
GEOLOGICAL SURVEY OF CANADA
COMMISSION GEOLOGIQUE DU CANADA

Open File 1124

# GEOLOGICAL DATA AND NOTES ON THE STRATIGRAPHY OF FOUR POTASH MINE SHAFTS IN THE PATIENCE LAKE - LANIGAN AREA, EAST OF SASKATOON, SASKATCHEWAN

L.L. Price

Geological Survey of Canada (Calgary)
3303 - 33 Street NW
Calgary, Alberta T2L 2A7

1985

CONTENTS



Cont.....

## Abstract

Fossils and large lithologic samples were collected from newly excavated material during construction of potash mine shafts at four sites east of Saskatoon, Saskatchewan, over the 83 km interval from Patience Lake to Lanigan. Stratigraphic data from this material are supplemented by logs of continuous core from the pilot holes for the shafts and observations of the shaft walls. A number of geological features are well illustrated in the shafts.

All of the shafts traverse atypical dolomitic post-Watrous sediments in a small Jurassic sub-basin marginal to the main Jurassic northern Williston Basin and controlled by sub-Mesozoic topography in the eroded surface of Paleozoic rocks.

The widespread unconformity at the top of the petroliferous Turonian Favel "second white specks" and beneath the petroliferous Boyne white specks is marked in the Saskatoon East area by a conglomerate containing silicified coarse fish bone fragments. Numerous bentonite beds in the interval of the Favel at Lanigan are followed consistently by heavy deposits of fishbones from extensive volcanic ash kills.

Belly River deltaic deposits are well developed at the top of the Upper Cretaceous marine Lea Park Formation except at Alwinsal, where erosion of the preglacial bedrock cuts down to marine Lea Park shale. The overlying marine Bearpaw shale is also present in all but the Lanigan (Alwinsal) area.

Fossils are listed in the stratigraphic logs as identified by G.S.C. paleontologists and their comments on the paleontology and correlations are given in the descriptive notes.

Exploitation of the potash ore of Saskatchewan began in 1960 when Potash Company of America commenced construction of a shaft at Patience Lake 22 km southeast of Saskatoon which was the first to reach the ore zone. This was the beginning of a decade-long construction era in potash exploitation which saw eight mine sites develop following approximately the 1000 m depth contour inside the northern and eastern edge of the Prairie Evaporite (shaded area, Fig. 1). The mine sites are concentrated in the Saskatoon and Esterhazy areas.

Construction of the Allan, Noranda, Central Canada and Alwinsal shafts proceeded simultaneously from 1965 to 1968. During that time, Darryl Holmes, and later, Rudy Klaubert, collected rock samples mainly from Allan and Alwinsal. There are breaks in continuity of the lithologic collections from these shafts and the fossil collections are not consistent with the quantities of fossil material in the rocks. This resulted in part from the large distances between shaft sites, construction delays at the Allan site, illness and change in personnel. Undescribed intervals from the shafts are supplemented in part by information from logs of the corresponding pilot holes. In the case of Central Canada Potash at Colonsay, the bulk of stratigraphic information is taken from a log of the core of an alternative pilot hole 2.9 km of the mine site and elevation of stratigraphic horizons and nature of lithology may vary considerably from those at the shafts.

Potash Company of America began construction of the second, PCA No. 2 shaft about the time the Allan, Noranda and Alwinsal shafts were completed. Dave Huffman, a student from the University of Saskatchewan in Saskatoon, was engaged by Dr. W.G.E. Caldwell to continue the collection program at this site, which yielded a large fossil collection and a complete set of lithologic samples.

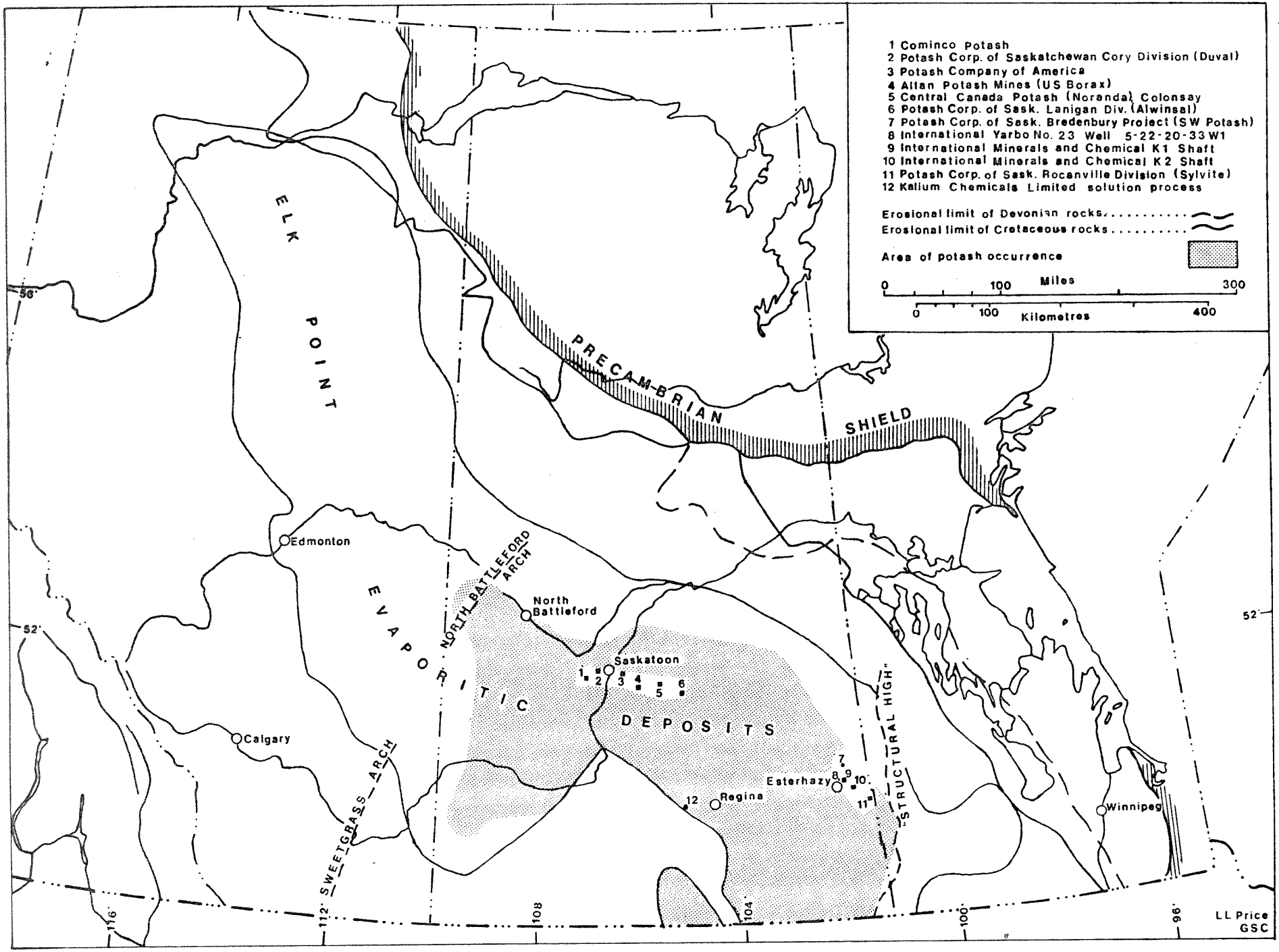



Figure 1. Index map of potash exploitation sites in Western Canada Sedimentary Basin

Huffman's log is included in this report together with fossils as identified by J.A. Jeletzky and A.E.H. Pedder of the Geological Survey. Their comments, included in this report, summarize collections from potash shafts reported both here and elsewhere.

The Geological Survey is indebted to Potash Company of America, U.S. Borax and successors Allan Potash Mines, Central Canada Potash Division of Noranda Mine Limited, and the Alwinsal Company, now Potash Corporation of Saskatchewan, Lanigan Division. These companies generously assisted observing geologists in documenting collections from excavated material and permitted inspection of shaft walls on request.

The following brief summary is intended to bring to light unusual stratigraphic features or trends noted in the course of the project, and reports of paleontologists of the Geological Survey who examined the fossils which are listed in the appended lithologic logs. The summary covers only those parts of the section in which such features occur.

## PALEOZOIC

### Dawson Bay Formation

Black "bituminous" limestone with lobate thamnoporoid corals, crinoids and atrypoid brachiopods, common to the Dawson Bay and to the Middle Devonian elsewhere, is well developed at Alwinsal and, to a lesser extent, at Central Canada, but this facies almost disappears westward, at PCA No. 2 shaft. Bioclastic and vuggy zones and the finely sucrosic dolomite noted for extreme porosity in the Dawson Bay elsewhere, are plugged with halite in much of the Saskatoon-Lanigan region and were an important consideration in the location of individual potash shaft sites.

Paleontology (A.E.H. Pedder): Many elements in these faunas, particularly among the species of *Moravophyllus?*, *Temnophyllum? Cylindrophyllum* and *Stringocephalus*, indicate a Givetian age. The occurrence of *Cylindrophyllum* points to a faunal link with the mid continent region in Givetian (Hamilton) time, while the species of *Temnophyllum* and *Stringocephalus* are of Cordilleran affinities. Rather surprisingly, faunas from the Subsurface Dawson Bay Formation of Saskatchewan have more in common with the Ramparts and Sulphur Point faunas of the Mackenzie River region than with those of the Dawson Bay Formation of the Manitoba outcrop area.

Souris River Formation

Paleontology (A.E.H. Pedder): *Eostrophalosia* sp., *"Atrypa"* cf. *oneidensis* and *Allanaria allani* (broad sense), which occur abundantly in some of the Souris River collections, are highly characteristic of the Waterways Formation of Alberta and its various correlatives. The Waterways fauna has long been recognized in the Snyder Creek Formation of Missouri and is now known in the west, from Powell Creek, near Norman Wells, to as far south as the Idaho-Utah border (*J. Paleont*, v. 39, p. 21).

Duperow Formation

The Birdbear beds are missing in the Alwinsal, Central Canada and Allan shafts, with considerable erosion of the sub-Mesozoic surface, including the upper part of the Duperow. They are believed to be missing also at PCA Shaft No. 2 where erosion of the Duperow is slight, only a short distance beyond the erosional northeastern limit of the Birdbear.

Fossils collected from a 30 m (100 ft) interval below the erosion surface (GSC locs. C-6562 to C-6564) were tentatively ascribed to the Birdbear Formation by Huffman for field collection purposes. However, an

8 m thick dolomitized zone below the paleozoic surface at PCA No. 2 shaft, at the top of the section assigned by Huffman to the Birdbear is believed to belong to the uppermost part of the Duperow Formation, with dolomitization related to the depositional chemistry of the Jura-Triassic dolomite sediments above the unconformity. The *Dysphyllum* n. sp. and other fossils described below by Pedder refer to this uppermost part of the Duperow Formation, which, like the Birdbear, is equivalent to a part of the Mount Hawk Formation.

Paleontology (A.E.H. Pedder, GSC Internal Report): Faunas from low in the Duperow Formation in the Sylvite St. Marthe #2 shaft (GSC locs. C-6562 to C-6564) carry *Neocolumnaria?* sp. nov. and *Allanaria* ex. gr. *minutilla*. These suggest correlation with the lower part of the upper member of the Hollebeke Formation of the southern Alberta Rocky Mountains (*Bull. Can. Petrol. Geol.*, v. 12, pp. 430-436) and with the Maligne Formation of the central Alberta Rocky Mountains. Higher Duperow faunas of the Elstow (GSC locs. C-6537, C-6538) and Wymark Members (GSC loc. C-3680) include *Mucrospirifer reidfordi* (broad sense) GSC loc. C-6537, C-6538, which suggests correlation with the upper beds of the upper member of the Hollebeke Formation and with part of the Hay River Formation (base of outcrop) of southern District of Mackenzie.

Collections GSC loc. C-6531 and GSC loc. C-6532 from the Potash Company of America's No. 2 shaft from high in the Duperow Formation contain a new species of *Disphyllum*, that is also known from the Mount Hawk Formation of the Alberta Rocky Mountains, and *"Tenticospirifer"* ex. gr. *cyrtinaformis*, which is present in the subsurface Ireton Formation as well as the Mount Hawk Formation. *Smithiphyllum martinense* was first described from the Martin Formation of Arizona; the Martin Formation has long been considered a correlative of the Mount Hawk Formation.

# MESOZOIC

## Jura-Triassic

### Watrous Formation

Silty and dolomitic red mudstones of the Watrous Formation are present at shaftsites from Allan eastward ranging from 80 feet (24 m) to perhaps as much as 214 feet (65 m) in thickness, depending on the somewhat arbitrary upper contact at Alwinsal. The Watrous is missing at PCA No. 2. It contains dedolomitized calcareous redbeds at Alwinsal.

## Jurassic

Atypical Jurassic dolomite sediments apparently equivalent to a part of the post-Watrous Marine Jurassic formations in other parts of the Williston Basin are deposited in an elongate sub-basin lying along the north side of the low cuesta formed in the sub-Mesozoic erosion surface of the northern erosional limit of Mississippian carbonate rocks. They extend, perhaps not continuously, from near Bredenbury, southeast of Yorkton, to the vicinity of Patience Lake near PCA No. 2 shaft. This restricted sub-basin is narrow, with clastic sediments in the Yorkton area, becoming predominantly dolomite near Alwinsal where the sub-basin broadens at a large southward embayment in the Mississippian erosion edge. Thickness of the post-Watrous beds ranges from 46 feet (14 m) at Alwinsal to 17 feet (5.2 m) at Allan and 32 feet (9.8 m) at PCA No. 2 shaft. They are thickest (60 ft, or 18 m) at Alwinsal Beaver 1-12, a completely cored alternate pilot hole for Alwinsal in Lsd. 1, Sec. 12, tp. 33, Rge. 24, W2 and are capped by a thick weathered zone in the Consolidated Morrison Colonsay 5-33 alternate pilot hole of Central Canada Potash, in Lsd. 5, Sec. 33, tp. 34, Rge. 27, W2.

The post-Watrous beds at Alwinsal are predominantly dolomitic mudstones and argillaceous dolomite, but the lower beds are calcareous. A limestone in this interval at Beaver 1-12 contains wood fragments in the manner of a travertine. A rose-coloured limestone at the Alwinsal shaft contains quartz-lined vugs and may be correlative with the chalcedonic quartz forming layers and vugs in limestone that constitutes a marker horizon in the Gravelbourg Formation of the Williston Basin proper.

## Cretaceous

### Manville Group

Cantuar fluvial and estuarine delta plain sediments and the overlying transgressive Pense barrier island shoreface deposits are virtually unfossiliferous. In the Alwinsal shaft the Cantuar-Pense boundary is marked by massive pyrite overlying calcareous sandstone.

### Lower Colorado (Ashville) Group

Shallow marine shales of the Lower Colorado are interrupted by two persistent sands. The Viking offshore sand is weakly developed in the Saskatoon-Lanigan area but is clearly recognizable in all of the shafts. The Fish Scale Sand equivalent is consistently evident but also confined to a narrow horizon in this area.

Organic remains in the Ashville interval are limited to comminuted copious remains of fish and a few *Inoceramus*, becoming more abundant upward. Bentonite bands occur also with increasing regularity.

No fossils were collected from the Ashville interval in the Saskatoon East area.

"Favel Formation (Second White Speckled Shale)"

Thickness of the Favel Formation ranges from 15 feet (5 m) at Allan to 98 feet (30 m) at Alwinsal. The contact of white-speckled calcareous Favel shales with non-calcareous marine shale below is sharp but conformable. The upper contact of the Favel with the similar Boyne white-speckled calcareous shale is erosional, marked by animal burrows and a fishbone layer at PCA No. 2, by a ferruginous bentonite band in the Colonsay 5-33 alternate pilot hole and by a chert conglomerate at Allan, consisting of elongate pebbles and silicified bone fragments up to 1 cm long. At Alwinsal the erosion surface is less easily identified, but appears to be marked by a pyrite band 2.5 cm thick.

No significant fossil collections came from the Favel in shafts in the Saskatoon East area. The Alwinsal shaft contained prominent bands of fishbones in shale, each subjacent to a bentonite layer. This repeated juxtaposition of fish remains and bentonite at Alwinsal is strong evidence that each bone bed is the remains of a general kill from volcanic ash fall.

"Boyne Formation (First White Speckled Shale)"

Thickness of the Boyne Formation varies from 96 feet (29 m) at Allan to 20 feet (6.1 m) at Alwinsal, apparently thickening where the underlying Favel is eroded.

Paleontology

Fossils (GSC loc. 70626) from 1290-1300 feet, near the base of the Boyne at Allan, were examined by J.A. Jeletzky (G.S.C. Internal Report).

Age and correlation: Some part of the Santonian stage of international standard. Could correspond either to *Scaphites (Clioscaphites) montanensis* (more likely) or *Scaphites (Clioscaphites) vermiformis* or to *Scaphites*

*(Clioscaphites) depresus* Zone but cannot be dated more closely. In any case, equivalent to the middle part of Wapiabi Formation of the Foothills and to the upper part of Boyne Member of Vermillion Formation of the Manitoba Escarpment. Is is thus within the first rather than second specks.

Lea Park Formation

The Lea Park marine shales are eroded at Alwinsal beneath a deep channel in the subtill bedrock surface. Where the Lea Park underlies the silty nonmarine Belly River, thickness ranges between 154 m (506 ft) and 227 m (746 ft), apparently thickening at the expense of the overlying and intertonguing Belly River arenaceous beds.

