The diamond potential of electronically disaggregated eclogites from Roberts Victor mine, SA

Hamdi Ali*, Margo Regier, D. Graham Pearson

Canadian Centre for Isotopic Microanalysis, University of Alberta, Edmonton; *hamdi2@ualberta.ca

Introduction

Mechanical disaggregation of xenoliths, such as jaw crushing, causes preventable damage to diamonds within eclogites. The SELFRAG is designed to disaggregate along grain boundaries, with the aim of releasing more diamonds with less fractures. We test this hypothesis, along with the diamond potential of Roberts Victors mine.

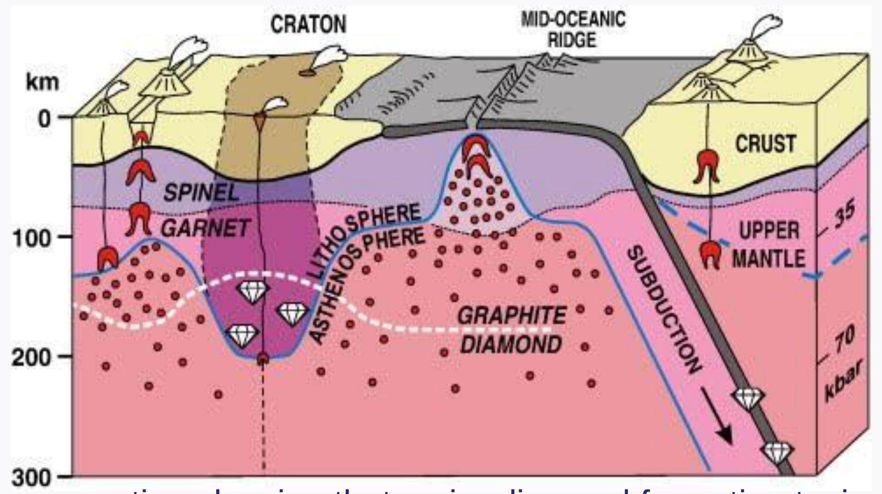

Figure 1. Cross-section showing that major diamond formation typically occurs in cratonic mantle. The cratonic root provides ideal temperature and pressure conditions. (1)

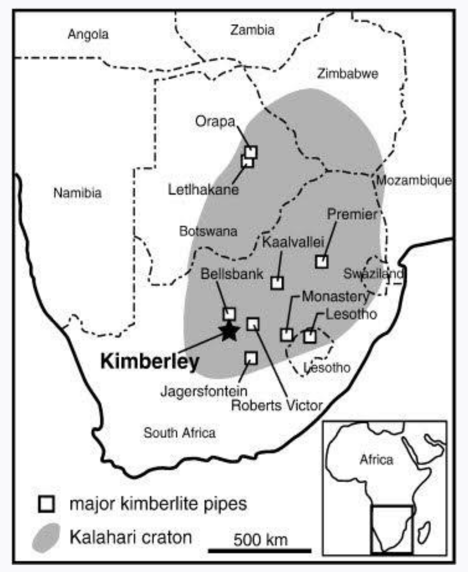

Figure 2. Map of southern Africa detailing the occurrence of major kimberlite pipes within the Kalahari craton. (2) Figure 3. Visible light image of the RV09 sample before it was halved. One half underwent jaw crushing while the other half went into the SELFRAG.

Figure 4. The SELFRAG uses high voltage (200 kV) electrical discharges to separate rocks into their individual constituents.

-200 kV

~100 shocks

-20 mm electrode gap.

5 hz frequency

SELFRAG disaggregation results

Does high voltage disaggregation cause damage to the diamonds?

