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STRATIGRAPHIC AND PALEOENVIRONMENTAL ANALYSIS OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS: COLD LAKE OIL SANDS AREA, EAST-CENTRAL ALBERTA

BY

BLAIR WILLIAM MATTISON

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF GEOLOGY
EDMONTON, ALBERTA
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The undersigned certify that they have read, and recommend to the faculty of Graduate Studies and Research for acceptance, a thesis entitled STRATIGRAPHIC AND PALEOENVIRONMENTAL ANALYSIS OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS: COLD LAKE OIL SANDS AREA, EAST-CENTRAL ALBERTA
submitted by BLAIR WILLIAM MATTISON
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ABSTRACT

Stratigraphic analysis of the Upper and Middle Mannville sub-groups in the Cold Lake Oil Sands area of east-central Alberta indicates the presence of seven regional unconformities which divide the interval into seven stratigraphic sequences. These units approximately equate with the seven lithostratigraphic units (Colony, McLaren, Waseca, Sparky, G.P., Rex, and Lloydminster) traditionally recognized in the Lloydminster heavy oil area of east-central Alberta and west-central Saskatchewan.

Regional unconformities within the Upper-Middle Mannville interval are indicated by the preservation of subaerial erosion surfaces at the top of regional shoreface to offshore coarsening-upwards successions, as well as by the presence of deeply incised valley-fill or "channel" systems. Seven distinct channel incision events define the *regional* unconformity surfaces, but uncertainties in defining the lower boundaries of these channel systems due to stacking of channels blur the exact delineation of sequence limits. Fluvial sedimentation dominates the basal sections of valley-fill successions, although indications of estuarine deposition are found toward the tops of most channels.

Relative transgressions and regressions within the Upper and Middle Mannville were superimposed upon a dominantly regressional regime which culminated in the withdrawal of the Boreal Sea from Western Canada. Micropaleontologic studies indicate complete withdrawal of this sea, and the creation of an extensive hiatus at the end of Mannville time prior to the inundation of the Joli Fou Sea.

Both micropaleontologic and ichnologic studies indicate increasingly brackish-water depositional conditions prevailed towards the end of Upper Mannville time as a result of an increase in the importance of fluvial systems and a consequent decrease in marine salinities. Other ichnologic studies of offshore-shoreface successions in the Middle Mannville extend the paleoenvironmental range of the trace fossil *Macaronichnus segregatis*, previously thought to be restricted to upper shoreface environments.

Paleoecologic studies of fossil gastropods collected from channelized sediments confirm the fresh-water nature of some of these paleochannel systems, while biostratigraphic analysis indicates extensions in both the biostratigraphic and paleogeographic ranges of these fossils.

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CHAPTER I

INTRODUCTION: A STRATIGRAPHIC REVIEW OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS OF EASTERN ALBERTA

The Lower Cretaceous Mannville Group of eastern and central Alberta represents the single most hydrocarbon-rich stratigraphic unit in the Western Canadian Sedimentary Basin owing to its abundance of oil, gas, and especially oil sand resources. Despite a long history of exploration, thorough understanding of the Mannville has traditionally been hampered by the sedimentologic complexity of the siliciclastic deposits within it and by the relative lack of good index fossils needed for reliable biostratigraphic and chronostratigraphic correlation. Because of this complexity, an equally complex stratigraphic nomenclature has evolved over the years (Fig. 1). In a large number of cases lack of data has prompted the creation of a duality of stratigraphic nomenclature based simply on geographic location rather than on real stratigraphic differences (Caldwell, 1984; Cant, 1990).

Mannville stratigraphy within the Cold Lake Oil Sands area of east-central Alberta (Fig. 2) represents a paradigm example of one such dual nomenclatural scheme. In the northern half of the Cold Lake deposit the Mannville is traditionally represented as having a rather simple three-fold division, consisting of (from oldest to youngest) the McMurray Formation, the Clearwater Formation, and the Grand Rapids Formation (Fig. 3). In the southern half a much more complex stratigraphic scheme (consisting of nine stratigraphic units-- Dina, Cummings, Lloydminster, Rex, General Petroleums, Sparky, Waseca, McLaren, and Colony formations) has been developed for the Mannville. In both cases these stratigraphic schemes have been created for type areas outside of the Cold Lake deposit, but have been extended over the years to include the Cold Lake Oil Sands area within their geographic range (e.g. Williams, 1963; Minken, 1974; Orr et al., 1977; Mathison, 1988). In the case of the Grand Rapids Formation, the type area is found in outcrop along the Athabasca River within the Wabasca Oil Sands area of northeastern Alberta (McConnell, 1893; Kramers, 1974; 1982; Keeler, 1978; 1980) while in the case of the nine-fold division of the Mannville, the type area is the Lloydminster heavy oil trend of extreme east-central Alberta and west-central Saskatchewan (Nauss, 1945; 1947;

Fuglem, 1970; Orr et al., 1977; Vigrass, 1977) (Fig. 4).

This thesis will focus specifically on the Upper and Middle intervals of the Mannville Group (*sensu* O'Connell, 1985; O'Connell and Benns, 1986) in the Cold Lake Oil Sands area. The primary aim is directed towards a better understanding of the stratigraphic and paleoenvironmental history of the Upper-Middle Mannville succession.

Relatively little has been published concerning Mannville stratigraphy in the Cold Lake deposit itself, although a large number of studies have addressed this subject in areas to the south (Lloydminster heavy oil area) and to the north (Wabasca Oil Sands Area). In order to understand the dualism of Upper and Middle Mannville stratigraphic nomenclature in this area, it is necessary to review each of the stratigraphic schemes employed in Cold Lake within their respective type areas. This introduction seeks only to summarize the most important aspects of previous studies related to the Upper-Middle Mannville succession in the Lloydminster Heavy Oil area and in the Wabasca Oil Sand area. For a more detailed review see Mattison (1987).

PREVIOUS STUDIES: GRAND RAPIDS FORMATION-WABASCA OIL SANDS AREA

Biostratigraphy and Chronostratigraphy

Like most of the Lower Cretaceous series in Alberta, the stratigraphic correlation of the Grand Rapids Formation with its equivalents has been the subject of debate ever since the first geological description of the formation by McConnell (1893). In comparison to much of the Lower Cretaceous succession, however, dating of the Grand Rapids Formation is rather more precise due to the occurrence of biostratigraphically important index fossils both within the formation itself and in bounding strata.

The Grand Rapids Formation lies transitionally between the Clearwater Formation, typified by the *Marginulinopsis collinsi - Verneuilinoides cummingensis* foraminiferal Subzone of Caldwell et al. (1978) (dated as Lower Albian), and the Joli Fou Formation, typified by the *Haplophragmoides gigas* foraminiferal fauna of Stelck et al. (1956) (dated as earliest Late Albian). The ammonite *Freboldiceras remotum* found in outcrop sections of the Grand Rapids along the Athabasca River (Stelck and Kramers, 1980) confirms an earliest Late Albian age for the unit. An extensive regional unconformity is thought to mark the contact between the Joli Fou and the uppermost Mannville (i.e. top of the Grand Rapids), although controversy has traditionally existed as to the exact placement of this break (see Chapter VI). This stratigraphic break represents a fairly extensive time span in eastern Alberta as all Middle Albian strata are thought to be absent from this area (Stelck et al., 1956; Jeletzky, 1971; Stelck and Kramers, 1980; Koke and Stelck, 1985).

Depositional History of the Grand Rapids Formation

The Grand Rapids Formation was first described by McConnell (1893) from outcrops along the Athabasca River (within the area now considered as the Wabasca Oil Sands deposit). McLearn (1917) was the first to propose a genetic interpretation for the Grand Rapids based on his study of these outcrops, concluding that the lower part of the formation was of marine origin due to the occurrence of large concretions which carried marine bivalves. He further concluded that the uppermost beds of the Grand Rapids along the Athabasca were of "subaerial origin" owing to the presence of rooted coals.

Modern studies of the Grand Rapids include those of Mellon (1967), Kramers (1974, 1982), Keeler (1978, 1980), Stelck and Kramers (1980), and Kramers and Prost (1986). Kramers (1974, 1982) divided the Grand Rapids in outcrop and in the subsurface into 3 major sand intervals which he dubbed the "A", "B", and "C" sands. Kramers and Prost (1986) maintained this three-fold division of the Grand Rapids and interpreted the formation as a progradational sequence built up through the regression of the Boreal (Clearwater) Sea. Each major sand unit (A, B, and C) was thought by Kramers and Prost (1986) to represent a single genetic clastic wedge developed in a high energy wave-dominated shoreline system in which longshore drift and wave action may have been the most important processes responsible for deposition.

In the Wabasca deposit the three Grand Rapids sand sequences are separated by relatively thin shaly units. The uppermost shales between the A and B sands carry a brackish to fresh microflora at the base with marine microflora and microfauna above. These transitional shales are underlain by shales which contain no foraminifera but do contain tintinnids and thecamoebians. This faunal change has been interpreted as representing a shift from marine to continental conditions in the interval above the B sand (Kramers, 1974). The shaly beds between the B and C sands also carry a marine microflora and microfauna.

Kramers and Prost (1986) envisaged that the shoreline during Grand Rapids time ran in a northeast-southwest direction in the Wabasca area and was dominated by shore-attached beaches as well as barrier islands, offshore sandbars, and local deltas at points where northerly-flowing rivers met the sea (Fig. 5).

Keeler (1978; 1980) proposed a similar depositional model (i.e. barrier island model) for the Grand Rapids Formation in the Wabasca Oil Sands area (TWP 80-83, RNG 22-25W4). Keeler's stratigraphic division of the formation wass much more complex, however, recognizing nine distinct sedimentary units. These units were grouped into four sedimentary sequences consisting of one or more sedimentary units (Fig. 6). These four sequences were referred to as sequences K, L, M, and N (in order of decreasing age) and were thought to be separated from each other by sedimentary breaks (either erosional or simply changes in environmental conditions and depositional style). In terms of Kramer's stratigraphic picture of the Grand Rapids, sequence K incorporates the C and B sands, while the A sand is roughly correlative to sequences M and N. Sequence K incorporates sedimentary units I (equivalent to Kramer's C sand), II, and III (Kramer's B sand); Sequence L consists of sedimentary unit IV; Sequence M incorporates units V, VI, VII, and VIII; while sequence N consists entirely of unit IX.

Keeler (1978, 1980) also envisaged a much more complex depositional history for the Grand Rapids Formation in the Wabasca area than had any authors before him. As an example, in Kramers and Prost's (1986) stratigraphic scheme for the Grand Rapids, the three progradational sands which they described were all thought to have advanced in a northerly to northwesterly direction in response to the northeasterly regression of the Clearwater Sea. In contrast, the basal sequence of Keeler's genetic subdivision, sequence K, was interpreted as westward prograding nearshore marine deposits formed during the westward retreat of the Boreal (or Clearwater) Sea. Sequence L, which erosionally overlies sequence K, was thought by Keeler to represent essentially continental to transitional (marine to non-marine) depositional conditions. Sequence L consists of an extremely variable assortment of lithologies, containing many facies changes and minor disconformities. Much of the sequence consists of apparently channelized (fluvial?) deposits. The upper contact is often sharp but more often is gradational into the basal marine shales (unit V) of sequence M, indicating that the uppermost sediments of sequence L may record the initial phase of a marine transgression recorded in sequence M.

Sequence M is made up of sedimentary units V, VI, VII, and VIII in Keeler's scheme. Sedimentary unit V was interpreted by him as a marine shale, units VI and VII as nearshore deposits, and unit VIII as a transitional to continental deposit. A southeast to northwest transect through the Wabasca Oil Sands area based on this interpretation (Fig. 6) indicates that the marine transgression recorded in Sequence M probably proceeded from the southeast toward the northwest and may represent the northward transgression of the Gulfian Sea into northeastern Alberta. Keeler compared the sequence of units represented in sequence M to classical models of regressive barrier sedimentation such as those outlined by Bernard, et al. (1962) and Davies et al. (1971) for the barrier island systems of the Texas Gulf Coast.

The picture of Grand Rapids sedimentation painted by most authors (e.g. Mellon 1967; Kramers, 1974, 1982; Kramers and Prost, 1986) is quite different from Keeler's (1978, 1980) view that the upper part of the Grand Rapids in the Wabasca area is related in some way to a pre-Coloradoan advance and retreat of the Gulfian Sea into eastern Alberta. Other authors attribute the regressional cycles observed in the upper Grand Rapids to waxing and waning during an overall regression of the Boreal Sea, while Keeler insisted that the facies pattern observable in the upper Grand Rapids was due to a preliminary and rather tentative advance (and subsequent withdrawal) of the Gulfian Sea from the south.

In most paleogeographic schemes, the waters of the Gulfian Sea did not invade Alberta until after the complete deposition of the Grand Rapids Formation. The Joli Fou shales represent the first deposits which record the linking of the Boreal and Gulfian seas to form the Western Interior Seaway (Fig. 7). The accompanying fauna (*Haplophragmoides gigas* and other foraminifera, and the bivalve *Inoceramus* *comancheanus*) are proof of both a marine incursion from the Gulfian sea as well as an early Late Albian age (Stelck et al., 1956; Williams and Stelck, 1975). No such diagnostic index fossils have as yet been recovered from the upper beds of the Grand Rapids (Stelck, pers. comm., 1988). Because there is no direct faunal evidence of a southern connection to Gulfian waters at the time that the sediments of the upper Grand Rapids were deposited Keeler's (1978, 1980) hypothesis of Gulfian advance and retreat into the Wabasca area during upper Grand Rapids time must remain rather contentious.

PREVIOUS STUDIES: UPPER AND MIDDLE MANNVILLE SUB-GROUP-LLOYDMINSTER HEAVY OIL AREA

The Mannville Group was originally described by Nauss (1945) from drill cores taken in the Vermilion area of east-central Alberta and was at that time given formation status. Badgley (1952) revised this stratigraphic decision on the basis of the wide lateral continuity of the unit, promoting it to the group level. By far the greatest number of geologic studies of the Mannville Group have focused on the Lloydminster heavy oil area of east-central Alberta and west-central Saskatchewan. Because in place bitumen resources are much easier to produce in this area (Mannville strata bearing heavy oil rather than tar sand), a tremendous amount of economic interest has been generated in the area by the oil industry, and has thus spurred academic interest. Although estimates of oil resources in the Lloydminster area vary, [recent estimates ranging from 20 billion bbls in place (McCrossan et al., 1981) to 60 billion bbls in place (Christopher and Knudson, 1980)], percentages of recoverable oil are much higher in the heavy oil area than in coeval tar sand deposits, and make the Mannville deposits in the Lloydminster area much more economically attractive.

Upper and Middle Mannville Depositional History: Lloydminster Area

The Mannville Group terminology as adopted in the Lloydminster area of Alberta and Saskatchewan has grown out of the terminology of Nauss (1945) and local driller's terminology. First reference to the local informal stratigraphy was provided by Edmunds (1948). Since then a number of stratigraphic schemes for the Mannville succession in this area have been proposed (see Fig. 1), although the one most frequently used by the petroleum industry at present recognizes nine stratigraphic units, comprising the Colony, McLaren, Waseca, Sparky, General Petroleums (or G.P.), Rex, Lloydminster, Cummings, and Dina formations. These units are typically marked by coarsening-upwards sequences on mechanical well logs and are generally correlatable throughout the Lloydminster area. A large number of informal stratigraphic schemes have arisen out of the basic nine-fold division of the Mannville in the Lloydminster area, owing to local studies which have sought to fine-tune the stratigraphic division in order to meet local needs. Therefore terms such as Upper Rex and Lower Rex (O'Connell, 1985) or Sparky "A", Sparky "B", Sparky "C", and Sparky "D" (Smith et al., 1984) are common in some studies, although it is generally agreed that only the nine major divisions are correlatable throughout the Lloydminster area. On the other hand, some authors (Caldwell, 1984; Putnam, 1979; Wightman et al., 1987) have argued that the nine-fold stratigraphic scheme is excessively complex. The terms Upper and Middle Mannville themselves mean different things to different people, at times making a complex stratigraphic terminology even more confusing, especially in terms of correlation of units on a regional basis. For example, some authors have argued that the Middle Mannville should include the Sparky, G.P., Rex, Lloydminster, and Cummings units, while others have argued that the Cummings should be placed within the Lower Mannville (O'Connell and Benns, 1986). Others have argued that the Lloydminster is correlatable to the upper part of the Clearwater Formation (McLean and Putnam, 1983), while still others have argued that the Lloydminster is correlatable with the basal Grand Rapids (O'Connell and Benns, 1986; see also Chapter II).

Much of the debate over the Upper and Middle Mannville has traditionally centred more on questions of paleoenvironmental interpretation than of stratigraphic nomenclature. For many years geologists argued the relative importance of continental versus marine deposition within the Upper and Middle Mannville, but a general consensus has been reached in recent years that both fluvial and paralic/marine deposits are represented within the succession. These two types of have been respectively dubbed as the "channel facies" and the "regional facies" (Smith, 1984; Smith et al., 1984; Van Hulten and Smith, 1984). Contrasting opinions have also arisen over such matters as fluvial depositional style (e.g. contrast the interpretations of Putnam, 1979; 1980; 1982a; 1982b; 1983 with those of Wightman et al., 1981, and Wightman et al., 1987), and types of nearshore deposition (e.g. Wightman et al., 1987 vs. Burnett and Adams, 1977 vs. Mathison, 1988).

Some authors, (e.g. Van Hulten, 1984) have argued that sea level changes were largely responsible for the alternate deposition of separate depositional sequences represented by each of the Mannville divisions. Other authors, although recognizing the role sea level adjustments have played in the development of the Mannville Group, have argued that these adjustments do not directly correlate to the deposition of individual formations. This subject will be dealt with extensively in Chapters II and III.

COLD LAKE AREA

Very little published information exists concerning the stratigraphy of Upper and Middle Mannville sediments in the Cold Lake Oil Sands deposit and what little does exist has been of a very general regional nature. Studies specific to Cold Lake have concentrated on the northern half of the deposit and have therefore applied the Grand Rapids/ Clearwater/ McMurray terminology developed for the Athabasca and Wabasca Oil Sands areas (Clack, 1967; Minken, 1974; Kramers, 1975; Kendall, 1977; Towson, 1977).

Although oil is found throughout the Mannville Group in the Cold Lake deposit, the bulk of in place hydrocarbon resources are found in the Grand Rapids Formation. Of the approximately 270 billion bbls of oil in place in the Cold Lake deposit, over 70% is thought to be within Grand Rapids reservoirs (Energy Resources Conservation Board, 1973). Despite this, Kramers (1975), Kendall (1977), and Towson (1977) all reported that reservoir sands have relatively poor continuity in the Grand Rapids Formation in comparison to the underlying Clearwater Formation sands. Therefore the Clearwater is at present the major exploration and development target in the northern part of the Cold Lake deposit. While Clearwater reservoirs in this area consist of rather massive sands, shale beds are common within the Grand Rapids in the Cold Lake area and serve to separate sandy reservoirs (especially within the Upper Grand Rapids), thus decreasing their attractiveness for development.

As in the Lloydminster area to the south, Upper and Middle Mannville sediments in the Cold Lake area have been interpreted as having both channelized and regional aspects. Kendall (1977) interpreted the shale beds of the Upper Grand Rapids as marine in nature and argued that they reflected initial phases of transgression prior to the inundation of the Joli Fou sea. The Grand Rapids reservoir sands on the other hand, were interpreted by Kendall as being the result of nearshore deltaic deposition within channels, as well as on beaches and point bars. Clack (1967) interpreted both the Upper and Lower Grand Rapids Formation (A and B units respectively in the terminology of Vigrass, 1968 and Clack, 1967, and equivalent to the Upper and Middle Mannville sub-groups as employed in this thesis) as being of deltaic origin. More recently this interpretation has been reiterated by Wightman et al. (1987), for the stratigraphic interval equivalent to the Upper Grand Rapids.

OBJECTIVES

Six topics will be addressed in this thesis, all of which focus in some way on unresolved or controversial problems of the Upper and Middle Mannville sub-groups. Prime in the analysis of this interval is a reconsideration of its complex stratigraphy. The lack of a consistent stratigraphic nomenclature within the Cold Lake area points out the need for reexamining and rethinking previously held conceptions about the Upper-Middle Mannville interval; for not only developing a consistent stratigraphic scheme, but for examining whether lithostratigraphic schemes are appropriate within such lithologically similar strata. In addition to stratigraphic questions, the paleoenvironmental and paleogeographic significance of Upper-Middle Mannville "regional" units (shoreface/offshore), form the basis of Chapter II.

Chapter III will examine the highly controversial topic of paleochannel systems within the Upper-Middle Mannville succession. This has been perhaps the most debated of all topics related to this interval, because of differing paleoenvironmental and paleogeographic interpretations. This chapter not only provides a new paleoenvironmental interpretation for Upper-Middle Mannville channels but also points out the importance of regional stratigraphic context in facies modelling and paleogeographic reconstruction of channelized units.

Chapter IV focuses on the ichnology of the regional units of the Upper-Middle Mannville stratigraphic interval, comparing differences in ichnologic signature between the various shoreface/offshore successions that make up these units. The purpose of the chapter is to demonstrate how these ichnologic differences are reflective of changes in paleoenvironmental conditions from one regional unit to the next over time.

Chapter V examines the occurrence of one specific ichnofossil, *Macaronichnus segregatis*, within the shoreface/offshore deposits of the Middle Mannville sub-group. This ichnospecies has often been cited as a foreshore to upper shoreface indicator in the past; its occurrence in offshore to lower shoreface sediments within the Middle Mannville demonstrates that the paleoenvironmental significance of the trace fossil should be rethought.

The micropaleontology of the Upper-Middle Mannville is examined in Chapter VI, from both a paleoecologic as well as a stratigraphic point of view. Micropaleontologic studies of basal shales of the Middle Mannville show paleosalinity trends similar to those revealed by ichnologic studies, while microfossil studies of strata bounding the Mannville/Colorado contact reveal important conclusions regarding the exact position of this boundary.

Finally, Chapter VII examines the macropaleontology of the Upper-Middle Mannville interval, specifically the taxonomy and paleoecology of gastropods from this succession. Gastropods from this interval have not been described before this study, and this contribution extends the biostratigraphic and paleogeographic range of a number of Lower Cretaceous non-marine Gastropoda previously only known from the Lower Mannville and from the Kootenai Formation of Montana (Stanton, 1903; Russell, 1932; Yen, 1949; 1951; Mattison, 1987), as well as demonstrating the paleoenvironmental and stratigraphic significance of the fauna.

NAUSS (1945)	WICKENDEN (1948)	EDMUNDS (1948)	KENT (1959)		BROWN (1965)	VIGRASS (1977)	ORR ET AL. (1977)	PUTNAM (1982a, '82b)	O'CONNELL (1985)		THIS STUDY	
O'Sullivan Mbr.	UPPER DIVISION	Colony sand	Colony Fm.		Upper McLaren unit	Colony Mbr.	Colony Fm.	UPPER MANNVILLE	UPPER	Colony unit	UPPER	Colony allomember
		McLaren sand			Lower McLaren unit	McLaren Mbr.	McLaren Fm.			McLaren unit		McLaren allomember
		Waseca sand			Waseca unit	Waseca Mbr.	Waseca Fm.			Waseca unit		Waseca allomember
Borradaille Mbr.	MIDDLE DIVISION	Sparky sand	Silverdale Fm.	Sparky Mbr.	Sparky unit	Sparky Mbr.	Sparky Fm.	MIDDLE MANNVILLE	MIDDLE	Sparky unit	MIDDLE	Sparky allomember
Tovell Mbr.		Rex sand		G.P. Mbr.	G.P. unit	G.P. Mbr.	G.P. Fm.			G.P. unit		G.P. allomember
				Rex Mbr.	Rex unit	Rex Mbr.	Rex Fm.			Rex unit		Rex allomember
										RL unit		
Islay Mbr.		Lloydmin. sand		Lloydmin. Mbr.	Lloydmin. unit	Lloydmin. Mbr.	Lloydmin. Fm.			Lloydmin. unit		Lloydmin. allomember
Cummings Mbr.		Cummings sand		Cummings Mbr.	Cummings unit	Cummings Mbr.	Cummings Fm.		LOWER	Cummings unit	LOWER	Cummings unit
Dina Mbr.	LOWER DIVISION	Dina sand	Dina Fm.			Dina Mbr.	Dina Fm.	LOWER MANNVILLE				Wabiskaw unit
										Dina unit		Dina unit
JURASSIC?												

FIGURE 1.-- Stratigraphic chart showing the development of Mannville Group nomenclature in the Lloydminster and southern Cold Lake areas. Note that terminology used in the present study extends to the northern Cold Lake area as well.

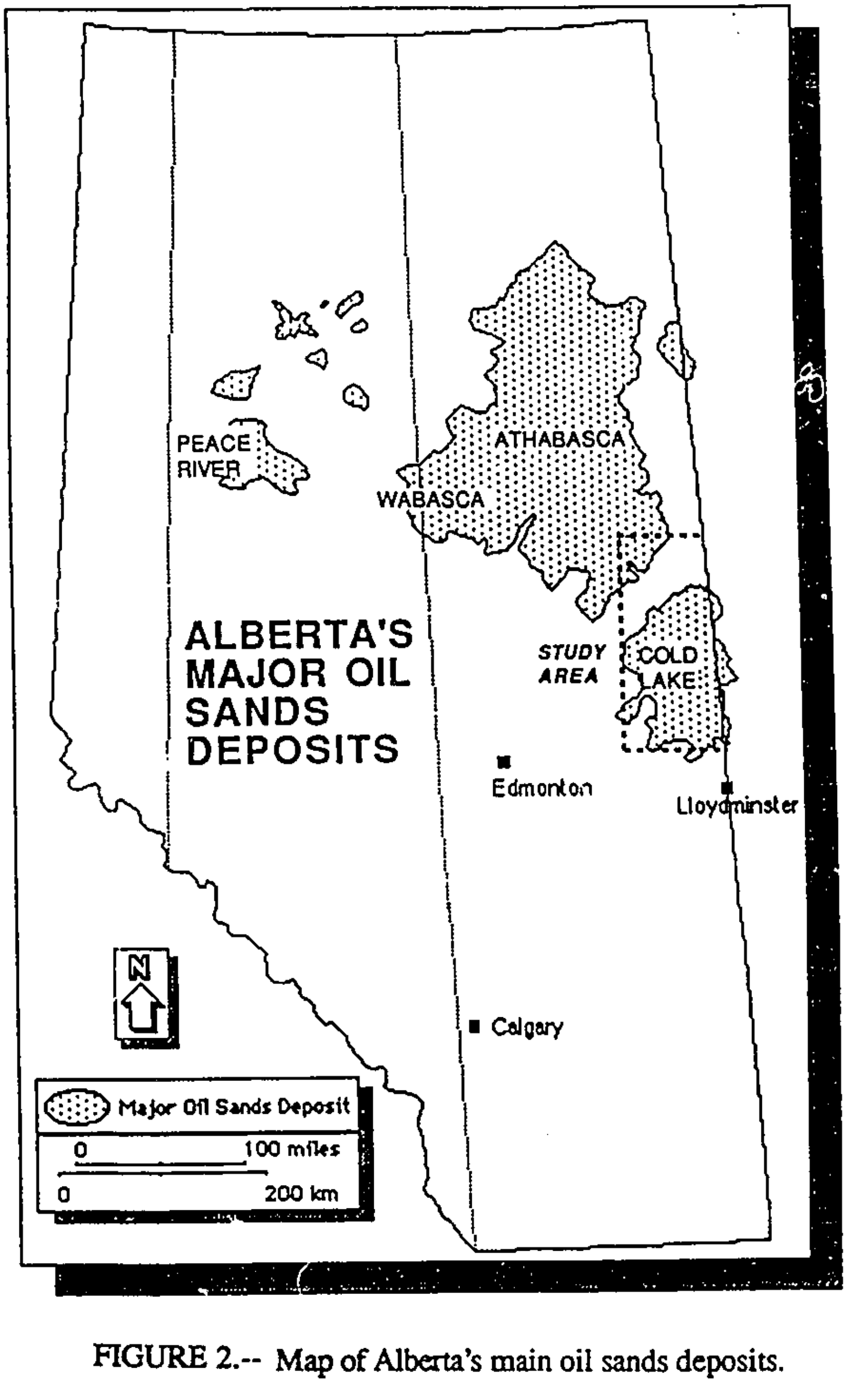

FIGURE 2.-- Map of Alberta's main oil sands deposits.

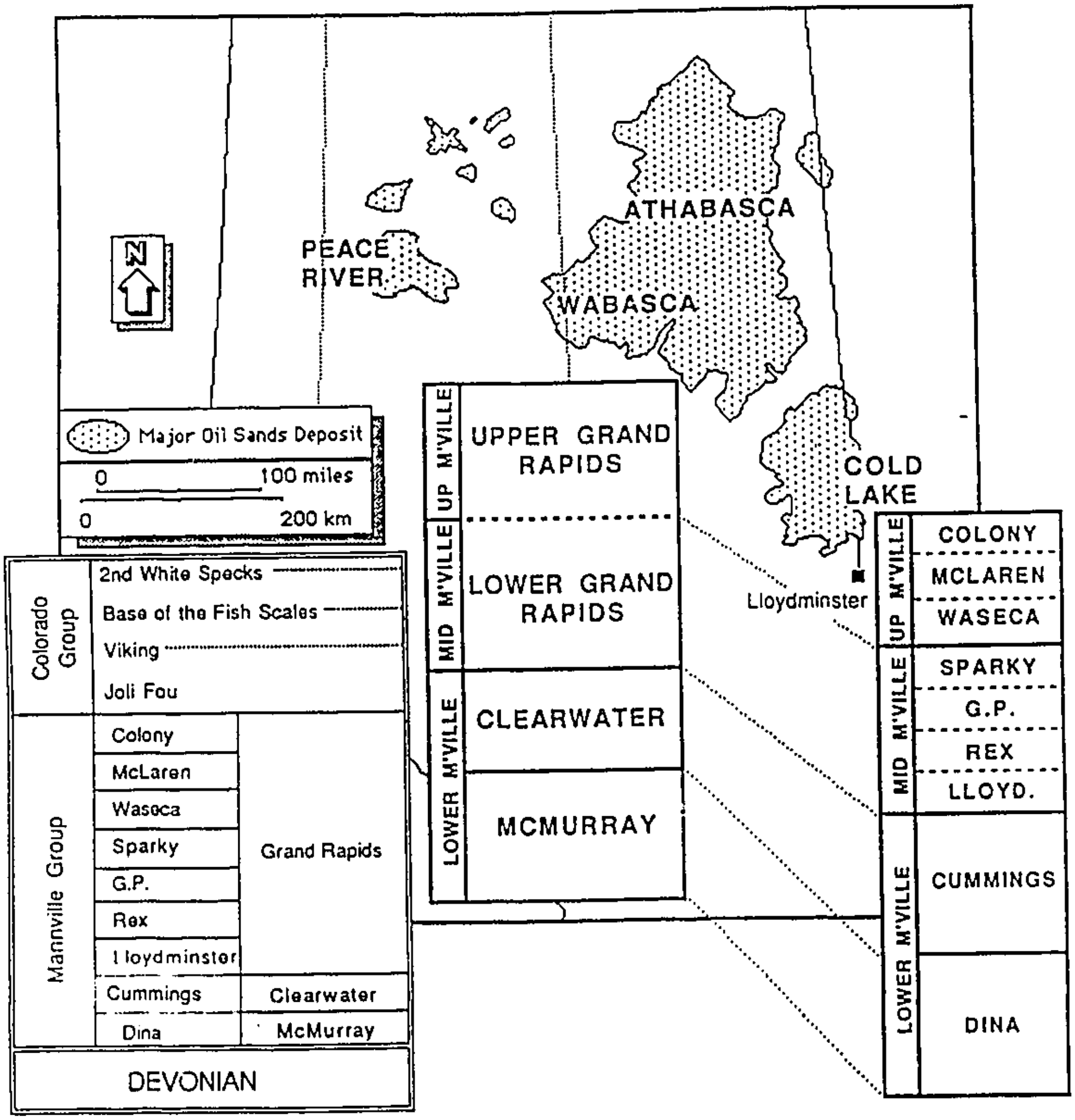

FIGURE 3.-- Dual stratigraphic nomenclatural scheme as traditionally applied in the Cold Lake Oil Sands area.

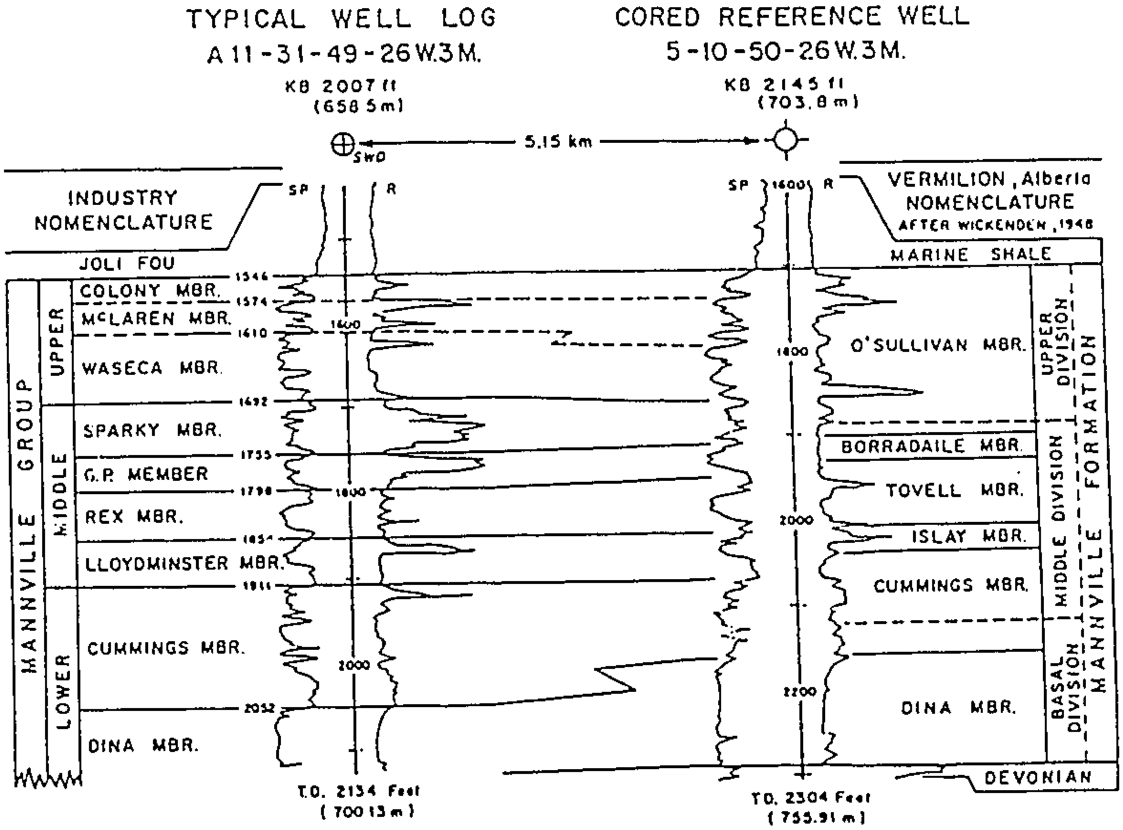

FIGURE 4.-- Correlation diagram comparing presently accepted Mannville nomenclature in the Lloydminster and Cold Lake areas with the stratigraphic nomenclatural schemes of Nauss (1945) and Wickenden (1948) (after Vigrass, 1977).

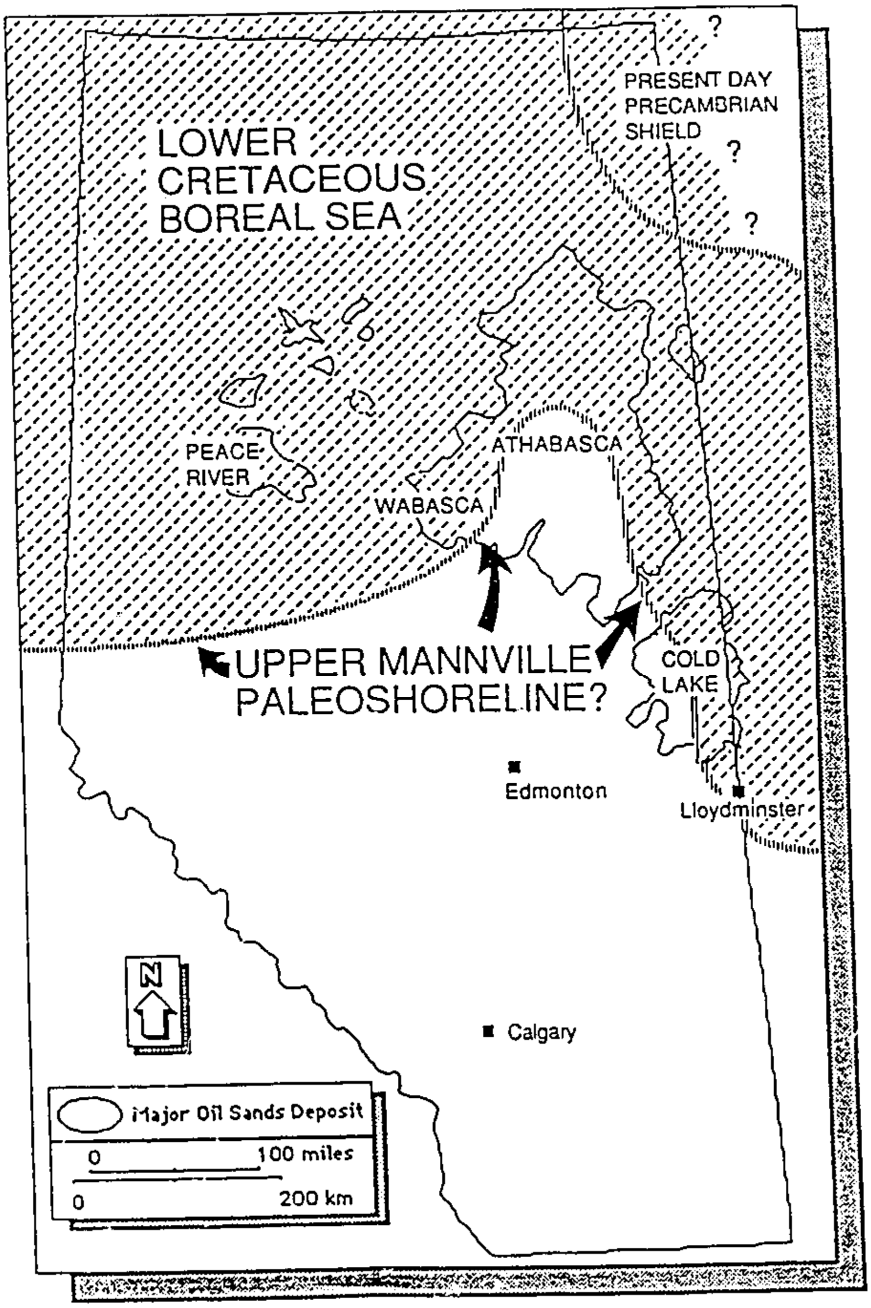

FIGURE 5.-- Hypothetical paleogeographic reconstruction of shoreline trends during Upper Mannville (Upper Grand Rapids equivalent) deposition (modified from Mossop, 1984).

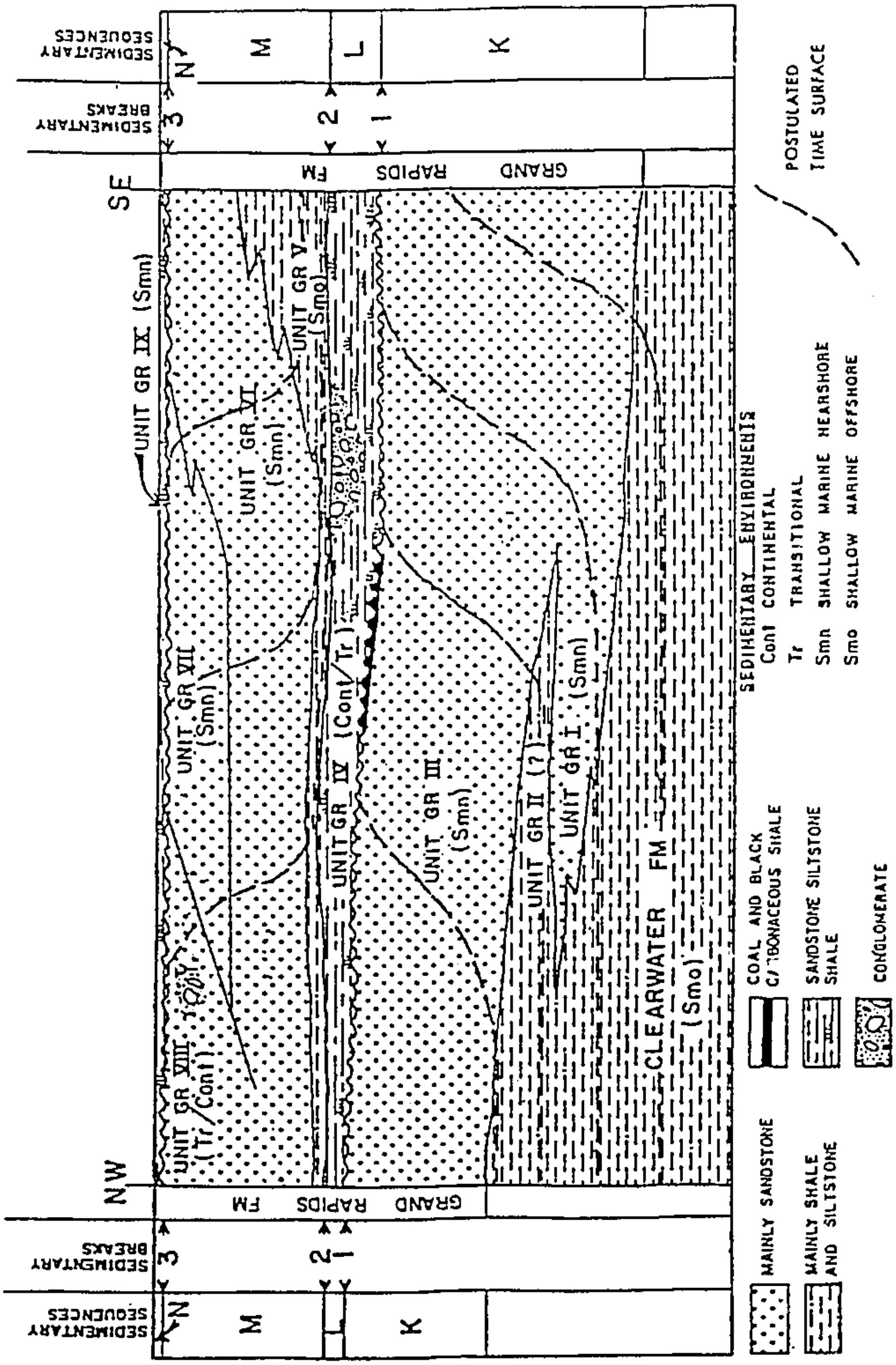

FIGURE 6.-- Southwest to northeast cross-section of the Grand Rapids Formation through the Wabasca deposit (after Keeler, 1978).

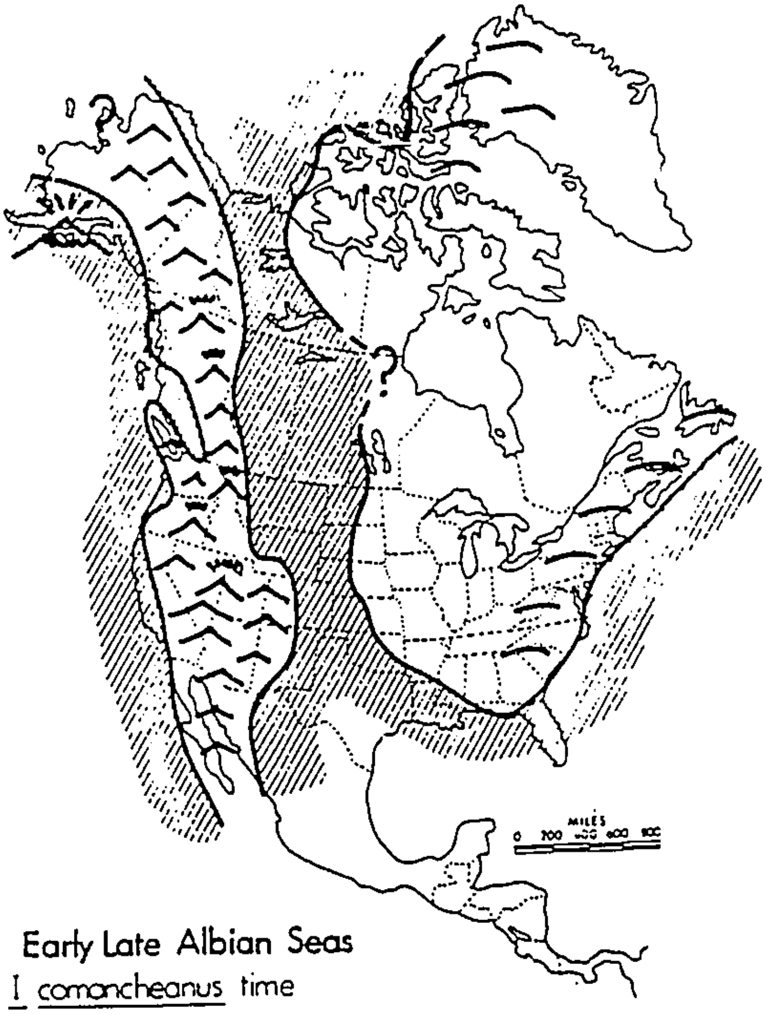

FIGURE 7.-- Paleogeographic map of the Western Interior Seaway during the time of deposition of the Joli Fou Formation (after Williams and Stelck, 1975).

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CHAPTER II

A STRATIGRAPHIC AND PALEOENVIRONMENTAL MODEL FOR THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS IN THE COLD LAKE OIL SANDS AREA OF EAST-CENTRAL ALBERTA

INTRODUCTION

The Lower Cretaceous (Late Neocomanian-Early Albian) Mannville Group of eastern Alberta and western Saskatchewan is one of the most hydrocarbon-rich stratigraphic units in the world, constituting the main reservoir for the extensive oil sands and heavy oil deposits of the Western Canadian Sedimentary Basin. The Cold Lake Oil Sands deposit in east-central Alberta is the second largest of these major oil sands areas, with reserve estimates of over 270 billion barrels of oil in place (Outtrim and Evans, 1977). However, despite a long history of exploration, published stratigraphic studies of the Mannville Group in the Cold Lake area are relatively rare. In addition, geologic studies of the Cold Lake Oil Sands deposit have been hampered by the lack of a consistent stratigraphic nomenclature for the Mannville as well as by differing opinions regarding the paleoenvironmental significance of the deposits within it (Chapter I). Using an extensive database, this study seeks to propose a revised stratigraphic and depositional environmental model for the Upper and Middle Mannville sub-groups (*sensu* O'Connell 1985; O'Connell and Benns, 1986), and attempts to understand the extreme depositional cyclicity which seems to characterize the interval in the Cold Lake Oil Sands area.

STUDY AREA AND DATA BASE

The area of investigation is shown in Figure 8. Exactly 1100 logged wells were chosen for this study, based on a maximum of one well per section. In addition, 304 of these wells contained good quality cores through the Upper and Middle Mannville interval, which were examined in order to facilitate stratigraphic and paleoenvironmental interpretations (Appendix 3).

TECTONIC SETTING

The Mannville Group in east-central Alberta sits unconformably above Upper Devonian carbonates along a surface generally referred to as the pre-Cretaceous unconformity (Fig. 9). The unconformity surface has a highly variable topographic expression, with local relief varying up to 150 m in some areas (Orr, et al., 1977). This extreme relief is thought to be due mostly to differential erosion of underlying Devonian carbonates along the unconformity surface. However, much of the topographic expression of this surface has also been shown to result from solutioning of Mid-Devonian salts (Prairie and Muskeg formations--Edmunds, 1980; Wilson, 1984). Salt solution occurred both prior to and synchronous with deposition of the Mannville Group (continuing to the present day), and is largely responsible for structural trapping of oil within the major oil sands deposits (Orr et al., 1977; Vigrass, 1977; Edmunds, 1980). The southeastern edge of the Cold Lake Oil Sands area lies within a low on the unconformity surface known as the Lloydminster sub-basin (Smith et al., 1984; Van Hulten, 1984) which was confined on the west and south by a northwest-southeast trending Paleozoic ridge (the Wainright ridge) and on the east by the Precambrian Shield (Fig. 10). Regional isopach maps of the Mannville in east-central Alberta and west-central Saskatchewan indicate that the sub-basin was deeper in the north than in the south and thus the paleotopography of the subbasin was one of a ramp rising from north to south along the sub-basinal axis.

TRADITIONAL STRATIGRAPHIC NOMENCLATURE

Mannville Group stratigraphic nomenclature is notorious for its lack of consistency from one area of Western Canada to the next, and nowhere is this more true than in east-central Alberta (Cant, 1990). Because exploration of the Mannville in eastern Alberta began not in the Cold Lake Oil Sands area itself but in outcrop areas to the northwest (Wabasca and Athabasca oil sands areas- McConnell, 1893) and through subsurface exploration in the south (Lloydminster heavy oil area- Nauss, 1945; 1947; Edmunds, 1948; Fuglem, 1970), two different lithostratigraphic nomenclatural schemes for the group have been extended into the Cold Lake area by various workers (e.g. Minken, 1974; Kendall, 1977; Orr et al., 1977; Putnam and Oliver, 1980). This has made a rather complex stratigraphic puzzle even more confusing, with a division of the Mannville into three lithostratigraphic divisions in the northern half of the Cold Lake deposit (Grand

Rapids, Clearwater, and McMurray formations) and nine in the southern half (Colony, McLaren, Waseca, Sparky, General Petroleums, Rex, and Lloydminster, Cummings, and Dina formations) (Chapter I). Other informal stratigraphic nomenclatures have been applied to the Mannville in the Cold Lake area, including the terms Upper and Lower Grand Rapids (Kendall, 1977), and the alphabetic scheme of Mannville A, B, C, and D divisions (Clack, 1967; Vigrass, 1968; Smith et al., 1984). However, it has been convincingly argued in other studies (Putnam, 1979; Caldwell, 1984; Wightman et al., 1987) that most of the Mannville displays such lithologic homogeneity (consisting essentially of fine-grained sands and shales) that there is little justification for extensive lithostratigraphic division. In light of this it is suggested that only three informal lithostratigraphic divisions be recognized within the Mannville, these being at the sub-group level (i.e. Upper, Middle, and Lower Mannville sub-groups). Although these terms have been used by different authors to refer to various stratigraphic intervals in the past, (see Putnam and Oliver, 1980; Wightman et al., 1987; Cant, 1990) the scheme used in this paper most resembles that suggested by O'Connell (1985), and O'Connell and Benns (1986) (Chapter I; Figs. 1 and 2).

THE STRATIGRAPHIC NOMENCLATURAL DILEMMA

Detailed stratigraphic correlation (Appendix 2: Figs. 47-61) reveals that the nine major units recognized in the Lloydminster Heavy Oil area (Edmunds, 1948; Fuglem, 1970) and in the southern half of the Cold Lake Oil Sands deposit (Orr et al., 1977; Gross, 1980; Mathison, 1988) are in fact traceable throughout the full extent of the Cold Lake Oil Sands area. Therefore it is suggested that there is no reason to continue the stratigraphic nomenclatural dichotomy that has existed for many years in the Cold Lake area. The so-called Lloydminster stratigraphic nomenclature (Colony, McLaren, Waseca, Sparky, General Petroleums, Rex, Lloydminster, Cummings, and Dina units) works well throughout the Cold Lake deposit in that it recognizes the inherent stratigraphic diversity within the Mannville Group as a whole and more specifically as this applies to the Upper and Middle Mannville sub-groups. It must be remembered, however, that these units are recognized on the basis of their stratigraphic position rather than on the basis of their lithic distinctiveness.

Many authors (see Caldwell, 1984 for an example) have commented on the difficulties in correlating the nine units of the Mannville recognized in the Lloydminster area on both a local and on a regional scale. These problems are due to the fact that the regional components of each of these units bear such lithic similarity to one another that correlation problems are inevitable. It is proposed that because these units lack the criteria of lithic uniqueness necessary for recognition as *lithostratigraphic* units (set forth in Article 22 of the North American Stratigraphic Code; NACSN, 1983), any lithostratigraphic implication to these names (i.e. member or formation status) should be abandoned. In other words the seven units of the Upper-Middle Mannville interval should be regarded simply as "units" (following the terminology of Brown, 1965, and of O'Connell, 1985, among others), rather than assuming formal lithostratigraphic status.

ALTERNATE STRATIGRAPHIC SCHEMES

On what basis, then, can these units be consistently correlated, and how can the boundaries between them be consistently recognized? I propose that each of the seven units of the Upper and Middle Mannville is bounded by regional unconformities which are subtle but which are ultimately recognizable on a regional basis. Recognition of these unconformities qualifies each of the seven Upper and Middle Mannville regional units as distinct stratigraphic *sequences* (following the definition of Van Wagoner, et al., 1988).

Much of the rest of this discussion will focus on this sequence stratigraphic redefinition of Upper-Middle Mannville stratigraphy, specifically on how the bounding unconformities within it have been recognized, and on the problems associated with strictly applying the concept.

A note on sequence stratigraphic terminology

Unconformity-bounded stratigraphic units have in the past been referred to as sequences (Wheeler, 1958, 1959a, 1959b; 1964) and they continue to be referred to in this way by an extensive school of stratigraphic researchers (Mitchum et al., 1977; Van Wagoner et al., 1988). The International Commission on Stratigraphic Classification

(1987) has pointed out a number of problems with using this terminology, however, since the term sequence has also had different meanings in both past and present stratigraphic literature (e.g. "Sloss sequences"--Sloss, 1963; 1988; Ricketts, 1990). The ICSC (1987) followed the terminology of Chang (1975; 1981) in choosing the term *synthem* to refer to unconformity-bounded stratigraphic units. The North American Commission on Stratigraphic Nomenclature has preferred to use the term *allostratigraphic unit* (North American Stratigraphic Code, Article 58; NACSN, 1983) to refer to units bounded by discontinuities, but recent inconsistencies in the literature as to the exact definition of these "bounding discontinuities" points to difficulties in applying the concept (see Walker, 1990, p. 780-781)]. Synthems and allostratigraphic units also differ from the depositional *sequences* of Mitchum et al. (1977) and Van Wagoner et al. (1988) in that they are only recognized as far as their bounding discontinuities are identifiable, while depositional sequences are defined as being bounded as well by their correlative conformities (Baum and Vail, 1988).

A note on the use of the term *unconformity*

The term unconformity as employed in the present study conforms to the definition of Van Wagoner et al. (1988; p. 39); i.e. "a surface separating younger from older strata, along which there is evidence of subaerial erosional truncation (and in some areas, correlative submarine erosion) or subaerial exposure, with a significant hiatus indicated". Furthermore, all of the unconformities discussed herein conform with the definition of Type 1 sequence boundaries (Fig. 11) also defined by Van Wagoner et al. (1988; p. 41) in being "characterized by subaerial exposure and concurrent subaerial erosion associated with stream rejuvenation, a basinward shift of facies, a downward shift in coastal onlap, and onlap of overlying strata". These Type 1 sequence boundaries are differentiated from Type 2 sequence boundaries, which are not marked by basinward facies shifts nor by channel incision (Van Wagoner et al., 1988; Posamentier et al., 1988; Posamentier and Vail, 1988).

SEQUENCE STRATIGRAPHY OF THE UPPER AND MIDDLE MANNVILLE

On a regional basis, the Upper and Middle Mannville interval generally consists of a number of stacked coarsening-upwards successions (CUS's) interpreted as progradational shoreface to offshore clastic wedges. In sequence stratigraphic parlance these CUS's are referred to as parasequences and are defined by their bounding marine flooding surfaces. Parasequences are reflective of small-scale relative sea level variations and may be a result of either autocyclic or allocyclic processes. Because of this they can be highly localized, or they may be regionally continuous. In the case of coastlines which have a significant deltaic component, in which lobe switching may be a major part of depositional style, multiple local parasequences may develop in deltaic areas and may be traceable into a single regional parasequence in areas not marked by deltaic deposition. The above scenario seems to have been active during Upper-Middle Mannville time, and, as a result, extreme difficulties in correlation of parasequences are encountered. Correlation of parasequences is best handled on a local study basis under these conditions (see Mathison, 1988 for an example from the Upper Mannville).

Regional studies such as the present one are better equipped to recognize the bounding unconformities which define stratigraphic sequences. Sequences are also more logical subdivisions for regional stratigraphic schemes because of the problems of regional correlation of parasequences and because sequences are by definition time-bounded while parasequences are not.

In some cases the recognition of the unconformities which define the sequences of the Upper and Middle Mannville interval is fairly obvious, but in other cases these unconformities are more subtle. Unconformity recognition is based on two sets of observations:

- Disconformities between Upper and Middle Mannville units are easily recognizable in cases where the tops of these units show evidence of subaerial exposure (e.g. root zones) and erosion and where these units are overlain by marine shales. In some cases, however, subaerial exposure surfaces are missing and erosion is thought to have also occurred during subsequent transgressive scouring. In these cases, the bounding horizons represent both unconformities and ravinement surfaces (Fig. 12). In many cases ravinement has destroyed much of the evidence of subaerial exposure and disconformable surfaces are much more difficult to recognize (Nummedal and Swift, 1987).

- All of the seven stratigraphic units of the Upper and Middle Mannville have a network of deep incised channels associated with them that cut down from their uppermost surfaces (Chapter III). The recognition of these incised channels is key to the recognition of sequences within the Upper and Middle Mannville, since it is these incised channels that generally define the unconformities, especially in cases where ravinement of paralic deposits has destroyed evidence of subaerial exposure. It is proposed that channel incision occurred due to a significant drop in sea level near the end of each individual progradational cycle. The detailed local cross-sections in Figs. 13-20 illustrate examples of deep channel incision associated with each of the Upper and Middle Mannville unconformities while the cross-sections in Appendix 2 (Figs. 47-61) illustrate the extent and variability of channel incision on a regional basis.

Problems in applying the sequence concept

Relationship between stratigraphic units and sequences

It is important that a clear distinction be drawn between the seven traditionally recognized stratigraphic units of the Upper and Middle Mannville and the seven regional sequences that comprise this interval. The stratigraphic units have been defined on the basis of regional strata (either single coarsening-upward successions or sets of CUS's) that are traceable throughout much of east-central Alberta. The definition of these stratigraphic units (whether they were recognized in the past as members or as formations) has not included a consideration of the incised channels. Where incised channel-fill successions have been previously recognized within the Upper and Middle Mannville, they have been referred to as being associated with the uppermost of the units into which they cut (Fig. 21A). Hence terms such as "McLaren channels" and "Waseca channels" have arisen (see Mathison, 1988; and Kramers et al., 1990). In contrast, the technical definition of a stratigraphic sequence encompasses all the strata between two subaerially formed unconformities (and their associated marine conformities). Incised channel fills therefore generally represent the basal components of stratigraphic sequences (Fig. 21B).

Figure 21 details the relationship between traditional stratigraphic terminology for the Upper and Middle Mannville and a parallel sequence stratigraphic scheme. Within the areas in which regional strata dominate, these sequences are for the most part equivalent to the regional stratigraphic units. Therefore, for example, regional Sequence 1 is roughly equivalent to the regional Colony unit and regional Sequence 2 is roughly equivalent to the regional McLaren unit. In areas in which incised channels dominate, however, the relationship breaks down. For example, Sequence 1 includes within it incised channel-fill deposits (referred to as Sequence 1 incised channel-fill deposits) that cut down from the top of Sequence 2; in tradtional stratigraphic schemes these channel-fill deposits would be referred to as McLaren channels.

Although there is a definite need for a sequence stratigraphic reevaluation of the Upper and Middle Mannville, traditional terminology for both regional deposits and for channel deposits is herein retained, in order to avoid unneccessary confusion and to maintain a sense of continuity with previous uses of stratigraphic terminology. This may create some nomenclatural confusion unto itself, since a sequence stratigraphic subdivision of the Upper-Middle Mannville interval means that (for example) "Waseca channels" are bounded within the same sequence as regional McLaren strata. Because this is also to some degree a genetic association, Waseca channels are herein dubbed as "McLaren sequence associated Waseca channels".

No matter what names are given to these units, it must be remembered that in recognizing the seven stratigraphic units which comprise the Upper and Middle Mannville Group in the Cold Lake Oil Sands area it is technically more correct to regard these units as stratigraphic sequences, since the cyclic and repetitive nature of reccurring lithofacies within the succession dictates that lithostratigraphic principles cannot be strictly applied. Therefore, the traditional stratigraphic names as employed herein refer to regional, mappable units, which are defined on the basis of their bounding unconformities in non-channelized successions. As will be demonstrated, channelized successions are more difficult to fit into any stratigraphic scheme, be that scheme lithostratigraphic, or sequence stratigraphic, but are, nonetheless, referred to informally by the conventions outlined above.

Uncertainty of unconformity delineation within incised channel systems

While regional correlation of the uppermost surfaces of incised channel fill successions with the tops of regional coarsening-upward successions defines the tops of those successions as unconformities rather than as parasequence boundaries, defining unconformities in channelized successions may be much more difficult.

For instance, in areas in which *exceptionally* thick channel successions are preserved, there is always the possibility that multiple incision events, associated with the creation of a number of unconconformities, may have occurred. Sorting out whether multiple incision and fill events have occurred (rather than a single cut and fill event) is rarely possible, however, due to the effects of amalgamation of channelized deposits (channel stacking). Therefore, resolution of the limits to sequences in areas in which incised channels are important becomes exceedingly problematic (see Chapter III).

Incised channels associated with the Mannville-Colorado boundary

In the above discussion I have shown that the Upper-Middle Mannville interval within the Cold Lake Oil Sands deposit can be divided into seven regional stratigraphic sequences. However, an eighth sequence is possible, composed of the incised channel-fill deposits found at the top of the Upper Mannville. As pointed out in Chapter VI, the boundary between the Mannville and the Colorado has been shown to represent an extensive regional unconformity, that may represent a time gap equivalent to the entirety of Middle Albian time. However, the relationship between the incised channel-fill deposits at the top of the Mannville and the overlying shales of the Joli Fou Formation of the Colorado Group has never been established. It is possible that the unconformity that separates these channel-fill deposits from the regional deposits of the Colony unit may have been followed by another unconformity event after channel fill was completed. In that case the uppermost surface of the channel-fill would represent another unconformity surface and the channel-fill itself would represent a separate sequence (tentatively referred to as Sequence 0). On the other hand, channel infill may not have been initiated until the initial stage of the Joli Fou transgression. In this case the channel fill deposits are not separated from the black shales of the Joli Fou by an unconformity and may be better regarded as basal Colorado deposits (Fig. 21B). As well, the time gap between deposition of the regional Colony deposits and the incised channel fill deposits would be very extensive. In the absence of biostratigraphic evidence, it may be impossible to determine which of these hypotheses is correct.

Are channelized valley-fill successions sequences unto themselves?

Uncertainty as to whether the so-called Colony channels may be considered as the uppermost sequence of the Mannville Group, or may be considered as basal deposits of the Joli Fou transgression, begs the question of whether other incised valley-fill successions might constitute stratigraphic sequences unto themselves. For instance, rooted coals are almost always present at the top of every one of the eight valley-fill successions within the Upper-Middle Mannville interval and these are almost always directly overlain by transgressive marine strata. Does the presence of these rooted coals indicate that there was enough evidence of subaerial exposure at these surfaces to constitute the "significant hiatus" (prior to full-scale transgression) required for recognition of these surfaces as unconformities? In light of these seemingly irresolvable questions it is best to address sequence stratigraphic relationships within valley-fill successions separately from the sequence stratigraphy of their regional counterparts, other than in using the upper surfaces of valley-fill successions as guides to demarcating regional unconformity surfaces in regional strata.

The "Lloydminster problem"

The detailed local cross-sections found in Figures 13-20 illustrate the evidence for deep channel incision associated with each of the eight unconformity surfaces within the Upper-Middle Mannville interval. In the case of the Colony, McLaren, Waseca, Sparky, G.P., and Rex channel systems there is convincing drill core evidence to support the contention that these channel systemes are in fact *incised* channels which developed as a response to base level drop and which were later infilled during base level rise. This rule of good core control is broken in the case of channel systems which cut down from the top of the Lloydminster unit, since little economic interest has been shown in the Lloydminster and it has only rarely been cored. Therefore, only one cored example of a Lloydminster channel could be found in juxtaposition with regional shoreface-offshore successions (Fig. 13), and only the uppermost section of the channellized succession at that. Gamma ray logs indicate a number of other incised channels cutting down from the top of the regional Lloydminster into the regional Cummings unit, but drill core evidence for an unconformity at the top of the Lloydminster is not as extensive as for the other unconformity surfaces within the succession.

Other evidence of depositional cyclicity within the Mannville Group

Depositional cyclicity is not confined to the Upper and Middle Mannville but occurs throughout the entire Mannville Group. Recent work by Taylor (1990) has shown that recognition of incised channels is important in defining depositional sequences and bounding unconformities within the Clearwater Formation (Cummings unit equivalent) of the Lower Mannville in the Cold Lake area as well. Extreme depositional cyclicity, with associated unconformity creation, might then be thought of as the main defining characteristic of the Mannville Group within the Cold Lake Oil Sands area.

At least three of the unconformities recognized within the Upper-Middle Mannville interval have previously been suggested (either directly or indirectly) by research conducted in west-central Saskatchewan and east-central Alberta. In many cases the definition of these unconformities has been based on the recognition of incised channels. Brown (1965), Vigrass (1977), and Smith, et al. (1984) all proposed that channelized erosional downcutting from the top of the Sparky unit was associated with a widespread unconformity, and Gross (1980) and Mathison (1988) recognized that the upper surfaces of the McLaren and Waseca units in east-central Alberta were also unconformities based on the occurrence of incised channels. Gross (1980), in fact, recognized that incised channel systems were associated with all of the units of the Mannville in eastern Alberta.

Nevertheless, the full extent of the disconformities found in the Upper and Middle Mannville has never been fully explored prior to this study, nor has the role that relative base level change has played in shaping the depositional history of this interval.

UPPER-MIDDLE MANNVILLE REFERENCE SECTIONS (REGIONAL STRATA)

Each of the regional units of the Upper and Middle Mannville changes facies character from place to place within the study area, partly due to the existence of local parasequences within them, and partly as a result of deep channel incision and subsequent infill.

Two cored wells were selected as reference sections in order to redefine the stratigraphy of the Upper-Middle Mannville interval in terms of sequence stratigraphic criteria; one for the Middle Mannville (Husky Tucker Lake 13-21-64-4W4), and another closely adjacent well for the Upper Mannville (Husky Tucker Lake 10-19-64-4W4). These wells were selected based on completeness of section, on level of broad representation of depositional facies within the regional units of the interval, and on the basis of non-display of evidence of incised channel deposits.

Middle Mannville (Husky Tucker Lake 13-21-64-4W4; Fig. 22)

Lloydminster unit

In this well the basal Lloydminster is made up of black to dark grey shales, which directly overlie fine-grained oscillation-rippled sands of the Cummings unit along a sharp (erosional) contact. The blackest of the basal shales appear to be unbioturbated, while some of the grey shales are highly burrowed, displaying a form of cryptobioturbation in which no distinct ichnofossils are preserved. Interbedded sands and shales in this interval display a diverse ichnocoenose, however, including *Chondrites*, *Zoophycos*, *Teichichnus*, and *Planolites*. The interval is interpreted as representing a shallow inner shelf environment in which alternating dysaerobic and aerobic conditions prevailed. The basal shales of the Lloydminster are overlain by interbedded bioturbated shales and very fine-grained unbioturbated sands displaying a highly diverse ichnocoenose made up of *Zoophycos*, *Asterosoma*, *Teichichnus*, *Chondrites*, *Planolites*, and *Ophiomorpha*, and interpreted as lower shoreface deposits. These interbedded sands and shales grade upward into low angle fine-grained sands containing a less diverse ichnocoenose consisting of *Teichichnus* and *Ophiomorpha*. These sands in turn grade up into cross-bedded, unbioturbated medium-grained sands interpreted as upper shoreface deposits. The upper surface of this sand displays a sharp contact with the overlying Rex unit.

Rex unit

Two coarsening-upwards successions are found within the Rex in this well. The CUS begins with a thin, moderately bioturbated, dark grey shale containing *Chondrites*, which is directly overlain by a fairly thick section of interbedded dark grey shales and massive to low angle medium-grained sands containing abundant carbonaceous detritus. Degree of bioturbation is highly variable within this interval, ranging from unbioturbated to highly bioturbated in a thin interbedded zone near the top of the interval which contains *Asterosoma*, *Planolites*, *Zoophycos*, and *Cylindrichnus*. This interbedded zone is thought to represent lower shoreface deposits which grade upward into low angle medium-grained sands thought to represent upper shoreface deposits.

A sharp contact separates the lower CUS of the Rex from the much thicker upper CUS. This upper succession begins with a 1 m interval of interbedded sands and moderately bioturbated shales containing abundant *Asterosoma* as well as *Ophiomorpha*, *Teichichnus*, and *Planolites*, and grades up into a thick section of hummocky cross-stratified sands in turn grading from very fine- to fine-grained. This thick sand section contains scattered horizontal *Ophiomorpha*, and is interpreted as representing lower shoreface conditions. It is overlain by medium-grained trough cross-stratified sands interpreted as middle shoreface deposits, and further overlain by hummocky cross-stratified medium-grained sands thought to represent upper shoreface deposits. A sharp contact at the top of this uppermost sand separates it from a 70 cm thick unbioturbated grey shale which may represent lagoonal or coastal plain deposits.

General Petroleums unit

Another sharp contact at the top of the Rex marks its interface with the General

Petroleums unit. In this well the G.P. does not appear to coarsen upwards but does contain some shale clasts near its base. The remainder of the G.P. contains very fine-grained, unbioturbated sand. Since a thin coal appears at the top of the G.P., the unit is interpreted as a lower to upper shoreface succession. The coal at the top of the G.P. separates it from the Sparky unit.

Sparky unit

In many cases, the Sparky consists of a number of coarsening-upwards successions (e.g. see Smith et al., 1984; Smith, 1984; Haidl, 1986; Mathison, 1988). In this case, however, only one CUS is found within the unit. The base of the Sparky consists of moderately- to highly-bioturbated, light to medium grey shales with some minor admixed sands. The interval is dominated by *Chondrites* and *Planolites* accompanied by *Palaeophycus*, *Teichichnus*, *Terebellina* and *Zoophycos*. The remaining shoreface succession of the Sparky CUS shows evidence of being influenced by alternating storm and non-storm deposition. Lower shoreface deposits consist of oscillation-rippled and cross-bedded fine-grained sands interbedded with shales containing *Skolithos* and *Planolites*. Some of the cross-bedded sands contain shale clasts. Upper shoreface deposits in the Sparky are hummocky cross-stratified for the most part but contain interbedded, moderately bioturbated shales with *Planolites* and *Chondrites*. Trace fossil assemblages within the thin shales may indicate opportunistic behaviour of infauna following a storm event (indicated by the hummocky cross-stratified sands) (see also Chapter IV). The top of the Sparky displays a sharp contact with dark grey shales of the basal Waseca.

Upper Mannville (Husky Tucker Lake 10-19-64-4W4; Fig. 23)

Waseca unit

In this well the Waseca overlies Sparky hummocky cross-stratified sands correlative with those of the Husky Tucker Lake 13-21-64-4W4 well (used as a reference section for the Middle Mannville), along a sharp contact. The basal Waseca consists of highly bioturbated silts (with *Chondrites*, and small forms of *Teichichnus* and *Zoophycos*), which grade into interbedded oscillation-rippled sands, silts, and bioturbated shales containing *Planolites*, *Cylindrichnus*, small *Teichichnus*, and *Chondrites*. This interbedded section further grades into another section of rhythmically interbedded silts and fine-grained sands, some of which are glauconitic, some of which display synaeresis cracks, and all of which display oscillation-ripples. Degree of bioturbation is low and bioturbated intervals are restricted to specific horizons. The section is interpreted as representing embayed shoreface to basinal conditions. As in the case of the Sparky Formation below, this embayment section shows evidence of alternating storm and non-storm depositional conditions in its sedimentary structures as well as in its constituent ichnofauna (which consists of *Cylindrichnus*, *Gyrolithes*, *Planolites*, and *Palaeophycus*). The interbedded silts and sands are in sharp contact with overlying hummocky cross-stratified to oscillation-rippled fine-grained sands (containing carbonaceous detritus and wood above), which are interpreted as shoreface sands. A thin carbonate-cemented zone is found in the middle of this shoreface succession.

The basal CUS of the Waseca is overlain by a second CUS that again is composed of highly bioturbated silts and admixed glauconitic sands at its base. Only moderate bioturbation levels are found throughout this basal section, although ichnologic diversity is strong. The dominant ichnocoenose is composed of small size representatives, including *Planolites*, *Chondrites*, *Cylindrichnus*, *Arenicolites*, *Zoophycos*, and *Terebellina*. The basal bioturbated silts and sands grade upward into interbedded oscillation-rippled silts and sands containing rare traces of bioturbation, synaeresis cracks, and rarely, siderite, separated by thin beds of moderately to highly bioturbated silts. As in the case of underlying units which display similar facies associations, this lithofacies is interpreted as being a product of alternating storm and non-storm conditions within an embayment. Again, the evidence for this lies in the interpretation of an opportunistic ichnocoenose in some of the interbedded sediments. In this case these ichnofossils include *Chondrites*, *Teichichnus*, *Cylindrichnus*, *Skolithos*, *Planolites*, *Palaeophycus*, and *Gyrolithes*. Interbedded sands and shales grade upward into alternating beds of bioturbated shales and either interbedded oscillation-rippled silts and very fine-grained sands or else non-interbedded very fine-grained sands. Sharp contacts separate the bioturbated shales from the coarser-grained beds giving further evidence of alternating non-storm and storm deposition.

This interbedded section in turn grades upward into hummocky cross-stratified very fine-grained sands further overlain by oscillation-rippled very fine-grained sands, interpreted as representing shoreface conditions. As in the case of the shoreface sands of the basal CUS of the Waseca, a thin carbonate cemented zone is found in the middle of the section. A sharp contact separates these sands from the overlying McLaren unit.

McLaren unit

The McLaren unit consists of a single CUS which at its base consists of alternating black to dark grey shales that display no bioturbation and which are interpreted as representing dysaerobic depositional conditions. These are overlain by highly to moderately bioturbated silts with some thin sand stringers and one 0.5 m thick hummocky cross-stratified fine-grained sand. These deposits display some indication of an opportunistic ichnocoenose (*Chondrites*, *Planolites*, *Cylindrichnus*, *Gyrolithes*), and are interpreted as representing embayment conditions. The section is sharply overlain by a fairly thick (3.5 m) section of hummocky cross-stratified very fine-grained sands which is thought to represent a shoreface environment. A sharp contact separates this sand from the second CUS above it.

Colony unit

The Colony unit is usually the thinnest of all of the units of the Upper-Middle Mannville interval. In this case it consists of a thin basal bioturbated shale with synaeresis cracks, which grades upward into interbedded bioturbated shales and oscillation-rippled very fine-grained sands. The trace fossil assemblage within this succession again indicates opportunistic behaviour, with *Chondrites*, *Planolites*, *Skolithos*, *Cylindrichnus*, *Palaeophycus*, and *Gyrolithes* (Chapter IV). As in similar facies of the McLaren, Waseca, and Sparky units, this section is interpreted as representing embayment conditions. The upper CUS shows evidence of truncation of its upper surface, however, as a very thin fine-grained sand containing a pebble horizon directly overlies the upper CUS along a very sharp contact. This thin sand is interpreted as a transgressive lag deposited during the initial onset of the Joli Fou transgression. The contact between the upper CUS of the Colony and this transgressive sand is interpreted as a ravinement surface. The transgressive lag is directly overlain by the distinctive black shales of the Joli Fou Formation, although the contact between the Colony and the Joli Fou is obscured by a carbonate-cemented zone (see also Chapter VI).

MAPPING OF REGIONAL UNITS

Structure and Isopach Maps (Figs.62-85)

Much of the structure of the units of the Upper and Middle Mannville sub-groups is a reflection of the structural attitude of the Devonian unconformity surface (Fig. 62). Within the study area, the main structural elements of this surface include the Lindbergh High (centred around T55-R6W4), and the salt solution low (see Fig. 10) which runs along most of the eastern edge of the study area, a series of smaller structural highs which run in a northeast-southwest line from T68-R4W4 to T63-R8W4, and some isolated structural lows which run parallel to the western edge of the salt solution low.

The structure of the Devonian unconformity surface is especially important in its effect on the units of the Lower Mannville (Figs. 63-65), but its effect diminishes upward through the seven units of the Upper-Middle Mannville interval (Figs. 66-72). Structural and isopach maps of the various units of the Mannville (Figs. 63-85) partially reflect the structural drape of successive units over top of one another, but anomalous thicks and thins in isopach maps and anomalous values in structure maps in the units of the Upper-Middle Mannville interval are thought to demonstrate the effect of the unconformable nature of these units due to differential erosion and subaerial exposure of their uppermost surfaces (Figs. 79-85). All of the units of the Upper-Middle Mannville interval demonstrate some erosional relief, but this is most apparent in isopach maps of the Sparky, McLaren, and Colony units. This may indicate that differential erosion through subaerial exposure may have been particularly well developed following the deposition of each of these units (see Brown, 1965; and Vigrass, 1977 for a discussion of the significance of the Sparky unconformity, as well as Chapters III and VI, for discussions of the McLaren and Colony unconformities).

Net Sand Trends (Figs. 86-94)

Net sand maps were created for each of the regional units of the Upper and Middle Mannville in order to try and determine the trends of regional shorelines within each of these units (Figs. 86-94). Summary diagrams of greater than average net sand trends within the units of the Upper and Middle Mannville are shown in Figs. 24-31. In some cases mapping of net sand trends was very successful and shoreline trends were easily discernible (such as for the General Petroleums and Rex units; Figs. 25 and 26). However, in other cases where a great deal of channel incision has taken place within an individual unit (such as in the case of the McLaren unit; Fig. 29), or where an unit has been heavily incised from channels originating in units above it, the net sand database for these regional units is greatly diminished. The same holds true for units whose unconformity surfaces have been subjected to differential erosion over long periods of subaerial exposure. In these cases it is more difficult to discern shoreline trends simply due to a lack of data for the regional offshore-shoreface coarsening-upward successions within the sequence stratigraphic units.

One of the recurring ideas in previous paleoenvironmental studies of the Mannville in east-central Alberta (especially in studies of the Upper Mannville), is that much of the succession represents deltaic deposition (e.g. McLearn, 1944; Orr et al., 1977; Wennekers et al., 1979; Van Hulten, 1984). This idea is ultimately based on the intimate association between offshore, shoreface, and channelized deposits within the interval. Virtually without exception, however, these studies have based their conclusions on facies criteria and have not sought to test their hypotheses through regional mapping. One recent interpretation of deltaic deposition in the Upper Mannville (Wightman et al., 1987) has faced criticism in the past (Mathison, 1988, p. 337; Putnam, 1988) partly because of the fact that regional shoreline deposits and deltas may display almost identical facies characteristics (see Miall, 1987). Evidence for deltaic depocentres lies not in facies associations but in the geometry of sand bodies and their relationship to other paleogeomorphologic elements.

One way in which the test of deltaic versus regional paralic deposition can be applied is to map net sand trends within each of the seven regional units in combination with mapping the trends of incised channel deposits associated with each of these units (Miall, 1987). If anomalously thick net sand values are found to occur which also appear to be associated with incised channel trends, then it is possible that these thick sands may represent localized deltas. In a number of cases such mapping reveals that some of the anomalously thick regional offshore-shoreface sands are associated with the termini of paleochannel systems, in which case the weight of evidence favours a deltaic interpretation for these local depocentres. In other examples, localized sand depocentres do not appear to be associated with paleochannel systems. In these cases it is much more difficult to explain the local sand thicks.

Much of the following discussion will focus on the interpretation of net sand maps of each of the units of the Upper-Middle Mannville interval, and on whether local deltas and even regional shorelines can be determined from these maps with any degree of certainty.

Middle Mannville

Lloydminster unit (Fig. 24; Fig. 86)

A dominant net sand trend is difficult to ascertain within the Lloydminster unit partly due to incisement of General Petroleums and Rex paleochannels into the regional Lloydminster. Two local (deltaic?) depocentres are discernible, however, one centred in the area of T59-R1-4W4, and the other in the area of T66-R6. The lack of sand development between the two depocentres may indicate the presence of an embayment in the area between Townships 61 and 65 and Ranges 1 and 7W4.

Rex unit (Fig. 25; Fig. 87)

The net sand map of the Rex unit reveals a strong northeast to southwest paleoshoreline trend in the northern two-thirds of the study area, with a more dominant north-south trend in the southern third. Overlay of Lloydminster channel trends indicates that eastward-draining paleochannels extend well beyond the trend of thicker than average net sand accumulation, possibly indicating that these channels incised beyond the limit of shoreline progradation and incised into offshore deposits. No obvious deltaic depocentres are discernible.

General Petroleums unit (Fig. 26; Fig. 88)

Net sand mapping indicates a dominant northwest-southeast trend within the General Petroleums unit in the extreme northern one-third of the study area. The middle one-third of the study area is dominated by a northeast-southwest trend similar to that of the Rex unit. Overlay of the trends of Rex paleochannel systems demonstrates that, as in the case of the Rex unit, eastern draining paleochannels have incised beyond the major net sand shoreline trend. There may be some relationship between the major eastward trending channel system in T64 and 65 and possible deltaic depocentres centred in the area of T66-R5W4 and T67-R2W4. Paleochannel systems in the southern half of the study area do not appear to be associated with any deltaic depocentres.

Sparky unit (Fig. 27; Fig. 89)

Major net sand trends in the regional Sparky are predominantly centred in the northern half of the study area. The distribution of these thicker net sands is somewhat patchy, however, and it is difficult to determine any paleoshoreline trends. As in the case of the Lloydminster unit this may be partly due to deep incision of younger channels into and through the regional Sparky (in this case McLaren channels in the area north of T72 and Waseca channels in the area between T67 and T71).

G.P. paleochannels associated with the Sparky sequence demonstrate a northeasterly trend in the northern half of the study area and may be associated with thick net sand zones centred in T68-R1W4, T65-R3W4, and T63-R3W4. One thick net sand area dominates the southern half of the study area, centred around T54-R5W4. Eastward trending G.P. paleochannels may have been associated with the creation of this depocentre.

Upper Mannville

Waseca unit (Fig. 28; Fig. 90)

The net sand map of the regional Waseca shows a number of local trends which may indicate that a fairly complicated shoreline system prevailed during the progradation of the Waseca unit. It must be stressed, nevertheless, that the Waseca surface is heavily dissected by McLaren paleochannels and regional net sand trends may not be entirely reflective of shoreline trends due to a lack of regional Waseca data.

Nevertheless, the southern part of the study area (T53-T60) does show a rough northwest-southeast trend dominated by a local sand depocentre in the area of T56-R1W4. Paleoflow directions of sequence associated Sparky paleochannels in this area indicate a dominant eastward trend. These channels may have fed the thick sand trend which stretches between T54-R1W4 and T58-R1W4. Another Sparky paleochannel to the north may have been responsible for the development of the regional Waseca net sand thick centred in T60-R1W4.

The central part of the study area (T61-T66) is dominated by isolated net sand thicks which are surrounded by large areas in which very little sand is found within the regional Waseca succession. Two net sand thicks are found in this area, one centred in the area of T63-R4W4 and the other in the area of T65-R7W4. The former of these sand thicks may be associated with an northeastward-trending Sparky feeder channel.

The northern part of the study area (T67-T73) shows one major thick sand trend in the northeast. Northeastward trending Sparky channels show an orientation towards this sand thick but lack of data points in this area precludes the demonstration of a direct relationship between the two.

McLaren unit (Fig. 29; Fig. 91)

The McLaren net sand map is dominated by a northeastward trending depocentre in the most northern third of the study area. A dense network of sequence associated northward trending Waseca paleochannels dominates the area between T69-T72, R4-R6W4 and may represent a major deltaic system associated with the McLaren paleoshoreline.

Net sand thicks are relatively absent from the southern half of the study area in comparison to the unit dominating sand thick to the north. Sequence associated Waseca channels trend towards the east in the southern half of the Cold Lake area. These channels may have fed a shoreline trend to the east of the study area. If so, the northeastwear trending McLaren paleoshoreline which dominates the northern part of the study area may have yielded to a dominant north-south trend to the south.

Colony unit (Fig. 30; Fig. 92)

The regional Colony is typically the thinnest of the seven regional units of the Upper-Middle Mannville succession. The Colony-Joli Fou unconformity surface also displays more post-depositional erosional relief than virtually any of the other bounding unconformities within the Upper-Middle Mannville interval. Differential erosion of relatively large sections of the regional Colony may partially explain why the net sand map displays so many small, isolated sand thicks, and why no general trends are discernible.

Colony sequence associated McLaren channels are the most pervasive channels systems within the Upper-Middle Mannville succession. These channels do appear to show some relationship to the regional Colony net sand trends (note for instance the dense network of McLaren paleochannels which appears to have fed the net sand trend cetred in T68-R2W4) but the relatively rarity of Colony sand thicks (due to differential erosion?) obscures any immediately perceivable regional paleoshoreline trends.

Colony channels (Fig. 31; Fig. 101)

The picture of Upper and Middle Mannville deposition is completed by the maps of Colony channels shown in Figures 31 and 101. As in the case of all of the other channel systems found within the interval, the fill within these channels post-dates the deposition of the regional strata bearing the same name. As discussed previously, it is unclear whether these Colony channel fill deposits belong to the Mannville Group or represent basal deposits of the Joli Fou Formation. The thickness of these channels, as well as their lateral confinement, indicate that they are indeed*incised* channels, however, it is possible that the extensive erosive event which formed the Mannville-Colorado unconformity, may post-date the incision of the Colony channels. If this is the case, the Joli Fou transgression may have removed any associated shoreline deposits (see Chapter VI).

DISCUSSION

Controls on Upper and Middle Mannville depositional cyclicity

In recent years much emphasis has been placed on the role of relative sea level changes in shaping cyclic shoreface/offshore successions, especially in terms of the mechanics of such changes. Most of the debate has centred over the respective influences of tectonic versus eustatic forces in bringing about relative sea level changes and consequent depositional cycles (Kendall and Lerche, 1988). The most poorly understood of these cycles are those of short term duration which have been dubbed 3rd (1-10 million years) and 4th order cycles (<1 million years) (e.g. Kauffman, 1977; Vail et al., 1977; Bally, 1980; 1982). Since the entire Mannville in east-central Alberta has been estimated to have been deposited over a period as short as 2 million years (Caldwell, 1984), the individual units must qualify as short duration (most likely 4th order) cycles.

Although eustacy has been invoked by some authors (Vail et al., 1977; Vail and Todd, 1981) as the main cause of short term variations in sea level, glacial cyclicity is the only non-tectonic mechanism that can produce rapid large-scale variations in sea level over a short time period (Pitman and Golovchenko, 1983). While this may explain part of the Cenozoic record, it does little to explain the rapid changes discernible from parts of the Cretaceous (Haq et al., 1988), when no permanent ice cap is thought to have existed (Frakes, 1979). Boyd et al. (1988) have pointed out that in the absence of evidence for glacial-eustatic changes, the weight of evidence must favour a tectonically driven mechanism to explain short-term rapid relative sea level changes (see also Cross and Pilger, 1978; Watts, 1982; Miall, 1986; Hallam, 1988).

A diverse assortment of tectonic mechanisms may be responsible for short-term relative sea level changes however. These mechanisms range from changes in rates of thermally- or load-induced basinal subsidence, to changes in volume at plate boundary spreading ridges, to orogenic activity, to changes in tectonically-controlled sediment supply (Pitman, 1978; Pitman and Golovchenko, 1983; Kendall and Lerche, 1988). So-called regional or global sea level adjustments may even vary from basin to basin according to basin architecture (e.g. foreland basins versus passive margins) (Jordan and Flemings, 1989).

Cloetingh et al. (1985) and Cloetingh (1986; 1988) have recently proposed a mechanism to explain the creation of 3rd order depositional cycles that involves a combination of varying horizontal intraplate stress fields and load-induced subsidence rates. These mechanisms are thought to not only affect relative sea level along passive margins, but may also be responsible for consequent base level changes in intracratonic and foreland basins. With specific reference to foreland basins, the foreland bulge may be highly influenced by variations in either compressional or tensional intraplate stress fields which in turn may result in either an increase or decrease in the height of foreland bulge areas and consequent relative base level adjustments in foreland seas (Cloetingh, 1988). However, changes in relative sea level brought about by variations in intraplate stress fields must be on a time scale of a few million years or longer in order to meet the requirements of Cloetingh's model. Thus, while changes in intraplate stress fields may be responsible for some of the variation in relative sea level inferred from the cyclic depositional record of the Mannville, they can not be totally responsible for the extreme short-term variations observed within it (see also Embry, 1988; Embry and Podruski, 1988).

Ultimately, it may be impossible to sort out the relative effects of eustacy versus tectonics or even to sort out the effects of various tectonic mechanisms versus one another when searching for the driving mechanisms responsible for observed short duration transgressive-regressive cycles. Certainly the effects of longer-duration changes in relative sea level (either tectonically or eustatically driven) must be considered as significant contributing factors to the creation of short term cycles, but may also mask the effects of other factors (e.g. changes in sediment supply, local changes in subsidence or uplift) responsible for short-term cyclicity. Kendall and Lerche (1988) have stated that no clear picture of the specific effects of changes in one of the prime factors of eustacy, tectonics, and sedimentation rate can be assessed without a specific knowledge of the effects of the other two factors (see also Collier et al., 1990; Lawrence et al., 1990).

Despite the general uncertainties involved in attributing relative sea level changes to specific factors, the extreme cyclicity observed in offshore/shoreface depositional packages within the Upper and Middle Mannville Group in the Cold Lake study area is undeniable. The pace of transgressive-regressive events within these cyclic units is so rapid as to be outside of the range of biostratigraphic or chronostratigraphic resolution. The inferred depth of incision of some of the Upper-Middle Mannville paleochannel networks, however (Chapter III), indicates that relative vertical adjustments in sea level may have been quite dramatic during this time period. As eustatic adjustments of sea level operate only on much longer time scales (in the absence of glacial events), and since there is no evidence that fluctuations in sediment supply could by themselves induce the dramatic changes in relative sea level that are envisaged, some tectonic mechanism(s) must be the main driving force behind the observed cyclicity in the Upper-Middle Mannville interval.

Upper and Middle Mannville time constitutes a period of long-term regression following the major flooding event that created the Clearwater Sea. One significant cause for periodic transgressional episodes imposed on this overall regressional pattern may have been subsidence local to areas of east-central Alberta and west-central Saskatchewan induced through periodic solution of underlying Devonian salts (Edmunds, 1980; Christopher, 1980; Wilmot and Oliver, 1983; Smith et al., 1984).

Salt solution has been shown to have been active throughout Mannville time (Christopher, 1980) although most solutioning occurred prior to or subsequent to Mannville deposition. Salt solution most likely occurred during discrete episodes separated by longer periods of non-solutioning (Wilmot and Oliver, 1983). It is suggested that minor discrete episodes of dissolution along the leading salt edge during Upper and Middle Mannville time may have been enough to trigger episodic basinal subsidence and consequent relative sea level rise which would have eventually yielded to the effects of long term regression of the Clearwater Sea. Such a pattern may have been repeated several times during Mannville time. The resulting short-term cyclic depositional pattern may have been superimposed on a tectonic regime in which other tectonic factors (e.g. changes in the intraplate stress field) governed longer term-cyclicity. Figure 32 summarizes the proposed model of relative transgression and regression, channel incision, and unconformity creation observed within the Upper-Middle Mannville interval in the Cold Lake study area.

Finally, it should be noted that the model of relative sea level change proposed in this study is in contrast to previous interpretations of Upper and Middle Mannville transgressive-regressive events. Clack (1967) and Minken (1974) characterized the entire Upper Mannville in the Cold Lake area as transgressive, while Van Hulten (1984) felt that each of the G.P. through Colony units represented alternating individual transgressive-regressive events (i.e. G.P. transgressive, Sparky regressive, Waseca transgressive, McLaren regressive, and Colony transgressive). The mapping of incised channels within each of these units, however, ultimately shows that relative sea level drop and the creation of concomitant unconformities divides each of the seven Upper-Middle Mannville sequence stratigraphic units into a transgressive-regressive couplet.

CONCLUSIONS

The recognition of relative lithologic homogeneity within the Upper and Middle Mannville sub-groups in the Cold Lake area of east-central Alberta dictates that traditional lithostratigraphic nomenclatural schemes for the seven units recognized within this interval should be reevaluated. Furthermore, regional mapping indicates that each of these seven units is bounded by unconformities, which are recognized on the basis of evidence of subaerial exposure and on the delineation of incised channel deposits associated with each of them. Therefore, a sequence stratigraphic division of the Upper-Middle Mannville interval is the most appropriate stratigraphic scheme to apply to this succession.

In depositional environmental terms, the Upper and Middle Mannville interval is generally divisible into stacked, offshore-shoreface, coarsening-upwards successions (referred to as regional units), and incised channel deposits. Each of the regional units is marked by at least one coarsening-upwards succession representing the deposition of transgressive offshore shales followed by regressive advance of paralic deposits and ultimately followed by unconformity creation. Incision of channels associated with each ultimately followed by unconformity creation. Incision of channels associated with each of the units began sometime after the initiation of each regressive phase of deposition. Facies associations within coarsening-upwards successions differ little from area to area or from unit to unit, but mapping of net sand trends and of incised channels aids in differentiating normal shoreline successions from possible deltas.

Paleoecologic indicators (ichnofossils, foraminifera, palynomorphs) within regional units indicate that normal marine conditions prevailed in offshore areas during the initial stages of Middle Mannville time, while more brackish conditions prevailed during Upper Mannville time. This is thought to have been due to an increase in fluvial drainage to offshore areas, as well as possible shallowing of the Clearwater Sea as successive regressions caused northward marine withdrawal from eastern Alberta and western Saskatchewan.

Extreme depositional cyclicity and unconformity creation during Upper-Middle Mannville time were probably the result of several interelated factors. Tectonic effects are favoured over eustatic changes in sea level to account for this cyclicity, but a number of tectonic effects may have worked in combination with one another. Possible factors include changes in the intraplate stress field, changes in subsidence rates or rates of solutioning of underlying Mid-Devonian salts, and changes in sedimentation rates due to tectonic adjustments or even to climatic changes.

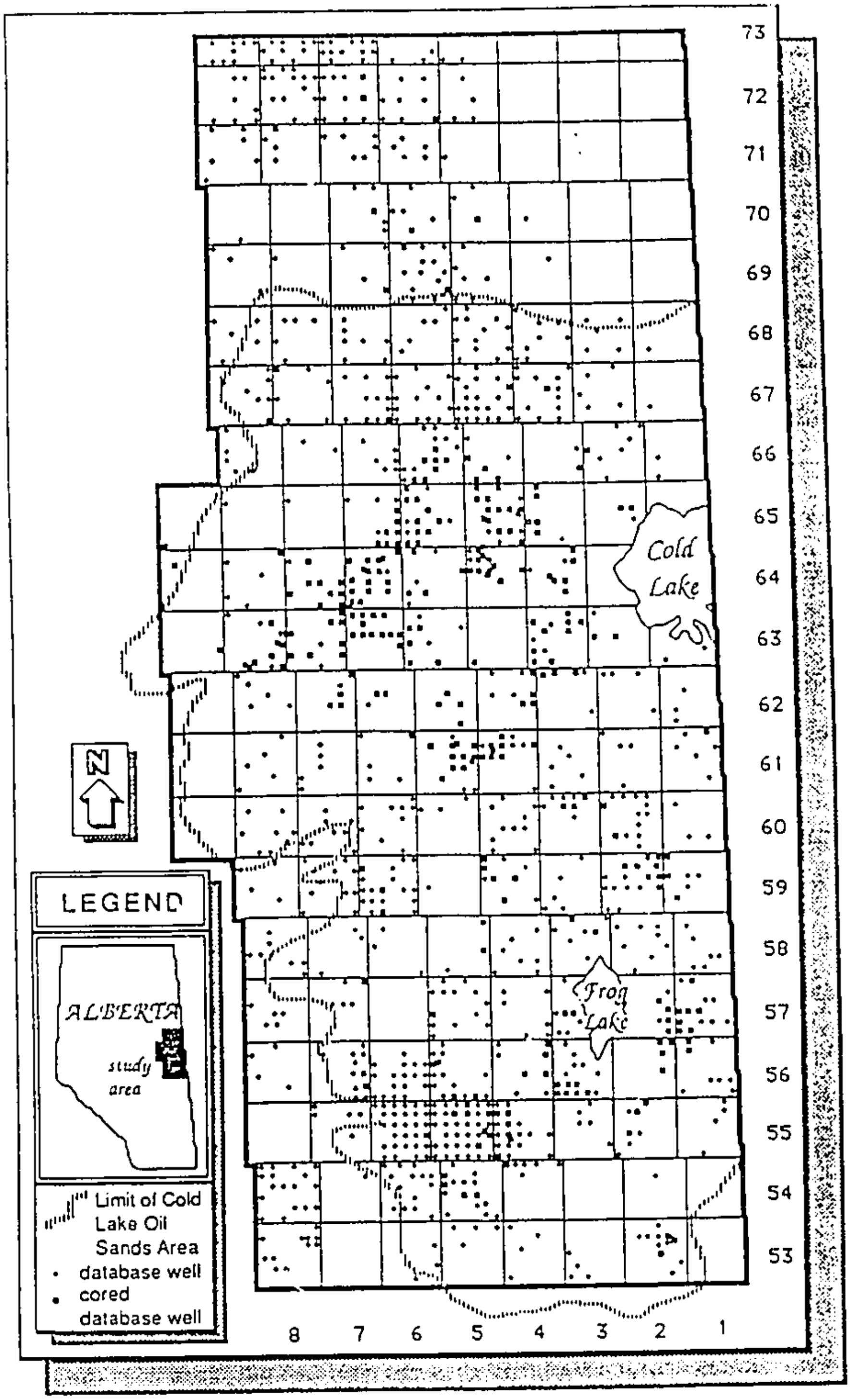


FIGURE 8.-- Study area map; Cold Lake and Primrose Lake Oil Sand areas.

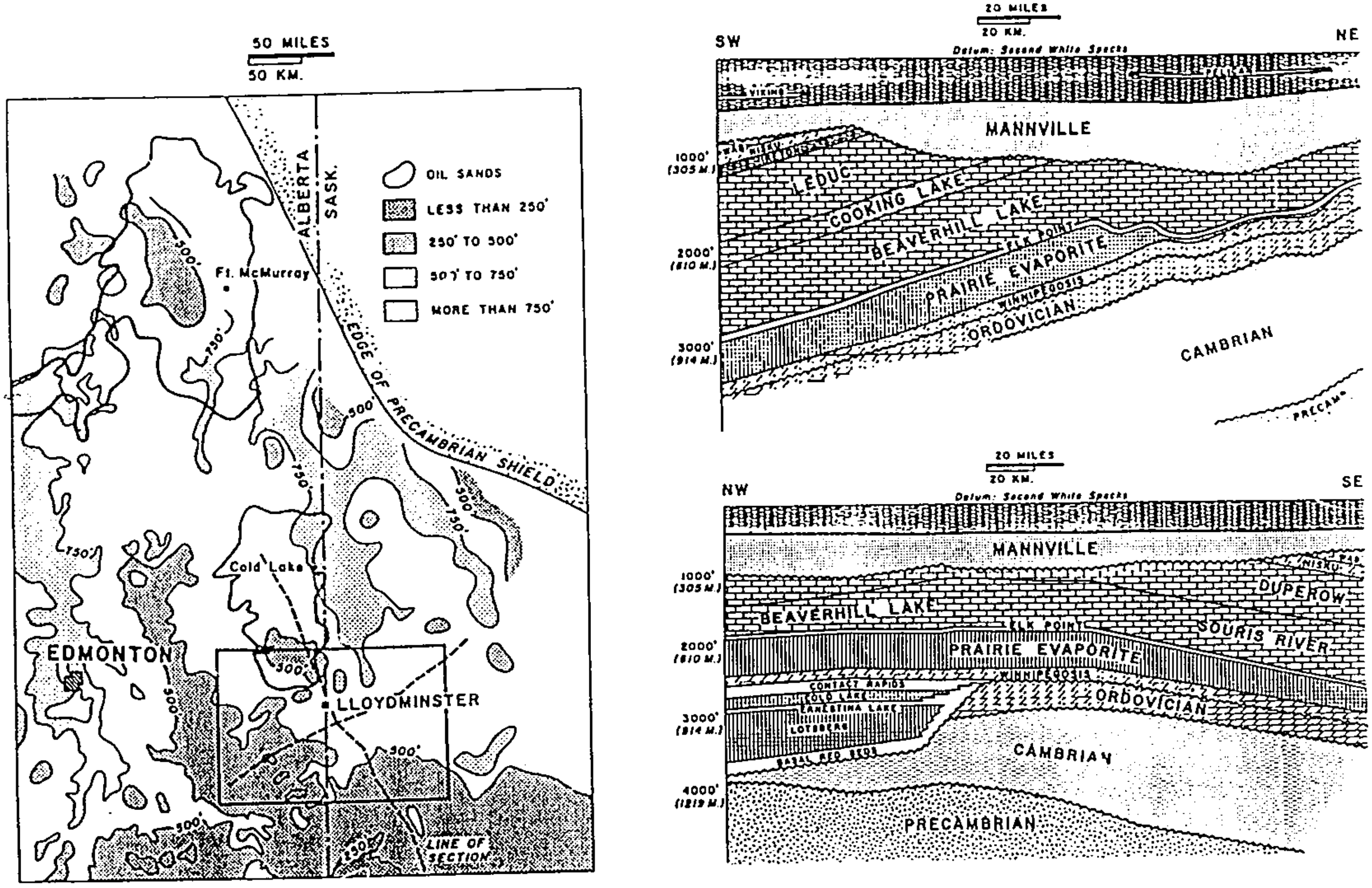


FIGURE 9.-- Regional cross-section of the Lower Cretaceous succession in eastern Alberta (after Orr et al., 1977).

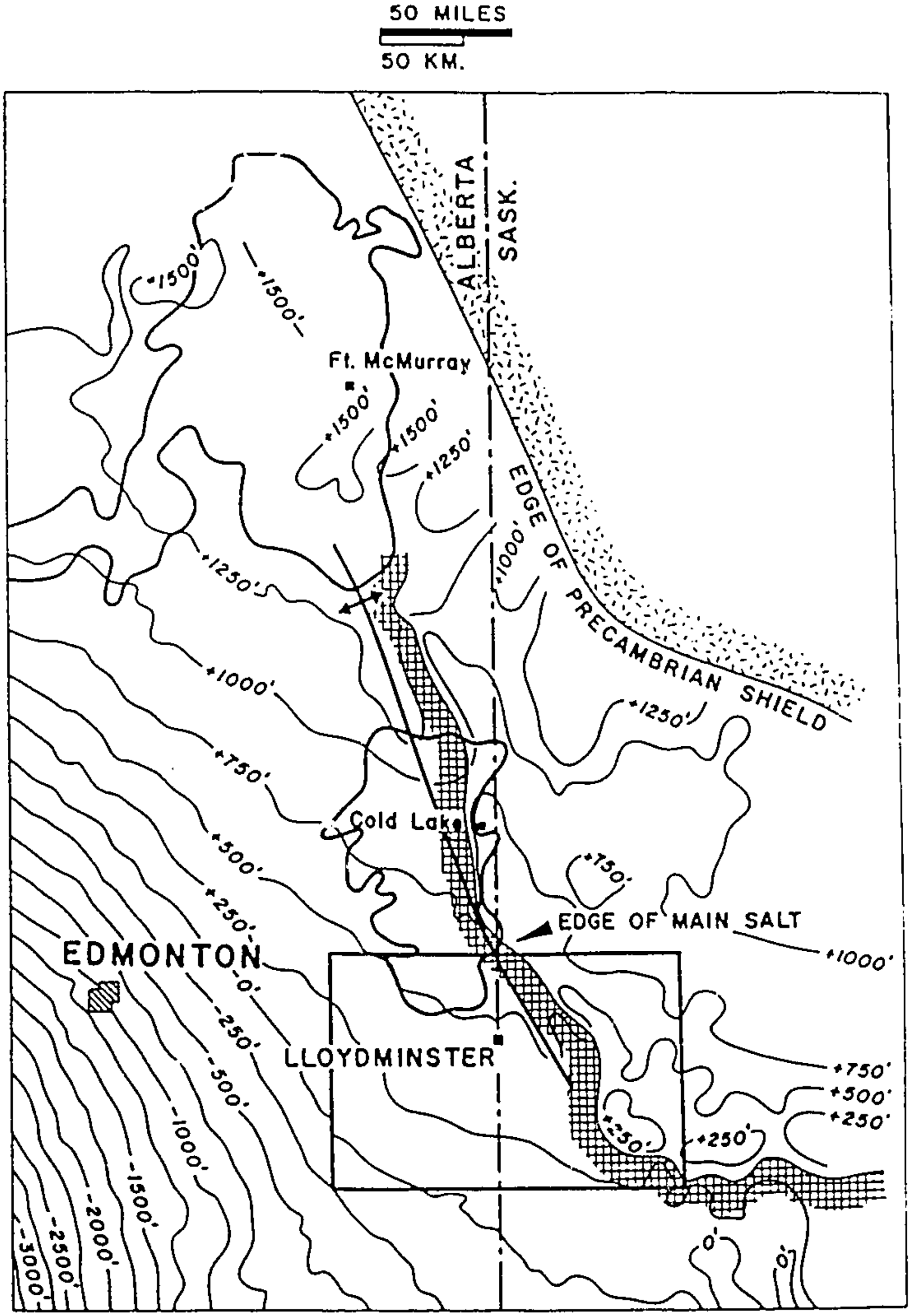


FIGURE 10.-- Important tectonic features of eastern Alberta (after Orr et al., 1977).

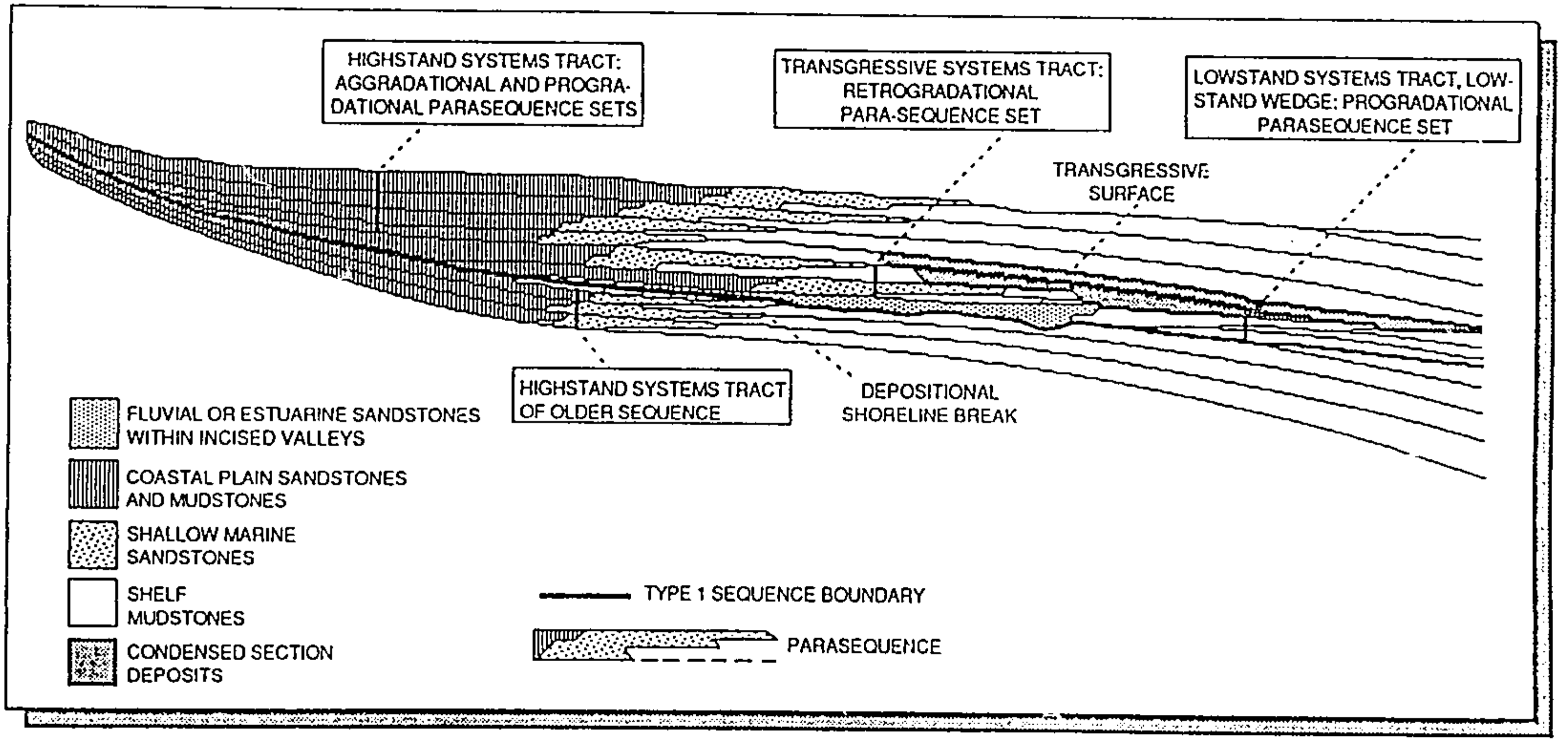


FIGURE 11.-- Illustration of Type 1 sequence boundary (after Van Wagoner, et al., 1988)

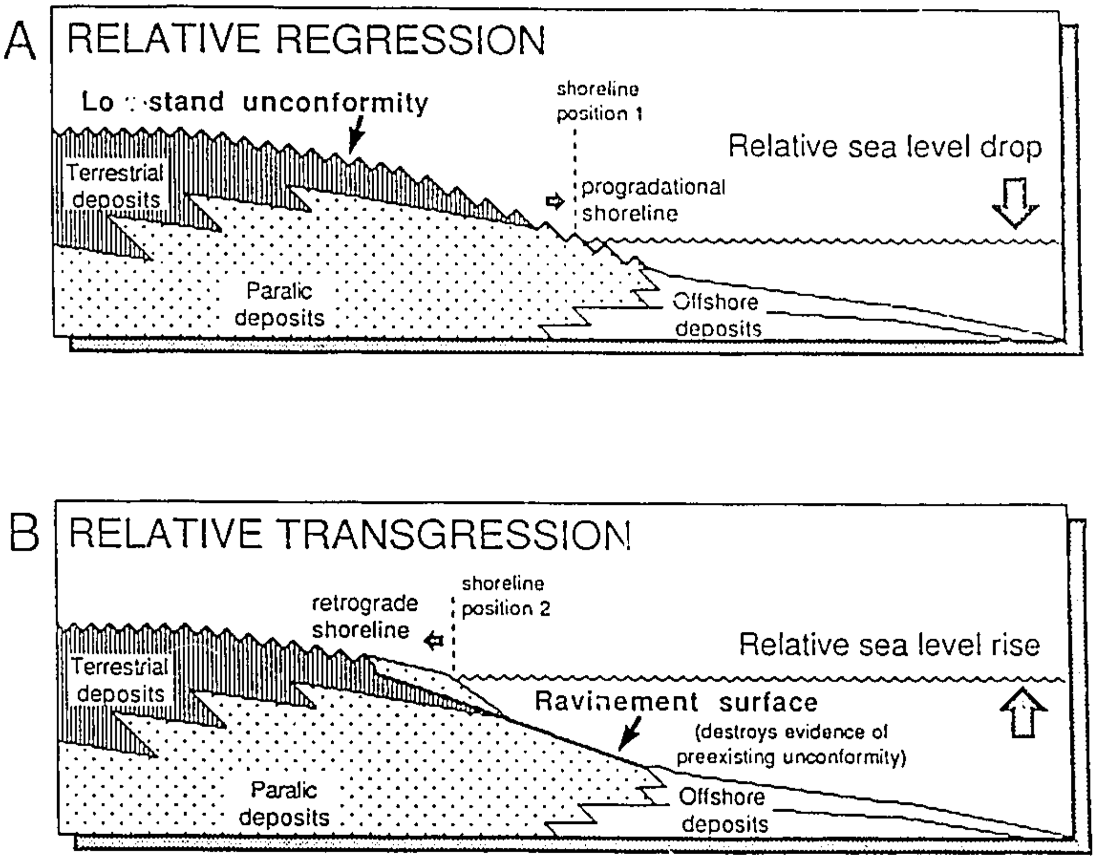


FIGURE 12.-- Illustration of destruction of evidence of subaerial exposure during transgressive ravinement.

A. Low-stand unconformity is created through subaerial exposure and erosion during relative sea level drop.
B. During relative transgression former shoreline and shoreface deposits are reworked thereby destroying evidence of pre-existing unconformity surface.

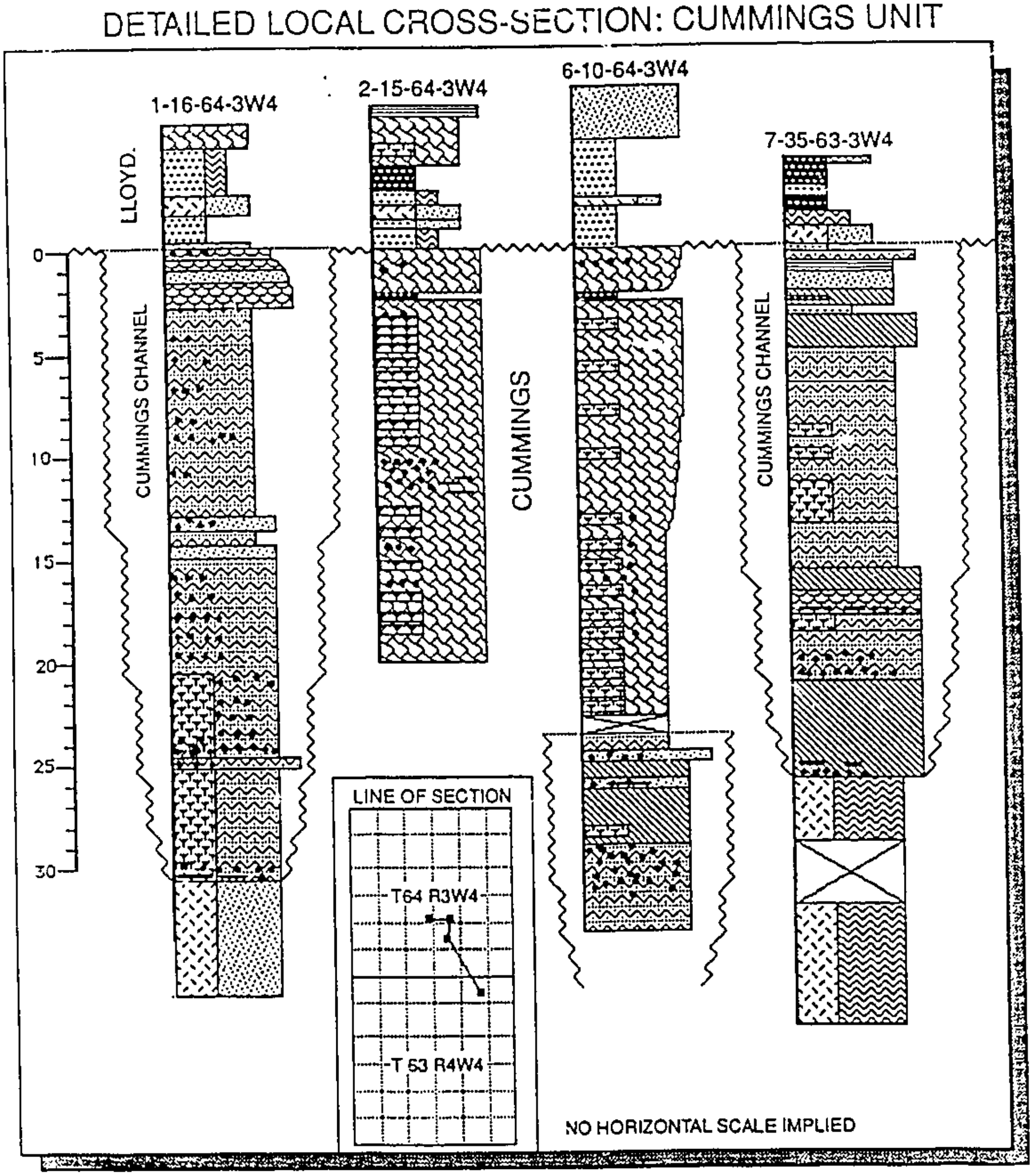


FIGURE 13.-- Detailed local cross-section illustrating the incisement of "Cummings channels" into older strata.

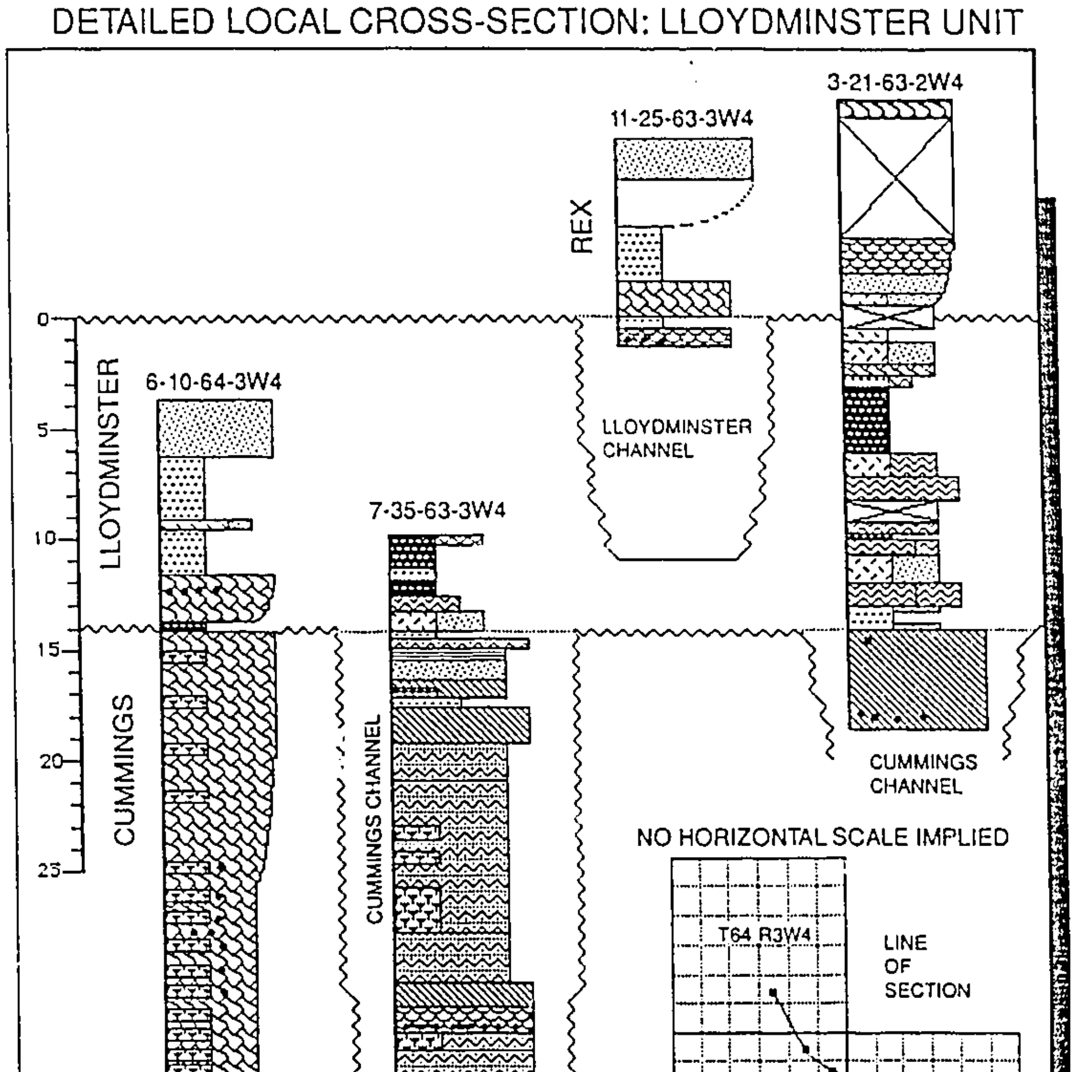


FIGURE 14.-- Detailed local cross-section illustrating the incisement of "Lloydminster channels" into older strata.

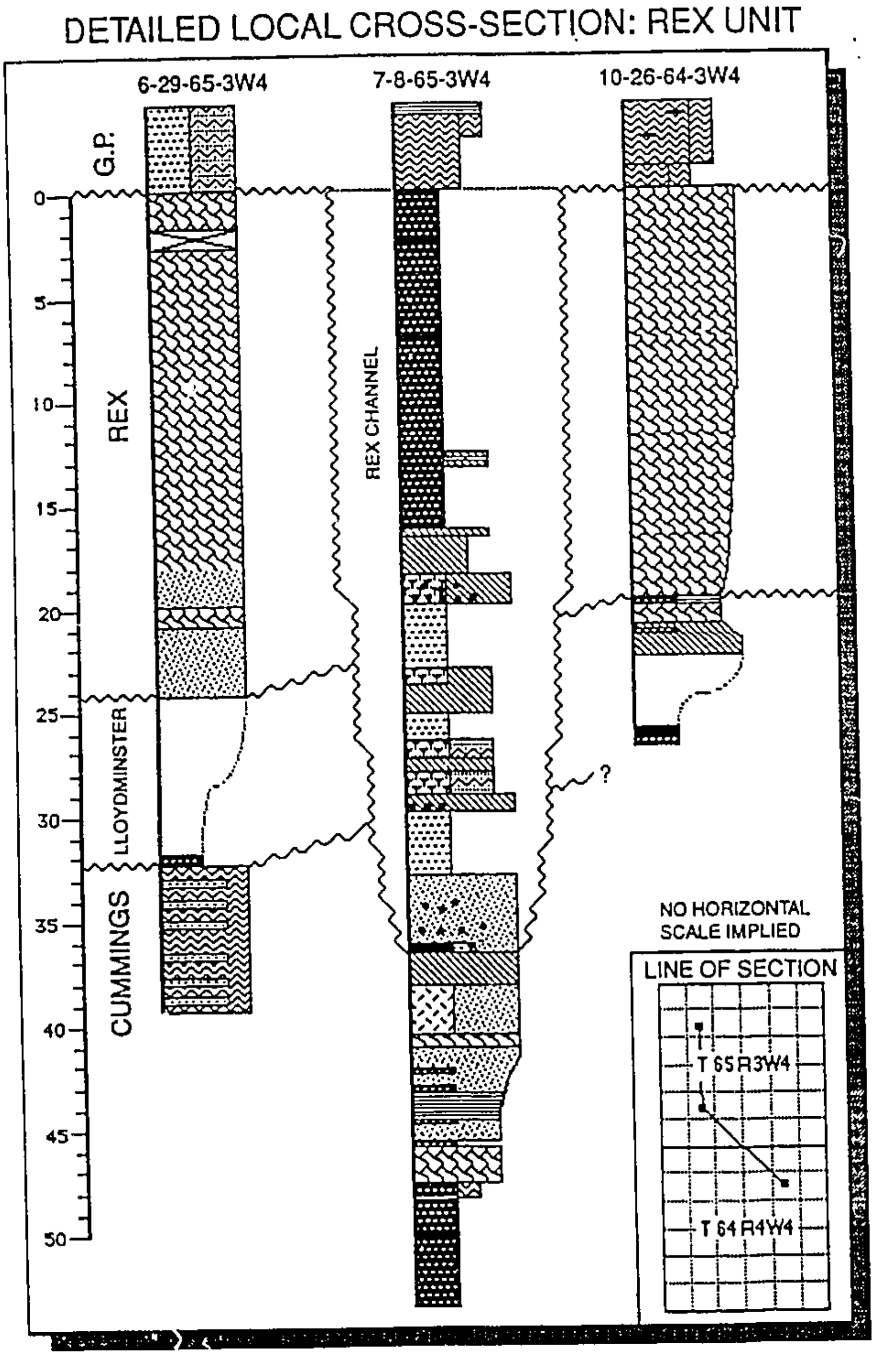


FIGURE 15.-- Detailed local cross-section illustrating the incisement of "Rex channels" into older strata.

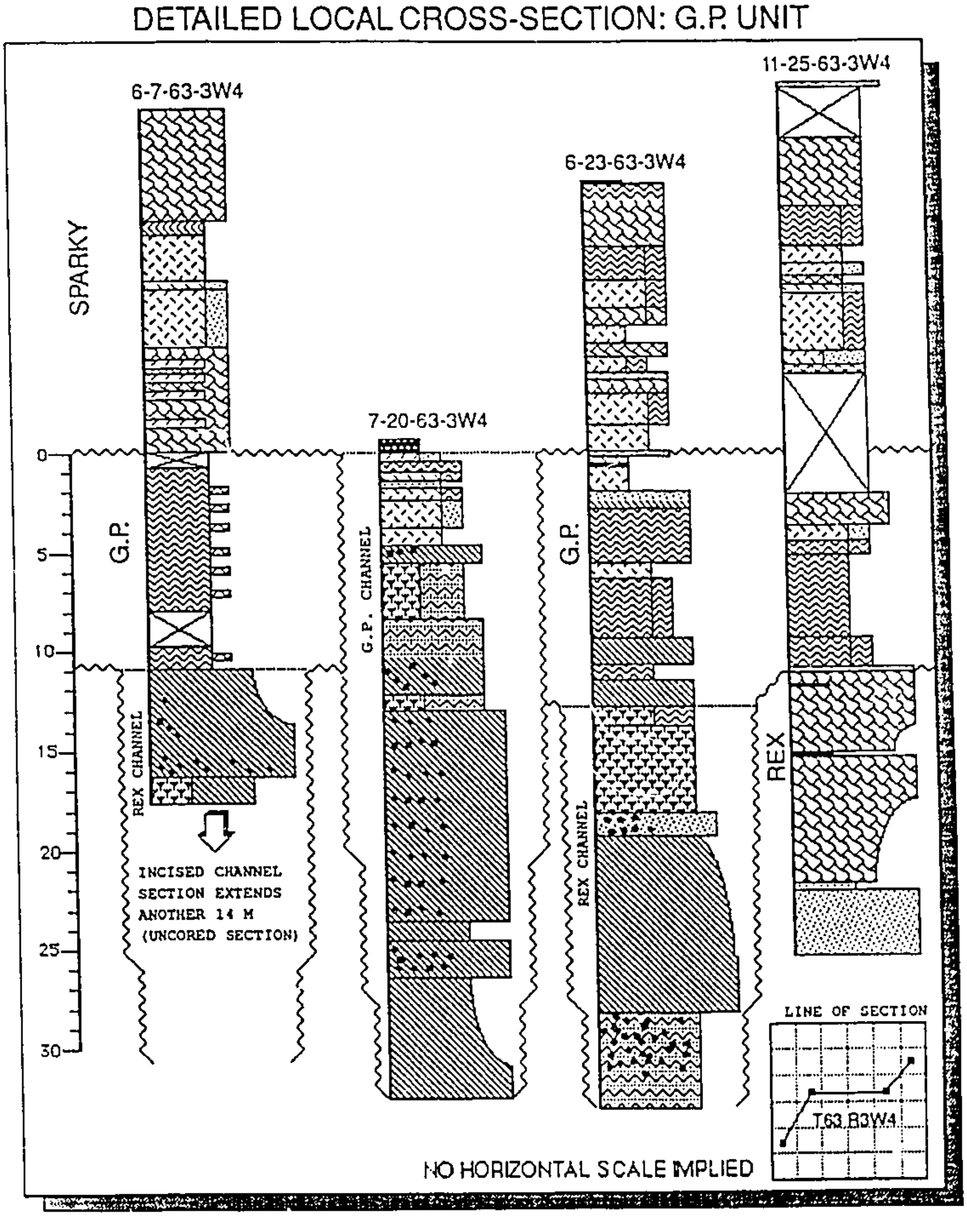


FIGURE 16.-- Detailed local cross-section illustrating the incisement of "General Petroleums channels" into older strata.

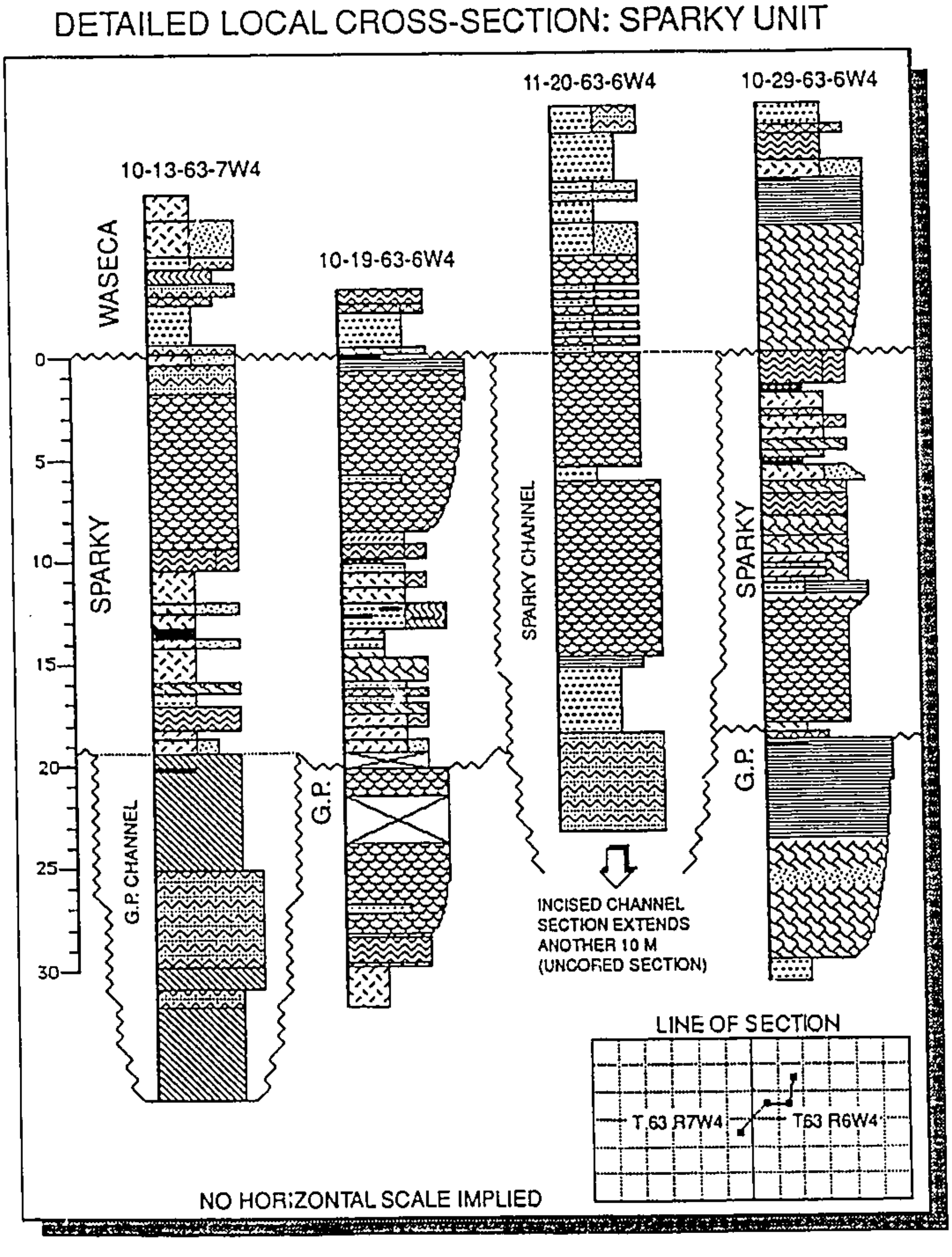


FIGURE 17.-- Detailed local cross-section illustrating the incisement of "Sparky channels" into older strata.

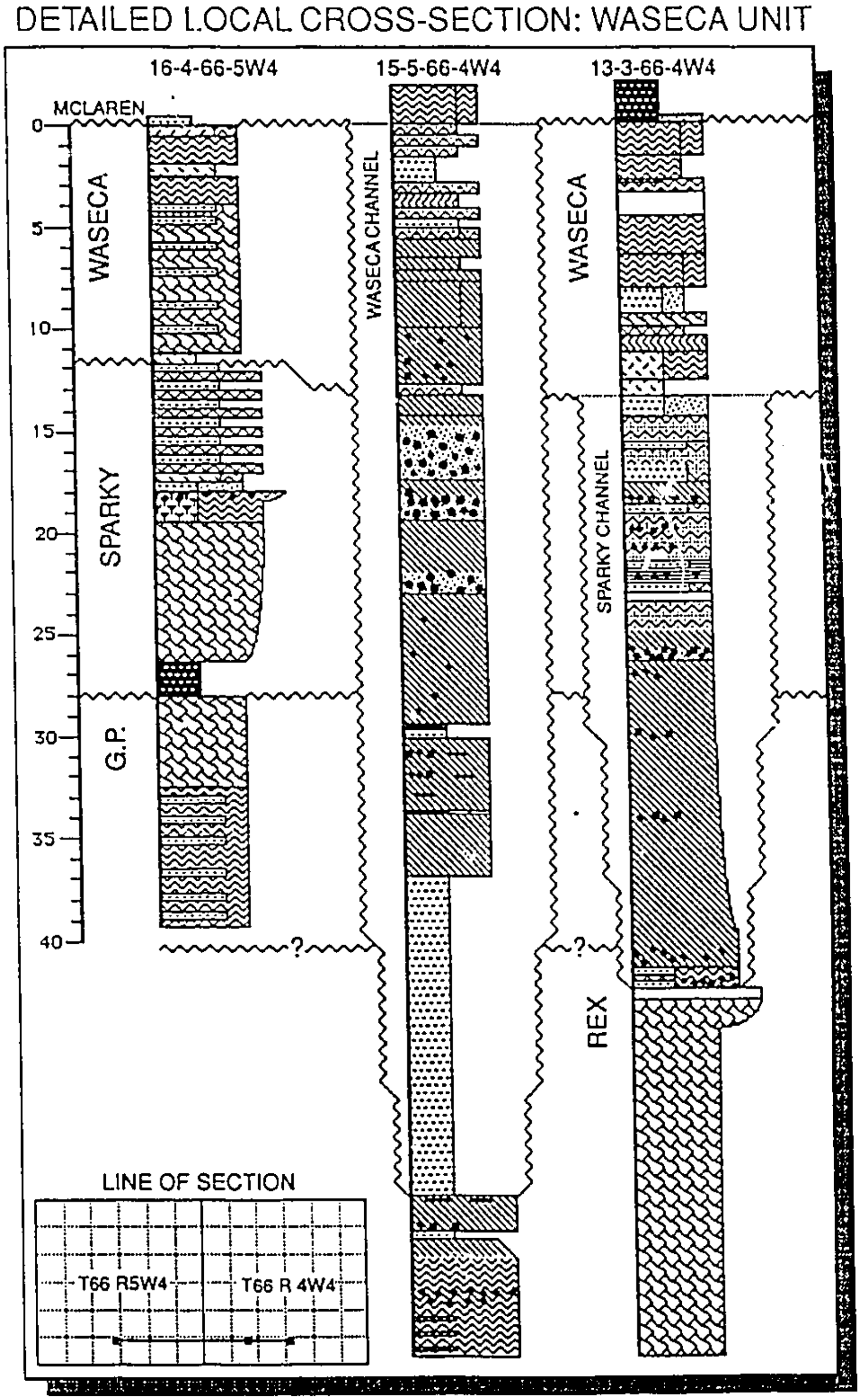


FIGURE 18.-- Detailed local cross-section illustrating the incisement of "Waseca channels" into older strata.

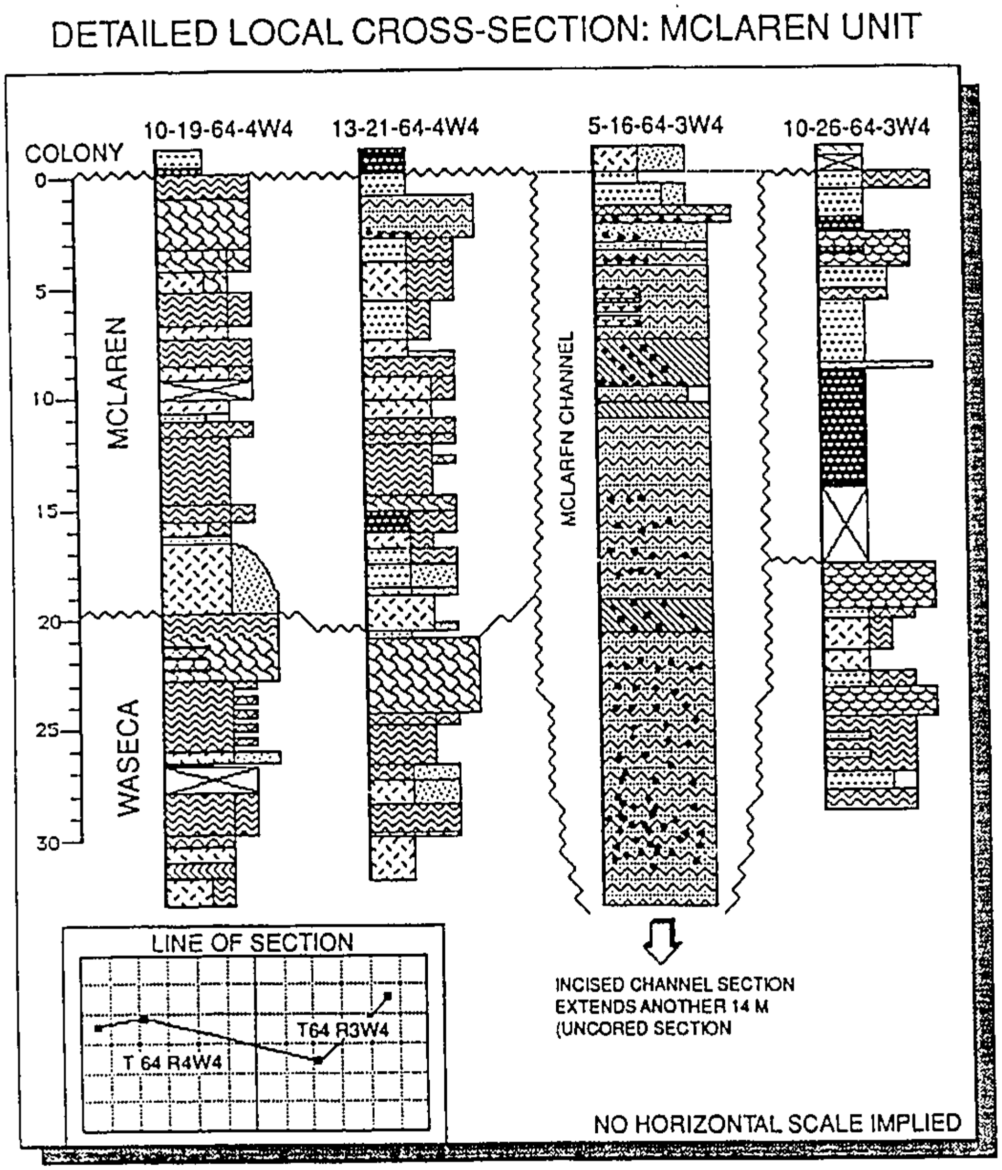


FIGURE 19.-- Detailed local cross-section illustrating the incisement of "McLaren channels" into older strata.

DETAILED LOCAL CROSS-SECTION: COLONY UNIT

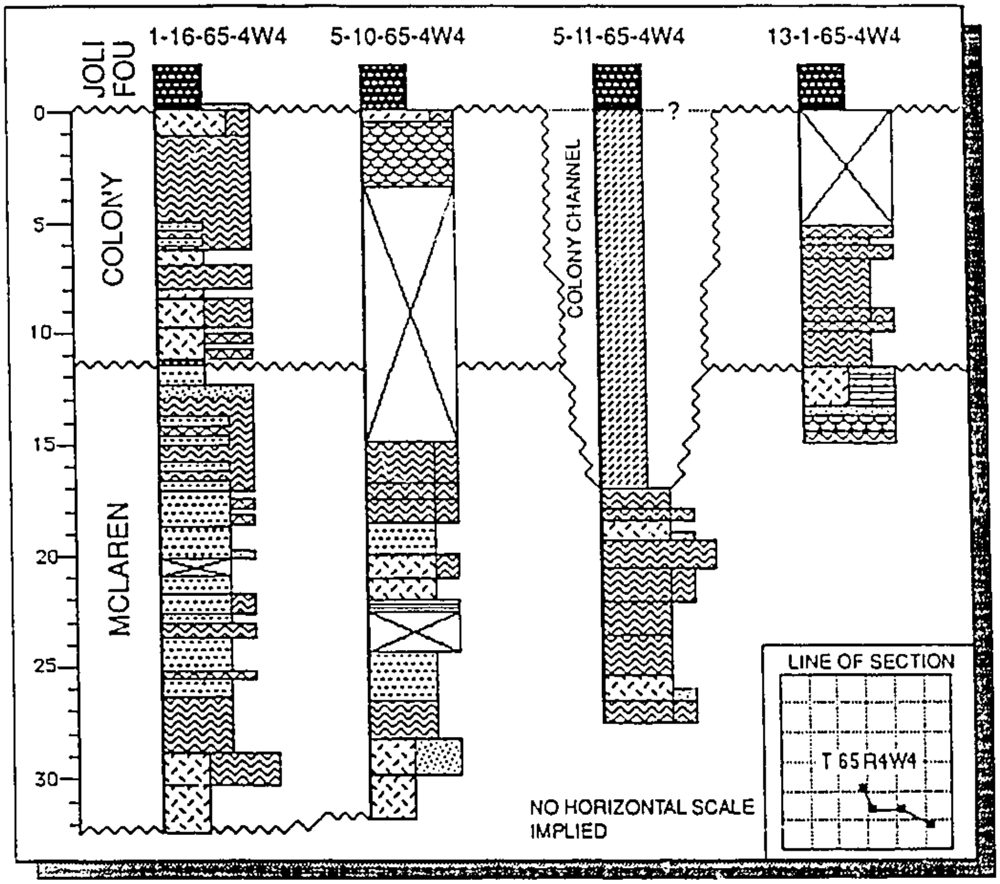


FIGURE 20.-- Detailed local cross-section illustrating the incisement of "Colony channels" into older strata.

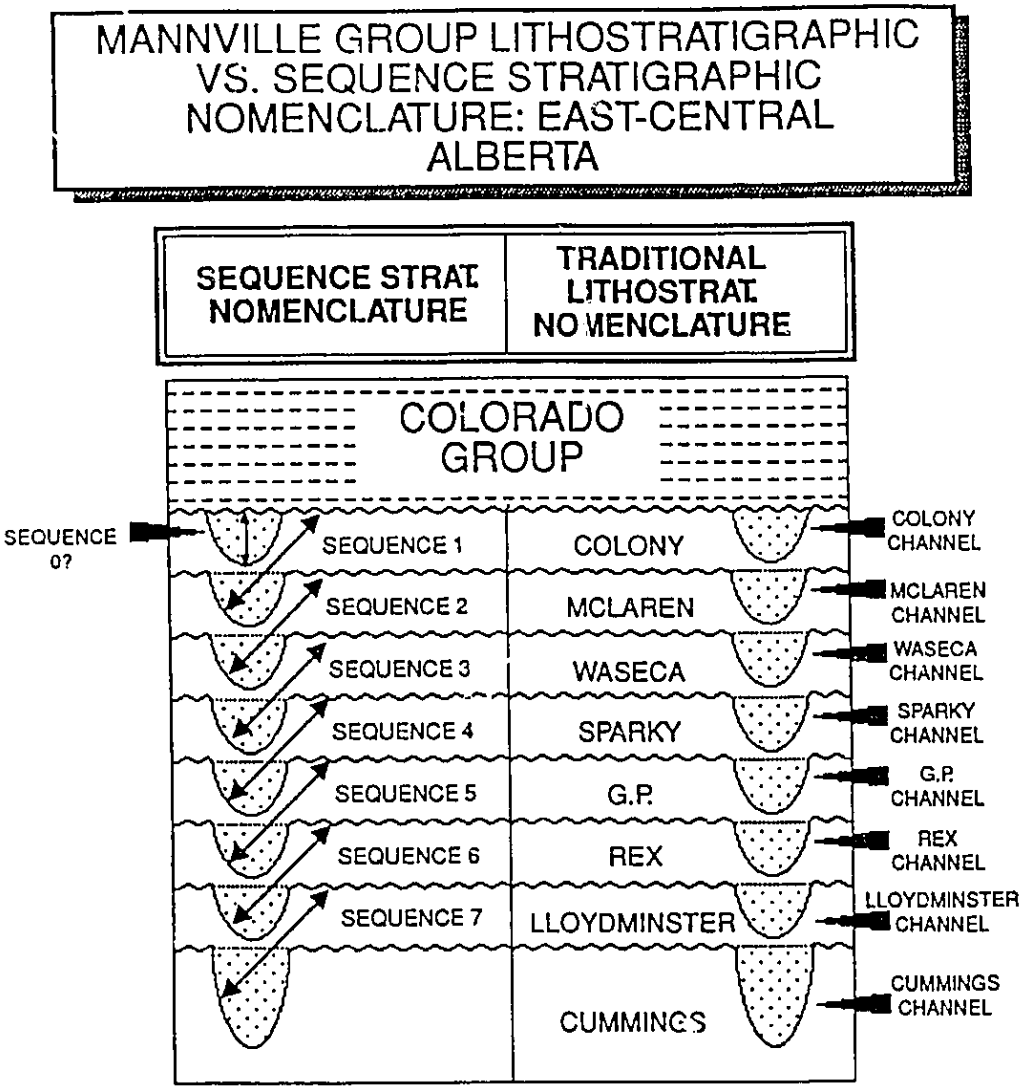


FIGURE 21.-- Relationship between the traditional lithostratigraphic and proposed sequence stratigraphic schemes for the Upper and Middle Mannville in east-central Alberta.

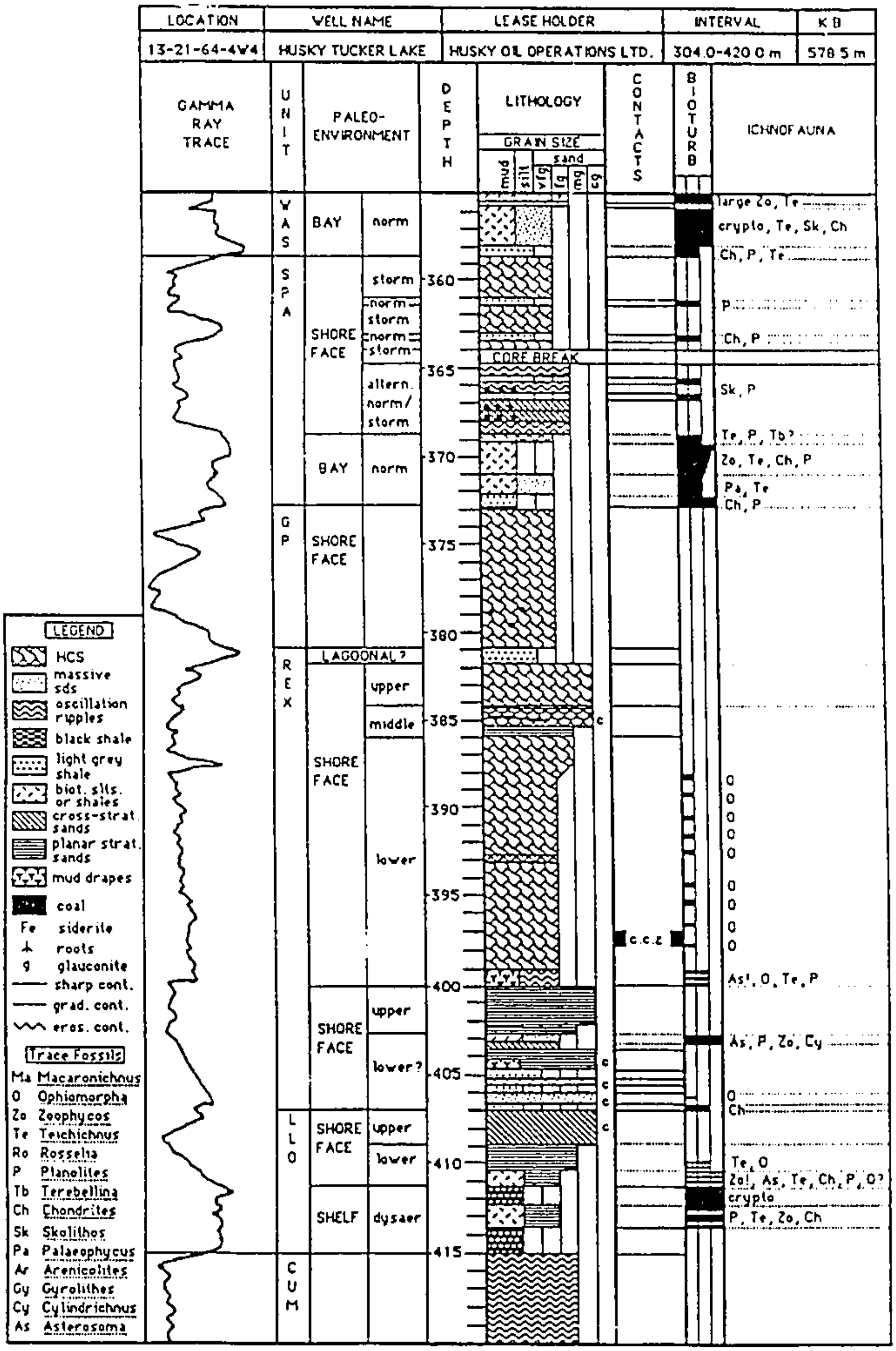


FIGURE 22.-- Drill core log of Middle Mannville reference section (Husky Tucker Lake 13-21-64-4W4)

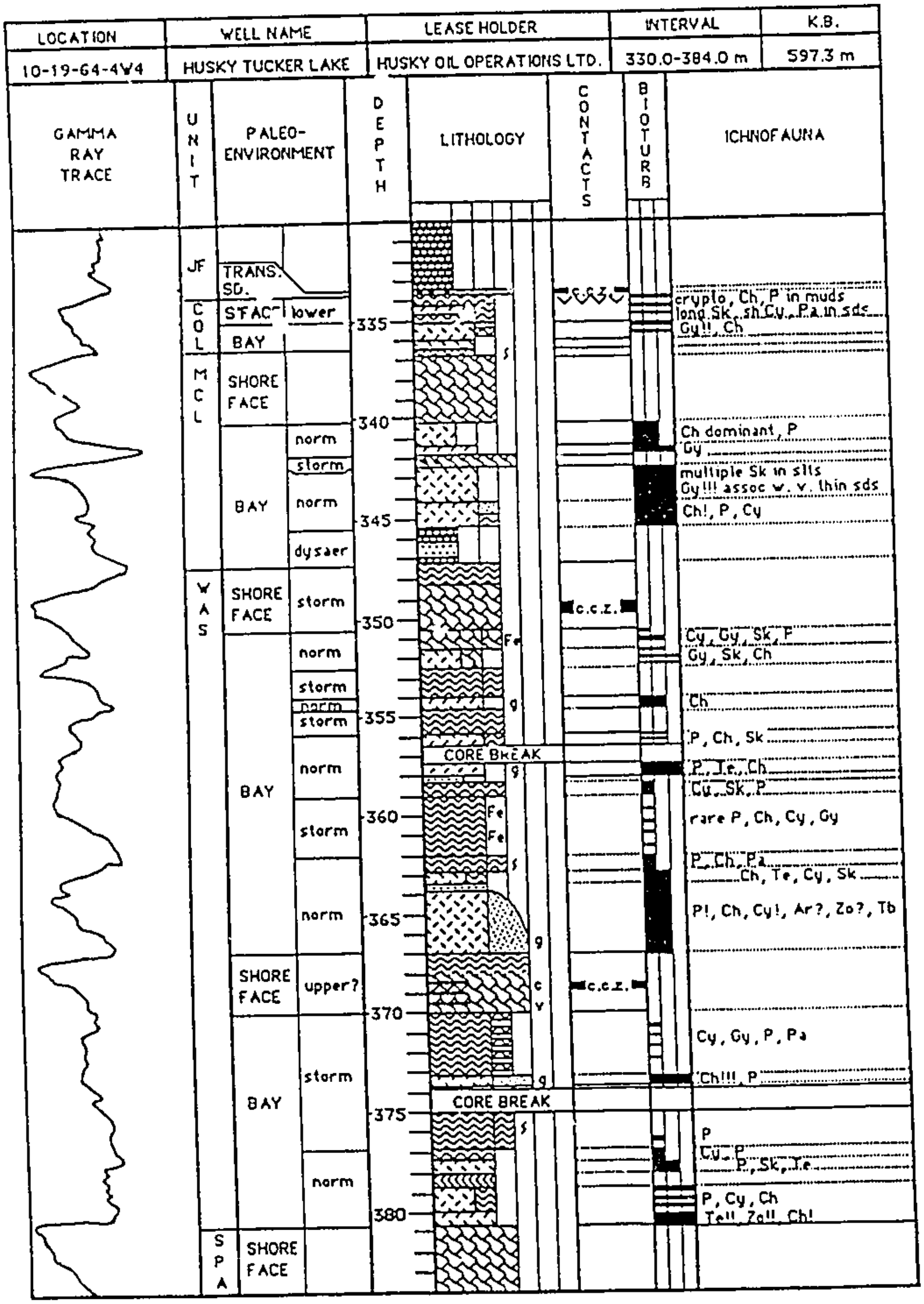
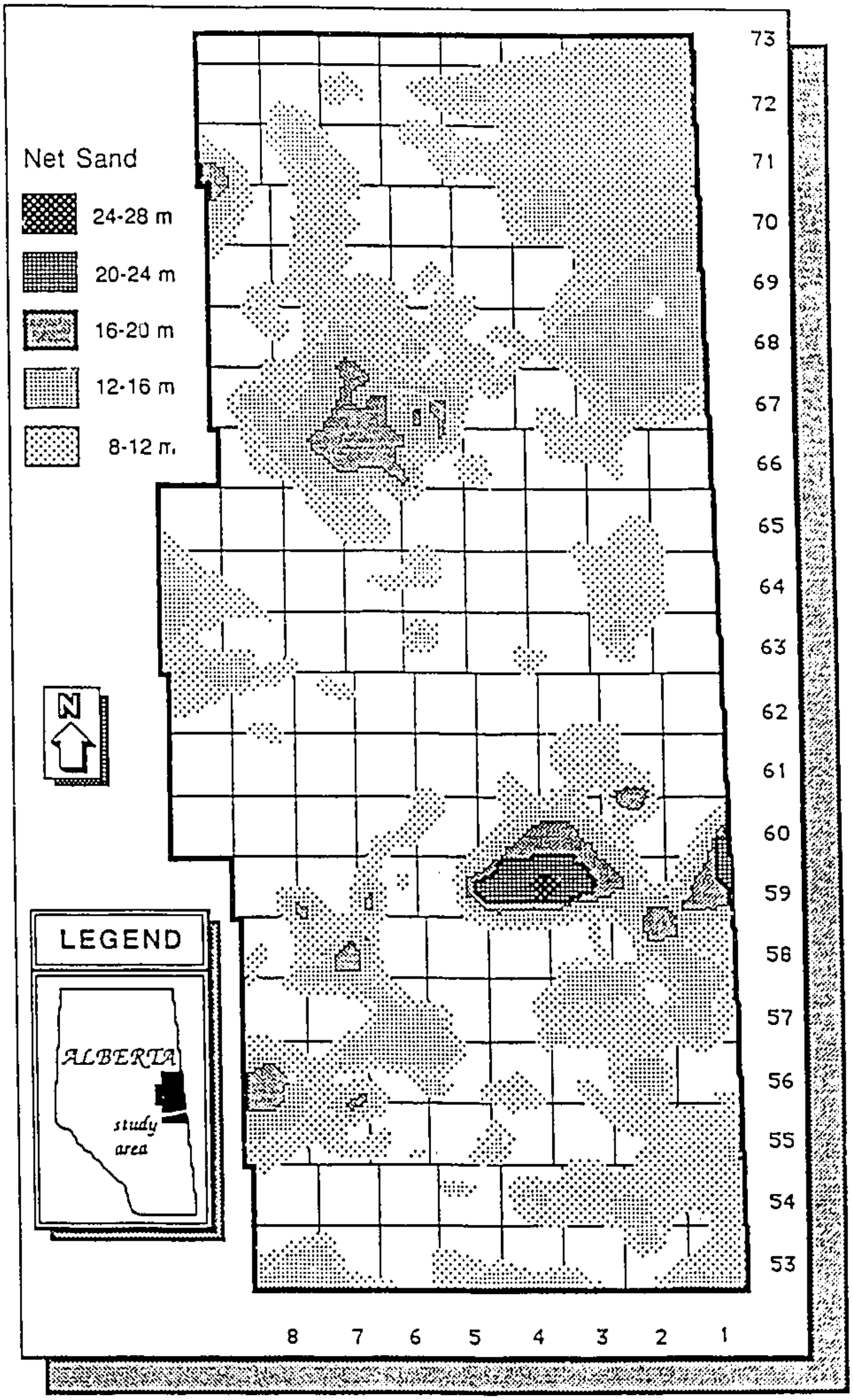
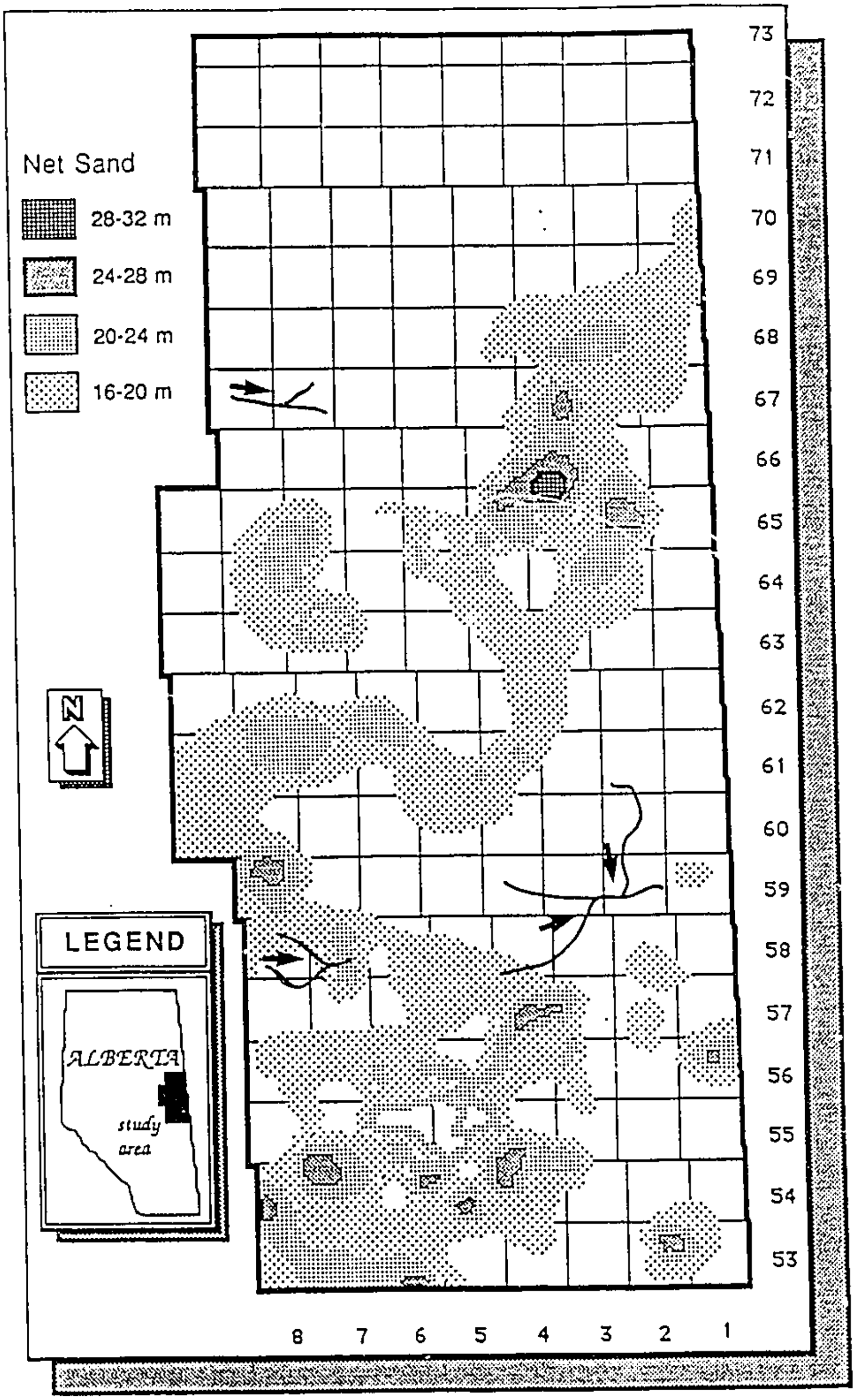


FIGURE 23.-- Drill core log of Upper Mannville reference section (Husky Tucker Lake 10-19-64-4W4)



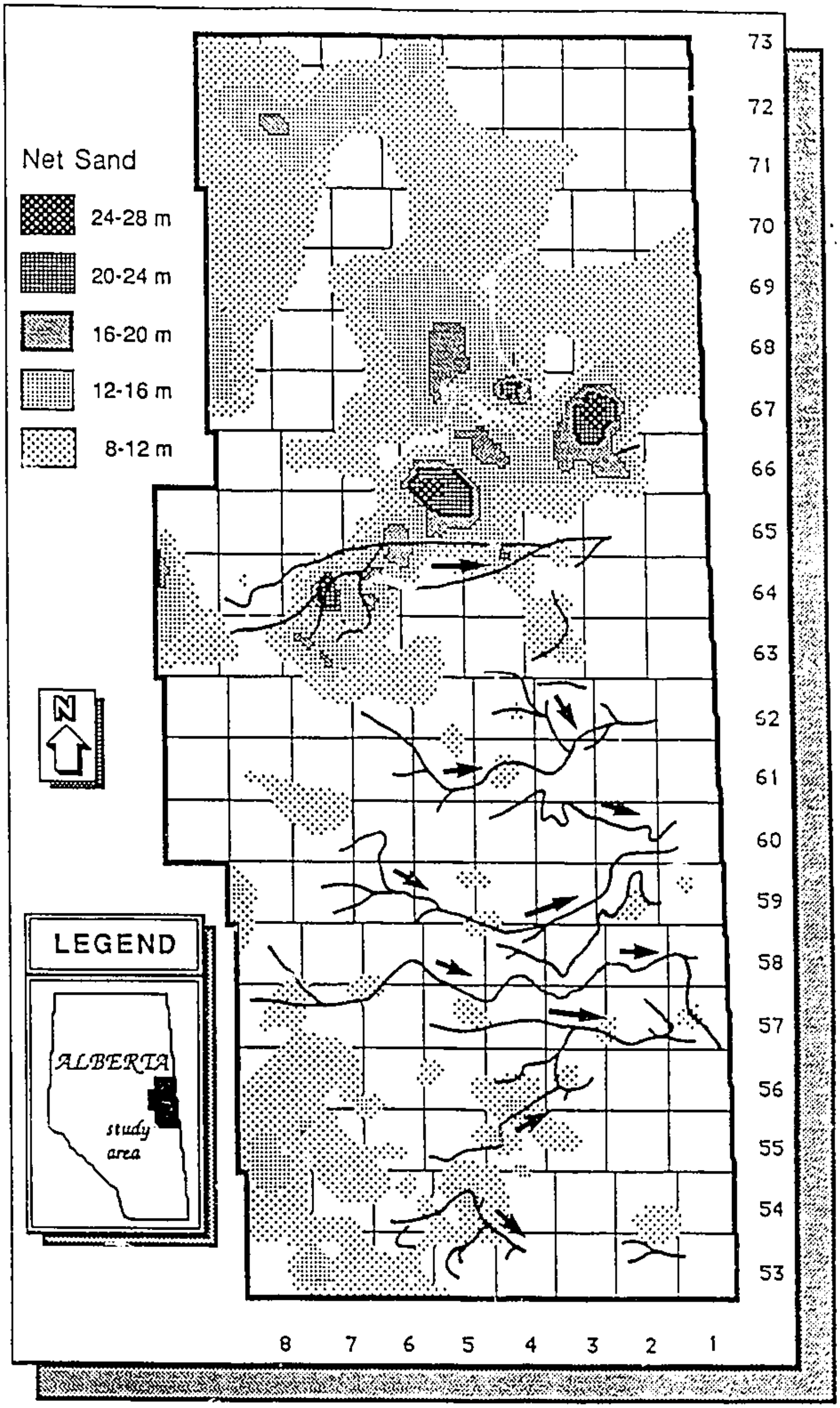
REGIONAL LLOYDMINSTER

FIGURE 24.-- Map of thicker than average net sand trends within the regional Lloydminster unit. See text for further explanation.



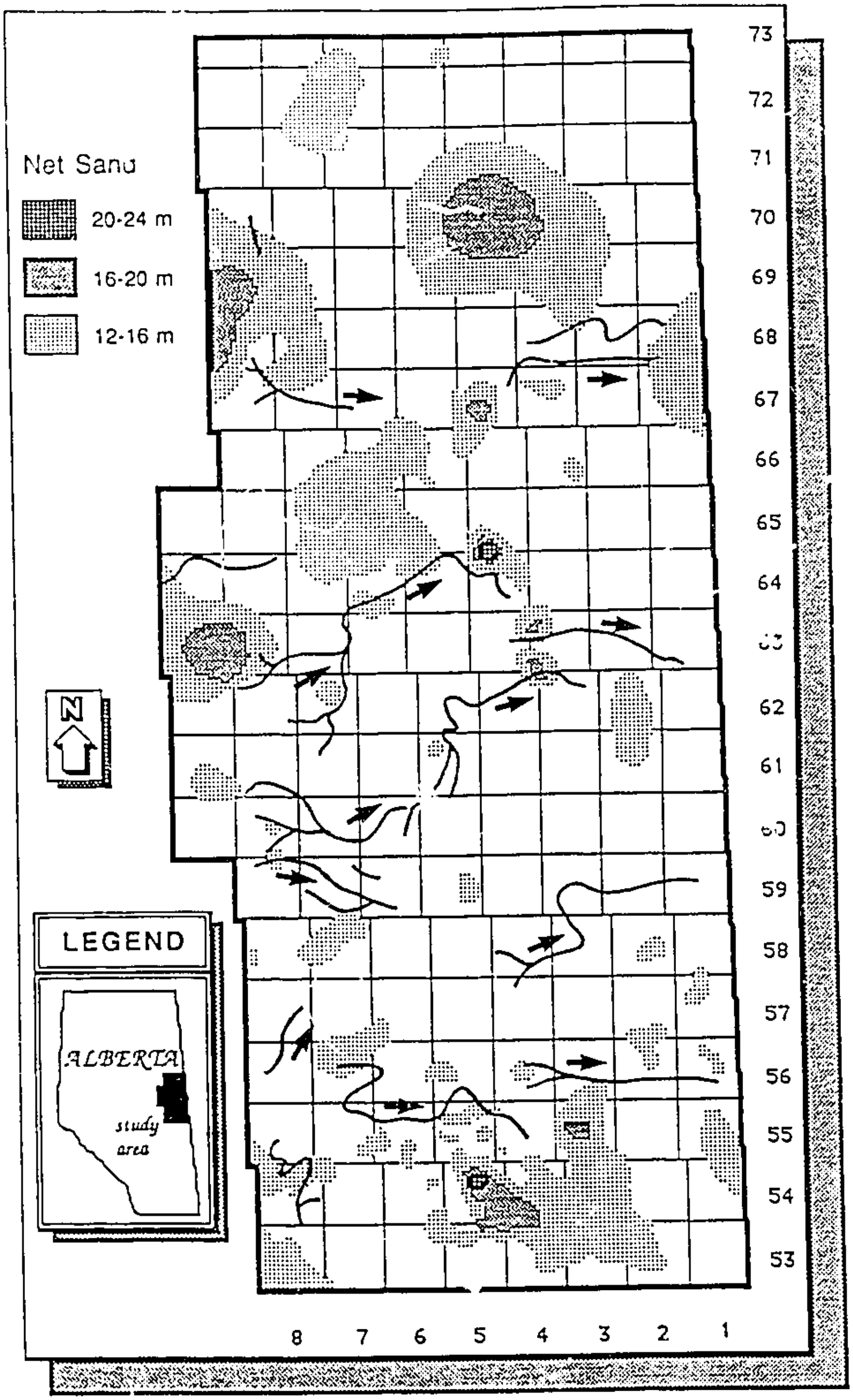
REGIONAL REX PLUS "LLOYDMINSTER CHANNELS"

FIGURE 25.-- Thicker than average net sand trends within the Rex unit shown with trends of channels incised from the top of the regional lloydminster unit into the Lloydminster and units below it. See text for further explanation.



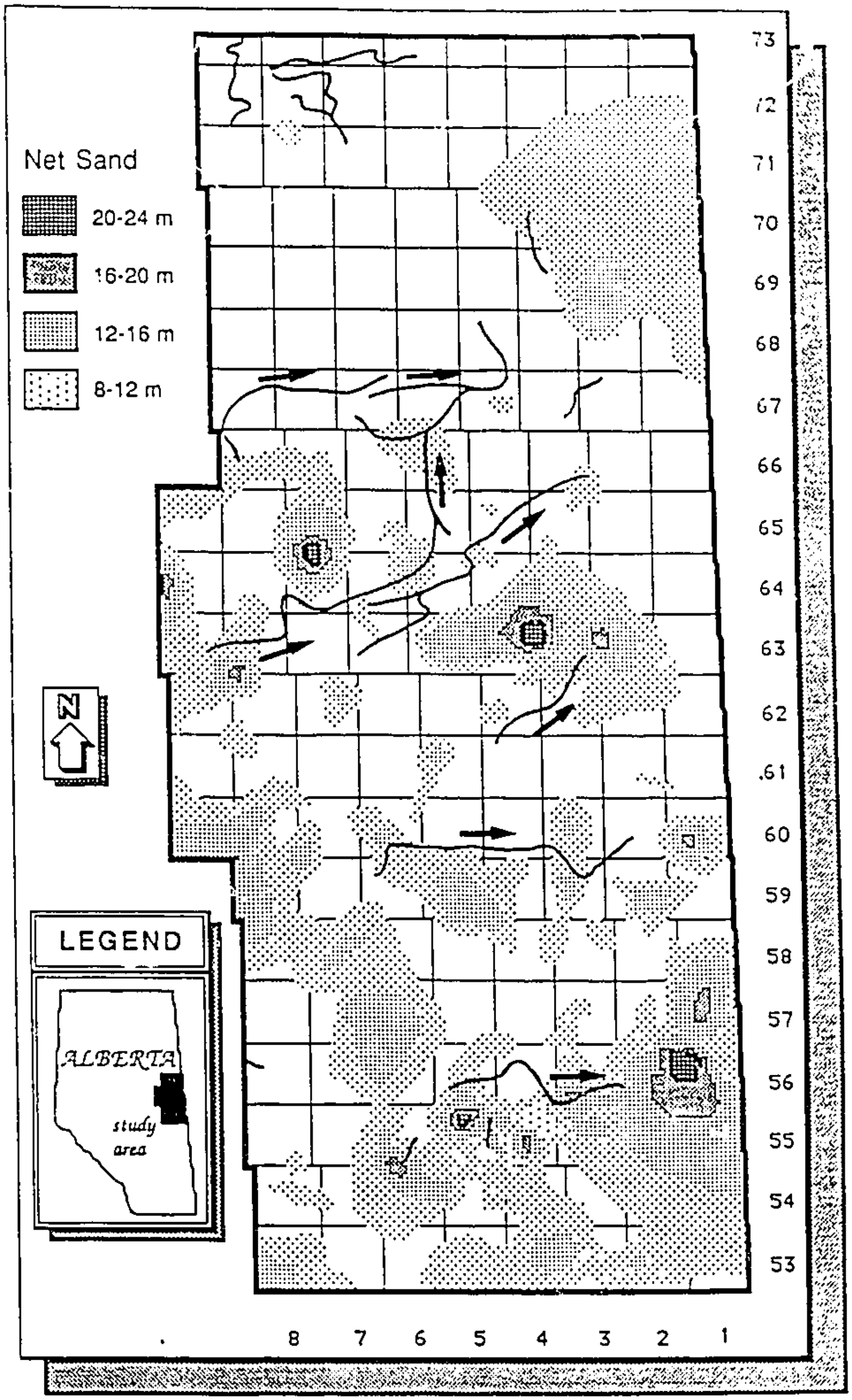
REGIONAL G.P. PLUS "REX CHANNELS"

FIGURE 26.-- Thicker than average net sand trends within the General Petroleums unit shown with trends of channels incised from the top of the regional Rex unit into the Rex and units below it. See text for further explanation.



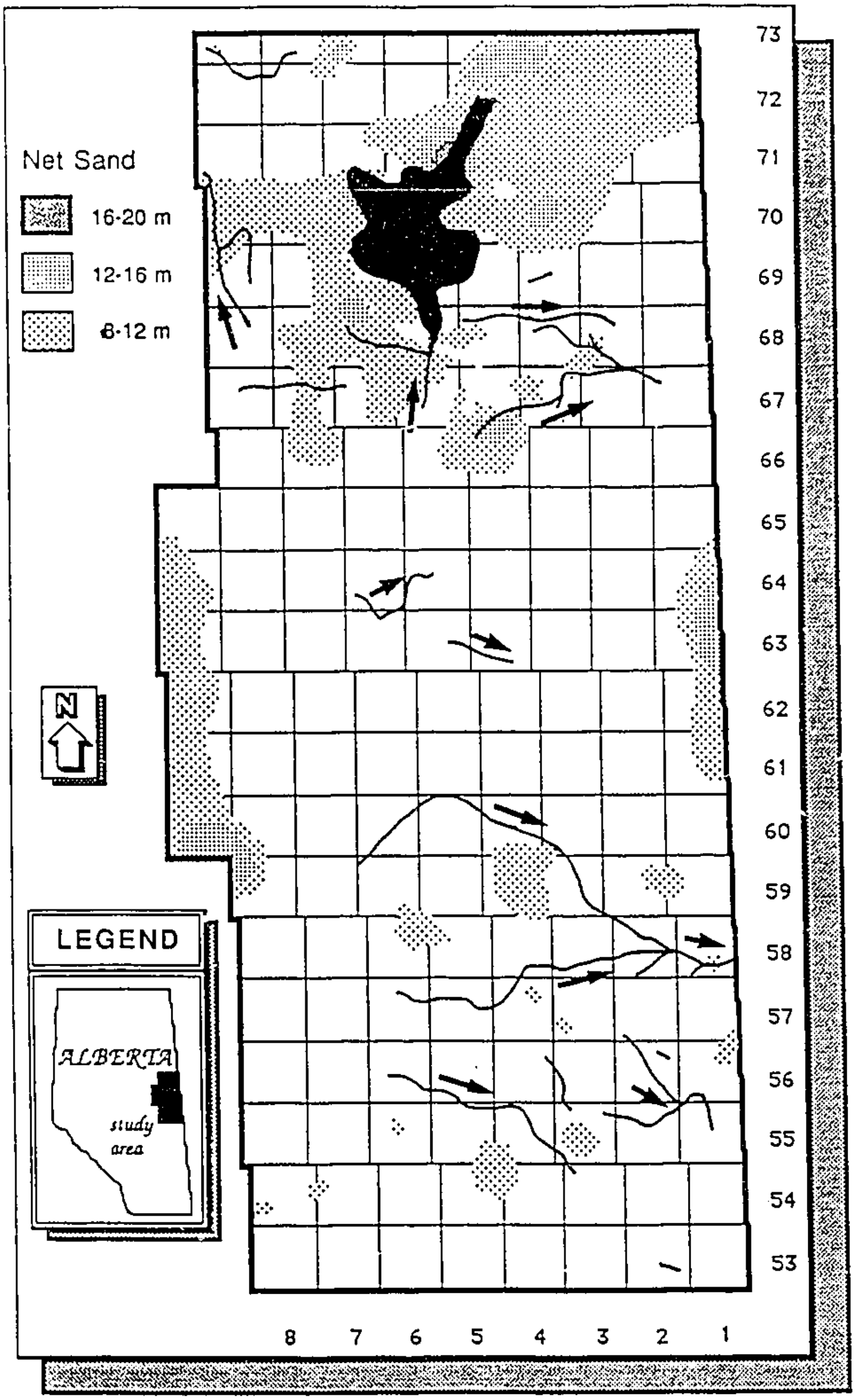
REGIONAL SPARKY PLUS "G.P. CHANNELS"

FIGURE 27.-- Thicker than average net sand trends within the Sparky unit shown with trends of channels incised from the top of the regional General Petroleums unit into the General Petroleums and units below it. See text for further explanation.



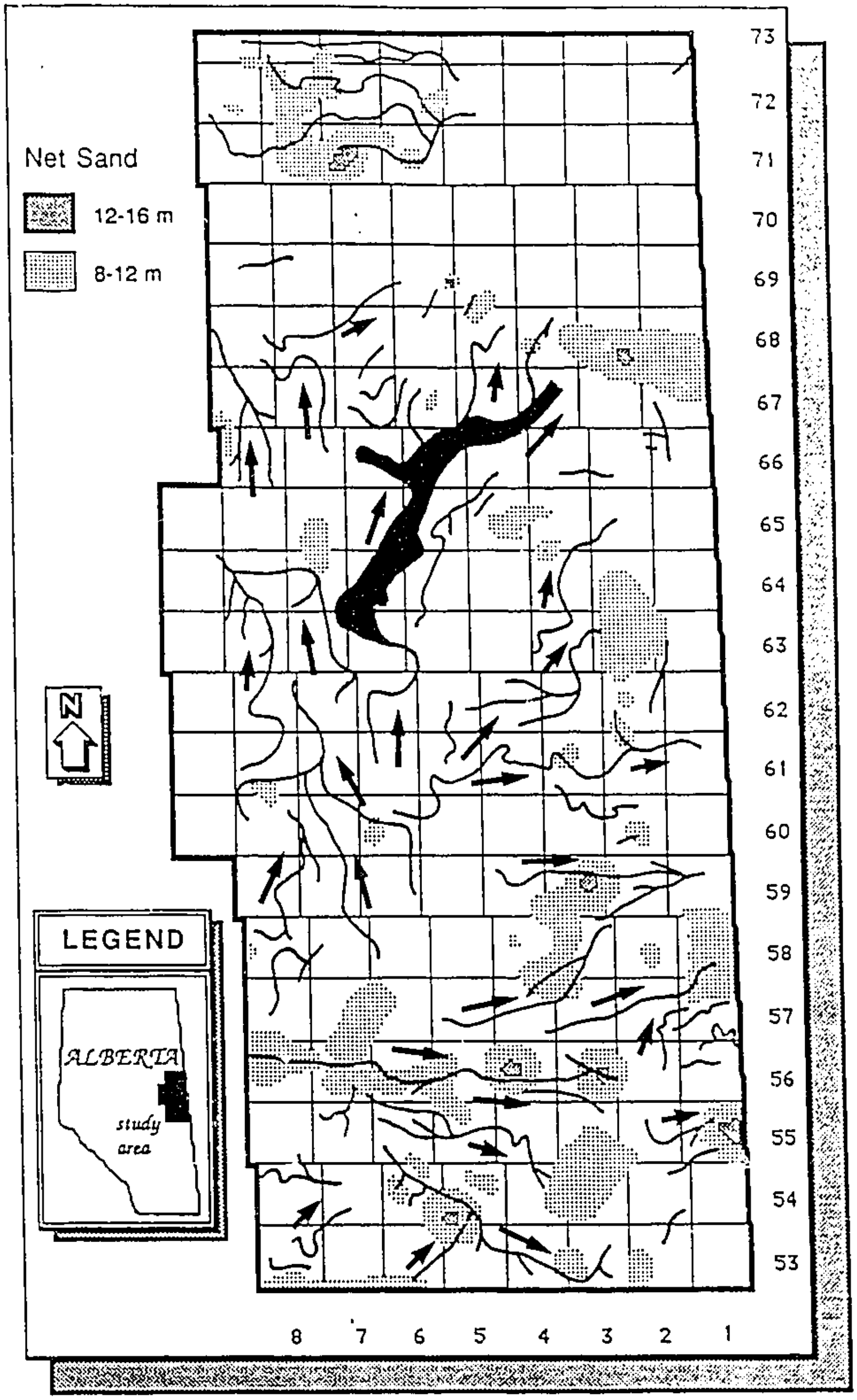
REGIONAL WASECA PLUS "SPARKY CHANNELS"

FIGURE 28.-- Thicker than average net sand trends within the Waseca unit shown with trends of channels incised from the top of the regional Sparky unit into the Sparky and units below it. See text for further explanation.



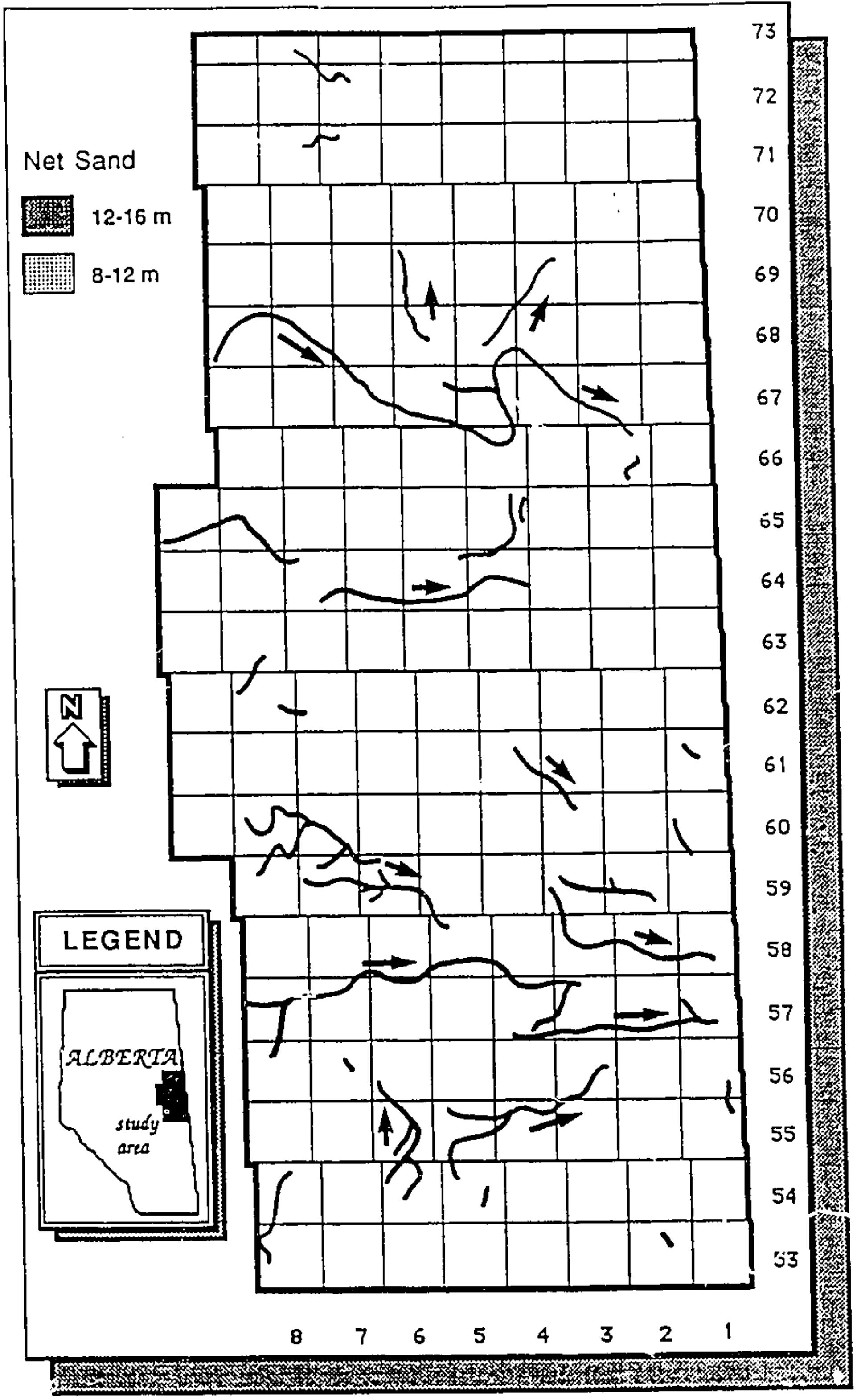
REGIONAL MCLAREN PLUS "WASECA CHANNELS"

FIGURE 29.-- Thicker than average net sand trends within the McLaren unit shown with trends of channels incised from the top of the regional Waseca unit into the Waseca and units below it. See text for further explanation.



REGIONAL COLONY PLUS "MCLAREN CHANNELS"

FIGURE 30.-- Thicker than average net sand trends within the Colony unit shown with trends of channels incised from the top of the regional McLaren unit into the McLaren and units below it. See text for further explanation.



"COLONY CHANNELS"

FIGURE 31.-- Map of trends of "Colony channel" networks. See text for further explanation.

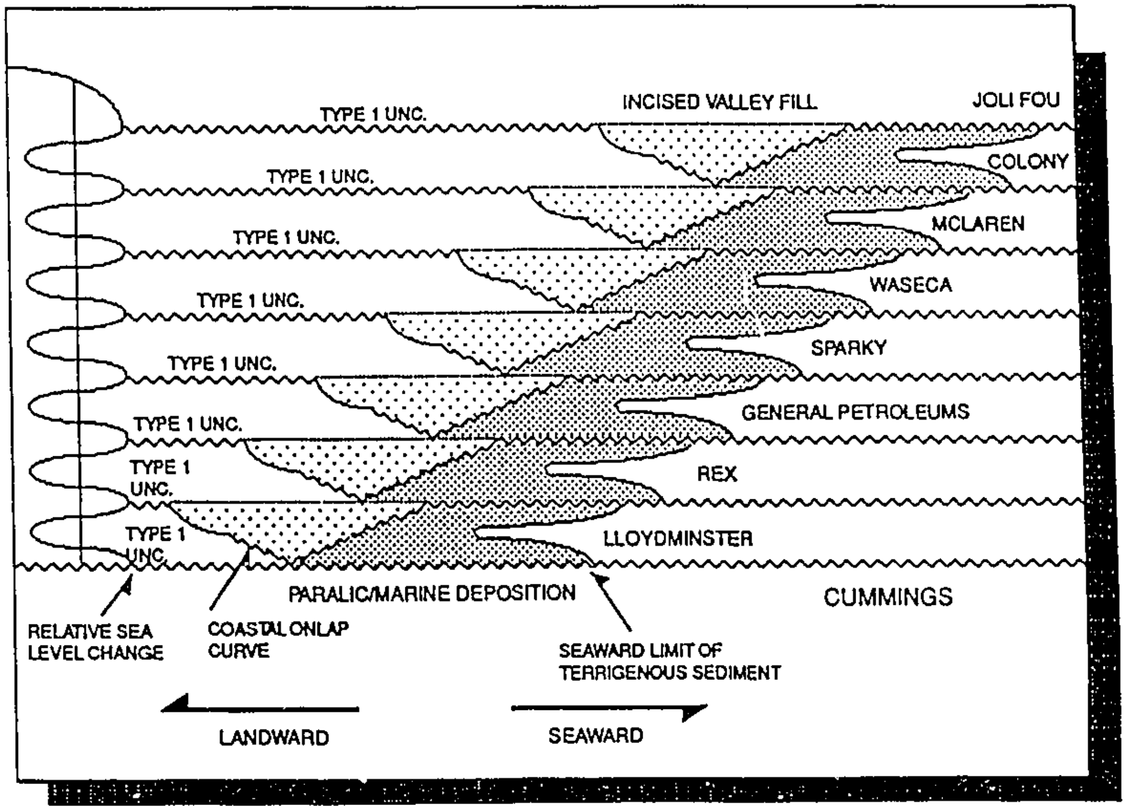


FIGURE 32.-- Model of transgressive-regressive cycles, channel incision and unconformity creation within individual units of the Upper and Middle Mannville subgroups. Note that the overall long-term trend within the interval is regressive as indicated by the overall seaward shift of the "seaward limit of terrigenous sediment" curve (modified after Posamentier et al., 1988).

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CHAPTER III

INCISED CHANNEL SYSTEMS OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS IN THE COLD LAKE OIL SANDS AREA OF EAST-CENTRAL ALBERTA

INTRODUCTION

Paleochannel systems within the Mannville Group of eastern Alberta have been the subject of interest in the oil and gas industry for over 40 years, due primarily to their reputation as prolific hydrocarbon reservoirs. During the last decade, there has been a great deal of controversy generated regarding the paleogeographic and facies characteristics of these channel systems, as well as their relationship to regional strata (Putnam, 1980; 1982a; 1982b; 1983; Putnam and Oliver, 1980; Wightman et al., 1981; Wightman et al., 1987). The purpose of this paper is to present a model for the development of Upper and Middle Mannville (Chapter I; Figs. 1 and 2) channel systems within a stratigraphic context, to describe their facies characteristics, and to map their networks throughout a large part of east-central Alberta.

FACIES CHARACTERISTICS

Recognition of paleochannels

Paleochannels of the Upper and Middle Mannville sub-groups typically display similar facies patterns regardless of their stratigraphic position. In drill cores (Fig. 35) they display a fining-upward profile typified by massive, fine- to coarse-grained sands overlying an erosive contact (Pl. 1A; 1B), commonly with a pebble lag or with angular to rounded shale clasts at their base (Pl. 2A). These intraformational conglomerates are thought to represent overbank material slumped into channels through lateral migration and bank collapse (see Mattison, 1987). Massive sands predominate near the base of channels but grade upward into fine- to very fine-grained cross-bedded sets with rare argillaceous interbeds (Pl. 2B), further grading into current rippled fine-grained sands (Pl. 3A) or interbedded sands and silts, and finally grading into laminated muds. Rare root traces and coals are found in these capping muds and indicate overbank depositional conditions (Pl. 3B). Mud-filled channels are uncommon within the succession, but where present are interpreted as having formed due to cut off and abandonment of previously active channels. These mud-filled channels are marked by thick successions of laminated muds displaying little or no evidence of bioturbation.

PREVIOUS STUDIES

Most previous studies of Mannville paleochannels in east-central Alberta and west-central Saskatchewan have focused on the Upper Mannville interval, although paleochannel systems are known to be pervasive within the Middle Mannville sub-group as well. Hume and Hage (1941) were the first to recognize the existence of paleochannels within the Upper Mannville (even before the name Mannville had been formally proposed). Since that time virtually every student of the Upper Mannville in east-central Alberta and west-central Saskatchewan has recognized the existence of these channels. A notable exception to this unanimity of opinion was provided by Lorsong (1982), who labelled supposed paleochannels within the interval "chimeras". Nevertheless, a consensus of opinion has been reached regarding the existence of Upper Mannville paleochannels, even though theories as to their genesis and their relationship to "regional" units have differed greatly.

The most debated issue in the past ten years has centred on the contention (Putnam, 1980; 1982a; 1982b; 1983; Putnam and Oliver; 1980) that Upper Mannville channels represent ancient anastomosed stream deposits (*sensu* Smith, 1973; Smith and Smith, 1980). Due to the difficulty in correlating and mapping channel systems in the subsurface, this model has faced a great deal of criticism in the past (Wightman et al., 1981). As an alternative to the anastomosed stream model, Wightman et al. (1987) proposed that parts of the Upper Mannville in east-central Alberta represent an ancient deltaic system with individual channels representing either fluvial channels or deltaic distributaries (see also McLearn, 1944; Clack, 1967; Kendall, 1977; and Orr et al., 1977).

ARGUMENTS FOR AND AGAINST PREVIOUS INTERPRETATIONS OF MANNVILLE PALEOCHANNELS

Anastomosed stream models

Putnam (1980; 1982b) suggested that Upper Mannville paleochannels represented anastomosed stream networks based on their thickness, their isolation in relation to regional strata, and other internal facies criteria. He felt that these criteria indicated that Upper Mannville paleochannels were characterised by rapid vertical aggradation, bank stability, and very little lateral migration. However, anastomosed stream networks also represent a specific type of drainage *pattern*, something that is exceedingly difficult to prove or disprove due to the limitations inherent in subsurface mapping. As well, two important lithofacies characteristics of these channels argue against an anastomosed interpretation that presupposes bank stability as an important criteria:

1. The common occurrence of intraformational conglomerates in Upper Mannville channels may indicate that channel banks were rather *unstable* and that lateral migration accompanied by bank undercutting was an important factor during deposition.
2. The anastomosed stream model of Smith (1973), and Smith and Smith (1980) dictates that a vegetated floodplain is a necessary requirement in promoting bank stability. Roots are found in overbank muds associated with Upper Mannville channels, but they are relatively rare. In addition, a lack of an abundance of carbonaceous detritus and detrital wood within these channelized deposits would indicate that channel banks were not stabilized by vegetation.

Fluvio-deltaic models

A number of authors have argued that the Upper Mannville in east-central Alberta represents an ancient deltaic system (e.g. McLearn, 1944; Clack, 1967; Kendall, 1977; Orr et al., 1977; Wennekers et al., 1979; Wightman et al., 1987) due to the intimate association of regional offshore-shoreface successions with channel systems. Wightman et al. (1987) argued the case for Upper Mannville deltaic systems on this basis as well as on the basis of facies associations and certain paleoecologic criteria (ichnology and palynology) which indicated a brackish water depositional regime. Putnam (1989) heavily criticised this interpretation on the basis that Wightman et al. (1987) produced no maps to illustrate the extent of their proposed deltaic depocentres. While many of the strongest arguments against the interpretation of channel anastomosis can be based on facies criteria alone (see Wightman et al., 1981), the facies similarities between deltas and regional shoreline successions dictate that ancient deltaic systems must be "proved in the mapping" (Miall, 1987). The following discussion will attempt to test the deltaic interpretation proposed by Wightman et al. (1987) as well as by others, and will focus on placing channel development within a regional paleoenvironmental and stratigraphic context.

PALEOCHANNEL DEVELOPMENT MECHANISMS

As previously stated, Upper and Middle Mannville paleochannels share an intimate association with regional shoreface to offshore depositional trends (Chapter II). Rather than simply keeping pace with the advance of individual progradational clastic wedges, however, these channels appear to deeply incise into underlying strata, achieving thicknesses of up to 60 m or more, depending on their paleogeographic position.

It is proposed that at least seven periods of channel incision took place during Upper and Middle Mannville time, and were responsible for creating at least seven distinct channel networks. Each of these incisional periods was initiated as a response to a rapid drop in base level near the regressional end of a relative transgressive-regressive cycle. The base of each channel system therefore represents a local unconformity surface, which, when traced laterally into regional offshore-shoreface coarsening-upwards successions, becomes a regional unconformity. Post-incisional infill of valleys created by fluvial downcutting occurred during subsequent transgressive events as rivers sought to readjust to a rising base level. Therefore, valley-fill successions are usually directly overlain by transgressive deposits. While valley-fill successions maintain an unconformable relationship with the strata into which their channels incise, the tops of the valley-fill successions are not (necessarily) unconformities, since they may be transitional to the transgressive marine strata above them.

It should be noted that the incised channels of the Upper-Middle Mannville interval are not unique within the Mannville as a whole. The highly dissected pre-Cretaceous unconformity surface that forms the lower boundary of the Mannville is a partial product of channel incision (Williams, 1963; McGookey et al., 1972; Mattison, 1987), and incised channel trends have also been found in other parts of the Lower Mannville (Clearwater Formation of the Cold Lake Oil Sands area -- Taylor, 1990; Glauconite Formation of southern and central Alberta --Rosenthal, 1988; Strobl, 1988; Wood and Hopkins, 1989). The valley-fill networks of the Upper and Middle Mannville are therefore a product of a cyclic depositional pattern that began early in the history of the Mannville Group and that are a common feature of the Cretaceous record of the Western Canadian Sedimentary Basin as a whole (Leckie, 1990).

The seven valley-fill systems within the Upper and Middle Mannville interval in the Cold Lake Oil Sands area cut down from the tops of seven unconformity-bounded stratigraphic units. These are referred to as the Colony, McLaren, Waseca, Sparky, General Petroleums, Rex, and Lloydminster units (Chapter II). The incised valley-fill channel networks form the basal deposits of these unconformity-bounded units. In effect, it is the valley-fill channel networks that define the vertical limits of these regional stratigraphic units, since it is the recognition of channel incision that most clearly demarcates the bounding unconformities between them. (See Chapter II for a full discussion of the relationship between the regional stratigraphic units and the incised channel systems) .

The limits of channel incision are sometimes uncertain, however. In some cases where channels are extremely deep, a number of episodes of cut and fill are thought to be represented. In these cases it is difficult to assign each episode of downcutting to a specific unconformity, since much of the record of underlying channels has been destroyed by later incision. This results in a situation where a number of stacked channels, formed as a result of several periods of incision, may appear to form a single thick channel infill, especially in cases where channel interpretation is based on well log signatures rather than drill core observations. Enough drill cores are available within the study area, however, to indicate that deep incision in response to relative base level drop has been a factor in the creation of all seven paleochannel networks. Despite the problems inherent in subsurface geomorphologic mapping of paleochannel systems, multiple, superimposed channel incision seems to be the only mechanism that would account for the extraordinary thicknesses of channels found in both the Upper and Middle Mannville, as well as for their relative local isolation in relation to regional stratigraphic successions.

It must be stressed that the evidence for channel incision does not exclude other genetic interpretations for Upper and Middle Mannville paleochannels, especially that these systems represent deltaic distributaries. As an attempt to test the deltaic hypothesis of Wightman et al. (1987), and to see whether or not local thick sand depocentres that might indicate deltaic deposition were present within the Upper Mannville interval, net sand maps of regional offshore-shoreface deposits were constructed for the Upper-Middle Mannville interval as well as for each of the regional stratigraphic units within it (Chapter II; Figs.13-20). These maps were in turn compared with maps of channel trends within all of the units in question (see following discussion). In some cases small local depocentres were found which seem to have had paleochannel feeder systems associated with them. This evidence agrees with the speculations of Wightman et al. (1987) that any deltas within the Upper Mannville would have been small, isolated systems. In some other cases though, paleochannel systems do not display an association with paralic sand depocentres. In these cases, lack of evidence for such centres may indicate that storm, wave, and current activity effectively redistributed alluvial material brought to the paleoshoreline. Therefore, while the entire Upper-Middle Mannville interval cannot be classified as "deltaic", local sand depocentres within some of the regional units of the interval suggest that small, local deltas may have periodically been an important paleogeographic feature during the evolution of the succession.

Model for channel incision

A basic model for channel incision is shown in Figure 34. Incision begins when a major drop of sea-level causes rivers to downcut towards a new base level. The relatively unconsolidated nature of Mannville sediments in the Cold Lake Oil Sands area may have allowed rivers to respond quite quickly to their new base level(s) during sea level fall, thus allowing deep channel incision within a relatively short period of time. Channel fill is thought to have begun during the waning stages of sea level withdrawal, and to have continued during subsequent transgression. In some cases transgression may have been great enough to drown channels through marine incursion, causing the development of estuaries in nearshore areas (see also Weimer, 1984; 1988; Posamentier, 1988; Posamentier and Vail, 1988, Posamentier et al., 1988).

Estuarine vs. fluvial channels: ichnologic evidence

Both estuarine and fluvial channels are recognizable within the Upper and Middle Mannville sub-groups. Recognition of the facies differences between these two types of channels is critical to precise paleoenvironmental mapping since it gives an indication of paleoshoreline locations during time of deposition. However, estuarine and fluvial channels for the most part display almost identical lithofacies patterns. Differentiation between the two types of channels is based primarily on presence or absence of a significant trace fauna, as well as on the presence or absence of small scale sedimentary structures indicative of tidal depositional conditions (e.g. mud layer couplets).

Ichnofossils are found only in channel sediments interpreted as developing under a brackish water depositional regime. While high energy regimes within these systems do not tend to preserve ichnofossils other than rare traces of escape (Pl. 4A), lower energy environments such as channel margins, or channel fill deposits that show evidence of depositional hiatuses, may display abundant bioturbation. The constituent trace fauna within these sediments is dominated by a small number of genera, with *Planolites*, *Skolithos*, *Cylindrichnus*, and *Chondrites* being the most common types (Pl. 4B). *Skolithos* and *Cylindrichnus* predominate within the constituent ichnocoenose, reflecting a dominance of filter feeders over deposit feeders in the original infaunal system. Accessory ichnogenera include *Teichichnus*, *Arenicolites*, *Helminthopsis*, *Helminthoida*, *Palaeophycus*, and *Bergaueria*, with rare *Rosselia*, *Trichichnus*, *Ophiomorpha*, *Thalassinoides*, *Conichnus*, *Asterosoma* and *Gyrolithes* . Sediments interpreted as having been deposited in tidal flats associated with these estuarine channel networks display much the same ichnofauna, although there is a general trend towards smaller size and greater overall ichnologic diversity. Similar ichnologic trends have previously been documented for a number of ancient estuarine depositional systems (e.g. Bjerstedt, 1987;

Mattison, 1987).

MAPPING UPPER AND MIDDLE MANNVILLE PALEOCHANNELS

Mapping of channel systems in the subsurface is a complicated process at best, because of such factors as well spacing and amount and quality of subsurface information obtained from well logs and cores. Even though they are based on an extensive (1100 wells) and high quality database, it should be emphasized that maps of paleochannel networks presented in this study are only hypothetical and are subject to revision as further subsurface information becomes available.

In order to try to determine the paleotopography of each of the unconformity surfaces associated with the seven regional units of the Upper-Middle Mannville interval, regional structure was normalized to a regional stratigraphic datum (Base of the Fish Scales marker). However, this procedure does not give any indication of the elevation of the base of paleochannels-- it only yields values for the uppermost unconformity surfaces associated with each of them. Since it is entirely likely that the topography of these unconformity surfaces may have been modified following channel infill, either through subaerial erosion or through ravinement associated with a subsequent transgression, or even through syn- or post-depositional differential compaction or differential subsidence, mapping of unconformity surfaces normalized to a stratigraphic datum will only give a very crude measure of paleotopography during channel incision and subsequent infill. Mapping the depth of incision of paleochannels does not aid in determining paleoflow directions either, since it is usually impossible to determine whether a particular well sits on the flanks or in the thalweg of a particular channel. The difficulties in mapping these paleochannels quickly becomes apparent when assessing whether channels have undergone one period of deep channel incision and subsequent infill, or whether they represent a number of periods of cut and fill associated with more than one unconformity surface (Fig. 35).

All of these factors were taken into account in drafting the maps of paleochannel trends illustrated in Figs. 95-101. Connections between wells which showed evidence of channel incision associated with a particular unit were made conservatively, based on overall trends in normalized paleotopographic data as well as trends in channelized section thickness. In addition, anomalously thick channelized sections were assessed in relation to trends of paleochannel systems associated with underlying units in order to determine the most likely points where channel amalgamation may have taken place. Anomalies in regional structure were also used in making decisions regarding the trends of paleochannels, especially in relation to post- or syn-depositional differential subsidence. Wherever possible drill core data were considered in order to determine depositional limits and trends in the course of paleochannels.

Middle Mannville paleochannels

Lloydminster channels (Appendix 4; Fig. 95)

Of all of the units within the Upper-Middle Mannville interval, the Lloydminster unit is the least dissected by its own associated channels. However, channel incision into the regional Lloydminster does occur from units much higher in the succession. In fact, some wells show channel incision from as high as the top of the Colony unit. There is little doubt that these particular wells represent amalgamated channels associated with more than one period of channel incision, and most of the channels that incise into the Lloydminster do so from the uppermost surfaces of the Rex and General Petroleums units. Most of these channels incise only part way into the Lloydminster rather than cutting into the underlying regional Cummings unit.

Rex channels (Appendix 4; Fig. 96)

The Rex paleochannel network displays much more regional dissection within the study area than is the case for the Lloydminster channels. For the most part, these channels display a dendritic drainage pattern with a large number of tributaries. Paleoflow direction was dominantly towards the east or northeast, although tributary systems may locally flow in any direction. No Rex paleochannel systems were found north of Township 67, although this is thought to be due mostly to the masking effects of a dense network of deeply incised Sparky, Waseca, and McLaren channels in the area north of Township 68. In the area south of Township 67 most of the truncation of regional Rex strata is due to either Rex channels themselves or else General Petroleums channels which generally cut through the regional Rex and terminate in the regional Lloydminster.

General Petroleums channels (Appendix 4; Fig. 97)

The degree of regional dissection associated with incision of General Petroleums channels is not as great as that achieved by Rex paleochannel networks. Dominant paleoflow direction of main channels was generally towards the northeast in the central part of the study area (T60-64), while in the south (T53-60) paleoflow was generally directed towards the east, even though local exceptions apply.

Sparky channels (Appendix 4; Fig. 98)

Paleochannel dissection of the regional Sparky by Sparky channels is similar to the levels achieved during General Petroleums incision. Again, as was the case for General Petroleums channels, an overall paleoflow trend from west to east is found in the southern part of the study area (T53-60) while in the central part of the study area (T61-68) paleochannels are thought to have flowed mostly towards the northeast. A fairly dense network of channels is found in the area north of T71 between R5W4 and R8W4. Paleoflow directions are highly uncertain in this area due to the lack of a good stratigraphic datum from which structural data might be normalized. The Base of the Fish Scales marker as well as the Second White Specks marker appear to be missing in this area due to incision of Cenozoic channels into the regional Colorado Group.

As in many of the other units of the Upper-Middle Mannville interval, depth of channel incision within the Sparky can be highly variable. Previous studies of the Sparky in the Lloydminster area have also shown a great range in channel thickness (see for instance Van Hulten and Smith, 1984; fig. 7), indicating that multiple periods of incision may have occurred during the exposure of the regional Sparky unconformity surface.

Studies of Sparky channels in the Lloydminster area (MacCallum, 1979; Putnam, 1982a; 1982b; Smith, 1984; Smith et al., 1984; Van Hulten and Smith, 1984; and Haidl, 1986) have shown that they consist of multiple sand- or mud-filled channels eroded through the regional Sparky, as well as into parts of the underlying regional G.P., Rex, and Lloydminster units. Maximum depths of Sparky channel incision agree with data from the present study. However, data from the Lloydminster area suggest that mud-filled channels are more common than sand-filled channels. In the Cold Lake area mud-filled channels are virtually absent.

Upper Mannville paleochannels

Waseca channels (Appendix 4; Fig. 99)

Within the Lloydminster heavy oil belt, reports of Waseca paleochannels include those of MacEachern (1982; 1984; 1986), Van Hulten (1984), and Haidl (1986). According to these authors the bulk of the Waseca channel systems show no apparent evidence of incision, and probably were deposited penecontemporaneously with the regional facies of the Waseca. These interpretations stand in direct contrast with the evidence from the Cold Lake Oil Sands area, where Waseca channels incise as deep as the regional Rex unit (see also Mathison, 1988).

As in the case of all underlying units previously mentioned, paleoflow direction is thought to have been dominantly west to east in the southern part of the study area (T53-60). Sparky channels are rare in the area between T62 and T66, but in the area north of T67 paleochannel direction is assumed to have been dominantly northward. Some channels demonstrate an eastward-flowing trend in the area between T67 and T68, although the major northward trend is demonstrated by the dense network of paleochannels found in the area between T68-72 and R4-6W4. The network in this area is so dense that trends of individual channels could not be determined based on the data available, although the general northward trend is discernible.

The regional Waseca is also dissected by McLaren and Colony channels, the former being the more common of the two. Most McLaren channels do not cut any deeper than the regional Waseca unit.

McLaren channels (Appendix 4; Fig. 100)

The McLaren paleochannel network is is by far the most dense of any of the seven networks in the Cold Lake area. Inferred paleoflow directions are similar to those of

Waseca channels, with most channels in the southern part of the study area (T53-59) flowing towards the east, and most channels in the central part of the study area (T59-68) flowing towards the north or northeast. This central part of the study area is dominated by a major north-northeasterly trending, highly dissected zone, similar to that which dominates the Waseca paleochannel network in the same area. Again, the density of paleochannels in this area is such that exact courses of channels cannot be ascertained. The extreme northern part of the study area (T71-73) is also dissected by an extremely dense paleochannel network which may show a west-east trend, although the lack of a good stratigraphic datum in this area poses problems in determining paleoflow direction (similar to those discussed for Sparky paleochannels)

Incised McLaren paleochannels have been the subject of a number of studies in the past. Gross (1980), for instance, made particular note of McLaren channels in his discussion of Mannville paleochannels in east-central Alberta, and Kramers et al. (1989) and Kramers et al. (1990) noted a particularly good example of a McLaren paleochannel system in the Provost area of southeastern Alberta. Wennekers et al. (1979) also noted good examples of McLaren paleochannels in the Lloydminster area. Within the Cold Lake Oil Sands deposit, Mathison (1988) recognized a northeasterly-trending McLaren channel system in the Fort Kent area (T61-R4W4). Mathison felt that these paleochannels were associated with a unit that he referred to as the "Lower McLaren" and that the so-called "Upper McLaren" consisted entirely of regional shoreface-offshore deposits. The present study disagrees with this interpretation slightly in that detailed mapping in this area indicates that Mathison's "Upper McLaren" should be included within the regional Colony unit. Nevertheless, the present study agrees with the main trend of McLaren paleochannels demonstrated by Mathison (1988). Mapping of McLaren channels on a regional basis also indicates eastward and westward extensions of this main trend.

Colony channels (Appendix 4; Fig. 101)

Although not as pervasive as McLaren or Waseca channel networks, incised Colony channels are common in the Cold Lake area. The dominant paleoflow trend of these channels was towards the east, although a number of exceptions to this rule appear in the southern part of the study area (T56-R6W4), and a weak northerly trend appears in the northern part of the study area, north of T68.

Channel incision near the end of Colony deposition may have been a regional phenomenon across the Western Canadian Sedimentary Basin. The uppermost surface of the Cadotte Member of the Peace River Formation in northeastern British Columbia, thought by some (Leckie and Reinson, in press) to be time-equivalent to the Colony-Joli Fou unconformity surface, shows evidence of incision indicative of a major drop in sea level near the end of early Albian time (Leckie, 1987; Hayes, 1988; Leckie and Reinson, in press). The Colony-Joli Fou unconformity represents an extensive hiatus (the whole of Middle Albian time), and the regional Colony may thus represent a period in which multiple incision has taken place. Part of the evidence for this hypothesis may lie in the variation in depths of incision displayed by main channel networks in the Colony as well as their inferred tributaries.

DISCUSSION

Mechanisms for channel incision

The great thicknesses observed in the Upper and Middle Mannville paleovalleys suggest that other factors, in addition to sea level change, were involved in channel development. Incision, as a consequence of relative sea level drop, must have recurred periodically during deposition of the interval. These episodes of incision resulted in a stacking of channel deposits in some areas. Terracing within the valleys may have been another consequence of these events. However, this is impossible to prove in the absence of extremely close core control or seismic data.

Syndepositional dissolution of underlying Devonian salts in the eastern part of the study area is also proposed as a mechanism for achieving rapid base level drops and consequent deep incision. Rapid incision can be achieved not only through base level drop or tectonic uplift but also through climatic change (e.g. periodic flooding events--Maizels, 1987). The unconsolidated nature of sediments within the Upper-Middle Mannville stratigraphic interval would have allowed channels to quickly incise and achieve their normal graded profile.

Upper-Middle Mannville channel incision: A complex response process?

As emphasized previously, incised channel networks within the Upper and Middle Mannville display a great deal of thickness variability. This variability exists not only on a study-area-wide level (as would be expected) but also on a local scale.

It should be remembered, though, that drainage networks are complex systems and that their response to any type of base level change, or to changes in sedimentation rate, or even to climatic change, will also be complex. Studies of Holocene incised alluvial channels in the southwestern United States have shown that magnitude and duration of cycles of incisement and aggradational infill within canyons and valleys vary not just from valley to valley but within the same valley (Kottlowski et al., 1965; Schumm, 1973). In Alberta, studies comparing terracing in Holocene valleys with their tributaries have shown out-of-phase relationships in cycles of incision and deposition even in closely related streams (Rains and Welch, 1988).

All of the examples cited above are illustrations of the principle of complex response (Schumm, 1973; 1975; 1979) (Fig. 36). Although originally based on scale model studies, there is abundant evidence from the Holocene record that base level change applied to full-scale geomorphic systems is a highly complicated process and that local diversity within drainage networks (e.g. depth of incision, timing of aggradation) may be exceedingly common. Thus, stream rejuvenation in response to a single base level drop may initiate a series of events that will result in multiple periods of incision and deposition, all of which may be out of phase within different parts of a drainage network (Rice, 1988).

Given the problems in ascertaining the effects of base level changes on the timing of erosional and depositional events in the examples of Holocene drainage networks cited above, the local variability of incision depth observed within Upper and Middle Mannville paleochannel networks (see Appendix 1; Table II, and Figs. 95-101) seems less than surprising. The inherent difficulties in dealing with complex response in surface Holocene examples must be greatly exaggerated by the uncertainties imposed by the subsurface mapping process (Schumm, 1985; Baker, 1988).

CONCLUSIONS

Detailed well log and drill core analysis reveals that seven distinct valley-fill networks are preserved within the Upper and Middle Mannville sub-groups of the Cold Lake Oil Sands area in east-central Alberta. Each of these networks is thought to represent a period of channel incision brought about by relative base level drop, followed by subsequent infill during a period of relative base level rise. Some valley-fill systems are thought to have fed small paralic sand depocentres which may represent local deltas. Successive periods of base level drop exposed regional paralic and terrestrial deposits to erosion, thus creating regional unconformities, which divide the Upper-Middle Mannville interval into seven regional sequences (*sensu* Van Wagoner, et al., 1988).

Depths of channel incision often exceed the thicknesses of their associated sequences. This indicates either a succession of periods of incision masked by the effects of subsequent downcutting events as newly incised channels reoccupied the course of former incised channels, or else exceptional relative base level drops brought about either eustatically or tectonically. In some cases relative cause may be impossible to ascertain. Depth of channel incision within networks also varies greatly on both a local and on a regional scale within the Cold Lake Oil Sands area, and is thought to represent the effects of complex response of geomorphic systems to changes in relative base level and sediment supply.

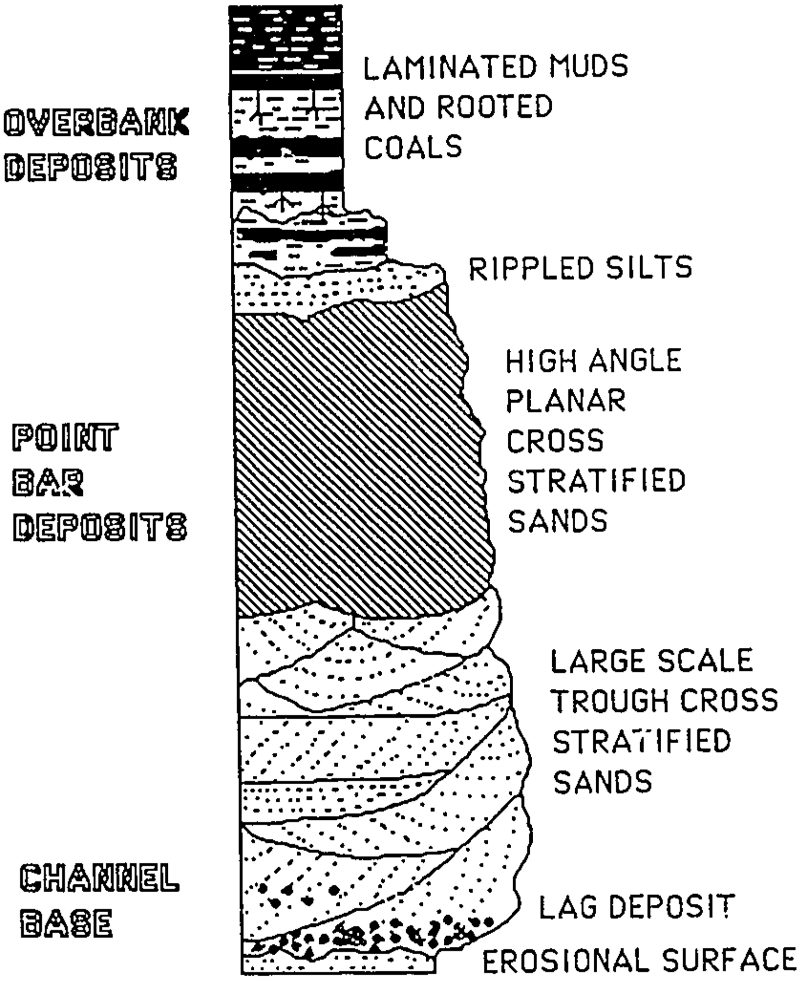


FIGURE 33.-- Illustration of typical facies associations in fining-upwards channel-fill successions within incised valleys.

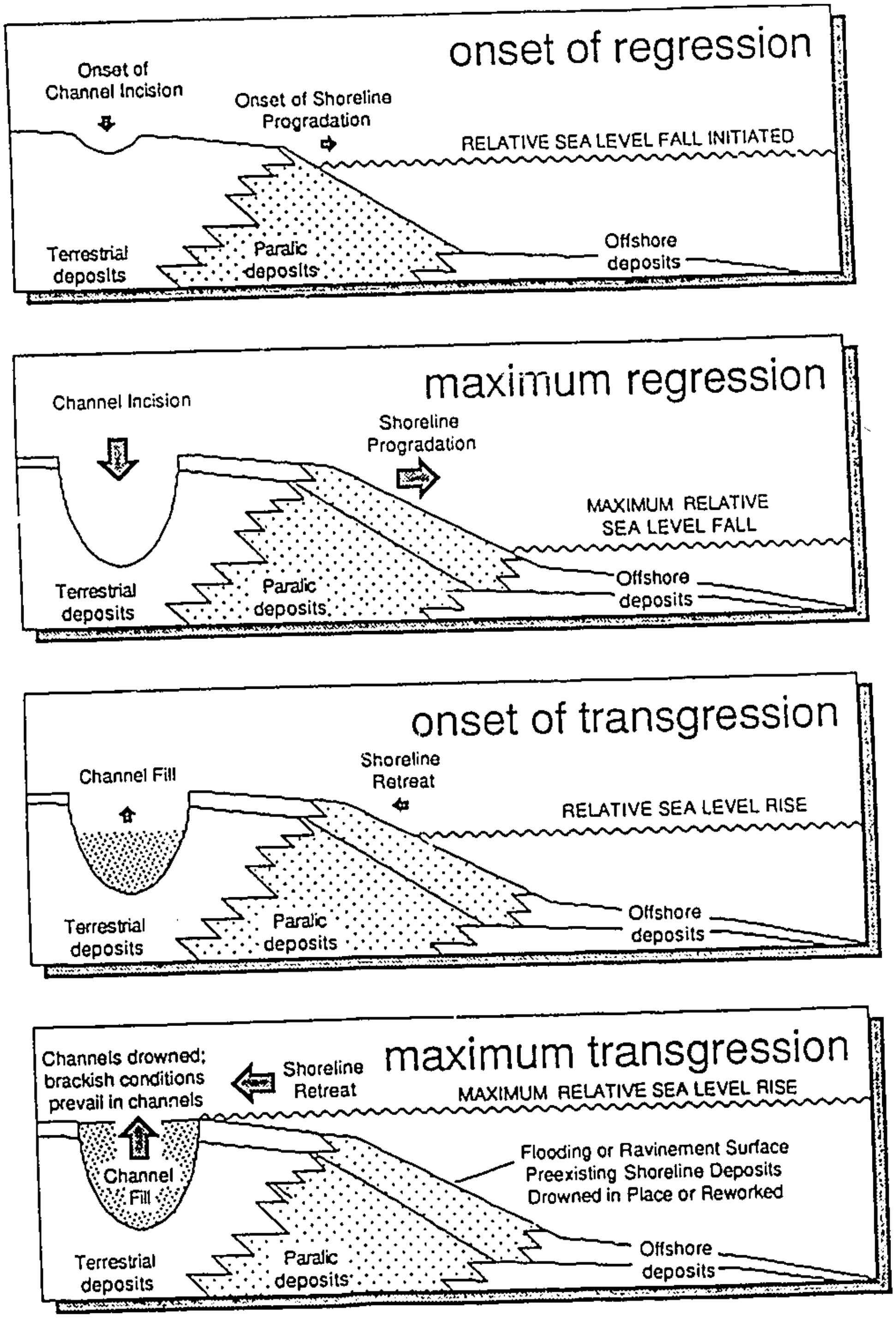


FIGURE 34. -- Highly simplified model of channel incision and aggradational infill in response to relative base level changes.

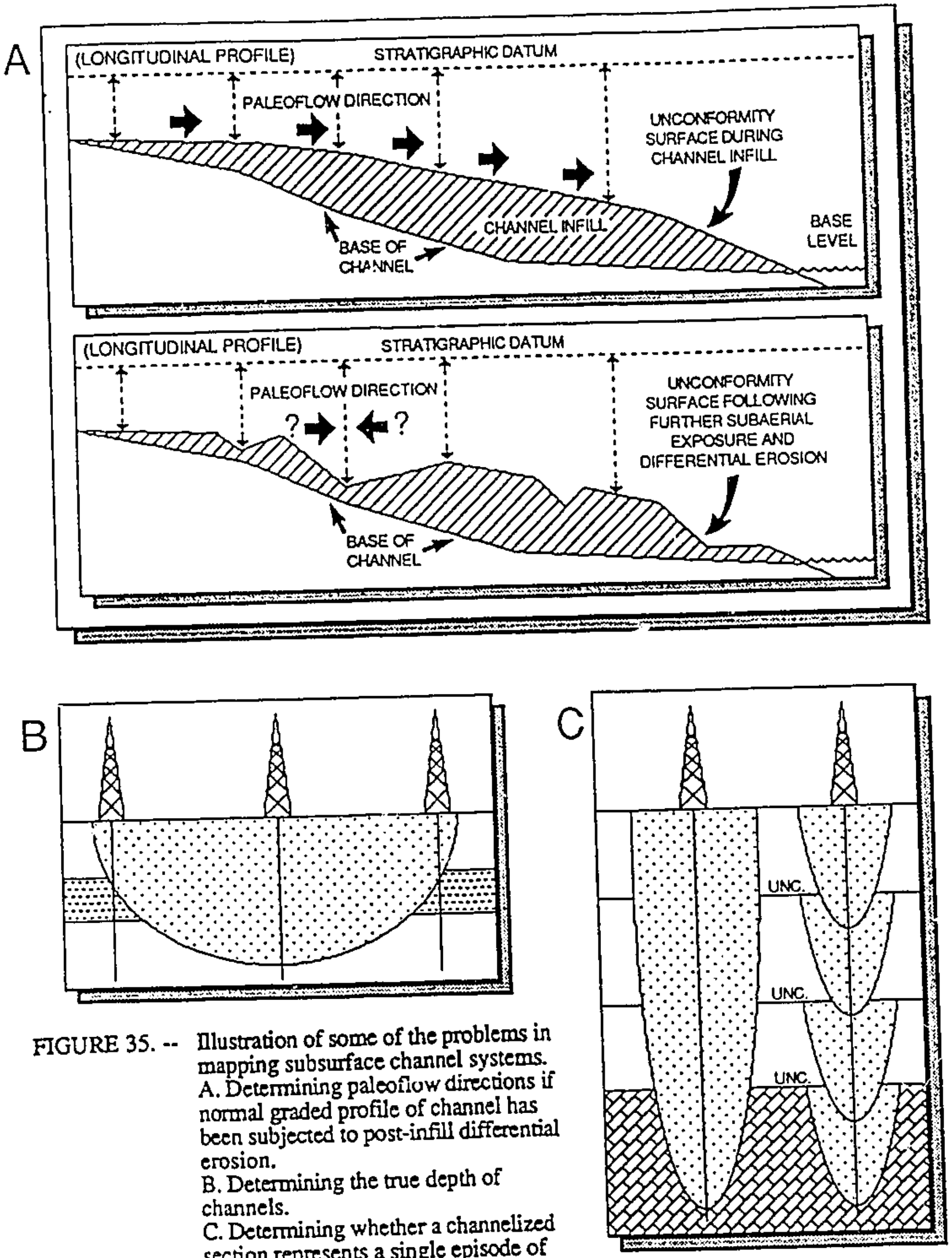


FIGURE 35. -- Illustration of some of the problems in mapping subsurface channel systems.
A. Determining paleoflow directions if normal graded profile of channel has been subjected to post-infill differential erosion.
B. Determining the true depth of channels.
C. Determining whether a channelized section represents a single episode of channel incision and fill or multiple episodes related to multiple unconformity creation.

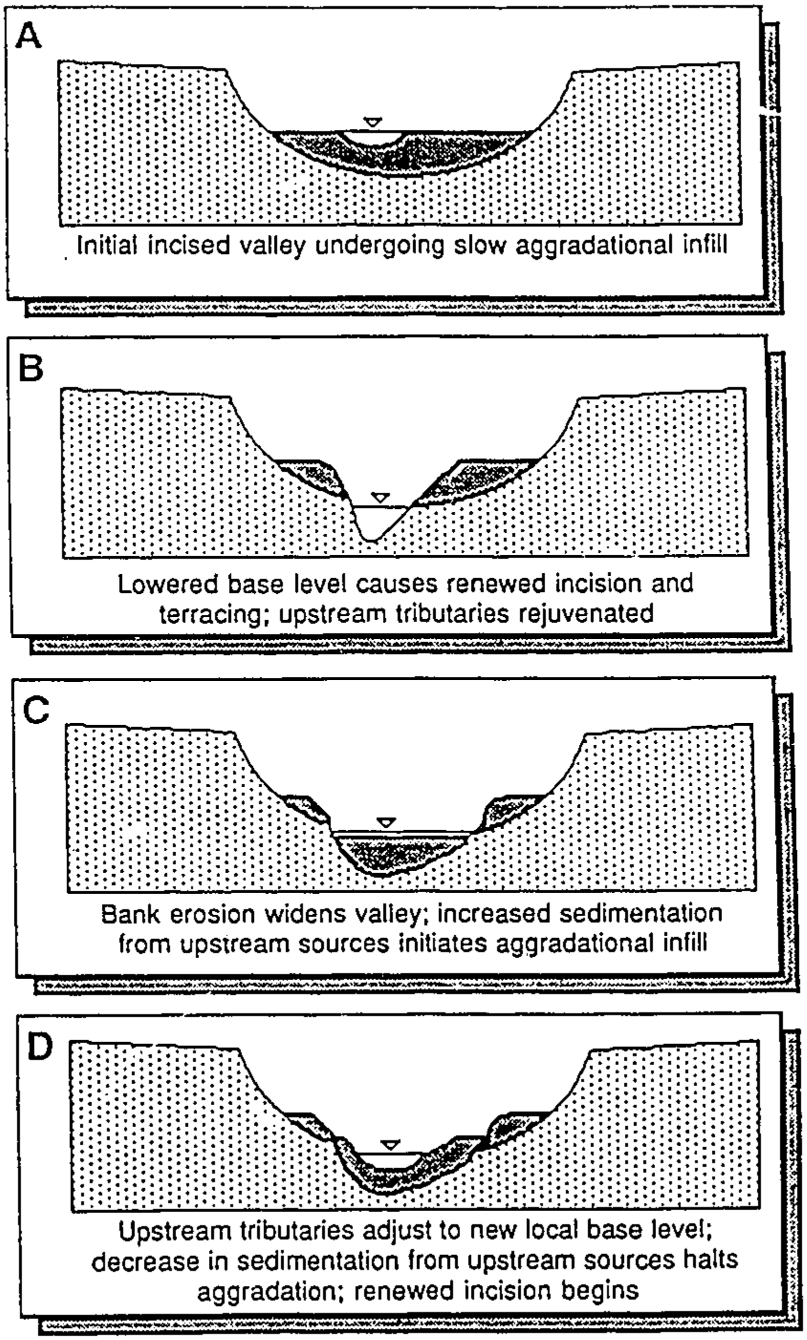


FIGURE 36. -- Example of complex response of a previously incised stream to a single period of base level drop and consequent rejuvenation (modified after Schumm, 1973; 1975)

PLATE 1. -- Examples of channel deposits erosively cut into offshore shales, Upper-Middle Mannville interval.

A. Highly oil saturated fluvial channel (Sparky channel) deposits cut into highly bioturbated offshore shales (G.P. unit). Note clasts at bottom of channel and erosive nature of the contact. Scale bar equals 2 cm. Core reads from upper right (top) to lower left (bottom). (6-27-55-5W4; 506.0 m below K.B.).

B. Load casts along erosive contact between fluvial channel (McLaren channel) sands and moderately bioturbated to oscillation rippled offshore silts (Sparky unit). Small divisions on scale bar equal 1 cm. (3-15-61-5W4; 350.0 m below K.B.).

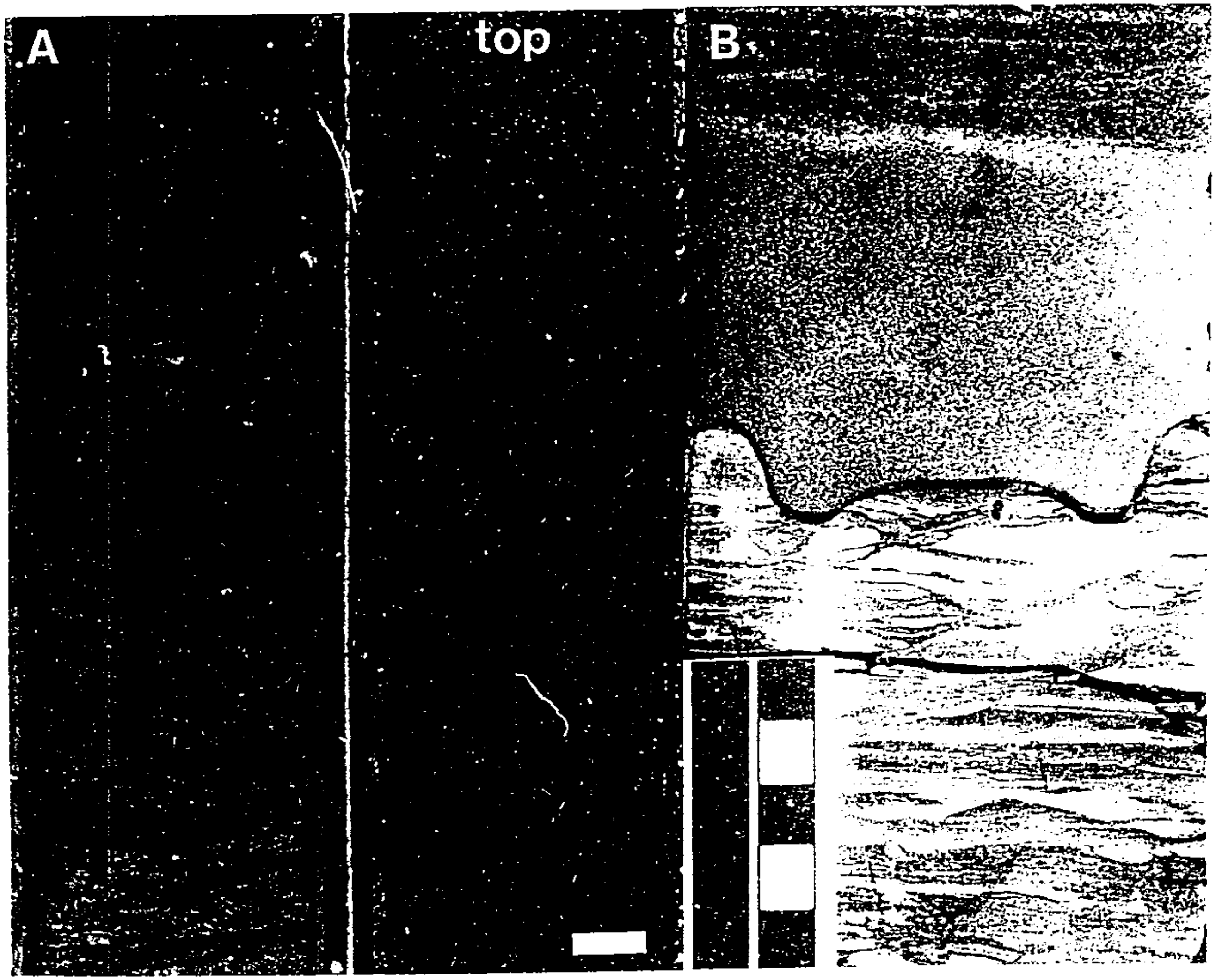

A
top
B

PLATE 2. -- Sedimentologic features of incised channel deposits, Upper-Middle Mannville interval. Features are common to all of the seven channel systems discussed in the text. Core reads from upper right (top) to lower left (bottom).

A. Example of intraformational conglomerate in basal sands of a channel fill succession (13-21-64-6W4; 308.5-313.0 m below K.B.).

B. Interbedded, cross-bedded sands and silts interpreted as point bar deposits within a fining-upwards channel-fill succession Scale the same as in A. (6-24-64-6W4; 319-323.5 m below K.B.).

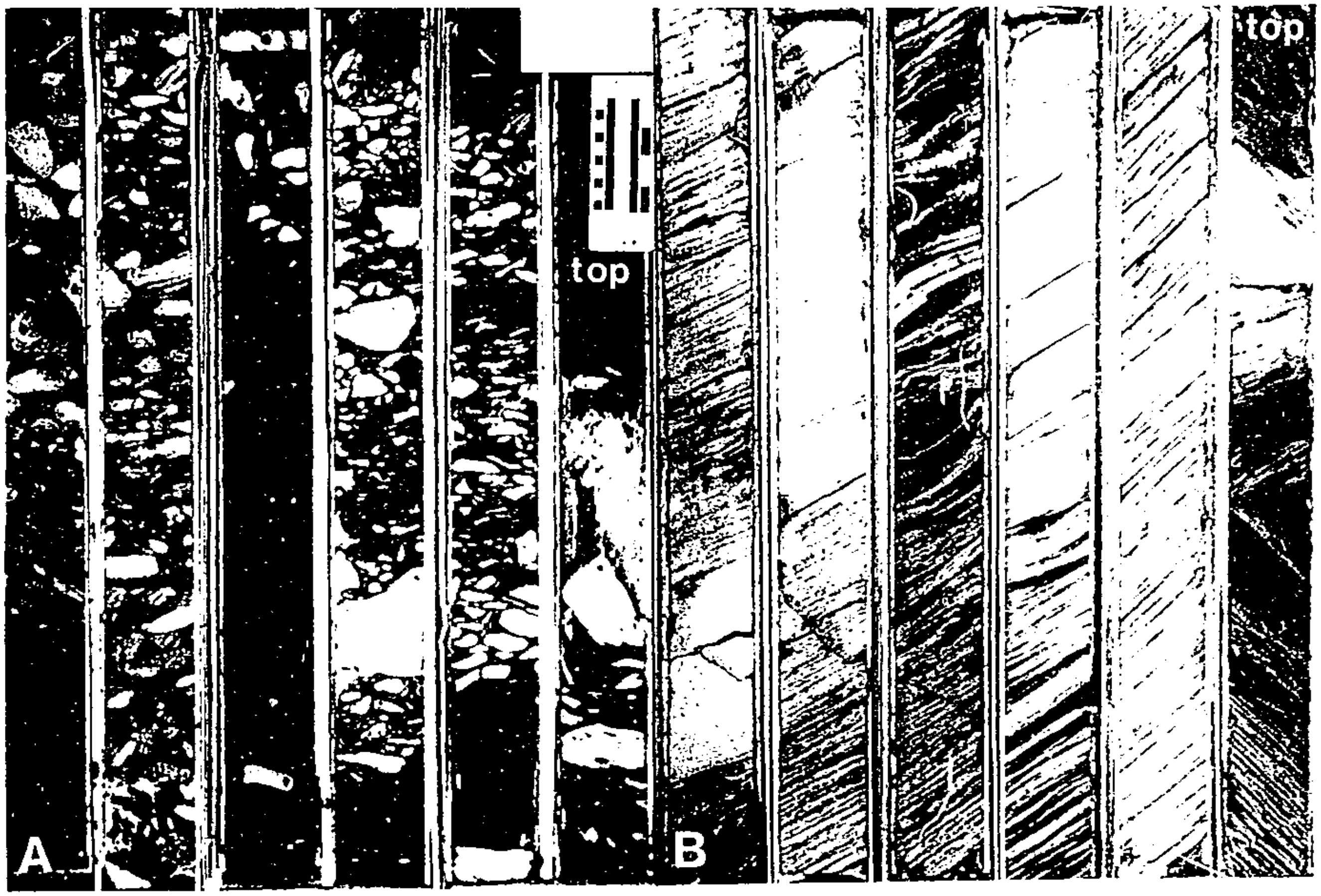

A
top
B
top

PLATE 3. – More sedimentologic features of incised channel deposits, Upper-Middle Mannville interval. Scale bar equals 1 cm.

A. Overbank muds at the top of a fining-upwards channel-fill succession capped by a rooted coal (4-7-56-3W4; 445.75 m below K.B.).

B. Current ripples in fining-upwards channel fill succession (3-6-63-3W4; 347.5 m below K.B.).

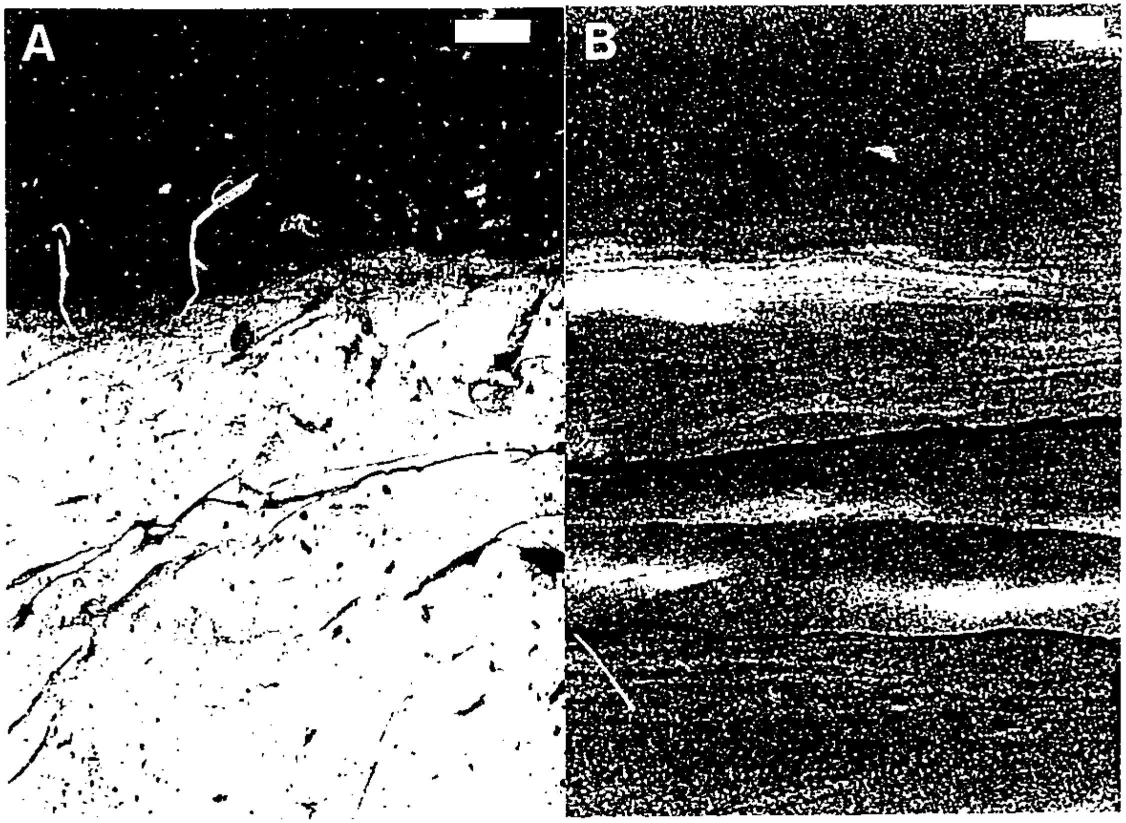
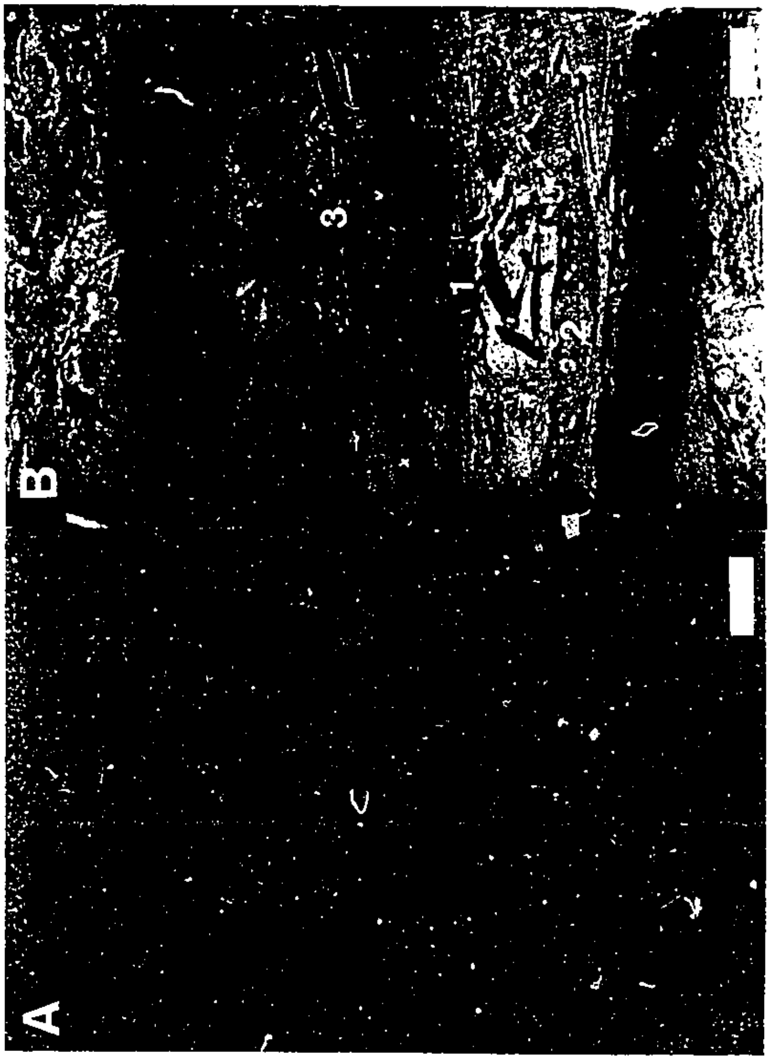

A
B

PLATE 4. -- Typical ichnofossils of estuarine channel fill successions, Upper-Middle Mannville interval.Scale bar equals 1 cm.

A. Escape trace in high-energy cross-bedded sands interpreted as point bar sediments (6-32-63-6W4; 396.5 m).

B. Characteristic ichnofossil suite in mixed sand-shale succession thought to have been deposited as estuarine channel margin sediments; 1. *Cylindrichnus*; 2. *Chondrites*; 3. *Planolites* (11-4-63-3W4; 354.0 m).


A
B
1
2
3

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CHAPTER IV

AN ICHNOLOGIC AND PALEOECOLOGIC COMPARISON OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS IN THE COLD LAKE OIL SANDS AREA OF EAST-CENTRAL ALBERTA

INTRODUCTION

The Upper Mannville sub-group (Early Albian) of eastern Alberta has in the past been cited as a classic example of a stratigraphic unit deposited within a dominantly brackish water depositional system (Singh, 1963; Putnam, 1979; Wilson, 1984; Wightman et al., 1987; Beynon et al., 1988; Mathison, 1988). Considerable controversy exists, however, as to the exact nature of the paleoenvironmental setting that existed during this time period, as well as to its paleogeographic extent. Opinions range from a scenario in which deposition occurred within a series of restricted bays and/or lagoons in deltaic environments (e.g. Wightman et al., 1987), to one in which the entire Clearwater Sea (the name given to the epeiric sea formed at this time in Western Canada) was itself drastically reduced in salinity (e.g. Mathison, 1988).

The present study forms one part of a larger inquiry into the stratigraphy, sedimentology, and paleontology of the Upper and Middle Mannville sub-groups in the Cold Lake Oil Sands area of east-central Alberta. The main aim of this paper is to reassess the paleoecologic parameters that define brackish versus marine deposits within the context of shoreface to offshore paleoenvironmental systems.

STRATIGRAPHY OF THE MANNVILLE GROUP IN EAST-CENTRAL ALBERTA

Mannville Group stratigraphic nomenclature in east-central Alberta is a reflection of an exploration history which has stressed local stratigraphic division rather than regional correlation problems (Cant, 1990). A number of lithostratigraphic schemes have thus arisen to subdivide the Mannville Group in various parts of Alberta and Saskatchewan, and has thus made for a rather confusing stratigraphic synonomy. The Cold Lake Oil Sands deposit occupies an area in which two different lithostratigraphic schemes have been used interchangeably over the years (e.g. Nauss, 1945; 1947; Wickenden, 1948; Clack, 1967; Fuglem, 1970; Kendall, 1977). These two schemes are referred to herein as the Lloydminster stratigraphy and the Wabasca stratigraphy (Chapter II). As pointed out by a number of authors, however (Caldwell, 1978; Wightman et al., 1987), there is justifiable uncertainty as to the validity and appropriateness of applying an extensive lithostratigraphic subdivision to a set of strata which displays more depositional cyclicity than lithologic heterogeneity. The sequence stratigraphic scheme outlined in Chapter II was proposed in order to demonstrate the advantages in stratigraphic correlation brought about by recognizing unconformities within the group as the natural horizons for stratigraphic subdivision.

The Mannville Group in east-central Alberta can be roughly broken down into three informal units known as the Upper, Middle, and Lower Mannville, of which only the Upper and Middle Mannville will be considered herein. The Upper Mannville consists of the Colony, McLaren, and Waseca units, while the Middle Mannville is made up of the Sparky, General Petroleums (usually referred to as the G.P.), Rex, and Lloydminster units (Chapter I). All of the units referred to above contain both a "regional" element and a "channelized" element, a division that has been referred to many times before by workers in both east-central Alberta and in west-central Saskatchewan (e.g. Wilson, 1984). The regional elements consist of regressional shoreface to offshore successions, while the channelized elements consist dominantly of incised channel-fill deposits. Mapping of net sand trends in the regional shoreface-offshore units reveals some local sand depocenters which may indicate deltaic deposition. However, there does not appear to be any facies criteria other than a greater sand:shale ratio to distinguish these deltaic sandbodies from regional shoreline sands (Chapter II). In any case, only the "regional" units will be addressed in this paper; the ichnology and paleoecology of the incised channel deposits are addressed in Chapter III).

The "regional" units of the Upper and Middle Mannville generally consist of multiple, stacked, coarsening-upwards depositional packages. More than one of these cyclic units may occur within a single stratigraphic unit on a local scale, but these become amalgamated such that on a more regional scale each unit is marked by only one coarsening-upward package. Each package coarsens-upward from shales or silts at the base into fine- to medium-grained sands at the top. Commonly, the packages are capped by thin coals or root zones indicative of subaerial exposure and erosion. The upper surface of each of these units is interpreted as an unconformity and each of the seven units of the Upper and Middle Mannville consequently represents an unconformity-bounded stratigraphic package (Chapter II). Each of these packages is so similar to the others that it is difficult to find any lithologic criteria to differentiate them. Ichnologic signatures do differ in each of these units however, and indicate that paleoenvironmental conditions shifted from time to time during deposition of the Upper-Middle Mannville package.

MIDDLE MANNVILLE GROUP

Rex and Lloydminster units

The Lloydminster unit forms the lowermost stratigraphic unit of the Middle Mannville in east-central Alberta. At its base the "regional" element of this unit generally consists of a relatively thick black to dark grey shale which coarsens upward into a fine-grained glauconitic sand. Foraminiferal studies of the shales at the base of the Lloydminster (Chapter VI) have revealed the presence of a well-developed foraminiferal assemblage. The assemblage is similar in most respects to the *Marginulinopsis collinsi* - *Verneuillinoides cummingensis* zone found at a lower stratigraphic level within the Mannville in what is generally referred to as the Clearwater shale (Stelck, et al., 1956; Caldwell, et al., 1978). The basal Lloydminster shale is an upper extension of this foraminiferal zone. Although the assemblage consists exclusively of arenaceous foraminifers, the abundance and diversity of types within the basal Lloydminster suggests that normal marine conditions prevailed throughout its deposition (Chapter VI).

The typical ichnofossil assemblage within the basal shale of the Lloydminster consists of three major genera, namely *Zoophycos*, *Chondrites*, and *Planolites*, with *Asterosoma* and *Terebellina* as common accessories (Fig. 37A; Pl. 5A). Intensity of bioturbation varies widely within the black to dark grey shales of the basal Lloydminster and is commonly coincident with shale color (i.e. the blacker the shale, the lower the degree of disruption). *Chondrites* is almost always present in the basal shales, except in the blackest of these, and is always the first trace fossil to reappear in shale sections which grade from black to dark grey. The assemblage is probably indicative of varying dysaerobic to anoxic conditions during deposition (see Ekdale and Bromley, 1984; Ekdale, 1985; Savrda and Bottjer, 1987).

The offshore marine sediments of the Lloydminster grade upward into highly glauconitic shoreface to foreshore sands, which are either massively bedded or hummocky cross-stratified. Lower shoreface deposits are typically highly bioturbated and contain a diverse ichnofossil suite. This suite includes forms (e.g. *Zoophycos*, *Chondrites*, *Planolites*, *Asterosoma*, and *Terebellina*) which are also found in the offshore shelf deposits, in addition to a diverse suite of ichnofossils which includes *Palaeophycus*, *Macaronichnus*, *Rosselia*, *Teichichnus*, *Asterosoma*, *Planolites*, and *Ophiomorpha* (Pl. 5B; 5C). As outlined in Chapter V, the occurrence of *Macaronichnus* in lower shoreface to shelfal deposits may be atypical (Clifton and Thompson, 1978) but does not appear to be unusual in the rock record.

Bioturbation is rare in the upper shoreface to foreshore deposits of the Lloydminster. *Skolithos*, small forms of *Ophiomorpha*, and *Macaronichnus* may occur (albeit rarely) in these sediments, but more commonly these deposits are overprinted by storm processes reflected in an overwhelming predominance of hummocky cross-stratification in the lower to upper shoreface. Escape traces are also found in some of these upper shoreface sediments (Pl. 5D).

The regional shoreface sands of the Lloydminster unit are directly overlain by black to grey shales which bear a great deal of resemblance to those of the basal Lloydminster and which form the base of the Rex unit. The Rex tends to be somewhat less bioturbated than the Lloydminster, both in the basal shale and in its overlying thick glauconitic sand section. The glauconitic sands are almost exclusively marked by hummocky cross-stratification. Foraminifera within the basal shale of the Rex are similar to those of the basal Lloydminster but are not as diverse nor as abundant (Chapter VI). This may indicate that the Rex was deposited in slightly less saline waters, or else under some other type of environmental restriction.

Trace fossil assemblages within the basal shales of the Rex are similar to those of the Lloydminster, and like those of the Lloydminster are dominated by *Zoophycos*, *Chondrites* and *Planolites*. Accessory traces are somewhat more diverse than in the Lloydminster however, and include such forms as *Asterosoma*, *Teichichnus*, *Diplocraterion*, *Palaeophycus*, *Skolithos*, *Arenicolites*. *Ophiomorpha* is found in lower shoreface sands, as are *Rosselia*, *Macaronichnus*, *Conichnus*, *Bergaueria*, *Palaeophycus*, and *Planolites*. Some upper shoreface sands contain *Skolithos*, *Ophiomorpha*, *Teichichnus*, and *Planolites*.

General Petroleums and Sparky units

At first glance, the General Petroleums and Sparky units contain many of the same ichnofauna as found in the underlying Lloydminster and Rex units (Fig. 37B). *Zoophycos* is present in abundance in basal (offshore) shales, as are *Terebellina* and *Chondrites* (Pl. 6A). Lower shoreface deposits are dominated by *Teichichnus*, *Ophiomorpha*, *Rosselia*, *Planolites*, and *Palaeophycus* in much the same way as underlying units, with rare small *Rhizocorralium* (Pl. 6B). *Macaronichnus* is still found within the G.P.-Sparky interval, but its occurrence is much rarer than in underlying units.

Despite the appearance of normal marine ichnofaunal elements in the G.P. and Sparky units, in both cases an ichnologic suite more typical of brackish conditions is also featured. Some shaly or mixed sand-shale sections (interpreted as lower shoreface to offshore transition) of the G.P. and Sparky units display a much different ichnofauna than those of the underlying Middle Mannville units. The most obvious change is in the appearance of the distinctive cork-screw shaped trace *Gyrolithes* (Pl. 6C) which has been cited by other authors as an indicator of brackish water depositional conditions (e.g. Beynon, et al., 1988). A number of other traces thought to represent opportunistic filter-feeding activities also are present (e.g. *Cylindrichnus*) (Pl. 6D). In addition, there is a general trend towards diminished size in individual ichnogenera, a trend which has often been attributed to stressful salinity conditions (Remain and Schlieper, 1971; Barnes, 1984; Mattison, 1987).

Ichnologically, the G.P. and Sparky units may mark a transition from the dominantly marine conditions of the Lloydminster and Rex units, to the more brackish conditions of the Upper Mannville. The general trend from dominantly marine conditions at the base of the Middle Mannville to dominantly brackish conditions in the Upper Mannville is confirmed by foraminiferal paleoecologic studies, even though there is disagreement as to the point of change (Chapter VII).

Middle Mannville flooding surfaces

The basal shales of the Sparky, G.P., and Rex units thicken from west to east, reflecting the thinning of progradational shoreface sands in this direction (Appendix 3; Figs. 87-89). In the western half of the Cold Lake deposit these basal shales may be only as much as 10 cm thick, with thick shoreface sands stacked above and below. The basal shales are typically dark in colour and contain a trace fauna dominated by *Diplocraterion*, *Chondrites*, *Planolites*, *Cylindrichnus*, *Skolithos*, *Zoophycos*, and *Teichichnus*. The larger trace fossils in this group (i.e. *Diplocraterion* and*Skolithos*) commonly penetrate the underlying sand (Pl. 7A; 7B). These thin, bioturbated shales are thought to represent the maximum edge of transgressive marine imprint on the Sparky, G.P., and Rex paralic systems. Regional mapping (Chapters II and III) has also shown them to represent the first transgressive marine deposits following regional exposure and erosion of the tops of the regional Sparky, G.P., and Rex units.

UPPER MANNVILLE GROUP

Waseca, McLaren, and Colony units

Like the underlying Middle Mannville, the three units of the Upper Mannville Group are comprised of coarsening-upward successions separated from one another by disconformities. Where these coarsening-upward packages differ most dramatically from those of the Middle Mannville is in their basal shales. Lighter shale colour and differences in ichnofauna combine to indicate a strong environmental shift away from the relatively stable environmental conditions of the Middle Mannville.

Ichnofossil suites in the Upper Mannville differ drastically from those of the Middle Mannville in that they seem to be dominated by species whose mode of preservation is indicative of opportunistic behaviour. The most distinctive association in this regard is one between *Gyrolithes* and *Trichichnus* (Pl. 8A). These two typically small (1-2 cm vertical length) traces are often found together at discrete horizons in mixed sand-mud units where they originate from thin mud or silt beds and penetrate into thicker hummocky cross-stratified or oscillation rippled sand beds. It is proposed that the trace making organisms responsible for this ichnofauna were able to quickly populate and exploit the substrate following a high energy depositional event such as a storm (Vossler and Pemberton, 1988a; 1988b). This opportunistic behaviour was superimposed on a reduced salinity regime indicated by a dramatically reduced size of the constituent ichnofauna as well as a predominance of so-called filter-feeding traces over deposit-feeding traces. Synaeresis cracks are also common throughout the Upper Mannville, and are further evidence of brackish water depositional conditions (Burst, 1965; Wightman et al., 1987)

The ichnofaunal suite of the Upper Mannville also includes *Skolithos*, *Teichichnus*, *Palaeophycus*, *Arenicolites*, *Chondrites*, *Planolites*, *Helminthopsis*, rare *Terebellina*, and *Asterosoma* (Fig. 37C and Pl. 8C). The basal shales of each coarsening-upward succession are most commonly dominated by *Teichichnus* and *Chondrites* with rare small forms of *Zoophycos*. One of the most common of the traces found in the basal shales of these depositional cycles is a spreiten structure which bears some resemblance to both *Teichichnus* and *Zoophycos* but does not appear to be strictly referable to either of these ichnogenera (Pl. 8D).

The brackish nature of the Upper Mannville trace fossil suite is probably reflective of increased shallowing and associated withdrawal of the Clearwater Sea, since trace fossil assemblages in each successive shaly section contain more elements indicative of brackish conditions and fewer which are indicative of marine conditions. Sedimentary cycles become thinner and more common as one progresses upward in the section, possibly indicating shoaling within a very shallow basin.

DISCUSSION

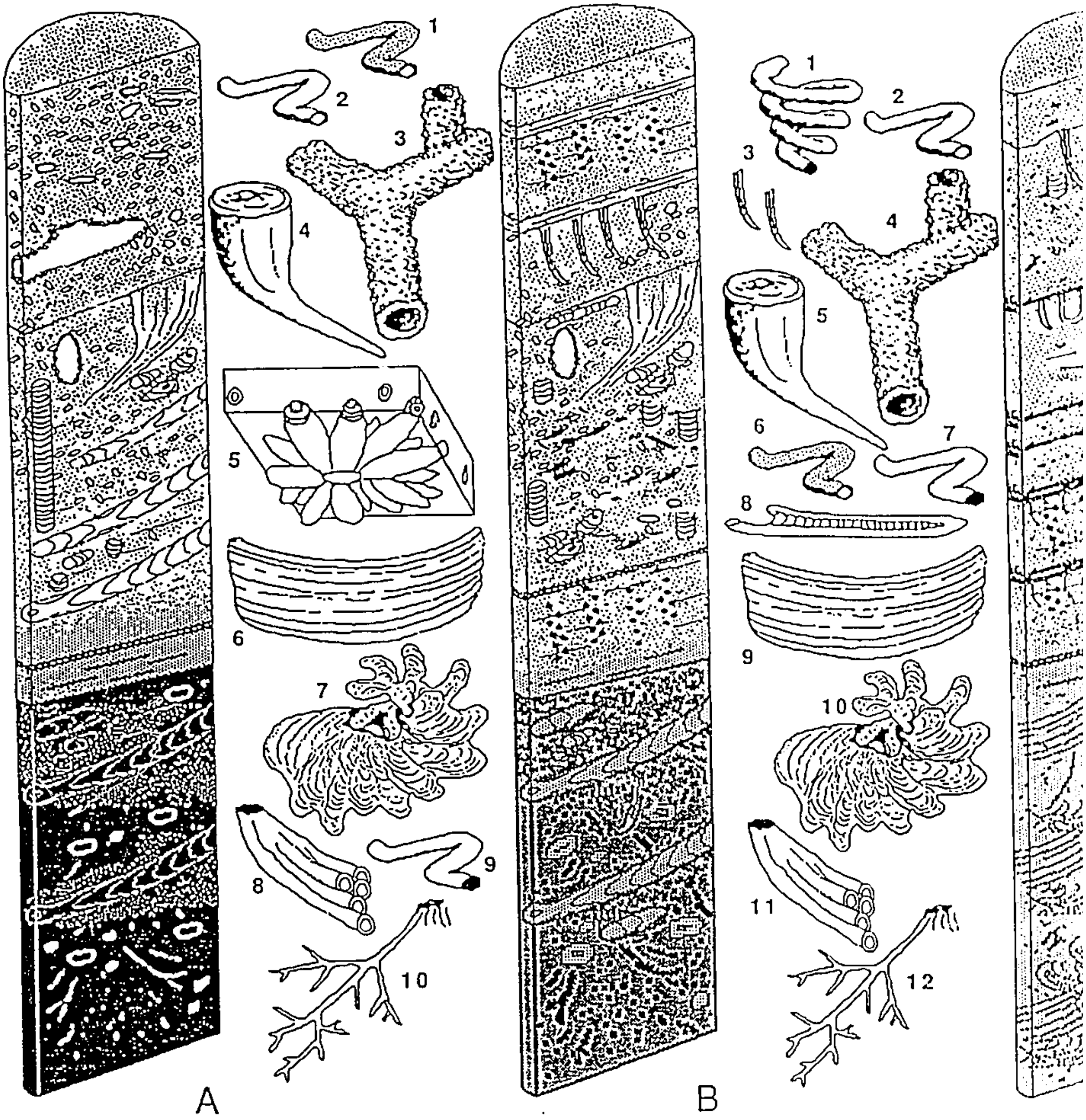
Data derived from $\partial^{18}O$ and $\partial^{13}C$ analysis of endemic bivalve shell fragments (as summarized in Kauffman, 1984) consistently indicate that low values (in comparison to those derived from normal modern marine biota) prevailed throughout much of the

Cretaceous within the Western Interior Seaway. This has been interpreted as an indication that slightly to moderately brackish water conditions predominated in the epicontinental areas of the basin throughout most of its history. Ichnologic and micropaleontologic studies cited above indicate that this was the case during the bulk (but not all) of Upper-Middle Mannville deposition in the Cold Lake Oil Sands area as well. The predominance of preserved brackish water paleoenvironmental elements in sediments of the Upper and Middle Mannville has previously been explained (Wightman, et al., 1987) as a product of paleoenvironmental restriction (embayment and lagoonal deposition) within an overall deltaic context. However, regional mapping of net sand trends in all of the units of the Upper and Middle Mannville (Chapter II, Figs. 24-30; Appendix 3, Figs. 86-94) reveal a more complex picture. Local sand depocenters do occur within individual units, and indicate that small deltas were part of the paleoshoreline. However, overall shoreline trends appear to have been fairly linear throughout the progradational development of all of the units of the Upper and Middle Mannville. The lateral continuity of offshore shales within each of the Upper and Middle Mannville units suggests that small, isolated embayments and/or lagoons are rare within the succession. The Cold Lake Oil Sands area is situated partially within a *regional* embayment (known as the Lloydminster sub-basin--Chapter II) however, and this relatively shallow basin may have acted as the means for paleogeographic restriction and consequent salinity reduction (Wilson, 1984; Mathison, 1988).

Salinity reduction of basinal waters in the Lloydminster sub-basin would have developed primarily due to the effects of freshwater input from rivers emptying into the basin. In such a scenario the uppermost parts of the water column would have been the most reduced in salinity, and thus the basin may have had a meromictic salinity profile. Normal salinity would only have occurred during times of peak transgression. Reductions in surface salinity may also be linked to periods of bottom water anoxia, perhaps due to density stratification of the water column, which would have limited oxygen exchange between surface and bottom waters. Minimal turnover of colder bottom waters and consequent higher rates of organic productivity would have promoted bottom water anoxia. Bottom waters would have become stagnant through this process due to metabolic processes and aerobic bacterial decay. Only the most environmentally tolerant of benthos would have been able to endure such conditions.

CONCLUSIONS

At least four distinctly different ichnologic assemblages are found in regional shoreface to offshore deposits of the Upper and Middle Mannville sub-groups in the Cold Lake Oil Sands area of east-central Alberta. Ichnocoenoses in basal shales of the two lowermost units of the Middle Mannville (Lloydminster and Rex units) contain elements that are indicative of relatively "normal marine" salinity conditions, while basal shales of Upper Mannville units (Waseca, McLaren, and Colony units) contain ichnocoenoses reflective of brackish water conditions. A third type of assemblage is found in basal shales of the two uppermost units of the Middle Mannville (General Petroleums and Sparky units) both of which contain elements common to the "brackish" and "normal marine" ichnocoenoses. The change from a normal marine ichnofauna to a brackish ichnofauna is thought to be reflective of increasingly restricted paleoenvironmental conditions during the deposition of each successive transgressive-regressive cycle of the Upper-Middle Mannville interval.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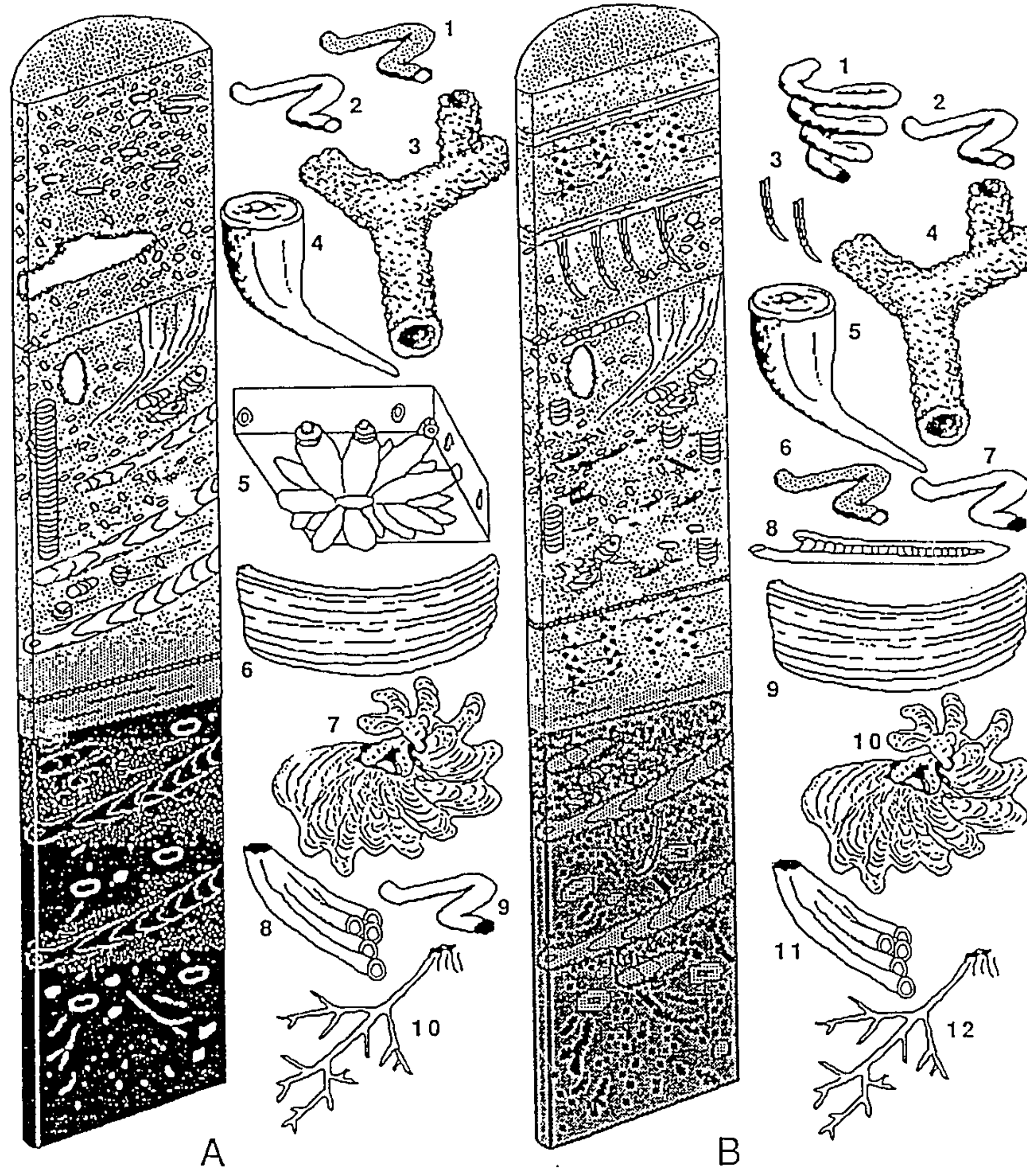
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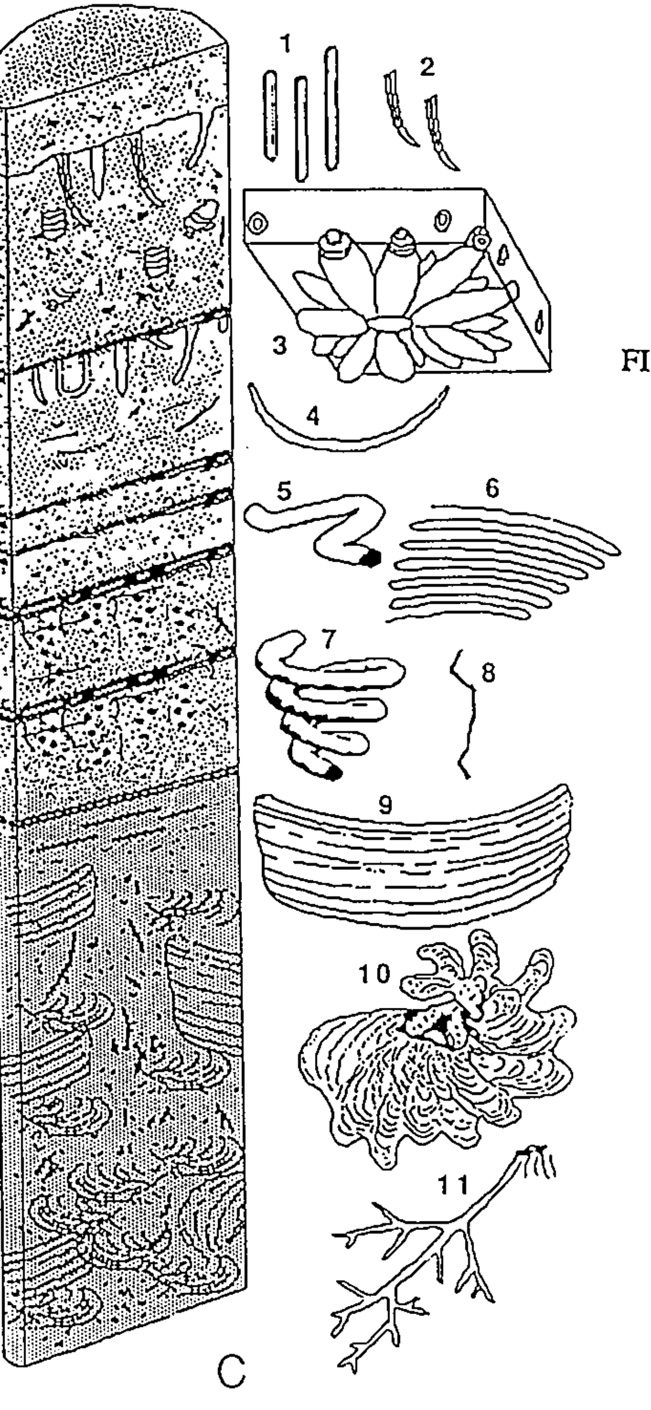

FIGURE 37.-- Illustration of common trace fossil suites within various stratigraphic intervals of the paralic-offshore coarsening-upwards successions (offshore-lower shoreface) of the Upper and Middle Mannville

A. Lloydminster-Rex association
  (1) *Macaronichnus* (2) *Palaeophycus*
  (3) *Ophiomorpha* (4) *Rosselia*
  (5) *Asterosoma* (6) *Teichichnus*
  (7) *Zoophycos* (8) *Terebellina*
  (9) *Planolites* (10) *Chondrites*
B. General Petroleums-Sparky association
  (1) *Gyrolithes* (2) *Palaeophycus*
  (3) *Cylindrichnus* (4) *Ophiomorpha*
  (5) *Rosselia* (6) *Macaronichnus*
  (7) *Planolites* (8) *Rhizocorallium*
  (9) *Teichichnus* (10) *Zoophycus*
  (11) *Terebellina* (12) *Chondrites*
C. Waseca-McLaren-Colony association
  (1) *Skolithos* (2) *Cylindrichnus*
  (3) *Asterosoma* (4) *Arenicolites*
  (5) *Planolites* (6) *Helminthopsis*
  (7) *Gyrolithes* (8) *Trichichnus*
  (9) *Teichichnus* (10) *Zoophycus*
  (11) *Chondrites*

PLATE 5.-- Typical ichnologic and sedimentologic features of offshore-shoreface coarsening-upwards successions, Lloydminster and Rex units; Scale bar equals 1cm.

A. Highly bioturbated offshore marine shales, Lloydminster unit

B. Ichnofossils in lower shoreface sediments, Rex unit (3-19-59-1W4; 470.5 m below K.B.); 1. *Zoophycos*; 2. *Teichichnus*.

C. Ichnofossils in lower shoreface sediments, Lloydminster unit.

D. Escape traces in upper shoreface sands, Lloydminster unit (10-26-64-3W4; 429.0 m below K.B.).

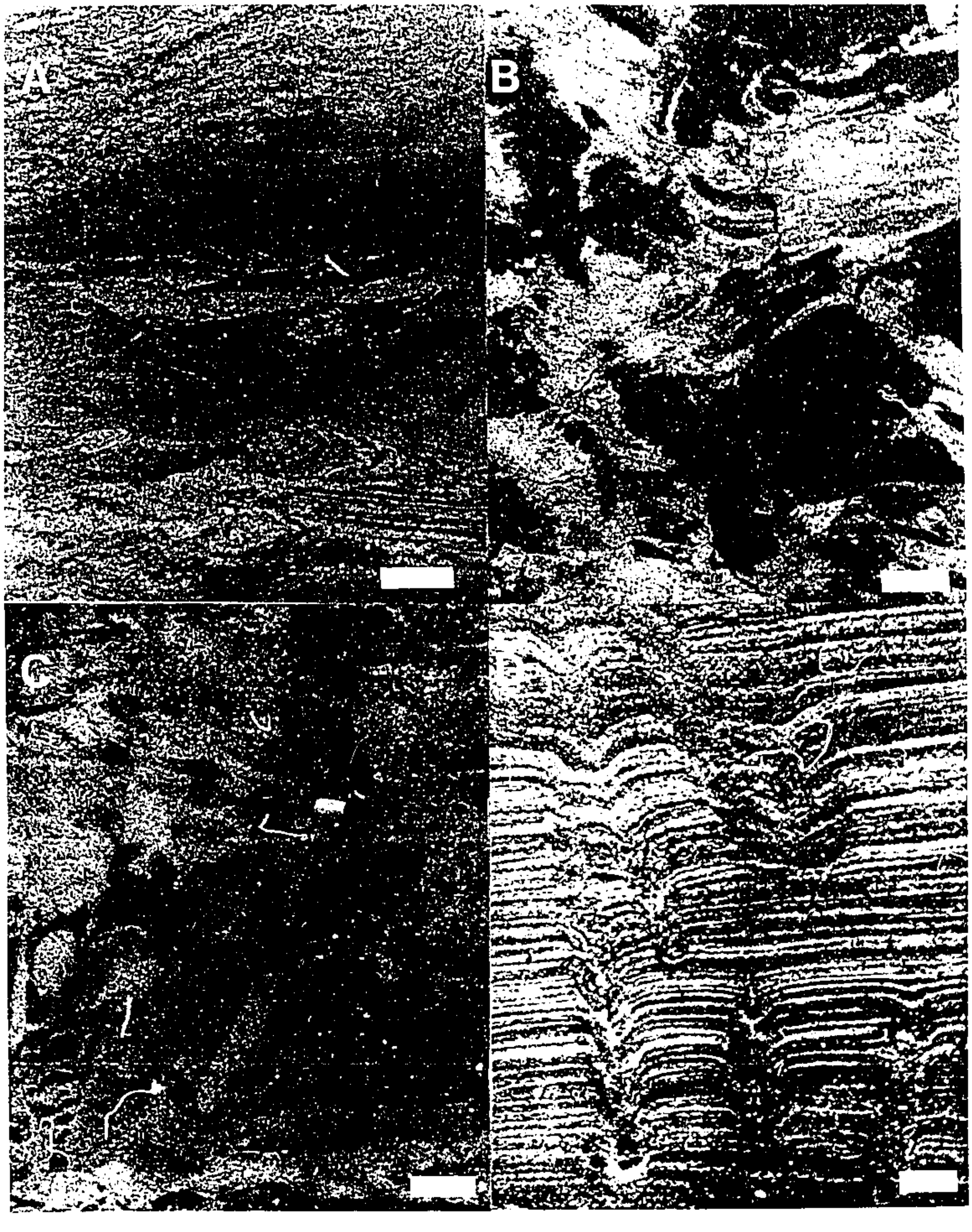
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PLATE 6.-- Typical ichnologic and sedimentologic features of offshore-shoreface coarsening-upwards successions, General Petroleums and Sparky units; Scale bar equals 1 cm.

A. Ichnofossils in basal offshore shales, Sparky unit (3-19-59-1W4; 445.0 m below K.B.).
B. Ichnofossils in lower shoreface sediments, General Petroleums unit (7-30-65-5W4; 438.0 m below K.B.): 1. *Rosselia*; 2. *Rhizocorralium*; 3. *Zoophycos*.
C. Example of *Gyrolithes* horizon in lower shoreface sands, General Petroleums unit (16-5-56-3W4; 459 m below K.B.).
D. Example of typical trace fossil suite of offshore (embayment?) shales, General Petroleums unit (11- 6-56-3W4; 464.5 m below K.B.): 1. *Cylindrichnus*; 2. *Zoophycos*; 3. *Chondrites*; 4. *Planolites*.

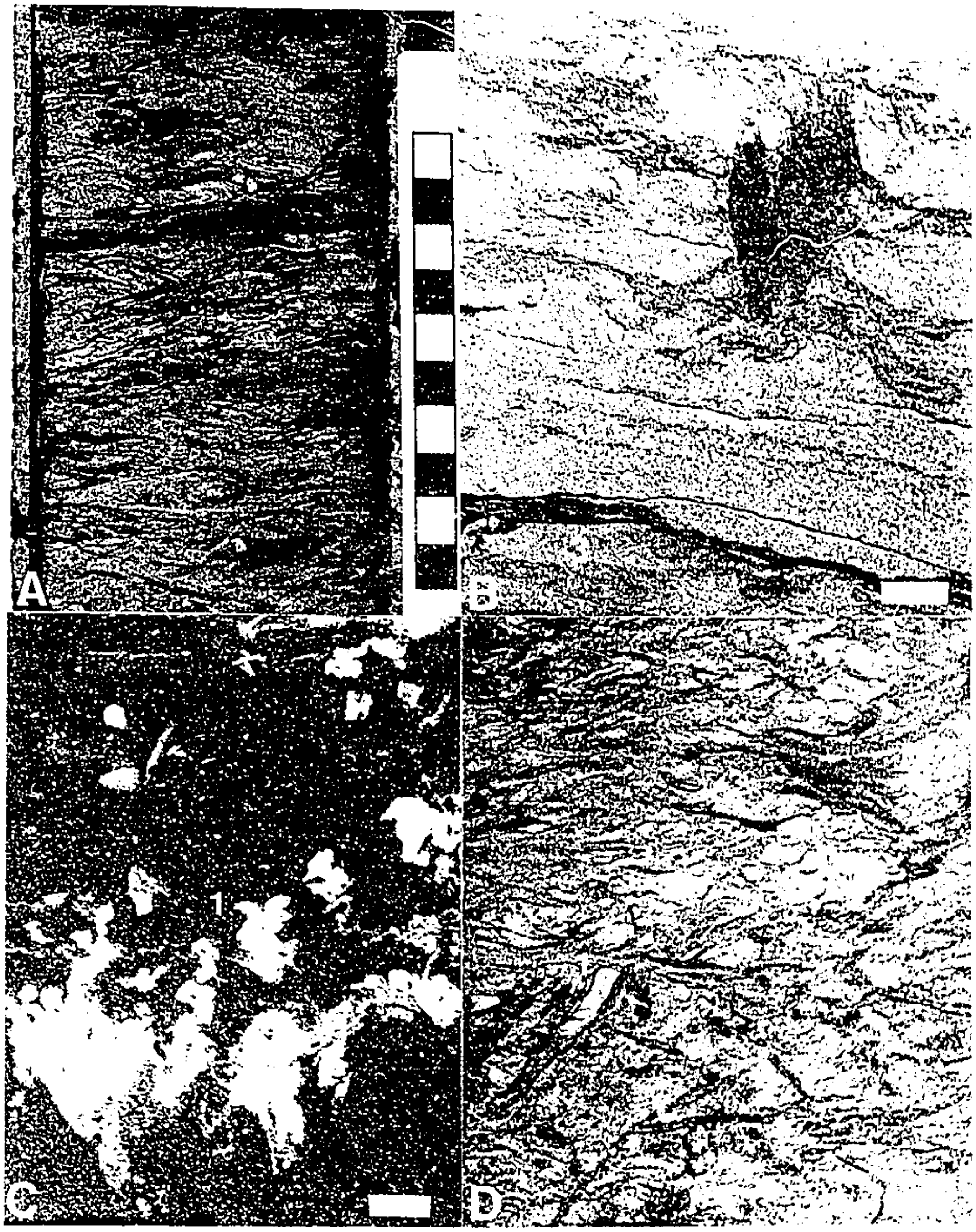
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PLATE 7. -- Vertical shafts (*Skolithos*?) at the base of transgressive Sparky muds penetrating underlying G.P. shoreface sands. Regional mapping (Chapters II and III) has shown that this surface is an unconformity, with the Sparky muds representing the first transgressive marine deposits following regional exposure and erosion of the top of the regional G.P. unit.

A. Core photograph of Sparky mudstones overlying G.P. shoreface sands.

B. Detail of A showing the nature of the burrowed contact.


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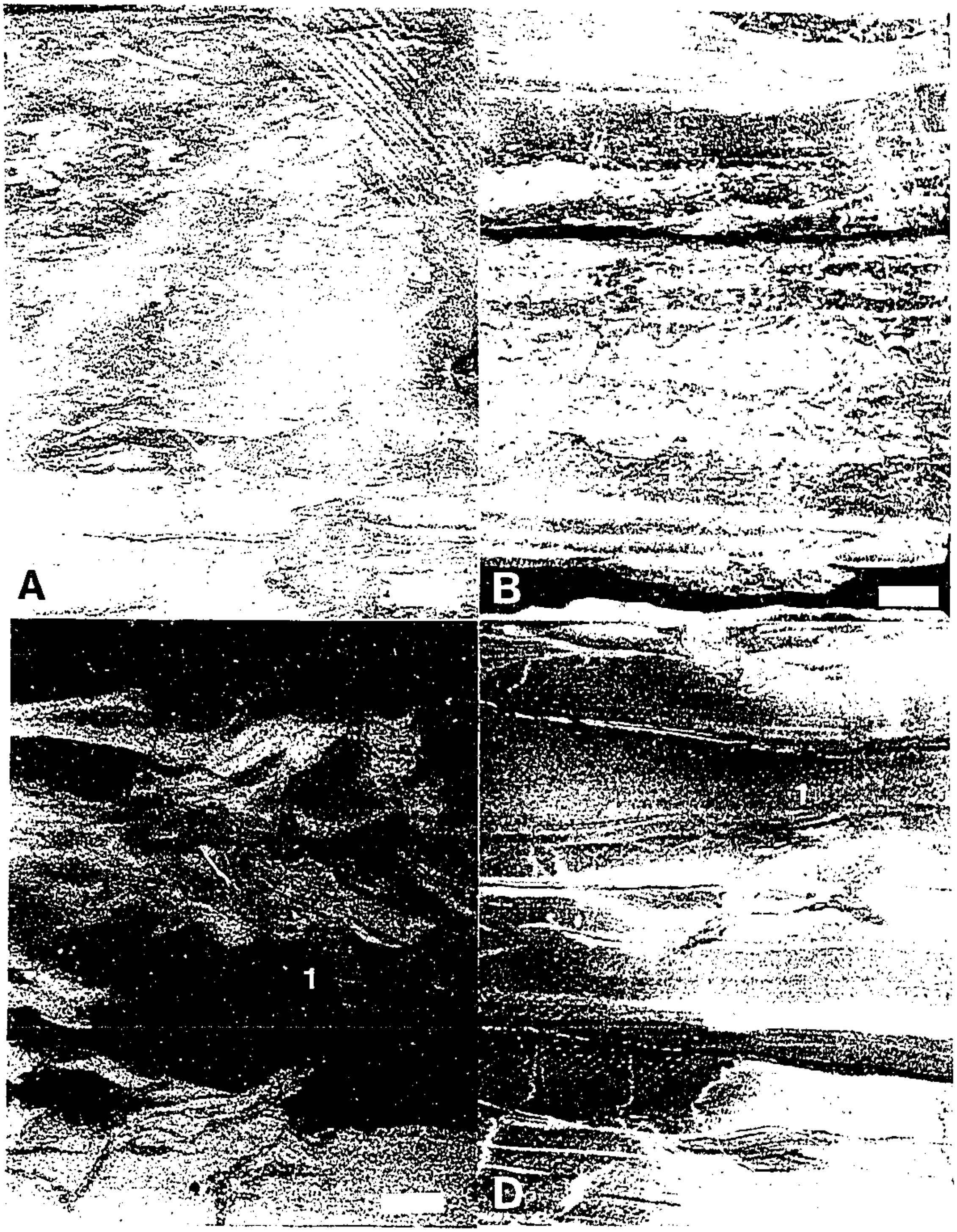
PLATE 8.-- Typical ichnologic and sedimentologic features of offshore-shoreface coarsening-upwards successions, General Petroleums and Sparky units; Scale bar equals 1 cm.

A. Example of *Gyrolithes-Skolithos* association in oscillation-rippled silts directly overlying hummocky cross-stratified sands, McLaren unit (8-7-56-3W4; 429.0 m below K.B.): 1. *Gyrolithes*; 2. *Skolithos*; 3. *Planolites*; 4. *Chondrites*.

B. Typical trace fossil suite in Upper Mannville offshore sediments. Note small size of constituent traces and synaeresis cracks. Basal Colony shale (16-5-56-3W4; 95.75 m below K.B.): 1. *Chondrites*; 2. *Skolithos*.

C. Further example of typical trace fossil suite in Upper Mannville offshore sediments, basal McLaren unit (7-22-59-4W4; 417 m below K.B.): 1. *Teichichnus*; 2. *Skolithos*.

D. Example of small spreiten structure possibly referrable to either *Zoophycos* or *Teichichnus*, Waseca unit (7-22-59-4W4; 421.5 m below K.B.).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CHAPTER V

NEW OBSERVATIONS ON THE PALEOENVIRONMENTAL SIGNIFICANCE OF THE TRACE FOSSIL *MACARONICHNUS SEGREGATIS*: AN EXAMPLE FROM THE MIDDLE MANNVILLE SUB-GROUP OF EAST-CENTRAL ALBERTA

INTRODUCTION

If anything has been learned from the last quarter-century of ichnologic research it is that individual trace fossil taxa, taken in and of themselves, have very little specific environmental significance. The list of so-called facies-breaking ichnofossils is long, growing, and includes many forms once thought to be extremely restricted in environmental terms. *Ophiomorpha* may be the prime example of a trace fossil once thought to be environmentally restricted (noted as a "reliable" beach indicator by Weimer and Hoyt, 1964) that has now been shown to have a wide ecologic distribution, but recent work has shown a whole range of other paradigms (e.g. Frey et al., 1978). For instance, *Chondrites*, long thought to be restricted to shelfal environments has been found in abundance in brackish intertidal sediments (e.g. Bjerstedt, 1987). Similarly, *Helminthopsis* and *Helminthoida*, both known as pascichnial traces and thought at one time to be entirely restricted to abyssal depths (e.g. Seilacher, 1967), have been found in very shallow marginal marine sediments in recent studies (e.g. Mattison, 1987; Moslow and Pemberton, 1988).

Instead of focusing on the significance of specific ichnotaxa, the paleoecologic impetus in ichnology has shifted towards an appreciation of the significance of ichnofaunal assemblages, their dynamics, their collective ethology, and their collective relationship to other depositional indicators (e.g. relative stratigraphic position as an indication of paleoenvironment in gradational sequences, physical sedimentologic evidence as an indication of environmental energy, etc.).

Still, there remain entrenched in the literature examples of single ichnotaxa that have been considered as having a one-to one equivalence with specific depositional environments. One of the most famous examples of this that of the trace *Macaronichnus segregatis* Clifton and Thompson, 1978. *Macaronichnus* is a small, intrastratal trail known to occur in a large number of formations from the Jurassic onwards (with at least one known Pennsylvanian example; C. Maples, pers. comm. 1989), and even having extant biogenic equivalents (Clifton and Thompson, 1978; Saunders, 1989). Its most distinctive diagnostic feature is a unique wall lining composed of refractory minerals selectively pushed aside or rejected after ingestion by the tracemaker. Selective feeding is common in infaunal deposit-feeding organisms, especially where paucity of food supply forces increased competition and greater foraging efficiency (Jumars and Fauchald, 1977). *Macaronichnus* is generally considered as one point in a behavioural triad along with *Planolites* and *Palaeophycus*, since it displays the combined feeding/locomotory behaviour of *Planolites*, yet shares the presence of a very distinct (yet very different) wall lining exhibited by *Palaeophycus*.

In introducing *Macaronichnus* as a new ichnogenus, Clifton and Thompson (1978) tied the trace emphatically to an intertidal or very shallow subtidal environment and used the analogy of the marine polychaete *Ophelia limacina* as one organism known to produce a similar feeding burrow in the modern shallow marine sediments of Willapa Bay, Washington. In fact, Clifton and Thompson (1978) concluded their argument by stating that "at the very least, we feel its [*Macaronichnus*] presence strongly suggests deposition in a very shallow marine environment". Since the publication of this paper, numerous articles have been published in which *Macaronichnus* has been described from the (inferred) intertidal zone, and the trace has become popularly known as a reliable foreshore to upper shoreface indicator in high-energy barred shoreline deposits (e.g. Leckie and Walker, 1982; Hunter et al., 1984; Saunders and Pemberton, 1987; Moslow and Pemberton, 1988; Nadon, 1988; Rahmani and Smith, 1988; Saunders, 1989).

Despite the wealth of studies which have undoubtedly corroborated Clifton and Thompson's original paleoenvironmental conclusions regarding *Macaronichnus*, it bears noting that these authors also sounded a warning note when they stated that "few, if any, trace fossils can be considered as diagnostic of a specific depositional environment, and *Macaronichnus segregatis* is no exception" (Clifton and Thompson; 1978, p. 1300). This latter statement may prove to have been more accurate than any subsequent workers have hitherto realized. The present study will provide conclusive evidence for the extension of the previously narrow paleoenvironmental range of *M. segregatis* to sediments representative of the entire foreshore to shoreface as well as the innermost shelf.

STUDY AREA AND STRATIGRAPHY

The specimens discussed in this study were found in cored intervals of the Sparky, General Petroleums, Rex, and Lloydminster units (Chapter II) of the Middle Mannville sub-group in the Cold Lake Oil Sands area of east-central Alberta (Chapter 1; Figs. 1 and 2).

Macaronichnus can be found in all of the units mentioned above although it is most commonly found within the Lloydminster and Rex units. In their regional context the four units in question are generally similar to one another, consisting of coarsening-upwards successions typified by a thin basal shale section which coarsens-upwards through a mixed succession of sands, silts, and shales and further into a fairly thick sand section. In the case of the Lloydminster and Rex units, the uppermost sands are highly glauconitic. The successions are representative of a continuum of environments ranging from offshore to upper shoreface/foreshore. However, other ichnologic studies (Chapter IV) and micropaleontologic studies indicate a general trend from normal marine to salinity-reduced conditions in the interval ranging from the Lloydminster to the Sparky units.

Drill core from the Esso Marie Lake 7-22-65-2W4 well (Fig. 38) was chosen as a representative section for illustrating the stratigraphic occurrence of *Macaronichnus* within the Middle Mannville. In this case, the black shales at the base of the Lloydminster unit are dominated by *Chondrites* and are interpreted as representing dysaerobic conditions in a proximal offshore environment. Micropaleontologic studies of the shales at the base of the Lloydminster (Chapter VI), have demonstrated the occurrence of an abundant and diverse foraminiferal assemblage consistent with deposition in an open marine setting. The black shales grade upwards into lighter grey shales interbedded with silts and sands marked by a high degree of bioturbation and by abundant oscillation ripples. The thick section of glauconitic sands overlying this interval is virtually unbioturbated and exhibits hummocky cross-stratification as its dominant bedform. The top of the interval typically shows horizontal planar cross-stratification and is commonly capped by a thin rooted coal horizon. The overwhelming predominance of HCS throughout these glauconitic sands records a predominance of storm conditions during the deposition of sediments along the inferred paleoshoreline.