A large number of collections from the Lea Park in various potash shafts have been identified and listed by J.A. Jeletzky in G.S.C. internal paleontology reports which refer to collections from IMC No. 2 (Yarbo No. 2) shaft and the Sylvite shafts in the Esterhazy Rocanville area as well as those from the shafts covered in this report area. Jeletzky's comments on age determination of specific collections are given below in order of distance from the base of the formation:

PCA No. 2 shaft, depth 520-595 feet (158-181 m), GSC locs. C-3714, C-3719, C-3723, C-3724: Mid-upper Campanian. Some part of *Scaphites (Hoploscaphites) gilli* Zone (see Cobban and Jeletzky, 1965, Journ. Pal., v. 39, no. 5, p. 800). In the United States Western Interior Region this zone appears to correspond to the upper part of *Baculites perplexus* Zone and to the zones of *Baculites gregoryensis, Baculites scotti, Didimoceras nebrascense* and *Didimoceras stevensoni*. However, in the Canadian Western Interior Region, *Scaphites (Hoploscaphites) gilli* definitely ranges down at least into the upper part of the next older *Baculites asperiformis* Zone. The *Scaphites (Hoploscaphites) gilli* Zone appears therefore to begin closely above the lower part of the Lea Park Formation equivalent to the Milk River Formation of southern Alberta Plains (i.e. its lower

Campanian beds representing *Scaphites hippocrepis* Zone; see Jeletzky, GSC Paper 70-22, pp. 63-64). This zone extends through all of the middle and upper beds of the type Lea Park Formation in the Lloydminster area (see Shaw and Harding, AAPG Bull., v. 33, no. 4, 1949, figs.. 2-4) and at least into the Grizzly Bear shale member of the overlying Belly River Formation. Still farther east in southwestern Saskatchewan, *Scaphites (Hoploscaphites) gilli* Zone appears to range at least as high up in the eastern Lea Park facies. However, it does not seem to extend into the uppermost beds of this facies of the Lea Park Formation equivalent to the Lower and Upper Birch Lake Members of southeastern Alberta (see Price and Ball, GSC Paper 70-71, pp. 42-44). This uppermost part of the northeastern facies of Lea Park Formation did not yield any diagnostic fossils. However, it (and the attenuated Belly River above it) is believed to correspond to *Exiteloceras jenneyi* and *Didimoceras cheyennense* Zones of the United States Western Interior Standard (see Scott and Cobban, USGS Miscellaneous Geologic Investigations Map I-439, 1965) because of the stratigraphic position between the *Scaphites (Hoploscaphites) gilli* and *Baculites compressus* s. lato Zones.

PCA Shaft No. 2, depths 600-745, GSC loc. C-3727, C-3742: So far as known, large and smooth *Baculites* of this type are restricted to the lower part of Pierre shale between the ?lower or ?middle part of *Scaphites (Hoploscaphites) gilli* and *Baculites mclearni* Subzone of *Baculites obtusus* s. str. Zone. They would be diagnostic of the lower middle part of Lea Park Formation, except that similar large and smooth *Baculites* are known to recur farther down in the Santonian part of the Alberta shale.

Because of its stratigraphic position in beds with large and smooth *Baculites* sp., GSC loc. C-3734 appears to represent the lower part of the *Scaphites (Hoploscaphites) gilli* Zone corresponding to the *Baculites perplexus* Zone or? possibly to the topmost part of *Baculites asperiformis* Zone of the

United States Western Interior standard (see Scott and Cobban, USGS Miscellaneous Geologic Investigations Map I-439, 1965). GSC loc. C-3734 is therefore believed to be derived from the middle part of the Lea Park Formation situated stratigraphically below the Brosseau Member of the Belly River Formation of southeastern Alberta (see Shaw and Harding, 1954, loc. cit.)

GSC loc. C-3741 is probably of mid-Upper Campanian age and from some part of *Baculites perplexus* Zone of Scott and Cobban (USGS Miscellaneous Geologic Investigations Map I-439, 1965). This baculite zone of the United States Western Interior standard appears to correspond to the lower but not the lowermost part of the Canadian zone of *Scaphites (Hoploscaphites) gilli* (see under the discussion of GSC locality C-3714). GSC loc. C-3741 appears therefore to be derived from the lower middle part of the Lea Park Formation corresponding to the level stratigraphically below the Brosseau Member of Belly River Formation of southeastern Alberta (see Shaw and Harding, 1949, loc. cit.).

PCA Shaft #2, depths 780-855 feet, GSC locs. C-3743, C-3748: Early Upper Campanian, represents some part of the restricted *Baculites asperiformis* Zone of the United States Western Interior standard (see Cobban, 1962, Journ. Pal., v. 36, no. 4, pp. 704-706 and Scott and Cobban, USGS Miscellaneous Geologic Investigations Map I-439, 1965). As already mentioned under the discussion of fossil GSC loc. C-3714, this baculite zone corresponds to the basal part of *Scaphites (Hoploscaphites) gilli* Zone in Canada, in part at least. GSC loc. C-3743 appears therefore to be derived from a bed situated in the middle part of Lea Park Formation corresponding to a level stratigraphically below that of the Brosseau Member of Belly River Formation in southeastern Alberta (see Shaw and Harding, 1949, loc. cit.).

PCA Shaft #2, depths 860-980 feet, GSC locs. C-3750-3765: Some part of *Baculites obtusus* Zone and probably from its upper part comprising the *Baculites mclearni* Subzone in the writer's interpretation (see below).

The beds carrying *Baculites mclearni* Landes, 1940 have been previously assigned an early to mid-lower Campanian age and treated tentatively as an upper subzone of *Baculites obtusus* s. str. Zone (see Price and Ball, GSC Paper 70-71, p. 32). More recent data necessitates a revision of this conclusion. The boundary between the lower and upper Campanian substages in Canada is now being placed at the base of *Baculitis obtusus* s. str. Zone (see Jeletzky, GSC Paper 70-22, Fig. 3) and the upper beds of this zone containing *Baculites mclearni* are placed somewhat above the lower/upper Campanian boundary. Cobban's (Journ. Pal., v. 36, no. 4, 1962, pp. 704-706) and Gill and Cobban's (USGS Miscellaneous Geologic Investigations Map I-439, 1965) elevation of *Baculites mclearni* beds to a full zonal status is not followed by the writer. The *Baculites mclearni* and *Baculites obtusus* s. str. faunas intermingle so strongly that they are best given a subzonal status only. This intermingling is rather apparent in the PCA Shaft No. 2 where forms referable to or comparable with *B. obtusus* Meek s. str. appear only about 25 feet below the assigned top of the *Baculites obtusus* Zone (see GSC loc. C-3755) and intermingle with forms referable to or comparable with *Baculites mclearni* through the next 95 feet of section down to the 995 foot to 1000 foot level (see under the discussion of GSC loc. C-3768). The following 40-45 foot thick interval can be assigned to the *Baculites obtusus* Subzone proper.

*Baculites mclearni* Subzone of *Baculites obtusus* s. str. Zone occurs low in the middle part of the Lea Park Formation closely but not immediately above its basal part which contains *Scaphites (Hoploscaphites) hippocrepis* fauna (see Jeletzky GSC Paper 67-72, pp. 43-45).

PCA Shaft #2, depth 989-1145 feet, GSC locs. C-3766-C-3779: Probably represents the *Baculites obtusus* Subzone proper rather than the *Baculites mclearni* Subzone of the *Baculites obtusus* senus stricto Zone. This suggestion

can be made because no specimens referable to or comparable with *Baculites mclearni* have been found in the shaft below the 970-980 foot level (see under discussion of GSC loc. C-3750-C-3765 above).

Nonmarine beds

Thickness of the nonmarine beds is variable, thickest (363 ft or 110.6 m) at Central Canada - Noranda, thinnest, (121 ft or 36.6 m) at Allan, without any discernible regional trend, possibly the result of intraformational and post-Cretaceous erosion as demonstrated in the Duval (Cory) Shaft on the west side of Saskatoon (Price and Ball, GSC Paper 70-71, p. 31). Fossils in this interval are confined to a few pelecypods without diagnostic indication of age, and some carbonized wood. The equivalent nonmarine beds in the Cominco and Duval shafts west of Saskatoon (Price and Ball, GSC Papers 72-11 and 70-71) were assigned to the Belly River, but it has been pointed out by Jeletzky (per. comm. 1983), that considering the presence of overlying marine shale in the Saskatoon east area, and fauna of the enveloping shales, that the nonmarine beds are more logically regarded as a nonmarine Lower Birch Lake Tongue of Belly River sands within the Lea Park Formation.

Upper marine shale

Marine beds overlying the Birch Lake Tongue range in thickness from 8 feet (2.4 m) at PCA No. 2 Shaft, to 188 feet at Allan, beneath the subglacial surface. Fossils collected at Central Canada Potash (Noranda) No. 2 Shaft were examined by J.A. Jeletzky whose comments follow:

No. 2 Shaft, depth 300-324 feet, GSC loc. C-3707: The presence of *Inoceramus* comparable to *I. sublaevis* Meek is somewhat suggestive of C-3707, representing some part of the mid-Upper Campanian *Baculites gregoriensis* Zone to which *I. sublaevis* Meek appears to be restricted in the Western Interior of the United States at least (see Cobban and Reeside, 1952, GSC Bull., v. 63, p. 1020, corr. chart).

Shaft No. 2, depth 320-330 feet, GSC loc. C-3708: The presence of well preserved and typical representatives of *Inoceramus pertenuis* Meek suggests that GSC loc. C-3708 represents some part of the *Baculites asperiformis* Zone of the early Upper Campanian age as *I. pertenuis* Meek appears to be restricted to this zone in the Western Interior of the United States at least (Cobban and Reeside, 1952, GSC Bull., v. 63, p. 1020, corr. table). The presence of *Inoceramus* comparable with *I. sublaevis* Meek suggests, furthermore, that GSC loc. C-3708 represents the upper part of *Baculites asperiformis* Zone (compare under the discussion of GSC loc. C-3707). If so, GSC loc. C-3708 is older than GSC loc. C-3707 in terms of the *Baculites* zonal standard of the Western Interior region of North America.

# References

Beus, S.S.
1965: Devonian Faunule from the Jefferson Formation, Central Blue Spring Hills, Utah-Idaho; Journal of Palaeontology, v. 29, p. 21.

Cobban, W.A.
1962: Bacculites from the lower part of the Pierre Shale and equivalent rocks in the Western Interior; Journal of Palaeontology, v. 36, no. 4, pp. 704-706.

Cobban, W.A., and Jeletzky, J.A.
1965: A new Scaphite from the Campanian rocks, Journal of Palaeontology, v. 39, no. 5, p. 800.

Cobban, W.A., and Reeside, J.B.
1952: Correlation of the Cretaceous formations of the Western Interior of North America; Geological Society of America, Bulletin, v. 63.

Jeletzky, J.A.
1968: Macrofossil zones of the marine Cretaceous of the Western Interior of Canada and their correlation with the zones and stages of Europe and the Western Interior of the United States; Geological Survey of Canada, Paper 67-72.

1971: Marine Cretaceous biotic provinces and paleogeography of Western and Arctic Canada by a detailed study of ammonites; Geological Survey of Canada, Paper 70-22.

Price, R.A.
1964: The Devonian Fairholme - Sassenach succession and evolution of reef-front geometry in the Flathead - Crowsnest Pass area, Alberta and British Columbia; Bulletin of Canadian Petroleum Geology, v. 12, pp. 430-436.

Price, L.L. and Ball, N.L.
1971: Stratigraphy of Duval Corporation Potash Shaft No. 1, Saskatoon, Saskatchewan; Geological Survey of Canada, Paper 70-71.

Scott, G.R., and Cobban, W.A.
1965: Geologic and biostratigraphic map of the Pierre Shale between Jarre Creek and Loveland Colorado; United States Geological Survey, Geologic Investigations Map I-439.

Shaw, E.W., and Harding, S.R.L.
1954: Lea Park and Belly River formations of East - Central Alberta; American Association of Petroleum Geologists, Bulletin, v. 33, no. 4.

# APPENDIX I

(a) Lithologic log of Potash Corporation of America

Shaft No. 2

(b) Graphic Log Potash Corporation of America

Shaft No. 2

Potash Company of America

SHAFT NO. 2

Location: Lsd. 11, Sec. 9, Tp. 36, Rge. 3, W3
Elevation of Ground level (datum): 1751 feet

| Depth (feet) | Lithology |
|---|---|
| 0-25 | No information. |
| | QUATERNARY |
| 26-31 | Clay beds: varved; varves 6-25 cm thick with interbedded, sandy till |
| 31-36 | Till: clayey; with rare boulders to 30 cm diameter, some thin, well bedded, sandy clay layers |
| 36-56 | Sand: light brown, medium grained, well sorted; with numerous lenses of gravel, 60-180 cm long, 30-45 cm thick, with cobbles to 6 cm, well rounded; grey, clay lenses usually associated with the gravel lenses (figs. 1, 2) |
| 56-57 | Gravel: cobbles 5-20 cm in diameter, a few up to 25 cm, well rounded; basal contact of gravel at 67' slopes west at 10-15° |
| 57-144 | Till: clayey |
| 144-156 | Sandy: light brown, fine grained, well sorted, with wood fragments; top and base contacts of bed undulating with 15-22 cm relief; wood age-dated at 39,000 years |
| 156-193 | Till: clayey; no samples |
| 193-212 | Till: clayey, light grey; scattered cobbles of igneous and carbonate rock, 15-61 cm diameter |
| 212-216 | Sand: light brown, fine grained; dips 20° south (Fig. 2) |
| 216-218 | Gravel: well rounded pebbles, 1-5 cm in diameter |
| 218-227 | Till: clayey, light grey; sand, fine grained, with scattered cobbles of igneous and carbonate rock, 15-30 cm diameter; clay till becomes darker and grades into silty, unconsolidated, medium grey shale near base (Fig. 2). |

| Depth (feet) | Lithology |
|---|---|
| | MESOZOIC (Cretaceous) |
| | Lea Park Formation |
| | Upper marine shale |
| 227-235 | Shale: dark grey, fine grained; scattered pelecypod fragments and slightly calcareous, mudstone nodules; *Inoceramus* cf. *balticus* Böhm s. lato, *Dentalium* (s. lato) sp. indet., GSC loc. C-3709 |
| | Lower Birch Lake tongue |
| 235-240 | Shale: medium to dark grey, silty; a few pelecypod fragments |
| 240-245 | Shale: medium to dark grey, silty; silt layers alternating with shale layers, a few scattered ironstone concretions |
| 245-250 | Shale: medium grey, very silty, scattered pelecypod shell fragments; layers of silt alternating with shale, silt layers light grey, 3-6 mm thick |
| 250-255 | No information |
| 255-260 | Shale: medium grey, silty, alternating with thin layers (3-6 mm) of light grey silt |
| 260-265 | Shale: medium grey, very silty; alternating with thin layers of light-grey silt |
| 265-270 | Shale: alternating with fine grained silt layers; scattered pelecypod fragments |
| 270-275 | Shale: alternating with fine grained silt layers; scattered pelecypod fragments |
| 275-280 | Shale: alternating with fine grained, light-grey silt layers; scattered pelecypod fragments |
| 280-285 | Shale: medium to dark grey, slightly silty; scattered pelecypod fragments; a few nodules of fine grained, light grey calcite, with fine layers of shale included within nodules |
| 285-290 | Shale: medium grey, silty; fine layers of light grey silt 3-6 mm thick interbedded with shale; *?Cymbophora* sp. indet., *?Protocardia* sp. indet., wood fragments (carbonized), GSC loc. C-3710 |

| Depth (feet) | Lithology |
|---|---|
| 290-295 | Shale: interbedded with fine grained, light-grey silt; scattered pelecypod shells |
| 295-300 | Shale: interbedded with fine grained, light-grey silt; scattered pelecypod shells and wood fragments |
| 300-305 | Shale: alternating with silty beds; wood fragments; *?Cymbophora* sp. indet., *?Protocardia* sp. indet., wood fragments (carbonized), GSC loc. C-3711 |
| 305-310 | Shale: medium grey, silty, wood fragments; layer, 7.5-30 cm thick, of light-grey mudstone; fossil wood (carbonized), GSC loc. C-3712 |
| 310-315 | Shale: interbedded with fine grained, light-grey silt |
| 315-320 | Shale: medium grey, slightly silty with layers of light-grey shale 1 cm thick in a few zones; silt, light-grey, fine grained, alternates with shale |
| 320-325 | Shale: as above; alternating with fine grained, light-grey silt |
| 325-330 | Shale: as above; alternating with silt, becomes more sandy near base; layer of black, carbonaceous, wood fragments mixed with shale, silt and sand |
| 330-335 | Sandstone: light grey, silty, feldspathic, unindurated, slightly calcareous grains, sub-rounded, poorly sorted; contains 3-5% feldspar, accessory amphibole 5%, biotite 1%, chlorite 3%; zone 45 cm thick near top, consisting of gravel with rounded pebbles 0.6-1 cm diameter, majority of pebbles quartz; black, calcareous, wood fragments near top; coaly sandstone; no megafossils noted, GSC loc. C-3713 |
| 335-340 | Sandstone: silty, light grey, poorly sorted, feldspathic; zone of indurated sandstone blocks with same composition as friable sands, 30 cm thick, non-porous, calcareous matrix |
| 340-345 | Sandstone: silty, unconsolidated, feldspathic, with zone of consolidated sandstone blocks of same composition, calcareous matrix, 15-30 cm thick |
| 345-350 | Sandstone: silty, light grey, feldspathic; gravel zone, 60-90 cm thick, with rounded pebbles of quartz and granitic rock 6 mm-2.5 cm diameter mixed with sand |
| 350-355 | Sandstone: light grey, silty, feldspathic |
| 355-360 | Sandstone: light grey, silty, feldspathic; becomes shaly near base |

