FLUID INCLUSION RESEARCH

Proceedings of COFFI

Edwin Roedder, *Editor*
Andrzej Kozlowski, *Associate Editor*

Volume 8

1975

Fluid Inclusion Research

Volume 8

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has been provided by the editor

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Volunteers Needed

The editors would appreciate any help that can be offered by the readers in issuing future volumes of Fluid Inclusion Research - Proceedings of COFFI. Help is particularly needed in covering various segments of the literature on a regular basis, preparing abstracts, indexing, and translation. These jobs can be partitioned into as small units as desired; please contact either editor at the above addresses. On an informal basis, it would be most helpful if readers could send to the editors reprints of even just reference citations of pertinent literature. Such help is particularly useful to avoid missing obscure publications, or ones in which the presence of inclusion data may not be obvious from title or abstract. If important papers have been missed in previous volumes, they also should be noted.

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Preface

In 1968 the publication of *Fluid Inclusion Research - Proceedings of COFFI* was started as an offshoot of the Commission on Ore-Forming Fluids in Inclusions (COFFI) of the International Association on the Genesis of Ore Deposits (IAGOD). Although closely connected with COFFI and IAGOD, the publication of these volumes is independently arranged and separately financed, solely by subscriptions, on a nonprofit basis. It was started with a loan, now mostly repaid, from the International Union of Geological Sciences.

The purpose of the publication is to provide entrée to the literature with English abstracts or annotated bibliographic citations of all items from the world literature published during the volume year that either contain fluid inclusion data or are pertinent to some aspect of fluid inclusion work. This covers all types of fluid inclusions (aqueous, organic, silicate melt, sulfide melt, gas, etc.), causes and mechanisms of trapping (including various types of immiscibility), physical, chemical, and isotopic data, and data on experimental studies of systems pertinent to the interpretation of all types of phase changes occurring in inclusions, as well as to the sources of such volatiles or fluids and their interactions with rocks. These data are generally given without editorial value judgments except in the case of obviously contradictory or obscure statements. Extent of coverage varies in part as an inverse function of the availability of the original text to the average Western reader and in part as a direct function of the usefulness of the data. In addition to abstracts and citations, we publish English translations of inclusion papers from foreign languages, where available and not otherwise published in English, and notices of meetings and symposia.

Most of the translations from Russian sources in this volume are by the associate editor. Included among these are 69 of the papers stemming from the 1975 conference at L'vov on "Carbon and its compounds in endogenetic processes of mineral formation", and 229 other items from the Russian literature. There are 38 items translated from other languages,+ 265 abstracts and 138 citations or annotated citations from English language sources for a total of 739.

Although each abstract is duly credited, the editors wish to acknowledge, in particular, the help of Dr. M. Fleischer, of the U.S. Geological Survey, who provided a full translation of one article and helped with many citations. *Chemical Abstracts*, of Columbus, Ohio, has most graciously permitted the use of a limited number of their copyrighted abstracts, as indicated in the abstract citations. Dr. Maurice Pagel of CRPG, Nancy, and Dr. Chris Eastoe of the Univ. of Tasmania have collaborated to provide translations of numerous French items. Many other individuals, too numerous to list, have helped by sending the editors books, reprints, references, and copies of abstracts. We particularly are indebted to Professor Ermakov, Chairman Emeritus of COFFI, for copies of Russian books; to H. E. Belkin for library searches; and to Mrs. Wieslawa Kozlowski for her extensive typing help.

To authors of pertinent articles that have been omitted or are misquoted here through haste, or through language difficulties, we extend our apologies and our request to have these things called to our attention; to authors whose original abstracts have been drastically shortened, edited, or revised, we offer a reminder that the following "abstracts" are not intended to be abstracts of the whole paper, but only that part most pertinent to inclusion workers. The obvious inconsistencies in citation, transliteration, abstracting, and indexing are strictly a result of lack of editorial time. A vigorous effort is being made to make future volumes much more current than this one. The editor will be glad to furnish free photocopies of the original Russian text of articles or abstracts that have not been translated, in exchange for partial or full translations for use in future issues. Otherwise, photocopies of the originals can be provided at twenty-five cents per page.

Edwin Roedder, Editor
Aug. 20, 1977 Andrzej Kozlowski, Associate Editor

Contents

Indices

Notices of Meetings and Symposia

The Fifth All-Union Conference on Thermobarometry met at Ufa (in the Urals), September 20-27, 1976; Professor N.P. Ermakov of Moscow University was the convenor. It was attended by 310 persons from USSR, plus 7 from other countries (ČSSR, Bulgaria, Romania, and Poland), from 85 organizations, and celebrated the 25th anniversary of the study of fluid inclusions in the USSR, as marked by the publication of Prof. Ermakov's book in 1950. Prof. Ermakov accepted a 5-year chairmanship of the Soviet section of COFFI. During the meeting 255 papers were presented; abstracts of many of these will be published in the 1976 volume of Fluid Inclusion Research -- Proceedings of COFFI.

A conference was held on September 30 to October 1, 1975, in L'vov U.S.S.R., on "Carbon and Its Compounds in Endogenetic Processes of Mineral Formation." A total of 47 papers were presented, and 150 members attended, mainly from the Soviet sector of COFFI. The abstract volume for this conference contains these 47 plus additional abstracts; translations of 69 of these abstracts will be found in the present volume of Fluid Inclusion Research.

A conference was held in Alma Ata, U.S.S.R., on November 11-13, 1975, on "Methods and Techniques for the Study of Gas and Liquid Inclusions and Their Practical Use for Prospecting and Exploration." There were 22 papers and 114 attendees, mainly from the Central Asian republics and Kazakhstan. The volume of abstracts for this conference has not yet been obtained.

The Fifth International Symposium on Fluid Inclusion Research was held in August, 1976, at Sydney, Australia, in conjunction with the 25th International Geological Congress. As only a part of the abstracts of the 21 papers were printed in the Congress Abstracts (vol. 3, p. 803-817, 1976), all are reproduced here. Following the last technical session on 24 August there was a brief business meeting of COFFI, at which there were announcements of recent or forthcoming publications, scientific meetings (see below), etc. as well as discussions of possible fluid inclusion standards, etc. No major actions were taken.

A meeting on Current research on fluid inclusions and on mineral deposits was held at Durham, England, December 14-17, 1976, under the sponsorship of the Mineral Deposits Study Group of the Geological Society and the Applied Mineralogy Group of the Mineralogical Society.

A meeting of the Inclusion Group of the Société française de Minéralogie et Cristallographie was held February 16 and 17, 1977, at Toulouse, with 16 papers presented on the subject Fluids and inclusions in minerals. English translations of the abstracts will be published in the next volume of Fluid Inclusion Research -- Proceedings of COFFI.

A special session on Fluid and melt inclusions will be held at the 1977 Midwest American Geophysical Union Meeting, Sept. 26-28, at Purdue University, West Lafayette, IN, (with Edwin Roedder as convenor). Abstracts will be published in the next volume of Fluid Inclusion Research.

The Sixth International COFFI Symposium on Fluid Inclusion Research, with Edwin Roedder as convenor, will be held August 17, 1978, at Salt Lake City, Utah, as part of the Fifth Quadrennial Meeting of the International Association on the Genesis of Ore Deposits (IAGOD), at the invitation of the United States National Committee on Geology and under the sponsorship of the United States Geological Survey and the Society of Economic Geologists. The main topic of the meeting will be "Ore deposits related to cratonic volcanic and subvolcanic processes", but the COFFI session will be open to any inclusion subject pertinent to the study of ore deposits. The technical sessions of the IAGOD Meeting (August 13-19) will be preceded (August 7-13) and followed (August 20-25) by field excursions to mineral deposits in Eastern and Western U.S., respectively. Further details are given in the Second Circular, available from the General Secretary, Dr. Charles B. Sclar, Dept. Geol. Sciences, Williams Hall no. 31, Lehigh University, Bethlehem, PA 18015. Abstracts for the COFFI session are due Dec. 1, 1977; they should conform to specifications as given in the Second Circular, and an extra copy should be sent directly to Edwin Roedder. Authors of those abstracts accepted by the Program Committee will be given detailed instructions on the preparation of full papers in English, to be received by June 1, 1978; verbal presentations at the meeting will be limited to these full papers.

The Eleventh General Meeting of the International Mineralogical Association will be held in Novosibirsk, USSR, on Sept. 4-10, 1978, on the invitation of the Academy of Sciences of the USSR and the All Union Mineralogical Society, with Dr. N.V. Sobolev, Inst. of Geol. & Geophysics, 630090 Novosibirsk-90, as Secretary General. Titles of papers should be sent by Oct. 15, 1977, and abstracts are due by Jan. 15, 1978. Sessions of particular interest to inclusioneers include such titles as "Inhomogeneities in minerals" and "Mineralogic criteria for the connection between acid magmatism and ore mineralization" (i.e., "MAWAM"). Questions concerning the latter subject should be addressed to Dr. I.D. Ryabchikov, IGEM, 35 Staromonetny, Moscow 109017, USSR.

The Sixth All-Union Conference on Thermobarogeochemistry is planned for Sept. 19-22, 1978 in Vladivostok, to be hosted by the Far East Geological Institute of the Far East Scientific Center of the Academy of Science of the USSR (Director Dr. Valetin Grigor'evich Moiseenko), with Dr. Miroslava Igor'evna Efimova as Scientific Secretary, 690022 Vladivostok-22 , Geological Institute, USSR. The subject areas include magmatic and metamorphic processes, ore formation, exploration, and methodology. Field trips will go to Kamchatka and to Primor'ye.

Organization of COFFI

The Bureau of COFFI consists of six officers as follows: Chairman Emeritus - N.P. Ermakov, U.S.S.R.; Chairman - E. Roedder, U.S.A.; First Vice-Chairman - H. Imai, Japan; Second Vice-Chairman - F.P. Mel'nikov, U.S.S.R.; Third Vice-Chairman - M. Solomon, Australia; and Secretary - G. Deicha, France. The following series of Regional Representatives have also been established to provide foci for coordination and exchange of information on COFFI activities, and to help assure complete coverage of the world literature by forwarding reprints or citations to the editors.

Africa: Dr. H.M. El Shatoury, Associate Professor of Geology, Egyptian Atomic Energy Authority (presently at Geology Department, Faculty of Science, University of Sanaa, Sanaa, Yemen)

Australia: Dr. Ronald W.T. Wilkins, CSIRO, Minerals Research Laboratories, P.O. Box 136, North Ryde, N.S.W. 2113, Australia

Belgium: Dr. Paul Bartholomé, Laboratoires de Géologie Appliquée, Université de Liège, 45, Avenue des Tilleuls, Liège, Belgium

Brazil: Dr. J. Cassedanne, Chief Researcher, Conselmo Nacional de Pesquisas , Avenida Marecmal Camara 6 and 350, Rio de Janeiro (G.B.) Brazil

Canada: Dr. S. D. Scott, Department of Geology, University of Toronto, Toronto 5, Canada

Czechoslovakia: Ing. Jána Ďurišová, Ústřední ústav Geologický, Malostranski Nam 19, Praha 1, Č.S.S.R.

Denmark: Dr. John Rose-Hansen, Universitetets Mineralogisk-Geologiske Institut, Mineralogisk Museum, Østervoldgade 5-7, København K., Denmark

E. Germany: Dr. Ludwig Baumann, Bergakademie Freiberg, Sektion Geowissensch, 92 Freiberg, Brennhausgasse 14, D.D.R.

France: Dr. Bernard Poty, Centre de Recherches Petrographiques et Geochimiques, C.o. no. 1, 54500 Vandoeuvre les Nancy, France

Great Britain: Dr. F.W. Smith, Weardale Lead Co., Ltd., Rookhope, Bishop, Auckland County, Durham, England DL13 2BE

Holland: Dr. Hugo Swanenberg, State University of Utrecht, Department of Petrology, Geological Institute, Oude Gracht 320, Utrecht, Holland

India: Dr. Ashoke K. Lahiry, Supt. Geologist, Min. and Mining Div., RIMDC, Ltd., 15 Uniara Garden, Jaipur - 302004, India

Japan: Dr. H. Imai, 1-53, Haramachi, Shinjuku-Ku, Tokyo, Japan 162

Malaysia: Dr. E.B. Yeap, Department of Geology, University of Malaya, Kuala Lumpur, Malaysia

Mongolia: Dr. J. Lkhamsuren, Box 46/433, Ulan Bator, Mongolia

New Zealand: Dr. Brian W. Robinson, Institute of Nuclear Sciences, D.S.I.R., Private Bag, Lower Hutt, New Zealand

Philippines: Dr. B.S. Austria, Professor of Geochemistry, Department of Geology, University of Philippines, Manila, Republic of the Philippines

Poland: Dr. A. Kozlowski, Wydzial Geologii, Uniwersytet Warszawski, Instytut Geochemii, Mineralogii, i Petrografii, 02-089 Warszawa Poland

Romania: Dr. Vasile V. Pomârleanu, Str. Cuza-Vodă Nr. 7, Jassy, Română

Sweden: Dr. D. T. Rickard, Geologiska Institutionen, Box 6801, 113 86 Stockholm, Sweden

Switzerland: Dr. H.A. Stalder, Naturhistorisches Museum, CH - 3000, Bern Switzerland

U.S.A.: Dr. Edwin Roedder, U.S. Geological Survey, National Center, Stop 959, Reston, VA 22092, USA

U.S.S.R.: Professor Evgenii Mikhailovich Laz'ko, Dept. of Geology, L'vov University, Moscow, Shcherbakova 4, L'vov, Ukr. SSR, USSR.

Abbreviations

Note: The following abbreviations are used in part of these abstracts to save space, and will be used more generally in future volumes. The correct form of the word (noun, adjective, verb, plural, etc.) can be obtained from context. The Cyrillic sequence а,б,в,г,д,е are converted to abcdef.

alk.	alkaline
alt.	altered
amorph.	amorphous
anal.	analysis
app.	apparatus
aq.	aqueous
assemb.	assemblage
assoc.	associated
atm.	atmosphere
avg.	average
calc.	calculated
char.	characterized
chem.	chemical
chrom.	chromatographic
coef.	coefficient
comp.	composition
conc.	concentrated
conds.	conditions
corr.	correction
cpd.	compound
crit.	critical
d.	density
decrep.	decrepitated
dep.	deposit
dept.	department
det.	determined
devel.	developed
diam.	diameter
diff.	difference
dist.	distinguish
distrib.	distribution
dm.	daughter mineral
dxl.	daughter crystal
equil.	equilibrium
est.	estimated
estab.	established
evid.	evidence
evol.	evolution
exam.	examined
exper.	experimental
extr.	extracted
F	degree of fill
form.	formation
fract.	fractionated
G	gas
gen.	generation
geochem.	geochemical
geol.	geological
HC	hydrocarbon
heterog.	heterogenization
homog.	homogenization
hyd.	hydrothermal
ident.	identification
ign.	igneous
inc.	inclusion
inst.	instrument, institute
invest.	investigated
iso.	isotopic
L	liquid
lab.	laboratory
max.	maximum
meas.	measurement
mech.	mechanism
meta.	metamorphic
min.	mineral, mineralization
obs.	observation
org.	organic
P	pressure
peg.	pegmatite
phen.	phenocryst
phys.	physical
P inc.	primary inclusion
pneu.	pneumatolytic
ppt.	precipitate
prelim.	preliminary
prep.	prepartion
prod.	production
prop.	property
PS	pseudosecondary
qual.	qualitative
quan.	quantitative
ref.	reference
sal.	salinity
sat.	saturation
sed.	sedimentary
sol.	solution
soly.	solubility
spec.	spectroscopy
std.	standard
strat.	stratigraphic
syn.	synthetic
T	temperature (°C)
T_D	temperature of decrepitation
T_F	temperature of formation (i.e., trapping)
T_{Frz}	temperature of freezing
T_H	temperature of homogenization
T_M	temperature melting
tech.	technique
thdy.	thermodynamic
theor.	theoretical
therm.	thermometer
univ.	university
V	vapor
xl.	crystal
xline	crystalline
xlized	crystallized
(...)	part of author's abstract omitted.

Abstracts, Translated Abstracts, or Annotated Citations to World Literature, 1975

Note - This section also includes a few earlier items that were not available in time for inclusion in the previous volume, and a few special items from 1976, such as the abstracts of the papers for the Fifth International Symposium on Fluid Inclusion Research, Sydney, Australia, some of which will not appear in print in any other form.

ADAMS, H.G., COHEN, L.H., and ROSENFELD, J.L., 1975, Solid inclusion piezothermometry I: comparison dilatometry: Amer. Mineral., v. 60, p. 574-583. First author at Dept. of Geology, University of California, Los Angeles, California 90024.

Solid piezotherm. is a technique for det. the P and T of incl. of one min. in a host min. Application of the technique requires knowing the P-T curves of constant diff. in natural strain between two xlographically oriented min. rods. For this purpose, two diff. kinds of comparison dilatometer, designed for use in an internally-heated high P gas app., have been devel. and are described in detail. Each design offers advantages and disadvantages in fabrication, demand upon size of sample material, and versatility.

The comparison dilatometers have been used at Ps up to 7 kbar simultaneously with Ts up to that of the low-high quartz transition. Data obtained have been cross-checked successfully between the two kinds of comparison dilatometer and between results from them and previously-determined physical prop. of syn. periclase, syn. halite, and quartz. As a test of accuracy, results from one design of comparison dilatometer were compared with predictions for periclase vs halite for the P range up to 7 kbar and Ts up to ∿600°C. The max. deviation between exper. results and prediction was ∿6°C at any P. Such accuracy is more than sufficient for developing data for use in solid inc. piezotherm. and may be of value in det. equations of state. (Authors' abstract)

ADRIANOVA, S. I., AMINEV, V. B., and VALYASHKO, L. M., 1975, Problem of role of CO_2 in formation of gold ore deposits from Lena River region (abst.), p. 99-100, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci.

Ukrainian SSR (in Russian). First author at Central Sci. Research Geol.-Prospect. Inst., Moscow.

Dep. is of Au-quartz and Au-sulfide type. Milky quartz of ores bears G/L incs. with T_H=380-400°C and 260-300°C, L_{CO_2} is visible at T<+12°C. O_2 is absent in incs., CO_2 occupies 50-75 vol. % of total G; sum of (H_2S, SO_2, HCl, HF, and NH_3) >25 vol. %. (Abs. by A.K.)

ADRIANOVA, S. I., and ZAREMBO, Yu. G., 1975, Regime of CO_2 in process of formation of complex tungsten-gold ore mineralization from Central Kyzylkum (abst.), p. 100-102, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Central Sci.-Research, Geol.-Prospect. Inst., Moscow.

Ore mineraliz. occurs as Au-quartz and scheelite-quartz veins and quartz-sulfide zones. Inc. cryometry reveals a higher conc. of CO_2 in the richest ores; pre-ore and post-ore quartzes bear only traces of CO_2, or none. Similar conclusions were derived from IR-spectrometry (2350 cm^{-1} absorption band); ore-bearing quartz is char. by value 1.3-3.9 of this band (arbitrary units), pre-ore - 0.07-0.8, late ore with sulfides - 0.1-0.78, post-ore - 0.1-0.3. By gas analysis pre-ore quartz bears 30 cm^3 CO_2/kg, ore-bearing: 80-90 cm^3 CO_2/kg for quartz-scheelite veins and 150-180 cm^3 CO_2/kg for quartz- arsenopyrite veinlets; post-ore - 25-30 cm^3 CO_2/kg. (Abs. by A.K.)

AKHVLEDIANI, R. A., and GIGASHVILI, G. M., 1975, Inclusions of hydrocarbons in quartz from hydrothermal veins of Teletskiy Chain (abst.), p. 57-59, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Inst. Geol. Acad. Sci. Georgian SSR, Tbilisi.

Quartz xls. occur in laumontite-quartz-calcite veins from Middle Eocene volcanogenic-sed. rocks. The mins. are assoc. with black bitumen, which is also found as incs. in outer zones of xls. Another vein system has P and S incs. of L and solid bitumens. P incs. are of two types: 1) L (85-90%) + G + yellow or brownish oil emulsion (sic.) on walls of vacuole. L is yellowish or pale brownish; T_H in L phase 87-102°C; T of dissolving of emulsion 130-140°C; P at room T 110-115 atm. Cooling to -110°C causes only slight enlarging of G bubble. UV causes yellowish-white luminescence. 2) G/L incs. with F 50-60%, plus small amounts of black bitumen. T_H in L phase 110-120°C; L phase luminesces light blue in UV. P at room T 200-205 atm. Cooling to -180°C indicates filling is methane. Above 2 types are the end members of a continuous series of intermediates. Salt conc. in water sol. ∿1%. (Abs. by A.K.)

ALEKHIN, Yu. V., SHMONOV, V. M. and SHMULOVICH, K. I., 1975, Possible mechanism of differentiation of hydrothermal solution (abst.), p. 21-22, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Experiment. Mineralogy of Acad. Sci. USSR, Chernogolovka.

The influence of the effect of filtration of sols. through rocks on composition of sols. and on the separation of components is evaluated using the system CO_2-H_2O as an example. At T = 600°C, ΔP = 100 bar (550 → 450 bar), starting X_{CO_2} of 0.5 changed to 0.85; for starting X_{CO_2} = 0.2, final X_{CO_2} = 0.75. Under relatively low T (<450°C) and P (<500 bar) there is an inversion of ratios of specific vols. of H_2O and CO_2 and this results in forming of inverse props.: H_2O becomes the most mobile cpd. (Abstract by A.K.)

ALEKSANDROV, S.M., 1975, The geochemistry of formation of skarns and ores in the crushed zones of carbonate rocks: Geokhimiya, 1975, no. 9, p. 1282-1299 (in Russian; translated in Geochem. Internat., v. 12, no. 5, p. 2-18). Author at V.I. Vernadskiy Inst. Geochem. Anal. Chem., Acad. Sci. USSR, Moscow.

Dep. of B, Sn, and other elements are used to illustrate the effect of short-lived and long-lived crushed zones on form. of skarns and ore dep. Tectonic movements in the crushed zones cause pulsating flow of heat and metasomatizing sols. into the rocks, producing rhythmically zoned diffusional skarns differing in min. comp., degree of devel. of zoning, and structure from the skarns replacing monolithic carbonate rocks. The diff. between the two kinds of skarns persits into the later stages of min., the skarns of the tectonically mobile crushed zones are not subjected to the early alkali metasomatism but are intensively greisenized with formation of mins. of B, Sn, Be, F, and other min., diff. from those dep. in the skarns formed in monolithic rocks. The results of invest. of skarns, presented here are of both scientific and practical interest. (Author's abstract)

ALLEN, J. C., and BOETTCHER, A. L., 1975, The stability of amphiboles in andesite-H_2O-CO_2 and basalt-H_2O-CO_2 at high pressures (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 973. First author at Department of Geology and Geography, Bucknell University, Lewisburg, Pennsylvania 17837.

ANAKHOV, V. V., 1975, Fluorite of productive stage of ore-formation from Rudnoe deposit: Vses. Min. Obshch. Zapiski, v. 104, no. 4, p. 478-481 (in Russian). Author at Geol. Expedition of Khrustal'nenskiy Mining Enterprise.

The dep. belongs to the tourmaline-cassiterite-silicate-sulfide type; four distinctly zoned stages of mineralz. are distinguished: cassiterite-quartz with tourmaline, sericite, chlorite and arsenopyrite; arsenopyrite-pyrrhotite-chalcopyrite with chlorite and sericite; pyrite-sphalerite-galena with chlorite; quartz-carbonate with fluorite and pyrite. Incs. in quartz were divided into three types: G/L, essentially G and composite. Composite incs. have up to 5 dms, one of which is always halite. Dms occupy up to 30 vol. %, and G up to 35%. Early G/L incs. homog. at 475-486°C, essentially G - at ∿500°C, composite incs: halite + L at 200-382°C, complete homog. (in L? - A.K.) at 240-505°C, NaCl conc. 31.5-44.4 wt. %. Fluorite has incs. with 1-5 dms (20-25 vol. %), and 35-37% G; dissolution of halite at 102-215°C, homg. at 443-525°C. Early G/L incs. have T_H 449-455°C, late incs. 199-283; NaCl conc. 30.4%. Cassiterite II bears only G/L incs.; early ones (P? - A.K.) gave T_H=476-485; S - 368-372°C. (Abstract by A.K.)

ANDERSON. A. T., 1975, Selected features of some circumpacific volcanoes and their significance (abst.): Amer. Geophys. Union Trans., v. 56, no.

9, p. 605. Author at Dept. of the Geophysical Sciences, The University of Chicago, Chicago, Illinois 60637.

The violence and T of eruption and xlinity and chem. comp. of magma (tephra) are related to the before-eruption conc. of H_2O which ranges from less than about 2% by weight for Fe- and K-rich, xl-poor tephra to more than 10% by weight for Mg-rich and K-poor, xl-rich tephra. Mg/Mg+Fe ratio and H_2O bear a complimentary relationship such that eruption Ts are rather uniform for basaltic tephra and range from 1130 to 1180°C. Magnetite xlizes early in H_2O-poor (Fe and K-rich) magmas whereas amphibole probably becomes stable in the andesite comp. in the H_2O-rich magmas. Vapor sat. generally is achieved at or before the andesite comp. Andesitic magmas appear to develop within the crust from basaltic parent magmas by means of segregation of L from largely solid magma with magma mixing playing a variable role. (Author's abstract.)

ANDERSON, A. T., and SANS, J. R., 1975, Volcanic temperature and pressure inferred from inclusions in phenocrysts (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ., Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

The ratio of MgO in host pyroxene or olivine to that in included glass (D) is a sensitive indicator of T. We have repeated the study of Roeder (1974) on olivine-liquid partitioning of MgO by heating (at 1360, 1283, 1210, 1115 and 1068°C) natural xls. of olivine with incs. of glass in evacuated SiO_2-glass vials and anal. with the microprobe the quenched products. The results are in close agreement with Roeder's.

We extended the exper. calib. to orthopyroxene and glass by using the same technique at 1210, 1115 and 1068°C. Glasses included in pyroxene phenocrysts are generally andesitic to rhyolitic in comp. This fact, together with the lower T, raises the question of equil. Results obtained at 1068° show that 200 hours is adequate.

Applied to natural materials, the calib. yield est. of T which are broadly consistent with other data. For Kilauea the T of extrusion inferred from glasses in olivine and pyroxene are within error of each other and of pyrometer readings on lava fountains. Also, the est. T of intratelluric xliz. (assuming 1 weight percent of H_2O) is in accord with est. based on Fe-Ti oxide phen. For Paricutin and Pacaya the range of T is consistent with pyrometer obs., but there is room for improvement.

The T of xliz. of phen. (T_p) is more important than the T of extrusion. An upper limit to T_p can be inferred by reconstructing the comp. of the melt from which the phen. grew. After melt is entrapped (and perhaps before) its comp. is modified by xliz. or resolution of the host xl. Since xliz. of pyroxene depletes the melt in MgO and plagioclase enriches it in MgO, inc. of glass in coppted. pyroxene and plagioclase suffice to establish the comp. of the initial melt. Values (16) of T_p (reported in Table 1) are arrived at in the above manner. The important result is that all andesitic melts so far encountered have xliz. Ts below 1100°C. The more silicic the melts, the lower the T. There is no support for the low T "andesite trough" proposed by some Australian scientists.

The upper T limit, T_p, should decrease with the conc. of H_2O in the melt. We have est. the latter by difference and arrived at a decreased T (T^*). The est. of the conc. of H_2O are consistent with evidence of loss of Cl relative to K_2O and with enlarged vapor bubbles in heated inc. of glass which become surrounded by haloes of darkened (? oxidized) pyroxene or olivine. Vapor sat. is indicated by the presence of inc. of vapor in phen. and by the Cl/K_2O relation for glasses included in phen. The modified T (T*) are 100 to 200°C lower than T inferred from anal. of magnetite and ilmenite phen., except for Kilauea where agreement is good. However, the low T and high conc. of H_2O do agree qual. with the presence of amphibole as phen. and with liquidus pyroxene in one sample. T* is commonly about 100°C lower than the extrusion T. This is possible because of mixing with hot basaltic magma before ascent and adiabatic xliz. and frictional heating during ascent.

A lapillus by lapillus dissection of stages of the 1783 eruption of Asama reveals that individual pumice lumps contain contributions from hot (andesitic and basaltic) sources and cold rhyolitic sources. The olivine xls. contain inc. of andesitic glass exceptionally rich in Al_2O_3 (up to 22 weight percent) and with dxls. of spinel and rare hornblende. The occurrence of hornblende dxl. is consistent with the inferred extrusion T of 900-1010°C and the conc. of H_2O inferred by diff. (4 wt. %) and exper. determined stabilities of hornblende in andesitic and basaltic melts. The coldest material is found mainly in the material from the early part of the eruption.

Variable comp. and apparent T of extrusion and initial xliz. (T_p) exist in most other andesitic tephra and suggest that in general andesites are assembled from variously solid parts of reservoirs of magma which range in P from about 500 atm. to more than 5000 atm. in rare cases, in Ts from about 1200°C to 700°C but mostly in the 900 to 1100°C interval, and which are commonly sat. with vapor, particularly in xl.-rich regions. (From the authors' four-page abstract.)

ANDERSON, G. M., 1975, The precipitation of Mississippi Valley-type ores (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 7, no. 6, p. 711-712. Author at Dept. of Geology, University of Toronto, Toronto, Ontario.

Soly. of galena in sodium chloride brines at Ts near 100°C are such that rather acid conds. are required to transport ore quantities of Pb if the required reduced S is transported in the same sol. If either calcite or dolomite is stable in the brine, this degree of acidity is ruled out, and if chalcopyrite is stable the brine must be not only quite acid but highly reduced. Form. waters probably do not attain this degree of acidity, so to transport ore quantities of Pb their reduced S content must be very low, and must therefore be supplied at the site of dep. causing pption. Soly. data thus support the Jackson and Beales model, in that Mississippi Valley-type ore bodies probably represent sites where metals from basinal brines and sulfide from limestones got together for considerable lengths of time, but it is emphasized that the migration of H_2S through the limestone to the site is at least as important as the flow of metal-bearing brine through the basin.

The lack of barite with the sulfide ore may indicate that the transporting sol. was relatively rich in sulfate, whereas the occurrence of barite may indicate a lack of sulfate in the basinal brine, and some oxidation of S during pption of the ore. (Author's abstract.)

ANDERSON, T.F., and KASPER, R.B., 1975, Oxygen self-diffusion in albite under hydrothermal conditions; Amer. Geophy. Union, Trans., v. 56, no. 6, p. 459. First author at Dept. of Geol., Univ. of Ill., Urbana, Ill. 61801).

Isotopic exchange expers. between a natural albite and O^{18}-enriched sols. at 600°-800°C and 2 kbars have been conducted in order to evaluate diffusivity. Diffusion coefs. were calc. from the rate at which equil. was approached in the albite-water system. Equil. alkali chloride sols. were used in most of the expers. in order to minimize O isotopic exchange as a consequence of alkali exchange and rexliz. However, results at 700°C using pure water are in excellent agreement with results from the alkali chloride sol. runs. The calc. diffusion coefs. are linear on an Arrhenius plot and yield $D_0 = 2.5 \pm 1.4 \times 10^{-5}$ $cm^2 sec^{-1}$ and an activation energy of 37±2 kcal/ gm-atom O. (From the authors' abstract.)

ANDERSON, Thomas F., and seven others, 1975, Leg 35 DSDP: Mineralogical, chemical and isotopic results on sediments, basalts and pore fluids delineate reaction zones (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 976-977. First author at Department of Geology, University of Illinois, Urbana, Illinois 61801.

The principal cause of O^{18}/O^{16} depletion, Ca^{+2} increases and Mg^{+2} decreases in the pore fluids of cores from leg 35 is alt. of basalt or volcanic ash. Alt. of biogenic silica and continental detritus at some horizons cause local changes in the Ca^{+2}, Mg^{+2}, silica, and K^+ gradients in the pore waters, and may be a secondary cause of O^{18}/O^{16} depletion. At sites 322 and 325 the seds. have an increasing amount of smectite in the clay size fraction with depth. At site 323 a sharp increase in the abundance of smectite in the clay size fraction occurs 60 meters above the basalt. In parts of this 60 meter interval Mn, Cu, Sr, Co, Ni, Mo, Ba and Fe exhibit high concs. in the sed. O^{18}/O^{16} of quartz (<0.1μm fraction) does not change significantly with depth indicating little isotopic exchange since burial. Authigenic opal CT, feldspar, clinoptilolite and carbonate have been ident. at numerous horizons. The O^{18}/O^{16} and C^{13}/C^{12} ($\delta = -18.4$ to -21.2) of the authigenic carbonates reflect pption. from a low T sol. having carbonate ion species derived from org. matter. (Authors' abstract.)

ANDRUSENKO, N.I., and KONSTANTINOV, M.M., 1976, Special features of formation of volcanogenic gold deposits, from gas-fluid inclusion data: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Authors at Central Research Geol. Inst. for Nonferrous and Noble Metals (TSNIGRI), Moscow, USSR.

Au ore deps. of volcanic belts are closely assoc. in space and time with volcanism in general, and with separate subvolcanic and subintrusive bodies. Sometimes they interlock in time with phases of the volcanism.

The form. of these deps. is characterized by the presence of screening horizons at depth which fix the ascending hyd. sols. The surfaces of the screens are represented by low-angle overthrusts and interformational shatter zones, surfaces of stratigraphic unconformities or separate sheets of volcanics, as well as roofs of subvolcanic bodies and their mushroom-shaped apophyses in the country rock. The deep through-going fractures formed at the stage of late orogenic development and activation contribute, under the conds. of tectonic tension, to the penetration of high-T and fluidized sols. to the levels of ore dep. The depth of form. of the deps. varies from a few tens of metres to 1,500-2,000 m.

The study of deps. of this group, in respect to gas-fluid inc. anal. of vein and ore mins., showed that their form. was characterized by a wide T range (480-50°C).

The aggregate state of the earlier portions of min.-form. sols. was gaseous or near critical and the fluids condensed in the range 420-330°C, the process being slower at deeper levels.

The char. feature of the form. of productive Au-bearing stages is the stability of the upper limit of the T range during a large period of time, embracing the form. of several Au-bearing assocs. in the following intervals: 420-200°C - Au-quartz-adularia; 410-300°C - Au-quartz; 320-200°C - main concs. of Au in the comp. of Au-polymetallic and Au-telluride assocs.; 380-220°C - Au-quartz-rhodonite. The latest segregations of Au in the Sb-Hg assocs. occur in the interval 260-100°C. Sharp interstadial ($\leqslant$190°C) and lesser (50-100°C) intermineralizational T drops are char.

The numerous gas-fluid incs. in mins. are exceedingly small, have vague outlines, high d of filling, and moderate to low conc. Anal. of water extracts and the obs. of the phase relations in the incs. showed that mins. formed from SO_4-Cl-HCO_3 sols., with higher K and CO_2 concs. at the productive stages. The P of form. calc. from the incs. with CO_2 or with chloride xls. varied from 1150-70 atm. P drops caused repeated boiling of the ore sols., accompanied sometimes by explosions. The most char. T intervals were 360, 320, 290°C, and these T levels of boiling can tentatively be regarded as the initial T of form. of ore concs. The boiling, with degassing of CO_2, must have stimulated the Au-ore formation. (Authors' abstract.)

ANDRUSENKO, N. I., KOSOVETS, T. N., and KONSTANTINOV, M. M., 1975, Role of CO_2 in forming of near-surface and intermediate-depth deposits of gold (abst.), p. 83-84, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Central Sci.-Research Geol.-Prospect. Inst., Moscow.

CO_2 is the important cpd. of ore-forming Au-bearing hydrotherms, especially for deps. from moderate depths. Ts of heterogenization ("boiling") of CO_2-H_2O sols. are indices of mass pption. of Au in commercial stages: those Ts for near-surface deps. are 290-320 and 240-260°C, for intermediate depths - 340-380 and 260-300°C. Under near-surface conds. the abrupt separation of CO_2 may cause the forming of intramineralization ("explosion") breccias. Decrease of conc. of CO_2 in sols. causes the pption of Au. (Abs. by A.K.)

ANFILOGOV, V. N., 1975, The nature and petrographical criteria of magmatic melt liquation: Geokhimiya, 1975, no. 7, p. 1035-1042 (in Russian). Author at Inst. of Geol. and Geochem. of the Uralian Sci. Center, USSR Acad. of Sci., Sverdlovsk.

ANON., 1975, Carbon and its compounds in endogenic processes of mineral-formation (data of studies of fluid inclusions in minerals) - Abstracts of the Regional Meeting (L'vov, September 1975): L'vov, Academy of Sciences of Ukrainian SSR, Division of Earth Sci., Inst. Geology and Geochemistry of Fuels (in Russian; 700 copies, 60 kopecks).

The 72 individual papers presented at this meeting are abstracted and listed in this volume of Fluid Inclusion Research alphabetically by author. (ER)

ANUFRIYEV, Yu. N., STUPAKOV, G.P., and MOSKALYUK, A.A., 1973, Characteristics of quartz of Kochkar gold deposit: Akad. Nauk SSSR, Izvestiya, ser. geol., no. 3, p. 68-81 (in Russian; translated in Internat. Geol. Review, v. 16, no. 4, p. 405-416 (1974); abstract on p. ii). First author at All-Union Scientific-Research Institute for Synthesis of Mineral Raw Materials, Alexandrov.

The four types of quartz veins in this dep. are: a) precursors of ore; b) bearers of the ore; c) bearers of the late ore; d) non-auriferous followers of the ore. Vein quartz from each of these types was anal. comprehensively to ascertain typomorphic char. and afford certain genetic conclusions. It was found that sols. in gas-liquid incs. in all types of the quartz are of the HCO_3-K char. and yet each type differs from the others appreciably, in comp. The precursors and bearers of the ore were alt. demonstrably by high-T meta. The Au-sulfide min. was demonstrably epigenetic, a medium T imposition onto the previously meta. veins. The followers of the ore were laid down after dep. of the auriferous sulfides; their weakly developed economic xl quartz, imposed as it is, is the last endogenic form. in the Kochkar dep. (Authors' abstract).

Includes numerous decrepigrams and 12 anals. of water leachates for K,Na,Mg,Ca,Li,NH_4,Cl,F,SO_4, and HCO_3 (ER).

APLONOV, V.S. and GORYAINOV, I.N., 1975, Peculiarities of inclusions of mineral-forming media in minerals of Noril'sk deposits, p. 89-107, in Copper-nickel ores of NW part of Siberian platform, N.N. Urvantsev, editor: Leningrad, Sci.-Research Inst. of Geology of the Arctic, 138 pp. (in Russian).

Incs. of melt occur in all rock-forming mins: olivines, pyroxenes and plagioclases, G phase occupies 10-12 vol. %, and in olivines an ore phase is also present. All types of melt incs. were found, from glass to xlized. Olivines and pyroxenes also contain G and G/L incs., the latter with T_H 120-540°C. T and melt and G composition data are extensively discussed, partly from reference data. Decrep. data on mono- and polymineral fractions are presented, as well as a discussion of the chem. comp. of sols in incs. Lack of sulfur in the incs. proves that the hypothesis of origin of Noril'sk Cu-Ni ores by liquid immiscibility cannot be accepted. (Abstract by A.K.)

ARANOVICH, L. J., 1975, Experimental investigation of exchange equilibria in system: epidote-garnet-water solution of Ca, Al, Fe chlorides at 500° and 580°C and under 1 and 2 kbar: Akad. Nauk SSSR, Doklady, v. 220, no. 4, p. 933-935 (in Russian).

AREVADZE, D. V., YAROSHEVICH, V. Z., and KUCHER, M. I., 1975, Studies of gaseous-liquid inclusions bearing hydrocarbons in minerals of quartz, calcite veins from vicinity of Tbilisi (abst.), p. 59-60, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Causasian Inst. of Raw Materials, Tbilisi.

Incs. of HCs in xls. of quartz and calcite in hyd. veins from Middle Eocene breccias, show following types of incs.: 1) one-phase (L, G or solid), 2) two-phase (G/L and L/solid), 3) three phase (polycomponent). Color of L phase ranges from colorless to brown, color of solid phase - from yellowish to black. T_H of G/L and polyphase incs. with HCs 60-145°C; dissolution of solid phases was not observed. T_H of incs. of aq. sols. 80-215°C. Mass spec. (MV-2302) showed the following in quartz: CH_4-

21.6, N_2-15.7, C_2H_6-2.5, C_3H_8-1.4, C_4H_{10}-3.1, heavy HCs-16.3, CO_2-0.8, H_2O-37.7(mol.%); in calcite: N_2-12.2, CO_2-3.5, CH_4-3.4, C_2H_6-0.1, heavy HCs-3.8, H_2O-77 (mol.%). HCs were also extd. from wall rocks. (Abs. by A.K.)

ARKHIPCHUK, R. Z., 1975, CO_2 of hydrothermal solutions of endogenic deposits from W. Zabaikal'ye (abst.), p. 87-89, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Buryatian Geol. Office, Ulan-Ude.

Fluid inc. studies were made on samples from deps, of W, Mo, Be, Sn, Au, Zn, Pb, apatite, amethyst, fluorite, and Iceland spar. Rare metal deps. formed from H_2O-CO_2 fluids at high T in the commercial stages (400-200°C); at lower T (200-90°C) CO_2 is not a char. cpd. Three-phase incs. (L_{H_2O} + L_{CO_2} + G) with widely varying ratios were reported. Density of CO_2 = 0.536 - 0.822 g/cm^3, P (on CO_2-bearing incs.) 1000-190 atm, usually 900-700 atm. Gas phase consists of H_2O, CO_2, CH_4 and other C_nH_{2n+2}, H_2, N_2, rare gases. H_2O + CO_2 = 60-73 vol.%, L_{CO_2} equals 17-94% (most often 60-80%) of volatiles other than H_2O.

A correlation between min. comp. of dep. and presence of CO_2 was not found, nor the correlation with comp., age and genesis of wall rocks.

At fluorite deps. (260-50°C) CO_2 is not char., volatiles are mainly H_2O, and subordinate amounts of CH_4, other C_nH_{2n+2}, N_2 + rare gases.

Main mass of ores of rare metal deps. ppted at moment of heterog. of CO_2-H_2O sols. Author suggests that CO_2 is char. feature of hypabyssal deps. (Abs. by A.K.)

ARMSTRONG, Eduardo, 1975, The distribution in time and space of granulite facies domains in the heart of the Precambrian shields: Thèse de spécialité, C.R.P.G., E.N.S.G., Université Nancy I, 143 pp. (in French). Author at Lab. Géol. Struct., Univ. Nancy I, C.O. 140, 54037 - Nancy Cedex, France.

A survey of the lit. shows that the granulite facies of the world are divided, in space and time, into two principal groups. The first, essentially Archaean, is char. by meta. at intermed. P while the second group, dating from the upper Proterozoic onwards, is of low-P type. The importance of the fluid phase as a P indicator is confirmed by microthermometry; two domains are found, characterizing the groups previously defined. The incs. consist of a mixture of which CO_2 is the major component. The Lofoten granulite facies (intermed. P) gives min. T_H from -50° to -30°C (d from 1.12 to 1.06 g/cm^3) while the Bamble gives T_H from -10° to 0°C (d from 0.98 to 0.92 g/cm^3). For granulite facies (700°-800°C), the Ps are est. at 8-10 kb for the Bamble. (Abstract by M. Pagel; translated by Chris Eastoe.)

ARNÓRSSON, Stefan, 1975, Application of the silica geothermometer in low temperature hydrothermal areas in Iceland: Amer. Jour. Sci., v. 275, p. 763-784. Author at National Energy Authority, Laugavegur 116, Reykjavik, Iceland.

ASHLEY, P. M., and CREELMAN, R. A., 1975, The Mount Black lead-zinc deposit, a probable Mississippi Valley-type sulphide occurrence at

Cooleman Plains, Southern New South Wales: Jour. Geol. Soc. of Australia, v. 22, pt. 4, p. 423-433.

Petrographic and field evidence indicates that the quartz and sulphides were dep. mainly by encrustation and pption from saline sols. (possibly diagenetically expelled connate brines) in cavities, probably at low T at shallow depth. The dep. has many similarities to Mississippi Valley-type lead-zinc deps. Fluid incs. in quartz (see p. 429), possibly P, have 15% vapor with or without 10% NaCl(?) dm. (Modified from authors' abstract.)

ATKINSON, W. W., Jr., and EINAUDI, M. T., 1975, Late alteration of skarn at Carr Fork, Bingham, Utah (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 982. First author at The Anaconda Company, 1849 West North Temple, Salt Lake City, Utah 84116.

As a first approximation, actinolite-calcite alt. in quartzite and skarn was isochem. except for addition of S and Cu and can be considered in terms of T-X_{CO_2} controlled carbonation-hydration reactions with f_{S_2}-f_{O_2} buffered by magnetite-hematite-pyrite. Changes in compatibilities for relatively water-rich fluids with decreasing T, with quartz, CO_2 and H_2O in excess, and written in terms of magnetite as the only Fe-phase, are: Salite + magnetite = andradite + actinolite, salite + andradite = actinolite + calcite, and andradite = calcite + magnetite. The appearance of actinolite-calcite-quartz-magnetite-sulfide assemb. marks the beginning of the thermal decline in the contact aureole and is an important ore-forming stage. (From the authors' abstract.)

AVDONIN, V.V., 1975, Liquation as a factor in ore genesis: Akad. Nauk SSSR, Doklady, v. 224, no. 4, p. 909-911 (in Russian; translated in Doklady Acad. Sci. USSR, v. 224, p. 125-127, pub. 1977). Author at M.V. Lomonosov State University, Moscow.

The author suggests that certain pyrite-polymet. ore deposits have formed in part through liquation (i.e., liquid immiscibility. (ER)

AVDONIN, V.V., DOROGOVIN, B.A., and OKRUGIN, V.M., 1975, Signs of liquation in Middle Devonian volcanogenic rocks of acidic composition (Leninogorsk district, Rudnyi Altai region): Vestnik Mosk. Univ., Geolog., v. 30, no. 6, p. 62-76 (in Russian; trans. in Mosc. Univ. Geol. Bull., Allerton Press, p. 43-53, 1975).

Silicate melt incs. in phen. in rhyolite porphyries showing textural features said to suggest immiscibility,(but with relatively small differences in bulk chemistry) have 5-30 vol. % G, 5-75 vol. % ore segregations, and T_H of 850-1320°C (Bazarov apparatus).

This homog. did not include all of the "ore component". One inc. is illustrated showing two silicate melts with a sharp interface. (ER)

BABCAN, Jan, 1975, Gas-liquid inclusions and pressure-temperature conditions for mineral formation: Cas. Mineral. Geol. 1975, v. 20, no. 3, p. 311-318 (in Czech.). Author at Geol. Ustav., Univ. Komenskeho, Bratislava, Czech.

The growing xl. tends to expel adsorbed impurities (elements not entering the structure) from the growing xl. faces into the cavities (incs.). Gas incs. originate by the same mech. A selective adsorption of impurities from the xliz. medium (e.g. fluorite incs. with oil) results in a different conc. of them in solns. of incs. and of the corresponding xliz. medium. The higher concs. of sols. in the incs., than those in the xliz. mediums, lead to higher Ts detd. by microscopic homog., than the real ones. These Ts depend on the concs. of sols., CO_2 content, etc. C.A. v. 84, no. 4, 47262M, 1976.

BACON, Charles R., 1975, High temperature heat content of silicate glasses and the partial molar heat capacities of oxide components of silicate melts between 298°K and the glass transition (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 983-984. Author at Department of Geology and Geophysics, University of California, Berkeley, California 94720.

BADALOV, S. T., Editor, 1975, Minerals of Uzbekistan, v. I, 344 pp., and v. II, 336 pp.: Tashkent, "FAN" (in Russian). Authors at Inst. of Geology and Geophysics of Acad. Sci. of Uzbek SSR.

Books bear reference data on fluid incs.: in v. I, p. 55-58: dimensions and comp. of filling of incs. in native sulfur, occurrence of bitumens; p. 104: T_D of sphalerite (350-450°C), p. 106, same (210°C); p. 260: results of analysis of water leachates from fluorites; p. 265: T_H of fluorites; p. 310-312: T_H of incs. in quartz; v. II, p. 93: T_H of incs. in calcite, p. 100 table 26: T_D and T_H of incs. in calcite; p. 104: same; p. 186: T_D and T_H of incs. in barite. (A.K.)

BAILEY, G. Bryan, and WILLIAMS, Kenneth L., 1975, The genesis and economic potential of gold-bearing jasperoids in the central Drum Mountains, Utah (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 984. First author at ASARCO, Inc., Salt Lake Exploration Division, Salt Lake City, Utah 84119.

Anomalous concs. of Au have been reported in jasperoid bodies in the central Drum Mountains, Utah. Surface outcrop sample assays from this study indicate several jasperoids contain sufficient Au to be of possible economic importance if reasonable tonnage can be proved. The Au, which occurs as free, disseminated grains averaging about 40 µm diam., is confined to the jasperoid bodies, thus additional Au-bearing jasperoid must occur at depth for this min. to be of economic interest.

Fluid inc. homog. Ts and stable isotope dets. indicate that most jasperoid was dep. from sols. of predominantly meteoric origin at Ts between 150°C and 200°C. A hyd., hypogene origin, rather than the supergene origin suggested by certain field relations is established, and occurrence of jasperoid at depth is therefore indicated. Petrographic relations suggest that much silica was originally dep. as a gel. Transformation of silica gel to quartz and subsequent xliz. and rexliz. of quartz resulted in a sequence of jasperoid textures identified during petrographic study. Form. of Drum Mountain jasperoid is thought to have started with the reaction of hot, acidic sols. with a cooling intrusive resulting in intense sericitic alt. of the intrusive and supersaturation of the sols. in silica. The sols. migrated away from the intrusive along structural planes and encountered a highly reactive carbonate section triggering the silica depositional and transformational sequence.

Significant quantities of Au were introduced late in the jasperoid form. sequence. The occurrence and grade of this Au in the Drum Mountain jasperoids and the probable occurrence of jasperoid at depth make the economic potential of this min. worthy of further evaluation.

BAKHANOVA, Ye. V., BOGOLEPOV, V. G., NARSEEV, V. A., and POLYVYANNYI, E. Ya., 1975, Criteria of "juvenile origin" of relics of hydrotherms and nature of compounds of carbon in inclusions (abst.), p. 33-34, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Kazakh Inst. of Miner. Raw Materials, Alma-Ata.

Early parts of hyd. sols. at numerous greisen, skarn, Au, and quartz deps. of Kazakhstan bear mainly juvenile Ar, but in later portions of sols. the role of atmospheric Ar increases, up to 100%. For shallow deps. the correlation between atmospheric Ar and C_nH_{2n+2} is simple and high; for deep ones - reverse and weak. (Abs. by A.K.)

BAKUMENKO, I.T., 1975a, Melt inclusions, their types and thermometric methods of studies, chapt. IV, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 33-54 (in Russian).

Mainly class. of incs. and course of work with melt incs. (Abstract by A.K.)

BAKUMENKO, I.T., 1975b, Inclusions in minerals of ultrabasic nodules as indicators of their origin: Inst. Geol. Geophys. Trudy, v. 271 - Deep-seated xenoliths and the upper mantle, eds. V.S. Sobolev, N.L. Dobretsov and N.V. Sobolev, p. 231-235: Novosibirsk, "Nauka", Siberian Branch, (in Russian). Author at Inst. Geol. Geophys. of Sib. Branch of Acad. Sci. USSR, Novosibirsk.

Author invest. nodules from E. Kamchatka (in andesite basaltoids) and from Mongolia, Australia and Minusinskaya structure, USSR (in alkaline basaltoids). Mins. from nodules bear three types of incs.: 1) glass and gas bubble; 2) L_{CO_2}, occasionally with G_{CO_2}; 3) composite, with various ratios of glass and CO_2, formed from a heterog. medium. Moreover, in olivines and orthopyroxenes from Avachinskiy volcano, the author found, together with S glass incs., S incs. filled mainly with aq. sol., T_H 340-375°C. G phase of water incs. consists mainly of CO_2 ($\geq$90%), but under relatively low P (after crushing vol. of bubble increases six times). Water incs. occur in mins. of harzburgite nodules. These nodules are probably xenoliths derived from a shallow (non-mantle) hyperbasic intrusion, until now hidden, but partly serpentinized. Deserpentinization under action of basaltoid magma to form xenoliths of secondary olivine (with higher content of Fo than primary olivine) released water which was trapped in aq. incs. (Abs. by A.K.)

BAKUMENKO, I. T., POPOVA, N. M., and SHUGUROVA, N. A., 1975, Melt inclusions in phenocrysts and xenocrysts from basalt lava flow of Apakhonchich, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 3-13 (in Russian).

Inc. data essentially the same as in Bakumenko, Popova and Shugurova, 1973 (see Fluid Inclusion Research, v. 7, p. 9-10). (A.K.)

BAKUMENKO, I. T., and SOBOLEV, V. S., 1974, Inclusions in minerals from ultrabasic xenoliths in volcanites of the Avachinskaya volcano: Akad. Nauk SSSR, Doklady, v. 218, no. 6, p. 1430-1433 (in Russian; abstract in Internat. Geol. Rev., v. 17, no. 2, p. 239 (1975)).

The xenoliths, 100 m.y. old, probably represent uneroded intrusions of ultrabasites in the base of the volcano. The absolute majority of gas-liquid incs. in olivine and orthopyroxene of these "Avachinian" xenoliths homog. in the L phase at 335-375°C. The incs. are not of the "liquid CO_2-gas" type, not the "two-L" type, not vitreous. They consist of L water and gaseous CO_2; some of them contain also an anisotropic xline insoluble phase, possibly diopside (fig. 1). The mins. also contain secondary incs. of glass which homog. at 1210°C and higher. Such incs. occur side-by-side with the syngenetic "gas" incs.; in one and the same healed fissure. They represent dehermetization (before expulsion of the xenoliths) of the earlier G-L incs. and filling of the lava-made fissures with the melt rather than capture of the boiling lava. The only possible source of water in the G-L incs. could be complete deserpentinization of the xenoliths themselves after their capture by the lava, for every other possibility is ruled out by careful analysis of the evidence. The autoclave of the host mins. by which the water incs. were preserved almost intact (notwithstanding high Ps inside them and high Ts of the eruptions) is here proved for the first time.

BALAGNA, J. P., and CHARLES, R. W., 1975, Permeability of a monzo-granite at elevated temperature (abst.): Amer. Geophys. Union, Revised Abstracts, Program of Western Meeting, p. 44. Authors at Los Alamos Scientific Laboratory CNC-11, Los Alamos, New Mexico 87544.

Chemical effects are shown to be of great importance in permeability changes in this geothermal system. (From the authors' abstract.)

BALASUBRAMANIAM, K. S., PANCHAPAKESAN, V., and SAHU, K. C., 1975, Fluid inclusion geothermometric studies of some Indian fluorites using a fabricated heating stage: Jour. Geol. Soc. India, v. 16, no. 4, p. 460-464 (in English). Authors at Indian Institute of Technology, Bombay.

The homog. studies of G-L fluid incs. in fluorites from Handev Dongar-Ambadongar (Gujarat) and Kahela-Mandokipal (Rajasthan) carried out with a fabricated heating stage corroborates the earlier view that both the deps. are typically of a low hyd. origin (T_H = 95 - 148). (Authors' abstract.)

BALITSKIY, V. S., and DOROGOVIN, B. A., 1975, Experimental studies of partitioning of hydrocarbons in process of hydrothermal mineral formation (abst.), p. 23-24, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at All-Union Sci.-Research Inst. for Synthesis of Mineral Raw Materials, Alexandrov.

Presence of light hydrocarbons has no influence on the intensity of transport and xliz. of calcite (T = 250-300°C; P = 150-200 atm), but heavy hydrocarbons (h.h.) and new cpds. formed during interaction of h.h. with water sol. significantly decrease the intensity of re-xliz. of calcite. Such calcite bears incs. of hydrocarbons, sometimes assoc. with G/L incs. (Abs. by A.K.)

BALITSKY, V.S., MOSGOVA, N.N., OZEROVA, N.A., DOROGOVIN, B.A., and KOMOVA, V.V., 1976, Conditions of formation of native antimony and stibnite and their interrelation in antimony deposits, from experimental data and results of inclusion investigations: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976.

The conds. of form. of native Sb and stibnite in deps. with major Sb have been invest. The relationship of these two mins. as well as inc. thermometry in quartz and ore minerals have been studied, and exper. invest. of stibnite stability have been made for sols. of various acidities in the T range 100-540°C and P up to 1000 atm.

1. A comparison of the Sb-stibnite relationships in the deps. at Seinajoki (Finland) as described by Pääkkonen (1966) and invest. by us, and the orebodies of Yakutia (USSR) showed the Sb to be the earlier min. The dep. of these two mins. in the Yakutia orebodies is closer in time than in the Seinajoky.

2. The aggregate state of the incs. and the inc. thermometric data from the better studied dep. of Seinajoky showed the importance of high-T (∿400°) sols. at the early stages of form. of the dep. The Sb formed following the growth of high-T quartz, and ppted. earlier than other ore mins. (antimonides, arsenides and sulfoarsenides of Fe and Ni which xlized. at 300° and higher Ts). Stibnite dep. at 200-300°.

3. The exper. results showed that metallic pption. was favored by comparatively high Ts, and was not det. by the pH of the sols. in the range of moderate pH values observed in the natural hydrotherms.

4. The exper. results are in good agreement with the calc. thdy. data on the stability of stibnite and metallic Sb in hyd. systems (Manucharyans, et al., 1970) as well as with the As distrib. in the Seinajoki natural Sb which is up to 7% in the absence of arsenide and antimonide incs. Besides T, an H_2S deficiency is very important for the form. of Sb. In hyd. sols. T decrease and increase of H_2S activity lead to the form. of stibnite. (Authors' abstract.)

BAMBA, Takeo, and YAJIMA, Junkichi, 1974, Talc and talc deposit of the Matsumae district, Western Hokkaido, Japan: Bull. Geol. Survey Japan, v. 25, p. 17-29 (also 273-285); in Japanese with English abstract.

The genesis of the talc deps. of this district is explained as follows: 1) Under low T and High P, i.e., at a depth around 10 km, talc deps. were formed in some parts of tremolite serpentinite under iso-chem. conds. Spotted calcites were formed contemporaneously by diffusion of Ca derived from the original tremolite. This view is supported by the presence of pseudomorphs of tremolite occasionally observed in talc deps. 2) Later a fault was formed along the boundary of the serpentinite mass and the slate, and the serpentinite mass moved upwards along the fault, followed by the injection of hyd. sol. Al derived from this sol. replaced the talc or serpentine, forming chlorite, at high T and low P. 3) T_H of liquid incs. in calcite xls was est. at 250°C. When the effect of high P is taken into consideration this increases to 400°C. Consequently, this T should be considered as the T_F of talc from tremolite within the serpentinite mass. 4) This explanation is also supported by the results of the exper. on the systems $MgO-SiO_2-H_2O$ (Bowen and Tuttle, 1949) and $MgO-Al_2O_3-SiO_2-H_2O$ (Yoder, 1952). (From the authors' abstract)

BANNIKOVA, L. A., SUSHCHEVSKAYA, T. M., AND VOLKOVA, B. I., 1975, Chemical composition and complexing in the solutions which formed the cinnabar deposits of the Northwestern Caucasus: Geokhimiya, 1975, no. 5, p. 715-

726 (in Russian; translated in Geochem. Internat., v. 12, no. 3, p. 60-70 (1975)).

The liquid phases of gas-liquid incs. in the mins. of the cinnabar deps. of Northwestern Caucasus showed that the sols. which formed the inner and outer zones of deps. had different comps. Twelve analyses are given, along with the analytical methods used. Incs. in calcite from the outer min. zone were high in Na, Ca, Cl, F, B, and HCO_3^- and low in K, Li, Mg, and SO_4^{2-}, relative to incs. from quartz and cinnabar of the inner zone. Incs. in sulfides were high in NH_4, Br, and I (relative to those in calcite), possibly from organometallic complexes. Calcns. were made for the main complexes of a Na-K-Ca-Mg-Cl-SO_4-F-HCO_3 sol. at 150°. The sol. would have >70% of the total Ca content bound in $CaHCO_3^+$ and $CaSO_4$ complexes. The ores probably formed by mixing of fluids. (Authors' abstract, modified by ER.)

BARABANOV, V. F., 1975, Chemistry of Russian wolframites: Mineralogy and geochemistry of tungsten deposits: Transactions of III All-Union Meeting v. 3, p. 242-263, Leningrad (in Russian). Author at Leningrad State University.

A critical discussion on p. 250-251 of T_H and T_D data presented by G. F. Ivanova and I. Ye. Maksimiuk. (A.K.)

BARABAS, Arthur H., 1975, CO_2-rich fluids from gabbroic intrusive complexes, with and without Ni mineralization, in the Lynn Lake region, Manitoba (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 988. Author at Equipe de Recherche sur les Equilibres entre Fluides et Minéraux, C.R.P.G., Case Officielle n° 1, 54500, Vandoeuvre-les-Nancy, France.

Fluid inc. studies by microthermometry and with the crushing stage of ig. and vein quartz from Precambrian gabbroic intrusive complexes in the Lynn Lake area, northwestern Manitoba, indicate that CO_2 is the most important constituent of the fluid phase during the late stage ig. and subsequent hyd. evolution. This conclusion applies to the Lynn Lake gabbro and "El plug," which contain economic Ni min., as well as to the nearly unmin. Fraser Lake and Flag Lake gabbros. The d. of CO_2 trapped in incs. in ig. quartz is highly variable ($> 1.1 - 0.45$ gm/cm^3). The highest ds. are believed to represent the earliest fluid and appear to be compatible with deeper conds. than the boundary greenschist - amphibolite facies meta. of the intruded rocks. Many of the lower d. CO_2 incs. are believed to be high d. incs. which exploded due to P reduction during emplacement at high T, or due to later reheating at low P conds. Ign. quartz also exhibits features not found in vein quartz: one phase incs. which may represent dense fluid mixtures (CO_2 with CH_4 or CO?), curious rounded ferroan dolomite incs. trapped along with dense CO_2 for which an ign. origin cannot be discounted, and an almost total lack of aq. incs. even when uralite devel. is intense. Quartz from veins, in equil. with one or more secondary mins.: fibrous amphibole (uralite), biotite, chlorite and calcite, contains CO_2-rich incs. (± H_2O) predominantly, and aq. incs. rich in divalent cations (probably Ca^{++} and Mg^{++}). The maximum d. for CO_2 from vein samples (≤ 1 gm/cm^3) is less than that found in ign. quartz. (Author's abstract.)

BARKER, Colin, and TORKELSON, B. E., 1975, Gas adsorption on crushed quartz and basalt: Geochim. Cosmo. Acta, v. 39, p. 212-218. Authors at

Dept. of Chem., Univ. of Tulsa, Tulsa, Oklahoma 74104, U.S.A.

The new surfaces generated by crushing rocks and mins. adsorb gases. Diff. gases are adsorbed to diff. extents so that both the total amount and comp. of the released gases are changed. This affects the interpretation of the comp. of the gases obtained by vacuum crushing lunar basalts, meteorites and mins. with fluid incs. (Authors' abstract.)

Quan. mass spec. anal. data are presented for eight gasses, obtained while crushing in vacuum, that reveal drastically diff. amounts of adsorption for diff. gases. Thus in one basalt, 27 times more H_2O than methane (in ml(S.T.P.)/g) were adsorbed. (ER)

BARNES, H., 1974, Processes of hydrothermal ore deposition (abst.): Fortsch. Mineral., v. 52, pt. 2, p. 88-89.

Accumulating exper. and geol. data indicate that bisulfide and chloride complexes are the dominant means of transport of the metals in ore-forming hyd. sols. The base metals are soluble to varying degrees in (1) neutral to alkaline bisulfide sols., and (2) chloride sols. that are either neutral and sulfide-free or sulfide-containing and acidic. Iron is soluble, not in bisulfide, but in weak chloride or hydroxyl complexes. On this basis, it has become worthwhile to identify those geologically feasible reactions which are capable of causing ore dep. from such complexes. Clearly, those geol. envirs. favoring dep. reactions are ideal exploration targets.

The factors which may cause dep. from these complexes can be ranked in probable order of decreasing efficiency of pption. The order, based on the fraction of dissolved metal dep. by a geol. reasonable change in state of the sol., is for most bisulfide complexes: oxidation, increasing acidity, decreasing T, dilution, and decreasing P; the sequence for chloride complexes is: contacting sulfide-rich sols. or rocks, reduction, decreasing acidity, decreasing T, and decreasing P.

In each type of ore dep., one or more causes of dep. may be important. Mississippi Valley-type deps. show evidence of oxidation (barite pption), pH decrease (carbonates dissolve), and dilution (variable D/H ratio of fluid incs.) - processes compatible with bisulfide transport. Porphyry copper deps. suggest increasing acidity (sericitization), T decrease (vertical extent), and P decrease (brecciation) - again permissive of bisulfide transport. Vein deps. of large vertical extent indicate decreasing T and P which may cause dep. from either complex. Contact metasomatic deps. suggest an increase in acidity (carbonate replacement), possible oxidation (andradite replacement), dilution (by released CO_2), and a decrease in T (gradient from the intrusive). For these and other types of hyd. deps., the operative causes of dep. imply limits to be expected in both lateral and vertical extent of ore bodies. (Author's abstract.)

BARNES, H. L., 1975, Zoning of ore deposits: types and causes: Roy. Soc. Edinburgh, Trans., v. 69, no. 13, p. 295-311. Author at Ore Deposits Research Section, The Pennsylvania State University, University Park, Pennsylvania.

The zoning found in ore deps. is dominantly of two distinctive types: that in syngenetic sed. deps., like the Kupferschiefer, and that in common hyd. deps. of either epigenetic or syngenetic characteristics. Here, epigenetic hyd. deps. include those commonly classified as vein, porphyry copper, contact metasomatic, and Mississippi Valley deps.; the syngenetic hyd. deps. are conformable, massive ores such as at Rammelsberg. The two zoning sequences, beginning nearest the source of the metals, are: in hydrothermal deposits, Fe-Ni-Sn-Cu-Zn-Pb-Ag-Au-Sb-Hg, and in sedimentary deps., Cu-Ag-Pb-Zn.

A zoning sequence represents the natural order of increasing solubilities of the metallic sulphides and other mins. in ore-forming sols. Comparison of zoning sequences with relative solubilities in proposed ore sols. provides a rigorous test of the efficacy of such sols. When corrected for relative metal concs. (mass-action effect), then both theoretically predicted, and exper. relative solubilities of sulphide complexes match precisely the order of hyd. zoning. The order in sed. zoning is identical to the mass-action-corrected calc. of the sequence in which sulphides must ppt. from sols. containing metallic ions or weak chloride or hydroxyl complexes. The consanguinity of these correlations imply (1) that hyd. zoning is the product of dep. from sulphide complexes, and (2) that chloride complexes may be the metal-transporting agent in sed. deps. (Author's abstract.)

BARNES, William C., and ROSS, John V., 1975, Some structural implications of gas hydrates in deep-ocean sediments (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 989-990. First author at Department of Geological Sciences, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5.

Gases, particularly methane, are abundant constituents of fine-grained marine seds. Exper. evidence suggests that, under deep-ocean Ts and Ps, these gases should exist as solid hydrates. These hydrates can create a frozen zone extending from the sed.-water interface to a depth controlled by the local geothermal gradient. An appreciation of the phase relations of gas hydrates is fundamental to understanding the devel. of slaty cleavage and overthrust faults in deep-water seds.

A common hypothesis for the form. of slaty cleavage in fine-grained slates involves rigid rotation of particles accompanying early dewatering of seds. under large deviatoric stress. If, however, connate water is sequestered in the form of solid hydrates, fracture cleavage is likely to develop without the form. of an earlier slaty cleavage. Upon release of water during the phase change solid hydrate → gas + water, two possibilities may occur. If large deviatoric stresses no longer exist, a poor regional fissility may develop through gravitational compaction. However, if large deviatoric stresses continue to operate, overthrust faulting and the devel. of subsidiary buckles will be facilitated.

The orientation of the phase boundary between hydrates and the underlying gas + water zone with respect to continental slopes may lead to gravitational instability and the form. of large submarine landslips and chaotic breccias. (Authors' abstract.)

BATCHELDER, J. N., 1975, Copper Canyon deposit (abst.): Geol. Survey Research 1975, U. S. Geol. Surv. Prof. Paper 975, p. 161.

Fluid-inc. water in quartz from the Copper Canyon dep. at Battle Mountain, Nev., has δD values that range from -101.5 to -75.6 per mil. The calc. δO^{18} of water from quartz ranged from +3.1 to 10.9 per mil. The calc. δD for water (from biotite anals.) ranged from -71.2 to -111.5 per mil, and the calc. δO^{18} of water from biotite ranged from +0.5 to +5.0 per mil. These data indicate that the ore-forming sols. were most likely composed of magmatic water mixed with significant amounts of meteoric water. (Author's abstract; note some numbers differ in next item.)

BATCHELDER, John N., and BLAKE, David W., 1975, Geochemical variations in the Copper Canyon porphyry copper deposits, Lander County, Nevada (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 992-993. First author at U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025.

The Copper Canyon Cu-Au-Ag deps. include two hypogene ore bodies developed primarily in late Paleozoic rocks adjacent to a 38-m.y. old potassic-altered granodiorite. Widespread, but subeconomic concs. of sulfide mins. as fracture and cavity fillings in skarn apparently preceded the final intrusion of the granodiorite. The east ore body probably formed after the granodiorite reached its present level. δD values of water from fluid incs. in quartz ranged from -101.5 to -75.6 per mil. Water calc. to be in equil. with the quartz using fluid-inc. filling Ts ranged in $\delta^{18}O$ from +3.1 to +10.9 per mil. Filling Ts of the fluid incs. ranged from 270° to 385°C. Ts of the fluid-incs. calc. utilizing the Na-K-Ca geothermometer of Fournier and others (1971) range from 275° to 450°C and are in good agreement with filling Ts.

The calc. δD values of water in equil. with the biotites are in the interval -99.3 to -76.4 per mil; the calc. $\delta^{18}O$ values from +5.8 to +10.4 per mil. The secondary biotites are depleted in both ^{18}O and D, and the Ts calc. from coexisting quartz-biotite pairs show a T gradient from 790° to 382° from the primary to the secondary biotites. These data suggest that fluids assoc. with potassic alt. at Copper Canyon were most likely composed of magmatic water mixed with significant amounts of meteoric water. (Authors' abstract.)

BATZLE, Michael L., and SIMMONS, Gene, 1975, Microfractures in rocks from two geothermal areas (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 993. First author at Department of Earth and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.

BAZAROV, L. Sh., 1974, Genesis of beryl crystals in a zoned pluton of rare-earth granite (apogranite): Akad. Nauk SSSR, Doklady, v. 219, no. 4, p. 955-958 (in Russian; translated in Doklady Acad. Sci. USSR, v. 219, p. 132-135; abstract published in Internat. Geol. Review, v. 17, no. 7, p. 855 (1975)). Author at Inst. of Geol. and Geophy., Siberian Div., USSR Academy of Sciences, Novosibirsk.

Essentially same material presented by Bazarov, Gordeeva, and Akimtsev, 1974; see Fluid Inclusion Research, v. 7, p. 15-16, 1974. (ER)

BAZAROV, L. Sh., 1975a, Effect of carbon dioxide on the solubility of rock-forming minerals of rare metal pegmatites in water: Akad. Nauk SSSR, Doklady, v. 221, no. 5, p. 1160-1162 (in Russian). Author at Inst. Geol. Geofiz., Novosibirsk, USSR.

Thermometric data on P G-L incs. show that an increase in the CO_2 content is accompanied by an increase in the T of complete dissoln. of the solid phase. CO_2 decreases the soly. of rock-forming silicates in aq. melts causing a higher T of homog. of incs. During the form. of albite pegs., CO_2 (content 5.0-58.0%) constitutes a major part of the volatiles. At the max. concn. (50% of volatiles) of CO_2, spodumene has the least soly. (Chem. Abst., v. 83, no. 12, 196250n, 1975.)

BAZAROV, L. Sh., 1975b, Genesis of spodumene rare-metal pegmatites, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 155-160 (in Russian).

Spodumenes of five peg. provinces of USSR bear incs. filled with melts-sols., d. of filling 1.2-1.6 g/cm^3; upper range of T_H = 500-520°C, P = 1500 atm. T_{frz} equals -42°C. Melts-sols. consist of water sol. of NaCl and $MgCl_2$ as well as SiO_2, and albite (5-8%). Secondary incs. (T_H 120-350°C) bear more CO_2. (Abstract by A.K.)

BAZAROV, L. Sh., 1975c, Inclusions of "melt solutions" in minerals of rare-earth pegmatite: Akad. Nauk SSSR, Doklady, v. 215, no. 4, p. 940-943 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 215, p. 102-105; abstract translated in Internat. Geol. Rev., v. 16, no. 9, p. 1079-1030). Author at Inst. of Geol. and Geophy., Siberian Division, USSR Acad. of Sci., Novosibirsk.

Quartz and orthoclase, syn. from sols. and under conds. intended to emulate xliz. of natural RE pegs. (table 1), were found to contain incs. whose phase comp. and homog. char. are similar to those in natural peg. mins. (e.g., figs. 1, 2, 3 vs fig. 4). Specifically, incs. in syn. quartz are very much like incs. in natural quartz, beryl, and spodumene. Also, the high conc. of Na, K and Cl in the L phase (alongside the rock-forming mins. in the solid phase, which is the crystallized melt), in incs. of natural mins. are commensurate with such conc. in the syn. ones. Therefore it appears reasonable that the parent medium of granite pegs. is a "sol.-melt," pending further invest. (Author's abstract.)

BAZAROV, L. Sh., and MIKHAILOV, M. Yu., 1975, Determination of the content of H_2O and CO_2 in inclusions in minerals by the method of freezing, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 93-97 (in Russian).

The method is based on meas. of T_o of phase transition G-solid (cooling) or solid-G (heating) of studied gas in vacuum app. Then the det. value of P_i of sat. vapor of the cpd at T_o permits calc. of the mass M of the cpd using the Clapeyron equation: $P_iV = \frac{M}{m} RT_o$; The app. is also described. (Abstract by A.K.)

BAZAROV, L. Sh., MIRONOVA, N. Yu., GORDEEVA, V. I., and ORLOVA, L. M., 1975, Problems of solution-melt in the pegmatite process, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 37-43 (in Russian). See Translations.

BAZAROV, L. Sh., SURZHKO, A. S., and ORLOVA, L. M., 1975, Chemical composition of the aqueous phase of inclusions of solution-melts in spodumene, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 81-92 (in Russian).

After detailed studies of T_H of generations of incs. in min. the sample is heated up to T_D of the lowest-temp. generation of incs. then leached, the leachate analysed and the sample heated to decrep. the subsequent generation of incs. By this mode the comp. of incs. of each generation was evaluated. Ranges of intervals for spodumene were as follows: 50-100-200-250-300-350-400-450°C. Li content decreases from high to low T (1.92 to 0.15 wt % of water in incs.), conc. of Na increases at T = 300-400°C, falls at 200°C and then has a low-T max. at 100°C (22.7 wt %). Conc. of K changes irregularly from 0.63 to 0.001 wt %, conc. of Ca either increases in low-T incs. up to 3.36 wt % or changes irregularly. Mg is absent in high-T incs., but in low-T ones it appears in ranges 0.03-0.76 wt %. HCO_3 and Cl are the main anions, SO_4 is subordinate ion at late stages and F occasionally occurs in trace amounts. Max. content of CO_2 is 64.86 wt %; min. values - 2.1 - 25.0 wt %, mainly at T = 250-350°C. (Abstract by A.K.)

BAZAROVA, T.Yu., BAKUMENKO, I.T., PANINA, L.I., and CHEPUROV, A.I., 1975, Inclusions of melt in minerals of volcanic and subvolcanic rocks, chapt. V, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 55-99 (in Russian).

Data on incs. in ultrabasites: (meymechites from Gulinskiy pluton, incs. in olivine and pyroxene; biotite peridotite-porphyries from Central Aldan, incs. in olivine and pyroxene); calcalkaline rocks: (incs. in olivine, plagioclase and clinopyroxene in trap rocks from Siberia, East-European platform and Iceland; incs. in olivine, pyroxene, plagioclase and amphibole from basalts, andesites and dacites from Kamchatka, Kuril Islands and Transcarpathia; incs. in quartz, sanidine and plagioclase from acid rocks from Bulgaria, Pribalkhash'e, Salair, Kamchatka, Japan, Zabaikal'ye, Tyan'-Shan', and Iceland; incs. in olivine, pyroxene, plagioclase, apatite, biotite and K-feldspar from trachybasalts from Tenerife, Kamchatka and Uganda); alkaline rocks: incs. in olivine, pyroxene, amphibole, nepheline, and apatite from nepheline basaltoids from Hungary, Cape Verde Islands and E. Africa; incs. in olivine, pyroxene, biotite, plagioclase and leucite from leucite basaltoids from Pamir, Vesuvius, Kolyma River, Wyoming, W. Africa, and Central Aldan. (Abstract by A.K.)

BAZAROVA, T.Yu., BAKUMENKO, I.T., PANINA, L.I., SHATSKIY, V.S., CHUPIN, V.P., and KOSUKHIN, O.N., 1975, Melt inclusions in minerals of plutonic rocks, chapt. VI, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 100-150 (in Russian).

Consists of three parts: Ultrabasic alkaline magmatism of platform areas: (incs. in forsterite, pyroxene, nepheline, dolomite, diopside-augite, aegirine-augite, apatite, ankerite, melilite, and olivine from Maymecha-Kotuy region, E. Sayan, Enisey River and Kola Peninsula). Alkaline magmatism of fold areas: (Na-alkaline rocks: incs. in pyroxene, nepheline, chkalovite and plagioclase from agpaites and miaskites from Lovozero, Ilimaussaq, Kuznetskiy Alatau, Tuva, E. Sayan, Ural and Central

Aldan; K-alkaline rocks: incs. in nepheline, pyroxene, K-feldspar and olivine from Synnyr pluton, N. Pribaikal'ye, pseudoleucite syenites from Dezhnevskiy massif and Central Aldan). Granitoids and granite pegs (incs. in quartz, plagioclase, K-feldspar and apatite from granites of small intrusions and batholiths, anatectic granitoids and granite pegs., including orthotectic pegs., zoned vein "ceramic-type" pegs., zoned chamber pegs. and rare-metal pegs. from Ascension Island, Sakhalin, W. Zabaikal'ye, Altai, Aldany, Kazakhstan, Lovozero, Khibiny) (Abstract by A.K.)

BAZAROVA, T. Yu., and KOSTYUK, V. P., 1975, The nature of pseudoleucite shonkinite of the Dezhnevskii* massif, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 151-154 (in Russian).

T_H of xlized. melt incs. in pyroxenes from shonkinite = 1100-1160°C, and xlized. melt incs. in alkali feldspar inside pseudoleucite phenocrysts = 1020-1050°C, proving the magmatic nature of late stage pseudoleucitic decomp. In other shonkinite bodies pyroxene has incs. with T_H = 1100-1230°C, and nepheline in nepheline syenites wall rocks has incs. with T_H = 980-1050°C. Cancrinite, aegirine and Ca-garnet in shonkinites have incs. with T_H = 400-500°C. (Abstract by A.K.) * Chukotka

BAZAROVA, T. Yu., and KRASNOV, A. A., 1975, Temperatures and sequence of crystallization of some leucite-bearing basaltoids: Akad. Nauk SSSR, Doklady, v. 222, no. 4, p. 935-938 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects. v, 222, p. 177-180, 1976). Authors at Inst. of Geol. and Geophy., Siberian Div., USSR Acad. of Sci., Novosibirsk.

Although leucite frequently has many silicate melt incs., "no reliable data" on xliz. Ts have been obtained by meas. T_H. Earlier studies by Bazarova and Dmitriyev (1967), Sobolev, Bazarova and Bakumenko (1972; Fluid Inclusion Research, v. 5, p. 103-104, 1972), and Sobolev (1973) showed only very high T_H (1600-1700°C), and Naumov and Polyakov (1971; Fluid Inclusion Research, v. 4, p. 53, 1971) were unable to homog. incs. in leucite. Present authors show, on basis of detailed studies, that 95% of all xlized. incs. have leaked, and 99% of the balance leak during homog., with "no char. evidence" of leakage. P xlized. incs. with 3% gas in leucite from leucitite from the East African rift system and the Leucite Hills, Wyoming, were homog. Only repeatable data are used. Melting (of silicate dms.) begins ~800°C and ends at 1100°C; ore phases melt 1150-1170°C and T_H = 1230-1250°C. Another type of inc. in these same samples (called "pseudosecondary") are all glass. On heating they develop bubbles (≤2%) at 700-740°C; xliz. at 800-820°C; xls. melt at 1000-1050°C; and homog. at 1100-1110°C. Melt incs. in pyroxene (T_H = 1220-1270°C), and biotite (T_H = 1240-1270°C). Secondary incs. have lower Ts. (ER)

BEANE, R. E., BLOOM, M. S., and JARAMILLO, L., 1974, Skarn and disseminated mineralization in the Jarilla Mountains, Otero County (abst.): New Mexico Geol. Soc. Guidebook, Central-Northern New Mexico, p. 383. Authors at New Mexico Institute of Mining and Technology, Socorro, New Mexico.

Fluid inclusion studies of hyd. calcite indicate that the diopside-scapolite skarns formed at lower Ts than the more complex zoisite-garnet-calcite and amphibole-garnet-zoisite-calcite types. (From the authors' abstract.)

BERG, A.N. van den, and ESSENE, E. J., 1975, Anion distribution among coexisting minerals of Grenville marbles (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

Partitioning of OH-F-Cl among coexisting amphiboles, phlogopites, apatites, scapolites, sphenes, tourmalines and humites has been determined for assemblages from Grenville marbles formed at medium grades of metamorphism (500-650°C) from the Adirondacks and S.E. Ontario. Some 120 phases were analysed for 15 elements (F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Mn, Fe, Sr, Ba) with the electron microprobe. Compositions were normalized using accepted stoichiometries allowing inference of the OH-content, and giving oxide totals of 98-102 wt %. Halogens often show extensive solid solutions in most of these minerals; mol% F(=100.F/F+OH) is 68-100 % in apatites, 3-50% in amphiboles. Sphenes have minor F (0.2-1.6 wt %) and OH (0.16-1.10 wt % as H_2O). The content of Cl is significant but F is negligible in scapolites: mol% Cl(=100.Cl/Cl+CO_3+SO_4+F) is 2-75%, mol% F is 0-2%. F/OH partitioning of amphibole vs. phlogopite is relatively constant $K_D = .61 \pm .05$ and is consistent with previously published analyses. This partitioning does not seem affected by temperature or bulk composition.

Assuming Muñoz and Eugster's (1969) partioning values for phlogopite-HF fluid at 700°C and 2 kb can be applied, one may limit the X(HF) in the fluid to less than 10^{-2} bars and it clearly is not a quantitatively important gas species. F/OH partitioning of apatite vs. phlogopite is rather erratic and gives a wide range of T (0-530°C) when applied to Stormer and Carmichael's (1971) calculated geothermometer.

BETTETINI, E., and TURCO, G. H., 1974a, The application of color macro- and micro-cinematography in studies of inclusions in crystals and gems, particularly fluid inclusions: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting Berlin-Regensburg 1974, p. 407-414 (in French with English abstract). See Bettetini, 1973, <u>Fluid Inclusion Research</u>, v. 6, p. 20, 1973.

BETTETINI, Etienne, and TURCO, Guy, 1974b, The application of the color macro-and micro-cinematography in the studies of the crystal's and gem's inclusions, particularly the fluid inclusions. Rendiconti della Società Italiana di Mineralogia e Petrologia, vol. XXX, p. 423-434. Authors at Lab. Pétr. Minér., E.R. n° 450, 06034 - Nice Cedex, France.

See Bettetini, 1973, <u>Fluid Inclusion Research</u> - <u>Proc. of COFFI</u>, v. 6, p. 20, 1973. (ER)

BETTETINI, Etienne and TURCO, Guy, 1975, The application of the color macro- and micro-cinematography in the studies of the crystal's and gem's inclusions, particularly the fluid inclusions. Fortschr. Miner. 52, Spec. Issue I.M.A. Papers 9th Meeting, Berlin-Regensburg, 1974, p. 407-414. Authors at Lab. Pétr. Minér. E.R. n° 450, 06034 - Nice Cedex, France.

See Bettetini, 1973, Fluid Inclusion Research - Proc. of COFFI, v. 6, p. 20, 1973. (ER)

BILAL, Ahmad, 1975, CO_2-bearing fluids in the charnockitic enclaves from Bournac, Massif Central, France: Réunion Annuelle des Sciences de la Terre, 3ème, Montpellier, April 1975, p. 43 (in French). Author at Lab. Géol. Struct., Univ. Nancy I, C.O. 140, 54037 - Nancy Cedex, France.

Microthermometry data are given for the fluid incs. in quartz, plagioclase, alkali feldspar and pyroxene of the charnockite and khondalo-kinzigitic gneiss enclaves in recent lavas from Bournac. All incs. contain CO_2 and correspond to granulite facies incs. T_F varies from -57.7° to -57.5°C, indicating probable predominance of CO_2, and T_H (for homog. in the L phase) from -34° to +31°C with some gas phase homog. at +31°C. Two gen. of CO_2-bearing fluids are distinguished, and discussed in relation to the modal T_H values at -25°C and +25°C. For the denser fluid, a T of 700° - 900°C implies a P of 10-12 kb, values corresponding remarkably with other min. data (from equil. diagrams, isotopes, buffers). (Author's abstract, abbrev. by M. Pagel and translated by Chris Eastoe.)

BINNS, R. A., and GROVES, D. I., 1975, Fe-Ni-partition in metamorphosed olivine-sulfide assemblages from Perseverance, Western Australia (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ., Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

BISCHOFF, J. L., and DICKSON, F. W., 1975, Seawater-basalt interaction at 200°C and 500 bars: implications for origin of sea-floor heavy-metal deposits and regulation of seawater chemistry: Earth Plan. Sci. Letters, v. 25, p. 385-397.

BISHOP, F. C., SMITH, J. V., and DAWSON, J. B., 1975, Pentlandite-magnetite intergrowth in De Beers spinel lherzolite: review of sulphides in nodules: Physics and Chem. of the Earth, v. 9, p. 323-338.

BLACKMAN, M., LISGARTEN, N. D., PEPPIATT, S. J., and RAHMAN, M. S., 1975, Singular behaviour of small crystallites near the melting point: Nature, v. 258, p. 139-141.

BLATTNER, Peter, 1975, Oxygen isotopic composition of fissure-grown quartz, adularia, and calcite from Broadlands geothermal field, New Zealand with an appendix on quartz-K-feldspar-calcite-muscovite oxygen isotope geothermometers: Amer. Jour. Sci., v. 275, p. 785-800.

BOBOLOVICH, G. N., 1975, Morphological analysis of groups of inclusions of hydrocarbons in fluorite from a deposit from the Koh-i-Maran Chain (W. Pakistan) (abst.), p. 64-65, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Komi Div. Acad. Sci. USSR, Syktyvkar.