Although *Macaronichnus* is rarely found near the top of the coarsening-upwards successions in some cores, (in a foreshore to upper shoreface position) it is especially abundant towards the bottom of the coarsening-upwards glauconitic sand section, as well as within the interbedded sands, silts, and shales which underlie it. It also occurs in some rare cases where glauconitic sands are found interbedded within the black shale section. The specimens exhibit a wide range of sizes (from about 1 to 5 mm in assumed cross-sectional diameter). Petrographic examination of the traces confirm their taxonomic assignation, since they show a wall lining made up of a concentration of refractory minerals (in this case both biotite and glauconite), while the centre of the burrow is essentially depleted of these minerals. In the distinctive green, highly glauconitic sediments of the lowermost Middle Mannville, *Macaronichnus* is very easy to spot since it shows up as small whitish ovals against a green background.

Based simply on the evidence of stratigraphic positioning within an overall coarsening-upwards succession, the most logical interpretation of the zone in which *Macaronichnus* occurs is that of a lower shoreface to slightly offshore environment. However, there is also an abundance of ichnologic evidence to back up this interpretation. Within the same stratigraphic interval in which *Macaronichnus* occurs, examples of the trace fossils *Rosselia*, *Palaeophycus*, *Ophiomorpha* (horizontal forms), *Teichichnus*, *Asterosoma*, *Terebellina*, *Chondrites*, and *Zoophycos* may also be found (Fig. 39) (Pl. 9). Such an assemblage is inconsistent with placement in either an intertidal or very shallow subtidal environment. The observation of *Zoophycos* in these sediments is also contrary to the opinion of Beynon, et al. (1988) that trace fossils representative of complex feeding behaviour (typical of fully marine environments) are absent from this stratigraphic interval. *Zoophycos* is not only present in the basal Middle Mannville, it is present in abundance, and is found consistently in most of the cores that were examined.

Both the stratigraphic context of the "*Macaronichnus* zone" as well as its association with an ichnologic assemblage typical of lower shoreface to upper offshore environments precludes the adoption of a shallow subtidal interpretation for the basal Middle Mannville. However, this does not appear to be an odd or random occurrence of the trace in an environmental sense. The author has also observed *Macaronichnus* in a similar stratigraphic position and environmental setting (storm-dominated shallow shelf) within offshore-shoreface successions of the Viking Formation (Upper Albian) immediately south of the Willesden Green oilfield of west-central Alberta (8-16-37-3W5; depth of approximately 2002 m) (T. Reynolds, pers. comm., 1989).

Over the past few years there have been a number of other hints that *Macaronichnus* may not be the kind of specific environmental indicator that Clifton and Thompson (1978) originally envisaged. "Deeper water" interpretations for the occurrence of *Macaronichnus* have been provided by Dupré (1984), who noted the occurrence of the trace in lower shoreface deposits of Late Pleistocene age from the Monterey Bay region of California; by Curran (1985), who described a trace fossil association dominated by *Macaronichnus segregatis* and *Skolithos* from middle to lower shoreface deposits of the Upper Cretaceous Englishtown Formation of Delaware; and by Rosenthal (1988; pers. comm., 1989) who described an association of *Macaronichnus*, *Terebellina*, and *Palaeophycus* from possible lower shoreface or shoreface-detached shelf sands of the Glauconite Formation (B sequence) of west-central Alberta. Recently, Maples (pers. comm., 1989) has noted a Pennsylvanian occurrence of *Macaronichnus* (the oldest occurrence thus far described) in what he interprets as transgressive marine deposits of the Fountain Formation of Colorado. To the author's knowledge these are the only other studies that have tied *Macaronichnus* to an environment deeper than the intertidal or shallow subtidal zone.

DISCUSSION

Although it would seem that there is abundant evidence to indicate that examples of "deeper-water" *Macaronichnus* are common in the geologic record, this does not mean that all traditional shallow water (foreshore to upper shoreface) interpretations of the occurrence of this ichnofossil are automatically open to question. In fact, it should be repeated that *Macaronichnus* does show up in a foreshore position within the Middle Mannville, as it does in many cases within the Glauconite Formation alluded to earlier as a "deeper-water" example (S. Brownridge, pers. comm., 1989). Instead, this study seeks to echo the words of warning first sounded by Clifton and Thompson (1978), and to emphasize the inherent dangers in relying on any single ichnotaxa as an environmental indicator without critically examining all other sources of environmental data. In the case of *Macaronichnus*, it is suggested that there may not be so much a strict environmental control on the trace (in the sense of a specific depositional environment) but rather, a substrate control whereby deposit-feeding organisms that would normally create other intrastratal traces (e.g. *Planolites*) are forced to displace refractory grains in the sediment rather than passing them through their gut. The presence of such grains is not restricted to the foreshore and it is suggested that organisms with the ability to create the *Macaronichnus* trace are not either. It may be that different organisms may create the trace in different environments; in any case, the behavioural response in creating the distinctive wall lining would seem to be identical.

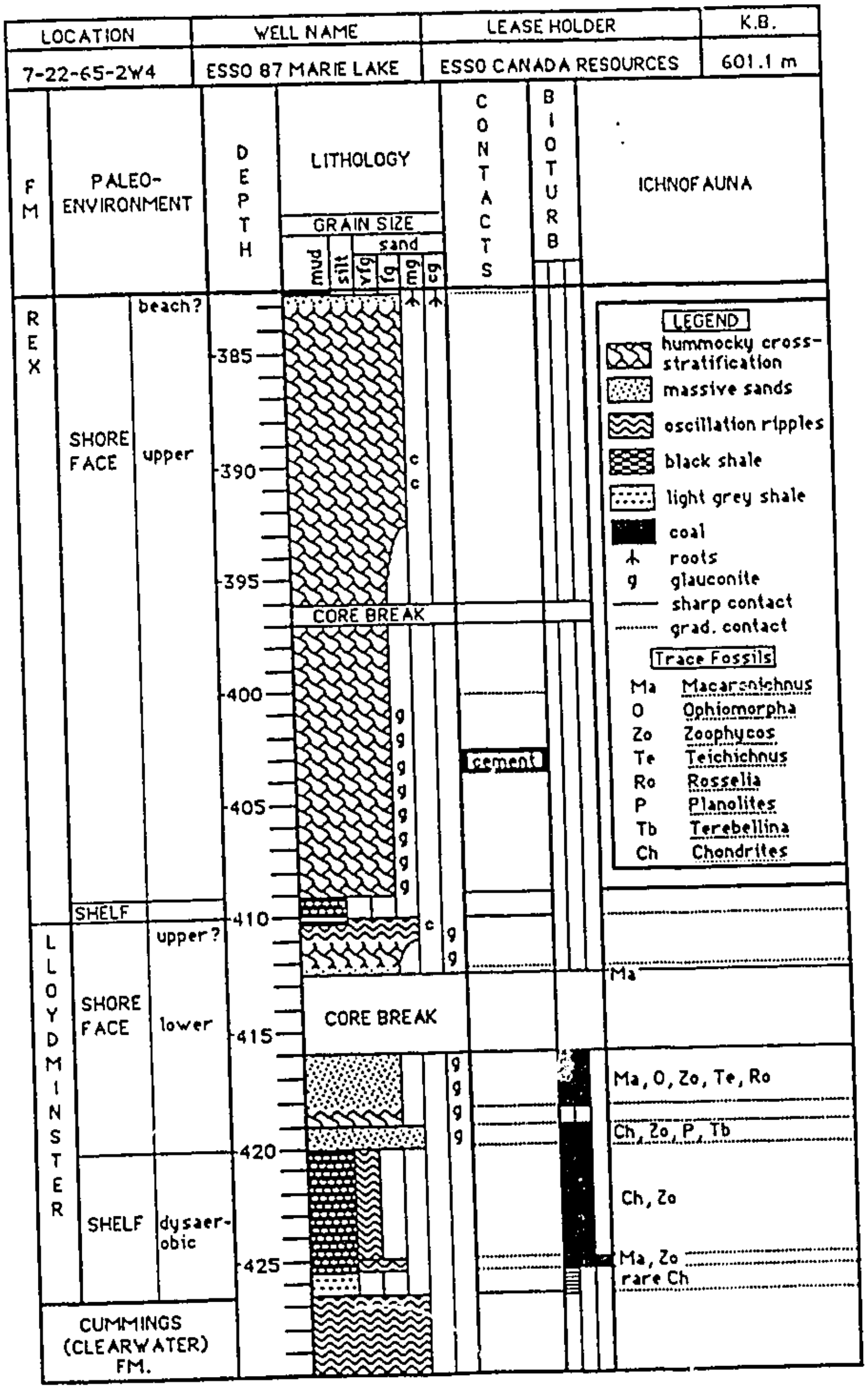


FIGURE 38. --Descriptive log of the Esso Marie Lake 07-22-65-2W4 well, illustrating the occurrence of *Macaronichnus* in a lower shoreface to shelfal stratigraphic position within the overall coarsening-upwards succession of the Lloydminster unit.

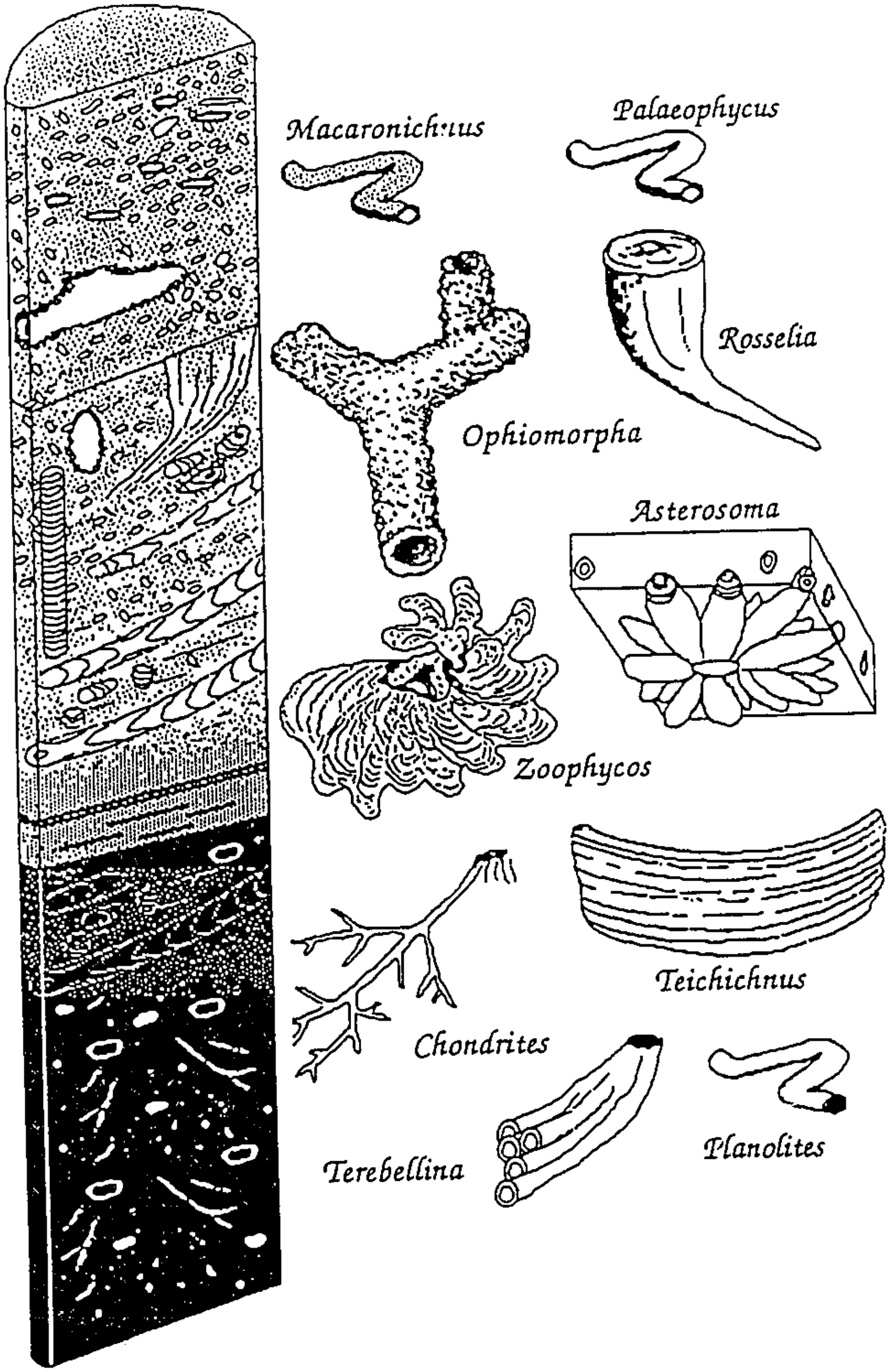


FIGURE 39. --Composite ichnofossil assemblage illustrating those ichnogenera which occur with *Macaronichnus* in lower shoreface to shelf sediments within the Sparky, Rex, and Lloydminster units.

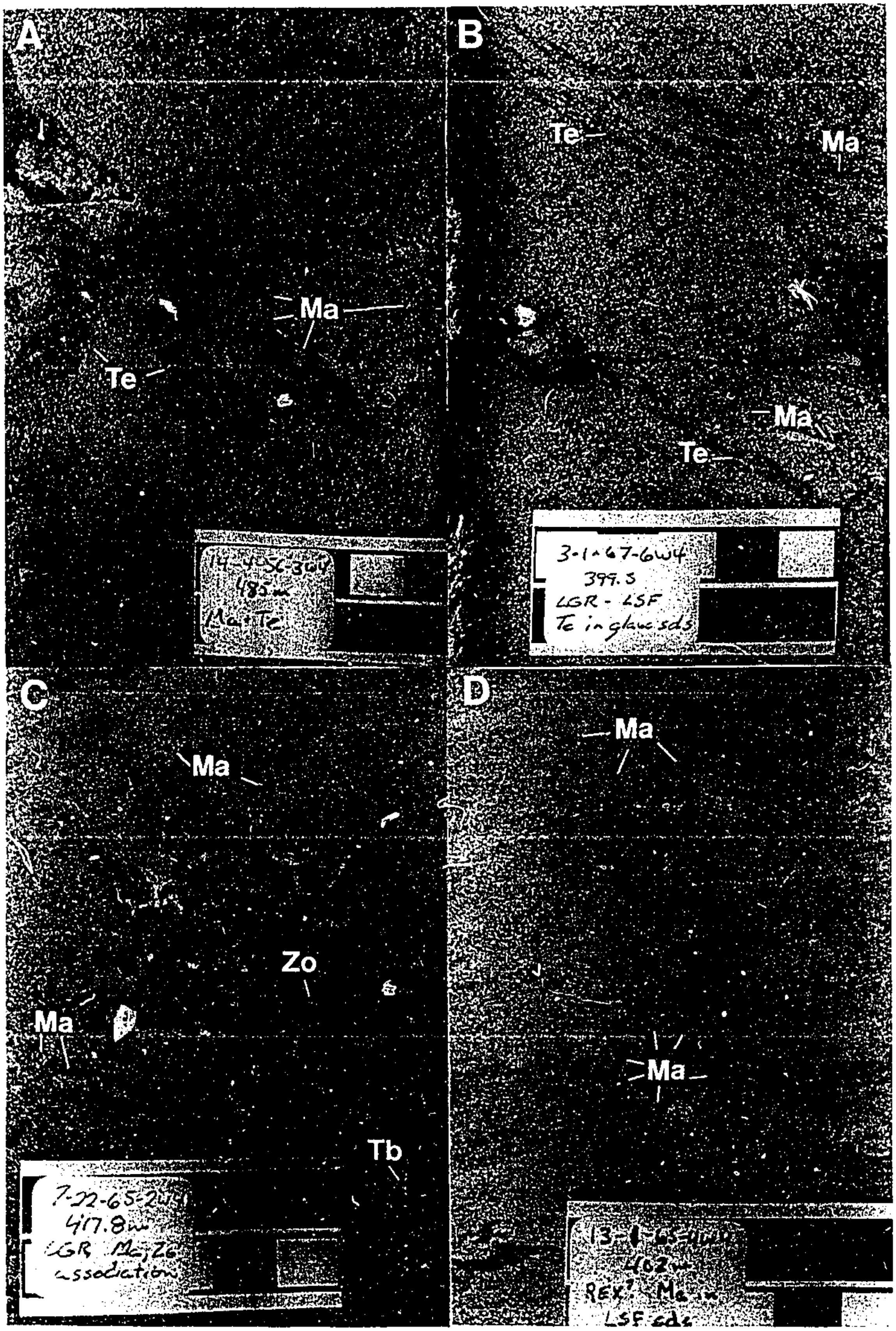
PLATE 9. -- Various examples of cored wells illustrating lower shoreface or shelfal occurrences of *Macaronichnus* . In all cases small divisions on scale equal 1 cm.

A. Deal et al. Frog Lake 14-4-56-3W4; 485 m below K.B.; Rex unit: association of *Macaronichnus* (Ma) and *Teichichnus* (Te) in lower shoreface sands.

B. Esso AEC 86 Fish Creek 3-1-67-6W4; 646.1 m below K.B., Rex unit: association of *Macaronichnus* (Ma) and *Teichichnus* (Te) in lower shoreface sands.

C. Esso 87 Marie 7-22-65-2W4; 417.8 m below K.B.; Lloydminster unit: association of *Macaronichnus* (Ma), *Zoophycos* (Zo), and *Terebellina* (Tb) in shelfal sands.

D. Esso 85 D24-13 Cold Lake 13-1-65-4W4; 402 m below K.B.; Sparky unit: multiple *Macaronichnus* (Ma) in lower shoreface sands.


A
Ma
Te
14-4-56-3W4
485m
Ma+Te
B
Te
Ma
Ma
Te
3-1-67-6W4
399.5
LGR - LSF
Te in glauc sds
C
Ma
Zo
Ma
Tb
7-22-65-2W
417.8m
LGR Ma, Zo
association
D
Ma
Ma
13-1-65-1W
402m
REX? Ma in
LSF sds

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CHAPTER VI

ARENACEOUS FORAMINIFERA FROM THE UPPER AND MIDDLE MANNVILLE AND LOWER COLORADO SUB-GROUPS IN THE COLD LAKE OIL SANDS AREA OF EAST-CENTRAL ALBERTA: STRATIGRAPHIC AND PALEOENVIRONMENTAL IMPLICATIONS

INTRODUCTION

Although the Lower Cretaceous Mannville Group of east-central Alberta represents one of the most economically important stratigraphic units in the world due to its abundance of oil, gas, and oil sand resources, it also represents a unit fraught with stratigraphic and paleoenvironmental interpretation problems. This chapter will address two of the most basic of these problems through an examination of the microfauna of the Upper and Middle sub-groups of the Mannville and of the overlying Colorado Group. The first part of this discussion will focus on the problem of defining the boundary between the Mannville and the Colorado, while the second part will address the paleoecologic significance of Upper and Middle Mannville microfauna. All identifications of microfauna were made by Dr. John H. Wall of the Geological Survey of Canada.

PREVIOUS STUDIES

Colorado Group

Joli Fou Formation

The black shales of the Joli Fou Formation in eastern Alberta record the linking of the Boreal and Gulfian seas which formed the Western Interior Seaway during Late Albian time (Williams and Stelck, 1975). Early studies of the foraminifera of the Joli Fou (Cushman, 1927; Wickenden, 1941; Nauss, 1947) revealed the presence of a diverse microfaunal assemblage that has come to be known as the *Haplophragmoides gigas* fauna (Stelck et al., 1956; Caldwell et al., 1978). The microfauna (*Haplophragmoides gigas* and other foraminifera) and macrofauna (most notably the bivalve *Inoceramus comancheanus*) are proof of both a marine incursion from the Gulfian sea and an early Late Albian age (Stelck et al., 1956; Williams and Stelck, 1975).

Mannville Group

Many of the stratigraphic problems associated with the Mannville Group have arisen out of its rather long and confusing history of differing stratigraphic nomenclatural schemes. Nauss (1945) was the first to use the name Mannville in connection with the Lower Cretaceous sand series in eastern Alberta (assigning it formation status at that time), and was also the first to attempt to divide it into units. His division of the Mannville into the O'Sullivan, Borradaille, Tovell, Islay, Cummings, and Dina members has never gained acceptance (with the exception of the names Cummings and Dina, which are still generally retained), instead being replaced by local driller's names which were first formalized by Edmunds (1948). It is Edmunds' scheme (with subsequent additions and modifications) which has been adopted by workers in the Lloydminster area of eastern Alberta and western Saskatchewan today (e.g. Fuglem, 1970; Orr, et al., 1977; Vigrass, 1977).

Colony Formation

The uppermost sandstone unit of the Mannville is referred to as the Colony Formation by most workers. Edmunds (1948) stated that the equivalence of the Colony to Nauss' (1945) O'Sullivan member was unequivocal. By Edmunds' definition, however, the original Colony would be equivalent to the entire Upper Mannville sub-group under current usage. This division differs significantly from subsequent stratigraphic schemes which have divided the Upper Mannville into three units known respectively as the Colony, McLaren, and Waseca formations (Fuglem, 1970; Orr, et al., 1977; Vigrass, 1977).

Badgeley (1952) attempted to unify the stratigraphic nomenclatural schemes used in the Athabasca area of north-eastern Alberta with that used in the Lloydminster area of east-central Alberta. In the Athabasca area the Upper Mannville forms the uppermost section of a unit known as the Grand Rapids Formation (originally defined by McConnell, 1893). Badgeley (1952) named the uppermost unit of the Mannville the St. Edouard Member (a term long since abandoned) of the Grand Rapids Formation and noted its one-to-one equivalence with the "Colony sandstone" of Edmunds (1948). Like most previous workers (e.g. Nauss, 1947), Badgeley recognized a distinct stratigraphic break between the dominantly sandy section of the Mannville and the distinctive dark grey shales of the overlying Joli Fou Formation.

Controversy over the Colorado-Mannville contact

Stelck (1958) was the first to express disagreement with these previous interpretations of the disconformity between the Joli Fou and the Mannville, stating that Badgeley's St. Edouard Member, as well as the equivalent Colony sand, should not be placed in the Mannville Group at all but rather in the overlying Colorado Group. Stelck (1958) argued that these sandy units were emplaced during the transgression of the Joli Fou Sea, and not during the regression of the Clearwater Sea, as is the case for the underlying units of the Upper and Middle Mannville. Singh (1963), and Stelck and Kramers (1980), also argued that the uppermost sections of the Grand Rapids Formation (Colony equivalent) should be included in the Colorado Group, since they felt that the basal sands of the Joli Fou transgression were often mistaken for Upper Mannville sands due to their being the product of reworked Mannville sands in the first place. Singh (1963), however, stated that no paleontologic criteria could be used to define the exact position of the disconformity between the Mannville and the Colorado in east-central Alberta since transgressive reworking would also rework fossil material. Later, Caldwell (1984) agreed with this position, stating that the foraminiferal evidence for defining the disconformity in west-central Saskatchewan was not at all clear, possibly due to transgressive reworking. If this interpretation is correct then the Colony would represent another example of those units which have generally been referred to as "basal Colorado sands" (Banerjee, 1989; 1990). Examples of other units that have been cited as basal Colorado sands include the Spinney Hill Member of the Colorado in central Saskatchewan (Edwards, 1960; Guliov; 1967; Simpson,1975; 1982), the upper sections of the Pense Formation in southern Saskatchewan (Atkin, 1986), the upper section of the Swan River Group of eastern Manitoba (Stelck, 1958), and the Paddy Formation of west-central Alberta (Stelck, 1958; see also Leckie and Reinson, in press, for a more recent interpretation of this unit).

The dichotomy of opinion as to the exact placement of the Mannville-Colorado contact has caused a great deal of confusion; confusion that is reflected in two recent, but markedly different stratigraphic charts of the Mannville (Fig. 40). The question is thus posed: Should the Colony be included within the Mannville Group or within the Colorado?

FORAMINIFERAL STUDIES OF THE COLORADO-MANNVILLE INTERVAL

Foraminiferal studies of the Joli Fou and Colony were initiated in order to determine the biostratigraphic affinity of the Colony; whether the foraminiferal fauna of the shaly sections of the formation had more in common with the *Haplophragmoides gigas* foraminiferal zone that characterizes the Joli Fou shale or with the next major underlying foraminiferal zone; i.e. the *Verneuillinoides cummingensis-Marginulinopsis collinsi* zone that is characteristic of the Clearwater Formation (Stelck, et al., 1956). From a drill core database of over 50 wells in which the Joli Fou-Colony contact was expressed, six wells, from widely dispersed locations (Fig. 41), were chosen for sampling:

Well:

Husky Lindberg 11-16-54-5W4
Husky Shell EOR Frog Lake 05-16-57-3W4
Murphy 65631 Lindbergh 16-13-58-5W4
Mobil Sugden 10-26-63-7W4
Husky Tucker Lake 10-19-64-4W4
Husky AEC Fisher 05-09-70-5W4

Both Joli Fou shales and Colony shales were sampled in the case of the first four wells listed, with samples from the Joli Fou being taken at the base of the formation and (in the case of the Husky Lindberg 11-16-54-5W4 well) at some distance above the base. Shaly sections of the Colony were sampled in all cases, however samples were unavailable for the Joli Fou shales in the case of the last two wells listed.

Abundant microfaunal and macrofaunal remains were recovered from the Joli Fou in most cases where it was sampled (Fig. 42), although the volume and diversity of faunal elements increased markedly in samples taken further above the contact. This may indicate that the *H. gigas* zonal assemblage did not develop until some time after the initial advance of the Joli Fou Sea. In the case of the Mobil Sugden 10-26-63-7W4 well, samples were taken from a cemented zone that may straddle the contact between the Colony and the Joli Fou.

The lack of microfauna observed within the Joli Fou in the Mobil Sugden well is only exceeded by that of the Colony shales that were sampled. In fact, no foraminifera were found within the shaly sections of the Colony. Instead, only a small number of megaspores, woody fragments, and some aragonite needles (assumed to be from marine bivalves, but which do not appear to be *in situ*)were recovered. There is therefore no evidence from this study to suggest that the Colony belongs to the early Late Albian *H. gigas* Zone that spans the overlying Joli Fou Formation.

This finding is not inconsistent with previous research. Many studies, including the pioneering work of Nauss (1947) and Wickenden (1948), and ranging to studies conducted by Putnam (1979), have reported that the entire Upper Mannville is devoid of foraminifera in many areas of east-central Alberta. The absence of microfauna within the Colony may indicate the dominance of terrestrial influence during deposition. This in turn may serve as an argument against the interpretation that the Colony represents a transgressive deposit. (NOTE: In this context it is also interesting that those studies which have proposed that the Colony represents the earliest transgressive phase of the incursion of the Joli Fou sea have never reported the occurrence of any elements of the *H. gigas* microfaunal assemblage within it).

Some studies in west-central Saskatchewan have reported the occurrence of foraminifera in the Colony, but have indicated that their affinity to any distinctive foraminiferal zone is not at all clear (Caldwell, 1984; Atkin, 1986). Although Atkin (1986; p. 38) suggested that the entire Mannville above the Dina should be included within the *M. collinsi-V. cummingensis* Subzone (characteristic of the Clearwater or Cummings formations), neither the diagnostic elements of that Subzone nor that of the *H. gigas* (characteristic of the basal Joli Fou) microfossil zone have been recorded from any part of the Upper Mannville. Instead, the Upper Mannville in west-central Saskatchewan is dominated by a completely different assemblage, characterized by representatives of the genera *Bathysiphon*, *Brachysiphon*, *Hippocrepina*, *Saccamina*, and

Thuramminoides.

STRATIGRAPHY OF THE JOLI FOU-COLONY CONTACT

Although the Colony is barren of foraminifera in east-central Alberta (possibly due to lack of marine influence), detailed mapping and drill core examination of this unit reveals a great deal more about the nature and position of the Colorado-Mannville contact than previous and present biostratigraphic studies have thus far yielded.

Within the Cold Lake Oil Sands area the contact at the base of the Joli Fou shales is universally sharp and is almost always characterized by a cemented zone just below the contact itself (Pl. 10A; 10B). Although cements may vary within this zone, siderite is by far the most common type. The base of the Joli Fou shales may contain a very thin sandy shale zone commonly associated with a chert pebble lag at the extreme base. The lag zone is also characterized by the presence of bioclastic debris, including bivalve shell fragments (*Inoceramus, Ostrea*) as well as fish scales, bones, and teeth. As such, the debris at the base of the Joli Fou shales is consistent with the interpretation of a transgressive lag created through reworking and winnowing during transgression of the Joli Fou Sea. The contact therefore represents a ravinement surface (Stamp, 1921; Swift, 1968; Nummedal and Swift, 1987) .

However, it must be remembered that the cemented zone at the top of the Colony is normally composed of siderite and is suggestive of subaerial conditions prior to the deposition of the Joli Fou shales. The Colony also contains a number of incised channels which may have cut down as deep as the Middle Mannville (Chapter III). In addition, small scale coarsening-upwards sedimentary cycles at the top of the regional paralic sands of the Colony have in many cases been extensively truncated by erosion. Structure contours on the top of the Colony (Appendix 3, Fig. 72) indicate that the degree of erosion was great enough to create a topographic expression that would not be consistent with simple shoreface retreat during transgression. This is an important point, since the contact between the Colony and the Joli Fou is often used as a stratigraphic datum. If the contact represents an erosive surface, then it would hardly seem suitable for this purpose.

The contact at the base of the Joli Fou shales therefore represents two erosive events. An earlier, large-scale erosive event is indicated by the truncation of sedimentary cycles, channel incision, and subaerial cementation, and is most likely evidence for an extensive withdrawal of the Clearwater Sea. The later, smaller-scale erosive event developed through the reworking of Mannville sands and is indicated by the chert pebble and bioclastic lag at the base of the Joli Fou. This contact thus represents both an erosive disconformity (formed prior to transgression) and a ravinement surface (formed during transgression) (*sensu* Van Wagoner, et al., 1988). The length of the first erosive event may encompass the entire middle Albian stage of the Lower Cretaceous, as all of the faunal index zones of the Middle Albian are missing from the sedimentary succession of the Mannville Group in the plains area of Alberta and Saskatchewan (Caldwell, et al., 1978; Caldwell, 1984). In contrast, a complete section through the Middle Albian is present in parts of northeastern British Columbia (Koke and Stelck, 1985) (Fig. 43).

Despite the weight of evidence favouring the stratigraphic relationship between the regional Colony and the Mannville Group, deposits which infill channels cut on the top of the regional Mannville (i.e. Colony channels) are another matter. These deposits are, by definition, younger than the regional offshore-shoreface Colony deposits. It is possible that these channel-fill deposits are the initial deposits of the Joli Fou transgression and it is also possible that another, later erosive event scoured the top of the Mannville prior to the Joli Fou inundation. Therefore, at present it is uncertain whether these deposits should be classified as belonging to the same time interval as the Mannville Group or as the Colorado Group.

Based on this evidence it is therefore proposed that the Colony sands do not represent the earliest transgressive deposits of the Colorado Group, but simply comprise the last regressive clastic wedge of sediment deposited during the retreat of the Clearwater Sea from east-central Alberta. There is a possibility that the sands which infill Colony channels may be related to the Joli Fou transgression, but in terms of the regional Colony unit the only record of the Joli Fou transgression found in the Cold Lake Oil Sands area is preserved in the very thin chert pebble horizon at the top of the Colony (see also Wilson, 1984).

PALEOECOLOGY OF UPPER AND MIDDLE MANNVILLE SHALES

Upper Mannville

As previously stated, foraminifera are rare within the Colony unit in the Cold Lake Oil Sands area. Even the most promising shales in this interval are barren of microfauna. While this result has been common in previous studies in eastern Alberta, and has been interpreted as being due to a high degree of terrestrial influence in the deposits of the Upper Mannville, others (most notably Singh, 1963; Putnam, 1979; and Wightman, et al., 1987) have reported the occurrence of dinoflagellates and acritarchs from some parts of the Upper Mannville that indicate fluctuating brackish and marine conditions, especially in areas near the Saskatchewan border. In all of the studies of the Upper Mannville in west-central Saskatchewan in which foraminifera have been reported, however, they have been found to be rare and to display low assemblage diversity (see for instance Atkin, 1986). They have therefore been interpreted as indicative of salinity-reduced environments. For instance, the basal shales of the regional Waseca in west-central Saskatchewan display a poorly diverse foraminiferal assemblage. Wickenden (1948), Fuglem (1970), Lorsong (1982), and Haidl (1986) all noted this microfauna and interpreted it as an indication of brackish (estuary/tidal flat) rather than freshwater (fluvial/floodplain) depositional conditions.

Middle Mannville

Two zones, one at the base of the Lloydminster unit and the other at the base of the Rex unit, were sampled for foraminifera within the Middle Mannville interval in the Esso 87 Marie well (07-22-65-2W4) in the northern half of the Cold Lake deposit. A faunal list for each of these units is found in Figure 44. According to Dr. J.H. Wall of the Geological Survey of Canada (pers. comm., 1988), the foraminiferal assemblage found in the Lloydminster shale indicates essentially normal conditions (at least for the basin at this time), while that of the Rex shale indicates a shallower and less saline depositional regime. Both of these units bear some faunal affinities with the *Marginulinopsis collinsi - Verneuilinoides cummingensis* foraminiferal Subzone of Caldwell, et al. (1978) that is characteristic of the Clearwater Formation. Similar paleoecologic interpretations have been made for the Middle Mannville in previous studies in both central Alberta (e.g. Mellon, 1967) and in west-central Saskatchewan (e.g. Kent, 1959; Caldwell, 1984; Zaitlin and Schultz, 1984; Atkin, 1986).

The change from dominantly marine conditions to dominantly restricted marine conditions, as reflected in the foraminiferal assemblages, appears to have been a gradual process. Varying opinions have been expressed as to the point of change. Caldwell (1984), for instance, noted that the foraminifers which occur in the basal shales of the Cummings, Lloydminster, Rex, and G.P. formations in west-central Saskatchewan have a much more open marine character than those which occur in the basal shales of units higher up in the Mannville. On the other hand, Fuglem (1970), and Haidl (1986), felt that, based on the presence of agglutinated foraminifera (e.g. *Ammobaculites*, *Ammomarginulina*, *Miliammina*, and *Gaudryina*), the basal shale of the G.P. represented much more restricted marine conditions than envisaged by Caldwell (1984).

CONCLUSIONS

The trend in foraminiferal assemblages exhibited through the Middle Mannville interval (the lower sections of which contain a relatively diverse foraminiferal assemblage) into the Upper Mannville interval (the upper sections of which contain virtually no microfauna) is a reflection of increasingly restricted marine conditions during the deposition of each of the seven units of the Upper-Middle Mannville succession.

These seven units represent seven unconformity-bounded progradational clastic wedges which developed during the withdrawal of the Clearwater Sea from the Lloydminster sub-basin of eastern Alberta and western Saskatchewan during the Late Early Albian (Chapter II). Superimposed on the overall regressive depositional regime of the Upper and Middle Mannville were periodic relative transgressive events which left regional paralic deposits mantled with offshore muds. As each progradational cycle caused increasingly restricted embayment-like conditions within the Lloydminster sub-basin, and the effects of greater fresh-water input through the actions of an increasingly more active drainage network began to be felt (Chapters II and III), the normal marine microfauna was gradually displaced. It is proposed that by the time of Upper Mannville deposition, in which virtually no foraminifers occur, shallow nearshore waters were so effectively diluted by the combined effects of geographical restriction and freshwater influx such that "offshore" deposits could not support a marine fauna.

The lack of a marine fauna is most pronounced in the shales of the Colony Formation. Total lack of a marine microfauna, as well as stratigraphic data that indicate that the contact between the Colony and the overlying Joli Fou Formation represents a major unconformity, argue against earlier interpretations that the Colony represents the initial transgressive phase of the Joli Fou inundation. Rather, the Colony simply represents the last in a series of regressional events that characterize the bulk of Upper and Middle Mannville deposition.

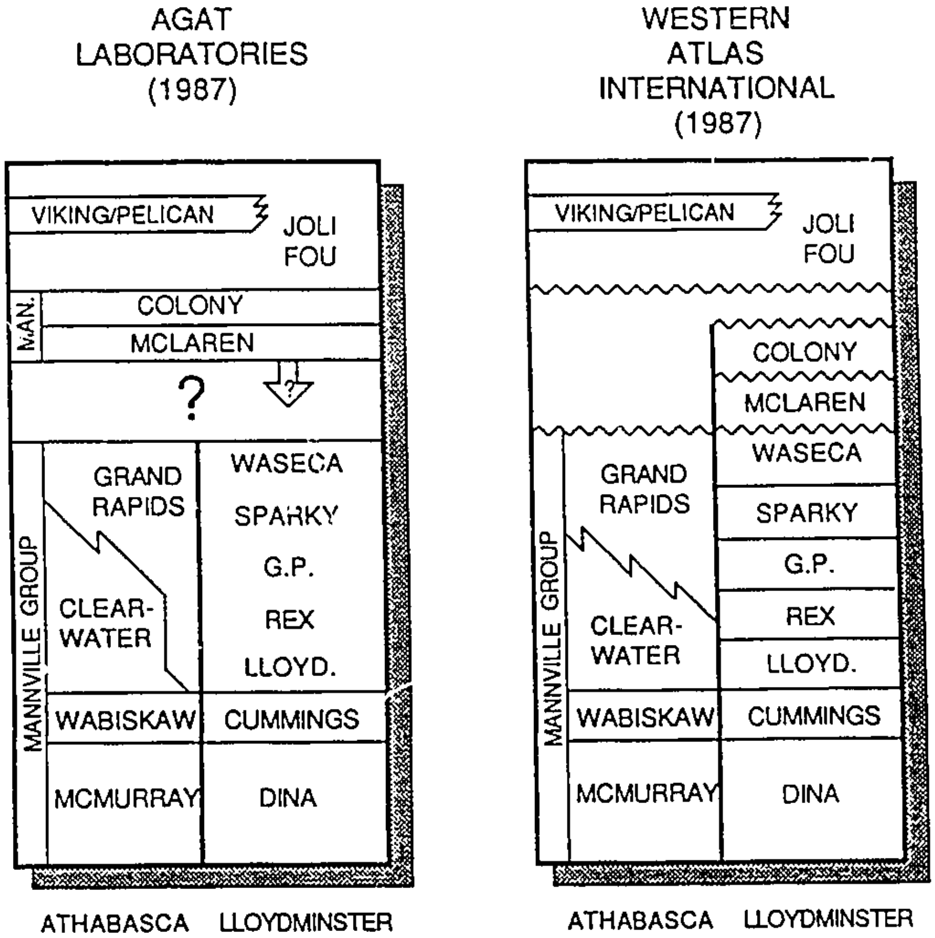


FIGURE 40.-- Two recent stratigraphic charts illustating alternate interpretations of the position of the Mannville-Colorado boundary.

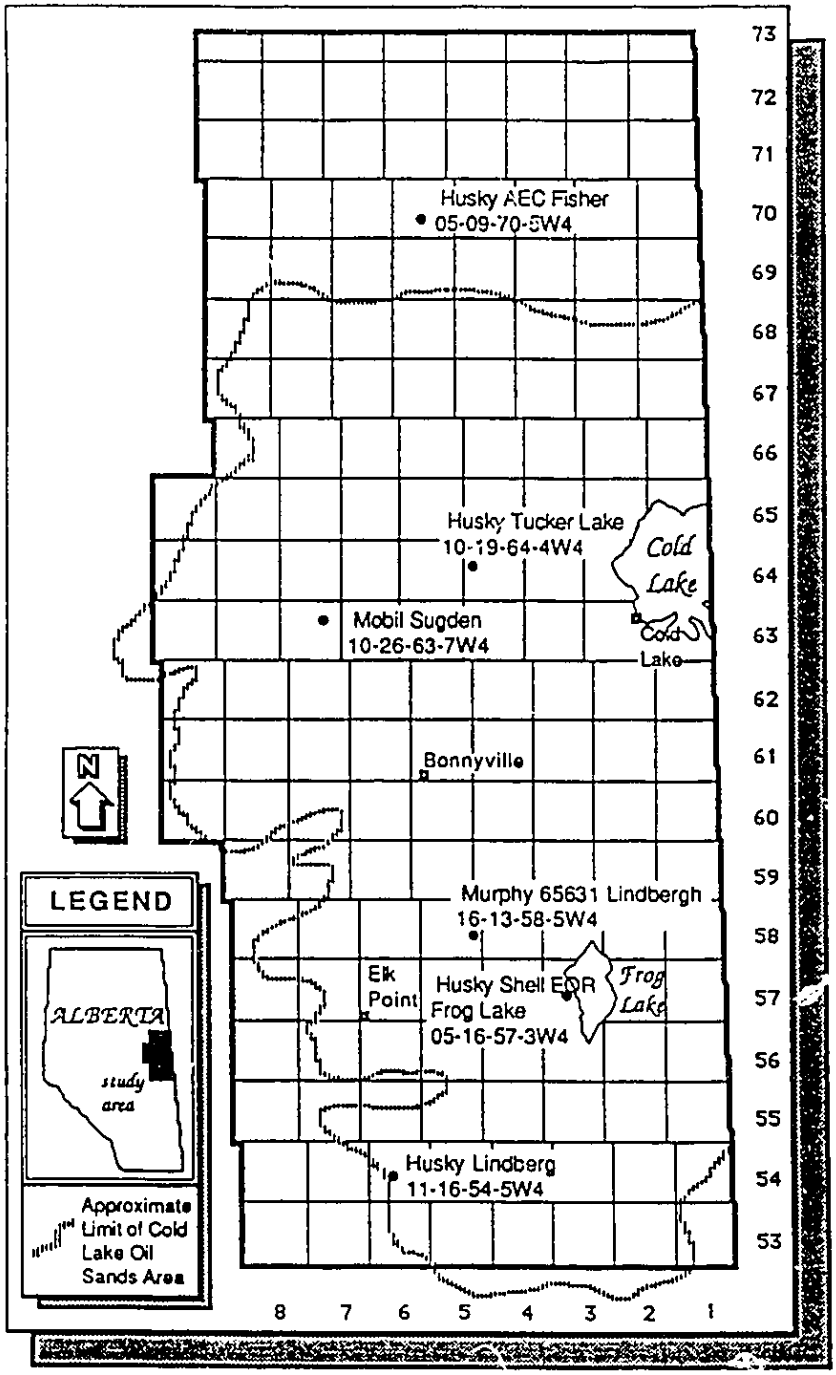


FIGURE 41.-- Location of wells from which micropaleontologic samples were obtained.

	11-16-54-5W4 472 m; 4.4 m above Joli Fou-Colony contact	05-16-57-3W4 411.5 m; at Joli Fou-Colony contact	16-13-58-3W4 448 m; at Joli Fou-Colony contact	10-26-63-7W4 310.5 m; at Joli Fou-Colony contact
Foraminifera:				
Ammobaculites whitneyi	10		1	
Ammobaculites sp. cf. *A. petilus*	4			
Ammobaculites sp.-spp.	3+	2	1	
Ammodiscus sp. cf. *A. anthosatus*		1		
Gaudryina hectori	6	2		
Haplophragmoides sp.-spp.	20	3		
Hippocrepina sp.	1			
Miliammina spp.	4			
Pseudobolivina sp.		1		
Pseudonodosaria sp.		1		
Saccammina sp.		1		
Trochammina sp.		1		
Verneuilinoides sp.		1		
Diatomacea:				
Coscinodiscus sp.-spp.	14	3		1
Algal cysts		3		
Bivalvia:				
Inoceramus sp.	▨	▨	▨	▨
Ostrea sp.			▨	
Ostracoda		▨		
Pisces:				
teeth, scales, bone fragments	▨	▨	▨	▨

FIGURE 42.-- List of microfauna collected from the Joli Fou Formation.

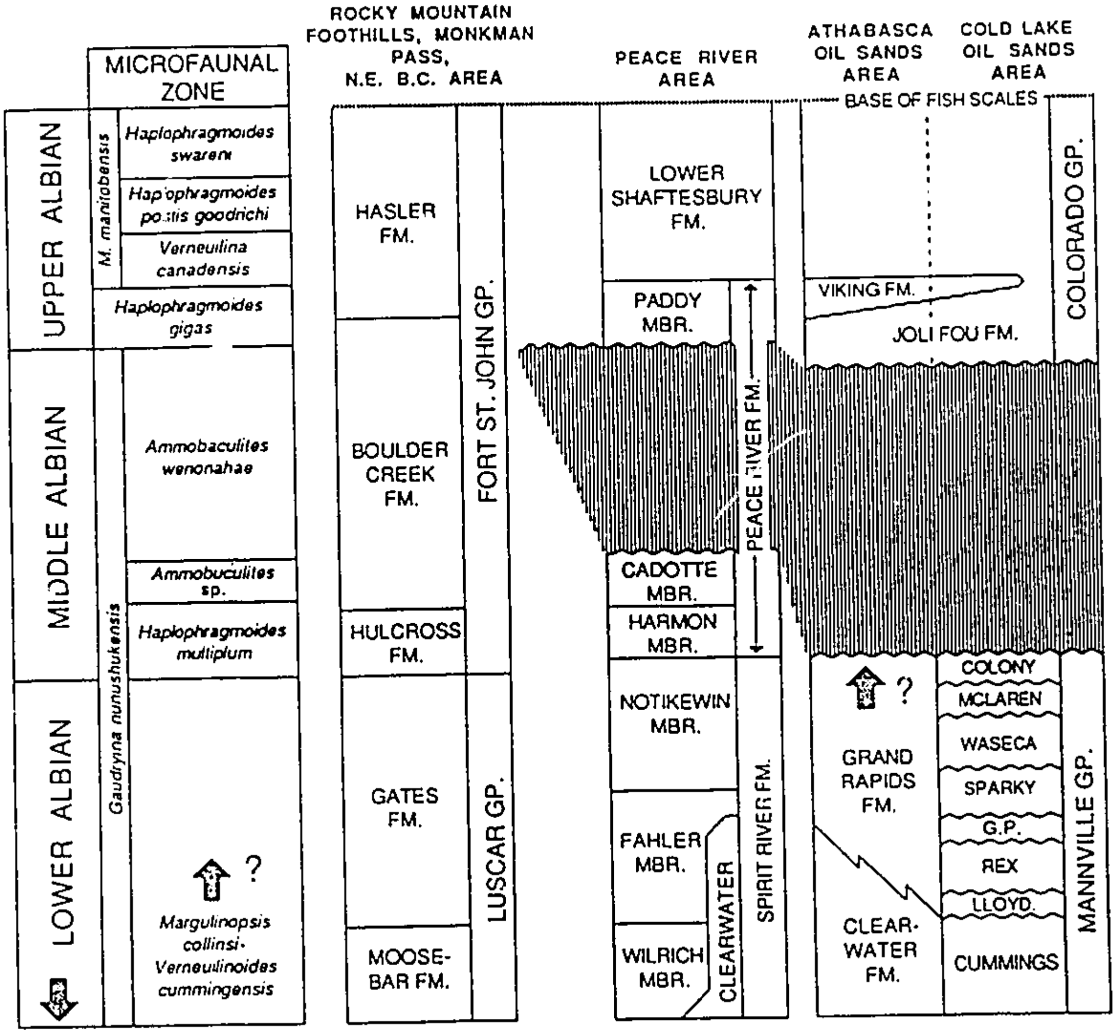


FIGURE 43.-- Regional correlation of Albian strata in east-central, northeastern, and northwestern Alberta and northeastern British Columbia. Note that the extensive unconformity that spans the entire Middle Albian in eastern Alberta is absent in northeastern British Columbia. Partially adapted from Koke and Stelck (1985) and Leckie and Reinson (in press).

	Basal Rex shale	Basal Lloyd-minster shale
Foraminifera:		
Ammobaculites spp.		▨
Ammodiscus sp. cf. *A. crenulatus*		▨
Haplophragmoides gigas minor		▨
Haplophragmoides sp.	▨	
Haplophragmoides spp.		▨
Miliammina sproulei	▨	▨
Trochammina sp.	▨	
Verneuilinoides sp.		▨
indeterminate genera	▨	

Basal Rex shale: 17 m above Cummings

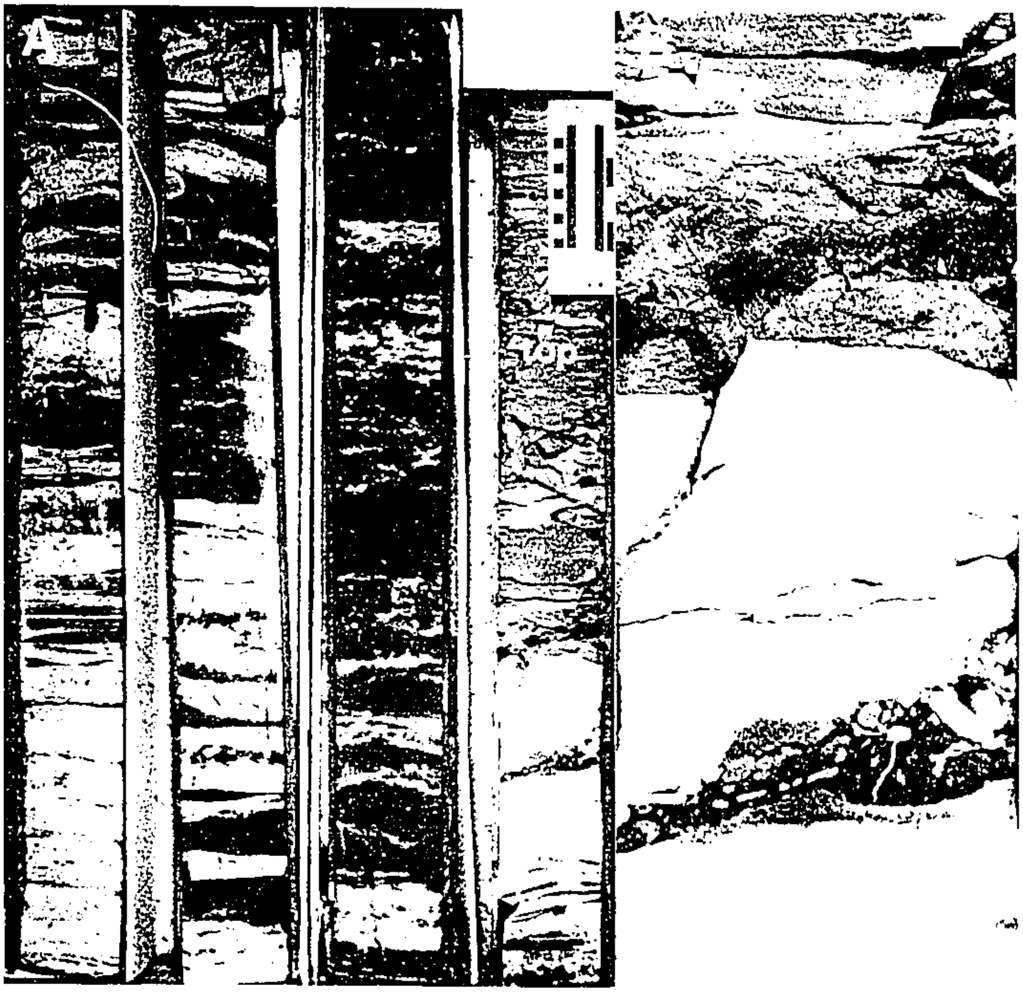
Basal Lloydminster shale: 1.4 m above Cummings

FIGURE 44.-- List of microfauna collected from the basal shales of the Lloydminster and Rex units.

PLATE 10. Colony-Joli Fou contact.

A. Black to dark grey shales of the Joli Fou Formation directly overlying coarsening-upwards succession of the Colony allomember (10-19-64-4W4; 333.0-336.0 m below K.B.). Sideritecemented zone extends across the contact.

B. Close up of the Colony-Joli Fou contact shown in 10A. Contact lies at the pebble horizon (transgressive lag) but is obscured by siderite cementation.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CHAPTER VII

GASTROPOD PALEONTOLOGY OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS OF EAST-CENTRAL ALBERTA

INTRODUCTION

Although the Lower Cretaceous Mannville Group of east-central Alberta and west-central Saskatchewan has been the subject of numerous studies in the last forty to fifty years (Chapter 1), the macropaleontology of the group has received relatively little attention. This is especially true of the Gastropoda of the Upper and Middle sub-groups of the Mannville (Fig. 45), whose occurrence has been noted before (McLearn, 1944, Lorsong, 1979), but has never been fully explored. The purpose of this chapter is to provide a systematic taxonomic treatment of the gastropod fauna of the Upper and Middle sub-groups of the Mannville in the Cold Lake Oil Sands area of east-central Alberta, as well as to speculate on the paleoecologic significance of individual gastropod assemblages in two specific occurrences.

DATABASE

Because the Mannville Group does not outcrop in east-central Alberta, all samples used in this study were obtained from drill core. Macroinvertebrate remains were found to be generally rare within the Upper and Middle Mannville, although in some localized occurrences they may be exceptionally numerous. Both bivalves and gastropods were found in this study -- however, the Bivalvia were preserved as shell hash and were not identifiable. Gastropods were found in only 4 wells (in a study of over 300 drill cores), and of these only 2 wells contained identifiable material. In both cases, gastropods were found in mixed sand-shale lithologies interpreted as representing the fill of abandoned channels (see following discussion). One assemblage was found within a channelized succession of the General Petroleums unit of the Middle Mannville sub-group while the other was found in a channelized succession of the McLaren unit of the Upper Mannville sub-group (see Chapters 2 and 3 and Figures 1 and 2). The wells in which identifiable fossil material were found are listed below:

Well name	*Unit from which fossil material was recovered*	*Depth below kelly bushing*
Murphy 65631 Lind 16-13-58-5W4	General Petroleums	500.0-506.5 m
Esso 85 D24-13 Cold Lake 13-1-65-4W4	McLaren	383.0-389.0 m

A total of 10 identifiable specimens were recovered from the 16-13-58-5W4 well; while 14 identifiable specimens were recovered from the 13-1-65-4W4 well.

SYSTEMATIC PALEONTOLOGY

CLASS Gastropoda
SUBCLASS Prosobranchia
ORDER Caenogastropoda
SUPERFAMILY Cyclophoracea
FAMILY Viviparidae

GENUS *Campeloma* Rafinesque
Campeloma? sp.
(Fig. 45A)

Description-- Shell ovoid to turbiniform. Spire weakly elongate and moderately rounded; large, well rounded body whorl comprising 80% of shell volume; sutures impressed. Prosocyrt growth lines, no carinae. One flattened and incomplete specimen.

Discussion-- *Campeloma* is a very common genus in Cretaceous rocks of the Western Interior. Henderson (1935) listed eight species known to occur in the North American Cretaceous, only 2 of which were thought to be restricted to the Upper Cretaceous. Along with virtually all of the Viviparidae, modern campelomids are always found in freshwater depositional systems (Prashad, 1928; Webb, 1942; Emerson and Jacobsen, 1976).

Occurrence-- Unit: General Petroleums channel
Well: Murphy 65631 Lind 16-13-58-5W4; 495.0-501.5 m

GENUS *Lioplacodes* Meek and Hayden, 1865

Lioplacodes bituminis Russell, 1932

(Fig. 45B)

Description--- Shell elongate ovoid to narrowly turbiniform. Spire elongate and acute, weakly convex, with a spiral angle of about 45°; protoconch very small but emergent; usually four to five volutions; sutures impressed, increasingly so towards the base. Aperture ovoid with angular outer lip; both outer and inner lips thin with no columellar fold or lip; growth lines strongly opisthocyrt and closely spaced, often with strong, closely spaced, paired varices on last two whorls. Slit-like umbilicus.

Discussion--- The taxonomic assignation of *Lioplacodes* has long been a matter of dispute. Meek and Hayden (1865) originally designated the genus and differentiated it from *Lioplax* Troschel, 1856, on the basis that the former displayed a "much less ventricose and proportionally smaller body whorl, more attenuate spire, and numerous thread-like revolving lines, instead of a simple carinae; while the posterior extremity of its aperture is subangular instead of rounded, in consequence of the oblique flattening of the upper part of the body volution". Prashad (1928) suggested that the genera *Lioplacodes* and *Campeloma*, both of which are closely related in form and in habitat, should be included as subgenera of the genus *Viviparus*, probably the most common of all fresh-water gastropods of the Late Mesozoic and Early Cenozoic within the Western Interior. Both *Lioplacodes* and *Campeloma* are retained herein, however, since they differ from *Viviparus* in enough important aspects (e.g. body whorl and spire morphology) to warrant their taxonomic segregation. Shell morphology within the various genera of the Viviparidae is often quite similar and the differentiation between the two genera is far from clear. Russell (1932) pointed out these problems with the distinction between *Lioplacodes* and *Lioplax* in his systematic description of *Lioplacodes bituminis*, stating that the form bears a close resemblance to both *Lioplacodes veternus* Meek (the type species) and to *Lioplax* ("*Goniobasis*") *nebrascensis* Meek and Hayden.

Occurrence-- Unit: McLaren channel

Well: Esso 85 D24-13 Cold Lake 13-1-65-4W4; 383.0-389.0 m

Other known occurrences-- abundant within the Calcareous Member of the

McMurray Formation in the Athabasca Oil Sands of northeastern Alberta (Russell, 1932; Mattison, 1987).

GENUS *Viviparus* Montfort, 1810

Viviparus murraiensis Russell, 1932

(Fig. 45C)

Description--- Shell ovoid to shallowly turbiniform. Spire short and convexly rounded, with a spiral angle of about 80°; protoconch slightly dome-shaped and flattened; usually three to four volutions; sutures impressed, increasingly so towards the base. Aperture broadly tear-shaped to ovoid and nearly as large in diameter as the main penultimate body whorl; outer lip well rounded and thin; inner lip thickened and displaying rugose axial folding of columellar lip. Growth lines are mostly orthocline to prosocyrt and are closely spaced.

Discussion--- *Viviparus* is among the most abundant of all known genera of gastropods from the Western Interior, with the family Vivipariidae representing the most conspicuous of all Late Mesozoic and Early Cenozoic non-marine Gastropoda (White, 1883). In fact Henderson (1935) listed 30 fossil species from North America, 14 from strata of Cretaceous age and 16 from the Tertiary. The only other known occurrence of *V. murraiensis* has been described from the Calcareous Member of the McMurray Formation in the Athabasca Oil Sands of northeastern Alberta (Russell, 1932; Mattison, 1987).

The most extensive study of the Viviparidae to date remains that of Prashad (1928), who was of the opinion that the modern North American Viviparidae fauna was directly descended from the fauna of the Upper Cretaceous. Bouvier (1887; in Prashad, 1928, p. 243) theorized that the Viviparidae as a family were directly descended from the Turbonidae and Trochidae, an event that may have occurred during the early Jurassic. The earliest known Viviparidae of North America are known from this time and may have been marine or estuarine in habitat. However, it has been proposed that members of the family Viviparidae became separated from their marine and estuarine ancestors by the beginning of the Cretaceous, assuming an exclusively fresh water mode of life (Prashad, 1928). The modern Viviparidae are all unisexual operculate gastropods, which can withdraw into their shells in order to protect themselves from predators and harsh environmental conditions.

Occurrence-- Unit: 1 specimen from the base of a McLaren channel

Well: Esso 85 D24-13 Cold Lake 13-1-65-4W4; 383.0-389.0 m

Other known occurrences-- common within the Calcareous Member of the McMurray Formation in the Athabasca Oil Sands of northeastern Alberta (Russell, 1932; Mattison, 1987). Russell (1932) remarked that of all the Western Interior fossil Viviparidae, *V. murraiensis* most closely resembles *V. prudentius* White from the uppermost Cretaceous.

SUPERFAMILY Cerithiacea

FAMILY Pleuroceridae

GENUS *Circamelania* Yen, 1951

Circamelania ortmanni (Stanton)

(Fig. 45D)

Goniobasis?ortmanni Stanton, Preceedings of the American Philosophical Society, v. 42, p. 197, pl. 4, fig. 7-10, 1903

Description-- Shell small, and moderately slender; elongate turbiniform to cyrtoconoid. Spire elongate with a spiral angle of about 80°. Aperture elongated and tear-shaped; about half the diameter of body whorl. Columella thickened with small axial columellar fold partially covering umbilical chink. Thickened peristomal margin; pronounced adapical channel. Very closely spaced, yet unpronounced growth lines, mostly weakly opisthocyrt to opisthocline. Sutures impressed forming prominent ridges between whorls. Strong revolving ornament lines parallel to sutures. Number of spiral lines increases towards aperture and becoming very closely spaced in body whorl; in some cases lines strong enough to be called small carinae. Number of spiral lines also varies between individuals.

Discussion-- Yen (1951), differentiated *Circamelania* from *Goniobasis* (consequently reassessing *G. ortmanni* Stanton) on the basis that the former displays more roundly convex whorls, deeply impressed sutures and a well-thickened peristomal margin". Although the spiral ornament is the most striking feature of the specimens of *C. ortmanni* noted in this study, Stanton (1903) found that sculpture was quite variable in this species, with some individuals lacking ornament entirely. Yen (1951) felt that *Circamelania* may be an ancestral group to *Pleurocera* and other like Pleuroceridae, all of which are of fresh-water habitat.

Occurrence--Unit: McLaren channel

Well: Esso 85 D24-13 Cold Lake 13-1-65-4W4; 383.0-389.0 m

Other known occurrences-- common within the "upper" Kootenai Formation near the town of Harlowton, Montana (Stanton, 1903; Henderson, 1935; Yen, 1949; 1951).

GENUS *Goniobasis* Lea, 1862

Goniobasis multicarinata Russell, 1932

(Fig. 45E)

Description--- Shell elongate-ovoid to turbiniform. Spire convex and moderately elongate with a spiral angle of about 45°; usually four or five volutions; body whorl well rounded; sutures impressed, increasingly so towards the base. Aperture ovoid; columella somewhat thickened. Orthocyrt growth lines and fine revolving carinae mark the shell, forming a hatchered external surface. Basal margin of aperture holostomastous.

Discussion--- Modern goniobasids are well distributed in fresh-water habitats in North America especially throughout the eastern United States, the Mississippi Valley, and along the western coast of the United States (Henderson, 1935; Abbott, 1974; Chambers, 1978; 1980; Diller, 1984).

Most of the fossil goniobasids from North America were originally described as melaniids, yet the designation of any Melaniidae from the fossil record of North America is open to some question. White (1883), for instance, noted that no modern true melaniids are found in North America and remarked that it was doubtful if any fossil representatives of this family had ever existed within the North American continent. The goniobasids do bear a great deal of resemblance to the melaniids, however, and it is often difficult to tell the difference between the two groups based on shell form alone. Modern forms are differentiated on the fact that goniobasids are oviparous while the viviparids are (as their name implies) viviparous (Shimer and Shrock, 1944).

Goniobasis is, nevertheless, a common genus in faunal lists of the late Mesozoic and early Cenozoic of North America. Henderson (1935), for instance, listed 49 species of fossil *Goniobasis* from North America, 18 of these from the Cretaceous and 32 from the Tertiary.

Occurrence--Unit: General Petroleums channel

Well: Murphy 65631 Lind 16-13-58-5W4; 495.0-501.5 m

Other known occurrences-- rare within the Calcareous Member of the McMurray Formation in the Athabasca Oil Sands of northeastern Alberta (Russell, 1932; Mattison, 1987).

BIOSTRATIGRAPHY

Three of the species found in the Upper and Middle Mannville, *G. multicarinata*, *V. murraiensis*, and *L. bituminis*, are also found within the abundant shell beds of the Calcareous Member of the McMurray Formation (Lower Mannville sub-group) sometimes also referred to as the Ostracode Zone (Russell, 1932; Hunt, 1950; Loranger, 1951; Badgeley, 1952; Wanklyn, 1985; Mattison, 1987; Mattison and Pemberton, 1987; 1988a; 1988b; Mattison, et al., 1989).

Goniobasis multicarinata is the only species found in the General Petroleums channel in the Murphy 65631 Lind 16-13-58-5W4 well, where it is especially abundant. Its common occurrence in the General Petroleums is in marked contrast to its occurrence in the McMurray Formation in the Athabasca Oil Sands area where it is exceptionally rare (Russell, 1932; Mattison, 1987). As a further contrast, *Viviparus murraiensis*, one of the most common gastropods known to occur in the McMurray Formation in the Athabasca Oil Sands area, is very uncommon in its McLaren channel occurrence in the Esso 85 D24-13 Cold Lake 13-1-65-4W4 well. *Lioplacodes bituminis* appears to be common within both the McLaren channel in the Esso 85 D24-13 Cold Lake 13-1-65-4W4 well, as well as within the Calcareous member of the McMurray Formation.

The only other known occurrence of *Circamelania* (*Goniobasis*) *ortmanni* is found near the town of Harlowton, Montana (Stanton, 1903; Henderson, 1935; Yen, 1949; 1951) within the "upper" Kootenai Formation (late Aptian?-earliest Albian), where it is reportedly very common. The discovery of this species in channelized sediments of the McLaren unit of the Upper Mannville sub-group extends its paleogeographic range, as well as its biostratigraphic range, since the "upper" Kootenai is generally considered to be much older than the (late early Albian) Upper Mannville (e.g. Burden, 1984).

The occurrence of all of these gastropods in the Upper and Middle Mannville extends their previous known stratigraphic range. Kauffman (1979) for instance, stated that the gastropod fauna of the McMurray Formation was limited to the upper Aptian. Although there is some question about this age range (see Mattison, 1987), the occurrence of species common to the McMurray and "upper" Kootenai formations within the Upper and Middle Mannville indicates a much longer biostratigraphic range for these species than previously thought.

PALEOECOLOGY

All of the gastropod genera found in the Upper and Middle Mannville have modern analogues which are found exclusively in fresh water habitats (e.g. lakes, ponds, streams). The two successions in which identifiable gastropods have been found differ somewhat, however, in both their constituent fauna and in other associated paleoecologic indicators. Although the paleoecologic significance of the gastropod fauna within these successions is admittedly limited (due to the small size of the database), some information can be derived when taken within a paleoecologic context in which stratigraphic, sedimentologic, and ichnologic variables are considered.

Murphy 65631 Lind 16-13-50-5W4 well: General Petroleums channel

The succession of interbedded sand and shale in the Murphy 65631 Lind 16-13-50-5W4 well (Fig. 46A) is completely dominated by the species *Goniobasis multicarinata*, along with one broken gastropod specimen tentatively assigned to *Campeloma* sp., and some thin-shelled, badly broken bivalves. This succession is underlain by fine-grained, planar cross-bedded sands, with shale clasts at the base. The contact between these cross-bedded sands and the mixed sand-shale succession is sharp and indicates a sharp break in sedimentation pattern from high-energy sand-dominated point bar or channel fill deposition, to lower-energy intermittent deposition of sands and shales. This change in sedimentation pattern is interpreted as a change from active sand deposition within channels to channel abandonment. Some abrasion is evident in the gastropods recovered from this interval (along with the complete breakage of the bivalves noted above), indicating that some faunal transport has taken place previous to deposition. Nevertheless, the absence of trace fauna that might indicate brackish or marine conditions as well as the complete faunal dominance of *G. multicarinata* indicates that fully fresh-water conditions prevailed during the deposition of this succession.

Esso 85 D24-13 Cold Lake 13-1-65-4W4: McLaren channel

The occurrence of identifiable gastropods in the Esso 85 D24-13 Cold Lake 13-1-65-4W4 well (Fig. 46B) is in many ways quite similar to that noted for the Murphy 65631 Lind 16-13-50-5W4 well. Again, gastropods were found within interbedded sands and shales interpreted as representing a low-energy abandonment phase of channel deposition, although in this case channel abandonment occurred prior to the deposition of a series of stacked channel-fill successions. Three species of gastropods are found within the shell beds in this interval: *Circamelania ortmanni*, *Lioplacodes bituminis*, and *Viviparus murraiensis*. All three are considered to be fresh-water species based on the salinity tolerance of modern representatives within their respective genera.

These fresh-water gastropods are distributed only through the lower three-quarters of the abandoned channel interval, however. The upper one-quarter of the interval is similar in all respects to the succession below except that a significant trace fauna is found within the interbedded sands. This ichnocoenose is dominated by *Planolites*, *Arenicolites*, and *Skolithos*, and is interpreted as a remnant of the activities of a brackish-water tolerant infauna (see Chapter 3). The absence of fresh-water gastropods from the upper part of this interval, along with the appearance of a brackish-water ichnocoenose, may indicate a change from fully fresh-water fluvial conditions to slightly brackish or estuarine conditions. Ichnologic and sedimentologic indicators (e.g. mud-drapes) within the series of multiple stacked channels above this interval also indicate estuarine depositional conditions.

Paleoecologic significance of Mannville gastropod assemblages

The presence of co-occurring species within the Upper and Middle Mannville, and in the rich shell beds of the Calcareous Member of the McMurray Formation (Lower Mannville) within the Athabasca Oil Sands of northeastern Alberta, is both biostratigraphically and paleogeographically important.

However, the Calcareous Member is a unit that has been interpreted in the past as having a distinct brackish-water paleoecologic signature (e.g. Russell, 1932; Mattison, 1987). The interpretation that the three species *G. multicarinata*, *V. murraiensis*, and *L. bituminis* collected from the Upper and Middle Mannville indicate fresh-water depositional conditions in the context of their specific occurrences within this interval, would therefore seem at first glance to be inconsistent with the paleoecologic conclusions reached in previous studies of the McMurray Formation.

It must be remembered, however, that these species do not occur by themselves within the McMurray Formation, but are accompanied by species that most likely had a brackish or marine salinity tolerance (e.g. *Turbonilla* (*Melania*) *multorbis* Russell, *Melampus athabascensis* Russell). Studies of death assemblages of molluscs in both modern and ancient estuaries as well as in other stressed environments (and paleoenvironments) have shown that typical thanatocoenoses are made up of species reflecting a wide range of habitats, from fluvial to brackish to marine (Cadée, 1968; Peterson, 1977; Fürsich and Kauffman, 1984; Mattison, 1987). The occurrence of some fresh-water species within a brackish-water depositional system is therefore to be expected; the occurrence of these species in the absence of other brackish or marine species, however, must always be considered as an indication of a fresh-water depositional system in the absence of evidence to the contrary.

CONCLUSIONS

Studies of gastropods collected from two drill cores of the Upper and Middle Mannville in the Cold Lake Oil Sands area of east-central Alberta reveal the presence of species previously thought to have been restricted to the Lower Mannville interval and to the "upper" Kootenai Formation of central Montana.

Sedimentologic and stratigraphic criteria indicate that both of these occurrences represent deposition within paleochannels; one channel being associated with the McLaren unit of the Upper Mannville and the other associated with the General Petroleums unit of the Middle Mannville.

The McLaren channel assemblage includes *Lioplacodes bituminis*, *Viviparus murraiensis*, both of which were previously known only from the Calcareous Member of the (Lower Mannville) McMurray Formation, as well as *Circamelania ortmanni*, which has only been found previously in the "upper" Kootenai Formation. The General Petroleums channel assemblage is almost completely dominated by *Goniobasis multicarinata*, a species which has only been found previously in rare numbers within the Calcareous Member of the McMurray Formation, along with a single specimen of a poorly preserved *Campeloma*.

All of the species collected from these intervals are interpreted as fresh-water species based on comparison with modern representatives.

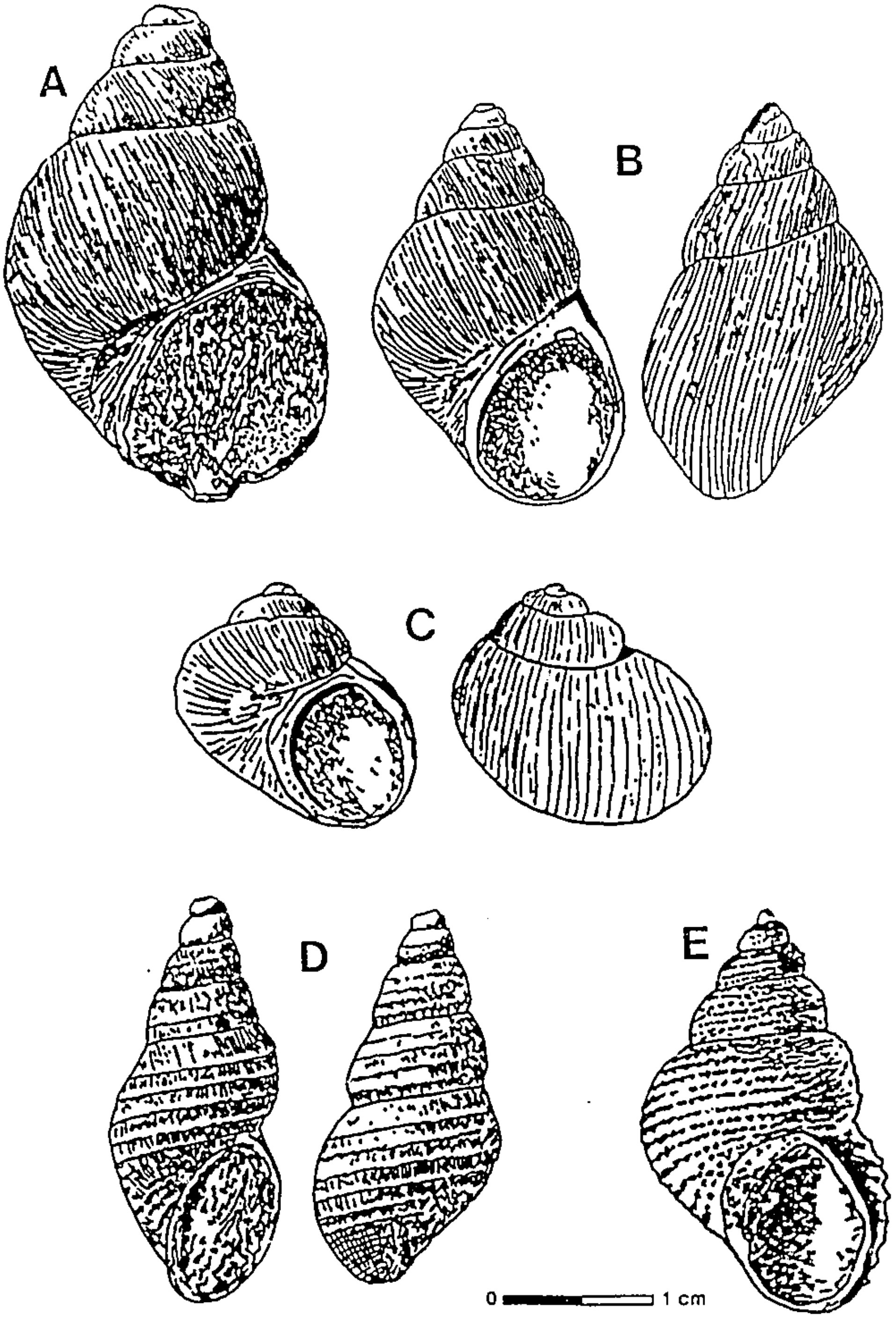

FIGURE 45.-- Line drawing of gastropods from the Upper-Middle Mannville interval.

A. *Campeloma* sp.
B. *Lioplacodes bitumis*
C. *Viviparus murraiensis*
D. *Circamelania ortmanni*
E. *Goniobasis multicarinata*

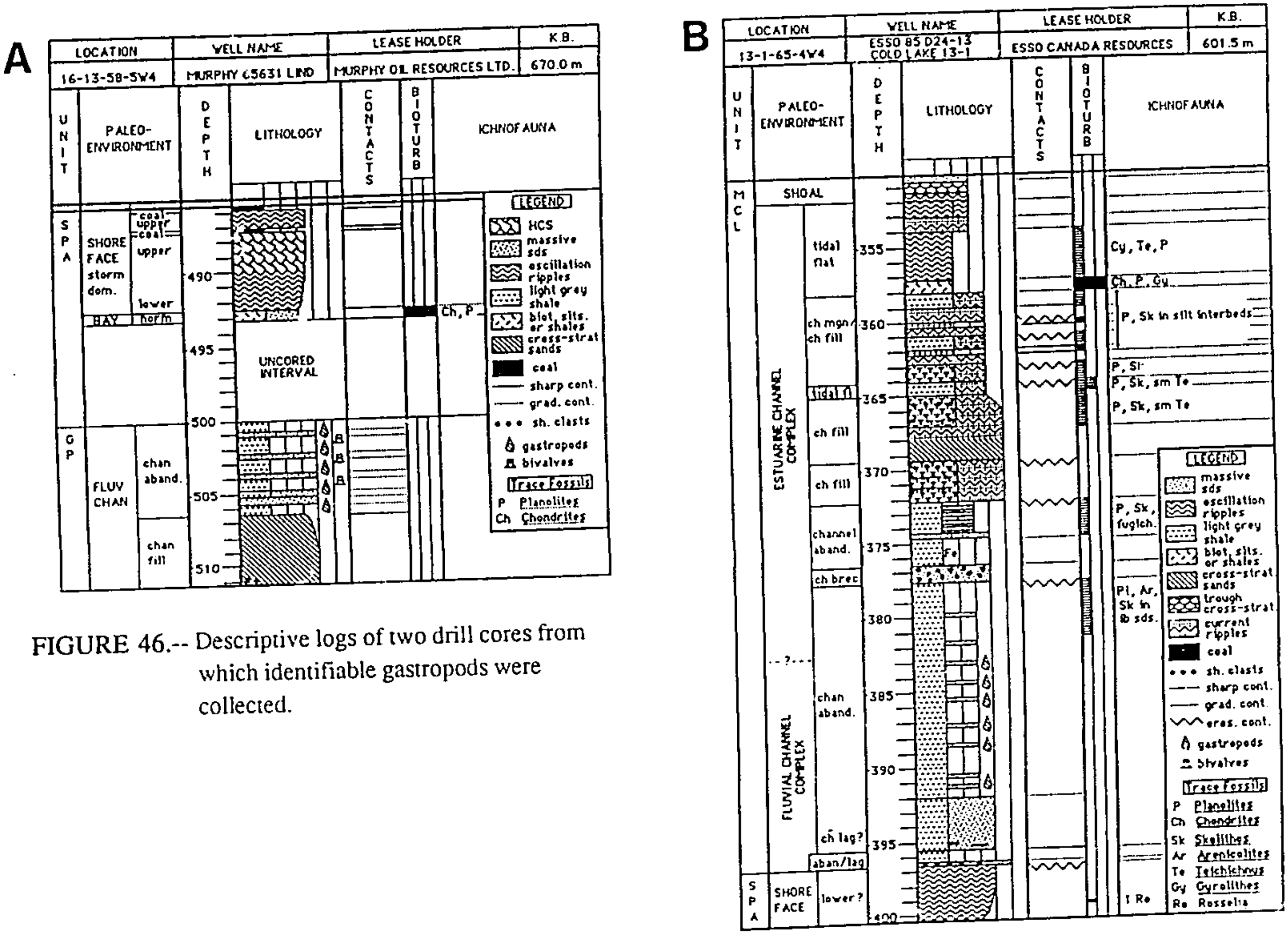

FIGURE 46.-- Descriptive logs of two drill cores from which identifiable gastropods were collected.

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CHAPTER VIII

GENERAL DISCUSSION AND CONCLUSIONS

The recognition of unconformity-bounded stratigraphic packages, although certainly not new to stratigraphy, has been the focus of increasing interest within the discipline in recent years (see Sloss, 1988, for a review). Stratigraphers, now more than at any time before, realize the utility and further interpretive value of erecting stratigraphic schemes which recognize unconformities and relative sea level change as being as important, if not more so, than schemes which recognize only lithologic differences in strata. This is especially true in vertical successions which display relative lithologic homogeneity, but which also display the influence of multiple transgressive and regressive events throughout their depositional history. Within the Cretaceous of the Western Canada Sedimentary Basin alone, a flurry of recent work (see Cant, 1990, and Leckie, 1990) has produced allostratigraphic or sequence stratigraphic schemes for such economically important Upper Cretaceous units as the Cardium Formation (e.g. Plint, 1988; Plint, et al., 1988), the Dunvegan Formation (Bhattacharya, 1988), and the Viking Formation (e.g. Posamentier et al., 1990). Recent work has also shown the value of sequence stratigraphy within the Lower Cretaceous succession, with studies of the Mannville Group in southern Alberta (e.g. James, 1985; Rosenthal, 1988), and even more recently in the oil sands areas of northern and central Alberta (Taylor, 1990). The problems of inconsistent lithostratigraphic nomenclature, and difficulties in correlation that have arisen within the Mannville literature over the years (Chapter I), have almost demanded that a new stratigraphic approach be taken if new revelations concerning Mannville depositional history were to be made. Such inconsistencies and interpretational differences have even caused confusion over the uppermost limit of the Mannville and its relationship to the overlying Colorado Group. Stratigraphic relationships and microfossil studies (Chapter VI) contradict earlier interpretations that the uppermost Mannville strata represent initial transgressive deposits of the marine Joli Fou Formation.

Detailed analysis of the Upper and Middle Mannville sub-groups in the Cold Lake Oil Sands area reveals that this section may be divided into seven correlatable sequences. These seven sequences are relatively equivalent to the Colony, McLaren, Waseca, Sparky, General Petroleums, Rex, and Lloydminster lithostratigraphic units defined for the Lloydminster Heavy Oil area (e.g. Nauss, 1945; Edmunds, 1948). However, the recognition that these units are all bounded by unconformities forces a redefinition of their stratigraphic significance. Relative sea level changes were responsible for the creation of these units, and it is likely that these relative changes were forced by a combination of eustatic, local tectonic, and local sediment supply adjustments.

Sediments of the Upper-Middle Mannville interval can be divided into two basic types according to their inferred depositional environment; paralic-offshore coarsening-upwards successions, and fining-upward incised channel deposits. Unconformities within the interval are indicated by evidence of subaerial exposure of paralic-offshore sediments and (more importantly) associated channel incision. Paralic-offshore successions consist of basal transgressive shales which coarsen upwards into fine-grained shoreface sands that may or may not be capped by thin rooted coal horizons. Allomembers may be composed of one or more of these coarsening-upwards successions depending on their stratigraphic and paleogeographic position. Although there is little to differentiate one coarsening-upwards succession from another throughout the entire Upper-Middle Mannville interval, some vertical and lateral facies changes are discernible. For the most part, Upper-Middle Mannville coarsening-upwards successions are interpreted as fairly linear offshore-shoreline deposits. Mapping of net sand trends within individual allomembers, however, reveals a number of thick sand depocentres within some of the units. These are interpreted as localized deltas. No real facies criteria other than sand thickness can be used to differentiate the deltaic depocentres from their lateral strandline counterparts; they are proved in the mapping process.

The paleoecologic signature of successive allomembers does change within the vertical succession however. Both ichnological (Chapter IV) and foraminiferal (Chapter VI) studies demonstrate an increase in elements (from the oldest allomember to the youngest) that indicate brackish water influence during deposition. This is taken as an indication of decreasing marine circulation and increasing fresh water runoff in response to the shallowing of basinal waters and the progressive seaward progradation of successive paleoshorelines.

Channelized sediments within the Upper and Middle Mannville (Chapter III) have been the most controversial aspect of the interval in the recent past, with opinions concerning their origin ranging from anastomosed streams to fluvio-deltaic distributaries. It is suggested that all of these channel networks were incised during lowstands in sea level associated with progradation of regional paralic systems. The bulk of sedimentation within these channels began during relative sea level rise associated with regional transgression and therefore some channels display brackish water (estuarine) influence in the uppermost channel-fill deposits. This is of course also dependent upon their position in relation to the paleoshoreline. Some of these estuarine channels are associated with deltaic depocentres but others are not.

Two other aspects of the Upper-Middle Mannville are of paleoecologic significance within the interval but also have wider ranging implications. The occurrence of the ichnofossil *Macaronichnus segregatis* in basal offshore to lower shoreface deposits of the Middle Mannville indicates an extended paleoecologic range for this trace than that which has previously been envisioned (Chapter V). This discovery reconfirms basic ichnologic tenets which hold that ichno-paleoecologic interpretations must take a multidisciplinary approach and take into account such factors as stratigraphic context. Within channelized deposits of both the Upper and Middle Mannville, the discovery of a number of species of gastropods previously known only from the Lower Mannville and equivalent strata in Montana extends the previously known stratigraphic and paleogeographic range of these species (Chapter VII), and also serves as an aid in paleoenvironmental interpretation.

By focusing much of this thesis on stratigraphic relationships it is hoped that a more consistent and coherent picture of the Upper and Middle Mannville has emerged. The Mannville Group has been a consistent subject of interest throughout its exploration history. However geographic distance between areas of active interest at different times in that history has introduced nomenclatural and conceptual differences in opinion that have caused stratigraphic confusion, especially in areas (such as the Cold Lake Oil Sands deposit) which have had a relatively recent exploration history.

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APPENDIX I :
STRATIGRAPHIC DATA

TABLE I
STRATIGRAPHIC TOPS: COLD LAKE OIL SANDS AREA

KEY TO ABBREVIATIONS:

K.B.= Kelly Bushing elevation
COL= Colony Fm.
MCL= McLaren Fm.
WAS= Waseca Fm.
SPA= Sparky Fm.
GP= General Petroleums Fm.
REX= Rex Fm.
LLO= Lloydminster Fm.
CUM= Cummings Fm. (Clearwater Fm. equivalent)
WAB= Wabiscaw Member of the Clearwater Fm.
DIN= Dina Fm. (McMurray Fm.equivalent)
DEV= Devonian

.= non-applicable or non-available data

Well locations listed in bold type indicate wells with cores through parts of the Upper-Middle Mannville interval (see Appendix 1)
All data listed are depths from K.B.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
2	7	2	53	2	100070205302W400	595.9	303	333	385	425	440	455	470	488	500	518	535	571	577	
3	7	14	53	2	100071405302W400	622.1	323	353	400	440	450	460			515	536	554			
4	6	15	53	2	100061505302W400	604.7	305	337	390	428	442	454	472	491	503	518	535			
5	8	22	53	2	100082205302W400	625.5	322	350	404	446	455	470	490	506	520	538	550			
6	13	23	53	2	100132305302W400	604	297	328	380	418	428	444	462	477						
7	5	26	53	2	100052605302W400	601.8	294	325	380	415		445	465	486	498		525			
8	13	26	53	2	100132605302W400	598.8	294	324	375	415		440	457	475	488		525			
9	8	27	53	2	100082705302W400	603.2	295	325	378	415		440	459	474	486	502			563	
10	11	28	53	2	100112805302W400	606.5	305	336	387	427	435	450	470	489	500	520	535	563	574	595
11	10	29	53	2	100102905302W400	586.5	288	318	365	406	415	428	450	467	479	501	515	548	557	
12	10	34	53	2	100103405302W400	591	286	317	367	408	416	430	451	465	481	505	520			
13	6	4	53	3	1A0060405303W400	587.5	305	343	389	426	437	452	474	489	502	522	545	575	587	
14	10	6	53	3	100100605303W400	596.8	312	340	390	430	442	455	475	492	505	525	540			
15	6	8	53	3	100060805303W400	590.6	305	336	386	427	440	455	475	490	504	525	541	575	583	
16	6	18	53	3	100061805303W400	596.2	316	346	396	436	446	460	481	495	510	529	550		590	604
17	7	6	53	4	100070605304W400	616	334	364	415	461	471		505	519	535	551	572	614	620	630
18	11	20	53	4	100112005304W400	608.3	329	356	406	447	455	470	491	507	520		560	585	595	
19	4	27	53	4	100042705304W400	599.8	322	352	401	445	454		491	508	520	544	558	594	605	
20	11	31	53	4	100113105304W400	615.4	335	360	413	455	466		491	510	530		562		596	
21	12	20	53	5	100122005305W400	642.2	361	390	440	482	495		525	541	557		595		630	
22	10	29	53	5	100102905305W400	636.6	354	380	430	470	481	493	518	535	545		585		625	639
23	7	30	53	5	100073005305W400	640.8	349	376	427	468	480			527	544		580		620	
24	2	32	53	5	100023205305W400	629.2	350	377	426	469	485		512	527	545		580			
25	1	34	53	5	100013405305W400	641.8	359	386	436	477	485						588		616	
26	6	36	53	5	100063605305W400	644.4	363	388	440	480	492		525	540	550		594			
27	10	3	53	6	100100305306W400	630.2	361	389	441	480	493		525	538	553	580	594		635	653
28	6	12	53	6	100061205306W400	648.9	376	406	455	497	510		537	550	566	586	599			
29	6	24	53	6	100062405306W400	635.4	358	386	438	480	497		525	542	550	579	590			
30	6	8	53	8	100060805308W400	680.2	442	468	521	566	580						670		710	728
31	12	9	53	8	100120905308W400	687.3	450	478	531	572	585						678	725	735	
32	6	17	53	8	100061705308W400	686.5	454	474	533	567							675	712	718	733
33	11	18	53	8	100111805308W400	693.9	463	488	545	580							690	725	732	752
34	16	23	53	8	100162305308W400	671.4	433	457	510	552	559	570	595	610	622	644	665	705	715	
35	16	24	53	8	100162405308W400	661.1	414	441	490	530	537	560	580				640		672	
36	7	25	53	8	100072505308W400	672.7	422	446	501	540										730
37	11	26	53	8	100112605308W400	678	436	461	511	554	570	585	602	616	627	650	562		699	
38	10	27	53	8	100102705308W400	679	438	465	513	552	565	583	602	615	628	650	670	700	710	
39	6	30	53	8	100063005308W400	674.6	437	460	510	551		572	597	615	624	647	660			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
40	7	36	53	8	100073605308W400	661	410	435	485	526	540		575	589	607	624	645		685	
41	10	27	54	2	100102705402W400	555.5	238	270	320	359	369		405	415	438	456	475			
42	1	28	54	4	100012805404W400	604.4	305	320	380	426	442	455	473	490	506	520	535		577	
43	9	31	54	4	100093105404W400	612.9	307	338	388	427	440	455	473	490	505	533	542			
44	7	32	54	4	100073205404W400	614.9	307	339	389	425	440	455	468	487	502	525	540			567
45	2	33	54	4	100023305404W400	611.3	306	336	387	420	431	447	463	483	500	522	536			560
46	7	34	54	4	100073405404W400	604	296	326	370	415	427		455	475	490	513	527			562
47	11	36	54	4	100113605404W400	600.6	295	325	375	410	425	436	465	481	488	510	525			546
48	10	1	54	5	100100105405W400	616.6	326	357	405	447	455		489	507	523	547	560			
49	10	2	54	5	100100205405W400	631.8	343	370	421	462	474		504	525	539	558	570			
50	6	6	54	5	100060605405W400	649.5	359	387	429	477	490	505	518	540			599			
51	10	10	54	5	100101005405W400	634.5	348	377	427	470		492	510	526	537		580	612	624	633
52	2	11	54	5	100021105405W400	624.5	336	360	410	454	466	479	494	517	530		562			
53	6	15	54	5	100061505405W400	633.2	343	372	423	465	479	490	507	522	543	563	575			
54	11	16	54	5	100111605405W400	645.3	352	380	430	476	489	501	520	538						
55	10	18	54	5	100101805405W400	636.3	349	375	425	464	478			525	540	565	580		617	
56	10	19	54	5	100101905405W400	630.7	342	368	416	462	477	486	500	517	530	548	564		595	614
57	10	20	54	5	100102005405W400	619.9	328	355	410	445			493	510	522		557			
58	7	21	54	5	100072105405W400	628.3	334	362	414	455	468	485	502	520	537		570			
59	6	22	54	5	100062205405W400	624	335	362	410	455	470	480	495	515	530	560	577			
60	11	27	54	5	100112705405W400	625.5	335	362	414	455	467	480	493	515	533	553	569			
61	11	29	54	5	100112905405W400	626.9	331	360	410	450		484	496	514	535	550	563			
62	10	30	54	5	100103005405W400	637.1	348	378	428	460		486	507	523	542		575			
63	6	32	54	5	100063205405W400	629.5	333	360	408	450		475	495	511	530		575			602
64	10	1	54	6	100100105406W400	660.8	368	396	445	487			531	546	565	587	605	633	645	
65	10	8	54	6	100100805406W400	663.4	388	418	465	507		535	550	565	580		620		672	
66	7	9	54	6	100070905406W400	641.4	363	392	442	490	496	506	520	532	550		590			655
67	10	10	54	6	100101005406W400	646.5	363	392	442	479	488		524	540	556		593			655
68	7	15	54	6	100071505406W400	652	367	395	445	485	490		527	544	555		597			
69	10	21	54	6	100102105406W400	659.7	374	402	451	490	506		536	551	566		600			
70	7	24	54	6	100072405406W400	656.8	370	396	447	492	495	512	535	552	564	585	600			
71	11	25	54	6	100112505406W400	633	340	368	420	462	474		505	520	538	566	578			626
72	6	26	54	6	100062605406W400	653.9	362	388	449	479	490	500			560	584	590			655
73	10	27	54	6	100102705406W400	644.1	354	382	433	475	488			535	554		582			
74	6	29	54	6	100062905406W400	652.3	367	395	449	487	500		534	550	566	581	598		648	674
75	16	31	54	6	100163105406W400	649.3	358	387	435	480			516	536	551	570	586		625	
76	11	33	54	6	100113305406W400	642.2	352	376	427	470	484			528	543	568	580		615	
77	3	34	54	6	100033405406W400	657	366	395	445	488	498				561	585	597	634	642	666

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
78	15	35	54	6	100153505406W400	637	345	375	427	462	.	.	510	525	540	561	575	.	.	.
79	13	36	54	6	100133605406W400	656	363	388	438	477	490	503	522	545	554	569	588	.	.	.
80	11	26	54	7	102112605407W400	648	371	400	450	488	.	.	.	545	560	580	597	.	.	.
81	10	4	54	8	100100405408W400	640.1	388	415	463	504	510	.	544	559	571	605	626	.	.	685
82	2	6	54	8	100020605408W400	630.4	385	412	452	501	505	.	549	562	580	604	612	645	655	685
83	4	10	54	8	100041005408W400	661.9	412	440	492	530	537	557	580	599	.	.	650	.	687	710
84	6	11	54	8	100061105408W400	653	400	425	479	518	532	552	567	531	.	.	634	.	685	699
85	6	12	54	8	100061205408W400	668.5	410	436	490	525	535	.	574	586	.	.	632	.	.	.
86	1	18	54	8	100011805408W400	607.7	362	385	436	470	485	500	520	538	552	576	585	.	.	.
87	10	20	54	8	100102005408W400	606.6	354	380	433	472	487	500	516	530	.	569	577	607	618	654
88	13	21	54	8	100132105408W400	605.5	355	383	437	471	.	495	516	536	.	567	580	.	625	650
89	11	22	54	8	100112205408W400	616.7	345	368	417	460	475	486	505	524	.	556	570	.	610	.
90	6	24	54	8	100062405408W400	613.8	355	380	431	474	.	.	.	.	.	.	.	.	.	.
91	6	26	54	8	100062605408W400	598.3	340	368	422	456	469	485	501	520	.	.	565	.	612	.
92	11	29	54	8	100112905408W400	595.6	337	365	419	455	470	.	500	517	.	546	560	595	605	625
93	14	30	54	8	100143005408W400	583	325	350	400	437	445	460	485	501	.	532	546	.	581	600
94	6	31	54	8	100063105408W400	578.9	323	350	397	436	453	463	480	496	.	.	548	.	.	.
95	11	32	54	8	100113205408W400	588	330	358	408	443	457	.	490	505	.	540	556	.	590	.
96	9	34	54	8	100093405408W400	595.6	339	365	418	456	469	.	506	520	535	550	562	.	605	.
97	11	36	54	8	100113605408W400	617.2	358	387	438	473	485	.	518	540	552	577	595	628	635	671
98	7	4	55	1	100070405501W400	604.1	288	320	372	416	425	.	454	471	486	506	520	.	.	549
99	7	22	55	1	100072205501W400	617.2	296	326	376	419	430	.	469	486	498	517	529	.	561	573
100	10	26	55	1	100102605501W400	662.7	335	365	420	456	475	490	.	518	532	550	568	.	.	612
101	7	35	55	1	100073505501W400	659	330	357	407	453	465	478	499	515	528	548	564	.	596	610
102	13	36	55	1	100133605501W400	654.8	325	355	407	449	.	.	.	.	.	.	.	.	.	604
103	14	6	55	2	100140605502W400	594.7	271	303	352	394	403	415	435	452	464	487	502	.	.	523
104	16	8	55	2	100160805502W400	605.6	281	311	364	401	410	429	448	464	475	490	511	.	.	.
105	10	16	55	2	100101605502W400	613	294	323	377	415	.	.	456	470	485	505	.	.	.	.
106	8	17	55	2	100081705502W400	596.5	273	303	358	395	406	.	440	455	462	490	508	.	.	525
107	6	29	55	2	100062905502W400	613.1	295	325	375	415	424	.	463	472	481	504	519	.	.	.
108	16	12	55	3	100161205503W400	618.5	281	320	370	410	424	437	453	470	487	498	521	.	.	543
109	6	21	55	3	100062105503W400	595.6	280	309	356	397	410	423	442	459	476	489	510	.	.	530
110	13	22	55	3	100132205503W400	612.7	297	326	382	416	428	440	458	476	495	515	529	.	.	551
111	16	28	55	3	100162805503W400	584.5	261	291	340	381	389	.	420	435	453	480	505	.	.	.
112	13	34	55	3	100133405503W400	576.3	249	277	330	370	382	398	415	432	440	.	480	.	.	.
113	11	1	55	4	100110105504W400	598.3	296	324	375	412	427	437	460	475	490	512	526	.	.	.
114	10	5	55	4	100100505504W400	608.8	296	326	376	415	422	.	458	.	486	515	529	.	.	.
115	6	6	55	4	100060605504W400	618.3	308	338	386	425	435	.	470	490	505	535	546	.	.	572

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	CCL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
116	6	7	55	4	100060705504W400	624.4	310	340	390	431	444	460	475	490	506	525	543	.	.	.
117	7	8	55	4	100070805504W400	609	292	322	372	410	420	435	452	472	487	510	525	.	.	.
118	11	9	55	4	100110905504W400	612.7	297	326	376	415	430	443	457	475	486	515	530	.	.	.
119	3	13	55	4	100031305504W400	586	270	301	351	387	405	417	430	450	465	490	505	.	.	.
120	6	15	55	4	100061505504W400	590.5	281	311	361	400	414	425	450	464	478	495	514	.	.	.
121	5	16	55	4	100051605504W400	611.6	294	323	375	415	429	440	457	478	490	510	528	.	.	548
122	7	17	55	4	100071705504W400	616	295	326	372	415	425	435	.	.	489	.	.	.	.	.
123	9	17	55	4	100091705504W400	615.8	295	327	376	414	427	437	462	473	.	516	531	.	.	551
124	11	18	55	4	100111805504W400	613.9	292	323	371	412	425	436	455	473	488	.	530	.	.	550
125	11	19	55	4	100111905504W400	611.2	288	319	365	403	410	427	448	468	481	500	524	.	.	545
126	7	20	55	4	100072005504W400	603.1	278	307	359	398	410	422	440	458	475	503	515	.	.	.
127	6	21	55	4	100062105504W400	579.2	259	289	338	378	390	400	419	436	450	.	482	.	.	.
128	12	29	55	4	100122905504W400	584.9	253	283	330	370	380	392	420	437	447	474	480	.	.	.
129	14	30	55	4	100143005504W400	590.4	260	290	338	380	395	406	425	441	450	474	489	.	.	503
130	6	31	55	4	100063105504W400	592.7	262	292	342	381	392	405	425	440	.	475	490	.	.	.
131	7	32	55	4	100073205504W400	568.1	239	269	320	356	.	380	398	414	430	.	460	.	.	485
132	11	1	55	5	100110105505W400	613.9	310	344	390	433	445	460	475	492	506	525	540	.	.	.
133	14	2	55	5	100140205505W400	586	277	308	354	397	410	423	442	460	475	492	508	.	.	537
134	11	3	55	5	100110305505W400	628.7	323	353	404	445	459	473	487	509	525	541	560	.	.	.
135	11	4	55	5	100110405505W400	632.9	336	366	420	452	458	470	496	512	520	.	567	.	.	.
136	10	5	55	5	100100505505W400	635.9	330	360	411	452	467	480	498	514	521	.	565	.	.	.
137	7	6	55	5	100070605505W400	627.5	323	352	401	443	458	475	490	502	517	.	555	.	.	.
138	11	7	55	5	100110705505W400	644.7	340	370	420	460	475	485	504	520	535	.	575	.	.	.
139	9	8	55	5	100090805505W400	637.6	330	367	417	454	470	481	495	511	520	.	570	.	.	.
140	13	9	55	5	100130905505W400	640.3	336	366	417	457	474	485	500	515	536	550	565	.	.	.
141	7	10	55	5	100071005505W400	629.6	325	355	407	449	460	472	491	503	520	.	560	.	.	.
142	4	11	55	5	100041105505W400	600.7	292	322	373	416	429	441	462	478	495	512	527	.	.	.
143	2	13	55	5	100021305505W400	627.4	306	336	386	423	434	444	465	485	500	520	534	.	.	.
144	16	13	55	5	100161305505W400	613.4	287	317	367	409	415	421	450	472	487	510	525	.	.	.
145	8	14	55	5	100081405505W400	630.7	312	342	392	430	441	455	476	493	507	525	540	.	.	.
146	13	15	55	5	100131505505W400	591	282	312	362	400	413	425	447	463	478	502	515	.	.	.
147	6	16	55	5	100061605505W400	644.8	336	369	417	460	469	483	500	519	538	555	570	.	.	.
148	7	17	55	5	100071705505W400	644.6	337	367	413	454	467	480	500	520	533	559	570	.	.	.
149	6	19	55	5	100061905505W400	650.2	345	375	425	466	480	.	510	526	541	565	581	.	.	.
150	10	20	55	5	102102005505W400	652.8	341	371	422	463	475	486	501	520	536	566	577	.	.	.
151	13	21	55	5	100132105505W400	606	295	325	378	411	424	435	455	473	487	515	526	.	.	.
152	7	22	55	5	100072205505W400	628	309	339	387	430	440	455	475	490	505	533	545	.	.	565
153	11	23	55	5	100112305505W400	632.7	313	342	391	431	444	459	476	492	506	536	546	.	.	570

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
154	10	24	55	5	100102405505W400	612.6	284	314	364	407	414	425	445		480	500	515			
155	11	25	55	5	100112505505W402	606	278	307	352	395	406	420	436	458	472	498	512			
156	6	26	55	5	100062605505W400	623.3	304	334	384	423	433	445	465	482	496	525	536			555
157	6	27	55	5	1B0062705505W400	644	321	350	398	441	454	465	488		517	542	555			569
158	7	29	55	5	100072905505W400	646.3	332	360	412	453	465	479	495	515	531	552	568			
159	12	30	55	5	100123005505W400	658.6	346	376	425	465	479		509	525	541	560	579			
160	12	31	55	5	100123105505W400	679.6	357	386	435	475	487		512	530	545	574	584			
161	6	32	55	5	100063205505W402	653.8	334	365	407	453	465	480	500	520	529	548	565			
162	7	33	55	5	100073305505W400	614.1	298	328	378	422	426	443	463	482			530			
163	14	34	55	5	100143405505W400	610.2	287	317	360	400	414	425	445	463	478	504	515			
164	13	35	55	5	100133505505W400	605.6	277	308	358	395	405	417	440	457	473	495	510			
165	1	36	55	5	100013605505W400	600.4	275	305	355	397	409	424	440	457	475	500	512			
166	4	1	55	6	100040105506W400	657.5	360	386	438	478	492	504	523	538	554	571	591			
167	14	2	55	6	100140205506W400	662	367	393	445	488	505	515	530		560	579	598			
168	16	4	55	6	100160405506W400	629.8	338	365	419	452	465	477	495	512	529	551	565		600	640
169	3	5	55	6	100030505506W400	642.2	355	383	435	472	486	510	520	530	548	566	583		625	657
170	16	8	55	6	100160805506W400	649.6	363	390	440	480	494	505	525	541						
171	10	9	55	6	100100905506W400	639.7	355	384	435	473	490	500	520	533	550	570	586			
172	7	10	55	6	100071005506W400	670.9	378	405	456	495			536	557	573	590	608		646	
173	7	11	55	6	100071105506W400	662.3	371	391	445	485	500	512	528	543	558	585	596		631	665
174	6	12	55	6	100061205506W400	638.7	345	371	423	462	476	493	506	520	536	570	578		617	
175	13	13	55	6	1AA131305506W400	641.5	340	370	421	464	471	482	502	525	538	569	580		617	
176	7	14	55	6	100071405506W400	641.2	339	370	417	460		489	505	520	535	565	575		608	
177	6	15	55	6	100061505506W400	684.9	391	420	473	508	523	534	551	570	583	612	621		660	
178	15	16	55	6	100151605506W400	689.4	397	422	476	514	528	540	555	573	588	615	625			
179	16	20	55	6	100162005506W400	692	396	425	477	511	524				583	610	622			
180	10	21	55	6	100102105506W400	666.1	367	397	450	490	504	515	535	547	562	587	599			
181	9	22	55	6	100092205506W400	645.6	346	378	425	467	483	498	515	529	543	570	580			
182	6	23	55	6	100062305506W400	642.9	339	370	421	459	474	495	505	519	534	562	573			
183	8	24	55	6	100082405506W400	644.9	339	370	420	460	474	485	505	519	533	565	576			
184	11	25	55	6	100112505506W400	661.3	350	380	431	475	485	500	515	529	545	573	582			
185	1	26	55	6	100012605506W402	644.8	335	364	416	457		485	500	515	528	566	570		600	
186	8	27	55	6	100082705506W400	633.7	342	372	422	462	477	491	505	522	535	563	573		615	
187	13	28	55	6	100132805506W400	654.8	358	388	442	476	490		521	535	546	576	584		625	
188	10	29	55	6	100102905506W400	689.5	428	461	513	559	573		606	625	638	676	681		725	
189	11	31	55	6	100113105506W402	692.9	396	424	474	515	527			575	587	620	627		667	
190	9	32	55	6	100093205506W400	656	360	390	440	478	492		522	537	549	579	586		630	
191	9	33	55	6	100093305506W400	632	332	362	412	454	468			507	522	550	560			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
192	11	34	55	6	100113405506W400	635.1	333	363	410	452	.	.	.	512	525	552	562	.	600	.
193	12	35	55	6	100123505506W400	660.2	353	383	438	473	486	.	.	529	542	569	580	.	.	.
194	6	36	55	6	100063605506W400	661.9	354	384	435	473	487	.	512	531	545	573	534	.	620	.
195	11	15	55	7	100111505507W400	617	350	377	429	465	477	.	512	527	543	559	580	.	615	.
196	6	26	55	7	100062605507W400	638.7	355	385	434	476	488	.	.	534	546	570	590	.	625	.
197	16	27	55	7	100162705507W400	627.8	341	370	420	455	470	.	500	515	533	550	570	.	613	.
198	10	30	55	7	100103005507W400	631.3	354	380	431	465	479	.	.	526	538	559	579	.	612	657
199	5	31	55	7	100053105507W400	607.9	327	357	401	445	457	.	.	498	510	537	554	.	590	.
200	10	1	56	1	100100105601W400	658.1	326	354	408	447	462	471	490	505	521	536	559	590	600	610
201	6	6	56	1	100060605601W400	665.6	335	365	415	455	466	479	505	515	530	553	570	.	.	.
202	7	10	56	1	100071005601W400	664.3	324	352	405	445	458	470	490	507	.	.	557	.	.	605
203	10	11	56	1	1AR101105601W400	660.7	322	351	402	442	454	466	491	506	524	539	555	.	585	616
204	6	12	56	1	100061205601W400	654.8	322	351	402	442	.	.	488	505	515	.	555	585	592	615
205	14	29	56	1	100142905601W400	658.3	313	343	395	436	448	460	484	500	510	535	555	.	.	.
206	7	31	56	1	100073105601W400	641.8	295	324	375	415	423	443	460	477	495	507	522	.	.	.
207	11	34	56	1	100113405601W400	677.5	342	372	422	465	477	490	505	525	537	560	575	.	610	622
208	6	14	56	2	100061405602W400	676.2	348	380	430	468	471	.	511	528	535	553	570	.	.	616
209	15	26	56	2	100152605602W400	635.4	300	330	380	415	425	.	467	482	495	517	528	.	573	584
210	13	35	56	2	100133505602W400	641.2	306	336	389	425	435	447	475	490	502	522	536	575	582	590
211	7	36	56	2	100073605602W400	649	305	335	385	425	433	443	473	491	505	515	529	.	.	586
212	10	2	56	3	100100205603W400	597.9	275	307	359	395	408	420	435	459	480	490	512	.	.	.
213	14	3	56	3	100140305603W400	582.4	256	292	343	379	393	410	425	.	.	.	.	.	.	.
214	14	4	56	3	100140405603W400	605.5	270	301	350	389	403	415	435	450	.	481	504	.	.	.
215	16	5	56	3	100160505603W400	607.2	272	301	353	392	405	412	437	452	465	491	505	.	.	517
216	11	6	56	3	100110605603W400	600.5	268	295	347	385	399	.	.	.	466	486	500	.	.	.
217	8	7	56	3	100080705603W400	597.7	277	306	359	396	405	428	439	454	464	.	.	.	.	.
218	14	7	56	3	100140705603W400	609.4	288	317	370	408	416	425	450	465	475	492	509	550	560	.
219	9	8	56	3	100080805603W400	606.5	270	298	354	387	393	403	430	446	460	.	490	.	.	.
220	16	9	56	3	100160905603W400	606.7	275	305	357	398	418	429	445	461	474	493	.	.	.	.
221	3	14	56	3	100031405603W400	585.6	257	287	335	375	390	400	420	438	450	.	485	.	.	.
222	11	17	56	3	100111705603W400	614.3	280	310	359	397	411	427	447	462	480	.	511	.	.	.
223	7	21	56	3	100072105603W400	621.3	287	318	365	404	410	.	450	461	485	.	.	.	.	.
224	2	22	56	3	100022205603W400	617.4	286	317	367	405	420	.	456	470	489	.	.	.	.	.
225	6	28	56	3	100062805603W400	612.6	279	312	360	401	416	.	.	463	481	505	520	.	.	.
226	4	32	56	3	100043205603W400	611	277	307	356	395	410	.	445	465	477	500	512	.	.	533
227	10	1	56	4	100100105604W400	609.6	272	300	351	389	400	.	430	445	.	485	502	.	.	516
228	11	4	56	4	100110405604W400	583.6	256	286	336	375	382	.	410	429	.	.	477	.	.	.
229	2	13	56	4	100021305604W400	616.5	278	308	354	395	410	.	.	455	475	.	510	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
230	11	15	56	4	100111505604W400	582.8	245	274	325	364	374	388	400	420	.	452	475	.	.	.
231	2	25	56	4	100022505604W400	614.7	272	300	351	394	404	415	.	455	468	500	505	.	.	.
232	6	30	56	4	100063005604W400	577.1	250	280	330	368	382	395	410	428	447	.	470	.	.	.
233	6	31	56	4	100063105604W400	621.7	297	328	380	415	425	435	457	478	494	515	520	557	565	.
234	8	36	56	4	100083605604W400	614.6	276	307	358	395	409	419	436	456	475	.	505	.	.	.
235	12	1	56	5	100120105605W400	600.2	265	295	346	385	395	407	430	446	460	483	499	.	.	.
236	5	2	56	5	100050205605W400	602.9	275	303	350	393	404	416	435	450	470	488	507	.	.	.
237	10	3	56	5	100100305605W400	606.2	285	312	361	395	406	420	440	456	475	498	512	.	.	.
238	1	4	56	5	100010405605W400	608	285	314	365	404	413	427	448	465	480	503	517	.	.	.
239	6	5	56	5	100060505605W400	618.4	298	328	378	416	429	440	.	475	490	510	526	.	.	.
240	10	7	56	5	100100705605W400	615.7	293	323	375	411	420	430	446	465	480	500	522	.	.	.
241	11	9	56	5	100110905605W400	599.2	275	305	355	395	405	415	435	.	.	.	.	.		.
242	4	13	56	5	100041305605W400	526.3	196	226	276	317	324	337	360	.	.	.	.	.	.	.
243	7	17	56	5	100071705605W400	597.3	274	304	353	394	405	415	430	450	464	486	501	.	.	.
244	2	18	56	5	100021805605W400	596.2	272	302	352	390	401	.	425	445	460	490	497	.	.	.
245	6	19	56	5	100061905605W400	585.7	260	291	339	380	394	.	415	435	450	472	486	.	.	.
246	7	19	56	5	100071905605W400	584.3	265	288	340	379	395	.	413	432	447	.	.	.	.	.
247	12	29	56	5	100122905605W400	557.6	234	265	313	352	.	.	377	407	422	447	460	.	.	.
248	11	30	56	5	100113005605W400	596.8	274	304	353	390	.	.	428	446	460	482	500	.	.	.
249	4	32	56	5	100043205605W400	603.7	280	310	360	400	.	.	434	457	471	492	.	.	.	.
250	9	3	56	6	100090305606W400	674.2	369	398	450	486	.	.	530	545	559	585	595	.	635	650
251	9	4	56	6	100090405606W400	641.2	332	362	410	453	.	.	491	512	525	552	562	.	.	.
252	11	5	56	6	100110505606W400	629.9	333	363	413	455	.	.	.	.	.	.	552	.	.	.
253	8	6	56	6	100080605606W400	642.3	345	373	421	462	.	.	.	518	535	550	.	615	624	634
254	8	9	56	6	100080905606W400	652	350	380	427	471	.	.	515	530	544	566	579	.	.	.
255	8	10	56	6	100081005606W400	677.5	367	397	447	489	495	.	.	.	557	580	592	.	.	.
256	13	12	56	6	100131205606W400	678.2	362	390	437	480	492	.	.	.	548	.	.	.	.	.
257	6	13	56	6	100061305606W400	643.3	320	350	400	440	.	.	480	495	510	528	550	.	.	.
258	4	14	56	6	100041405606W400	680.6	366	394	434	480	.	.	.	538	553	575	587	.	.	615
259	10	15	56	6	104101505606W400	659.6	357	390	437	488	504	.	537	556	575	595	615	.	.	.
260	9	16	56	6	100091605606W400	651.9	344	373	422	462	.	.	505	520	533	551	570	.	.	615
261	11	18	56	6	100111805606W400	602.7	311	340	392	433	448	.	482	495	510	532	555	595	605	.
262	3	19	56	6	100031905606W400	560.6	268	297	346	385	399	.	.	.	.	.	.	.	.	.
263	3	22	56	6	100032205606W400	647	335	365	408	454	466	.	.	510	525	545	560	.	.	.
264	1	23	56	6	1A0012305606W400	642.3	318	348	400	440	447	.	483	500	510	530	546	.	.	567
265	7	24	56	6	100072405606W400	544.9	218	247	297	337	350	.	375	392	407	430	445	.	.	.
266	16	27	56	6	100162705606W400	610.3	293	323	373	414	.	.	.	.	.	.	.	.	.	.
267	8	1	56	7	100080105607W400	677.5	382	413	460	505	515	.		559	570	589	617	.	652	.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
268	14	2	56	7	100140205607W400	608.8	317	345	393	436	450	.	480	500	.	.	550	595	605	.
269	9	11	56	7	100091105607W400	639	345	372	425	465	477	.	515	525	535	.	570	625	633	655
270	9	12	56	7	100091205607W400	624.8	327	355	404	445	458	471	492	505	.	.	560	.	.	.
271	8	13	56	7	100081305607W400	615.9	325	357	410	445	458	470	492	506	520	545	568	.	.	.
272	1	14	56	7	100011405607W400	624.6	331	360	408	450	461	.	.	.	.	.	575	.	.	.
273	9	23	56	7	100092305607W400	590	297	325	371	412	432	440	460	480	.	520	528	575	582	.
274	9	25	56	7	100092505607W400	594.7	300	326	371	416	429	.	460	480	.	.	.	.	.	.
275	6	26	56	7	100062605607W400	582	290	318	372	409	419	.	450	470	.	495	513	555	566	.
276	11	29	56	7	100112905607W400	635	343	370	425	459	470	.	503	520	.	545	559	595	600	650
277	1	36	56	7	100013605607W400	601.8	306	335	382	424	435	.	.	.	.	.	.	.	.	.
278	11	10	56	8	100111005608W400	630.8	352	380	430	465	476	.	.	.	.	.	.	.	.	.
279	11	17	56	8	100111705608W400	630.4	350	376	420	465	471	489	507	525	.	555	575	612	623	.
280	5	30	56	8	100053005608W400	662.6	385	410	463	500	510	.	545	.	.	590	605	.	.	.
281	8	33	56	8	100083305608W400	644.5	360	385	433	471	490	500	515	531	.	.	.	.	.	.
282	7	1	57	1	100070105701W400	665.1	361	390	444	485	495	510	525	542	550	570	585	.	635	662
283	6	4	57	1	100060405701W400	682.8	338	365	420	457	466	.	.	.	525	540	562	.	610	620
284	12	5	57	1	100120505701W400	672.3	347	377	428	465	472	482	505	521	530	552	566	.	.	.
285	12	6	57	1	100120605701W400	670.3	335	362	415	455	463	479	500	512	528	540	558	592	603	614
286	5	7	57	1	100050705701W400	638	317	347	402	438	449	463	490	504	517	.	545	587	598	.
287	15	9	57	1	100150905701W400	654.4	315	345	392	434	445	455	480	500	512	527	550	.	580	604
288	12	10	57	1	100121005701W400	662.6	330	360	413	452	460	483	500	514	525	.	560	600	610	617
289	5	12	57	1	100051205701W400	656.7	335	364	415	455	466	.	500	521	535	550	563	.	605	629
290	6	16	57	1	100061605701W400	634.7	320	350	400	440	451	.	490	505	517	529	550	587	598	611
291	10	17	57	1	100101705701W400	651.9	332	360	410	455	462	474	500	515	530	545	565	.	.	617
292	14	18	57	1	100141805701W400	635.2	307	334	390	427	440	455	471	492	506	516	535	.	575	60[illegible]
293	7	22	57	1	100072205701W400	662.9	348	379	430	471	481	.	527	.	.	.	.	.	.	.
294	6	23	57	1	100062305701W400	668.5	346	374	428	470	484	.	.	535	545	.	.	.	.	.
295	6	31	57	1	100063105701W400	658	330	361	413	454	465	.	.	.	.	.	.	.	.	.
296	6	32	57	1	100063205701W400	671.9	331	361	413	453	465	.	505	518	531	544	562	.	605	636
297	10	1	57	2	100100105702W400	656.7	324	353	407	447	455	470	493	512	525	550	560	.	595	614
298	8	11	57	2	100081105702W400	627.1	300	330	385	423	.	450	468	483	495	520	535	.	570	602
299	15	12	57	2	100151205702W400	626.4	290	325	372	410	421	451	465	480	494	517	535	.	575	588
300	10	13	57	2	100101305702W400	636	305	341	385	425	440	.	474	490	500	518	535	.	580	605
301	2	19	57	2	100021905702W400	621.9	289	318	370	410	420	430	455	470	485	502	520	.	560	571
302	15	23	57	2	100152305702W400	651.9	312	341	392	430	.	450	475	492	504	.	545	.	592	606
303	10	25	57	2	100102505702W400	642.4	303	333	383	421	430	445	465	487	500	520	532	567	577	600
304	10	5	57	3	100100505703W400	638	298	330	380	417	432	445	460	480	490	.	529	.	.	555
305	16	6	57	3	100160605703W400	621	278	308	360	396	410	422	443	459	470	.	508	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
306	4	10	57	3	100041005703W400	659.6	326	358	408	448	460	475	491	512	530		570			
307	5	16	57	3	100051605703W400	636.4	295	323	373	412	420									
308	3	17	57	3	100031705703W400	633	292	322	371	410	418	434								
309	13	18	57	3	100131805703W400	647.3	307	337	388	426			476	490	502	530	545			
310	5	32	57	3	100053205703W400	627.8	288	315	372	405			452	470	483		525		565	580
311	9	1	57	4	100090105704W400	630.6	289	317	371	408	422	434	451	470	484	500	520			546
312	10	3	57	4	100100305704W400	622.1	283	314	362	400	413	425	443	461	475	501	515			540
313	10	12	57	4	100101205704W400	629.4	294	325	377	411	421	437	458	475	489	518	534			554
314	15	20	57	4	100152005704W400	636.2	312	342	392	426	436	455	473	493	507	535	545	585	593	610
315	2	25	57	4	100022505704W400	637.1	296	328	375	415	430	450	465	480	490	512	530	569	578	
316	10	29	57	4	100102905704W400	638.3	306	335	389	427	439	453	469	488			549		585	607
317	16	6	57	5	100160605705W400	582.3	252	281	333	372	383	392	415	433	441					
318	10	7	57	5	100100705705W400	611.7	282	311	363	404	411	427	448	460	472					
319	9	9	57	5	100090905705W400	570.5	241	272	323	362	373		398	418	427	450	465			499
320	9	12	57	5	100091205705W400	659.4	335	365	416	454	470	480	496	515	530	542	558			
321	6	14	57	5	100061405705W400	645.1	322	352	402	442	455	465	480	500	515	532	543	590	606	
322	1	18	57	5	102011805705W400	594.1	257	287	336	375	379	392	410	430	437		475			
323	6	24	57	5	100062405705W400	645.7	318	348	401	440	452	465								
324	6	26	57	5	100062605705W400	646.7	311	342	395	430	440	450	474							
325	11	28	57	5	100112805705W400	634	297	327	373	415	425	435	455	470	485					
326	1	29	57	5	100012905705W400	609.8	270	300	350	390	400	410	430	445	458					
327	16	30	57	5	100163005705W400	652	322	352	402	440	450		484	503						
328	6	32	57	5	100063205705W400	650.8	317	347	399	436	446		478	495						
329	6	34	57	6	100063405706W400	682.6	366	396	448	486	495	505		547						
330	11	21	57	7	100112105707W400	667.2	366	396	440	478	490		520	535	545		580		630	
331	11	22	57	7	100112205707W400	679.4	376	405	448	489	497	512	530	549	561	579	594		640	692
332	11	23	57	7	100112305707W400	678.2	379	410	463	494	500	515	533	552	561		604	640	651	
333	16	34	57	7	100163405707W400	686	380	407	455	493	506	520	540	555	565	589			655	
334	5	36	57	7	100053605707W400	671.4	368	398	453	485	495	507	531	552	562	584				
335	8	9	57	8	100080905708W400	666.2	379	409	456	495			530	543	558	575	588	635	645	
336	14	10	57	8	100141005708W400	668	385	415	462	495	507		540	555		580	600	639	650	686
337	8	15	57	8	100081505708W400	685.8	397	426	479	510	522		555	572		600	616	655	665	
338	10	16	57	8	100101605708W400	678.7	395	420	471	503			555	572	582	600	615	665	675	701
339	10	19	57	8	100101905708W400	689.5	400	430	480	511				570	580	607	620	646	655	709
340	11	3	58	1	100110305801W400	672.1	355	385	439	480	489	500	533	542	553	570	587	620	630	672
341	9	4	58	1	100090405801W400	671	358	385	437	478	490	497	515	530		560	575	620	632	678
342	7	10	58	1	100071005801W400	667.7	345	375	431	467	480									
343	7	11	58	1	100071105801W400	670.9	358	388	443	484	496	507	527							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
344	5	21	58	1	100052105801W400	637.1	340	371	425	463	474	485	495	515	525	540	555	595	605	655
345	9	29	58	1	100092905801W400	701.1	375	405	457	496	507	517	530	550	563	575	591	.	630	690
346	12	4	58	2	100120405802W400	649.3	302	333	386	416	423	433	.	484	496	515	535	.	.	580
347	5	10	58	2	100051005802W400	669.6	333	363	414	455	465	474	499	515	528	552	560	595	605	624
348	5	13	58	2	100051305802W400	692.3	359	389	447	488	498	507	530	550	560	.	610	637	645	667
349	8	17	58	2	100081705802W400	668.8	332	362	415	455	469	486	.	520	530	551	568	600	610	.
350	7	23	58	2	100072305802W400	683.5	347	377	431	471	480	490	515	.	.	.	.	.	.	.
351	8	26	58	2	100082605802W400	681.6	343	378	427	465	480	493	.	528	542	565	585	620	632	643
352	10	28	58	2	100102805802W400	684.2	325	355	408	446	457	465	.	510	520	545	557	588	598	610
353	15	30	58	2	100153005802W400	670.1	312	340	395	432	445	460	476	495	512	.	.	.	.	.
354	4	8	58	3	100040805803W400	621.3	277	307	358	396	411	425	442	460	470	.	510	545	555	559
355	9	10	58	3	100091005803W400	598.3	247	278	328	367	375	385	.	421	432	452	465	512	520	526
356	10	21	58	3	100102105803W400	633.7	285	313	364	405	420	.	.	.	.	.	.	.	.	.
357	7	26	58	3	100072605803W400	662	298	330	375	423	437	450	465	480	491	510	525	575	.	585
358	8	27	58	3	100082705803W400	661.9	298	328	381	420	430	440	465	481	.	.	540	.	.	583
359	6	30	58	3	100063005803W400	644	300	330	382	420	427	435	447	485	495	514	527	563	580	613
360	7	33	58	3	100073305803W400	647.2	297	329	378	419	434	445	465	482	495	515	.	570	575	604
361	12	36	58	3	100123605803W400	660	303	334	384	422	430	.	468	485	495	511	529	.	575	595
362	1	2	58	4	100010205804W400	642.7	303	334	384	422	437	.	467	484	498	.	528	.	575	609
363	6	6	58	4	100060605804W400	654.9	311	343	390	433	.	458	475	495	505	525	.	.	.	.
364	10	9	58	4	100100905804W400	650.6	305	338	380	425	435	.	465	480	490	.	535	570	580	.
365	15	11	58	4	100151105804W400	636.4	290	320	370	411	425	.	455	473	485	.	524	.	565	593
366	15	17	58	4	100151705804W400	721	383	415	467	503	515	528	547	564	575	.	613	.	660	.
367	7	21	58	4	100072105804W400	658.3	314	344	396	434	445	462	474	492	501	.	540	590	600	610
368	5	26	58	4	100052605804W400	659	321	351	401	442	451	461	478	496	506	.	552	590	601	637
369	6	4	58	5	100060405805W400	653.6	315	343	395	431	440	.	.	.	.	.	.	.	.	.
370	16	13	58	5	103161305805W400	670.4	325	357	405	446	457	469	485	504	.	.	552	.	.	.
371	10	36	58	5	1AA103605805W400	600.3	257	287	335	374	382	393	418	435	446	470	485	515	525	555
372	7	1	58	6	100070105806W400	684.3	347	376	425	463	.	.	510	525	535	557	574	.	.	.
373	7	19	58	6	100071905806W400	642.7	321	350	400	435	445	.	475	490	501	520	535	571	585	630
374	11	29	58	6	100112905806W400	642.3	316	345	395	434	444	456	473	485	495	517	528	560	570	.
375	4	5	58	7	100040505807W400	684.9	382	412	460	497	506	515	535	560	567	595	610	650	660	.
376	12	24	58	7	100122405807W400	579	265	295	345	383	390	407	425	440	448	475	495	.	525	570
377	6	26	58	7	100062605807W400	641.8	324	353	405	442	452	465	481	500	510	536	548	591	601	.
378	5	1	58	8	100050105808W400	605	305	335	386	417	430	450	467	482	492	510	525	574	584	615
379	5	10	58	8	100051005808W400	654.7	357	386	435	475	485	505	518	533	540	555	569	620	630	.
380	6	12	58	8	100061205808W400	599.5	302	332	387	416	430	.	459	472	480	497	509	555	567	607
381	14	16	58	8	100141605808W400	650.7	358	388	435	470	480	499	510	530	537	556	570	615	630	657

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
382	11	17	58	8	100111705808W400	649.4	357	387	440	470	483	.	512	530	539	560	575	.	626	665
383	15	18	58	8	100151805808W400	650.8	355	385	425	469	480	.	510	525	535	555	564	615	626	655
384	15	19	58	8	100151905808W400	650	357	387	440	471	481	.	515	531	.	.	.	.	.	.
385	12	21	58	8	100122105808W400	645.8	351	380	431	464	475	495	510	525	532	550	560	.	612	654
386	14	28	58	8	100142805808W400	642.5	350	380	425	462	474	.	.	525	535	555	576	616	626	646
387	9	8	59	1	100090805901W400	676.9	341	371	421	461	471	.	500	513	525	540	560	.	600	642
388	14	16	59	1	100141605901W400	641.4	303	332	384	425	433	448	468	484	500	517	530	572	583	608
389	3	19	59	1	100031905901W400	622.5	266	297	350	388	395	.	425	448	456	473	485	.	.	.
390	11	21	59	1	100112105901W400	612.2	270	300	350	386	395	409	427	443	455	476	492	525	538	562
391	8	22	59	1	100082205901W400	623.4	288	317	375	412	424	440	460	475	.	.	527	555	565	.
392	16	31	59	1	100163105901W400	640.8	307	339	398	435	445	460	475	490	.	.	.	.	.	.
393	11	5	59	2	100110505902W400	676.7	315	350	397	435	450	.	482	498	510	.	545	.	.	.
394	11	6	59	2	100110605902W400	673.8	312	346	395	435	448	464	480	498	510	.	545	585	595	.
395	5	13	59	2	100051305902W400	651.5	292	321	375	415	.	435	455	472	483	.	528	.	.	.
396	7	15	59	2	100071505902W400	644	281	312	361	402	415	426	445	461	475	492	504	.	555	576
397	7	16	59	2	100071605902W400	651.3	288	318	370	409	.	.	452	470	478	.	525	553	560	570
398	14	17	59	2	100141705902W400	648.4	287	318	367	405	413	423	450	467	475	490	507	555	565	580
399	14	18	59	2	100141805902W400	650.6	287	318	367	403	.	424	450	467	476	.	518	558	567	578
400	11	19	59	2	100111905902W400	623.4	259	290	347	383	395	.	425	440	450	470	.	530	540	559
401	8	21	59	2	100082105902W400	641.9	275	305	361	395	.	415	440	455	464	482	.	.	545	555
402	15	23	59	2	100152305902W400	630	263	294	346	384	391	405	425	443	450	.	500	.	.	.
403	10	24	59	2	100102405902W400	623.3	268	298	355	390	400	410	425	449	456	.	.	.	.	.
404	14	25	59	2	100142505902W400	623	255	287	336	376	385	399	420	.	.	.	.	.	.	.
405	7	27	59	2	100072705902W400	624.9	247	277	330	368	378	390	410	426	436	.	472	.	505	543
406	7	28	59	2	100072805902W400	617.1	240	270	323	364	375	387	409	426	435	.	.	.	.	.
407	1	35	59	2	100013505902W400	643.7	276	307	357	400	410	425	441	459	.	.	.	.	.	.
408	9	36	59	2	100093605902W400	615.5	248	277	330	370	378	391	410	433	444	.	.	.	.	.
409	11	4	59	3	100110405903W400	652.8	303	333	387	421	436	447	465	483	495	.	545	574	583	615
410	10	6	59	3	100100605903W400	645.2	296	326	377	417	431	444	464	480	490	510	525	570	580	.
411	6	8	59	3	100060805903W400	640.8	288	320	372	409	424	435	455	472	483	494	523	570	580	.
412	11	21	59	3	100112105903W400	621.8	268	298	350	395	403	.	437	455	.	.	509	545	565	578
413	6	34	59	3	100063405903W400	621	262	291	341	381	390	401	.	.	.	.	503	525	540	.
414	6	9	59	4	100060905904W400	621.2	280	305	354	396	405	.	.	451	460	474	497	.	552	567
415	6	12	59	4	1AA061205904W400	660	318	347	401	436	450	.	480	497	506	518	548	590	600	636
416	10	19	59	4	100101905904W400	620.6	259	294	341	379	390	.	411	442	448	472	485	533	543	579
417	11	20	59	4	100112005904W400	610.5	256	287	335	375	384	.	430	436	443	457	475	521	533	570
418	7	22	59	4	102072205904W400	634	274	305	354	393	399	413	434	453	460	474	498	.	.	.
419	7	26	59	4	100072605904W400	623	262	293	346	383	390	.	426	445	453	467	492	535	547	590

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
420	10	30	59	4	100103005904W400	610.8	252	283	332	369	378	.	.	418	433	453	475	515	526	570
421	10	31	59	4	100103105904W400	588.3	233	264	314	353	363	.	399	415	424	437	457	497	506	549
422	10	33	59	4	100103305904W400	613.7	253	284	340	373	382	395	415	434	441	455	478	523	535	568
423	6	17	59	5	100061705905W400	641.3	305	334	384	425	433	451	466	479	491	506	523	567	576	616
424	2	1	59	6	100020105906W400	670.9	337	367	416	453	465	475	495	513	520	.	.	.	.	.
425	14	4	59	6	100140405906W400	615.9	282	312	356	391	.	.	430	445	455	475	492	530	540	.
426	13	5	59	6	100130505906W400	598	262	292	336	376	.	405	422	438	.	.	.	.	.	.
427	11	7	59	6	100110705906W400	575.9	242	272	320	357	365	380	400	415	.	.	.	.	.	.
428	11	8	59	6	100110805906W400	577.3	244	271	320	360	370	378	399	416	425	.	457	497	503	552
429	10	9	59	6	100100905906W400	581.3	245	275	320	358	.	384	400	420	430	443	460	500	515	.
430	11	12	59	6	100111205906W400	578.2	246	277	326	365	375	386	410	425	433	448	463	502	515	.
431	13	13	59	6	100131305906W400	578.9	242	272	320	358	368	380	402	417	425	455	472	510	521	.
432	14	14	59	6	100141405906W400	575.4	236	266	315	354	365	380	398	412	422	441	455	.	.	.
433	4	16	59	6	100041605906W400	579.5	242	271	319	360	370	380	400	417	.	.	.	.	.	.
434	15	17	59	6	100151705906W400	577.9	235	265	312	348	.	.	390	412	421	.	452	495	510	555
435	8	18	59	6	100081805906W400	579.5	240	271	322	357	.	381	400	415	425	.	460	.	.	.
436	11	19	59	6	100111905906W400	585.1	245	275	320	361	371	381	399	416	425	.	460	500	515	558
437	2	22	59	6	100022205906W400	583.9	242	270	318	358	367	380	400	417	425	.	462	497	510	.
438	6	27	59	6	100062705906W400	571.5	230	260	310	347	355	365	385	405	414	.	448	487	500	.
439	[illegible]	30	59	6	100073005906W400	604.5	261	288	342	377	.	400	425	440	.	.	477	515	527	567
440	6	1	59	7	100060105907W400	638.6	306	333	381	421	430	.	454	474	482	.	533	.	.	.
441	5	6	59	7	100050605907W400	639.7	323	353	403	440	450	461	485	501	.	531	550	.	600	.
442	3	13	59	7	100031305907W400	604	273	302	348	388	397	415	435	450	.	477	495	.	.	.
443	12	14	59	7	100121405907W400	633.7	305	330	376	416	.	440	456	475	.	.	518	555	573	.
444	5	17	59	7	100051705907W400	639.9	325	354	405	438	.	467	485	502	506	521	535	570	581	630
445	5	21	59	7	100052105907W400	640.8	318	346	391	435	447	.	.	494	.	.	.	.	.	.
446	12	25	59	7	100122505907W400	620.7	284	315	358	397	410	419	.	450	457	.	495	535	548	594
447	9	27	59	7	100092705907W400	621.9	290	320	360	402	415	425	440	460	466	.	505	550	560	595
448	10	31	59	7	100103105907W400	636.1	309	338	385	421	431	450	469	484	.	514	523	574	582	615
449	8	35	59	7	100083505907W400	609	270	300	346	381	397	405	430	444	.	.	482	528	540	.
450	11	10	59	8	100111005908W400	615.5	304	333	378	415	425	.	.	468	475	498	510	547	555	589
451	16	17	59	8	100161705908W400	627.5	315	345	395	430	442	460	476	490	502	520	531	571	585	610
452	9	30	59	8	100093005908W400	623.3	303	331	381	411	427	442	457	475	.	506	514	543	558	588
453	12	34	59	8	100123405908W400	641.8	310	339	387	424	435	445	465	485	.	517	529	565	575	.
454	5	9	60	1	100050906001W400	608	261	291	344	392	404	412	432	450	459	490	496	542	554	615
455	10	11	60	1	100101106001W400	586	252	285	344	386	395	405	425	440	447	470	490	525	536	612
456	11	29	60	1	100112906001W400	564.5	220	254	313	352	367	375	400	418	430	.	465	510	520	560
457	16	3	60	2	100160306002W400	622.8	250	280	337	373	379	396	415	428	440	.	498	525	535	562

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
458	5	8	60	2	100050806002W400	603.2	237	268	327	360	365	385	405			452	472	515	522	551
459	7	9	60	2	100070906002W400	600.5	223	252	310	345	358		390	400	410	430	444	483	492	520
460	5	10	60	2	100051006002W400	600.3	220	252	303	344	355	365	385	400	410	427	440			
461	9	15	60	2	100091506002W400	597.3	220	250	302	344	355	369	390	405	415					
462	9	22	60	2	100092206002W400	583.8	203	235	282	327	342	355	375	390	400	417				
463	13	23	60	2	100132306002W400	576.2	196	226	284	321	330	340	365	380	390	410		465	477	505
464	13	26	60	2	100132606002W400	568.9	188	218	274	310	320	330	355	370	380	400			465	486
465	12	30	60	2	100123006002W400	565.9	196	228	281	320	330			382	390		430	470	480	507
466	7	32	60	2	100073206002W400	556.7	179	210	263	302	310	325	340	357	367	385	401			
467	6	33	60	2	100063306002W400	555	173	205	260	295	307		337	353	363	382	400			
468	5	34	60	2	100053406002W400	557.1	175	203	257	297	305	325	340	355	365	385	400			
469	12	35	60	2	100123506002W400	552.5	170	200	252	290	298	310	332	350	359	380			436	458
470	10	22	60	3	100102206003W400	586.5	210	240	297	330	339	355								
471	14	27	60	3	1AA142706003W400	569.3	197	229	281	320	324		364	380	388	410	425	469	479	526
472	6	28	60	3	100062806003W400	565	189	220	274	310	318	331	351	369	376	396	414	457	467	516
473	2	30	60	3	100023006003W400	621.5	245	276	333	370	380	392	410	428	437	455	475			
474	10	32	60	3	100103206003W400	592.5	217	250	300	340	350	363	385	398	407	426	440	488	496	
475	6	33	60	3	100063306003W400	567.9	193	225	278	314	325		354	371	380	400	417	460	471	520
476	6	34	60	3	100063406003W400	559	183	212	267	302				361	370	390	410	440	451	507
477	10	35	60	3	100103506003W400	572.5	195	225	275	320	325	340	360	375	385	400	420	460	471	515
478	6	1	60	4	100060106004W400	616.4	257	287	341	376	385	400	420	438	447	465	485	525	535	552
479	10	5	60	4	100100506004W400	601.8	242	271	323	358	370	380								
480	9	8	60	4	100090806004W400	595.8	230	262	310	349	359	371								
481	10	14	60	4	100101406004W400	618.2	245	275	330	365	376									
482	8	15	60	4	100081506004W400	606.2	237	267	316	357	368	380	400							
483	12	16	60	4	100121606004W400	595.6	228	258	310	347	355	370		405	415	433	450		500	558
484	4	23	60	4	100042306004W400	621.9	250	280	335	370	381									
485	14	25	60	4	100142506004W400	589.7	218	250	302	341	347									
486	7	29	60	4	100072906004W400	582.2	213	248	297	337	347	357			402	422				
487	6	33	60	4	100063306004W400	566.3	195	227	277	317	323	333								
488	13	28	60	5	1A2132806005W400	576.6	222	251	304	340	344	355								
489	8	30	60	5	100083006005W400	587	235	262	309	351										
490	10	35	60	5	100103506005W400	563.1	200	230	285	320	328	342				410	422	467	478	525
491	11	2	60	6	100110206006W400	561.2	215	243	292	330	340		370				431	475	480	530
492	7	9	60	6	100070906006W400	565.8	219	248	297	335	345	356		391	398		433			
493	10	18	60	6	100101806006W400	569.1	224	253	302	338	351	360	378	396		421	439	475	488	527
494	6	23	60	6	100062306006W400	578.5	231	262	314	347	358		383	400		429	449	490	500	544
495	10	25	60	6	100102506006W400	576.7	223	254	302	340	350	360								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
496	10	26	60	6	100102606006W400	584	235	265	312	352	360	375			418	435	450	490	500	544
497	10	27	60	6	100102706006W400	592.2	243	274	322	358	365	380	394	415	425	440	458	496	505	557
498	5	30	60	6	100053006006W400	573.3	226	256	307	343										
499	6	36	60	6	100063606006W400	564.7	207	237	290	324	334	347	370	385		413	428	468	478	520
500	6	1	60	7	100060106007W400	591.4	247	277	323	360		381	399	415	422		460	500	510	555
501	9	7	60	7	100090706007W400	577.4	242	270	321	354	365		400	415			458		496	547
502	12	8	60	7	100120806007W400	577.3	240	270	322	356	369		401	416			458	495	510	548
503	4	14	60	7	100041406007W400	595.3	253	280	330	365		385	410	425		450	465	500	510	554
504	12	15	60	7	100121506007W400	551.1	206	235	289	320		341	365	381		411	424	470	480	515
505	4	22	60	7	100042206007W400	538.8	190	221	270	306	315		350	365		395	407	444	452	
506	3	24	60	7	100032406007W400	604	255	289	335	369	373									
507	10	28	60	7	100102806007W400	537.8	187	216	267	302	310		342	360		390	404	440	448	479
508	3	3	60	8	100030306008W400	612.6	283	313	357	395		415	435	450			500	535	544	585
509	10	4	60	8	100100406008W400	616.3	289	317	365	400		420	437	455	465	485	502	538	545	
510	9	11	60	8	100091106008W400	587.9	259	286	335	371		392	410	427	436		475	510	520	
511	10	13	60	8	100101306008W400	540	200	229	275	310			359	374			415	452	465	485
512	16	15	60	8	100161506008W400	617.5	275	306	350	387	400	415	435	453			493	527	535	555
513	8	18	60	8	100081806008W400	616	280	310	358	393	404		440	450	458	475	495	530	536	552
514	4	26	60	8	100042606008W400	616.5	273	303	351	385		402	425	440	450		490	530	540	562
515	6	29	60	8	100062906008W400	607.2	262	292	330	375		396	420	431			477	513	523	530
516	6	11	61	1	100061106101W400	557.3	196	220	283	330	345	360	385	402						
517	7	22	61	1	100072206101W400	550.6	197	218	281	352			363	381						
518	2	25	61	1	100022506101W400	545.5	194	218	280	317	326									
519	7	29	61	1	1AA072906101W400	539.9	200	235	290				366	391						
520	7	33	61	1	100073306101W400	542.8	205	235	282	327	335	358								
521	4	35	61	1	100043506101W400	562.4	216	250	296	334	346		384							
522	3	4	61	2	100030406102W400	556	178	209	263	302	312	325	343	360	370	388				
523	12	27	61	2	100122706102W400	548.3	179	208	265	304	313		358	365	371	395	408		460	484
524	9	28	61	2	100092806102W400	549.1	180	210	265	305	310		355	364	371	395	407		460	
525	12	31	61	2	100123106102W400	547.7	162	192	248	283	294	305	325	340	350		385	450	460	
526	3	5	61	3	100030506103W400	604.5	226	257	311	350	360	380	390	407	423	440	448	490	501	553
527	6	11	61	3	100061106103W400	563.5	189	222	273	310	323	342	355	370	380	405	415	462	472	507
528	15	17	61	3	100151706103W400	557.5	185	217	270	307	320		355	370	380		405	449	460	509
529	7	22	61	3	100072206103W400	552.6	175	204	258	293	305						395	435	446	485
530	11	28	61	3	100112806103W400	551.6	170	200	255	289	299				368	385	395			
531	6	1	61	4	100060106104W400	583.7	213	245	297	336	350	360	378	395	405	424	440			
532	14	19	61	4	1AD141906104W400	558	191	223	274	310	315			380						
533	13	20	61	4	102132006104W400	562.4	197	228	280	318	325			385						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	BEX	LLO	CUM	WAB	DIN	DEV
534	12	21	61	4	1001221ü6104W400	565.4	195	226	280	314		332	351	366	381	405	418			
535	7	25	61	4	100072506104W400	550.8	178	207	259	298	303	315	332	350	365	388	401	444	445	
536	7	26	61	4	100072606104W400	556.4	182	214	264	304	315		345							
537	7	27	61	4	100072706104W400	563 2	190	220	270	310	320		350	365	375	400	410	455	467	
538	12	28	61	4	100122806104W400	556.1	185	217	267	308	320		355							
539	2	29	61	4	100022906104W400	562.5	195	225	277	317	325		356	366						
540	8	29	61	4	100082906104W400	557.5	187	217	267	304	311		343	360	370					
541	1	30	61	4	102013006104W400	558.5	189	220	267	309	315			367	379					
542	10	33	61	4	100103306104W400	563	194	226	277	314	323	335	347	363	378	402	415			
543	6	34	61	4	100063406104W400	558	187	218	273	306	316			367	374	395	407	450	462	
544	6	1	61	5	100060106105W400	558.1	195	226	277	315	326									
545	7	2	61	5	100070206105W400	558.8	201	233	284	322	328									
546	3	9	61	5	100030906105W400	559.2	203	235	276	320	326		366	378			415		470	514
547	13	14	61	5	100131406105W400	555.1	195	225	271	311	315		354	370		395	410	455	466	512
548	3	15	61	5	100031506105W400	555.1	194	224	275	311	314		350	366	375		410	451	461	513
549	10	22	61	5	100102206105W400	551.6	190	220	270	310	318	333	348	360	372	395	405	445	460	506
550	3	23	61	5	100032306105W400	552.3	192	222	270	312			350	365	380	395	410	440	450	513
551	5	24	61	5	100052406105W400	556.8	192	224	273	310	320		355	360	375	396	410	455	468	515
552	6	24	61	5	100062406105W400	556.9	193	223	271	309	316		350	365	373	395	410	455	465	515
553	8	24	61	5	100082406105W400	550.8	193	223	275	310	316		352	370	375	400	410	460	468	517
554	6	25	61	5	100062506105W400	550.7	183	213	263	303	310		350	365	375	390	400		450	502
555	3	27	61	5	100032706105W400	553.1	192	221	269	306							407	450	461	502
556	11	27	61	5	100112706105W400	553.2	200	233	283	317	328						415	457	469	
557	7	29	61	5	100072906105W400	560.9	197	228	278	313	325	335	355	373	378	400	415	460	471	509
558	12	34	61	5	100123406105W400	558.1	192	223	270	310	320					395				
559	9	8	61	6	100090806106W400	570.2	210	241	289	326	335					415	431	475	485	
560	6	11	61	6	100061106106W400	551.1	195	225	275	310	317	326	350	367	375	395	410	455	465	478
561	10	23	61	6	100102306106W400	555.9	195	226	272	308	315	325	340	358	370	390	408	445	457	491
562	10	31	61	6	100103106106W400	550.6	194	224	274	310	315	325	340	360	375	396	408	445	458	478
563	11	36	61	6	100113606106W400	560.7	194	225	274	310	315	325	340	360	375	396	410	455	465	478
564	7	6	61	7	100070606107W400	555.3	206	233	279	317	326		360	375	390	405	420	465	477	494
565	10	7	61	7	100100706107W400	573	219	250	295	335	345		380	391	402	422	435	469	485	
566	10	16	61	7	100101606107W400	560.9	200	228	275	312	325									
567	9	21	61	7	100092106107W400	556.9	187	218	268	302										
568	12	28	61	7	100122806107W400	566.2	198	228	280	314	325		359	373		405	420		475	484
569	6	6	61	8	100060606108W400	605.1	255	285	333	370	380									
570	10	10	61	8	100101006108W400	583.7	222	252	300	335	345									
571	10	17	61	8	100101706108W400	581.4	225	257	300	337	346		381	394	400	425	440	476	487	496

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
572	6	22	61	8	100062206108W400	582.3	215	245	297	328	335	.	377	388	.	420	435	472	485	496
573	11	35	61	8	100113506108W400	566.7	205	235	281	317	325	.	360	375	.	403	420	455	466	482
574	10	5	62	2	100100506202W400	542.9	161	192	246	285	295	315	326	344	355	375	387	424	440	.
575	10	8	62	2	100100806202W400	540.4	148	177	229	268	275	.	310	323	333	.	365	405	420	455
576	14	12	62	2	100141206202W400	533.5	183	213	273	314	317	.	.	378	393	415	427	472	483	531
577	7	21	62	2	100072106202W400	540.1	149	180	233	271	282	293	308	329	338	357	369	411	422	.
578	15	12	62	3	100151206203W400	539.6	155	186	235	275	287	.	.	.	.	.	.	.	.	.
579	11	31	62	3	100113106203W400	552.3	170	201	250	290	295	.	330	344	355	380	392	430	446	485
580	14	32	62	3	100143206203W400	551.7	175	206	256	303	310	318	335	348	359	384	394	435	450	495
581	11	34	62	3	100113406203W400	539.7	152	185	235	273	282	.	.	327	338	364	375	415	427	463
582	9	35	62	3	100093506203W400	543.5	150	182	235	272	290	295	315	331	.	361	371	415	427	468
583	10	13	62	4	100101306204W400	542.6	160	196	251	287	295	315	329	348	360	377	390	430	445	.
584	10	14	62	4	100101406204W400	555.9	180	210	260	300	307	.	340	357	363	387	404	442	455	505
585	6	20	62	4	100062006204W400	554	177	207	257	293	300	320	335	350	.	386	398	450	460	.
586	6	22	62	4	100062206204W400	556.1	175	206	259	290	300	.	335	350	360	385	396	.	.	.
587	11	24	62	4	100112406204W400	556	170	202	259	287	295	324	332	347	356	379	395	430	446	476
588	7	32	62	4	100073206204W400	558.3	184	214	265	303	310	325	345	.	.	.	.	.	.	.
589	16	35	62	4	100163506204W400	550	167	197	250	285	293	.	327	345	360	377	390	430	443	.
590	10	36	62	4	100103606204W400	550.6	170	201	253	289	297	.	.	345	351	377	390	430	444	485
591	11	2	62	5	100110206205W400	557.7	196	227	276	314	327	.	.	.	.	.	415	460	472	521
592	10	14	62	5	100101406205W400	554.7	177	208	255	293	301	327	340	355	.	383	395	435	450	505
593	10	16	62	5	100101606205W400	555.3	188	220	268	307	317	.	.	.	.	395	410	450	456	510
594	7	22	62	5	1AA072206205W400	554.9	185	215	270	305	315	.	.	363	371	390	411	445	456	512
595	11	17	62	6	100111706206W400	559.9	184	216	260	303	311	335	347	360	367	393	407	445	459	468
596	11	21	62	6	100112106206W400	549.2	170	201	250	288	295	.	327	337	350	375	386	424	.	434
597	5	22	62	6	100052206206W400	553.8	180	210	259	298	305	.	335	355	.	384	400	438	452	461
598	7	14	62	7	100071406207W400	564.1	196	226	274	313	321	336	355	373	.	400	418	457	468	489
599	16	15	62	7	100161506207W400	592.6	221	251	300	335	345	355	370	390	.	420	440	475	485	496
600	6	23	62	7	100062306207W400	554.4	176	206	254	293	299	.	326	344	355	378	394	431	.	442
601	6	26	62	7	100062606207W400	553.2	178	208	256	292	305	320	339	357	.	385	400	.	.	450
602	10	36	62	7	100103606207W400	554.4	178	215	261	298	308	.	.	353	366	382	396	438	.	448
603	9	13	62	8	100091306208W400	547	186	215	266	300	315	.	330	350	.	.	395	410	442	460
604	12	17	62	8	100121706208W400	588.1	222	252	298	334	345	360	380	393	400	424	440	477	487	505
605	2	22	62	8	100022206208W400	552.4	193	223	269	305	317	335	352	.	.	396	416	452	465	485
606	12	29	62	8	100122906208W400	594.4	224	255	331	335	.	363	378	396	407	427	445	494	503	507
607	11	31	62	8	100113106208W400	582.4	217	247	295	330	340	350	370	390	.	423	439	475	485	500
608	9	5	63	1	100090506301W400	546.5	180	208	260	308	319	331	355	370	.	405	420	455	464	539
609	4	11	63	1	100041106301W400	541.6	200	224	282	323	332	344	372	390	402	418	431	472	485	.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
610	5	19	63	2	100051906302W400	544.5	158	189	243	277	285	304	322	340	355	370	379	422	430	481
611	3	21	63	2	100032106302W400	549.9	165	195	251	286	292	300	328	343		378	393	425	440	485
612	12	31	63	2	100123106302W400	546.8	150	180	230	273	282	300	317							
613	11	4	63	3	100110406303W400	545.7	175	207	250	291	305		337	353		385	398	435	450	497
614	3	6	63	3	100030606303W400	547.5	165	195	247	285	292	305	325	345		375	386			
615	6	7	63	3	100060706303W400	551.2	173	203	254	290	293	313	331	348	359	380	393	437	450	500
616	15	18	63	3	100151806303W400	559	164	193	243	283	290	316	325	345		375	387	430	440	
617	7	20	63	3	100072006303W400	550.7	157	190	238	275	284	300	319	335		368	382	422	430	
618	6	23	63	3	100062306303W400	545.1	140	170	222	263	267		303	319	334	352	363	403	415	465
619	11	25	63	3	100112506303W400	551.7	145	175	227	267	278	288	306	325	336	358	369	410	420	470
620	3	26	63	3	100032606303W400	548.6	146	176	226	282	290		314	326		360	370	412	422	477
621	10	28	63	3	100102806303W400	554.2	158	188	243	277	287									
622	2	30	63	3	100023006303W400	549	157	187	238	276	285	295	317	339	352	371	385	425	440	
623	7	35	63	3	1AA073506303W400	551.2	172	203	253	295	302		331	350	365	385	398	440	447	505
624	7	6	63	4	100070606304W400	548.3	185	217	265	305	311	325	350	365	376	390	410	452	462	
625	10	3	63	5	100100306305W400	558.6	188	220	265	309	315	330	354	371	385	401	416	453	465	517
626	11	6	63	5	100110606305W400	543.7	175	205	253	293	300	323	337	355	370	389	401	440	451	497
627	7	16	63	5	100071606305W400	549.6	175	210	258	295	300	310	330	346	358	384	397	437	452	498
628	11	18	63	5	100111806305W400	556.8	183	217	267	305	310	322	345	362	377	392	407	445	460	499
629	9	25	63	5	102092506305W400	588.9	217	250	300	339	350	364								
630	1	29	63	5	100012906305W400	551.6	177	210	259	300	314	325		370	380	400	415	451	463	500
631	10	30	63	5	100103006305W400	558.4	185	217	269	305	310		352	370	381	395	410	445	460	503
632	7	32	63	5	1AA073206305W400	561.9	189	223	270	310	316		360	375	385	398	416	455	470	510
633	7	13	63	6	1AA071306306W400	558.8	190	222	272	311	319		352	368	383	400	416	452	465	504
634	10	19	63	6	100101906306W400	559	183	215	262	300	310	320	336	356		385	405	440	451	475
635	11	20	63	6	100112006306W400	559.6	195	223	277	318	325	345	357		390	410	420	459	471	
636	8	21	63	6	100082106306W400	561.2	187	219	270	308	318	343	356	370	384	403	413	443	452	478
637	16	22	63	6	100162206306W400	563.3	186	219	266	305	312				385	400	415	449	460	494
638	9	23	63	6	100092306306W400	573.8	206	238	286	321	332		369	385	400	417	433	470	480	522
639	3	24	63	6	100032406306W400	569	195	225	275	311	324		360	380	395	413	420	455	470	510
640	10	29	63	6	100102906306W400	571.2	188	220	267	306	315	332	350	368	380	400	415	455	466	480
641	6	31	63	6	100063106306W400	581.8	195	227	276	314	323					410	425	460	470	503
642	6	32	63	6	100063206306W400	578.4	200	233	281	320	325		355	370	382	400	415	455	465	494
643	6	33	63	6	100063306306W400	579.4	202	235	285	322	327			375	385	402	425	459	468	494
644	7	34	63	6	100073406306W400	582.1	202	233	287	320	328	350	360	378	394	410	425	460	470	491
645	10	3	63	7	100100306307W400	560.5	186	218	265	302	314		341	354	373	390	408	451	451	482
646	7	7	63	7	100070706307W400	560.4	188	219	265	303	308	316	342	360		393	410	445	456	487
647	10	9	63	7	100100906307W400	546.1	178	209	257	295	300	310	334	350	365	385	400	435	451	492

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	CCL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
648	11	12	63	7	100111206307W400	560.5	187	218	260	302	312	320	345	362	379	396	410	445	455	470
649	10	13	63	7	100101306307W400	564.2	193	223	265	306	316	329	346	365	383	400	420	449	461	
650	6	15	63	7	100061506307W400	560.8	184	216	262	302	308	318	335	352	369	390	405	442	452	491
651	10	19	63	7	100101906307W400	571.8	196	226	273	310	323	334	349	370	386	401	415	452	465	496
652	10	25	63	7	100102506307W400	569.6	190	224	273	305	310	330	340	358	367	390	412	445	455	502
653	10	26	63	7	1AA102606307W400	565.9	190	224	273	309	315	324	350	365	375	408	415	450	465	505
654	14	36	63	7	100143606307W400	578.6	193	224	270	308	319	335	347	362	370	397	420			
655	12	1	63	8	1AA120106308W400	567.9	192	220	270	310	318	330	345	360		410	440	450	462	475
656	6	2	63	8	100060206308W400	562.3	191	221	265	305	308	317	340	357	395	410				
657	3	4	63	8	1AA030406308W400	569.1	202	231	280	317	335	345								
658	4	4	63	8	1AC040406308W400	566.6	199	228	277	313	336	345								
659	5	4	63	8	1AA050406308W400	566.7	200	230	275	310	334	345								
660	6	4	63	8	1AB060406308W400	568.6	201	233	283	314	334	345								
661	14	11	63	8	100141106308W400	567.5	194	224	270	308	319	336	347	365		400	420	453	463	490
662	1	13	63	8	100011306308W400	572.7	193	223	271	306	317	335	355			400	420	455	467	497
663	2	13	63	8	1AG021306308W400	578.9	202	232	280	315	326	344	364			405	429	464	476	506
664	6	13	63	8	100061306308W400	576.7	200	228	275	317	327	341	362			405	426	460	471	503
665	8	24	63	8	100082406308W400	578.3	200	230	277	315	327	343	362			405	425	460	471	502
666	10	26	63	8	100102606308W400	5°1.4	208	238	286	327	340					417	437	472	482	521
667	4	27	63	8	100042706308W400	./9.7	206	236	280	323	329	347	372							
668	6	31	63	8	100063106308W400	584.2	214	240	289	325	337	362	375	393	406	428	443	475	484	515
669	5	13	63	9	100051306309W400	598.1	227	254	302	339	350	365	387			427	447	481	495	515
670	6	10	64	3	100061006403W400	548.3	163	194	250	287	296	308	329	344	358	378	390		448	492
671	2	15	64	3	1AA021506403W400	553.7	176	205	256	289	295		337	350	362	380	392			
672	1	16	64	3	1AA011606403W400	564.3	170	200	250	293	296		337	352	368	388	399	430	440	
673	5	16	64	3	1AA051606403W400	556.2	166	197	247	282	284		332	345	360	377	390	420	430	
674	1	19	64	3	100011906403W400	594	200	230	280	320	325	355	367	381	395	411	426	466	481	532
675	10	26	64	3	1AA102606403W400	605.3	213	247	302	340	351	368	380	399	409	428	446			
676	3	27	64	3	1AC032706403W400	600	197	228	278	318	331		365	385						
677	14	35	64	3	1AA143506403W400	642.7	236	267	320	359	370		399	414	425	453	465		515	570
678	12	15	64	4	100121506404W400	586.8	195	227	277	317	330	340	357	372		404	422		480	537
679	10	19	64	4	100101906404W400	597.3	208	243	285	333	347	367	381	396	407	428	445		495	
680	2	20	64	4	100022006404W400	558.1	170	204	258	292	305	317	330	350	361	378	395		355	
681	6	21	64	4	100062106404W400	574.7	185	215	267	305	320	330	345	365		400	412		470	
682	10	21	64	4	100102106404W400	580.1	190	220	272	310	323	335	348	365			413		470	
683	13	21	64	4	100132106404W400	578.5	187	218	251	308	320	341	358	373	382	407	415		472	
684	6	24	64	4	100062406404W400	581.5	193	225	275	315		345	360	379	394	407	423		463	525
685	6	28	64	4	1AA062806404W400	610.9	206	239	289	328	339		367	385	406	420	433		490	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
686	7	29	64	4	100072906404W400	614.8	215	249	303	338	350	361	375	395	410	.	445	.	504	.
687	10	29	64	4	1AA102906404W400	621.3	220	252	305	340	350	368	385	400	410	429	446	507	517	.
688	11	30	64	4	100113006404W400	616.7	227	257	310	345	358	.	385	404	.	442	455	504	511	.
689	15	31	64	4	100153106404W400	626.6	225	259	312	345	.	.	389	405	415	437	452	495	505	.
690	7	32	64	4	100073206404W400	624.2	221	252	301	340	.	.	372	398	409	429	450	.	500	.
691	10	32	64	4	100103206404W400	622.7	217	251	299	336	.	.	.	.	.	429	444	.	502	.
692	13	32	64	4	100133206404W400	627.5	226	260	309	347	.	.	.	.	425	437	452	.	505	.
693	11	6	64	5	100110606405W400	570.5	192	225	272	310	322	335	360	.	390	405	422	455	466	503
694	6	7	64	5	1AA060706405W400	564.3	210	240	287	325	337	350	370	385	.	.	.	.	.	.
695	8	9	64	5	1AA080906405W400	564.1	210	240	287	325	337	350	370	385	.	.	.	.	.	.
696	10	17	64	5	100101706405W400	592.5	224	256	305	343	357	373	393	.	418	434	453	488	498	544
697	3	24	64	5	100032406405W400	570	194	223	265	308	320	332	358	.	.	404	421	460	472	521
698	5	32	64	5	1AA053206405W400	639.3	252	285	332	370	380	398	421	436	450	470	486	520	530	.
699	10	34	64	5	100103406405W400	641.3	250	283	331	375	381	399	416	431	445	463	483	524	536	585
700	14	5	64	6	100140506406W400	596.3	210	242	291	330	.	353	377	393	407	425	437	.	.	.
701	11	6	64	6	100110606406W400	589.4	200	232	282	320	332	342	358	375	405	417	428	465	472	508
702	12	6	64	6	100120606406W400	590	200	232	282	320	330	357	372	385	400	.	420	.	.	.
703	16	6	64	6	1AA160606406W400	592.7	208	238	285	327	337	356	370	383	391	415	430	470	480	510
704	3	7	64	6	100030706406W400	583.7	198	231	276	315	326	353	363	380	400	412	425	.	475	502
705	11	9	64	6	100110906406W400	588.3	207	237	280	325	335	.	375	390	410	424	437	.	481	502
706	6	11	64	6	100061106406W400	580.4	188	220	267	305	315	341	353	367	.	402	415	.	460	477
707	11	14	64	6	100111406406W400	588.9	200	228	278	316	322	330	350	366	374	.	410	.	460	.
708	14	16	64	6	1AA141606406W400	584	197	230	278	320	328	349	365	.	.	.	425	460	470	487
709	6	18	64	6	100061806406W400	593.7	205	235	290	325	335	.	.	379	387	.	431	465	475	508
710	2	21	64	6	1AA022106406W400	590.1	200	233	282	321	331	.	367	382	396	410	425	466	476	495
711	12	21	64	6	1AA122106406W400	601.6	211	245	290	330	340	.	376	392	408	430	440	475	485	509
712	3	22	64	6	1AA032206406W400	590.7	203	236	281	324	336	.	.	387	.	.	430	470	480	488
713	6	23	64	6	100062306406W400	603.9	218	250	295	335	344	355	382	398	415	427	445	480	490	507
714	3	27	64	6	1AA032706406W400	606.9	221	251	301	344	351	.	388	403	420	432	450	485	495	512
715	9	27	64	6	1AA092706406W400	613	228	260	305	346	355	.	396	410	425	440	458	492	502	520
716	9	28	64	6	1AA092806406W400	604.2	217	249	296	335	343	.	383	399	417	426	445	485	495	517
717	7	30	64	6	100073006406W400	604.1	228	261	308	347	353	366	392	410	420	440	454	490	500	536
718	11	36	64	6	100113606406W400	648.1	255	287	328	375	385	397	.	.	.	.	488	520	530	570
719	16	1	64	7	100160106407W400	582.7	197	227	272	313	319	330	350	365	376	395	420	460	470	506
720	7	3	64	7	100070306407W400	575	197	230	275	314	324	336	365	.	.	.	427	462	472	521
721	4	7	64	7	1AA040706407W400	577.8	200	233	275	317	325	347	368	.	.	.	425	460	470	520
722	11	11	64	7	100111106407W400	578.5	197	230	277	315	.	355	365	380	398	410	426	465	474	514
723	8	12	64	7	100081206407W400	582.1	193	225	275	310	318	.	345	368	393	405	417	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
724	10	13	64	7	100101306407W400	592	208	241	287	325	.	345	365	386	407	430	440	475	485	521
725	6	15	64	7	100061506407W400	591.4	223	257	301	343	350	365	381	400	419	440	452	488	498	545
726	11	16	64	7	1AA111606407W400	586.9	218	248	296	334	342	.	373	400	415	435	445	480	492	540
727	10	28	64	7	100102806407W400	608.6	227	261	310	349	357	370	397	412	430	450	460	495	506	555
728	6	30	64	7	100063006407W400	589	212	245	295	331	340	360	377	394	410	.	440	474	485	530
729	15	4	64	8	100150406408W400	596.2	210	241	287	326	335	351	370	386	395	.	431	465	475	490
730	13	7	64	8	100130706408W400	588.6	217	250	297	331	342	368	380	395	405	422	444	479	490	510
731	10	22	64	8	100102206408W400	599.5	219	251	299	337	347	361	384	402	411	.	448	479	491	524
732	10	30	64	8	100103006408W400	596.4	232	262	308	352	363	.	394	405	416	.	460	497	508	551
733	6	36	64	8	1AA063606408W400	593.5	216	249	301	341	.	372	390	405	.	.	450	477	488	535
734	6	29	64	9	100062906409W400	655	285	315	360	397	408	425	440	460	.	495	510	540	550	.
735	8	14	65	2	100081406502W400	593.4	185	217	270	310	320	335	356	372	387	405	422	.	.	.
736	7	22	65	2	100072206502W400	601.1	187	212	273	315	320	335	358	375	382	410	427	.	488	565
737	15	23	65	2	100152306502W400	580.3	162	190	250	288	300	315	331	346	355	385	398	.	453	520
738	2	3	65	3	102020306503W400	655.7	247	279	329	366	376	390	408	425	439	457	472	509	521	576
739	7	8	65	3	1AN070806503W400	606	218	242	305	348	360	370	383	400	415	.	455	.	.	494
740	3	17	65	3	1AA031706503W400	602.2	197	230	284	317	327	335	355	370	380	400	421	.	.	.
741	10	18	65	3	1AA101806503W400	601.2	195	225	274	310	324	335	350	367	375	400	417	475	485	.
742	6	29	65	3	1AA062906503W400	609.3	184	220	265	305	320	340	356	371	381	400	415	455	465	.
743	6	32	65	3	1AA063206503W400	617.5	195	223	270	310	323	335	355	370	379	410	425	.	480	.
744	13	1	65	4	110130106504W400	601.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
745	5	3	65	4	100050306504W400	614.3	202	233	280	325	333	.	.	380	400	415	430	.	489	.
746	1	9	65	4	100010906504W400	618.7	202	233	282	322	332	345	363	380	390	414	430	.	482	.
747	5	10	65	4	100051006504W400	616.2	200	231	280	322	334	344	364	.	.	420	433	.	485	.
748	5	11	65	4	100051106504W400	601.8	194	220	276	312	326	334	354	.	.	405	420	.	470	.
749	13	12	65	4	103131206504W400	606.3	193	225	274	310	.	335	354	.	.	.	420	.	.	.
750	1	16	65	4	100011606504W400	606.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
751	16	16	65	4	100161606504W400	614,3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
752	10	21	65	4	100102106504W400	615,8	.	.	.	.	.	.	.	.	.	.	.	.	.	.
753	12	22	65	4	100122206504W400	615,3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
754	3	23	65	4	1AA032306504W400	609,6	193	219	270	306	318	332	.	369	382	403	416	.	.	500
755	2	24	65	4	105022406504W400	611	.	.	.	.	.	.	.	.	.	.	.	.	.	.
756	12	24	65	4	100122406504W400	612,9	190	225	275	315	.	.	.	.	.	410	425	.	475	.
757	9	25	65	4	100092506504W400	628,2	192	220	266	306	.	331	345	.	.	.	420	.	469	.
758	14	28	65	4	1AA142806504W400	610.6	.	.	.	.	.	.	.	.	.	.	.	.	.	.
759	10	29	65	4	1AA102906504W400	619,8	190	224	271	310	315	332	354	367	385	405	420	.	461	505
760	1	32	65	4	1AA013206504W400	618,1	187	221	268	306	314	337	.	.	.	397	410	.	480	524
761	14	34	65	4	1AA143406504W400	622.1	195	223	277	311	324	335	355	370	379	406	422	.	478	529

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
762	7	5	65	5	1AA070506505W400	642.1	242	275	329	363	370	389	410	426	446	461	480	.	525	574
763	3	6	65	5	100030606505W400	645	243	276	325	362	373	.	.	429	450	470	482	515	525	.
764	2	7	65	5	100020706505W400	645.2	238	269	323	355	365	380	405	422	.	.	.	.	.	.
765	7	8	65	5	1AA070806505W400	642.1	234	265	313	352	361	371	402	419	436	455	472	.	520	570
766	7	9	65	5	1AA070906505W400	646.2	235	268	318	355	365	385	405	420	437	455	473	.	522	570
767	11	14	65	5	100111406505W400	642.7	227	262	308	346	355	.	.	.	.	445	462	500	510	566
768	6	15	65	5	1AA061506505W400	659.6	250	282	335	371	380	390	408	430	445	465	482	524	535	587
769	9	17	65	5	1AA091706505W400	640.9	235	267	317	363	373	385	403	.	.	.	470	508	519	562
770	14	18	65	5	100141806505W400	651.2	243	277	322	360	370	.	410	425	445	462	477	510	521	564
771	11	21	65	5	1AA112106505W400	648.5	238	270	320	354	365	380	401	425	438	454	469	505	515	568
772	14	29	65	5	1AA142906505W400	644.8	225	257	305	342	353	373	392	.	430	445	457	495	508	.
773	7	30	65	5	100073006505W400	655.9	246	276	326	361	371	390	410	425	445	460	473	508	521	562
774	7	31	65	5	100073106505W400	650.4	230	262	308	348	358	375	394	410	434	446	460	495	508	550
775	10	33	65	5	100103306505W400	639.8	220	250	301	338	348	.	385	402	420	435	447	489	500	545
776	11	1	65	6	1AA110106506W400	654	247	280	329	365	375	390	410	430	448	.	483	515	525	545
777	2	2	65	6	100020206506W400	647.7	243	276	325	364	373	391	410	428	447	460	478	510	520	540
778	2	3	65	6	100020306506W400	644.2	241	273	323	358	366	386	406	422	441	462	470	508	520	539
779	11	10	65	6	100111006506W400	647.3	246	276	325	360	370	390	410	425	442	.	472	510	521	550
780	11	11	65	6	100111106506W400	646.5	245	278	323	361	370	387	407	423	441	457	472	510	520	536
781	5	12	65	6	100051206506W400	644.6	240	270	315	356	366	385	405	420	440	459	471	505	515	540
782	11	13	65	6	100111306506W400	645.5	238	272	316	355	366	385	405	422	442	459	471	505	514	558
783	7	24	65	6	100072406506W400	641.6	233	265	314	350	360	378	400	415	435	454	465	498	510	547
784	10	25	65	6	100102506506W400	636.7	225	255	301	341	350	370	390	406	425	440	452	488	500	533
785	6	27	65	6	100062706506W400	634.1	226	257	306	345	355	370	390	410	425	440	452	490	500	535
786	11	30	65	7	100113006507W400	694	302	334	378	418	433	445	469	485	500	518	538	569	579	.
787	10	30	65	8	100103006508W400	644.2	262	294	337	375	385	405	424	441	455	471	485	520	528	584
788	12	6	65	9	100120606509W402	637.6	270	301	338	375	.	.	.	445	463	480	497	529	538	596
789	11	9	65	9	100110906509W400	606.9	240	270	314	347	.	377	402	420	435	450	465	500	508	567
790	10	13	65	9	100101306509W400	617.8	242	274	320	358	375	385	405	417	435	450	462	499	508	560
791	9	16	65	9	100091606509W400	602.2	233	263	303	346	355	370	391	409	426	440	456	.	499	552
792	12	5	66	1	100120506601W400	602.1	195	219	280	331	343	.	.	.	416	428	440	.	497	.
793	7	17	66	1	100071706601W400	609.9	204	229	291	331	352	.	.	.	421	433	443	.	497	585
794	11	4	66	2	100110406602W400	609.9	190	215	271	313	327	340	360	380	393	410	430	.	485	564
795	7	17	66	2	1AA071706602W400	612.9	198	226	282	326	.	.	378	399	418	436	451	.	.	.
796	8	19	66	2	100081906602W400	621	204	236	288	331	340	350	389	405	420	436	448	492	500	573
797	6	22	66	2	100062206602W400	620.3	198	235	282	308	.	.	383	396	415	433	448	.	492	572
798	7	26	66	2	100072606602W400	616.5	193	227	276	325	336	350	368	385	396	415	437	475	485	.
799	13	34	66	2	100133406602W400	616.5	193	219	276	325	345	360	383	395	412	425	442	.	490	.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
800	5	36	66	2	100053606602W400	616.5	195	226	278	325	335	350	370	390	400	428	440	477	490	
801	11	12	66	3	1AA111206603W400	610.6	191	225	270	331	350	377	400	414	430	446	459		509	
802	6	24	66	3	100062406603W400	616.4	197	231	276	331	340		376	390	408	425	440	485	495	567
803	13	3	66	4	1AA130306604W400	610.9	199	232	284	297	307	329	342		369	389	406	450	461	
804	15	5	66	4	1AA150506604W400	625	213	246	298	312	323	346				397	414	467	473	527
805	3	9	66	4	1AA030906604W400	625.4	193	226	277	314	324					407	423	467	475	527
806	5	14	66	4	1AA051406604W400	633	201	231	283	319	335			380	400	415	433			
807	11	18	66	4	1AA111806604W400	643	208	241	288	333	340		370	387	407	420	435	465	475	542
808	7	30	66	4	100073006604W400	655.6	212	244	289	337	341			396	415	430	443	486	496	544
809	16	4	66	5	100160406605W400	640.3	217	250	296	330	340	370	380	397	420	432	447	490	500	540
810	10	5	66	5	1AA100506605W400	644.2	223	255	305	345	352	370	390	405	420	437	452	490	502	545
811	6	6	66	5	100060606605W400	641.7	222	255	297	338	350	360	378	394	406	430	450	490	502	529
812	8	7	66	5	100080706605W400	641.8	216	250	300	340	349		383	402	421	431	447	484	494	
813	12	8	66	5	1AT120806605W400	637	221	255	302	338	347	375	385	403	422	432	448	485	495	
814	15	10	66	5	102151006605W400	642.8	211	248	296	330	342			395	416	427	444	482	495	532
815	7	14	66	5	1AA071406605W400	639.7	208	245	293	328	341			394	413	425	440		488	542
816	10	15	66	5	100101506605W400	640.6	214	250	297	337	347			401	413	435	449	480	490	534
817	1	16	66	5	100011606605W400	643.5	215	250	295	335	347			404	415	426	442	492	502	530
818	13	22	66	5	100132206605W400	644.6	206	240	287	327	337				406	421	439	480	485	529
819	10	24	66	5	100102406605W400	650.4	212	244	293	330	345				410	424	439	483	490	
820	7	26	66	5	100072606605W400	652.3	213	244	291	330	342			398	413	425	441	485	497	549
821	7	27	66	5	100072706605W400	651.4	210	241	291	330	342			400	411	425	440	475	485	540
822	6	33	66	5	100063306605W400	645.6	206	237	285	328	340					406	430			
823	6	34	66	5	100063406605W400	648.9	212	244	289	330	340	352				414	438	481	491	
824	10	36	66	5	100103606605W400	664.6	225	255	303	341	355			410	415	430	455	495	505	
825	7	11	66	6	100071106606W400	635.3	215	247	293	334	346			400	410	425	437	480	490	515
826	2	12	66	6	100021206606W400	633.5	209	244	285	326	335		366	384	396	411	436	462	472	
827	6	13	66	6	100061306606W400	640.7	217	249	295	330	340			390	402	417	443	480	490	517
828	11	15	66	6	100111506606W400	633	208	240	286	328	342					413	435	475	485	510
829	6	24	66	7	100062406607W400	631.2	221	253	299	332	341	354	369	387	399	418	436	479	489	530
830	5	28	66	7	100052806607W400	635.8	221	253	299	337	346	357	378	393	405	427	442	488	498	546
831	6	8	66	8	100060806608W400	658.5	271	300	347	384	396	413	433	448	457	477	492	536	546	588
832	9	10	66	8	100091006608W400	599.9	203	237	278	315	327		355	375	385	404	425	462	470	528
833	8	18	66	8	100081806608W400	649.5	254	285	325	362	375					455	478	512	520	574
834	10	19	66	8	100101906608W400	640.6	242	272	319	353	365	385	405			450	465	502	509	565
835	4	31	66	8	100043106608W400	625.3	225	257	296	335	345	370	388			436	449	482	488	545
836	12	8	67	1	100120806701W400	613.4	197	219	281	321	335				404	421	437		482	567
837	7	8	67	2	100070806702W400	648.1	225	250	310	350							475		519	605

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MOL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
838	9	11	67	2	100091106702W400	622.9	196	220	286	322	333	345	366	386	400	420	440	.	490	563
839	3	18	67	2	100031806702W400	674.6	240	265	320	365	375	385	405	430	455	475	490	532	539	608
840	10	29	67	2	100102906702W400	710.7	265	285	345	384	400	414	430	450	465	492	508	545	560	637
841	6	34	67	2	100063406702W400	689.6	240	260	327	367	385	397	410	.	.	.	488	525	542	613
842	11	2	67	3	100110206703W400	662.7	225	250	307	346	360	371	388	.	.	450	464	500	512	570
843	11	4	67	3	100110406703W400	657.8	215	244	296	335	350	.	.	404	415	435	449	485	499	555
844	11	6	67	3	100110606703W400	676	230	255	310	347	359	370	.	423	435	452	465	503	510	568
845	10	8	67	3	100100806703W400	678	228	257	309	348	362	.	.	.	430	450	464	495	505	576
846	11	11	67	3	100111106703W400	686.6	245	270	330	366	380	392	410	428	443	470	483	525	535	590
847	10	14	67	3	100101406703W400	701	263	287	348	385	402	.	.	450	.	490	506	538	550	607
848	7	22	67	3	**100072206703W400**	681.1	227	250	308	348	360	.	.	.	427	445	456	498	508	558
849	6	23	67	3	100062306703W400	700	248	273	333	387	396	.	.	.	.	.	.	.	.	.
850	11	26	67	3	100112606703W400	692.5	243	266	323	362	.	.	.	.	455	475	485	515	532	600
851	10	28	67	3	100102806703W400	682.5	221	244	298	339	350	.	.	.	428	445	455	.	510	557
852	6	30	67	3	100063006703W400	673.6	205	229	284	321	330	345	371	385	410	425	435	.	480	543
853	7	31	67	3	100073106703W400	680.3	210	233	288	330	340	358	.	392	410	425	435	.	473	540
854	7	36	67	3	100073606703W400	704.3	255	278	335	376	393	410	.	.	.	480	495	532	546	615
855	10	2	67	4	100100206704W400	697.1	253	278	333	371	380	.	.	437	443	460	487	525	535	589
856	10	3	67	4	100100306704W400	699	252	282	332	368	381	395	.	440	458	475	485	521	530	588
857	7	4	67	4	100070406704W400	693.9	252	282	331	370	383	.	.	440	460	475	485	516	526	586
858	10	5	67	4	1AG100506704W400	686.5	244	276	324	362	375	.	.	434	450	464	477	514	524	580
859	10	6	67	4	100100606704W400	675.4	234	261	312	360	370	.	.	422	439	452	465	503	513	566
860	10	7	67	4	100100706704W400	686.3	242	270	321	365	374	.	.	432	447	460	474	510	525	569
861	10	8	67	4	100100806704W400	701	258	288	337	377	388	.	.	450	464	480	491	530	540	588
862	9	9	67	4	100090906704W400	703.8	253	283	335	375	387	.	.	450	464	478	490	520	530	595
863	10	10	67	4	100101006704W400	703.4	256	286	337	371	385	405	420	440	462	475	488	518	530	598
864	2	12	67	4	100021206704W400	682.9	232	257	309	347	.	390	409	422	437	453	464	501	515	570
865	6	14	67	4	100061406704W400	698.1	250	280	329	379	385	405	431	445	455	470	482	520	530	585
866	7	16	67	4	100071606704W400	709.6	263	293	343	392	404	415	432	452	465	480	495	532	545	595
867	6	17	67	4	100061706704W400	694.4	250	280	329	371	380	395	420	440	455	470	482	520	535	580
868	10	20	67	4	100102006704W400	699.9	242	272	323	365	375	.	411	428	450	465	475	507	530	567
869	11	24	67	4	**100112406704W400**	678.6	214	243	291	330	.	367	384	398	422	435	448	481	491	552
870	10	26	67	4	100102606704W400	698.3	234	256	310	350	372	390	.	.	445	448	470	517	527	575
871	11	28	67	4	100112806704W400	699	235	365	310	351	360	373	388	405	420	448	470	503	513	565
872	15	30	67	4	100153006704W400	684.3	220	252	302	338	351	361	378	395	410	436	457	493	500	553
873	7	33	67	4	100073306704W400	701.6	232	262	313	350	360	374	396	.	.	458	470	505	515	570
874	11	2	67	5	100110206705W400	663.9	224	255	302	341	.	365	382	395	414	430	455	492	504	553
875	13	3	67	5	100130306705W400	657.6	216	247	296	336	350	.	.	.	.	423	445	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
876	6	4	67	5	100060406705W400	650.4	213	244	294	331	.	363	377	.	.	415	439	475	485	516
877	6	6	67	5	100060606705W400	667.9	205	237	282	320	332	.	370	386	400	.	434	.	510	525
878	8	7	67	5	100080706705W400	652.9	212	243	291	330	344	355	.	.	.	424	445	480	490	531
879	11	12	67	5	100111206705W400	672.9	232	262	313	354	364	380	.	.	425	444	465	502	512	563
880	11	14	67	5	100111406705W400	677.6	223	255	307	342	357	.	.	.	418	438	460	490	502	552
881	6	16	67	5	100061606705W400	660	215	245	290	332	345	.	.	.	.	426	446	482	494	540
882	7	18	67	5	100071806705W400	653.4	205	235	283	322	335	350	.	.	415	430	440	477	487	.
883	10	22	67	5	100102206705W400	669.5	207	242	290	331	343	.	.	.	410	425	447	476	486	542
884	7	25	67	5	100072506705W400	677.6	217	247	298	335	.	361	380	.	413	435	453	485	495	558
885	7	30	67	5	100073006705W400	667.6	223	253	298	335	350	365	.	.	412	432	455	489	506	546
886	10	33	67	5	100103306705W400	671	207	237	287	328	335	350	365	.	.	410	426	.	478	535
887	3	1	67	6	1AA030106706W400	646.1	205	238	284	320	333	.	361	378	390	411	435	.	490	527
888	11	2	67	6	100110206706W400	647.8	208	240	288	325	335	345	365	381	395	414	435	480	490	523
889	12	3	67	6	100120306706W400	653.2	215	245	293	330	342	355	380	.	405	424	449	484	492	522
890	11	5	67	6	100110506706W400	656.2	224	254	303	340	352	363	380	402	415	433	455	490	500	535
891	10	12	67	6	100101206706W400	652.2	211	243	288	327	340	350	372	387	400	425	443	480	491	.
892	5	13	67	6	100051306706W400	648.8	202	235	280	320	328	.	375	390	400	415	438	474	484	525
893	5	14	67	6	100051406706W400	657.7	216	248	291	328	340	.	.	.	415	432	450	485	495	535
894	6	15	67	6	100061506706W400	664.6	229	260	308	345	.	.	.	.	.	440	462	500	511	537
895	7	25	67	6	100072506706W400	670.4	229	259	302	342	352	366	385	.	.	438	459	500	.	.
896	10	27	67	6	100102706706W400	656.8	212	245	294	330	347	368	382	.	.	.	445	475	485	520
897	2	29	67	6	100022906706W400	662.7	225	256	303	341	357	375	.	.	416	435	456	498	510	543
898	13	1	67	7	100130106707W400	651.7	225	258	302	340	349	365	380	398	408	430	450	490	500	546
899	11	5	67	7	100110506707W400	625.2	205	238	282	321	332	345	365	382	395	415	435	470	480	537
900	5	18	67	7	100051806707W400	625	201	234	279	320	330	340	358	375	385	405	428	470	477	.
901	3	25	67	7	100032506707W400	649.9	218	250	295	340	350	360	.	400	.	430	448	490	500	.
902	12	31	67	7	100123106707W400	608.9	180	213	257	305	320	333	352	368	.	404	.	.	.	.
903	13	34	67	7	100133406707W400	763	327	360	404	442	450	466	482	500	510	530	550	597	607	.
904	14	1	67	8	100140106708W400	600.9	185	218	263	300	310	.	343	356	368	390	418	453	463	.
905	6	13	67	8	100061306708W400	650.7	228	262	305	343	350	372	385	400	412	430	452	490	501	.
906	12	14	67	8	100121406708W400	621.7	203	236	281	319	327	.	360	375	389	405	428	475	485	.
907	7	22	67	8	100072206708W400	619.2	202	235	284	325	330	349	370	.	.	410	430	473	485	535
908	3	25	67	8	100032506708W400	610.3	183	215	258	300	306	315	334	350	.	.	405	.	447	.
909	10	29	67	8	100102906708W400	643.6	225	257	297	335	345	370	.	410	432	445	455	489	494	550
910	8	36	67	8	100083606708W400	613.2	188	220	265	305	311	320	343	360	377	390	410	.	470	.
911	11	8	68	1	100110806801W400	669.8	270	288	353	394	410	423	440	454	.	.	516	.	565	630
912	10	8	68	2	100100806802W400	747.7	298	318	378	417	439	452	465	480	.	.	540	.	580	659
913	9	11	68	2	100091106802W400	686	237	255	322	360	375	391	407	421	.	.	485	.	535	603

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
914	6	21	68	2	100062106802W400	729.8	259	278	345	394	415	427	440	460	.	.	515	.	571	630
915	6	26	69	2	100062606802W400	713.9	279	295	360	396	405	421	440	452	.	.	510	.	560	627
916	11	29	68	2	100112906802W400	729.1	279	297	364	399	413	427	445	460	.	495	520	.	570	627
917	9	5	68	3	100090506803W400	709	235	258	316	353	374	385	.	.	.	450	470	505	515	575
918	10	6	68	3	100100606803W400	700.5	235	257	315	355	368	.	.	.	.	445	465	503	510	574
919	10	8	68	3	100100806803W400	715.8	218	265	317	357	370	380	400	413	425	452	472	505	515	573
920	6	13	68	3	100061306803W400	726.9	268	289	355	390	400	410	430	450	460	490	512	545	555	625
921	7	16	68	3	100071606803W400	740.0	265	285	339	379	392	.	421	439	449	477	495	535	545	598
922	6	26	68	3	100062606803W400	77[illegible]	325	345	407	445	465	477	491	505	518	546	565	595	605	660
923	10	28	68	3	100102806803W400	752.9	288	306	368	403	415	430	.	.	470	498	515	545	557	611
924	6	31	68	3	100063106803W400	722.6	254	274	333	370	380	400	.	.	437	465	482	515	525	577
925	11	2	68	4	100110206804W400	709.4	240	262	321	360	371	.	.	.	425	455	471	508	520	527
926	7	6	68	4	100070606804W400	690.8	226	255	305	340	350	360	376	397	415	435	459	493	505	556
927	6	9	68	4	100060906804W400	696.5	225	249	305	345	355	378	388	401	415	441	460	495	505	563
928	11	12	68	4	100111206804W400	724.1	255	277	333	371	385	395	415	425	440	466	485	524	535	588
929	13	16	68	4	100131606804W400	704.7	232	255	310	343	365	375	.	.	423	450	467	503	513	575
930	6	18	68	4	100061806804W400	695.3	225	255	302	340	355	365	381	396	415	439	460	497	507	556
931	7	22	68	4	100072206804W400	726.1	257	278	335	372	388	405	.	.	447	475	487	532	543	590
932	2	24	68	4	100022406804W400	726.5	254	274	335	369	383	.	.	.	435	464	482	519	529	584
933	10	26	68	4	100102606804W400	735.7	263	284	340	377	390	400		.	445	470	492	530	540	590
934	6	29	68	4	100062906804W400	715	240	267	320	356	370	385	.	.	430	458	475	510	520	580
935	11	30	68	4	100113006804W400	722.9	248	279	330	368	380	395	.	.	.	467	485	521	531	596
936	10	32	68	4	100103206804W400	716.4	242	269	324	360	370	.	410	.	.	460	478	515	525	580
937	7	8	68	5	100070806805W400	694.6	234	264	314	352	365	380	.	.	431	450	470	498	508	558
938	11	16	68	5	100111606805W400	687.6	223	252	303	340	355	365	383	397	413	436	457	487	500	552
939	15	26	68	5	100152606805W400	717.2	250	280	327	365	382	397	.	.	452	468	489	520	530	.
940	13	27	68	5	100132706805W400	695.5	224	253	305	342	357	373	.	.	418	441	460	489	499	555
941	11	36	68	5	100113606805W400	714.2	240	269	316	358	370	.	.	.	446	460	480	512	522	587
942	7	1	68	6	100070106806W400	675.6	225	255	300	351	361	.	390	400	416	440	460	488	498	.
943	7	5	68	6	100070506806W400	663.9	222	252	298	336	355	365	382	395	405	432	455	485	494	539
944	5	13	68	6	100051306806W400	699.6	245	277	325	360	375	.	.	.	442	465	485	512	522	575
945	7	15	68	6	100071506806W400	697	246	277	322	361	373	390	.	.	.	460	482	510	520	575
946	8	17	68	6	100081706806W400	688.5	240	270	312	353	366	.	.	.	.	450	473	500	510	565
947	9	20	68	6	100092006806W400	701.3	247	278	322	364	375	390	.	.	.	460	480	509	519	575
948	10	29	68	6	100102906806W400	699.1	244	274	317	358	370	385	.	.	.	455	475	503	513	566
949	14	5	68	7	100140506807W400	611.8	172	204	247	285	297	310	325	350	366	389	408	431	441	508
950	12	18	68	7	100121806807W400	623.3	186	219	265	300	310	.	345	360	380	400	422	450	460	523
951	6	26	68	7	100062606807W400	636.5	190	217	263	300	317	330		.		400	425	450	460	513

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	CCL	MCL	WAS	SPA	GP	REX	LLO	CUM	WAB	DIN	DEV
952	10	28	68	7	100102806807W400	666.1	219	249	298	335	345	.	.	.	405	430	455	481	491	559
953	5	29	68	7	100052906807W400	631.9	189	220	261	301	315	335	.	.	375	405	423	450	460	.
954	15	5	68	8	100150506808W400	671.5	247	279	325	360	.	389	400	416	435	459	480	515	525	.
955	11	14	68	8	100111406808W400	647.9	214	245	292	327	335	350	366	382	400	429	448	480	485	541
956	16	21	68	8	100162106808W400	649.8	217	248	288	325	343	355	.	.	403	430	448	477	487	.
957	1	26	68	8	100012606808W400	605.7	164	195	239	275	285	.	320	334	353	377	400	425	435	493
958	13	30	68	8	100133006808W400	731.7	300	330	372	410	425	.	.	.	492	510	530	570	580	621
959	10	27	69	3	100102706903W400	710.9	255	275	331	371	385	400	415	.	.	465	480	529	535	.
960	5	4	69	4	100050406904W400	728.1	255	283	337	373	390	.	.	.	.	470	490	528	538	610
961	6	6	69	4	100060606904W400	699.3	229	257	308	353	.	.	.	.	.	445	463	497	507	590
962	5	15	69	4	100051506904W400	714.5	244	270	324	357	375	390	.	426	437	460	478	505	515	.
963	6	17	69	4	100061706904W400	695.3	217	244	296	330	345	360	.	.	.	430	445	475	485	547
964	6	19	69	4	100061906904W400	691.6	215	240	290	326	342	355	.	.	.	422	440	475	485	547
965	6	32	69	4	100063206904W400	689.6	205	231	289	323	330	345	.	.	.	415	430	464	474	538
966	6	2	69	5	100060206905W400	694.6	230	256	308	345	360	373	.	.	430	445	463	496	506	573
967	7	4	69	5	100070406905W400	683.8	217	245	292	335	345	360	.	.	425	433	453	482	492	550
968	8	9	69	5	100080906905W400	681.6	212	238	292	328	345	357	.	.	415	430	450	480	490	553
969	7	12	69	5	100071206905W400	692.9	219	245	299	336	349	.	.	.	.	435	454	.	.	.
970	5	14	69	5	100051406905W400	677.5	208	236	290	323	340	350	.	.	410	425	443	475	485	572
971	6	20	69	5	100062006905W400	682.1	214	242	292	325	340	352	.	.	409	425	445	475	485	542
972	6	22	69	5	100062206905W400	673.8	203	232	277	317	331	350	.	.	395	417	438	470	480	575
973	5	24	69	5	100052406905W400	681.5	206	233	282	324	336	350	.	.	.	417	437	471	481	560
974	8	26	69	5	100082606905W400	683.2	207	233	283	322	337	350	.	.	.	420	436	470	480	554
975	8	27	69	5	100082706905W400	677.7	205	235	286	320	338	350	.	.	.	422	437	473	483	579
976	11	32	69	5	100113206905W400	672	197	225	275	320	332	345	.	.	400	419	436	467	478	565
977	10	34	69	5	100103406905W400	677.2	202	230	280	315	330	345	.	.	400	415	432	467	477	550
978	8	36	69	5	100083606905W400	691.7	214	240	288	335	340	353	.	.	400	425	440	477	487	557
979	5	12	69	6	100051206906W400	719.6	254	283	327	369	382	399	411	433	448	470	490	516	526	.
980	6	22	69	6	100062206906W400	714.2	248	275	325	360	375	395	.	.	.	463	480	515	525	584
981	8	32	69	6	100083206906W400	688.8	230	259	303	342	358	370	.	.	430	440	459	485	495	565
982	6	36	69	6	100063606906W400	696	235	265	310	347	365	385	.	.	433	450	467	496	506	584
983	12	30	69	7	100123006908W400	660.6	210	239	285	318	333	.	.	.	.	.	428	464	475	535
984	8	11	69	8	100081106908W400	618.9	178	210	250	290	300	311	.	.	.	.	387	435	448	502
985	12	28	69	8	100122806908W400	666.6	224	252	293	330	345	.	374	392	.	.	435	475	485	508
986	12	31	69	8	100123106908W400	687.1	247	277	315	355	372	385	.	.	.	.	455	505	515	548
987	7	17	70	3	100071707003W400	689.7	207	235	285	323	337	352	365	.	395	410	435	.	476	.
988	7	16	70	4	100071607004W400	680.5	196	222	271	322	332	345	360	385	.	413	430	475	486	512
989	11	30	70	4	100113007004W400	676.3	191	218	263	305	320	339	.	.	.	410	425	460	470	513

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	2WS	BFS	V1K	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
990	8	33	70	4	100083307004W400	663.7	175	201	249	286	300	315	.	.	.	386	402	.	445	482
991	5	9	70	5	100050907005W400	682	208	238	280	324	332	350	.	.	.	420	437	480	490	542
992	7	14	70	5	100071407005W400	680.4	198	225	276	311	326	341	.	.	.	414	430	475	484	532
993	5	19	70	5	100051907005W400	671	203	233	275	314	330	345	.	.	395	410	428	470	476	545
994	7	20	70	5	100072007005W400	684.3	210	240	287	321	335	350	.	.	405	420	436	480	491	553
995	6	33	70	5	100063307005W400	657.5	188	210	257	296	310	329	.	.	.	397	413	450	460	507
996	9	12	70	6	100091207006W400	678.8	211	238	288	324	340	353	.	.	400	420	438	.	480	557
997	8	13	70	6	100081307006W400	686.3	217	245	293	331	347	363	.	.	410	428	445	.	486	551
998	5	23	70	6	100052307006W400	660.6	196	218	276	311	325	340	363	380	388	408	425	.	465	535
999	10	33	70	6	100103307006W400	641.8	178	207	251	290	305	320	.	.	370	385	404	441	450	494
1000	9	35	70	6	100093507006W400	668.3	205	234	282	317	335	350	.	.	402	419	437	474	485	556
1001	7	3	70	8	100070307008W400	643.7	200	230	270	307	320	337	.	.	.	410	426	.	466	.
1002	12	18	71	4	100121807104W400	674.2	.	.	264	300	315	334	.	.	.	400	416	444	454	510
1003	10	14	71	5	100101407105W400	665.6	.	.	257	294	310	325	.	.	.	393	410	.	460	504
1004	12	16	71	5	100121607105W400	679.1	.	.	276	314	330	349	.	.	.	416	432	.	489	539
1005	6	20	71	5	100062007105W400	681.5	.	.	286	320	335	.	365	385	400	424	440	.	480	550
1006	11	23	71	5	100112307105W400	673.7	.	.	266	302	317	335	.	.	375	400	416	.	460	512
1007	10	28	71	5	100102807105W400	579.2	.	.	275	310	327	.	.	.	.	414	429	455	465	543
1008	9	14	71	6	100091407106W400	676.3	.	.	280	313	332	347	.	.	.	415	432	461	471	520
1009	5	15	71	6	100051507106W400	671.7	200	230	275	315	330	345	.	.	.	411	430	.	475	520
1010	9	24	71	6	100092407106W400	676.3	.	.	284	323	340	355	.	.	400	425	442	470	480	543
1011	11	25	71	6	100112507106W400	692.8	.	.	308	344	358	.	395	413	424	440	458	500	510	527
1012	5	28	71	6	100052807106W400	671.9	.	.	276	312	328	.	.	.	.	408	428	.	485	513
1013	6	30	71	6	100063007106W400	665.2	.	.	275	310	325	347	355	.	390	405	424	450	460	517
1014	11	17	71	7	100111707107W400	663.5	205	228	275	310	326	.	.	375	389	412	430	.	476	515
1015	7	20	71	7	100072007107W400	664	202	230	272	308	320	.	.	.	387	410	425	465	475	517
1016	10	30	71	7	100103007107W400	664.6	.	.	272	309	318	332	352	369	385	411	430	.	476	516
1017	7	32	71	7	100073207107W400	657.8	.	.	259	298	311	321	345	360	377	402	420	470	480	506
1018	14	6	71	8	100140607108W400	657.1	200	231	274	308	321	339	.	.	.	.	411	455	465	589
1019	10	13	71	8	100101307108W400	666.7	.	.	278	314	328	.	.	.	.	.	420	465	475	520
1020	7	17	71	8	100071707108W400	667.6	215	243	285	323	335	.	.	.	.	420	437	480	490	514
1021	11	26	71	8	100112607108W400	660.5	200	227	266	302	316	325	346	365	375	390	406	457	468	510
1022	7	32	71	8	100073207108W400	652.6	198	225	264	300	315	.	346	363	375	395	410	460	471	512
1023	11	35	71	8	100113507108W400	666.9	205	235	275	312	327	340	359	375	390	415	435	470	480	518
1024	16	36	72	1	100163607201W400	679.3	.	.	290	329	341	.	.	392	405	425	440	473	483	528
1025	6	3	72	4	100060307204W400	680.1	.	.	.	303	319	.	.	.	375	402	417	460	472	488
1026	5	5	72	4	100050507204W400	677.8	.	.	.	301	318	.	.	.	377	400	415	447	457	494
1027	11	15	72	4	100111507204W400	685.3	.	.	.	325	335	350	.	.	.	423	440	470	480	495

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
1028	7	28	72	4	100072807204W400	701.5				325	338	355				425	440	465	475	505
1029	6	1	72	5	100060107205W400	674.8				296	310					397	413	440	450	498
1030	12	4	72	5	100120407205W400	682.4				315	332					416	435	472	482	560
1031	11	6	72	5	100110607205W400	673			273	309	323					409	425		485	531
1032	12	14	72	5	100121407205W400	718.2			310	343	357					445	460	505	515	550
1033	8	16	72	5	100081607205W400	702.2			293	331	345				407	430	447	497	505	555
1034	8	18	72	5	100081807205W400	708.3			303	337	353					446	463		520	564
1035	12	26	72	5	100122607205W400	697.8				324	337					421	437	485	497	520
1036	12	28	72	5	100122807205W400	720.4				345	360					445	460	500	510	565
1037	11	2	72	6	100110207206W400	674.4			273	310	323					410	428	455	465	530
1038	12	4	72	6	100120407206W400	694.6			295	331	347					430	447	495	505	538
1039	9	6	72	6	100090607206W400	677.7			277	314	330					410	430	475	482	522
1040	7	14	72	6	100071407206W400	706.9			299	334	347			397	412	437	455	485	495	566
1041	8	16	72	6	100081607206W400	715.7			308	342	358					441	460	495	509	550
1042	3	18	72	6	100031807206W400	688.5			284	320					394	420	438	475	486	530
1043	12	26	72	6	100122607206W400	718.2				345						432	450		505	574
1044	12	28	72	6	100122807206W400	718.1			308	347							450		508	560
1045	2	29	72	6	100022907206W400	736.3			332	367	382			434	450	466	485		525	576
1046	9	30	72	6	100093007206W400	735.8			329	366	382	400				465	485	520	530	574
1047	10	1	72	7	100100107207W400	667.1			269	309	325	335	353			395	415		477	520
1048	10	3	72	7	100100307207W400	668.2			275	309	325	335	355				415		475	518
1049	10	13	72	7	100101307207W400	685.8			287	323	340	351	368		395	410	430		490	535
1050	10	16	72	7	100101607207W400	703.6			307	341	360	370	388			430	450	495	505	548
1051	10	17	72	7	100101707207W400	693			292	330	345	355	375			418	432		480	540
1052	10	23	72	7	100102307207W400	694.7			295	330	350		375		405	420	445		500	543
1053	10	25	72	7	100102507207W400	722.1			316	352	370		400			440	458		510	570
1054	10	26	72	7	100102607207W400	701.4			294	335	350	365	380	395	405	420	440		500	
1055	10	27	72	7	100102707207W400	696.7			293	330	345				403	420	440		495	
1056	10	29	72	7	100102907207W400	699.2			298	334	350	360				420	440		485	540
1057	11	30	72	7	100113007207W400	684.7			280	320	335	345	365			409	425		480	532
1058	11	31	72	7	100113107207W400	685.9			277	317	331	345	360			398	420		475	523
1059	10	33	72	7	100103307207W400	690.4			285	321	338		368		391	410	421		485	530
1060	11	34	72	7	100113407207W400	703.6			299	334	355		382			425	440		508	543
1061	10	1	72	8	100100107208W400	679.7			285	324	340	350	368	385		405	428		480	532
1062	10	3	72	8	100100307208W400	688.2			297	332	350	360	375			420	440		495	540
1063	10	5	72	8	100100507208W400	667			274	310	326	339	355	370	385	400	415		488	525
1064	6	12	72	8	100061207208W400	679.3			280	320	336	347	365			405	423		486	529
1065	10	15	72	8	100101507208W400	686.9			285	326	341	351	370			411	430		502	535

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	LSD	SEC	TWP	RNG	IDENTIFIER	KB.	2WS	BFS	VIK	COL	MCL	WAS	SPA	GP	FEX	LLO	CUM	WAB	DIN	DEV
1066	11	26	72	8	100112607208W400	683.7	.	.	277	318	335	345	.	.	.	410	425	.	490	530
1067	10	27	72	8	100102707208W400	690.7	.	.	291	326	342	355	371	.	.	415	430	.	490	534
1068	8	4	73	4	100080407304W400	708.3	.	.	294	329	345	.	370	387	400	415	430	.	489	515
1069	7	6	73	4	100070607304W402	719.3	.	.	305	340	354	.	.	405	415	435	450	498	510	531
1070	11	2	73	5	100110207305W400	693.3	.	.	.	310	330	.	.	.	.	409	425	477	490	512
1071	11	5	73	5	100110507305W400	708.1	.	.	.	328	345	.	373	.	.	415	440	495	505	545
1072	7	12	73	5	100071207305W400	703.9	.	.	.	320	335	350	363	381	394	410	430	.	485	522
1073	8	2	73	6	100080207306W400	707.7	.	.	.	326	340	.	370	.	.	.	430	.	500	554
1074	6	5	73	6	100060507306W400	715.9	.	.	.	341	355	.	377	394	407	425	448	.	505	549
1075	6	7	73	6	100060707306W400	716.1	.	.	.	343	360	375	387	.	415	429	450	.	506	547
1076	6	8	73	6	100060807306W400	705.3	.	.	.	330	345	365	375	.	400	415	438	.	500	540
1077	11	9	73	6	100110907306W400	689.1	.	.	.	308	324	335	353	373	383	402	420	.	475	514
1078	10	11	73	6	100101107306W400	705.4	.	.	.	322	335	.	365	.	.	.	425	.	494	586
1079	6	12	73	6	100061207306W400	705.4	.	.	.	327	343	360	375	390	400	420	439	.	505	545
1080	6	13	73	6	100061307306W400	697.7	.	.	279	320	334	.	.	.	391	414	432	.	490	544
1081	11	14	73	6	100111407306W400	697.3	.	.	286	322	340	.	.	.	.	.	433	.	495	575
1082	11	15	73	6	100111507306W400	680.9	.	.	262	301	315	.	.	.	.	.	415	.	465	505
1083	11	17	73	6	100111707306W400	680.9	.	.	.	304	315	.	348	.	390	416	430	.	467	510
1084	6	18	73	6	100061807306W400	686.3	.	.	.	310	325	336	351	.	.	394	415	.	483	515
1085	10	3	73	7	100100307307W400	723.7	.	.	.	355	370	380	398	412	425	441	455	.	518	557
1086	10	5	73	7	100100507307W400	686.2	.	.	.	314	330	340	359	.	.	.	416	.	480	522
1087	11	7	73	7	100110707307W400	685.1	.	.	.	310	330	340	356	.	.	.	416	.	475	522
1088	10	9	73	7	100100907307W400	721.2	.	.	.	355	370	386	400	.	.	.	460	.	532	555
1089	10	11	73	7	100101107307W400	728.6	.	.	.	353	365	380	395	.	.	.	455	.	515	560
1090	10	13	73	7	100101307307W400	698.4	.	.	.	323	339	.	.	.	.	.	425	.	490	555
1091	10	14	73	7	100101407307W400	716	.	.	.	340	355	.	.	.	.	.	445	.	500	546
1092	6	16	73	7	100061607307W400	733.1	.	.	.	370	377	.	.	.	.	.	463	.	521	570
1093	10	17	73	7	100101707307W400	726	.	.	.	351	367	.	.	.	.	.	452	.	512	560
1094	10	3	73	8	100100307308W400	706	.	.	308	354	370	385	.	.	426	440	460	.	520	548
1095	10	4	73	8	100100407308W400	696	.	.	290	327	345	355	375	.	.	416	431	.	492	535
1096	10	5	73	8	100100507308W400	700.7	.	.	299	337	350	363	380	395	405	423	440	.	498	540
1097	6	10	73	8	100061007308W400	705.5	.	.	298	336	356	370	.	.	.	425	440	.	503	550
1098	10	13	73	8	100101307308W400	696.6	.	.	.	328	345	.	.	.	.	415	429	.	483	538
1099	10	14	73	8	100101407308W400	707.5	.	.	.	337	352	.	.	.	.	425	441	.	505	536
1100	10	15	73	8	100101507308W400	714.2	.	.	.	344	360	370	389	.	.	422	443	.	500	550
1101	10	17	73	8	100101707308W400	694.1	.	.	.	336	352	363	.	.	405	425	440	.	495	535

TABLE II
PALEOCHANNEL DATA: UPPER AND MIDDLE MANNVILLE SUB-GROUPS COLD LAKE OIL SANDS AREA

KEY TO ABBREVIATIONS:

K.B.= Kelly Bushing elevation
TOP= top of channel
BOT= base of channel
COL= Colony Fm.
MCL= McLaren Fm.
WAS= Waseca Fm.
SPA= Sparky Fm.
GP= General Petroleums Fm.
REX= Rex Fm.
LLO= Lloydminster Fm.

. = non-applicable or non-available data

Well locations listed in bold type indicate wells with cores through parts of the Upper-Middle Mannville interval (see Appendix 1)
All data listed are thicknesses in metres.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
2	7	2	53	2	100070205302W400	596	.	.	.	.	.	.	.
3	7	14	53	2	100071405302W400	622	.	.	48	.	.	.	.
4	6	15	53	2	100061505302W400	605	.	.	.	.	.	.	.
5	8	22	53	2	100082205302W400	626	.	.	.	.	.	.	.
6	13	23	53	2	100132305302W400	604	.	.	.	.	.	.	.
7	5	26	53	2	100052605302W400	602	21	.	.	.	.	20	.
8	13	26	53	2	100132605302W400	599	20	.	.	.	.	22	.
9	8	27	53	2	100082705302W400	603	25	.	.	.	.	.	.
10	11	28	53	2	100112805302W400	607	.	15	.	.	.	.	.
11	10	29	53	2	100102905302W400	587	.	.	.	.	.	25	.
12	10	34	53	2	100103405302W400	591	.	13	.	.	.	.	.
13	6	4	53	3	1A0060405303W400	588	.	13	.	.	.	.	.
14	10	6	53	3	100100605303W400	597	.	19	.	.	.	.	.
15	6	8	53	3	100060805303W400	591	.	15	.	.	.	.	.
16	6	18	53	3	100061805303W400	596	.	.	.	.	.	.	.
17	7	6	53	4	100070605304W400	616	.	19	.	.	.	.	.
18	11	20	53	4	100112005304W400	608	.	17	.	.	.	30	.
19	4	27	53	4	100042705304W400	600	.	19	.	.	.	.	.
20	11	31	53	4	100113105304W400	615	.	26	.	.	.	24	.
21	12	20	53	5	100122005305W400	642	.	15	.	.	.	27	.
22	10	29	53	5	100102905305W400	637	.	.	.	.	.	27	.
23	7	30	53	5	100073005305W400	641	.	50	.	.	.	19	.
24	2	32	53	5	100023205305W400	629	.	27	.	.	.	25	.
25	1	34	53	5	100013405305W400	642	.	90	.	.	.	.	.
26	6	36	53	5	100063605305W400	644	.	32	.	.	.	32	.
27	10	3	53	6	100100305306W400	630	.	45	.	.	.	.	.
28	6	12	53	6	100061205306W400	649	.	27	.	.	.	.	.
29	6	24	53	6	100062405306W400	635	.	28	.	.	.	.	.
30	6	8	53	8	100060805308W400	680	.	75	.	.	.	.	.
31	12	9	53	8	100120905308W400	687	.	75	.	.	.	.	.
32	6	17	53	8	100061705308W400	687	92	.	.	.	.	.	.
33	11	18	53	8	100111805308W400	694	95	.	.	.	.	.	.
34	16	23	53	8	100162305308W400	671	.	14	.	49	.	.	.
35	16	24	53	8	100162405308W400	661	.	.	.	.	.	.	.
36	7	25	53	8	100072505308W400	673	.	12	.	.	.	29	.
37	11	26	53	8	100112605308W400	678	.	.	.	.	.	.	.
38	10	27	53	8	100102705308W400	679	.	19	.	.	.	.	.
39	6	30	53	8	100063005308W400	675	20	.	.	.	.	24	.
40	7	36	53	8	100073605308W400	661	.	18	.	.	.	.	.
41	10	27	54	2	100102705402W400	556	.	35	.	.	.	.	.
42	1	28	54	4	100012805404W400	604	.	15	.	17	.	.	.
43	9	31	54	4	100093105404W400	613	.	.	.	.	.	.	.
44	7	32	54	4	100073205404W400	615	.	.	.	.	.	.	.
45	2	33	54	4	100023305404W400	611	.	15	.	.	.	.	.
46	7	34	54	4	100073405404W400	604	.	28	.	.	.	.	.
47	11	36	54	4	100113605404W400	601	.	.	.	.	.	.	.
48	10	1	54	5	100100105405W400	617	.	33	.	.	.	32	.
49	10	2	54	5	100100205405W400	632	.	34	.	.	.	.	.
50	6	6	54	5	100060605405W400	650	.	.	.	.	.	.	.
51	10	10	54	5	100101005405W400	635	23	.	.	.	.	31	.
52	2	11	54	5	100021105405W400	625	.	15	.	.	.	30	.
53	6	15	54	5	100061505405W400	633	15	.	.	.	.	.	.
54	11	16	54	5	100111605405W400	645	.	11	.	.	.	.	.
55	10	18	54	5	100101805405W400	636	.	52	.	.	.	.	.
56	10	19	54	5	100101905405W400	631	.	.	.	5	.	.	.
57	10	20	54	5	100102005405W400	620	35	.	.	.	.	23	.
58	7	21	54	5	100072105405W400	628	.	18	.	.	.	24	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
59	6	22	54	5	100062205405W400	624	.	.	.	.	.	30	.
60	11	27	54	5	100112705405W400	626	.	.	.	.	.	.	.
61	11	29	54	5	100112905405W400	627	22	.	.	.	.	.	.
62	10	30	54	5	100103005405W400	637	15	.	.	.	.	35	.
63	6	32	54	5	100063205405W400	630	13	.	.	.	.	38	.
64	10	1	54	6	100100105406W400	661	28	.	.	.	.	.	.
65	10	8	54	6	100100805406W400	663	16	.	.	.	.	33	.
66	7	9	54	6	100070905406W400	641	.	.	.	.	.	27	.
67	10	10	54	6	100101005406W400	647	.	37	.	.	.	30	.
68	7	15	54	6	100071505406W400	652	.	18	.	.	.	30	.
69	10	21	54	6	100102105406W400	660	.	29	.	.	.	26	.
70	7	24	54	6	100072405406W400	657	.	16	.	.	.	.	.
71	11	25	54	6	100112505406W400	633	.	31	.	.	.	29	.
72	6	26	54	6	100062605406W400	654	10	.	45	.	.	.	.
73	10	27	54	6	100102705406W400	644	.	47	.	.	.	28	.
74	6	29	54	6	100062905406W400	652	.	.	35	.	.	.	.
75	16	31	54	6	100163105406W400	649	36	.	.	.	.	.	.
76	11	33	54	6	100113305406W400	642	.	43	.	.	.	.	.
77	3	34	54	6	100033405406W400	657	.	52	.	.	.	.	.
78	15	35	54	6	100153505406W400	637	48	.	.	.	.	.	.
79	13	36	54	6	100133605406W400	656	13	.	.	.	.	.	.
80	11	26	54	7	102112605407W400	648	57	.	.	.	.	.	.
81	10	4	54	8	100100405408W400	640	.	34	.	.	.	.	.
82	2	6	54	8	100020605408W400	630	.	20	.	.	.	.	.
83	4	10	54	8	100041005408W400	662	.	20	.	.	33	.	.
84	6	11	54	8	100061105408W400	653	.	.	.	.	34	.	.
85	6	12	54	8	100061205408W400	669	.	30	.	.	38	.	.
86	1	18	54	8	100011805408W400	608	.	.	.	.	.	.	.
87	10	20	54	8	100102005408W400	607	.	.	.	.	34	.	.
88	13	21	54	8	100132105408W400	606	24	.	.	.	31	.	.
89	11	22	54	8	100112205408W400	617	.	.	.	.	31	.	.
90	6	24	54	8	100062405408W400	614	.	.	.	.	.	.	.
91	6	26	54	8	100062605408W400	598	.	.	.	.	32	.	.
92	11	29	54	8	100112905408W400	596	.	30	.	.	28	.	.
93	14	30	54	8	100143005408W400	583	.	15	.	.	33	.	.
94	6	31	54	8	100063105408W400	579	.	.	.	.	37	.	.
95	11	32	54	8	100113205408W400	588	.	20	.	.	35	.	.
96	9	34	54	8	100093405408W400	596	.	27	.	.	.	.	.
97	11	36	54	8	100113605408W400	617	.	35	.	.	.	.	.
98	7	4	55	1	100070405501W400	604	.	29	.	.	.	.	.
99	7	22	55	1	100072205501W400	617	.	37	.	.	.	.	.
100	10	26	55	1	100102605501W400	663	.	.	28	.	.	.	.
101	7	35	55	1	100073505501W400	659	.	.	21	.	.	.	.
102	13	36	55	1	100133605501W400	655	56	.	.	.	.	.	.
103	14	6	55	2	100140605502W400	595	.	.	.	.	.	23	.
104	16	8	55	2	100160805502W400	606	.	18	.	.	.	.	.
105	10	16	55	2	100101605502W400	613	10	.	.	.	.	.	.
106	8	17	55	2	100081705502W400	597	.	33	.	.	.	.	.
107	6	29	55	2	100062905502W400	613	.	39	.	.	.	23	.
108	16	12	55	3	100161205503W400	619	.	.	.	.	.	.	.
109	6	21	55	3	100062105503W400	596	.	.	.	.	.	.	.
110	13	22	55	3	100132205503W400	613	.	.	.	.	.	.	.
111	16	28	55	3	100162805503W400	585	.	16	.	.	.	.	.
112	13	34	55	3	100133405503W400	576	.	16	.	.	.	40	.
113	11	1	55	4	100110105504W400	598	.	.	24	.	.	27	.
114	10	5	55	4	100100505504W400	609	.	19	.	27	.	.	.
115	6	6	55	4	100060605504W400	618	.	21	.	.	.	30	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
116	6	7	55	4	100060705504W400	624	.	11	.	15	.	.	.
117	7	8	55	4	100070805504W400	609	.	.	.	20	.	.	.
118	11	9	55	4	100110905504W400	613	.	.	.	18	.	29	.
119	3	13	55	4	100031305504W400	586	.	.	.	.	.	.	.
120	6	15	55	4	100061505504W400	591	.	.	.	.	.	.	.
121	5	16	55	4	100051605504W400	612	.	.	.	.	.	.	.
122	7	17	55	4	**100071705504W400**	616	.	.	54	.	.	.	.
123	9	17	55	4	**100091705504W400**	616	.	.	27	.	43	.	.
124	11	18	55	4	100111805504W400	614	.	.	.	.	.	32	.
125	11	19	55	4	100111905504W400	611	.	.	.	.	.	.	.
126	7	20	55	4	**100072005504W400**	603	.	.	.	18	.	35	.
127	6	21	55	4	100062105504W400	579	.	.	.	.	.	32	.
128	12	29	55	4	**100122905504W400**	585	.	.	28	.	.	27	.
129	14	30	55	4	**100143005504W400**	590	15	.	.	.	.	35	.
130	6	31	55	4	100063105504W400	593	.	.	18	.	35	.	.
131	7	32	55	4	100073205504W400	568	14	.	.	.	.	30	.
132	11	1	55	5	100110105505W400	614	.	.	.	.	.	.	.
133	14	2	55	5	100140205505W400	586	.	.	.	.	.	.	.
134	11	3	55	5	100110305505W400	629	.	.	.	.	.	.	.
135	11	4	55	5	100110405505W400	633	.	.	.	.	.	39	.
136	10	5	55	5	100100505505W400	636	.	.	.	.	.	44	.
137	7	6	55	5	100070605505W400	628	.	.	.	.	.	.	.
138	11	7	55	5	100110705505W400	645	.	.	.	.	.	30	.
139	9	8	55	5	100090805505W400	638	.	.	.	.	.	35	.
140	13	9	55	5	100130905505W400	640	17	.	.	.	.	.	.
141	7	10	55	5	100071005505W400	630	.	.	.	.	.	35	.
142	4	11	55	5	**100041105505W400**	601	.	.	.	.	.	.	.
143	2	13	55	5	**100021305505W400**	627	11	7	.	.	.	.	.
144	16	13	55	5	**100161305505W400**	613	.	10	.	7	.	.	.
145	8	14	55	5	100081405505W400	631	.	.	.	.	.	.	.
146	13	15	55	5	100131505505W400	591	.	.	.	.	.	.	.
147	6	16	55	5	100061605505W400	645	.	14	.	.	.	.	.
148	7	17	55	5	100071705505W400	645	.	.	.	.	.	.	.
149	6	19	55	5	100061905505W400	650	.	20	.	15	.	.	.
150	10	20	55	5	102102005505W400	653	.	.	.	.	.	.	.
151	13	21	55	5	100132105505W400	606	.	.	.	18	.	.	.
152	7	22	55	5	100072205505W400	628	.	.	.	.	.	.	.
153	11	23	55	5	100112305505W400	633	.	.	.	.	.	.	.
154	10	24	55	5	**100102405505W400**	613	.	.	.	32	.	.	.
155	11	25	55	5	100112505505W402	606	.	.	.	21	.	.	.
156	6	26	55	5	**100062605505W400**	623	.	.	.	.	.	.	.
157	6	27	55	5	**1B0062705505W400**	644	.	.	.	10	.	.	.
158	7	29	55	5	100072905505W400	646	.	.	.	.	.	.	.
159	12	30	55	5	100123005505W400	659		48	.	15	.	.	.
160	12	31	55	5	100123105505W400	680	.	26	.	.	.	.	.
161	6	32	55	5	100063205505W402	654	13	.	.	.	.	.	.
162	7	33	55	5	100073305505W400	614	.	.	.	.	48	.	.
163	14	34	55	5	**100143405505W400**	610	.	.	.	.	.	.	.
164	13	35	55	5	100133505505W400	606	.	.	.	.	.	.	.
165	1	36	55	5	100013605505W400	600	.	.	.	.	.	.	.
166	4	1	55	6	100040105506W400	658	14	.	.	.	.	.	.
167	14	2	55	6	100140205506W400	662	15	.	.	30	.	.	.
168	16	4	55	6	100160405506W400	630	13	.	.	.	.	.	.
169	3	5	55	6	100030505506W400	642	.	24	.	.	.	.	.
170	16	8	55	6	100160805506W400	650	.	.	.	.	.	.	.
171	10	9	55	6	100100905506W400	640	.	.	.	.	.	.	.
172	7	10	55	6	100071005506W400	671	41	.	.	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
173	7	11	55	6	100071105506W400	662	.	.	.	.	.	.	.
174	6	12	55	6	100061205506W400	639	.	.	.	.	.	.	.
175	13	13	55	6	1AA131305506W400	642	.	7	.	.	.	.	.
176	7	14	55	6	100071405506W400	641	17	.	.	.	.	.	.
177	6	15	55	6	100061505506W400	685	.	.	.	.	.	.	.
178	15	16	55	6	100151605506W400	689	.	.	.	.	.	.	.
179	16	20	55	6	100162005506W400	692	.	.	.	.	.	.	.
180	10	21	55	6	100102105506W400	666	.	.	.	.	.	.	.
181	9	22	55	6	100092205506W400	646	.	.	.	.	.	.	.
182	6	23	55	6	100062305506W400	643	.	22	.	.	.	.	.
183	8	24	55	6	100082405506W400	645	.	.	.	15	.	.	.
184	11	25	55	6	100112505506W400	661	.	.	.	.	.	.	.
185	1	26	55	6	100012605506W402	645	18	.	.	.	.	.	.
186	8	27	55	6	100082705506W400	634	.	.	.	18	.	.	.
187	13	28	55	6	100132805506W400	655	.	30	.	.	.	.	.
188	10	29	55	6	100102905506W400	690	.	34	.	.	.	.	.
189	11	31	55	6	100113105506W402	693	.	48	.	.	.	.	.
190	9	32	55	6	100093205506W400	656	.	28	.	.	.	.	.
191	9	33	55	6	100093305506W400	632	.	40	.	.	.	.	.
192	11	34	55	6	100113405506W400	635	60	.	.	.	.	.	.
193	12	35	55	6	100123505506W400	660	.	45	.	.	.	.	.
194	6	36	55	6	100063605506W400	662	.	26	.	.	.	.	.
195	11	15	55	7	100111505507W400	617	.	35	.	.	.	.	.
196	6	26	55	7	100062605507W400	639	.	36	.	.	.	.	.
197	16	27	55	7	100162705507W400	628	.	32	.	.	.	.	.
196	10	30	55	7	100103005507W400	631	.	38	.	.	.	.	.
199	5	31	55	7	100053105507W400	608	.	40	.	.	.	.	.
200	10	1	56	1	100100105601W400	658	15	.	.	.	.	.	.
201	6	6	56	1	100060605601W400	666	.	.	27	.	.	.	.
202	7	10	56	1	100071005601W400	664	.	.	20	.	43	.	.
203	10	11	56	1	1AR101105601W400	661	.	.	24	.	.	.	.
204	6	12	56	1	100061205601W400	655	46	.	.	.	.	40	.
205	14	29	56	1	100142905601W400	658	.	12	.	.	.	25	.
206	7	31	56	1	100073105601W400	642	.	21	.	.	.	.	.
207	11	34	56	1	100113405601W400	678	.	.	.	.	.	.	.
208	6	14	56	2	100061405602W400	676	.	40	.	.	.	.	.
209	15	26	56	2	100152605602W400	635	.	42	.	.	.	27	.
210	13	35	56	2	100133505602W400	641	.	.	25	.	.	.	.
211	7	36	56	2	100073605602W400	640	.	.	.	.	.	.	.
212	10	2	56	3	100100205603W400	598	.	.	.	.	.	.	.
213	14	3	56	3	100140305603W400	582	.	.	.	20	.	.	.
214	14	4	56	3	100140405603W400	606	15	.	.	.	31	.	.
215	16	5	56	3	100160505603W400	607	.	9	.	8	.	.	.
216	11	6	56	3	100110605603W400	600	.	61	.	.	.	.	.
217	8	7	56	3	100080705603W400	598	.	.	25	.	.	.	.
218	14	7	56	3	100140705603W400	609	.	.	.	.	.	.	.
219	8	8	56	3	100080805603W400	606	.	23	.	.	.	22	.
220	16	9	56	3	100160905603W400	607	20	.	.	.	.	20	.
221	3	14	56	3	100031405603W400	586	.	.	20	.	.	35	.
222	11	17	56	3	100111705603W400	614	.	37	.	.	.	39	.
223	7	21	56	3	100072105603W400	621	.	36	.	.	.	.	.
224	2	22	56	3	100022205603W400	617	.	36	.	.	.	.	.
225	6	28	56	3	100062805603W400	613	.	35	.	.	.	.	.
226	4	32	56	3	100043205603W400	611	.	34	.	.	.	.	.
227	10	1	56	4	100100105604W400	610	.	30	.	.	40	.	.
228	11	4	56	4	100110405604W400	584	.	29	.	.	37	.	.
229	2	13	56	4	100021305604W400	617	.	45	.	.	.	21	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
230	11	15	56	4	100111505604W400	583	.	.	.	.	32	.	.
231	2	25	56	4	100022505604W400	615	.	.	40	.	.	33	.
232	6	30	56	4	100063005604W400	577	.	.	.	.	.	23	.
233	6	31	56	4	100063105604W400	622	.	.	.	.	.	.	.
234	8	36	56	4	100083605604W400	615	.	.	.	.	.	30	.
235	12	1	56	5	100120105605W400	600	.	.	.	.	.	.	.
236	5	2	56	5	100050205605W400	603	.	.	.	.	20	.	.
237	10	3	56	5	100100305605W400	606	.	.	.	.	.	.	.
238	1	4	56	5	100010405605W400	608	.	.	.	.	.	.	.
239	6	5	56	5	100060505605W400	618	.	.	25	.	.	.	.
240	10	7	56	5	100100705605W400	616	.	.	.	.	.	.	.
241	11	9	56	5	100110905605W400	599	.	.	.	30	.	.	.
242	4	13	56	5	100041305605W400	526	.	13	.	54	.	.	.
243	7	17	56	5	100071705605W400	597	.	.	.	.	.	.	.
244	2	18	56	5	100021805605W400	596	.	23	.	.	.	.	.
245	6	19	56	5	100061905605W400	586	.	.	.	.	.	.	.
246	7	19	56	5	100071905605W400	584	.	.	.	.	.	.	.
247	12	29	56	5	100122905605W400	558	17	.	.	.	.	.	.
248	11	30	56	5	100113005605W400	597	37	.	.	.	.	.	.
249	4	32	56	5	100043205605W400	604	40	.	.	.	.	.	.
250	9	3	56	6	100090305606W400	674	43	.	.	.	.	.	.
251	9	4	56	6	100090405606W400	641	37	.	.	.	.	.	.
252	11	5	56	6	100110505606W400	630	45	.	.	.	.	.	.
253	8	6	56	6	100080605606W400	642	43	.	.	.	.	.	25
254	8	9	56	6	100080905606W400	652	43	.	.	.	.	.	.
255	8	10	56	6	100081005606W400	678	.	55	.	.	.	.	.
256	13	12	56	6	100131205606W400	678	.	55	.	.	.	.	.
257	6	13	56	6	100061305606W400	643	40	.	.	.	.	.	.
258	4	14	56	6	100041405606W400	681	44	.	.	.	.	.	.
259	10	15	56	6	104101505606W400	660	30	.	.	.	.	.	.
260	9	16	56	6	100091605606W400	652	43	.	.	.	.	.	.
261	11	18	56	6	100111805606W400	603	35	.	.	.	.	.	.
262	3	19	56	6	100031905606W400	561	.	.	.	.	30	.	.
263	3	22	56	6	100032205606W400	647	.	44	.	.	.	.	.
264	1	23	56	6	1A0012305606W400	642	.	36	.	.	.	.	.
265	7	24	56	6	100072405606W400	545	.	25	.	.	.	.	.
266	16	27	56	6	100162705606W400	610	.	.	.	.	.	.	.
267	8	1	56	7	100080105607W400	677	.	44	.	.	.	.	.
268	14	2	56	7	100140205607W400	609	.	30	.	.	41	.	.
269	9	11	56	7	100091105607W400	639	.	38	.	.	.	35	.
270	9	12	56	7	100091205607W400	625	.	.	.	.	55	.	.
271	8	13	56	7	100081305607W400	616	13	.	22	.	.	25	.
272	1	14	56	7	100011405607W400	625	.	99	.	.	.	.	.
273	9	23	56	7	100092305607W400	590	20	.	.	.	40	.	.
274	9	25	56	7	100092505607W400	595	.	21	.	.	39	.	.
275	6	26	56	7	100062605607W400	582	.	32	.	.	26	.	.
276	11	29	56	7	100112905607W400	635	.	33	.	.	.	.	.
277	1	36	56	7	100013605607W400	602	.	.	.	.	.	.	.
278	11	10	56	8	100111005608W400	631	.	.	.	.	.	.	.
279	11	17	56	8	100111705608W400	630	.	.	.	.	29	.	.
280	5	30	56	8	100053005608W400	663	.	35	.	30	.	.	.
281	8	33	56	8	100083305608W400	644	19	.	.	.	29	.	.
282	7	1	57	1	100070105701W400	665	.	15	.	.	.	20	.
283	6	4	57	1	100060405701W400	683	.	60	.	.	.	.	.
284	12	5	57	1	100120505701W400	672	.	10	.	.	.	.	.
285	12	6	57	1	100120605701W400	670	.	16	.	.	.	.	.
286	5	7	57	1	100050705701W400	638	.	14	.	.	.	23	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
287	15	9	57	1	100150905701W400	654	.	.	.	.	.	.	.
288	12	10	57	1	100121005701W400	663	.	23	.	.	.	30	.
289	5	12	57	1	100051205701W400	657	.	35	.	.	.	.	.
290	6	16	57	1	100061605701W400	635	.	28	.	.	.	.	.
291	10	17	57	1	100101705701W400	652	4.5	8	.	.	.	.	.
292	14	18	57	1	100141805701W400	635	.	15	.	.	.	.	.
293	7	22	57	1	100072205701W400	663	.	46	.	.	.	.	.
294	6	23	57	1	100062305701W400	669	.	36	.	.	.	.	.
295	6	31	57	1	100063105701W400	658	.	.	.	.	.	.	.
296	6	32	57	1	100063205701W400	672	.	40	.	.	.	.	.
297	10	1	57	2	100100105702W400	657	.	16	.	.	.	25	.
298	8	11	57	2	100081105702W400	627	17	.	.	.	.	25	.
299	15	12	57	2	100151205702W400	626	.	30	.	.	.	22	.
300	10	13	57	2	100101305702W400	636	.	27	.	.	.	18	.
301	2	19	57	2	100021905702W400	622	.	13	.	.	.	.	.
302	15	23	57	2	100152305702W400	652	20	.	.	.	.	41	.
303	10	25	57	2	100102505702W400	642	.	16	.	.	.	.	.
304	10	5	57	3	100100505703W400	638	14	.	.	.	.	38	.
305	16	6	57	3	100160605703W400	621	.	.	.	.	.	38	.
306	4	10	57	3	100041005703W400	660	.	.	.	.	.	37	.
307	5	16	57	3	100051605703W400	636	.	24	.	.	.	.	.
308	3	17	57	3	100031705703W400	333	.	15	.	.	.	.	.
309	13	18	57	3	100131805703W400	647	48	.	.	.	.	.	.
310	5	32	57	3	100053205703W400	628	46	.	.	.	.	34	.
311	9	1	57	4	100090105704W400	631	13	.	.	.	.	.	.
312	10	3	57	4	100100305704W400	622	13	.	.	.	.	.	.
313	10	12	57	4	100101205704W400	629	.	17	.	.	.	.	.
314	15	20	57	4	100152005704W400	636	.	14	.	.	.	14	.
315	2	25	57	4	100022505704W400	637	.	20	.	.	.	.	.
316	10	29	57	4	100102905704W400	638	.	.	.	.	45	.	.
317	16	6	57	5	100160605705W400	582	.	.	.	.	.	.	.
318	10	7	57	5	100100705705W400	612	.	.	.	.	.	.	.
319	9	9	57	5	100090905705W400	571	.	26	.	.	.	23	.
320	9	12	57	5	100091205705W400	659	.	15	.	.	.	.	.
321	6	14	57	5	100061405705W400	645	.	.	.	.	.	.	.
322	1	18	57	5	102011805705W400	594	.	13	.	.	.	33	.
323	6	24	57	5	100062405705W400	646	.	.	.	.	.	.	.
324	6	26	57	5	100062605705W400	647	.	.	25	.	.	.	.
325	11	28	57	5	100112805705W400	634	.	.	20	.	.	.	.
326	1	29	57	5	100012905705W400	610	.	.	20	.	.	.	.
327	16	30	57	5	100163005705W400	652	.	34	.	.	.	.	.
328	6	32	57	5	100063205705W400	651	.	32	.	.	.	.	.
329	6	34	57	6	100063405706W400	683	.	.	23	.	.	.	.
330	11	21	57	7	100112105707W400	667	.	18	.	.	.	20	.
331	11	22	57	7	100112205707W400	679	.	12	.	.	.	.	.
332	11	23	57	7	100112305707W400	678	.	15	.	.	.	24	.
333	16	34	57	7	100163405707W400	686	13	.	.	.	.	.	27
334	5	36	57	7	100053605707W400	671	.	.	.	.	.	.	.
335	8	9	57	8	100080905708W400	666	25	.	.	.	.	.	.
336	14	10	57	8	100141005708W400	668	.	21	.	.	26	.	.
337	8	15	57	8	100081505708W400	686	.	26	.	.	28	.	.
338	10	16	57	8	100101605708W400	679	.	52	.	.	.	.	.
339	10	19	57	8	100101905708W400	690	58	.	.	.	.	25	.
340	11	3	58	1	100110305801W400	672	.	.	33	.	.	17	.
341	9	4	58	1	100090405801W400	671	11	.	.	.	30	.	.
342	7	10	58	1	100071005801W400	668	.	15	.	.	.	.	.
343	7	11	58	1	100071105801W400	671	12	.	20	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
344	5	21	58	1	100052105801W400	637	.	.	.	.	.	.	.
345	9	29	58	1	100092905801W400	701	.	.	.	.	.	.	.
346	12	4	58	2	100120405802W400	649	.	.	30	.	.	.	.
347	5	10	58	2	100051005802W400	670	.	.	26	.	.	.	.
348	5	13	58	2	100051305802W400	692	.	.	23	.	.	50	.
349	8	17	58	2	100081705802W400	669	14	.	35	.	.	21	.
350	7	23	58	2	100072305802W400	683	.	.	.	.	.	.	.
351	8	26	58	2	100082605802W400	682	.	.	36	.	.	.	.
352	10	28	58	2	100102805802W400	684	.	.	30	.	.	.	.
353	15	30	58	2	100153005802W400	670	.	.	.	.	.	.	.
354	4	8	58	3	100040805803W400	621	.	14	.	.	.	30	.
355	9	10	58	3	100091005803W400	598	.	.	36	.	.	.	.
356	10	21	58	3	100102105803W400	634	15	.	.	.	.	.	.
357	7	26	58	3	**100072605803W400**	662	.	13	.	.	.	30	.
358	8	27	58	3	100082705803W400	662	.	.	.	.	50	.	.
359	6	30	58	3	100063005803W400	644	.	.	.	.	.	.	.
360	7	33	58	3	**100073305803W400**	647	.	10	.	.	.	.	22
361	12	36	58	3	100123605803W400	660	.	38	.	.	.	.	.
362	1	2	58	4	100010205804W400	643	.	30	.	.	.	29	.
363	6	6	58	4	100060605804W400	655	15	.	.	.	.	.	19
364	10	9	58	4	100100905804W400	651	.	30	.	.	.	45	.
365	15	11	58	4	100151105804W400	636	.	30	.	.	.	40	.
366	15	17	58	4	100151705804W400	721	.	.	.	.	.	38	.
367	7	21	58	4	100072105804W400	658	.	15	.	.	.	24	.
368	5	26	58	4	100052605804W400	659	.	.	.	.	.	47	.
369	6	4	58	5	100060405805W400	654	.	35	.	.	.	.	.
370	16	13	58	5	**103161305805W400**	670	.	13	.	.	36	.	.
371	10	36	58	5	**1AA103605805W400**	600	.	.	.	.	.	24	.
372	7	1	58	6	100070105806W400	684	48	.	.	.	.	21	.
373	7	19	58	6	100071905806W400	643	.	30	.	.	.	.	.
374	11	29	58	6	100112905806W400	642	.	.	.	.	.	.	.
375	4	5	58	7	100040505807W400	685	.	.	.	.	.	.	.
376	12	24	58	7	100122405807W400	579	.	.	.	.	.	.	.
377	6	26	58	7	100062605807W400	642	.	.	.	.	.	.	.
378	5	1	58	8	100050105808W400	605	.	20	.	.	.	.	.
379	5	10	58	8	100051005808W400	655	.	20	.	.	.	.	57
380	6	12	58	8	100061205808W400	600	.	21	.	.	.	17	.
381	14	16	58	8	100141605808W400	651	.	18	.	.	.	.	.
382	11	17	58	8	100111705808W400	649	.	27	.	.	.	.	.
383	15	18	58	8	100151805808W400	651	.	30	.	.	.	.	.
384	15	19	58	8	100151905808W400	650	.	34	.	.	.	.	.
385	12	21	58	8	100122105808W400	646	.	20	.	.	.	.	.
386	14	28	58	8	100142805808W400	642	.	24	.	.	.	.	21
387	9	8	59	1	**100090805901W400**	677	.	29	.	.	.	.	.
388	14	16	59	1	100141605901W400	641	.	13	.	.	.	.	.
389	3	19	59	1	**100031905901W400**	623	.	30	.	.	.	.	.
390	11	21	59	1	100112105901W400	612	.	.	.	.	.	.	.
391	8	22	59	1	100082205901W400	623	.	15	.	.	52	.	.
392	16	31	59	1	**100163105901W400**	641	.	.	4	.	.	.	.
393	11	5	59	2	100110505902W400	677	.	24	.	.	.	35	.
394	11	6	59	2	100110605902W400	674	.	.	.	.	.	23	.
395	5	13	59	2	**100051305902W400**	652	20	.	.	.	.	45	.
396	7	15	59	2	100071505902W400	644	13	.	.	.	.	.	.
397	7	16	59	2	100071605902W400	651	43	.	.	.	.	48	.
398	14	17	59	2	100141705902W400	648	.	.	.	.	.	.	.
399	14	18	59	2	100141805902W400	651	21	.	.	.	.	42	.
400	11	19	59	2	100111905902W400	623	.	30	.	.	.	.	42

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
401	8	21	59	2	100082105902W400	642	20	.	.	.	.	.	36
402	15	23	59	2	100152305902W400	630	.	.	.	.	.	50	.
403	10	24	59	2	100102405902W400	623	.		.	.	.	.	.
404	14	25	59	2	100142505902W400	623	.	14	.	.	.	.	.
405	7	27	59	2	100072705902W400	625	.	.	.	.	.	36	.
406	7	28	59	2	100072805902W400	617	.	.	.	.	.	.	.
407	1	35	59	2	100013505902W400	644	.	.	.	.	.	.	.
408	9	36	59	2	100093605902W400	616	.	.	.	.	.	.	.
409	11	4	59	3	100110405903W400	653	14	.	.	.	.	.	.
410	10	6	59	3	100100605903W400	645	.	.	.	.	.	.	.
411	6	8	59	3	100060805903W400	641	15	.	.	.	.	.	28
412	11	21	59	3	100112105903W400	622	.	34	.	.	54	.	.
413	6	34	59	3	100063405903W400	621	.	.	102	.	.	.	.
414	6	9	59	4	100060905904W400	621	.	46	.	.	.	.	.
415	6	12	59	4	1AA061205904W400	660	.	30	.	.	.	.	.
416	10	19	59	4	100101905904W400	621	.	37	.	.	.	.	.
417	11	20	59	4	100112005904W400	611	.	46	.	.	.	.	.
418	7	22	59	4	102072205904W400	634	.	.	.	.	.	.	.
419	7	26	59	4	100072605904W400	623	.	35	.	.	.	.	.
420	10	30	59	4	100103005904W400	611	.	27	.	.	.	.	23
421	10	31	59	4	100103105904W400	588	.	.	.	.	.	.	.
422	10	33	59	4	100103305904W400	614	.	.	.	.	.	.	.
423	6	17	59	5	100061705905W400	641	.	.	.	.	.	25	.
424	2	1	59	6	100020105906W400	671	12	.	.	.	.	25	.
425	14	4	59	6	100140405906W400	616	24	.	.	.	.	.	.
426	13	5	59	6	100130505906W400	598	28	.	.	.	37	.	.
427	11	7	59	6	100110705906W400	576	.	.	.	.	.	.	.
428	11	8	59	6	100110805906W400	577	.	.	.	.	.	.	.
429	10	9	59	6	100100905906W400	581	25	.	.	.	.	.	.
430	11	12	59	6	100111205906W400	578	.	.	.	.	.	.	.
431	13	13	59	6	100131305906W400	579	.	.	.	.	.	30	.
432	14	14	59	6	100141405906W400	575	.	15	.	.	.	.	.
433	4	16	59	6	100041605906W400	580	.	.	4.5	.	.	.	.
434	15	17	59	6	100151705906W400	578	42	.	.	.	.	34	.
435	8	18	59	6	100081805906W400	580	25	.	.	.	.	23	.
436	11	19	59	6	100111905906W400	585	.	.	.	.	.	30	.
437	2	22	59	6	100022205906W400	584	.	.	.	.	.	26	.
438	6	27	59	6	100062705906W400	572	.	.	.	.	.	27	.
439	7	30	59	6	100073005906W400	605	13	.	.	.	30	.	.
440	6	1	59	7	100060105907W400	639	.	27	.	.	.	52	.
441	5	6	59	7	100050605907W400	640	.	.	.	.	19	.	.
442	3	13	59	7	100031305907W400	604	.	18	.	.	30	.	.
443	12	14	59	7	100121405907W400	634	25	.	.	.	38	.	.
444	5	17	59	7	100051705907W400	640	30	.	.	.	.	.	.
445	5	21	59	7	100052105907W400	641	.	37	.	.	30	.	.
446	12	25	59	7	100122505907W400	621	.	30	.	.	.	30	.
447	9	27	59	7	100092705907W400	622	14	.	.	20	.	31	.
448	10	31	59	7	100103105907W400	636	.	19	.	.	30	.	.
449	8	35	59	7	100083505907W400	609	16	.	25	.	31	.	.
450	11	10	59	8	100111005908W400	616	.	43	.	.	25	.	.
451	16	17	59	8	100161705908W400	628	.	.	.	.	.	.	.
452	9	30	59	8	100093005908W400	623	15	.	.	.	30	.	.
453	12	34	59	8	100123405908W400	642	.	.	.	.	32	.	.
454	5	9	60	1	100050906001W400	608	14	.	.	.	.	31	.
455	10	11	60	1	100101106001W400	586	.	.	.	.	.	.	.
456	11	29	60	1	100112906001W400	565	14	.	.	.	.	35	.
457	16	3	60	2	100160306002W400	623	.	.	.	.	.	59	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
458	5	8	60	2	100050806002W400	603	.	20	.	40	.	.	19
459	7	9	60	2	100070906002W400	601	.	32	.	.	.	.	.
460	5	10	60	2	100051006002W400	600	.	.	.	.	.	.	.
461	9	15	60	2	100091506002W400	597	.	.	.	.	.	25	.
462	9	22	60	2	100092206002W400	584	.	.	.	.	.	25	.
463	13	23	60	2	100132306002W400	576	.	.	.	.	.	.	22
464	13	26	60	2	100132606002W400	569	.	.	.	.	.	.	30
465	12	30	60	2	100123006002W400	566	.	52	.	.	.	35	.
466	7	32	60	2	100073206002W400	557	.	15	.	.	.	.	.
467	6	33	60	2	100063306002W400	555	.	29	.	.	.	.	.
468	5	34	60	2	100053406002W400	557	.	20	.	.	.	.	.
469	12	35	60	2	100123506002W400	553	.	.	.	.	.	.	26
470	10	22	60	3	100102206003W400	587	.	.	.	.	.	.	.
471	14	27	60	3	1AA142706003W400	569	.	38	.	.	.	21	.
472	6	28	60	3	100062806003W400	565	.	15	.	.	.	15	.
473	2	30	60	3	100023006003W400	622	.	.	.	.	.	.	.
474	10	32	60	3	100103206003W400	593	.	.	.	.	.	20	.
475	6	33	60	3	100063306003W400	568	.	15	.	.	.	20	.
476	6	34	60	3	100063406003W400	559	58	.	.	.	.	20	.
477	10	35	60	3	100103506003W400	573	.	15	.	.	.	30	.
478	6	1	60	4	100060106004W400	616	.	.	.	18	.	.	.
479	10	5	60	4	100100506004W400	602	.	.	.	.	.	.	.
480	9	8	60	4	100090806004W400	596	.	.	.	.	.	.	.
481	10	14	60	4	100101406004W400	618	.	.	.	.	.	.	.
482	8	15	60	4	100081506004W400	606	.	.	.	.	.	.	.
483	12	16	60	4	100121606004W400	596	.	.	35	.	.	.	.
484	4	23	60	4	100042306004W400	622	.	.	.	.	.	.	.
485	14	25	60	4	100142506004W400	590	.	.	.	.	.	.	.
486	7	29	60	4	100072906004W400	582	.	.	40	.	.	20	.
487	6	33	60	4	100063306004W400	566	.	.	.	.	.	.	.
488	13	28	60	5	1A2132806005W400	577	.	11	.	.	.	.	.
489	8	30	60	5	100083006005W400	587	.	.	.	.	.	.	.
490	10	35	60	5	100103506005W400	563	.	.	67	.	.	.	.
491	11	2	60	6	100110206006W400	561	.	20	.	60	.	.	.
492	7	9	60	6	100070906006W400	566	.	.	30	.	.	27	.
493	10	18	60	6	100101806006W400	569	.	.	.	.	24	.	.
494	6	23	60	6	100062306006W400	579	.	25	.	.	30	.	.
495	10	25	60	6	100102506006W400	577	.	.	.	.	.	.	.
496	10	26	60	6	100102606006W400	584	.	.	43	.	.	.	.
497	10	27	60	6	100102706006W400	592	.	15	.	.	.	.	.
498	5	30	60	6	100053006006W400	573	.	.	.	.	.	.	.
499	6	36	60	6	100063606006W400	565	.	.	.	.	27	.	.
500	6	1	60	7	100060106007W400	591	21	.	.	.	.	29	.
501	9	7	60	7	100090706007W400	577	.	20	.	.	36	.	.
502	12	8	60	7	100120806007W400	577	.	31	.	.	35	.	.
503	4	14	60	7	100041406007W400	595	20	.	.	.	23	.	.
504	12	15	60	7	100121506007W400	551	21	.	.	.	30	.	.
505	4	22	60	7	100042206007W400	539	.	34	.	.	30	.	.
506	3	24	60	7	100032406007W400	604	.	.	.	.	.	.	.
507	10	28	60	7	100102806007W400	538	.	32	.	.	30	.	.
508	3	3	60	8	100030306008W400	613	14	.	.	.	40	.	.
509	10	4	60	8	100100406008W400	616	20	.	.	.	.	.	.
510	9	11	60	8	100091106008W400	588	16	.	.	.	.	29	.
511	10	13	60	8	100101306008W400	540	48	.	.	.	32	.	.
512	16	15	60	8	100161506008W400	618	14	.	.	.	.	.	.
513	8	18	60	8	100081806008W400	616	.	36	.	.	.	.	.
514	4	26	60	8	100042606008W400	617	17	.	.	.	.	31	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
515	6	29	60	8	100062906008W400	607	21	.	.	.	36	.	.
516	6	11	61	1	100061106101W400	557	.	.	.	.	.	.	.
517	7	22	61	1	100072206101W400	551	43	.	.	.	.	.	.
518	2	25	61	1	100022506101W400	546	.	.	.	.	.	.	.
519	7	29	61	1	1AA072906101W400	540	31	.	.	.	.	.	.
520	7	33	61	1	100073306101W400	543	.	23	.	.	.	.	.
521	4	35	61	1	100043506101W400	562	.	10	.	.	.	.	.
522	3	4	61	2	100030406102W400	556	.	.	.	.	.	.	27
523	12	27	61	2	100122706102W400	548	.	30	.	.	.	.	.
524	9	28	61	2	100092806102W400	549	.	35	.	.	.	.	.
525	12	31	61	2	100123106102W400	548	.	.	.	.	.	30	.
526	3	5	61	3	100030506103W400	605	.	20	.	.	.	17	.
527	6	11	61	3	100061106103W400	564	.	19	.	.	.	.	.
528	15	17	61	3	100151706103W400	558	.	25	.	.	.	20	.
529	7	22	61	3	100072206103W400	553	.	85	.	.	.	.	.
530	11	28	61	3	100112806103W400	552	.	48	.	.	.	20	.
531	6	1	61	4	100060106104W400	584	.	.	.	.	.	.	.
532	14	19	61	4	1AD141906104W400	558	.	55	.	.	.	.	.
533	13	20	61	4	102132006104W400	562	.	60	.	.	.	.	.
534	12	21	61	4	100122106104W400	565	18	.	.	.	.	24	.
535	7	25	61	4	100072506104W400	551	.	.	.	.	.	.	.
536	7	26	61	4	100072606104W400	556	.	30	.	.	.	.	.
537	7	27	61	4	100072706104W400	563	.	30	.	.	.	25	.
538	12	28	61	4	100122806104W400	556	.	35	.	.	.	.	.
539	2	29	61	4	100022906104W400	563	.	31	.	.	.	.	.
540	8	29	61	4	100082906104W400	558	.	26	.	.	.	.	.
541	1	30	61	4	102013006104W400	559	.	40	.	.	.	.	.
542	10	33	61	4	100103306104W400	563	.	.	.	19	.	24	.
543	6	34	61	4	100063406104W400	558	.	40	.	.	.	22	.
544	6	1	61	5	100060106105W400	558	.	.	.	.	.	.	.
545	7	2	61	5	100070206105W400	559	.	.	.	.	.	.	.
546	3	9	61	5	100030906105W400	559	.	40	.	.	33	.	.
547	13	14	61	5	100131406105W400	555	.	37	.	.	25	.	.
548	3	15	61	5	100031506105W400	555	.	35	.	.	.	21	.
549	10	22	61	5	100102206105W400	552	.	.	.	.	.	22	.
550	3	23	61	5	100032306105W400	552	.	30	.	.	.	15	.
551	5	24	61	5	100052406105W400	557	.	39	.	.	.	21	.
552	6	24	61	5	100062406105W400	557	.	34	.	.	.	23	.
553	8	24	61	5	100082406105W400	551	.	36	.	.	.	.	.
554	6	25	61	5	100062506105W400	551	.	39	.	.	.	.	.
555	3	27	61	5	100032706105W400	553	.	80	.	.	.	.	.
556	11	27	61	5	100112706105W400	553	.	76	.	.	.	.	.
557	7	29	61	5	100072906105W400	561	.	.	.	.	.	21	.
558	12	34	61	5	100123406105W400	558	.	75	.	.	.	.	.
559	9	8	61	6	100090806106W400	570	.	79	.	.	.	.	.
560	6	11	61	6	100061106106W400	551	.	.	.	.	.	.	.
561	10	23	61	6	100102306106W400	556	.	.	.	.	.	20	.
562	10	31	61	6	100103106106W400	551	.	.	.	.	.	.	.
563	11	36	61	6	100113606106W400	561	.	.	.	.	.	.	.
564	7	6	61	7	100070606107W400	555	.	35	.	.	15	.	.
565	10	7	61	7	100100706107W400	573	.	35	.	.	.	.	.
566	10	16	61	7	100101606107W400	561	.	15	.	.	.	.	.
567	9	21	61	7	100092106107W400	557	.	.	.	.	.	.	.
568	12	28	61	7	100122806107W400	566	.	25	.	.	32	.	.
569	6	6	61	8	100060606108W400	605	.	25	.	.	27	.	.
570	10	10	61	8	100101006108W400	584	.	.	25	.	42	.	.
571	10	17	61	8	100101706108W400	581	.	35	.	.	.	25	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
572	6	22	61	8	100062206108W400	582	.	41	.	.	32	.	.
573	11	35	61	8	100113506108W400	567	.	35	.	.	27	.	.
574	10	5	62	2	100100506202W400	543	.	20	.	.	.	20	.
575	10	8	62	2	100100806202W400	540	.	25	.	.	.	27	.
576	14	12	62	2	100141206202W400	534	.	64	.	.	.	21	.
577	7	21	62	2	100072106202W400	540	.	.	.	.	.	.	.
578	15	12	62	3	100151206203W400	540	.	.	.	.	.	.	.
579	11	31	62	3	100113106203W400	552		23	.	.	.	25	.
580	14	32	62	3	100143206203W400	552	.	.	.	.	.	25	.
581	11	34	62	3	100113406203W400	540	.	47	.	.	.	27	.
582	9	35	62	3	100093506203W400	544	.	.	.	.	30	.	.
583	10	13	62	4	100101306204W400	543	.	21	.	.	.	17	.
584	10	14	62	4	100101406204W400	556	.	18	.	.	.	25	.
585	6	20	62	4	100062006204W400	554	.	25	.	.	36	.	.
586	6	22	62	4	100062206204W400	556	.	34	.	.	.	25	.
587	11	24	62	4	100112406204W400	556	.	29	.	.	.	24	.
588	7	32	62	4	100073206204W400	558	.	.	.	.	.	.	.
589	16	35	62	4	100163506204W400	550	.	31	.	.	.	22	.
590	10	36	62	4	100103606204W400	551	.	38	.	.	.	27	.
591	11	2	62	5	100110206205W400	558	.	78	.	.	.	.	.
592	10	14	62	5	100101406205W400	555	.	26	.	.	28	.	.
593	10	16	62	5	100101606205W400	555	.	77	.	.	.	.	.
594	7	22	62	5	1AA072206205W400	555	.	48	.	.	.	.	.
595	11	17	62	6	100111706206W400	560	.	24	.	.	.	.	.
596	11	21	62	6	100112106206W400	549	.	31	.	.	.	25	.
597	5	22	62	6	100052206206W400	554	.	20	.	.	30	.	.
598	7	14	62	7	100071406207W400	564	.	14	.	.	27	.	.
599	16	15	62	7	100161506207W400	593	.	.	.	.	34	.	.
600	6	23	62	7	100062306207W400	554	.	27	.	.	.	.	.
601	6	26	62	7	100062606207W400	553	.	.	.	.	28	.	.
602	10	36	62	7	100103606207W400	554	.	34	.	.	14	.	.
603	9	13	62	8	100091306208W400	547	15	.	20	.	32	.	.
604	12	17	62	8	100121706208W400	588	.	16	.	.	.	.	.
605	2	22	62	8	100022206208W400	552	12	.	.	44	.	.	.
606	12	29	62	8	100122906208W400	594	27	.	.	.	.	.	.
607	11	31	62	8	100113106208W400	582	.	.	.	.	33	.	.
608	9	5	63	1	100090506301W400	547	.	.	25	.	35	.	.
609	4	11	63	1	100041106301W400	542	.	.	.	.	.	.	.
610	5	19	63	2	100051906302W400	545	.	.	.	.	.	.	.
611	3	21	63	2	100032106302W400	550	.	.	.	.	25	.	.
612	12	31	63	2	100123106302W400	547	.	.	.	.	.	.	.
613	11	4	63	3	100110406303W400	546	.	32	.	33	.	.	.
614	3	6	63	3	100030606303W400	548	.	.	.	.	25	.	.
615	6	7	63	3	100060706303W400	551	.	25	.	.	.	21	.
616	15	18	63	3	100151806303W400	559	.	26	.	.	29	.	.
617	7	20	63	3	100072006303W400	551	.	.	.	.	33	.	.
618	6	23	63	3	100062306303W400	545	.	36	.	.	.	18	.
619	11	25	63	3	100112506303W400	552	.	.	.	.	.	.	11
620	3	26	63	3	100032606303W400	549	.	24	.	.	34	.	.
621	10	28	63	3	100102806303W400	554	.	.	.	.	.	.	.
622	2	30	63	3	100023006303W400	549	.	.	.	.	.	.	.
623	7	35	63	3	1AA073506303W400	551	.	28	.	.	.	25	.
624	7	6	63	4	100070606304W400	548	.	.	25	.	.	15	.
625	10	3	63	5	100100306305W400	559	.	.	.	.	.	.	.
626	11	6	63	5	100110606305W400	544	.	23	.	.	.	.	.
627	7	16	63	5	100071606305W400	550	.	.	.	.	.	.	.
628	11	18	63	5	100111806305W400	557	.	.	.	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
629	9	25	63	5	102092506305W400	589	.	.	.	.	.	.	.
630	1	29	63	5	100012906305W400	552	.	.	45	.	.	.	.
631	10	30	63	5	100103006305W400	558	.	42	.	.	.	.	.
632	7	32	63	5	1AA073206305W400	562	.	44	.	.	.	.	.
633	7	13	63	6	1AA071306306W400	559	.	33	.	.	.	.	.
634	10	19	63	6	100101906306W400	559	.	10	.	.		30	.
635	11	20	63	6	100112006306W400	560	.	20	.	33	.	.	.
636	8	21	63	6	100082106306W400	561	.	25	.	.	.	.	.
637	16	22	63	6	100162206306W400	563	.	73	.	.	.	.	.
638	9	23	63	6	100092306306W400	574	.	36	.	.	.	.	.
639	3	24	63	6	100032406306W400	569	.	37	.	.	.	.	.
640	10	29	63	6	100102906306W400	571	.	16	.	.	.	.	.
641	6	31	63	6	100063106306W400	582	.	87	.	.	.	.	.
642	6	32	63	6	100063206306W400	578	.	18	.	.	.	17	.
643	6	33	63	6	100063306306W400	579	.	50	.	.	.	.	.
644	7	34	63	6	100073406306W400	582	.	22	.	.	.	.	.
645	10	3	63	7	100100306307W400	561	.	26	.	.	.	.	.
646	7	7	63	7	100070706307W400	560	.	.	.	.	33	.	.
647	10	9	63	7	100100906307W400	546	.	.	.	.	.	.	.
648	11	12	63	7	100111206307W400	561	.	.	.	.	.	.	.
649	10	13	63	7	100101306307W400	564	.	.	.	.	17	.	.
650	6	15	63	7	100061506307W400	561	.	.	.	.	.	.	.
651	10	19	63	7	100101906307W400	572	.	.	.	.	.	.	.
652	10	25	63	7	100102506307W400	570	.	20	.	.	.	20	.
653	10	26	63	7	1AA102606307W400	566	.	.	.	.	.	34	.
654	14	36	63	7	100143606307W400	579	.	16	.	.	.		.
655	12	1	63	8	1AA120106308W400	568	.	11	.	.	31	.	.
656	6	2	63	8	100060206308W400	562	.	.	.	.	.	.	.
657	3	4	63	8	1AA030406308W400	569	18	.	.	.	.	.	.
658	4	4	63	8	1AC040406308W400	567	23	.	.	.	.	.	.
659	5	4	63	8	1AA050406308W400	567	24	.	.	.	.	.	.
660	6	4	63	8	1AB060406308W400	569	19	.	.	.	.	.	.
661	14	11	63	8	100141106308W400	567	.	17	.	.	35	.	.
662	1	13	63	8	100011306308W400	573	.	.	.	45	.	.	.
663	2	13	63	8	1AG021306308W400	579	.	.	.	.	.	.	.
664	6	13	63	8	100061306308W400	577	.	.	.	43	.	.	.
665	8	24	63	8	100082406308W400	578	.	.	.	32	.	.	.
666	10	26	63	8	100102606308W400	581	.	77	.	.	.	.	.
667	4	27	63	8	100042706308W400	580	.	21	.	.	.	.	.
668	6	31	63	8	100063106308W400	584	.	26	.	.	.	24	.
669	5	13	63	9	100051306309W400	598	.	.	.	27	.	.	.
670	6	10	64	3	100061006403W400	548	.	18	.	.	.	20	.
671	2	15	64	3	1AA021506403W400	554	.	42	.	.	.	.	.
672	1	16	64	3	1AA011606403W400	564	.	16	.	.	.	.	.
673	5	16	64	3	1AA051606403W400	556	.	47	.	.	.	.	.
674	1	19	64	3	100011906403W400	594	.	20	.	.	.	.	.
675	10	26	64	3	1AA102606403W400	605	.	.	.	.	.	.	.
676	3	27	64	3	1AC032706403W400	600	.	22	.	.	.	.	.
677	14	35	64	3	1AA143506403W400	643	.	18	.	.	.	28	.
678	12	15	64	4	100121506404W400	587	.	.	.	.	32	.	.
679	10	19	64	4	100101906404W400	597	.	.	.	.	.	.	.
680	2	20	64	4	100022006404W400	558	.	.	.	.	.	.	.
681	6	21	64	4	100062106404W400	575	15	.	.	.	36	.	.
682	10	21	64	4	100102106404W400	580	7	5	.	.	.	.	.
683	13	21	64	4	100132106404W400	579	5	3	.	.	.	.	.
684	6	24	64	4	100062406404W400	582	18	.	.	.	.	.	.
685	6	28	64	4	1AA062806404W400	611	.	18	.	.	21	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
686	7	29	64	4	100072906404W400	615	.	.	.	.	.	26	.
687	10	29	64	4	1AA102906404W400	621	.	.	.	.	.	.	.
688	11	30	64	4	100113006404W400	617	.	17	.	.	38	.	.
689	15	31	64	4	100153106404W400	627	44	.	.	.	.	.	.
690	7	32	64	4	100073206404W400	624	33	.	.	.	.	.	.
691	10	32	64	4	100103206404W400	623	95	.	.	.	.	.	.
692	13	32	64	4	100133206404W400	628	79	.	.	.	.	.	.
693	11	6	64	5	100110606405W400	571	.	13	.	30	.	.	.
694	6	7	64	5	1AA060706405W400	564	12	.	.	.	.	.	.
695	8	9	64	5	1AA080906405W400	564	12	.	.	.	.	.	.
696	10	17	64	5	100101706405W400	593	.	17	.	27	.	.	.
697	3	24	64	5	100032406405W400	570	.	12	.	37	.	.	.
698	5	32	64	5	1AA053206405W400	639	.	16	.	15	.	.	.
699	10	34	64	5	100103406405W400	641	.	18	.	.	.	.	.
700	14	5	64	6	100140506406W400	596	23	.	.	.	.	.	.
701	11	6	64	6	100110606406W400	589	.	5	.	.	24	.	.
702	12	6	64	6	100120606406W400	590	.	28	.	.	.	.	.
703	16	6	64	6	1AA160606406W400	593	.	20	.	.	.	.	.
704	3	7	64	6	100030706406W400	584	.	27	.	.	.	.	.
705	11	9	64	6	100110906406W400	588	.	35	.	15	.	.	.
706	6	11	64	6	100061106406W400	580	.	26	.	.	24	.	.
707	11	14	64	6	100111406406W400	589	.	10	.	.	.	28	.
708	14	16	64	6	1AA141606406W400	584	.	19	.	50	.	.	.
709	6	18	64	6	100061806406W400	594	.	32	.	.	.	7	.
710	2	21	64	6	1AA022106406W400	590	.	24	.	.	.	.	.
711	12	21	64	6	1AA122106406W400	602	.	31	.	.	.	.	.
712	3	22	64	6	1AA032206406W400	591	.	41	.	.	38	.	.
713	6	23	64	6	100062306406W400	604	.	16	.	.	.	.	.
714	3	27	64	6	1AA032706406W400	607	.	33	.	.	.	.	.
715	9	27	64	6	1AA092706406W400	613	.	35	.	.	.	.	.
716	9	28	64	6	1AA092806406W400	604	.	38	.	.	.	.	.
717	7	30	64	6	100073006406W400	604	.	.	.	.	.	.	.
718	11	36	64	6	100113606406W400	648	.	.	75	.	.	.	.
719	16	1	64	7	100160106407W400	583	.	.	.	.	.	.	.
720	7	3	64	7	100070306407W400	575	.	27	.	50	.	.	.
721	4	7	64	7	1AA040706407W400	578	.	17	.	47	.	.	.
722	11	11	64	7	100111106407W400	579	40	.	.	.	.	12	.
723	8	12	64	7	100081206407W400	582	.	22	.	.	.	.	.
724	10	13	64	7	100101306407W400	592	20	.	.	.	.	.	.
725	6	15	64	7	100061506407W400	591	.	.	.	.	.	.	.
726	11	16	64	7	1AA111606407W400	587	.	17	.	.	.	.	.
727	10	28	64	7	100102806407W400	609	.	14	.	.	.	.	.
728	6	30	64	7	100063006407W400	589	.	20	.	.	.	23	.
729	15	4	64	8	100150406408W400	596	.	16	.	.	.	27	.
730	13	7	64	8	100130706408W400	589	.	26	.	.	.	17	.
731	10	22	64	8	100102206408W400	600	.	23	.	.	.	26	.
732	10	30	64	8	100103006408W400	596	.	21	.	.	.	24	.
733	6	36	64	8	1AA063606408W400	594	20	.	.	.	30	.	.
734	6	29	64	9	100062906409W400	655	.	.	.	.	35	.	.
735	8	14	65	2	100081406502W400	593	.	.	.	.	.	.	.
736	7	22	65	2	100072206502W400	601	.	15	.	.	.	.	.
737	15	23	65	2	100152306502W400	580	.	.	.	.	.	.	.
738	2	3	65	3	102020306503W400	656	.	.	.	.	.	.	.
739	7	8	65	3	1AN070806503W400	606	.	.	.	.	.	25	.
740	3	17	65	3	1AA031706503W400	602	.	.	.	.	.	.	.
741	10	18	65	3	1AA101806503W400	601	.	.	.	.	.	.	.
742	6	29	65	3	1AA062906503W400	609	.	.	.	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
743	6	32	65	3	1AA063206503W400	618	.	.	.	.	.	.	.
744	13	1	65	4	110130106504W400	602	.	.	.	.	.	.	.
745	5	3	65	4	100050306504W400	614	.	47	.	.	.	.	.
746	1	9	65	4	100010906504W400	619	.	.	.	.	.	.	.
747	5	10	65	4	100051006504W400	616	.	.	.	48	.	.	.
748	5	11	65	4	100051106504W400	602	18	.	.	42	.	.	.
749	13	12	65	4	103131206504W400	606	25	.	.	55	.	.	.
750	1	16	65	4	100011606504W400	607	.	.	.	.	.	.	.
751	16	16	65	4	100161606504W400	614	.	.	.	.	.	.	.
752	10	21	65	4	100102106504W400	616	.	.	.	.	.	.	.
753	12	22	65	4	100122206504W400	615	.	.	.	.	.	.	.
754	3	23	65	4	1AA032306504W400	610	.	.	.	.	.	.	.
755	2	24	65	4	105022406504W400	611	.	.	.	.	.	.	.
756	12	24	65	4	100122406504W400	613	95	.	.	.	.	.	.
757	9	25	65	4	100092506504W400	628	24	.	.	62	.	.	.
758	14	28	65	4	1AA142806504W400	611	.	.	.	.	.	.	.
759	10	29	65	4	1AA102906504W400	620	.	15	.	.	.	.	.
760	1	32	65	4	1AA013206504W400	618	.	.	60	.	.	.	.
761	14	34	65	4	1AA143406504W400	622	.	11	.	.	.	.	.
762	7	5	65	5	1AA070506505W400	642	.	18	.	.	.	.	.
763	3	6	65	5	100030606505W400	645	.	56	.	.	.	.	.
764	2	7	65	5	100020706505W400	645	.	.	25	.	.	.	.
765	7	8	65	5	1AA070806505W400	642	.	.	32	.	.	.	.
766	7	9	65	5	1AA070906505W400	646	.	20	.	.	.	.	.
767	11	14	65	5	100111406505W400	643	.	90	.	.	.	.	.
768	6	15	65	5	1AA061506505W400	660	.	10	.	.	.	.	.
769	9	17	65	5	1AA091706505W400	641	.	.	.	42	.	.	.
770	14	18	65	5	100141806505W400	651	.	40	.	.	.	.	.
771	11	21	65	5	1AA112106505W400	648	.	.	.	25	.	.	.
772	14	29	65	5	1AA142906505W400	645	.	19	.	38	.	.	.
773	7	30	65	5	100073006505W400	656	.	20	.	.	.	.	.
774	7	31	65	5	100073106505W400	650	.	.	.	.	.	.	.
775	10	33	65	5	100103306505W400	640	.	34	.	.	.	.	.
776	11	1	65	6	1AA110106506W400	654	.	15	.	.	.	26	.
777	2	2	65	6	100020206506W400	648	.	.	19	.	.	.	.
778	2	3	65	6	100020306506W400	644	.	.	.	.	.	.	.
779	11	10	65	6	100111006506W400	647	.	20	.	.	.	.	.
780	11	11	65	6	100111106506W400	647	.	.	.	.	.	.	.
781	5	12	65	6	100051206506W400	645	.	.	.	.	.	.	.
782	11	13	65	6	100111306506W400	646	.	.	.	.	.	.	.
783	7	24	65	6	100072406506W400	642	.	.	.	.	.	.	.
784	10	25	65	6	100102506506W400	637	.	20	.	.	.	.	.
785	6	27	65	6	100062706506W400	634	.	15	.	.	.	.	.
786	11	30	65	7	100113006507W400	694	.	.	.	.	.	.	.
787	10	30	65	8	100103006508W400	644	.	.	.	.	.	.	.
788	12	6	65	9	100120606509W402	638	70	.	.	.	.	.	.
789	11	9	65	9	100110906509W400	607	30	.	.	.	.	.	.
790	10	13	65	9	100101306509W400	618	17	.	.	.	.	.	.
791	9	16	65	9	100091606509W400	602	.	.	.	.	.	.	.
792	12	5	66	1	100120506601W400	602	.	68	.	.	.	.	.
793	7	17	66	1	100071706601W400	610	.	70	.	.	.	.	.
794	11	4	66	2	100110406602W400	610	.	13	.	.	.	23	.
795	7	17	66	2	1AA071706602W400	613	52	.	.	.	.	.	.
796	8	19	66	2	100081906602W400	621	.	.	39	.	.	.	.
797	6	22	66	2	100062206602W400	620	75	.	.	.	.	.	.
798	7	26	66	2	100072606602W400	617	.	.	.	.	.	.	.
799	13	34	66	2	100133406602W400	617	20	.	.	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
800	5	36	66	2	100053606602W400	617	.	15	.	.	.	29	.
801	11	12	66	3	1AA111206603W400	611	.	22	.	28	.	.	.
802	6	24	66	3	100062406603W400	616	.	.	.	.	.	.	.
803	13	3	66	4	1AA130306604W400	611	.	.	.	.	.	.	.
804	15	5	66	4	1AA150506604W400	625	.	.	51	.	.	.	.
805	3	9	66	4	1AA030906604W400	625	.	83	.	.	.	.	.
806	5	14	66	4	1AA051406604W400	633	.	35	.	.	.	.	.
807	11	18	66	4	1AA111806604W400	643	.	20	.	.	.	.	.
808	7	30	66	4	100073006604W400	656	.	40	.	.	.	.	.
809	16	4	66	5	100160406605W400	640	.	30	.	.	.	.	.
810	10	5	66	5	1AA100506605W400	644	.	19	.	.	.	.	.
811	6	6	66	5	100060606605W400	642	.	.	.	.	.	.	.
812	8	7	66	5	100080706605W400	642	.	32	.	.	.	.	.
813	12	8	66	5	1AT120806605W400	637	.	27	.	.	.	.	.
814	15	10	66	5	102151006605W400	643	.	54	.	.	.	.	.
815	7	14	66	5	1AA071406605W400	640	.	54	.	.	.	.	.
816	10	15	66	5	100101506605W400	641	.	55	.	.	.	.	.
817	1	16	66	5	100011606605W400	644	.	63	.	.	.	.	.
818	13	22	66	5	100132206605W400	645	.	66	.	.	.	.	.
819	10	24	66	5	100102406605W400	650	.	67	.	.	.	.	.
820	7	26	66	5	100072606605W400	652	.	57	.	.	.	.	.
821	7	27	66	5	100072706605W400	651	.	57	.	.	.	.	.
822	6	33	66	5	100063306605W400	646	.	55	.	.	.	.	.
823	6	34	66	5	100063406605W400	649	.	.	49	.	.	.	.
824	10	36	66	5	100103606605W400	665	.	55	.	.	.	.	.
825	7	11	66	6	100071106606W400	635	.	54	.	.	.	.	.
826	2	12	66	6	100021206606W400	633	.	30	.	.	.	.	.
827	6	13	66	6	100061306606W400	641	.	50	.	.	.	.	.
828	11	15	66	6	100111506606W400	633	.	71	.	.	.	.	.
829	6	24	66	7	100062406607W400	631	.	18	.	.	.	.	.
830	5	28	66	7	100052806607W400	636	.	.	.	.	.	.	.
831	6	8	66	8	100060806608W400	659	.	.	.	.	.	.	.
832	9	10	66	8	100091006608W400	600	.	28	.	.	.	.	.
833	8	18	66	8	100081806608W400	650	.	65	.	.	.	.	.
834	10	19	66	8	100101906608W400	641	.	20	.	37	.	.	.
835	4	31	66	8	100043106608W400	625	.	25	.	38	.	.	.
836	12	8	67	1	100120806701W400	613	.	69	.	.	.	.	.
837	7	8	67	2	100070806702W400	648	.	105	.	.	.	.	.
838	9	11	67	2	100091106702W400	623	.	.	.	.	.	.	.
839	3	18	67	2	100031806702W400	675	10	.	.	.	.	.	.
840	10	29	67	2	100102906702W400	711	.	.	.	.	.	.	.
841	6	34	67	2	100063406702W400	690	.	.	.	75	.	.	.
842	11	2	67	3	100110206703W400	663	.	.	.	60	.	.	.
843	11	4	67	3	100110406703W400	658	.	53	.	.	.	.	.
844	11	6	67	3	100110606703W400	676	.	37	.	.	.	.	.
845	10	8	67	3	100100806703W400	678	.	69	.	.	.	.	.
846	11	11	67	3	100111106703W400	687	.	.	.	.	.	.	.
847	10	14	67	3	100101406703W400	701	.	59	.	.	.	.	.
848	7	22	67	3	100072206703W400	681	.	67	.	.	.	.	.
849	6	23	67	3	100062306703W400	700	.	28	.	.	.	.	.
850	11	26	67	3	100112606703W400	692	93	.	.	.	.	.	.
851	10	28	67	3	100102806703W400	683	.	78	.	.	.	.	.
852	6	30	67	3	100063006703W400	674	.	.	26	.	.	.	.
853	7	31	67	3	100073106703W400	680	.	.	32	.	.	.	.
854	7	36	67	3	100073606703W400	704	.	.	70	.	.	.	.
855	10	2	67	4	100100206704W400	697	.	58	.	.	.	.	.
856	10	3	67	4	100100306704W400	699	.	.	45	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
857	7	4	67	4	100070406704W400	694	.	53	.	.	.	.	.
858	10	5	67	4	1AG100505704W400	687	.	55	.	.	.	.	.
859	10	6	67	4	100100606704W400	675	.	47	.	.	.	.	.
860	10	7	67	4	100100706704W400	686	.	54	.	.	.	.	.
861	10	8	67	4	100100806704W400	701	.	55	.	.	.	.	.
862	9	9	67	4	100090906704W400	704	.	57	.	.	.	.	.
863	10	10	67	4	100101006704W400	703	.	20	.	.	.	.	.
864	2	12	67	4	100021206704W400	683	43	.	.	.	.	.	.
865	6	14	67	4	100061406704W400	698	.	.	27	.	.	.	.
866	7	16	67	4	100071606704W400	710	.	.	.	.	.	.	.
867	6	17	67	4	100061706704W400	694	.	.	.	.	.	.	.
868	10	20	67	4	100102006704W400	700	.	20	.	.	.	.	.
869	11	24	67	4	**100112406704W400**	679	37	.	.	.	22	.	.
870	10	26	67	4	100102606704W400	698	23	.	55	.	.	.	.
871	11	28	67	4	100112806704W400	699	.	.	.	.	.	.	.
872	15	30	67	4	100153006704W400	684	.	.	.	.	.	.	.
873	7	33	67	4	100073306704W400	702	.	.	.	62	.	.	.
874	11	2	67	5	100110206705W400	664	24	.	.	.	.	.	.
875	13	3	67	5	100130306705W400	658	.	51	.	.	.	.	.
876	6	4	67	5	100060406705W400	650	32	.	.	38	.	.	.
877	6	6	67	5	100060606705W400	668	.	34	.	.	.	25	.
878	8	7	67	5	100080706705W400	653	.	.	55	.	.	.	.
879	11	12	67	5	100111206705W400	673	.	.	40	.	.	.	.
880	11	14	67	5	100111406705W400	678	.	59	.	.	.	.	.
881	6	16	67	5	100061606705W400	660	.	52	.	.	.	.	.
882	7	18	67	5	100071806705W400	653	.	.	45	.	.	.	.
883	10	22	67	5	100102206705W400	670	.	67	.	.	.	.	.
884	7	25	67	5	100072506705W400	678	19	.	.	28	.	.	.
885	7	30	67	5	100073006705W400	668	.	.	47	.	.	.	.
886	10	33	67	5	100103306705W400	671	.	.	.	45	.	.	.
887	3	1	67	6	**1AA030106706W400**	646	.	18	.	.	.	.	.
888	11	2	67	6	100110206706W400	648	.	20	.	.	.	.	.
889	12	3	67	6	100120306706W400	653	.	.	.	15	.	.	.
890	11	5	67	6	100110506706W400	656	.	.	.	.	.	.	.
891	10	12	67	6	100101206706W400	652	.	.	.	.	.	.	.
892	5	13	67	6	100051306706W400	649	.	46	.	.	.	.	.
893	5	14	67	6	100051406706W400	658	.	60	.	.	.	.	.
894	6	15	67	6	100061506706W400	665	85	.	.	.	.	.	.
895	7	25	67	6	100072506706W400	670	.	14	.	31	.	.	.
896	10	27	67	6	100102706706W400	657	.	21	.	43	.	.	.
897	2	29	67	6	100022906706W400	663	.	.	41	.	.	.	.
898	13	1	67	7	100130106707W400	652	.	16	.	.	.	.	20
899	11	5	67	7	100110506707W400	625	.	.	.	.	.	.	.
900	5	18	67	7	100051806707W400	625	.	.	.	.	.	.	23
901	3	25	67	7	100032506707W400	650	.	.	26	.	30	.	.
902	12	31	67	7	**100123106707W400**	609	.	15	.	.	16	.	.
903	13	34	67	7	100133406707W400	763	.	15	.	.	.	.	20
904	14	1	67	8	**100140106708W400**	601	.	28	.	.	.	.	.
905	6	13	67	8	100061306708W400	651	.	22	.	.	.	.	22
906	12	14	67	8	100121406708W400	622	.	23	.	.	.	.	23
907	7	22	67	8	100072206708W400	619	.	18	.	19	.	.	.
908	3	25	67	8	100032506708W400	610	.	.	.	.	55	.	.
909	10	29	67	8	100102906708W400	644	.	.	35	.	.	.	20
910	8	36	67	8	100083606708W400	613	.	.	.	.	.	.	.
911	11	8	68	1	100110806801W400	670	16	.	.	.	61	.	.
912	10	8	68	2	100100806802W400	748	.	.	.	.	60	.	.
913	9	11	68	2	100091106802W400	686	.	.	.	.	64	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
914	6	21	68	2	100062106802W400	730	.	.	.	.	55	.	.
915	6	26	68	2	100062606802W400	714	.	.	.	.	56	.	.
916	11	29	68	2	100112906802W400	729	.	.	.	.	60	.	.
917	9	5	68	3	100090506803W400	709	21	.	60	.	30	.	.
918	10	6	68	3	100100606803W400	701	.	66	.	.	18	.	.
919	10	8	68	3	100100806803W400	716	.	.	20	.	21	.	.
920	6	13	68	3	100061306803W400	727	.	.	.	.	.	.	.
921	7	16	68	3	100071606803W400	741	.	33	.	.	.	.	.
922	6	26	68	3	100062606803W400	775	.	13	.	.	.	.	.
923	10	28	68	3	100102806803W400	753	.	.	40	.	.	.	.
924	6	31	68	3	100063106803W400	723	.	.	38	.	.	.	.
925	11	2	68	4	100110206804W400	709	.	54	.	.	.	.	.
926	7	6	68	4	100070606804W400	691	.	.	.	.	.	.	.
927	6	9	68	4	100060906804W400	697	.	23	.	.	.	.	.
928	11	12	68	4	100111206804W400	724	.	.	.	.	.	.	.
929	13	16	68	4	100131606804W400	705	19	.	48	.	.	.	.
930	6	18	68	4	100061806804W400	695	.	.	.	.	.	.	.
931	7	22	68	4	100072206804W400	726	.	.	35	.	.	.	.
932	2	24	68	4	100022406804W400	727	.	51	.	.	.	.	.
933	10	26	68	4	100102606804W400	736	13	.	45	.	.	.	.
934	6	29	68	4	100062906804W400	715	.	.	45	.	.	.	.
935	11	30	68	4	100113006804W400	723	.	.	59	.	.	.	.
936	10	32	68	4	100103206804W400	716	.	20	.	36	.	.	.
937	7	8	68	5	100070806805W400	695	.	.	50	.	.	.	.
938	11	16	68	5	100111606805W400	688	.	.	.	.	.	.	.
939	15	26	68	5	100152606805W400	717	.	.	58	.	.	.	.
940	13	27	68	5	100132706805W400	696	14	.	45	.	.	.	.
941	11	36	68	5	100113606805W400	714	.	76	.	.	.	.	.
942	7	1	68	6	100070106806W400	676	.	29	.	.	.	.	.
943	7	5	68	6	100070506806W400	664	18	.	.	.	.	.	.
944	5	13	68	6	100051306806W400	700	.	66	.	.	.	.	.
945	7	15	68	6	100071506806W400	697	.	.	60	.	.	.	.
946	8	17	68	6	100081706806W400	689	.	59	.	.	.	.	.
947	9	20	68	6	100092006806W400	701	.	.	51	.	.	.	.
948	10	29	68	6	100102906806W400	699	.	.	48	.	.	.	.
949	14	5	68	7	100140506807W400	612	.	.	.	.	.	.	.
950	12	18	68	7	100121806807W400	623	.	33	.	.	.	.	.
951	6	26	68	7	100062606807W400	637	.	47	.	.	.	.	.
952	10	28	68	7	100102806807W400	666	60	.	.	.	.	.	.
953	5	29	68	7	100052906807W400	632	.	40	.	.	.	.	.
954	15	5	68	8	100150506808W400	672	28	.	.	.	.	.	.
955	11	14	68	8	100111406808W400	648	.	.	.	.	.	.	.
956	16	21	68	8	100162106808W400	650	18	.	47	.	.	.	.
957	1	26	68	8	100012606808W400	606	.	35	.	.	.	.	.
958	13	30	68	8	100133006808W400	732	.	14	.	.	.	.	.
959	10	27	69	3	100102706903W400	711	14	.	.	50	.	.	.
960	5	4	69	4	100050406904W400	728	.	69	.	.	.	.	.
961	6	6	69	4	100060606904W400	699	.	.	50	.	.	.	.
962	5	15	69	4	100051506904W400	715	.	.	36	.	.	.	.
963	6	17	69	4	100061706904W400	695	.	.	54	.	.	.	.
964	6	19	69	4	100061906904W400	692	.	.	55	.	.	.	.
965	6	32	69	4	100063206904W400	690	.	.	57	.	.	.	.
966	6	2	69	5	100060206905W400	695	.	.	56	.	.	.	.
967	7	4	69	5	100070406905W400	684	.	.	55	.	.	.	.
968	8	9	69	5	100080906905W400	682	.	.	55	.	.	.	.
969	7	12	69	5	100071206905W400	693	.	94	.	.	.	.	.
970	5	14	69	5	100051406905W400	678	.	.	58	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
971	6	20	69	5	100062006905W400	682	.	.	53	.	.	.	.
972	6	22	69	5	100062206905W400	674	.	.	45	.	.	.	.
973	5	24	69	5	100052406905W400	682	.	.	55	.	.	.	.
974	8	26	69	5	100082606905W400	683	.	.	54	.	.	.	.
975	8	27	69	5	100082706905W400	678	.	.	57	.	.	.	.
976	**11**	**32**	**69**	**5**	**100113206905W400**	672	13	.	54	.	.	.	.
977	10	34	69	5	100103406905W400	677	.	.	55	.	.	.	.
978	8	36	69	5	100083606905W400	692	.	.	47	.	.	.	.
979	**5**	**12**	**69**	**6**	**100051206906W400**	720	.	20	.	.	.	.	.
980	6	22	69	6	100062206906W400	714	.	.	50	.	.	.	.
981	8	32	69	6	100083206906W400	689	.	.	53	.	.	.	.
982	6	36	69	6	100063606906W400	696	.	.	43	.	.	.	.
983	12	30	69	7	100123006908W400	661	.	79	.	.	.	.	.
984	8	11	69	8	100081106908W400	619	.	.	65	.	.	.	.
985	12	28	69	8	100122806908W400	667	.	16	.	.	43	.	.
986	12	31	69	8	100123106908W400	687	.	.	58	.	.	.	.
987	7	17	70	3	100071707003W400	690	.	.	.	30	.	.	.
988	**7**	**16**	**70**	**4**	**100071607004W400**	681	.	13	.	.	15	.	.
989	11	30	70	4	100113007004W400	676	.	.	43	.	.	.	.
990	8	33	70	4	100083307004W400	664	.	.	63	.	.	.	.
991	**5**	**9**	**70**	**5**	**100050907005W400**	682	.	.	55	.	.	.	.
992	7	14	70	5	100071407005W400	680	.	.	59	.	.	.	.
993	5	19	70	5	100051907005W400	671	.	.	50	.	.	.	.
994	7	20	70	5	100072007005W400	684	.	.	55	.	.	.	.
995	6	33	70	5	100063307005W400	658	.	.	52	.	.	.	.
996	9	12	70	6	100091207006W400	679	.	.	47	.	.	.	.
997	8	13	70	6	100081307006W400	686	.	.	46	.	.	.	.
998	**5**	**23**	**70**	**6**	**100052307006W400**	661	.	.	24	.	.	.	.
999	10	33	70	6	100103307006W400	642	.	.	50	.	.	.	.
1000	9	35	70	6	100093507006W400	668	.	.	52	.	.	.	.
1001	7	3	70	8	100070307008W400	644	.	.	62	.	.	.	.
1002	12	18	71	4	100121807104W400	674	.	.	55	.	.	.	.
1003	10	14	71	5	100101407105W400	666	.	.	55	.	.	.	.
1004	12	16	71	5	100121607105W400	679	.	.	55	.	.	.	.
1005	6	20	71	5	100062007105W400	682	.	20	.	20	.	.	.
1006	11	23	71	5	100112307105W400	674	.	.	40	.	.	.	.
1007	10	28	71	5	100102807105W400	679	.	72	.	.	.	.	.
1008	9	14	71	6	100091407106W400	676	.	.	52	.	.	.	.
1009	5	15	71	6	100051507106W400	672	.	.	50	.	.	.	.
1010	9	24	71	6	100092407106W400	676	.	.	45	.	.	.	.
1011	11	25	71	6	100112507106W400	693	.	30	.	.	.	.	.
1012	5	28	71	6	100052807106W400	672	.	67	.	.	.	.	.
1013	6	30	71	6	100063007106W400	665	.	22	.	35	.	.	.
1014	11	17	71	7	100111707107W400	664	.	49	.	.	.	.	.
1015	7	20	71	7	100072007107W400	664	.	67	.	.	.	.	.
1016	10	30	71	7	100103007107W400	665	.	.	.	.	.	.	.
1017	**7**	**32**	**71**	**7**	**100073207107W400**	658	11	.	.	.	.	.	.
1018	14	6	71	8	100140607108W400	657	.	.	57	.	.	.	.
1019	10	13	71	8	100101307108W400	667	.	92	.	.	.	.	.
1020	7	17	71	8	100071707108W400	668	.	58	.	.	.	.	.
1021	11	26	71	8	100112607108W400	660	13	.	.	.	.	.	.
1022	7	32	71	8	100073207108W400	653	.	19	.	.	.	.	.
1023	11	35	71	8	100113507108W400	667	.	.	.	.	.	.	.
1024	16	36	72	1	100163607201W400	679	.	49	.	.	.	.	.
1025	6	3	72	4	100060307204W400	680	.	55	.	.	.	.	.
1026	5	5	72	4	100050507204W400	678	.	57	.	.	.	.	.
1027	11	15	72	4	100111507204W400	685	.	.	45	.	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
1028	7	28	72	4	100072807204W400	702	.	60	.	.	.	.	.
1029	6	1	72	5	**100060107205W400**	675	.	75	.	.	.	.	.
1030	12	4	72	5	100120407205W400	682	.	70	.	.	.	.	.
1031	11	6	72	5	100110607205W400	673	.	71	.	.	.	.	.
1032	12	14	72	5	100121407205W400	718	.	75	.	.	.	.	.
1033	8	16	72	5	100081607205W400	702	.	52	.	.	.	.	.
1034	8	18	72	5	100081807205W400	708	.	82	.	.	.	.	.
1035	12	26	72	5	100122607205W400	698	.	66	.	.	.	.	.
1036	12	28	72	5	100122807205W400	720	.	70	.	.	.	.	.
1037	11	2	72	6	100110207206W400	674	.	72	.	.	.	.	.
1038	12	4	72	6	100120407206W400	695	.	63	.	.	.	.	.
1039	9	6	72	6	100090607206W400	678	.	66	.	.	.	.	.
1040	7	14	72	6	**100071407206W400**	707	.	48	.	.	.	.	.
1041	8	16	72	6	100081607206W400	716	.	69	.	.	.	.	.
1042	3	18	72	6	100031807206W400	689	.	55	.	.	.	.	.
1043	12	26	72	6	**100122607206W400**	718	80	.	.	.	.	.	.
1044	12	28	72	6	100122807206W400	718	91	.	.	.	.	.	.
1045	2	29	72	6	100022907206W400	736	14	49	.	.	.	.	.
1046	9	30	72	6	100093007206W400	736	.	65	.	.	.	.	.
1047	10	1	72	7	100100107207W400	667	.	.	.	27	.	.	.
1048	10	3	72	7	100100307207W400	668	.	.	.	25	.	.	.
1049	10	13	72	7	100101307207W400	686	.	.	.	26	.	.	.
1050	10	16	72	7	100101607207W400	704	.	.	.	42	.	.	.
1051	10	17	72	7	100101707207W400	693	.	.	.	40	.	.	.
1052	10	23	72	7	100102307207W400	695	.	15	.	30	.	.	.
1053	10	25	72	7	100102507207W400	722	.	20	.	40	.	.	.
1054	10	26	72	7	100102607207W400	701	.	16	.	.	.	.	.
1055	10	27	72	7	100102707207W400	697	.	57	.	.	.	.	.
1056	10	29	72	7	100102907207W400	699	.	.	60	.	.	.	.
1057	11	30	72	7	100113007207W400	685	.	.	.	31	.	.	.
1058	11	31	72	7	100113107207W400	686	.	.	.	38	.	.	.
1059	10	33	72	7	100103307207W400	690	.	19	.	23	.	.	.
1060	11	34	72	7	100113407207W400	704	.	15	.	44	.	.	.
1061	10	1	72	8	100100107208W400	680	.	.	.	.	20	.	.
1062	10	3	72	8	100100307208W400	688	.	.	.	32	.	.	.
1063	10	5	72	8	100100507208W400	667	.	.	.	.	.	.	.
1064	6	12	72	8	100061207208W400	679	.	.	.	32	.	.	.
1065	10	15	72	8	100101507208W400	687	.	.	.	30	.	.	.
1066	11	26	72	8	100112607208W400	684	.	.	55	.	.	.	.
1067	10	27	72	8	100102707208W400	691	.	.	.	33	.	.	.
1068	8	4	73	4	100080407304W400	708	.	15	.	.	.	.	.
1069	7	6	73	4	100070607304W402	719	.	50	.	.	.	.	.
1070	11	2	73	5	100110207305W400	693	.	64	.	.	.	.	.
1071	11	5	73	5	100110507305W400	708	.	15	.	41	.	.	.
1072	7	12	73	5	100071207305W400	704	.	15	.	.	.	.	.
1073	8	2	73	6	100080207306W400	708	.	25	.	45	.	.	.
1074	6	5	73	6	100060507306W400	716	.	20	.	.	.	.	.
1075	6	7	73	6	100060707306W400	716	.	15	.	28	.	.	.
1076	6	8	73	6	100060807306W400	705	.	20	.	25	.	.	.
1077	11	9	73	6	100110907306W400	689	.	.	.	.	.	.	.
1078	10	11	73	6	100101107306W400	705	.	20	.	48	.	.	.
1079	6	12	73	6	100061207306W400	705	.	.	.	.	.	.	.
1080	6	13	73	6	100061307306W400	698	.	57	.	.	.	.	.
1081	11	14	73	6	100111407306W400	697	.	13	.	45	.	.	.
1082	11	15	73	6	100111507306W400	681	.	71	.	.	.	.	.
1083	11	17	73	6	100111707306W400	681	.	25	.	22	.	.	.
1084	6	18	73	6	100061807306W400	686	.		.	43	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
1085	10	3	73	7	100100307307W400	724	.	.	19	.	.	.	.
1086	10	5	73	7	100100507307W400	686	.	.	.	41	.	.	.
1087	11	7	73	7	100110707307W400	685	.	.	.	42	.	.	.
1088	10	9	73	7	100100907307W400	721	.	15	.	44	.	.	.
1089	10	11	73	7	100101107307W400	729	12	.	.	46	.	.	.
1090	10	13	73	7	100101307307W400	698	.	71	.	.	.	.	.
1091	10	14	73	7	100101407307W400	716	.	74	.	.	.	.	.
1092	6	16	73	7	100061607307W400	733	.	73	.	.	.	.	.
1093	10	17	73	7	100101707307W400	726	.	70	.	.	.	.	.
1094	10	3	73	8	100100307308W400	706	.	.	32	.	.	.	.
1095	10	4	73	8	100100407308W400	696	.	.	.	30	.	.	.
1096	10	5	73	8	100100507308W400	701	.	.	.	.	.	.	.
1097	6	10	73	8	100061007308W400	706	.	.	45	.	.	.	.
1098	10	13	73	8	100101307308W400	697	.	55	.	.	.	.	.
1099	10	14	73	8	100101407308W400	708	.	60	.	.	.	.	.
1100	10	15	73	8	100101507308W400	714	.	.	.	32	.	.	.
1101	10	17	73	8	100101707308W400	694	.	.	42	.	.	.	.