| Depth (feet) | Lithology |
|---|---|
| 360-365 | Shale: medium grey, silty; layers of fine, silty sandstone interspersed throughout, sandy shale near top, light-brown mudstone nodules scattered in shale, nodules are slightly calcareous |
| 365-370 | Shale: as above; with zones of light-brown mudstone nodules, calcareous; thin sandstone layers interspersed throughout shale, sandstone, light-grey, silty, with gravel having pebbles of quartz averaging 1 cm diameter located near base |
| 370-375 | Shale: as above; medium grey, silty |
| 375-380 | Shale: as above; medium grey, silty with light-brown mudstone nodules, some varved layers present, silt layers alternating with fine, organic, black shale |
| 380-384 | Shale: medium grey, silty, with thin layers of silt interspersed, light-brown mudstone nodules scattered in shale, sand layers alternating with shales near base, sand is light grey, poorly sorted with accessory amphibole, chlorite and biotite, slightly calcareous, layers of fine silty sand in varves with black organic shale alternating |
| 384-390 | Sandstone: light grey, silty, slightly calcareous, poorly sorted with accessory amphibole, chlorite and biotite, feldspathic; sandstone is very unconsolidated but contains zones of indurated calcareous sandstone, 15-30 cm thick, with the same composition as unconsolidated sandstone |
| 390-395 | Sandstone: as above; highly unconsolidated with lenses of indurated, calcareous sandstone |
| 395-400 | Sandstone: as above; with indurated, calcareous sandstone lenses |
| 400-405 | Sandstone: as above; light grey, slightly calcareous, silty, with lenses and blebs of indurated, calcareous sandstone of same composition |
| 405-410 | Sandstone: light grey, slightly calcareous, silty; with lenses and blebs of indurated, calcareous sandstone |
| 410-415 | Sandstone: light grey, slightly calcareous, fine grained, silty; with layers of calcareous shale, medium to light grey, silty |
| 415-420 | Sandstone: as above, slightly calcareous with layers of calcareous shale |
| 420-425 | Sandstone: as above; slightly calcareous with layers of silty, calcareous shale |

| Depth (feet) | Lithology |
|---|---|
| 425-430 | Sandstone: as above; with layers of light to medium-grey silty, calcareous shale; zones of light-grey silt scattered within shale layers |
| 430-444 | Sandstone: light grey, slightly calcareous; silty with a few thin layers of calcareous, medium-grey shale becoming more shaly near base |
| 444-450 | Shale: with thin, fine grained sand beds; shale is medium grey to light grey with varves of shale and silt; fine, silty, light-grey sandstone present as thin beds within shale; fossils absent or rare |
| 450-455 | Shale: medium grey, slightly calcareous, silty; thin silt layers alternating with shale; fine, silty, light-grey sandstone forms thin beds within shale; fossils absent or rare |
| 455-460 | Shale: medium grey, with scattered buff-coloured, calcareous mudstone concretions; medium-grey, silty shale with thin, fine grained sand beds; fossils absent or rare |
| 460-470 | Shale: medium grey, silty; with fine grained, light-grey, thin sandstone beds included, fine grained sandstone bed near base 20-25 cm thick, light-grey, slightly calcareous, silty with accessory amphibole and micas |
| 470-475 | Shale: medium grey; with light-grey thin sandstone beds included, bed of light-grey, highly calcareous, fine grained sandstone 15-25 cm thick |
| 475-480 | Shale: medium grey, silty; with thin layers of silt; slightly calcareous |
| 480-485 | Shale: medium grey, silty; with thin silt layers |
| 485-490 | Shale: medium grey, silty; with thin silt layers and layers of fine grained sandstone 15-20 cm thick; highly calcareous. |
| | Lower marine shale |
| 490-520 | Shale: medium grey, silty; thin silt layers scattered in shale, shell fragments are quite common, pelecypods and small coiled ammonites are most prevalent with a few gastropods also present, no sand layers are associated with shale |
| 520-525 | Shale: medium grey, silty; with few scattered mudstone concretions; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, 1965; *Inoceramus balticus* Böhm f. typ., GSC loc. C-3714 |
| 525-535 | Shale: medium grey, silty with fossil pelecypods and small coiled ammonites |

| Depth (feet) | Lithology |
|---|---|
| 530-535 | Shale: medium grey, silty, lens of light to medium grey calcite and shale mixed, 25-30 cm thick; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky; *Fasciolaria (Piestochilus)* cf. *culbertsoni* Meek, GSC loc. C-3715 |
| 535-550 | Shale: medium grey, silty, very slightly calcareous; thin layers of silt at scattered intervals; *Scaphites (Hoploscaphites)* cf. *gilli* Cobban and Jeletzky; cf. *Chemnitzia cerithiformis* Meek, GSC loc. C-3716, (535-540'), GSC loc. C-3717 (540-545') |
| 550-570 | Shale: medium grey, silty, *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Scaphites (Hoploscaphites)* n. sp. ex. aff. *gilli* Cobban and Jeletzky (large,nodose and bullate form), GSC loc. C-3718 (550-555'), GSC loc. C-3719 (555-560') |
| 570-600 | Shale: medium to light grey, silty; *Inoceramus balticus* Böhm s. lato, *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, 1965; *Inoceramus balticus* Böhm cf. car. *saskatchewanensis* Warren, *Inoceramus* sp. indet., cf. *Chemnitzia coalvillensis* Meek (a gastropod), GSC locs. C-3720-C-3725 |
| 600-605 | Shale: medium to light grey; thin layers of silt scattered within: *Inoceramus* cf. *oblongus* Meek, 1871; *Baculites* sp. indet. (a large, smooth form), GSC loc. C-3726 |
| 605-620 | Shale: medium to light grey; mudstone concretions 30-45 cm in diameter, calcareous and containing veins of brownish, finely crystalline calcite; *Baculites* sp. indet. (the same large and smooth form as in loc. C-3726), GSC loc. C-3727 |
| 620-630 | Shale: as above; *Baculites* sp. indet. (the same large and smooth form as in GSC loc. C-3727), GSC loc. C-3728 |
| 630-635 | Shale: as above; with mudstone concretions 30-60 cm in diameter; *Baculites* sp. indet. (the same large, smooth form as in GSC locs. C-3727 and C-3728), GSC loc. C-3729 |
| 635-640 | Shale: medium to light grey with thin layers of fine silt at scattered intervals |
| | 636-637' Horizontal, calcitic layer, light grey in colour, consisting of fine grained calcite with some shale mixed in, the calcite forms numerous fine veins disecting and enclosing the small particles of shale; *Inoceramus balticus* Böhm var. *saskatchewanensis* Warren, *Baculites* sp. indet. (the same large and smooth form as in GSC locs. C-3727-C-3729), indeterminate pelecypods (juvenile shells), GSC loc. C-3730 |
| 640-660 | Shale: light to medium grey in colour, with fine grained silt; light, buff coloured,calcareous mudstone concretions ranging in size from a few inches to over a foot in diameter are found at scattered intervals; fossil wood, GSC loc. C-3731; *Baculites* sp. indet. (the same large and smooth form as in GSC locs. C-3727-C-3730), GSC loc. C-3732 |

| Depth (feet) | Lithology |
|---|---|
| 660-675 | Shale: light to medium grey, with fine grained silt layers; light-buff coloured calcareous mudstone concretions ranging in size from 7.5-25 cm in diameter; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Baculites* sp. (the same large and smooth form as in GSC locs. C-3727- C-3730, C-3732), GSC loc. C-3733-C-3735 |
| 675-700 | Shale: medium to light grey; slightly silty with scattered inclusions of silt, small lenses of highly calcareous shale at scattered intervals, fossil content not as rich as above; indeterminate gastropod (marine), *Scaphites (Hoploscaphites)* cf. *gilli* Cobban and Jeletzky, *Baculites* sp. indet. (the same large and smooth form as in GSC locs. C-3727 - C-3730 and C-3732 - C-3736), *Baculites* sp. indet. *"A"* (the same large and smooth form as in GSC loc. C-3727 and the other lots of that group), *Baculites* sp. indet. *"B"* (a large, feebly sculptured form), GSC locs. C-3737, C-3738, C-3739 |
| 700-730 | Shale: medium to light grey, silty; with scattered silt layers, shale generally medium-grey in colour when fresh but weathers to a light grey; *Baculites* sp. indet. (the same large and smooth form as in GSC loc. C-3727 and other lots of that group), GSC loc. C-3740 |
| 730-735 | Shale: medium to light grey, silty; with scattered silt layers, lenses of hard, highly calcareous medium-grey mudstone 15-30 cm thick; *Baculites* cf. *perplexus* Cobban, 1962, (adult, nearly smooth form), GSC loc. C-3741 |
| 735-745 | Shale: medium to light grey; with scattered mudstone nodules, the nodules are highly calcareous with a medium grey core and buff coloured shell, 5-13 cm in diameter; *Baculites* sp. indet. (the same large and smooth form as in GSC loc. C-3727 and other lots of that group), *Acila* (s. lato) sp. indet., GSC loc. C-3742 |
| 745-750 | Shale: medium to light grey, silty; with scattered layers of silt; *Baculites asperiformis* Meek, 1876 emend. Cobban, 1962 (well preserved typical form), GSC loc. C-3743 |
| 750-755 | Shale: medium to light grey, silty, with scattered layers of silt, lenses of hard, light grey to buff mudstone, 15-25 cm thick |
| 755-815 | Shale: as above, medium to light grey, silty; with scattered silt layers, scattered nodules of buff-coloured, calcareous mudstone, shale weathers and drys to a light grey; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Baculites asperiformis* Meek 1876 emend. Cobban, 1962; *Baculites* sp. indet. (the same large and smooth form as in GSC loc. C-3727 and other lots of that group); indeterminate pelecypod, *Baculites* sp. indet. (poor fragments of an indeterminate large form), GSC locs. C-3744, C-3745, C-3746 |

| Depth (feet) | Lithology |
|---|---|
| 815-820 | Shale: medium to light grey, silty, with lenses, 15-20 cm thick, of hard, calcareous shale |
| 820-825 | Shale: medium to light grey, silty |
| 825-830 | Shale: medium to light grey; with nodules 10-15 cm in diameter, of light grey, calcareous mudstone, sparse fossil content of *Baculites* and small pelecypods |
| 830-845 | Shale: medium to light grey, silty and scattered layers of silt; *Baculites asperiformis* Meek 1876 emend. Cobban 1962 (a well preserved fragment), GSC loc. C-3748 |
| 845-870 | Shale: medium to light grey, with scattered inclusions of silt; shale weathers and dries to a light grey colour; *Lingula* sp. indet. (a hingeless brachiopod); *Baculites* cf. *mclearni* Landes (adult living chamber); *Baculites* ex. gr. *obtusus-mclearni* (not identifiable as to the species), GSC locs. C-3749, C-3750, C-3751 |
| 870-875 | Shale: as above, with lenses of medium grey, hard, highly calcareous siltstone, 20-25 cm thick; *Baculites mclearni* Landes 1940 (several juvenile and adult specimens), GSC loc. C-3752 |
| 875-890 | Shale: medium to light grey, with scattered inclusions of light grey silt; *Baculites mclearni* Landes 1940 (fragments of typical adult specimens), indeterminate marine pelecypods (juvenile); *Baculites* sp. indet. (poor fragment); *Baculites obtusus* Meek, 1876 s. str. (well preserved fragment of an adult living chamber), GSC locs. C-3753, C-3754, C-3755 |
| 890-910 | Shale: medium to light grey, with scattered layers of hard tan siltstone, slightly calcareous and 7.5-13 cm thick; *Baculites* cf. *obtusus* Meek, 1876 s. str. (poor fragments of apparently typical adults), indeterminate pelecypod (half grown); *Baculites* sp. indet. (poor fragments), *Lingula* sp. indet., GSC locs. C-3756-C-3758 |
| 910-915 | Shale: medium to light grey, silty, with scattered inclusions of light grey silt; *Baculites* sp. indet. (poor fragments), GSC loc. C-3759 |
| 915-920 | Shale: medium to light grey; with lenses of light grey to brownish, ferruginous siltstone, the lenses are 15-20 cm thick and are slightly calcareous with small, circular inclusions of buff, calcareous clay material 3-9 mm in diameter; *Baculites* cf. *mclearni* Landes, 1940, GSC loc. C-3760 |
| 920-925 | Shale: medium to light grey; with scattered, light grey siltstone concretions 30-45 cm in diameter, concretions also contain small, circular inclusions of buff, calcareous, clay material 3-9 mm in diameter; *Baculites* cf. *mclearni* Landes, 1940, *Baculites* sp. indet., GSC loc. C-3761 |

| Depth (feet) | Lithology |
|---|---|
| 925-950 | Shale: medium to light grey; with scattered inclusions of silt, fossil content poor with only a few *Baculites* and small pelecypods being noted |
| 950-955 | Shale: medium grey, silty; with noncalcareous layers of light grey to buff siltstone, 7.5-13 cm thick occurring at scattered intervals |
| 955-965 | Shale: medium grey, silty; with scattered, thin layers of light grey silt; *Baculites* sp. indet., *Inoceramus* sp. indet., GSC loc. C-3762 |
| 965-980 | Shale: light to medium grey, silty, with scattered, thin layers of light grey silt; *Baculites* ex. gr. *obtusus-mclearni* (not identifiable as to species), *Baculites mclearni* Landes, 1940; *Baculites* sp. indet. (a poor fragment), GSC locs. C-3753-C-3765 |
| 980-1010 | Shale: medium grey, silty; *Baculites obtusus* Meek, 1870, s. str. (well preserved intermediate and late growth stages), *Baculites* ex. gr. *obtusus-mclearni* (not identifiable as to species), GSC locs. C-3766-C-3769 |
| 1010-1055 | Shale: light to medium grey, silty, *Baculites* ex. gr. *obtusus-mclearni* (not identifiable as to species); *Baculites* sp. indet. (poor fragments); *Baculites* cf. *obtusus* Meek, 1876, s. str., *Baculites* sp. indet. (numerous poor fragments), GSC locs. C-3770-C-3774 |
| 1055-1065 | Shale: light to medium grey; with layers of calcareous siltstone 20-25 cm thick, siltstone is light grey in colour, highly calcareous and has a few scattered *Baculites* remains preserved in it |
| 1065-1105 | Shale: light to medium grey, silty, *Baculites* cf. *obtusus* Meek, 1876, s. str., *Baculites* sp. indet., GSC locs. C-3775-C-3777 |
| 1105-1125 | Shale: medium to light grey, silty, with thin, scattered layers of light grey silt; fossil content sparse with a few *Baculites* and pelecypods present |
| 1125-1130 | Shale: medium to light grey, silty, with light grey to buff calcareous, siltstone nodules and lenses 20-25 cm thick; fossil content consists of scattered *Baculites* remains |
| 1130-1135 | Shale: medium to light grey; *Baculites* cf. *obtusus* Meek, 1876, s. str., GSC loc. C-3778; (some *Baculites* shells show pyritization) |

| Depth (feet) | Lithology |
|---|---|
| 1135-1140 | Shale: medium to light grey; with a few, scattered, light grey to buff, calcareous siltstone concretions 15-20 cm in diameter; scattered *Baculites* shell fragments |
| 1140-1165 | Shale: medium to light grey; occasional light grey to buff, calcareous siltstone concretions; *Baculites* cf. *obtusus* Meek, 1876, s. str., GSC loc. C-3779 |
| 1165-1210 | Shale: medium to light grey, silty; *Baculites* shell fragments, small pelecypods |
| 1210-1224 | Shale: medium grey, silty, slightly calcareous; scattered fragments of *Baculites* and occasional, small pelecypods. |
| | Boyne Formation |
| 1224-1250 | Shale: white-speckled, medium grey, silty, highly calcareous; with numerous inclusions of white calcite grains spread throughout; absent or rare fossil occurrences |
| 1250-1262 | Shale: white-speckled, medium grey, silty, highly calcareous; with numerous inclusions of white calcite grains spread throughout and scattered veinlets of calcite 6-9 mm thick. |
| | Favel Formation |
| 1262-1295 | Shale: white-speckled, medium grey; siltstone layers 2.5-3 cm thick and lenses 15-25 cm thick occurring at scattered intervals within the shale; the siltstone is brownish grey in colour, coarse grained, highly calcareous with occasional, greyish white calcite veinlets, small amber coloured fish scales and a few small fish teeth are found scattered throughout the shale and siltstone layers; scales and teeth are more abundant in the siltstone than in the shale; fish scales, light grey worm burrows in interbedded lighter and darker shale, GSC loc. C-3780 |
| 1295-1302 | Shale: white-speckled, as above, highly calcareous, silty, medium grey; a few fish scales. |
| | Lower Colorado (Ashville) Group |
| | Unnamed beds |
| 1302-1330 | Shale: dark grey, silty, noncalcareous; fossils rare or absent |