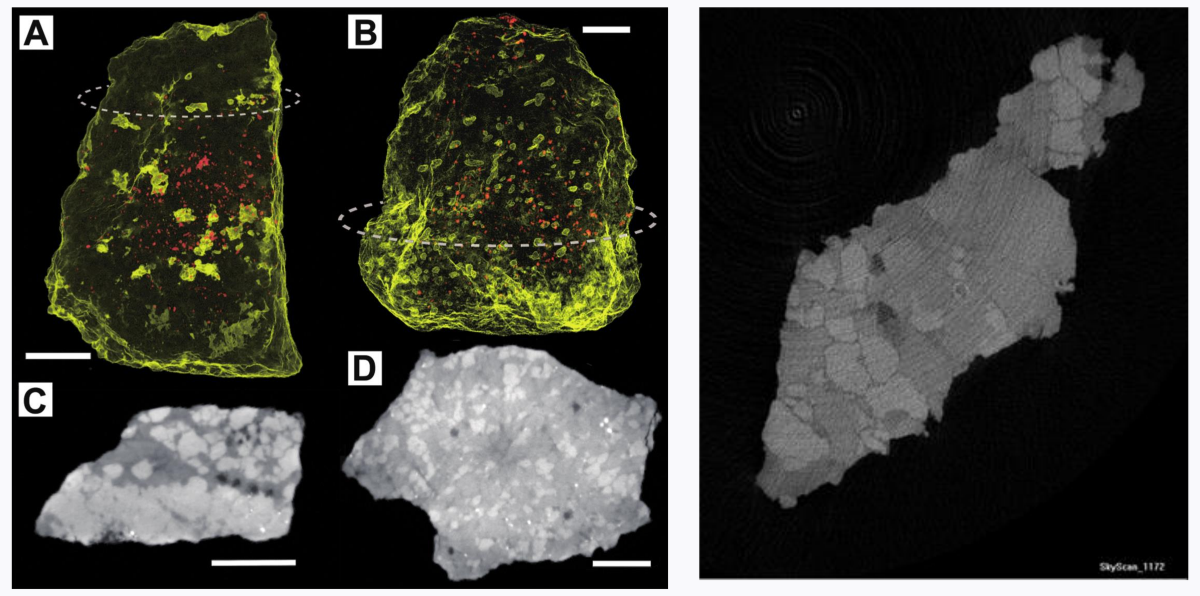

Figure 5. Using methods similar to Ishikawa et al (figure on the left), we probed our sample RV09 for its constituent minerals (figure on right). The brighter areas correspond to garnet, while the larger spots of dark grey are clinopyroxene. The dark spots found on the right are likely diamond. (3)

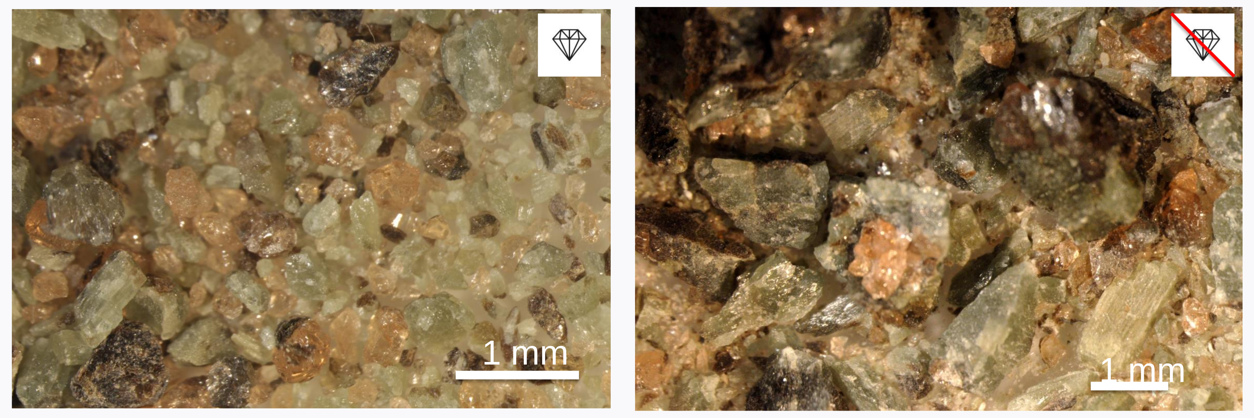

Figure 6. The piece of the sample that went into the SELFRAG (figure on the left) is separated into its individual minerals and is more uniform compared to the sample that underwent conventional disaggregation (figure on the right).