HCs occurred as droplets in hyd. sols. Following stages of growth of fluorite were recognized: 1) a brief appearance of HCs in system under quiet conds., 2) no HCs, 3) small influx of HC, plus small changes of rate of growth of fluorite xls., 4) no HCs, 5) influx of HCs and intensive xl. growth, 6) stoppage of xl. growth, 7) block growth of xls. and minimum influx of HCs. T_H increases at the end of process. (Abs. by A.K.)

BOETTCHER, A. L., 1975a, Experimental igneous petrology: Reviews of Geophysics and Space Physics, v. 13, no. 3, p. 75-79. Author at Pennsylvania State University, Department of Geosciences, University Park, Pennsylvania 16802.

Exper. igneous petrology in the period 1971-1975 produced many exciting results that aided significantly our understanding of conceptual mechs. involved in global-scale tectonics. The invest. of melting and other phase relationships of rocks and syn. systems ranging from intermediate to ultrabasic in comp., particularly in the presence of H_2O and H_2O-CO_2 vapors, has estab. limits to conds. under which anatexis and phase transformations can occur, particularly at plate boundaries. Much of the H_2O in the upper mantle and lower crust is bound in hydrous mins. such as amphiboles and micas; estab. of the conds. under which these phases are stable in the lab. has provided the basis of several models for the genesis of orogenic zone calc-alkaline rocks and for melting and other transformations of subducted lithosphere. Because of the significance of H_2O, CO_2, and other volatile components in upper mantle processes, considerable effort was devoted to the study of solubs. of these species in silicate melts at high Ps, and some thdy. data derived from meas. at high Ps and Ts enabled the calc. of phase relations previously unobtainable. Many new exper. techniques were developed to extend the capabilities of reproducing natural conds. in the lab. Nevertheless, many more refinements and new devels. must be made; for example, new alloys for encapsulation of Fe-bearing samples must be sought. (Author's abstract.)

BOETTCHER, A. L., 1975b, The role of water fugacity and oxygen fugacity during anatexis in the mantle (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 7, no. 6, p. 724; also Canad. Min., v. 13, pt. 3, p. 305-306. Author at Department of Geosciences, Pennsylvania State University, University Park, Pennsylvania 16802.

BOETTCHER, A. L., MYSEN, B. O., and MODRESKI, P. J., 1975, Melting in the mantle: phase relationships in natural and synthetic peridotite-H_2O and peridotite-H_2O-CO_2-C-H-O-S with application to kimberlite: Physics and Chem. of the Earth, v. 9, p. 855-868. Authors at Department of Geosciences, The Pennsylvania State University, University Park, Pennsylvania 16802, U.S.A.

To invest. the proposal that kimberlites and assoc. rocks originate by anatexis of mantle peridotite in a H_2O- and CO_2-rich envir., phase relationships of four peridotite (lherzolite) nodules and one websterite nodule were invest. to 1200°C and 30 kbar in the presence of H_2O and H_2O-CO_2 vapors with controlled oxygen fugacity. Solidus Ts, which are a function of various parameters including bulk comp., total P, and a_{H_2O}, are considerably (120-200°C) lower than previous dets. Melting of garnet lherzolite, even in the presence of a vapor of 50/50 mol. % H_2O/CO_2

($X_{H_2O}^{v}$ = 0.5), begins at depths of less than 150 km beneath the continental shields.

This invest. was augmented by a study of the stability of phlogopite in the system K_2O-MgO-CaO-Al_2O_3-SiO_2-H_2O to 35 kbar at $Pe_{H_2O} << P_T$ and $\sim P_T$. The reaction phlogopite + $enstatite_{ss}$ + $diopside_{ss} \rightleftarrows$ forsterite + pyrope + liquid occurs at about 1350°C at 35 kbar. These Ts are considerably higher than those of the vapor-sat. solidii of the peridotite nodules, reflecting the absence of Fe and Na and the very low values of a_{H_2O}. In expers. with the nodules, phlogopite appeared only when the comps. were spiked with phlogopite. Amphiboles occurred in all expers. with the nodules at Ps below 20-25 kbar. These amphiboles become enriched in pargasite component relative to tschermakite component with increasing P and decreasing T. Ts indicated by the comps. of orthopyroxenes coexisting with clinopyroxenes are ~100°C lower than those obtained from previously published pyroxene geothermometers.

Liquids under conditions of $X_{H_2O}^{v} \gtrsim 0.6$ are rich in SiO_2 and mimic andesites. For more CO_2-rich compositions, liquids are usually nepheline normative and rich in CaO and Al_2O_3, resembling melilitite lavas, which commonly accompany kimberlites. (Authors' abstract.)

BOGARD, D. D., and GIBSON, E. K., Jr., 1975, Volatile gases in breccia 68115 (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, Texas, p. 63-65. Authors at TN 7/Geochemistry Branch, NASA Johnson Space Center, Houston, TX 77058.

BOGOLEPOV, V. G., and DAVIDENKO, I. V., 1974, Transmagmatic solutions and ground water as factors in regional metamorphism and metasomatism: Akad. Nauk SSSR, Doklady, v. 214, p. 397-400 (in Russian; translated in Doklady Acad. Sci. USSR, v. 214, p. 50-53; abstract in Internat. Geol. Rev., v. 16, no. 5, p. 612, 1975). First author at Kazakh Research Institute of Mineral Products, Alma Ata, USSR.

Isotopic comp. of Ar in gas-liquid incs. in mins. and rocks, i.e., the $Ar^{40}:Ar^{36}$ ratio (table 1), affords the following interpretations, in line with the author's original method (1970 et seq.), inasmuch as Ar in subsurface waters and gases is almost entirely atmospheric and not magmatogenic: a) greisens, skarns, pegs. which are assoc. with allochthonous granitoids, and hyd. rejuvenated metamorphics were developed with a recognizable participation of nonmagmatogenic fluids (subsurface waters, etc.); b) magmatogenic pegs., products of granitization of their meta. hosts by acidic magmas, xl. quartz veins, etc., show no effects of any subsurface waters or gases, inasmuch as atmospheric Ar is practically missing in the incs. therein. (Authors' abstract.)

BOGOLEPOV, V. G., GULYAEVA, N. A., SAFIN, D. A., POLYVYANNYI, E. Ya., GOLUBIN, V. N., and ZEYLIK, B. S., 1975, Methods of prospecting for hidden ore bodies at the Akchatau rare-metal deposit (Central Kazakhstan), p. 55-65, in Mineralogy and geochemistry of tungsten deposits, Transactions of III All-Union Meeting v. 3, Leningrad (in Russian). First author at Kazakh Sci.-Research Inst. Mineral Raw Materials.

Low-T incs. (150-340°C) bear mainly atmospheric Ar (64-99.7 %) in contrast with high-T ones (360-600°C), where the amount of atmospheric Ar varies widely from 7 to 79 %. Then pegs. formed from sols. bearing a small juvenile component. Greisens xlized. from envir. consisting of about equal parts of juvenile and supergene sols., and post-ore mins. formed from mainly juvenile sols. Amount of water in incs. in mins. ranges from 0.68 to 2.77 mg/g. (Abstract by A.K.)

BOLTYROV, V. B., STRASHNENKO, G. I., and OGORODNIKOV, V. N., 1975, Metasomatic phenomena associated with forming of rock-crystal-bearing quartz veins (Terensay deposit, S. Ural), p. 45-48, in Minerals and parageneses of minerals of metasomatic and metamorphic rocks: Leningrad, "Nauka" (in Russian).

Solns. of stage of chloritization and forming of quartz veins had T (T_H) >300°C and were of HCO_3^- - Ca^{2+} type; xliz. of rock xls., albitization and adularization took place at T = 220-270°C under action of solns. of Cl^- - Na type. (Abstract by A.K.)

BORISENKO, A. S., 1974, Determination of sodium carbonates and bicarbonates in solutions of gas-liquid inclusions in minerals: Akad. Nauk SSSR, Doklady, v. 214, no. 4, p. 917-920 (in Russian; translated in Doklady Acad. Sci. USSR, v. 214, p. 208-211 (1975); abstract in Internat. Geol. Rev., v. 16, no. 6, p. 739 (1974)). Author at Inst. of Geol. and Geophy., Siberian Div., USSR Acad. of Sci., Novosibirsk.

A further improvement in the cryometric method, based on physical char. of solid phases in five diff. $Na-Cl-HCO_3-CO_3$ systems, with or without K and SO_4 (table 1), is represented by "diagnostic diagrams" (fig. 1) in which behavior of the easily identifiable solid phases (and of the eutectic) on supercooling, melting, rexliz., etc., correlates directly with percentages of Na_2CO_3, $NaHCO_3$, and NaCl in the system. (Author's abstract.)

BORISENKO, A. S., 1975, Determination of sodium carbonate and bicarbonate in solutions of gas-liquid inclusions by the cryometric method, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novisibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 98-104 (in Russian).

Same as in preceeding abstract. (A.K.)

BORISENKO, A. S., VASIL'YEV, V. I., OBOLENSKIY, A. A., and SHUGUROVA, N. A., 1974, Composition of gas-liquid inclusions in minerals of mercury deposits and the chemistry of ore-bearing solutions: Akad. Nauk SSSR Doklady, v. 214, no. 3, p. 673-676 (in Russian; translated in Doklady Acad. Sci. USSR, v. 214, p. 202-205 (1975); abstract translated in Internat. Geol. Rev., v. 16, no. 6, p. 736 (1974)). Authors at Inst. of Geol. and Geophy., Siberian Div., USSR Acad. of Sci., Novosibirsk.

Incs. in cinnabar, quartz, barite, calcite, fluorite, ankerite (T_H as high as 240°, as low as 75°C) examined here (table 1), ranging from comp. complicated brines to relatively simple $NaCl-Na_2CO_3$ sols., suggest on the whole a gradual dilution of the min. sols. by oxygenated vadose waters during dep. of the epithermal ores. The gas phase of the incs. consists mainly of CO_2 and N_2 (incl. rare gases); O_2 is present, as a rule; H_2S, SO_2, HCl, HF, NH_3 are present in significant quantities or are missing entirely, depending on stage of the process and other variables. (Authors' abstract.)

BOSSIERE, G., and GROMOV, A., 1975, Preliminary note on the pegmatites of the crystalline massif of Grand Kabylie (Algeria): Publ. Serv. géol. Algérie (new series), Bull., no. 45, p. 99-111 (in French).

T_H (50-300°C) and T_D (180-550°C) are given for various types of inclusions, some with CO_2 (ER).

BOWMAN, J. R., and ESSENE, E. J., 1975, Application of thermometry to contact metamorphism at Elkhorn, Montana (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

Progressive metamorphism in the aureole of the Black Butte Stock has resulted in the successive appearance of tremolite, forsterite, and periclase in siliceous dolomites, diopside in calc-pelites, and andalusite + K-feldspar in pelites. Microprobe analyses of tremolite $(K_{.015}Na_{.058})(Na_{.006}Ca_{1.994})(Mg_{4.958}Fe_{.046}Ti_{.019})(Al_{.153}Si_{7.847})(O_{21.940-21.965}OH_{1.925}F_{.061}Cl_{.006})$ and forsterite $(Mg_{1.965}Fe_{.031}Ca_{.004}Mn_{.001})Si_{.999}O_{4.00}$ in the dolomites indicate that equilibria in these rocks can be treated within the system $CaO-MgO-SiO_2-H_2O-CO_2$. Application of Cc-Dol thermometry and $T-X(CO_2)$ topologies at P=1Kb allow estimates of T and fluid composition for isograds located in the aureole:

$Dol+Qz+H_2O = Tr+Cc+CO_2$ ($T=415\pm25°C$; $.5<X(CO_2)<.8$)
$Tr+Dol = Fo+Cc+CO_2+H_2O$ ($T=520\pm20°C$; $.15<X(CO_2)<.35$)
$Dol = Per+Cc+CO_2$ ($T=590\pm20°C$; $X(CO_2)<.1$)

Approximate T=580°C and 440°C for the $Mu+Qz = And+Kfs+H_2O$ (pelites) and $Tr+Cc+Qz = Di+CO_2+H_2O$ (calc-pelites) reactions are based on their locations relative to Cc-Dol pairs and isograds in the nearby carbonates. Microprobe analyses indicate impurities in these tremolites (Fe/Fe+Mg=.19; F/F+OH=.17) and pyroxenes (Fe/Fe+Mg=.19) and in muscovite $(K_{1.847}Na_{.059})(Mg_{.138}Fe_{.338}Ti_{.036}Al_{3.481})(Si_{6.053}Al_{1.947})(O_{19.969}OH_{3.871}F_{.096}Cl_{.007})$ found with And+Kfs+Qz. $T-X(CO_2)$ topologies for the two reactions, corrected for the reduced activities of the pure phases, restrict their $X(CO_2)<.2$. The decrease in $X(CO_2)$ within the dolomites suggests only local and/or temporary buffering of the fluids by the reactions. The presence of metasomatic Gn+Px+Ves Ep assemblages in many parts of the aureole also suggest that there are additional fluid sources apart from the decarbonation reactions. Possible sources include plutonic and/or connate-meteoric fluids. (Authors' abstract)

BOYLE, R. W., ALEXANDER, W. M., and ASLIN, G. E. M., 1975, Some observations on the solubility of gold: Geol. Survey Canada Paper 75-24, 6 pp.

Soly. expers. confirm that Au can be transported in natural humic waters probably in the form of a metal-organic cpd., as a chelate, or adsorbed to humic matter. In gossans and in auriferous sulphide (pyritic) deps. similar expers. indicate that Au can be transported in ferric sulphate sols. Under hyd. conds. Au is readily sol. in alkali carbonate sols. containing H_2S, AsH_3, or SbH_3 or combinations of these constituents. (Authors' abstract.)

BOZZO, A. T., CHEN, H.-S., KASS, J. R., and BARDUHN, A. J., 1975, The properties of the hydrates of chlorine and carbon dioxide: Desalination, v. 16, p. 303-320. Authors at Syracuse University, Syracuse, New York.

The phase diagrams of Cl hydrate and CO_2 hydrate have been det. in both pure water and aq. NaCl sols. Heats of form., the hydrate comp., the critical decomp. conds., the effects of salt and other information are summarized. All necessary thdy. data are now available for evaluating Cl and CO_2 as agents for use in the hydrate process for desalination of sea water or brackish water. (Authors' abstract.)

BRADBURY, J. W., 1975, A reconnaissance study of fluid inclusions from Tertiary intrusives in Colorado: M.S. thesis, Univ. of Colorado.

Studies were made of fluid incs. in phenocrystic and interstitial quartz from 15 Tertiary intrusives in Colorado located both on and off the Mineral Belt, and ranging in age from Late Cretaceous to Early Pliocene.

Low salinity liquid-vapor fluid incs. were obs. in samples from each intrusive. High salinity fluid incs. were obs. in all of the intrusives sampled but two. Halite, sylvite and hematite are common dms. Many dms. remain unidentified. Fluid incs. containing liquid CO_2 were obs. in samples from two intrusives.

Glass incs., some with dms. but without obs. fluid, were found in samples from four intrusives. Most glass incs. have 25 vol. % bubble. Some glass incs. are strongly devitrified; others are not.

T_H of fluid incs. range from 100°C to 500°C, with most between 200°C and 350°C. P corrections are thought to be <150°C. P fluid incs. in phenocrystic and interstitial quartz, defined by those with T_H above 600°C, were not observed.

A correlation between fluid inc. comp. and the age of the intrusive is not apparent. (From the author's abstract.)

BRATUS', M. D., SVOREN', I. M., and DANYSH, V. V., 1975, Inclusions of hydrocarbons in "Marmarosh diamonds" from Carpathians as indicators of migration of oil fluids (abst.), p. 60-62, <u>in</u> Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fossil Fuels, Acad. Sci. Ukrainian SSR, L'vov.

"Marmarosh diamonds" (i.e., colorless, smoky or pink quartz xls) are found in fractures in Carpathian Cretaceous and Paleocene flysch. Most P incs. are G, more rarely L/G, with L either aq. sol. or light brown oil (L_1). Meas. P in G incs. 40-50 atm (room T); T_D - 70-100°C; contents almost pure methane (MX 1303 mass spec.; see items 1-3 in table). Incs. with L_1+L_2 have heavier HCs (see item 4 in table).

No.	Occurrence and type of inc.	Components, %								
		CH_4	C_2H_6	C_3H_8	C_4H_{10}	C_5H_{12}	CO_2	N_2	H_2	H_2O
1.	Village Lyuta Dukla zone, G inc.	97.48	--	--	--	--	--	2.52	--	--
2.	Village Volovets zone, G inc.	97.66	--	--	--	--	--	2.34	--	--
3.	Village Nizhnye Vorota, Krosno zone, G inc.	100.00	--	--	--	--	--	--	--	--
4.	Same, L_1+L_2 inc.	62.21	6.71	6.06	3.97	1.32	1.04	5.37	--	13.32
5.	Crimea, G inc.	97.39	0.12	--	--	--	--	1.67	0.25	0.57

(Ed. note - see also Zatsika, 1975, this volume.)

BRETT, Robin, 1975, Reduction of mare basalts by sulfur loss (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, TX, p. 89-91.

Metallic iron in mare basalts probably resulted from reduction by loss of S. (ER)

BREY, G., and GREEN, D. H., 1975, The role of CO_2 in the genesis of olivine melilitite: Contr. Miner. and Pet., v. 49, p. 93-103.

BROUGHTON, Paul L., and KENDALL, Alan C., 1975, The genesis of some stalactitic crystal fabrics and their relevance to the origin of limestone cements (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1010-1011. First author at Department of Mineral Resources, Regina, Saskatchewan, Canada S4P 3P5.

Fibrous calcite xls. that characterize the most common type of stalactite are not p. Absence of competitive xl. growth fabrics shows that xls. did not interact on the growth surfaces to generate the characteristic radiating fibrous fabrics.

Former growth surfaces are marked by concs. of linear incs. - each a fluid-filled cavity. This inc. pattern records an ephemeral xlite. growth morphology. Immediate and complete xlite. coalescence generates inc.-free growth-layers; partial coalescence forms xls. with linear incs. (fluid-filled inter-xlite. spaces) and no xlite. coalescence gives rise to growth layers having an acicular xl. habit.

The xlite. growth morphology is formed from a moving, thin water film from which CO_2 is lost. Small protruberances on growing surfaces (xlites) are favored during growth - they extend into regions of higher carbonate supersaturation. Conversely, larger projections (xl. terminations) disturb the water-shedding characteristics of the stalactite and are suppressed during growth.

Most stalactite carbonate fabrics also occur in limestone cements of vadose origin and in calcites believed to be replacive after marine, acicular carbonate cements (e.g. radiaxial fibrous calcite). It is difficult, petrographically, to dist. between calcites of these two diverse origins for such a dist. is an attempt to separate calcites that replace acicular-like precursors penecontemporaneously (vadose and stalactitic calcites) and those in which replacement may occur at a much later date and possibly as a consequence of the metastability of the acicular carbonate precursor. (Authors' abstract.)

BRYAN, G. M., 1974, In situ indications of gas hydrate, in Natural gases in marine sediments, I. R. Kaplan, Ed.,: New York, Plenum Press, p. 299-308. Author at Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York 10964.

Unusually high seismic velocities in gas-rich seds. of the Blake-Bahama outer ridge suggest the possibility of gas hydrate deps. in the upper few hundred meters. A prominent reflector lies at a depth that coincides with the lower limit of the hydrate zone, as calc. on the basis of reasonable T gradients. A similar reflector in the Bering Sea is assoc. with a more normal velocity profile and with the presence of gas only at the reflector itself. (Author's abstract.)

BRYZGALIN, O. V., 1975, Certain possible forms of presence of tungsten in hydrothermal solutions, p. 404-407, in Mineralogy of geochemistry of tungsten deposits, Transactions of III All-Union Meeting, v. 3, Leningrad (in Russian). Author at Inst. Geochem. and Analyt. Chem. of Acad. Sci. USSR.

BUCHINSKAYA, N. I., GALABURDA, Yu. A., GALIY, S. A., 1974, Genetic peculiarities of sphalerite from the Krivoy Rog region: Geologicheskii Zhurnal, v. 34, no. 3, p. 132-134 (in Russian).

T_H of incs. in sphalerite 220-226°C; T_{Frz} -7.6-7.3°C, corresponding to 11.0-10.8% NaCl equiv. (ER)

BULKIN, G. A., 1974, Determination of temperatures of formation of primary mercury dispersion haloes: Akad. Nauk SSSR, Doklady, v. 215, no. 3, p. 697-700 (in Russian; translated in Doklady Acad. Sci. USSR, v. 215, p. 190-193 (1975); abstract in Internat. Geol. Review, v. 16, no. 4, p. 1078 (1974)). Author at All-Union Geol. Inst., Leningrad.

Dets. of native and sulfide Hg by phase anal. (table 1) and their conversion into form. Ts of the halos by the method of Saukov et al. (1972) indicate 20 to 217°C range. The same range is indicated also by the equil. constants and the Ts of the reactions (fig. 1). In Nikitovka, Nagol'nyy Kryazh, Crimea, Donbass, Transcarpathia, form. Ts of the known Hg and Pb-Zn ores (T_H and T_D = 50-250°C) are only occasionally somewhat higher than form. Ts of their primary Hg halos. (Author's abstract.)

BURNHAM, C. W., 1975a, Thermodynamics of melting in experimental silicate-volatile systems: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting Berlin-Regensburg 1974, p. 101-118. Author at Dept. of Geosci., The Penn. State Univ., University Park, Pa. 16802.

Numerous efforts have been made to deduce the thdy. of melting in rock-forming silicate-volatile systems using exper. phase equil. data. The limited success of these efforts is due mainly to the rather large uncertainties of the slopes of exper. det. equil. curves that have been used to obtain thdy. information. Recently, however, sufficient thdy. data have become available to obviate the need for such indirect methods.

Thdy. relations in the system $NaAlSi_3O_8$-H_2O recently have been obtained from exper. P-V-T and soly. data. Largely on the basis of these relations, a sol. model for H_2O has been developed which is generally applicable to aluminosilicate melts of a wide range in comp.

The Raoult's law behavior of the silicate components also implies that there are neither heat nor volume effects upon mixing of magmas in the comp. range gabbro to granite. Consequently, stable liquid immiscibility is precluded in magmas of these comps. (From author's abstract.)

BURNHAM, C. W., 1975b, Water and magmas; a mixing model: Geochim. Cosmo. Acta, v. 39, p. 1077-1084. Author at Department of Geosciences, The Pennsylvania State University, University Park, Pa. 16802, U.S.A.

A model for the mixing of H_2O and silicate melts has been derived from the exper. det. effects of H_2O on the viscosity (fluidity), volumes, electrical conductivities, and especially the thdy. props. of hydrous aluminosilicate melts. It involves primarily the reaction of H_2O with those O^{2-} ions of the melt that are shared (bridging) between adjacent $(Al, Si)O_4$ tetrahedra to produce OH^- ions. However, in those melts that contain trivalent ions in tetrahedral coordination, such as the Al^{3+} ion in feldspathic melts, the model further involves exchange of a proton from H_2O with a non-tetrahedrally coordinated cation that must be present to balance the net charge on the AlO_4 group. This cation exchange reaction, which goes essentially to completion, results in dissoc. of the H_2O and is limited only by the availability of H_2O and the number of exchangeable cations per mole of aluminosilicate.

In the system $NaAlSi_3O_8$-H_2O, upon which this thdy. model is based, there is 1 mole of exchangeable cations (Na^+) per mole (GFW) of $NaAlSi_3O_8$, consequently ion exchange occurs for H_2O contents up to a 1:1 mole ratio (X_w^m = mole fraction H_2O = 0.5). For mole fractions of H_2O greater than 0.5, no further exchange can occur and the reaction with additional bridging oxygens of the melt produces 2 moles of assoc. OH^- ions per mole of H_2O dissol. These reactions lead to a linear dependence of the thdy. activity of H_2O (a_w^m) on the square of its mole fraction (X_w^m) for values of X_w^m up to 0.5, and an exponential dependence on X_w^m at higher H_2O contents. Thus, for values of $X_w^m \leq 0.5$, $a_w^m = k(X_w^m)^2$, where k is a Henry's law constant for the dissoc. solute.

Extension of the thdy. model for $NaAlSi_3O_8$-H_2O to predict H_2O sols. and other behavior of compositionally more complex aluminosilicate melts (magmas) requires placing these melts on an equimolal basis with $NaAlSi_3O_8$. This is readily accomplished using chem. anal. of quenched glasses by normalizing to the stoichiometric requirements of $NaAlSi_3O_8$, first in terms of equal numbers of exchangeable cations for mole fractions of H_2O up to 0.5 and secondly in terms of 8 moles of oxygen for higher H_2O contents. Chem. anals. of three igneous-rock glasses, ranging in comp. from tholeiitic basalt to lithium-rich peg., were thus recast and the exper. H_2O sols. were computed on this equimolal basis. The resulting equimolal sols. are all the same, within exper. error, as the soly. of H_2O in $NaAlSi_3O_8$ melt calc. from the thdy. relations.

The equivalence of equimolal sols. implies that the Henry's law constant (k), which is a function of T and P, is independent of aluminosilicate comp. over a wide range. Moreover, as a consequence of the Gibbs-Duhem relation and the props. of exact differentials, it is clear that the silicate components of the melt, properly defined, mix ideally. Thus, a relatively simple mixing model for H_2O in silicate melts has led to a quantitative thdy. model for magmas that has far-reaching consequenches in igneous petrogenesis. (Author's abstract.)

BURT, D. M., 1975, Natural fluorine buffers in the system BeO-Al_2O_3-SiO_2-F_2O_{-1} (abst.): Amer. Geophy. Union, Trans., v. 56, no. 6, p. 487. Author at Dept. Geol., Ariz. State Univ., Tempe, AZ 85281.

Considering the phases found, there are four fluorine buffer reactions that can occur with increasing chemical potential of F_2O_{-1}. These four reactions are well-represented in beryllium-bearing pegs. and greisens. The successive assembs. formed indicate increasing acidity of the "pneumatolytic" environment. (From the author's abstract.)

BYERLY, G. R., MELSON, W. G., and VOGT, P. R., 1975, Extreme differentiation of ocean ridge volcanic rocks: Galapagos Ridge and Juan de Fuca Ridge (abst.): Transactions, American Geophysical Union, v. 56, no. 6, p. 469. First author at U.S. Geological Survey, 959 National Center, Reston, Virginia 22092.

Glass anals. of dredged samples from greater than 1000 m. depth on the Juan de Fuca and Galapagos Ridges confirm that these have undergone extensive Fe, Ti, K and P enrichment relative to samples dredged from other segments of the worldwide ocean ridge system. The differences in chem. between ridge segments may be explained by local "hot spots" or melting anomalies inferred to be assoc. with the anomalous segments. The variation in chem. within these anomalous segments appears to be due largely to fractionation of plagioclase, clinopyroxene, and olivine, in that order of importance. New data from the Galapagos Ridge suggests that separation of a silica-rich L from the fractionating basaltic L is also an important process, although the depth at which this occurs is unknown. Rhyodacite, andesite, and FeTi basalt (FeO >18%; TiO_2>3.5%) have been recovered from between 85°W and 95°W on this ridge segment. Small spheres (up to 5 mm in diameter) of silica-rich glass containing a eutectoid intergrowth of quartz and plagioclase are found in all the rock types mentioned above. The relative contributions of the fractionating min. phases and silica-rich L phase are currently being modeled by least squares methods. The assoc. of this extreme differentiation with "hot spots" or melting anomalies may be a function of the greater depth of onset of diapiric uprise and perhaps to faster ascent rates for the upwelling material. Rapid ascent rates may aid in the gravitational separation of the denser min. phases and the lighter silica-rich L from the uprising basaltic L. (Authors' abstract.)

CASADEVALL, Tom, and OHMOTO, Hiroshi, 1976, Sunnyside mine, Eureka mining district, San Juan County, Colorado: Geochemistry of gold and base metal ore formation in the volcanic environment: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. First author at 959 Natl. Center, U.S. Geol. Survey, Reston, Va. 22092.

The Sunnyside mine, in the Eureka mining district, San Juan County, Colorado, produces 700 tons/day of Au-Ag-Cu-Pb-Zn-Cd ore and is the State's leading Au producer (32,000 ounces in 1974). Production is from faults and fracture fillings within the northern walls of the Eureka graben, which formed during resurgent doming of the San Juan - Uncompahgre calderas about 28.0 m.y. ago. The Sunnyside mine workings cover a vertical range of 610 meters, from 3230 to 3840 meters elev., and extend laterally for ∿2100 meters.

The six periods of min., and their approximate volumetric abundances, are: (I) pyrite-quartz ores (5%); (II) banded quartz-sulfide ores (30%); (III) massive galena-sphalerite-chalcopyrite-bornite-hematite ores (40%); (IV) Au-telluride-quartz ores (1-2%); (V) Mn ores (20%); (VI) quartz-fluorite-carbonate-sulfate ores (5%).

Heating studies of fluid incs. in quartz, fluorite, and rhodochrosite indicate T ranges of 260° to 320°C for Periods I-V min. and 170° to 245°C for Period VI min. Evidence of boiling of Period VI fluids at 240°C has been observed from samples collected at 3800 meters elev. These data, together with the P-V-T data of dilute salt sols. and a max. erosion rate of 17cm/1000yr indicates a P_{H_2O} of 150 ± 40 bars for Periods I-V and about 35 bars for Period VI. The depth to min. at 3800 meters elev. was 570 meters ± 170 meters during Periods I-V and about 400 meters during Period VI. Ps during Periods I-V were probably closer to lithostatic conds., whereas Period VI Ps were hydrostatic. T_{Frz} indicate a range from ∿ 0 to 3.6 eq. wt.% NaCl. The ore-forming fluids were essentially K-Na-Ca fluids whose conc. ranged from 0.03-0.27 wt.% K; 0.23-0.64 wt.% Na; and 0.03-0.26 wt.% Ca. Metal concs. in inc. fluids agree well with values calc. from thdy. data and lie in the range of 10 to 1000 ppm for Cu, Fe, Zn, and Mn. The dominant gaseous species in the fluid was H_2O, accounting for greater than 0.99 mole fraction of total fluids. CO_2 is the only other gas species present in significant proportions. Period VI fluids contain numerous odd-mass hydrocarbons. The pH of Periods I-V fluids appeared to be in equil. with the assemb. sericite + quartz and ranges from 4.3-5.9 at $aK^+ = 0.02$. Total S conc. is estim. to be 0.05 ± 0.02 molal.

The δD values of inc. fluids from quartz, fluorite, sphalerite, and galena range from -96. to -135. ^{o}/oo during Periods I-VI. The $\delta^{18}O$ values of water calc. from O isotopic comp. of quartz and carbonates ranges from -5.7 to -8.0 ^{o}/oo for Periods I-V and from -7.2 to -14.1 ^{o}/oo for Period VI. The $\delta^{18}O$ values of whole rocks for wall rocks adjacent to a major vein range from +1.9 to -3.9 ^{o}/oo. These δD and $\delta^{18}O$ data suggest that the hyd. fluids were predominately meteoric water which underwent moderate isotopic exchange with wall rocks during Periods I-V, but only slight exchange during Period VI. The $\delta^{13}C$ values of Period VI carbonate mins. are -2.8 and -3.8 ^{o}/oo for calcite and -6.3 to -7.9 ^{o}/oo for rhodochrosite, indicating a limestone source for carbon in calcite while suggesting either a meteoric or magmatic source for carbon in rhodochrosite.

S isotope values are -6.0 to +2.7 ^{o}/oo for sulfides and +15.5 to +22.9 ^{o}/oo for sulfates. These values, together with consideration of the physico-chem. conds. of the ore-forming fluids, suggest that upper-Paleozoic marine evaporites with $\delta^{34}S \simeq + 12$ ^{o}/oo may have been the source for Sunnyside S. Isotopic studies of Pb and Rb-Sr suggest that metals in the Sunnyside ore fluids were scavenged from both Tertiary volcanic rocks and from 1.4 to 1.8 b.y. Precambrian basement.

Geol. and geochem. studies suggest a model of Sunnyside ore form. in which a probable recharge area for the ore-form. fluids was located south of the San Juan - Silverton caldera. Fluids were channeled through and out of the caldera along fractures radiating to the northwest and the northeast. In-flowing fluids picked up carbon, salts and S by sol. of Mesozoic and/or Paleozoic sed. rocks. As these dilute fluids became heated, metal-carrying capacity increased and metals were leached from wall rocks. At this same time, SO_4^{2-} was reduced to H_2S by reaction with the volcanic rocks. Fluids carrying both metals and reduced sulfur continued their northerly flow until they encountered the structures of the Eureka Graben. Here the primary mech. of pption was decreasing T. (Authors' abstract.)

ČERNÁ, Iva, ČERNÝ, Petr, and FERGUSON, R. B., 1973, The fluorine content and some physical properties of the amblygonite-montebrasite minerals: Amer. Min., v. 58, p. 291-301. Authors at Department of Earth Sciences, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2

Extensive studies are reported. Specific gravity was found to be very sensitive to the presence of fluid incs. (ER)

ČERNÝ, Petr, 1975, Granitic pegmatites and their minerals: selected examples of recent progress: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg 1974, p. 225-250.

This is the full publication of abstract given in Černý, 1974, Fluid Inclusion Research, v. 7, p. 33.

CHAIGNEAU, M. V., 1975, On the composition of gas from levels of the upper mantle (abst.): Internat. Union Geodesy and Geophy., 16th Gen. Assembly, Abstracts of Papers, p. 113 (in French).

A brief discussion of the gases enclosed in nodule olivine. (ER)

CHAIGNEAU, M., CHEMINEE, J. L., and HEKINIAN, R., 1975, Gases occluded and included in the rocks of the Mid-Atlantic rift at latitude 36°50'N: Réunion Annuelle des Sciences de la Terre, 3ème, Montpellier, April 1975, p. 95 (in French). First author at C.N.R.S., Service d'Analyse des Gaz, 4, av. de l'Observatoire, 75270 - Paris,Cedex 06, France.

Gases occluded and included in 25 spec. of picritic basalts, olivine basalts, pyroxene basalts with plagioclase megacrysts and plagioclase basalts have been extracted by heating to 1000°C in vacuo. The avg. yield is 0.9 ml gas/gm (at 0°C and 760 mm Hg). Concs. of CO, H_2, SO_2, CxHy and N_2 + noble gases have been det. CSO, CS_2 and H_2S occur at trace level. The major constituents are CO, CO_2, H_2 and HCl. Some spec. are relatively rich in SO_2.

The ratio CO/CO_2 is lower in the glass of the outer crust than in the interior of a spec. For olivine and pyroxene the ratio is 6 - 12, indicating xliz. in a reducing medium with transformation of CO into CO_2 during cooling of the lava. A contamination by seawater of the outer crust, either at the moment of quenching or over a long period, is not discounted. Hydrocarbons (avg. conc. 1%, and up to 5%) are always present, having formed during cooling of the lava. (Authors' abstract, abbrev. by M. Pagel and translated by Chris Eastoe.)

CHAPMAN, H. J., SPOONER, E. T. C., and SMEWING, J. D., 1975, ^{87}Sr enrichment of ophiolitic rocks from Troodos, Cyprus indicates sea water interaction (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1074. First author at Department of Geology and Mineralogy, Parks Road, Oxford OX1 3PR, England.

This study confirms the hypothesis that hyd. meta. was a consequence of sea water/rock interaction. (From the authors' abstract.)

CHARLES, R. W., and BALAGNA, J. P., 1975, Monzo-granite alteration in a hydrothermal system (abst.): Amer. Geophys. Union, Revised Abstracts, Program of Western Meeting, p. 44-45. Authors at Los Alamos Scientific Laboratory CNC-11, Los Alamos, New Mexico 87544.

Calcite veined monzo-granite cores from the LASL Geothermal Power Demonstration have been reacted in a circulatory system of our design for periods up to 500 hrs. Experimental conditions were: P_{Tot} = 165 kgm/cm^2, T = 200°C, flow rate = 1082 cc/min. Two of the reacting solutions were 0.1 N Na_2CO_3 and distilled water. Alteration with a solution of 0.1 N Na_2CO_3 removes all quartz from the rock in less than 300 hrs. producing a "Queen's Lace" type morphology. Chem. alt. changes the original oligoclase and microcline to albite on the surface presumably by base exchange. No base exchange occurs with the biotite. Calcite remains resistant. Secondary overgrowths were quite prominent. The best example is the acicular overgrowth of metastable zeolites grading from a mordenite core to heulandite near the tip. Alt. with distilled water is less apparent. The albite is preferentially removed from the oligoclase yielding a spongy bytownite on the surface. The microcline is relatively resistant but does have fine overgrowths of clays which can be detected by AUGER and ESCA surface analysis. K^+ is leached from the biotite producing a ferribiotite. Quartz and oligoclase exhibit stream channeling and are the least resistant phases.

These exper. and isothermal-isobaric results inferfaced with mass transfer computer techniques will be invaluable for predicting time dependent chem. reaction in the LASL Geothermal Power Project. (Authors' abstract.)

CHARLES, R. W., ROGERS, P., and HERRICK, C. C., 1975, Albite alteration in a sodium carbonate solution (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1075. First author at Los Alamos Scientific Laboratory, CNC-11, M/S 514, Los Alamos, New Mexico 87545.

CHAROY, Bernard, 1975a, Greisenization phenomena in the mineralized district of Penfeunteum (Saint-Renan Massif, Amoricain Massif): Petrological and geochemical aspects and genesis. Bulletin du B.R.G.M. (2^e serie), Section II, no. 5, p. 363-383 (in French). Author at Centre de Recherches Pétr. et Géochim., C.O. no. 1, 54500 Vandoeuvre-les-Nancy, France.

Three types of fluids have been dist. in the obs. granitic and greisenized facies: Type A is in non-alt. or slightly alt. granites. It has aq. fluid of 13-18 eq. wt. % NaCl, with T_H 140° - 300°C. Type B is in greisenized units; it has aq. fluid of 4-10 eq. wt. % NaCl, and T_H 150° - 270°C. Type C is in the enclosing form.; it has inc. of aq. sol. + CO_2 (CO_2 50-70% by vol. of incs.) with homog. of CO_2 in gas phase. $T_D \sim 220°C$, before homog. Discussion of hypotheses as to the origin of the salinity variation between A and B concludes principally that the greisenization phenomenon is not isothermal, that the fluid phase, being of low salinity, is in distinct disequil. with the initial feldspathic paragenesis. (Abstract by Maurice Pagel; translated by Chris Eastoe.)

CHAROY, Bernard, 1975b, Ploemeur kaolin deposit (Brittany): an example of hydrothermal alteration: Pétrologie, v. I, no. 4, p. 253-266 (in English).

The anal. of the fluid phase in quartz veins and vuggy quartzes of the Ploemeur kaolin dep. (Morbihan, Brittany) proves its hyd. origin and permits an evaluation of the phys. and chem. cond. of the alt. of the enclosing granite. P, T, comp. (Na, K, Cl, Al), pH of the aggressive sol. can be est. (Author's abstract.)

CHAROY, Bernard and WEISBROD, Alain, 1975, Characteristics of the fluid phase associated with the genesis of the tin deposits of Abbaretz and La Villeder (Southern Brittany). Mineral. Deposita, v. 10, p. 89-99 (in French with English abstract). Authors at Centre de Recherches Pétr. et Géochim., C.O. n° 1, 54500 - Vandoeuvre-les-Nancy, France.

The fluid inc. occuring in quartz of cassiterite-bearing quartz veins from two localities of Southern Brittany have been studied (microthermometry and chem. anal.). In both localities, two sorts of fluids have been recognized: 1. Early fluids, related to the pption of cassiterite. Those fluids are essentially a chloride-bearing aq. sol., with very little CO_2 and hydrocarbons. The sal. is rather low (6 to 9 wt % eq. NaCl). The incs. homog. at 150-300°C. The K/Na atomic ratio is about 0.1. From these data and the min. assoc. (muscovite + kaolinite), the phys. and chem. prop. of the sol. at the time of cassiterite xliz. have been cal.: T ∿350°C, P ∿800 bars; molalities of NaCl, KCl and HCl are, respectively about 1, 0.1 and 0.01 (pH at 25°C, 1 bar ∿2, lower than 3 in any case). 2. Late fluids, related to an important kaolinization. They are generally colder, and have a either lower or higher sal., than the early fluids. (Authors' abstract.)

CHENEY, Eric S., and TRAMMELL, John W., 1975, Batholitic ore deposits (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1025. First author at Department of Geological Sciences, University of Washington, Seattle, Washington 98195.

Compared to porphyry deps. batholitic Cu/Mo deps. (1) occur in batholiths, (2) lack porphyritic rocks with aphanitic or fine grained groundmasses, (3) have multiple hypogene mins. restricted to veins, veinlets, and fractures, (4) have biotitic alt. as thin envelopes around the veinlets, (5) have unalt. rocks peripheral to the zone of biotitic alt., (6) have structurally controlled zones of quartz-sericite-pyrite and chloritic alt. superimposed on and commonly inside the zone of biotitic alt., (7) produce only weak supergene alt. and secondary enrichment. Not all batholithic deps. have all of these characteristics, and some porphyry deps. do have some of these; evidently porphyry and batholithic deps. are end members of a series.

Examples of batholithic deps. include the Quartz Creek and Middle Fork deps. in the epizonal, Miocene Snoqualmie batholith of Washington, Brenda (British Columbia), and the Pre-Main Stage alts. and mins. at Butte (Montana). These are not deep portions of porphyry ore systems.

Compared to porphyry deps., batholithic deps. probably form in more nearly isothermal environments, and their ore-forming fluids either were more nearly in equil. with their host rocks or were less abundant. The absence of quartz-sericite-pyrite alt. or its restriction to discrete structures that cut biotitically alt. rocks suggest that the batholithic environment impedes meteoric fluids.

Exploration programs and Federal land withdrawals based on models of porphyry ore deps. may not recognize batholithic deps. (Authors' abstract.)

CHEPUROV, A. I., 1973, Crystallization temperature of biotite peridotite-porphyrite from central Aldan region: Akad. Nauk SSSR, Siber. Ot., Geol. i Geof., 1973, no. 5, p. 117-119 (in Russian; trans. in Inter. Geol. Rev., v. 16, no. 3, 1974, p. 359-360).

Incs. in diopside and olivine were heated in an inert medium microthermochamber (see Chepurov, 1973b, Fluid Inclusion Research - Proc. of COFFI, v. 7, p. 35, 1974). Incs. in olivine melted mainly in range 1200-1250°C; bubble at 1300°C was 4-6 vol. %. At 1420-1440 most incs. leaked ("were hermetically sealed," sic.). Incs. in diopside homog. at 1230-1270°C (heating time from complete melting to T_H of 2-5 minutes, since this is a fluid, ultrabasic magma). (ER)

CHEPUROV, A.I., 1975, Apparatus for studies of melt inclusions in minerals, chapt. III, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 20-32 (in Russian).

Method of quenching is described, as well as microstages heated by air-convection mode (models of Dolgov-Bazarov 1965 and Bazarov 1968) and by contact heating (models of Kalyuzhnyi, 1965, Chepurov-Pokhilenko 1972 and Mikhailov-Shatskiy 1974), all with detailed cross-sections. Materials used for calib., accuracy of meas., and cooling of objectives are described. Short char. of methods of det. of chem. comp. of incs. is given (microprobe analysis and cryometric method). (Abstract by A.K.)

CHEPUROV, A.I., BAKUMENKO, I.T., and BAZAROVA, T.Yu., 1975, Chemical composition of silicate and gas phases of melt inclusions, chapt. VII, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 151-166 (in Russian)

Direct det. of comp. of silicate part of melt incs (changes of comp. during process of differentiation of melt, xliz. differentiation inside incs., comp. of unusual magm. melt incs. in mins, comp. of melts obtained by homog. and quenching of xlized incs. in mins), chem. comp. of G phase in individual incs. in mins of alkaline rocks and calcalkaline rocks from basalts, andesites and acid rocks, pyroclastic, effusive, subvolcanic, granites, and pegs. (Abstract by A.K.)

CHEPUROV, A. I., BAZAROV, T. Yu., LAVRENT'YEV, Yu. G., and POKACHALOVA, O. S., 1974, Composition of inclusions of magmatic melt in minerals of fergusite porphyry of the Eastern Pamirs and pseudoleucitite of the Central Aldan: Akad. Nauk SSSR, Doklady, v. 218, no. 5, p. 1185-1188 (in Russian; translated in Doklady Acad. Sci. USSR, v. 218, p. 154-155, 1975; abstract in Internat. Geol. Rev., v. 17, no. 2, p. 236, 1175). Authors at Institute of Geology and Geophysics, Siberian Division, USSR Academy of Sciences, Novosibirsk.

Such inc. were described in the authors' earlier pubs. (DAN 1972, v. 213, no. 2, et seq.). Comp. of their silicate fraction (glass) is exam. here in fair detail, before and after homog. (tables 1-3). Among other things, comp. of the glass in pyroxenes from the fergusite-porphyry and the olivine pseudoleucitite is practically the same, indicative possibly of the ultimate product of differentiation of the alkalic-basaltoid magma. From the early to the late mins., significant changes in comp. of the magma, as represented by incs., are clearly demonstrable. The included glass represents the residual postxliz. melt in every case. For example, incs. in pyroxene are comp. almost the same as incs. in the periphery (but not the core) of olivine, its predecessor. Also, the captured glass continued to xliz. even after it was captured and sealed in the min., as evidenced by appearance of xlites. on the walls of the incs. alongside sediment derived from the host min. For that reason the melt obtained by homog. of the included glass, further heating, and quenching is comp. anomalous. (Authors' abstract.)

CHEPUROV, A. I., SHATSKIY, V. S., POKACHALOVA, O. S., and LAVRENT'YEV, Yu. G., 1975, Evidence from melt inclusions on the chemistry and crystallization of theralites in some Kuznetsk Alatau intrusions: Geokhimiya, 1975, no. 4, p. 595-602 (in Russian; translated in Geochem. Internat., v. 12, no. 2, p. 242-250). Authors at Inst. of Geol. and Geophy., Sib. Div., Acad. of Sci. of the USSR, Novosibirsk.

Xlized incs. in mins. from Kuznetsk Alatau theralites indicate that the latter are magmatic. T_H ranged from 1280° (presumably olivine), 1240-1260° (plagioclase), 1100-1190° (apatite, pyroxene, and nepheline), down to 1040-1080°C (nepheline). Several hrs. are needed for equil. An Ms-46 x-ray microanalyzer (i.e., electron microprobe) has been used in a detailed study of the chem. of the incs., and 14 anals. are given, plus 3 anals. of gases from the incs. (mainly CO_2). Some incs. contain dm amphibole possibly representing trapping of more water-rich melt in incs. than the bulk rock now has. (ER)

CHESNOKOV, B. V., 1974, The effect of pressing in of walls of a gaseous-liquid inclusion in a crystal of galena under conditions of increasing pressure in a druse cavity: Zap. Vses. Min. Obsh., v. 103, no. 3, p. 388-390 (in Russian). Author at Sverdlovsk Mining Inst.

In galena xls. from Berezovskoe and Tetukhe deps., formed in drusy vugs, small depressions were found on the xl faces. The shapes of the depressions are circular, elliptical or rectangular with rounded angles (when rectangular, the depressions are arranged according to [100] or [110]. The dimensions vary from 0.25 to 3.5 mm (depth of the latter 0.5 mm), usually ∿1 mm, the depth 0.1-0.2 mm; several tens of depressions were studied. Below these depressions vacuoles were found, with dimensions close to dimensions of depressions and with upper wall 0.1-0.2 to 0.75 mm thick. Depressions were found on xls which were distinctly dissolved by natural sols. The author supposes that the depressions formed under increasing fluid P in the vug on G/L incs. occurring near the xl surface. The sequence is as follows: 1) xl growth, 2) increase of P of sol. in vug, 3) dissolution of galena xls, making the outer wall of vacuole of G/L inc. thin, 4) pressing in of outer vacuole wall since $P_{int} < P_{ext}$, 5) dissolution of the bottom and walls of depression, 6) opening of G/L inc. by forming of hole in the bottom of depression by way of dissolution (sic), 7) forming of void of dissolution in the place of primitive inc. (sic), 8) decrease of P_{ext} sol., and weak regeneration of galena xls. Most galena xls stopped development at one of the listed stages. Small peaks at the bottom of depression are interpreted as result of decrease of sol. P ($P_{int} > P_{ext}$). Depressions prove the changes of P during min.-forming process. Author supposes that the evaluation of P of parent sols. by exper. forming of such depressions above G/L incs. will be possible. (Abstract by A.K.)

CHESNOKOV, B.V., 1975, On the role of pressure connected with tectonic movements in process of hydrothermal mineral formation (exemplified by Berezovskoe ore field at Middle Urals): Ilmenskiy Gosud. Zapovednik Trudy, Acad. Sci. USSR, Urals Sci. Center - Materials on Mineralogy of Urals, v. 13, p. 11-20 (in Russian).

Walls of vacuoles of G/L incs. in galena are indented by increasing P in the druse cavity, forming depressions on xl faces. In xls. of pyrite the G/L incs. bear small xls. of pyrite as dms, proving the high conc. of Fe and S^{2-} in sol, since the ratio: volume of vacuole to volume of pyrite dm $\leq$ 10. (Abs. by A.K.).

CHESNOKOV, D., and CHESNOKOV, B. V., 1974, The denting effect on the walls of gas-liquid inclusions in galena crystals by increase of pressure in the druse opening: Vses. Mineral. Obsh., Zap., v. 103, p. 388-390 (in Russian).

CHI, J. M., 1975, A study on the genesis of fluorite deposits of South Korea: Korean Inst. Mining Geol., Jour., v. 8, no. 1, p. 25-56 (in Korean with English abstract).

Studies of the fluid incls. in fluorites of the region reveal following T_H: Hwacheon metallogenic zone: 95° ~ 165°C; Hwangangni metallogenic zone: 97° ~ 235°C; Geumsan metallogenic zone: 93° ~ 236°C.

Hence the deps. of the Hwancheon region were formed at the epithermal stage, and those in the Hwangangni and Geumsan regions were dep. at the epithermal stage preceded by mesothermal min. of small scale in which some sulphide minerals were dep.

The anal. data of minor elements in the fluorites reveal that ore sols, of Hwangangni metallogenic zone seemed to have emanated in a more acidic stage of magma differentiation than those of the Hwacheon metallogenic zone. (From the author's abstract)

CHILIŃSKA, Hanna, GÓRECKA, E., KARWOWSKI, Łukasz, and PAWŁOWSKA, Jadwiga, 1975, Fourth Symposium of International Assoc. on the Genesis of Ore Deposits (IAGOD): Geologia (Poland), v. 23, no. 5, p. 248-251 (in Polish).

A review of the IAGOD meeting in Bulgaria, 1974. (ER)

CHINNECK, J. M., 1975, Petrologic, geochemical and fluid inclusion evidence bearing on sphalerite petrogenesis at the Goz Creek zinc prospect, Yukon: B.S. thesis, The Univ. of Western Ontario.

The geol. envir. and min. of the newly-discovered Goz Creek zinc prospect is suggestive of a Mississippi Valley-type occurrence. Petrological, geochem. and fluid inc. work on sphalerite support this idea and suggest that the Goz Creek min. has undergone a slightly more complex paragenetic history than normal.

Field and lab. evidence indicates two major types of sphalerite - each with distinctive formational Ts, chem. and hostrock relationships. There are unusually high silica concs. assoc. with both.

Stratabound sphalerite occurs as a semi-continuous stratiform massive to disseminated ore in silicified dolostone. It is red, contains many fluid incs. and colorgrowth bands, has relatively high Cu and Fe concs. (relative to breccia sphalerite) and T_H of 125°C-195°C.

Breccia sphalerite occurs with silica in high grade pods in a fault discordant to the bedding. The xls. are large, euhedral and amber-colored with relatively lower Fe and Cu concs. Suitable fluid incs. are rare, as are color growthbands, and indicate lower Ts of xliz. than the stratabound sphalerite.

Both zones have several phases of chert and quartz and evidence that suggest min. was generally long and involved polyphase dep.

These results suggest a diagenetic to epigenetic origin for the stratabound sphalerite and an epigenetic origin for the breccia ores. Mixing of heated connate brines with meteoric and formational water at the dep. for extended periods of time is envisioned as the mech. for stratabound sphalerite min. Subsequent shifting of the mixing zone downward such that the ore zone lies above the mixing in stable, cooler conds. is proposed to explain silica pption. and remobilization of sphalerite into Laramide deformation structures. (Author's abstract.)

CHUKHROV, F. V., 1975, On the formation of ores from vadose solutions: Z. angew. Geol., Berlin, v. 21, p. 429-433 (in German with English abstract; author's name transliterated "Tschuchrow, F. W.," in original).

The origin of ore-forming substances in hyd. ore deps. is an important genetic problem. Contrary to common ideas conditioning derivations of ore-bearing sols. from the magmatic range, the author reviews a great number of facts expressing the determining influence of vadose waters on the form. of deps. Incs. of liquids in mins., too, show that there are accords between metal-bearing sols. and vadose waters of the hydrosphere. The non-magmatic nature of sulphidic sulphur in many deps. shows (in) their isotopic comp. (Author's abstract.)

CHUKROV, F. V., YERMILOVA, L. P., CHURIKOV, V. S., and NOSSIK, L. P., 1975, Regeneration of sulphate and the isotopic composition of natural sulphur: Chemical Geology, v. 16, no. 1, p. 39-52. (Note - transliterated "Tschuchrow, F.W." in original)

CHUPIN, V. P., 1975, Inclusions of melt in quartz from anatectites of the Aldan shield and the generation of granitoid melts: Akad. Nauk SSSR, Doklady, v. 221, no. 3, p. 710-713 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 221, no. 3, p. 186-189 (1976)). Author at Inst. of Geol. and Geophy., Siberian Div., USSR Acad. of Sci., Novosibirsk.

T_H of xlized. 5-10 μm incs. in quartz from granulite facies migmatite granites were 840-900°C; of amphibolite facies migmatites and granites were 760-870°C. At room T these contain xline phases (K-feldspar, plagioclase, and quartz) plus ∿10-15% fluid and probably some CO_2. Melting starts at 700-720°C and small bubbles appear at 760-820°C. (Some secondary G-L incs. with NaCl dms also were found.) T_H require 10-20 hr. at T for equil.; 20 days at T 20 to $30° < T_H$ did not homog. The author's T_H values are 50°C higher than those of others. The comp. and amount of volatiles present are estim. by various procedures "to be described by Chapin and Bakumenko in a special publication." (ER)

CHUPIN, V. P., TOMILENKO, A. A., BAKUMENKO, I. T., and SHUGUROVA, N. A., 1975, Recrystallized inclusions in quartz of autochtonous granites and migmatites of the Aldan metamorphic complex and their petrological significance, *in* Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 14-27 (in Russian).

Rexliz. melt incs. in mins. of autochtonic granitoids of the Verkhnealdanian complex, Jengrian series, connected with rocks of granulitic and amphibolitic facies prove that T of xliz. (T_H) varied from 860-870 to 870-910°C, and in quartz of migmatites - 820-850°C. Incs. are several μm in diam. and consist of xls. of quartz, feldspars, gas and small amounts of L. For granulite facies CO_2 and "acid" gases are char., and for amphibolite facies - also N_2 + rare gases are present. Prelim. data on thermal expansion and other phys. props. of melts in incs. are given. (Abstract by A.K.)

CLAYPOOL, George E., 1975, Bacterial methane and natural gas deposits (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1029-1030. Author at U.S. Geological Survey, Denver, Colorado 80225.

CLAYTON, R.N., GOLDSMITH, J.R., KAREL, K.J., MAYEDA, T.K., and NEWTON, R.C., 1975, Limits on the effect of pressure on isotopic fractionation: Geochim. Cosmo. Acta, v. 39, p. 1197-1201. First author at Enrico Fermi Inst., The Univ. of Chicago, 5630 Ellis Avenue, Chicago, Illinois 60637.

Results of exper. at 500°C and 1-20 kbar and 700° and 0.5-1 kbar, plus theory, leads to the conclusion that P effects on O isotopic fract. between silicates are <0.2‰ at Ps of tens of kilobars. Thus the obs. large variations of O^{18}/O^{16} ratio in kimberlitic eclogites cannot be attributed to the effect of P. (From the authors' abstract.)

CLAYTON, R. N., and STEINER, A., 1975, Oxygen isotope studies of the geothermal system at Wairakei, New Zealand: Geochim. et Cosmo. Acta, v. 39, p. 1179-1186. First author at Enrico Fermi Institute, and Departments of Chemistry and Geophysical Sciences, University of Chicago, Chicago, Illinois 60637, U.S.A.

Volcanic rocks in the Wairakei geothermal field have undergone extensive oxygen isotope exchange with the thermal waters, resulting in an O^{18}-depletion avg. about 4 °/oo. A lower limit on the ratio of the mass of water to rock in the exchange system is 4·3, at least ten times greater than the corresponding figure for the Salton Sea geothermal system. Carbonates, present as alt. products in most samples, are found to be in equil. with waters at present-day Ts in some wells, and to record higher "fossil" Ts in others. Quartz phen. and xenocrysts remain unexchanged, and only new hyd. quartz is in isotopic equil. with geothermal sols. (Authors' abstract.)

CLOCHIATTI, ROBERT, 1972, Quartz crystals in pumice from the Valley of Ten Thousand Smokes (Katmai, Alaska): Acad. Sci. Paris, C.R., v. 274, Ser. D, p. 3037-3040 (in French). Author at CNRS, E.R. n° 45, Lab. Géochimie, 91405 - ORSAY (France).

Quartz xls in three specimens show shallow (2-5 μm) cavities at their edges, with a succession of depressions becoming deeper (20-100 μm) in steps towards the center. When they are covered, the cavities are filled by glass, a main contraction cavity, and uniformly distrib. tiny bubbles (1-2 μm). The shape and contents reveal one of the xliz. processes responsible for the form. of vitreous incs. According to T_H, the min. T of xliz. is 850 ± 10°C. The chem. comp. of the glasses, anal. by electron microprobe, is similar from one inc. to another and comparable with the whole rock analyses of SiO_2, Al_2O_3, $K2O$, and Na_2O. This shows that quartz is one of the first mins. to xliz. at depth in a magma rich in volatiles. (French abstract by M. Pagel; translated by Chris Eastoe.)

CLOCCHIATTI, Robert, 1974, Vitreous melt inclusions in crystals of quartz of eruptive origin: Soc. Ital. Mineral. e Petrol. (Milan), v. 30, no. 1, p. 353-372 (in Italian).

Covers part of the material in following entry. (ER)

CLOCCHIATTI, Robert, 1975a, Glassy inclusions in crystals of quartz; optical, thermo-optical and chemical studies, and geological applications: Soc. Géol. de France, Mémoires, New Series, v. 54, (no. 122), 96 pp plus 24 figs and 16 plates (in French). Author at C.N.R.S., E.R. no. 45, Lab. Géochimie, 91 405-Orsay, France.

Since this is a very thorough discussion of many aspects the study of silicate melt incs., drawing on both the author's extensive work and the published literature (~170 references), with 117 excellent photomicrographs, the following extended abstract is included, abridged from the author's original French abstract by M. Pagel and translated by Chris Eastoe.

Chapt. 1: An outline and historical survey of studies of vitreous incs., with detailed description of sample prep. tech. so that samples can be used for optical and thermo-optical study and chem. anal. by ion and electron microsprobes. A summary of xlographic and outward char. of quartz, with special reference to a) differentiating between corrosion cavities and cavities from free xliz. (the latter being a growth phenomenon, not from corrosion); and b) the diversity of factors bearing on the fracturing of quartz with notably a reduction of the importance of the role of the $\alpha \rightarrow \beta$ transition.

Chapt. 2: The form, dimensions, density, and nature of the filling material and the refractive index of included glasses are described. Together these char. lead to a class. of magmatic melt incs. The change in form of the cavity walls, even after trapping, is emphasized, for the xl. may continue to grow from the included glass. The morphology and the contents (glass only, glass + gas bubble or contraction cavity, glass + gas + xls) are strictly linked with the volcanic facies being considered. The mode of emplacement of the rock, and its cooling rate, control the evolution of the cavity walls and contents. Results of a detailed study on the identification by ion probe anal. of mins. trapped in the glass in the cavities or arising from xliz. of the glass are presented.

Chapt. 3: A study of the behaviour of vitreous incs. during T increase under the heating microscope (Fig. 1).

Chapter 4: Chem. comp. of magmatic melt incs. and its petrogenetic consequences. The gases dissolved in the glass are dominantly H_2O and CO_2, and CH_4 and Ar in lesser quantities. The major element study, performed on the electron microprobe for samples from various geological contexts, proves that magmatic melt incs. are samples of the liquid from which the quartz xlized.

Two xlisation processes occur: a) A fractional xlization of quartz from an initial liquid having a comp. quite close to that of the whole rock; as xliz. progresses the trapped liquid is depleted in silica until its chem. comp. resembles that of the residual glass (Mont Dore, Alaska, Guadeloupe). b) An evolution of the glass trapped along quartz-feldspar cotectic lines, following an anatectic fusion model. (Tuscany, Ethiopia). A knowledge of the xliz. T and chem. comp. of the included glasses makes it possible to est. P at the moment of xliz. of the quartz (Fig. 2).

Chapt. 5: Vulcanological and sedimentological applications. The problem of the origin of the quartz in the basalts of Martinique, and the consequences of the presence of xls. from dated pumices (on Mt Dore) in the non-fossiliferous sandy claystones in the Burbonais are examined. An exper. study of quartz from the thick Permian porphyritic series of the Italian Dolomites is presented.

Chapt. 6: The contribution of studying vitreous incs. in quartz to the different branches of geology are reviewed:]) The "personality" of the cavities and their contents opens the way to sedimentological applications; b) The variation of this "personality" from one volcanic facies to another comes to light in vulcanological and sedimentological applications (fig. 3); and c) The chem. nature of the glasses makes it possible to retrace the evolution of liquids during the xliz. of the quartz and involves the use of new petrogenetic models.

CLOCHIATTI, Robert, 1975b, Vitreous melt inclusions: La Recherche, Paris, v. 6, no. 58, p. 669-671 (in French). Author at C.N.R.S., E.R. n° 45, Lab Geochimie, 91405 - Orsay, France.

A short review. (ER)

COHEN, Lewis H., and ROSENFELD, John L., 1975, Pressure of inclusion of garnet in diamond (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1075. First author at Department of Earth Sciences, University of California, Riverside, California 92502.

COLE, Rex D., JENSEN, M. L., and PICARD, M. Dane, 1975, Sulfur isotope geochemistry of iron-sulfide minerals in the Green River formation (Eocene), Piceance Creek Basin, Colorado, Uinta Basin, Utah (abst.): Geol. Soc. Amer., Abstracts with Programs, v., 7, p. 1031-1032. First author at Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112.

COLEMAN, Dennis D., 1975, Isotopic analysis as a tool for determining the origin of methane in ground water (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1032. Author at Illinois State Geological Survey, Urbana, Illinois 61801.

COLLINS, A. G., 1975, Geochemistry of oilfield waters: Amsterdam, Elsevier Sci. Pub. Co., 496 pp. Author at Bartlesville Energy Research Center, Bureau of Mines, USDI, Bartlesville, Oklahoma, U.S.A.

A thorough discussion of analytical methods, the data obtained, and their significance. (ER)

COOPER, A. F., GITTINS, J., and TUTTLE, O. F., 1975, The system Na_2CO_3-K_2CO_3-$CaCO_3$ at 1 kilobar and its significance in carbonatite petrogenesis: Amer. Jour. Sci., v. 275, p. 534-560.

The xliz. of natrocarbonatite lavas from the volcano Oldoinyo Lengai in Tanzania is interpreted in terms of the ternary system, and good accord is found between the phase equil. and field obs. It is concluded that the lava has probably separated immiscibly from a nephelinite magma. It is suggested that alkalic carbonatite magmas are relatively common but that they persist only when the silica activity is too low to permit the formation of silicates, when the CO_2 activity is high enough to form alkali carbonates, and the magma is dry. In most alkalic carbonatite magmas the silica activity is high enough to bind part of the alkali content as silicates (biotite, amphibole, pyroxene), and a fluid phase is sufficiently rich in water to remove excess alkalies and become a fenitizing fluid. This removal leaves an alkali-depleted magma which crystallizes as the commoner calcitic, dolomitic, and/or ankeritic carbonatite. Fenitizing fluids may derive both from carbonatitic magmas and silicate magmas. (From the authors' abstract.)

COX, Dennis P., GONZÁLEZ, Ileana Pérez, and NASH, J. Thomas, 1975, Geology, geochemistry, and fluid-inclusion petrography of the Sapo Alegre porphyry copper prospect and its metavolcanic wallrocks, west-central Puerto Rico: Jour. Research, U.S. Geol. Survey, v. 3, no. 3, p. 313-327.

The Sapo Alegre prospect, a small porphyry Cu-Mo occurrence in west-central Puerto Rico, is char. by distinct zones of alt. and min. of quartz diorite porphyry. Fluid-inc. data suggest Ts between 300° and 400°C for hyd. fluids in the biotite-chlorite zone of the porphyry and 250° to 300°C for fluids in the quartz-sericite-pyrite zone. Ps equiv. to about 1.5 km of burial are indicated. (From the authors' abstract.)

COX, Dennis P., WIGGINS, Lovell B., and O'NEIL, James R., 1975, Amphibole-quartz-magnetite assemblages in hydrothermal alteration zones in the Tanama porphyry copper deposit, Puerto Rico (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1041. First author at U.S. Geological

Survey, Reston, Virginia 22092.

COX, G. F. N., and WEEKS, W. F., 1975, Brine drainage and initial salt entrapment in sodium chloride ice: U.S. Army Cold Regions Research and Eng. Lab., Research Report 345, 88 pp. Authors at U.S. Army Cold Regions Research and Eng. Lab., Hanover, N.H. 03755.

To obtain a better understanding of the desalination of natural sea ice, an exper. technique was devel. to meas. sequential salinity profiles of a growing sodium chloride ice sheet. Using radioactive ^{22}Na as a tracer, it was possible to det. both the conc. and movement of the brine within the ice without destroying the sample. A detailed T and growth history of the ice was also maintained so that the variation of the salinity profiles could be properly interpreted. Since the exper. salinity profile represented a smoothed, rather than a true salinity distrib., a deconvolution method was devised to restore the true salinity profile. This was achieved without any significant loss of end points. In all respects, the salinity profiles are similar to those of natural sea ice. They have a char. C-shape, and clearly exhibit the effects of brine drainage. Not knowing the rates of brine expulsion or gravity drainage, the variation of the salinity profiles during the period of ice growth could be explained by either process. To det. the relative importance of the desalination mechanisms, a theor. brine expulsion model was derived and compared to the exper. data. As input for the model, equations describing the variation of some props. of NaCl brine with T were derived. These included the brine salinity, viscosity, specific heat, thermal conductivity, and latent heat of freezing. The theor. brine expulsion model was derived by performing mass and energy balances over a control volume of NaCl ice. A simplified form of the model, when compared to the exper. results, indicated that brine expulsion was only important during the first several hours of ice growth, and later became a minor desalination process relative to gravity drainage which continued to be the dominant mech. for the remainder of the study period (up to 6 weeks). The rate of gravity drainage was found to be dependent on the brine volume and the T gradient of the ice. As either the brine volume or T gradient was increased, the rate of change of salinity due to gravity drainage increased. The equation commonly used to calc. the effective distrib. coef. (Weeks and Lofgren 1967) was modified and improved by taking brine drainage into account. An expression was also derived to give the distrib. coef. at very low growth velocities. (Authors' abstract.)

CRAIG, J. R., 1970, Saline waters: genesis and relationship to sediments and host rocks, in Saline Water, ed. R. B. Mattox, Contrib. 13 of Committee on Desert and Arid Zones Research: Las Vegas, New Mexico, New Mexico Highlands Univ., p. 3-30. Author at Dept. of Geol. Sci., Virginia Polytechnic Inst., Blacksburg, Virginia 24061.

A very thorough review of comp., genesis, evolution, and phase equil. on evaporation, for various saline waters. (ER)

CUNEY, Michel, 1974, The Bois Noirs-Limouzat uranium deposit (Massif Central, France). Relationship between minerals and fluids: Thèse de Spécialité, CRPG-ENSG-Université de Nancy I, May 1974, 174 pp. plus 7 plates (in French).

A detailed sequence of min. generations in six steps has been established. The dep. of quartz, marcasite, pitchblende and pyrite (1st step) is followed by hematitic quartz (2nd step). At that time pitchblende is slightly altered to coffinite, while epidote and adularia grow in the surrounding rocks. Then appears banded smoky quartz (3rd step) and after this fluorite, carbonates, and whewellite (4th step). A late generation of quartz+bismuthinite is seen to cross most previous generations (5th step). A supergene alt. during the Alpine orogeny and lasting until the present ends the evolution of this vein (6th step).

Char. fluids have been isolated for the first five steps. Ts and comps. varied quite widely during dep. Fluids assoc. with pitchblende dep. as well as those assoc. with bismuthinite are CO_2-rich. This suggests the transport of U as uranyl carbonate complexes. Reduction of uranyl ion was probably controlled by species in sol. (Author's own English abstract.)

CUNEY, Michel, 1975, Conditions of deposition of uranium in the Bois Noirs-Limouzat deposit (Forez, Massif Central, France): Réunion Annuelle des Sciences de la Terre, 3éme, Montpellier, April 1975, p. 116 (in French). Author at Centre de Recherches Pétr. et Géochim., C.O. n° 1, 54500 - Vandoeuvre-les-Nancy, France.

Fluid inc. in quartz devel. sometimes simultaneously with pitchblende show that dep. of U occurred at 70°-85°C and that U has been transported in sol. principally as uranyl carbonates in the presence of reducing sulphide ions. The pitchblende was remobilized by CO_2-bearing aq. fluids assoc. with the quartz-bismuthinite episode and by acid, SO_4-bearing aq. sols. during secondary remobilization. Coffinite was ppted. after pitchblende from sols. of medium sal. (9-12 eq. wt. % NaCl) at a T which could have reached 285°C. (Author's abstract, abbrev. by Maurice Pagel and translated by Chris Eastoe.)

CUNNINGHAM, C. G., 1975, Fluid inclusions as exploration guides in the porphyry environment, in Mining Year Book, 1975, Papers presented at 78th meeting: Colorado Mining Assoc. Author at U.S. Geological Survey, Denver Federal Center, Denver, Colorado 80225.

Geochemical and isotopic studies have shown that variations in comp., T, d, origin, component fugacity, and pH of ore fluids. together with the ore fluid hydrology, are the dominant factors in controlling transportation, dep., and, thus, distrib. of metals in the porphyry environment. Fluid incs. in quartz phen., ore mins., and gangue mins. are samples of the ore fluid, and provide a means of measuring these controlling factors. Recent studies show that the phy. and chem. props. of fluid in the incs., det. qual. using a standard petrographic microscope and quant. using simple heating and freezing stages, can be used as a prospecting tool.

Porphyry plutons, emplaced at relatively shallow depths, function as heat sources and cause large-scale convection of ore-forming fluids. Porphyry ore deps. typically have core min. assoc. with brecciated and quenched intrusive rocks that formed as a result of volcanic venting; assoc. hyd. alt. formed hyd. K-silicate and biotite. Fluids assoc. with these ore deps. were derived largely from the magma; they formed in the range 300°-500°C, are strongly saline, contain up to 60 wt. % dissolved salts, and exhibit evidence of sporadic boiling. Epithermal vein-type min. peripheral to this environment formed at lower Ts from lower sal. brines containing dominantly meteoric waters.

Favorable host rocks for Cu and Mo deps. commonly contain highly sal. fluid incs., which are easily recognized by the presence of dxls.

of salt, even where the rocks have been strongly leached. At elevated Ts these dense Na-K-Ca-Cl brines have the ability to transport metals as chloride complexes. At the interface with adjacent cooler, less dense, meteoric waters, the sols. mix, and the radical changes in sol. chem. and phy. environment that take place commonly cause pption. of the contained metal, forming deps. (Author's abstract.)

CURRIE, J. B., 1974, Fracture porosity and permeability in stratigraphic traps (abst.): Amer. Assoc. Pet. Geol., Soc. Econ. Paleontol. Mineral., Annu., v. 1, p. 23. Author at Univ. of Toronto, Toronto, Ontario, Canada.

(See Currie and Nwachukwu, 1974, Fluid Inclusion Research, v. 7, p. 42, 1974, for similar material.) (ER)

D'ANDREA, Ralph F., Jr., 1975, A study of fluid inclusions in anhydrite crystals grown under controlled conditions (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1045. Author at Ore Deposits Research Section, The Pennsylvania State University, University Park, Pennsylvania 16802.

Anhydrite xls. grown during sulfide replacement exper. were found to contain numerous two phase (L-V) fluid incs. Ts of xl. growth and inc. sal. were det. by meas. filling and freezing Ts in an attempt to evaluate the accuracy of conventional fluid inc. meas. techniques. The T of the sol. from which the anhydrite was grown was controlled at 250± 2°C. Filling Ts of nine incs. from four xls. ranged from 242°C to 260°C and avg. 250°C. The initial NaCl conc. in the parent sol. was 1.00 molal and increased to 1.02 molal by the end of the run because of evaporation of H_2O into the additional vapor space resulting from withdrawal of sol. samples. Equivalent NaCl conc. calc. from freezing Ts of six incs. was 1.05±.02 molal. The slight diff. between obs. inc. sals. and known parent fluid sal. is probably due to minute amounts of $CaCl_2$, $CO_{2(aq)}$, $H_2S_{(aq)}$, and other solutes formed during the run.

These data show that fluid incs. are, within the combined uncertainties, accurate samples of the parent fluid from which xls. grow. (Author's abstract.)

D'ANDREA, Ralph F., Jr., and BARNES, Hubert L., 1975, Experimental replacement of marble in chloride systems (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1044-1045. Authors at Ore Deposits Research Section, The Pennsylvania State University, University Park, Pennsylvania 16802.

DANILOVA, S. G., EPEL'BAUM, M. B., and STUPAKOVA, G. D., 1975, Methods of investigation of diffusion of water in magmatic melts at elevated pressure and temperature and determination of coefficient of diffusion of water in water-albite melt: Contributions to physico-chemical petrology, v. 5, p. 9-15, "Nauka," Moscow (in Russian).

DAVIDENKO, N. M., 1975a, Paragenesis of native gold and rock crystal at Chukotka: Minerals and parageneses of minerals of endogenic deposits, p. 122-125, "Nauka," Leningrad (in Russian).

T_H of incs. in quartz proves that gold xlized. at 155-180°C. (A.K.)

DAVIDENKO, N.M., 1975b, Mineral associations and conditions of formation of gold-bearing quartz veins from Malo-Anyuiskiy region, W. Chukotka: NE Complex Sci.-Research Inst. Trudy, v. 56: Novosibirsk, "Nauka" Sib. Branch, 134 pp. (in Russian).

In Au-bearing quartz veins several min. assoc. were distinguished: arsenopyrite-quartz (T_H 360-200°C, P 1100 atm, sols. pneu. to hyd., alk. to acid); chlorite-carbonate (T_H 200°C, P 1100 atm, sols. hyd., neutral (?)); scheelite-arsenopyrite-quartz (T_H 365-200°C, P 1100-280 atm, sols. pneu. to hyd., alk. to acid); calcite-rock xl (T_H 360-100°C, P 280-300 atm, sols. hyd., acid to neutral or weakly alk.); galena-Au-mica-quartz (T_H 235-100°C, P 280-300 atm, sols. hyd., weakly acid to alk.); axinite-calcite (T_H 125°C and lower, P 280 atm, sols. hyd., alk.). Anal. of leachates showed Na, K, Li, Ca, Cl, SO_4, HCO_3, CO_3, and F; G phase consists of CO_2 (∿60-70%), N_2 (∿19-25%), CH_4 (∿1-5%) and H_2 (∿6-7%). (Abs. by A.K.)

DE GROOT-POMMART, Christine, 1975, A study of iron-bearing and associated mineralizations in the skarns of Seriphos (Cyclades Archipelago, Greece): Thèse de Spécialité, Université de Nancy I, May 1975, 203 pp. (in French). Author at Lab. Géol. Struct., Univ. Nancy I, C.O. 140, 54037 - Nancy Cedex, France.

Invest. of incs. in ore bearing skarns and in granodiorite at Serifos (Cyclades, Greece) shows 3 main episodes of skarn form.: 1) (T ≃ 550-600°C) garnet - pyroxene (hedenbergite) - magnetite; fluid: $H_2O + CO_2$ (roughly equal amounts). 2) (T ≃ 500°C) calcite - quartz - ilvaite - wollastonite; fluid : H_2O + hydrocarbons. 3) $T < 400$°C idiomorphic quartz in vugs + hematite; fluid : only H_2O (+ dissolved salts). The idiomorphic quartz xls contain growth zones (up to 20) with the same fluid evolution (T_H 350 → 300°C), except for the last 2 zones. (Abstract by J. Touret).

DEICHA, G. A., 1975, Fluid inclusions in crystals, Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg 1974, p. 399-406.

A review of the formation, methods of study, and significance of incs. (ER)

DEINES, P., 1975, Oxygen isotope geothermometry, a review (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

DELITSYN, L. M., MELENT'YEV, B. N., and DELITSYNA, L. V., 1974, The system acmite-nepheline-villiaumite and the differentiation of alkalic magma: Akad. Nauk SSSR, Doklady, v. 214, no. 1, p. 186-189 (in Russian; translated in Doklady Acad. Sci. USSR, v. 214, p. 194-196; abstract in Internat. Geol. Rev., v. 16, no. 5, p. 611-612 (1975)). Authors at Central Prospecting Research Inst. for Base, Rare and Noble Metals, Moscow.

In view of the proved important function of fluorine in the devel. of apatite ores from alkalic magma, the authors' earlier exper. (Geokhimiya, 1971, no. 5, and others) are here continued. The results (table 1, the acmite-villiaumite part of the system), the $NaFe^{3+}Si_2O_6$-

NaF system (fig. 1), the field of immiscible liquid phases in the $Na_2O \cdot 4SiO_2 \cdot Fe_2O_3$-NaF system (fig. 2), and liquid phases in the $NaFe^3Si_2O_6$-$NaAlSiO_4$-NaF system (fig. 3) suggest that the nepheline xls. in certain apatite ores (in the Khibiny) represent the initial xline phase of the in situ differentiation of the ijolite-urtite magma. (Authors' abstract.) The range of immiscibility is also shown for each system. (ER)

DEMIN, Yu. I., ZOLOTAREV, V. G., OKRUGIN, V. M., and SOROKIVSKIY, M. G., 1974, Sulfide mineralization in quartz veins in ore deposits of the Leninogorsk district, Rudnyy Altai: Akad. Nauk SSSR, Doklady, v. 215, no. 6, p. 1431-1434 (in Russian; translated in Doklady Acad. Sci. USSR, v. 215, p. 88-91 (1975)).

T_D of quartz veins in various deps. of this district range from 240-400°C. The authors suggest identification of these can reveal concealed ore bodies. (ER)

DERNOV-PEGAREV, V. F., ZHADOVSKAYA, I. G., and KHITAROV, D. N., 1975, Genesis of carbonates on the basis of experimental data in systems of the type: alkali carbonate-alkaline earth-carbonate-water (abst.), p. 30-31, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Mingeo SSSR, Moscow.

Exper. data on soly. of calcite in K_2CO_3-Na_2CO_3-H_2O at $T = 200$-$500°C$ and P up to 1500 atm. and conc. of alkali metal 0.3-30 M prove that calcite dissolves well, forming complexes. Authors apply part of the system to explanation of origin of carbonatites. (Abstract by A.K.)

DIETRICH, J. E., and GRITTI, C., 1972, Crystals of barite from El-Kiar (Maroc Central), morphology and crystalline structure: Notes Serv. géol. Maroc, v. 32, no. 241, p. 87-99 (in French). Authors at Lab. Minér. Cristallogr., Université Paul Sabatier, Toulouse.

Dep. El-Kiar is connected with N boundary of granitic massif Zaër and is localized in Silurian schists in a zone of brecciation. Typical parageneses include barite, calcite, chalcocite, malachite and native copper. Barite xls. up to 1.5 cm long gave T_H for internal zone: 135-145°C, intermediate zone: 192-202°C and external zone: 200-223°C. (Abstract by A.K.)

DIMITROV, D. K., and KRĂSTEVA, M. K., 1975, Temperature of formation of the lead-zinc deposits in the Spahievo ore field: Abstracts of Bulgarian Sci. Lit., Geology and Geography, v. 18, no. 2, p. 15-16 (in English), from Izv. Geol. inst. BAN. Ser. rudni i nerudni polezni izkopaemi, no. 23, 1974, p. 157-174.

T_H of P incs. in quartz, calcite and sphalerite were meas. to ±1°C on a Koffler heating stage. T_H for individual stages of min. form. yielded the deps. embedded in medium-acid Oligocene volcanic and pyroclastic rocks, are as follows: 300°C-280°C for the galena-sphalerite stage: 310°C-230°C for the quartz-specularite-chlorite stage: 270°C-160°C for the epidote-calcite stage. The paleogeothermal gradient in the ore field (Cala dep.) during the form. of the lead-zinc min. was about ten times higher than the normal geothermal gradient in the Earth's crust. Considerable amounts of NaCl were present in the sols. of the galena-sphalerite stage (halite is found in the fluid incs.). (From the authors' abstract.)

DISTANOV, Z. G., STEBLEVA, A. T., OBOLENSKY, A. A., KOCHETKOVA, K. V., and BORISENKO, A. S., 1975, Genesis of Uderei gold-antimony deposit in Yenisei Ridge area: Akad. Nauk SSSR, S. O., Geol. Geofiz, 1975, no. 8, p. 19-27 (in Russian; English abstract).

Superposed nature of Sb quartz-antimonitic min. over earlier quartz-Au ore min. has been estab. as based on mineralographic and thermobarogeochemical data obtained for the ores of Uderei dep. in Yenisei Ridge. Uderei dep. belongs to quartz-antimonite ore terrain. The presence of Au can be explained by telescopic superposition of Sb min. on the earlier formed ore veins of low-sulphidic quartz-gold ore terrain. The Sb min. in Yenisei Ridge is of Proterozoic age. (Authors' abstract.)

DISTLER, V. V., LAPUTINA, I. L., SMIRNOV, A. V., and BALBIN, V. S., 1975, Arsenides, sulfoarsenides and antimonides of nickel, cobalt and iron of Talnakh ore field: Minerals and parageneses of minerals of endogenic deposits, p. 61-74, "Nauka," Leningrad (in Russian).

Two- and three-phase (with liquid CO_2) incs. in calcite homog. at 120-165°C and 270°C (with L_{CO_2}), in sphalerite - 215-240°C. (A.K.)

DOLGOV, Yu., A., ed., 1975, Mineralogy of endogenetic formations from inclusions in minerals, Transactions of West-Siberian Division of All-Union Mineralogical Society, v. 2, 176 pp.: Novosibirsk, W. Siberian Book Publishing House (in Russian). (V. S. Sobolev is Chief Editor)

The volume bears 21 papers, mainly pertinent to fluid inc. studies, arranged into three chapters: I. Phys.-chem. conds. of min.-forming and ore-forming on data of thermobarogeochemistry, II. Methods of study of incs. in min., III. Mineralogy, xlchem. and petrogenesis. Individual papers are abstracted in this volume of Fluid Inclusion Research under the authors' names. (A.K.)

DOLGOV, Yu. A. and GIBSHER, N. A., 1975, Source of ore elements during the formation of pyritic-polymetallic ores, exemplified by the Korbalikhinskii deposits (Rudnyi Altai), in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 44-55 (in Russian).

Distrib. of ore elements was studied in wall-rocks of dep., as well as T_F of ores, comp. and conc. of ore-forming sols., also T of alt. of certain wall-rocks are given. Great influence of geothermal gradient in the areas of paleovolcanism on extrac. of polymetals is presented, not only for wall rocks, but also for underlying ones. (...) (Authors' abstract, transl. and shortened by A.K.)

DOLGOV, Yu. A., SHCHERBAN', I. P., BOROVIKOVA, G. A., and GIBSHER, N. A., 1975, Physico-chemical conditions of Babilonian deposit formation in the light of thermodynamic and thermobarometric data: Akad. Nauk SSSR, S. O., Geol. Geofiz., 1975, no. 11, p. 35-45 (in Russian with English abstract).

Phys.-chem. conds. of form. of Babilonian copper-pyrrhotite dep.

(Rudny Altai) are discussed as based on the new evidence. The results of thdy. calcs. and thermobarometric dets. of hyd. processes which proceeded in the dep. are reported. (Authors' abstract.)

Seven samples show T_H of ≥500°C, and analyses for cation ratios and gases are given for some samples. (ER)

DOLOMANOVA, E. I., BOGOYAVLENSKAYA, I. V., BOYARSKAYA, R. V., VLASOVA, Ye. V., GROSHENKO, A. R., and NOSIK, L. P., 1975, Form of occurrence of carbon in minerals of tin depsoits (abst.), p. 18-19, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Inst. Geol. Ore Deps., Petrogr. Mineral. and Geochem. Acad. Sci. USSR, Moscow.

Following cpds. of C were found by IR spectroscopy and mass spectrometry in quartz from Sn deps.: CO_2, CO, CH_4, $C_3HX(X = F,Cl)$, CN. Heating expers. prove that below 400-450°C, CO_2 is completely removed from quartz, i.e., CO_2 occurs in defect channels, not in structural channels. CO was found rarely, especially in mins. from deps. localized in coal-clayey (i.e., low T?) metamorph. rocks. CH_4 occurs in vein quartz in sandstones and schists with coal-like matter or in contact with carbonate rocks. CH_3X was found in defect channels of quartz from Sn-bearing granite, peg. and veins from deps. of cassiterite-feldspar-quartz and cassiterite-quartz forms. CN was found by spectral emission anal. in quartz from dolomite. (Abstract by A.K.)

DOLOMANOVA, E. I., GASOYAN, M. S., KOROLEV, N. V., RUDNITSKAYA, E. S., TYUTNEVA, G. K., and ELINSON, M. M., 1972, Typomorphic features of hydrothermal vein quartz, in Typomorphism of minerals and its practical significance, F. V. Chukhrov, ed.: Moscow, "Nedra" Press, p. 138-148 (in Russian).

This reference was cited without abstract in an earlier volume. The authors present six pairs of spectrographic analys. for quartz and "microaqueous extracts" for Al, Ti, Ca, Mg, Fe, Mn, Ni, Cr, Na, K, Li, Cl, S, C, B, Sn, and Zn, all using Si as reference. They also give 41 anals. of evolved gases for H_2, CO_2, N_2+Ar, CH_4, O_2, and H_2S. (ER)

DOLOMANOVA, E. I., LOSEVA, T. I., and TSEPIN, A. I., 1974, The problem of the chemical composition of solid deposits in vacuoles of cassiterite, tourmaline, and quartz from tin-ore deposits, in Mineralogy of endogenic deposits, V. S. Sobolev, ed.: Novosibirsk, Western Siberia Pub. House, p. 138-149 (in Russian). (See Fluid Inclusion Research, v. 7, p. 251)

DONALDSON, C. H., 1975, Calculated diffusion coefficients and the growth rate of olivine in a basalt magma: Lithos, v. 8, p. 163-174. Author at Lunar Science Institute, 3303 Nasa Road 1, Houston, Texas 77058, U.S.A., and University of St. Andrews, Scotland.