| Depth (feet) | Lithology |
|---|---|
| 1330-1375 | Shale: as above; noncalcareous, and more silty than above shale; fine lenses of light grey silt scattered throughout the shale |
| 1375-1380 | Shale: as above; with scattered veins of sparry gypsum 6-9 mm thick |
| 1380-1405 | Shale: dark grey, silty, noncalcareous with fine lenses of light grey silt scattered throughout; occasional selenite gypsum vein present approximately 1 cm thick |
| 1405-1445 | Shale: dark grey, silty, noncalcareous |
| 1445-1460 | Shale: dark grey, silty, noncalcareous, slightly bentonitic with scattered veining of selenite gypsum approximately 6 mm thick |
| 1460-1474 | Shale: dark grey, silty, noncalcareous, bentonitic, no definite layers of bentonite present, minor spherical inclusions of pyrite; few scattered organic fragments and fish scales present. |
| | Fish Scale Marker beds |
| 1474-1475 | Siltstone: light grey, noncalcareous; varies from 25-30 cm thick in places. |
| | Unnamed beds |
| 1475-1480 | Shale: dark grey, silty, non calcareous, slightly bentonitic; few scattered organic fragments and fish scales |
| 1480-1495 | Shale: dark grey, silty, noncalcareous with fine layers and lenses of light grey silt scattered throughout; minor amounts of pyrite present in the form of scattered blebs approximately 1 mm in diameter, occasional fish scale observed in shale; 1480' - layer of light-grey siltstone, 15-20 cm thick |
| 1495-1520 | Shale: dark grey, silty, noncalcareous, bentonitic; pyrite blebs 1 mm in diameter scattered throughout shale |
| 1520-1540 | Shale: dark grey, silty, noncalcareous, slightly bentonitic; pyrite blebs, 1 mm in diameter scattered throughout shale, no fossil content noted |
| 1540-1566 | Shale: medium to dark grey, highly silty, noncalcareous, slightly bentonitic; thin lenses of hard grey silt scattered throughout. |

| Depth (feet) | Lithology |
|---|---|
| | Viking Formation |
| 1566-1573 | Shale and siltstone: shale dark grey, silty, noncalcareous, mixed with light-grey, hard, noncalcareous siltstone; siltstone is in the form of lenticular masses and thin layers with shale partings scattered throughout, majority to siltstone confined to two zones 1566-1568' and 1572-1573' being separated by dark grey, silty, noncalcareous shale with minor, small lenses of siltstone; small lenses of buff-coloured, hard, calcareous siltstone with scattered fish remains. |
| | Joli Fou Formation |
| 1573-1580 | Shale: medium to dark grey, silty, noncalcareous, with scattered, buff, mudstone nodules 2.5-5 cm diameter and occasional siltstone lenses |
| 1580-1585 | Shale: medium grey, silty, noncalcareous, slightly bentonitic |
| 1585-1590 | Shale: medium to dark grey, silty, slightly bentonitic, with scattered mudstone nodules, buff coloured, and lenses of hard siltstone; small lenses of hard, calcareous, glauconitic, greenish-grey siltstone broken up and interspersed with shale, occasional flakes of mica and tiny blebs of pyrite are found scattered throughout the siltstone; scattered fish remains observed in siltstone |
| 1590-1600 | Shale: medium grey, silty, slightly calcareous; quite hard and brittle with scattered thin layers of silt |
| 1600-1605 | Shale: medium grey, silty, very slightly calcareous, with light grey siltstone and buff mudstone concretions scattered within shale; the concretions are calcareous and are dissected by calcite veining |
| 1605-1610 | Shale: medium grey, silty, slightly calcareous, with scattered thin layers of silt; fragments of large shells scattered throughout shale |
| 1625-1637 | Shale: medium to dark grey, silty, noncalcareous; hard siltstone lenses are present throughout, up to 15 cm thick and may be 2.4 meters long, fragments of large, pelecypod shells scattered throughout; pyrite stringers in 1 cm thick zone in last 13 cm of shale (Fig. 4). |

| Depth (feet) | Lithology |
|---|---|
| | Mannville Group |
| | Pense Formation |
| 1637-1643 | Contact between the sandstone and overlying shale is quite sharp with very little gradation, sloping from the SE to the NW; on the SE wall the sandstone starts at 1637' while it does not appear until 1639' on the NW wall |
| | The sandstone is medium grey, fine grained, quite calcareous, composed of sub-rounded to rounded quartz grains with minor amphibole grains, predominantly hard with lenses and pockets of soft sandstone; the soft sandstone is quite porous and less calcareous than the hard layers, shale partings and thin lenses occur at scattered intervals within the sandstone; the shale is soft, black and carbonaceous |
| 1643-1660 | Sandstone: medium grey, fine grained, slightly calcareous, soft, with the same composition as the hard sandstone above; partings and small lenses of black, carbonaceous shale occur at intervals within the sandstone, two shale partings 15 cm apart start at 1647' on the N wall and slope to 1648' on the S wall; the sandstone is very porous, thin seams of coal are present in the last .9 m, the seams are thin, 2.5 cm thick with a base of black, carbonaceous shale 2.5-5 cm thick (Fig. 4) |
| 1660-1665 | Shale: medium to dark grey; carbonaceous with numerous bands and lenses of soft, fine grained sandstone varying from less than 2.5-10 cm in thickness |
| 1665-1678 | Shale: medium grey, noncalcareous, highly silty with lenses and fine streaks of silt scattered throughout; occasional small lenses of fine grained,grey sandstone; massive siltstone layer below, medium grey in colour and lying almost horizontal |
| 1678-1695 | Siltstone: medium grey, very fine grained, hard; contains scattered, small fragments of carbonized material and occasional small blebs of pyrite. |
| | Cantuar Formation |
| 1696-1702 | Siltstone: light grey to white, possibly arkosic; little or no trace of carbonized,organic remains |
| 1702-1708 | Siltstone: light to medium grey with disseminated brick red to purple-red iron oxide mottling |
| 1708-1714 | Shale: medium to light grey, silty, slightly bentonitic |

| Depth (feet) | Lithology |
|---|---|
| 1714-1717 | Shale: dark grey, silty with stringers and lenses of fine grained sandstone scattered throughout, occasional fragments of carbonized organic matter throughout zone |
| 1717-1721 | Shale: dark grey to greyish black; scattered fragments of carbonized organic matter |
| 1721-1726 | Shale: medium to light grey, with stringers and lenses of fine grained, light grey sandstone; sandstone lenses vary from 2.5-15 cm in thickness, a few ironstone concretions present, and scattered fragments of carbonized organic material; the contact with the overlying dark shale is very sharp, almost horizontal and very even at 1721' |
| 1726-1729 | Sandstone: light grey, fine grained, quite calcareous, hard; with streaks and patches of black, bituminous material; sandstone composed of sub-rounded to rounded quartz grains |
| 1729-1732 | Sandstone: light grey, fine grained, noncalcareous, soft, quite porous with lenses and partings of shale interspersed throughout the sandstone; shale is medium grey in colour |
| 1732-1738 | Shale: medium to light grey, silty with thin layers and stringers of fine grained, light grey sandstone throughout; some carbonized organic matter present |
| 1738-1741 | Siltstone: medium to purplish grey, the siltstone is hard and has a few scattered, carbonized, organic fragments, shows purplish to reddish iron oxide staining throughout |
| 1741-1749 | Shale: medium to dark grey, silty, top 4' lighter grey in colour while lower 4' darker grey with lenses and stringers of fine grained, light grey sandstone throughout |
| 1749-1752 | Sandstone: medium to light grey, hard with a few small scattered shale lenses, the sandstone is very fine grained and contains minor amounts of bituminous material |
| 1752-1755 | Shale: dark grey, silty, carbonaceous, with fine grained, light grey sandstone stringers and lenses |
| 1755-1762 | Sandstone: light to medium grey, fine grained, hard, with scattered partings and thin lenses of dark, carbonaceous shale |
| 1762-1765 | Shale: medium to dark grey, with small lenses and blebs of very finely disseminated pyrite and patches of carbonized material just above the first thin coal seam; the lenses of pyrite are approximately 6 mm thick and 15-20 cm long |

| Depth (feet) | Lithology |
|---|---|
| 1765-1767 | Shale: dark grey to black, carbonaceous with a few small coal lenses approximately 6 mm to 1 cm thick and 1.5-1.8 m long; 1765-1765.7' coal seam; the seam lies almost horizontal dipping 1-2° north, thickness of the seam is quite constant and it contains inclusions of finely disseminated pyrite, 2.5-5 cm long and 1.8-2.3 cm thick |
| 1767-1769 | Coal: black with inclusions of finely disseminated pyrite; the upper contact of the coal with the shale is irregular and somewhat gradational, the basal contact with the underlying shales is quite regular and sharp; there is no evidence of roots extending into the underlying shales, the seam lies almost horizontal, dipping 1-2° north (Fig. 2) |
| 1769-1774 | Shale: medium to dark grey, carbonaceous, with stringers and small lenses of fine grained, light grey sandstone; a few patches of carbonized material at scattered intervals within the shale |
| 1774-1783 | Sandstone: fine grained, grey with alternating bands of dark grey to black, carbonaceous shale; a few small patches of black, carbonized, organic material |
| 1783-1794 | Shale: light to medium grey, slightly bentonitic; silty in part |
| 1794-1807 | Sandstone: light grey, fine grained with thin layers of dark grey organic shale, quite porous; first few feet of sandstone bed are quite calcareous |
| 1807-1816 | Shale: medium to dark grey, carbonaceous, silty with thin layers and lenses of fine grained light grey sandstone; the shales appear slightly bentonitic and have small patches of carbonized organic material scattered throughout, some small inclusions and thin layers of disseminated pyrite are present in the lower two feet (1814-1816') of the shale beds |
| 1816-1823 | Sandstone: fine grained, light grey, with thin layers of dark grey to black, carbonaceous shale; the quartz grains are sub-angular to sub-rounded, bits of bituminous material are scattered throughout the sandstone along with a very minor amount of pyrite in the form of tiny grains |
| 1823-1826 | Shale: dark grey, carbonaceous, medium hard with inclusions of light grey silt and patches of black, carbonized, organic material |
| 1826-1831 | Siltstone: light grey, medium hard, with thin stringers and veins of black, bituminous material and occasional, scattered blebs of disseminated pyrite |
| 1831-1838.5 | Shale: dark grey, carbonaceous, with alternating layers of light grey siltstone; patches of black carbonaceous material and small lenses and blebs of disseminated pyrite are scattered throughout the shale |

| Depth (feet) | Lithology |
|---|---|
| 1838.5-1842 | Sandstone: light grey, fine grained, with thin, black, carbonaceous layers scattered throughout; a few inclusions and blebs of disseminated pyrite also present |
| 1842-1846 | Shale: medium to dark grey, hard, silty with thin lenses and stringers of light grey silt throughout; inclusions of disseminated pyrite |
| 1846-1857 | Sandstone: light grey, porous, with a few thin, scattered layers of dark grey shale; occasional inclusions of finely disseminated pyrite |
| 1857-1865 | Shale: medium to dark grey, silty, with scattered layers and small lenses of light grey silt throughout; occasional, small inclusions of pyrite |
| 1865-1869 | Siltstone: light grey; occasional, scattered layers of dark grey shale |
| 1869-1882 | Shale: medium to dark grey, silty, with layers and small lenses of light grey silt and very fine grained sandstone; occasional inclusions of pyrite present |
| 1882-1888 | Shale: brownish-black to black, carbonaceous, very slightly silty near the top of the zone with a few very thin silt layers; a few pyrite nodules and layers approximately 6 mm thick are present near the base of the zone. |
| | Jurassic (?) |
| 1888-1889 | Limestone: medium grey, hard, dense |
| 1899-1891.5 | Siltstone: hard, grey, calcareous; thin layers of dark grey shale and inclusions of greenish-grey siltstone and shale |
| 1891.5-1893 | Mudstone: light to medium grey with greenish coloured inclusions, quite hard, slightly calcareous |
| 1893-1901 | Mudstone: light to medium grey, calcareous in part with shale and grey-green to grey, silty limestone intervals |
| 1901-1907 | Shale: medium grey, slightly calcareous with fragments of light grey mudstone and limestone; fragments are subangular to sub-rounded and range in size from 6 mm to 2.5 cm diameter, some finely disseminated pyrite is present in the shale |
| 1907-1915 | Shale: medium grey, with fragments of light grey limestone; fragments are sub-angular to sub-rounded and range in size from approximately 6 mm to a few inches in diameter |

| Depth (feet) | Lithology |
|---|---|
| 1915-1917 | Limestone: yellowish grey, hard, dense, fine grained |
| 1917-1921 | Shale: grey-green, calcareous, hard; the upper 45 cm of the shale zone contains sub-angular to sub-rounded fragments of yellowish grey limestone |
| 1921-1924 | Shale: grey-green, dolomitic, with fragments and nodular inclusions of light grey dolomite. |
| | PALEOZOIC (Devonian) |
| | Saskatchewan Group |
| | Duperow Formation |
| 1924-1930 | Dolomite: light grey, fine grained, vuggy, with fine flecks of finely disseminated pyrite; the samples are coated with salt precipitated while the samples were drying |
| 1930-1935 | Dolomite: light grey, fine grained, vuggy, with fine flecks of finely disseminated pyrite; the dolomite shows banding with medium grey bands alternating with light grey bands a millimetre or less in thickness; the samples are coated with salt precipitated while the samples were drying |
| 1935-1949 | Dolomite: light to medium grey, very vuggy, fine grained; the dolomite has a mottled appearance and the light yellowish grey dolomite alternates with the medium grey dolomite in irregular bands and lenses, the samples are coated with salt precipitated while the samples were drying |
| 1949-1956 | Limestone: light olive grey, fine grained, dense; some hair-line healed fractures; *"Atrypa"* sp. indet., GSC loc. C-6528 |
| 1956-1975 | Limestone: light olive grey, mottled, fine grained, dense, with scattered partings of dark grey shale; some fracturing present, healed with calcite; *"Atrypa"* sp. indet., GSC loc. C-6529 |
| 1975-1993 | Limestone: hard, dense, light olive grey, fine grained; thin, dark grey shale layers scattered throughout |
| 1993-1999 | Limestone: light olive grey, hard, dense with dark grey shale inclusions and layers of scattered intervals; some vugs, approximately 2.5 cm in diameter present, and lined with calcite crystals |

| Depth (feet) | Lithology |
|---|---|
| 1999-2001 | Limestone and shale: the shale is hard and greenish-grey in colour with nodules and small lenses of light greenish grey to grey limestone present throughout; *Thamnopora* sp. indet., *Smithiphyllum* sp. ex. gr. *S. martinense* (Stumm) *Gypidula* sp. indet., *"Atrypa"* sp. indet. *Cyrtospirifer* sp. indet., *"Tenticospirifer"* sp. ex. gr. *"T" cyrtinaformis* (Hall & Whitfield), GSC loc. C-6531 |
| 2001-2007 | Limestone: light grey showing some mottling due to presence of greenish shale, hard, dense; scattered, thin, irregular layers of greenish-grey shale, numerous brachiopods throughout |
| 2007-2010 | Limestone: medium light grey, fine grained, mottled with medium grey shale; some thin shale layers and lenses present and a few scattered blebs of finely crystalline pyrite, 3 mm in diameter; *Disphyllum* sp. nov., *"Atrypa"* sp. indet., *Cyrtospirifer* sp. indet., GSC loc. C-6532, from 2008-2009' |
| 2010-2012 | Shale: grey-green, calcareous, hard, with nodes and lenses of light grey to buff, fine grained limestone; the lenses and nodes average 2.5-3.5 cm in thickness; *Cyrtospirifer* sp. indet., GSC loc. C-6533 |
| 2012-2014 | Limestone: light grey to buff, fine grained, dense with irregular layers of grey-green calcareous shale; brachiopod fossils are present in the zone |
| 2014-2019 | Limestone: medium light grey, fine grained, dense with occasional thin shale layer; coarse crystalline calcite patches and thin patches of pyrite crystals found concentrated along fracture lines |
| 2019-2025 | Limestone: medium light grey, fine grained, dense, mottled with grey green, calcareous shale; scattered shale layers up to 2.5 cm thick, pyrite blebs and small patches are present |
| 2025-2035 | Limestone: medium light grey, fine grained, dense |
| 2035-2076 | Limestone: medium light grey to buff, argillaceous, hard, dense, fine grained, mottled, with scattered thin dark grey shale layers; thin patches of finely crystalline pyrite found scattered along shale partings |
| 2076-2082 | Limestone: dense medium light grey, hard, fine grained, with thin dark grey shale layers; argillaceous |
| 2082-2090 | Shale: hard, grey-green in colour, calcareous with irregular thin grey limestone layers; the limestone is fine grained, dense and somewhat argillaceous, varying in colour from light to medium grey |
| 2090-2096 | Shale: hard, greenish-grey colour, calcareous with irregular thin layers and inclusions of limestone; appears to be dolomitic near contact with underlying dolomite |

| Depth (feet) | Lithology |
|---|---|
| 2096-2101 | Dolomite: brown, hard, dense, vuggy; vugs 3-5 mm in diameter, the dolomite is fine grained and appears to be quite porous |
| 2101-2104 | Dolomite: medium to light grey, hard, dense, with thin layers of medium grey shale |
| 2104-2108 | Dolomite: light grey to tan showing slight mottling appearance, hard, dense, fine grained, slightly shaly |
| 2108-2118 | Limestone: light grey to tan, hard, dense, slightly porous; lower 1.5 m shows fracturing healed with clear calcite, veins varying from 1-4 mm thick, thin layer of pyrite has formed along the border of the calcite veins in some cases |
| 2118-2128 | Limestone: medium to light grey, mottled, hard, dense, fine grained; some fracturing healed with clear calcite, shale partings present at scattered intervals |
| 2128-2133 | Shale: highly calcareous, medium to dark grey, with thin, irregular layers and lenses of grey limestone |
| 2133-2141 | Limestone: medium to light grey, slightly mottled, hard, dense, quite shaly, with irregular shale partings and stringers; some hair-line fractures healed with pyrite in some cases |
| 2141-2143 | Shale: medium grey, calcareous with thin lenses and layers of grey limestone; the limestone is fine grained, hard, dense, with scattered blebs of bituminous material, some small pyrite crystal patches are found scattered in the limestone, a few small brachiopods are present |
| 2143-2149 | Limestone: light to medium grey, hard, dense, with small scattered blebs of pyrite and a few small brachiopods |
| 2149-2154 | Limestone: medium grey, hard, dense: 2149-2151' - limestone is quite shaly and dark grey in colour, scattered, small fractures are healed with crystalline calcite and small crystals of pyrite |
| 2154-2162 | Limestone and shale: medium grey; limestone is hard, fine grained and dense; some traces of carbonized organic material; *"Atrypa"* sp. indet., GSC loc. C-6534 |
| 2162-2170 | Limestone: light to medium grey, hard, fine grained, dense with scattered fractures filled with small crystals of clear calcite; scattered traces of carbonized organic material; *"Atrypa"* sp. indet., *Spinatrypa* sp. indet., GSC loc. C-6535 |
| 2170-2178 | Limestone: medium grey, hard, dense, fine grained, with irregular lenses and layers of grey, calcareous shale |
| 2178-2195 | Limestone: hard, dense, medium to dark grey, fine grained, argillaceous, with scattered, thin, shale layers |