TABLE III
NET SAND THICKNESS; PARALIC-OFFSHORE SUCCESSIONS: UPPER AND MIDDLE MANNVILLE SUB-GROUPS COLD LAKE OIL SANDS AREA

KEY TO ABBREVIATIONS:

K.B.= Kelly Bushing elevation
TOP= top of channel
BOT= base of channel
FM= formation into which base of channel cuts
COL= Colony Fm.
MCL= McLaren Fm.
WAS= Waseca Fm.
SPA= Sparky Fm.
GP= General Petroleums Fm.
REX= Rex Fm.
LLO= Lloydminster Fm.

.= non-applicable or non-available data

Well locations listed in bold type indicate wells with cores through parts of the Upper-Middle Mannville interval (see Appendix 1)
All data listed are thicknesses in metres.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	FEX	LLO
2	7	2	53	2	100070205302W400	596	7	4	7	6	5.5	9.5	12
3	7	14	53	2	100071405302W400	622	5	8	.	.	.	16	11
4	6	15	53	2	100061505302W400	605	8.5	5	13	12	4.5	9	3.5
5	8	22	53	2	100082205302W400	626	6.5	6	11	12	4.5	7	4
6	13	23	53	2	100132305302W400	604	6.5	4.5	8	11	4.5	.	.
7	5	26	53	2	100052605302W400	602	.	.	10	12	6	.	.
8	13	26	53	2	100132605302W400	599	.	.	10	12	6	.	.
9	8	27	53	2	100082705302W400	603	.	.	10	10	6	24	.
10	11	28	53	2	100112805302W400	607	5	.	9	12	6	8	14
11	10	29	53	2	100102905302W400	587	2	7	8	13	6	.	12
12	10	34	53	2	100103405302W400	591	3.5	.	9	11	10	19	8
13	6	4	53	3	1A0060405303W400	588	6	.	9	10	6	16	13
14	10	6	53	3	100100605303W400	597	6.5	.	4	12	7	17	15
15	6	8	53	3	100060805303W400	591	10	.	0	10	5	14	13
16	6	18	53	3	100061805303W400	596	9	4.5	13	12	4.5	9	4
17	7	6	53	4	100070605304W400	616	5	.	.	11	7	11	14
18	11	20	53	4	100112005304W400	608	4	.	8	9	5	.	.
19	4	27	53	4	100042705304W400	600	4.5	.	12	12	6	19	6
20	11	31	53	4	100113105304W400	615	7	.	.	16	9	.	.
21	12	20	53	5	100122005305W400	642	8	.	.	11	3.5	.	.
22	10	29	53	5	100102905305W400	637	3	7	9	13	2	.	.
23	7	30	53	5	100073005305W400	641	5	.	.	.	7	.	.
24	2	32	53	5	100023205305W400	629	8	.	.	9	9	.	.
25	1	34	53	5	100013405305W400	642	6	.	.	.	.	.	.
26	6	36	53	5	100063605305W400	644	8	.	.	11	8	.	.
27	10	3	53	6	100100305306W400	630	10	.	.	.	9	24	6.5
28	6	12	53	6	100061205306W400	649	5	.	.	9	9	16	8
29	6	24	53	6	100062405306W400	635	5	.	.	9	8	14	8
30	6	8	53	8	100060805308W400	680	8	.	.	.	.	.	.
31	12	9	53	8	100120905308W400	687	8	.	.	.	.	.	.
32	6	17	53	8	100061705308W400	687	.	.	.	.	.	.	.
33	11	18	53	8	100111805308W400	694	.	.	.	.	.	.	.
34	16	23	53	8	100162305308W4C0	671	3.5	.	11	.	12	22	13
35	16	24	53	8	100162405308W400	661	4	.	8	.	.	.	.
36	7	25	53	8	100072505308W400	673	3	.	10	11	12	.	.
37	11	26	53	8	100112605308W400	678	8	5	12	12	4	17	7
38	10	27	53	8	100102705308W400	679	2	.	10	11	7	21	5
39	6	30	53	8	100063005308W400	675	.	5	12	12	4	17	7
40	7	36	53	8	100073605308W400	661	3	.	8	10	11	13	8
41	10	27	54	2	100102705402W400	556	6	.	.	8	4.5	7	8
42	1	28	54	4	100012805404W400	604	6	.	10	.	4	18	10
43	9	31	54	4	100093105404W400	613	5	9	8	9	9	27	0
44	7	32	54	4	100073205404W400	615	8	7	6.5	11	5	23	8
45	2	33	54	4	100023305404W400	611	3	.	11	10	4	19	3.5
46	7	34	54	4	100073405404W400	604	3	.	.	15	8.5	20	1
47	11	36	54	4	100113605404W400	601	8	7	6.5	11	5	23	8
48	10	1	54	5	100100105405W400	617	4	.	.	18	11	.	4
49	10	2	54	5	100100205405W400	632	4	.	.	18	11	17	4.5
50	6	6	54	5	100060605405W400	650	13	3	5	16	.	.	.
51	10	10	54	5	100101005405W400	635	.	.	7	10	6	.	.
52	2	11	54	5	100021105405W400	625	3	.	7	12	7	.	.
53	6	15	54	5	100061505405W400	633	.	3	10	11	11	20	0
54	11	16	54	5	100111605405W400	645	0	.	5	5	.	.	.
55	10	18	54	5	100101805405W400	636	8	.	.	.	9.5	25	4
56	10	19	54	5	100101905405W400	631	4	3	4.5	10	6.5	10	17
57	10	20	54	5	100102005405W400	620	.	.	.	10	7	.	.
58	7	21	54	5	100072105405W400	628	8	.	8	7	7	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	W/S	SPA	GP	REX	LLO
59	6	22	54	5	100062205405W400	624	10	6	8	15	10	.	6
60	11	27	54	5	100112705405W400	625	10	7	9	20	12	20	4
61	11	29	54	5	100112905405W400	627	.	.	4	7	9.5	15	2.5
62	10	30	54	5	100103005405W400	637	.	.	12	12	4.5	.	.
63	6	32	54	5	100063205405W400	630	.	.	8	11	4.5	.	.
64	10	1	54	6	100100105406W400	661	.	.	.	7	6	20	5
65	10	8	54	6	100100805406W400	663	.	.	10	10	5	.	.
66	7	9	54	6	100070905406W400	641	3	3	9	10	6	.	.
67	10	10	54	6	100101005406W400	647	3	.	.	11	6	.	.
68	7	15	54	6	100071505406W400	652	3	.	.	11	5.5	.	.
69	10	21	54	6	100102105406W400	660	12	.	.	10	6	.	.
70	7	24	54	6	100072405406W400	657	3	.	16	13	0	8	4.5
71	11	25	54	6	100112505406W400	633	9	.	.	7.5	6	28	0
72	6	26	54	6	100062605406W400	654	.	5	.	.	.	24	0
73	10	27	54	6	100102705406W400	644	6	.	.	.	10	.	0
74	6	29	54	6	100062905406W400	652	6	5	.	.	10	15	0
75	16	31	54	6	100163105406W400	649	.	.	.	9	9	19	4
76	11	33	54	6	100113305406W400	642	8	.		.	5	23	0
77	3	34	54	6	100033405406W400	657	6	.	.	.	.	18	0
78	15	35	54	6	100153505406W400	637	.	.	.	.	8	20	5
79	13	36	54	6	100133605406W400	656	.	3	9	12	7	15	3
80	11	26	54	7	102112605407W400	648	.	.	.	.	9	20	4
81	10	4	54	8	100100405408W400	640	1.5	.	.	.	9	20	4
82	2	6	54	8	100020605408W400	630	1	.	.	12	11	24	0
83	4	10	54	8	100041005408W400	662	1	.	5	11	.	.	.
84	6	11	54	8	100061105408W400	653	7	3	7	6	.	.	.
85	6	12	54	8	100061205408W400	669	6	.	.	7.5	.	.	.
86	1	18	54	8	100011805408W400	608	5	8	4	10	10	24	0
87	10	20	54	8	100102005408W400	607	5	3.5	6	7.5	.	.	6
88	13	21	54	8	100132105408W400	606	.	.	9	16	.	.	5
89	11	22	54	8	100112205408W400	617	7.5	4	10	12	.	.	0
90	6	24	54	8	100062405408W400	614	2	8	11	12	.	.	.
91	6	26	54	8	100062605408W400	598	5	5	3	13	.	.	.
92	11	29	54	8	100112905408W400	596	8	.	.	13	.	.	5
93	14	30	54	8	100143005408W400	583	8	.	2	11	.	.	7
94	6	31	54	8	100063105408W400	579	5	5	3	13	.	.	.
95	11	32	54	8	100113205408W400	588	6	.	.	13	.	.	7
96	9	34	54	8	100093405408W400	596	6	.	.	10	12	13	2
97	11	36	54	8	100113605408W400	617	6	.	.	12	4	25	4.5
98	7	4	55	1	100070405501W400	604	6	.	.	12	5	8	11
99	7	22	55	1	100072205501W400	617	6.5	.	.	13	5	8	11
100	10	26	55	1	100102605501W400	663	15	5	.	.	7	15	8
101	7	35	55	1	100073505501W400	659	8	8	.	9	5	15	7
102	13	36	55	1	100133605501W400	655	.	.	.	.	5	15	10
103	14	6	55	2	100140605502W400	595	8	5	10	12	5	.	7
104	16	8	55	2	100160805502W400	606	6	.	13	9	5	8	8
105	10	16	55	2	100101605502W400	613	.	.	.	9	5	8	8
106	8	17	55	2	100081705502W400	597	4.5	.	.	10	6	17	6
107	6	29	55	2	100062905502W400	613	2	.	.	8	7	.	10
108	16	12	55	3	100161205503W400	619	10	5	11	12	6.5	11	7
109	6	21	55	3	100062105503W400	596	8.5	9	15	17	9	13	7
110	13	22	55	3	100132205503W400	613	3	4	11	12	7	16	7.5
111	16	28	55	3	100162805503W400	585	1	.	.	15	6.5	16	7.5
112	13	34	55	3	100133405503W400	576	3.5	.	12	13	6.5	.	.
113	11	1	55	4	100110105504W400	598	7	4	.	8.5	5	.	2
114	10	5	55	4	100100505504W400	609	3	.	.	.	.	25	8
115	6	6	55	4	100060605504W400	618	2.5	.	.	13	7	.	0

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
116	6	7	55	4	100060705504W400	624	7	.	13	.	6	18	18
117	7	8	55	4	100070805504W400	609	0	6	7	.	3	22	0
118	11	9	55	4	100110905504W400	613	5.5	3	7	.	7	.	3
119	3	13	55	4	100031305504W400	586	3	6	7	10	10	19	3
120	6	15	55	4	100061505504W400	591	4	5	18	8	6	14	2
121	5	16	55	4	100051605504W400	612	5	2	6	12	6	17	3
122	**7**	**17**	**55**	**4**	**100071705504W400**	616	2	4	.	.	.	.	.
123	**9**	**17**	**55**	**4**	**100091705504W400**	616	7	5	.	.	.	.	3.5
124	11	18	55	4	100111805504W400	614	5	5	9	7	5	.	.
125	11	19	55	4	100111905504W400	611	5	2	6	12	6	17	3
126	**7**	**20**	**55**	**4**	**100072005504W400**	603	5	4	10	.	5	.	3
127	6	21	55	4	100062105504W400	579	5	2.5	6	9	10	.	.
128	**12**	**29**	**55**	**4**	**100122905504W400**	585	3	5	.	11	0	.	0
129	**14**	**30**	**55**	**4**	**100143005504W400**	590	.	5	14	13	2.5	.	5
130	6	31	55	4	100063105504W400	593	2.5	7.5	.	7	.	.	8.5
131	7	32	55	4	100073205504W400	568	.	.	10	7	14	.	.
132	11	1	55	5	100110105505W400	614	6	10	10	10	9	19	13
133	14	2	55	5	100140205505W400	586	2	5	7	11	6	16	13
134	11	3	55	5	100110305505W400	629	6	7.5	8	13	8	16	13
135	11	4	55	5	100110405505W400	633	3	3	10	14	6	.	.
136	10	5	55	5	100100505505W400	636	6	3	11	11	4	.	.
137	7	6	55	5	100070605505W400	628	6	3	11	11	4	.	.
138	11	7	55	5	100110705505W400	645	6	3	11	11	4	.	.
139	9	8	55	5	100090805505W400	638	6	3	11	11	4	.	.
140	13	9	55	5	100130905505W400	640	.	4	6	9	13	24	3
141	7	10	55	5	100071005505W400	630	6	3	11	11	4	.	.
142	**4**	**11**	**55**	**5**	**100041105505W400**	601	4.5	7	9	10	8	17	15
143	**2**	**13**	**55**	**5**	**100021305505W400**	627	.	.	11	16	6	20	13
144	**16**	**13**	**55**	**5**	**100161305505W400**	613	4	.	15	.	9	23	8
145	8	14	55	5	100081405505W400	631	3	5	8	15	6	17	5
146	13	15	55	5	100131505505W400	591	4	6.5	7	11	9	24	1
147	6	16	55	5	100061605505W400	645	3	.	8	15	6	17	5
148	7	17	55	5	100071705505W400	645	3	5	8	15	6	17	5
149	6	19	55	5	100061905505W400	650	5	.	.	.	9	17	5
150	10	20	55	5	102102005505W400	653	0	5	1	6	9	24	0
151	13	21	55	5	100132105505W400	606	5	6	6	.	9	28	3
152	7	22	55	5	100072205505W400	628	2.5	5	4.5	6	6	27	0
153	11	23	55	5	100112305505W400	633	3	5	4	6	6	25	0
154	**10**	**24**	**55**	**5**	**100102405505W400**	613	4	4.5	15	.	.	20	15
155	11	25	55	5	100112505505W402	606	2	5	5	.	3	26	7
156	**6**	**26**	**55**	**5**	**100062605505W400**	623	2	7.5	12	13	10	28	4
157	**6**	**27**	**55**	**5**	**1B0062705505W400**	644	4	5	10	.	.	25	2
158	7	29	55	5	100072905505W400	646	6	4	9	14	11	21	3
159	12	30	55	5	100123005505W400	659	6	.	.	.	9	18	7.5
160	12	31	55	5	100123105505W400	680	3	.	.	11	12	28	0
161	6	32	55	5	100063205505W402	654	.	6	8.5	3	8	17	6
162	7	33	55	5	100073305505W400	614	4.5	5	16	14	.	.	.
163	**14**	**34**	**55**	**5**	**100143405505W400**	610	3	4	11	8	7	25	0
164	13	35	55	5	100133505505W400	606	3	7	20	11	8	22	0
165	1	36	55	5	100013605505W400	600	5	7	17	10	3.5	20	3
166	4	1	55	6	100040105506W400	658	.	3	6	6	8	17	8
167	14	2	55	6	100140205506W400	662	.	3	6	.	.	18	11
168	16	4	55	6	100160405506W400	630	.	4	14	12	5	22	2
169	3	5	55	6	100030505506W400	642	5.5	.	.	7	8	19	6
170	16	8	55	6	100160805506W400	650	7	4	12	11	.	.	.
171	10	9	55	6	100100905506W400	640	7	2	6	0	10	19	5
172	7	10	55	6	100071005506W400	671	.	.	.	13	9.5	17	3

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	U.O
173	7	11	55	6	100071105506W400	662	9	3	10	11	8	28	3
174	6	12	55	6	100061205506W400	639	8	5	8	4	5	32	0
175	13	13	55	6	1AA131305506W400	642	4	.	11	9	6.5	31	0
176	7	14	55	6	100071405506W400	641	.	.	4	7	7	30	3
177	6	15	55	6	100061505506W400	685	6	.	2	7	5	29	2
178	15	16	55	6	100151605506W400	689	5	4	10	10	5	28	2
179	16	20	55	6	100162005506W400	692	4	.	.	.	.	27	6
180	10	21	55	6	100102105506W400	666	8	2	8	5	4	25	3
181	9	22	55	6	100092205506W400	646	8	9	7	8	5	27	5
182	6	23	55	6	100062305506W400	643	7	.	4	8	9	27	5
183	8	24	55	6	100082405506W400	645	5	3	7	.	9	32	2
184	11	25	55	6	100112505506W400	661	2	5	5	7	8	28	3
185	1	26	55	6	100012605506W402	645	.	.	6	7	6	37	0
186	8	27	55	6	100082705506W400	634	5	5.5	4	.	4	27	2
187	13	28	55	6	100132805506W400	655	8	.	.	7	4	31	0
188	10	29	55	6	100102905506W400	690	4	.	.	.	0	37	0
189	11	31	55	6	100113105506W402	693	9.5	.	.	.	7	32	0
190	9	32	55	6	100093205506W400	656	7	.	.	5	5	29	0
191	9	33	55	S	100093305506W400	632	8	.	.	.	5.5	28	0
192	11	34	55	6	100113405506W400	635	.	.	.	.	4.5	27	0
193	12	35	55	6	100123505506W400	660	2	.	.	.	3.5	27	3
194	6	36	55	6	100063605506W400	662	6	.	.	7	7	27	5
195	11	15	55	7	100111505507W400	617	5.5	.	.	10	12	15	10
196	6	26	55	7	100062605507W400	639	1.5	.	.	.	9	24	6
197	16	27	55	7	100162705507W400	628	3	.	.	8	10	16	9
198	10	30	55	7	100103005507W400	631	7	.	.	.	12	16	11
199	5	31	55	7	100053105507W400	608	7	.	.	.	12	16	11
200	10	1	56	1	100100105601W400	658	.	4	15	6	7	12	8
201	6	6	56	1	100060605601W400	666	6	5	.	10	7	12	8
202	7	10	56	1	100071005601W400	664	6	5	.	10	.	.	.
203	10	11	56	1	1AR101105601W400	661	7	7	.	12	7.5	12	8
204	6	12	56	1	100061205601W400	655	.	.	.	10	7	.	.
205	14	29	56	1	100142905601W400	658	3	.	19	9	4	.	4
206	7	31	56	1	100073105601W400	642	2	.	17	11	9	9	7
207	11	34	56	1	100113405601W400	678	6	8	5	12	5.5	22	3.5
208	6	14	56	2	100061405602W400	676	0	.	.	12	6	7	14
209	15	26	56	2	100152605602W400	635	4	.	.	12	6	.	11
210	13	35	56	2	100133505602W400	641	8	6	.	13	6	19	5
211	7	36	56	2	100073605602W400	649	7	4	19	10	6	10	4
212	10	2	56	3	100100205603W400	598	6	6	13	13	5	10	7
213	14	3	56	3	100140305603W400	582	6	6	15	.	.	.	.
214	14	4	56	3	100140405603W400	606	.	5	19	11	.	.	8
215	16	5	56	3	100160505603W400	607	5	.	19	.	5	19	4
216	11	6	56	3	100110605603W400	600	5.5	.	.	.	.	12	3.5
217	8	7	56	3	100080705603W400	598	2	5	.	6	6	14	3
218	14	7	56	3	100140705603W400	609	2	5	6	6	6	14	3
219	8	8	56	3	100080805603W400	606	2.5	.	8	11	5	.	3.5
220	16	9	56	3	100160905603W400	607	.	5	10	6	3	.	4
221	3	14	56	3	100031405603W400	586	8	6	.	8	8	.	.
222	11	17	56	3	100111705603W400	614	7	.	10	8	12	.	.
223	7	21	56	3	100072105603W400	621	6	.	10	9	12	.	.
224	2	22	56	3	100022205603W400	617	8	.	.	10	6.5	.	.
225	6	28	56	3	100062805603W400	613	5	.	.	.	8	15	4
226	4	32	56	3	100043205603W400	611	6.5	.	.	10	6.5	23	3
227	10	1	56	4	100100105604W400	610	5.5	.	.	6	.	.	9
228	11	4	56	4	100110405604W400	584	5	.	.	8	.	.	.
229	2	13	56	4	100021305604W400	617	13	.	.	.	8	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
230	11	15	56	4	100111505604W400	583	5	7	8	14	.	.	9
231	2	25	56	4	100022505604W400	615	8	5	.	.	6.5	.	0
232	6	30	56	4	100063005604W400	577	8.5	4.5	5	9	6	.	.
233	6	31	56	4	100063105604W400	622	3	6	11	6	5.5	20	0
234	8	36	56	4	100083605604W400	615	6	4	7	6	6	.	.
235	12	1	56	5	100120105605W400	600	4	4	10	7	7	20	8
236	5	2	56	5	100050205605W400	603	6	5.5	15	9.5	.	18	3
237	10	3	56	5	100100305605W400	606	6	7	14	8.5	6	22	0
238	1	4	56	5	100010405605W400	608	9	5.5	10	6	7	22	1.5
239	6	5	56	5	100060505605W400	618	6	3	.	.	10	20	4
240	10	7	56	5	100100705605W400	616	4	5	4	8.5	0	19	11
241	11	9	56	5	100110905605W400	599	4	3	7	.	.	21	2
242	4	13	56	5	100041305605W400	526	0	.	13	.	.	.	.
243	7	17	56	5	100071705605W400	597	5	3	7	11	4	21	8
244	2	18	56	5	100021805605W400	596	4	.	.	5	7	21	1
245	6	19	56	5	100061905605W400	586	6	3	5	13	8	22	8.5
246	7	19	56	5	100071905605W400	584	12	3	5	13	8	21	8
247	12	29	56	5	100122905605W400	558	.	.	7	12	10	17	11
248	11	30	56	5	100113005605W400	597	.	.	.	11	9	18	14
249	4	32	56	5	100043205605W400	604	.	.	.	12	10	15	.
250	9	3	56	6	100090305606W400	674	.	.	.	9	9	26	6
251	9	4	56	6	100090405606W400	641	.	.	.	12	6	27	1.5
252	11	5	56	6	100110505606W400	630	.	.	.	.	.	.	.
253	8	6	56	6	100080605606W400	642	.	.	.	.	13	13	.
254	8	9	56	6	100080905606W400	652	.	.	.	8	7	22	1
255	8	10	56	6	100081005606W400	678	5	.	.	.	.	23	1
256	13	12	56	6	100131205606W400	678	6	.	.	.	.	22	11
257	6	13	56	6	100061305606W400	643	.	.	.	4	7	17	20
258	4	14	56	6	100041405606W400	681	.	.	.	.	6	19	2
259	10	15	56	6	104101505606W400	660	11	.	.	10	11	20	7
260	9	16	56	6	100091605606W400	652	.	.	.	4	8	17	7
261	11	18	56	6	100111805606W400	603	8	.	.	2	0	21	8
262	3	19	56	6	100031905606W400	561	10	5	15	4	.	.	9
263	3	22	56	6	100032205606W400	647	6	.	.	.	6	20	6
264	1	23	56	6	1A0012305606W400	642	6	.	.	9	6	20	6
265	7	24	56	6	100072405606W400	545	7	.	.	6	7	23	14
266	16	27	56	6	100162705606W400	610	7	.	.	.	.	.	.
267	8	1	56	7	100080105607W400	677	3	.	.	.	10	17	17
268	14	2	56	7	100140205607W400	609	9	.	.	11	.	.	.
269	9	11	56	7	100091105607W400	639	8	.	.	8	4	.	.
270	9	12	56	7	100091205607W400	625	5	6	9	11	.	.	.
271	8	13	56	7	100081305607W400	616	.	6	.	4	12	.	4
272	1	14	56	7	100011405607W400	625	9	.	.	.	.	.	.
273	9	23	56	7	100092305607W400	590	.	0	12	9	.	.	0
274	9	25	56	7	100092505607W400	595	13	.	.	11	.	.	.
275	6	26	56	7	100062605607W400	582	5.5	.	.	13	.	.	10
276	11	29	56	7	100112905607W400	635	7	.	.	14	.	.	8
277	1	36	56	7	100013605607W400	602	5	.	.	.	.	.	.
278	11	10	56	8	100111005608W400	631	8	.	.	.	.	.	.
279	11	17	56	8	100111705608W400	630	6	0	8	9	.	.	19
280	5	30	56	8	100053005608W400	663	9	.	.	.	.	.	10
281	8	33	56	8	100083305608W400	644	.	0	6	3	.	.	.
282	7	1	57	1	100070105701W400	665	6	.	7	10	3	.	5.5
283	6	4	57	1	100060405701W400	683	4	.	.	.	.	4	14
284	12	5	57	1	100120505701W400	672	7	.	12	11	7	8	14
285	12	6	57	1	100120605701W400	670	6	.	12	7	5	.	10
286	5	7	57	1	100050705701W400	638	5.5	.	17	9	6	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
287	15	9	57	1	100150905701W400	654	2	6	12	5	7	7	12
288	12	10	57	1	100121005701W400	663	7	.	11	7	6	.	.
289	5	12	57	1	100051205701W400	657	7	.	.	10	6	15	6
290	6	16	57	1	100061605701W400	635	6	.	.	9	5	10	13
291	10	17	57	1	100101705701W400	652	.	.	16	13	10	10	14
292	14	18	57	1	100141805701W400	635	8	.	12	11	7	8	15
293	7	22	57	1	100072205701W400	663	8	.	.	.	.	.	.
294	6	23	57	1	100062305701W400	669	7.5	.	.	.	5	.	.
295	6	31	57	1	100063105701W400	658	6	3	13	9.5	5	19	17
296	6	32	57	1	100063205701W400	672	10	.	.	8.5	5	12	16
297	10	1	57	2	100100105702W400	657	6	.	13	13	6	.	2
298	8	11	57	2	100081105702W400	627	.	.	10	10	6.5	.	8
299	15	12	57	2	100151205702W400	626	8.5	.	8	8.5	5.5	.	6.5
300	10	13	57	2	100101305702W400	636	9	.	.	8	5	.	14
301	2	19	57	2	100021905702W400	622	4	.	6	12	8	14	9
302	15	23	57	2	100152305702W400	652	.	.	8	7	5	.	.
303	10	25	57	2	100102505702W400	642	2	.	5	6.5	5	17	7
304	10	5	57	3	100100505703W400	638	.	6	8	9	6	.	.
305	16	6	57	3	100160605703W400	621	7.5	5.5	12	6	6	.	.
306	4	10	57	3	100041005703W400	660	8	6	6	9	7	.	.
307	5	16	57	3	100051605703W400	636	0	.	.	.	.	.	.
308	3	17	57	3	100031705703W400	633	5.5	.	.	.	.	.	.
309	13	18	57	3	100131805703W400	647	.	.	.	8	8	25	9.5
310	5	32	57	3	100053205703W400	628	.	.	.	8	6	.	.
311	9	1	57	4	100090105704W400	631	.	4.5	11	10	6	12	14
312	10	3	57	4	100100305704W400	622	.	6.5	7	11	6	24	7
313	10	12	57	4	100101205704W400	629	3	.	5	5	6	24	3
314	15	20	57	4	100152005704W400	636	3	.	4.5	7.5	.	19	4
315	2	25	57	4	100022505704W400	637	5	.	6	5	6.5	18	12
316	10	29	57	4	100102905704W400	638	4.5	7.5	3.5	9	.	.	.
317	16	6	57	5	100160605705W400	582	4	3	9	11	4	.	.
318	10	7	57	5	100100705705W400	612	3	6.5	9	7.5	2	.	.
319	9	9	57	5	100090905705W400	571	2	.	.	7	4	.	9
320	9	12	57	5	100091205705W400	659	.	8	4	8.5	8	11	8
321	6	14	57	5	100061405705W400	645	0	2.5	2.5	7	8.5	17	5
322	1	18	57	5	102011805705W400	594	3	.	6	10	4.5	.	.
323	6	24	57	5	100062405705W400	646	3	2	.	.	.	.	.
324	6	26	57	5	100062605705W400	647	5	8	.	.	.	.	.
325	11	28	57	5	100112805705W400	634	3	2	.	6	8	.	.
326	1	29	57	5	100012905705W400	610	6	2	.	7	8	.	.
327	16	30	57	5	100163005705W400	652	4.5	.	.	8.5	.	.	.
328	6	32	57	5	100063205705W400	651	6.5	.	.	11	.	.	.
329	6	34	57	6	100063405706W400	683	0	4	.	.	.	.	.
330	11	21	57	7	100112105707W400	667	8.5	.	.	5	4	.	.
331	11	22	57	7	100112205707W400	679	3	.	4.5	4.5	3.5	14	3.5
332	11	23	57	7	100112305707W400	678	3	.	11	7.5	4.5	.	.
333	16	34	57	7	100163405707W400	686	.	7	10	5.5	5	23	.
334	5	36	57	7	100053605707W400	671	2.5	4	8	3	9	15	15
335	8	9	57	8	100080905708W400	666	.	.	.	3	7	16	6
336	14	10	57	8	100141005708W400	668	7.5	.	.	6	.	.	7
337	8	15	57	8	100081505708W400	686	7	.	.	5.5	.	.	7
338	10	16	57	8	100101605708W400	679	3.5	.	.	4	10	6	7
339	10	19	57	8	100101905708W400	690	.	.	.	.	3	.	7
340	11	3	58	1	100110305801W400	672	9	7	.	3	6	.	14
341	9	4	58	1	100090405801W400	671	.	2	15	12	.	.	14
342	7	10	58	1	100071005801W400	668	9	.	.	.	.	.	.
343	7	11	58	1	100071105801W400	671	.	7	.	8	6	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
344	5	21	58	1	100052105801W400	637	8	4	2	7	5	13	9
345	9	29	58	1	100092905801W400	701	9	5	3	5.5	8	7	9
346	12	4	58	2	100120405802W400	649	5	4	.	.	5.5	17	14
347	5	10	58	2	100051005802W400	670	10	5	.	13	7	17	8
348	5	13	58	2	100051305802W400	692	7.5	3	.	13	5	.	.
349	8	17	58	2	100081705802W400	669	.	2	.	.	5	.	2
350	7	23	58	2	100072305802W400	683	8	2	8	.	.	.	.
351	8	26	58	2	100082605802W400	682	7	5	.	.	7	6	18
352	10	28	58	2	100102805802W400	684	7	2.5	.	.	5	15	8
353	15	30	58	2	100153005802W400	670	6.5	2	7	8	5	.	.
354	4	8	58	3	100040805803W400	621	12	.	10	10	5	.	.
355	9	10	58	3	100091005803W400	598	5	5	.	.	4	12	10
356	10	21	58	3	100102105803W400	634	.	.	.	.	.	.	.
357	**7**	**26**	**58**	**3**	**100072605803W400**	662	11	.	11	8	5	.	10
358	8	27	58	3	100082705803W400	662	5	6	5	6	.	.	.
359	6	30	58	3	100063005803W400	644	7	0	12	4	5.5	11	0
360	**7**	**33**	**58**	**3**	**100073305803W400**	647	10	.	6	11	7.5	8	.
361	12	36	58	3	100123605803W400	660	4.5	.	.	8	7	4.5	8
362	1	2	58	4	100010205804W400	643	11	.	.	9	7	.	.
363	6	6	58	4	100060605804W400	655	.	.	6	8	4	20	.
364	10	9	58	4	100100905804W400	651	7	.	.	8	2	.	.
365	15	11	58	4	100151105804W400	636	8	.	.	7	7	.	.
366	15	17	58	4	100151705804W400	721	7	4	9	10	3.5	.	.
367	7	21	58	4	100072105804W400	658	8	.	6	8	7	.	.
368	5	26	58	4	100052605804W400	659	0	3	3	7	4.5	.	.
369	6	4	58	5	100060405805W400	654	3	.	5.5	7	.	.	.
370	**16**	**13**	**58**	**5**	**103161305805W400**	670	4	.	2	7	.	.	.
371	**10**	**36**	**58**	**5**	**1AA103605805W400**	600	2.5	8	15	11	8.5	.	10
372	7	1	58	6	100070105806W400	684	.	.	.	9	6	.	6
373	7	19	58	6	100071905806W400	643	2	.	.	10	5	15	3.5
374	11	29	58	6	100112905806W400	642	2	8	10	9	6	17	2.5
375	4	5	58	7	100040505807W400	685	4	5	12	10	7	10	15
376	12	24	58	7	100122405807W400	579	4	8	12	6	4	18	16
377	6	26	58	7	100062605807W400	642	3.5	10	10	15	5	21	7.5
378	5	1	58	8	100050105808W400	605	6	.	4	4	8	7	11
379	5	10	58	8	100051005808W400	655	6	.	6	7	4	15	1
380	6	12	58	8	100061205808W400	600	6	.	.	13	3	.	1
381	14	16	58	8	100141605808W400	651	1	.	9	9	3	19	6
382	11	17	58	8	100111705808W400	649	4	.	.	8	3	17	9
383	15	18	58	8	100151805808W400	651	8	.	.	13	3.5	18	9
384	15	19	58	8	100151905808W400	650	5	.	.	6	6	18	1
385	12	21	58	8	100122105808W400	646	5	.	11	6	3	18	1
386	14	28	58	8	100142805808W400	642	5	.	.	.	6	18	1
387	**9**	**8**	**59**	**1**	**100090805901W400**	677	7	.	.	6	6	8	15
388	14	16	59	1	100141605901W400	641	6	.	13	8.5	7	16	12
389	**3**	**19**	**59**	**1**	**100031905901W400**	623	5	.	.	3	6	16	2
390	11	21	59	1	100112105901W400	612	5	7	7.5	5	9	18	15
391	8	22	59	1	100082205901W400	623	6	.	6	5	.	.	.
392	**16**	**31**	**59**	**1**	**100163105901W400**	641	7	7	.	2	5	.	.
393	11	5	59	2	100110505902W400	677	8	.	.	8	8	.	.
394	11	6	59	2	100110605902W400	674	8	2.5	3.5	7	7	.	.
395	**5**	**13**	**59**	**2**	**100051305902W400**	652	.	.	15	10	7	.	.
396	7	15	59	2	100071505902W400	644	.	3	11	7	10	9	12
397	7	16	59	2	100071605902W400	651	.	.	.	10	6	.	.
398	14	17	59	2	100141705902W400	648	0	0	8	8.5	5.5	7	16
399	14	18	59	2	100141805902W400	651	.	.	7	8	6	.	.
400	11	19	59	2	100111905902W400	623	12	.	.	10	5	12	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
401	8	21	59	2	100082105902W400	642	.	.	6	6.5	6	7	.
402	15	23	59	2	100152305902W400	630	3	11	7	8	4	.	.
403	10	24	59	2	100102405902W400	623	3	10	6	4	4	.	.
404	14	25	59	2	100142505902W400	623	6	.	3	.	.	.	.
405	7	27	59	2	100072705902W400	625	4	2.5	1.5	8	6	.	.
406	7	28	59	2	100072805902W400	617	3	1.5	2	2	6	0	.
407	1	35	59	2	100013505902W400	644	4	1	2	3	.	.	.
408	9	36	59	2	100093605902W400	616	7	3	6	7	2	.	.
409	11	4	59	3	100110405903W400	653	.	2	11	3.5	8	.	.
410	10	6	59	3	100100605903W400	645	8	2	8	6	6	13	15
411	6	8	59	3	100060805903W400	641	.	0	15	2.5	5	7	.
412	11	21	59	3	100112105903W400	622	5.5	.	.	5	.	.	.
413	6	34	59	3	100063405903W400	621	5.5	6.5	.	.	.	.	.
414	6	9	59	4	100060905904W400	621	1.5	.	.	.	7.5	6	23
415	6	12	59	4	1AA061205904W400	660	7.5	.	.	6	6	7	21
416	10	19	59	4	100101905904W400	621	2	.	.	5	6	6.5	21
417	11	20	59	4	100112005904W400	611	3	.	.	4.5	6	6	21
418	7	22	59	4	102072205904W400	634	2	2	3	11	6	6	21
419	7	26	59	4	100072605904W400	623	4	.	.	5	5	10	24
420	10	30	59	4	100103005904W400	611	4	.	.	.	10	15	.
421	10	31	59	4	100103105904W400	588	3	9	7.5	11	6	4.5	9
422	10	33	59	4	100103305904W400	614	2	2	9	4	5	4	21
423	6	17	59	5	100061705905W400	641	6	8.5	15	5.5	4	.	0
424	2	1	59	6	100020105906W400	671	.	1.5	5.5	5	4	.	.
425	14	4	59	6	100140405906W400	616	.	.	.	7	3.5	14	6
426	13	5	59	6	100130505906W400	598	.	.	10	8	.	.	19
427	11	7	59	6	100110705906W400	576	6	6	7	5.5	.	.	.
428	11	8	59	6	100110805906W400	577	5	2	4	5.5	3	.	.
429	10	9	59	6	100100905906W400	[illegible]	.	.	3	11	6	12	6.5
430	11	12	59	6	100111205906W400	578	7	6	9	8	6	11	6.5
431	13	13	59	6	100131305906W400	579	3	5	8	6	6.5	.	10
432	14	14	59	6	100141405906W400	575	2.5	.	7	8	5	12	7.5
433	4	16	59	6	100041605906W400	580	1.5	4	.	6	.	.	.
434	15	17	59	6	100151705906W400	578	.	.	.	7	4	.	.
435	8	18	59	6	100081805906W400	580	.	.	8	7	9	.	.
436	11	19	59	6	100111905906W400	585	5	4.5	6.5	7.5	5	.	.
437	2	22	59	6	100022205906W400	584	2.5	7	12	8.5	6	.	.
438	6	27	59	6	100062705906W400	572	5	1.5	11	9.5	6	.	.
439	7	30	59	6	100073005906W400	605	.	.	8	8	.	.	.
440	6	1	59	7	100060105907W400	639	3	.	.	7.5	4	.	.
441	5	6	59	7	100050605907W400	640	3	0	8	6	.	.	18
442	3	13	59	7	100031305907W400	604	4	.	6	10	.	.	5
443	12	14	59	7	100121405907W400	634	.	.	7	8	.	.	.
444	5	17	59	7	100051705907W400	640	.	.	3	4	4	15	0
445	5	21	59	7	100052105907W400	641	7	.	.	.	.	.	.
446	12	25	59	7	100122505907W400	621	7	3.5	.	.	4	.	.
447	9	27	59	7	100092705907W400	622	.	5.5	2	.	2	.	.
448	10	31	59	7	100103105907W400	636	7	.	15	6	.	.	0
449	8	35	59	7	100083505907W400	609	.	5	.	6	.	.	.
450	11	10	59	8	100111005908W400	616	5	.	.	.	0	22	1
451	16	17	59	8	100161705908W400	628	2	8	12	4	10	18	7
452	9	30	59	8	100093005908W400	623	.	12	15	6.5	.	.	0
453	12	34	59	8	100123405908W400	642	6.5	9	8	.	0	27	0
454	5	9	60	1	100050906001W400	608	.	7	17	9	4	.	0
455	10	11	60	1	100101106001W400	586	2	4	10	8.5	4	11	15
456	11	29	60	1	100112906001W400	565	.	3	1	9	4	.	.
457	16	3	60	2	100160306002W400	623	5	4.5	4	3	3.5	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
458	5	8	60	2	100050806002W400	603	4.5	.	5	.	.	.	.
459	7	9	60	2	100070906002W400	601	8	.	.	7	6	6	8.5
460	5	10	60	2	100051006002W400	600	7.5	4	3	3.5	5	6	10
461	9	15	60	2	100091506002W400	597	8	2	3.5	7.5	5	.	.
462	9	22	60	2	100092206002W400	584	10	1.5	1.5	8	5	.	.
463	13	23	60	2	100132306002W400	576	6	3.5	3	6.5	5	11	.
464	13	26	60	2	100132606002W400	569	4	2	4	10	5	9	.
465	12	30	60	2	100123006002W400	566	1	.	.	.	7	.	.
466	7	32	60	2	100073206002W400	557	4.5	.	3	11	5	9	13
467	6	33	60	2	100063306002W400	555	7	.	.	6.5	4	12	12
468	5	34	60	2	100053406002W400	557	6	.	.	7	4	11	14
469	12	35	60	2	100123506002W400	553	4	5	1	6	5	12	.
470	10	22	60	3	100102206003W400	587	7	1	.	.	.	.	.
471	14	27	60	3	1AA142706003W400	569	4	.	.	8	6	.	12
472	6	28	60	3	100062806003W400	565	4	.	13	12	7	.	15
473	2	30	60	3	100023006003W400	622	5	7	8	5	6	13	16
474	10	32	60	3	100103206003W400	593	5	8	7	5	6.5	.	13
475	6	33	60	3	100063306003W400	568	3.5	.	.	0	7	.	13
476	6	34	60	3	100063406003W400	559	.	.	.	.	6	.	15
477	10	35	60	3	100103506003W400	573	3.5	.	5.5	10	5	.	2
478	6	1	60	4	100060106004W400	616	4	1	8	.	4	6	19
479	10	5	60	4	100100506004W400	602	5.5	10	.	.	.	.	.
480	9	8	60	4	100090806004W400	596	3	4	.	.	.	.	.
481	10	14	60	4	100101406004W400	618	5	.	.	.	.	.	.
482	8	15	60	4	100081506004W400	606	3	7	3	.	.	.	.
483	12	16	60	4	100121606004W400	596	3	3	.	.	5	14	7
484	4	23	60	4	100042306004W400	622	4	.	.	.	.	.	.
485	14	25	60	4	100142506004W400	590	4	.	.	.	.	.	.
486	7	29	60	4	100072906004W400	582	3.5	3.5	.	.	.	.	.
487	6	33	60	4	100063306004W400	566	3	2	.	.	.	.	.
488	13	28	60	5	1A2132806005W400	577	4	.	.	.	.	.	.
489	8	30	60	5	100083006005W400	587	4	2	2	5	.	.	.
490	10	35	60	5	100103506005W400	563	5	4	.	.	.	.	4
491	11	2	60	6	100110206006W400	561	3.5	.	.	.	.	.	.
492	7	9	60	6	100070906006W400	566	5.5	6.5	.	.	5	.	.
493	10	18	60	6	100101806006W400	569	9	7	11	3	.	.	6
494	6	23	60	6	100062306006W400	579	7	.	.	13	.	.	9.5
495	10	25	60	6	100102506006W400	577	4	4	.	.	.	.	.
496	10	26	60	6	100102606006W400	584	3	2	.	.	.	15	2
497	10	27	60	6	100102706006W400	592	3	.	5	3	9.5	2.5	2.5
498	5	30	60	6	100053006006W400	573	3	4	5	3	9.5	2.5	2.5
499	6	36	60	6	100063606006W400	565	3	2.5	10	8	.	.	7.5
500	6	1	60	7	100060106007W400	591	.	.	4	3	2	.	.
501	9	7	60	7	100090706007W400	577	3.5	.	.	4	.	.	.
502	12	8	60	7	100120806007W400	577	1	.	.	5	.	.	.
503	4	14	60	7	100041406007W400	595	.	.	2	4	.	.	5
504	12	15	60	7	100121506007W400	551	.	.	8	6	.	.	1
505	4	22	60	7	100042206007W400	539	5	.	.	11	.	.	3
506	3	24	60	7	100032406007W400	604	4	4	6	4.5	4	.	7
507	10	28	60	7	100102806007W400	538	7	.	.	10	.	.	5
508	3	3	60	8	100030306008W400	613	.	.	8.5	14	.	.	.
509	10	4	60	8	100100406008W400	616	.	.	8	7.5	2	20	3
510	9	11	60	8	100091106008W400	588	.	.	8	6	0	.	.
511	10	13	60	8	100101306008W400	540	.	.	.	4.5	.	.	.
512	16	15	60	8	100161506008W400	618	.	2	0	14	.	.	.
513	8	18	60	8	100081806008W400	616	3	.	.	8	5	17	3
514	4	26	60	8	100042606008W400	617	.	.	6	8.5	3	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
515	6	29	60	8	100062906008W400	607			13	7			
516	6	11	61	1	100061106101W400	557	5	8	6.5	7			
517	7	22	61	1	100072206101W400	551				5			
518	2	25	61	1	100022506101W400	546	7						
519	7	29	61	1	1AA072906101W400	540				5	6.5		
520	7	33	61	1	100073306101W400	543	4						
521	4	35	61	1	100043506101W400	562	6						
522	3	4	61	2	100030406102W400	556	5	2	1	7.5	4	6	
523	12	27	61	2	100122706102W400	548	7			7	4	15	4
524	9	28	61	2	100092806102W400	549	4			9	3.5	14	2.5
525	12	31	61	2	100123106102W400	548	5.5	2	4	7	6		
526	3	5	61	3	100030506103W400	605	1		4	4	5.5		3.5
527	6	11	61	3	100061106103W400	564	4		3	7.5	2	3.5	10
528	15	17	61	3	100151706103W400	558	9			7	7		
529	7	22	61	3	100072206103W400	553	9						
530	11	28	61	3	100112806103W400	552	8.5						10
531	6	1	61	4	100060106104W400	584	4	3	3	8	6	11	10
532	14	19	61	4	1AD141906104W400	558	3.5				5		
533	13	20	61	4	102132006104W400	562	4						
534	12	21	61	4	100122106104W400	565			4	8	6		6
535	7	25	61	4	100072506104W400	551	0	7	2.5	7	5	20	7
536	7	26	61	4	100072606104W400	556	3.5						
537	7	27	61	4	100072706104W400	563	0			5	8		3
538	12	28	61	4	100122806104W400	556	5						
539	2	29	61	4	100022906104W400	563	2			7			
540	8	29	61	4	100082906104W400	558	0			9	0		
541	1	30	61	4	102013006104W400	559	1				0		
542	10	33	61	4	1001033[illegible]104W400	563	4.5	1.5	4.5		3		3
543	6	34	61	4	1000634[illegible]04W400	558	1.5				4		2.5
544	6	1	61	5	100060106105W400	558	4.5						
545	7	2	61	5	100070206105W400	559	3.5						
546	3	9	61	5	100030906105W400	559	2			4			
547	13	14	61	5	100131406105W400	555	2			0			5.5
548	3	15	61	5	100031506105W400	555	2			4	4		
549	10	22	61	5	100102206105W400	552	4	2.5	4	3	4		2.5
550	3	23	61	5	100032306105W400	552	5.5			7.5	7		6.5
551	5	24	61	5	100052406105W400	557	5			3	0.5		4.5
552	6	24	61	5	100062406105W400	557	1.5			4	2		10
553	8	24	61	5	100082406105W400	551	2.5			5	3	18	5.5
554	6	25	61	5	100062506105W400	551	3			2.5	9	13	5
555	3	27	61	5	100032706105W400	553	5						
556	11	27	61	5	100112706105W400	553	7						
557	7	29	61	5	100072906105W400	561	5	9	14	14	4		0
558	12	34	61	5	100123406105W400	558	3						
559	9	8	61	6	100090806106W400	570	6.1						0
560	6	11	61	6	100061106106W400	551	5	2	5				
561	10	23	61	6	100102306106W400	556	1.5	3.5	4	5	3.5		2.5
562	10	31	61	6	100103106106W400	551	2	3	4	10	2	20	1
563	11	36	61	6	100113606106W400	561	1.5	1.5	3	4	5.5	20	1.5
564	7	6	61	7	100070606107W400	555	3			3.5		13	7
565	10	7	61	7	100100706107W400	573	1			5	8	20	2
566	10	16	61	7	100101606107W400	561	6						
567	9	21	61	7	100092106107W400	557	6						
568	12	28	61	7	100122806107W400	566	8			10			0
569	6	6	61	8	100060606108W400	605	2		5	12			
570	10	10	61	8	100101006108W400	584	10	5		4			
571	10	17	61	8	100101706108W400	581	8			7	4		6

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
572	6	22	61	8	100062206108W400	582	2	.	.	5	.	.	2
573	11	35	61	8	100113506108W400	567	1	.	.	6	.	.	7.5
574	10	5	62	2	100100506202W400	543	10	.	5	8	5	.	7
575	10	8	62	2	100100806202W400	540	6	.	.	7	6	.	.
576	14	12	62	2	100141206202W400	534	0	.	.	.	7.5	.	3
577	7	21	62	2	100072106202W400	540	9	6	11	14	5.5	12	7.5
578	15	12	62	3	100151206203W400	540	7	0	10	.	.	.	.
579	11	31	62	3	100113106203W400	552	4	.	.	9	8	.	0
580	14	32	62	3	100143206203W400	552	5	3	8.5	6	7	.	2
581	11	34	62	3	100113406203W400	540	4	.	.	.	3	.	1.5
582	9	35	62	3	100093506203W400	544	2	2	6.5	7	.	.	0
583	10	13	62	4	100101306204W400	543	4	.	5	5	4	.	1.5
584	10	14	62	4	100101406204W400	556	3.5	.	.	7	9	.	8
585	6	20	62	4	100062006204W400	554	4.5	.	9	6	.	.	2
586	6	22	62	4	100062206204W400	556	3.5	.	.	11	7.5	.	0.5
587	11	24	62	4	100112406204W400	556	4	.	5	5	4	.	1.5
588	7	32	62	4	100073206204W400	558	1	2	4	.	.	.	.
589	16	35	62	4	100163506204W400	550	8	.	.	5	7	.	1.5
590	10	36	62	4	100103606204W400	551	6	.	.	.	5	.	2.5
591	11	2	62	5	100110206205W400	558	4	.	.	.	.	.	.
592	10	14	62	5	100101406205W400	555	6.5	.	6	10	.	.	3
593	10	16	62	5	100101606205W400	555	7.5	.	.	.	.	.	0
594	7	22	62	5	1AA072206205W400	555	5	.	1	.	.	.	.
595	11	17	62	6	100111706206W400	560	3	.	6	6	4.5	20	3
596	11	21	62	6	100112106206W400	549	2	.	.	5	6	.	0
597	5	22	62	6	100052206206W400	554	3	.	.	9	.	.	4
598	7	14	62	7	100071406207W400	564	4.5	.	11	9	.	.	2.5
599	16	15	62	7	100161506207W400	593	2.5	0	4	10	.	.	0
600	6	23	62	7	100062306207W400	554	2	.	.	10	6	15	1
601	6	26	62	7	100062606207W400	553	5	6	14	15	.	.	14
602	10	36	62	7	100103606207W400	554	5	.	.	.	.	12	0
603	9	13	62	8	100091306208W400	547	.	1	.	2	.	.	1.5
604	12	17	62	8	100121706208W400	588	5	.	6	5	5	17	6
605	2	22	62	8	100022206208W400	552	.	2	3.5	.	.	.	7
606	12	29	62	8	100122906208W400	594	.	.	0	5.5	3	10	4.5
607	11	31	62	8	100113106208W400	582	5	6	14	15	.	.	14
608	9	5	63	1	100090506301W400	547	6	1	.	7.5	.	.	0
609	4	11	63	1	100041106301W400	542	2	12	4	9	4.5	6	3
610	5	19	63	2	100051906302W400	545	1	0	18	9	9	15	0
611	3	21	63	2	100032106302W400	550	9	.	15	14	.	.	12
612	12	31	63	2	100123106302W400	547	6	5	10	.	.	.	.
613	11	4	63	3	100110406303W400	546	9	.	15	.	.	.	.
614	3	6	63	3	100030606303W400	548	7	0	11	20	.	.	14
615	6	7	63	3	100060706303W400	551	0	.	7	9	4	.	8
616	15	18	63	3	100151806303W400	559	5	.	.	15	.	.	7.5
617	7	20	63	3	100072006303W400	551	3	1	8	8	.	.	6.5
618	6	23	63	3	100062306303W400	545	2.5	.	.	8	14	.	1
619	11	25	63	3	100112506303W400	552	2.5	0	5	8	5.5	16	.
620	3	26	63	3	100032606303W400	549	2.5	.	.	2.5	.	.	0
621	10	28	63	3	100102806303W400	554	5	.	.	.	.	.	.
622	2	30	63	3	100023006303W400	549	5	8	20	19	8	18	8
623	7	35	63	3	1AA073506303W400	551	3	.	.	6	7	.	2
624	7	6	63	4	100070606304W400	548	0	5	.	8	8	.	2.5
625	10	3	63	5	100100306305W400	559	0	4	7	11	6	8	2.5
626	11	6	63	5	100110606305W400	544	4.5	.	1.5	6.5	11	7	1
627	7	16	63	5	100071606305W400	550	2	3	14	3	9	16	0
628	11	18	63	5	100111806305W400	557	1.5	5.5	5	5.5	8	12	2.5

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
629	9	25	63	5	102092506305W400	589	4	3	14	.	.	.	.
630	1	29	63	5	100012906305W400	552	3	8	.	.	5.5	4	15
631	10	30	63	5	100103006305W400	558	5	.	.	9	8	11	8
632	7	32	63	5	1AA073206305W400	562	3	.	.	8	7	13	2
633	7	13	63	6	1AA071306306W400	559	3.5	.	.	2	3	10	0
634	10	19	63	6	100101906306W400	559	2	.	1.5	11	.	.	3
635	11	20	63	6	100112006306W400	560	3	.	2.5	.	.	3	3
6[illegible]	8	21	63	6	100082106306W400	561	1.5	.	9	9	12	8	0
637	16	22	63	6	100162206306W400	563	2	.	.	.	.	9	4
638	9	23	63	6	100092306306W400	574	2	.	.	2	5	9	4
639	3	24	63	6	100032406306W400	569	4	.	.	8.5	7	4	1
640	10	29	63	6	100102906306W400	571	1	.	11	12	10	17	2
641	6	31	63	6	100063106306W400	582	4	.	.	.	.	.	2
642	6	32	63	6	100063206306W400	578	0	.	.	9	12	.	3
643	6	33	63	6	100063306306W400	579	3	.	.	.	5	15	3
644	7	34	63	6	100073406306W400	582	3	.	1	10	9	6	3
645	10	3	63	7	100100306307W400	561	2	.	.	9	13	12	2.5
646	7	7	63	7	100070706307W400	560	0	3	6	8	.	.	7
647	10	9	63	7	100100906307W400	546	2	3	7	7	5	13	7
648	11	12	63	7	100111206307W400	561	6	8	0	11	16	14	0
649	10	13	63	7	100101306307W400	564	6	5	2.5	12	.	14	1
650	6	15	63	7	100061506307W400	561	3	6	6	9.5	15	12	6
651	10	19	63	7	100101906307W400	572	6.5	5	3	11	16	15	7
652	10	25	63	7	100102506307W400	570	2.5	.	1	8	7	.	9
653	10	26	63	7	1AA102606307W400	566	4	5	3	11	10	.	8
654	14	36	63	7	100143606307W400	579	4	.	1.5	9	6	27	12
655	12	1	63	8	1AA120106308W400	568	3	3	2	8.5	.	.	8
656	6	2	63	8	100060206308W400	562	1.5	4	4	8	.	15	8
657	3	4	63	8	1AA030406308W400	569	.	1	.	.	.	.	.
658	4	4	63	8	1AC040406308W400	567	.	.	.	.	.	.	.
659	5	4	63	8	1AA050406308W400	567	.	.	.	.	.	.	.
660	6	4	63	8	1AB060406308W400	569	.	1.5	.	.	.	.	.
661	14	11	63	8	100141106308W400	567	1.5	.	0	9	.	.	0
662	1	13	63	8	100011306308W400	573	7.5	3.5	6	.	.	.	5
663	2	13	63	8	1AG021306308W400	579	7.5	3.5	6	9.5	.	.	.
664	6	13	63	8	100061306308W400	577	5.5	3	6	.	.	.	6
665	8	24	63	8	100082406308W400	578	1	2	3	.	.	.	3
666	10	26	63	8	100102606308W400	581	3	.	.	.	.	.	8
667	4	27	63	8	100042706308W400	580	4.5	.	7.5	.	.	.	.
668	6	31	63	8	100063106308W400	584	7	.	.	16	10	.	8
669	5	13	63	9	100051306309W400	598	1.5	6.5	8.5	.	.	.	8
670	6	10	64	3	100061006403W400	548	2	.	14	9	11	.	5.5
671	2	15	64	3	1AA021506403W400	554	2	.	.	8	5	18	5.5
672	1	16	64	3	1AA011606403W400	564	2	.	.	8.5	5	18	5
673	5	16	64	3	1AA051606403W400	556	2	.	.	8	5	16	5
674	1	19	64	3	100011906403W400	594	2	.	10	3	7	13	5
675	10	26	64	3	1AA102606403W400	605	7	2	8	10	5	20	7
676	3	27	64	3	1AC032706403W400	600	3	.	.	10	.	.	.
677	14	35	64	3	1AA143506403W400	643	2	.	.	5	8	.	7
678	12	15	64	4	100121506404W400	587	5	2.5	4	0	.	.	8.5
679	10	19	64	4	100101906404W400	597	5	6	6	9	9.5	20	10
680	2	20	64	4	100022006404W400	558	.	6	4	8	8	18	12
681	6	21	64	4	100062106404W400	575	.	3	5	11	.	.	6
682	10	21	64	4	100102106404W400	580	.	.	2	9	2.5	.	.
683	13	21	64	4	100132106404W400	579	.	.	2	6.5	8	21	4
684	6	24	64	4	100062406404W400	582	.	.	13	16	12	12	5
685	6	28	64	4	1AA062806404W400	611	6	.	.	12	.	13	5

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
686	7	29	64	4	100072906404W400	615	4	0	0	5	13	.	.
687	10	29	64	4	1AA102906404W400	621	0	4	8	7	10	19	8
688	11	30	64	4	100113006404W400	617	5	.	.	9	.	.	5.5
689	15	31	64	4	100153106404W400	627	.	.	.	12	10	15	9
690	7	32	64	4	100073206404W400	624	.	.	.	26	11	19	8.5
691	10	32	64	4	100103206404W400	623	.	.	.	.	.	.	7
692	13	32	64	4	100133206404W400	628	.	.	.	.	.	10	8.5
693	11	6	64	5	100110606405W400	571	6.5	.	7	.	.	9	4
694	6	7	64	5	1AA060706405W400	564	.	4	7	9	.	.	.
695	8	9	64	5	1AA080906405W400	564	.	4	7	9	.	.	.
696	10	17	64	5	100101706405W400	593	5.5	.	6	.	.	14	9
697	3	24	64	5	100032406405W400	570	4	.	4	.	.	.	4
698	5	32	64	5	1AA053206405W400	639	5	.	13		15	20	13
699	10	34	64	5	100103406405W400	641	4.5	.	4.5	12	9.5	17	7.5
700	14	5	64	6	100140506406W400	596	.	.	8	15	15	9	1
701	11	6	64	6	100110606406W400	589	3.5	.	4	11	.	6	1
702	12	6	64	6	100120606406W400	590	3	.	7	9	10	.	.
703	16	6	64	6	1AA160606406W400	593	3	.	4	9.5	8	15	5
704	3	7	64	6	100030706406W400	584	3	.	7.5	12	20	5	1.5
705	11	9	64	6	100110906406W400	588	6	.	.	.	20	3	2
706	6	11	64	6	100061106406W400	580	2	.	7	14	.	.	3
707	11	14	64	6	100111406406W400	589	2	.	7	11	5	.	.
708	14	16	64	6	1AA141606406W400	584	4	.	4	.	.	.	.
709	6	18	64	6	100061806406W400	594	0	.	.	.	4	.	.
710	2	21	64	6	1AA022106406W400	590	3	.	.	9	14	3	0
711	12	21	64	6	1AA122106406W400	602	5	.	.	14	16	.	5
712	3	22	64	6	1AA032206406W400	591	5	.	.	.	.	.	.
713	6	23	64	6	100062306406W400	604	2	.	10	16	15	6	12
714	3	27	64	6	1AA032706406W400	607	5	.	.	7	17	8.5	11
715	9	27	64	6	1AA092706406W400	613	4.5	.	.	12	15	7	3
716	9	28	64	6	1AA092806406W400	604	4.5	.	.	13	17	3	5.5
717	7	30	64	6	100073006406W400	604	2.5	2.5	4.5	12	9.5	9	4.5
718	11	36	64	6	100113606406W400	648	2	3	.	.	.	.	.
719	16	1	64	7	100160106407W400	583	2	3	5	8	7.5	16	4.5
720	7	3	64	7	100070306407W400	575	6	.	4	.	.	.	.
721	4	7	64	7	1AA040706407W400	578	3	.	5.5	.	.	.	.
722	11	11	64	7	100111106407W400	579	.	.	7	5.5	18	.	5
723	8	12	64	7	100081206407W400	582	4	.	.	9	22	5	0
724	10	13	64	7	100101306407W400	592	.	.	4	11	21	8	0
725	6	15	64	7	100061506407W400	591	5	3	3	8	7	7	1
726	11	16	64	7	1AA111606407W400	587	2	.	.	6	6.5	17	0
727	10	28	64	7	100102806407W400	609	8	.	21	14	8	20	3
728	6	30	64	7	100063006407W400	589	3	.	9	2	5	.	.
729	15	4	64	8	100150406408W400	596	2	.	9	11	0	.	.
730	13	7	64	8	100130706408W400	589	3.5	.	6	7.5	5	.	10
731	10	22	64	8	100102206408W400	600	0	7.5	.	9	7.5	.	.
732	10	30	64	8	100103006408W400	596	5	.	.	5	5	.	.
733	6	36	64	8	1AA063606408W400	594	.	.	6	5.5	.	.	.
734	6	29	64	9	100062906409W400	655	7	13	14	12	.	.	13
735	8	14	65	2	100081406502W400	593	4	5.5	1.5	8	8	17	11
736	7	22	65	2	100072206502W400	601	3	1	1	6	4	27	3.5
737	15	23	65	2	100152306502W400	580	4	1	1	6	4.5	26	4
738	2	3	65	3	102020306503W400	656	5	2	9	11	12	15	3
739	7	8	65	3	1AN070806503W400	606	9	1	3.5	2.5	3.5	.	.
740	3	17	65	3	1AA031706503W400	602	4	2.5	3	3.5	3	20	6
741	10	18	65	3	1AA101806503W400	601	5.5	2	1	4	3.5	25	3
742	6	29	65	3	1AA062906503W400	609	9	4	3	5	7	18	6

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
743	6	32	65	3	1AA063206503W400	618	6	1	3.5	1.5	7	29	5
744	13	1	65	4	110130106504W400	602	.	.	.	.	.	.	.
745	5	3	65	4	100050306504W400	614	2	.	.	.	20	15	8.5
746	1	9	65	4	100010906504W400	619	7	2.5	3.5	8	8	24	5.5
747	5	10	65	4	100051006504W400	616	7	3.5	5	.	.	.	8.5
748	5	11	65	4	100051106504W400	602	.	1	1	.	.	.	9
749	13	12	65	4	103131206504W400	606	.	.	2	.	.	.	.
750	1	16	65	4	100011606504W400	607	.	.	.	.	.	.	.
751	16	16	65	4	100161606504W400	614	.	.	.	.	.	.	.
752	10	21	65	4	100102106504W400	616	.	.	.	.	.	.	.
753	12	22	65	4	100122206504W400	615	.	.	.	.	.	.	.
754	3	23	65	4	1AA032306504W400	610	9	5	.	.	13	17	9.5
755	2	24	65	4	105022406504W400	611	.	.	.	.	.	.	.
756	12	24	65	4	100122406504W400	613	.	.	.	.	.	.	3
757	9	25	65	4	100092506504W400	628	.	.	2	.	.	.	.
758	14	28	65	4	1AA142806504W400	611	.	.	.	.	.	.	.
759	10	29	65	4	1AA102906504W400	620	4	.	8	7	18	16	11
760	1	32	65	4	1AA013206504W400	618	5.5	3	.	.	.	.	3.5
761	14	34	65	4	1AA143406504W400	622	6.5	.	2	3.5	9	25	8.5
762	7	5	65	5	1AA070506505W400	642	2.5	.	5	15	20	14	9.5
763	3	6	65	5	100030606505W400	645	1.5	.	.	.	17	20	0
764	2	7	65	5	100020706505W400	645	4	5	.	14	.	.	.
765	7	8	65	5	1AA070806505W400	642	5	3	.	15	17	16	6.5
766	7	9	65	5	1AA070906505W400	646	0	.	5	13	16	15	4.5
767	11	14	65	5	100111406505W400	643	1	.	.	.	.	.	5
768	6	15	65	5	1AA061506505W400	660	2.5	.	2.5	7	15	18	8
769	9	17	65	5	1AA091706505W400	641	2	2	3	.	.	.	.
770	14	18	65	5	100141806505W400	651	5	.	.	13	18	17	4
771	11	21	65	5	1AA112106505W400	648	7.5	2	5	.	2.5	16	5.5
772	14	29	65	5	1AA142906505W400	645	4.5	.	9	.	.	15	4
773	7	30	65	5	100073006505W400	656	8	.	10	12	15	15	7
774	7	31	65	5	100073106505W400	650	3	4	6	9	.	11	4
775	10	33	65	5	100103306505W400	640	3.5	.	.	10	18	12	2
776	11	1	65	6	1AA110106506W400	654	4.5	.	7.5	8.5	16	.	.
777	2	2	65	6	100020206506W400	648	4	2.5	.	13	18	8	4
778	2	3	65	6	100020306506W400	644	5	5	6	14	15	7	7.5
779	11	10	65	6	100111006506W400	647	4	.	6.5	11	11	12	.
780	11	11	65	6	100111106506W400	647	5	6	10	13	15	13	7
781	5	12	65	6	100051206506W400	645	5	5	8.5	13	18	13	3.5
782	11	13	65	6	100111306506W400	646	5.5	5	6	13	12	14	5
783	7	24	65	6	100072406506W400	642	6.5	4	9	14	17	17	2
784	10	25	65	6	100102506506W400	637	4	.	7	14	8	15	4.5
785	6	27	65	6	100062706506W400	634	5	.	5.5	17	3.5	15	7.5
786	11	30	65	7	100113006507W400	694	6	2	5	9	4.5	13	2
787	10	30	65	8	100103006508W400	644	3	8	5	6	1.5	12	1
788	12	6	65	9	100120606509W402	638	.	.	.	.	17	17	10
789	11	9	65	9	100110906509W400	607	.	.	0	6	0	6	2
790	10	13	65	9	100101306509W400	618	.	3	6	10	0	13	0
791	9	16	65	9	100091606509W400	602	2	2	10	7	0	7.5	1
792	12	5	66	1	100120506601W400	602	6	.	.	.	.	11	0
793	7	17	66	1	100071706601W400	610	.	.	.	.	.	12	4.5
794	11	4	66	2	100110406602W400	610	3	.	2	7	3	.	9
795	7	17	66	2	1AA071706602W400	613	.	.	.	4.5	17	18	7.5
796	8	19	66	2	100081906602W400	621	4	4	.	5.5	15	16	8
797	6	22	66	2	100062206602W400	620	.	.	.	6	18	18	12
798	7	26	66	2	100072606602W400	617	4.5	4	2.5	6.5	5	11	4
799	13	34	66	2	100133406602W400	617	.	1.5	5	7	16	13	10

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
800	5	36	66	2	100053606602W400	617	1.5	.	1	11	5	.	5
801	11	12	66	3	1AA111206603W400	611	.	3	11	13	15	15	7
802	6	24	66	3	100062406603W400	616	3	3	5.5	9	17	17	7
803	13	3	66	4	1AA130306604W400	611	7	.	2.5	.	.	19	9
804	15	5	66	4	1AA150506604W400	625	8	5	.	.	.	.	10
805	3	9	66	4	1AA030906604W400	625	7	.	.	.	.	.	6.5
806	5	14	66	4	1AA051406604W400	633	3.5	.	.	.	16	15	6.5
807	11	18	66	4	1AA111806604W400	643	0	.	.	12	14	12	10
808	7	30	66	4	100073006604W400	656	0.5	.	.	.	19	9	5
809	16	4	66	5	100160406605W400	640	4.5	.	9	8.5	23	3.5	6
810	10	5	66	5	1AA100506605W400	644	5	.	6.5	14	8.5	14	6
811	6	6	66	5	100060606605W400	642	5	3	5	9.5	10	5.5	20
812	8	7	66	5	100080706605W400	642	6	.	.	12	3	7.5	6
813	12	8	66	5	1AT120806605W400	637	0	.	8	13	4	8.5	8
814	15	10	66	5	102151006605W400	643	2	.	.	.	20	2	4
815	7	14	66	5	1AA071406605W400	640	.	.	.	.	18	4	7
816	10	15	66	5	100101506605W400	641	0	.	.	.	5	20	4.5
817	1	16	66	5	100011606605W400	644	5	.	.	.	11	10	9
818	13	22	66	5	100132206605W400	645	5	.	.	.	.	10	12
819	10	24	66	5	100102406605W400	650	0	.	.	.	.	9	8
820	7	26	66	5	100072606605W400	652	5.5	.	.	.	4	9	9
821	7	27	66	5	100072706605W400	651	4.5	.	.	.	6.5	12	10
822	6	33	66	5	100063306605W400	646	8	.	.	.	.	.	11
823	6	34	66	5	100063406605W400	649	7	4	.	.	.	.	17
824	10	36	66	5	100103606605W400	665	6.5	.	.	.	2.5	10	8.5
825	7	11	66	6	100071106606W400	635	5	.	.	.	6.5	10	11
826	2	12	66	6	100021206606W400	633	0	.	.	12	9	6	21
827	6	13	66	6	100061306606W400	641	4	.	.	.	8	8	19
828	11	15	66	6	100111506606W400	633	5	.	.	.	.	.	18
829	6	24	66	7	100062406607W400	631	5.5	.	7.5	12	9	0	18
830	5	28	66	7	100052806607W400	636	4	11	8	7	10	5	15
831	6	8	66	8	100060806608W400	659	0	4.5	12	9	3	9	3
832	9	10	66	8	100091006608W400	600	4	.	.	10	5	0	9
833	8	18	66	8	100081806608W400	650	7	.	.	.	.	.	8
834	10	19	66	8	100101906608W400	641	8	.	6.5	.	.	.	2
835	4	31	66	8	100043106608W400	625	9	.	5	.	.	.	0
836	12	8	67	1	100120806701W400	613	7	.	.	.	.	17	12
837	7	8	67	2	100070806702W400	648	7	.	.	.	.	.	.
838	9	11	67	2	100091106702W400	623	2	2	2	7	12	18	15
839	3	18	67	2	100031806702W400	675	.	2	4	3.5	25	20	6
840	10	29	67	2	100102906702W400	711	2	3	2	4	15	18	10
841	6	34	67	2	100063406702W400	690	9	4	3.5	.	.	.	.
842	11	2	67	3	100110206703W400	663	5.5	8	5	.	.	.	9
843	11	4	67	3	100110406703W400	658	11	.	.	.	11	20	8.5
844	11	6	67	3	100110606703W400	676	8	6	.	.	10	17	3
845	10	8	67	3	100100806703W400	678	7	.	.	.	.	17	6.5
846	11	11	67	3	100111106703W400	687	4.5	5	5	9	7	26	4.5
847	10	14	67	3	100101406703W400	701	7	.	.	.	5	25	5.5
848	7	22	67	3	100072206703W400	681	7.5	.	.	.	.	18	.5
849	6	23	67	3	100062306703W400	700	6.5	.	.	12	.	.	.
850	11	26	67	3	100112606703W400	692	.	.	.	.	.	16	3
851	10	28	67	3	100102806703W400	683	4	.	.	.	.	17	0
852	6	30	67	3	100063006703W400	674	2	13	.	12	23	15	3
853	7	31	67	3	100073106703W400	680	5	4.5	.	.	11	10	0
854	7	36	67	3	100073606703W400	704	5.5	9.5	.	.	.	.	10
855	10	2	67	4	100100206704W400	697	1	.	.	.	12	15	3
856	10	3	67	4	100100306704W400	699	2	13	.	12	18	15	3

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
857	7	4	67	4	100070406704W400	694	4	.	.	.	13	15	3
858	10	5	67	4	1AG100506704W400	687	5	.	.	.	16	13	6
859	10	6	67	4	100100606704W400	675	5	.	.	.	16	13	6
860	10	7	67	4	100100706704W400	686	6.5	.	.	.	12	13	8
861	10	8	67	4	100100806704W400	701	3.5	.	.	.	7.5	14	5
862	9	9	67	4	100090906704W400	704	4	.	.	.	7	12	4
863	10	10	67	4	100101006704W400	703	2	.	9	11	14	13	4
864	2	12	67	4	100021206704W400	683	.	.	8	5	6	14	1
865	6	14	67	4	100061406704W400	698	3	2	.	9	6	15	4.5
866	7	16	67	4	100071606704W400	710	7	1	3.5	14	3.5	10	3.5
867	6	17	67	4	100061706704W400	694	3	10	7.5	15	7.5	10	7.5
868	10	20	67	4	100102006704W400	700	3	.	.	5	6	10	2.5
869	**11**	**24**	**67**	**4**	**100112406704W400**	679	.	.	7	11	.	13	0
870	10	26	67	4	100102606704W400	698	.	.	.	.	.	0	13
871	11	28	67	4	100112806704W400	699	3	4	7.5	5	12	16	7.5
872	15	30	67	4	100153006704W400	684	3.5	4	6	12	15	7	13
873	7	33	67	4	100073306704W400	702	2	4	6	.	.	.	3.5
874	11	2	67	5	100110206705W400	664	.	.	3	9	14	4	19
875	13	3	67	5	100130306705W400	658	7	0	.	.	.	.	14
876	6	4	67	5	100060406705W400	650	.	.	9	.	.	.	17
877	6	6	67	5	100060606705W400	668	6	.	.	13	11	.	.
878	8	7	67	5	100080706705W400	653	6.5	5.5	.	.	.	.	13
879	11	12	67	5	100111206705W400	673	6	6.5	.	.	.	6	16
880	11	14	67	5	100111406705W400	678	9	.	.	.	.	7.5	16
881	6	16	67	5	100061606705W400	660	5	.	.	.	.	.	16
882	7	18	67	5	100071806705W400	653	5.5	8	.	.	.	15	10
883	10	22	67	5	100102206705W400	670	5	.	.	.	.	3	16
884	7	25	67	5	100072506705W400	678	.	.	5	.	.	9.5	16
885	7	30	67	5	100073006705W400	668	5	11	.	.	.	13	16
886	10	33	67	5	100103306705W400	671	2	12	0	.	.	.	3
887	**3**	**1**	**67**	**6**	**1AA030106706W400**	646	4.5	.	.	12	10	10	19
888	11	2	67	6	100110206706W400	648	3	.	7	8	10	6	17
889	12	3	67	6	100120306706W400	653	4	8	5	.	.	5	16
890	11	5	67	6	100110506706W400	656	3	7	4	8	11	0	18
891	10	12	67	6	100101206706W400	652	4.5	9	4	7	9	12	17
892	5	13	67	6	100051306706W400	649	2.5	.	.	12	8.5	0	16
893	5	14	67	6	100051406706W400	658	2	.	.	.	.	11	16
894	6	15	67	6	100061506706W400	665	.	.	.	.	.	.	16
895	7	25	67	6	100072506706W400	670	7	.	5	.	.	.	15
896	10	27	67	6	100102706706W400	657	7	.	5	.	.	.	.
897	2	29	67	6	100022906706W400	663	4	3.5	.	.	.	4.5	17
898	13	1	67	7	100130106707W400	652	2.5	.	3.5	5	3	1.5	.
899	11	5	67	7	100110506707W400	625	2	7	2	4	6	1.5	12
900	5	18	67	7	100051806707W400	625	2	7.5	2	7	8	1	.
901	3	25	67	7	100032506707W400	650	1.5	8	.	.	.	.	13
902	**12**	**31**	**67**	**7**	**100123106707W400**	609	2	.	0	12	.	.	12
903	13	34	67	7	100133406707W400	763	1.5	.	0	14	5.5	5.5	.
904	**14**	**1**	**67**	**8**	**100140106708W400**	601	3	.	.	6	5	2.5	14
905	6	13	67	8	100061306708W400	651	3	.	3	7	9	4	.
906	12	14	67	8	100121406708W400	622	4	.	.	6	6	0	.
907	7	22	67	8	100072206708W400	619	0.5	.	7.5	.	.	.	13
908	3	25	67	8	100032506708W400	610	[illegible]	1.5	2	12	.	.	.
909	10	29	67	8	100102906708W400	644	5	6	.	.	12	3	.
910	8	36	67	8	100083606708W400	613	4	1	8	14	5	7.5	1
911	11	8	68	1	100110806801W400	670	.	6	7	12	.	.	.
912	10	8	68	2	100100806802W400	748	.	9	0	12	.	.	.
913	9	11	68	2	100091106802W400	686	12	4	2.5	10	.	.	.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
914	6	21	68	2	100062106802W400	730	.	6	0	8	.	.	.
915	6	26	68	2	100062606802W400	714	2.5	1	4	7.5	.	.	.
916	11	29	68	2	100112906802W400	729	.	8	12	13	.	.	14
917	9	5	68	3	100090506803W400	709	.	2	.	.	.	.	9
918	10	6	68	3	100100606803W400	701	6	.	.	.	.	.	14
919	10	8	68	3	100100806803W400	716	8.5	3	4	7.5	10	18	10
920	6	13	68	3	100061306803W400	727	10	4	5	9	7	23	15
921	7	16	68	3	100071606803W400	741	1.5	.	.	5.5	7.5	18	8
922	6	26	68	3	100062606803W400	775	.	.	2	11	10	16	12
923	10	28	68	3	100102806803W400	753	3.5	4	.	.	.	19	7
924	6	31	68	3	100063106803W400	723	4	4	.	.	.	16	7
925	11	2	68	4	100110206804W400	709	0	.	.	.	.	17	8
926	7	6	68	4	100070606804W400	691	4.5	5	4	2.5	16	14	7
927	6	9	68	4	100060906804W400	697	3.5	.	0	5	14	7.5	13
928	11	12	68	4	100111206804W400	724	7	6	3	8	14	19	6
929	13	16	68	4	100131606804W400	705	.	6	.	.	.	13	5.5
930	6	18	68	4	100061806804W400	695	5	9	4	8	18	15	9
931	7	22	68	4	100072206804W400	726	0	3	.	.	.	13	7
932	2	24	68	4	100022406804W400	727	6	.	.	.	.	20	11
933	10	26	68	4	100102606804W400	736	.	3.5	.	.	.	14	8.5
934	6	29	68	4	100062906804W400	715	6	9.5	.	.	.	16	10
935	11	30	68	4	100113006804W400	723	5	7	.	.	.	.	9.5
936	10	32	68	4	100103206804W400	716	5	.	.	.	.	.	11
937	7	8	68	5	100070806805W400	695	7	9	.	.	.	4.5	15
938	11	16	68	5	100111606805W400	688	4	7.5	7	7.5	15	8	9.5
939	15	26	68	5	100152606805W400	717	7.5	4	.	.	.	0	3.5
940	13	27	68	5	100132706805W400	696	.	4.5	.	.	.	9.5	8
941	11	36	68	5	100113606805W400	714	5	.	.	.	.	2.5	10
942	7	1	68	6	100070106806W400	676	8	.	.	3.5	11	5.5	8.5
943	7	5	68	6	100070506806W400	664	.	8	4	8	6	4.5	17
944	5	13	68	6	100051306806W400	700	4	.	.	.	.	6	11
945	7	15	68	6	100071506806W400	697	3.5	9	.	.	.	.	11
946	8	17	68	6	100081706806W400	689	4	.	.	.	.	.	13
947	9	20	68	6	100092006806W400	701	7	8	.	.	.	.	13
948	10	29	68	6	100102906806W400	699	6	12	.	.	.	.	13
949	14	5	68	7	100140506807W400	612	4	10	6.5	13	2.5	4	6
950	12	18	68	7	100121806807W400	623	5	.	.	11	6	5.5	9.5
951	6	26	68	7	100062606807W400	637	2	.	7	.	.	1.5	8.5
952	10	28	68	7	100102806807W400	666	5		.	.	.	1	7
953	5	29	68	7	100052906807W400	632	6	2	.	.	.	9	9
954	15	5	68	8	100150506808W400	672	.	.	.	15	13	5.5	6.5
955	11	14	68	8	100111406808W400	648	5	6	0	5	6	3	1
956	16	21	68	8	100162106808W400	650	.	5	.	.	.	10	6
957	1	26	68	8	100012606808W400	606	5.5	.	.	13	7.5	12	9
958	13	30	68	8	100133006808W400	732	6	.	.	.	.	6	7
959	10	27	69	3	100102706903W400	711	.	6	8	.	.	.	5
960	5	4	69	4	100050406904W400	728	11	.	.	.	.	.	5
961	6	6	69	4	100060606904W400	699	2	.	.	.	.	.	6.5
962	5	15	69	4	100051506904W400	715	7	6	.	.	9.5	2.5	9
963	6	17	69	4	100061706904W400	695	4	4.5	.	.	.	.	5.5
964	6	19	69	4	100061906904W400	692	4.5	5	.	.	.	.	5.5
965	6	32	69	4	100063206904W400	6[illegible]0	4	5	.	.	.	.	4.5
966	6	2	69	5	100060206905W400	695	3.5	2.5	.	.	.	1.5	5.5
967	7	4	69	5	100070406905W400	684	8	8	.	.	.	4	6.5
968	8	9	69	5	100080906905W400	682	8	7	.	.	.	3.5	10
969	7	12	69	5	100071206905W400	693	12	.	.	.	.	.	12
970	5	14	69	5	100051406905W400	678	3	10	.	.	.	8	12

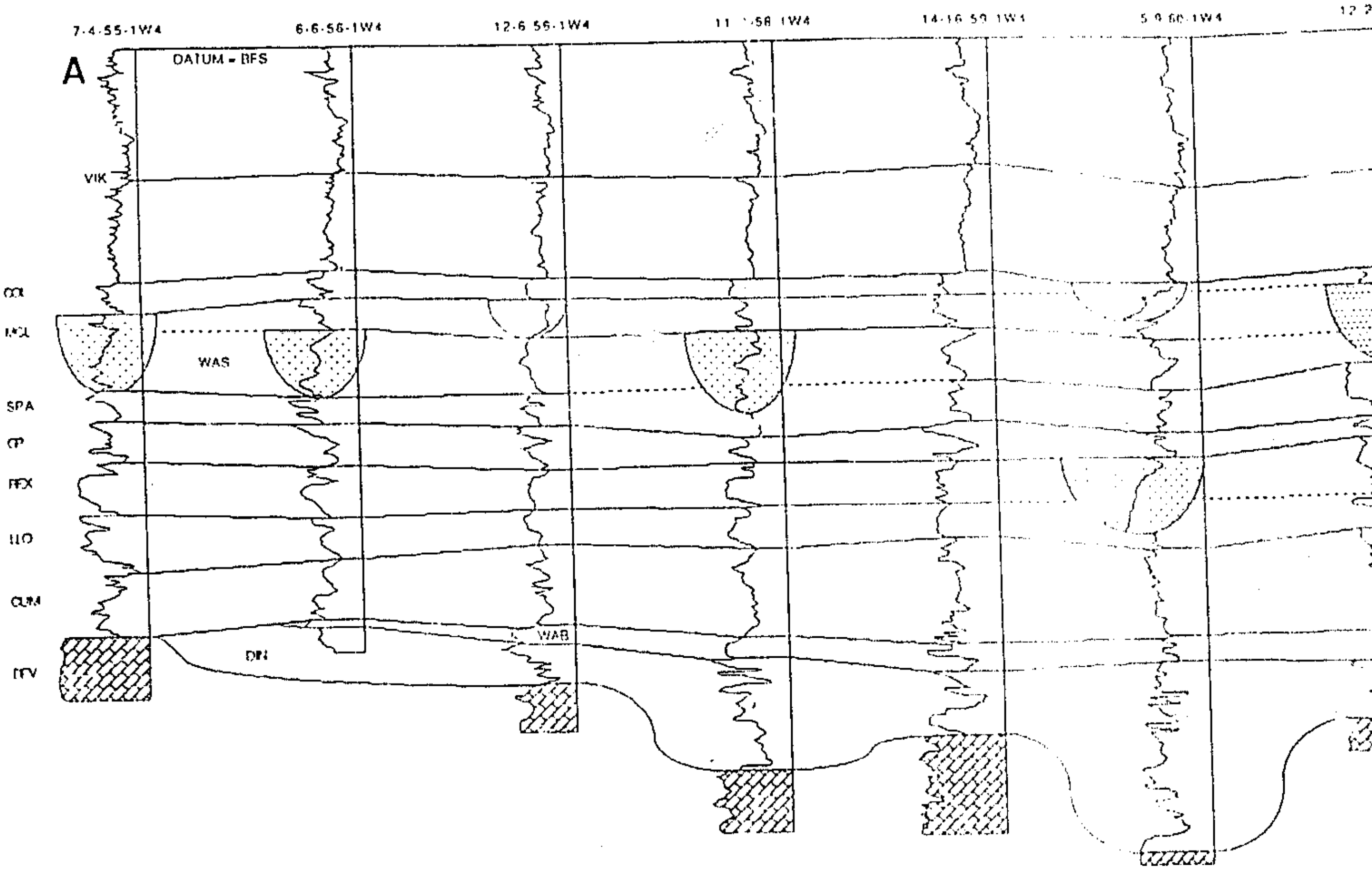
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
971	6	20	69	5	100062006905W400	682	9.5	8	.	.	.	6	7
972	6	22	69	5	100062206905W400	674	6	5.5	.	.	.	0	3
973	5	24	69	5	100052406905W400	682	3	3.5	.	.	.	.	2.5
974	8	26	69	5	100082606905W400	683	5.5	7	.	.	.	.	4.5
975	8	27	69	5	100082706905W400	678	11	8	.	.	.	.	3.5
976	11	32	69	5	100113206905W400	672	.	5	.	.	.	12	4
977	10	34	69	5	100103406905W400	677	7	9	.	.	.	2	6.5
978	8	36	69	5	100083606905W400	692	2	9	.	.	.	13	4.5
979	5	12	69	6	100051206906W400	720	5	.	0	8.5	13	1	9
980	6	22	69	6	100062206906W400	714	6	6	.	.	.	.	2.5
981	8	32	69	6	100083206906W400	689	7	10	.	.	.	2	11
982	6	36	69	6	100063606906W400	696	6.5	8.5	.	.	.	5	4.5
983	12	30	69	7	100123006908W400	661	5	.	.	.	.	.	.
984	8	11	69	8	100081106908W400	619	6.5	4	.	.	.	.	.
985	12	28	69	8	100122806908W400	667	7	.	.	15	.	.	.
986	12	31	69	8	100123106908W400	687	5	9	.	.	.	.	.
987	7	17	70	3	100071707003W400	690	9.5	13	9	.	.	8	13
988	7	16	70	4	100071607004W400	681	4	.	7	20	.	.	2.5
989	11	30	70	4	100113007004W400	676	5	14	.	.	.	.	3
990	8	33	70	4	100083307004W400	664	3.5	7.5	.	.	.	.	5
991	5	9	70	5	100050907005W400	682	4	8.5	.	.	.	.	6
992	7	14	70	5	100071407005W400	680	3.5	10	.	.	.	.	6
993	5	19	70	5	100051907005W400	671	6	13	.	.	.	3	10
994	7	20	70	5	100072007005W400	684	3.5	8.5	.	.	.	3	6
995	6	33	70	5	100063307005W400	658	5	7.5	.	.	.	.	5.5
996	9	12	70	6	100091207006W400	679	4	8.5	.	.	.	9.5	4.5
997	8	13	70	6	100081307006W400	686	5	11	.	.	.	9	6.5
998	5	23	70	6	100052307006W400	661	5	8	.	9	3	3	4
999	10	33	70	6	100103307006W400	642	6	13	.	.	.	5	8
1000	9	35	70	6	100093507006W400	668	1.5	5.5	.	.	.	1.5	5.5
1001	7	3	70	8	100070307008W400	644	5	8	.	.	.	.	4
1002	12	18	71	4	100121807104W400	674	7	19	.	.	.	.	12
1003	10	14	71	5	100101407105W400	666	4	14	.	.	.	.	5.5
1004	12	16	71	5	100121607105W400	679	12	8.5	.	.	.	.	6
1005	6	20	71	5	100062007105W400	682	8	.	.	.	12	0	5
1006	11	23	71	5	100112307105W400	674	7.5	13	.	.	10	6.5	7
1007	10	28	71	5	100102807105W400	679	6	.	.	.	.	.	11
1008	9	14	71	6	100091407106W400	676	7	5	.	.	.	.	3.5
1009	5	15	71	6	100051507106W400	672	13	5	.	.	.	.	3.5
1010	9	24	71	6	100092407106W400	676	7	11	.	.	.	12	13
1011	11	25	71	6	100112507106W400	693	10	.	.	8	1.5	6.5	5
1012	5	28	71	6	100052807106W400	672	7	.	.		.	.	5.5
1013	6	30	71	6	100063007106W400	665	8.5	.	.	.	.	4	11
1014	11	17	71	7	100111707[illegible]7W400	664	7	.	.	.	13	0	4.5
1015	7	20	71	7	100072007107W400	664	8.5	.	.	.	.	6	0
1016	10	30	71	7	100103007107W400	665	2	5.5	5	8	15	2	4
1017	7	32	71	7	100073207107W400	658	.	3	11	12	17	13	15
1018	14	6	71	8	100140607108W400	657	7.5	7.5	.	.	.	.	.
1019	10	13	71	8	100101307108W400	667	5	.	.	.	.	.	.
1020	7	17	71	8	100071707108W400	668	5	.	.	.	.	.	16
1021	11	26	71	8	100112607108W400	660	.	6	4	6	6.5	0	1
1022	7	32	71	8	100073207108W400	653	6.5	.	.	8.5	8.5	7	1
1023	11	35	71	8	100113507108W400	667	6	6	4.5	11	13	2.5	8
1024	16	36	72	1	100163607201W400	679	7	.	.	.	.	12	9
1025	6	3	72	4	100060307204W400	680	7	.	.	.	.	4	5.5
1026	5	5	72	4	100050507204W400	678	7	.	.	.	.	4	5
1027	11	15	72	4	100111507204W400	685	6	8.5	.		.	.	12

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
1028	7	28	72	4	100072807204W400	702	7	13	.	.	.	.	12
1029	6	1	72	5	**100060107205W400**	675	7	.	.	.	.	.	7
1030	12	4	72	5	100120407205W400	682	5.5	.	.	.	.	.	7
1031	11	6	72	5	100110607205W400	673	5	.	.	.	.	.	6.5
1032	12	14	72	5	100121407205W400	718	10	.	.	.	.	.	6
1033	8	16	72	5	100081607205W400	702	7.5	.	.	.	.	12	8
1034	8	18	72	5	100081807205W400	708	5	.	.	.	.	.	4
1035	12	26	72	5	100122607205W400	698	6	.	.	.	.	.	8.5
1036	12	28	72	5	100122807205W400	720	5	.	.	.	.	.	4
1037	11	2	72	6	100110207206W400	674	5	.	.	.	.	.	8
1038	12	4	72	6	100120407206W400	695	6.5	.	.	.	.	.	7
1039	9	6	72	6	100090607206W400	678	7	.	.	.	.	.	3.5
1040	7	14	72	6	**100071407206W400**	707	4	.	.	.	13	14	3.5
1041	8	16	72	6	100081607206W400	716	8.5	.	.	.	.	.	9
1042	3	18	72	6	100031807206W400	689	7	.	.	.	.	10	13
1043	12	26	72	6	**100122607206W400**	718	.	.	.	.	.	.	7
1044	12	28	72	6	100122807206W400	718	.	.	.	.	.	.	.
1045	2	29	72	6	100022907206W400	736	.	.	.	.	15	5.5	9.5
1046	9	30	72	6	100093007206W400	736	9	.	.	.	.	.	9
1047	10	1	72	7	100100107207W400	667	5.5	3.5	3	.	.	.	8
1048	10	3	72	7	100100307207W400	668	10	3	5.5	.	.	.	.
1049	10	13	72	7	100101307207W400	686	10	5	4	.	.	12	4
1050	10	16	72	7	100101607207W400	704	12	5	4	.	.	.	4
1051	10	17	72	7	100101707207W400	693	6	3	3	.	.	.	0
1052	10	23	72	7	100102307207W400	695	5.5	.	.	.	.	10	0
1053	10	25	72	7	100102507207W400	722	8	.	.	.	.	.	.
1054	10	26	72	7	100102607207W400	701	7	.	2	15	4	12	1
1055	10	27	72	7	100102707207W400	697	8	.	.	.	.	6	1
1056	10	29	72	7	100102907207W400	699	8	7	.	.	.	.	0
1057	11	30	72	7	100113007207W400	685	7	5.5	3	.	.	.	0
1058	11	31	72	7	100113107207W400	686	8	5	4.5	.	.	.	0
1059	10	33	72	7	100103307207W400	690	7.5	.	.	.	.	9	0
1060	11	34	72	7	100113407207W400	704	6.5	.	.	.	.	.	0
1061	10	1	72	8	100100107208W400	680	6.5	5	4.5	6	.	.	2.5
1062	10	3	72	8	100100307208W400	688	8	5	3.5	.	.	.	0
1063	10	5	72	8	100100507208W400	667	7.5	4.5	3	6.5	11	2	2
1064	6	12	72	8	100061207208W400	679	7.5	6	4	.	.	.	2.5
1065	10	15	72	8	100101507208W400	687	7.5	4.5	4	.	.	.	5
1066	11	26	72	8	100112607208W400	684	6	5	.	.	.	.	0
1067	10	27	72	8	100102707208W400	691	6	5	4	.	.	.	3
1068	8	4	73	4	100080407304W400	708	6	.	.	6	6	6	5
1069	7	6	73	4	100070607304W402	719	6	.	.	.	6	6	5
1070	11	2	73	5	100110207305W400	693	3	.	.	.	.	.	1.5
1071	11	5	73	5	100110507305W400	708	5	.	.	.	.	.	2
1072	7	12	73	5	100071207305W400	704	5.5	.	1	13	13	5	7.5
1073	8	2	73	6	100080207306W400	708	5.5	.	.	.	.	.	.
1074	6	5	73	6	100060507306W400	716	6	.	.	.	.	13	4
1075	6	7	73	6	100060707306W400	716	9	.	.	.	.	7	4
1076	6	8	73	6	100060807306W400	705	7	.	.	.	.	8	4
1077	11	9	73	6	100110907306W400	689	5	11	0	14	6	8	2.5
1078	10	11	73	6	100101107306W400	705	6	.	.	.	.	.	.
1079	6	12	73	6	100061207306W400	705	7.5	0	5	5	6.5	13	5
1080	6	13	73	6	100061307306W400	698	6	.	.	.	.	8	4.5
1081	11	14	73	6	100111407306W400	697	6	.	.	.	.	.	.
1082	11	15	73	6	100111507306W400	681	6.5	.	.	.	.	.	.
1083	11	17	73	6	100111707306W400	681	4	.	.	.	.	10	0
1084	6	18	73	6	100061807306W400	686	5	2.5	4	.	.	.	1.5

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LSD	SEC	TWP	RNG	IDENTIFIER	K.B.	COL	MCL	WAS	SPA	GP	REX	LLO
1085	10	3	73	7	100100307307W400	724	4.5	5	.	8	10	6	0
1086	10	5	73	7	100100507307W400	686	7	2	6.5	.	.	.	.
1087	11	7	73	7	100110707307W400	685	7.5	0	1.5	.	.	.	.
1088	10	9	73	7	100100907307W400	721	4.5	.	.	.	.	.	.
1089	10	11	73	7	100101107307W400	729	.	3	6	.	.	.	.
1090	10	13	73	7	100101307307W400	698	5	.	.	.	.	.	.
1091	10	14	73	7	100101407307W400	716	5	.	.	.	.	.	.
1092	6	16	73	7	100061607307W400	733	4	.	.	.	.	.	.
1093	10	17	73	7	100101707307W400	726	7	.	.	.	.	.	.
1094	10	3	73	8	100100307308W400	706	6.5	0	.	.	.	5	5
1095	10	4	73	8	100100407308W400	696	5.5	0	4	.	.	.	1.5
1096	10	5	73	8	100100507308W400	701	6.5	2	4	5.5	10	8.5	3.5
1097	6	10	73	8	100061007308W400	706	6	7.5	.	.	.	.	1
1098	10	13	73	8	100101307308W400	697	6	.	.	.	.	.	0
1099	10	14	73	8	100101407308W400	708	7	.	.	.	.	.	0
1100	10	15	73	8	100101507308W400	714	6	1.5	2.5	.	.	.	0
1101	10	17	73	8	100101707308W400	694	2.5	1.5	.	.	.	3	2

APPENDIX 2:

STRATIGRAPHIC CROSS-SECTIONS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MCL
WAS
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GP
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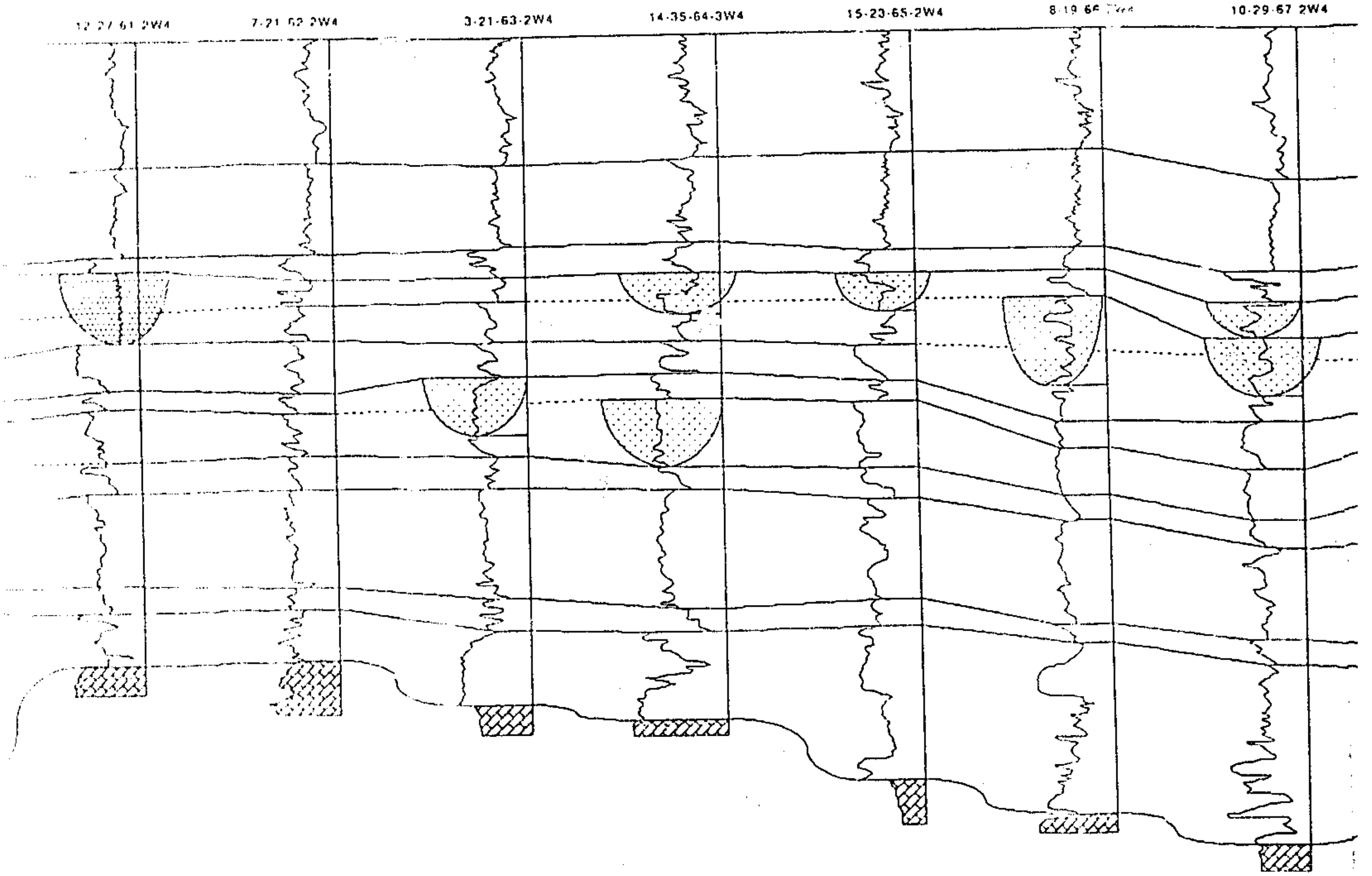
LLO
CUM
WAB
DIN
DEV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15-23-65-2W4
8-19-66-2W4
10-29-67-2W4

FIGU

STRAT
CROSS-S
COLD LAKE

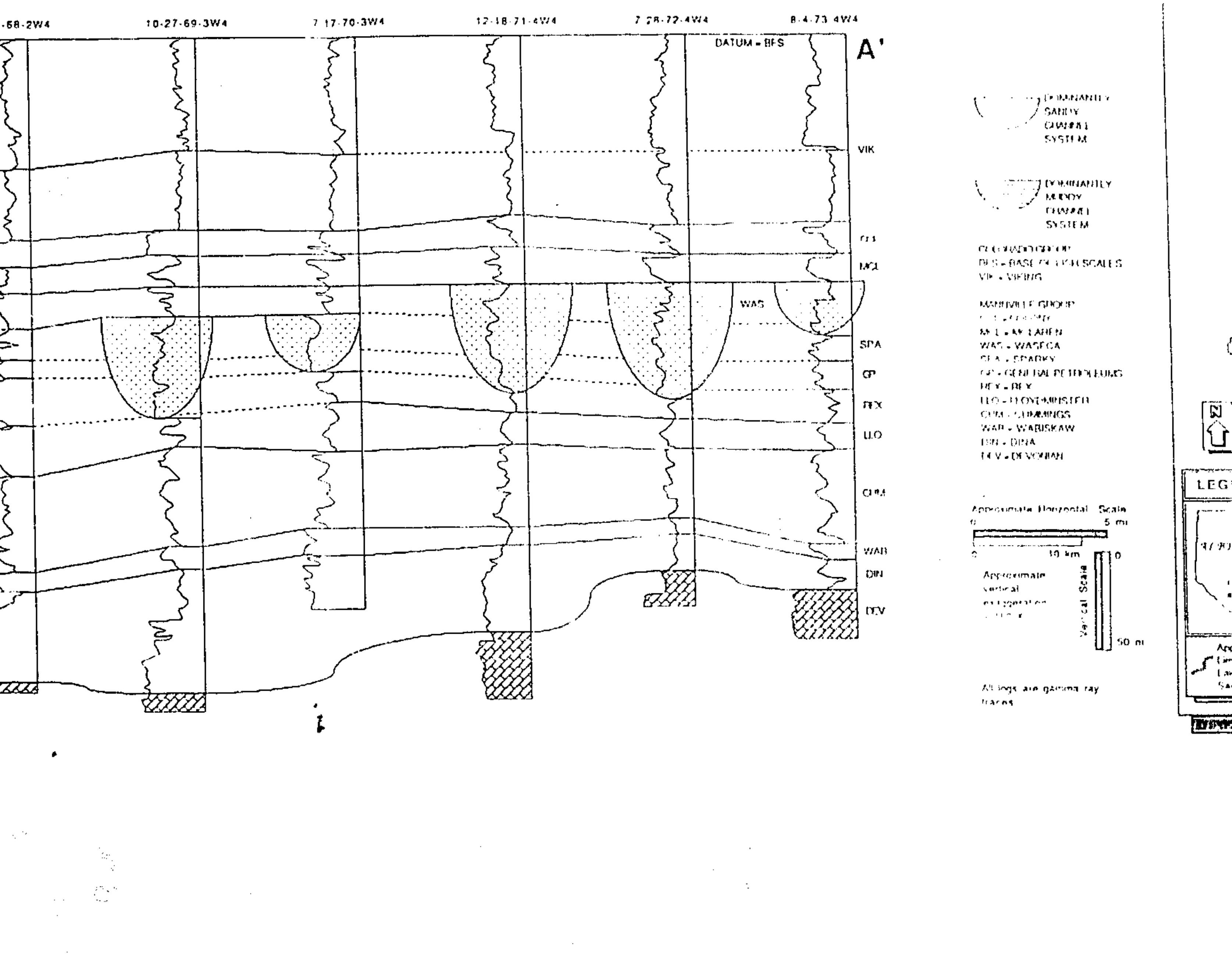


FIGURE 47

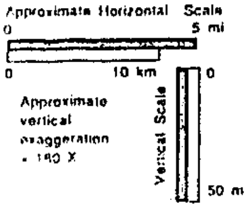
STRATIGRAPHIC CROSS-SECTION A-A': COLD LAKE OIL SANDS AREA

DOMINANTLY SANDY CHANNEL SYSTEM

DOMINANTLY MUDDY CHANNEL SYSTEM

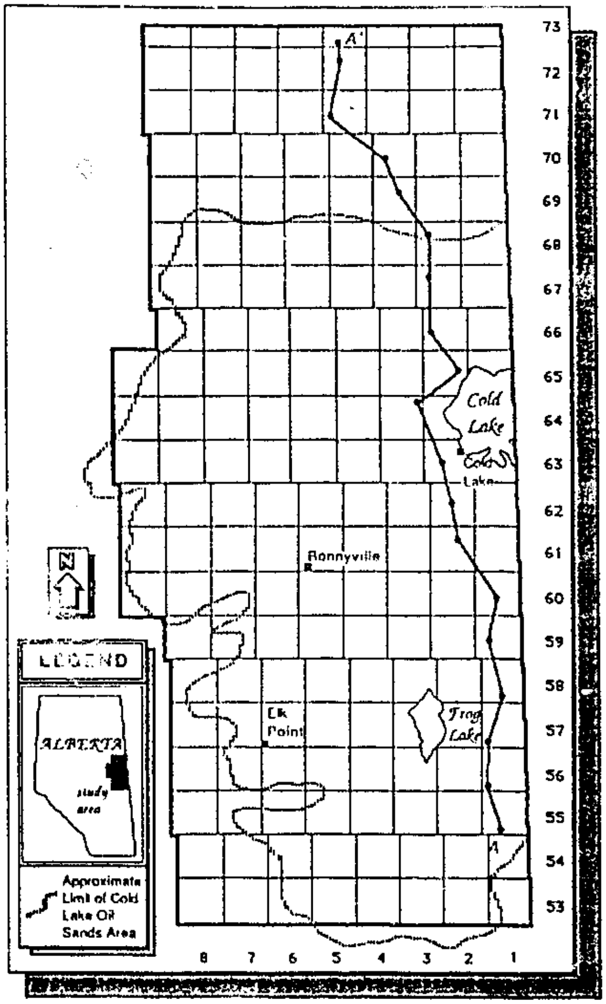
COLORADO GROUP
BFS = BASE OF FISH SCALES
VIK = VIKING

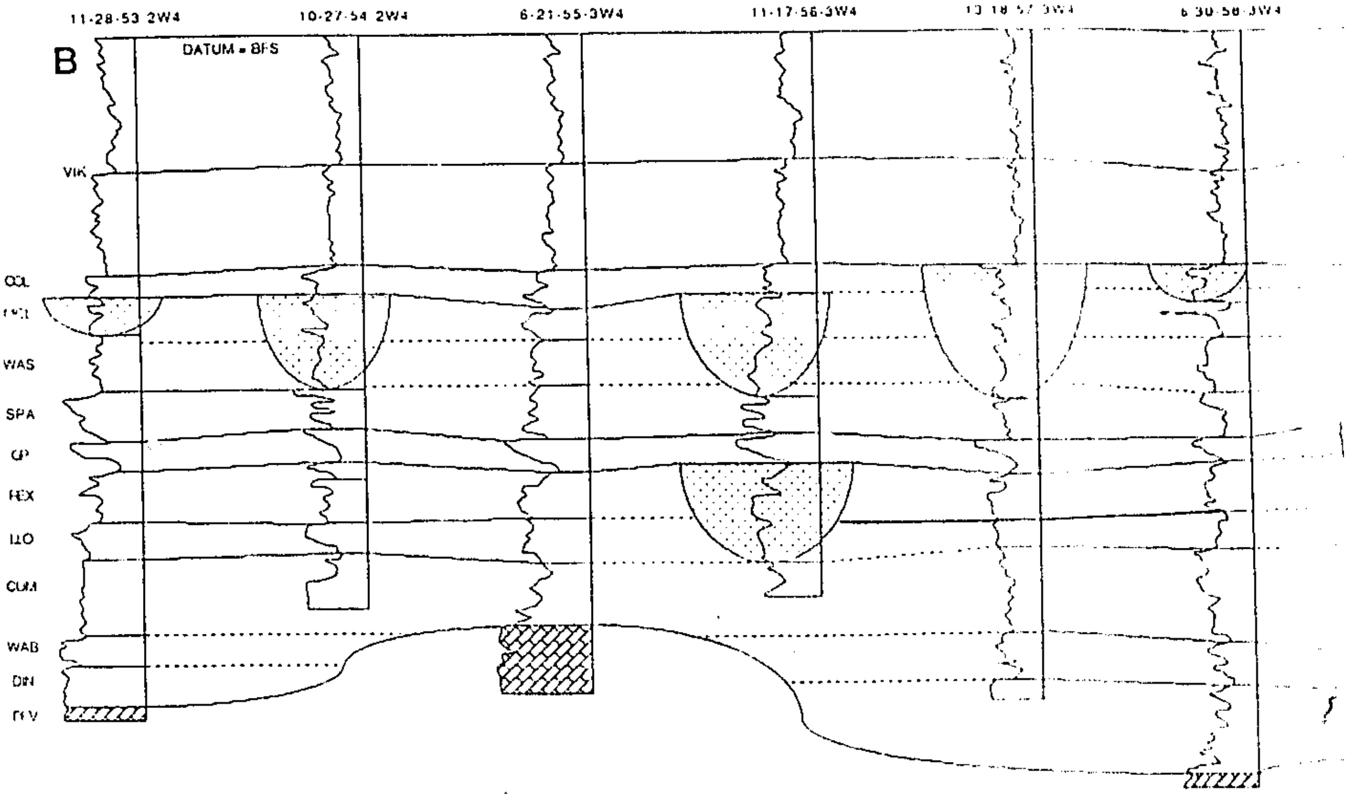
MANNVILLE GROUP
COL = COLONY
MCL = MCLAREN
WAS = WASECA
SPA = SPARKY
GP = GENERAL PETROLEUM
REX = REX
LLO = LLOYDMINSTER
CUM = CUMMINGS
WAB = WABISKAW
DIN = DINA
DEV = DEVONIAN

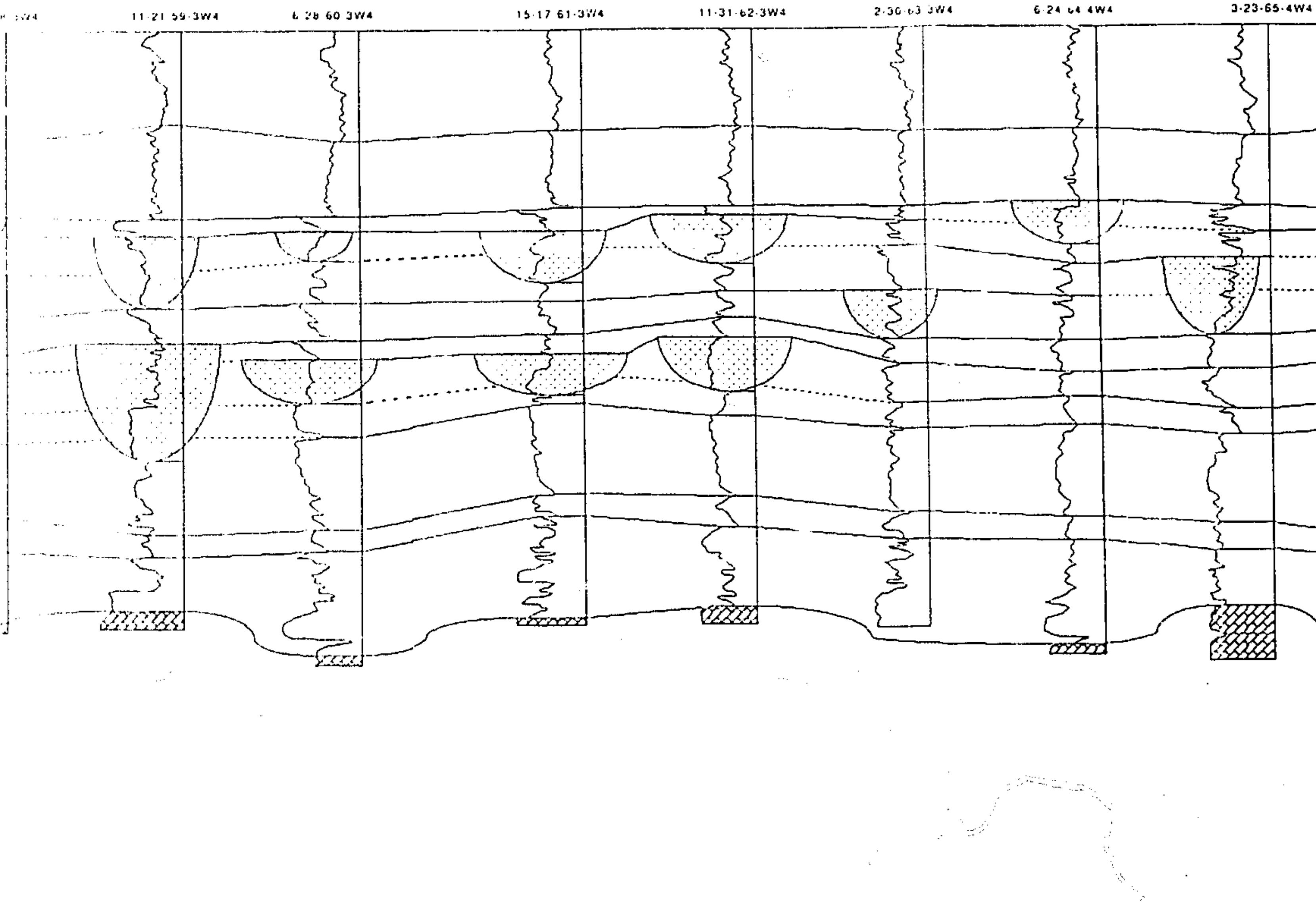


Approximate vertical exaggeration = 180 X

All logs are gamma ray traces




11-28-53-2W4
10-27-54-2W4
6-21-55-3W4
11-17-56-3W4
13-18-57-3W4
6-30-58-3W4
B
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV


3W4
11-21-59-3W4
6-28-60-3W4
15-17-61-3W4
11-31-62-3W4
2-30-63-3W4
6-24-64-4W4
3-23-65-4W4

C
COLL

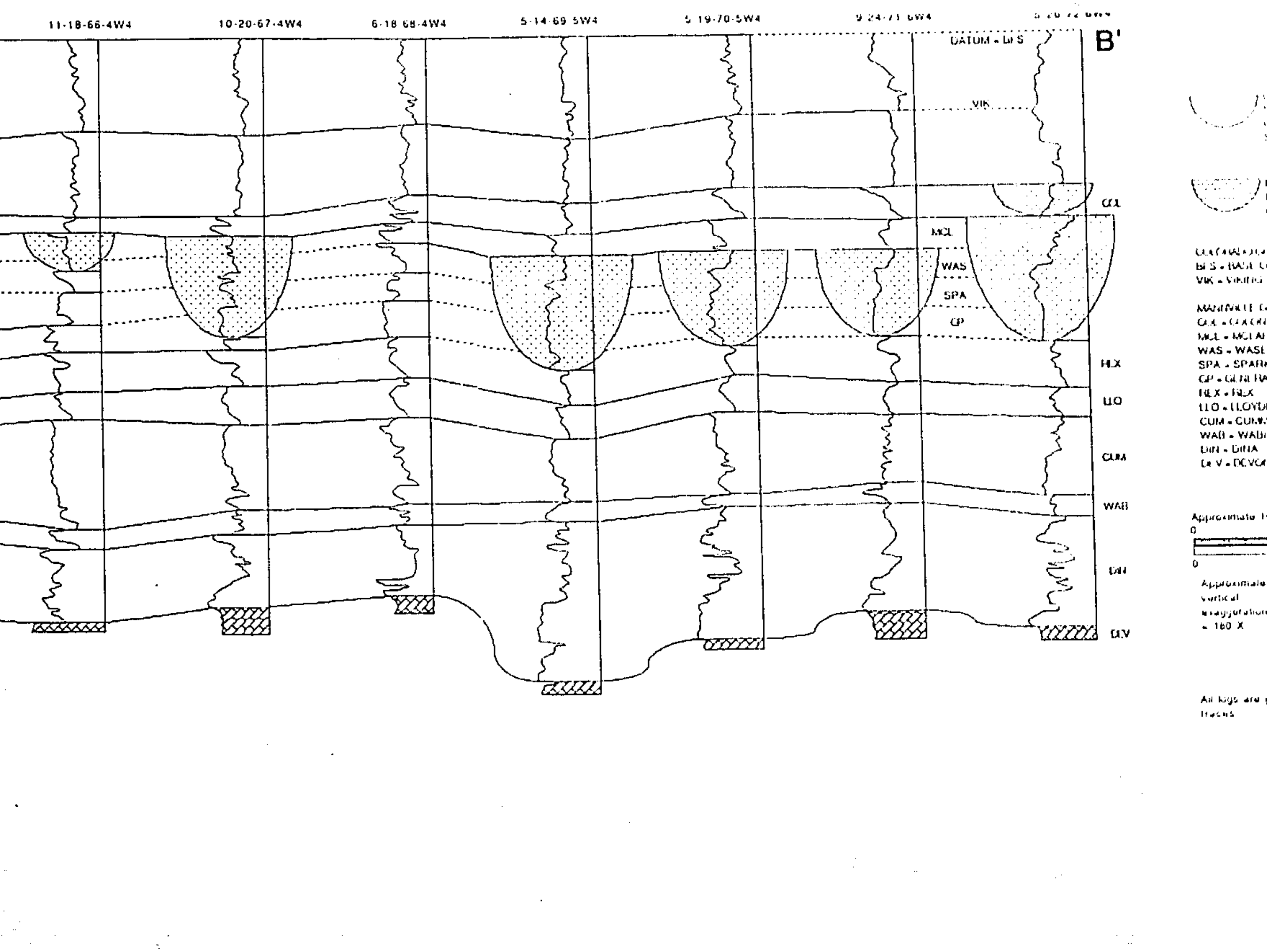

11-18-66-4W4
10-20-67-4W4
6-18-68-4W4
5-14-69-5W4
5-19-70-5W4
9-24-71-6W4
5-20-72-6W4
B'
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV
BFS = BASE C
VIK = VIKING
MANNVILLE G
COL = COLON
MCL = MCLAR
WAS = WASE
SPA = SPARK
GP = GENERA
REX = REX
LLO = LLOYD
CUM = CUMM
WAB = WABI
DIN = DINA
DEV = DEVO
Approximate H
0
0
Approximate vertical exaggeration = 160 X
All logs are g
tracks

FIGURE 48
STRATIGRAPHIC CROSS-SECTION B-B': COLD LAKE OIL SANDS AREA

DOMINANTLY SANDY CHANNEL SYSTEM

DOMINANTLY MUDDY CHANNEL SYSTEM

COLORADO GROUP:
BFS = BASE OF FISH SCALES
VIK = VIKING

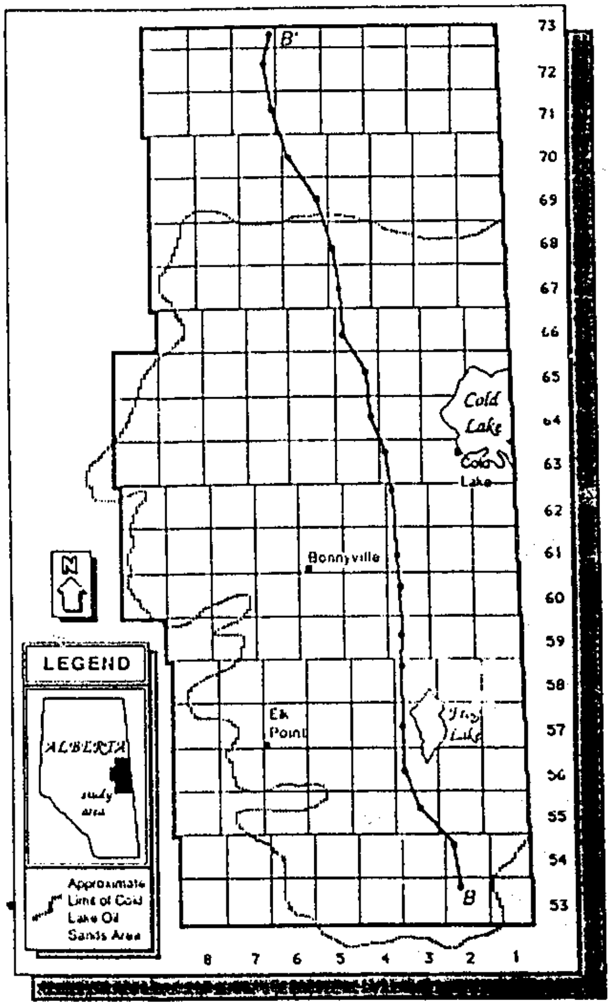
MANNVILLE GROUP:
COL = COLONY
MCL = MCLAREN
WAS = WASECA
SPA = SPARKY
GP = GENERAL PETROLEUMS
REX = REX
LLO = LLOYDMINSTER
CUM = CUMMINGS
WAB = WABISKAW
DIN = DINA
DEV = DEVONIAN

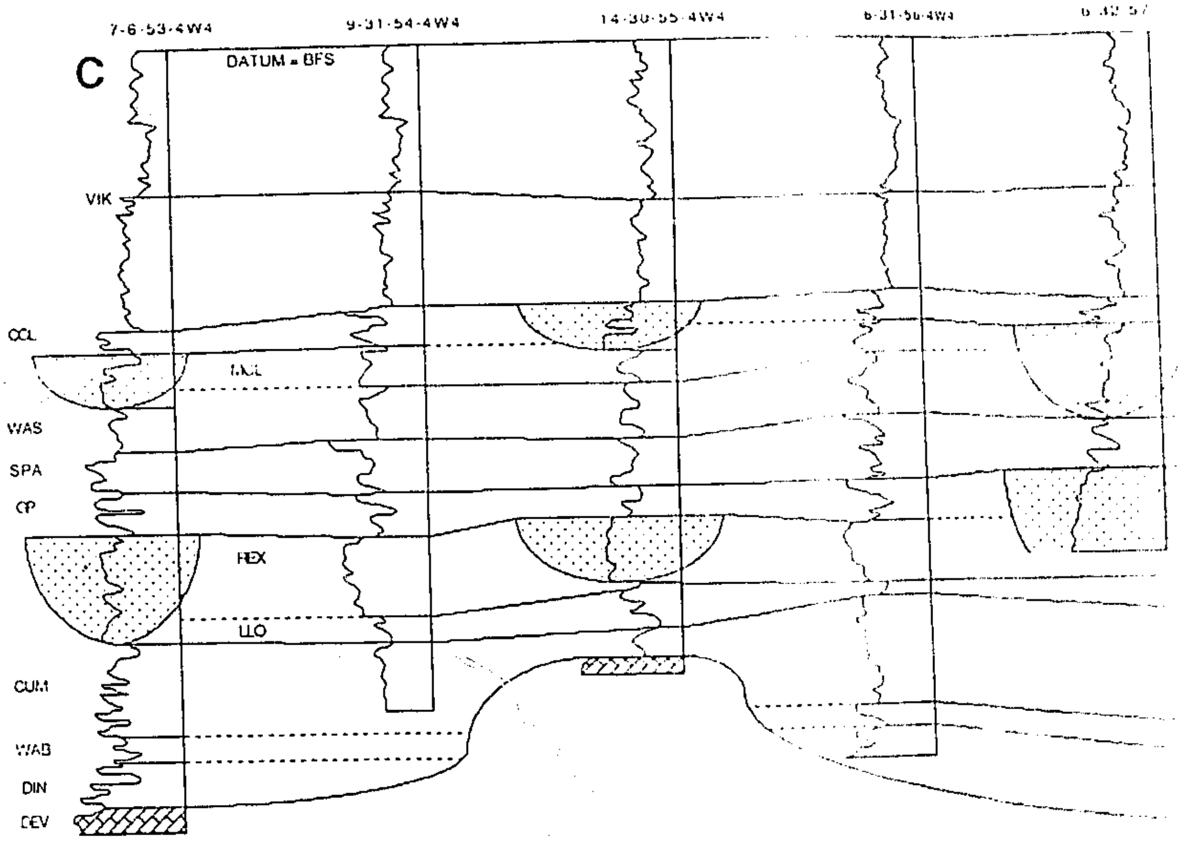
Approximate Horizontal Scale
0 5 mi
0 10 km

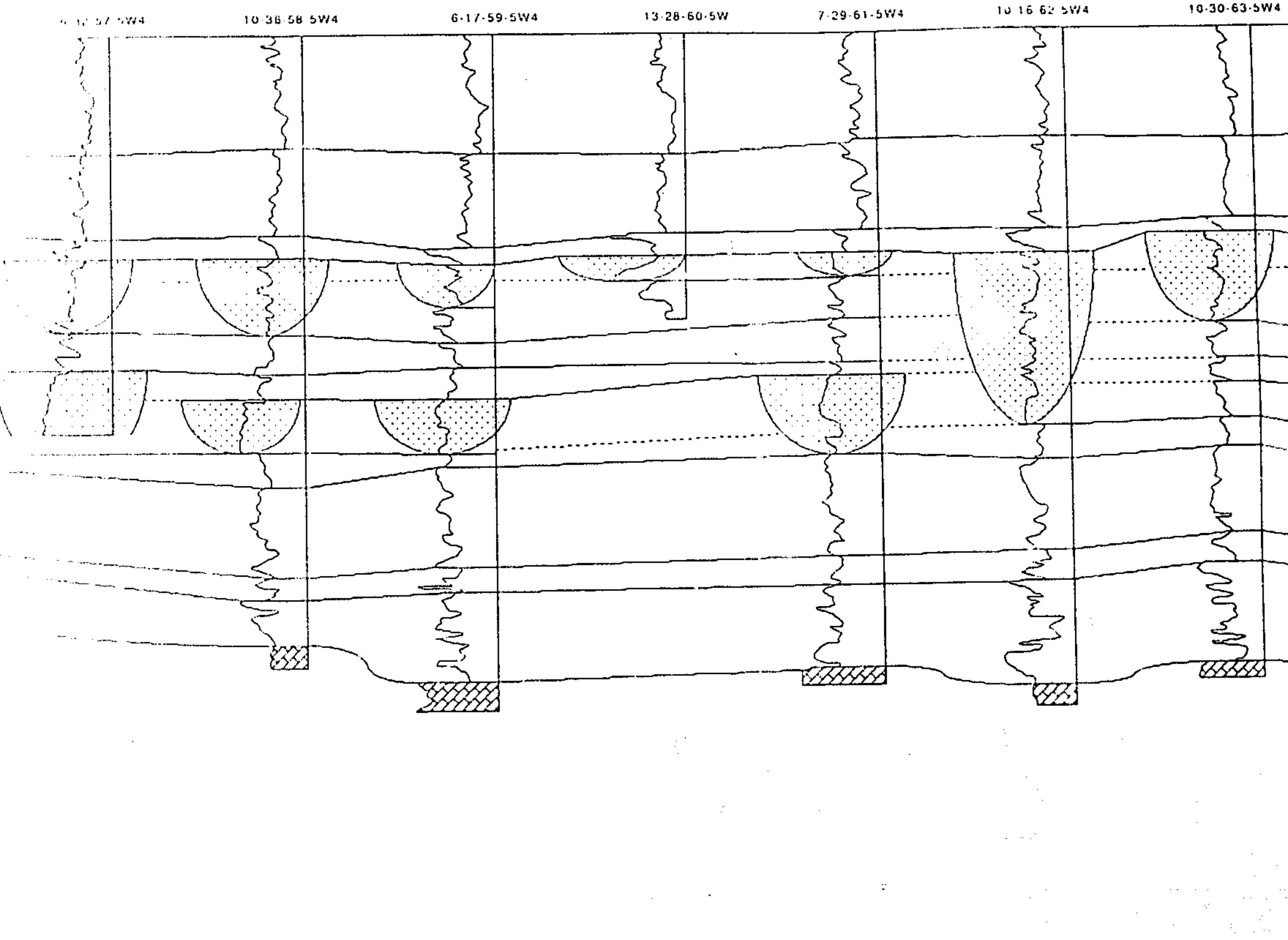
Approximate vertical exaggeration = 180 X

Vertical Scale 0 50 m

All logs are gamma ray traces




C
7-6-53-4W4
9-31-54-4W4
14-30-55-4W4
6-31-56-4W4
6-32-57
DATUM = BFS
VIK
CCL
MCL
WAS
SPA
CP
HEX
LLO
CUM
WAB
DIN
DEV


57-5W4
10-36-58-5W4
6-17-59-5W4
13-28-60-5W
7-29-61-5W4
10-16-62-5W4
10-30-63-5W4

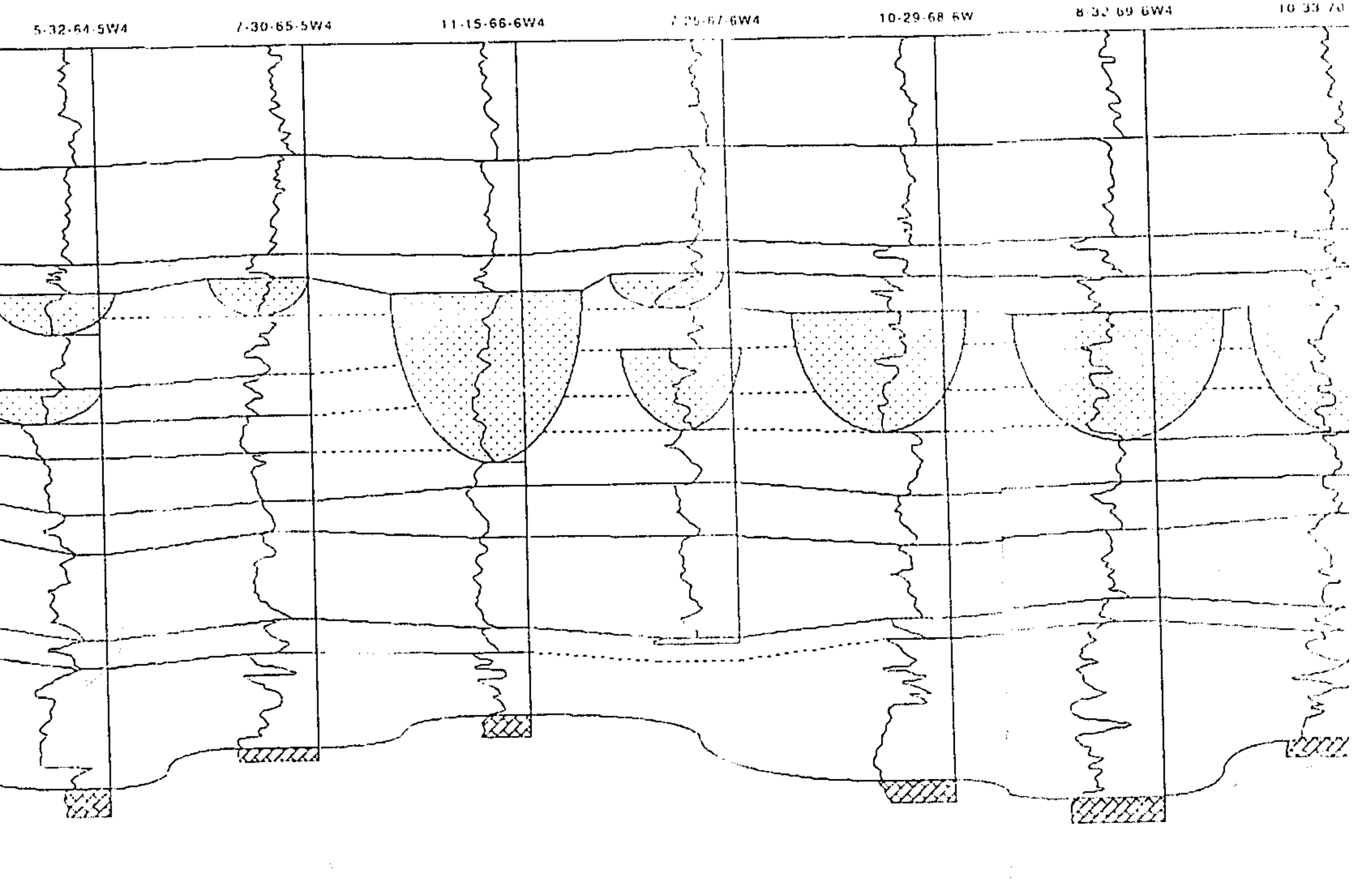
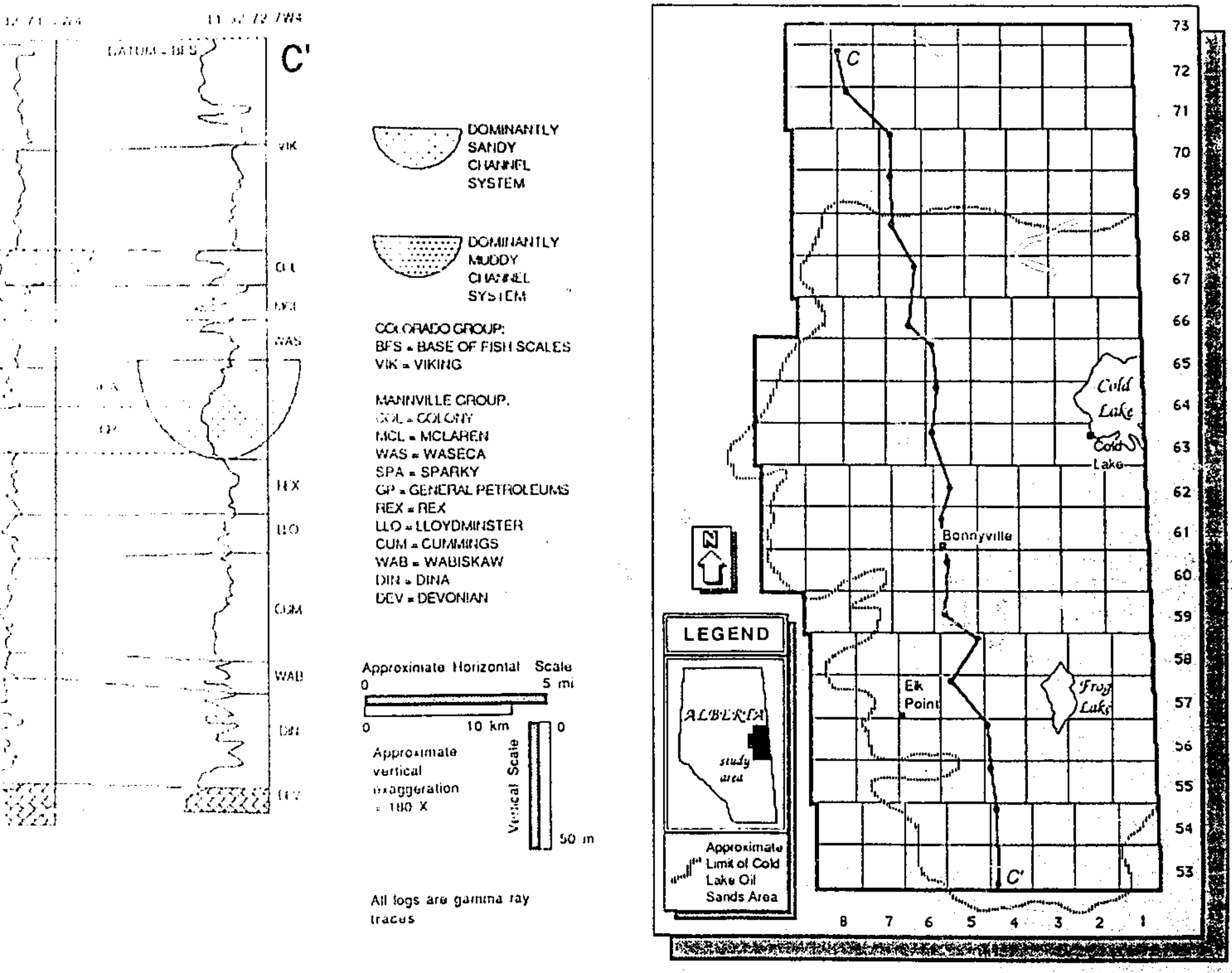
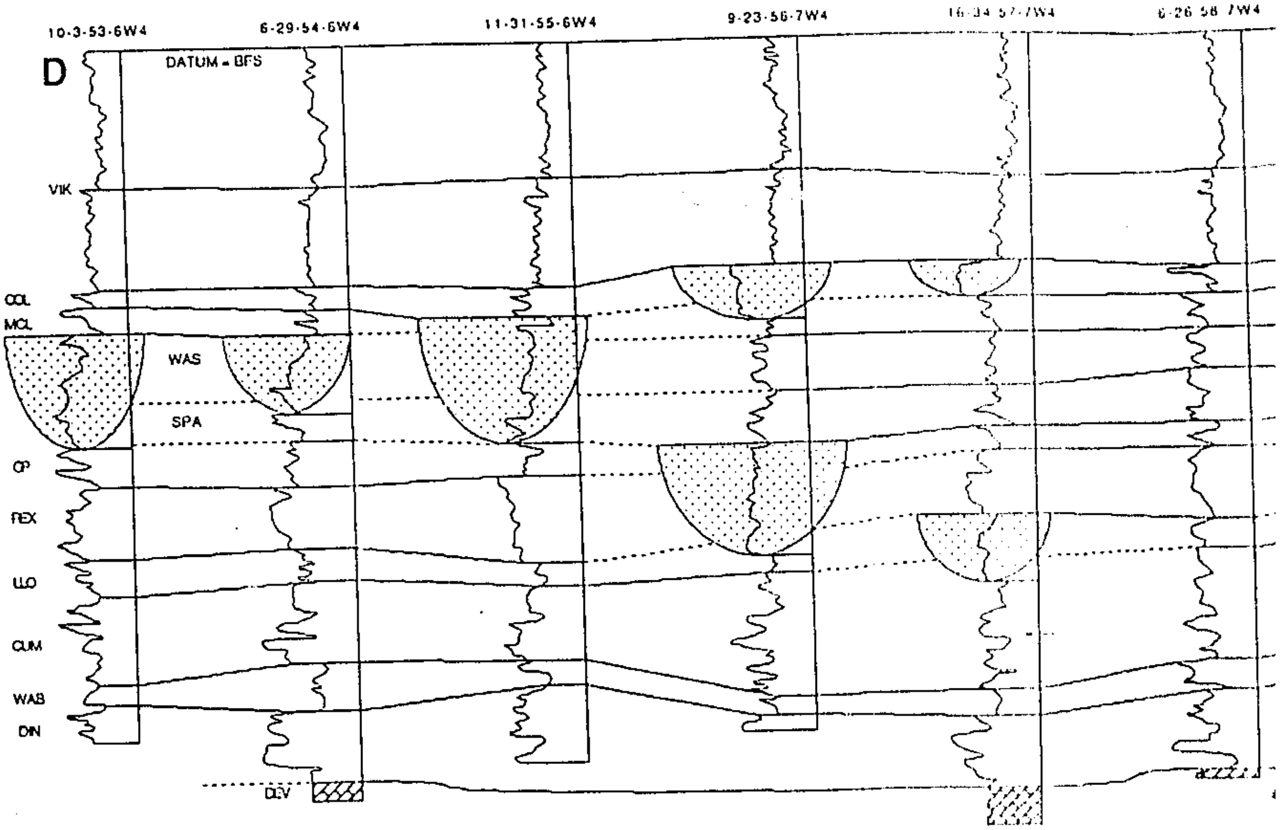
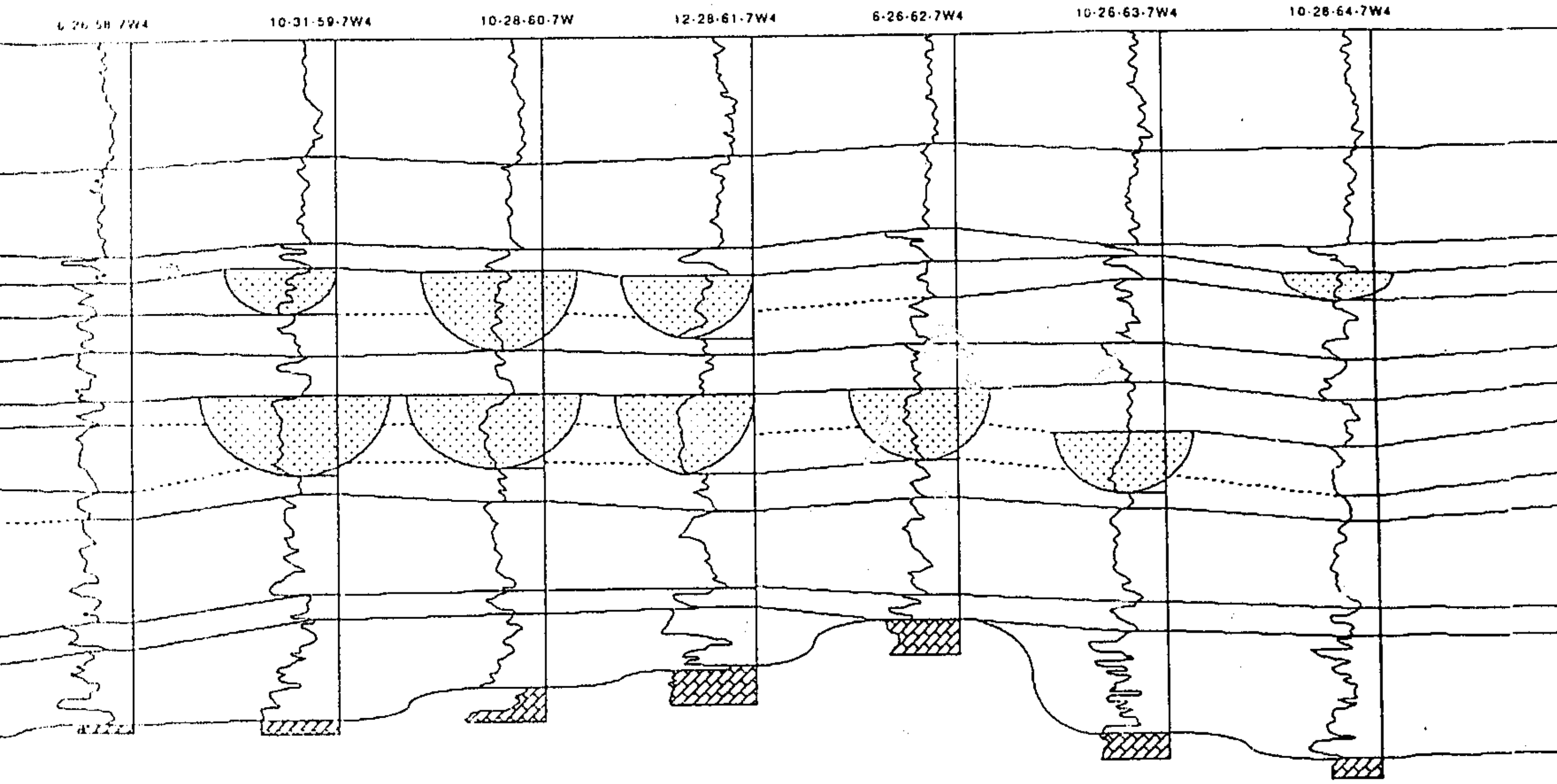

5-32-64-5W4
7-30-65-5W4
11-15-66-6W4
7-25-67-6W4
10-29-68-6W
8-32-69-6W4
10-33-70

FIGURE 49
STRATIGRAPHIC CROSS-SECTION C-C': COLD LAKE OIL SANDS AREA

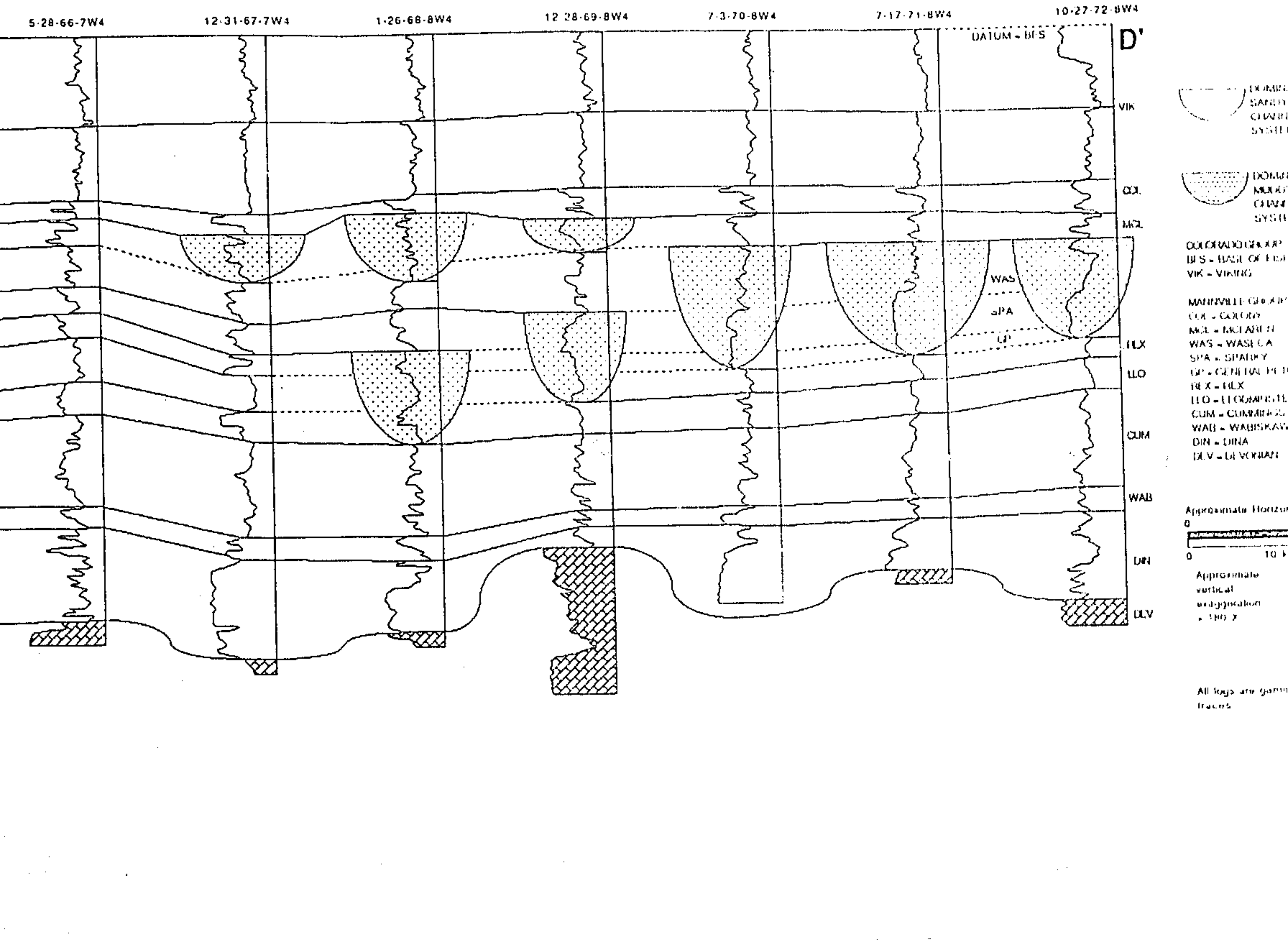



10-3-53-6W4
6-29-54-6W4
11-31-55-6W4
9-23-56-7W4
16-34-57-7W4
6-26-58-7W4
D
DATUM = BFS
VIK
COL
MCL
WAS
SPA
CP
REX
LLO
CUM
WAB
DIN
DEV



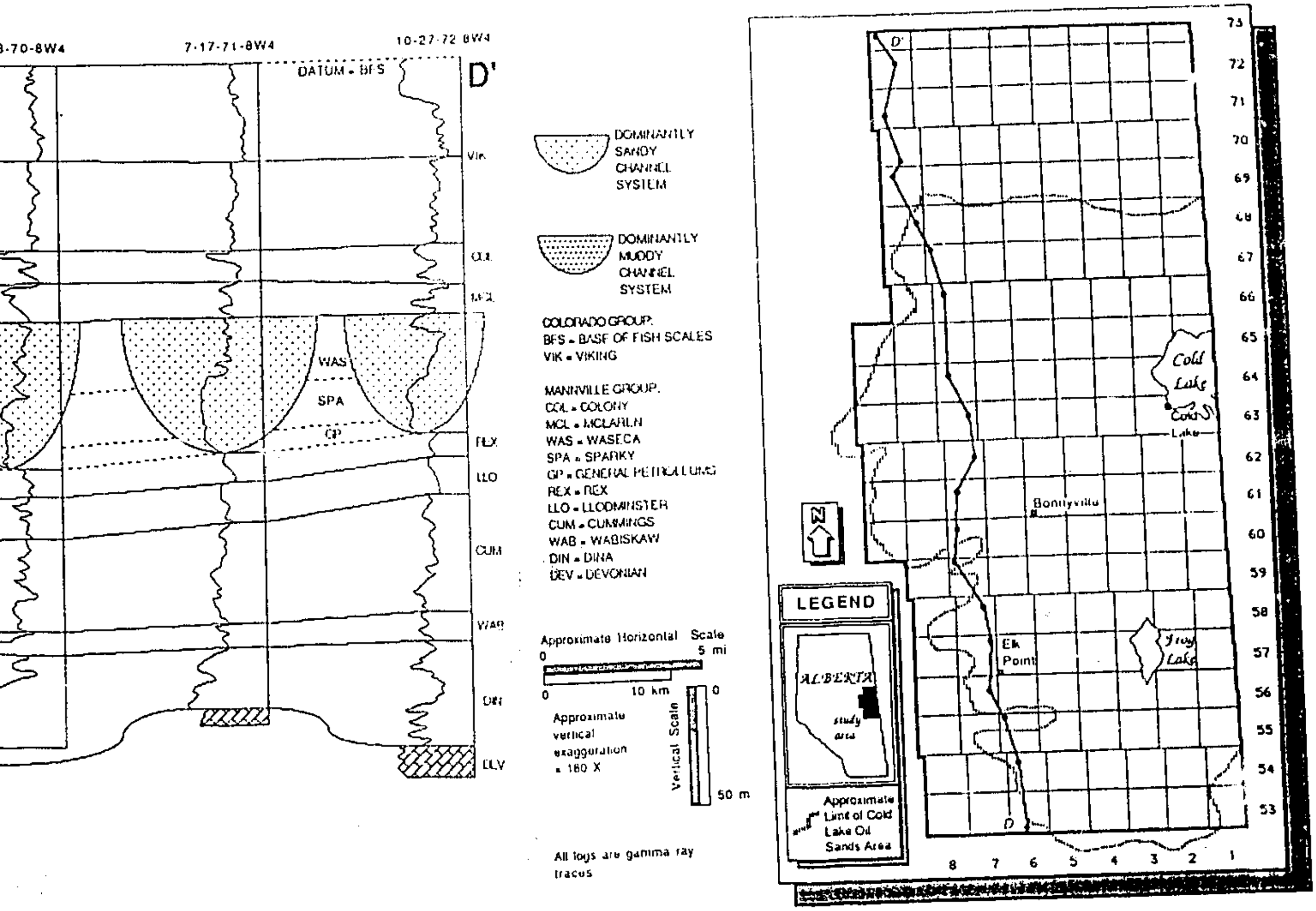
6-26-58-7W4
10-31-59-7W4
10-28-60-7W
12-28-61-7W4
6-26-62-7W4
10-26-63-7W4
10-28-64-7W4

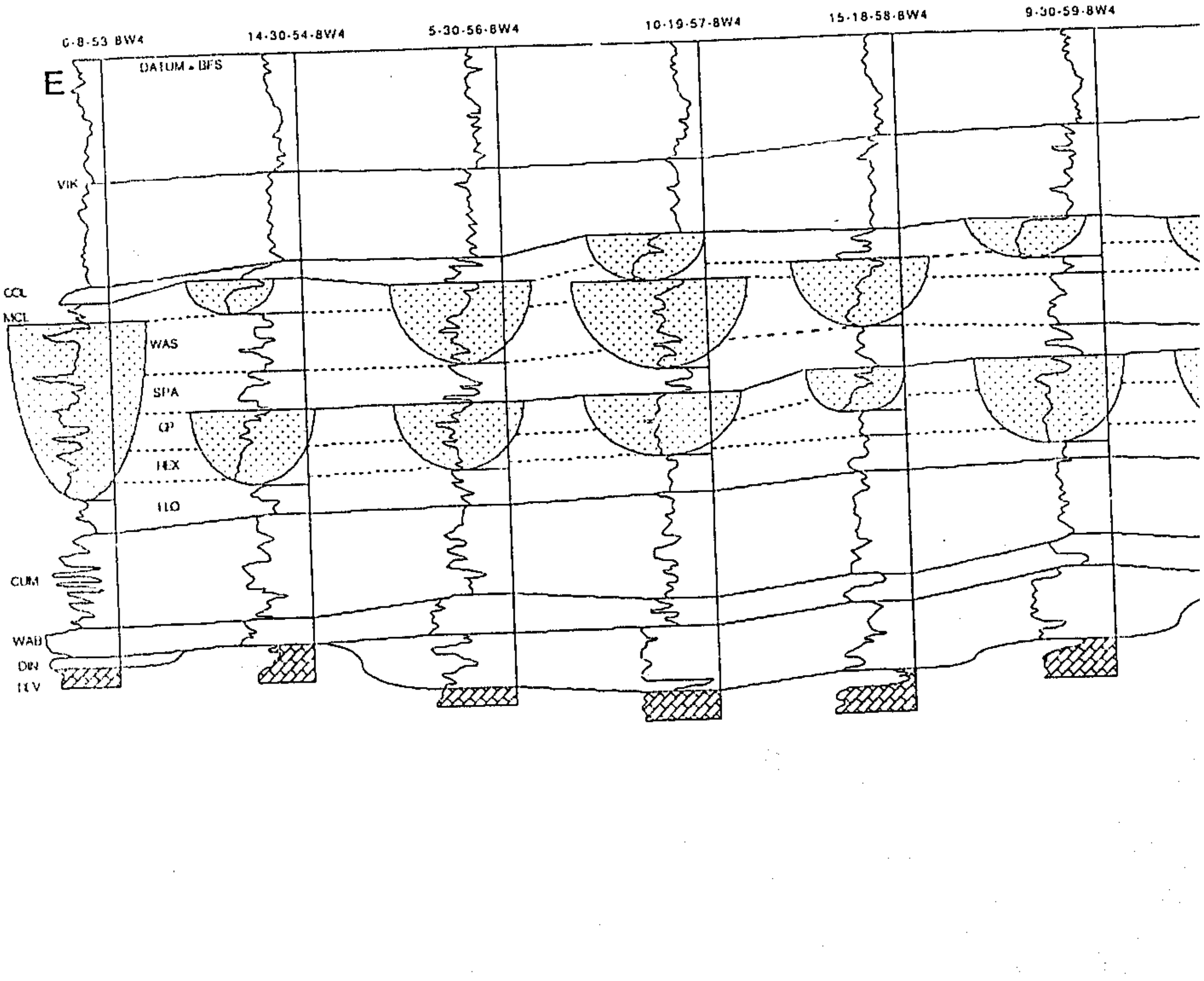
CI
COLD



5-28-66-7W4
12-31-67-7W4
1-26-68-8W4
12-28-69-8W4
7-3-70-8W4
7-17-71-8W4
10-27-72-8W4
DATUM = BFS
D'
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DLV
DOMIN
SANDY
CHANN
SYSTE
DOMIN
MUDD
CHAN
SYSTE
COLORADO GROUP
BFS = BASE OF FISH
VIK = VIKING
MANNVILLE GROUP
COL = COLONY
MCL = MCLAREN
WAS = WASECA
SPA = SPARKY
GP = GENERAL PET
REX = REX
LLO = LLOYDMINSTE
CUM = CUMMINGS
WAB = WABISKAW
DIN = DINA
DLV = DEVONIAN
Approximate Horizon
0
0
10 K
Approximate vertical exaggeration = 180 X
All logs are gamm traces

FIGURE 50
STRATIGRAPHIC CROSS-SECTION D-D': COLD LAKE OIL SANDS AREA




E
6-8-53 8W4
14-30-54-8W4
5-30-56-8W4
10-19-57-8W4
15-18-58-8W4
9-30-59-8W4
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGUR

STRATIG

CROSS-SEC

COLD LAKE O

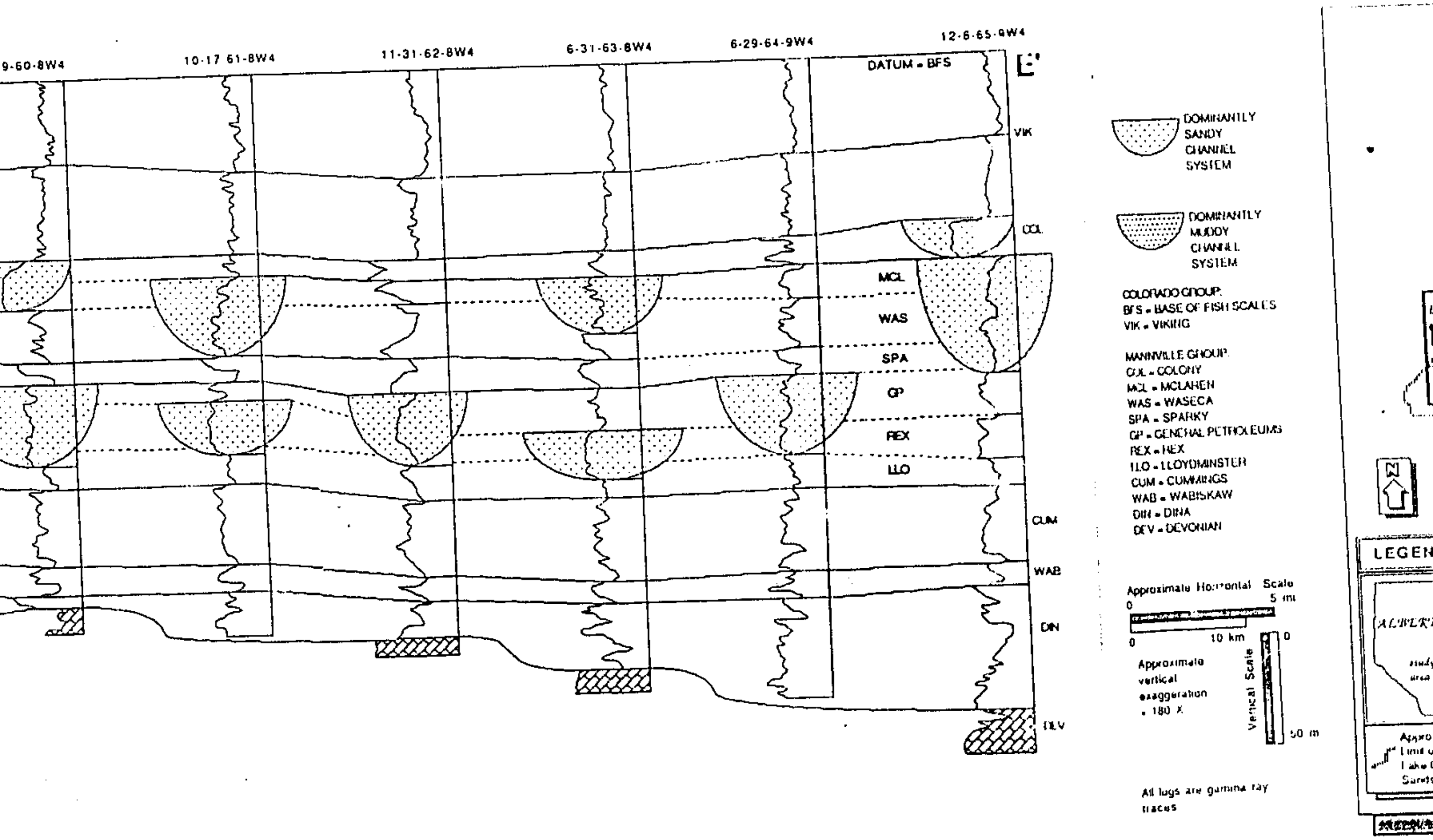
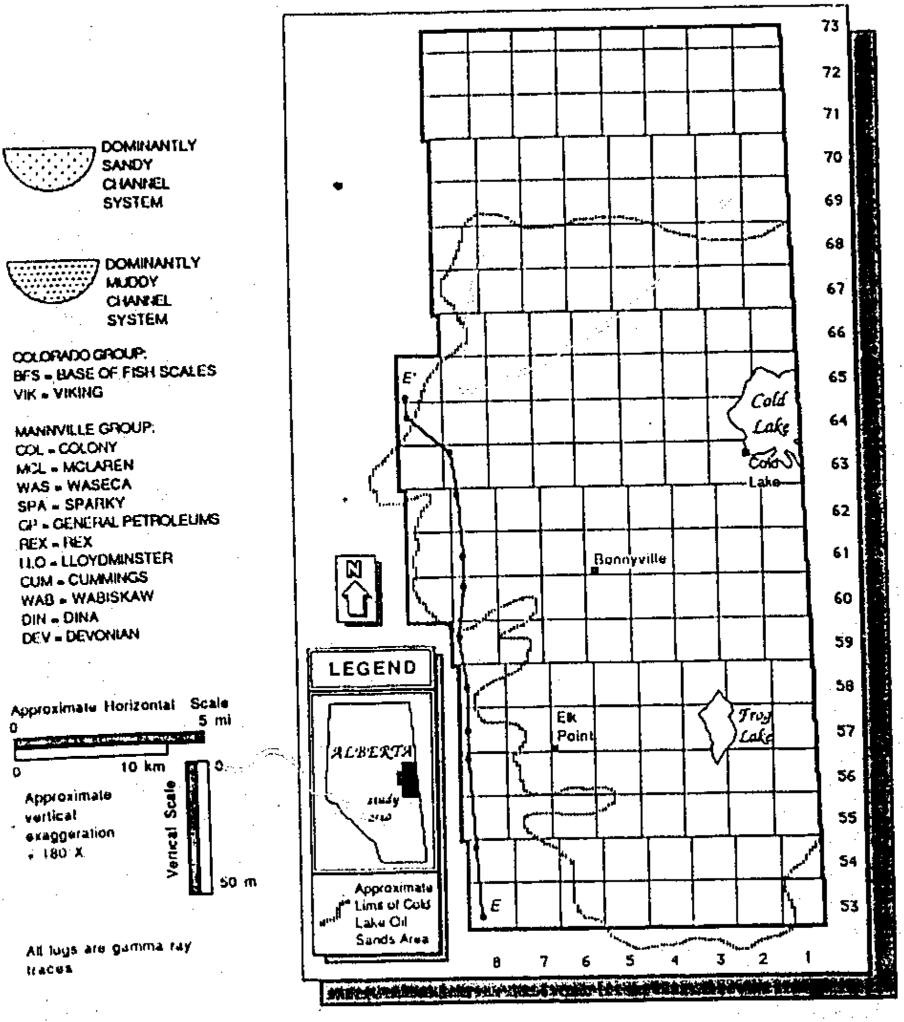


FIGURE 51
STRATIGRAPHIC CROSS-SECTION E-E': COLD LAKE OIL SANDS AREA



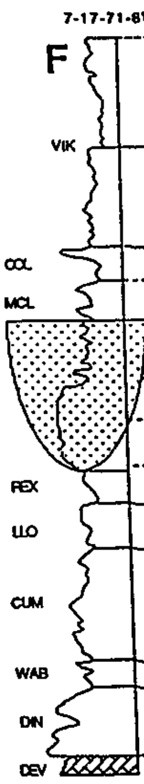
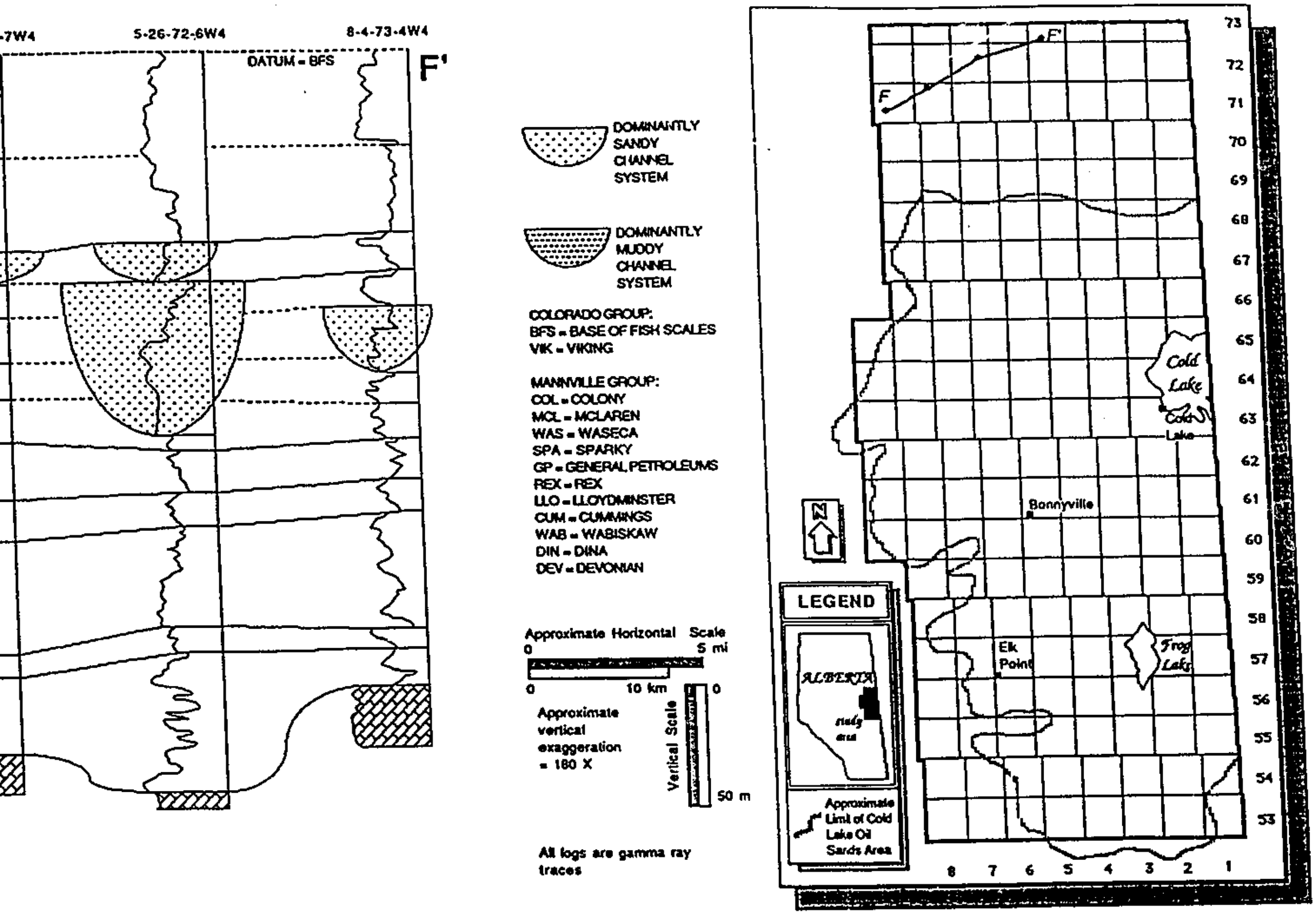


FIGURE 52

STRATIGRAPHIC CROSS-SECTION F-F': COLD LAKE OIL SANDS AREA



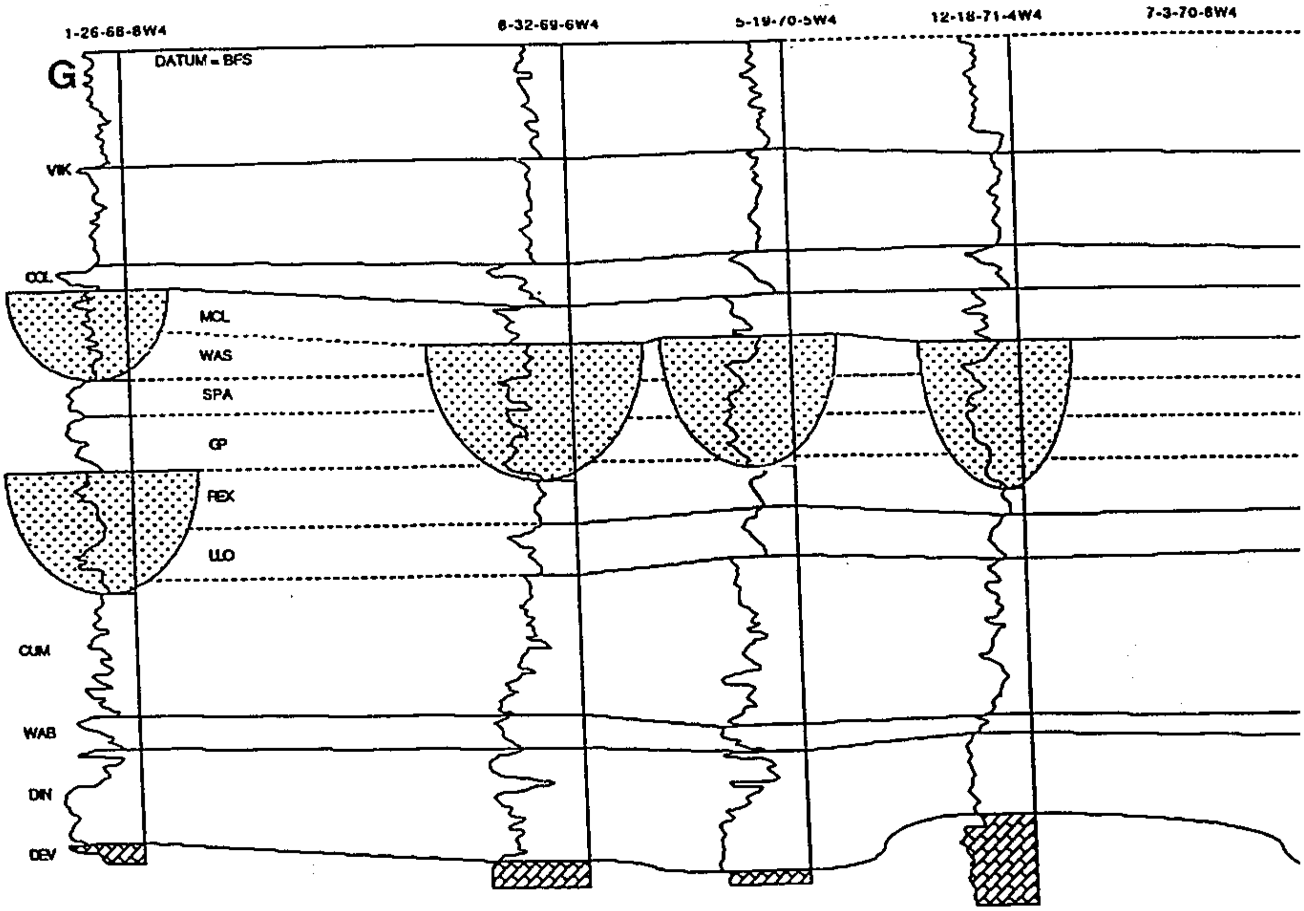
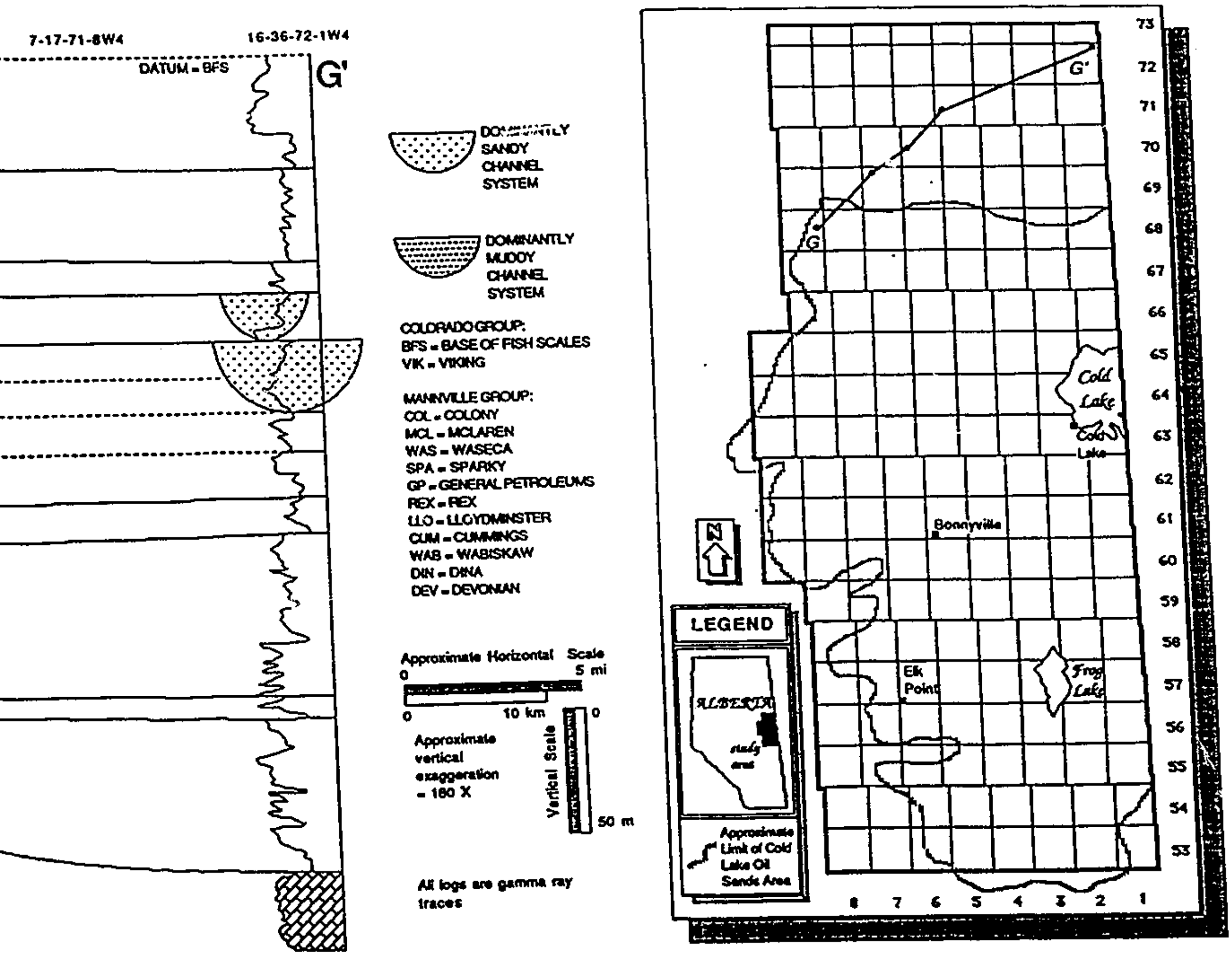

1-26-68-8W4
6-32-69-6W4
5-19-70-5W4
12-18-71-4W4
7-3-70-6W4
G
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 53

STRATIGRAPHIC CROSS-SECTION G-G': COLD LAKE OIL SANDS AREA



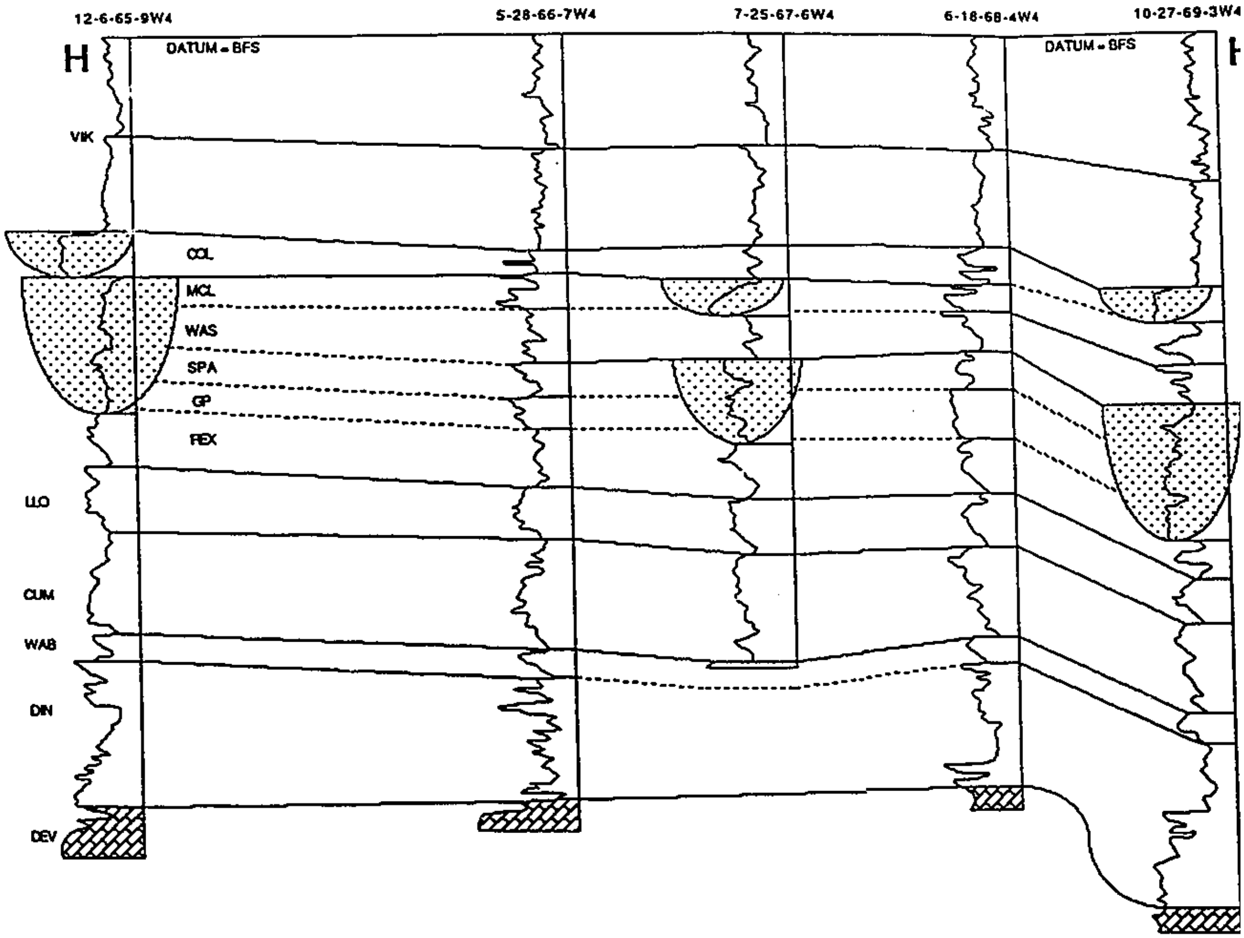
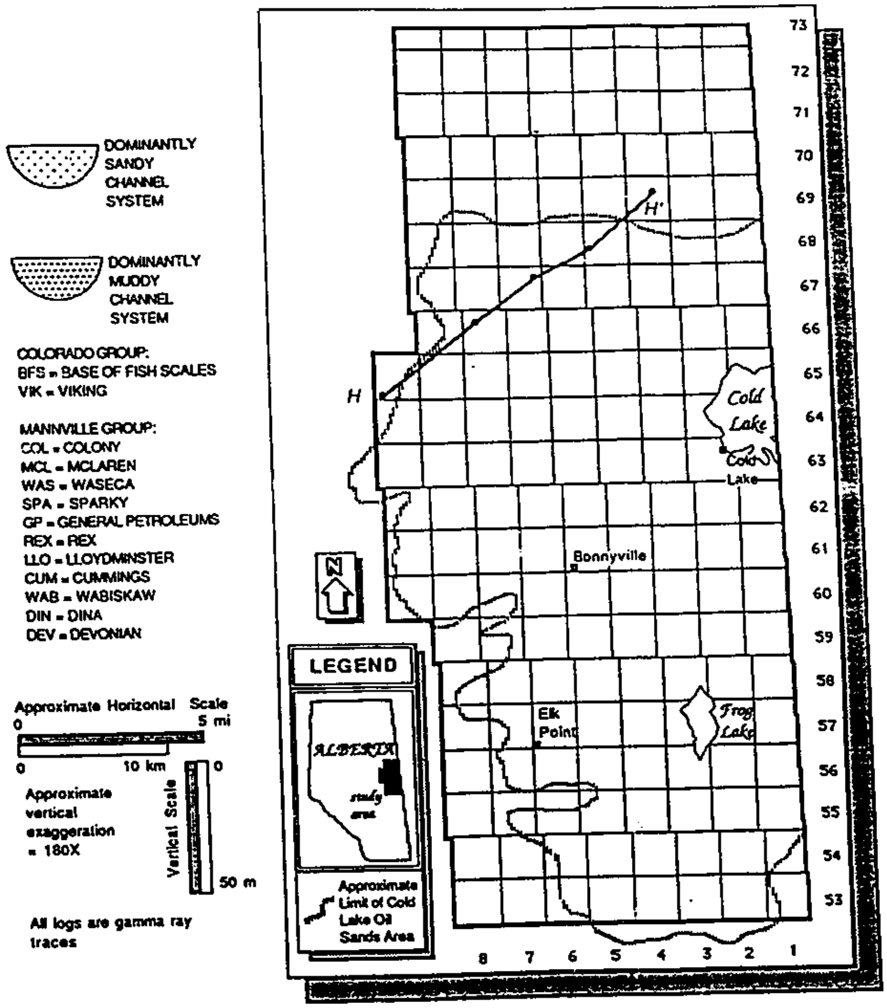

12-6-65-9W4
5-28-66-7W4
7-25-67-6W4
6-18-68-4W4
10-27-69-3W4
H
DATUM = BFS
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 54

STRATIGRAPHIC CROSS-SECTION H-H': COLD LAKE OIL SANDS AREA



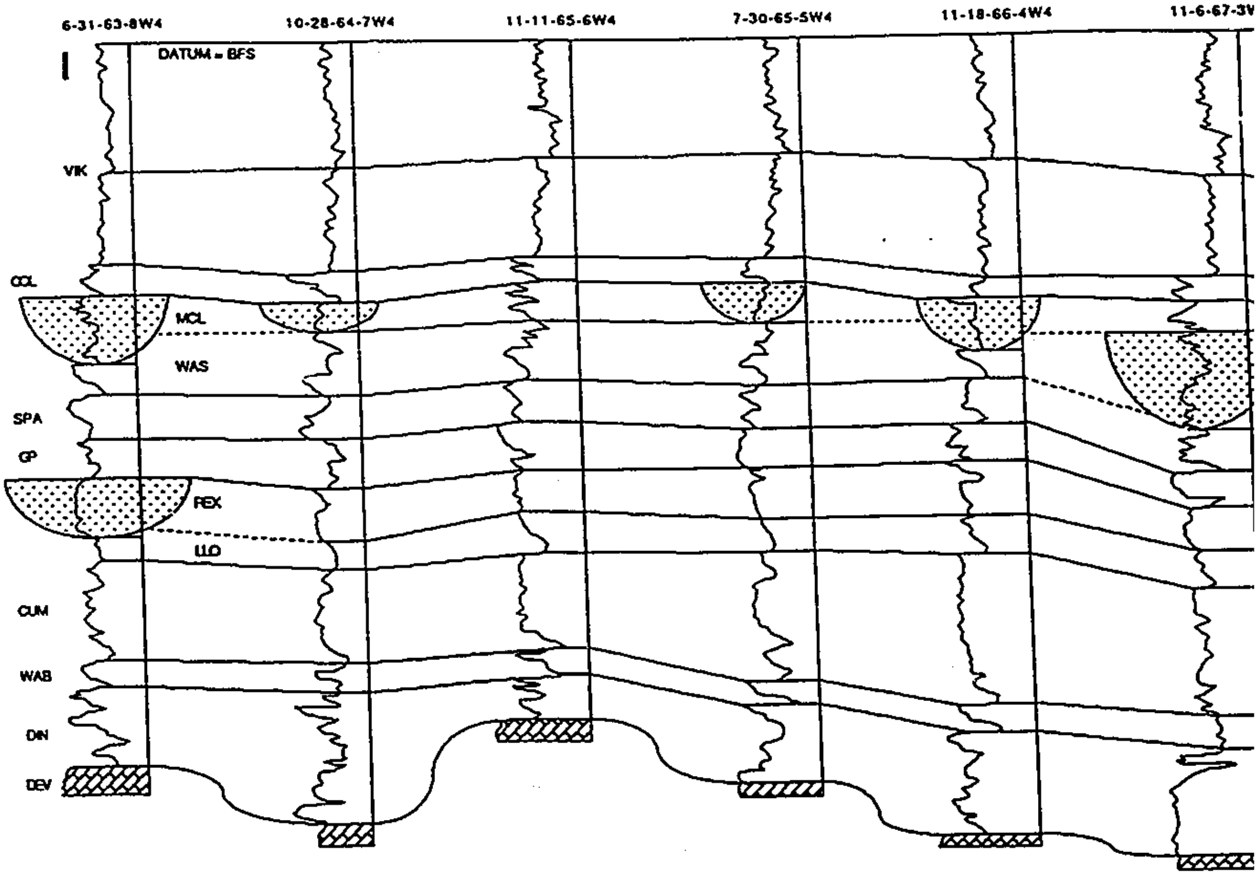
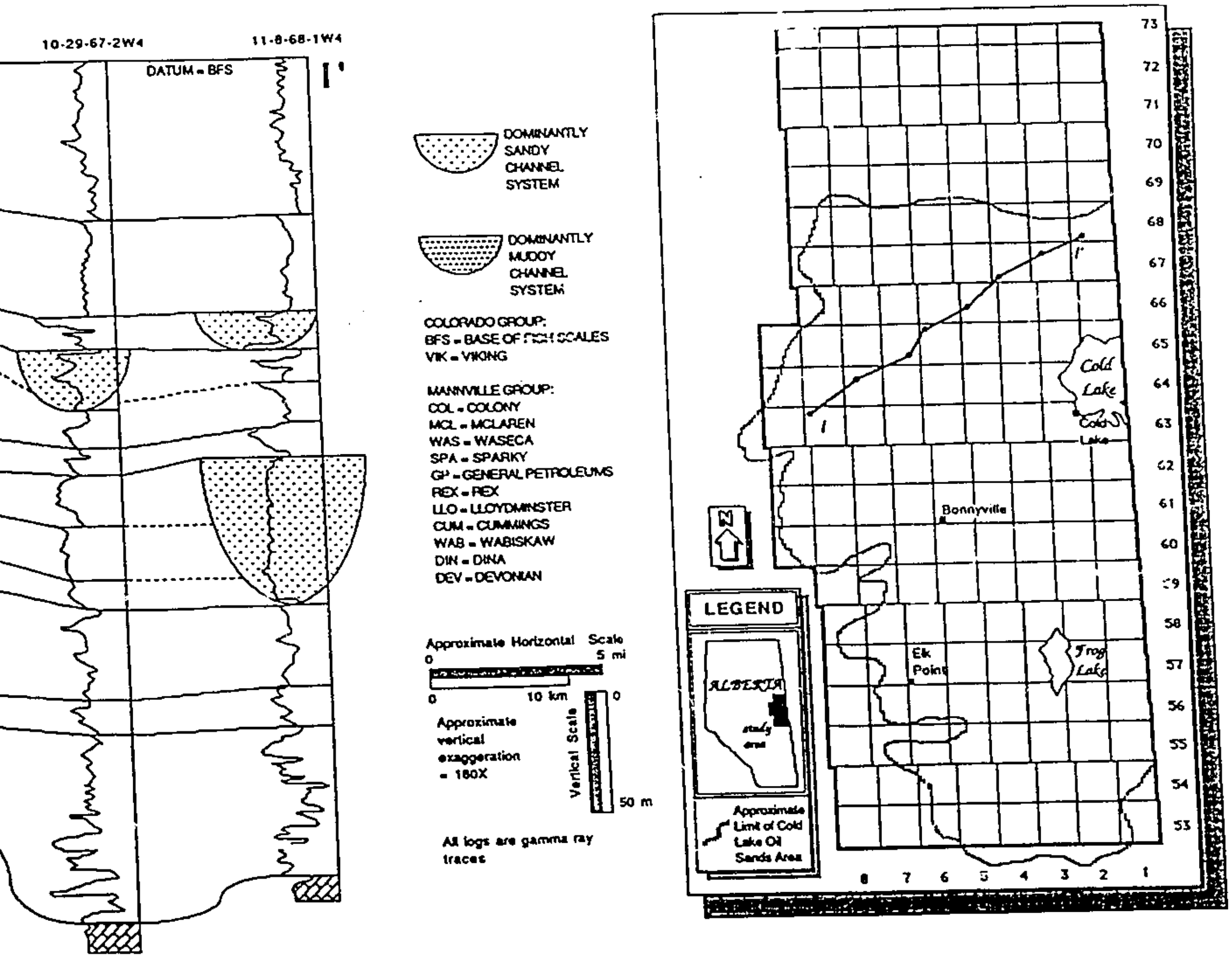

6-31-63-8W4
10-28-64-7W4
11-11-65-6W4
7-30-65-5W4
11-18-66-4W4
11-6-67-3
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 55

STRATIGRAPHIC CROSS-SECTION I-I': COLD LAKE OIL SANDS AREA



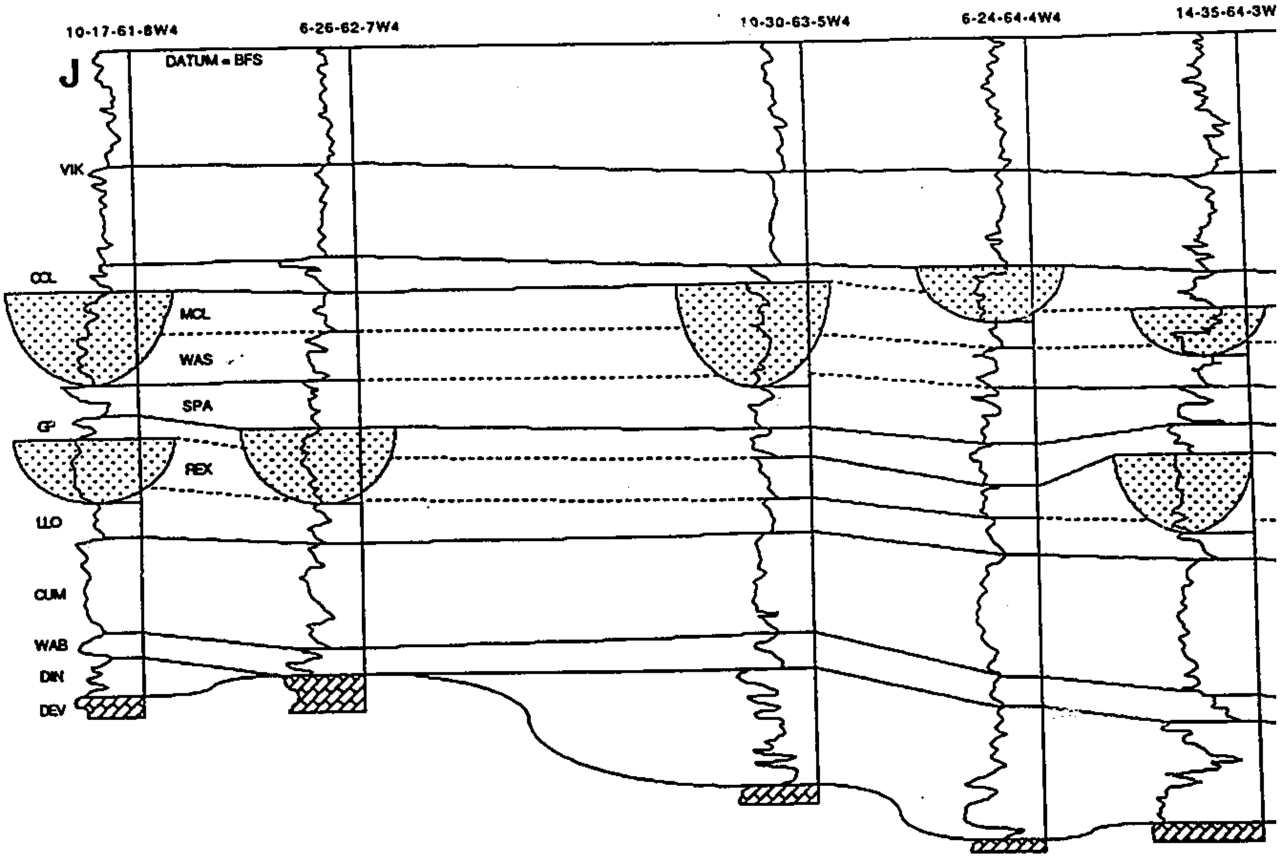
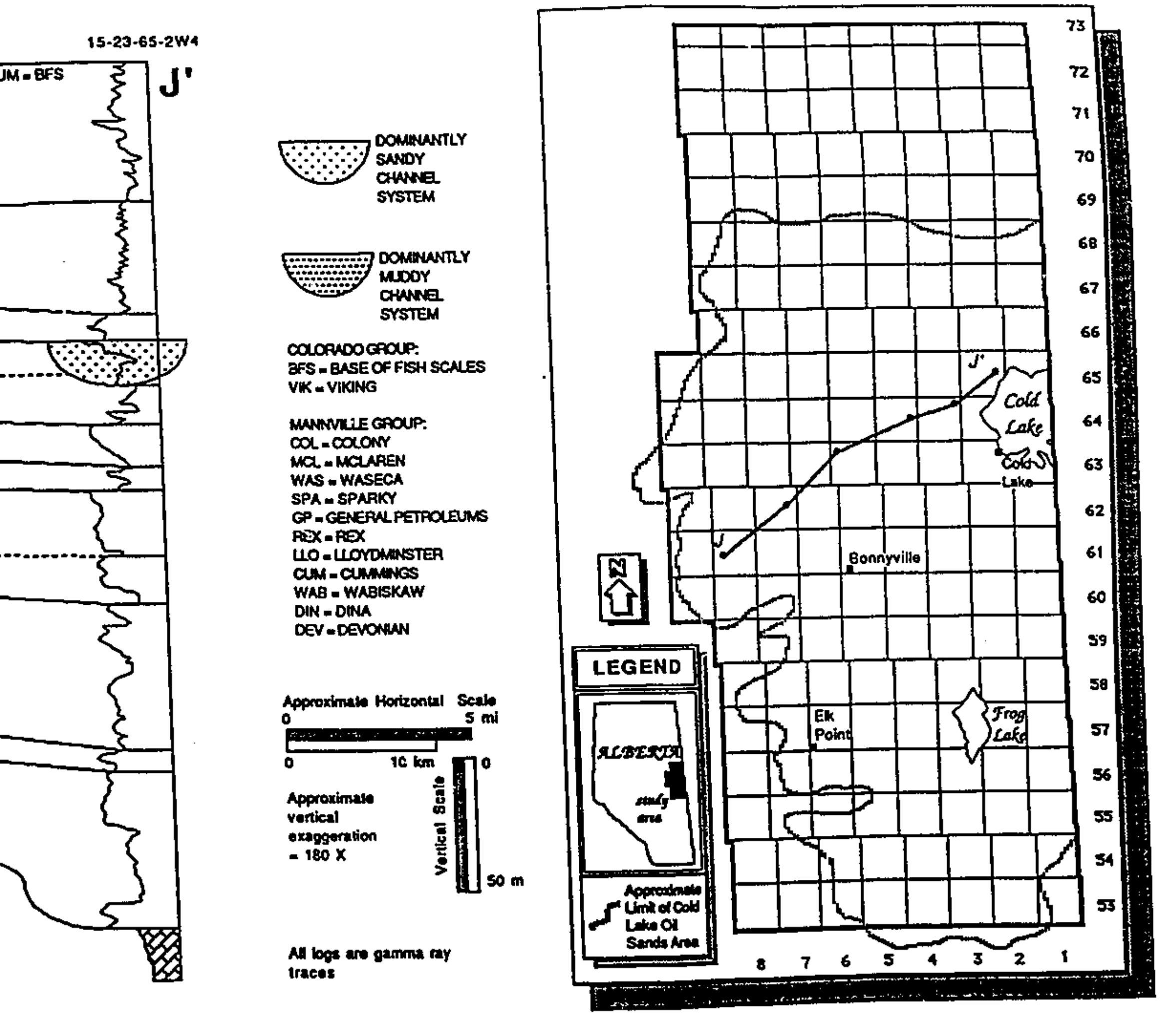

J
10-17-61-8W4
6-26-62-7W4
10-30-63-5W4
6-24-64-4W4
14-35-64-3W
DATUM = BFS
VIK
CCL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 56

STRATIGRAPHIC CROSS-SECTION J-J': COLD LAKE OIL SANDS AREA



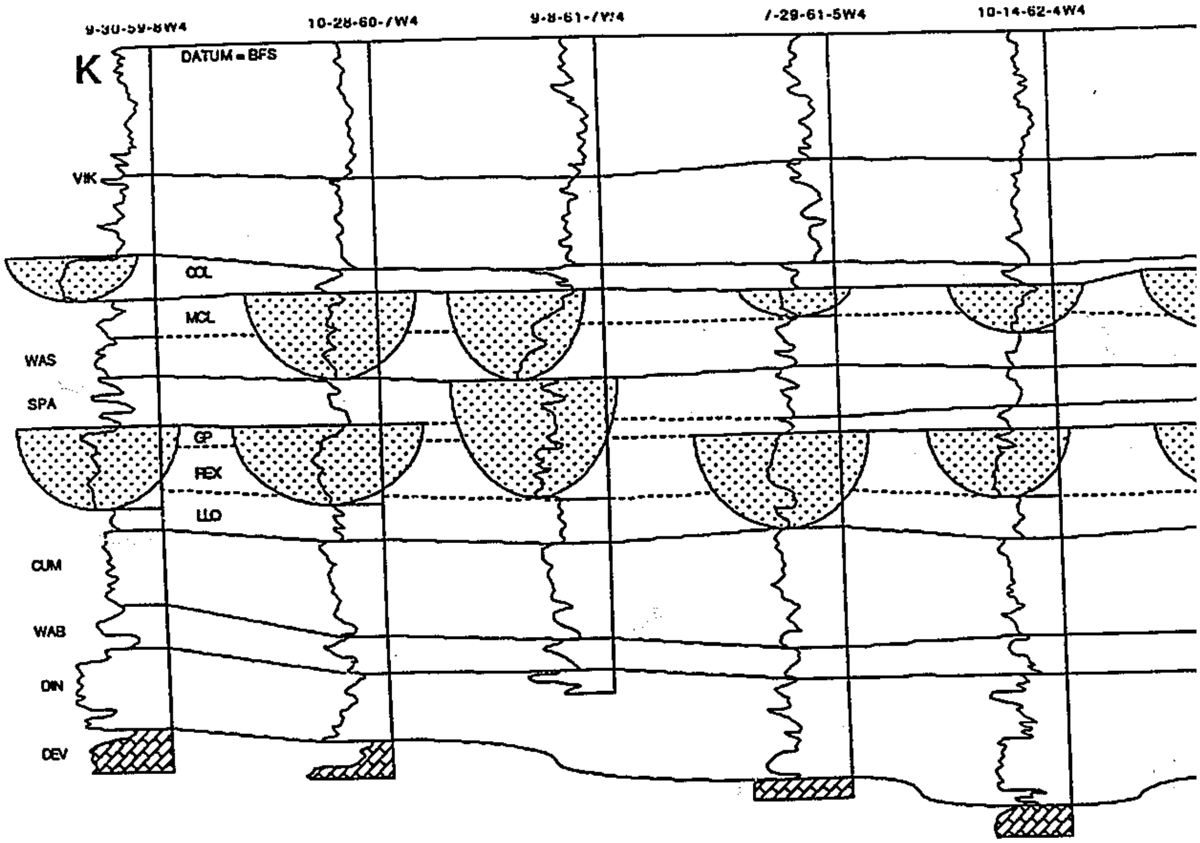
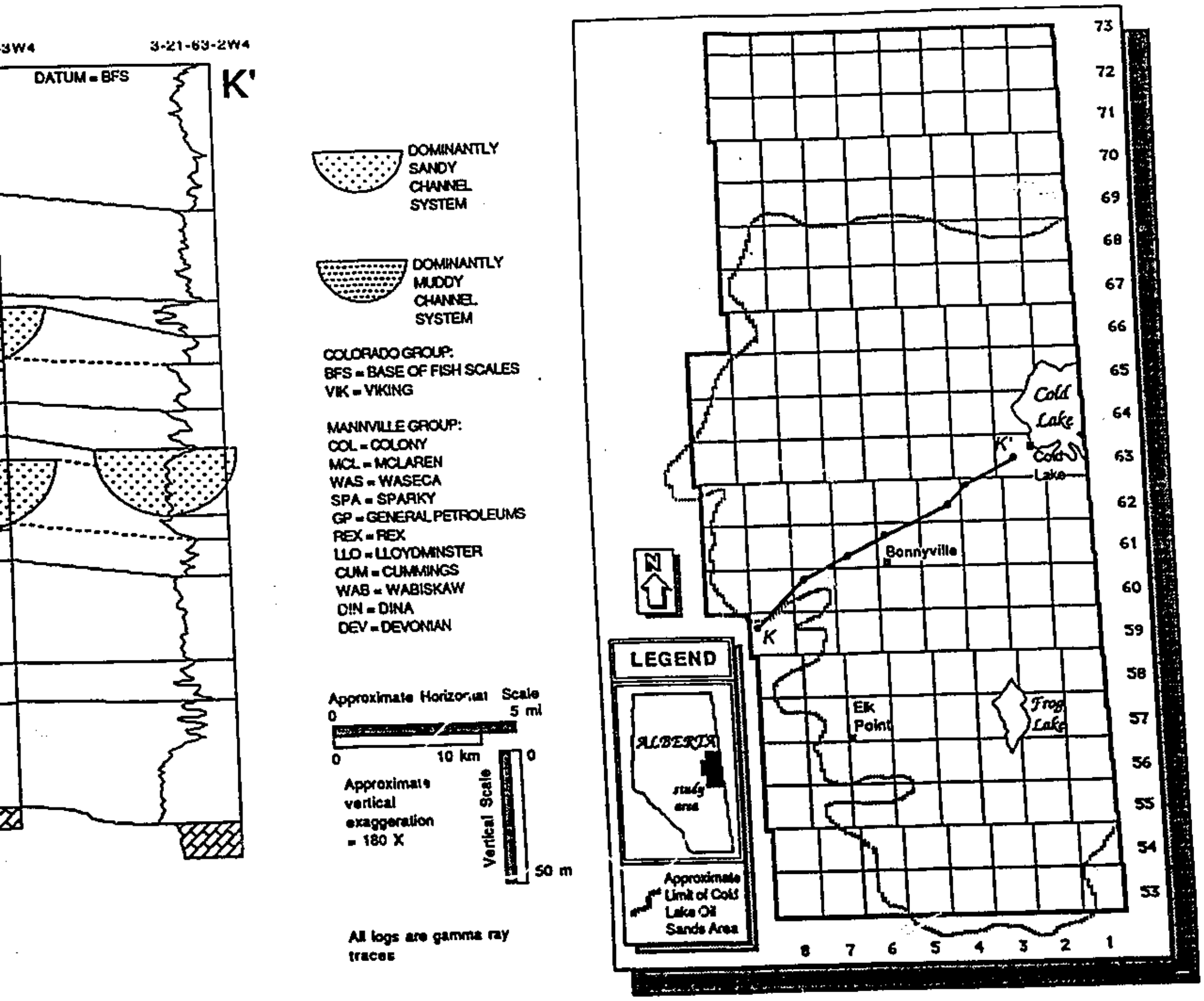

9-30-59-8W4
10-28-60-7W4
9-8-61-7W4
7-29-61-5W4
10-14-62-4W4
K
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 57

STRATIGRAPHIC CROSS-SECTION K-K': COLD LAKE OIL SANDS AREA



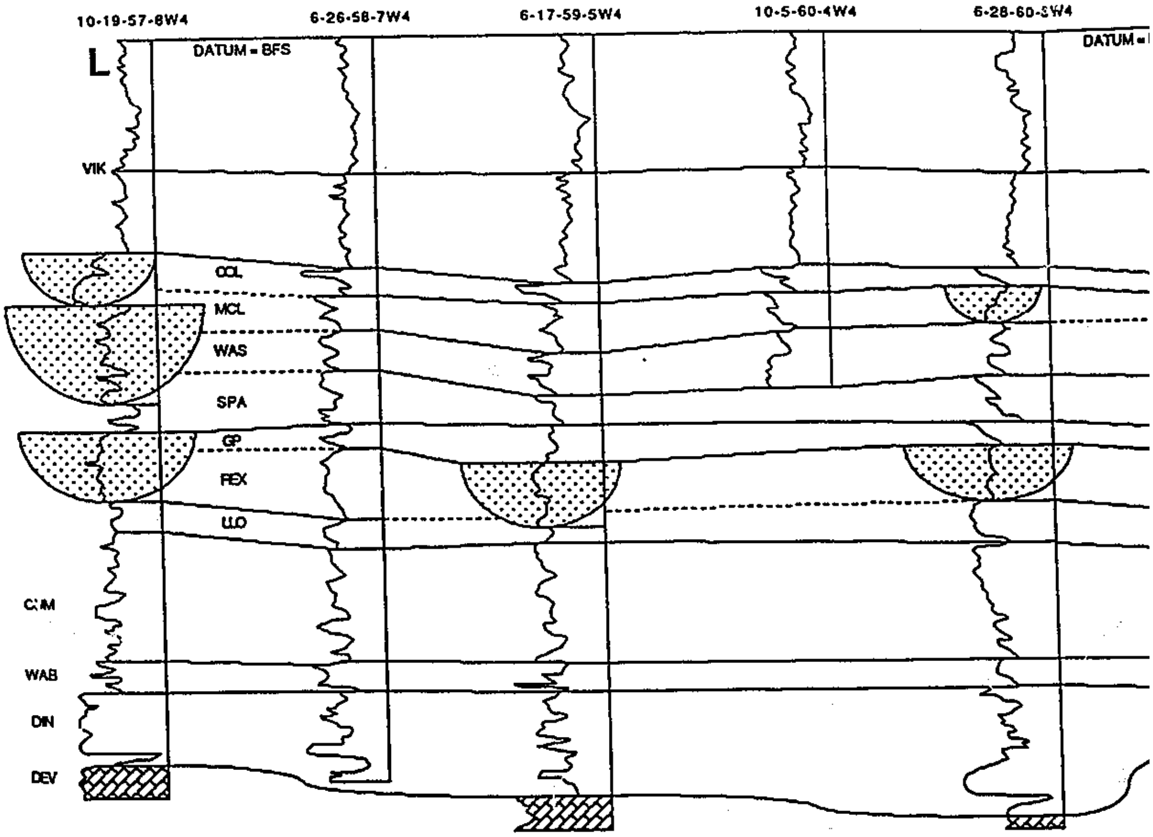
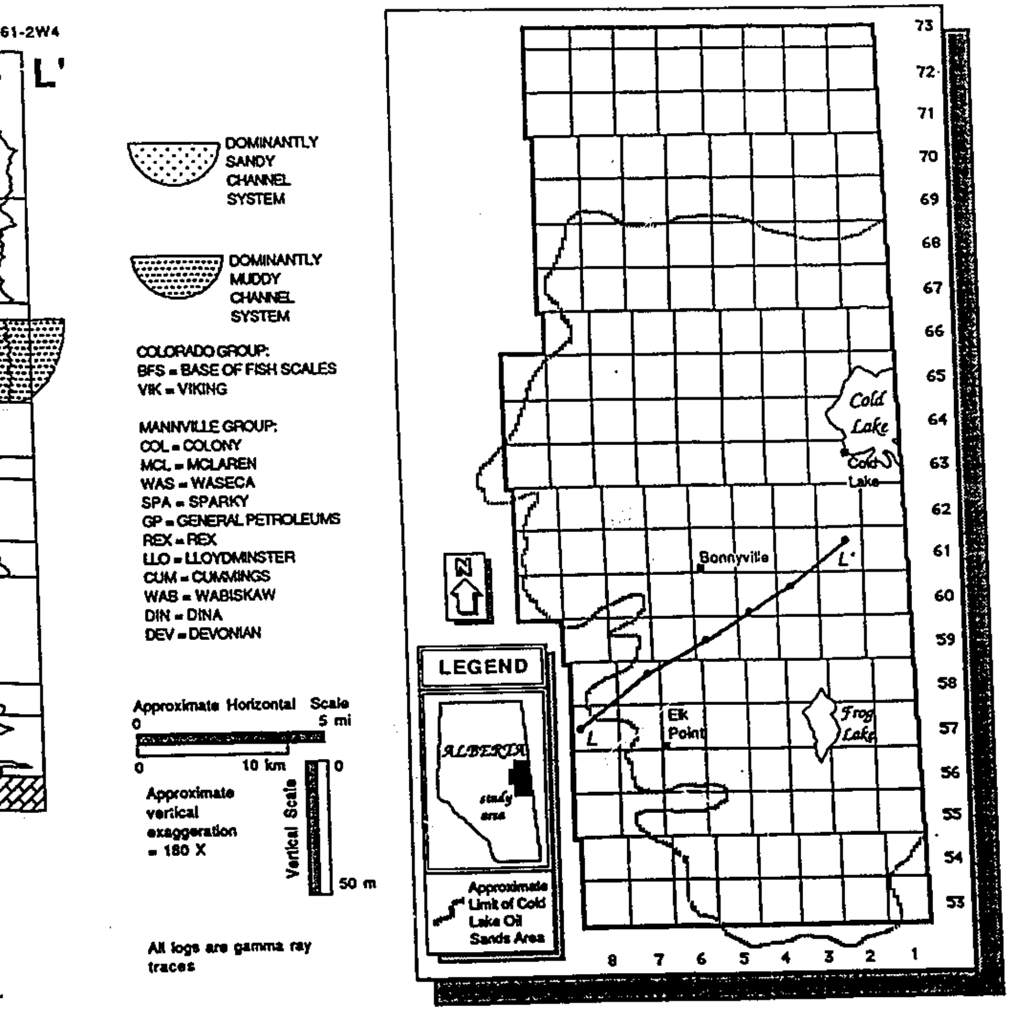

10-19-57-8W4
6-26-58-7W4
6-17-59-5W4
10-5-60-4W4
6-28-60-3W4
L
DATUM = BFS
DATUM =
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 58

STRATIGRAPHIC CROSS-SECTION L-L': COLD LAKE OIL SANDS AREA



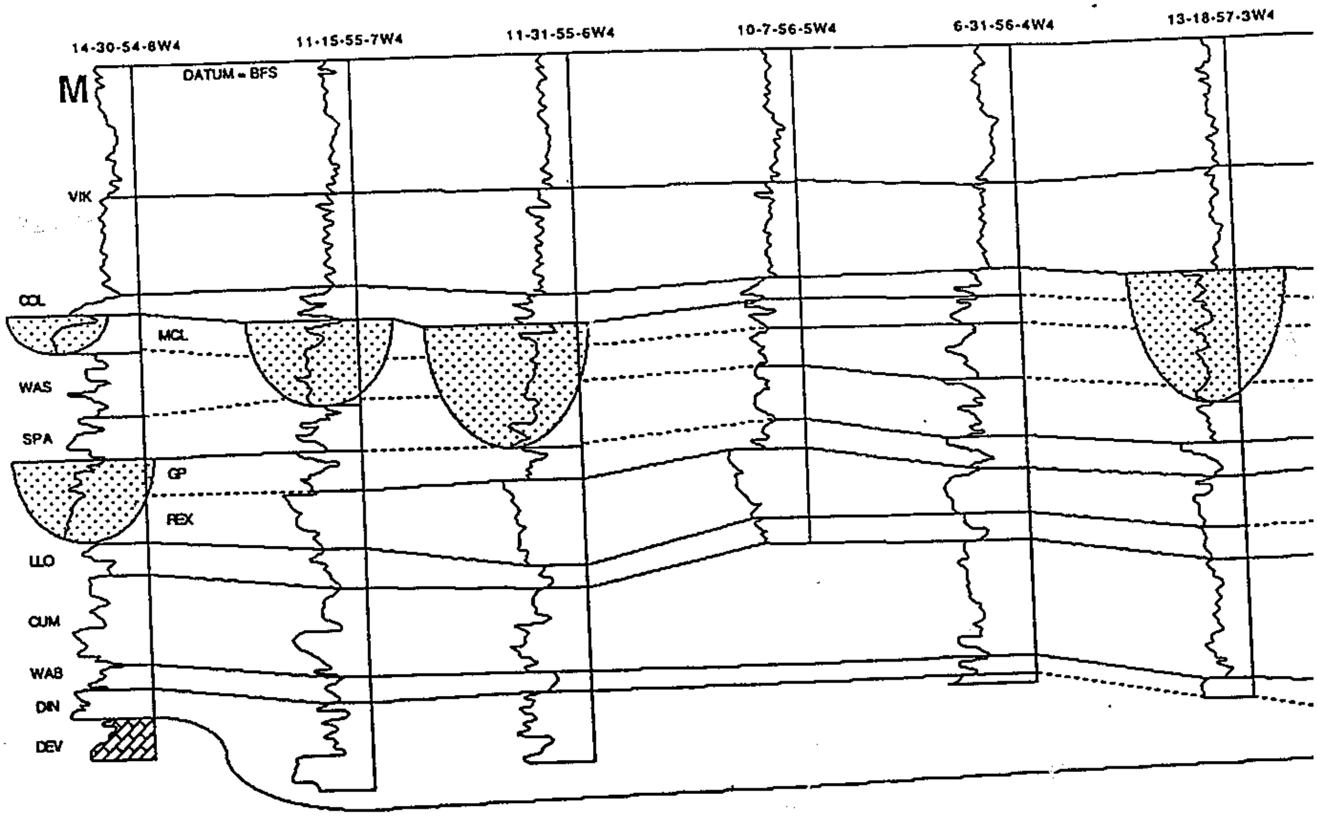
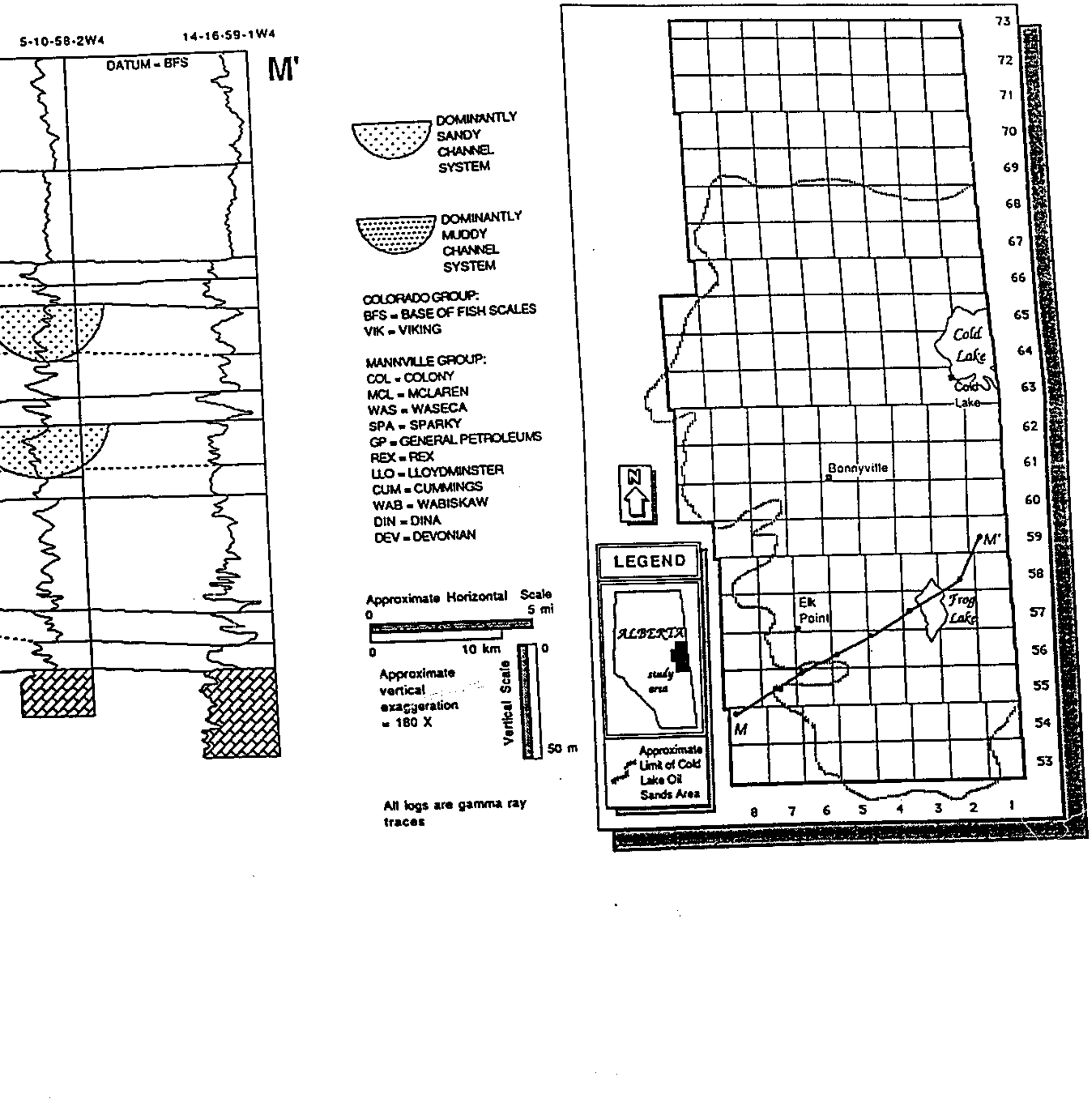

14-30-54-8W4
11-15-55-7W4
11-31-55-6W4
10-7-56-5W4
6-31-56-4W4
13-18-57-3W4
M
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 59

STRATIGRAPHIC CROSS-SECTION M-M': COLD LAKE OIL SANDS AREA



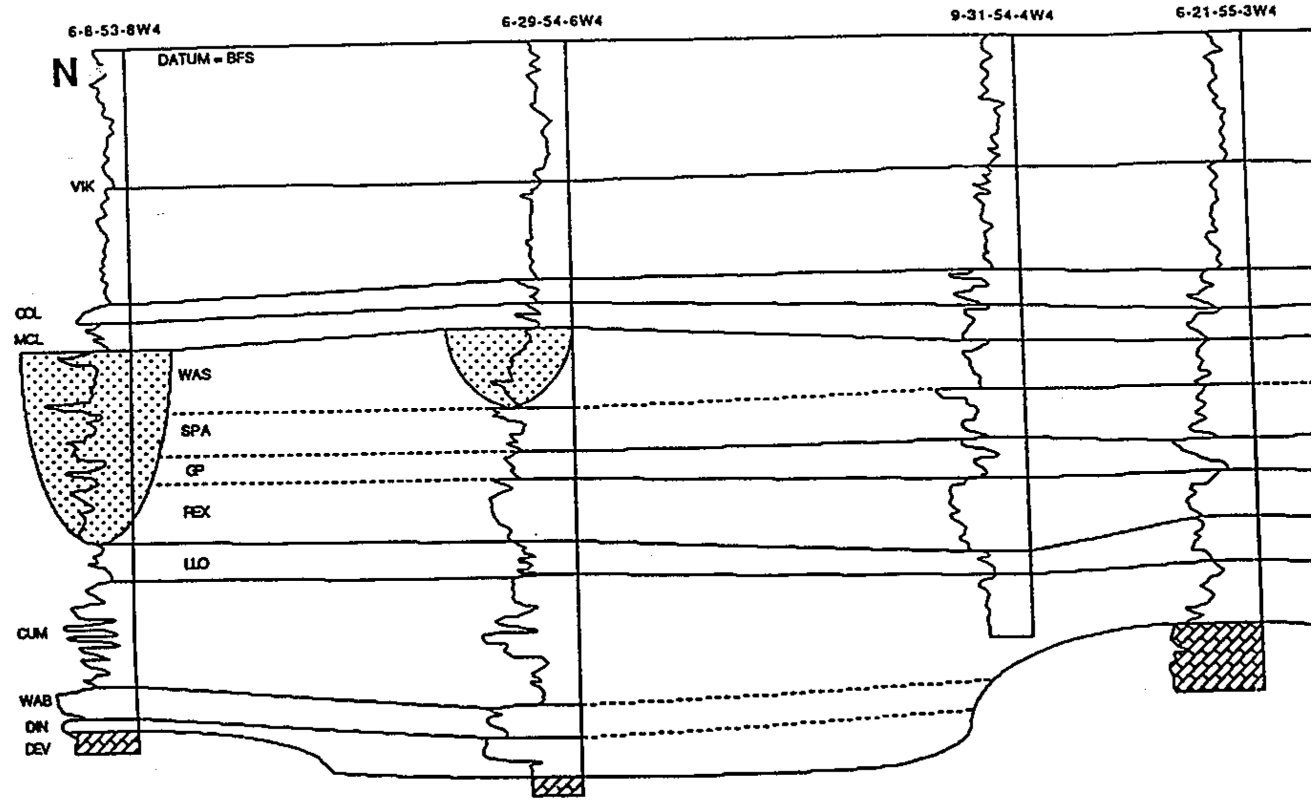
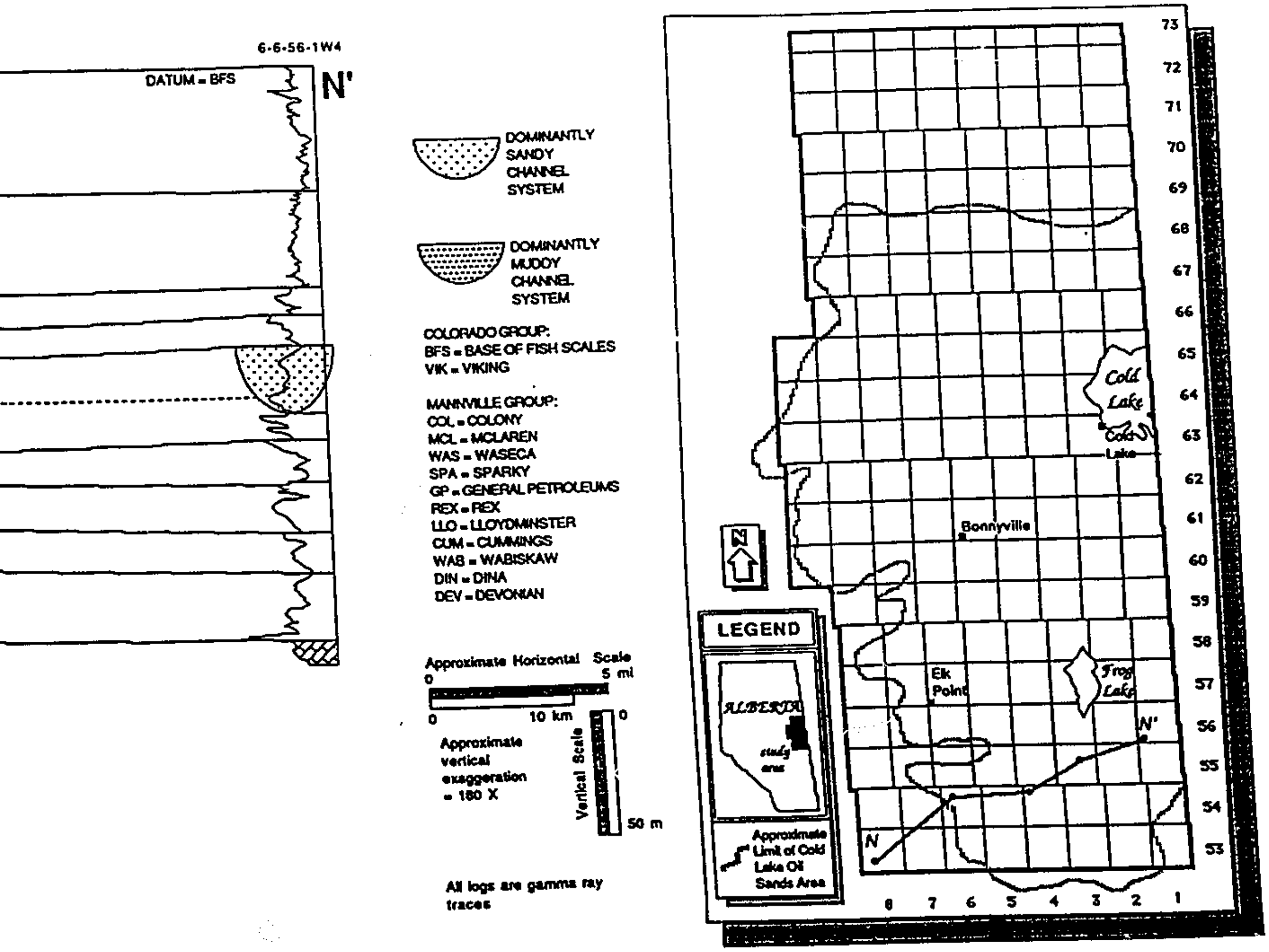

6-8-53-8W4
6-29-54-6W4
9-31-54-4W4
6-21-55-3W4
N
DATUM = BFS
VIK
COL
MCL
WAS
SPA
GP
REX
LLO
CUM
WAB
DIN
DEV

FIGURE 60

STRATIGRAPHIC CROSS-SECTION N-N': COLD LAKE OIL SANDS AREA



THE UNIVERSITY OF ALBERTA

STRATIGRAPHIC AND PALEOENVIRONMENTAL ANALYSIS OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS: COLD LAKE OIL SANDS AREA, EAST-CENTRAL ALBERTA

(Appendix 3)

BY

BLAIR WILLIAM MATTISON

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

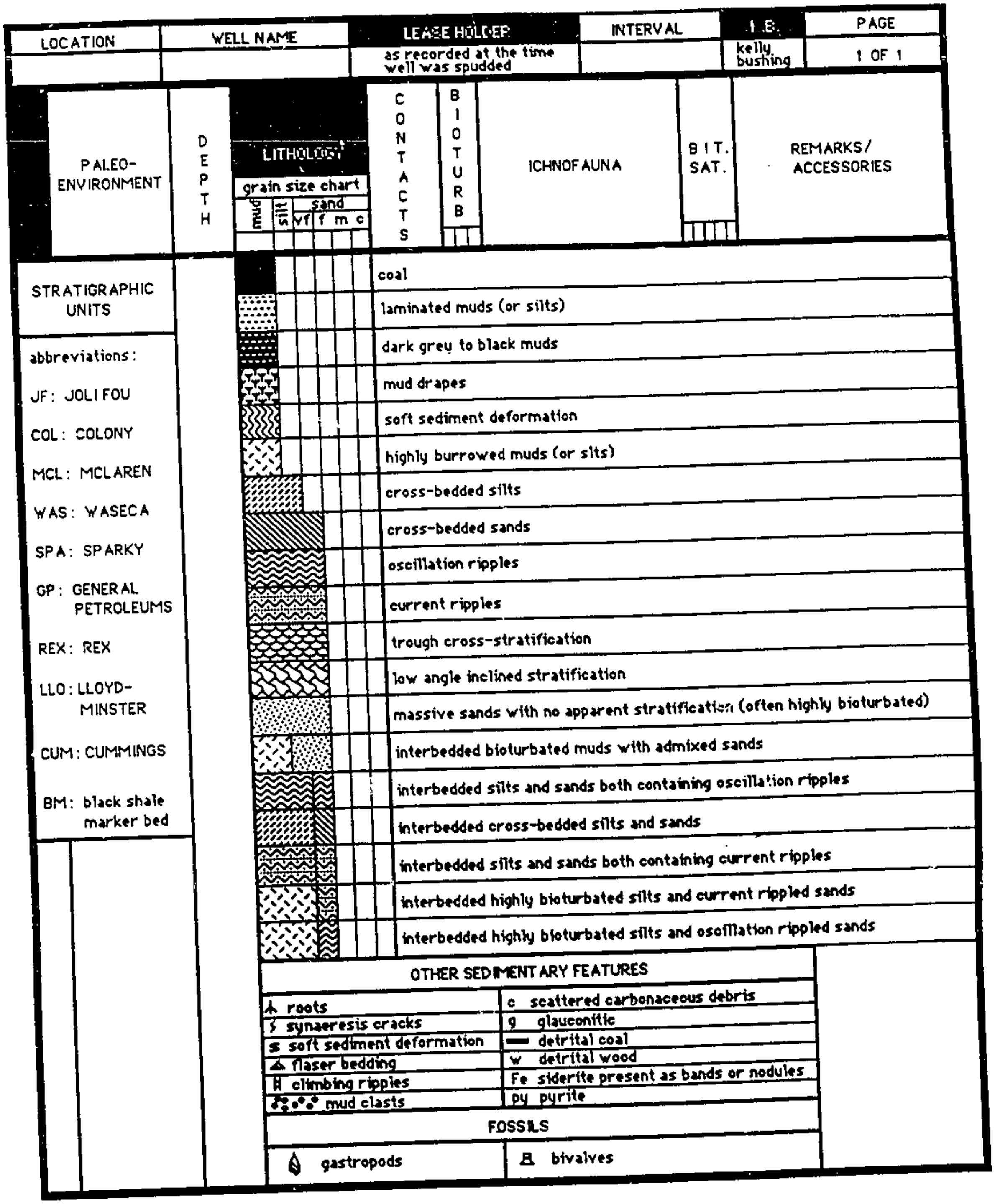
DEPARTMENT OF GEOLOGY
EDMONTON, ALBERTA
FALL, 1991

TABLE OF CONTENTS

VOLUME II

APPENDIX 3:

DRILL CORE LOGS



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
		as recorded at the time well was spudded		kelly bushing	1 OF 1

PALEO-ENVIRONMENT	DEPTH	LITHOLOGY grain size chart mud silt sand vf f m c	CONTACTS	BIOTURB	ICHNOFAUNA	BIT. SAT.	REMARKS/ ACCESSORIES

STRATIGRAPHIC UNITS

abbreviations:

JF: JOLI FOU

COL: COLONY

MCL: MCLAREN

WAS: WASECA

SPA: SPARKY

GP: GENERAL PETROLEUMS

REX: REX

LLO: LLOYD-MINSTER

CUM: CUMMINGS

BM: black shale marker bed

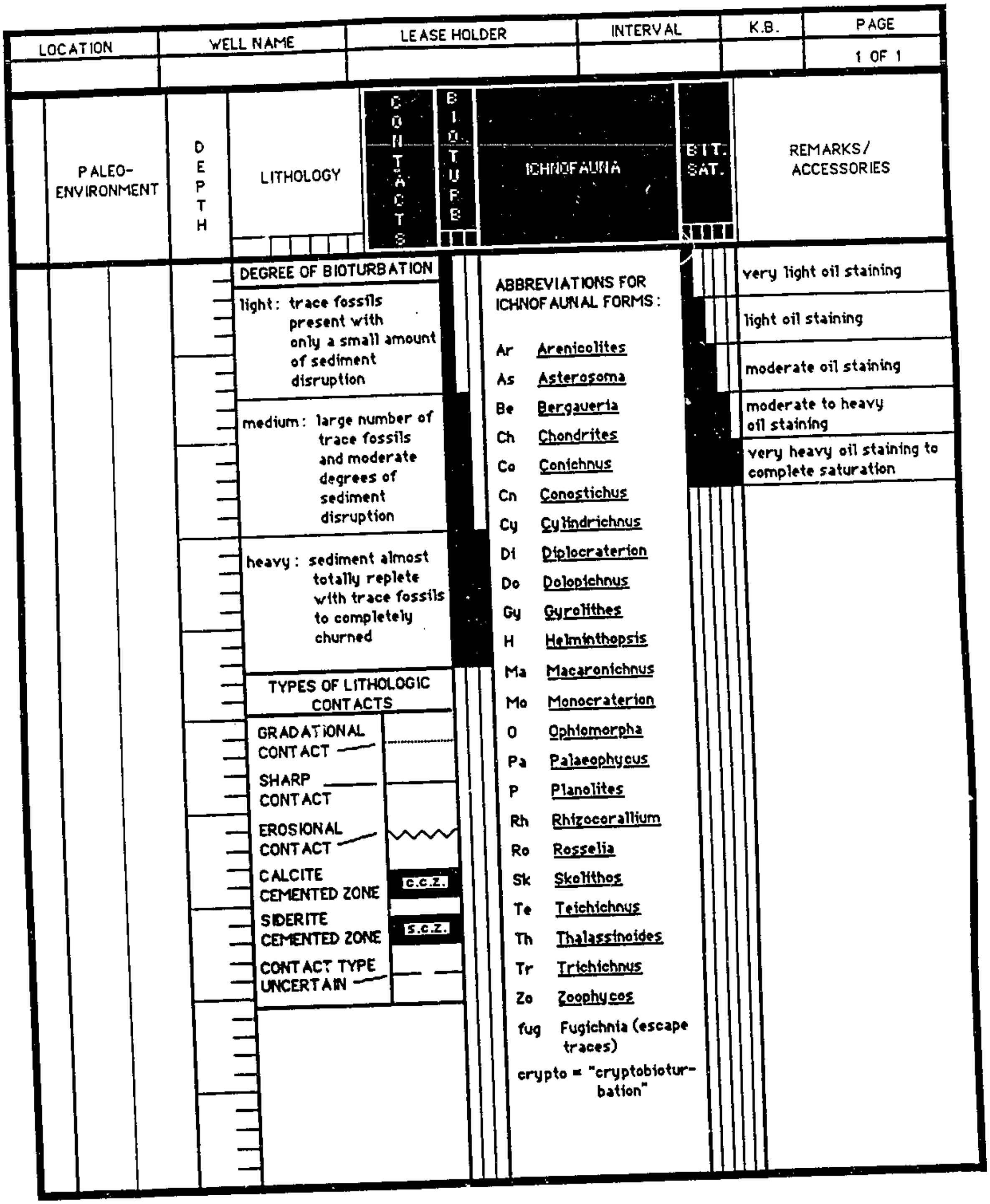
- coal
- laminated muds (or silts)
- dark grey to black muds
- mud drapes
- soft sediment deformation
- highly burrowed muds (or silts)
- cross-bedded silts
- cross-bedded sands
- oscillation ripples
- current ripples
- trough cross-stratification
- low angle inclined stratification
- massive sands with no apparent stratification (often highly bioturbated)
- interbedded bioturbated muds with admixed sands
- interbedded silts and sands both containing oscillation ripples
- interbedded cross-bedded silts and sands
- interbedded silts and sands both containing current ripples
- interbedded highly bioturbated silts and current rippled sands
- interbedded highly bioturbated silts and oscillation rippled sands

OTHER SEDIMENTARY FEATURES

roots	c scattered carbonaceous debris
synaeresis cracks	g glauconitic
soft sediment deformation	▬ detrital coal
flaser bedding	w detrital wood
climbing ripples	Fe siderite present as bands or nodules
mud clasts	py pyrite

FOSSILS

gastropods	bivalves



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
					1 OF 1

PALEO-ENVIRONMENT	DEPTH	LITHOLOGY	CONTACTS	BIOTURB	ICHNOFAUNA	OIL SAT.	REMARKS/ ACCESSORIES

DEGREE OF BIOTURBATION

light:	trace fossils present with only a small amount of sediment disruption
medium:	large number of trace fossils and moderate degrees of sediment disruption
heavy:	sediment almost totally replete with trace fossils to completely churned

TYPES OF LITHOLOGIC CONTACTS

GRADATIONAL CONTACT	┈┈┈
SHARP CONTACT	───
EROSIONAL CONTACT	︿︿︿
CALCITE CEMENTED ZONE	c.c.z.
SIDERITE CEMENTED ZONE	s.c.z.
CONTACT TYPE UNCERTAIN	— —

ABBREVIATIONS FOR ICHNOFAUNAL FORMS:

Ar	*Arenicolites*
As	*Asterosoma*
Be	*Bergaueria*
Ch	*Chondrites*
Co	*Conichnus*
Cn	*Conostichus*
Cy	*Cylindrichnus*
Di	*Diplocraterion*
Do	*Dolopichnus*
Gy	*Gyrolithes*
H	*Helminthopsis*
Ma	*Macaronichnus*
Mo	*Monocraterion*
O	*Ophiomorpha*
Pa	*Palaeophycus*
P	*Planolites*
Rh	*Rhizocorallium*
Ro	*Rosselia*
Sk	*Skolithos*
Te	*Teichichnus*
Th	*Thalassinoides*
Tr	*Trichichnus*
Zo	*Zoophycos*
fug	Fugichnia (escape traces)

crypto = "cryptobioturbation"

very light oil staining

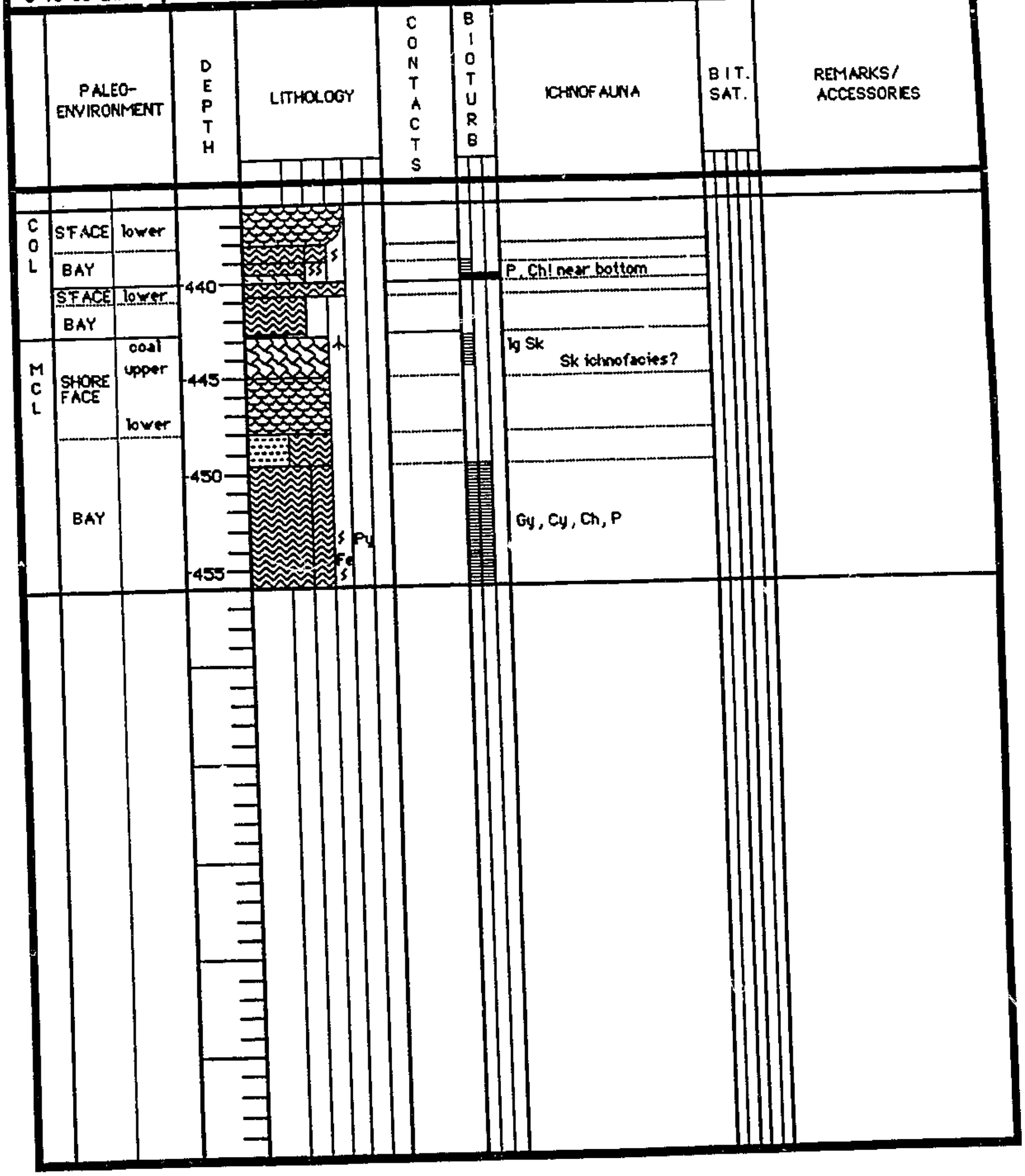
light oil staining

moderate oil staining

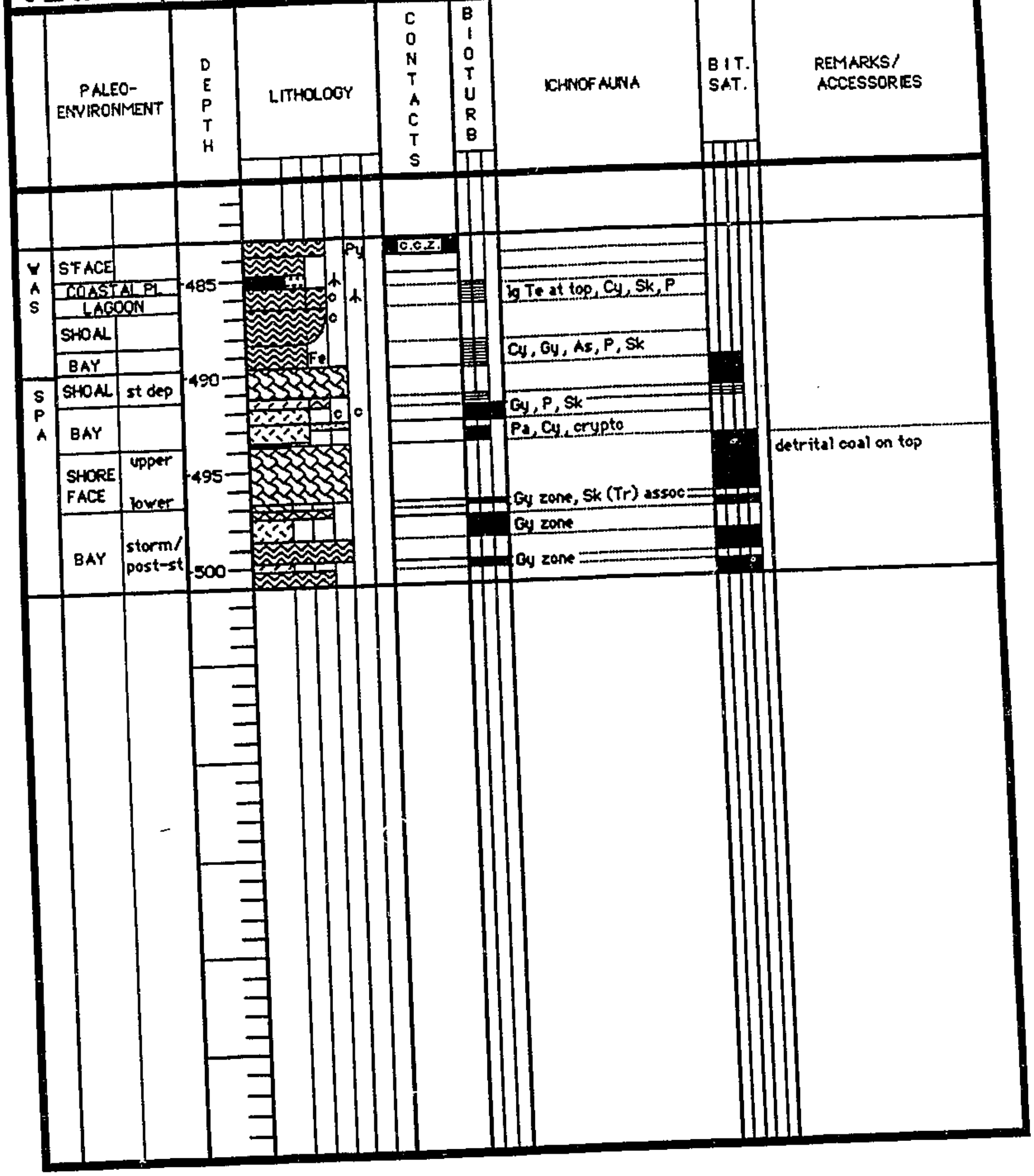
moderate to heavy oil staining

very heavy oil staining to complete saturation

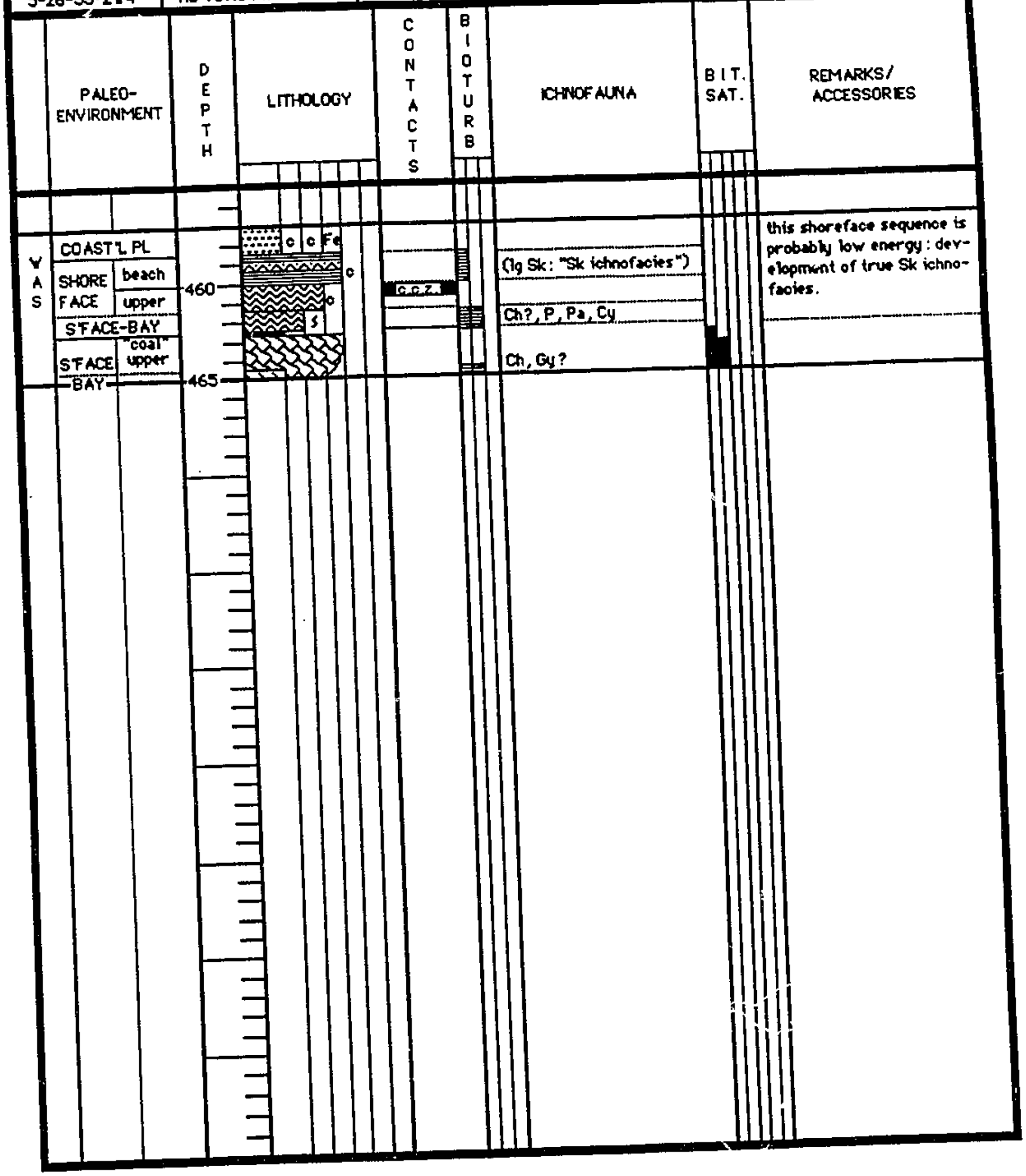
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-15-53-2W4	HUSKY MARWAYNE	HUSKY OIL OPERATIONS LTD	443.0-456.0 m	604.7 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-22-53-2W4	WESTMIN LINDBERGH	WESTMIN RESOURCES LTD	483.0-501.0 m	625.0 m	1 OF 1

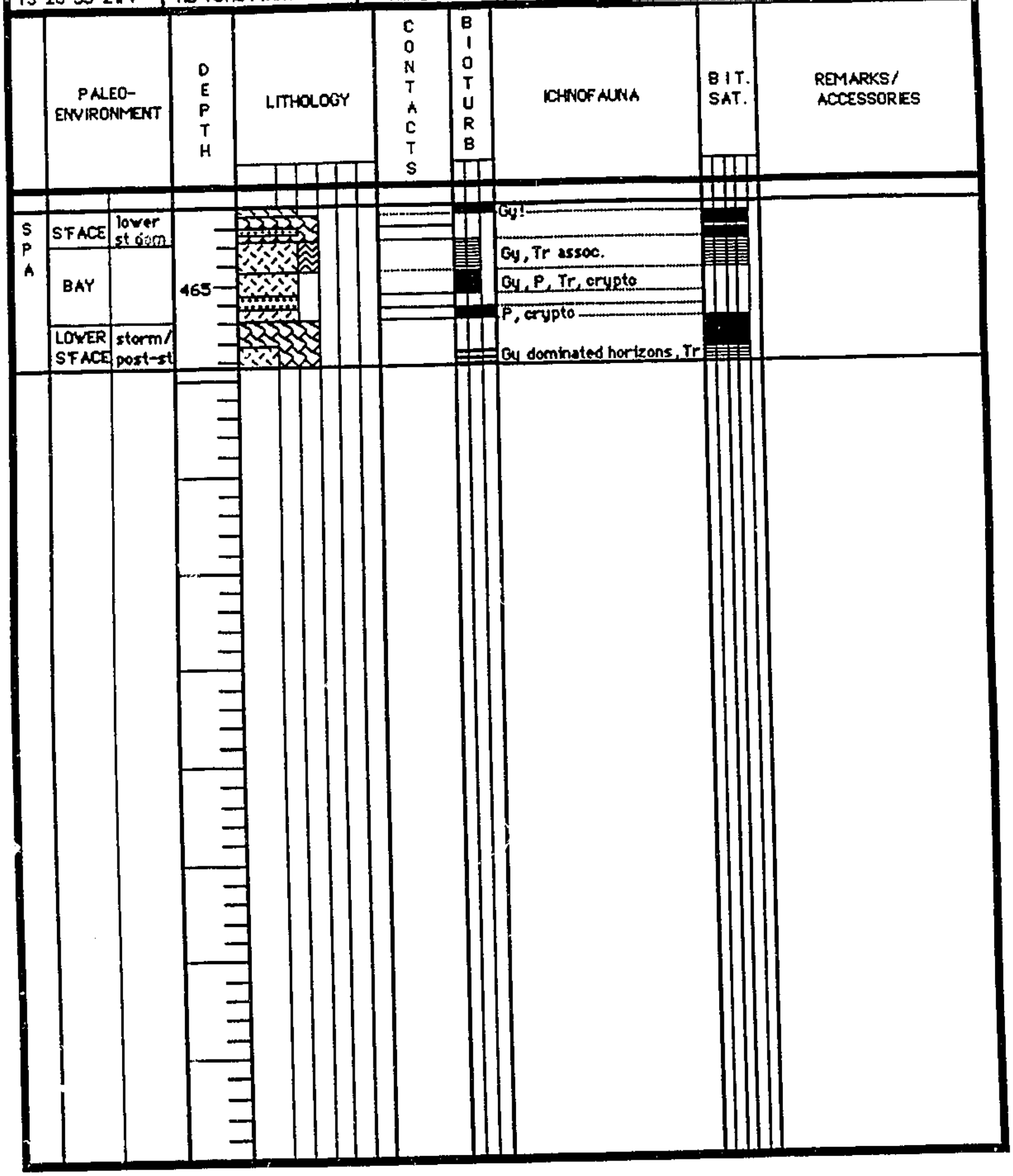


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-26-53-2W4	HB VGAS MARWAYNE	HUSKY OIL OPERATIONS, NW UTILITIES, WESTMIN	457.0-465.0 m	601.8 m	1 OF 1

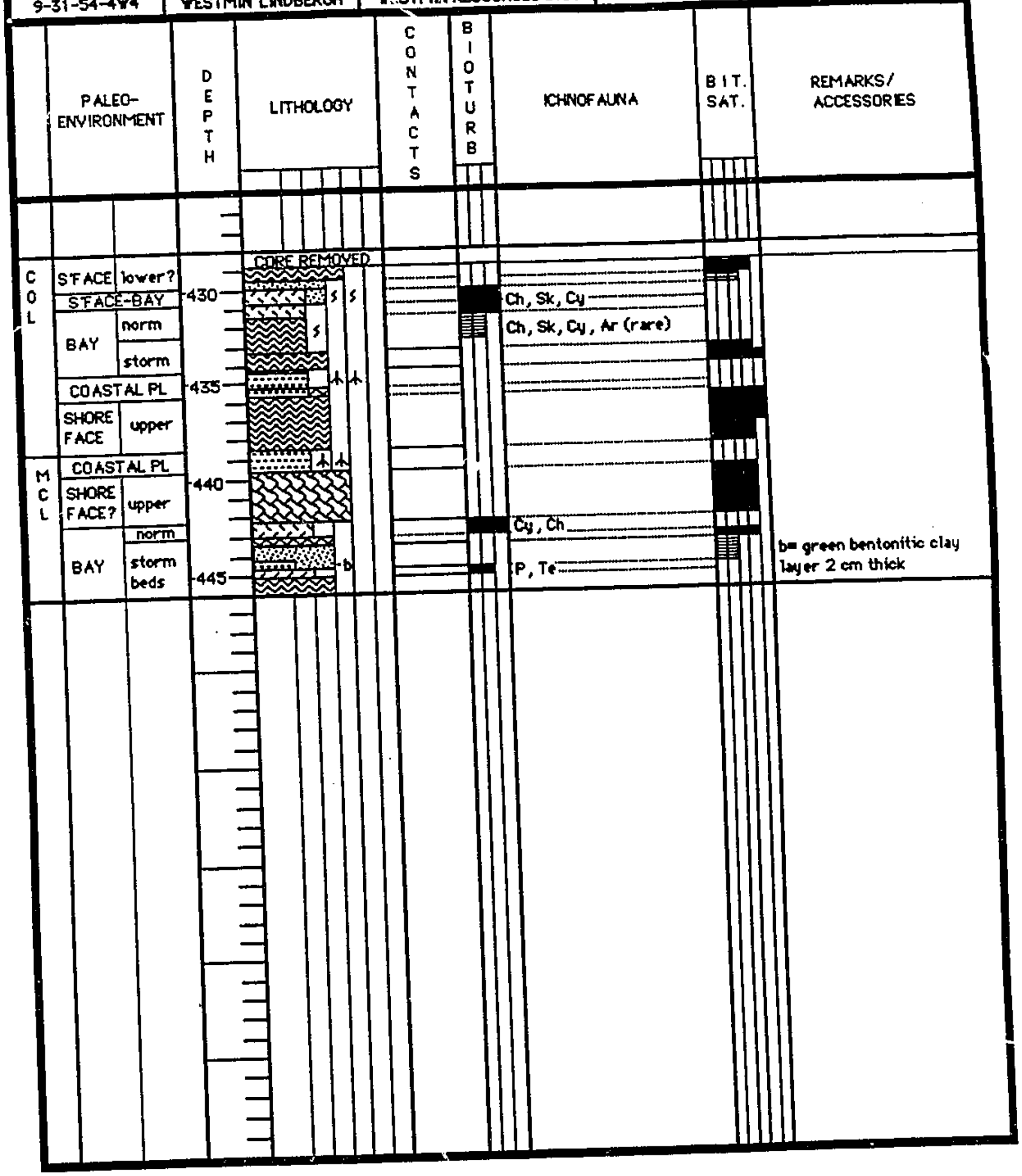


this shoreface sequence is probably low energy: development of true Sk ichnofacies.