Conc. gradients in glass adjacent to skeletal olivines in a DSDP basalt have been exam. by electron probe. The glass is depleted in Mg, Fe, and Cr and enriched in Si, Al, Na, and Ca relative to that far from olivine. Ionic diffusion coef. for the glass comps. are calc. from T, ionic radius and melt viscosity, using the Stokes-Einstein relation. At

1170°C, the diffusion coef. of Mg^{2+} ions in the basalt is $4\cdot5.10^{-9}$ cm^2/s. Comparison with meas. diffusion coef. in a mugearite suggests this value may be 16 times too small. The conc. gradient data and the diffusion coef. are used to calc. instantaneous olivine growth rates of $2\text{-}6.10^{-7}$ cm/s. This is too slow for olivine to have grown in situ during quenching. Growth necessarily preceded emplacement such that the comp. of the xls. plus the enclosing glass need not be that of a melt. The computed olivine growth rates are compatible with the rate of xliz. deduced for the Skaegaard intrusion. (Author's abstract.)

DONTSOVA, Ye. I., SAL'YE, M. Ye., GAVRILOVA, L. M., AND IOFFE, L. I., 1975, Oxygen-isotope fractionation in the high-temperature carbonates of metamorphic complexes. Geokhimiya, 1975, no. 8, p. 1223-1241 (in Russian; translated in Geochem. Internat., v. 12, no. 4, p. 202-219). First author at Vernadskiy Inst. Geochem. and Anal. Chem., Acad. Sci. USSR, Moscow.

The principal factors det. the O-isotope comp. of high-T carbonates are discussed; particular attention is given to the balance between the effects of T, amounts of sol., and sol. comp. as regards O-isotope fractionation during regional meta. A method is given for comparing natural and lab curves for $\delta^{18}O$ against $10^3 \ln \alpha^{18}O$, which allows one to est. the amounts and comp. of the sols, the disequil. in isotope fractionation, and the scope for using the lab.-meas. fractionation coef. as functions of T. It is found that there is no single mode of evolution of $\delta^{18}O$ and $\ln \alpha^{18}O$ for dolomites and calcites in sequential zones of progressive meta. The scope for using the $\ln \alpha^{18}O = f(T)$ relationship is restricted by the effect of the fluid comp. on $\ln \alpha^{18}O$, and also evidently from the initial isotope comp. of the reacting phases. (Authors' abstract)

DORONIN, A. Ya., and GIBSHER, N. A., 1975, Expression of the hypsometric rule and the temperatures of formation of sulfide veinlets of the Srednee polymetallic deposit (Rudnyi Altai), in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 76-80 (in Russian).

On the basis of new material the conds. and mech. of form. of zoned veinlets from Srednee deps. were evaluated. Data on T_H are given (sphalerite, G/L incs. 225-350°C, colloidal incs. 220-260°C as T of segregation of syneretic liquid;* quartz - 210-350°C; barite - 180-315°C), as well as on conc. and comp. of sols. Dimensions and weight of particles of sphalerite (3.2×10^{-5} cm, 2×10^{-5} cm, 1.5×10^{-5} cm and 680×10^{-16} g, 150×10^{-16} g, 17×10^{-16} g, respectively, for various veinlets) at the moment of pption., were calc. (Authors' abstract, transl. and extended by A.K.) *During xliz. of the gel (sic.)

DOWTY, Eric, 1975, A theory of sector zoning in minerals (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1058-1059. Author at Department of Geological and Geophysical Sciences, Princeton University, Princeton, New Jersey 08540.

DRUCHOK, L.P. and KALYUZHNYI, Vl. A., 1975, Microspectral method of studies of solid phases of inclusions in minerals (abst.), p. 72-73, in:

Carbon and its compounds in endogenic processes of mineral-formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fuels of Acad. Sci. of Ukrainian SSR, L'vov.

The app. consists of a microscope, electrode holder (graphite electrodes in horizontal position) and spectrograph ISP30. Samples were excited in an inert medium. Many elements, including halogens, S and As were det. Method was used to identify muscovite, biotite, alunite, siderite, phenakite, zircon, xenotime, fluocerite, topaz,etc. Quant. anal. may be made in min. grains with dim. 0.02-0.03 mm to det. main elements and sometimes also admixtures in mins. (Abs. by A.K.)

DUBROVSKII, V. N., SAVINSKII, I. D., and SIROTINSKAYA, S. V., 1974, Attempts to determine the level of erosion of sulfide-cassiterite ore bodies according to the complex minor elements in cassiterite, in Mineralogy of endogenic deposits, V. S. Sobolev, ed.: Novosibirsk, Western Siberia Pub. House, p. 127-137 (in Russian).

DUNN, David E., and HAYES, Michael J., 1975, Effect of pore-fluid chemistry on frictional behavior of orthoquartzite (abst.): Ceol. Soc. Amer., Abstracts with Programs, v. 7, p. 1060-1061. First author at Department of Geology, University of North Carolina, Chapel Hill, N. C. 27514.

DUNN, P. J., 1975, Inclusions in beryllonite from Stoneham, Maine, USA: Jour. Gemmology, v. 14, p. 208-212.

Cut gemstones of beryllonite, a rare peg. phosphate ($NaBePO_4$), contained tubular two-phase incs. with <1/3 gas by vol., oriented parallel to [010]. Warming of the stone to about 55°C during photography caused fracturing and escape of the inc. fluid, evaporation of the fluid at the surface formed a residue which was examined by x-ray diffraction using a Gandolfi powder camera. The phases found were halite and nahcolite ($NaHCO_3$).

Gem beryllonite from Minas Gerais, Brazil, has similarly oriented two-phase inclusions with >1/2 gas by volume. (ER)

EADINGTON, P.J., 1976, Fluid inclusions in the minerals of an intrusive quartz-topaz rock near Glen Innes, New South Wales: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at CSIRO Minerals Research Labs., North Ryde, Australia.

Fluid incs. have been studied in an intrusive quartz-topaz rock (silexite) which occurs as sills and dykes in a roof pendant in the Mole (biotite-) Granite. The granite is a high level pluton and has high concs. of F (3440 ppm) and Li (620 ppm). It has an oval-shaped outcrop of 40 km x 20 km, with a roof pendant of siltstones and sandstones of 10 km x 4 km in the centre of the pluton.

The silexite is a fine-grained mixture of quartz and topaz with granitic allotriomorphic texture and miarolitic cavities. The average topaz content is 25%. The main chem. constituents are SiO_2, Al_2O_3, and F, and other oxides (excluding H_2O) amount to less than 1%.

The silexite has intrusive relations with both granite and seds. and it in turn is cut by peg. veins. Evidence for an intrusive origin of the silexite is given by the contact meta. of the siltstone country rocks, the presence of xenolithic blocks of siltstone in the silexite, and the general form of the silexite bodies.

Fluid incs. in the topaz in silexite are of two comp. types; multiphase incs. with three large dm. xls. and a number of smaller xls., interspersed with gas-phase incs. containing liquid and a very large vapor bubble. Many of the incs., which are large (50 µm diam.) and have a scattered distrib., are thought to be P. Data were collected for the multiphase incs. only. They have T_H 580°C to 620°C and the inc. fluid has a salinity of 58 wt.%.

In addition to fluid incs., the topaz contains solid incs. which vary from colorless to pale yellow-brown. Some have shrinkage bubbles and others contain dxls. They are thought to be silicate glass.

The quartz in silexite has numerous small incs. (5 µm diam.) which are aligned in sub-parallel planes having a uniform orientation from grain to grain. These incs. are the multiphase comp. type containing two salt xls., and there are no gas-phase incs. T_H = 250°C to 300°C and the salinity is 37 wt.%. The quartz also contains solid incs. similar to those in the topaz.

Fluid incs. in the quartz are S and bear no relationsip to the origin of the silexite. The uniform orientation of inc. planes from grain to grain shows that they formed subsequently to xliz. It is thought that they have trapped hyd. sols. that permeated the silexite at a later time.

The presence in topaz of P fluid incs. (of multiphase and gas-phase comp. types) together with P glass incs. indicates xliz. from a three-phase system of silicate melt, conc. aqueous brine, and low salinity aqueous vapor. Since the aqueous phase which was trapped in fluid incs. was boiling, T_H is the T of xliz. of the topaz and of the silexite. The vapor pressure of the aqueous phase (∿750 bar) indicates a shallow depth of form.

The origin of the silexite as a high-F, water-saturated melt is consistent with published exper. data in the system granite—H_2O—HF, with the field relationships of the rock, and with the fluid inc. types contained in topaz.

Two possible origins for the silexite melt could be enrichment in F and water of a residual magma during xliz. of the biotite granite; or accumulation of volatiles as a separate aqueous phase in the xlized. roof zone of the pluton causing the granite solidus to be lowered below the ambient rock T. (Author's abstract.)

EASTOE, C.J., 1976, Fluid inclusion studies of the Panguna and Frieda porphyry coppers, Papua, New Guinea: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at Univ. of Tasmania.

Cu min. at Panguna and Frieda occurred from >600°C to as low as 400°C. Subsequent quartz-sulfide, sulfide and sulfate min. occurred between 450°C and 300°C. White anhydrite dep. between 150° and 100°C at Frieda, followed by gypsum with no fluid incs.

The Cu min. fluids were boiling and were chem. and physically complex. They were conc. sols. of ionic salts and water. If the phase system H_2O-NaCl-KCl is used as a model, the fluids contained 40% or less of water and about twice as much NaCl as KCl by weight. A range of comp. existed, however. Another salt, possibly $CaSO_4$, was an important constituent in certain fluids. Besides halite, sylvite and possible anhydrite, six other solid phases have been observed in the incs. of these sols. They were hematite, chalcopyrite, possible bornite and three other, anisotropic salts. The fluids exhibit a range of physical behavior, even within groups of neighboring incs. The sol. of halite may precede or follow the homog. of the gas bubble during runs. The boiling of the fluids yielded vapor phases rich in volatiles and poor in salts. Commonly neither a liquid rim nor dms. are visible in incs. of the vapor phases. Any which contain visible liquid or salt were probably heterogeneous when trapped for they decrep. before homog.

Fluids introduced after the principal min. included at least three more generations of conc. saline sols., each assoc. with an intrusive event. At least six phases of lower sal. aq. sols. were introduced. The sal. meas. of these fluids were found to cover a wide range within single specimens, and were not interpretable in terms of NaCl conc. because of the presence of other interfering ions.

Several factors make data interpretation difficult. The fluid incs. were in some cases heterogeneous when trapped. Necking of the incs. and the introduction of cooler, less sal. fluids into existing incs. occurred subsequently. There is a metastability phenomenon which increases the gas T_H of an inc. during a series of short-duration heating exper.

At Panguna, where the study was more detailed, the fluid incs. have yielded valuable physico-chem. data. Equally the study has emphasized the problems of interpretation of complex fluids, and the complexity of the dep. itself. (Author's abstract.)

EGGLER, D. H., 1975a, CO_2 as a volatile component of the mantle: The system Mg_2SiO_4-SiO_2-H_2O-CO_2: Physics and Chem. of the Earth, v. 9, p. 869-882. Author at Geophysical Laboratory, Carnegie Institution of Washington, Washington, D. C. 20008, U.S.A.

The system Mg_2SiO_4-SiO_2-H_2O-CO_2 has been studied at a P of 20 kbar as a model for the melting behavior of peridotite in the presence of two volatile components. In the presence of CO_2 and H_2O, the assemb. forsterite (Fo) + enstatite (En) begins to melt at a higher T than in the presence of H_2O alone. The liquids are CO_2- and H_2O-charged, yet show no tendency toward carbonatite immiscibility. Partial melts are generated at Ts >1400°C when CO_2/H_2O ratios are >45 mole % CO_2 and are silica-undersaturated in the CIPW norm, whereas partial melts produced at lower Ts and H_2O-rich conditions are silica-oversaturated. Liquids in the vapor-absent region of the join Fo-En-H_2O which are in equil. with Fo + En also exhibit this normative change in char. at 1400°C at 20 kbar. The chem. change therefore is not a result of changes in melt structure due to CO_2 sol., even though up to about 7 wt. % CO_2 dissolves in En melt at 20 kbar. Rather, CO_2 raises the T of the peridotite solidus relative to the beginning of melting with H_2O and reduces activity of H_2O.

Hydrous magmas produced in the mantle in general contain much less H_2O than is needed to saturate the melt and hence do not evolve vapor as they rise, until shallow depths are reached. By contrast, magmas containing CO_2 and H_2O may evolve vapor in the mantle or lower crust. The principal cause is the relatively lower soly. of CO_2 in silicate melts, which is less than that of H_2O at high P and very much less at Ps <10 kbar. Vapor rich in CO_2 dissolves less total silicate than H_2O-vapor and has markedly lower soly. of silica but does dissolve alkalies.

The relationship of silica-undersaturated liquid and CO_2-rich vapor may explain some of the chars. of kimberlite or of magmas assoc. with kimberlite. (Author's abstract.)

EGGLER, D.H., 1975b, Carbonatite generation by a reaction relation in the system $CaO-MgO-SiO_2-CO_2$ at 30 kbar pressure: Amer. Geophys. Union, Trans. v. 56, no. 6., p. 470. Author at Geophys. Lab., Carnegie Insti. of Wash., Wash., DC 20008.

Expers. on the joins $CaMgSi_2O_6$(Di)-$MgSiO_4$(Fo)-CO_2 and $CaSiO_4$(La)-$MgSiO_4$-CO_2 have revealed operation of a new reaction relation. It has been shown previously that opx is a liquidus phase (1650°C) on the join Di-Fo-CO_2 at 30 kbar (Eggler, 1974) and that the solidus (Di+Fo+V) is at 1480°C. It has now been found that at subsolidus Ts a univariant reaction occurs: $\underline{x}CaMgSi_2O_6 + 2Mg_2SiO_4 + 2CO_2 + (2x+2)\ MgSiO_3 + Ca_xMg_{2-x}(CO_3)_2$ where $1<\underline{x}<0.4$. Temperature of the change from silicate to silicate + carbonate assemb. varies with carbonate comp. More remarkably, the carbonate assemb. melts at 1150-1400°C to a carbonate-rich melt. On the join Fo-La-CO_2 olivine ($Fo_{99}La_1$) is the liquidus phase for a wide range of comps, joining cpx at a piercing point at a bulk comp. of $Fo_{35}La_{65}$. However, olivine is replaced by opx at subliquidus Ts by the reaction above. Some implications for peridotite-carbonatite relations: (1) The partial melting product of peridotite-CO_2 (oliv-cpx-opx) at 30 kbar is La-normative (Eggler, 1974) and will differentiate by cpx-oliv. fractionation to a calcite-rich carbonatite melt (cf. Huang and Wyllie, 1974). (2) A magnesite-rich carbonatite melt can form at Ts subsolidus to the silicate phase assemb; fractionation of such melts will be largely by opx subtraction. (3) In some cases cpx may be replaced by carbonate or carbonatite melt in CO_2-rich peridotites. (Author's abstract.)

EGGLER, D. H., 1975c, Peridotite-carbonate relations in the system $CaO-MgO-SiO_2-CO_2$: Carnegie Inst. Wash., Geophy. Lab. Year Book 74, for 1974-1975, p. 468-474.

(See previous abstract.)

EINAUDI, M. T., 1975, Graphical analysis of some skarn assemblages in the system $Ca-Fe-Mg-Si-H_2O-CO_2-O_2$ (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1081.

EINAUDI, M. T., and ATKINSON, W. W., Jr., 1975, The contact aureole and copper skarn at Carr Fork, Bingham, Utah (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1066. Authors at The Anaconda Company, 1849 West North Temple, Salt Lake City, Utah 84116.

EL GORESY, A., and RAMDOHR, Paul, 1975, Subsolidus reduction of lunar opaque oxides: evidence, assemblages, geochemical relevance, and evidence for a late stage reducing gaseous mixture (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, Texas, p. 245-247. Authors at Max-Planck-Institut für Kernphysik, 69 Heidelberg, Germany.

ELINSON, M. M., and ALIDODOV, B. A., 1973, Gas composition of inclusions in minerals and physicochemical conditions of mineral formation in Chorukh-Dayron ore field, Akad. Nauk SSSR, Izvestiya, Ser. Geol., 1973, no. 7, p. 103-111 (in Russian; translated in Internat. Geol. Review, v. 16, no. 5, p. 557-564, 1975).

Previously translated in Fluid Inclusion Research, v. 6, 1973, p. 176-185. (ER)

EL SHATOURY, H. M., TAKENOUCHI, Sukune, and IMAI, Hideki, 1974, Fluid inclusion studies of some beryliferous pegmatites and a tin-tungsten lode from Egypt: Mining Geology (Japan), v. 24, p. 307-314 (in English).

Some P incs. in beryl contain CO_2, and widely variable F. T_H ranged 250-458°C (uncorrected for P). Incs. in quartz also show evidence of boiling and T_H of 190-390°C. S incs. have T_H 122-250°C. (ER)

EL SHATOURY, H. M., TAKENOUCHI, Sukune, and IMAI, Hideki, 1975a, Nature and temperature of ore-forming fluids at Toyoha mine in the light of fluid inclusions in quartz porphyry: Mining Geology (Japan), v. 25, p. 11-25 (in English).

Fluid incs. in quartz phen. of quartz porphyry, quartz veinlets cutting quartz porphyry, and quartz and sphalerite in ores, were studied by the heating-stage and freezing-stage methods. Polyphase fluid incs. carrying transparent cubic xls. were found particularly in samples from deeper places. Liquid incs. were found in most samples. T_H of liquid incs. was in the range of 200°C and 300°C, and the sal. varied from 1-20 wt. %. Gaseous incs. were found mainly in shallower places with some polyphase incs. suggesting the "boiling" of ore-forming fluids. Generally speaking, the T and sal. of ore-forming fluids at the Toyoha mine, Hokkaido, decreased from earlier to later stages and from deeper to shallower places. (Authors' abstract.)

EL SHATOURY, H. M., TAKENOUCHI, Sukune, and IMAI, Hideki, 1975b, A preliminary note on fluid inclusions in some granitic rocks from Egypt: Mining Geology (Japan), v. 25, p. 261-266 (in English). Fluid incs. in granitic rocks from Egypt were invest. to find out any genetic relation between the intrusion of granitic rocks and min. Liquid incs. with high F are generally found in "Older Granites" which form batholithic masses with some gaseous incs. Polyphase fluid incs. carrying halite xls. are char. recognized in "Younger Granitoids" which generally form stock-like bodies. The coexistence of fluid and gaseous incs. with various F is also char. obs. in this type of granites. Some of these "Younger Granitoids" are genetically related to the Sn-W and Cu min. It is inferred that apophyses of granitic intrusives are favorable for the conc. of postmagmatic brines and that these stocks intruded into shallow places. (Authors' abstract.)

ELWELL, D. and SCHEEL, H.J., 1975, Crystal growth from high-temperature solutions: London, Academic Press, 634 pp.

Includes, as part of chapt. 9, a section (pp. 535-544) on determination and removal of inclusions. The literature on movements of inclusions in thermal gradients (20-750°C/cm) is summarized; movements of 0.05 to 1.8 mm $\cdot$ hr^{-1} were found, in various oxides and metals, at Ts of 667-1200°C. Relationship of dislocation bundles to inclusions is also discussed.

Many chapters involve at least some discussions of inclusions and the theory of various mechanisms of formation (see 34 index entries).(ER).

ERICKSEN, George E., 1975, Origin of the Chilean nitrate deposits (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1068. Author at U.S. Geological Survey, Reston, Virginia 22092.

ERNST, Theodor, 1975, Problems of the earth mantle - report and theory: Fortsch. Mineral., v. 52, no. 2, p. 106-140 (in German with English abstract).

Ernst believes that H_2O and CO_2 are incorporated in the crystal structures and come out during ascent to aid in various volcanic actions in the formation of kimberlites and carbonàtites. (ER)

FAIZIEV, A. P., and YURGENSON, G. A., 1975, Strontium and barium in fluorites from some deposits and prospects from Central Tadzhikistan: Geokhimiya, 1975, no. 2, p. 259-272 (in Russian with English abstract). Authors at Tadzhikistan State Univ., Dushanbe, and Transbaikalian Complex Sci.-Research Inst. of the Ministry of Geol. of USSR, Chita.

Some T_H data as well as P values for incs. in fluorites (160-140°C, 145-172°C - 220-260 atm, 140-165°C - 190-240 atm) are given; pH of G/L incs. in early fluorites is higher than in late, but range of values not given. (A.K.)

FAUGERES, Jean-Claude, 1972, Use of the scanning electron microscope in the study of detrital quartzes from the "Zerhoun sandstone" series (Bajocian of the pre-Riff folds, northern Morocco): Serv. Geol. Maroc, Notes, v. 32, no. 241, p. 129-133 (in French). Author at Lab. Géol., Faculté des Sciences, Rabat, Morocco.

A qual. study based on microscope obs. of incs. from detrital grains in the Zerhoun sandstone. Under the scanning electron microscope, certain unident. solids have been obs. assoc. in platelets or in distinct polyhedral aggregates of platelets. The role of these zones of weakness during transport of the grains and diagenesis is inferred from the influence of planes of incs. on the direction of fractures brought about during specimen preparation. (Abstract by Maurice Pagel, translated by Chris Eastoe.)

FAUST, G. T., 1975, A review and interpretation of the geologic setting of the Watchung basalt flows, New Jersey: U. S. Geol. Survey Prof. Paper 864-A, 42 pp.

Includes a section on vesiculation of basalt flows (p. 35-36). (ER)

FEDOROVA, T.V. and KOCHKIN, Yu. N., 1975, Mathematical modelling of composition of gaseous mixtures of magmatic processes, in Materials on genetic and experimental mineralogy, v. 8, V.S. Sobolev, ed., Inst. of Geol. and Geophysics, no. 184: Novosibirsk, "Nauka" Press, Siberian Division, p. 317-327 (in Russian).

FISHER, D. W., and CROFT, M. G., 1975, [Methane, propane, ethane, ammonia, and CO_2 in ground water] (abst.): Geol. Survey Research 1975, U. S. Geol. Surv. Prof. Paper 975, p. 158.

FISHER, James R., HAAS, John L., Jr., and BARTON, Paul B., Jr., 1975, Nitrogen as an oxidant in hydrothermal systems (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1074. Authors at U.S. Geological Survey, Reston, VA 22092.

Studies by others have shown that waters of meteoric origin participate extensively in shallow hyd. systems. Dissolved O_2 in such waters would inevitably be consumed in the oxidation of sulfide, ferrous iron, org. matter, and so on. This study evaluates the potential of N_2 to play a similar role.

The sol. constant of N_2 from 0 to 100°C is about half that of O_2. The partial P of N_2 in air is four times that for O_2. So air-sat. water contains twice as much N_2 as O_2. Furthermore, when N_2 is reduced to NH_3, 6 electrons are exchanged compared with 4 for O_2 reduced to H_2O. Thus, air-sat. water at 0°C and 1 atm entering a hyd. system has the oxidation capacity of 5.1 meq/kg H_2O from the dissolved N_2 and 1.7 meq/kg H_2O from the dissolved O_2. An important factor, however, is not how many electrons N_2 can accept, but under what conds. it will accept them.

Available data on the relative stabilities of aq. N_2, NH_3 and NH_4^+, for $\Sigma N = 10^{-3}m$ and $\Sigma S = 10^{-2.5}m$, indicate that N_2 is thdy. capable of: 1) oxidizing pyrrhotite to $FeS_2 + Fe_3O_4$ (+ NH_3) below 250°C, 2) oxidizing Fe_3O_4 to Fe_2O_3 (+ NH_4^+) only below pH 5.5 at 25°C and pH 2.1 at 250°C, 3) oxidizing H_2S to S° (+ NH_4^+) only below pH 5.8 at 25°C and pH 2.9 at 100°C, 4) oxidizing S° or H_2S to $SO_4^=$ or HSO_4^- (+ NH_4^+) only below pH 7.4 at 25°C or pH 3.0 at 100°C.

The reduction of aq. N_2 to NH_3 or NH_4^+ is expected to show pronounced fractionation of the N isotopes and thus to provide a means for tracing the N source in fluid incs. and for identifying the processes of N fixation in ammonium-bearing mins. (Authors' abstract.)

FLEET, M. E., 1975, Growth habits of clinopyroxene: Canadian Min., v. 13, p. 336-341.

FLETCHER, R. C., and VIDALE, R. J., 1975, A finite-difference model for diffusion and combined diffusion-infiltration metasomatism in a multicomponent system: Carnegie Inst. Wash., Geophy. Lab. Year Book 74, for 1974-1975, p. 424-428.

FOORD, Eugene E., and JAHNS, Richard H., 1975, Tourmaline in the Himalaya pegmatite-aplite dike system, Mesa Grande District, San Diego County, California (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1077. Authors at Dept. of Geology, Stanford University, Stanford, California 94305.

FORBES, Robert B., TURNER, Donald L., and NAESER, Charles W., 1975, Downhole fission track - $^{40}K/^{40}Ar$ age determinations and the measurement of perturbations in the geothermal gradient (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

FRANCK, E. U., 1974, Water and various solutions at high temperature and pressure (abst.): Fortsch. Mineral., v. 52, pt. 2, p. 91-92.

FRANTZ, J. D., and MAO, H. K., 1975, Bimetasomatism resulting from intergranular diffusion: multimineralic zone sequences: Carnegie Inst. Wash., Geophy. Lab. Year Book 74, for 1974-1975, p. 417-424.

FRIEDMAN, Irving, 1974, Meteoric water in magmas (abst.): Amer. Geophy. Union Trans., v. 55, no. 4, p. 478. Author at U. S. Geological Survey, Federal Center, Denver, Colorado 80225.

Oxygen isotope anal. of sanidine phen. from eruptive rock sequences in Nevada and Colorado and in Yellowstone National Park, Wyoming, Montana, and Idaho, show that the δO^{18} decreases in these magmas as a function of time. This decrease in δO^{18} may be caused by isotopic exchange between the magma and O^{18}-depleted ground water. For the Yellowstone National Park rhyolites, 7,000 km^3 of magma could decrease in δO^{18} by 2 $^{o}/oo$ in 600,000 years by reacting with 3 mm of pption. per year, which is 3% of the present annual pption. in this region. The possibility of reaction between large magmatic bodies and meteoric water at liquidus Ts has major implications in the possible diff. history of the magma and in the generation of ore deps. (Author's abstract.)

FRIEDMAN, Irving, 1975, Oxygen-18 in chert as an indicator of ancient geothermal gradients (abst.): Geol. Survey Research 1975, U. S. Geol. Surv. Prof. Paper 975, p. 141.

GALABURDA, Yu. A., GRITSAI, Yu. L., and PEDAN, M. V., 1975, Solution of some genetic questions on the mineralogy of Krivoi Rog depsoits by examining inclusions of the mineral forming medium: L'vov Gos. Univ. Min. Sborn., v. 29, no. 1, p. 14-22 (in Russian). Authors at Inst. Geokhim. Fiz. Miner., Kiev, USSR.

Two (early and late) groups of S incs. are recognized in quartz grains. The early-formed incs. are equigranular with a high (386-323°) T_H. The irregular late-formed incs. have a low (280-140°) T_H. Results are presented of the quant. estn. of Na^+, K^+, Li^+, Ca^{2+}, Mg^{2+}, HCO_3-, Cl^-, and $SO_4{}^{2-}$ in the aq. exts. of gas-liq. incs. in quartz. Data on incs. show that hematite formed at 380-200° and 800-900 atm. Physicochem. conds. of form. were detd. for acicular goethite, tourmaline, sphalerite, and garnet. C.A., v. 83, no. 10, 166956e, 1975.

GALLUP, A. L., GREENWOOD, B., and WILSON, J. F., 1975, A microscope cold stage: Jour. Microscopy, v. 103, pt. 2, p. 285-287.

A simple plastic box cooled by a flow of dry N cooled to LN_2 Ts. Flow rate controls T. Condensation on objective and substage is eliminated by heating wires. Photography has been "satisfactory" at -40°C with oil immersion objectives. Thermal gradients are said to be large and no statements are made as to precision or accuracy. (ER)

GARDNER, F. M., 1972, Hollow apatites in a layered basic intrusion, Norway: Geological Magazine, v. 109, no. 5, p. 385-464.

Cumulate apatite xls. with infilled tube-like cavities parallel to the c-axis are described from a layered gabbro intrusion in Northern Norway. These are considered to be skeletal xls. produced by rapid growth in the supercooled roof zone of the magma chamber. At least two stages of growth are suggested on the basis of the morphology of the apatites. The interiors of the xls. contain phases representing the trapped magma or the cumulus min. phase within which they are enclosed. Recirculation of the apatite primocrysts by convection currents is indicated by the interrupted form of some of the tubes. (Author's abstract.)

GARTH, R. J., 1975, Tectonic control on the formation of some fibrous quartz veins, Mid-Wales: Geol. Magazine, v. 112, p. 81-90.

GAVRILENKO, B. V., and FUGZAN, M. M., 1974, Helium in sulfide minerals of metamorphic rocks of the Kolmozero-Voron'ya zone, Kola Peninsula: Akad. Nauk SSSR, Doklady, v. 214, no. 4, p. 921-922 (in Russian; translated in Doklady Acad. Sci., USSR, Earth Sci. Sects., v. 214, p. 212-213 (1975); abstract in Internat. Geol. Rev., v. 16, no. 6, p. 739-740 (1975)). Authors at Geol. Inst., S. M. Kirov Kola Branch, USSR Acad. of Sci., Apatity.

He is present (0.02 to 0.77 mm^3/g) in pyrite, arsenopyrite, pyrrhotite, magnetite (table 1), but Ar is missing in all of them, except in one sample of arsenopyrite (in which the $Ar^{40}:K^{40}$ ratio corresponds to a geologically nonsensical age of nearly 7 b.y.); this Ar was somehow captured by the min. during xliz. Aside from that, an odd kind of He-Ar regime is definitely indicated in this particular abyssal zone. The Precambrian age of the sulfides has no expression in their Ar:He ratio. They are not at all the same, in that respect, as their analogs in Ural.

GEGUZIN, Ya. E. and DZYABA, A. S., 1975, On quasiequilibrium forms of liquid inclusions in crystals: Kristallografiya, v. 20, no. 3, p. 675-676 (in Russian).

GENKIN, A. D., KAZANSKIY, V. I., and SMIRNOV, V. I., 1975, Chronicle of International Meeting on Genesis of Ore Deposits: Geol. Rudnikh Mestorozh., v. 17, no. 1, p. 117-122 (in Russian).

A review of papers presented at the Varna meeting, including COFFI session. (A.K.)

GERLACH, T. M., and NORDLIE, B. E., 1975, The C-O-H-S gaseous system: Am. Jour. Sci., v. 275, no. 4, p. 353-410.

Consists of three parts: I. Composition limits and trends in basaltic cases; II. Temperature, atomic composition, and molecular equilibria in volcanic gases; and III. Magmatic gases compatible with oxides and sulfides in basaltic magmas. (ER)

GERLACH, Terrence, NORTON, Denis, and KNIGHT, Jerry E., 1975, Porphyry pluton environments: Computed mass transfer for reactions between hydrothermal fluids and sedimentary host rocks (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1085. First author at Department of Geosciences, University of Arizona, Tucson, Arizona 85721.

GERMANOV, A. I., and MELKANOVITSKAIA, S. G., 1975, Organic acids in hydrothermal formations of polymetallic deposits and underground waters of the Earth's sedimentary shell: Akad. Nauk SSSR, Doklady, v. 225, no. 1, p. 192-195 (in Russian).

Chromatographic methods are used to detect the presence of a variety of org. cpds. (ER)

GIARDINI, A. A., and MELTON, C. E., 1975a, Chemical data on a colorless Arkansas diamond and its black amorphous C-Fe-Ni-S inclusion: Amer. Min., v. 60, p. 934-936. First author at Dept. of Geology, University of Georgia, Athens, Georgia 30602.

A 27-element emission spec. anal. of "inc.-free" fragments of an 0.885 carat type II colorless Arkansas diamond, previously crushed for a mass spec. anal. of occluded gas, showed detectable traces of Na, Ca, Al and Si. Xrd and chem. anal. of a thin (<2 µm), lustrous, black, opaque, totally-enclosed inc. lying on (111) of the same diamond showed it to be amorphous and, in decreasing order of abundance, heterogeneously composed mainly of C, Fe, S, and Ni. It is speculated that the black material represents epigenetic carbonization of diamond on (111) by included gas and decomp. products of iron sulfide and iron nickel sulfide incs. (Authors' abstract.)

GIARDINI, A. A., and MELTON, C. E., 1975b, The nature of cloud-like inclusions in two Arkansas diamonds: Am. Min., v. 60, p. 931-933. First author at Dept. of Geology, University of Georiga, Athens, Georgia 30602.

In a recent study of occluded gas in Arkansas diamonds, two otherwise transparent xls. were crushed that contained internal translucent regions (clouds). A scanning electron microscope exam. showed that the translucency was caused by numerous small (∿1 to 30 µm) cavities. Many are of unusual form. Min. incs. were not found in the cavities nor among the crushed diamond fragments. Both diamonds yielded gas upon crushing, but comp. and quantity were different. (Authors' abstract.)

GIARDINI, A. A., and MELTON, C. E., 1975c, Gases released from natural and synthetic diamonds by crushing under high vacuum at 200°C, and their significance to diamond genesis: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg 1974, p. 455-464. First author at Dept. of Geology, Univ. of Georgia, Athens, Georgia 30602.

Thirty-six natural diamond samples (21: 0.1 to 2.1 ct each, Arkansas, U.S.A.; 14: 0.1 to 4.5 ct each, Africa; one 1.9 ct, Brazil) were crushed in the inlet of a research mass spec. at about 10^{-8} torr and 200°C. Six 36-mesh General Electric syn. diamond samples (2 from regular production, 4 from a new high T and P process) also were crushed. Most diamonds contained totally-enclosed solid incs. All samples released gas. The overall ratio of STP gas volume to diamond sample volume with only a "gentle" crushing of the diamond is $1 \cdot 10^{-3}$. The averaged gas comp. from the 36 natural diamond samples is: $H_2O = 33.3$, $H_2 = 23.9$, $CO_2 = 19.5$, $N_2 = 8.2$, $CH_4 = 7.6$, $CO = 6.5$, alcohols = 0.6, Ar = 0.3, other hydrocarbons = 0.2, $O_2 = 0.04$ vol. %. Except for N_2 (once, Arkansas) and for H_2O and N_2 (once each, Africa), H_2O, H_2, CO_2, CH_4 and N_2 always were present. O_2 was found only in diamonds of cube form. Commercial synthetics gave $CH_4 = 54.7$ av. vol. %, $H_2 = 33.2$, $CO_2 = 12.1$, and those from the new process gave $H_2 = 26.2$, $H_2O = 25.8$, $CH_4 = 24.8$, $CO_2 = 17.4$, $N_2 = 5.1$, Ar = 0.6. The gas difference in natural diamonds and commerical synthetics indicates a diff. form. environment, as does the presence of metal incs. in the latter. The range of gas comp., and the overall similarity from geographical origin, suggest that natural genesis occurred under similar but a broad range of conds. Recent hypotheses on natural diamond genesis are discussed in light of these data. (Authors' abstract.)

GIARDINI, A.A., and MELTON, Charles E., 1976, The significance of gases released from natural diamonds by crushing and by graphitization: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. First author at Geol. Dept., Univ. of Georgia, Athens, Ga. 30602.

Oxygen and hydrogen, not nitrogen as previously accepted, are the major gaseous impurities found in natural diamonds. This fact is demonstrated by two diff. types of exper. In the first type of exper., occluded gases were released by crushing at 200°C. In the second type of exper., gases were released by graphitization of diamonds over the T range 1500°C to 3000°C. These exper. were carried out under a vacuum of 10^{-8} torr in the inlet system of a research mass spectrometer. Results from crushing African and Arkansas, USA, diamonds showed an average oxygen and hydrogen comp. of 81.1% as compared to 6.7% for nitrogen. Similar results were obtained by graphitization of diamonds from Arkansas, with an oxygen and hydrogen content of 69.2% vs 2.5% for nitrogen. These exper. data are discussed in terms of kimberlite genesis and a gas-solid growth mech. for natural diamonds. (Authors' abstract.)

GIBSHER, N. A., 1975, Study of ore-forming solutions of the Srednee polymetallic and Zarechenskoe barite-polymetallic deposits of Rudnyi Altai (according to inclusions in minerals), in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 67-69 (in Russian).

At Zarechenskoe dep. T_H of incs. are as follows: sphalerite 320-340°C and 280-300°C, quartz 330-350°C, barite 300-320 and 260-280°C; salt conc. (by freezing) 16-20 wt. %; main salts in incs. in sphalerite and quartz - $MgCl_2$, and in barite - K_2CO_3; gases in incs. in sphalerite - $H_2S+SO_2+HCl+HF+NH_3 = 37$, $CO_2 = 35$, $O_2 = 0.0$, $CO = 0-8$, $H_2 = 9-16$, and N_2+rare gases = 10 vol. %; Srednee dep., T_H of incs. in sphalerite = 300-320 and 290-330°C; main salt $MgCl_2$; quartz - 310-320 and 300-320°C; main salt $MgCl_2$; carbonate (with chalcopyrite) - 290-300°C; main salt $CaCl_2$; barite - 250-270; main salt K_2CO_3; conc. of salts = 12-26 wt. %, gases in incs. in sphalerite are almost the same as at Zarechenskoe. (Abstract by A.K.)

GIBSON, E.K., 1975, Sulfur in mare basalts and their source magmas (abst.), p. 49-52 in Conf. on origins of mare basalts and their implications for lunar evolution, Nov. 17-19, 1975: Houston, The Lunar Sci. Inst.

A discussion of lunar and Hawaiian basalt sulfur contents and their escape during eruption (ER).

GIBSON, Everett K., Jr., CHANG, Sherwood, LENNON, Kenneth, MOORE, Gary W., and PEARCE, G. W., 1975, Carbon, sulfur, hydrogen and metallic iron abundances in Apollo 15 and Apollo 17 basalts (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, Texas, p. 290-292. First author at NASA Johnson Space Center, Houston, Texas 77058.

Anals. are given of gases evolved on acid hydrolysis of samples in 6 N H_2SO_4 at 105°C for one week; anals. for CO, CO_2, H_2, H_2S, total C, and S isotopes. (ER)

GIGASHVILI, G. M., STUPKA, O. S., and PLOTNIKOV, A. M., 1975, Conditions of migration and evolution of hydrocarbon-bearing fluids as indicated by inclusions of hydrocarbons in hydrothermal minerals from Mountainous Crimea (abst.), p. 6-8, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fuels of Acad. Sci. Ukr. SSR, L'vov.

Two regions of oil occurrence are known in Mountainous Crimea: (1) Opolznevoe-Frunzenskoe and (2) Feodosia-Planerskoe. The first locality is in volcanic rocks, with fractures and geodes often filled by light oil. Walls of geodes consist of chalcedony, covered with quartz and calcite xls. The latter mins. bear incs. (0.005-0.1 mm) of bitumens and aq. sols. plus bitumens. Ten varieties of incs. were found, based on genetic or morph. differences. After pption. of chalcedony ceased, it was partly dissolved and quartz began to xlize., including relics of chalcedony. The quartz contains aq. P incs. with hydrocarbons; $T = 280°C$. Subsequent zones of quartz xlizing under more stable cond. entrapped only hydrocarbon phase, $T \geq 115°C$, $P \geq 70$ atm. (Sic. Probably a misprint for 700 atm. (A.K.)). At $T \geq 112°C$ and $P \geq 400$ atm. hydrocarbons separated to form two phases: a methane-rich one and an oil-like one. External zones of xls. formed at $T \geq +75°C$; P, based on d of methane ~600-700 atm. S incs. formed at $P = 350$-400 atm., together with late calcite xls. (Abstract by A.K.)

GINSBURG, A. I., PANTELEEV, A. I., and PLESKOVA, M. A., 1975, On the content of excess argon in pollucites: Geokhimiya, 1975, no. 12, p. 1794-1799 (in Russian).

GITTINS, J., ALLEN, C. R., and COOPER, A. F., 1975, Phlogopitization of pyroxenite; its bearing on the composition of carbonatite magmas: Geol. Mag., v. 112, p. 503-507.

GOMELAURI, A. I., GUNIAVA, V. D., and AREVADZE, D. V., 1974, Formation temperatures of certain barite deposits in Western Gruziya (Georgia): Moscow Univ. Bull., Geology, v. 29, no. 5, p. 113-116 (in Russian; translation by Allerton Press Journal Program, 1974, p. 90-92).

Most incs. (99%) in barite were one-phase (liquid); the other 1% ranged 10-40% vapor bubble, with T_H 220-280°C. No leakage was detected on repeated homog. Incs. in quartz and sphalerite have T_H 250-280°C; witherite, 110-120°C; calcite, 90-120°C. Calcite and witherite (but not quartz and sphalerite) also had one-phase incs. Some T_D data also obtained. The authors believe the one-phase incs. are S, and the deposit formed in the range 250-280°C. (ER)

GOROKHOV, S.S., DOROGOVIN, B.A., and KHETCHIKOV, L.N., 1975, Inclusions of the mineral-forming medium in eclogite and their genetic significance: Akad. Nauk SSSR, Doklady, v. 225, no. 2, p. 412-414 (in Russian; translated in Doklady Acad. Sci. USSR, v. 225, p. 141, published 1977). Authors at All-Union Research Inst. for the Syn. of Min. Products, Aleksandrov.

Several different eclogite occurrences were studied. Incs. of melt with dms., in omphacite and garnet, have T_H (long runs in argon atm.) of 1180-1360°. CO_2 incs. (T_H +5 to +12° and T_{Frz} -57°C) occur in garnet also, possibly trapped at a later time. (ER)

GORYAINOV, I.N., 1975, Viscosity of basalt melts in connection with gravitational fractionation, p. 108-116 *in* Copper-nickel ores of NW part of Siberian platform, N.N. Urvantsev, ed: Leningrad, Sci.-Research Inst. of Geology of the Arctic, 138 pp. (in Russian).

GORYAINOV, I. N., and SUKHOV, L. G., 1975, Phase state of material that formed copper-nickel sulfide shoots: Akad. Nauk SSSR, Doklady, v. 221, no. 2, p. 447-450 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 221, p. 173-176 (1976)).

The authors conclude from a study of the distrib. of (light) gangue mins. in (heavy) massive sulfide Talnakh dep. is inconsistent with the theory of ore dep. from a sulfide melt. (ER)

GOW, A. J., and WILLIAMSON, Terrence, 1975, Gas inclusions in the Antarctic ice sheet and their significance: U.S. Army Cold Regions Research and Eng. Lab., Research Report 339, 23 pp. Authors at U.S. Army Cold Regions Research and Eng. Lab., Hanover, N.H. 03755.

Cores obtained to the bottom of the Antarctic Ice Sheet at Byrd Station were used to anal. the physical prop. of air bubbles trapped in the ice. These bubbles originate as pockets of air in the upper layers of snow and ∿10 ml of air/100 cm^3 of ice; i.e., 10% by vol. is retained permanently when the snow transforms into ice. Parameters meas. were the sizes, shapes, abundances, spatial distrib., gas volumes and Ps of bubbles, and their variations with depth in the ice sheet. Bubbles occur abundantly in the top 800 m of ice but then gradually disappear until they can no longer be detected optically below 1100 m. This disappearance is not accompanied by any significant loss of air from the ice and all available evidence indicates that the air actually diffuses into the ice in response to increasing overburden P. The possibility exists that the dissolved gases are retained in the form of a gas hydrate or clathrate which, because of release of confining Ps, begins to decompose soon after ice cores are pulled to the surface. This decomp. is accompanied by the growth of gas-filled bubble-like cavities, and as much as 40% of the dissolved air has exsolved already from some cores in the space of less than three years. Bubble P meas. show that (1) bubbles with Ps >∿16 bars begin to relax back to this value soon after in situ Ps are relieved by drilling, (2) further slow decompression occurs with time, and (3) the rate of decompression is controlled to some extent by the intrinsic structural prop. of the ice and its thermal and deformational history. Only small variations were observed in the entrapped air content of the ice cores; they probably reflect variations in the T and/or P of the air at the time of its entrapment, but the data are not sufficient to draw any firm conclusions regarding past variations in ice sheet thickness. Only ice from the bottom 4.83 m was found to lack any detectable trace of air. Since this absence of air coincided precisely with the first appearance of stratified moraine in the cores, it is concluded that this ice originated from the refreezing of air-depleted water produced under P melting conds. at the bottom of the ice sheet. (Authors' abstract.)

GREBENSHCHIKOVA, V. I., 1973 (pub. 1974), Geochemical zoning of Adun-Chelon pegmatites in eastern Transbaikalia: Ezheg., Inst. Geokhim., Sib. Otd., Akad. Nauk SSSR, p. 124-128 (in Russian). Author at Inst. Geokhim., Irkutsk, USSR.

Changes in compn. of fluid inc. in quartz and trace element content in min. of peg. bodies conform to changes in content of these components in granites of the region. The no. of peg. bodies in the Adun-Chelon granite massif increases from the apical southwestern to the plutonic northeastern part. The F^-/Cl^-, $(F^- + Cl^-)/HCO_3^-$, $(Na^+ + K^+)/(Ca^{2+} + Mg^{2+})$, and $Li^+/(Na^+ + K^+)$ ratios also increase in this direction whereas the Na^+/K^+ and K^+/Rb^+ ratios decrease in granites and peg., implying the form. of the peg. magma solns. close to consolidation sites. Peg. of the inner massif zones contain more Sn and Be but less Mn and Pb than the periphery. Chem. Abst., v. 84, no. 5, 626340, 1976.

GREEN, D. H., 1975a, The roles of water and carbon dioxide in the upper mantle (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 7, no. 6, p. 766. Author at Research School of Earth Sciences, Australian National University, Canberra, Australia.

Exper. studies have defined a specific model for the existence of the lithosphere and low velocity zone in the upper mantle in terms of the limited high P stability of pargasitic amphibole and a region of incipient melting (LVZ) at depths >85-95 kms. This model is applicable to a mantle of pyrolite comp. with $\lesssim 0.4\%$ H_2O. In regions of higher water content, the lithosphere is thinner (~60 kms) and the degree of partial melting in the underlying zone is greater - these conds. probably apply beneath island arcs. Water-sat. melting of pyrolite produces alkali-rich, probably shoshonitic, magmas for very low degrees ($\lesssim 5\%$) of melting and shallow (30 km) depths of magma segregation. Basaltic andesite to alkali-rich quartz tholeiite result from moderate degrees (15-30%) of partial melting and quartz and olivine-poor tholeiite for high degrees of partial melting at 30-60 kms depth. Andesites, dacites or rhyodacites are not produced by partial melting of peridotite at depths $\gtrsim 30$ km. Melting of pyrolite containing $\leq 0.4\%$ H_2O produces magmas ranging from olivine nephelinite to olivine tholeiite and tholeiitic picrite.

Extremely undersaturated magmas such as olivine melilitite require the presence of CO_2 in the source region and, at their depth of origin, contain important dissolved CO_2. The high soly. of CO_2 in olivine melilitite magmas is genetically very important in relation to kimberlite and carbonatite genesis. (Author's abstract.)

GREEN, D. H., 1975b, The roles of water and carbon dioxide in the upper mantle (abst.): Canadian Min., v. 13, part 3, p. 308. Author at Research School of Earth Sciences, Australian National University, Canberra.

(See preceding abstract.)

GREEN, D.H., 1975c, The genesis of magmas and petrological nature of the lithosphere and low velocity zone: Amer. Geophy. Union, Trans., v. 56, no. 6, p. 463. Author at Research School of Earth Science, A.N.U., Canberra.

Andesites, dacites or rhyodacites are not produced by partial melting of peridotite at depths ≥ 30 km. Melting of pyrolite containing $\leq 0.4\%$ H_2O produces magmas ranging from olivine nephelinite to olivine tholeiite and tholeiitic picrite. Extremely undersaturated magmas such as olivine meliltite require the presence of CO_2 in the source region and, at their depth of origin, contain important dissolved CO_2. The high sol. of CO_2 in olivine meliltite magmas is genetically very important in relation to kimberlite and carbonatite genesis. (From the authors' abstract.)

GREEN, H. W., and RADCLIFFE, S. V., 1975, Fluid precipitates in rocks from the earth's mantle: Geol. Soc. Amer. Bull., v. 86, p. 846-852. First author at Department of Geology, University of California, Davis, California 95616.

Xenoliths of rocks from the Earth's mantle are commonly included in alkalic basalt and kimberlite diatremes. The xenoliths, many of them highly deformed by plastic flow, consist primarily of olivine and pyroxene and may be derived from depths as great as the seismic low-velocity zone. Large numbers of very small bubbles of CO_2-rich fluid are within the major phases. The combined techniques of optical and high-voltage electron petrography demonstrate that the smallest bubbles, many of them below optical resolution, are attached to crystal defects induced by deform. and exsol. and to grain boundaries. It is concluded that formation of the smallest bubbles precedes incorporation of the xenoliths into the host magma and occurs by solid state pption. on the deform. and exsol. features. The bubbles then collect on migrating grain boundaries during syntectonic rexliz.

The occurrence of bubble form. before xenolith incorporation into the magma strengthens previous suggestions that the tectonite xenoliths may be the magma source rock or residuum and that the asthenosphere is not partially melted. Furthermore, since the presence of analogous "bubble structure" in ceramics and metals is known to weaken significantly the high-T creep resistance of such materials, it appears likely that the mode of flow in mantle rocks may be influenced similarly. (Authors' abstract.)

GREENWOOD, H. J., 1975, Buffering of pore fluids by metamorphic reactions: Amer. Jour. Sci., v. 275, p. 573-593.

GRIGORIEV, D. P., 1975, Morphology of skeletal crystals of olivine in a fragment of spinel troctolite delivered by the Luna 20 automatic station: Akad. Nauk SSSR, Doklady, v. 225, no. 2, p. 403-405 (in Russian).

Shows the complex growth sequence required to yield the skeletal crystal shapes seen. (ER)

GRIGORIEV, D. P., and ZHABIN, A. G., 1975, Ontogeny of minerals: Moscow, Nauka Press, 339 pp. (in Russian).

Includes some discussion of the mech. of origin of some types of incs. and their study (p. 194-199). (ER)

GRITTI-BAUDRACCO, C., 1975, Fluid inclusions in some gangue minerals from deposits in Southern France: Fortschr. Miner., v. 52, Spec. Issue; IMA Papers 9th Meeting, Berlin-Regensburg, 1974, p. 495-400 (in French with English abstract). Author at Lab. Minér. Cristall. 39, Allées Jules Guesde, 31400 - Toulouse, France.

The "Laboratoire de Minéralogie et de Cristallographie de Toulouse" has been making studies of fluid incs. in ore gangues of local deps. for several years, using decrepitometry, decrepitoscopy and Deicha's heating stage. Barite has been selected as an example because it frequently occurs in Southern France: Pessens, Colombies (Aveyron) and Clermont l'Hérault (Hérault). Recently, the electron microscope brought to light, in these samples, very small cavities which cannot be investigated by ordinary means. The different methods discussed in this paper are complementary. Their conjugate use is recommended for determination of the T of deposition. (Author's abstract.)

GROMOV, Alexandre, and BOSSIERE, Gérard, 1975, Fluid inclusions in the quartz from quartz-andalusite veins in the metamorphic basement in the Annaba region, Algeria. Réunion Annuelle des Sciences de la Terre, 3ème, Montpellier, April 1975, p. 176 (in French). Authors at Dept. Sci. de la Terre, Fac. Sciences, Alger, Algeria.

Two types of fluid incs. are dist. in the quartz from two described categories of quartz-andalusite veins: (1) primary, polyphase incs. of sol., liq. CO_2 gas (F = 40% - 45%) and anisotropic xls.; (2) incs. of variable comp. with 80% - 100% liquid phase and enclosing unidentified xls. Xliz. took place from aq. sols. (max. T_H = 520°C). The min. xliz. P det. from the CO_2 incs., is 2 - 2.5 Kb. These P-T conds. correspond to the stability field of andalusite. (Authors' abstract, abbrev. by Maurice Pagel and translated by Chris Eastoe.)

GRUSHKIN, G. G., and KHELVAS, I. G., 1974, Physico-chemical conditions of forming of the Khingan tin ore deposit: Zap. Vses. Min. Obsh., v. 103, no. 2, p. 219-240 (in Russian). Authors at Blagoveshchenskii Polytechnical Inst.

The authors studied late min. assemb. of deps. classified as silicate-cassiterite type (min. from early to late: violet fluorite - green fluorite - pink fluorite - hydromuscovite - cassiterite - wolframite - arsenopyrite+loellingite - marmatite - quartz, chlorite). At this dep. mins. of the same genetic zone contain incs. with various G:L ratios, but the same or a very narrow range of T_H, and in other cases, the same G:L ratio and various T_H; authors explain these variations by the influence of law of Van der Waals (sic) on changing T-P-V-C parameters in natural systems. Mean values of T_H permit detection of the general changes of T_F of dep. Following reasons cause the variations: high T of sol. (450-320°C), high conc. of CO_2 (12-18%), and near-surface xliz. results in sharp changes of P. Incs. in fluorite bear numerous solid incs. in various ratios: quartz, cassiterite, hematite, chlorite. The amount of these is higher in the thin ends of wedge-shaped fractures in min. and lower (or they are absent) in incs. in the wide ends. Grushkin and Khelvas believe that this is not a result of real changes in the conc. of min.-form. sols., but supersat. during fluctuation in xliz., and mechanical trapping of solids. Violet fluorite xlized at T≳450°C, then sharp decrease of T to 360°C is accompanied by xliz. of cassiterite; following increase of T up to 426°C causes xliz. of green fluorite; a series of abrupt decreases and increases of T generally changing from 421 to 323 °C is accompanied by xliz. of pale-green and pink fluorite. Next under isothermal cond. 323±1 to 2°C, hydromuscovite, arsenopyrite, cassiterite quartz and chlorite xlized; the last part of quartz xlized at ∿300°C. P varied from 570 to 350 bar in T interval 421-323°C with some abrupt changes. P was evaluated on basis of the comp. of incs. compared with system H_2O-CO_2-NaCl. (Abstract by A.K.)

GÜBELIN, E. J., 1975, Where gemstone research stands today: Fortschr. Miner., v. 52, Spec. Issue: IMA-Paper 9th Meeting, Berlin-Regensburg 1974, p. 501-512.

A review, including brief mention of the use of fluid incs. (ER)

GUNDSAMBUU, Ts., 1974, Certain greisen deposits of Mongolia: Geol. Rudn. Mestor., v. 16, no. 3, p. 80-84 (in Russian).

Contains only T_H, T_D, and chem. data from the literature on greisens from Baga-Gazryn and Khara-Moritu. (A.K.)

GUROV, Ye. P., and GUROVA, Ye. P., 1975, Yttrium-synchsite from chamber pegmatites: Transactions of Mineralogical Museum (New data on minerals of USSR), v. 24, p. 171-174 (in Russian).

Incs. of Y-synchisite in fluorite from Ukrainian pegs. formed at 460-490°C, as evidenced by T_H of G/L incs. in fluorite. (A.K.)

GUROV, Ye. P., GUROVA, Ye. P., LOGINOVA, L. P., and LAVITSKAYA, Yu. A., 1975, Rare-earth-bearing fluorites from Ukrainian crystalline shield: Minerals and parageneses of minerals of metasomatic and metamorphic rocks, "Nauka," Leningrad, p. 106-114 (in Russian).

Yttrofluorites ($Y + \Sigma TR = 0.46 - 7.87$ wt. %) contained incs. with $T_H = 450\text{-}490°C$. (A.K.)

HAJASH, Andrew, 1975a, Mineralogy and chemistry of experimental seawater/basalt reactions, 200-500°C (abst.): Amer. Geophys. Union, Revised Abstracts, Program of Western Meeting, p. 44. Author at Dept. of Geology, Texas A&M Univ., College Station, Texas 77843.

Natural seawater was allowed to react with fresh oceanic tholeiite glass in Au & Pt capsules at 200-500°C, 500-800 bars for 14-30 days. During the reactions, the seawater tended to change from an oxygenated, slightly alkaline, Na^+, Mg^{++}, $SO_4^=$, Cl^- sol. to a reducing, acidic, Na^+, Ca^{++}, Si, Cl^- sol. with Fe, Mn and Cu conc. up to 1500, 190, and 0.3 ppm respectively. Except for the high metal content, the exper. fluids are chem. similar to Reykjanes geothermal waters.

The solid phases were studied by standard petrographic, X-ray diffraction and SEM techniques; the results are summarized below:

Temperature	Mineral Phases Identified
200°C	Montmorillonite, Anhydrite
300°C	Montmorillonite, Anhydrite, Analcite, Gypsum (?)
400°C	Montmorillonite (gray), Fe-rich smectite (nontronite), Tremolite-Actinolite, Albite, Pyrrhotite
500°C	Montmorillonite (gray), Fe-rich smectite (nontronite), Tremolite-Actinolite, Albite, Epidote (?), Cordierite (?), Chalcopyrite, Marcasite, Pyrite (?)

The exper. produced min. assemb. are similar to those found in meta. rocks from the ocean crust and ophiolite complexes.

At 500°C, the chem. and min. results were the same, even though the grain size was varied from <100µ to 5mm, indicating that the reactions take place rapidly at high T even for coarse grained material.

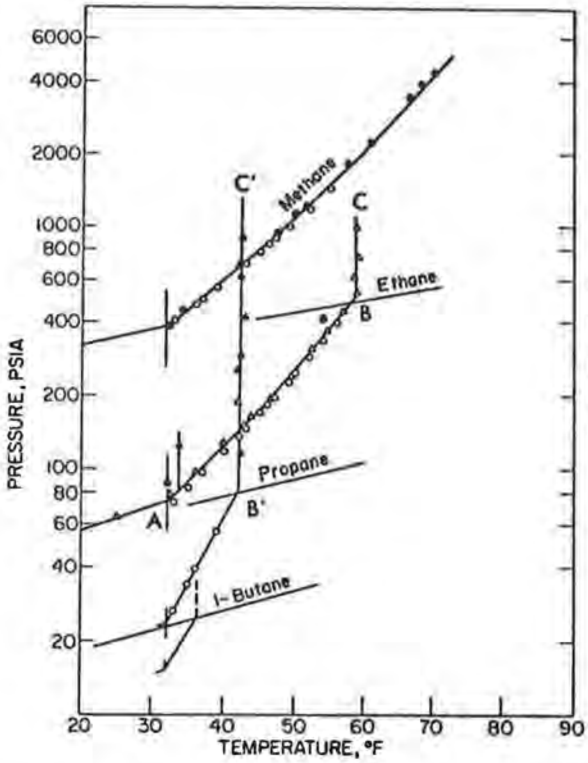
The data indicate that seawater circulation in the oceanic crust could be instrumental in submarine meta. and hyd. processes, including the form. of Fe-Mn-rich seds. and massive Fe-Cu ore bodies. The process may also be geochemically significant for certain elements, notably Na, Ca, Mg, Fe, Mn and H. (Author's abstract.)

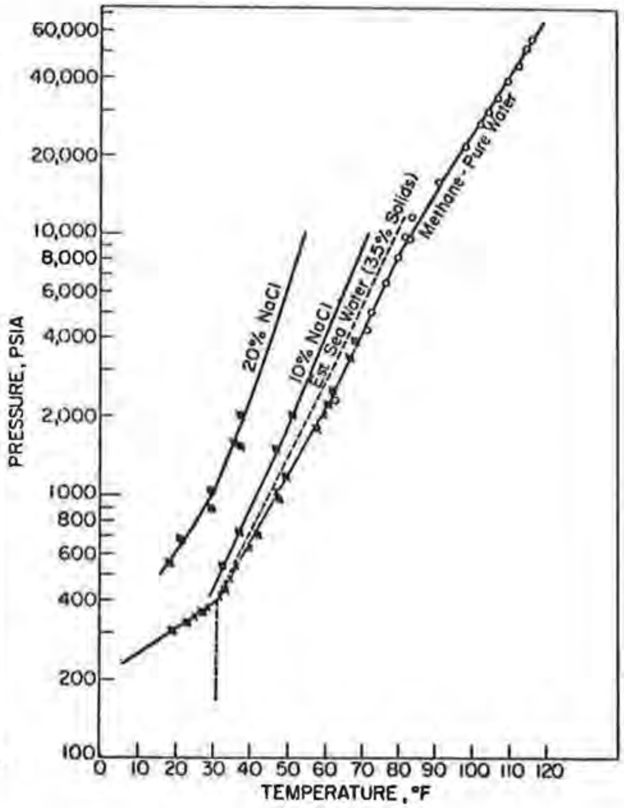
HAJASH, A., 1975b, Hydrothermal processes along mid-ocean ridges - experimental investigation: Contrib. Min. and Pet., v. 53, no. 3, p. 205. (See preceeding abstract.)

HAND, J. H., KATZ, D. L., and VERMA, V. K., 1974, Review of gas hydrates with implication for ocean sediments, in Natural Gases in Marine Sediments, I. R. Kaplan, Ed.: New York, Plenum Press, p. 179-194. Authors at Dept. of Chem. Eng., The Univ. of Mich., Ann Arbor, Michigan 48104.

A general review of gas hydrate knowledge, including the utilization of such knowledge in the natural gas industry, some contemplated uses of gas hydrates in sea water desalinization, and a discussion of the existence of natural gas hydrates under the permafrost of the Northern Hemisphere. The theory of how gases enter the water phase and cause premature xliz. of water into an ice-like hydrate structure is presented. With this background, hydrate form. in ocean seds. is considered. (Authors' abstract.)

Several figures from this publication are useful to freezing studies on fluid incs. Fig. 2 (left) shows P-T conds. for hydrate form. for paraffinic hydrocarbons, and Fig. 5 (right) shows the effect of salt on methane hydrate form. (ER)





HARMON, R.S., THOMPSON, Peter, SCHWARCZ, H.P., and FORD, D.C., 1976, Late Pleistocene paleotemperatures from stable isotope analysis of fluid inclusions in speleothems: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. First author at Dept. of Geol., Mich. State Univ., East Lansing, Mich. 48824.

Speleothems, calcium carbonate cave deps., commonly contain fluid-filled incs. comprising from 0.01 to 0.1 wt.% of the dep. These incs. are presumably samples of the seepage water from which the speleothem ppted. Some speleothems can be shown to have been dep. in O isotopic equil. with their parent seepage waters. From a knowledge of the O isotopic comp. of both speleothem calcite and fluid inc. water, a T can be calc. from the well defined T dependence of the calcite-water isotopic fract. Because deep cave Ts are a reflection of average annual surface T, fluctuations in speleothem dep. Ts are a direct indicator of past surface climate change.

As long as the seepage water was not isotopically fract. prior to its entrapment as an inc., then the isotopic comp. of the inc. will initially be the same as that of the seepage water from which the carbonate was ppted. It is possible, however, that subsequent to its entrapment, O isotopic comp. of the inc. waters may have been alt. by exchange with the host calcite, but their D/H ratios should have been preserved. Because cave seepage waters fall on the meteoric water line ($\delta D = \delta O\text{-}18 + 10$), the initial O-18/O-16 ratios of the fluid inc. waters can be inferred from a meas. of the D/H ratios whose isotopic comp. shows no T dependence.

Modern deps. are obs. to give isotopic Ts within ±2°C of meas. cave Ts. For 8 of 9 ancient speleothems anal., O-18/O-16 ratios have decreased with increasing T, indicating that the dominant cause of climate-dependent change in O-18 of speleothem carbonate is the T dependence of the calcite-water isotopic fract. factor, not the change in O-18 of meteoric pption. with T.

Fluid inc. paleo T data for speleothems from the unglaciated continental interior of the United States indicate that surface Ts during the last two glacial periods (the Wisconsinian and Illinoian of North America) were slightly more than 10°C lower than that at present. During the last two interglacial periods paleo Ts are obs. to have been equal to or slightly greater than that at present.

The speleothem fluid-inc. paleo Ts agree well with other paleoclimate records. Periods of thermal maxima correspond in time to high sea-stands as det. from Th-230/U-234 dating of raised coral reefs, and thermal minima to glacier advance in the Lakes area of North America as det. from C-14 dating of loess and moraine deps. Continuing study should further our understanding of the T changes which occurred during the Pleistocene ice ages. (Authors' abstract.)

HATTORI, Keiko, 1975, Geochemistry of ore deposition at the Yatani lead-zinc and gold-silver deposit, Japan: Econ. Geol., v. 70, p. 677-693. Author at Geological Institute, Faculty of Science, University of Tokyo, Tokyo, Japan.

The Yatani mine, a representative of volcanic epithermal precious and base metal deps. of Tertiary age in Japan, contains both Pb-Zn and Au-Ag veins. Chem. char. of the ore-forming sol., derived in part from inc. data, are: NaCl equiv. conc. 0.1 to 0.2 mole/l; pH, about 6 or more for Au-Ag veins and 6 or less for Pb-Zn veins; conc. of total dissolved sulfur, 10^{-3} to 10^{-2} mole/l; dominant dissolved sulfur species for Pb-Zn veins is hydrogen sulfide, while the Au-Ag veins are formed near the boundary separating dominant sulfate ion from hydrogen sulfide.

Au was mainly transported as Au-S complexes rather than Au-chloride complexes. Au pption. was mainly caused by oxidation process. Coppt. of sphalerite and galena with Au would be expected in neutral or weakly alkaline sol. with low salinity and total dissolved S of 10^{-2} mole/l when fugacity of O increased through rising of ore sol. and breakdown of metal-sulfur complexes occurred.

Most epithermal Au-Ag veins in Japan show similar features in their min. parageneses, chem. comp. of constituent mins., fluid inc. data, and geol. environments. The similarities suggest that these deps. were formed under the same conditions. (From the author's abstract.)

HAYAKAWA, Norihisha, NAMBU, Masateru, and AOSHIMA, Takaaki, 1972, Studies on fluid inclusions as geothermometers (1st report) - decrepitation analysis: Jour. Mining and Met. Inst. of Japan, v. 89, p. 185-190 (in Japanese with English abstract).

A device was built for decrep. anal. Anhydrite from 6 hyd. gypsum ore deps. and NaCl and quartz xls. syn. by hyd. methods at various Ts were tested. Decrepigraphs of these mins. show char. patterns respectively, regardless their localities or growth Ts. On the other hand, decrepigraphs of the mins. grown from H_2O but with N_2 pressure show broader curves than those of mins. grown under the vapor P. of water. Consequently, a decrep. anal. is expected to be more applicable as the geobarometer of gas Ps than as a geothermometer. Thus anhydrite, collected from diff. ore deps., might have been grown under similar gas Ps. (Authors' abstract)

HAYAKAWA, Norihisa, NAMBU, Masateru, and AOSHIMA, Takaaki, 1973, Studies on fluid inclusion as geothermometers (2nd report) - filling temperature analysis: Jour. Mining and Met. Inst. of Japan, v. 89, p. 285-289 (in Japanese with English abstract).

The various problems of the homogenization method are discussed. Ordinary heating stages often permit leakage of the incs., due to latent cracks, the strength of enclosing xl., the diff. of forming conds. of each inc. and the dynamic interactions of incs. These phenomena cannot be disregarded and should be prevented as far as possible in the heating-stage method.

To avoid these problems, a pressure heating stage was made. It permitted dets. even on brittle mins. such as anhydrite without decrep. Syn. quartz xls. homog. with the probable T est. from the growth conds., and hence provides a useful geothermometer. (From the authors' abstract)

HAYAKAWA, Norishisa, and NAMBU, Masateru, 1974, Shapes of inclusions in synthetic crystals - Studies on fluid inclusions as geothermometers (3rd Report): Jour. Mining and Met. Inst. of Japan, v. 90, p. 479-485 (in Japanese with English abstract).

Studies of shapes and arrangement of inc. in syn. quartz and potash alum xls show that frequency of inc. form. during xl growth is mainly controlled by the (degree of) supersat. of the sol., but impurities in the sol. have negligible effects. As the degree of supersat. increases, the number of inc. increases and the shape becomes irregular. In some cases, a micro-channel connects the inc. to the outside and allows leakage. The mode of arrangement of inc. is significantly affected by the direction of xl growth and flow of the fluids. The form. of gas bubbles on the surface of the growing xl occurs not only under boiling conds. or chem. reaction, but also at lower Ts.

HAYHURST, David T., and SAND, L. B., 1975, Experimental kinetics related to alkali zeolite paragenesis (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1106. First author at Department of Chemical Engineering, Worcester Polytechnic Institute, Worcester, Massachusetts 01609.

HELGESON, Harold C., NESBITT, H. Wayne, and DELANY, Joan M., 1975, Summary and critique of the thermodynamic properties of rock-forming minerals (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p.

1108-1109. First author at Department of Geology and Geophysics, University of California, Berkeley, California.

HELZ, R. Tuthill, 1975, Alkali exchange between hornblende and melt: a temperature-sensitive reaction (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

HEMLEY, J. J., SHAPIRO, L., SHAW, D. R., and LUCE, R. L., 1975, Stability relations of anthophyllite (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1109. Authors at U.S. Geological Survey, Reston, Va. 22092.

HENNECKE, E.W., and MANUEL, O.K., 1975a, Noble gases in an Hawaiian xenolith: Nature, v. 257, no. 5529, p. 778-780. Authors at Nuclear Division, Dept. of Chem., University of Missouri, Rolla, MO. 65401.

Anal. for He, Ne, Ar, Kr, Xe, and their isotopic ratios, are presented and discussed. (ER)

HENNECKE, E.W., MANUEL, O.K., and SABU, D.D., 1975b, Noble gases in Thailand tektites: Jour. Geophys. Research, v. 80, p. 2931-2934. First author at Nuclear Division, Chemistry Department, University of Missouri, Rolla, Missouri 65401.

The abundance pattern of noble gases in Thailand tektites shows an anomalous spike of neon, apparently from the diffusion of atmospheric neon through the glass. The isotopic comp. of non-radiogenic Ne, Ar, Kr, and Xe are atmospheric, but the Ar/Xe and Kr/Xe ratios in the tektites are each about an order of magnitude lower than the values in air. (Authors' abstract.)

HEWITT, D.A. and GILBERT, M.C., 1975, Experimental metamorphic petrology: Reviews of Geophysics and Space Physics, v. 13, no. 3, p. 79-81, 120-128. Authors at Dept. of Geol. Sci., Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

A very thorough review, with emphasis on studies involving volatile constituents. (ER)

HITCHON, Brian, 1974, Occurrence of natural gas hydrates in sedimentary basins; in Natural Gases in Marine Sediments, R. Kaplan, Ed.,: New York, Plenum Press, p. 195-225. Author at Alberta Research, Edmonton, Alberta Canada.

Clathrates are a special variety of inc. cpd. in which the guest molecules fit into separate spherical or nearly spherical chambers within the host molecule, and when the host molecule is water and the guest molecules are largely gases or liquids with low boiling points found in natural gas, the clathrates are termed natural gas hydrates. They are solid cpds, resembling ice or wet snow in appearance, and form both below and above the freezing point of water under specific PT conds. The water molecules form pentagonal dodecahedra, which can be arranged into two diff. structures, leaving interstitial space in the form of either tetrakaidecahedra or hexakaidecahedra. Methane and hydrogen sulfide can be accommodated in all the spaces, ethane and carbon dioxide can fit in both the tetrakaidecahedra and the hexakaidecahedra, but propane and isobutane fit only in the hexakaidecahedra. Normal butane, pentane, and hexane are not known to form hydrates. PT diagrams describing the initial conds for hydrate form indicate that, relative to methane, all common components of natural gas (except N and the rare gases) raise the hydrate form. T, propane and ethane being the most effective. The presence of dissolved salts in the water, or N and rare gases in the natural gas, depresses the T of initial hydrate form.

The most likely way to produce natural gas hydrates in sed. basins is through a reduction of T, rather than an approach to lithostatic Ps, and the most pertinent situation is that found in regions with relatively thick permafrost sections. (From the author's abstract.)

HITCHON, Brian, BROWN, H. M., and KROUSE, H. R., 1975, Stable isotope geochemistry of natural gases from Devonian strata, Alberta, Canada (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1118. First author at Alberta Research Council, Edmonton, Alberta, Canada T6G 2C2.

This study forms part of a major invest. of the geochemistry of 52 suites of reservoir fluids from Upper and Middle Devonian strata of western Canada, ranging in depth from 500 to 4000 meters and reservoir T from 20 to 165°C. The natural gases range from wet gases to dry gases with more than 98% methane, and δC^{13} of the methane from -35 to -61‰. Hydrogen sulphide ranges up to nearly 35% with δS^{34} between +7 and +30‰, and δS^{34} on the sulphate of the co-produced form. water often isotopically similar (δS^{34} +16 to higher than +42‰). Carbon dioxide ranges up to 17% with δC^{13} from +16.2 to -13‰. Deuterium (majority between -35 and -160‰) and O^{18} (+5.9 to -18.1‰) of the co-produced form. waters show the same range in values and similar relations found in a previous study of this basin. General trends observed include increases of C^{13} in both methane and carbon dioxide, and of S^{34} in hydrogen sulphide with increasing reservoir T. These and other relations among the data have been interpreted in terms of maturation and biodegradation processes which have affected the reservoired fluids. (Authors' abstract.)

HIZA, M.J., KIDNAY, A.J. and MILLER, R.C., 1975, Equilibrium properties of fluid mixtures, a bibliography of data on fluids of cryogenic interest: New York, IFI/Plenum, 157 pp.

Phase equil. and physical props. of a wide variety of systems of components of interest to fluid inc. studies, including particularly inorg. and org. gases. (ER)

HOBSON, J.H. and MIDDLEBROOKS, E.J., 1967, Checking the correctness of water analyses with freezing point depressions: State College, Mississippi, Water Resources Research Institute, 53pp. Authors at Water Resources Research Institute, Mississippi State University.

A study was made on the relationship between freezing point depression and conc. for various cpds. normally found in natural waters. The primary objective was to develop a simple method to check the correctness of water anals.

Through the use of Raoult's Law and Arrhenius and Van't Hoff's theories on electrolytic dissoc., a theor. relationship between freezing point depression and conc. was developed. This relationship, when expressed in terms of calcium carbonate, is identical for cpds. containing equal hydrogen equiv. provided the cpds. completely dissoc. in water.

Freezing point depressions were meas. for various electrolytic cpds. with the conc. varying from 50 mg/ℓ to 400 mg/ℓ. These results were then expressed as calcium carbonate to obtain a common base for comparison. Freezing point depressions were also meas. on syn. and natural water samples of known conc.

Two methods were used to compare standards and exper. results. One method utilized the total conc. of the water sample and the line of best fit for data representing the freezing point depressions and conc. for all of the cpds. used in the study. The other was based upon the freezing point depressions caused by the individual cpds. in the water sample.

Cpds. containing sulfates and nitrates exhibited abnormal behavior, causing significant deviations from the theor. results. (From the authors' abstract.)

HOEFS, J., 1975, The carbon isotopic composition of CO_2 from fluid inclusions: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg 1974, p. 475-478. Author at Geochemisches Institut der Universität Göttingen, D-34 Göttingen, Goldschmidtstr. 1, W. Germany.

CO_2 from fluid incs. is extrac. through decrep. in vacuum. 3 diff. sets of samples have been anal: (1) Quartzes from granulite facies of Norway; (2) olivines from xenoliths in basaltic rocks from various localities; and (3) granitic rocks from South West Africa. The δ^{13} C-values of the anal. CO_2 are shown in Fig. 1. Some speculations are given about the meaning of the isotopically light CO_2. (Author's abstract.)

HOEFS, J., and TOURET, J., 1975, Fluid inclusion and carbon isotope study from Bamble granulites (South Norway), a preliminary investigation: Contrib. Mineral. Petrol., v. 52, p. 165-174. First author at Geochemisches Institut der Universität Göttingen, Germany.

The carbon isotopic comp. of CO_2 from fluid incs. in granulite facies rocks has been det. The "primary" carbonic fluid - most probably being of Upper Mantle origin - appears to have δ^{13}C-values around -15 ^{o}/oo or even lighter, up to -20 ^{o}/oo. During the late stages of retromorphosis an enrichment in the heavy carbon isotope seems to occur resulting in δ-values between -5 and -7 ^{o}/oo which, on the basis of $^{13}C/^{12}C$ ratios of carbonatites, kimberlites and diamonds have been taken up till now as representative for juvenile carbon. The implications of these findings are discussed. (Authors' abstract.)

HOLDAWAY, M. J., 1975, Effect of rock and fluid composition on chloritoid-staurolite equilibria, Picuris Range, New Mexico (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 7, p. 1119. Author at Dept. of Geological Sciences, Southern Methodist University, Dallas, Texas 75275.

HOWD, F. H., and BARNES, H. L., 1975, Ore solution chemistry IV. Replacement of marble by sulfides at 450°C: Econ. Geol., v. 70, p. 968-981.

HSU, L. C., 1975, Effects of oxygen and sulfur fugacities on the scheelite-tungstenite and powellite-molybdenite stability relations (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1123.

Author at Nevada Bureau of Mines-Geology and Department of Geology-Geography, Mackay School of Mines, University of Nevada, Reno, Nevada 89507.

HUANG, C.-I., ROSE, A. W., and DEINES, P., 1975, Isotopic and petrologic studies of contact metasomatic ores at Ely, Nevada: Amer. Geophy. Union Trans., v. 56, no. 6, p. 460. First author at Dept. of Geosciences, Penn State Univ., Univ. Pk, PA 16802.

Contact metasomatic replacements of limestone adjacent to porphyry Cu ore at Ely show outward zoning of early stage mins from andradite-rich to pyroxene-rich to local wollastonite-rich to a quartz-calcite-pyrite assem, to peripheral marble and limestone with local calc-silicates and clays. Superimposed on these early mins. are veins of quartz-calcite-pyrite-chalcopyrite-magnetite with alt. envelopes of nontronite or actinolite accompanied by quartz, calcite and magnetite. Typical fluid incs. in garnet, pyroxene and quartz from the garnet and pyroxene zones contain relatively dense fluids with one tiny dm. These incls. usually homog. to L at Ts of 450 to>500°C. Incs. in quartz of the quartz-calcite pyrite zone show a similar range of homog. Ts. Many incs. in quartz of later quartz-sulfide veins fill at 275 to 400°C and contain several dms. Ts estim. from O isotope fract. between quartz and magnetite are 400 to 690°C, with the highest Ts near the contact. Calc. comps. of hydr. fluid are 7 to 10‰ (SMOW). Nine andradites have δO^{18} values of 4.8 to 8.5‰, 9 pyroxenes 8.3 to 12.4‰ (one 18.8‰), and 2 actinolites 7.2 to 7.8‰. The δ^{18} values of pyroxene and actinolite are also consistent with water having δO^{18} values of 7 to 10‰. Calcites are richer in O^{18} than co-existing quartz and have apparently reequil. after the initial dep. These results contrast strongly with contact metasomatic ores at Cornwall, Pa. where δO^{18} values of water are inferred to have been +16 ^{o}/oo. (Authors' abstract.)

HUANG, Wuu-Liang, and WYLLIE, P. J., 1974, Eutectic between wollastonite II and calcite contrasted with thermal barrier in $MgO-SiO_2-CO_2$ at 30 kilobars, with applications to kimberlite-carbonatite petrogenesis: Earth Plan. Sci. Letters, v. 24, p. 305-310.

HUANG, Wuu-Liang, and WYLLIE, Peter J., 1975a, Peridotites, kimberlites and carbonatites in the system $CaO-MgO-SiO_2-CO_2$ (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1123-1124. First author at Department of Geology, National Taiwan University, Taipei, Taiwan.

The key to the origin of carbonatites and kimberlites lies in the system $CaO-MgO-SiO_2-CO_2$. Increase in P carbonates the mantle assemb.: $Fo+Cpx+CO_2 = Opx+Ccd$ (carbonate solid solution); this reaction intersects the solidus and introduces carbonates as P mins. alongside silicates on the liquidus surface. The reaction passes through 15kb-960°C with slope 45b/°C. At 20 kb the melting T of mantle assemb. Fo+Opx+Cpx is lowered 75°C by sol. of 5 wt % CO_2 (Eggler). Stabilization of carbonate increases CO_2 sol.; above 25 kb the solidus reaction with CO_2 sweeps down through 400°C via a P max. at 32 kb to meet the invariant point at 25kb-1200°C, that also terminates the carbonation reaction. The mantle solidus curve at higher Ps involves fusion of silicates and carbonates producing a L with 90 wt % carbonates. There is an intricate series of reactions between 25 and 35 kb involving changes in phase fields on the CO_2-

saturated liquidus surface. At depths greater than 80 km, fusion of mantle peridotite with CO_2 (as carbonate) yields first carbonatite, then kimberlite. Fractional xliz. of CO_2-bearing basic magmas at most depths yields kimberlites and residual carbonatites. Kimberlites and carbonatites rising from the asthenosphere must evolve CO_2 as they reach a reaction boundary between about 100 km and 80 km depth. This contributes to their explosive emplacement. (Authors' abstract.)

HUANG, Wuu-Liang, and WYLLIE, P. J., 1975b, Melting reactions in the system $NaAlSi_3O_8$-$KAlSi_3O_8$-SiO_2 to 35 kilobars, dry and with excess water: Jour. Geol., v. 83, p. 737-748. Authors at Department of Geophysical Sciences, University of Chicago, Chicago, Illinois 60637.

HUANG, W. L., and WYLLIE, P. J., 1975c, Influence of mantle CO_2 in the generation of carbonatites and kimberlites: Nature, v. 257, p. 297-299.

IIJIMA, Azuma, 1975, Effect of pore water to clinoptilolite - analcime - albite reaction series: Jour. Fac. Sci. Univ. Toky., Sect. II, v. 19, no. 2, p. 133-147, (in English).

IKORNIKOVA, N. Yu., 1975, Hydrothermal synthesis of crystals in chloride-bearing systems: Moscow, "Nauka" Publ. House, 224 pp. (in Russian).

In the book results of exper. invest. of Cl^--bearing hyd. and pneu. systems in T ranges 200-700°C and P up to 2500 kg/cm^2 are described. Data on conc. of Na, K, Ca, Mg, Al, Cu, Mn, Li, Cl, SO_4, HCO_3, F, SiO_2, SiF_6, BO_2 in incs. in natural fluorite, barite, galena, sphalerite, beryl, topaz, spodumene, microcline, olivine, kyanite, Iceland spar, are given at p. 46-49. (A.K.)

IKORSKY, S. V., and EVETSKAYA, E. A., 1975, On CO_2 sorption during gas extraction from rocks and minerals in the vacuum mill: Geokhimiya, 1975, no. 11, p. 1712-1719 (in Russian with English abstract). Authors at Geol. Inst. of the Kola Branch of the USSR, Acad. of Sci., Apatity.

The value of CO_2 sorption by min. powder was exper. studied under conds. char. of the bulk method of gas extrac. from rocks in vacuum mills. The exper. consisted in the following: the crushing of rocks (nepheline syenites, granites, gabbro-norites, olivinite, alkaline pegmatite, soda-potash feldspar) was carried out in an atmosphere of CO_2, specific amounts of which were artificially introduced into an evacuated glass with the rock before crushing. The sorption value was estab. according to the diff. between the CO_2 amount introduced before the exper. and the volume of CO_2 pumped out from the glass after rock crushing. The CO_2 outpumpings from the glass were made at temperatures of 20, 70 and 105°. In all experiments an intensive CO_2 sorption by the crushed rock has been estab. At a pumping T of 20 and 70° its max. values are 100 cm^3/kg of the rock and at 105° -71 cm^3/kg. A conclusion about the limited suitableness of the method of gas extrac. from rocks in a vacuum mill for quan. CO_2 det. is drawn. (Authors' abstract.)

ILERI, Saldiray, 1975, Relationship between geological setting and genesis of antimony deposits: Geol. Soc. Turkey, Bull., v. 18, no. 1, p. 41-46 (in Turkish with English abstract).

Sb deps., among many other sulphide dep., generally occur as vein type, and are found in close vicinity of volcanic areas, but strata-bound min. is also expected to be formed in the same area. Subsequent geol. events may cause mobilization of Sb in both types and change the original setting fo the min.

Petrofabric analysis of stibnite ores, fluid inc. studies and radiometric age dets. at the Murchison Range (South Africa) Sb deps., revealed that the min. is contemporaneous with the seds. and volcanics. On the other hand, petrochem. anal. of stibnite ores and country rock at Niğde (Turkey) Sb deps. showed that the ore was mobilized from a strata-bound source. (Author's abstract.)

IMAI, Hideki, LEE, Min Sung, IIDA, Kohei, FUJIKI, Yoshinori, and TAKENOUCHI, Sukune, 1975, Geologic structure and mineralization of the xenothermal vein-type deposits in Japan: Econ. Geol. v, 70, p. 647-676.

Sn-W-Cu-Zn-Pb-Ag vein deps. in Japan, belonging to xenothermal class, occur in or in close proximity to regions of rhyolitic (and andesitic) rocks intruded by granitic rocks. The Akenobe, Ikuno, and Tada mines in western Japan and the Ashio mine in eastern Japan belong to the class.

From fluid inc. studies, the decrep. Ts of the min. in the Akenobe mine are det. to be 355° to 155°C. The fluid inc. in the quartz from the Ashio mine are two-phase (liquid and vapor), with T_H of 350-200°C. The NaCl equiv. conc. are 0 to 9 percent, respectively. In some cases, it is observed under the microscope that in the same quartz xl from the veins of the Ashio mine, fluid incs. with predominate liquid phase coexist with predominately vapor phase incs. This indicates that the boiling phenomenon of the ore-forming fluid has occurred in the course of min. (From the authors' abstract.)

IMAI, Hideki, TAKENOUCHI, Sukune, and NAGANO, Ken'ichi, 1976, Fluid inclusion study of the Mamut porphyry copper deposit, Sabah, Malaysia: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Authors at Univ. of Tokyo.

The Mamut porphyry Cu mine is located about 65 km to the east of Kota Kinabalu on the southern foot of Mt. Kinabalu, Sabah, Malaysia. The mine operation was started in May 1975 on the scale of 18,000 tons of 0.52% Cu per day. The district consists of Tertiary sed. and igneous rocks. Mt. Kinabalu consists of adamellite, with an area of 15 km by 12 km. The absolute age of the adamellite is 9 m.y., by the K-A method (Jacobson). In the vicinity of the mine, sed. rocks consist mainly of Paleocene to Eocene sandstone and siltstone, which were intruded by serpentinite and peridotite in the Miocene. These sed. and igneous rocks were intruded by adamellite porphyry in the late Miocene or early Pliocene. The size of the main stock, which is considered to be one of the satellite stocks of Mt. Kinabalu batholith, is ∿800 m by 300 m. The stock branches into many dikes, forming an intricate shape.

The ore dep. exists in adamellite porphyry, serpentinite and siltstone, but ore of high Cu grade forms a tilted shell which corresponds to the boundary of the main intrusive stock. The ore reserves are estimated at 179 million tons of 0.476% Cu. Major sulfide minerals are chalcopyrite, pyrite, and pyrrhotite. The Au content of crude ore is 0.635 g/t.

The Nungkok dep., which is located about 22 km to the WNW of the Mamut deposit, is the other porphyry Cu dep. found in another satellite stock. It is reported that the dep. is smaller in scale than the Mamut but higher in Mo content.