| Depth (feet) | Lithology |
|---|---|
| 2195-2201 | Limestone: hard, dense, fine grained, brownish grey to medium grey, quite shaly |
| 2201-2204 | Limestone: dark grey, very shaly; breaks along bedding planes |
| 2204-2220 | Limestone: medium grey, shaly with scattered, thin layers of black, carbonaceous shale; brecciated zones containing fragments of light grey to buff limestone, up to 2.5 cm diameter, enclosed in a dark grey, shaly limestone matrix; in lower 3 m a few vugs observed, infilled with coarse calcite crystals, most average 7 mm in diameter with maximum size up to 2.5 cm |
| 2220-2228 | Limestone: medium to dark grey, fine grained, dense, hard, shaly, with scattered thin layers of black, carbonaceous shale |
| 2228-2233 | Limestone: medium grey, dense, fine grained with black, carbonaceous shale; much of the zone is brecciated |
| 2233-2244 | Limestone: medium to dark grey, fine grained, dense, very shaly, especially in dark grey areas, some branching present; bands are 1 mm or less in thickness, some disseminated pyrite found along shale partings |
| 2244-2248 | Shale: medium to dark grey, calcareous, shows some thin banding of medium and dark grey shales; thin lenses of grey limestone, 6-18 mm thick, scattered in shale zone, also fragments of limestone |
| 2248-2252 | Limestone: medium grey, hard, dense, fine grained with scattered shale partings; slightly brecciated and fractured with clear calcite crystals and small amounts of disseminated pyrite filling the fracture lines |
| 2252-2268 | Limestone: light to medium grey, hard, fine grained, brecciated, slightly vuggy, with scattered partings of black, carbonaceous shale; crystals of clear calcite and small amounts of finely disseminated pyrite are found along fracture lines and filling vugs |
| 2268-2275 | Limestone: light grey, hard, dense, brecciated with small fragments of tan to white limestone in grey matrix; thin, scattered, irregular layers of shale also present |
| 2275-2268 | Limestone: light grey, hard, brecciated, vuggy, with scattered, thin, irregular partings and layers of black, carbonaceous shale; many fracture lines and vugs are filled with coarse, white calcite crystals |
| 2268-2293 | Limestone: light to medium grey, hard, dense, with scattered shaly partings; a few brachiopods are present |
| 2293-2296 | Limestone: tan to light grey, mottled, dense, hard with irregular, black, shaly partings; bottom 30 cm composed of dark grey, hard dense shale |

| Depth (feet) | Lithology |
|---|---|
| 2296-2303 | Limestone: buff, hard, fine grained, banded, with scattered partings of black, carbonaceous shale; finely disseminated pyrite found scattered in limestone |
| 2303-2304 | Limestone: dark grey, fine grained, dense, carbonaceous, very shaly |
| 2304-2306.5 | Limestone: tan, brecciated, argillaceous; vuggy with coarse crystals of clear calcite lining the vugs and sealing fractures |
| 2306.5-2310 | Limestone: medium and dark grey bands, hard, argillaceous with thin, brownish black, organic seams, 3-6 mm thick |
| 2310-2315 | No information |
| 2315-2325 | Limestone: laminated with medium grey alternating with tan laminae; laminae are from 3-6 mm with the grey laminae being usually thicker than the tan |
| 2325-2327 | Limestone: medium grey, fine grained, hard, dense, shaly |
| 2327-2337 | Limestone: tan and grey, mottled and banded, fine grained, dense, hard; very thin, black, carbonaceous partings occur scattered within the zone, evidence of fractures being present and small crystals of finely disseminated pyrite is found along these zones |
| 2337-2338 | Limestone: tan, fine grained, hard, dense, argillaceous; numerous small blebs and lenticular masses of black, carbonaceous material ranging from 6 mm - 1 cm in diameter |
| 2338-2370 | Limestone: fine grained, hard, dense, tan and light grey, banded; numerous partings of black, carbonaceous material varying from 1-5 mm in thickness |
| 2370-2381 | Limestone: fine grained, hard, dense, tan and light grey, banded, with numerous thin beds of black, carbonaceous shale; the bands vary from 1-10 mm, the shale beds are hard and from 3-6 mm thick |
| 2381-2387 | Limestone: tan and grey, hard, medium grained to fine grained, with scattered vugs and fractures filled with clear calcite crystals; vugs up to 2.5 cm in diameter |
| 2387-2405 | Limestone: grey and tan, hard, fine grained, with inclusions of fragmental limestone; contains vugs, up to 2.5 cm diameter lined with clear calcite crystals, numerous partings of black, carbonaceous shale are present |
| 2405-2420 | No information |

| Depth (feet) | Lithology |
|---|---|
| 2420-2429 | Limestone: tan and grey, banded, hard, fine grained; scattered partings of black, carbonaceous shale and thin beds of dark grey to black, carbonaceous shale, up to 6 mm thick |
| 2429-2436 | Limestone: tan, hard, fine grained, dense; some fragmental limestone and a few scattered black, carbonaceous shale partings |
| 2436-2442 | Limestone: tan, fine grained, hard, banded with dark grey limestone; occasional small vugs and some fracturing filled in with calcite crystals, a few scattered beds of dark grey limestone, up to 5 cm thick, are present |
| 2442-2447 | Limestone: tan and grey, hard, dense, fine grained with scattered partings of black, carbonaceous shale; some fragmental limestone |
| 2447-2460 | Limestone: tan and grey, hard, fine grained, banded; scattered tiny vugs, 1-3 mm in diameter, occur between 2456-2457', scattered partings of black, carbonaceous shale |
| 2460-2464 | Limestone: light tan, fine grained, hard, dense. |
| | Elstow Member (?) |
| 2464-2467 | Limestone and shale: medium to dark grey, hard, dense; scattered fractures filled with calcite crystals and disseminated pyrite |
| 2467-2469 | Limestone: grey-green and tan, banded, fine grained, hard, dense |
| 2469-2471 | Limestone: tan, fine grained, hard, dense |
| 2471-2480 | Limestone: dark greenish grey, fine grained, hard; dense except for some tiny vugs and pinpoint porosity between 2472-2475', vugs vary from 1-2 mm in size |
| 2480-2481 | Limestone: tan and grey, hard, dense, fine grained with numerous small, medium grey, limestone inclusions, 6 mm to 1 cm in diameter, scattered throughout |
| 2481-2488 | Limestone: grey-green, medium hard, highly shaly with fragments of hard grey limestone |
| 2488-2494 | Limestone: grey-green mixed with tan, mottled, hard, fine grained, with scattered shale partings; scattered brachiopod shell fragments present |
| 2494-2502 | Limestone: grey-green, medium hard, with shale inclusions and thin beds of shale; shale beds more numerous toward base of zone, 2.5-4 cm thick, fossiliferous zone at approximately 2500'; thin limestone beds, approximately 2.5-5 cm thick are overlain by thin shale beds; pyrite nodules 6 mm to 1.9 cm in diameter, are also common on the fossiliferous surface; *Schizophoria* sp. indet., |

| Depth (feet) | Lithology |
|---|---|
| 2494-2502 (cont'd) | *Productella* sp. indet., *Spinatrypa* sp. indet., *Musrospirifer reidfordi* (Crickmay), bryozoa, not studied, *Spirorbis* sp. indet., ostracods, not studied; GSC loc. C-6537, C-6538 |
| 2502-2520.5 | Shale: medium grey, highly calcareous, with hard limestone fragments; for the most part the shale is soft and weathers very readily; the contact with the overlying limestone is sharp and almost horizontal. |
| | Saskatoon Member |
| 2520.5-2527 | Limestone: tan, hard, fine grained, dense with scattered shale partings; scattered fractures filled with clear calcite crystals |
| 2527-2531.5 | Limestone: tan, hard, fine grained, dense |
| 2531.5-2534 | Limestone: tan and grey, fine grained; brecciated with coarse to medium grained white calcite and bluish-white, fine-grained, anhydrite cementing the limestone fragments together |
| 2534-2539 | Limestone: grey-green, fine grained, hard; numerous small hair-line fractures healed with fine calcite crystals and disseminated pyrite |
| 2539-2565 | Limestone: tan, fine grained, hard to medium hard, with scattered partings of black to brownish black, carbonaceous shale; a few small, scattered, hair-line fractures and tiny vugs healed with fine calcite crystals and some disseminated pyrite, occasional scattered inclusions to whitish anhydrite, 6 mm to 1.9 cm in diameter |
| 2565-2574 | Limestone: tan to greyish tan, medium hard, fine grained; a few scattered, hair-line fractures healed with fine calcite crystals; base of zone somewhat brecciated with some whitish anhydrite infilled between limestone fragments |
| 2574-2580 | Limestone: tan, fine grained, hard; numerous thin partings of brownish grey shale |
| 2580-2589 | Limestone: medium to dark grey, fine grained, medium hard, dense; scattered fractures healed with anhydrite |
| 2589-2593 | Limestone: tan to grey, mottled, fine grained, hard, dense |
| 2593-2603 | Limestone: medium to dark grey, fine grained, medium hard, dense; a small vein of white fibrous anhydrite, 9 mm thick |
| 2603-2612 | Limestone: medium to dark grey, banded, wavy texture, dense, hard, fine grained. |

| Depth (feet) | Lithology |
|---|---|
| | MANITOBA GROUP |
| | Souris River Formation |
| | Hatfield Member |
| 2612-2621 | Limestone: dark grey, dense, fine grained, shaly, medium hard; a few scattered, hair-line fractures healed with white calcite |
| 2621-2628 | Limestone: light to dark grey, mottled, shaly, fine grained; the dark grey limestone is highly shaly and soft whereas the light limestone is medium to hard |
| 2628-2634 | Limestone: tan and light grey, fine grained, medium hard, dense; the tan and grey limestone occurs in alternating layers of 2.5-20 cm thick, with occasional, scattered, shale partings |
| 2634-2635 | Limestone: light grey, fine grained, medium hard, dense |
| 2635-2638 | Anhydrite: greyish-white and brown, mottled with grey limestone fragments throughout, dense, fine grained, hard |
| 2638-2640.5 | Dolomite: tan with fine bands of brown dolomite giving a wavy banded pattern to the rock; the dolomite is fine grained, hard, dense |
| 2640.5-2643 | Anhydrite: brown to grey, fine grained, hard with small lenses of limestone and grey dolomite |
| 2643-2675 | Limestone: medium grey, fine grained, hard, dense; occasional small inclusions of anhydrite, 6-9 mm in diameter, and scattered anhydrite veinlets up to 1 cm thick, in upper 20' of zone, some banding of greyish-tan with medium grey limestone |
| 2675-2689.5 | Limestone: medium grey, fine grained, dense, medium hard with thin bands of dark grey, hard limestone; some fracturing healed with milky white calcite and white anhydrite, a 25 cm band of brown, hard, dense, fine granular textured limestone occurs at 2680' |
| 2689.5-2719.5 | Anhydrite: white and brown, mottled, fine grained, dense; inclusions of thin layers of medium to light grey, hard, dense, fine grained dolomite |
| 2719.5-2748.5 | Dolomite: buff, fine grained, hard, dense, with some brown banding; thin beds of organic shale are present, as well as some grey, dolomitic limestone |
| 2748.5-2754 | Limestone: medium grey, fine grained, dense, hard, slightly dolomitic; some brown anhydrite and grey shale mixed together at the base of the zone |

| Depth (feet) | Lithology |
|---|---|
| 2852-2855.5 | Dolomite: medium to dark grey, fine grained, medium hard, dense |
| 2855.5-2857 | Anhydrite: brown and white, mottled, crystalline, hard |
| 2857-2859 | Dolomite: medium to dark grey, medium hard, fine grained, shaly |
| 2859-2869 | Dolomite: buff, fine grained, hard, dense; banded and mixed together with brown, hard, crystalline anhydrite |
| 2869-2870 | Dolomite: medium grey, fine grained, medium hard, dense, and slightly shaly |
| 2870-2874 | Anhydrite: medium grey, hard, dense, crystalline; some greyish buff to buff dolomite intermixed throughout |
| 2874-2879 | Dolomite: grey and buff, fine grained, hard, dense, banded; some greyish crystalline anhydrite mixed in with buff dolomite in the middle of the zone |
| 2879-2883 | Anhydrite: brown, crystalline, hard, dense with some buff dolomite mixed in |
| 2883-2884.5 | Dolomite: tan and grey, medium hard, fine grained, with some anhydrite mixed in; the grey dolomite appears dense while the tan appears slightly porous |
| 2884.5-2901 | Anhydrite: greyish white and brown, mottled, hard, crystalline, dense with some buff dolomite intermixed |
| 2901-2903.5 | Dolomite: tan and buff, wavy banding, fine grained, hard with some anhydrite |
| 2903.5-2905.5 | Dolomite: medium grey, fine grained, medium hard, shaly with some anhydrite |
| 2905.5-2914 | Dolomite and anhydrite: bluish grey to brown anhydrite banded and intermixed with tan to buff dense dolomite |
| 2914-2917.5 | Anhydrite: bluish grey, crystalline; some buff dolomite intermixed throughout |
| 2917.5-2918.5 | Dolomite: light buff, fine grained, hard; scattered tiny inclusions of whitish anhydrite |
| 2918.5-2919.5 | Dolomite: tan to brown, fine grained, hard, dense |
| 2919.5-2926 | Dolomite: tan to grey, fine grained, hard, dense; mixed with bluish grey, hard, finely crystalline anhydrite, a band of salt, 19 mm thick, is present at 2919.5' |

| Depth (feet) | Lithology |
|---|---|
| 2926-2928 | Dolomite and anhydrite: light to medium grey dolomite intermixed with grey, hard, crystalline anhydrite |
| 2928-2936 | Dolomite: buff to tan, in thin bands, fine grained, hard, dense; some bluish grey anhydrite intermixed |
| 2936-2946 | Dolomite: tan to buff, banded, fine grained, hard, dense; thin beds of grey finely crystalline anhydrite interspersed throughout. |
| | Davidson Member |
| 2946-2950 | Halite: clear to whitish; mixed with anhydrite and a few thin bands of buff dolomite |
| 2950-2958 | Halite: clear to whitish; scattered bands of anhydrite, brown to bluish grey, up to 13 cm thick and a few thin bands of buff dolomite; *"Atrypa"* sp. cf. *"A." oneidensis* Beus; GSC loc. C-6539 |
| 2958-2859 | Dolomite: buff to tan; banded with brown to greyish, finely crystalline anhydrite |
| 2959-2964 | Anhydrite: brown to greyish white, mottled, crystalline, hard |
| 2964-2967.5 | Dolomite: buff, fine grained; slightly porous and vuggy with vugs up to 3 mm in diameter |
| 2967.5-2972 | Anhydrite: greyish white to brown, mottled, crystalline, hard; small inclusions of buff dolomite throughout |
| 2972-2974 | Dolomite: tanish grey, fine grained, hard |
| 2974-2980 | Dolomite: dark tan, fine grained, hard, dense |
| 2980-3007 | Limestone: dolomitic, buff, fine grained, hard, dense with a slightly mottled appearance; becoming vuggy at 2987' and a few scattered, poorly preserved brachiopods are associated with the vugs, at the base of the zone, (3007'), there is a thin bed of buff limestone containing abundant brachiopod shell remains |
| 3007-3020 | Limestone: medium to dark grey, mottled, fine grained, hard, dense; *Schizophoria* sp. indet., *"Atrypa"* sp. cf. *"A." oneidensis* Beus, *Mucrospirifer* sp. indet., GSC locs. C-6540, C-6541, C-6542 |
| 3020-3070 | Limestone: medium grey to tan, mottled, fine grained, hard, dense; *"Atrypa"* sp. cf. *"A." oneidensis* Beus, GSC loc. C-6543 |
| 3070-3092 | Limestone: tan and buff, mottled, fine grained, hard, dense; a few scattered brachiopods *(Atrypa)*, and a few small scattered vugs lined with calcite crystals |