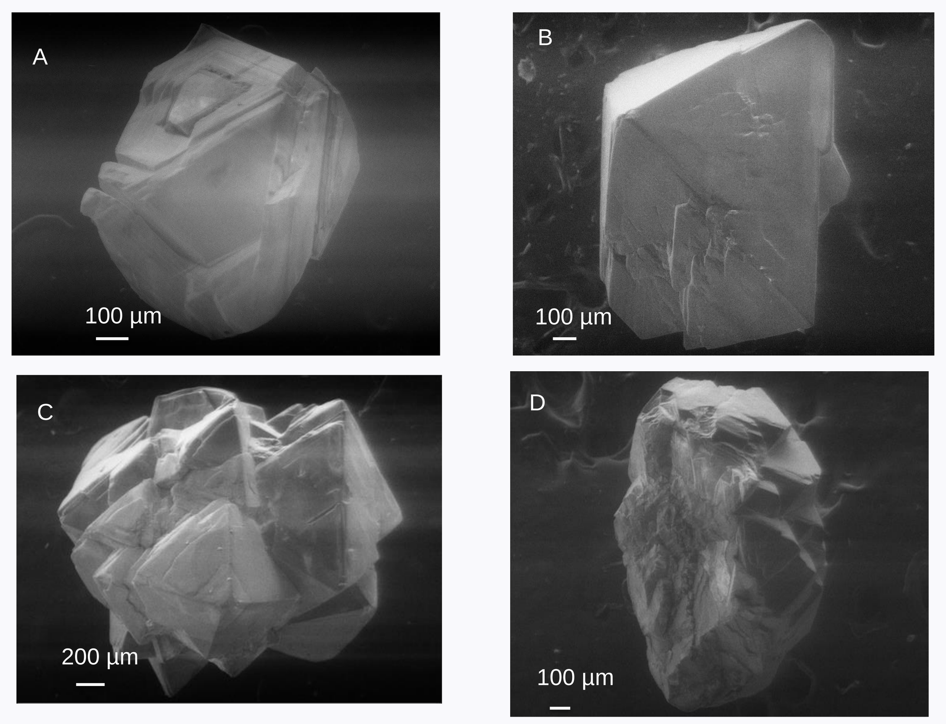

Figure 7. Diamonds released from the SELFRAG imaged with a Scanning Electron Microscope (SEM). Most diamonds liberated showed no signs of visible breakage (Fig 7b,c) but a few show signs of possible damage, although it may have occurred during the kimberlite eruption. (Fig 7a,d).

Diamond formation results

To better understand the process of diamond formation we analyzed liberated diamonds for their nitrogen aggregation and calculated thermometric constraints.