Fluid incs. in quartz are classified into three major groups: (1) Polyphase: Most incs. carry a cubic transparent xl. of halite and two or three solid phases which are too small to identify. Upon heating the bubble generally disappears at a lower T than does halite (230-390°C vs 310° - 460°C). A few data show that sylvite disappears at Ts between 100° and 200°C. From this result, the sal. of ore-forming fluids at this stage is inferred to vary from 40 to 50 wt.%. (2) Gaseous: Most gaseous incs. have negative xl. shapes and various F. Gaseous incs. seem to be abundant in the upper parts of the orebody or outside the ore shell. (3) Liquid: Liquid incs. are very few compared with polyphase and gaseous incs. F is high and the shape is generally irregular.

The ratio of the number of polyphase incs. to the total number of incs. was det. on some samples. The ratio varies within the orebody, but higher values are found more often in the lower parts. The ratio of the volume of chalcopyrite to the total volume of sulfides was also meas. on the same samples. These two ratios have a positive correlation, showing the intimate relation between the Cu min. and saline ore-forming fluids.

Heating exper. were carried out on polyphase incs. in quartz from the Nungkok deposit. The bubble disappears between 250° and 380°C, and halite between 230° and 320°C. Both of these Ts are slightly lower than those at the Mamut dep. (Authors' abstract.)

IRVINE, T. N., 1975, Crystallization sequences in the Muskox intrusion and other layered intrusions--II. Origin of chromitite layers and similar deposits of other magmatic ores: Geochim. Cosmo. Acta, v. 39, p. 991-1029. Author at Geophysical Lab., Carnegie Inst. of Wash., Washington, D. C. 20008, USA.

Some evidence is presented of trapped globules of granitic melt (from contamination?) as incs. in chromite (p. 1008), and of immiscible sulfide melt. (ER)

IRVING, A. J., and WYLLIE, P. J., 1975, Subsolidus and melting relationships for calcite, magnesite and the join $CaCO_3$-$MgCO_3$ to 36 kb: Geochim. Cosmo. Acta, v. 39, p. 35-53. Authors at Dept. of Geophys. Sci., Univ. of Chicago, Chicago, Illinois 60637, USA.

IVANOV, J. P., and GUREVICH, L. P., 1975, Experimental study of T-X_{CO_2} boundaries of metamorphic zeolite facies: Cont. Min. Pet., v. 53, p. 55-60.

IVASIV, S.M., and POZDEEV, K.M., 1975, Role of CO_2 in hydrothermal solutions forming ores of Arkhonskoe polymetallic deposit (N. Caucasus) (abst.), p. 86-87, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at L'vov State Univ., L'vov.

Arkhonskoe Pb-Zn dep. is localized at Arkhono-Kholstinskiy anticlinal zone in N. part of Main Caucasian Chain. The dep. is of vein type and formed at T 370-110°C (T_H) in three stages: quartz-pyrite, quartz-galena-sphalerite and quartz-carbonate. Incs. bearing water sol. (2-3%), L_{CO_2} (90-95%) and G_{CO_2} (2-8%) were found, as well as syngenetic incs.

without CO_2, proving the heterogeneous state of sols. (Abs. by A.K.)

JACOBSON, Roger L., and USDOWSKI, Eberhard, 1975, Variables influencing partitioning of strontium between calcite, dolomite and hydrothermal fluids (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1131-1132. First author at Sedimentpetrographisches Institut der Universität Göttingen, Göttingen, West Germany.

JANZ, G. J., TOMKINS, R. P. T., ALLEN, C. B., DOWNEY, J. R., JR., GARDNER, G. L., KREBS, U., and SINGER, S. K., 1975, Molten salts: Volume 4, Part 2, Chlorides and Mixtures: Jour. Phys. & Chem. Ref. Data, v. 4, no. 4, p. 871-1179. Authors at Molten Salts Data Center, Dept. of Chem., Rensselaer Polytechnic Institute, Troy, N. Y. 12181.

Data on the electrical conductance, density, viscosity, and surface tension of chloride mixtures have been systematically collected and evaluated. Results are given for 124 binary mixtures over a range of comp. and Ts. Values of the above prop. for the single salts have been updated in accord with previously advanced recommendations. (Authors' abstract.)

Includes extensive bibliography on the system KCl-NaCl, of interest in inc. studies. (ER)

JEHL, Vincent, 1975, The metamorphism of the oceanic rocks of the North Atlantic and fluids associated with it: Thèse de Docteur-Ingénieur, Univ. Nancy, March 1975, 242 pp. (in French). Author at Centre de Recherches Pétr. et Géochim., C.O. n° 1, 54500 - Vandoeuvre-les-Nancy, France.

Fluid inc. and petrographic studies are reported on 25 specimens from the Mid-Atlantic Ridge, adjacent zones and transverse fractures. Chapter I contains numerous microprobe anal. of meta. mins. from veins and vesicles. Chapter II deals with the microthermometric study of fluid incs. assoc. with the meta. from quartz, calcite and feldspar. Only aq. incs. (2-16 eq. wt.% NaCl) are present; these have T_H = 124-335°C and medium to high d = 0.6-1.0 g/cm^3. In Chapter II it is concluded that a hyd. meta. has taken place at low P, under high geothermal gradients and in the presence of an abundant, essentially aq. fluid phase at T = 140-460°C and P = 250-2200 bars. Seawater is invoked as the origin of the hyd. fluid phase down to depths of 4-5 km in the crust. An appendix is devoted to the standardisation and calibration of microthermometry app., with application to the Chaix-Meca stage. (Abstract by Maurice Pagel, translated by Chris Eastoe.)

JOESTEN, Raymond, 1975, High temperature contact metamorphism of carbonate rocks in a shallow crustal environment, Christmas Mountains, Big Bend region, Texas (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

JOWETT, E. C., 1975, Nature of the ore-forming fluids of the Polaris lead-zinc deposit, Little Cornwallis Island, N.W.T., from fluid inclusion studies: Can. Mining & Metal. Bull., March, 1975, p. 1-6. Author at

St. Joseph Explorations Limited, Truro, Nova Scotia.

The min. assemb. and the environment of the recently discovered Polaris Pb-Zn dep. exhibit many features which are char. of the Mississippi Valley type of dep., and of Pine Point in particular. The data obtained from the study of the fluid inc. support this comparison.

Useable fluid inc. are rare in most of the ore, but 86 P two-phase inc. in sphalerite were found to homog. in the range of 52° to 105°C (with one at 131°C). The true T_F are probably only a few degrees higher. Single-phase (liquid) inc. in late calcite indicate lower Ts in later stages of dep. No inc. in sphalerite could be frozen at -19.5°C, indicating possibly very saline fluids.

These results, in conjunction with general obs., essentially preclude syngenetic and magmatic-hyd. origins and favour an epigenetic connate-water origin, with possible addition of meteoric waters. (Author's abstract.)

KADIK, A. A., 1975, Water and carbon dioxide in magmatic processes, <u>in</u> "Physico-chemical problems of hydrothermal and magmatic processes"; Moscow, Publ. House "Nauka," p. 5-32 (in Russian).

On the basis of exper. and theor. data on contemporaneous soly. of H_2O and CO_2 in magmatic melts of basic and acid comp., processes connected with behavior of CO_2 and H_2O during forming of magmas and degassing of basaltic melts during their movement to the Earth's surface are evaluated. The processes are: influence of H_2O/CO_2 ratio on melting of rocks of the Earth's crust, on conc. of water in originating granite melts, change of ratios H_2O/CO_2 in magmatic fluids in moving granitic intrusions, possible influence of degassing of basaltic magmas on exchange of material between mantle and lower parts of crust. (Author's abstract, translated by A.K.)

KADIK, A. A., and EGGLER, D. H., 1975, Melt-vapor relations on the join $NaAlSi_3O_8$-H_2O-CO_2: Carnegie Inst. Wash., Geophy. Lab. Yearbook 74, for 1974-1975, p. 479-484.

KADIK, A. A., EGGLER, David H., and MYSEN Bjørn, 1975, Crystal-melt-vapor relations on the joins $NaAlSi_3O_8$-H_2O-CO_2 and $CaMgSi_2O_6$-H_2O-CO_2 (abst.): Transactions, American Geophysical Union, v. 56, no. 6, p. 470. First author at Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow.

Eight isobaric, isothermal sections of the join $NaAlSi_3O_8$(Ab)-H_2O-CO_2 have been det. at Ps of 3-20 kbar, and four new sections in the system $CaMgSi_2O_6$(Di)-CO_2-H_2O at Ps of 3-30 kbar. These data allow modeling of xl-melt-vapor relations in both an acidic and a basic (pyroxenite) silicate melt. Principal discoveries are: (1) Maximum soly. of CO_2 in Ab melt is 2.2 wt % (1.0 wt % at P<10 kbar). Correlative with this low soly. is a freezing-point depression (even at 30 kbar) of less than 20°C. Up to 10 wt % CO_2 (and up to 30 wt % H_2O) can dissolve in Di melt. (2) Max. soly. of CO_2 in Di xl. is 37 ppm, of Di in CO_2 vapor $\sim$0.1 wt %, of Di in H_2O vapor 10 wt %. Thus storage of CO_2 in silicate xls. must be unimportant in the upper mantle. Vapor transport, particularly in H_2O-bearing vapor, could be very important. Melting curves of Ab, for a particular $CO_2/(CO_2+H_2O)$ ratio show T minima in P-T projection for higher $CO_2/(CO_2+H_2O)$ values, the min. occurring at Ps of 5-9 kbar. This con-

figuration implies that CO_2-H_2O-bearing acidic magmas rising into the crust could undergo a complex history of remelting (or superheating) then freezing, while evolving first relatively CO_2-rich, then (at shallower depths) relatively H_2O-rich vapor. Di melting curves also show slight low-P T min., but a more remarkable feature is a T at 30 kbar; Di in the presence of CO_2-H_2O vapor richer in H_2O than $CO_2/(CO_2+H_2O)=0.2$ melts at lower T than Di in the presence of H_2O alone. (Authors' abstract.)

KADIK, A. A., OSTAPENKO, G. T., and FRENKEL, M. Ya., 1975, Pressure of water vapor during crystallization of magma in a chamber of constant volume: Geokhimiya 1975, no. 6, p. 812-821 (in Russian; translated in Geochem. Internat., v. 12, no. 3, p. 130-138 (1975)).

KAJIWARA, Yoshimichi, 1975, Ultimate origin of "ore solutions": Ocean water?: Geochem. Jour. (Japan), v. 9, pp. 235-239. Author at Geol. and Min. Inst., Fac. of Sci., Tokyo Kyoiku Univ., Otsuka 3-29-1, Bunkyo, Tokyo 112, Japan.

Available thermochem. data suggest that the present-day ocean waters have a great potentiality of ore dep. in a comparatively wide range of such hyd. conds as might generally be encountered within the earth's crust environ. It appears probable that a majority of hyd. metalliferous ores in nature are the essential products of incorporated ocean waters heated and reduced in the earth's crust during processes of orogeny.

It is also suggested that the ocean waters are linked with hyd. sols in the earth's crust to form a single cyclic geochem. system and that the abundances of ore-forming elements in the oceans are indirectly being controlled by the sol. limits of common ore mins, existing in the uppermost earth's crust. (Author's abstract)

KALYUZHNYI, V.A., 1975a, Genesis of "Zanorsh" pegmatites, criteria of their search and estimation: Geologicheskii Zhur., v. 35, no. 5, p. 48-57 (in Russian with English abstract).

Fine-grained porphyritic aplitic-poikilitic granites (type 2) are a facies of indistinctly porphyric medium-grained allotriomorphic-granular granites (type 1). They are contiguous to peg. bodies more often on the sides and from above. Gradual transitions of type 1 granites to type 2 granites are obs. The latter appear due to melt after its boiling up and release of fluid water phase. The syngenetic gas aureoles arising in enclosing granites as well as metasomatic rocks under pegs, are exploration guides for peg. bodies. Commercial value of the pegs. is estim. on the basis of typomorphic chars. det. by peculiarities of xliz. in isolated (chambers) at the post-inversion stage. (Author's abstract) (Note: In the English abstract the term "Zanorsh" was translated "Bag"; "Cavity" or "Chambered" might be more appropriate translations. Ed.)

KALYUZHNYI, V.A., 1975b, Genetic information from inclusions of deep fluids in minerals, p. 19-20 (in Russian). Author at Inst. Geol. Geochem. of Fuels of Acad. Sci. Ukr. SSR., L'vov.

For correct understanding of information for incs. it is necessary to solve three essential questions: a) to what part of the xl are the incs. syngenetic; b) does the actual filling of inc. correspond with the primary one; c) is the filling authigenic or xenogenic, i.e., does it correspond with the environment of xliz? These questions may be solved only by mass invest. of syngenetic groups of incs. Classification of incs. is essential to such invest., but it cannot be the key of mineralogenesis; the latter needs ought to be det. individually for each min. group, and dep. Carbon-bearing cpds. complicate the phase and chem. comp., but they also extend the possibilities of methods using fluid incs. Heterogeneous state (boiling) is the most common state of min.-forming sols, in the majority of deps. Homogeneity is the special case of heterogenous natural systems. Methods of barometry are developed on the basis of heterogeneity of fluids (with CO_2) and interesting perspectives exist for heterogenuous equil. of H_2O-hydrocarbon systems and their relics in incs. (Abs. by A.K.)

KALYUZHNYI, Vl.A., 1975, Evolution of phase changes of carbon-bearing fluids (on the basis of inclusions in minerals) (abst.), p. 109, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. Fuels of Acad. Sci. Ukrainian SSR, L'vov.

The system C-bearing cpd.-water, e.g. CO_2-H_2O, and C_nH_{2n+2}-H_2O in numerous cases have partial or complete miscibility. During ascension of deep fluids there is an increase in the number of co-existing phases, and depending on external cond., the comp. of these phases vary. Heterogenization of fluids causes the pption and conc. of materials in solution. Evolution of the phase state of min.-forming systems may be exemplified by hyd. and metasom.-hyd. deps of: a) Donbass, Volhyn and Zabaikal'ye (H_2O+CO_2); b) Transcarpathians and Donbass (H_2O+CH_4); Volhyno-Podol'ye, Crimea, Caucasus (H_2O+CH_4+C_nH_{2n+2}+...). The above are deps. of Au, polymetals, piezo-quartz, Hg, hydrocarbons etc. (Abs. by A.K.)

KALYUZHNYI, Vl.A., DAVIDENKO, N.M., ZINCHUK, I.N., SVOREN', I.M., and PISOTSKIY, B.I., 1975, Role of CO_2-H_2O and CH_4-H_2O fluids in forming of ores of gold at Chukotka (abst.), p. 80-81, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Inst. Geol. Geochem. Fuels Acad. Sci. Ukrainian SSR, L'vov.

Hyd. quartz of one dep. is enriched in CO_2, and of the second - in CH_4. Quartz and scheelite from the first dep. contain (by mass spec.): CO_2 81.3-95.6%, CH_4 0.9-7.3%, N_2 5.2-12.4%. Quartz from pre-ore stage is richer in CO_2 than ore-bearing and late quartz. CO_2 was lowest ($\geq$81%) in metasom. quartz of wall rocks and in scheelite. Gases in incs. in quartz from the second dep. are mainly CH_4 (58.6-84.0%), with CO_2 2.8-34.7, and N_2 6.7-13.2%. Positive correlation was found between conc. of CH_4 and Au in ore, and a reverse correlation for CO_2 and Au. Migration of Au is intensive in high-CO_2 sols.; loss of CO_2 causes pption. of Au. CH_4 aids the pption. of Au, and CH_4 concs. may be a prospecting guide for commercial zones of Au ores. (Abs. by A.K.)

KALYUZHNYI, V.A., SHCHEPAK, V.M., GIGASHVILLI, G.M. SVOREN', I.M., and MAKOVSKAYA, I.A., 1975, Application of hydrochemical aureoles and fluid inclusions in minerals for evaluation of oil and gas migration through deep faults, p. 269-272, in Regularities of formation and distribution of commercial deposits of oil and gas, G.N. Dolenko, editor: Kiev, Acad. Sci. Ukr. SSR, Publ. House "Naukova Dumka", 332 pp. (in Russian, English abstracts).

Quartz-calcite veins in the Belz-Milyatin fault at Volhyn-Podolia on the periphery of the East-European platform occur at depths of 917-1162 m. Quartz xls (L_3 = 5-8 mm) bear incs. of three types. Type a - P incs., euhedral, filled by L+G+bitumen, T_H increases from 60-65 to 95-110°C with increasing depth; composition (mass chrom.): CH_4 - 50-55%, N_2 - 25-30%, H_2 - 8-10%, CO_2 - 3-5%, $C_2H_6 + C_3H_8$ - 10%; refr. index of L = 1,400; P_{int} at 21°C = 100 atm; at 61°C = 130 atm. Type b - P and S incs., irregular, sometimes refilling "a - type" incs., usually filled by yellowish paraffin, + G (5%) + brown bitumen, T_H = 39-50°C. Type c - Mainly S incs., filled by G (5-10% vol.) + oil-like yellow liquid + L_{H_2O} + brown bitumen, T_{Frz} = -20°C, T of melting of last ice xl - 0.9°C (0.5 wt. NaCl); G bubble disappears at 62°C, homog. of L_{H_2O} and organic L was not reached due to decrep. of incs. at 130-150°C. Brown bitumen does not change during heating. Organic phase was transported as a separate phase by water sol. (Abstract by A.K.)

KALYUZHNYI, V.A., SVOREN', I.M. and PLATONOVA, E.L., 1974, Gas composition of fluid inclusions and the detection of their hydrogen by mass spectrometry: Akad. Nauk SSSR, Doklady, v. 219, no. 4, p. 973-976 (in Russian; translated in Doklady Acad. Sci. USSR, v. 219, p. 209-212, 1975). Authors at Institute of Geology and Geochemistry of Fossil Fuels, Ukrainian Academy of Sciences, L'vov.

Covers essentially the material presented at Fourth Regional Conference on Thermobarogeochemistry of Mineral-Forming Processes, Rostov, 1973 but with supporting data; see same authors, 1973, Fluid Inclusion Research, v. 6, p. 72, 1972. (ER)

KALYUZHNYI, V.A., ZINCHUK, I.N., and SVOREN', I.M., 1975, Methane and aqueous-methane inclusions of high density in minerals of hydrothermal veins from Donbass, p. 52-54, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fossil Fuels, Acad. Sci. Ukrainian SSR, L'vov.

Calcite veins from Central Donbass have quartz xls. up to 1 mm long. P incs. (0.02-0.03 mm) are one-phase at room T, G forms on cooling, and at -80°C occupies 30-35 vol. %; T_H -77°C; comp. (by MX 1301 mass-spec.): CO_2 1.6%, N_2 2.8%, CH_4 95.6%, C_2H_6 + others <1%; hence L phase (L_1) is supercrit. methane. Significant increase of T_H over crit. T of CH_4 (-82.1°C) depends on presence of C_2H_6 and other cpds.

S incs. are filled by methane (G, L_1), water-methane (L_1+L), methane-water (L+L_1) and gas-water (L+G). G incs. (methane) are rare and have T_H -70°C. Early S L+G incs. in central parts of xl have T_H 148-150°C, and in upper parts T_H 130-132°C, both in L phase. Conc. by cryometry 3% NaCl equiv. In calcite incs. are very minute, with similar phase ratios and composition (CO_2 2.0%, N_2 3.1%, CH_4 94.9%, C_2H_6 + others <1%); P was >360 atm. (Abs. by A.K.)

KAMILLI, Robert J., and OHMOTO, Hiroshi, 1975, Isotopic and chemical evolution of the hydrothermal fluid responsible for the Pb-Zn-Ag-Au

mineralization of the Finlandia Vein, Colqui District, Department of Lima, Peru (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1137-1138. First author at Department of Geological Sciences, Harvard University, Cambridge, Massachusetts 02138.

The Finlandia mine, a Pb-Zn-Ag-Au vein in Tertiary andesitic volcanic rocks, is 75 km. NE of Lima, Peru. The age of the min. is 10 m.y. Detailed studies of the min., anal. of fluid incs. (T, sal., δD, gases and dissolved species) and O and S isotopic anals. of ore and gangue mins. revealed 7 stages of min. which can be grouped into 2 major episodes, each char. by distinct min. and chem. and isotopic comps. of the ore-forming fluids.

The first episode can be divided into 3 stages and is char. by abundant quartz, plus electrum and Ag-sulfosalt dep. at 270° ± 20°C. Chem. and isotopic char. of the fluid are those of meteoric origin: δD of water = -70 to -110‰, $\delta^{18}O$ = -10 to -4‰, $\delta^{34}S$ of H_2S (calc.) = -2‰, and the sal. generally less than 2 wt.% except during the dep. of Stage-2, when boiling took place.

The second episode is char. by Pb-Zn min. with minor quartz (Stage-4, sp + gn; Stage-5, qz; Stage-6, sp + gn; Stage-7, sp + gn + barite). The T of the fluid decreased gradually from ca. 270° to ca. 140°C. Fluids responsible for the major sulfide dep. (Stages 4 & 6) contain some char. of magmatic (?) or connate (?) origin: $\delta D = -50 \pm 5$‰, $\delta^{18}O = 0 \pm 3$‰, $\delta^{34}S$ of H_2S (calc.) = 0‰ and a lack of low sal. fluid incs.

$\delta^{18}O$ values of Stages 5 and 7 waters are similar to those of Stages 4 & 6. However, the δD values are considerably lower and similar to Episode 1 water, suggesting influx of meteoric water during these stages. (Authors' abstract.)

KANEHIRA, Keiichiro, YUI, Shunzo, SAKAI, Hitoshi and SASAKI, Akira, 1973, Sulphide globules and sulphur isotope ratios in the abyssal tholeiite from the Mid-Atlantic Ridge near 30°N latitude: Geochem. Jour. (Japan), v. 7, p. 89-96. First author at Geological Institute, Faculty of Science, Chiba University, Chiba 280, Japan.

Sulphide globules were found in glassy rim as well as in more xline interior of pillowed abyssal tholeiite from the Mid-Atlantic Ridge near 30°N lat. The magma reached sat. with respect to sulphide at the time of eruption and immiscible silicate and sulphide Ls were quenched when the magma was extruded on the sea floor. Sat. S content of the basaltic L was estim. at $\sim 0.15 \pm 0.03$ wt. %. S isotopic abundance of the rocks expressed in $\delta^{34}S$ ranges from +0.3 to +1.6 ‰. This value may represent the isotopic ratio of mantle sulphur. (Authors' abstract)

KARWOWSKI, Lukasz, 1975, Tungsten mineralization in greisens of the Izera Upland: "Przeglad Geologiczny", v. 23, no. 1, p. 3-8: (in Polish with Russian and English summaries).

The disseminated W min. was ascertained in greisens of Izera Upland The greisens are devel. by replacement of meta. rocks (gneisses and granite-gneisses) and metasomatic leucogranites. Ferberite and S post-ferberitic scheelite are the main W mins. On the other hand, the permanent occurrence of Nb-bearing rutile as well as the minor amounts of cassiterite, native Bi, arsenopyrite and chalcopyrite are noted in the whole greisen zone. On the basis of the invest. on fluid incs. in greisen mins. and decrep. det. it may be assumed that greisens with accompanying ore min. originated under conds. of high-T (400-300°C) hyd. sols. from moderately conc. sols. rich in CO_2, at P about 800 atm. (Author's abstract)

KARWOWSKI, L., and KOZLOWSKI, A., 1975a, Temperature, pressure and composition of parent solutions of quartz from Jeglowa (abst.): Sprawozdania z posiedzeń komisji naukowych PAN, Oddział w Krakowie, v. 18, no. 2 (July-Dec. 1974), p. 535-536 (in Polish). Authors at IGMiP UW, Faculty of Geology, 02-089 Warszawa, al. Żwirki i Wigury 93, Poland.

Abst. of paper presented on Meeting Physico-chemistry of geological processes II, Krakow, Oct. 3-4, 1974; complete text abstracted in next item. (AK)

KARWOWSKI, Lukasz and KOZLOWSKI, Andrzej, 1975b, Temperature, pressure and composition of the parent solutions of quartz from Jeglowa, Lower Silesia: Mineralogia Polonica, v. 6, no. 1, p. 53-60 + 10 plates, (in English with Polish and Russian summaries). First author at The Silesian University, Institute of Geology, 41-200 Sosnowiec, ul. Partyzantow 1, Poland.

In an attempt to eludicate the genesis of rock xl occurring in the kaolinite rock at Jeglowa, Lower Silesia, T_H of quartz xls. ranged from 350 to 120°C. Anal. show Na, Ca, K, Al, and Cl were the principal ions. The mean conc. of the sols. was 18 wt. %(T_{Frz}). The probable P during the xliz. of quartz from these sols. attained a value of 500-600 atm (at 220-160°C) (Authors' abstract)

KARYAKIN, A. V., KHOLINA, Yu. B., and SOBOLEVA, N. V., 1975, The interaction of water with silica: Geokhimiya, 1975, no. 10, p. 1590-1593 (in Russian; translation in Geochem. Internat., v. 12, no. 5, p. 176-179). Authors at Vernadskiy Inst. Geochem. and Anal. Chem., Moscow.

A discussion of the connection between interaction of H_2O with silica and superdense water ("polywater," discredited in 1973 - see Derjaguin, 1973, Fluid Inclusion Research - Proc. of COFFI, v. 6, p. 34, 1973). (ER)

KARZHAVIN, V.K., 1975, Studies of products of thermodesorption of apatite and nepheline and kinetics of emanation of gases (abst.), p. 31-33 in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) — Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Geol. Inst. of Kola Division of Acad. Sci. USSR, Apatity.

The above mins. emanate gases in range 400-1000°C as listed in table, in cm^3/kg of min.:

Mineral	Total vol. of gases	CH_4	H_2	H_2O	CO	CO_2
Apatite (Kovdor dep.)	4644.0	17.20	189.8	352.2	603.2	3476.2
Do. (Lovozero dep.)	427.6	0.94	131.2	87.5	174.5	33.2
Nepheline (Lyavoyok dep.)	9278.0	53.84	628.9	7467.9	834.8	286.2
Do. (Kukisvumchorr)	2874.0	40.60	133.0	2192.0	292.6	235.4

Low-T emanation (400-600°C) is connected with decrep. of incs., and the high-T one (800-1000) is probably connected with diffusion of gases from xline lattice. (Abs. by A.K.)

KARZHAVIN, V. K., DUDKIN, O. B., and PRIPACHKIN, V. A., 1975, Gas phase of some natural apatite samples: Akad. Nauk SSSR, Doklady, v. 222, no. 4, p. 942-945 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 222, p. 183-185 (1976)). Authors at Geol. Inst., S. M. Kirov Kola Branch, USSR Acad. of Sci., Apatity.

Gases were released from large fluid incs. in apatite by stepwise heating in quartz in vacuum in a glass system. Apatites were from Khibiny, Lovozero, and Slyudyanka. Adsorbed gases were removed by heating to 110-125°C for 2.5 hrs. under vacuum. Evolved gas was passed through Ca carbide and pressure rise monitored for 1.5 hrs., then gas was transferred by Hg pump. Anal. was by gas chromatography ("Tsvet" and "Ukh-2" units). Chem. anal. (18 constituents) of the apatites used are given, and the amounts of H_2, H_2O, CH_4, C_2H_6, CO, CO_2, and total volume/Kg (up to 4600 cm^3/Kg, using 300-g samples) are given for gases evolved at 400, 600, 800, and 1000°C. C_3-C_5 hydrocarbons concs. (not given) range from 0.1-0.001 vol. %. Several samples evolved "sulfur." Decrep. ceased below 700°C, and no G-L incs. are visible thereafter, but much gas was evolved at 800 and 1000°.

The authors believe the H_2 is not from dissociation of H_2O or CH_4, and that gases evolved at 800 and 1000°C come from submicroscopic defects and "intermolecular layers." Eh and pH dets. were made on suspensions of heated and unheated samples, and interpretation attempted. Optical and x-ray d-values were also monitored and heating changed some. (ER)

KARZHAVIN, V. K., and PETERSIL'E, I. A., 1975, Possible genetic connection of hydrocarbon compounds of rocks and minerals of intrusive massifs with alkaline component of the rocks (abst.), p. 16-18, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Geol. Inst. Kola Division of Acad. Sci. USSR, Apatity.

Exper. in range 400-800°C in the system $C_{17}H_{36}$-$CaCl_2$-NaCl-NaF proved that products of cracking of heptadecane are stable at 150-200°C higher than in control run, and form. of amorphous solid phase (carbon) was less intensive in the system with alkalies. Increasing conc. of Na causes a decrease in vol. of CH_4, C_2H_6 and H_2, and some increase of conc. of benzene. In liquid phase ($T=700°C$, $[Na] = 30$ wt.%) a number of aromatic hydrocarbons and sat. hydrocarbons C_{20} (the former was C_{17}) were found. The distinct influence of Na as an inhibitor on decomp. of org. matter was ascertained. (Abs. by A.K.)

KAZITSYN, Yu.V., and MOSKALYUK, A.A., 1976, Composition of mineral-forming media adjacent to ore formation in time and space: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Authors at VSEGEI, Leningrad, USSR.

(1) One can draw some reliable conclusions concerning the comp. of the ore-forming medium on the basis of gas-liquid incs. in mins. of ore bodies. However, ore dep. takes place within a relatively narrow time interval, and as a rule it occurs during the concluding stage of the hyd. process. This process proceeds under conds. of active exchange of matter with ore-forming medium. The duration of the hyd. process considerably exceeds that of ore dep. And in order to be able to judge about its character and succession one must invest. the comp. of gas-liquid incs. in vein mins. and in zoned metasomatically modified rocks adjacent to the vein.

(2) For the first time the comp. of the min.-forming medium within all zones of metasomatic columns of hyd. modified rocks of the deps. was studied by the water-extract method. The following deps. were invest.: high-T Au dep. (albitization-tourmalinization); medium-T Mo dep. (beresitization and orthoclasization); low-T Sb-Hg, Au-Ag and fluorite deps. (argillization).

The comp. was studied, and the conc. and the pH of the sols. were det., which enabled us to reveal a number of regularities in the distrib. of separate elements in the changed zones adjacent to ore and to char. the comp. of the sols. which caused these changes.

(a) Sols. responsible for the high-T changes are char. by a Cl-Na-K-NH_3 comp. with salt conc. 0.64-9.90 g/l; they have a liquid water phase and the incs. amount to 0.14-3.36 wt.% H_2O; pH - 6.80-7.80.

(b) Medium-T fluids are of SO_4-Na-K comp. with 0.95-47.55 g/l; H_2O - 0.11-0.76%; pH - 6.70-8.20.

(c) Low-T fluids are of HCO_3-K-Na-Mg-Ca comp. with 2.66-15.98 g/l; H_2O - 0.18-0.64%; pH - 6.60-8.30.

(3) Along with the regular change of the sol. char. from high-T to low-T deps., a certain diff. in sol. comps. in various zones of metasomatic columns of each dep. can be obs.

The essence of the general tendency of these distinctions is the gradual increase, at first of the role of HCO_3, then of SO_4, and lastly of F, from unalt. rocks to the zone of max. alt. For example, in the greisen column of the Be dep. the sol. comp. changes according to zones in the following way: zone of slight alt. - % eq. - HCO_3 - 68, SO_4 - 7.6, F - 1.5, Cl - 22.7; intermediate zone - 70,22, 2,4, respectively; zone of max. alt. - 45, 30, 15, 10.

For a medium-T Mo dep.: zone of slight alt. - 65, 12, 16, -; - in the intermediate zone - 53, 44, 2.6, -; and - in the inner zone - 46, 49, 4.6; -, respectively.

The sol. comp. for a column of low-T argillized rocks in an Sb-As dep. is as follows: Zone of slight alt. - 59, traces, 6.6, 34; intermediate zone - 76, 19, traces, 5.3; inner zone - 81, 15, traces, 5.0.

An increased Cl content has been revealed in the peripheral zone. Thus, the invest. of the comp. of the liquid phase of incs. in metasomatically alt. rocks enables us to establish the evolution of the ore-bearing sols. in space and time and to reveal the dynamics of the hyd. process. (Authors' abstract.)

KERRICK, D. M., 1975, The genesis of zoned skarns in the Sierra Nevada, California (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1081. Author at Dept. of Geosciences, The Penn. State Univ., Univ. Park, Penn. 16802.

Zoned skarns occur at plutonic-meta. contacts, in veins cutting marble, and at contacts between marbles and interlayered amphibolites and biotite-rich rocks. Fluid incs. and P-T-X_{CO_2} stability relations of calc-silicates suggest P = 1-3 Kb, T = 550-650°C, and a H_2O-rich fluid (X_{CO_2} <.1). Small-scale, Ca-rich endoskarns are common near exoskarns. Assemb. and textural data, coupled with the soly. of components in aq. sols. in equil. with granitic magmas, suggest that endoskarns formed from loss of Al, Fe, Mg, and Si in the granitic source, largely due to influx of CO_2 from the form. of exoskarn. Mass balance calcs. indicate that limestone assimilation was of negligible importance. The constancy in comp. of garnet and pyroxene throughout much of each zone, and discontinuities in the comps. of these phases from one zone to the next, suggest that the exoskarns formed largely by infiltration metasomatism. Fluid flow calc. show that thick exoskarns could readily form by intergranular infiltration of aq. sol. Positive vol. change, as required in the form. of exoskarn by infiltration, was probably accommodated by expansion of skarn toward the magma. Alternating layers of contrasting min., common in thicker skarn deps., were inherited from the unmetasomatized precursor by initial infiltration along bedding contacts, or replacement of favorable lithologies, followed by lateral growth (and eventual coalescence) of individual skarn layers. Assemb. and chem. data suggest that zoned skarns at contacts between interlayered meta. lithologies formed by reciprocal diffusional exchange. (Author's abstract.)

KESLER, Stephen E., 1975, Geochemistry of fluorite deposits, northern Coahuila, Mexico (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1145. Author at Dept. of Geology, Univ. of Toronto, Toronto, Ontario, Canada.

Widespread and econ. important manto fluorspar deps. in northern Coahuila are found in limestones of uppermost lower Cretaceous age near their contact with a disconformably overlying shale. Although veins and chimneys of fluorite in the limestones are closely related to Tertiary rhyolitic rocks (containing anomalously high fluorine), the mantos are much more widespread. Most of these fluorite deposits exhibit good evidence for replacement of their limestone host and consist of fluorite with moderate amounts of calcite and quartz and local celestite, barite and later gypsum. Homog. Ts of about 300 apparently P fluid incs. in fluorite from 43 manto deps. (from 9 districts in an area of 5000 km^2) range from 100 to 330°C with about 66% of the incs. falling in the 130° to 170°C range. Higher T manto deps. are commonly found in areas close to rhyolitic ign. rocks. Petroleum is abundant in these incs.; dms. are largely absent; and freezing studies indicate sals. of 10 to 15 equiv. wt. % NaCl. Incs. in fluorite from a vein dep. adjacent to a rhyolitic intrusion and manto deps. homog. at about 400°C and contain numerous dxls. S isotope data on celestite and gypsum from these deps. suggest that the S was derived largely from ign. sources. (Author's abstract.)

KHAYRETDINOV, I. A., AVZYANOV, V. S., ANDRIYANOVA, N. A., YEVDOKIMOVA, Z. V., and BELIKOVA, G. I., 1974, Temperatures and pressures of formation of pyrite ore of the southern Urals: Akad. Nauk SSSR, Doklady, v. 219, p. 1220-1223 (in Russian; translated in Doklady Acad. Sci. USSR, v. 219, p. 139-142 (1975)).

Gives the documentation for a paper presented at Fourth Regional Conf. on Thermobarogeochemistry of Mineral-Forming Processes, 1973, Rostov, by same authors except the last (see Khayretdinov et al., 1973, Fluid Inclusion Research, v. 7, p. 99-100 (1974)). (ER)

KHETCHIKOV, L. N., and DOROGOVIN, B. A., 1975a, Influence of compounds of carbon on temperature of homogenization of gaseous-liquid inclusions (abst.), p. 22-23, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at All-Union Sci.-Research Inst. for Synthesis of Miner. Raw Materials, Alexandrov.

Exper. with rexliz. of quartz in autoclaves at T 280-340°C, P $\leq$540 atm. in sols. of Na_2CO_3-H_2O-CO_2 (salt conc. $\leq$7 %, $CO_2 \leq$19% by weight) proves the lower rate of xliz., less solub. of SiO_2, higher T_H and P in system bearing CO_2 in comparison with CO_2-free conds. Under high initial P of CO_2 (30-70 atm) the heating of system leads to a change of curve of sat. in P-T diagram caused by variations in gas soly. and effect of pption. of salt. Xliz. of quartz in system: Na_2CO_3-H_2O- heavy hydrocarbons, gave incs. containing aq. sol. + gas, and aq. sol. + gas + irregular amount of liquid and solid hydrocarbons (i.e., xliz. in heterogeneous medium.) T of dissol. of gas bubble in hydrocarbon-bearing incs. varies strongly, depending on vol. of vacuole occupied by hydrocarbons. (Abs. by A.K.)

KHETCHIKOV, L. N., and DOROGOVIN, B. A., 1975b, Role of CO_2 in formation of metamorphic rocks of Archean age (abst.), p. 15-16, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at All-Union Sci.-Research Inst. of Synthesis of Miner. Raw Materials, Alexandrov.

1. In mins. of strongly meta. rocks of Archean age from Yakutia, Scandinavia, Africa, Antarctica, etc., inc. bearing liquid CO_2 are very common; in younger rocks of these regions (including rocks of Proterozoic age) such incs. are almost absent.

2. D_{CO_2} depends on conds. of meta. and decreases from granulite to amphibolite facies. P_{CO_2} calc. for various facies of meta. for granulite facies is 5-6 kbar, and for amphibolite - 1.5-3 kbar.

3. Presence of CO_2 elevates T of melting of rocks (for migmatites and granites the elevation is 100-150°C).

4. The presence of CO_2 may be explained by decarbonatization of rocks under high lithostatic P. (Authors' abs. shortened by A.K.)

KHITAROV, N. I., LEBEDEV, Ye. B., VENITSIANOV, Ye. V., and DORFMAN, A. M., 1975, Diffusion of water in molten silica: Geokhimiya, 1975, no. 8, p. 1190-1203 (in Russian; translated in Geochem. Internat., v. 12, no. 4, p. 172-183). Authors at Vernadskiy Inst. of Geochem. and Anal. Chem., Acad. Sci. USSR, Moscow.

A model has been devised for the diffusion of water in molten silica on the basis of displacement of a molten diffusion zone; meas. have been made of the diffusion coeff. D over a wide range in T and P. The value of D at a water P of 300 atm and a temperature of 1100-1400°C is 0.58-1.21 X 10^{-5} cm^2/sec; at 1200°C and 3000-5000 atm the value is 0.95-2.8 X 10^{-5} cm^2/sec. The meas. indicate that the high mobility of the water is governed by the mobility of the hydrogen primarily. The results serve as a first indication of diffusion processes in acid magmas. (Authors' abstract.)

KHODAKOVSKIY, I. L., 1975, Some problems of thermodynamics of aqueous solutions at elevated temperatures and pressures: in "Physico-chemical problems of hydrothermal and magmatic processes," Moscow, Publ. House "Nauka," p. 124-150 (in Russian).

Author proposes a new equation of state of liquid water, which in ranges of exper. error defines its P-T features in T interval 0-300°C and Ps 1-10,000 bar. Equations permitting det. the standard thermal effects of reactions as well as thermal heat capacities (partial) of dissol. substances in solns. with high ionic strength are given by the author. (From author's abstract, transl. by A.K.)

KHOLIEF, M. M., 1974, Study of inclusions in detrital quartz of Nile Delta sediments, Egypt: Neues Jahr. Mineral., Monatshefte Jahrg. 1974, v. 4, p. 418-424 (in English). Author at Dokki, Cairo.

Incs. were invest. in 150 quartz grains of the Nile Delta seds. Diff. types of solid, fluid and gaseous incs. were recorded. Cracks are common in many grains and aligned with S incs. Open cracks and peripheral incs. have an effect on the surface morphology of some grains. (Author's abstract.)

KHOLIEF, M. M., 1975a, Genetic significance of fissures and inclusions in detrital quartz of Oligocene sediments at Cairo, Egypt: Chem. Erde, v. 34, p. 302-308.

About 50 quartz grains of Oligocene seds. at Cairo were exam. microscopically to define their content of fissures and incs. This study reveals the presence of abundant preexisting fissures and solid incs. Other types of incs. such as fluid-gaseous and magmatic relics are less common and rare respectively. This assem. of incs. together with the system of fissures indicate that the contributing source rock is mainly a meta. xline rock, taking in consideration similar assemb. in quartz of parent rocks from other examples. (Author's abstract.)

KHOLIEF, M. M., 1975b, Endoscopical study of some Carboniferous detrital sediments from west central Sinai, Egypt: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg 1974, p. 447-453.

Essentially as given in 1974 abstracts of the meeting - see Kholief, 1974, Fluid Inclusion Research, v. 7, p. 103. (ER)

KHOLODKOV, Yu.I., 1975, Influence of CO_2 from inclusions on determination of balance of organic matter of rocks (abst.), p. 76-77, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Rostov State Univ., Rostov-on-Don.

Using det. of organic CO_2 based on CO_2 formed during calcination of rock samples bearing clastic mins., one must consider possible presence of CO_2 in incs. in mins. (From author's abstract, transl. by A.K.)

KILLINGLEY, J. S., and MUENOW, D. W., 1975a, Thermal stress-induced release of CO_2 inclusions in olivine on cooling from high temperatures: Amer. Min., v. 60, p. 148-151. First author at Chem. Dept., Univ. of Hawaii, Honolulu, Hawaii 96822.

The previously obs. phenomenon of CO_2-release from incs. when olivine cools from high Ts (Killingley and Muenow, 1974, Fluid Inclusion Research, v. 7, p. 104) was invest. The obs. rate of release of incs. is shown to be directly proportional to the calc. T gradient across individual grains. (Authors' abstract.)

KILLINGLEY, J.S. AND MUENOW, D.W., 1975b, Volatiles from Hawaiian submarine basalts determined by dynamic high temperature mass spectrometry, Geochim. Cosmo. Acta, v. 39, p. 1467-1473. First author at Chem. Dept., Univ. of Hawaii, Honolulu, Hawaii, 96822, U.S.A.

Quan. meas. of volatiles from Hawaiian submarine basalts have been made using a Knudsen cell dynamic-mass spec. system. The principal advantage of the technique is the ability to det. simultaneously the absolute amounts of more than one volatile released from the same sample.

From mass pyrograms it was obs. that the release of water was bimodal, with the major release occurring above 600°C. Water released below this T is believed not to have been present in the magma at the time of extrusion. Sulfur dioxide was evolved only after the bulk of the water was released and coincided with the general expansion and melting of the sample. S and C-containing gases which were released in surges (above 1000°C) correspond to the bursting of bubbles from the softened basalt.

The molar amounts of vesicle gases were plotted as a function of extrusion depth. A change in the slope of the resulting linear curve indicates sat. of the basalt with respect to water. (Authors' abstract)

KIRKPATRICK, R.J., 1974, Kinetics of crystal growth in the system $CaMgSi_2O_6$ - $CaAl_2SiO_6$; American Jour. Sci., v. 274, p. 215-242.

KIRKPATRICK, R.J., 1975, Crystal growth from the melt: A review, Amer. Min., v. 60, p. 798-814. Author at Hoffman Lab., Harvard Univ., Cambridge, Mass. 02138.

This paper reviews four aspects of xl growth theory; the nature of the rate-controlling process, the mech. controlling molecular attachment onto the growing xl surface, the nature of the xl-melt interface, and the stability of planar interfaces relative to cellular interfaces. (From the author's abstract.)

KIRKPATRICK, R. James, ROBINSON, Gilpin R., Jr., and HAYS, James Fred, 1975, Kinetics of crystal growth from silicate melts: Diopside and anorthite (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1147. Authors at Hoffman Laboratory, Harvard University, Cambridge, MA 02138.

KNIGHT, Jerry E., 1975, Porphyry pluton environments: Alunite-kaolinite-pyrophyllite-silica phases and Cu-As sulfosalt distribution with respect to pluton tops (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1148-1149. Author at Department of Geosciences, University of Arizona, Tucson, Arizona 85721.

KNYAZEV, G.I., BELOUS, I.R., ZOLOTOROG, M.A., KIRIKILITSA, S.I., KOZLOV, I.T., KUBIS, N.S. AND YAKOVENKO, F. Ya., 1974, Electrophysical and morphogenetic properties of pyrite from the Nikitovka mercury deposit: Akad. Nauk SSSR, Doklady, v. 218, no. 3, p. 668-670 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 218, p. 113-115 (1975); abstract translated in Internat. Geol. Rev., v. 17, no. 2, p. 230, (1975)). Authors at Dnepropetrovsk Group of Sections, Inst. of Min. Resources, Artemgeologiya Trust.

The authors find that three morphologically different types of pyrite from the deposit also differ in thermoelectromotive force, electrical resistivity, and vacuum T_Ds. The latter show three ranges, 40-60°, 120-180°C, and 220-360°C; and since one type is most closely assoc. with Hg min., it can serve as an exploration guide. (ER)

KOGARKO, L.N. AND KRIGMAN, L.D., 1975, Fluorine in silicate melts and natural magmatic systems, in "Physico-chemical problems of hydrothermal and magmatic processes": Moscow, Publ. House "Nauka", p. 48-68 (in Russian).

KOKAREV, G.N., and MEL'NIKOVA, E.M., 1975, Carbon and its compounds in hydrothermal quartz veins from Pripolyarnyi Urals (abst.), p. 69-70, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at All-Union Sci.-Research Inst. for Synthesis of Min. Raw Mat., Alexandrov.

Quartz from hyd. veins formed at 300-400°C contains incs. with several cpds. of C: G and L CO_2, moissanite (SiC), calcite, siderite, and graphite. This is the first report of moissanite in hyd. deps.; it was also found in quartz from S. Urals, Central Kazakhstan, and Aldan, in concs. up to 0.005 g/t. X-ray dets. show it is the α-II hex. modification. Moissanite could xlize. by reaction SiO_2 + graphite under high P stress during tectonic phenomena. (Abs. by A.K.)

KOL'KOVSKI, Boris, 1974, Certain peculiarities of the Varli Brjag ore field and the forecasts for undiscovered mineralizations in it: Rudodobiv, 1974, no. 10, p. 1-6 (in Russian?), abstracted in Abstracts of Bulgarian Scientific Literature, Geology and Geography, v. 18, 1974/1975, no. 1, p. 13-14 (1975).

The two main deps. in the Varli Brjag ore field, Varli Brjag and Cerni Vrah, have similar min. Four successive min. assoc. are dist., each of them represented by several facies: (1) chlorite-epidote (propylitic) assoc. occurring in a chlorite-epidote facies in the effusive rocks and in quartz-pyrite facies in the veins; (2) quartz-chalcopyrite assoc. with three facies; (3) quartz-sphalerite-galena assoc. with four facies; (4) calcite assoc. with two facies. There is a facies as well as a pulsation zonality. T_H of fluid incs. in quartz from the economic quartz-chalcopyrite assoc. range between 350 to 340°C and 260 to 250°C in the Varli Brjag dep. and 10 to 20°C higher in the Cerni Vran dep. (without correction for P). Vertical T gradient is 2 to 3°C per 100 m. The denudation truncation at the Varli Brjag dep. is assumed to be shallow thus making the dep. more prospective in depth. The prospects of finding new ore bodies are assessed as favorable not only within the area of the already known deps. in the Varli Brjag ore field but outside it as well. On comparing the Varli Brjag and the Rosen ore field, it is assumed that they are related to diff. magmatic hearths, being formed under the effect of tectonic force fields of diff. orientation. Ore form. in the Varli Brjag ore field has taken place at smaller depth owing to which this field is regarded as more promising in potential reserves of ore. (Abstract by I. Bonev.)

KOLONIN, G. R., LAPTEV, Yu. V., and SHIRONOSOVA, G. P., 1975, Experimental studies of conditions of formation of molybdenite: Mineralogy and geochemistry of tungsten deposits (Trans. of III All-Union Meeting), v. 3, p. 413-419, Leningrad (in Russian). Authors at Inst. Geol. and Geophysics of Siberian Branch of Acad. Sci. USSR.

KOLONIN, G. R., and SHIRONOSOVA, G. P., 1975, Conditions of formation of ferberite and sulfides of iron (experimental data): Mineralogy and geochemistry of tungsten deposits (Trans. of III All-Union Meeting), v. 3, p. 419-424, Leningrad (in Russian). Authors at Inst. Geol. and Geophysics of Siberian Branch of Acad. Sci., USSR.

KONOVALOV, I. V., 1975, Temperature of formation of gold-ore deposits in the Lena field as a function of metamorphic facies: Akad. Nauk SSSR, Doklady, v. 220, no. 3, p. 694-697 (in Russian; translated in Doklady Acad. Sci. USSR, v. 220, p. 191-193). Author at Inst. of the Earth's Crust, Sib. Div., USSR Acad. of Sci., Irkutsk.

Fluid incs. were used to det. the T of form. of gold quartz veins of the Lena meta.-hyd. Au ore field, both from T_H and T_D. Small S incs. have F = 0.9-1.0; other incs. have F=0.4-0.8, and some have CO_2 L as well. Most T_H in liquid phase; those with CO_2 frequently decrep. before T_H. Three ranges of T_H were found, for diff. deps.: 260-280°, 260-300°, and 400-460°C; these Ts fit into the regional T zoning of the meta. rocks (i.e., sericite-chlorite subfacies of greenschist facies to epidote-amphibolite facies). T_D gave similar results. P, from CO_2-bearing incs., was 1000-2000 atm. There were differences between barren and Au-bearing veins that may be useful in exploration. (ER)

KONOVALOVA, O. G., 1975, Temperature regime of formation of rock-crystal-bearing quartz veins of Aldan, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 56-66 (in Russian).

Rock-xl-bearing veins of the Aldan area are char. by relatively low T_F (quartz xls., T_H = 410-460°C) in comparison with barren ones (quartz xls., T_H = 580-610°C). Possible lower boundary of critical phenomena in barren veins is at T = 240°C, caused by presence of CO_2 in sols. (Author's abstract, translation by A.K.)

KONSTANTINOV, R. M., and MAKEEVA, I. T., 1975, New data on geology of deposits of tin, tungsten and molybdenum: Results of science and technics - ore deposits, vol. 6, p. 120 (in Russian).

Review of 324 papers published during 1973 and 1974, with numerous data on fluid incs. (A.K.)

KORCHAGIN, U. A., and YURGENSON, G. A., 1975, Peculiarities of geologic structure and typomorphism of main ore-forming minerals of the Ikh-Khayrkhan tungsten deposit (Central Mongolia): Mineralogy and geochemistry of tungsten deposits (Transactions of III All-Union Meeting, v. 3, p. 135-140, Leningrad (in Russian). Authors at Transbaikalian Complex Sci.-Research Inst. of Ministry of Geology of USSR.

T_D of wolframite is higher at outcrops (280°C) and lower at deep levels of mining (200-230°C); intensity of decrep. increases from surface to depth about 1300 m. T_D of quartz ranges from 160 to 210°C. (Abstract by A.K.)

KORMUSHIN, V.A., IBRAEVA, N.Zh., and LIPOVA, Z.M., 1975, Compounds of carbon in mineral-forming solutions of rare-metal deposits of Kazakhstan (based on inclusions in minerals) (abst.), p. 91, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Sci. Acad. Sci. Kazakh SSR Alma-Ata.

In G/L incs. of mins. of W and Mo deps. of Kazakhstan, C occurs as $CO_2 > HCO_3^- > CH_4 > CO$ (total 100 to 400 g per 1000 g of water). Dep. Boguty, formed in zone higher than intrusive one, is char. by higher amounts of HCO_3^-, CO and CH_4 in comparison with deps. of intrusive zone (Karaoba, E. Kounrad, etc.); CO and CH_4 are contamination from wall rocks (sandstones, slates and limestones). At deps. of intrusive zone CH_4 and CO probably form during ore pption. One may not exclude the possibility of forming of CH_4 in fluid incs. after their isolation. (Abs. by A.K.)

KOROBEINIKOV, A.F., 1974, Geochemistry of hydrothermal solutions of gold-ore deposits according to gas-liquid inclusions in minerals: Tr. Sib. Nauchno-Issled. Inst. Geol., Geofiz. Miner. Syr'ya 1974, 144, p. 88-106 (in Russian).

The total min. content and props. of solns. in gas-liq. incs. in mins. of ore veins and near-vein alt. rocks were studied. The samples were taken from the Lower Paleozoic Au-bearing skarns, albitites, Au-quartz stockworks, and veins in various medium-depth and near surface deps. Incs. in mins. of productive complexes generally had alk. chloride or alk.-bicarbonate-S type of hyd. solns. with Na>K and Cl>F and T_H 420-180°. The anionic part of hyd. solns. depended, more than the cationic part, on the source and T factor: halogens predominated in high-T and bicarbonates in low solns. The main components of inc. solns. (Cl^-, F^-, H_2S, CO_2, SO_2, NH_4^+, and heavy metals) had a magmatic origin except N_2, NO_2, NO_3, and other gases of air origin which were absent in high-T solns. and in mins. of contact meta. The transportation of heavy metals, in particular Au, was realized in the form of alk. chloride complexes at high acidity of solns. and in alk.-S complexes in essentially alk. solns. Chem. Abst., v. 84, 76955v (1976)

KOSTER VAN GROOS, A. F., 1975a, The distribution of strontium between coexisting silicate and carbonate liquids at elevated pressures and temperatures: Geochim. Cosmo. Acta, v. 39, p. 27-34. Author at Dept. Geol. Sci., Univ. of Illinois, Chicago, Illinois 60680, U.S.A.

Sr is char. enriched in carbonatites and assoc. ign. rocks. Exper. between 600 and 800°C at 5 and 10 kb show that Sr fractionates strongly toward both L phases of a carbonate L-silicate L-solid assemb., with the xline phases depleted in Sr. Considering that the alkalic ign. rocks assoc. with carbonatites are not significantly depleted in Sr compared with the carbonatites, it is concluded that these complexes are formed by a pair of immiscible magmas, rather than the carbonatites being late-stage fractionation products of the alkalic silicate magmas. (Author's abstract.)

KOSTER VAN GROOS, A. F., 1975b, The effect of high CO_2 pressures on alkalic rocks and its bearing on the formation of alkalic ultrabasic rocks and the associated carbonatites: Amer. Jour. Sci., v. 275, p. 163-185.

KOSTINA, R. I., and SUSHCHEVSKAYA, T. M., 1975, Inclusions in quartz of felsic volcanic rocks as indicators of the presence of ores: Geokhimiya, 1975, no. 3, p. 382-386 (in Russian; translation in Geochem. International, v. 12, no. 2, p. 59-63). First author at Moscow State University.

Quartz phen. of felsic volcanic rocks of the Southern Urals, containing Cu sulfide min., have four kinds of incs: (1) solidified melts (T_H=980-1090°C), (2) solidified ore-bearing melts (T_H=1200-1312°C), (3) gas-liquid incs. with KCl and NaCl dms. (T_H=300-400°C), and (4) gas-liquid incs. (T_H=200-400°C). According to polarographic anal. of aq. extracts from the late incs. in quartz, the L phase of these incs. has high Pb and Cu content, indicating that the invest. felsic volcanics may contain accumulations of ore. (Authors' abstract.)

KOSTYUK, V.P., 1975a, Certain theoretical approach to the nature of the main types of igneous rocks, chapt. I, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 8-12 (in Russian).

KOSTYUK, V.P., 1975b, Concise characteristics of some indirect geothermeters, chapt. II, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 13-19 (in Russian).

KOSTYUK, V.P., 1975c, Comparison of results of thermometric studies of rock-forming minerals with data of indirect geothermometers and data of experimental studies of respective mineral associations, chapt. VIII, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 167-177 (in Russian).

KOSTYUK, V. P., and CHEPUROV, A. I., 1975, The reliability of temperatures of crystallization of natural nepheline, calculated from a diagram of the type composition - conditions of formation, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 132-144 (in Russian).

T_H in nephelines and alkali feldspars (400-800°C in alkaline and miaskite pegs. and 700-1140°C in alkaline rocks) agree in certain ranges with data obtained from exp. diagrams of Hamilton, 1961, and Hamilton and McKenzie, 1961 (Jour. Geol., v. 69, no. 3, and Jour. Petrol., v. 1, no. 1). Complications due to the comp. of the melt and volatiles in comparison with exper. patterns, are discussed. (Abstract by A.K.)

KOSTYUK, V.P. and PANINA, L.I., 1975, Possible conditions of formation of some special types of igneous rocks, chapt. IX, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P.

Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 178-198 (in Russian).

KOVAL', P.V., 1975a, Acid-alkaline trend of post-magmatic processes in massifs of albitized granites on geochemical data, in Geochemistry and petrology of metasomatites, ed. E.I. Popolitov: Novosibirsk, "Nauka", Siberian Division, p. 36-42 (in Russian). (A.K.)

KOVAL', P. V., 1975b, Petrology and geochemistry of albitized granites, p. 258, Novosibirsk, "Nauka" Press - Siberian Div., 258 pp. (in Russian).

Reference data on T, P and sol. comp. of albitization, derived from fluid incs., are collected on p. 214-223. (A.K.)

KOVALEVICH, V. M., 1975a, Thermometric studies of inclusions in artificial crystals of halite, (abst.), p. 25-26, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. of Fuels of Acad. Sci. Ukr. SSR, L'vov.

Halite xls. were grown from sols. of ocean water comp. and from pure NaCl sols. at T = 20, 58, 75 and 100°C ± 0.75°C. The T values were selected in accordance with T_H data on halite from salt deps. from Forecarpathians. In syn. halite xls. all the types of incs. known from natural halite were found: one-phase, two-phase and three-phase (solid phase - sylvite). T_H of 2- and 3-phase incs. agrees with T_F of halite. (Abs. by A.K.)

KOVALEVICH, V. M., 1975b, Conditions of formation of Verkhnevorotyshchenskiye saline deposits in the region of Stebnik, based on inclusions in halite: Geology and Geochemistry of Fuels, v. 44, p. 42-50, Kiev (in Russian). Author at Inst. of Geol. and Geochemistry of Fuels, L'vov 290047, Ukr. SSR.

Primary (sed.) halite usually bears incs. in a skeletal xl. array. Incs. are commonly 10-15 µm long, but some of diam. 100-150 µm were found. In some large incs. a dm. (sylvite) occurs (≤ 1 vol. %). Individual incs. bear conc. of ions. (g/liter); K^+ 12.8 - 42.2 (60 dets.); SO_4^{2-} 46.1 - 98.5 (56 dets.); Mg^{2+} 53.3 - 95.2 (42 dets.), general conc. of salts about 430 g/ℓ, d 1.310 g/cm^3; conc. of NaCl $\sim$40 g/ℓ, so halite was salted out from brine. T_H of incs. with sylvite xl. (two-phase) were 38-42°C (10 dets.) and 56-60°C (2 dets.). P halite formed in a late stage of devel. of sed. basin.

S halite (coarse grained, rexliz.) bears two-phase G + L or dm. + L incs., and rarely one-phase L incs. The dm. (sylvite) usually occupies 3 vol. %. Incs. with sylvite (dm. + L) have conc. of ions (anal. of individual incs.); K^+ 28.2 - 55.4 (24 dets.), SO_4^{2-} 10.0 - 89.9 (24 dets.), Mg^{2+} 43.0 - 90.3 (18 dets.), Ca^{2+} not found; G + L incs. and L incs. bear ions; K^+ 16.6 - 32.1 (24 dets.), SO_4^{2+} 80.4 - 91.1 (5 dets.), Mg^{2+} 9.0 - 68.5 (15 dets.), Ca^{2+} 30.5 - 60.0 (25 dets.). T_H of dm. + L incs. are 56-86°C, av. of 80 dets. - 71°C; increased P is noted: after opening incs. "boil" or G bubble enlarges 150-250 times. T_H of similar incs. in halite from sylvite rock was higher (100-120°C, 10 dets.). (A.K.)

KOVALEVICH, V. M., and SVOREN', I. M., 1975, Carbon-bearing gases in inclusions in sylvite from potassium salt deposits from Forecarpathians (abst.), p. 67-68, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fossil Fuels, Acad. Sci. Ukrainian SSR, L'vov.

Sylvite from Forecarpathians is the main gas-bearing min. in K salt deps. (Stebnik, Kalush (Kałusz) and Markovo-Rossilnyany). Samples were taken from depth 80-650 m. G incs. are P, with cubooctahedral shape 0.000 n to 1 mm. Inc. P - 30 to 250 atm, roughly proportional to depth of sampling.

T_H of two-phase incs. (L_{H_2O} + dm) suitable for det. of T_{xliz} = 60 to 120°C. Gas comp. is: $N_2 = 40\text{-}90\%$, $CO_2 = 2\text{-}20\%$, $H_2 = 6\text{-}34\%$, $CH_4 = 1.5\text{-}17\%$, O_2 up to 3%, heavy HCs absent. CO_2/CH_4 ratio is variable. These conds. may be accepted as the environment of rexliz. of salt sed. (Abs. by A.K.)

KOVALISHIN, Z. I., 1975, Content of CO_2 in gaseous phase as indicator of physico-chemical conditions of mineral formation of zanorysh (chambered) pegmatites in Volhyn (abst.), p. 43-45, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. Fossil Fuels, Acad. Sci. Ukr. SSR, L'vov.

The role of CO_2 during peg. process is discussed, using mainly data from refs. The author concludes that conc. of CO_2 in G phase depends very strongly on P-T conds. in min.-forming system. (Abs. by A.K.)

KOZŁOWSKI, Andrzej, 1975, On discerning of paramorphs of low-quartz after high-quartz: Przeglad Geologiczny, v. 23, no. 3, p. 102-107 (in Polish with English and Russian summaries).

The criteria for the high- to low-quartz inversion are discussed. Material collected by the author verifies the criteria of habit as well as fractures and other morphological features. The morphology of Dauphiné twins was reinvest. on 60 specimens and gave positive results for the majority. As a supplementary method, Dennen's Al thermometer was used (55% positive results) for the selection of specimens; det. of xliz. Ts by fluid incs. was the main method used.

Over 100 specimens, selected as above, were invest. by the IR absorption method in the 3 μm region as described by Dolomanova et al., who suggested that the absorption band of molecular H_2O (3400-3500 cm^{-1}) can be used as a criterion of P high- or low-quartz xliz. A low band intensity would be char. of paramorphs after high quartz, and P low quartz ought to exhibit strong absorption. The absorption intensity of molecular H_2O (mainly entrapped in fluid incs.) was found to depend on size and amount of incs. and amount of water in inc. filling. Molecular H_2O can be present in both P and S incs., and the S ones are usually more numerous. On the other hand, high quartz bears only a minor amount of rather low-water P incs. and variable but usually higher amount of S, water-rich incs.; the latter will determine the intensity of absorption. There also are numerous low quartzes bearing only individual aq. incs. and without the molecular H_2O band in their spectrum. As the amount of water in quartz does not depend directly on the inversion, the intensity of the IR absorption band for molecular water cannot be used as a criterion of presence of low-quartz paramorphs after high quartz. (Author's abstract.)

KOZŁOWSKI, Andrzej, and KARWOWSKI, Łukasz, 1975, Genetic indications of tungsten-tin-molybdenum mineralization within the Karkonosze-Izera block: Kwartalnik Geologiczny, v. 19, no. 1, p. 65-73 plus 25 photo. (in Polish with English and Russian summaries).

W-Sn-Mo min. with sulphides has been recognized within the Karkonosze granite in the Karkonosze-Izera block. The W min. together with cassiterite has also been found in greisens occurring in the meta. cover. Cassiterite min. is well known in the overlying chlorite-mica schists. Sodium-type metasomatism is found in the area and the symptoms of solvent action due to sols. enriched with F, B, and CO_2. On this basis the authors claim a common source for all these processes, stemming from the Karkonosze granitoid massif.

The Karkonosze-Izera block makes up the granitoid massif with the developed ore-bearing zones in late magmatic system of ore-bearing quartz veins, metasomatites and with an aureole of influence of the mobile components in the overlying rocks. The authors consider the Karkonosze-Izera block as a good area for prospecting for conc. of Sn, W, and Mo. (Authors' abstract.)

KOZŁOWSKI, Andrzej, KARWOWSKI, Łukasz, and OLSZYŃSKI, Wiesław, 1975, Tungsten-tin-molybdenum mineralization in the Karkonosze massif: Geologica Polonica, v. 25, no. 3, p. 415-430, with 82 figs. (in English with Polish summary).

Ore min. in the zone of aplogranites in the NW part of the Karkonosze massif (Sudetes Mts.), partly metasomatized by Na-bearing sols., and in quartz veins, reveal a lengthly list of mins., such as wolframite, cassiterite, molybdenite, scheelite, native bismuth, bismuthite and bismuth sulfosalts. Studies of fluid incs. reveal the xliz. conds. as: P ∿ 700 atm, T 405-375°C in the pneu. stage and, after condensation, from 375°C down to about 100°C (hyd. stage). The min. assemb. as well as the sequence and conds. of xliz. are typical of the majority of W-Sn-Mo deps. (Authors' abstract.)

KRASOV, N. F., 1975, Conditions of crystallization of phenocrysts of clinopyroxenes in lavas of the "Jubilee eruption" of Klyncheskii Volcano, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 28-32 (in Russian).

The lower range of T of xliz. of clinopyroxenes, from T_H, is 1115-1225°C. (A.K.)

KRAVCHENKO, N.S. and POPOV, V.A., 1975, Rhythmic-lamellar textures in granitoid rocks and mechanism of their formation: Ilmenskiy Zapovednik Trudy, Acad. Sci. USSR, Urals S;ci. Center - Materials on Mineralogy of Urals, v. 13, p. 81-89 (in Russian).

Rhythmic-lamellar textures in granitoids formed by post-magm. rexliz. at T ∿360-500°C (T_D of quartz). (A.K.)

KRAVTSOV, A.I., KROPOTOVA, O.I., VOYTOV, G.I., and IVANOV, V.A., 1975, Isotopic composition of carbon of diamonds and carbon compounds in pipes of the East Siberian diamond province: Akad. Nauk SSSR, Doklady, v. 223, no. 1, p. 206-208 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 223, p. 206-208, pub. in 1977). Authors at S. Ordzhonikidze Geol. Pros. Inst., Moscow.

C^{13} values are given for many samples of diamonds, carbonates, bitumens, and methane from the Udachnaya, Aykhal, Mir, and Zarnitsa pipes in Eastern Siberia. Total variation is over 5 percent, but all might still be genetically related (ER).

KRAVTSOV, A. I., VOYTOV, G. I., GNIPP, L. V., KROPOTOVA, O. I., and CHEREVICHNAYA, L. V., 1974, Hydrocarbon gases in mineral waters of the central part of the greater Caucasus: Akad. Nauk SSSR, Doklady, v. 217, no. 1, p. 176-179 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 217, p. 44-46 (1975); abstract translated in Internat. Geol. Rev., v. 16, no. 11, p. 1307 (1974)). Authors at S. Ordzhonikidze Geol. Prospecting Inst., Moscow.

Outcrops of gas in mines, hot springs, min. springs and wells, particularly abundant at articulations of differently oriented fractures and at expressions of recent and modern volcanism, more than 150 samples in all, show wide variations in their H_2, He, N_2, CO_2, H_2S content, but always contain CH_4 and aliphatic hydrocarbons, up to and including hexane (table 1), and the C_4-C_5 isomers (table 1, fig. 1). The CO_2 carbon in the gas phase of the waters is isotopically heavy (table 2); its δC^{13} varies from -0.58 to -1.19, overlapping the endogenic range of such variations but still within their thermometamorphic range.

KRISTMANNSDÓTTIR, Hrefna, and TÓMASSON, Jens, 1975, Hydrothermal alteration of basaltic rocks in Icelandic geothermal areas (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section II, Abstract No. 25.

KROPACHEV, S.M., and OKRUGIN, V.M., 1975, Inclusions of mineral-forming media as indicators of age relationships: Akad. Nauk SSSR, Doklady, v. 224, no. 2, p. 415-417 (in Russian; translated in Doklady Acad. Sci. U.S.S.R., v. 224, p. 43-45, published 1977).

Lack of a decrep. anomaly in quartz samples taken at the contact of a quartz vein with a diabase dike prove that the age relations of dike and vein are the reverse of that originally thought. (ER)

KRYLOV, G.I., 1975, Comparative characteristics of coal-graphite components in metamorphic rocks of various age at S. Urals, (abst.), p. 37-38 in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at All-Union Sci. Research Inst. for Synthesis of Mineral Raw Materials, Alexandrov.

In Ordovician-Silurian and Lower Carboniferous meta. rocks of Adamov anticlinorium the finely dispersed coal-graphite component has δC^{13} from -18.1 to -29.0‰, and hence is of primarily organic origin. (A.K.).

KUCHER, M.I., BATYRMURZAEV, A.S.Sh., MATSAPULIN, V.U., and UMAKHANOV, E.M., 1975, On the gas phase composition of the ore-forming medium of sulfide shows in the Gorny Dagestan: Geokhimiya, 1975, no. 12, p. 1890-1898 (in Russian).

Includes 10 analyses of gases obtained, in part for H_2O, CO_2, O_2, H_2, Ar, He, H_2S, Cl, NH_3, and CH_4. (ER)

KURODA, Yoshimasu, SUZUOKI, Tetsuro, MATSUO, Sadao, and AOKI, Ken-ichiro, 1975, D/H ratios of the coexisting phlogopite and richterite from mica nodules and a peridotite in South African kimberlites: Contrib. Mineral. Petrol., v. 52, p. 315-318. First author at Dept. of Geol., Shinshu Univ., Matsumoto, Nagano Pref., 390 Japan.

The water content and D/H ratio of pairs of phlogopite and richterite in kimberlite samples were meas. The water contents of both mins. were lower than the formula content. On the basis of D/H ratios of the pair, phlogopite and richterite cannot be regarded as a simple equil. product with respect to H isotope exchange. It seems impossible to est. D/H ratio of the mantle water through D/H ratios of the hydrous silicate pairs. (Authors' abstract.)

KURODA, Yoshimasu, SUZUOKI, Tetsuro, MATSUO, Sadao, and KANISAWA, Satoshi, 1975, D/H fractionation of coexisting biotite and hornblende in some granitic rock masses - a supplement: J. Japn. Assoc. Min. Petr. Econ. Geol., v. 70, p. 352-362. First author at Dept. of Geol., Shinshu Univ., Matsumoto, Japan.

KUSHIRO, Ikuo, 1975, On the nature of silicate melt and its significance in magma genesis: regularities in the shift of the liquidus boundaries involving olivine, pyroxene, and silica minerals: Amer. J. of Sci., v. 275, p. 411-431. Author at Geophysical Laboratory, Carnegie Institution of Washington, Washington, D. C. 20008.

KUSHIRO, I., SATAKE, H., and AKIMOTO, S., 1975, Carbonate-silicate reactions at high pressures and possible presence of dolomite and magnesite in the upper mantle: Earth Plant. Sci. Lett., v. 28, p. 116-120.

LAHIRY, Ashoke, 1975, Geological significance of fluid inclusions, p. 275-282, *in* Recent Researches in Geology, v. 2, V. K. Verma, ed., 1975, 361 pp. (in English).

A review of the methods of study and significance of the data obtained. (ER)

LAMBERT, S.J., and EPSTEIN, S., 1975, Stable isotope studies of an active hydrothermal system in New Mexico; Amer. Geophy. Union, Trans., v. 56, no. 6, p. 460. First author at Div. of Geol. and Planetary Sci., CA Institute of Technology, Pasadena, CA 91125.

$^{18}O/^{16}O$ and D/H meas. have been made on cuttings from Baca Well #7, drilled by the Union Oil Co. in a geothermally active part of the Valles Caldera of New Mexico, penetrating 1687 meters of volcanic tuffs, tuffaceous and arkosic sandstones, limestones and granite. Meteoric waters as hot as 229°C have interacted with the rocks to form the authigenic mins, calcite, quartz, pyrite, wairakite, alkali feldspar, epidote and chlorite. Unaltered Bandelier tuff from a nearby outcrop, consisting mainly of quartz and sanidine phen. in glass, has a $\delta^{18}O$ value of +7.5‰(SMOW). The Redondo Creek rhyolite, occupying the upper 430m, contains no primary quartz, but varies in $\delta^{18}O$ between +4.5 and 7‰, and exhibits slight alt. of biotite, plagioclase and K-feldspar. Altered Bandelier tuff from the well having $\delta^{18}O$ values between +1.8 and 2.5‰, has undergone a shift of at least -5‰ and exhibits a rexliz. groundmass of quartz 1 to 2‰ heavier than phen. quartz. The rexliz. quartz is apparently an alt. product having a $\delta^{18}O$ consistent with that resulting from low-T (around 100°C) interaction with meteoric water of -12‰. The underlying altered sandstones are isotopically similar to the Bandelier tuff. Calcite of -2‰ in the marine limestone is indicative of similar interaction but the lightest carbonate from the well, -4.3‰, gives an isotopic T of 220°C. Fragments of Bandelier tuff from Baca Well #4 give somewhat lighter $\delta^{18}O$ values, consistent with the slightly higher T observed in that well. The data from this system indicate lower Ts and more profound isotopic alt. of a larger volume of host rock than at The Geysers, CA. (Authors' abstract.)

LAPUKHOV, A. S., 1975, Decrepitometry of inclusions in minerals, along with gas chromatography, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 105-108 (in Russian).

After thermal breaking of incs. the G cpds. are registered by standard chromatograph. Gases from incs. are transported to chromatograph by a stream of H_2 or He. Wt. of sample used 1-2 g. Scheme of the app., discussion of data obtained, and comparison with T_H data are given. (Abstract by A.K.)

LAZARENKO, E. E., 1975, Gases in quartz from miarolitic cavities and schlieren pegmatites (abst.), p. 50-52, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. Fossil Fuels, Acad. Sci. Ukrainian SSR, L'vov.

The Émelyanovka red biotite amphibole granites (Volhyn) show schlieren pegs. with zonal structure: an outside graphic zone, then a blocky zone (quartz and feldspathic) and finally a "zanorysh" (chambered) zone with morion (smoky quartz) xls. up to 30 cm along L_3. In quartz from pegs. P and early S incs. have T_H 390-70°C; in quartz xls. of miarolitic cavities max. T_H 180°C. In graphic zone only S incs. were found, T_H 374-100°C. In quartz from zanorysh and blocky zone incs. contain 80-90% CO_2; in granite the conc. decreases to 40-60%. C_nH_{2n+2} are conc. mainly in granite (28 vol.%); N_2 + noble gases in quartz from granite, block zone and zanorysh occupy 4.5-10 vol.%. N_2 concs. up to 90 vol.% were found only on the contact of fine-grained granite and graphic zone. Conc. of gases from incs. in given genetic groups in gray quartz from graphic zone and morion, respectively, were as follows: CO_2, 90.45, 67.6; N_2, 5.11, 10.12; CH_4, 2.57, 1.06; H_2, 1.79, 21.19; O_2, 0.079, 0.03% (MX 1303 mass-spec.). (Abs. by A.K.)

LAZARENKO, E. K., LAZARENKO, E. A., ZAYTSEVA, V. N., and MALYGINA, O. A., 1974, Zoning of alpine igneous associations and mineralization in the Carpathians: Akad. Nauk SSSR, Doklady, v. 218, no. 4, p. 913-915 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 218,

p. 79-81 (1975); abstract in Internat. Geol. Rev., v. 17, no. 2, p. 232 (1975)). First author at Inst. of Geochem. and Min. Phys., Ukrainian Acad. of Sci., Kiev.

A broad study of the distrib. of Au, Pb, Te, B, and As in the area in geol. time and space. The widespread distrib. of "Marmarosh diamonds" (well-formed, water-clear quartz crystals with T_H 100-200°C), and of oil and gas, are related to dewatering of sed. rocks in a subsiding plate. (ER)

LAZARENKO, E. K., PANOV, B. S., and GRUBA, V. I., 1975, Mineralogy of the Donets Basin: Kiev, Izdat. "Naukova Dymka," 2 vols., 503 pp. (in Russian with Russian and English summaries).

A thorough review (∿1450 references) of the min. of this complex area, covering a wide range of ore deps. (including diamonds), with detailed indices. There are 89 references to incs. in the subject index. (ER)

LAZARENKO, E. K., PAVLISHIN, V. I., LATYSH, V. T., and SOROKIN, Yu. G., 1973, Mineralogy and genesis of chamber pegmatites in Volynia: Ukrainian Min. Soc., Inst. of Geochem. and Physics of Minerals, Acad. Sci. Ukr. SSR, Univ. L'vov Press, 360 pp. (in Russian with English summary). Reviewed in Internat. Geol. Rev., v. 17, no. 9, p. 1108-1109 (1975).

This is a longer review of a book that was abstracted briefly in *Fluid Inclusion Research*, v. 6, p. 89-90 (1973). (ER)

LAZARENKO, Ye.Ye. and PISOTSKIY, B.I., 1975, Evolution of gaseous components in process of pegmatite formation (abst.), p. 106-107, *in* Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept. 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fuels of Acad. Sci. Ukrainian SSR, L'vov.

H_2, CH_4, O_2, N_2 and CO_2 were found in G/L incs. At marginal parts of Volodarsk - Volynskiy peg. field the conc. of CH_4 decreases from 15-40% in zone of granophyric intergrowths and massive quartz to 1.5-6.5 % in xls in "zanorysh" (i.e., central cavity), and sometimes is absent. In central parts of peg. field there are no such variations in CH_4, the conc. there is 3-5 %. CO_2 constitutes 90%. Marginal parts of field bear quartz xls with incs. containing low CO_2 (4-18 %) or none at all. In reticulate quartz from central part of field, mean CO_2 conc. is 60 %, and for marginal parts, 80 %. Conc. of N_2 is the reverse of that of CO_2; high values were found in the margins of peg. field (30-90 %). Reticulate quartz bears low conc. of N_2 (8-15 %). (Abs. by A.K.)

LAZ'KO, E.M., DOROSHENKO, Yu.P., KOLTUN, L.I., LYAKHOV, Yu.V., MYAZ', N.I., and PIZNYUR, A.V., 1976, Processes of hydrothermal minerogenesis in the East Transbaikalian deposits from a study of gas-liquid inclusions in minerals: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Authors at L'vov State Univ., L'vov, USSR.

Most East Transbaikalian post-magmatic deps. are char. by a common history and physico-chemical conds. of development, which are as follows: (I) the pneu.-hyd. stage, which includes (1) the quartz-tourmaline substage (T - 450-300°C, P > 1000 atm), (2) the quartz-molybdenite substage (T - 500-350°C, P > 1000 atm), (3) the early sulphides substage (T - 400-270°C, P - 1000-700 atm) and (II) the hyd. stage, which includes (4) the gold-galena-sphalerite substage (T - 300-170°C, P - 750-500 atm), and (5) the quartz-carbonate-fluorite substage (T - 200-50°C, P - 400-200 atm). These and subsequent thermobarogeochemical data are from incs. in mins.; T_H are given without corrections for P.

The predominant development of stages I or II determines the origin of spatially separate deps. of diff. genetic types: (I) pneu.-hyd. deps. (W, Mo, Au-Mo; Au deps. of intermediate depths) and (II) hyd. deps. (Pb-Zn, fluorite; Au deps. of shallow depths).

Most deps., irrespective of what stage of the ore process they are connected with, are char. by a comparatively narrow T interval of dep. of economic min. parageneses: 20-50°C - for Au, 20-40°C - for wolframite, 30-50°C - for molybdenite, 20-50°C - for galenite and sphalerite, 60-80°C - for fluorite.

In the comp. of ore-form. sols. CO_2 is an important factor in a majority of the deps. examined; this holds true with both gaseous sols. of pneum.-hyd. and hyd. stages of the process. In the W, Pb-Zn and most of Au deps. of intermediate depth considerable concs. of CO_2 were obs. in the medium of corresponding substage of the ore process, when the dep. of the main mass of native Au and Cu, Pb and Zn sulphides occurred.

During the early substages the form. of Mo and Au deps., the sols. were conc. NaCl brines; in the W deps., these sols. were $NaHCO_3$.

Sols. during intermediate-T substages at all these deps., as well as at Pb-Zn deps., had a HCO_3 comp. (Mg-Ca or Ca-Mg). The devel. of the low-T substage (quartz-carbonate with fluorite), which concludes the ore-forming process at all the above mentioned deps. and corresponds to the form. of fluorite deps., occurred from sols. of Ca bicarbonate and fluoride, coupled with increased hydrosilicate content.

By the end of the ore process the conc. of H^+ in the sols. decreased, but with reversals at the beginning of each ore-forming substage. The known cyclic dep. of mins. (quartz-sulphides-carbonates) and their complexities are the result of changes of acidity of the sols. with time. Cyclic changes of other physico-chem. parameters of the sols. (T, P, d, etc.) also correspond to substages of min. form.; signs of such cyclicity can serve as important criteria for det. of the substage of form. of diff. post-magmatic deps. (Authors' abstract.)

LAZ'KO, E. M., KOLTUN, L. I., LYAKHOV, Yu. V., MYAZ, N. I., and PIZNYUR, A. V., 1974, Review of "Geochemical systems of inclusions in minerals" by N. P. Ermakov: Vses. Mineral. Obsh., Zap., v. 103, p. 503-506 (in Russian).

This book was reviewed and translations of the extensive table of contents and captions to the 27 pages of photomicrographs are given in Fluid Inclusion Research, v. 5, p. 114-124 (1972). (ER)

LEBEDEV, L. M., 1975, Recent ore-forming hydrotherms, "Nedra," Moscow, 261 pp. (in Russian).

On the basis of the Cheleken hyd. system, the author char. the geochemical peculiarities of thermal brines, their ability to transport metals, problems of complex formation, and physico-chem. conds. of form. of recent hyd. min. and ores. (From author's abstract, translated by A.K.)

LEROY, Jacques, LE FORT, Patrick, and POTY, Bernard, 1975, Some quartz crystals and their fluid inclusions from the Nepal Himalaya: Himalayan Geology, v. 5, 1975, A.G. Jhingran and P.K. Verma, eds. Delhi, Wadia Inst. of Himalayan Geology. Authors at Centre de Recherches Pet. Geochim. du C.N.R.S. Case Officielle n° 1, 54500-Vandoeuvre-les-Nancy, France.

Quartz xl-bearing fractures have been sampled in seven diff. localities. The morphology of the xls is described. Their incs. have been studied by microthermometric methods (heating and freezing). High conc. of CO_2 in the fluid incs. have been found in four samples. The inferred source of the CO_2 is decarbonation reactions of the progressive regional and contact meta. Initial est. of P show that the pegs. were emplaced at a fairly high P. This is consistent with the known meta. cond. and thickness of the sed. overburden in the area. (Authors' abstract)

LETNIKOV, F. A., KASHCHEYEVA, T. V., MINTSIS, A. Sh., and KISELEV, A. B., 1975, Relaxation of activated water: Akad. Nauk. SSSR, Doklady, v. 222, no. 1, p. 204-207 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 222, p. 225-228 (1976)). First author at Inst. of the Earth's Crust, Sib. Branch of the USSR Acad. of Sci., Irkutsk.

Earlier Russian work (8 refs.) reported that water acquires new physical and chem. props. after heating to high T and P (hence called "activated"). The authors have measured the effects of various factors, such as exposure to air or other gases, in deactivating (relaxing) activated water. If verified, activation of water could be pertinent to fluid inc. experimentation. (ER)

LETNIKOV, F. A., VILOR, N. V., GANTIMUROVA, T. P., KONOVALOV, I. V., SHKANDRII, B. O., and SHKARUPA, T. A., 1975, Evolution of fluids during formation of gold-bearing metamorphogenetic quartz veins and possible forms of gold transfer: Geokhimiya, 1975, no. 12, p. 1827-1836 (in Russian; translated in Geochem. Internat., v. 12, no. 6, p. 126-134, 1975). Authors at Inst. of the Earth's Crust, Sib. Branch of the USSR Acad. of Sci., Irkutsk.

Low-grade Au-bearing meta. quartz veins from various meta. zones in lithologically uniform strata have been studied. The P-T conds. of quartz vein form. have been calc. taking into account the conc. of sols., the amounts of gases included in quartz and the results of exam. of min. parageneses of rocks enclosing the veins. Thdy. cals. of O, H, and S volatility have been carried out and the ratios of activities of chloride and hydrosulfide Au complexes have been calc. The conclusion is that hyd. Au is transferred in the form of thioaurates of the AuHS and $Au(HS)_2^{1-}$ type. (Authors' abstract.)

LIKHACHEV, A. P., 1975, Redeposition of ore-producing and petrogenetic components by aqueous solutions: Geokhimya, 1975, no. 10, p. 1459-1474 (in Russian; translated in Geochem. Internat., v. 12, no. 5, p. 101-113 (1975)). Author at Central Geol. Prospecting Research Inst. for Nonferrous and Precious Metals, Moscow.

Exper. have been performed on the hyd. redep. of sulfide ores and picrite gabbro-dolerite from the Noril'sk deps.; it is found that elements are dissolved and removed from the dissolution zone in a definite sequence and produce differentiated products in the dep. zone, no matter what the comp. of the initial material and the form of the solvent. (From the author's abstract.)

LIPMAN, P. W., and FRIEDMAN, Irving, 1975, Interaction of meteoric water with magma: an oxygen-isotope study of ash-flow sheets from southern Nevada: Geol. Soc. Amer., Bull., v. 86, p. 695-702. Authors at U.S. Geol. Survey, Federal Center, Denver, CO 80225.

Glassy rocks from ash-flow sheets and cogenetic lava flows show systematic oxygen-isotope variations (90 analyses) among all major phen. phases. Oxygen-isotope comps. of each phen. phase become lighter in O^{18} with decreasing age and are interpreted as indicating major interaction between meteoric ground water and batholithic-sized bodies of silicic magma prior to eruption. (From the authors' abstract.)

LISTER, C. R. B., 1975, Rapid evolution of geothermal systems in new oceanic crust predicts mineral output mainly near ridge crests (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1074. Author at Depts. of Geophys. and Oceanog., WB-10, Univ. of Wash., Seattle, Wash. 98195.

Heat-flow evidence suggests that water is circulating to considerable depths beneath ocean floor of moderate age, but it is probable that such systems are not highly active geochemically. The principal ion exchange and dissolution reactions should occur during the vigorous penetration phase of geothermal activity, when water Ts are high and fresh rock surfaces are exposed at shrinkage cracks. The natural heat outputs of hyd. systems, such as those in the Taupo, New Zealand area, suggest that water penetrates at a rate somewhere in the range of 1-10 $m \cdot yr^{-1}$. This is one order of magnitude lower than the range predicted by oversimplified one-dimensional theory, but is still consistent with the evidence of seismic refraction, tectonic, and heat-flow studies at ridge crests, that the oceanic crust is fully formed and cooled within a few km of the spreading axis. The picture is thus consistent with the geochemical findings of a high conc. of hyd. mobile elements in seds. within a narrow zone near ridge crests. (Author's abstract.)

LKHAMSUREN, J., 1976, Fluid inclusion data on the fluorite occurrences in Eastern Mongolia: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at Lab. of Genetic Mineralogy, Mongolian State Univ., Ulan-Bator, Mongolian Peoples Republic.