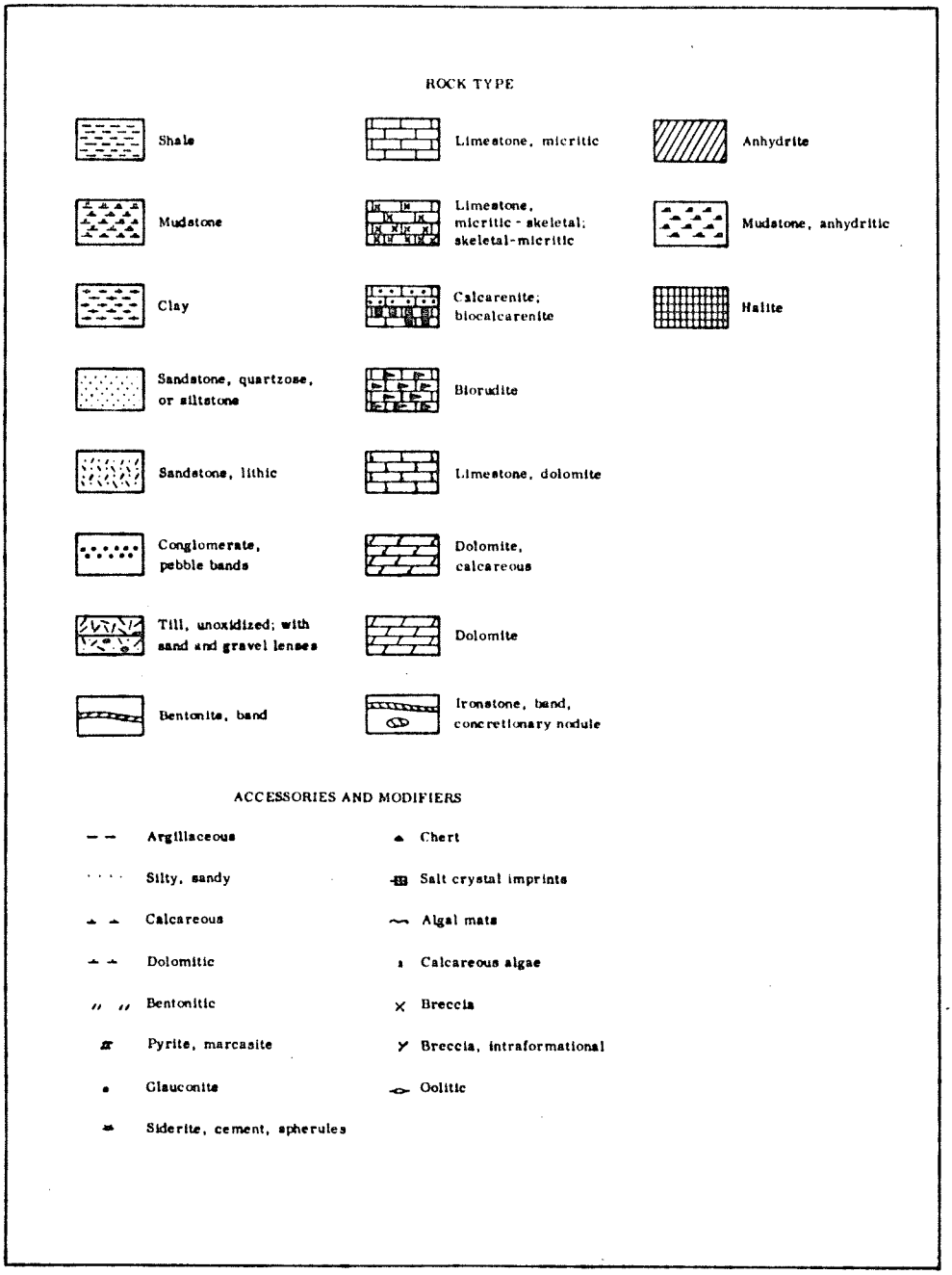
| Depth (feet) | Lithology |
|---|---|
| 3092-3096 | Limestone: tan to grey, mottled, fine grained, hard, dense |
| 3096-3130 | Limestone: medium to light tan, fine grained, hard, dense; a few scattered brachiopod shells |
| 3130-3144 | Limestone: tan, fine grained, hard, dense; a few scattered brachiopod shells and occasional, black, carbonaceous shale. |
| | First Red Bed unit |
| 3144-3150 | Shale contact: grey, slightly calcareous, hard, grading to greyish green and reddish brown; mottled near 3150' |
| 3150-3187 | Shale: slightly calcareous, hard; reddish brown and greenish grey in alternating beds. |
| | Dawson Bay Formation |
| 3187-3196 | Dolomite: brownish grey, hard, dense; mixed with hard blue-grey massive anhydrite |
| 3196-3204 | Limestone: brown to tan, fine grained, hard, dense; a few scattered inclusions of greyish white anhydrite, 6-10 mm in diameter |
| 3204-3210 | Limestone: brown to greyish brown, fine grained; with numerous crinoid stems and bryozoans, highly vuggy with diameters ranging up to 19 mm; black bitumen covers the vuggy areas and many of the vugs are partially infilled with white, sparry gypsum |
| 3210-3231 | Limestone: brownish grey, fine grained, hard, dense; a few scattered crinoid stems |
| 3231-3247 | Limestone: tan to greyish brown, fine grained, hard, vuggy; vugs up to 6 mm in diameter with partial infilling by salt crystals and sparry gypsum; crinoid stems scattered throughout the limestone |
| 3247-3268 | Limestone: tan to grey, fine grained, hard, dense; *"Atrypa"* sp. ex gr. *"A." snakensis* McCammon, *Cyrtina* sp. indet., GSC loc. C-6544 |
| 3268-3275 | Limestone: tan, fine grained, hard, dense |
| 3275-3280 | Shale: medium grey, slightly calcareous, hard |
| 3280-3283 | Limestone: tan to buff, hard, fine grained, dolomitized in part. |

| Depth (feet) | Lithology |
|---|---|
| | Second Red Bed unit |
| 3283-3296 | Shale: medium grey at top becoming brick red at 3290', dense, hard, with fractures 50° to vertical; fractures are healed with salmon coloured, fibrous salt veins ranging in thickness from 6 mm to 3.8 cm, lower part of redbed contains a few thin salt beds (Fig. 6). |
| | ELK POINT GROUP |
| | Prairie Evaporite Formation |
| 3296-3306 | Halite: milky to pinkish, crystalline with disseminated patches of red clay; contact with overlying redbeds sharp and almost level - 3296', on south wall, 3296.5' on north wall, a few salt veins protrude up into overlying shales |
| 3306-3318 | Halite: milky to clear, crystalline with some red sylvite and disseminated red clay; scattered, thin layers of greenish grey shale. |
| 3318 | End of sampling. |

Appendix I (b)

Lithologic Log Potash Corporation of America

Shaft No. 2




Legend for lithologic log

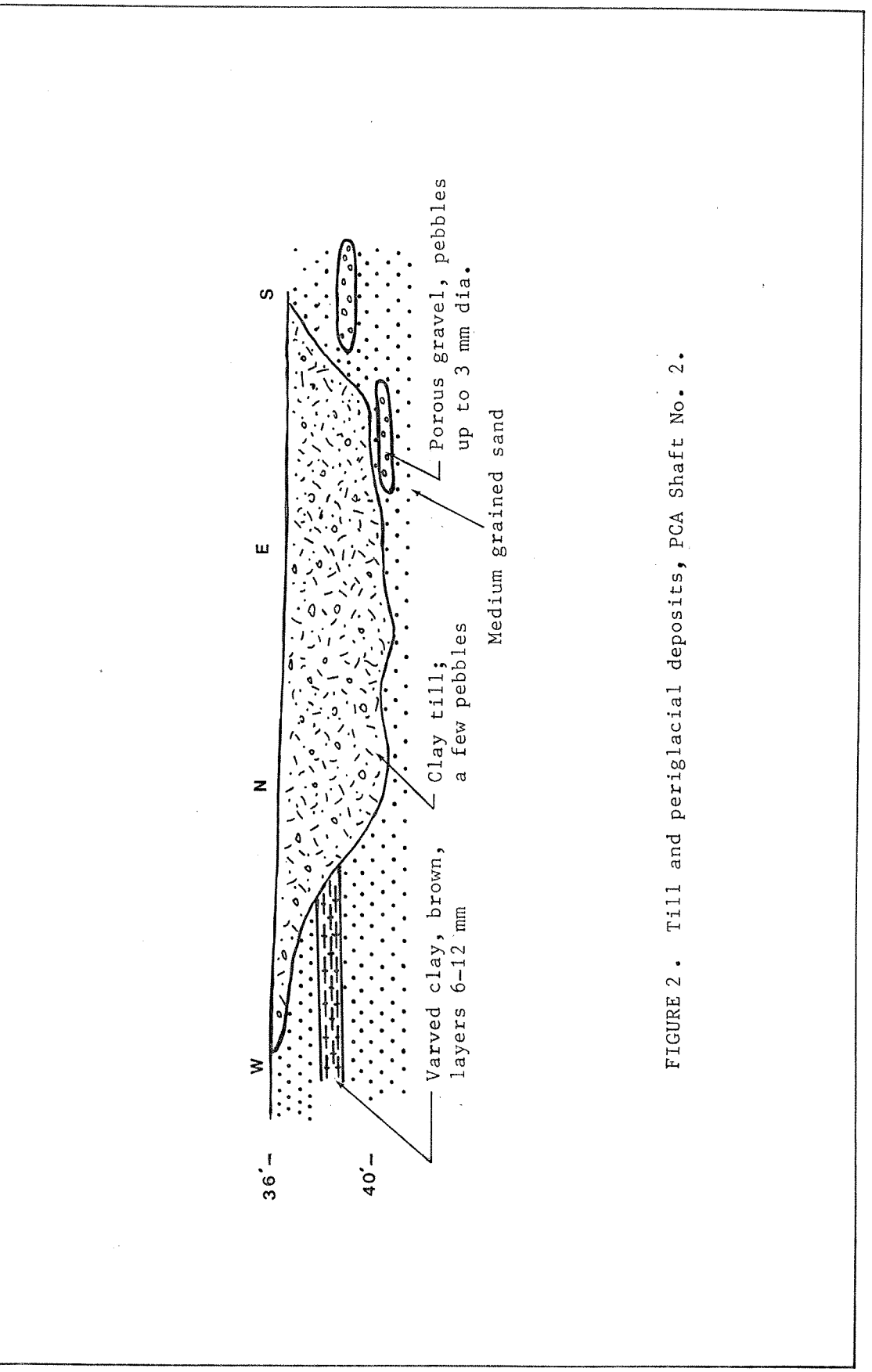



FIGURE 2. Till and periglacial deposits, PCA Shaft No. 2.

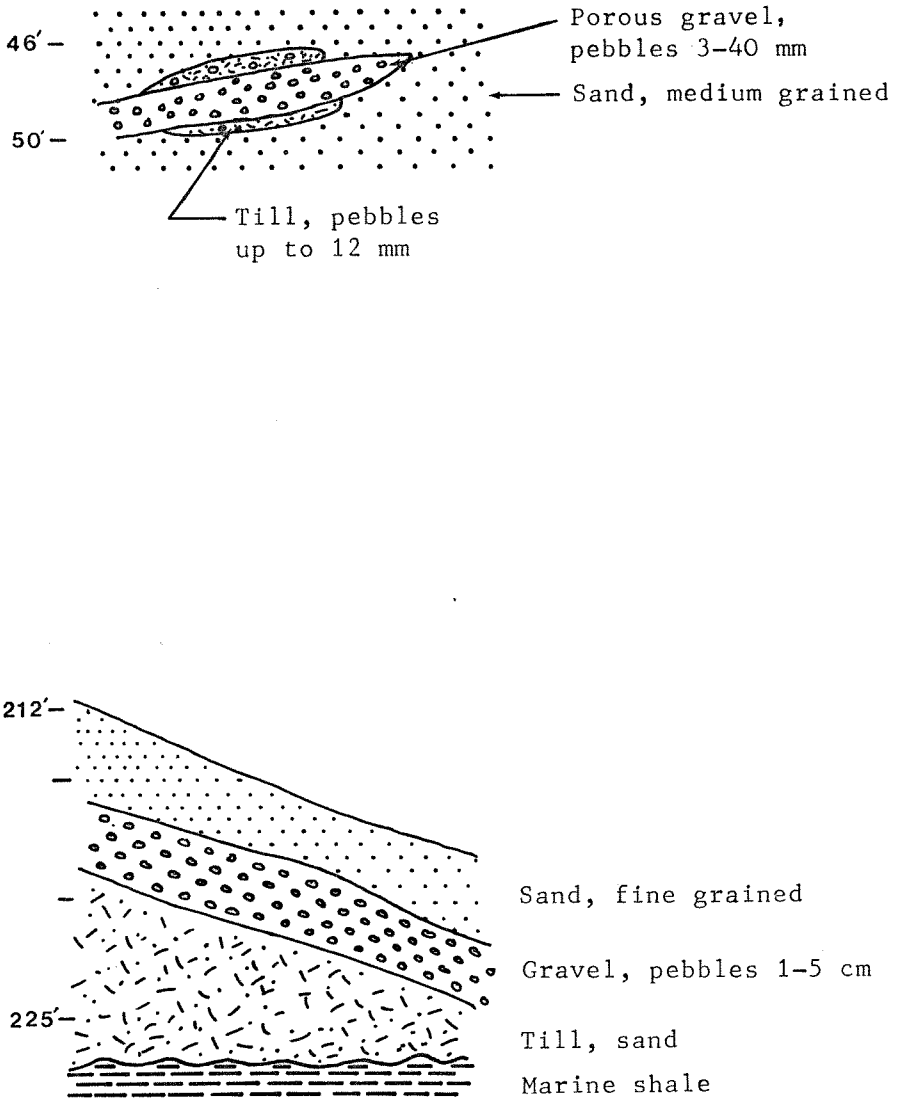
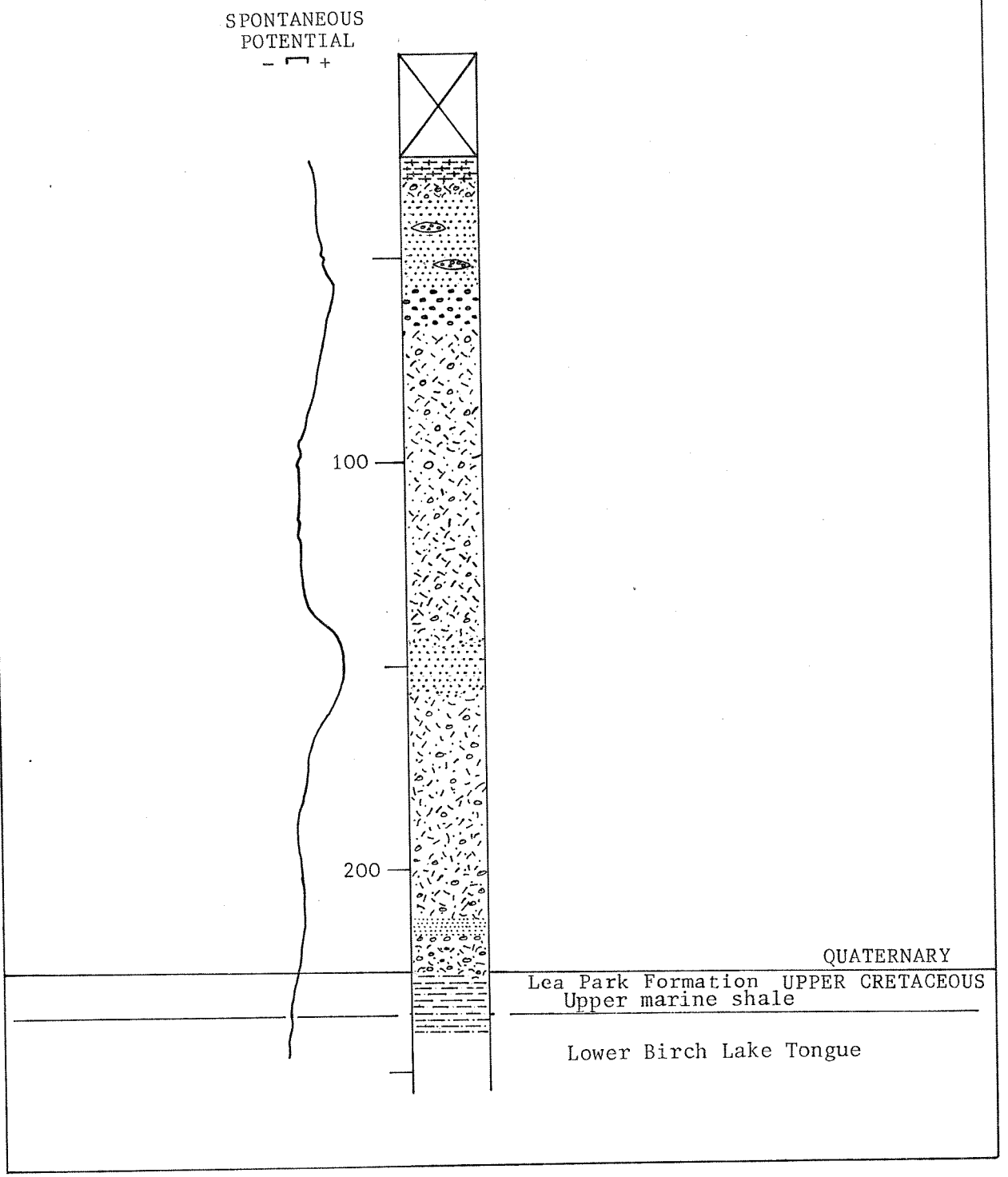
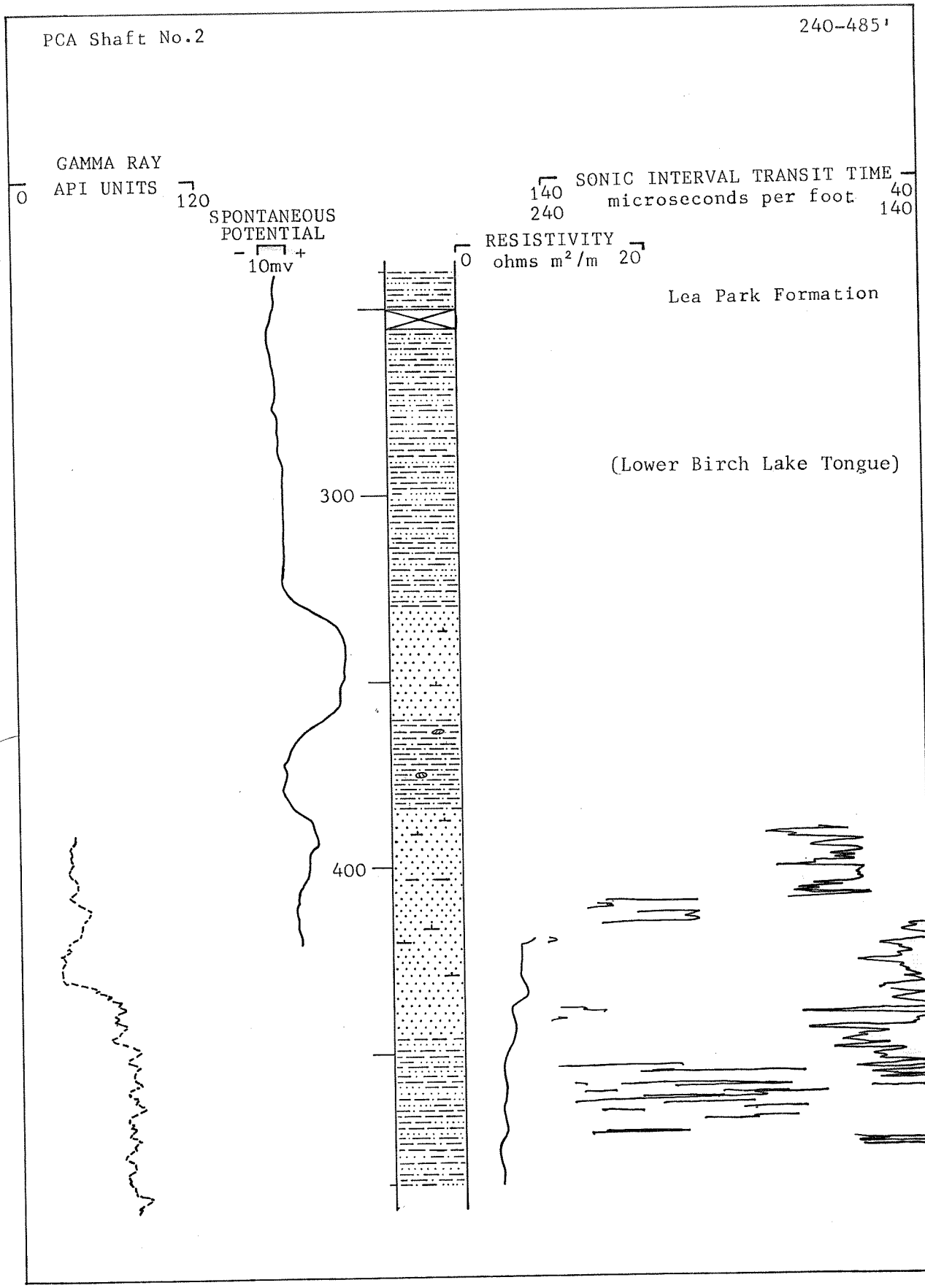
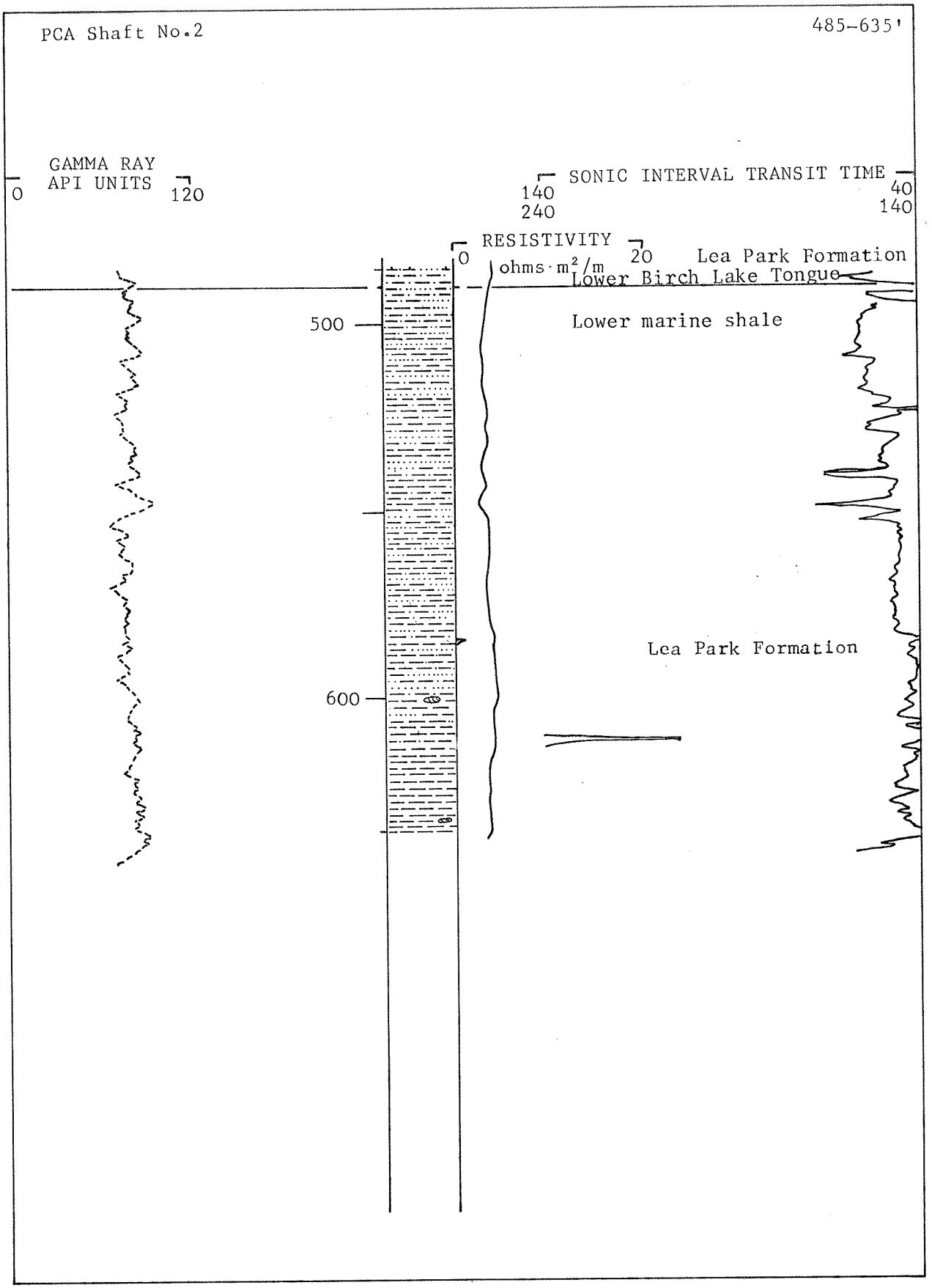