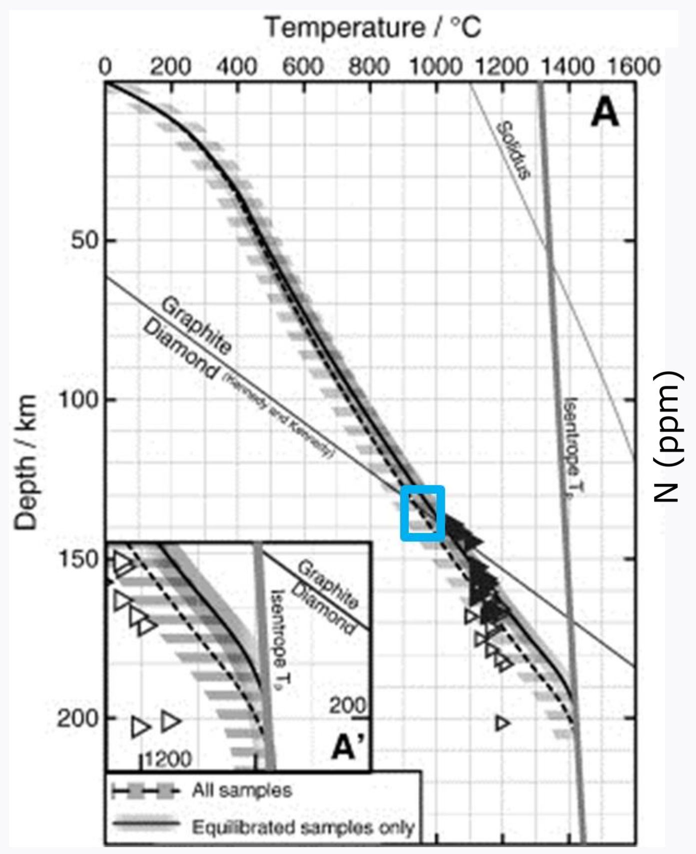

Figure 8. Using Electron Probe Microanalysis (EPMA), we calculated the temperature of the garnets and clinopyroxene at Mg-Fe equilibrium . (6) Then we plotted the point on a Finsch geotherm (7), which indicates that our eclogite lies at the diamond-graphite transition.

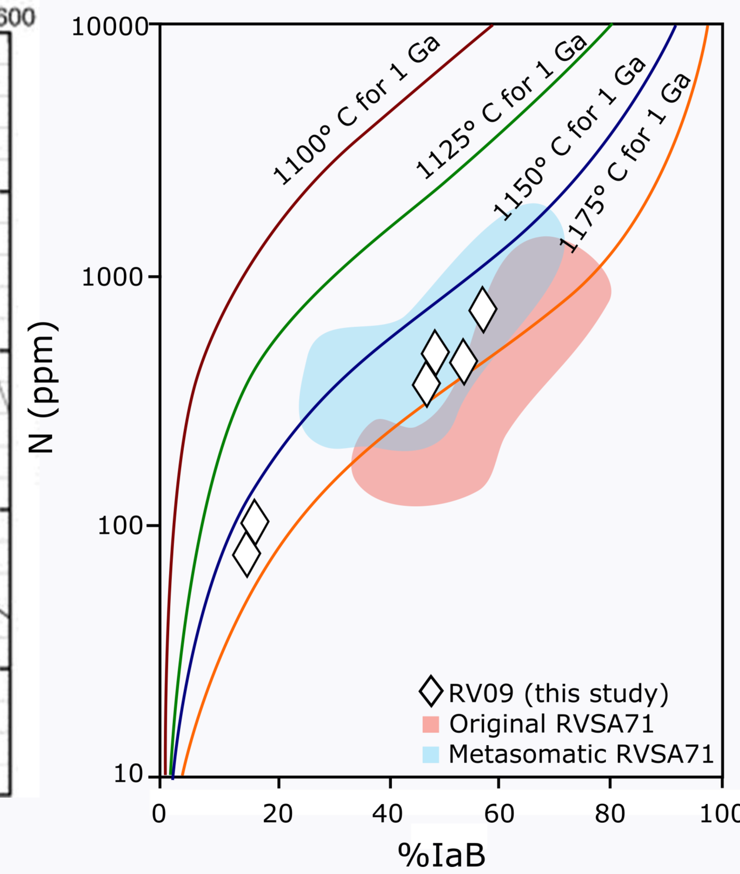

Figure 9. The diamonds represent the nitrogen concentration and aggregation of samples from RV09. Our samples lie within the Cpx-rich metasomatic zone of diamondiferous eclogite RVSA71. (3) (Shaded regions.) Data processed using D. Howell's spreadsheet.(4,5)