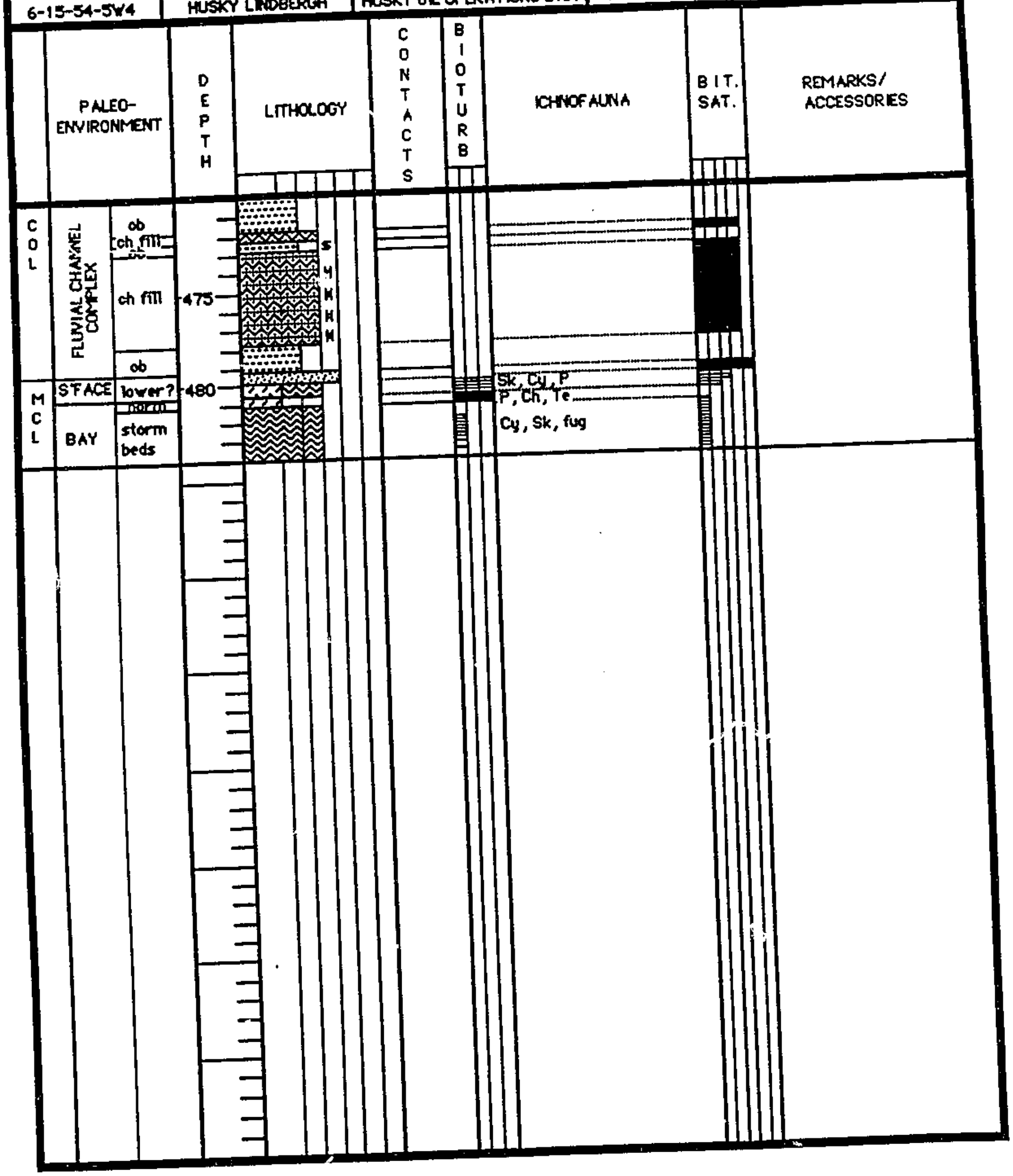
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-26-53-2W4	HB VGAS MARWAYNE	HUSKY OIL OPERATIONS, NW UTILITIES, WESTMIN'	461.0-469.3 m	598.8 m	1 OF 1

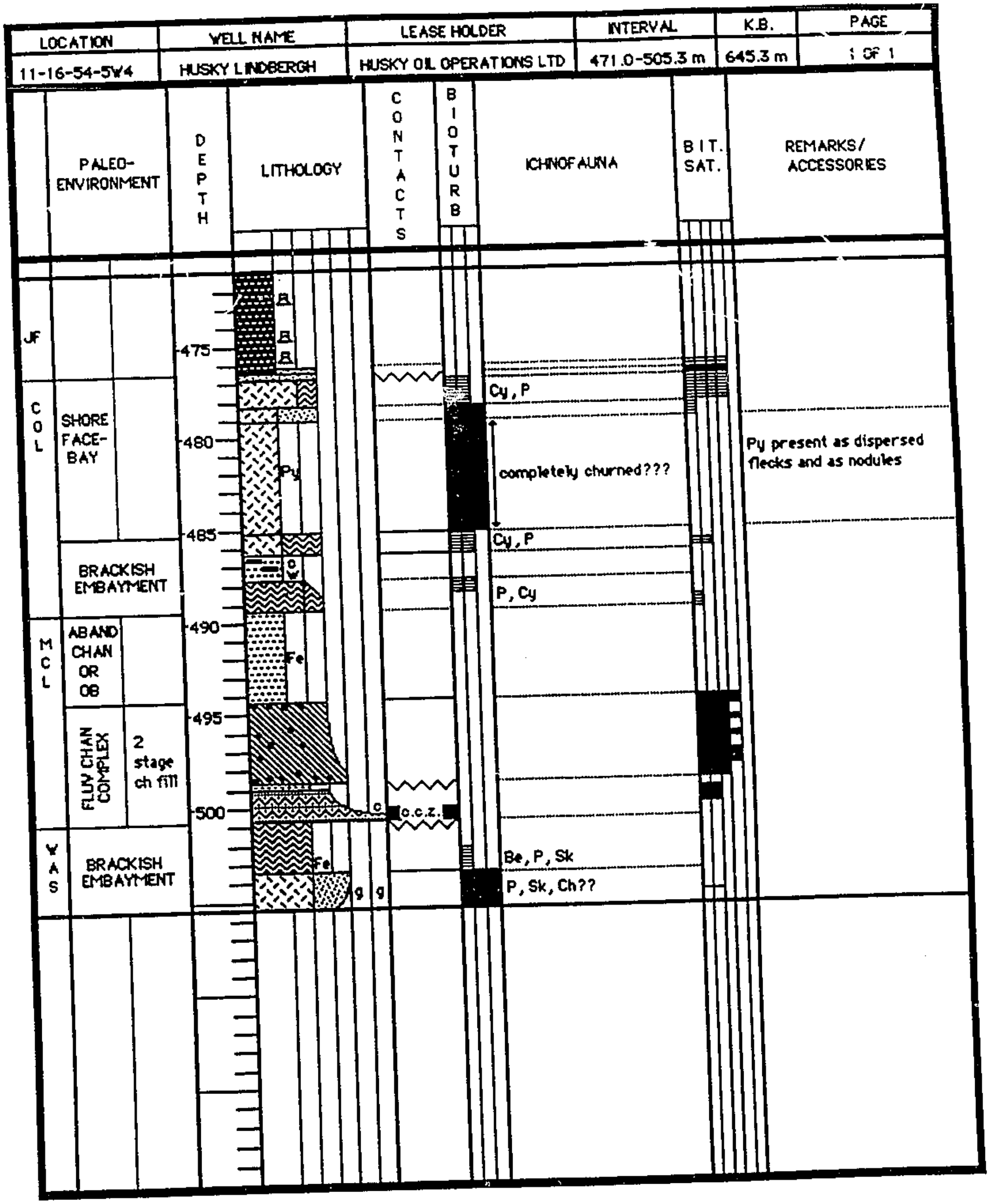


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-31-54-4W4	WESTMIN LINDBERGH	WESTMIN RESOURCES LTD.	428.0-446.0 m	613.0 m	1 OF 1



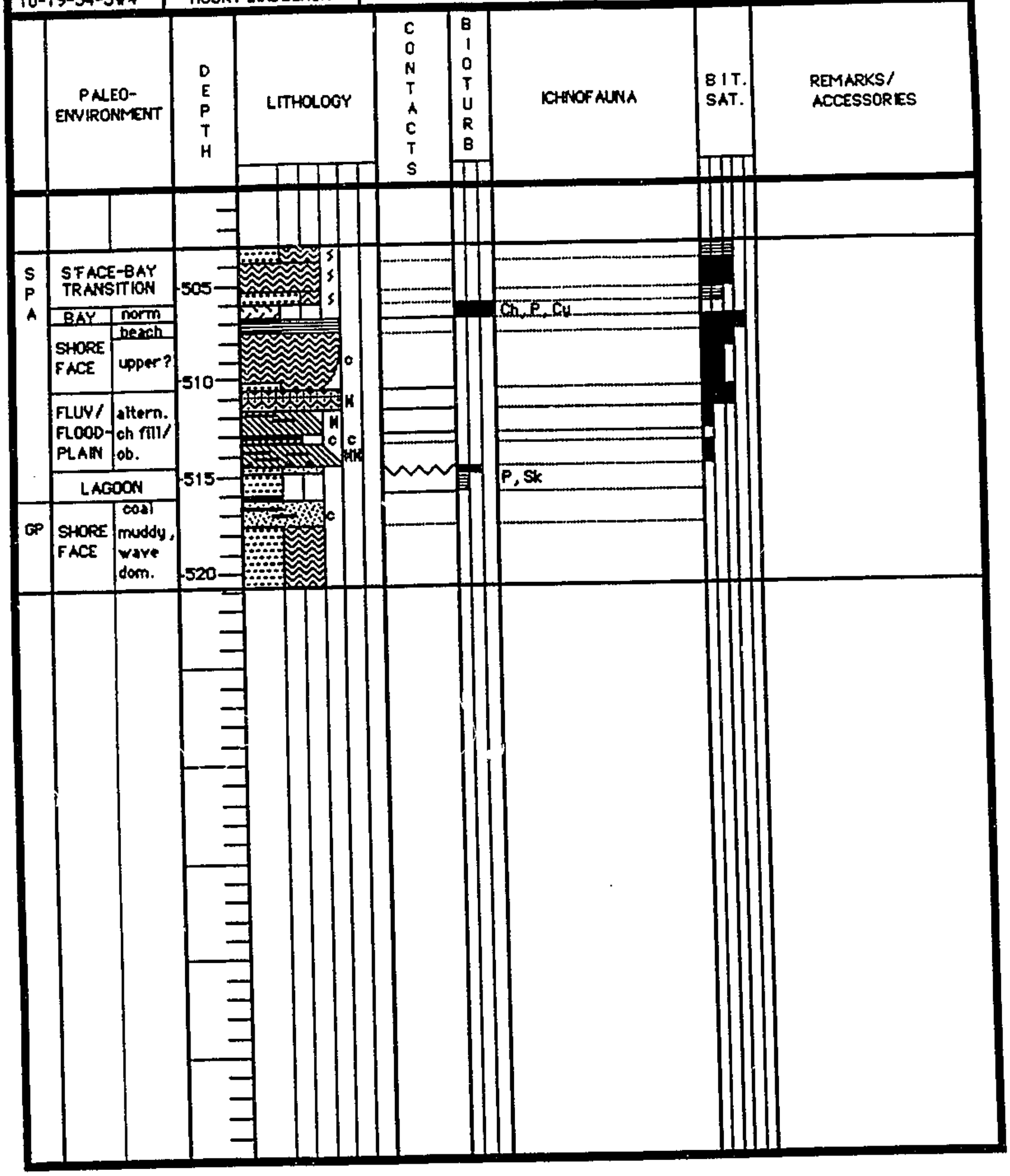
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-15-54-5W4	HUSKY LINDBERGH	HUSKY OIL OPERATIONS LTD.	473.0-485.0 m	633.2 m	1 OF 1



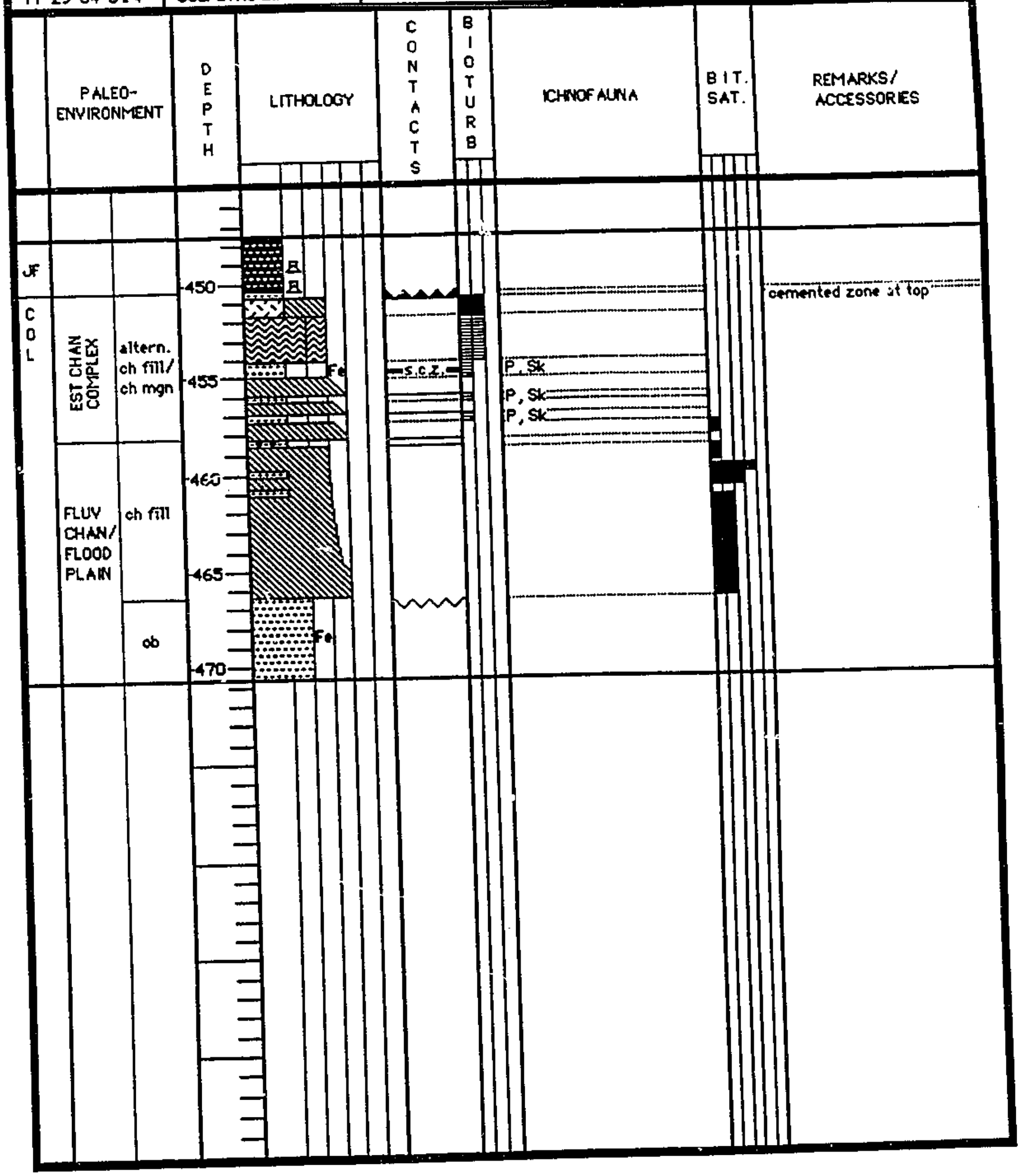


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-16-54-5W4	HUSKY LINDBERGH	HUSKY OIL OPERATIONS LTD	471.0-505.3 m	645.3 m	1 OF 1

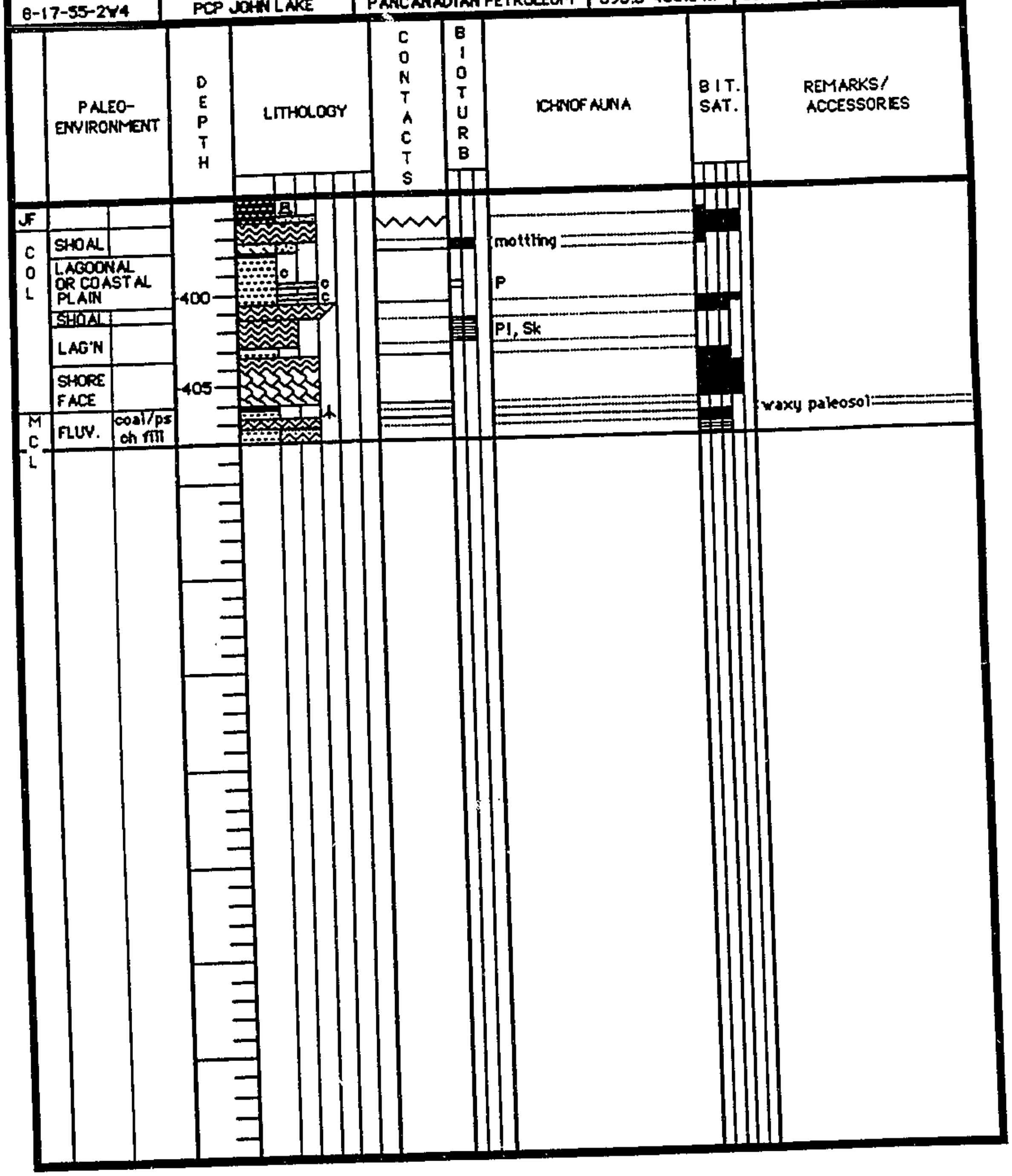
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-19-54-5W4	HUSKY LINDBERGH	HUSKY OIL CO. LTD.	503.0-521.0 m	630.7 m	1 OF 1



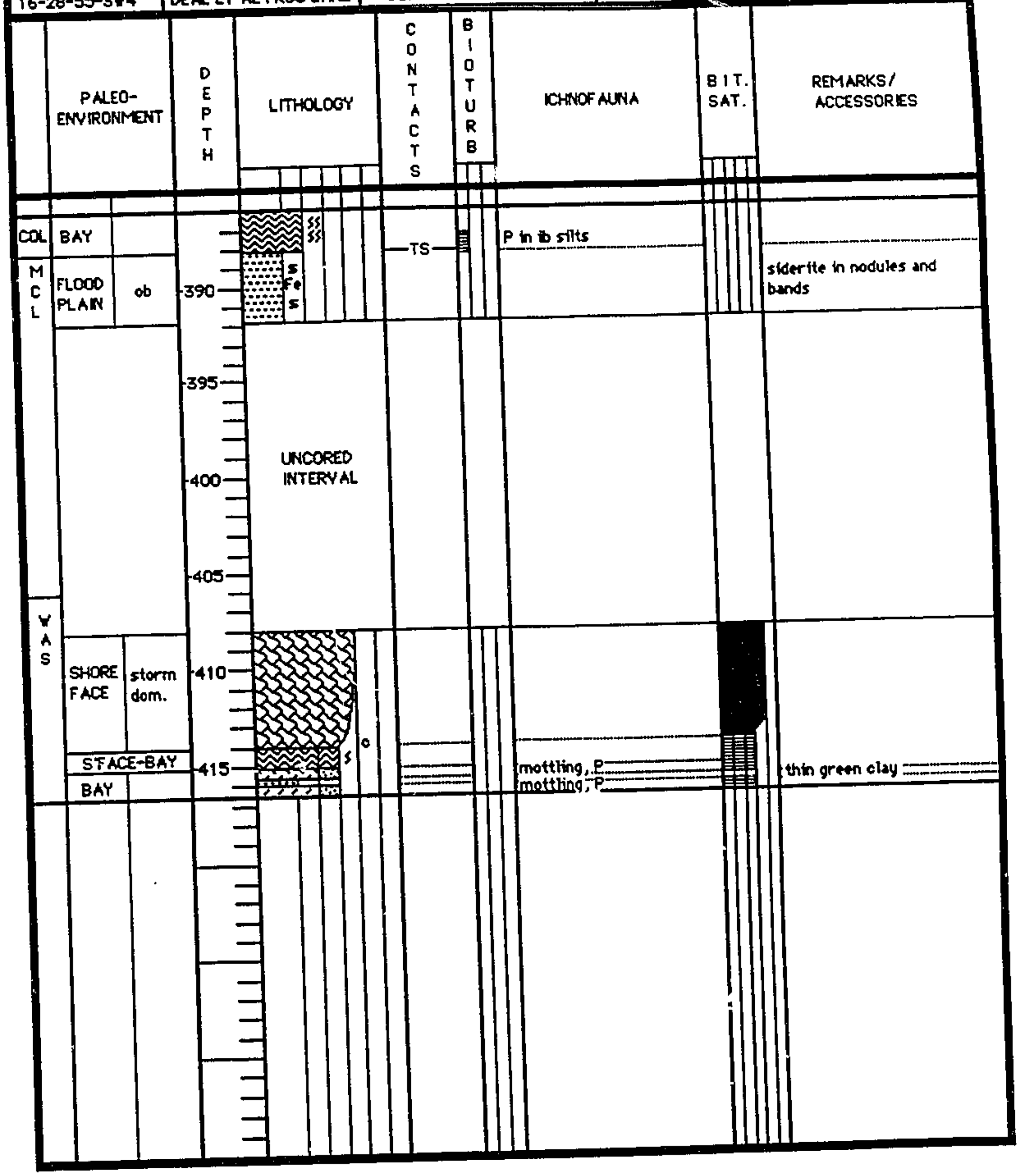
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-29-54-5W4	SULPETRO LINDBERGH	ESSO CANADA RESOURCES	447.5-470.5 m	626.9 m	1 OF 1



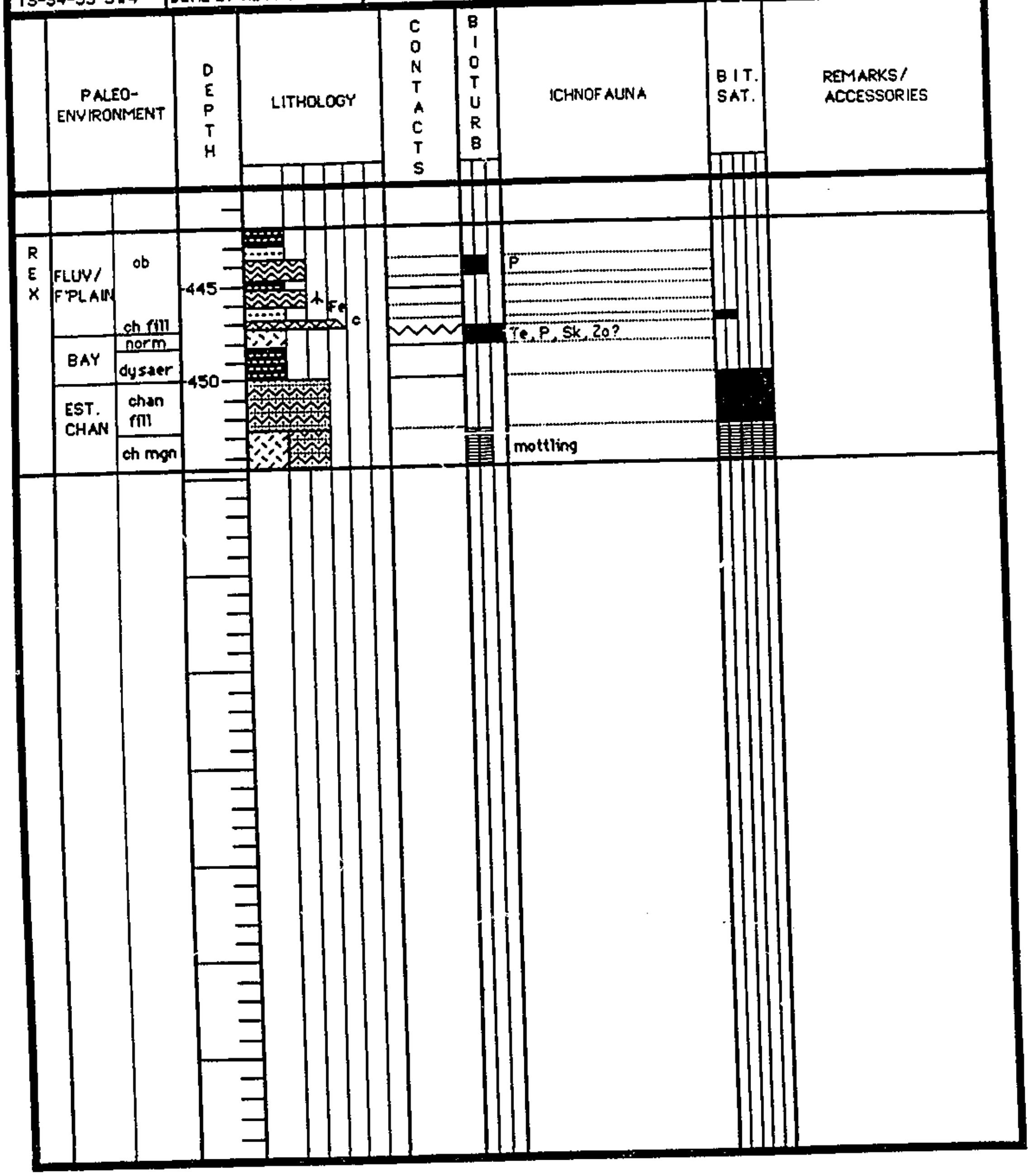
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-17-55-2W4	PCP JOHN LAKE	PANCANADIAN PETROLEUM	395.0-408.0 m	596.5 m	1 OF 1



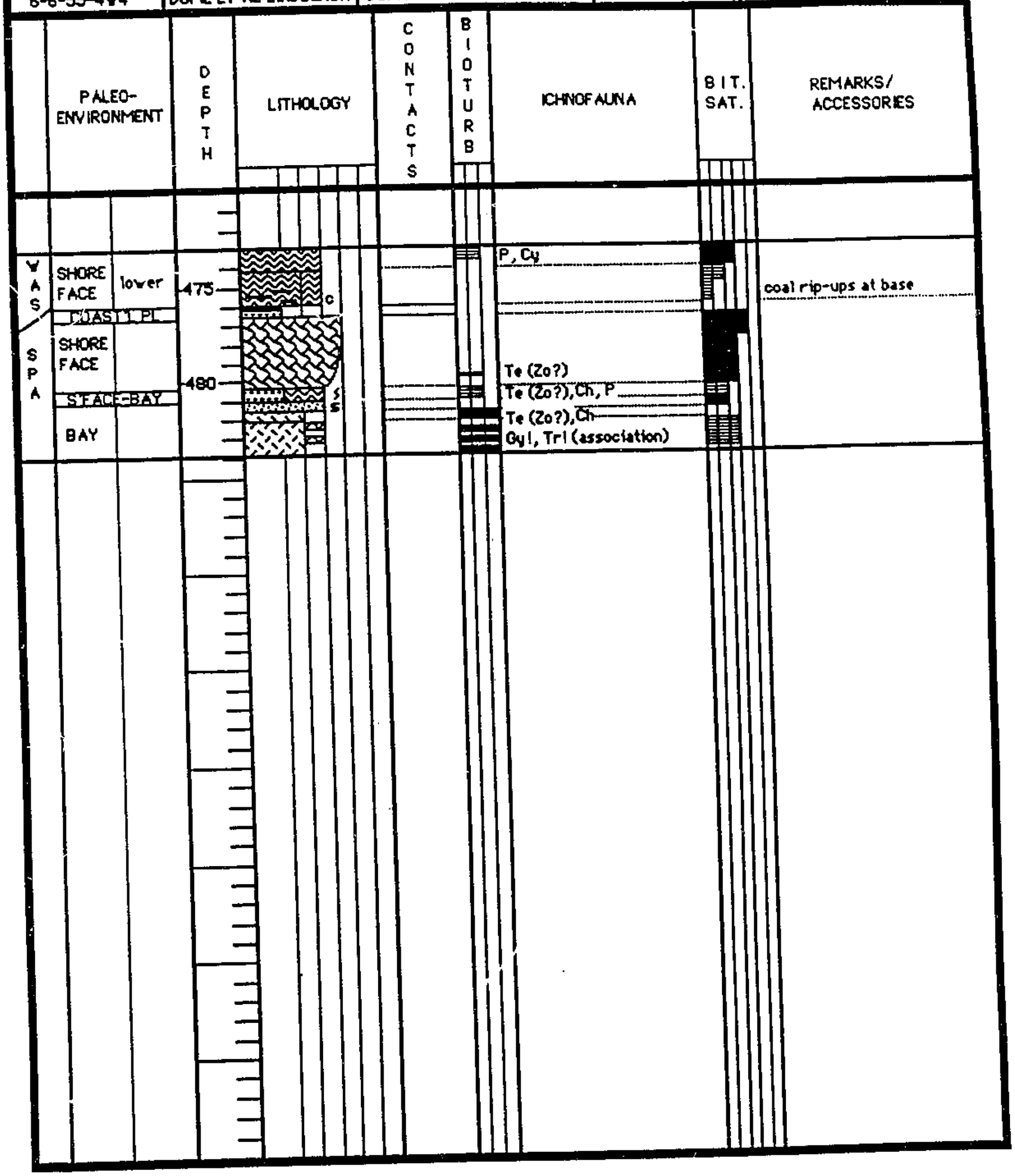
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-28-55-3W4	DEAL ET AL FROG LAKE	DEAL RESOURCES MGMT.	386.0-416.5 m	585.0 m	1 OF 1



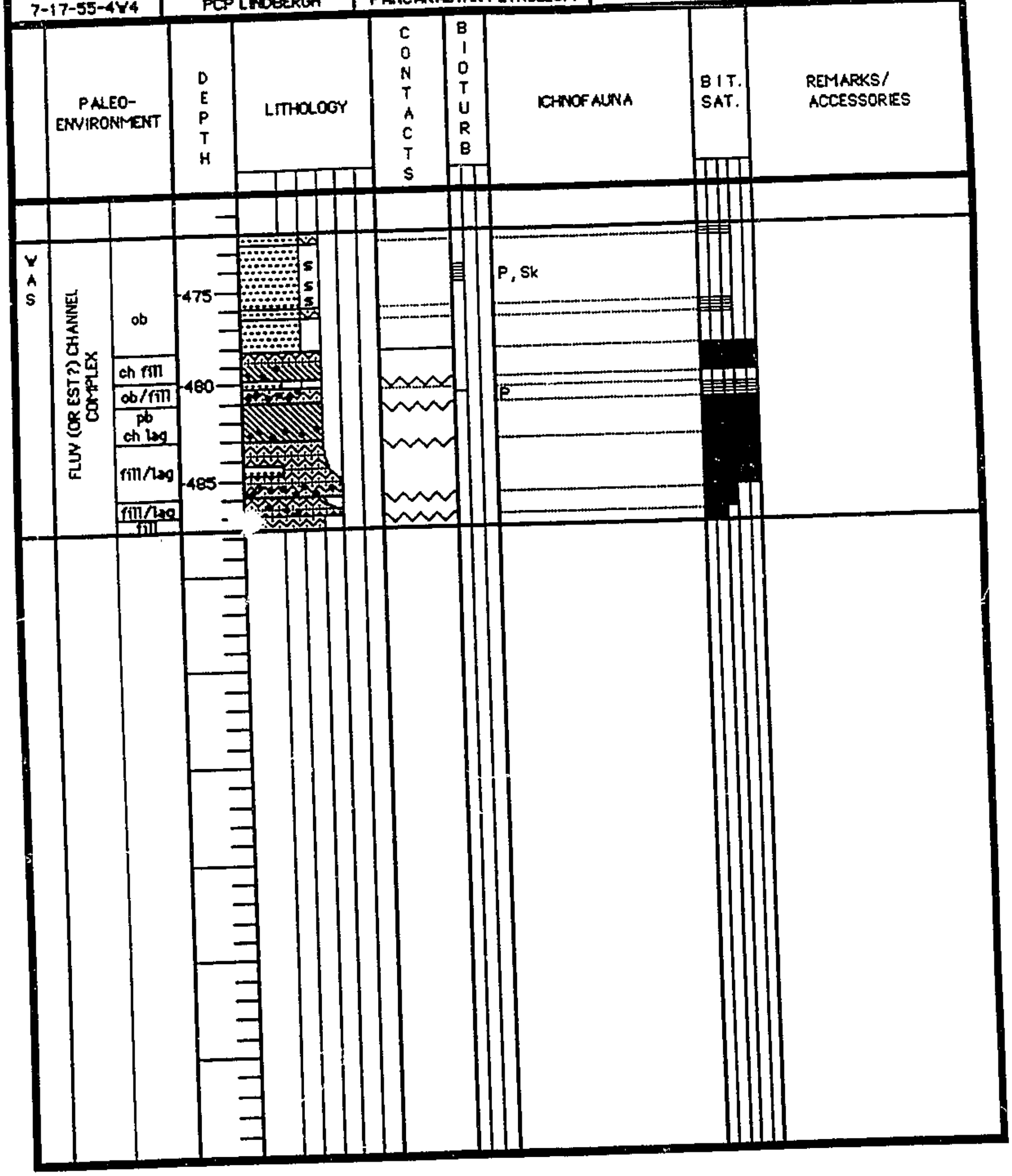
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-34-55-3W4	DEAL ET AL FROG LAKE	DEAL RESOURCES MGMT. LTD.	442.0-454.4 m	576.3 m	1 OF 1



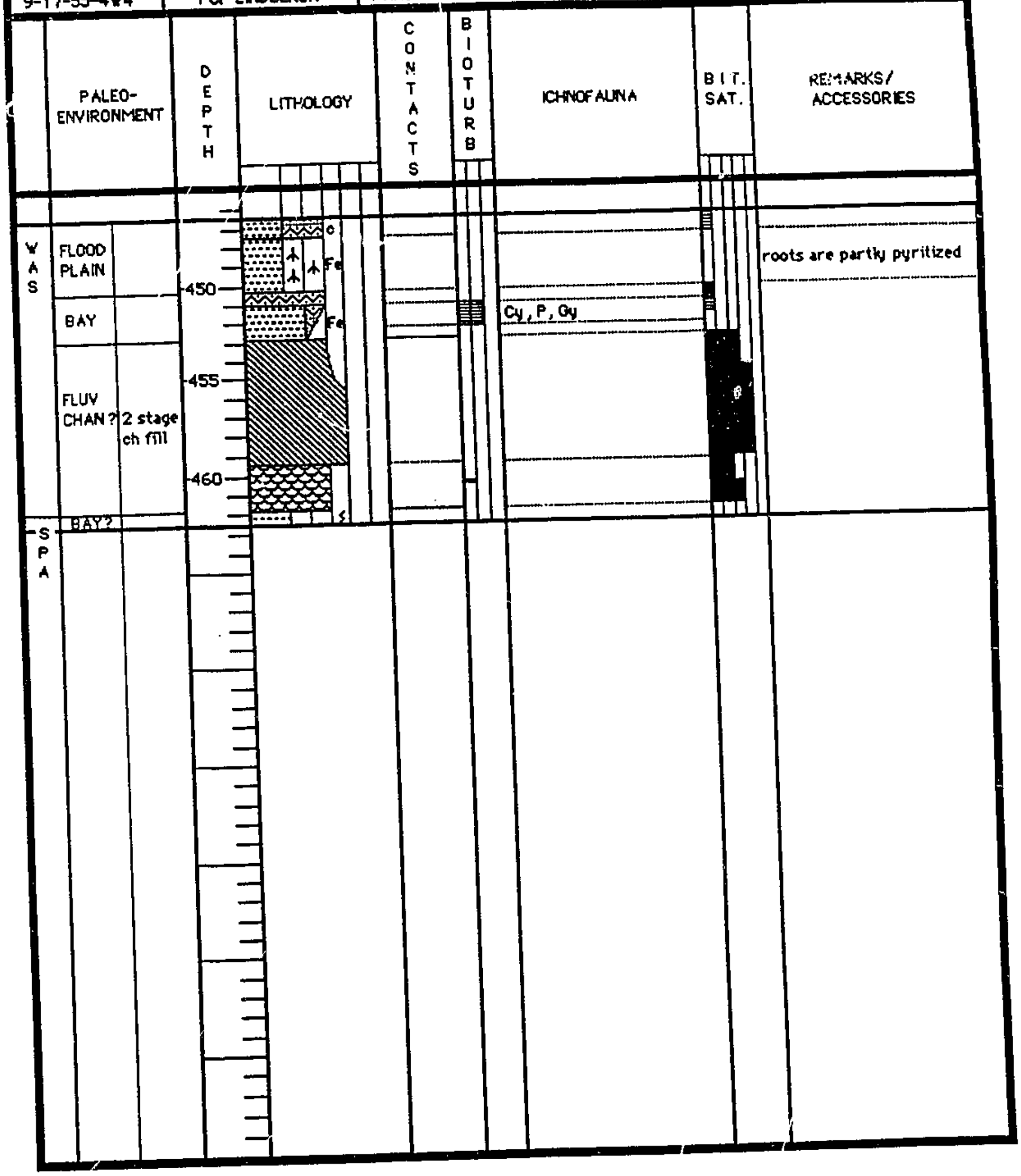
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-6-55-4W4	DOME ET AL LINDBERGH	DOME PETROLEUM & OTHERS	473.0-484.0 m	618.3 m	1 OF 1



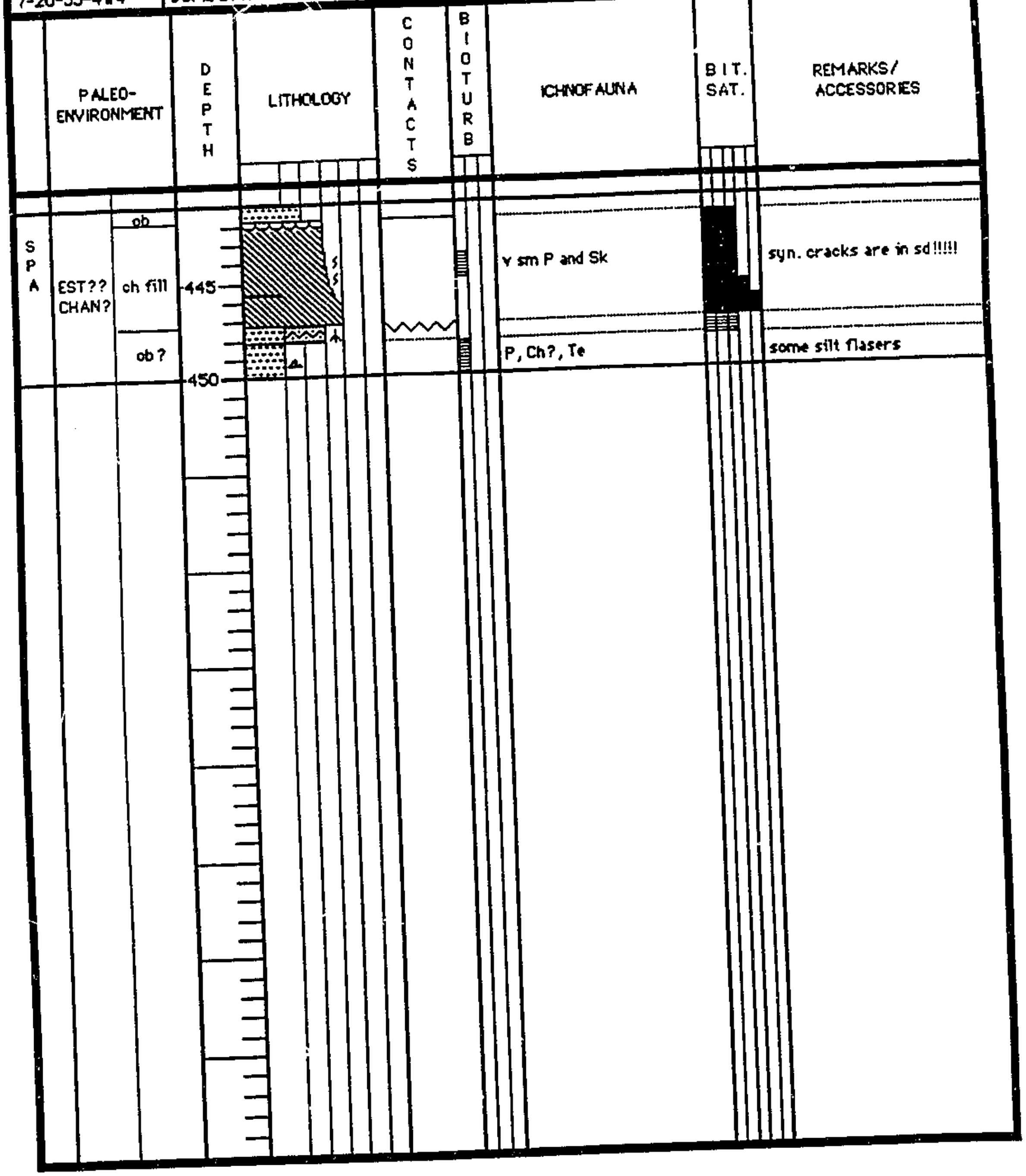
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-17-55-4W4	PCP LINDBERGH	PANCANADIAN PETROLEUM	472.0-489.0 m	616.0 m	1 OF 1



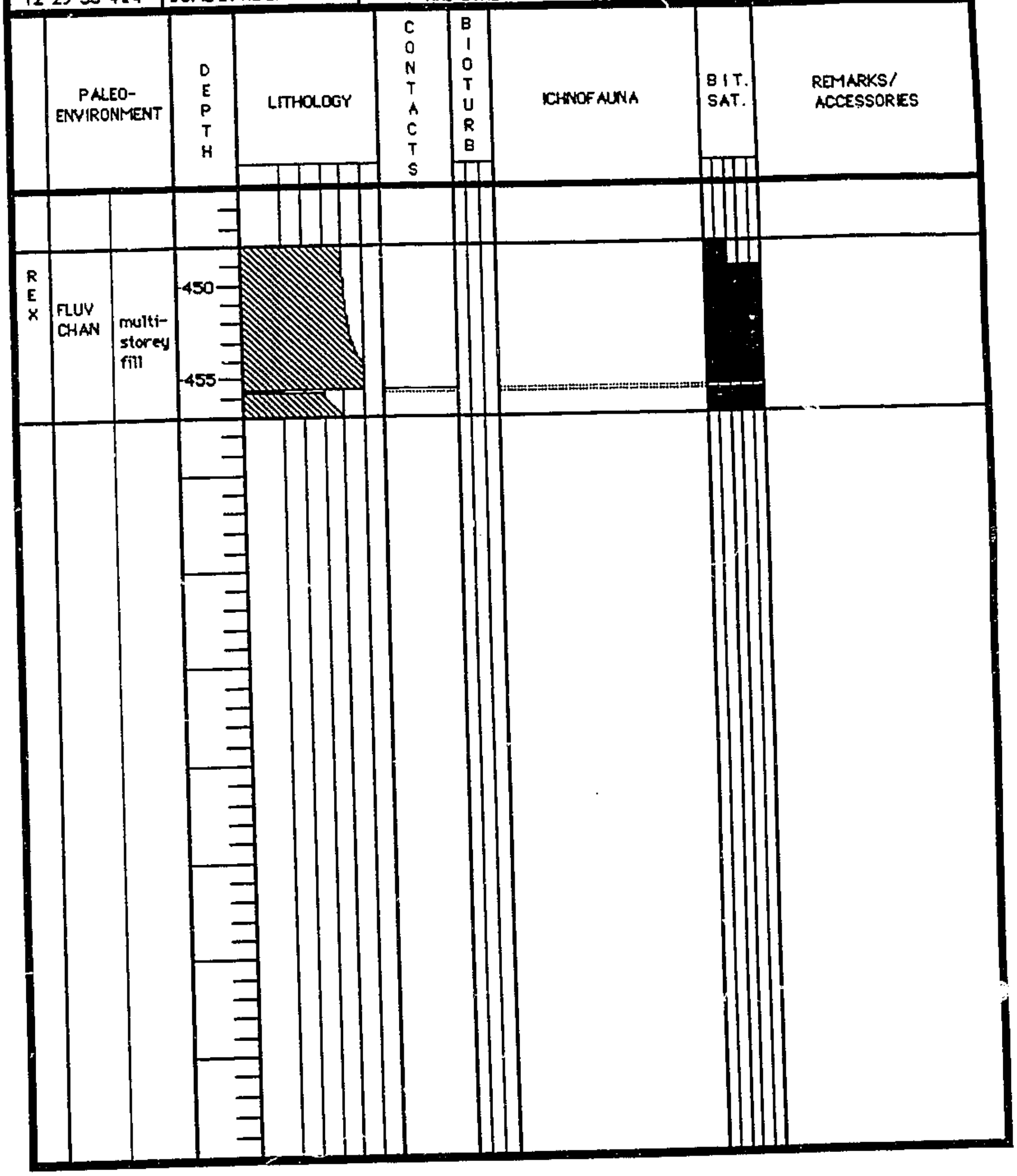
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-17-55-4W4	PCP LINDBERGH	PANCANADIAN PETROLEUM	446.5-555.0 m	615.8 m	1 OF 1

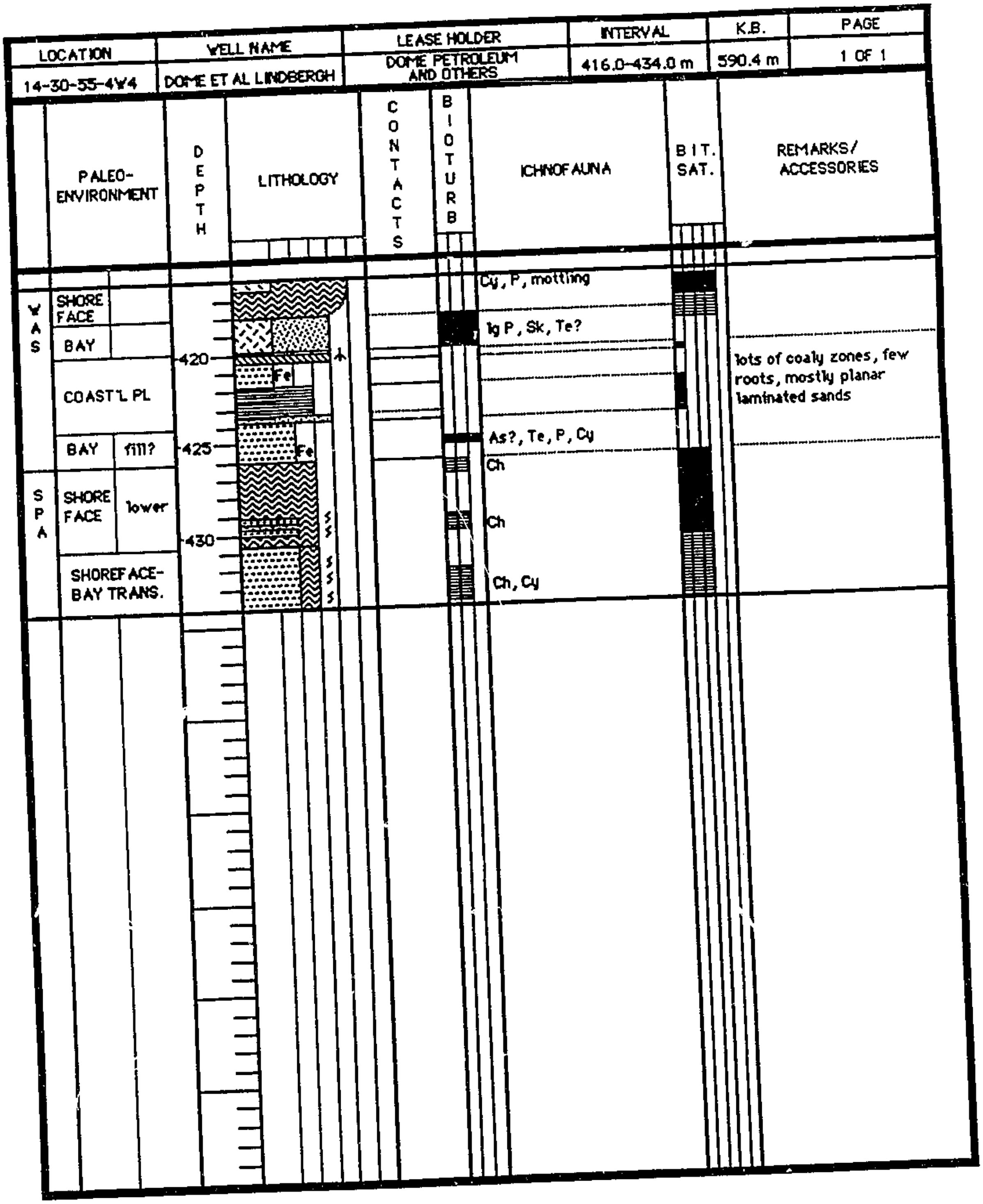


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-20-55-4W4	DOME ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	441.0-450.0 m	603.1 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-29-55-4W4	DOME ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	448.0–457.0 m	584.9 m	1 OF 1

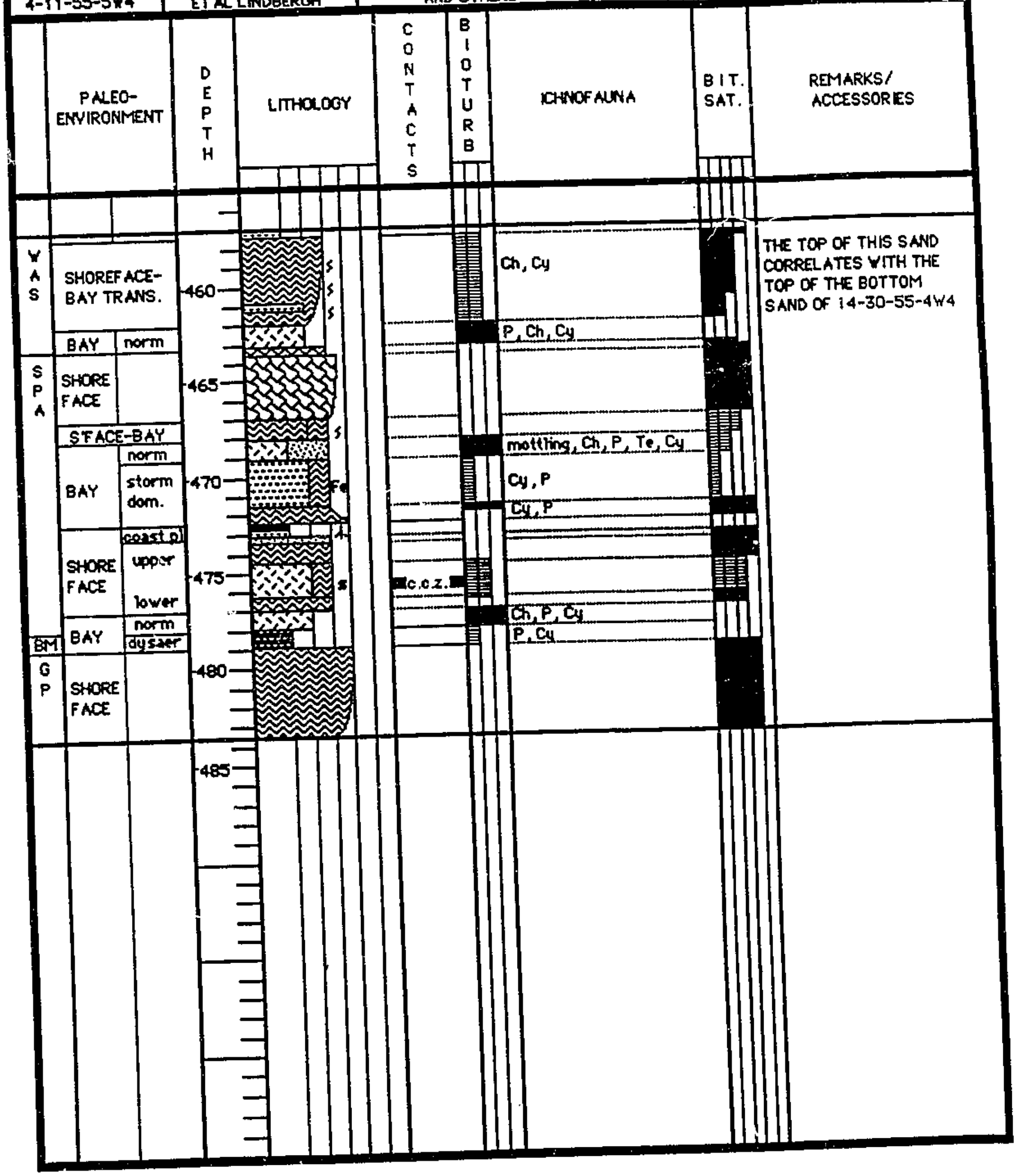




LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-30-55-4W4	DOME ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	416.0-434.0 m	590.4 m	1 OF 1

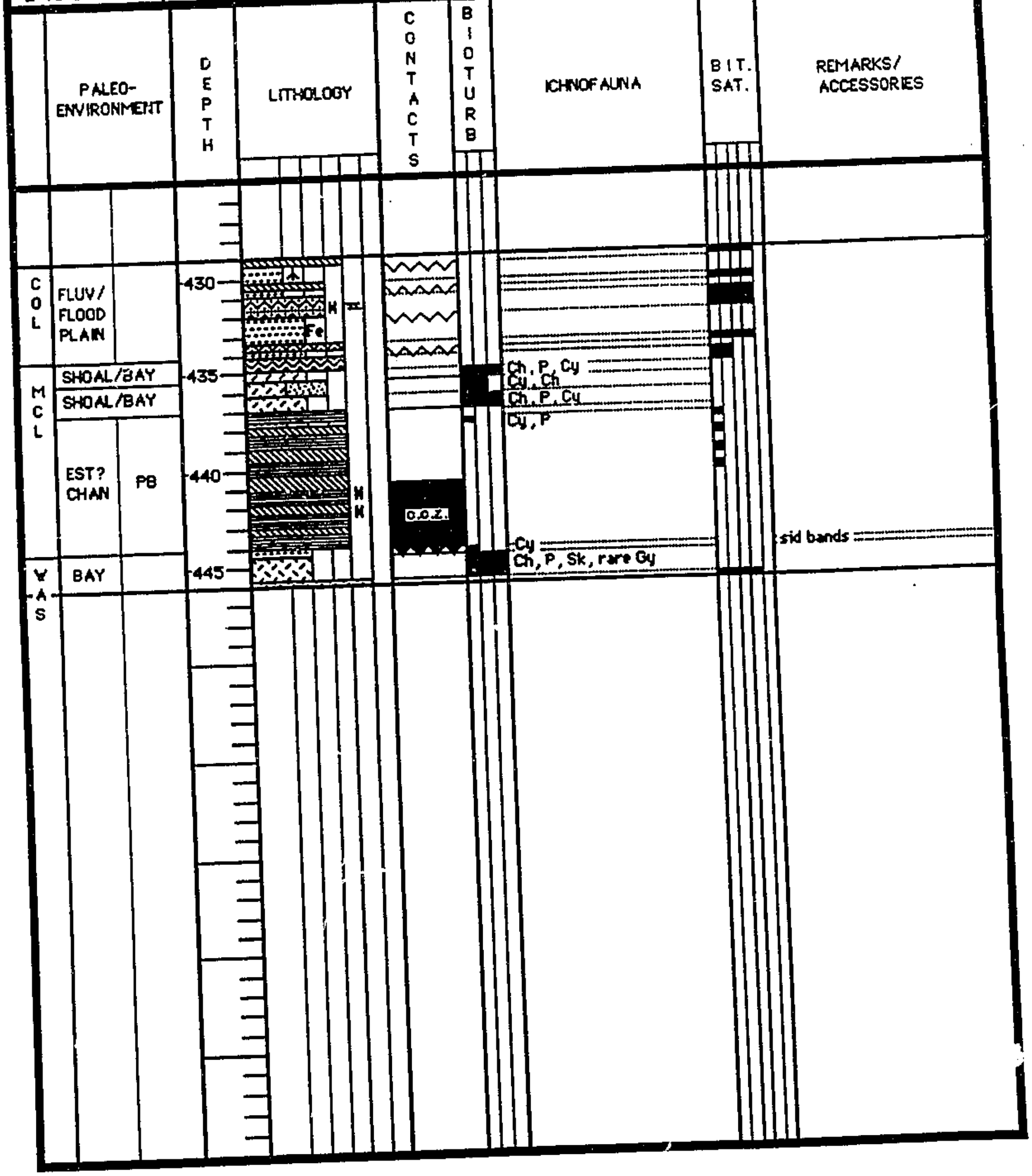
lots of coaly zones, few roots, mostly planar laminated sands

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
4-11-55-5W4	DOME CDA ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	457.0-487.0 m	600.7 m	1 OF 1

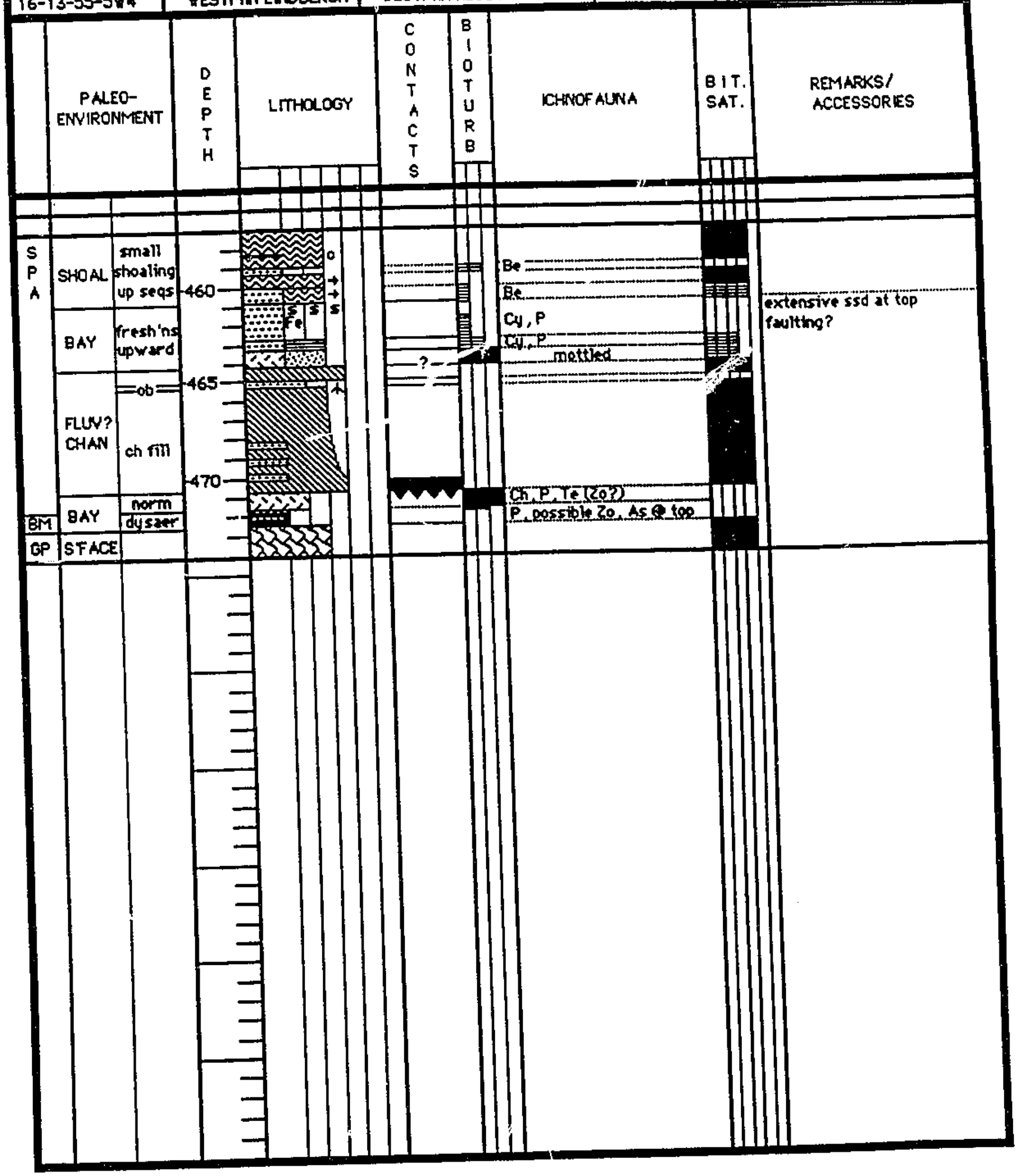


THE TOP OF THIS SAND CORRELATES WITH THE TOP OF THE BOTTOM SAND OF 14-30-55-4W4

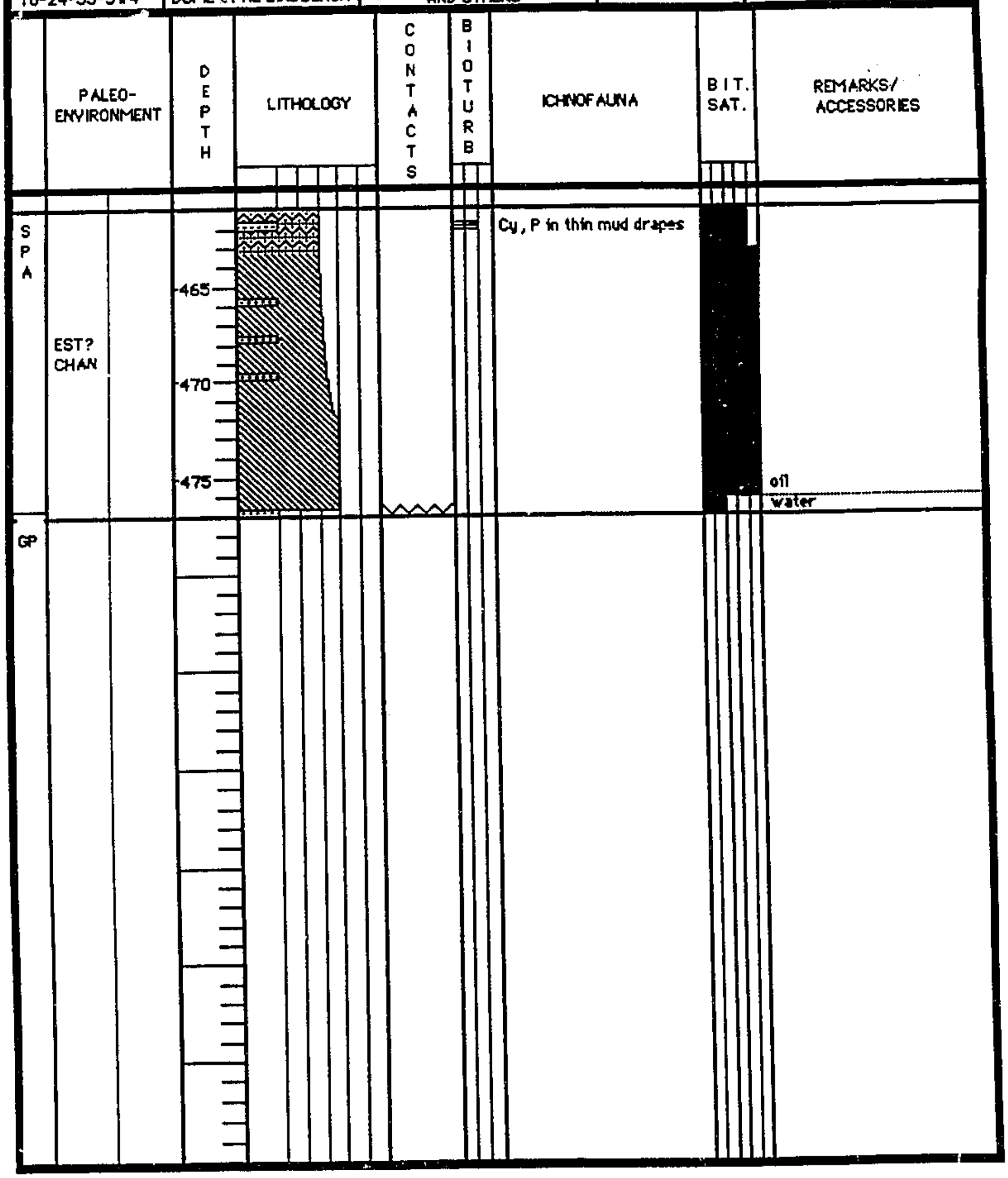
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-13-55-5W4	BRASCAN LINDBERGH	BRASCAN RESOURCES CAN.	429.0-446.0 m	627.6 m	1 OF 1



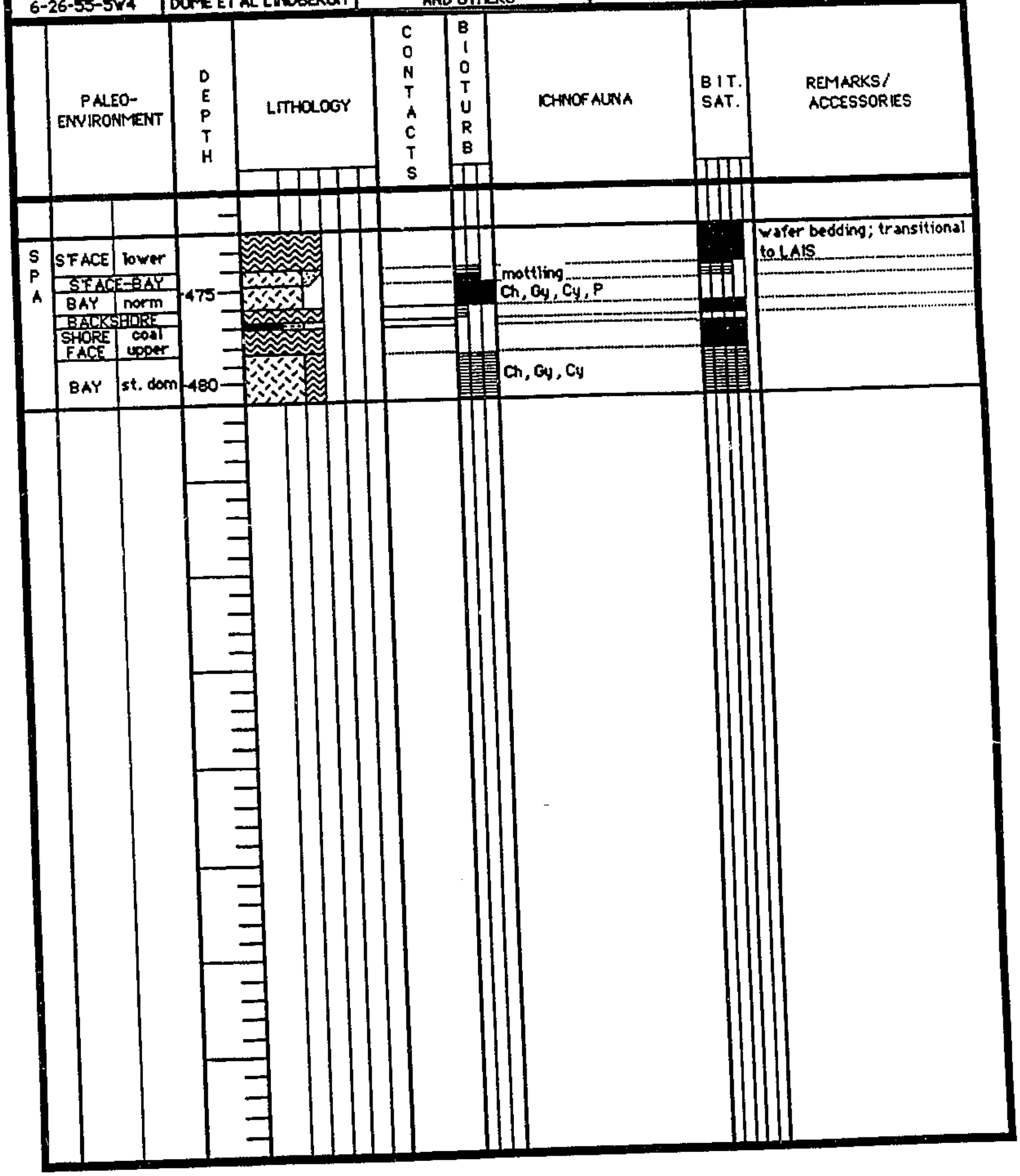
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-13-55-5W4	WESTMIN LINDBERGH	WESTMIN RESOURCES LTD.	456.0-474.0 m	613.4 m	1 OF 1



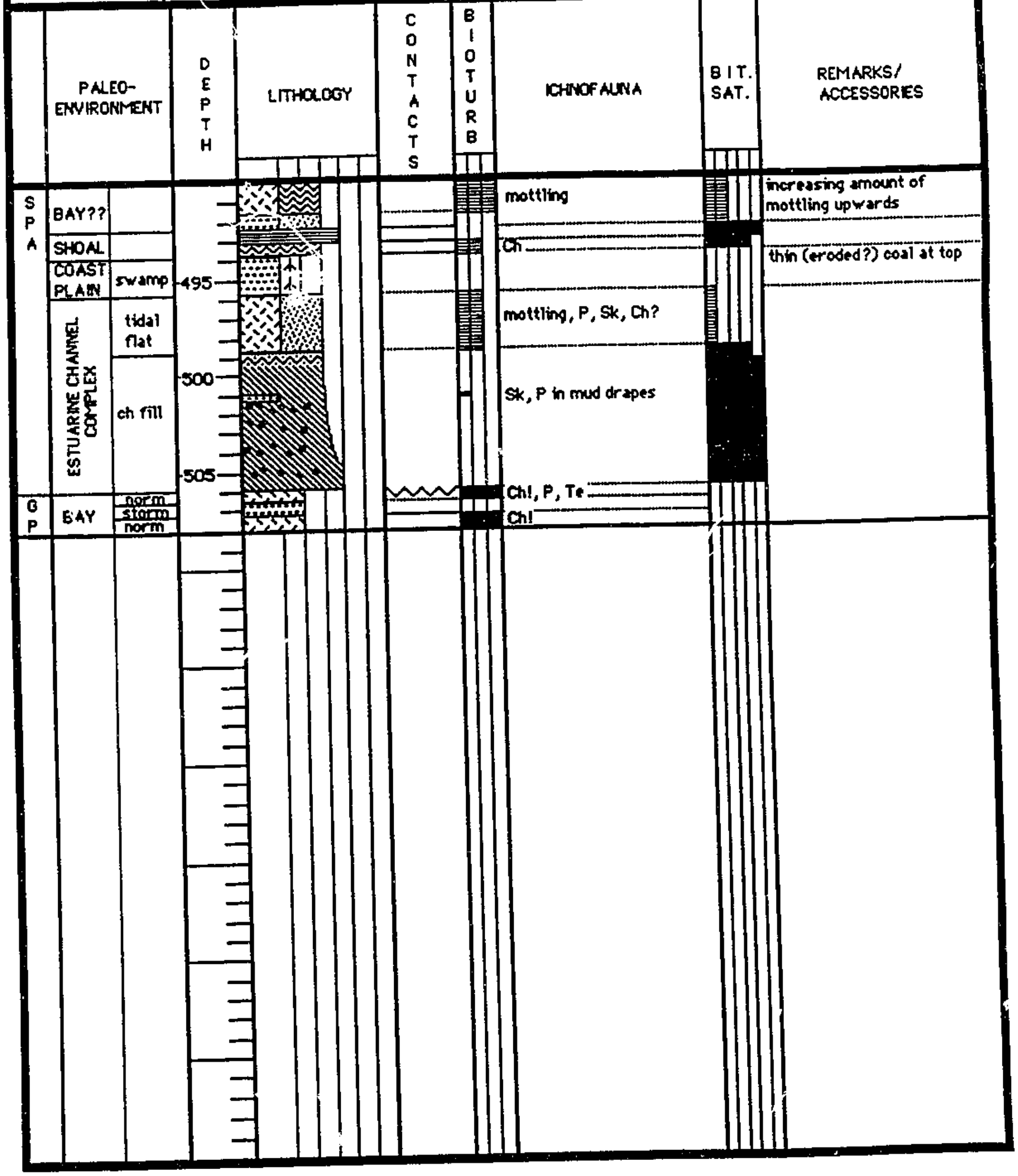
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-24-55-5W4	DOME ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	461.0-477.0 m	612.6 m	1 OF 1



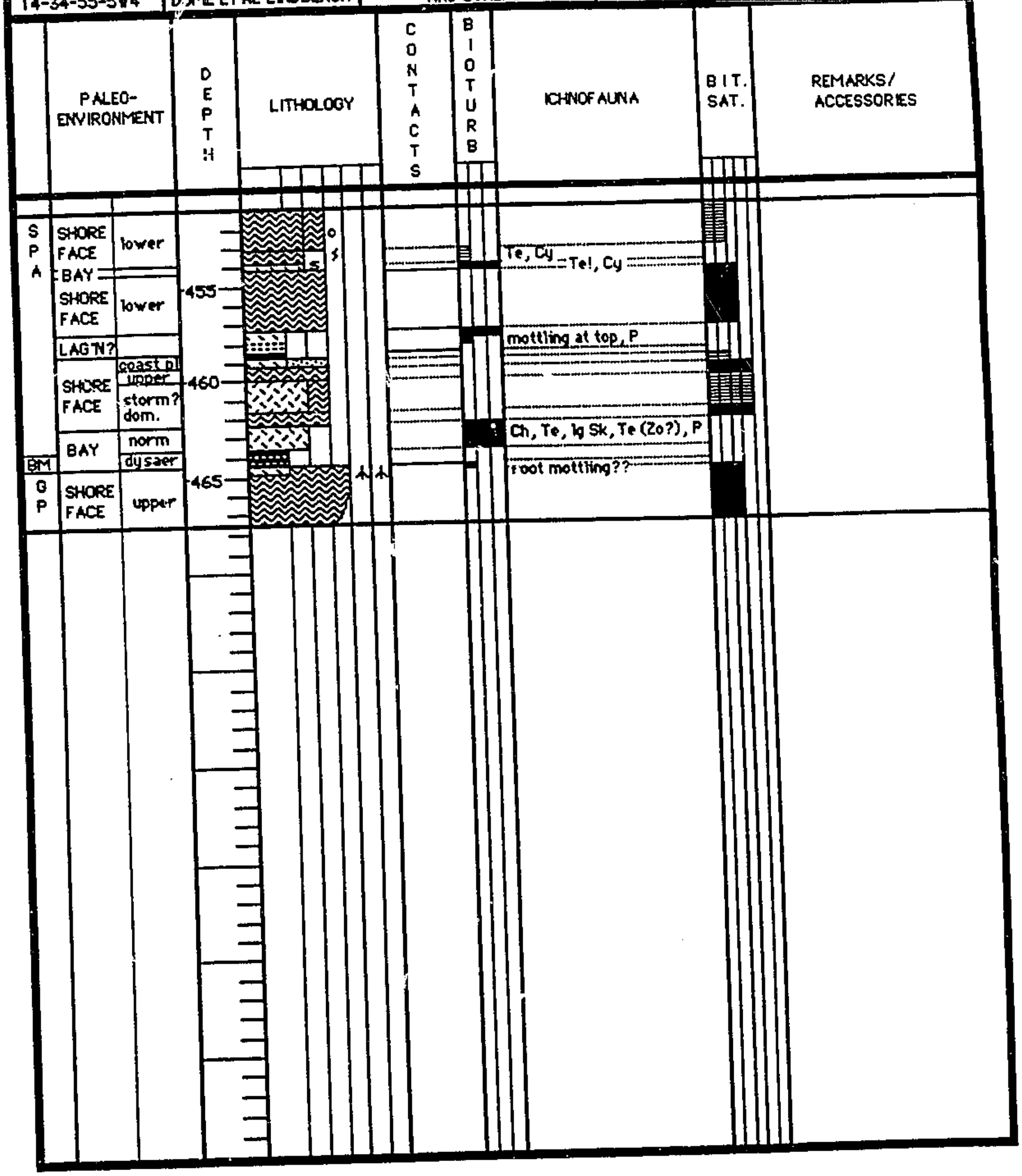
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-26-55-5W4	DOME ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	472.0-481.0 m	623.3 m	1 OF 1



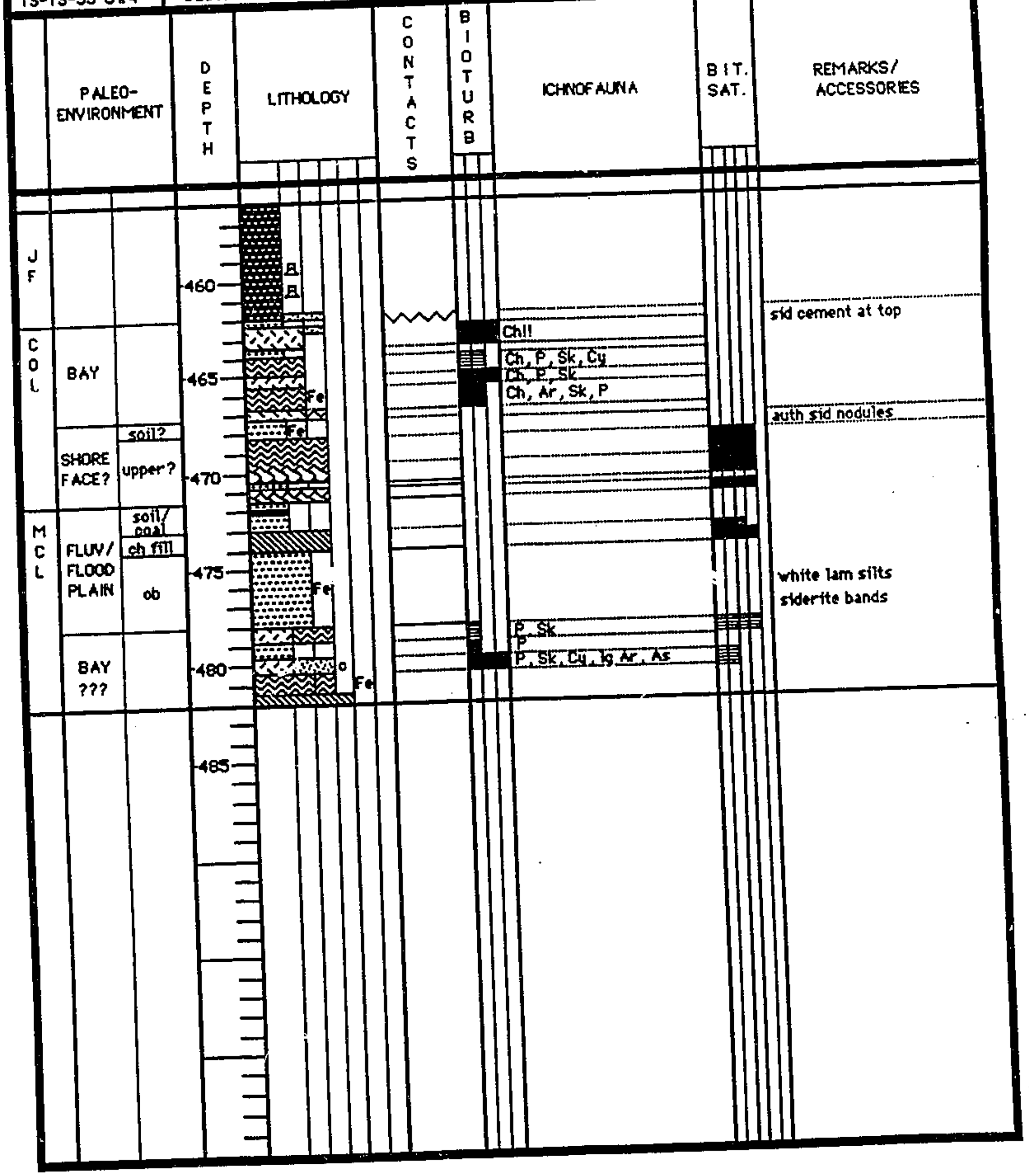
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-27-55-5W4	BRASCAN LINDBERGH	BRASCAN RESOURCES LTD.	490.0-508.0 m	644.0 m	1 OF 1



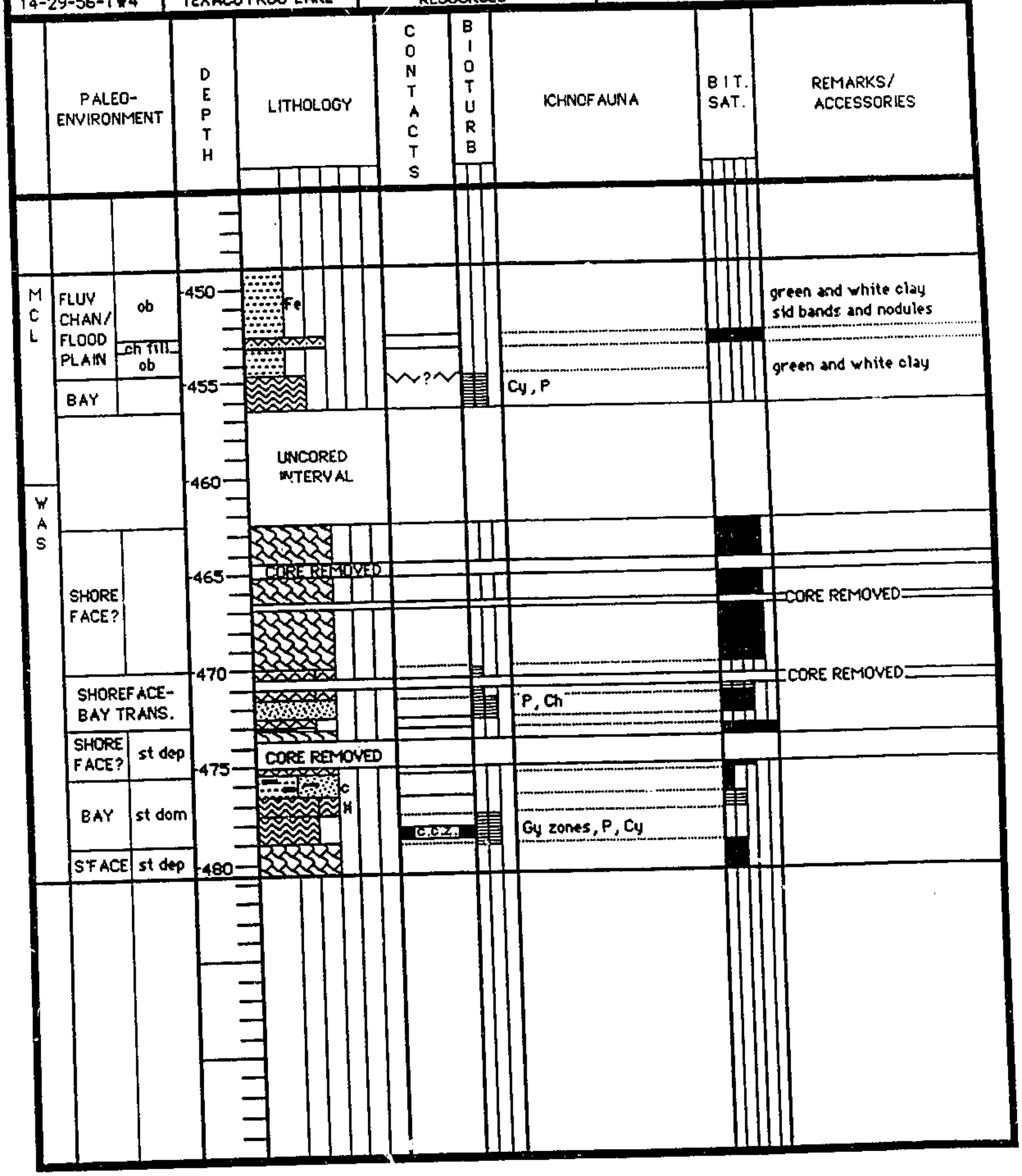
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-34-55-5W4	DOME ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	451.0-467.5 m	610.2 m	1 OF 1



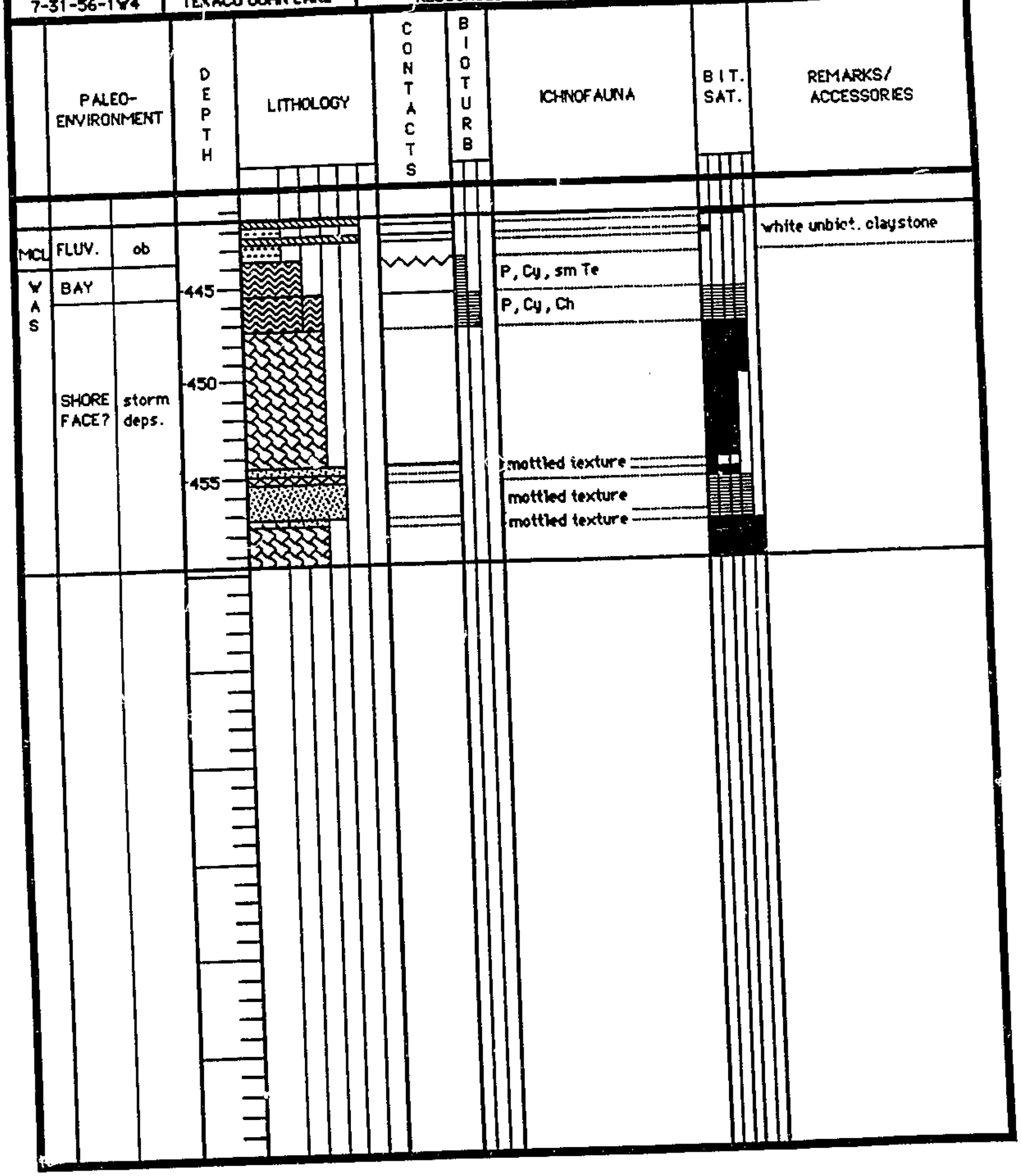
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-13-55-6W4	WESTMIN LINDBERGH	WESTMIN RESOURCES LTD.	456.0-483.0 m	641.5 m	1 OF 1

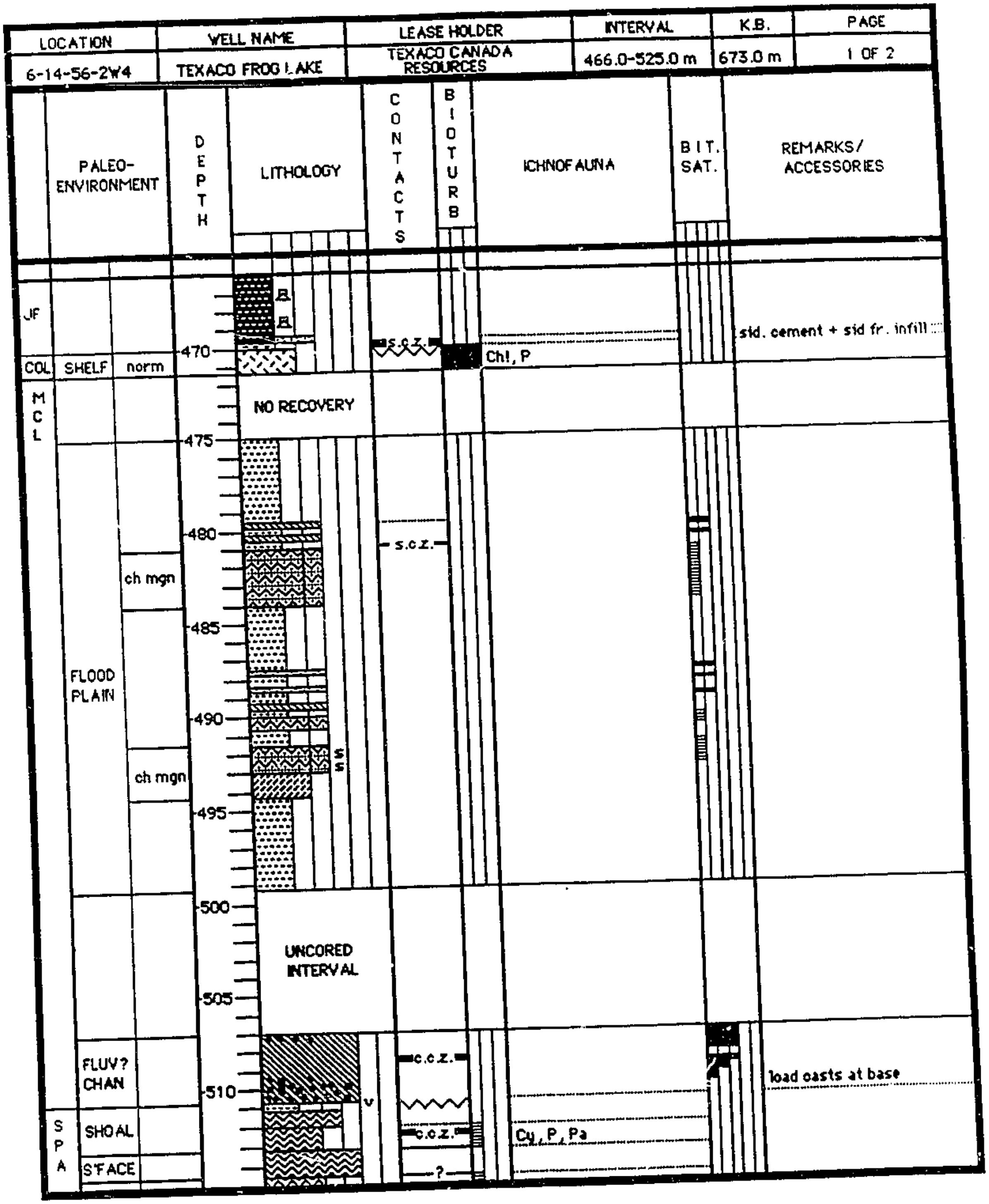


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-29-56-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	449-480.5 m	658.3 m	1 OF 1

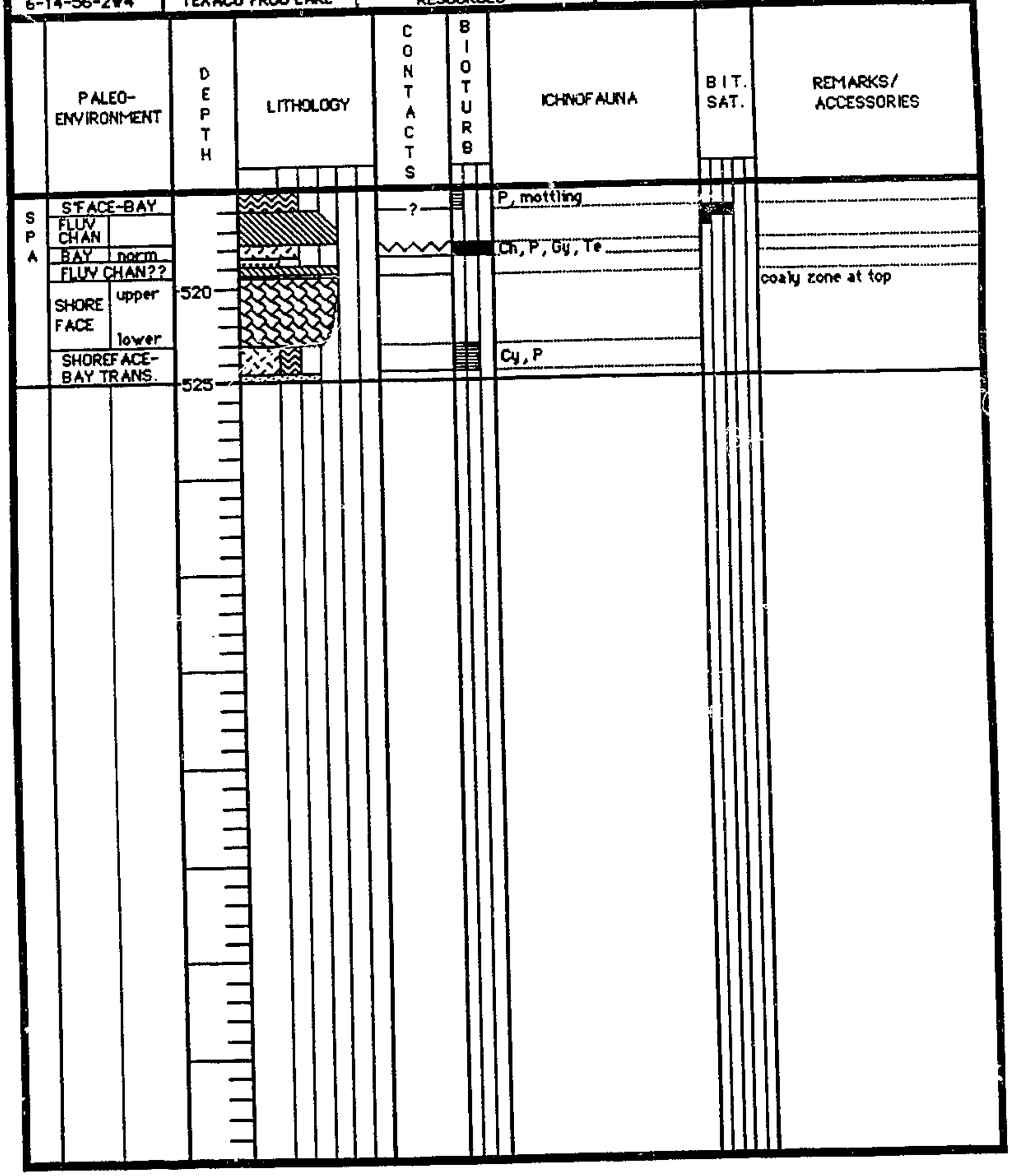


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-31-56-1W4	TEXACO JOHN LAKE	TEXACO CANADA RESOURCES	441.5-459.5 m	641.76 m	1 OF 1

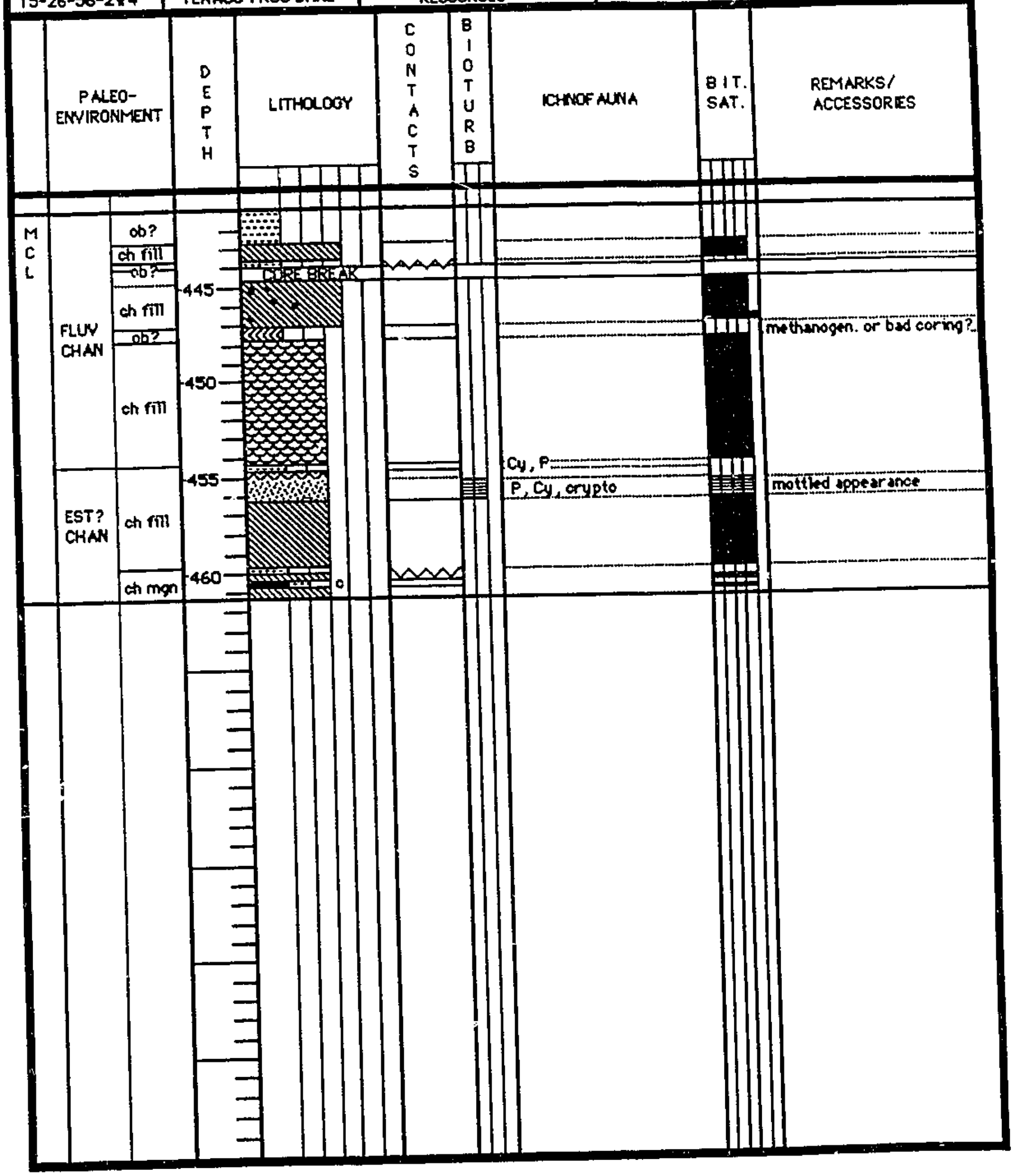



LOCATION
6-14-56-2W4
WELL NAME
TEXACO FROG LAKE
LEASE HOLDER
TEXACO CANADA RESOURCES
INTERVAL
466.0-525.0 m
K.B.
673.0 m
PAGE
1 OF 2
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ACCESSORIES
JF
COL
SHELF
norm
MCL
FLOOD PLAIN
ch mgn
ch mgn
FLUV? CHAN
SPA
SHOAL
S'FACE
470
475
480
485
490
495
500
505
510
NO RECOVERY
UNCORED INTERVAL
s.c.z.
s.c.z.
c.c.z.
c.c.z.
?
s
s
v
Chl, P
Cy, P, Pa
sid. cement + sid fr. infill
load casts at base

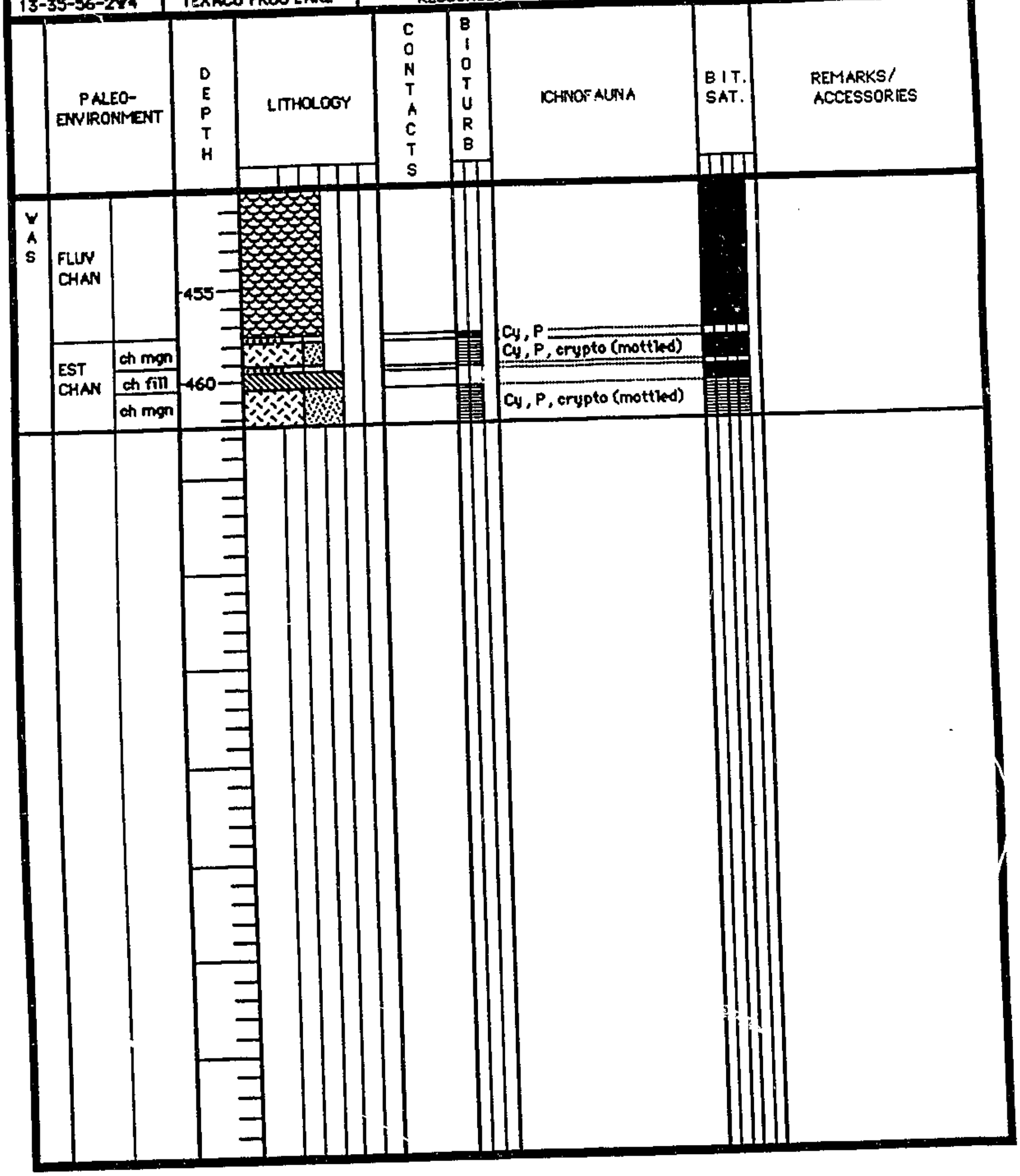
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-14-56-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	466.0-525.0 m	673.0 m	2 OF 2



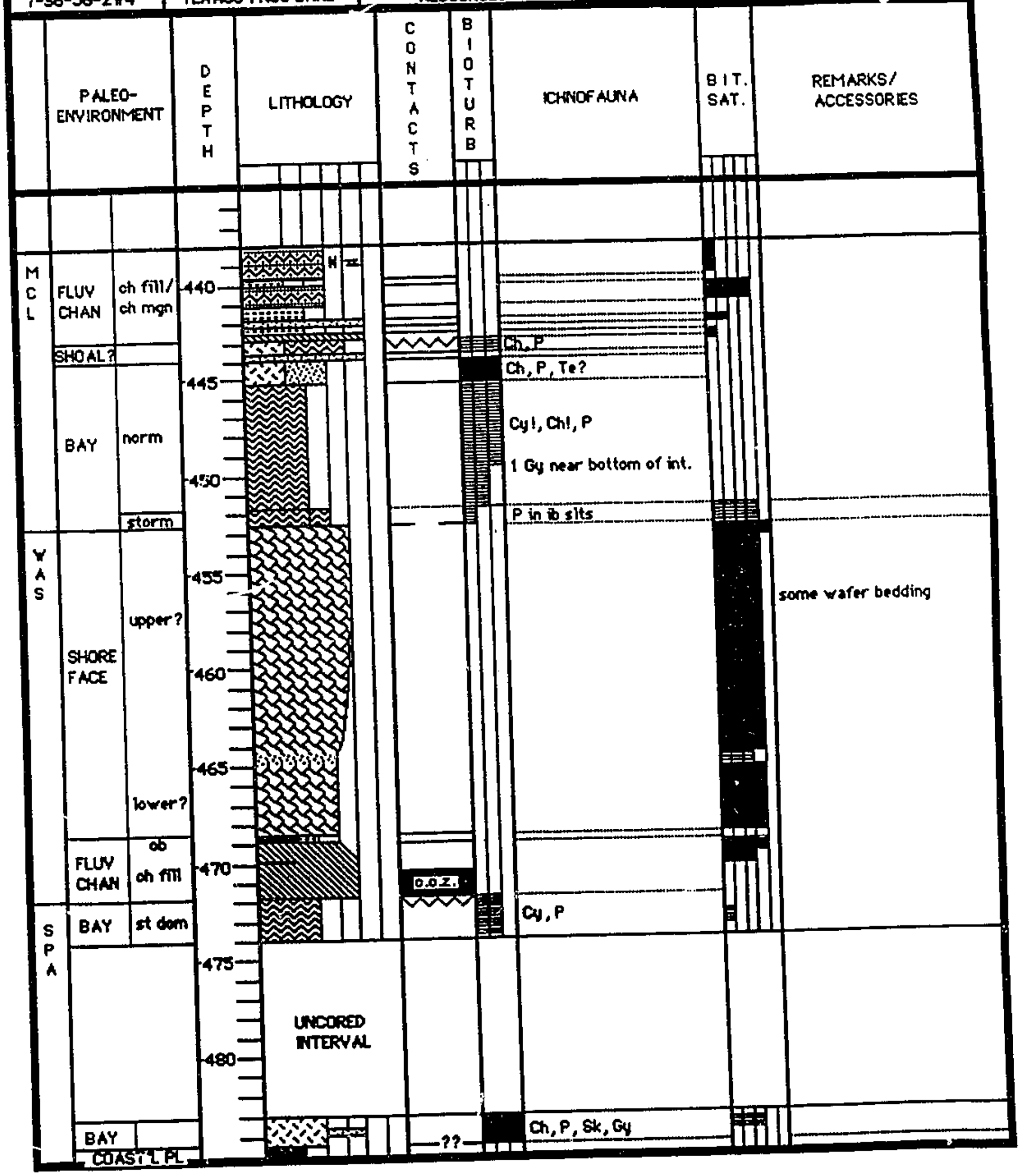
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-26-56-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	441.0-461.5 m	635.7 m	1 OF 1



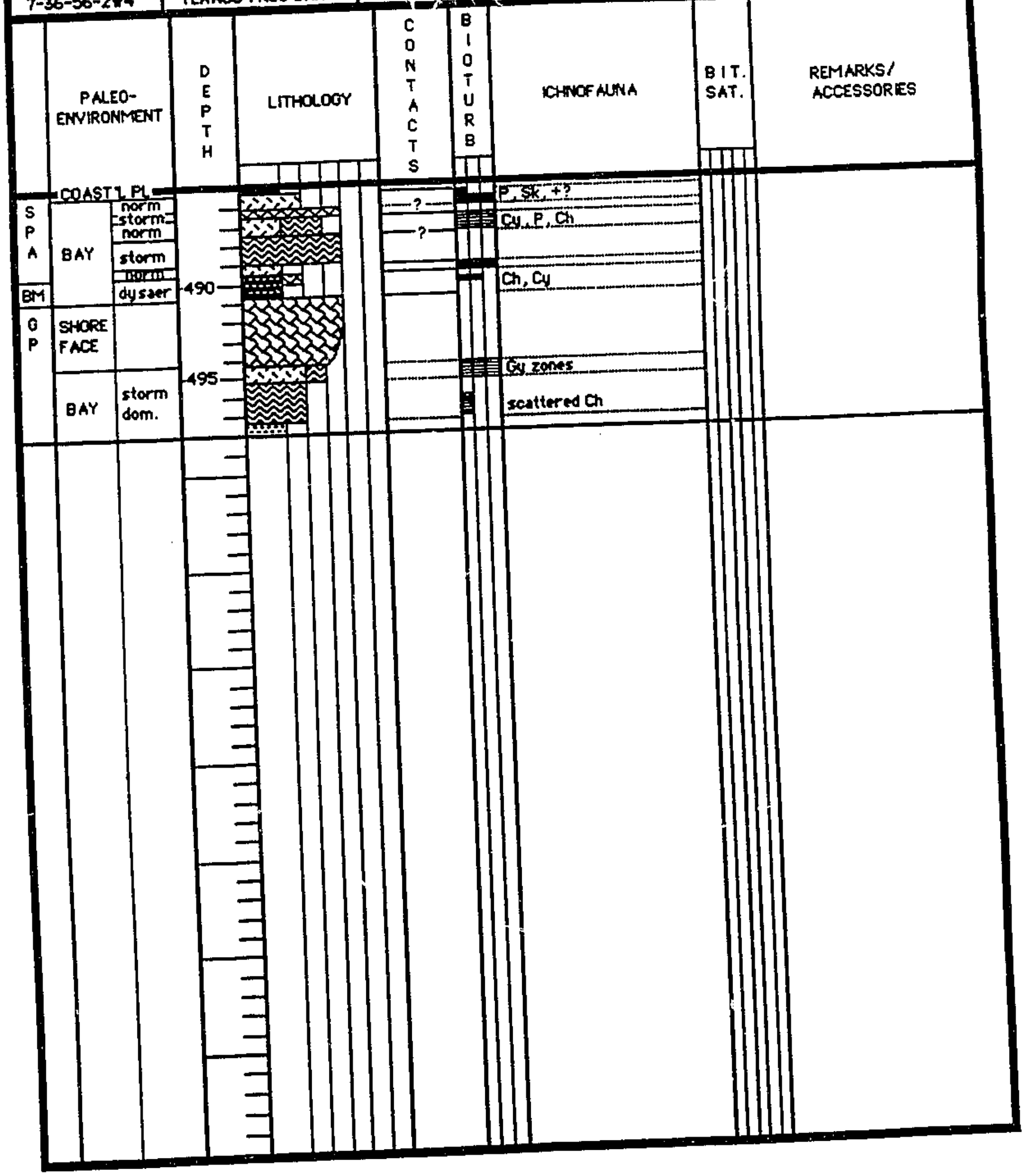
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-35-56-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	450.0-462.3 m	641.2 m	1 OF 1



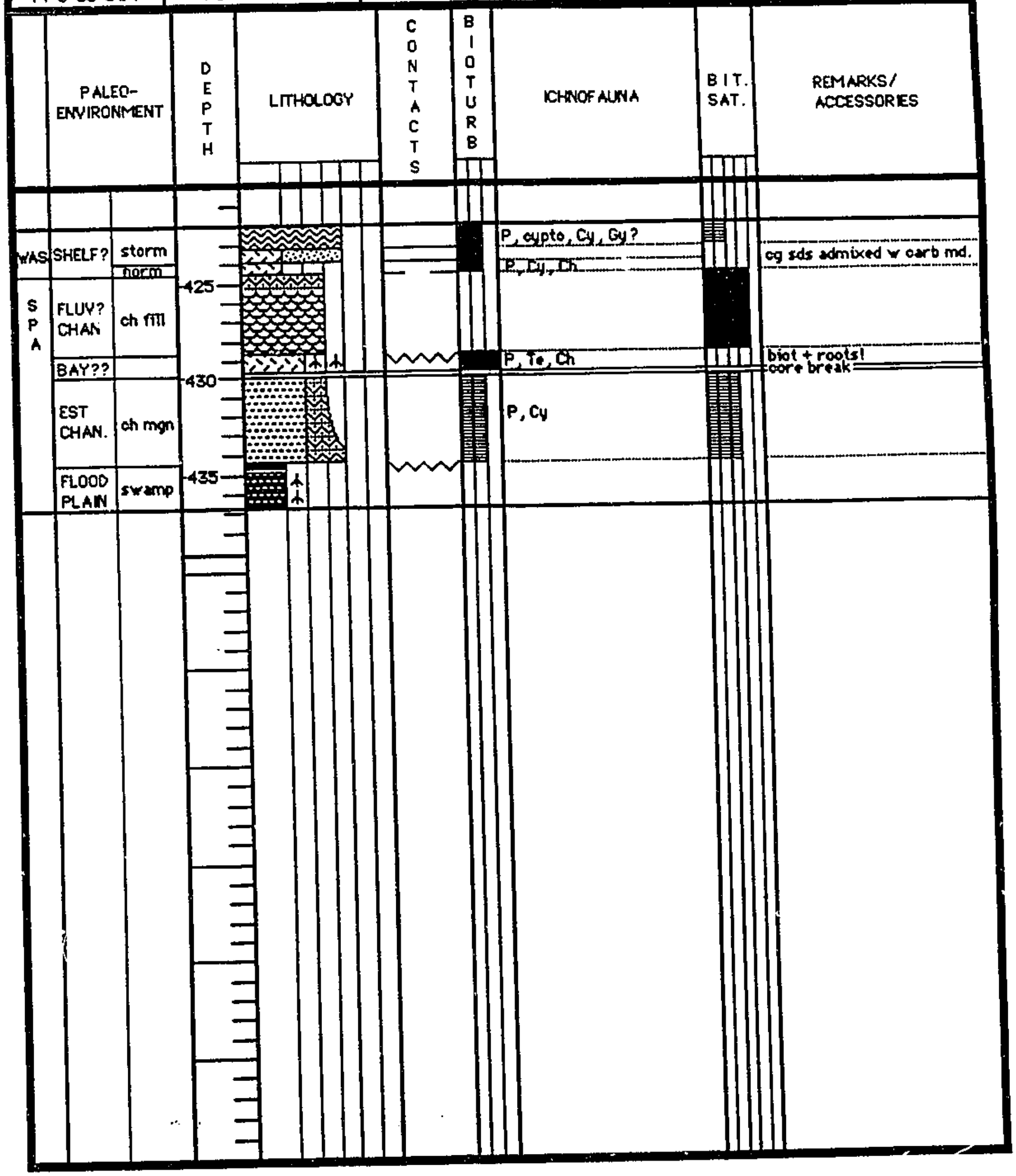
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-36-56-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	438.0-498.0 m	645.01 m	1 OF 2



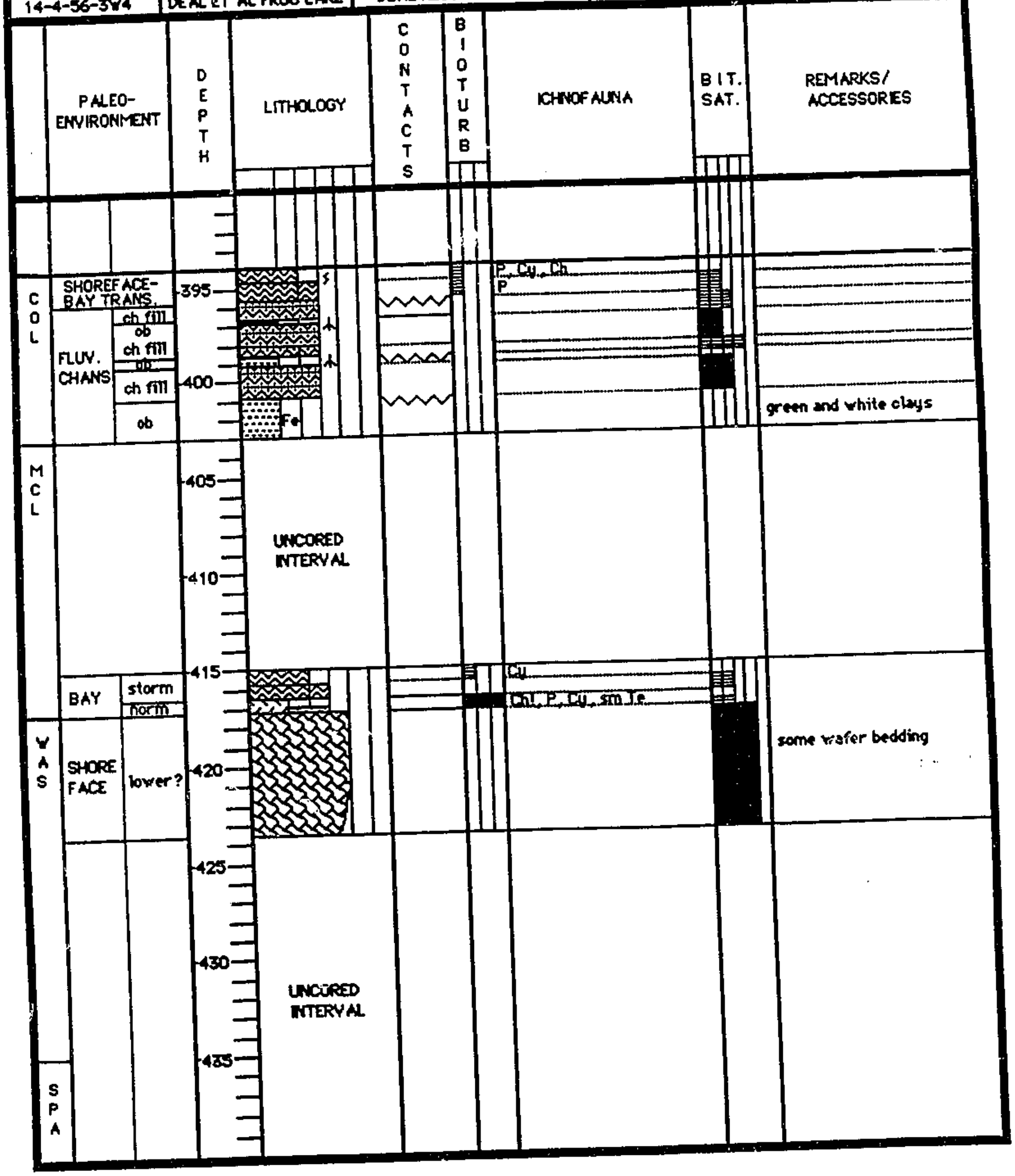
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-36-56-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	438.0-498.0 m	645.01 m	2 OF 2



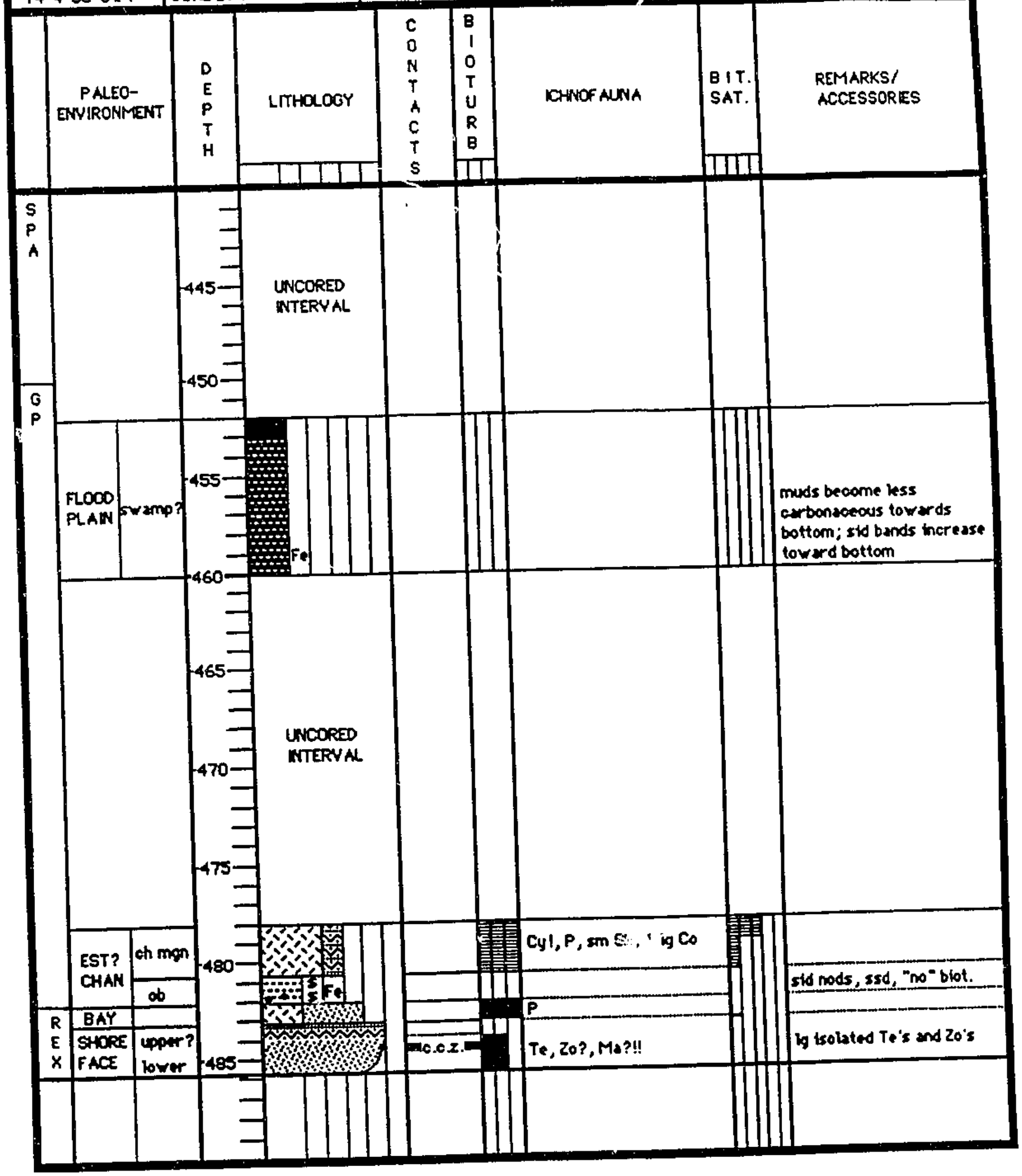
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-3-56-3W4	PCP FROG LAKE	PANCANADIAN PETROLEUM	422-436.75 m	582.4 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-4-56-3W4	DEAL ET AL FROG LAKE	DEAL RESOURCES ET AL	394.0-486.5 m	605.5 m	1 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-4-56-3W4	DEAL ET AL FROG LAKE	DEAL RESOURCES ET AL	394.0-486.5 m	605.5 m	2 OF 2

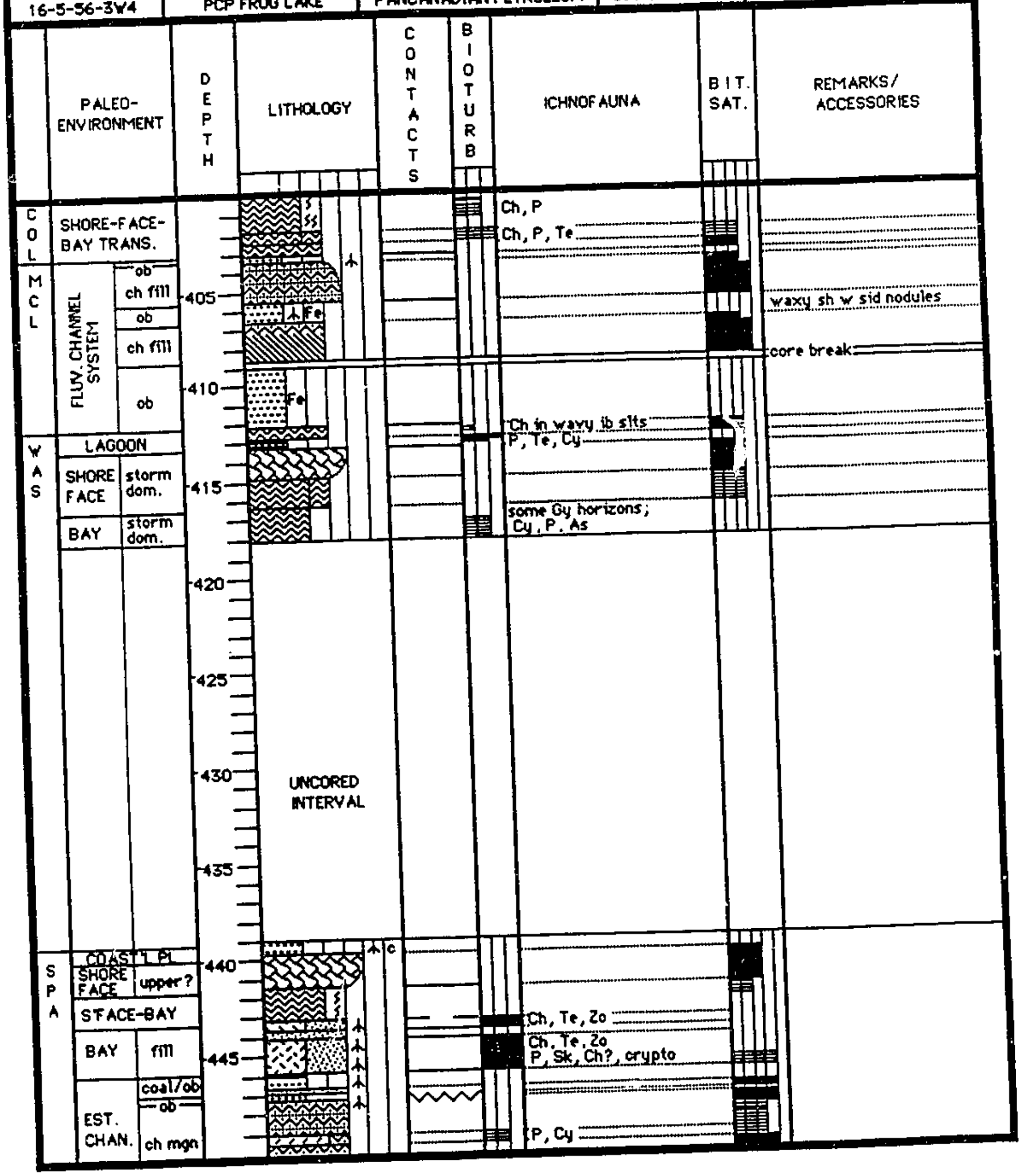


muds become less carbonaceous towards bottom; sid bands increase toward bottom

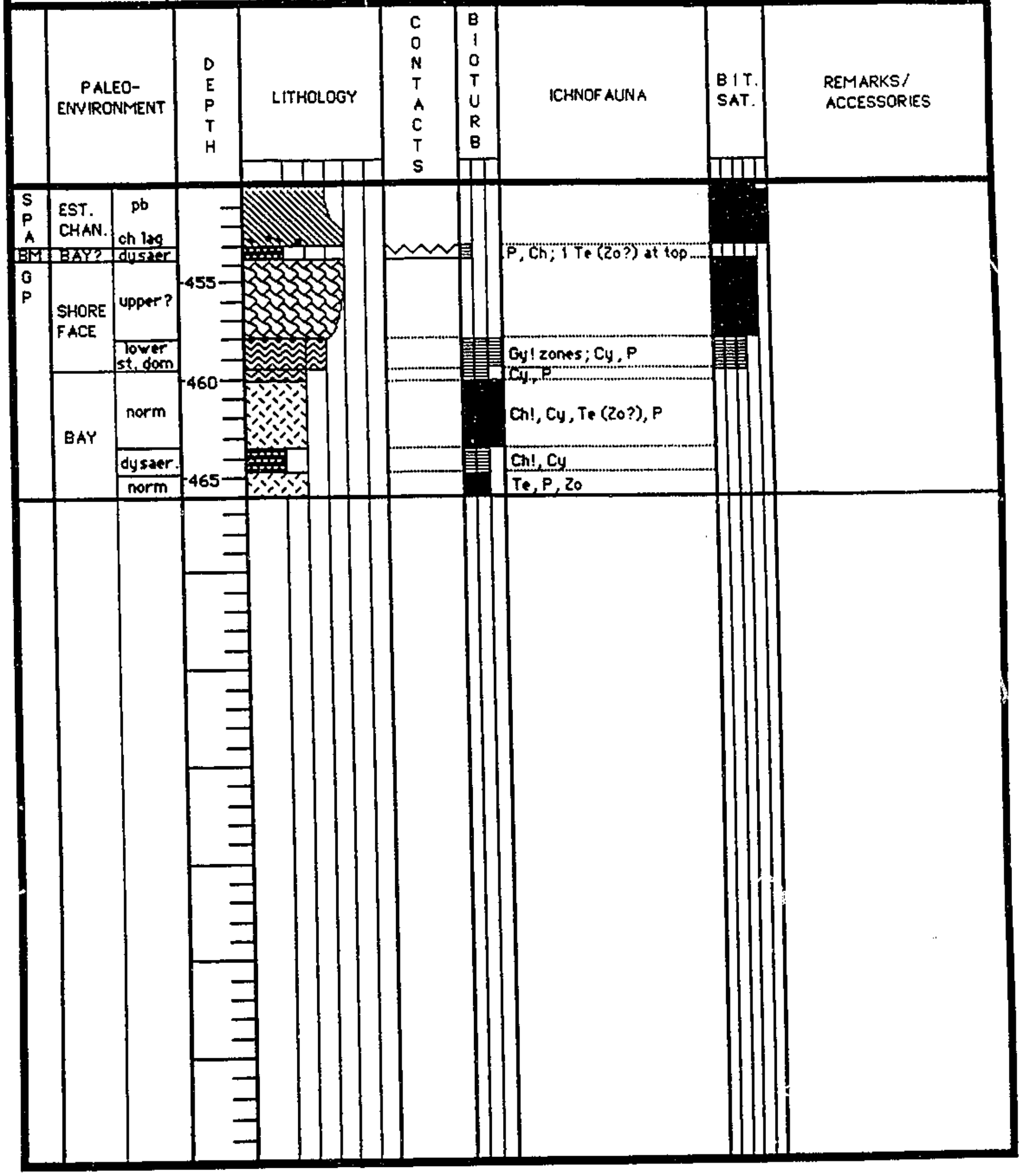
sid nods, ssd, "no" biot.

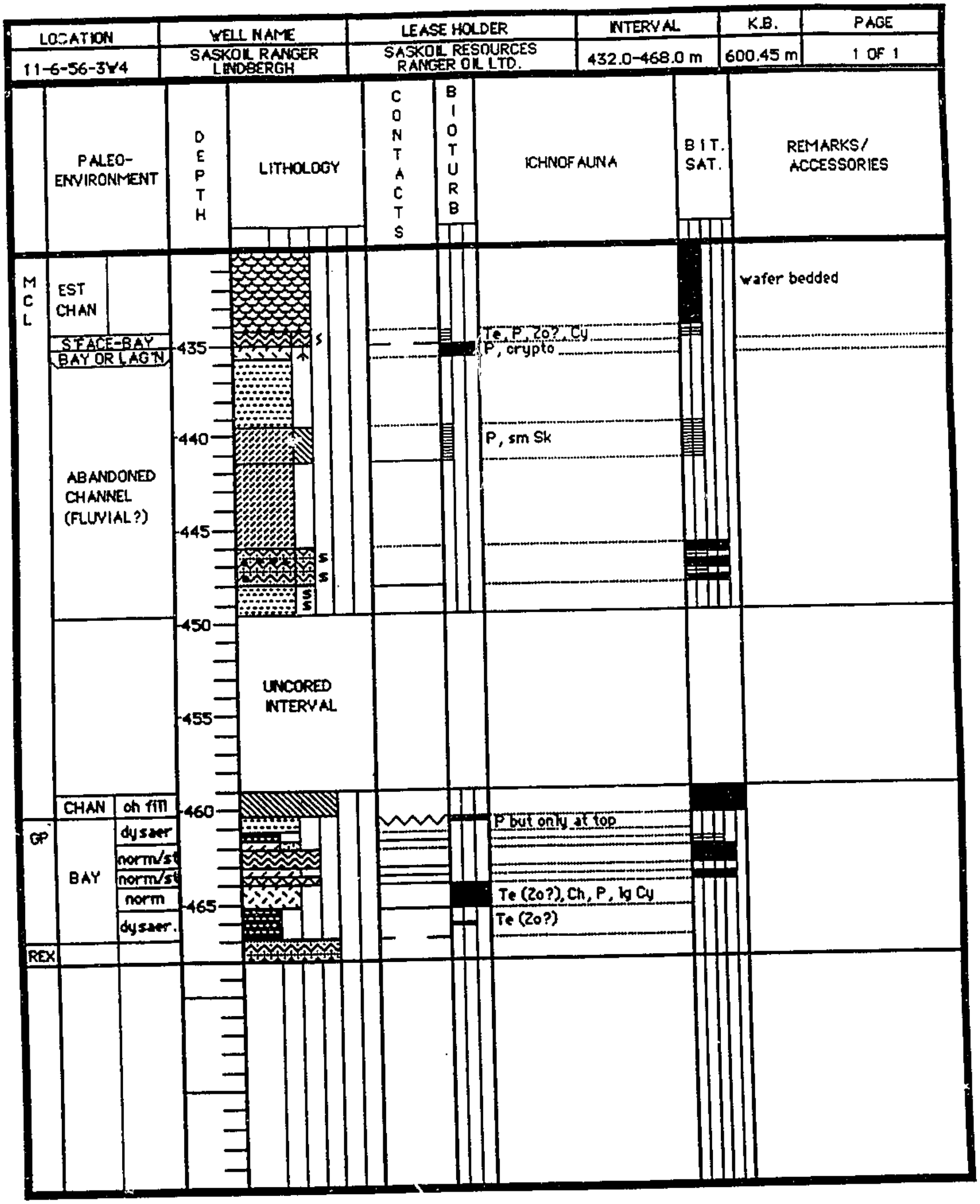
lg isolated Te's and Zo's

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-5-56-3W4	PCP FROG LAKE	PANCANADIAN PETROLEUM	395.0-466.0 m	607.2 m	1 OF 2

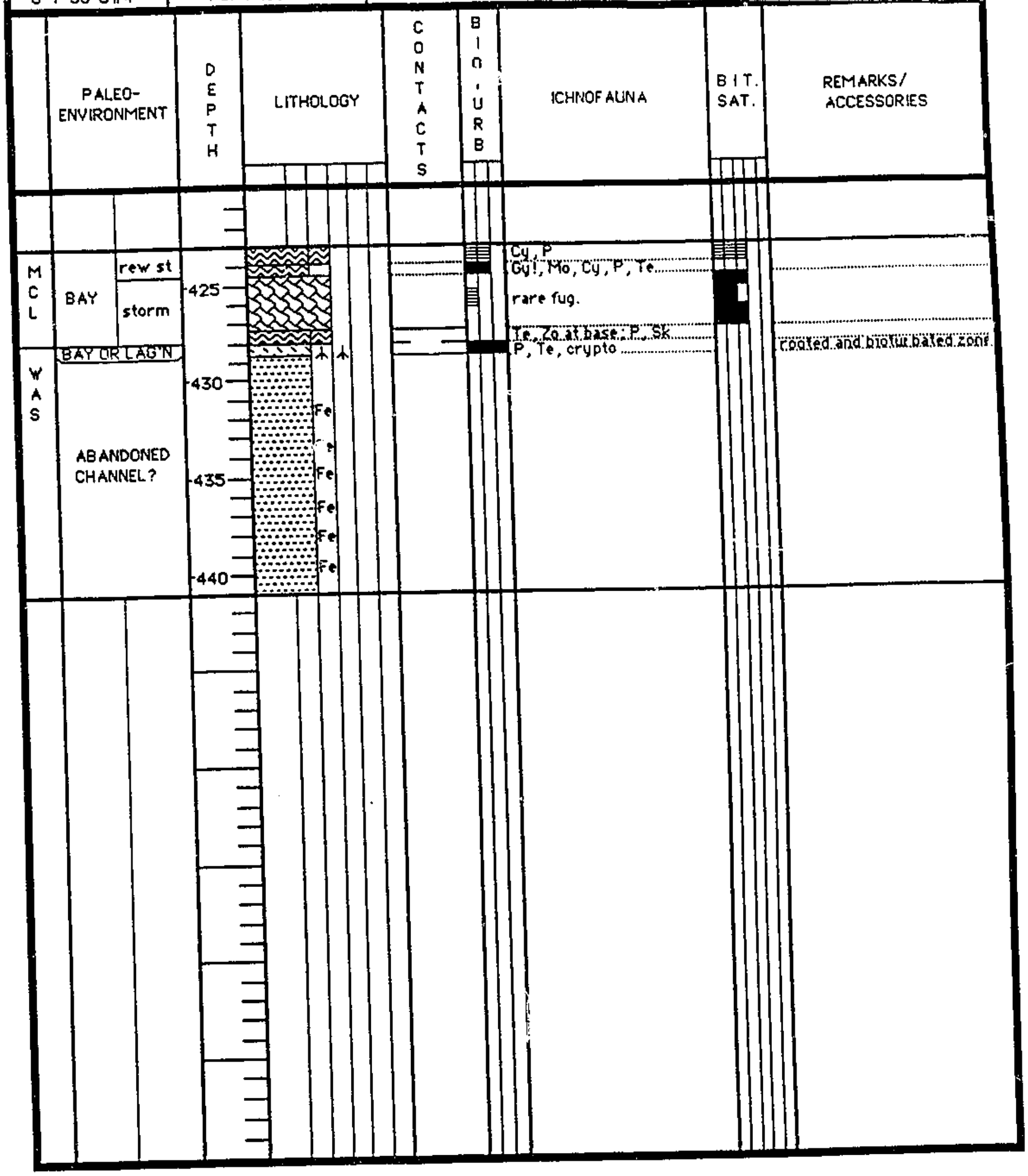


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-5-56-3W4	PCP FROG LAKE	PANCANADIAN PETROLEUM	395.0–466.0 m	607.2 m	2 OF 2

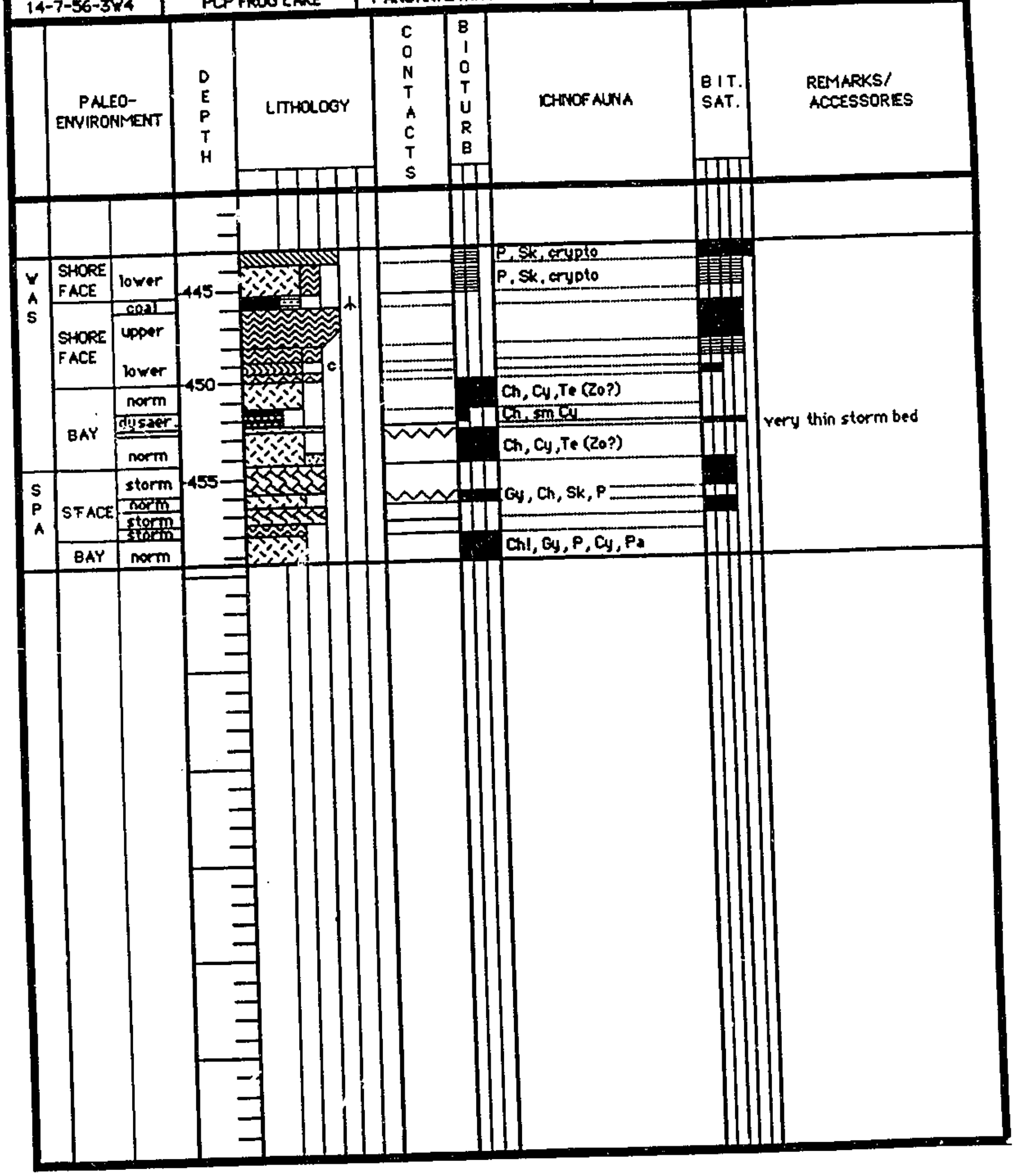



LOCATION
11-6-56-3W4
WELL NAME
SASKOIL RANGER LINDBERGH
LEASE HOLDER
SASKOIL RESOURCES RANGER OIL LTD.
INTERVAL
432.0-468.0 m
K.B.
600.45 m
PAGE
1 OF 1
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
MCL
EST CHAN
S'FACE-BAY
BAY OR LAG'N
ABANDONED CHANNEL (FLUVIAL?)
CHAN
oh fill
GP
BAY
dysaer
norm/st
norm/st
norm
dysaer.
REX
435
440
445
450
455
460
465
UNCORED INTERVAL
Te, P, Zo?, Cy
P, crypto
P, sm Sk
P but only at top
Te (Zo?), Ch, P, lg Cy
Te (Zo?)
wafer bedded
s
s
s
s
s

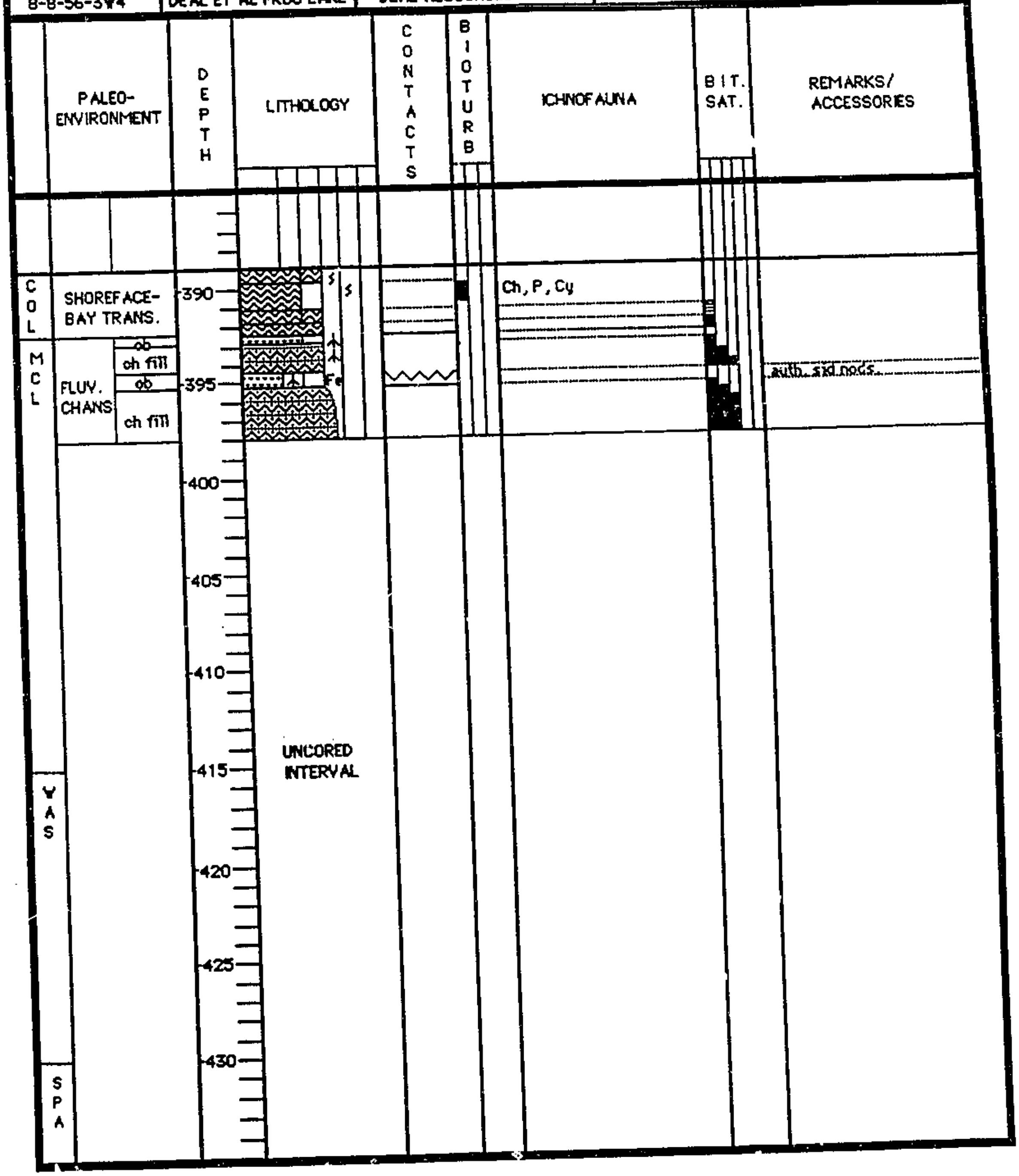
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-7-56-3W4	PCP FROG LAKE	PANCANADIAN PETROLEUM	423.0-441.0 m	597.7 m	1 OF 1



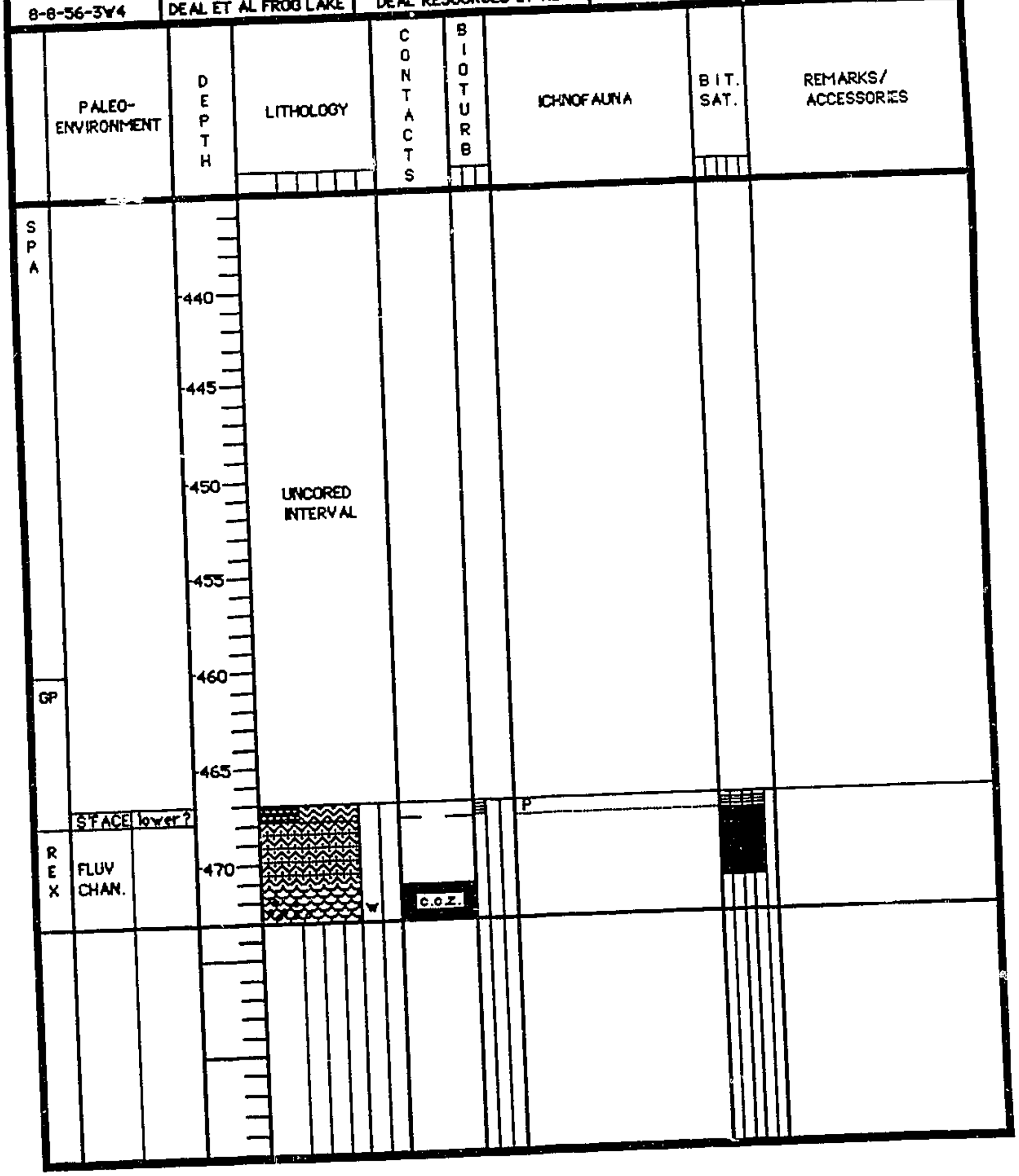
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-7-56-3W4	PCP FROG LAKE	PANCANADIAN PETROLEUM	443.0-459.25 m	609.4 m	1 OF 1



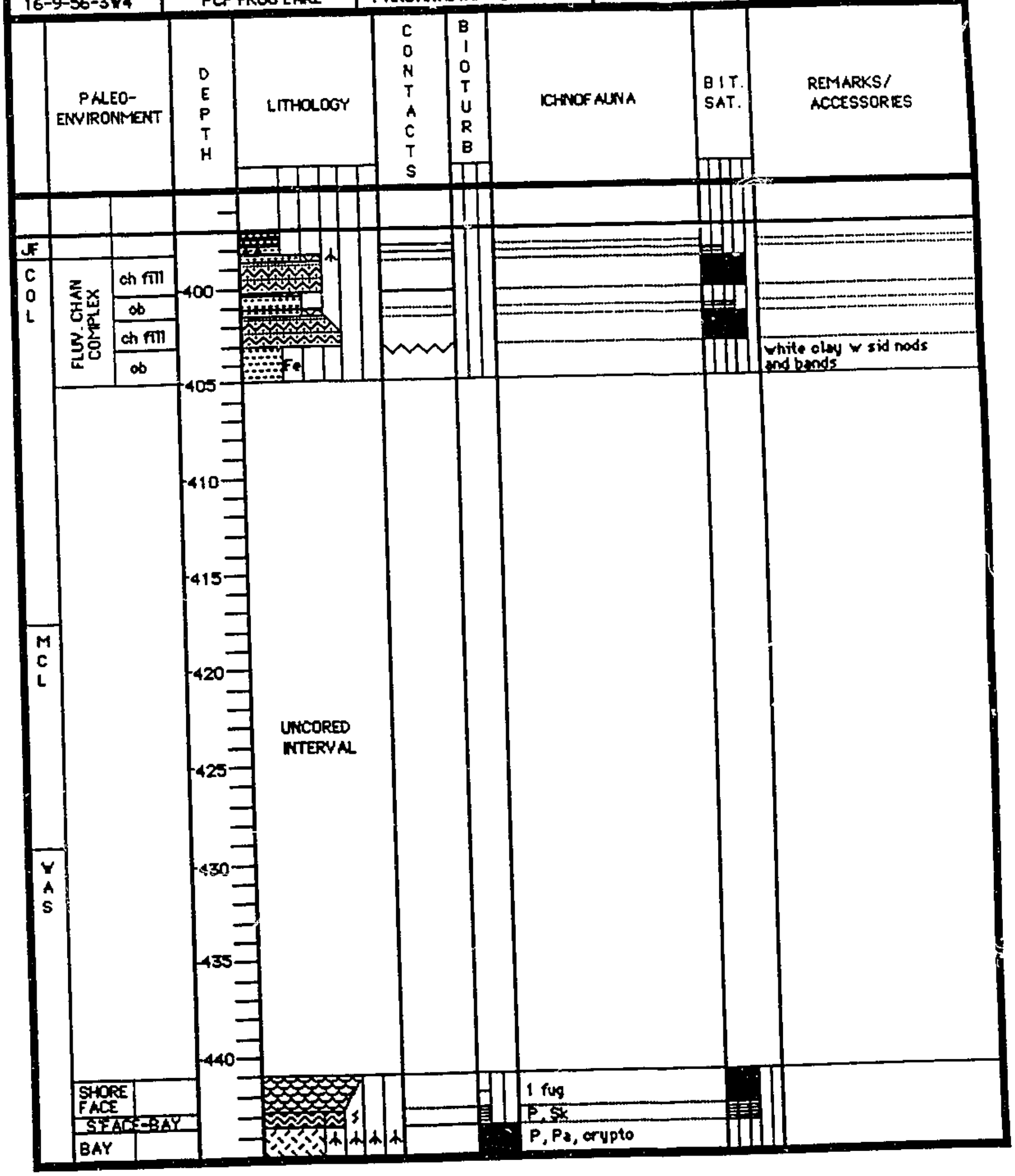
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-8-56-3W4	DEAL ET AL FROG LAKE	DEAL RESOURCES ET AL	389.0-473.0 m	606.45 m	1 OF 2



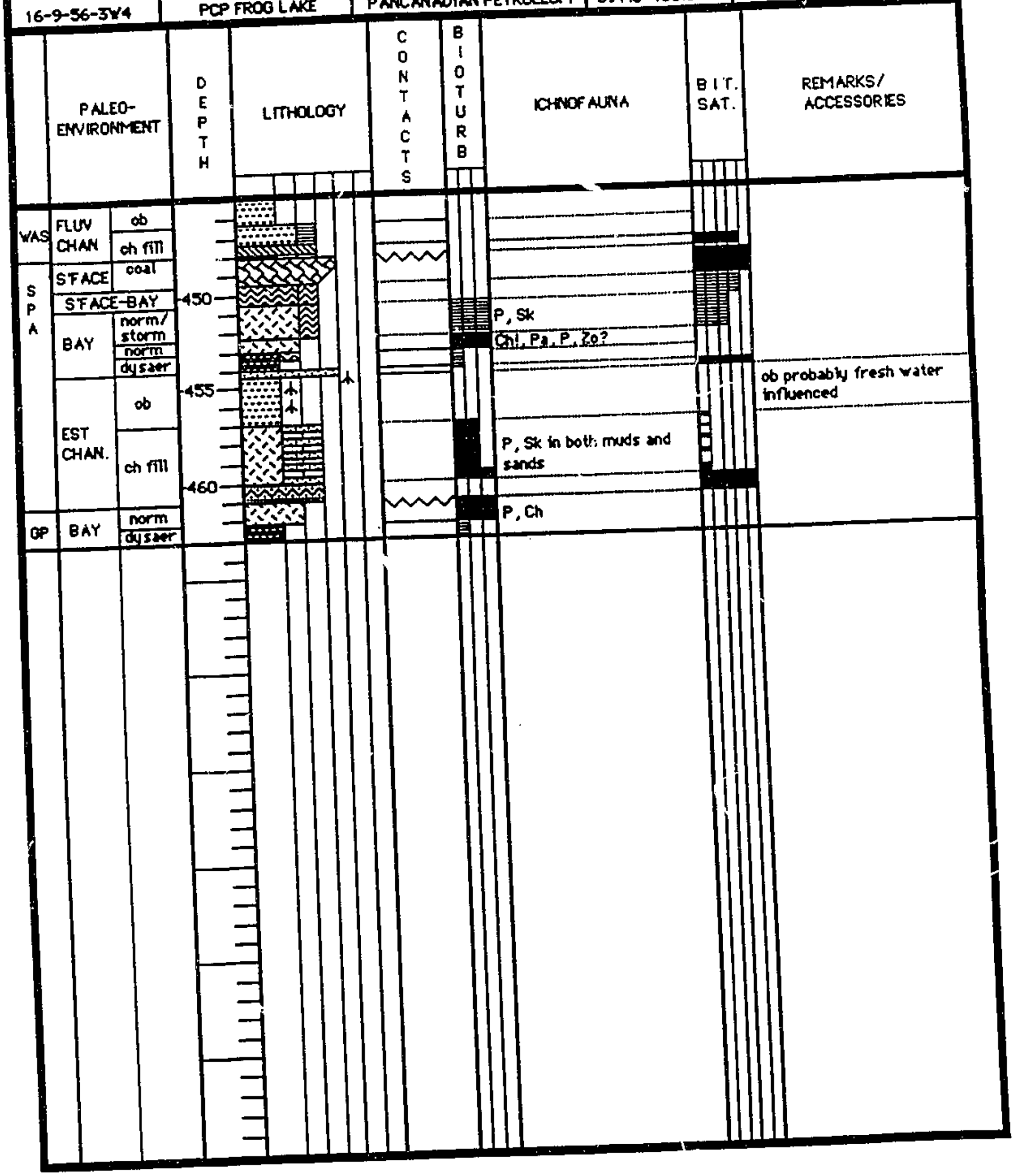
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-8-56-3W4	DEAL ET AL FROG LAKE	DEAL RESOURCES ET AL	389.0–473.0 m	606.45 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-9-56-3W4	PCP FROG LAKE	PANCANADIAN PETROLEUM	397.0-463.0 m	606.7 m	1 OF 2

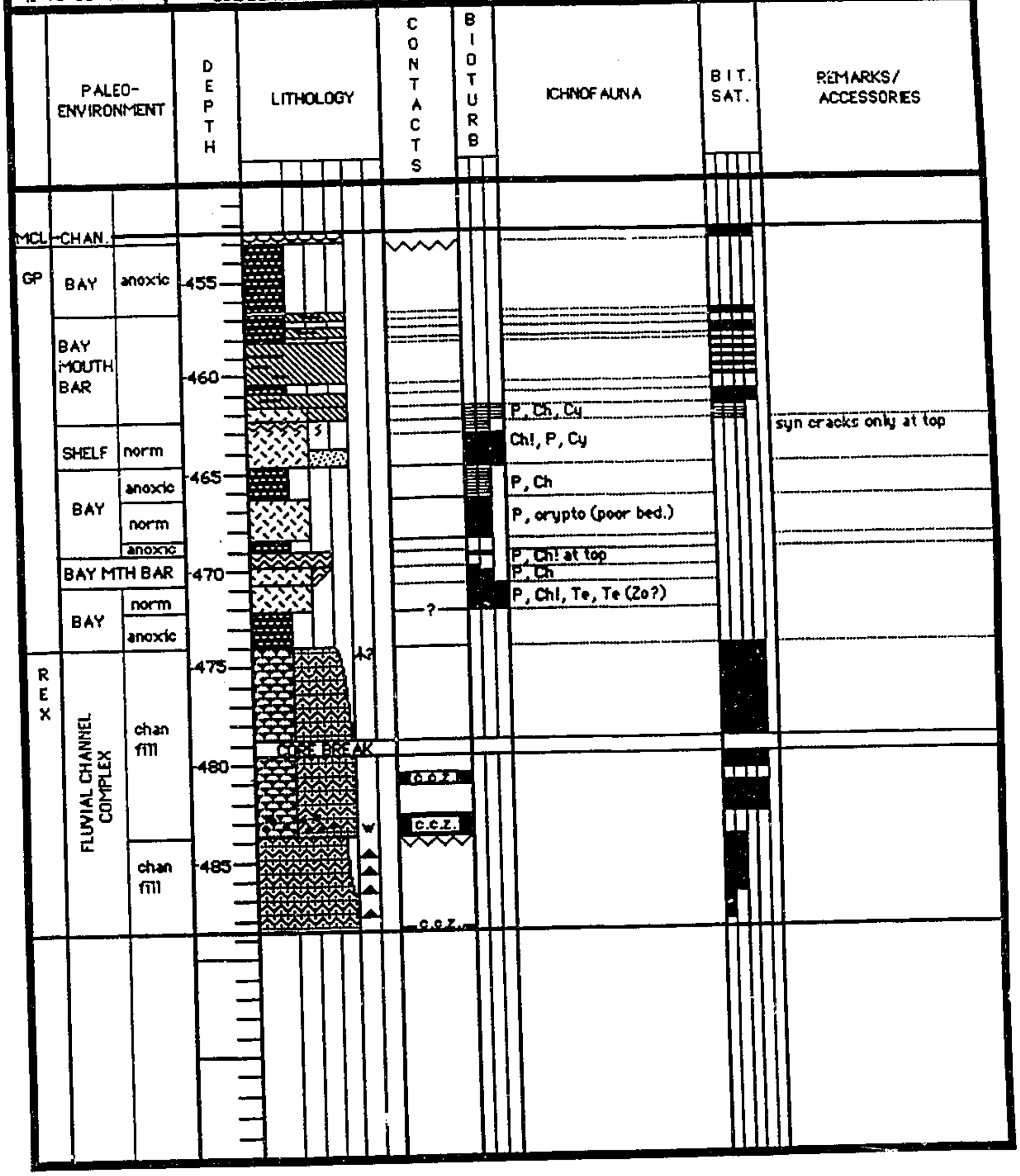


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-9-56-3W4	PCP FROG LAKE	PANCANADIAN PETROLEUM	397.0–463.0 m	606.7 m	2 OF 2

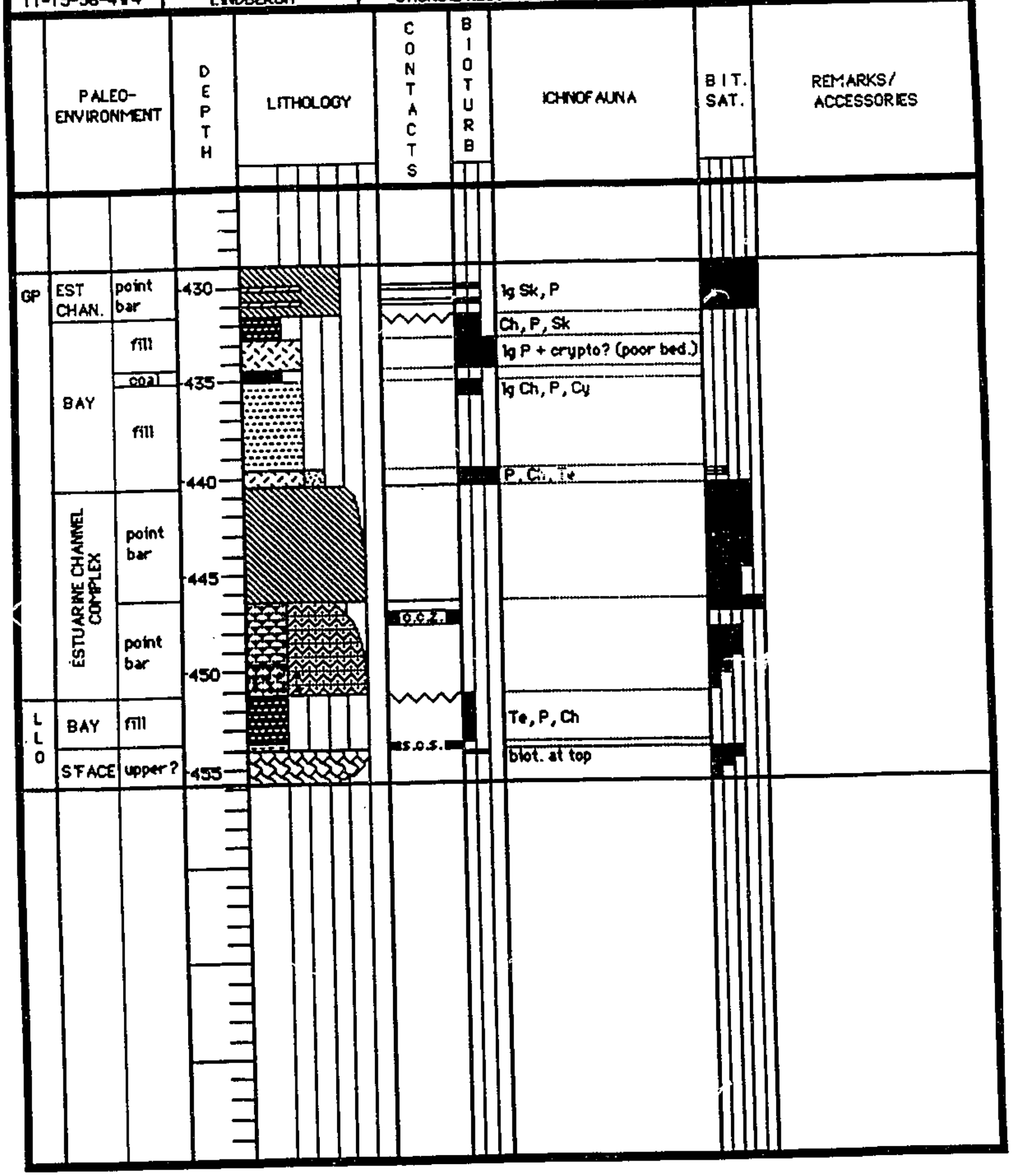


ob probably fresh water influenced

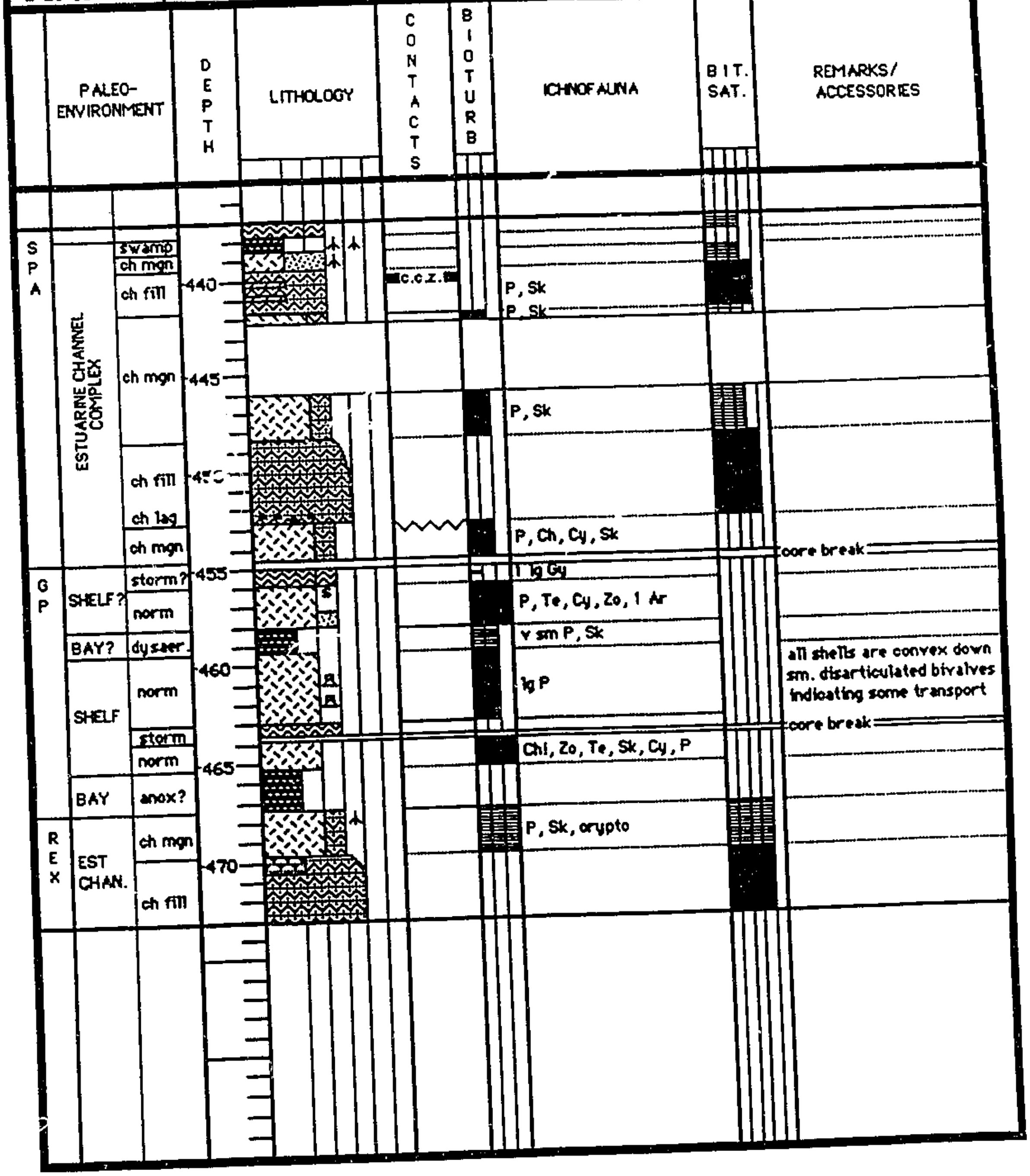
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-13-56-4W4	SASKOIL RANGER LINDBERGH	RANGER OIL LTD. SASKOIL RESOURCES	452.5-488.5 m	616.65 m	1 OF 1



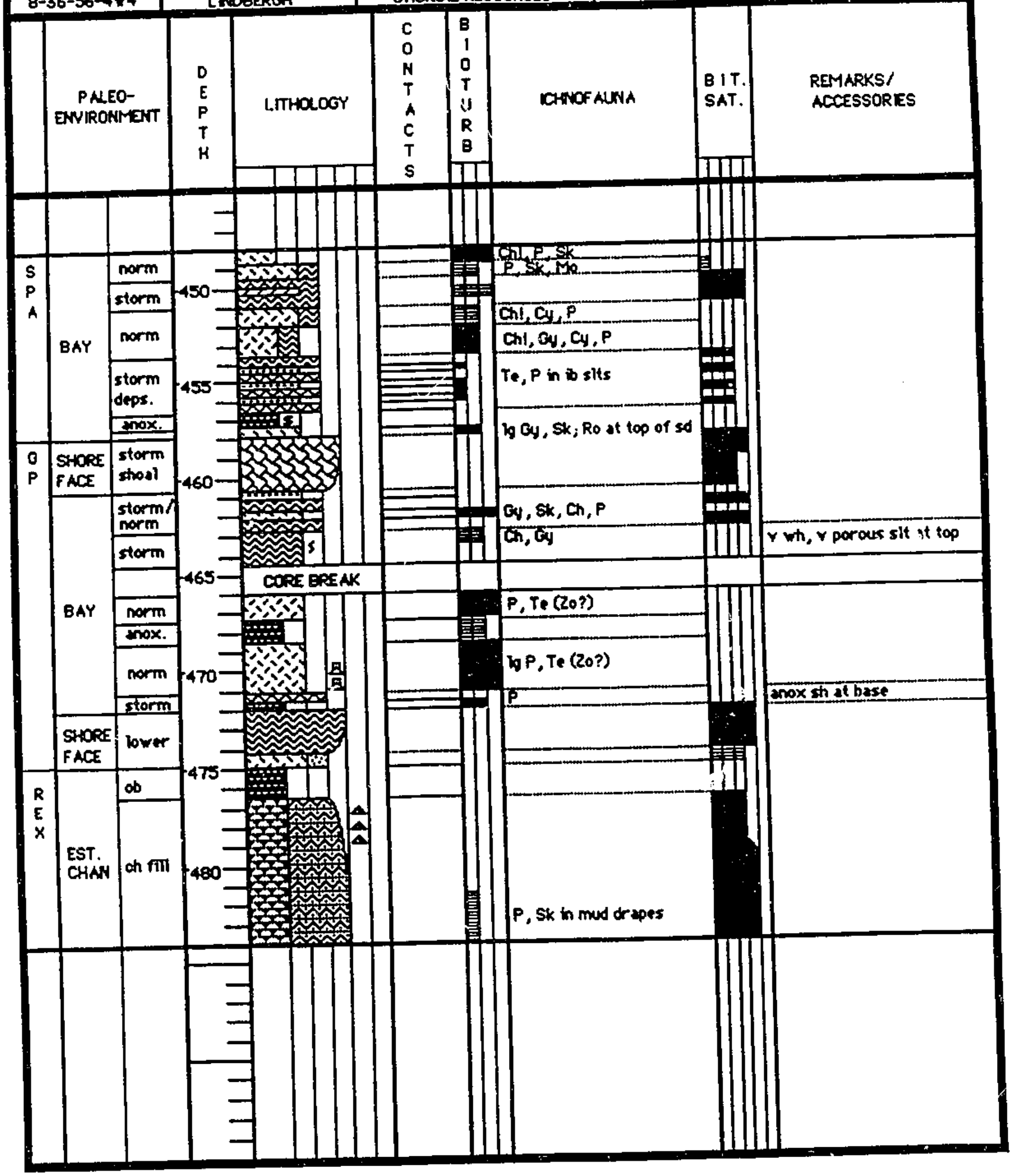
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-15-56-4W4	SASKOIL RANGER LINDBERGH	RANGER OIL LTD., SASKOIL RESOURCES	429-455.75 m	582.8 m	1 OF 1



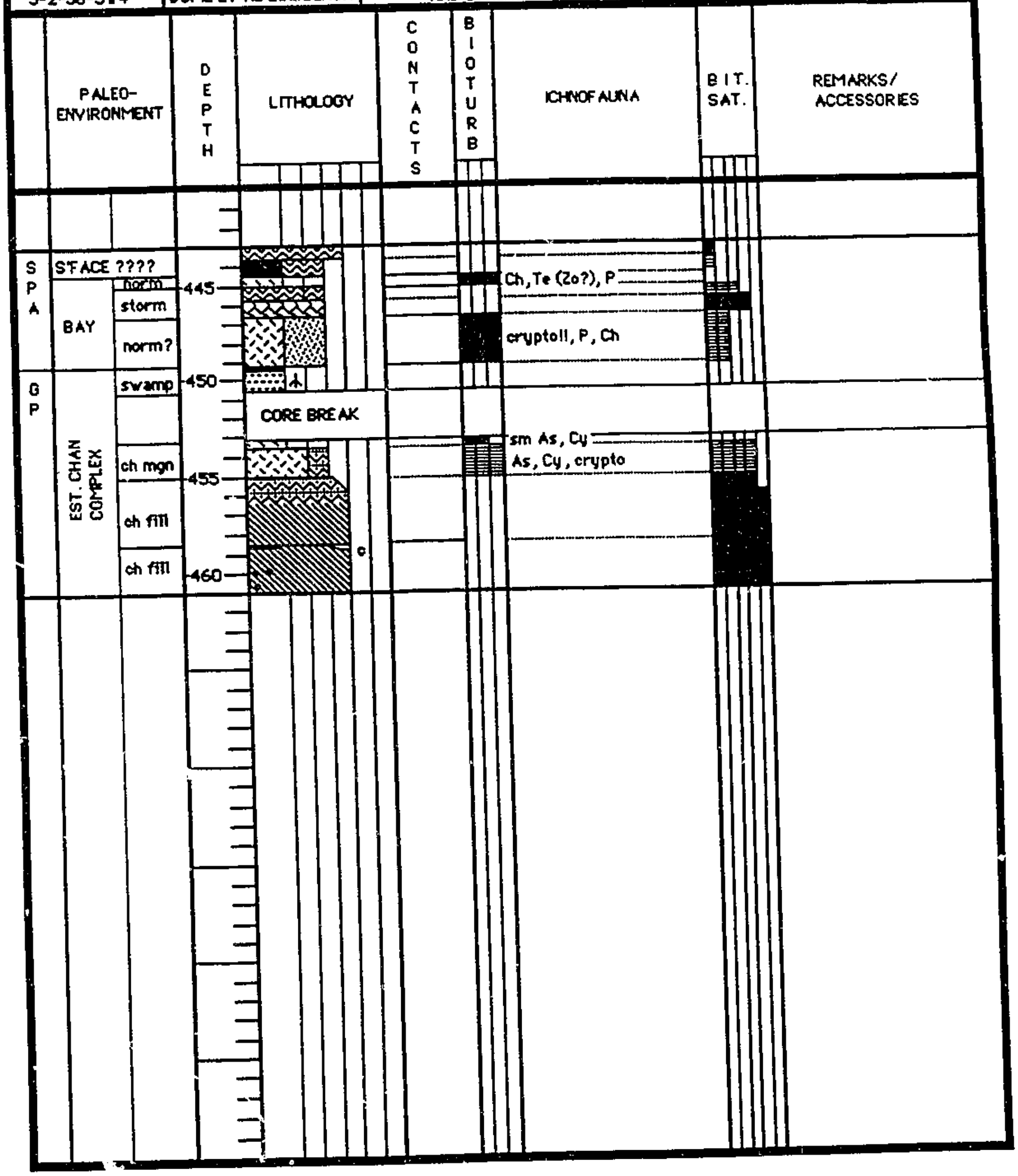
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-25-56-4W4	SASKOIL RANGER LINDBERGH	RANGER OIL LTD., SASKOIL RESOURCES	437.0-473.0 m	614.19 m	1 OF 1



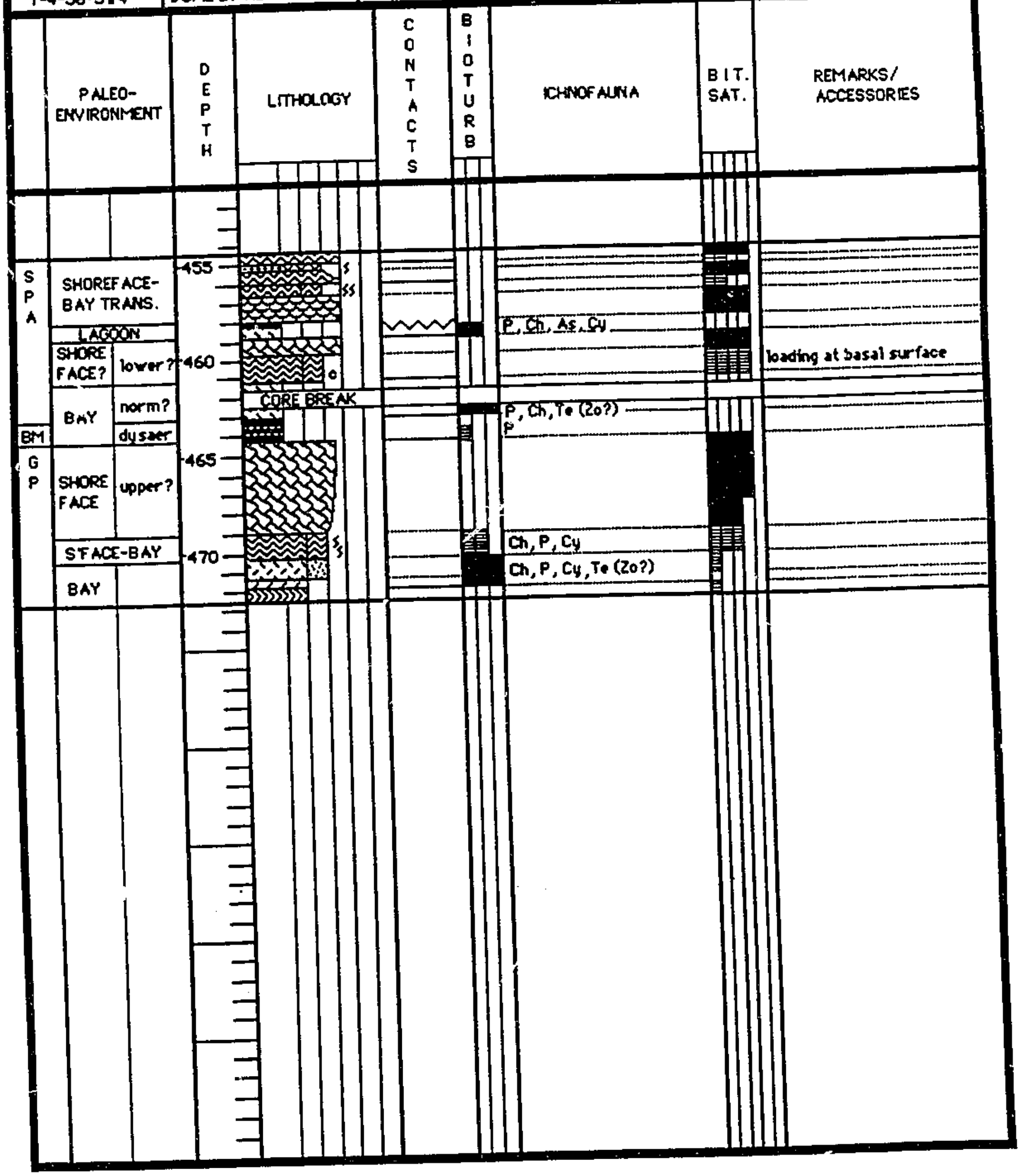
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-36-56-4W4	SASKOIL RANGER LINDBERGH	RANGER OIL LTD., SASKOIL RESOURCES	448.0-484.0 m	614.55 m	1 OF 1



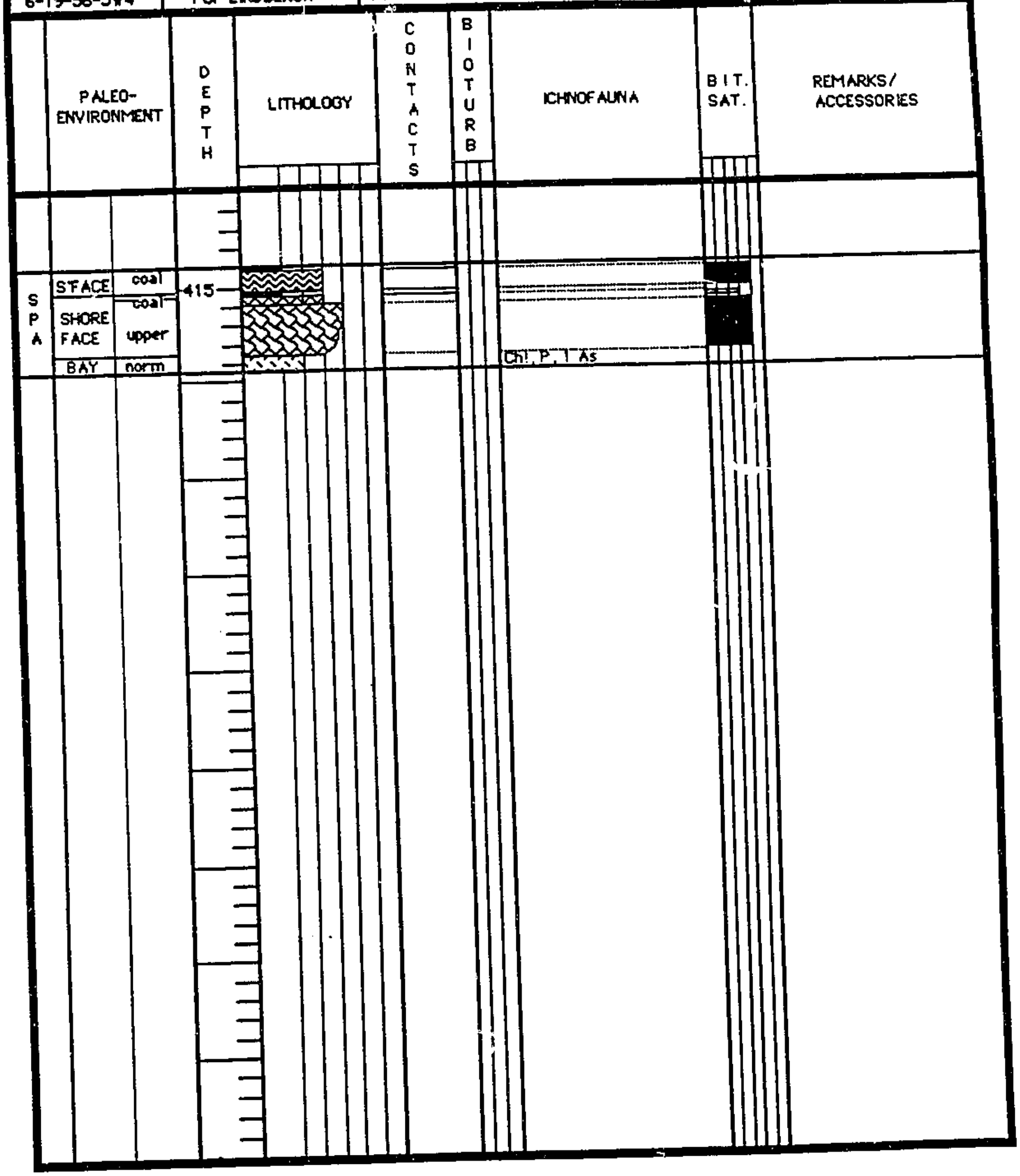
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-2-56-5W4	DOME ET AL LINDBERGH	DOME PETROLEUM AND OTHERS	443.0-461.0 m	602.89 m	1 OF 1



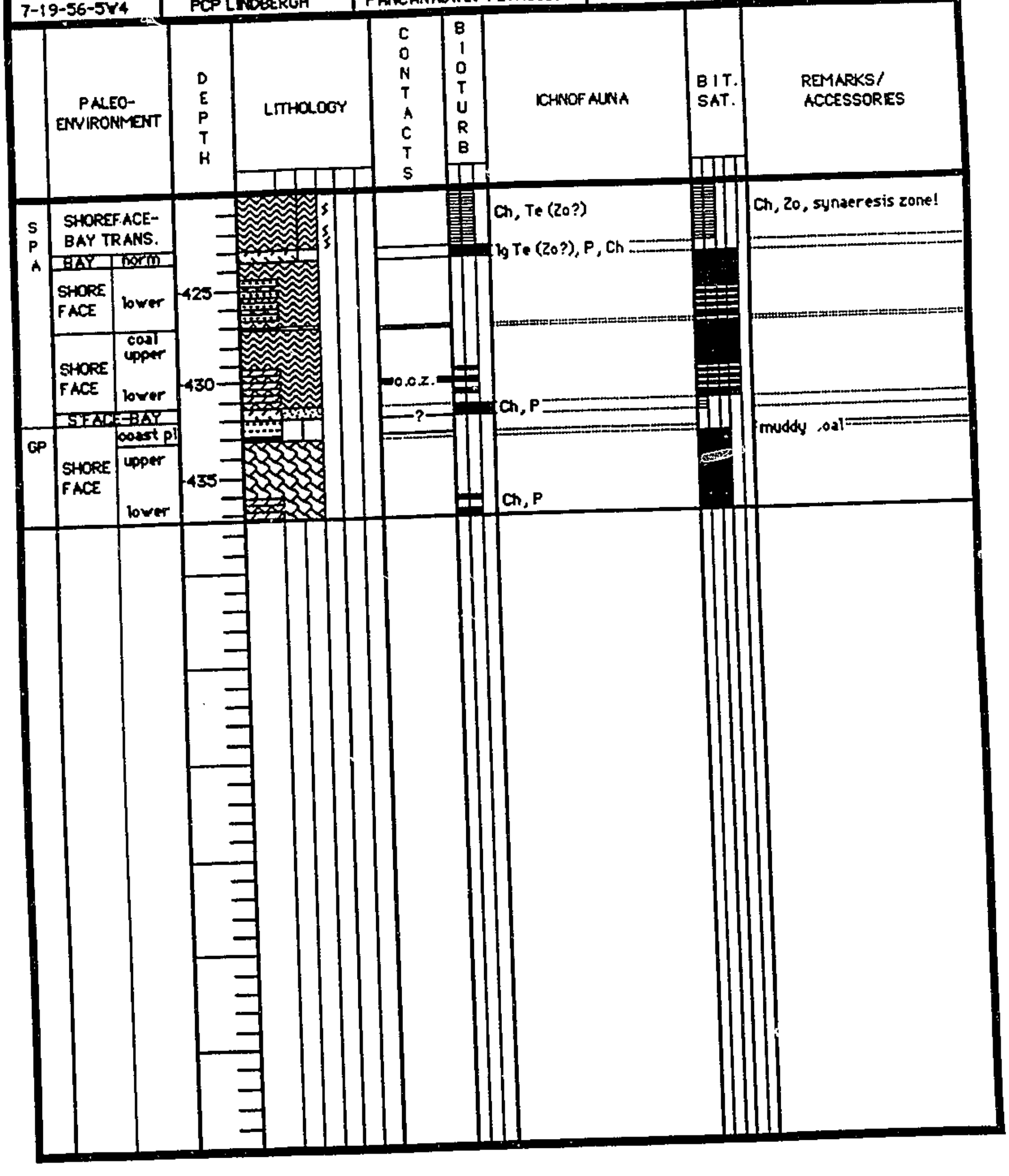
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-4-56-5W4	DOME ET AL LINDBERGH	DOME OIL AND OTHERS	453.5-471.5 m	607.94 m	1 OF 1



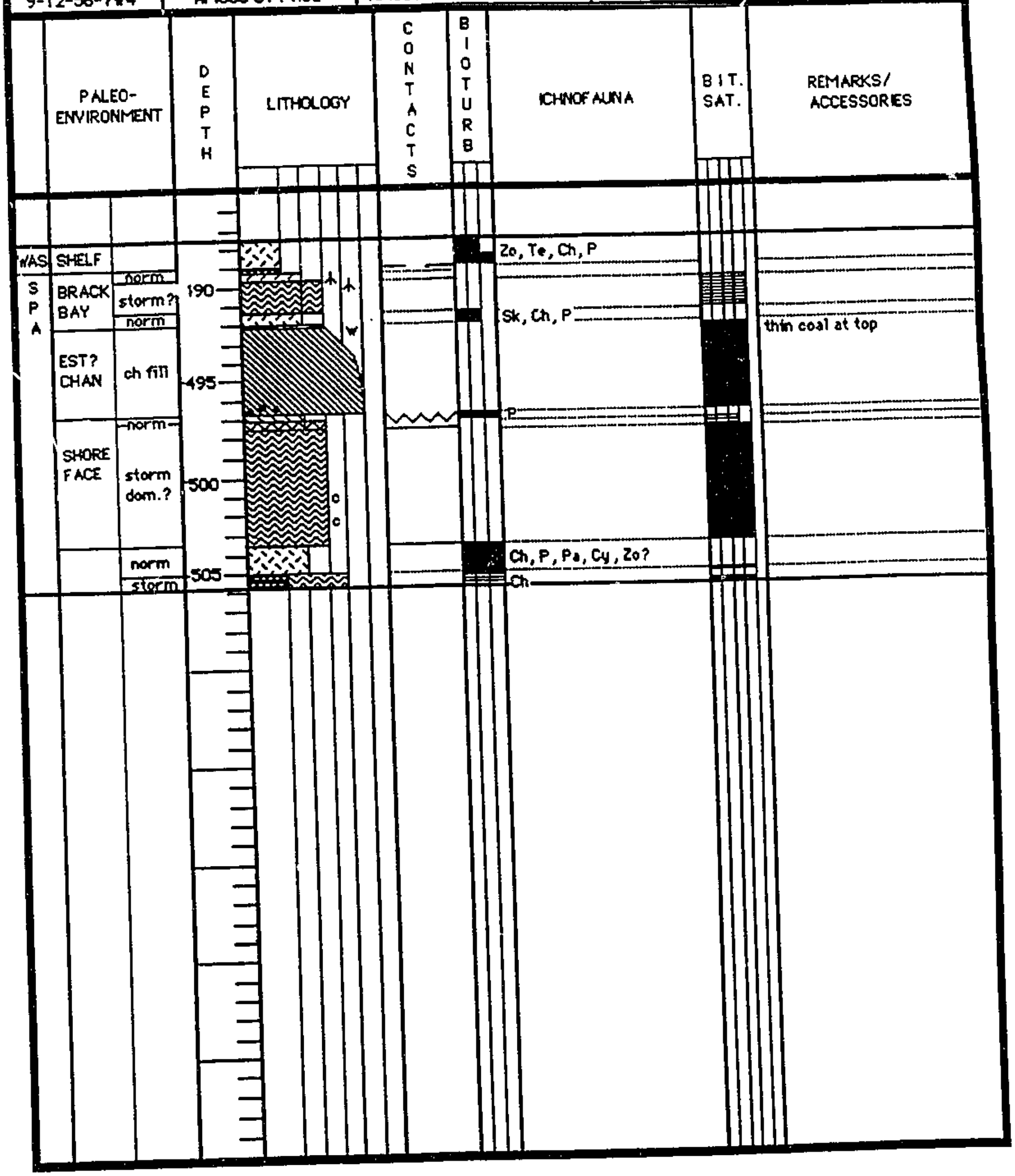
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-19-56-5W4	PCP LINDBERGH	PANCANADIAN PETROLEUM	414-419.3 m	585.7 m	1 OF 1



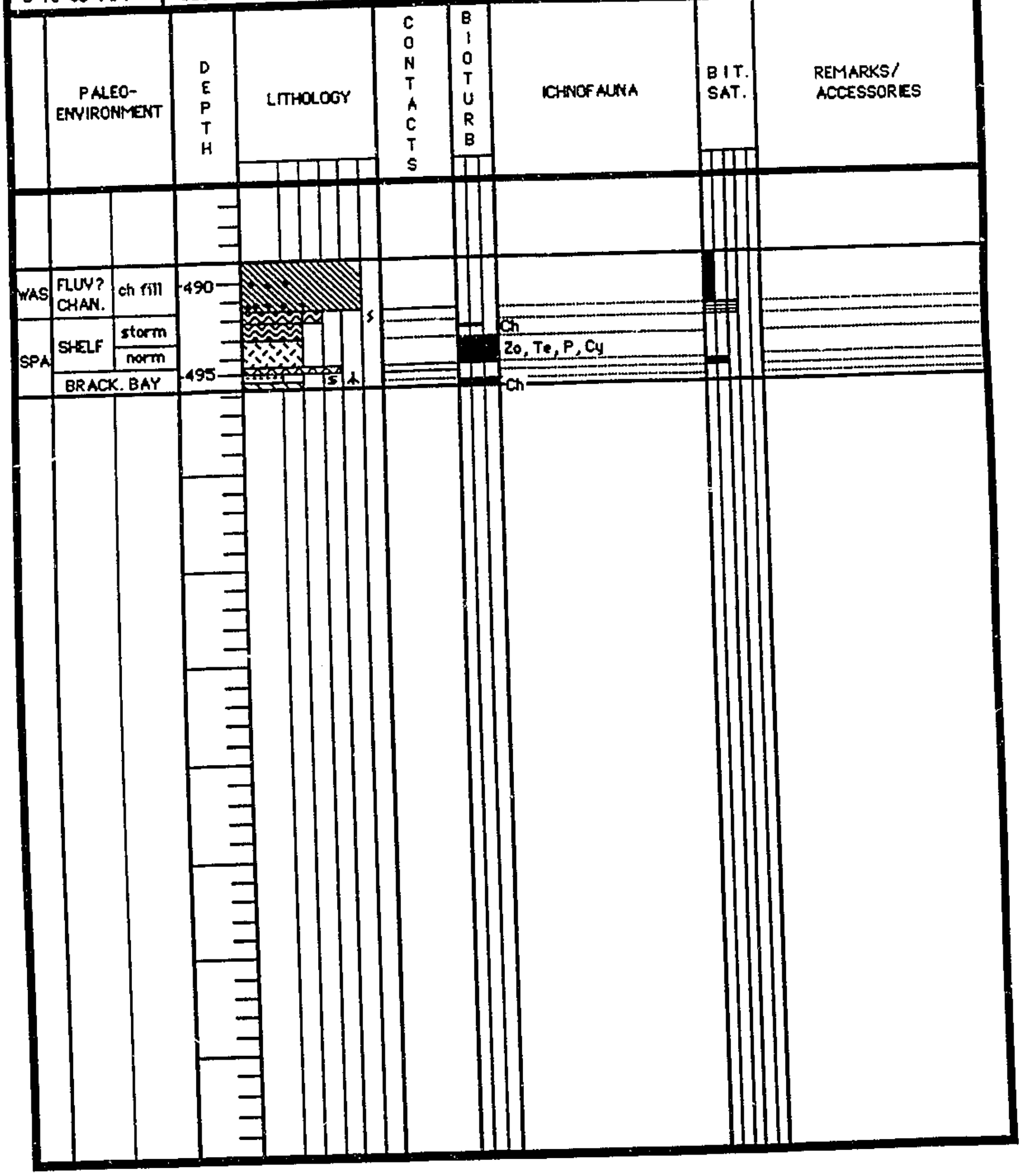
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-19-56-5W4	PCP LINDBERGH	PANCANADIAN PETROLEUM	420.0–437.2 m	584.4 m	1 OF 1



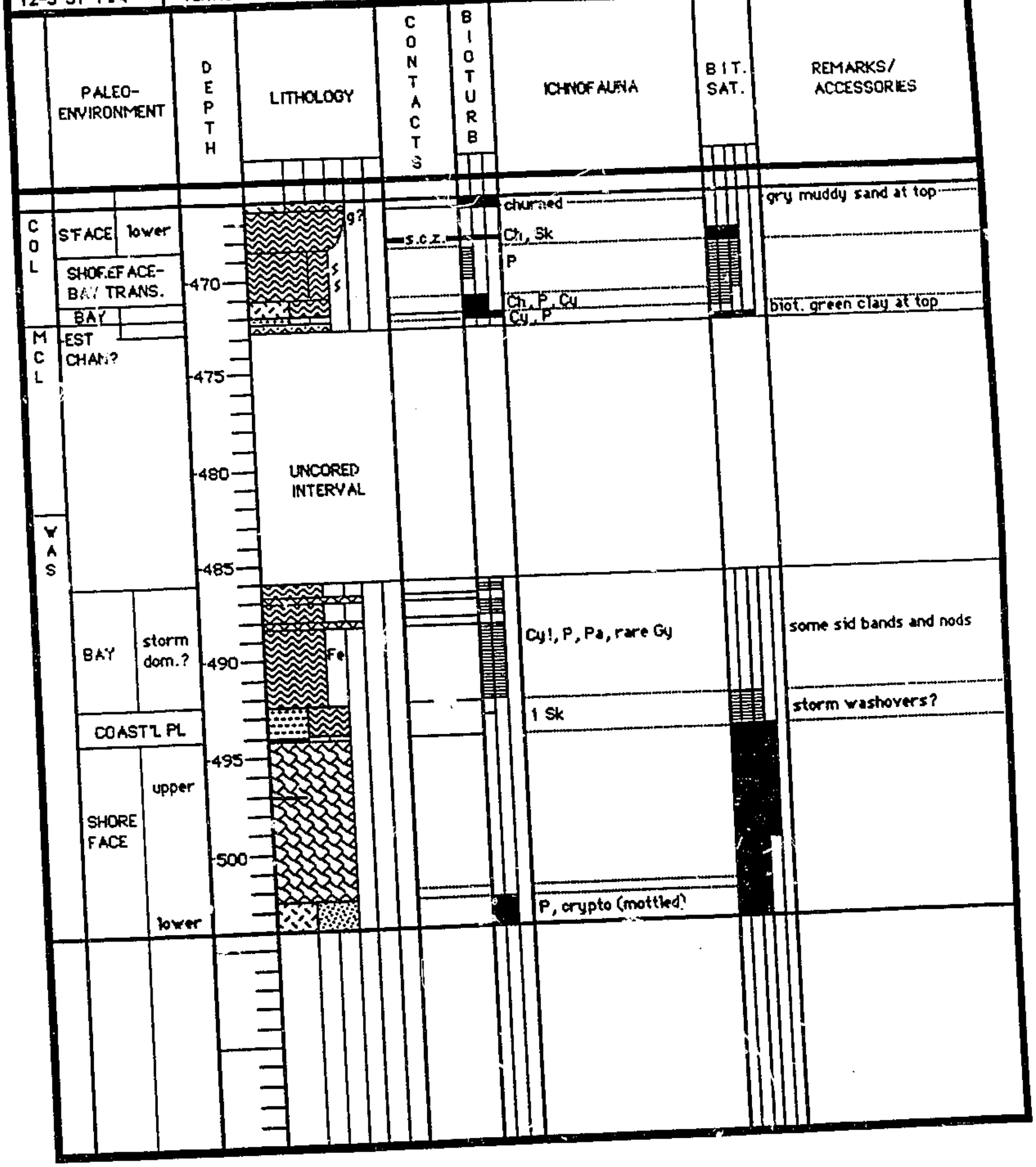
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-12-56-7W4	AMOCO ST PAUL	AMOCO CANADA PETROLEUM	487.5-505.5 m	624.8 m	1 OF 1



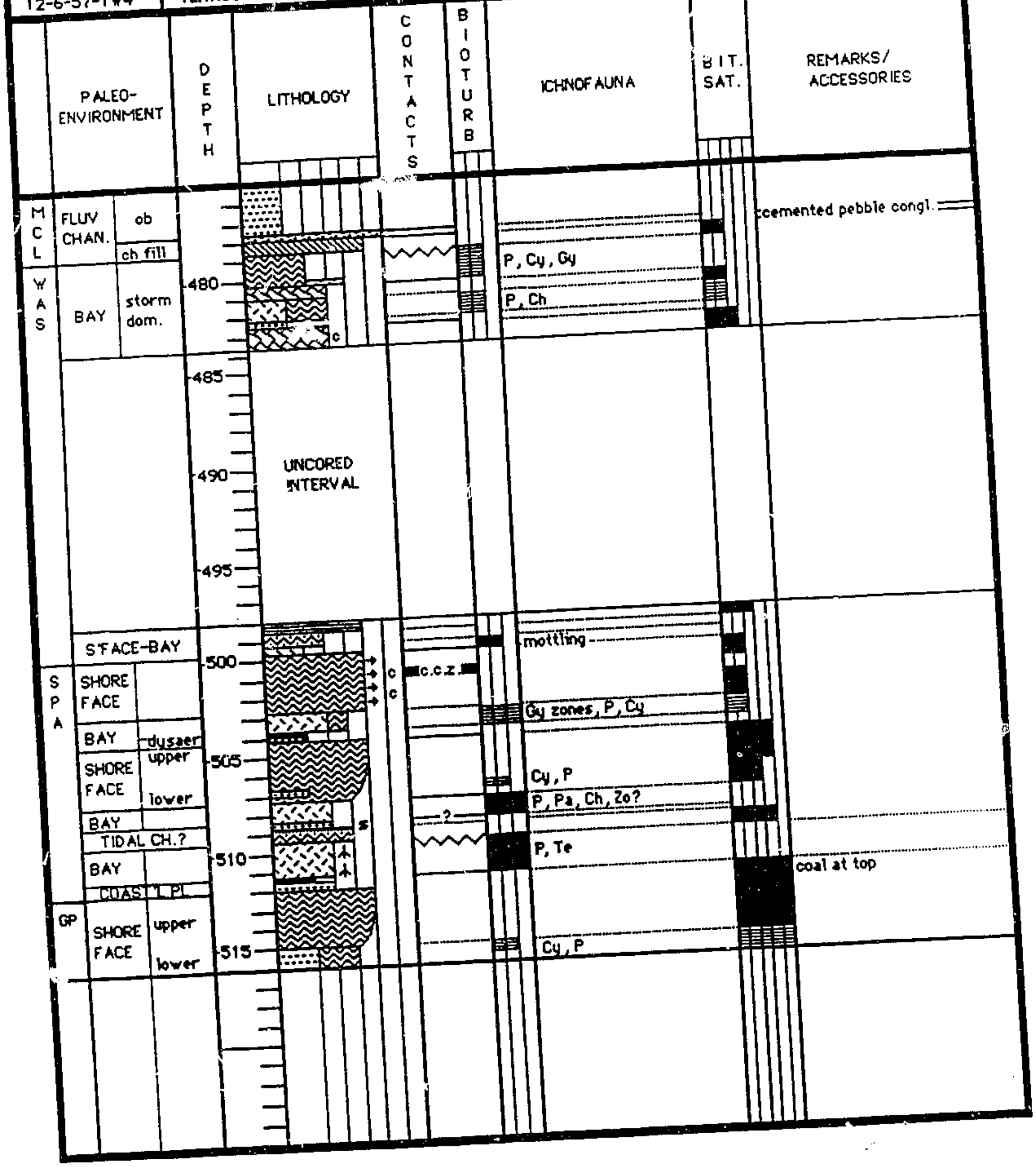
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-13 56-7W4	WESTMIN LINDBERGH	UNNUMBERED	489-495.85	615.9 m	1 OF 1



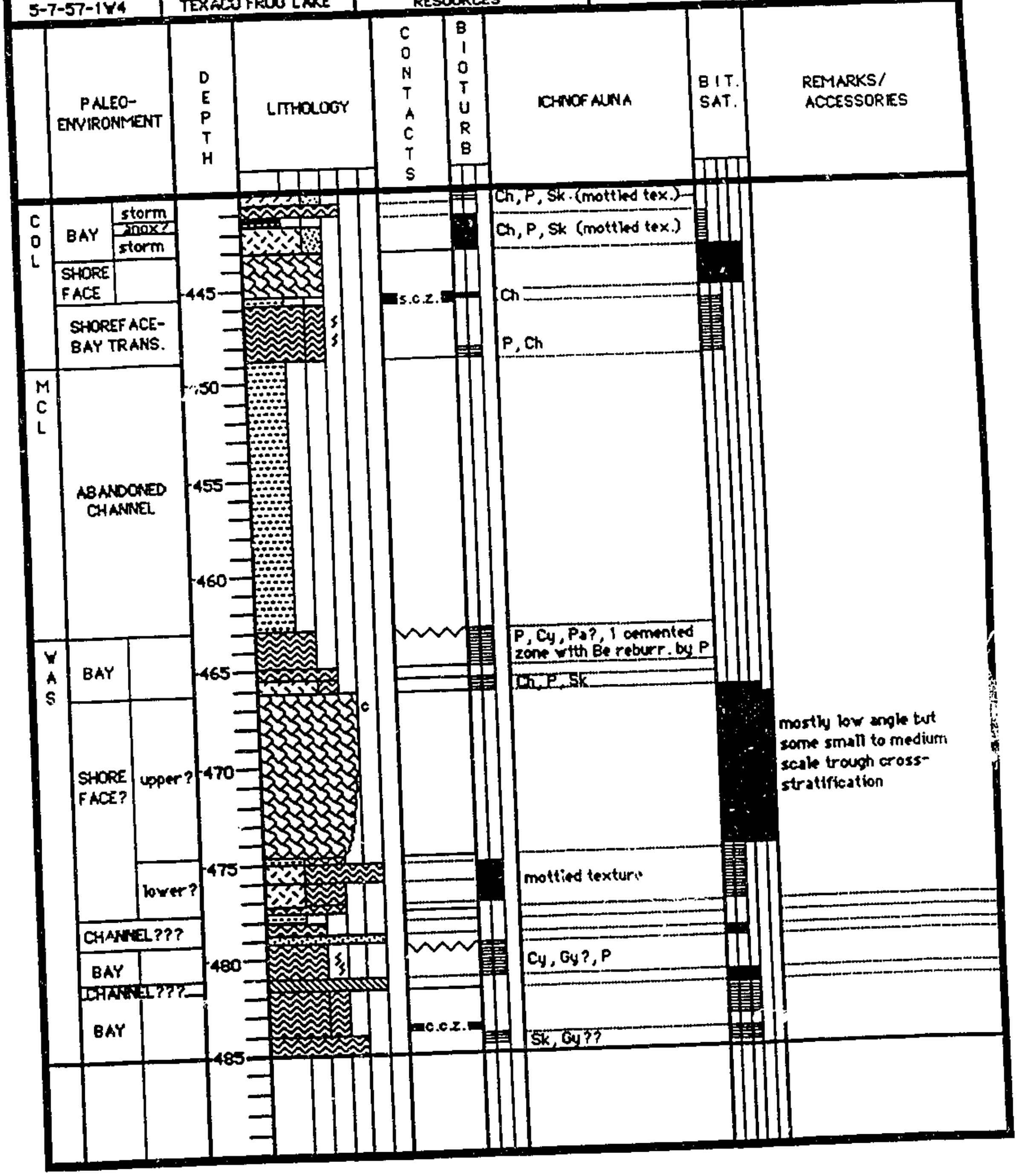
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-5-57-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	466.0-504.0 m	672.3 m	1 OF 1



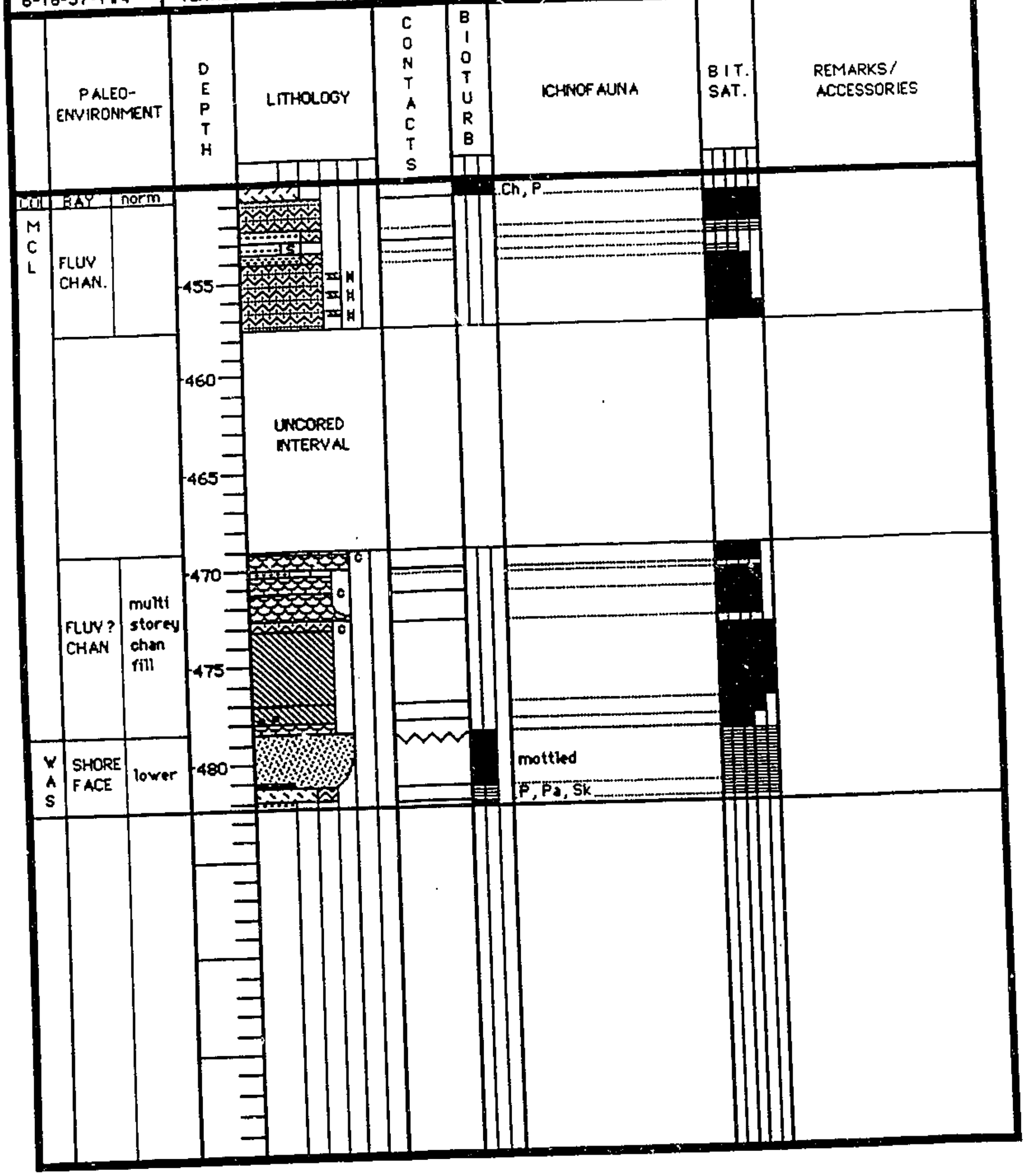
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-6-57-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	475.0-516.0 m	670.3 m	1 OF 1



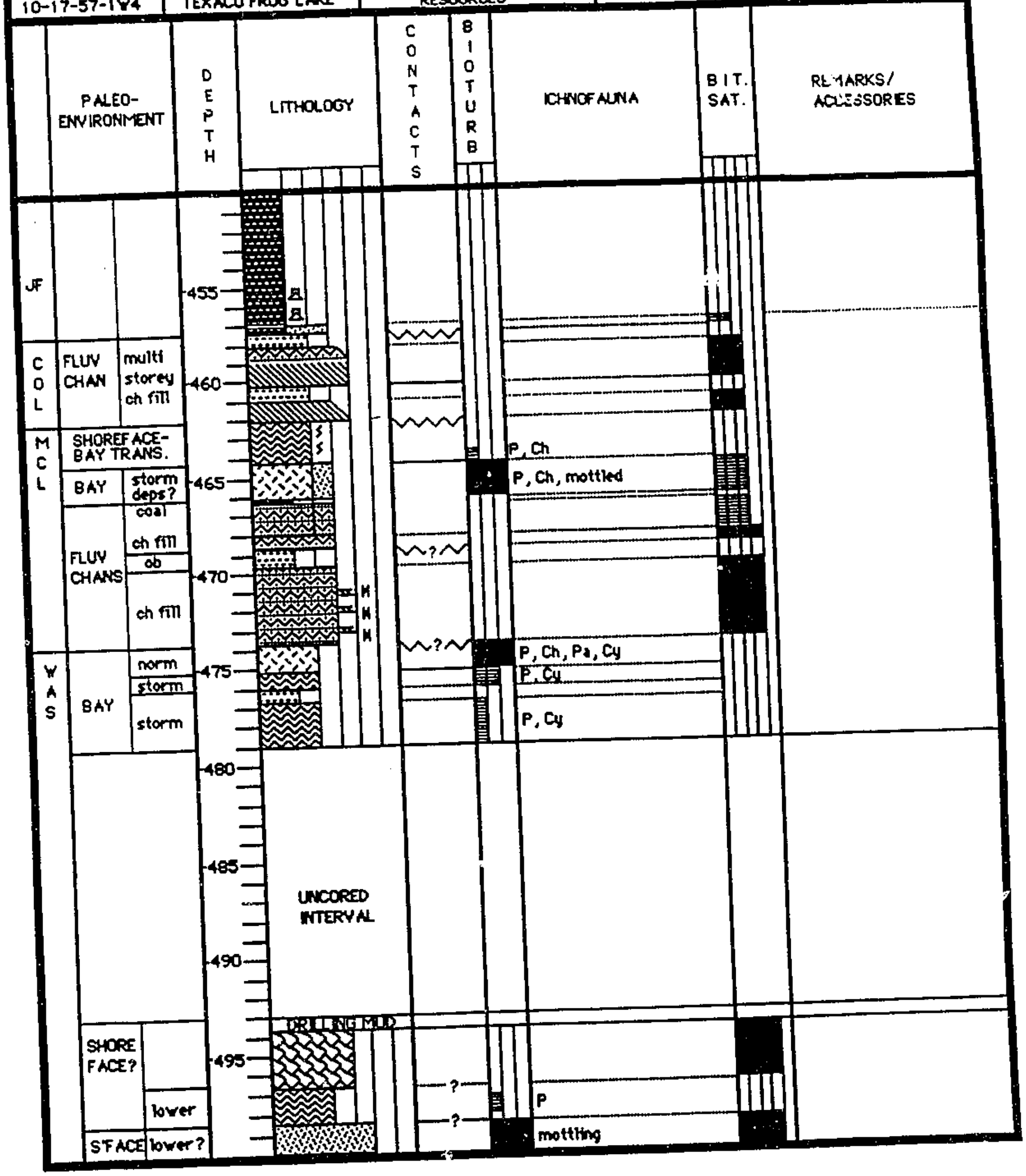
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-7-57-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	440.0-485.0 m	637.9 m	1 OF 1



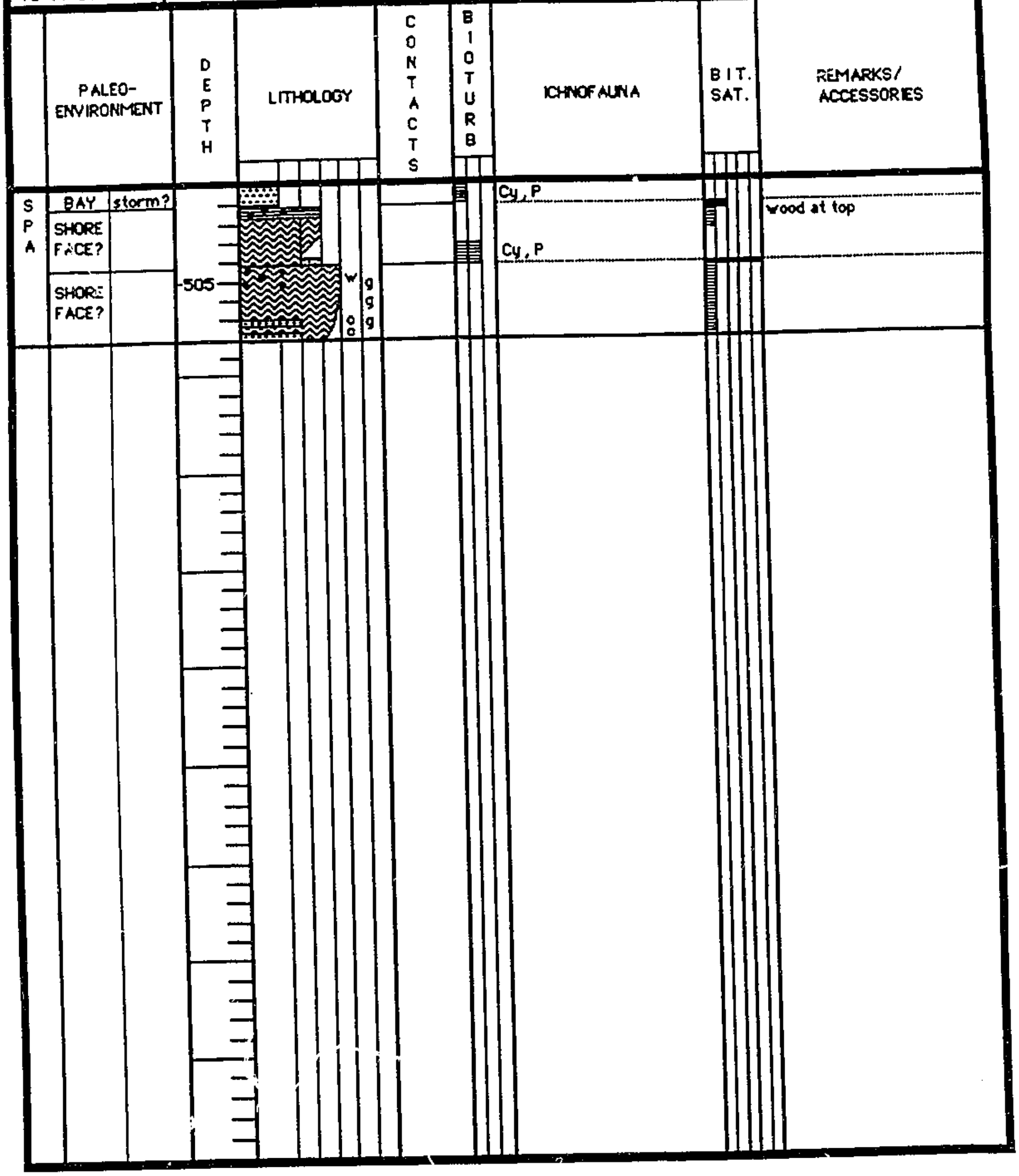
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-16-57-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	450.0-482.25 m	634.7 m	1 OF 1



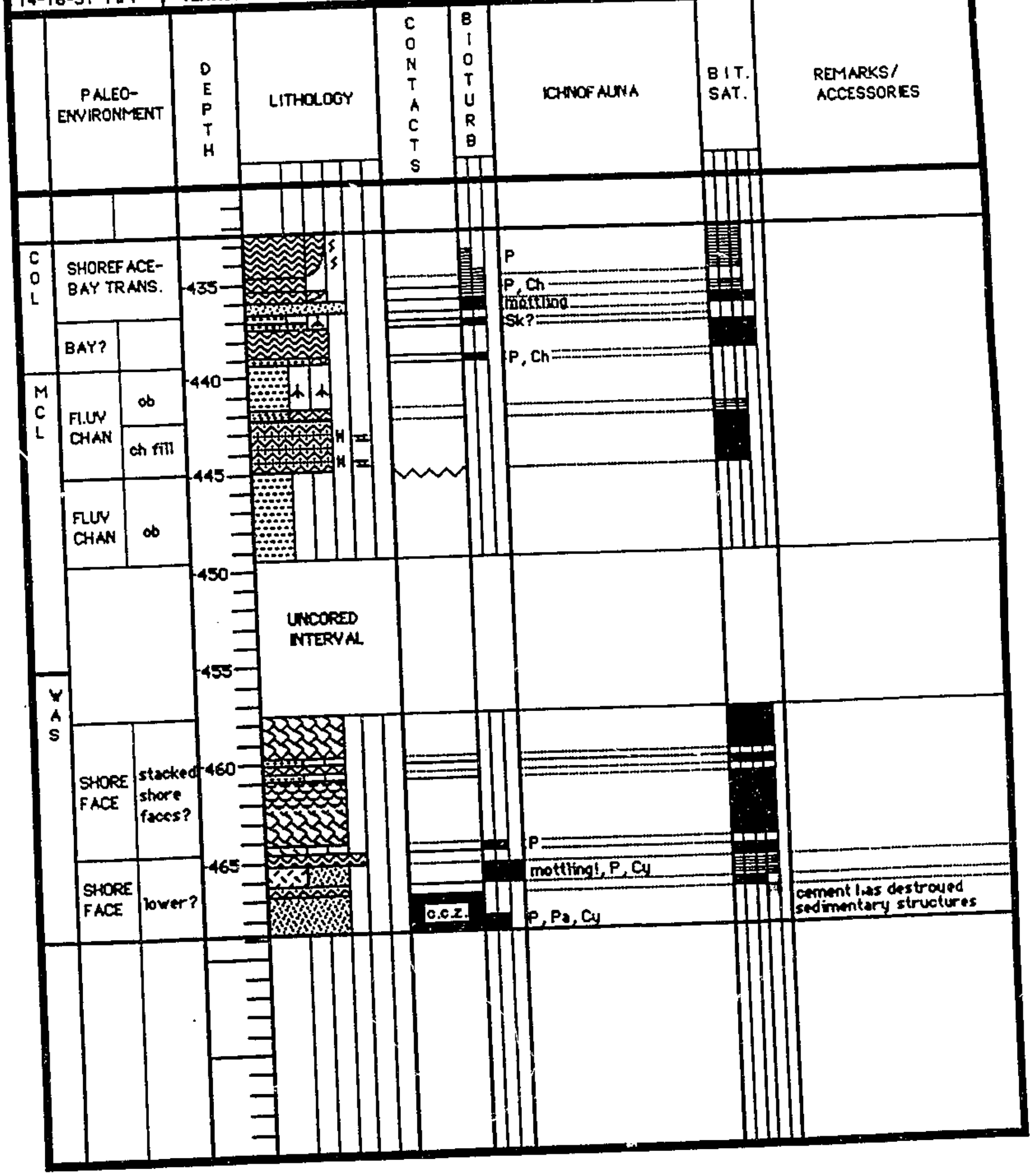
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-17-57-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	450.0-510.0 m	652.0 m	1 OF 2



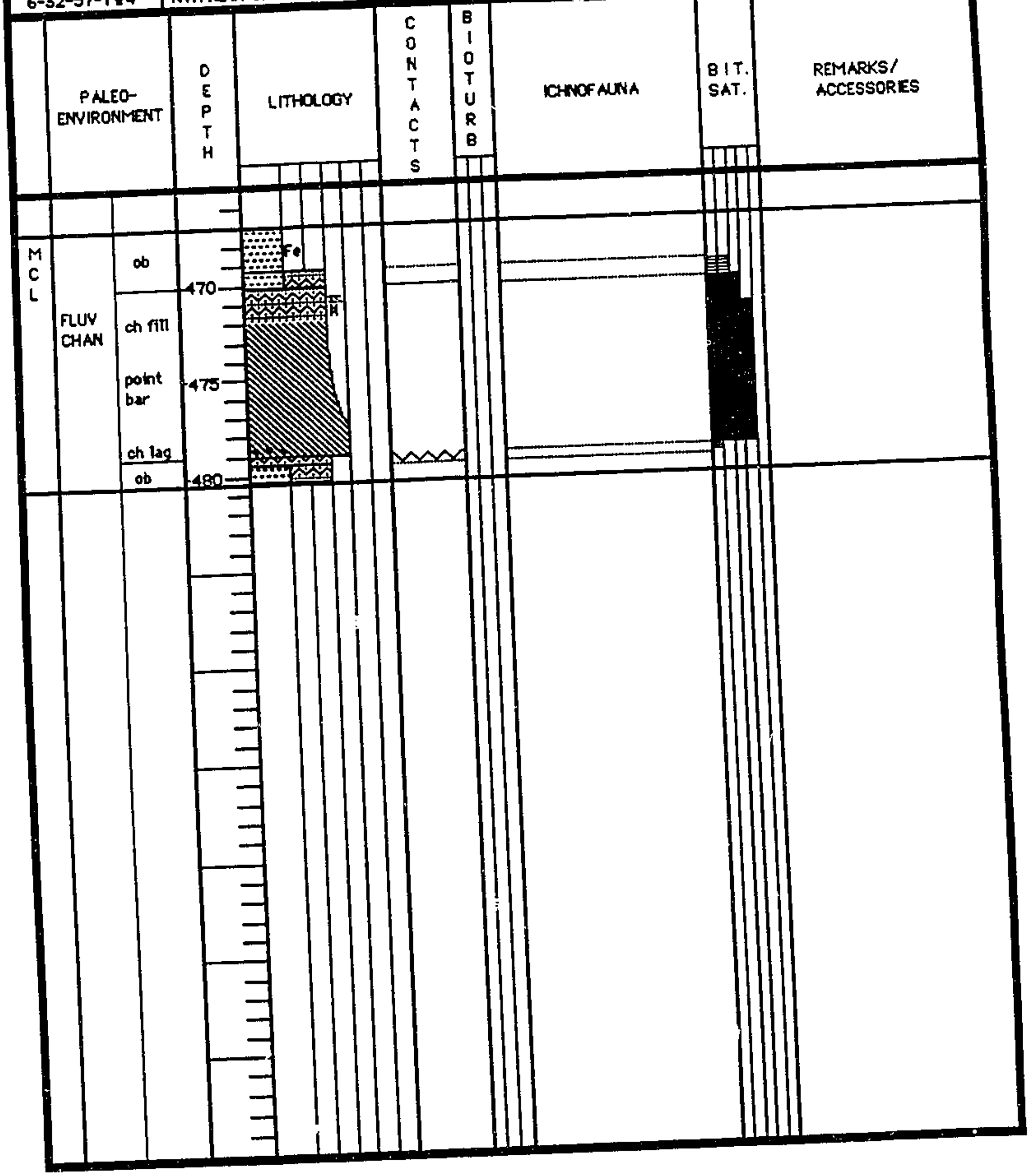
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-17-57-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	450.0-510.0 m	652.0 m	2 OF 2



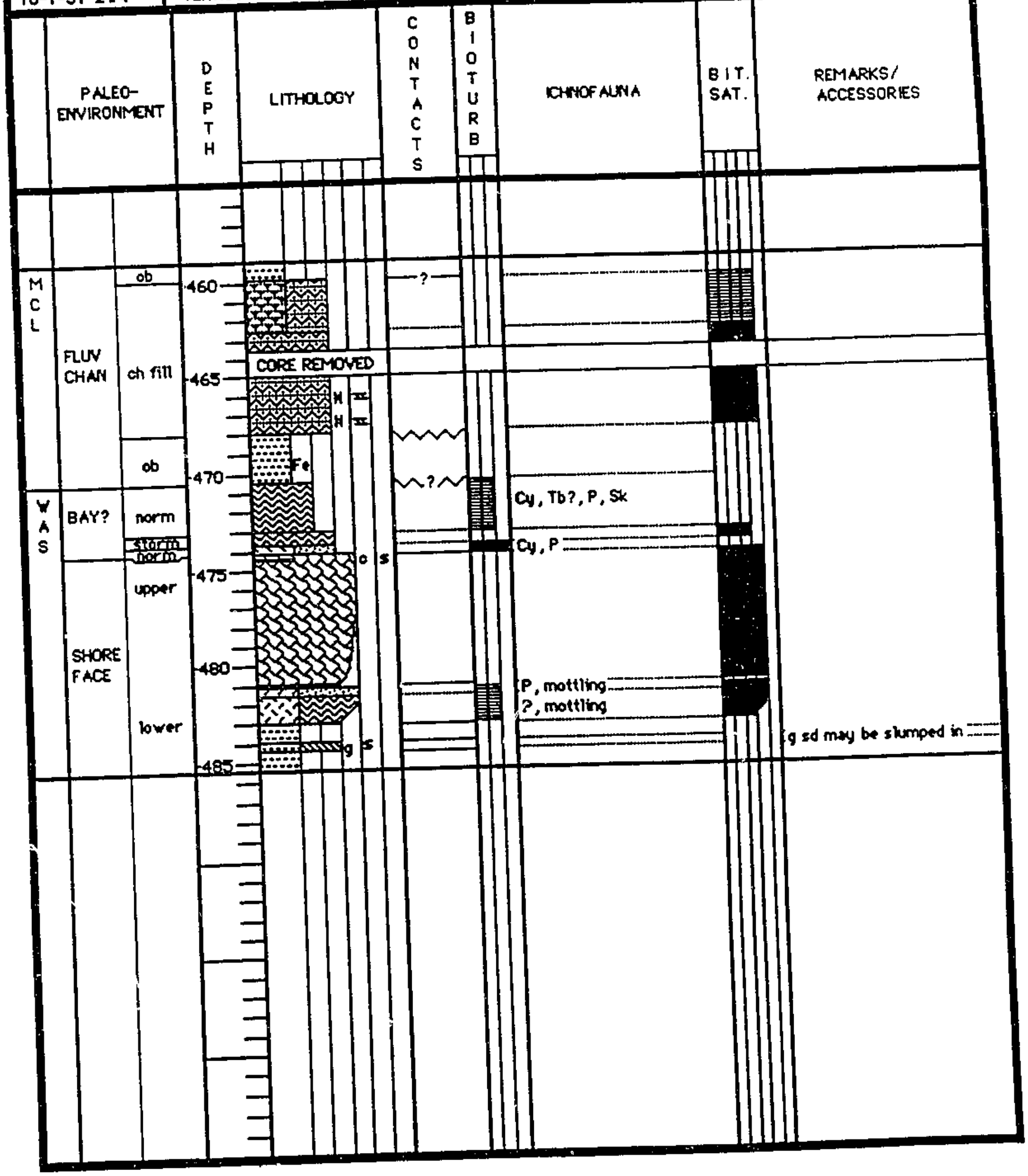
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-18-57-1W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	432.5-468.75 m	635.7 m	1 OF 1

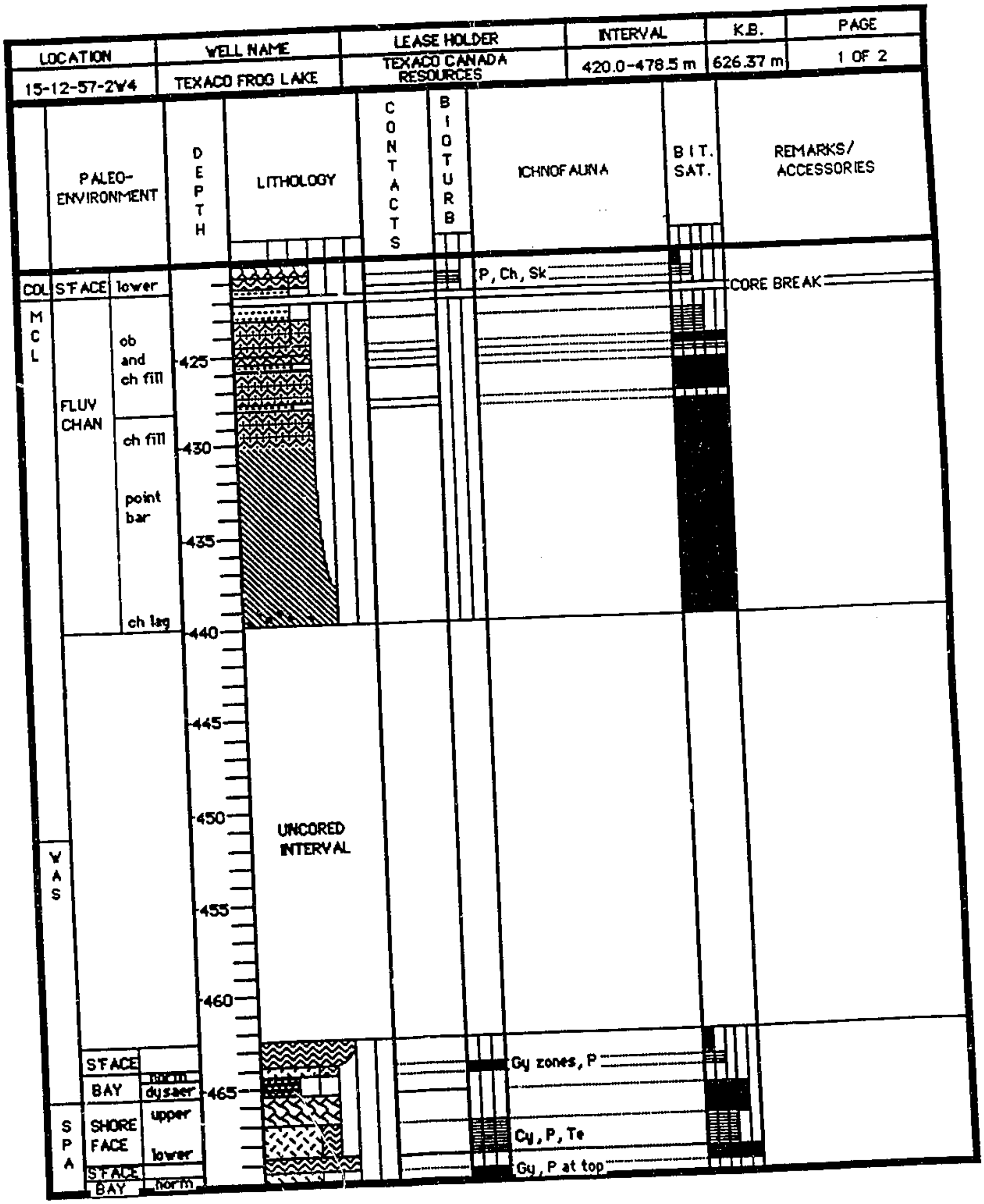


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-32-57-1W4	NVX NEWPORT FROG LK	UNLEASED	467.0-480.3 m	671.94 m	1 OF 1

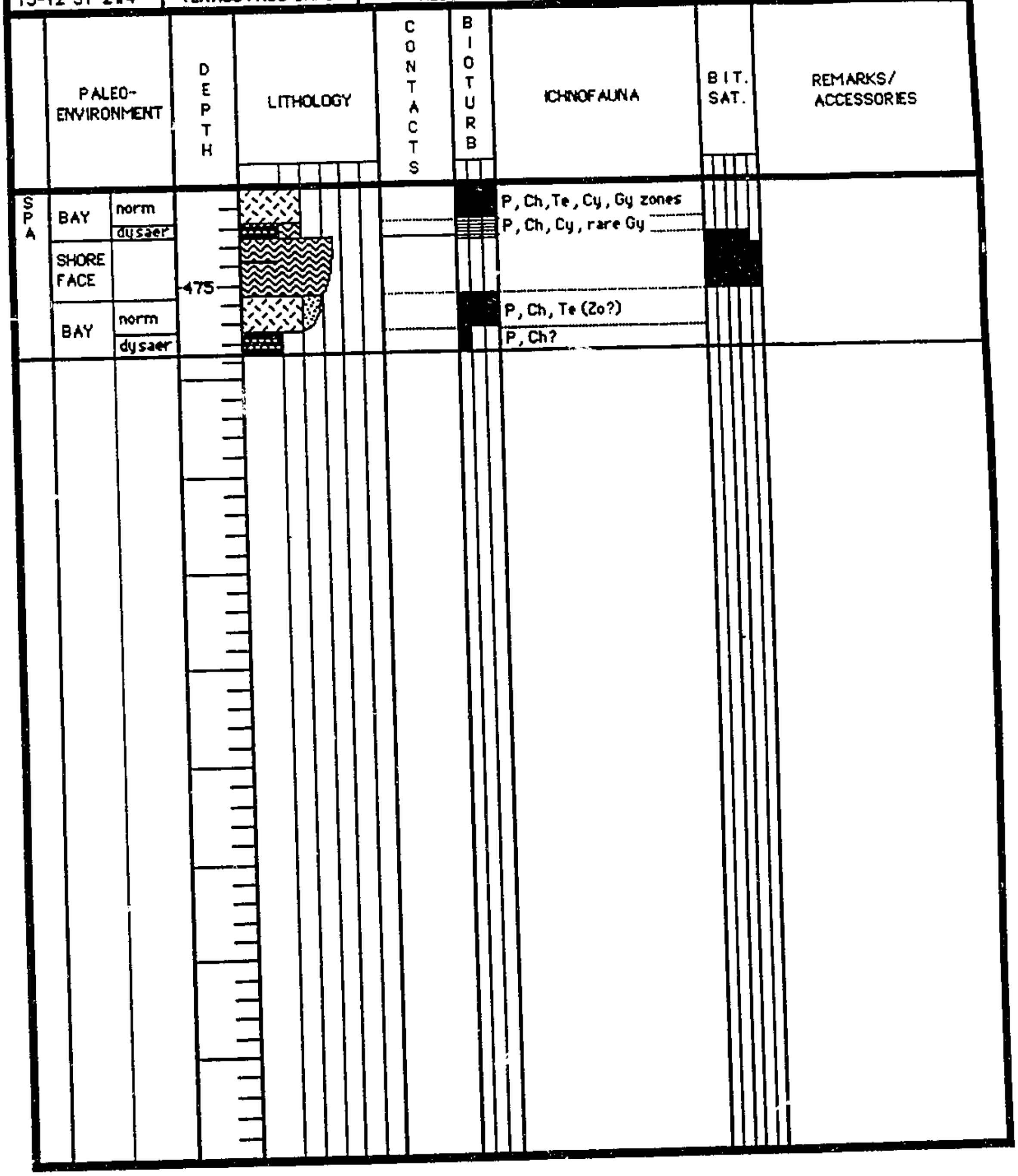


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-1-57-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	459.0-485.4 m	656.7 m	1 OF 1

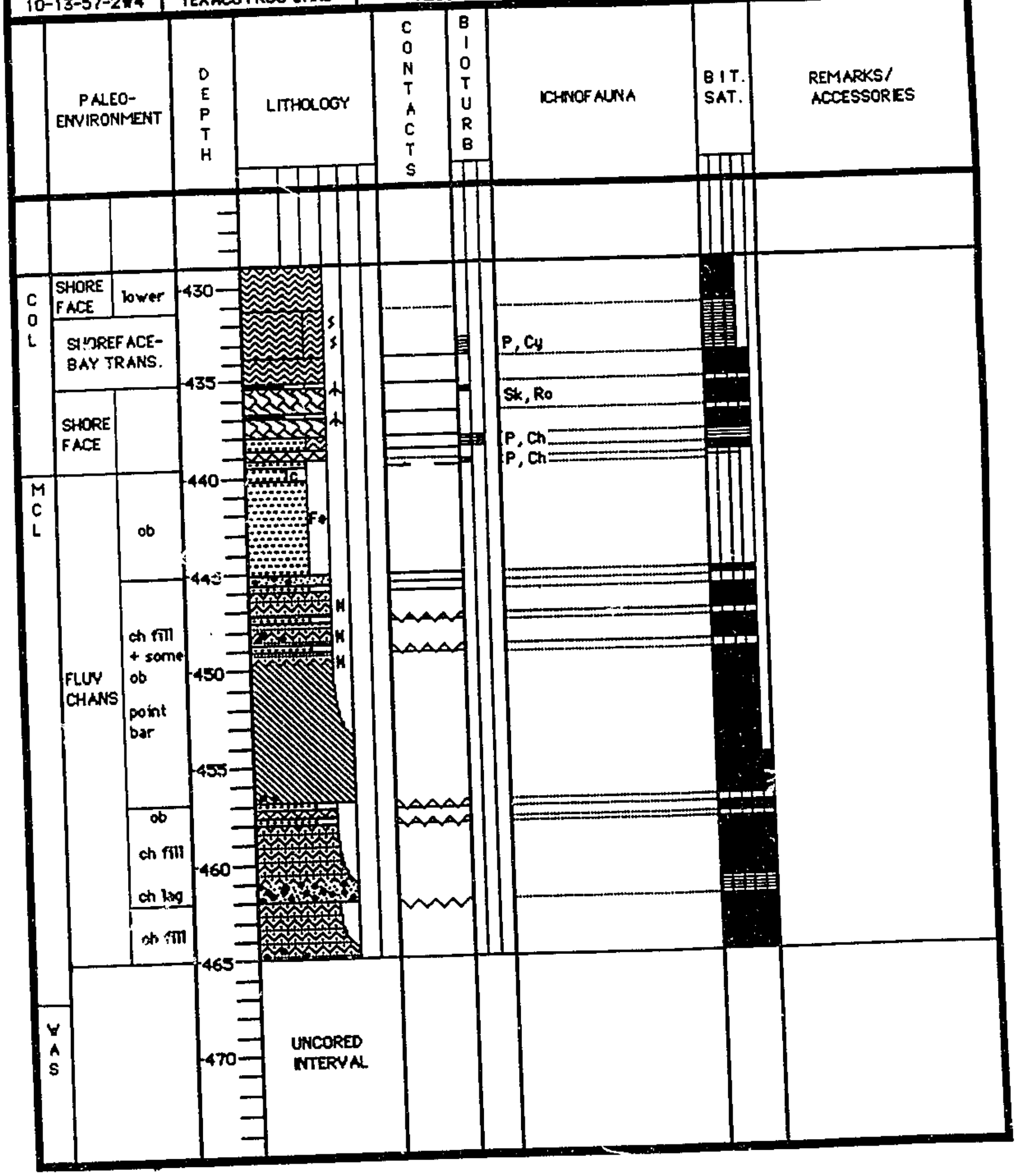



LOCATION
15-12-57-2W4
WELL NAME
TEXACO FROG LAKE
LEASE HOLDER
TEXACO CANADA RESOURCES
INTERVAL
420.0-478.5 m
K.B.
626.37 m
PAGE
1 OF 2
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
COL
S'FACE
lower
MCL
FLUV CHAN
ob and ch fill
ch fill
point bar
ch lag
WAS
S'FACE
norm
BAY
dysaer
SPA
SHORE FACE
upper
lower
S'FACE
BAY
norm
425
430
435
440
445
450
455
460
465
UNCORED INTERVAL
P, Ch, Sk
Gy zones, P
Cy, P, Te
Gy, P at top
CORE BREAK

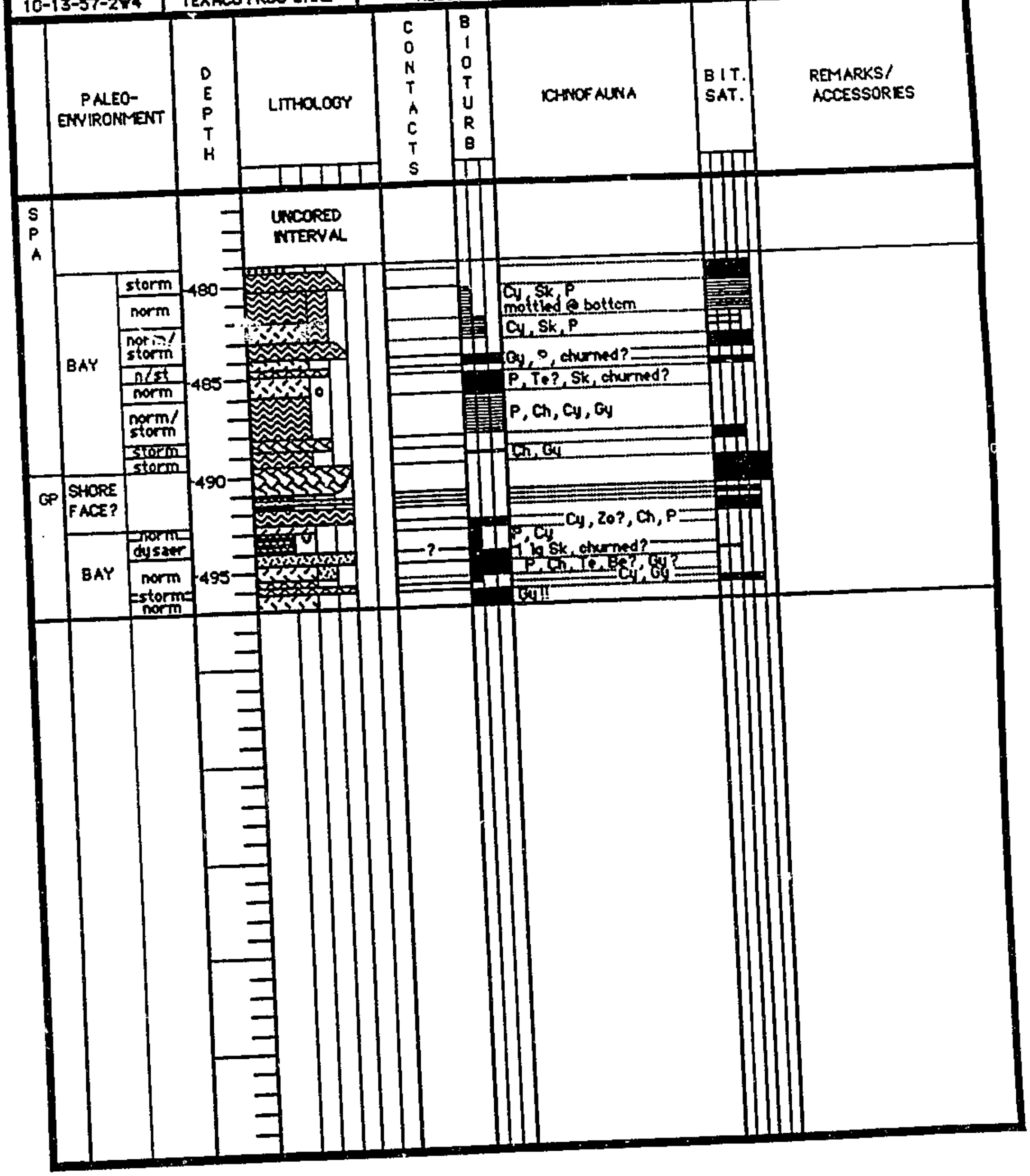
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-12-57-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	420.0-478.5 m	626.37 m	2 OF 2



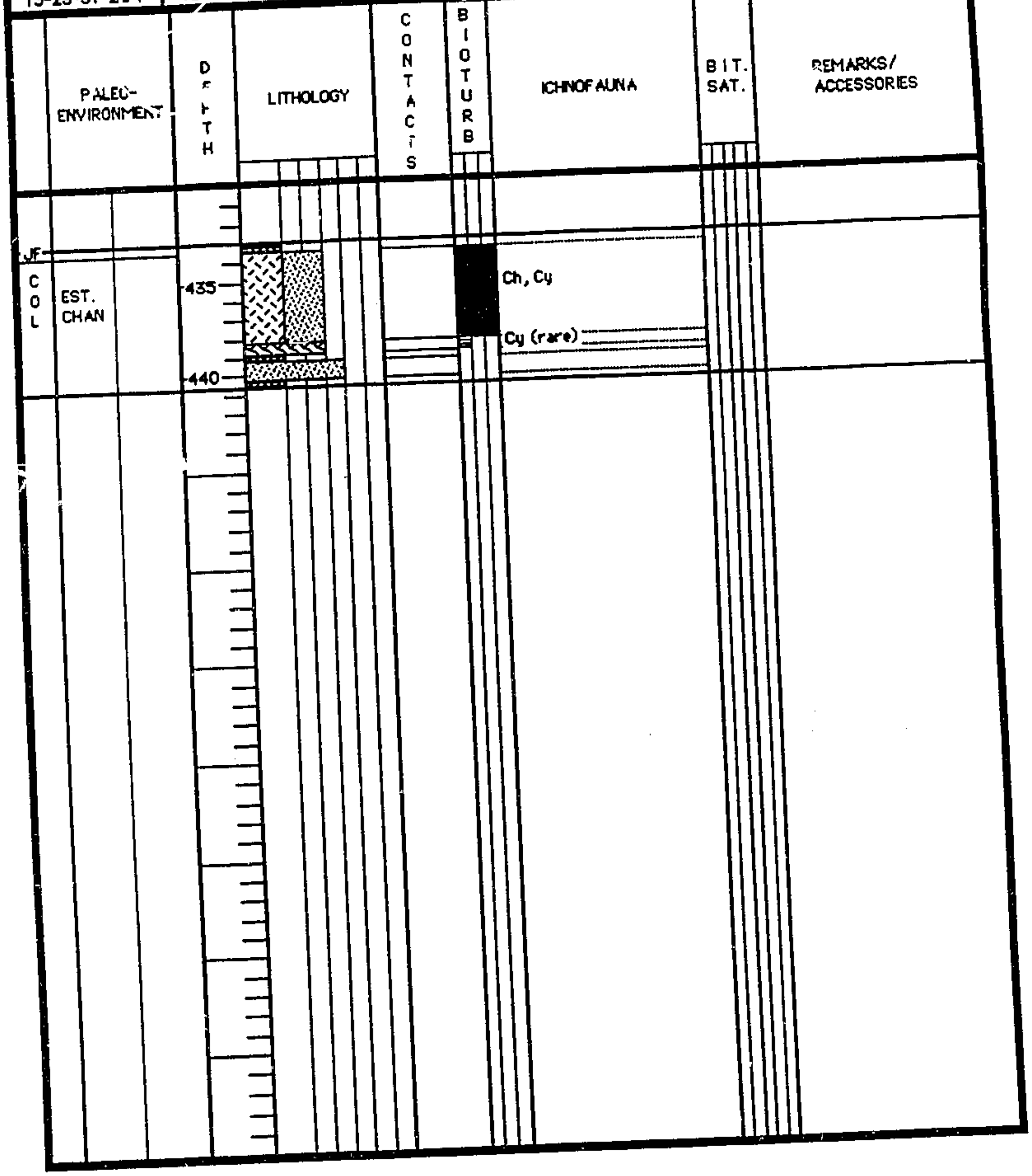
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-13-57-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	429.0-497.0 m	636.0 m	1 OF 2



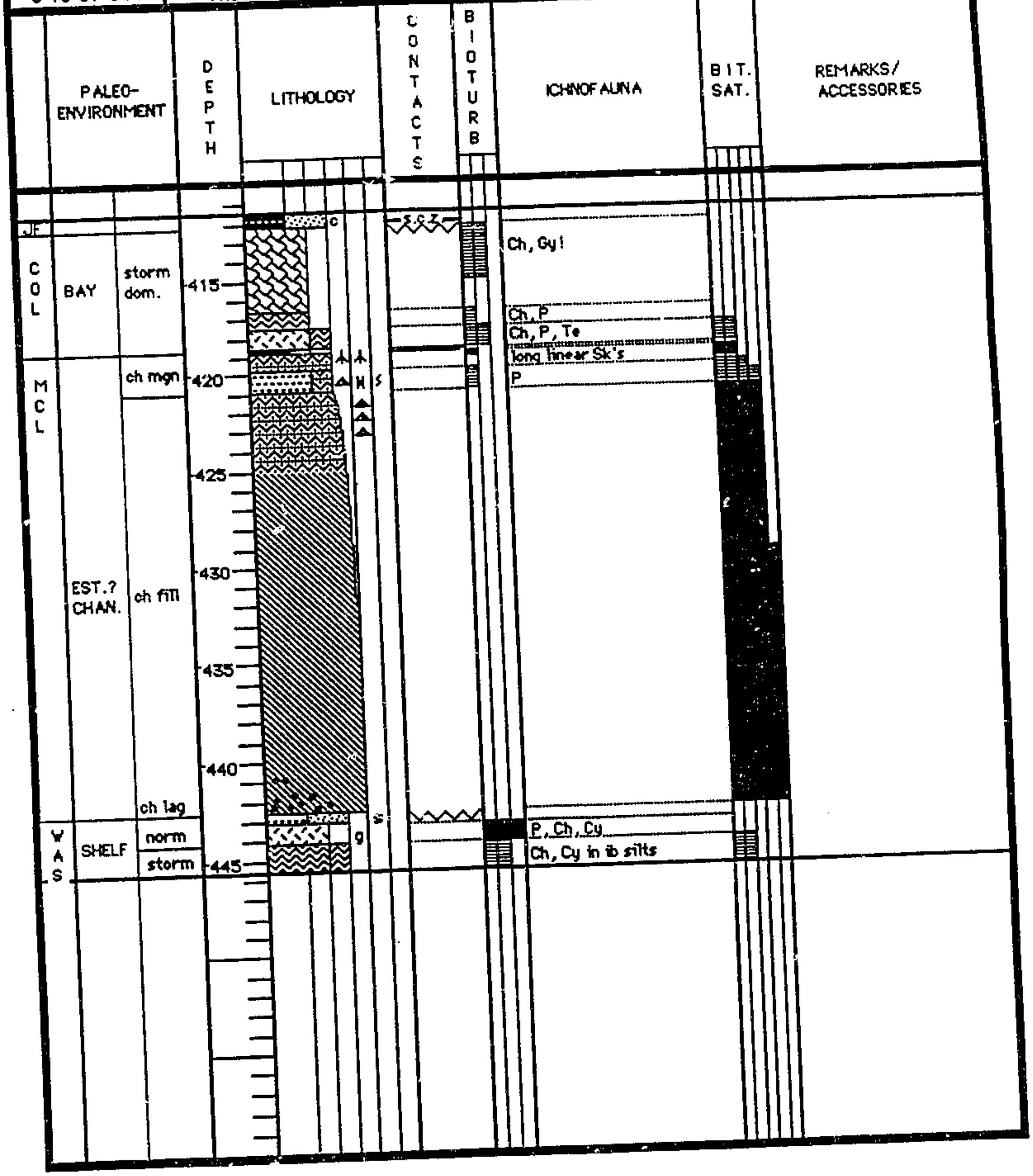
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-13-57-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	429.0-497.0 m	636.0 m	2 OF 2



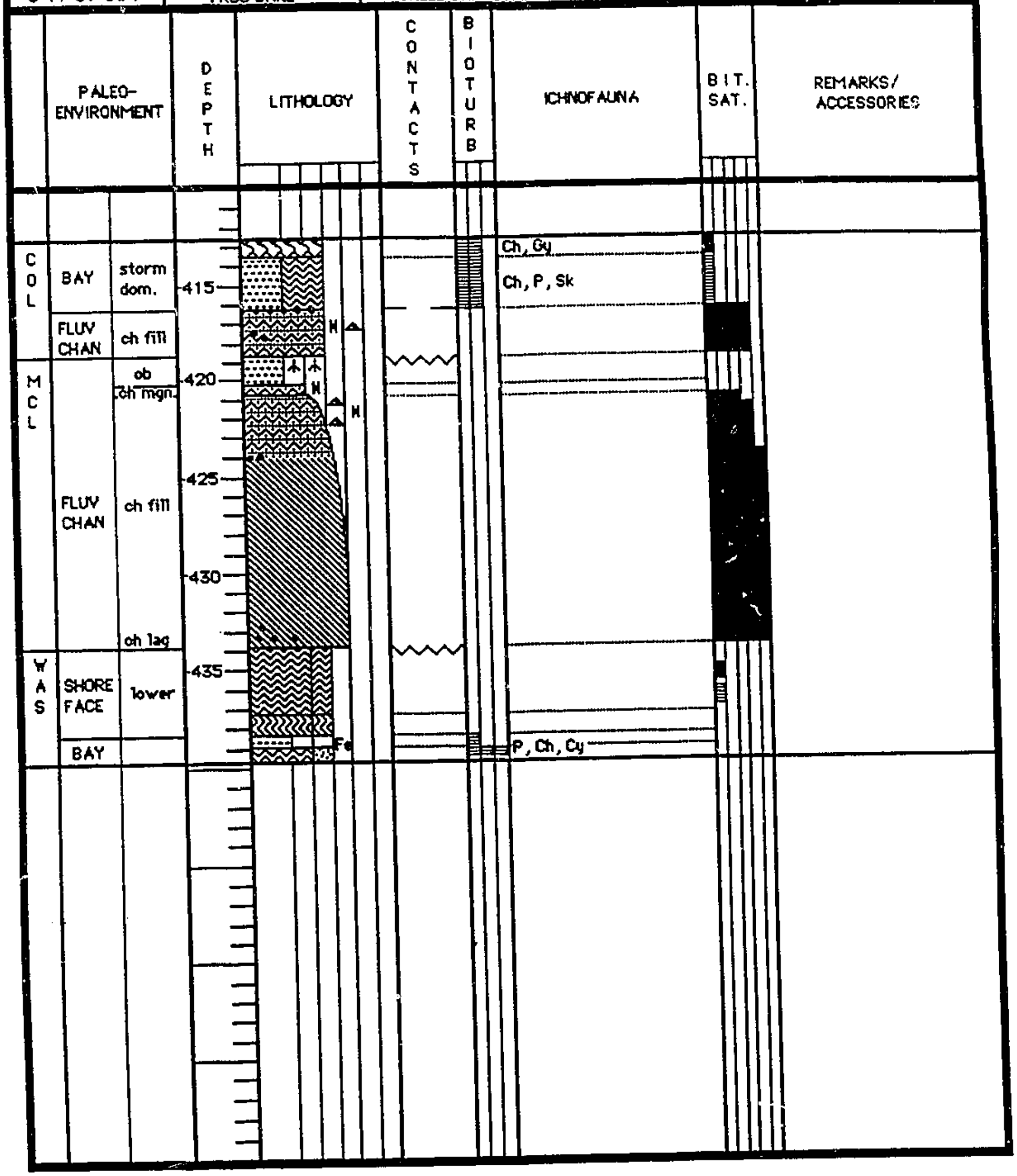
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-23-57-2W4	TEXACO FROG LAKE	TEXACO CANADA RESOURCES	438.0-445.5 m	651.85 m	1 OF 1



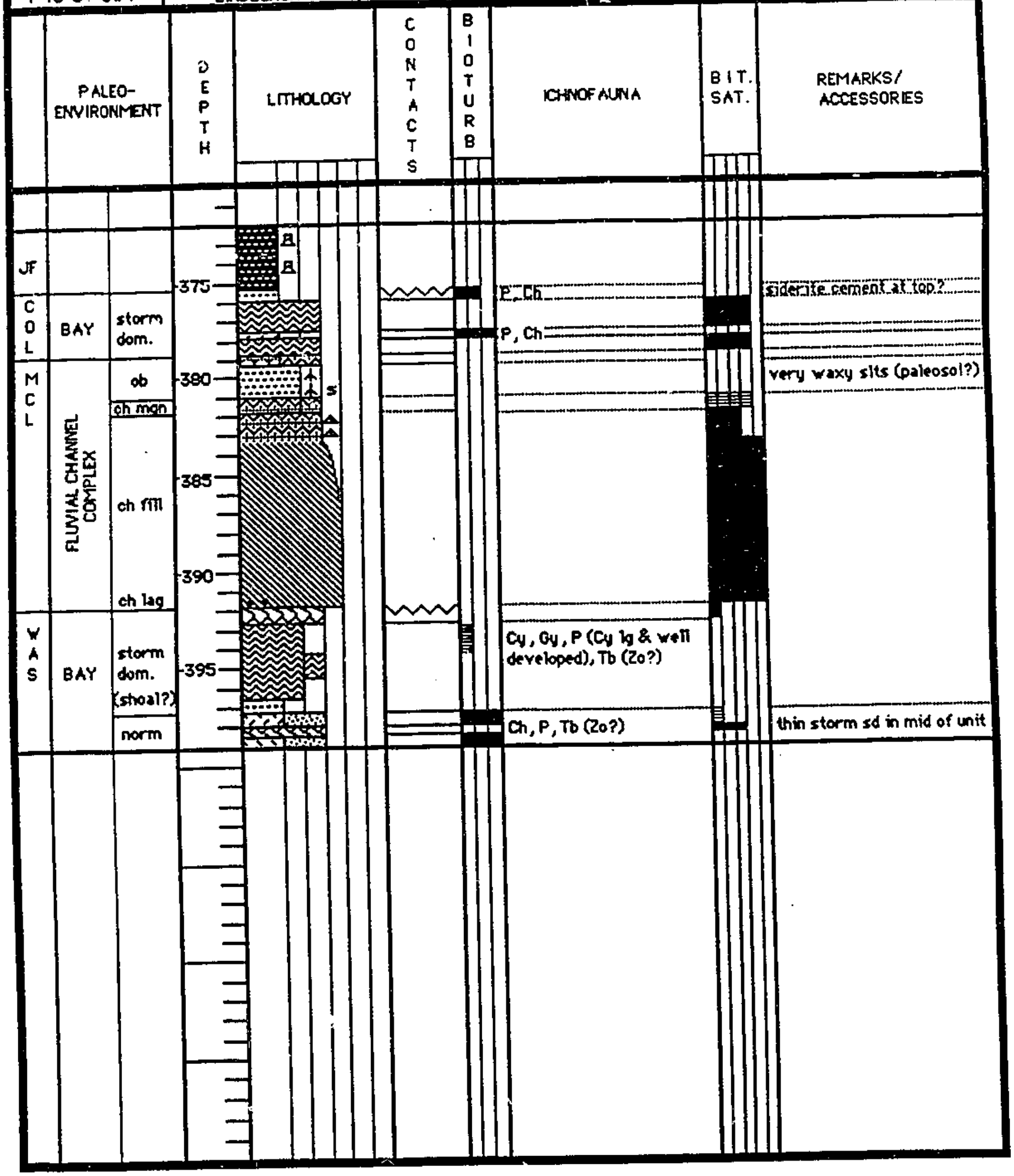
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-16-57-3W4	HUSKY SHELL EOR FROG LAKE	HUSKY OIL OPERATIONS SHELL CANADA LTD.	411.5-445.35 m	636.3 m	1 OF 1



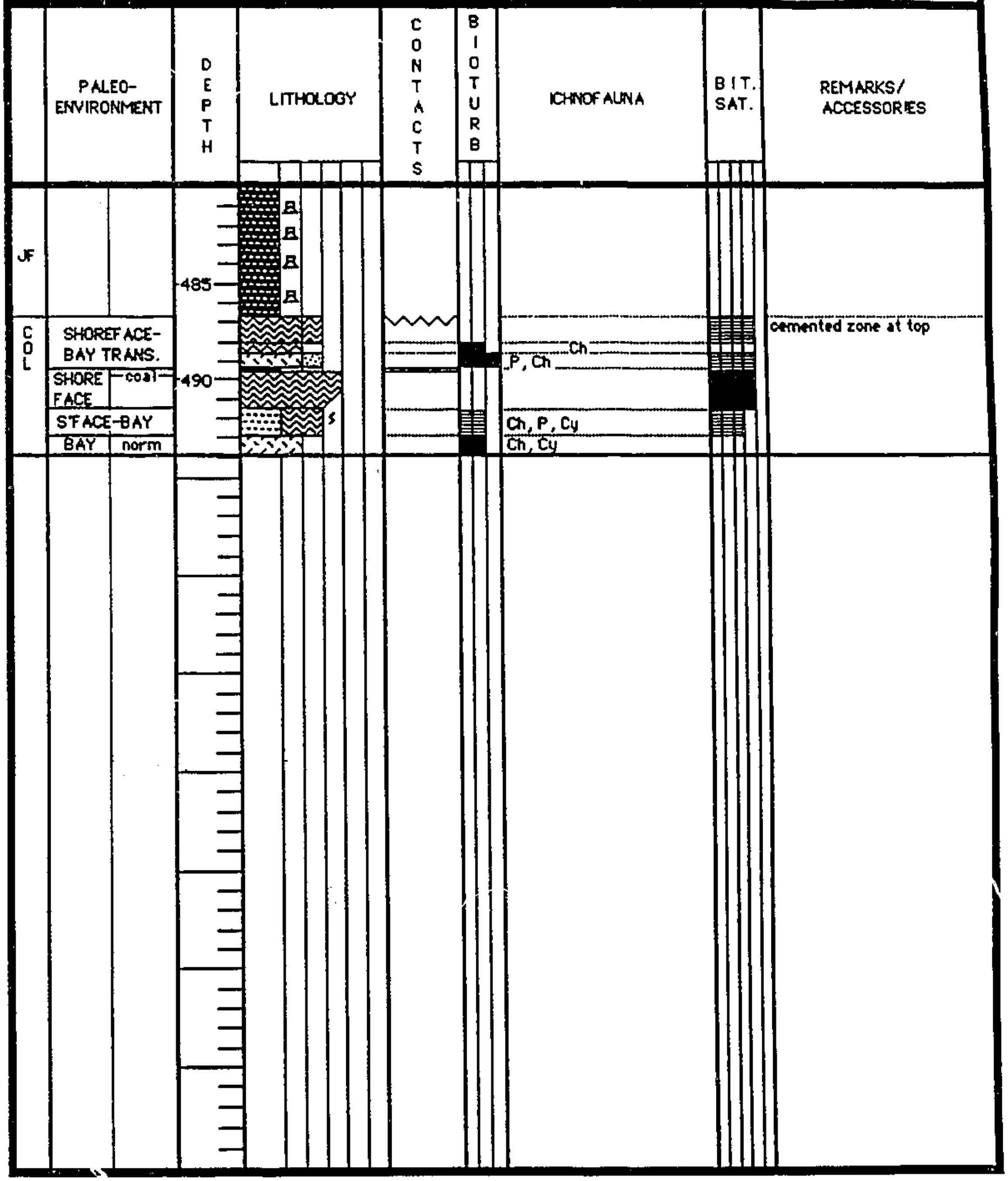
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-17-57-3W4	HUSKY SHELL EOR FROG LAKE	HUSKY OIL OPERATIONS SHELL CANADA LTD.	412.75-439.75 m	633.0 m	1 OF :



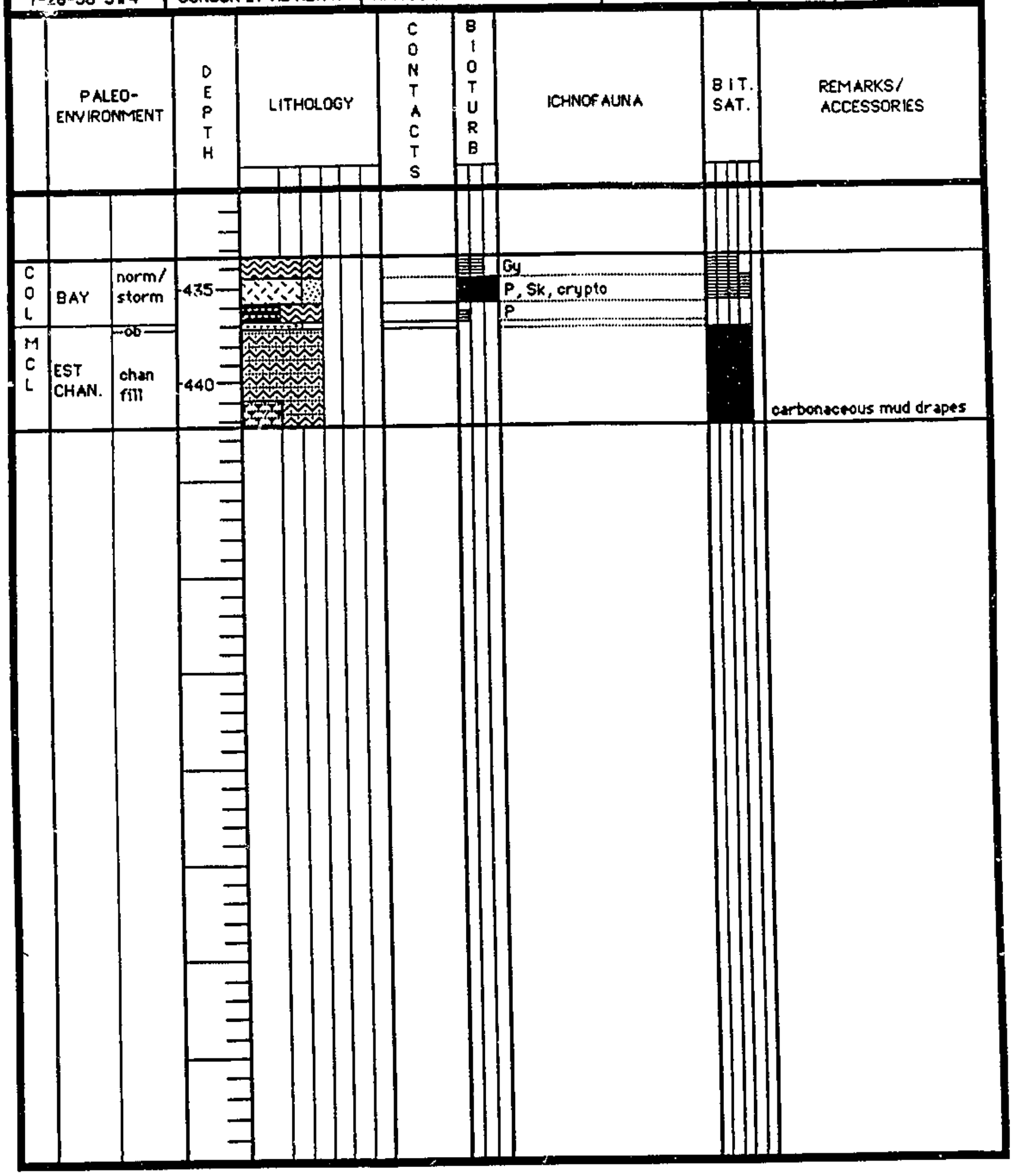
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-18-57-5W4	MURPHY ET AL LINDBERGH	MURPHY OIL CO. LTD.	372.0-399.0 m	594.0 m	1 OF 1



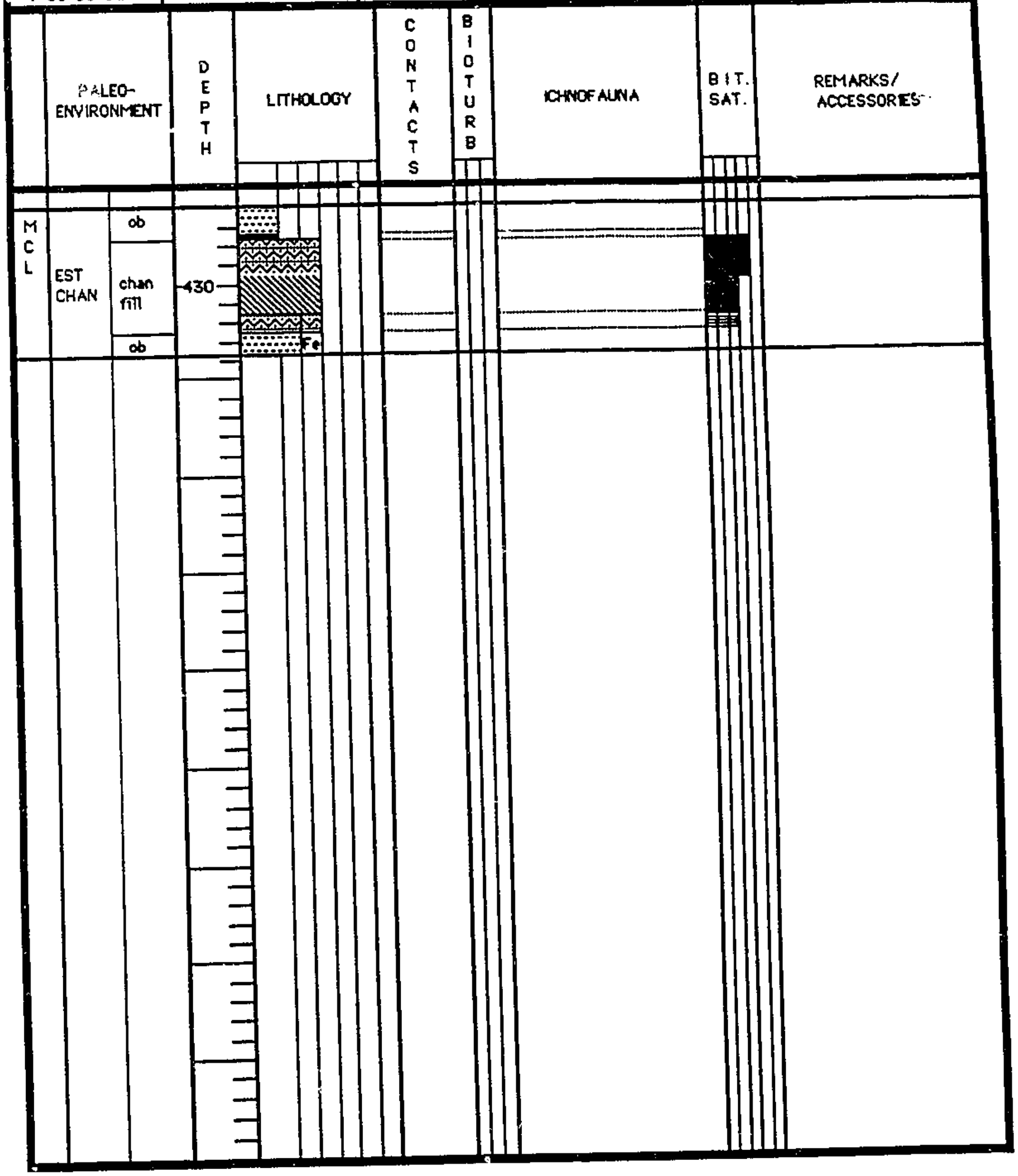
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-36-57-7W4	SUNCOR ELK PT	UNLEASED	484.85-493.85 m	671.41 m	1 OF 1



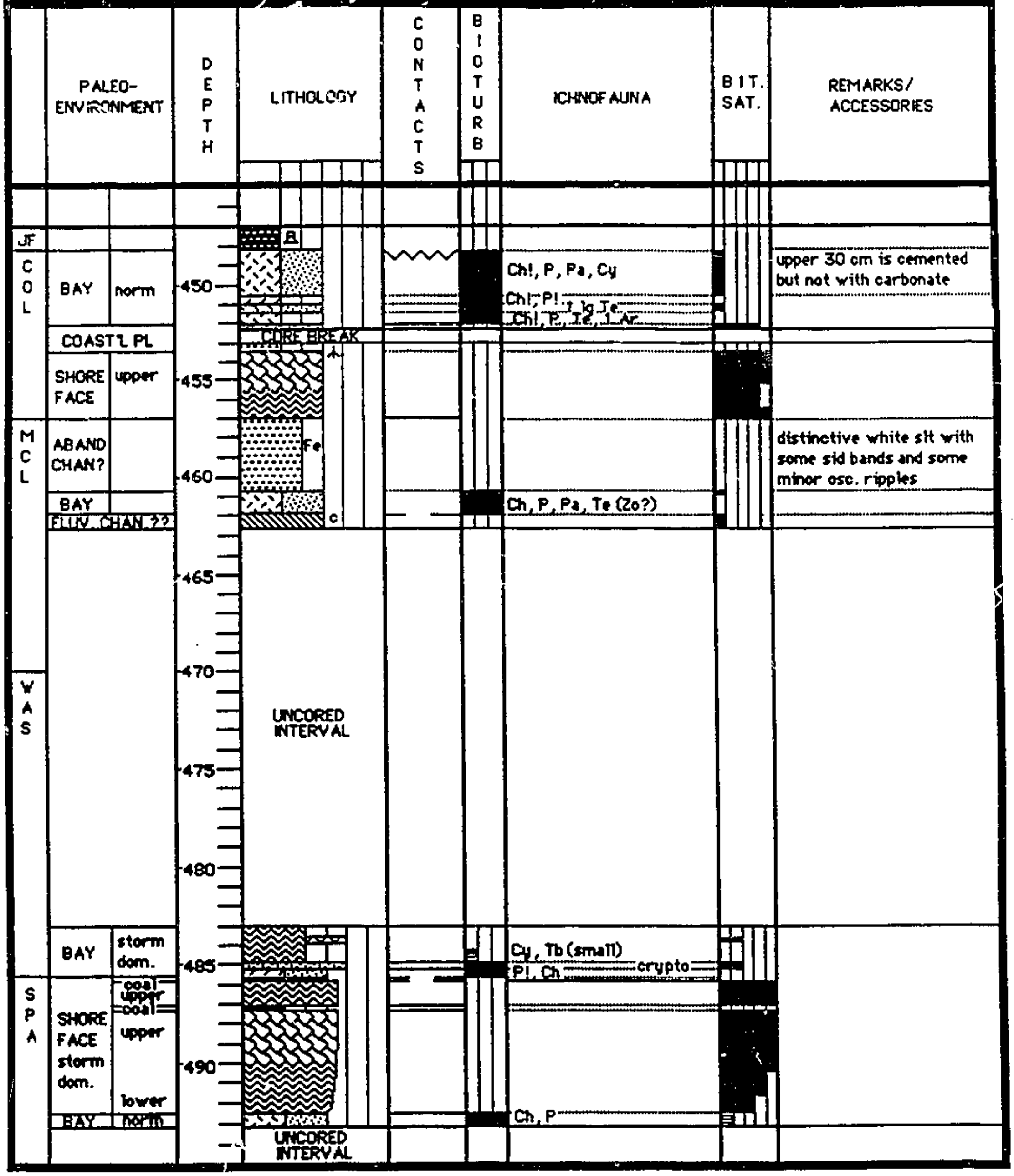
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-26-58-3W4	SUNCOR ET AL REITA	AMOCO CANADA PETROLEUM	432.5-442.2 m	662.9 m	1 OF 1



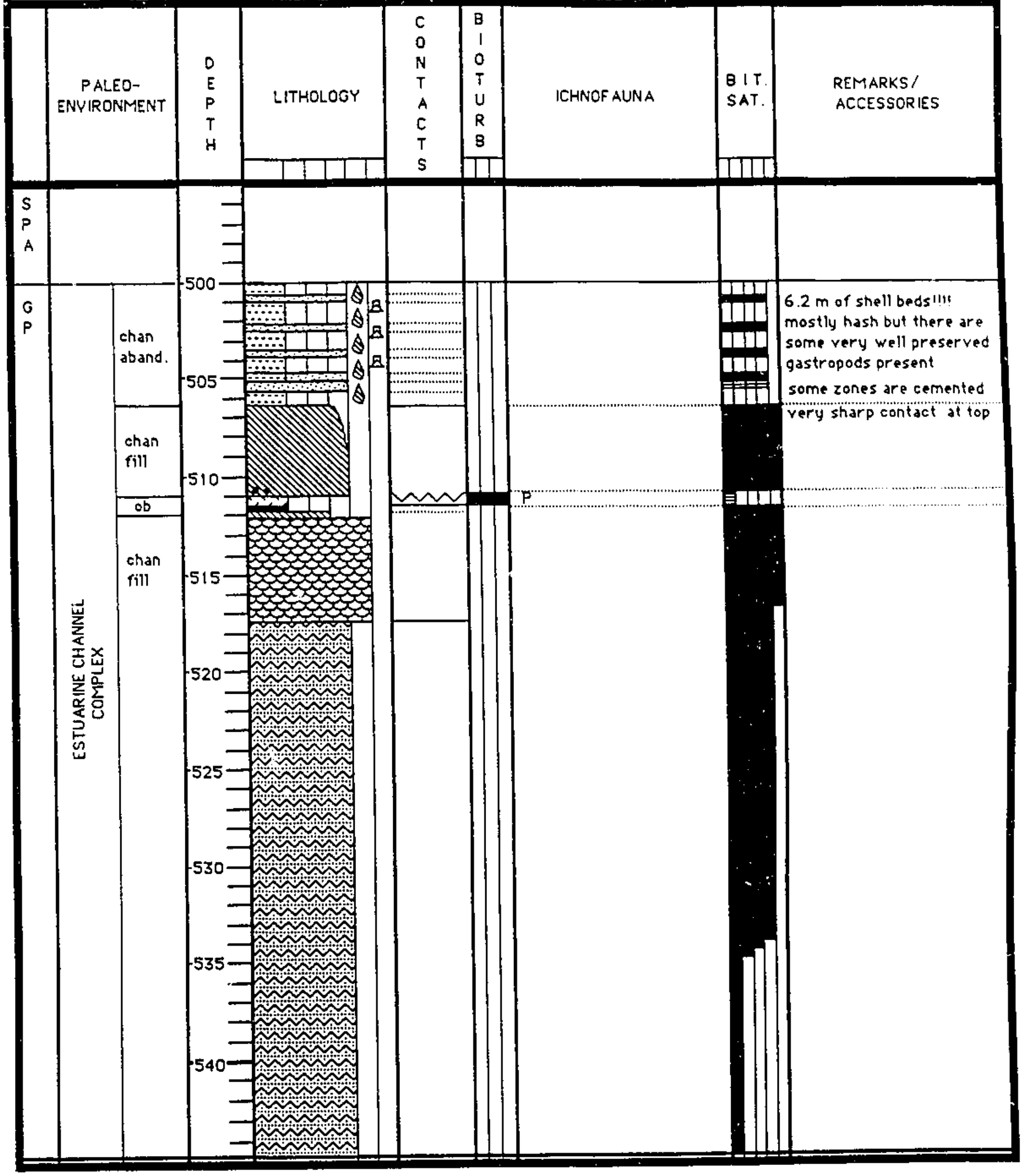
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-33-58-3W4	SUNCOR ET AL REITA	AMOCO CANADA PETROLEUM	426.0-433.5 m	647.2 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-13-58-5W4	MURPHY 6⁵631 LIND	MURPHY OIL CO. LTD.	447.0-540.0 m	670.0 m	1 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-13-58-5W4	MURPHY 65631 LIND	MURPHY OIL CO. LTD.	447.0-540.0 m	670.0 m	2 OF 2

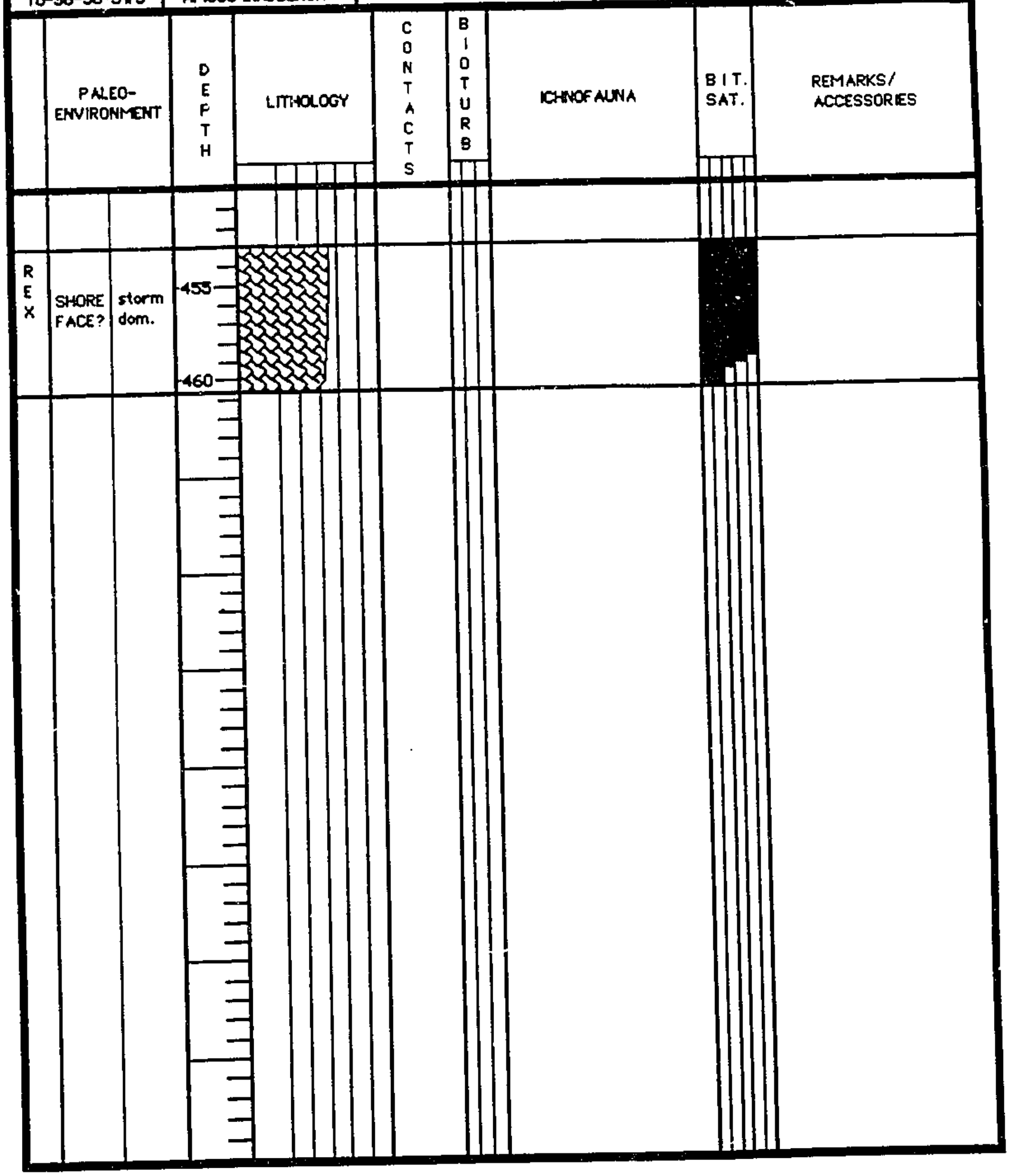


6.2 m of shell beds!!!!
mostly hash but there are some very well preserved gastropods present

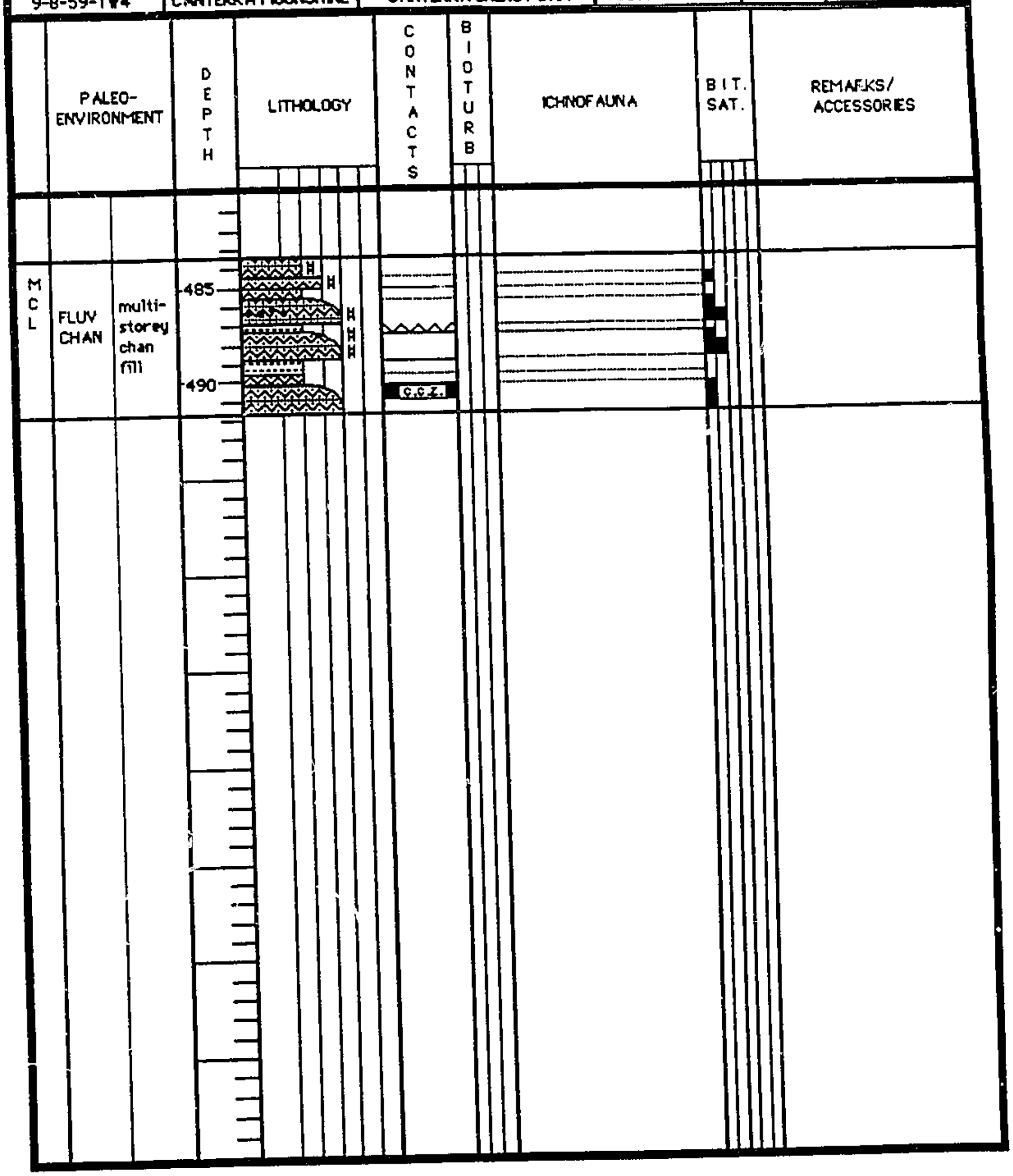
some zones are cemented

very sharp contact at top

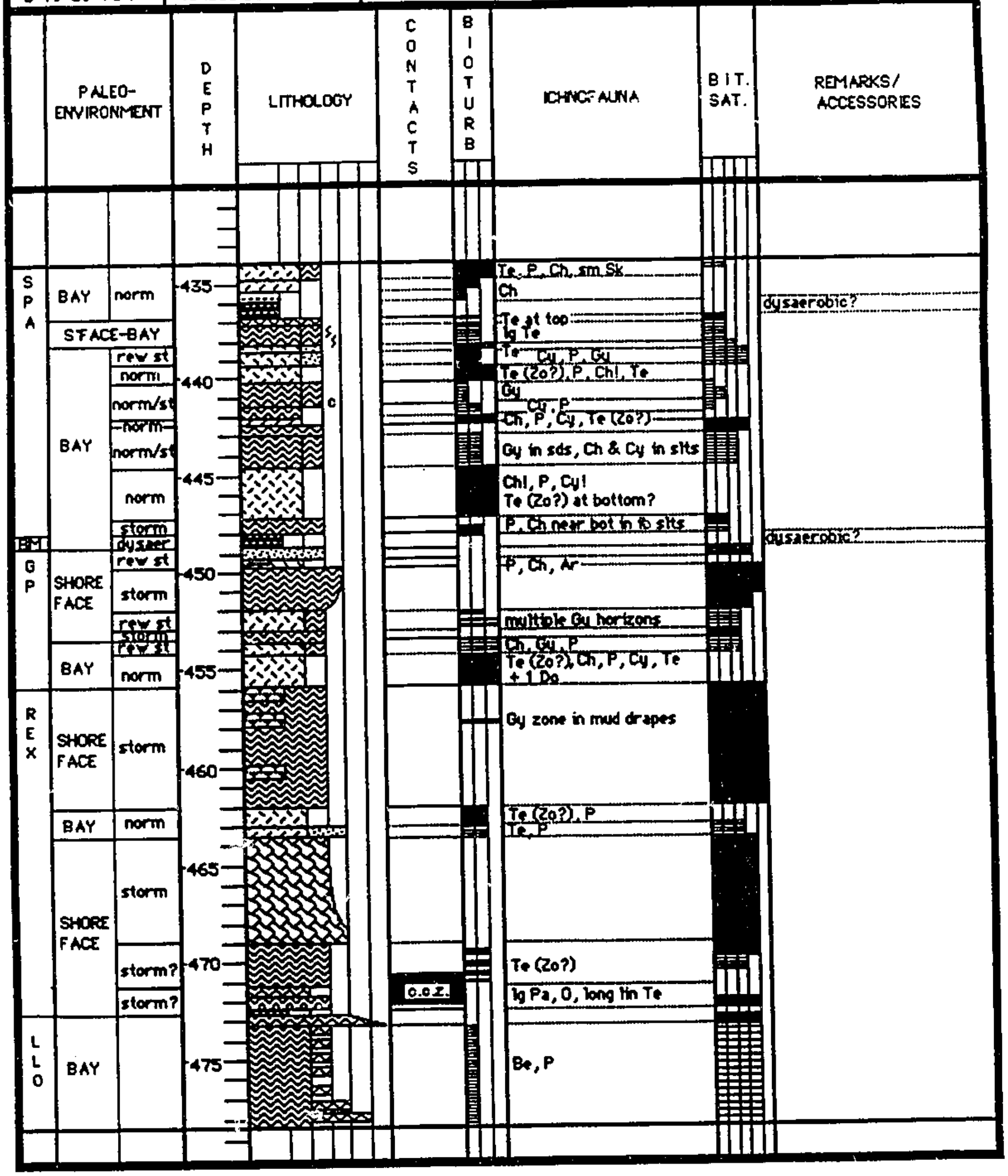
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-36-58-5W5	AMOCO LINDBERGH	AMOCO CANADA PETROLEUM	453.0-460.5 m	600.0 m	1 OF 1



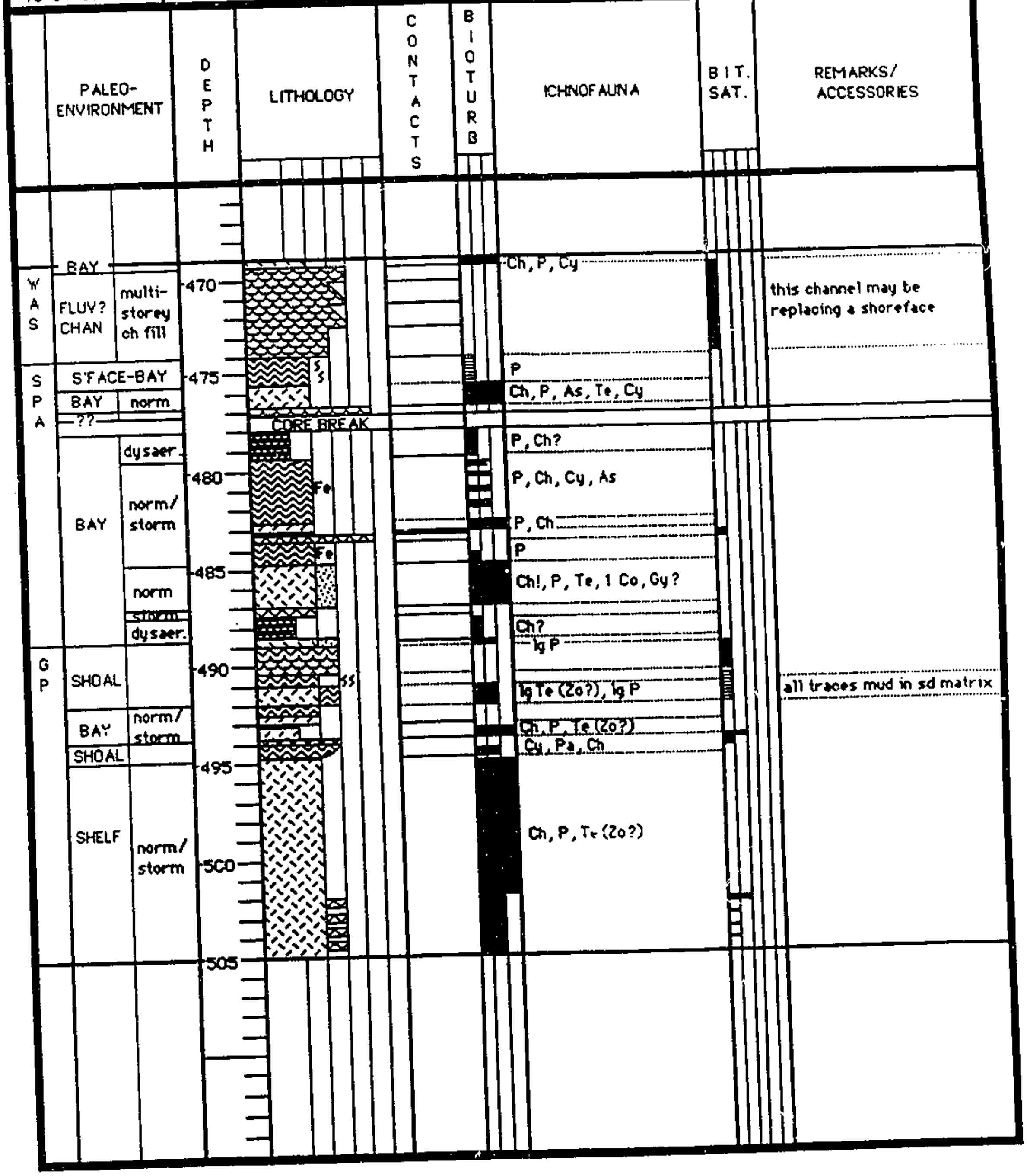
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-8-59-1W4	CANTERRA MOONSHINE	CANTERRA ENERGY LTD.	483.4-491.6 m	677.0 m	1 OF 1



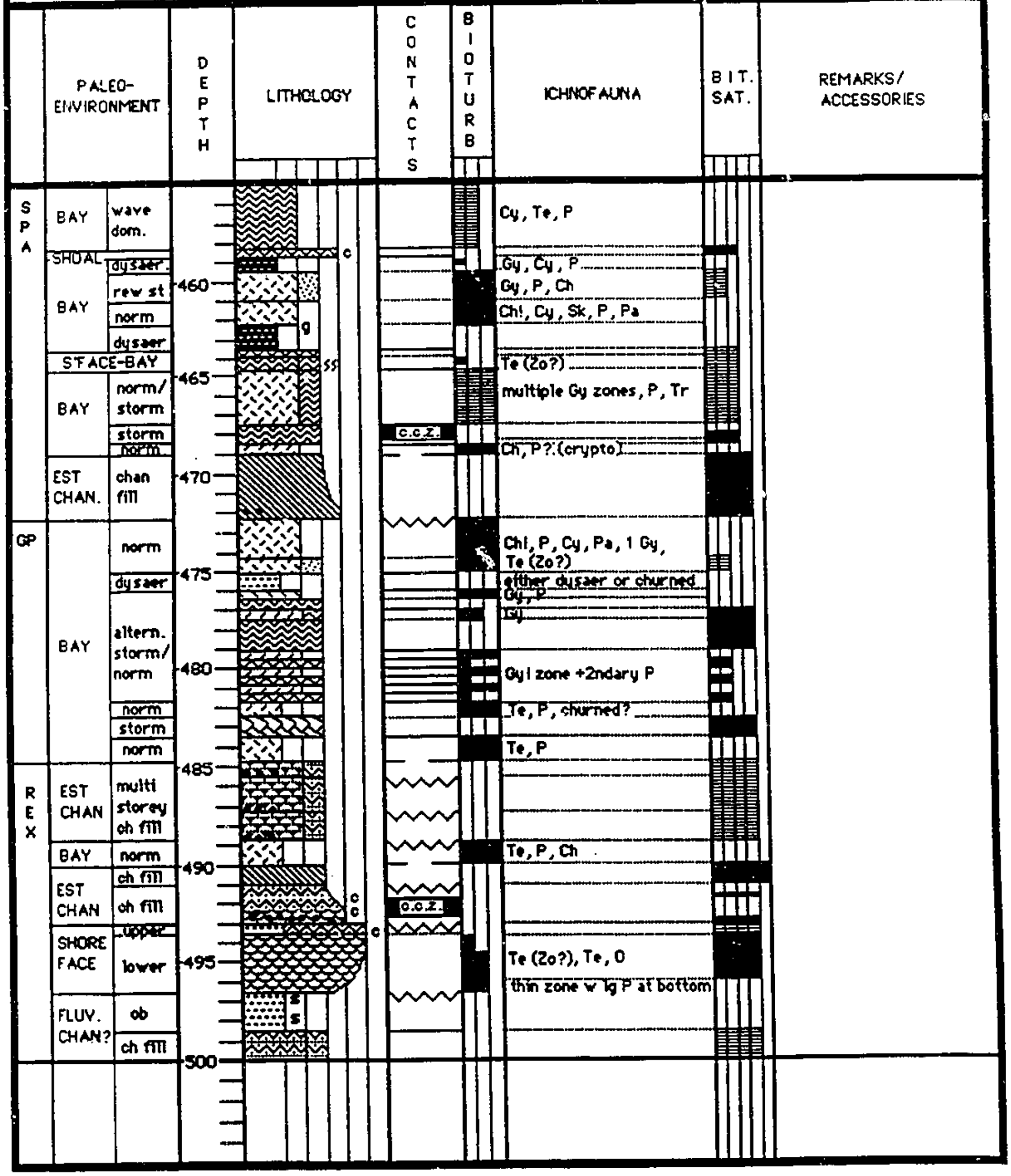
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-19-59-1W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	434-478.5 m	622.5 m	1 OF 1



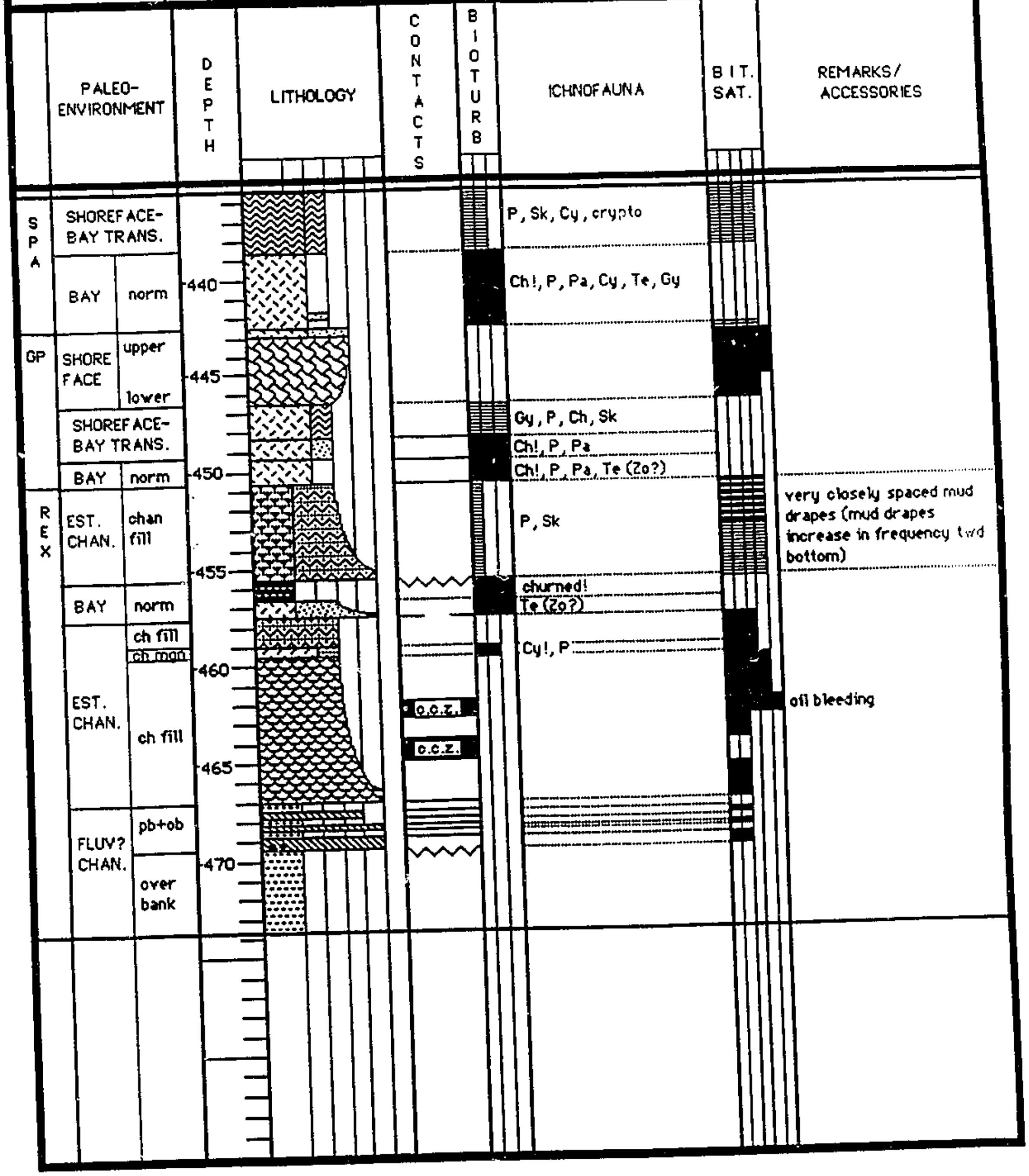
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-31-59-1W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	469-505 m	640.8 m	1 OF 1



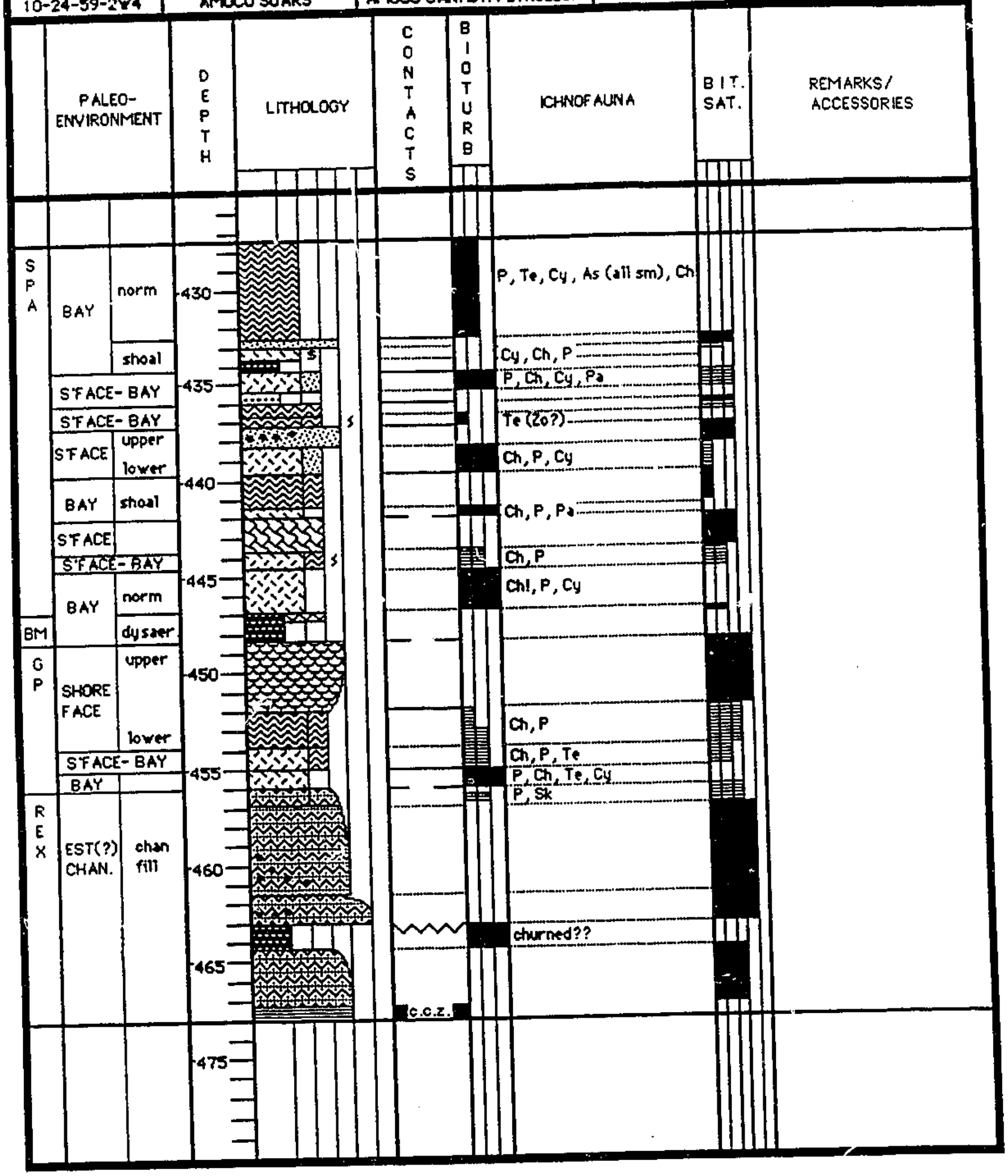
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-13-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	455.0-500.0 m	651.5 m	1 OF 1

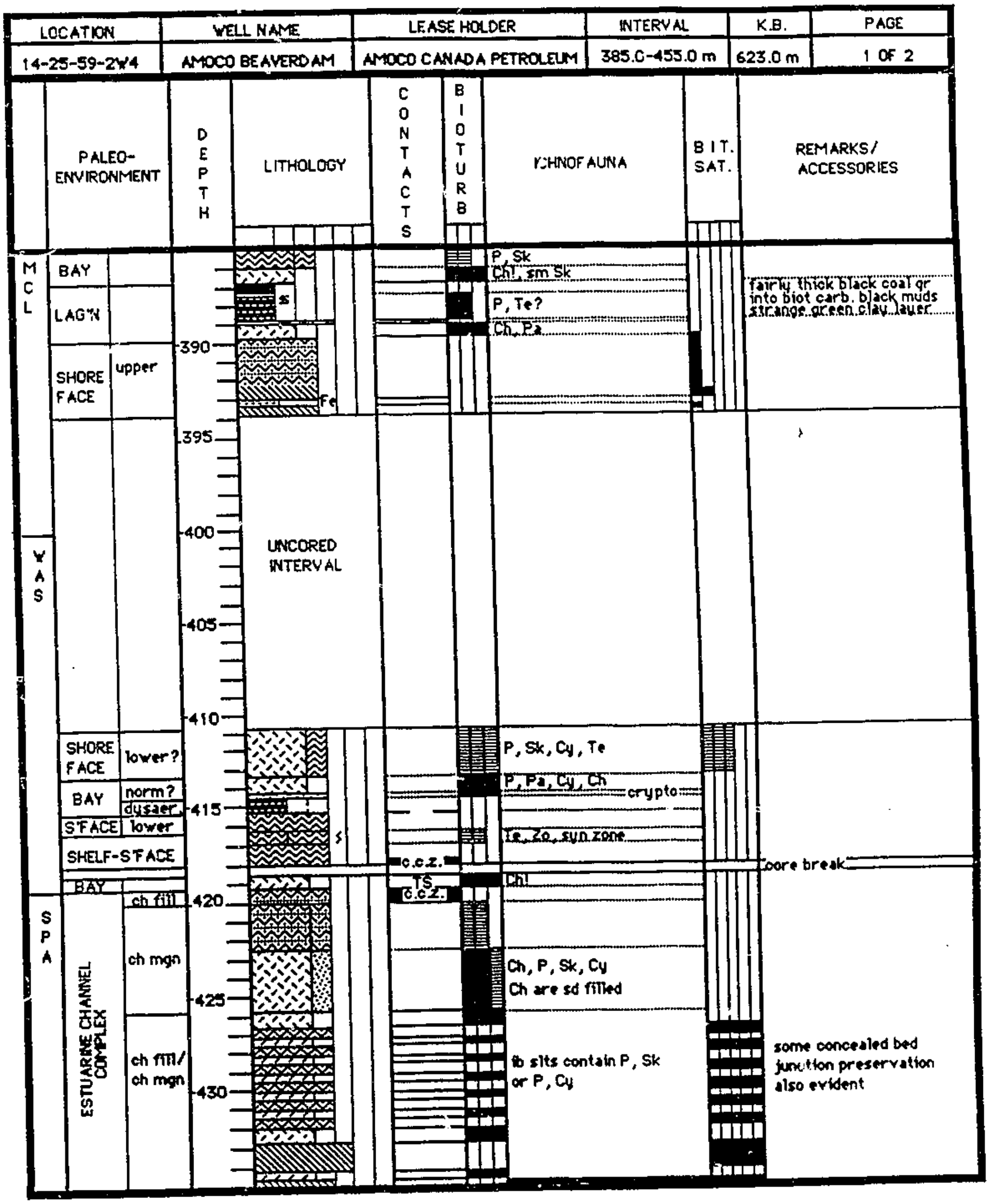


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-23-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	435.5 - 474.0 m	630.0 m	1 OF 1

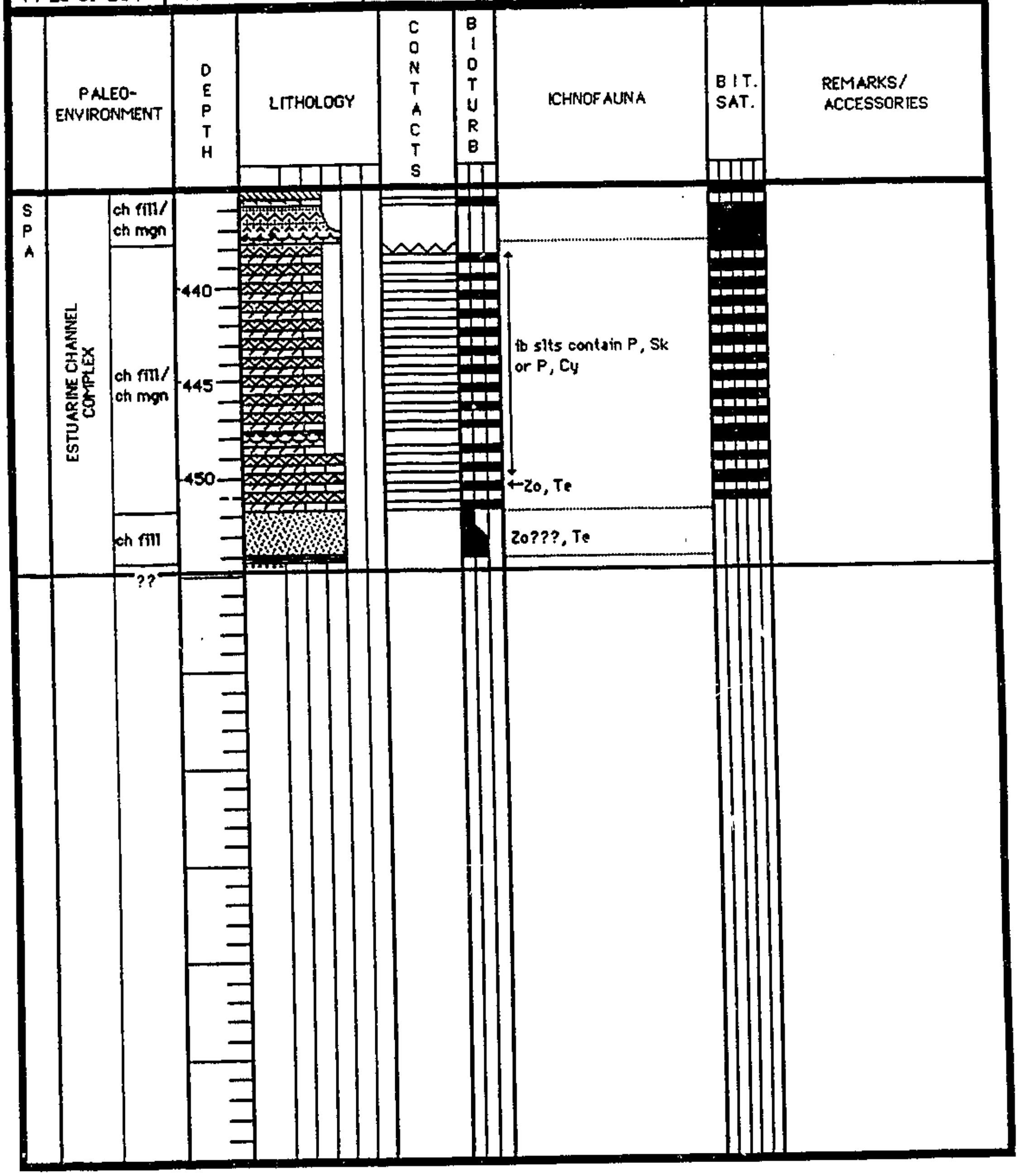


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-24-59-2W4	AMOCO SOARS	AMOCO CANADA PETROLEUM	427.5-468.0 m	623.3 m	1 OF 1

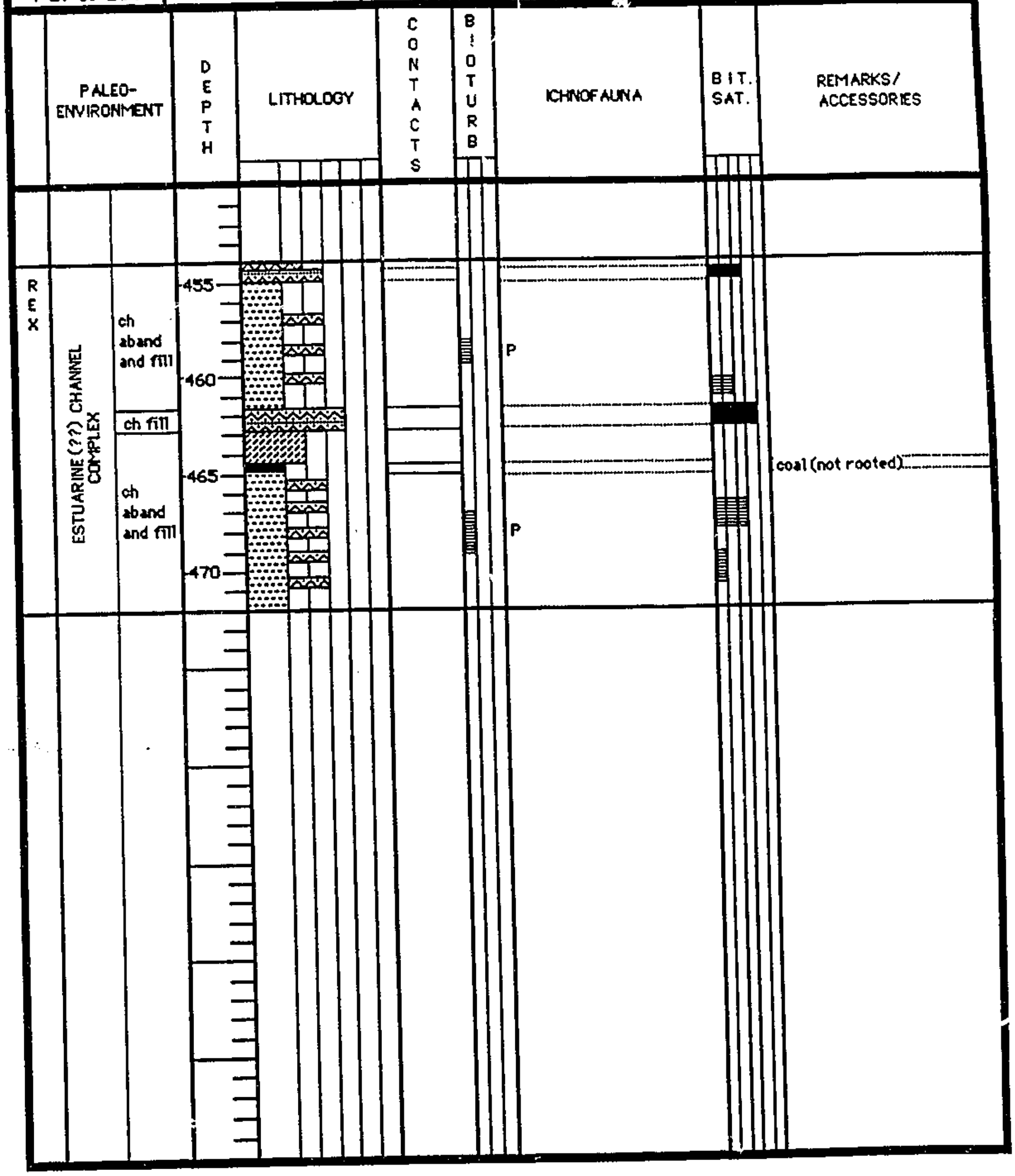



LOCATION
14-25-59-2W4
WELL NAME
AMOCO BEAVERDAM
LEASE HOLDER
AMOCO CANADA PETROLEUM
INTERVAL
385.0-455.0 m
K.B.
623.0 m
PAGE
1 OF 2
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
MCL
WAS
SPA
BAY
LAG'N
SHORE FACE
upper
SHORE FACE
lower?
BAY
norm?
dysaer.
S'FACE
lower
SHELF-S'FACE
BAY
ESTUARINE CHANNEL COMPLEX
ch fill
ch mgn
ch fill/ ch mgn
390
395
400
405
410
415
420
425
430
Fe
UNCORED INTERVAL
c.c.z.
TS
c.c.z.
P, Sk
Ch!, sm Sk
P, Te?
Ch, Pa
P, Sk, Cy, Te
P, Pa, Cy, Ch
crypto
Te, Zo, syn zone
Ch!
Ch, P, Sk, Cy
Ch are sd filled
ib slts contain P, Sk or P, Cy
fairly thick black coal gr into biot carb. black muds
strange green clay layer
core break
some concealed bed junction preservation also evident

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-25-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	385.0-455.0 m	623.0 m	2 OF 2