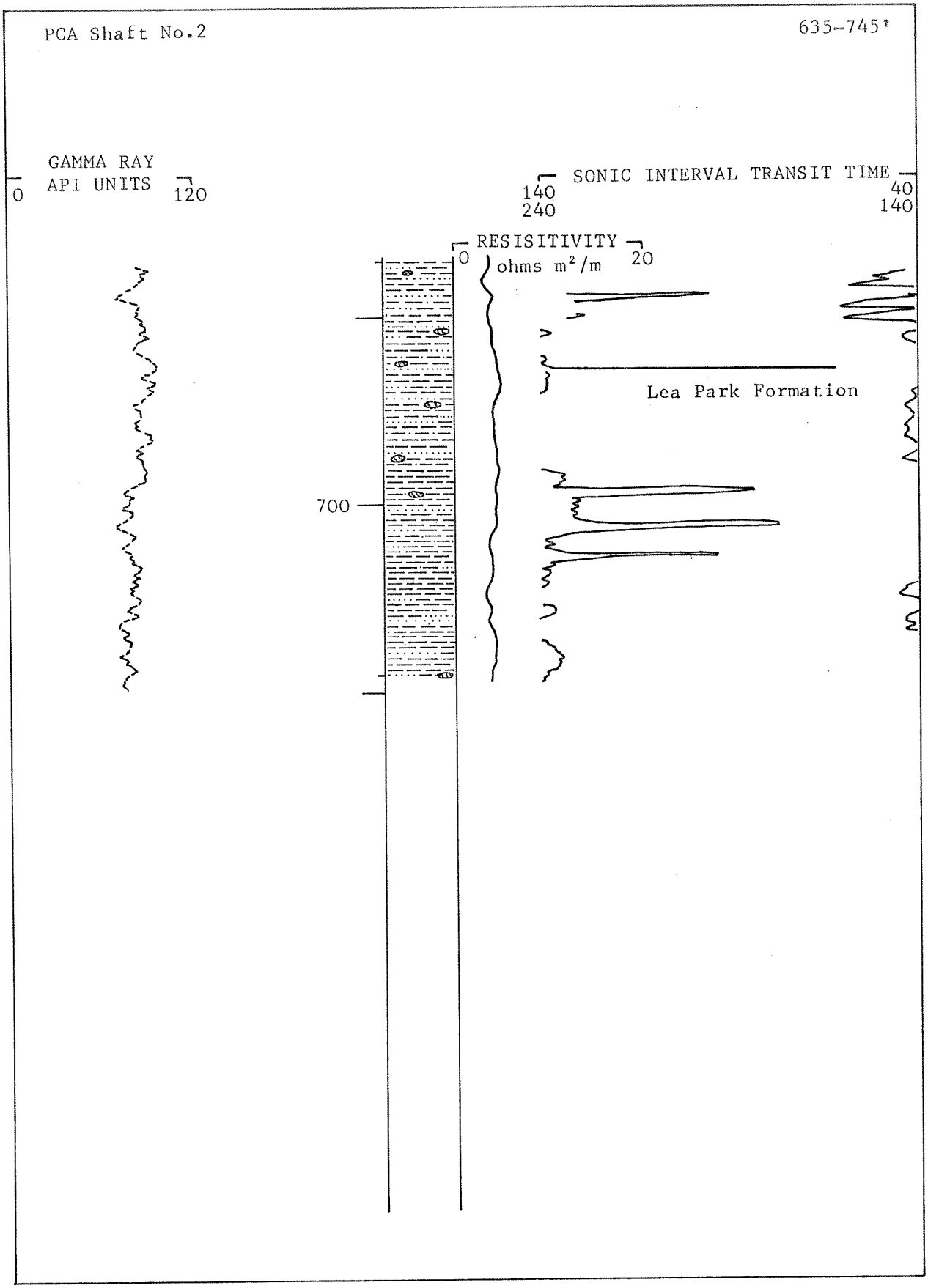

FIGURE 3. Glacial deposits and bedrock contact, PCA Shaft No. 2.

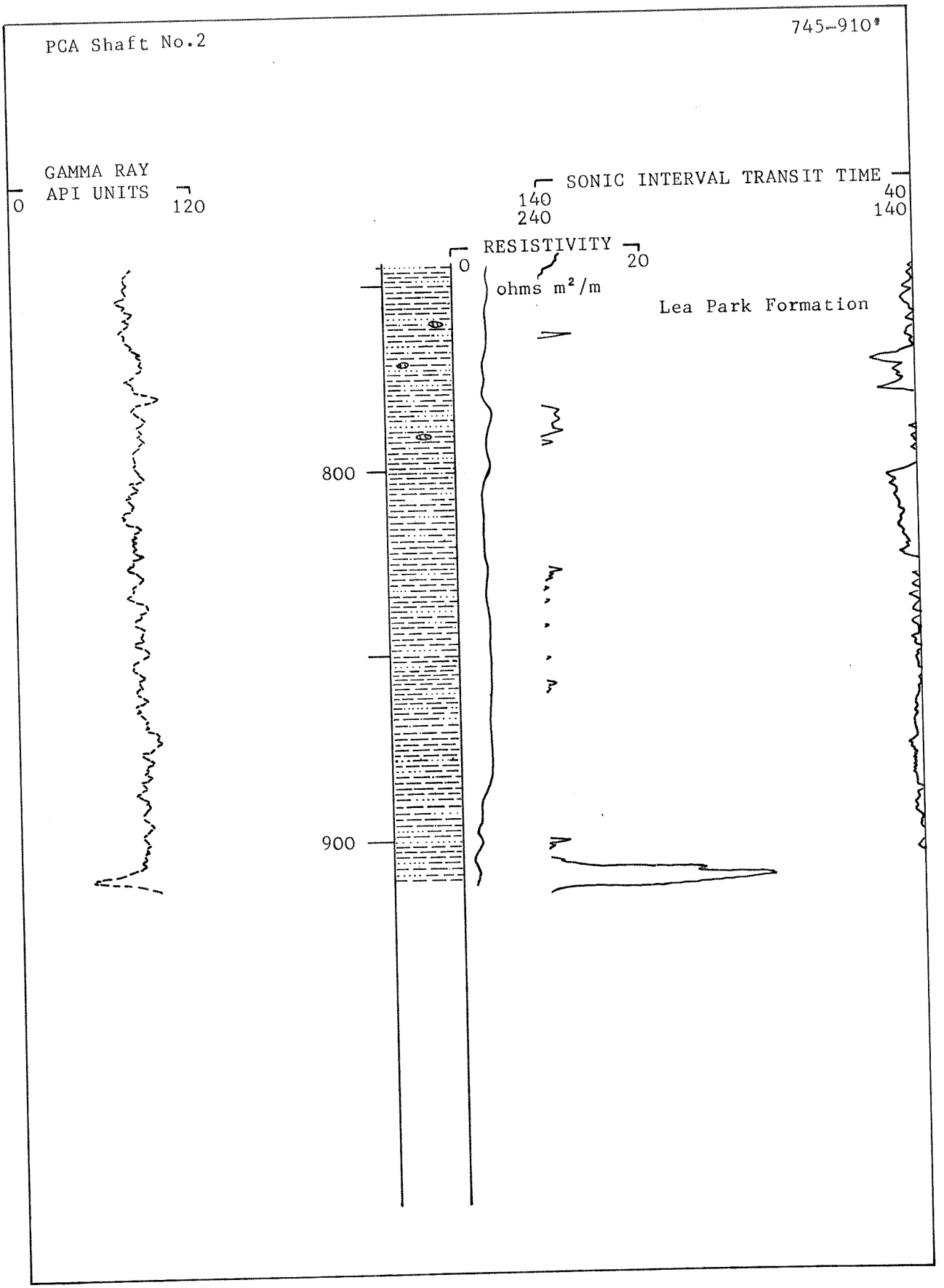
Potash Company of America Shaft No.2, Patience Lake 0-240'