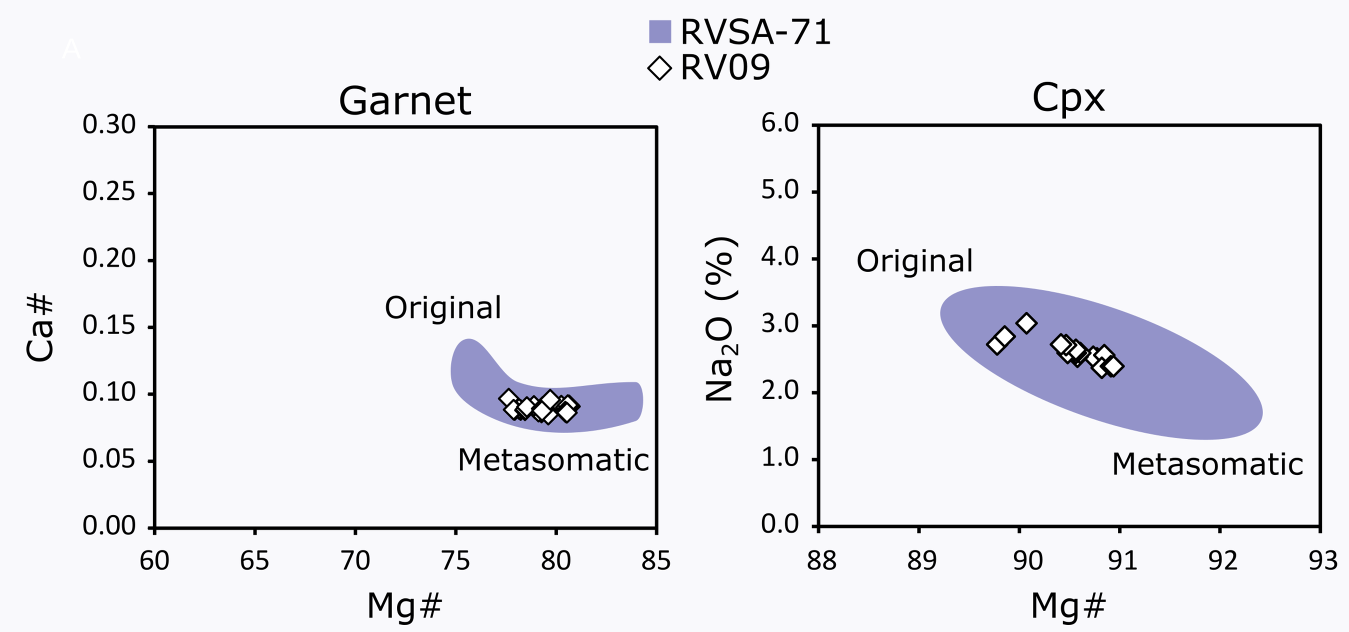

Figure 10. Plots of major element chemistry of garnet and Cpx for RV09 compared to diamondiferous eclogite RVSA-71 (3). Our sample lies between the garnet-rich zone and the diamondiferous metasomatic Cpx-zone of RVSA71.

Conclusion

SELFRAG disaggregation

	SELFRAG	Jaw crusher
Diamonds recovered	10	0

- The lack of diamonds found in the jaw crushed portion suggests that the SELFRAG preserves grains that would otherwise be broken during jaw crushing.

-The SELFRAG causes minimal fracturing of diamonds within the eclogite, as seen in Fig 7.

-Use of the SELFRAG is limited by the lengthy process of disassembling and assembling the sample chamber in between every use to prevent cross-contamination. The inconveniences caused by this could hamper industry applicability.

Diamond formation

-Sample RV09 is derived from close to the diamond-graphite transition at a depth of ~145 km within the lithosphere.

-RV09 diamond nitrogen aggregation matches the 'young vein' diamond population found in RVSA71 by Ishikawa et al (2008). Garnet and Cpx chemistry of RV09 approaches those of the diamond-rich portion of RVSA71.

-This shows, for the first time, evidence of a shared diamond population in two distinct host rocks produced by metasomatism.

References and Acknowledgments

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