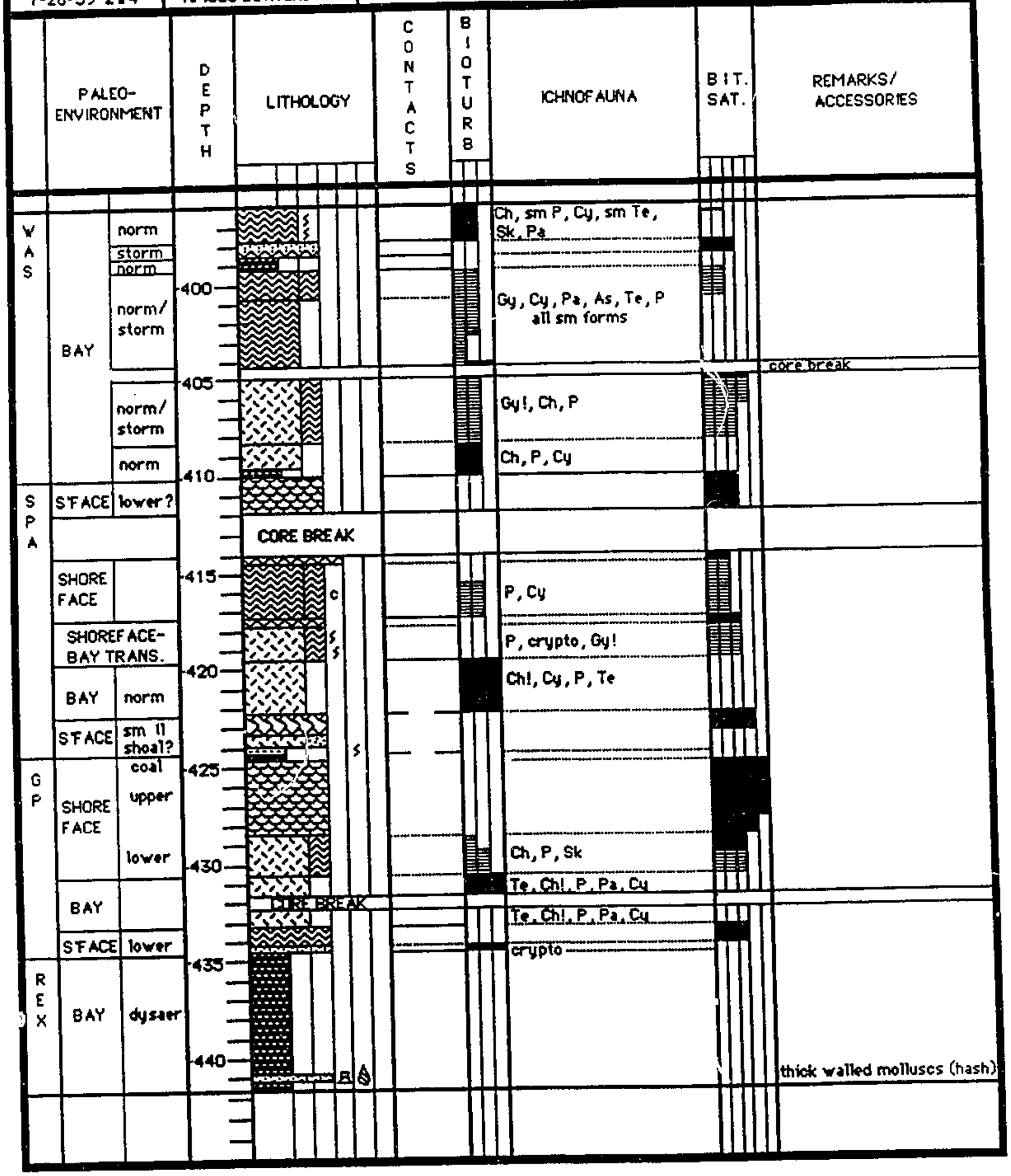


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-27-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	454.0-472.0 m	624.9 m	1 OF 1

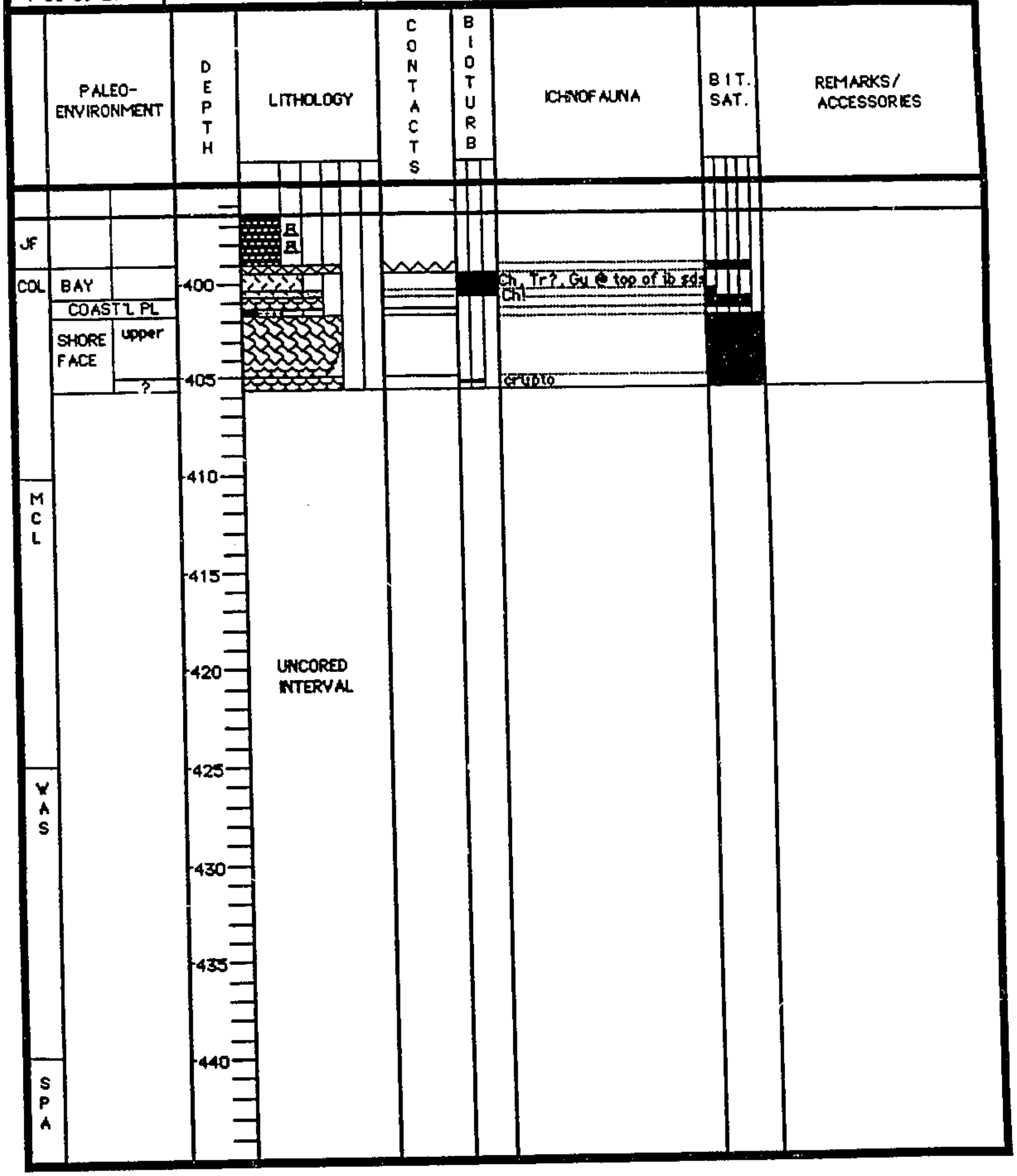


]

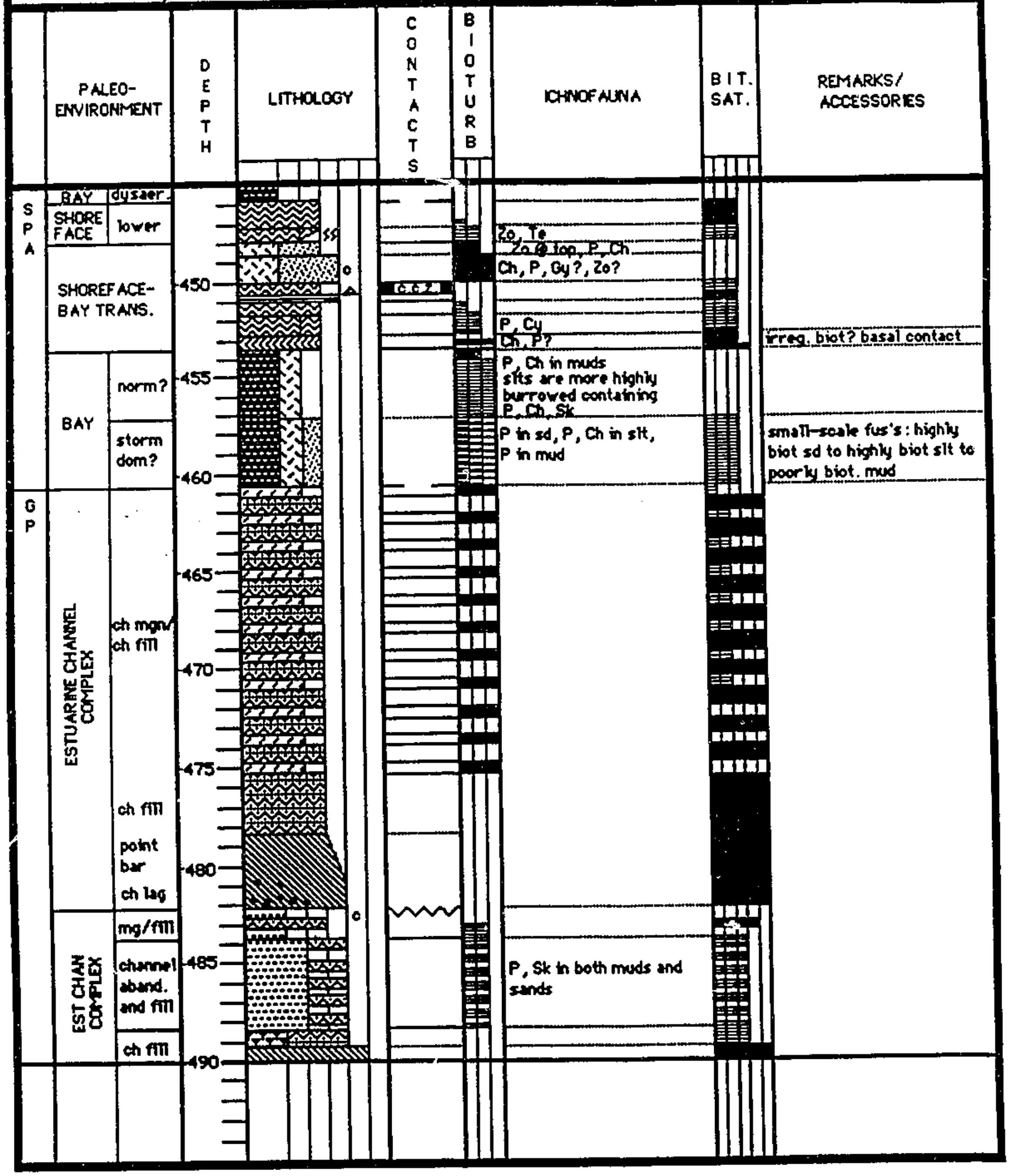
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-28-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	401.0-446.5 m	617.1 m	1 OF 1



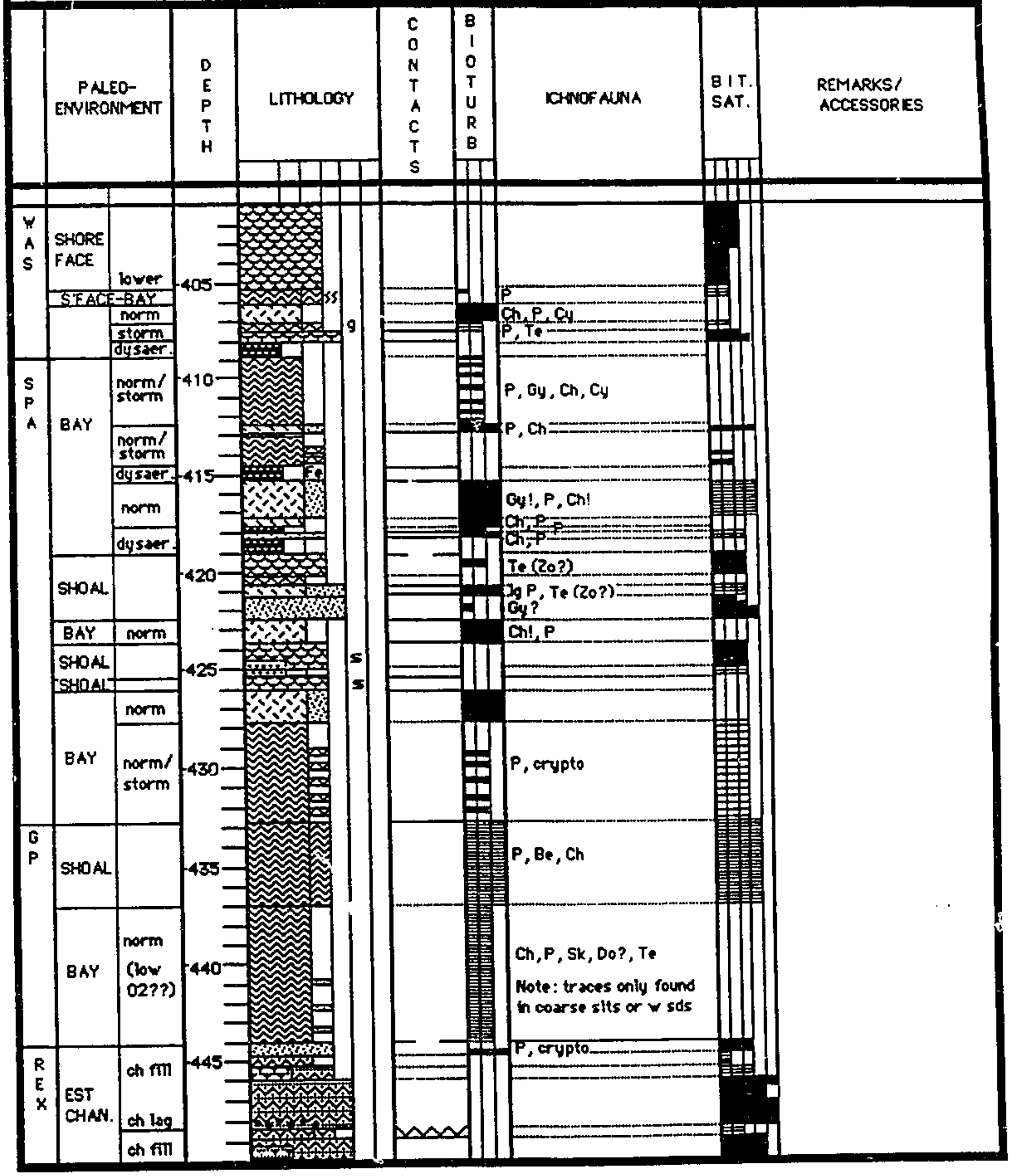
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-35-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	396.6-490 m	643.7 m	1 OF 2



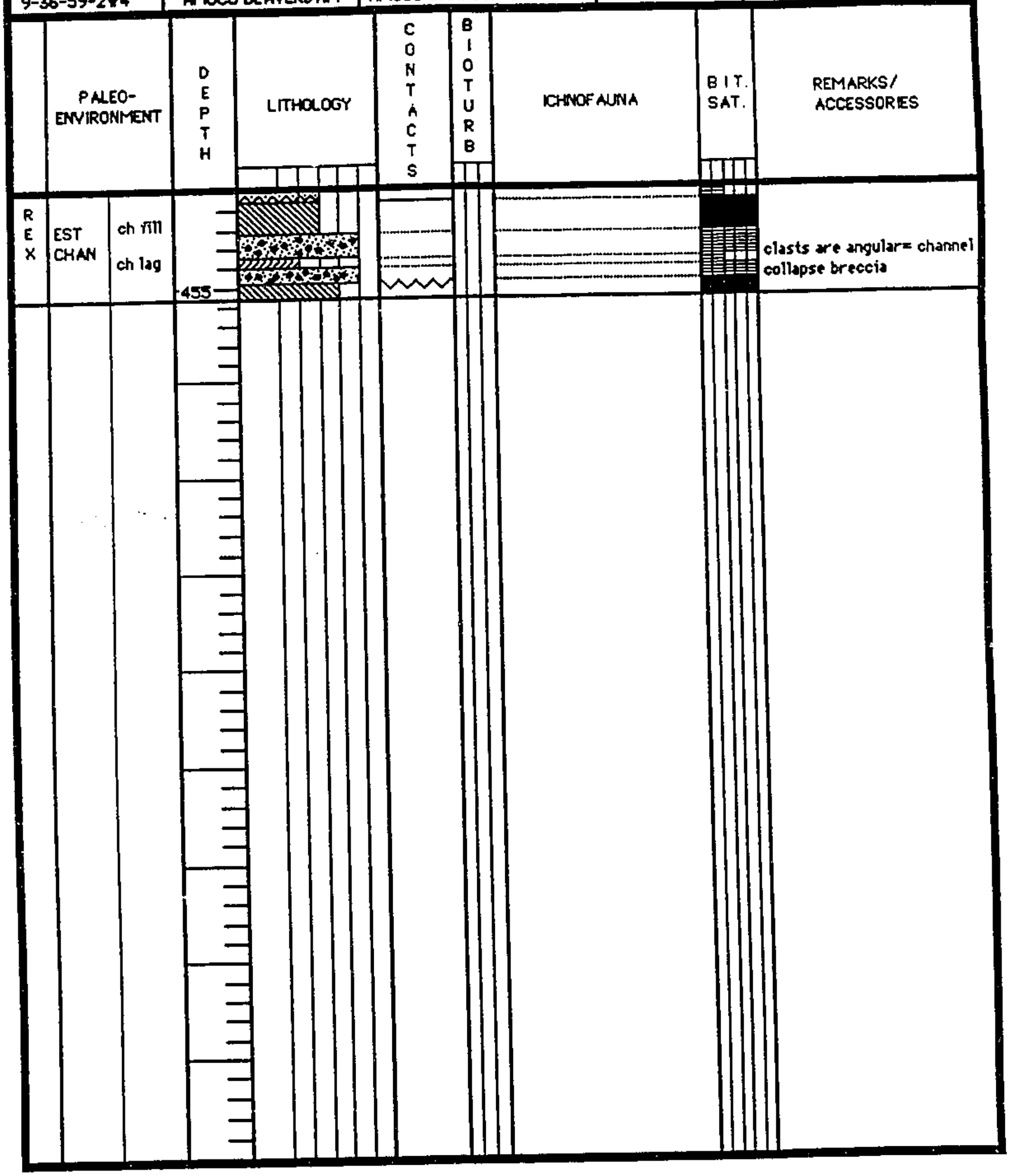
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-35-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	396.6-490 m	643.7 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-36-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	401.0-455.5 m	615.5 m	1 OF 2

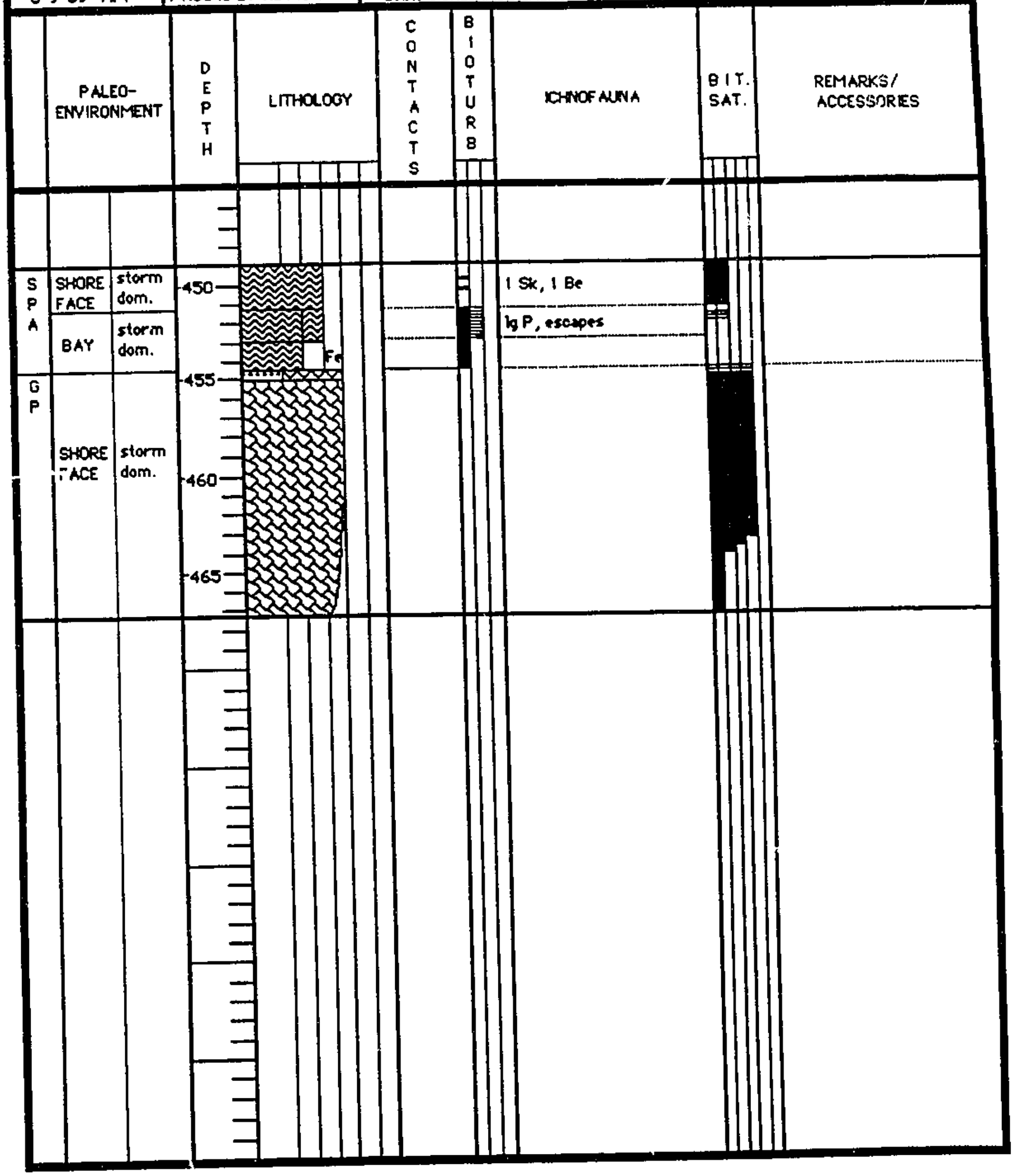


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-36-59-2W4	AMOCO BEAVERDAM	AMOCO CANADA PETROLEUM	401.0-455.5 m	615.5 m	2 OF 2

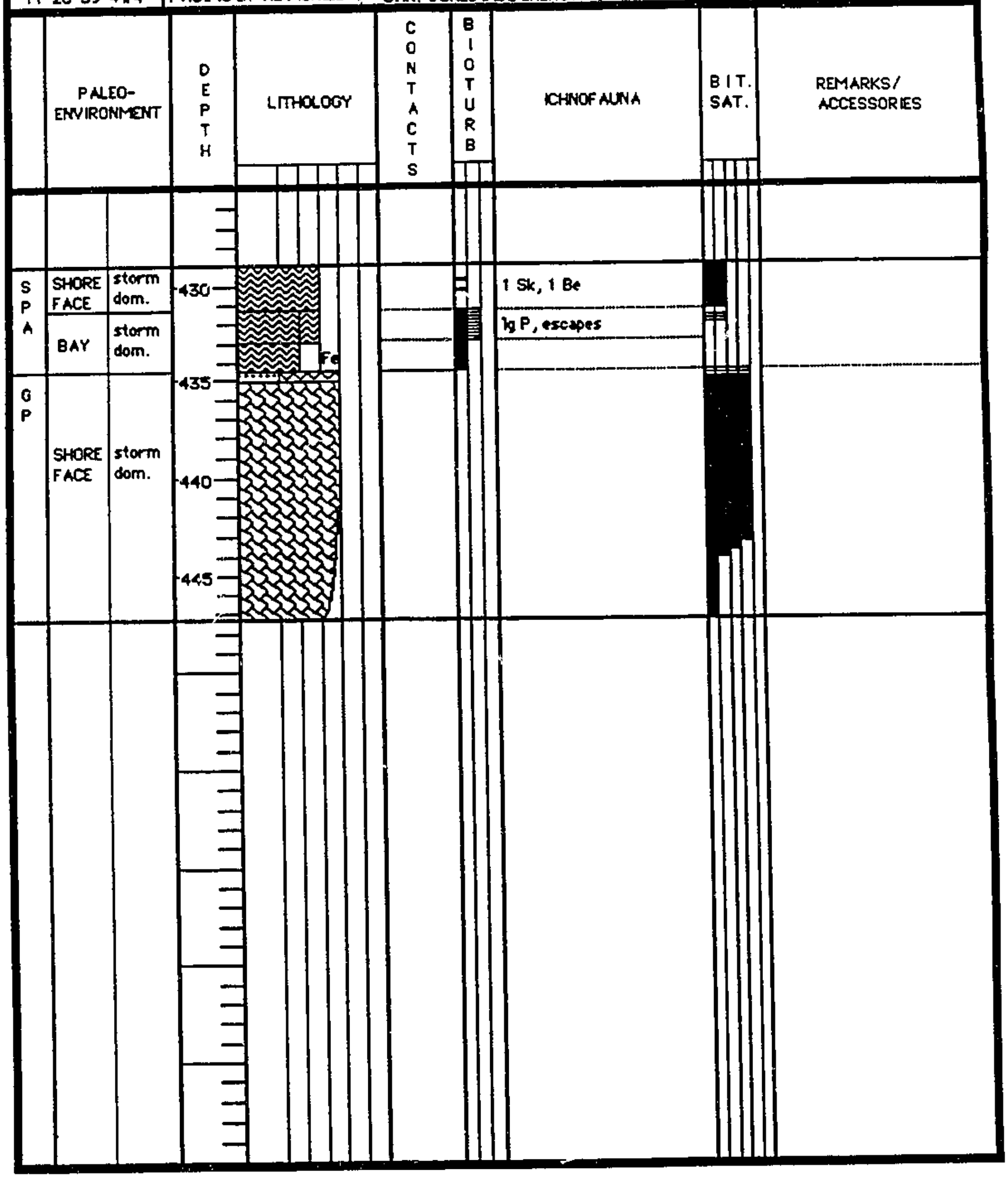


clasts are angular= channel collapse breccia

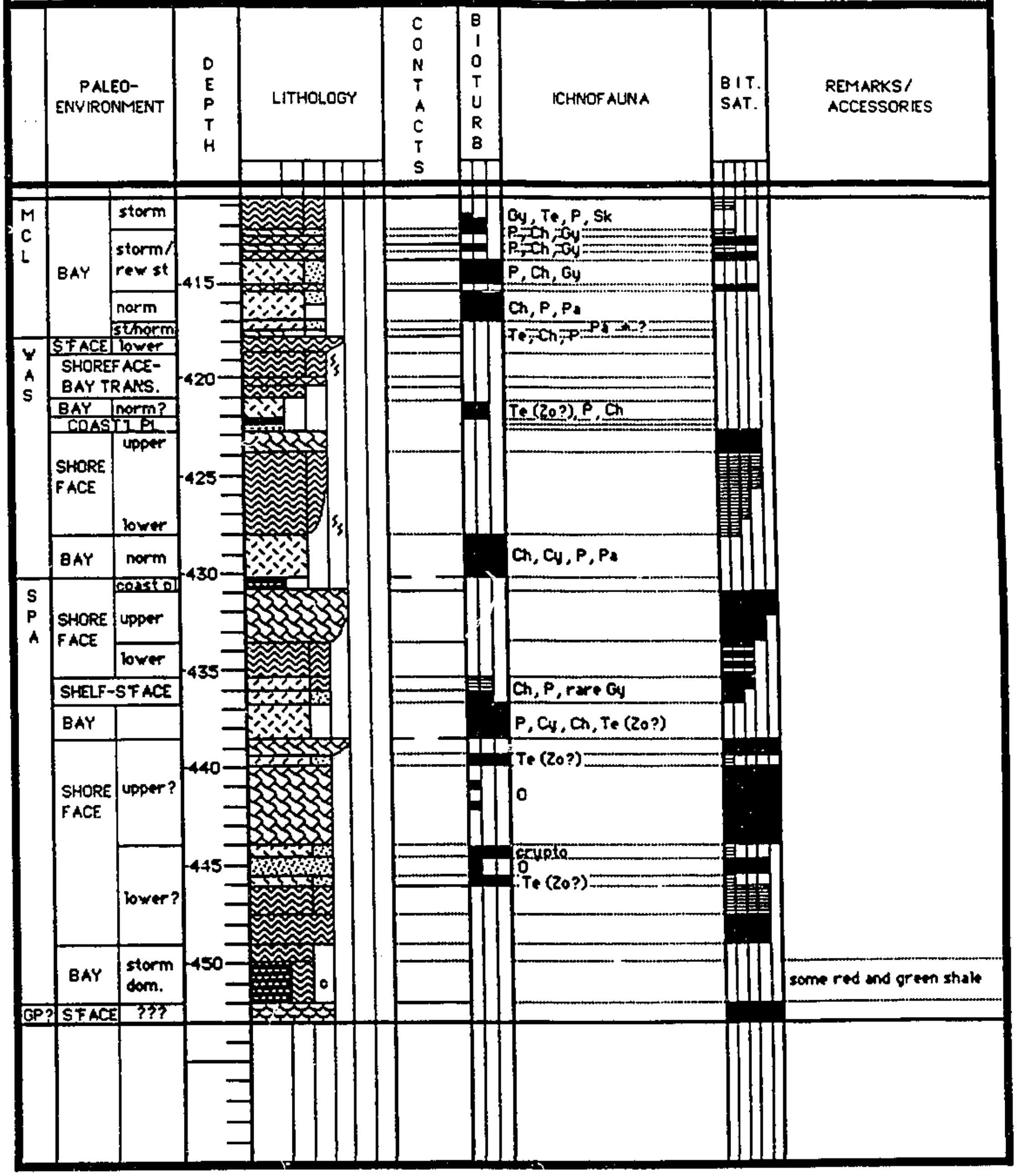
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-9-59-4W4	PACIFIC ET AL MURIEL	PETRO-CANADA, ABERFORD, CAN. WORLDWIDE ENERGY	448.97-467.25 m	610.5 m	1 OF 1



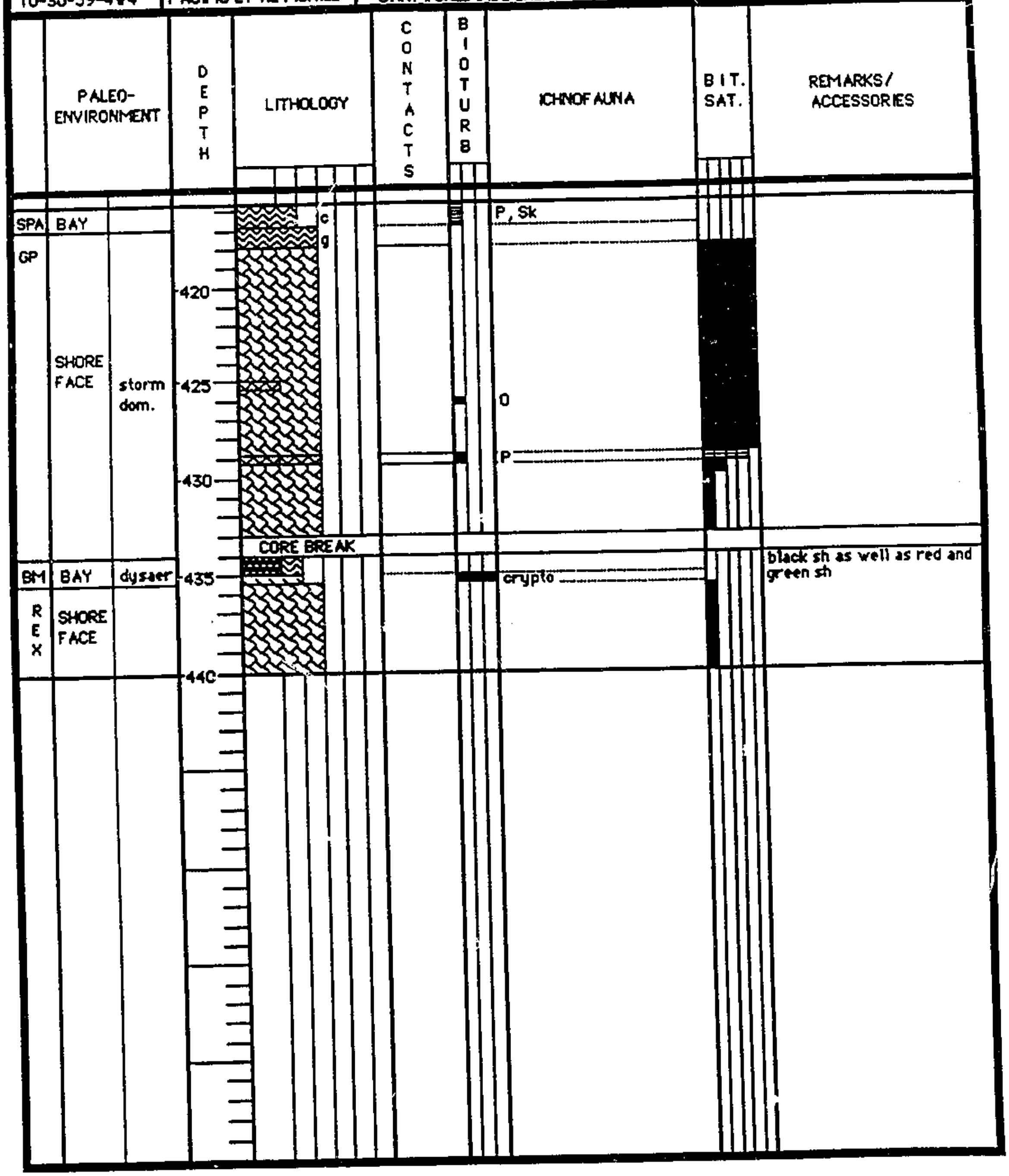
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-20-59-4W4	PACIFIC ET AL MURIEL	PETRO-CANADA, ABERFORD, CAN. WORLDWIDE ENERGY	428.97–447.25 m	610.5 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-22-59-4W4	PACIFIC ET AL MURIEL	PETRO-CANADA, ABERFORD, CAN. WORLDWIDE ENERGY	410.68-453.0 m	633.65 m	1 OF 1

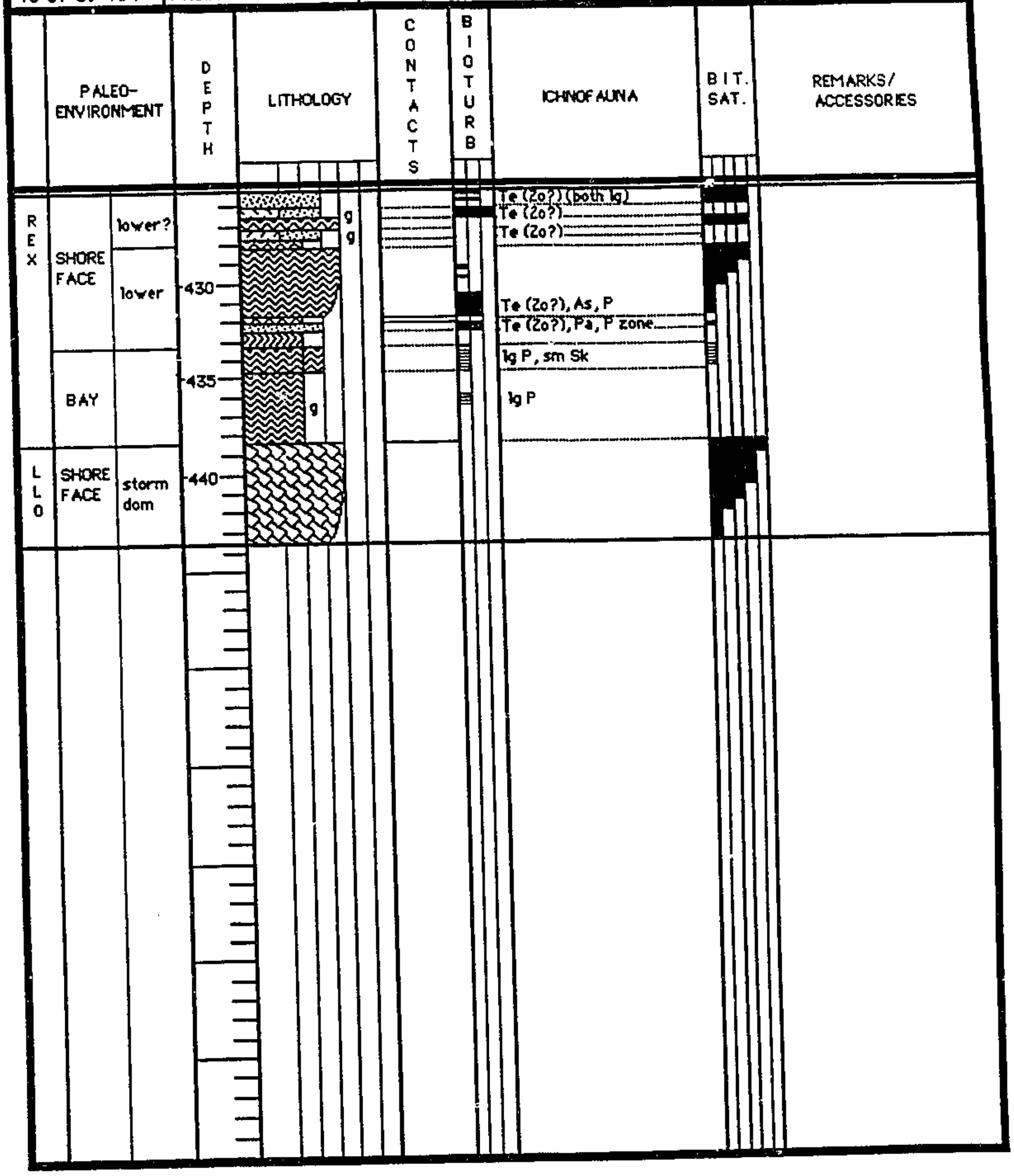


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-30-59-4W4	PACIFIC ET AL MURIEL	PETRO-CANADA, ABERFORD, CAN. WORLDWIDE ENERGY	415.79-475.18 m	610.8 m	1 OF 1

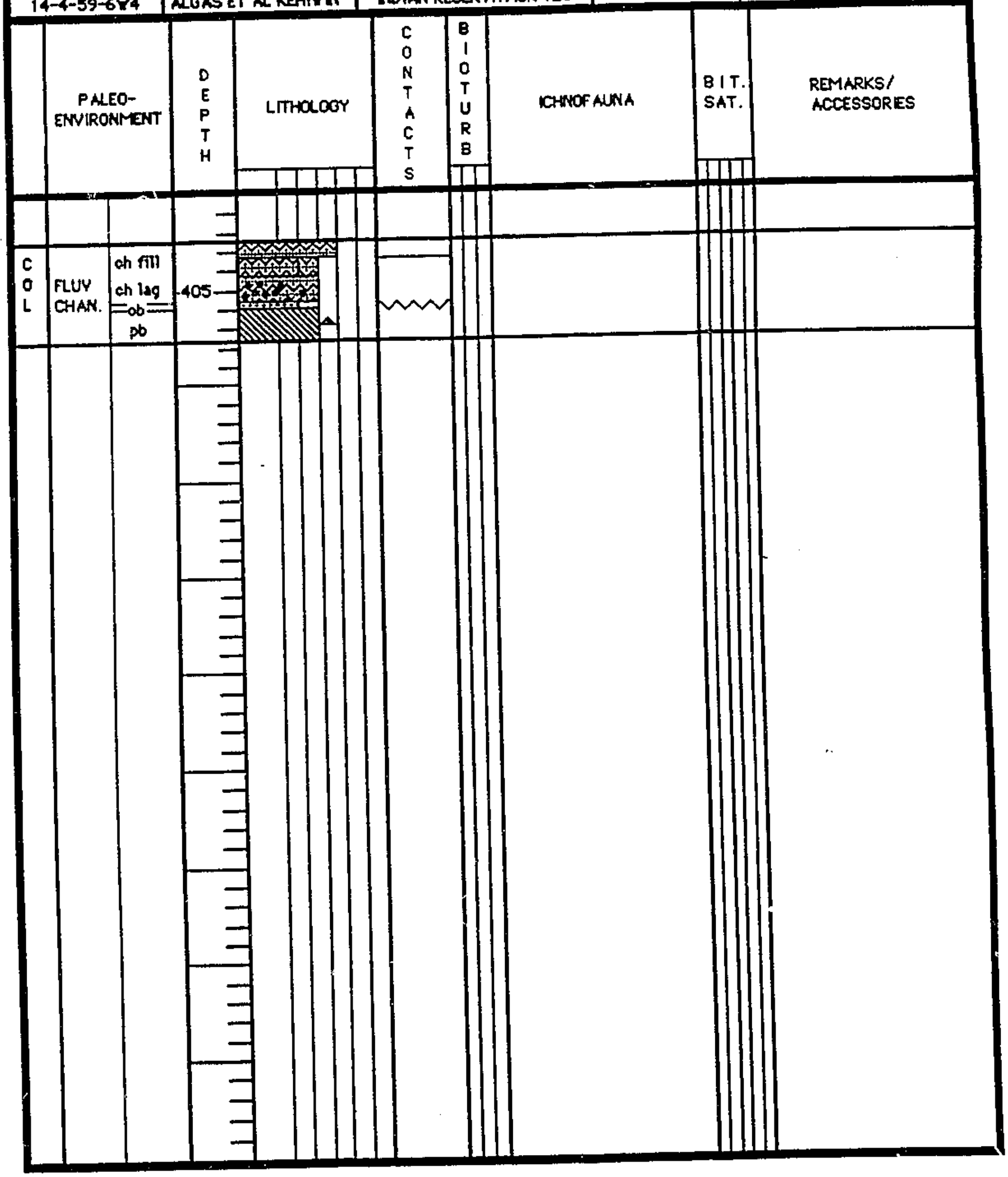


black sh as well as red and green sh

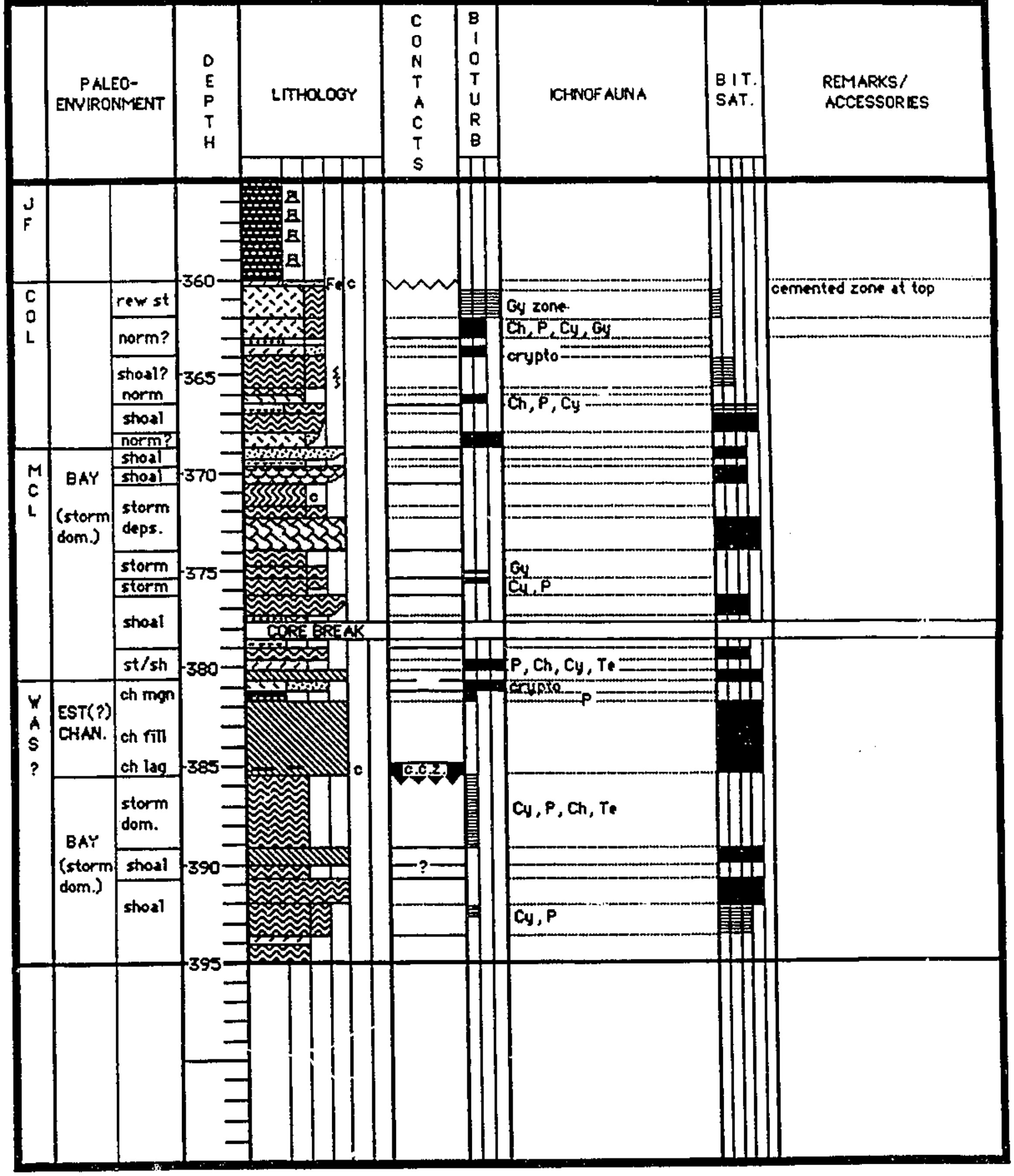
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-31-59-4W4	PACIFIC ET AL MUREL	PETRO-CANADA, ABERFORD, CAN. WORLDWIDE ENERGY	425.19-443.48 m	588.23 m	1 OF 1



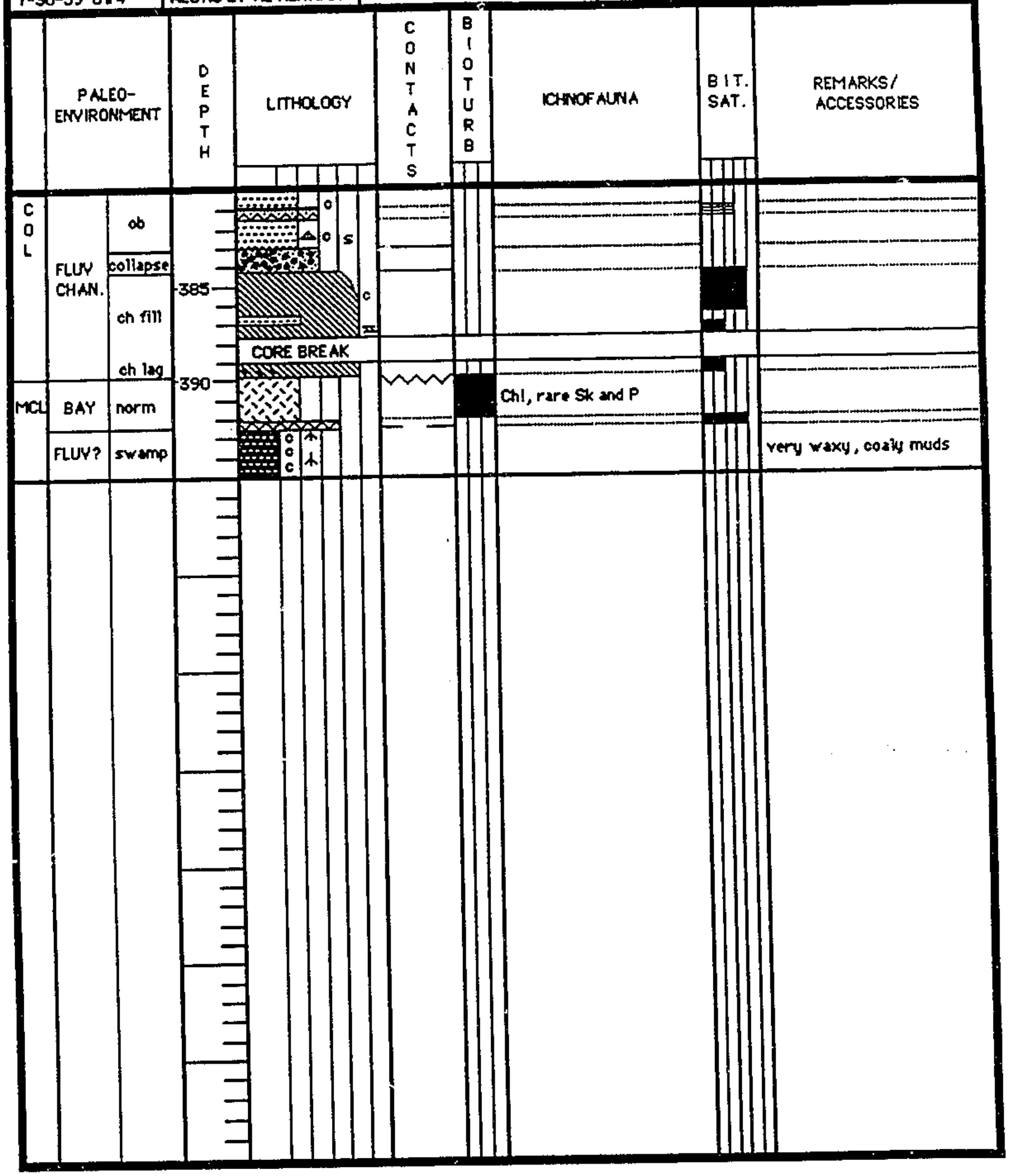
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-4-59-6W4	ALGAS ET AL KEHIWIN	INDIAN RESERVATION 123	402.5-407.5 m	615.2 m	1 OF 1



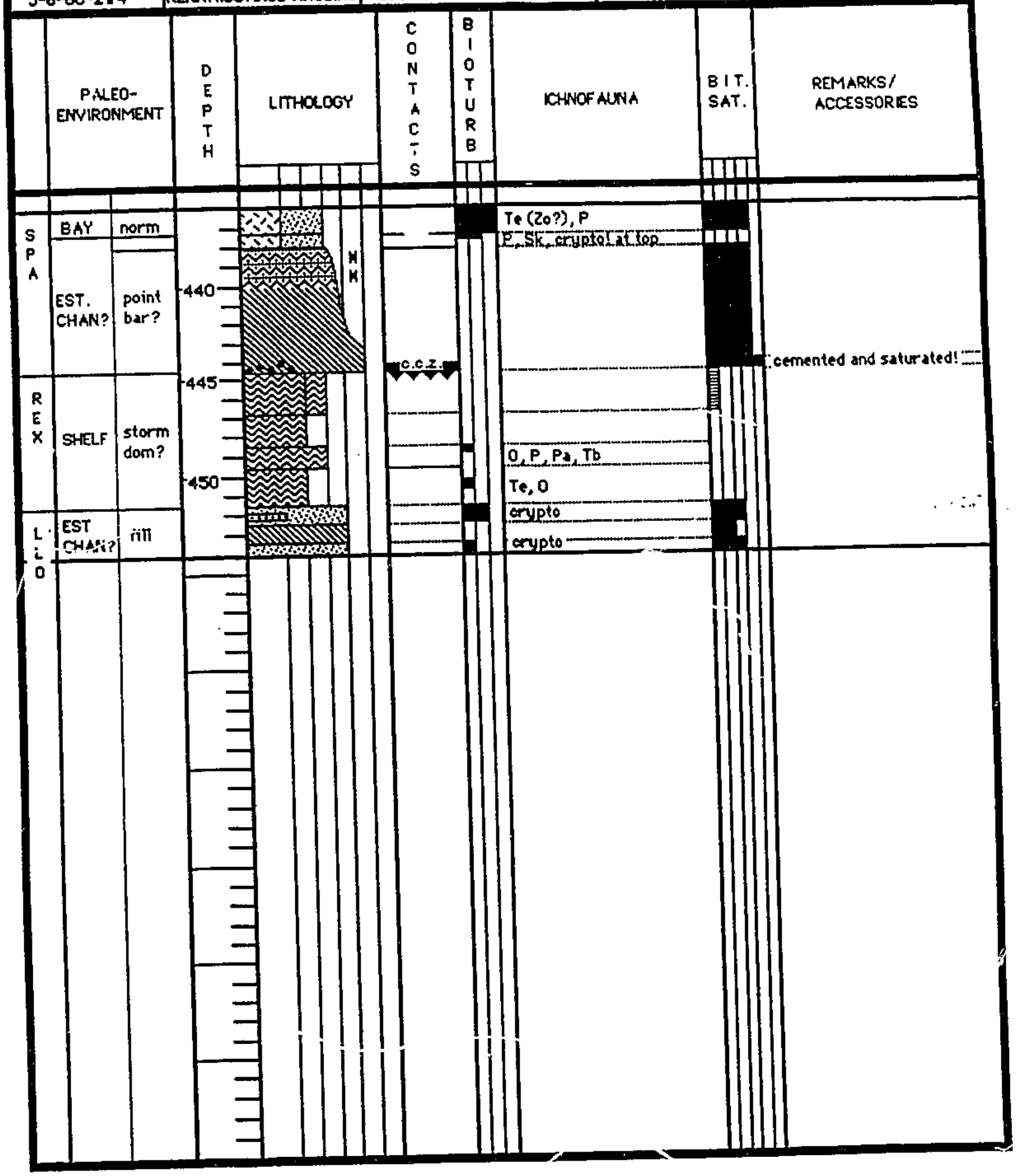
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
4-16-59-6W4	NOVALTA KEHIWIN	INDIAN RESERVATION 123	355.0-396.5 m	579.5 m	1 OF 1



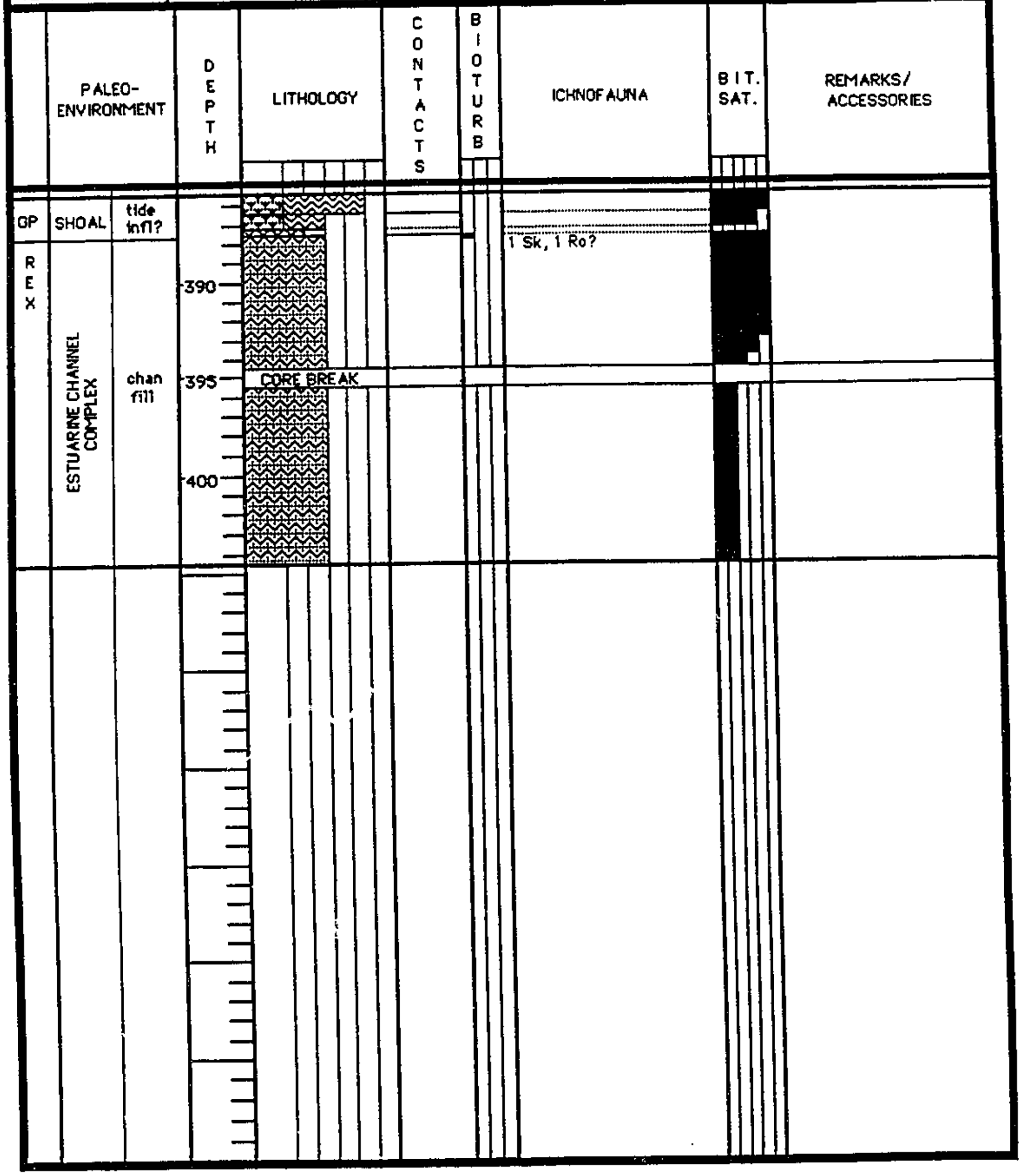
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-30-59-6W4	ALGAS ET AL KEHIWIN	INDIAN RESERVATION 123	380.0-394.8 m	604.5 m	1 OF 1



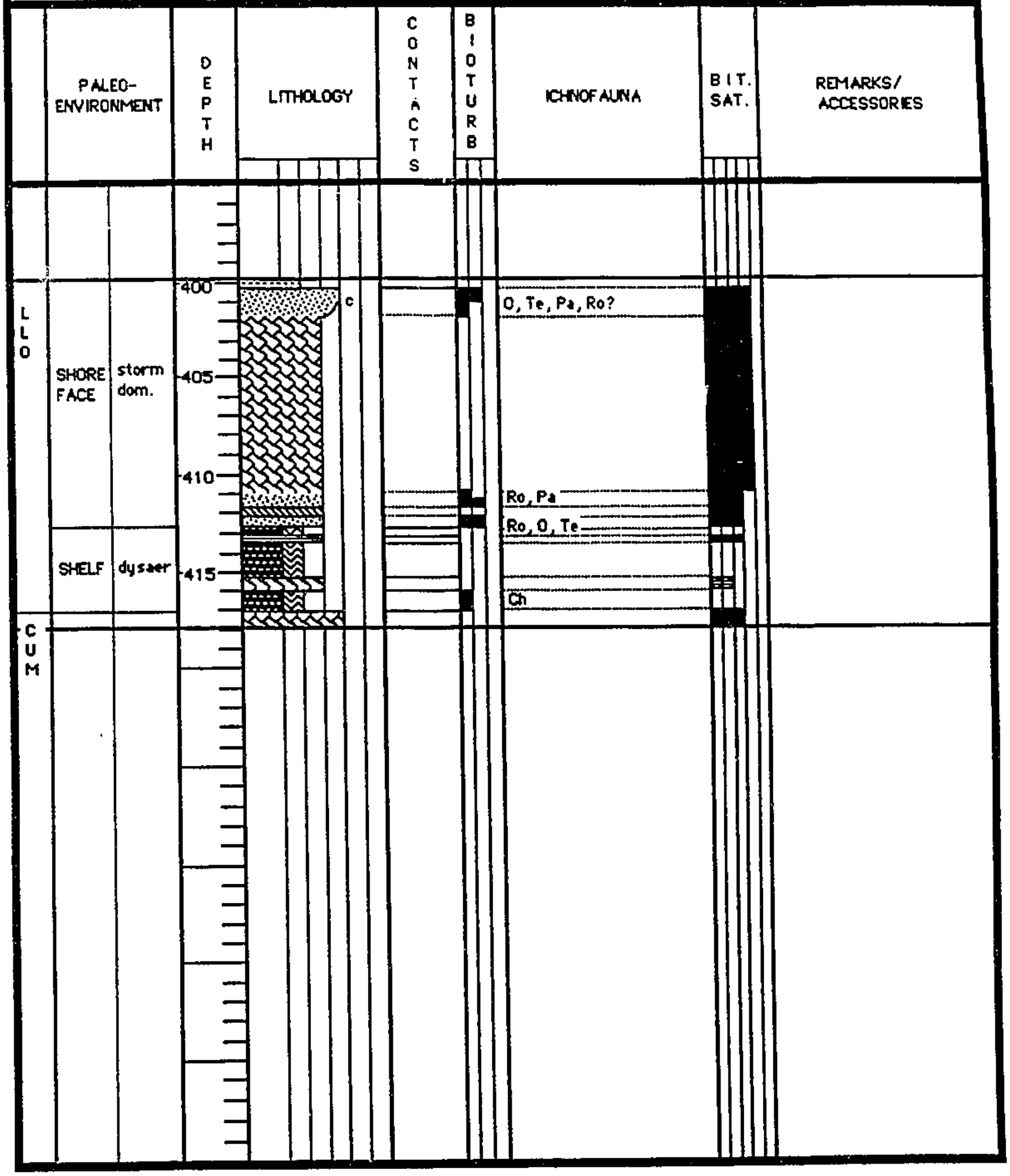
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-8-60-2W4	RENNAISSANCE ANGLING	ESSO RESOURCES CANADA	436.0-454.0 m	603.15 m	1 OF 1



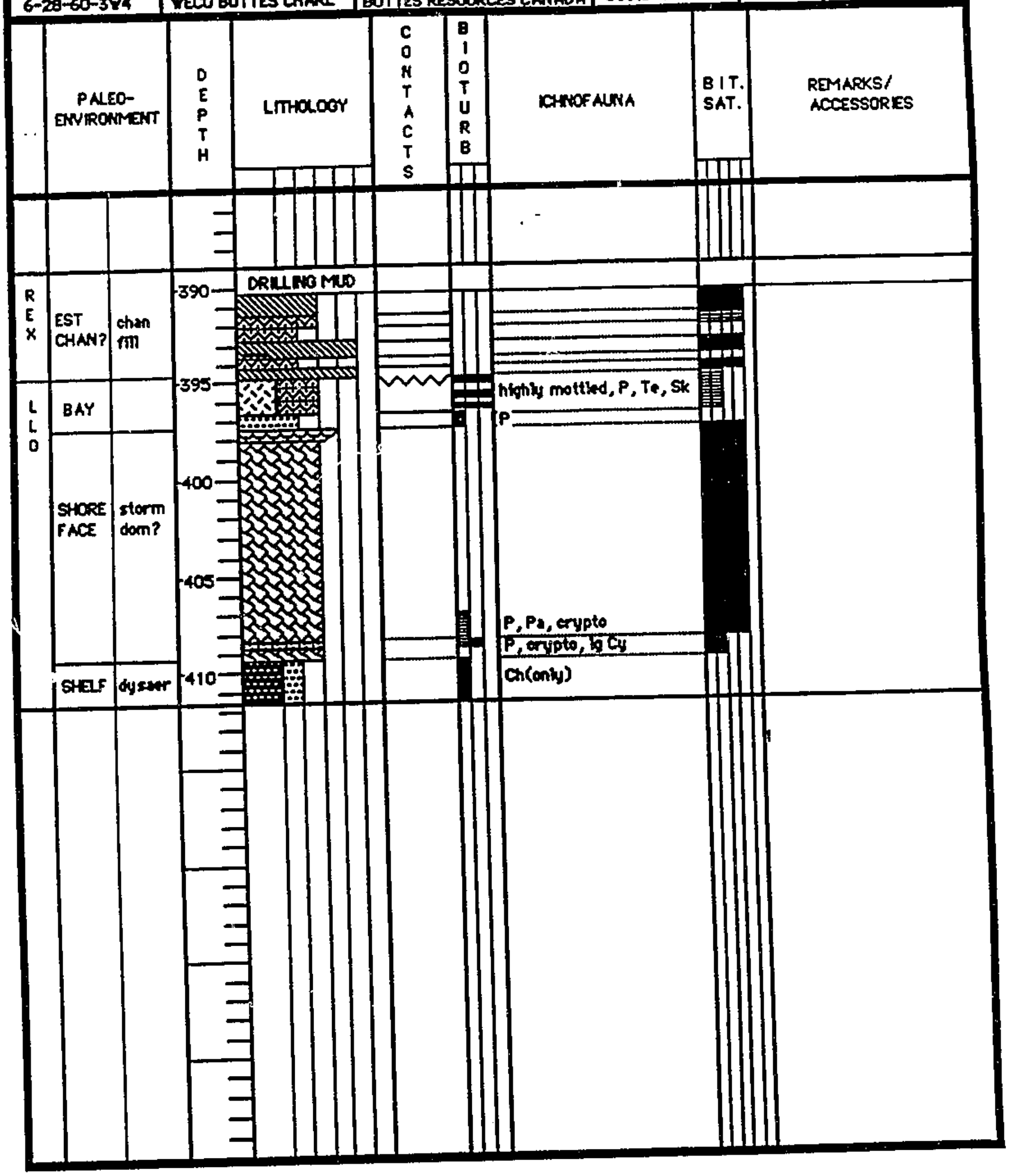
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-30-60-2W4	RENNAISSANCE ANGLING	ESSO RESOURCES CANADA	385.5-404.5 m	565.9 m	1 OF 1



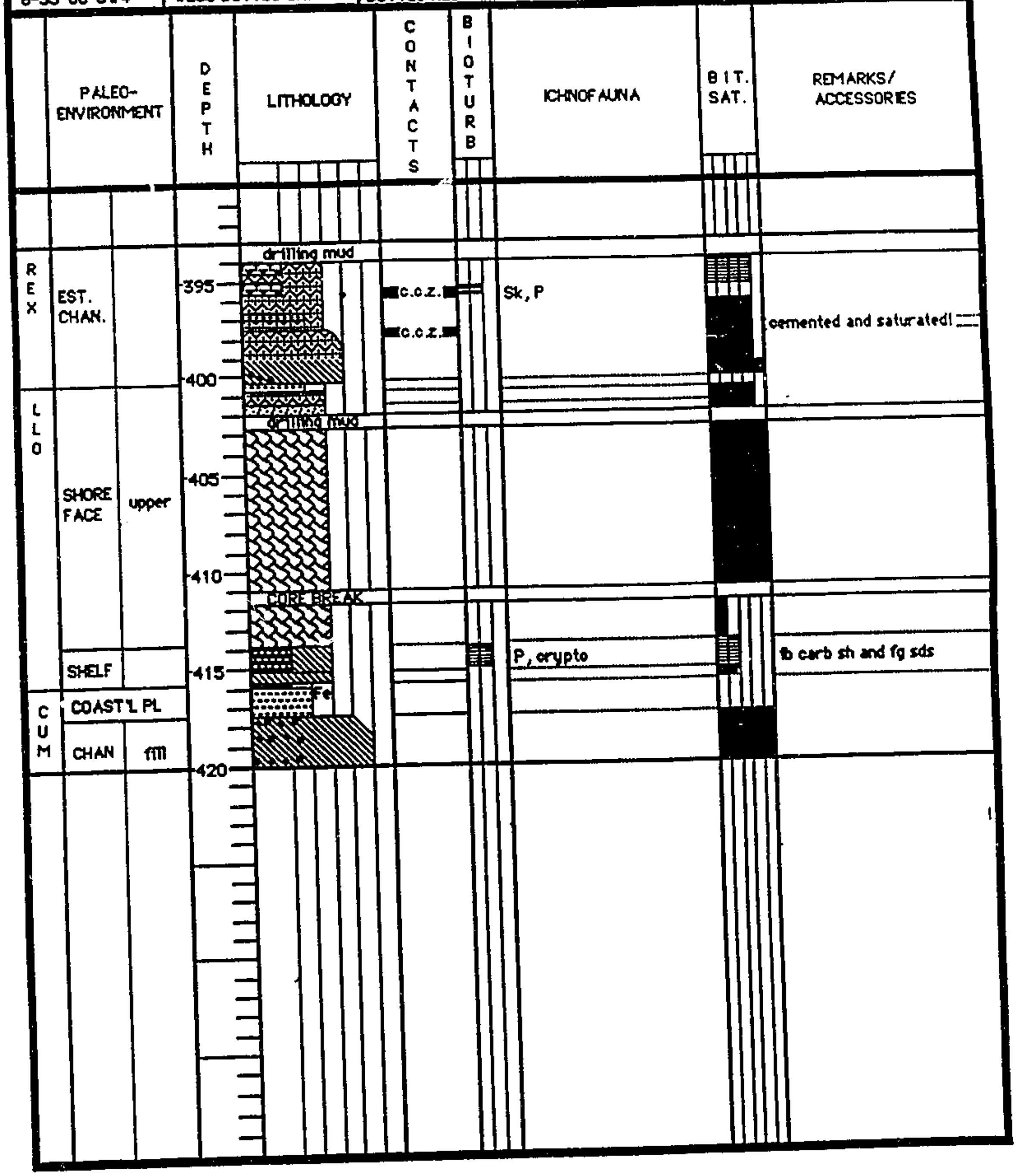
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-27-60-3W4	HUSKY CWWE BEAVERDAM EX	HUSKY OIL OPERATIONS BUTTES RESOURCES CANADA	399.9-417.9 m	569.3 m	1 OF 1



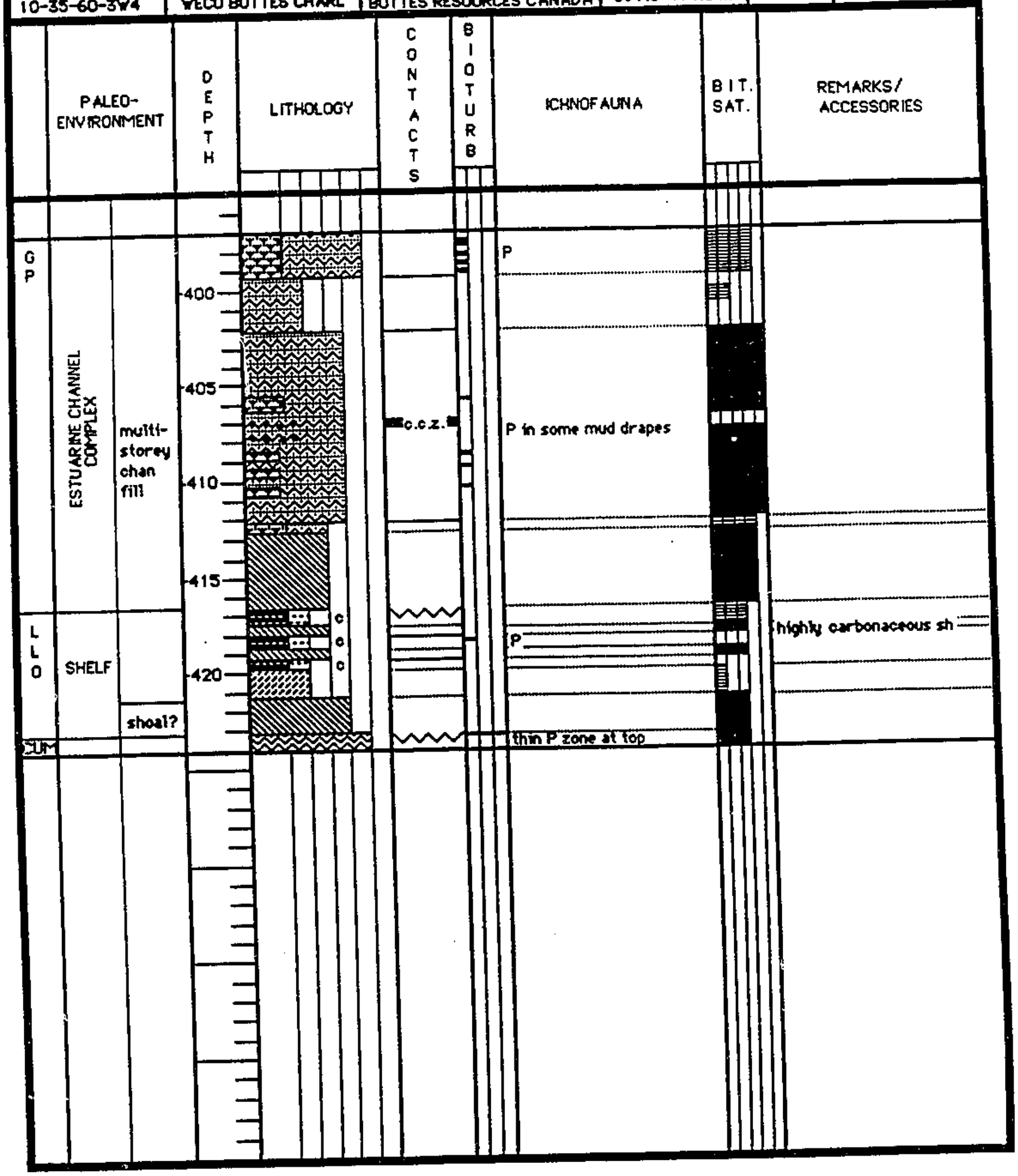
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-28-60-3W4	WECO BUTTES CHARL	HUSKY OIL OPERATIONS BUTTES RESOURCES CANADA	389.0-411.5 m	564.97 m	1 OF 1



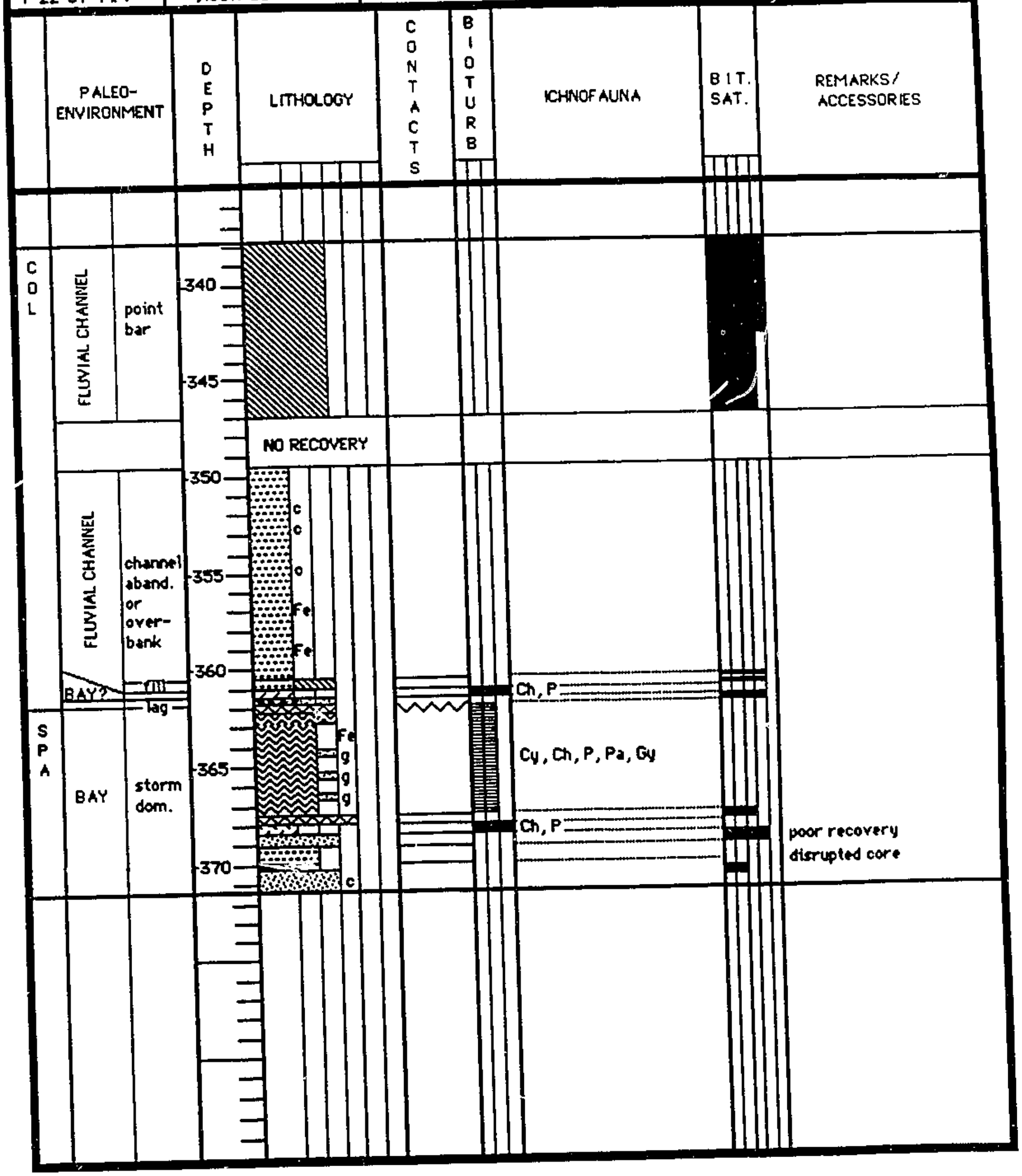
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-33-60-3W4	WECO BUTTES CHARL	HUSKY OIL OPERATIONS BUTTES RESOURCES CANADA	393.0-420.0 m	567.92 m	1 OF 1



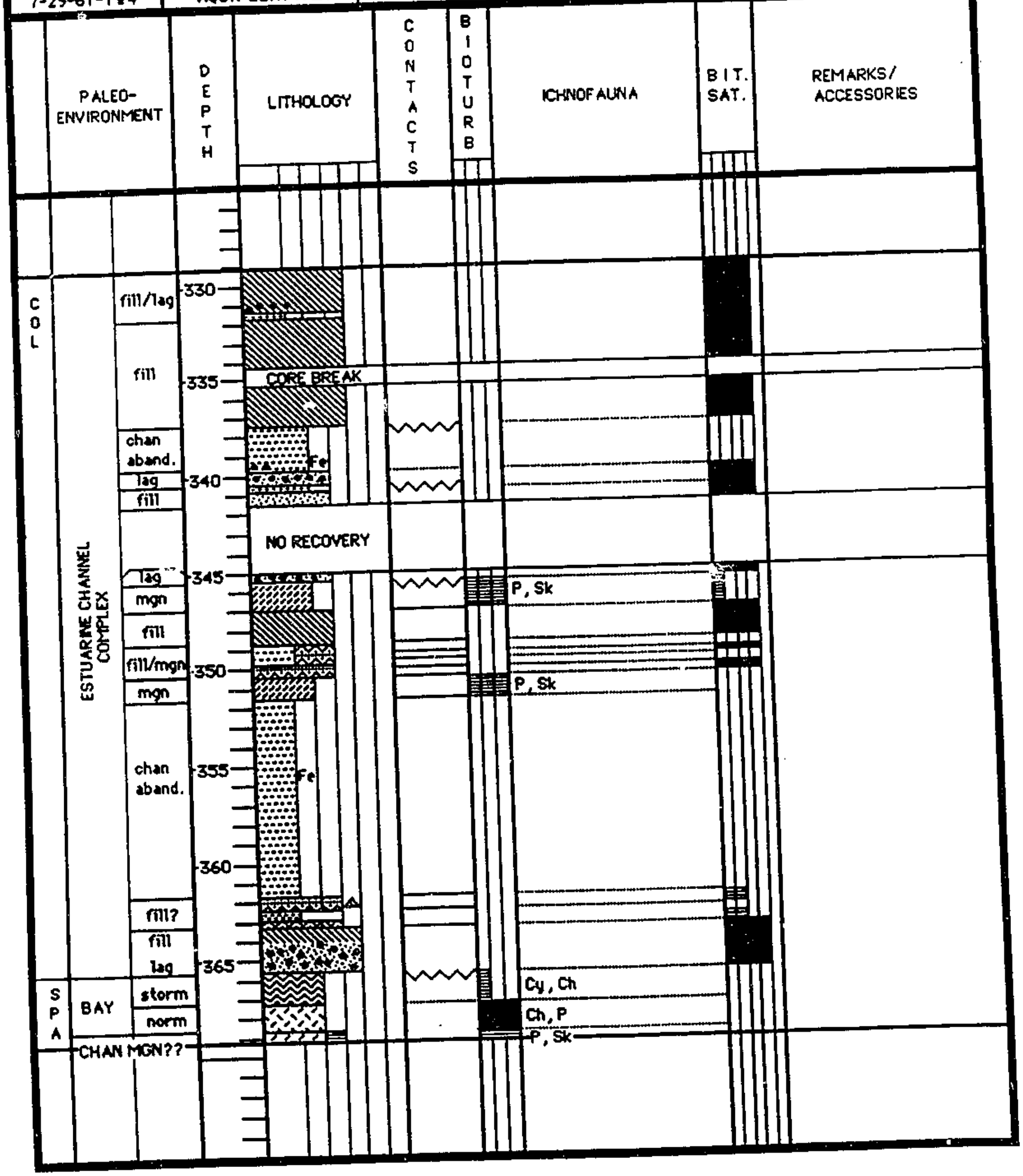
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-35-60-3W4	WECO BUTTES CHARL	HUSKY OIL OPERATIONS BUTTES RESOURCES CANADA	397.0-414.0 m	572.5 m	1 OF 1



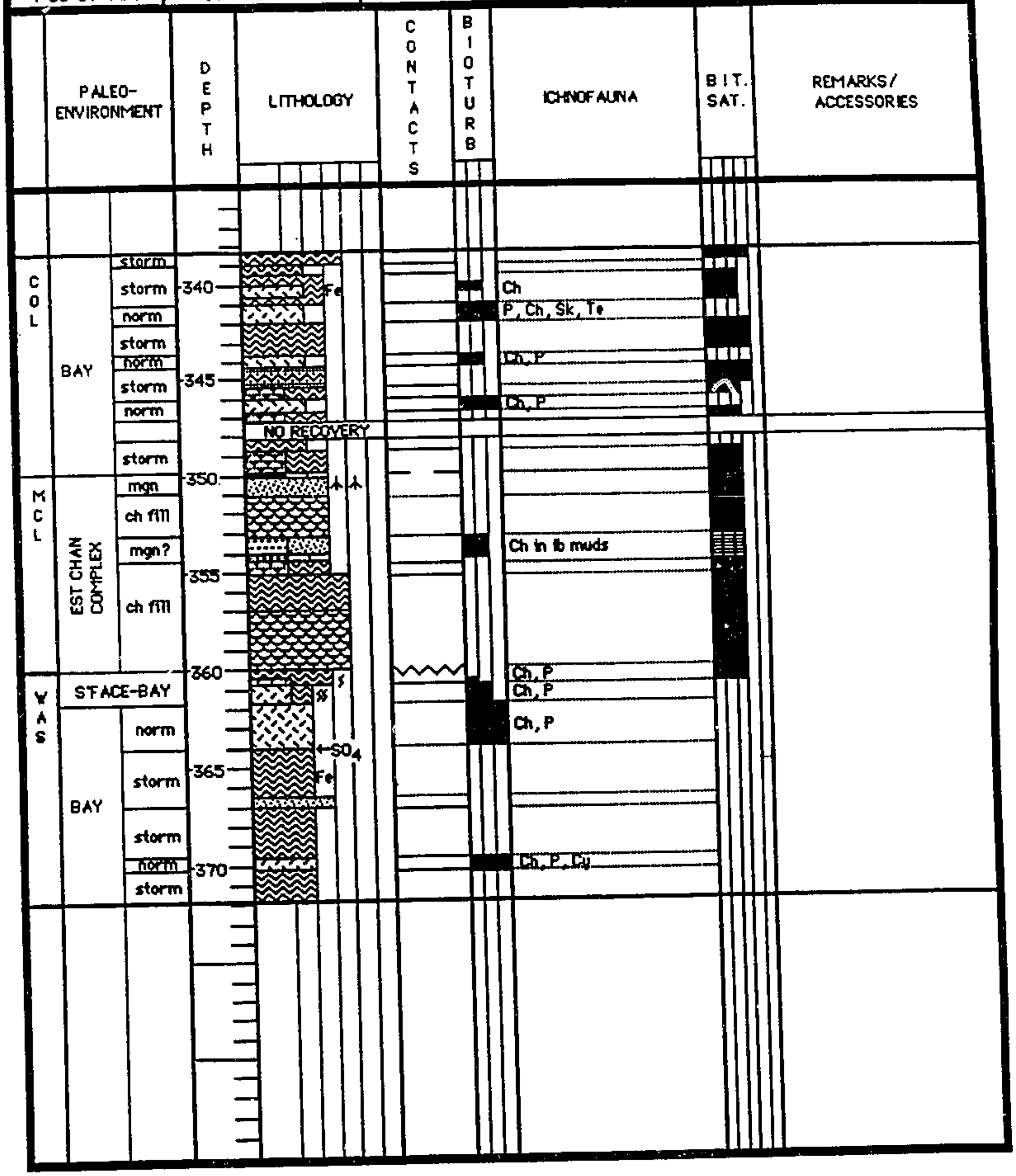
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-22-61-1W4	AOUIT BEAV X EV	CANTERRA ENERGY LTD.	332.84-366.97 m	550.75 m	1 OF 1



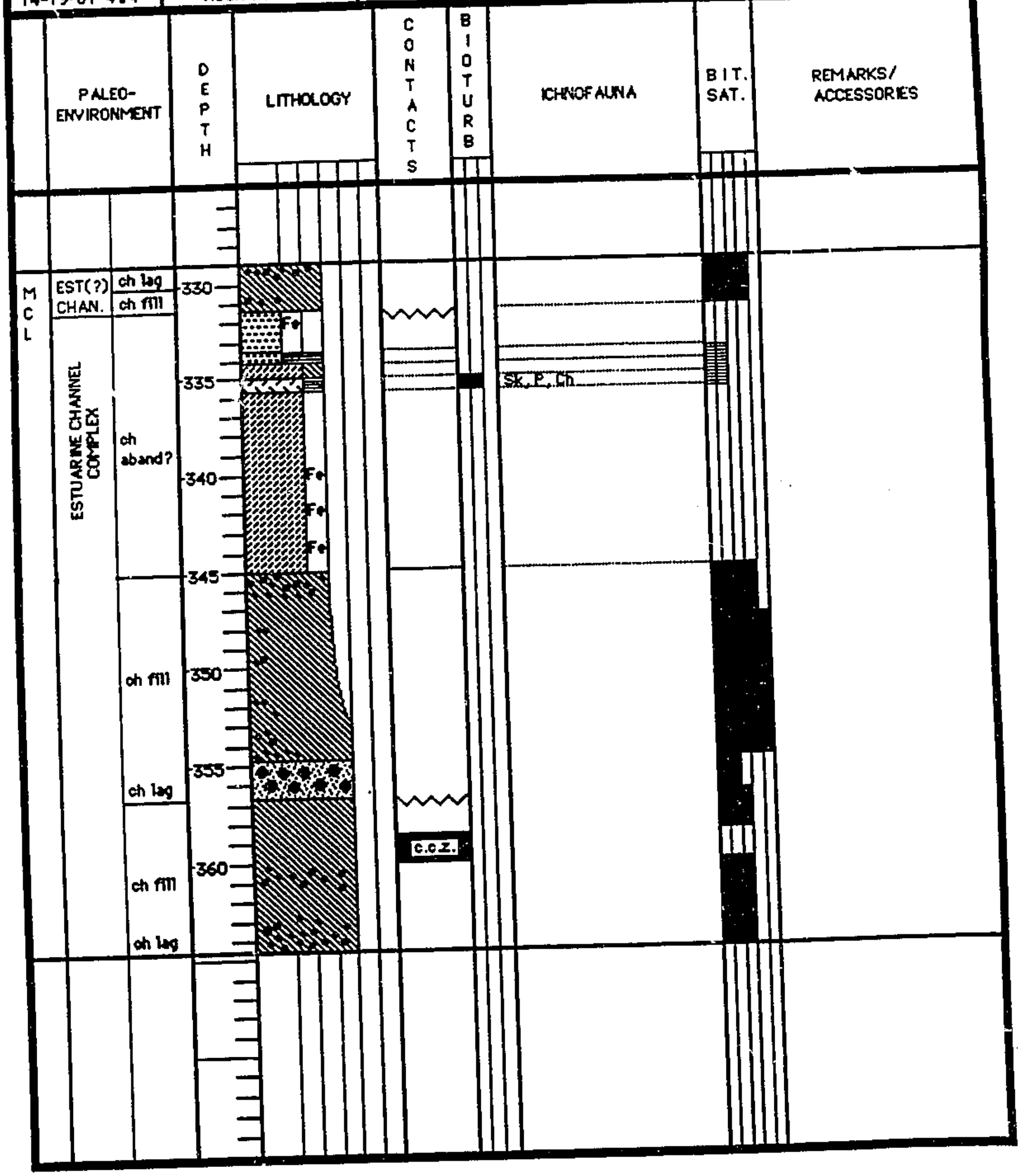
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-29-61-1W4	AQUIT BEAV X EX	CANTERRA ENERGY LTD.	329.18-369.11 m	539.9 m	1 OF 1



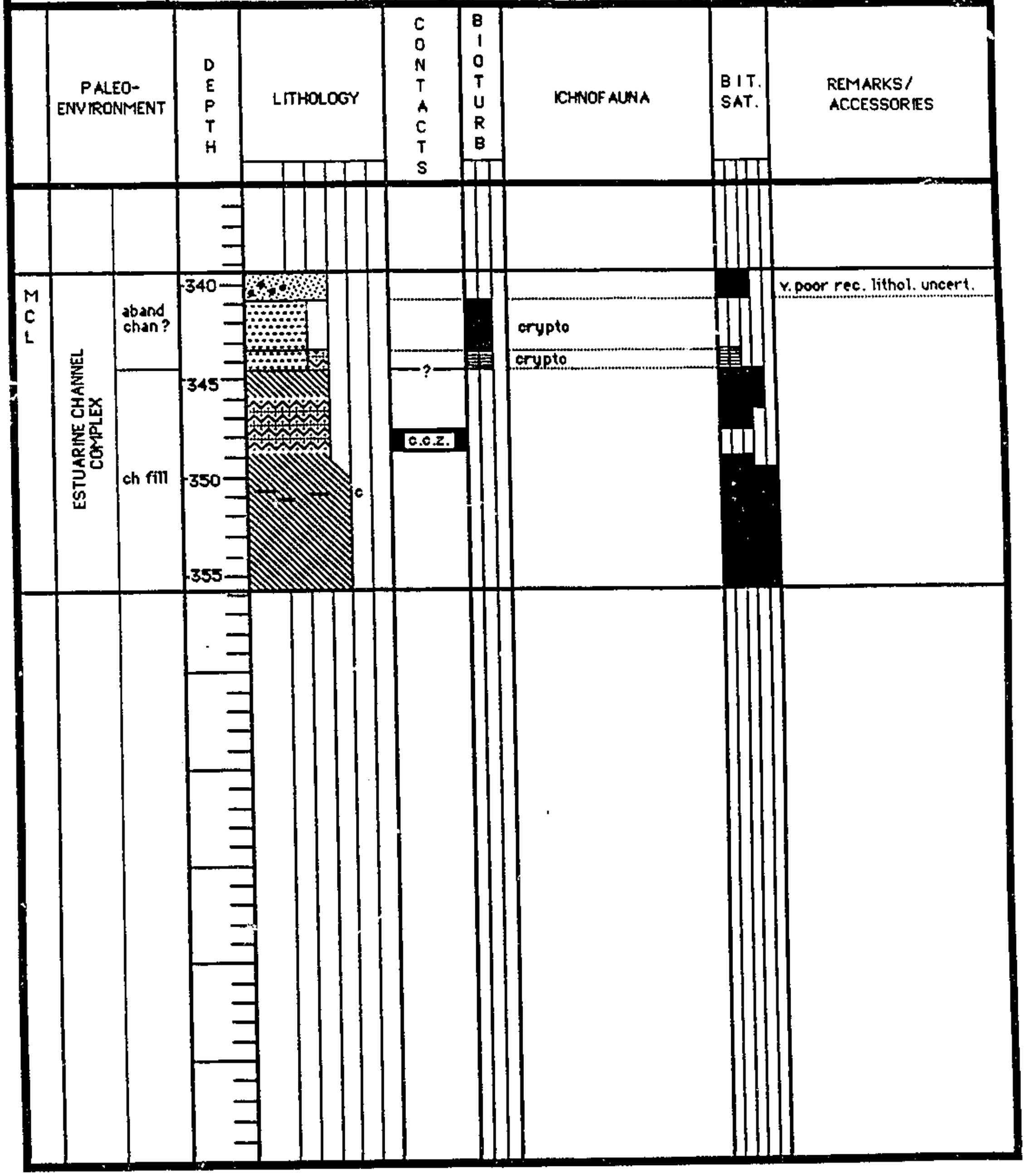
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
4-35-61-1W4	AQUIT BEAV X EV	CANTERRA ENERGY LTD.	338.32-371.85 m	561.7 m	1 OF 1



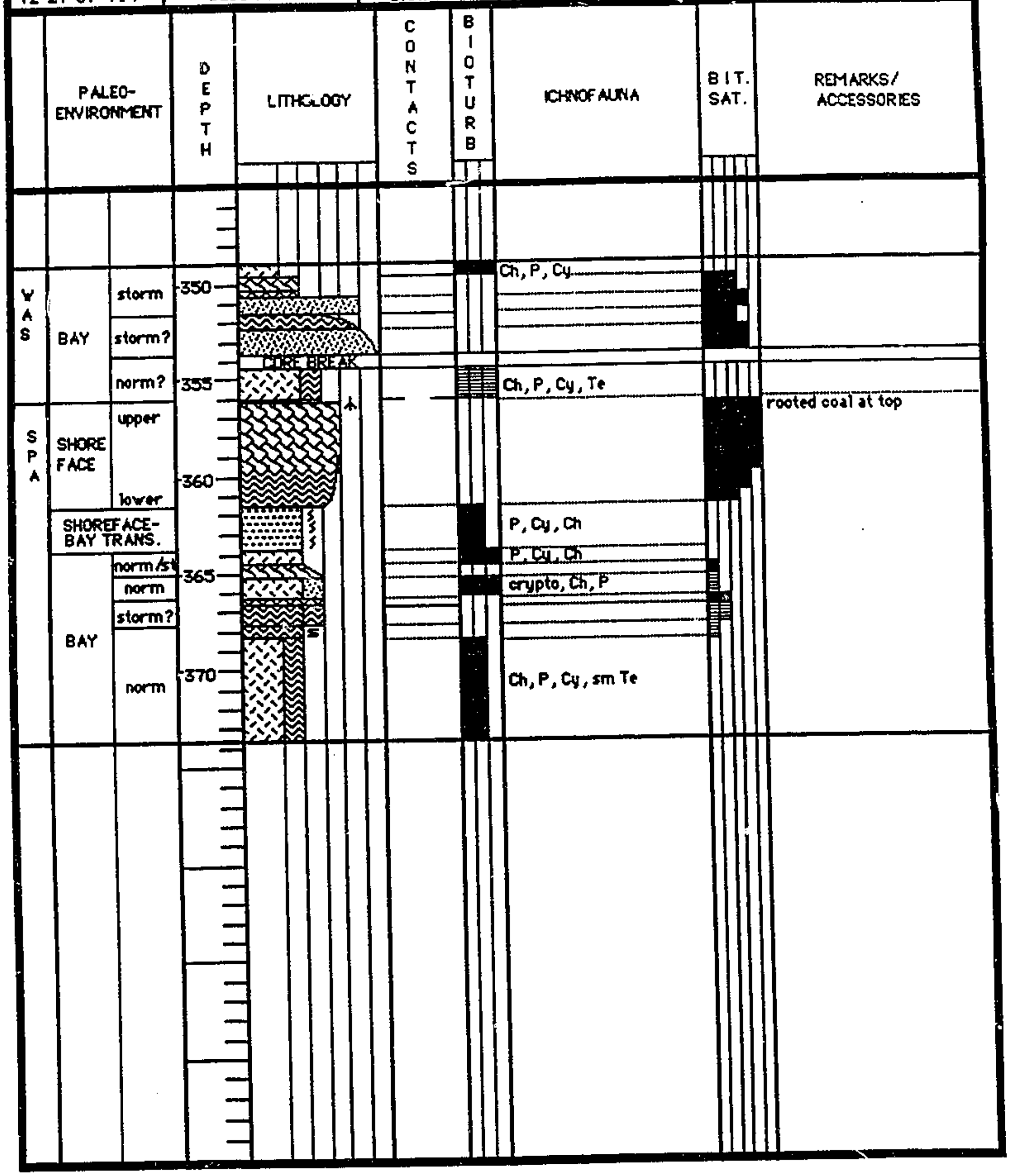
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-19-61-4W4	KOCH FT. KENT	SUNCOR INC. CAN. WORLDWIDE ENERGY	329.0-364.5 m	556.6 m	1 OF 1



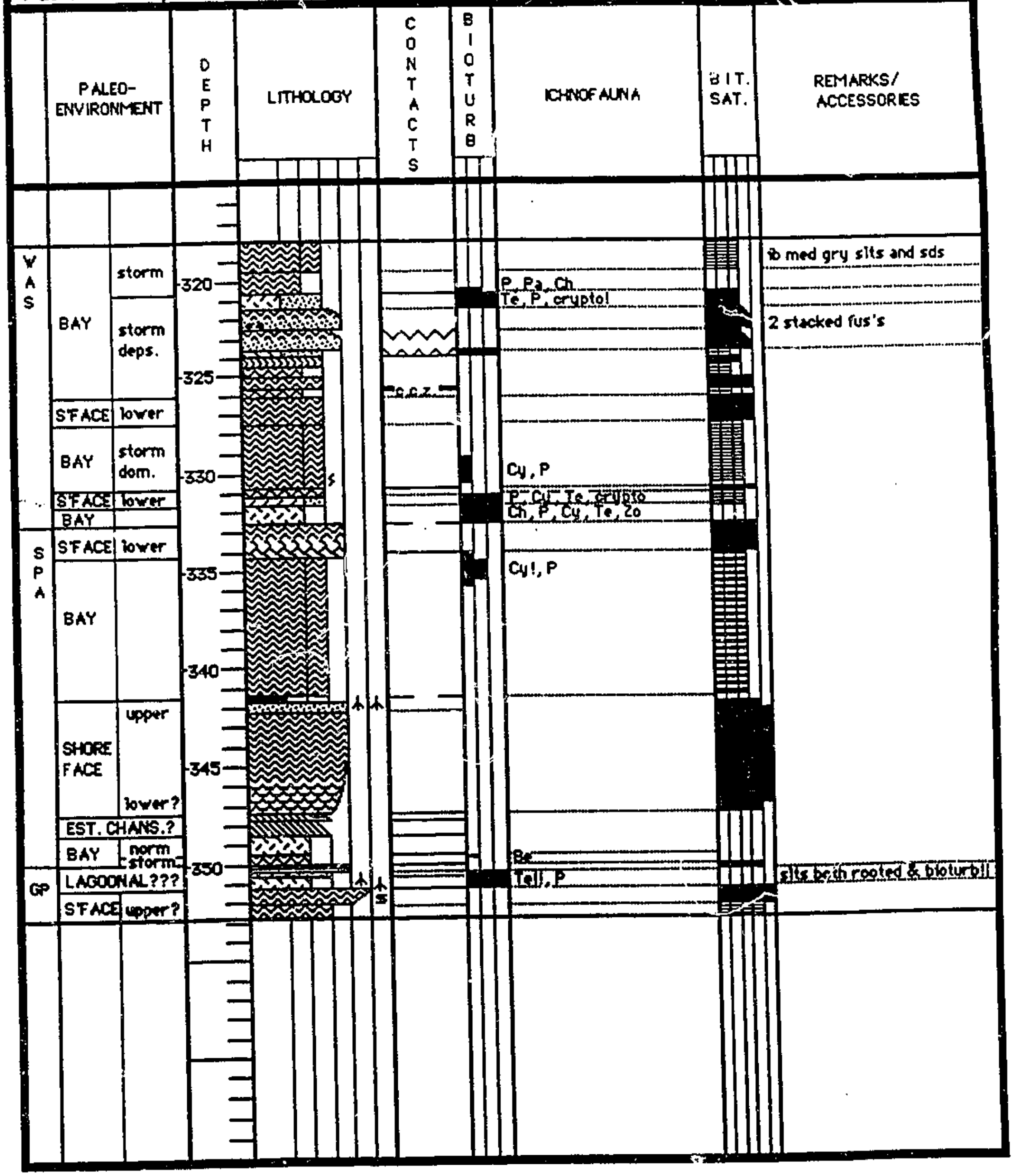
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-20-61-4W4	WECO FT. KENT	SUNCOR INC. CAN. WORLDWIDE ENERGY	339.36-352.65 m	560.2 m	1 OF 1

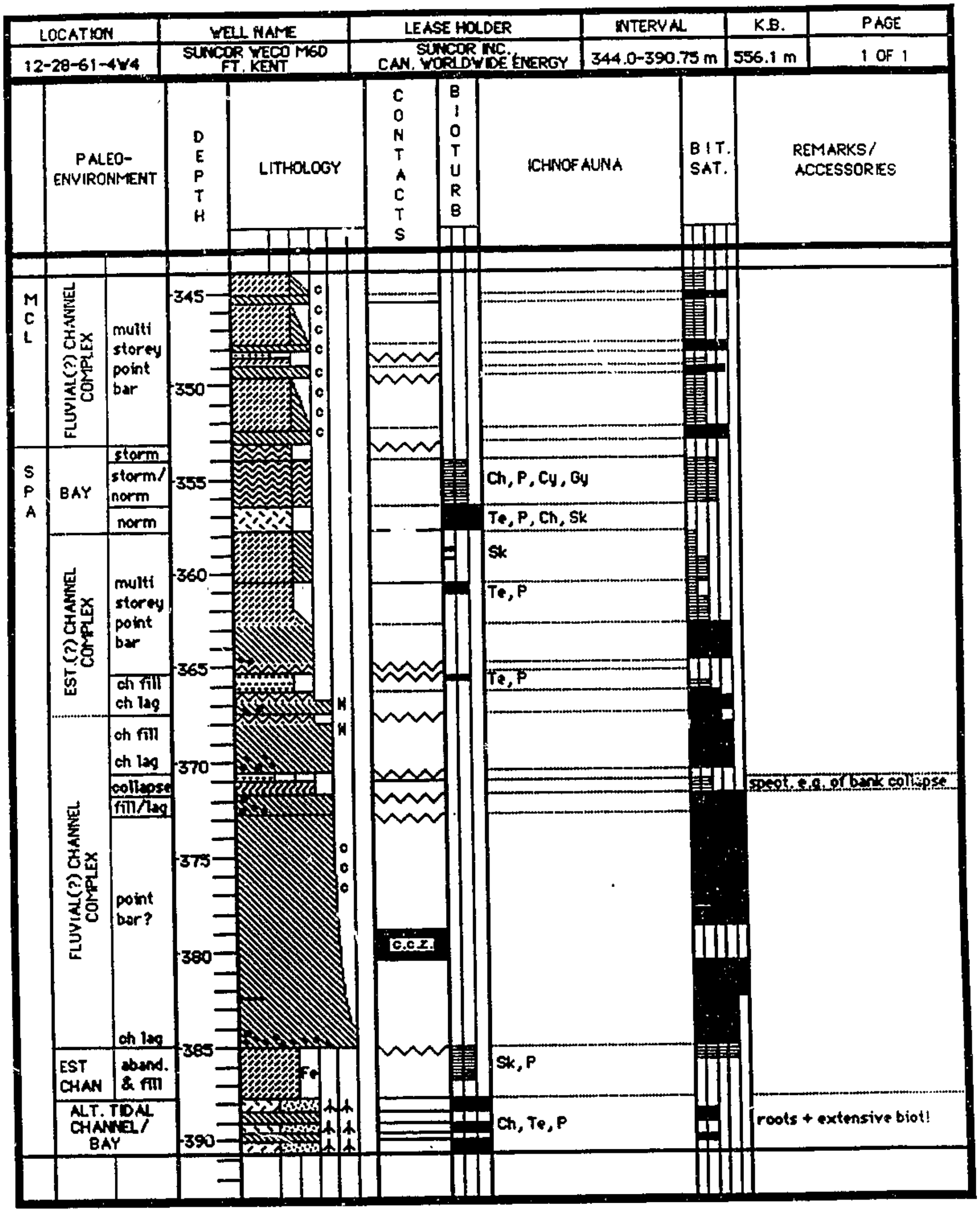


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-21-61-4W4	WECO FT. KENT	SUNCOR INC. CAN. WORLDWIDE ENERGY	349.0-373.5 m	565.7 m	1 OF 1

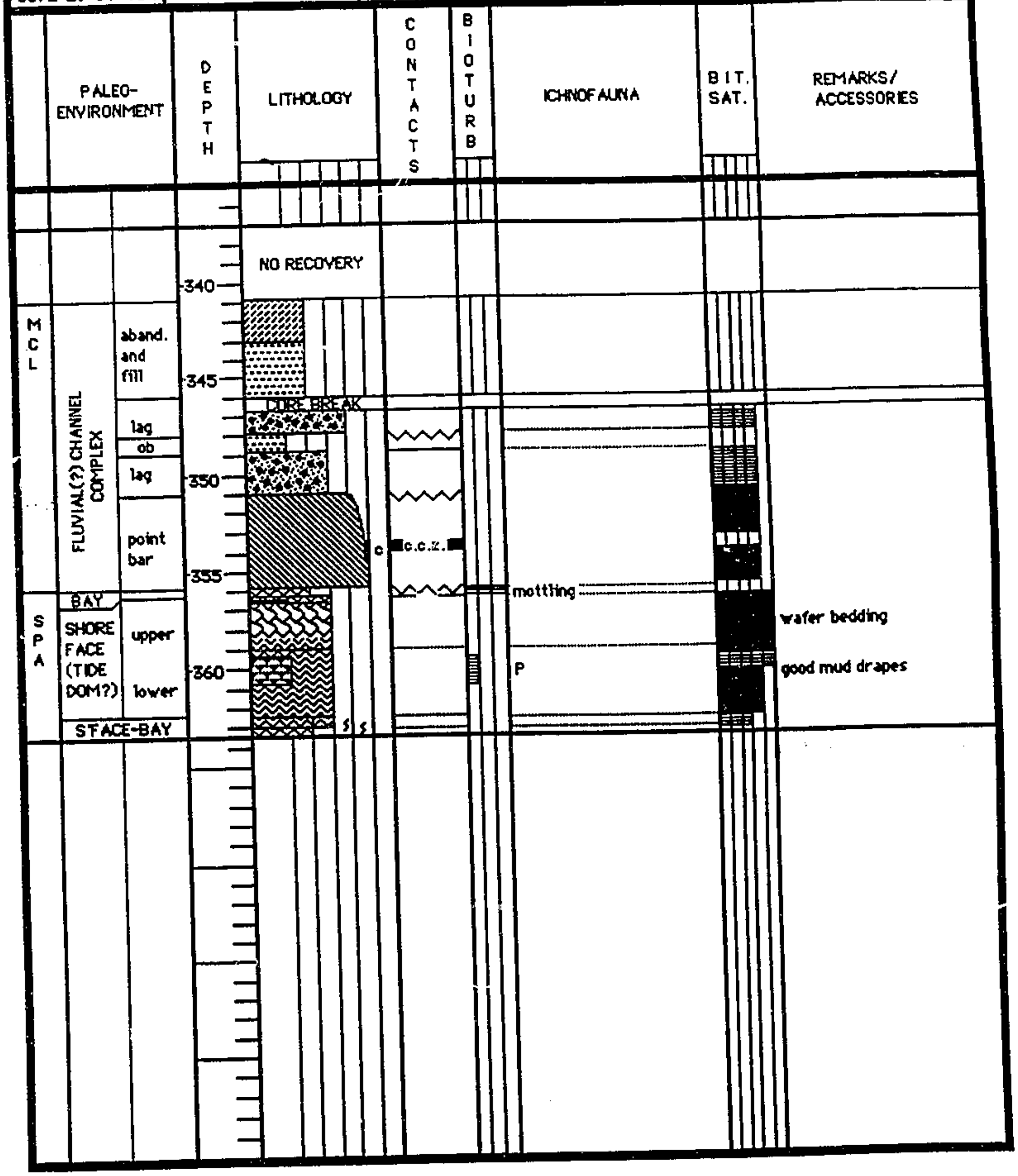


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-25-61-4W4	KOCH FT. KENT	KOCH EXPLORATION CANADA	318.0-354.0 m	547.4 m	1 OF 1

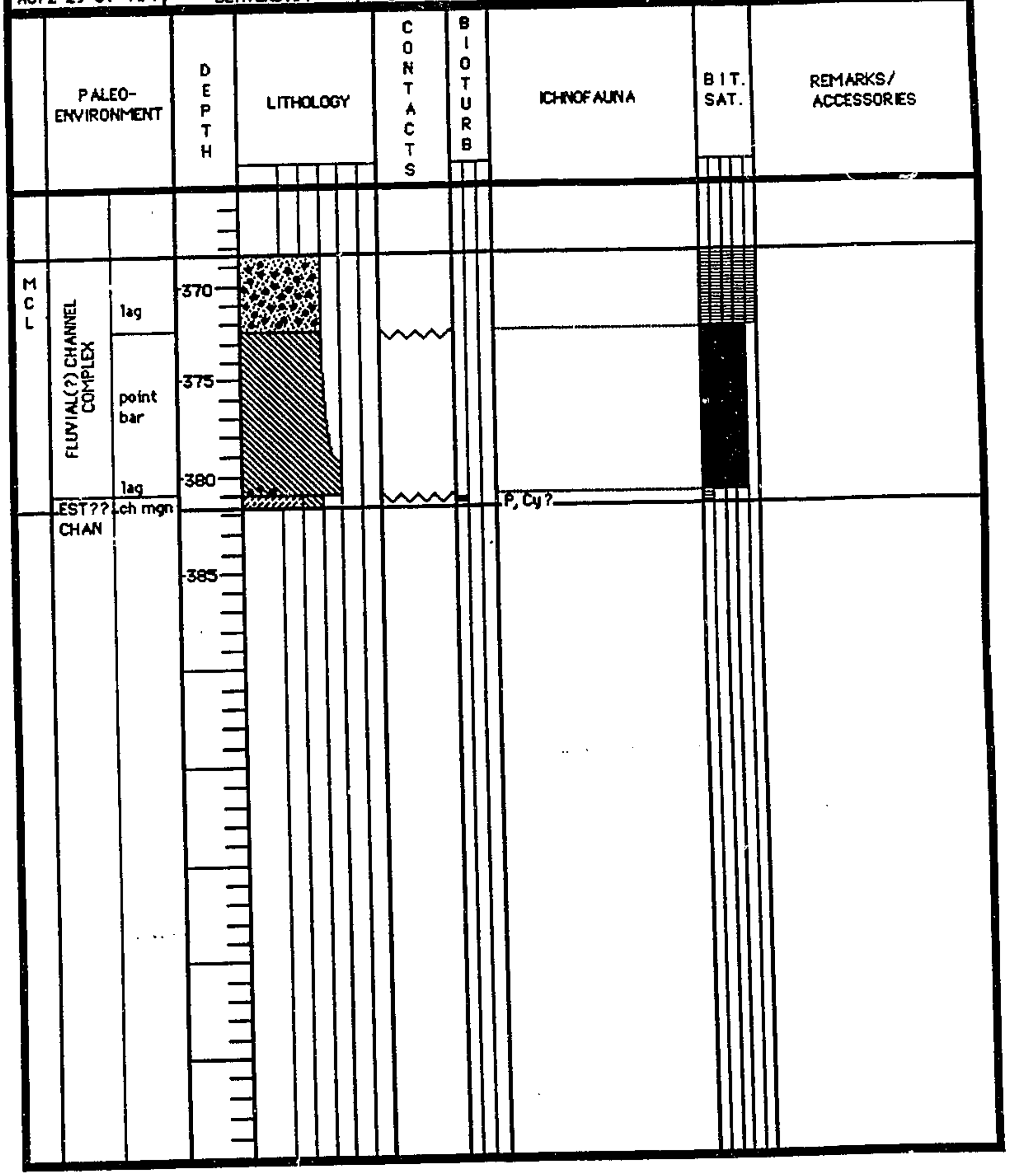



LOCATION
12-28-61-4W4
WELL NAME
SUNCOR WECO M60 FT. KENT
LEASE HOLDER
SUNCOR INC. CAN. WORLDWIDE ENERGY
INTERVAL
344.0-390.75 m
K.B.
556.1 m
PAGE
1 OF 1
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
MCL
FLUVIAL(?) CHANNEL COMPLEX
multi storey point bar
SPA
storm
BAY
storm/ norm
norm
EST.(?) CHANNEL COMPLEX
multi storey point bar
ch fill
ch lag
ch fill
ch lag
collapse
fill/lag
FLUVIAL(?) CHANNEL COMPLEX
point bar?
ch lag
EST CHAN
aband. & fill
ALT. TIDAL CHANNEL/ BAY
345
350
355
360
365
370
375
380
385
390
c
c
c
c
c
c
c
c
Fe
c.c.z.
Ch, P, Cy, Gy
Te, P, Ch, Sk
Sk
Te, P
Te, P
Sk, P
Ch, Te, P
spect. e.g. of bank collapse
roots + extensive biot!

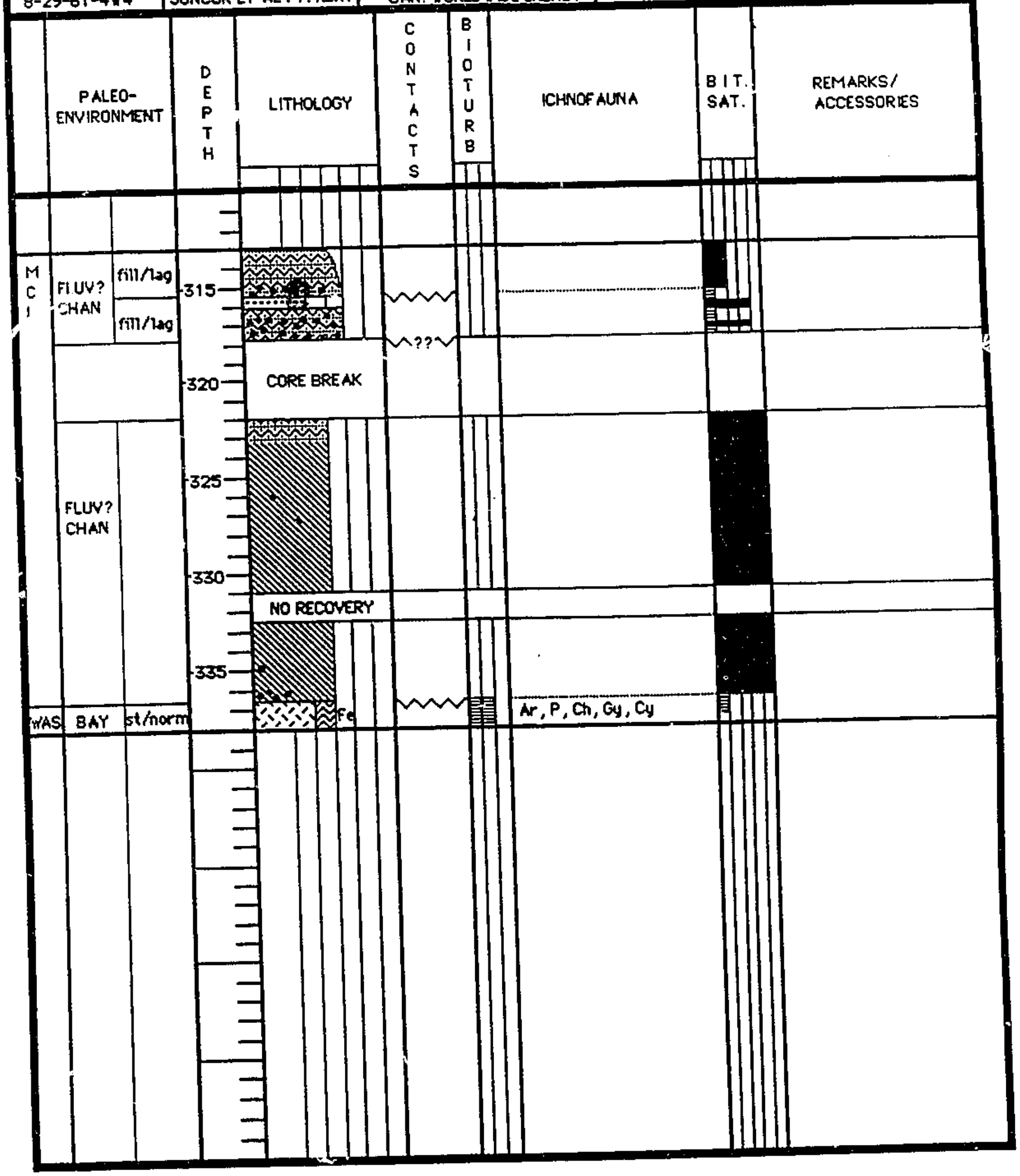
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
00/2-29-61-4W4	WECO FT. KENT	SUNCOR INC. CAN. WORLDWIDE ENERGY	337.0-363.5 m	562.5 m	1 OF 1



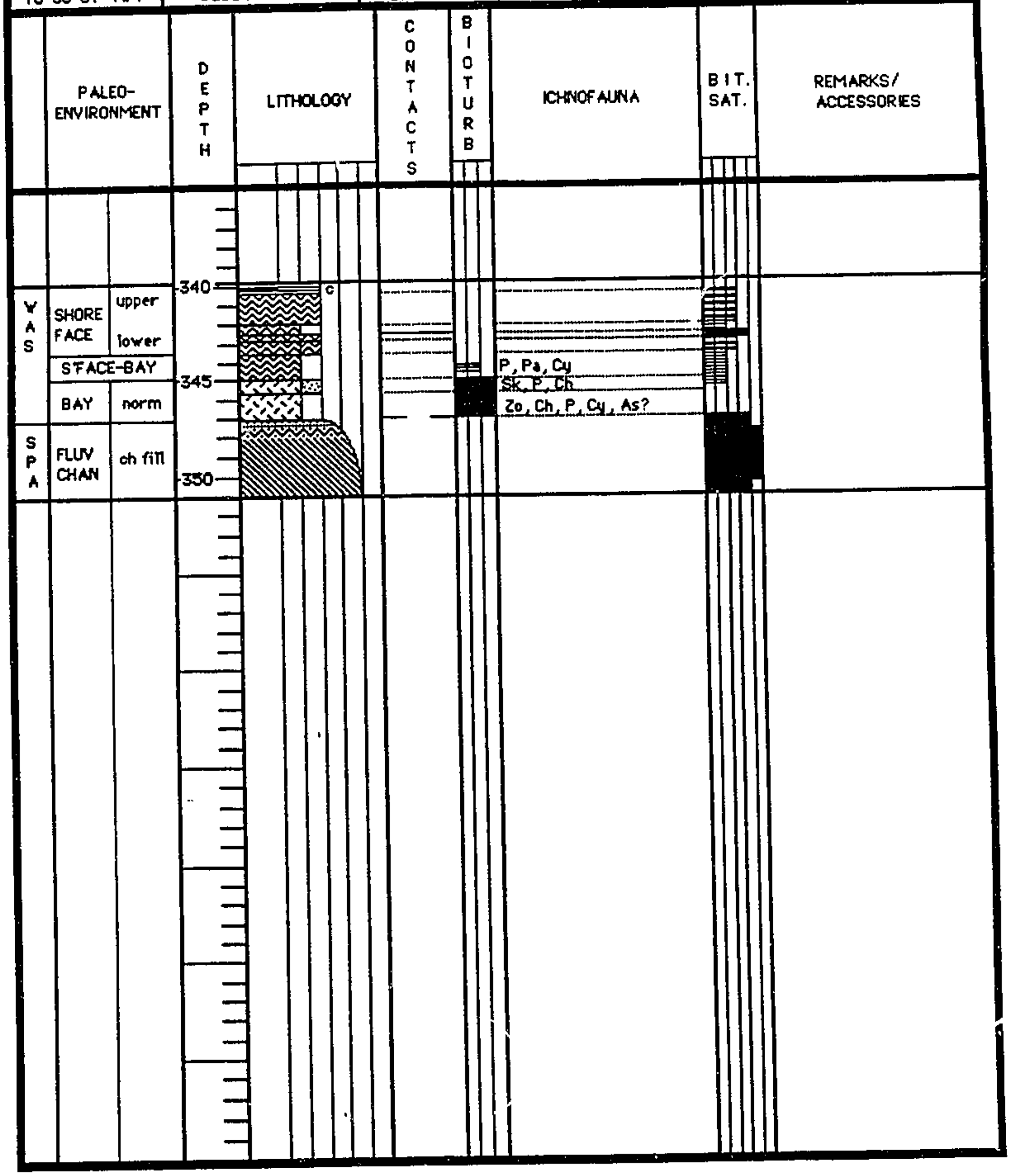
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
AC/2-29-61-4W4	SUNCOR CWWE NSD BEAVERDAM	SUNCOR INC., CAN. WORLDWIDE ENERGY	368.5-381.5 m	553.7 m	1 OF 1



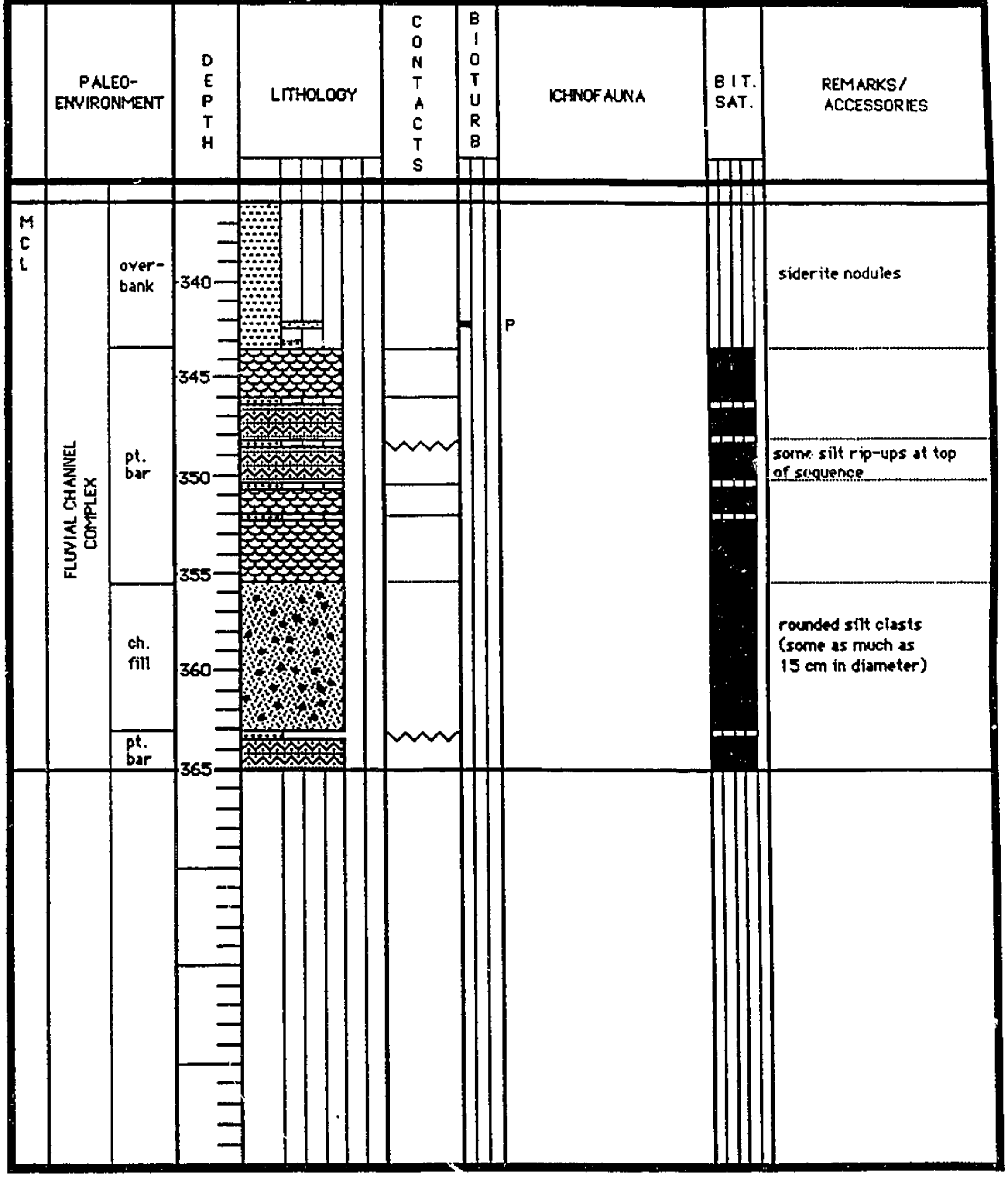
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-29-61-4W4	SUNCOR ET AL FT. KENT	SUNCOR INC. CAN. WORLDWIDE ENERGY	313.0-340.0 m	557.5 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-33-61-4W4	VECO FT. KENT	SUNCOR INC. CAN. WORLDWIDE ENERGY	339.85-351.12 m	562.94 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-9-61-5W4	SUNCOR ET AL FT. KENT	SUNCOR ET AL	336.0-365.0 m	554.9 m	1 OF 1

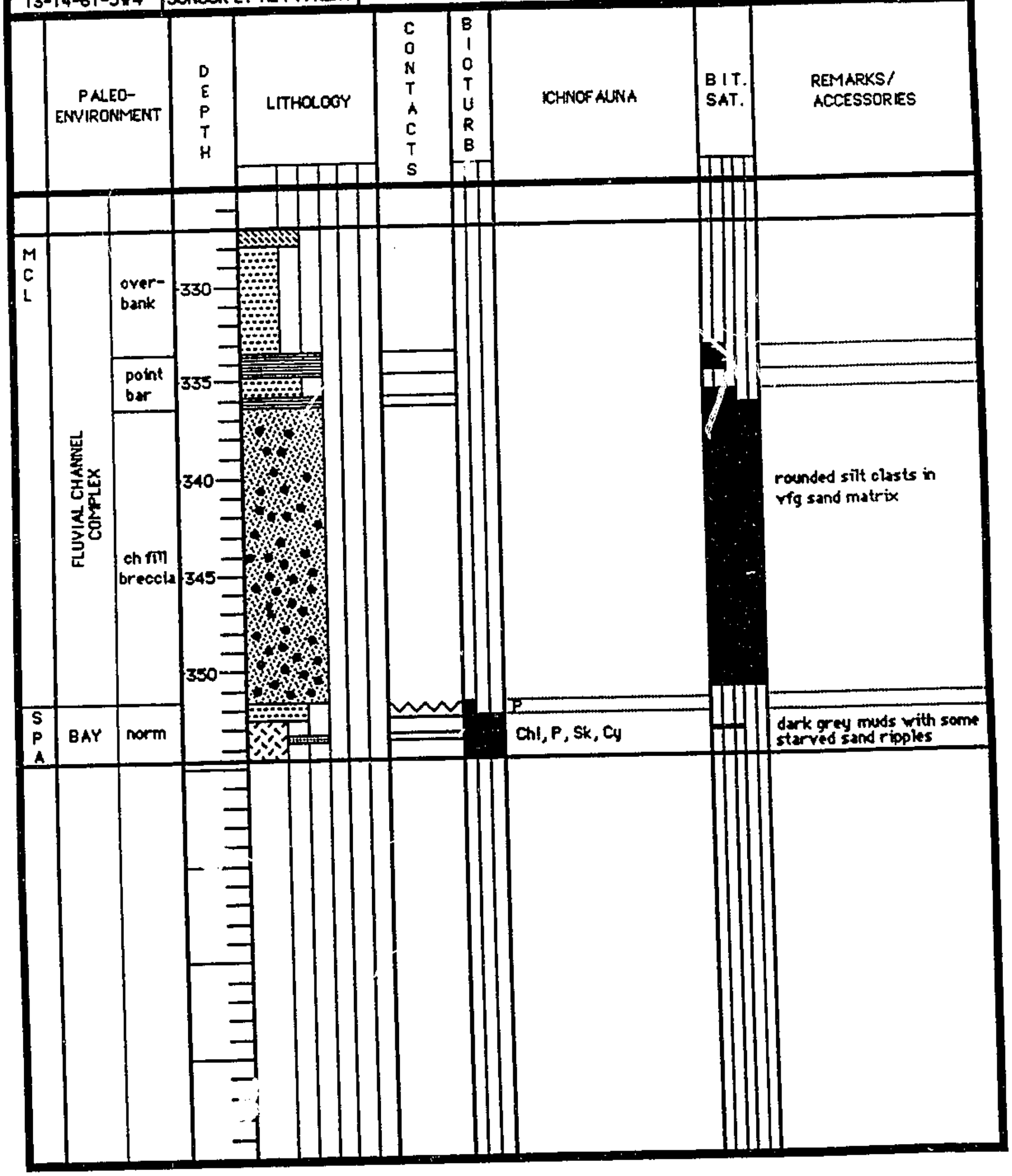


siderite nodules

some silt rip-ups at top of sequence

rounded silt clasts (some as much as 15 cm in diameter)

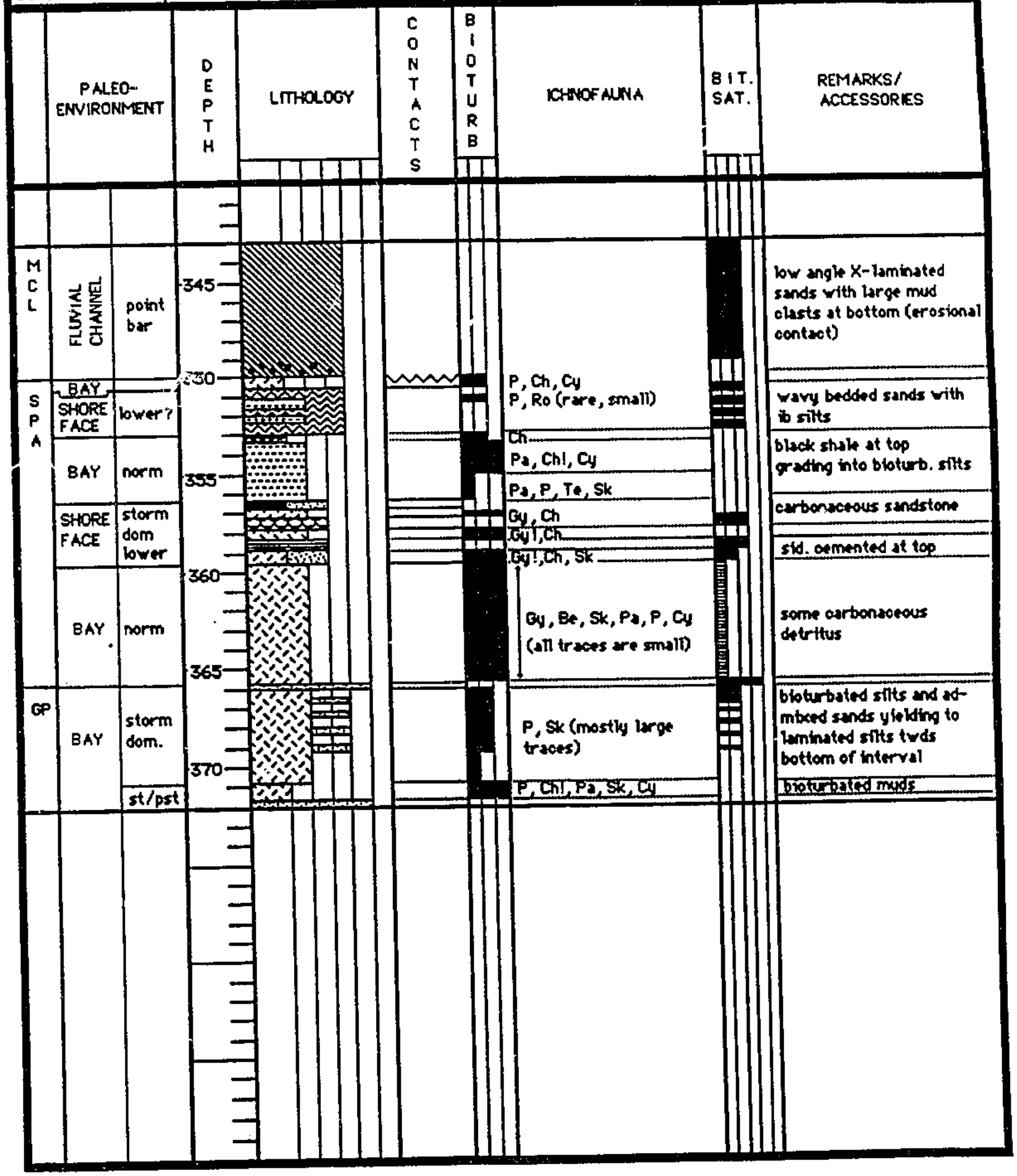
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-14-61-5W4	SUNCOR ET AL FT. KENT	AMOCO CANADA PETROLEUM	327.0-354.5 m	555.3 m	1 OF 1



rounded silt clasts in vfg sand matrix

dark grey muds with some starved sand ripples

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
00-3-15-61-5W4	SUNCOR ET AL FT. KENT	AMOCO CANADA PETROLEUM	343.0-372.0 m	555.0 m	1 OF 1



low angle X-laminated sands with large mud clasts at bottom (erosional contact)

wavy bedded sands with ib silts

black shale at top grading into bioturb. silts

carbonaceous sandstone

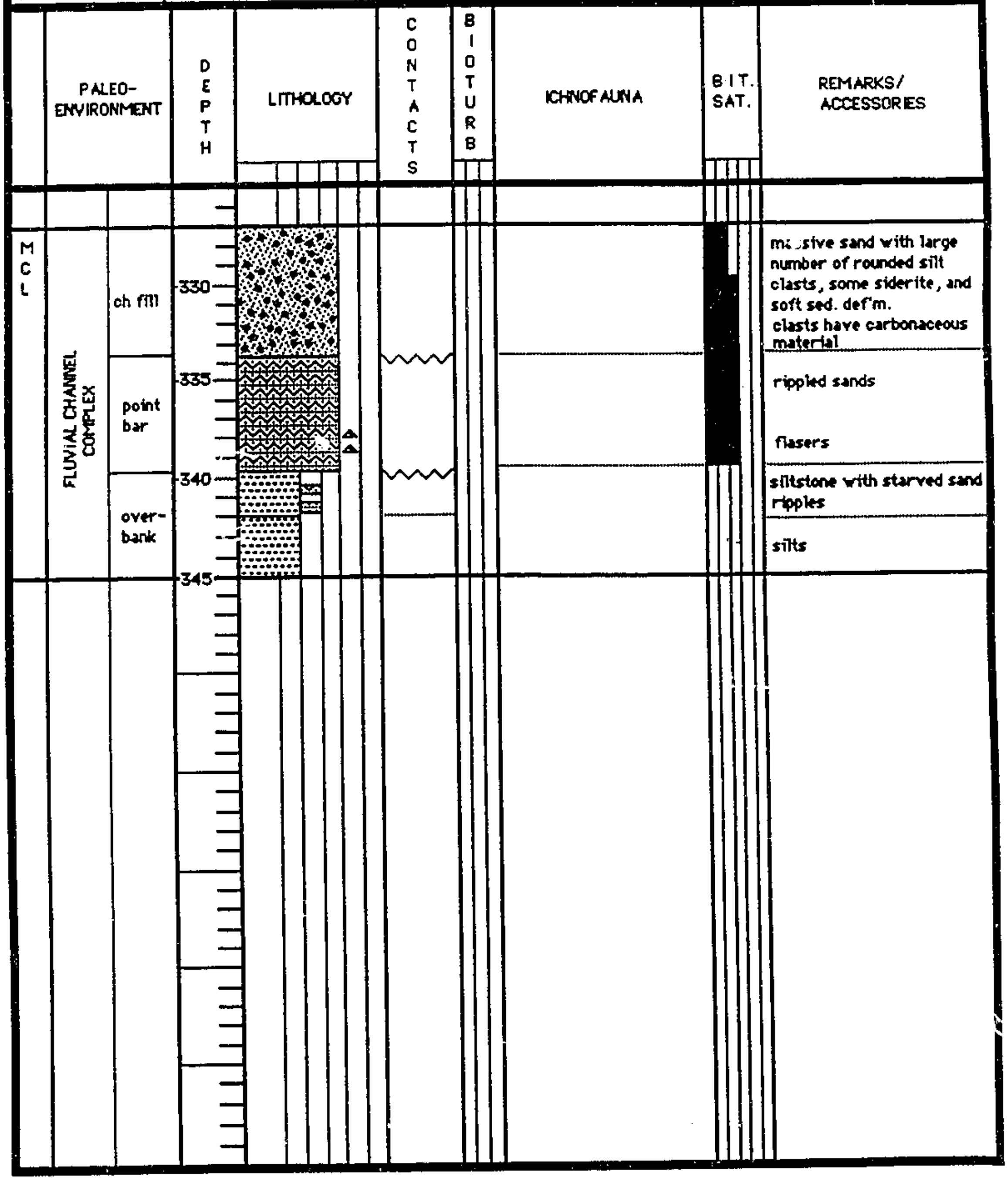
sld. cemented at top

some carbonaceous detritus

bioturbated silts and admixed sands yielding to laminated silts twds bottom of interval

bioturbated muds

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
02-3-15-61-5W4	SUNCOR ET AL FT. KENT	SUNCOR ET AL.	327.0-345.0 m	552.3 m	1 OF 1



massive sand with large number of rounded silt clasts, some siderite, and soft sed. def'm.
clasts have carbonaceous material

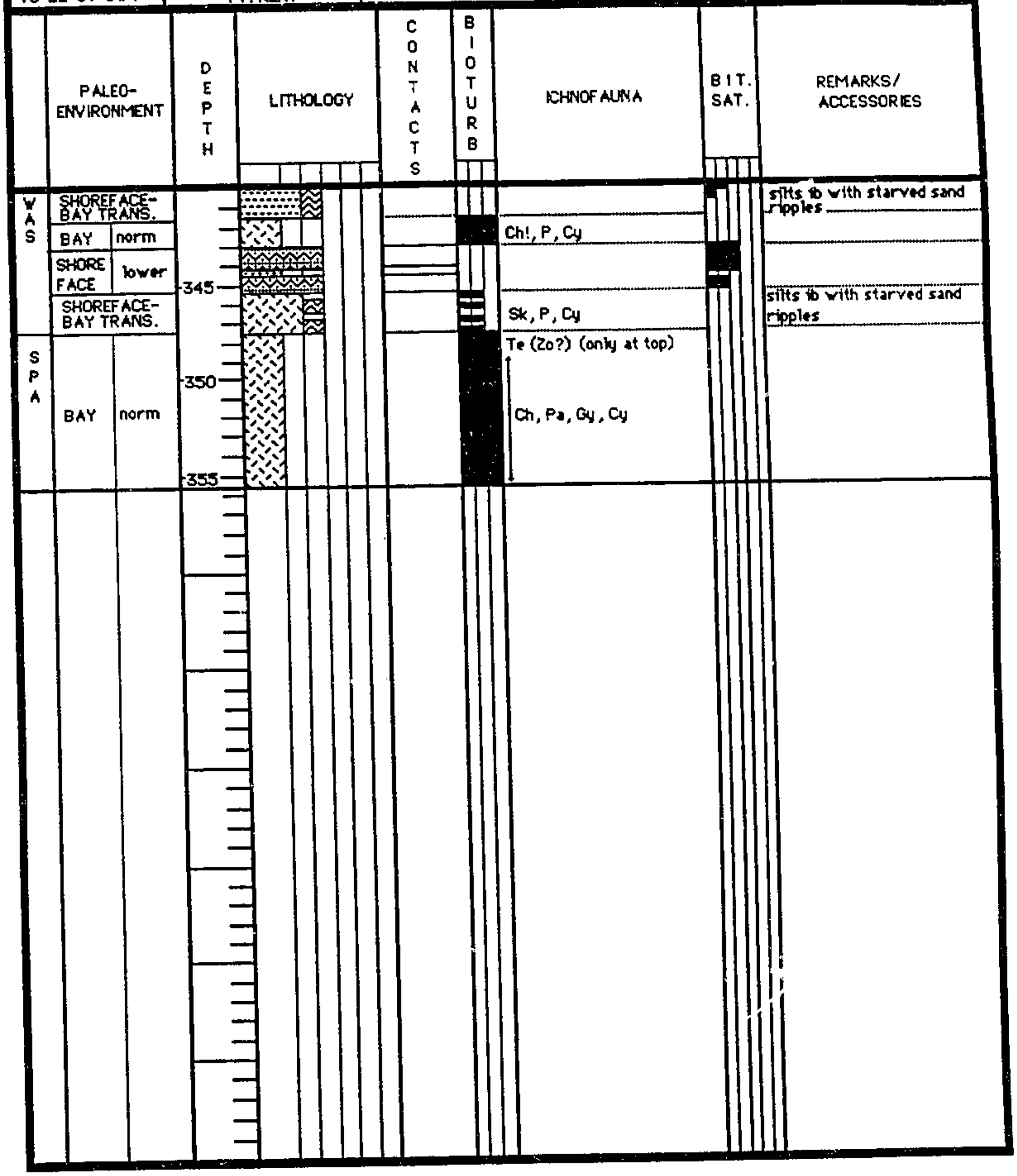
rippled sands

flasers

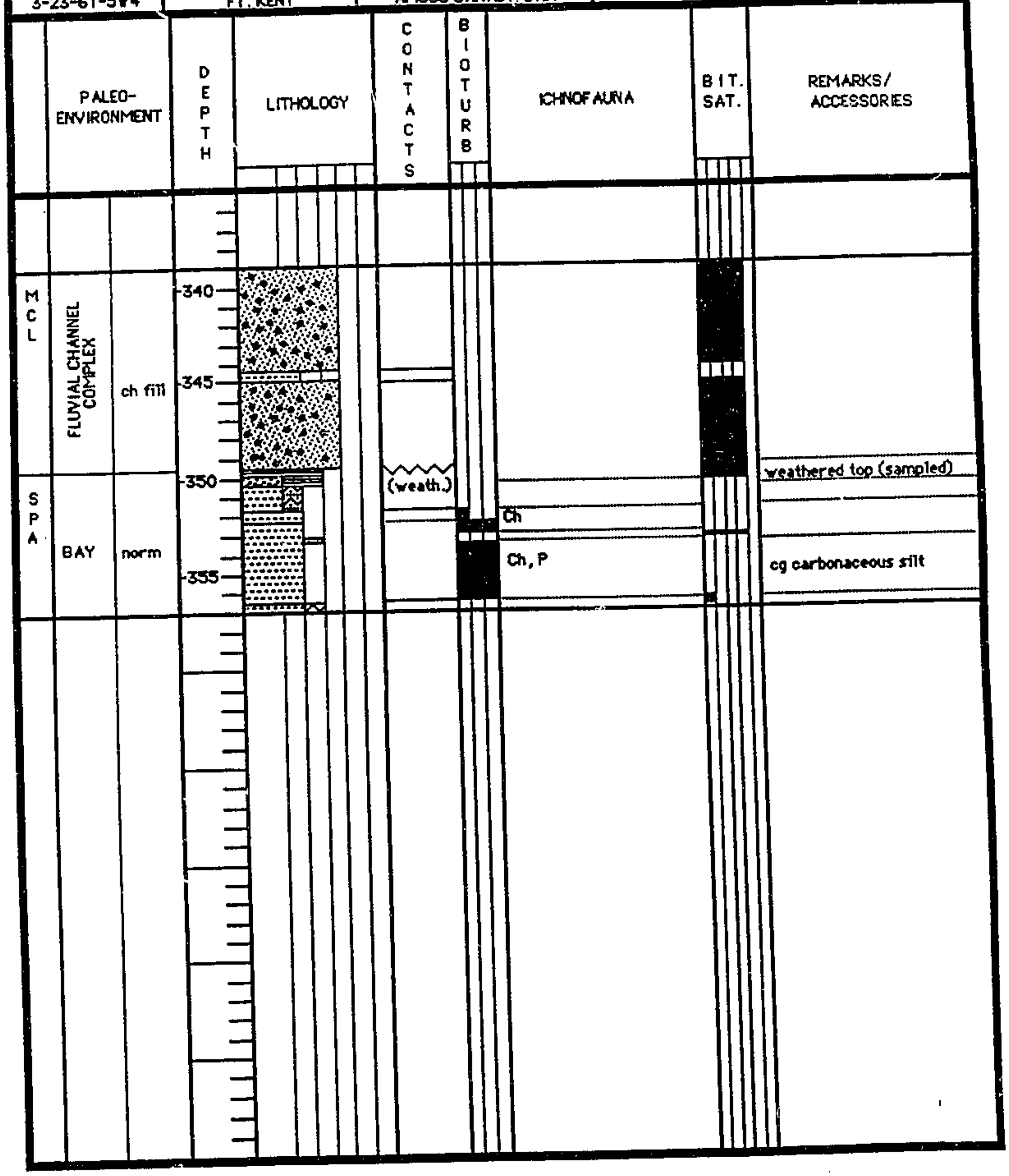
siltstone with starved sand ripples

silts

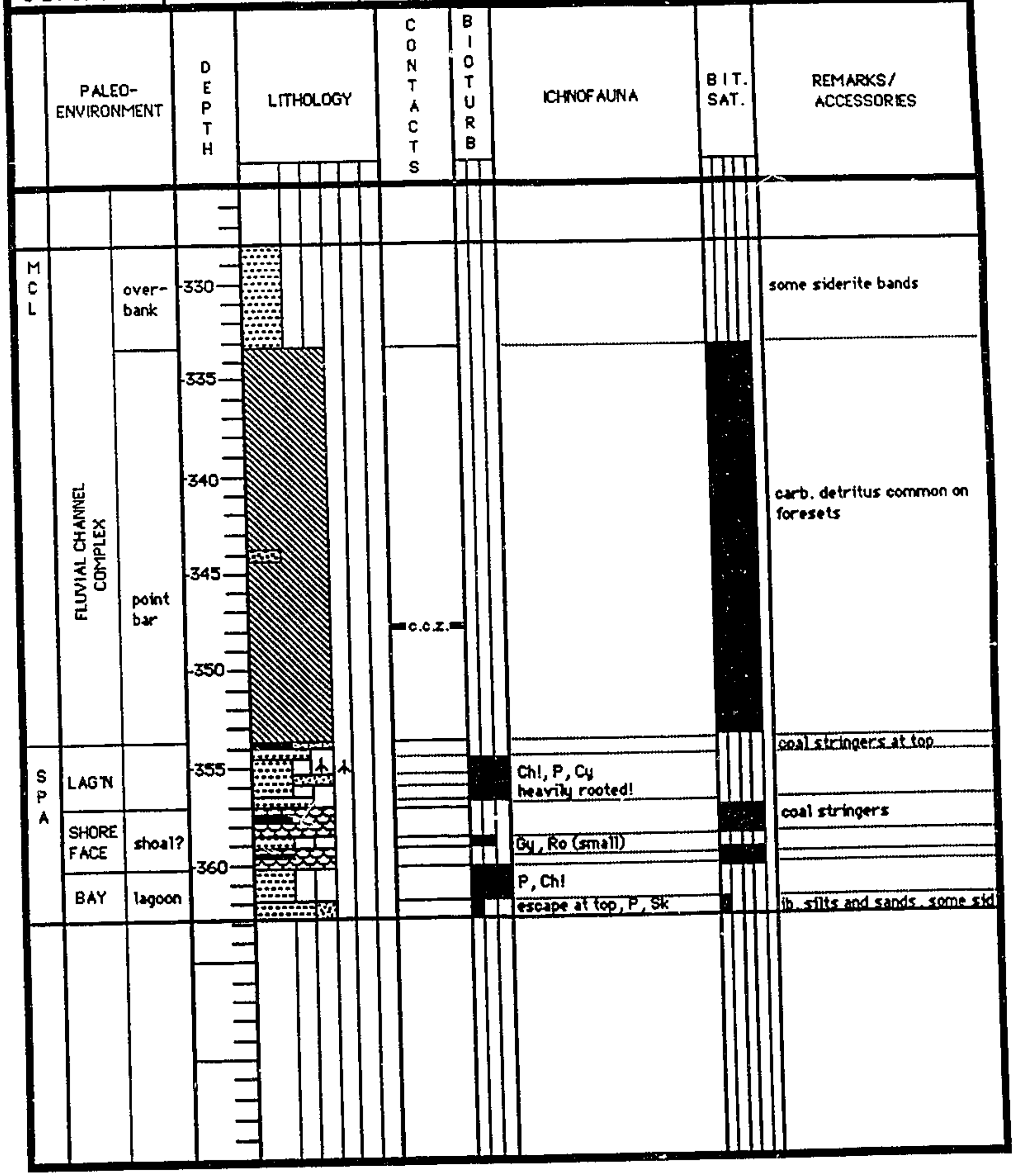
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-22-61-5W4	SUNCOR AMOCO FT. KENT	SUNCOR AMOCO	340.0-355.5 m	551.6 m	1 OF 1



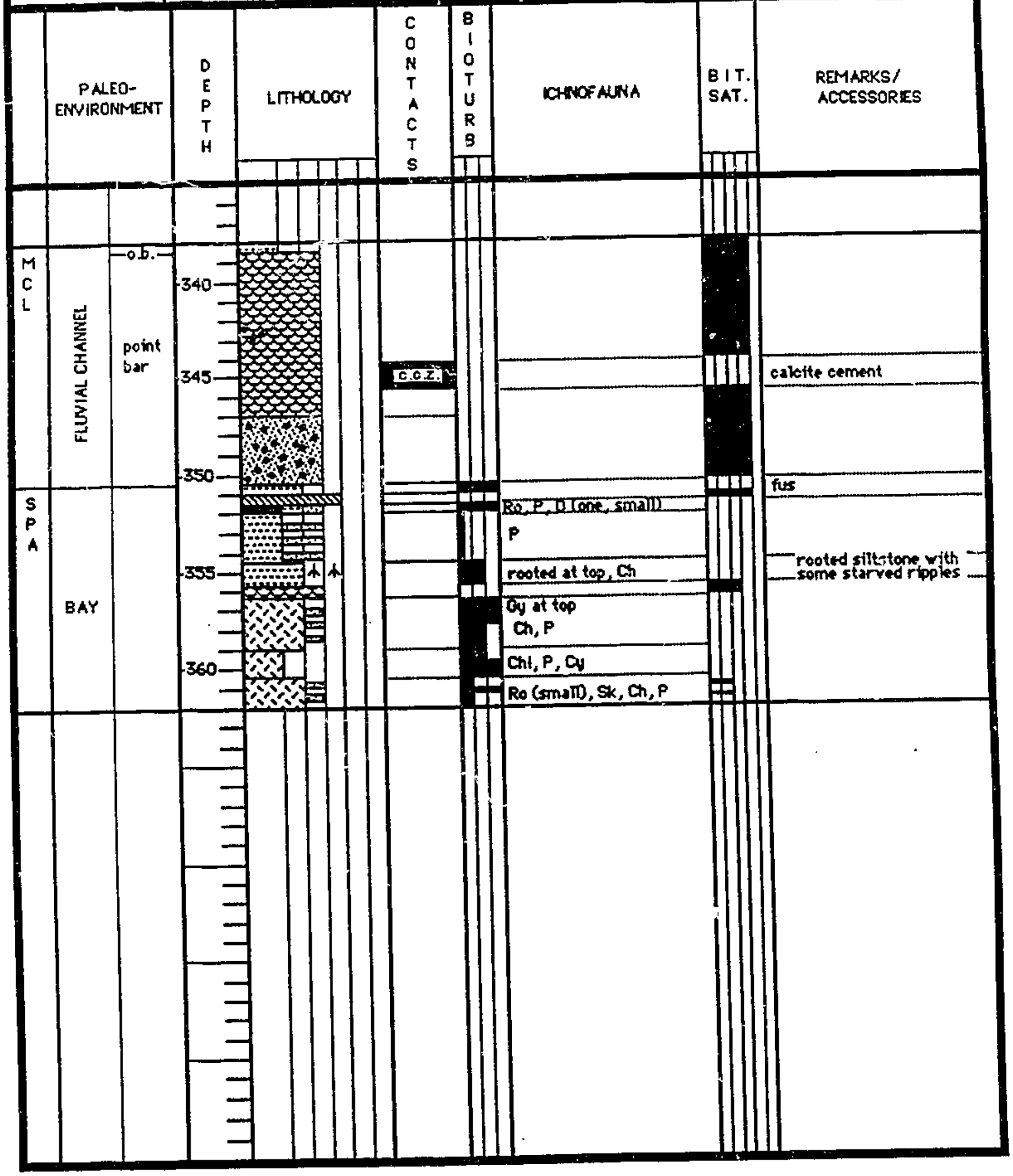
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-23-61-5W4	SUNCOR AMOCO FT. KENT	SUNCOR INC., AMOCO CANADA LTD.	339.0-357.0 m	552.3 m	1 OF 1



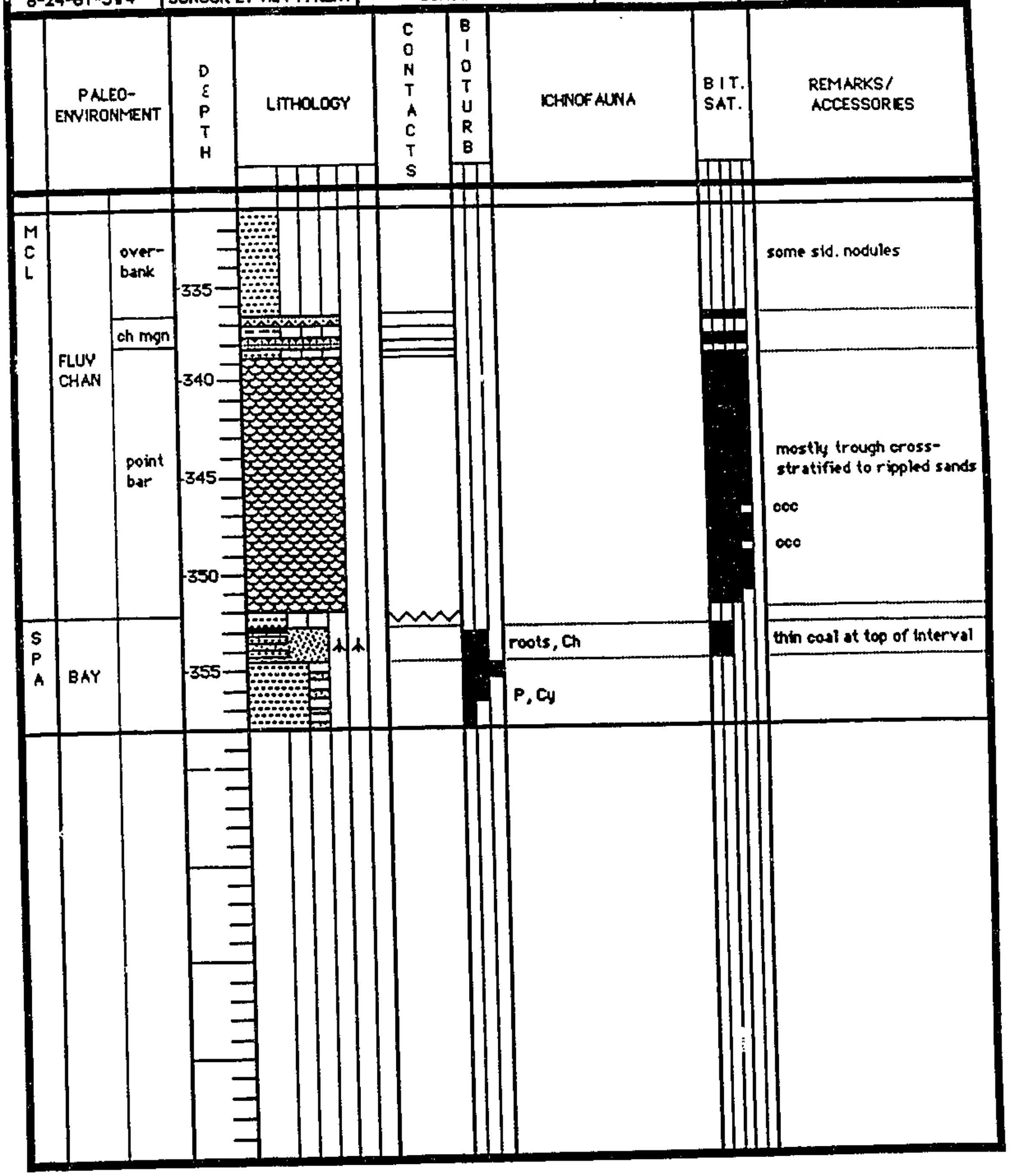
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-24-61-5W4	SUNCOR ET AL FT. KENT	SUNCOR ET AL	327.0-362.75 m	556.8 m	1 OF 1



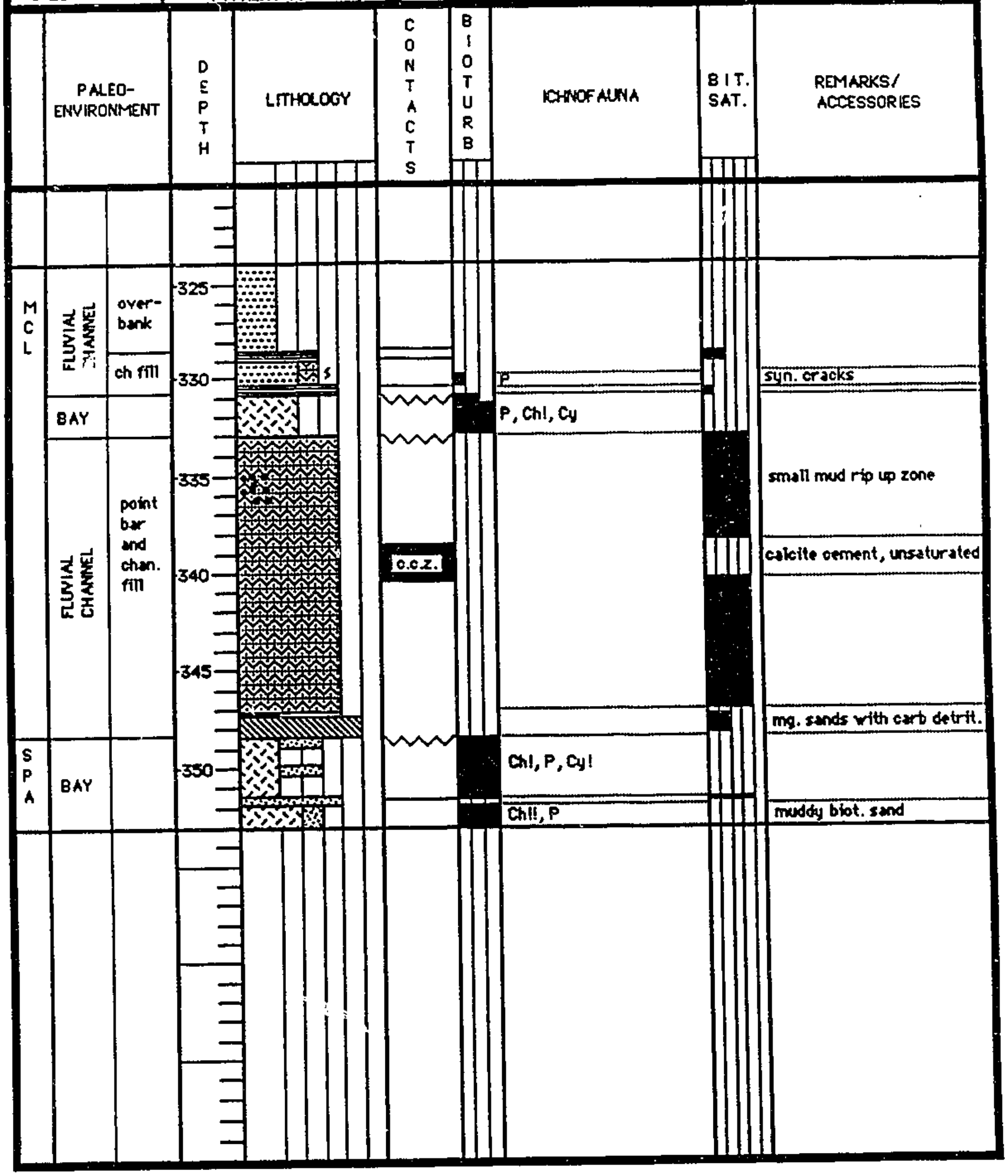
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-24-61-5W4	SUNCOR AMOCO FT. KENT	SUNCOR INC., AMOCO CANADA LTD	338.0-362.0 m	556.9 m	1 OF 1



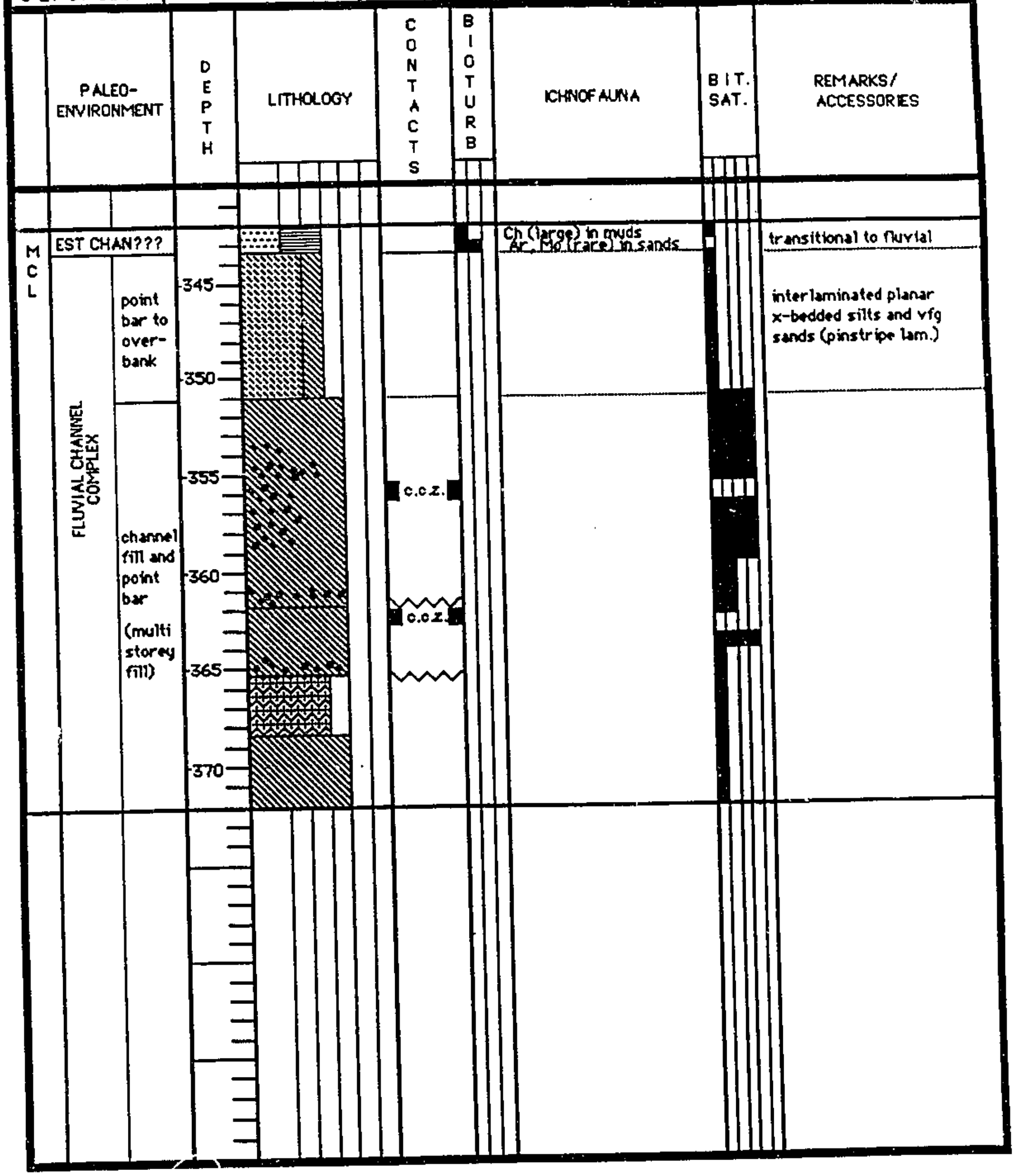
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-24-61-5W4	SUNCOR ET AL FT. KENT	SUNCOR ET AL	331.0-358.0 m	559.8 m	1 OF 1



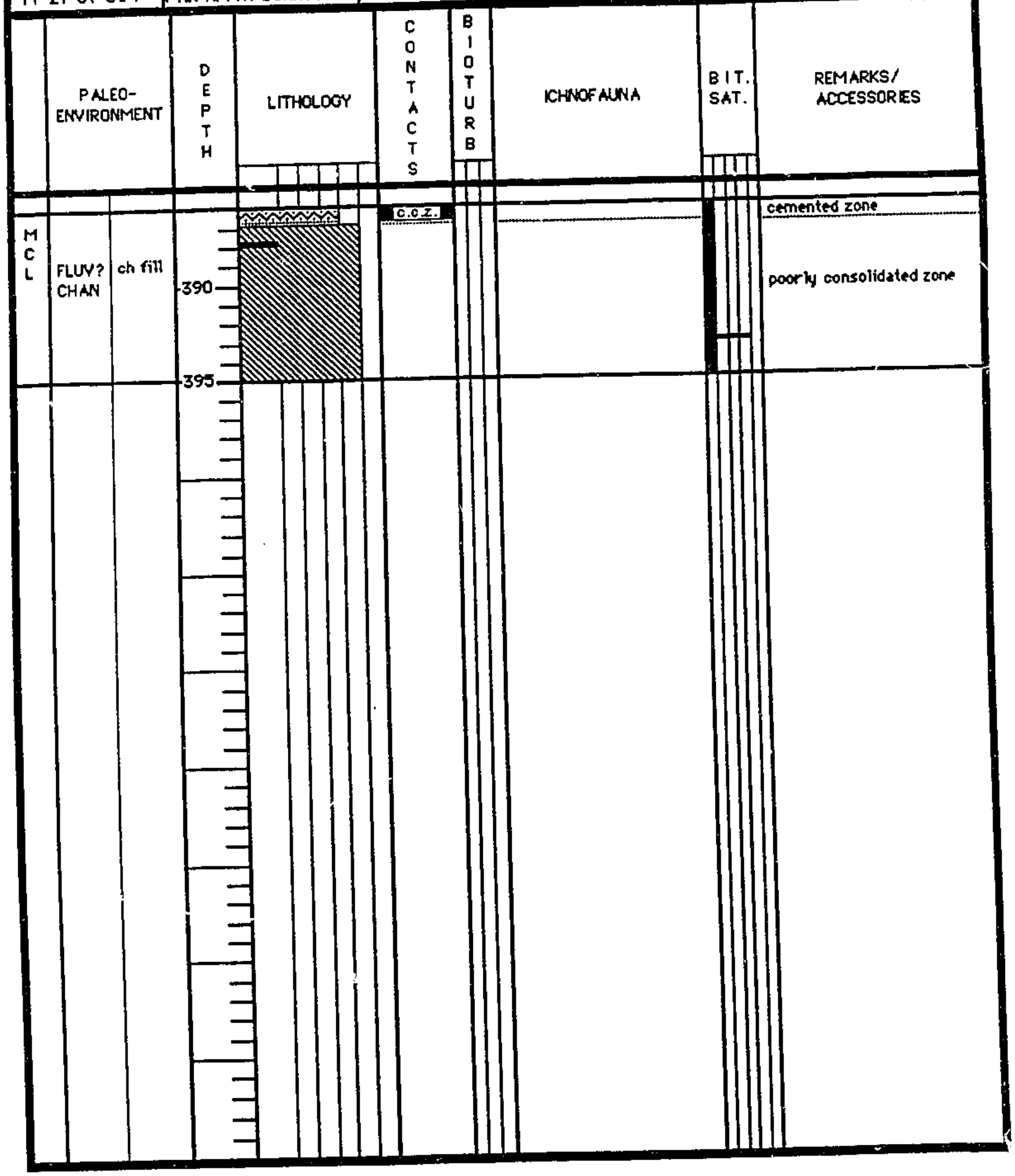
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-25-61-5W4	SUNCOR AMOCO FT. KENT 73	SUNCOR INC., AMOCO CANADA LTD	324.0-353.0 m	550.6 m	1 OF 1



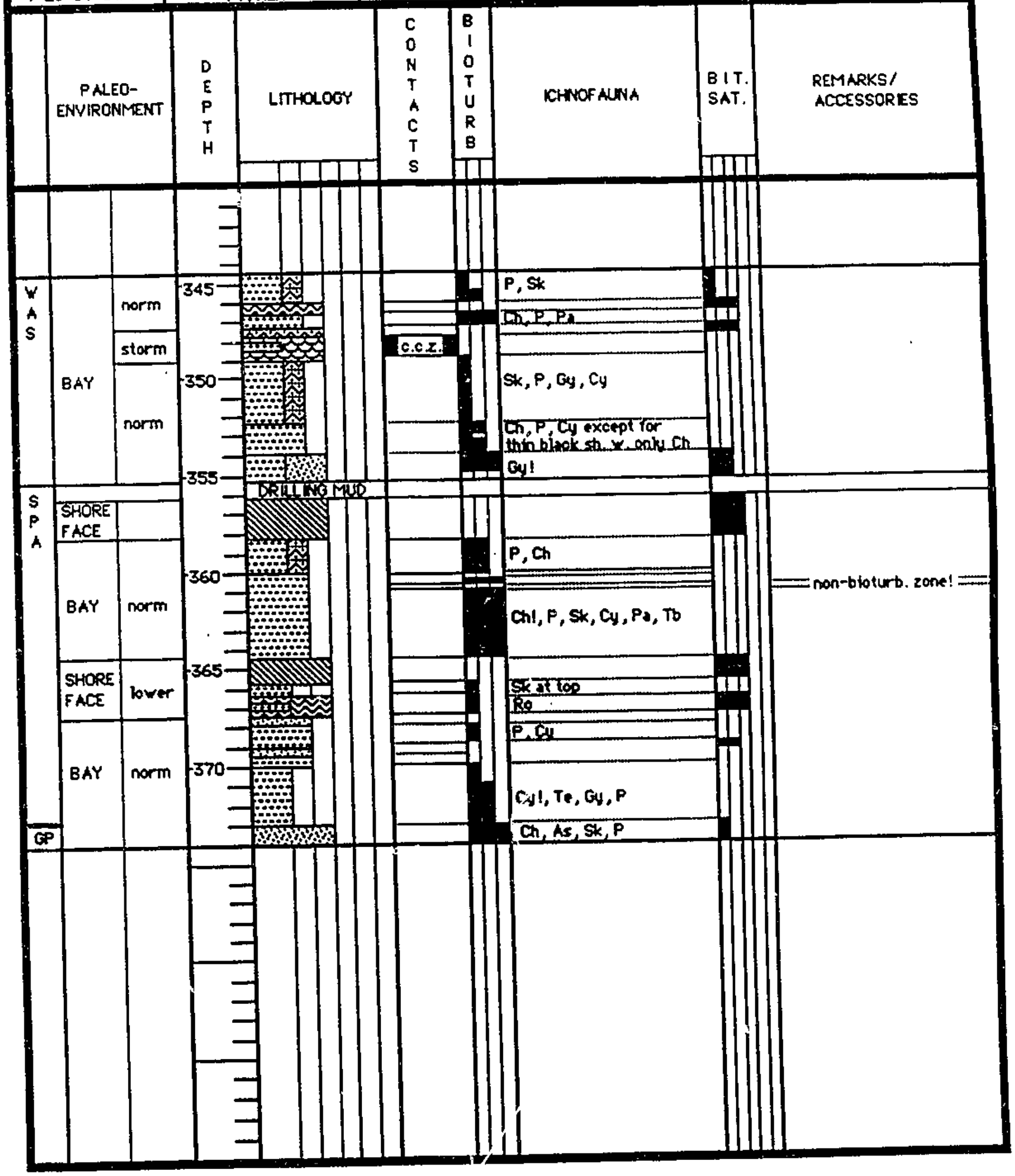
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-27-61-5W4	SUNCOR ET AL FT. KENT	SUNCOR ET AL	342.0-372.0 m	553.0 m	1 OF 1



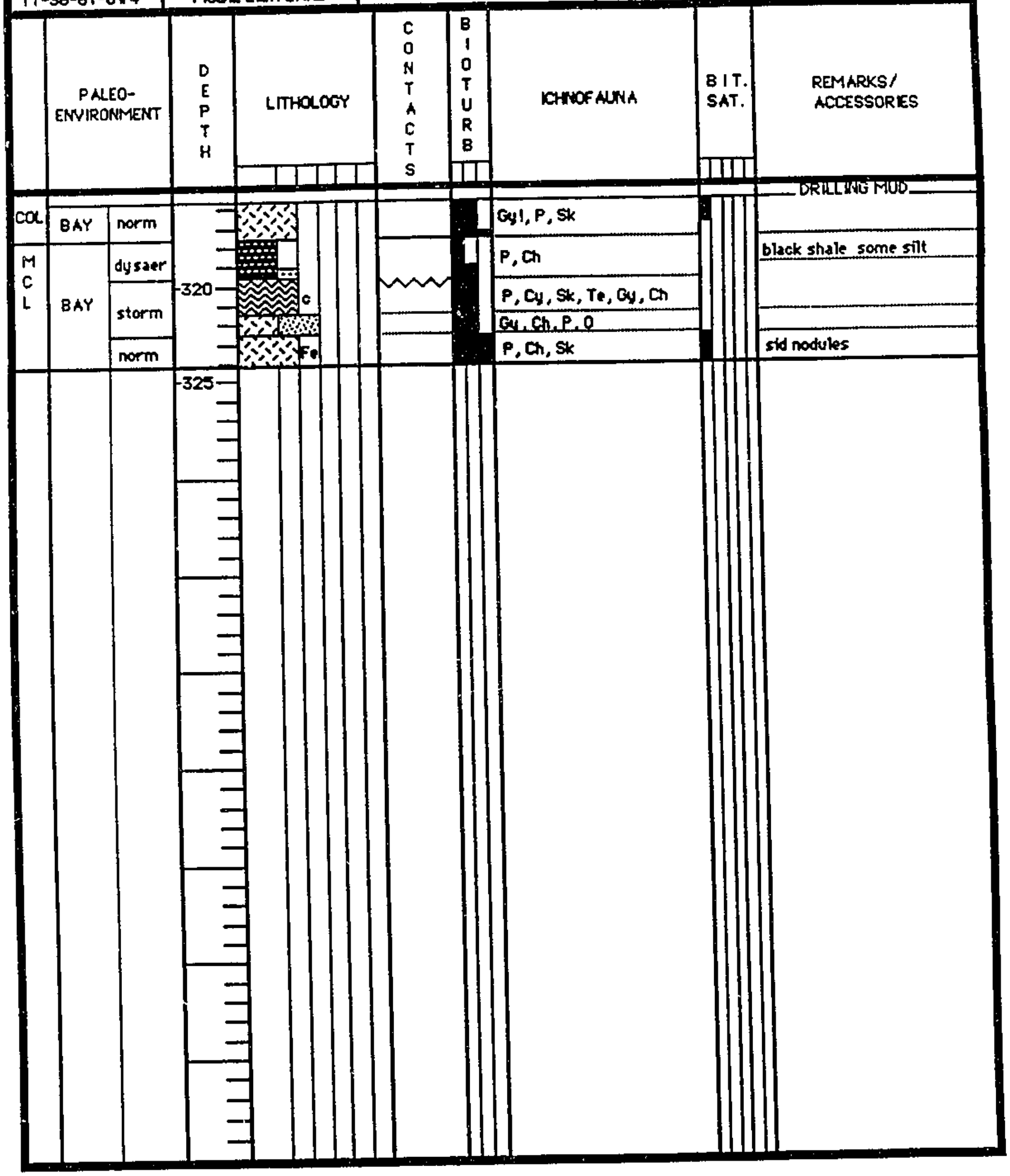
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-27-61-5W4	PAN AM A1 BONNYVILLE	AMOCO CANADA PETROLEUM	385.97-395.02 m	553.8 m	1 OF 1



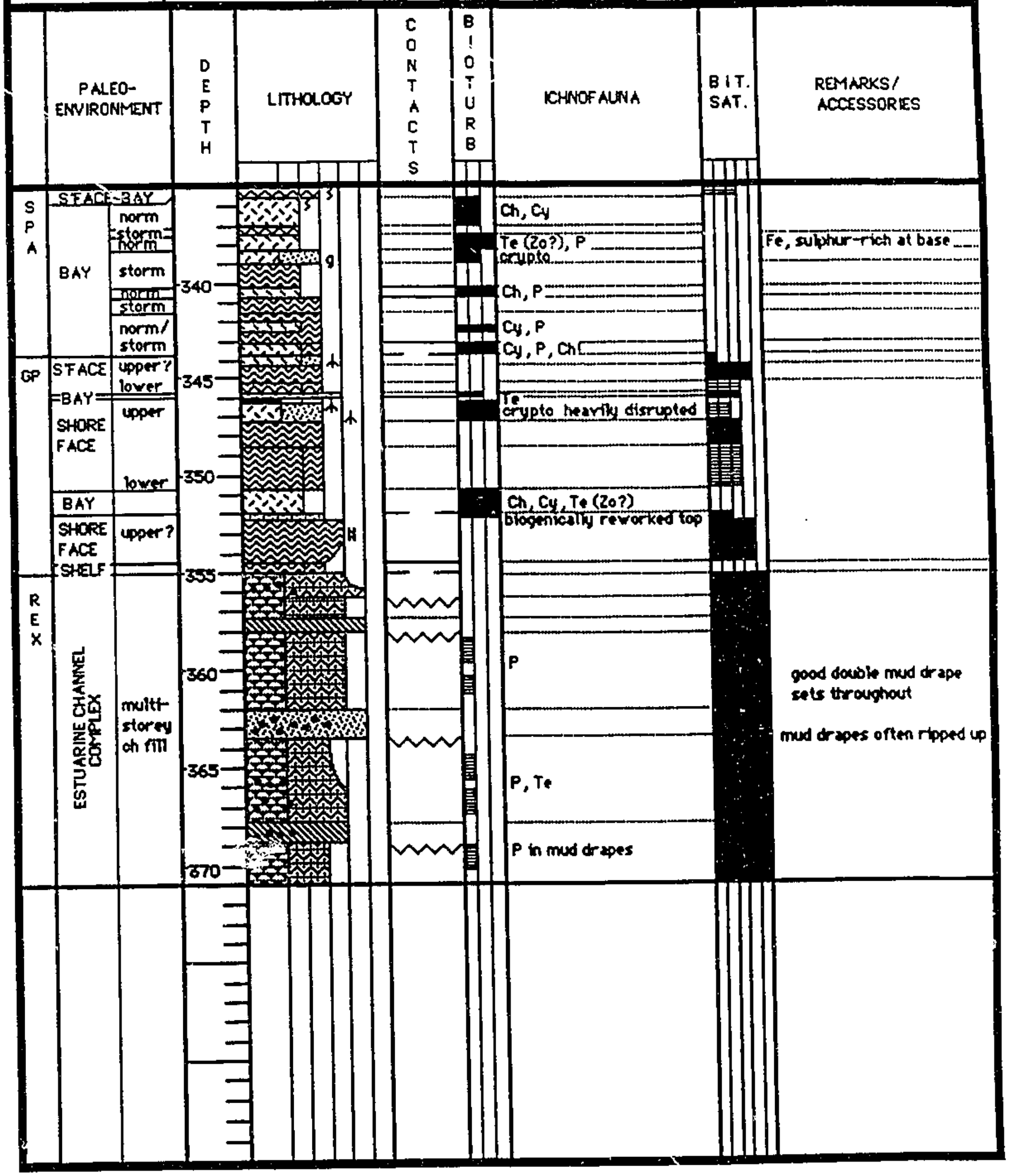
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-29-61-5W4	SUNCOR AMOCO FT. KENT	SUNCOR AMOCO	344.5-374.0 m	560.9 m	1 OF 1



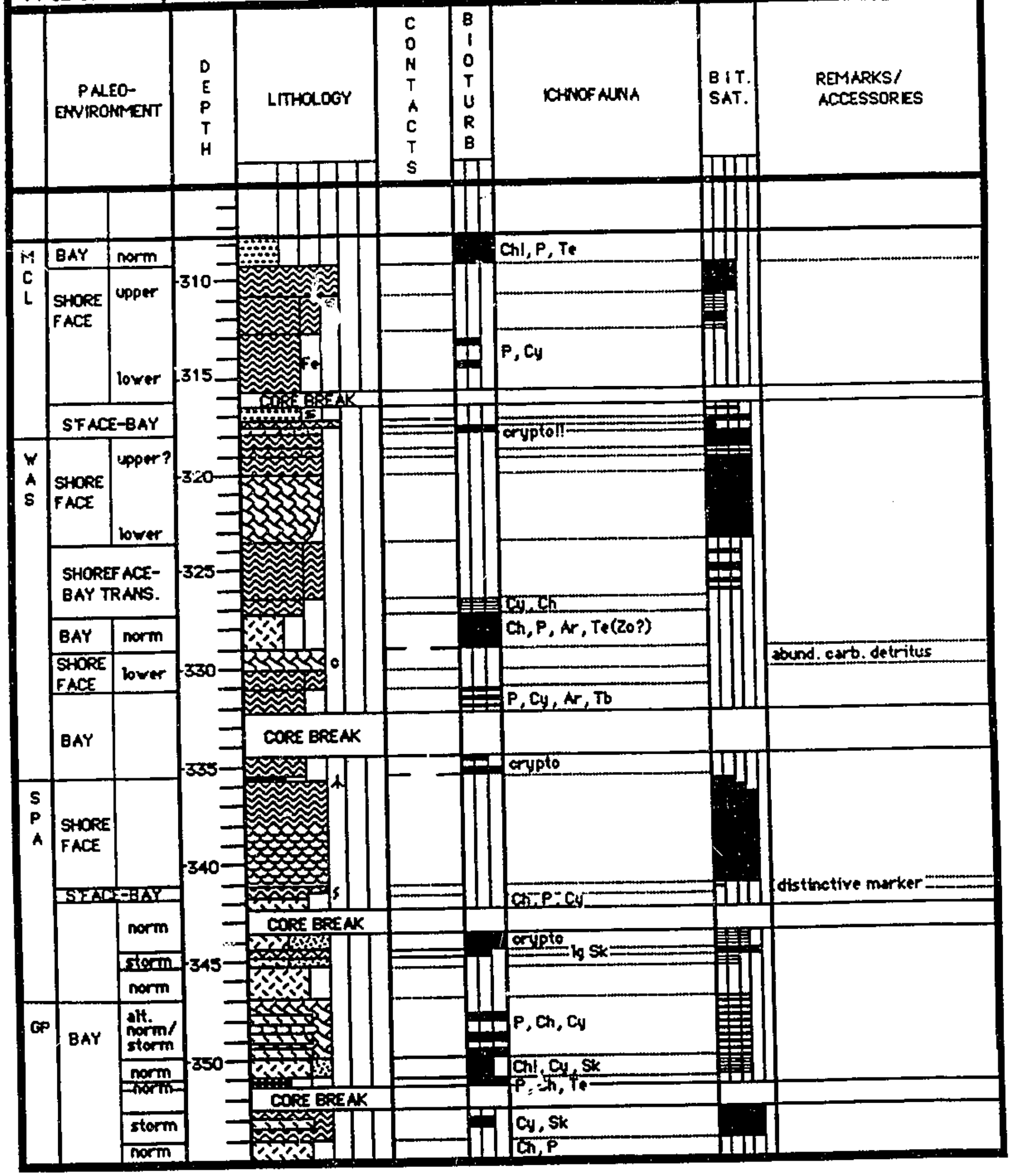
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-36-61-6W4	MOBIL LIZA LAKE	MOBIL OIL CANADA LTD.	315.12-324.12 m	560.7 m	1 OF 1



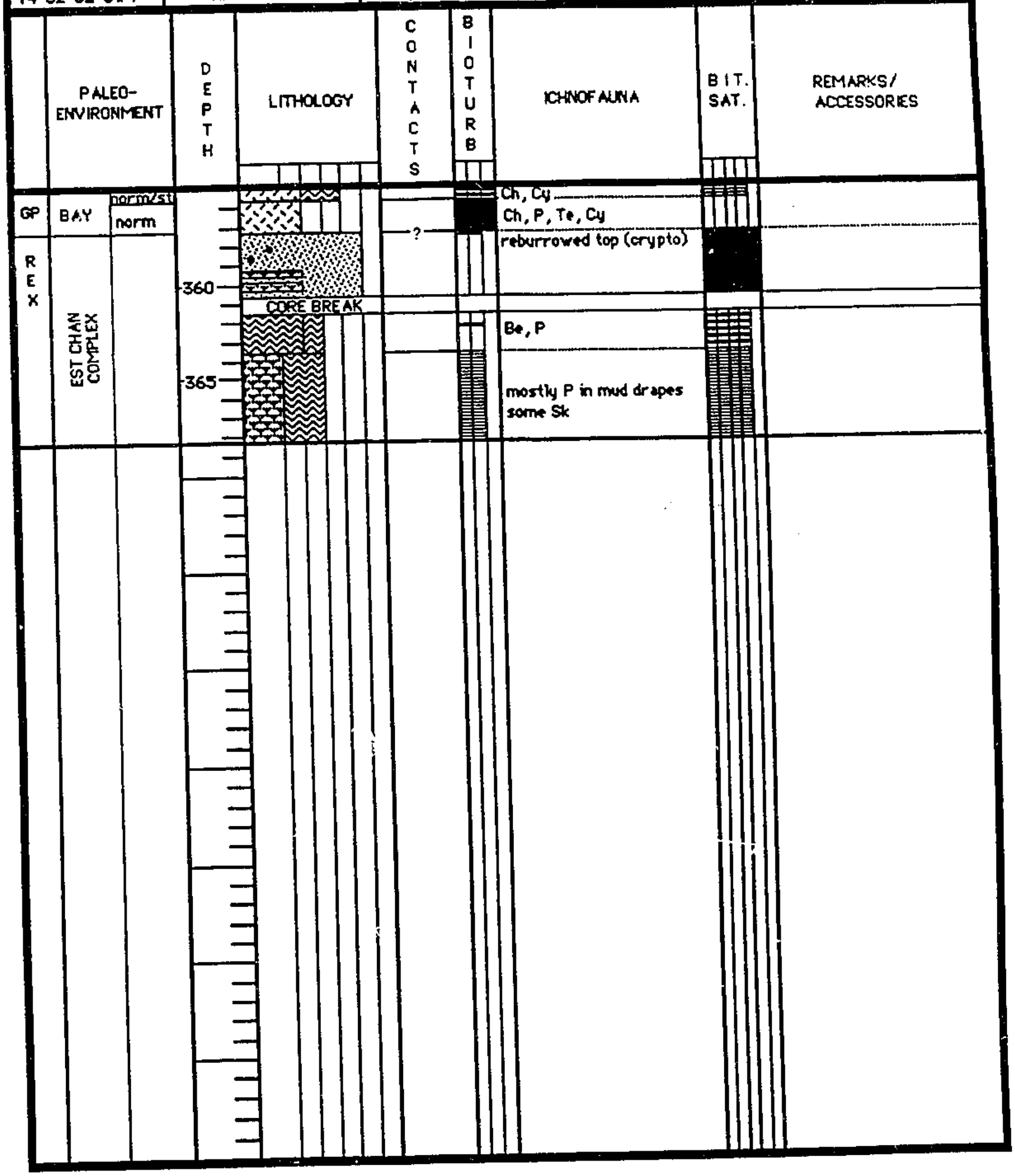
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-31-62-3W4	AMMIN KENT	AMERADA MINERALS CORP. OF CANADA	335-371 m	552.3 m	1 OF 1



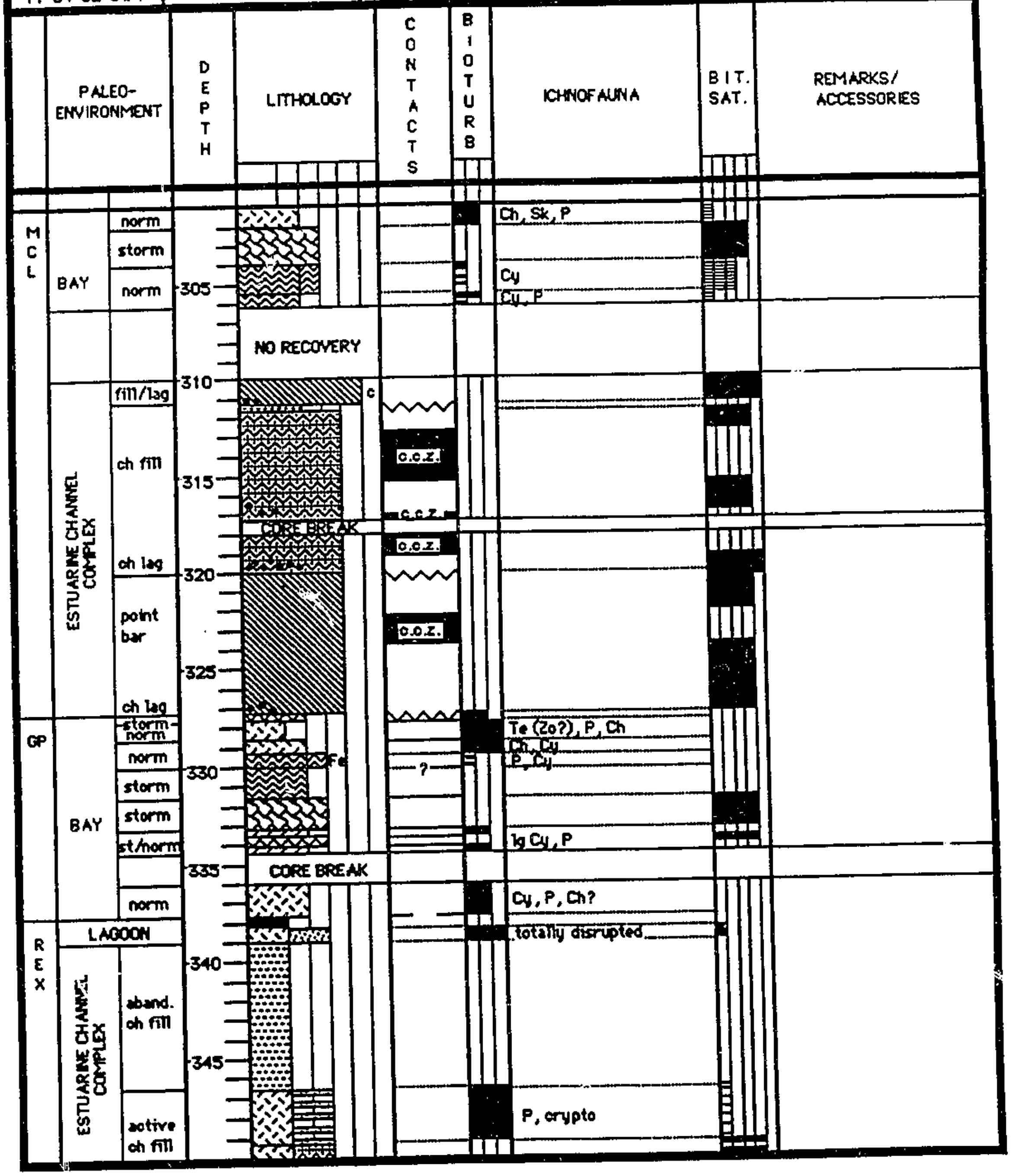
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-32-62-3W4	AMMIN KENT	AMERADA MINERALS CORP. OF CANADA	307.5-369 m	551.7 m	1 OF 2



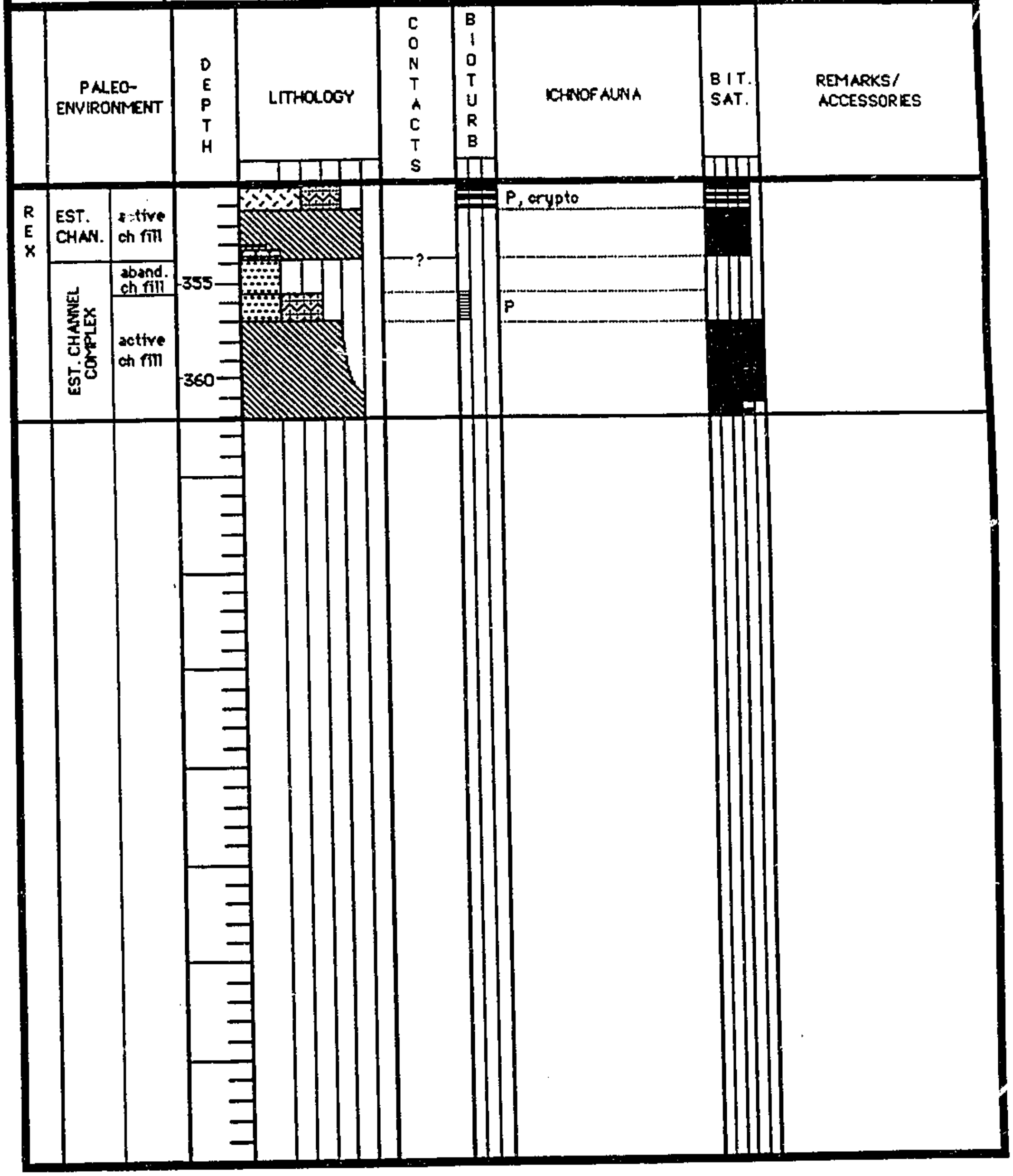
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-32-62-3W4	AMMIN KENT	AMERADA MINERALS CORP. OF CANADA	307.5-369.0 m	551.7 m	2 OF 2



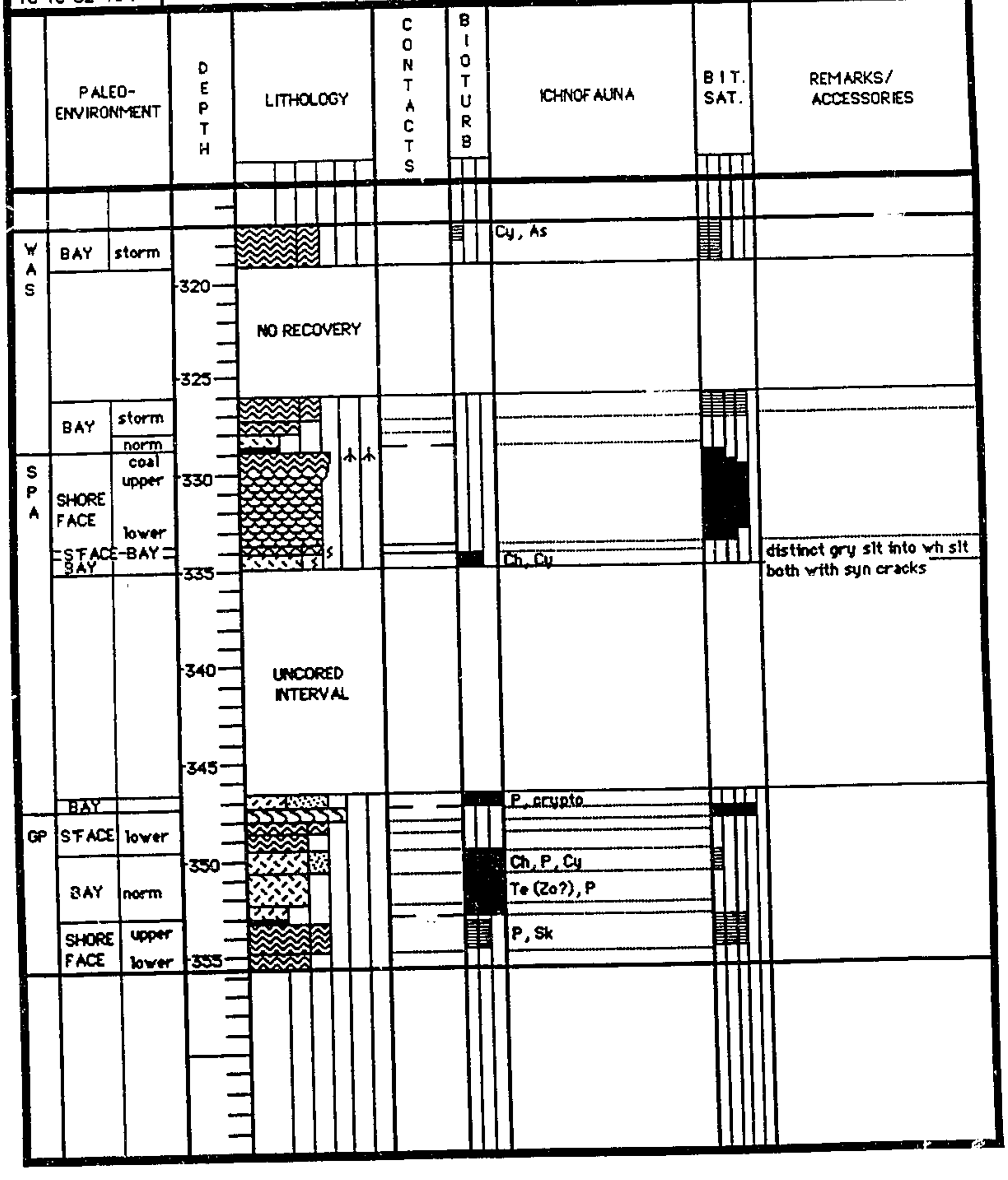
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-34-62-3W4	AMMIN KENT	AMERADA MINERALS CORP. OF CANADA	301.0-362.1 m	539.7 m	1 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-34-62-3W4	AMMIN KENT	AMERADA MINERALS CORP. OF CANADA	301.0-362.1 m	539.7 m	2 OF 2

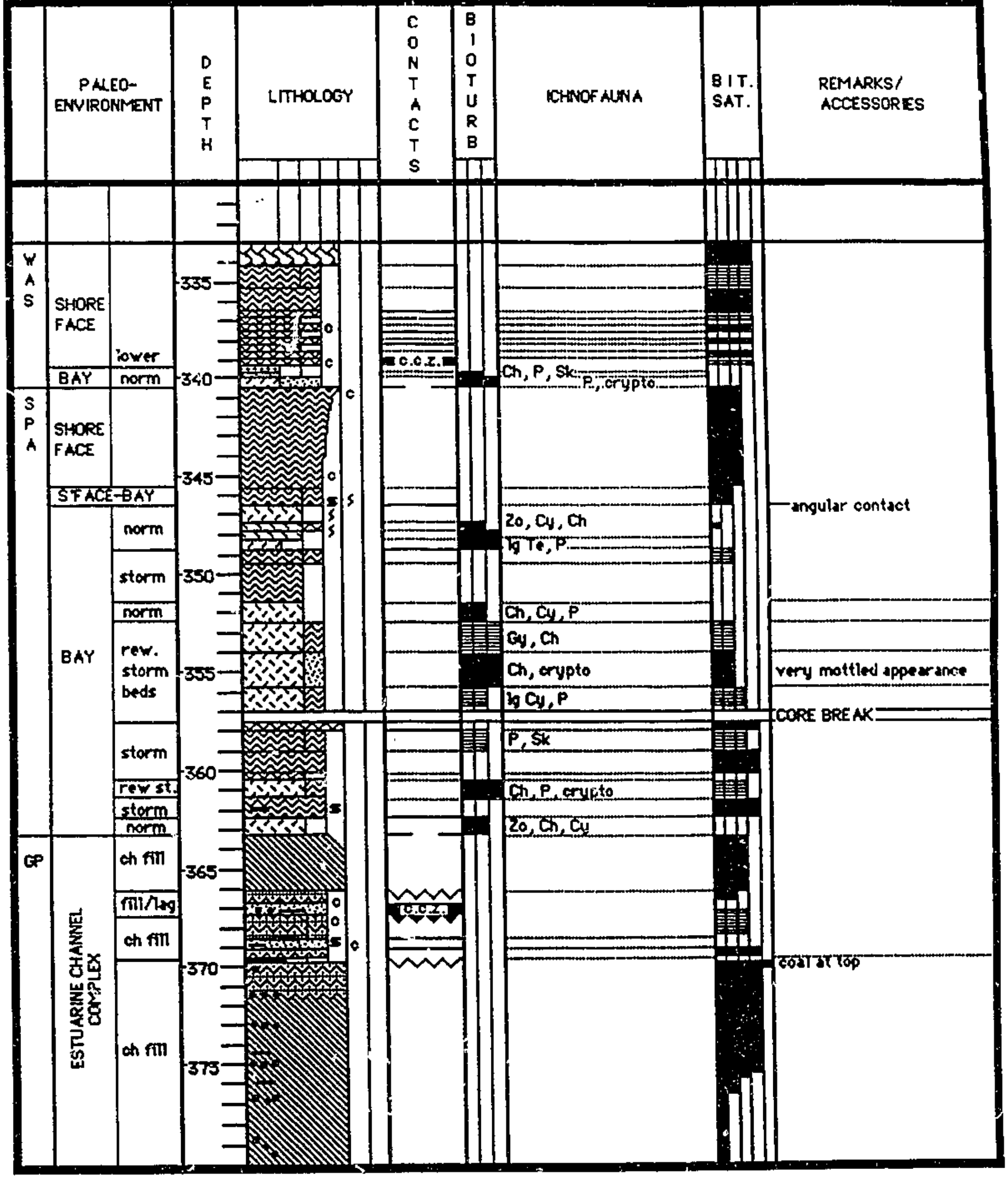


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-13-62-4W4	AMMIN KENT	AMERADA MINERALS CORP. OF CANADA	317.0-355.5 m	542.7 m	1 OF 1

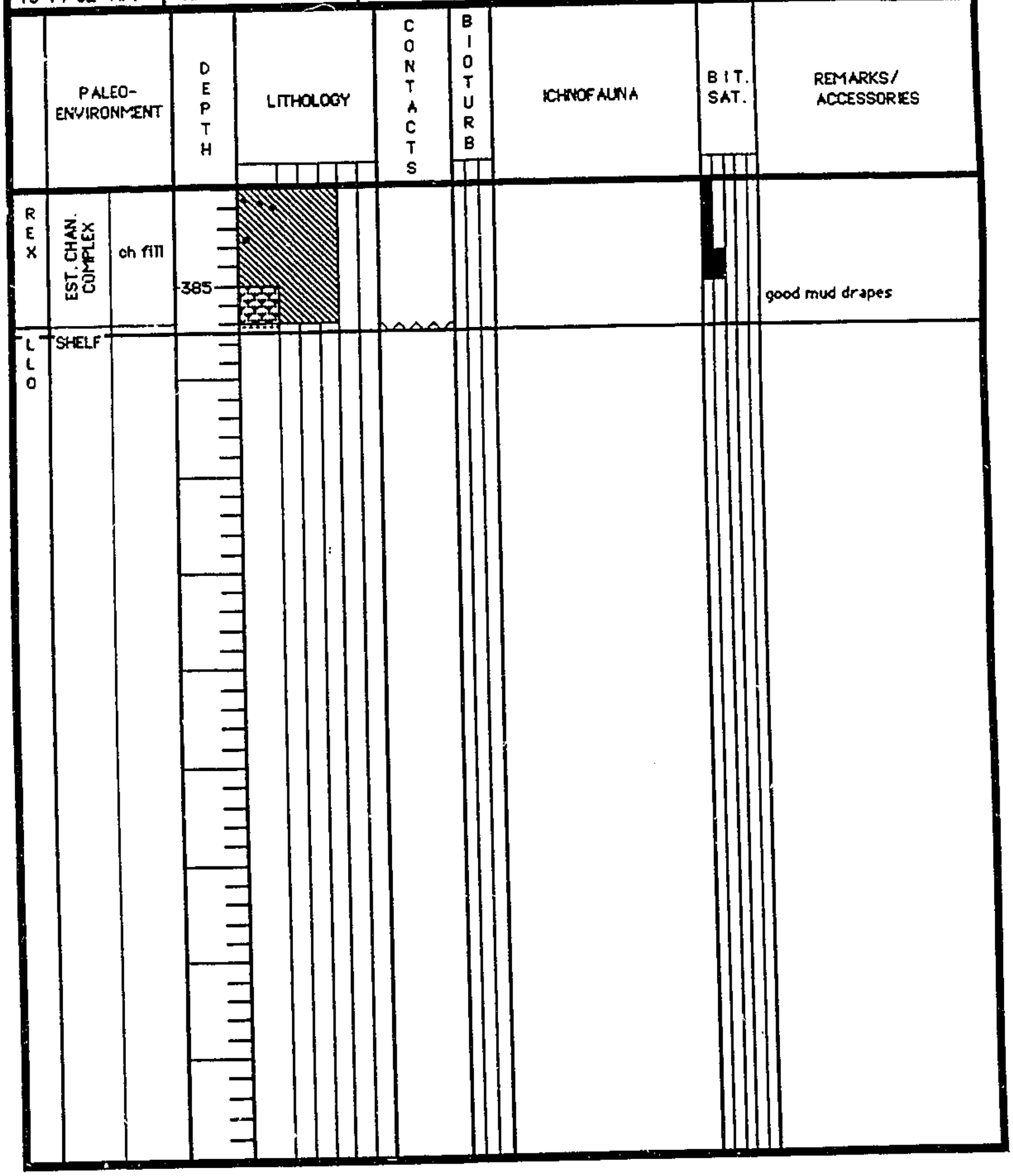


distinct gry slt into wh slt both with syn cracks

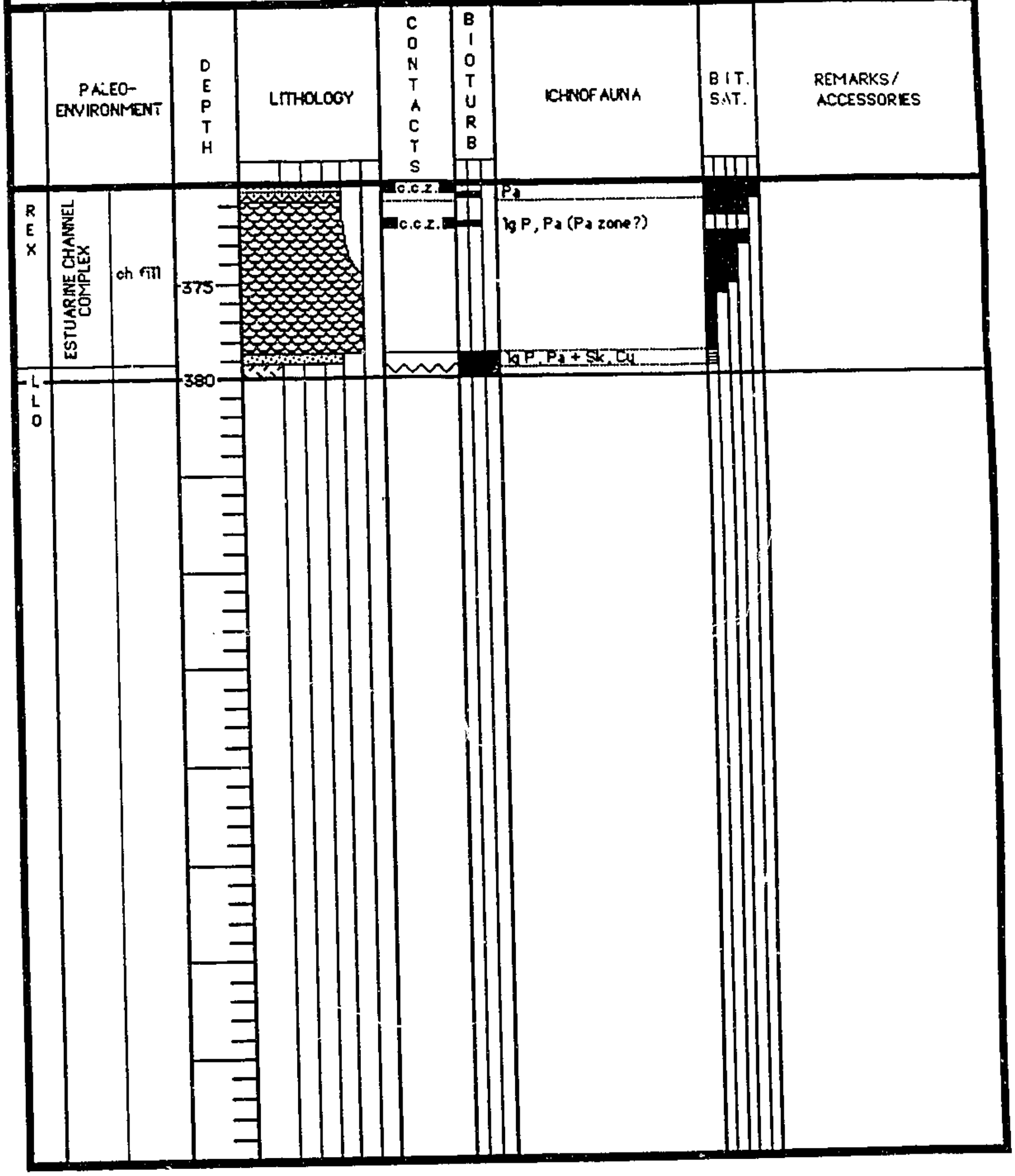
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-14-62-4W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	333.0-387.3 m	555.9 m	1 OF 2

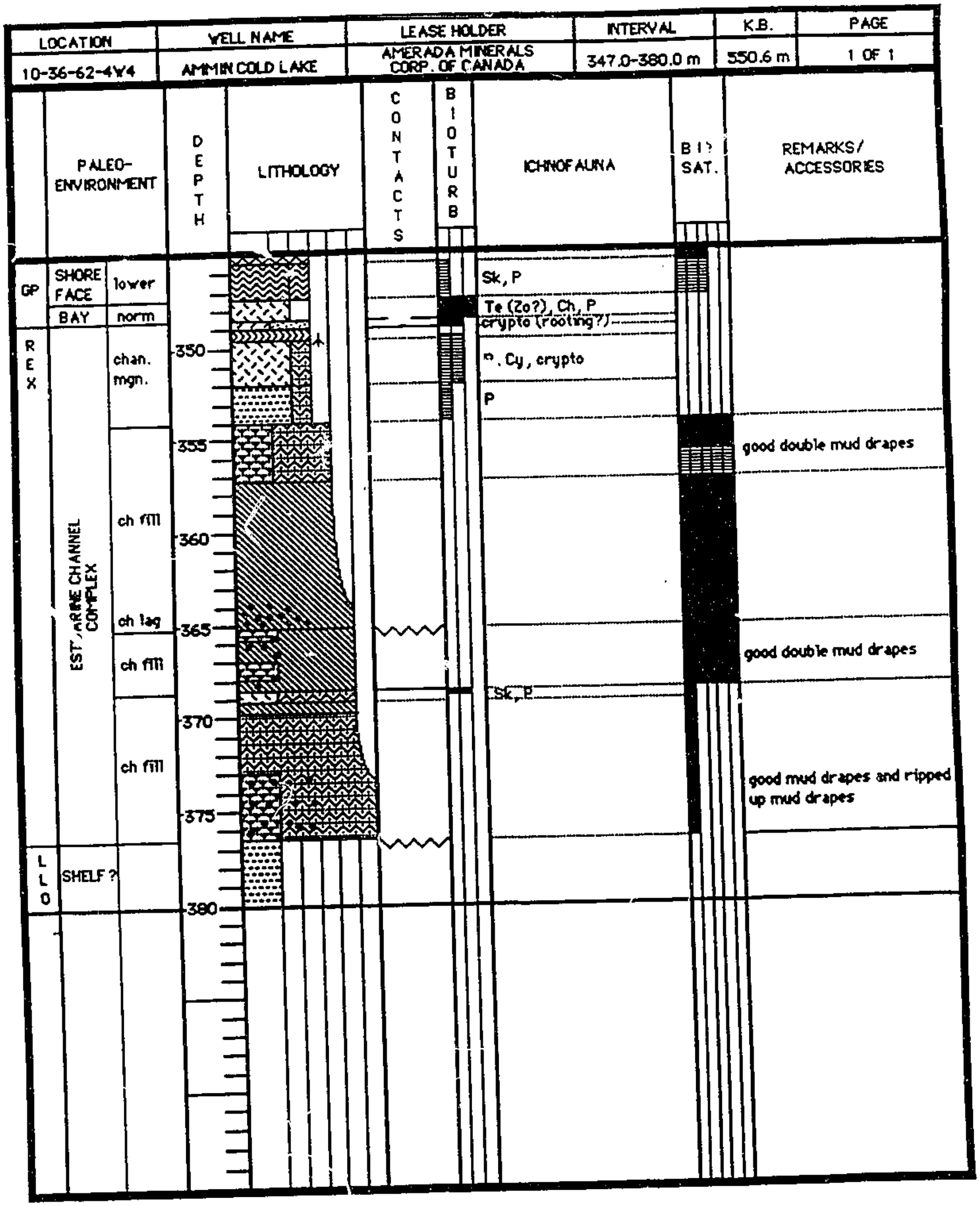


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-14-62-4W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	333.0-387.3 m	555.9 m	2 OF 2



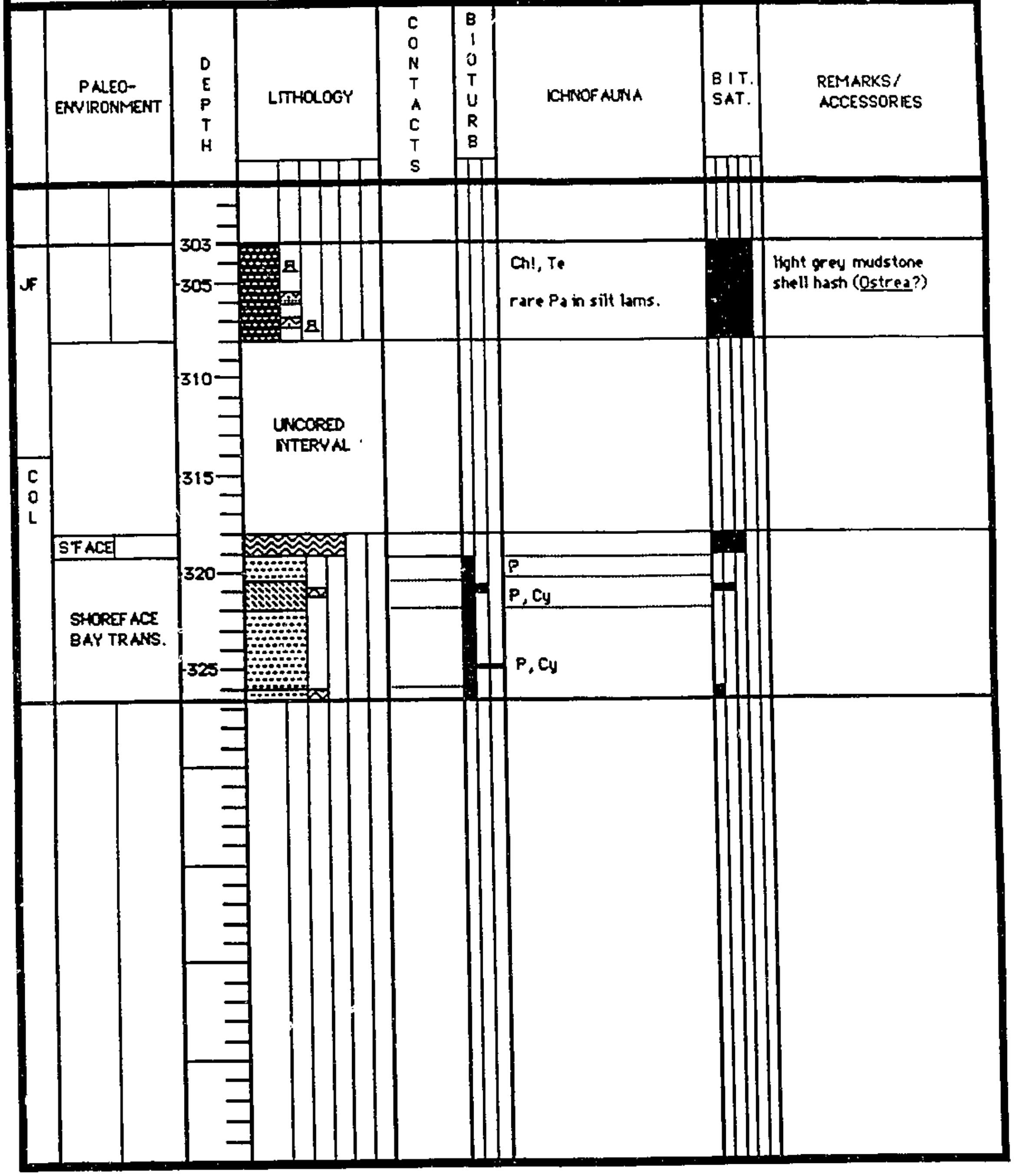
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-24-62-4W4	AMMIN FORT KENT	AMERADA MINERALS CORP. OF CANADA	370.0-380.0 m	556.0 m	1 OF 1



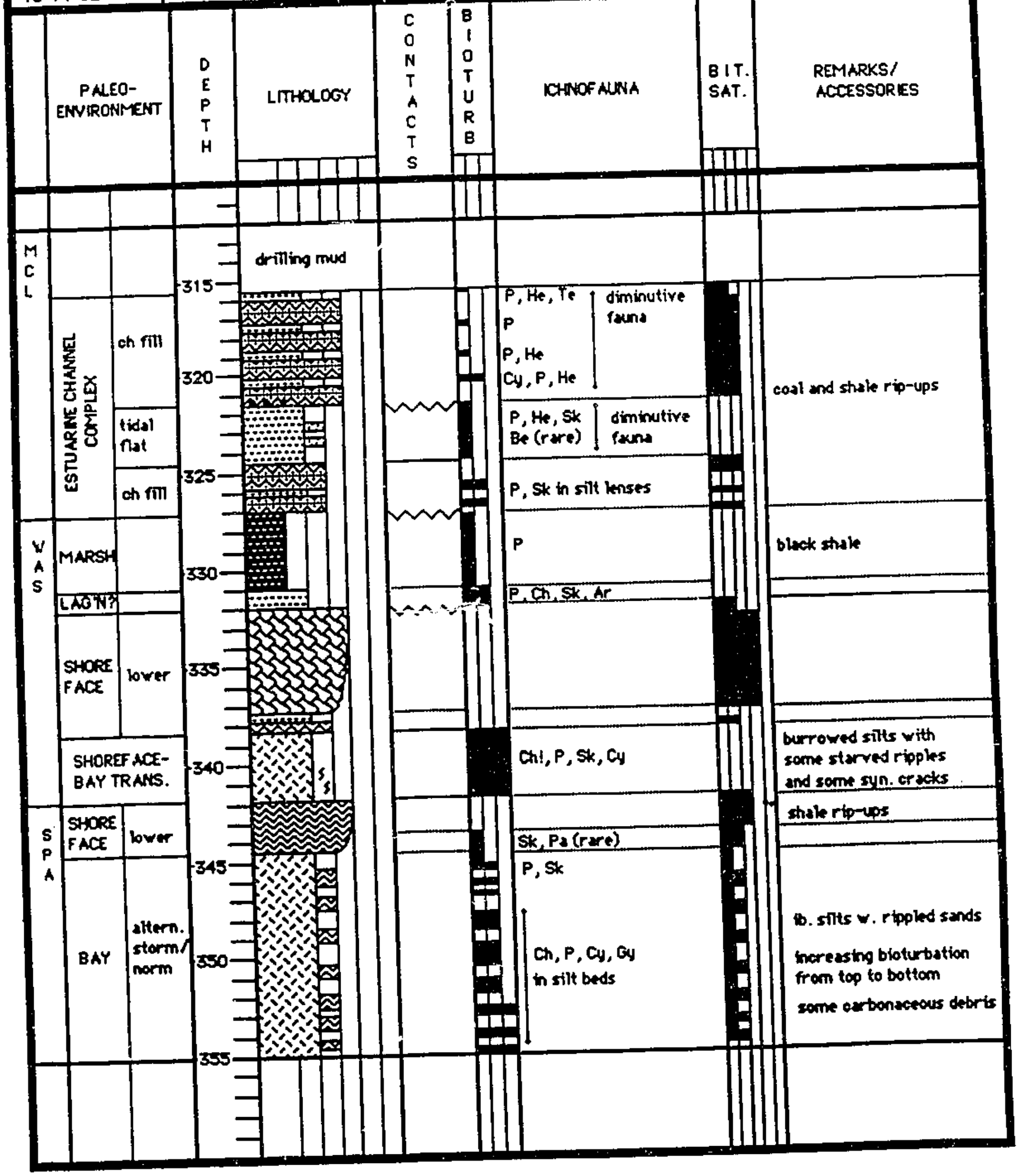


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-36-62-4W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	347.0-380.0 m	550.6 m	1 OF 1

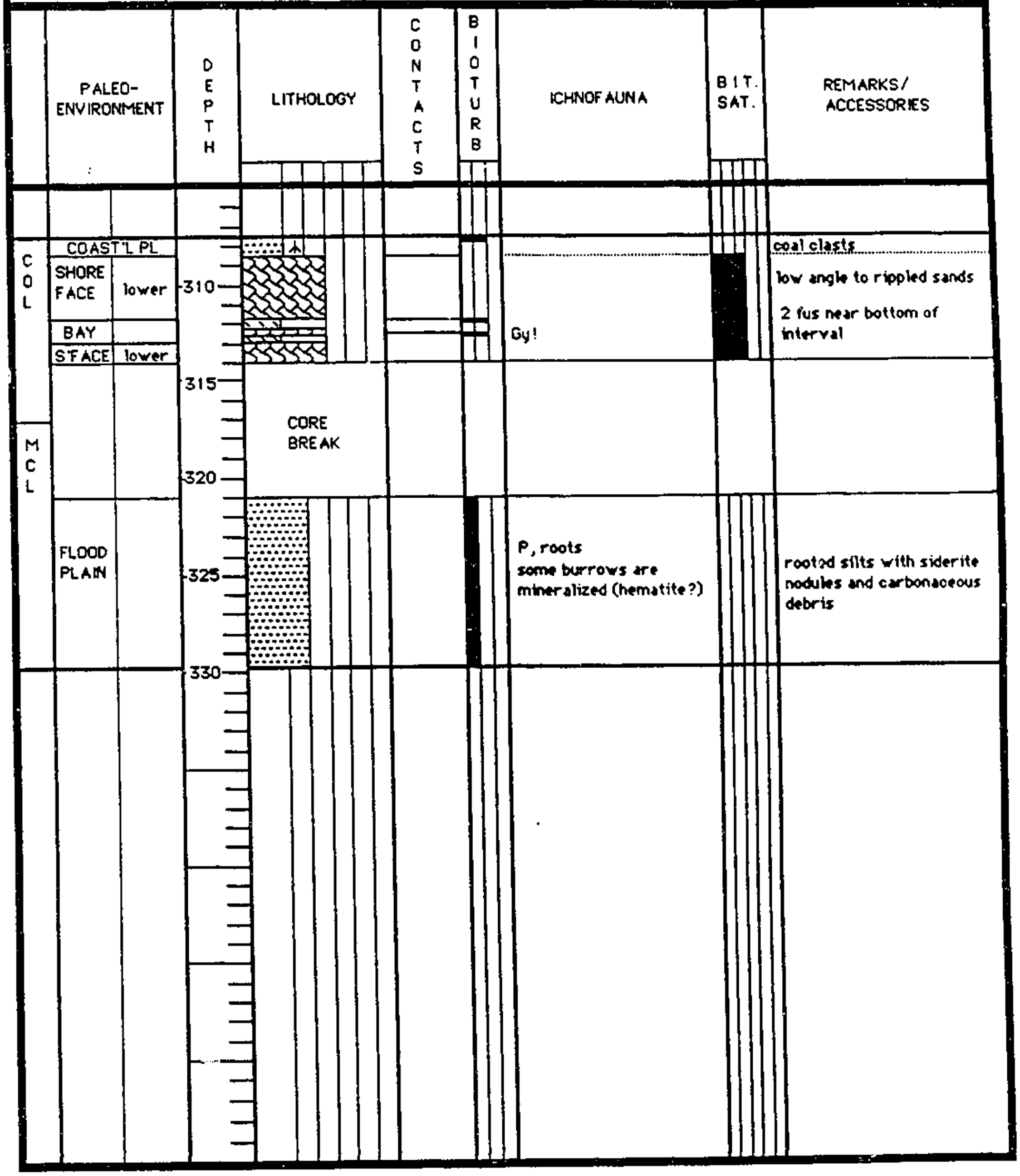
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-2-62-5W4	MOBIL BIG MEADOW	MOBIL OIL CANADA LTD.	303.0-326.5 m	557.7 m	1 OF 1



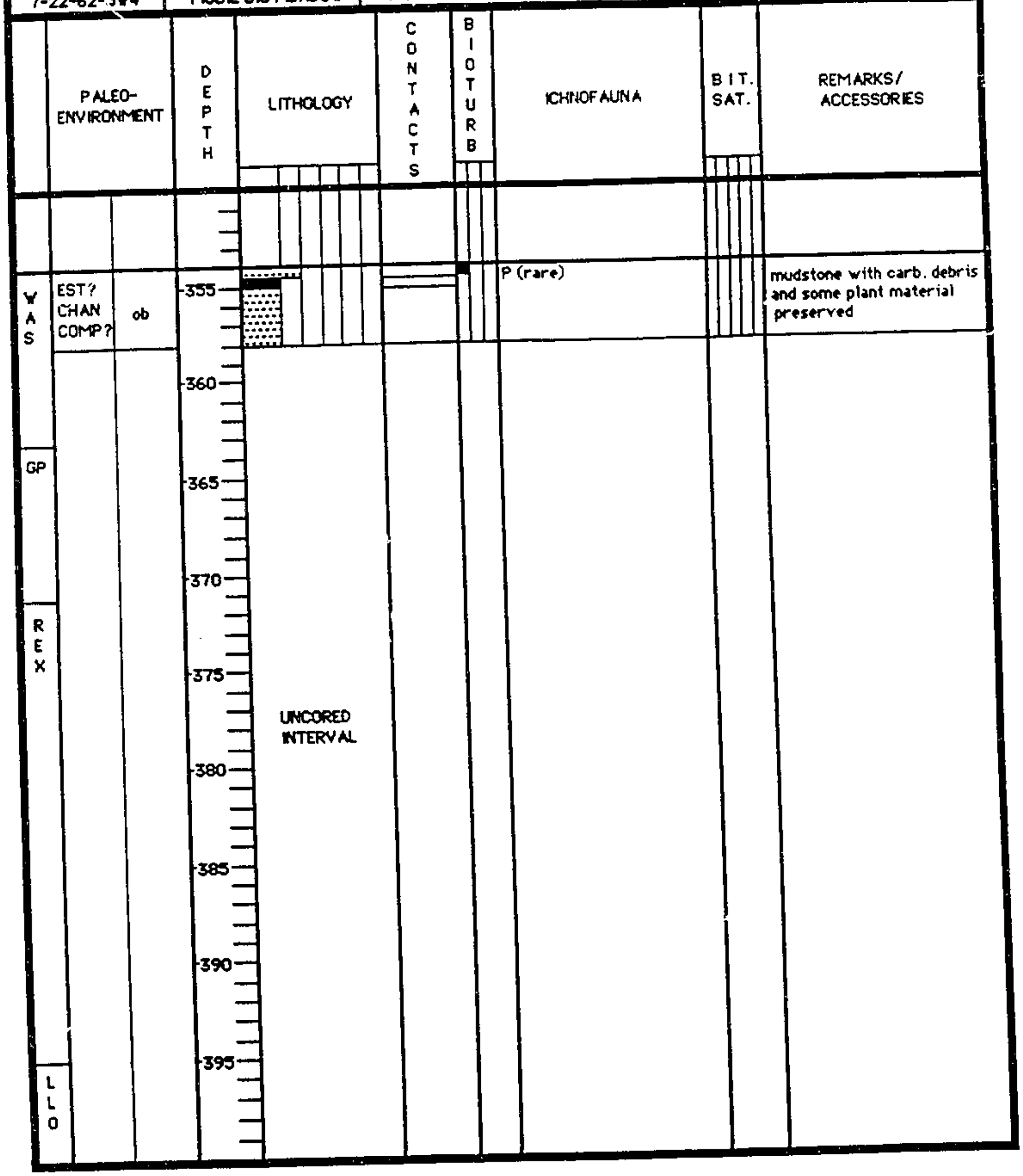
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-14-62-5W4	MOBIL BIG MEADOW OV	MOBIL OIL CANADA LTD.	312.0-355.0 m	554.7 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-16-62-5W4	MOBIL BIG MEADOW	MOBIL OIL CANADA LTD.	308.5-329.8 m	555.0 m	1 OF 1

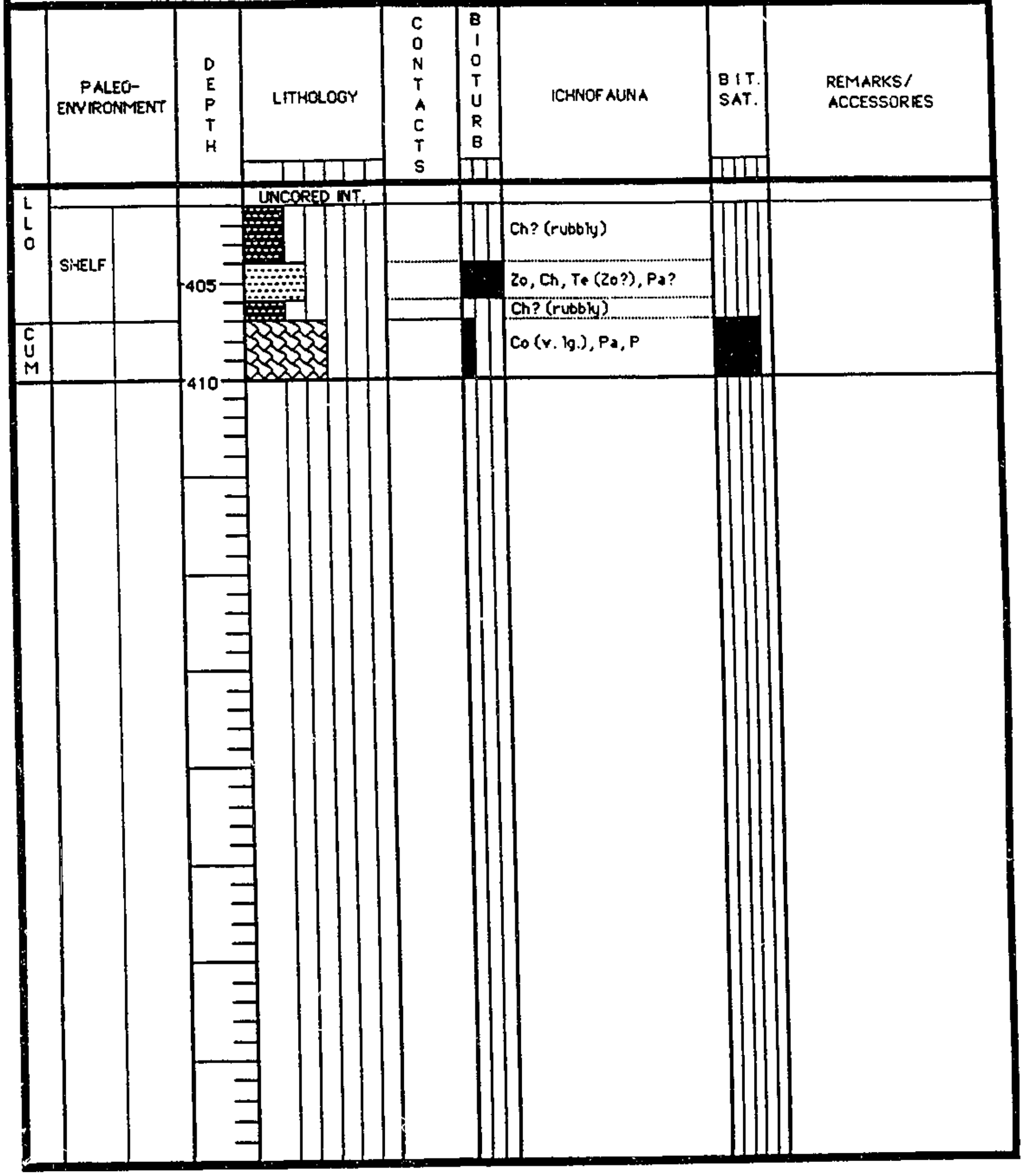


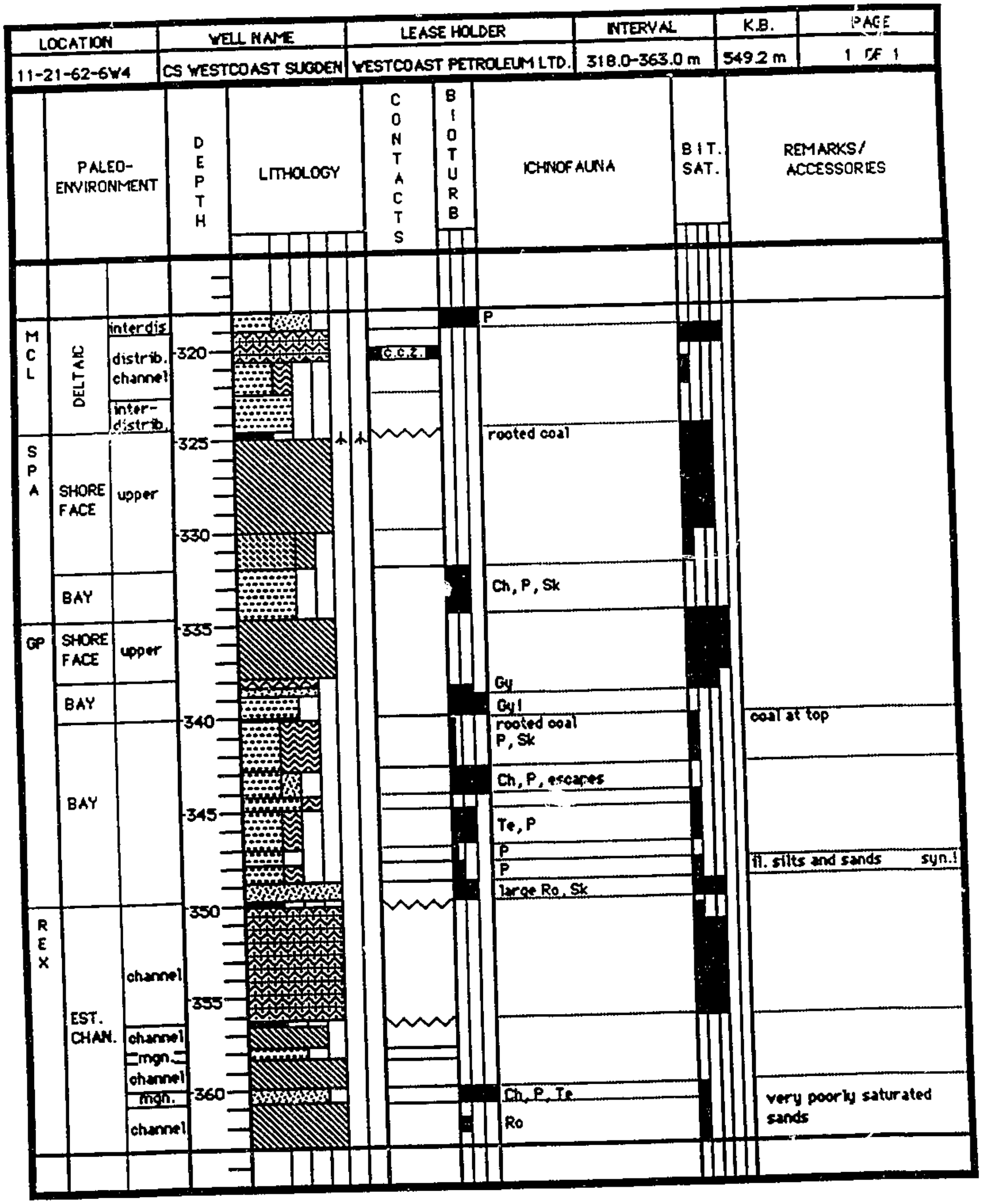
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-22-62-5W4	MOBIL BIG MEADOW	MOBIL OIL CANADA LTD.	354.0-410.0 m	554.9 m	1 OF 2



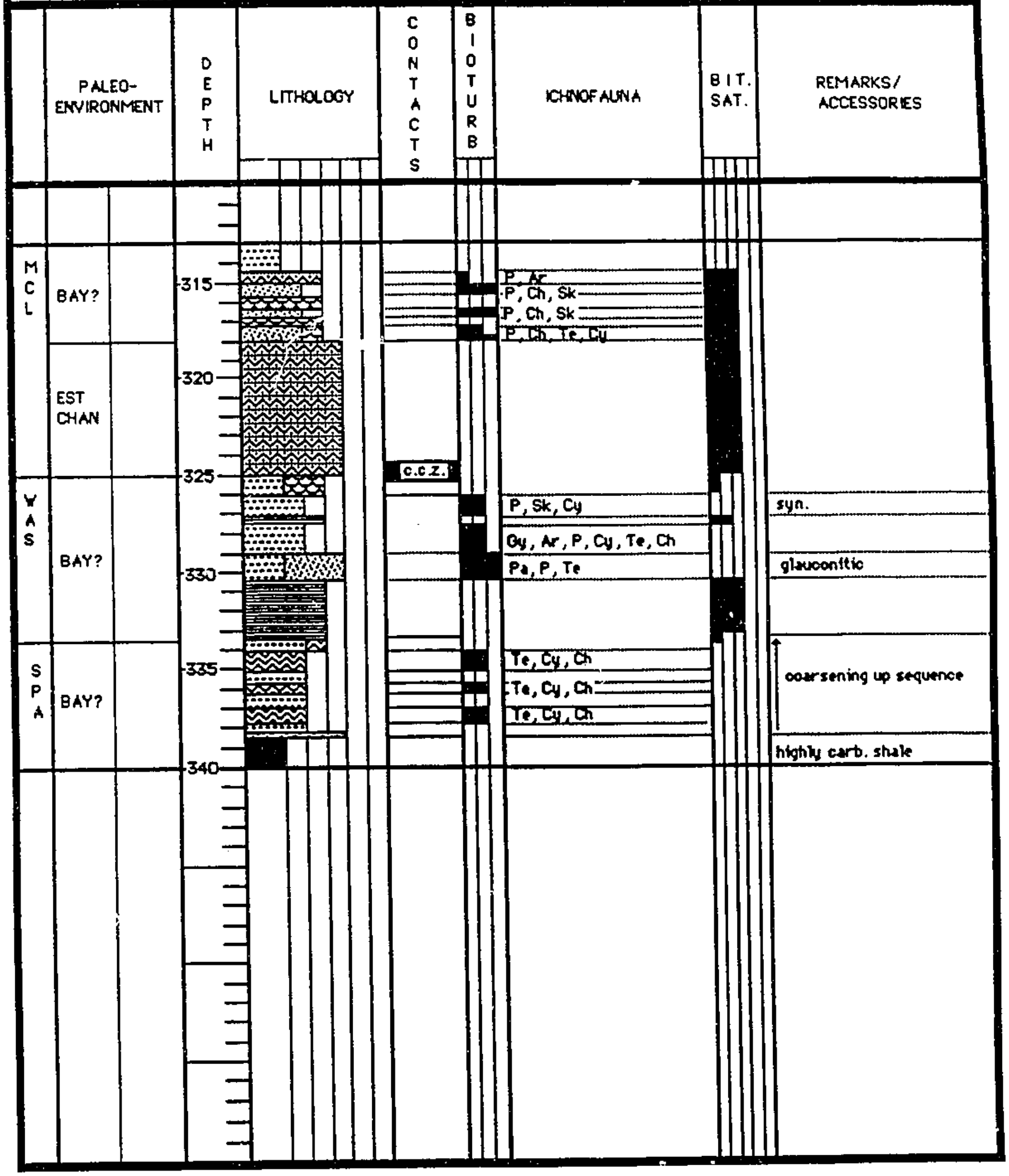
mudstone with carb. debris and some plant material preserved

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-22-62-5W4	MOBIL BIG MEADOW	MOBIL OIL CANADA LTD.	354.0-410.0 m	554.9 m	1 OF 2

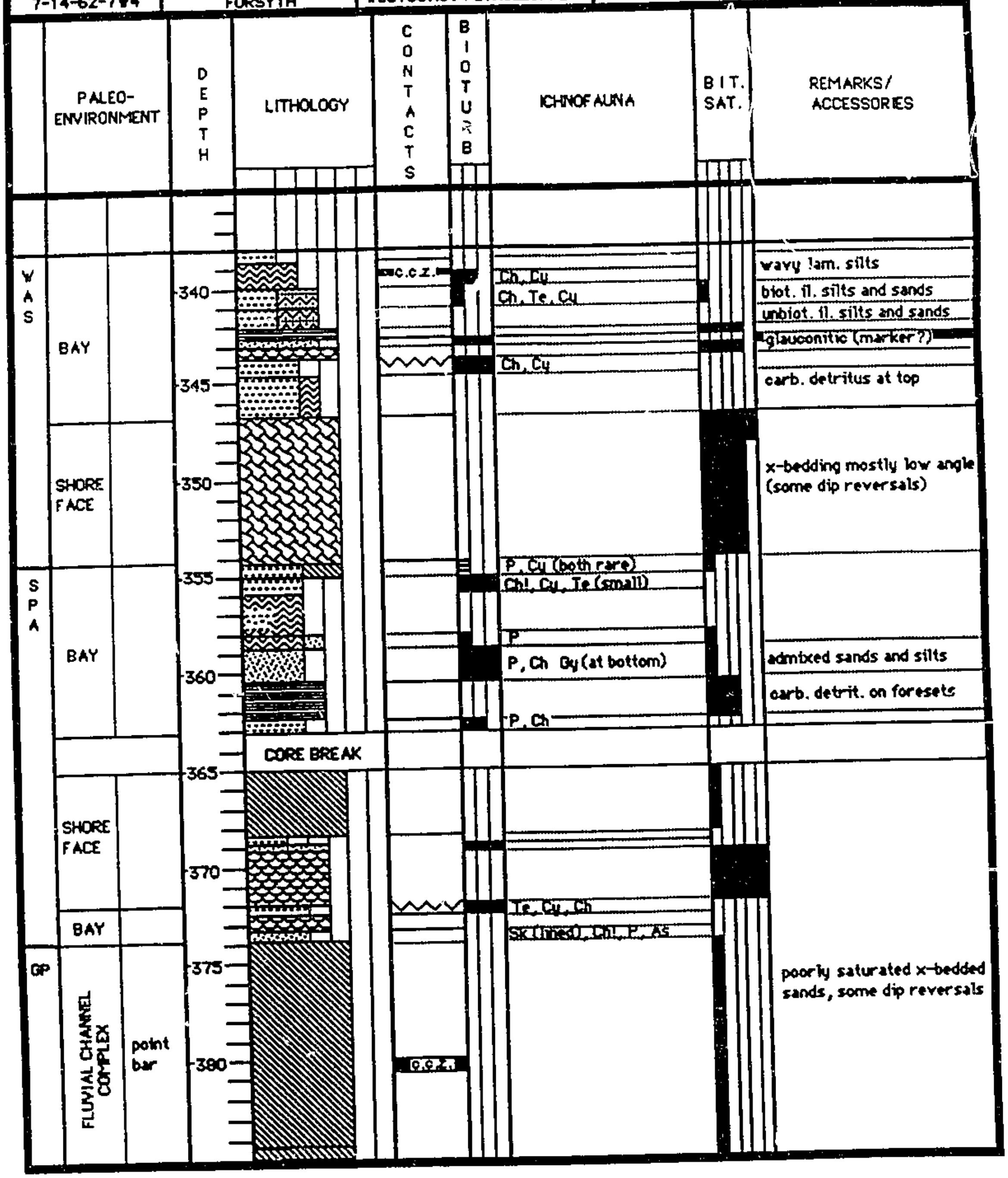



LOCATION
11-21-62-6W4
WELL NAME
CS WESTCOAST SUGDEN
LEASE HOLDER
WESTCOAST PETROLEUM LTD.
INTERVAL
318.0-363.0 m
K.B.
549.2 m
PAGE
1 OF 1
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
MCL
DELTAIC
interdis.
distrib. channel
inter-distrib.
SPA
SHORE FACE
upper
BAY
GP
SHORE FACE
upper
BAY
BAY
REX
EST. CHAN.
channel
channel
mgn.
channel
mgn.
channel
320
325
330
335
340
345
350
355
360
c.c.z.
P
rooted coal
Ch, P, Sk
Gy
Gy!
rooted coal
P, Sk
Ch, P, escapes
Te, P
P
P
large Ro, Sk
Ch, P, Te
Ro
coal at top
fl. silts and sands
syn.!
very poorly saturated sands

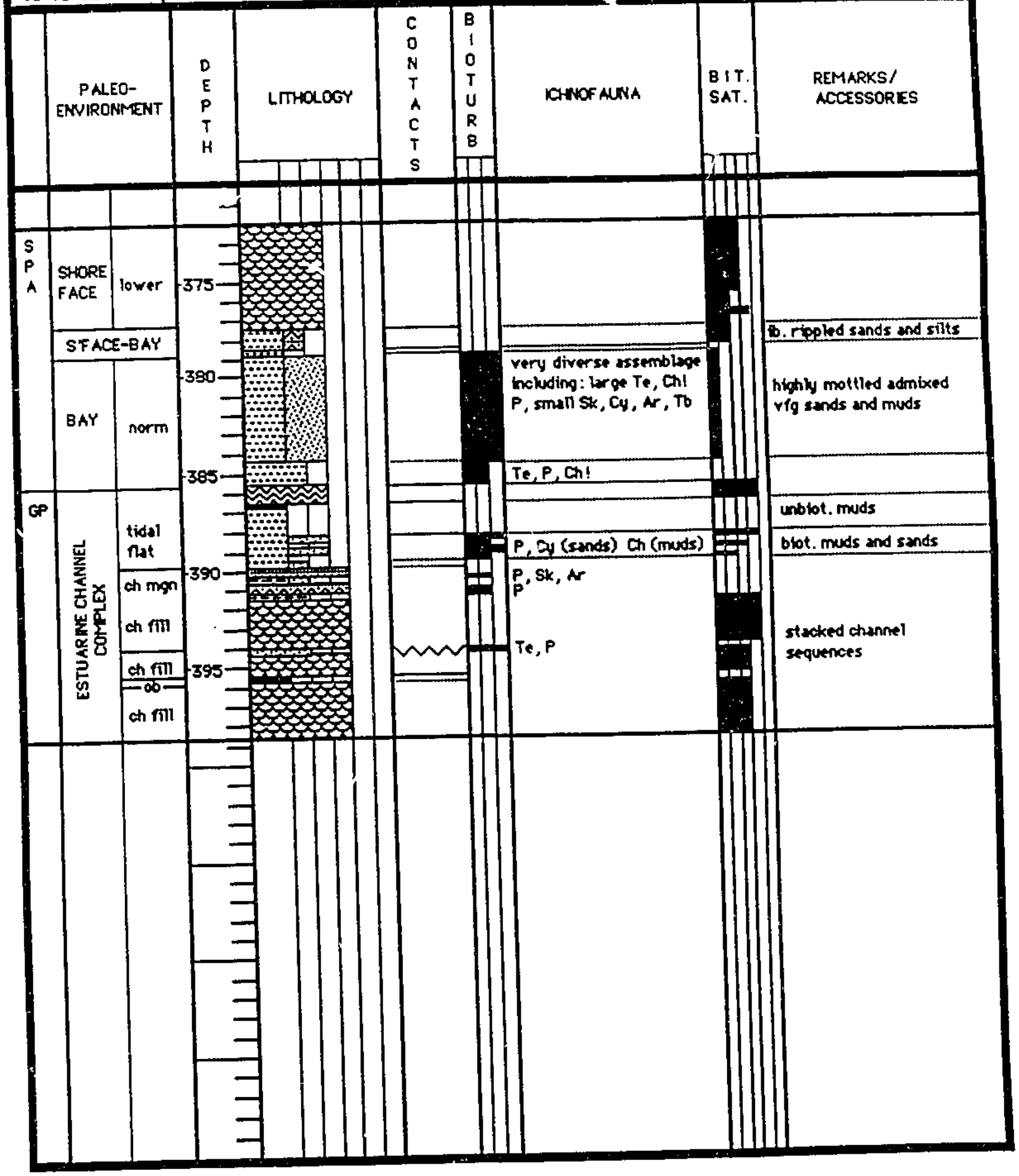
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-22-62-6W4	WESTCOAST FORSYTH	WESTCOAST PETROLEUM LTD	313-340 m	553.7 m	1 OF 1



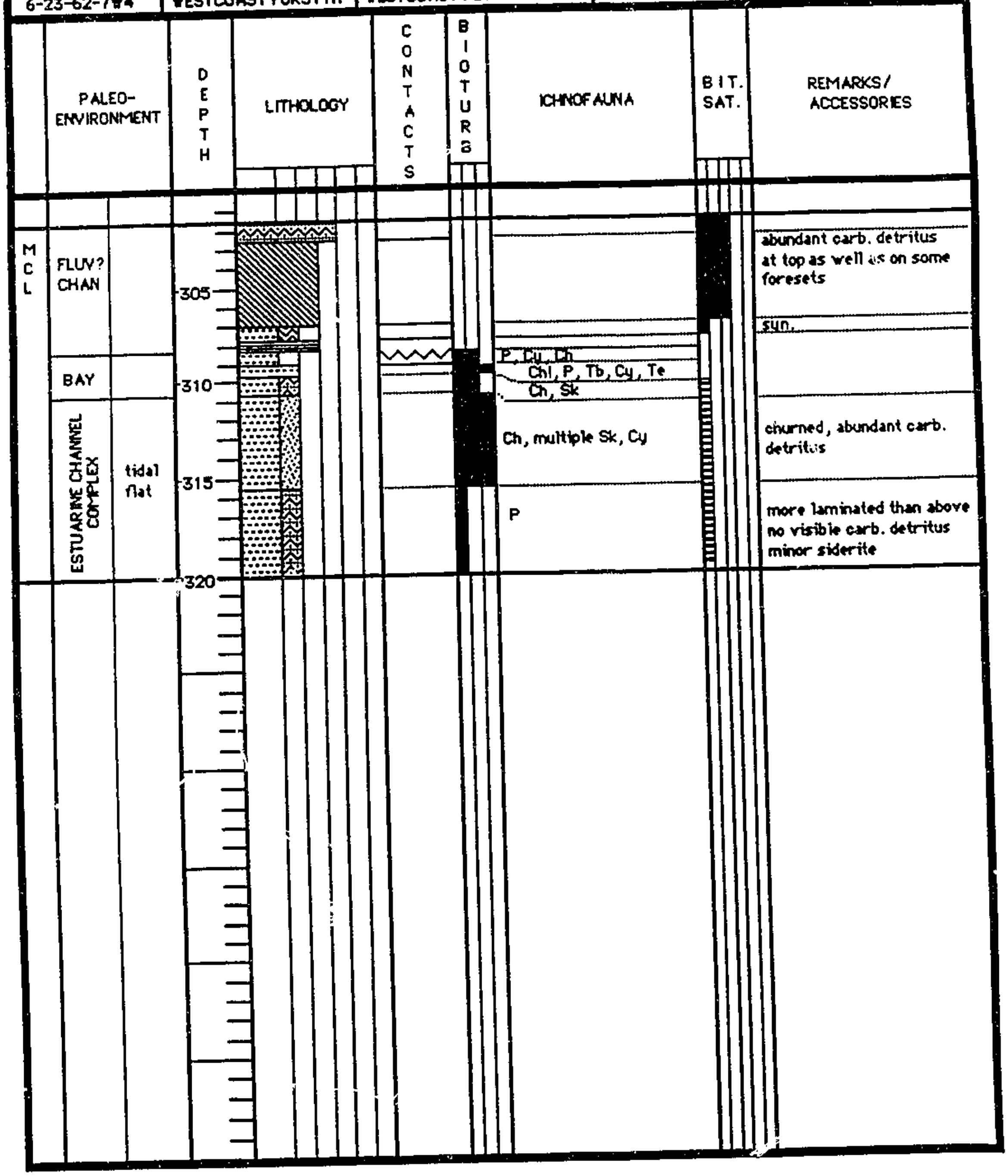
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-14-62-7W4	CS WESTCOAST FORSYTH	WESTCOAST PETROLEUM LTD	338.0-385.0 m	564.1 m	1 OF 1



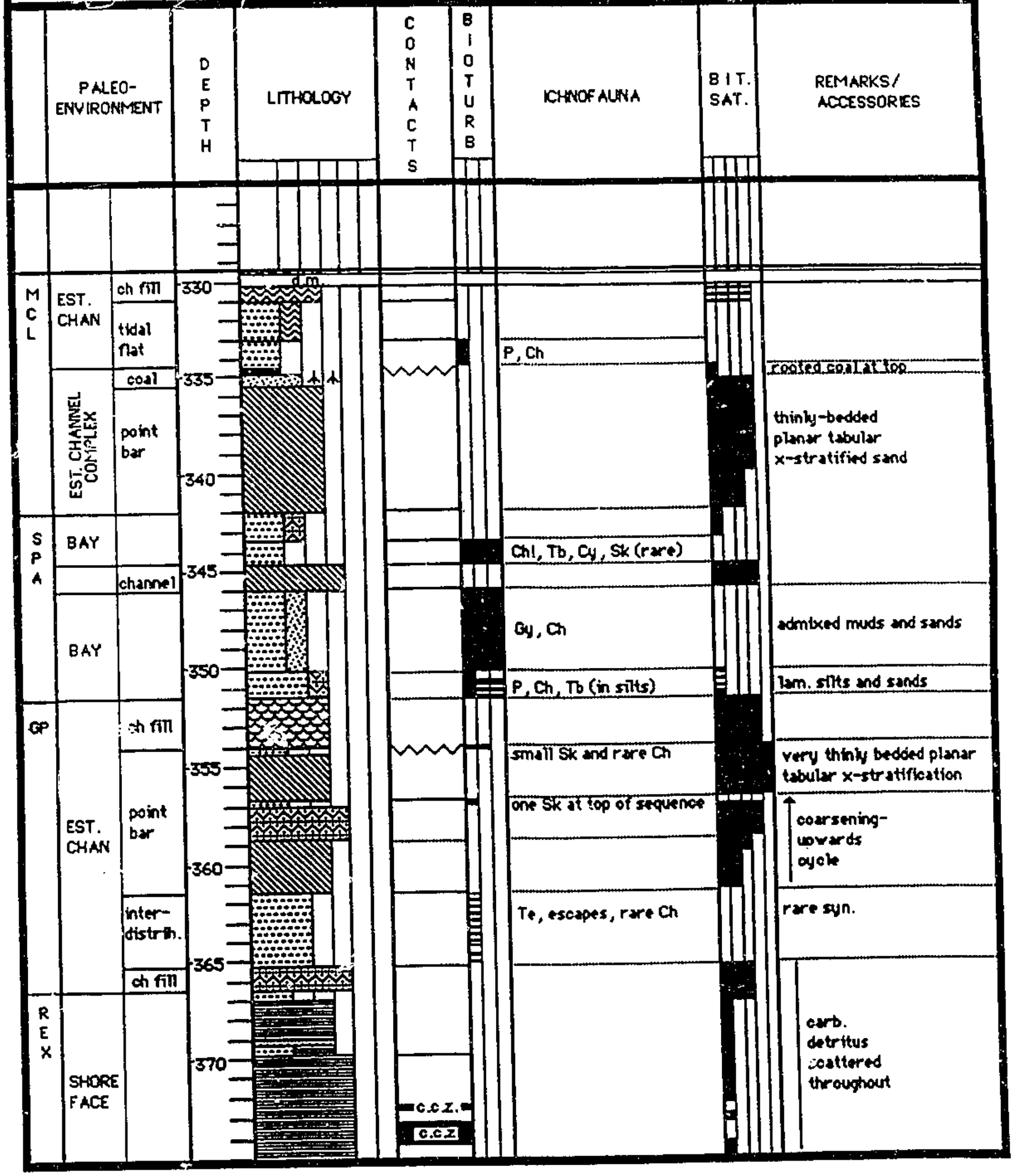
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-15-62-7W4	WESTCOAST FORSYTH	WESTCOAST PETROLEUM LTD	372.0-398.5 m	592.6 m	1 OF 1



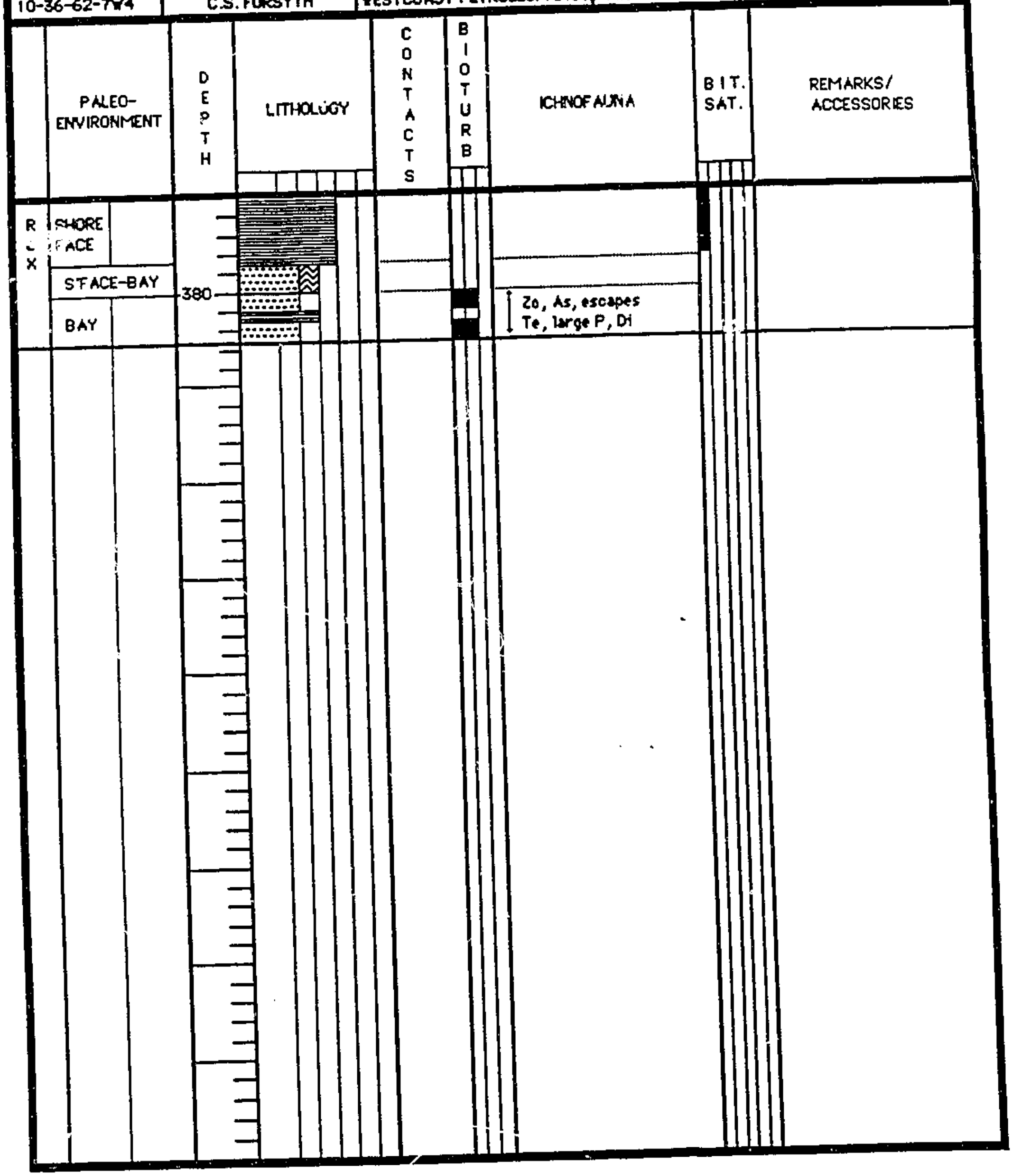
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-23-62-7W4	WESTCOAST FORSYTH	WESTCOAST PETROLEUM LTD	301.5-320.0 m	554.4 m	1 OF 1



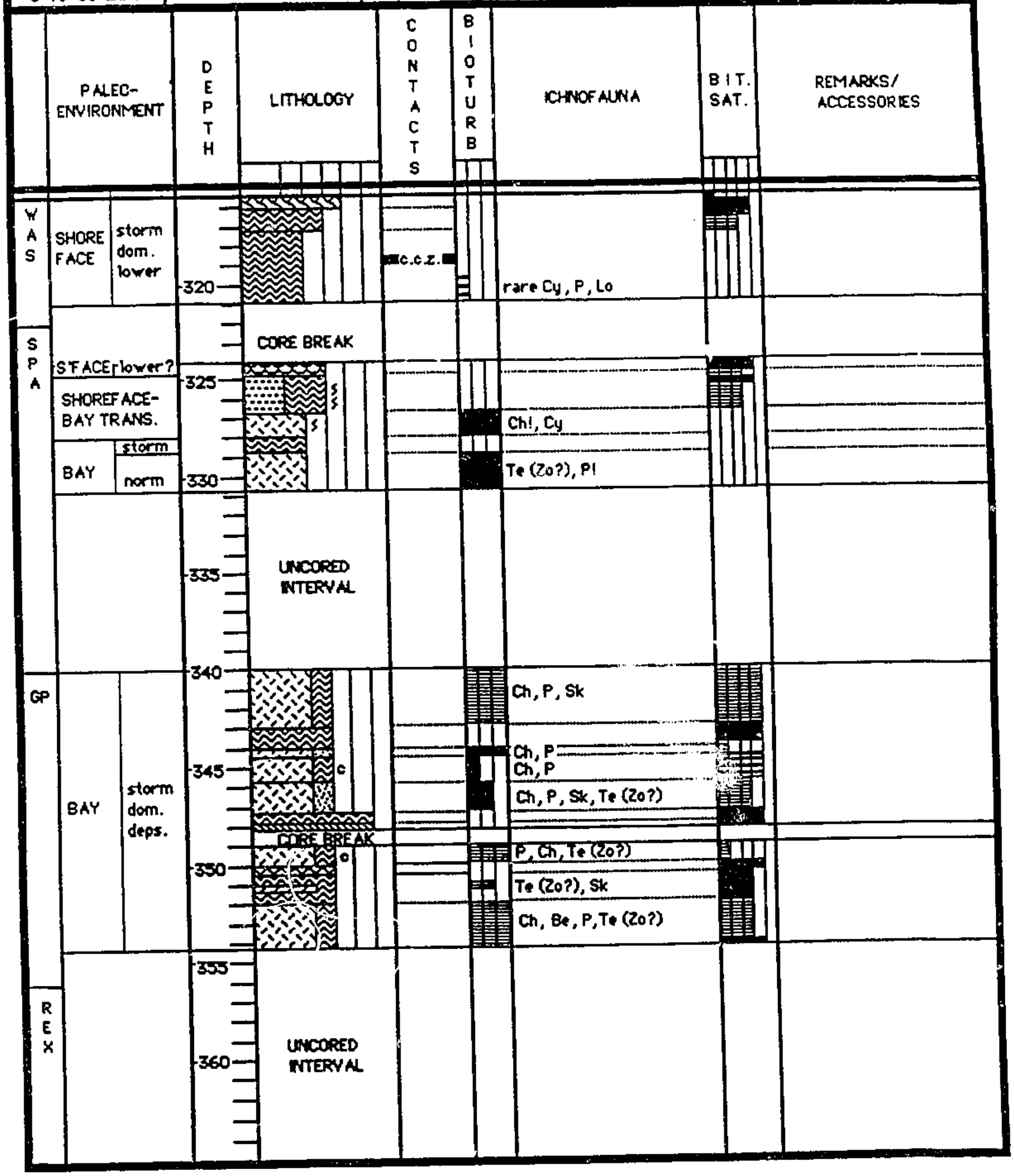
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-36-62-7W4	C.S. FORSYTH	WESTCOAST PETROLEUM LTD	329.5-382.8 m	554.4 m	1 OF 2



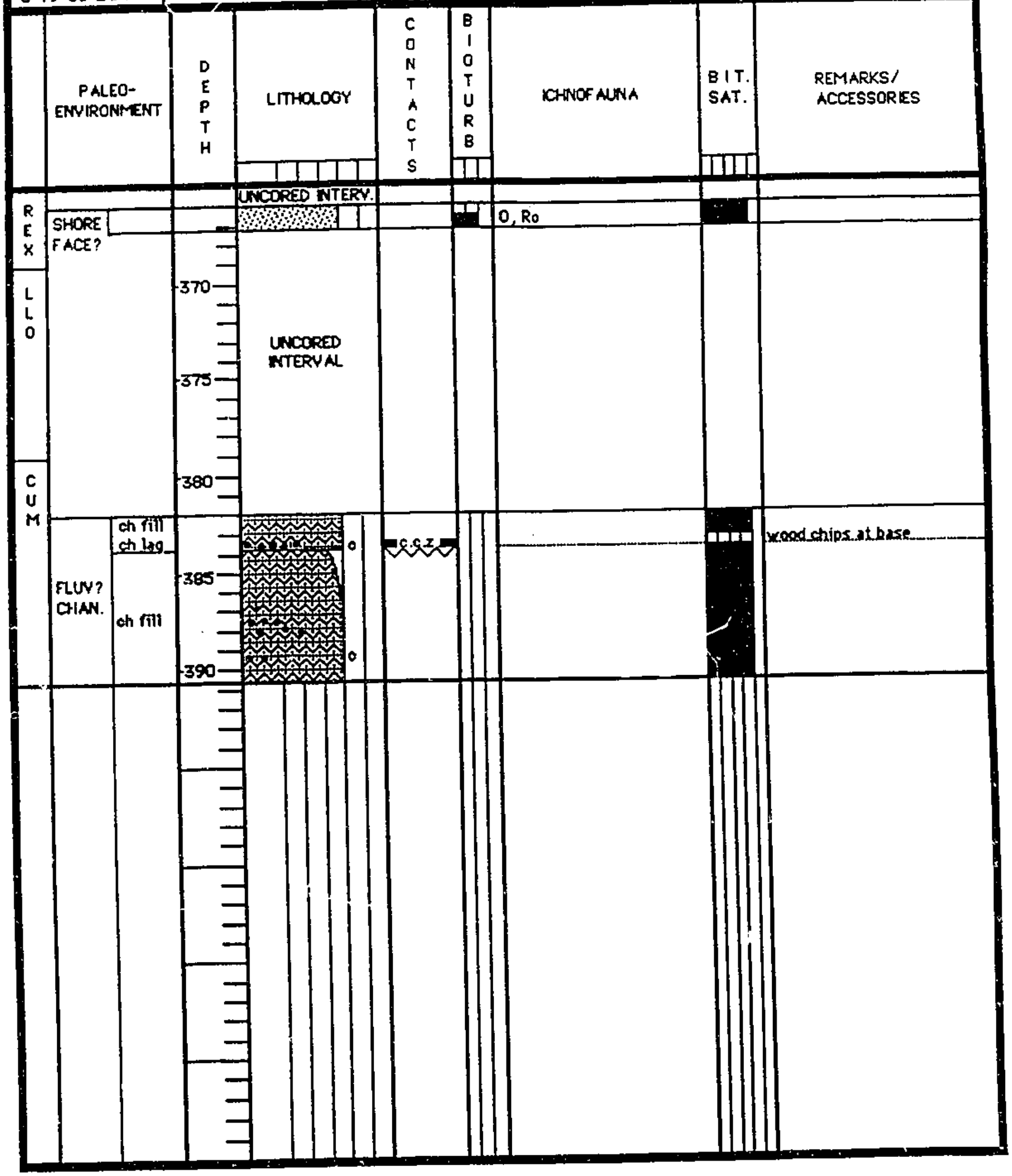
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-36-62-7W4	C.S. FORSYTH	WESTCOAST PETROLEUM LTD.	329.5-382.8 m	554.4 m	2 OF 2

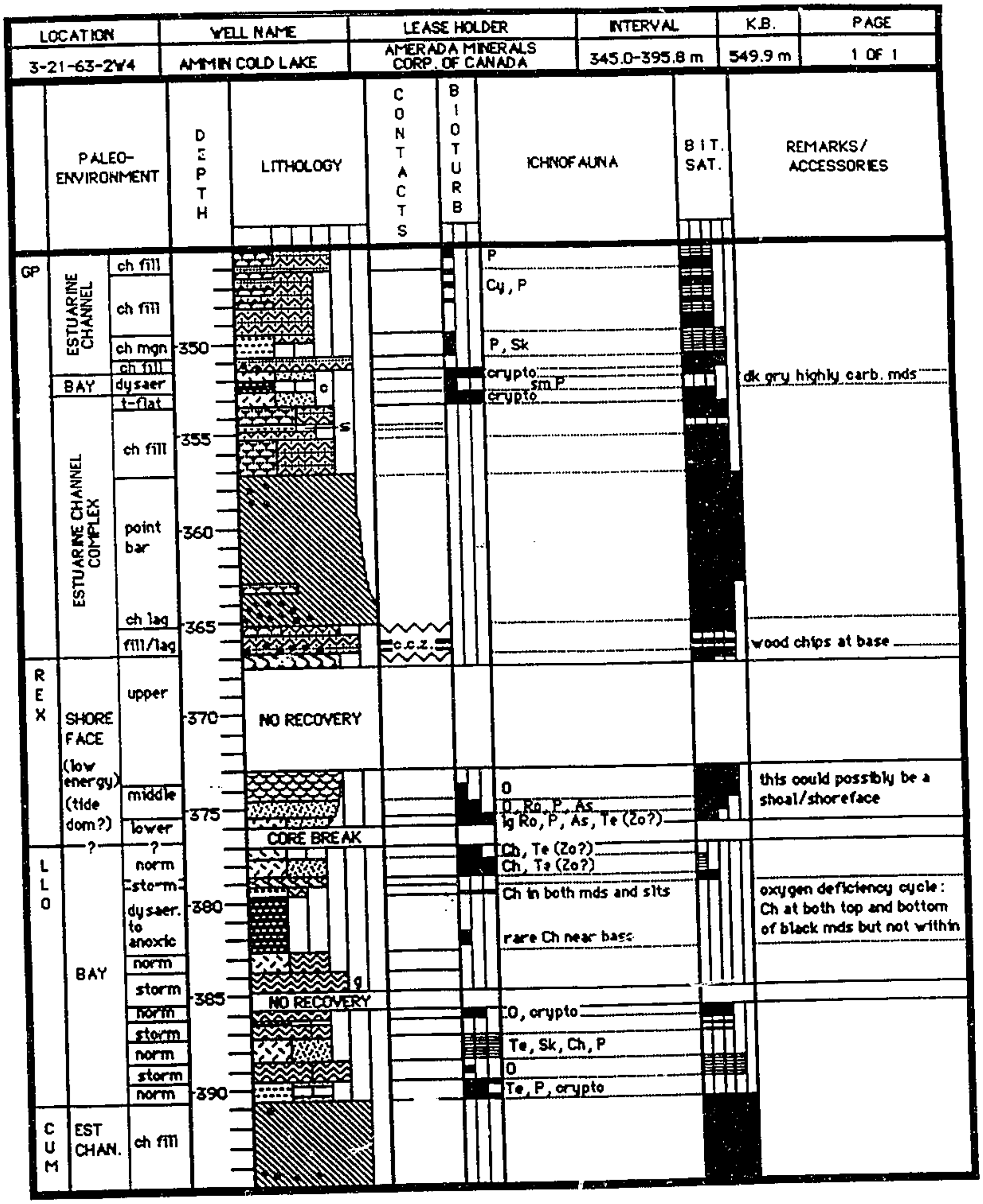


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-19-63-2W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	315.5-390.45 m	544.5 m	1 OF 2



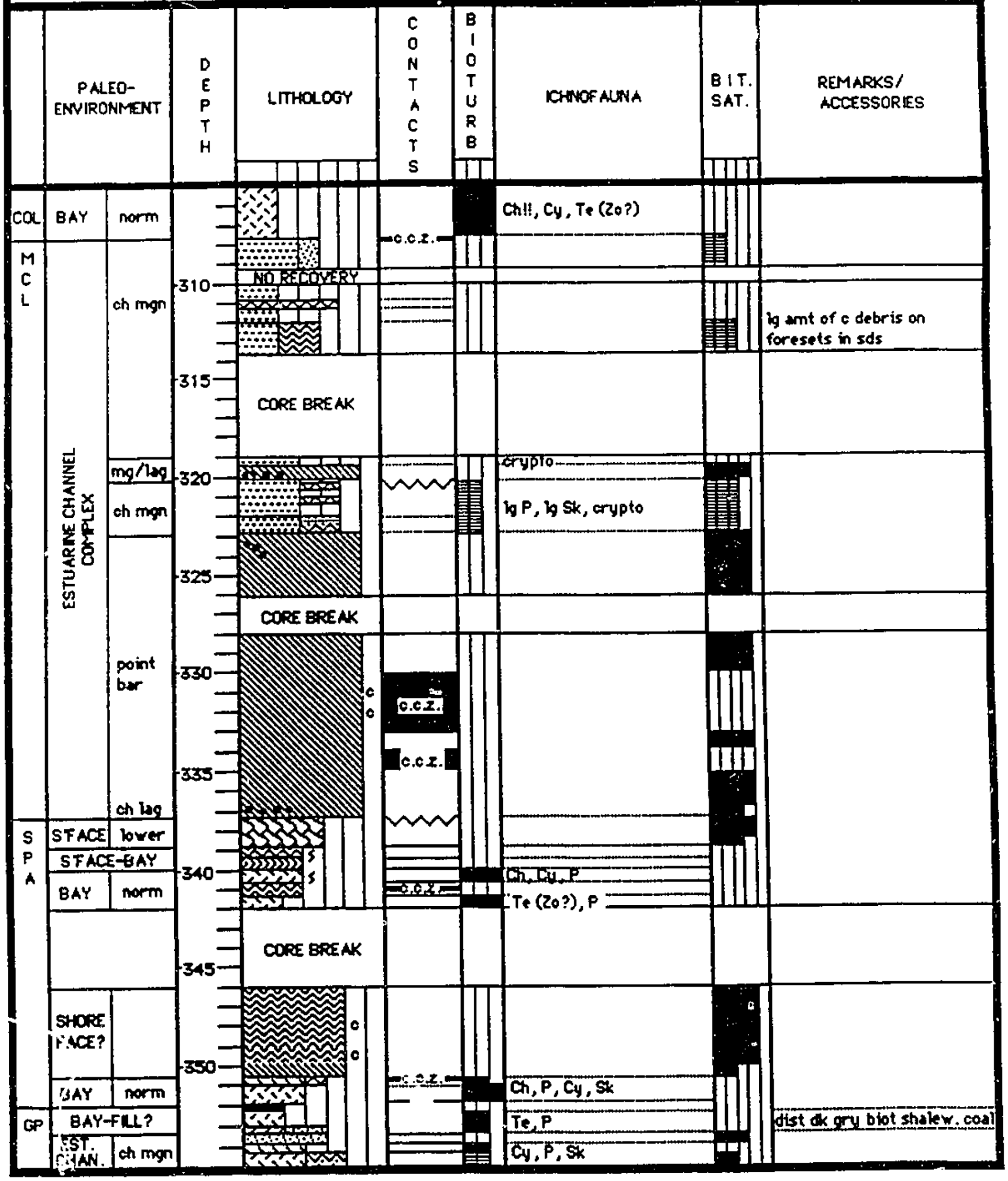
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-19-63-2W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	315.5-390.45 m	544.5 m	2 OF 2



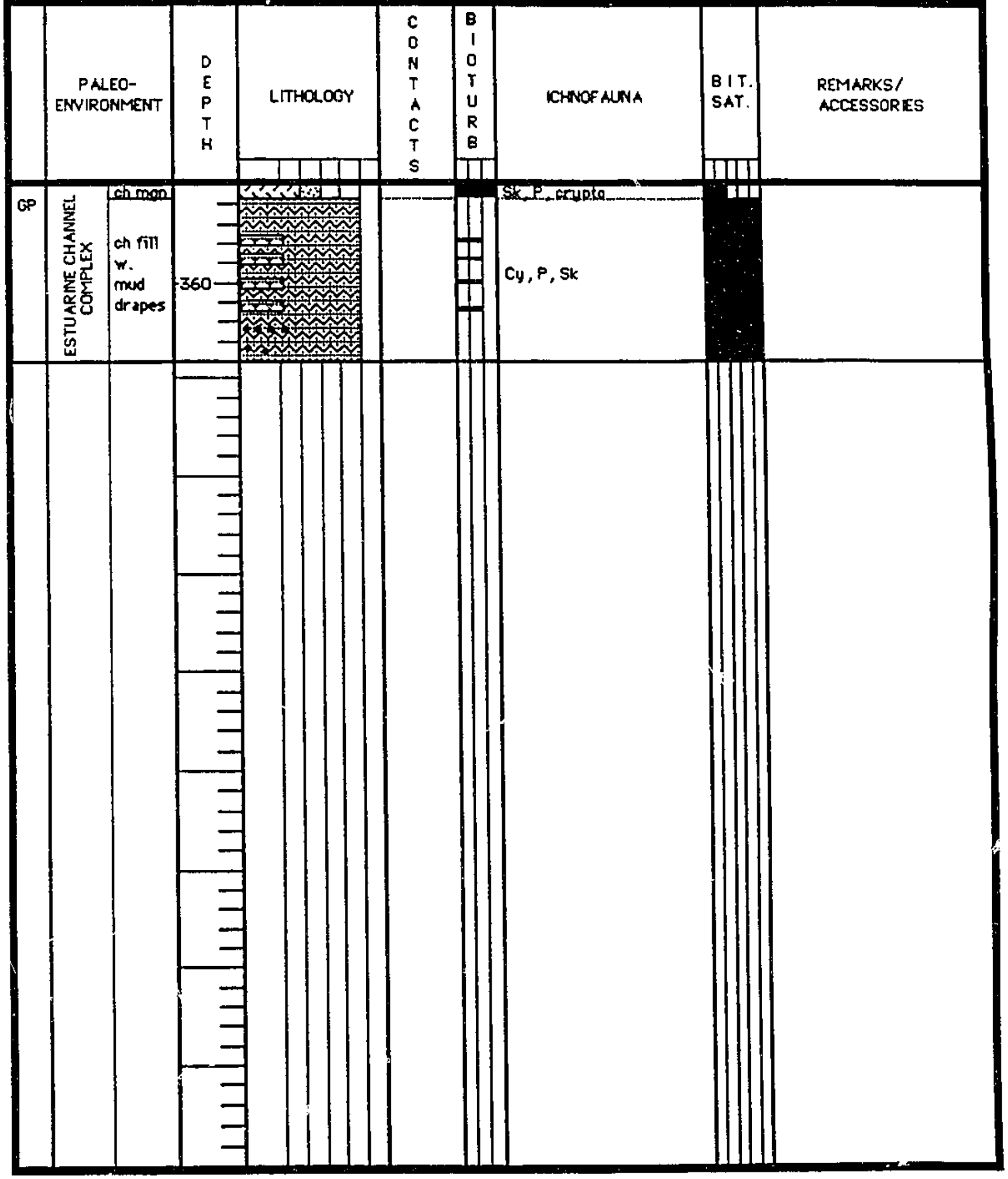


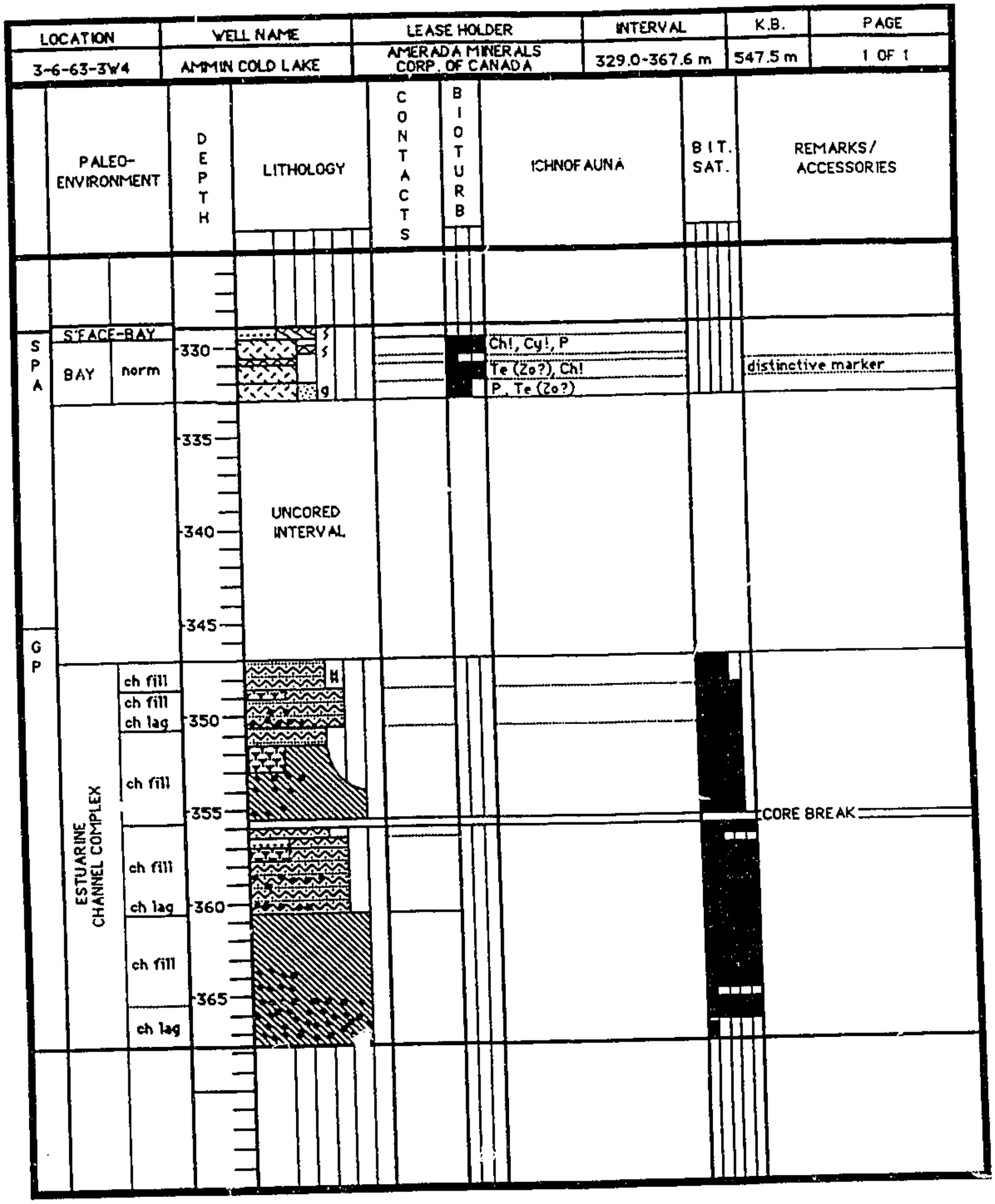
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-21-63-2W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	345.0-395.8 m	549.9 m	1 OF 1

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-4-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	305.0-364.0 m	545.7 m	1 OF 2

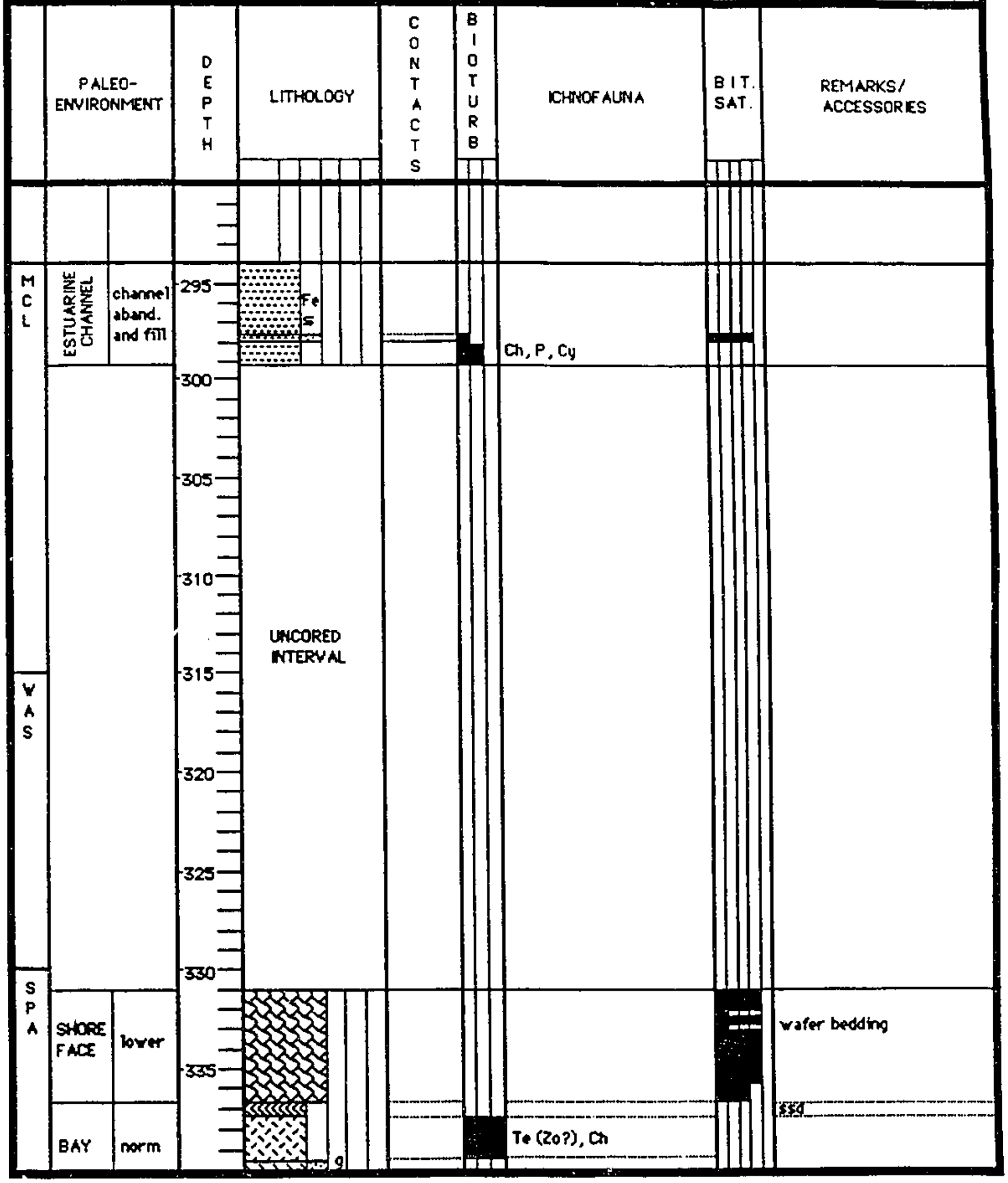


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-4-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	305-364 m	545.7 m	2 OF 2

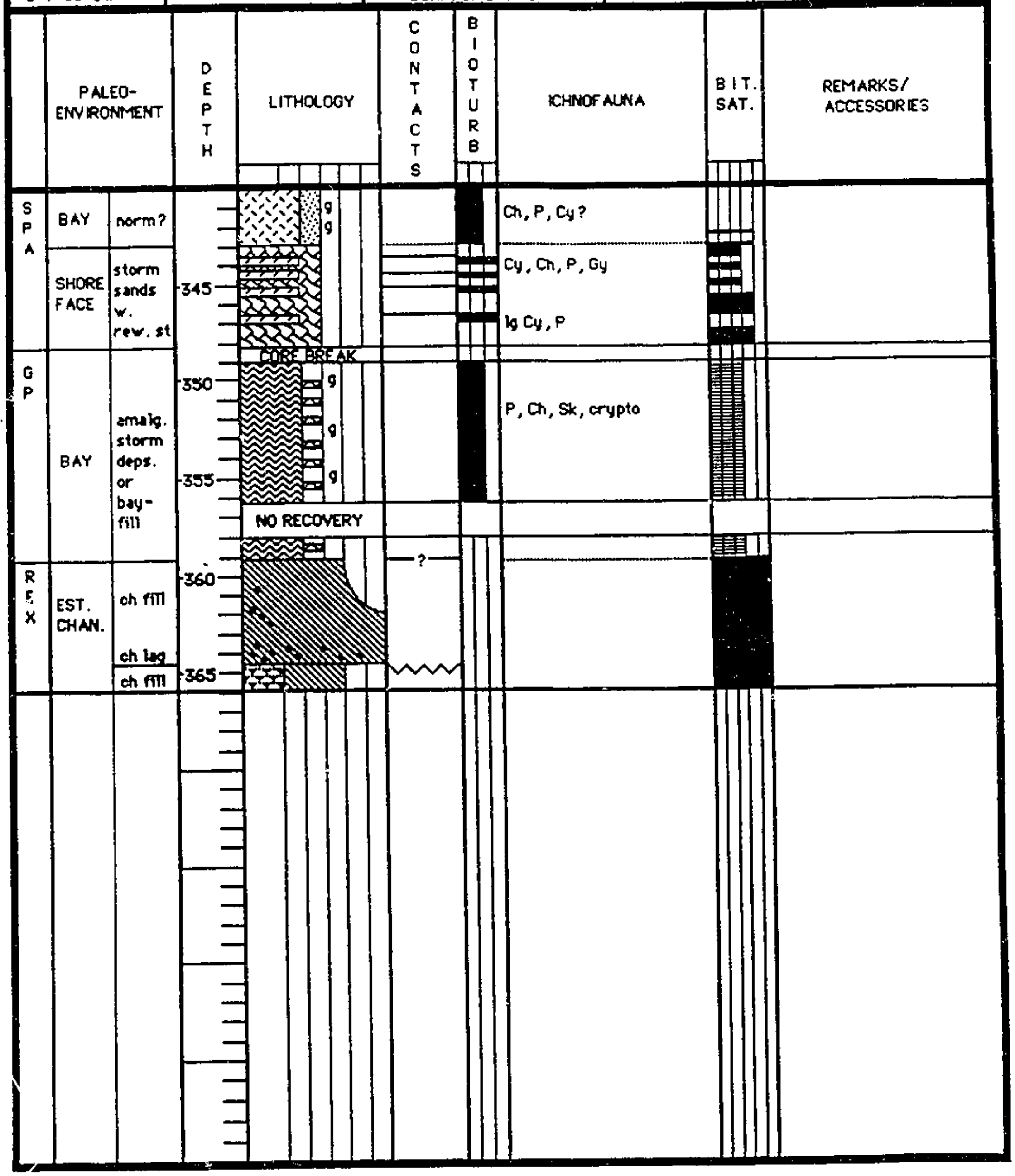



LOCATION
3-6-63-3W4
WELL NAME
AMMIN COLD LAKE
LEASE HOLDER
AMERADA MINERALS CORP. OF CANADA
INTERVAL
329.0-367.6 m
K.B.
547.5 m
PAGE
1 OF 1
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
SPA
S'FACE-BAY
BAY
norm
330
Ch!, Cy!, P
Te (Zo?), Ch!
P, Te (Zo?)
distinctive marker
335
340
UNCORED INTERVAL
345
GP
ESTUARINE CHANNEL COMPLEX
ch fill
ch fill
ch lag
350
ch fill
355
CORE BREAK
ch fill
ch lag
360
ch fill
365
ch lag