The fluorite-bearing province of Eastern Mongolia has numerous fluorite occurrences and deps., of diff. endogenic types. Fluorite is found as impregnations, compact masses, granular and columnar aggregates, and druses. The sizes of the well formed fluorite xls. reach 20 cm along the edge of the cube. The colors of the xls. are green, light-grey, dark-violet, blue and yellow. Fluorite xls. contain numerous diff. kinds of fluid incs. Most incs. are S or PS and are of the two-phase gas-liquid type. These are small and contain 10-30% gas phase. T_H = 100-280°C. Incs. with CO_2 are often observed in fluorite xls. and have T_H = 210-330°C. CO_2-H_2O incs. with 1-5% liquid CO_2 and 20-26% gas (vapor) have T_H = 275-340°C. Incs. with much gas (40-45%) have T_H = 290-350°C. Multiphase incs. have also been found.

P incs. are bigger and often have pyramidal and parallelepiped forms. These incs. occur separately or in small groups. T_H depends on the quan. of gas and reach 320-380°C.

Gas-liquid incs. in fluorites from various wolframite deps. were studied in detail by G.F. Ivanova, who found a wide range of T_H, 45-53° to 385°C. The calc. P in these incs. ranges from 300-400 bar to 1150 bar.

G.F. Rudenko and G.O. Simkov studied fluorite xls. from hyd. quartz-carbonate-fluorite veins and granite pegs. of the chamber type. They det. the comp. of the liquid incs. by chem. anal.: cations - Ca^{++}, Na^{+}, K^{+}, Mg^{++}, Li^{+}, and anions - F^{-}, $HSiO_3^{-}$, Cl^{-}, HCO_3^{-}, SO_4^{--}. The pH of the extract was: 6.56 - 5.82 - 6.28 - 6.47 and the Eh was: 182-196-218-226-236. Two-phase water incs. in the outer zones, which formed after intensive dissolution of the fluorite xls., have T_H 90-130°C. Therefore fluorite dissolved considerably at these Ts.

Many fluorite samples from rare element veins and greisens contain S and PS water and gaseous incs., which indicate the existence of two immiscible fluids during healing of the cracks. These heterogenous incs. correlate with changes of the physico-chem. conds. and tectonic movements during min. Fluorites from the Hg-polymetallic-fluorite assoc. recently found in Eastern Mongolia contain two-phase water incs. with T_H 80-120°C.

The distrib. of the fluid incs. allowed us to ascertain the mech. of form. of the fluorite xls. and aggregates in diff. min. stages and in the diff. geological-structural conds. The physical props., xllomorphic peculiarities and fluid inc. data indicate a general trend of the fluorite xl. habit from octahedral in the hypothermal conds. through complicated combs. to cubic forms under low T conds. Thus the fluid inc. data indicate not only physico-chem. parameters of the min.-form. sols. but numerous aspects of the genetic history of the minerals, too. (Author's abstract.)

LOFGREN, G., 1974, An experimental study of plagioclase crystal morphology: isothermal crystallization: Amer. Jour. Sci., v. 274, p. 243-273. Author at Geol. Branch, TN6, Johnson Space Center, Houston, Texas 77058.

Xliz. exper. on plagioclase gels using internally heated P vessels have shown that it is possible to grow plagioclase xls. sufficiently large to study min. textures. By first melting the charge and then rapidly cooling to the xliz. T, nucleation is restricted, and the fewer xls. can attain larger sizes (up to 6 mm long). Plagioclase xl. morphology is markedly dependent on degree of supercooling, ΔT, changing from tabular xls. at small ΔT to skeletal xls., dendrites, and spherulites with increasing ΔT. Many of the xl. forms have been obs. in terrestrial and lunar basalts and other glassy rocks. The change in xl. morphology can be related to the diffusion coef., D, of components rejected during growth and the growth rate, G, by the ratio C/G. If D/G approaches or exceeds unity, the xl. form is tabular, but if D/G becomes much less than unity spherulites are observed. (Author's abstract.)

LOFGREN, G. E., 1975, Dynamic crystallization experiments on mare basalts: Origins of mare basalts, Lunar Sci. Inst. Contrib. 234, p. 99-103. Author at NASA Johnson Space Center, Houston, TX 77058.

Mare basalt comps. were xlized. under very carefully controlled conds., yielding data on supercooling, nucleation, mineral zoning, and fractional xliz., pertinent to any understanding of silicate melt incs. (ER)

LOFGREN, G. E., and DONALDSON, C. H., 1975, Curved branching crystals and differentiation in comb-layered rocks: Contrib. Mineral. Petrol., v. 49, p. 309-319. First author at Geol. Branch, TN6, NASA-Johnson Space Center, Houston, Texas, USA.

Layering in which one or more of the component mins. has grown perpendicular to layer boundaries occurs, under a variety of names, in volcanic, hypabyssal and plutonic ign. rocks. The most recent and best name is comb layering. The oriented mins. are elongate, are commonly branching and may be curved. Exper. xliz. of plagioclase and ternary feldspar melts confirms that a substantial degree of supercooling or a significant cooling rate is necessary to produce the curved or branching xl. morphologies typical of comb layering. The more viscous the melt, the less the supercooling required. Changes in the water content or confining P are mechs. for inducing supersat. in deep-seated magmas, that are consistent with field and exper. evidence. The change from modal dominance by a single elongate xl. phase in one comb layer to dominance by another phase in a contiguous comb layer is explained by the presence of constitutional supercooling ahead of the growing xls. of a given layer. (Authors' abstract.)

LOFGREN, G. E., USSELMAN, T. M., and DONALDSON, C. H., 1975, Cooling history of Apollo 15 quartz normative basalts determined from cooling rate experiments (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, TX, p. 515-517. First author at NASA Johnson Space Center, Houston, TX 77058.

LOFGREN, Gary E., WILLIAMS, Richard J., DONALDSON, Colin H., and USSELMAN, Thomas M., 1975, An experimental investigation of porphyritic texture (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1173-1174. First author at NASA Johnson Space Center, Houston, Texas 77058.

Porphyritic texture has been defined in at least three ways: a bimodal size distrib. of one min.; a bimodal size distrib. of different mins.; and phen. set in a glassy groundmass (vitrophyre). All three have been reproduced by exper. xliz., at linear cooling rates in the range 1 to 50°C/hr, a variety of lunar and terrestrial basaltic comps. The charges were suspended on a Pt wire loop in a one-atm., gas-mixing furnace at approximate O fugacities. As the cooling rate increases, the shapes of the phen. change systematically from subhedral to skeletal and the texture of the matrix changes from ophitic to radiate to spherulitic to glassy. In the expers., porphyritic textures develop only when the dominant liquidus phase has a sufficient xliz. interval (>20-30°C), prior to matrix xliz., to permit significant phen. growth. Vitrophyres form because the matrix phases do not nucleate. These findings conflict with the classic interpretation of porphyritic texture as the result of a two-stage cooling history involving two-site xliz. We conclude that one-stage, as well as two-stage, cooling histories can produce porphyritic texture. The origin of porphyritic texture under one-stage cooling conds. is related to the change in the slope of the equil. liquidus caused by the appearance of the second phase to xliz. from the melt. The morphology of phen. provides an index of magmatic cooling rate and the correspondence between the morphologies of phen. and the matrix texture of a porphyritic rock provides a means of dist. whether phen. grew *in situ*, or are the result of intratelluric xliz. (Authors' abstract.)

LOGINOV, V. P., 1975, Sulfide sulfur deposits of young age and their significance for geological classification and evaluation of conditions of genesis of pyritic deposits: Metasomatites and ore formation, N. N. Pertsev, ed.: "Nauka," Moscow, Acad. Sci. USSR, p. 217-246 (in Russian).

T_D of pyrites from Sibay dep. (S. Ural) reaches 330-350°C; from Oktiabr'skoe and Yubileynoe deposits - 280-330°C, but in these deps. T_D

of assoc. galena, bornite, tennantite and chalcopyrite is 150-230°C (p. 237). (A.K.)

LONG, Philip E., and LUTH, William C., 1975, Genetic implications of Ba zoning in microcline megacrysts from Precambrian granitic rocks of the Dixon-Peñasco area, Northern New Mexico (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1176. First author at Department of Geology, Stanford University, Stanford, California 94305.

Variations in Ba content across microcline megacrysts from the Puntiagudo granite porphyry and the Peñasco quartz monzonite can be qual. correlated from xl to xl in the same hand specimen. The largest megacrysts from each rock-type show first an increase, then a decrease in Ba from their centers outward. This similarity exists even though the two rock-types are very different petrographically and were intruded at different times and apparently at different depths. The reversals in Ba conc. gradients in the megacrysts are difficult to explain by a simple two-phase xliz. model if the distribution coef. for Ba (K_D^{Ba}) between K-feldspar and silicate melt or a water-rich fluid phase is > 1, as indicated by exper. data. Anal. of interface flux conditions for a closed system suggests that such reversals may result from changes in K_D^{Ba}, changes in conc. of Ba in the L, or non-linearities in growth rate. Since quartz and plagioclase have $K_D^{Ba} < 1$, an increasing Ba conc. in a granitic silicate L can be readily explained by simultaneous xliz. of one or both of those mins. with the K-feldspar megacrysts. This does not mean that changes in K_D^{Ba} or growth rate can be ignored nor does it positively preclude subsolidus xliz. of the megacrysts from an aq. phase, but it does provide a mech. for producing the obs. consistent Ba distrib. No such mech. seems inherent in subsolidus xliz. or in arbitrary changes in growth rate or K_D^{Ba}. Effects of the total phase xliz. sequence on zoning in igneous mins. generally have been neglected. Such effects are not limited to trace elements, and they may account for reverse zoning trends in some ig. plagioclases. (Authors' abstract.)

LONGHI, J., WALKER, D., and HAYS, J. F., 1975, Fe-Mg distribution between olivine and lunar basaltic liquids (abst.): Amer. Geophys. Union Trans., EOS, v. 56, p. 471. Authors at Dept. of Geol. Sci., Harvard Univ., Cambridge, Mass. 02138.

The distrib. of Fe and Mg between lunar basaltic Ls and olivine has been obs. in over 100 exper. in Fe capsules. For low-Ti Ls the Fe-Mg distrib. is essentially ideal with $K_D = (X_{Fe})_{ol}(X_{Mg})_{liq}/(X_{Mg})_{ol}(X_{Fe})_{liq}$ unchanged over a range of T (1325-1125°C), P (0-12 kb) and comp. (liquid Fe/Fe+Mg of 0.3 to 0.9). These data closely agree with the data of Roeder and Emslie on terrestrial basalt comps. (Contr. Min. Pet. <u>29</u>, 275-289, 1970); however, our avg. K_D(0.33) is slightly larger than theirs (0.30). Controlled cooling exper. on a low-Ti basalt comp. at rates from 0.5 to 2000°C/hour and Ts of 1325 to 600°C produced zoned olivines for which the K_D between the rims and L is the same as in the equil. expers. However, equil. expers. on high-Ti basalt comp. show that K_D is systematically reduced to values of 0.29 to 0.26 by the large amounts of TiO_2 (7 to 11 mole %) in these Ls. The lower K_D results from lower activity of fayalite in the melt at constant $(Fe/Fe+Mg)_{liq}$. These large amounts of Ti apparently cause structural changes in the melt. (Authors' abstract.)

LOPATINA, N. L., 1975, Experimental studies on halogenide transport of lead and zinc in water vapor: Collected Papers on Experimental and Geological-Mineralogical Studies of the Process of Ore Formation, v. 2, A. I. Zakharchenko, ed.: Leningrad, VSEGEI, p. 6-28.

LU, Huanzhang, SHI, Jixi, and YU, Cimei, 1975, Temperatures of petrogenesis and metallogenesis for a certain tantalum-niobium-bearing granite: Geochimica, 1975, no. 3, p. 210-221 (in Chinese with English abstract).

Fluid incs. in quartz, wolframite, Mn-rich columbite, microlite and other mins. yield T_F for a Ta-Nb-bearing granite (512-530°C), the feldspar-quartz zone (495°C), the quartz zone (483°C) in the peg. and wolframite-quartz vein (262-273°C; no P correction has been made). These results demonstrate that petrogenesis and metallogenesis of this district are a protracted, multistage process. (Authors' abstract.)

(These are all decrep. data. ER)

LU, Huanzhang, YU, Cimei, and SHI, Jiyjixi, 1975, Characteristics of fluid inclusions and their formation temperature in a certain quartz vein in Eastern China: Geochimica, 1975, no. 4, p. 273-278 (in Chinese with English abstract).

Chars. and geol. implications of the four diff. types of fluid incs. (P, PS., S, and multi-phase incs.) are studied for a quartz dep. in Eastern China. T_F of this dep. has been det. and a brief geol. setting given. (Authors' abstract.)

LUDINGTON, Steve, and MUNOZ, J. L., 1975, Application of fluor-hydroxyl exchange data to natural micas (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1179. First author at U.S. Geological Survey, Reston, Virginia 22092.

LUKANIN, O. A., and KADIK, A. A., 1975, Influence of CO_2 upon the melting temperature of albite and diopside at pressures up to 3000 atm.: Geokhimiya, 1975, no. 5, p. 693-699 (in Russian).

LUTH, W. C., 1975, Specific volume as a system variable in treating crystallization of silicate-H_2O systems (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1180. Author at Department of Geology, Stanford University, Stanford, California 94305.

The assumption that specific volume of the system ($\tilde{V}_S$) is fixed by P, T, and comp., X, is implicit in most of the applications of exper. studies to ign. rocks. If $\tilde{V}_S$ is constrained during xliz., or melting, processes then effective pressure (P_S) will depart from confining pressure (P_C). Est. of P based on min. coexistence geo-barometers refer to P_S and not to P_C. Calcs. relevant to xliz. of hydrous vapor undersaturated liquids in the "albite"-H_2O system using P-V-T-X data from Burnham and Davis (1971) provide a base for consideration of the P_S-P_C-$\tilde{V}_S$-T-X_{H_2O} relations. The slope (dP_S/dT) of constant $\tilde{V}_S$ curves for xliz. assemb. ranges from 60 to 20 bar/°C in this system. Imposing a constant $\tilde{V}_S$ constraint results in: dramatic reduction of the liquidus to vapor saturation T interval; decrease in the xl/L ratio at vapor sat.; and reduction of P_S by as much as several kilobars prior to the appearance of a vapor phase. Low P_C values, or rapid xliz., would appear to particularly favor an approach to constant $\tilde{V}_S$ rather than constant P_S xliz.

Evolution of the vapor phase with continued xliz. of vapor-saturated

Ls requires: change in comp. of the system, through loss of the vapor phase; increase in V_S; increase in P_S; or all three. In summary, then constant V_S xliz., at constant P_C, of bulk comps. initially undersaturated with respect to an aq. vapor phase requires a decrease in P_S, to the point of vapor sat., followed by an increase in P_S accompanying evolution of the vapor phase. High initial H_2O content, or conc. of the residual Ls., are required if P_S is to exceed the P_C value effective initially. (Author's abstract.)

LYAKHOV, Yu. V., 1975, Temperature zoning of Darasun deposit: Geol. Rudn. Mest., v. 17, no. 2, p. 28-36 (in Russian). Author at L'vov Univ., L'vov.

The Darasun dep. formed from pneu.-hyd. solns., T_H of incs. from more than 450°C to 40°C, P 1200-300 atm, during five stages: (1) quartz-molybdenite 370-300°C; (2) quartz-tourmaline 430-300°C; (3) early sulfides (quartz-pyrite, quartz-pyrrhotite, and quartz-pyrite-arsenopyrite)-450-275°C; (4) gold-sulfoantimonite-chalcopyrite -285-170°C; (5) carbonate 120-40°C. The thermal field had a concentric shape during the transition from early to late stage of min.; toward the intrusion of plagiogranite-porphyries T increases at 2-10°C per 1000 m horizontally, and 10-25° per 100 m depth. Adequate paleoisotherms were obtained from the T_H data. (Abstract by A.K.)

LYON, G. L., 1974, Geothermal gases, in Natural Gases in Marine Sediments, I. R. Kaplan, ed.: New York, Plenum Press, p. 141-150. Author at Inst. of Nuclear Sci., Dept. of Sci. and Indust. Research, Lower Hutt, New Zealand.

The major components of geothermal gases are steam and carbon dioxide. At high Ts, chem. and isotopic equil. will be estab., but as the gases cool, equil. conditions are not maintained. Interaction of gases with wet seds. will result in a gas mixture consisting of CH_4, H_2, N_2, and rare gases. (Author's abstract.)

MAALØE, S., and WYLLIE, P. J., 1975a, The join grossularite-calcite through the system $CaO-Al_2O_3-SiO_2-CO_2$ at 30 kilobars: crystallization range of silicates and carbonates on the liquidus: Earth and Planet. Sci. Letters, v. 28, p. 205-208.

From the equil. det., the authors conclude that there is a link between kimberlite and some carbonatite magmas. (ER)

MAALØE, S., and WYLLIE, P. J., 1975b, Water content of a granite magma deduced from the sequence of crystallization determined experimentally with water-undersaturated conditions: Contr. Mineral. Petrol., v. 52, p. 175-191.

MCGEE, K. A., and HOSTETLER, P. B., 1975, Studies in the system $MgO-SiO_2-CO_2-H_2O$ (IV): The stability of $MgOH^+$ from 10° to 90°C: Amer. Jour. Sci., v. 275, p. 304-317.

MCKENZIE, W. F., and TRUESDELL, A. H., 1975, Geothermal reservoir temperatures estimated from the oxygen isotope composition of dissolved sulfate and water from hot springs (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section III, Abstract No. 65. (Abstract also in Geol. Survey Research, 1975, U. S. Geol. Survey Prof. Paper 975, p. 116). Authors at U.S. Geol. Survey, Menlo Park, CA 94025.

McLIMANS, Roger K., 1975, Systematic fluid inclusion and sulfur isotope studies of the Upper Mississippi Valley Pb-Zn deposits (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1197. Author at Department of Geosciences, The Pennsylvania State University, University Park, Pennsylvania 16802.

Based on sphalerite stratigraphy, filling T meas. of fluid incs. indicate that early sphalerite dep. occurred at 150-210°C, Ts significantly higher than previously reported for Mississippi Valley-type ore form. Ts decreased during min. until the late sulfide stage was dep. near 75°C.

In conflict with previously published work of others $\delta^{34}S$ values of sphalerite were found to be very uniform at 15.5 ± 1.5 o/oo throughout the min. sequence except for 11 ± 1 o/oo in the very late sulfide stage. $\delta^{34}S$ values of galena, however, decrease from 12.8 o/oo to 9.5 o/oo toward the late stage. Sphalerite-galena isotopic Ts agree well with fluid inc. filling Ts indicating that chem. and isotopic equil. were established between aq. sulfide species and ppting sulfide mins. $\delta^{34}S_{H_2S}$ in the ore fluid remained essentially constant at 15 ± 1.5 o/oo except in the very late stage.

Early barite has a $\delta^{34}S$ value of 22 o/oo while the late stage barite shows wide variation between 25.7 o/oo and 32.5 o/oo. SO_4^{-2} in the early stage fluids could have been produced by partial oxidation of H_2S of 15 o/oo and the obs. $\Delta_{SO_4^{-2} - H_2S}$ value of + 6 o/oo may reflect kinetic isotopic effects. $\Delta_{SO_4^{-2} - H_2S}$ values of +10 o/oo to + 20 o/oo and the source of SO_4^{-2} for the late barite stage are problematic and not readily explained by kinetic isotopic effects. (Author's abstract.)

McLIMANS, Roger K., and BARNES, Hubert L., 1975, Sphalerite stratigraphy in the Upper Mississippi Valley Pb-Zn deposits (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1197-1198. Authors at Ore Deposits Research Section, The Pennsylvania State University, University Park, Pennsylvania 16802.

MAE, Shinji, 1975, The shape of small Tyndall figures in pure ice: Journal Jap. Soc. of Snow & Ice, v. 37, no. 3, p. 1-7 (also paginated 107-113). (In Japananese with English abstract).

Detailed study of the formation mechanism for these liquid and vapor inclusions within ice crystals. (ER).

MARGARITZ, M., and TAYLOR, H.P., Jr., 1975a, $^{18}O/^{16}O$, D/H, and $^{13}C/^{12}C$ studies of the Franciscan formation, California (abst.): Amer. Geophy. Union, Trans., v. 56, no. 6, p. 460. Authors at Div. Geological and Planetary Sciences, Caltech, Pasadena, California 91125.

Anal. of 220 Franciscan rock and min. samples, including the San Luis Obispo ophiolite, show that meta. produces no change in the $\delta^{18}O$ of the graywackes (+11 to +14), but the igneous rocks become enriched in ^{18}O by 2 to 6‰ and the cherts depleted by 5 to 10‰. The shales are of two types, a high-^{18}O type assoc. with chert and a low-^{18}O type isotopically and min. similar to the graywackes. The vein quartz (δ=+15 to +20) is invariably richer in ^{18}O than the host rock quartz, and most of the min. assembl. are not in isotopic equil. Although the $\delta^{18}O$ values are very uniform (+13 to +16), the $\delta^{13}C$ of vein aragonite and calcite is widely variable (0 to -14), indicating that a major source of the carbon is oxidized org. material. The δD values of 83 igneous and sed. rocks are

-45 to -80, except for the Fe-rich mins, howieite and deerite, which have $\delta D = -100$; all of these samples could have equil. with a H_2O having a uniform $\delta D \approx +10$ to -20 and $\delta^{18}O \approx -3$ to +8, assuming Ts of 100°-300°C. However, the serpentines ($\delta D = -85$ to -110) and the vein mins. ($\delta D =$ -23 to -55) are exceptions. The lizardite-chrysotile must have formed from a low-δD meteoric water subsequent to Franciscan meta., and the vein mins. formed from a higher-δD meta. water. The meta. pore fluid involved in the alt. of the ophiolite and the other Franciscan rocks was sea water which became somewhat depleted in D and enriched in ^{18}O during meta., evolving to values of $\delta D \approx -20$ and $\delta^{18}O \approx +6$ to +8 at the highest grades. The $\delta^{18}O$ values of orogenic andesites are too low for such magmas to have formed by direct partial melting of Franciscan-type materials in a subduction zone. Andesites either form in some other fashion, or the melts must undergo thorough isotopic exchange with the upper mantle. (Authors' abstract.)

MAGARITZ, Mordeckai, and TAYLOR, Hugh P., Jr., 1975b, $^{18}O/^{16}O$ and D/H studies of igneous and sedimentary rocks along a 500-km traverse across the Coast Range batholith into central British Columbia at latitudes 54°-55°N (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1185. Authors at Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125.

The batholithic intrusions created gigantic meteoric-H_2O circulation systems, larger than has heretofore been documented. (From the authors' abstract.)

MAHON, W. A. J., 1975, The hydrogeochemistry of geothermal systems prospecting, development and use: a review (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section III, Abstract no. 59.

MAISKIY, Yu. G., 1975, Hydrocarbon-bearing relics in hydrothermalites of Donbass (abst.), p. 55-56, <u>in</u> Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Rostov Univ., Rostov-on-Don.

Quartz, quartz-carbonate and carbonate hyd. veins from Central and E. Donbass usually bear relics of C and its cpds. as various incs. in mins. These include a fine coal-like substance, L and G CO_2, and bituminous substances. L CO_2 occupies up to 80-90 vol.% of incs. Rapid xliz. of quartz is connected with changes of conc. of CO_2 in parent sols. Coal-like material is a mechanical admixture. (Abs. by A.K.)

MAKOGON, Yu. F., TROFIMUK, A. A., TSAREV, V. P., and CHERSKIY, N. V., 1973, Possible origin of natural gas hydrates at floor of seas and oceans: Akad. Nauk SSSR, So, Geol. i Geofiz., 1973, no. 4, p. 3-6 (in Russian; translated in Internat. Geol. Rev., v. 16, no. 5, p. 553-556 (1974)). Authors at IG i G, Sib. Branch, USSR Acad. Sci., Novosibirsk.

These cpds. may influence the comp. of mixed org-H_2O incls. trapped in diagenetic incs. (ER)

MAKAGON, V. M., 1975, Role of CO_2 in processes of formation of muscovite [and] rare-metal pegmatites (abst.), p. 45-46, <u>in</u> Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geochem., Sib. Div., Acad. Sci. USSR, Irkutsk.

Muscovite pegs. formed in amphibolite facies of kyanite-sillimanite type, under action of H_2O-CO_2 fluids. CO_2 content increases from greenschist facies to pegs., reaching high density (up to 1.06 g/cm^3). High volatile P defined the peculiarities of granite and peg. formation. High conc. of CO_2 in post-magm. sols. caused the hydrolysis of feldspars to form commercial muscovite zones. During meta. from greenschist to amphibolite facies with T increase, carbon becomes more oxidized, and during cooling of peg. system the redox potential decreases and C cpds. reduce to form graphite.

RM pegs. were divided into two types: 1) spodumene with pollucite, and 2) lepidolite-albite with topaz, amblygonite and elbaite. Type 1 was formed from peg. melts rich in CO_2; type 2 from fluids rich in H_2O, F, and B. Incs. were studied in spodumene and pollucite. (Abs. by A.K.)

MALININ, S. D., 1974, Thermodynamics of the H_2O-CO_2 system: Geokhimiya, 1974, no. 10, p. 1523-1549 (in Russian; translated in Geochem. Internat., v. 11, no. 5, p. 1060-1085 (1975)). Author at Vernadskiy Inst. of Geochem. and Anal. Chem., Acad. of Sci. of the USSR, Moscow.

Published data have been used on the P-V-T relationships in the CO_2-H_2O (electrolyte) system to calc. the partial molar volumes of CO_2 in water and water-salt sols., V_{CO_2}, over wide ranges in P and T. V_{CO_2} increases rapidly above 300° and passes through a max., which has the char. of a discontinuity near the critical region. The soly. relationships in this system are satisfactorily described by a phase equil. equation for binary systems of L-G type, including the partial molar vol. The equation has been used to calc. the activity coef. for CO_2 in such sols. A generalized equation is presented for salting-out of CO_2, which takes into account the conc. of the dissolved electrolyte and of the dissolved CO_2 over a wide range in the parameters. (Author's abstract.)

MALININ, S. D., and KUROVSKAYA, N. A., 1975, Solubility of CO_2 in chloride solutions at elevated temperatures and CO_2 pressures: Geokhimiya, 1975, no. 4, p. 547-550 (in Russian; translated in Geochem. Internat., v. 12, no. 2, p. 199-201). Authors at Vernadskiy Inst. of Geochem. and Anal. Chem., Acad. of Sci. of the USSR, Moscow.

The soly. of CO_2 in sols. of NaCl and $CaCl_2$ (conc. from 0 to 6-7 m) has been examined at 25, 100, and 150° with a total P of about 50 kg/cm^2; the Sechenov constants K_s have been calc. from the solys., with $K_s = \log (S_o/S)/m$, where S_o and S are the solys. of CO_2 in water and in the electrolyte sol. of conc. m respectively. These constants are found to fall considerably as m increases. The relationship for low values of m is linear and becomes steeper as the T increases. However, the curves tend to flatten out at high concs. (Authors' abstract.)

MALININ, S. D., and UCHAMEYSHVILI, N. Ye., 1975, Application of theory of strong electrolytes for problems of hydrothermal mineral formation, in "Physico-chemical problems of hydrothermal and magmatic processes": Moscow, Publ. House "Nauka," p. 99-123 (in Russian). (A.K.)

MALYSHEV, A. G., 1974, Determination of rock-forming pressures from measurements on gas-liquid inclusions in minerals with a high-density gas phase: Akad. Nauk SSSR, Doklady, v. 216, no. 3, p. 625-627 (in Russian; translated in Doklady Acad. Sci. USSR, v. 216, p. 139-141 (1975)). Author at All-Union Research Inst. for the Syn. of Min. Products, Aleksandrov.

Meta. quartz from Urals has incs. of water sol. with 4 to 20% vol. % gas bubbles consisting of N_2 and rare gases with no CO_2, under such high P that on heating, the bubble sank in the brine (at 60-180°C). Some contain dm halite. Only small incs. could be homog.; larger ones decrep. Rough calcs. of P at T_H from these data = 2000 atm. (ER)

MALYSHEV, A. G., and SKOBEL', L. S., 1975, Peculiarities of formation of inclusions in crystals of quartz of pegmatite deposits: Akad. Nauk SSSR, Doklady, v. 225, no. 3, p. 665-666 (in Russian). Authors at All-Union Sci.-Research Inst. of Synthesis of Mineral Raw Materials, Alexandrov.

In peg. quartz xls. (colorless, amethyst and smoky) giant incs., up to 5x20x50 mm (group I) and anomalous incs. (1-1.5 mm) (group II) were found. All incs. are connected with zones of growth of xls. (P incs.). Incs. of group II are naturally decrep. Giant incs. are open for a relatively long period during which quartz can continue to xlize on the inside of the vacuole. T_H of incs. in the zone of giant incs. is 184°C at the beginning of growth of the smoky zone, and about 430-450°C for later zones on the basis of the dimension of gas bubble before decrep. at 390°C. The authors interpret these data as indicating a rapid increase in temperature during xliz. of quartz. (Abstract by A.K.)

MAMCHUR, G.P., 1975, Geochemistry of stable isotopes of carbon under endogenic conditions (abst.), p. 110-111, in Carbon and its compounds in endogenic processes of mineral-formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. Fuels of Acad. Sci. of Ukrainian SSR, L'vov.

Review of current data. (A.K.)

MAMCHUR, G. P., GIGASHVILI, G. M., and AKHVLEDIANI, R. A., 1975, Isotopic composition of carbon in calcites from hydrothermal veins of Teletskiy Chain (abst.), p. 39-40, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Inst. of Geol. and Geochemistry of Fossil Fuels, Acad. Sci. Ukr. SSR, L'vov.

Calcites from veins from tuffogenic rocks have δC^{13} values (PDB, accuracy ±0.5‰) generally ranging from -4.7 to +4.0‰; early calcite (T_H = 120-110°C) from -4.7 to 1.2‰; late calcite (xlized. at T<60°C) from +1.0 to +4.0‰. (Abs. by A.K.)

MAMCHUR, G. P., MATVIYENKO, A. D., and YARYNYCH, O. A., 1975, On genesis of chamber pegmatites in Volyn from δC^{13} data: Geolog. Zhur., v. 35, no. 3, p. 91-98 (in Russian with English abstract).

The carbon isotopic comp. of CO_2 from incs. in granite ranges from 3.43 to 1.28% (δC^{13}-values) on approaching the peg. δC^{13} of CO_2 from peg. ranges from -1.92 to 0.93%. The light carbon is contained in CO_2 of high-

T pegs. δC^{13} of siderite ranges from -1.8 to -0.8%. The pegs. were formed by both granitic volatiles and endogeneous fluids. (Authors' abstract.)

MAMCHUR, G. P., ZHOVTULA, B. D., and YARYNYCH, O. A., 1975, δC^{13} of hydrothermal carbonates in igneous rocks from Transcarpathia (abst.), p. 98-99, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fuels of Acad. Sci. Ukrainian SSR, L'vov.

δC^{13} of hyd. carbonates from Vyshkovo varies from -8.4‰ to +4.1‰ (PDB); the values increase with decrease in T of pption. of carbonates. δC^{13} for travertines (lowest T) is +10.2‰. Mode of obtaining of T data unspecified. (Abs. by A.K.)

MAMONTOV, B. V., 1975, Use of decrepitometric mapping at skarn-scheelite ore deposit Yubileynoe: Mineralogy and geochemistry of tungsten deposits (Transactions of III All-Union Meeting), v. 3, p. 371-379, Leningrad (in Russian). Author at Kanimansur Expedition of Tadzhik SSR.

T_D proves that post-magm. activity was at 200-300 and 400-500°C. Albitites and granodiorites have highest decrep. activity, limestones and skarns - lower. Decrepitometric mapping establishes the P and S aureoles of post-magm. activity and it is recommended as a prospecting method. (Author's abstract, translated and shortened by A.K.)

MǍNKOV, S., and ANDREEVA, L., 1975, A tertiary tungsten-molybdenum mineralization in the central Osogovo Mt., district of Kjustendil: Abstracts of Bulgarian Sci. Lit., Geology and Geography, v. 18, no. 2, p. 18 (in English).

Quartz, molybdenite, pyrite, scheelite, ferberite, albite and K-feldspar are the main mins. formed under high-T conds. (T_H of quartz 350°C - 330°C.) It is younger than the lead-zinc min. which is also of a Tertiary age and strikes in the same direction, 330° to 350°. It is supposed that such W-Mo-min. occur in other places of the Rhodope metallogenic zone as well. (From the authors' abstract.)

MARTIN, R., 1975, Morphology and inclusions in quartz from the Orpierre section (High Alps, France): Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg 1974, p. 415-418 (in French with English abstract).

Limestone-nodules in Oxford-Marls (Terres-Noires) of Orpierre-region (High Alps, France) contain the following newly-formed mins.: calcite, dolomite, celestite, strontianite, quartz, cryptoxline silica, hatchettine and hydrocarbons.

Morphology of quartz is char. by the presence of faces like (1012), (0112), (1013), (0113), (2021) and sometimes even coarse-grained surfaces near (0001) can be obs.

Their devel. might be influenced by the presence of hydrocarbon-incs. and low Ts. According to Barlier (1974) Ts were $\leq$170°C. Farther to the east with higher Ts only normal quartz xls. were formed which do not display special morphological features. (Author's abstract.)

MARTIN, R., and MULLIS, J., 1971, Inclusions in quartz crystals from Val d'Illiez (film and commentary): Schweiz. Mineral. Petrog. Mitt., v. 51, p. 533-534 (in German).

A commentary on a film made to display the occurrence, and the thermal behavior (heating and freezing) of inclusions containing H_2O, CH_4, etc., and some interpretation of the data. (ER)

MARTIN, R. J., III, and DURHAM, W. B., 1975, Mechanisms of crack growth in quartz: Jour. of Geophys. Research, v. 80, no. 35, p. 4837-4844. First author at U.S. Army Cold Regions Research and Eng. Lab., Hanover, N. H. 03755.

The fact that the stress, T, and water dependencies of crack growth are independent of orientation is interpreted to suggest that the observed time-dependent cracking is controlled by the transport of water to the crack tip. (From the authors' abstract.)

MASALOVICH, A. M., 1975, Transport of substance during precipitation of pyrite in hydrothermal systems: Geol. Rudn. Mest., v. 17, no. 2, p. 59-69 (in Russian). Author at Inst. of Min., Geochem. and Crystallochem. of Rare Elements, Moscow.

Studies of dissolution of pyrite were made in 0.010 and 0.338 M solns. of HCl at 192-458°C, proving the possibility of contemporaneous transport of Fe and S in soln. Influence of T decrease and acidity on pption. of pyrite is presented, and author compares his data with conditions of formation of natural pyrite. (Author's abstract, translated by A.K.)

MASI, Umberto, TURI, Bruno, and VALERA, Roberto, 1975, Isotopic composition of quartz and calcite gangue of "Giacimento Argentifero" del Sárrabus (Southeastern Sardinia) and its genetic implications: Soc. Italiana di Min. e Pet. - RENDICONTI, v. 31, no. 2, p. 467-485 (in Italian with English abstract).

Oxygen isotope anal. were obtained for 9 quartz samples and 18 calcites from three zones (Monte Narba, Serra S'Ilixi, Terra Mala) of the most prominent Pb-Zn-Ag dep. in Sardinia, located east of Cagliari: the so-called "Giacimento Argentifero" of Sárrabus. Several T_H meas. on fluorite were also made.

The $\delta^{18}O$ (SMOW) of quartz range from 13.01 to 17.25; the $\delta^{18}O$ and $\delta^{13}C$ (PDB) values of calcite vary from 12.36 to 18.77 and from -7.60 to -2.82, respectively. In general, isotopic equil. was not attained in the assemb. studied, except in one sample from M. Narba. From the $^{18}O/^{16}O$ anal. of this sample, we calc. (1) the "isotopic" T_F of the coexisting quartz and calcite (about 160°C); this value is in good agreement with the inc. data (80°-100°C at Terra Mala, 100°-115°C at Serra S'Ilixi, 105°-140°C at M. Narba); and (2) the $\delta^{18}O$ of the aqueous sol. in equil. with the two mins. (+1.0), which suggests that the ore-forming fluids essentially derived from surface waters (meteoric, marine or connate). (Authors' abstract.)

MATVIYENKO, A. D., 1975, Influence of conditions of formation of zanorysh (chambered) pegmatites on distribution of endogenic CO_2 in individual mineral-structural zones (abst.), p. 47-49, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. Fossil Fuels, Acad. Sci. Ukrainian SSR, L'vov.

In the Korostenskiy pluton, the outer zone of fine-grained graphic peg. contains small amounts of endogenic CO_2 (10-13 cm^3/kg); the succeeding skeletal-graphic zone bears G/L incs. with T_H 200-600°C and varying conc. of CO_2 (15-30 cm^3/kg), reflecting the metasomatic alt. of graphic zone. The pegmatoid and giant-xled. (blocky) zone bears mainly high T G incs., with CO_2 up to 40 cm^3/kg, as the xliz. was from a residual melt enriched in CO_2. Quartz from the inner core usually bears the highest conc. of CO_2 (50 cm^3/kg). The latest part, smoky or morion quartz, bears few incs. and a low conc. of CO_2, 3-5 cm^3/kg. Albite and microcline zones formed by replacement of quartz bear 17 and 6 cm^3/kg CO_2, respectively. (Abs. by A.K.)

MATVIYENKO, A. D., MAMCHUR, G. P., BURLAKOV, V. N., and YARYNYCH, O. A., 1975, Some peculiarities of distribution of endogenic CO_2 and its isotopic composition in granites surrounding zanorysh (chambered) pegmatites (abs.), p. 36-37, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Inst. Geol. Geochemistry of Fossil Fuels, Acad. Sci. Ukr. SSR, L'vov.

In peg. no. 25 at Korostenskiy pluton, where in granites conc. of endogenic CO_2 was 1.3-11.9 cm^3/kg and δC^{13} (PDB) varies from -15.0 to -45.5‰, in interval 1-7 m from peg., there is an abrupt increase of conc. of CO_2 and continuous increase of conc. of C^{13}. A tectonic zone at 6-7 m from peg. causes a distinct decrease of CO_2 conc. Peg. no. 31 was found to have a distinct aureole of endogenic CO_2. (Abs. by A.K.)

MAZOR, Emanuel, The atmospheric noble gases as potential multitracers in geothermal prospection and steam production studies (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section III, Abstract No. 62. Author at Isotope Dept., The Weizmann Inst. of Sci., Rehovot, Israel.

The atm. noble gases, He, Ne, Ar, Kr, and Xe become dissolved in surface waters and tag every meteoric groundwater. They serve as conservative tracers which prefer the steam phase whenever it is formed. Mass spec. meas. of the atm. noble gases dissolved in groundwaters revealed that the latter are commonly kept in closed systems which preserve their original noble gas content. This has been found in cold waters and in waters up to 80°C meas. in Israel, Rhodesia, Swaziland, South and South-West Africa and in the US.

In contrast, in thermal waters fed by superheated reservoirs, significant noble gas depletions have been obs. (retention values being as low as 10%). Examples studied so far are Yellowstone National Park and Sulfurbank in the United States, Binga in Rhodesia, and Windhoek in South-West Africa. The depletion is explained by steam separation and flushing which depleted the residual L phase. This model needs refinement as little or no fractionation is obs. in the depleted water, nor in steam phases anal. from Yellowstone.

Meas. of the dissolved noble gases in geothermal regions are much recommended as their degree of depletion might be useful in (a) reconnaissance prospecting, and dist. hot springs fed by superheated reservoirs from those fed by low T reservoirs; (b) studying the steam separation mech. in geothermal fields, and (c) tracing the progress of production and exhaustion of a geothermal field. (Author's abstract.)

MAZUROV, M. P., 1974, The mineral associations and conditions characterizing the formation of the amphiboles in the Irba iron-bearing metasomatites (Eastern Sayan region): Geologiya i Geofizika, v. 15, no. 11, p. 51-58 (in Russian; translated in Soviet Geol. and Geoph., v. 15, no. 11, p. 43-49, Allerton Press, N. Y.)

The comp., props., and parageneses of the amphiboles in polychronic Fe-bearing calcareous skarns and propylitized rocks were studied. It was shown that the changes in the parageneses are specific to each hypogene stage and that the Fe contents depend on the type of the paragenesis. The depth of form. of the amphibole min. was ascertained. T_H of G-L incs. was used to det. T_F of the chlorine-containing hastingsite (480-350°), the apohastingsite actinolite (390-270°), and the actinolite in the propylitized rocks (450-400°C). It is concluded that these were formed under conds. of diminishing alkalinity of the sols. The results obtained were used to est. the parameters of form. of the magnetite ores. (Author's abstract.)

MEL'NIKOV, F. P., 1975, Endogenic mineral formation and hydrocarbons (abst.), p. 4-6, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci., Ukrainian SSR (in Russian). Author at Moscow Univ.

Relations between the type of min. dep. and the kind of hydrocarbons are complicated. The paragenetic connection of individual gas components with dep. of metals: Hg, Au, Cu, Fe, is apparent. Significant occurrence in ore bodies of liquid hydrocarbons and solid asphalt-like substances is noted, commonly called bitumens. G/L incs. of hydrocarbons were studied and classified in quartz, fluorite, topaz, calcite, at low and elevated T. The connection of organic cpds. with certain meta. min. and metallorganic insol. cpds. is discussed as well as their influence on Eh of sols. Organic cpds. play the main role in min.-form. sols. after H_2O and CO_2. (Abstract by A.K.)

MEL'NIKOVA, N. I., and MEL'NIKOV, Ye. P., 1974, Barren vein-quartz associations in metamorphic complexes of the Central and Southern Urals: Akad. Nauk SSSR, Doklady, v. 214, no. 6, p. 1423-1426 (in Russian; translated in Doklady Acad. Sci. USSR, v. 214, p. 182-184 (1975); abstract in Internat. Geol. Review, v. 16, no. 8, p. 980 (1974)).

Positions of the unmin. quartz veins in the geol. plan (fig. 1), in relation to level and type of the regional meta., facilitate their formational identification. Geochem. and thdy. distinctions of the three geol. discrete forms. (table 1) represent the sequence of the three stages in tectonometa. evolution of the Uralian geosyncline. Typomorphic form. chars. of the quartz veins, in the different geostructural zones, namely conc. of fluid inc. and impurity elements, H_2O/CO_2 and Na/K ratios, partial pressures of H_2O and CO_2, activities of the alkalies, indicate the following sequence of environments of origin: (a) shallow depths, low P, low T, high P_{H_2O}, low P_{CO_2}, high chem. potential of Na; (b) great depths, low P_{H_2O}, high P_{CO_2} (juvenile sols. in dehydrated granulitic complexes), roughly the same Na and K chem. potentials; (c) intermediate between (a) and (b).

MELTON, C. E., and GIARDINI, A. A., 1975, Experimental results and a theoretical interpretation of gaseous inclusions found in Arkansas natural diamonds: Amer. Min., v. 60, p. 413-417. First author at Dept. of Chem., Univ. of Georgia, Athens, Georgia 30602.

A detailed anal. of the comp. of G incs. in seven Arkansas diamonds ranging in size from 2.06 to 0.37 carats and containing other incs. has been made by mass spec. tech. The diamonds were crushed in the high vacuum inlet of a research mass spec. The relased gases were found to be of variable comp. and similar to those reported earlier from diamonds of African origin. The gases are composed of C, H, O, N and Ar atoms; water is the most abundant cpd., followed in decreasing abundance by H_2, N_2, CO_2, CO, methyl and ethyl alcohols, and Ar. Based on the tentative assumption that the gases are genetically related to the host diamond, a theoretical G-solid diamond growth model is presented which can account for the observed comp. variations in the included gas. (Authors' abstract.)

MERRILL, R. B., and WYLLIE, P. J., 1975, Kaersutite and kaersutite eclogite from Kakanui, New Zealand - water-excess and water-deficient melting to 30 kilobars: Geol. Soc. Amer., Bull., v. 86, p. 555-570.

METZGER, Fredrick W., NESBITT, Bruce E., and KELLY, William C., 1975, Scanning electron microscopy of daughter minerals in fluid inclusions (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1199.

Authors at Department of Geology and Mineralogy, The University of Michigan, Ann Arbor, Michigan 48104.

The scanning electron microscope (SEM) offers a powerful new tool for the study of dms. in fluid incs., particularly when the instrument is equipped with a solid-state X-ray detector. The general character and abundance of incs. is first established by conventional optical study of thin polished plates of the host xl. The plates or other pieces of the same material are then cleaned and split open by chipping, cleaving, or decrep. Under the SEM, opened incs. appear like numerous caverns in the newly broken surfaces, many giving spectacular views of contained dms. Xl morphology is revealed in great detail and the electron beam produces char. X-ray spectra which are visibly displayed on a multichannel analyzer. The resulting chem. and morphological information, coupled with the previous optical obs., define or greatly limit the identity of the dm. Volumetric est. of the dms. then provide approximate bulk comps. of the original fluid in the incs.

The techniques are illustrated by application to incs. in quartz from the Alleghany gold mine, California, confirming the presence of dawsonite (Coveney and Kelly, 1971). The identity of several of the previously unknown dms. in fluorite from the Emmett mine at Jamestown, Colorado (Nash and Cunningham, 1973) include gypsum, thenardite, mirabilite(?), Fe-rhodochrosite, and Sr-barite. Incs. with several dms. were also examined from the carbonatite complex at Magnet Cove, Arkansas (see companion abstract, Nesbitt and Kelly). (Authors' abstract.)

MEYER, H. O. A., and SVISERO, D. P., 1975, Mineral inclusions in Brazilian diamonds: Physics and Chem. of the Earth, v. 9, p. 785-796.

MICHEELSEN, Harry, 1975, In situ measurements of the refractive indices of liquid and gaseous inclusions in minerals: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 95h Meeting, Berlin-Regensburg 1974, p. 465-473. Author at Inst. of Min., Univ. of Copenhagen, Oestervoldgade 5, Copenhagen K, Denmark.

The refractive indices of single incs. or groups of small incs. in mins. can be meas. in the microscope by total reflection of light. L, G, and xline. phases can be det. Using oblique pinhole diaphragm illumination and conoscopy with an immersion objective a range from n = 1.00 to 1.55 is covered. The accuracy varies from ±0.01 at n ∿ 1.5 to ±0.02 at n = 1.0. (Author's abstract.)

MIKHAILOV, M. Yu., and SHATSKII, V. S., 1975, Silite heater for high-temperature microthermal chamber, <u>in</u> Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 109-110 (in Russian).

Silite heating element (drawings given in the paper) permits study of incs. in range +20 - +1600°C; accuracy 1-2%. Electrical current used 10-15 A at 30-35 V. (Abstract by A.K.)

MILLER, S. L., 1974, The nature and occurrence of clathrate hydrates, <u>in</u> Natural Gases in Marine Sediments, I. R. Kaplan, ed.: New York, Plenum Press, p. 151-177. Author at Dept. of Chem., Univ. of Cal. at San Diego, La Jolla, CA 92037.

Clathrate hydrates are xline. cpds. in which an expanded ice lattice forms cages that contain gas molecules. There are two principal gas hydrate structures. Structure I, with a 12 Å cubic unit cell, contains 46 water molecules and 8 cages of two types, giving an ideal formula (for CH_4) of $CH_4 \cdot 5\text{-}3/4H_2O$. The actual formula contains somewhat more water as the cages are not completely filled. Examples of gases that form Structure I hydrates are ethane, N_2, O_2, Ar, Xe, CH_3Cl, H_2S. Structure II, with a 17 Å cubic unit cell, contains 136 water molecules, and 8 large cages and 16 small cages. This gives an ideal formula of, for example, $CHCl_3 \cdot 17H_2O$. Other molecules that form a Structure II hydrate include propane, ethyl chloride, acetone, and tetrahydrofuran. The conds. of P and T for hydrate form. are discussed. The statistical-mechanical treatment of hydrate stabilities shows that the cages are not completely occupied; thus the clathrate hydrates are non-stoichiometric cpds. (From the author's abstract.)

P-T diagrams are given for CO_2 and CH_4 hydrates, and may be useful in inc. studies: (See next page)

Fig. 3. The phase diagram of methane hydrate. The line hydrate + CH_4(l) + CH_4(g) ends very close to the critical point of methane (191°K). Q is the quadruple point [ice + hydrate + water + CH_4(g)].

Fig. 4. The phase diagram of CO_2 hydrate near 0°. C.P. is the critical point of CO_2 (31.0°C and 72.8 atm). Q_1 is the quadruple point [ice + water + hydrate + CO_2(g)] at -1.77°C and 10.20 atm, Q_2 is the quadruple point [water + hydrate + CO_2(l) + CO_2(g)] at 10.20°C and 44.50 atm.

Fig. 3.

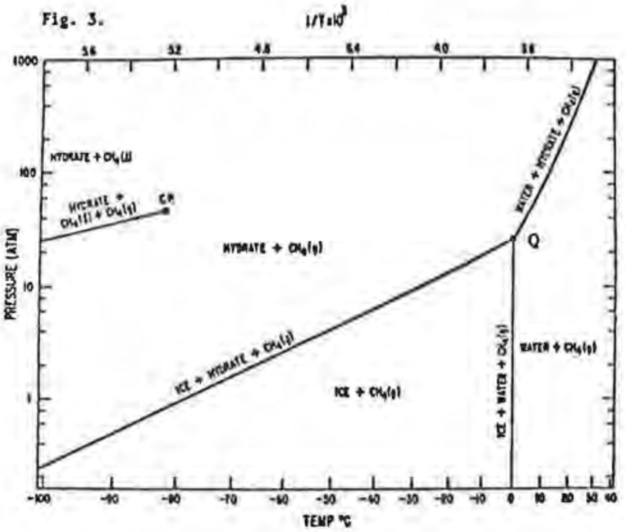
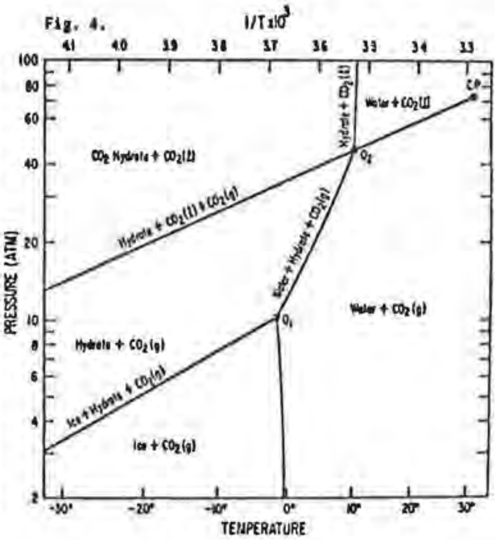


Fig. 4.



MITCHELL, R. H., 1975, Theoretical aspects of gaseous and isotopic equilibria in the system C-H-O-S with application to kimberlite: Physics and Chem. of the Earth, v. 9, p. 903-916. Author at Dept. of Geol., Lakehead Univ., Thunder Bay, Ont., Canada.

Gas equil. involving CO_2, CO, CH_4, H_2, H_2O, H_2S and SO_2 in equil. with graphite or diamond are discussed with reference to the later stages of kimberlite evolution. Partial Ps of gaseous species are considered with respect to variations in T (900-1100°K), P (1-10 kbar), f_{O_2} and f_{S_2}. Comps. of mins. xliz. at the time of groundmass form. are used in conjunction with thdy. data to det. f_{O_2} and f_{S_2}. Calc. indicate that H_2O is the dominant gas over much of the range of conds. considered; that the proportions of CO_2 and CH_4 can vary widely; and that H_2S is the dominant S-bearing species. The dominant phases during fluidized intrusion are H_2O, CO_2 and CH_4. Gas comp. are similar to those calc. for agpaitic alkaline rocks. The natural variation in the carbon isotopic comp. of diamond is discussed with respect to gas-reduction mech. involving CO_2, CO and CH_4. Calc. of the changes in isotopic comp. of the solid phases (graphite and diamond) in response to changes in gas comp. indicates that diamond isotopic comp. can be explained by variations in the proportions of carbon-bearing gases; wide variations in the isotopic comp. of kimberlite graphite are predicted. (Author's abstract.)

MITCHELL, R. H., and KROUSE, H. R., 1975, Sulphur isotope geochemistry of carbonatites: Geoch. et Cosmo. Acta, v. 39, p. 1505-1513. First author at Dept. of Geol., Lakehead Univ., Thunder Bay, Ont., Canada.

S isotopic data for sulphides and barite from several carbonatites (Mountain Pass, Oka, Magnet Cove, Bearpaw Mountains, Phalabora) show that individual carbonatites have diff. mean sulphide or barite isotopic comp. which deviate from the meteoritic mean $\delta^{34}S$ (0 °/oo).

Classification of carbonatites in terms of T, f_{O_2} and pH during form. of the S-bearing assemb. indicates that with decreasing T and increasing relative f_{O_2} the mean $\delta^{34}S$ sulphide becomes increasingly negative relative to the mean magma $\delta^{34}S$. Only barite-free high T carbonatites (Phalabora) in which the mean $\delta^{34}S$ sulphide approaches the mean magma $\delta^{34}S$ as a consequence of the paucity of oxidized anionic S species in the magma can be used to directly estim. the mean isotopic comp. of the source material.

Barites from the Mountain Pass carbonatite show an increase in δ^{34}S with sequence of intrusion of the carbonatite units; dolomitic carbonatite (mean δ^{34}S, + 5.4%), calcite carbonatite (+4.8%), silicified carbonatite (+6.9%), tabular carbonatite dikes (+8.7%), min. shear zones (+9.5%). Within each of these units a spread of 6-8% is evident. Isotopic trends in this low T (300°C) carbonatite are evaluated by treating the system as a hyd. fluid. The obs. isotopic variations can be explained by removal of large amounts of sulphur from a fluid whose mean δ^{34}S is 0 to +1%. (Authors' abstract.)

MITCHELL, S. L., and APPLEYARD, E. C., 1975, Miaskitic coronites from the Bentley-Siddon Lakes area, near Bancroft, Ontario (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 7, no. 6, p. 824. First author at Dept. of Geol., Univ. of Toronto, Toronto, Ont. M5S 1A1.

Albite-oligoclase is scapolitized by the clearing of liquid brine incs. to the margin of nepheline. (From the authors' abstract.)

MOGAROVSKY, V.V., FAISIEV, A.R., ALIDODOV, B.A., and MOROSOV, S.A., 1976, Bituminous inclusions in the minerals of some hydrothermal deposits in South Tien-Shan: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Authors at Inst. of Geol., Acad. of Sci. of Tajik SSR, Dushanbe, USSR.

Bituminous incs. along with relicts of min.-forming sols., were found in scheelite, quartz, calcite, fluorite, barite, orthoclase, and celestine. In the majority of these mins. the trapping of bituminous incs. is connected with the last stages of xl growth at 150-50°C. However, for deps. of scheelite and xl.-bearing vein quartz the bulk of the bitumens is connected with the early assoc. (200-350°). In the xls. invest. bitumen incs. occur separately or in groups. The shape is oval sometimes irregular and tubular. The size is 0.002-0.008 mm, seldom - 0.05 mm (in scheelite, quartz, calcite), and sometimes - 0.3 mm (in celestine). Hydrocarbons in incs. have various states of aggregation: solid (SB), liquid (LB), gaseous (GB); a min.-forming sol. occurs as an additional phase. The results of luminescence-bitumen anal. are given in the table.

Deposits	Minerals	n[1]	Bitumen[2]		Ratio of alcohol-benzene bitumens to chloroform ones
			min.-max.	average	
fluorite	fluorite, calcite, barite, orthoclase	132	0.001-0.02	0.007	2:1 - 8:1
rock crystal	vein quartz, rock crystal	18	0.001-0.017	0.011	2:1 - 6:1
scheelite	quartz, scheelite, calcite	11	0.003-0.008	0.007	2:1 - 3:1
celestine	celestine, calcite	27	0.001-0.01	0.003	1:1 - 1:2

[1] number of samples.
[2] oily and pitchy-oily bitumens predominate in comp.

Fluorite deps. in which bitumens were invest. belong to quartz-fluorite, sulphide-fluorite and calcite-barite-fluorite forms. Fluorite in the deps. of Sb and Hg, in peg., and optical fluorites were also invest. Bitumens were found in fluorite, calcite, barite, orthoclase. Inc. phase comp., in the order of their abundance are LB, LB + GB, and along with both, min.-forming sols. The elementary comp. of bitumen in fluorite is: C, 77-83%; H, 13%; N_2, 6%; O_2, 0.9-7%; S, 2.2-2.6%.

The bituminous incs. in quartz of xl.-bearing veins and in rock xl. are both two-phase (LB + GB) and single phase (LB).

In quartz, scheelite, and calcite of veins and skarns, the bituminous incs. are char. by a complex combination of hydrocarbons in various states of aggregation (SB, LB, GB), and aqueous sols. Among the gaseous hydrocarbons methane predominates (0.17 - 0.45 cm^3/kg).

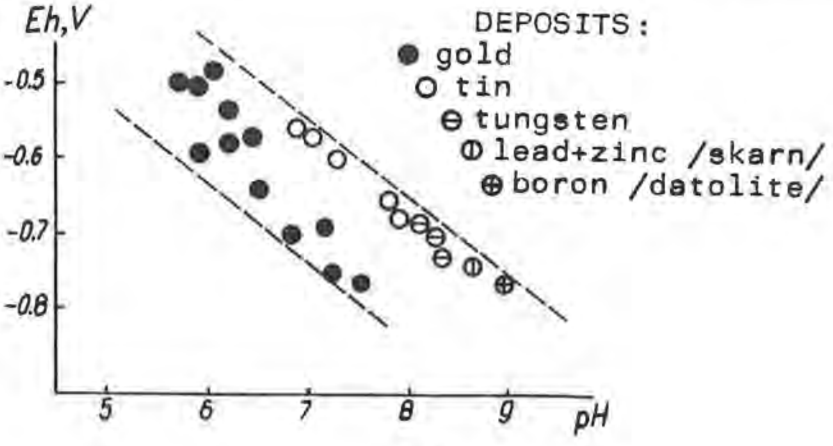
In celestine and calcite of quartz-calcite-celestine, sulphide-celestine, and celestine min., the most abundant bituminous incs. are two-phase (LB + GB) and single-phase (LB).

The above data show that hydrocarbons are present in ore-forming sols. and are present in the mins. formed to the extent of 0.001-0.01%. Mins. containing them are formed in the range of 350-50°C. The bitumen conc. in mins. does not depend on the type of the enclosing rocks. On the contrary. the maximum of bitumen is char. of mins. from deps. in granitoids and meta. ores, but not in the sed. rocks. Bitumens contained in hyd. fluids might have influenced the redox potential of the environments, especially in the end of min.-forming processes when bitumen conc. in the sols. increased markedly. Hence, studies of the hydrocarbons in hyd. mins. would be of considerable scientific interest. (Authors' abstract.)

MOISEENKO, V.G., STEPANOV, G.N. and MALAKHOV, V.V., 1975, Role of compounds of carbon in formation of ore deposits of East of USSR (abst.), p. 78-80; in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Far-East Geol. Inst. of Far-East Sci. Center of Acad. Sci. of USSR, Vladivostok.

Bicarbonate ion dominates in salt comp. of min.-form. fluids of ore deps.; the fluids bear 0.1-5 g. equiv./ℓ, i.e., 30-90 % of total anions; G cpds. of carbon usually occupy over 90% of total G in fluid incs. Values of pH and Eh calc. from chem. anal. of incs. for ore deps. from Eastern USSR are presented on the Fig. Ores are ppted. from sols. with low values of Eh and almost neutral to weakly alkaline sols. (Abs. by A.K.)

Figure. Eh-pH of hyd. sols. forming ore deps. of Eastern USSR.



MONTGOMERY, C. W., and BRACE, W. F., 1975, Micropores in plagioclase: Contrib. Mineral. Petrol., v. 52, p. 17-28. Authors at Dept. of Earth and Planet. Sci., Mass. Inst. of Tech., Cambridge, MA 02139.

Plagioclase feldspar is often surprisingly porous on a small scale. Pores range in size from less than 1 μm to about 40 μm, and occupy up to 2.3% by volume. In general, the highest plagioclase porosities occur in rocks which would have had a comparatively "wet" history: normal granites and pegs. Rocks which were drier - a gabbro, a diabase and an exceptionally dry granite - have much lower plagioclase porosities, as do two low-grade meta. samples. It is suggested that the nearly equant pores represent sites of former fluid incs., while the planar cavities of cracklike cross-section may be partially annealed fractures formed early in the history of the rock. (Authors' abstract.)

(Ed. note: Throughout the paper the pores, which the excellent SEM photomicrographs show to be ∿10-30 μm in size, are "believed to be" or "probably are" the site of former fluid incs., although they are "too small" for ordinary light microscopy (p. 25), and "...the literature contains few references to inclusions of liquid in plagioclase...")

MOORE, W. J., 1975a. Chemical characteristics of hydrothermal alteration at Bingham, Utah (abst.): Geol. Survey Research 1975, U. S. Geol. Surv. Prof. Paper 975, p. 3-4. (See next item)

MOORE, William J., 1975b, Chemical characteristics of hydrothermal alteration at Bingham, Utah (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1204-1205. Author at U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025.

Chem. variations in ign. host rocks of the disseminated copper ore zone at Bingham are systematically related to the distrib. of potassic and sericitic alt. assemb. Potassic alt. (biotite ± orthoclase) is present throughout the ore zone and is the dominant alt. type in monzonitic rocks from the southeast half, in which primary diopsidic pyroxene and hornblende are totally replaced by hyd. biotite (Mg: Mg+Fe = 0.74). Chem. changes between these rocks and their unalt. equivs. include a slight gain in SiO_2 and K_2O, and moderate loss of Al_2O_3 and CaO; FeO, MgO, and Na_2O are generally unchanged. Both hyd. orthoclase and biotite (Mg: Mg+Fe = 0.80) are conspicuous alt. phases in aplitic porphyry. Bulk comps. of added or re=equil. feldspars (Or_{81}) are more potassic than those from unalt. rocks (Or_{73}). Pervasive sericitic alt. of plagioclase (sericite + quartz ± kaolinite) is largely confined to ign. host rocks from the northwest half of the ore zone. Rocks from the sericitic zone show substantial gains in SiO_2 and K_2O; all other major elements show losses. The southern limit of the sericitic alt. transects generally concentric zones of sulfides. This alt., indirectly supergene in origin, was superimposed upon potassic assemb. as the hyd. system cooled. In monzonitic rocks of the Bingham stock peripheral to the ore zone, primary augite is commonly rimmed by hornblende or replaced by fibrous (uralitic ?) amphibole, and plagioclase is rimmed by orthoclase. These were the earliest reactions in a magmatic evolution leading subsequently to the generation of hydrous fluids responsible for successive stages of ore dep. and hyd. alt. (Author's abstract.)

MOROZOV, S. A., MOGAROVSKIY, V. V., AVER'YANOV, G. S., and FAYZIYEV, A. F., 1974, Temperatures and pressures of formation of hypogene alpine deposits in the Pamirs, the Afghan-Tadzhik basin and the southern Tien Shan (Tadzhikistan): Akad. Nauk SSSR, Doklady, v. 217, no. 2, p. 449-451 (in Russian, translated in Doklady Acad. Sci. USSR, v. 217, p. 185-186 (1975); abstract published in Internat. Geol. Rev., v. 10, no. 11, p. 1311 (1974)).

This paper covers the same material, but with considerably less data, than an abstract presented at Varna in 1974 and translated in Fluid Inclusion Research - Proceedings of COFFI, v. 7, p. 146-148 (1974). (ER)

MOROZOVA, I. M., SPRINTSON, V. D., and SHURKINA, L. K., 1975, Kinetics of argon-40 release from plagioclase in gabbro (Kola Peninsula): Geokhimiya, 1975, no. 5, p. 684-692 (in Russian; abstract translated in Geochem. Internat., v. 12, no. 3, p. 222 (1975)).

By anal. of the argonograms of the samples it was possible to distinguish the positions of "excess" and radiogenic Ar in the xl. structure of the plagioclases and to correct their apparent K-Ar ages. (From the authors' abstract.)

MOTTL, Michael J., CORR, Rosamund F., and HOLLAND, H. D., 1975, Trace element content of the Reykjanes and Svartsengi thermal brines, Iceland (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1206-1207. First author at Department of Geological Sciences, Harvard University, Cambridge, Mass. 02138.

MOTTL, M. J., and HOLLAND, H. D., 1975, Basalt-sea water interaction, seafloor spreading, and the dolomite problem (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1074. Authors at Dept. of Geol. Sci., Harvard Univ., Cambridge, MA 02138.

Alt. of basalt by sea water at Reykjanes, Iceland, and in exper. studies indicates that between 70 and 500°C, Mg is removed from sea water into basalt, while K, Ca, SiO_2, Ba, B, Li, Fe, and Mn are removed from basalt into sea water. These data are extrapolated to the mid-ocean ridges to explain the disappearance of dolomite as a major rock-type during the last 200 million years. (From the authors' abstract.)

MUEHLENBACHS, K., and CLAYTON, R. N., 1975, The interaction of seawater with the oceanic crust: oxygen isotope studies (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1074. First author at Dept. of Geol., Univ. of Alberta, Edmonton, Alberta.

O isotope anal. are very useful in studying the alt. of rocks from the oceanic crust. In many cases, not only can their T and extent of alt. be estab., but also the identity of any involved fluid. Anal. of materials recovered by dredging or deep-sea drilling reveal that most submarine basalts, even those recovered from several hundred meters depth within the oceanic crust, are a few percent weathered by cold seawater. No evidence for the presence of hot seawater was found in basalts from DSDP Legs 34 and 37. In marked contrast, however, all anal. intrusive rocks recovered by dredging or drilling, are hyd. alt. The hyd. alt. resulted most likely from the interaction of seawater with solidified but still hot ign. intrusions. The above obs. suggest that the reaction of seawater with oceanic crust involves two distinct processes: (1) the weathering of basalt at depth in the crust by cold seawater and (2) the high T, post solidus exchange between ign. intrusions and seawater. If the heavy metals found in certain seds. are products of seawater - crust interaction, then they should be considered as a mixture of those extracted by cold seawater from basalt and those extracted by hot seawater from cooling intrusives. (Authors' abstract.)

MUEHLENBACHS, K., and KUSHIRO, I., 1975, Measurements of oxygen diffusion in silicates; Amer. Geophy. Union, Trans., v. 56, no. 6, p. 459. First author at Dept. of Geol., Univ. of Alberta, Edmonton, Alberta, Canada.

Diffusion coefs. have been deted. in a variety of silicate melts and mins. by a high T gas-solid isotope exchange technique. In silicate liquids the O diffusion coefs. are inversely correlated with SiO_2 content ranging at 1280°C from 3.1×10^{-8} cm^2/sec in basaltic melt to 4.2×10^{-11} cm^2/sec in rhyolitic melt. (From the authors' abstract.)

MUELLER, G., 1975, Crystallographically ordered organic inclusions from fluorites of the Illinois-Kentucky orefield, p. 46-47, in Colloquium on Chemical Evolution of the Precambrian (Early Precambrian), College Park, Md., 1975: College Park, Md., Dept. Chem., Univ. of Md. Author at Dept. of Chem. and Geol., Florida Atlantic Univ., Boca Raton, Florida 33432, USA.

The author provides some additional xlographic details on the occurrence of oriented org. matter on the walls of incs. in Illinois fluorite. first reported by Roedder (1962 and 1972), and extrapolates to the possibility that this might provide a "missing link" in the biochemical processes in chemical evolution. (ER)

MUKAIYAMA, Hiromu, MONONOBE, Sakiyuki, and YOSHIDA, Tetsuo, 1974, Genesis of the ore deposits of the Iwami mine, Shimane Prefecture, Japan, in Ishihara, S., ed., Geology of Kuroko Deposits: Tokyo, Soc. Mining Geol. of Japan, p. 221-234.

T_F has been est. from T_H of incs. in sphalerite and quartz. Generally higher Ts are observed towards the deeper part of the dep. Diff. in T exist between diff. orebodies and groups of the deps. T_H in sphalerite in sandy ores in the lower horizon of bedded "Kuroko" range from 204°C to 230°C and the values are similar to those obs. in the upper part of the network deps. The T in the bedded clayey ores is not available. Ts in gypsum deps. are 177°C-192°C, corresponding to the lowest T in the network deps.

In the network deps., the eastern group shows higher Ts than the western; the northern group is intermediate. Higher Ts are generally obs. from the deeper parts. Diff. in T between the eastern and western is less distinct in lower levels.

The salinity is est. to be $\sim$1-5 wt% NaCl equiv. Ores showing higher Ts have higher sal. This suggests dilution of ore sol. during form. of the dep.

Foraminifera and sed. structures indicate stagnant, shallow, open sea envir. If T_F of the uppermost network deps. is assumed to be 200°C from the inc. data on the 55 m level (186°C-231°C), the vapor P of water is about 15 kg/cm^2. Boiling appears improbable in Kuroko deps. in view of the sed. structures. The depth of sea water needs to be more than 150 m to prevent boiling. Network deps. are, however, covered with clay beds, bedded Kuroko, and gypsum deps. as overburdens. So we may assume that the ore deps. formed in the sea at <150 m deep. (Adapted from the authors' abstract by E.R.)

MULLIS, Josef, 1975, Growth conditions of quartz crystals from Val d'Illiez (Valais, Switzerland): Schweiz. mineral. petrogr. Min., v. 55, p. 419-429 (in English). Author at Inst. de Min. et Pét., Univ., 1700 Fribourg-Pérolles, Switz.

Quartz xls. from Val d'Illiez show a close relationship between tectonics at the outcrop scale, quartz morphology and fluid incs. Four different habits (normal prismatic, prismatic with a white stripe, sceptres and skeletal habit) are found in four different generations of growth, each one showing two stages, an early and a late one. Microthermometric methods gave Ts and Ps of form. of the four generations. Sceptres and skeletal forms (early stages) grew quickly in a methane-rich phase during enlargement of alpine clefts. Methane-rich phase in alpine clefts was formed by quick diffusion of methane into the cleft-cavity due to lower P in the cavity (70-1200 bars difference). Prismatic growth (late stages) are the product of slower growth, when xliz. was influenced by presence of water. (Author's abstract.)

Note: The above abstract does not indicate the detailed studies of the results of freezing on mixed org.-H_2O-salts incs. that are given here in abbreviated form and will be available in full in a 1976 Ph.D. thesis. (ER)

MUNOZ, J. L., and LUDINGTON, Steve, 1975, Fluoride-hydroxyl exchange in muscovite: exchange equilibrium in muscovite-biotite assemblages (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1208. First author at Department of Geological Sciences, University of Colorado, Boulder, Colorado 80302.

MURRAY, D. P., 1974, Formation of epidote in calc-silicates from east of the Canopus Valley fault, Reading prong, New York (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 6, no. 7, p. 1051. Author at Dept. of Geol., Amherst College, Amherst, MA 01002.

The environment of form. is interpreted in terms of X_{CO_2} of the adjacent fluid. Epidote comps. indicate that T_{max} attained during meta. in this area was 625°C. (ER)

MUSTART, David A., 1975, An experimental model for continuous transition from magma to hydrothermal solution in peralkaline systems (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1208-1209. Author at Department of Geology, San Francisco State University, San Francisco, California 94132.

In order to model the xliz. history of hydrous peralkaline silicic magmas, phase relations in the system albite-sodium disilicate-water have been invest. at Ps to 72,000 psi and Ts to 1100°C. Evaluation of the subsystem sodium disilicate-water indicates that the join is binary and that the melting curve, Ds+V=L, is discontinuous and terminates at a second critical end point at 330°C and 15,000 psi. Above this P, xl. sat. sols. pass continuously on cooling, to a fluid containing 55 wt% dissolved silicates at 200°C. The binary critical curve, L=V, extends from the second critical end point to a P max. at 70,000 psi, above which only a single supercritical fluid exists on the join. Addition of CO_2 to the system was found to markedly affect phase relations and therefore, considerable care must be taken to avoid atmospheric contamination of starting materials.

In extending invest. to the aluminum-bearing peralkaline system albite-sodium disilicate-water, the tendency for sol. immiscibility is greater than that shown by simple alkali silicate melts. However, below the ternary critical curve, the miscibility gap for albite sat. sols. disappears. As a result, at 72,000 psi, xliz. of albite follows a continuous path from a peralkaline melt containing 2 wt% water at 1000°C, to a sol. bearing 26 wt% water at 400°C, without separation of a separate vapor phase. This evidence supports the suggestion made by Tuttle and Bowen (1958) that hydrous peralkaline melts will show a continuous gradation from vapor undersaturated magma to water-rich hyd. sols. (Author's abstract.)

MYSEN, Bjørn, 1975a, Solubility of CO_2 in the system $Na_2O-Al_2O_3-SiO_2-H_2O-CO_2$ to 30 kbar: Amer. Geophy. Union, Trans., v. 56, no. 6, p. 469-470. Author at Geophy. Lab., 2801 Upton St. NW, Wash. DC, 20008.

C-14 has been used to det. C contents of $NaAlSi_3O_8$ (Ab), $NaAlSi_2O_6$ (Jd) and $NaAlSiO_4$ (Ne) Ls in the presence of both pure CO_2 and CO_2+H_2O vapors.

The values are insensitive to T and silicate chem. IR reveals both CO_2 and CO^{2-}_3, but no other C-O cpds in these liquids, CO^{2-}_3/CO_2 increases with increasing T, presence of H_2O and decreasing degree of silicate polymerization. For example, no CO^{2-}_3 is detected in Ab melt at 20 kbar and 1450°C, whereas perhaps 50% of the C-O is carbonate at 1600°C. (From the author's abstract.)

MYSEN, B. O., 1975b, Solubility of volatiles in silicate melts at high pressure and temperature: the role of carbon dioxide and water in feldspar, pyroxene, and feldspathoid melts: Carnegie Inst. Wash., Geophy. Lab. Yearbook 74, for 1974-1975, p. 454-468.

See two adjacent entries. (ER)

MYSEN, Bjørn O., and ARCULUS, R. J., 1975, Solubilities of carbon dioxide in natural andesite, tholeiite and olivine nepheline melilitite melts to 30 kbar pressure (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1209. Authors at Geophysical Laboratory, 2801 Upton St., N. W., Washington, D. C. 20008.

Beta-track mapping techniques have been used to measure soly. of CO_2 in three natural melt comps., andesite (CA), tholeiite (K1921) and olivine nepheline melilitite (OM1), in the presence of a vapor anal. as containing 98 mole % CO_2 (2% $CO+H_2O$). CO_2 soly. vary between 1.43 wt % (CA at 1650°C) and 7.11 wt % (OM1 at 1650°C and 30 kbar). On a weight basis, 150-180% more CO_2 dissolves in OM1 than in CA. Tholeiite is intermediate between these two. Soly. increase isobarically with increasing T and isothermally with increasing P. The addition of H_2O increases the CO_2 soly. to pass through a max. at some intermediate $CO_2/(CO_2+H_2O)$ value (X_{CO_2}). This X_{CO_2} only depends on P, but the value of CO_2 soly. at this max. increases with increasing basicity of the melt. In these respects, natural silicate melts are similar to simple min. melts in the systems $CaO-MgO-SiO_2$ and $Na_2O-Al_2O_3-SiO_2$ reported on previously. IR meas. demonstrate the presence of both molecular CO_2 and $CO^{2}{}_{\overline{3}}$ anions in the quenched melts. The $CO^{2}{}_{\overline{3}}$ anion becomes more important with increasing basicity of the melt. The data are combined with published phase equil. data on model and natural mantle systems in the presence of CO_2 and CO_2+H_2O vapors. The contrasting soly. of CO_2 and H_2O have been used to argue that a separate vapor phase is likely to be present in an oceanic upper mantle. Given this condition, the data can explain the existence of andesitic, tholeiitic and nephelinitic melts occurring together in various island arcs, and the appearance of tholeiitic and nephelinitic magmas on oceanic islands such as Hawaii. (Authors' abstract)

MYSEN, B. O., ARCULUS, R. J., and EGGLER, D. H., 1975, Solubility of carbon dioxide in melts of andesite, tholeiite, and olivine nephelinite composition to 30 kbar pressure: Contr. Min. Petrol., v. 53, p. 227-239.
See previous item. (ER)

MYSEN, B. O., and BOETTCHER, A. L., 1975, Melting of a hydrous mantle: I, Phase relations of natural peridotite at high pressures and temperatures with controlled activities of water, carbon dioxide, and hydrogen; and II, Geochemistry of crystals and liquids formed by anatexis of mantle peridotite at high pressures and high temperatures as a function of concontrolled activities of water, hydrogen, and carbon dioxide: Jour. Petrology, v. 16, no. 3, p. 520-548, 549-590.

NALDRETT, A. J., and SHIMA, H., 1975, Solubility of sulfur in ultramafic melts and the relevance of the system Fe-S-O (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 7, no. 6, p. 828. Authors at Dept. of Geol., Univ. of Toronto, Toronto, Ontario M5S 1A1.

An ultramafic silicate melt (SiO_2=45.6; Al_2O_3=8.75; FeO=12.43; MgO= 22.96; CaO=7.73; $NaO_{1/2}$=0.50 wt%) has been equil. at 1450°C and a series of sulfur fugacities (ranging from 10^{-4} to $10^{-1.4}$ atm.) at two different oxygen fugacities ($10^{-10.4}$ and $10^{-9.2}$ atm.) and the sulfur content det. for each of the exper. charges.

At the lower f_{O_2}, an immiscible sulfide liquid first segregated from the melt at a sulfur fugacity between $10^{-2.4}$ and 10^{-2} atm. at which stage the melt contained between 0.16 and 0.27 wt% S. It was not possible to saturate the melt at the higher f_{O_2} even with the $f_{S_2}=10^{-1.4}$ atm.

An immiscible sulfide-rich liquid will segregate from a silicate melt when the activities of all components in the liquid equal those in the melt. Using data from the metallurgical literature and from Naldrett (1969), a portion of the Fe-S-O system has been contoured in terms of a_{FeO}, f_{O_2} and f_{S_2} at 1450 and 1200°C. In this way, for any given T and oxygen fugacity, it is possible to predict the sulfur conc. in the melt when segregation occurs. (From the authors' abstract.)

NARSEEV, V. A., and BAKHANOVA, Ye. V., 1975, Evolution of hydrocarbons in hydrothermal systems (abst.), p. 35-36, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Kazakh Inst. of Mineral Raw Materials, Alma Ata.

The authors suggest two branches of development of magmatogenic hydrotherms: hydrocarbon (HC) and hydroxile (oxygen). The first is connected with mantle ultrabasic and basic magmas and the second with crustal acid magmas. The preservation of HCs depends on continuous presence of H_2 precluding the interaction between oxygen and HCs. In G/L incs. of plutonic deps. (Bestyube) the content of HCs increases from low to high levels (effect of volatility) and it decreases from early to late generations of quartz (effect of decrease of reducing ability of sols.). The average molecular weight of HCs increases from early to late stages. (Abs. by A.K.)

NASEDKIN, V. V., 1975, Petrogenesis of acid volcanites: Moscow, "Nauka" Press, 207 pp. (in Russian).

T_H of glass incs. in plagioclase from liparite (p. 38; locality not given) are 956-1030°C. (A.K.)

NAUMOV, G. B., and DOROFEYEVA, V. A., 1975, Chemical nature of the acidity evolution in endogenous solutions: Geokhimiya, 1975, no. 2, p. 248-258 (in Russian; abstract in Geochem. Internat., v. 12, no. 1, p. 201, 1975)).

A model for pH changes in the cooling of an endogenous sol. is discussed. Changes in the assoc. constants of various alkali chlorides, acids, and gases are discussed with respect to the dissoc. constant of water. The influence of country rocks and the significance of the K-feldspar-muscovite equil. occurring at diff. pH's due to the varying comp. of the sol. are discussed. The authors conclude that CO_2 is the major control of pH changes in the endogenous sols. from 25° to 500°C. (Robert W. Potter)

NAUMOV, G.B., MIRONOVA, O.F. and KUZ'MIN, M.B., 1972, Carbon dioxide of hydrothermal solutions, pp. 181-188, in Recent contributions to geochemistry and analytical chemistry, A.I. Tugarinov, ed.: Moscow, Izdat. "Nauka" (in Russian; translated by Israel Program for Sci. Translations, pub. by J. Wiley, 695 pp., 1975). Authors at V.I. Vernadskii Inst. Geochem. Anal. Chem., Acad. Sci. USSR, Moscow.

Data on the contents of CO_2 in G-L incs. in mins. of hyd. veins demonstrate that appreciable amounts of CO_2 are permanently present in ore-bearing sols. It is shown that the highest CO_2 contents are char. of high-T quartz and fluorite veins devoid of carbonate mins. The geochem. importance of CO_2 in hyd. min. form. is discussed.

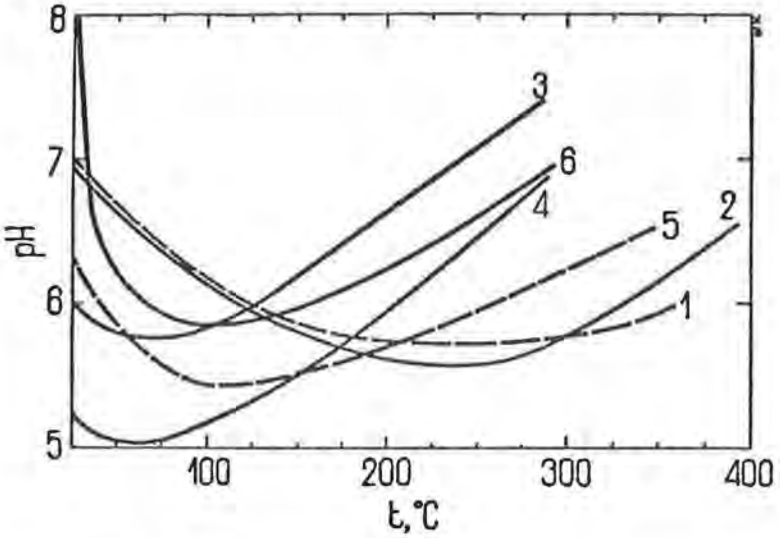
NAUMOV, G. B., MIRONOVA, O. F., and NAUMOV. V. B., 1975, Compounds of carbon in inclusions in hydrothermal quartzes (abst.), p. 3-4, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Vernadsky Inst. of Geochem. and Anal. CHem. of Acad. Sci. USSR, Moscow.

One of common components forming dep. of Sn, Au, W, Sb, As, Hg, etc., is CO_2 in conc. usually not lower than 10 g/l, and often it forms a liquid phase at $T < 31°C$ (conc. 50-400 g/l). Also reduced forms of C are known from incs. (CH_4, etc.). The possibility of carbon existing with various degrees of oxidation complicates the methods of opening of incs. and interpretation of the results. The thermal method may cause oxidation of reduced forms of C to the end form of oxidation: CO_2 (examples were given). Also the det. of CH_4 may be uncertain due to the possibility of synthesis of this cpd. from other forms.

Crushing also yields ambiguous results, due to change of gas equil. from T_F to room T and processes of sorption of gases by crushed min. However, the presence of both reduced and oxidized forms of C in incs. is now sure and these cpds. ought to display as significant a role in min. forming processes as pH and Eh buffers, having influence on the behaviors of other ions, including ore elements and especially elements with variable valence such as S, det. the devel. of ore process. (A.K.)

See also Figure (Note: this figure was given during Naumov's presentation of the article in L'vov, but not in the abstract volume; for additional data see Naumov and Dorofeeva, 1975, this volume. (A.K.)

Figure. Relationship between T and pH of CO_2-bearing aq. sols.: 1 - neutral line of water $H^+ = OH^-$, 2 - 1 M sol. of KCl, 3 - $\Sigma CO_2 = 1M$, $K^+ = 0.2$ M, 4 - $\Sigma CO_2 = 5M$, $K^+ = 0.2M$, 5 - $\Sigma CO_2 = 1M$ in equil. with potash feldspar, 6 - curve of acidity of cooling hyd. soln. with decreasing conc. of ΣCO_2 (T/conc. in M per kg H_2O: 300/10, 250/5, 200/3, 150/2, 100/1.5, 50/1, 25) in equil. with air, conc. of alkaline elements 0.2 gram-equiv. per kg H_2O.



NAUMOV, V. B., 1976, Results obtained in laboratories of the USSR on thermometric measurements of inclusions in standard samples of quartz: Geokhimiya 1976, no. 7, p. 1109-1112 (in Russian). Author at Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR, Moscow. (See translations)

NAUMOV, V. B., and IVANOVA, G. F., 1975, Thermobaric conditions of fluorite formation in wolframite deposits: Geokhimiya, 1975, no. 3, p. 387-400 (in Russian; translated in Geochem. Internat., v. 12, no. 2, p. 64-77, 1975). First author at V. I. Vernadsky Inst. of Geochem. and Anal. Chem., USSR Acad. Sci., Moscow.

Invest. of G-L incs. in the mins. of wolframite deps. of diff. types shows that fluorite xlizes in a broad T range, from 400 to 50°C. The fluorites fall into two groups. The first group contains fluorites syngenetic with Mo-Sn-W min., whose T_H range from 400 to 250°C and in most cases from 340 to 260°C. The second group includes fluorites which xlized after dep. of ores, their T_H range from 250 to 50°C. Some of them with T_H 250-200°C are assoc. with feldspars and carbonates. Ts from 170 to 100°C are char. of late fluorites occurring in druses in quartz-wolframite veins and of fluorites of fluorite deps. Fluorites syngenetic with W min. xliz. under high Ps (1150-550 bars), while the low T fluorites xliz. at lower Ps (400-300 bars). (Authors' abstract.)

NAUMOV, V. B., NIKITIN, A. A., and SALAZKIN, A. N., 1975, A thermometric study of melt inclusions in quartz phenocrysts in East Transbaykalia acid lavas: Geokhimiya, 1975, no. 2, p. 295-298 (in Russian; abstract translated in Geochem. Internat., v. 12, no. 2, p. 201.

T_H of gas + glass and of gas + glass + xl. incs. were det. Three major ranges were found: 860-940°C, 980-1100°C, and 1180-1260°C. (L. P. Greenland)

NEDACHI, Munetomo, 1974, Mineralization of the Kohoku gold, silver and copper ore deposits, Miyagi Prefecture, Japan: Tohoku Univ., Sci. Reports, Series 3, v. 12, no. 3, p. 331-394 (in English).

Many hypothermal-epithermal Cretaceous Au-sulfide-quartz veins are located in the southern Kitahami mountainland, Northeastern Japan. Three kinds of ore bodies can be dist. as follows: (1) arsenopyrite-pyrite-pyrrhotite, (2), pyrite-pyrrhotite-chalcopyrite, and (3) calcite. Each ore body shows zonal arrangement. Especially the pyrite-pyrrhotite-chalcopyrite ore body can be divided into the following zones: pyrite, magnetite, pyrrhotite-chalcopyrite-sphalerite, and sphalerite-galena. The T_H of fluid incs. in quartz in the above zones are 300°C, 270°C, 260°C, and 240°C, respectively. T_{Frz} is about -7°C.

Fluid incs. of three phases; halite, liquid and gas, are often obs. in the granitic rocks, especially in granodiorite.

The conds. of pption of the ore mins. were calc. and given in terms of log f_{O_2}, log f_{S_2}, pH, and Eh. (From the author's abstract.)

NEDUMOV, I.B., 1975, Magmatism and pegmatite formation. Investigations of geological systems of various ranges: Moscow, "Nauka", 235 pp. (in Russian). Author at Inst. Mineral. Geoch. Crystallochem. of Rare Elements, Moscow.

Author summarizes (p. 180-191) ideas on separation of volatiles from magm. melts and on peg. form., pertinent to fluid inc. studies. (A.K.)

NEHRU, C. E., and WYLLIE, P. J., 1975a, Compositions of glasses from St. Paul's peridotite partially melted at 20 kilobars: Jour. Geol., v. 83, p. 455-471.

NEHRU, C. E., and WYLLIE, P. J., 1975b, Electron microprobe measurement of pyroxenes coexisting with H_2O-undersaturated liquid in the join $CaMgSi_2O_6$-$Mg_2Si_2O_6$-H_2O at 30 kilobars, with applications to geothermometry: Contrib. Mineral. Petrol., v. 48, p. 221-228.

NEKRASOV, I. Ya., and BORTNIKOV, N. S., 1975, Conditions of formation of sulfosalts and sulfostannates of lead and antimony: Geol. Rudn. Mest., v. 17, no. 6, p. 53-64 (in Russian). Authors at Inst. of Exper. Min. of Acad. Sci. USSR.

Exper. studies of the system Pb-Sn-Sb-S were made, as well as the ternary joins Pb-Sn-S and PbS-Sb_2S_3, in aq. sols. of HCl, NH_4Cl and NaOH at T = 300-400°C and general $P = P_{H_2O}$ = 1000 atm. All known natural sulfosalts of Pb and Sb, and sulfostannates (teallite, franckeite and cylindrite) were xliz. Phase relations in the part of system Pb-Sn-Sb-S were studied and the conds. of pption of appropriate mins. for Bolivian-type deps. were evaluated. (Authors' abstract, translated by A.K.)

NEKRASOV, I. Ya., and RYADCHIKOV, A. P., 1975, Conditions of synthesis of teallite and phase relations in the system PbS-SnS-HCl (at 300-400°C): Contributions to physico-chemical petrology, v. 5, p. 195-210, "Nauka" Press, Moscow (in Russian).

In chloride hyd. sols. teallite was syn., with comp. close to $PbSnS_2$. Acid sols. are preferable under reducing conds. for pption of teallite at $T \leq 300°C$. From 0.5 N sol. of HCl at 300°C, in addition to PbS and a series of solid sols. based on teallite, ottemanite (Sn_2S_2) is stable, and at 400°C - cassiterite. In 1 N HCl these phases disappear. (From authors' abstract, translated by A.K.)

NESBITT, Bruce E., and KELLY, William C., 1975, Fluid and magmatic inclusions in the carbonatite at Magnet Cove, Arkansas (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1212. Authors at Department of Geology and Mineralogy, The University of Michigan, Ann Arbor, Michigan 48104.

Study of the carbonatite complex at Magnet Cove, Arkansas, reveals a variety of fluid and magmatic incs. which were studied by optical and scanning electron microscopic methods (see abstract by Metzger, Nesbitt and Kelly). Monticellite contains P magmatic incs. now xliz. to calcite, Ca-Mg silicates and Fe or Mg-Fe oxides. The original melt contained at least 10 wt % each of Si and Mg and lesser amounts of Fe, S, K and Na. Apatite also entrapped this melt along with a CO_2-rich fluid in separate primary incs. Magmatic calcite contains S, water-rich incs. of highly varied comp. The most saline of these display up to 8 dms., commonly including halite, sylvite, gypsum, glauberite and arcanite(?)*. These grade into more dilute incs. that normally contain needles of strontianite, often accompanied by barite.

*K_2SO_4

These incs. offer a significant, albeit fragmentary, record of fluids involved in evolution of the carbonatite complex. The primary incs. in montecellite and apatite indicate coexistence of $CaCO_3$-rich melt and a CO_2-rich fluid at an early magmatic stage. Secondary incs. in calcite reveal the presence of hot (> 300°C), highly saline, aq. brines at a later time, and such fluids may be related to those responsible for fenitization in other carbonatite localities. With dilution and cooling (to $\sim$110°C), these brines evidently evolved into Sr-Ba sols. that may be assoc. with a replacement dep. of barite near the Magnet Cove complex. (Authors' abstract.)

NEWTON, R. C., and GOLDSMITH, J. R., 1975, Stability of the scapolite meionite ($3CaAl_2Si_2O_2 \cdot CaCO_3$) at high pressures and storage of CO_2 in the deep crust: Contrib. Mineral. Petrol., v. 49, p. 49-62. Authors at Dept. Geophys. Sci., Univ. Chicago, Chicago, Illinois 60637.

From this study, the authors conclude that, in view of its great thermal stability, meionite can play a role as a P min. in deep-seated basic or intermediate magmatic processes. It is also likely that CO_2 coming from the earth's interior will be captured by reaction with plagioclase and clinopyroxene. Scapolite has been noted in basic granulite incs. from basaltic pipes in three continents. It seems probable that scapolite acts as a major storage site for CO_2 in the deep crust. (From the authors' abstract.)

NIKANOROV, A. M., and SIANISIAN, E. S., 1975, Inclusions of hydrocarbons in calcite veins from NE Caucasus (abst.), p. 70-71, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Rostov State Univ.

Vein calcite from Upper Cr limestones from region of deep fault in Chernogor'e have one-phase incs. of bitumen, and 3-phase incs., 40-50 µm (bitumen + G + L_{H_2O}). The first type contain asphaltene; the second an oil-like bitumoid. G/L incs. from this same xl. zone gave T_H = 95-105°C. Wall limestones have decrepigraphs with two peaks, 100-110°C and 180-220°C. Authors tried to apply inc. data to det. the zones of migration of HCs. (Abs. by A.K.)

NORDSTROM, D. K., and JENNE, E. A., 1975, Fluorite solubility equilibria in selected geothermal waters (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section III, Abstract No. 70. Authors at U. S. Geol. Survey, Menlo Park, CA 94025.

Calc. of chem. equil. in hot springs and other surface waters from selected geothermal areas in the Western United States indicate that these waters are in equil. with the min. fluorite (CaF_2) if conc. are compared with published soly. meas. rather than with thdy. data based on calorimetric meas. A critical review of available thdy. data leads to revised est. for the log K_{sp} (-11.0), $\Delta G^{\circ}_{f,CaF_2}$ (-280.79), and ΔH°_{f} (-293.15 kcal per mole) of fluorite. (These est. also consider recent data on the weak CaF^+ complex although it has little effect on the CaF_2 soly. value.) This CaF_2 soly. value is confirmed by the computer-based activity product calc. of several geothermal waters. Thus, chem. studies of geothermal waters indicate equil. between fluorite and the thermal waters under a variety of cond. Such studies may provide a means of evaluating published soly. values of other mins. when the thdy. data contain major discrepancies. (Authors' abstract.)

NORMAN, D.I., 1975, Analysis of volatiles in fluid inclusions, Amer. Geophys. Union, Trans., v. 56, no. 6, p. 459-460. Author at Dept. of Geol. & Geophys., Univ. of Minn., Minn., Minn. 55455.

A quadrapole mass spectrometer system equipped to measure surface areas using the B.E.T. technique was used to invest. various aspects of the problem of anal. the volatiles in fluid incs.

Crushing quartz (fused silica) rod with ampules of H_2, CH_4, N_2, CO, CO_2, NH_3, and C_2H_6 totalling $\sim$950 µl, at room T, resulted in the absorption of 155 µl/m² of fresh surface area generated. Absorption is roughly inversely proportional to the room T gas-liquid vp. of the various gases.

Crushing similar amounts of quartz with a capillary containing $\sim$10 mg. H_2O and ampules of various gases inc. H_2, He, CH_4, N_2, O_2, Ar, CO, CO_2, C_2H_6 and C_3H_8 totalling $\sim$70 µl decreased the absorption to 13 µl/m². Again absorption was inversely proportional to vp. with the exception of CO_2 and C_2H_6. These gases can be almost totally recovered by pumping with liq. N_2. Water, which apparently is preferentially absorbed leaving fewer sites for other gases, can be recovered by warming the sample to 125°C and pumping with liq. N_2 for $\sim$24 hours. Water loss averages 0.38 mg/m². When crushed with water, NH_3, SO_2, and H_2S totally disappear. It is not clear if they react with the system or travel with the water which is drawn off and weighed.

A comparison of liberating gases by crushing and decrep. was accomplished using material from a single xl of quartz from the Snowbird Mine, Montana. It was chosen because of its homogeneous inc. assemb. The results of the two methods were nearly identical: in mol % 92.6±0.8 H_2O, 6.8±0.7 CO_2, 0.58±0.11 N_2. No serious reactions between N_2, CO_2, H_2O and furnace were det.

The evidence suggests that both methods may be used to accurately anal. the major volatiles in inc-rich material. (Authors' abstract.)

NORONHA, Fernando, 1974, A study of fluid inclusions in quartz veins from the tungsten deposit at Borralha, northern Portugal. Publicaçoes do Museum e Laboratorio mineralogico e geologico da faculdade de Ciencias do Porto, v. 85, series 4, p. 1-36 (in French). Author at Departamento de geologia, Faculdade de Ciencias, Porto, Portugal.

The paragenetic succession is given for the ores from Borralha, a woframite-scheelite assemb. with assoc. sulphides (mainly chalcopyrite, pyrite, sphalerite and molybdenite).

350 incs. in quartz reveal four P or PS types: A, 3-phase H_2O-CO_2 incs. in quartz assoc. with wolframite; B, 3-phase aq. incs. (one solid phase) in quartz assoc. with chalcopyrite; C, 2-phase aq. incs., the most abundant type; and D, single phase aq. incs.

An ordered and systematic fluid evolution corresponds to the succession of observed metallic parageneses, with correlated lowering of both T_H and salinity. The P - T form. conds. of the wolframite are est. to be 280 - 350°C and I Kbar. Anal. of Na^+, K^+, Ca^{2+}, Mg^{2+} on wolframite-bearing quartz (K/Na from 0.022 to 0.077) and on chalcopyrite-bearing quartz (K/Na from 0.033 to 0.049) are given. (Abstract by M. Pagel; translated by Chris Eastoe).

NORTON, Denis, 1975, Porphyry pluton environments: fluid-rock interactions predicted from theoretical models of heat and mass transfer (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1215. Author at Department of Geosciences, University of Arizona, Tucson, Arizona 85721.

NOVGORODOV, P. G., 1975, Solubility of quartz in H_2O-CO_2 mixtures at 700°C and pressures of 3 and 5 kbar: Geokhimiya, 1975, no. 10, p. 1484-1489 (in Russian; translated in Geochem. Internat., v. 12, no. 5, p. 122-126, 1975.) Author at Inst. of Geol., Yakutia Branch, Sib. Div., Acad. of Sci. of the USSR, Yakutsk.

Meas. have been made on the soly of quartz in H_2O-CO_2 mixtures at 700°C and P of 3 and 5 kbar; the soly increases with the proportion of water in an exponential fashion up to a certain point. Equas. describing the soly have been derived. It is supposed that the deviation from linear behavior on the soly curve represents the limiting comp. of the H_2O-CO_2 mixture set by the fugacity rule. The results are of value in elucidating the conds. of transport and dep. of silica in endogenous processes, and can also be used in thdy. calcs. on the SiO_2-H_2O-CO_2 system. (Author's abstract.)

OHMOTO, H., KERRICK, D. M., and SHETTEL, D. L., 1975, Stability of graphite-bearing metamorphic mineral assemblages in P - T - f_{O_2} space (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1217-1218. Authors at Department of Geosciences, The Pennsylvania State Uni-

versity, University Park, Pennsylvania 16802.

Mole fractions of gaseous species (H_2O, CO_2, CH_4, H_2, CO, H_2S, SO_2, SCO, etc.) in fluids in equil. with graphite ± pyrite ± pyrrhotite can be computed as functions of P_{fluid}, T, and f_{O_2}. Computations were carried out using the latest thdy. data and fugacity coef. of individual species in the P-T range: 0.5-10 kb and 300-1000°C.

At a constant P-T, the predominant fluid specie changes from CO_2 to H_2O to CH_4 with decreasing f_{O_2}. Contours of X_{H_2O} on f_{O_2}-T sections define a narrow H_2O-rich region (e.g., 3 log f_{O_2} units at 350°C and 1 log f_{O_2} unit at 1000°C at 2 kb) which progressively crosses more reduced oxygen buffer assemblages (NNO→QFM→WM) with increasing T. With increasing P, this narrow H_2O-rich band expands (e.g., 5 log f_{O_2} units at 350°C and 8 kb). On these log f_{O_2} - T diagrams, dehydration equil. have maximum Ts coinciding with the central part of the water-rich zone, and the equil. Ts drop sharply in the f_{O_2} - T regions away from this zone. Hydrous assemb. in graphitic pelites thus define a narrow zone in f_{O_2}-T space, providing an excellent monitor of O fugacities. Addition of decarbonation and two-volatile (H_2O-CO_2) equil., as in calcareous pelites, provide particularly narrow brackets of f_{O_2}-T conds. For graphitic pelites, buffered devolatilization equil. provide a mech. for controlling O fugacities, and for reduction of assemb. with prograde meta. Migmatites formed in the presence of graphite + muscovite + quartz are restricted to a narrow region in f_{O_2}-T space below the QFM buffer and to Ps above ∿ 5 kb. (Authors' abstract.)

OHRING, Milton, and TAI, King Lien, 1969, Gas-filled bubbles in ionic solids: Jour. Amer. Ceramic Soc., v. 52, p. 559-562. Authors at Dept. Metal., Stevens Inst. Tech., Hoboken, N.J. 07030.

A device to selectively introduce gases into a melt of KCl from which single xls or oriented bixls are being pulled is described. The insol. gases (e.g. Ar, Cl_2, N_2, and CO_2) were incorporated into the growing xls in the form of bulk and grain boundary bubbles having a decided xlog. appearance. The as-grown bubbles of Ar and Cl_2 were extended along the growth axis, whereas those of N_2 and CO_2 were compressed in this direction. The bubble shapes are expected to depend on surface energy considerations and on the way in which the gas interacts with the solid; the bubble geometries were qual. consistent with available data on the theor. adsorption behavior of these gases on (100) xl faces of KCl. On annealing under load, the bubbles became highly faceted. Only the very stable (100) plane developed; this indicates the extreme anisotropy of the surface energy even at Ts approaching the melting point. The failure of bubbles to evolve completely into cubes is probably due to the difficulty of establishing growth habits normal to the (100) plane. (Authors' abstract.)

OKAMURA, Saburo, 1974, On the formation temperature of carbonatite from the Oka, Quebec, Canada: Jour. Mining and Met. Inst. of Japan, v. 90, p. 763-768 (in Japanese with English abstract).

Many very small polyphase incs. are found in calcite, apatite and biotite from the Oka carbonatite. T_H for calcite was 275-395°C (320° avg.) and 260-350°C (300° avg.) for apatite. Birefringent dms (unidentified) do not melt at T_H. T_F is est. at 600-800°C from these data. (From the author's abstract.)

O'NEIL, J. R., ADAMI, L. H., and EPSTEIN, Samuel, 1975, Revised value for the O^{18} fractionation between CO_2 and H_2O at 25°C: Jour. Research U.S. Geol. Survey, v. 3, no. 5, p. 623-624. First author at U.S. Geol. Survey, Menlo Park, Calif.

A new value of 1.0412 for the fractionation factor α between CO_2 and H_2O at 25°C is recommended on the basis of new data and a reevaluation of earlier published data. (Authors' abstract.)

O'NEIL, J. R., TRUESDELL, A. H., and McKENZIE, W. F., 1975, ΔC^{13} (CO_2-HCO_3^-) as a possible geothermometer (abst.): Second U.N. Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section III, Abstract no. 71. Authors at U.S. Geol. Survey, Menlo Park. CA 94025.

In several geothermal areas it has been observed that C^{13} concentrates in HCO_3^- relative to gaseous CO_2. For systems in isotopic equil., this would obtain only at Ts >∿150°C. Inasmuch as water Ts at the surface are ∿90°C, it appears that retrograde C^{13} exchange on ascent of the fluids is not significant, and that isotopic records of high T phenomena are retained.

With few exceptions, Ts calc. from ΔC^{13} (CO_2-HCO_3^-), and from silica and Na-K-Ca contents are in good agreement for Ts ranging from ∿170° to 290°C. At Yellowstone, HCO_3^- can be demonstrated to have been produced by reaction of CO_2 with silicates in shallow reservoirs, and the isotope Ts reflect this.

On the basis of limited field obs., ΔC^{13} (CO_2-HCO_3^-) appears to be a geothermometer with about the same kinetic behavior as the silica geothermometer. However, there is disagreement in published equil. carbon isotope fractionation factors between CO_2 and HCO_3^- in the T range of interest, and lab. exper. are in progress in an attempt to resolve it. (Authors' abstract.)

ONTOEV, D. O., 1975, Criteria of stages of mineralization during formation of sulfide-rare-metal deposits (exemplified by Transbaikalia): Mineralogy and geochemistry of tungsten deposits (Trans. of III All-Union Meeting, v. 3, p. 140-150, Leningrad)(in Russian). Author at Inst. Geol. Ore Dep., Petrogr., Mineral. and Geochem. of Acad. Sci. USSR.

At Dzhida and Bom-Gorkhon deps., at the beginning of each stage of min. incs. bear 60-80% G phase, but only 15-20% at the end of stage. At the beginning H_2S and SO_2 prevail and at the end - CO_2, CO, N_2 and noble gases. G-rich incs. have T_H = 400-500°C. G-poor incs. - 200-250°C. Stages and differences in inc. data are distinguished in Fig. 3, p. 146-147. (Abs. by A.K.)

ORLOVA, L. M., and BAZAROV, L. Sh., 1975, Character of change of composition of volatiles during the process of formation of spodumene in pegmatites, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 33-36 (in Russian).

Spodumenes bear following incs.: P xline, P melt-sols., and S G-L. Melt-sol. incs. consist of gas + L + 3-4 solid phases (quartz, feldspar?), partial homog. (L + G) at 210-420°C, complete homog. was not reached. Only in one peg. was the partial homog. of incs. in gas. T_H of S incs. equals 120-200°C. By anal. of gases in 24 individual incs. it was det. that in P incs. O_2, CO and hydrocarbons are absent; H_2 is present in some (9) incs. in small amounts (2-9.8 vol.%), CO_2 occupies 35 to 83.6 vol.% and the "acid" gases (H_2S, SO_2, NH_3, HCl and HF) - 3.8 to 28.3 vol.%. Max. conc. of CO_2 occurs at 380-350°C, conc. of "acid" gases decreases with T decrease. (Abs. by A.K.)

ORR, Wilson L., 1975, Geologic and geochemical controls on the distribution of hydrogen sulfide in natural gas (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1220-1221. Author at Mobil Research and Development Corp., Field Research Lab., Dallas, Texas, 75211.

ORVILLE, P. M., 1975, Stability of scapolite in the system Ab-An-NaCl-$CaCO_3$ at 4 kb and 750°C: Geochim. Cosmo. Acta, v. 39, p. 1091-1105. Author at Dept. Geol. and Geophys., Yale Univ., New Haven, CT 06520.

Scapolite solid sol. has been syn. at 750°C and 4 kbar and is stable relative to plagioclase + calcite + halite over the range of plagioclase comp. from $Ab_{85}An_{15}$ to $Ab_{70}An_{30}$, although albite + halite is stable relative to marialite, $Na_4Al_3Si_9O_{24}Cl$, and anorthite + calcite is stable relative to meionite, $Ca_4Al_6Si_6O_{24}CO_3$. A chloride-free scapolite, mizzonite, has been syn. at the approx. comp. $NaCa_3Al_5Si_7O_{24}CO_3$ ($Ab \cdot 2An \cdot CaCO_3$). In the absence of chloride, a three-phase invariant assemb., sodic plagioclase ($\sim Ab_{60}An_{40}$) + scapolite + calcite is stable relative to plagioclase + calcite over the approx. range of plagioclase comp. $Ab_{60}An_{40}$-$Ab_{35}An_{65}$ and another three-phase invariant assemb., calcic plagioclase ($\sim Ab_{15}An_{85}$) + scapolite + calcite is stable over the approx. range $Ab_{30}An_{7\_}$-$Ab_{15}An_{85}$.

Unit-cell dimensions and refractive indices have been det. for the scapolite syn. in these exper. and are compared with values for chem. anal. natural scapolites.

Scapolite must be regarded as a ternary solid sol. in which, at a given equiv. An-content, the Cl/CO_3 ratio in the large anion site can vary as a function of NaCl and $CaCO_3$ activities. (Author's abstract.)

PAGEL, Maurice, and POTY, Bernard, 1975, Fluid inclusion studies in rocks of the Charlevoix structure (Quebec, Canada): Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg, 1974, p. 479-489. Authors at Centre de Recherches Pét. et Géochim., C. O. no. 1, F-54500 Vandoeuvre-Nancy, France.

Fluid inc., related to the form. or the late evolution of the Charlevoix cryptoexplosion structure, are filled mainly by an aq. fluid, the salinity of which is variable but generally rather low. The healing of the decorated planar features as well as the rexliz. of quartz began at high Ts and low Ps and continued down to low Ts. The shock event caused a modification of earlier-formed fluid inc. especially of the CO_2 bearing inc. which are abundant in anorthosites and granulite facies rocks. After the cryptoexplosion, the circulation of hot sols. caused a local alt. of these rocks and a cementation of breccias. Finally, the chemical comp. of the fluid phase, as well as the physicochemical conds., mainly the lack of CO_2, the absence of high Ps, the presence of gaseous and transformed inc. in the center of the structure, suggest strongly a meteorite origin rather than a volcanic one for this structure. (Authors' abstract.)

Note: Five gas chrom. anals. for H_2O, CO_2 and 11 diff. org. species are included. (E.R.)

PAL'MOVA, L. G., and KOPNEVA, L. A., 1975, Physico-chemical conditions of forming of vein and metasomatic quartz of a gold ore deposit (abst.), p. 92, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Moscow Geol. - Prospect. Inst., Moscow.

Main comp. of parent fluids of metasom. and vein quartz are CO_2, CH_4, K, Na and Cl. Conc. CO_2 in vein quartz ranges from 170 to 700 g per kg of H_2O; drop of CO_2 conc. is connected with tectonic zones. Sols. in incs. in quartz from quartz-feldspar metasom. bear more stable conc. of CO_2 (270 g per kg H_2O). Eh and pH of sols. were calc. (Abs. by A.K.)

PAMPURA, V. D., KARPOV, I. K., and KAZMIN, L. A., 1975, Physico-chemical evolution of natural sodium chloride hydrothermal systems in the range 25-200°C and 1-500 bars: Akad. Nauk SSSR Doklady, v. 222, no. 1, p. 208-211 (in Russian).

Presents calcs. of Eh, pH, and various ionic species in sol. (E.R.)

PAMPURA, V. D., and NOVIKOV, V. M., 1975, The Pauzhet hydrothermal system and the geochemistry of pore solutions from ore-formation zones in active volcanic regions: Geokhimiya, 1975, no. 4, p. 614-623 (in Russian; translated in Geochem. Internat., v. 12, no. 2, p. 262-271). Authors at Inst. Geochem., Sib. Div., Acad. Sci. USSR, Irkutsk.

The pore waters in clay zones of the East Pauzhet and North Kambal subsurface thermal areas were studied. Max. Ts of 105°C were encountered at 2 m depth. Clay zones are composed of kaolinite, montmorillonite, hydromica, sulfides (dominantly pyrite and marcasite), opal, α-cristobalite, alunite, and native sulfur. The pore sols. were anal. for Na^+, K^+, Li^+, Rb^+, Zn^{++}, Cu^{++}, Mg^{++}, Ca^{++}, Cl^- and SO_4^{2-}. A geochemical zoning pattern was noted in the area. (Abs. by R. Potter.)

PANINA, L. I., and PODGORNYKH, N. M., 1974, Temperature of formation of melilite rocks of the Turiy Peninsula: Akad. Nauk SSSR, Doklady, v. 217, no. 1, p. 198-201 (in Russian; translated in Doklady Acad. Sci. USSR, v. 217, no. 1, p. 141-144 (1975); abstract in Internat. Geol. Review, v. 16, no. 11, p. 1308 (1974)). Authors at Inst. Geol. Geophys., Sib. Div., USSR Acad. Sci., Novosibirsk.

P and S incs. of glass, xlized melt, ore substance, occasionally with gas (fig. 1) homog. into melt at 1210-1230° and at 1050-1180°C respectively, were found in every one of the rock-forming mins., in nearly every one of melilitic rocks of the peninsula. These T_H of the P incs. were in accord with the reported melting and xliz. Ts of syn. mixtures: åkermanite was produced at 1454°C, diopside at 1315°, nepheline at 1173°, green pyroxene at 1160°, etc. Presence of water and volatiles in the system may account for minor discrepancies in the results. It is evident nonetheless that melilite and pyroxene xliz. at much higher Ts than nepheline. Also, the development of nepheline is unrelated to postmagmatic nephelinizing sols., since it xlizes from the melt, like melilite. Nepheline and melilite in monomin. veinlets and pockets resemble metasomatic formations only morphologically.

PANINA, L.I., and PODGORNYKH, N.M., 1975, Inclusions of melt in minerals from carbonatite of the Beloziminskiy Pluton: Akad. Nauk SSSR, Doklady,

v. 223, no. 6, p. 1447-1450 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 223, p. 165-167, pub. in 1977). Authors at Inst. of Geol. and Geoph., Sib. Div., USSR Acad. of Sci., Novosibirsk.

Incs of xlized melt, with or without brines, were found in pyroxene, nepheline, olivine, and ankerite. T_H - 760 to 1260°C, verifying the existence of magmatic conditions during form. of this carbonatite body, and suggesting the origin of carbonatites from the crystallization of alkaline peridotites. (ER).

PANINA, L. I., and VASIL'YEV, Yu. R., 1975, Genesis of ultrabasic and alkalic rocks of Odikhincha intrusive, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 145-150 (in Russian).

T_H of P melt incs. in olivines from olivinite is 1340-1360°C, and S incs. 1170°C; in diopside augites: 1260°C (P incs.) and 1100-1210°C (S incs.) in nepheline from holoxline ijolite-melteigite: 1170-1200°C (P incs.) and 1070-1190°C (S incs.); in diopside augite - 1220-1260°C (P incs.) and 1190-1220°C (S incs.); in aegirine augite from dikes of ijolite-melteigite, 1230-1240°C (P incs.). (Abs. by A.K.)

PAN'KIV, R. P., and SVOREN', I. M., 1975, Composition of dispersed gases in ores and rocks of Yazovskoe deposit of native sulfur (abst.), p. 89-91, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L 'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. Fuels, Acad. Sci. Ukrainian SSR, L'vov.

The dep. is in NW part of Forecarpathian basin, L'vov district. It is built up of sed. rocks of Tortonian and Sarmatian age. Sulfur-bearing ore dep. is 1-33 m thick and it occurs at depth 50-300 m; it consists of limestones bearing avg. conc. 25% of sulfur. Underlying rocks consist of gypsum and anhydrite; overlying are sands and clays. Sulfur-bearing rocks are saturated with waters of H_2S-SO_4-Ca type. Anal. of dispersed gases from these rocks (mass spec. method) are given in table:

Sample, depth (m)	Components, vol. %				
	N_2	CO_2	H_2S	CH_4	H_2
Fine-grained, dark gray anhydrite, 275.6	25.3	31.4	9.0	29.5	4.8
Fine-grained, monomineralic, bluish anhydrite, 299.5	2.0	36.8	45.9	15.3	not found
Fine-grained gray gypsum, 180.5	27.5	47.3	12.8	4.0	8.4
Average of sulfate rocks	20.6	40.7	20.1	13.2	5.4
Biochemogenic limestone bearing finely dispersed sulfur 76.8	72.7	18.8	0.7	4.5	3.3
Biochemogenic limestone bearing compact fine-xline sulfur, 79.0	28.5	67.5	not found	1.1	2.9
Biochemogenic limestone with coarse-xline sulfur, 111.6	82.6	8.4	0.7	5.2	3.1
Average of sulfur-bearing limestones	61.3	31.6	0.4	3.6	3.1
Biochemogenic limestone without sulfur, 64.1	2.2	77.7	not found	10.8	9.3

Differences in G comp. from sulfur ores, sulfate rocks and barren limestones probably reflect the variations of G comp. of parent sols. (Abs. by A.K.)

PANOV, V. V., 1975, Paleo-temperature studies on gas-liquid inclusions in halite: Akad. Nauk Belorusskoi SSR, Doklady, v. 19, no. 3, p. 257-260 (in Russian).

Lists in a table 25 samples, their depth in meters (up to 4178), their stratigraphic horizon, the Ts from G/L incs. (each a range, total range 240-360°C) and the "Paleotemperatures det. by the method of actualism" (sic.). These later are also ranges, with total range 225-375°C. (Abs. by E.R.)

PAVLOV, D.I., 1974, Significance of exogenic chloride waters for the formation of ore-forming solutions of endogenic ores of different stages of geosynclinal cycles of geological development: in Mineralogy of endogenic deposits, V.S. Sobolev, ed: Novosibirsk, Western Siberia Pub. House, p. 19-31 (in Russian).

PAVLOV, D.I., 1975, Magnetite ore formation from the action of hypergene chloride waters: Moscow, "Nauka", 246 pp. (in Russian).

The book presents extensive exper. and natural studies of interaction of halite rocks and chloride-rich sols. with magm. rocks pertinent to chloride-rich incs. in mins. (A.K.)

PAVLOVA, M.A., 1975, Experimental studies of thermal alterations of bituminous substance of igneous rocks of Khibiny massif (abst.), p. 102-104, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Geol. Inst. of Kola Division of Acad. Sci. USSR, Apatity.

Samples of khibinite were heated to 200, 400, 600 and 800°C then milled and extracted with chloroform. Before heating the rock contained 20 mg of bitumens per kg, of which 15 % was L and 19 % was solid paraffins. Comp. of bitumens after heating is as follows:

T (°C)	Amount of bitumens (wt % of rock)	Amount of paraffins (wt % of bitumens)	Comp. of paraffins	Prevailing comp. (wt. % of paraffins)
200	0.0027	6	C_7-C_{23}	C_{17}= 16
400	0.0027	28	C_{15}-C_{25}	C_{21}= 77
600	0.0029	6	C_{13}-C_{22}	C_{17}= 52
800	0.0057	47	C_{16}-C_{29}	C_{24}= 17; C_{25}=15 C_{26}=17; C_{27}=14 C_{28}=14; C_{29}=9

Dispersed carbon in rocks may be the source of bitumens. (Abs. by A.K.)

PAWLOWSKA, Jadwiga, 1975, Thermobarogeochemistry: applications and methods, Inst. Geol., Warsaw, in Kwartalnik Geologiczny, v. 19, no. 2, p. 371-388 (in Polish with English summary).

A review of methods and results, with some discussion of equipment designed in Poland (ER)

PEK, A.A. and PILOYAN, G.O., 1975, Evaluation of depth of source of hydrothermal solutions on the basis of mineralogical thermobarometry: Geol. Rudn. Mest. v. 17, no. 4, p. 68-82 (in Russian). Authors at Inst. Geol. Ore Deposits, Petrography, Mineral. and Geochem. Acad. Sci. USSR, Moscow.

A discussion of interpretation of data on T evolution of hyd. process. A model of a hyd. system with slowly disappearing source of hyd. sols. is presented. A solution of the exchange of heat between hyd. sols. and wall rocks is given. Procedure of evaluation of depth of source of hyd. sols. is given, on the basis of data of mineralogical thermobarometry and data on geometry of ancient hyd. system and thermophysical features of rocks. (Authors' abs., transl. by A.K.)

PERCHUK, L.L., and KARPOV, I.K., 1975, Thermodynamic features of carbon dioxide at 100-10,000 bar and 100-1,000°C: Contributions to Physicochemical Petrology, v. 5, p. 221-234, Moscow, "Nauka" (in Russian).

On the basis of exper. data, the linear isobaric relationship between molar volume CO_2 and T was det. By the method of polystage regression, the empirical equation $V_{CO_2} = f\ (T,P)$ was studied in the ranges indicated. In those ranges, on the basis of the PVT relations found, the values of Gibbs' free energy, entropy, fugacity and fugacity coef. were calc. and arranged in intervals of each 500 bar and each 50-100°C. (Authors' abstract, translated by A.K.).

PETERSIL'E, I.A., AKHMEDOV, A.M., and UVAD'YEV, L.I., 1974, Hydrocarbon gases and organic carbon in Proterozoic rocks of the Kola Peninsula: in Akad. Nauk SSSR, Doklady, v. 215, no. 4, p. 961-964 (in Russian; translated in Doklady Acad. Sci. USSR, v. 215, p. 201-204 (1975); abstract in Internat. Geol. Review, v. 16, no. 9, p. 1081 (1974)). Authors at Geol. Inst., S.M. Kirov Kola Branch, USSR Acad. Sci., Apatity.

Facies-by-facies det. of CH_4, He, H_2 and other gases, and C_{org} in "Body IV" (abs. age 1720 m.y.), the topmost part of the Pechenga volcanogenic-sed. complex (tables 1, 2) showed a definite correspondence between lithological comp. of the rock facies of the sed., and comp. of the gas phase alongside the C_{org} conc. Gas logs of a core from a borehole, in the same area (fig. 1), led to identification of large gas-conducting tectonic zones which were proved to have clear-cut expressions in methane and He anomalies, in the gas phase of the subsoil, despite the seemingly unfavorable surficial conds. of the survey. The same tectonic zones are known to function regionally as migration paths for the min. sols.

PETERSIL'E, I.A., and PAVLOVA, M.A., 1975, Organic compounds in igneous rocks (abst.), p. 28-30: in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian), Authors at Geol. Inst. of Kola Div. of Acad. Sci. USSR, Apatity.

Samples of alk. rocks from Khibiny, Lovozero, Kia-Shaltyr, Sredne-Tatarskiy and Ilímaussaq. massifs were anal. up to 100 cm^3 CH_4/kg rock was found. Bituminous cpds. include paraffins, naphthene and aromatic hydrocarbons. These org. materials are syngenetic and formed abiogenically. C from CH_4 from incs. is enriched in heavy carbon ($\Delta C^{13} = 0.9$ %, international standard). Distrib. of C^{13} in gases is the reverse of that in sed. rocks: δC^{13} (CH_4) = 0.32→δC^{13} (C_2H_6) = -0.91→δC^{13} (C_3H_8) = 2.61 (in %; Khibiny massif). Dispersed bituminous substances occur in all rocks usually <0.00n% by wt. These contain from 39.8 to 50.7 % oils; for all rocks, except alk. ones, alcohol-benzene resins typically exceed benzene ones. The comp. of oil fraction of dispersed bituminous substances is as follows (wt % of oil fraction):

Rock	Fractions					
	paraffin	Methane-naphthene	Naphthene mono-aromatic	Bicyclo-aromatic	Polycyclo-aromatic	Petroleum-ether resins
Norite	10.12	0.00	0.00	5.06	78.06	6.75
Peridotite	6.25	0.00	18.33	2.49	38.33	33.34
Pyroxenite	8.35	0.00	23.12	26.56	12.53	27.61
Khibinite	38.85	31.79	12.26	14.82	traces	1.78
Granodiorite	2.93	0.00	56.20	12.67	14.09	11.58
Porphyritic granite	6.25	0.37	67.75	15.28	2.99	10.90

Chloroform extracts from ign. rocks typically show only C_{17} - C_{30}, except agpaitic rocks containing liquid C_9 - C_{16} paraffins. All ign. rocks contain 0.0n% (by wt.) dispersed coaly subst.; comp. not studied. (Authors' abstract, translated and shortened by A.K.)

PETRICHENKO, O.I., DOLISHNIY, B.V., and SVOREN', I.M., 1975, Compounds of carbon in inclusions in halite, (abst.), p. 10-12, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals)-Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. and Geochem. of Fuels, L'vov.

Saline rocks of Devonian age from the 500-950 m Dniepr-Donets rift zone were meta. by hydrotherms. T in ores decreased from 400-350°C to 50°C, P from 600-500 to several tens atm. Gas comp. changed from complex (CO_2, CH_4, heavy HCs, H_2S, N_2, H_2) to simple (CH_4 and CO_2). Low-temp. mins. (calcite, quartz) bears oil incs.

Incs. in halite adjacent to ores are gaseous (CO_2 80-95%, CH_4 0.1-0.5%); in more distant zones gas ratios change (CO_2 40-55%, CH_4 35-45%). Central parts of salt bodies bear incs. with gases consisting of 50-60% CH_4 and 10-20 % CO_2 and with rare liquid HCs. Each salt body has its own typical gas ratios; sometimes N_2 is the main component. P of gas (from 350-180 to 100-60 atm) does not correspond to lithostatic P of overlying rocks. Authors suppose that carbon-bearing gases formed from organic matter from evaporites. (abstr. by A.K.)

PETROVSKAYA, N.V., NOVGORODOVA, M.I., and TSEPIN, A.I., 1975, Chemical composition of relicts of mineral-forming media in native gold: Geol. Rudn. Mest., v. 17, no. 5, p. 53-61 (in Russian). Authors at Inst. of Geol. of Ore Deps., Pet., Min. and Geochem. Acad. Sci. USSR, Moscow.

At the surface of abrasion rounded gold particles, small (<0.5 mm dia.) hemispheres occur above near-surface gas incs. The inc. cavities have various shapes: irregular, spherical, and negative gold xls. Photo shows salt xls ppted on inc. wall. Vacuoles also contain gas and small amount of liquid. Qual. electron microprobe anal. of incs. showed Si, Ti, Fe, Mg, Ca, Al, Na, K, S, Cl, sometimes P (in gold from Lena River); Ca was ∿3 %, Ag - 1 %, S - 2 %; Cu, Pb, Zn, As, Bi, Sb are absent; Ag is higher in vacuole than in Au walls of vacuole. (Abstract by A.K.).

PIZNYUR, A.V., 1973a, Fundamentals of Thermobarogeochemistry; Part II (sic) Methods of Thermobarogeochemical Investigation. Methods of thermometry - Summary of lectures: L'vov, L'vov. Univ. Press, 106 pp., 21 kopecks (in Russian). (1000 copies printed)

This book (plus the two subsequent items) apparently constitute the lecture notes for a university course on inclusions. 45 references. (ER)

PIZNYUR, A.V., 1973b, Fundamentals of Thermobarogeochemistry; Part II (sic). Methods of Thermobarogeochemical Investigations, Methods of barometry - Summary of lectures: L'vov, L'vov. Univ. Press, 82 pp., 14 kopecks (in Russian). (1000 copies printed)

A companion volume to the preceding item. 43 references (ER)

PIZNYUR, A.V., 1975, Fudamentals of Thermobarogeochemistry. Study of the composition and concentration of solutions. Summary of lectures: L'vov, L'vov. Univ. Press, 132 pp., 23 kopecks (in Russian). (500 copies printed)

Apparently the third volume to the series (see preceding two items). 101 references (ER)

PLATT, R.G., and ROSE-HANSEN, J., 1975, The system ussingite-water and its bearing on crystallization in persodic portions of the system Na_2O-Al_2O_3-SiO_2-H_2O at 1 kb total pressure: in Jour. Geol., v. 83, p. 763-772. First author at Dept. Geol., Lakehead Univ., Thunder Bay, Ontario, Canada.

Ussingite is unstable at 1 kb total P in the system ussingite - H_2O. Instead, the natural ussingite has an albite liquidus slightly in excess of 775°C. This liquid can dissolve 5.6 wt% H_2O before becoming satd. At subliquidus Ts, two isobaric invariant assemb. occur: (1) nepheline (ne) + albite (ab) + analcite (anl) + vapor (v) + liquid (l) at 525 ± 5°C and (2) ne + ab + anl + sodium disilicate (ns_2) + l at 462 ± 12°C. These are most likely the expressions of the univariant reactions anl + v → ab + ne + l, and anl + ns_2 → ab + ne + l. Assemb. involving analcite and a persodic liquid in the system Na_2O-Al_2O_3-SiO_2-H_2O are found to occur at lower Ts for a constant P, and at lower Ps for a constant T. The high potential water contents of persodic-rich liquids produces a prolonged negative slope to the vapor-sat. boundary at subliquidus Ts. This will increase by one the types of subsolidus assemb. originally defined by Robertson and Wyllie (1971) in rock-water systems. This new assemb. is designated Type V, water excess-intermediate vapor absent. (Authors' abstract).

POKROVSKII, P.V., and PURTOV, V.K., 1971 (pub. 1975), Gas-liquid inclusions in quartzes of veins of huebnerite deposits of the Boevsko-Biktimirovskoe ore zone in the Central Urals: (Inst. Geol. Geokhim., Sverdlovsk, USSR). Mineral. Geokhim. Vol'framouykh Mestorozhd., Tr. Vses. Soveshch., 3rd, p. 424-432. Ed. by Barabanov, V.F., Izd. Leningr. Univ: Leningrad, USSR. Authors at Inst. Geol. Geokhim., Sverdlovsk, USSR.

Three types of inc. were found in quartz from huebnerite dep. of the Boevsko-Biktimirovskoe ore field: (1) 3-phase (aq. soln. + liq. and gas CO_2 phases), (2) 2-phase (aq. soln. + gas phase), and (3) single phase inc. Three-phase inc. predominated in quartz of all dep. Complete homog. of quartz inc. occurred at 200-300°. Two-phase inc. contg. 85-90% aq. soln. and 10-15% gas, homog. at 150-180°. Three-phase gas inc. were selected to det. quartz vein form. cond. The presence in quartz of inc. homog. in aq. and in liq. CO_2 indicated that the hyd. soln. was heterog. and consisted of aq. and CO_2 phases. The CO_2 concn. in quartz inc. for most dep. except the Prokhorovskoe dep., was 8-12 mol. % and the total soln. d. in quartz of the 1st and 2nd stage veins was 0.6-0.9 and 0.8-1.0 g/cm^3. The d. of the soln. increased during quartz xliz in continuous vein form. An increase in d. of hyd. solns. was attributed to a decrease in T which was substantiated by the decrease in T_H in quartz from 2nd stage veins. Chem. Abst., v. 84, no. 11, 153265z, (1976).

Fluid incs. in quartz had T_H (°C): Boevskoe - 200-270, Karas' yevskoe - 320-360, Yugo-Konevskoe - 200-280, Gorokhovskoe - 200-250, Biktimirovskoe - 220-280 (huebnerite-bearing veins); P'yankovskoe - 285-360, Yugo-Konevskoe - 320-350 (barren veins). CO_2 in incs. homog. either in L or in G at 2-25°C, T_{Frz} ∿-32°C (P'yankovskoe). V_{CO_2} - 15 to 70 vol %. The d of sols. increases from the start to end of quartz xliz. Complete soly. of this much CO_2, at meas. T, needs P = 300 to 1500 bars. (Abstract by A.K.).

POLYKOVSKIY, V.S., ELINSON, M.M. and KOZYREV, V.N., 1975, Gas composition of solutions forming fluorites from Yangi-kan (Kugitang-tau, S. Tyan'-Shan'), (abst.), p. 68-69, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Ministry of Geology of Uzbek SSR, Tashkent.

Fluorite-bearing veins are connected with granitoids. Gases from incs. in fluorites were extracted by vacuum milling. Incs. contain N_2, H_2 and Ar, and other G. At lower levels N_2 was the main comp. (to 14.4 cm^3/kg) and 100 m higher - H_2 dominates (up to 36 cm^3/kg). Wallrocks bear H_2 and CO_2; close to contact with ore body CO_2 is major (up to 50%); in granites distant from contact incs. bear mainly H_2 (75 to 100%). Vertical and horizontal zoning is then found. (Abs. by A.K.)

POLYKOVSKIY, V.S., MOSKALUK, A.A. and KALINKIN, V.I., 1975, Temperature regime and salt composition of solutions forming fluorites from Kengutan (Kuraminskiy Chain) (abst.), p. 107-109, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at Ministry of Geology of Uzbek SSR, Tashkent.

T_D of semitransparent fluorites are as follows: start 160-220°C, max. 200-230°C, end - 320-360°C. Sol. in incs. are of low conc., with following salt compositions formulae:

Cl-50, HCO_3-25, SO_4-18.3, F-6.7; Ca-48.3, Na-24, NH_4-15, Mg-6.9, and K-5.1, and (another sample ?): Cl-53.3, HCO_3-33.3, SO_4-11.1, F-2.2; Ca-50, Na-2.4, K-12, Mg-10, and NH_4-4. Opaque fluorites are higher-T, differing in T_D max. (280-300°C) and end (400-410°C), and parent sols. are also somewhat different: Cl-39.8, SO_4-32.7, HCO_3-26.5, F-0.88; Na-51.3, Ca-24.3, Mg-16.2, K-5.4, and NH_4-2.7. (Abs. by A.K.)

POMÂRLEANU, V.V., 1975, Decrepitometry and its applications in prospecting ore deposits: Bucharest, Editura Technică (in Hungarian) 180 pp., 77 figures, plus 44 photomicrographs. See translations.

POMÂRLEANU, Vasile, MOVILEANU, Aurelia, and MIHALKA, Stefan, 1972, Studies of hydrothermal ore deposition in the Văratic ore-field (Baia Mare, Romania): Chemie der Erde, v. 31, no. 3/4, p. 275-285 plus two plates (in German).

Includes a short section on decrepitation data. (ER).

POPIVNYAK, I.V., 1975, Role of CO_2 in forming of deposits of Muyskiy gold ore region (N. Buryatia) (abst.), p. 84-86, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at L'vov State Univ. L'vov.

By thermobarogeochem. methods over 70 deps. of low-sulfide formation (class: pyritic, sub-class: quartz-bearing) were studied. Changes of chem. comp. of sols. were abrupt, from highly conc. Cl-Na (high T), to essentially carbonate (moderate T), and low-conc., practically without CO_2, low T. Ore-forming process was divided into 5 stages: 1-dark quartzes (450-350°C), 2-tourmaline-quartz (500-350°C, 1100-1000 atm), 3-pyrite-quartz (460-310°C, 600-700 atm) 4-gold-spalerite-galena (330-170°C, 950-820 atm), 5-quartz-carbonate (170-100°C). Sols. from commercial gold-sulfide stage saturated with CO_2 (83 % of G); earlier and later sols. are almost CO_2-free. At 260-200°C heterog. of H_2O-CO_2 sols. was reported, accompanied by pption. of Au. Thus, the T interval 260-200°C, the heterog. sols., and the presence of CO_2 in incs are the prospecting criteria for Au. (Abs. by A.K.).

POTTER, R.W., II, BABCOCK, R.S., and BROWN, D.L., 1975, Solubility relationships in the NaCl-KCl-H_2O system (abst.): in Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1075. Authors at U.S. Geol. Survey, Menlo Park, CA. 94025

The soly. of NaCl and KCl in aq. sols. from 100 to 300°C has been exper. det. in the binary systems NaCl-H_2O and KCl-H_2O and for several comp. in the ternary system NaCl-KCl-H_2O. The method involves heating sols. of known comp. in Pt-lined bombs until the solid phase completely dissolved. This is evidenced by a distinct discontinuity in $(\partial P/\partial T)_{x,v}$. The following equa., fitted to the data by least squares, give the soly. of NaCl and KCl (wt. %) in various sols. over the T range of 100 to 300°C:

NaCl in H_2O: $X_{NaCl} = 26.218 + .0072T + .000106T^2$
KCl in H_2O: $X_{KCl} = 28.454 + .0732T + .0000417T^2$
NaCl in 10% KCl: $X_{NaCl} = 19.657 + .02901T + .0000591T^2$
NaCl in 20% KCl: $X_{NaCl} = 18.201 + .01252T + .0000848T^2$
NaCl in 30% KCl: $X_{NaCl} = 12.791 + .03030T + .0000475T^2$
KCl in 5% NaCl: $X_{KCl} = 30.202 + .05638T + .0000077T^2$
KCl in 10% NaCl: $X_{KCl} = 30.985 + .03535T + .0000652T^2$
KCl in 15% NaCl: $X_{KCl} = 27.694 + .06231T - .0000014T^2$
Note: the uncertainty in the above equations is $\pm$.05 wt. %.

These results indicate that many of the previously reported values, especially in the ternary system, are significantly in error. The errors may be due to corrosion of stainless steel P vessels, chem. reactions between the sol. and a Hg P media, or reequil. during quenching. The refined values of the present study should prove useful for recalib. geothermometers in geothermal systems and fluid inc. research. (Authors' abstract).

POTTER, Robert W., II, and BROWN, David L., 1975, The volumetric properties of aqueous sodium chloride solutions from 0° to 500°C at pressures up to 2000 bars based on a regression of the available literature data: U.S. Geol. Surv. Open-file report 75-636, 29 pp., One page of explanatory text, 3 refs., and 26 pages of tables. (ER)

POTTER, R.W., II, SHAW, D.R., and HAAS, J.L., JR., 1975, Annotated bibliography of studies on the density and other volumetric properties for major components in geothermal waters 1928-1974: U.S. Geol. Survey Bull. 1417, 78 pp.

Since this bibliography includes studies of most of the "salts" found in fluid inc., as well, it is an extremely valuable source book. The annotations on each of the 240 references give the cpds. used, type of data obtained, the method(s) used, and the ranges covered. (ER)

POVILAYTIS, M.M., 1975, Regularities of distribution and formation of deposits of tungsten: "Nauka", Moscow, 255 pp, (in Russian).

Data on T_H, P and pH of fluid incs. (from the literature) on many pages. (A.K.)

POWELL, Marjorie, and POWELL, Roger, 1975, A nepheline-alkali feldspar geothermometer (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

PRICE, N.J., 1975, Fluids in the crust of the earth: in Sci. Prog., Oxf., v. 62, p. 59-87, Author at Geol. Royal School of Mines, London, S.W.7.

Fluids in the crust play a tremendously important role in the deformation of the crust and the emplacement of ore-bodies. These fluids are, therefore, important to man.

This paper deals with the generation of fluid Ps in the pores and void spaces in sed. and meta. rocks when such rocks are progressively buried to greater depths. The magnitudes of these Ps, obtained from direct meas. and inferred from other evidence, are quoted; and an est. is made of the quantity of fluids (which are mainly water or brines) trapped in a thick sequence of rapidly accumulating seds. It is indicated how such rocks may de-water and give rise to commercial ore-bodies. (From the author's abstract).

PRINZ, M., MANSON, D.V., HLAVA, P.F., and KEIL, K., 1975, Inclusions in diamonds: garnet lherzolite and eclogite assemblages: in Physics and Chem. of the Earth, v. 9, p. 797-816.

PSHENICHNYI, G.N., 1975, Gayskoe copper-pyrite deposit at S. Ural: Moscow, "Nauka", 187 pp., (in Russian).

Probable T of pption of sulfides and coexisting gangue mins, are 190-380°C (T_H and T_D); P calc. after Naumov and Malinin, is 800 atm. at ~1400 m depth and ~550 atm. at ~200 m. The P diff. is close to those calc. from the diff. in depth. (p. 174-178). (Abstract by A.K.).

PUZANOV, L.S., 1975, Genetic type of fluorite-barite-iron-ore deposit in Tuva ASSR: Akad. Nauk SSSR, Doklady, v. 225, no. 3, p. 669-672 (in Russian). Author at All-Union Sci.-Research Inst. of Raw Materials, Moscow.

In fluorite and barite seven types of incs. were found: 1 - rare P incs. bearing dms.: isotropic (halite and sylvite?) and anisotropic (carbonates and sulfates of Sr and RE?); 2 - numerous P incs. bearing dms. as above (50-80 vol.%), G (5-10%), and L_{CO_2} (15-25%); 3 - PS incs., dms. as above (80-90% vol.%), salt sol., and G (5-10%); L_{CO_2} appears at T <0°C; 4, 5 and 6 - very rare, bear salt sol. (70-80 vol.%), dms. (20-30 vol. %), L_{CO_2}, and G; 7 - G/L incs. with G 5-10%. Homog. of L_{CO_2} and salt sol. in type 2 >700°C, 3 - T_H of G 110-170°C, 4 - dissolution of dms. 150-480°C, 5 and 6 - homog. not achieved, 7 - $T_H = 90 - 140$°C. Probable initial T were higher than 700°C, P est. 4-6 kbar. (Abstract by A.K.)

PUZANOV, L.S. and KANDIDOV, A.A., 1975. Significance of liquid CO_2 in minerals of fluorite-barite-iron ore mineralization (abst.), p. 96-98: *in* Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at All-Union Sci. - Research Inst. of Mineral Raw Materials, Moscow.

Fluorite-barite-iron deps. with rare earths (E. Siberia), formed from middle- and low-T metasom. of limestones and other rocks by fluids connected with small sub-alkaline massifs. Inc data are essentially as in previous abstract. (AK)

RADTKE, A.S., and DICKSON, F.W., 1975, Features of Carlin-type gold deposits (abst.): Geol. Survey Research 1975, U.S. Geol. Surv. Prof. Paper 975, p. 4-5.

Fine-grained, disseminated Au deps. designated as Carlin-type deps. were formed by the action of ascending hot waters that penetrated to the surface or to shallow depths. Conds. during ore dep. ranged from the low T and P of a hot-spring environment to epithermal conds. of as much as 225°C and 25 bars. The Carlin-type deps. constitute a previously unrecognized class of ore deps. They are characterized by the assoc. of gold, pyrite, silica, and organic carbon; exceedingly fine-grained ore mins; introduced organic cpds.; localization of Au in brecciated, carbonaceous, silty carbonate rocks and along high-angle faults that commonly contain altered dikes; fine-grained silicified rocks and jasperoids; and argillized rocks. Visible Au is rare, and base-metal mins. are uncommon. Abnormally large amounts of As, Sb, and Hg occur in the Au ore and in the surrounding country rocks. Tl occurs in high-As ores. Most deps. contain veinlets of quartz, barite, and calcite. Pyrite occurs as preore syngenetic or diagenetic grains in host rocks and with the ore and also was dep. from the hyd. sols. before and possibly during Au dep.

Ore dep. was in response to drops in T and P, reaction with wall rocks, and boiling. Boiling took place over a vertical distance of at least 100 m and perhaps as much as 300 m. During the waning stages of hyd. activity, the upper level of boiling lowered progressively, and previously min. rocks were thus exposed to oxidation. Soluble cpds. produced by oxidation migrated downward to react with the hyd. sols. and to form late sulfate and carbonate min. veins. (Authors' abstract).

RAKHMANOV, A.M., 1975, Role of carbon-bearing components in post-magmatic stage of development of high-temperature ore formation at S. Gissar (data on studies of fluid inclusions) (abst.), p. 93-95, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Tadzhik State Univ., Dushanbe.

Deps. are of peg. and skarn type. Pegs. may be divided into rare metal, tourmaline, ceramic, Sn-bearing, plagioclase, and rock-xl. types. Incs. contain dm_1-dm_2-CO_2-H_2O and CO_2-H_2O (dm_1-easily soluble: **halite**, sylvite; dm_2 - slightly soluble: quartz, rutile, hematite). CO_2 and H_2O conc. vary widely, from CO_2-free to H_2O-free. D of most common CO_2-H_2O incs. ranges from 0.511 g/cm^3 (early stages of peg. process) to 0.160 g/cm^3 (late veins). Incs. vary from G, G>L to L>G and L>G>dm_1>dm_2. P of form. of granite pegs (calc. from CO_2-bearing incs.) = 600-700 atm; late stages of peg. form. are char. by P = 170-210 atm; T of peg. xliz. = 700-110°C; T_{Frz} = -15.1°C (early stage), -56.3°C (middle; freezing of L_{CO_2}) and lower than -60.9°C (late; freezing of complicated C-bearing cpds). Skarn ore deps. occur at the contact of Upper-Paleozoic granitoids and Middle Paleozoic sed. carbonates. One may distinguish following groups of deps.: skarn-magnetite (mt) (Kharangon, Sangi-Bektash), skarn-rare metal (RM) (Maykhura, Yak-Archa, Kanyaz) skarn-chalcopyrite (Verkhniy Kafander), skarn-polymetallic (Loylya-Kul, Garianak). Following stages of form. may be stated: skarn (T_H and T_D = 600-400°C), quartz-mt or quartz - RM (480-220°C), quartz - sulfide (420-200°C), quartz-carbonate, sometimes with fluorite (200-150°C). In graphite (sic.), quartz and scheelite incs. with L_{CO_2} were found; CO_2/H_2O ratio varies widely. Mins. of two first stages bear incs. of almost pure CO_2(95-100 %). P equals usually 750-730 atm, the lowest are 650 atm. (Abs. by A.K.).

RANKIN, A.H., 1975, Fluid inclusion studies in apatite from carbonatites of the Wasaki area of western Kenya: Lithos, v. 8, p. 123-136. Author at Dept. Geol., Royal School of Mines, Imperial College, London, S.W.7, England.

Apatites from the carbonatites contain relatively large (up to 120μ), aq., CO_2-rich, saline incs. T_H dets. show that the min. T_F of these apatites ranged from 200°C to 484°C. The mode of homog. of incs. in the Wasaki sovite apatites indicates that these apatites xlized. from a supercritical fluid. A higher estimate of the T_F of the apatites from this sample (500°C-590°C) was obtained from the sol. T of a transient phase (probably Na_2CO_3) ppted. from the inc. fluid at elevated Ts. These fluids are considered to represent trapped portions of a fluid carbonatite magma. (Author's abstract).

Dms identified or suspected include nahcolite ($NaHCO_3$); kalicinite ($KHCO_3$); pyrrhotite (FeS_{1-x}); magnetite (Fe_3O_4); halite (NaCl); and several unidentified carbonates. (ER)

RANKIN, A.H., and LeBAS, M.J., 1974, Liquid immiscibility between silicate and carbonate melts in naturally occurring ijolite magma: Nature, v. 250, p. 206-209.

Large (<150μm) tubular multiphase incs., in apatite xls from two carbonatites in West Kenya, are of 4 types: 1) silicate glass, no bubble; 2) carbonate-rich, 60% anisotropic colorless xls + L & V (mostly insol. in H_2O but readily sol., with effervescence in dilute HCl-glycerol), plus minor opaque magnetic grains; 3) nahcolite + L + CO_2G; 4) CO_2. Intermediates between types 1 & 2 show two immiscible melts form, & homog. at higher Ts in some cases, but not in others. Phase changes are reversible on cooling. This evidence shows that there were two immiscible melts present, a silicate-rich and a carbonate-rich one, along with a CO_2-rich vapor phase and a carbonate-bearing aq. phase (i.e., 4 fluid phases). The details will be published elsewhere. (ER).

RASUMNY, J., 1975, Cavities and inclusions in quartz from King Salomon's Mines (Mene'iyeh). Some aspect of their studies under the scanning electron microscope: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting Berlin - Regensburg 1974, p. 427-429 (in French). Author at Lab. Géol. structurale, Bâtiment 504, Univ. Paris-Sud, Centre d'Orsay, F-91405 Orsay.

Obs. under the scanning electron microscope in the geol. lab. of the "Museum d'Histoire Naturelle de Paris" have been made of the quartz of this copper occurrence. The electron fractographs have shown, besides intragranular incs. in quartz xls, already described from other localities by various authors, also intergranular cavities. (Author's abstract).

RAVINSKAYA-IOFFE, L.I., 1975, Natural solid solutions in the system $CaCO_3$-$MgCO_3$ as indicators of the temperature of metamorphism, in Metasomatites and ore formation, N.N. Pertsev, ed.: Moscow, Acad. Sci. USSR, "Nauka", p. 123-166 (in Russian).

REKHARSKIY, V.I., PASHKOV, Yu.N., SUKHORUKOV, Yu.T., and AVETISYAN, G.G., 1975, Hydrothermal-metasomatic formations and their connection with ores at Kadzharanskoe deposit: Metasomatism and ore formation, Yu.V. Kazitsyn, ed.: Moscow, "Nedra", p. 135-146 (in Russian).

Early metasomatites contain gaseous incs, filled with H_2, N_2, Ar, and polyphase incs., with feldspar, biotite, magnetite and halite. Feldspar-quartz form. contains three-phase incs, with L CO_2; quartz-sericite form. - polyphase incs. with sylvite and halite; berezite form. - two-phase G-L incs. Conc. of salts reach 600 g/l. Early metasomatites xlized at 320-440°C, ore-bearing ones - at 110-360°C (T_H). Main components of ore-forming sols. are NaCl and sulfide forms of sulfur. (Abstract by A.K.)

REZNITSKIY, L.Z., and VOROB'YEV, E.I., 1975, Oriented microinclusions of barite in calcite from the phlogopite veins of Slyndyanka: Akad. Nauk SSSR, Doklady, v. 222, no. 3, p. 690-693 (in Russian; translated in Doklady-Earth Sci. Sect., v. 222, p. 144-147 (1976)).

T_H of incs. in coarse barite 180-230°C. Calcite incs. that "show signs of bursting at low Ts" have T_H of 120-250, and well-preserved incs. with T_H 350-380°C. Data from Bazarov (1964) show that incs. in apatite from same dep. have T_H 330-395°C (in liquid) and T_F of 410-570°C. R & V corroborate this with T_H of 375-385°C, and peak T_D of 440-550°C. R & V conclude barite incs. in calcite come from exsolution. (ER).

RICH, R.A., 1975, Fluid inclusions in metamorphosed Paleozoic rocks of eastern Vermont: PhD. disser., Harvard Univ., 199 pp.

Fluid incs. were studied in quartz samples from Paleozoic meta. rocks collected over a wide area of eastern Vermont. Emphasis, however, was placed on the study of fluid incs. in conformable quartz lenses and pods from garnet zone Siluro-Devonian metapelites and metacarbonates from the east side of the Chester and Athens Domes in southeastern Vermont. Available evidence suggests that the quartz bodies formed under garnet zone conds. Consequently, the fluid incs, which occur on healed fractures in these bodies contain garnet zone and/or retrograde meta. fluids.

Predictably, one, two, and three phase CO_2-H_2O fluid incs. were found in the samples studied. Unexpected though was the discovery of fluid incs. containing saturated NaCl-rich brine. Typical incs. of this type contained six phases: brine, halite xl, v bubble, two birefringent xls, and an opaque solid. Some halite-bearing fluid incs. also contained L CO_2. Fluid incs. were studied by standard heating and freezing stage techniques. Data from these studies suggests that autodecrep. and partial decrep. were generally occurring phenomena for the CO_2-rich and/or high salinity fluid incs.

Regionally, the occur. of halite-bearing fluid incs. is restricted to a relatively narrow strat. zone near the base of the Siluro-Devonian sequence. Evidence suggests that this brine zone was formed by the dissol. of an evaporite unit by prograde meta. fluids. The distrib. of halite-bearing fluid incs. indicates that the evaporite unit was an upper member of the Silurian Shaw Mountain Form. Interestingly, this form. is roughly correlative with the Salina evap. beds of neighboring New York.

Electron microprobe anal. were performed to investigate the existence of comp. diff. between mins. of similar lithologic units from within and above the brine zone. Na was found to be relatively enriched in brine zone muscovites. Brine zone biotites had higher Na and Cl contents than biotites from above the brine zone.

In the samples studied, fluid incs. were found to occur only in quartz pods, lenses, and veins and not in the host rock. This obs. suggests that the sites now occupied by the quartz bodies were the loci of fluid activity in the meta. system. The presence of several types of fluid incs. in the samples of meta. quartz exam. suggests the existence of comp. distinct garnet zone and/or retrograde fluids in the meta. system of the study area. P-V-T props. of the several inc. fluid types are compatible with garnet zone inc. form. Evidence suggests a max. P and T of 5 kb and 500°C respectively for garnet zone meta. in the study area.

Calc. suggest that CH_4 should be an important species in garnet zone aq. fluid inc. of the study area rocks, but fluid inc. studies produced no indication of the presence of CH_4. The occur. of H leakage from fluid incs. can explain this conflict. The wide range of CO_2/H_2O ratios exhibited by the fluid incs. in most quartz samples examined can be explained by the generation of several comp. distinct fluids in a small volume of rock. The CO_2/H_2O ratios of these fluids were controlled on a small scale by the locally dominant prograde meta. reactions occurring in the various sectors of the small volume of host rock. (Author's abstract).

RICH, R.A., HOLLAND, H.D., and PETERSEN, Ulrich, 1975, Vein-type uranium deposits: U.S. Energy Research and Development Administration, Grand

Junction Office Report GJO-1640, Oct. 10, 1975, 383 pp.

A critical review of pub. data bearing on the min., paragenesis, geochem., and origin of vein-type U deps. It includes (Chapt. B, pp. 33-48) a thorough review of the lit. data (24 refs.) on fluid-inc. studies of vein-type U deps. Other chapters include dist. of U, min. & geol. of deps., chem. of hyd. U deps., dep. of U from ore fluids, origin of deps., and 270 pp of descriptions of deps. (ER).

RICHARDSON, Catherine K., and MALININ, Sergei D., 1975, Solubility of fluorite and complexing in the system CaF_2-NaCl-HCl-H_2O (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1246. First author at Department of Geological Sciences, Harvard University, Cambridge, Massachusetts 02138.

The soly. of fluorite has been det. by a weight-loss technique at 200° and 260°C in sols. in which the initial sum of the HCl and NaCl conc., I, was 0.4, 1.00, and 2.0M. The ratio m°HCl/m°HCl+m°NaCl was varied between 0 and 1.0.

SOLUBILITY IN NaCl SOLUTIONS

T°C	I	S($gCaF_2$/1000g)
200	0.40	0.046
200	1.00	0.052
200	2.00	0.064
260	0.40	0.023
260	1.00	0.044
260	2.00	0.068

SOLUBILITY IN NaCl-HCl SOLUTIONS AT 260°C and I = 2.00M

m°HCl	S($gCaF_2$/1000g)
0	0.068
0.002	0.106
0.004	0.146
0.020	0.408
0.040	0.733
0.100	2.37
0.200	5.42
0.530	12.18

The large increase in the soly. of fluorite in HCl-containing sols. is probably due to the form. of the complex HF°. The F^- ion is the most important F species when m°HCl $\leq$ 0.0001M. In strongly acid sols. HF° dominates. From present data, HF_2^- does not appear to be important except in the transition region. In the regions where the F^- ion is important, the soly. of fluorite increases with ionic strength; in acid sols. it is nearly independent of ionic strength. In hyd. sols. at 260°C, 1 molar in KCl, and in equil. with Kspar-musc-qtz, the ratio mF(complexed)/mF^-<<1; if these sols. are in equil. with kaol-musc-qtz mF(complexed)/mF^-=2. (Authors' abstract.)

RICKARD, D.T., WILLDEN, M., MÅRDE, Y., and RYHAGE, R., 1975, Hydrocarbons associated with lead-zinc ores at Laisvall, Sweden: Nature, v. 255, p. 131-133. First author at Geol. Inst., Stockholm Univ.

There is evid. that these are not modern contaminants, and the data suggest the dep. formed from highly saline oilfield brines. (ER).

RIPLEY, Edward M., 1975, Mineralogy and sulfur isotopes of the cupriferous sulfide ores at the Raul Mine, Peru (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1248. Author at Department of Geosciences, The Pennsylvania State University, University Park, Pennsylvania 16802.

The Raul Mine, situated within the Coastal Mesozoic Belt of Central Peru, consists of stratabound pyrite-chalcopyrite ores in Upper Cretaceous andesitic volcanics and marine sed. rocks. The host rocks and ores are meta. to the greenschist facies.

The obs. suggest that the source of S in the ores was largely seawater sulfate, which underwent various degrees of reduction during deep circulation through hot volcanic rocks. (From the author's abstract.)

RODIONOV, S.M., and SHAPENKO, V.V., 1974, Gas-liquid inclusions in cassiterites of the Pridorozhnoe deposit (Komsomol'sk District): Vestnik Moskov. Univ., v. 29, no. 6, p. 96-100 (in Russian; translated in Moscow Univ. Geol. Bull., v. 29, no. 6, p. 78-80, Allerton Press Inc., pub. 1976).

Translated in full in Fluid Inclusion Research-Proceedings of COFFI, v. 7, 1974, p. 266-269) (ER).

ROEDDER, Edwin, 1975a, Petrologic data from experimental studies on crystallized silicate melt and other inclusions in olivine. (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ., Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination); 3 pp.), Author at U.S. Geol. Survey, Reston, VA 22092.

Incs. trapped in olivine of lunar mare and Hawaiian lava lake basalts have yielded data on the following: (1) comp. of the melt at the time of olivine xliz., except for subsequent xliz. of olivine on the walls (from probe anal. on natural or lab. homo. glasses); (2) amount and nature of immiscible sulfide melt, and the stage at which it separated (from simple microscopy); (3) equil. Ts and sequence of melting, the nature of the phases other than olivine xlized within the incs. during cooling, and a crude measure of the solidus T of the trapped fluids (from phase-disappearance heating exper. on xlized incs.); (4) relative cooling rates of diff. flows and some constraints on absolute cooling rates (from simple microscopy and annealing expers.); (5) possible distinctions between phen. and exotic xenocrysts (from the comp. of incs.); (6) presence of a vapor phase at the time of growth of the olivine and some data on its comp. (from crushing-stage studies); and (7) min. Ps at the time of olivine growth (from gas incs.).

Limitations are imposed by the suitability of the available incs, by the implicit assumptions, particularly as to the representativeness of the sample, and by the exper. techniques. Not all types of data can be obtained on any given sample, and several important questions and conflicts remain unanswered. In spite of these shortcomings, some of these data are believed to be valid, and some cannot be obtained otherwise. (ER).

ROEDDER, Edwin, 1975b, Fluid inclusion studies on simulated Martian samples, (abst.): Geological Research 1975, U.S. Geol. Survey Prof. Paper 975, p. 233.

Simulated Martian samples were studied in an attempt to evaluate the effects of various suggested sterilization procedures on the scientific info. obtainable from a returned Mars sample. Fluid inc. studies are particularly appropriate here in that they can yield much info. from very tiny samples, even those in the 1-μg range. Although almost any sterilization protocol would seriously affect or totally negate the results of at least some petrological, geochem., or geophys. exper. performed on the samples, one-day sterilization at 275°C in He at 1 atm had almost no noticeable effect on the significance of the data obtainable from a study of fluid incs. However, these results cannot necessarily be extrapolated to higher Ts or to other types of sample materials. (Authors' abstract).

ROEDDER, Edwin, and KOPP, O.C., 1975, A check on the validity of the pressure correction in inclusion geothermometry, using hydrothermally grown quartz: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting Berlin - Regensburg 1974, p. 431-446, First author at U.S. Geological Survey, 959 National Center, Reston, Virginia 22092, USA.

P. fluid incs. were studied in syn. quartz xls (∿ 1 cm^3 in size) grown in static thermal gradients from 0.5N CsOH or RbOH at 0.8-1.8 kb and 371°-467°C (partial fill 63.5-74.0%). Inc. T_H were det., corrected for known P to yield T_T^*, and compared with lab. growth Ts (T_G). This permitted evaluation of the validity of inc. therm. when P corr. (ΔTp) are large. The diff. ΔT ($T_T - T_G$) ranged from only - 14° to +25°C, in spite of relatively large ΔTp values (72° to 170°C). The ΔT is the result of several possible sources of error, only part of which can be evaluated with any precision: 1) Errors in meas. of T_H (here probably ∿ ±5°C); 2) errors in cal. ΔTp (here probably ∿ ±5°C); 3) other possible sources of error intrinsic to the T_H method, such as bubble surface tension, pption on the inc walls, trapping of nonrepresentative fluid, etc. (here probably <1°C); and 4) errors in meas. and interpolation of T_G in the autoclave at the xl face. We believe that (4) is probably the largest single source of error here (estimated ± 10-15°C) and that these data prove that if the Ps (and to a lesser extent, the sol. comp.) are known adequately, P corr. can be large and still permit relatively accurate therm. by means of incs. The errors evaluated here are relatively small in comparison with those stemming from uncertainties in geol. depth est. for natural samples from deep environments. (Authors' abstract). ($^*T_T$ = temp. of trapping)

ROEDDER, Edwin, ROSASCO, G.J., and SIMMONS, J.H., 1975, Laser Raman spectroscopy of fluid inclusions (abst.): Geol. Survey Research 1975, U.S. Geol. Surv. Prof. Paper 975, p. 148 (see Rosasco and Roedder, 1975).

ROEDDER, Edwin, and WEIBLEN, P.W., 1975a, (Anomalous melt inclusions in lunar ilmenite) (abst.): Geological Research 1975, U.S. Geol. Survey Prof. Paper 975, p. 233.

An anomalous type of silicate melt inc. of unexplained origin was found in the Apollo 17 mare basalts. Ilmenite xls in all 7 mare basalt samples exam. contain relatively large silicate melt incs. These are now either wholly glass or glass that contains a few feathery xls. Bulk comp. are of two types. (Some individual small ilmenite grains have both types of incs.) The less abundant type is of potassic granite comp. (6.4% K_2O and 76.7% SiO_2) and formed by late-stage immiscibility of the silicate melt; similar incs. are found in most lunar mare basalts and some terrestrial basalts. The more abundant type has identical SiO_2 content, 76.4%, but only 0.03% K_2O (average of 29 anal.); the diff. is made up largely by an increased CaO content, and most other oxides have similar conc. in the two types. At present, none of the theories proposed for the origin of these anomalous "low-K" incs. satisfactorily explains all the obs. (Authors' abstract)

ROEDDER, Edwin, and WEIBLEN, P.W., 1975b, Anomalous low-K silicate melt inclusions in ilmenite from Apollo 17 basalts (extended abstract): Lunar Sci. VI, Lunar Sci. Inst., Houston, p. 683-685.

This is an extended abstract of the previous item. (ER)

ROMANCHEV, B.P., KOGARKO, L.N., KAMENEV, Ye.A., and SHEVALEEVSKIY, I.D., 1975, Genetic types of apatite from Koashvinskoe deposit: Transactions of Mineralogical Museum (New data on minerals of USSR), v. 24, p. 207-211 (in Russian).

Apatite and nepheline from Koashvinskoe apatite dep. (Khibiny) contain xlized, melt incs. (T_H = 750-920°C) as well as G/L incs. (in apatite; T_H = 270-400°C), both P, testifying to exist. of 2 gener. of apatite: a magmatic and a hyd. one. In ijolite-urtite peg. apatite has G/L incs. with 2-3 dms, T_H = 360-380°C. High-T inc. was anal. by electron microprobe method (Figs 1 and 2 below); besides the named mins., NaCl was found in the interstices between min. grains. After homog. such incs. may be quenched to form glass. (Abstract by A.K.)

Fig. 1. Xlized melt inc. in apatite, x 530.

Fig. 2. Min. phases identified by electron microprobe: f - K-feldspar, p - pyroxene, b - biotite, s - iron sulfide, a - apatite, ne - nepheline.

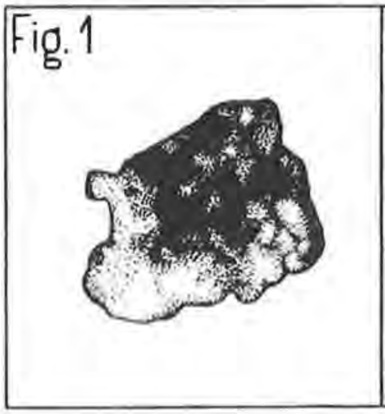


Fig.1

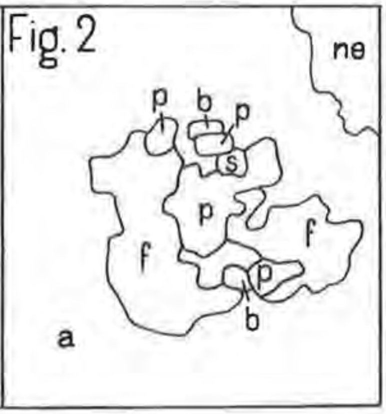


Fig.2

ROSASCO, G.J., and ROEDDER, Edwin, 1975, Laser Raman spectroscopy for nondestructive partial analysis of individual phases in fluid inclusions in minerals; Amer. Geophy. Union, Trans., v. 56, no. 6, p. 460. First author at Inst. Materials Research, Nat. Bur. Stds., Wash. D.C. 20234).

Laser-excited Raman spectroscopy was successfully applied to the nondestructive ident. and partial anal. of individual solid, liquid, and gaseous phases in a series of fluid inc. The procedure is no panacea for problems of inc. anal., as it can yield data only on those elements present in polynuclear species. It can, however, readily produce qual. and quan. data on individual constituents in the range 10^{-6} to 10^{-10} g, some of which cannot be obtained otherwise. Present instrumentation places somewhat stringent requirements on sample geometry because it involves entry of the exciting laser beam into the inc. through a surface at ~90° to the axis of the spectrometer. This limitation could probably be minimized by special optical design. These experiments involve high irradiance levels and hence significant heating problems can occur in absorbing phases. The technique has been applied and shows strong promise for discrimination and det. of several geochemically important dissolved species in water, e.g., $SO_4^=$ (~100 ppm), $CO_3^=$ (~100 ppm), HCO_3^-, and CO_2^c. In these same incs., separate coexisting phases were anal. for CO_2, CH_4, N_2, and other gases. Such anal. also permit estim. of the P of CH_4, and crude C^{12}/C^{13} ratios in CO_2 liquid. A dm. of ~10^{-10} g in an inc. of size 10 x 50 x 100 μm in apatite was unambiguously ident. as anhydrite. The present instrumentation is not specifically designed for anal. of very small samples, so modifications of both the optical system and spectrometer should improve discrimination and hence make the method suitable for smaller samples. (Authors' abstract.)

ROSASCO, G. J., ROEDDER, Edwin, and SIMMONS, J. H., 1975, Laser-excited Raman spectroscopy for nondestructive partial analysis of individual phases in fluid inclusions in minerals: Science, v. 190, p. 557-560.
See previous item.

ROSASCO, G.J., and ROEDDER, Edwin, 1976, Application of a new laser-excited Raman spectrometer to nondestructive analysis of sulfate in individual phases in fluid inclusions in minerals: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. First author at U.S. Nat. Bureau of Stds., Wash., D.C. 20234.

Rosasco et al. (Science, v. 190, p. 557, 1975), reported the first successful application of laser-excited Raman spectroscopy for the ident. and nondestructive partial anal. of individual solid, liquid, and gaseous phases in fluid incs. One of the major limitations of their inst. was its sample requirements: relatively "large" fluid incs. (∿100 µm), of such shape and host min. clarity that the emitted Raman spectra could be collected in a direction approximately perpendicular to the path of the exciting laser beam. In addition, total reflection at sloping inc. walls made many otherwise ideal incs. inaccessible by this technique. We report here the results of the application of a new inst. that eliminates many of the previous limitations and hence greatly expands the range of applicability of Raman spectroscopy to fluid incs.

This new inst. was recently developed at the U. S. Nat. Bureau of Stds. for Raman spectroscopic anal. of individual micrometer-sized particles. It is unique in that the fore optical system is designed to limit the effective scattering volume sampled to the order of 10 μm^3, under optimum conds. The exciting Ar-ion laser radiation (514.5 nm) is focused to a principal spot of ∿2 µm diam. (in air) by a 15x reflecting-type microscope objective. This lens also serves as the objective of a viewing microscope. The scattered radiation is collected by a high-numerical aperturn (∿0.86) ellipsodial mirror, whose major axis is centered on the backscattering direction. A high-efficiency double monochromator and a photoelectric detection system are used.

The applicability and limitations of the inst. have been explored on several types of anal. problems, but will be illustrated here by studies of the presence of $SO_4^=$ in fluid incs., both in dxls and in sol. The samples were ordinary double polished plates, as used in most inc. studies.

Using the earlier inst., Rosasco et al. unambiguously ident. a dxl. as anhydrite in an inc. in yellow apatite from Durango, Mexico. The same dxl., which was far larger than needed for the new inst. (10 x 12 x 39 µm), was reexamined. The spectrum was equiv. to that obtained earlier in signal-to noise, but showed improved discrimination between host and dxl.; hence, more anhydrite Raman peaks were measurable. Another smaller dxl. in the same inc. was also found to be anhydrite.

Many porphyry copper deps. contain incs. with 5-10 µm dxls. that have been tentatively ident. as anhydrite solely on the basis of shape, birefringence, and parallel extinction. These xls. are too small for the previous Raman technique, but, by using the new inst., some of these xls. from quartz-chalcopyrite-molybdenite veins in the Cu-Mo core of the dep. at Bingham, Utah, yielded excellent spectra, char. of the sulfate ion in the anhydrite structure.

As anhydrite has retrograde solubility in most sols., and as the anhydrite xls. in these incs. are generally reported not to redissolve during heating runs, they cannot be normal dxls., formed simply by sat. on cooling. The only feasible mech. for their form. seems to be the loss of H_2, from dissociation of the inc. liquid, by diffusion through the quartz host, resulting in the autooxidation and hence conversion of $S^=$ ion originally present in the sol. to $SO_4^=$ and pption. of anhydrite. (The hematite xls. commonly present in such incs. in porphyry copper deps., which also do not redissolve, could be formed by similar autooxidation of original Fe^{++} in sol.)

Standard anal. dets. of submicrogram amounts of total sulfur in sol. in incs. are very difficult, and distinction between the various possible ionic species ($S^=$, $SO_4^=$, etc.) is even more difficult, yet this distinction, which is readily made by Raman spectroscopy, is of considerable significance in many applications of fluid-inc. data to the chem. of ore dep. Rosasco et al. demonstrated the ability to detect $SO_4^=$ concs. of <500 ppm from fluid incs. of such size that a 250-μm beam path through liquid could be obs. In the present study, we successfully detected $SO_4^=$, estim. to be ∼ 900 ppm., in incs. having total fluid volumes one to two orders of magnitude smaller (i.e., irregular incs. of ∿20-μm diam.). The incs. were the same ones in which anhydrite dxls. had been det., and the $SO_4^=$ conc. assumed is based on sat. with respect to anhydrite.

The major limitations of the present technique include the high-irradiance levels required (similar to those used previously), the requirement of the present optical system that the incs. be <∿100 μm from the surface, and the extensive instrumentation needed. Also, our anal. of the spectra observed from cond. phases in this study suggests that detection of low-P gases would be difficult in these incs. The most important advantage of this new inst. is that it is routinely applicable to small, even irregular incs. in normal inc. sample preps. Thus, the basic anal. capabilities demonstrated earlier have now been extended to most ordinary fluid incs. (Authors' abstract.)

ROSASCO, G.J., and SIMMONS, J.H., 1974, Investigation of gas content of inclusions in glass by Raman scattering spectroscopy: Amer. Ceramic Soc. Bull., v. 53, no. 9, p. 626-630. Authors at National Bureau of Standards, Washington, D.C.

Laser Raman spect. is used to identify the gaseous contents of incs. in glass. This test is offered as a valuable complement to other anal. tech. It requires relatively simple specimen prep., offers good sensitivity to the gases of interest and is a nondestructive test. Further, since the sample is not contained in a confining test app., the T of the contents of the bubble may be raised, for example, to vaporize solid deps. for anal. Spherical bubbles 0.5 mm in diam. have been routinely anal. without special optics and with good signal-to-noise ratio. The elements of the theory and practice of laser Raman spect. are outlined and their application to the study of the gaseous content of incs. is discussed in detail. (Authors' abstract)

ROSENHAUER, M., and EGGLER, David H., 1975a, Melting of diopside in the presence of H_2O and CO_2 (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1251-1252. Authors at Geophysical Laboratory, 2801 Upton St., N. W., Washington, D. C. 20008.

Melting of diopside ($CaMgSi_2O_6$) in the presence of H_2O, of CO_2, and for H_2O-CO_2 mixtures has been det. At Ps to 7 kbar, differential thermal anal. (DTA) in internally-heated P vessel has been used. From 7-30 kbar melting was detected by quenching expers. in solid-media app. Solidus curves for $CO_2/(CO_2+H_2O)$ vapor comps. of 0.8 and 0.4 show previously unsuspected T minima at ∿5 kbar P and max. at ∿30 kbar. These phenomena have significant implications to melting, paths of ascent, and evolution of vapor from basic magmas. In particular, vapor evolved from an ascending magma will change most rapidly (from CO_2-rich to H_2O-rich) at P less than 5 kbar. Soly. of H_2O in diopside melt has been det. to 30 kbar P. A distinct break in the soly. curve is obs. between 5 and 10 wt % H_2O (39-57 mole %). This break is interpreted to indicate entry of one mole of H_2O, separating double chains of silica tetrahedra into single chains. Additional H_2O probably enters the melt by breaking single chains into smaller units and as molecular H_2O. (Authors' abstract.)

ROSENHAUER, M., and EGGLER, D.H., 1975b, Solution of H_2O and CO_2 in diopside melt: Carnegie Inst. Wash., Geophy. Lab. Yearbook 74, for 1974-1975, p. 474-479 (see preceding item).

RUB, M.G., ASHIKHMINA, N.A., TRONEVA, N.A., and TOKSUBAEVA, G.N., 1975, Tungsten-bearing magmatic complexes and their relation to ore-mineralization, in Mineralogy and geochemistry of tungsten deposits (Trans. of III All-union Meeting), v. 3, p. 193-203, Leningrad (in Russian). Authors at Inst. Geol. Ore Dep. Petrogr., Mineral. and Geochem. of Acad. Sci. USSR.

For scheelite deps. Ca^{2+} - Na^+ - HCO_3^- - SO_4^{2+} comp. of fluid incs. is characteristic. (A.K.)

RUTHERFORD, M.J., and HESS, P.C., 1975, Origin of lunar granites as immiscible liquids (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, TX, p. 696-698.

An exper. study of residual melts in mare basalt comps. revealing the amount of fractional xliz. needed to reach immiscibility. (ER)

RYABOV, V.V., 1975a, Anhydrite of Oktiabr'skoe copper-nickel deposit (Noril'sk region), in Materials on genetic and experimental mineralogy, v. 8, V.S. Sobolev. ed., Inst. of Geol. and Geophysics, no. 184: Novosibirsk, "Nauka" Press, Siberian Division, p. 89-106 (in Russian).

Hypogene anhydrite (in assoc. with chalcopyrite, T_D = 110 and 270°C; magnetite, T_D = 470°C; vesuvianite, prehnite, sphalerite, and hornblende) gave T_H of fluid incs. ranging from 80 to 630°C, and T_H of incs. in selenite - 130-145°C.

K_2O, Na_2O and Li_2O in incs. in anhydrite range as follows, respectively: 85-190, 510-860 and 29-128, (10^{-5} mg/ml), and pH of water leachates from 6.73 to 7.40. High -T incs. are enriched in CO_2 and O_2, low-T ones in N_2 + rare gases. Incs. in anhydrite assoc. with chalcopyrite contain H_2. (Abstract by A.K.).

RYABOV, V.V., 1975b, Some peculiarities of mineralogy of metasomatites from the aureole of the Talnakh differentiated ore-bearing intrusion (NW part of Siberian Platform), in Materials on genetic and experimental mineralogy, v. 8, V.S. Sobolev, ed., Inst. of Geol. and Geophysics, no.

184: Novosibirsk, "Nauka" Press, Siberian Division, p. 107-147 (in Russian).

T_H of fluid incs. in clinopyroxenes of high-T metasom. stage - 710-820°C, and 550°C; T_H for vesuvianite - 120-820°C, for garnet - 670-740°C. (Abs. by A.K.).

RYE, R.O., LANDIS, G.P., and SAWKINS, F.J., 1975, Magmatic or meteoric water in ore fluids (abst.): Geol. Survey Research 1975, U.S. Geol. Surv. Prof. Paper 975, p. 161.