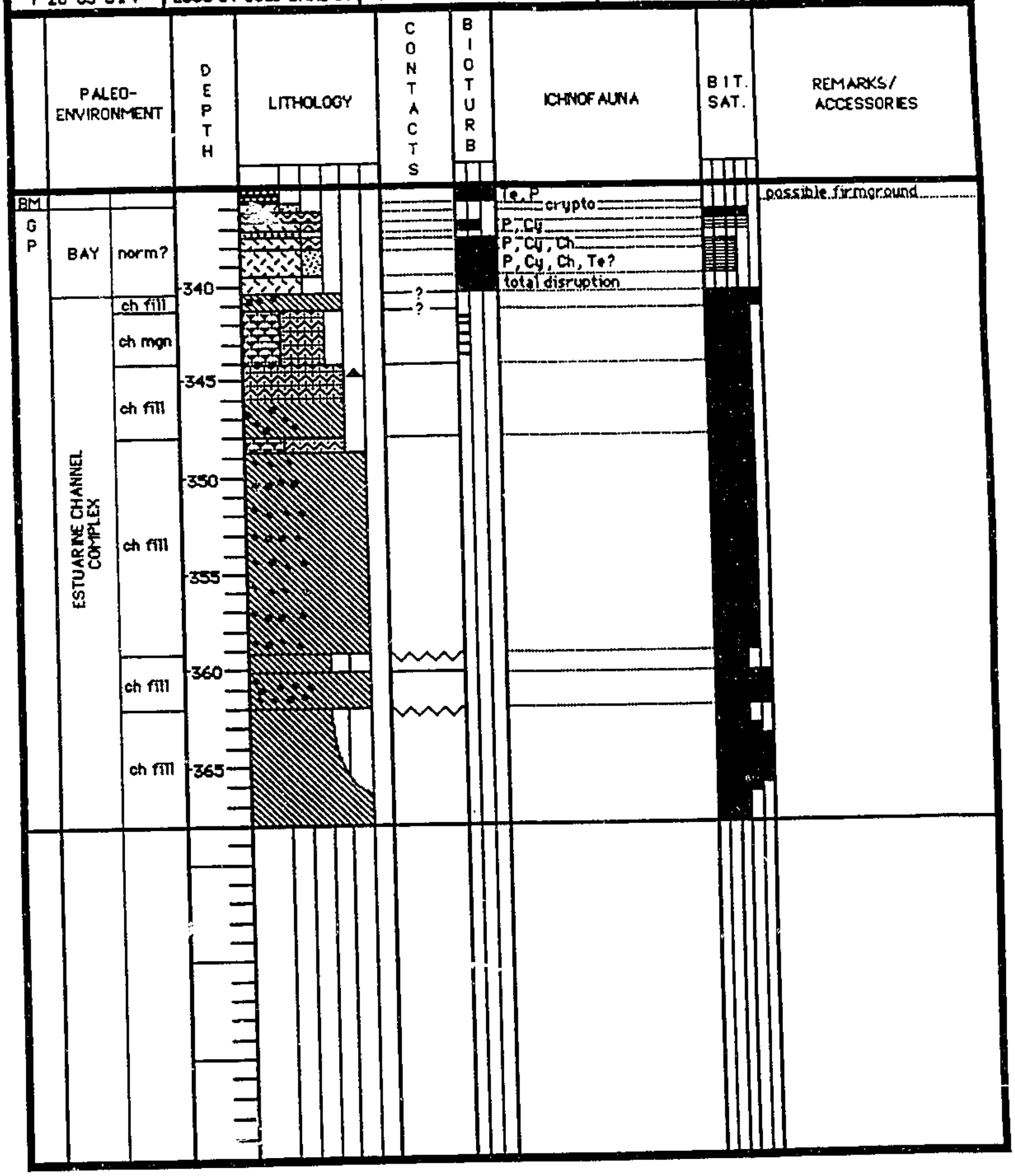
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-7-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	294.0-366.5 m	551.2 m	1 OF 2



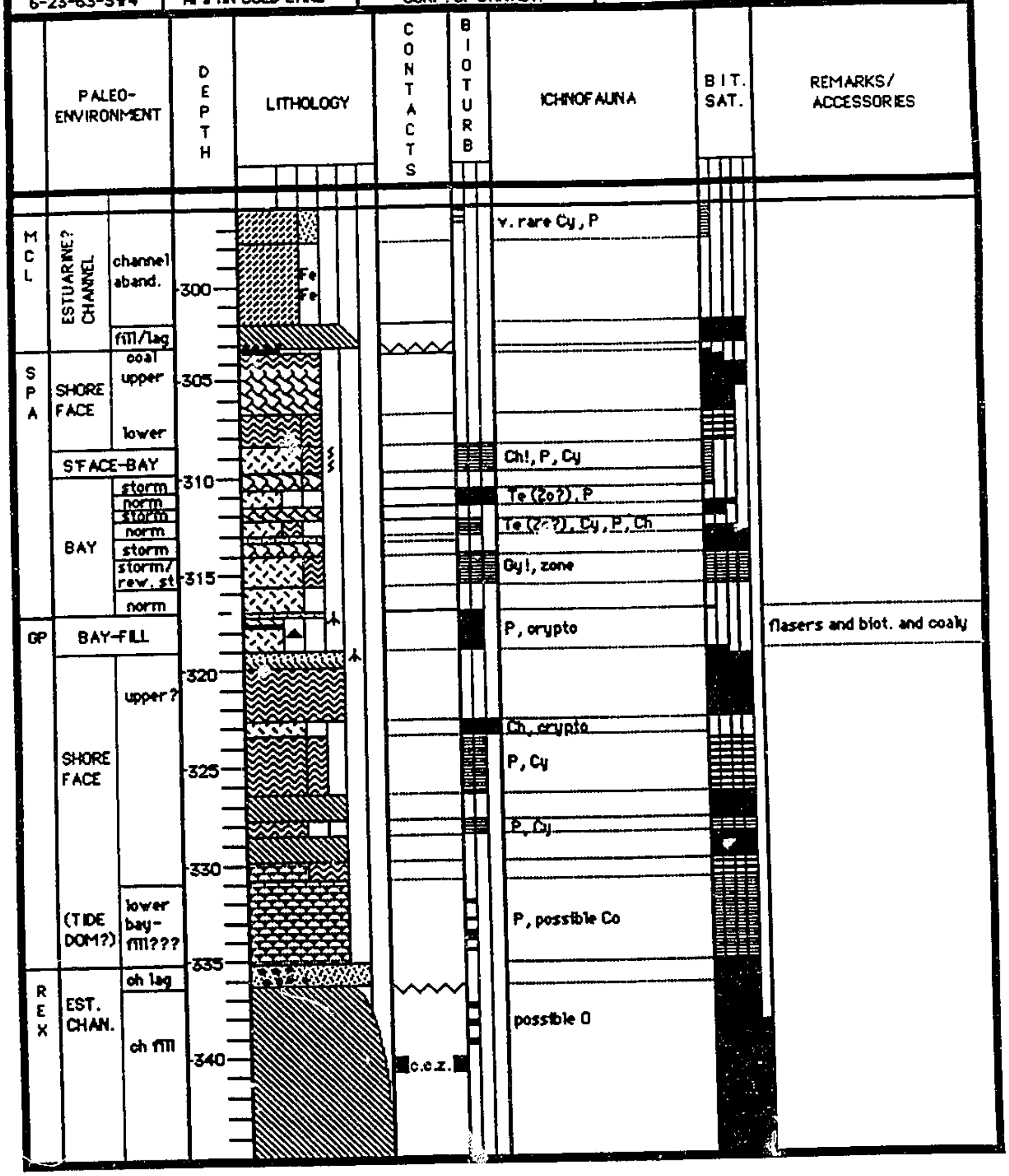
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-7-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	294.0-366.5 m	551.2 m	2 OF 2



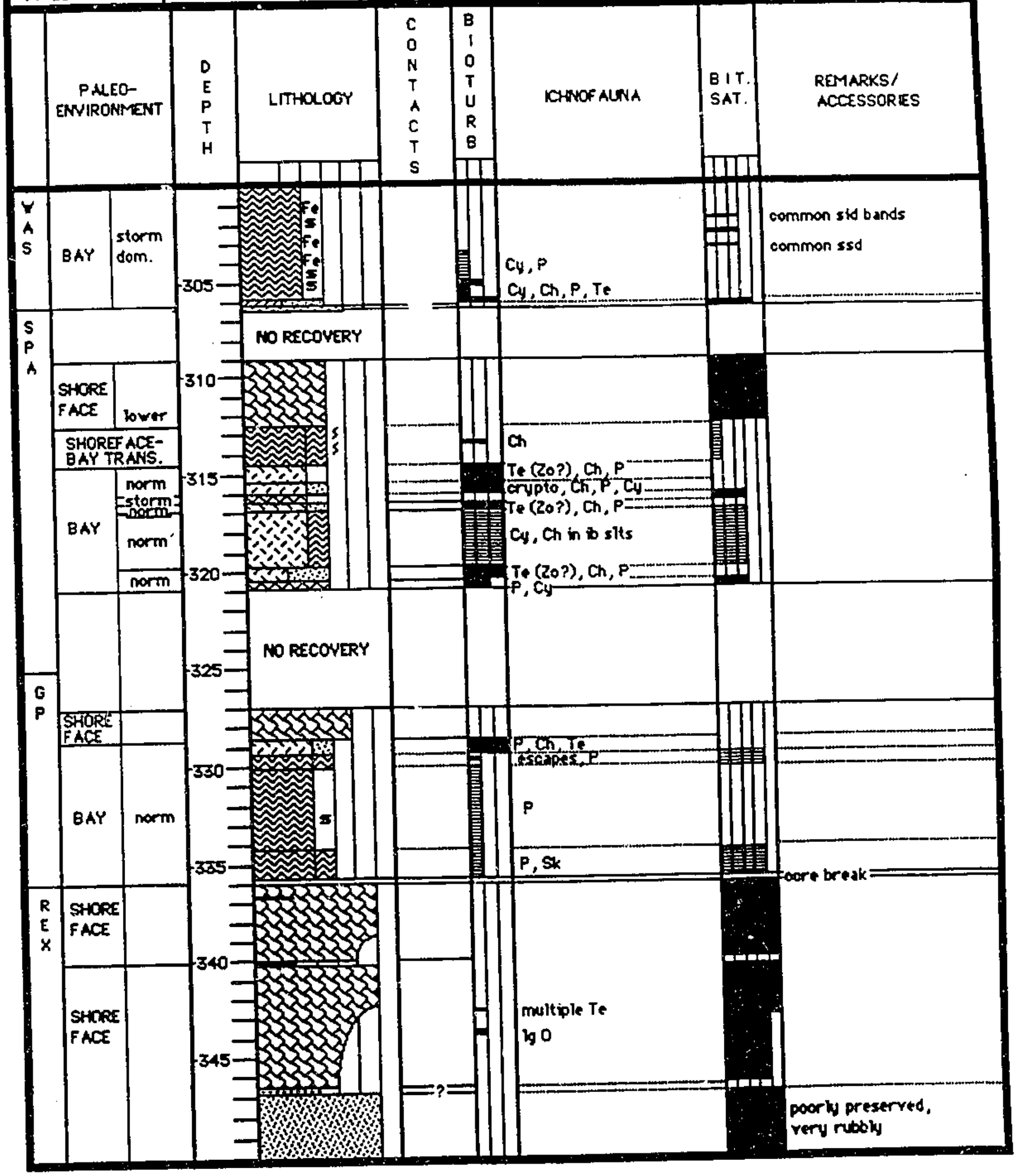
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-20-63-3W4	ESSO 81 COLD LAKE OV	ESSO RESOURCES CANADA	335.0-368.0 m	550.7 m	1 OF 1



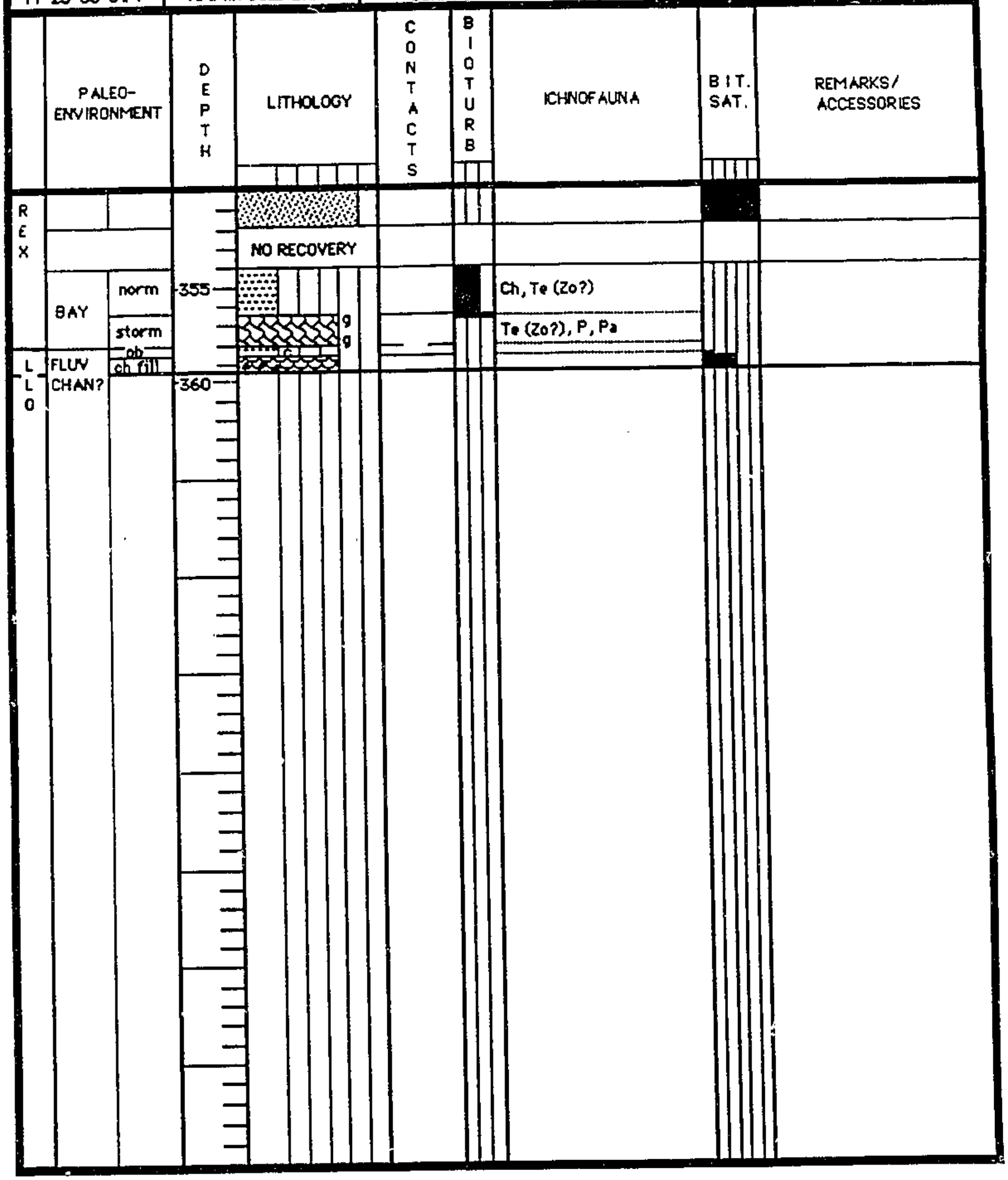
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-23-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	296.0-345.0 m	545.1 m	1 OF 1



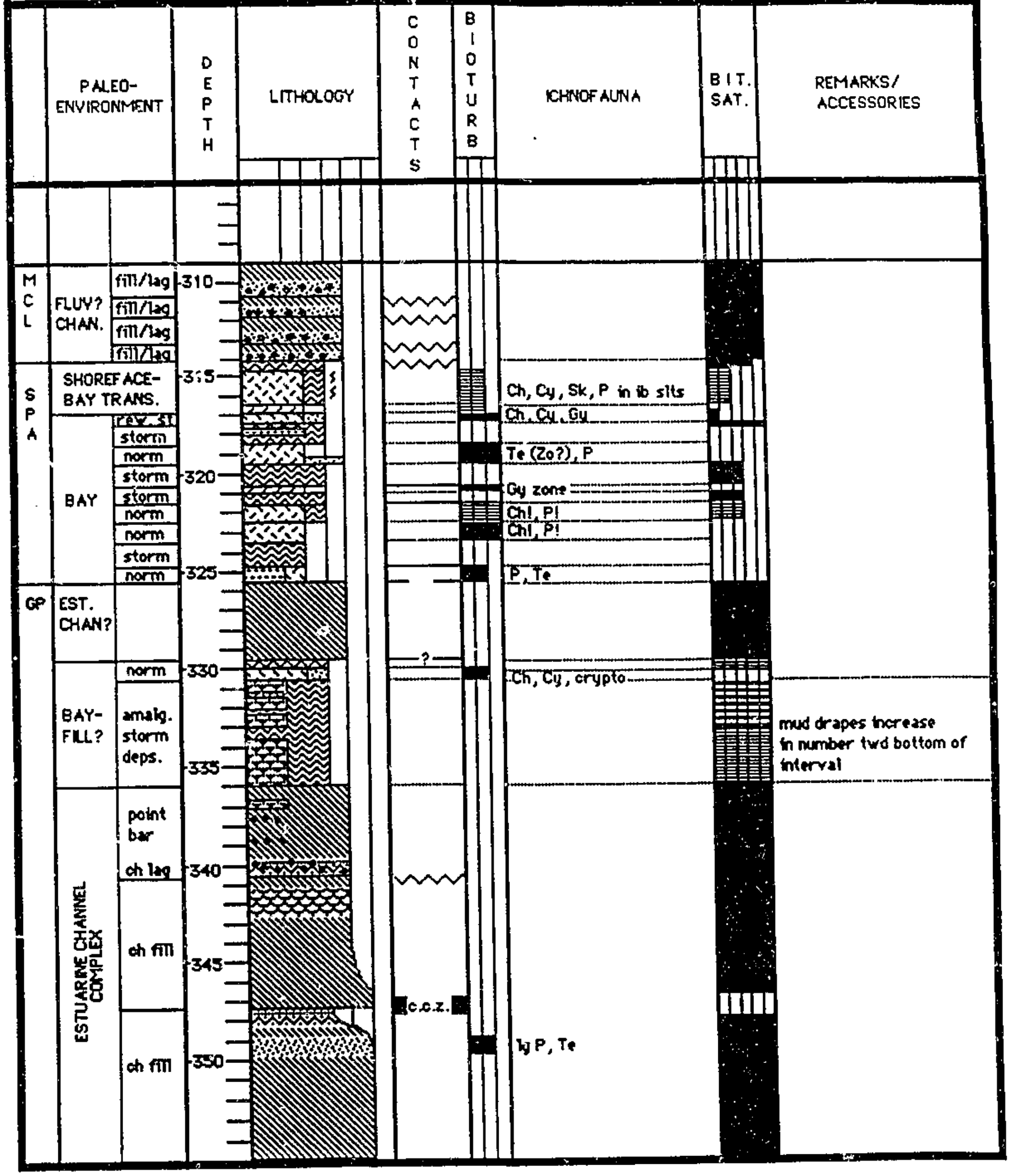
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-25-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	300-360 m	551.7 m	1 OF 2



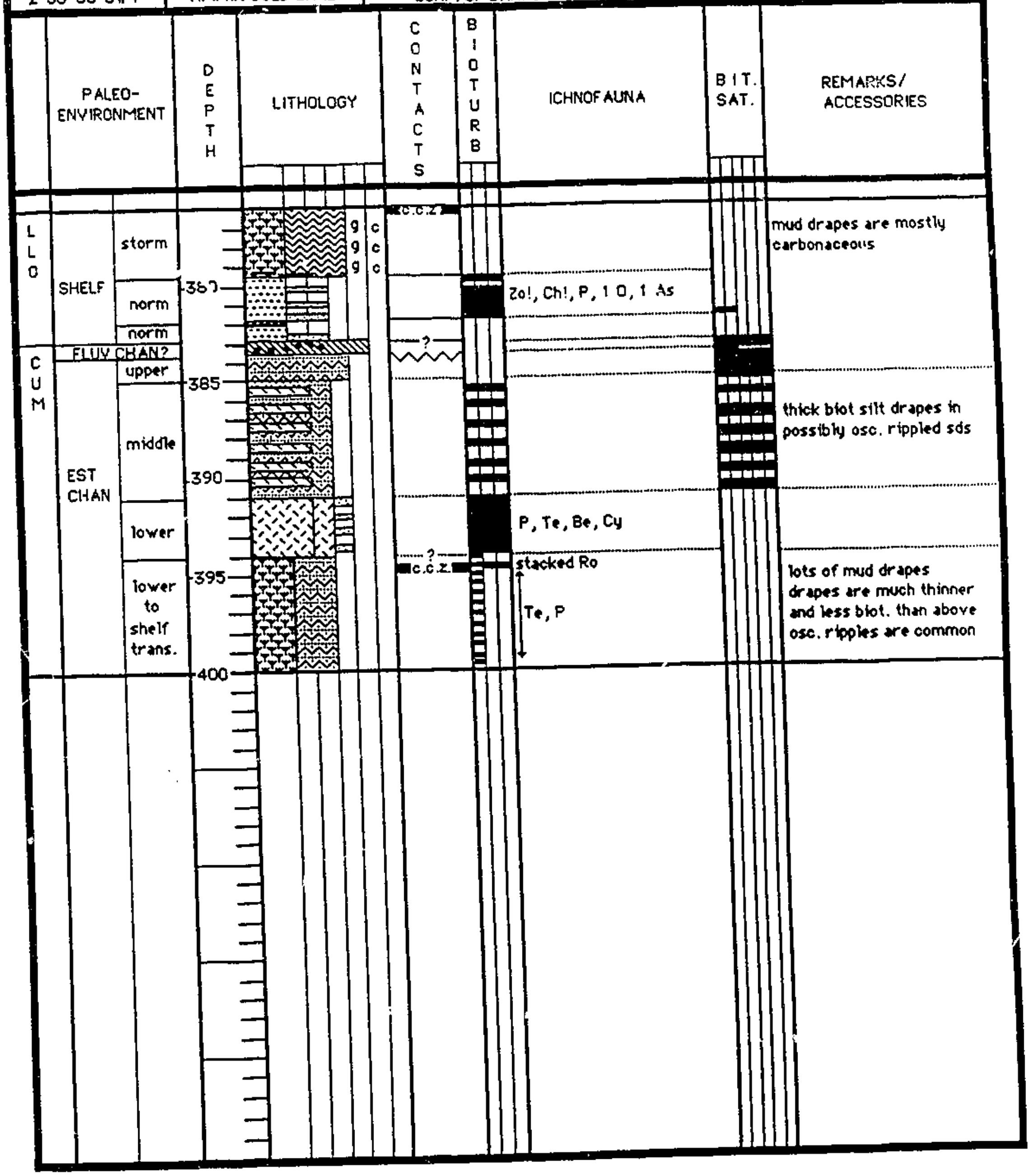
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-25-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	300-360 m	551.7 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-26-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	309.06-355.0 m	548.6 m	1 OF 1



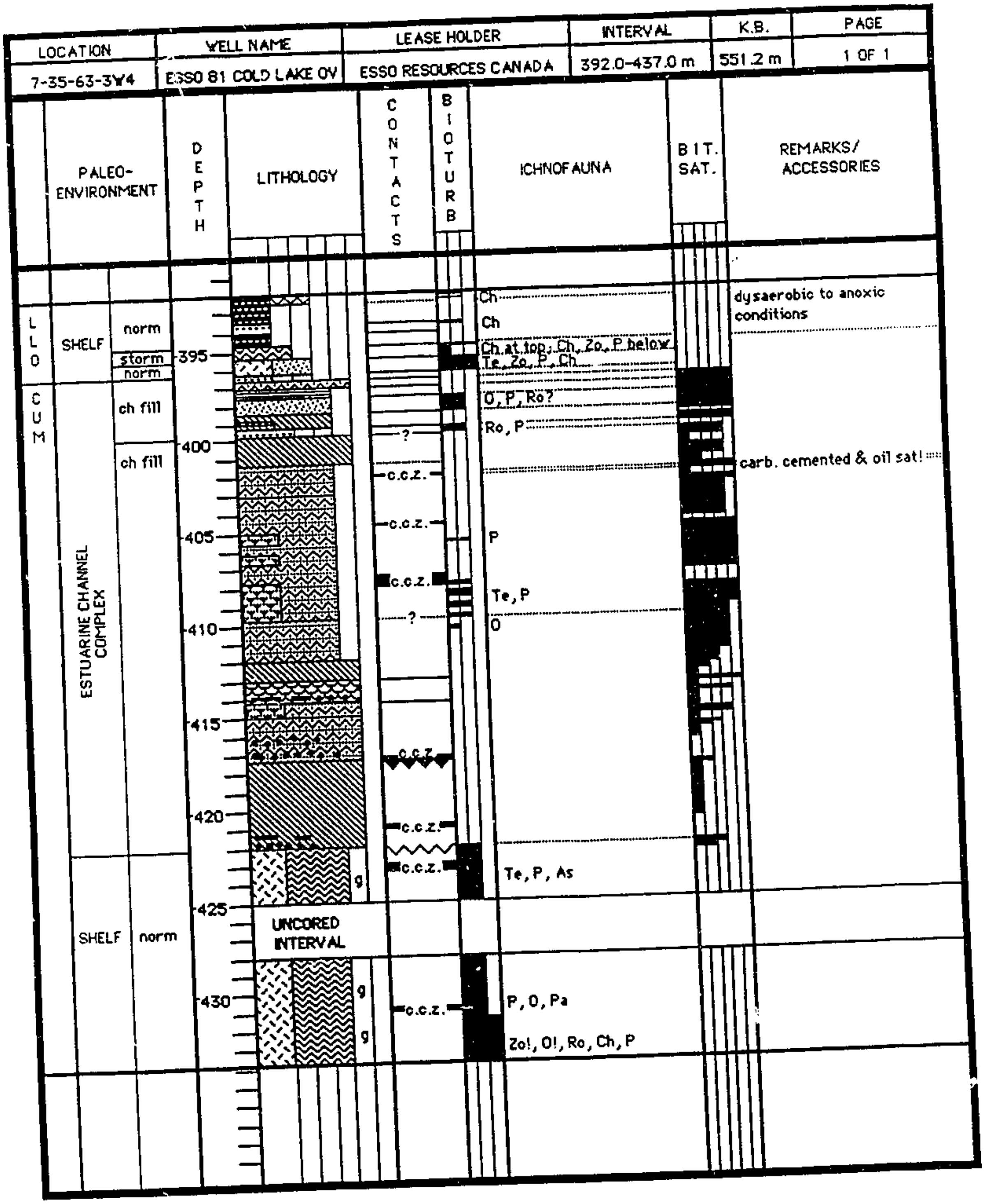
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-30-63-3W4	AMMIN COLD LAKE	AMERADA MINERALS CORP. OF CANADA	376.0-399.0 m	549.0 m	1 OF 1



mud drapes are mostly carbonaceous

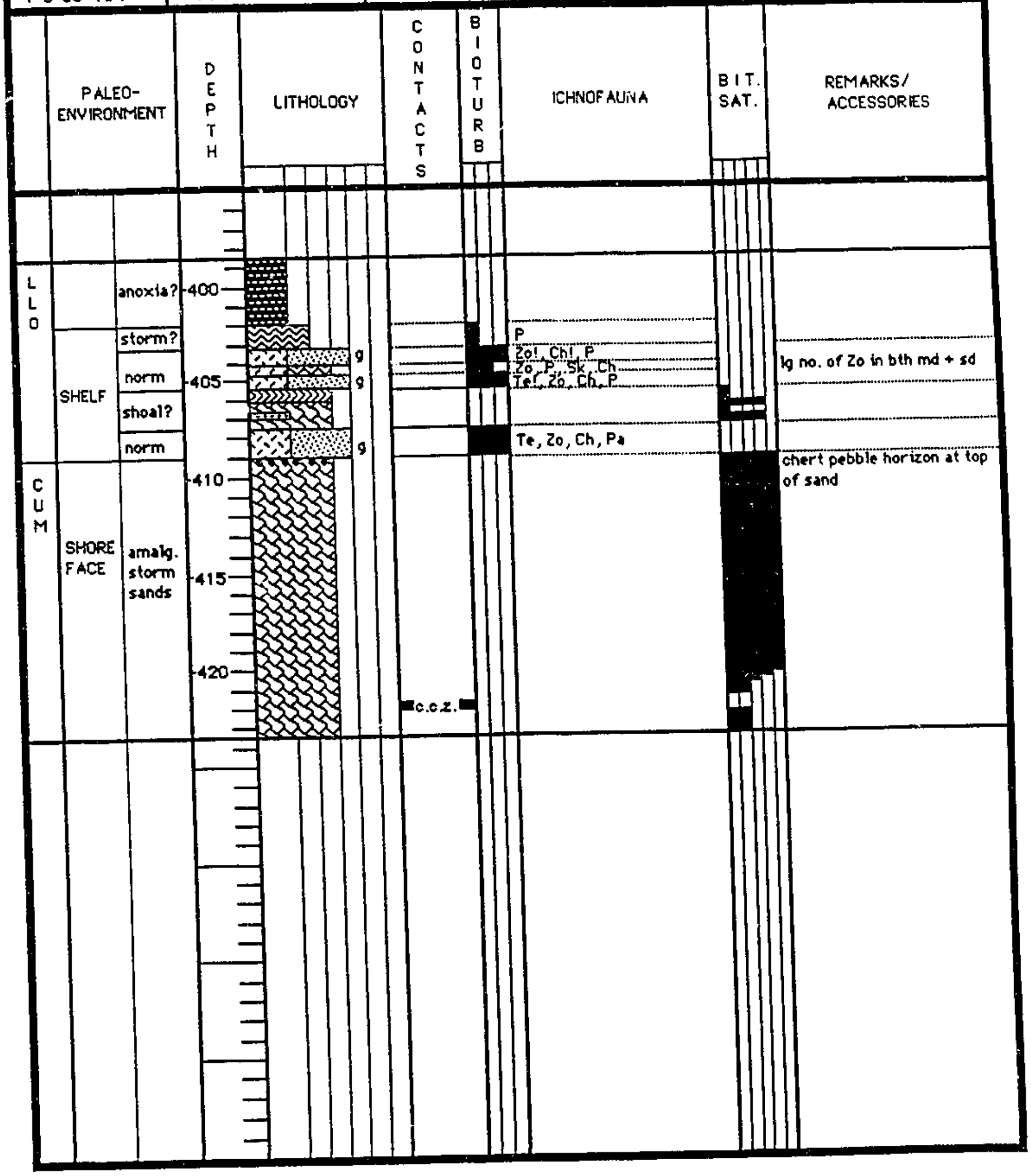
thick biot silt drapes in possibly osc. rippled sds

lots of mud drapes
drapes are much thinner and less biot. than above
osc. ripples are common

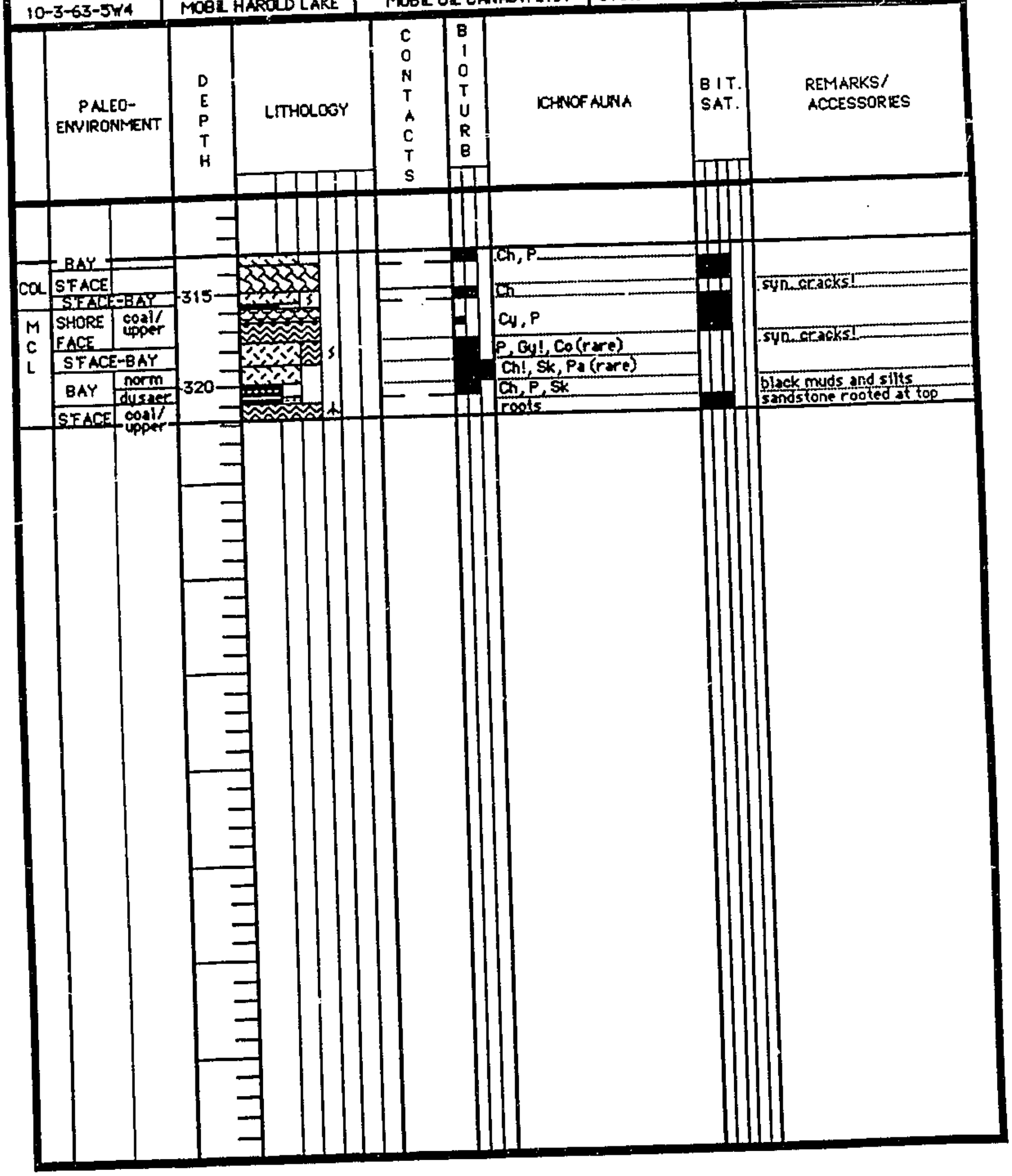


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-35-63-3W4	ESSO 81 COLD LAKE OV	ESSO RESOURCES CANADA	392.0-437.0 m	551.2 m	1 OF 1

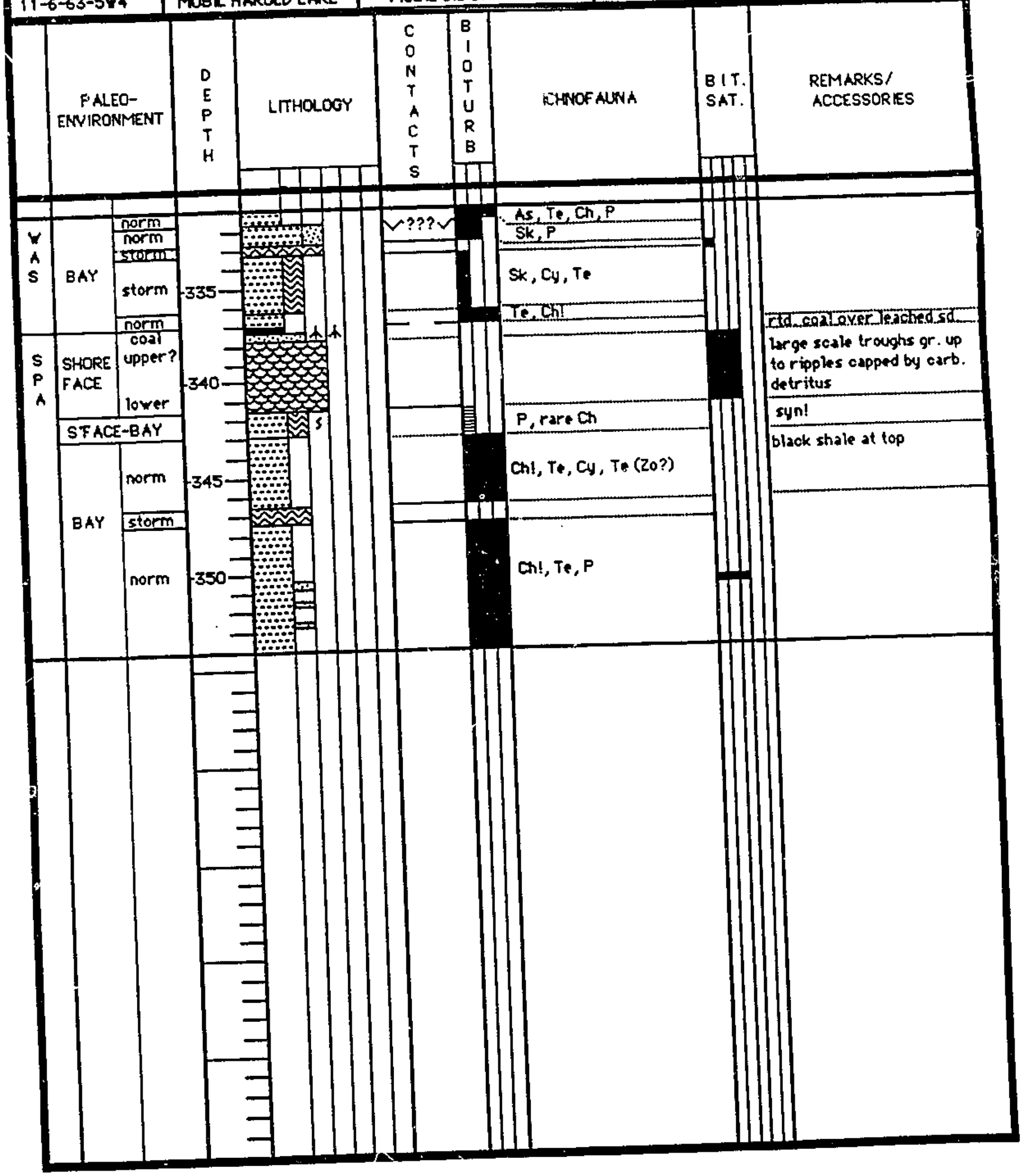
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-6-63-4W4	PACIFIC HAROLD	PETRO-CANADA INC.	398.62-413.3 m	559.6 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-3-63-5W4	MOBIL HAROLD LAKE	MOBIL OIL CANADA LTD.	313.0-321.78 m	558.6 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-6-63-5W4	MOBIL HAROLD LAKE	MOBIL OIL CANADA LTD.	331.0-354.0 m	543.7 m	1 OF 1



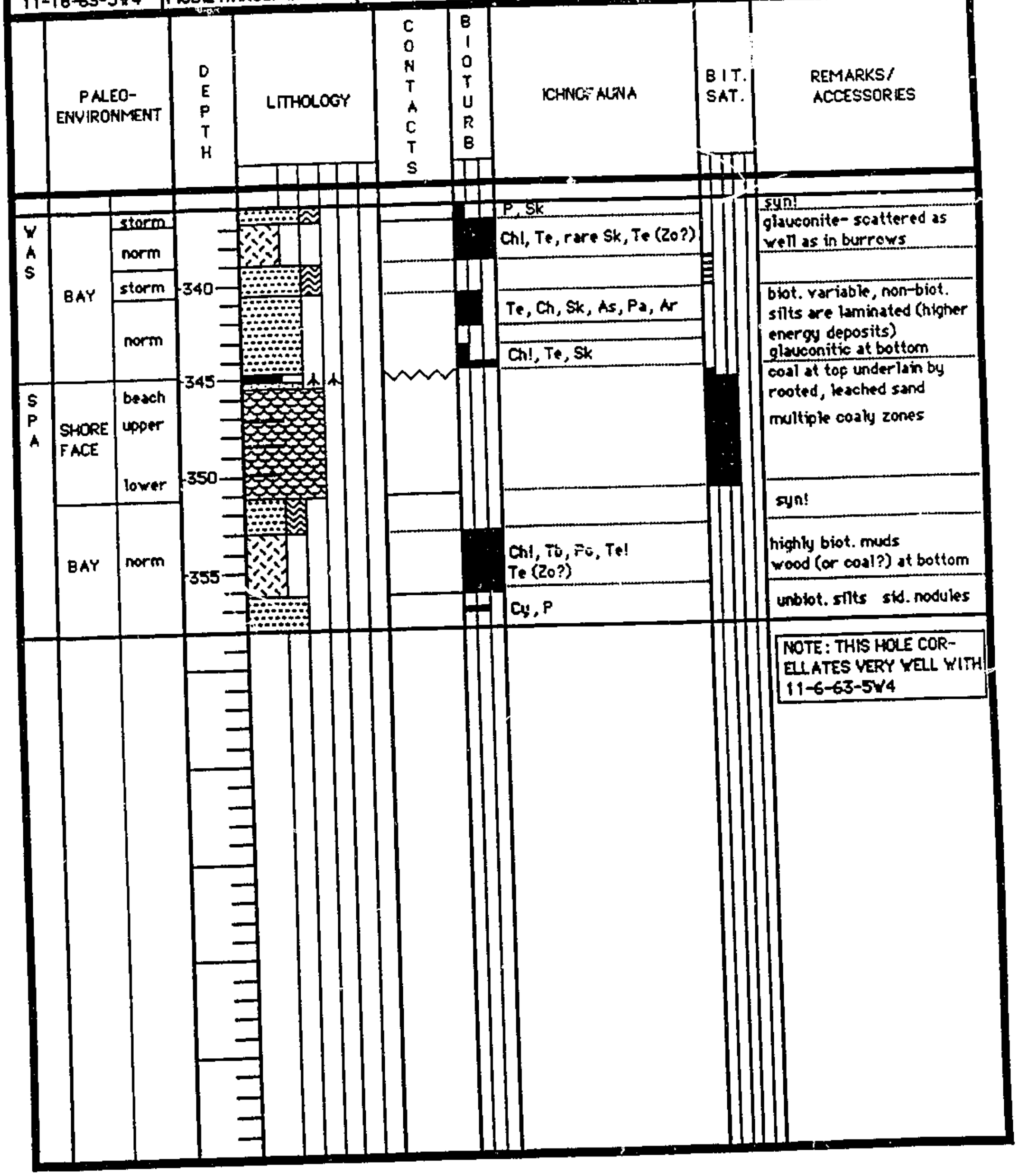
rtd. coal over leached sd.

large scale troughs gr. up to ripples capped by carb. detritus

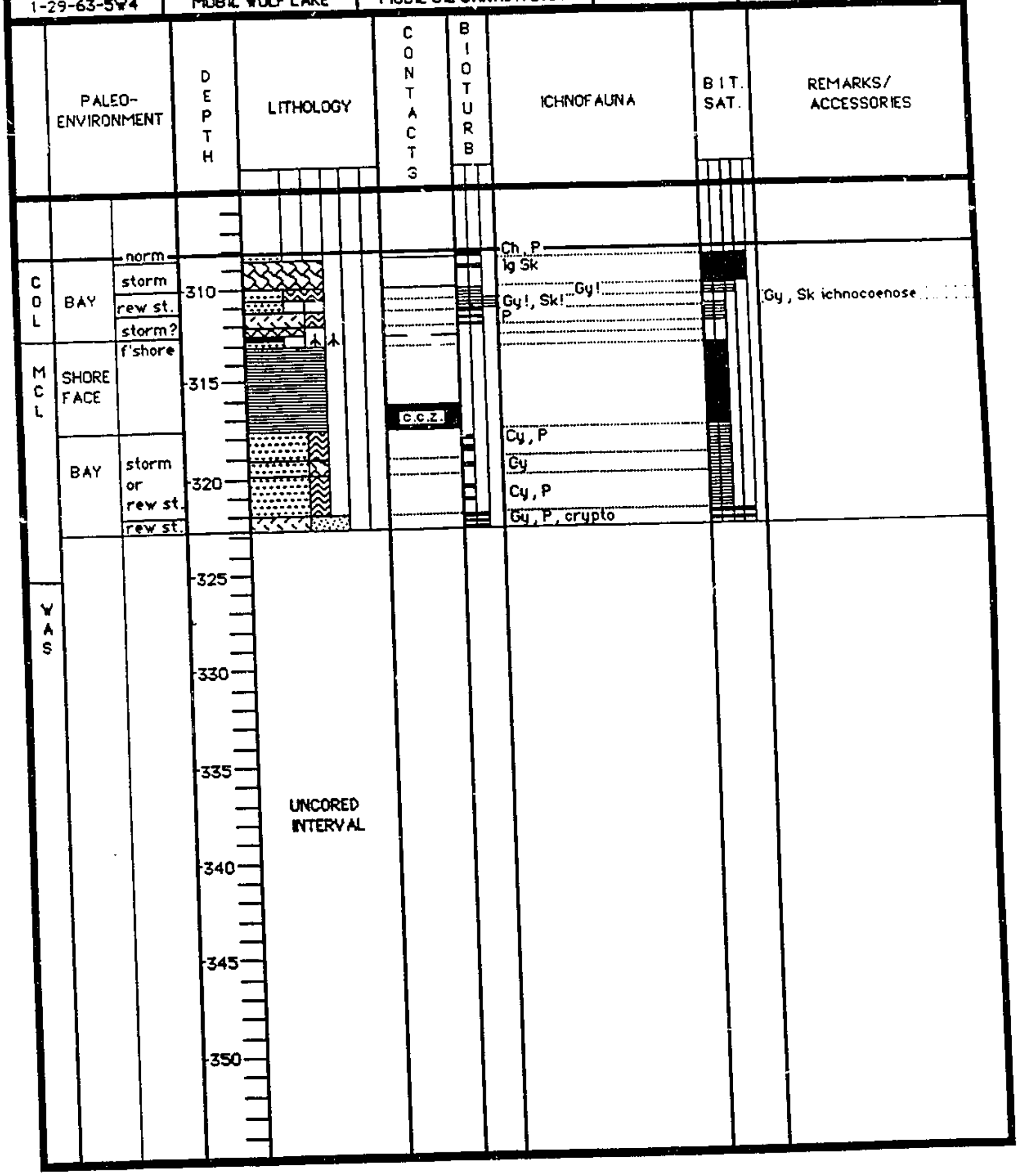
syn!

black shale at top

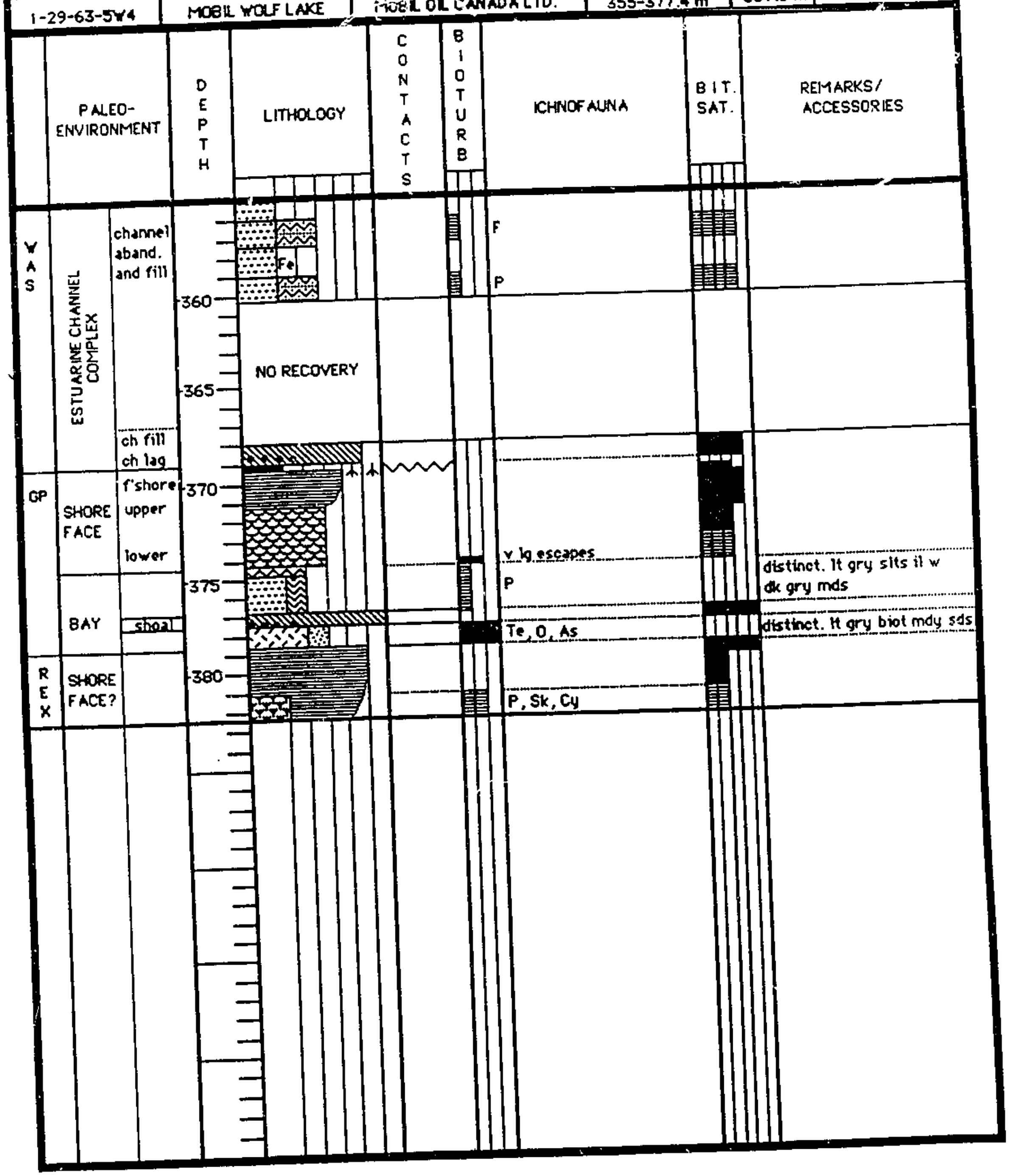
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-18-63-5W4	MOBIL HAROLD LAKE OV	MOBIL OIL CANADA LTD.	336.0-358.0 m	549.6 m	1 OF 1



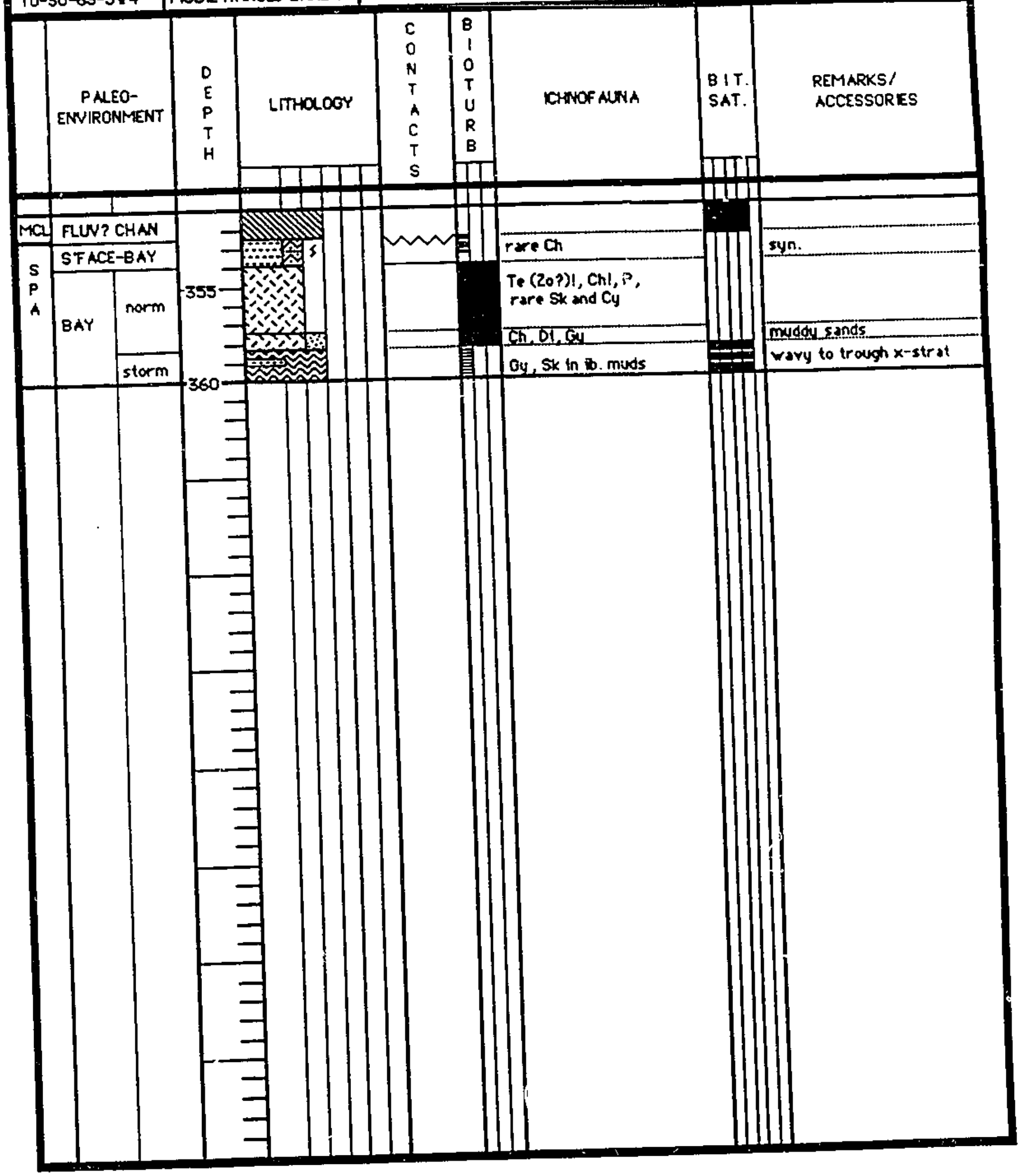
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-29-63-5W4	MOBIL WOLF LAKE	MOBIL OIL CANADA LTD.	308.25-377.4 m	551.6 m	1 OF 2



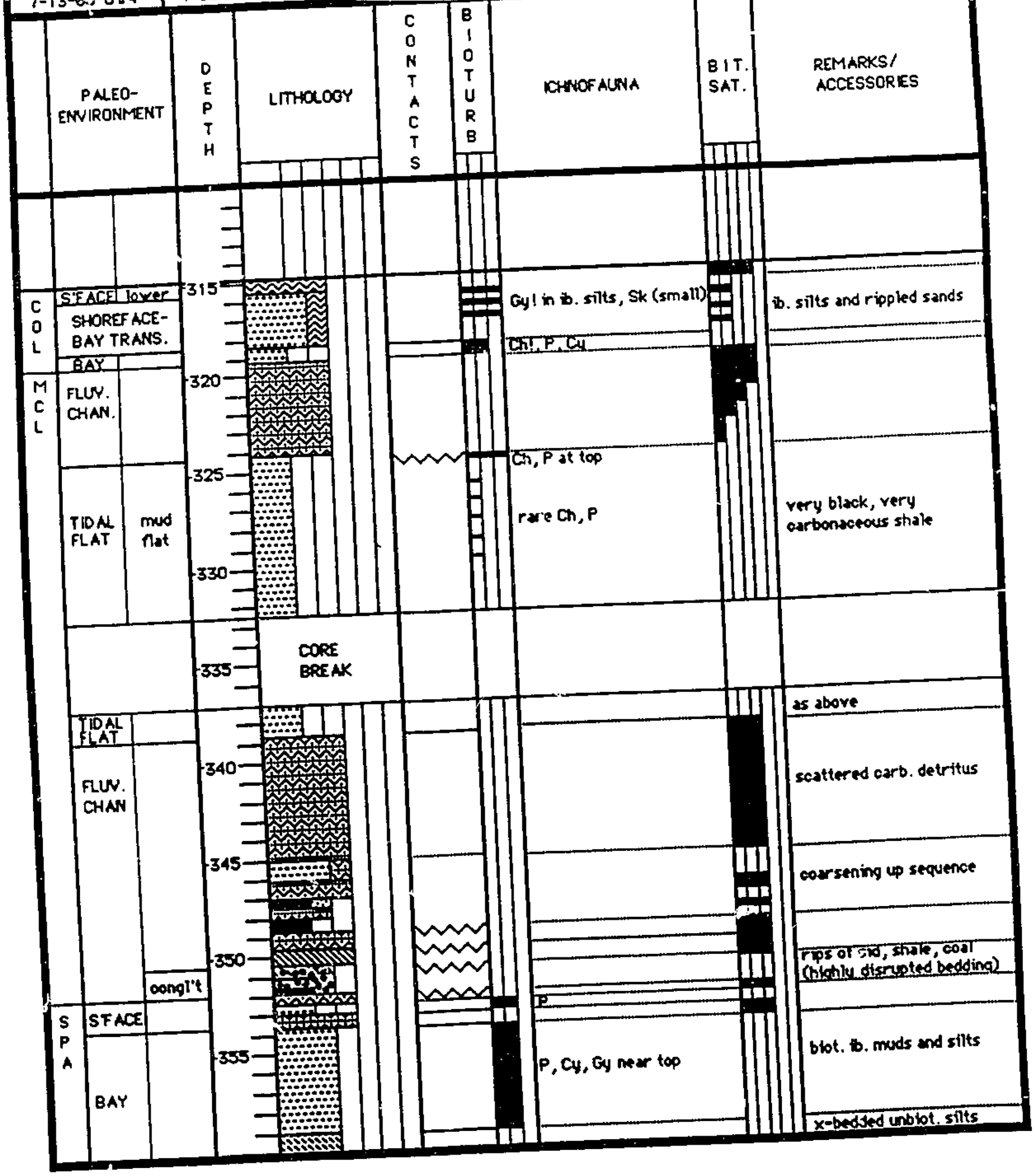
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-29-63-5W4	MOBIL WOLF LAKE	MOBIL OIL CANADA LTD.	308.25-322.75 m 355-377.4 m	551.6 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-30-63-5W4	MOBIL HAROLD LAKE OV	MOBIL OIL CANADA LTD.	351.0-360.0 m	558.4 m	1 OF 1

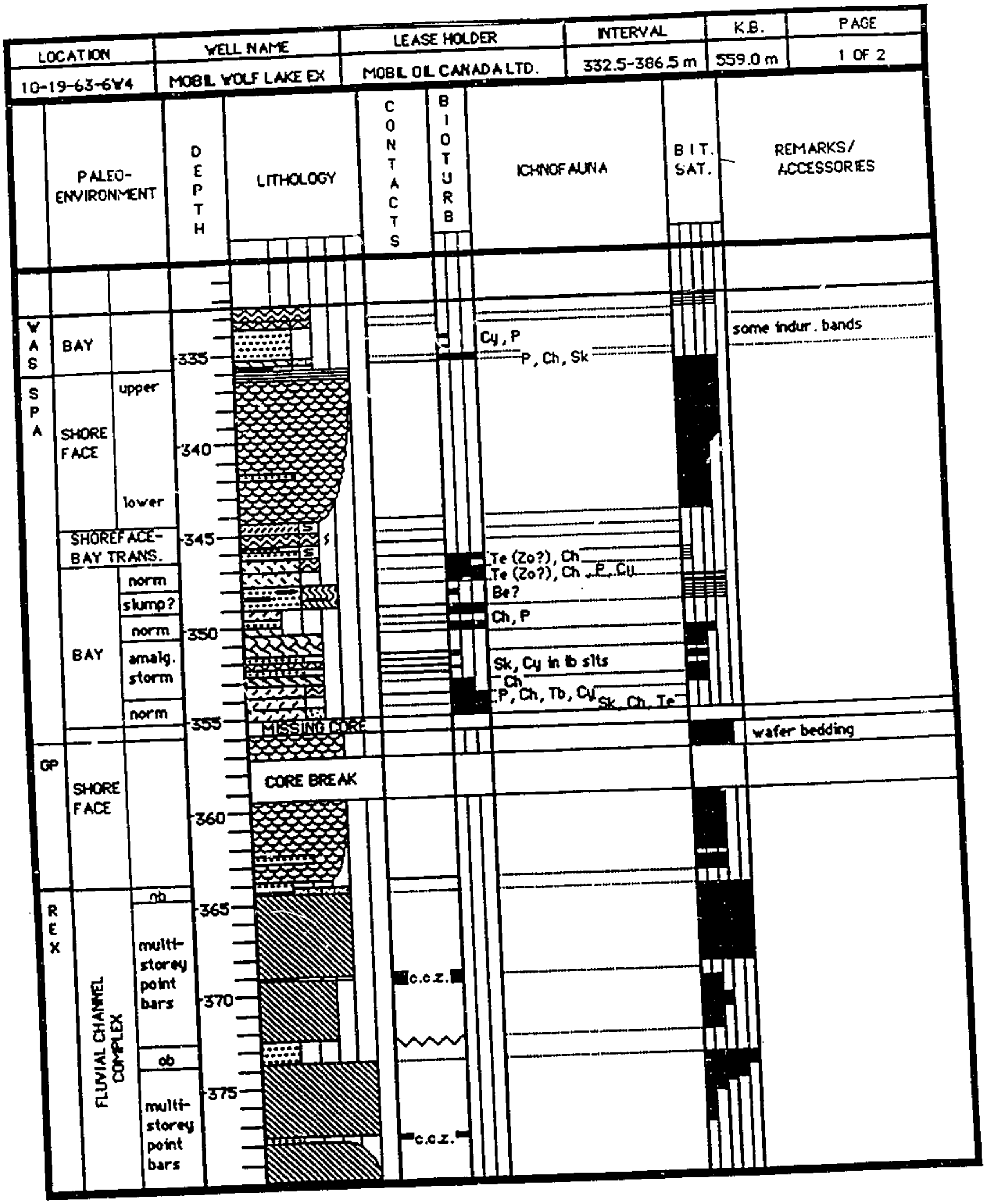


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-13-63-6W4	MOBIL MANITOKAN	MOBIL OIL CANADA LTD.	314.8-364.0 m	558.8 m	1 OF 2



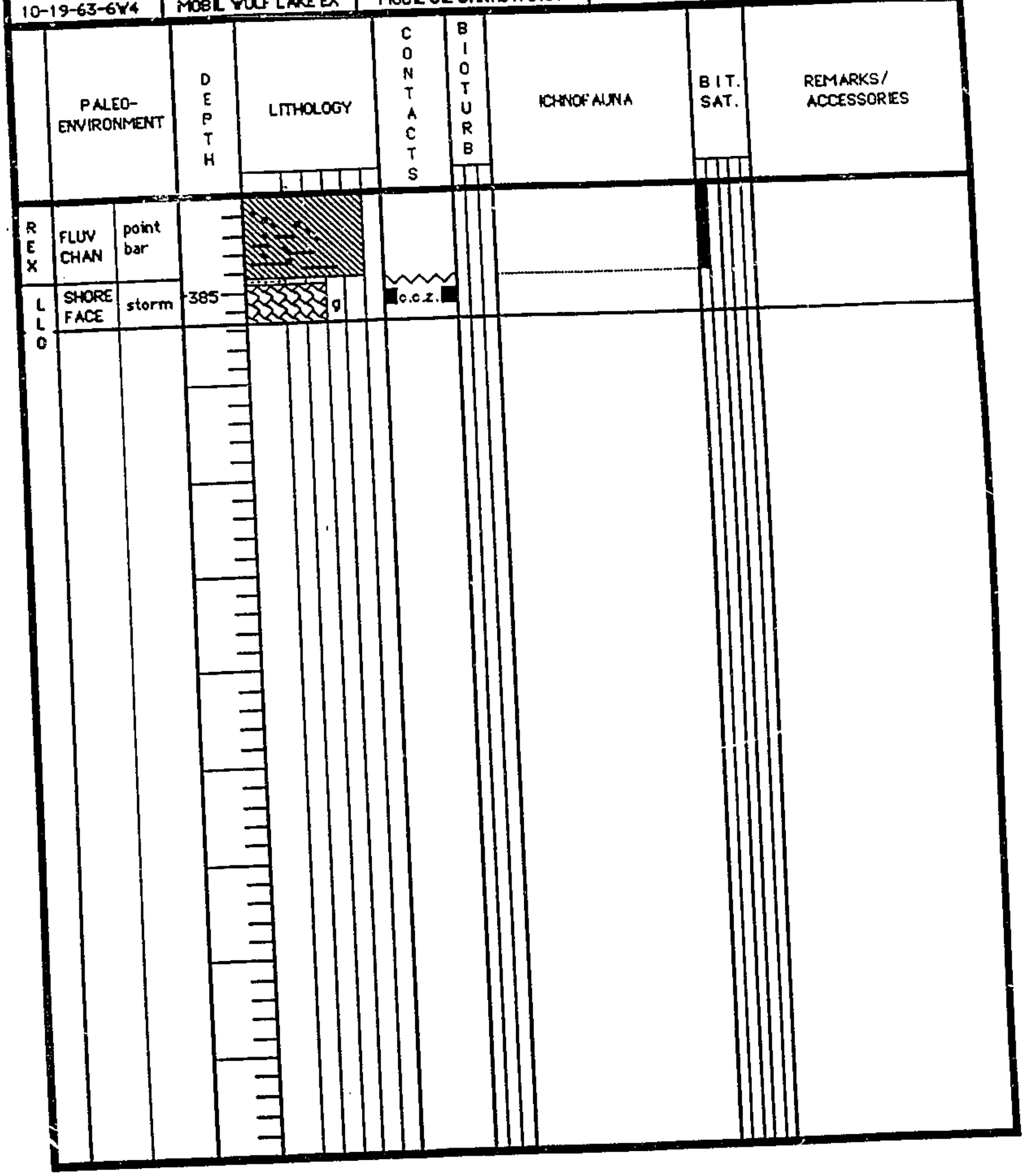
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-13-63-6W4	MOBIL MANITOKAN	MOBIL OIL CANADA LTD.	314.8-364.0 m	558.8 m	2 OF 2

	PALEO-ENVIRONMENT	DEPTH	LITHOLOGY	CONTACTS	BIOTURB	ICHNOFAUNA	BIT. SAT.	REMARKS/ ACCESSORIES
S P A	BAY		▨					as above
	SHORE FACE	364	▨					

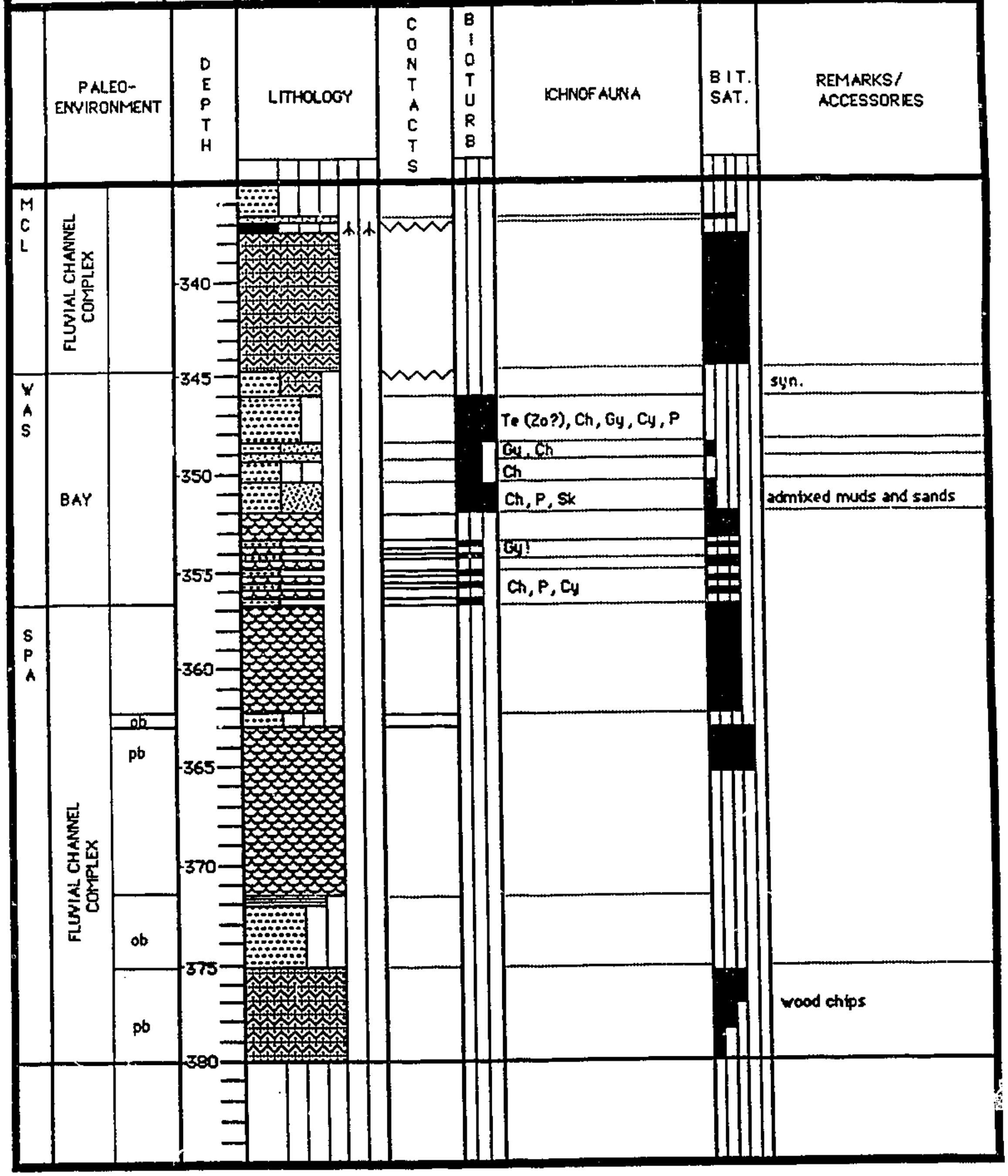


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-19-63-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	332.5-386.5 m	559.0 m	1 OF 2

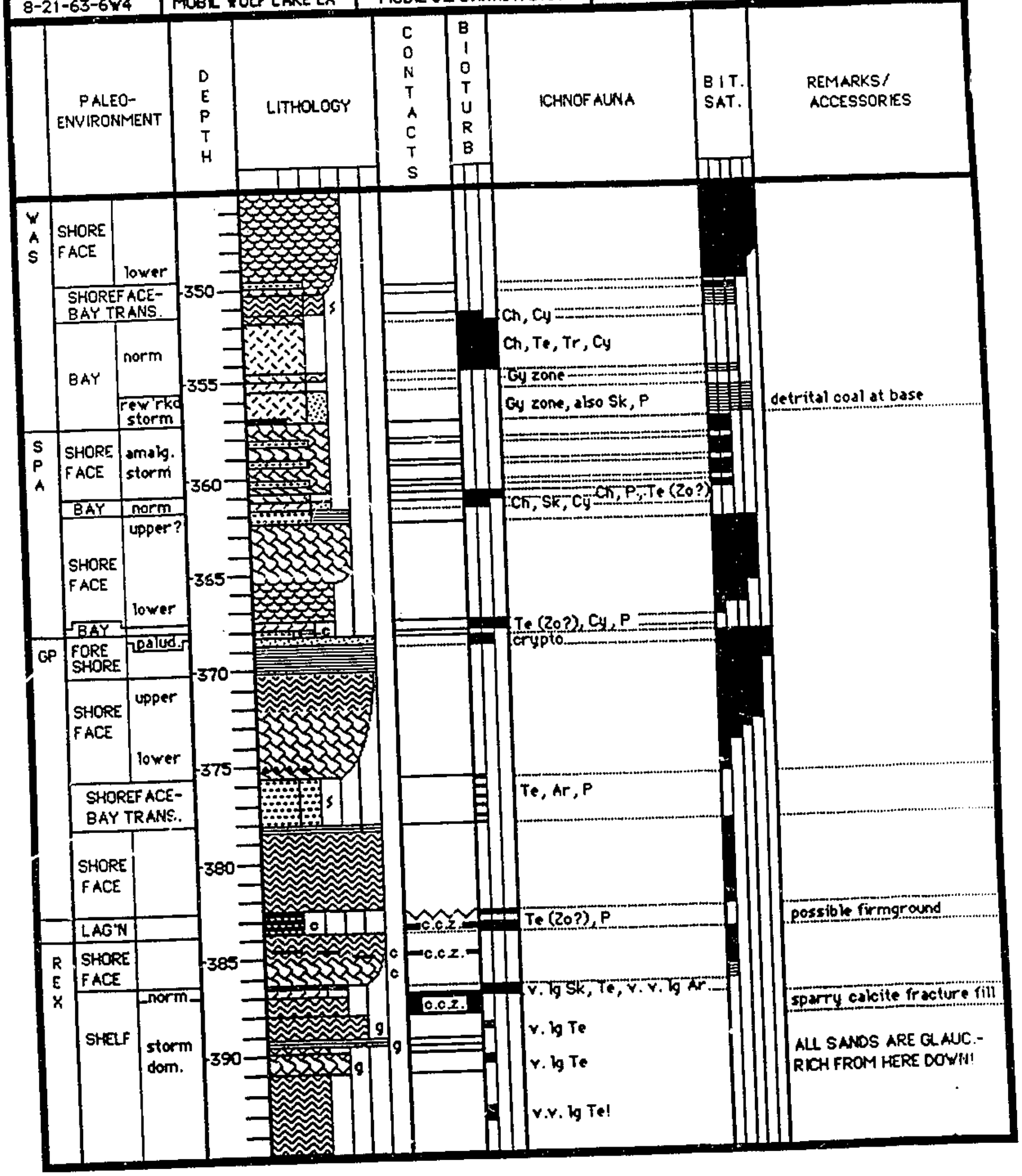
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-19-63-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	332.5-386.5 m	559.0 m	2 OF 2



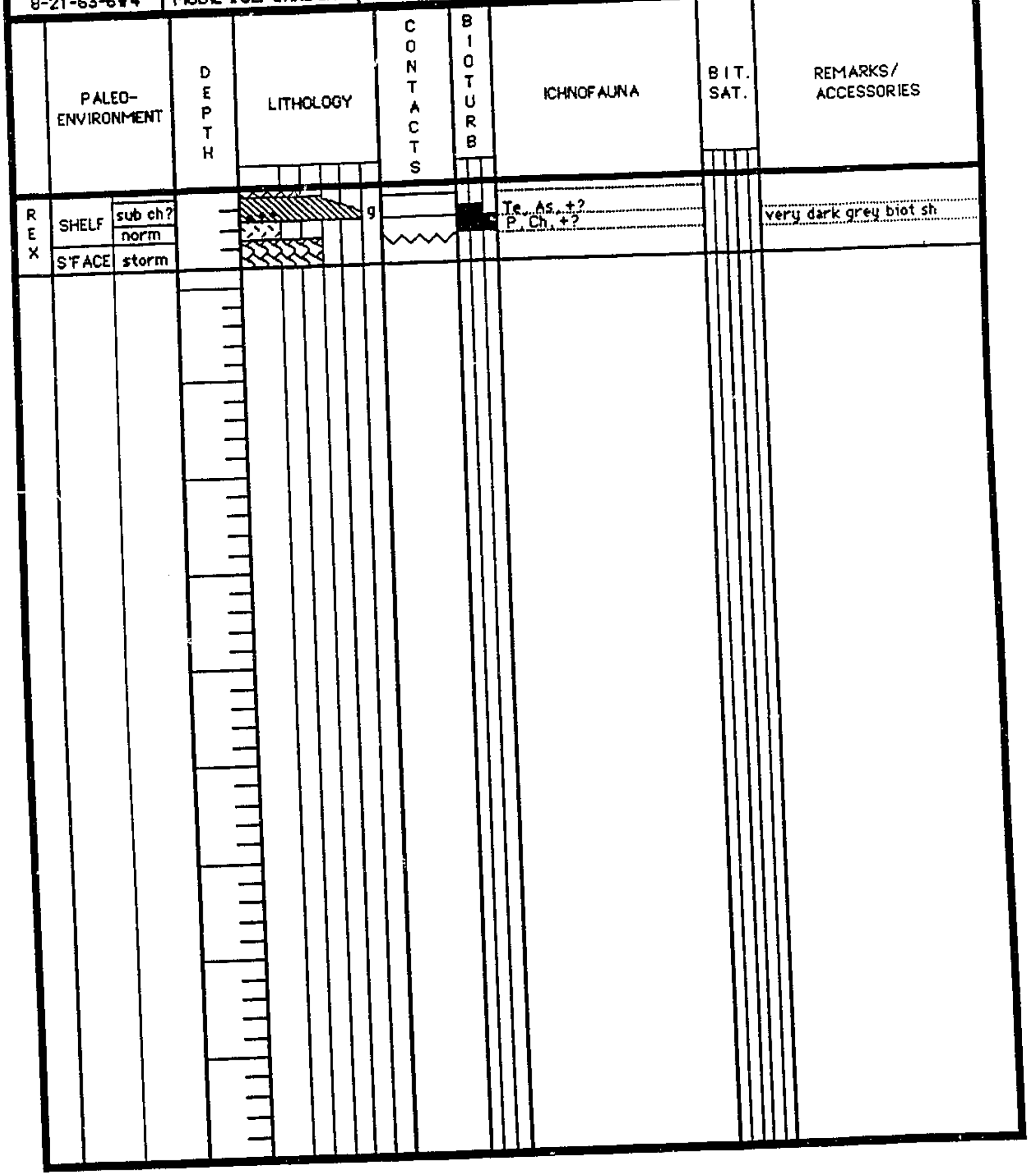
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-20-63-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	335.0-380.0 m	559.9 m	1 OF 1



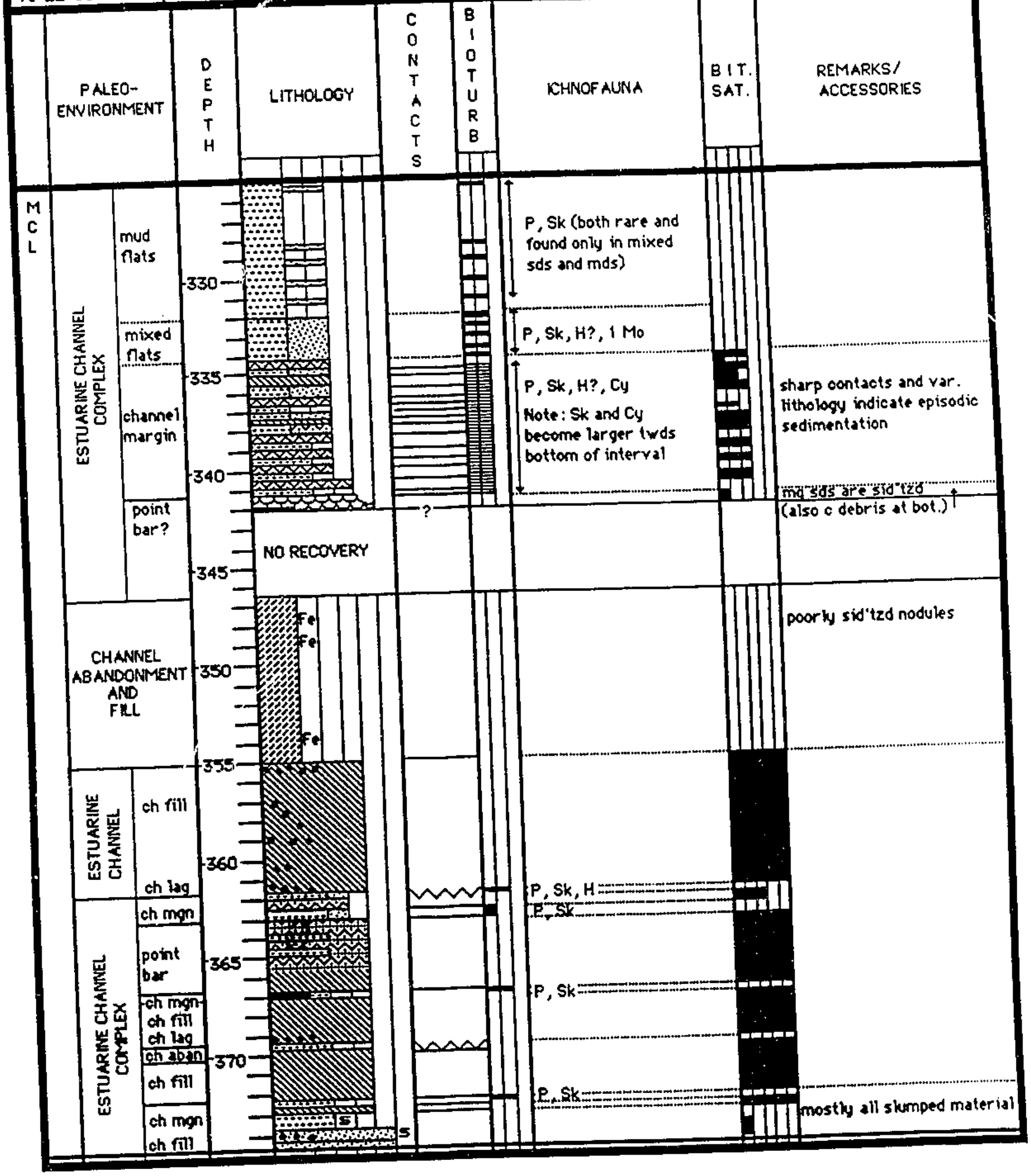
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-21-63-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	345.0-399.0 m	561.2 m	1 OF 2



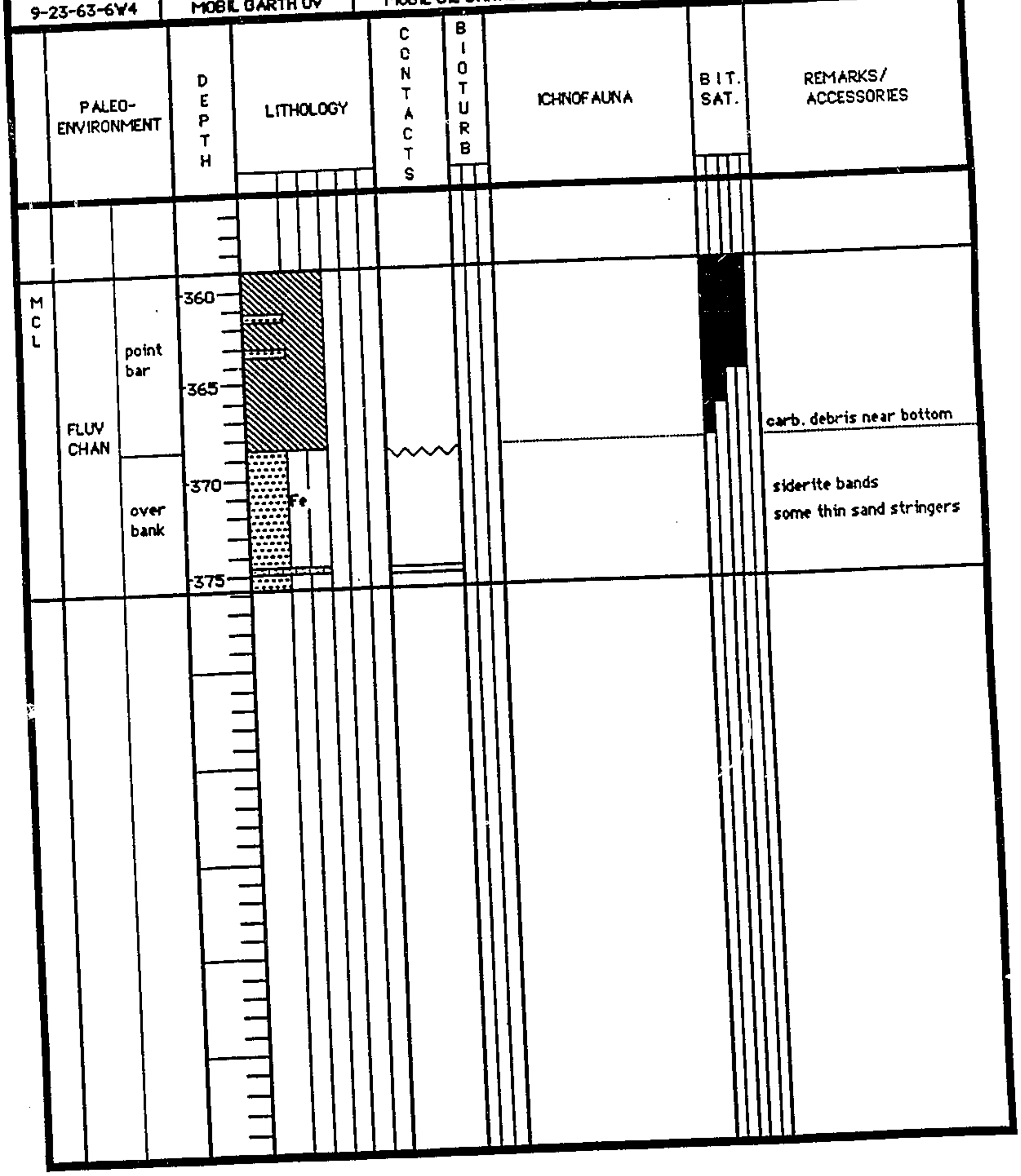
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-21-63-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	345.0-399.0 m	561.2 m	2 OF 2



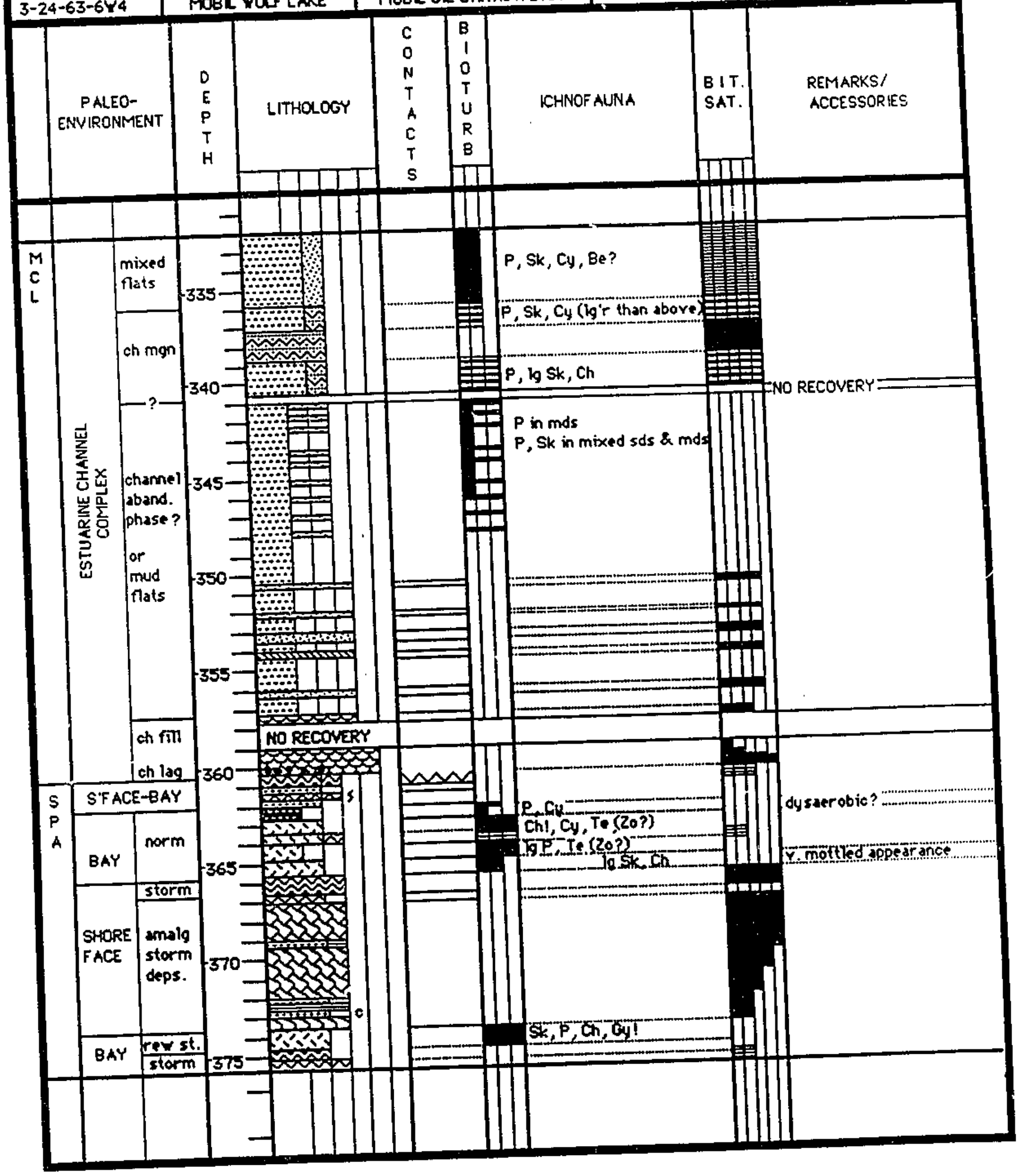
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-22-63-6W4	MOBIL WOLF LAKE	MOBIL OIL CANADA LTD.	325.0-374.55 m	563.3 m	1 OF 1



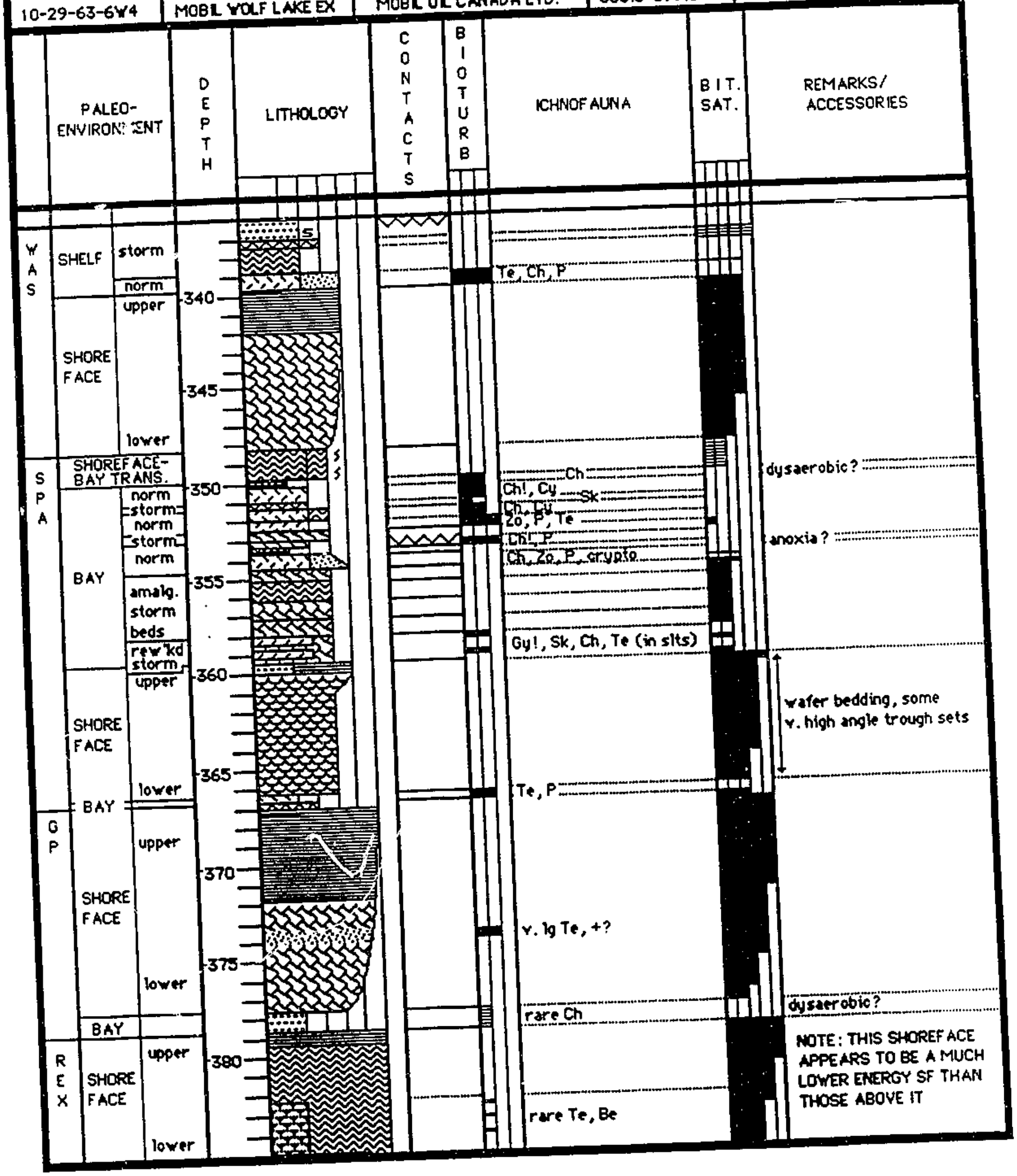
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-23-63-6W4	MOBIL GARTH OV	MOBIL OIL CANADA LTD.	359.0-375.8 m	573.8 m	1 OF 1



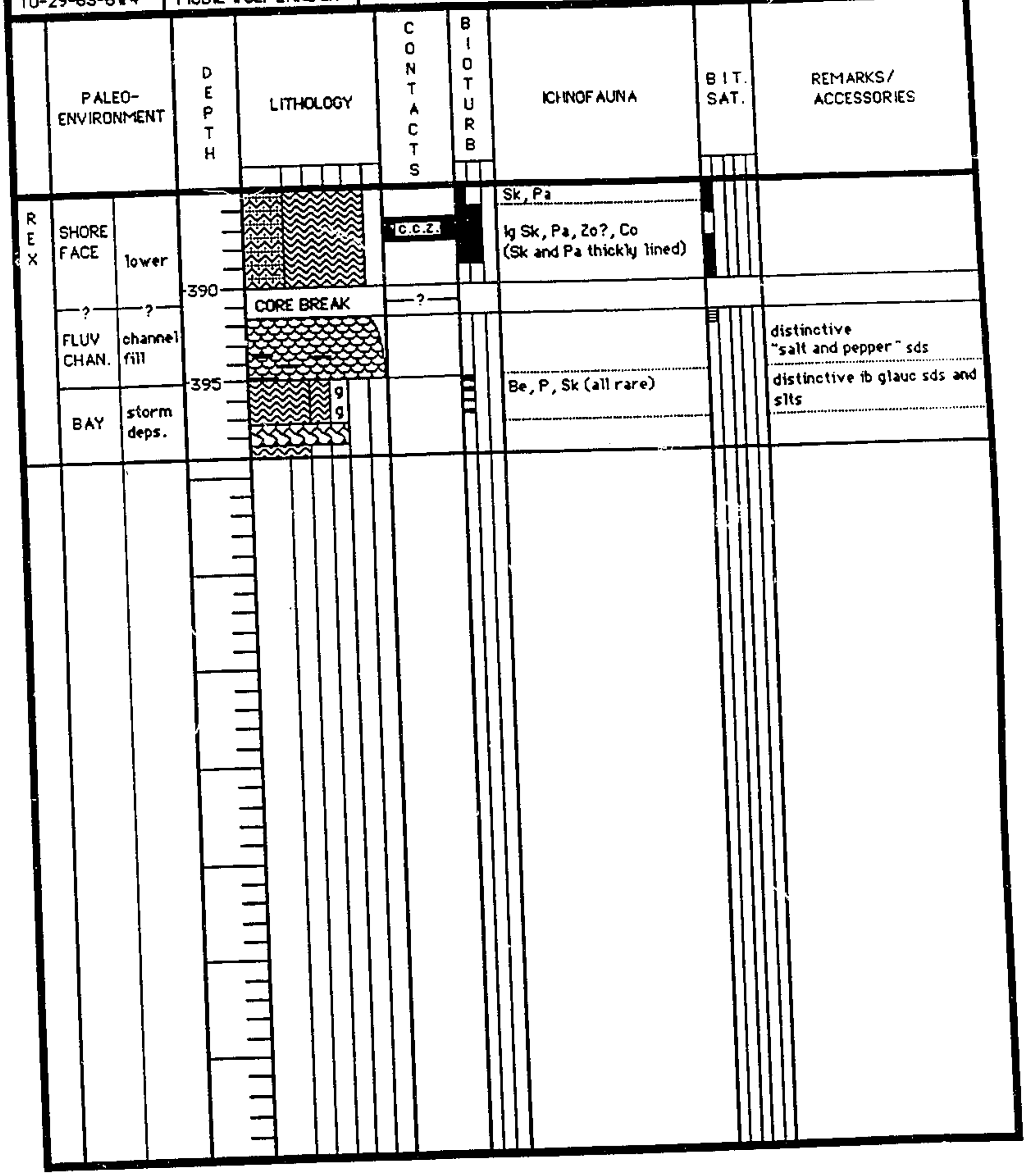
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-24-63-6W4	MOBIL WOLF LAKE	MOBIL OIL CANADA LTD.	332.0-337.0 m	569.0 m	1 OF 1



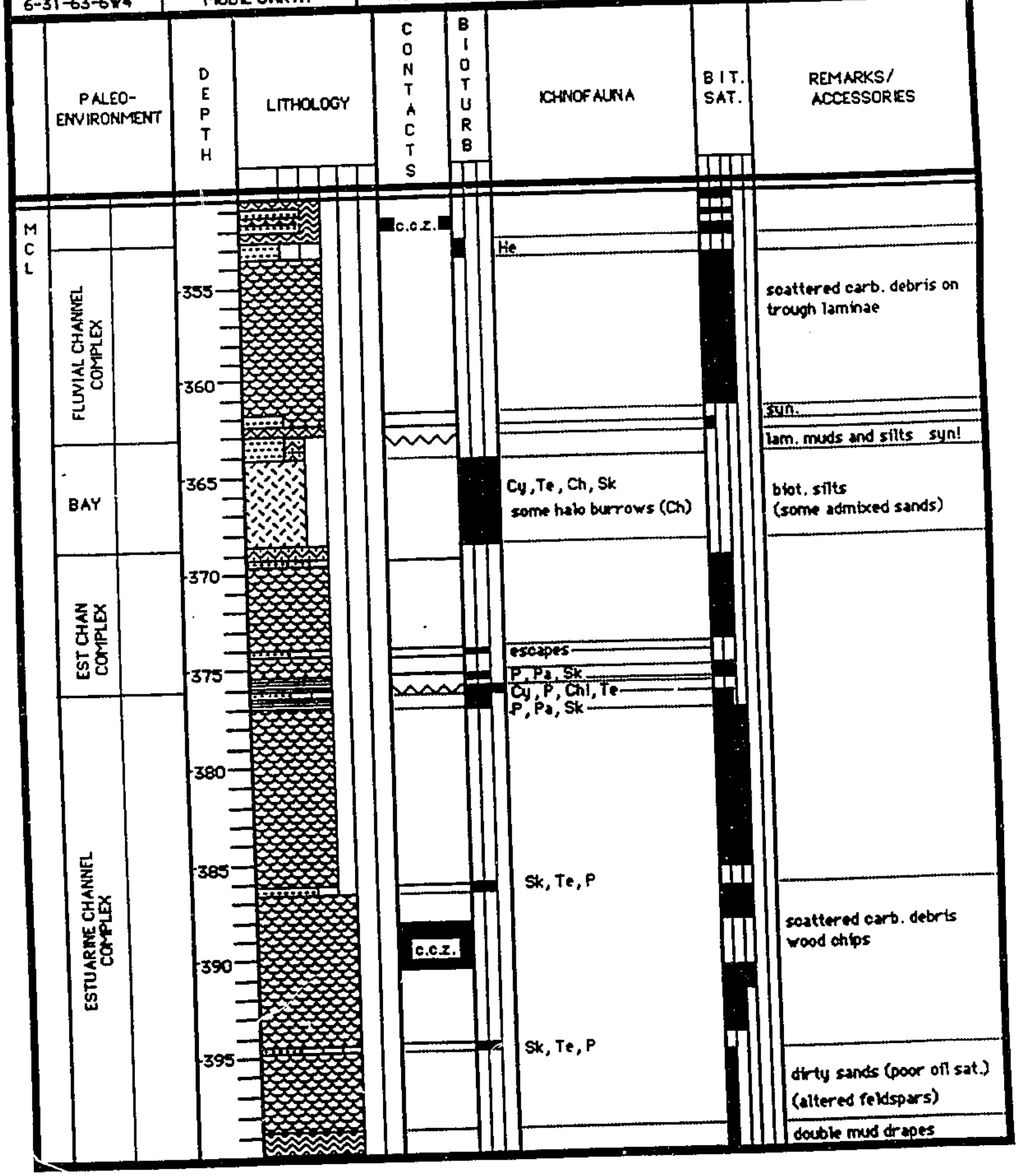
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-29-63-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	336.0-399.0 m	571.2 m	1 OF 2



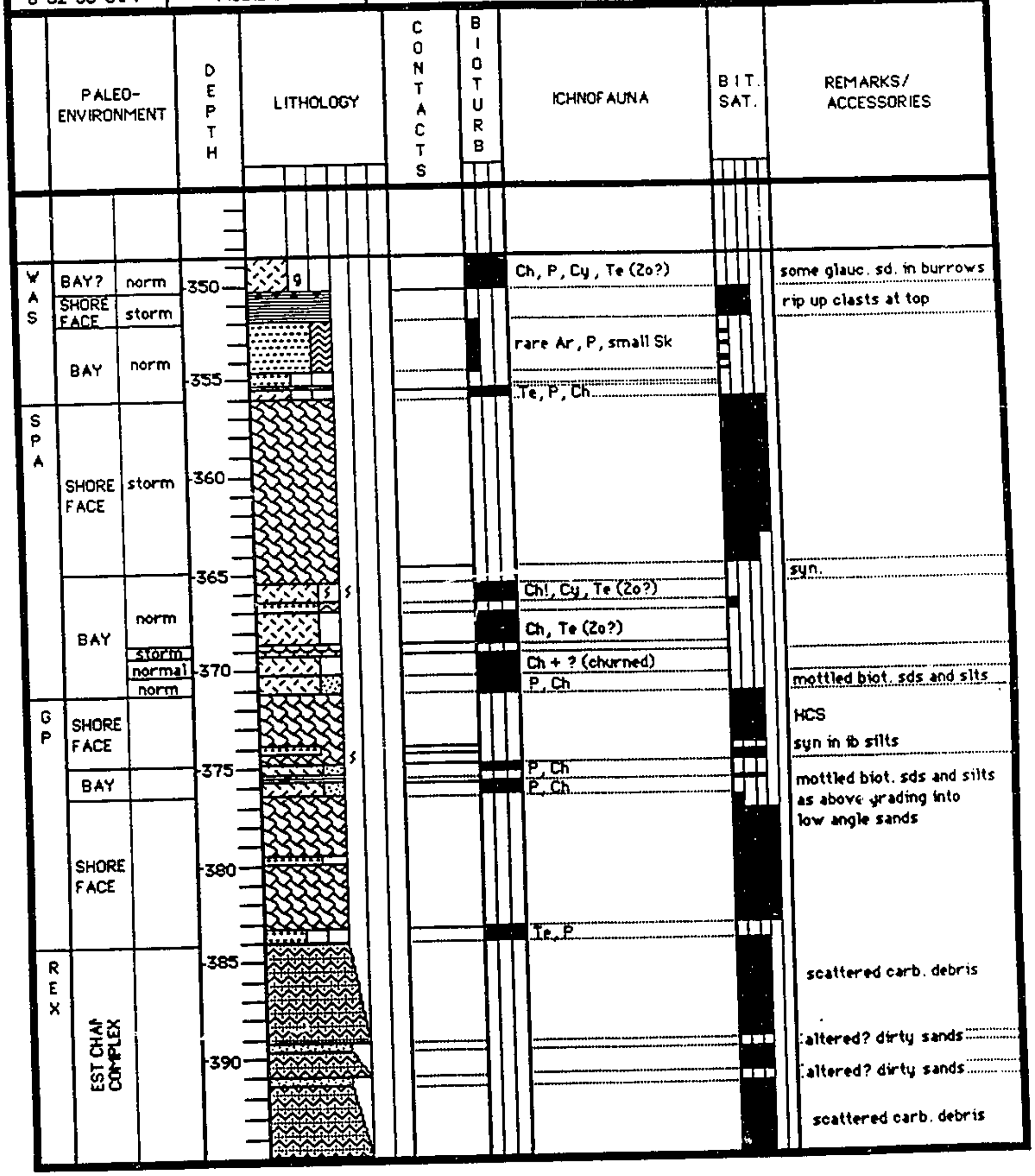
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-29-63-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	336.0-399.0 m	571.2 m	2 OF 2



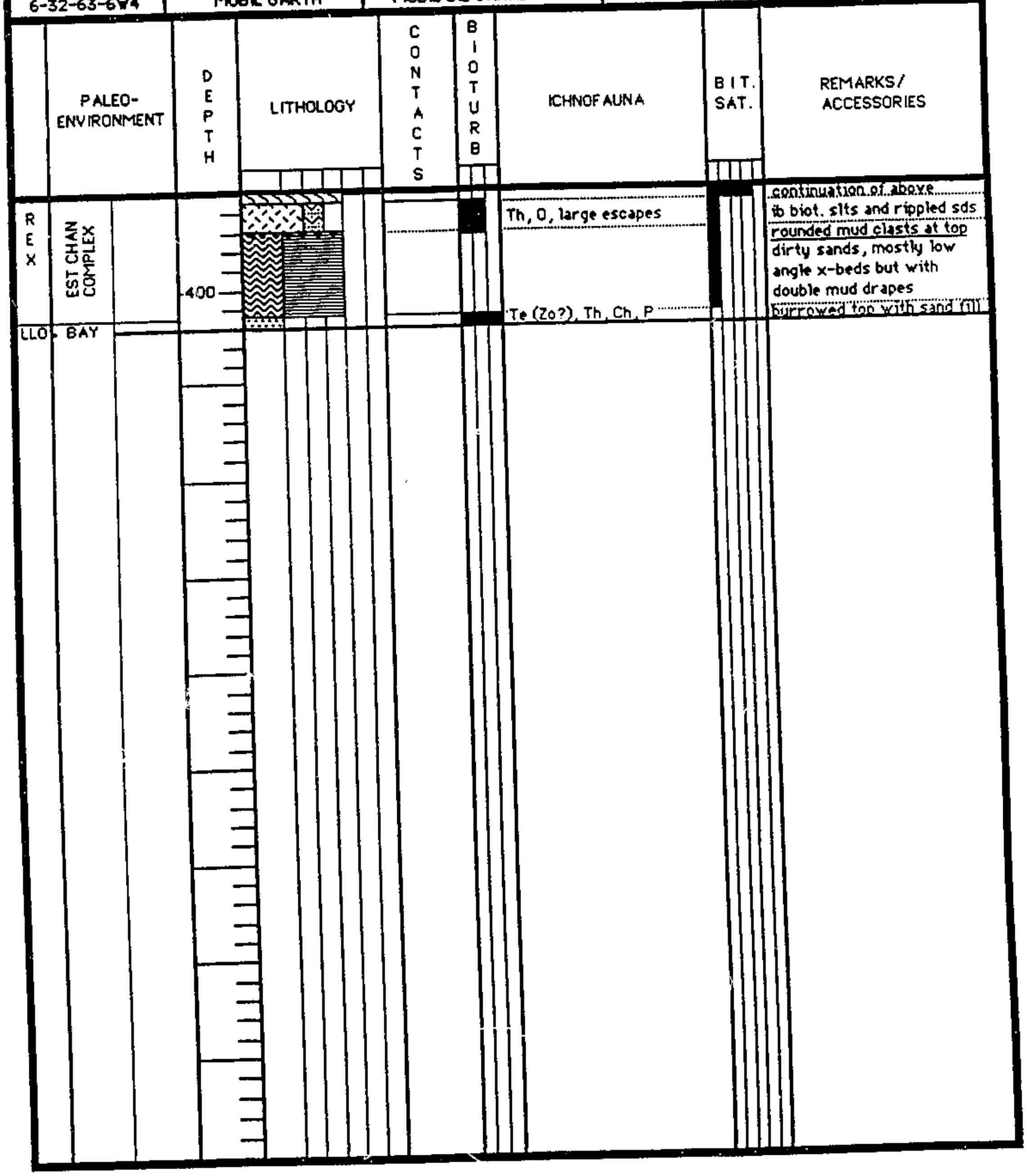
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-31-63-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	351.5-400.0 m	581.8 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-32-63-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	348.5-402.0 m	578.5 m	1 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-32-63-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	348.5-402.0 m	578.5 m	2 OF 2



Th, O, large escapes

Te (Zo?), Th, Ch, P

continuation of above

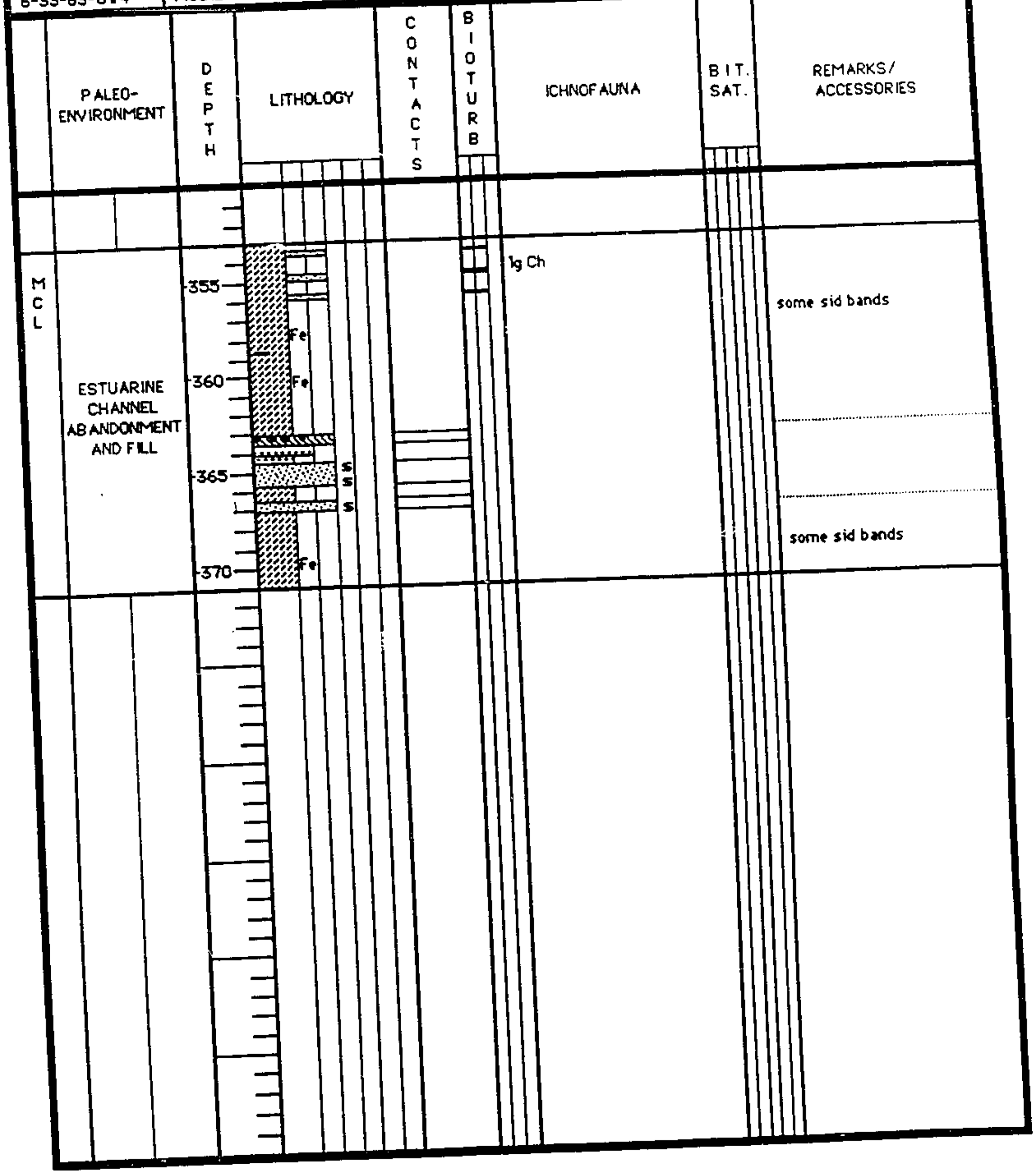
ib biot. slts and rippled sds

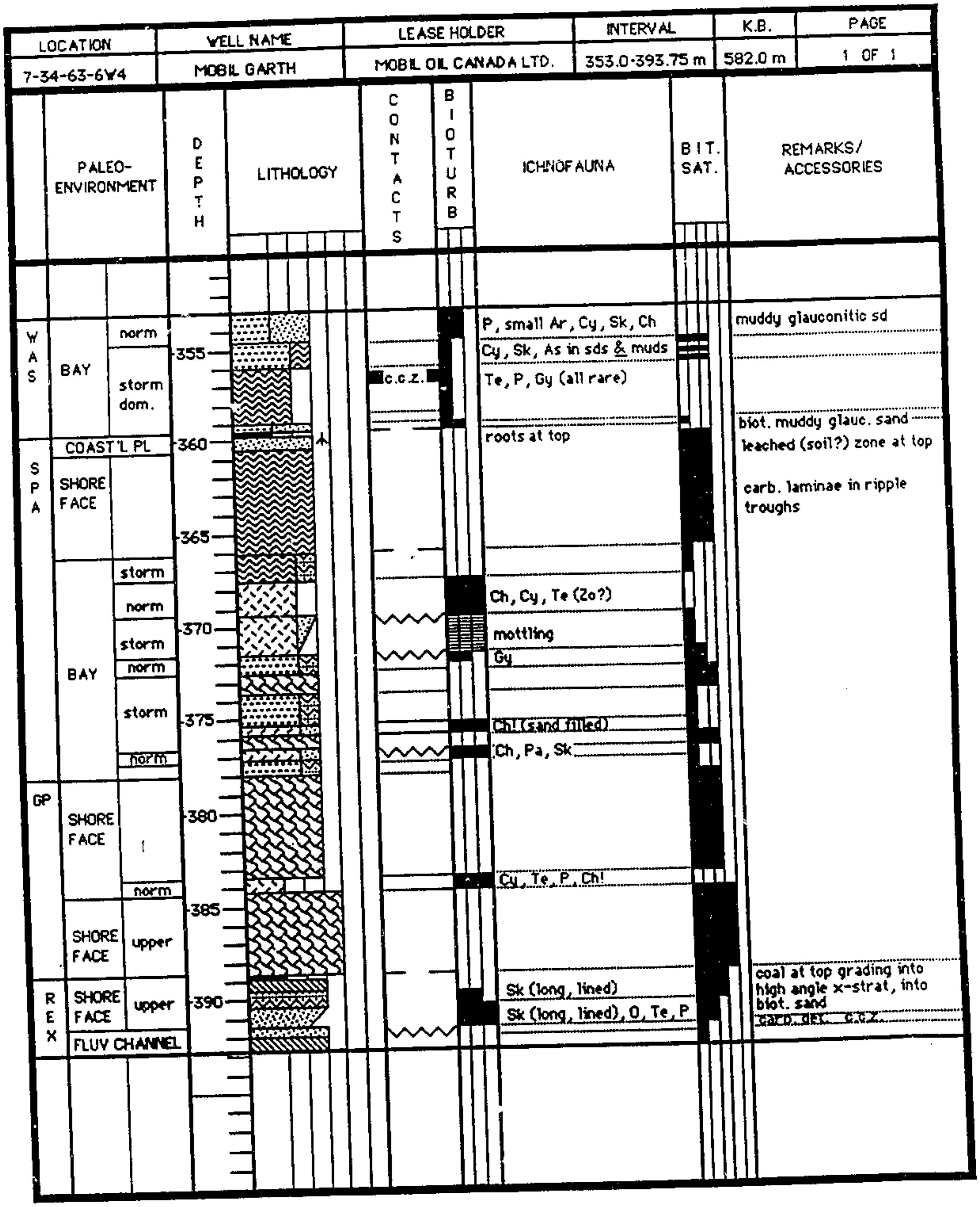
rounded mud clasts at top

dirty sands, mostly low angle x-beds but with double mud drapes

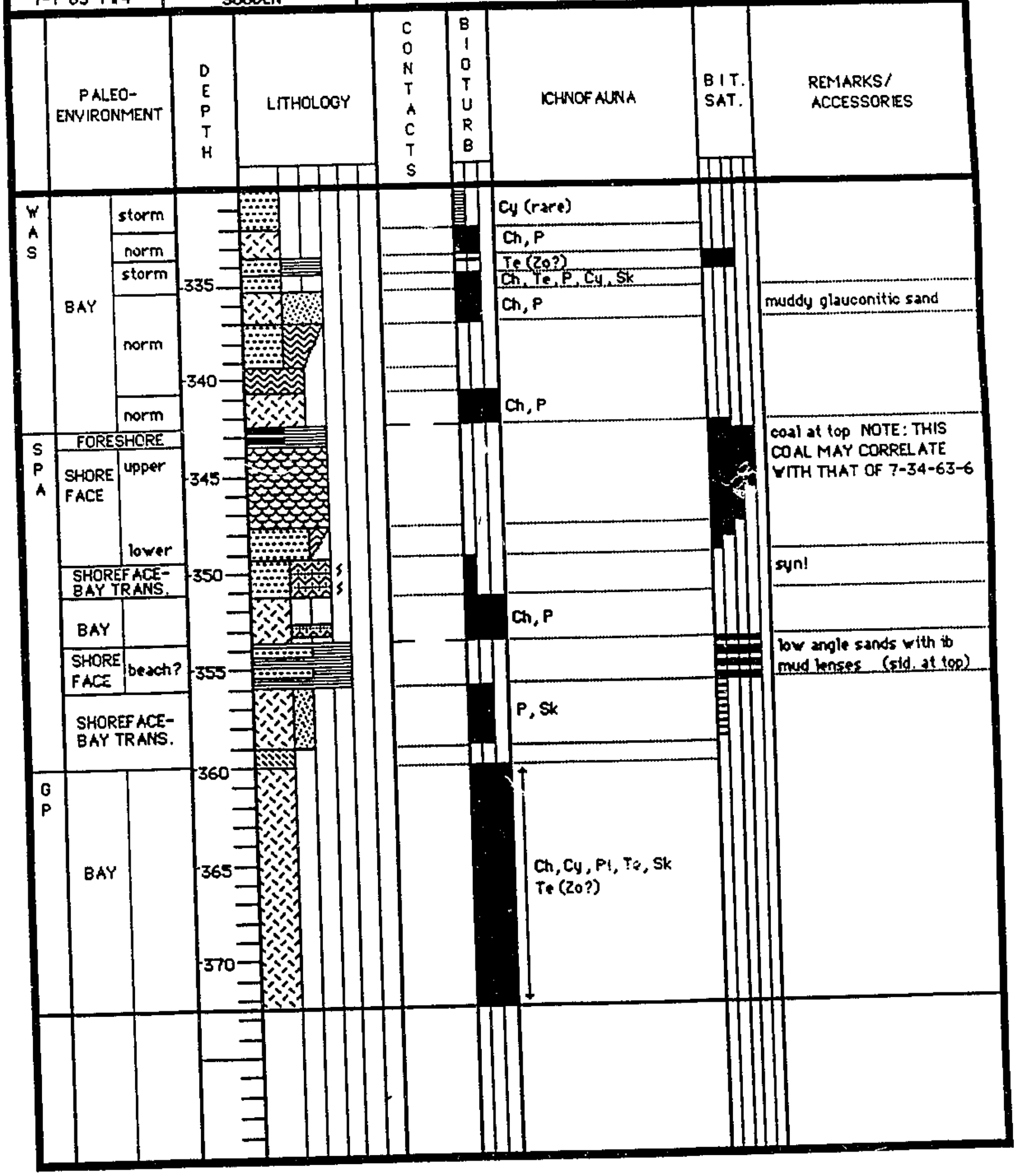
burrowed top with sand fill

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-33-63-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	353.0-371.0 m	579.4 m	1 OF 1

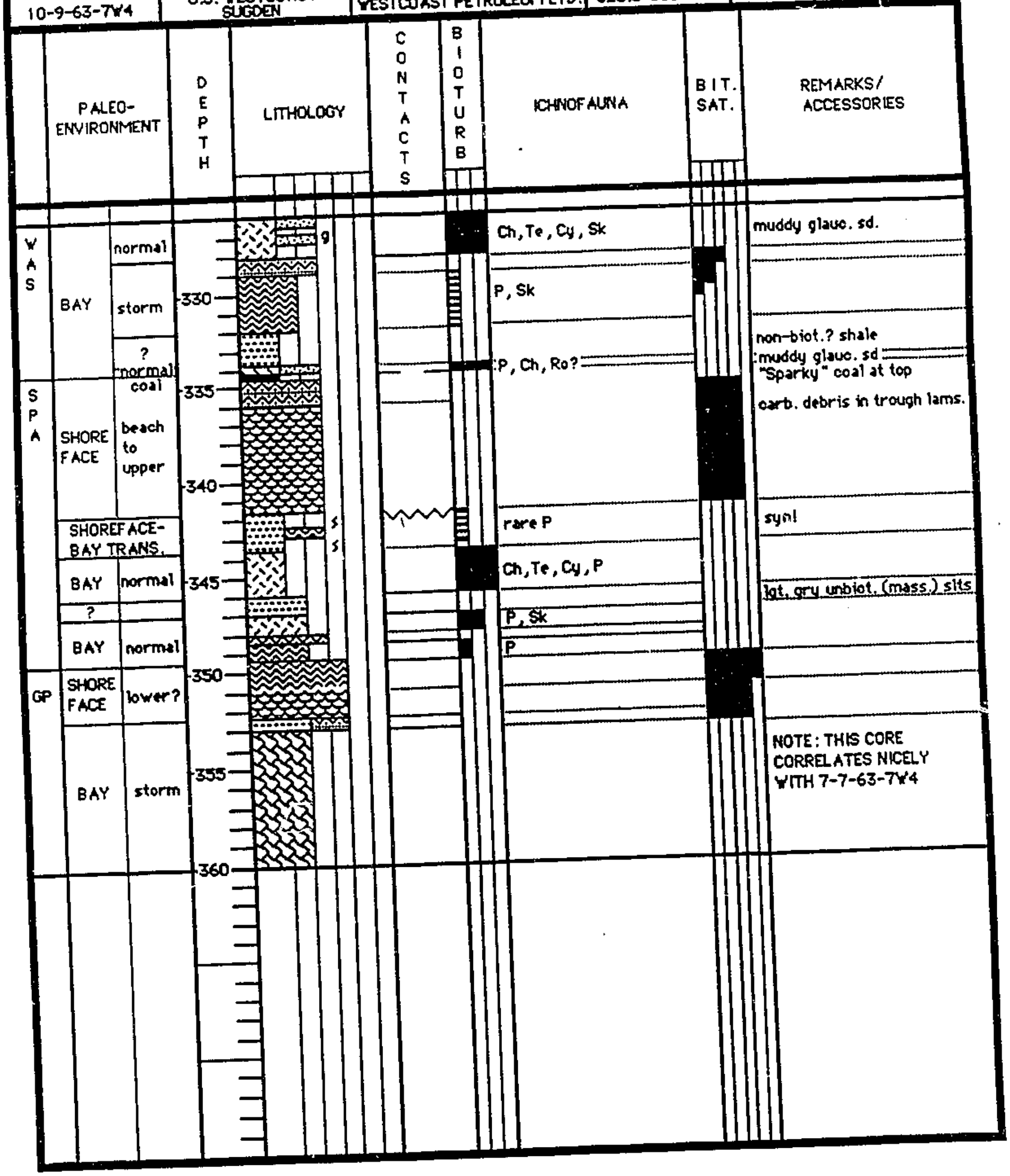


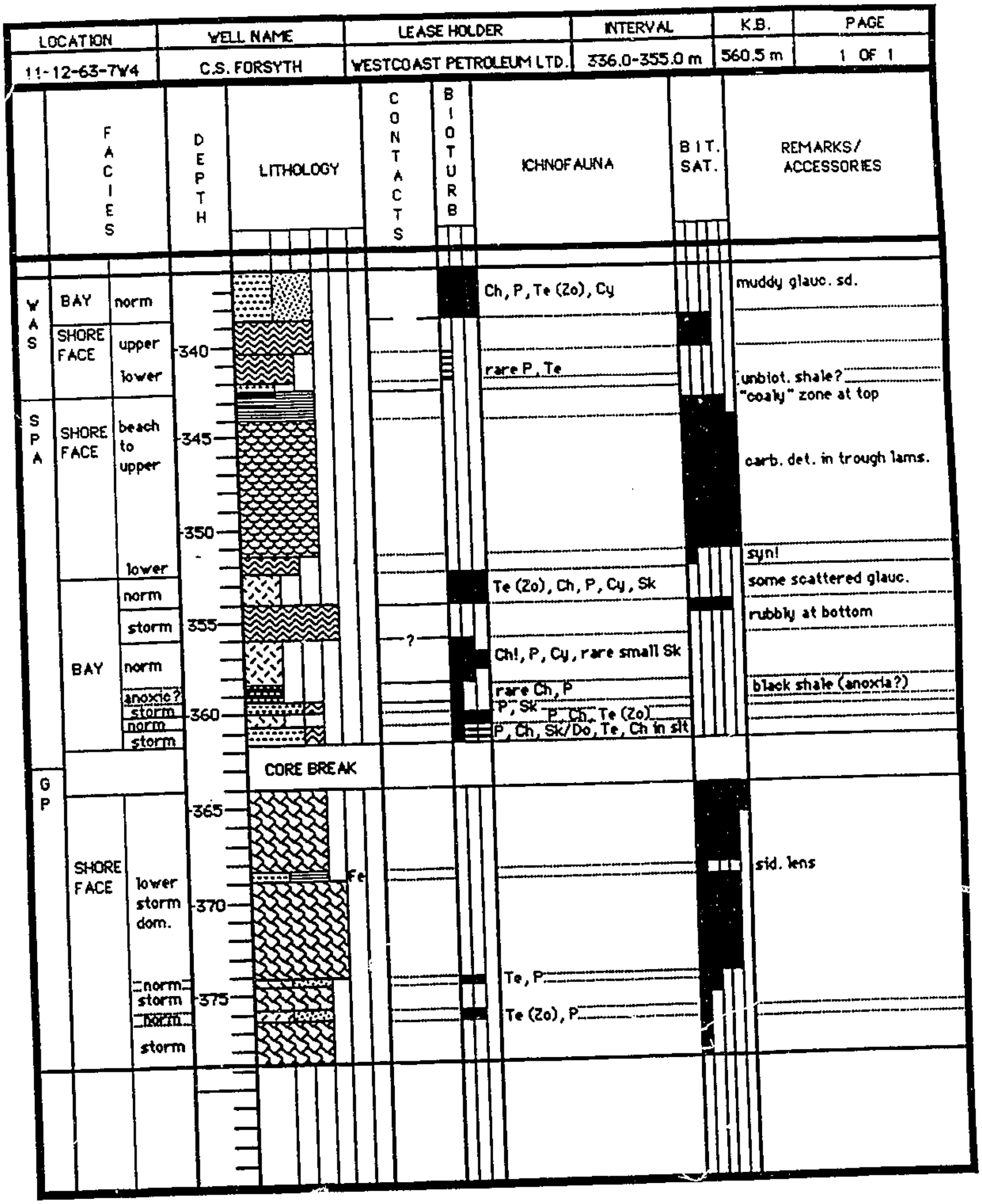

LOCATION
7-34-63-6W4
WELL NAME
MOBIL GARTH
LEASE HOLDER
MOBIL OIL CANADA LTD.
INTERVAL
353.0-393.75 m
K.B.
582.0 m
PAGE
1 OF 1
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
WAS
BAY
norm
storm dom.
COAST'L PL
SPA
SHORE FACE
storm
norm
storm
norm
BAY
storm
norm
GP
SHORE FACE
norm
SHORE FACE
upper
REX
SHORE FACE
upper
FLUV CHANNEL
355
360
365
370
375
380
385
390
c.c.z.
P, small Ar, Cy, Sk, Ch
Cy, Sk, As in sds & muds
Te, P, Gy (all rare)
roots at top
Ch, Cy, Te (Zo?)
mottling
Gy
Ch! (sand filled)
Ch, Pa, Sk
Cy, Te, P, Ch!
Sk (long, lined)
Sk (long, lined), O, Te, P
muddy glauconitic sd
biot. muddy glauc. sand
leached (soil?) zone at top
carb. laminae in ripple troughs
coal at top grading into high angle x-strat, into biot. sand
carb. dec. c.c.z.

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-7-63-7W4	C.S. WESTCOAST SUGDEN	WESTCOAST PETROLEUM LTD	330.0-372.25 m	560.3 m	1 OF 1

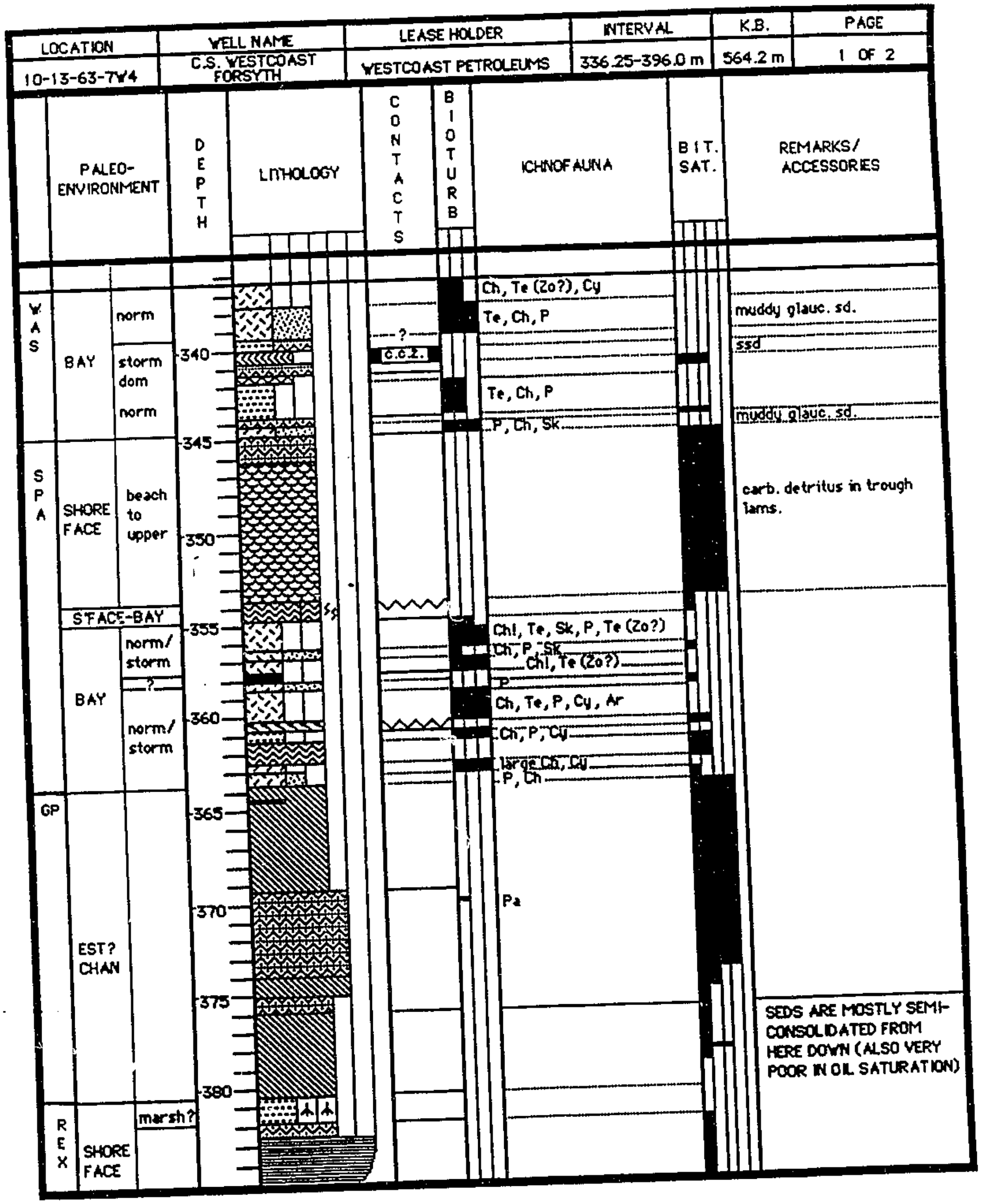


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-9-63-7W4	C.S. WESTCOAST SUGDEN	WESTCOAST PETROLEUM LTD.	326.0-360.0 m	546.1 m	1 OF 1



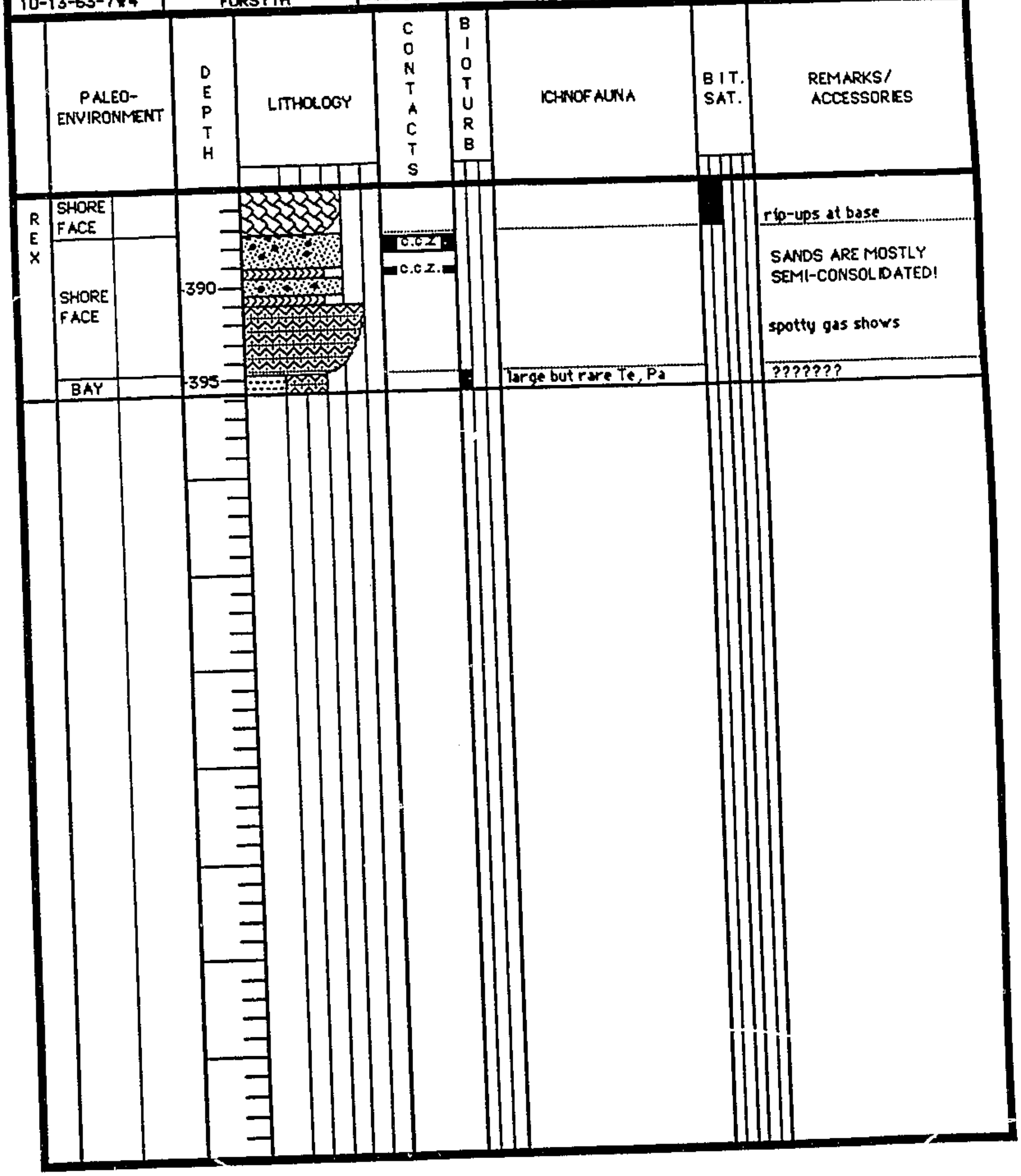


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-12-63-7W4	C.S. FORSYTH	WESTCOAST PETROLEUM LTD.	336.0-355.0 m	560.5 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-13-63-7W4	C.S. WESTCOAST FORSYTH	WESTCOAST PETROLEUMS	336.25-396.0 m	564.2 m	1 OF 2

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-13-63-7W4	C.S. WESTCOAST FORSYTH	WESTCOAST PETROLEUMS LTD	336.25-396.0 m	564.2 m	2 OF 2



large but rare Te, Pa

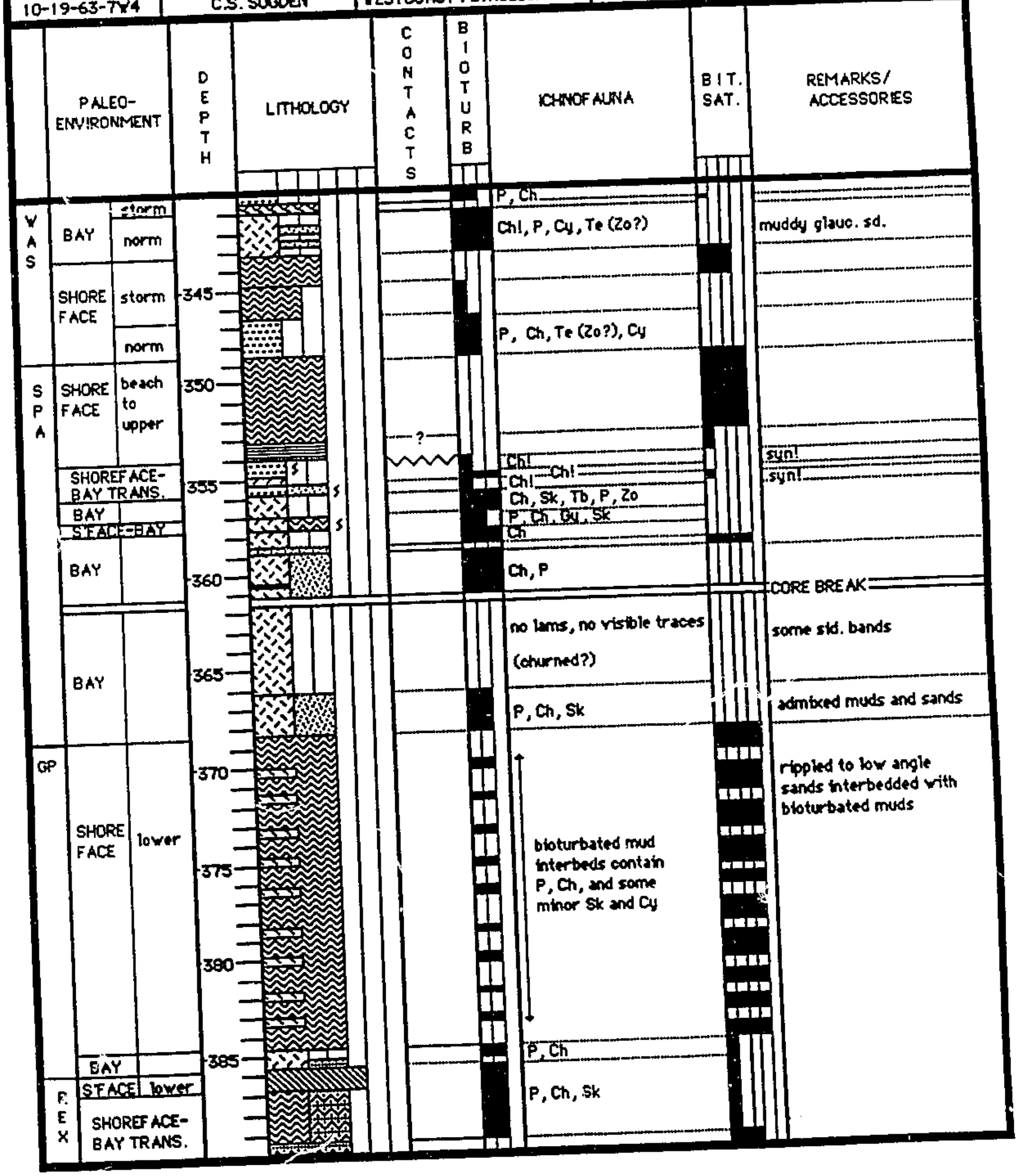
rip-ups at base

SANDS ARE MOSTLY SEMI-CONSOLIDATED!

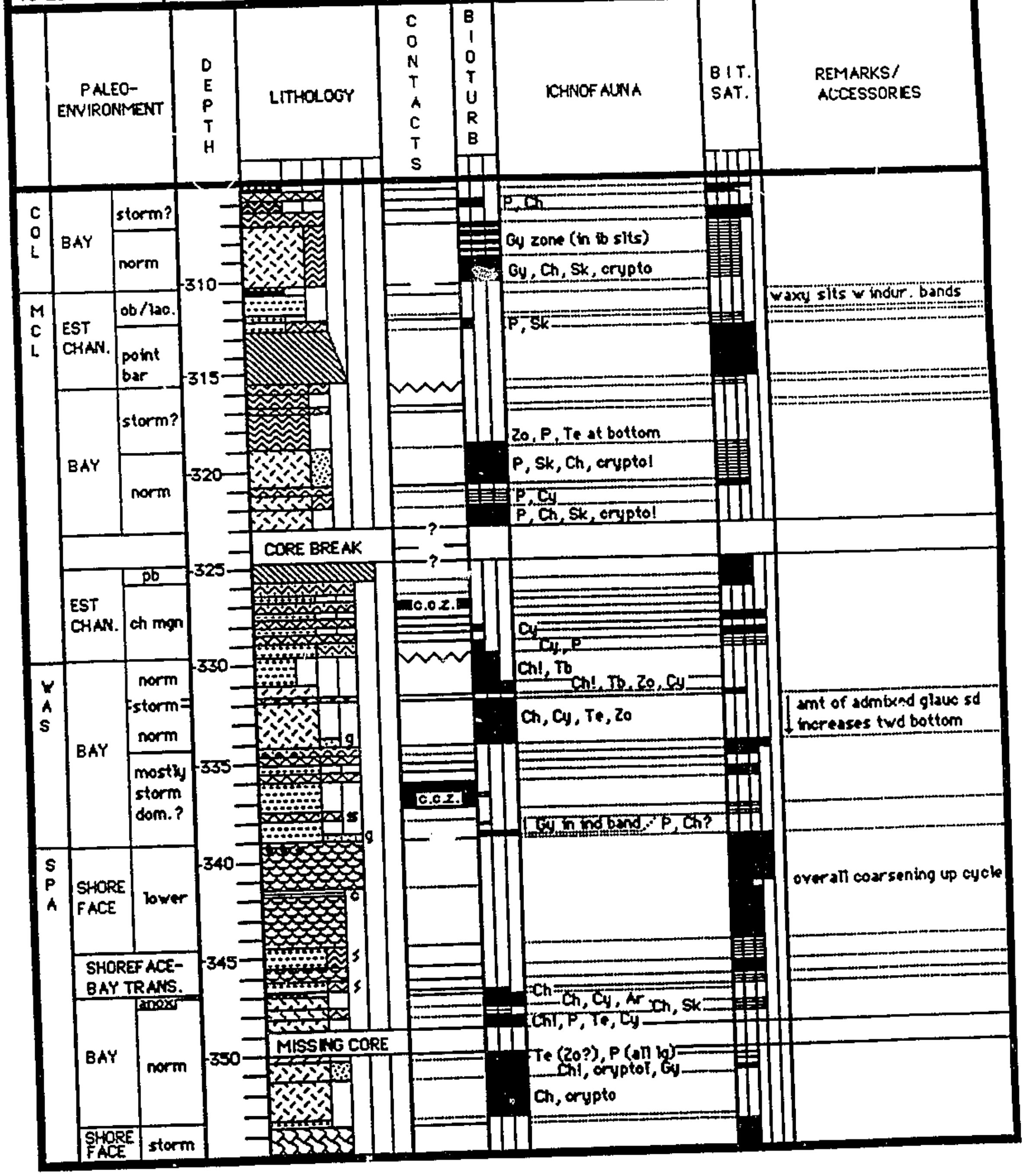
spotty gas shows

???????

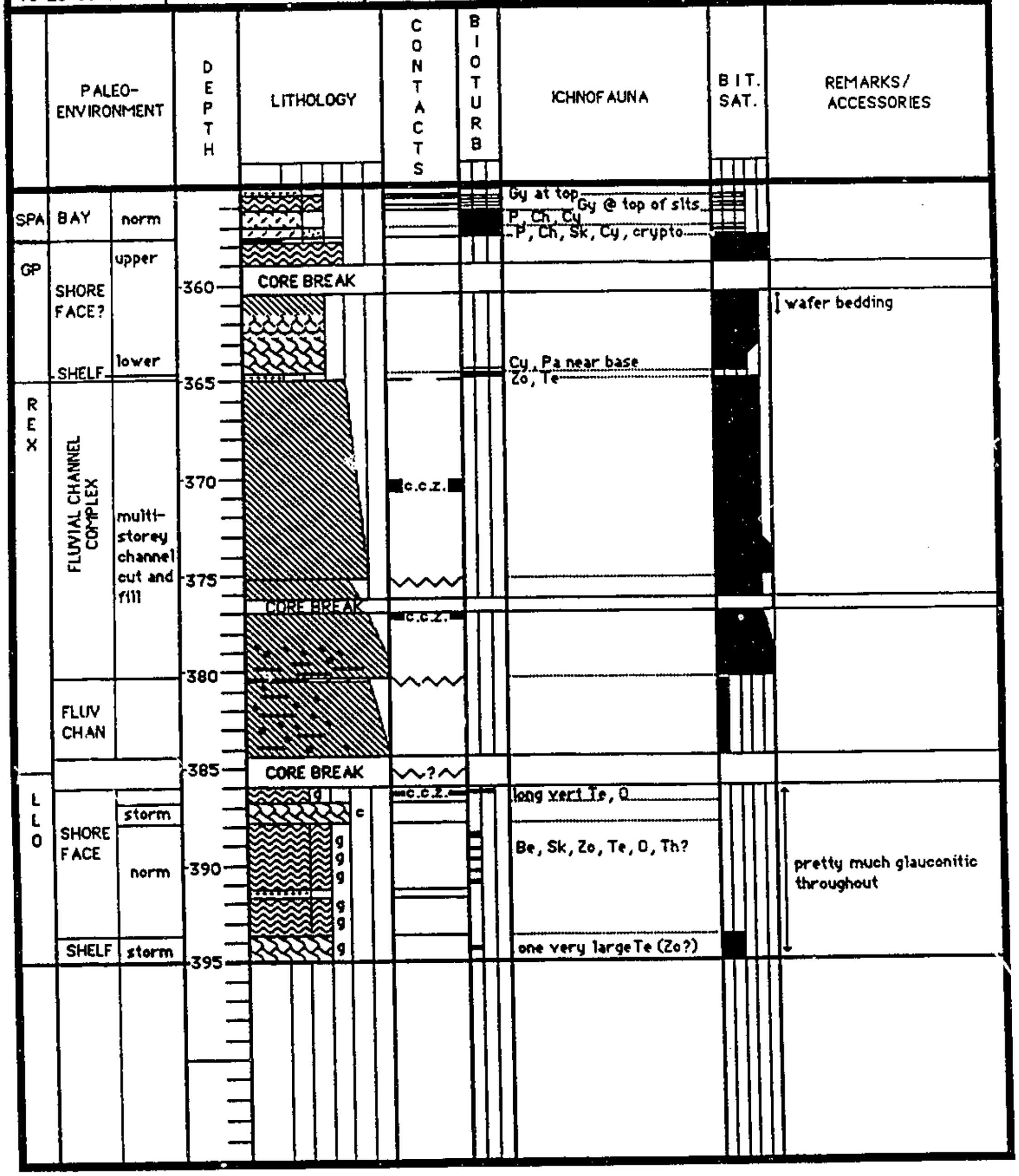
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-19-63-7W4	C.S. SUGDEN	WESTCOAST PETROLEUM LTD.	340.0-395.0 m	571.8 m	1 OF 1



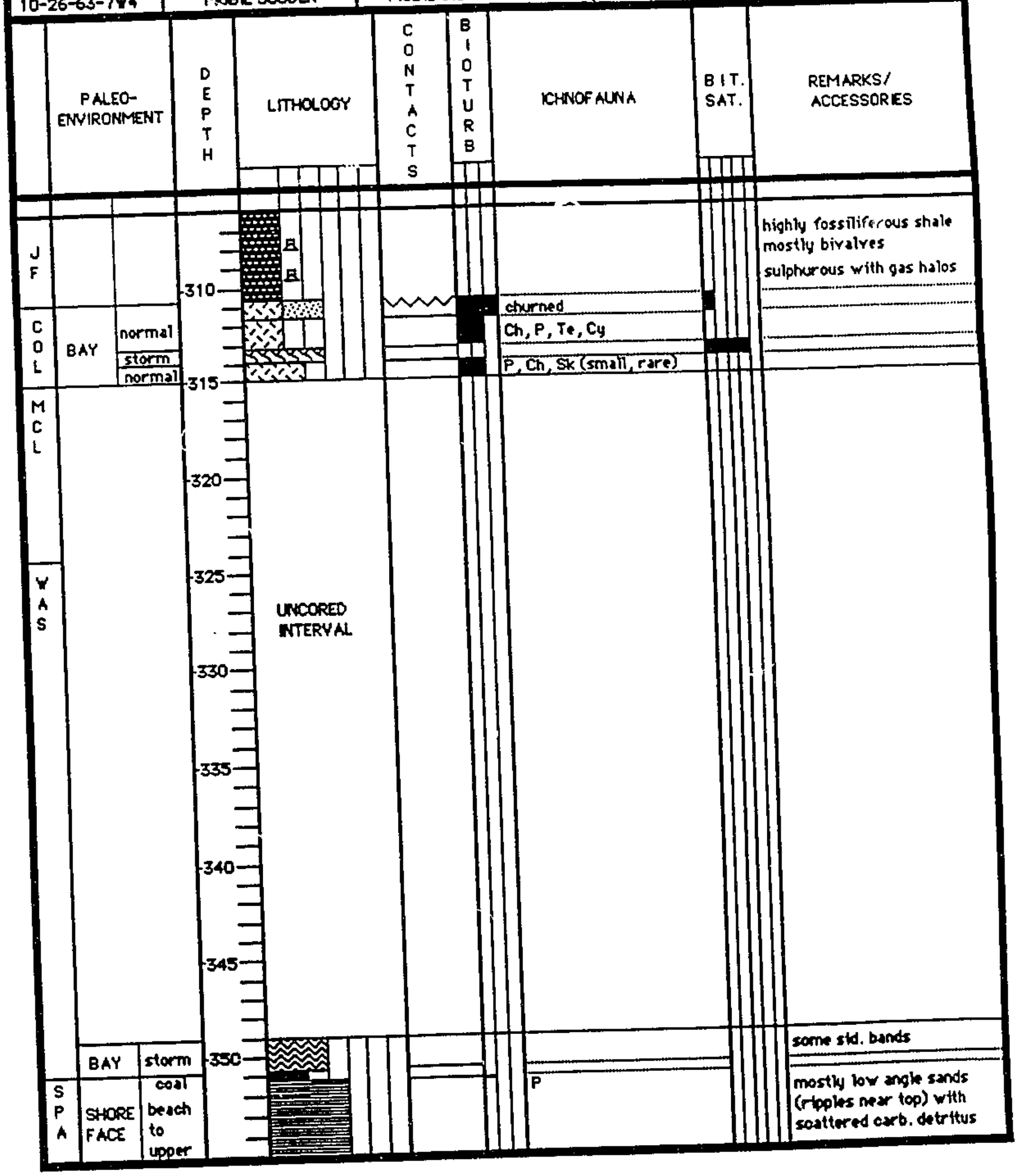
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-25-63-7W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	305.0-395.0 m	569.6 m	1 OF 2



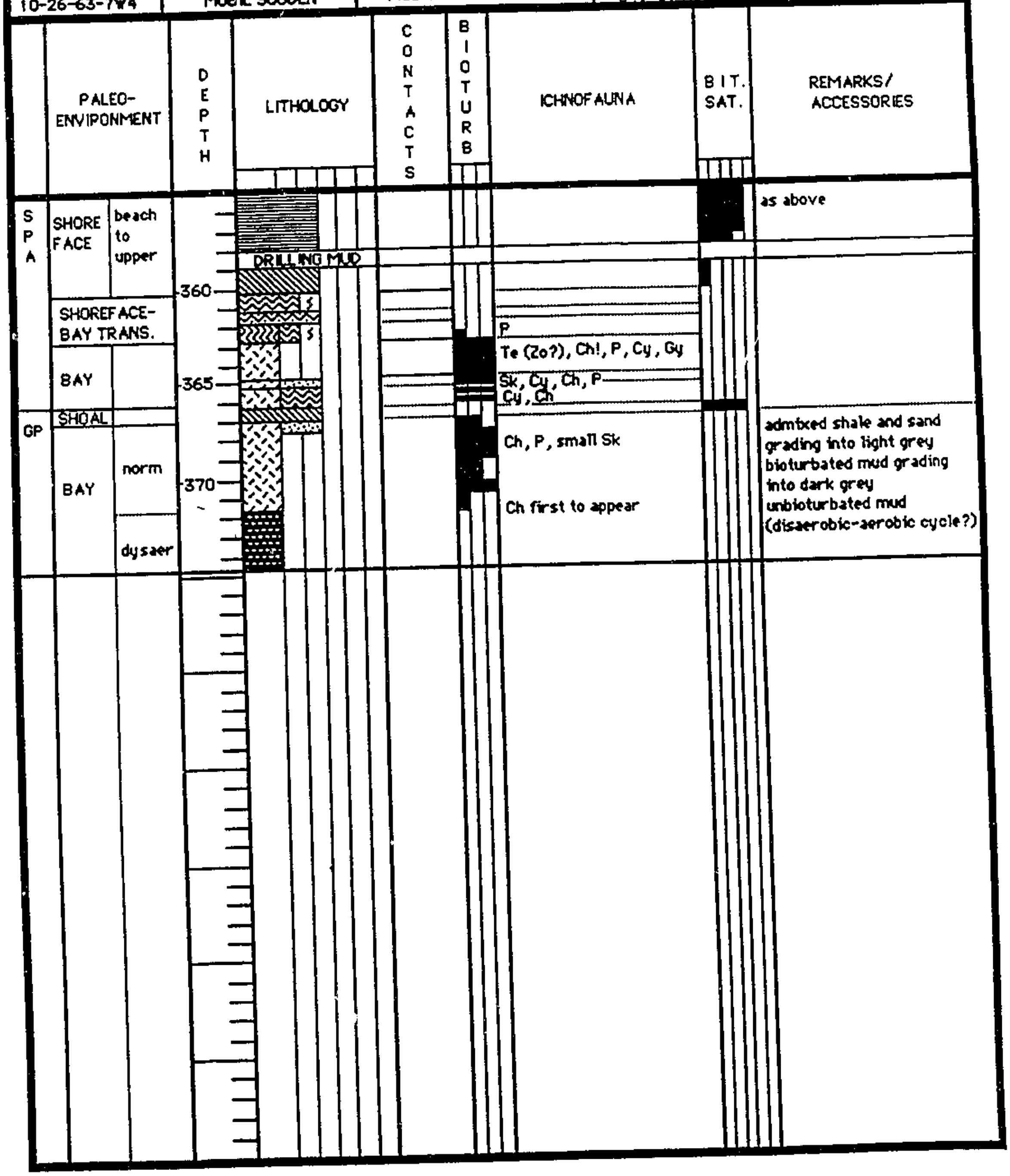
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-25-63-7W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	305-395 m	569.6 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-26-63-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	306.0-374.6 m	569.1 m	1 OF 2



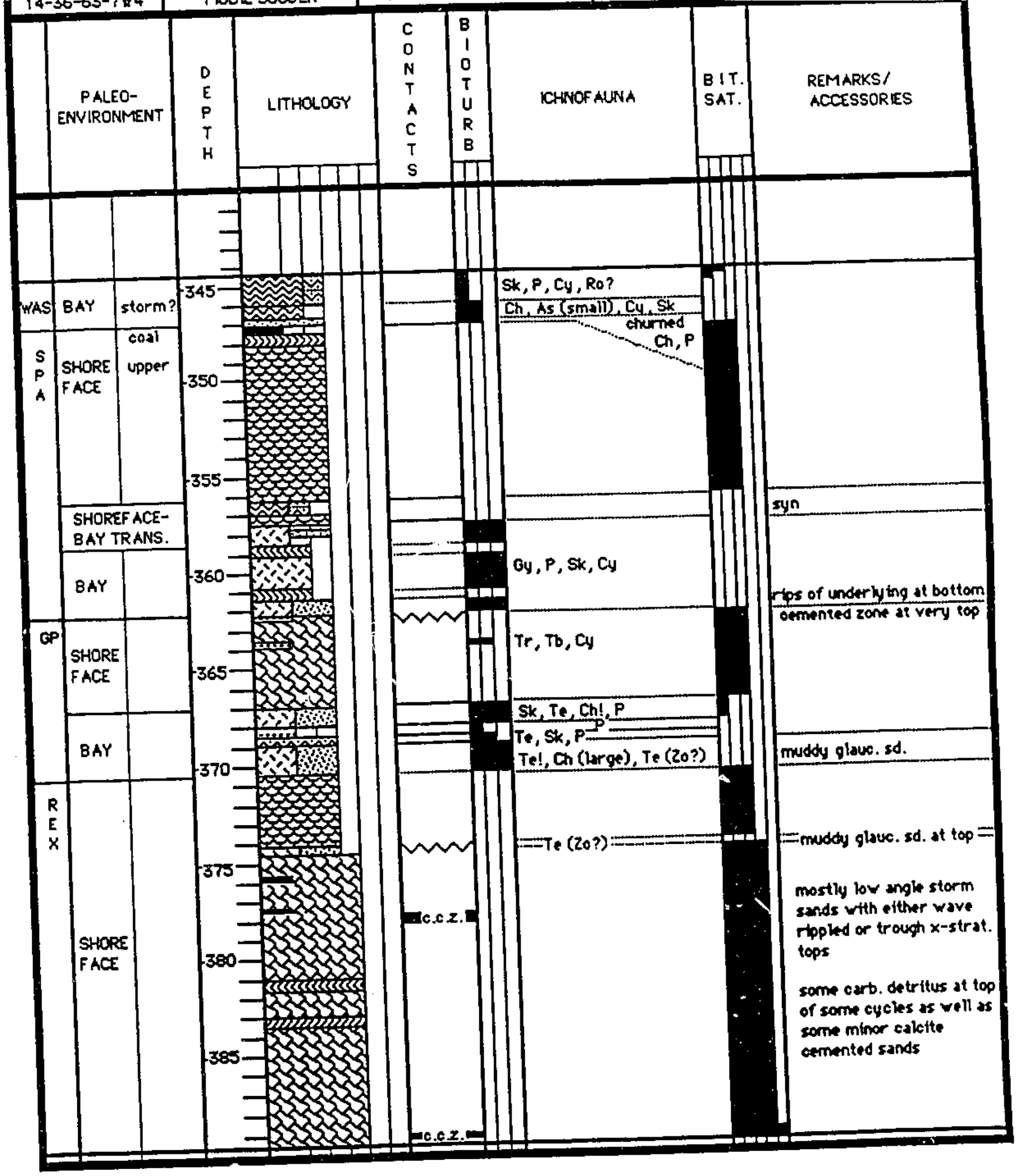
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-26-63-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	306-315 m 349-374.6 m	569.1 m	2 OF 2



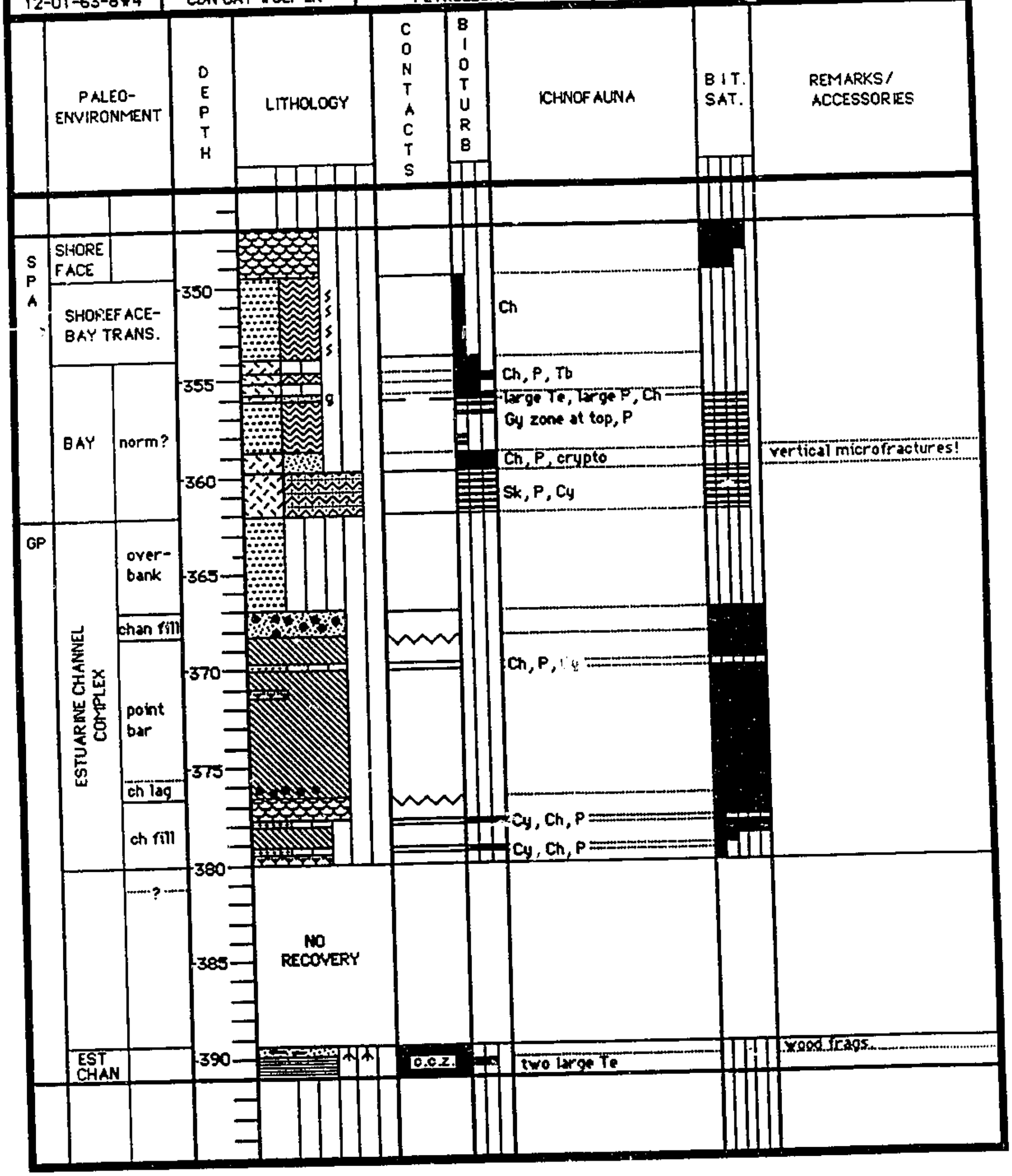
as above

admixed shale and sand grading into light grey bioturbated mud grading into dark grey unbioturbated mud (disaerobic-aerobic cycle?)

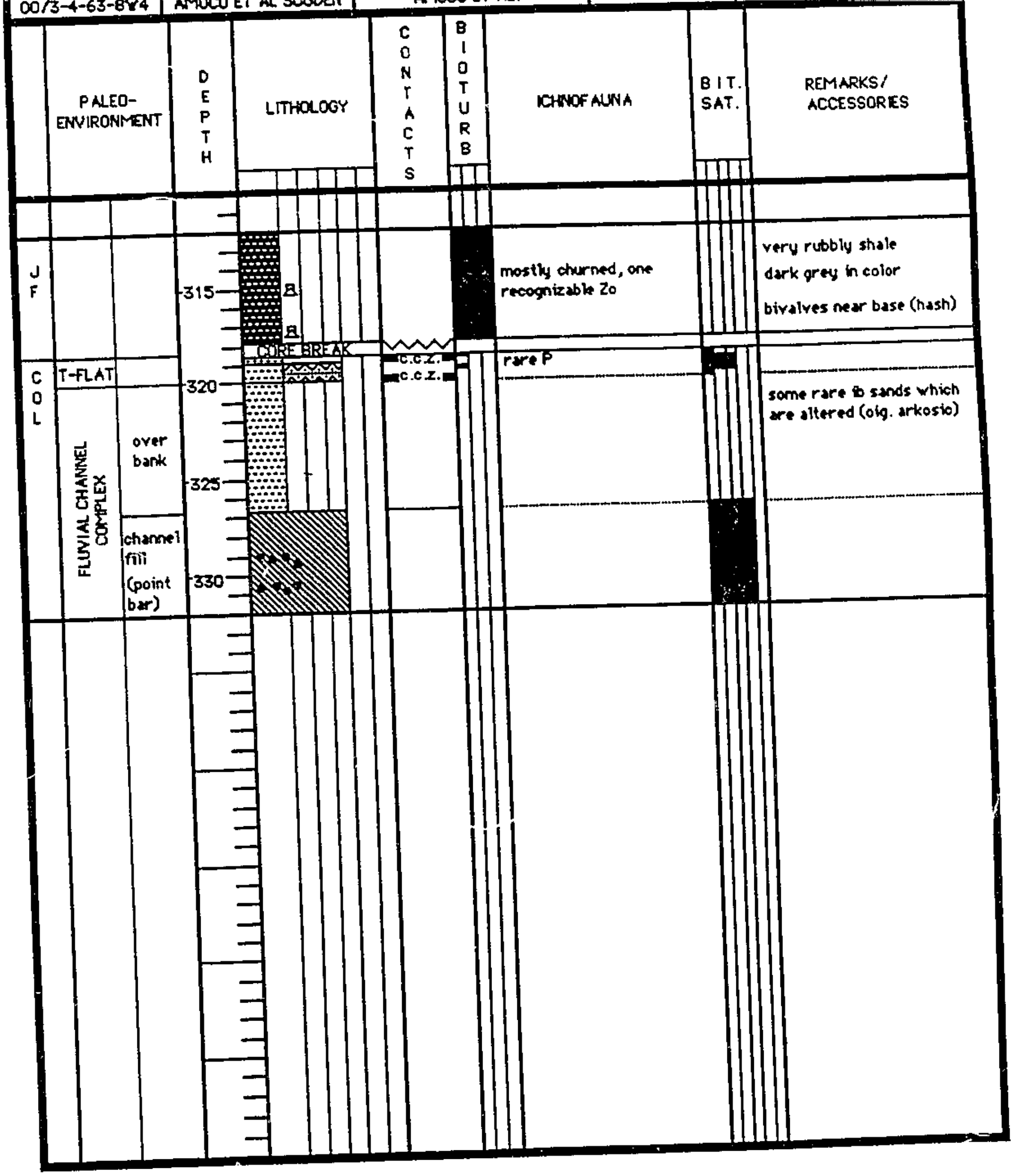
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-36-63-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	344.5-389.35 m	578.6 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-01-63-8W4	CDN OXY WOLF LK	CANADIAN OCCIDENTAL PETROLEUM LTD.	347.0-391.0 m	569.1 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
00/3-4-63-8W4	AMOCO ET AL SUGDEN	AMOCO ET AL.	312.0-332.0 m	568.7 m	1 OF 1



mostly churned, one recognizable Zo

rare P

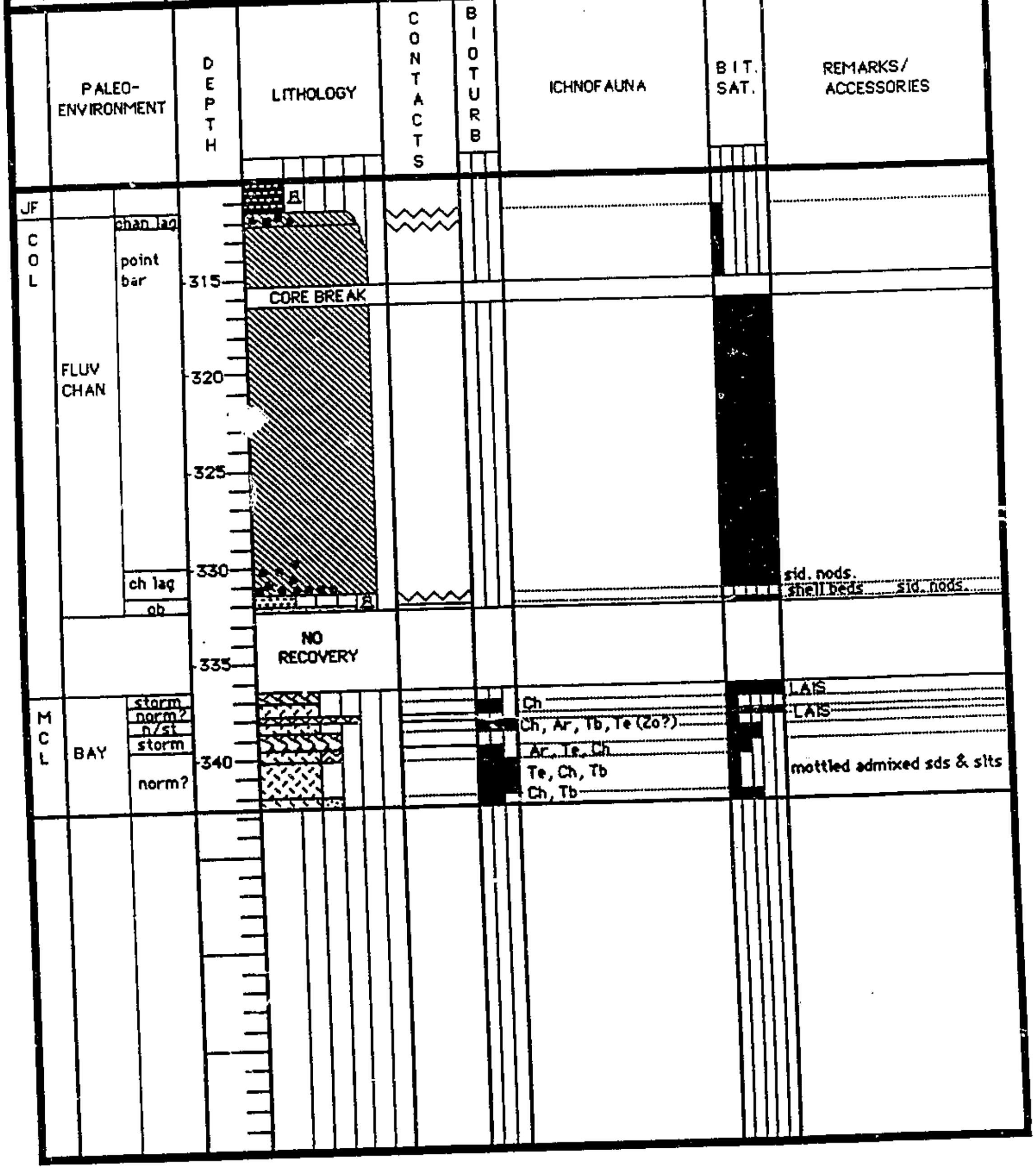
very rubbly shale

dark grey in color

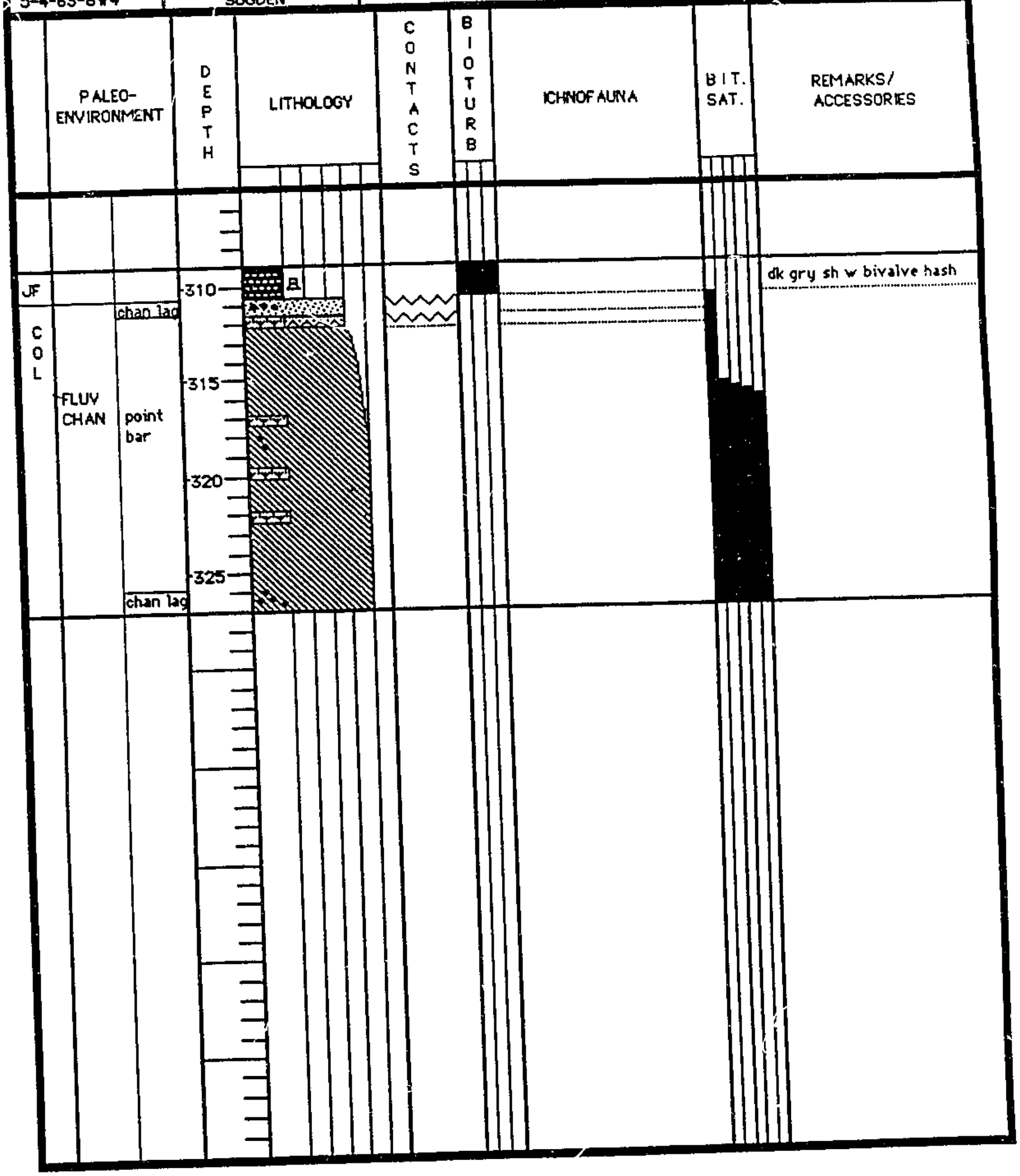
bivalves near base (hash)

some rare b sands which are altered (oig. arkosic)

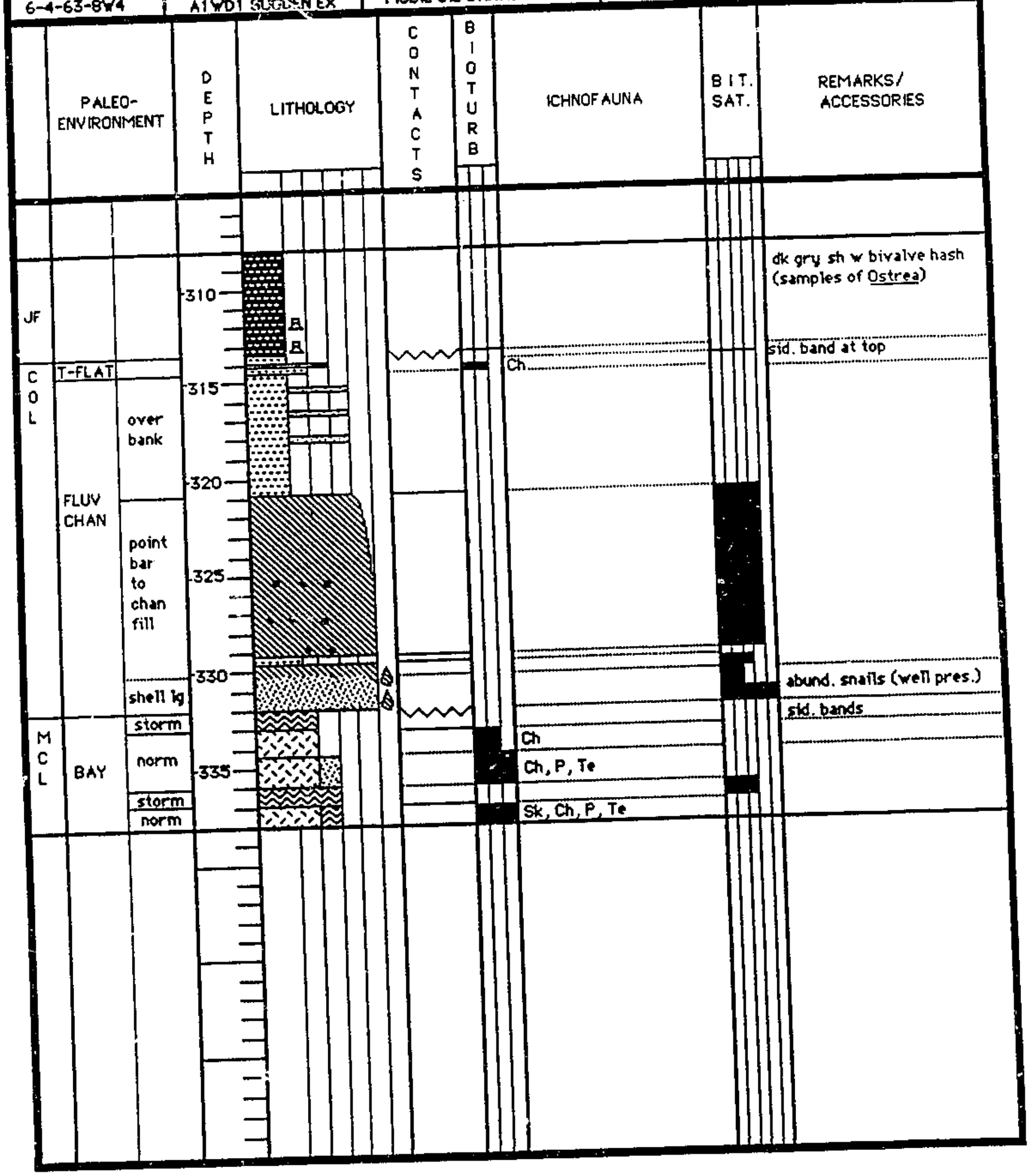
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
4-4-63-8W4	AMOCO ET AL PL-5 SUGDEN	AMOCO ET AL.	310.0-342.5 m	567.7 m	1 OF 1



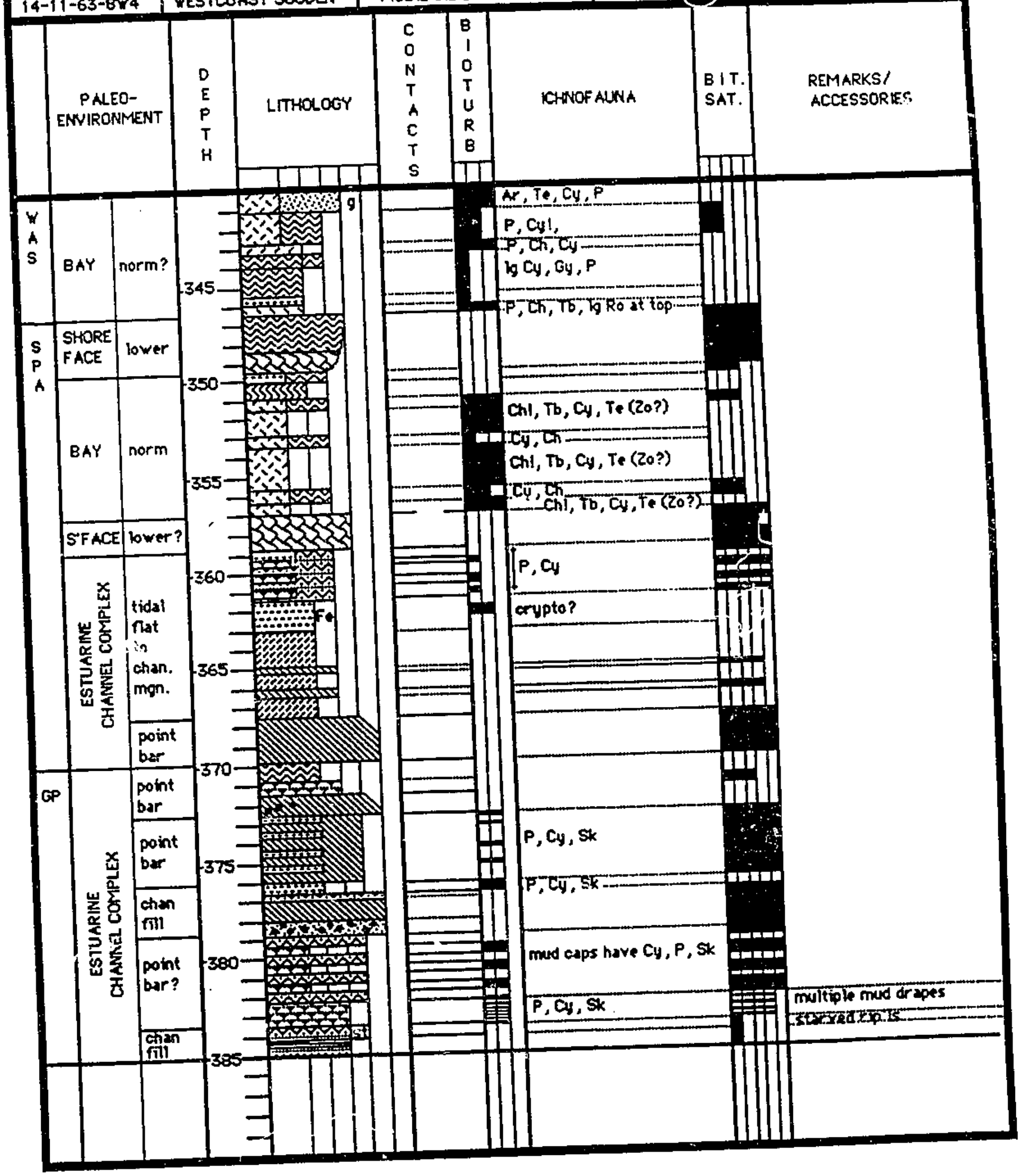
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-4-63-8W4	AMOCO ET AL PL-6 SUGDEN	AMOCO ET AL	309.0-327.0 m	567.3 m	1 OF 1

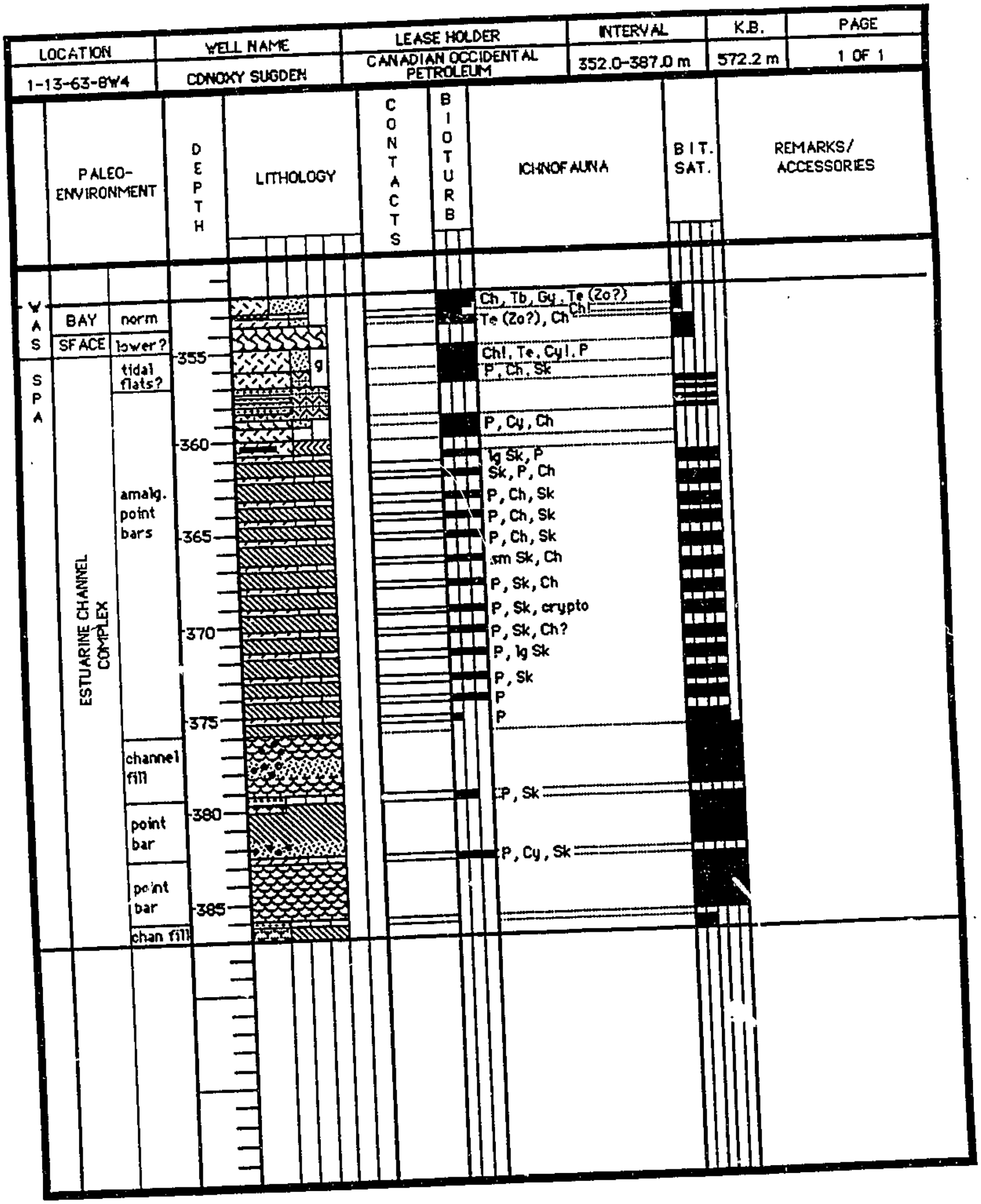


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-4-63-8W4	AMOCO ET AL A1 WD1 SUGDEN EX	MOBIL OIL CANADA LTD.	308.0-338.0 m	566.6 m	1 OF 1



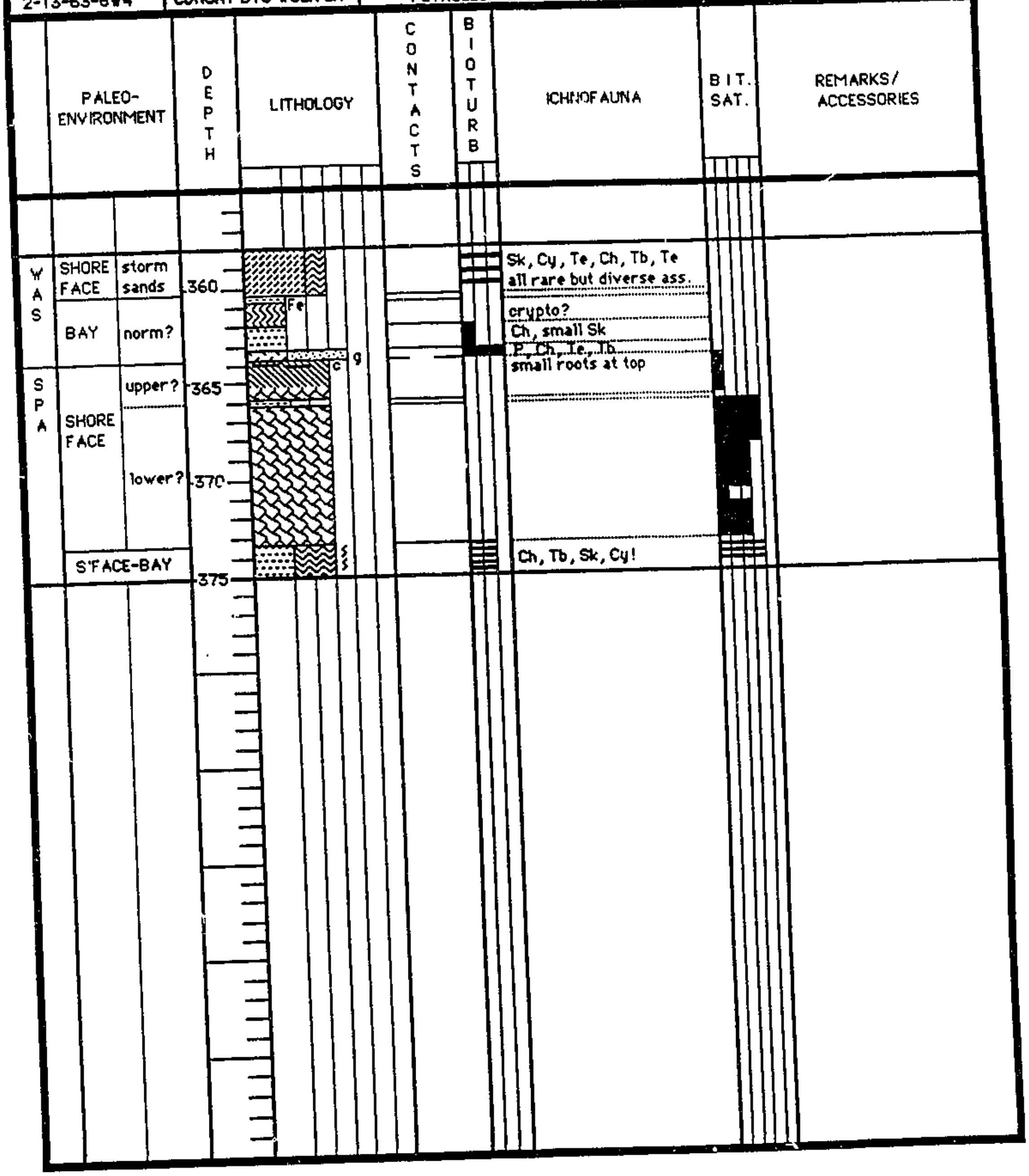
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-11-63-8W4	WESTCOAST SUGDEN	MOBIL OIL CANADA LTD.	340.0-383.0 m	567.2 m	1 OF 1

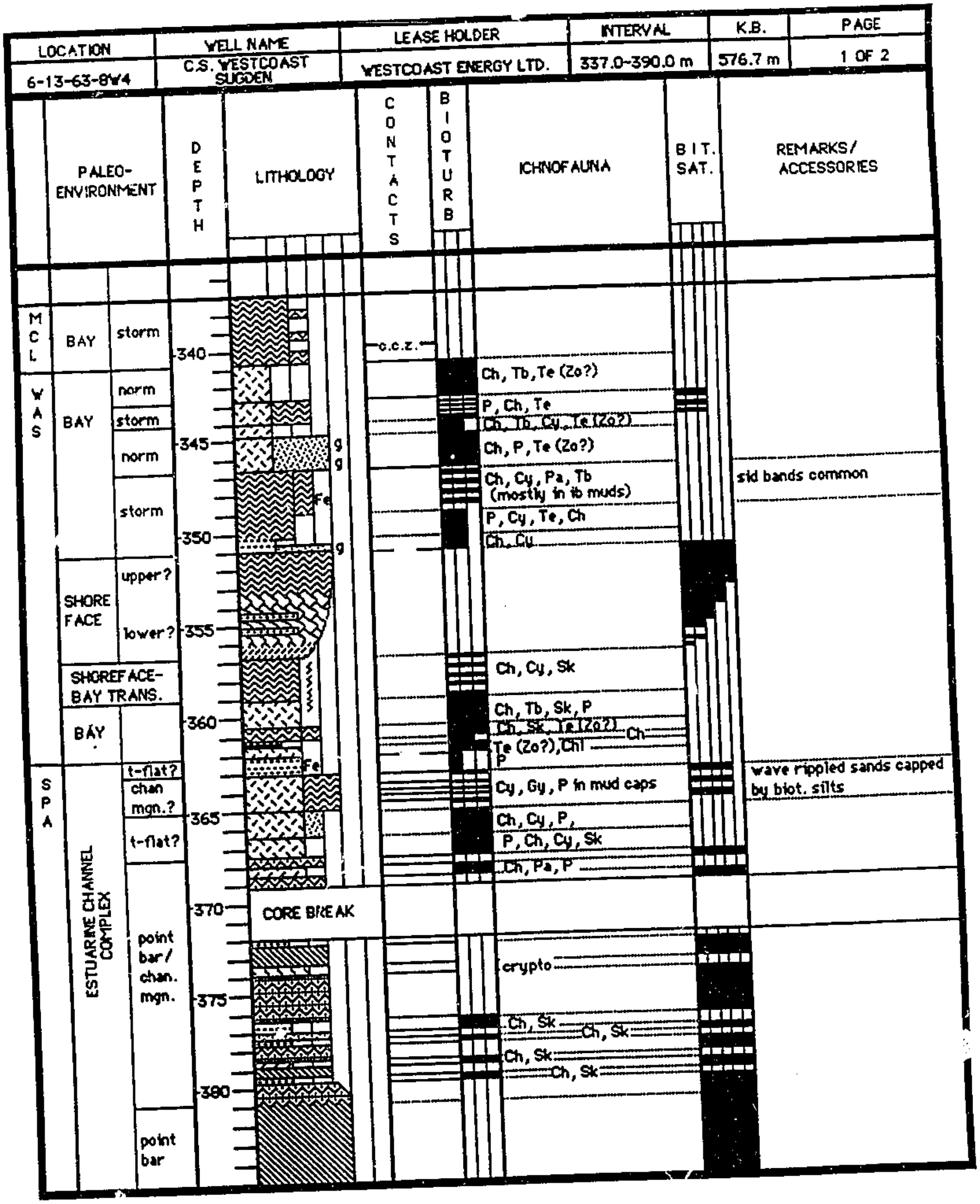




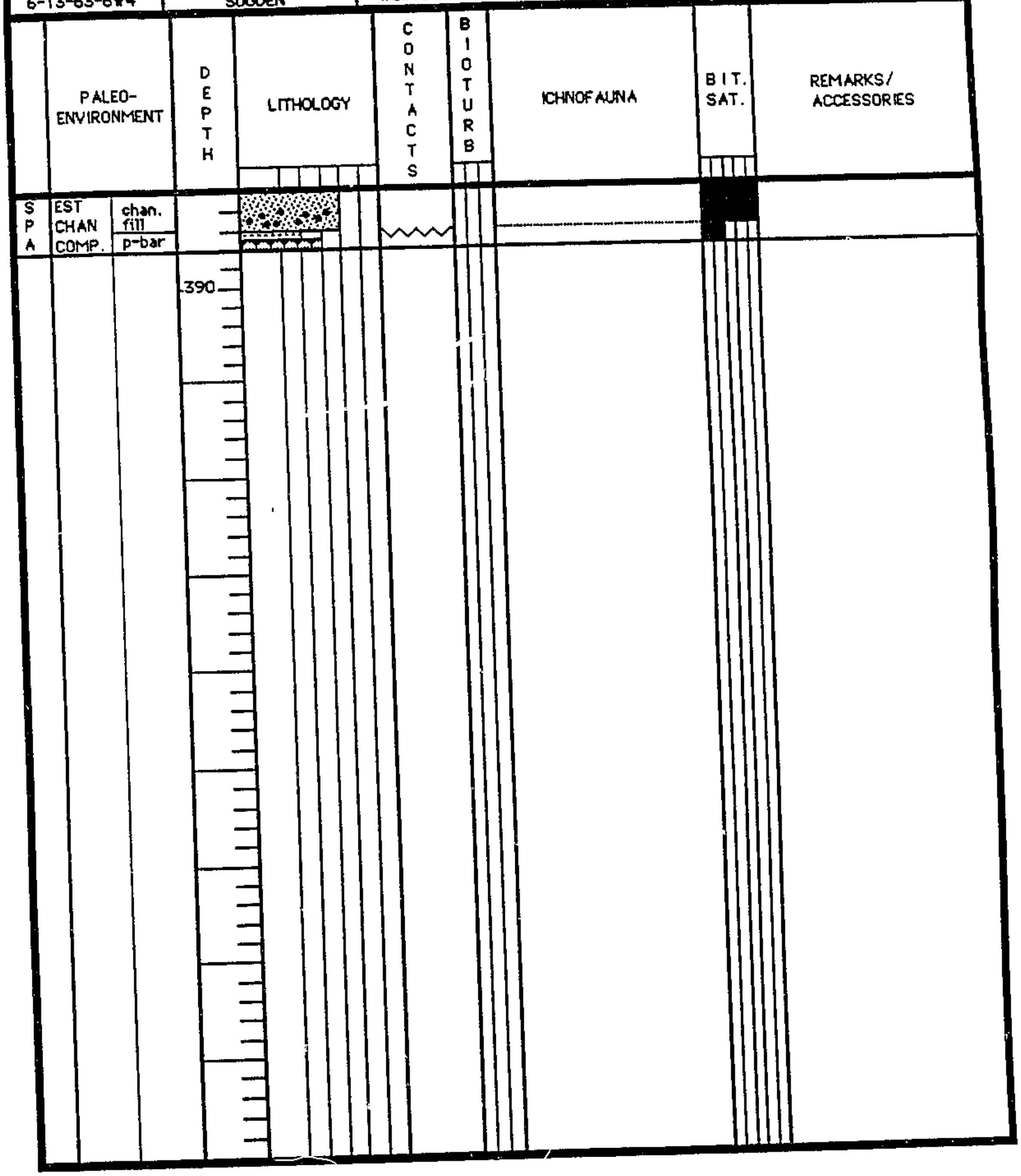
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-13-63-8W4	CONOXY SUGDEN	CANADIAN OCCIDENTAL PETROLEUM	352.0-387.0 m	572.2 m	1 OF 1

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-13-63-8W4	CDNOXY B13 WOLK LK	CANADIAN OCCIDENTAL PETROLEUM LTD.	358.0-375.0 m	578.9 m	1 OF 1

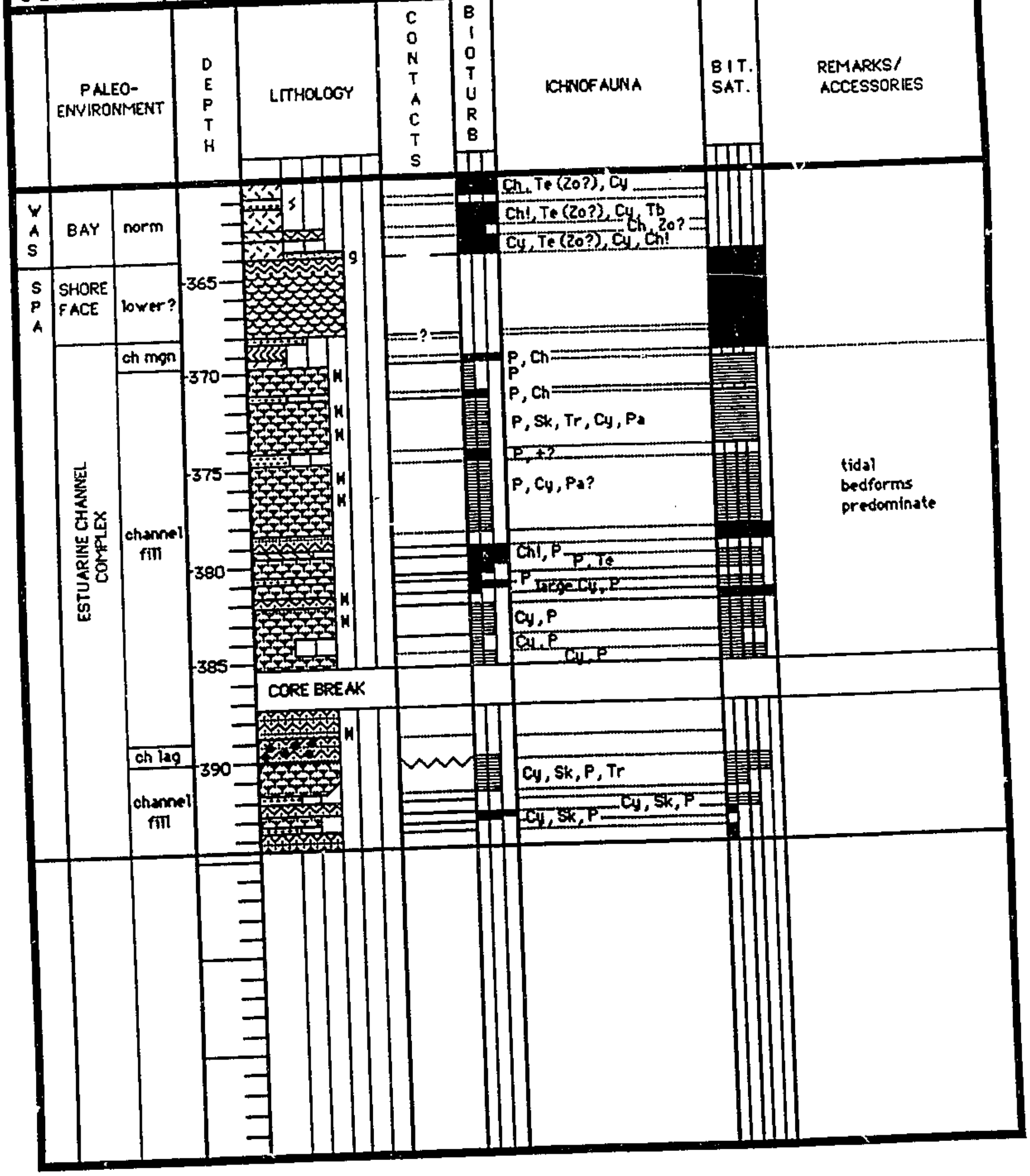



LOCATION
6-13-63-8W4
WELL NAME
C.S. WESTCOAST SUGDEN
LEASE HOLDER
WESTCOAST ENERGY LTD.
INTERVAL
337.0-390.0 m
K.B.
576.7 m
PAGE
1 OF 2
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
MCL
BAY
storm
WAS
BAY
norm
storm
norm
storm
SHORE FACE
upper?
lower?
SHOREFACE-BAY TRANS.
BAY
SPA
ESTUARINE CHANNEL COMPLEX
t-flat?
chan mgn.?
t-flat?
point bar/ chan. mgn.
point bar
340
345
350
355
360
365
370
375
380
g
g
Fe
g
Fe
c.c.z.
CORE BREAK
Ch, Tb, Te (Zo?)
P, Ch, Te
Ch, Tb, Cy, Te (Zo?)
Ch, P, Te (Zo?)
Ch, Cy, Pa, Tb
(mostly in tb muds)
P, Cy, Te, Ch
Ch, Cy
Ch, Cy, Sk
Ch, Tb, Sk, P
Ch, Sk, Te (Zo?)
Ch
Te (Zo?), Chl
P
Cy, Gy, P in mud caps
Ch, Cy, P,
P, Ch, Cy, Sk
Ch, Pa, P
crypto
Ch, Sk
Ch, Sk
Ch, Sk
Ch, Sk
sid bands common
wave rippled sands capped by biot. silts

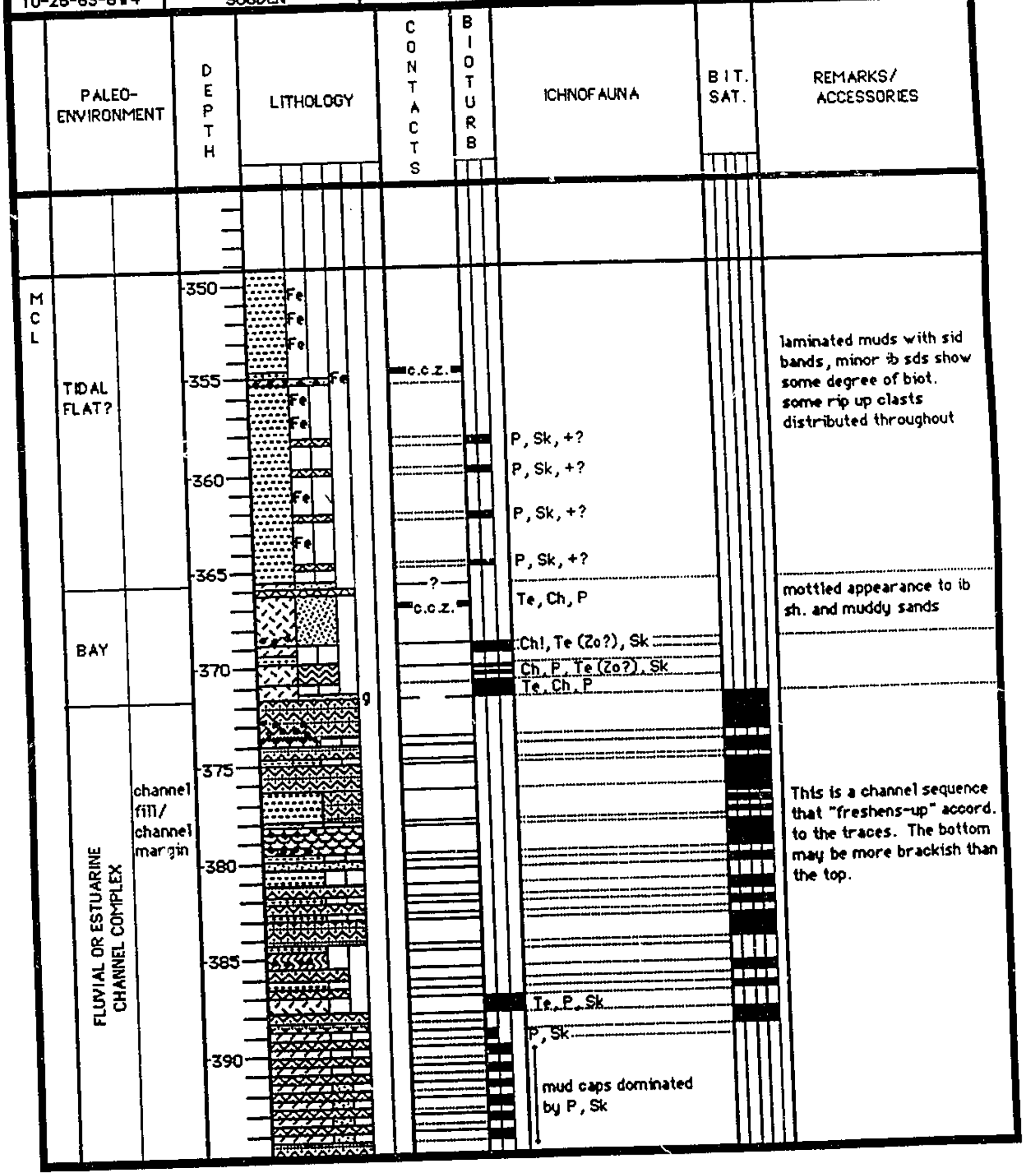
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-13-63-8W4	C.S. WESTCOAST SUGDEN	WESTCOAST ENERGY LTD.	337.0-390.0 m	576.7 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-24-63-8W4	CDNOXY WOLF LAKE	CANADIAN OCCIDENTAL PETROLEUM LTD.	360.0-396.0 m	578.6 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-26-63-8W4	C.S. WESTCOAST SUGDEN	WESTCOAST ENERGY LTD.	349.2-408.8 m	581.3 m	1 OF 2

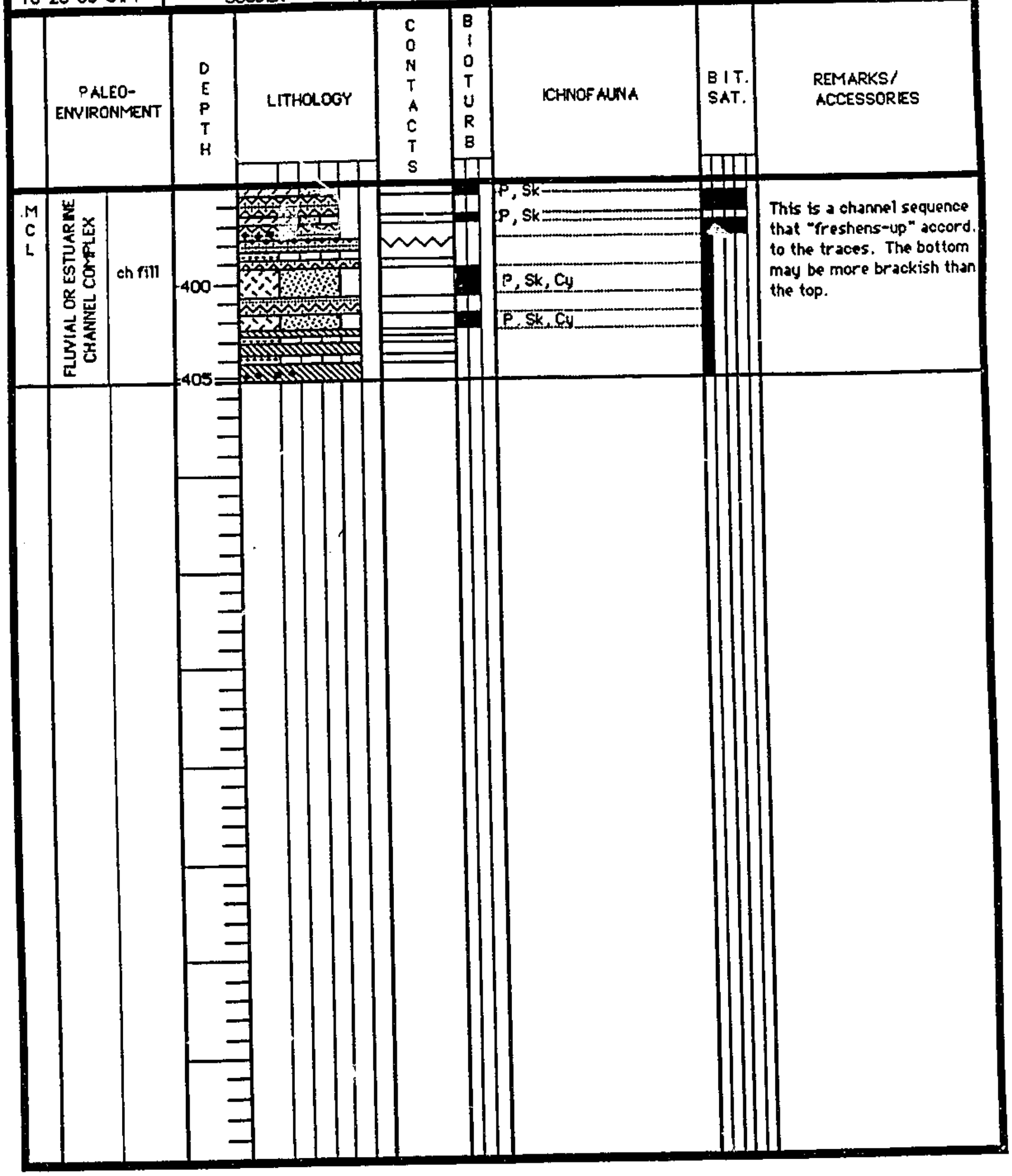


laminated muds with sid bands, minor ib sds show some degree of biot. some rip up clasts distributed throughout

mottled appearance to ib sh. and muddy sands

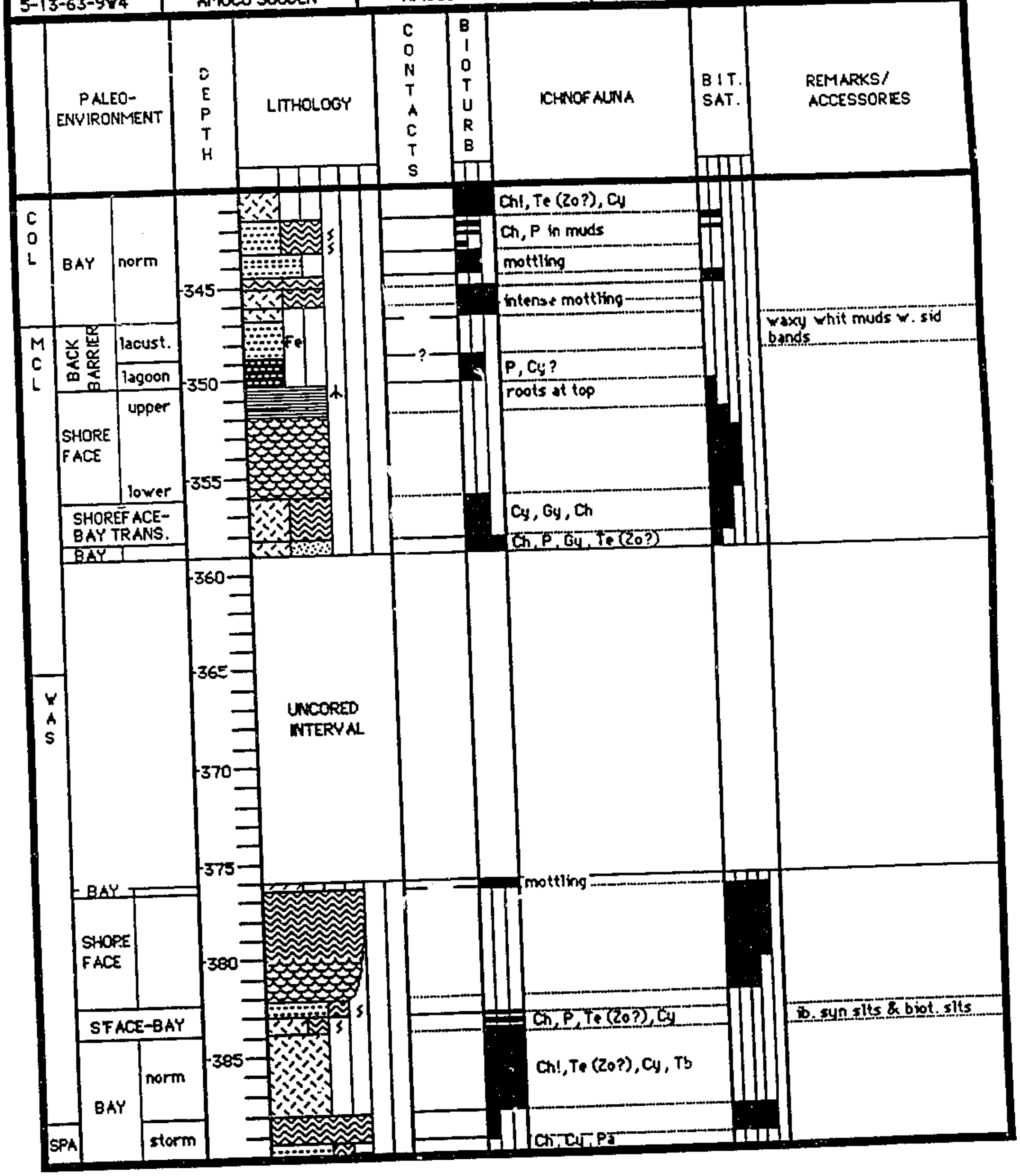
This is a channel sequence that "freshens-up" accord. to the traces. The bottom may be more brackish than the top.

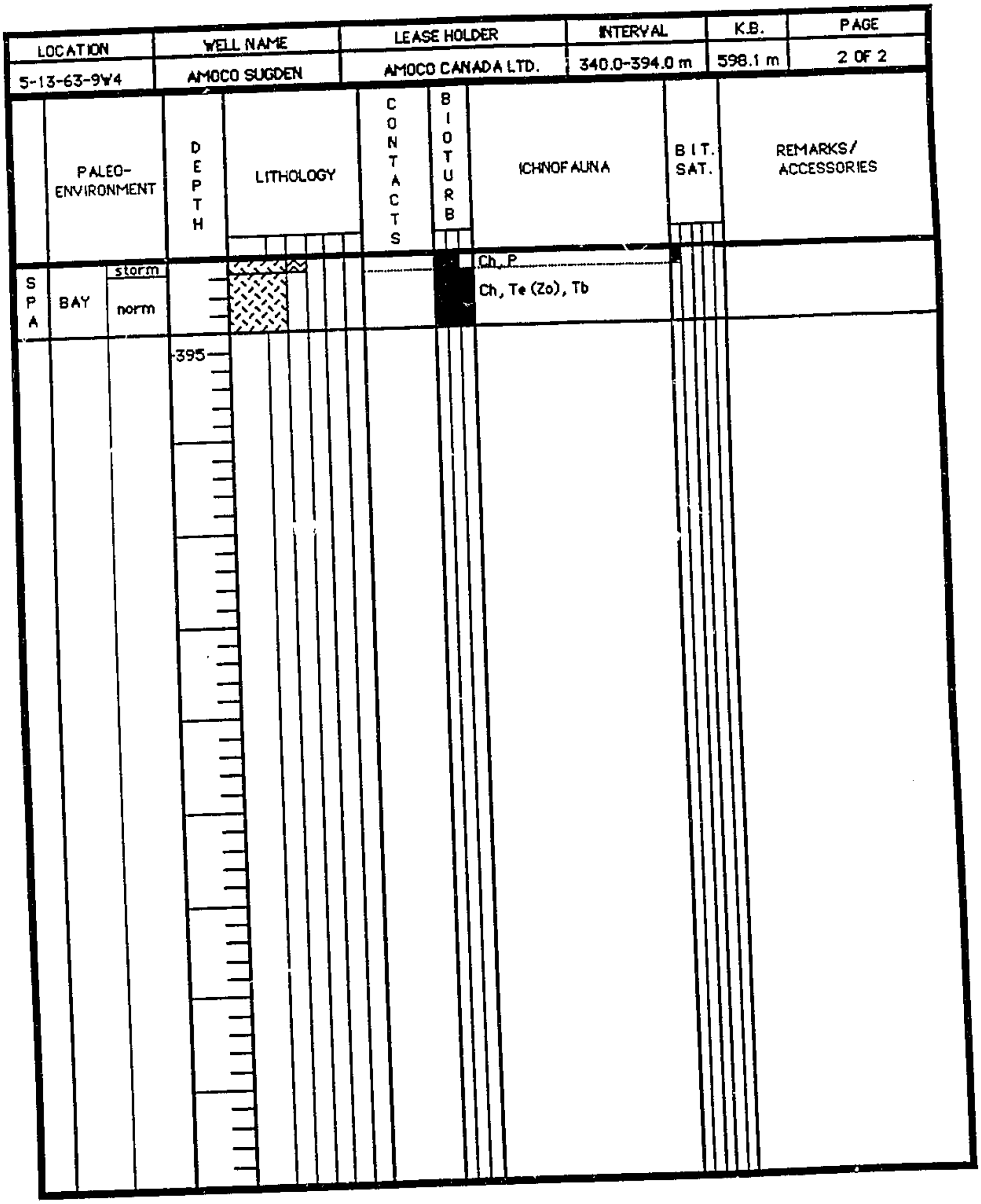
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-26-63-8W4	C.S. WESTCOAST SUGDEN	WESTCOAST ENERGY LTD.	349.2-408.8 m	581.3 m	2 OF 2



This is a channel sequence that "freshens-up" accord. to the traces. The bottom may be more brackish than the top.

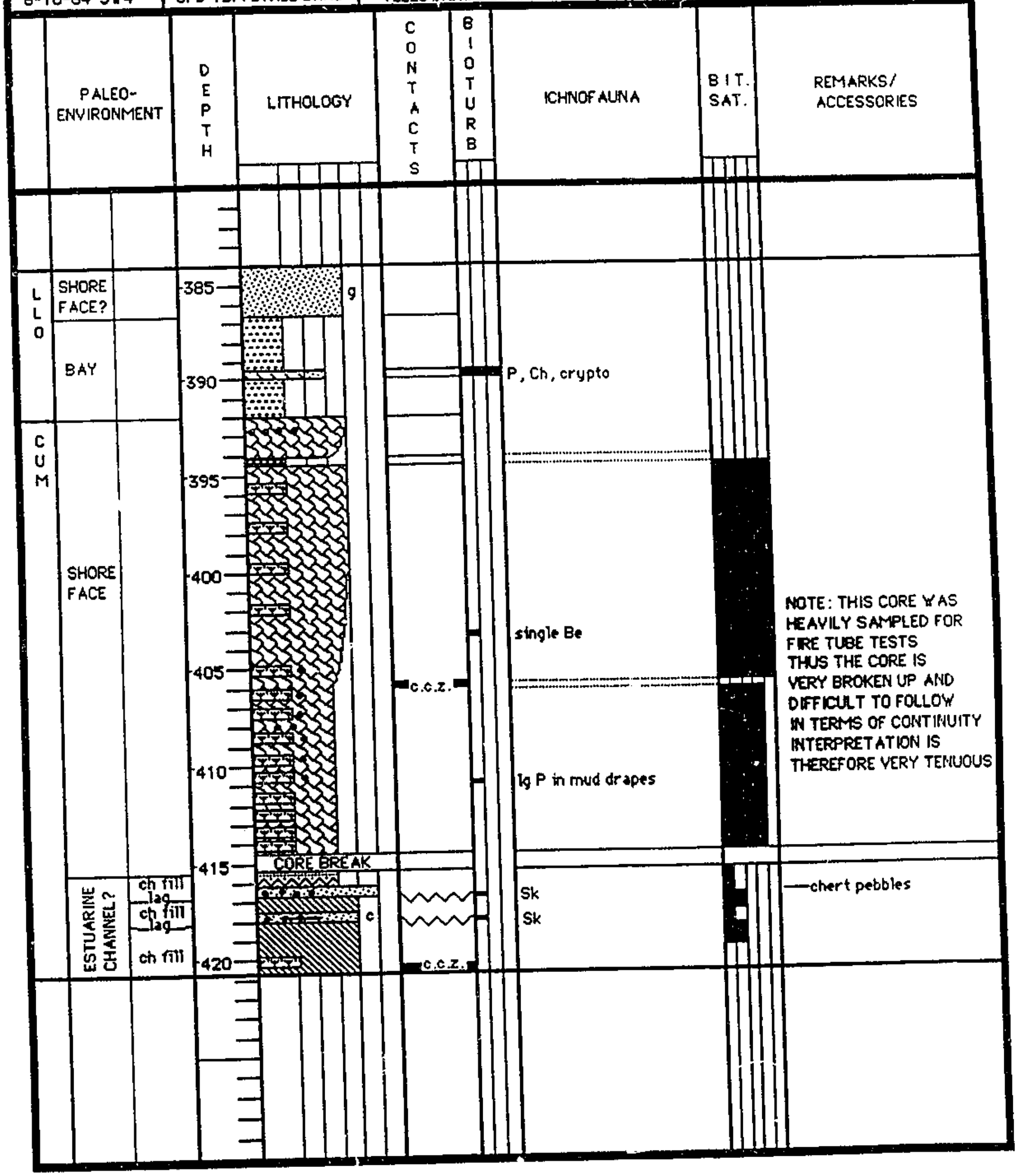
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-13-63-9W4	AMOCO SUGDEN	AMOCO CANADA LTD.	340.0-394.0 m	598.1 m	1 OF 2





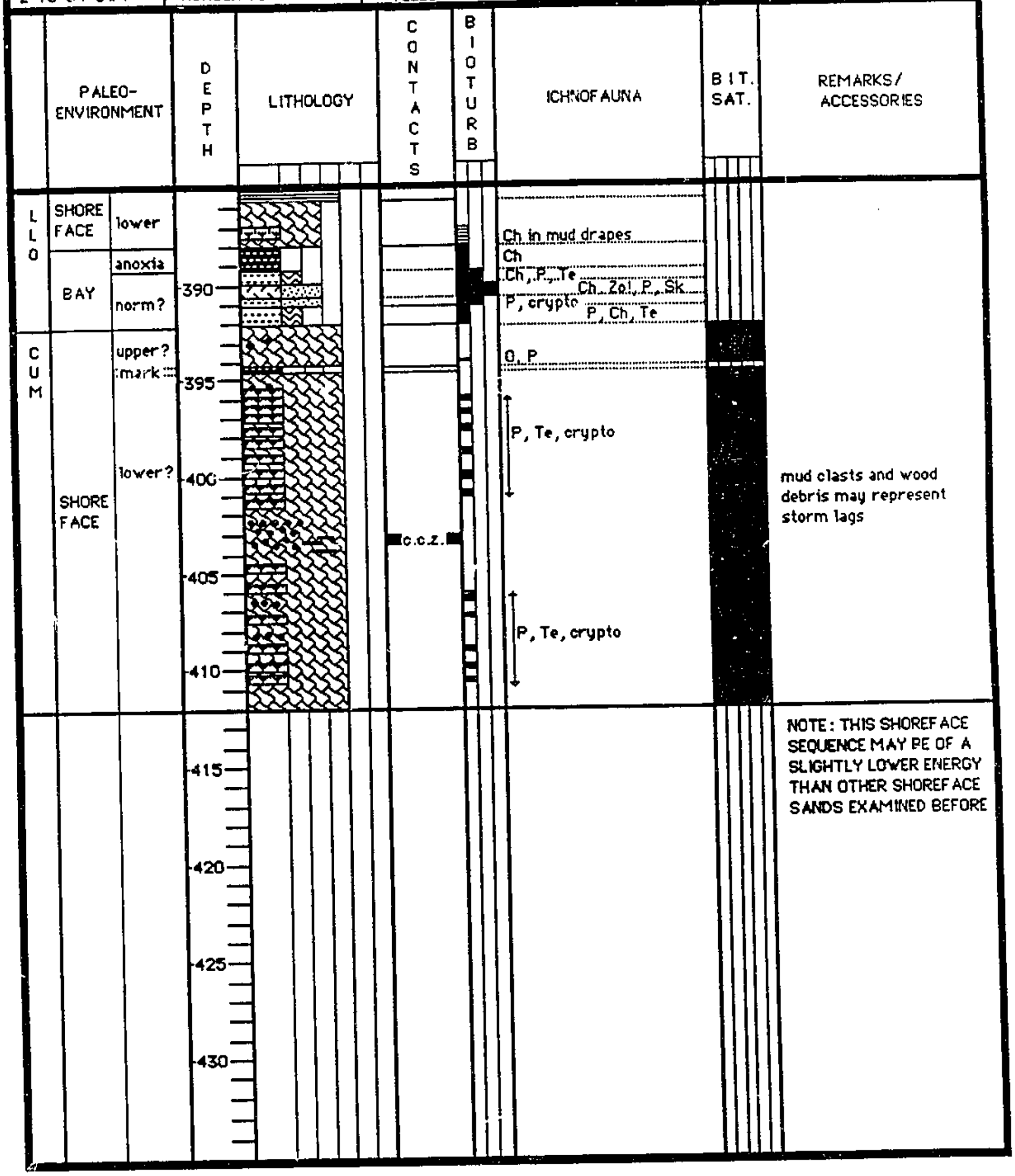
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-13-63-9W4	AMOCO SUGDEN	AMOCO CANADA LTD.	340.0-394.0 m	598.1 m	2 OF 2

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-10-64-3W4	GPD YBM ETHEL LAKE	NORCEN ENERGY RESOURCES YELLOWKNIFE BEAR RES.	384.04-420.62 m	548.3 m	1 OF 1



NOTE: THIS CORE WAS HEAVILY SAMPLED FOR FIRE TUBE TESTS THUS THE CORE IS VERY BROKEN UP AND DIFFICULT TO FOLLOW IN TERMS OF CONTINUITY INTERPRETATION IS THEREFORE VERY TENUOUS

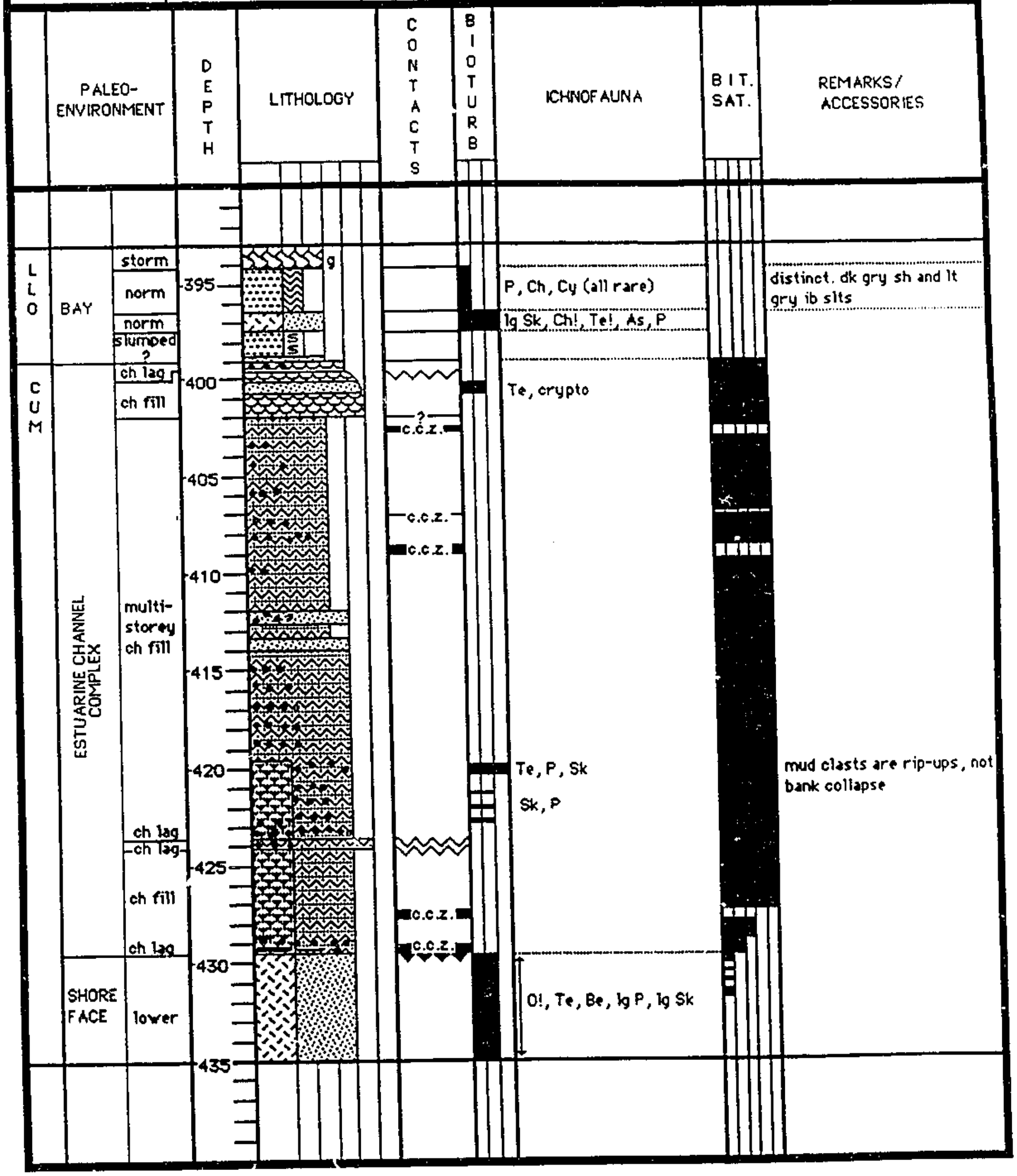
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-15-64-3W4	NORCEN YBR ETHEL LK	NORCEN ENERGY RES. YELLOWKNIFE BEAR RES.	385.0-412.0 m	552.7 m	1 OF 1



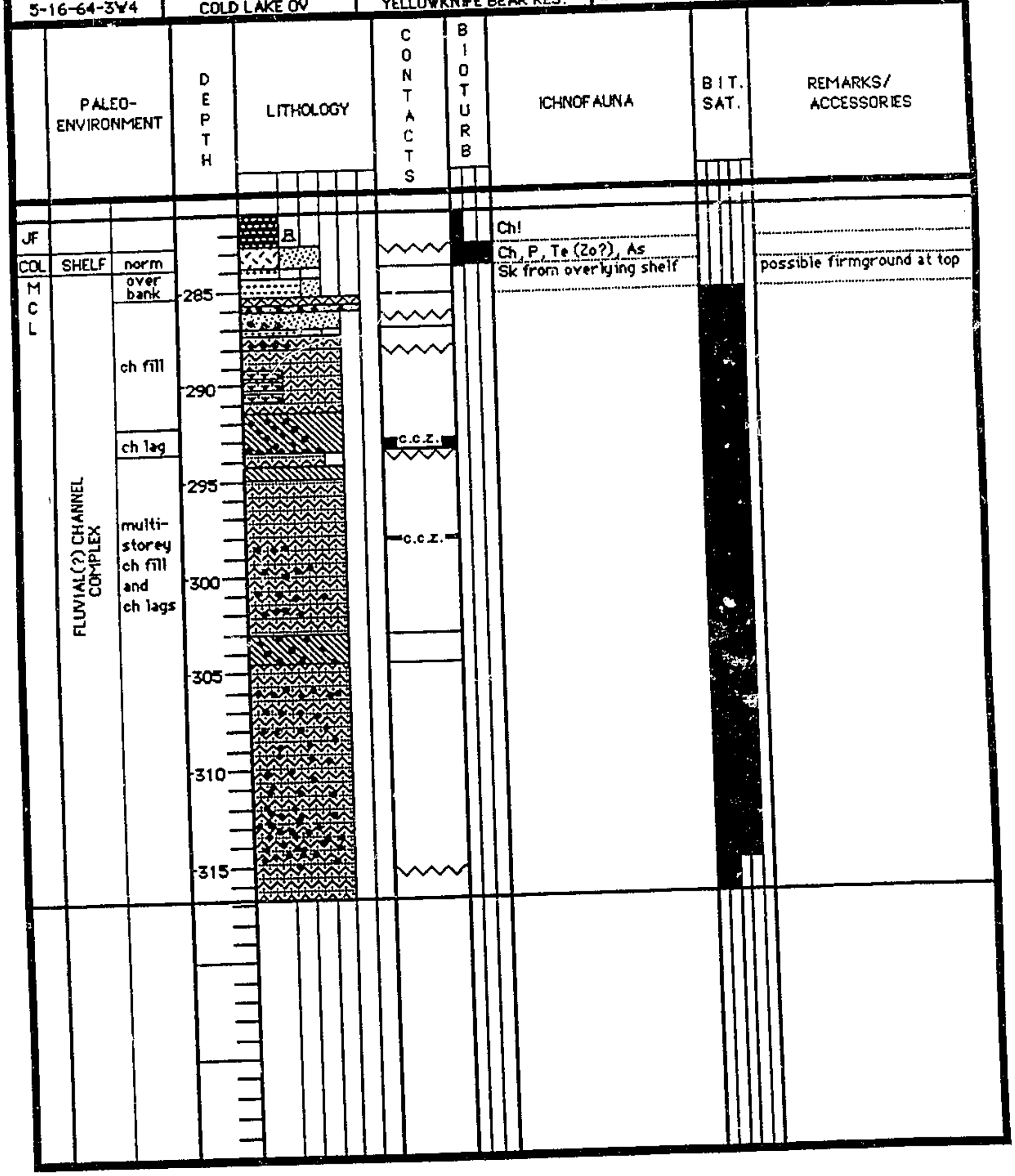
mud clasts and wood debris may represent storm lags

NOTE: THIS SHOREFACE SEQUENCE MAY PE OF A SLIGHTLY LOWER ENERGY THAN OTHER SHOREFACE SANDS EXAMINED BEFORE

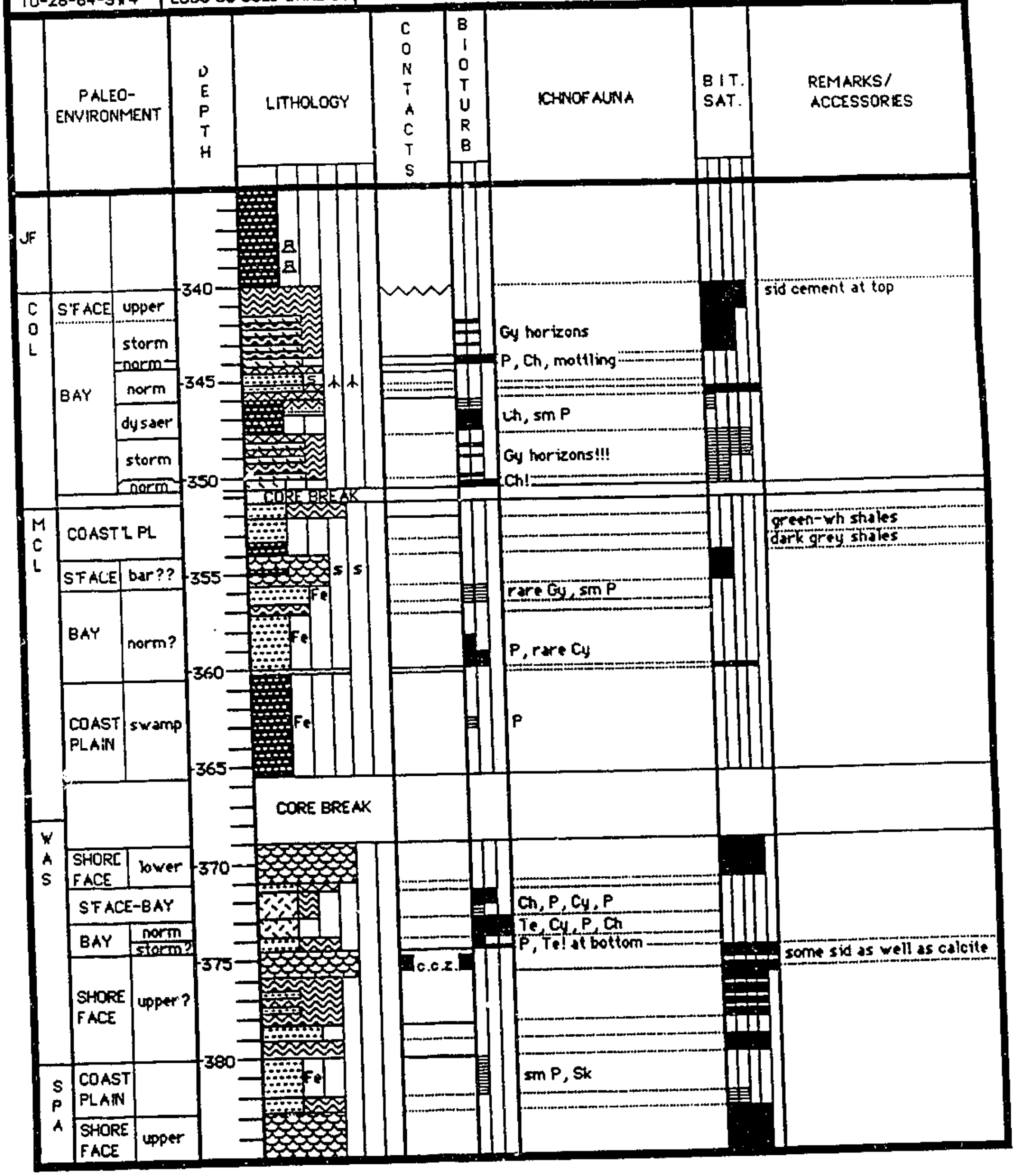
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-16-64-3W4	NORCEN YBR COLD LK	NORCEN ENERGY RES. YELLOWKNIFE BEAR RES.	393.0–438.0 m	564.3 m	1 OF 1



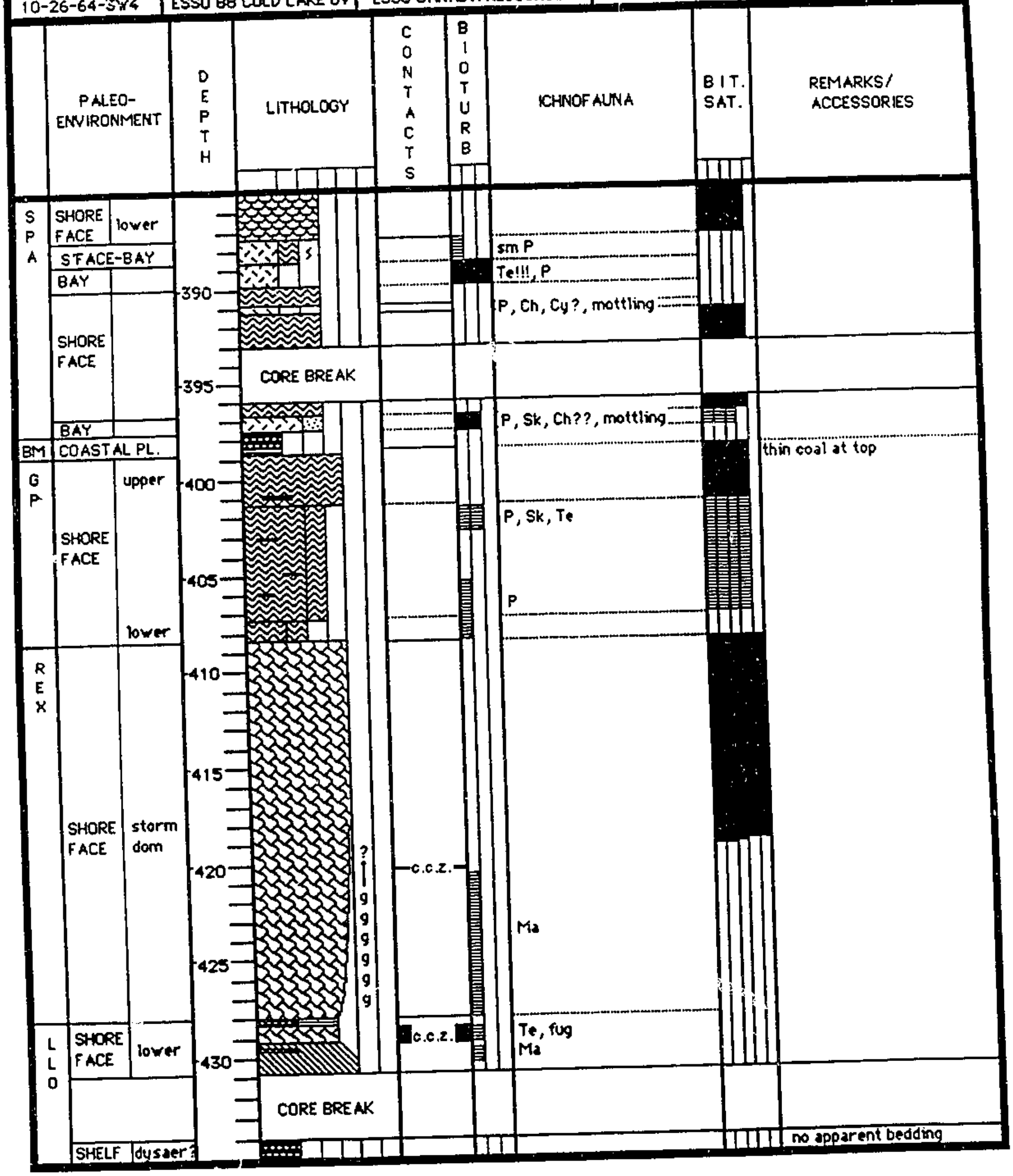
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-16-64-3W4	NORCEN YBR COLD LAKE OV	NORCEN ENERGY RES. YELLOWKNIFE BEAR RES.	281.0-416.75 m	556.2 m	1 OF 1



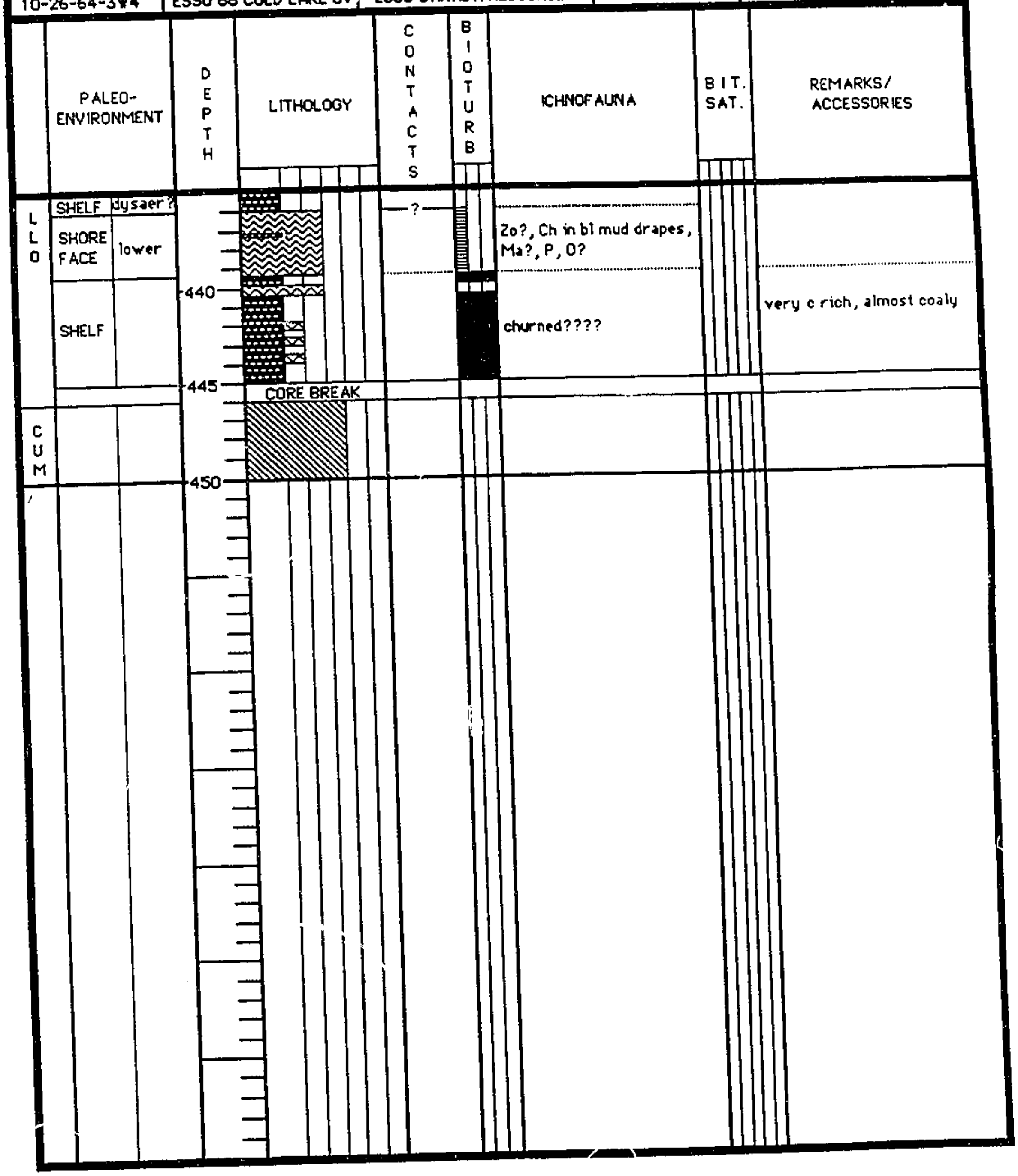
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-26-64-3W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	335.0-450.0 m	605.3 m	1 OF 3



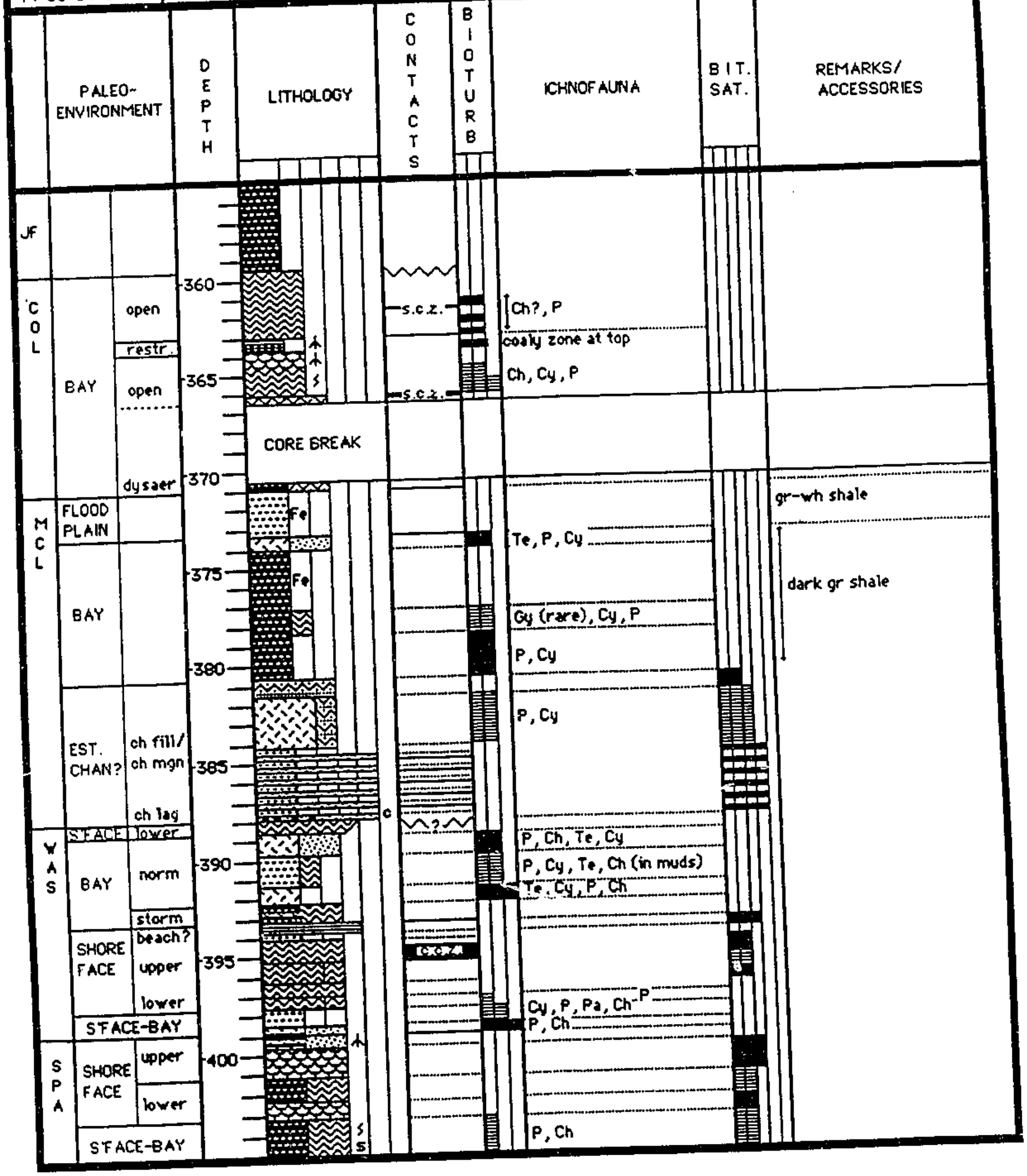
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-26-64-3W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	335.0-450.0 m	605.3 m	2 OF 3



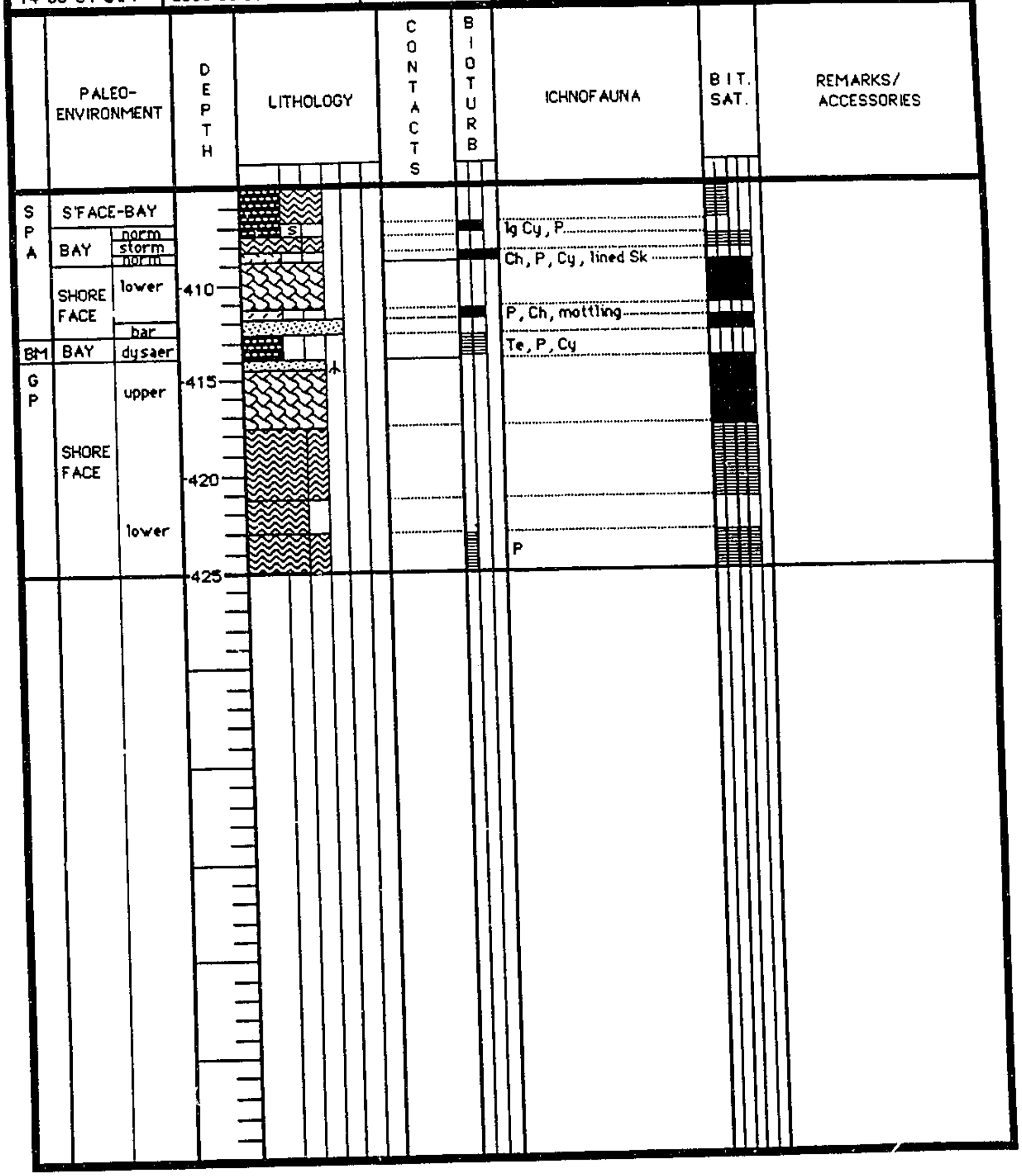
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-26-64-3W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	335.0-450.0 m	605.3 m	3 OF 3



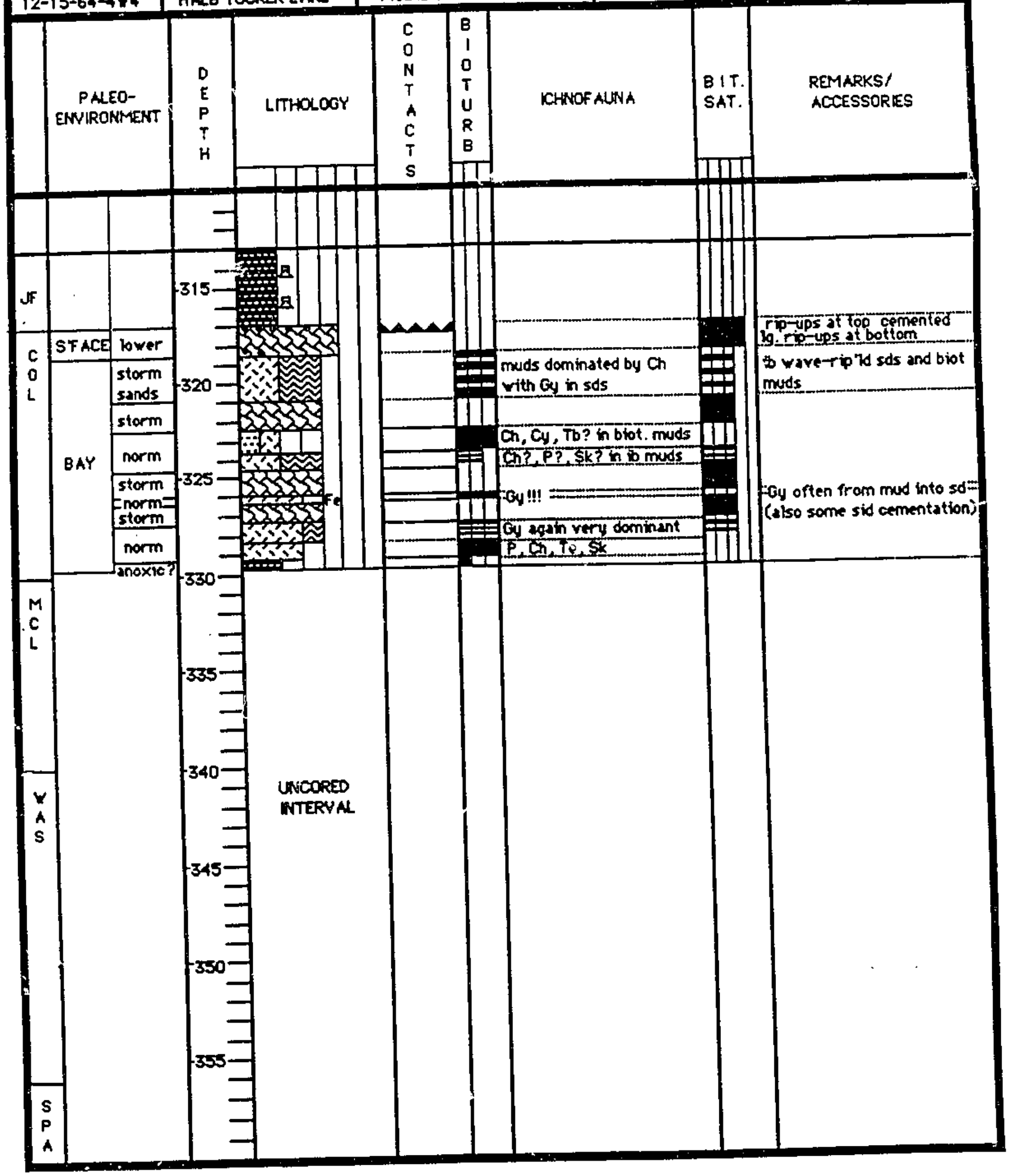
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-35-64-3W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	355.0-425.0 m	642.7 m	1 OF 2



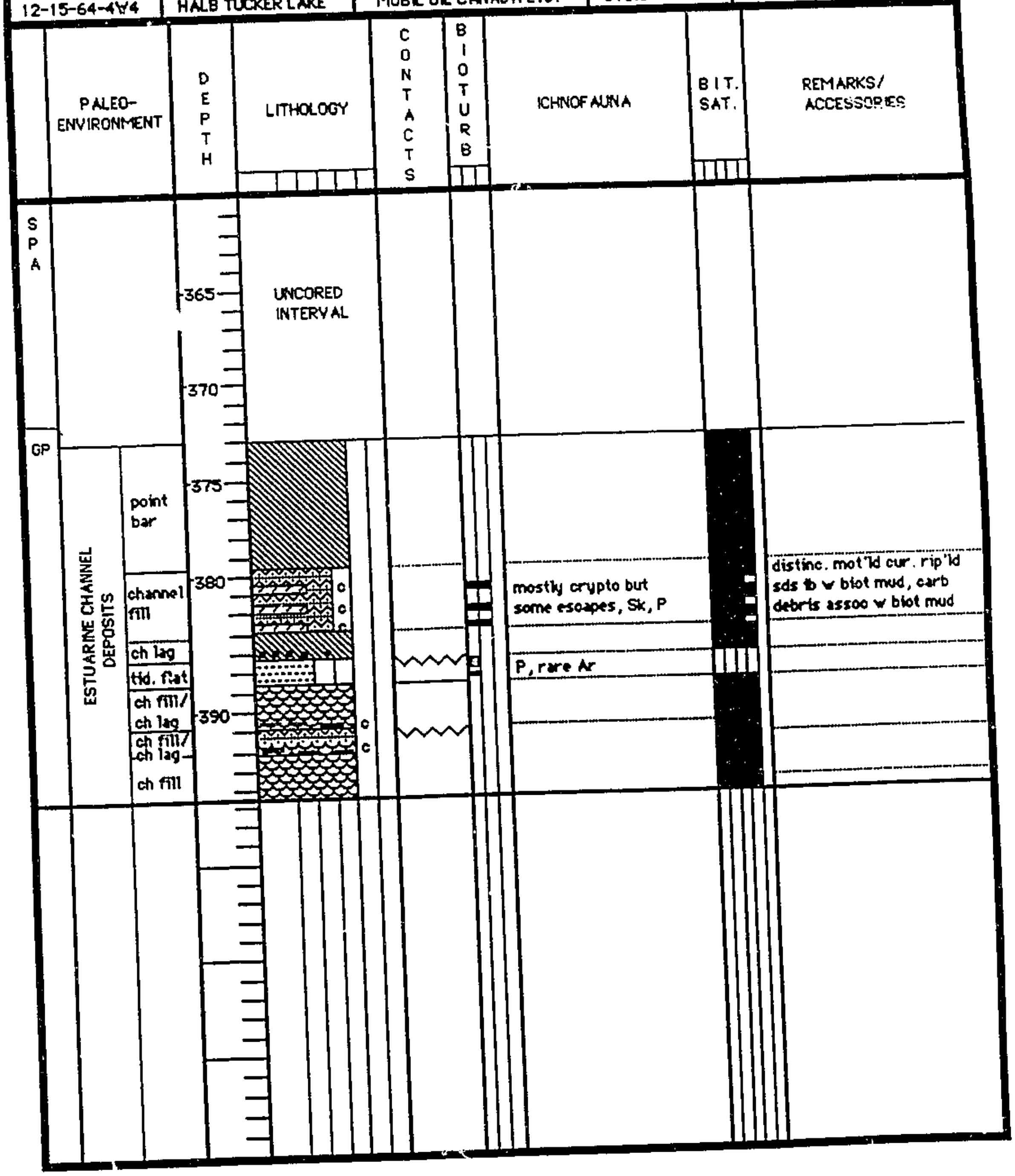
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-35-64-3W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	355.0-425.0 m	642.7 m	2 OF 2



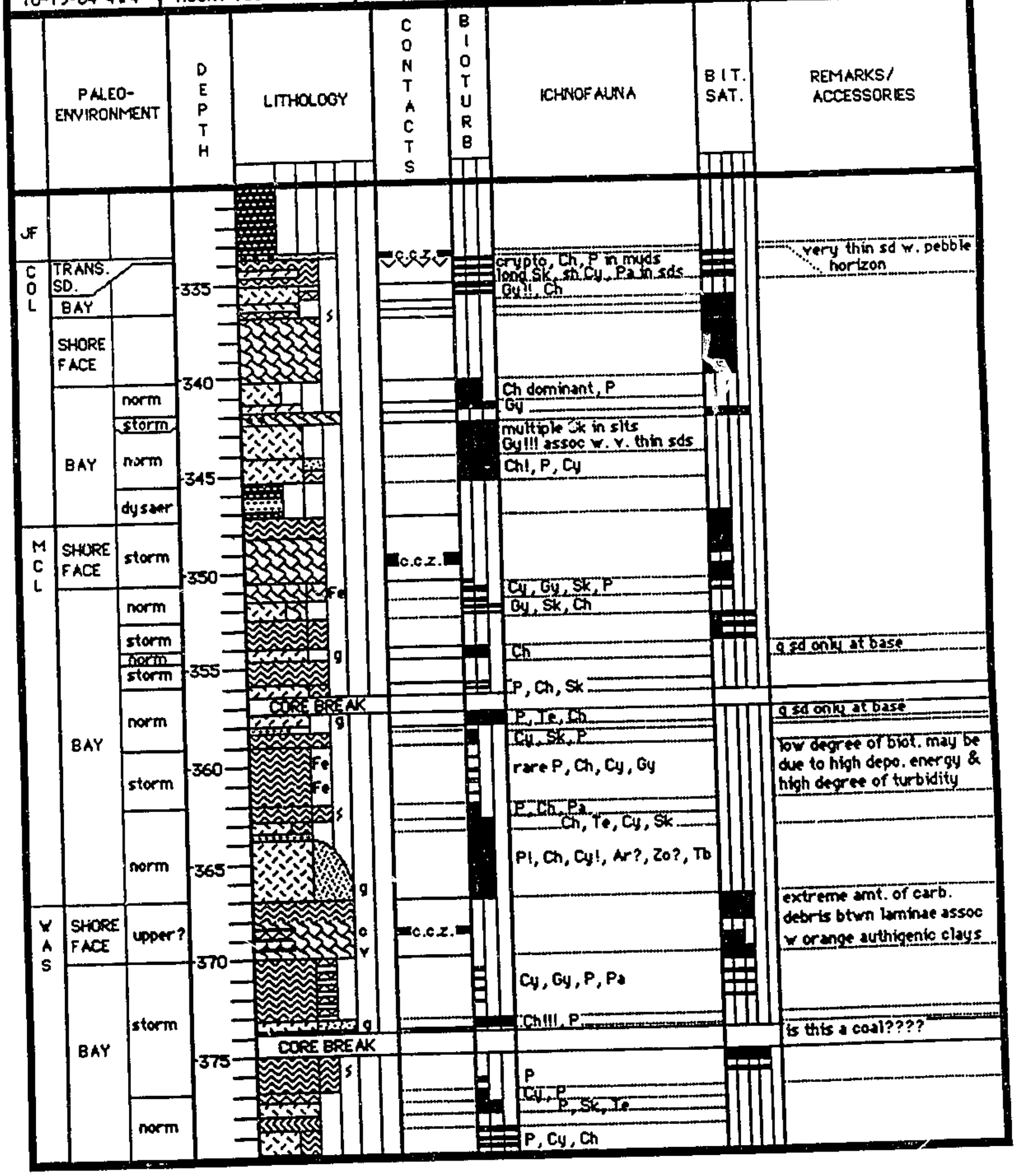
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-15-64-4W4	HALB TUCKER LAKE	MOBIL OIL CANADA LTD.	313.0-391.5 m	585.8 m	1 OF 2



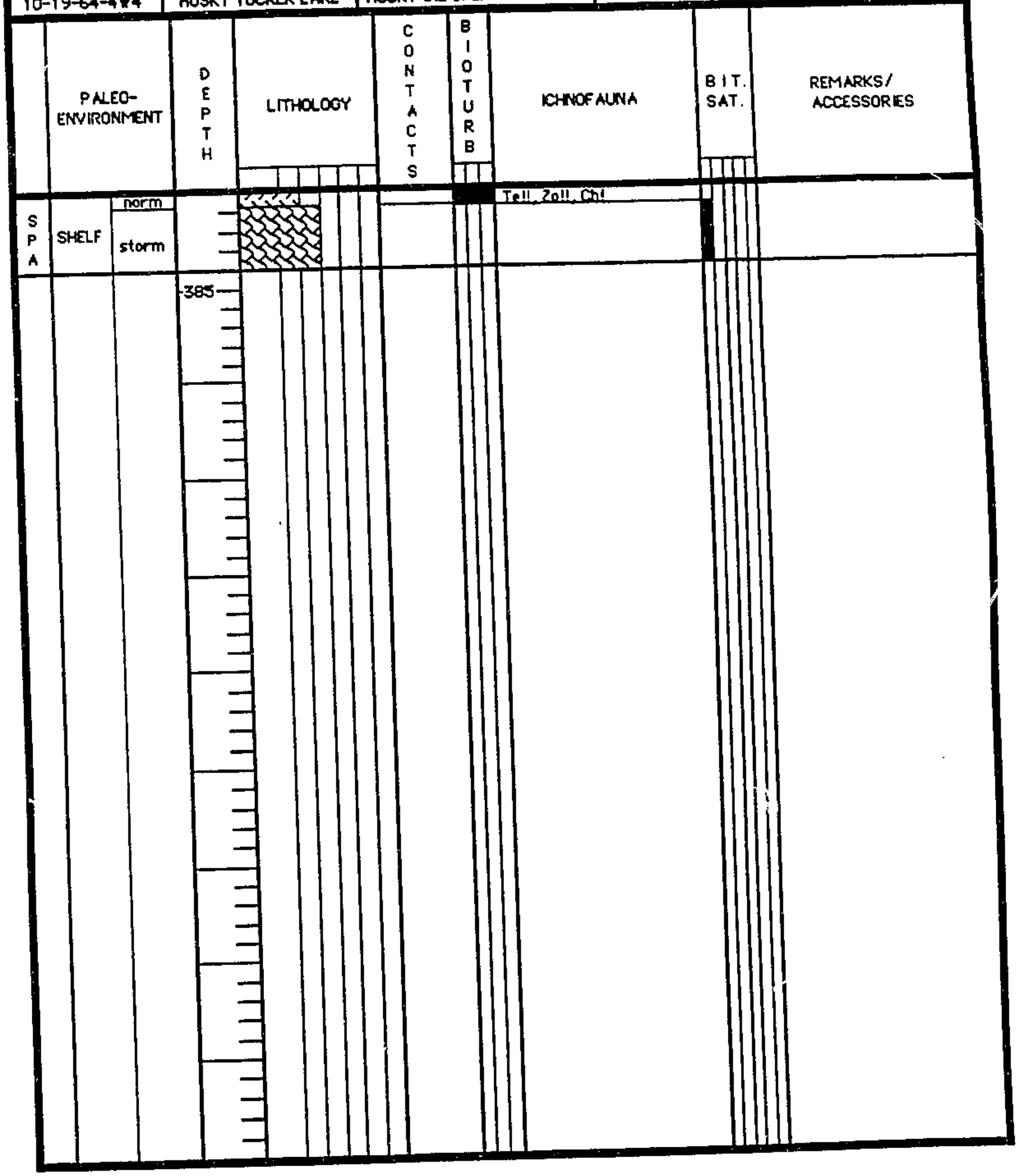
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-15-64-4W4	HALB TUCKER LAKE	MOBIL OIL CANADA LTD.	313.0-391.5 m	585.8 m	2 OF 2



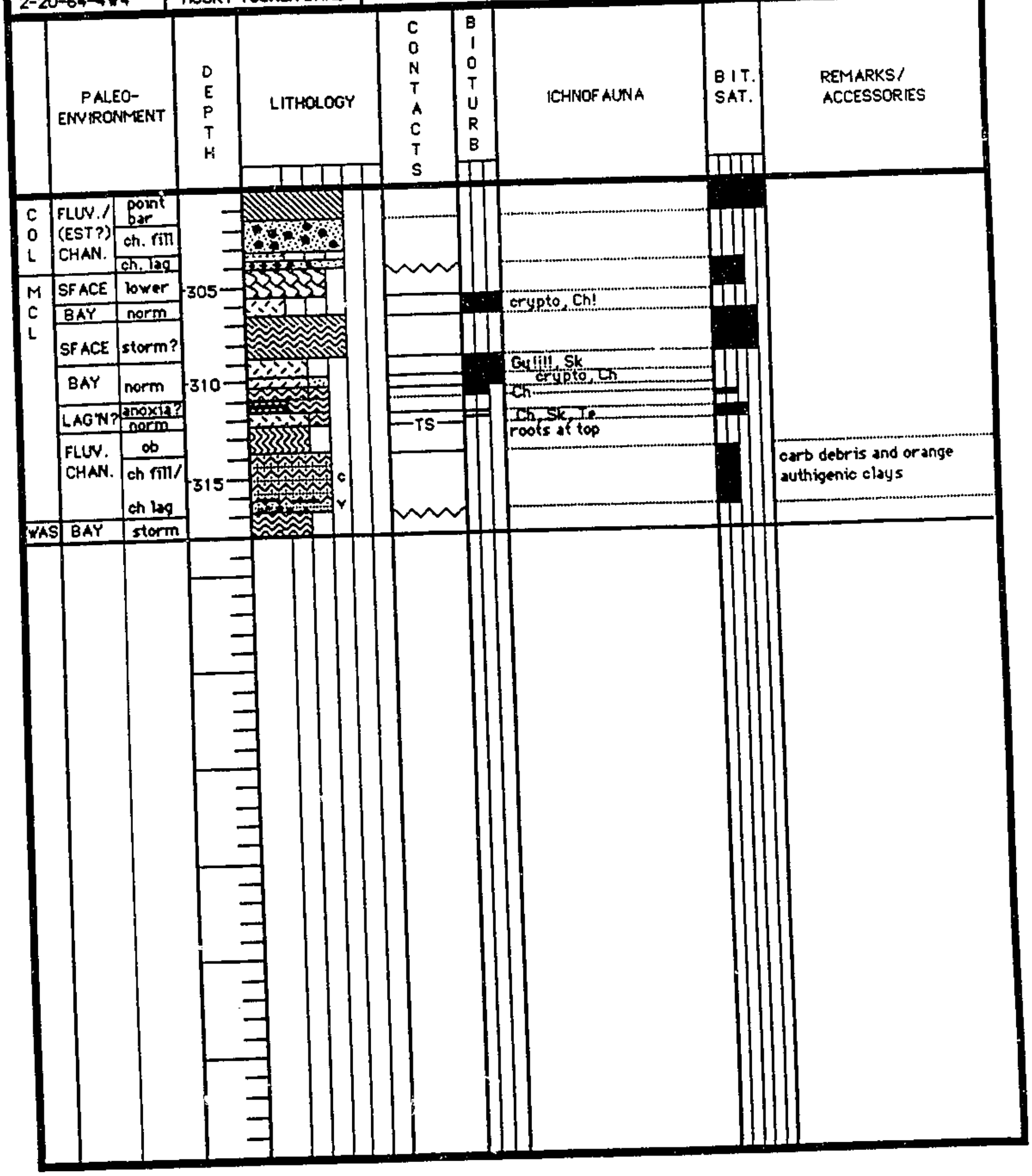
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-19-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	330.0-384.0 m	597.3 m	1 OF 2



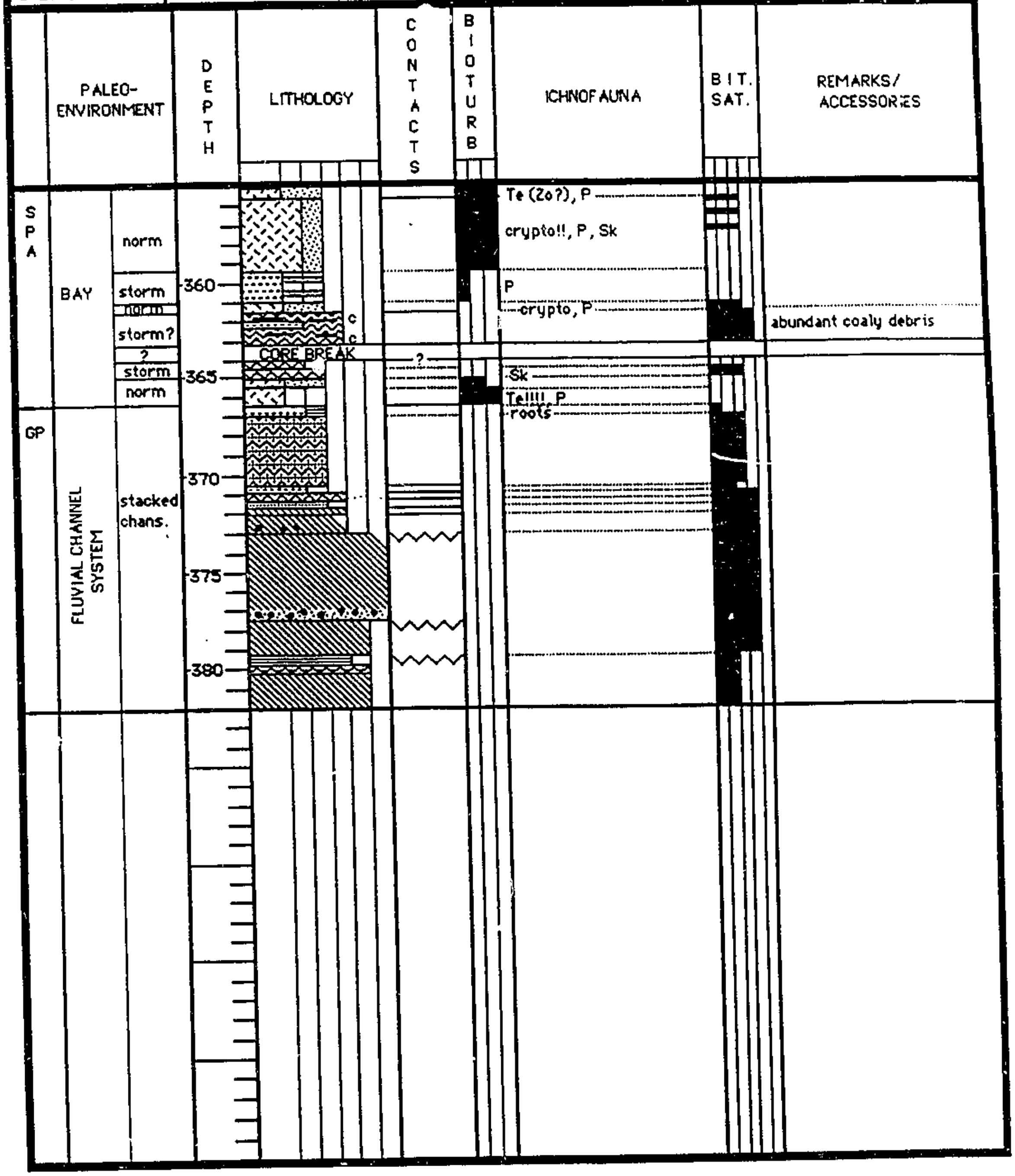
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-19-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	330-384 m	597.3 m	2 OF 2



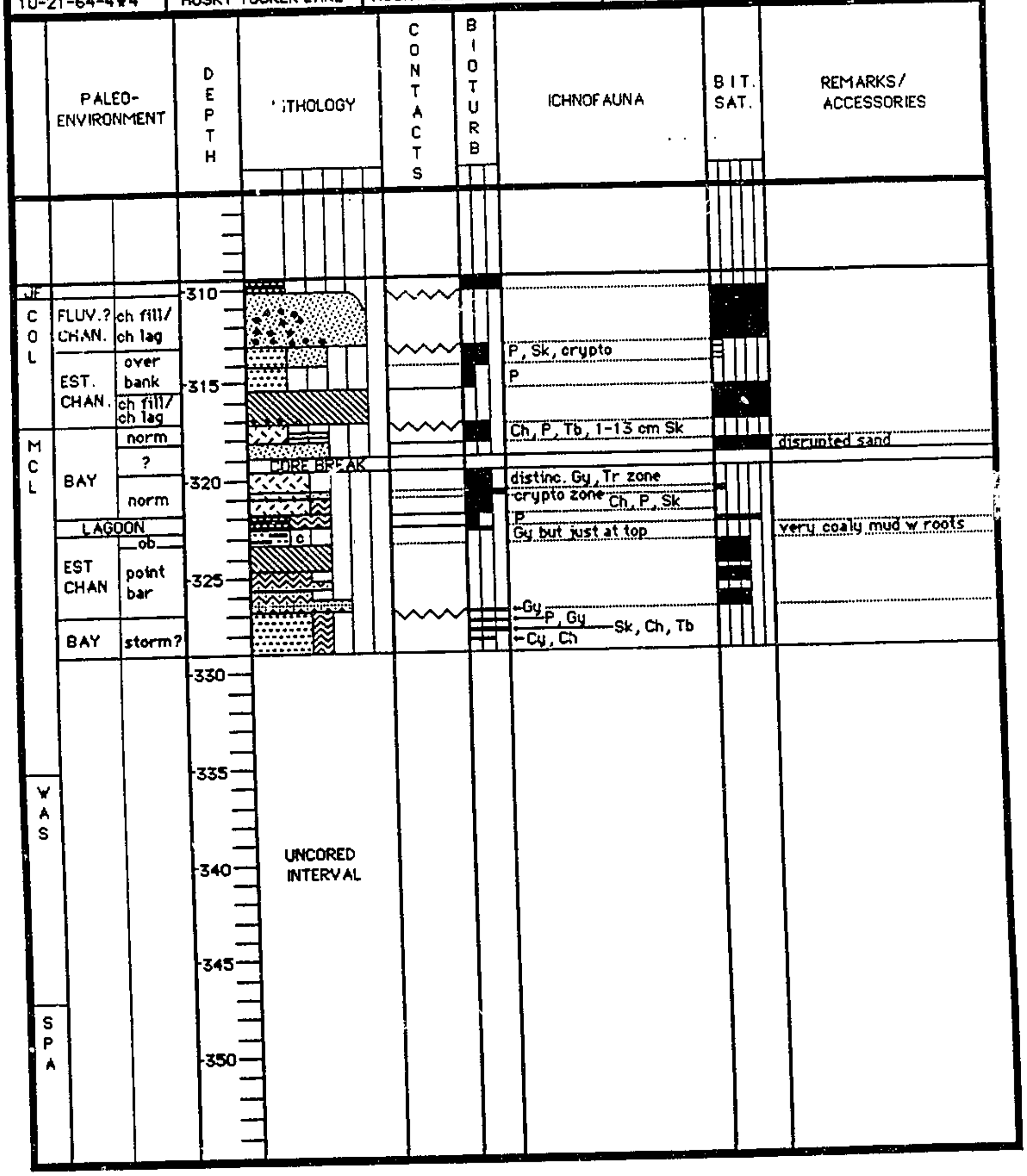
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-20-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	295.0-303.0 m	558.0 m	1 OF 1



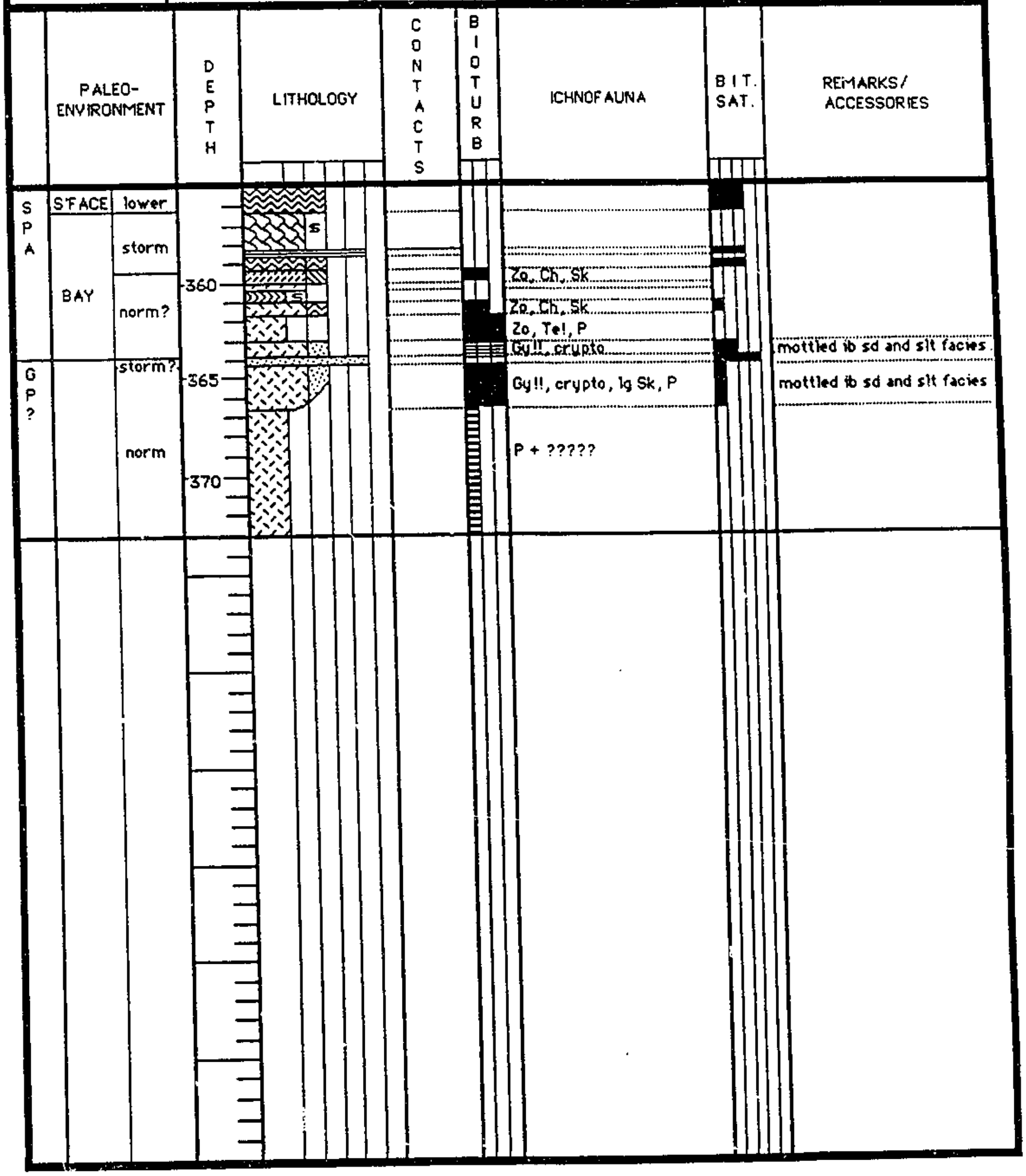
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-21-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	355.0-382.0 m	574.7 m	1 OF 1



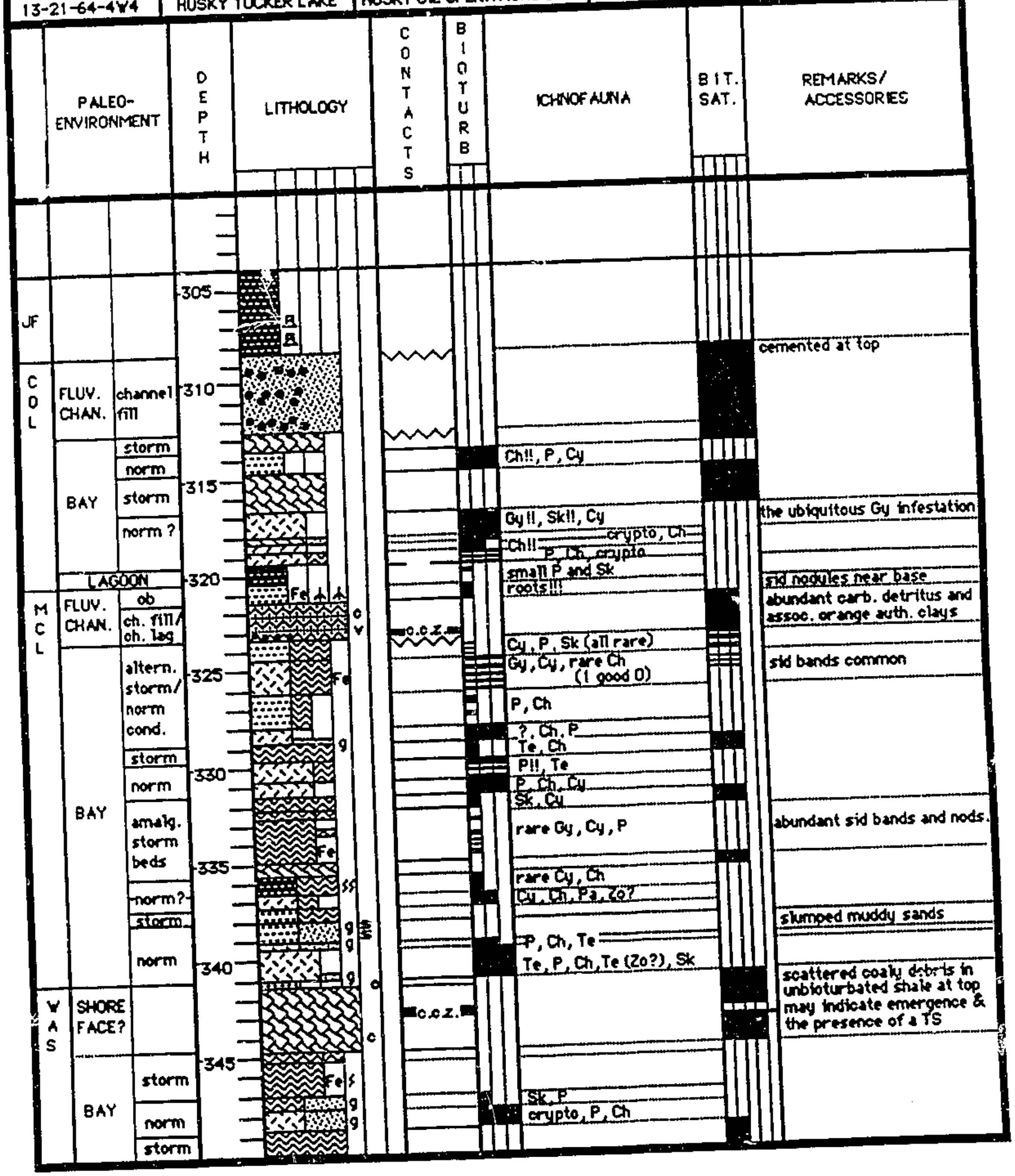
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-21-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	309.5-373.0 m	580.1 m	1 OF 2



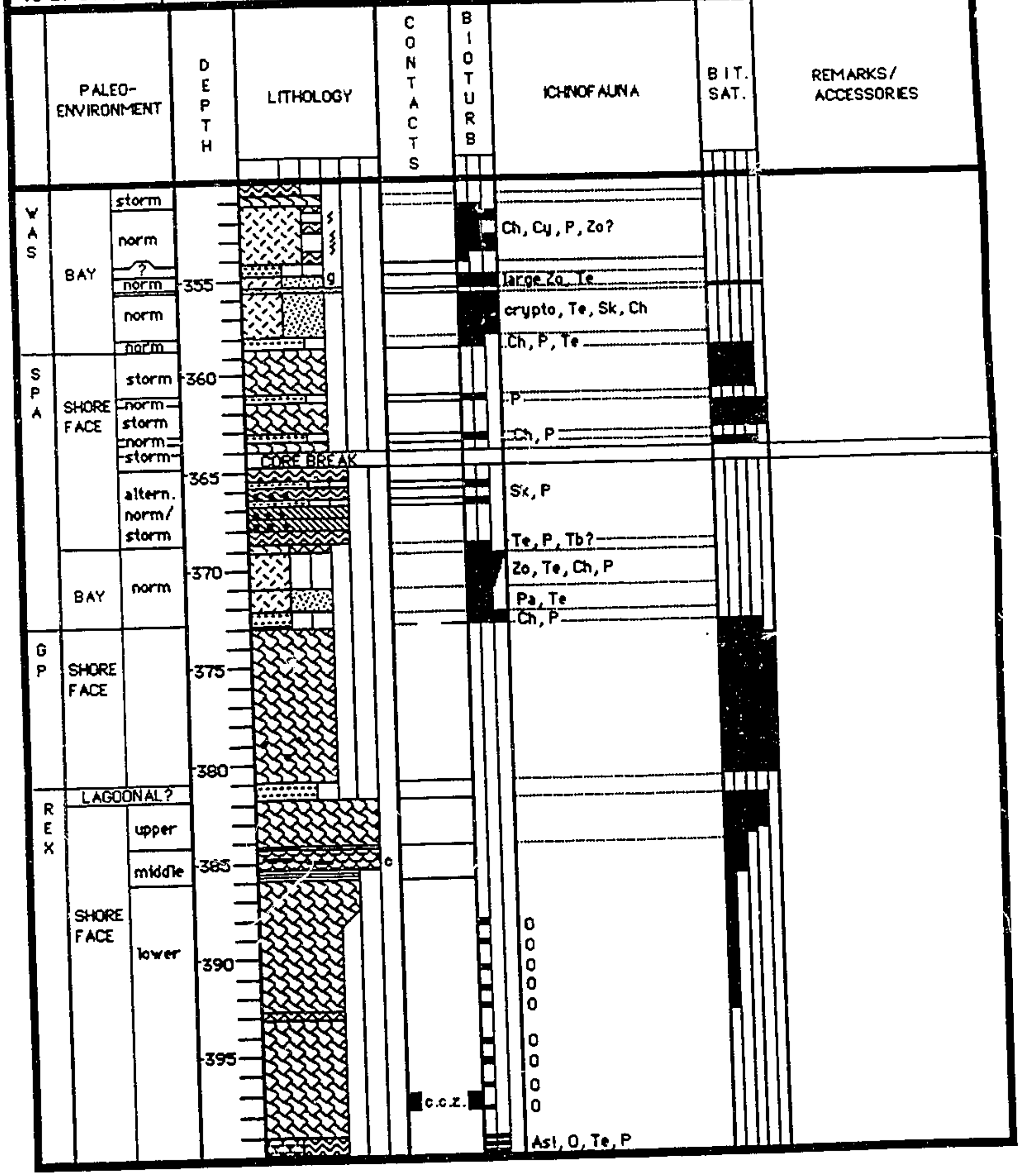
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-21-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	309.5-373.0 m	580.1 m	2 OF 2



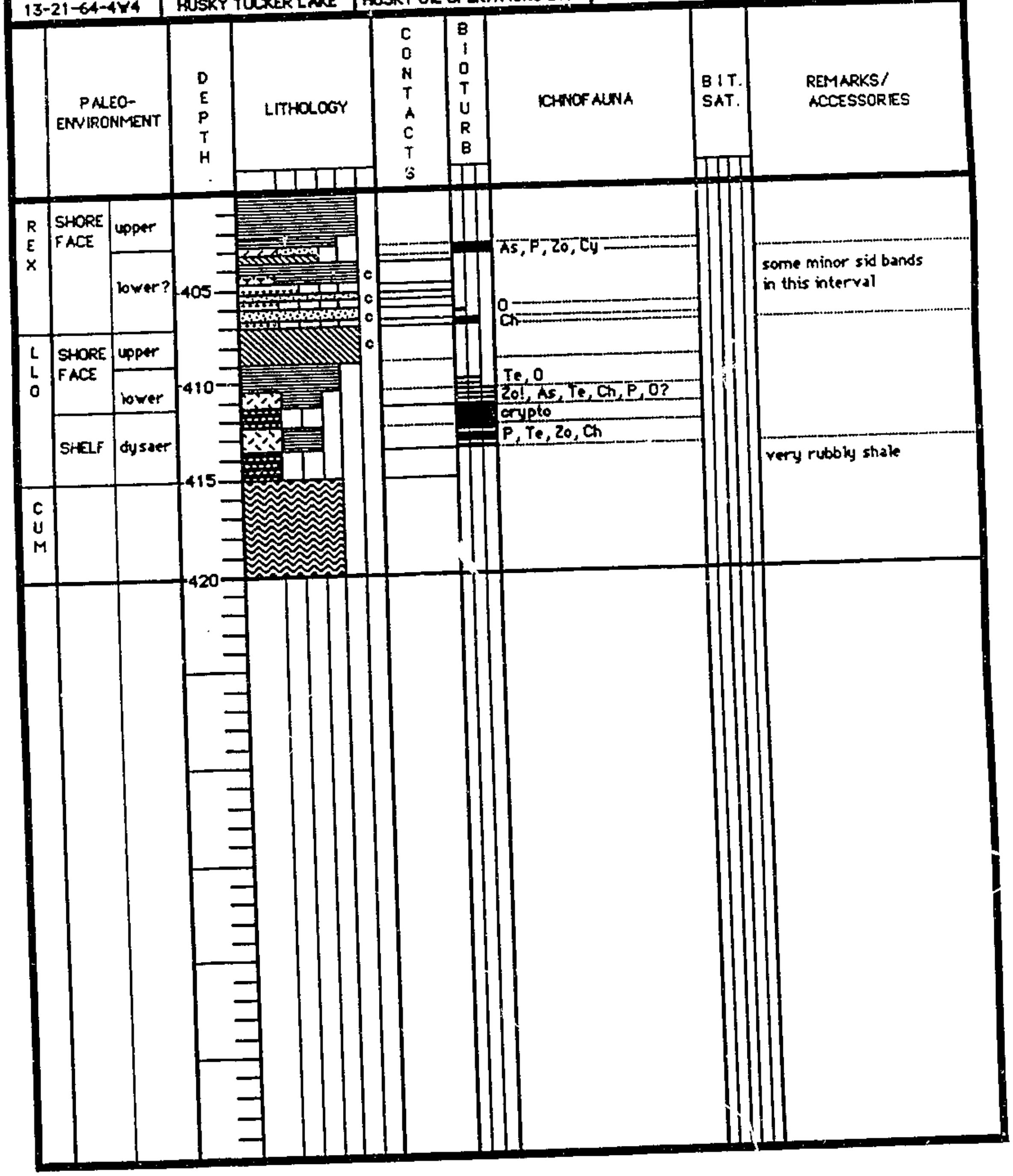
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-21-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	304.0-420.0 m	578.5 m	1 OF 3



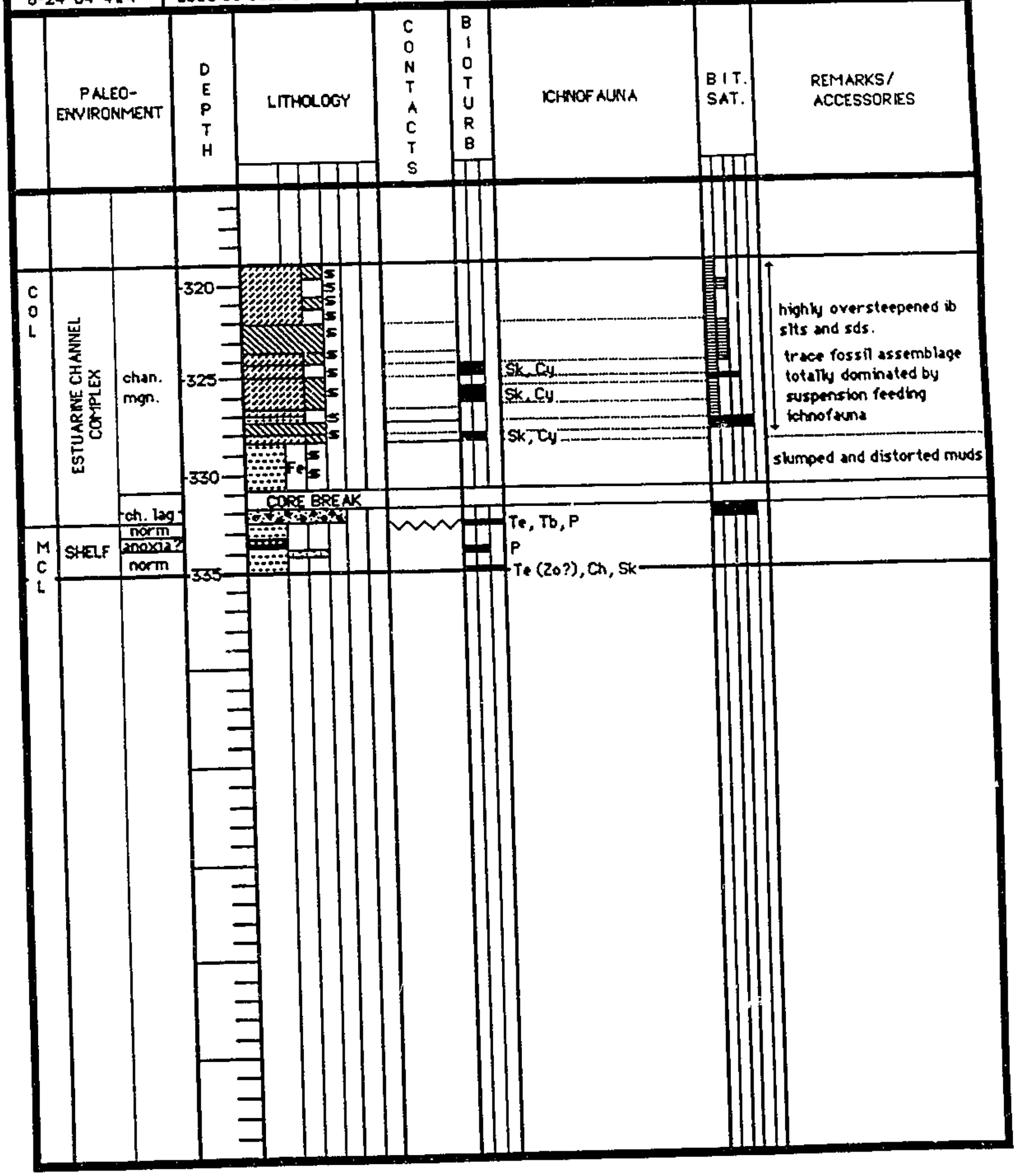
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-21-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	304.0-420.0 m	578.5 m	2 OF 3



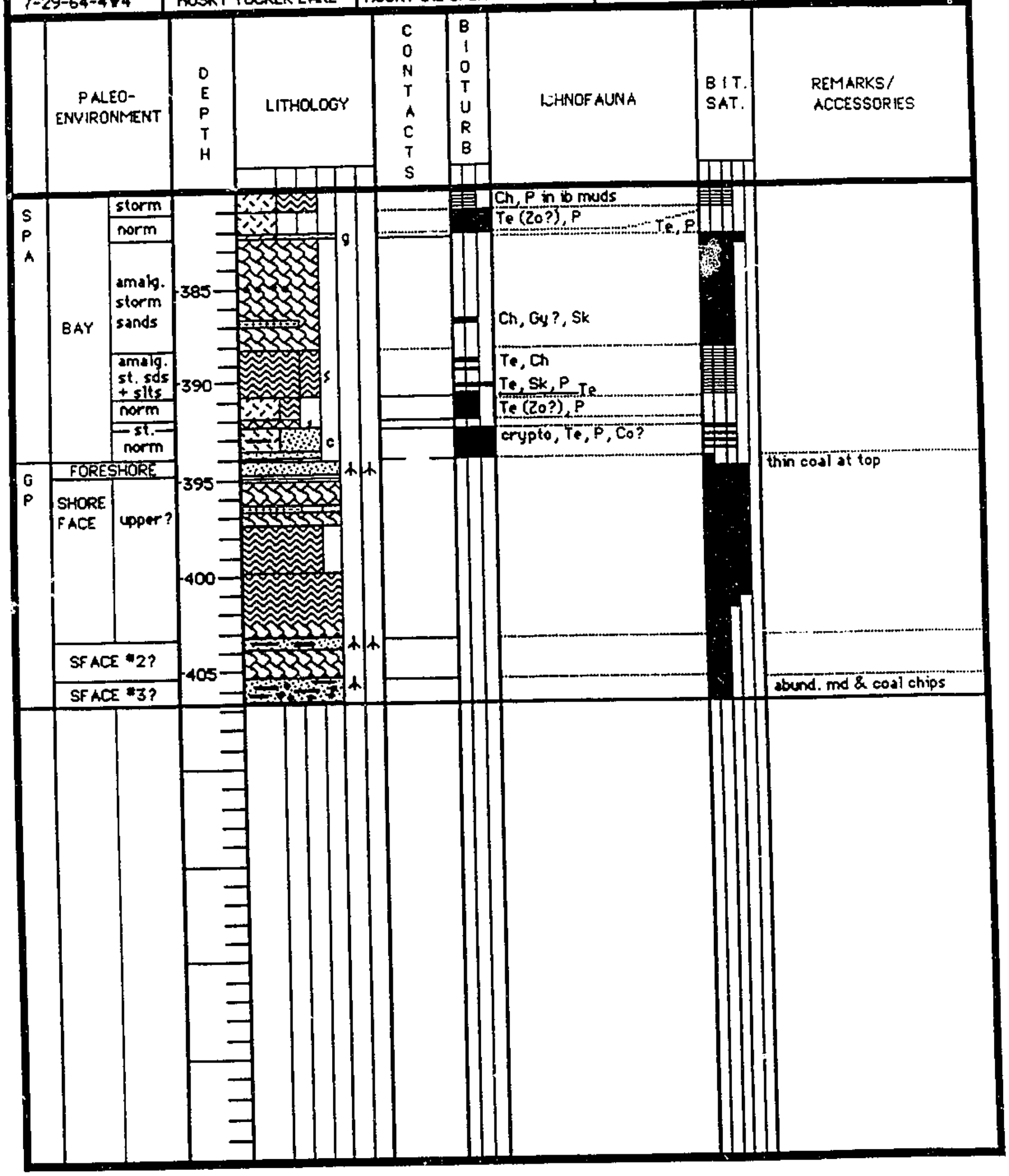
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-21-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	304.0-420.0 m	578.5 m	3 OF 3



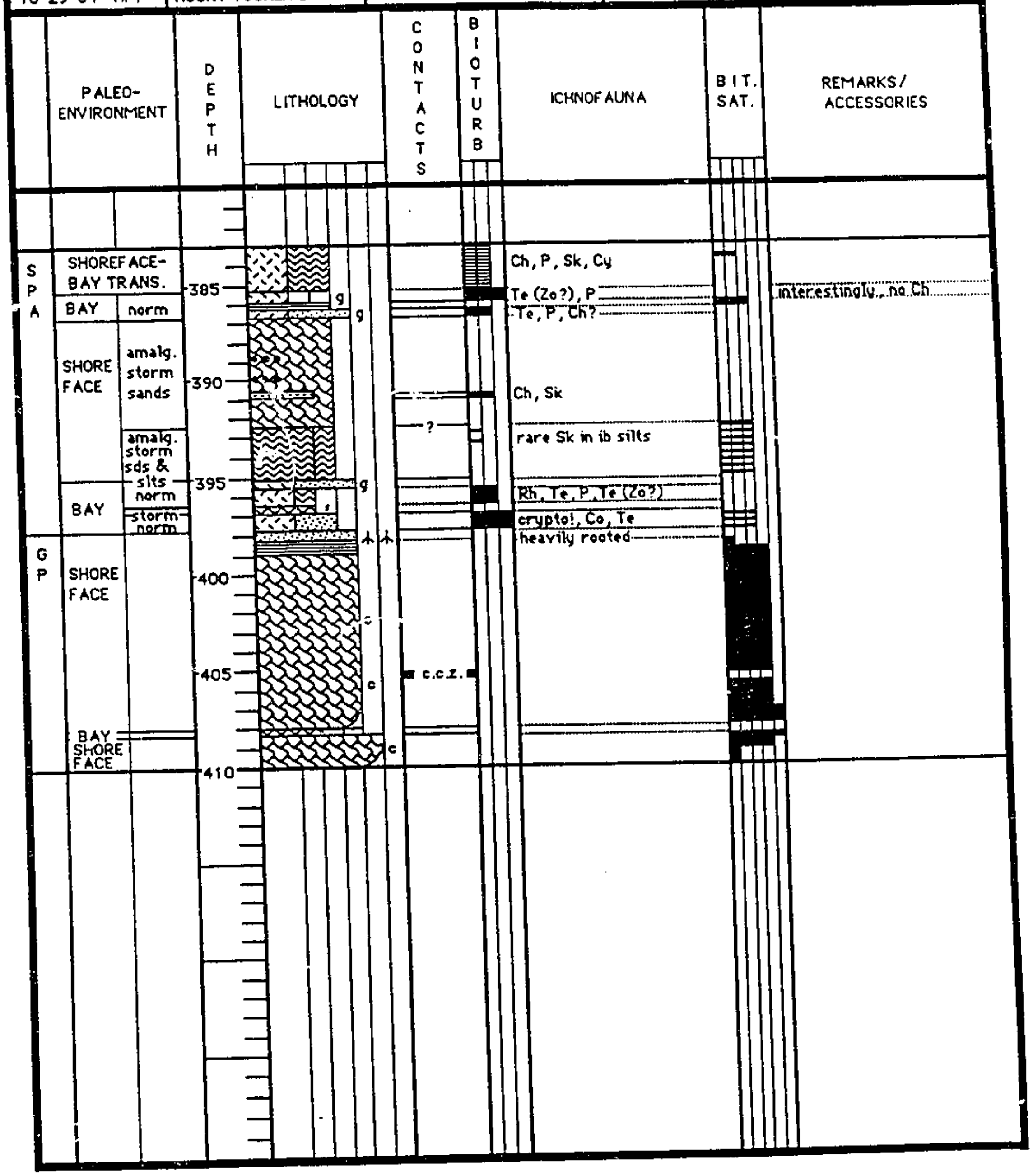
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-24-64-4W4	ESSO 86 COLD LAKE	ESSO RESOURCES CANADA	319.0-335.0 m	581.3 m	1 OF 1



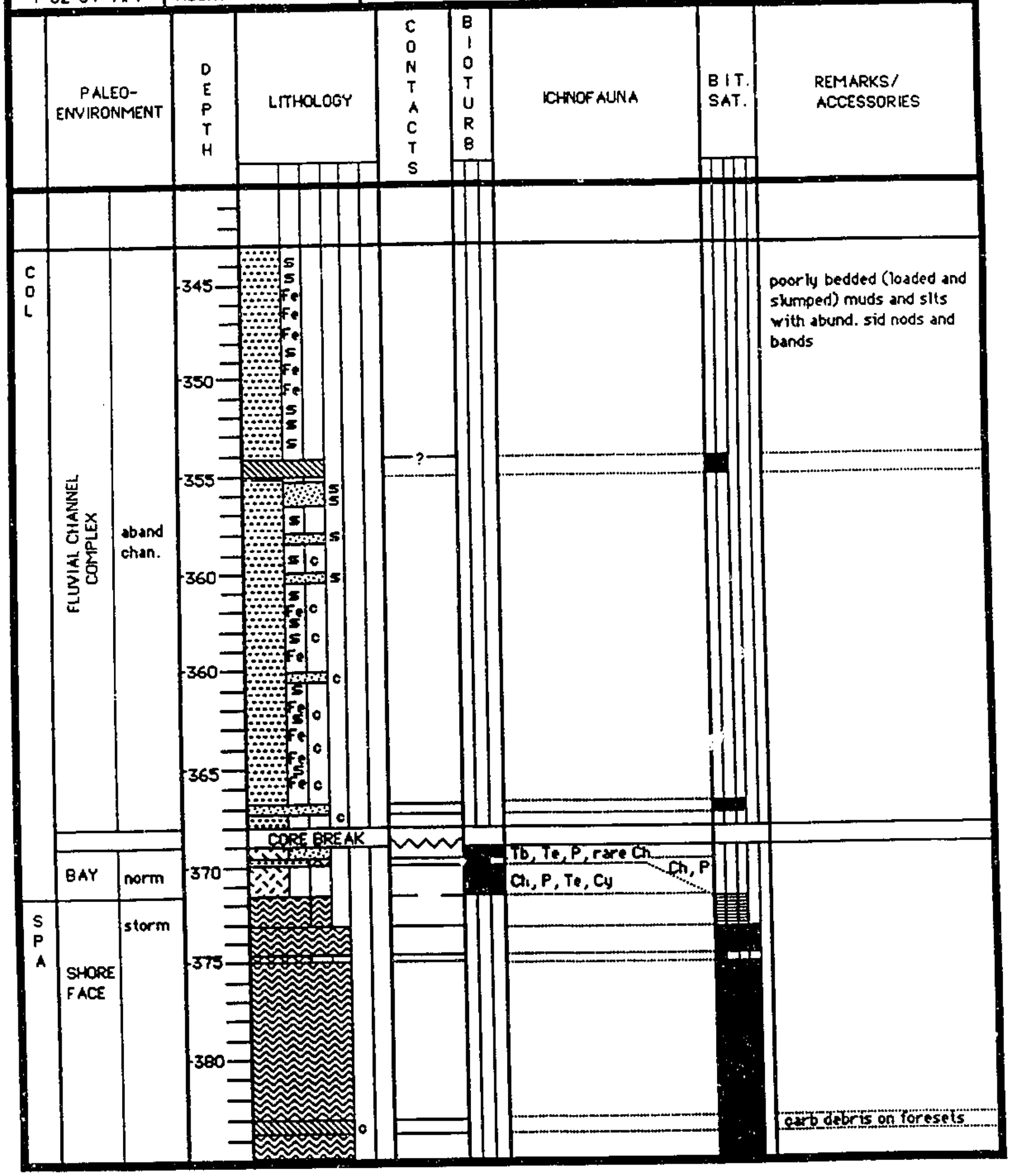
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-29-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	380.0-406.5 m	614.9 m	1 OF 1



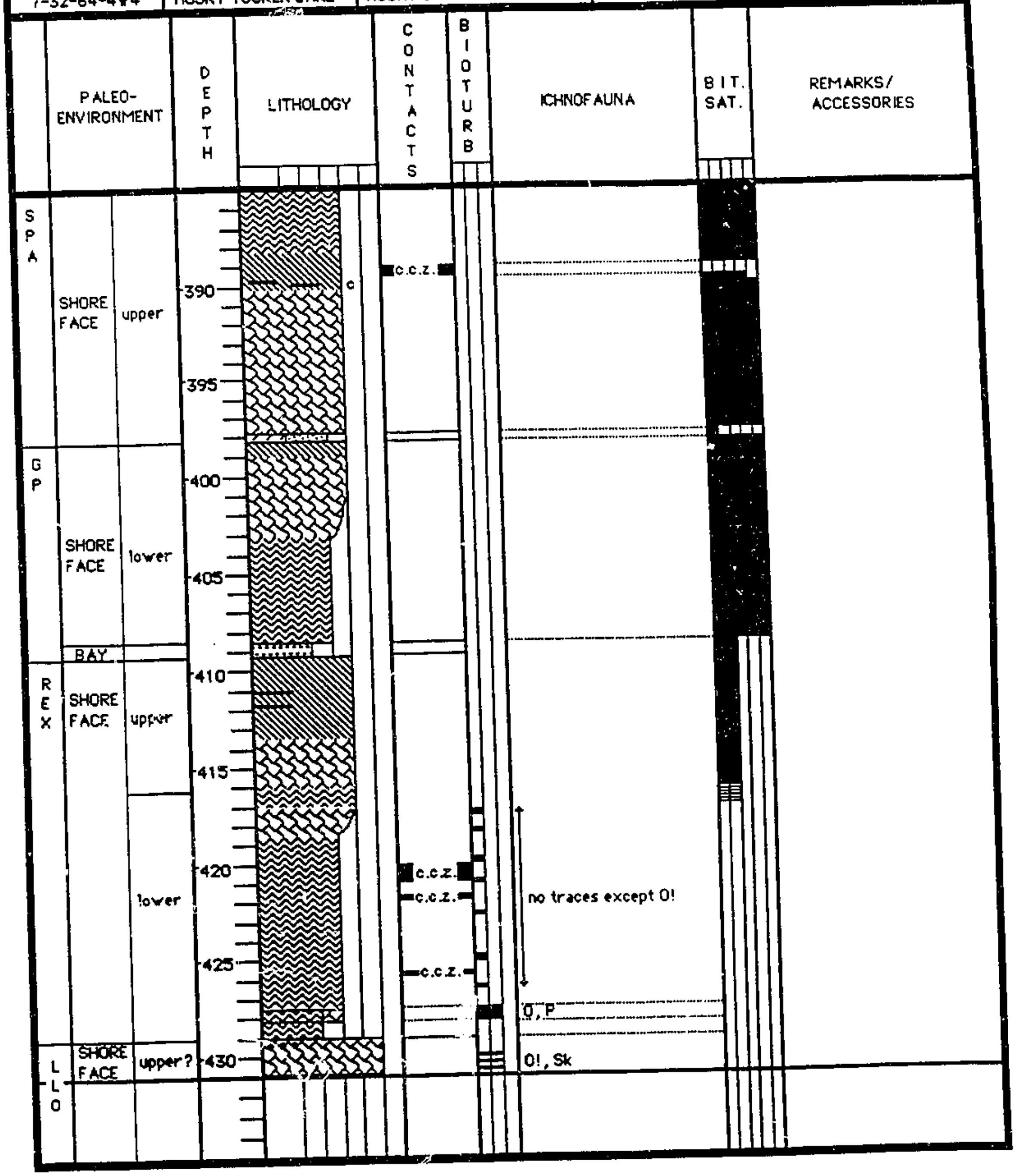
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-29-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	383.0-410.0 m	580.1 m	1 OF 1



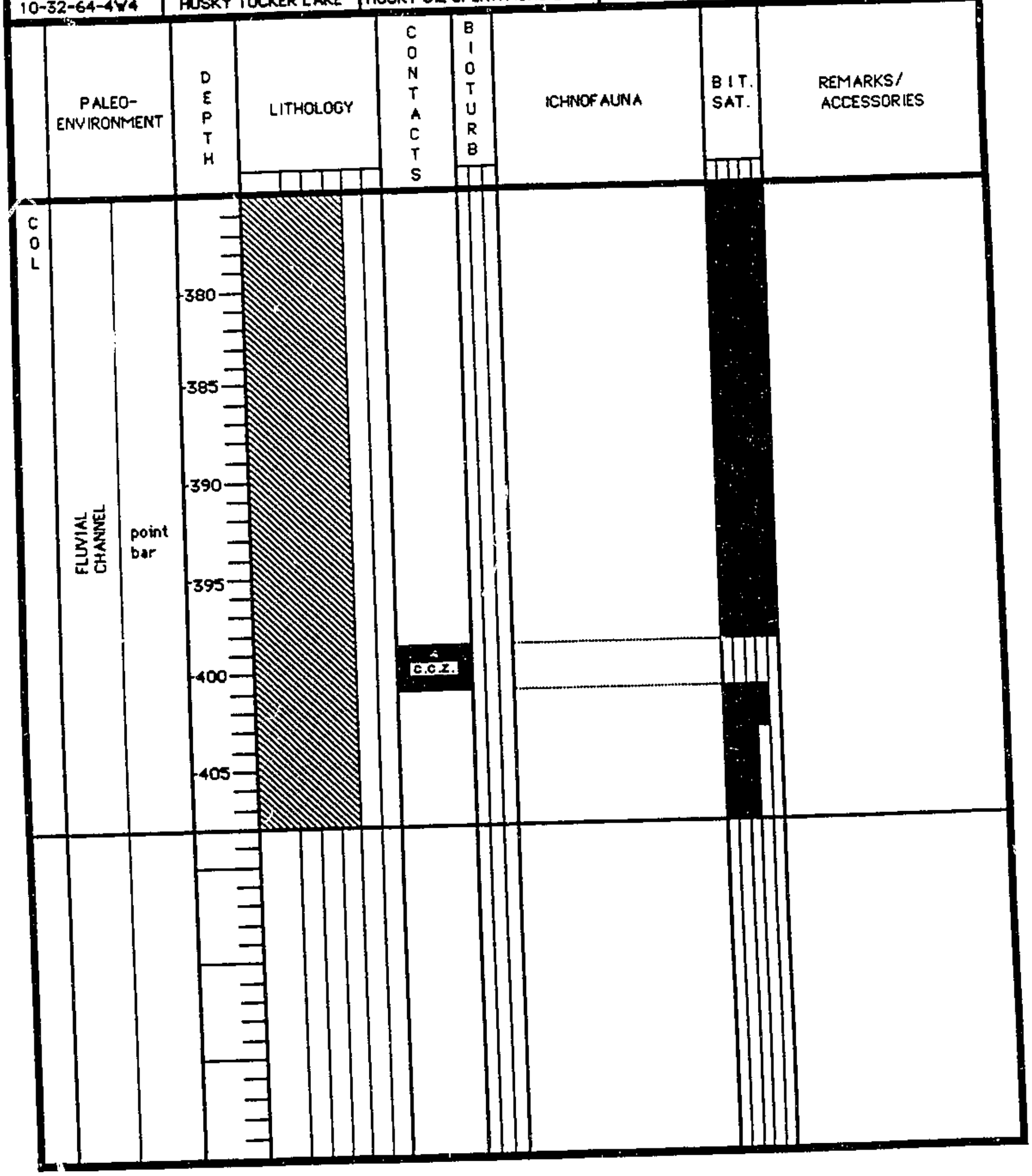
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-32-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	343.0-431.0 m	624.2 m	1 OF 2



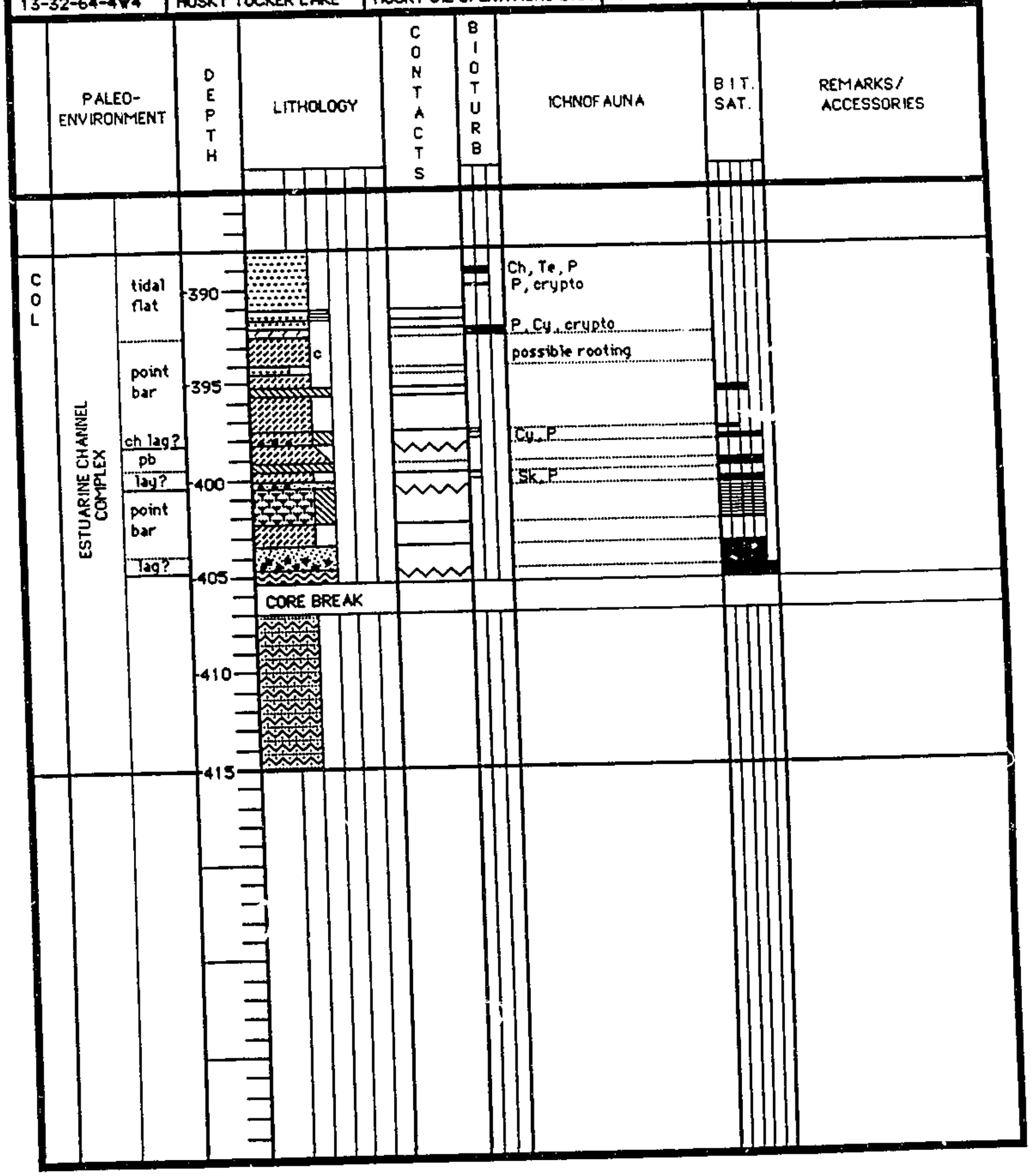
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-32-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	343.0-431.0 m	624.2 m	2 OF 2



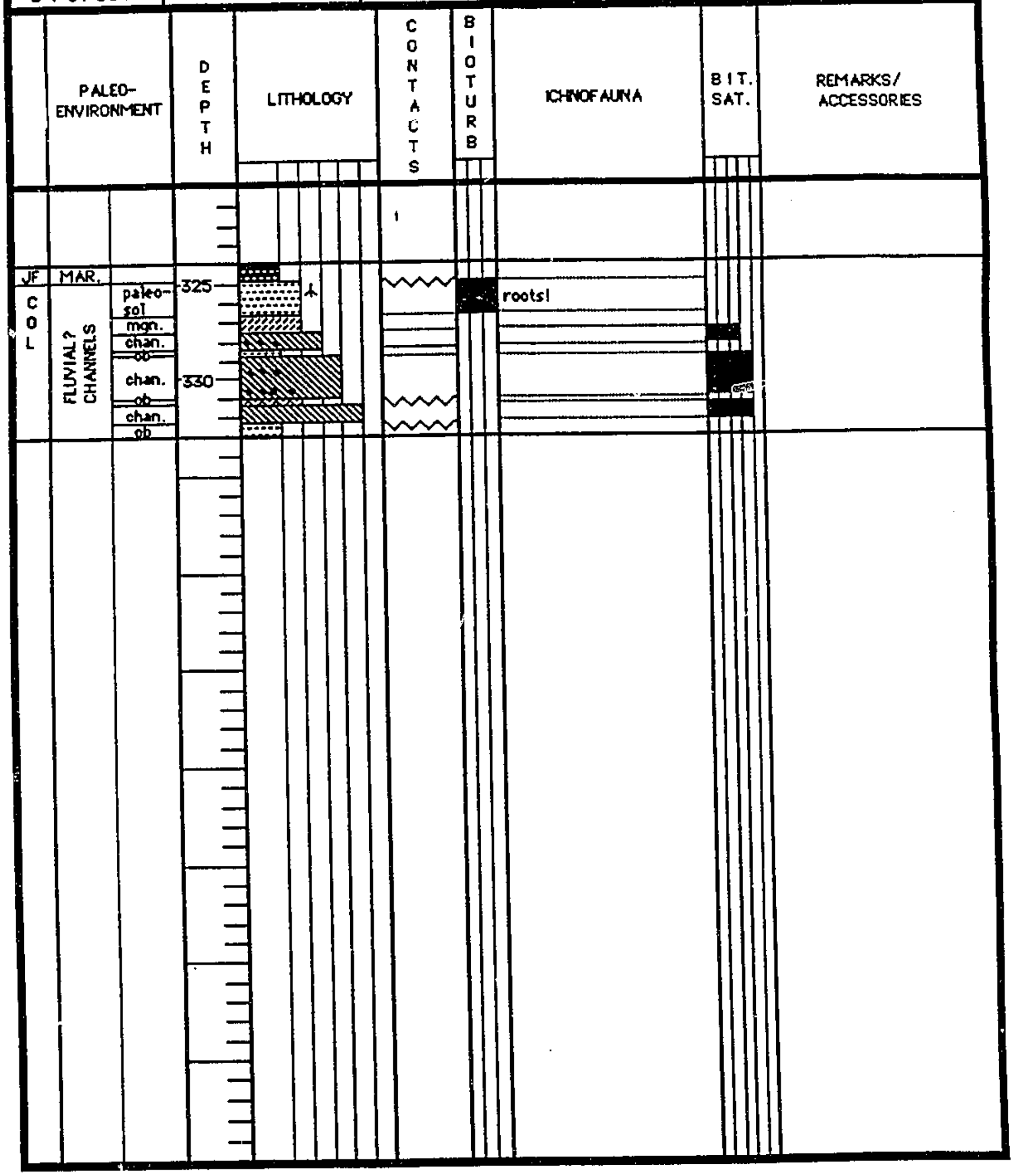
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-32-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	375.0-408.0 m	622.7 m	1 OF 1



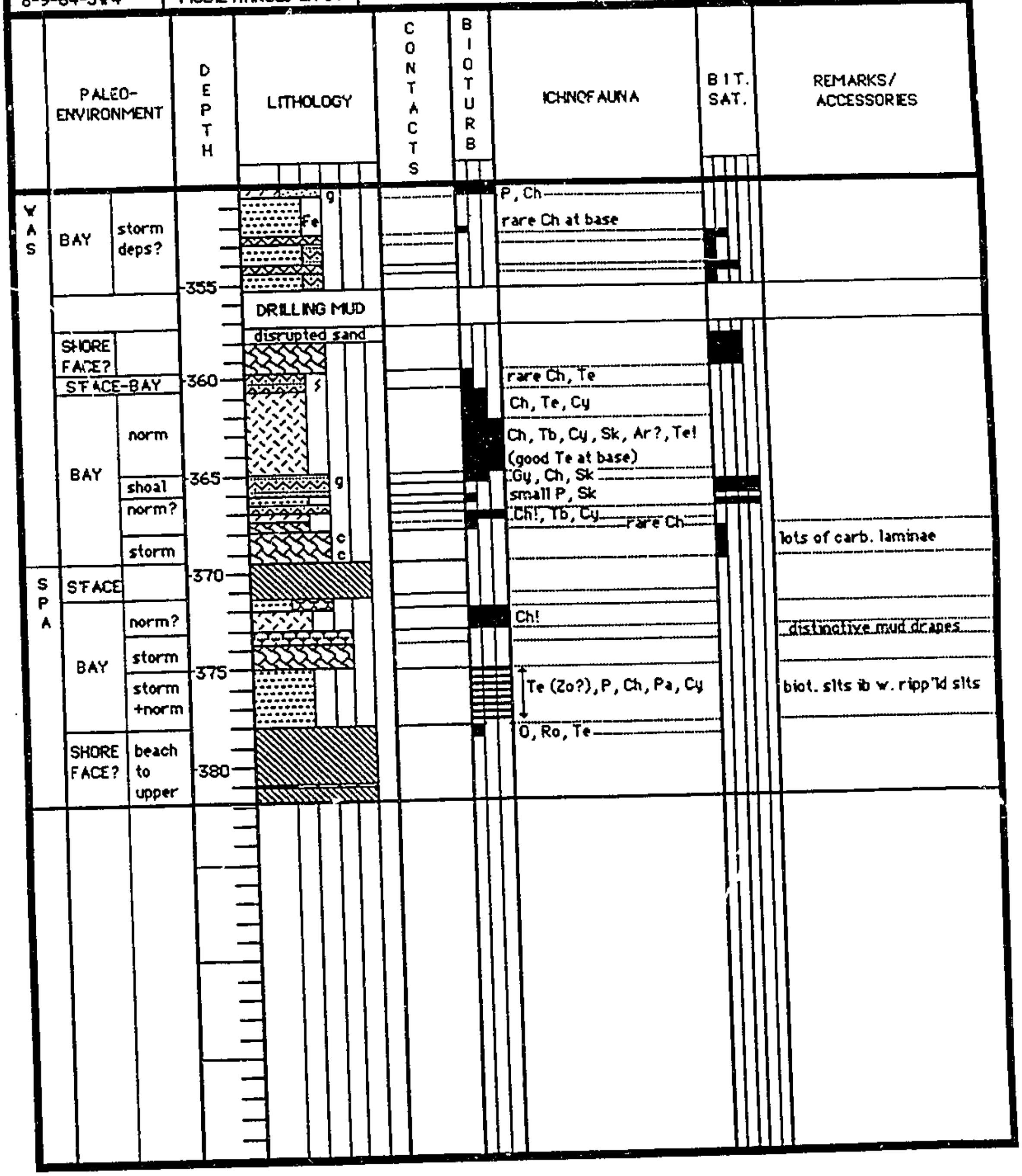
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-32-64-4W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	388.0-415.0 m	627.2 m	1 OF 1



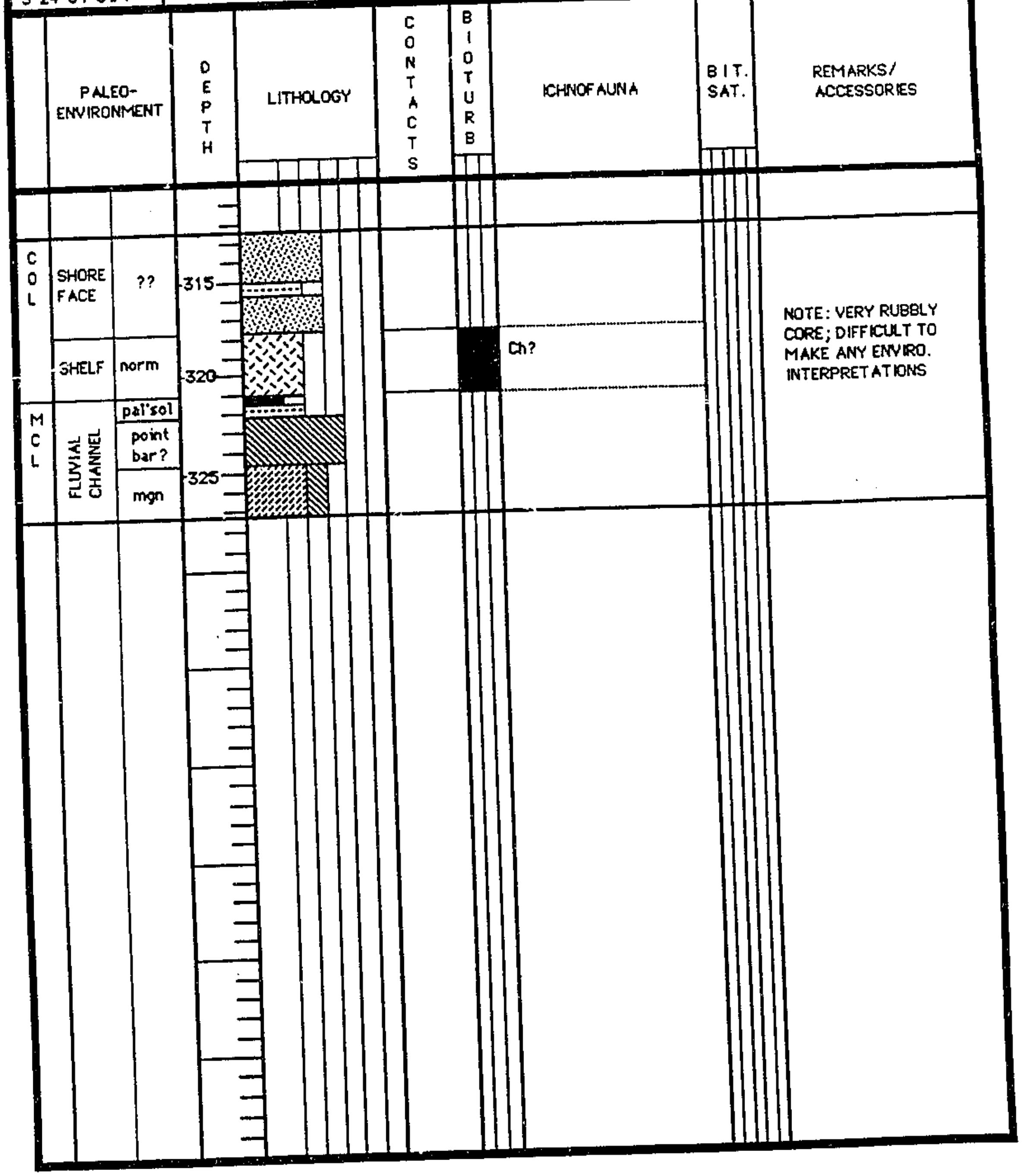
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-7-64-5W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	324.0-333.0 m	564.34 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-9-64-5W4	MOBIL HAROLD LK OV	MOBIL OIL CANADA LTD.	350.0-381.7 m	564.09 m	1 OF 1

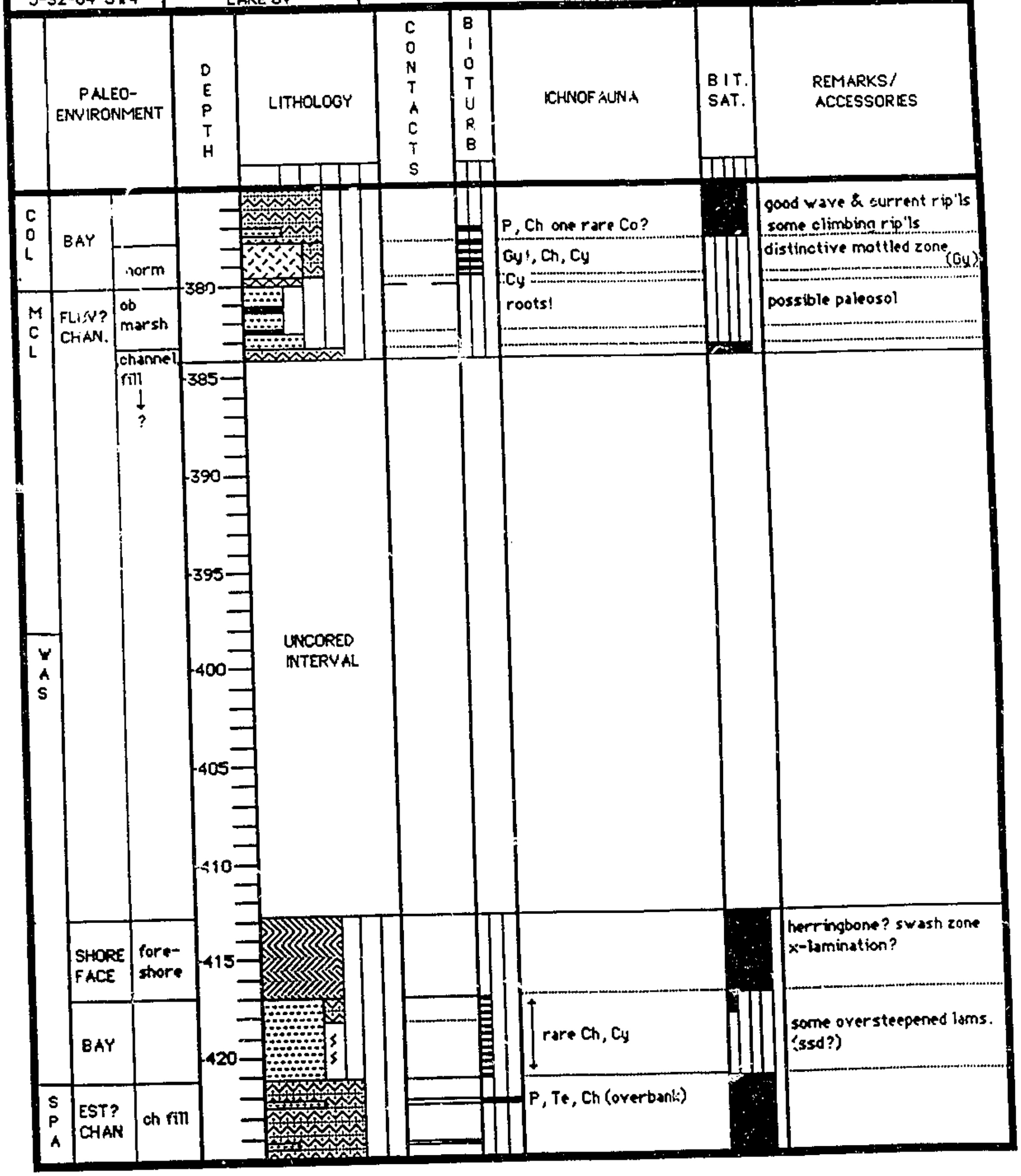


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-24-64-5W4	HUSKY COLD LAKE	PETRO-CANADA	312.42-327.66 m	569.9 m	1 OF 1

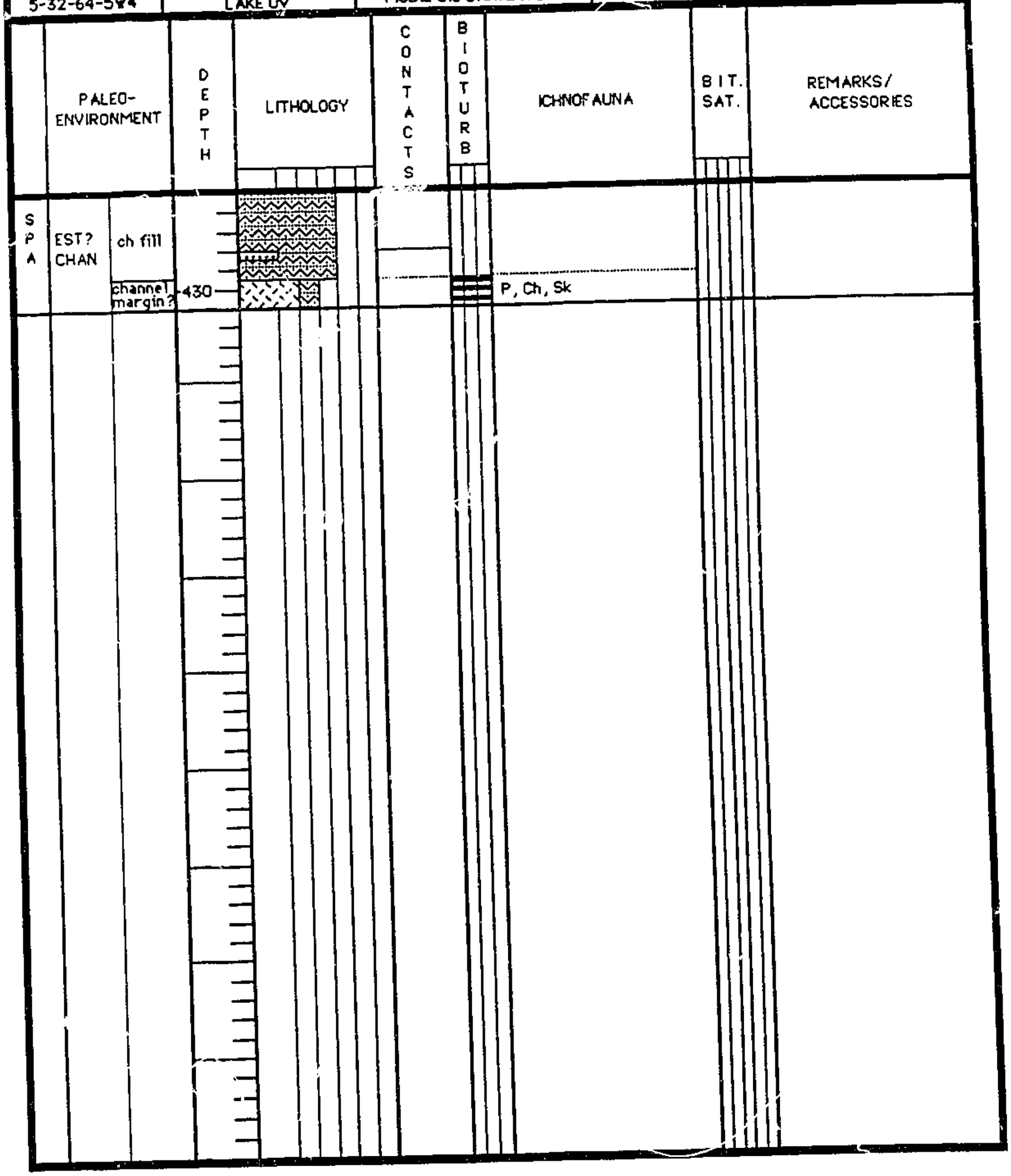


NOTE: VERY RUBBLY CORE; DIFFICULT TO MAKE ANY ENVIRO. INTERPRETATIONS

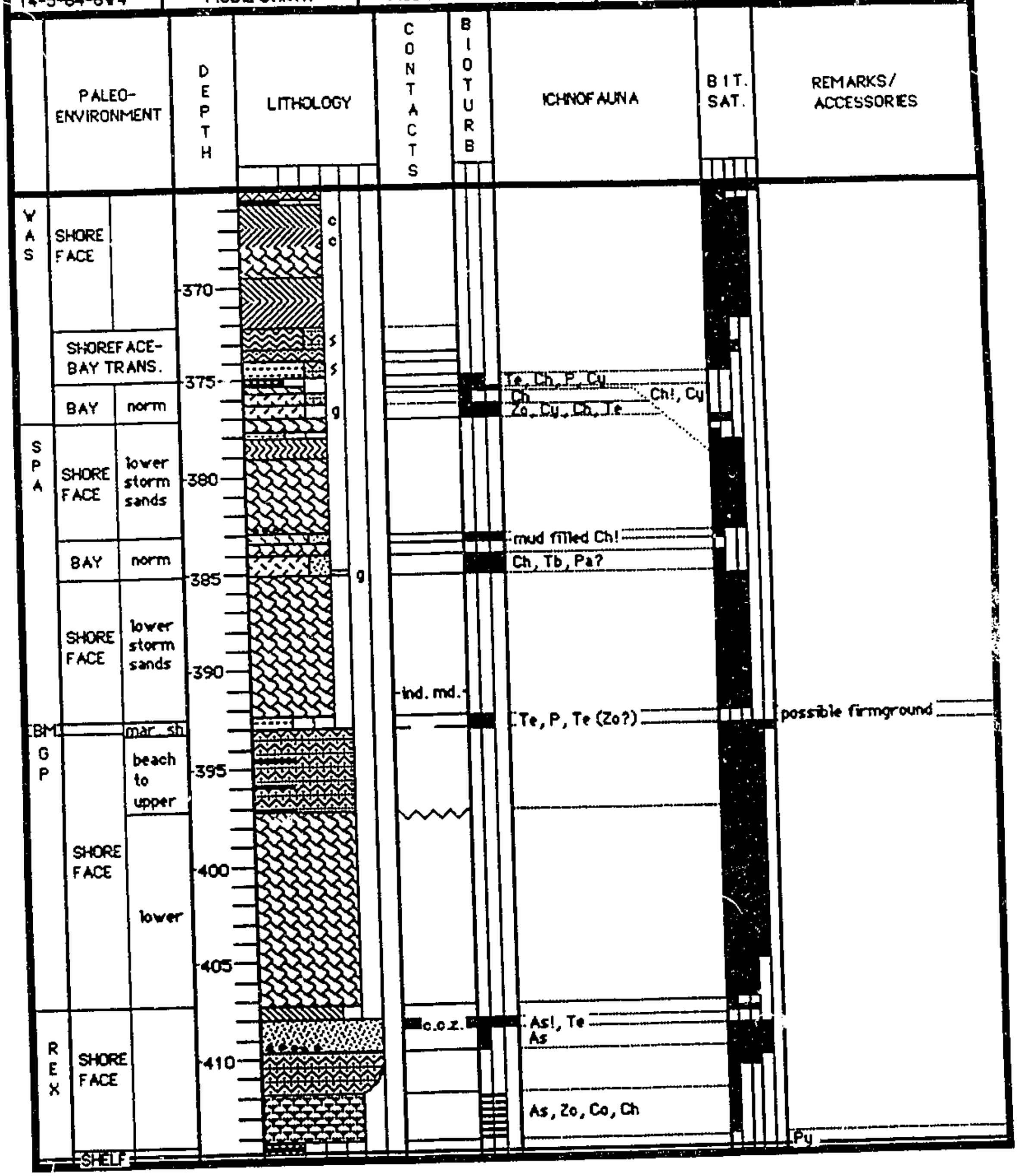
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-32-64-5W4	MOBIL MARGUERITE LAKE OV	MOBIL OIL CANADA LTD.	377.0-431.0 m	639.26 m	1 OF 2



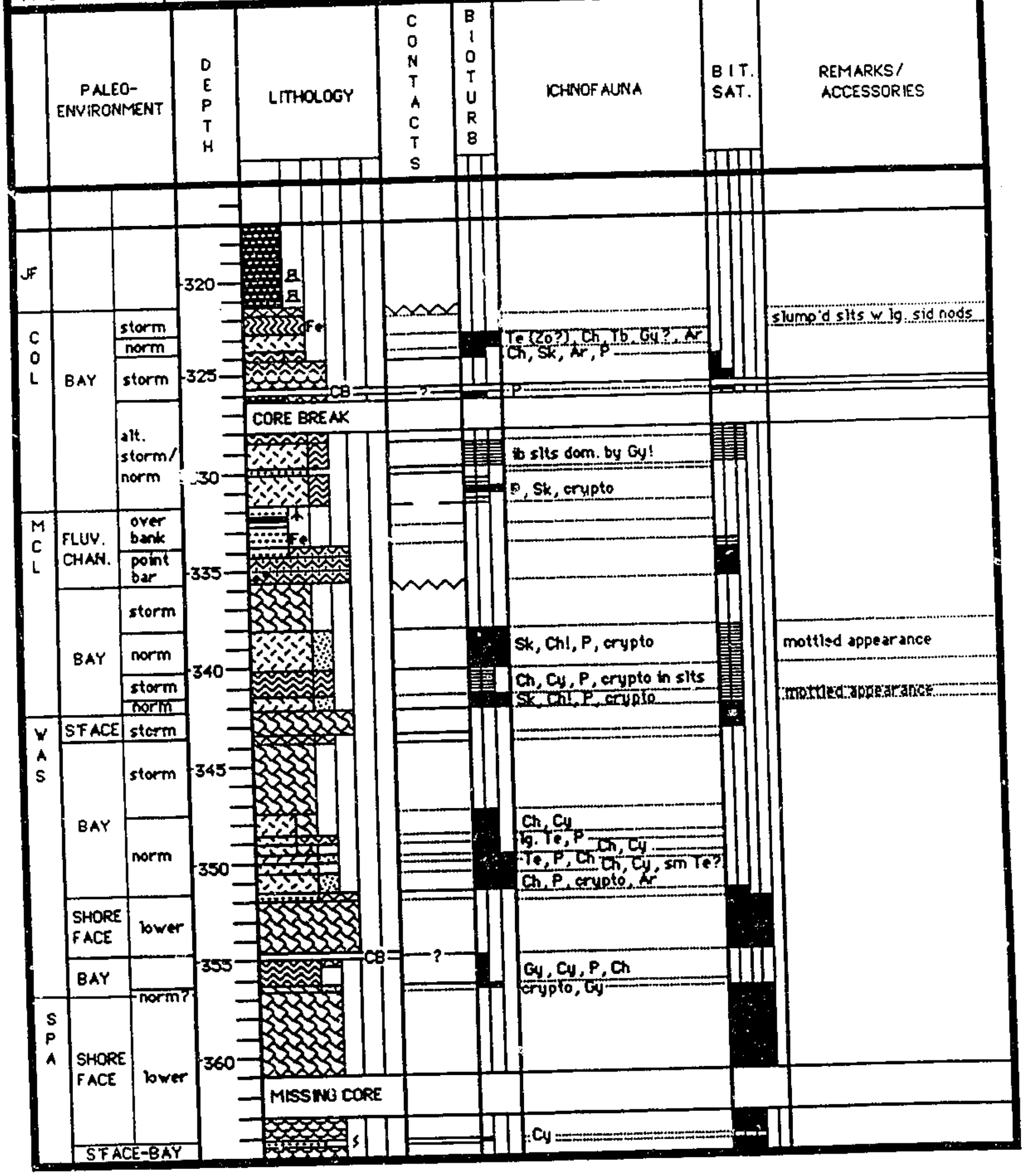
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-32-64-5W4	MOBIL MARGUERITE LAKE OV	MOBIL OIL CANADA LTD.	377.0–431.0 m	639.26 m	2 OF 2



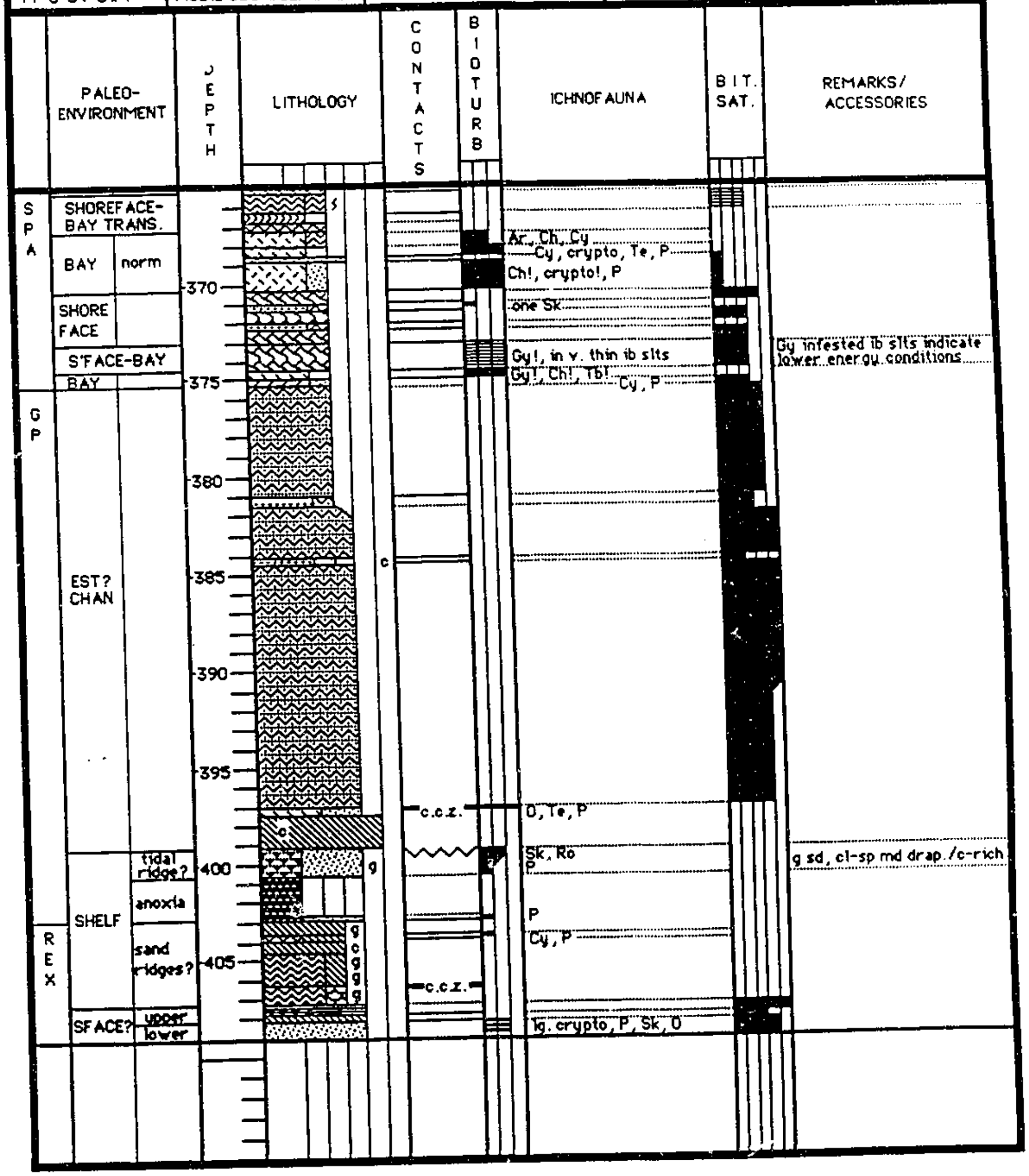
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-5-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	365.0-414.7 m	596.3 m	1 OF 1



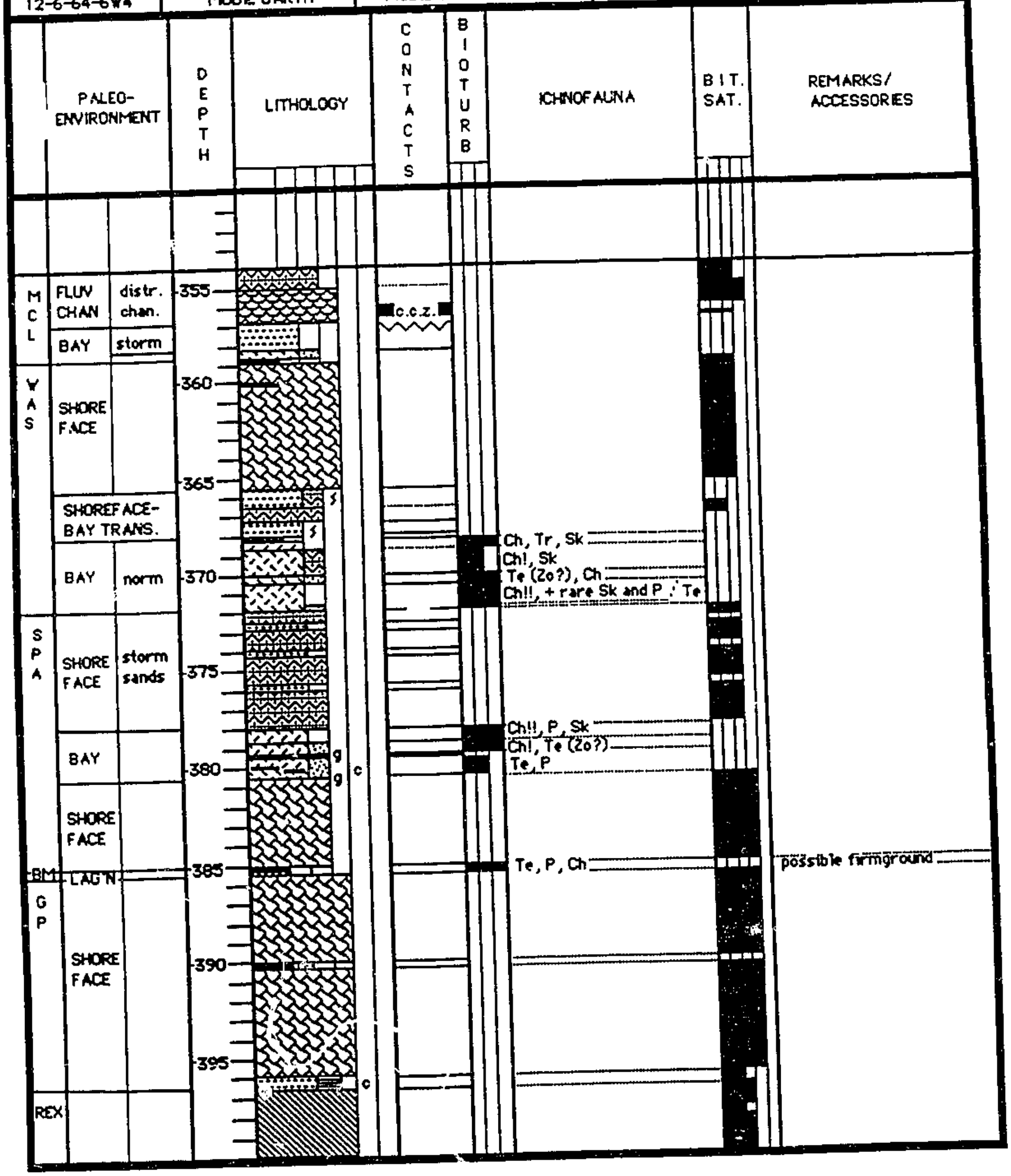
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-6-64-6W4	MOBIL OBS WOLF LK EX	MOBIL OIL CANADA LTD.	317.0-409.0 m	589.4 m	1 OF 2



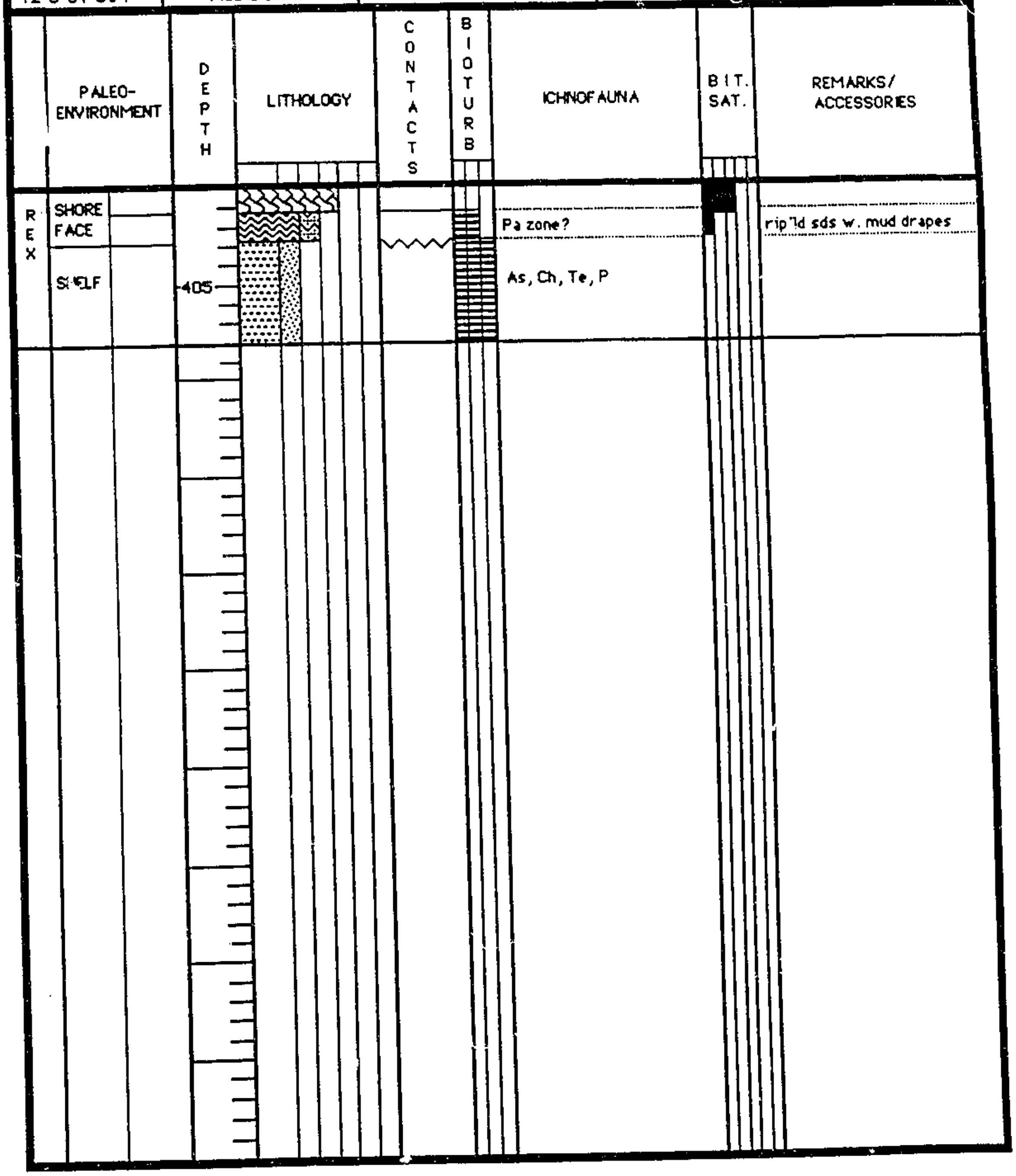
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-6-64-6W4	MOBIL OBS WOLF LK EX	MOBIL OIL CANADA LTD.	317.0-409.0 m	589.4 m	2 OF 2



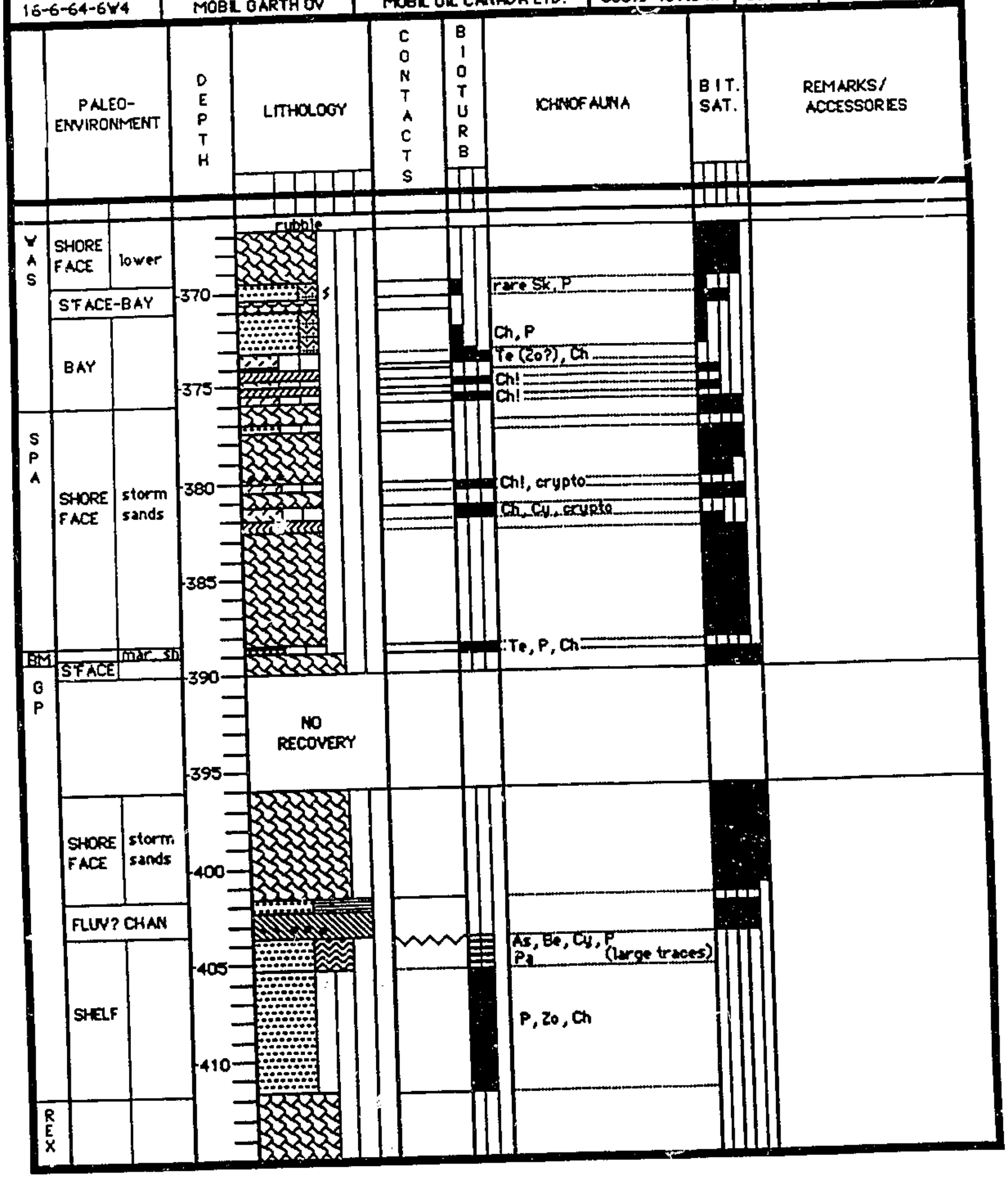
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-6-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	354.0-408.0 m	589.9 m	1 OF 2



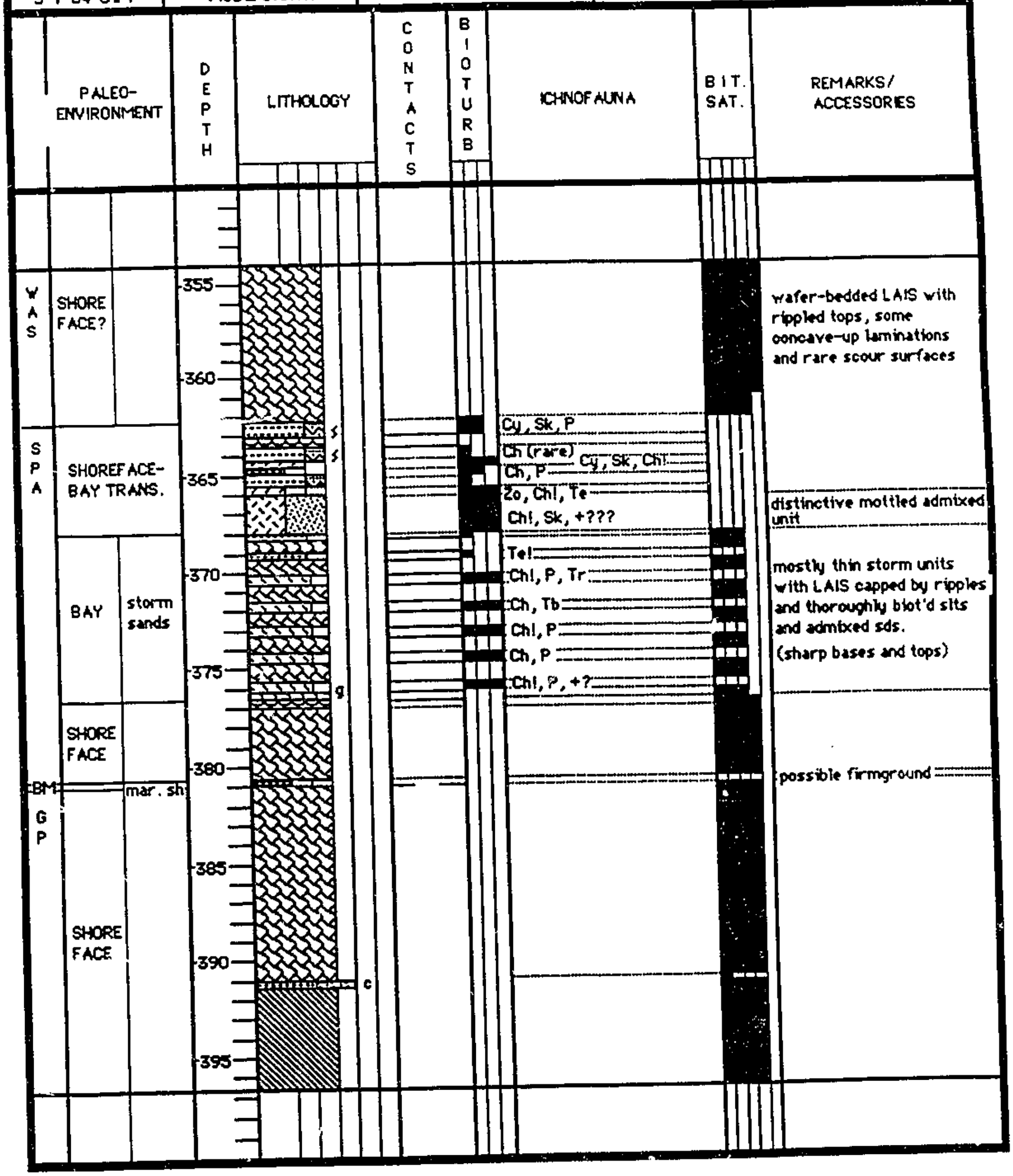
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-6-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	354.0-408.0 m	589.9 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-6-64-6W4	MOBIL GARTH OV	MOBIL OIL CANADA LTD.	366.0-407.5 m	591.6 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-7-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	354.0-396.5 m	587.6 m	1 OF 1



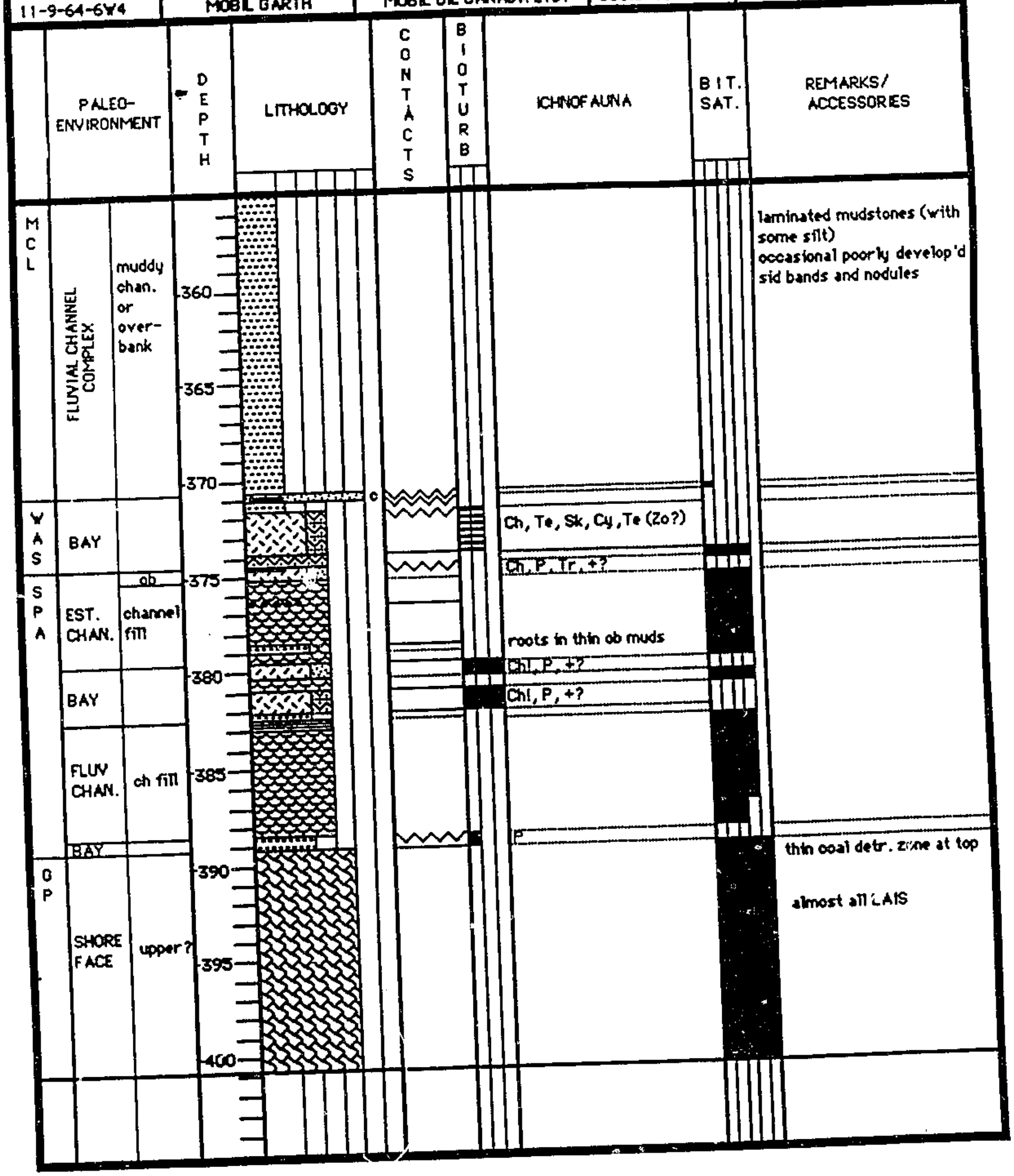
wafer-bedded LAIS with rippled tops, some concave-up laminations and rare scour surfaces

distinctive mottled admixed unit

mostly thin storm units with LAIS capped by ripples and thoroughly biot'd slts and admixed sds.
(sharp bases and tops)

possible firmground

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-9-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	355.0-400.75 m	588.4 m	1 OF 1

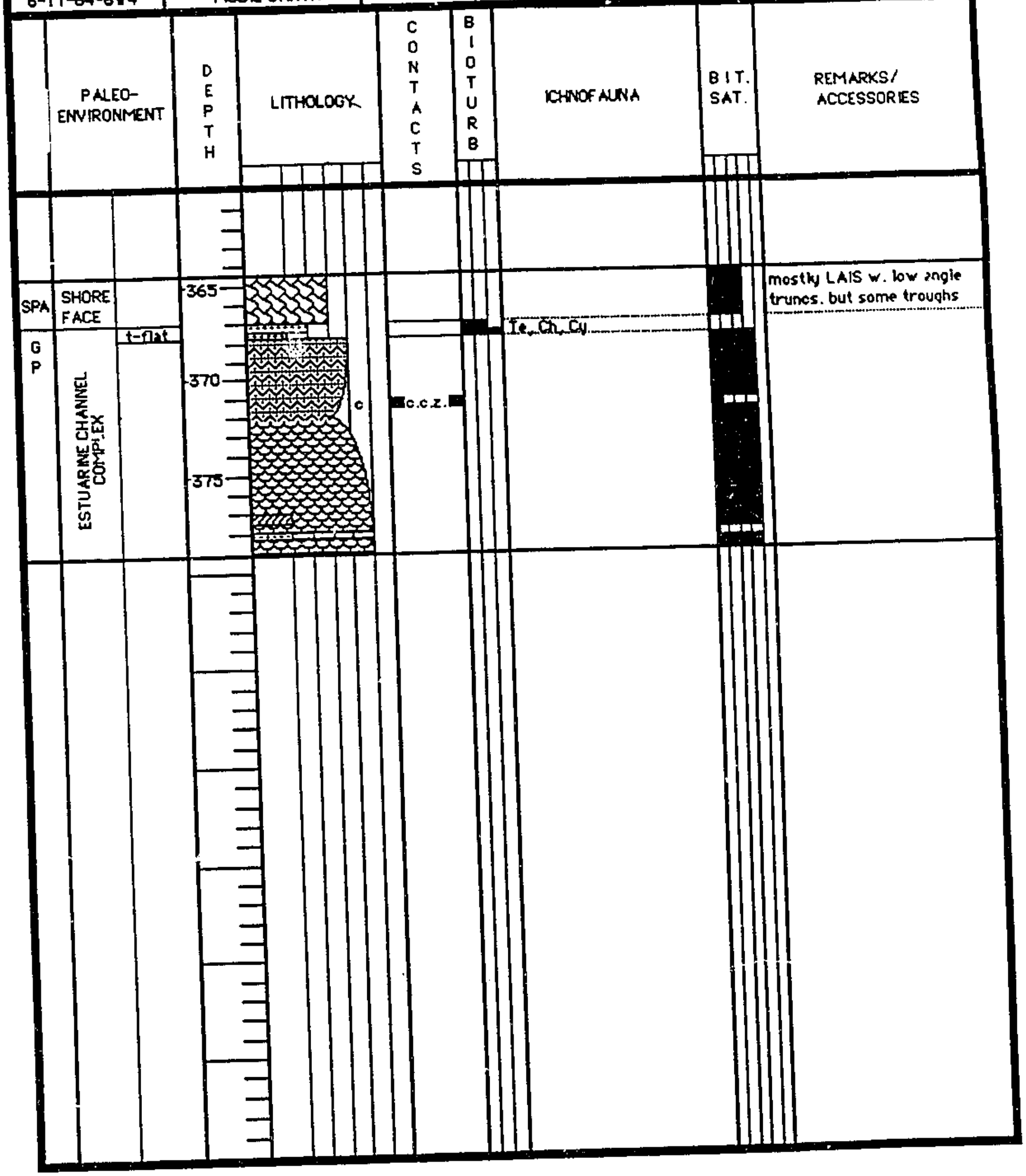


laminated mudstones (with some silt)
occasional poorly develop'd sid bands and nodules

thin coal detr. zone at top

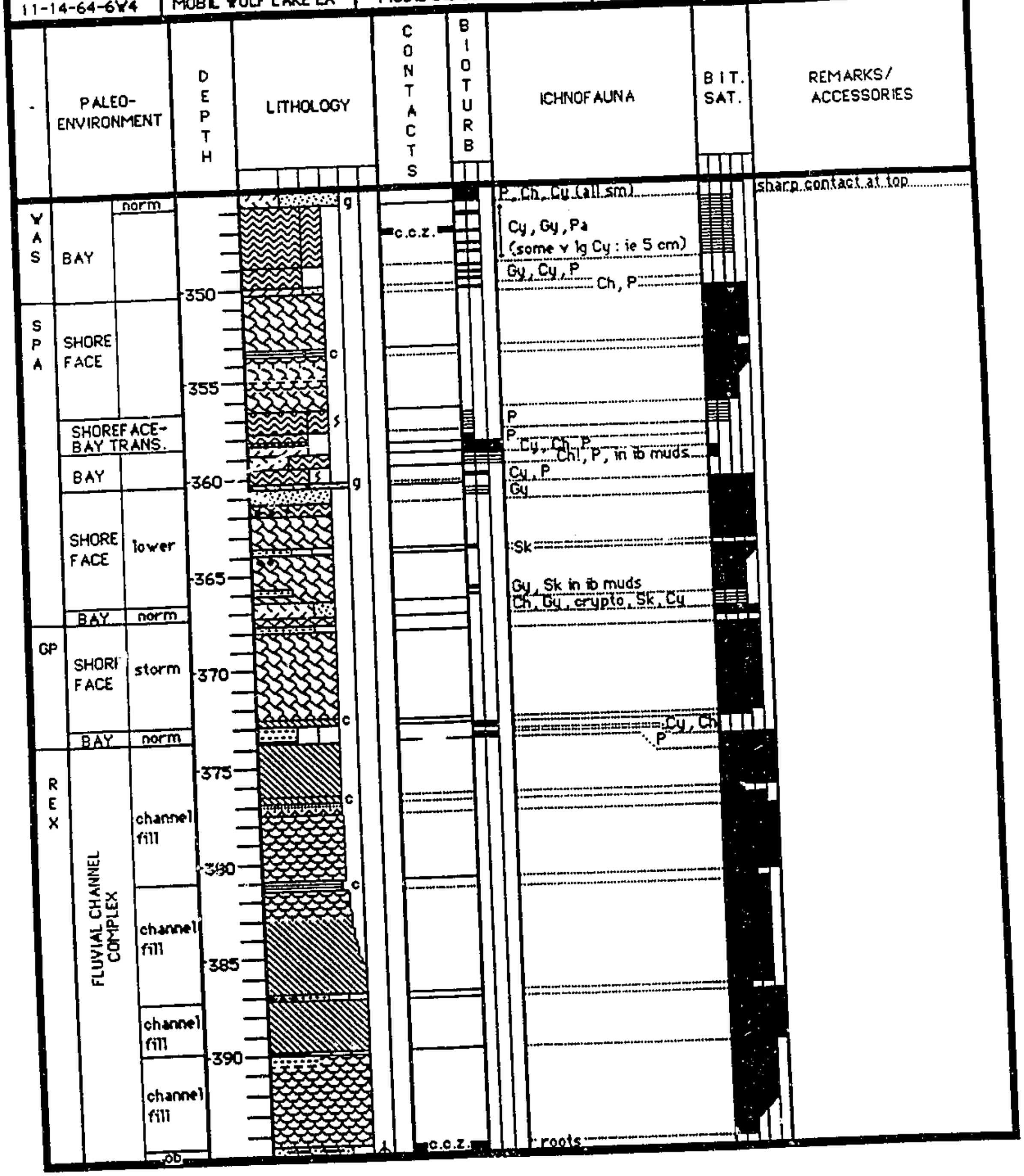
almost all LAIS

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-11-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	364.75-379.0 m	580.4 m	1 OF 1



mostly LAIS w. low angle truncs. but some troughs

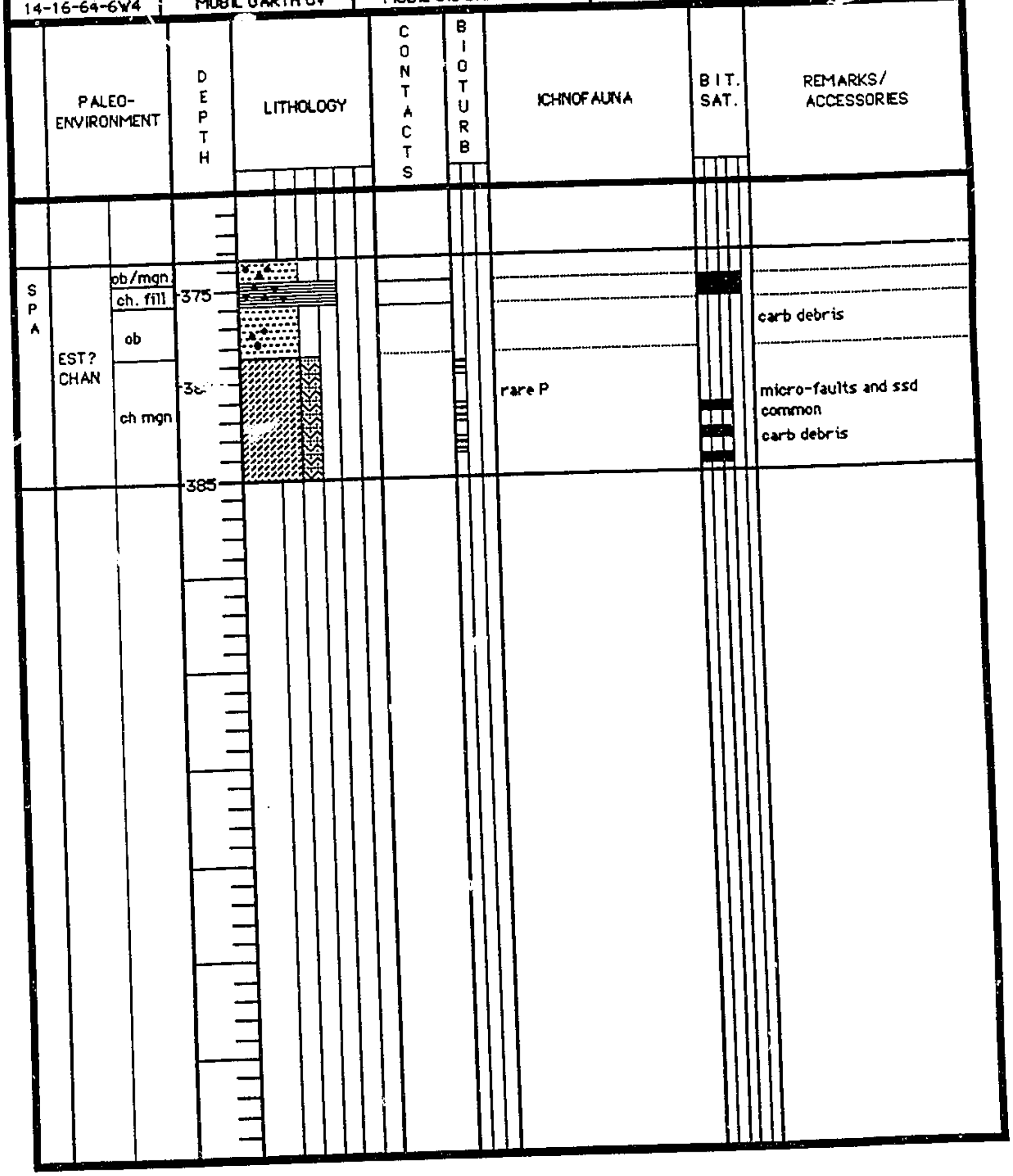
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-14-64-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	345.0-399.0 m	588.9 m	1 OF 2



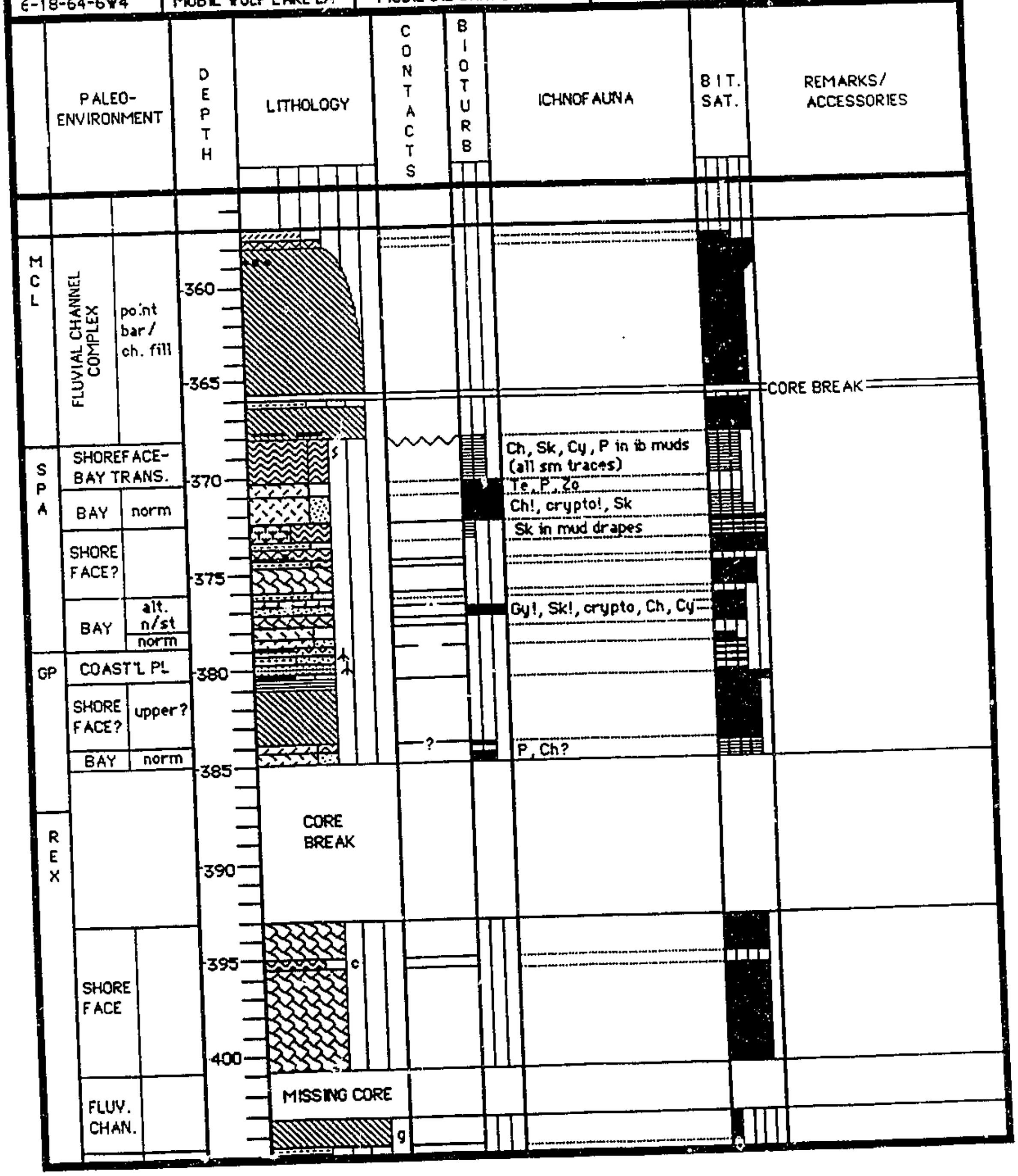
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-14-64-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	345.0-399.0 m	588.9 m	2 OF 2

	PALEO-ENVIRONMENT		DEPTH	LITHOLOGY	CONTACTS	BIOTURB	ICHNOFAUNA	BIT. SAT.	REMARKS/ ACCESSORIES
REX	FLUV CHAN	channel fill/pt		▨	c.c.z.		odd roots	■	

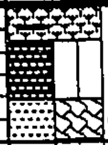
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-16-64-6W4	MOBIL GARTH OV	MOBIL OIL CANADA LTD.	373.5-385.0 m	583.96 m	1 OF 1



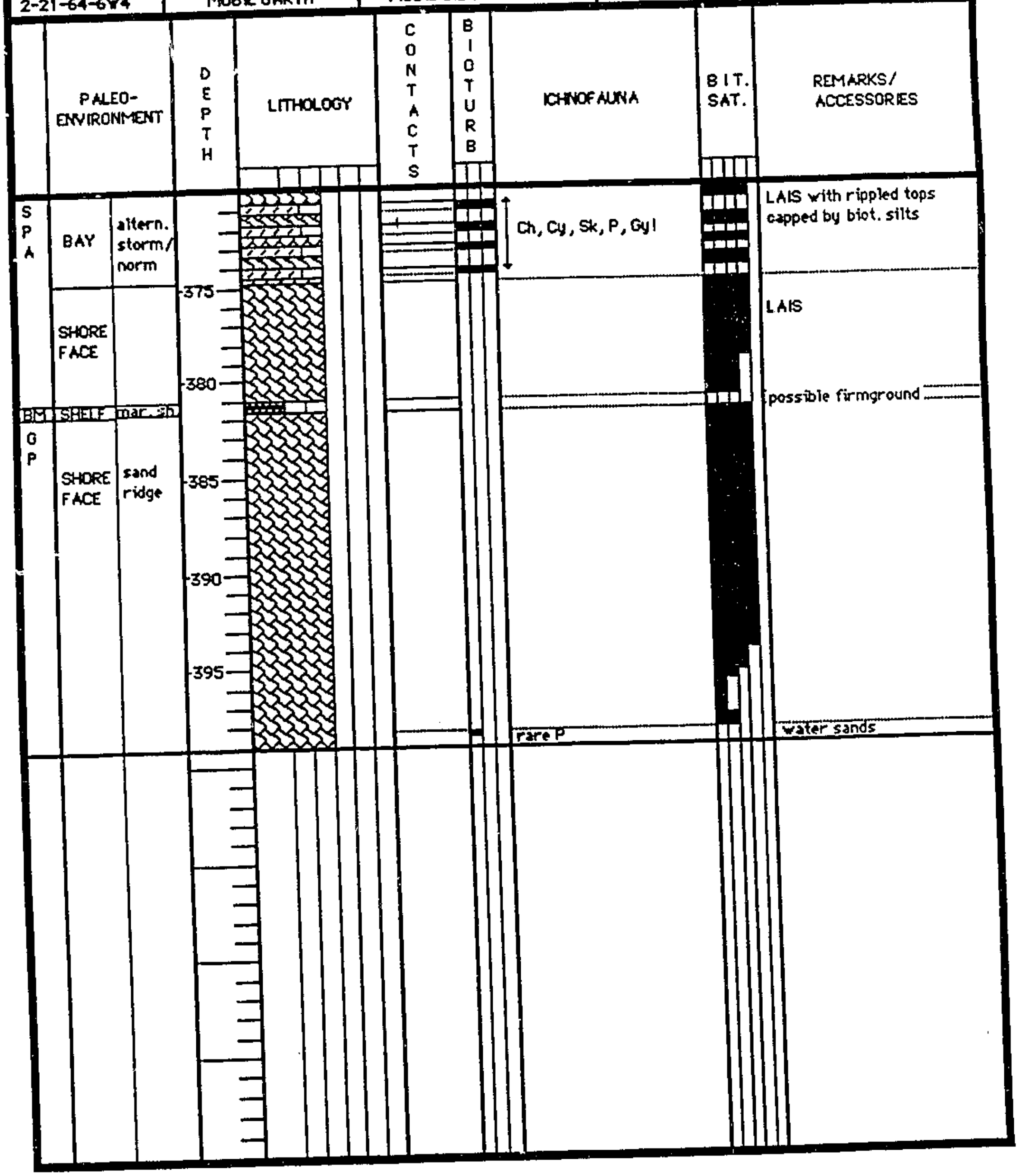
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-18-64-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	357.0-411.0 m	593.7 m	1 OF 2



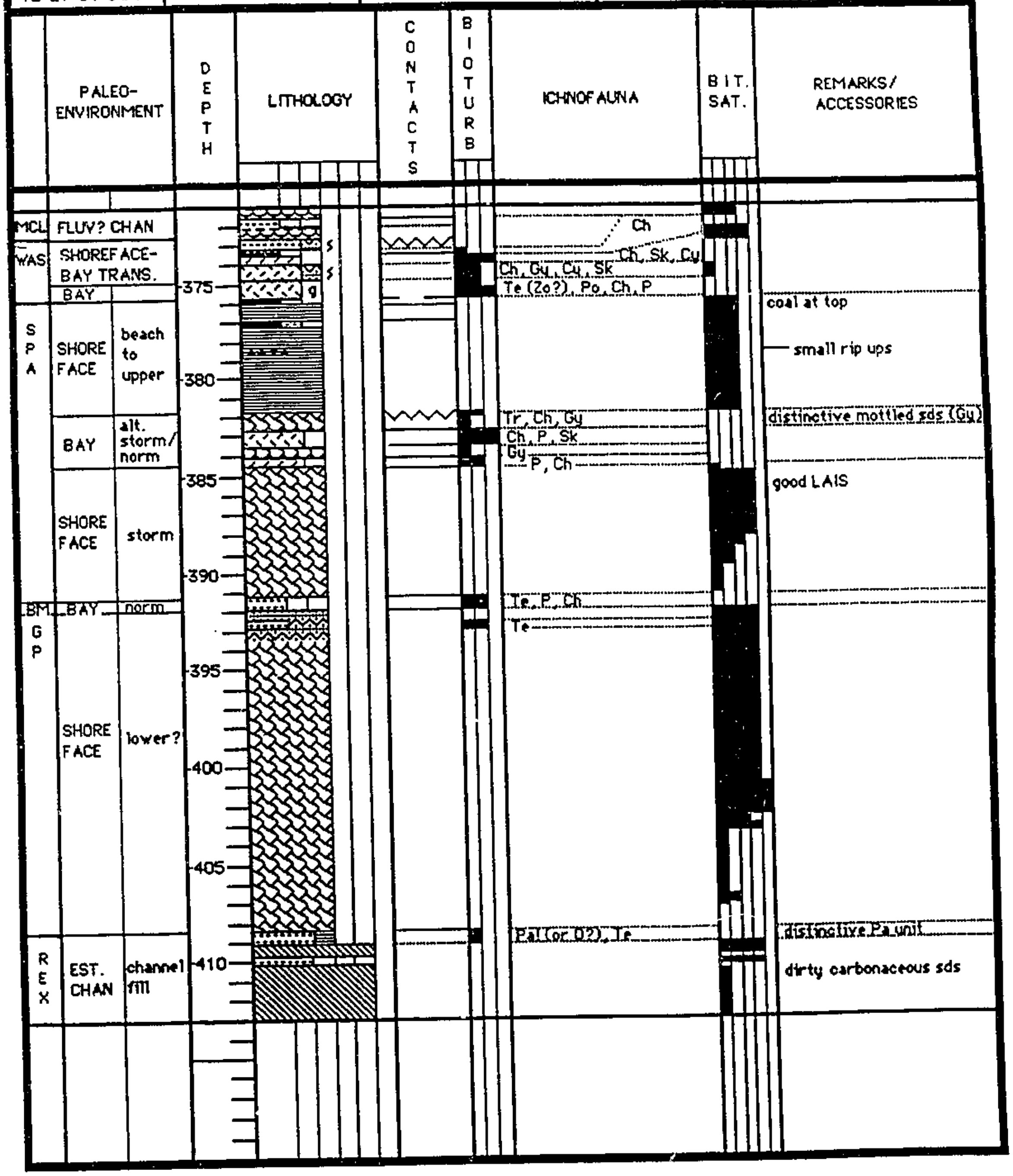
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-18-64-6W4	MOBIL WOLF LAKE EX	MOBIL OIL CANADA LTD.	357.0-411.0 m	593.7 m	2 OF 2

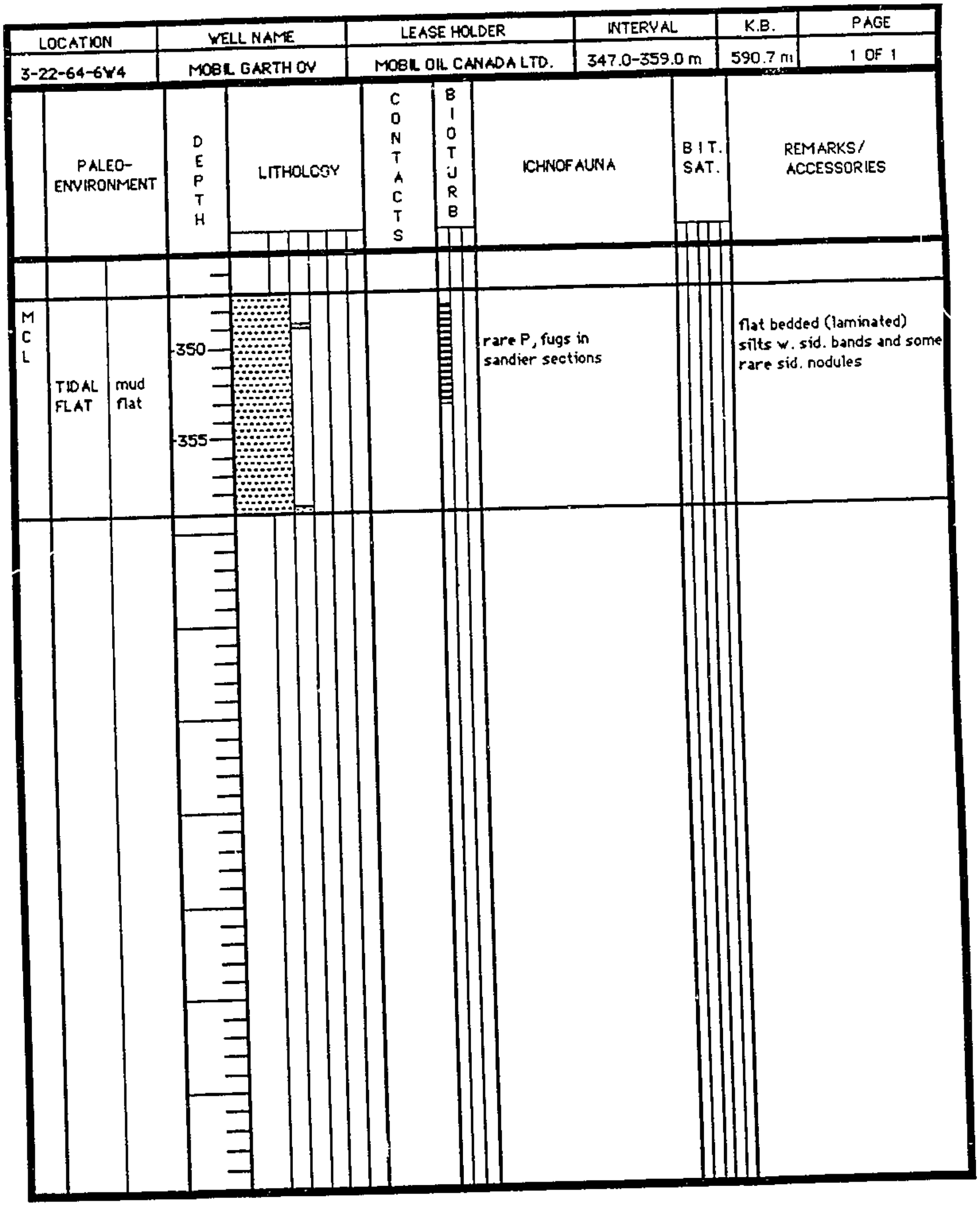
	PALEO-ENVIRONMENT		DEPTH	LITHOLOGY	CONTACTS	BIOTURB	ICHNOFAUNA	BIT. SAT.	REMARKS/ ACCESSORIES
REX	CHAN	tidal?					rare O		
LLO	LAG'N								possible firmground
		storm/ norm	410	g			some rare Sk and Ch		sands are glauconitic

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-21-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	370.0-399.0 m	590.1 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-21-64-6W4	MOBIL GARTH OV	MOBIL OIL CANADA LTD.	371.0-413.0 m	601.6 m	1 OF 1

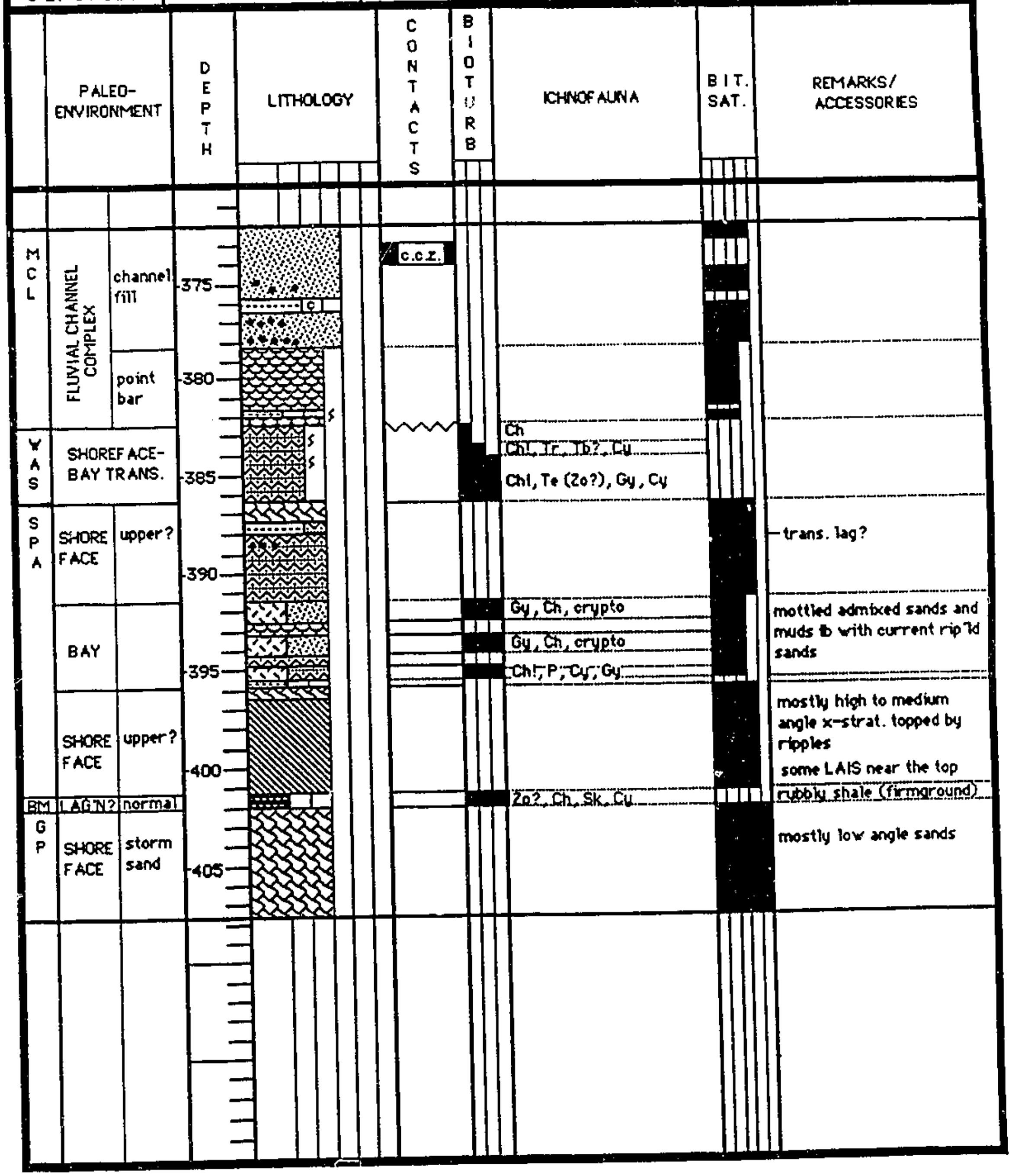




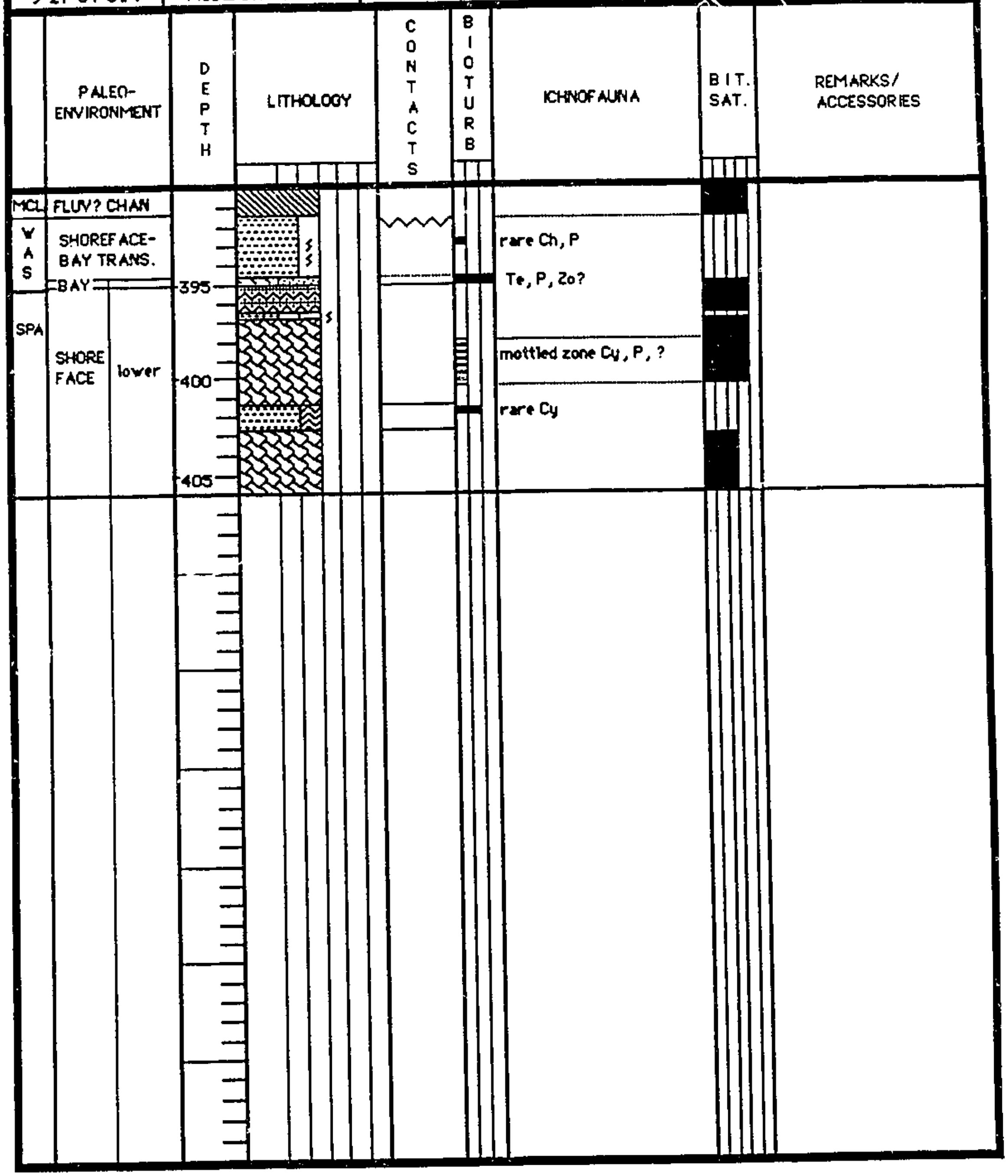
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-22-64-6W4	MOBIL GARTH OV	MOBIL OIL CANADA LTD.	347.0-359.0 m	590.7 m	1 OF 1

	PALEO-ENVIRONMENT		DEPTH	LITHOLOGY	CONTACTS	BIOTURB	ICHNOFAUNA	BIT. SAT.	REMARKS/ ACCESSORIES
MCL	TIDAL FLAT	mud flat					rare P, fugs in sandier sections		flat bedded (laminated) silts w. sid. bands and some rare sid. nodules

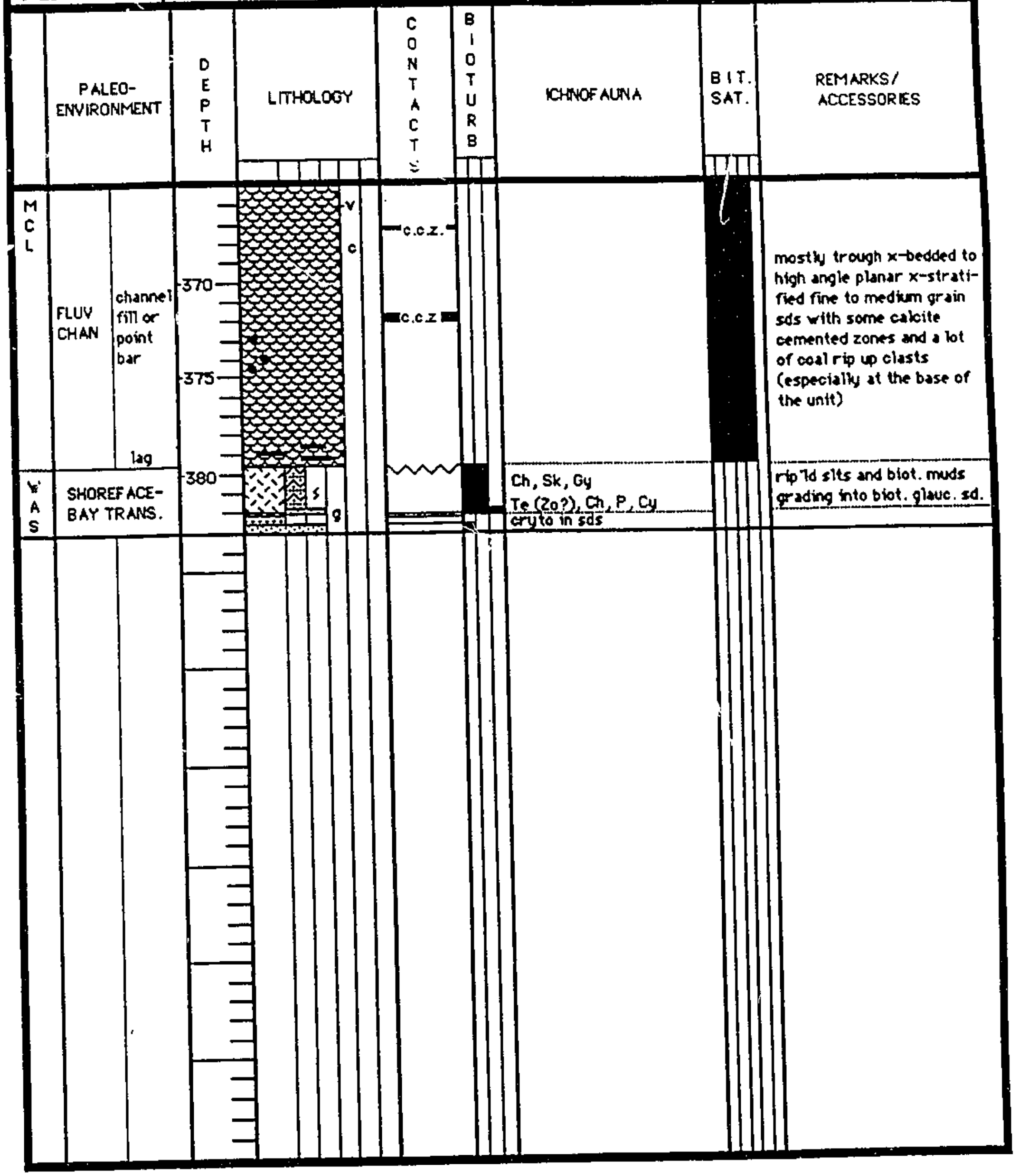
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-27-64-6W4	MOBIL GARTH OV	MOBIL OIL CANADA LTD.	372.0-407.5 m	606.9 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-27-64-6W4	MOBIL GARTH OV	MOBIL OIL CANADA LTD.	390.0-408.0 m	613.0 m	1 OF 1



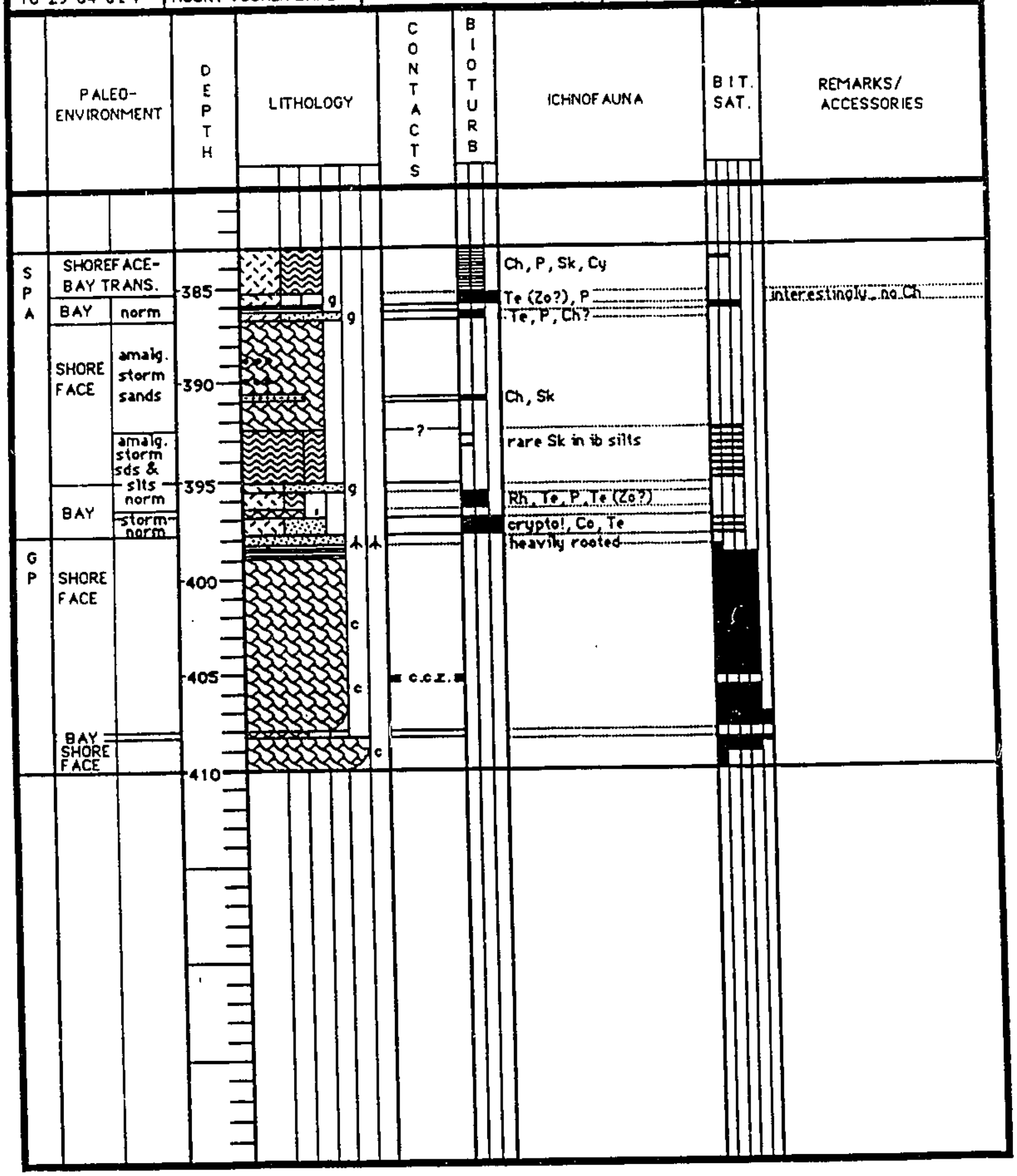
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-28-64-6W5	MOBIL GARTH	MOBIL OIL CANADA LTD.	365.0-383.0 m	604.2 m	1 OF 1



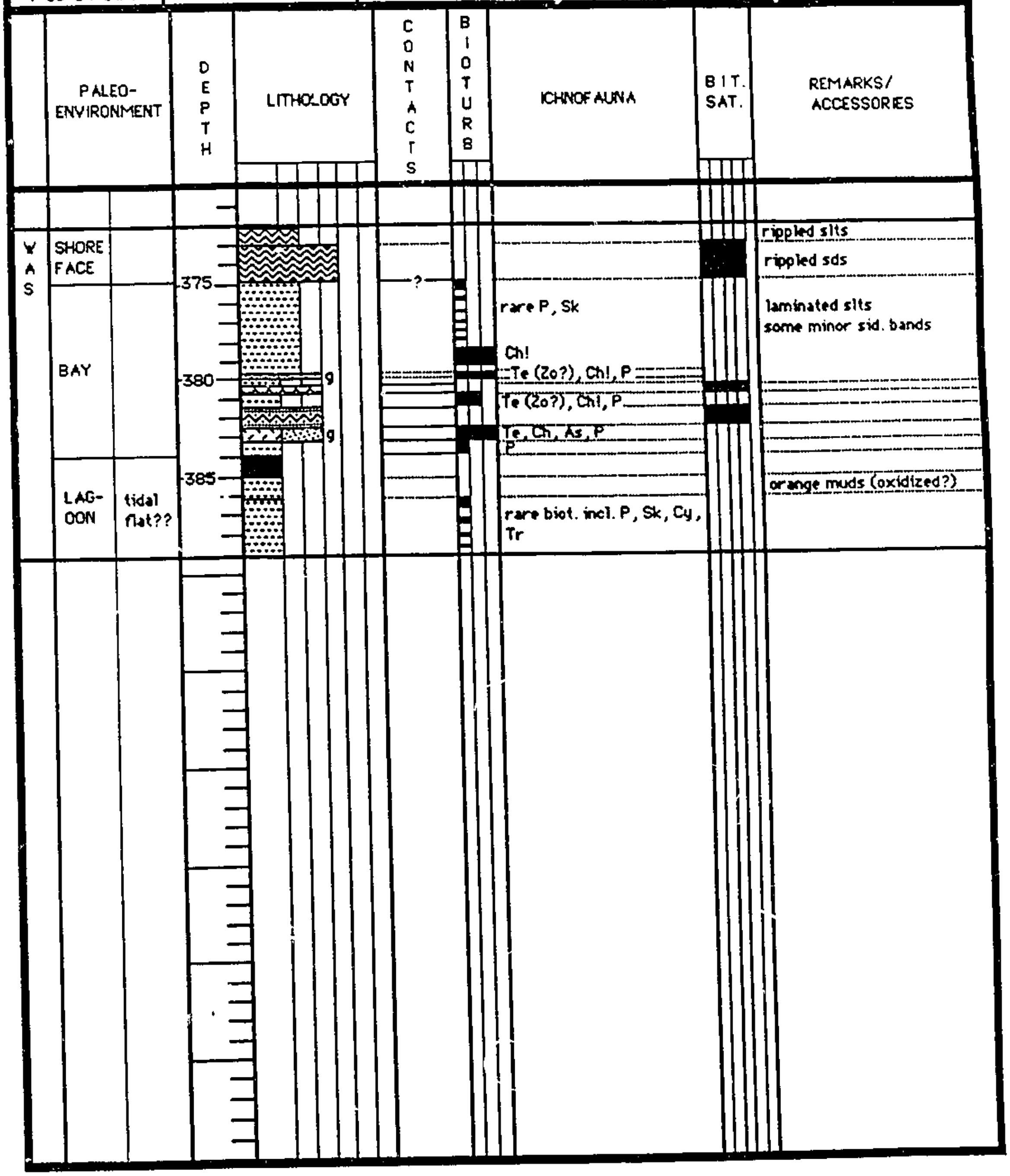
mostly trough x-bedded to high angle planar x-stratified fine to medium grain sds with some calcite cemented zones and a lot of coal rip up clasts (especially at the base of the unit)

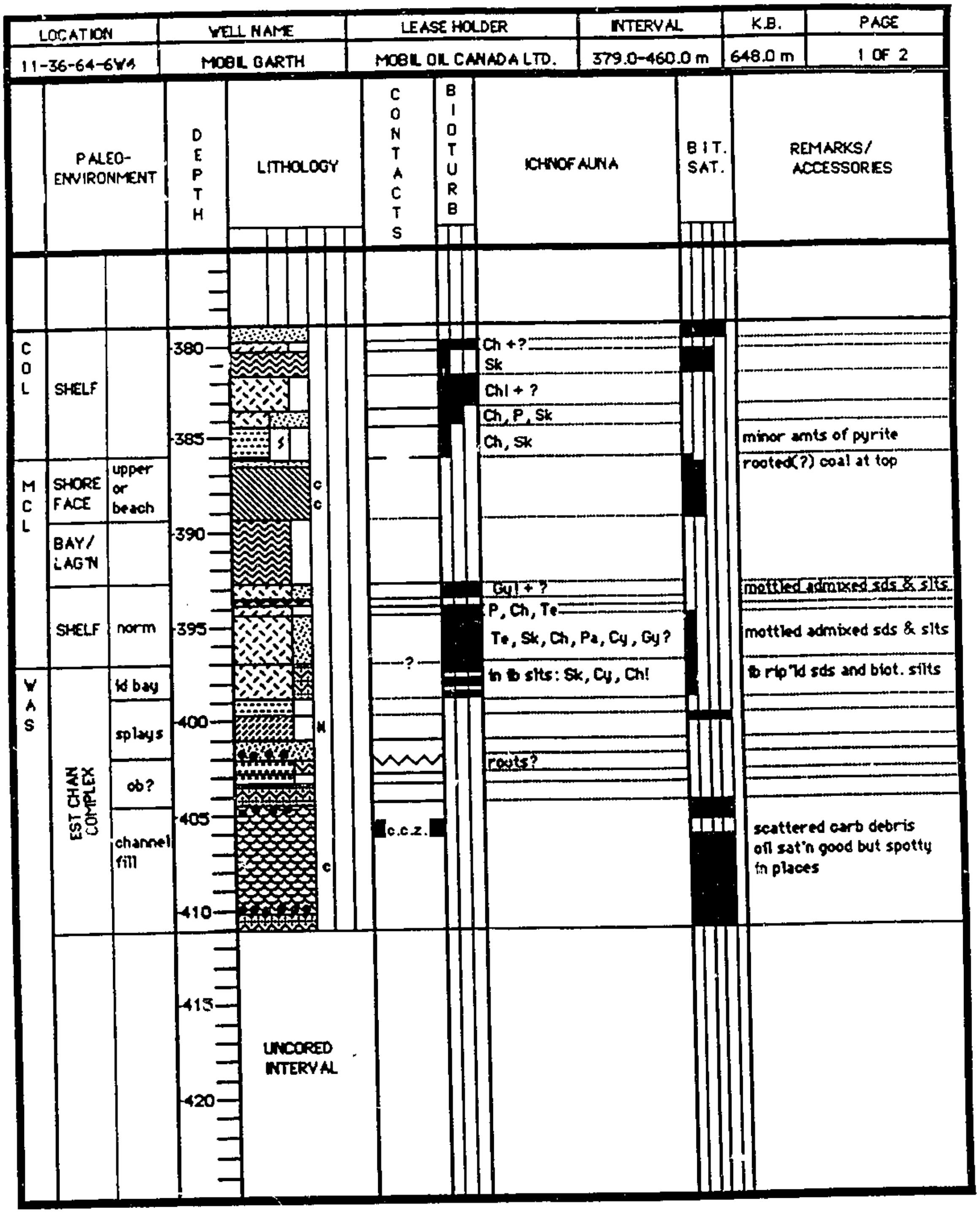
rip'ld slts and biot. muds grading into biot. glauc. sd.

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-29-64-6W4	HUSKY TUCKER LAKE	HUSKY OIL OPERATIONS LTD.	383.0-410.0 m	580.1 m	1 OF 1



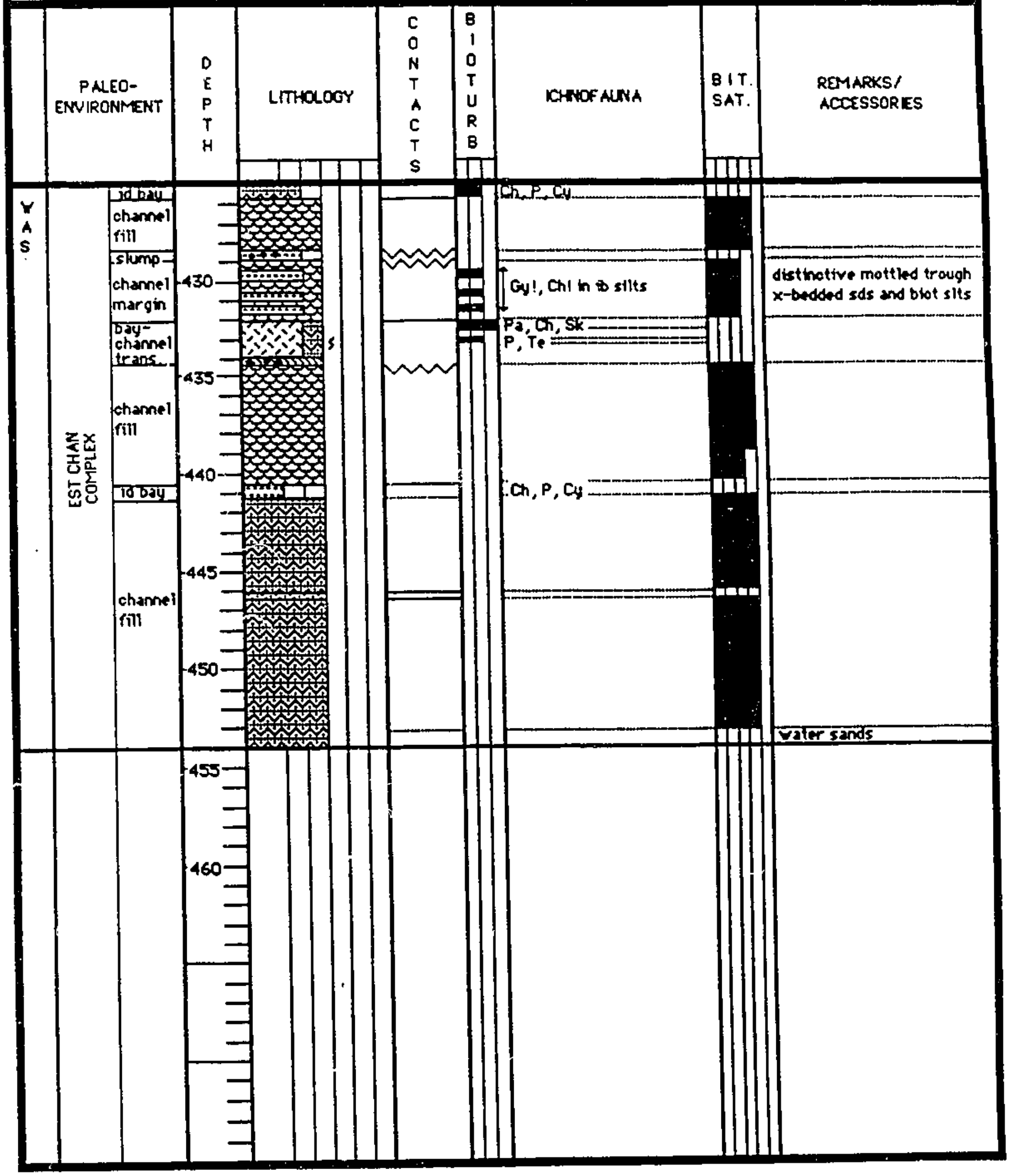
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-30-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	372.0-389.0 m	604.1 m	1 OF 1



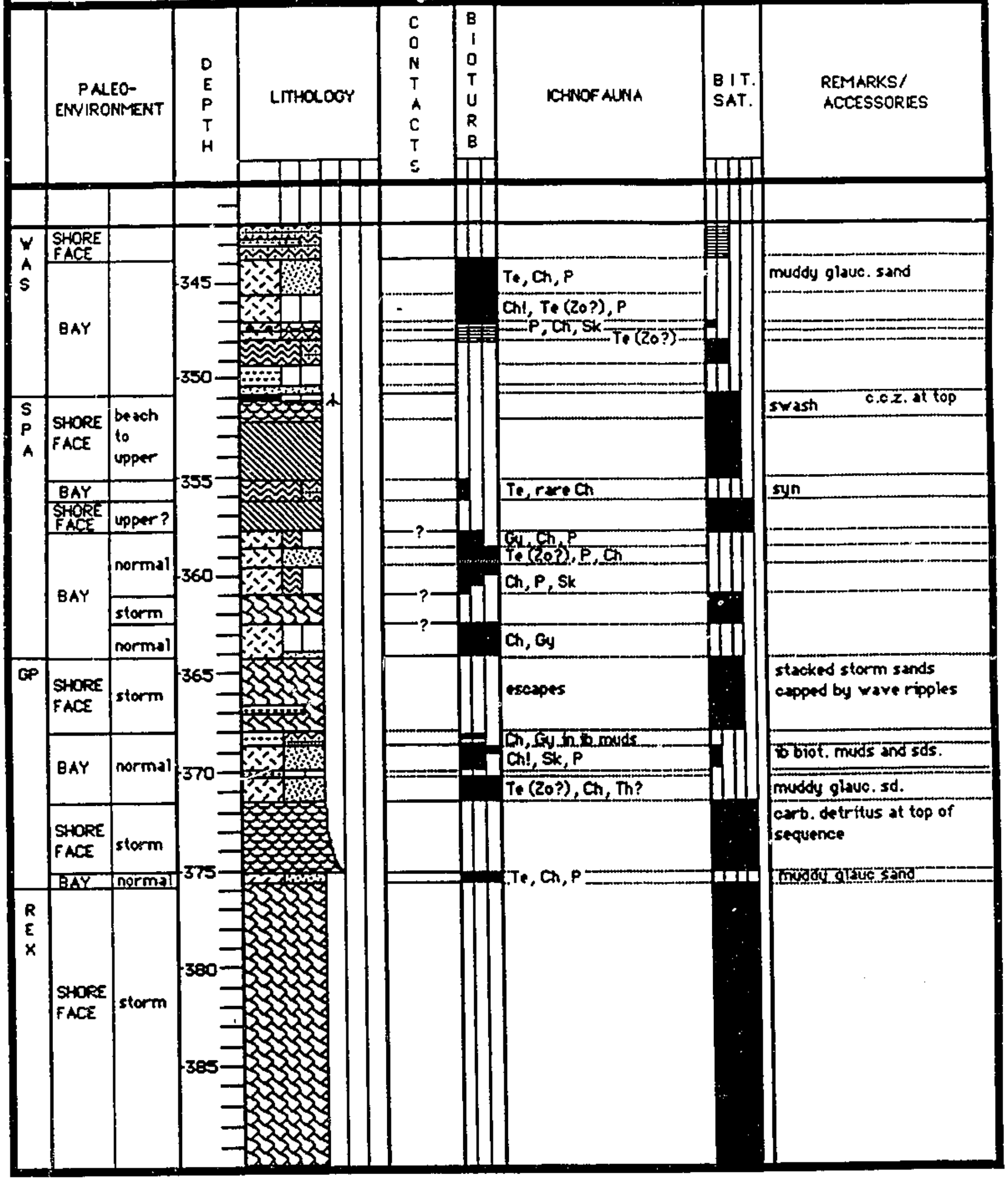


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-36-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	379.0-460.0 m	648.0 m	1 OF 2

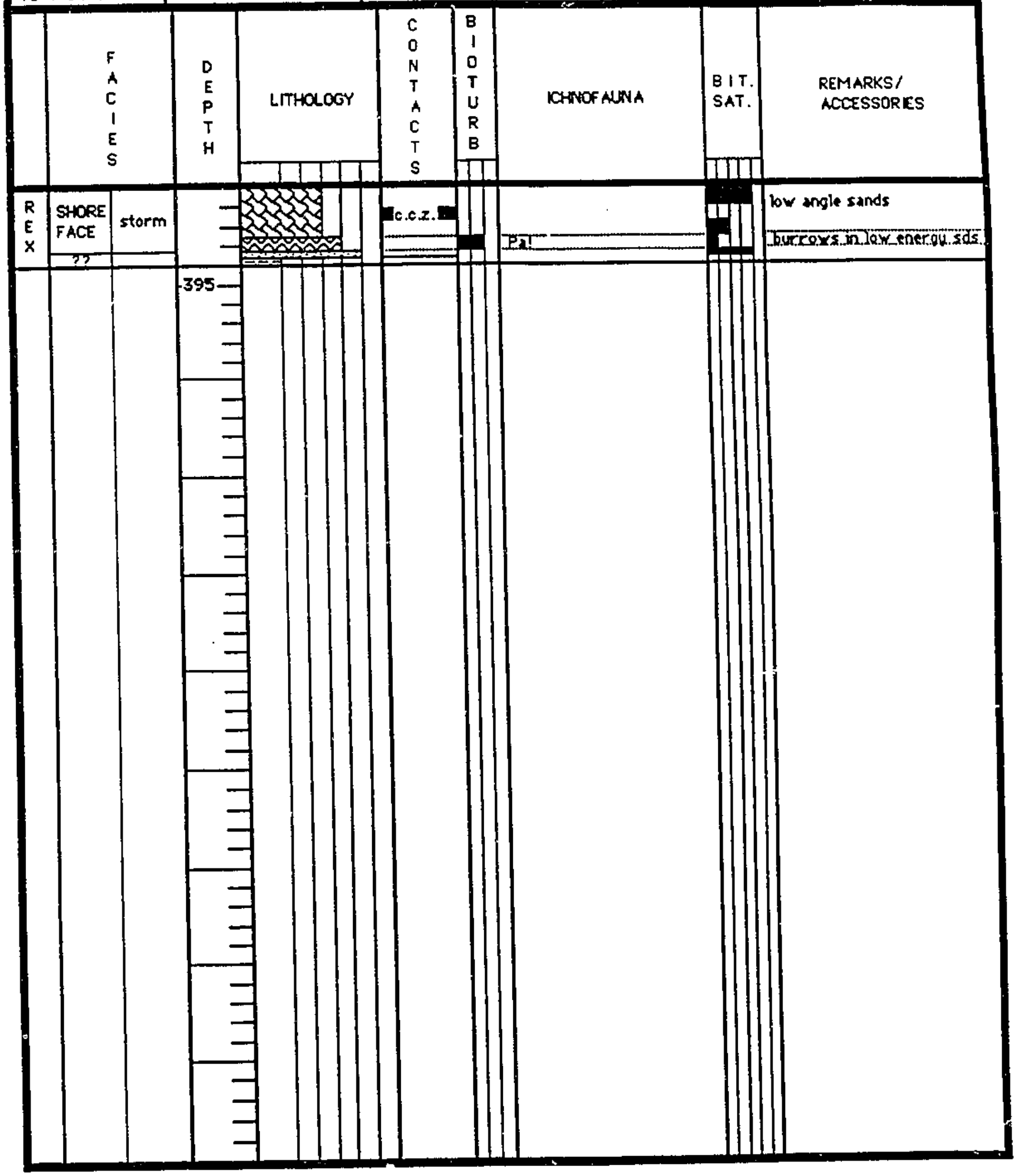
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-36-64-6W4	MOBIL GARTH	MOBIL OIL CANADA LTD.	379.0-453.9 m	648.0 m	2 OF 2



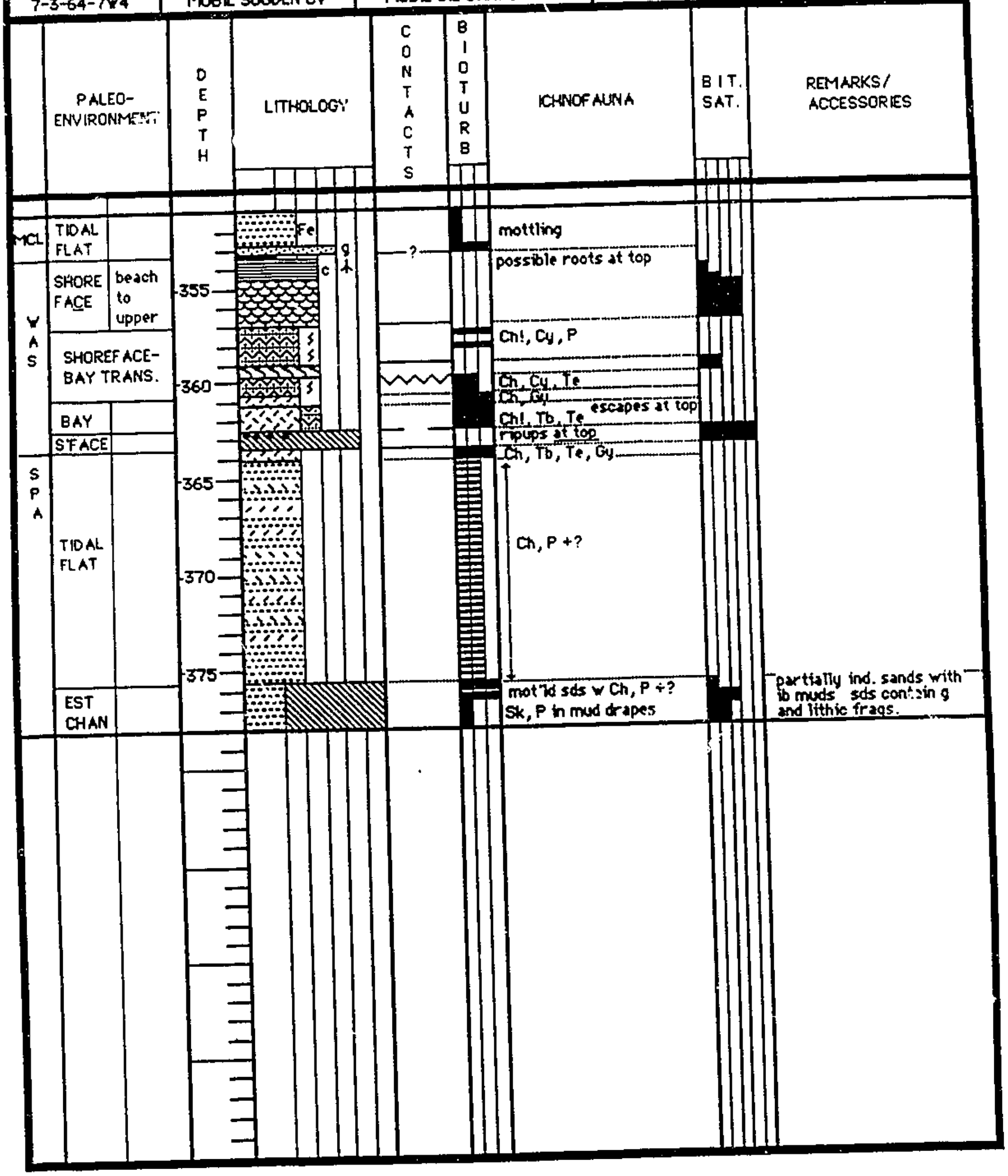
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-1-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	342.0-395.5 m	582.7 m	1 OF 2



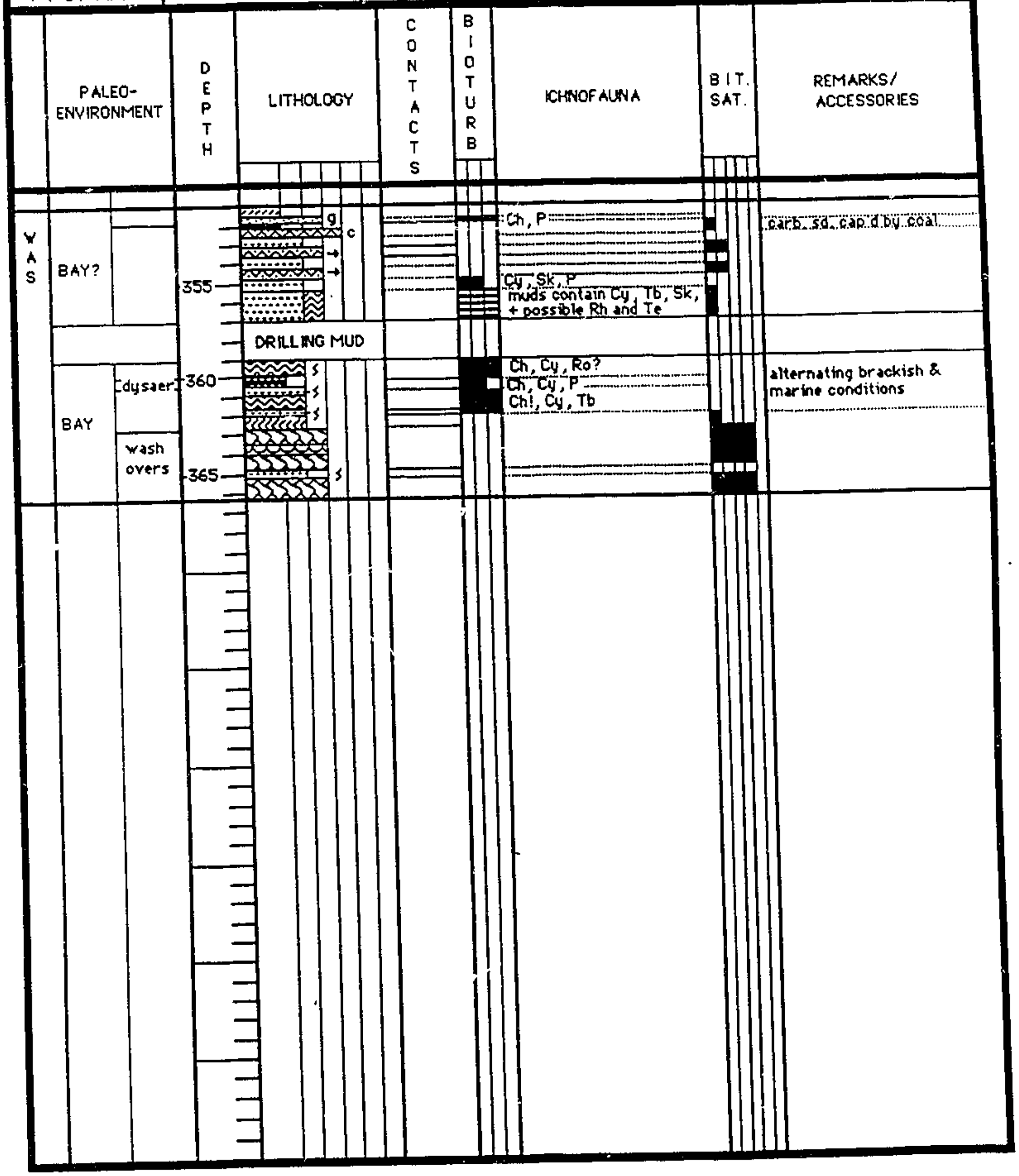
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-1-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	342.0-395.5 m	582.7 m	2 OF 2



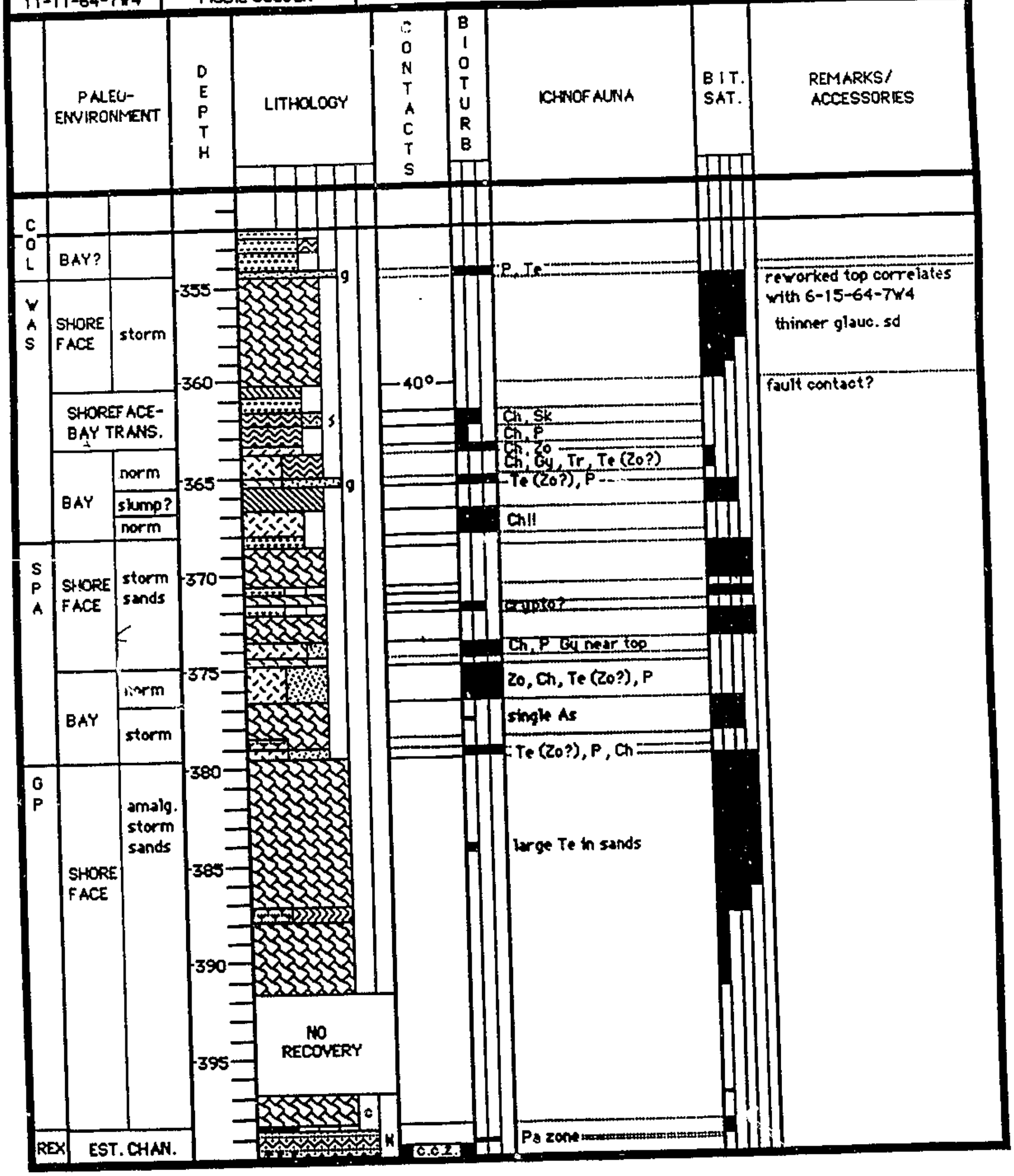
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-3-64-7W4	MOBIL SUGDEN OV	MOBIL OIL CANADA LTD.	351.0-378.0 m	575 m	1 OF 1



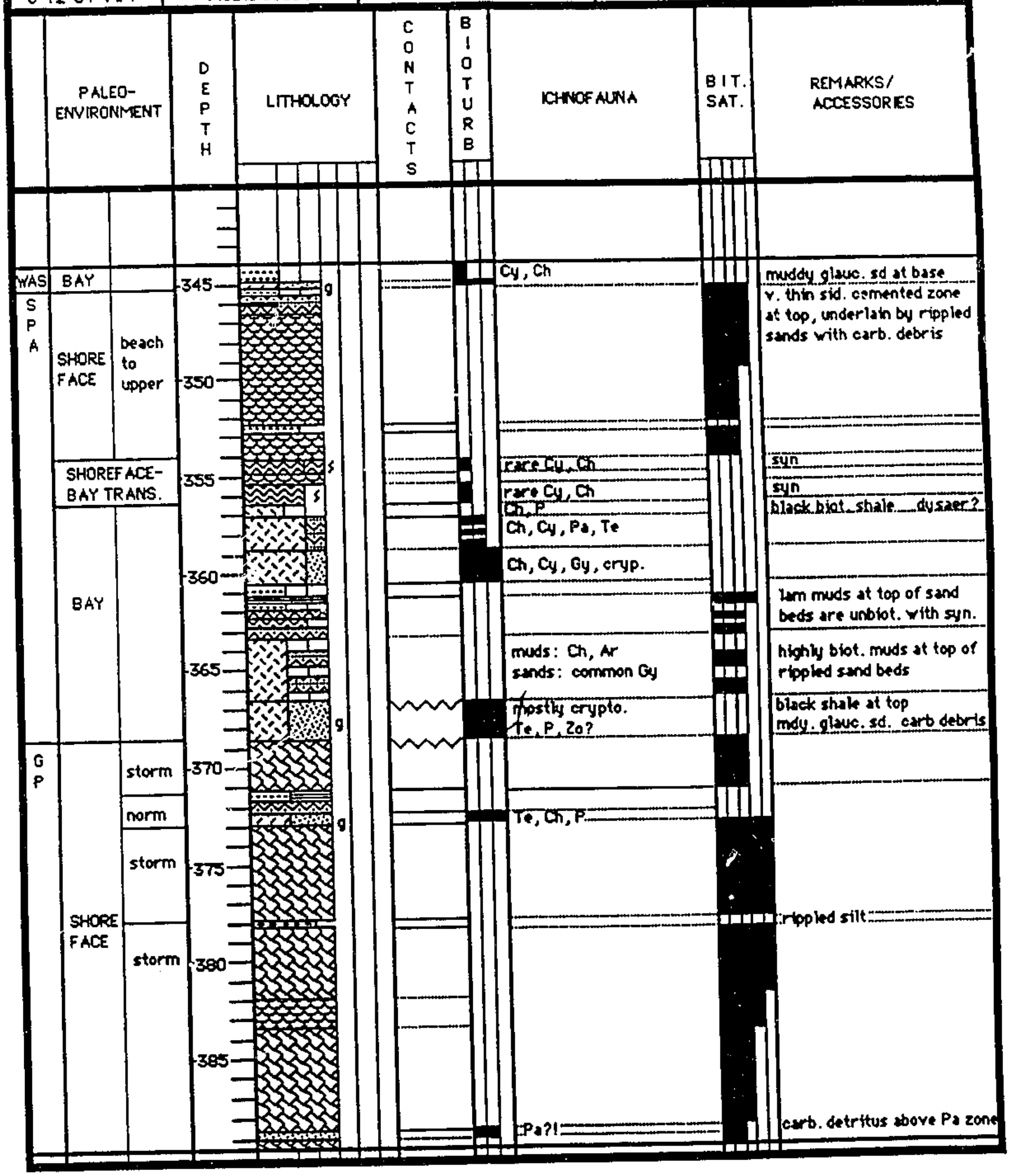
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
4-7-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	351.0-366.2 m	577.8 m	1 OF 1



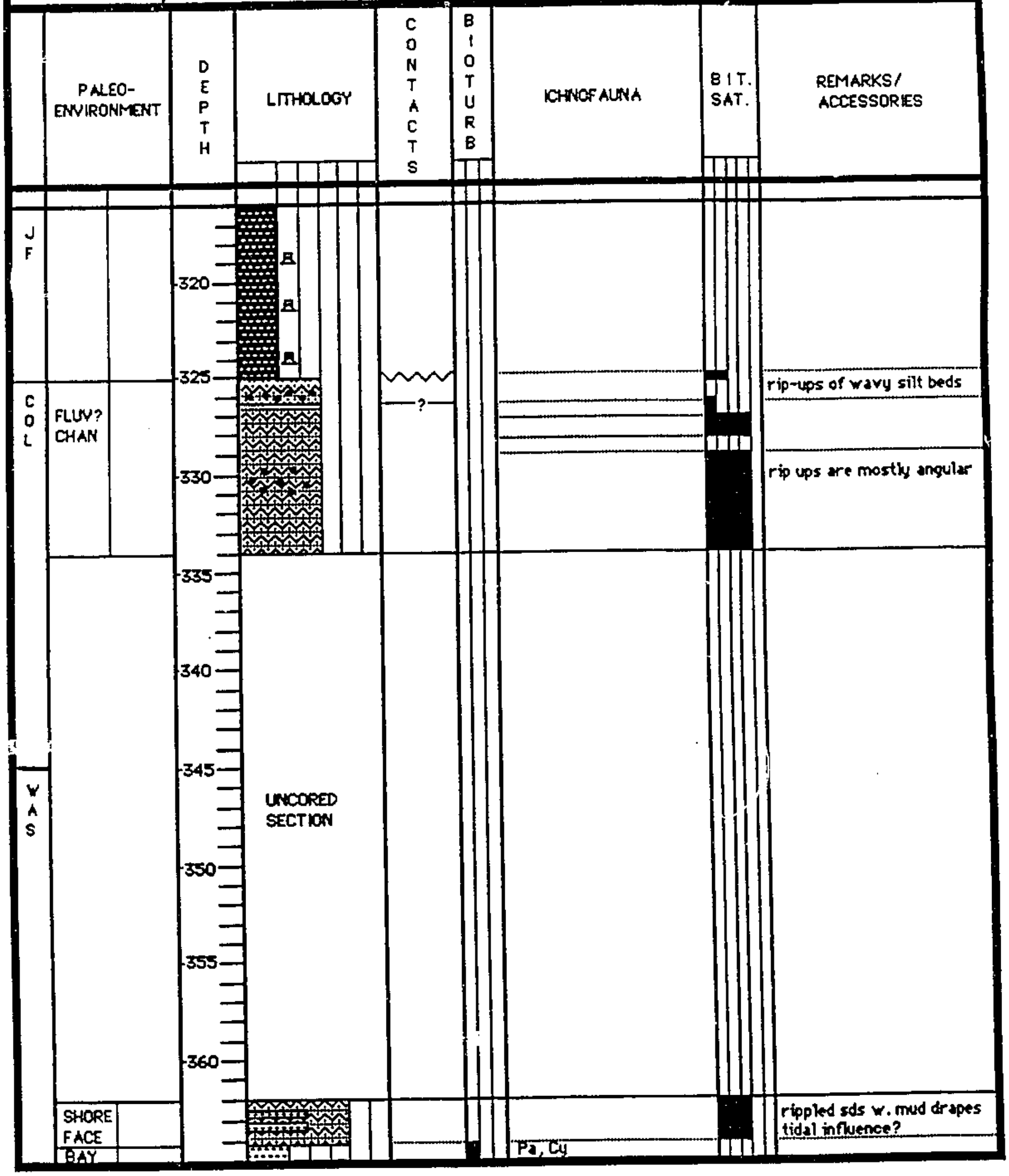
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-11-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	352.0-400.0 m	578.5 m	1 OF 1



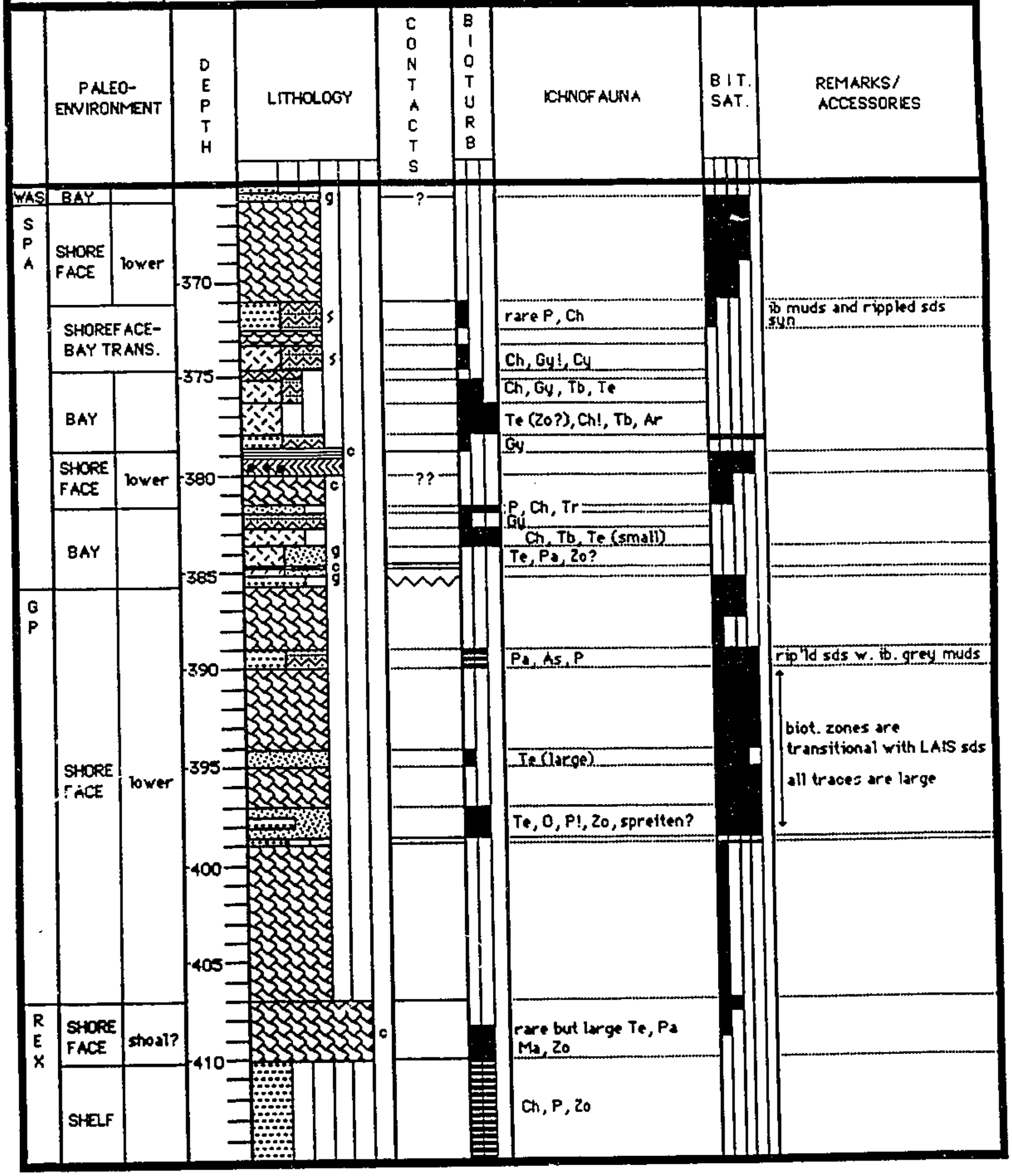
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-12-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	344.0-389.5 m	582.1 m	1 OF 1



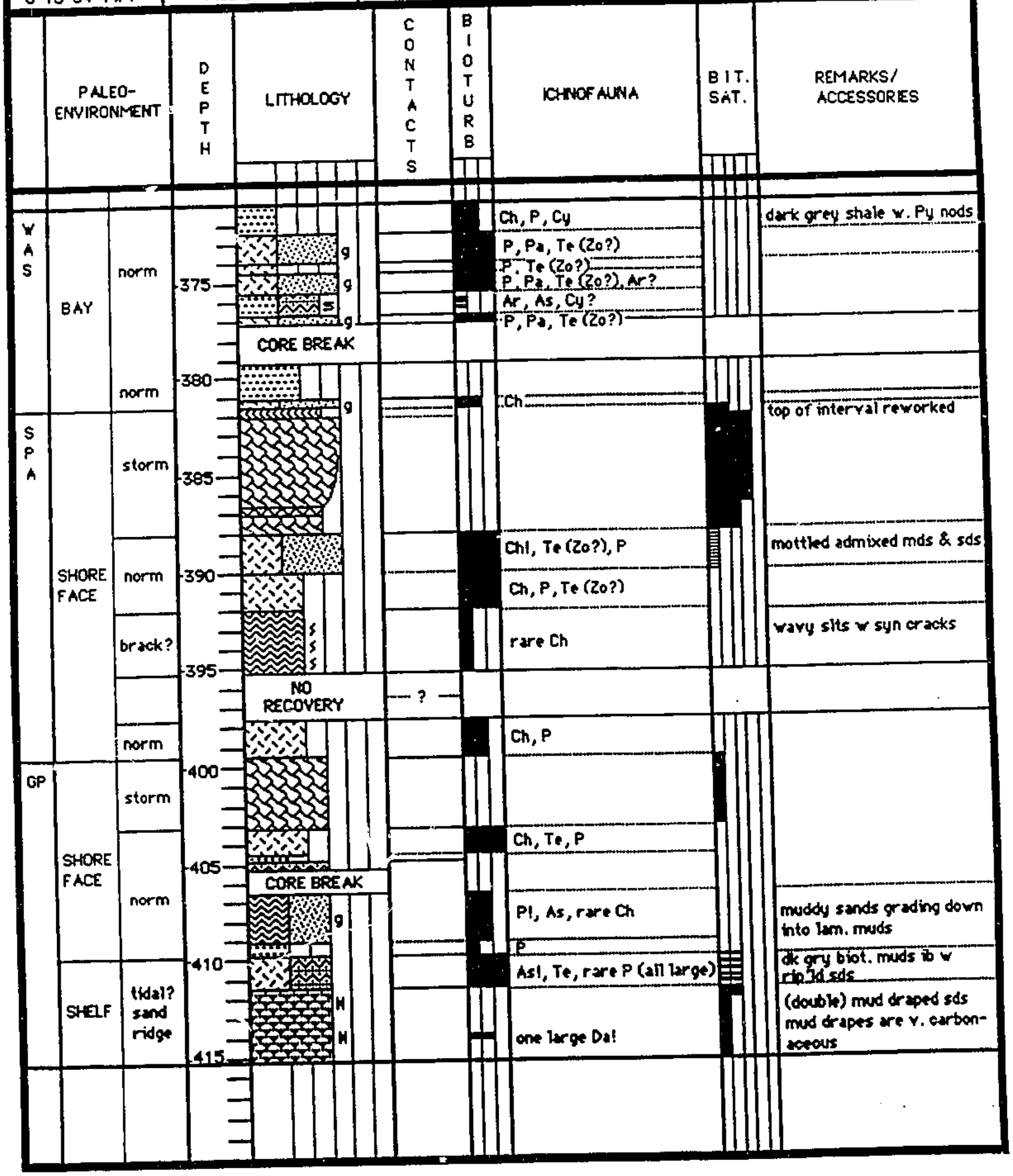
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-13-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	316.0-415.0 m	592.0 m	1 OF 2



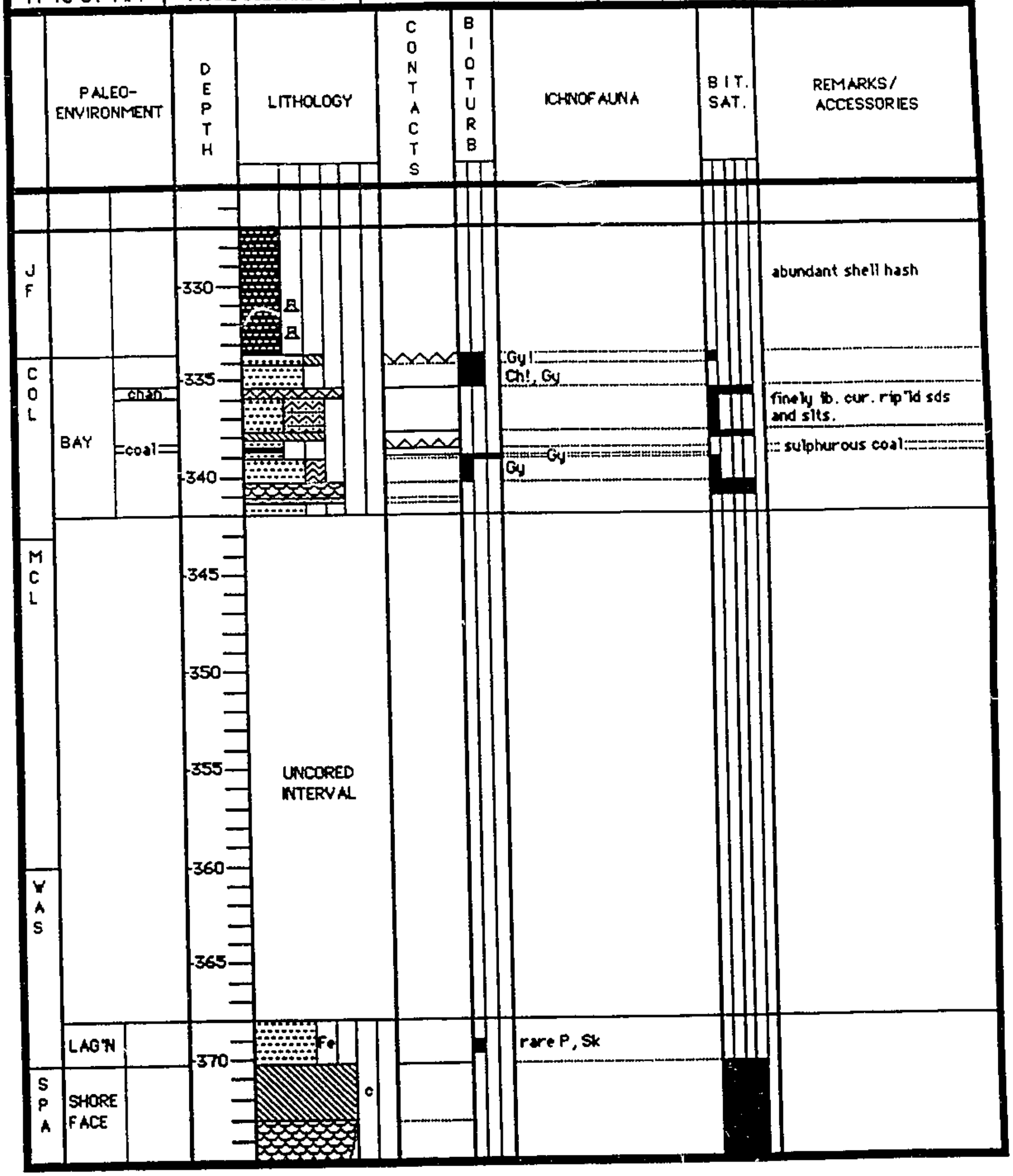
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-13-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	316.0-415.0 m	592.0 m	2 OF 2



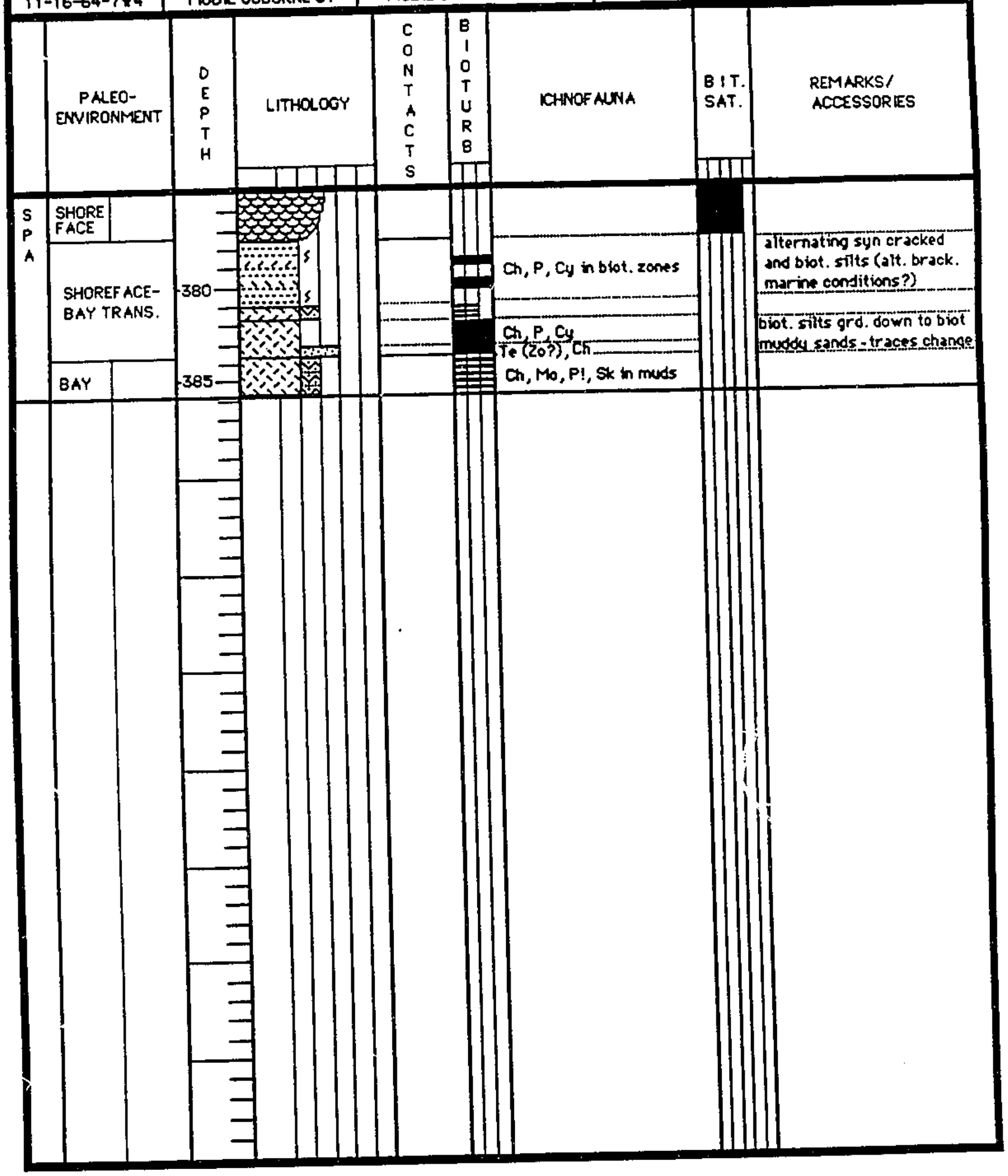
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-15-64-7W4	MOBIL SUGDEN	MOBIL OIL CANADA LTD.	371.0–415.25 m	590.5 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-16-64-7W4	MOBIL OSBORNE OV	MOBIL OIL CANADA LTD.	327.0-385.7 m	586.9 m	1 OF 2



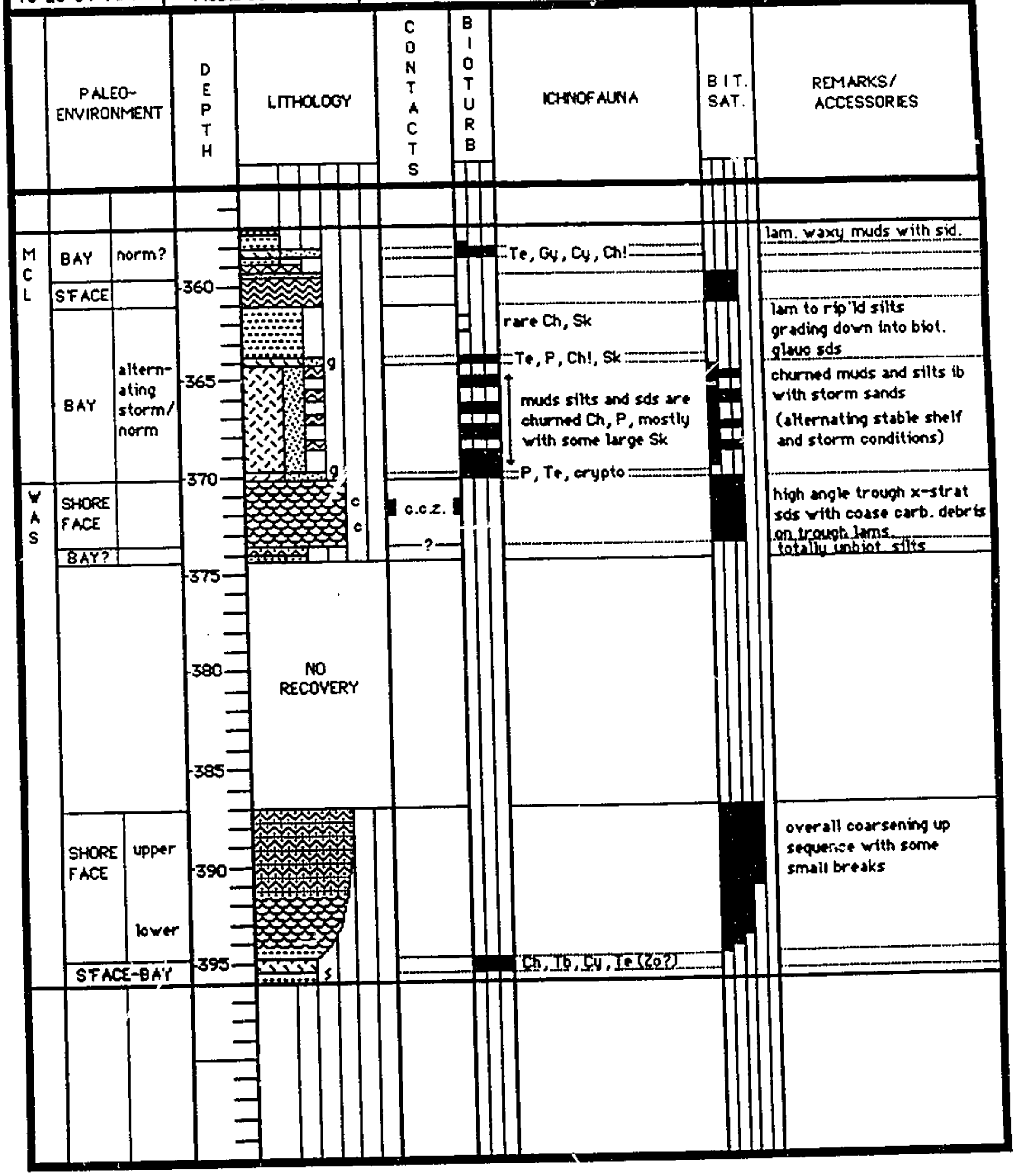
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-16-64-7W4	MOBIL OSBORNE OV	MOBIL OIL CANADA LTD.	327.0-385.7 m	586.9 m	2 OF 2



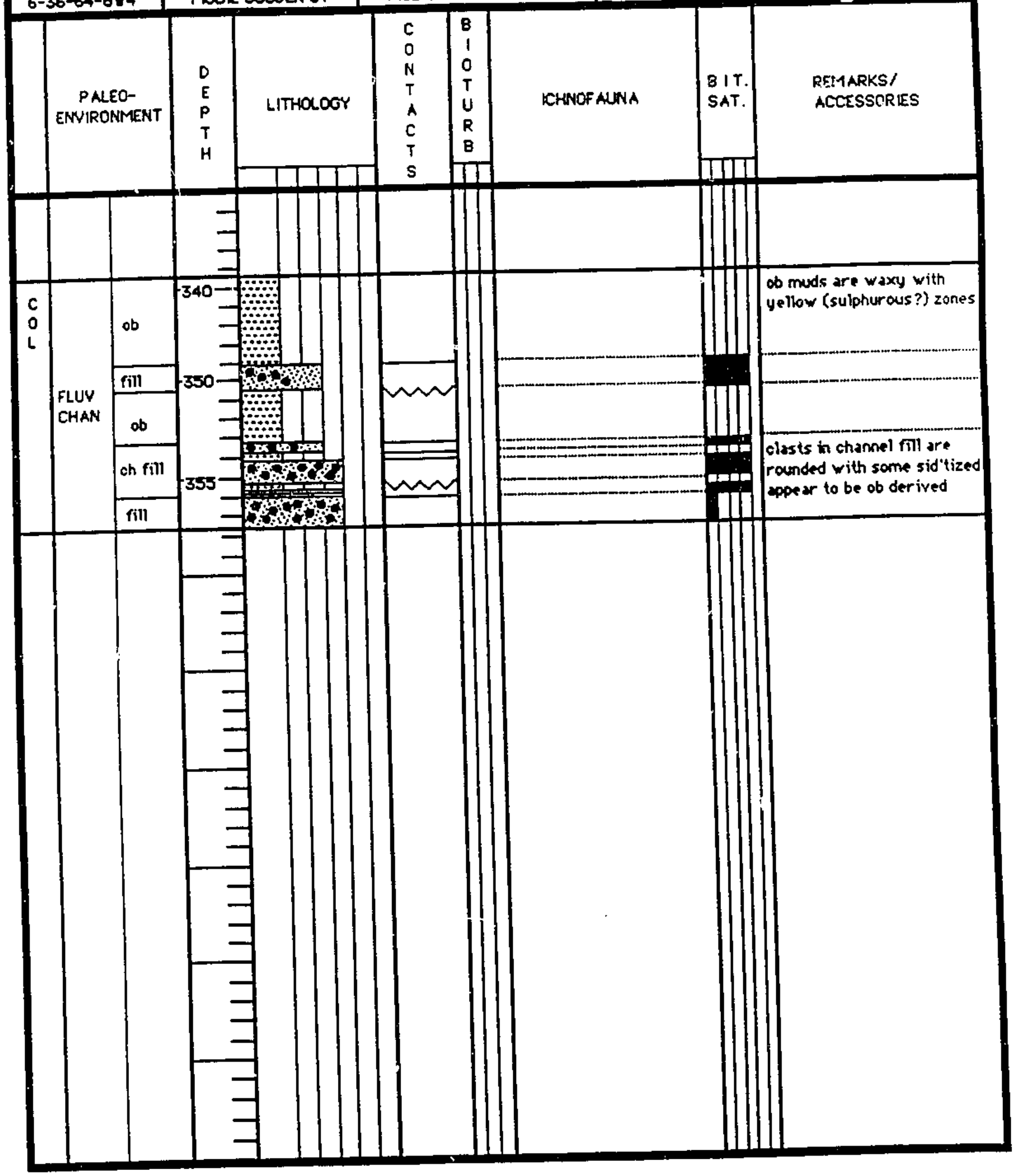
alternating syn cracked and biot. silts (alt. brack. marine conditions?)

biot. silts grd. down to biot muddy sands - traces change

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-28-64-7W4	MOBIL SUGDEN OV	MOBIL OIL CANADA LTD.	357.0-396.0 m	608.6 m	1 OF 1



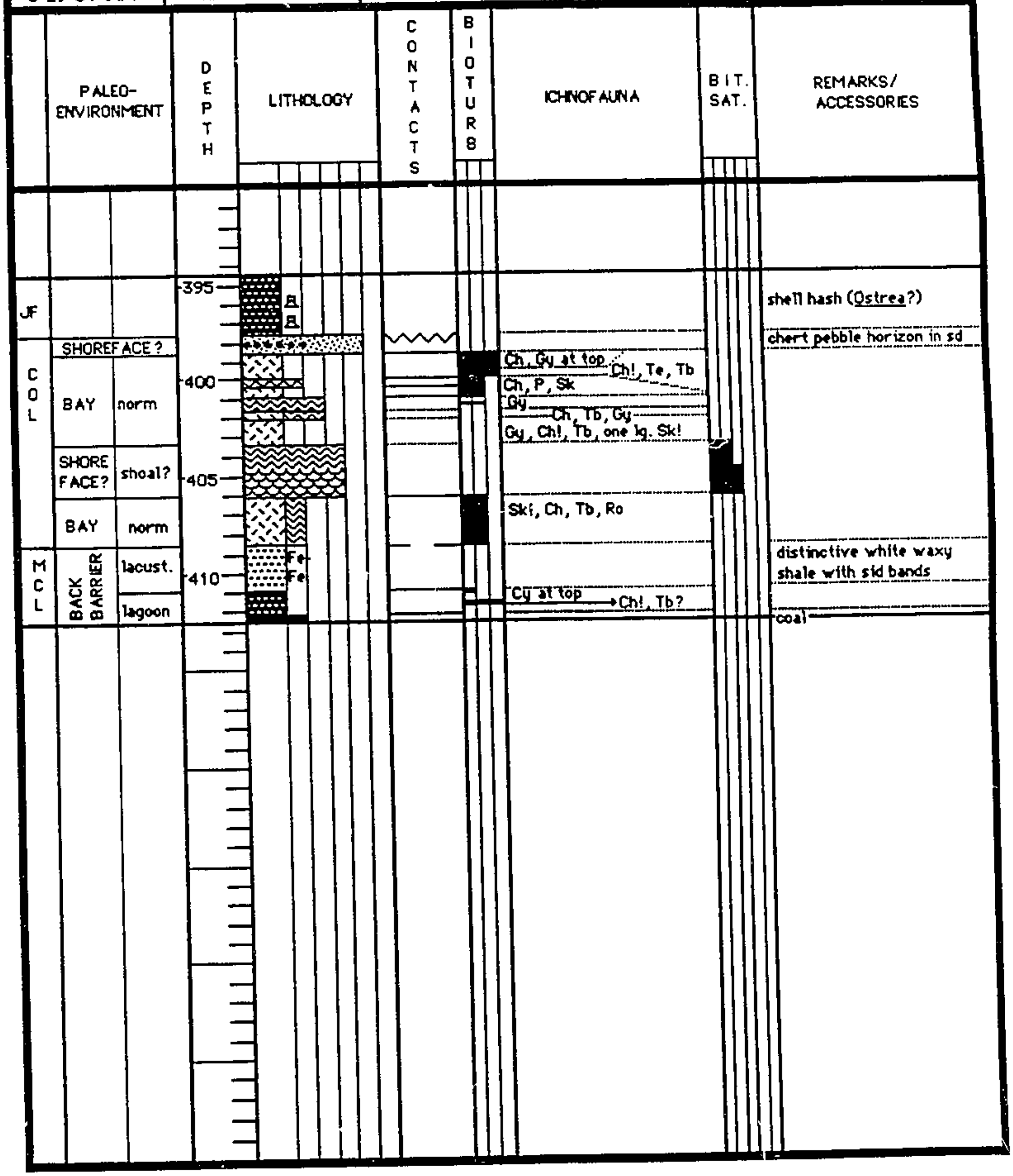
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-36-64-8W4	MOBIL SUGDEN OV	MOBIL OIL CANADA LTD.	339.5-357.5 m	603.4 m	1 OF 1



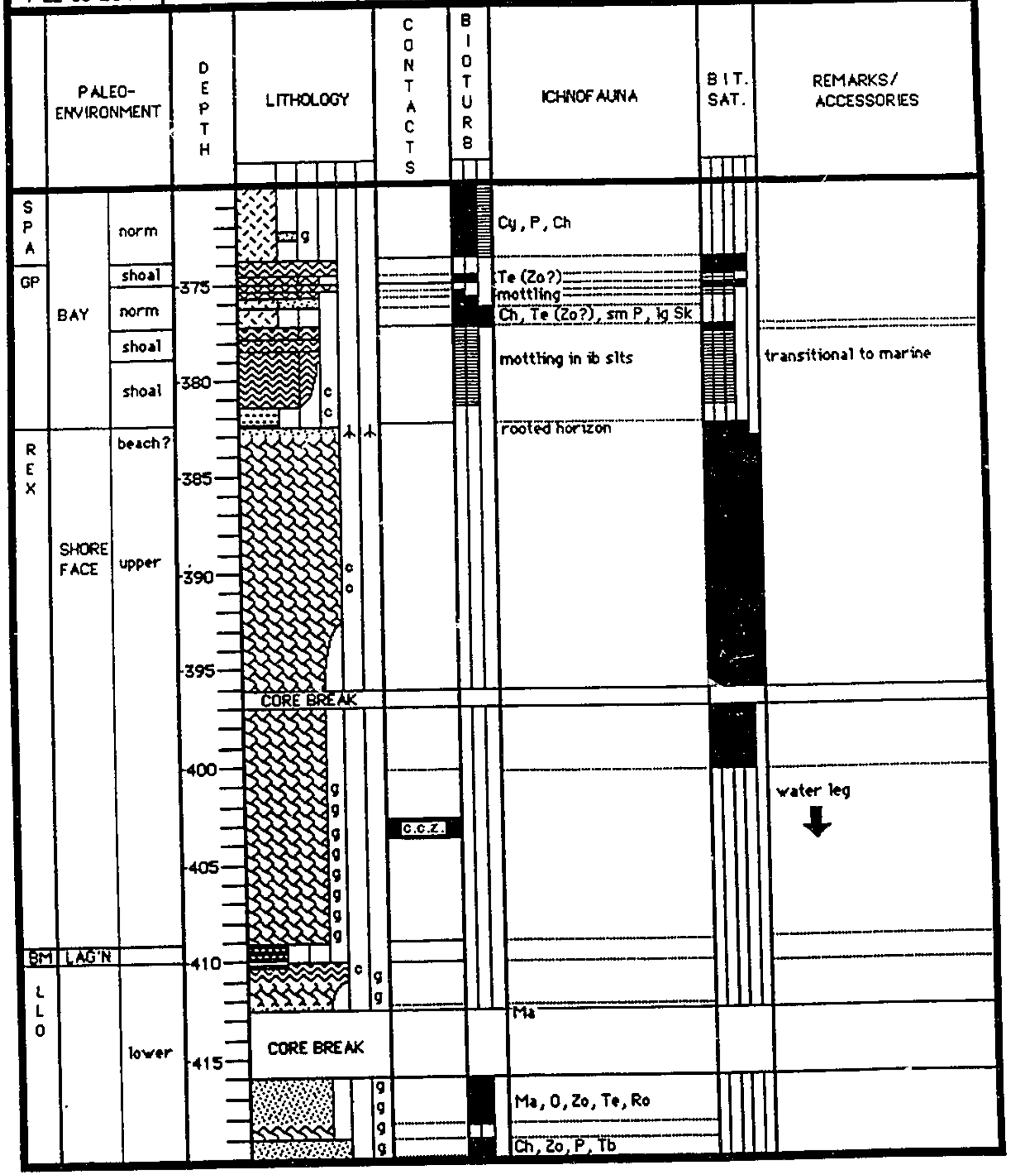
ob muds are waxy with yellow (sulphurous?) zones

clasts in channel fill are rounded with some sid'tized appear to be ob derived

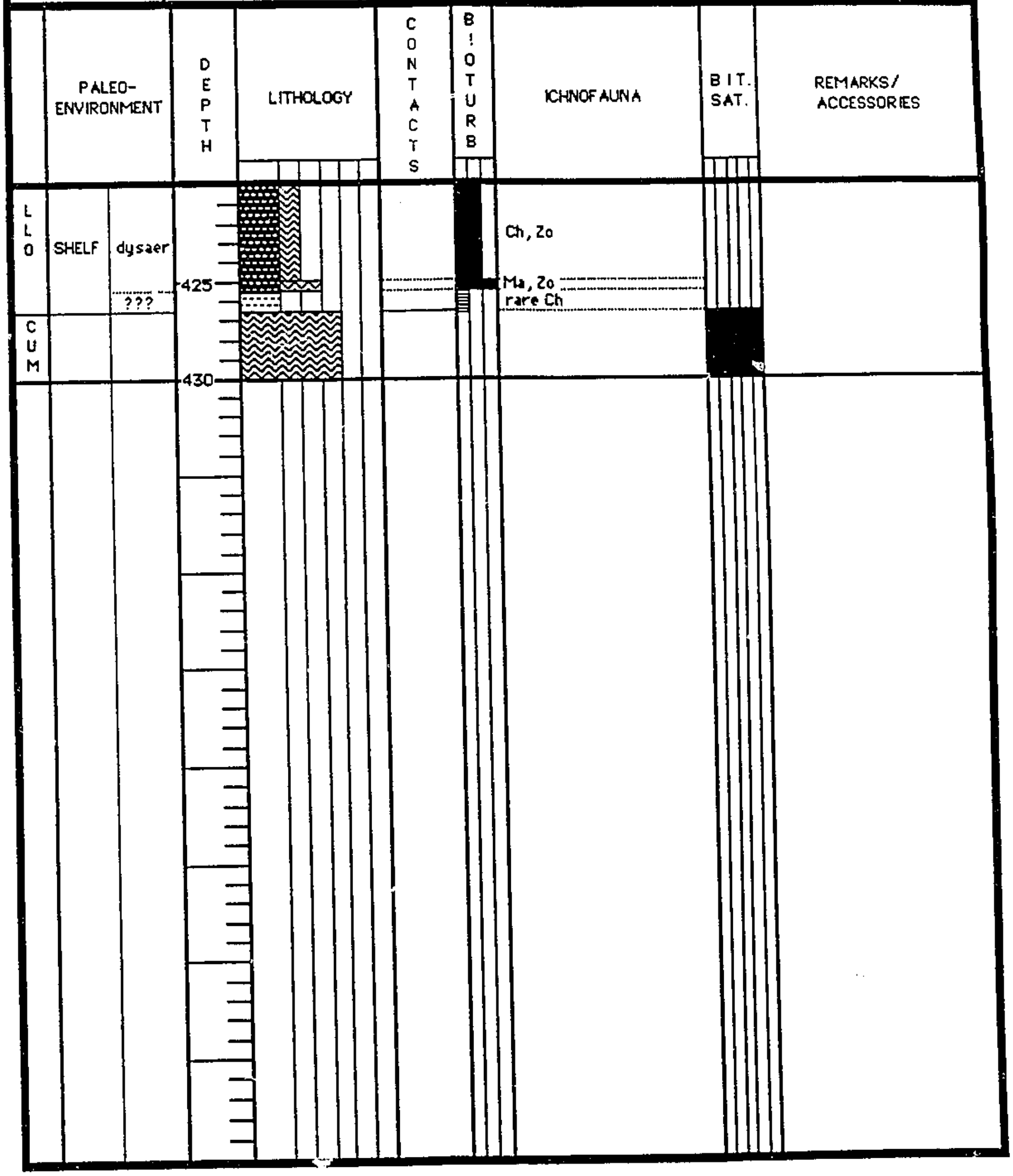
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-29-64-9W4	AMOCO SUGDEN	AMOCO PETROLEUM LTD.	394.5-412.5 m	655.2 m	1 OF 1



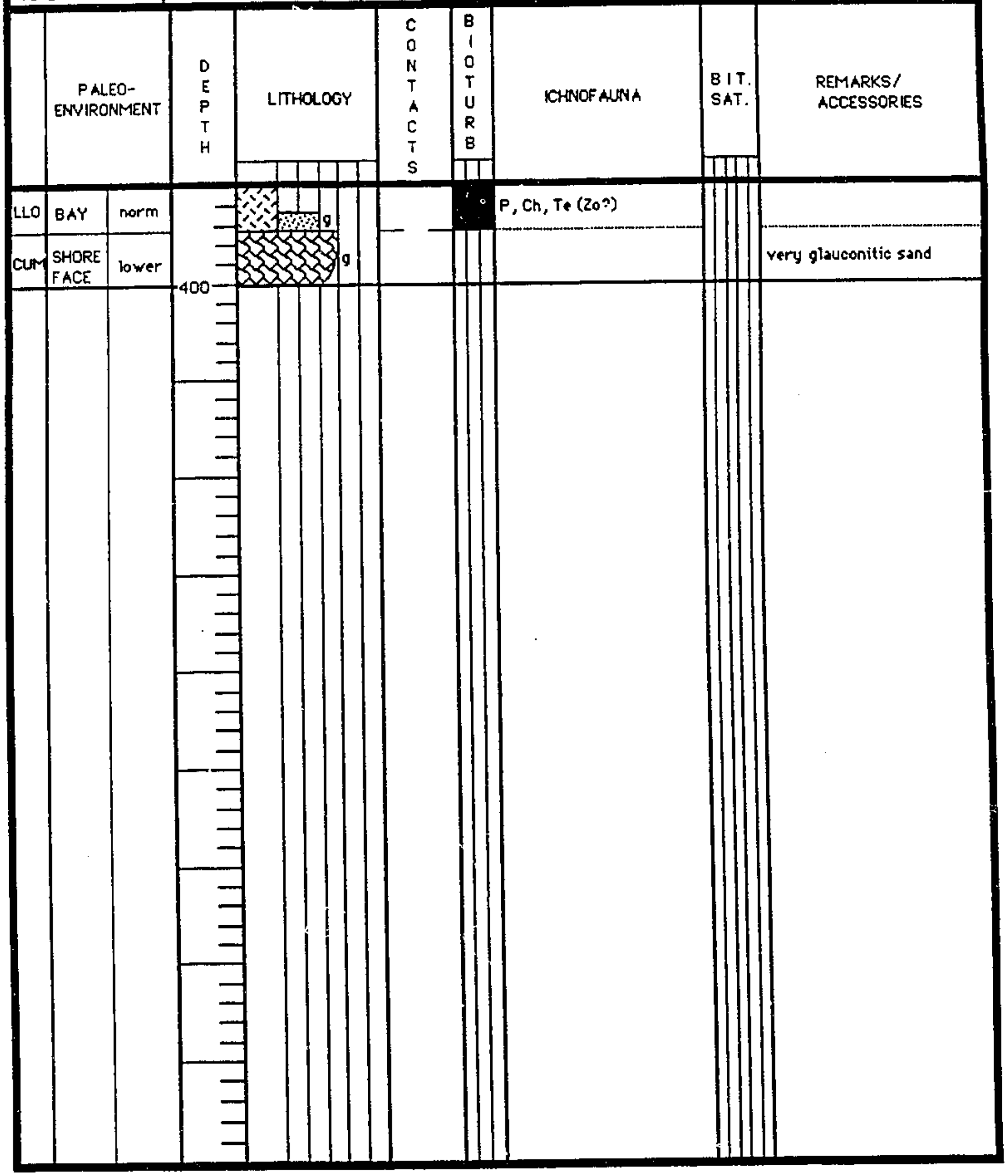
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-22-65-2W4	ESSO 87 MARIE	ESSO CANADA RESOURCES	370.0-425.0 m	601.1 m	1 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-22-65-2W4	ESSO 87 MARIE	ESSO CANADA RESOURCES	370.0–430.0 m	601.1 m	2 OF 2

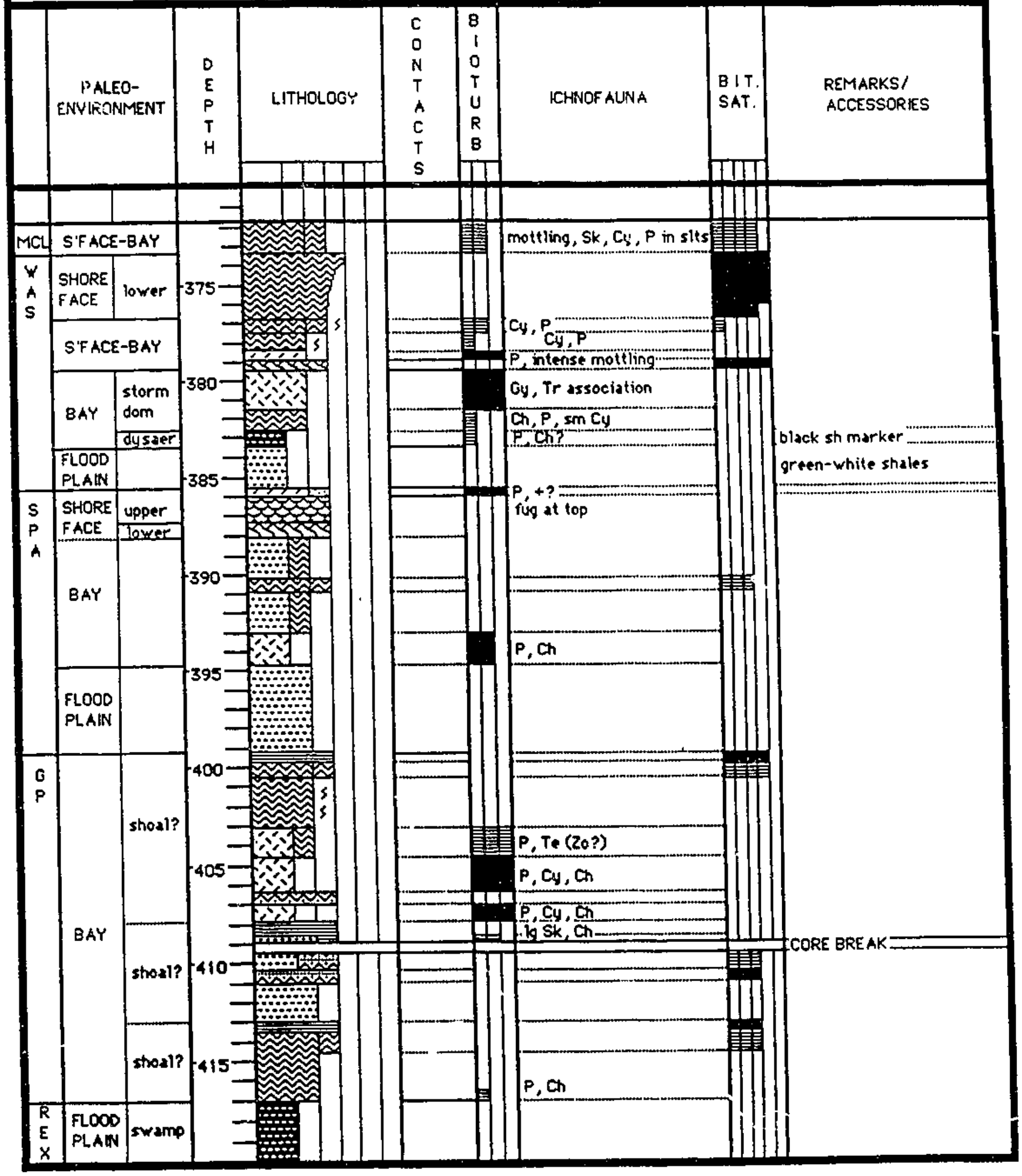


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-23-65-2W4	ESSO 86 COLD LAKE	ESSO CANADA RESOURCES	395.0-400.0 m	580.3 m	1 OF 1

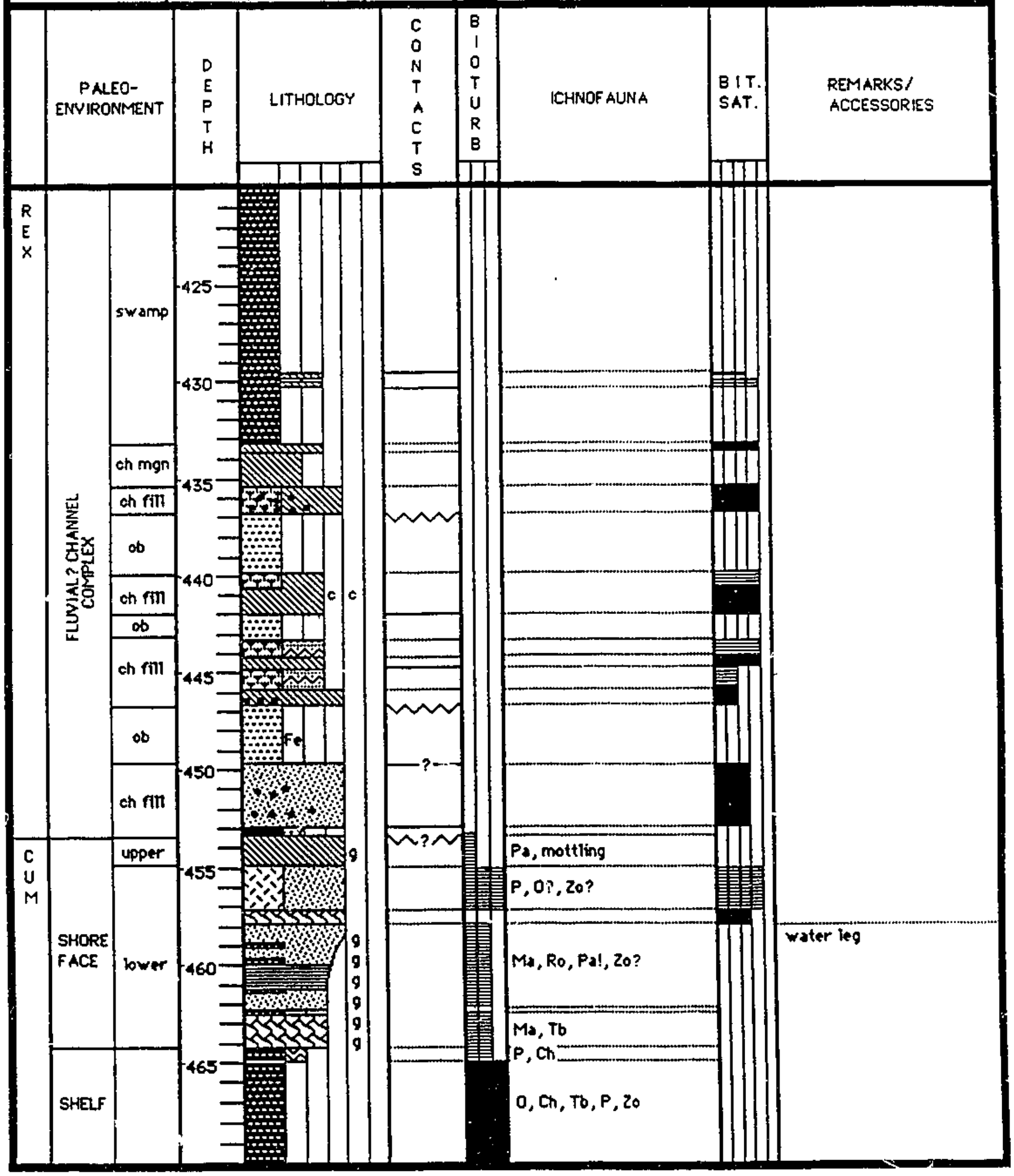


	PALEO-ENVIRONMENT		DEPTH	LITHOLOGY	CONTACTS	BIOTURB	ICHNOFAUNA	BIT. SAT.	REMARKS/ ACCESSORIES
LLO	BAY	norm		g			P, Ch, Te (Zo?)		
CUM	SHORE FACE	lower	400	g					very glauconitic sand

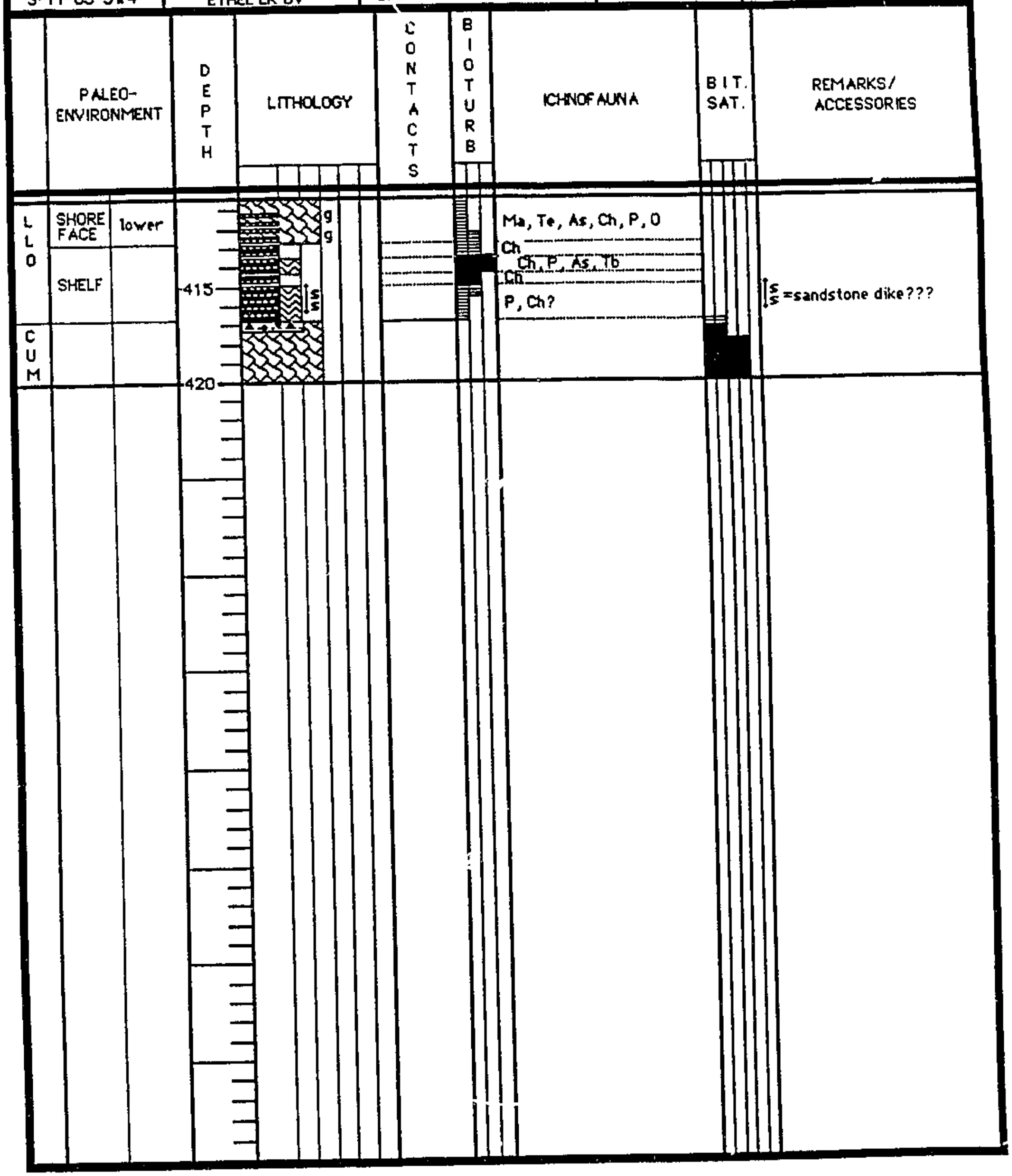
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-8-65-3W4	ESSO 84 ROB 5 LEM COLD EX	ESSO RESOURCES CANADA	373.0-470.0 m	606.0 m	1 OF 2



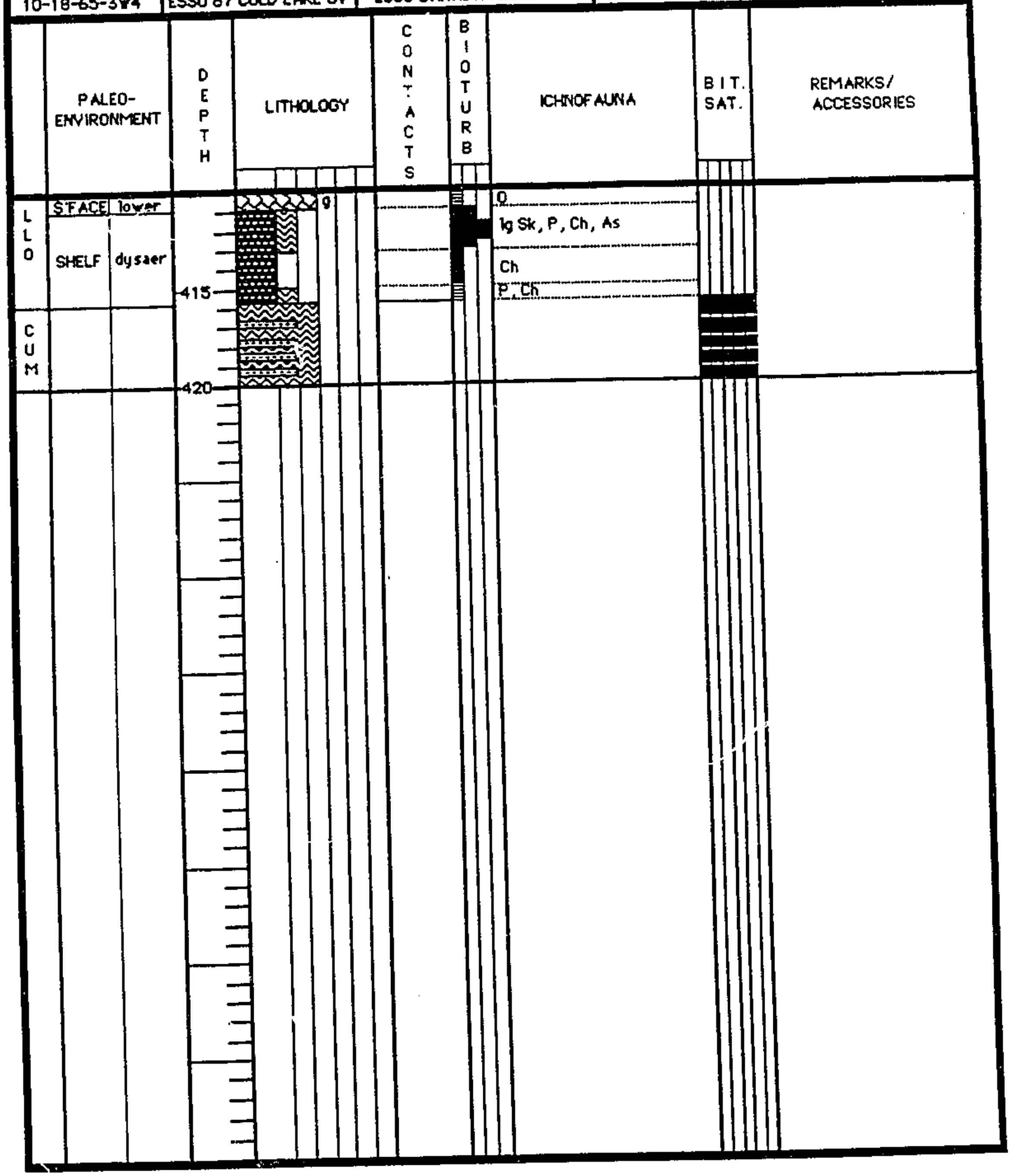
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-8-65-3W4	ESSO 84 ROB 5 LEM COLD EX	ESSO RESOURCES CANADA	373.0–470.0 m	606.0 m	2 OF 2



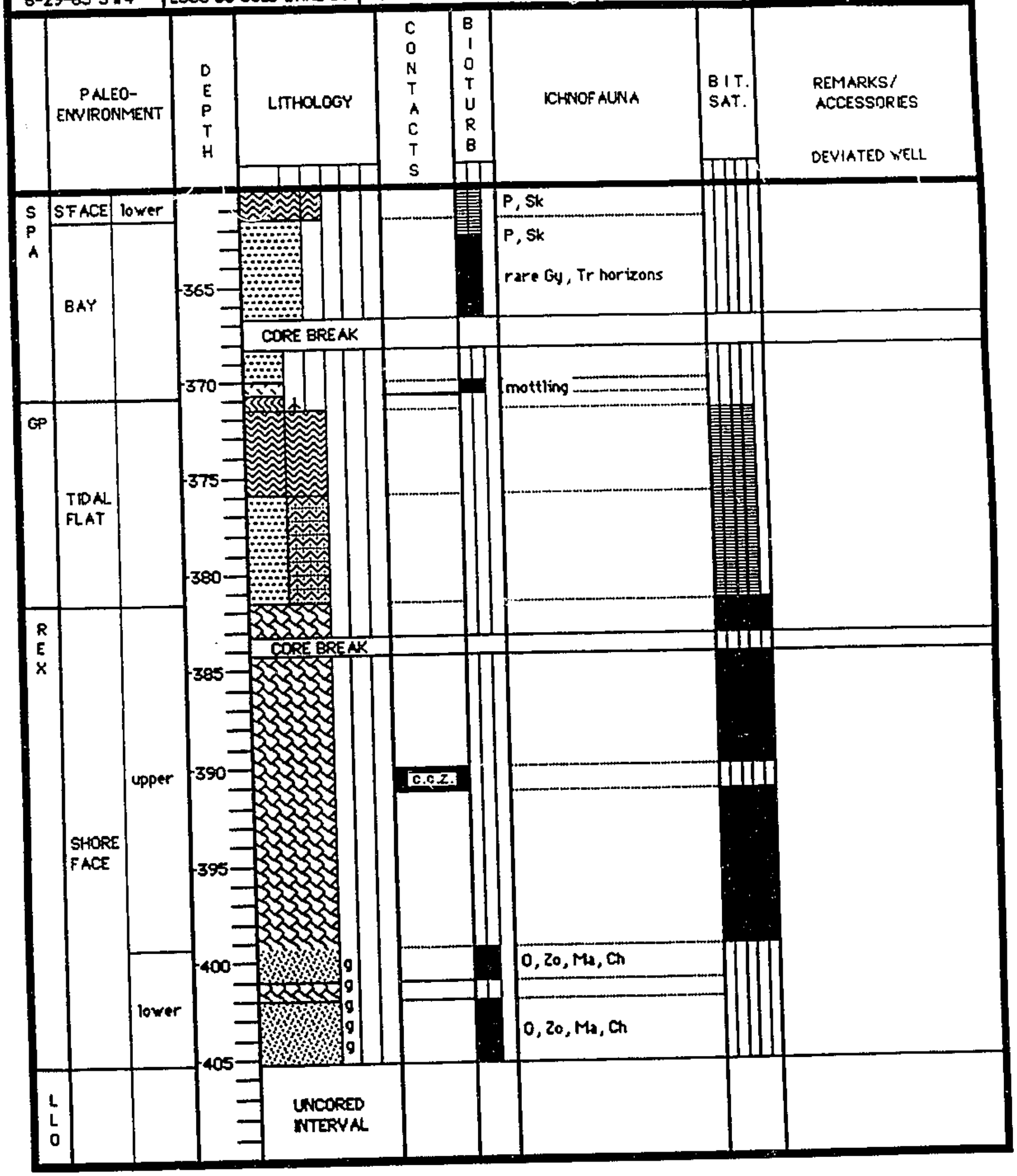
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-17-65-3W4	ESSO 84-01 ETHEL LK OV	ESSO CANADA RESOURCES	410.5-420.0 m	602.2 m	1 OF 1



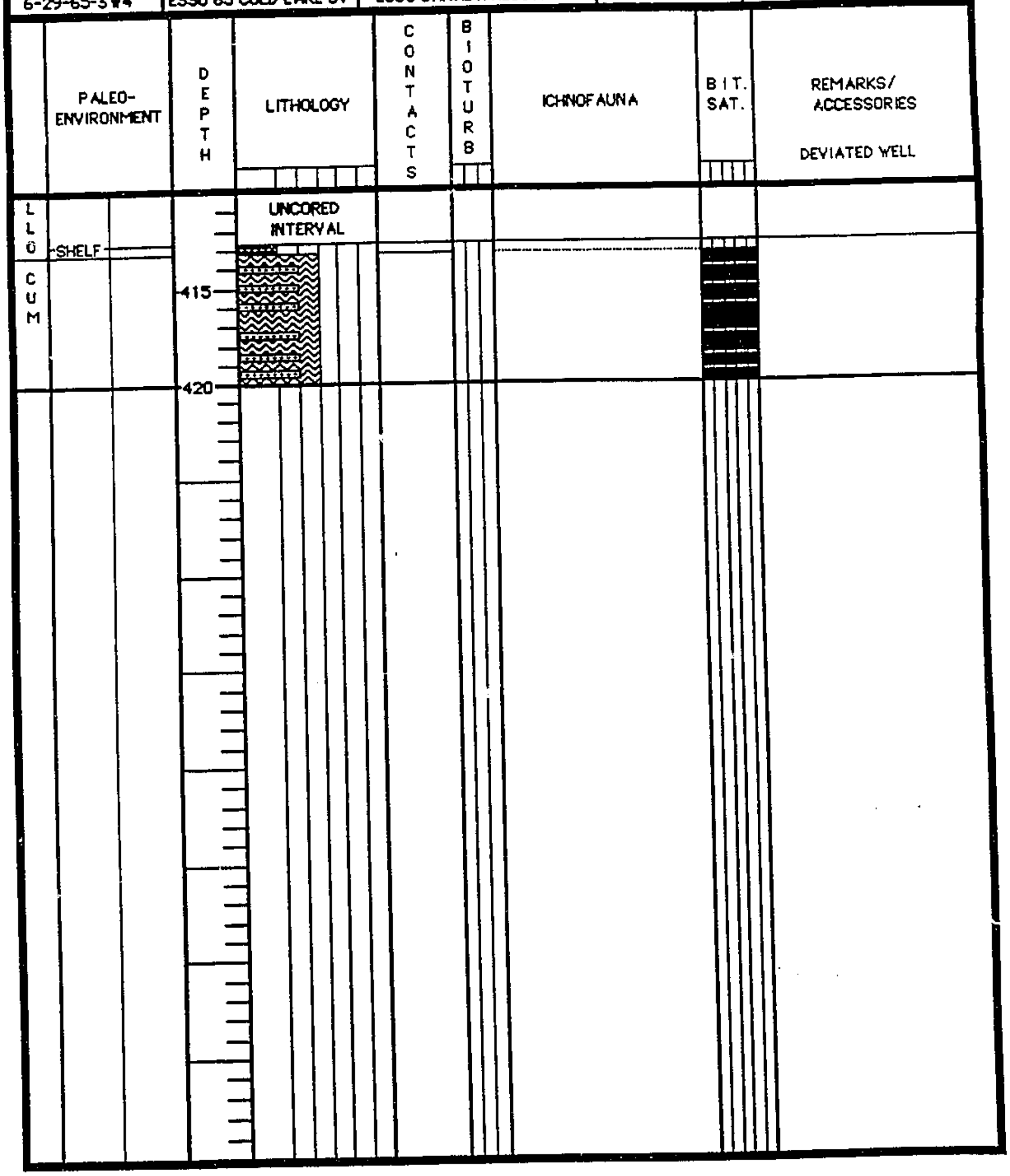
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-18-65-3W4	ESSO 87 COLD LAKE OV	ESSO CANADA RESOURCES	410.0-420.0 m	602.4 m	1 OF 1



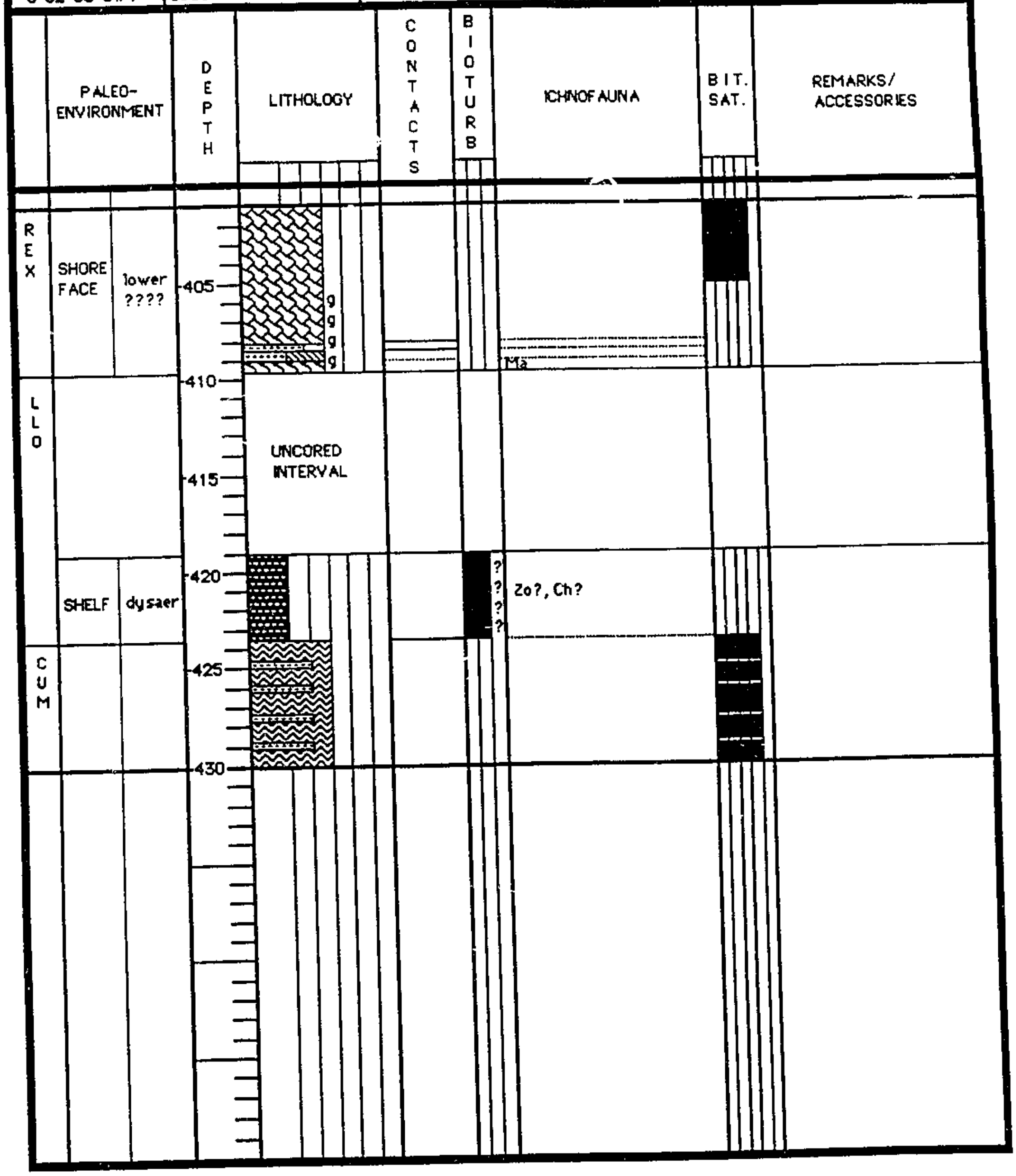
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-29-65-3W4	ESSO 85 COLD LAKE OV	ESSO CANADA RESOURCES	362.22-420.0 m	609.3 m	1 OF 2



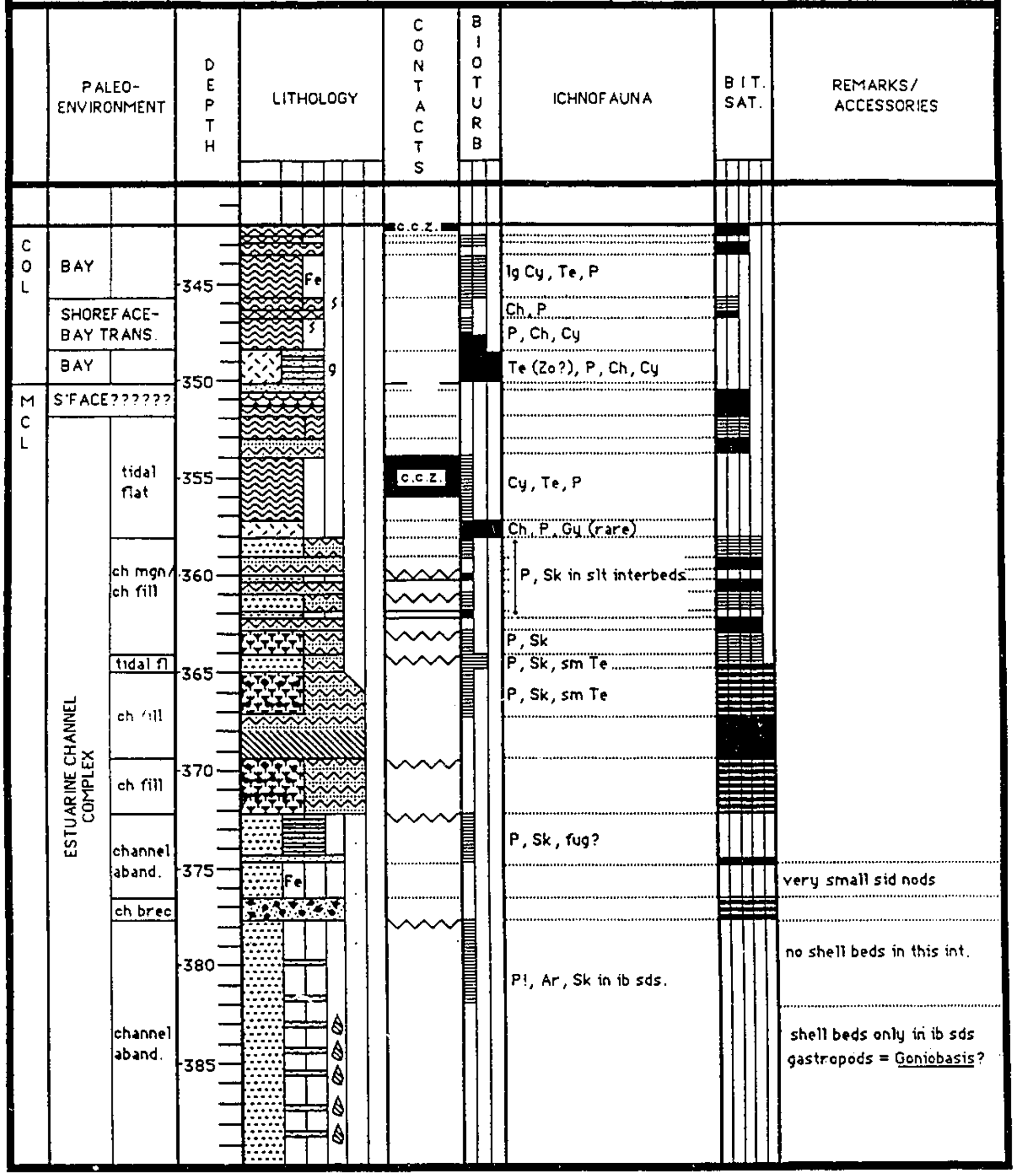
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-29-65-3W4	ESSO 85 COLD LAKE OV	ESSO CANADA RESOURCES	362.22-420.0 m	609.3 m	2 OF 2



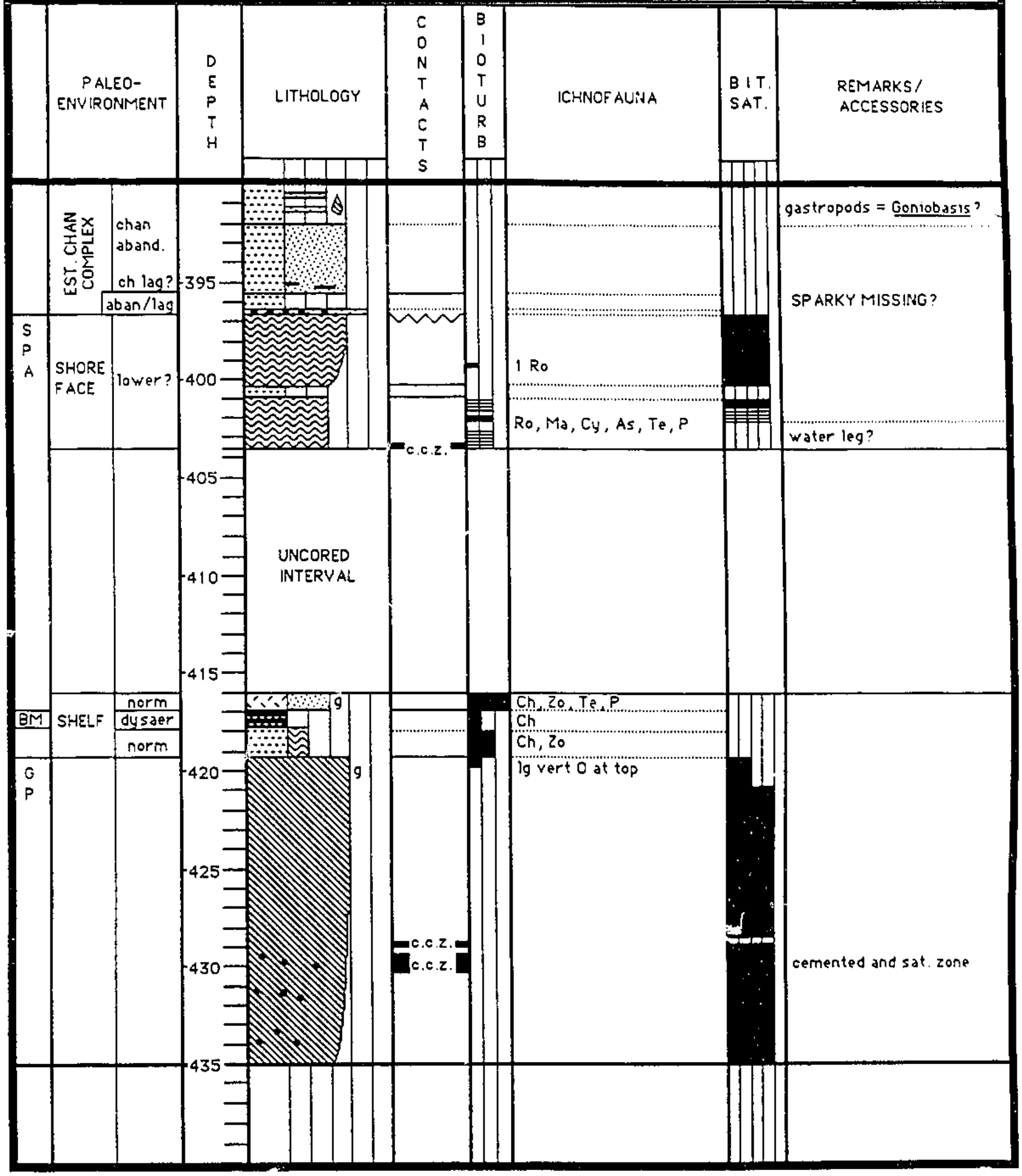
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-32-65-3W4	ESSO 85 COLD LAKE OV	ESSO CANADA RESOURCES	401.0-430.0 m	617.5 m	1 OF 1



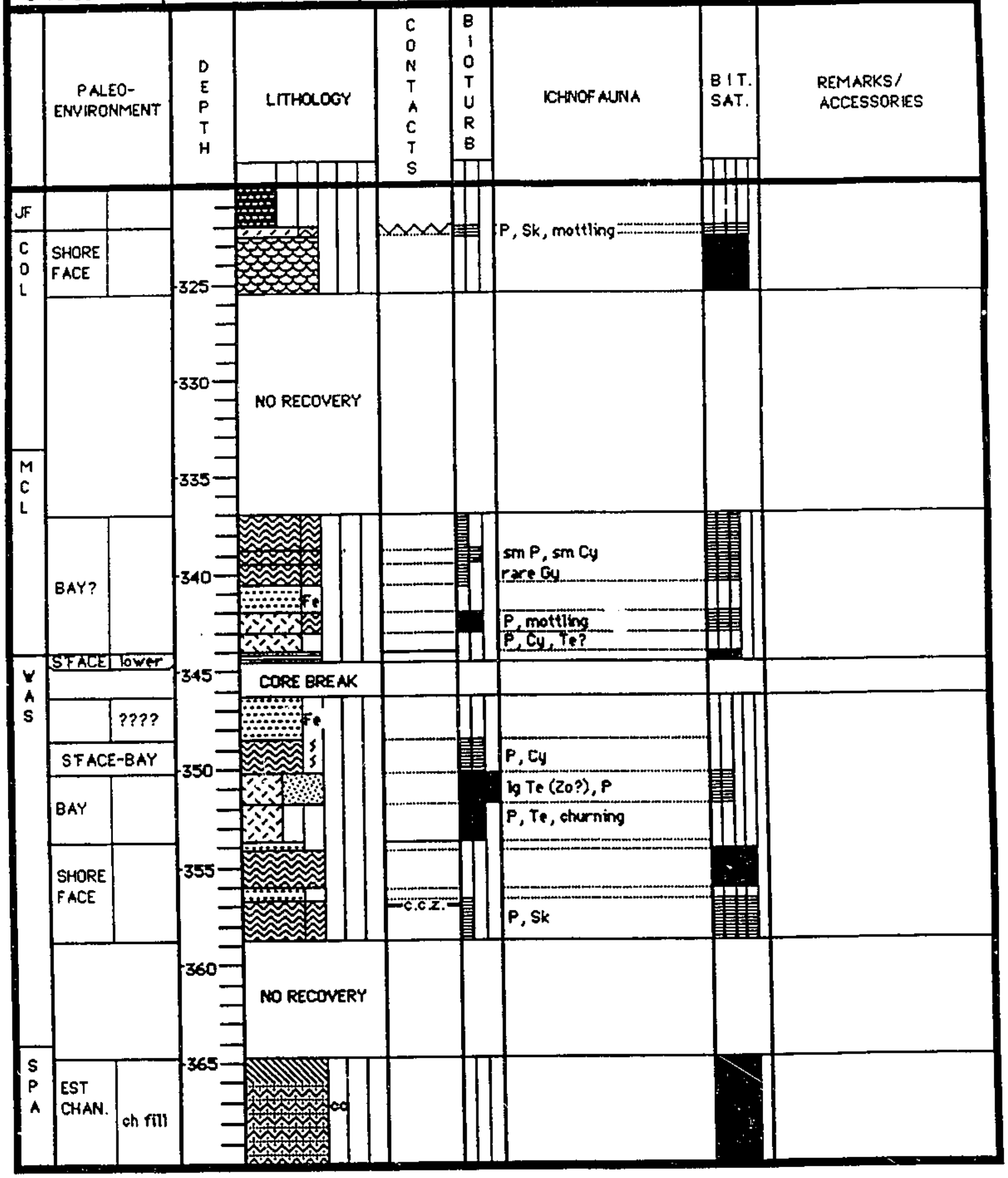
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-1-65-4W4	ESSO 85 D24-13 COLD LAKE 13-1	ESSO CANADA RESOURCES	342.0-435.0 m	601.5 m	1 OF 2



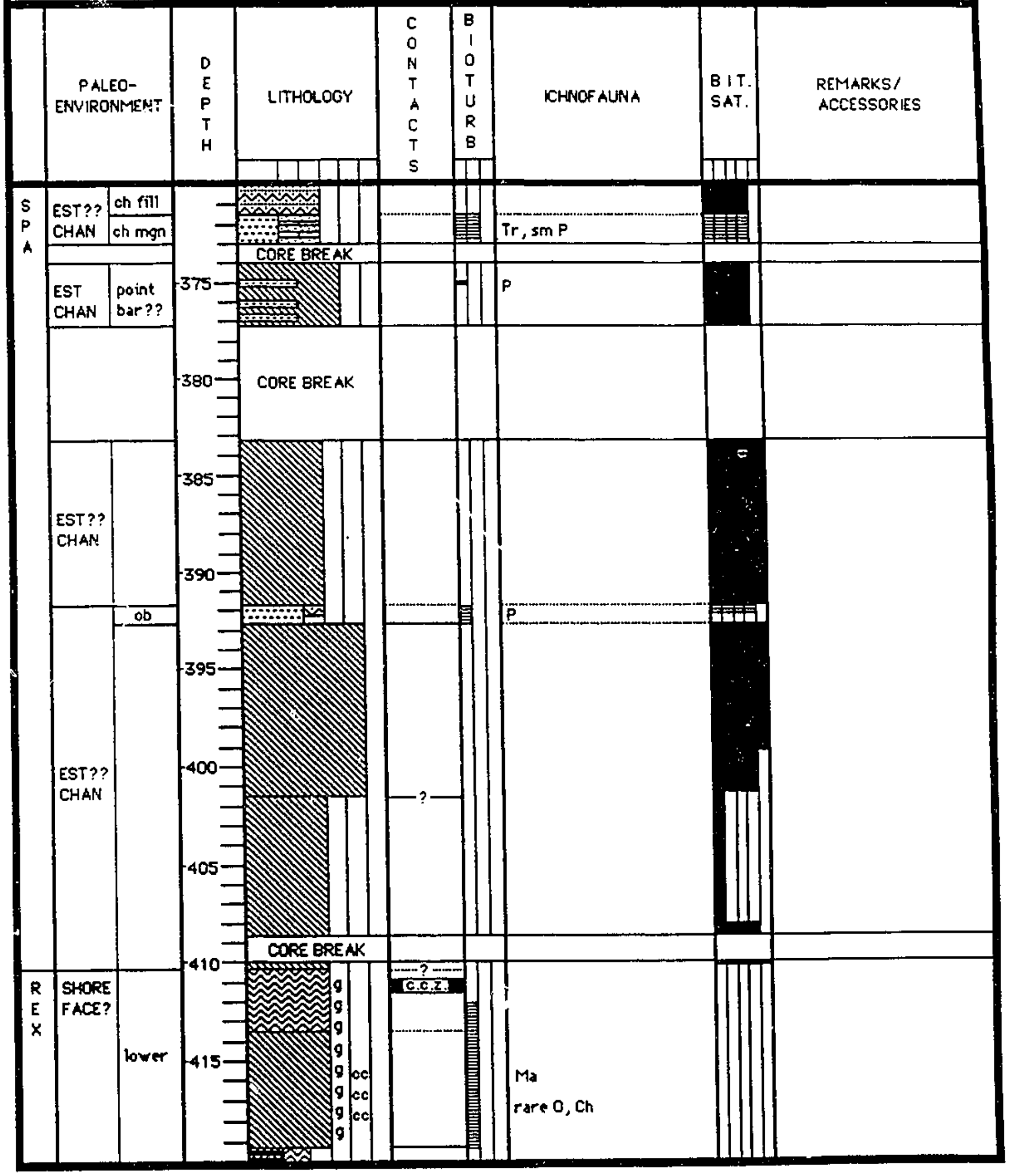
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-1-65-4W4	ESSO 85 D24-13 COLD LAKE 13-1	ESSO CANADA RESOURCES	342.0-435.0 m	601.5 m	2 OF 2



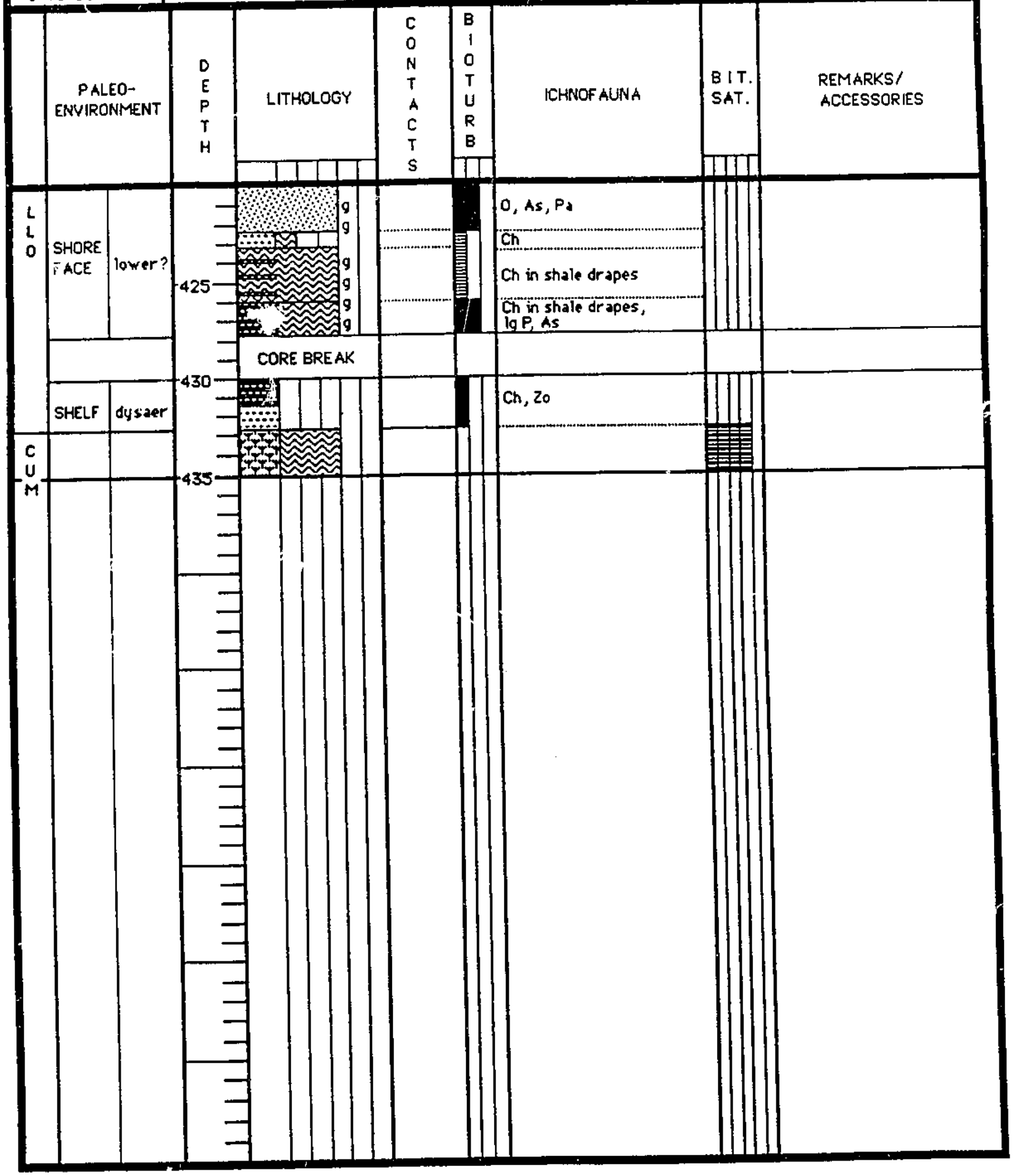
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-10-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	320.0-435.0 m	616.2 m	1 OF 3



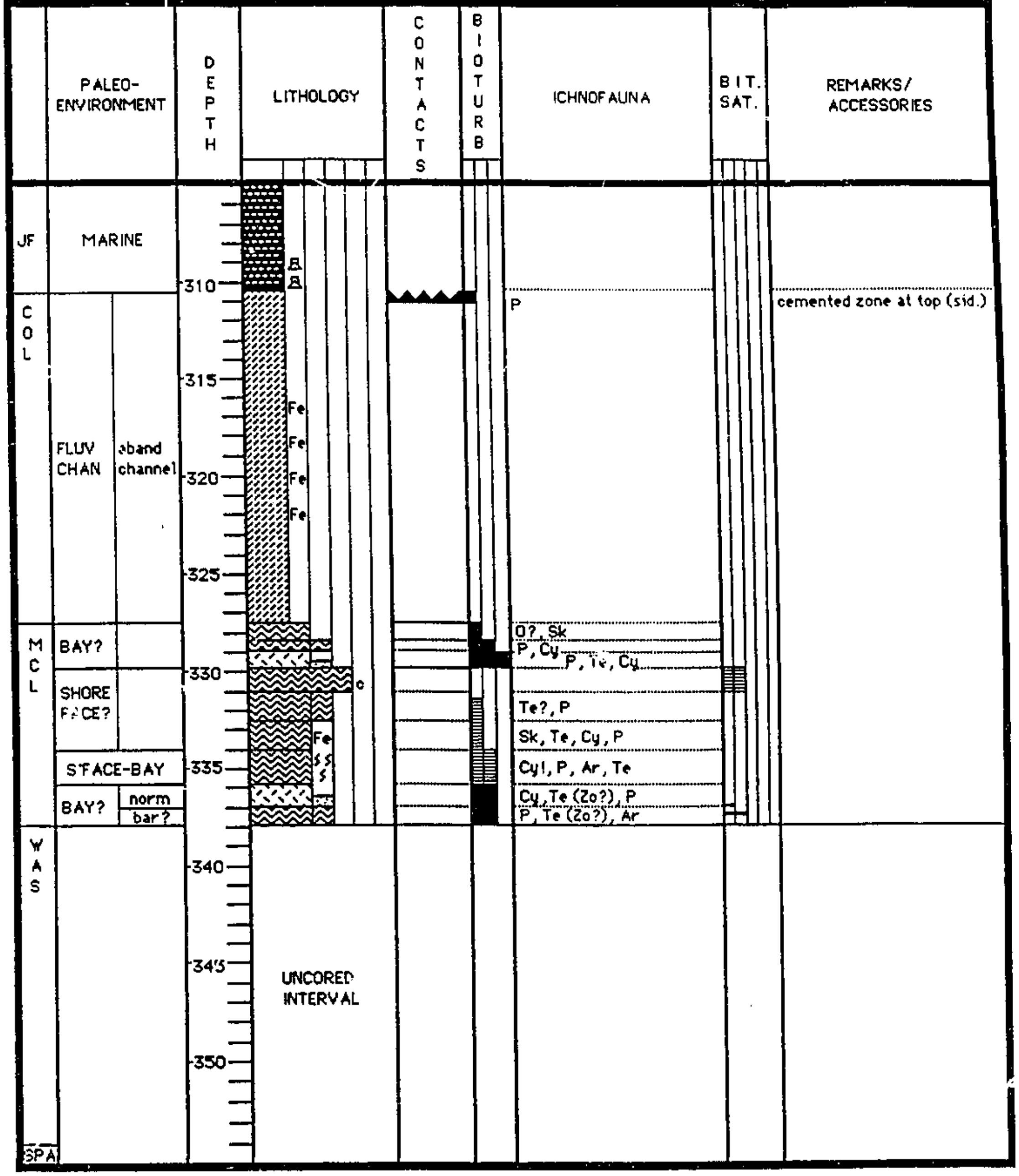
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-10-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	320.0-435.0 m	616.2 m	2 OF 3



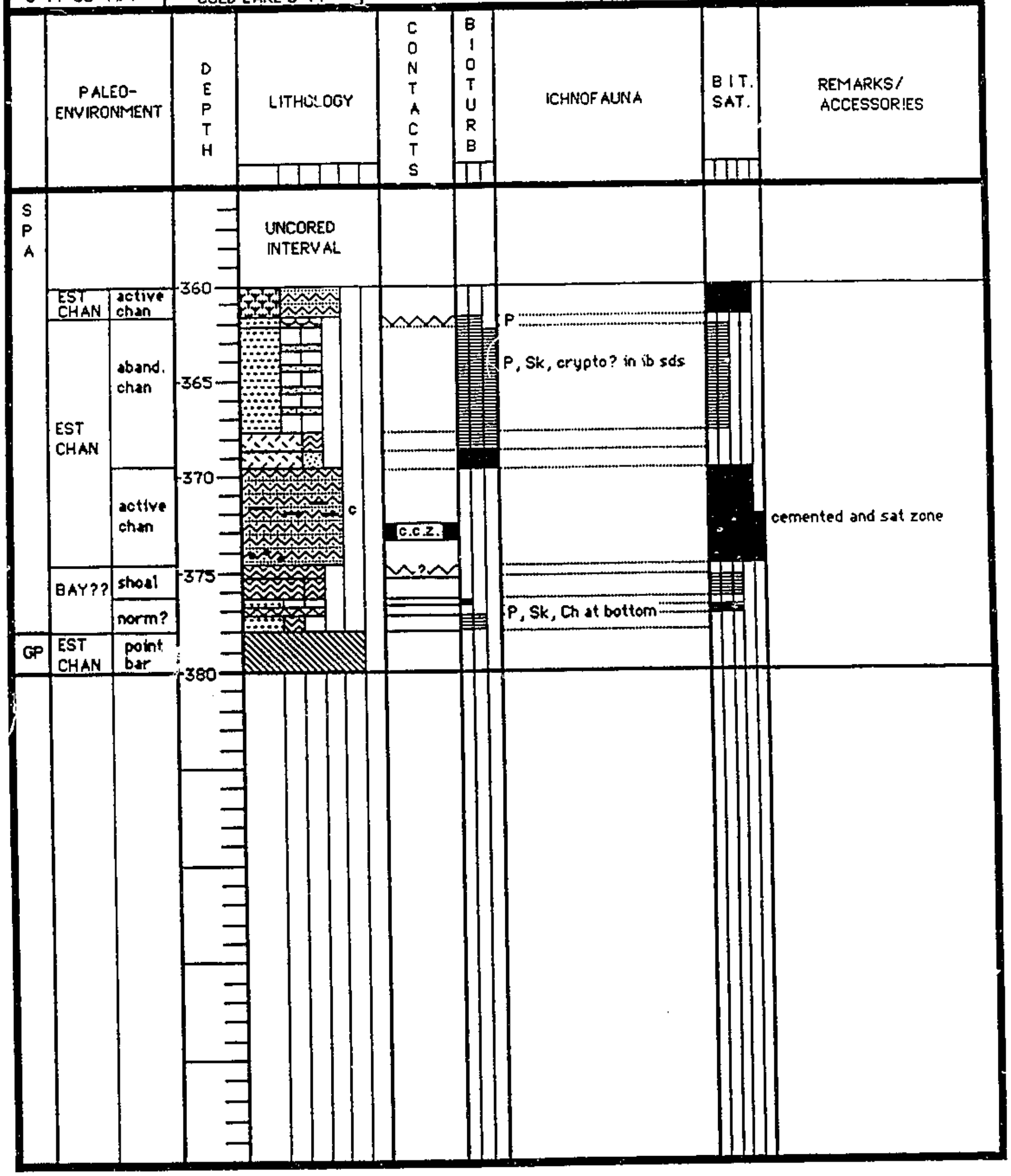
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-10-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	320.0-435.0 m	616.2 m	3 OF 3



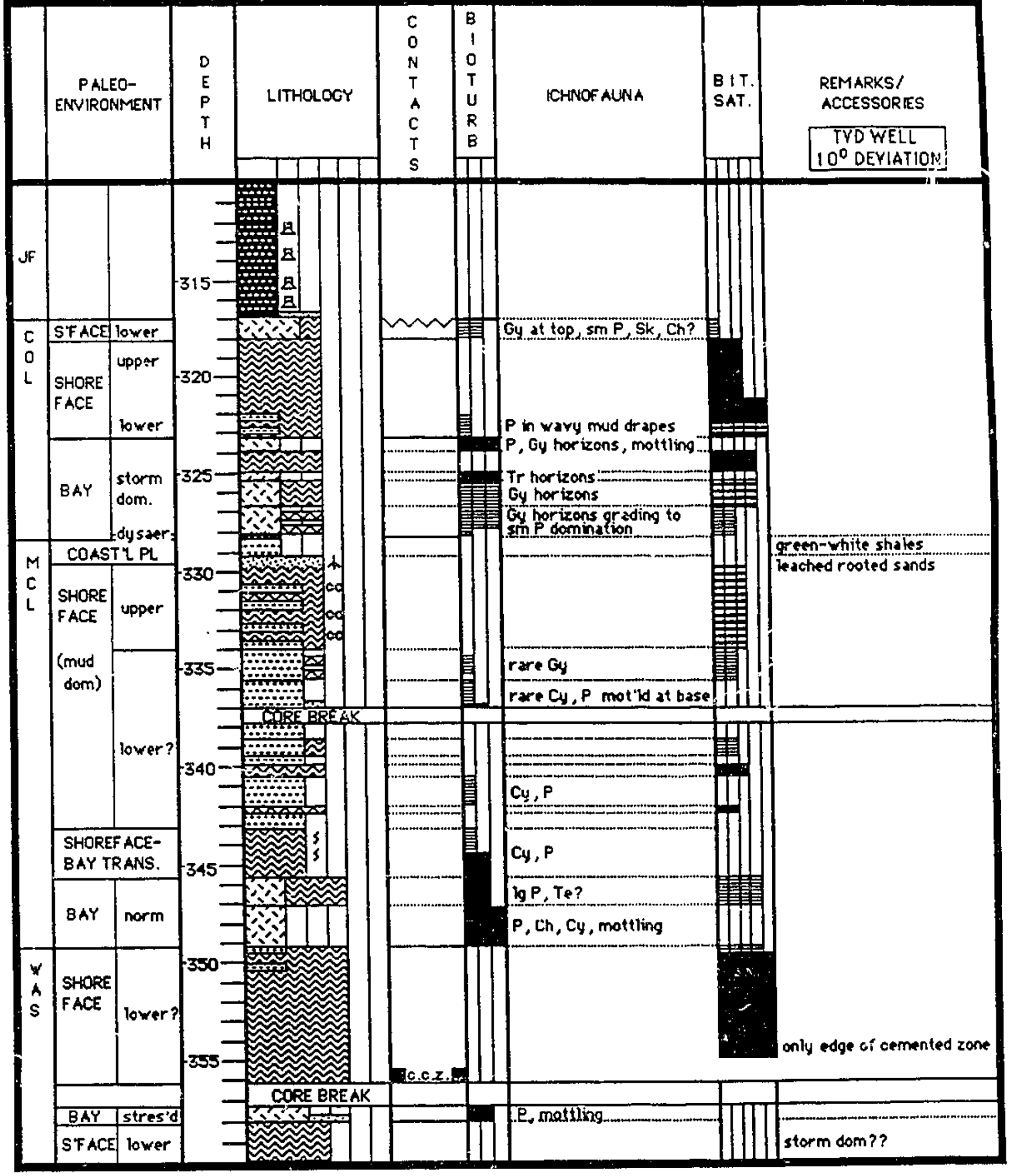
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-11-65-4W4	ESSO 85 D6-13 COLD LAKE 5-11	ESSO CANADA RESOURCES	305.0-380.0 m	600.5 m	1 OF 2



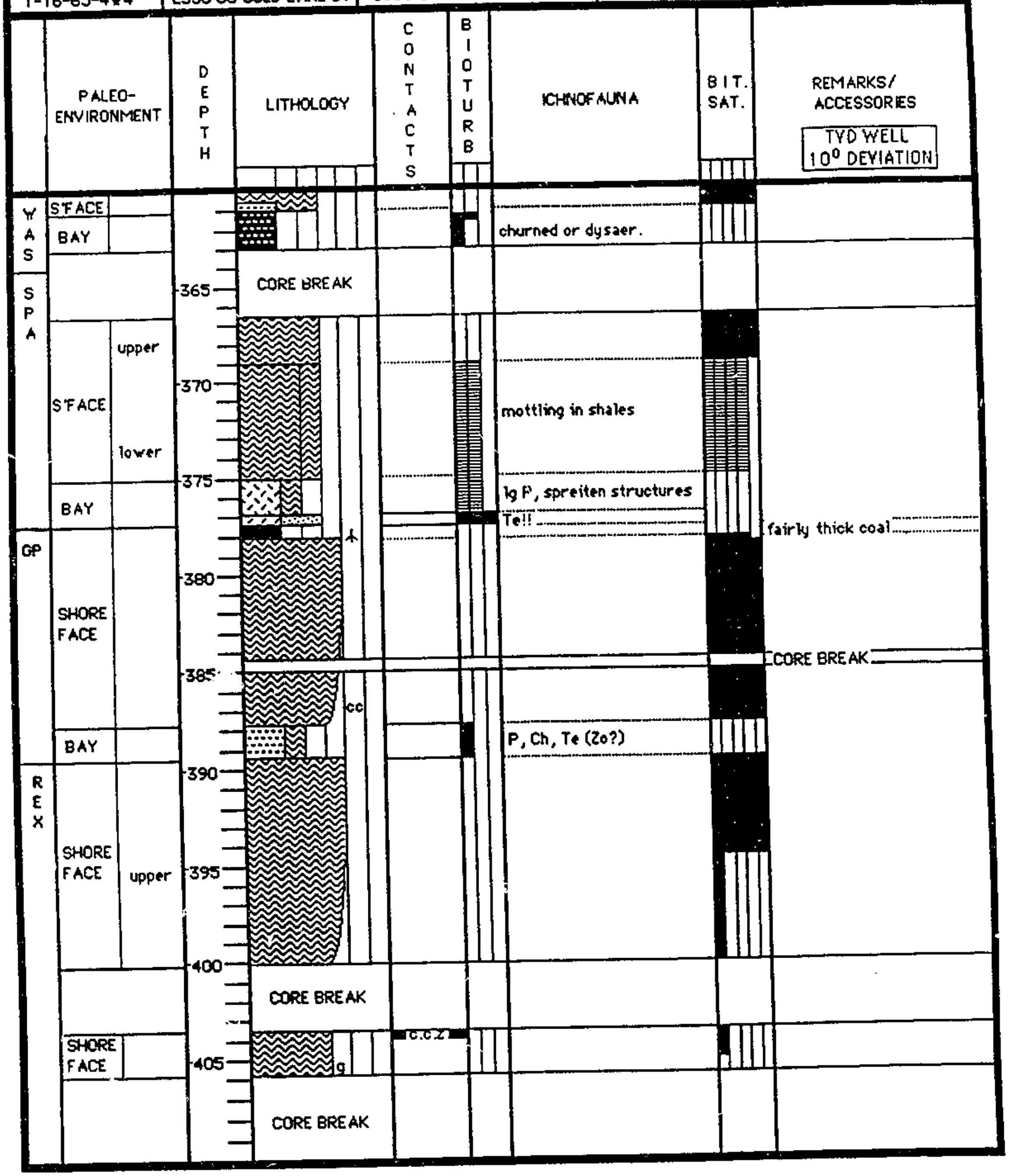
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-11-65-4W4	ESSO a5 D6-13 COLD LAKE 5-11	ESSO CANADA RESOURCES	305.0-380.0 m	600.5 m	2 OF 2



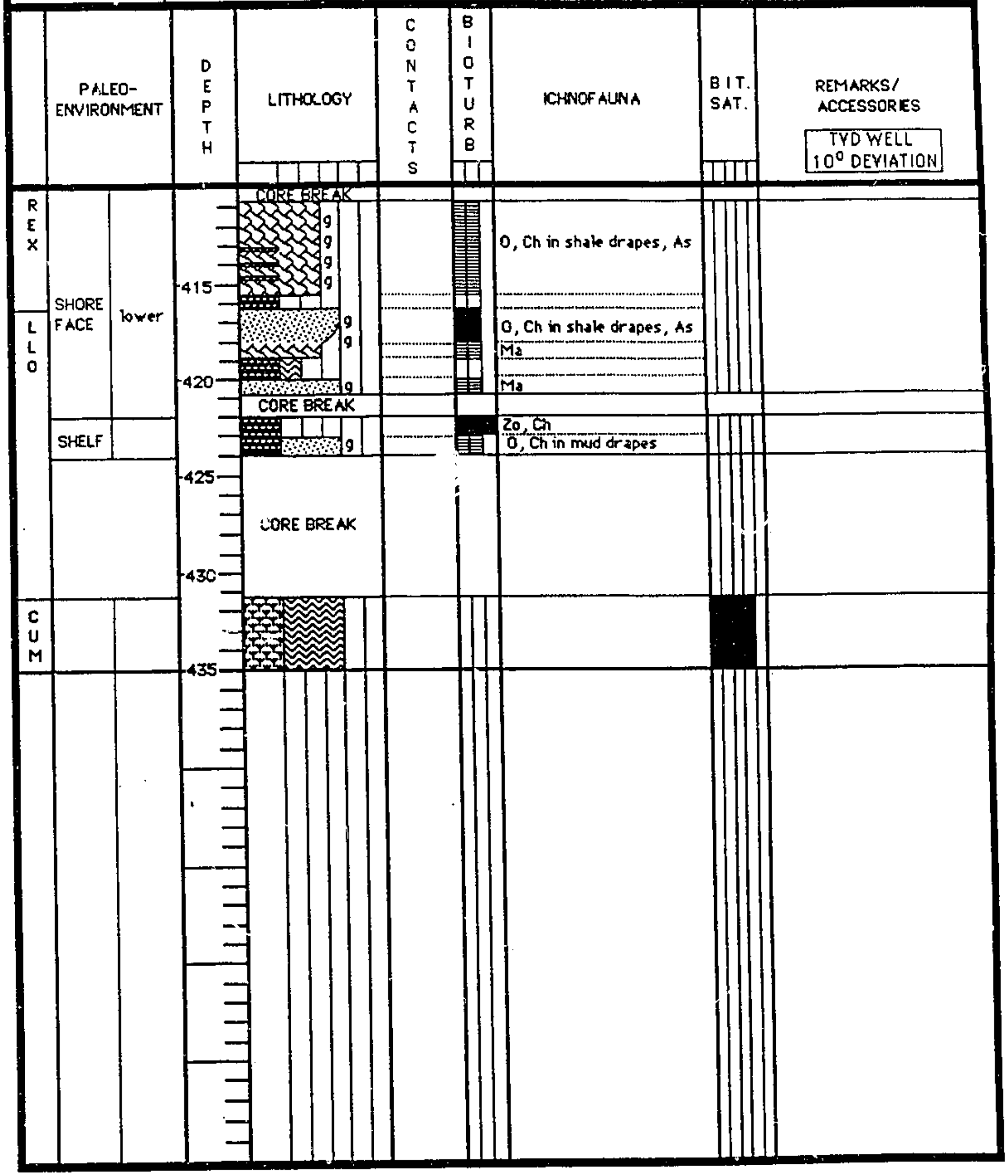
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-16-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	310.0-435.0 m	606.7 m	1 OF 3



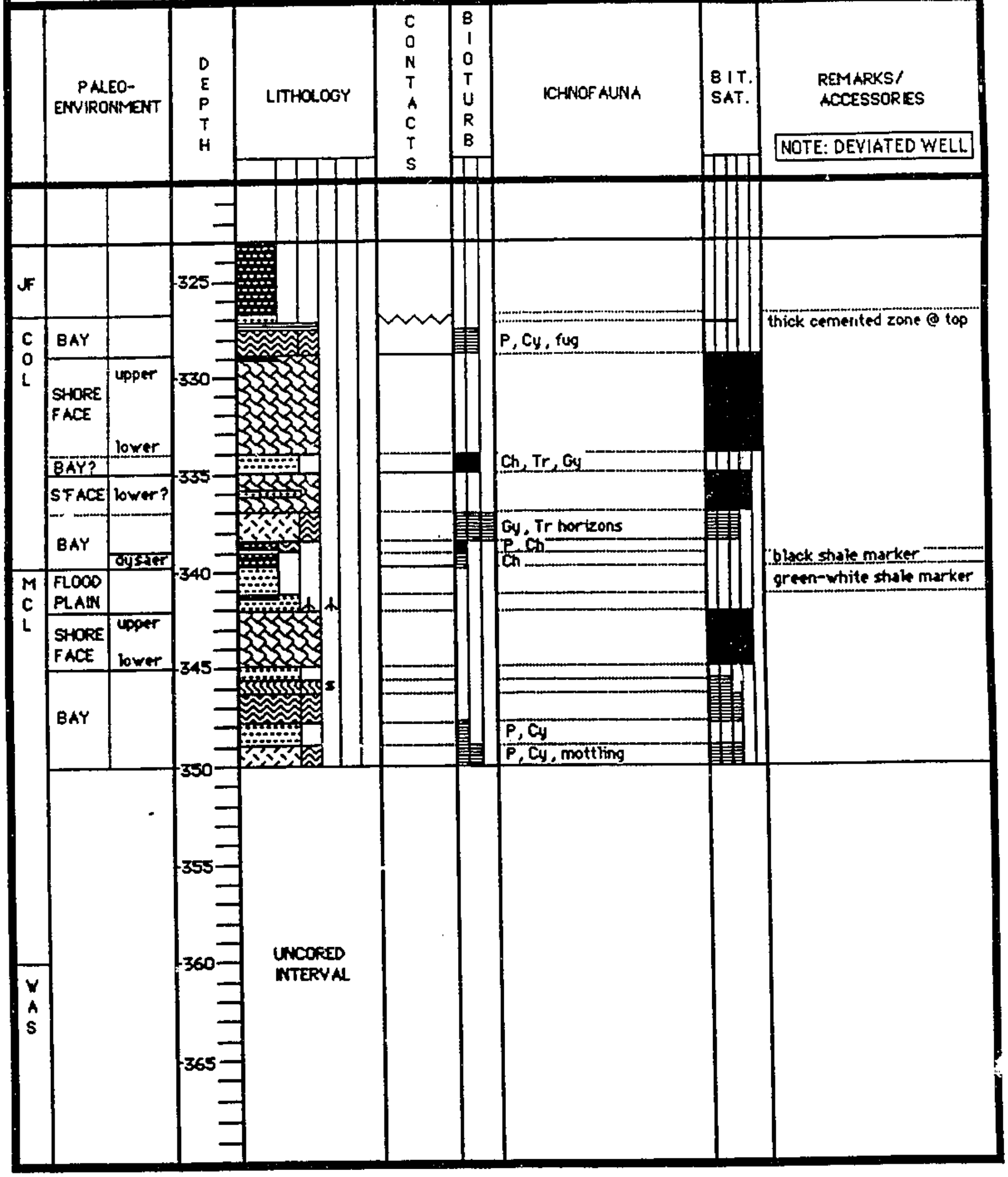
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-16-65-4W4	ESSO 38 COLD LAKE OV	ESSO CANADA RESOURCES	310.0-435.0 m	606.7 m	2 OF 3



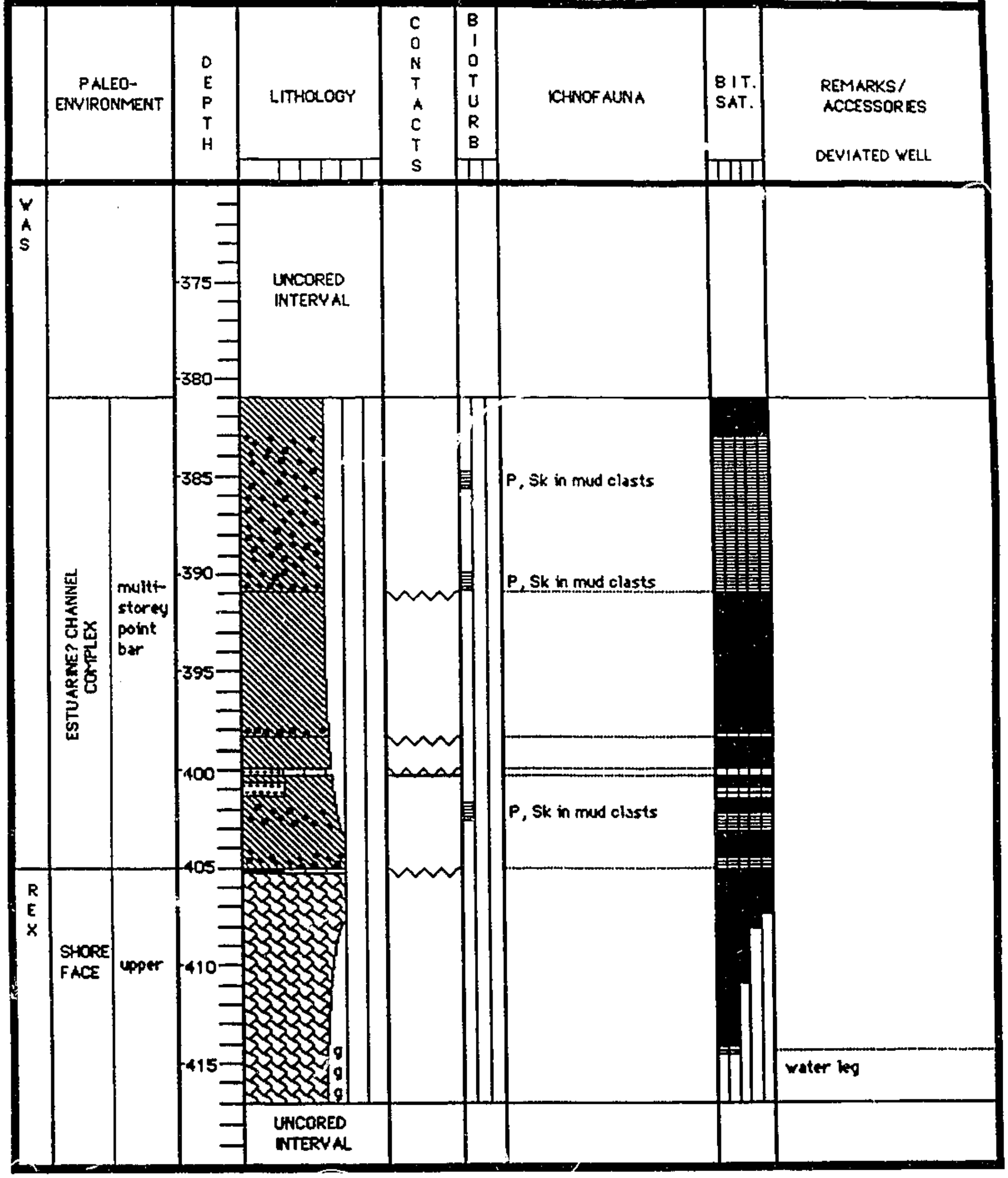
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-16-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	310.0-435.0 m	606.7 m	3 OF 3



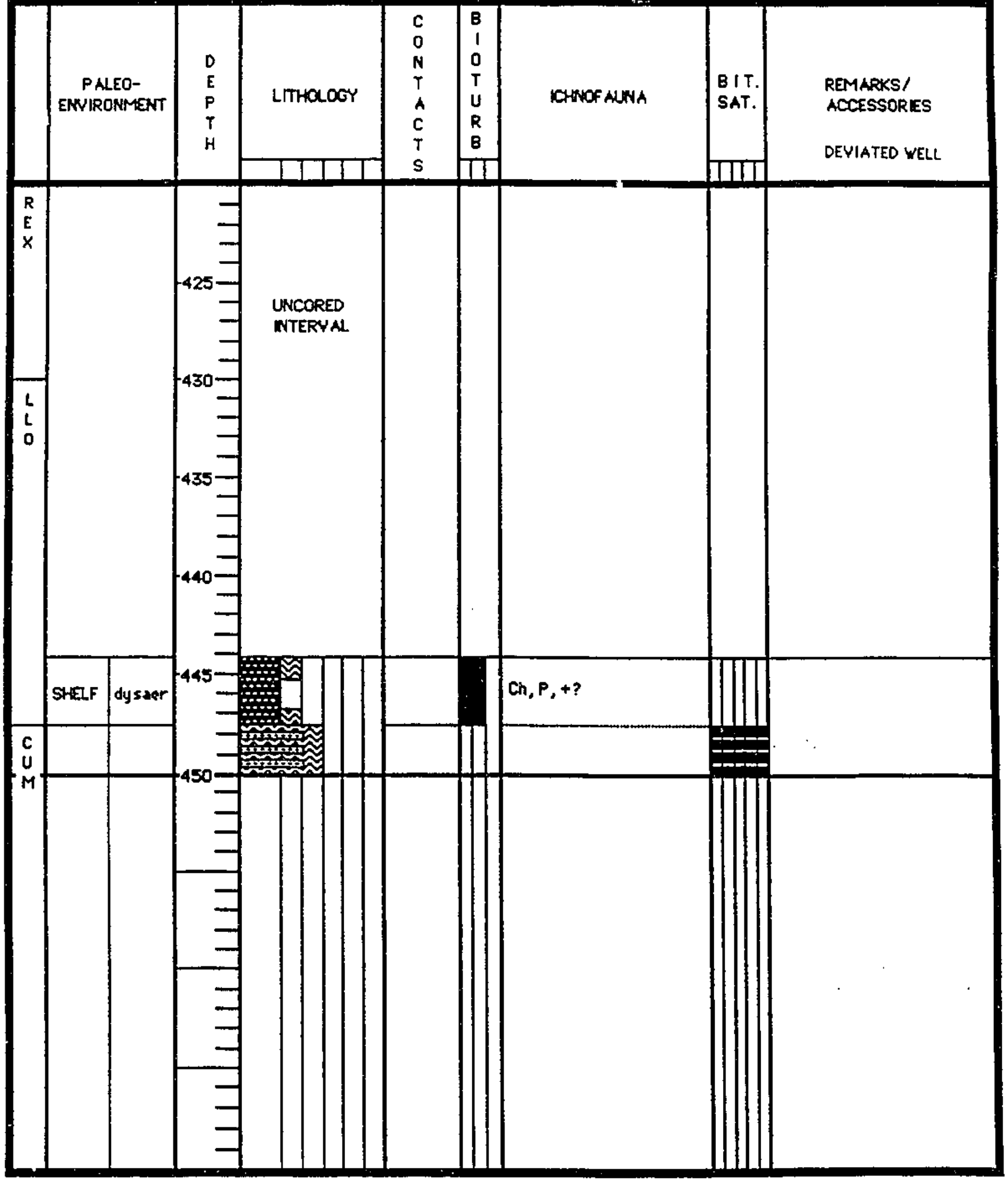
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-16-65-4W4	ESSO 84 J7-13 COLD LK	ESSO CANADA RESOURCES	323.0-450.0 m	614.3 m	1 OF 3



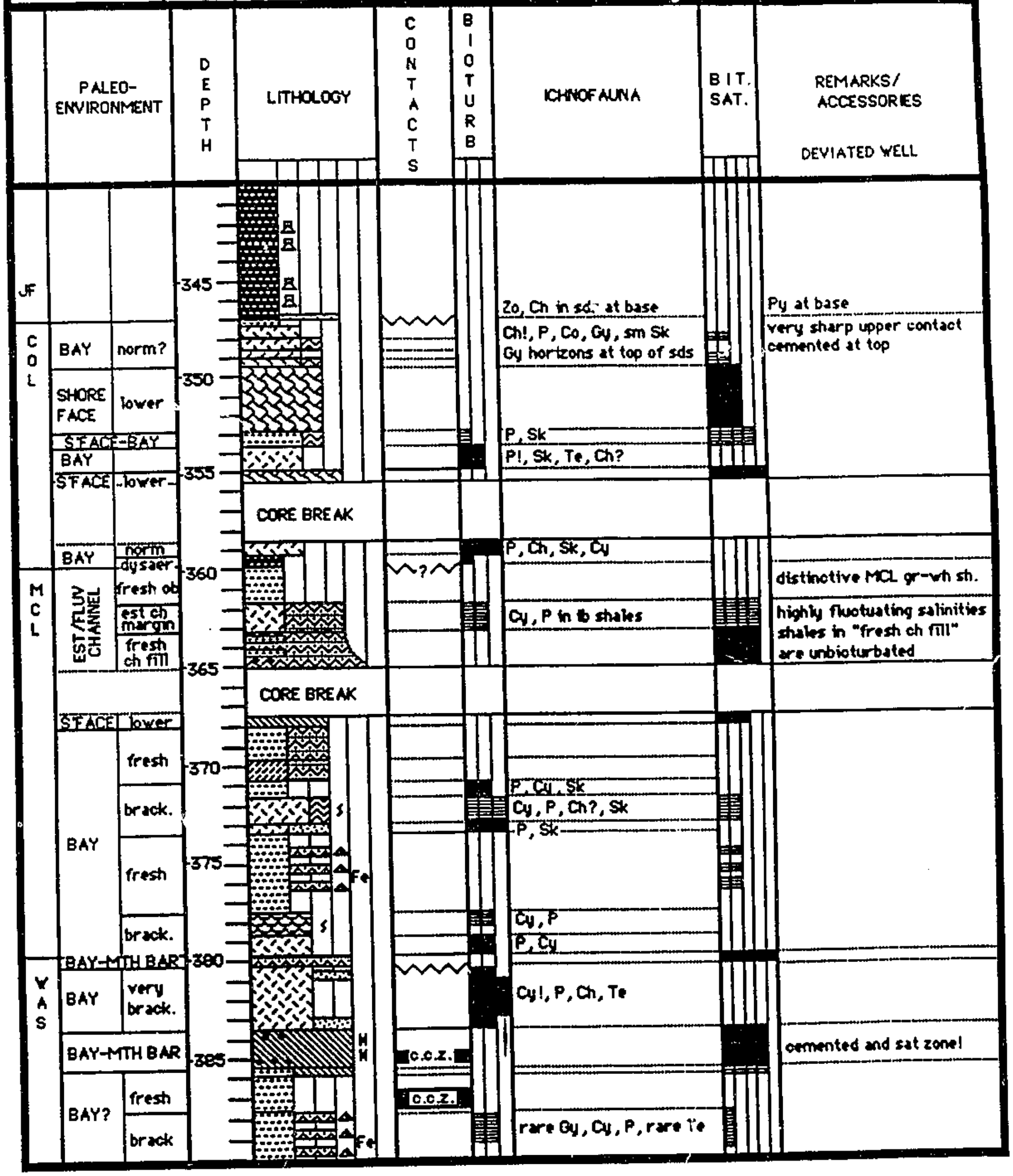
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-16-65-4W4	ESSO 84 J7-13 COLD LK	ESSO CANADA RESOURCES	323.0-450.0 m	614.3 m	2 OF 3



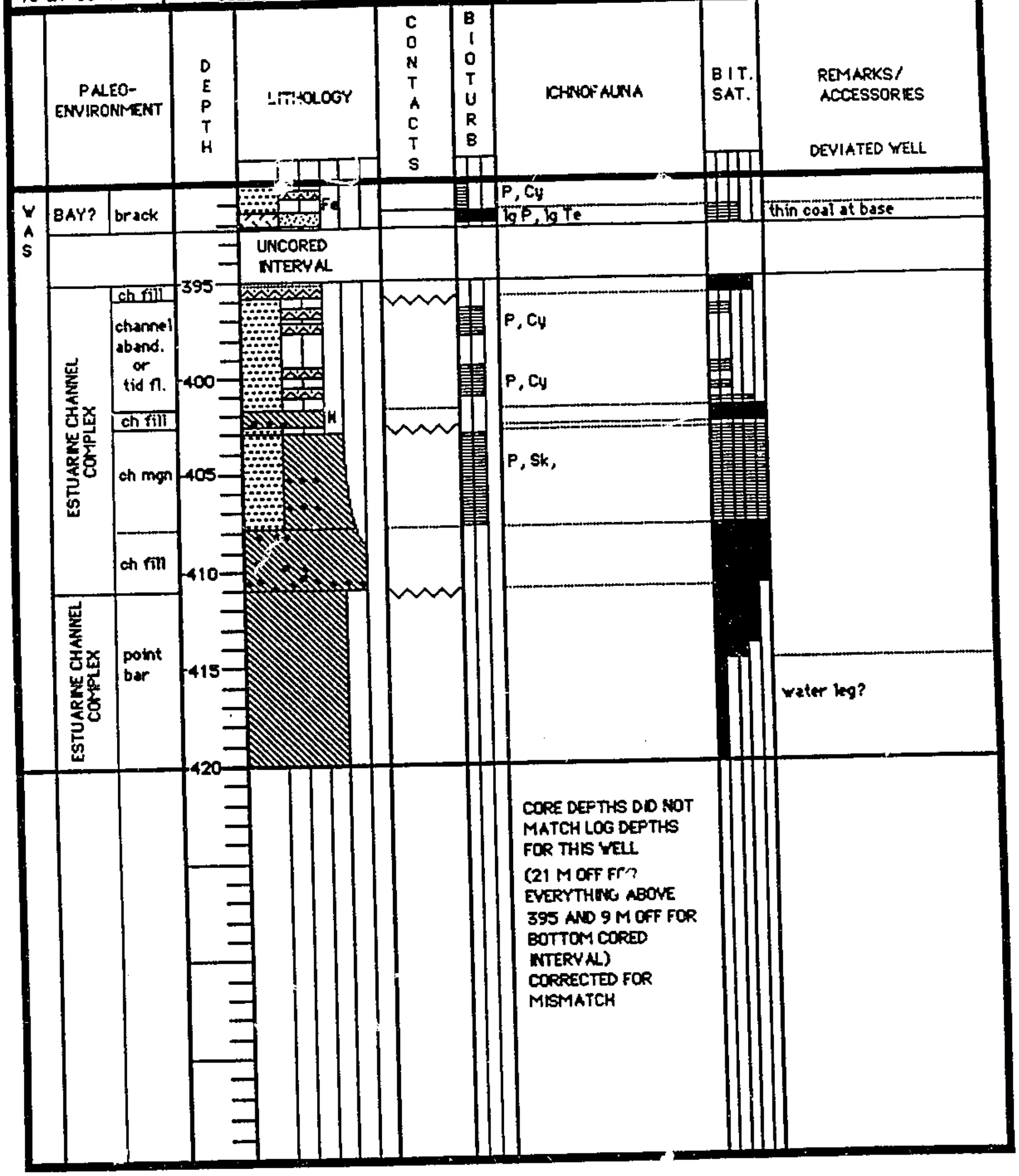
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-16-65-4W4	ESSO 84 J7-13 COLD LK	ESSO CANADA RESOURCES	323.0-450.0 m	614.3 m	3 OF 3



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-21-65-4W4	ESSO 84 H2-13 COLD LAKE	ESSO CANADA RESOURCES	340.0–420.0 m	615.7 m	1 OF 2

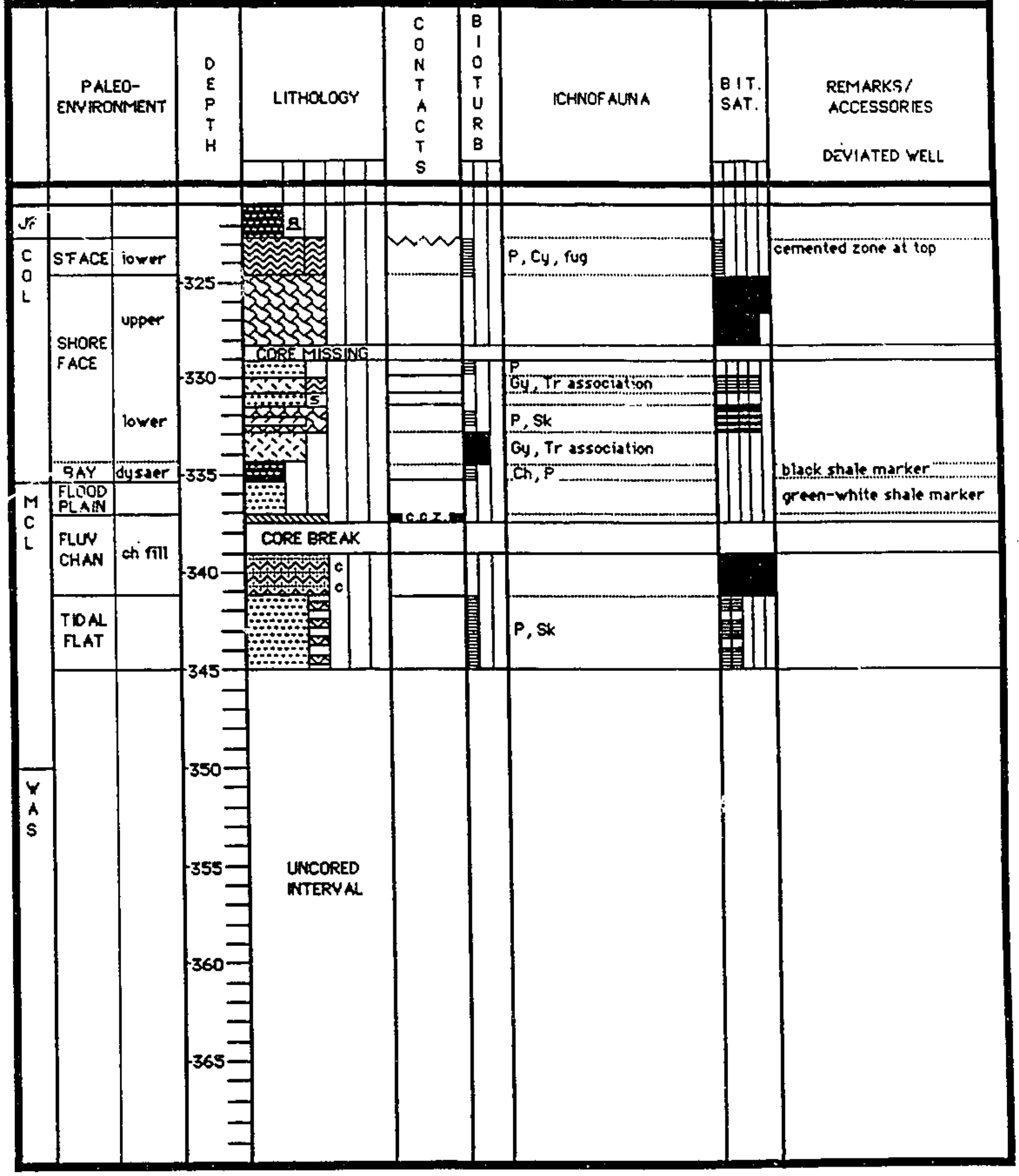


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-21-65-4W4	ESSO 84 H2-13 COLD LAKE	ESSO CANADA RESOURCES	340.0-420.0 m	615.7 m	2 OF 2