Studies of the H and O isotopic comp. of numerous Tertiary hyd. ore deps. in the Andes of South America indicated that magmatic fluids are nearly always present at some stage during the history of the hyd. fluids. The hyd. fluids in these Tertiary ore deps. are probably not dominated by meteoric waters, as are those in similar deps. in the Western United States, because of the relatively dry climate in the Andes during ore dep. The study suggests that the dominance of meteoric water in the hyd. fluids of certain ore deps. may be related to local climate and hydrology rather than to anything fundamental about ore dep. (Authors' abstract)

RYERSON, F. J., and HESS, P. C., 1975, The partitioning of trace elements between immiscible silicate melts (abst.): Transactions, American Geophysical Union, v. 56, no. 6, p. 470. Authors at Dept. of Geological Sciences, Brown University, Providence, R. I. 20912.

Distribution coefs. have been det. for La, Yb, Ba, P for coexisting granite and ferropyroxenite immiscible melts at Ts between 980°C and 1020°C at 1 bar. These K_D's are not unique, but are a function of the proximity of the critical point, and the concs. of the major and trace elements. An initial conc. of 0.14 wt % P_2O_5 produced an enrichment of 20 to 1 in the ferropyroxenite over the coexisting granite. K/P changes from 0.35 in the initial melt to 0.12 in the ferropyroxenite and 19.0 in the granite. Initial concs. of 0.1, 0.3, 0.5 wt % La_2O_3 and Yb_2O_3 produced a 4 to 1 enrichment of these elements in the ferropyroxenite over the granite. At higher concs. of La_2O_3 and K_D's became larger. For melts initially containing 0.3 wt % La_2O_3 and Yb_2O_3, K/La and K/Yb ratios of 10.7 in the initial melt were altered to 1.2 and 2.0 respectively in the ferropyroxenite and 14.7 and 15.2 in the granite. K/REE, K/P, K/Ba ratios will remain constant during L-xl. fractionation of a basaltic magma, and will therefore reflect the ratios of the source area. L immiscibility will greatly affect these interelement ratios and may be used to recognize Ls derived by this process. (Authors' abstract.)

RYZHENKO, B.N., 1975, Physico-chemical bases of the determination of the forms of chemical element transfer in mineral-forming aqueous solutions: Geokhimiya, 1975, no. 11, p. 1635-1644 (in Russian; translated in Geochem. Internat., v. 12, no. 6, p. 12-21, 1975). Author at Dept. of Geochem., Moscow State Univ.

The methods of det. the effects of T and P upon the values of electrolytic dissoc. constants in aq. sols. are shown. On the basis of the electrostatic theory the change of dissoc. constants of electrolytes of diff. charge type under conds. of hyd. min. form. has be considered. (Author's abstract)

SABOURAUD-ROSSET, Christiane, 1975, Solid and liquid inclusions in gypsum. Thèse d'Etat, Université Paris Sud, Centre d'Orsay, 173 pp. plus 23 plates. Author at Lab. de Géol., Ecole Normale Supérieure, 16, rue d'Ulm, 75005 - Paris, France.

Covers in part material abstracted previously in Sabouraud-Rosset, 1972, (Fluid Inclusion Research, v. 5, 1972, p. 97), 1973 (ibid, v. 7, p. 195), and 1974 (ibid., v. 7, p. 195-196). The abstract was published in 1976 and will be abstracted in that volume. (ER)

SALIKHOV, V.S., 1973, Postsedimentation changes in copper-bearing deposits of the South Siberian Platform: Akad. Nauk SSSR, Izvestiya, Ser. Geol., 1973, no. 12, p. 117-131 (in Russian; translated in Internat. Geol. Review, v. 17, no. 1, p. 83-94, (1975)). Author at Chita Branch, VNIIprozolota, Chita.

Includes a summary of decrep. Ts of alpine veins in Cu-bearing sequences in the South Siberian Platform (Table 3); all data from the literature. (ER)

SAMOYLOV, V.S., 1974, Effect of temperature and pressure on acidity and basicity of carbonatite-forming solutions: Akad. Nauk SSSR, Doklady, v. 218, no. 2, p. 452-455 (in Russian; translated in Doklady Acad. Sci. USSR, v. 218, p. 193-195, (1975)). Author at Inst. Geochem., Sib. Div., USSR Acad. Sci., Irkutsk.

Includes a brief summary of T_H and T_D for various depths and assemb. in 3 plutons. T_S range from 235 to 430°C. (ER)

SAMOYLOV, V.S., 1975a, The temperatures of formation of carbonatites (based on geothermometric studies): Geokhimiya, 1975, no. 11, p. 1684-1690 (in Russian; translated in Geochem. Internat., v. 12, no. 6, p. 52-58, 1975). Author at Inst. of Geochem., Sib. Br. of the Acad. of Sci. USSR, Irkutsk.

T_F of different facies of carbonatites from the massifs in Siberia and on the Kola Peninsula has been det. by various geothermometers. Incs. in the chlorite-sericite-ankerite facies (some with bitumen) had T_H of 210-430°C. (ER)

SAMOYLOV, V.S., 1975b, Influence of acidity-alkalinity on equilibria of rock-forming and accessory minerals, in Geochemistry and petrology of metasomatites, ed. E.I. Popolitov: Novosibirsk, "Nauka", Siberian Division, p. 3-15 (in Russian). (A.K.)

SAMOYLOV, V.S., 1975c, Regime of acidity-alkalinity of carbonatite-forming solutions, in Geochemistry and petrology of metasomatites, ed. E.I. Popolitov: Novosibirsk, "Nauka", Siberian Division, p. 28-35 (in Russian). (A.K.)

SAMOYLOV, V.S., and MILYUTINA, I.P., 1975, Crystallization temperature of rocks of the acid leaching stage in carbonatite complexes as a possible indicator of depth of formation: Akad. Nauk SSSR, Doklady, v. 221, no. 4, p. 942-945 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sect., v. 221, p. 190-192). Authors at Inst. Geochem., Sib.

Div., USSR Acad. Sci., Irkutsk.

T_H for carbonate, apatite, and quartz given for various stages in form. of 4 carbonatites (T = 210 to 430°C). Some bitumens and small amounts of dms were found. (ER)

SAZONOV, V.D., 1974, New type of tin mineralization in eastern Transbaikal: Akad. Nauk SSSR, Doklady, v. 215, no. 5, p. 1223-1225 (in Russian; translated in Doklady Acad. Sci. USSR, Earth Sci. Sects., v. 215, p. 208-210 (1975)). Author at Transbaikal Interdisciplinary Research Inst., Chita.

Includes anals. of aq. extracts, from calcite and from quartz, for K, Na, Ca, Mg, F, Cl, HCO_3, SO_4, and $HSiO_3$. (ER)

SAZONOV, V.N., 1975, Listvenitization and ore mineralization: Moscow, "Nauka", 172 pp. (in Russian).

T_H of incs. in vein quartz in listvenites are as follows (°C): at dep. Berezovskoe 220-240, and 330-340; Shul'ginskoe 150-200; Pyshminsko-Kluchevskoe 140-200; Berezovskoe, Severnaya mine 260-270; Pyshminskoe 220-300. These limit the T interval of form. of listvenites to 140-340°C. Gases in incs. in listvenites from Berezovskoe (cm^3/kg sample/wt% of total gas) consist of CO_2 (0.97/18.4), H_2 (2.49/45.7) and N_2 (1.9/35.9). (Abstract by A.K.)

SCHRÖCKE, H., 1974, Mineralizers in the supercritical range (abst.): Fortsch. Mineral., v. 52, pt. 2, p. 102.

SCLAR, Charles B., and BAUER, Jon F., 1975, Relationship of a high-pressure oxonium mica in the system $MgO-SiO_2-H_2O$ to thermal models of descending lithospheric slabs (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

SCOTT, Robert B., MALPAS, John, UDINTSEV, Gleb, and RONA, Peter A., 1975, Submarine hydrothermal activity and seafloor spreading at 26°N, MAR (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1263. First author at Department of Geology, Texas A&M University, College Station, Texas 77843.

SCOTT, S. D., 1975, Sulfide geothermometers and geobarometers (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

SENDEROV, E.E., 1975, Composition of solutions and equilibria of minerals of zeolite facies in Physico-chemical problems of hydrothermal and magmatic processes, Moscow, "Nauka", p. 171-194 (in Russian).

Thdy. calc. of comp. of sol. in equil. with zeolites and with rocks (A.K.)

SERDYUCHENKO, D.P., 1975, Some Precambrian scapolite-bearing rocks evolved from evaporites: Lithos, v. 8, p. 1-7. Author at Inst. Min., Geochem. and Xlog. of Rare Elements, Sadovnicheskaya nab., 71, Moscow 127, USSR.

Scapolite gneisses and schists and conformable layers and lenses of scapolite-bearing marbles and calciphyres with scapolitites and parapyroxenites are well developed in metased. series of the Aldan shield, south Yakutia, USSR. Here scapolite, either by itself or assoc. with plagioclase, quartz, diopside or hornblende, is believed to be a meta. derivative of Archean saline seds. Discoveries of disseminations and interlayered beds of anhydrite along with S-isotope data, support the theory that the scapolite rocks owe their origin to the meta. of evaporites. Commonly, the metaseds. alternate with magnetite-rich horizons that were possibly derived from siderite, chlorite or hydroxide ironstones, interstratified with the evaporites.

Rather similar rocks in the Precambrian of the Vitim and Baikal regions in Siberia and in the Canadian, Scandinavian and Madagascar-Australian shields, were probably also generated through the meta. of evaporites. (Author's abstract)

SEYFRIED, W.E. JR., BISCHOFF, J.L., and DICKSON, F.W., 1975, Basalt-seawater interactions from 25°C-300°C and from 1-500 bars: an experimental study (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1073. First author at Dept. Geol., Stanford Univ., Stanford, CA 94305.

The interaction between seawater and basalt in a ratio of 10:1 has been carried out for time periods up to several months in large volume Au and teflon cells. The exper. system employed provides continuous and thorough agitation of the basalt in the seawater; and furthermore allows aq. samples to be withdrawn from the reaction cells throughout the duration of the runs, while maintaining the system at the desired P and T. Results to date indicate that the direction and magnitude of chem. exchange between the seawater and the basalt is strongly T dependent. The basalt gives up Ca and Si at all Ts studied; however, the direction of Mg exchange is masked due to the rapid pption of seawater Mg as Mg-smectite to a degree dependent upon the Si activity in sol. This removal of seawater Mg as $Mg(OH)_2$ initially creates acid conds. solubilizing Fe and Mn. With the eventual depletion of Mg in the seawater, hydrolysis continues and the pH rises, significantly limiting both Fe and Mn concs. K is leached from the basalt at Ts >200°C, while at lower Ts the altered seawater either shows no change or a slight depletion in K with respect to its initial content. Sulfide is solubilized from the rock only significantly at the highest T studied (300°C) reaching a conc. of 17 ppm after five weeks of reaction; while sulfate, precipitating as anhydrite, was continuously removed from the system in all runs greater than 150°C. Increases in Σ CO_2 are observed at both 200-300°C due to the solubilization of interstitial CO_2 trapped in the rock. (Authors' abstract)

SHANKS, W. C., and BISCHOFF, J. L., 1975, Sulfur isotopes and sulfide deposition in the Red Sea geothermal system (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1266. First author at Department of Geological Sciences, University of Southern California, Los Angeles, CA 90007.

The Red Sea geothermal deps. provide a unique opportunity to study a modern ore dep. in the process of form. Of particular interest is the sulfide facies which is analogous to many ancient massive sulfides in ore potential, bulk comp. and S isotope comp.

The most likely process of sulfide form. is moderately high T reduction of sea water sulfate in contact with recent shallow intrusives in the axial rift zone. (From the authors' abstract.)

SHAPENKO, V.V., 1975, Role of CO_2 in formation of molybdenum-tungsten ores from Zabaikal'ye (abst.), p. 95-96, <u>in</u> Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Moscow State Univ., Moscow.

CO_2 is present at all the stages of form. of rare metal deps., but in variable amounts. Char. features of filling of CO_2-bearing incs. may clarify the source of mineraliz. sols. Veins filling contraction fractures in granitoids (Bom-Gorkhon) have early inc. fluids rich in CO_2; more complicated ore structures are char. by some events of increasing CO_2 content (Dzhida). (Abs. by A.K.)

SHAYDETSKAYA, V.S., 1975, Inclusions of liquid CO_2 in halite from Devonian salts of Dniepr-Donets rift (abst.), p. 65-66, <u>in</u> Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. Fossil Fuels, Acad. Sci. Ukrainian SSR, L'vov.

Incs. in halite from salt dome at Novo-Senzharskaya area yielded $P = 100\text{-}125$ atm, $T \sim 50$°C, and a Cl-Ca-Na fluid. Ca conc. 75-150 g/l, Mg 5-20 g/l, K 8-15 g/l, Fe^{2+} 0.0005-0.1 %, Fe^{3+} 0.0005 %, BO_3^{3-} 0.001 %, pH 5.65-6.15 (±0.2). Incs. with liquid CO_2 were found only in coarse-grained transparent halite in fracture ("halite veins") cutting salt wall rock. Incs. are of two types: $L + CO_2$ and $L + CO_2$ + solids; shape cubic; dim. 0.1 - 1 mm; F = 38-67 %, most common 50 %. Triple point (solid + L + G) -56°C, T_H (partial) in L_{CO_2} = 10-14°C. Solid phases are accidental solid incs. (not dms). L is sol. of Cl-Ca-Na type (Ca 21-50 g/l, Mg 2-4 g/l, K 32.5-44.5 g/l, Fe^{3+} present; pH 4.5-4.9, ±0.2; Eh 120 to 180 mV). Halite xlized from heterog. sols. of H_2O+CO_2. CO_2-bearing incs. were found also in halite from Bogdany and E. Slavyanskaya. (Abs. by A.K.)

SHCHEPOT'EV, Yu.M., and ANDRUSENKO, N.I., 1975, Genetic peculiarities of sub-surface gold and mercury deposits of Kamchatka: Sovetskaya Geologia, 1975, no. 6, p. 62-71 (in Russian). Authors at Central Sci.-Research Geol.-Prospect. Inst., Moscow.

Sub-surface Au-Ag deps. formed at depth 100-600 m bear mins. xlized. over a 50-80°C T interval (commercial ores), from hyd. and partly also pneum. sols. Quartz from granodiorite wall rocks has P melt incs. T_H = 750-830°C and S incs. with T_H close to T_H of incs. in metasom. secondary quartzites (520-420°C) and quartz-sericite-hydromica metasomatites (505-480-420°C). Early Au-quartz assoc. ppted. at 410-290°C, and commercial Au-telluride and Au-Ag ores at 300-140°C. Deps. of galena-sphalerite-chalcopyrite formed only from hyd. sols. bearing CO_2 at 360-50°C. In one dep. the earliest Cu-Mo mineraliz. formed at 315-190°C, then Au-Ag-

Hg at 260-70°C. Commercial Hg dep. from N Kamchatka have T_H = 90-80°C. Characteristics are: abrupt T changes between both major and minor (internal) mineraliz. stages, with a general T decrease, good develop. of medium-T period of ore form., and presence of periods of boiling and pneumatolysis. Vertical T zonation was not found. P, from inc. studies, varied from 640 to 450 atm during pre-ore stages, and 420 to 190 atm at Au-polymetallic commercial stage; at one dep. from N Kamchatka (argentite type) xliz. of amethyst occurred at 150-70 atm. Sols. had $SO_4 < Cl < HCO_3$; Na<Ca (with Mg, Si, and NH_4); conc. at early stages up to 30%, later more dilute. CO_2 is the main G and N_2 is commonly present. (Abs. by A.K.)

SHCHERBAKOVA, Z.V., 1975, Temperatures of formation of subalkaline rocks (on the basis of inclusions in rock-forming minerals), in Materials on genetic and experimental mineralogy, v. 8, V.S. Sobolev, ed., Inst. of Geol. and Geophysics, no. 184: Novosibirsk, "Nauka" Press, Siberian Division, p. 170-177 (in Russian).

Subalkaline granitoids of Balyaginskiy massif gave T_H of incs. as follows: melt incs. in quartz of granites - 970°C, in quartz phenocrysts of fine-grained granites - 720-880°C (melt incs.) and 420-630°C (xline-liquid incs), in quartz from dikes of granite-porphyry - 1010°C (melt incs) and 890°C. Pegmatoid aggregates bear incs. of L+G+xls with T_H = 700-770°C or incs. decrep. at 890°C before homog.

Totkhotoyskiy massif consists of granitoids of two phases: those of the first phase bear incs. with T_H = 700-830°C (melt incs) and 570-600°C (in liquid). Anomalous incs. with T_H = 970°C were noted. Low-T,S, G/L incs. have T_H = 270-390°C. Leucocratic granites (probably the second phase, A.K.) bear incs. with T_H = 470-610°C and in micropeg. - 350-600°C and 180-270°C.

Estimated pressures vary from 1500 to 3500 atm for Balyaginskiy massif and 1200-3200 atm for Totkhotoyskiy massif. (Abstract by A.K.).

SHCHERBAKOVA, Z.V., VARTANOVA, N.S. and KRIVOPUTSKAYA, L.M., 1975, Temperatures of formation of K-Na-feldspars from alkaline granitoids of Kunaley complex, Zabaikal'ye, in Materials on genetic and experimental mineralogy, v. 8, V.S. Sobolev, ed., Inst. of Geol. and Geophysics, no. 184: Novosibirsk, "Nauka" Press, Siberian Division, p. 303-309 (in Russian).

T_H of melt incs. in quartz (interstitial between feldspar xls) from alkaline syenites is 890°C. (A.K.).

SHCHERBAN', I.P., 1975, Conditions of formation of low-temperature near-ore metasomatites (exemplified by Altae-Sayan area): Novosibirsk, "Nauka", Siberian Division, 200 pp. (in Russian), Author at Inst. Geol. Geophysics of Sib. Branch of Acad. Sci. USSR, Novosibirsk-90.

The book bears thdy. evaluation of parameters of origin of metasomatic rocks (listvenites, siliceous rocks, argillites, dolomitized rocks, chloritized rocks, gumbeites, albite-carbonate rocks) and calc. of thermal fields around fractures, as well as equations for metasomatic zonality. (Abs. by A.K.)

SHCHIRITSA, A.S., 1975, Comparative characteristics of carbonates of surficial and hypogene origin from Crimea (abst.), p. 71-72 in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geochem. and Physics of Minerals, Acad. Sci. Ukrainian SSR, Kiev.

Vein calcite is usually low-T, bearing one-phase incs. G phase in incs. in recent carbonates from walls of caves is mainly N_2 (50-60 %), plus CO_2, and sometimes O_2 and H_2S. (Abs. by A.K.)

SHEGELSKI, R.J., and SCOTT, S.D., 1975, Geology and mineralogy of the silver-uranium-arsenide veins of the Camsell River District, Great Bear Lake, N.W.T. (abst.): Geol. Soc. Amer. Abstracts with Programs, v. 7, no. 6, p. 857-858. Authors at Dept. Geol., Univ. Toronto, Toronto, Ontario M5S 1A1, Canada.

The Bear Province contains several small Ag,Bi,U, Ni-Co-Fe-As vein deps., within Proterozoic sed. and volcanic rocks of the Echo Bay Group in close proximity to the granite-granodiorite Great Bear batholith. Six periods of vein min. are evident at Terra Mine: (1) pitchblende + hematite + quartz; (2) Ag + quartz; (3) Ag + carbonate; (4) Ni,Co arsenide + carbonate; (5) Co,Fe arsenide and sulpharsenide + Bi + carbonate; and (6) Cu,Pb,Zn,Fe sulphide + carbonate. The arsenide vein periods exhibit an orderly paragenetic sequence from early monoarsenide through intermediate diarsenides to late triarsenides and sulpharsenides, and a corresponding comp. change of arsenides with time from early Ni through intermediate Co to late Fe-enriched phases. At least one vein system within the Terra mine exhibits a lateral zonation in the distrib. of arsenide assemb. with the Ni zone closest and the Fe zone farthest from the batholithic intrusion. This zoning is consistent and is similar to that found at Cobalt, Ontario. Fluid incs. in the carbonate gangue intimately assoc. with the Ni diarsenide min. (period 4) have high salinities between 30 and 35 equiv. wt. % NaCl and a wide range of P-corr. T_H of 180-510°C. The proximity of all the arsenide vein deps. to the Great Bear batholith, the orderly nature of the mineral parageneses, the distrib. of arsenide min. zones relative to the contact with the batholith, the fluid inc. data, and the $\delta 34S$ values of the sulfides near + 1 $^{o}/oo$ (Robinson and Badham, 1974) all suggest that the batholith was instrumental in the localization and emplacement of the vein min. (Authors' abstract)

SHIKAZONO, Naotatsu, 1975, Mineralization and chemical environment of the Toyoha lead-zinc vein-type deposits, Hokkaido, Japan: Econ. Geol., v. 70, p. 694-705.

Epithermal lead-zinc vein-type deposits of the Toyoha mine, Hokkaido, Japan, occur in the Green Tuff region of Miocene age. Literature data and some new dets. of T_H show 150-250°C (quartz and sphalerite), in agreement with S-isotope Ts. Chem. comp. of ore sols. are calc. (ER)

SHIMRON, A.E., 1975, Petrogenesis of the Tarr albitite-carbonatite complex, Sinai Peninsula: Mineralog. Mag., v. 40, p. 13-24. Author at Dept. of Geol., Hebrew Univ., Jerusalem, Israel.

Large albitite bodies assoc. with explosive brecciation, fenite aureoles, intrusive carbonate rocks, olivine dolerites, and porphyry copper min. are described from the Dead Sea rift region in the southeastern Sinai Peninsula. The main carbonate phases comprise breunnerite and dolomite with actinolite the main phase in the fenites. Field and isotopic evidence indicates that the intrusive carbonate rocks are of carbonatitic origin. The cogenetic, almost monomineralic main phases can be attributed to fractional xliz. and liquid immiscibility acting on a highly gas-charged, slow-cooling gabbroic magma. (From the author's abstract)

Two stages of immiscibility are proposed: first a Na-Si-rich and a gas-rich, Mg-Ca-Fe-rich liquid separate, then the latter splits to form a Mg-Si-rich liquid and a gas-rich carbonatite melt. (ER)

SHIPULIN, F.K., REKHARSKIY, V.I., ROZBIANSKAYA, A.A., PASHKOV, Yu.N., KAPSAMUN, V.P., ZVYAGINTSEV, L.I., LANGE, Ye.K., KANTSEL', A.V., AVETISYAN, G.G., and SUKHORUKOV, Yu.T., 1975, Intrusions, hydrothermal-metasomatic formations and copper-molybdenum ore mineralization: Moscow, "Nauka", 231 pp. (in Russian).

At Kadzharan ore dep. (Little Caucasus), in quartz of quartz-tourmaline veins, P incs. contain H_2, N_2, etc., in gas phase, but no CO_2, H_2S, etc., since T_{Frz} -195°C. Polyphase incs. bear DMs: halite, hematite, biotite, feldspar and magnetite, T_{Frz} = -15 - -17°C; salt conc. up to 43%, T_H = 320-440°C. Incs. in quartz of quartz-hornblende metasomatites have T_H = 350-450°C, of epidote-albite rocks - 380-400°C, of biotite-quartz rocks - about 400°C (polyphase incs. with dms and L CO_2), of feldspar-quartz-molybdenite form. - 250-360°C, (polyphase incs. with L CO_2, salt conc. 5-8%), quartz-sericite-chalcopyrite form. - 190-280°C (incs. with dms: halite and sylvite), berezite form. - 140-210°C and in sphalerite - 110-190°C (salinity 6-15%), argillite form. - $\sim$60°C, salinity $\sim$1%. (p. 106-138 and Table 45 at p. 176, also photos at Fig. 43). (Abstract by A.K.)

SHMONOV, V.M., and SHMULOVICH, K.I., 1974, Molal volumes and equation of state of CO_2 at temperatures from 100 to 1000°C and pressures from 2000 to 10,000 bars: Akad. Nauk SSSR, Doklady, v. 217, no. 4, p. 935-938 (in Russian; translated in Doklady Acad. Sci. USSR, v. 217, p. 206-209 (1975); abstract in Internat. Geol. Rev., v. 17, no. 1, p. 107, (1974)). Authors at Inst. Exper. Min., Acad. Sci. USSR, Chernogolovka, Moscow Province, USSR.

The authors' meas. (table 1), comparisons with the results obtained by other invest. (fig. 1), and critical considerations of the lit. are followed by derivation of the method (eq. 4), which is suited for extrapolation of the results into the higher P-T fields (table 2). The range of cal. volumes of CO_2, cm^3/mol, is from 29.01 at 100°C and 10,000 bar to 84.55 at 1000°C and 2000 bar.

SHMULOVICH, K.I., MOISEEVA, L.S., and DOKINA, T.N., 1975, Conditions of synthesis and lattice parameters of garnets of pure grossular-andradite composition: Contributions to physico-chemical petrology, v. 5; Moscow, "Nauka", p. 267-270 (in Russian).

Synthesis of pure grossular-andradite garnets was successful at 600-700°C in presence of chlorides of Ca, Al, and Fe, and H_2O in 15-20 days; equil. was not attained in <10 days. (From authors' summary of results, translated by A.K.).

SHMULOVICH, K.I., and SHMONOV, V.M., 1975, Fugacity coefficients for CO_2

from 1.0132 to 10,000 bar and 450-1300° K: Geokhimiya, 1975, no. 4, p. 551-555 (in Russian; translated in Geochem. Internat., v. 12, no. 2, p. 202-206, 1975) Authors at Inst. Exper. Min., Acad. Sci. USSR, Chernogolovka.

From molar volume data for CO_2 for the ranges 1-600, 2000-10,000, and 700-4000 bar, two equa. of state for the range 1 to 10,000 bar and 450-1300 °K have been derived. Algebraic integration of the equa. provides the fugacity coef. for this P-T range. The values of γCO_2 have been cal. in increments of 50°K and 250 bar and tabulated. The cal. results compared favorably with exper. values from the lit. data. (Authors' abstract).

SHTEYNBERG, D.S., BUSHLYAKOV, I.N., and VILISOV, V.A., 1974, Petrogenetic significance of fluorine-chlorine-water ratio in rock-forming minerals: Akad. Nauk SSSR, Doklady, v. 218, no. 6, p. 1438-1441 (in Russian; translated in Doklady Acad. Sci. USSR, v. 218, p. 164-167 (1975); abstract in Inter. Geol. Review, v. 17, no. 2, p. 239 (1975)). Authors at A.N. Zavaritskiy Inst. of Geol. and Geochem., Ural Science Center, USSR Acad. Sci, Sverdlovsk.

Data from Uralian mag. and meta. rocks, & the lit., are summarized. Distrib. of F and Cl in coexisting amphiboles and biotites (figs. 1, 2), F-Cl correlations in biotites from a wide variety of granites and granitoids, meta., etc., in reference to the OH background (fig. 3), and F:Cl ratios in rocks and accessory apatites, vs OH mol fractions, as in the OH + F + Cl group (fig. 4) show the existence of general and yet definite series of rocks wherein the following petrogenetic factors are recognizable singly and in combinations: T, P, relative abundance of H_2O in parent magma, assoc. mineralizations or enrichments (iron, rare metals, etc.), others, including progressively increasing F:OH ratio at decreasing basicity of the rocks and certain deviations, as expressed in the F:Cl anomalies. (Modified from IGR).

SHUR, A.S., 1975, On methods of determination of pressure in mineral-forming solutions, p. 24-25, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. and Geochem. of Ural Sci. Center, Acad. Sci. USSR, Sverdlovsk.

Paper bears the proposal of approximate det. of P: $\lg P = \varphi(T^{-1})$ (φ undefined in original; ed.). On the basis of graph made by the author the value of heat of evaporation of G/L incs (ΔQ) can be det.; then included in equation for det. P:

$$P = \frac{Q}{v 2.303 \lg v};$$

v - specific volume of vapor extracted during exper. at final T. (sic.) Decrepigraphs are also useful for det. of specific vol. of gases. Comparison of data obtained by above method agrees well with data received by use of other methods. (Abs. by A.K.).

SHVADLUS, M.I., 1975, Melt microinclusions in quartz in ore-bearing granitoids from Central Buryatya and the first results of their studies: Akad. Nauk SSSR, Sib. Branch, Geol. i Geofiz., v. 192, no. 12, p. 97-101 (in

Russian with English abstract). Author at Geol. Inst. of Buryatian Div. of Sib. Branch AN SSSR, Ulan-Ude.

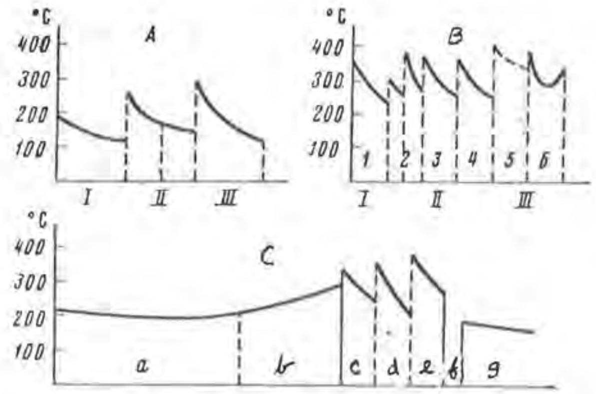
Melt incs. in quartz (rounded, 4-120 μm diam. contain G and 1-3 xline phases at room T. T data are evaluated on basis of 540 T_H meas. Three types of incs. were distinguished: 1) solid phase is a mica-like min. with a high refr. index, n>quartz; occurs in quartz from marginal parts of granite bodies; G:solid = 10:90; melting begins at 690-700°C; at 800-830°C gas phase disappears; T_H = 890-910°C. 2) All xl phases have n< quartz; occur in quartz from central parts of massifs; G:xls = 15:85 (vol.); beginning of melting - 680-690°C; at 730-750°C all xls are melted and G:melt - 10:90; T_H=780-810°C; dms are probably feldspars. 3) Incs with dms having low and high indices; occur in quartz from granites and syenogranites in transitional zone from central to marginal part of massif. G 10-15 vol. %; beginning of melting 700-710°C; last xls melt at 830°C; T_H = 860-865°C. These data prove that T of xliz. of granitoids increased from the center to margins of massif. (Abs. by A.K.).

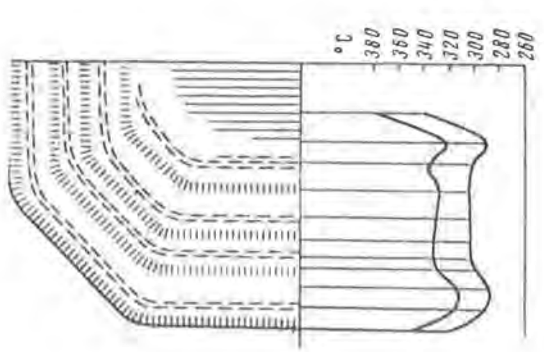
SIDOROV, A.A., GONCHAROV, V.I., NAYBORODIN, V.I., EREMIN, R.A., and SAVVA, N.Ye., 1975, Peculiarities of volcanogenic hydrothermal ore-formation: Akad. Nauk SSSR, Doklady, v. 225, no. 6, p. 1397-1399 (in Russian) Authors at NE Complex Sci.-Research Inst. of the Far-East Sci. Center of Acad. Sci. USSR, Magadan.

Incs. from hyd. ore deps. show high Ts at beginning and at end of mineraliz., both in the dep. (Fig. 1) and in sufficiently large min. individuals (Fig. 2). Final T increase may be from mafic dike; data are from deps. of Okhotsko-Chukotskiy chain.

Fig. 1. T regime of formation of Au-Ag deps of NE USSR. A-Au-Ag, B - essentially Ag, stages: I - pre-ore, II - ore, III - post-ore; substages: 1 - quartz-chlorite (+adularia), 2 - sulfide-polymetallic (galena, sphalerite, chalcopyrite, quartz, chlorite), 3 - native Ag argentite (+ quartz, adularia, chlorite, chalcopyrite, Ag sulfosalts), 4 - rhodonite-rhodochrosite (+quartz, chlorite, galena, sphalerite, bornite, chalcopyrite, native Ag), 5 - helvite-garnet (spessartine) (+quartz, adularia, rhodonite, axinite), 6 - prismatic quartz (see fig. 2). C - generalized scheme of develop. of hyd. process at Au-Ag deps: pre-ore stages of metasom. alt., a - propylitization; b - silicification; form. of ore bodies: c - early, d - commercial, e - late; f - intrusion of post-ore basalt dikes; g - post-dike propylitization.

Fig. 2. T regime of xliz. of quartz of post-commercial substage of essentially Ag dep. (Abs. by A.K.).





SIGURDSON, D.R., and LAWRENCE, E.F., 1976, Mineral paragenesis and fluid inclusion thermometry at four tungsten deposits in the western USA: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. First author at Dept. of Chem., California State College, Dominguez Hills, CA., 90774.

Most W deps. of the USA occur in the western mountain states as tactite-skarn deps. or within quartz veins near the periphery of silicic plutons. Scheelite is the most abundant W ore min. in these deps. The sequence of mineral dep. and fluid inc. T_H have been obtained at four of the deps. in Nevada and Idaho.

The Silver Dyke scheelite dep. in the Excelsior range of western Nevada occurs along an extensive and highly silicified fault which cuts Mesozoic and Tertiary volcanic rocks. The scheelite is conc. in sheared quartz veins near the margin of a diorite pluton. Albitization and sericitization of the diorite suggest that hydrogen and sodium metasomatism accompanied the W dep. Scheelite may have formed as a result of increasing pH and calcium ion conc. as the ore sols. passed through the diorite. The sols. were sufficiently oxidizing to maintain some or all of the Mo^{+6} in the higher oxidation state as it is partly substituted for W^{+6} in scheelite. The high oxidation conds. may have maintained Fe and Mn in their higher valence states and thus prevented their reaction with WO_4^{-2} to form wolframite.

T_H of P fluid incs. in both quartz and scheelite were grouped around 290°C. Corrections for 0-25% sal. and 400 ± 100 bars give corrected Ts of 313 ± 19°C for scheelite and quartz. Small amounts of pyrite, chalcopyrite, and tellurides were formed later, presumably at lower Ts.

The Tungsten Jim dep. occurs in central Idaho where scheelite and ferberite were dep. with tactite mins. at the contact between calcareous quartzite breccia and a granitic pluton of the Idaho batholith. Garnet, scheelite and diopside were the first mins. to replace the meta. breccia and were followed by quartz, calcite, phlogopite and fluorite in order. Pyrrhotite, pyrite, sphalerite, chalcopyrite, molybdenite, native Bi and bismuthinite were dep. in sequence after the contact metasomatic mins.

Fluid incs. in garnet, scheelite and diopside filled at 350°C, 340°C and 330°C, respectively. Corrections for P, estim. at 700 ± 100 bars and 0-25% sal. yields T_F of 420 ± 25°C, 410 ± 25°C and 400 ± 25°C for these mins. Native Bi xlized with bismuthinite below the 268°C melting point of the native metal. Thus the later sulfide group of mins. apparently formed at lower Ts than the tactite mins.

Ferberite formed as a replacement of scheelite during dep. of the sulfides. Replacement occurred in conjunction with pyrite dep. but did not occur in areas where pyrrhotite is the predominant sulfide. Exper. and theoretical studies by others indicate that both pyrrhotite and scheelite are more stable under slightly alkaline conds. and that ferberite and pyrite are stable under more acid conds. Thus the lab. studies are supported by the textural obs. and the replacement process is indicated to be pH dependent.

The Oreana scheelite dep. in the Humboldt range, Nevada, occurs in peg. dikes which cut a meta. diorite sill. The earliest mins. to form were beryl, oligoclase, scheelite, quartz, tourmaline, fluorite, and phlogopite in order. Fluid inc. studies yield corrected T_F for the mins.: beryl - 437 ± 30°C, scheelite - 392 ± 29°C, quartz - 325°C, tourmaline - 315°C, and fluorite - 310°C. Following the peg. mins., small amounts of calcite, molybdenite, pyrite, pyrrhotite, sphalerite, bismuthinite, native Bi and chalcopyrite were dep. in sequence.

The occurrence of molybdenite (Mo^{+4}) in the late stage of dep. suggests that conds. were not so oxidizing as at Silver Dyke. The form. of scheelite rather than wolframite may reflect higher oxidation conds. in the early peg. fluids or be due to low Fe and Mn conc. in the fluid.

At the Quick-Tung mine in the Stillwater range of Nevada, scheelite occurs in silicified limestone lenses that are interbedded with Triassic and Jurassic shale. The scheelite, which contains no Mo in solid sol., is found in quartz veins and pods within the silicified limestone. Sols. bearing Sb and Hg rejuvenated and reppted some of the scheelite during dep. of stibnite and cinnabar.

The corrected fluid inc. T for scheelite and quartz is 340 ± 20°C and that for quartz assoc. with cinnabar is 380 ± 25°C. These high Ts indicate that the dep. is xenothermal or telescoped.

A Cretaceous (?) pluton outcrops one-half mile north of the Quick-Tung dep. and is regarded as the source of the W ore fluids. Molybdian scheelite and quartz replaced calcareous shale and limestone at the contact with the pluton. Magnetite, cassiterite and fluorite dep. followed the W min. The corrected fluid inc. T_H in cassiterite is 560 ± 30°C but no suitable fluid incs. were found in the molybdian scheelite. (Authors' abstract.)

SIMMONS, Gene, and RICHTER, Dorothy, 1974, Microcracks in rocks: a new petrographic tool. (abst.): Amer. Geoph. Union Trans., v. 55, no. 4, p. 478. Authors at Dept. of Earth & Plan. Sci., Mass. Inst. Tech. Cambridge, MA 02139.

Microcracks in rocks possess distinctive char. that correlate well with the process that produced the cracks. We now recognize the unique char. of cracks produced by each of these processes: (1) "normal" intrusive terrestrial ign. processes, (2) non-hydrostatic stress that exceeds the fracture strength, (3) diff. expansion of totally enclosed grains, (4) sol. by fluids, (5) thermal cycling, (6) large thermal gradients, and (7) shock waves. The processes that have operated on a rock can be identified from obs. data on microcracks such as relations of cracks to grain boundaries, to other cracks, xl orientation, and cleavage. Because we can also recognize the presence of healed cracks, we have the potential for studying time sequences of processes. Several techniques that are necessary for studying cracks in rocks have been developed by our group in the last few years: crack decorating methods, rock sectioning procedures that do not introduce additional cracks, and a plot in which we combine meas. values of the dynamic and static elastic props. (Authors' abstract).

SIMMONS, G., RICHTER, D., and SIEGFRIED, R., 1975, Characterization of microcracks in lunar igneous rocks, (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, TX, p. 741-743.

(See previous item).

SIMMONS, G., RICHTER, D., SIEGFRIED, R., and FEVES, M., 1975, Microcracks in igneous rocks - a new petrologic tool, (abst.): Internat. Union Geodesy and Geophy., 16th Gen. Assembly, Abstracts of Papers, p. 10.

(See Simmons and Richter, (1974) above).

SKIPPEN, George, and TROMMSDORFF, Volkmar, 1975, Invariant phase relations among minerals on T-X_{fluid} sections: Amer. Jour. Sci., v. 275, no. 5, p. 561-572.

SLAUGHTER, J., KERRICK, D.M., and WALL, V.J., 1975, Experimental and thermodynamic study of equilibria in the system $CaO-MgO-SiO_2-H_2O-CO_2$: American Journal of Science, v. 275, no. 2, p. 143-162.

SLAUGHTER, J., WALL, V. J., and KERRICK, D. M., 1975, APL computer programs for thermodynamic calculations of equilibria in P-T-X_{CO_2} space (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

SMELOV, S.B., VINOGRADOV, V.I., KONONOV, V.I., and POLYAK, B.G., 1975, Isotopic composition of argon in the thermal fluids of Iceland: Akad. Nauk SSSR, Doklady, v. 222, no. 2, p. 429-432 (in Russian; translated in Doklady Acad Sci. USSR, Earth Sci. Sects., v. 222, p. 60-62 (1976)).

Comp. of Ar (and He) indicates enrichment in juvenile gases introduced from the mantle. (ER).

SMITH, F.W., and PHILLIPS, R., 1975, Temperature gradients and ore deposition in the North Pennine orefield: Fortschr. Miner., v. 52, Spec. Issure: IMA-Papers 9th Meeting Berlin - Regensburg 1974, p. 491-494.

Meas. on fluid incs. in fluorite have been used to estab. transverse, longitudinal and vertical T gradients in the $PbS-ZnS-CaF_2-BaSO_4$-bearing veins of these Hercynian age deps. Vertical gradients varying from 0.1°C/m at 500m depth to 0.5°C/m near surface are found, with T_F from 226 to 130°C. The significance of the results in understanding the mode of form. of the ores is discussed. (Authors' abstract).

SMITH, J. V., and DAWSON, J. B., 1975, Chemistry of Mg-rich micas from kimberlites and xenoliths, with implications for volatiles in upper mantle (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1275-1276. First author at Department of Geophysical Sciences, University of Chicago, Chicago, Illinois 60037.

SOBOLEV, V.S., Chief Ed., 1975a, Mineralogy of endogenetic formations from inclusions in minerals, Transactions of West-Siberian Division of All-Union Mineralogical Society, v. 2, 176 pp: Novosibirsk, W. Siberian Book Publishing House, (in Russian). (See entry under Dolgov, Yu. A., 1975, who was Responsible Editor.)

SOBOLEV, V.S., 1975b, Conclusions on conditions of formation of magmas and magmatic rocks, chapt. X, in Magmatic crystallization, as evidenced by melt inclusion studies, V.S. Sobolev and V.P. Kostyuk, editors: Novosibirsk, "Nauka" Pub. House, Siberian Division, pp. 199-211 (in Russian).

SOBOLEV, V.S., (ed.), 1975c, Materials on genetic and experimental mineralogy, v. 8 of Transactions of Inst. Geol. and Geophysics (no. 184): Novosibirsk, "Nauka", Siberian Division, 336 pp. (in Russian).

Individual articles are abstracted in this volume of Fluid Inclusion Research.

SOBOLEV, V.S., BAZAROVA, T.Yu., and KOSTYUK, V.P., 1974, Inclusions in the minerals of some types of alkaline rocks, in The Alkaline Rocks, H. Sørensen, ed.: New York, J. Wiley & Sons, 622 pp.

An extensive review of the lit. on incs. in alkaline rocks, with comp. & T_H data tabulated for various mins. & massifs. P of form. was det. from amount of CO_2 and T_{Frz} and calc. of P at T_H from physico-chemical diagram (sic.). Xliz. of phen. of effusive alk. rocks began at 1250-1290°C, and in leucite rocks possibly >1000°C (but see Volokhov, 1975, this vol.); nepheline syenites xlized at 800-1040°C, and some magmatic calcite at >600°C and P >1000 bars; peg. nepheline syenites xlized at 700-900°C down to 300°C (aq.-chloride-silicate melts); secondary sodalite - 400-600°C; scapolite - 450-650°C. (ER).

SOBOLEV, V.S., BAZAROVA, T.Yu, and YAGI, Kenzo, Crystallization temperature of wyomingite from Leucite Hills: Contrib. Mineral. Petrol., v. 49, p. 301-308. First author at Inst. Geol. and Geophy., Lab. Min., Novosibirsk, USSR.

Wyomingite collected from Leucite Hills is composed mainly of leucite, diopside, phlogopite, and small amounts of apatite, calcite, magnetite and rare amphibole, and is char. by very high content of K.

Thermal exper. at atm. P indicate that the liquidus phase is always diopside with liquidus T of 1320°C, and solidus T is about 1000°C. Various kinds of melt incs are abundant in all constituent mins. They comprise mono-phase (glass only), two-phase (gas+glass), three-phase (gas+glass+one xline phase) and multi-phase (gas+glass+more than two xline phases) incs.

Thermal exper. have been made on these incs in phlogopite, diopside, and leucite in order to est. the T of xliz. by homog. these incs. The results show that the xliz of wyomingite began with form. of phlogopite accompanied by diopside at 1270°C. Although diopside ceased xliz. at 1220°C recurrent xliz. of phlogopite was noticed between 1120° and 1040°C. Leucite xlized out abundantly between 1250° and 1150°C. Complete solidification of wyomingite occurred at about 1000°C. (Authors' abstract).

SOBOLEV, V.S. and KOSTYUK, V.P., editors, 1975, Magmatic crystallization, as evidenced by melt inclusion studies: Novosibirsk, "Nauka" Pub. House, Siberian Division, 230 pp. + 10 plates of photographs (in Russian).

The book consists of an Introduction, p. 5-7, by V.P. Kostyuk, ten chapters, by various authors, abstracted individually in this volume of Fluid Inclusion Research (pp. 8-211) a summary of the data presented in the book and concluding remarks (pp. 212-216), and a reference list (430 items). (Abstract by A.K.) (See translations for Table of Contents)

SOKOLOV, S.V., 1975, Endogenic carbon-bearing substance in inclusions in minerals of carbonatite massifs, (abst.), p. 12-13, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrinian SSR (in Russian). Author at All-Union Sci.-Research Inst. Min. Raw Materials.

In incs. in calcite, apatite, nepheline and pyroxene from carbonatites from Yakutia and Kola, a black "bituminous" substance was found. This phase fluoresced yellow and rarely blue under UV, as is typical of oils. These carbon-bearing phases in P incs are probably of abiogenic origin. (Abstract by A.K.).

SOKOLOVA, N.F., and SPIRIDONOV, E.M., 1974, Carbonate veins in the Khovu-Aksa ore deposits: Moscow Univ. Bull., Geology, v. 29, no. 5, p. 65-72 (in Russian, translation by Allerton Press Journal Program, 1974,

A study of carbonates in the As-Ni-Co ore deps. of Khovu-Aksa, by x-ray & fluid inc. techniques. Some incs. contain halite or sylvite dms. T_H (in liquid) of some incs. in calcite - 300-310°C; others were at 240-260°C. (Editor's note: paper submitted Oct., 1971). (ER).

SOLOMON, Sean C., 1975, Geophysical constraints on radial and lateral temperature variations in the upper mantle (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: Univeristy Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

SOMMER, M.A., 1975, Volatiles in quartz: a potential method of geobarometry (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ., Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination), 4 pp. Author at Dept. of Geol. Sci., Brown Univ., Providence, Rhode Island 02912.

The location of volatiles in hyd. quartz has been invest. as a function of P. Having det. the nature of three major volatile sites within the quartz, one site, a high T lattice contribution, appears to be a direct function of the hydrostatic growth P. Using syn. hyd. quartz a P versus lattice water calib. has allowed for P dets. of natural hyd. quartz. These dets. appear in agreement with geologic est. and have been used to correct fluid inc. T_H and T_F. (From the author's abstract)

SOTNIKOV, V.I. and BERZINA, A.P., 1975, Peculiarities of metasomatism at the Kal'makyr deposit, in Materials on genetic and experimental mineralogy, v. 8, V.S. Sobolev, ed., Inst. of Geol. and Geophysics, no. 184: Novosibirsk, "Nauka" Press, Siberian Division, p. 217-236 (in Russian).

Metasomatites at Kal'makyr Cu-Mo dep. have formed at temp. (T_H) 840-860°C (G incs. in K-feldspathized granodiorite porphyry), and 380-800°C (G incs.) and below 450-470°C (L incs.) in silified and sericitized parts. At 400°C sols. boiled to form highly conc. salt sol. Incs in sericite (sic.) of altered granodiorite have T_H = 330-350°C, in L. Incs. in quartz from quartz-muscovite veinlets homog. in G at 380-410°C and in L at 340-380°C. (Abstract by A.K.).

SOTNIKOV, V.I., and PROSKURYAKOV, A.A., 1973, Thermometric analysis of explosion breccias in Obkoronda deposit: Vyssh. Ucheb. Zaved. Izv., Geologiya i Pazvedka, 1973, no. 10, p. 65-68 (in Russian; translated in Intern. Geol. Rev., v. 17, no. 2, p. 221-223 (1975; abstract on p. iii).

The body of breccia is found to have been formed by two recognizable brecciations, the first one of which preceded dep. of the ore. Judging by T_H of incs. in quartz from the "metamorphogenic" cements in the breccia, the early and late brecciations occurred at 220-480°C and 260-330°C respectively. Comp. of the gas assoc. with the late brecciation and in the quartz-feldspar bodies on the periphery of the breccia is not the same: H_2S, SO_2, SO_4, NH_3, HCl, HF are definitely present in the latter but missing in the "brecciation incs." which are significantly higher in H_2, N_2 and the rare gases. No O_2 or CO was found in either group. The somewhat lower CO_2 in the gas phase of the "brecciation incs." may be due to the relatively high fugacity of that gas in the effervescent sols.

SOTNIKOV, V.I., PROSKURYAKOV, A.A., NIKITINA, Ye.I., and SHUGUROVA, N.A., 1975, Possibilities of use of accessory apatite for mineral-thermometric analysis, in Mineralogy of endogenetic formations from inclusions in minerals, V.S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 70-74, (in Russian).

T_H of incs. in apatites from porphyritic rocks of ore-bearing subvolcanic complex of Shakhtama dep. - 260-440°C (in L) and sometimes up to 600°C (in G); from dikes - 330-400°C in L and 440-520°C in G; in certain zones of apatite xls. incs. homog. at 450°C either in L, or in G. Highest T in apatite from wall-rocks of dikes - 700-770°C; many incs. decrep. T_H for apatites from explosive breccias - 250-610°C (either in L or G) and from hyd. alt. rocks - 300-450°C in L and 400-600°C in G (level 1), 370-390°C in L and 370-450°C in G (level 3). G comp. of incs. in apatites (vol. %): $H_2S + SO_2 + NH_3 + HCl + HF = 30-72$ for porphyry-granite (1) and 23-26 for hyd. alt. granitoids (2), $CO_2 = 5-42$ (1) and 62-76 (2), N_2 + rare gases 0-56 (1) and 0.3-12 (2). (Abstract by A.K.)

SOTNIKOV, V.I., VOLOGDIN, N.F., NIKITINA, Ye.I. and PROSKURYAKOV, A.A., 1975, Explosive breccias from Tsagan-Suburgi Cu-Mo deposit, in Materials on genetic and experimental mineralogy, v. 8, V.S. Sobolev, ed., Inst. of Geol. and Geophysics, no. 184: Novosibirsk, "Nauka" Press, Siberian Division, p. 287-302 (in Russian).

T_H of G/L incs. in apatites from syeno-diorites of this dep. in Mongolia equal 325-440°C, in L, in central parts of xls, and in G, at T up to 580°C in outer rim of xls. Most of apatites connected with formation of body of explosive breccias homog. at 70-200°C. Incs in inner core of xls have T_H about 20-30°C higher than in outer rim. Some apatites from breccias have T_H close to T_H of incs. from quartz-sulfide veinlets (280-320°C and 280-400°C, respectively); T_H in quartz from quartz-feldspar nests are somewhat higher, 320-440°C in L and 390-500°C in G. (Abstract by A.K.).

STALDER, H.A., and HAVERKAMP, Franz, 1973, Minerals, hidden resources in our Alps, Mando-Verlag, 175 pp. (in German).

Many excellent photos of Alpine clefts and their minerals. (ER)

STEEN-McINTYRE, Virginia, 1975, Hydration and superhydration of tephra glass - a potential tool for estimating age of Holocene and Pleistocene ash beds: Quaternary Studies-R.P. Suggate + M.M. Cresswell (Eds.). The

Royal Society of New Zealand, Wellington, pp. 271-278. Author at U.S. Geol. Survey, Denver, Colo.

An application of the crude but fast and cheap age-determination method described by Roedder (1970c, Fluid Inclusion Research, v. 3, 1970, p. 61), based on water filling of vesicles in volcanic glass. (ER)

STEINER, J.C., JAHNS, R.H., and LUTH, W.C., 1975, Crystallization of alkali feldspar and quartz in the haplogranite system $NaAlSi_3O_8$-$KAlSi_3O_8$-SiO_2-H_2O at 4 kb, Geol. Soc. Amer. Bull., v. 86, p. 83-98. Authors at Dept. Geol., Stanford Univ., Stanford, CA 94305.

Results of exper. studies in the system $NaAlSi_3O_8$-$KAlSi_3O_8$-SiO_2-H_2O, at 4 kb and from 650 to 1000°C, have been used to generate comp. paths for L and xl fractions as functions of T and bulk comp. In both the exper. work and the anal. of xliz., attention has been devoted mainly to silicate L that is sat. with quartz and an alkali feldspar but unsat. with respect to an aq. V phase. Such L can be represented on a compound T-X surface that slopes, with decreasing H_2O content in the system, toward SiO_2 for $NaAlSi_3O_8$-rich comp. and away from SiO_2 for $KAlSi_3O_8$-rich comps. The occurrence of two-phase bubbles embedded in glass was taken as a criterion for the presence of a free aq. vapor phase under conds. of the exper. Such bubbles are distinct from one-phase bubbles that commonly are present in quenched water-undersat. Ls and presumably represent air trapped in the capsule when it was loaded.

The exper. det. complexities of xliz. are reasonable indications of what can occur under natural plutonic conds., and are useful for testing of genetic models based upon detailed studies of rocks in a geologic and petrographic context. They also lead to the conclusions that (1) the bulk comp. of a granitic plutonite is not by itself sufficient for est. conds. under which the rock was formed and (2) exper. data obtained for the haplogranite system under conds. that include the presence of an aq. fluid phase ($P_{H_2O} \approx P_{fluid} = P_{tot}$) are highly restricted in their pertinence to the xliz. histories of most granitic plutonites. (From the authors' abstract)

STERN, C.R., HUANG, W.L., and WYLLIE, P.J., 1975, Basalt-andesite-rhyolite-H_2O: crystallization intervals with excess H_2O and H_2O-undersaturated liquidus surfaces to 35 kilobars with implications for magma genesis: Earth and Planet. Sci. Letters, 28, p. 189-196.

STRENS, R. G. J., 1975, Intracrystalline distributions in geothermometry and geobarometry (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

STRÜBEL, G., and SCHÄFER, B., 1974, Experimental investigation of the hydrothermal solubility of fluorite in the system CaF_2-NaCl-H_2O (abst.): Fortsch. Mineral., v. 52, pt. 2, p. 104.

SUSHCHEVSKAYA, T.M., and MALAKHOV, V.V., 1975, CO_2 and other gases in inclusions in minerals from tin ore deposits (abst.), p. 78-79, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). First author at GEOKHI, Acad. Sci. USSR, Moscow.

Studies were made by gas chrom. in app. with two detectors; using sample 0.5 g it was possible to determine H_2O, CO_2, CO, CH_4, N_2, H_2; adsorbents: Polisorb-1 and zeolite type CaA. Incs were opened in He medium by decrep.; sensivity of det. 10^{-7} g for all det. gases except H_2 (10^{-6} g). Studied cassiterite-silicate deps. of Komsomol'skiy region (bearing quartz, tourmaline and arsenopyrite) formed at 300-400°C from weakly alkaline sols. of Cl-HCO_3-K-Na type. Main G comp. is CO_2 (conc. 0-5 - 10 mol/ℓ), plus CH_4 (0.01-0.25 mol/ℓ), and occasionally CO and H_2. Eh-values calc. from the above indicate reducing conds. (Abs. by A.K.)

SUZUOKI, Tetsuro, KURODA, Yoshimasu, and MATSUO, Sadao, 1975, Hydrogen extractions from silicate minerals by sodium carbonate fusion and its application to deuterium analyses of fluid inclusions in some olivines: Geochem. Jour., v. 9, p. 107-111. First author at Marine Dept., Japan Meteorological Agency, Otemachi, Chiyoda-ku, Tokyo 100 Japan.

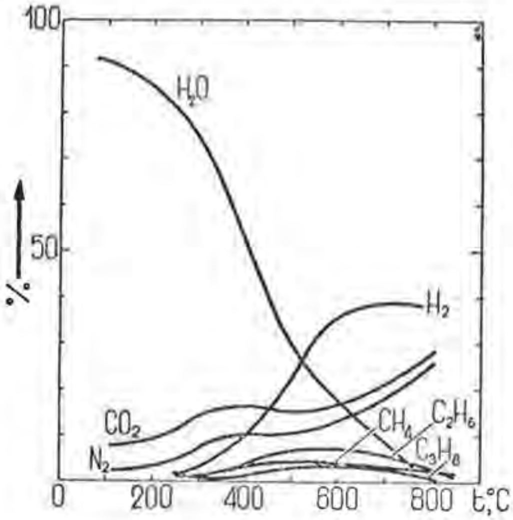
Fluid incs in olivine were extract. in vacuum by a sodium carbonate fusion method. In the present study, bulk H content and D/H ratio of the inc. were meas. The results showed that a consistent value of δD was obtained with a standard deviation of ±2‰, when the absolute amount of H extracted was more than 40μmol (0.9ml STP H_2). On the other hand, when the absolute amount of extracted H was less than 40μmol, δD value of the extract fluctuated, probably being affected by the contamination of the whole procedure. (Authors' abstract)

SVOREN', I.M., 1975a, On the question of possibility of reconstruction of gaseous environment of mineral formation (abst.), p. 26-28, in Carbon and its compounds in endogenic processes of mineral formation (data of studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. and Geochem. of Fuels, Acad. Sci. Ukr. SSR, L'vov.

In earlier reports, excess H_2 was found during milling of samples to release gases from incs., in comparison with opening of individual incs. by drilling (Kalyuzhnyi et al. 1974). To find the source of H_2 and other gases, samples of quartz from Volhyn, after crushing and det. of gas comp., were then heated in the range 100-800°C for 25-30 minutes and then the comp. of escaping gases det. Results of such treatment of a sample of smoky quartz are given in Figure. At lower Ts the main amounts of H_2O, CO_2 and N_2 are released with strong predominance of H_2O. HCs appear above 200°C and C_2H_6+C_2H_4 prevail, with a max. at 500-600°C, as well as H_2. Gases are released from xline lattice and from a transitional layer between the lattice and inc. filling (sic.). (Author's abstract, shortened by A.K.)

Figure. Relationship between T and amount of released gases from milled smoky quartz.

(See next page)



SVOREN', I.M., 1975b, Sources of carbon-bearing gases in inclusions (abst.), p. 104-106, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geochem. Fuels, Acad. Sci. Ukrainian SSR, L'vov.

During heating of sample of peat up to 800°C, the emission of H_2O, CO_2, H_2, N_2, O_2, SO_2, H_2O, CH_4, C_2H_6 and C_3H_8 was noted. (A.K.)

SWANENBERG, H.E.C., 1976, Fluid inclusion bubbles in a thermal gradient: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at Rijksuniversiteit Utrecht, Dept. of Petrology, Geol. Inst., Oude Gracht 320, Utrecht, Holland.

The unrestrained bubble of a fluid inc. will move when a thermal gradient is applied to the inc. The sense of the movement depends on fluid comp. and ambient T. An initial movement up the gradient (attraction) can be observed in incs. containing one volatile component. Movement down the gradient (repulsion) is shown by bubbles in incs. containing substantial amounts of CO_2 (>0.5 mol %). Oscillatory movements are shown by a very limited number of inc. bubbles. The direction of the oscillations is essentially perpendicular to the thermal gradient in which the bubble itself provides the activation for the next cycle.

The attraction and repulsion phenomena can be explained energetically with a model in which the total free energy of the system (i.e., the inc.) is lowered by a movement of the bubble. This movement is governed by the tension of the bubble surface. In a one-component, two-phase inc. the surface tension is decreased when the T increases and consequently the bubble will move to the warmest position in the inc. (general effect of T). Conversely, if CO_2 is present in a two-phase aqueous inc., the decrease of CO_2 sol. with increasing T gives rise to a decrease in CO_2 surface excess and increases the surface tension. At low ambient T (room T) this factor dominates the general effect of T and the bubble will be repelled in order to achieve a position of lowest possible surface tension. At high ambient T (>100°C) the reverse is true: the general effect of T has taken over and the same bubble is now attracted. The cause of the movements in terms of hydrodynamics probably is a flow of fluid along the interface between the bubble and the surrounding liquid. (Author's abstract.)

TAKENOUCHI, Sukune, 1975a, Fluid inclusion study of the Jishakuyama and Koganetsubo ore deposits and acidic igneous rocks at the Akagane mine, Iwate Prefecture: Mining Geol. (Japan), v. 25, p. 247-259 (in Japanese with English abstract).

The fluid inc. study of ore dep. and genetically related ign. rocks would suggest the origin of ore-forming fluids and the change of prop. of fluids during the min. From this point of view, fluid inc. in quartz from the Jishakuyama and Koganetsubo dep., quartz of quartz-porphyry and granodiorite of the Akagane mine were invest. by the microscopic obs. using a high mag. oil-imm. obj. The size of inc. were so small that no det. of T_H and salinity was carried out. The Jishakuyama dep. is a vein and disseminated copper dep. in quartz-porphyry and skarn, and the Koganetsubo is a scheelite-bearing breccia pipe formed in gabbroic rocks, though most of the ore dep. of the Akagane mine are the skarn-type.

In the Jishakuyama dep. many liquid inc. and polyphase inc. which bear a minute opaque min. were found in vein-quartz, whereas, highly saline inc. were recognized in quartz-phenocrysts of intensively silicified quartz-porphyry which forms wall-rocks of the dep. In the Koganetsubo dep., however, many CO_2-rich fluid inc. and liquid inc. were found. Saline inc. were generally not found in quartz-porphyry except in those around the granodioritic stocks, but minute CO_2-rich fluid inc. were occasionally recognized in samples of quartz-porphyry.

From these results of invest., it is inferred that the ore-forming fluids of the Jishakuyama dep. was hyd. sol. having a salinity <26 wt.% which succeeded the ascent of highly saline sol., and that the fluids of the Koganetsubo dep. were rich in CO_2 but the CO_2 conc. and the fluid d. were various during and after the min. It is also deduced from the distrib. of inc. of various types that these ore-forming fluids originated in some deeper places of the granodioritic stocks. (Author's abstract)

TAKENOUCHI, Sukune, 1975b, Basic knowledge on studies of fluid inclusions in minerals - 1: The Gemmological Soc. of Japan, Jour., v. 2, no. 1, p. 25-33 (in Japanese with English abstract). Author at Dept. Min. Dev. Eng., Univ. Tokyo, Tokyo.

Basic knowledge from studies of fluid inc. in min. is introduced as a basis for gemmology. The definition and ident. of P, S and PS inc., and their signif. for the cond. of xl growth are discussed briefly. The class. of fluid inc. based on the phase assemb. is also described. They are classified into five groups: G, L, polyphase, CO_2, and petroleum. The mech. of trapping of P and S inc. is explained. Microphotographs of some typical fluid inc. such as G, L, polyphase and CO_2-bearing inc. are shown. (Author's abstract)

TAKENOUCHI, Sukune, 1975c, Basic knowledge on studies of fluid inclusions in minerals - 2: The Gemmological Soc. of Japan, Jour., v. 2, no. 2, p. 65-73 (in Japanese with English abstract). Author at Dept. Min. Dev. Eng., Univ. Tokyo, Tokyo.

The principle, hypotheses and problems of fluid inc. geothermometry are introduced. The relation between the T_F and T_H of fluid inc. is discussed. The relation of the P corr. for T_H, the P-V-T relations and the critical point of water are explained. The methods of fluid inc. geothermometry (heating-stage and decrep. method) are also explained. (Author's abstract). Note: Calibration technique and a Japanese heating stage are also figured (ER).

TAKENOUCHI, Sukune, 1975d, Basic knowledge on studies of fluid inclusions in minerals - 3: The Gemmological Soc. of Japan, Jour., v. 2, no. 3, p. 110-121 (in Japanese with English abstract). Author at Dept. Min. Dev. Eng., Univ. Tokyo, Tokyo.

The principle, tech. procedure and equip. design of the freezing-stage method in fluid inc. studies is introduced. The relation between the conc. of salts and the melting point of ice in saline sol. is reviewed. The form. of liquid CO_2 and CO_2 hydrate in cooled CO_2-bearing fluid inc. is also discussed briefly. Concerning with the comp. of fluid inc., the P-V-T and P-T-X relations of binary systems of H_2O-NaCl and H_2O-CO_2 in hyd. cond. are reviewed. (Author's abstract)

TAKENOUCHI, Sukune, 1975e, Basic knowledge on studies of fluid inclusions in minerals - 4: The Gemmological Soc. of Japan, Jour., v. 2, no. 4, p. 165-171 (in Japanese with English abstract). Author at Dept. Min. Dev. Eng., Univ. Tokyo, Tokyo.

Destructive methods of anal. of fluid inc. are reviewed. Data on the comp. of aq. sol., content of base metals, G comp. and stable isotopic comp. of H, O, and C are obtained. In the anal. of fluid inc., however, there are some problems peculiar to the fluid inc. studies. Because of the small volume of inc. and the intimate occurrence of P and S inc. in xls, the selection of inc. to be anal. is important. Contaminations from the host xls, app. and outside of the system are serious. Atomic absorption spectrometric, X-ray fluorescence, neutron activation, mass spect. and gas chrom. methods are suitable. The stable isotopic comp. of water in fluid inc. is reviewed for evidence of the mixing of waters in the earth crust. (Author's abstract)

TAKENOUCHI, Sukune, 1976, Basic knowledge on studies of fluid inclusions in minerals - 5: The Gemmological Soc. of Japan, Jour., v. 3, no. 1, p. 25-31 (in Japanese with English abstract). Author at Dept. Min. Dev. Eng., Univ. Tokyo, Tokyo. Note - although dated 1976, this is included here since it is the last of the series (ER).

Research on fluid inc. in peg. min., especially those in beryl, topaz and quartz, is reviewed. The results obtained from peg. min. are compared with those from hyd. min. Some anal. studies of gases released from diamond xls are noted. The genetic significance of solid inc. trapped in xls are also discussed briefly. (Author's abstract)

TAKENOUCHI, Sukune, and IMAI, Hideki, 1975, Glass and fluid inclusions in acidic igneous rocks from some mining areas in Japan: Econ. Geol., v. 70, p. 750-769.

Glass and fluid inc. in quartz of rhyolites, porphyries, and granites from mining areas in Japan were invest. Rhyolites contain various types of glass inc. and high d L incs. but they are devoid of highly saline polyphase inc. Glass incs. in rhyolites are generally transparent, indicating rapid cooling. Some of them contain dendritic xls or small euhedral xls. Porphyries considered to be genetically related to min. generally contain highly saline inc. besides many L inc. Porphyries also contain many glass inc., but in general they are completely or partially devitrified. Size effect on devitrification is remarkable. Larger glass inc. are easily devitrifed, while smaller inc. occasionally remain transparent. In most granitic rocks highly saline incs. are not found, but high d L incs. are common. Small granitic stocks related to min., however, are rich in polyphase incs. Since fluid incs. in ign. rocks are generally very small, the ordinary heating-stage and freezing-stage microscopic methods are generally inapplicable. However, microscopic obs. of these fluid incs., especially of polyphase incs., gives valuable information on the possible change in ore-forming fluids during their migration from the center of min. It is inferred that highly saline fluids represented by polyphase inc. would have been released from silicate melts in late magmatic stages, and that dilution of these highly saline fluids would be an important factor controlling the ore dep. (Author's abstract)

TAKENOUCHI, Sukune, and IMAI, Hideki, 1976, Fluid inclusion study of the Santo Tomas II porphyry copper deposit, Philippines: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Authors at Univ. of Tokyo.

The Santo Tomas II porphyry copper dep. is located about 20 km to the south of Baguio City in the Mountain Provinces of the Philippines. The area is a steep mountainous area in the northern part of Luzon Island and known as one of the important min. regions of the country. The mine was opened in July, 1958. The prod. of the first stage was 1800 tons per day, but at the present time it produces daily 21,000 tons of crude ore containing 0.42% Cu.

The geology of the area consists of a thick pile of pre-Tertiary metavolcanics, a quartz diorite or diorite batholith, stocks of diorite-porphyry of Miocene age, and andesite. In the vicinity of the mine, the metavolcanics are intruded by a 500 x 700 m stock of diorite-porphyry. The ore dep. formed in the metavolcanics and diorite-porphyry along their contact, as a pipe-like ore body 240 m E-W x 120 m N-S. The ore reserve is estim. as 100 million tons of 0.51% Cu. The alt. of the country rocks consists mainly of biotitization and sericitization, but silicification is also remarkable in the high grade ore zone. Pyritization is recognized outside the ore body up to 530 m from the center of min. and epidotization is the main alt. outside the pyrite zone.

Quartz samples were collected at the outcrop and the 1190 m level adits. Quartz veins, which form the network of the ore body, are generally from 1 mm to 50 mm in width and accompany chalcopyrite, magnetite and a small amount of pyrite. Fluid incs. in quartz are classified into three major groups under the microscope: (I) Polyphase: These contain several solid phases and vary in size from a few micrometres to about 25 micrometres. Halite is found in almost every polyphase inc. and is nearly the same size or larger than the bubble. Sylvite is recognized as a minute cubic xl. in the larger incs. but it is difficult to recognize in smaller incs. A reddish brown flake of hematite is common in polyphase incs. but the volume ratio of hematite to the other phases is not necessarily constant. Two or three optically anisotropic mins. are found in addition to the chloride xls. One is prismatic and shows a low interference color. In general, two opaque mins., one of which shows a cubic shape, occur with the other solid phases. (II) Gaseous: These have a negative xl. shape and occur intimately assoc. with the polyphase incs. The degree of filling is very low and variable. (III) Liquid: These are rare, and occur in irregular shapes. The degree of filling is high but the sal. is not known.

T_H of the polyphase incs. are remarkably high. Sylvite dissolves at Ts 100°C - 200°C, and halite at 500°C∿550°C. In general, the bubble disappears later than does halite. In many cases, the bubble is still obs.

even at 600°C. From this result and the NaCl-KCl-H_2O ternary phase diagram, the approximate conc. of NaCl is estim. as 45 wt.% and that of KCl is about 20 wt.%. The intimate coexistence of polyphase and gaseous incs. is suggestive of "boiling" of ore-forming fluids at the site of ore dep. The T and sal. of the ore-forming fluids at the Santo Tomas II seem to be remarkably high compared to those of some other porphyry copper deps. in the Southwest Pacific area. (Authors' abstract.)

TARASOV, A.V., and LAPUKHOV, L.S., 1975, Temperatures of quartz formation in solid sulphidic ores of Norilsk: Akad. Nauk SSSR, Sib. Otdel., Geol. i Geofiz., 1975, no. 5, p. 118-123 (in Russian with English abstract).

T_H of G-L incs. in quartz from Cu-Ni ores of exocontact intrusion in Norilsk-1 show that form. of quartz took place after xliz. of chalcopyrite of the second generation and was char. by a sudden change of Ts with local areas between 170 and 250°C and mean values 210-212°C. The P of the G-L incs. under study was 900-1200 bar (3-4 km of lithostatic P). (From the authors' abstract)

TAYLOR, B.E., 1974, Communication between magmatic and meteoric fluids during formation of Fe-rich skarns in north-central Nevada (abst.): Amer. Geophy. Union Trans., v. 55, no. 4, p. 478. Author at Dept. of Geol., Stanford Univ., Stanford, Calif. 94305.

D/H ratios were meas. for amphiboles and fluid incs. from garnet-pyroxene skarn and for hornblendes in assoc. late Cretaceous hornblende-biotite granodiorite. δD of hornblendes in the granodiorite varies from "magmatic" values of -75 ∿300 m. from skarn contacts to values of -96 adjacent to skarn. An av. gradient in δD of -0.5/m. obtains over a 30 m. contact margin. This isotopic shift is not always correlated with chloritic alt. Hornblende in granodiorite at contacts without skarn, on the other hand, often retain "magmatic" values. δD values of amphiboles in the skarns are commonly around -95, but are as low as -120. Isotopic comp. of fluid from incs. in quartz found at the intrusive contact and within the skarns varies from δD -75 (dominantly magmatic) to -110 (meteoric) and $\delta^{18}O$ (calc.) +9.8 to +12.4. These data suggest that (1) meteoric water was a principal component of the skarn-forming fluid and became dominant with the onset of garnet breakdown, dep. of sulfide min. and quartz veining, and (2) climatic conds. in this region during emplacement of the granodiorite and skarn form. were diff. than those of today. (Author's abstract)

TAYLOR, B.E., and LIOU, J.G., 1975, Low-temperature stability of andradite in C-O-H fluids: experimental and field data (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1075. Authors at Dept. of Geol., Stanford Univ., Stanford, CA 94305.

The low T stability of andradite was exper. invest. as a function of T, X_{CO_2}, and f_{O_2} at $P_{fluid} = 2$ kb. C-O-H fluids were generated using oxalic acid dihydrate $\pm H_2O$; the results were compared with field and isotopic data on skarn form. (From the authors' abstract)

TAYLOR, H.P., Jr., 1974, Oxygen and hydrogen isotope evidence for large-scale circulation and interaction between ground waters and igneous intrusions, with particular reference to the San Juan volcanic field, Colorado: Geochemical Transport and Kinetics, ed. A. W. Hofmann, et al., Washington, D.C., Carnegie Inst. of Wash. Pub. 634, p. 299-324. Author at Div. of Geol. and Plan. Sci., Calif. Inst. of Tech., Pasadena, CA 91109.

Very large-scale convective circulation systems in the volcanic rocks involving heated meteoric ground waters were established by the epizonal ign. intrusions, but not in the less permeable sed. sections. The meteoric-hyd. alt. processes that have affected these types of rocks can in certain circumstances produce almost complete oxygen exchange in plagioclase phen. while preserving ign. textural features and delicate oscillatory zoning in the plagioclase.

With two exceptions all of the low-O^{18} ign. rocks throughout the world are of late Mesozoic to Tertiary age. In Precambrian rocks, however, the reverse is true. Although this could have resulted from much higher-O^{18} meteoric waters in the Precambrian (which would imply that the oceans also were much higher in O^{18}), it seems more likely that this is due to very low-T (∿150°C) exchange with ground-water brines that circulated through these rocks for long periods of time. All these alkali feldspars are turbid and contain disseminated hematite dust; this high oxidation state is readily explained if the alt. occurs at low Ts. It would also explain why Rb-Sr ages on these rocks are generally younger and much more variable than are the Pb-U zircon ages. It is because zircon is very resistant to exchange, and the turbid feldspars and altered mafic minerals are not. (From the author's abstract)

TAYLOR, H.P., Jr., 1975, Stable isotope geochemistry: Reviews of Geophy. and Space Physics, v. 13, no. 3, p. 102-107 and 159-163. Author at Div. of Geol. and Plan. Sci., Cal. Inst. of Tech., Pasadena, CA 91125.

A thorough review, with a very extensive bibliography, covering meteorites, lunar samples, sed., meta., and ign. rocks, ore deps., hyd. alt. and water-rock interactions, hydrosphere, atmosphere, org. geochem., exper. studies and anal. tech. (ER)

TAYLOR, Hugh P., Jr., and MAGARITZ, Mordeckai, 1975, Oxygen and hydrogen isotope studies of 2.6 - 3.4 b.y. old granites from the Barberton Mountain Land, Swaziland, and the Rhodesian Craton, Southern Africa (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1293. Authors at Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125.

THEODORE, T.G. and BLAKE, D.W., 1975a, Geology and geochemistry of the Copper Canyon porphyry copper deposit and surrounding area, Lander County, Nevada: U.S. Geol. Survey Prof. Paper 798B, 86 pp.

Exper. data suggest that biotite may have xlized at ∿ 800°C and suggest high $P_{H_2O}:P_{total}$ equil. ratios during the xliz.

Early-stage sulfide dep., beginning at ∿ 300°C and continuing to at least 360°C, may have occurred when metal-bearing fluids reacted with hematite-rich beds. Oxygen fugacities in the envir. of ore dep. appear to have been very low during this stage. Later, during the intermediate stages, siderite- and marcasite-bearing assembl. developed as the fluids became enriched in CO_2 and became possibly more acidic because of the dissociation of hydrogen gas. (sic.) Most Au may have been dep. very late in the metallization sequence, along with quartz that fills vugs. (From the authors' abstract)

THEODORE, Ted G., and BLAKE, David W., 1975b, Petrochemistry of skarn in the Copper Canyon porphyry copper deposits, Lander County, Nevada (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1296-1297. First author at U.S. Geological Survey, Menlo Park, California 94025.

The Copper Canyon porphyry copper deps. include a 4-million-ton Cu-Au-Ag ore body in skarn developed primarily in calcareous argillite of the upper Paleozoic Pumpernickel Formation. Andradite-rich rock, in a flat-lying tabular body, served as the locus for most metallization, and it extends at least 400 m from an adjacent potassic-alt. granodiorite that is 38 m.y. old. Mapped silicate min. zones in the skarn are symmetric about the andradite-rich rock, and they include andradite-diopside, diopside-sphene-quartz, diopside-tremolite, tremolite-quartz, and biotite-K-feldspar-quartz assemb. The ore consists of pyrrhotite-pyrite-chalcopyrite, pyrrhotite-chalcopyrite, and pyrite-chalcopyrite assemb. as fracture fillings and replacements of earlier silicates. Because the skarn is zoned mineralogically at right angles to the granodiorite's contact, the adjacent granodiorite apparently did not provide the skarn-forming fluids. Fluid-inc. studies suggest xliz. of andradite occurred at about 500° ± 50°C from saline fluids. Other geologic relations suggest that deeply circulating meteoric fluids may have been involved in the generation of the skarn. Locally close to the granodiorite, andrqdite-pyrrhotite assembs. are replaced by epidote-pyrite ones that are in turn cut by a second generation of hyd. biotite related probably to final emplacement of the granodiorite. (Authors' abstract.)

THIEDE, David S., and CAMERON, Eugene N., 1975, Concentration of heavy metals in the Elk Point evaporite sequence, Saskatchewan (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1297. Authors at Department of Geology and Geophysics, University of Wisconsin, Madison, Wisconsin 53706.

Cores representing a complete section of the Elk Point evaporite sequence in the Saskatchewan Sub-basin have been analyzed for copper, lead, and zinc. Relative to sea water, all members of the sequence are enriched in all three metals, by factors ranging from 14 to 392 for copper, from 10^4 to 9×10^5 for lead, and from 97 to 1745 for zinc. Enrichment is highest in basal shales, dolomite, and anhydrite, lowest in halite, carnallitic halite, and sylvinite. The enrichment of shales, dolomite, and anhydrite in lead is extraordinary; amounts of lead present are far too great to be furnished by evaporation of water in the Saskatchewan Sub-basin.

The data bear on the general problem of the relation of evaporite sequences to stratabound deposits of copper and deposits of the Mississippi Valley type. It appears that an evaporite basin can be both a source of large amounts of metals and a source of chloride-rich brines capable of transporting metals. Any of three types of metal-bearing brines might be generated during the history of such a basin: (1) brines residual from evaporation, (2) diagenetic brines released by dehydration of gypsum to anhydrite, and (3) postdepositional brines generated when evaporites are dissolved and leached by circulating groundwater. Calculations from analytical data for the Elk Point Group suggest that copper-bearing residual brines were possible, but that lead or zinc-bearing brines could have been generated only during diagenesis or during postdepositional groundwater circulation. (Authors' abstract.)

THOMPSON, G., WOO, C. C., and SUNG, W., 1975, Metalliferous deposits on the Mid-Atlantic Ridge (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1297. First author at Department of Chemistry, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543.

TIMOFEEVSKIY, D.A., and ADRYANOVA, S.I., 1975, Comparative characteristics of role of certain compounds of carbon in gold ore deposits of various formations (abst.), p. 82-83 in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Central Sci.-Research Geol.-Prospect. Inst., Moscow.

CO_2 and carbonate ions are the main comp. of parent sols. of quartz of Au deps. in the early pneu.-hyd. stages (excluding Au-adularia-chalcedony-quartz form., where pneu. is absent). CO_2 is the main comp., and the highest concs were found in skarn Au-silicate-sulfide form. Later stages are char. by presence of CO_2 in aqueous sols., especially high in a number of deps. of Au-sulfide, Au-quartz-sulfide, Au-albite-quartz form.; activity of CO_2 causes berezitization and listvenitization. Bicarbonate occurs in sols. from all forms.; at deps. of Au-adularia-chalcedony-quartz form. the HCO_3 conc. are somewhat higher than at the others. Conc. of bicarbonate increases at the end of each min.-form. stage, and after pption of ores. During decrease of G conc. the Au complexes are destroyed and commercial Au ores then ppt. (Abs. by A.K.)

TODOROV, T., 1975, Mineral composition, stages of mineralization and genesis of the fluorite deposits in the Mihalkovo ore field: Abstracts of Bulgarian Sci. Lit., Geology and Geography, v. 18, no. 2, p. 19 (in English).

The hypogene min. formed in three stages, sulphide-quartz, fluorite and calcite. No regular trend is obsd. in the distrib. of the min. parageneses. The dep. belongs to the quartz-fluorite type. The T range was 260-60°C, at small depth. It is assumed that it is paragenetically assoc. with the effusive rocks of the Bracigovo-Dospat rhyolitic sheets, a source of low-T fluorine-bearing sols. (an active zone during the Paleogene). (From author's abstract)

TOLSTIKHIN, N.N. and ERLIKH, E.N., 1975, Isotopic composition of He in ultrabasic xenolites: Inst. Geol. Geophys. Trudy, v. 271 - Deep-seated xenoliths and the upper mantle, eds. V.S. Sobolev, N.L. Dobretsov and N.V. Sobolev, p. 225-231: Novosibirsk, "Nauka", Siberian Branch, (in Russian).

TÓMASSON, Jens, FRIDLEIFSSON, I.B., and STEFÁNSSON, Valgardur, 1975, A hydrological model for the flow of thermal water in SW-Iceland with a special reference to the Reykir and Reykjavik thermal areas (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section II, Abstract no. 53. Authors at National Energy Authority, Reykjavik, Iceland.

TOURAY, Jean-Claude, and BARLIER, Jacques, 1975, Liquid and gaseous hydrocarbon inclusions in quartz monocrystals from "Terres Noires" and "Flysch à helminthoides" (French Alps): Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting, Berlin-Regensburg 1974, p. 419-426.

This is the full text of work abstracted in Fluid Inclusion Research - Proceedings of COFFI, v. 7, p. 226, 1974. (ER)

TOURET, Jacques, 1972, Granulite facies and fluid inclusions in Southern Norway: Paragneisses and quartzites: Sci. de la Terre, v. 17, no. 1/2, p. 179-193 (in French with English abstract). Author at Univ. de Nancy 1, Lab. de Géol. Struct., C.o. 140, 54037, Nancy-Cedex, France.

In quartz from metased. paragneisses and quartzites of the Bamble province (Southern Norway) three types of incs. occur: water-rich fluids of variable sal., carbonic fluids (mixture CO_2 and HCs with $T_{Frz} \sim -63°C$ and mixtures of these two. The repartition of these fluids is related to metamorphic grade: carbonic fluids are typical of granulite facies, but may exist sporadically within amphibolite facies; water-rich fluids are predominant in amphibolite facies and, in the whole region, correspond to diff. gen., some of them at least are retromorphic. Mixed fluids occur probably in blastomylonitic zones where amphibolite and granulite facies rocks are deformed and granulated. (Author's abstract)

TREIVUS, E.B., and USHAKOVSKAYA, T.V., 1975, Investigation of formation of inclusions of solution in crystals: Leningrad Univ., Vestnik, 1975, v. 3, no. 18, p. 78-83 (in Russian with English abstract).

The form. of incs. of sols. in xls of sodium chlorate formed by xliz. in a regime of free convection and in xls of epsomite in a regime of forced convection was invest. The results are represented in form of dependence between undimensionless numbers. The work confirmed the diffusive nature of incs. and the possibility of their description by the method of theory of mass transfer. (Authors' abstract)

TRUESDELL, A.H., and FOURNIER, R.O., 1975, Calculation of deep reservoir temperatures from chemistry of boiling hot springs of mixed origin (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section IV, Abstract no. 88. Authors at U.S. Geol. Survey, Menlo Park, CA 94025.

A new method has been devised to calc. deep Ts and hot-water fractions for mixed springs that issue at boiling Ts. The method has successfully predicted observed deep Ts for drilled geothermal systems in New Zealand and Chile. (From the authors' abstract) (Also given in Geol. Survey Research 1975, U.S. Geol. Survey Prof. Paper 975, p. 166.)

TRUESDELL, A.H., FOURNIER, R.O., McKENZIE, W.F., and NATHENSON, M., 1975, Yellowstone's deep plumbing? (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section III, Abstract no. 87. Authors at U.S. Geol. Survey, Menlo Park, CA 94025.

Invests. suggest that the Yellowstone caldera contains an extensive aquifer with hot (370± °C), moderately saline (1000 ppm NaCl) water that escapes upward where suitable fractures exist. Many relatively small and cooler reservoirs exist in the shallow parts of the hyd. system. Although the residence time of water within these reservoirs is variable, the overall rate of upward flow between reservoirs and to the surface is rapid. The chemistry of the ascending waters is altered by dilution, reaction with rocks, and steam separation. The highest T likely to be attained by dilute, convecting, vapor-sat. water is about 370± °C because heating to slightly higher Ts induces very substantial increases in volume (30% increase between 370° and 374°C). Thus, convecting fluid near the critical point may serve to regulate Ts in deep geothermal systems. (From the authors' abstract) (Also given in Geol. Survey Reserach, 1975, U.S. Geol. Survey Prof. Paper 975, p. 165)

TRUESDELL, A.H., and WHITE, D.E., 1975, The role of near-surface dilution in the evolution of geothermal waters (abst.): Internat. Union Geodesy and Geophy., 16th Gen. Assembly, Abstracts of Papers, p. 263. Note - this is only one of eight papers at this session on the geochemistry of thermal waters.

TRUFANOV, V.N., and GRANOVSKIY, A.G., 1975, Contribution to thermodynamics of carbon-bearing inclusions in minerals of stratiform ores from Central Caucasus (abst.), p. 77-78, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Rostov State Univ., Rostov-on-Don.

In sphalerite and barite from carbonate-sulfide concretions from Tashly-Syrt, Tala-Su, Podgornenskoe, etc., together with org. matter, G/L incs. of aq. salt sols., and of CO_2-H_2S were found with T_H 160-210 and 60-70°C, respectively, assoc. with incs. of bituminous subst. and CO_2-H_2O-bituminous incs. (the latter in barite, 0.01-0.002 mm dia.). (From authors' abstract, A.K.)

TSCHUCHROW, F.W. - see Chukhrov, F.V.

TSUI, T. F., HOLLAND, H. D., and SNETSINGER, K. G., 1975, Laser microprobe analysis of fluid inclusions (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1304-1305. First author at Department of Geological Sciences, Harvard University, Cambridge, Mass. 02138.

The laser microprobe uses the intense energy of a focused laser beam to vaporize very small sample volumes for spectrochemical anal. We have found that this technique can give useful information regarding the comp. of single fluid incs. A Jarrell-Ash Mark II laser microprobe was used to make the meas. The instrument was calibrated by anal. fluids of known comp. in holes recessed in fused silica glass plates. Detection limits were found to be ca. $3x10^{-10}$ gm for Cu, Mn, Ca and Mg, $1x10^{-9}$ gm for Fe and $3x10^{-8}$ gm for Na. Absolute quantities of the elements are difficult to measure to better than a factor of five, but elemental ratios can be det. with an uncertainty of less than a factor of two in favorable conc. ranges.

Fluid incs. in quartz from Casapalca, Colqui district and Orcopampa district (Peru), Creede and the Illinois fluorspar district were anal. with the laser microprobe after their sal. had been meas. on a freezing stage. The laser microprobe gives approx. values of the conc. ratios of all the major cations except K, and a combination of the sal. data with the laser microprobe data allows a rough calc. of element concs. in the inc. fluids. We found that the Mg/Ca, Cu/Ca, Mn/Ca and Fe/Ca ratios in the inc. fluids were all less than 0.1, that the Ca/Na ratio was quite variable, and that the conc. of Cu, Mn and Fe was invariably less than 1000 ppm. (Authors' abstract.)