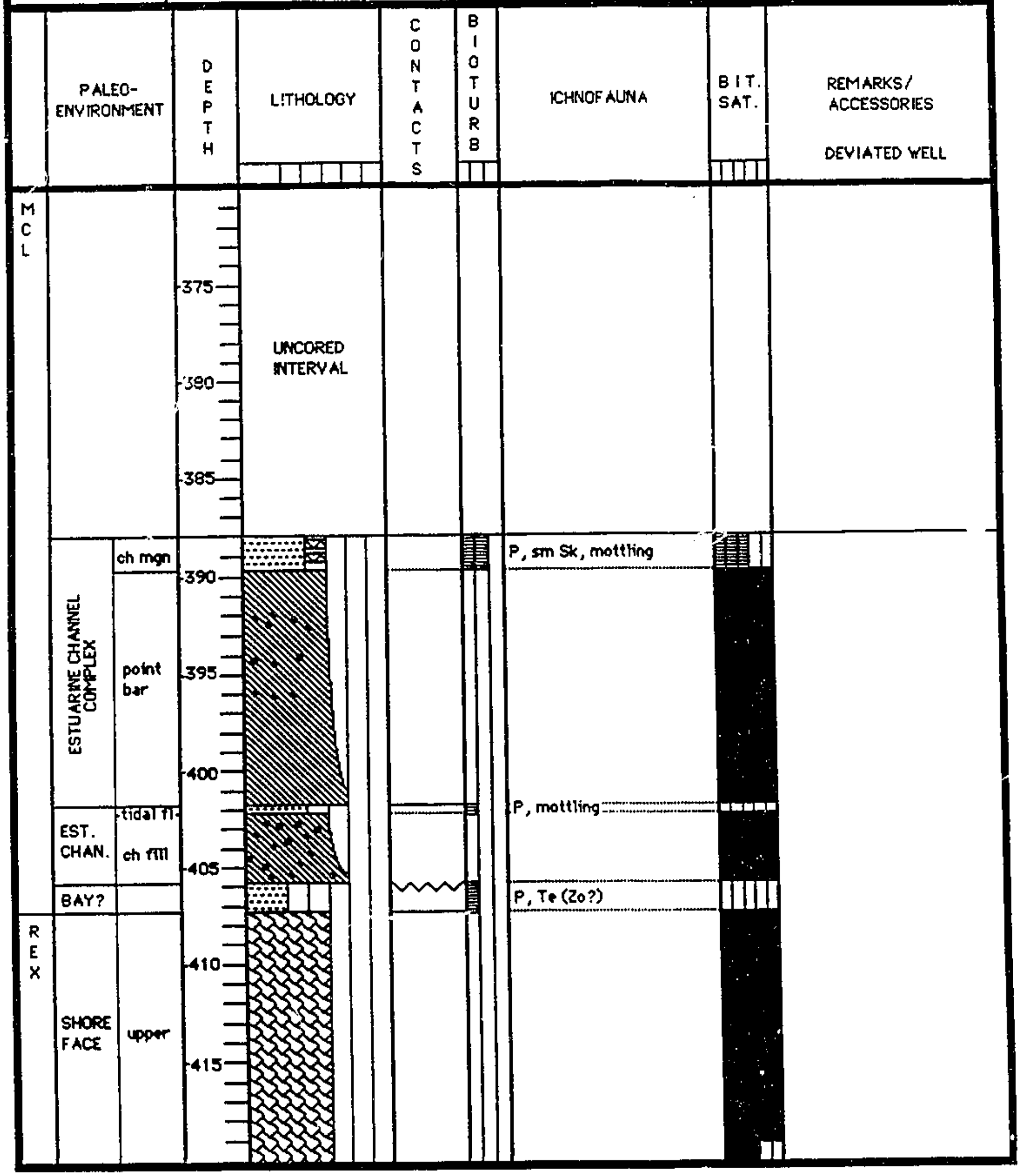


CORE DEPTHS DID NOT MATCH LOG DEPTHS FOR THIS WELL (21 M OFF FF? EVERYTHING ABOVE 395 AND 9 M OFF FOR BOTTOM CORED INTERVAL) CORRECTED FOR MISMATCH

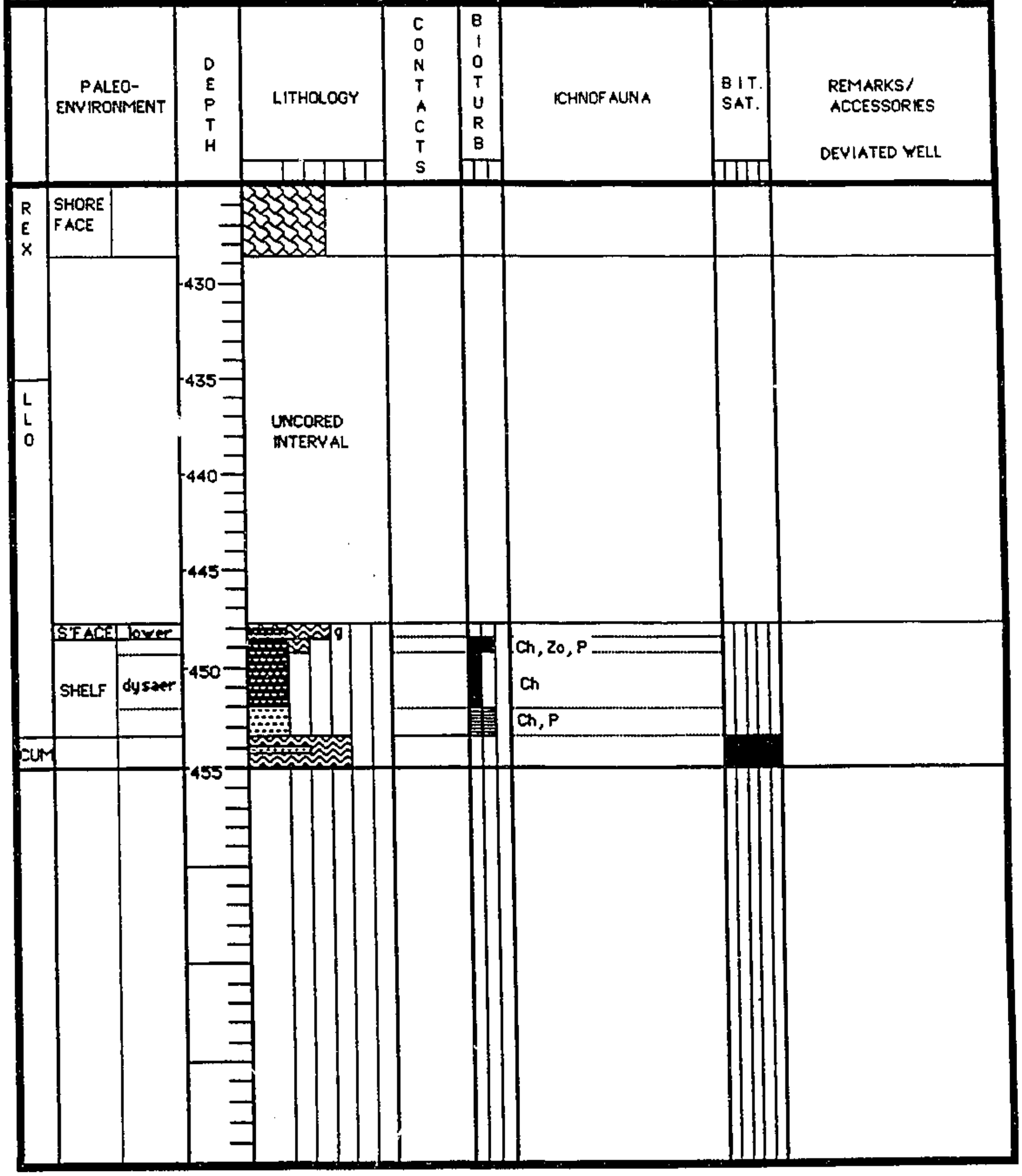
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-22-65-4W4	ESSO 84 J2-13 COLD LK	ESSO CANADA RESOURCES	321.0-440.0 m	615.2 m	1 OF 3



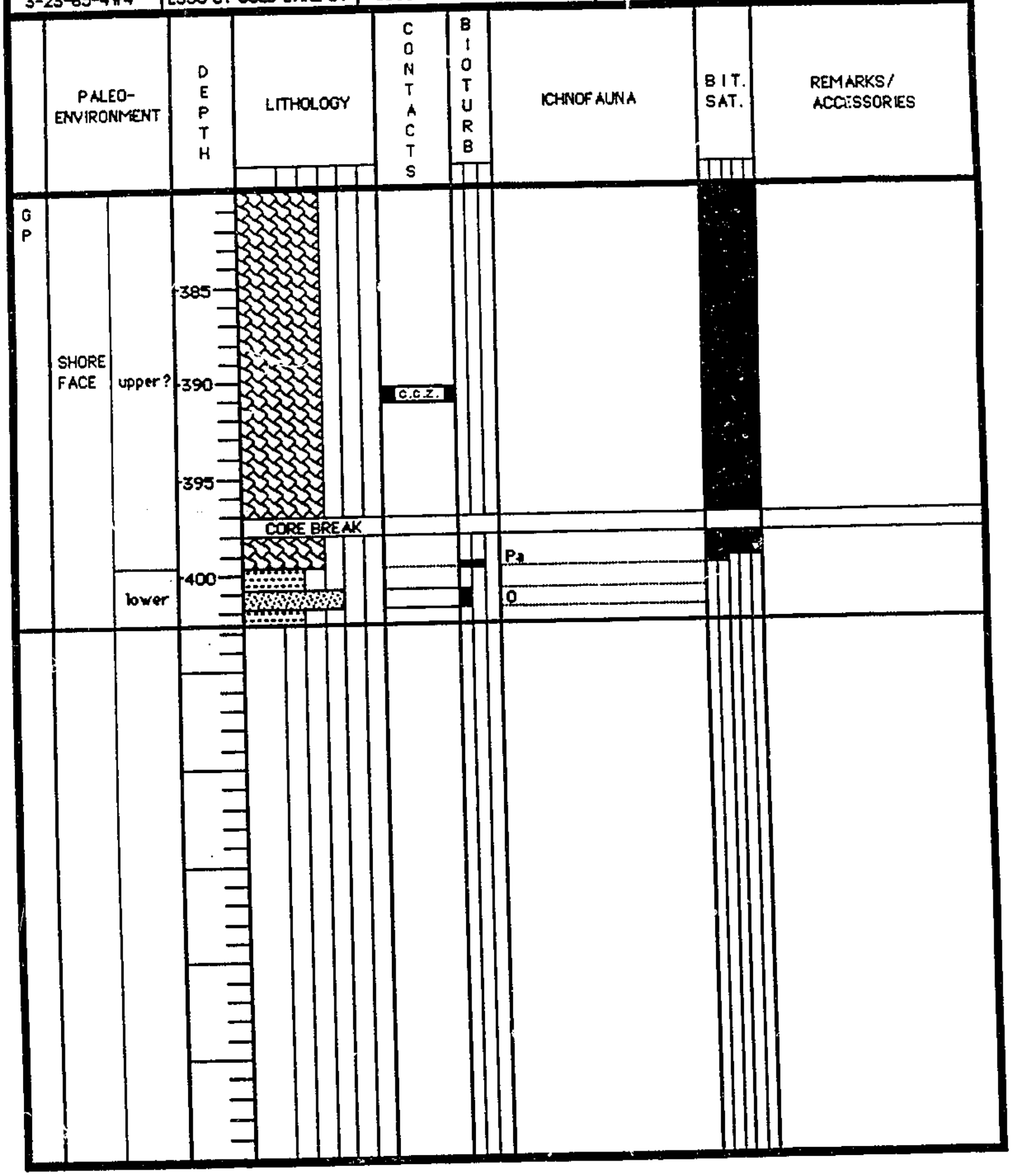
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-22-65-4W4	ESSO 84 J2-13 COLD LK	ESSO CANADA RESOURCES	321.0-455.0 m	615.2 m	2 OF 3



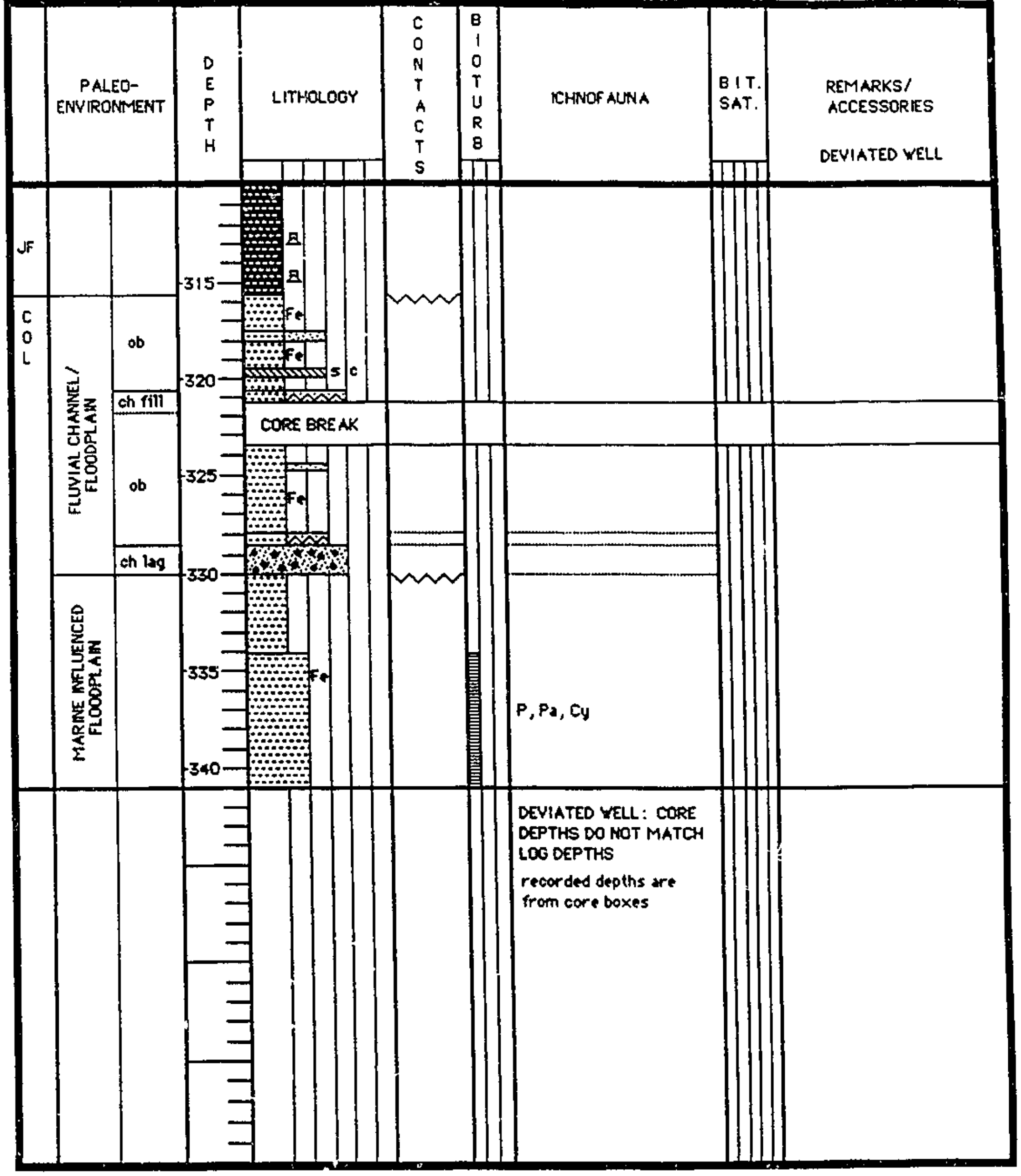
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-22-65-4W4	ESSO 84 J2-13 COLD LK	ESSO CANADA RESOURCES	321.0-455.0 m	615.2 m	3 OF 3



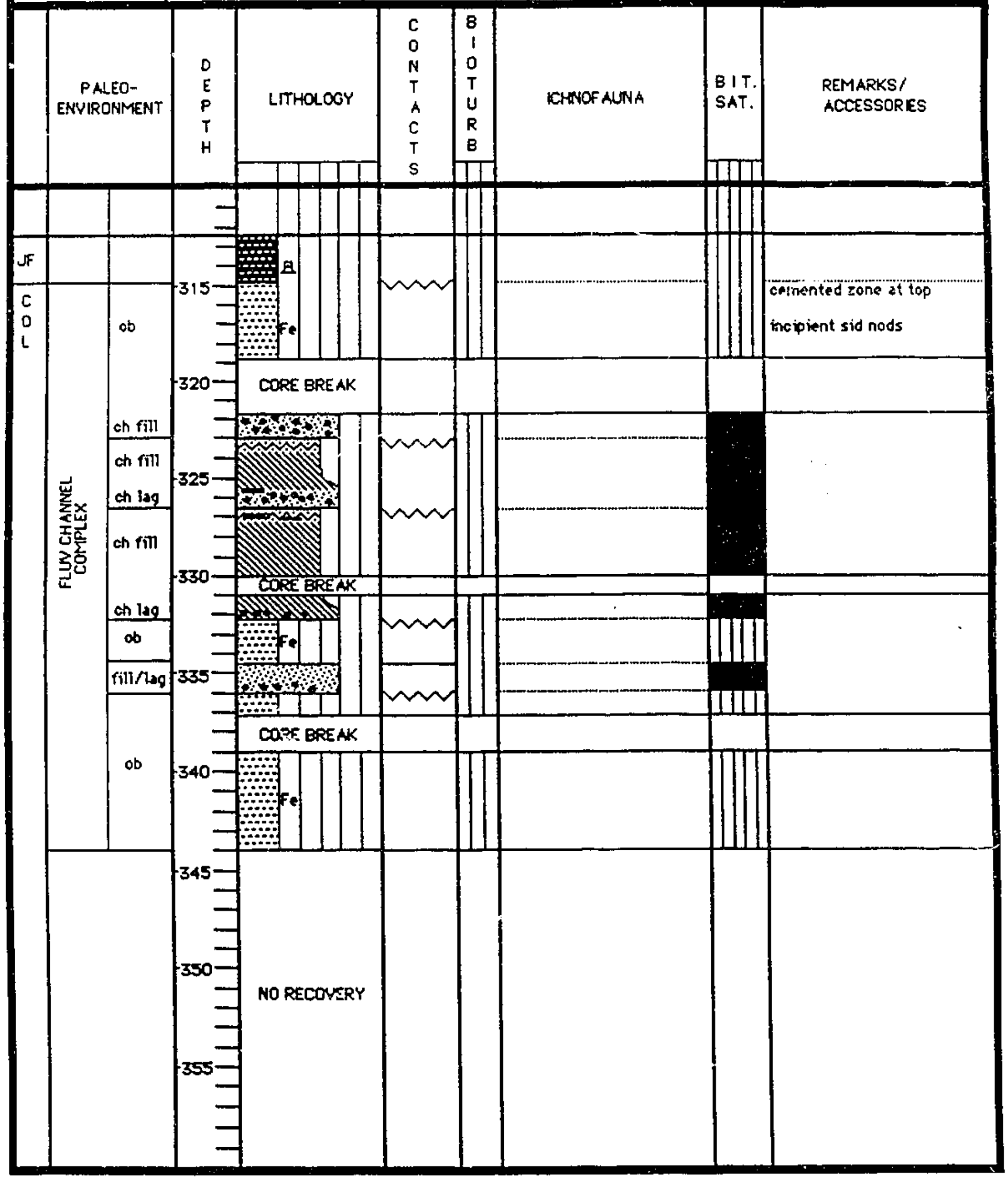
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-23-65-4W4	ESSO 87 COLD LAKE OV	ESSO CANADA RESOURCES	380.0-402.5 m	612.0 m	1 OF 1



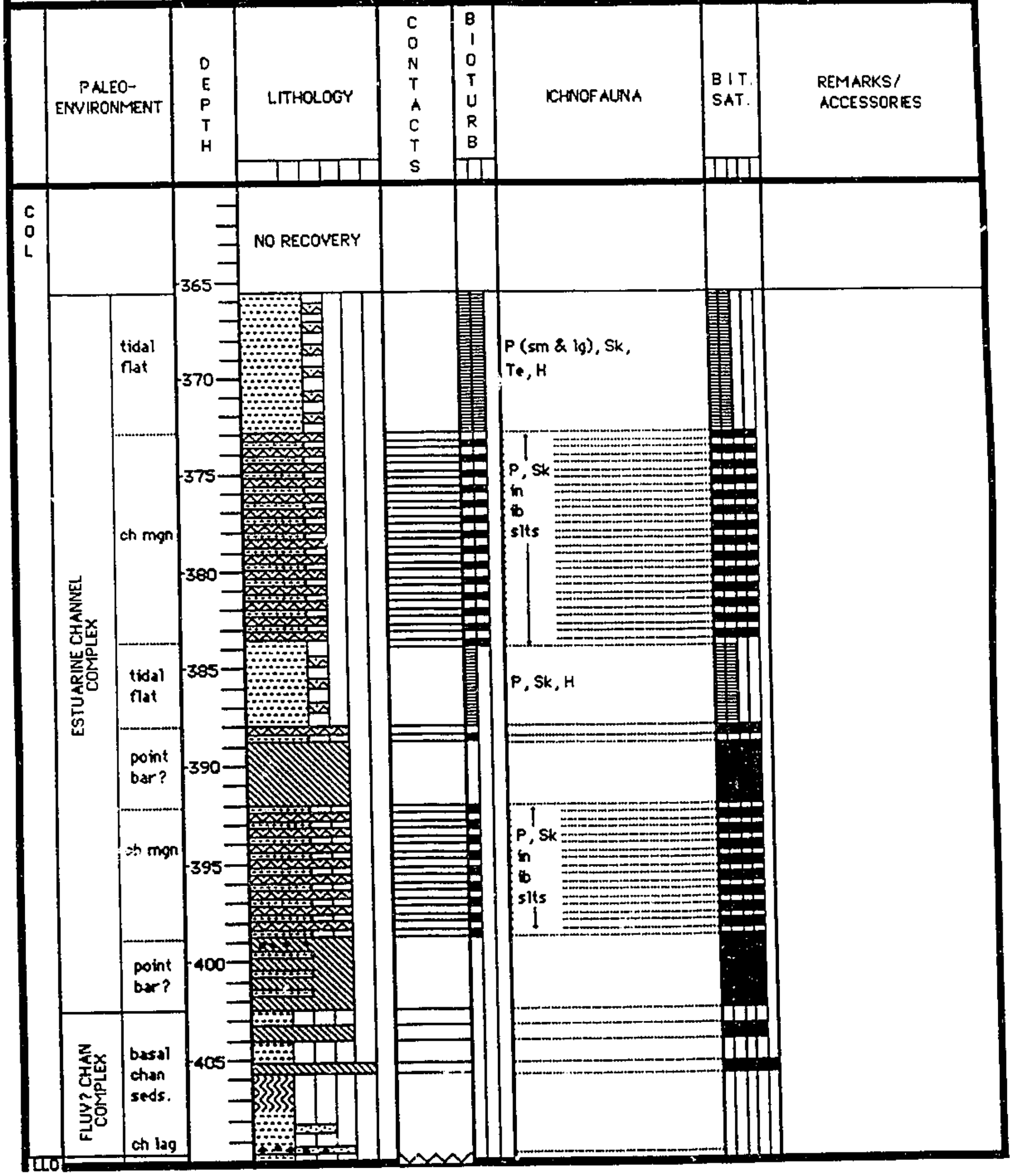
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-24-65-4W4	ESSO 84 B68 COLD LK 2-24	ESSO CANADA RESOURCES	321.0-455.0 m	611.0 m	1 OF 1



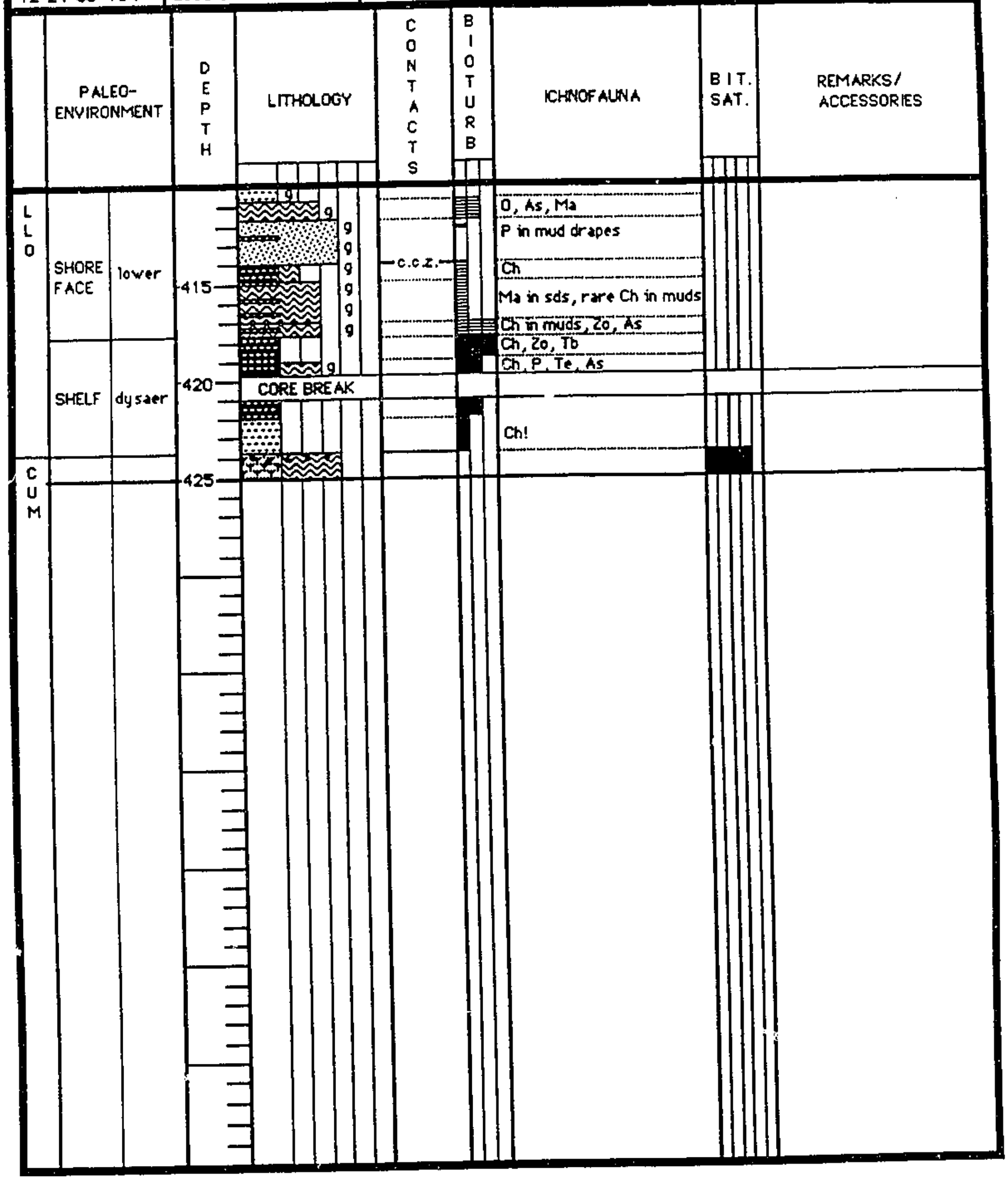
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-24-65-4W4	ESSO 98 COLD LAKE OV	ESSO CANADA RESOURCES	312.5-425.0 m	612.9 m	1 OF 3

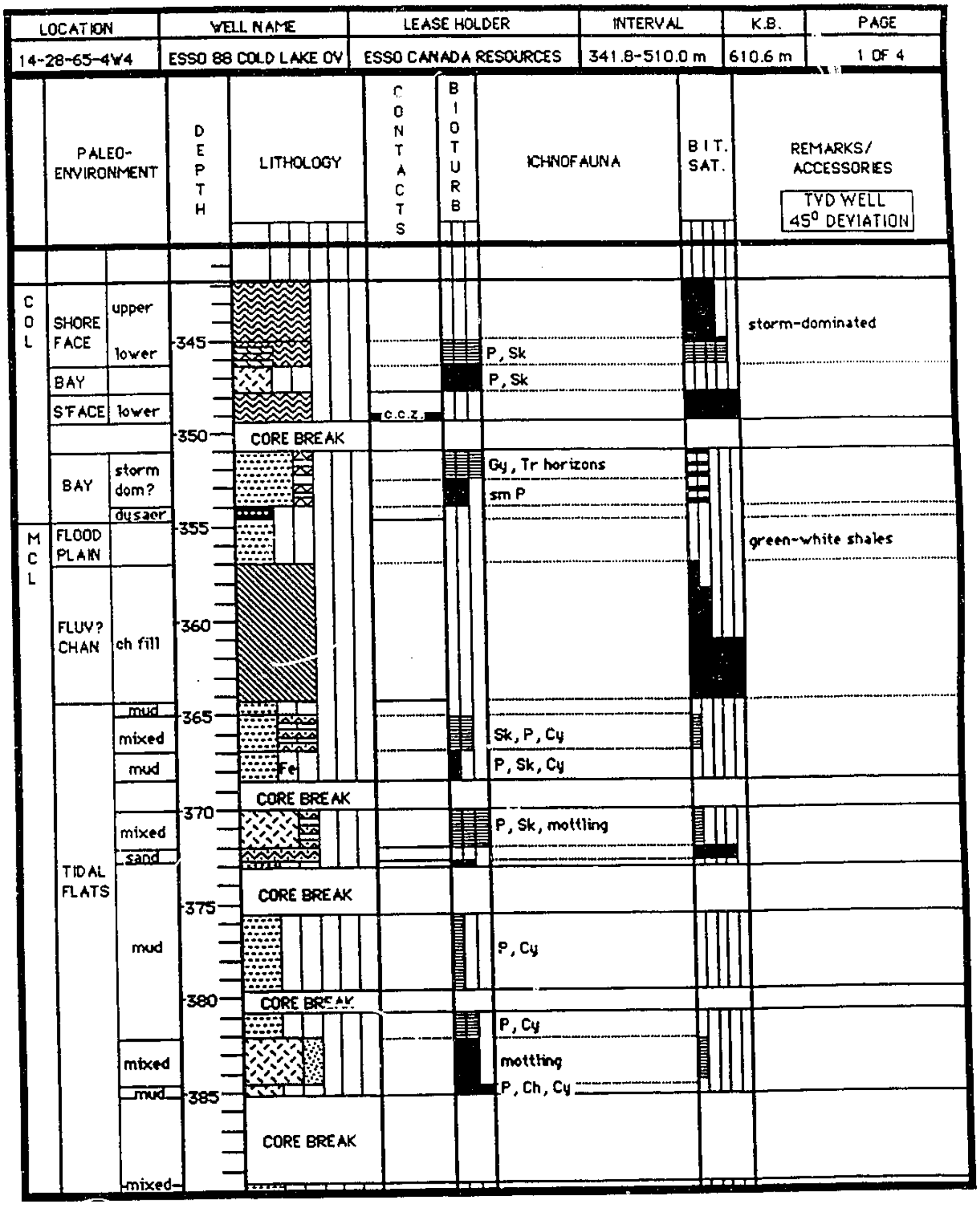


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-24-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	312.5-425.0 m	612.9 m	2 OF 3

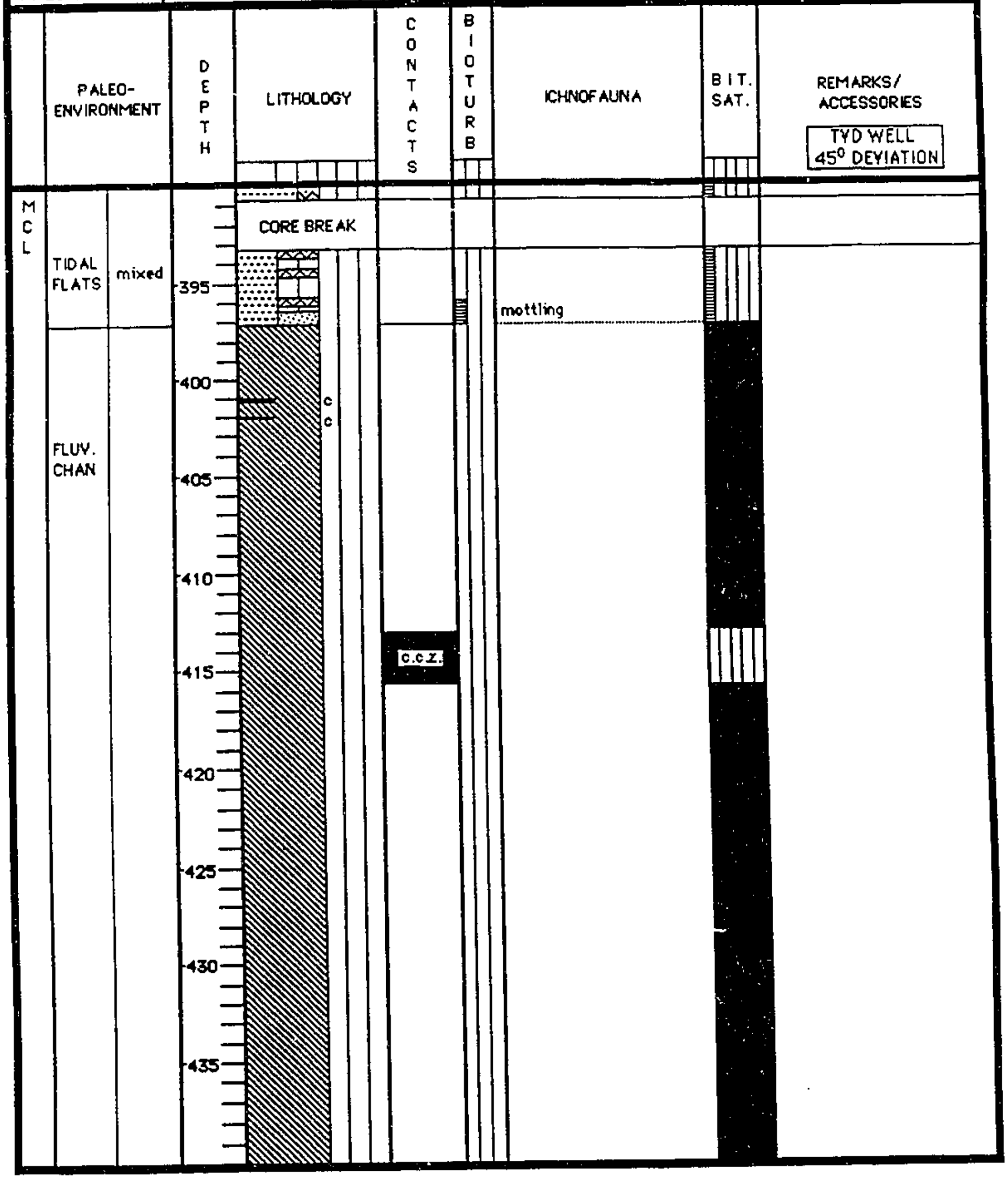


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-24-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	312.5-425.0 m	612.9 m	3 OF 3

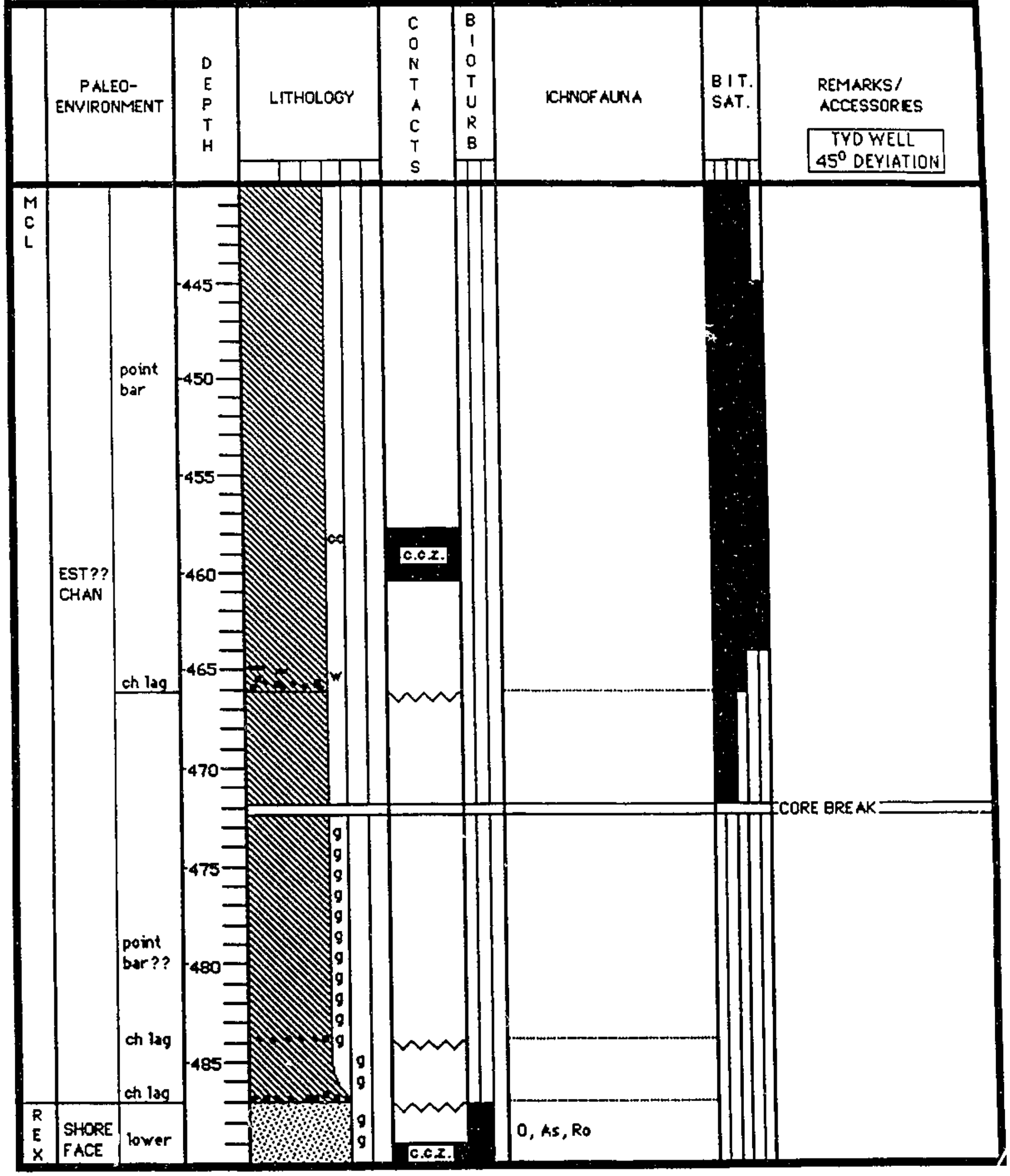



LOCATION
14-28-65-4W4
WELL NAME
ESSO 88 COLD LAKE OV
LEASE HOLDER
ESSO CANADA RESOURCES
INTERVAL
341.8-510.0 m
K.B.
610.6 m
PAGE
1 OF 4
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
TVD WELL 45° DEVIATION
COL
SHORE FACE
upper
lower
BAY
S'FACE
lower
345
P, Sk
P, Sk
storm-dominated
c.c.z.
350
CORE BREAK
BAY
storm dom?
dysaer
Gy, Tr horizons
sm P
MCL
FLOOD PLAIN
355
green-white shales
FLUV? CHAN
ch fill
360
TIDAL FLATS
mud
365
mixed
mud
Sk, P, Cy
P, Sk, Cy
Fe
CORE BREAK
370
mixed
sand
P, Sk, mottling
CORE BREAK
375
mud
P, Cy
380
CORE BREAK
P, Cy
mixed
mottling
mud
385
P, Ch, Cy
CORE BREAK
mixed

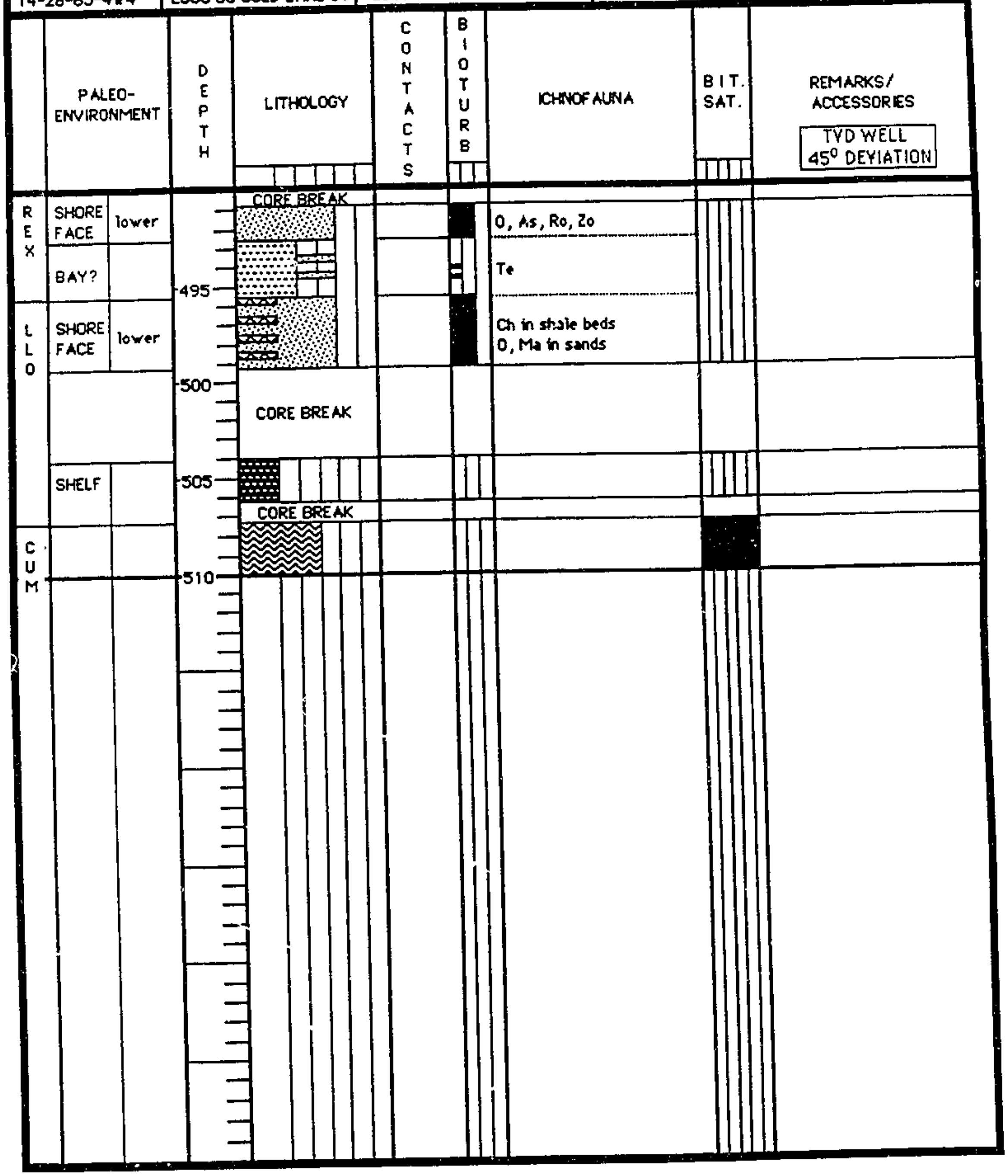
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-28-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	341.8-510.0 m	610.6 m	2 OF 4



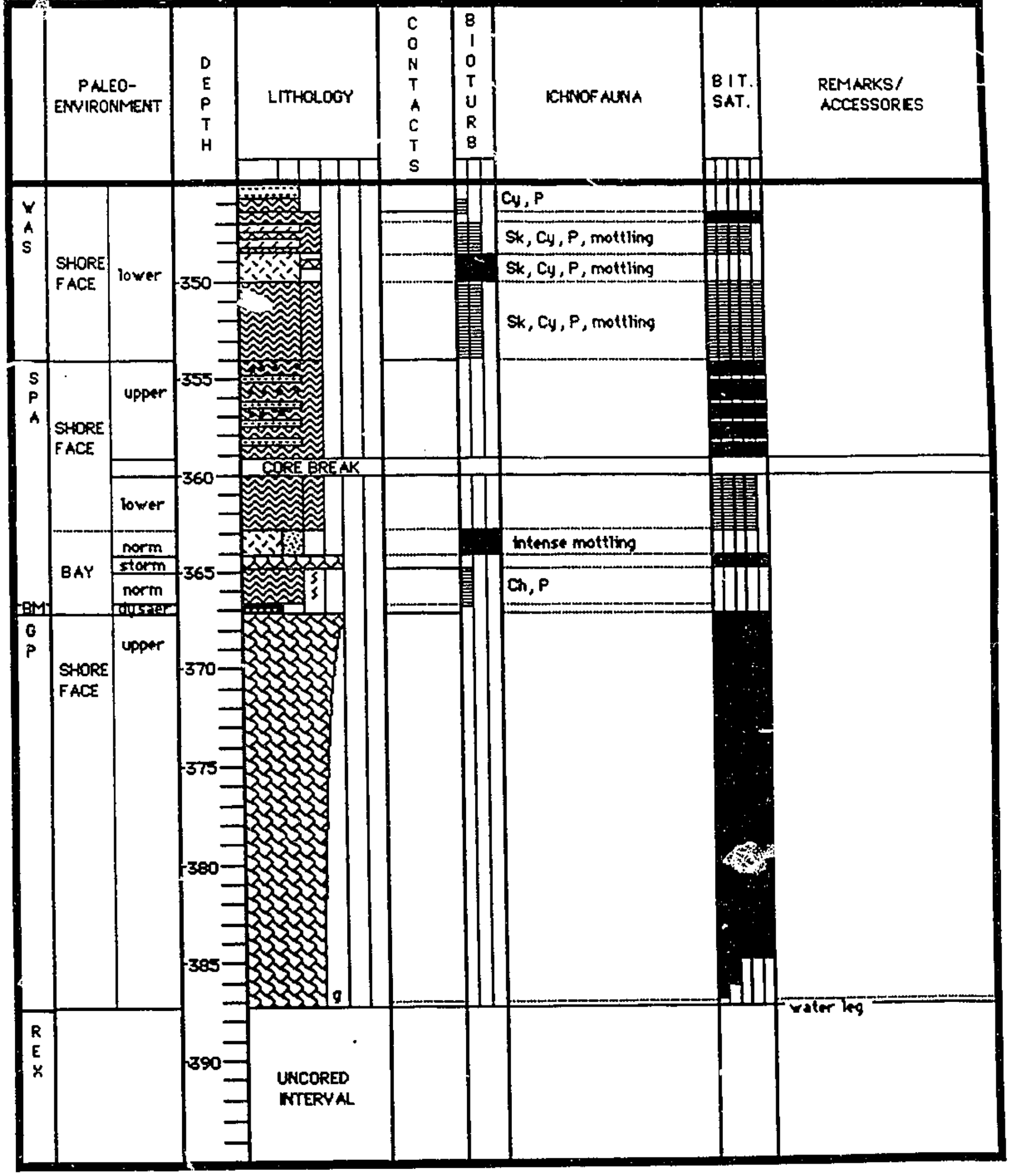
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-28-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	341.8-510.0 m	610.6 m	3 OF 4



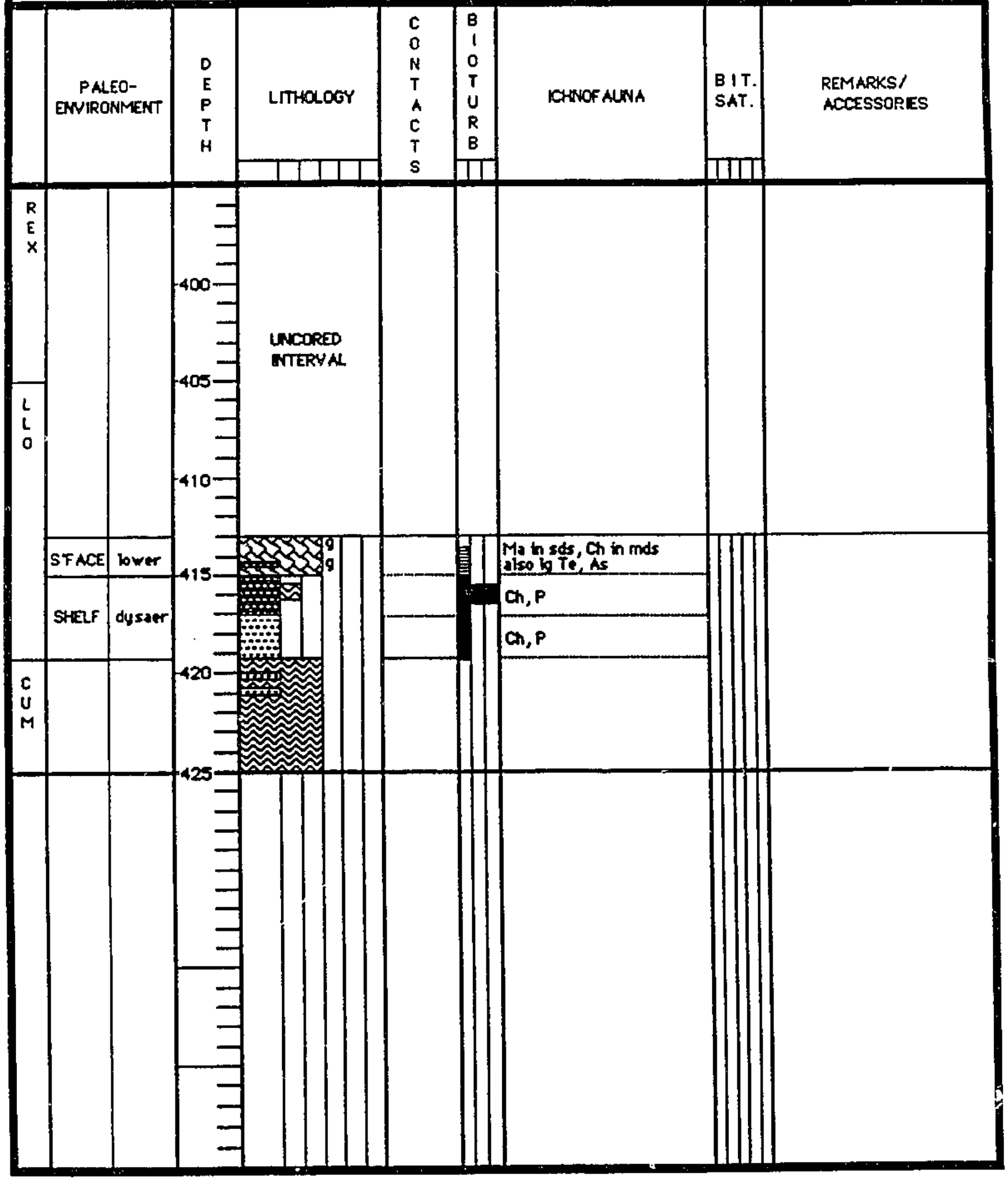
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-28-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	341.8-510.0 m	610.6 m	4 OF 4



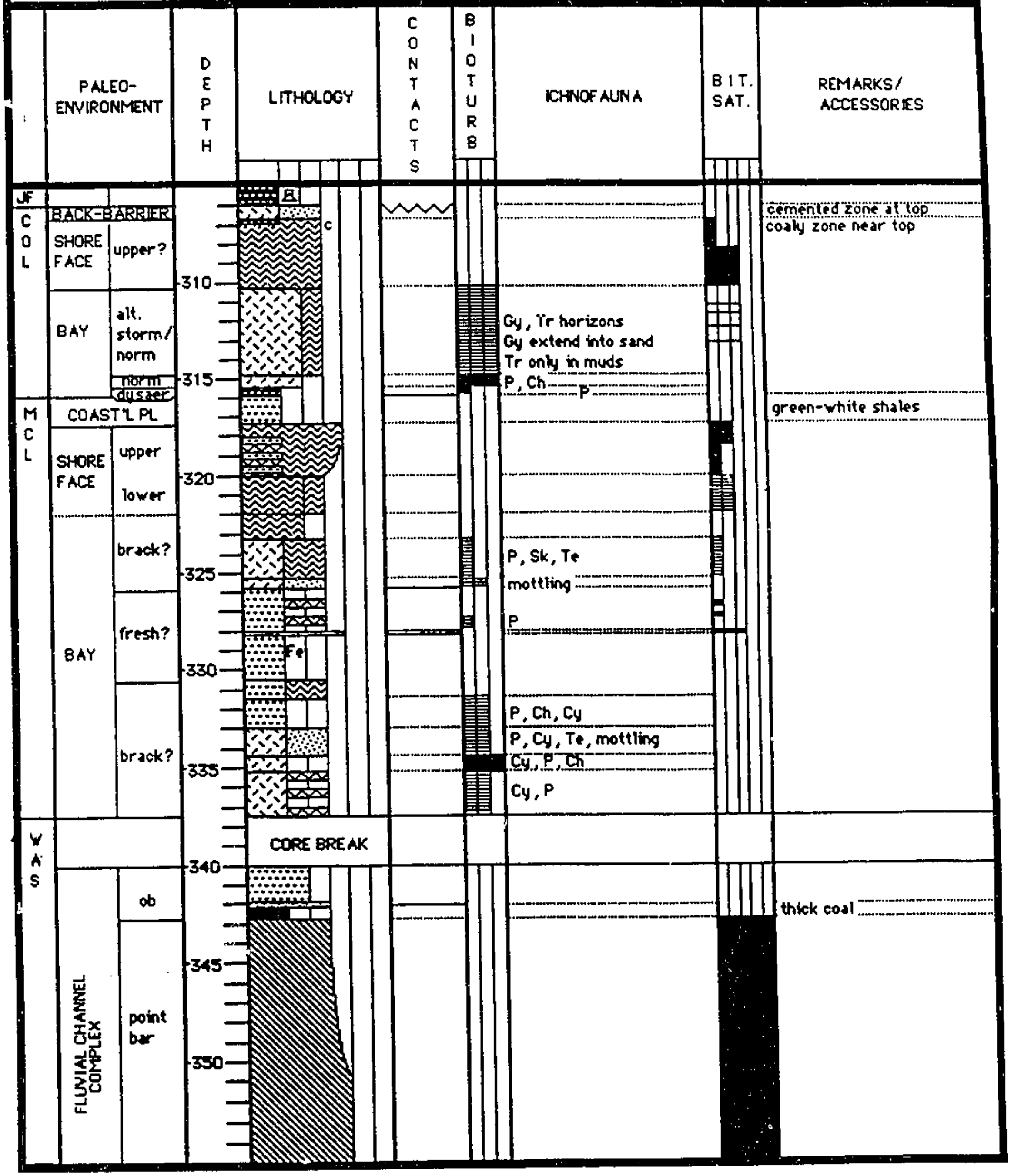
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-29-65-4W4	ESSO 86 COLD LAKE OV	ESSO CANADA RESOURCES	345.0-425.0 m	619.7 m	1 OF 2



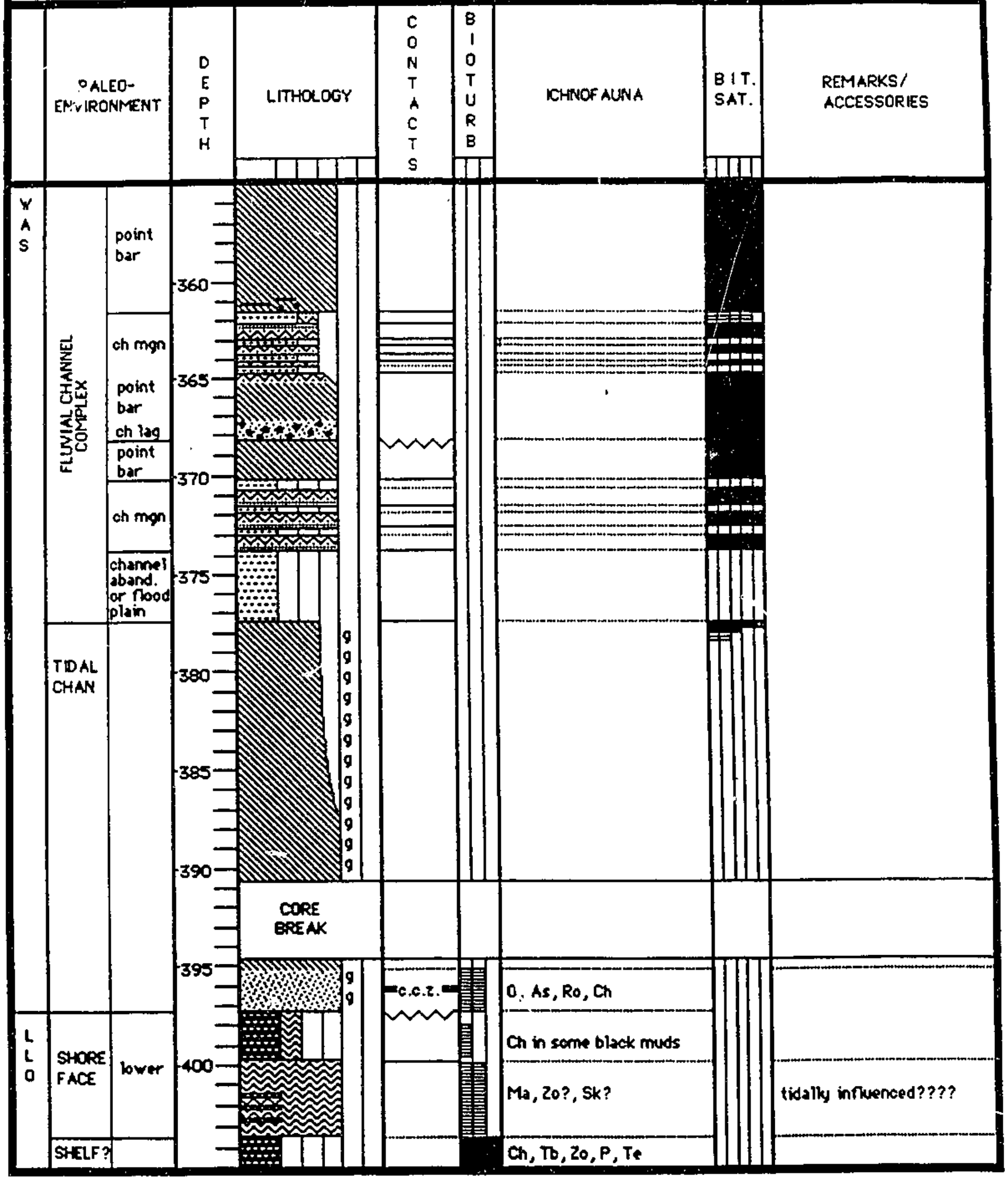
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-29-65-4W4	ESSO 86 COLD LAKE OV	ESSO CANADA RESOURCES	345.0–425.0 m	619.7 m	2 OF 2



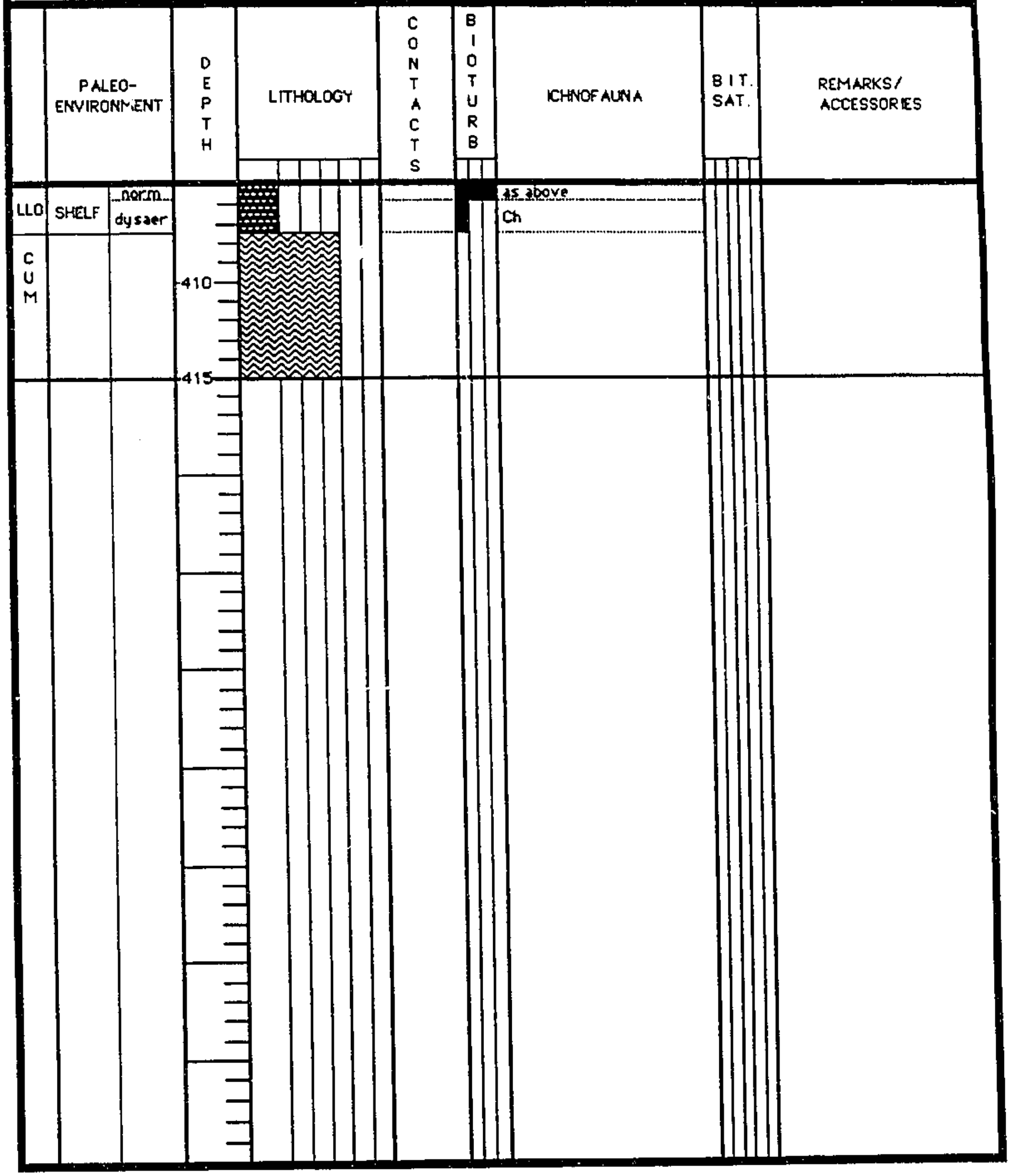
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-32-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	305.0-415.0 m	616.1 m	1 OF 3



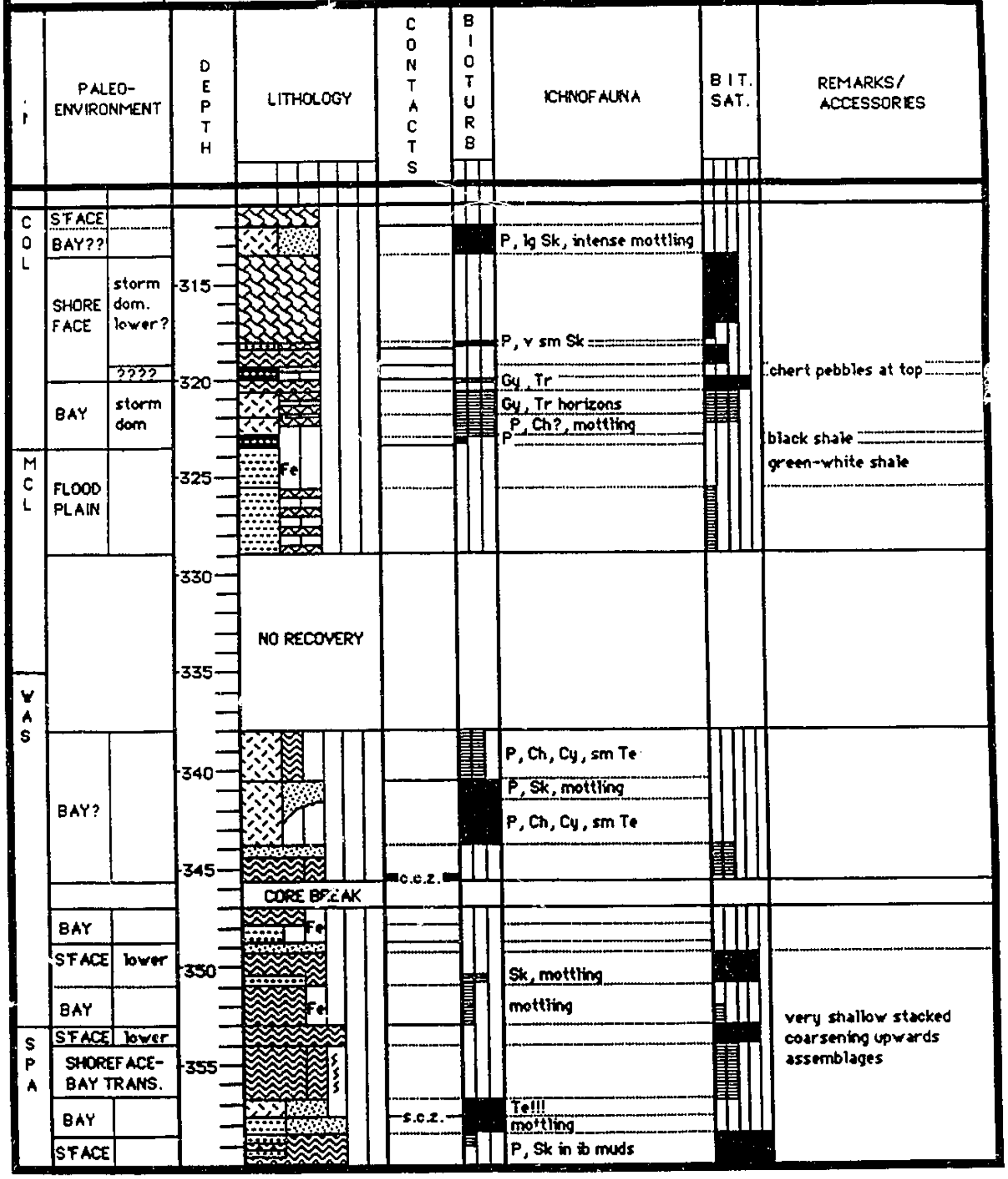
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-32-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	305.0-415.0 m	616.1 m	2 OF 3



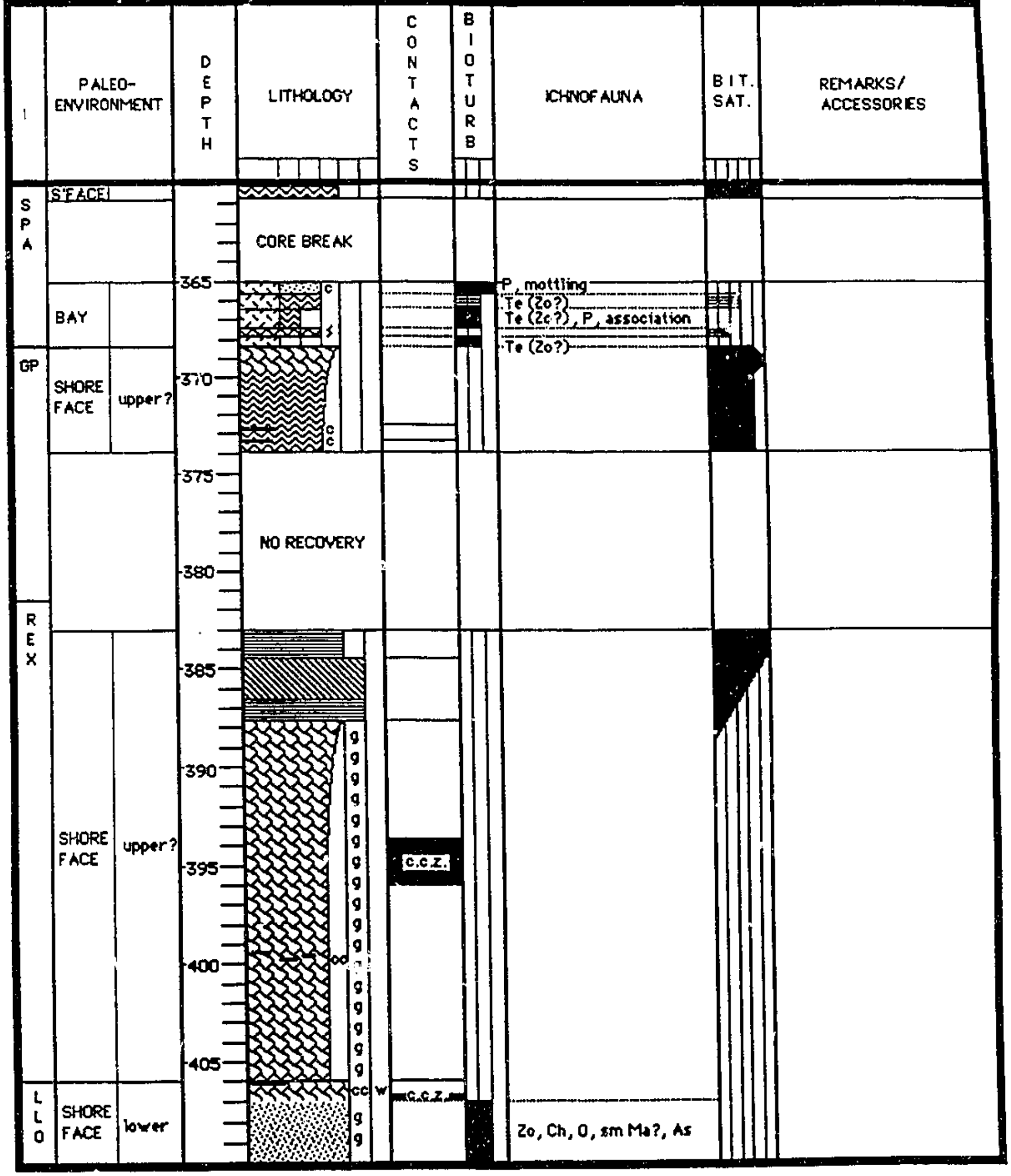
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-32-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	305.0-415.0 m	616.1 m	3 OF 3



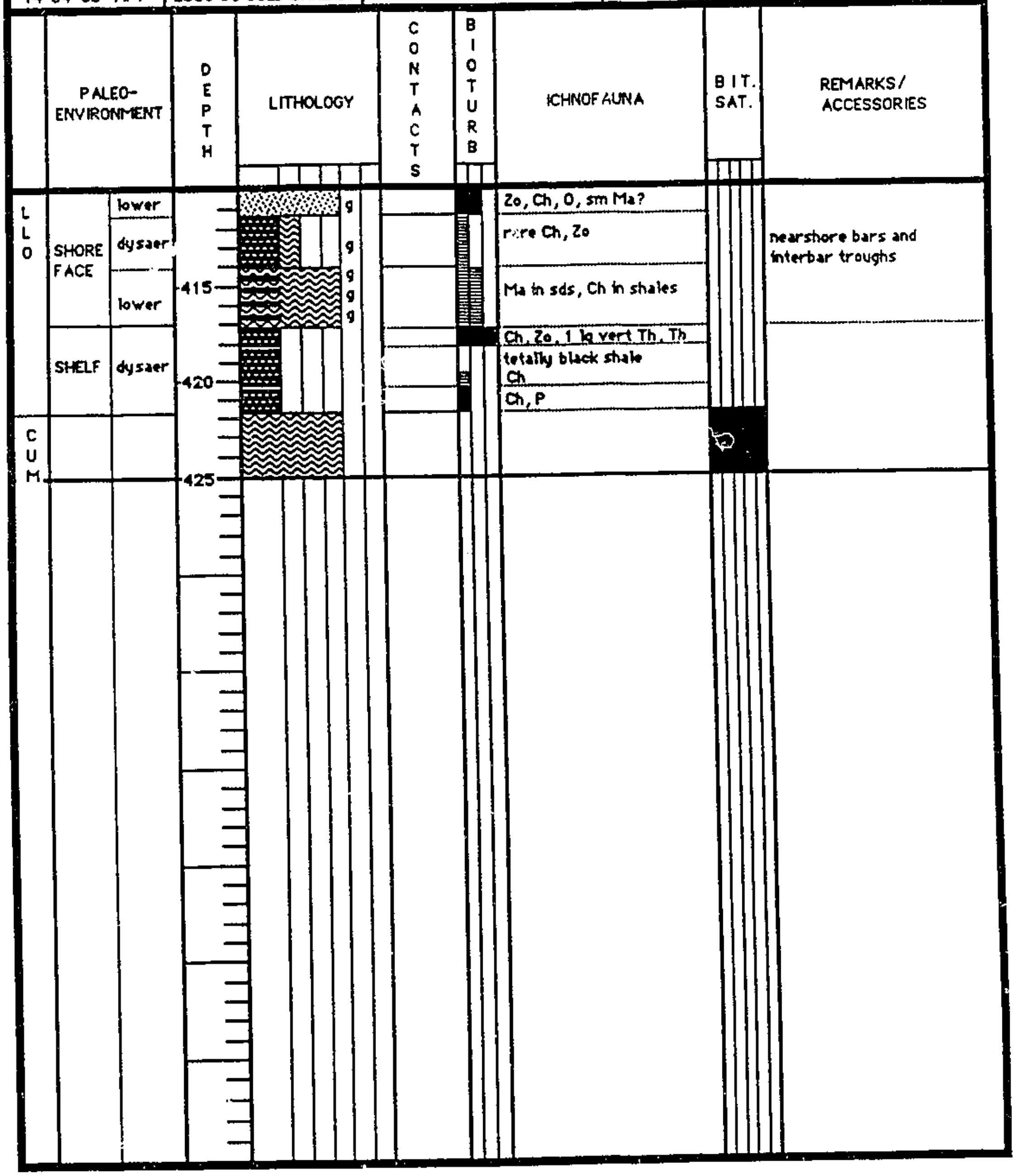
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-34-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	311.0-425.0 m	622.1 m	1 OF 3



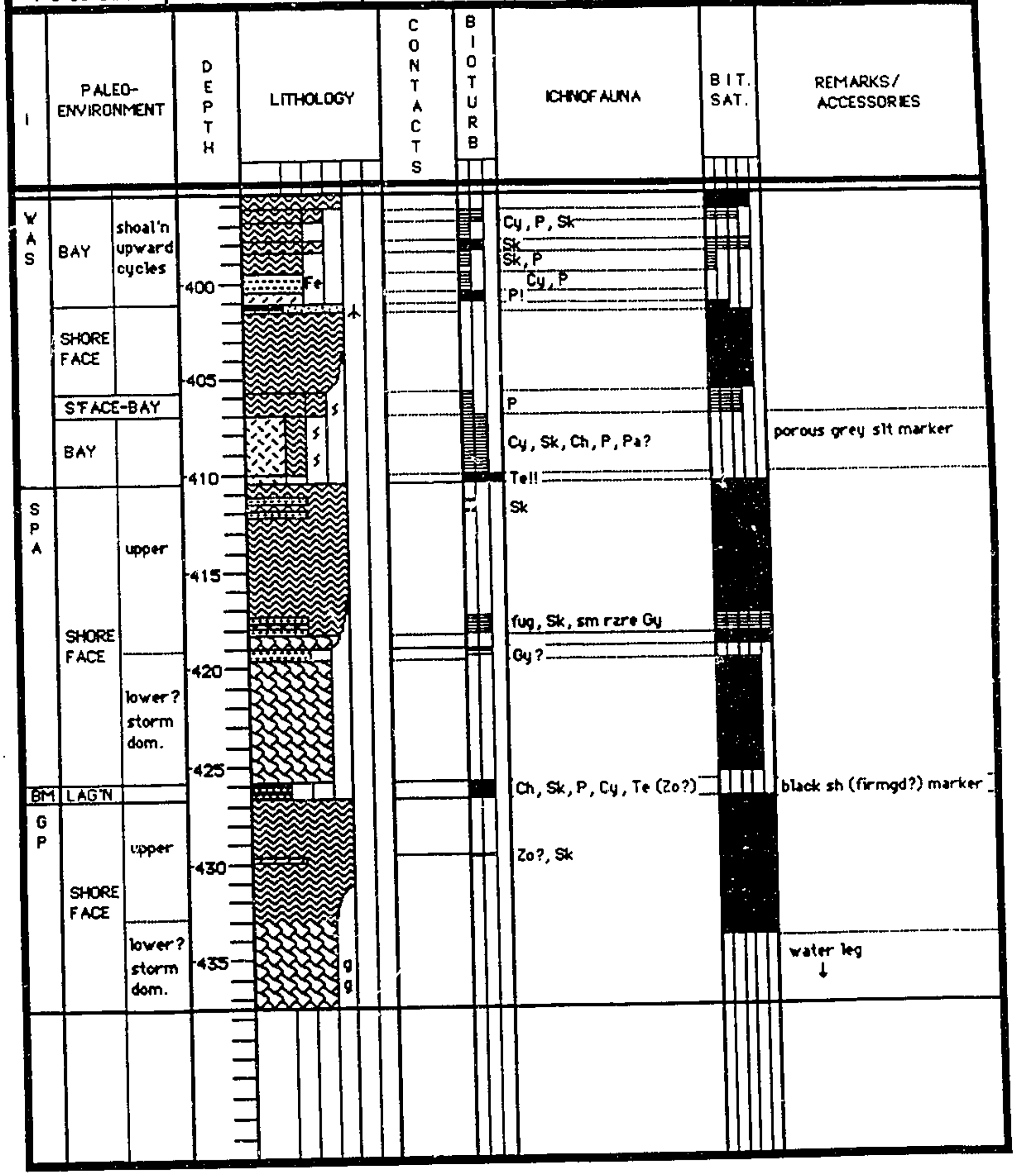
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-34-65-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	311.0-425.0 m	622.1 m	2 OF 3



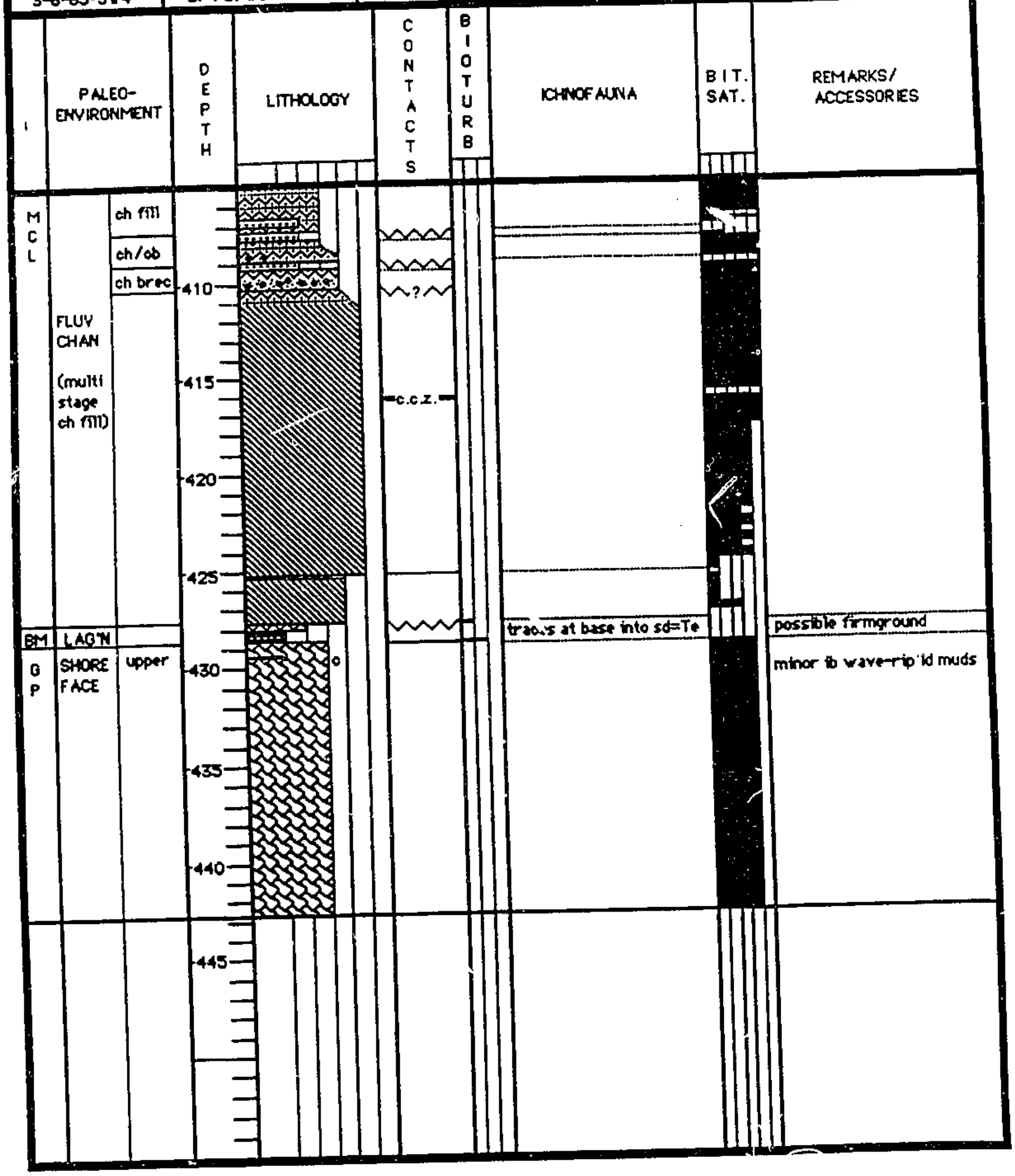
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-34-65-4W4	ESSO 38 COLD LAKE OV	ESSO CANADA RESOURCES	311.0-425.0 m	622.1 m	3 OF 3



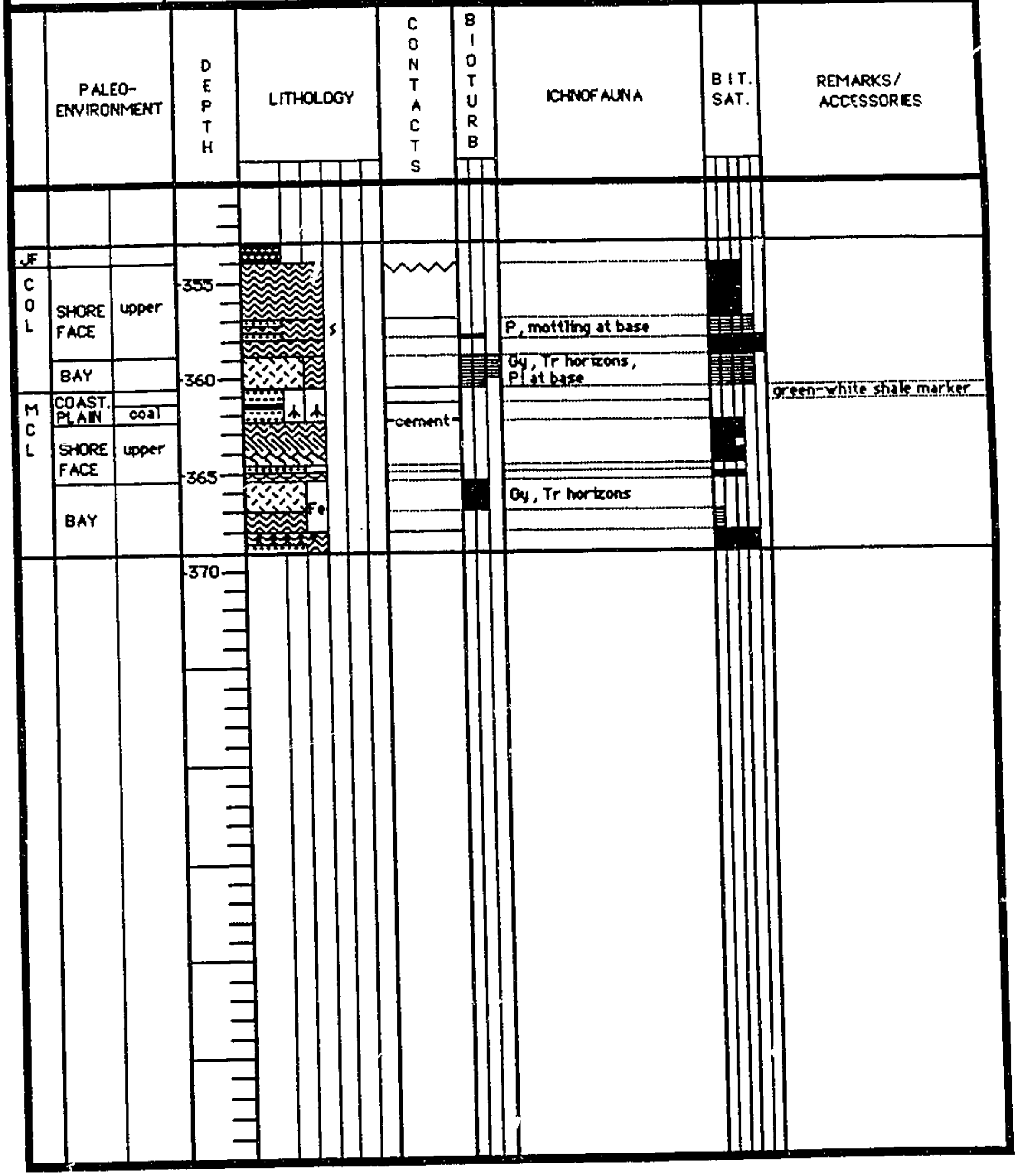
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-5-65-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	395.5-437.5 m	642.1 m	1 OF 1

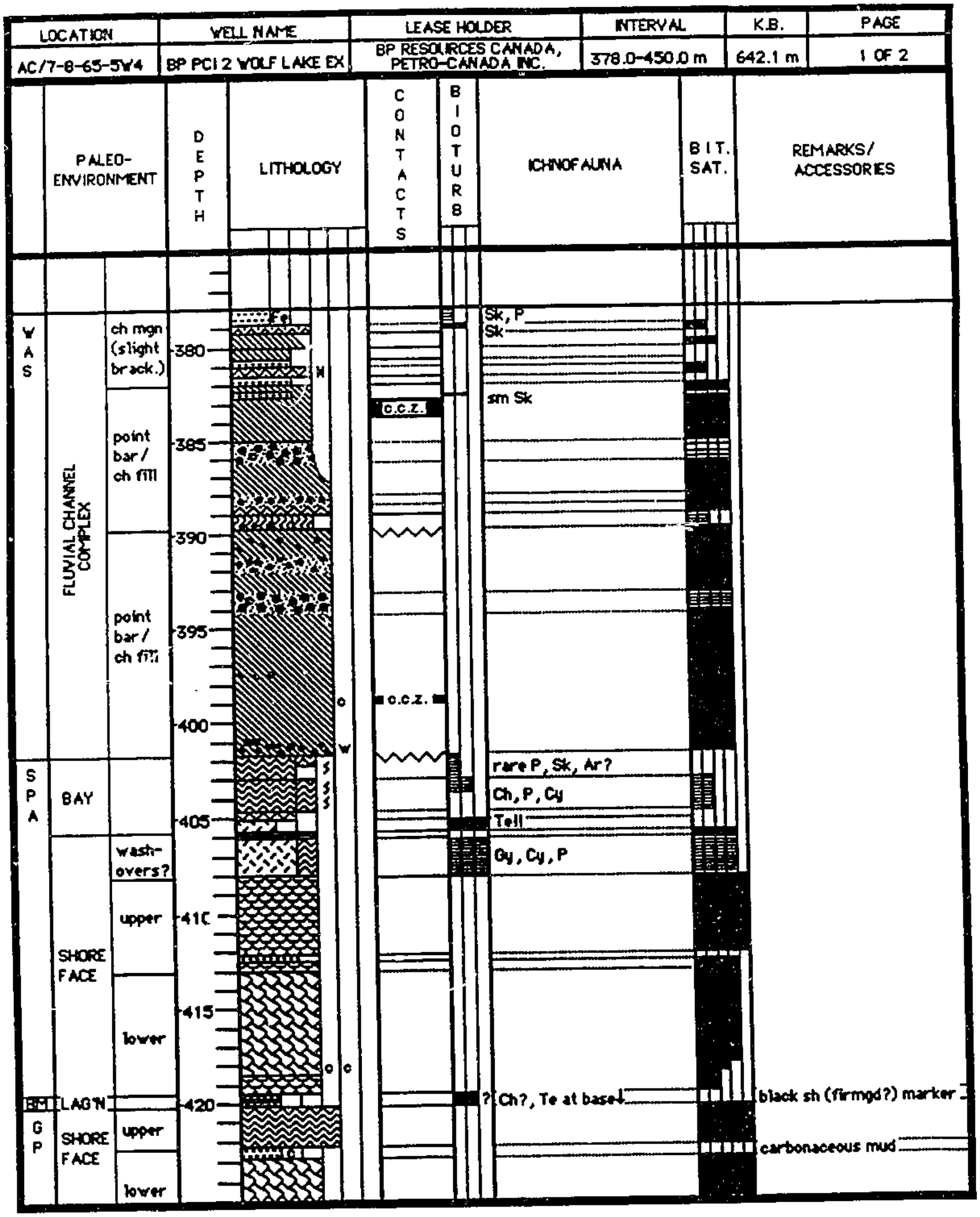


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-6-65-5W4	BP PCI WOLF LAKE	BP PETROLEUM CANADA PETRO-CANADA INC.	405.0-445.0 m	644.33 m	1 OF 1

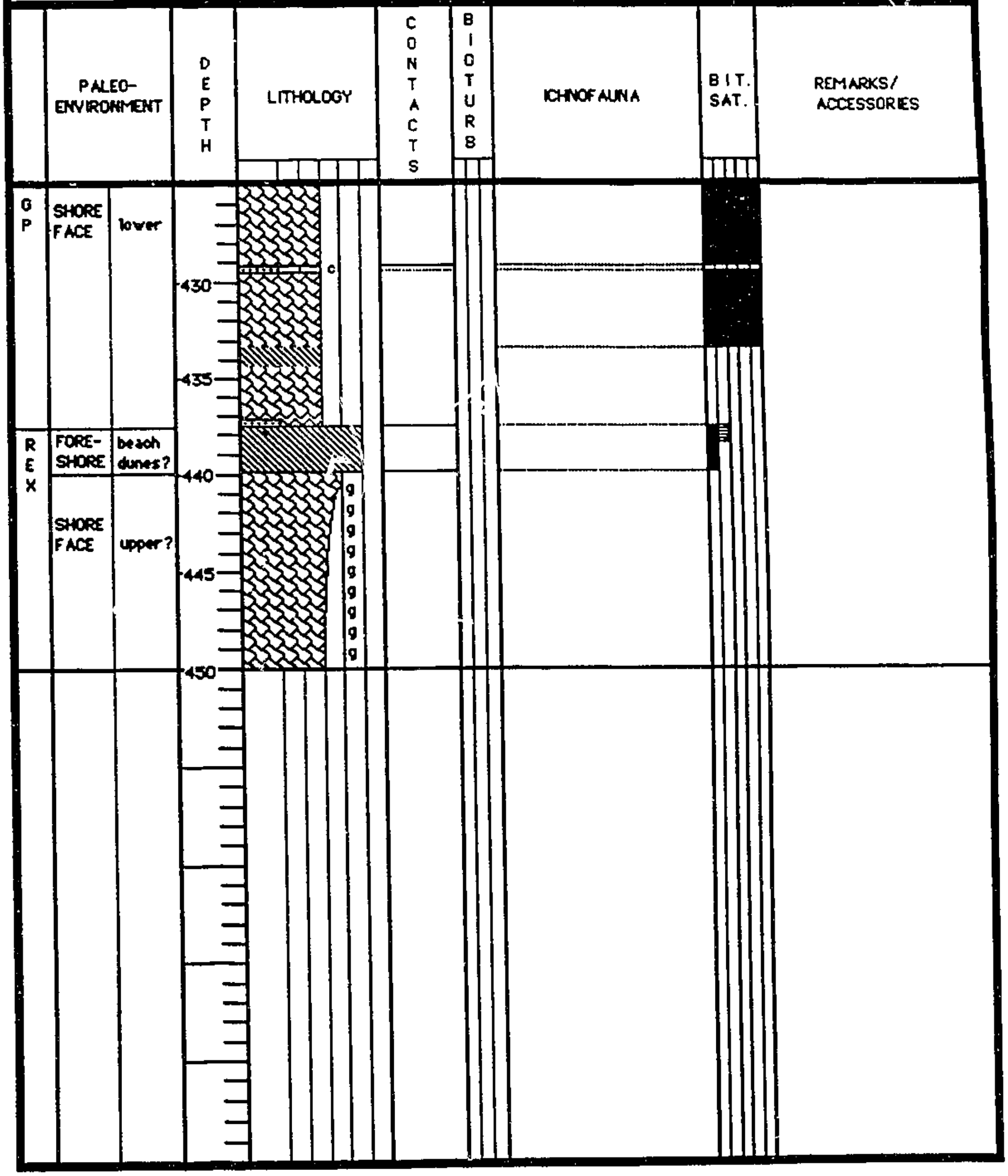


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
AB/7-8-65-5W4	BP PC1 1 WOLF LAKE EX	BP RESOURCES CANADA, PETRO-CANADA INC.	353.0-369.0 m	642.11 m	1 OF 1

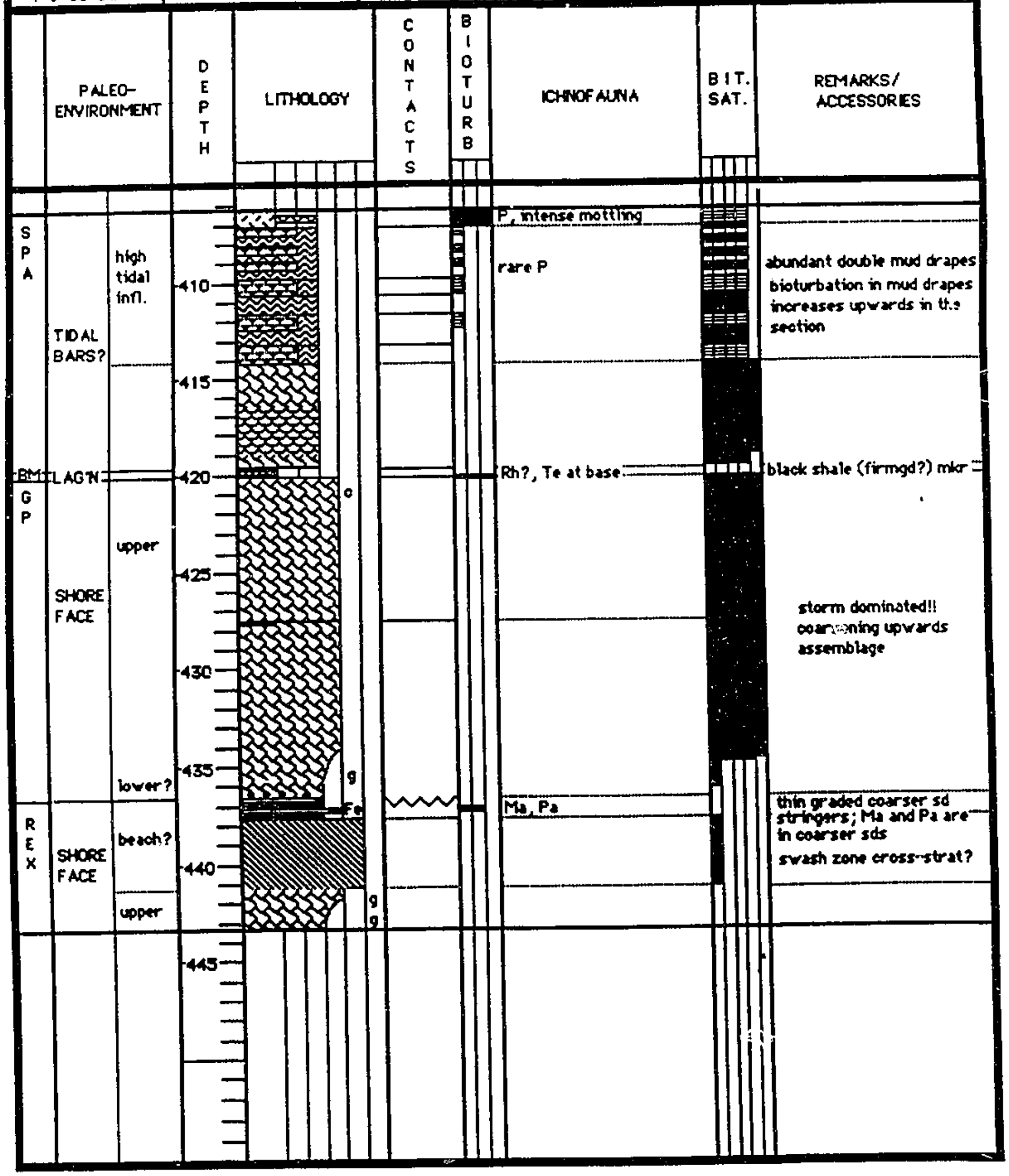



LOCATION
AC/7-8-65-5W4
WELL NAME
BP PCI 2 WOLF LAKE EX
LEASE HOLDER
BP RESOURCES CANADA, PETRO-CANADA INC.
INTERVAL
378.0-450.0 m
K.B.
642.1 m
PAGE
1 OF 2
PALEO-ENVIRONMENT
DEPTH
LITHOLOGY
CONTACTS
BIOTURB
ICHNOFAUNA
BIT. SAT.
REMARKS/ ACCESSORIES
WAS
SPA
GP
FLUVIAL CHANNEL COMPLEX
BAY
SHORE FACE
LAG'N
SHORE FACE
ch mgn (slight brack.)
point bar / ch fill
point bar / ch fill
wash-overs?
upper
lower
upper
lower
380
385
390
395
400
405
410
415
420
Fe
c.c.z.
c.c.z.
Sk, P
Sk
sm Sk
rare P, Sk, Ar?
Ch, P, Cy
Teil
Gy, Cy, P
? Ch?, Te at base
black sh (firmgd?) marker
carbonaceous mud

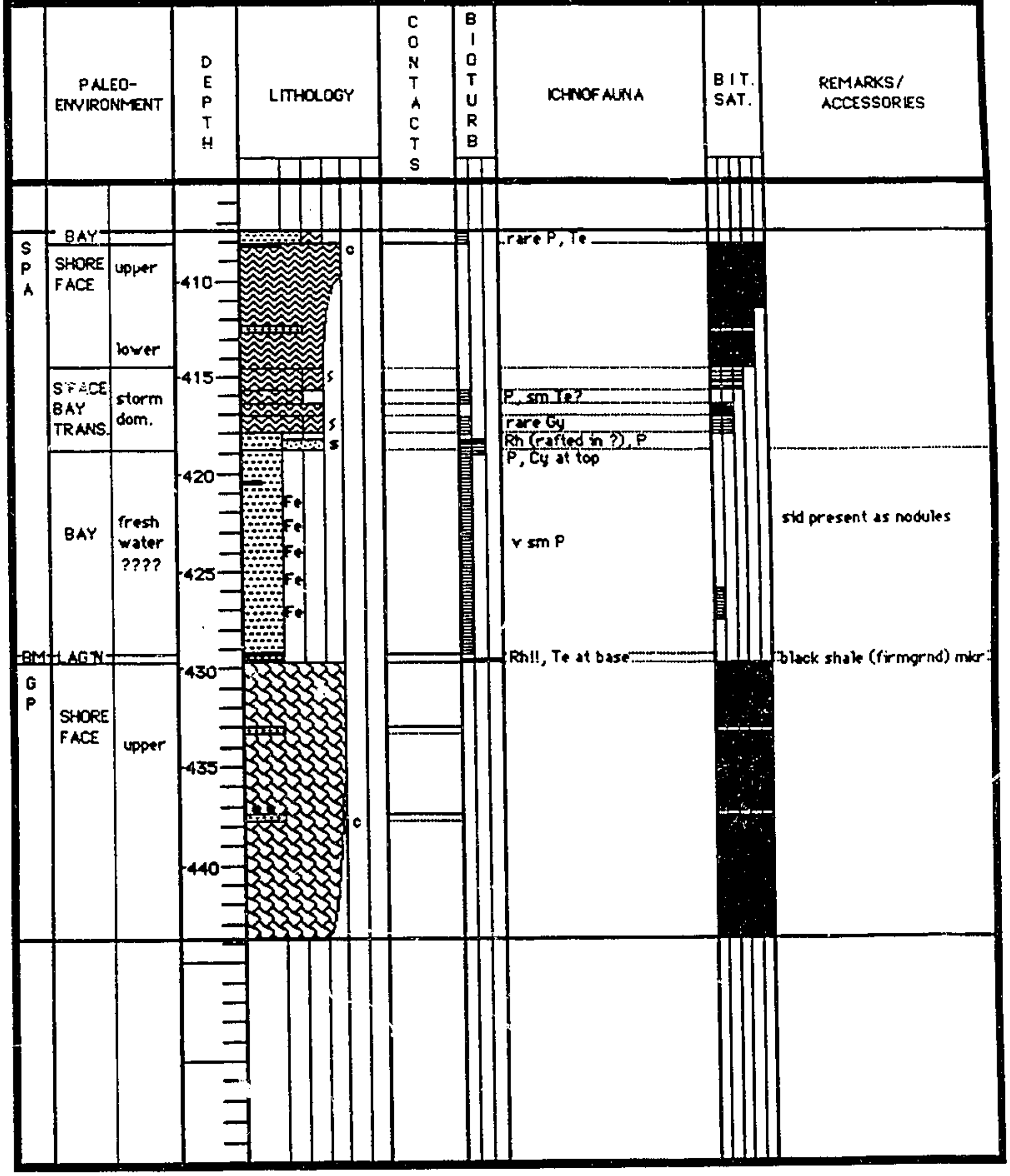
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
AC/7-8-65-5W4	BP PCI 2 WOLF LAKE EX	BP RESOURCES CANADA, PETRO-CANADA INC.	378.0-450.0 m	642.1 m	2 OF 2



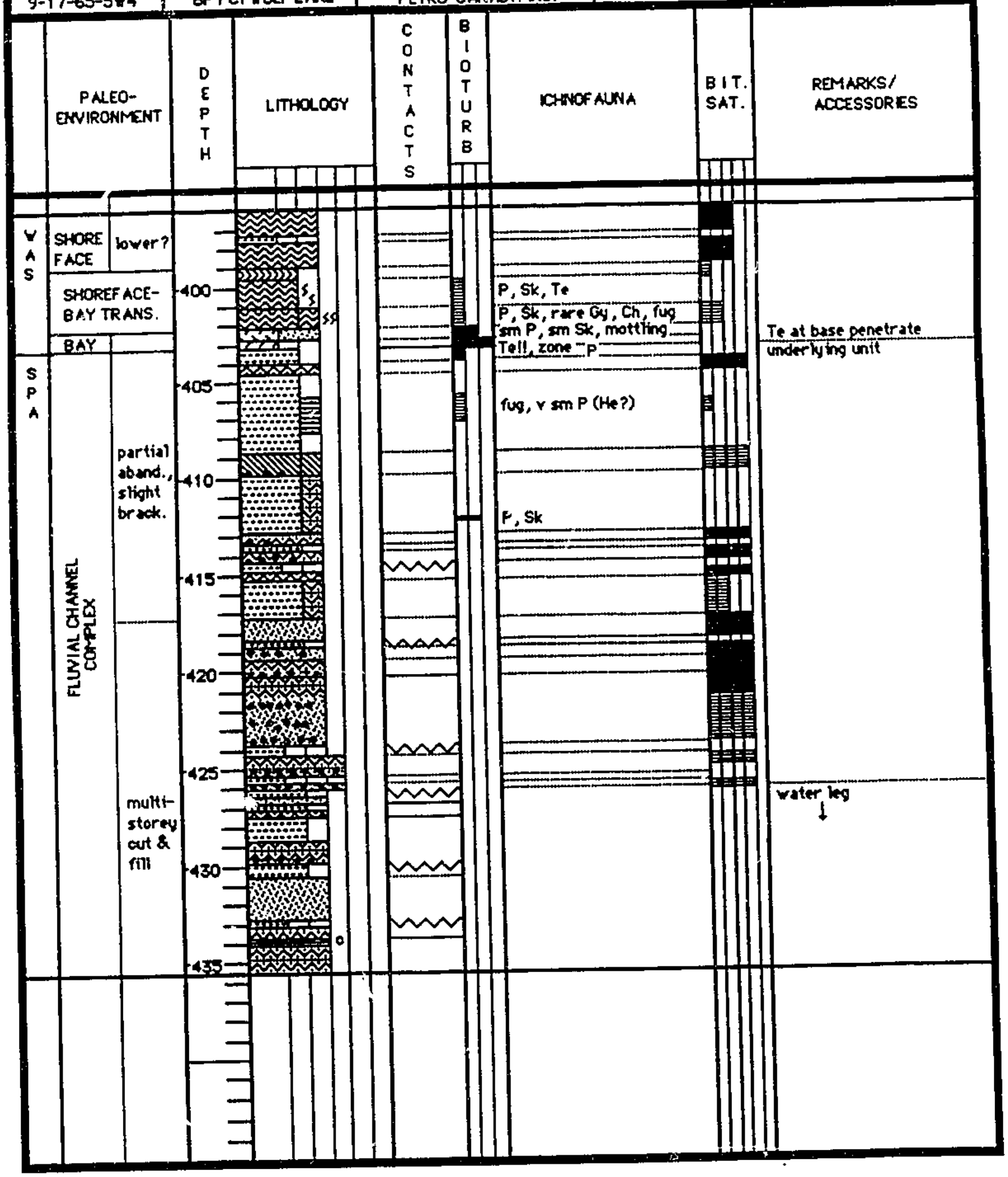
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-9-65-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	406.3-443.25 m	646.17 m	1 OF 1



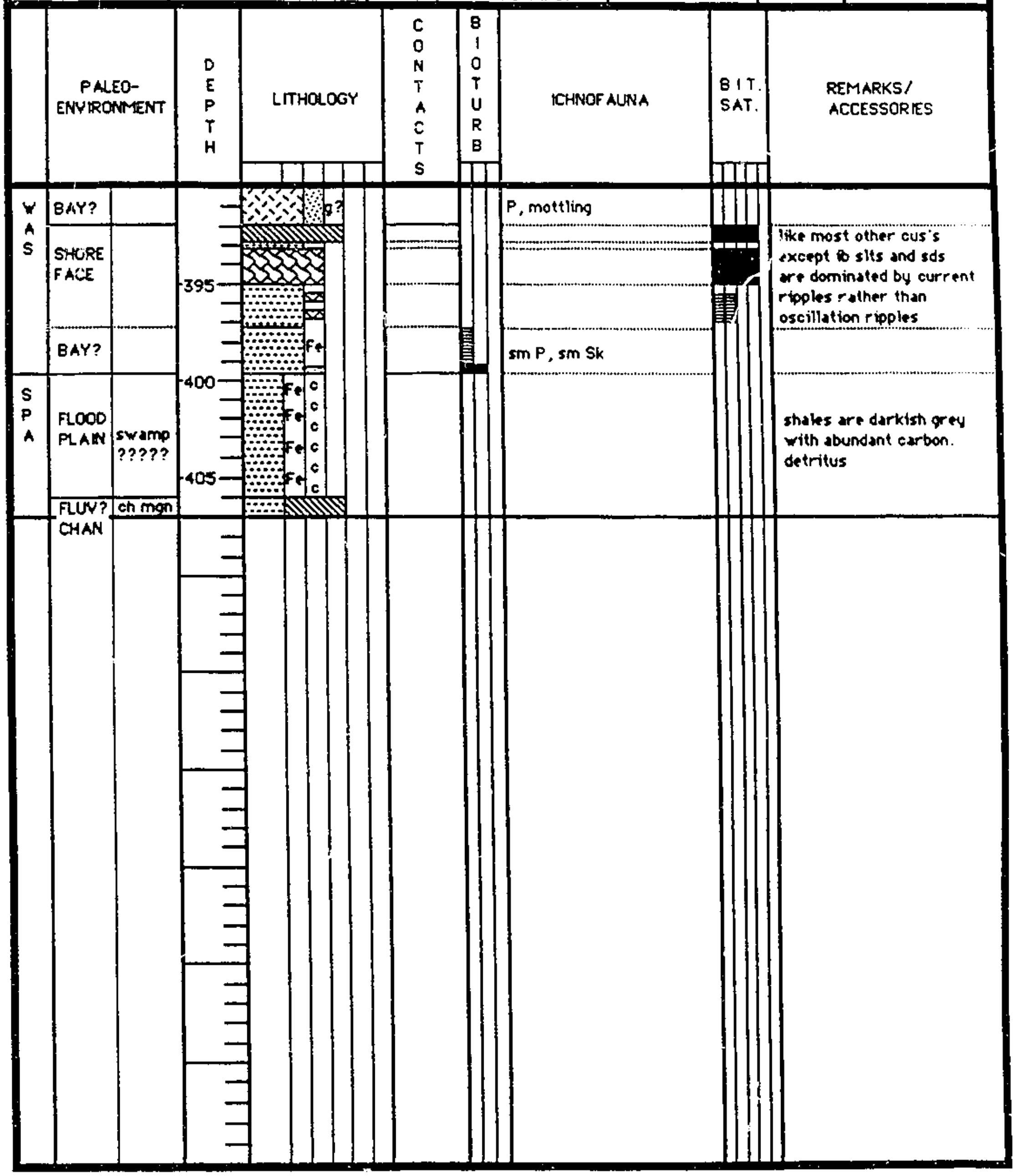
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-15-65-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	407.5-443.75 m	656.8 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
9-17-65-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	396.0-437.5 m	640.9 m	1 OF 1



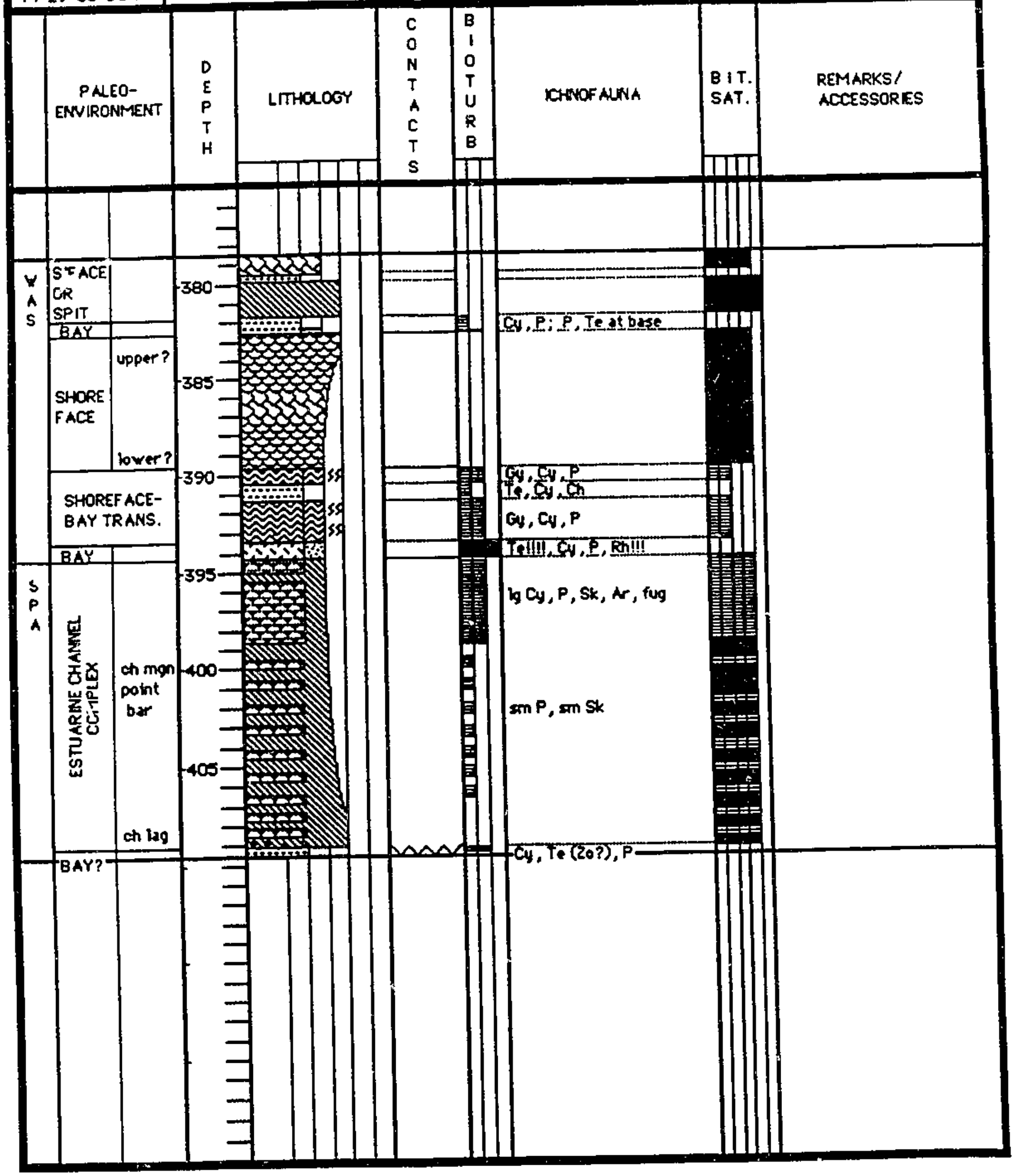
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-21-65-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	390.0–407.0 m	648.45 m	1 OF 1



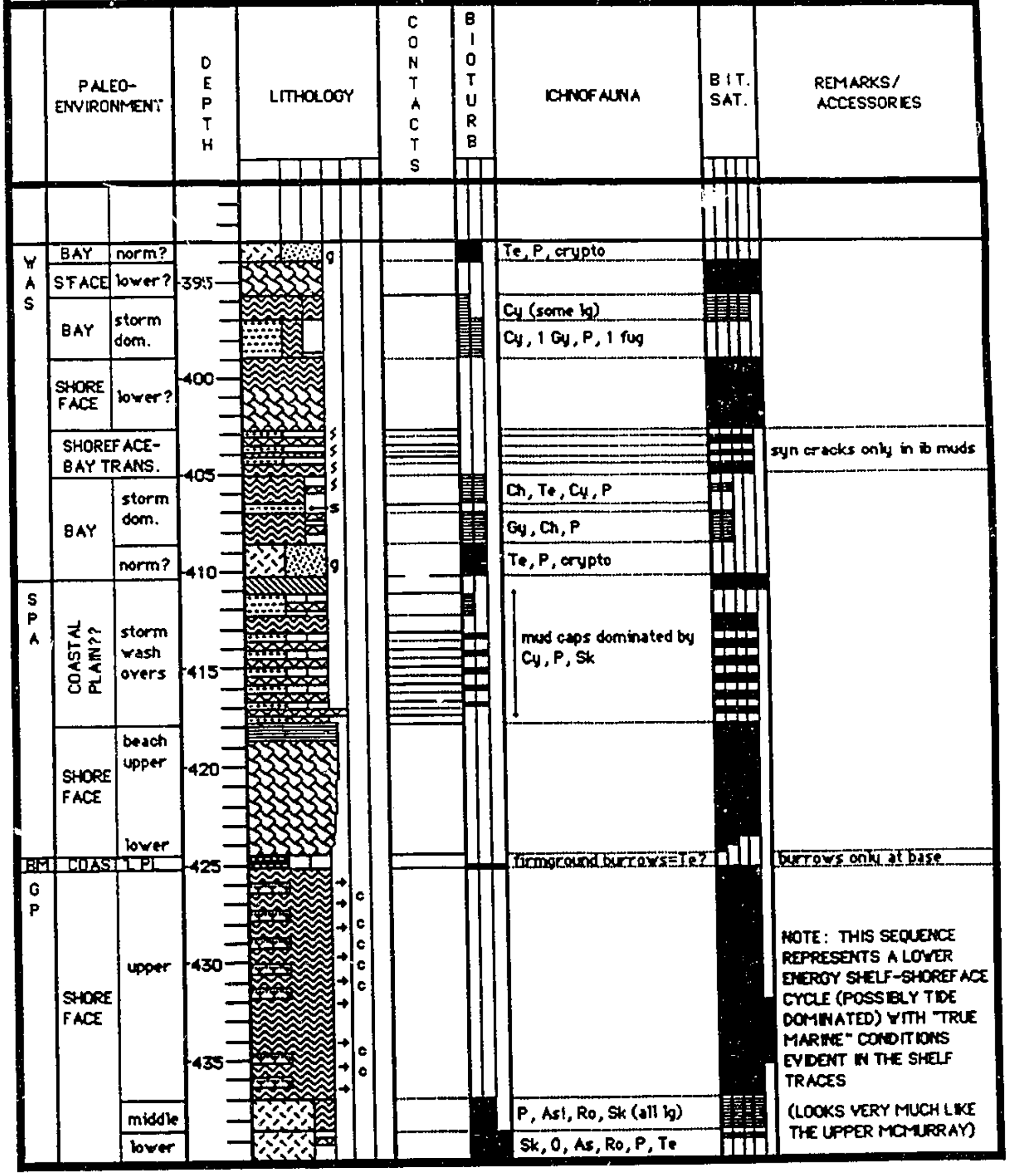
like most other cus's except fb slts and sds are dominated by current ripples rather than oscillation ripples

shales are darkish grey with abundant carbon. detritus

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-29-65-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	378.5–409.25 m	644.04 m	1 OF 1



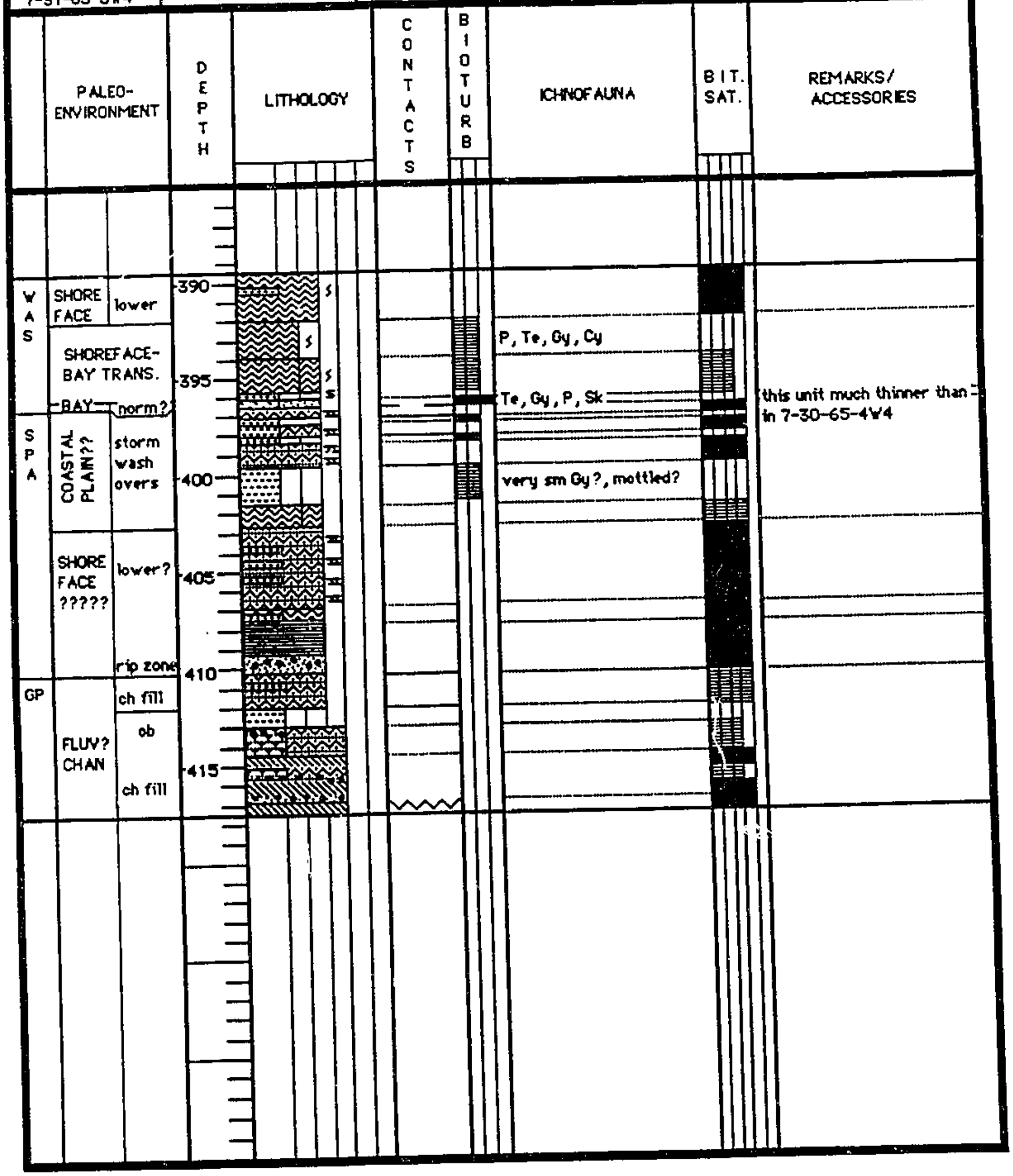
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-30-65-5W4	BP PCI WOLF LAKE	BP PETROLEUM CANADA PETRO-CANADA INC.	393.0-440.0 m	655.86 m	1 OF 1



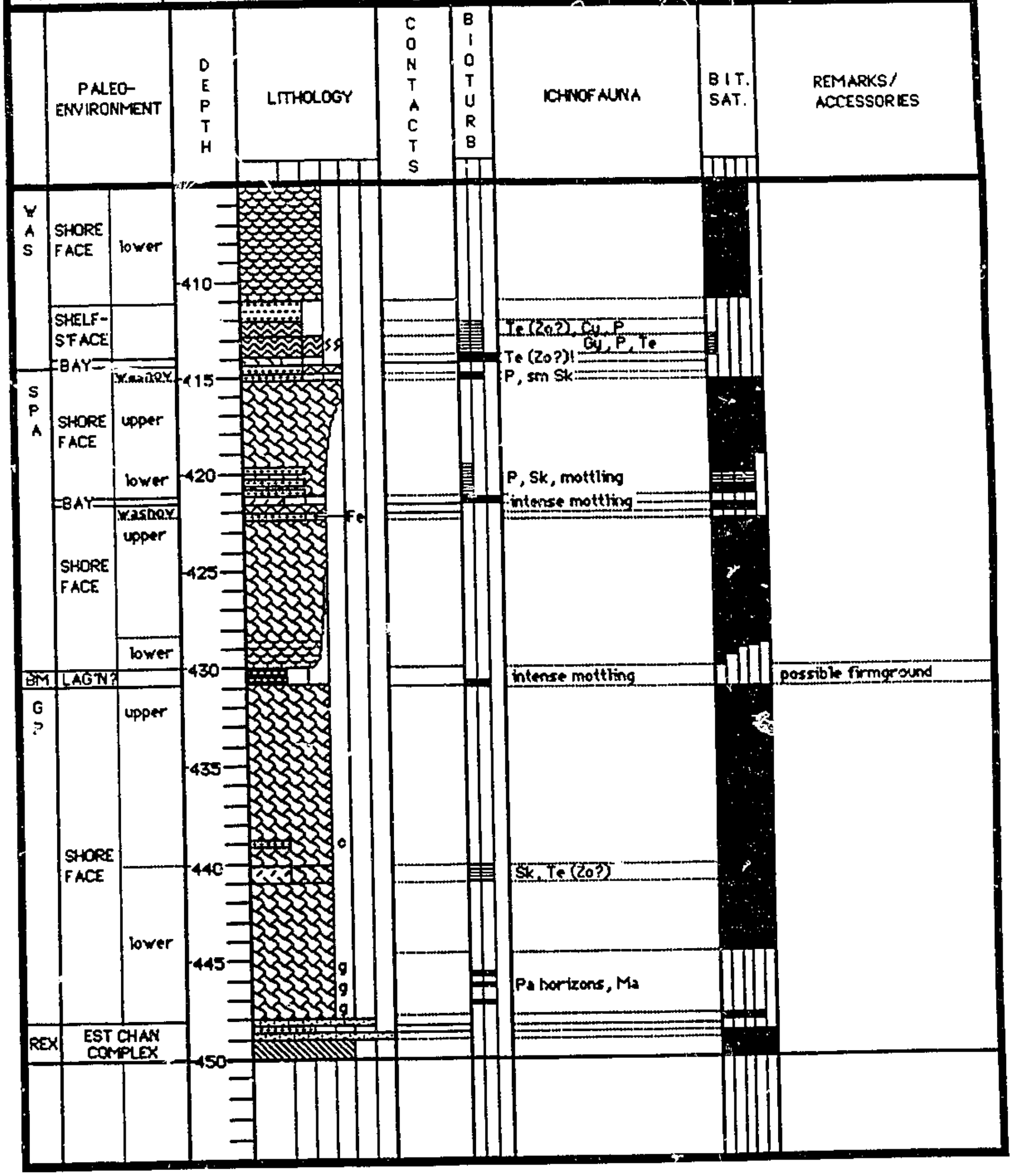
NOTE: THIS SEQUENCE REPRESENTS A LOWER ENERGY SHELF-SHOREFACE CYCLE (POSSIBLY TIDE DOMINATED) WITH "TRUE MARINE" CONDITIONS EVIDENT IN THE SHELF TRACES

(LOOKS VERY MUCH LIKE THE UPPER MCMURRAY)

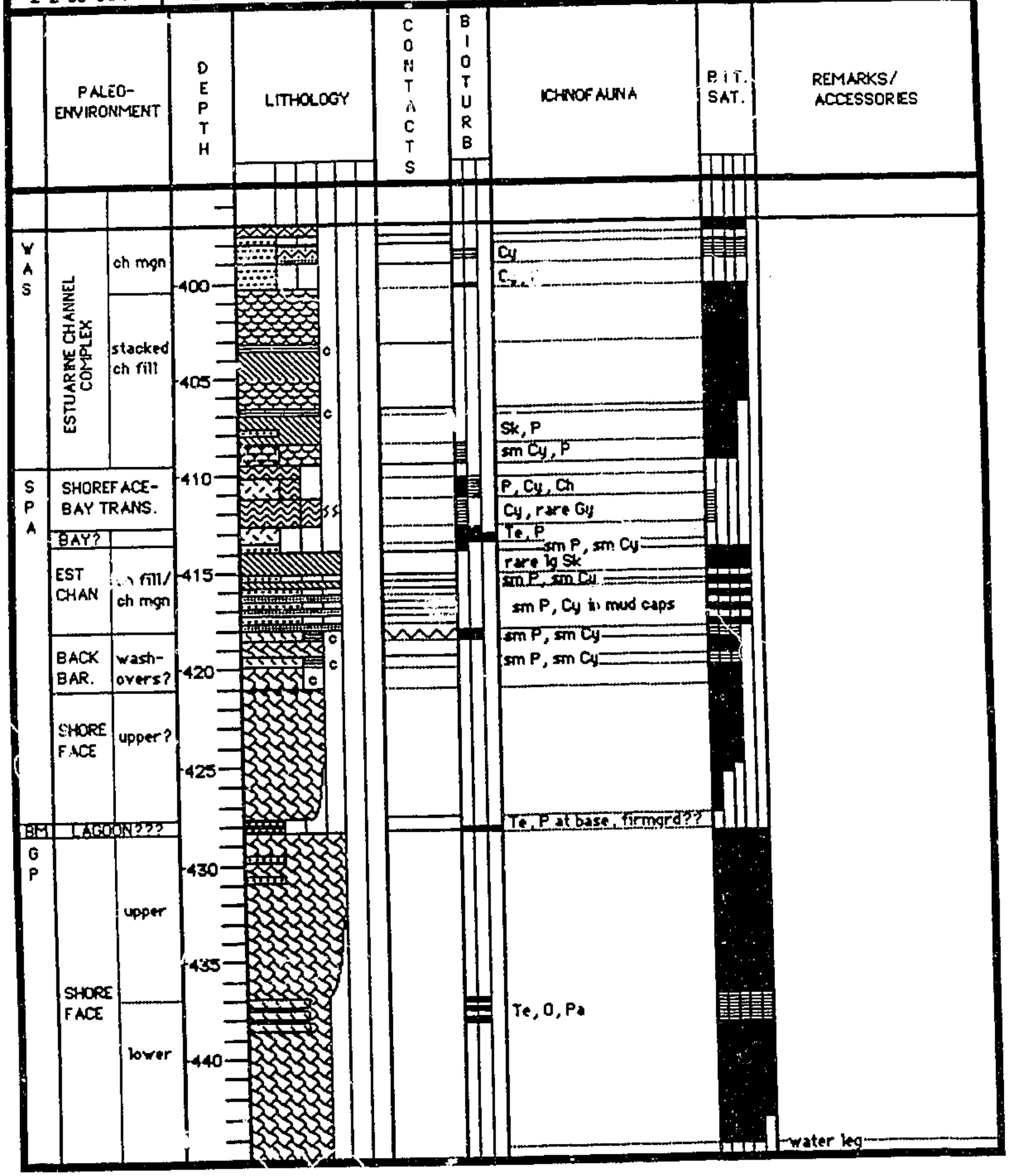
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-31-65-5W4	BP LEMING	BP PETROLEUM CANADA PETRO-CANADA INC.	389.4-417.5 m	650.4 m	1 OF 1



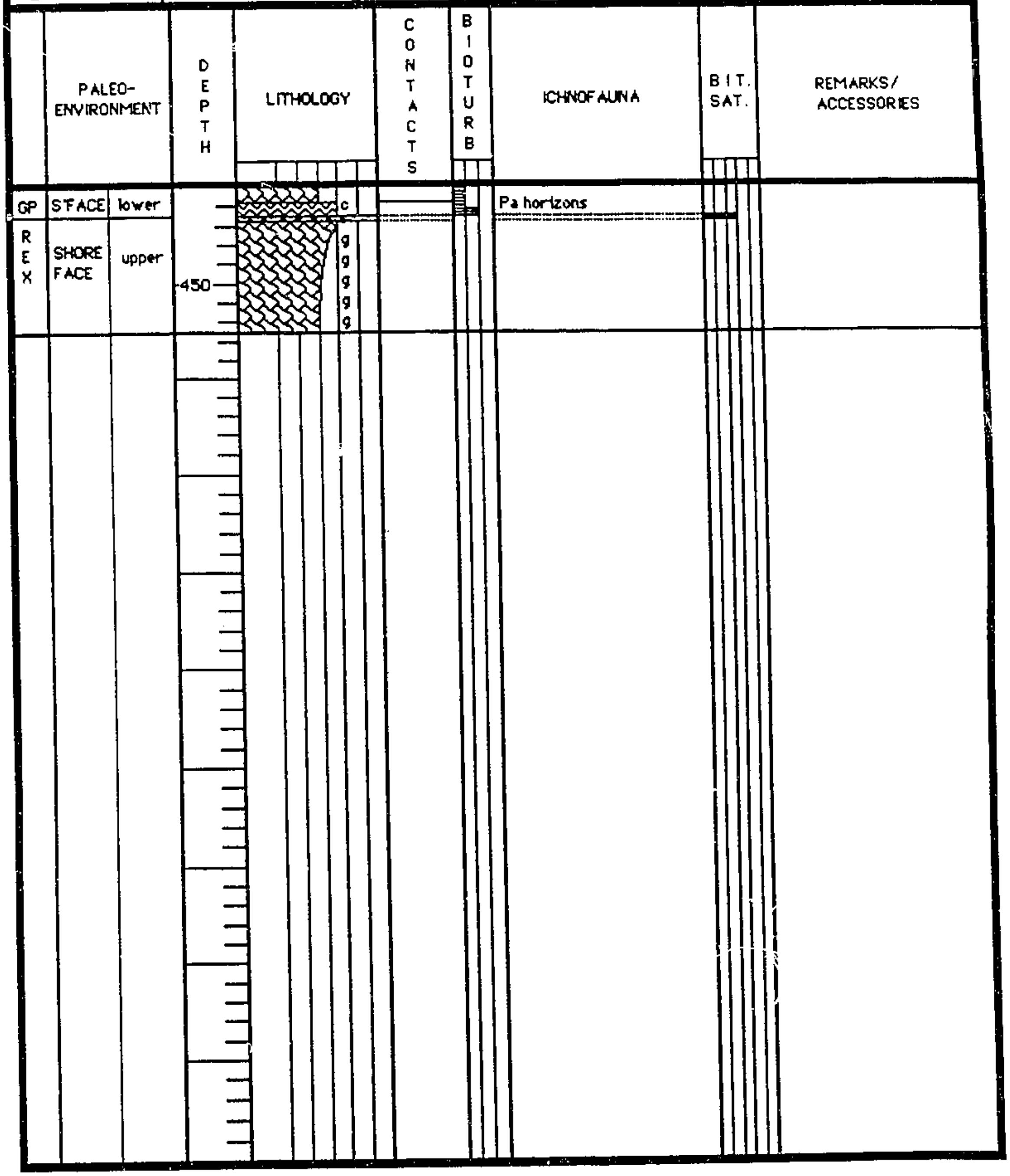
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-1-65-6W4	BP MARGUERITE LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	405.0-450.0 m	653.8 m	1 OF 1



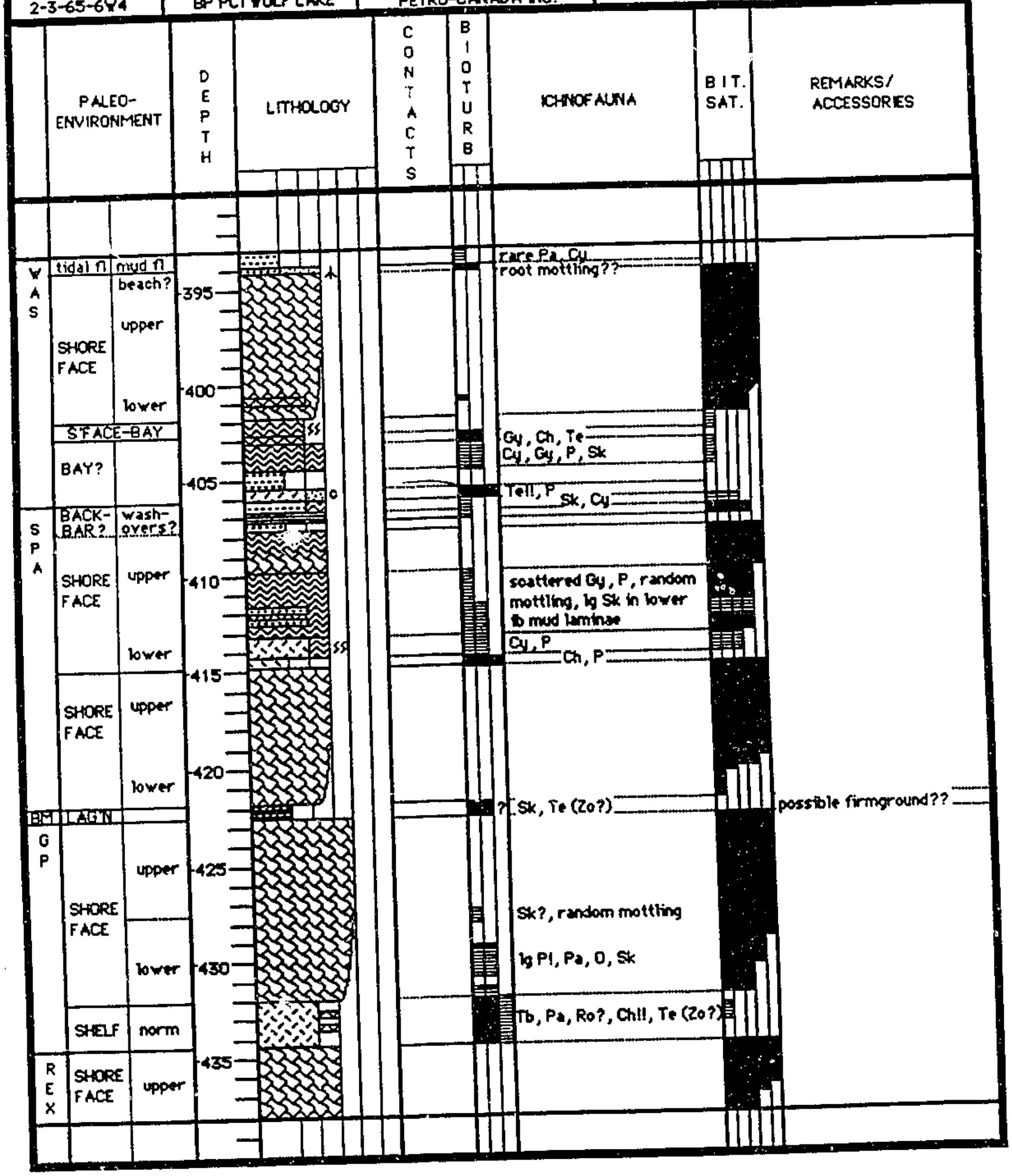
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-2-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	397.0-452.5 m	647.7 m	1 OF 2



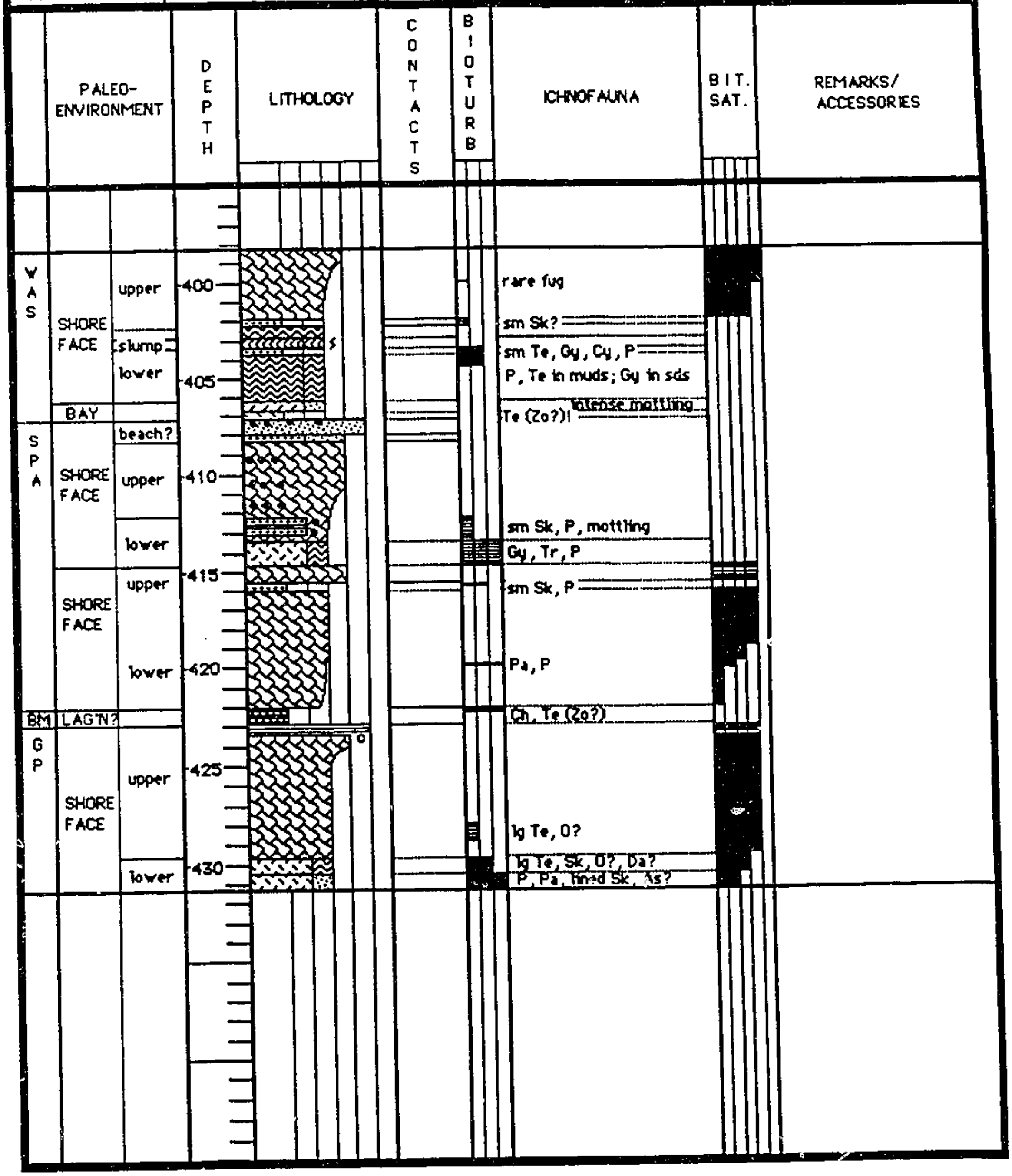
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-2-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	397.0-452.5 m	647.7 m	2 OF 2



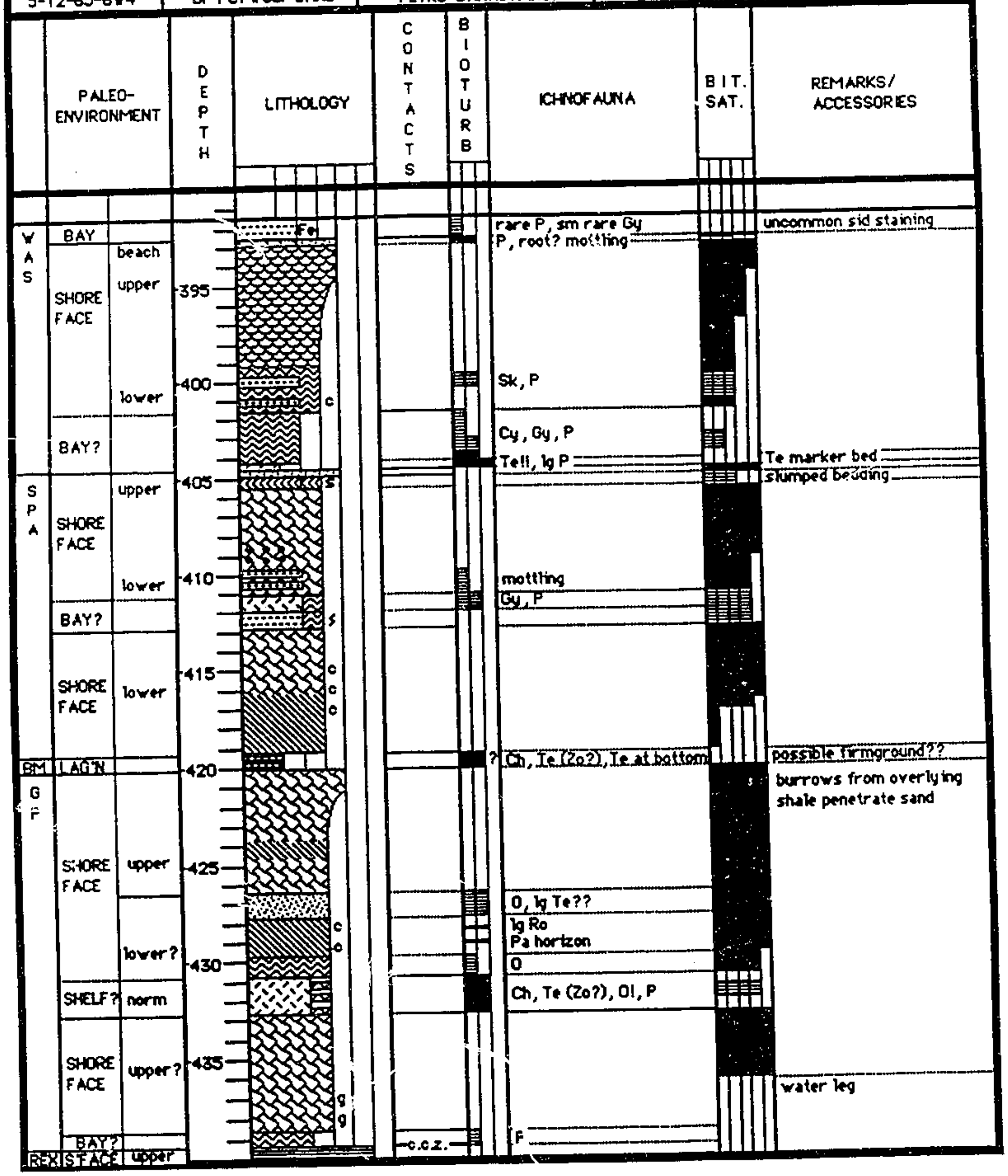
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
2-3-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	393.0-438.2 m	644.0 m	1 OF 1



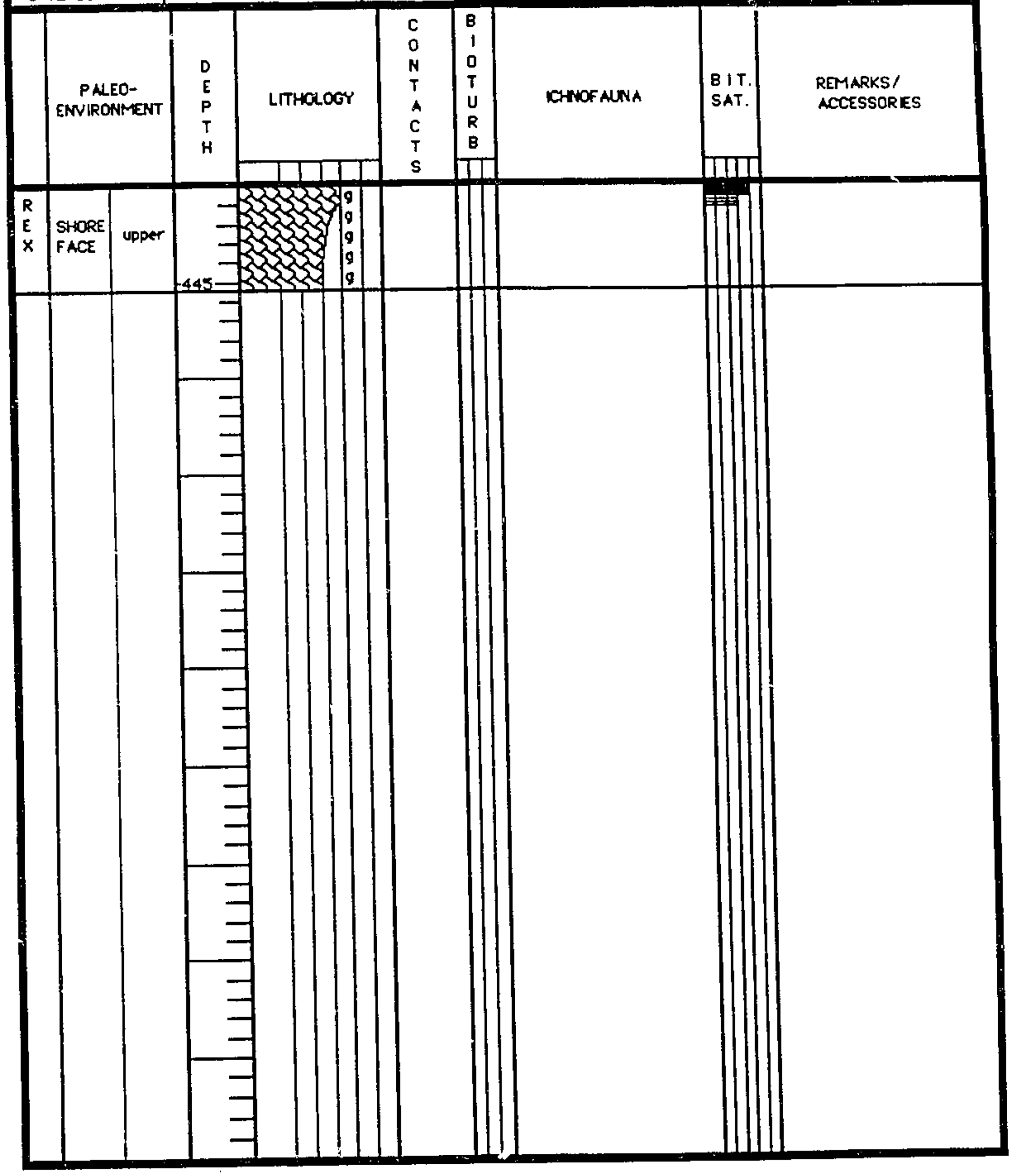
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-11-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	398.25-431.25 m	646.5 m	1 OF 1



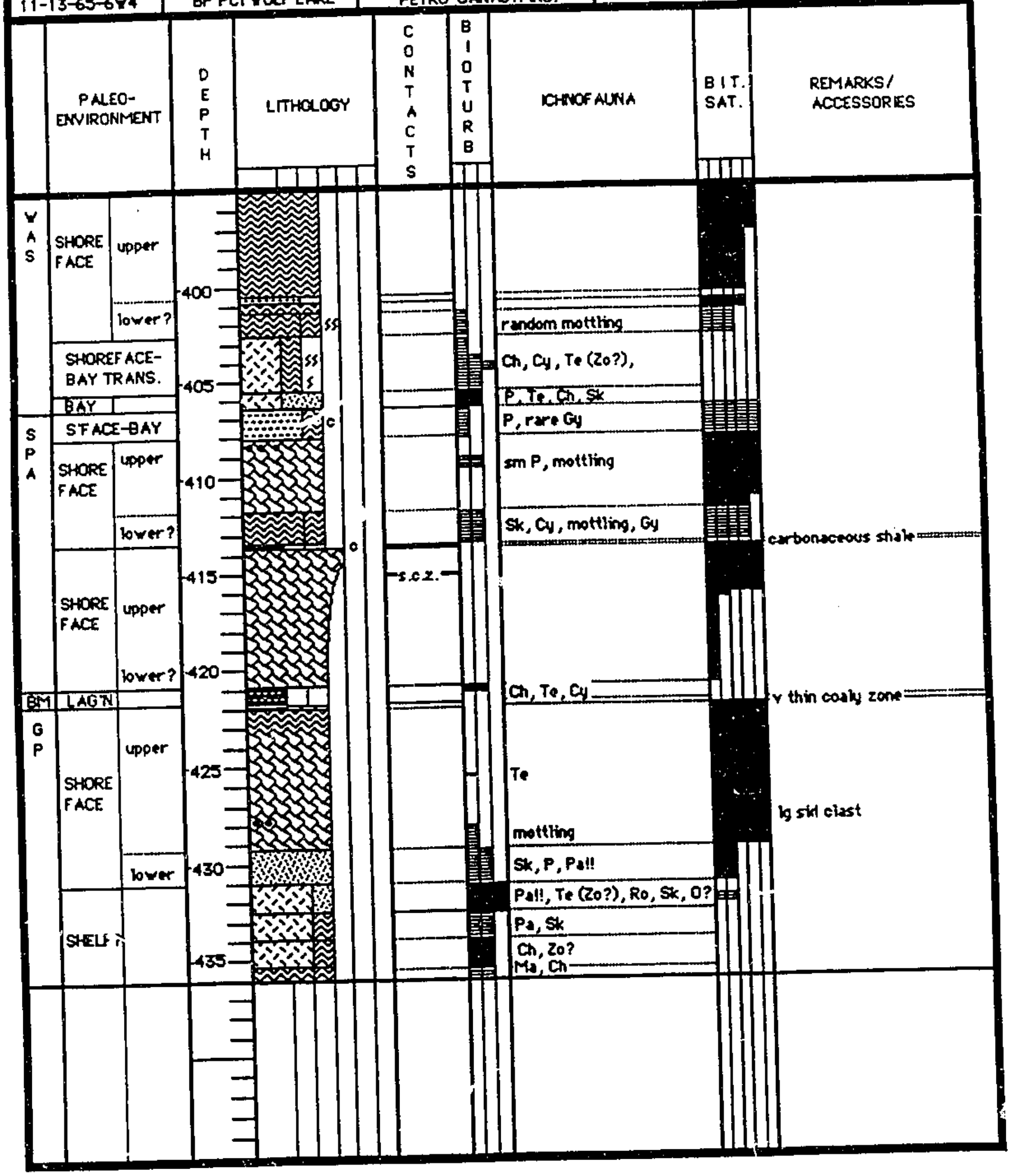
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-12-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	391.5-445.25 m	644.6 m	1 OF 2



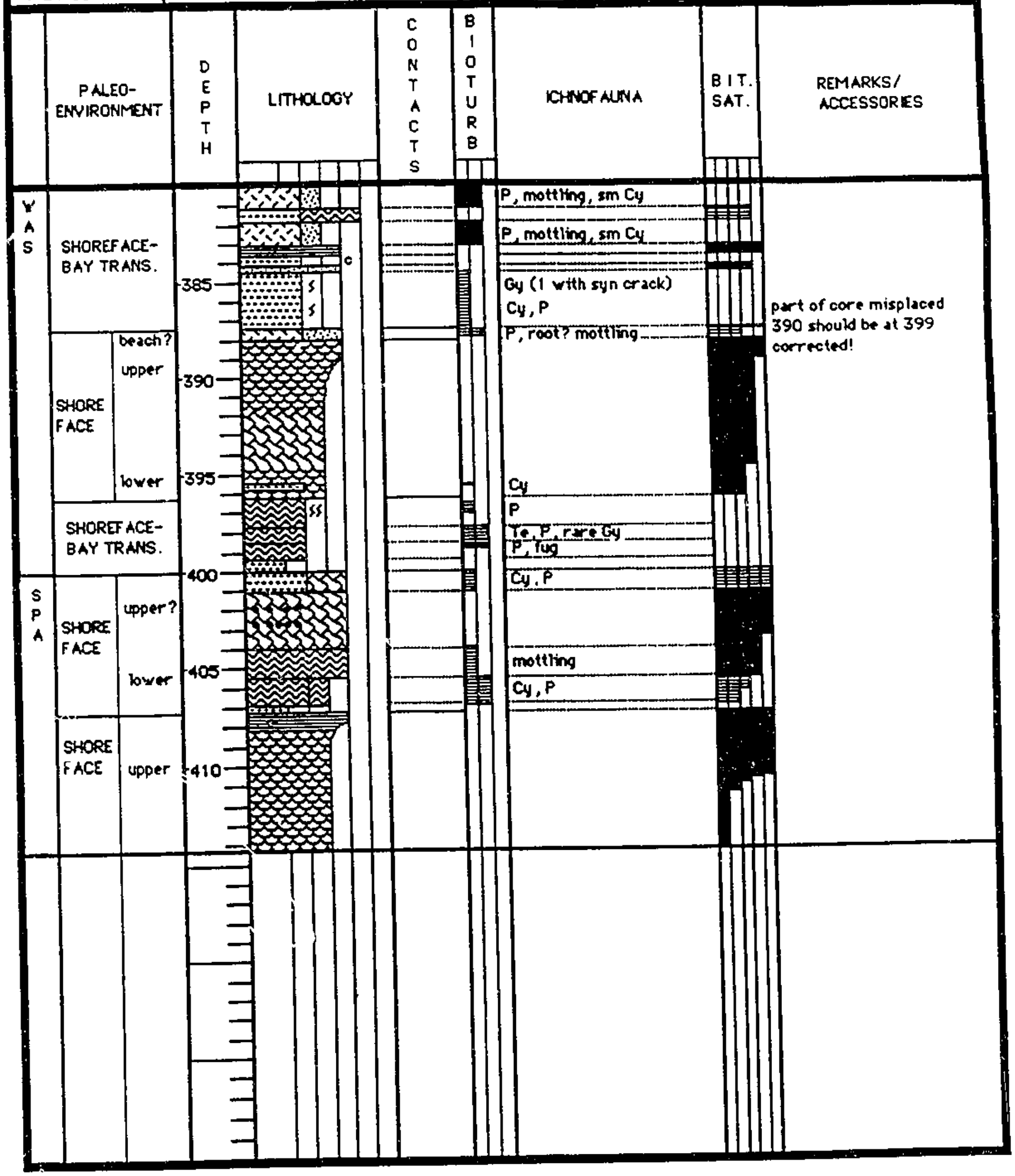
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-12-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	391.5-445.25 m	644.6 m	2 OF 2



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-13-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	395.0-436.0 m	644.8 m	1 OF 1

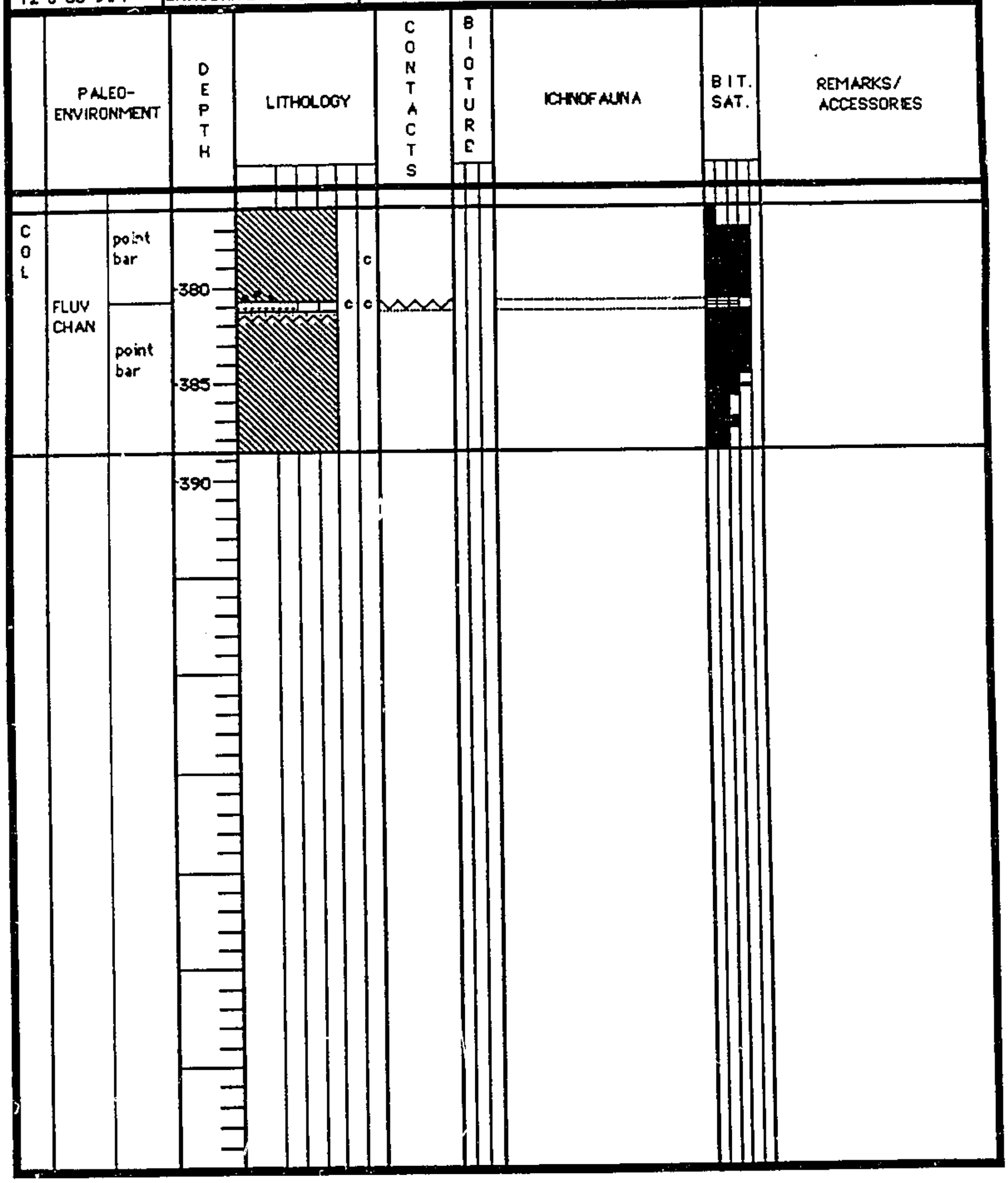


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-24-65-6W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	380.0-413.0 m	640.1 m	1 OF 1

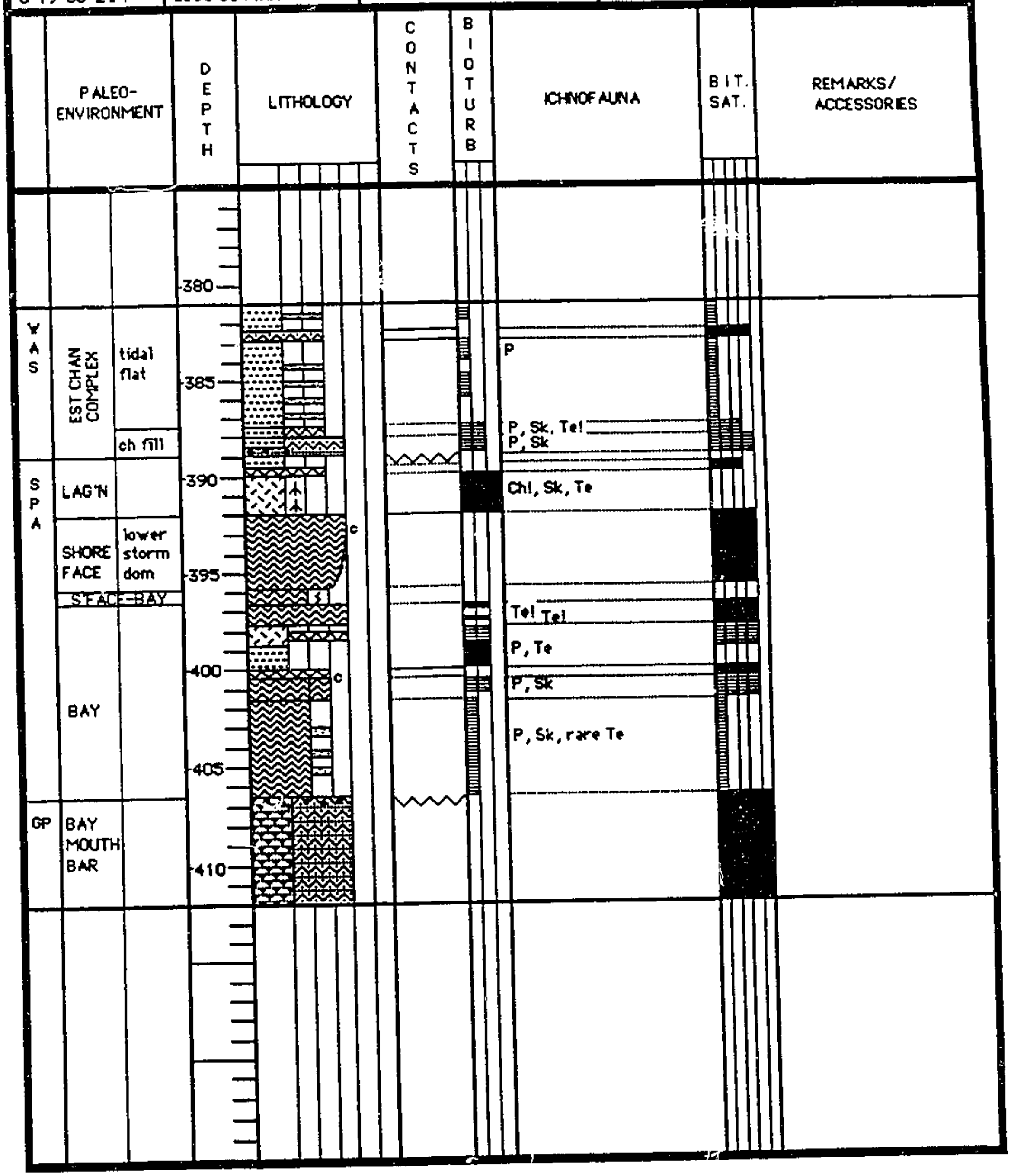


part of core misplaced
390 should be at 399
corrected!

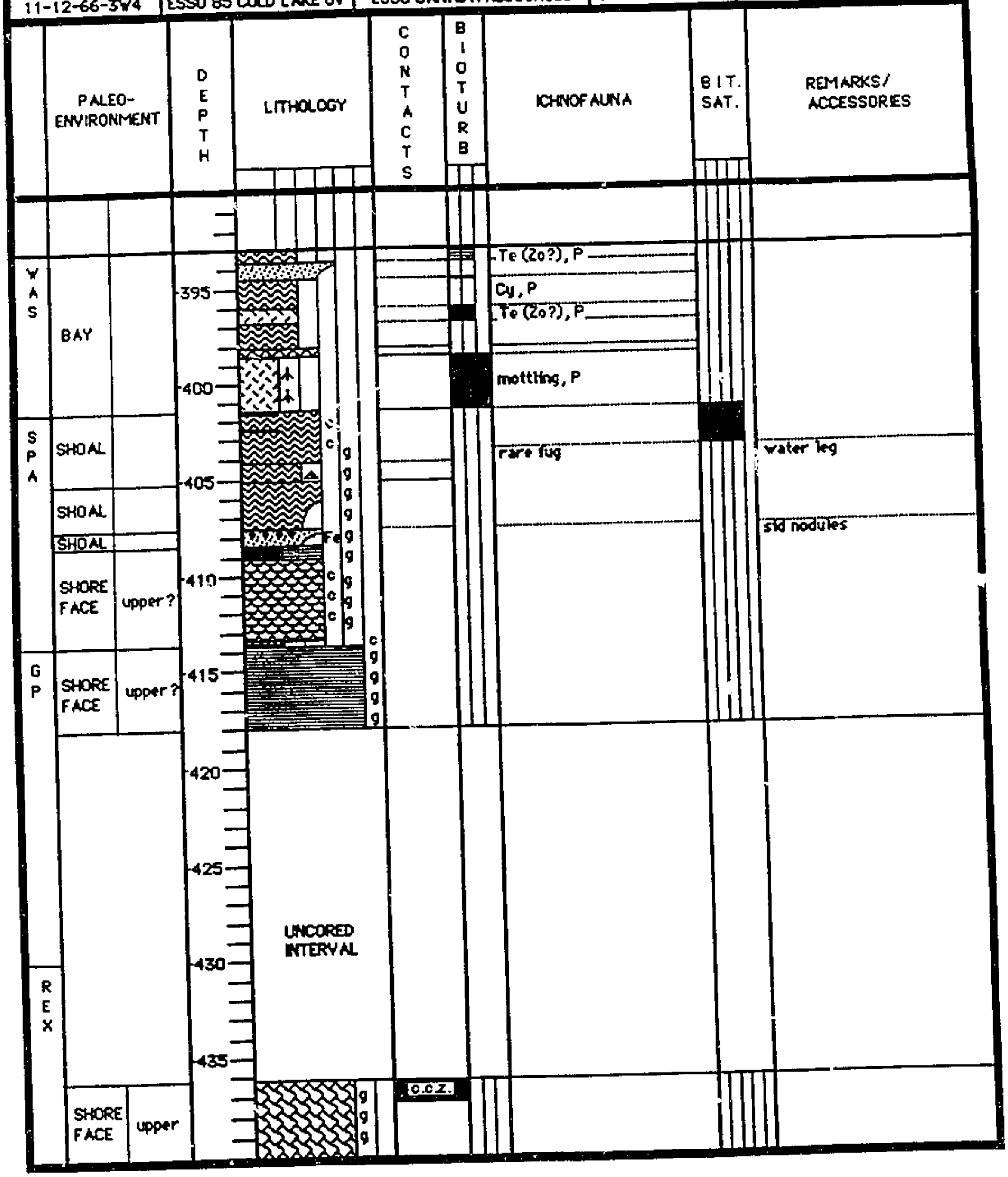
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-6-65-9W4	BRASCAN ET AL SUGDEN	BRASCAN AND OTHERS	376.0-393.5 m	637.6 m	1 OF 1



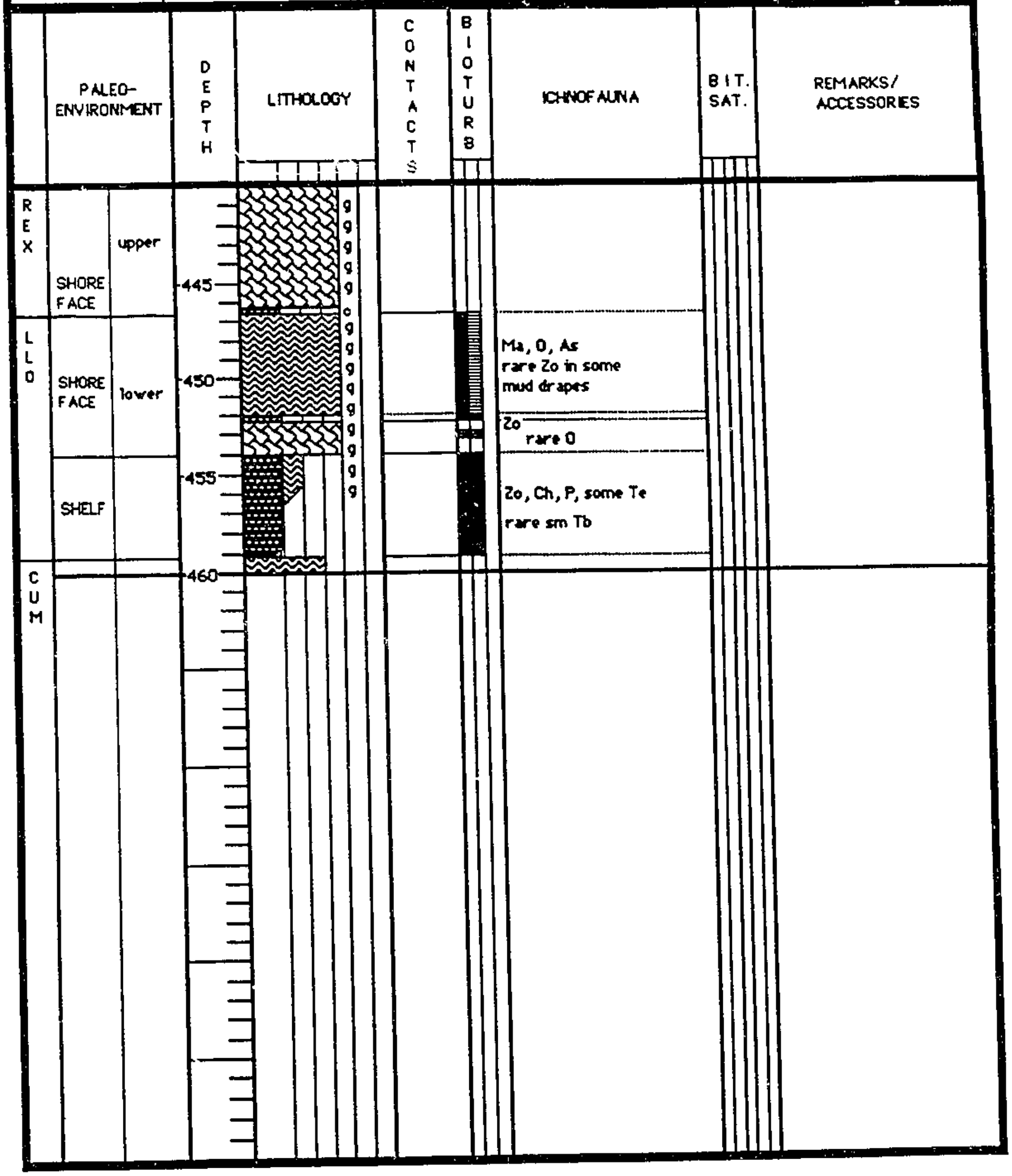
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
8-19-66-2W4	ESSO 86 MARIE 8-19	ESSO CANADA RESOURCES	381.0-412.0 m	621.0 m	1 OF 1



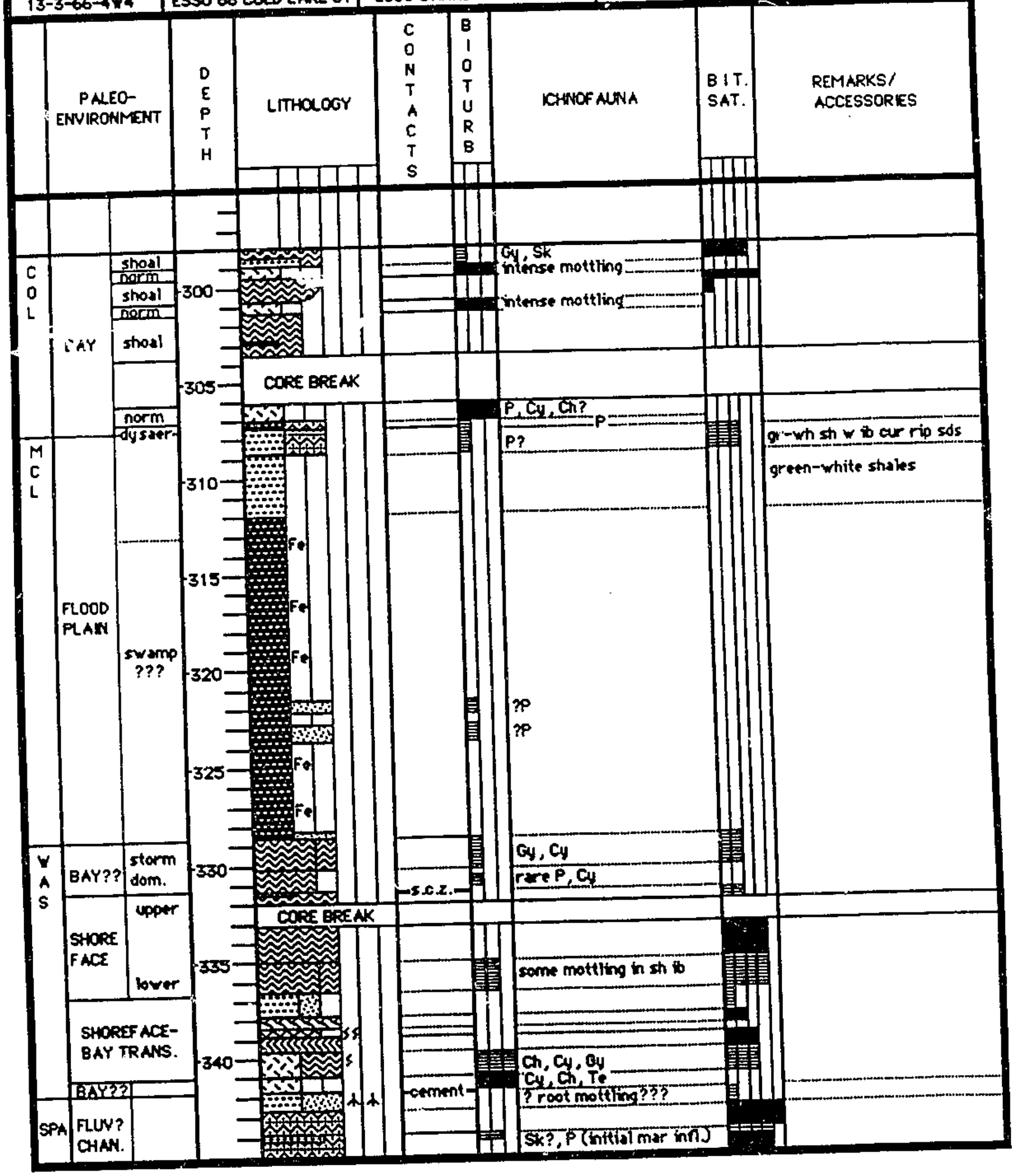
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-12-66-3W4	ESSO 85 COLD LAKE OV	ESSO CANADA RESOURCES	393.0 -460.0 m	610.6 m	1 OF 2



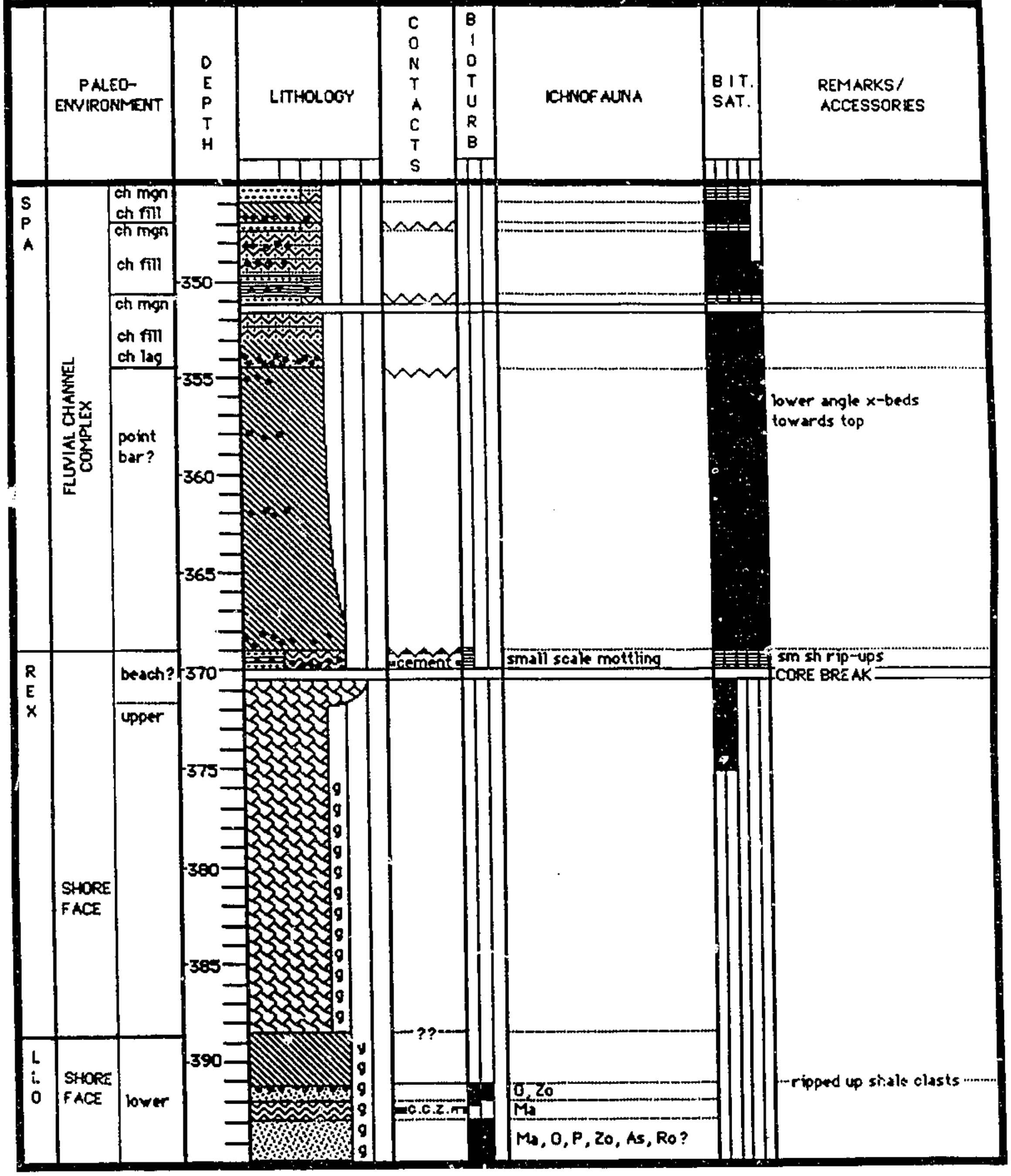
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-12-66-3W4	ESSO 85 COLD LAKE OV	ESSO CANADA RESOURCES	393.0 -460.0 m	610.6 m	2 OF 2



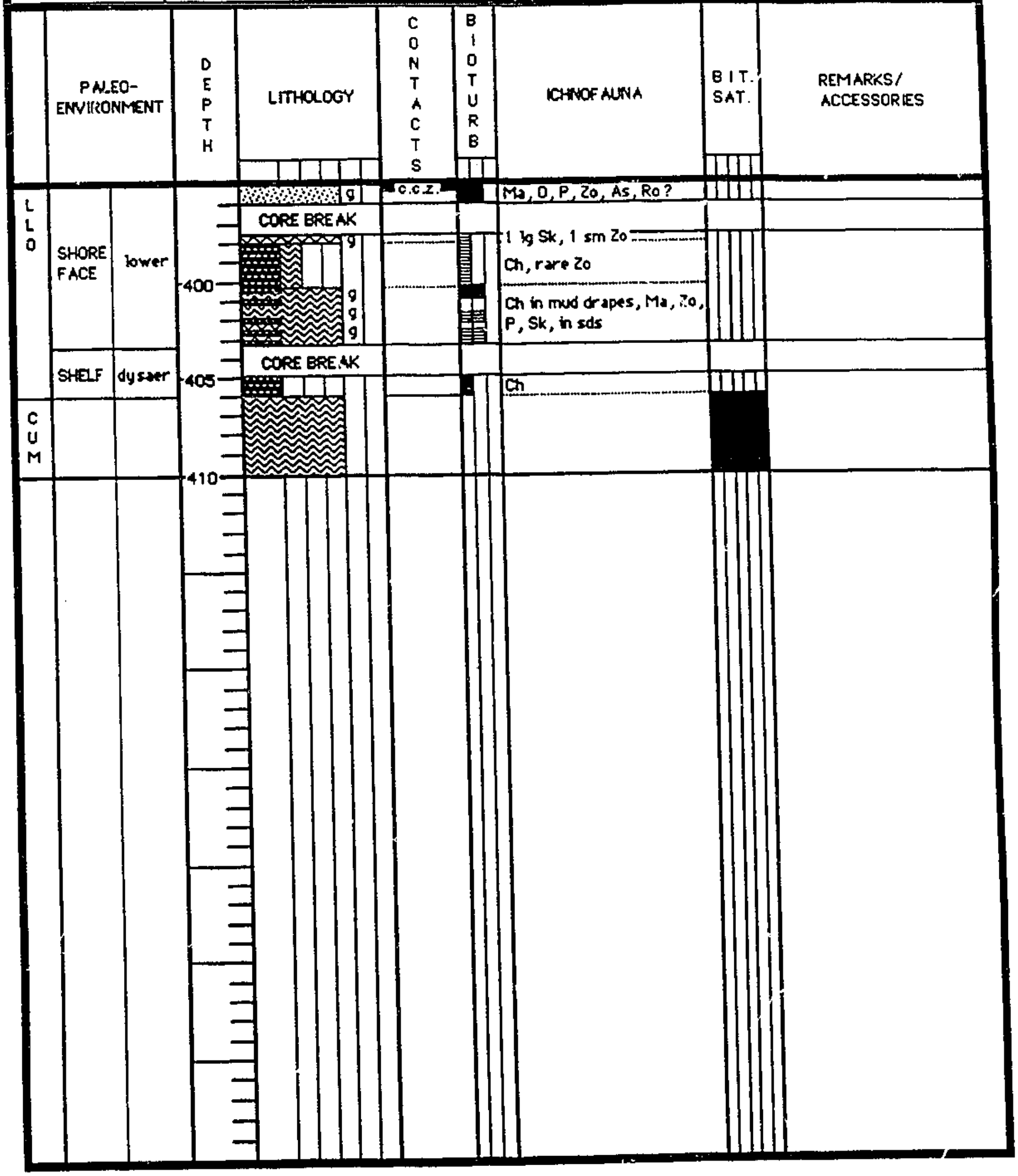
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-3-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	298.0-410.0 m	610.7 m	1 OF 3



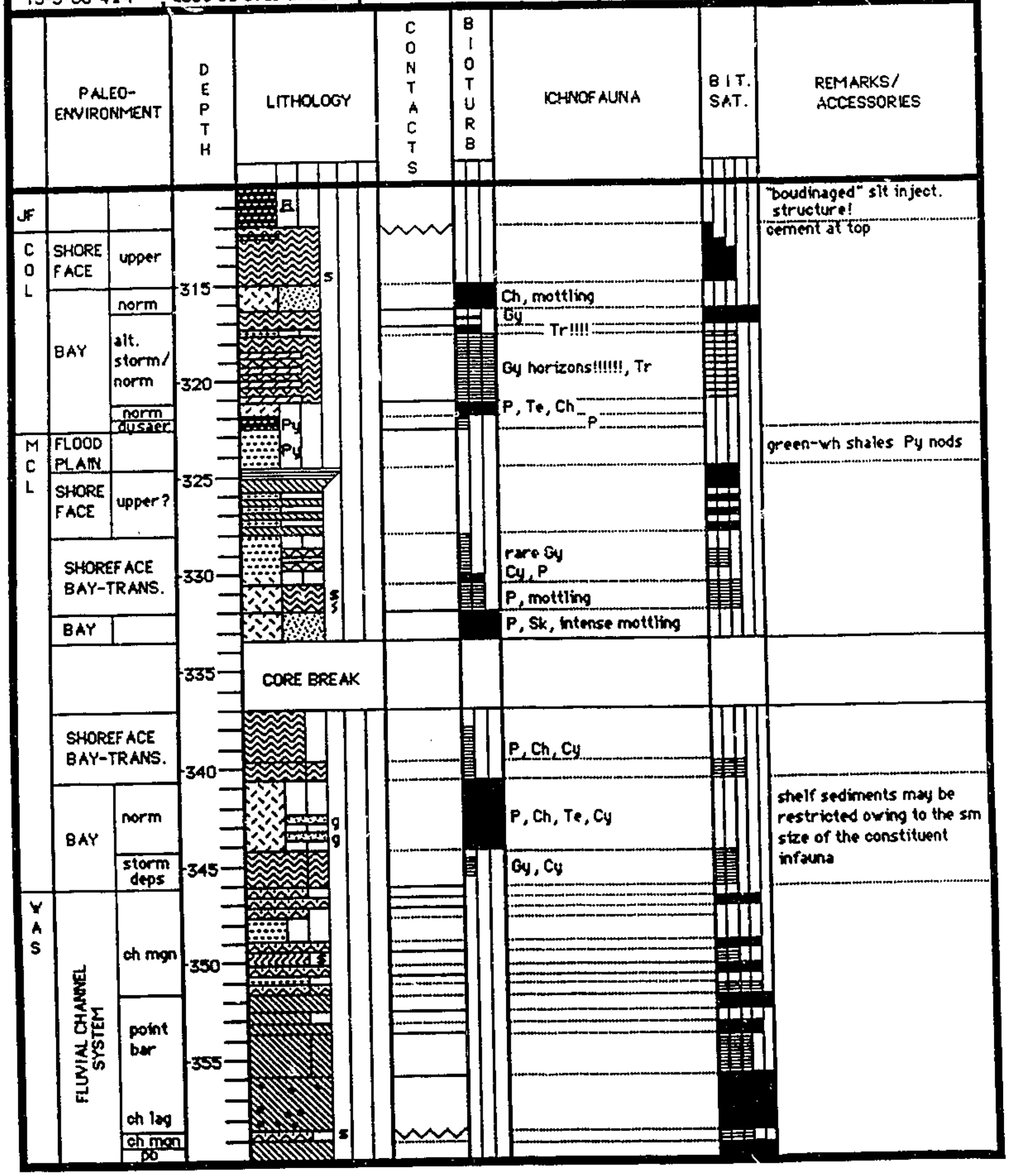
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-3-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	298.0-410.0 m	610.7 m	2 OF 3



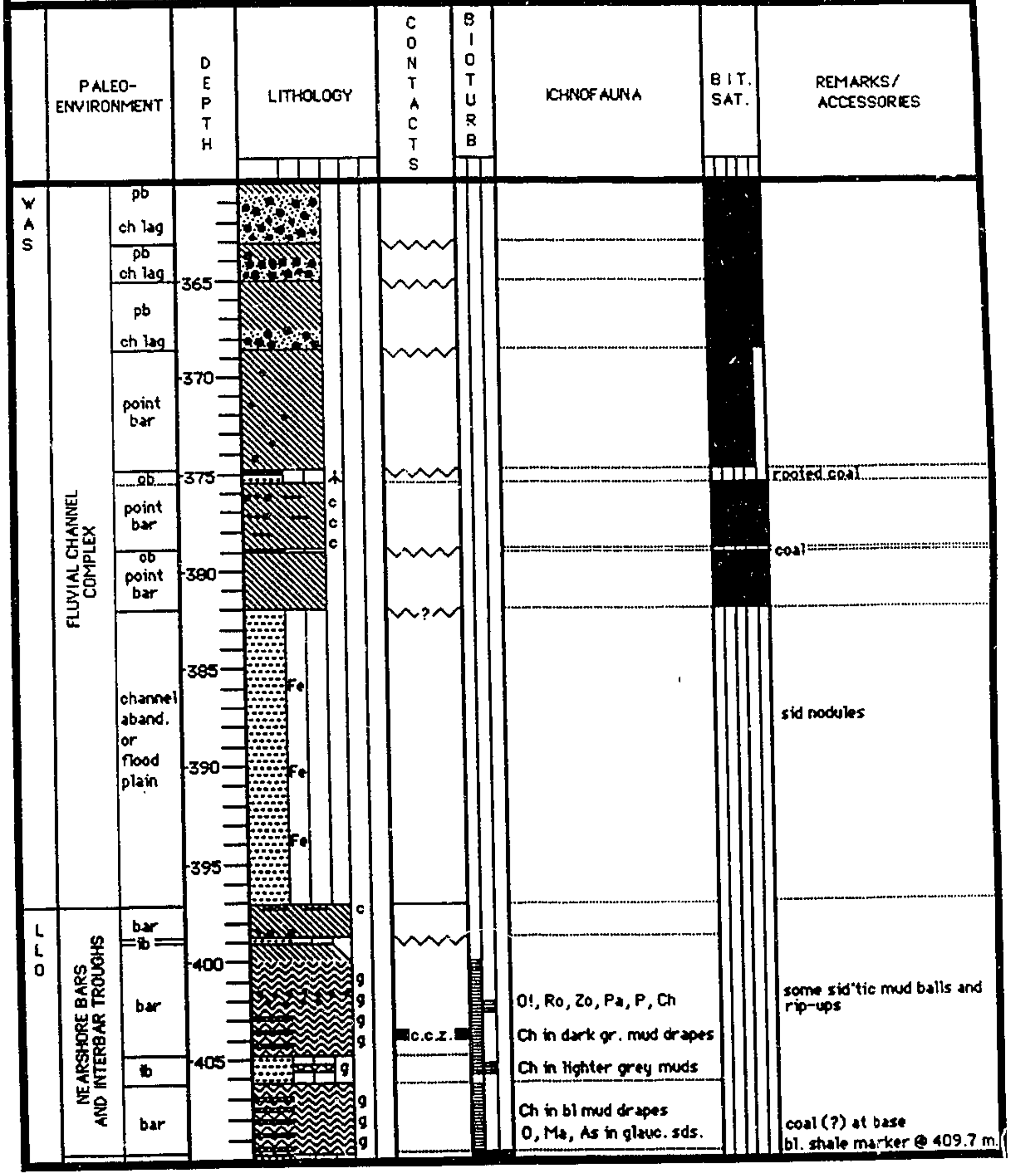
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-3-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	298.0-410.0 m	610.7 m	3 OF 3



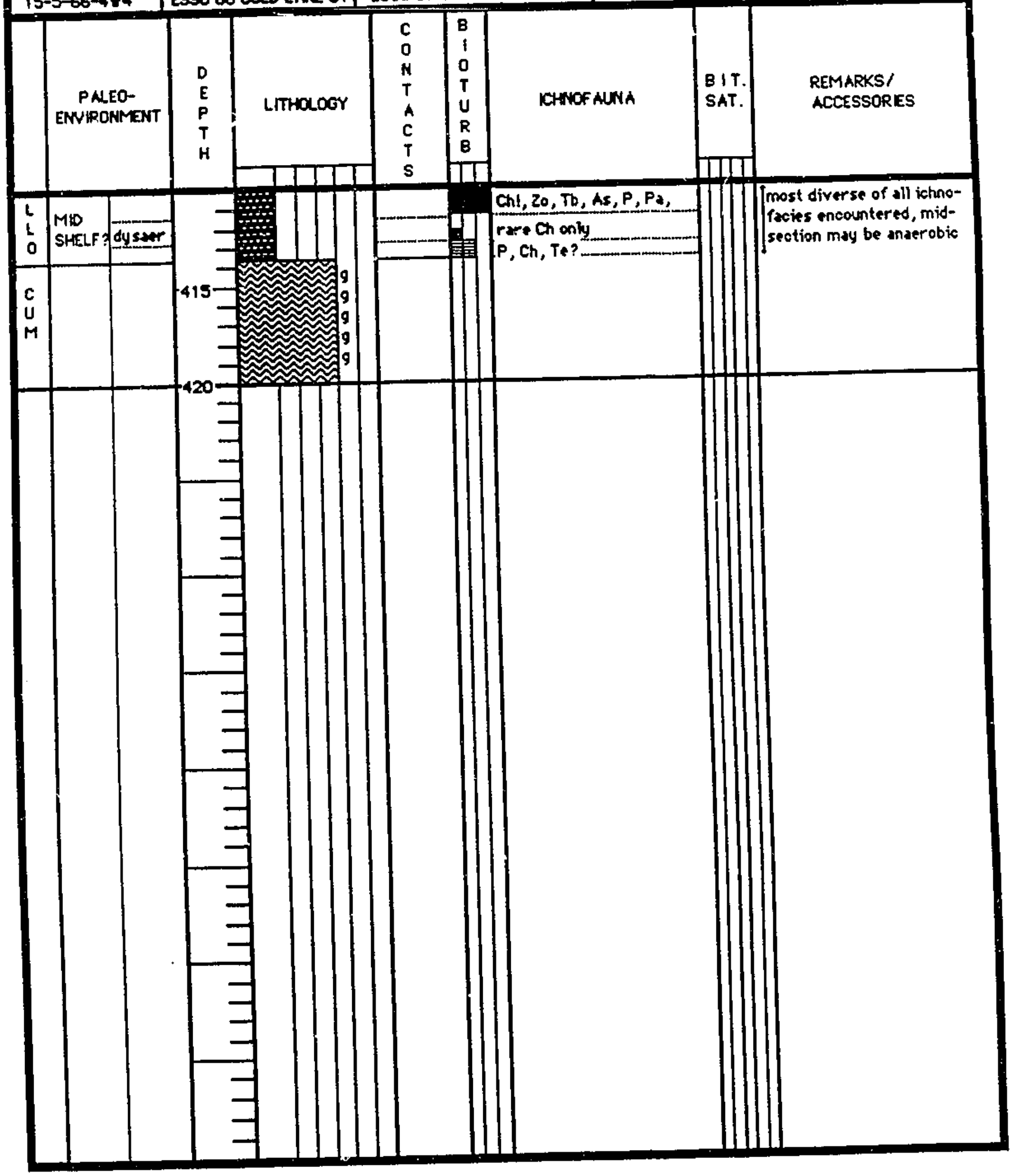
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-5-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	310.0-420.0 m	625.0 m	1 OF 3



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-5-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	310.0-420.0 m	625.0 m	2 OF 3

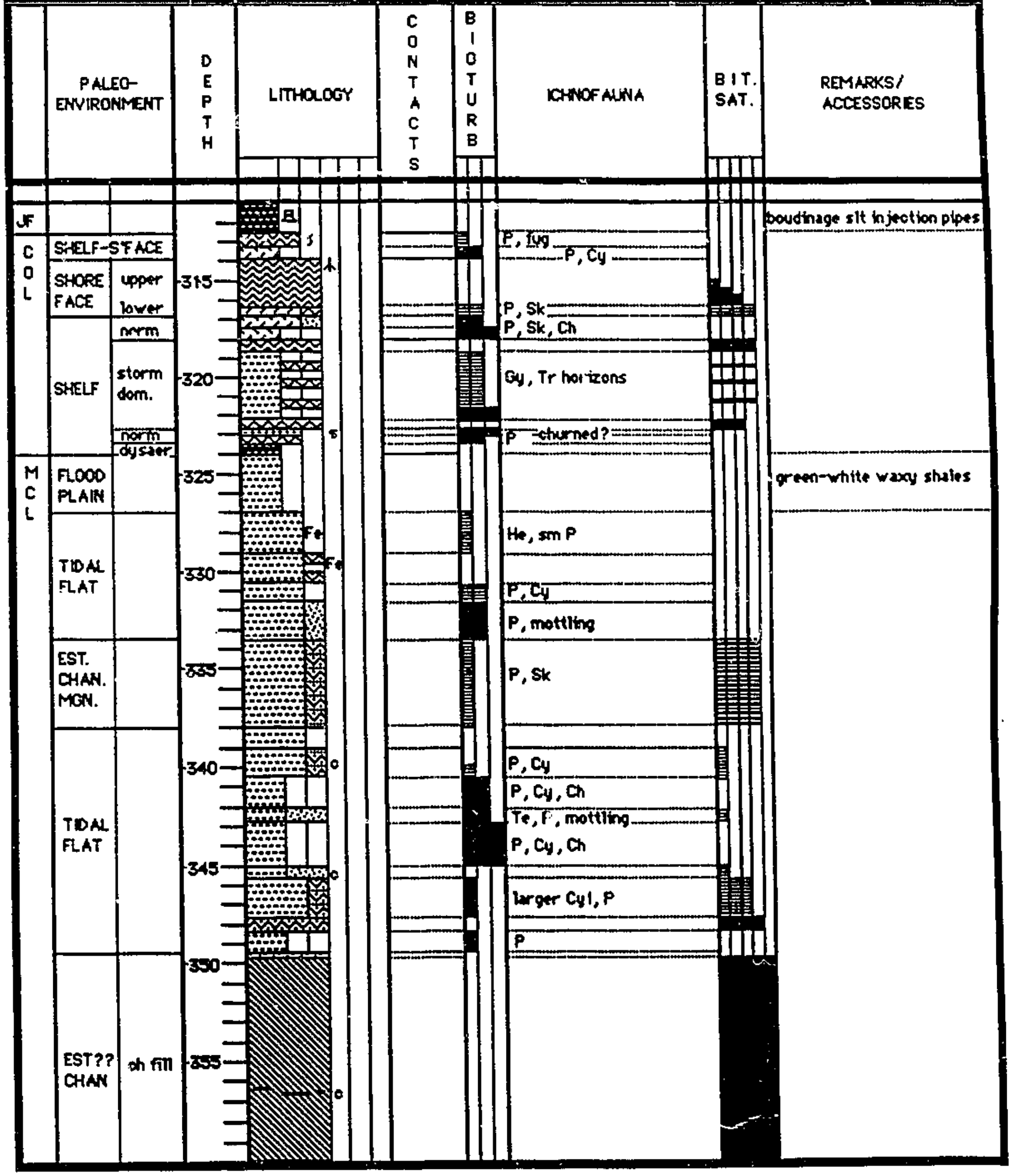


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-5-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	310.0-420.0 m	625.0 m	3 OF 3

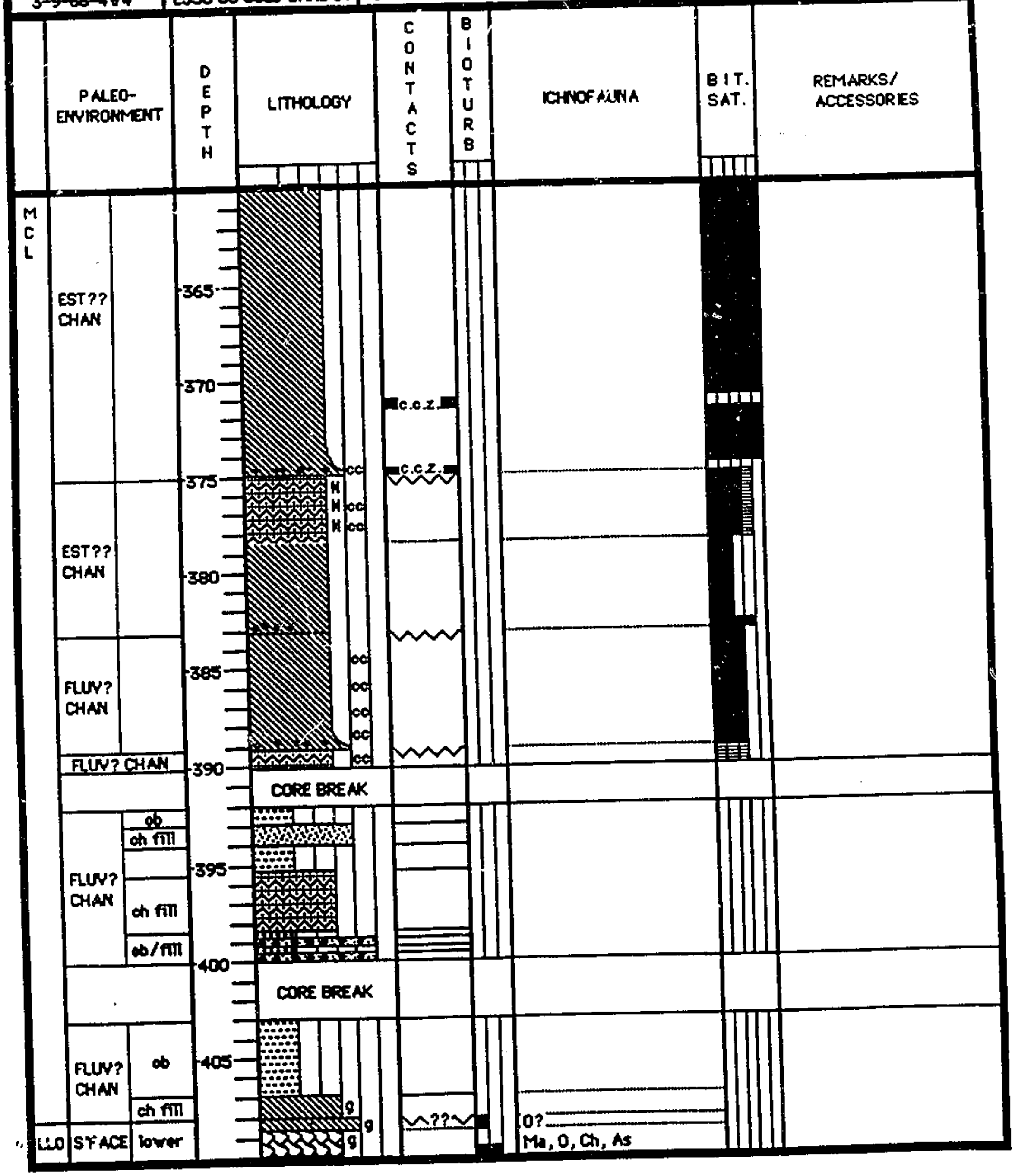


most diverse of all ichnofacies encountered, mid-section may be anaerobic

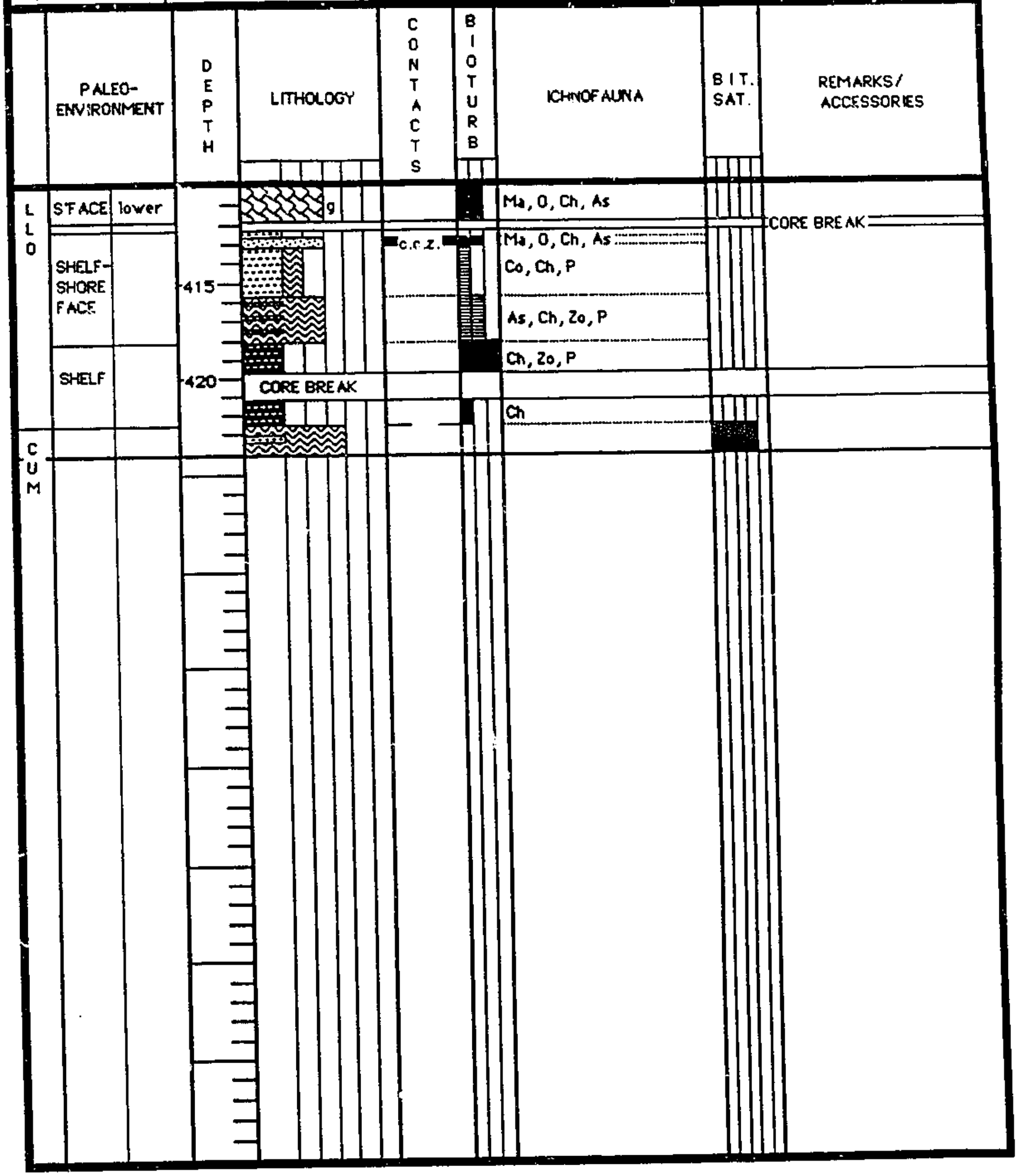
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-9-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	311.0-424.0 m	624.8 m	1 OF 3



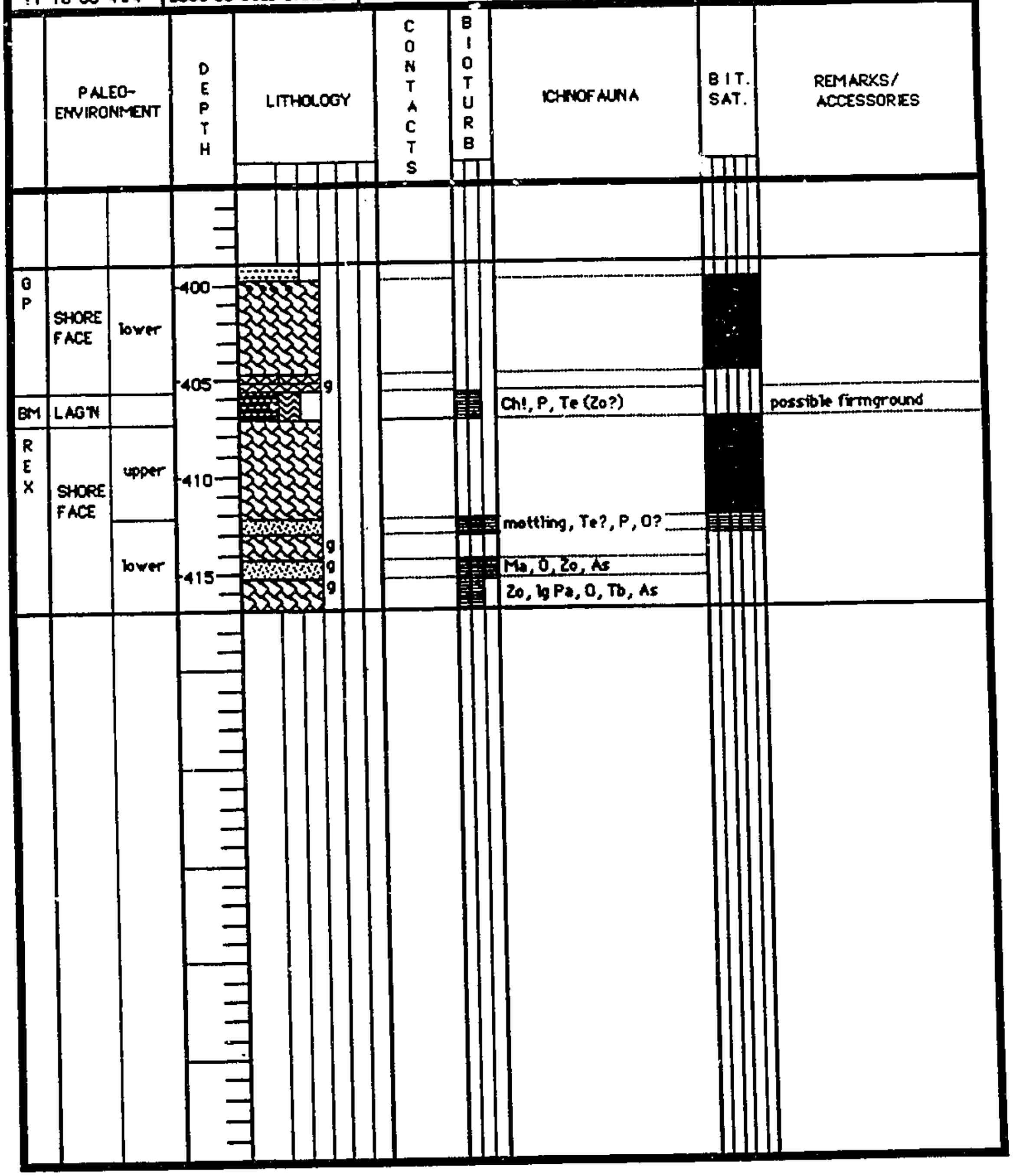
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-9-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	311.0-424.0 m	624.8 m	2 OF 3



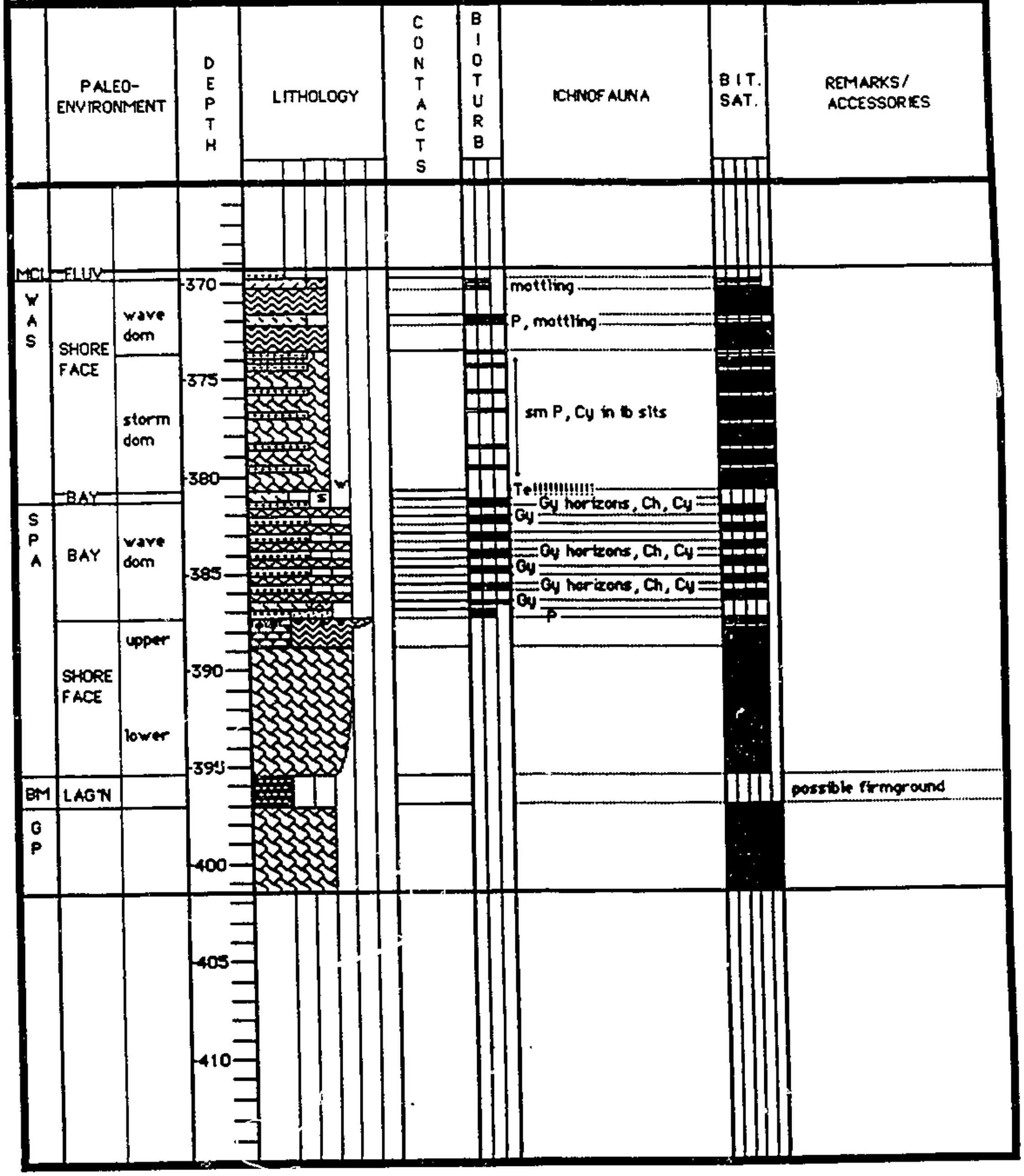
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-9-66-4W4	ESSO 88 COLD LAKE OV	ESSO CANADA RESOURCES	311.0-424.0 m	624.8 m	3 OF 3



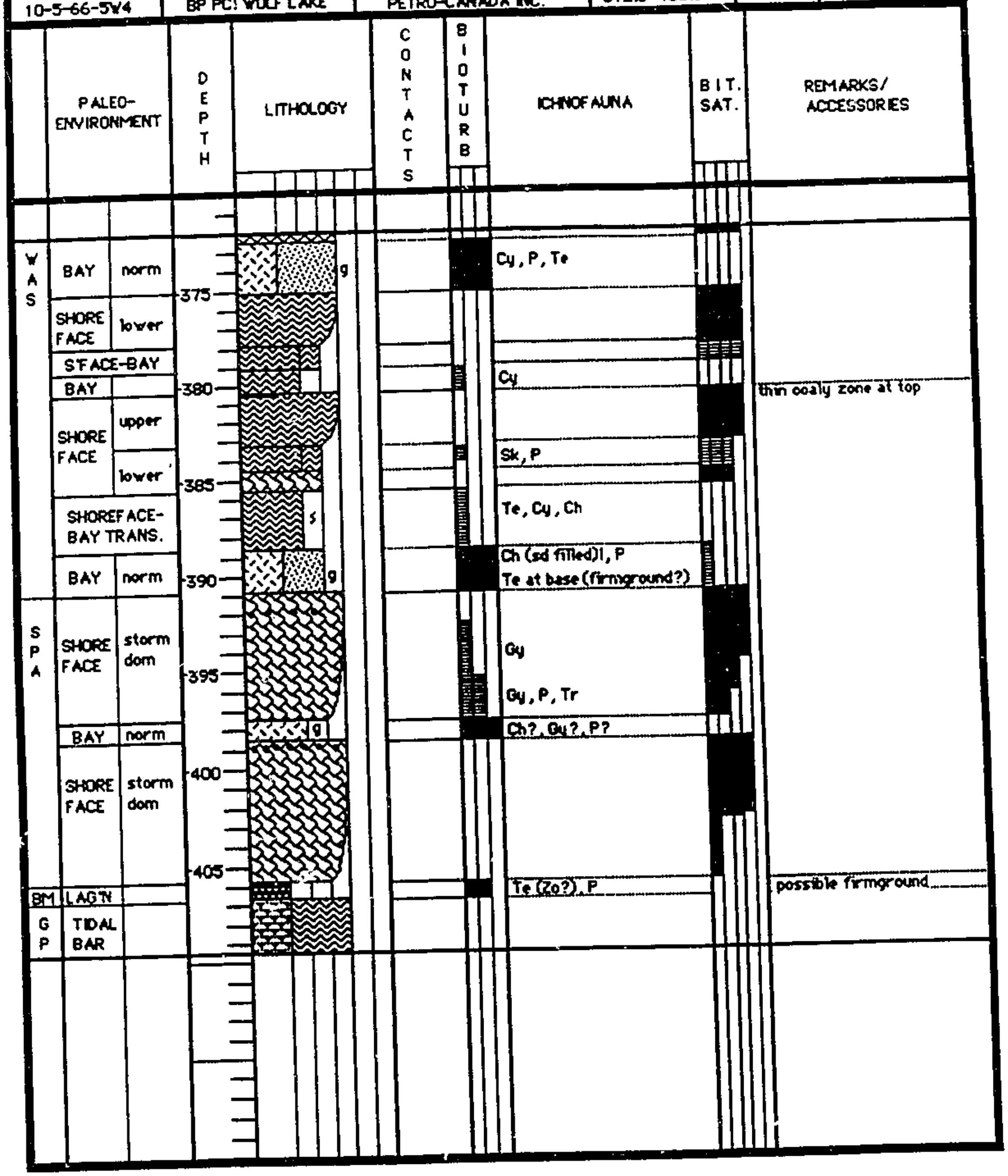
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-18-66-4W4	ESSO 85 COLD LAKE OV	ESSO CANADA RESOURCES	399.0–416.9 m	642.0 m	1 OF 1



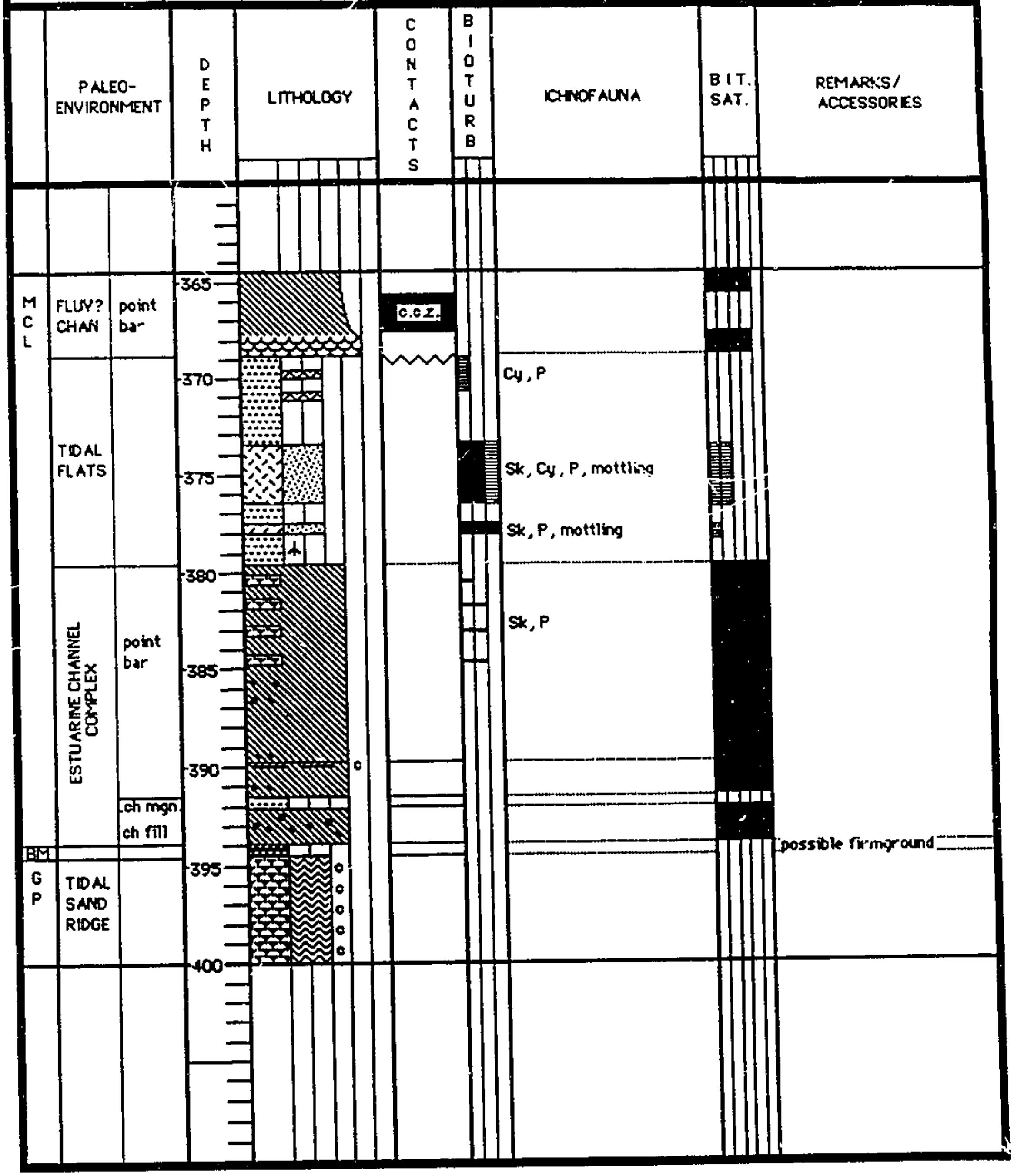
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
16-4-66-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETROCANADA INC.	369.5-401.5 m	642.7 m	1 OF 1



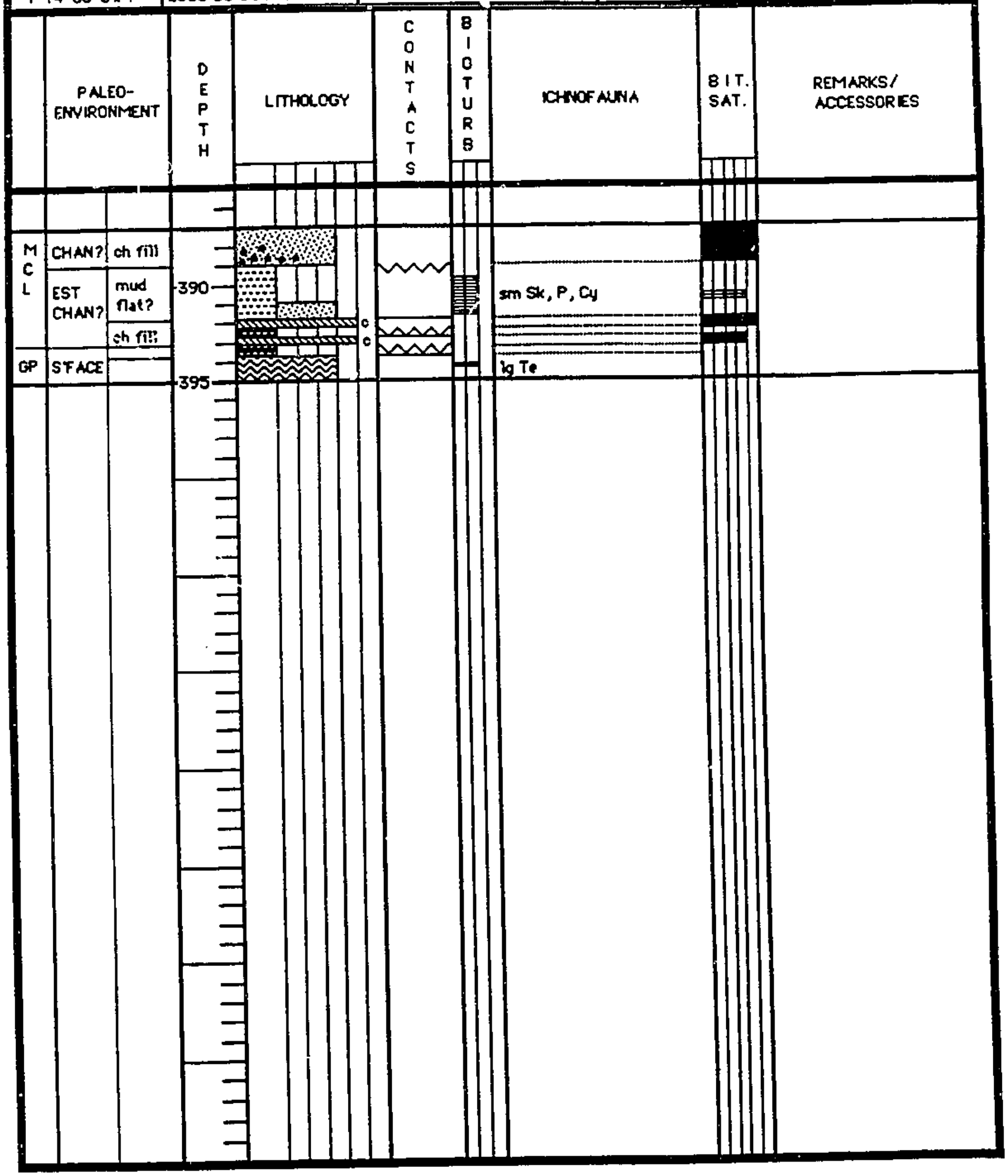
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-5-66-5W4	BP PC! WOLF LAKE	BP PETROLEUM CANADA PETRO-CANADA INC.	372.0–408.6 m	644.2 m	1 OF 1



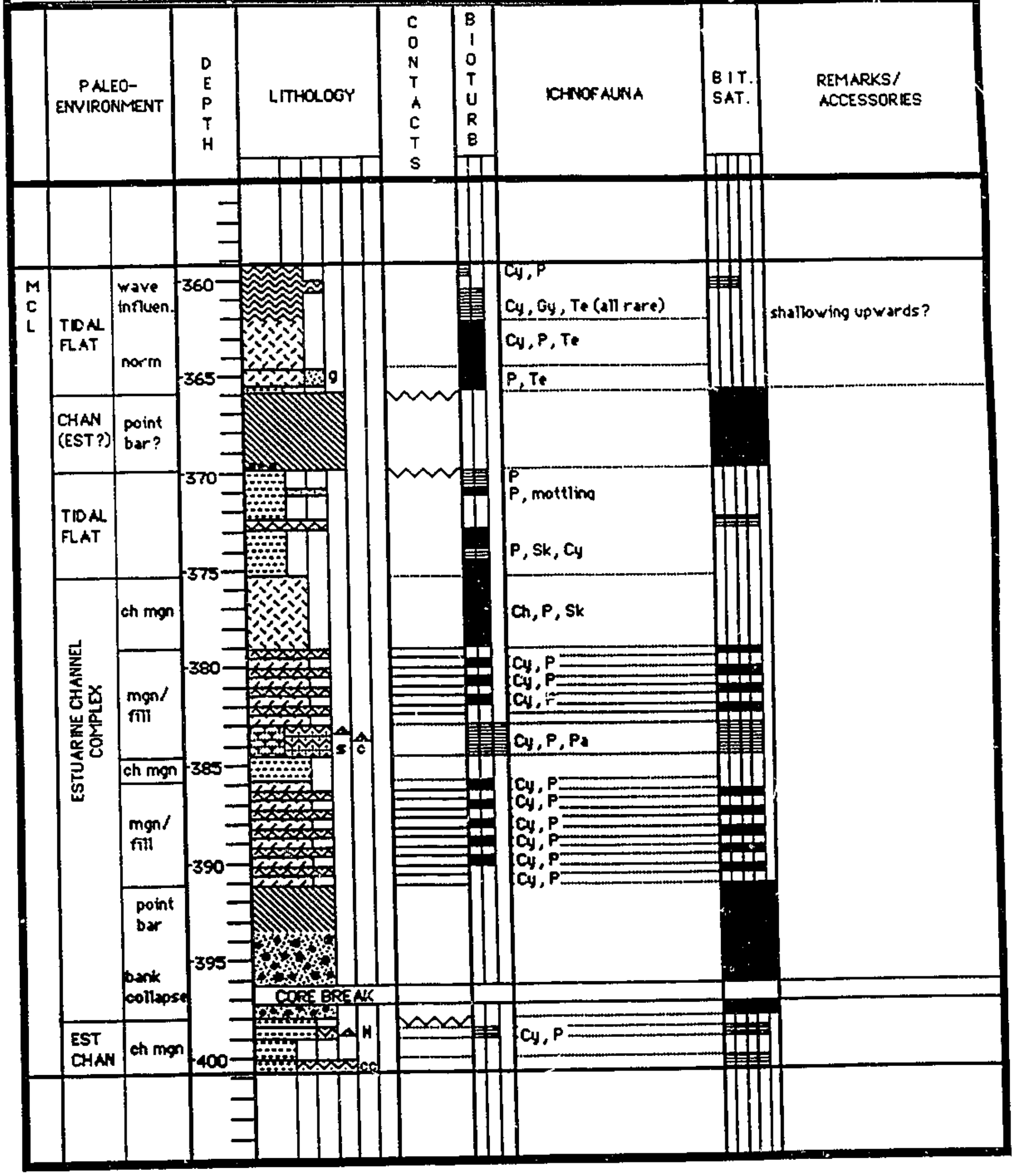
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
15-10-66-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETROCANADA INC.	364.5-400.0 m	642.7 m	1 OF 1



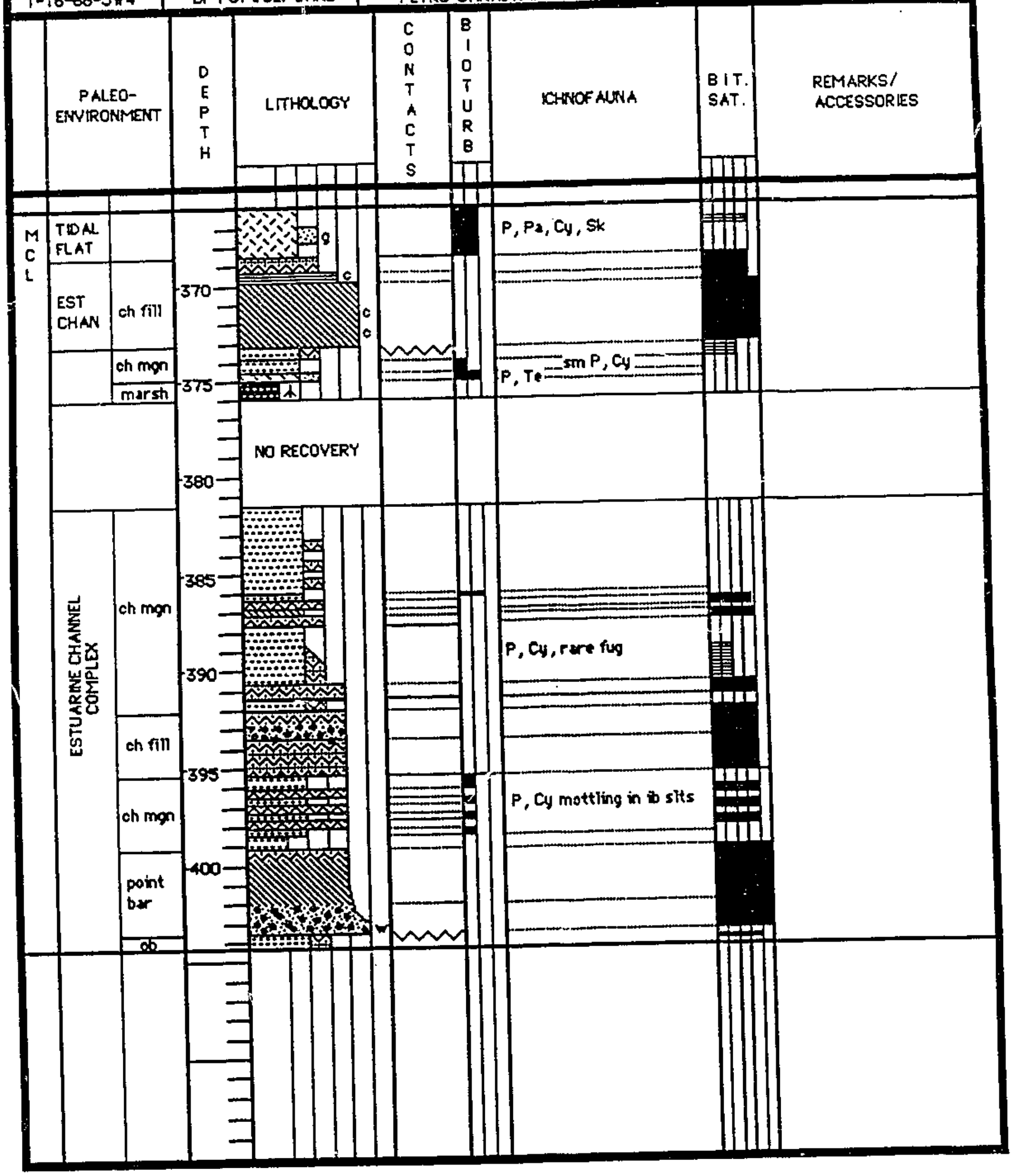
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-14-66-5W4	ESSO 86 WOLF LAKE OV	ESSO RESOURCES CANADA	387.0-395.0 m	639.7 m	1 OF 1



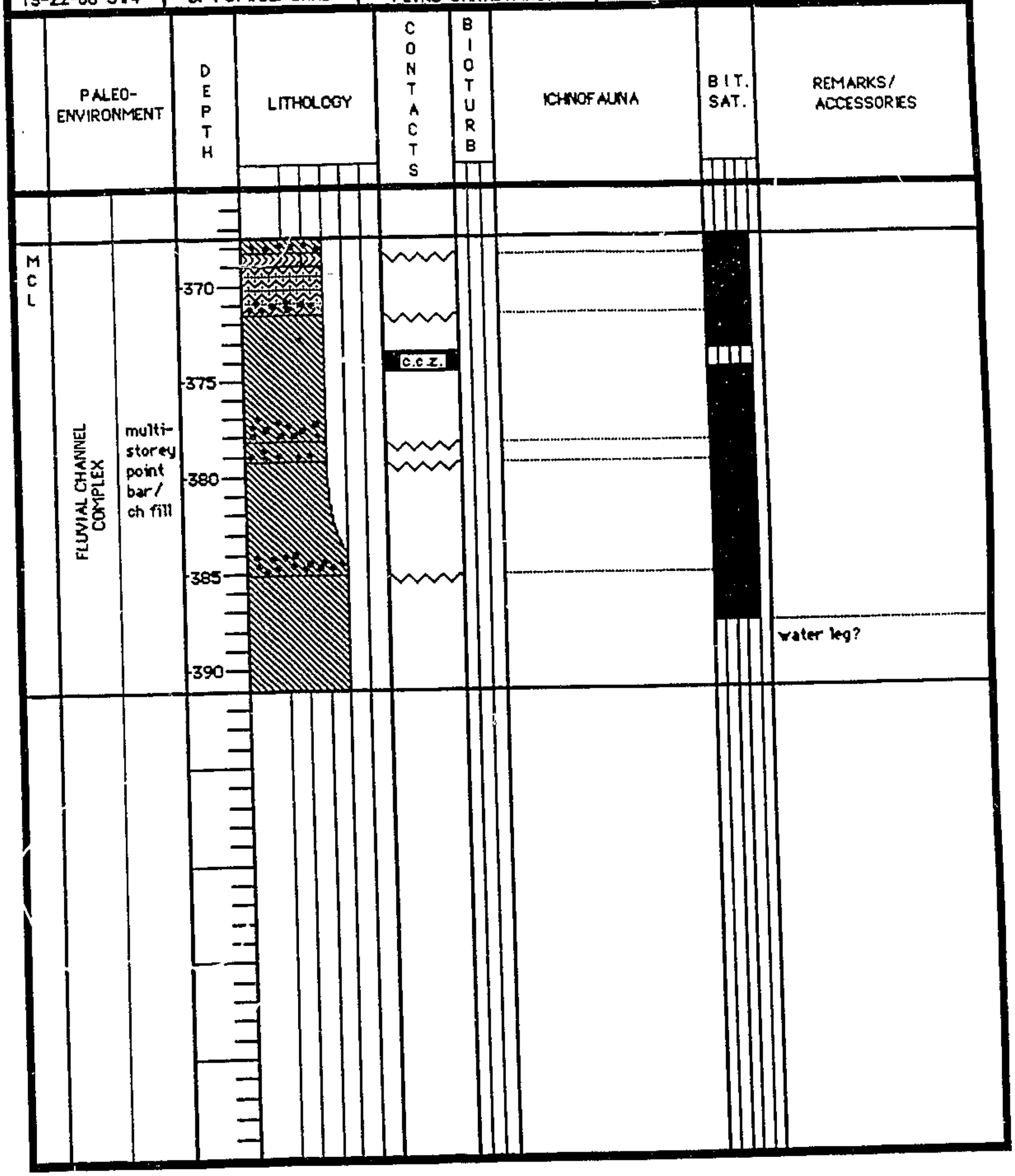
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
10-15-66-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETROCANADA INC.	359.3-400.75 m	640.6 m	1 OF 1



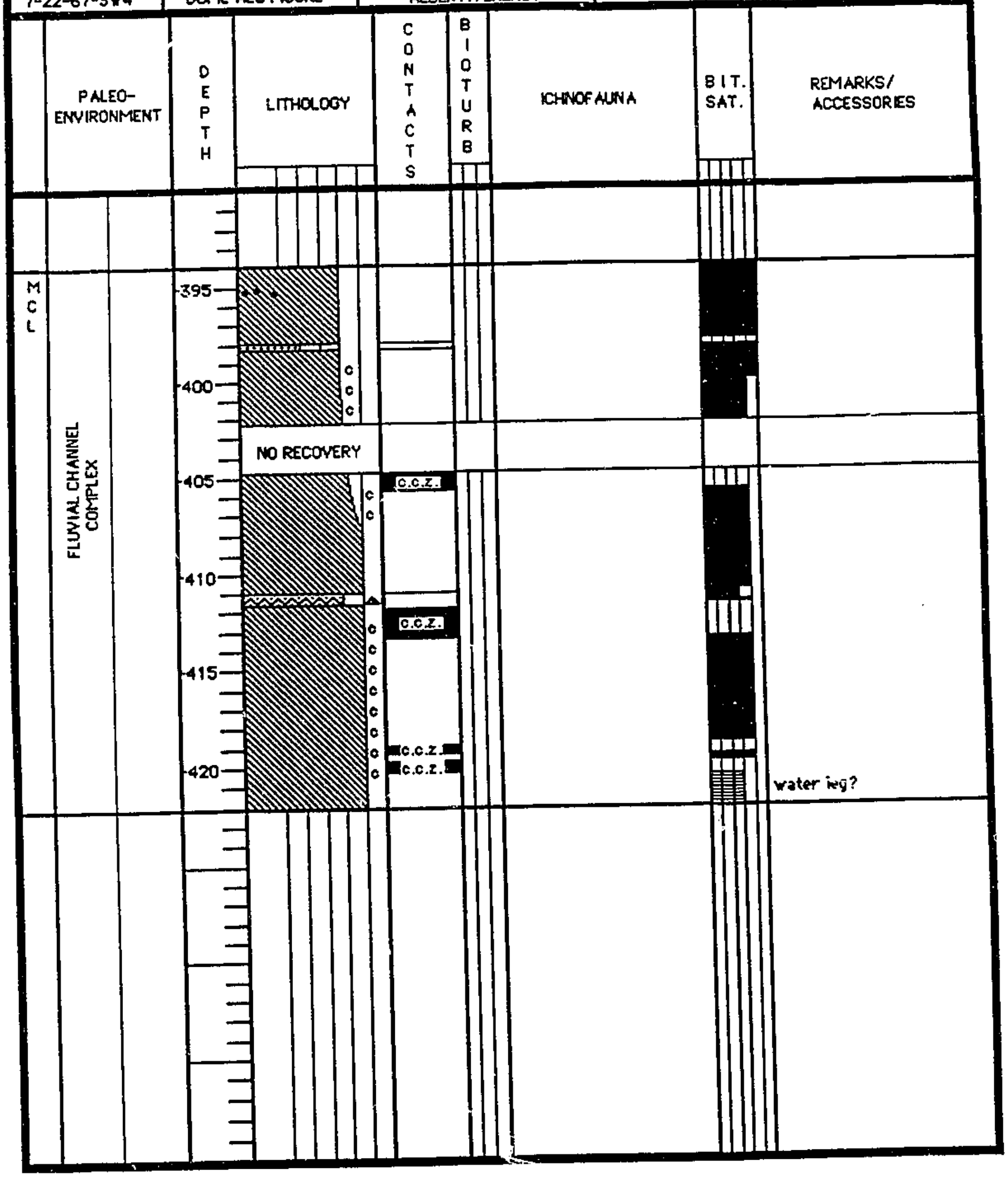
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
1-16-66-5W4	BP PCI WOLF LAKE	BP RESOURCES CANADA, PETRO-CANADA INC.	366.0-404.25 m	643.5 m	1 OF 1



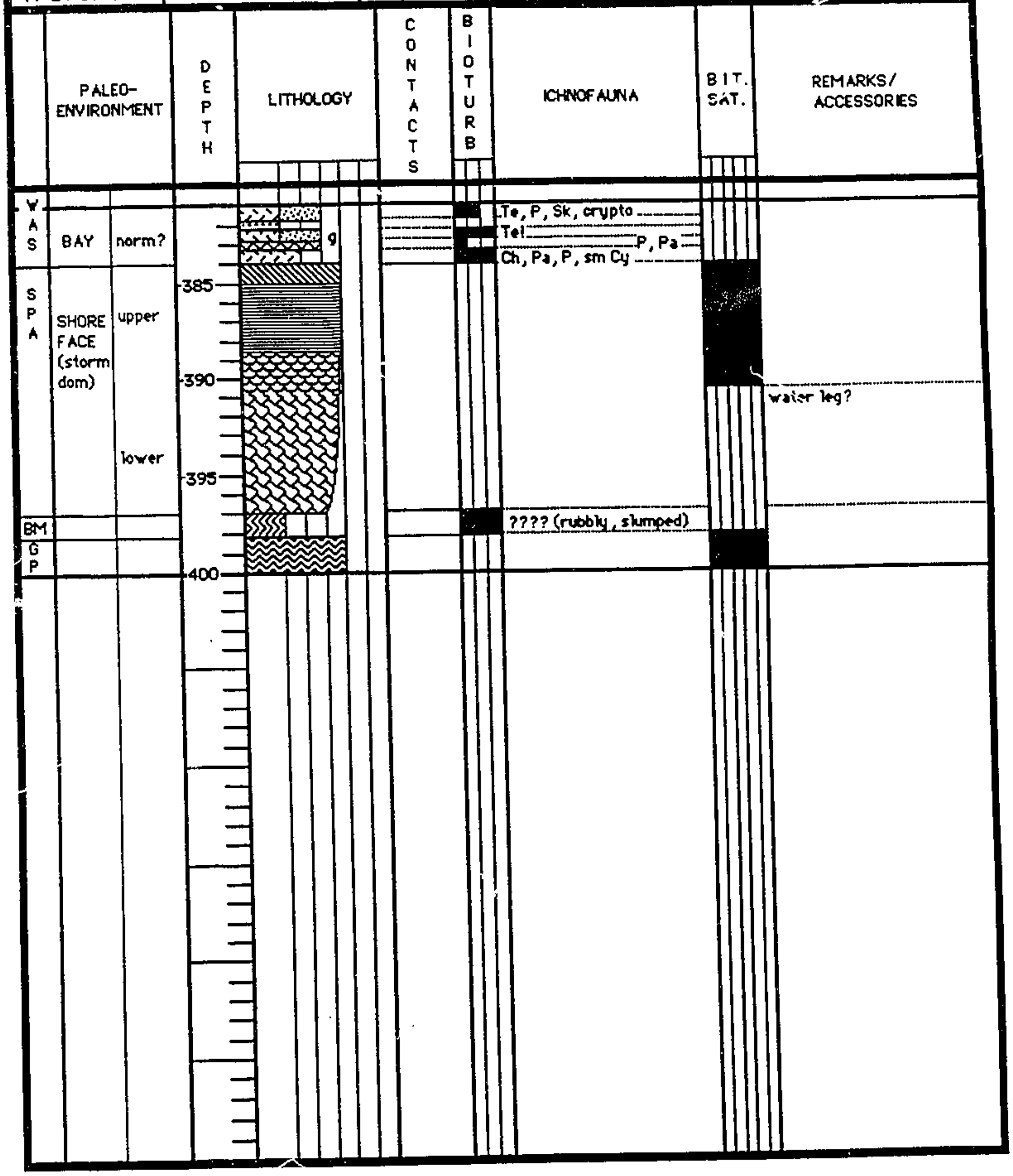
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
13-22-66-5W4	BP PCI WOLF LAKE	BP PETROLEUM CANADA PETRO-CANADA INC.	367.5-391.0 m	644.6 m	1 OF 1



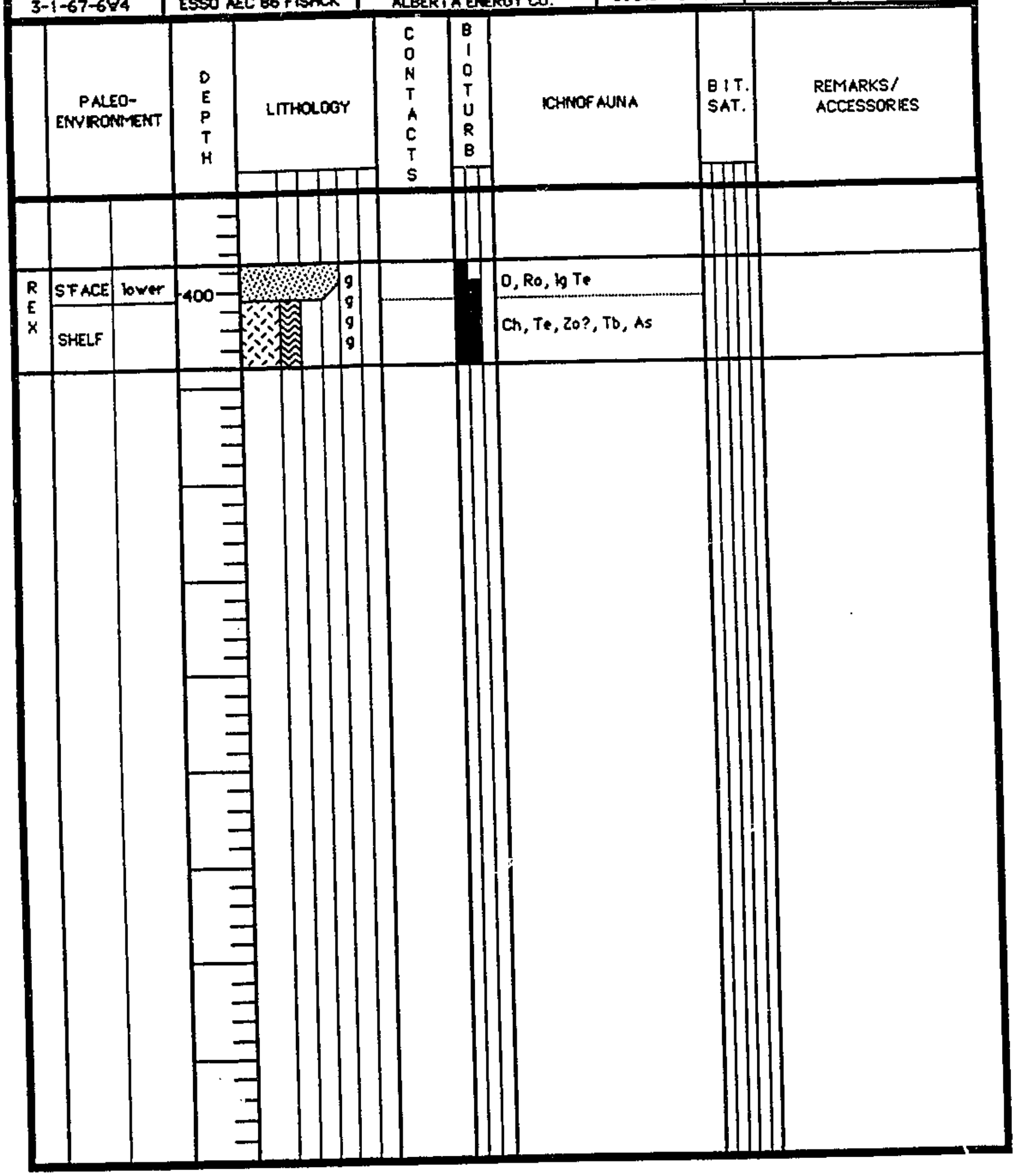
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-22-67-3W4	DOME AEC MOORE	AMOCO PETROLEUM, ALBERTA ENERGY	394.0-422.0 m	681.1 m	1 OF 1



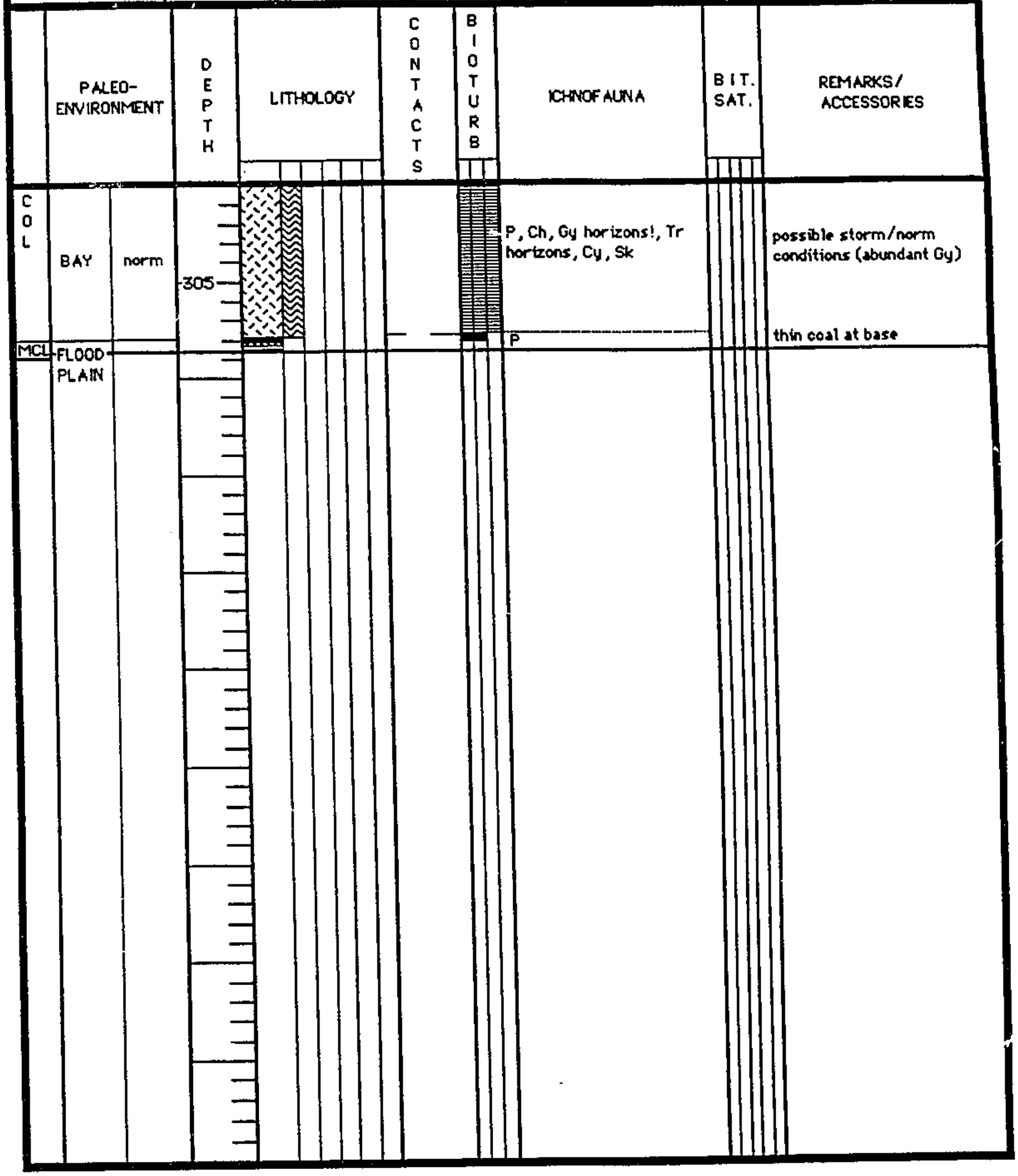
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-24-67-4W4	DOME AEC BURNT LK	AMOCO PETROLEUM, ALBERTA ENERGY	381.0-400.0 m	678.6 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
3-1-67-6W4	ESSO AEC 86 FISHCK	ESSO CANADA RESOURCES, ALBERTA ENERGY CO.	398.6–403.9 m	646.1 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-31-67-7W4	ESSO AEC FISHCK 12-31	ESSO CANADA RESOURCES, ALBERTA ENERGY	300.0-308.5 m	608.9 m	1 OF 1

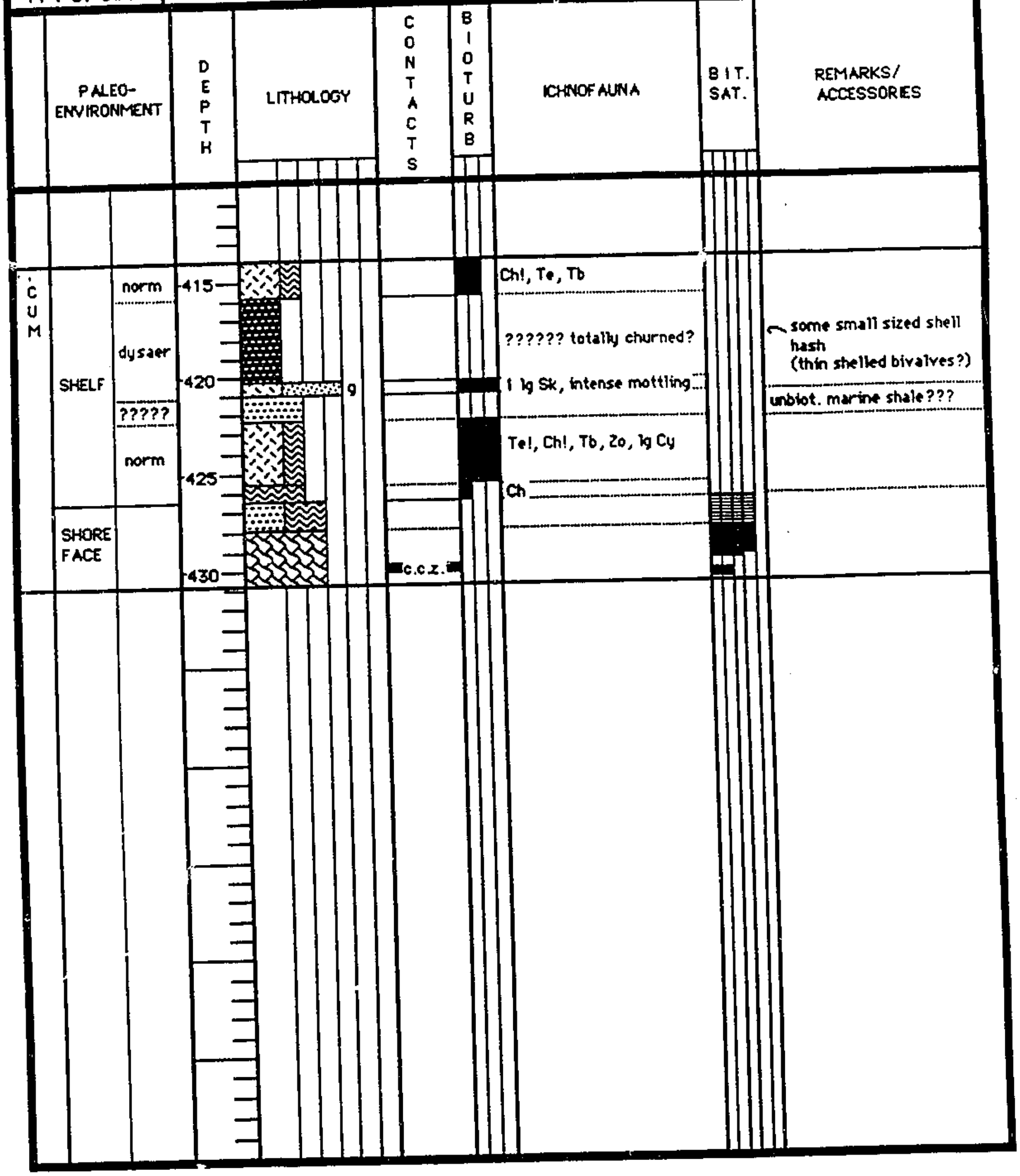


P, Ch, Gy horizons!, Tr horizons, Cy, Sk

possible storm/norm conditions (abundant Gy)

thin coal at base

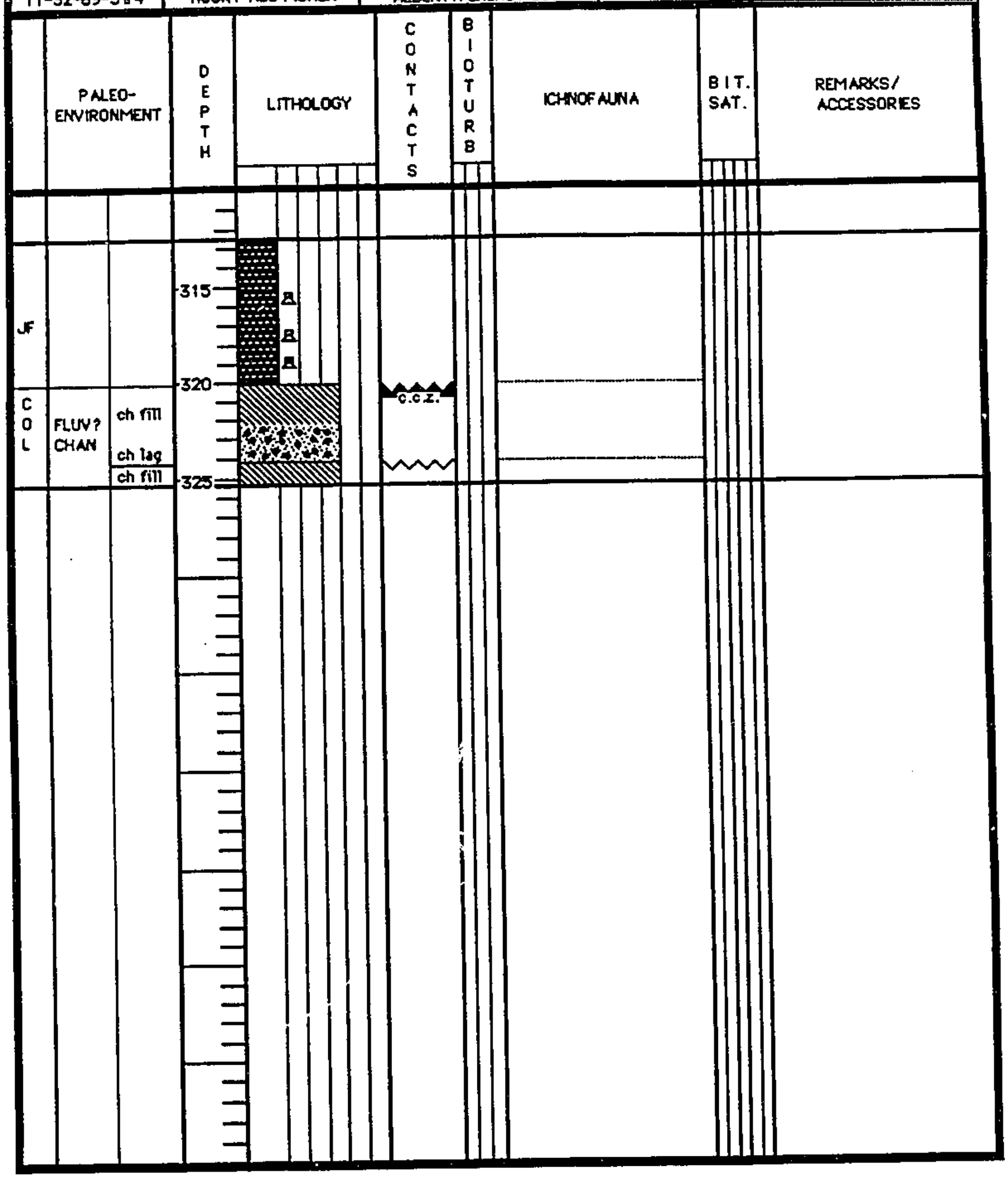
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
14-1-67-8W4	ESSO AEC 85 FISHCK	ESSO CANADA RESOURCES, ALBERTA ENERGY CO.	413.0-430.75 m	650.7 m	1 OF 1



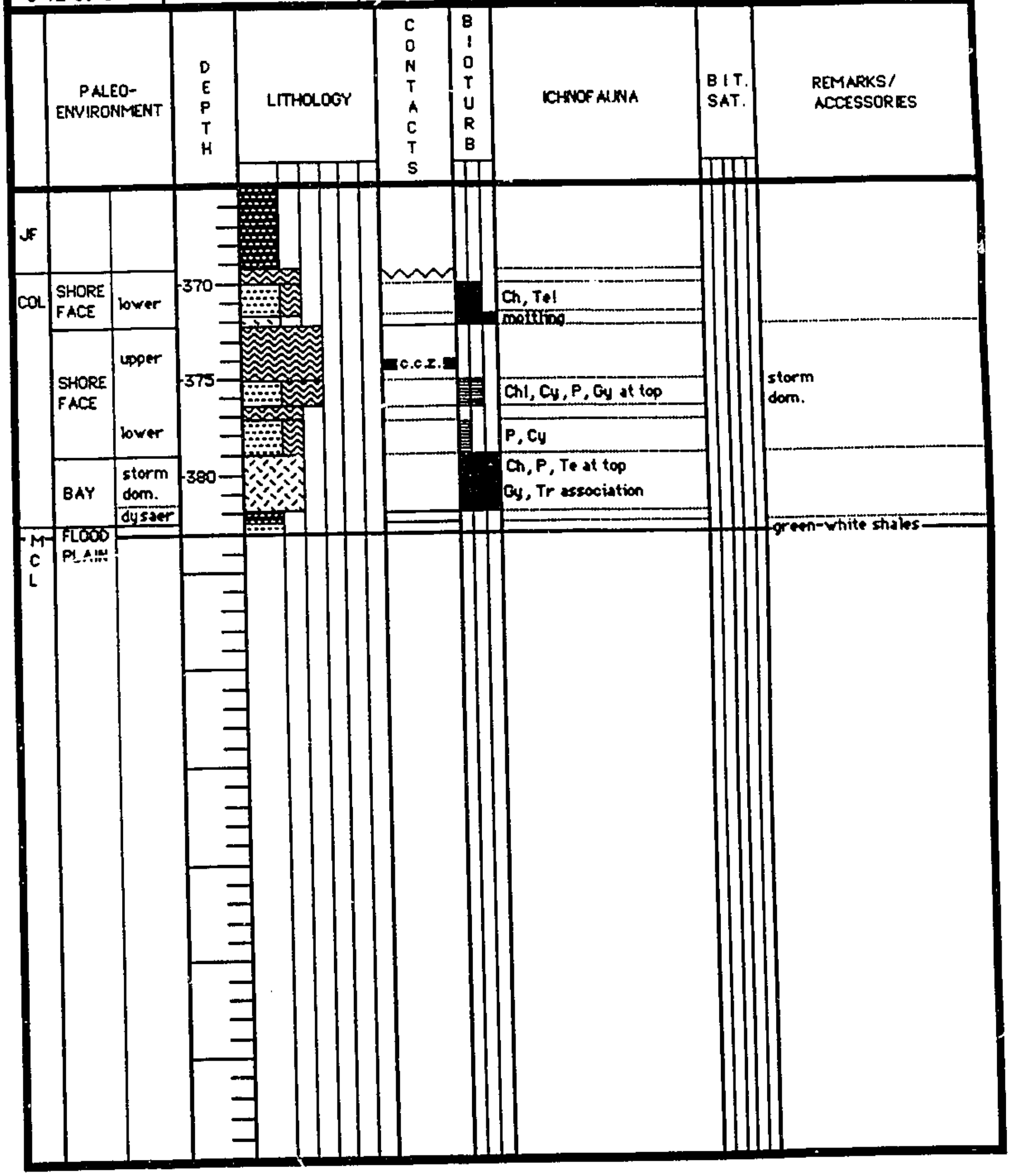
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-12-69-5W4	HUSKY AEC FISHER	HUSKY OIL OPERATIONS, ALBERTA ENERGY CO.	340.0-345.0 m	692.0 m	1 OF 1

	PALEO-ENVIRONMENT		DEPTH	LITHOLOGY			CONTACTS	BIOTURB	ICHNOFAUNA	BIT. SAT.	REMARKS/ ACCESSORIES
COL	SHORE FACE?	upper	345		c c	g g g g	C.C.Z.				

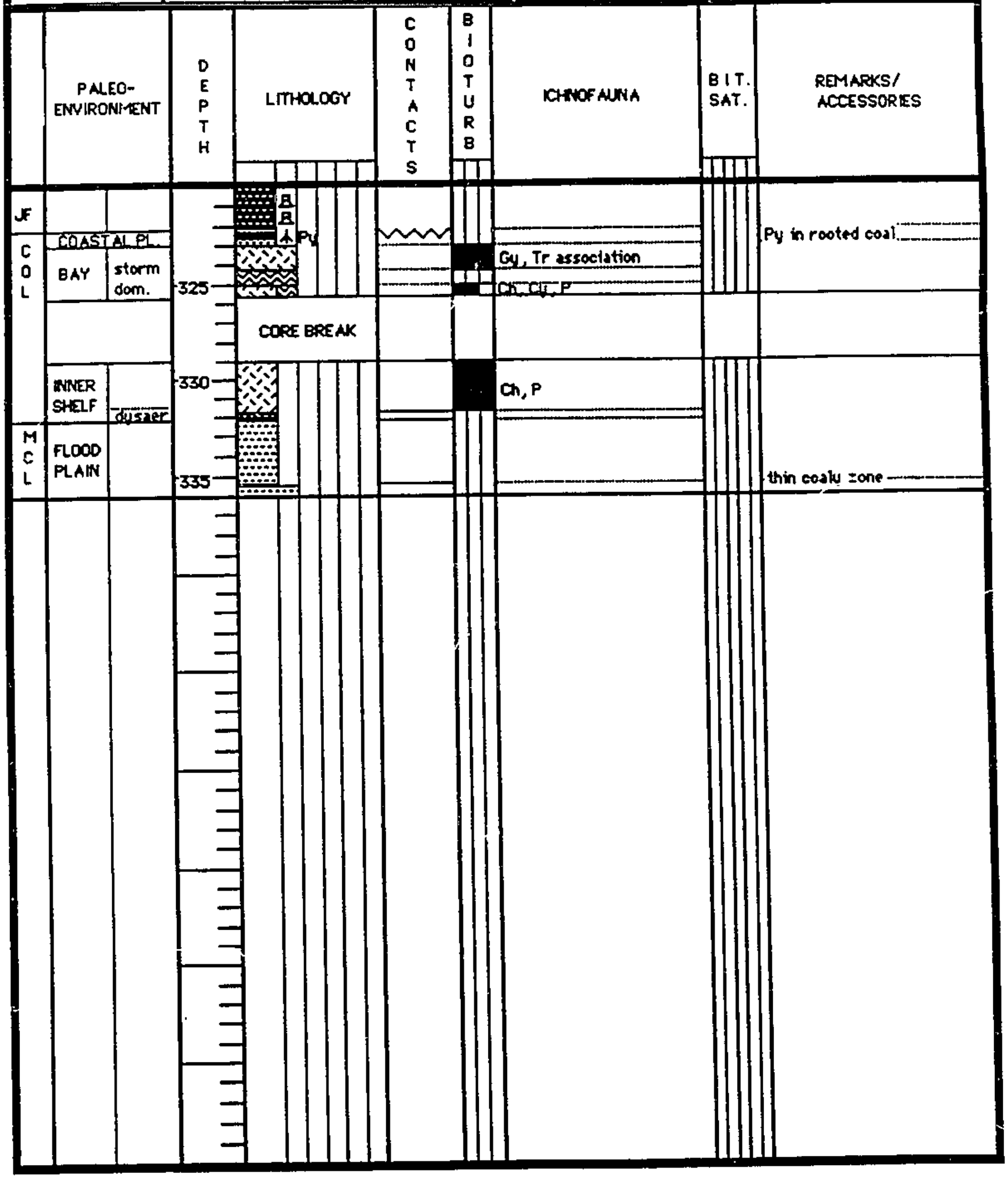
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
11-32-69-5W4	HUSKY AEC FISHER	HUSKY OIL OPERATIONS, ALBERTA ENERGY CO.	312.5-325.25 m	672.0 m	1 OF 1



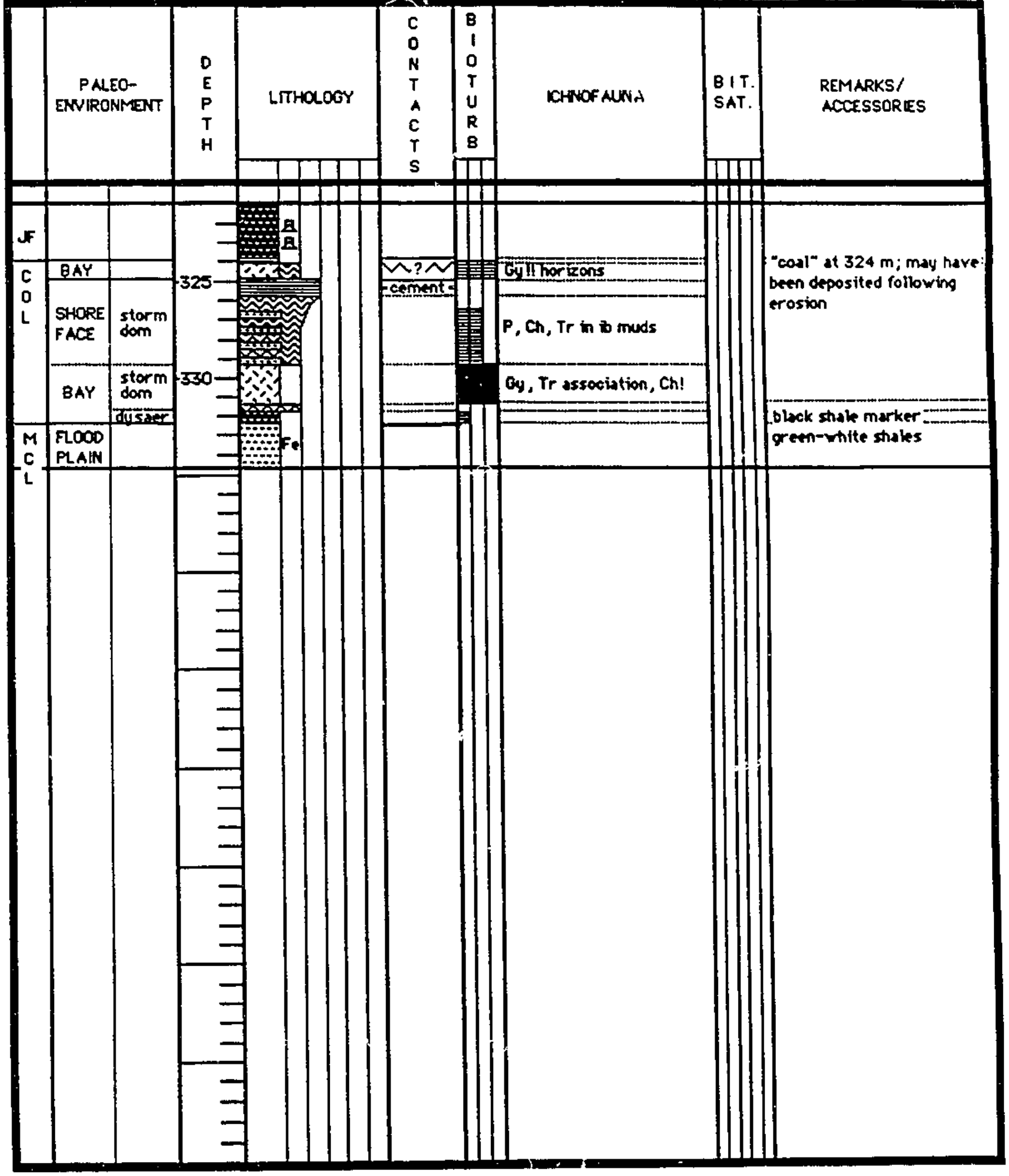
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-12-69-6W4	HUSKY AEC FISHER	HUSKY OIL OPERATIONS, ALBERTA ENERGY CO.	365.0-383.0 m	719.6 m	1 OF 1



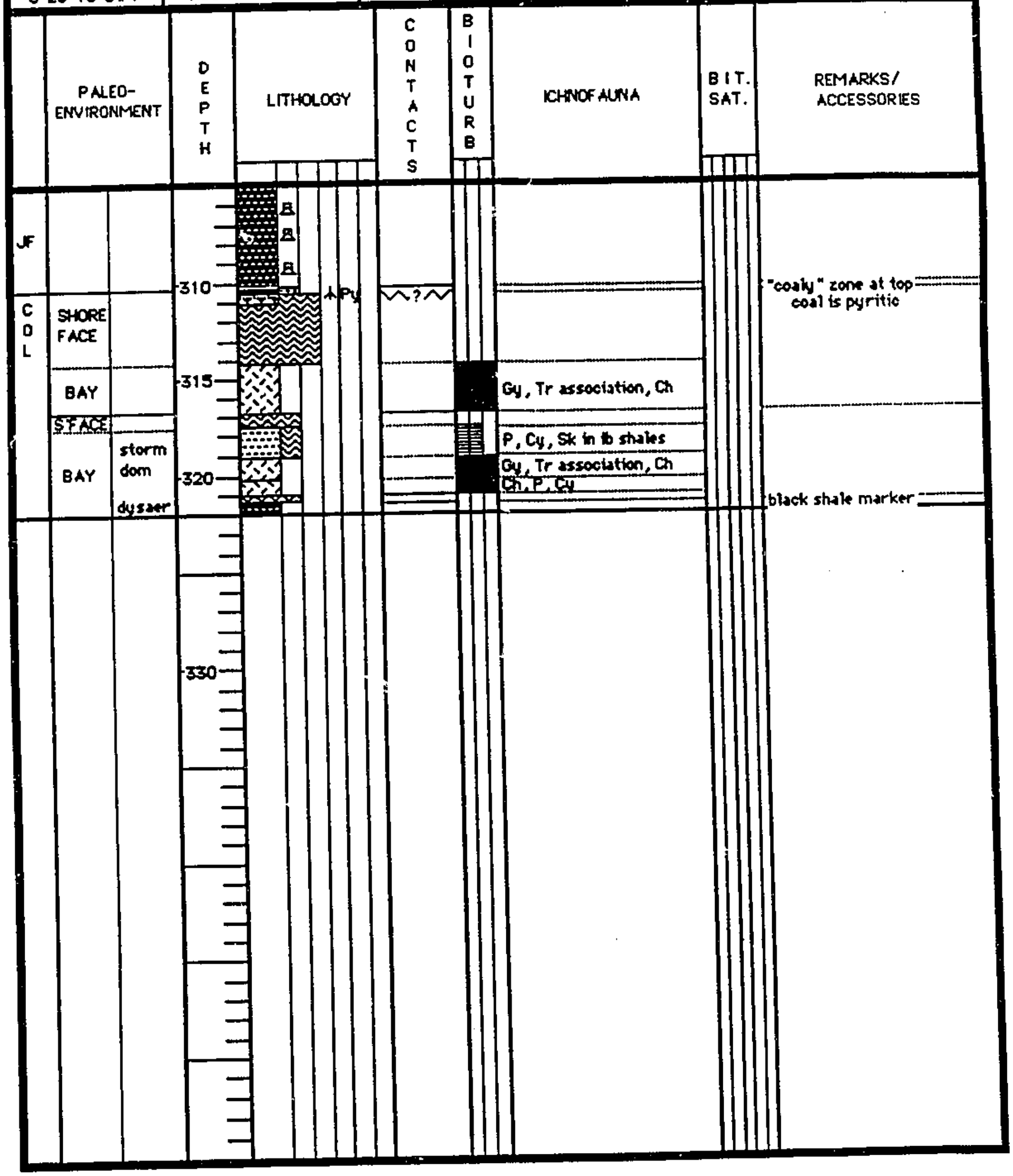
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-16-70-4W4	HUSKY AEC FISHER	HUSKY OIL OPERATIONS, ALBERTA ENERGY CO.	305.0-321.0 m	680.5 m	1 OF 1



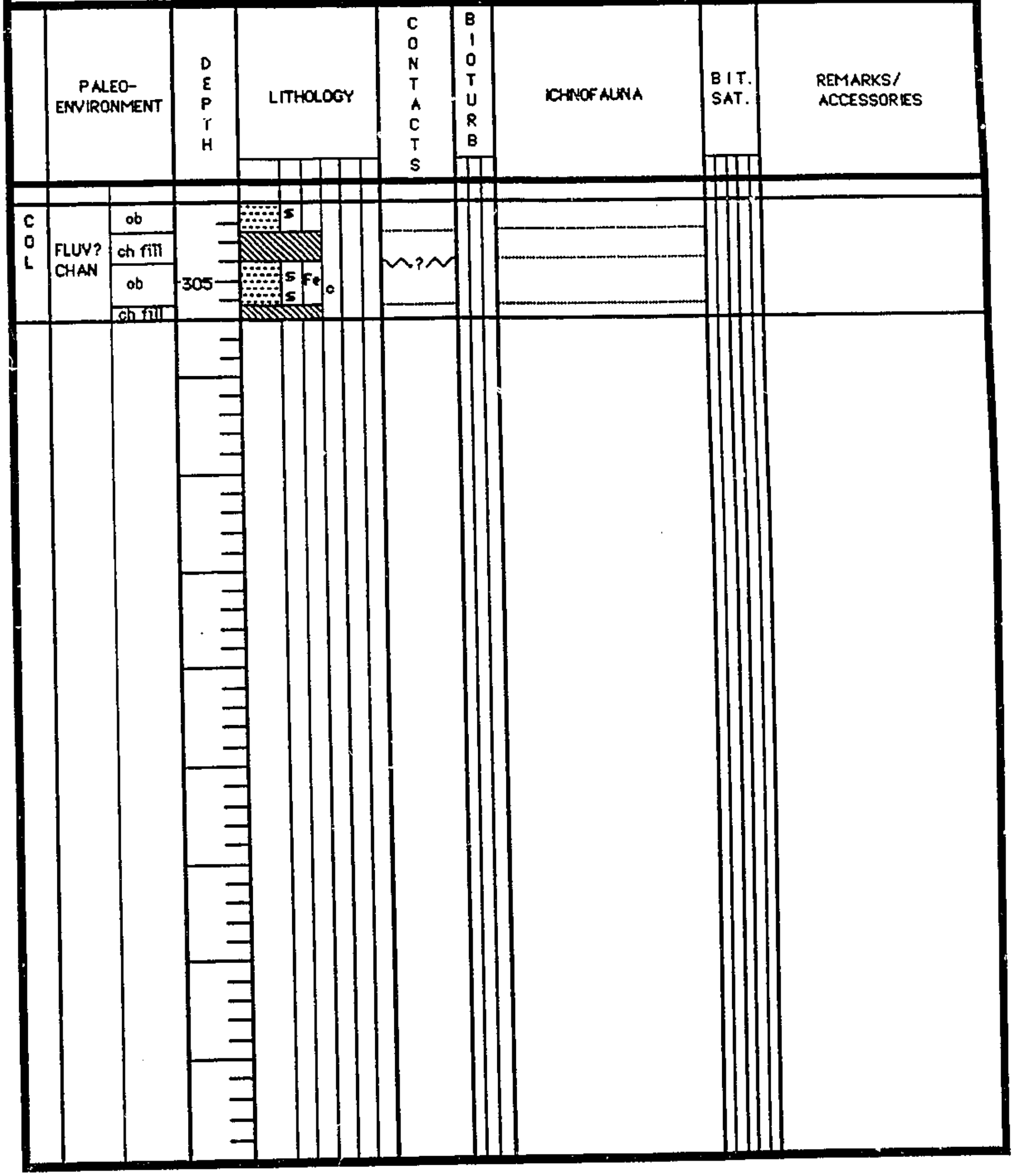
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-9-70-5W4	HUSKY AEC FISHER	HUSKY OIL OPERATIONS, ALBERTA ENERGY CO.	321.0-334.5 m	681.7 m	1 OF 1



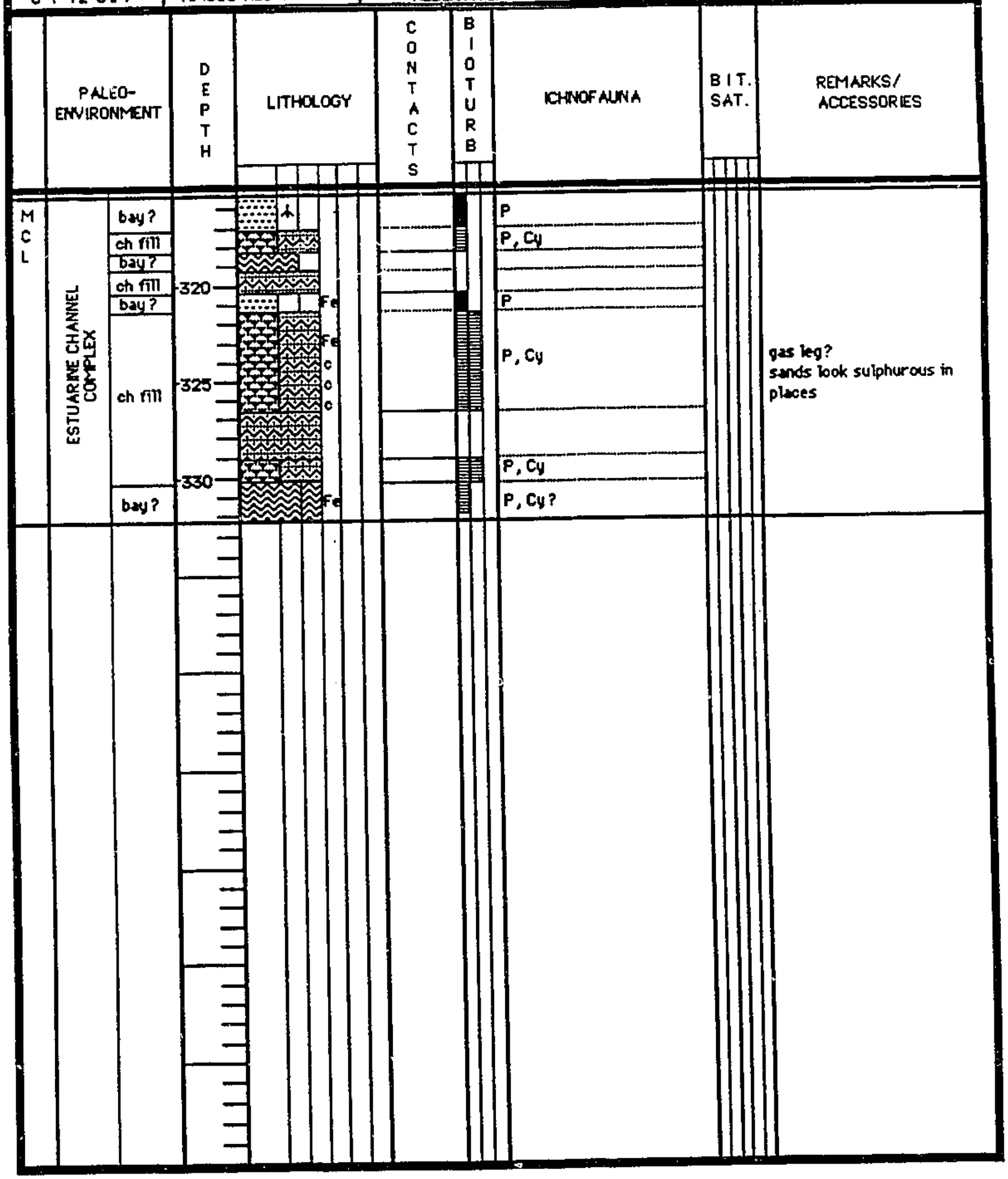
LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
5-23-70-6W4	HUSKY AEC FISHER	HUSKY OIL OPERATIONS, ALBERTA ENERGY CO.	305.0-322.0 m	660.6 m	1 OF 1



LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-32-71-7W4	PEX PHILLIPS AEC KIRBY	ALBERTA ENERGY	301.0-307.0 m	660.2 m	1 OF 1

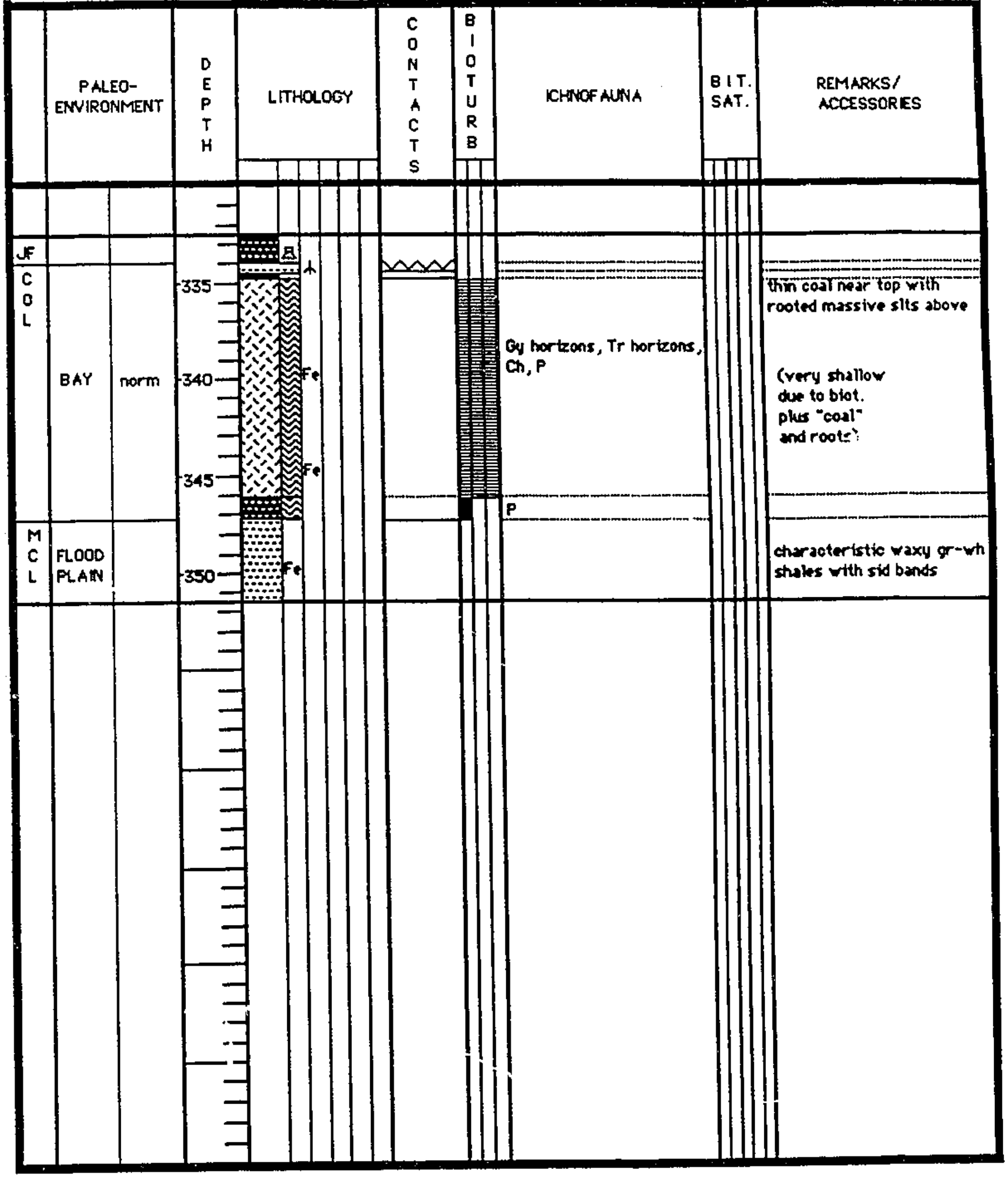


LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
6-1-72-5W4	AMOCO AEC IPIATIK	AMOCO PETROLEUM, ALBERTA ENERGY	315.4-332.3 m	674.8 m	1 OF 1



gas leg?
sands look sulphurous in places

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
7-14-72-6W4	AMOCO AEC IPIATIC	AMOCO PETROLEUM, ALBERTA ENERGY	332.5-351.4 m	706.9 m	1 OF 1

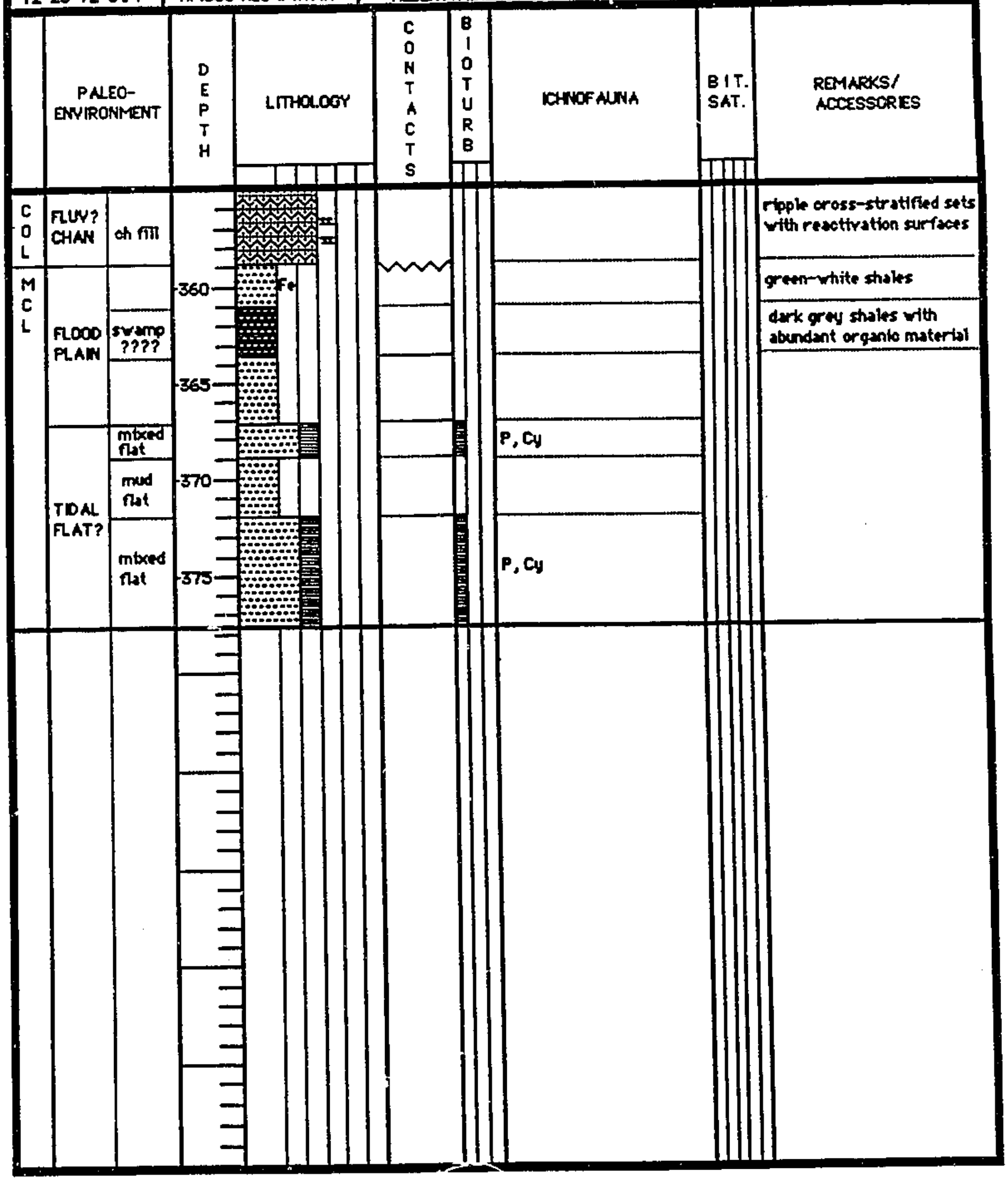


thin coal near top with rooted massive slts above

(very shallow due to biot. plus "coal" and roots)

characteristic waxy gr-wh shales with sid bands

LOCATION	WELL NAME	LEASE HOLDER	INTERVAL	K.B.	PAGE
12-26-72-6W4	AMOCO AEC IPIATIK	AMOCO CANADA LTD. ALBERTA ENERGY CO.	355.0-379.0 m	718.0 m	1 OF 1



ripple cross-stratified sets with reactivation surfaces

green-white shales

dark grey shales with abundant organic material

THE UNIVERSITY OF ALBERTA

STRATIGRAPHIC AND PALEOENVIRONMENTAL ANALYSIS OF THE UPPER AND MIDDLE MANNVILLE SUB-GROUPS: COLD LAKE OIL SANDS AREA, EAST-CENTRAL ALBERTA

(Appendix 4)

BY
BLAIR WILLIAM MATTISON

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF GEOLOGY
EDMONTON, ALBERTA
FALL, 1991

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