TUGARINOV, A.I., ed., 1972, Recent contributions to geochemistry and analytical chemistry: Moscow, Izdat. "Nauka" (in Russian; translated by Israel Program for Sci. Translations, pub. by J. Wiley, 695 pp., 1975).

Includes several review papers of pertinence to fluid inc. studies such as the separation of water, CO_2, and other volatiles from magmas and silicate systems, various elements and isotopes in hot spring systems, etc. One on CO_2 by Naumov, Mironova and Kuz'min is separately abstracted. (ER).

UEDA, R., and MULLIN, J.B., eds., 1975, Crystal growth and characterization: Proceedings of the ISSCG2 Springschool, Japan, 1974: Amsterdam, North-Holland Publishing Company, 419 pp.

Contains 27 chapters, many of which are pertinent to inc. trapping problems. (ER)

URABE, T., 1974, Mineralogical aspects of the Kuroko deposits in Japan and their implications: Mineral. Deposita (Berl.), v. 9, p. 309-324.

Includes a review of the literature on inclusion studies (p. 317) and some previously unpublished data. (ER)

USSELMAN, T.M. and LOFGREN, G.E., 1975, Crystallization of mare basalts: Pyroxene zoning (abst.): Amer. Geophys. Union Trans., EOS, v. 56, p. 471. Authors at NASA-JSC, Houston, TX 77058.

Xliz. on lunar basaltic analogs with controlled thermal history and f_{O_2} have reproduced many of the chemical zoning patterns of the pyroxenes. Oscillatory zoning is attributed to xl-L growth kinetics and the development of a boundary layer enriched in components rejected by the growing xl. (From the authors' abstract.)

USSELMAN, T.M., LOFGREN, G.E., DONALDSON, Colin, and WILLIAMS, R.J., 1975, Experimentally reproduced textures and mineral chemistries of high titanium mare basalts (extended abstract): Lunar Science VI, Lunar Sci. Inst., Houston, TX, p. 635-637. First author at NASA-JSC, Houston, TX 77058.

Morphology of olivine, plagioclase and pyroxene xls vary with various linear and nonlinear cooling rates. (ER)

VALYASHKO, M.G. and VLASOVA, N.K., 1975, The stability of magnesium salts in solutions of marine origin and its geochemical significance: Vestnik Moskov. Univ. Geol., v. 30, no. 4, p. 16-27 (in Russian; translated in Moscow Univ. Geol. Bull, v. 30, no. 4, p. 7-15, publ. 1976).

VASCONCELLOS, K.F. and BEECH, J., 1975, The development of blowholes in the ice/water/carbon dioxide system: Jour. Crystal Growth, v. 28, no. 1, p. 85-92.

VERVIALLE, Jean-Pierre and GUILHAUMOU, Nicole, 1975, Geological and mineralogical study of the "Trois Vallons" fluorite vein (Esterel, France). Acad. Sc. Paris, Compte Rendus, v. 281, ser. D, p. 1207-1210 (in French). First author at Lab. de Géol. Appliquée, Univ. d'Orléans, 45045 - Orléans Cedex, France.

Three successive forms. are dist. The last one xlized near 115°C from strong brines. The vein dep. is related to the form. of the Permian "graben des Adrets". (Author's abstract)

VIDALE, Rosemary, 1975, Equilibria in the system plagioclase-muscovite-phlogopite-sanidine-quartz-aqueous chloride solution, Carnegie Inst. Wash., Geophy. Lab. Yearbook 74, for 1974-1975, p. 428-432.

VINOGRADOV, V.I., KONONOV, V.I. and POLYAK, B.G., 1974, Isotopic composition of sulfur in thermal springs of Iceland: Akad. Nauk SSSR, Doklady, v. 217, no. 5, p. 1149-1152 (in Russian; translated in Acad. Sci. USSR, Doklady, v. 217, p. 82-84, pub. 1975). Authors at Geol. Inst., USSR Acad. Scis., Moscow.

VOCHTEN, R., and ESMANS, E., 1976, Study of the solid and gaseous inclusions in some varieties of fluorite by the microprobe and high resolution mass spectrometry: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. First author at Lab. voor Techn. en Fysische Min., Univ. Antwerpen, Middelheimlaan 1, 2020 Antwerpen, Belgium.

The enclosed gases and solid incs. of fluorite from Wölsendorf and Margnac were invest. by high-resolution mass spectrometry and electron microprobe respectively. The gases, liberated on crushing the specimens, were introduced into the source of the mass spectrometer by means of an all-glass inlet system.

The data are summarized in tables I and II. Free fluorine was not det. On crushing, an increased intensity was obs. for masses m/e = 32 and 44. The increase for m/e = 32 was markedly higher in the fluorite of Margnac. Whether this enhanced intensity is primarily due to S^+ ions, or to oxygen, was not estab.

However, we would like to point out that the possibility exists that, under the influence of α-particles, SO_2F_2, which was not det. in the fluorites, can be converted into SOF_2 and oxygen, according the following reaction: $2\ SO_2F_2 \xrightarrow{\alpha} 2\ SOF_2 + O_2$

If we compare the theoretical masses of O_3 (47.9847) and SO (47.9670) with the observed values (tables I and II), the presence of O_3 seems to be very unlikely. Only the Margnac samples showed traces of H_2S and S_2F_2. The fluorite contains traces of U mins., which locally destroy the xl. lattice by the action of α-particles. As a consequence, free F is generated, which rapidly reacts with the SO_2 present in the fluorite to SO_2F_2(1).

The SO_2 can be considered as a gas of hyd. origin. The presence of S_2F_2 can be understood as a reaction prod. of F with H_2S and metal sulfides(2).

The obs. m/e value of 102 could be ascribed either to SO_2F_2 or to S_2F_2. The exper. obs. value of 101.9401 points to S_2F_2 (calc. 101.9410; mass diff. 0.9 a.m.u.).

The mass diff. with SO_2F_2 (calc. 101.9587) of 18.6 a.m.u. exceeds any acceptable deviation. Hence we conclude that S_2F_2 is present instead of SO_2F_2.

The obs. masses at m/e = 33; 48; 67; 83; 64 and 51 can be explained by fragmentation processes.

The distrib. of Ca, Si, U, Fe, and Pb in the fluorite and quartz phase, invest. by the microprobe technique, gave the following results: the distribs. of U and Pb are very analogous; there is a distinct assoc. of U with Fe in the quartz phase; and the U is very homogeneously distrib. in the fluorite phase. Authors' abstract.

1 HIRST and SMITH, 1974, Trans. Inst. Min. Metal. (Sect. B, Appl. Earth Sci.), 83, 844.

2 HOFMANN, 1974, Fortschr. Miner., 52, 21.

Table I. Calc. and obsd. masses for fluorites of Wölsendorf

m/e	calc. mass	obsd. mass	formula	Δm a.m.u.	R.I.
48	47,9670	47.9678	SO	0.8	10
64	63.9619	63.9631	SO_2	1.2	4
67	66.9654	66.9641	SOF	1.3	6
86	85.9638	85.9629	SOF_2	0.9	8

Table II. Calc. and obsd. masses for fluorites of Margnac

m/e	calc. mass	obsd. mass	formula	Δm a.m.u.	R.I.
34	33.9895	33.9877	H_2S	1.8	3
33	32.9816	32.9810	HS	0.6	4
48	47.9670	47.9714	SO	4.4	8
64	63.9619	63.9683	SO_2	6.4	8
67	66.9654	66.9677	SOF	2.3	17
86	85.9638	85.9635	SOF_2	0.3	13
102	101.9410	101.9401	S_2F_2	0.9	15
83	82.9426	82.9449	S_2F	2.3	8
64	63.9442	63.9450	S_2	0.8	8
51	50.9705	50.9757	SF	5.2	6

VOITOV, G.I., 1974, On estimation of gas exchange intensity in shields: Geol. Zhurnal, v. 34, no. 2, p. 70-85 (in Russian with English abstract).

V. has examined the chem. comp. and gas distrib. in the Ukrainian shield rocks. It is shown that gases in the shield rocks are in inclusions, and in accumulations in tectonic dislocations. The latter play a deciding role in gas exchange of the shields with the Earth's atm. Gases in incs. are mainly H_2 and CO_2; gases in tectonic fractures are complex mixtures of HCs, N_2 and noble gases. Helium content is very high. Free jets from tectonically mobile zones differ by an extreme stability with respect to both comp. and intensity.

The gas flow from the Ukrainian shield body into the earth atm. is est.

VOLOKHOV, I.M., 1975, Evaluation of accuracy of thermobarogeochemical reconstructions of conditions of formation of magmas and magmatic minerals: Akad. Nauk SSSR, Sib. Otdel., Geol. i Geofiz. no. 1 (181) p. 12-19 (in Russian). Author at Inst. Geol. Geophysics of Siberian Branch, Acad. Sci. USSR, Novosibirsk. See translations.

VOLOSHIN, A.V., DAVIDENKO, I.V. and IKORSKIY, S.V., 1975, Genetic connection of compounds of carbon with processes of formation of granite pegmatites (abst.), p. 13-15, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Geol. Inst. of Kola Division of Acad. Sci. USSR, Apatity.

In incs. in quartz (33 samples) from Kola pegs. the following cpds. of C were found by gas chrom.: CO, $\underline{CO_2}$, $\underline{CH_4}$, C_2H_4, $\underline{C_2H_6}$, C_3H_6, C_3H_8, C_4H_{10} (the main ones underlined). Ranges of typical conc. of main C-bearing gases for various types of pegs. are given in table, suggesting possible prospecting criteria (high conc. of CO_2 in pegs. rich in Ta and Cs).

Carbon cpds. in quartz of granite pegs. of Precambrium of Kola Peninsula (cm^3/kg)

Granite pegs.	CO_2	CH_4	C_2H_6
Barren "background" pegs. in kyanite gneisses of Precambrian age	6.94-16.02	1.01-3.07	0.05-0.12
Muscovite pegs (commercial), without beryl	0.89-6.12	0.16-0.54	0.0051-0.0173
Do., with beryl	5.38	0.095	0.0003
Rare-metal pollucite pegs.	23.96-26.00	0.047-1.576	0.013-0.030
Spodumene pegs. with tantalite	33.00-100.00	0.92-2.40	0.013-0.30
Do., with columbite	3.16-8.90	0.02-0.10	traces
Ceramic pegs with orthite, zircon and monazite	5.44-15.62	0.009-0.13	0.0002-0.05
Intragranitic pegs. (potentially rock-xol-bearing)	4.23	0.165	0.0044

(Abs. by A.K.)

VOSKRESENSKIY, S.S., KOLOSOVA, G.N. and NAUMOV, V.B., 1972, Thermobaric formation characteristics of quartz veins, in Upper Kolyma basin and plane of erosion: Izv. Vyssh. Ucheb. Zaved., Geol. Razved., 1972, v. 15, no. 10, p. 42-45 (in Russian; translated in Internat. Geol. Review, v. 16, no. 1, 1974, p. 25-28).

Abstracted in Fluid Inclusion Research, v. 5, 1972, p. 109 (ER)

VOZNYAK, D.K. and PAVLISHIN, V.I., 1975, Quartz with inclusions of hydrocarbons from veins in Donets Basin (abst.), p. 54-55, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geochem. and Physics of Minerals, Acad. Sci. Ukrainian SSR, Kiev.

Samples are from vugs in quartz vein 1-8 cm thick, from C_2^5 sandstones, 5 km South of Krasnodon. Xls. up to 5 cm along L_3 have mainly P incs., up to 6 mm, filled by HCs. S incs are rarer. Filling of P incs.

varies: $L_2(G_2)$; $L_1+L_2(G_2)$, (L_2=2-5%); L_1+G(L 80-95%) (sic.). Cryometry shows T_H (L_2,G_2) varies from -75 to -80°C. Most incs. show critical phenomena; more rarely homog. in L or G. At -180°C most of the filling freezes; from this, plus the critical T of ∿ -80°, one may conclude that incs. are filled by methane. IR spec. revealed presence of HC close to CH_4 (absorption bands at 2800-3000 cm^{-1}). Other HCs present in sol. dissolve in CH_4 between -145 and -79°C. T of melting of L_1 > 0°C (+10 to +15°C); T_H of incs. with phase L_1 = +150 to +160°C; HCs do not luminescence under U.V.

Aq. sol. in P incs. L+G (L 80-95%) has low conc. of salts; sometimes these occur in same zone as HC incs. $L_2(G_2)$; $L_2(G_2) + L_1$, thus proving the heterog. of parent sols. Min. T_H +125 to +160°C. Hypothetical inc. of methane of critical d at above T has P=350-400 atm. and probable P of min. form. ought to be close to this value. (Abs. by A.K.)

VYNAR, O.N. and REMESHILO, B.G., 1975, On role of carbon-bearing fluids in postmagmatic processes of mineral formation (exemplified by intrusive complexes of Ukrainian crystalline shield)(abst.), p. 41-43; *in* Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. Geochem. of Fossil Fuels, Acad. Sci. Ukr. SSR, L'vov.

Fluid incs. were invest. in Precambrian intrusive complexes of various age: Precambrian II - charnockites from Pobuzhye; Precambrian III - Kirovgrad-Zhitomir complex, granites from Uman, Antonovka; Precambrian IV - granitoids from Osnik and Korosten', and metasomatites. Conc. of CO_2 in incs. varies: in quartz (regardless of origin), 40-90 vol. %, in granites, 30-40 vol. %, and in hybridized mafic rocks; 4-6 to 0 vol. %. In zonal pegs the conc. of CO_2 increases from periphery to the center cavity of peg. Max. conc. of CH_4 was found in incs. in diorites and granodiorites (61 vol. %) and conc. of CH_4 is reversely correlated with conc. of CO_2. Quartz xlized. from H_2O-CO_2 sols. plus 10-20 % of CH_4. N_2 occurs in incs. in granitoids (80-45 vol. %) as well as in veins (4-8 vol. %). Average conc. of H_2 equals 3.5 vol. %. In aq. phase main ions are CO_3, HCO_3, SO_4, F, Cl, and K. Lower T intervals were found for sols. at Osnik complex: granites, 450-250°C; hybrid rocks, 400-220°C; veins and pegs, 350-200°C. NW margin of Ukrainian shield is probably a geochemical province of higher activity of sols. rich in CH_4. (Abstract by A.K.)

WALKER, John, 1975, Nitrogen in synthetic diamond: Nature, v. 257, p. 14.

WALRAFEN, G.E. and LUONGO, J.P., 1975, Raman and infrared investigations of OH- and H_2O in hydrothermal α-quartz: The Spex Speaker, v. 20, no. 3, p. 1-6 (Spex Ind., Inc., 3880 Park Ave. Metuchen, N.J., 08840). Authors at Bell Laboratories Murray Hill, New Jersey 07974.

Laser-excited Raman and IR spectra, obtained from syn. quartz, are interp. as arising from oriented hydrogen-bonded O-H....O-H^- units of hydrated OH^- ions, hydrogen-bonded oriented aggregates of H_2O molecules, and probably randomly oriented H_2O aggregates, (i.e., fluid incs.?). ER

WALTHER, John V., and HELGESON, Harold C., 1975, Calculation of the

thermodynamic properties of aqueous silica and the solubility of quartz and its polymorphs at high pressures and temperatures (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1311-1312. First author at Department of Geology and Geophysics, University of California, Berkeley, California 94720.

WATSON, E.B., 1975, Liquid line of descent for a South Atlantic triple junction basalt: information from silicate melt inclusions; Amer. Geophy. Union, Trans., v. 56, no. 6, p. 468. First author at Dept. of Earth & Planetary Sci., Mass. Inst. Tech., Cambridge, MA, 02139.

Plagioclase, olivine, and clinopyroxene phen. in a fresh tholeiitic basalt dredged near Bouvet Island (54°13.7'S, 4°3.1'E) contain silicate melt (glass) inc. of less fractionated comp. than the glassy groundmass of the rock. Compared with an average oceanic tholeiite comp. the glass inc. have high MgO/FeO and low abundances of TiO_2 and total alkalies. Some of the comp. variation among melt incl. from different host mins. is attributed to continued pption of the respective host phases after melt entrapment. However, the magmatic L comp. at the time of trapping can be estimated by plotting inc. anal. from the three host phases in a $CaO-MgO-Al_2O_3$ triangular diagram, in which plagioclase, olivine, or clinopyroxene fractionation is defined by a unique direction. The relative abundances of chemically distinct melt inc. indicate that the first and most significant trapping episode occurred when plagioclase (An_{88}), olivine (Fo_{88}), and diopside were present in the melt. At this time, the L comp. was: SiO_2 50.5; TiO_2 0.7; Al_2O_3 15.7; FeO* 6.8; MgO 9.1; CaO 13.8; Na_2O 2.1; K_2O 0.3; MnO 0.2; molar MgO/FeO = 2.4. More differentiated melt incs. were sporadically trapped in plagioclase at later times; these show a range in molar MgO/FeO down to the groundmass value of 1.4. (Author's abstract.)

WATSON, M.D. and SNYMAN, C.P., 1975, The geology and the mineralogy of the fluorite deposits at the Buffalo fluor-spar mine on Buffelsfontein, 347 KR, Naboomspruit District: Trans. Geol. Soc. S. Afr., v. 78, p. 137-151.

"T_H" (apparently calculated from T_D) is given as "283 ± 370°C", with P ∿ 1200 bar and T_F 390 ± 50°C, so the deps. "are probably of pneu. origin" (ER).

WEBSTER, Robert, 1975, Gems, their sources, descriptions, and identification, 3rd ed.: Butterworth & Co., England, 931 pp.

Many references to inclusions in various gemstones. ER.

WEISBROD, A. and POTY, B., 1975, Thermodynamics and geochemistry of the hydrothermal evolution of the Mayres pegmatite, South-eastern Massif Central (France). (Part I): Petrologie, v. 1, no. 1, p. 1-16, and Part II, ibid, p. 89-102 (in English with French & English abstracts). First author at Equipe de Recherche sur les Equil. entre Fluides et Min., ENSG. B.P. 452, 54000 Nancy.

An important hyd. evol. occurred in the Mayres peg., alt. the primary min. and yielding four generations of new assoc.:

I. - Quartz, orthoclase ($Or_{75}Ab_{25}$), albite (tourmaline).
II. - Quartz, albite, muscovite, tourmaline and chlorite.
III.- Quartz, orthoclase ($Or_{80}Ab_{20}$), chlorite, then albite + muscovite.

IV. - Quartz, microcline ($Or_{100}Ab_0$) (metastable?), montmorillonite, chlorite.

The chem. and phys. props. of fluid incs. occurring in quartz of each stage have been det. The fluid phase is essentially an aq. sol. with very little CO_2 or HCs present. The total sal. is constant (about 5 wt % eq. NaCl). Chlorine is by far the most important anion except in stage IV. Divalent cation molality increases from 0.03 to 0.15 and NaCl molality decreases from 0.8 during stage I to 0.50 during stage IV. The KCl molality is variable (0.03 to 0.13). pH increases from 3.5 during stage I to 5.5 at the end of stage II.

T_H (in vapor. for stage I, in liquid for the others) decrease from 410°C in stage I to 50°C in stage IV.

A model is proposed for the hyd. evol., that takes into account the successive min. assoc. and the props. of fluid incs:

-Muscovitic alt. (from 500°C 0.6 Kbar to 400°C, 0.3 Kbar) is started by tectonics, opening fissures and allowing a very large amount of water to infiltrate the rock. K-feldspars are converted into muscovite + quartz by H metasom.

-Albitic alt. (from 400°C, 0.3 Kbar to 300°C, 0.2 Kbar). The quartz, ppted from the sol. during muscovitization, fills the channels and drastically reduces the water flow. Orthoclase replacement by albite occurs by alkali exchanges with the fluid.

-Potassic alt. (from 300°C, 0.2 Kbar to 200°C, 0.1 Kbar) results from exchanges of K and divalent cations between the peg., the vaugnerites and the sol.

-Argillic alt. affects mainly the Na-feldspar.

It seems that the variations of the K/Na equil. values is much more complicated at low P (below 1 Kbar) than expected from the exper. data at higher P. It is thought that these variations are of major importance amongst the parameters that control the patterns of hyd. alt. in granites and related rocks. (Authors' abstract)

WENNER, David B., 1975, Stable isotope evidence for the origin of rodingites (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1314-1315. Author at Department of Geology, University of Georgia, Athens, Georgia 30602.

H and O isotope anals. (reported in per mil relative to SMOW) were made of some of the mins. that occur in rodingites found largely assoc. with the lizardite-chrysotile type serpentinites from California and Oregon, New Zealand, and the Northern Appalachian Mtns. δD values reveal the following three groupings: monomin. veins of pectolite (3 samples, -429 to -377); monomin. veins of xonotlite (5 samples, -127 to -112); other mins. (-77 to -34). The latter group include hydrogarnet (3 samples, -77 to -36), idocrase (3 samples, -38 to -34), chlorite (1 sample, -43), nephrite (1 sample, -50), actinolite-tremolite (1 sample, -60). $\delta^{18}O$ values are: pectolite (2 samples, 10.2 and 12.4) and xonotlite (5 samples, 7.0 to 10.9). These data suggest that only xonotlite and possibly pectolite formed from isotopically depleted meteoric waters; all other mins. infer form. from non-meteoric type waters. Extensive stable isotope evidence from previous studies indicate that lizardite-chrysotile type serpentinites probably form from waters of meteoric-hyd. origin. Thus, much of the metasomatism assoc. with the form. of rodingites, except for the late-stage monomin. veins of xonotlite and possibly pectolite, apparently did not occur in assoc. with serpentinites of the type commonly obs. with these rocks. This metasomatism may form at depth during regional meta. in assoc. with antigorite-type serpentinization. Some metasomatism, however, appears to have continued at relatively shallow levels of the earth's crust in assoc. with lizardite-chrysotile serpentine, generating late-stage monomin. veins of xonotlite and pectolite. (Author's abstract.)

WENNER, D.B., and TAYLOR, H.P., Jr., 1974, D/H and O^{18}/O^{16} studies of serpentinization of ultramafic rocks: Geochim. Cosmo. Acta., v. 38, p. 1255-1286.

WHITE, D.E., 1975, Traces of deep saline brines in most subsurface dilute waters, (abst.): Geological Research 1975, U.S. Geol. Survey Prof. Paper 975, p. 166-167.

WHITE, D.E., FOURNIER, R.O., MUFFLER, L.J.P., and TRUESDELL, A.H., 1975 Temperature-pressure relations and self-sealing in shallow parts of thermal areas of Yellowstone National Park, Wyoming (abst.): Second UN Symp. on Devel. and Use of Geothermal Resources, Abstracts, Section II, Abstract no. 56.

WHITE, D.E., FOURNIER, R.O., MUFFLER, L.J.P. and TRUESDELL, A.H., 1975, Physical results of research drilling in thermal areas of Yellowstone National Park, Wyoming: U.S. Geol. Survey Prof. Paper 892, 70 pp., including 34 figs. and 17 tables.

A thorough review of the extensive drilling program (≤ 1088 ft.), which found temperatures ≤ 237.5°C (ER)

WHITNEY, J.A., 1975, Vapor generation in a quartz monzonite magma: a synthetic model with application to porphyry copper deposits: Econ. Geol., v. 70, p. 346-358.

The evol. of an aq. V phase from a simplified quartz monzonite magma during intrusion and xliz has been quan. modeled using the thermal distrib. for a stock of square cross section, calc. according to the simplified theory of Jaeger (1969) and modified by an initial T distrib.

During the intrusion of a body, the portion intruded at Ps significantly less than that of a certain intersection point (P_1) on an isocomp. P-T diagram will generate a V phase. The P of the point P_1 is dependent on the water content and bulk comp. of the magma, while the exact P at which a V is generated is also dependent on T. Upon xliz, those parts of the body at Ps less than P_1 will actively generate a V phase, forming a V-sat. cap. Those portions at Ps greater than that of another intersection point P_2 will generate a V phase only within a narrow region adjoining the solidifying front of the magma where xliz has proceeded sufficiently to reach V sat. Any mass movement can cause the entire magma column undergoing the process to be leached of part of its volatile content if the magma passes through the zone of vapor sat. The model may be directly applied to the generation of magmatic fluids in stocks assoc. with porphyry copper dep. The generation of such an aq. V, in conjunction with connate and meteoric waters circulating through the xline portions of the body and surrounding rocks, may be important in the generation of hyd. sols. which are responsible for the dep. of porphyry copper deps. (Author's abstract)

WILKINS, R.W.T., 1976, Fluid inclusions of the metamorphosed stratiform Pb/Zn orebody at Broken Hill, New South Wales, Australia: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at CSIRO Div. of Min., North Ryde, N.S.W., Australia.

A comprehensive account of the fluid incs. of the Broken Hill orebody is a task of considerable magnitude. This is due to the size of the orebody (∿7 km in length), the richness of the min. suites and their variability from lode to lode, the age of the dep. (at least 1700 m.y.), and the intensity and complexity of deformational and meta. history. These factors require that the study is undertaken on a fundamental level, with careful consideration of assumptions, which with good justification, are often tacitly assumed in fluid inc. studies of younger and less metam. deps. Only under these conds. will it be possible to meaningfully relate the inc. fluids to specific geol. episodes in the history of the area. The present paper is designed to illustrate these points, using data which are essentially preliminary.

Despite the fact that no significant reference has been made to them, fluid incs. are very common in most of the mins. in the Broken Hill lode rocks. A decided contrast is made by the country rock gneisses and amphibolites in which fluid incs. are quite rare. It is clear from detailed examination of the fluid incs. that rather distinctive types of fluid have invaded the lode rocks from time to time.

The overwhelming proportion of the incs. contain a moderate to very high sal. aq. sol. and a moderate-sized vapor bubble but no halite dxl. Freezing point depressions of these sols. range from 3°C to 50°C, showing that they are multicomponent aq. fluids. Another common and widespread variety contains a small halite xl. and a vapor bubble of similar dims. Fluid inclusions in fluoride commonly contain liquid CO_2. No undoubted P incs. have been seen though they may well exist. Most of the incs. are in curved planes and clearly S.

T_H fall mainly in the range 100-300°C. It is extremely difficult to obtain repeatable data from silicates in general and quartz in particular, due to leaking of the incs. during heating runs. The best T_H data have been obtained from fluorite. Because of uncertainties in relating the fluids to particular geol. episodes, corrections for P, which could be of the order of hundreds of °C, cannot be made at present. It is therefore not possible to deduce T_F.

In the collecting of heating and freezing stage data it has been borne in mind that necking and major retexturing involving the fluid incs. may have occurred. It is possible, for example, to show that some fluid incs. in bustamite have migrated up to 200 μm from their original position of trapping. They also appear to have played an important role in the process of exsolution of some min. phases during cooling.

It cannot be assumed that the fluids now trapped in the mins. of the lode rocks are in any way related to the ore-forming fluids. The available evidence is more compatible with the supposition that the lode rocks have become fluid-rich zones as a result of deformation during the long period of retrograde meta. Fractures formed during successive episodes of deformation would have been healed by fluids appropriate to the changing meta. conds. If this supposition is correct, the fluid incs. offer the possibility of providing a new approach to the elucidation of events in that somewhat enigmatic period in the geol. history of Broken Hill between 1700 and 500 m.y. during which the retrograde meta. imprint was devel. (Author's abstract.)

WILLIAMS, Richard J., and LOFGREN, Gary E., 1975, An experimental study of the effects of heat removal on the phase relations of basaltic systems (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

WILSON, D.A., HOYT, J.W., and McKUNE, J.W., 1975, Measurement of tensile strength of liquids by an explosion technique: Nature, v. 253, p. 723-725.

(Of interest in consideration of metastable single-phase incs. E.R.).

WILSON, John C., 1975, Ore-magma relation at Bingham, Utah (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1319. Author at Kennecott Exploration, Inc., 2300 West 1700 South, Salt Lake City, Utah 84104.

A miniature, "frozen" example of the process of magmatic ore-fluid form. was preserved in a 70-foot elongate plug of vesicular porphyritic quartz monzonite at Bingham, Utah. After the outer rind of the plug had solidified, volatiles separated from the silicate portion of the magma. Tear-drop bubbles up to 6 inches in diameter contained this fluid which apparently could not excape from the now harder porphyritic quartz monzonite. Chalcopyrite, quartz, and apatite xlized. to form 15% by volume of the fluid which originally shaped the vesicles. Subsequently water, other volatiles, and probably some metals escaped slowly from the vugs through the hardened rock by intercrystal flow. The ratio of sulfides to the voids in the rock indicated that the comp. of this magmatic-hyd. ore-forming fluid was far more conc. (e.g., 40 wt. % solids) than is generally postulated. (From the author's abstract.)

WINTSCH, R.P., 1975, Muscovite, sillimanite, sanadine, quartz, and H_2O equilibria as a function of chloride concentration (abst.): Am. Geop. Union Trans., v. 56, no. 6, p. 485-486. Author at Dept. Geol. Sci., Brown Univ., Providence, Rhode Island 02912.

WISE, W.S., 1975, The origin of the assemblage: Quartz + Al-silicate + rutile + Al-phosphate: Fortschr. Miner., v. 52, Spec. Issue: IMA-Papers 9th Meeting Berlin - Regensburg 1974, p. 151-159. Author at Dep. Geol. Sci., Univ. Cal., Santa Barbara, CA 93106.

Large economically impt. bodies of quartz-kyanite or quartz-andalusite occur in several, widely separated localities in the United States and Sweden.

Interp. of potassium-hydrogen ion activity diagrams lead to the conclusion that ascending fluids having previously equil. with a silicate assemb. like muscovite + quartz + andalusite cannot cause large amounts of muscovite to be replaced by andalusite. Large volumes of fluids high in total chloride and H^+, possibly from nearby degassing magmas, are required to form the large volumes of Al-silicate and quartz. (From the author's abstract)

WISE, William S., and LOH, Spencer E., 1975, Amblygonite: Interpretations of F-OH exchange equilibria (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1320-1321. First author at Department of Geological Sciences, University of California, Santa Barbara, California 93106.

WOLERY, T.J. and SLEEP, N.H., 1975, Hydrothermal reaction at mid-ocean ridges: some implications and constraints (abst.): Amer. Geophys. Union Trans., EOS, v. 56, no. 12, p. 1073. Authors at Dept. of Geol. Sci., Northwestern Univ., Evanston, Ill. 60201.

WOOD, J.R., 1975, Thermodynamics of brine-salt equilibria-I. The systems $NaCl-KCl-MgCl_2-CaCl_2-H_2O$ and $NaCl-MgSO_4-H_2O$ at 25°C: Geochim. Cosmo. Acta., v. 39, p. 1147-1163. Author at The Johns Hopkins Univ., Baltimore, MD 21218, U.S.A.

WOOD, James R., CHOU, I-Ming, and GUNTER, William, 1975, Thermodynamics of supercritical brines: Some new experimental techniques (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1321. First author at Earth & Planetary Sci., Johns Hopkins University, Baltimore, Md. 21218.

WYLLIE, P. J., and HUANG, W.-L., 1975a, Petrogenetic grid for siliceous dolomites extended to mantle peridotite compositions, and to conditions for magma generation (extended abstract): Internat. Conf. on Geothermometry and Geobarometry, 5-10 Oct., 1975, Penn. State Univ. Extended Abstracts: University Park, Pa., Penn. State Univ. (arranged alphabetically, with no pagination).

WYLLIE, P.J. and HUANG, W-L., 1975b, Peridotite, kimberlite, and carbonatite explained in the system $CaO-MgO-SiO_2-CO_2$: Geology, v. 3, no. 11, p. 621-624. First author at Dept. Geophy. Sci. Univ. Chic. Chicago, Illinois 60637.

Fractional xliz of CO_2-bearing under-silicated basic magmas at most Ps yields residual kimberlite and carbonatite. Kimberlite and carbonatite magmas rising from the asthenosphere evolve CO_2 as they reach a reaction boundary at a depth of about 100 to 80 km. This contributes to their explosive eruption. Free CO_2 cannot coexist with subsolidus mantle peridotite with normal T distrib. CO_2 appears to be as effective as H_2O in causing incipient melting in the asthenosphere. (From the authors' abstract).

WYLLIE, P.J. and HUANG, W-L., 1975c, Influence of mantle CO_2 in the generation of carbonatites and kimberlites: Nature, v. 257, p. 297-299. (See previous item)

YAKOVLEV, G.F., KHISAMUTDINOV, M.G., and DEMIN., Yu. I., 1975, Polygenetic and polychronous nature of pyrite-lead-zinc deposits of the Rudnyi Altai: Geol. Rudn. Mest., v. 17, no. 3, p. 66-77 (in Russian). First author at Moscow State Univ., Moscow.

T_H (?) of incs. in cordierite = 540-500°C; in gahnite - ∿ 500°C, and in epidote- 370-350°C (Starkovskoe and Talovsko-Turgusunskoe ore fields). (Abstract by A.K.)

YAMAOKA, Kazuo and UENO, Teiichi, 1975, On the fluid inclusions in quartz crystals from the Oppu mine, Aomori Prefecture, Japan: Takeuchi Memorial Volume, p. 129-140 (in Japanese with English abstract).

The Oppu mine is one of the most productive mines of hyd. Pb-Zn-Cu veins genetically related to the Miocene ign. activity in Japan.

Main ore mins. from the mine are galena, sphalerite, chalcopyrite and pyrite, and vertical hypogene sulfide min. zoning is obs. Quartz occurs as the major gangue min. The min. paragenesis and T_H of incs. in quartz indicate that the major sulfide ores were dep. at T between 290°C and 220°C. T_{Frz} meas. on inc. fluids have shown that the sal. of the hyd. fluids changed gradually from about 8.0 wt. % to about 2.2 wt. % equiv. NaCl during a decrease of the fluid Ts from 290°C to 220°C.

At this mine, the vertical distance from the deepest to the shallowest level is about 450 m. The T gradient in the hyd. fluid system is about 1.4° - 1.5°C/10 m. This value is as half as the Miocene vein type sulfide dep. in Japan. (Authors' abstract)

YARDLEY, Bruce W. D., 1975, Evidence of fluid circulation in the genesis of plagioclase gneiss (abst.): Geol. Soc. Amer., Abstracts with Programs, v. 7, p. 1324. Author at Department of Geological Sciences, University of Washington, Seattle, Washington 98195.

YEFREMOVA, A.G. and ZHIZHCHENKO, B.P., 1972, Occurrence of crystal hydrates of gases in the sediments of modern marine basins: Akad. Nauk SSSR, Doklady, v. 214, p. 1179-1181, (in Russian; translated in Doklady Acad. Sci. U.S.S.R., v. 214, p. 219-220, pub. 1975). Authors at All-Union Inst. of Natural Gases, Moscow.

Clathrates (gas hydrates) form in some sediments and present a way of temporarily fixing gases such as methane (E.R.)

YEN, C.F. and COBLE, R.L., 1972, Spheroidization of tubular voids in Al_2O_3 crystals at high temperatures: Jour. Amer. Ceram. Soc., v. 55, p. 507-509. Authors at Mass. Inst. of Tech., Cambridge, MA 02139.

Cracks introduced into single-crystal sapphire broke up after annealing, first into channels of cylindrical voids and ultimately into rows of spherical pores, with the thicker gap spacings in the original crack remaining open. Breakup of the cylindrical voids on subsequent annealing conformed to the models for surface-diffusion-controlled material transport. At the Ts of meas., the magnitudes of the calc. surface diffusivities agree well with values reported previously. (Authors' abstract).

YODER, H.S., Jr., 1975, Relationship of melilite-bearing rocks to kimberlite: A preliminary report on the system akermanite-CO_2: Phys. & Chem. of the Earth, v. 9, p. 883-894. Author at Geophy. Lab. , Carn. Inst. Wash., Washington, D.C. 20008.

YOSHIDA, Tetsuo, 1975, Fluid inclusions of the molybdenum deposits at the Higashiyama mine, Shimane Prefecture, Japan: Mining Geol., (Japan), v. 25, p. 285-292 (in English). Author at Dept. Mining, Faculty of Eng., Kyushu Univ.

The dep. of the Higashiyama mine consist mainly of molybdenite-bearing quartz and clayey veins. Fluid incs. are commonly found in quartz and calcite of the veins, and in quartz phen. of host granitic rocks. Most of incs. from the veins are composed of two phases consisting of L and G. Three-phase incs. consisting of L, G, and cube-shaped transparent solid are observed frequently in the phen. of the granite porphyry.

T_H ranges from 262°C to 318°C for the host granitic rocks and from 156°C to 352°C for the molybdenite-bearing quartz veins. T_H increases westward from the Kawahira through Onobe to Higashiyama deposits, and higher Ts are obs. in deeper parts of the deposits. (Author's abstract)

YPMA, P.J.M., 1976a Fluid inclusion characteristics of low-temperature near-surface ore deposits. Example from the Beltana willemite orebody, South Australia: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at Dept. Econ. Geol., Univ. of Adelaide, Adelaide, S.A. 5001, Australia.

Fluid inc. data are rarely used to demonstrate near-surface origin of min. deps. Fluid incs., confined to single xls. (intraxline.), do not tend to form under these conds., because of lack of P or T gradients or gross disturbances of sol. equil. Only very small incs. may be present, which tend to be single phased because of phase nucleation retardation. The most common source of fluid entrapment under surface conds. is exsolution of air. The latter preserves interxline. cavities and blocks xliz. where this would have occurred under hyd. conds.

The exsolution of air or a plain surface-air entrapment process may cocapture min. brines. Highly variable liquid:vapor ratios are the result. Such fluids can be dist. from shrinkage bubbles or gas under pressure by the unaltered size of the vapor phase during crushing. Air can be positively identified by gaschromatography of a vacuum ball-mill extract. Examples from the Beltana willemite and Ediacara lead zinc deps. (S. Australia) will be given.

Genetic models for the Beltana zinc orebody are controversial because of the difficulty in explaining an ore mass of about one million tons of 40% willemite devoid of primary sulphides. Beltana and similar ore occurrences in the vicinity are located at the faulted contact between Cambrian limestones and sed. breccias (Callana beds) of lower Adelaidean age. The Callana beds consist of carbonates and siltstones featuring halite casts.

Fluid incs. in quartz and willemite established low T near-surface origin, because of many trapped air bubbles. The jointly trapped fluids are slightly undersaturated brines of Na, Ca and K chlorides. Freezing produces $NaCl\cdot 2H_2O$, which is an indication for 23 to 26 wt.% NaCl in the case of pure NaCl brines. Fluid inc. extracts and T_{Frz} (-24.5 to -26.5°C) indicate brines of 22 wt.% NaCl and about 4 wt.% $CaCl_2$. The KCl:NaCl mol. ratio is high for such a low T dep.: 0.38. This could be the result of evaporite dissolution - as a source of brine generation.

The Cambrian limestones close to the dep. have a high Zn content: up to 5 mol.% $ZnCO_3$ in the calcite lattice. This implies a Ca^{2+}: (total dissolved Zn) mol. ratio of 0.003 for a brine of 4 molar NaCl at 50°C. Because of the high Zn content of calcite the min. sol. could not have had a higher T since this would have required unrealistic high Zn^{2+} concs. for a 4 molar NaCl sol. The Zn-rich calcite formed a buffer zone preventing all dissolved Zn from pption as carbonate. The massive nature of the orebody may be explained in this way. (Author's abstract.)

YPMA, P.J.M., 1976b, Fluid inclusion study of copper deposits of the W. margin of the Mt. Painter Block, South Australia. Porphyry copper characteristics of stratabound sulphides: Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at Dept. Econ. Geol., Univ. of Adelaide, Adelaide, S.A. 5001, Australia.

Copper deps. occurring in the lower Adelaidean at the W. margin of the Mt. Painter block (xline. basement) show some strat. control. They prevail in the carbonate Wywyana Formation, Wooltana volcanics, and the sulphide-rich Tindelpina shale and their coarse clastic time equivalents. The host rocks are in the upper greenschist fringe zone of a sillimanite almandine amphibolite meta. domain, mainly affecting the Mt. Painter block. The meta. produced calc-silicates in the carbonates and widespread scapolitization in the pelitic rocks. It has been suggested that this meta. is related to the emplacement of Ordovician granites of the Mt. Painter block and their pegs. straying into the sed. margin.

Fluid inc. studies of quartz established a genetic relationship between the acid pegs. and the Cu min. The latter is marked by pyrite-pyrrhotite-chalcopyrite assemb. T_H ranges from 450° to 550°C with a mode at 495°C. This T bracket also features the dissolution of halite dms., normally 20°C below the disappearance of the vapor phase. Salinities range between 35% (S) and 70 wt.% equiv. NaCl. Other dms. include anhydrite (very common) and carbonates. CO_2 is present in all P incs.: as a minor constituent in brine incs. and a major one (+ 90 vol. %) in the apparent contemporaries of P brine incs. The fluids were trapped at the phase boundary conds. of the system $NaCl-H_2O-CO_2$. CO_2-rich fluids probably split off at this stage to be entrapped separately. Reconstruction of PT conds. based upon CO_2 densities of incs. of low hydrocarbon content leads to a postulated P interval of 750-1200 bar and negligible P correction for T_H.

Quartz incs. of pegs. from the area have a slightly higher T range: 500-560°C and equiv. salinities 50-70 wt.%, eg., NaCl. The Na:K molar ratio of fluid inc. extracts average 3.43. The Ab content of K-feldspar averages 31.5% Ab. Both values point to Or being at the two-feldspar (Ab-Or) solvus boundary in equil. with a Cl-rich fluid phase in a 560-600°C T bracket at 1 Kb. The P peg. incs. thus represent fluids in equil. with a cooling peg. magma.

S isotope ratios of pyrite-chalcopyrite pairs can be construed as an equil. distrib. at 400-550°C. The source of S, however, is not magmatic since the deps. reflect the strat. variation (even within a single dep.) of sulphides derived from sed. sulphides and sulphates. The range in values (between δ^{34}s of -7 to +27‰) has possibly been extended by fractionation. (Author's abstract.)

YUSHKIN, N.P., YEREMIN, N.I. and KHOROSHILOVA, L.A., 1974, New manganiferous variety of sphalerite: Akad. Nauk SSSR, Doklady, v. 216, no. 5, p. 1138-1141 (in Russian; translated in Doklady Acad. Sci. USSR, v. 216, p. 166-169, pub. 1975). First author at Inst. Geol., Komi Branch, USSR Acad. Sci., Syktyvkar.

A sphalerite with $\leq$ 13% MnS has T_H of 80-120°C (ER).

ZAKHARCHENKO, A.I., 1976, Transition of melts into fluid solutions, the evolution of their composition, nature and metal content (on inclusions in minerals of granites and chambered pegmatites): Abstracts of papers, Fifth Internat. Symp. on Fluid Inclusion Research, Sydney, Australia, Aug. 1976. Author at VSEGEI, Leningrad, USSR.

Evolution of fluid sols. from gas-sat. melts is obs. exper. and in nature with decrease in P and T (especially during the rise of magma) and during their xliz. No one else has successfully observed the transitions with evolutionary changes of their comp. and nature. As a result of our studies of alaskite and rapakivi granites and the occurrence in them of zonal chambered (quartz xl.-bearing) pegs., greisen, etc., formed under stagnant conds., we successfully observed such gradual transitions with evolution of the comp., nature and even metal content on many P incs. in successive generations (in quartz, topaz, partly in beryl, etc.).

(1) In granites and marginal zones (graphical, partly pegmatoidal) of pegs. truly P incs. are gaseous-solid, consisting of a xlized aggregate of mins. (70-90% by volume) which is close to granites in comp. and a gas phase (10-30%), practically without the liquid phase. The aggregates start to melt at 650-700°C (with gas dilution), with T_H at 800-900°C (in granites), 700-750°C (in pegs.).

(2) In successive incs. in inner zones of pegs. and also in early generations of topaz, beryl, and in P incs. of cellular quartz from cavities, a gradual decrease of the role of melt aggregate to 50-20-0% is obs., but from 650-600°C dxls. appear and their role increases to 50-70% by volume; aq. liquid phase increases as T_F falls. The dxls. start to dissolve first and then simultaneously (at 530-550°C) with the start of melting of the aggregates, with T_H at 650-600°C. The lowest Ts of fluid melts were obs. at 530-525°C.

(3) Further, a gradual decrease of the role of euhedral xls. (70% and less) and also gases with an increase (to absolute predominance) of aq. liquid phase with gradual drop of T_H to 450-30-150°C, is obs. in incs. of mins. from cavities (and in zones of rexliz. and metasomatism of peg. zones) in successive min. generations. Sol. and xliz. of huge min. concs. in incs. have been checked and photographed frequently as evidence that they are not accidental solid incs.

(4) In high T (650-500°C) incs., slightly soluble dxls. prevail (quartz, feldspar, micas, etc.) and as T_F drops to 500-400°C these decrease suddenly and disappear, and readily soluble mins. (halite, sylvine, etc.) increase, as residual products of chem. reactions. Melt fluids transform from essentially alumosilicate sols. to halide ones.

(5) Form. of mins. of heavy metals are met only in multiphase essentially gaseous-liquid incs. Anal. of fluid comps. from the incs. establish that mobilization, transport and dep. of heavy metals (and genesis) of such deps. occurred only by post-magmatic essentially aq. sols.; rare metals (Sn, W, Mo, etc.) by chloride-fluoride ones and mainly in the interval 450-250°C and polymetals (Pb, Zn, etc.) by chloride sols. in the interval 300-250°C. (Author's abstract.)

ZATSIKHA, B.V., 1975, Inclusions of hydrocarbons in hydrothermal quartz from Transcarpathian metallogenic province, (abst.), p. 62-64, in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Ivano-Frankovskiy Inst. of Petroleum and Gas, Ivano-Frankovsk.

HC-bearing incs. were studied in quartz xls. called "Marmarosh diamonds" (M.d.) and in vein quartz from Vyshkovo ore field (Au-polymetalic plus Hg). Extractions by alcohol-benzene and chloroform from

M.d. yielded "bitumoid A", fluorescing bluish-white in electron radiation. Char. of incs. in M.d. are given in table.

Table (modified by A.K.)

Composition, %	Village Volovets	Village Torun'	Village Liskovets	Perkalab River
CH_4	81.6	44.6	99.23	91.4
C_2H_6	8.1	34.2	0.61	6.2
C_2H_4	–	–	traces	traces
C_3H_8	4.1	8.1	0.08	1.2
C_4H_6	–	–	0.05	–
iso-C_4H_{10}	2.4	4.0	0.03	0.7
n-C_4H_{10}	3.8	6.0	–	–
C_5H_{12}	–	3.1	–	–
Cryometry, °C (sic.)	-110 (L)	-68 (G)	-80 (G)	-89 (L)
T_H, °C	+240	+140	+180	+170

Note: Meas. of partial T_H of HCs: from Chernogolovo (-70.5°C), Turitsy (-68°C), Rakhova (-100°C), all in L phase. P incs in these samples are naturally decrepitated.

P incs. in quartz from Vyshkovo ore field also contain methane; partial homog. at -65 to -72°C; bitumoid A was also found. Author supposes that metals (Au, Pb, Zn and Hg) might be transported as HC complexes. On isotope comp. of S, one may suppose that S was originally SO_4, later reduced to sulfide by HCs. (Abs. by A.K.) (Ed. note- See also Bratus, et al., 1975, this volume).

ZEN, E-an, 1975, Reassessment of the concept of "burial metamorphism" (abst.): Geol. Survey Research 1975, U.S. Geol. Surv. Prof. Paper 975, p. 157.

Exper. data of the phase equil. of the typical zeolite min. laumontite and analcime give the max. stability fields for the meta. of these rocks. In nature, other factors such as additional chem. components and the cond. of P_{H_2O} less than P_{total} tend to restrict the stabilities of these zeolites to lower perhaps to no more than 1 to 2 kb. (From the author's abstract.)

ZENG, Qing-Feng and YANG, Bo-Lin, 1975, Ore-forming temperature of hydrothermal tungsten deposit from the Nanling Range, South China: Ti Chih K'o Hsueh, 1975, no. 2, p. 166-172 (in Chinese). Authors at Inst. Geol., Acad. Sin., Peking, Peop. R. China).

The T det. of *cassiterite* and *wolframite* min. in the Nanling Range, South China, was studied on the basis of the relation to the W-, Sn-, Bi-, and Mo-rich Yenshan granite during min., and min. of the ore body. Cassiterite and *beryl* were formed at ~500°-400°; wolframite at ~400°-300°; and *pyrite*, *arsenopyrite*, *sphalerite*, *chalcopyrite*, and *galena* at 360°-260°. Vertical zoning of wolframite ore bodies is common; cassiterite, beryl, topaz, and apatite are rich in the middle and upper parts of the ore body, and sulfide min. gradually increases in the middle and lower parts. Chem. Abst., v. 83, no. 16, 135103 v, (1975).

ZHOVTULA, B.D., 1975, Distribution of endogenic CO_2 in magmatic rocks of Vyshkov region (abst.) p. 49-50; in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Author at Inst. Geol. Geoch. Fossil Fuels, Acad. Sci. Ukrainian SSR, L'vov.

Volatiles occur in incs. dissolved in glass and in bubbles. Glass incs. occur in phenocrysts of quartz, plagioclase and pyroxenes from quartz diorite-porphyrites, granodiorite-porphyries, hyalodacites, andesite-basalts; they are equant, and rarely irregular, 10-100 μm in size with phase ratios: glass 85-95%, G 15-5%, and sometimes xls. Xlized. incs. were found. G phase (mass-spec. MX1303) consists of CO_2 (18.0-97.9), N_2 (3.97-75.92), CH_4 (0.97-10.77), and O_2 (0.48-8.0 vol. %). H_2 occurs in various amounts and is here omitted. Amount of CO_2 increases toward the top of intrusive massifs, but in effusive rocks this distribution is reversed. For intrusive rocks typical conc. of CO_2 are 65-98 vol. %; for effusive ones, 18-50. T_H of incs. in quartz in diorite-porphyrites 1320-1280°C, in granodiorite-porphyries 1495-1145°C, in hyalodacites 1430-1390°C, and in andesite-basalts 1310-1260°C; n of glass ranges from 1.483 to 1.493, proving the uniform conc. of SiO_2 in primary magm. melt. (Abs. by A.K.)

ZIMMERMANN, Jean-Louis, 1974, Fluids in quartz from tin-copper deposits of Lanmeur-Kerprigent (Finistère). Sciences de la Terre, Nancy, v. 19, no. 1, p. 65-79 (in French). Author at Centre de Recherches Pétr. et Geóchim., C.O. n°1, 54500 - Vandoeuvre-les-Nancy, France. (Abstracted briefly in Fluid Inclusion Research, v. 7, p. 248, 1974.)

Quartz from veins is char. by aq. incs.: V_G/V_T = 5-10%, T_{Frz} = -2 to -7.7°C, T_H = 190-200°C. Quartz from nearby coarse-grained rocks contains two-phase incs. (V_G/V_T = 15 to 20%, T_{Frz} = -4 to -11.5°C, T_H = 150-200°C) or three phases $T_{Frz}CO_2$ = -59.5°C and -63.7°C). From mass spect. anal. the molar ratio of $CO_2 \leq 2\%$ and those of org. cpds. are <3% for incs. from veins. Large incs. in coarse-grained rocks contain 5 to 20% CO_2 and org. cpds. up to 10%. In some inc. HF and HCl are present. The presence of a more abundant G phase in the coarse-grained rocks would indicate a higher T_F in these rocks than in the quartz veins. The kinetic study of dehydration suggests the same conds. (Author's abstract, abbreviated and modified by M. Pagel.)

ZOLOTUKHIN, V.V., and VASIL'EV, Yu.R., 1975, Occurrence of compounds of carbon in ultramafic and alkaline-ultramafic rocks of Northern Siberian Platform (abst.), p. 8-10; in Carbon and its compounds in endogenic processes of mineral formation (data on studies of fluid inclusions in minerals) - Abstracts of Regional Meeting, L'vov, Sept., 1975: L'vov, Acad. Sci. Ukrainian SSR (in Russian). Authors at Inst. Geol. and Geophysics, Sib. Branch Acad. Sci. USSR, Novosibirsk.

Authors noted the macroscopic occurrence of bitumens in the named rocks, and the lack of CH_4, C_2H_6 and C_3H_8 in ground rocks, contrary to similar rocks of Anadyr-Kamchatka folded zone. Only $CO_2 + SO_2$ and H_2 was found. (Abstract by A.K.)

Translations

Items presented here are selected on the basis of (1) availability of a translation that has not been published elsewhere; (2) significance to inclusion research; and (3) date of publication. Thus older items may be included when particularly significant. The Editors would welcome suggestions from readers as to other papers that should be translated, and would particularly appreciate copies of privately-made translations not here-to-fore published.

BAZAROV, L. Sh., MIRONOVA, N. Yu., GORDEEVA, V. I., and ORLOVA, L. M., 1975, Problems of solution-melt in the pegmatite process, in Mineralogy of endogenetic formations from inclusions in minerals, V. S. Sobolev, ed.: Novosibirsk, W. Siberian Publishing House (All-Union Mineralog. Soc., Western Siberia Branch (ZSOVMO), Trudy, v. 2), p. 37-43 (in Russian). Translation courtesy A. Kozlowski.

(...) Currently there is no consensus on the origin of pegs., which would permit successful scientific prospecting and evaluation of the deps.

The existence of various theories of genesis of pegs. ("magmatic" and "metasomatic") is caused by the extreme complication of the problem and the lack of unambiguous arguments, permitting numerical accuracy in the char. of conds. of min. form. in pegs.

(...) A. E. Fersman (1940), on the basis of ideas of Vogt and Niggli, probably first proposed the existence of peg. sol.-melt. Stage of magma xliz. with coexistence in equil. of solid and fluid phase, is, after Fersman, the beginning of peg. process, taking place in various magmas in T interval 700-400°C. (...) Most writers define sol.-melt as "magmatic granitic melt enriched in "volatile" mineralizers (water, alkalies, CO_2, HF, etc.)." Quan. ratios of components of sol.-melt usually are not evaluated. Reconstruction of the true polycomponent comp. of natural peg. rock-forming media by usual geol.-min. methods is extremely difficult. Volatiles of the system usually are not present in the final rock, but escape at the end of stage of xliz., and they are not found during normal studies.

Data on solub. of water and other volatiles in silicate melts are very valuable. (...) But studies of incs. in mins. permit ascertaining the true conds. of origin of pegs. (...) During studies of several hundreds of thousands of incs. in mins. from various zones of pegs. - in quartz, spodumene, beryl, feldspars, etc., besides magmatic, G/L and L/G incs., incs. of a nebulous genetic nature were found (Table V, 1). These incs. had some features of xlized incs. (xls. of rock-forming mins. and G phase), but they differed from magm. ones in that they contained major amounts of L phase (sol.) and sometimes xls. of easily soly. dms. (Na and K chlorides). From xl-fluid incs. described by Ermakov in 1957 from "chamber" pegs of Volhyn and Kazakhstan (1972, p. 149) the studied incs. differ by presence of significant amounts of rock-forming mins. (50-80 vol. %) and less L and G. Volumes of each solid phase of rock-forming mins. exceed vols. of either L or G phase. (...) P incs. in the same growth zone have strictly the same phase relations.

Expers. were made in system K_2O-Al_2O_3-SiO_2-H_2O at T = 500-700°C, searching for appropriate sols.-melts with unlimited H_2O-silicate melt miscibility. Also one exper. of xliz. of L (sol.-melt) was made in the system Li_2O-K_2O-Al_2O_3-SiO_2-H_2O (see Table).

Establishing the initial comps. of system, the authors took into account the following: 1. At T of beginning of xliz. (about 500°C) ratios of components ought to guarantee the homog. medium - sol.-melt. 2. Specific vol. of water component ought to be similar to that in natural incs. described above. 3. Vol. ratios of solid, L and G phases also ought to be like those in natural incs. 4. Until recently it was not possible to determine the exact conc. of volatiles and alkalies in peg.-forming media, but the conc. of alkalies in the xliz. L ought to prevail over alk./Al_2O_3 ratios in feldspars, to obtain the homog. sol.-melt.

Comp. No. 1 (see Table) is similar to comp. of a point at field of xliz. of orthoclase (500°C isotherm) in the system K_2O-Al_2O_3-SiO_2-H_2O (Tuttle, 1961); Comp. No. 2 - point in field of xliz. of quartz (same isotherm). Comp. No. 3 is char. of point of crossing of 500°C isotherm and line of two-phase equil. quartz-orthoclase: 50% of K_2O is replaced by equiv. amount of Li_2O. P_{H_2O} was calc. on the basis of F of autoclave, using tables of Vukalovich (1958)(...).

From all types of comp. of L at T = 290-500°C (±5°) and P = 300-1300 atm. quartz and orthoclase were syn., and in addition, lithium silicates (Li_2SiO_3 and $Li_2Si_2O_5$) xlized. from L No. 3. Quartz No. 1 (Pl. III, 3) and No. 2 (Pl. III, 4) formed numerous, minute (≤0.5 mm along L_3), euhedral xls., sometimes forming X-shaped aggregates.

Quartz No. 3 forms euhedral, ≤4 mm long xls. (Pl. III, 5-6), sometimes in drusy aggregates (Pl. III, 7).

Orthoclase forms transparent, tabular, euhedral xls. with cleavage, 0.8 mm wide (Pl. IV, 1). Content of feldspar depends on Al_2O_3 content.

Lithium silicates form polycrystalline aggregates on faces of quartz and feldspar (Pl. III, 7). (...).

The largest incs. of sols.-melts were found in quartz xls. No. 3 (Pl. III, 6 and Pl. IV, 2-3). They are numerous, subhedral, elongated, with phase comp.: G+L+ solids (quartz, Li silicates, and small xl. of orthoclase). KCl and LiOH are not present as phases. Max. length of incs. equals 0.2 mm. Phase boundary quartz-Li silicates is easily visible in microscope, but not in micrographs. The division is shown on Figs. 2 and 4 g (Pl. IV).

Homog. of sol.-melt incs. in syn. quartz No. 3 is presented at Pl. IV, Figs. 4a-4g: a) inc. at T = 23°C, G+L+quartz+Li silicate+small xl. of orthoclase; b) same at 300°C, intensive dissolution of solids; c) partial homog., sol.-melt + G; d) complete homog. at 510°C; e) heterog. during decrease of T from 510 to 500°; f) subsequent phase changes during decrease of T to 300°, mainly dissolution of small xls. and growth of large ones; g) complete segregation and rexliz. of phases, T = 200°C.

The rate of T increase during homog. was 5-7°C per minute, and the speed of T increase was lower at T close to T_H, because when speed of heating was greater, the incs. decrepitated even if overheating was as small as 5-15°C, caused by thermal inertia of the heating stage.

Partial homog. (G+L) was in G phase with d. 0.276 g/cm^3; complete homog. - in L phase.

Sols.-melts., in comparison with usual silicate melts, have very low viscosity, permitting thermal movements of G bubble at T from 20° to 510°C, even after complete dissolution of solids.

Natural incs. in mins. of rare-metal pegs. (Pl. V, 1a-c) are similar to artificial ones. Incs. of sols.-melts were found in beryl (T of partial homog.: G+ sol.-melt = 560°C), in pegmatoid quartz (partial homog. at 600°C) and in spodumene (partial homog. at 400°C), and these incs. have following general features:

1. Presence of xls. of rock-forming mins. in amounts much larger than their solub. in aq. solns.

2. The absence or scarcity of easily soluble dms. proves the low conc. of chlorides and other salts in solns.

3. In all natural incs. partial homog. (G+L+easily-soluble solids) is easy to reach, but rock-forming mins. dissolve only in part, not exceeding 50% of their vol. Even at T = 1000°C during 4-6 hours, full homog. was not reached. It is probably connected with kinetics of dissolution of quartz, spodumene and beryl in sols.-melts with relatively low conc. of alkalies. Probably longer times of heating are needed; the authors are continuing this work.

4. Ratio of G to any rock-forming mins. is always significantly <1.

Concluding, one may state the following:

1. Incs. in artificial mins. grown from appropriate sols.-melts, have numerous features similar to incs. in natural mins. of rare-metal pegs.

2. Results of exper. studies of artificial and natural incs. testify to the presence of sols.-melts in forming of rare-metal pegs. (at least in the cases described).

3. Additional expers. in the near future will solve finally the question of the genetic role of sols.-melts in peg. processes.

Explanation for plates: (Note - the photomicrographs illustrate the features described in the text very well, but are not suitable for reproduction by the method used in producing this volume. For this reason the following drawings were made from the authors' photomicrographs.(AK)

Pl. III: 3 - Quartz No. 1; 4 - Quartz No. 2; 5 - Quartz No. 3 of elongated prismatic habit; 6 - Quartz No. 3 of short-prismatic habit; 7 - Quartz No. 3, drusy aggregates.

Pl. IV: 1 - Orthoclase No. 3; 2 - Tubular incs. of sol.-melt in quartz No. 3; 3 - Morphology of incs. in quartz No. 3; 4a - inc. at room T; 4b - at 300°C, 4e - heterog. of sol.-melt; 4f - intensive recryst. of solid phases; 4g - complete separation of solid phases, T = 200°C.

Pl. V: 1a - inc. of sol.-melt in beryl; 1b - inc. in peg. quartz; 1c - inc. of sol.-melt in spodumene.

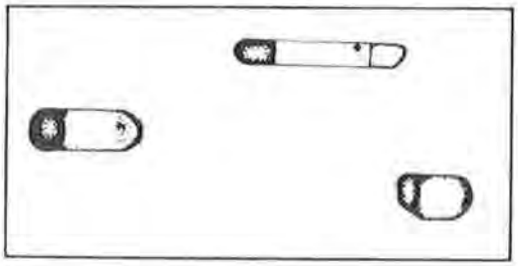
Table

No. of comp.	Comp. of systems, g					Max. T, °C	Hours in max. T	Synthetized mins.
	Li_2O	K_2O (KCl)	Al_2O_3	SiO_2	H_2O			
1	-	1.900	0.076	2.016	3.610	750	52	quartz orthoclase
2	-	1.66	0.054	2.232	3.69	800	56	quartz orthoclase
3	0.712	0.743	0.146	2.247	3.80	800	52	quartz orthoclase Li_2SiO_3, $Li_2Si_2O_5$

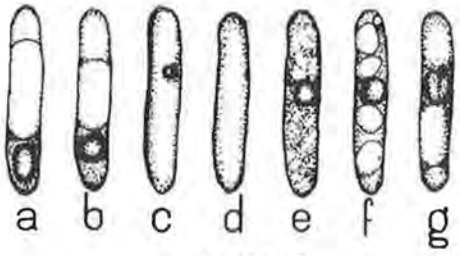
Notes: For all three compositions, T, at start of xliz., from Tuttle, = 500°C; from T_H = 510°C; T, at end of xliz., 290°C; P_{H_2O} at T = 700°C, = 1000 atm; cooling rate = 2.5°C/hour.

Pl. III, 5

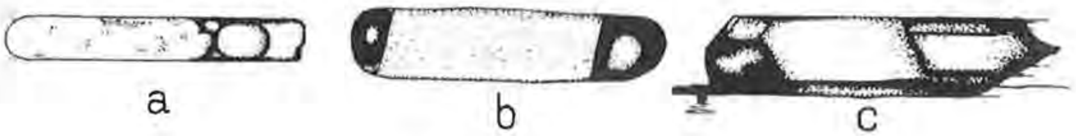
Pl. IV, 2



Pl. IV, 3



Pl. IV, 4



Pl. V, 1

Drawn by A.K. from the authors' micrographs

NAUMOV, V. B., 1976, Results obtained in laboratories of the USSR on thermometric measurements of inclusions in standard samples of quartz: Geokhimiya 1976, no. 7, p. 1109-1112 (in Russian). Author at Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR, Moscow. (Note - because of the importance and timeliness of this study, and the availability of the translation, it is given here rather than holding it for the 1976 volume of COFFI.)

One of the characteristic features of the contemporary development of geological science is the tendency to obtain quantitative information on the physico-chemical conditions at which natural processes occur. Therefore there is great interest in the method of study of inclusions formed in minerals in the process of their growth, because the method in many cases permits one to obtain such data. Thus, in the last ten years have appeared 76% of the 2900 papers published after 155 years of the study of inclusions. A significant increase of these studies is also observed in the USSR. In the latest symposium on the thermobarogeochemistry of the process of mineral formation, in Rostov-on-Don in 1973, 156 talks were presented by 82 research, industrial, and teaching organizations from 49 cities of the country. At this symposium the decision was made to establish under the chairmanship of D. N. Khitarov a commission on scientific methods, which should provide for the further development and the perfection of methods of study of inclusions in minerals.

At present the most successfully applied is the method of homogenization of inclusions, permitting one to determine the minimum temperature of crystallization of minerals in a broad range of values (from 1500° to 30°C). Therefore, in the first stage of activity of the commission, the author of this paper was assigned the task of comparison of thermometric measurements, at first up to the comparatively low temperatures, 300-400°C. The need for such comparisons can be illustrated by the example of tests of two constructions of thermal chambers, made in the USA (2). Temperatures of homogenization were measured on 16 inclusions in fluorite in the laboratory of the University of Tennessee, and afterwards in the laboratory of the U.S. Geological Survey. It turned out that for the first the results were on the average 34° lower than in the second, for temperatures of homogenization of 200-230°C. By this comparison the authors also reached the conclusion of possible partial leakage of inclusions in fluorite as the result of the formation of microfractures during superheating. Therefore the choice of fluorite as a standard mineral is not completely desirable.

In connection with this, we have chosen for comparison of thermometric measurements samples of synthetic quartz, the conditions of crystallization of which are given in Table 1.

Table 1

Conditions of crystallization of synthetic samples of quartz

No. of samples	Temperature, °C	Pressure, atm.
487	330	360
478	341	370
543	337	340
356	400	600

For each sample several polished plates were prepared. All inclusions in these plates (Fig., a-d) were characterized by constant ratio of gas and liquid phases, and correspondingly uniform temperature of homogenization for each sample. The temperatures of homogenization were measured by us for all the plates in a thermal chamber constructed by Kalyuzhnyi (3) and

Figure. Gas-liquid inclusions in synthetic samples of quartz
(a) sample 487, magnification X270, $T_{hom.}$ = 302°C;
(b) sample 478, magnification X250, $T_{hom.}$ = 309°C;
(c) sample 543, magnification X150, $T_{hom.}$ = 309°C;
(d) sample 356, magnification X600, $T_{hom.}$ = 355°C.

carefully standardized at the melting points of metals (Sn,Zn) and salts ($AgNO_3$, $K_2Cr_2O_7$). In the thermal chamber the plates with the inclusions to be studied were surrounded on all sides by metal, through which heat was transferred, and the junction of a chromel-alumel thermocouple, rigidly fixed in the heating chamber, was in contact with the plate. The observation was made by means of a long-focus objective. Because the number of plates of each sample did not exceed 5-7, each plate was first sent to one investigator, and on its return, to another. Each time, on return of a plate, I checked the temperature of homogenization in case of possible partial leakage of the inclusion, which, however, did not occur. In all cases, the temperatures of homogenization of the inclusions for each sample remained unchanged: 302°C for sample 487, 309°C for samples 478 and 543, and 355°C for sample 356.

In Table 2 are given the results of determination of temperature of homogenization of gas-liquid inclusions in the standard samples of synthetic quartz, carried out by 53 investigators in 24 organizations of the USSR. In these measurements there were used mainly different variants of the thermal chambers constructed by Ermakov (4), Kalyuzhnyi (3), and Dolgov and Bazarov (5). In some organizations (Moscow Gos. Univ., Rostov Gos Univ.) several thermal chambers of different construction were

Table 2

Results of determination of temperature of homogenization of inclusions in standard samples of synthetic quartz

City	Institute	Investigator	Temp. of homogenization, °C		
			No. 487	Nos. 478 & 543	No. 356
			302±2	309±2	355±2
Aleksandrov	VNIISIMS	Dorogovin, B.A.	318	326	379-381
		Malyshev, A.G.	295	310	---
Alma-Ata	Inst. Geol. Acad. Sci. Kazakh SSR	Kormushin, V.A.	---	324	353
Vladivostok	DVGI DVNTs. Acad. Sci. USSR	Kokorin, A.M.	312	---	398
Dushanbe	Inst. Geol. Acad. Sci. Tadzhik SSR	Morozov, S.A.	---	310	365
Ivano-Frankovsk	Inst. Neffi i Gaza	Zatsikha, B.V.	---	300	342
Irkutsk	Inst. Geochem., Sib. Branch, Acad. Sci. USSR	Makagon, V.M.	---	322-327	380
Irkutsk	Inst. Earth's Crust, Sib. Branch, Acad. Sci. USSR	Reznitskii, L.Z.	---	318-322	380-382
		Konovalov, I.V.	---	322-324	382

City	Institute	Investigator	Temp. of homogenization, °C		
			No. 487	Nos. 478 & 543	No. 356
			302±2	309±2	355±2
Kiev	IGFM, Acad. Sci. Ukr. SSR	Voznyak, D.K.	---	309	355
		Koval', V.B.	306	---	364
		Kuznetsova, S.V.	288	---	345
Leningrad	VSEGEI	Levitskii, Yu.F.	---	290-295	---
	Leningrad Gos.Univ.	Kozlov, A.V.	---	310	---
L'vov	IG & IGGI Acad. Sci. Ukr SSR	Krasnova, N.I.	318	328	375
	L'vov Gos. Univ.	Kalyuzhuyi, V.A.	---	312	361
		Doroshenko, V.A.	---	309	357
		Ivasiv, S.M.	---	322	367
		Lysak, G.I.	---	323	367
		Lyakhov, Yu.V.	---	309	357
		Myaz', N.I.	---	309	362
		Piznyur, A.V.	---	282	327
Magadan	SVKNII, DVNTs, Acad. Sci. USSR	Goncharov, V.I.	295	---	350
Moscow	VIMS	Kandinov, M.N. Puzanov, L.S.	312	328	397
		Rudnev, V.V.	310	316	361
		Kharlamov, E.S. Khitarov, D.N.	303	310	353
	GEOKhI, Acad. Sci., USSR	Naumov, V.B.	302	309	355
		Salazkii, A.N.	301	309	355
	IGEM, Acad. Sci., USSR	Kotov, E.I.	301	307	---
		Mel'nikov, I.V.	305	311	---
		Pashkov, Yu.N.	303	309	350
	IMGRE	Manucharyants, B.O.	291	297	354
	KGE VSkhPO	Khakimov, A.Kh.	265	280	---
	MGRI	Pal'mova, L.G.	306	315	363
	Moscow Gos. Univ.	Bogoyavlenskaya, I.V.	300	308	355
		Valyashko, L.M.	282	294	---
		Mel'nikov, F.P.	265	307	315
		Shapenko, V.V.			
Novosibirsk	Inst. Geol. Geofiz, Sib. Branch, Acad. Sci. USSR	Akimfsev, V.A.	302	308	365
		Gibsher, N.A.	295	300	360
		Gordeeva, V.I.	305	310	360
		Dimitrieva, A.N.	300-305	310	360-365
		Kosukhin, O.N.	305-310	310-312	355-365
Novosibirsk	Inst. Geol. Geofiz, Sib. Branch, Acad. Sci. USSR	Senina, V.A.	308	310	368

City	Institute	Investigator	Temp. of homogenization, °C No. 487	 Nos. 478 & 543	 No. 356
			302±2	309±2	355±2
Rostov-on-Don	Rostov Gos. Univ.	Granovskii, A.G. Maiskii, Yu.G. Prokopov, N.S. Timchenko, N.A. Trufanov, V.N.	--- ---	308-310 295-302	352-356 348-350
Tibilisi	KIMS	Arevadze, D.V.	---	302	354
Ufa	Inst. Geol. Bash. Branch, Acad. Sci. USSR	Khairetdinov, I.A.	---	345	---

used. In many cases there were obtained in the thermal chambers of different construction similar temperatures of homogenization within the limits 5°C. At the same time it must be noted that, in some cases, different investigators with the same type of thermal chamber (for example, in Vladivostok, Irkutsk, and Novosibirsk) obtained different results, which indicates insufficiently accurate standardization of the thermal chamber. Thereby in the future, all investigators carrying out thermometric measurements of gas-liquid inclusions ought to pay attention to the accuracy of the standardization of the thermal chamber, taking account thereby of the recommendations available in the literature (2, 6-8).

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Translated by Michael Fleischer, Jan. 28, 1977.

POMÂRLEANU, V.V., 1975, Decrepitometry and its applications in prospecting for ore deposits: Bucharest, Editura Technicǎ (in Hungarian) 180 pp., 77 figures, plus 44 photomicrographs.

This little book covers the extensive literature on the use of decrepitation (224 references), as well as many other aspects of fluid inclusion study. Dr. Pomarleanu has kindly provided the following English translation of the table of contents (ER).

Page

SOBOLEV, V.S., and KOSTYUK, V.P., eds., 1975, Magmatic crystallization based on a study of melt inclusions: Trudy Inst. Geol. Geofiz., Sib. Otd., Akad. Nauk SSSR, v. 264, 231 pp., 41 text-figs., 26 tables, 10 plates (144 individual figures): Novosibirsk, "Nauka" Press, Sib. Div., (in Russian).

This important book summarizes much of the Soviet work on melt inclusions that has been centered at Akademgorodok (Novosibirsk). Full translations of selected chapters will be found in vol. 9 of COFFI; only short chapter abstracts (see individual authors) are available now (ER).

VOLOKHOV, I.M., 1975, Evaluation of accuracy of thermobarogeochemical reconstructions of conditions of formation of magmas and magmatic minerals: Akad. Nauk SSSR, Sib. Otdel., Geol. i Geofiz. no. 1 (181) p. 12-19 (in Russian). Author at Inst. Geol. Geophysics of Siberian Branch, Acad. Sci. USSR, Novosibirsk.

Abstract.

A revision is made of ideas on agreement of T_H of melt incs in magm. mins. with T of trapping of incs. from magma. During high-T homog. partial leakage of incs. is possible by the diffusion of protons through xl lattice: these protons are produced by dissoc. of water. This

possible leakage has not been taken into account and could cause a large increase of T_H over the T of trapping. The isolation of incs. occurs under effusive and shallow-facies cond., where an "aqueous" magma, under decreased P, forms a two-phase "pyromagma", with the main part of the water forming a gaseous phase, and leaving a practically "dry" silicate melt at the relatively low T of the "aqueous" magma at the moment of its boiling; the T of trapping of incs. of the "dry" melt, estimated by homog., will be too high.

Omitting certain imperfections in thermobarogeochem. studies of G/L incs (8), the recent well-known successes in reconstructing parameters of min.-form. under cond of hyd. and pneum. processes caused optimistic ideas on application of thermobarogeochem. methods in studies of problems of magmato- and petrogenesis. The first steps in this direction became possible on constructing of special high-T microstages heating to 1400 and later to 1700°C, permitting exper. with normal and with superheated magm. melts. Incs in mins of magm. rocks were studied. The incs were of 3 types: 1) G/L (or xl-fluid) incs. of sols-melts from late stages of magm. evolution; 2) glass incs; and 3) xlized melt incs.

The similarity of P-T cond. of homog. of incs and P-T cond. of isolation of incs was assumed on the basis of theory and some exper. But the values of T_H obtained were very high, "significantly higher than those proposed by numerous petrographers" (12) on the basis of much geol., petrogr., and exper. data, including materials of numerous exper. with melting of quasimagmatic systems bearing volatile. This serious disagreement ought to have been the reason for serious reexamination of new method, but instead were used as the basis for new, strongly stated petrologic conclusions (1, 4, 5, 12 etc.).

The following two errors are most important: 1) The possibility of diffusion of H^+ ions (protons) through the xl lattice was not taken into account. These protons originate by dissociation of water and other H-bearing cpds. present in incs. during heating to high T_H. Without consideration of such diffusion, all conclusions on presence or absence of water in incs or in magma at the moment of trapping of incs are in doubt. 2) The method does not take into account the fact that melt incs. form mainly in mins of effusive and hypabyssal depth facies, i.e. under cond. of intensive separation of water (and gases) from the magma. Under such cond. the one-phase magma becomes two-phase (type: "pyromagma") with a vapor-gaseous phase as bubbles, concentrating volatiles formerly dissolved in the magma, and a liquid silicate phase, practically anhydrous, which forms incs. in phenocrysts of magm. mins. Such melt incs. thus do not characterize the whole system, but only the dehydrated silicate part. Extending the physico-chem. infor. gotten during homog. to the whole system is methologically doubtful, especially if used for reconstruction of the cond. of origin and following the evolution of deep magmatic magma systems.

Discussion of first error. If diffusion of protons occurs, the most fundamental assumption of the method, the equivalence of T_H of incs with T_F (temperature of formation) of the incs., is in doubt. This assumption is more or less suitable for "dry" silicate melts, but cannot be accepted for melts saturated with water and other volatiles to various degrees. At the homog. Ts, the volatiles are supercritical and highly mobile, and, moreover, water and other H-bearing comp. (HF, HCl, H_2S etc.) dissociate, forming hydrogen ions (protons). The presence of protons in incs., at supercritical Ts, makes leakage inevitable. Excape of such protons at T_H would strongly affect the elemental comp. of incs, and preclude obtaining true values for T_F. Such diffusion of protons also increases the oxidation potential of the inc. medium. Fe-bearing host min. (olivine, pyroxene, hornblende, biotite etc.) show oxidation of Fe^{2+} in the inc. walls, forming opaque oxides, often precluding the visual observations of process of homog. of incs (4, 9, 10, 12-14 etc.).

This difficulty cannot be solved by use of inert media (14), because the source of O_2 is not the external atmosphere but the incs themselves, as one may conclude from therm. invest. of melt incs. in olivines from meymechites (12). During exper. melting of basalts and peridotites under hyd. cond., the oxidation of Fe usually is precluded by use of a reducing buffer, stabilizing the redox potential of the system at a known and desired level (15, 16). However, this method cannot now be used for studies of incs.

It is also necessary to point out the inadequacy of duplicability of T_H data on the same inc. as a criterion for lack of leakage of high-T incs (4), as well as comparison with exper. with syn. incs. (6). The first is invalid if the water is lost during the first T_H det. Each following homog. of such. inc. will repeat the false T_H of the "dried" inc.

To evaluate the possibility of diffusion of components of water from incs, it would be useful to make a dynamic study of the chem. comp. of inc. during the first homog. However, although ultramicrochem. invest. of incs. are successful in certain cases (3, 11, 17, etc.), they seem very difficult for this purpose due to the low accuracy of quant. ultramicrochem. anal. The exper. studies mentioned above, proving the similarity of T_H and T_F (systems with CaF_2, without water) are not suitable for proving the preservation of water in incs during high-T heating.

Contrary to statements of a number of investigators (5, 12, etc.), the "data on T_H of S incs. in healed fractures and in marginal parts of xls" cannot prove the absence of escape of water (H^+ ions) from high-T incs; these T are "always lower than T_H of P incs. in central part of xls" (12). Also insufficient is the argument that in case of escape of water from incs."...water here (in S incs - I.V.) ought to escape especially easily and hence T_H ought to be higher" (12) than in incs in the central parts; first, conds. of separation of water from incs. in xls (studied usually in polished flat preparations 0.1-1.0 mm thick) are approximately similar for both types of incs, and, second, the relative values of T_H of P and S incs may be preseved also in "dried" incs. depending on other flux comp. present in incs, especially alkalies, halogens etc., that do not diffuse through the xl lattice of the host min. Thus, relatively low T_H of incs. in mins. of some alkaline and acid magm. rocks (1, 2, 7, etc.), testify to the important role of alkalies and "acid gases" in decreasing T_H of xl-fluid incs.

The evidence for the accumulation of violatiles during xliz. of melts is not an adequate basis for the conclusion, that "...if diffusion of volatiles does occur at measurable rates, diffusion of volatiles would take place not from incs but into incs" (5). Similar data and conclusions are true only for magm. systems that are closed (or quasiclosed), with respect to volatiles. Such, especially, are the magm. melts present during form. of pegs and pegmatoids, as well as lamprophyres and similar, generally rare magm. deps. Most often, xliz. of magmas occurs during escape of volatiles. The faster the volatiles are removed, the faster the crystallization, reaching a maximum under effusive conds. It is hence nearly impossible to imagine a significant diffusion of volatiles from melt into inc., and to use this to prove the impossibility of diffusion of comp. of water from high-T incs.

Discussion of second error. During interpretation of data of thermobarogeochemistry of glass and xlized melt incs. in magm. mins., it is necessary to take into account the possibility of obtaining systematically too high T_F due to the diffusion of volatiles from incs. not during heating in the microstage, but during magm. period of existence of incs. Such diffusion ought to be kept in mind especially during studies of glass and xlized melt incs, most widespread in lava mins. and, partly, in mins. of rapidly cooled endocontact facies of magm. bodies of subvolc. and other shallow hypabyssal depth facies (especially dikes, sills etc.), i.e., in levels of the Earth's curst where magm. melts are characterized by low total P and low partial P (and solubility) of volatiles in magma. Under these conds. water (and other volatiles) exists in magm. melt in two forms: a) as dissociated water, dissolved in the homogeneous melt phase; the amount at saturation is a function of magma comp. and total P, and b) as a discrete vapor phase, appearing in the melt when saturation with water occurs either due to decrease of total P or as a result of additional influx of water from deeper horizons of magm. column; the melt then becomes a two-phase liquid-vapor (gaseous) system of the "pyromagma" type of A. Ritman. The evidence for such water is found in the vesicular lavas.

For correct interpretation of results of thermometry of "high-T" melt incs. in magm. (mainly lava) mins., this second form of magm. water is important. Thus one may have a magma that is rich in (total) water under such low total P that it has a low P_{H_2O} (and hence low dissolved H_2O). Water in such magma, in the main mass, will concentrate as bubbles of vapor phase consisting mainly of water, and exceeding its solubility in melt under a given total P.

In a magm. column, existing in an open physico-chem. system, P_{H_2O} in the melt and the pressure of the vapor phase each equal total P at the given depth. This contrasts with the rarer closed or partly closed (for volatiles) systems, where P_{H_2O} of dissolved water in the melt and P in the bubbles of vapor phase add one to another, being close in sum to total P on magma. (sic.)

In open or quasiopen systems (e.g., magmas forming all volcanics, almost all subvolcanic rocks, and the majority of hybabyssal magm. rocks assoc. with relatively high conc. of water, mainly occurring as a vapor phase from "boiling" of magma), the formation of magm. rocks, as a rule, occurs under relatively low P, and especially under very low and widely varying P_{H_2O}. Excess H_2O from the depths, separated as a vapor phase during magm. processes will leave the magma; earlier or later the majority of dissolved water will also escape from the melt.

If this model of the evolution of the cond. of existence of magma and trapping of its individual microscopic portions in incs in magm. mins. adequately describes the real processes at this stage of development, it is undoubtedly necessary to take into account the existence of vapor phase in interpretation of the results of thermometry of melt incs.

Hence one may conclude from the above that a) dets. of T_H of melt incs. are not equivalent to T_F of the whole magm. system; b) high T_H of such incs. does not imply relatively low conc. of water in such systems, and c) the data on incs. cannot be extrapolated to regularities and cond. of formation of magmas in deep magm. chambers.

In a magm. system "filtering" through itself intratelluric (transmagmatic) sols. or boiling with P decrease, loss of water (or gases) is not connected with heating of magma. The only deviation from this rule probably is the increase of T of melts immediately under subaeral cond., e.g. in subsuperficial layer of lava lakes or lava flows, during burning (oxidation) of H_2, hydrocarbons, sulfur, etc. However, this phenomenon does not extend to portions of magma occurring deeper, and may, in part, be taken into account in paleotemperature reconstructions of peculiarities of volcanic processes.

Depending on the comp. and initial T of the melt, "boiling" leads to changes in the physical features of melts. Acid melts usually become very viscous; alkaline and basic ones remain mobile until complete loss of gases and xliz. due to the flux effect of alkalies and alkaline earths, present even in the water-free L phase of "boiled" lava.

Thus, loss of water from the L phase of a "boiled" magma with separation of excess of water to form a vapor phase, although it decreases P_{H_2O} in the L phase, does not change the general amount of water in magma and does not increase its T. Xliz. of magm. mins and trapping of incs. by them from the L phase poor in water occurs at T not higher than T of the "boiled" magma, which is not higher than T of water-saturated magma, before its "boiling". Incs in mins, xlized from the "dried" L phase of such a "boiled" "pyromagma", after their trapping, show themselves only to have a low conc. of dissolved water (equiv. to a low P_{H_2O}), and, as a rule, they would not preserve any information about the vapor phase that was removed from the system practically completely at the end of existence of magma (sic.).

Thus, these features of the comp. and conds. of formation of incs. in magm. mins. make such incs. inadequate for reconstruction of the true thermal evolution of the magma. Unfortunately, with the recent degree of development of thermobarogeochemistry, the data on T_H of melt incs. not only don't help in reconstruction of this thermal evolution, but introduce serious errors, especially in suggesting much too low values for the conc. of water in magmas. On the other hand, T_F of melt incs, det. as T_H, are much too high.

Recent data on thermometry of high-T incs. in magm. mins need serious corrections. This conclusion holds, if not to an even greater degree, to barometric and microchemical data, because the methods now used are only in the initial stage of development and far from perfect. Unfortunately, our desires to improve the data are not realizable with present methods and instruments.

In conclusion, it is probably necessary to reevaluate all petrologic schemes and conclusions made on the basis of thermobarogeochemistry of high-T incs, since the supporting data are invalid and clearly premature.

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Indices

The user should keep in mind the following features of these indices. The indexing procedures and entries are evolving and hence are not completely uniform from one volume of COFFI to the next, and even within a given volume consistency cannot be claimed (caveat emptor). Where several different items in the given category occur on the same page, the number of such items is put in parentheses after the page reference. Some items may continue on to following pages. Transliteration of Cyrillic has not been uniform in the various sources used, and hence the user must look under both possible spellings, e.g., Ye and E., ...iy and ...ii, etc. As all entries in the Translation section are also entered in the Abstracts section in alphabetical order, no Author index is needed.

SUBJECT INDEX

See general notes above. I have tried to make this a user-oriented index rather than a documentalist's type index. Only data in the title and abstract are indexed, and then only if they appear to be of more than incidental mention. Misleading or erroneous translations may have resulted in occasional incorrect or omitted entries. Some entries are included under a given subject heading even though the index word does not occur in the abstract. The deposit type is indexed only where it is evident without research. The aim has been to err on the side of completeness and convenience to the user. Thus I have attempted to index some related or possibly pertinent items, and even ones involving negative data or evidence, under each category. The ore type terms such as porphyry copper and Mississippi Valley are used loosely. Analyses for specific elements are indexed only when they are particularly unusual or significant; thus semiquantitative spectrographic analyses are generally ignored. The mineral host for the inclusions studied is indexed except for decrepitation studies. Entries that would include too many page references (such as Homogenization, Quartz) are omitted. Some entries with broad and diffuse applicability (e.g., "Geobarometry, methods and comparisons" or "Homogenization of inclusions, factors affecting") have only a few of the most appropriate page references.

DEPOSIT INDEX

Notes: See page 220. Individual deposit place names are indexed only when significant data are presented. Inexact place names (e.g., "Soviet Far East") are not entered, nor are individual mines in districts known by a district name. Soviet place names may be listed under various transliterations and in particular, with different endings; thus Began and Began'skii, Blyava and Blyavinsk, Kochkar and Kochkarskoje.

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