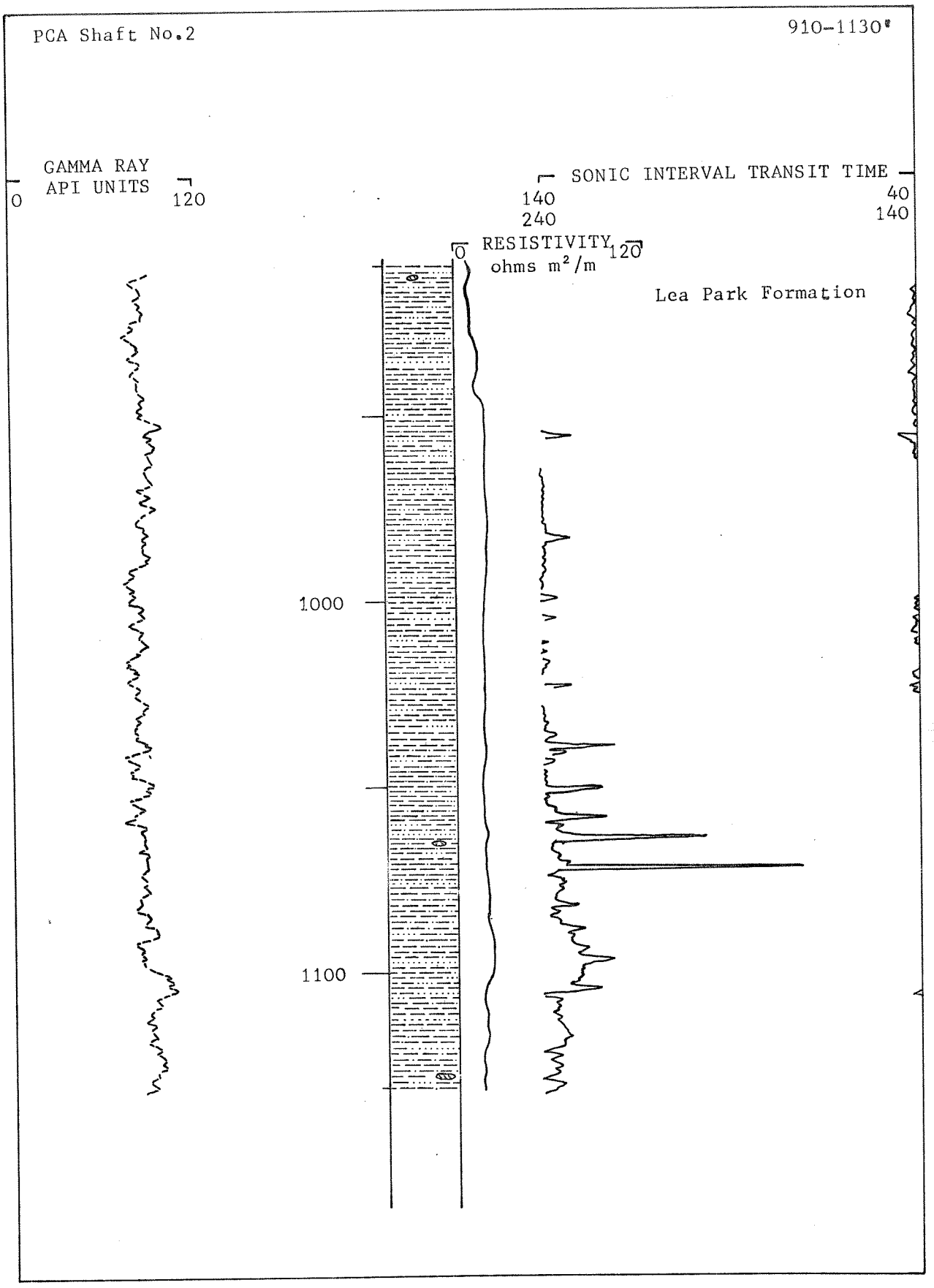


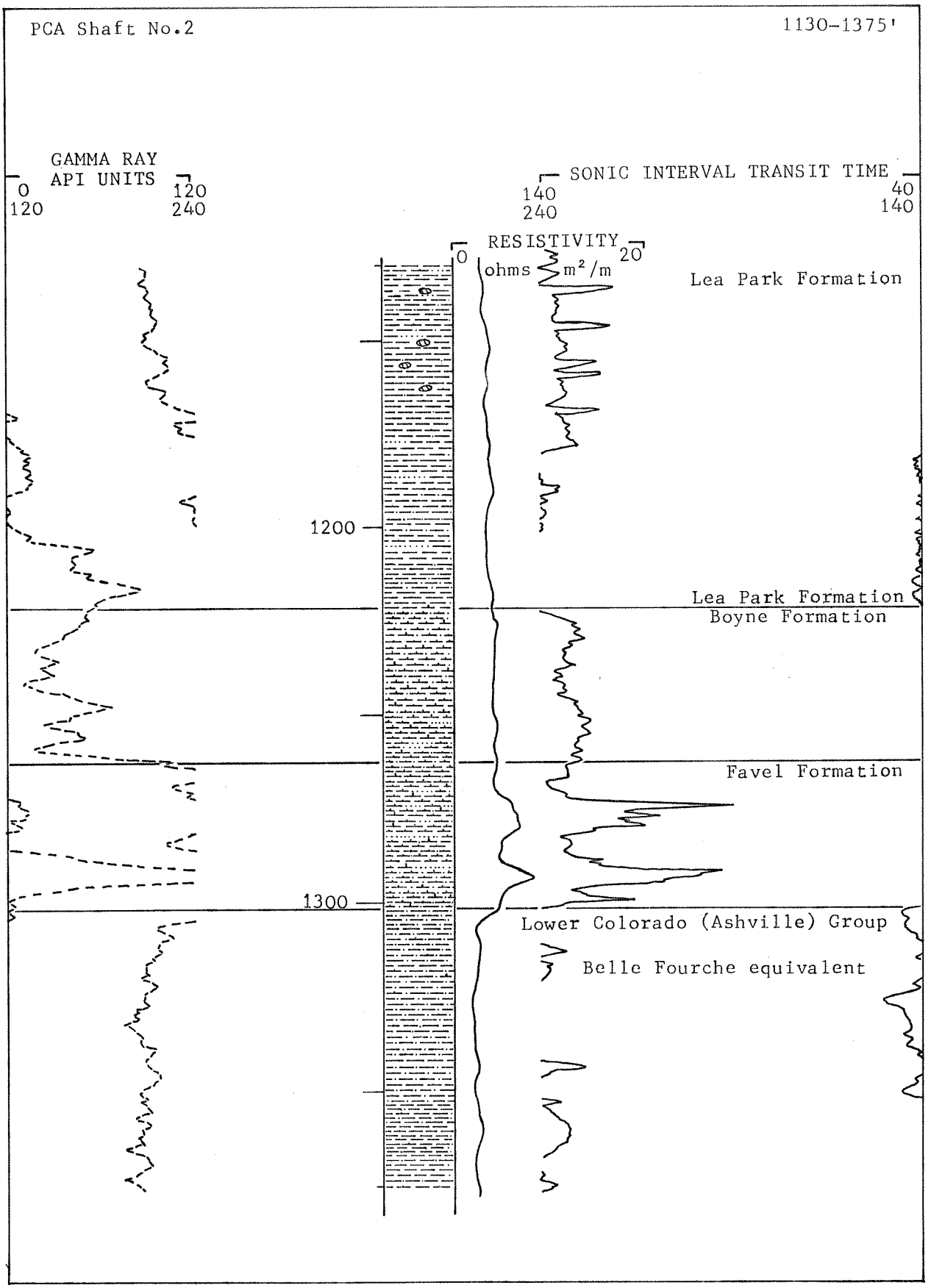

PCA Shaft No.2
240-485'
GAMMA RAY
API UNITS
0
120
SPONTANEOUS
POTENTIAL
- 10mv +
SONIC INTERVAL TRANSIT TIME
140
240
microseconds per foot
40
140
RESISTIVITY
0
ohms m²/m
20
Lea Park Formation
(Lower Birch Lake Tongue)
300
400

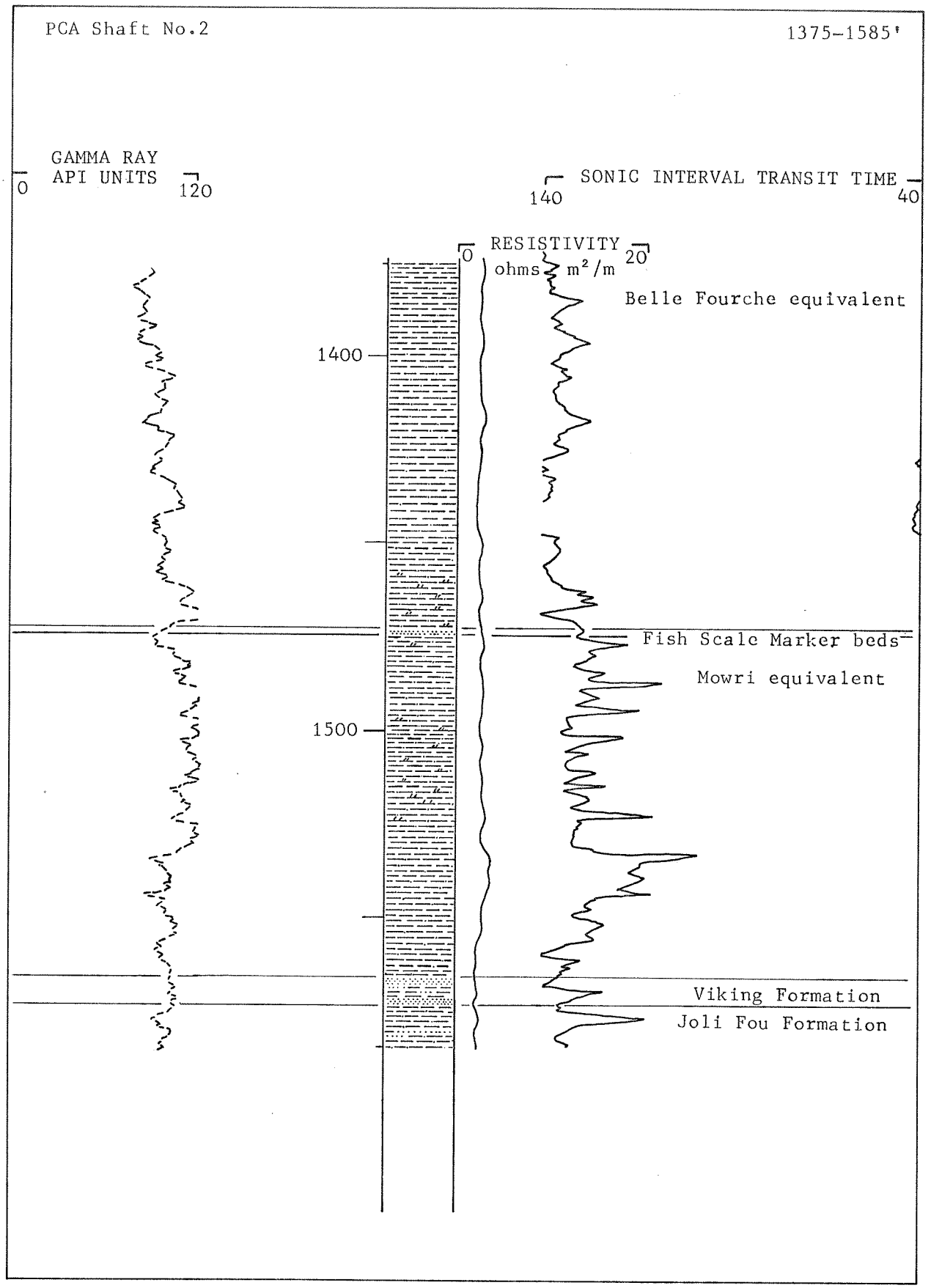

PCA Shaft No.2
485-635'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
240
40
140
RESISTIVITY
0
ohms·m²/m
20
Lea Park Formation
Lower Birch Lake Tongue
Lower marine shale
500
Lea Park Formation
600


PCA Shaft No.2
635-745'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
240
40
140
RESISITIVITY
0
ohms m²/m
20
Lea Park Formation
700


PCA Shaft No.2
745-910'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
240
40
140
RESISTIVITY
0
20
ohms m²/m
Lea Park Formation
800
900


PCA Shaft No.2
910-1130'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
240
40
140
RESISTIVITY
ohms m²/m
0
120
Lea Park Formation
1000
1100


PCA Shaft No.2
1130-1375'
GAMMA RAY
API UNITS
0
120
120
240
SONIC INTERVAL TRANSIT TIME
140
240
40
140
RESISTIVITY
0
ohms
20
m²/m
Lea Park Formation
1200
Lea Park Formation
Boyne Formation
Favel Formation
1300
Lower Colorado (Ashville) Group
Belle Fourche equivalent


PCA Shaft No.2
1375-1585'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
ohms m²/m
0
20
Belle Fourche equivalent
1400
Fish Scale Marker beds
Mowri equivalent
1500
Viking Formation
Joli Fou Formation

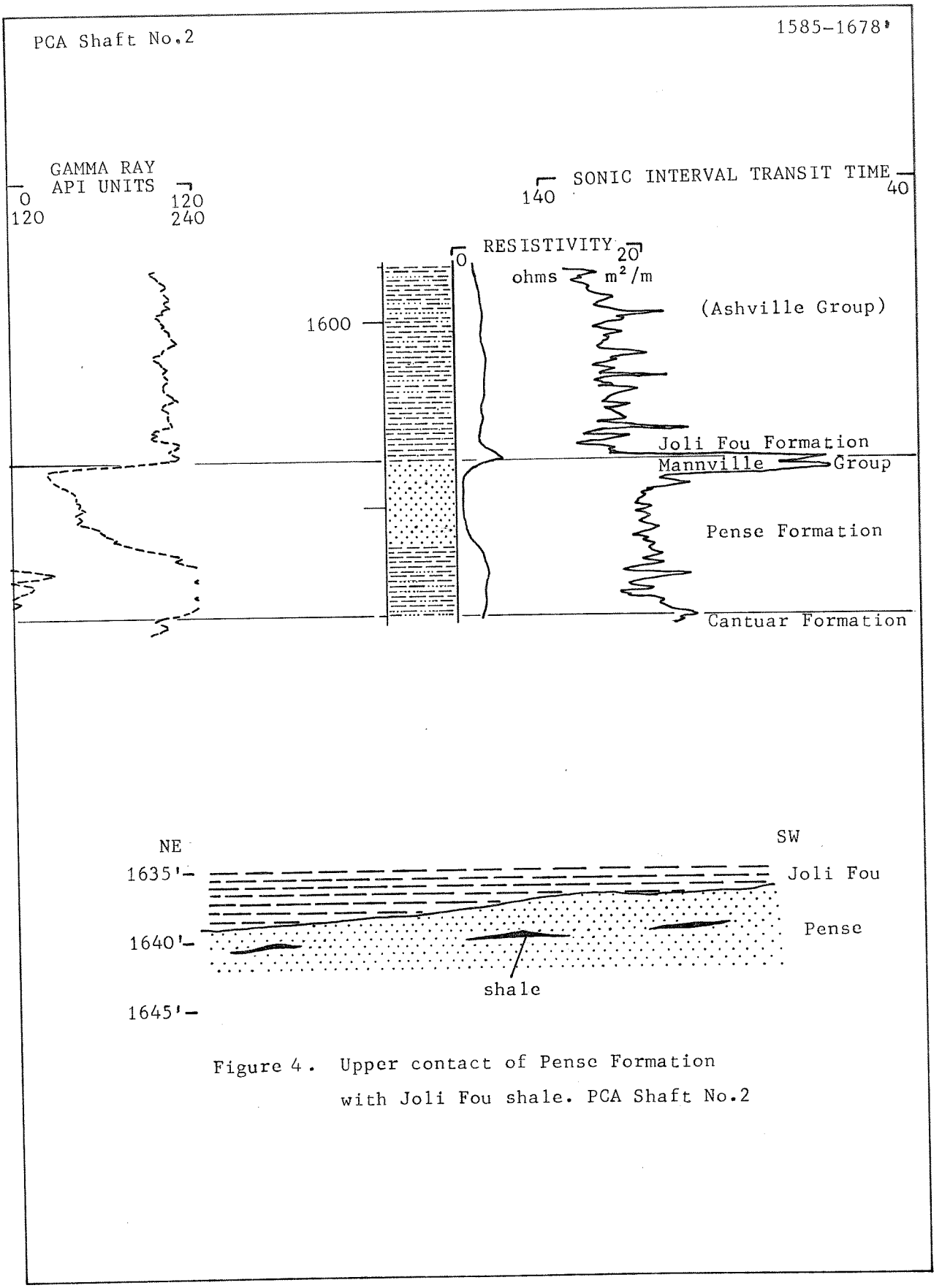
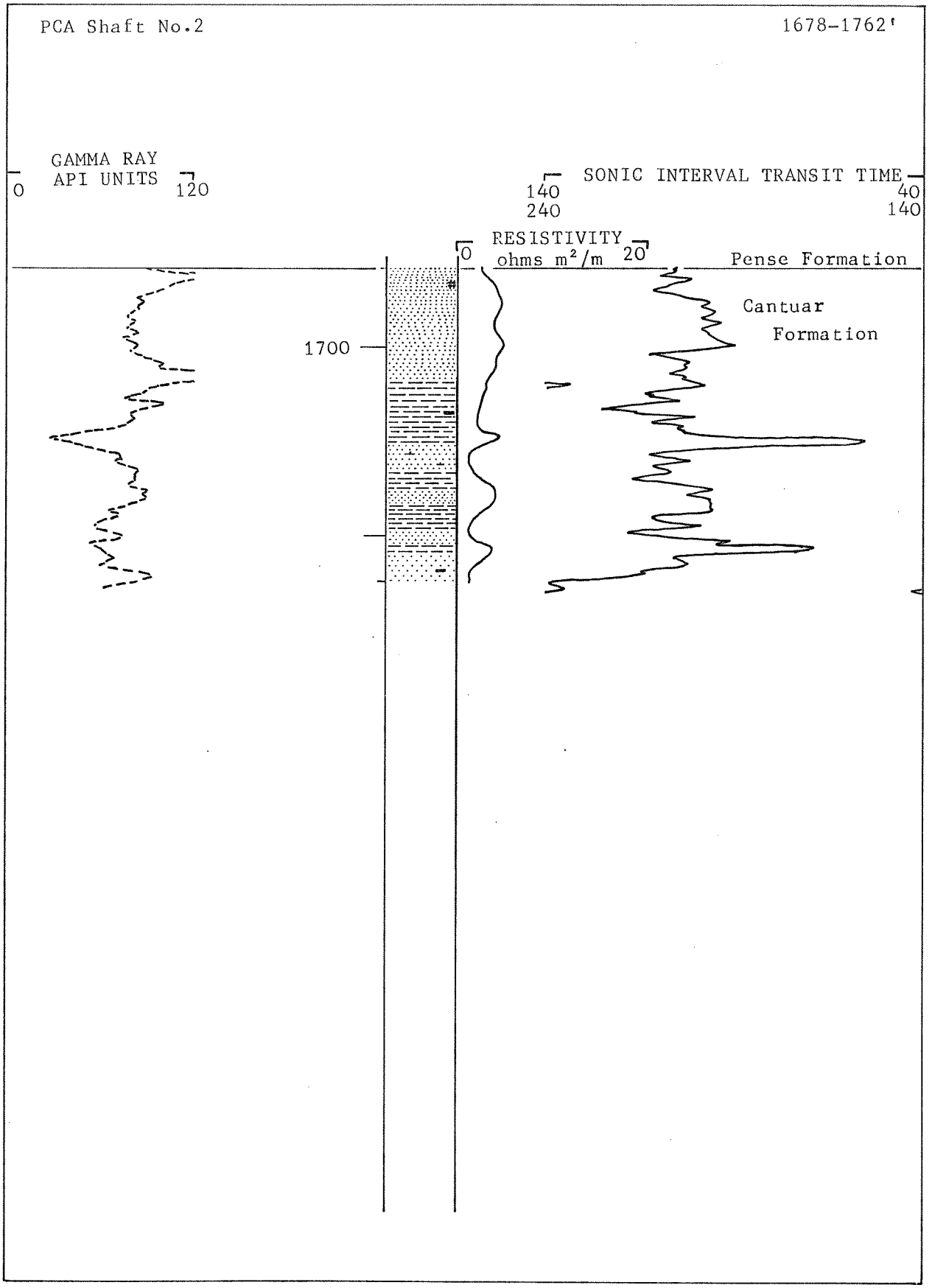



Figure 4. Upper contact of Pense Formation with Joli Fou shale. PCA Shaft No.2


PCA Shaft No.2
1678-1762'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
240
40
140
RESISTIVITY
ohms m²/m
0
20
Pense Formation
Cantuar
Formation
1700

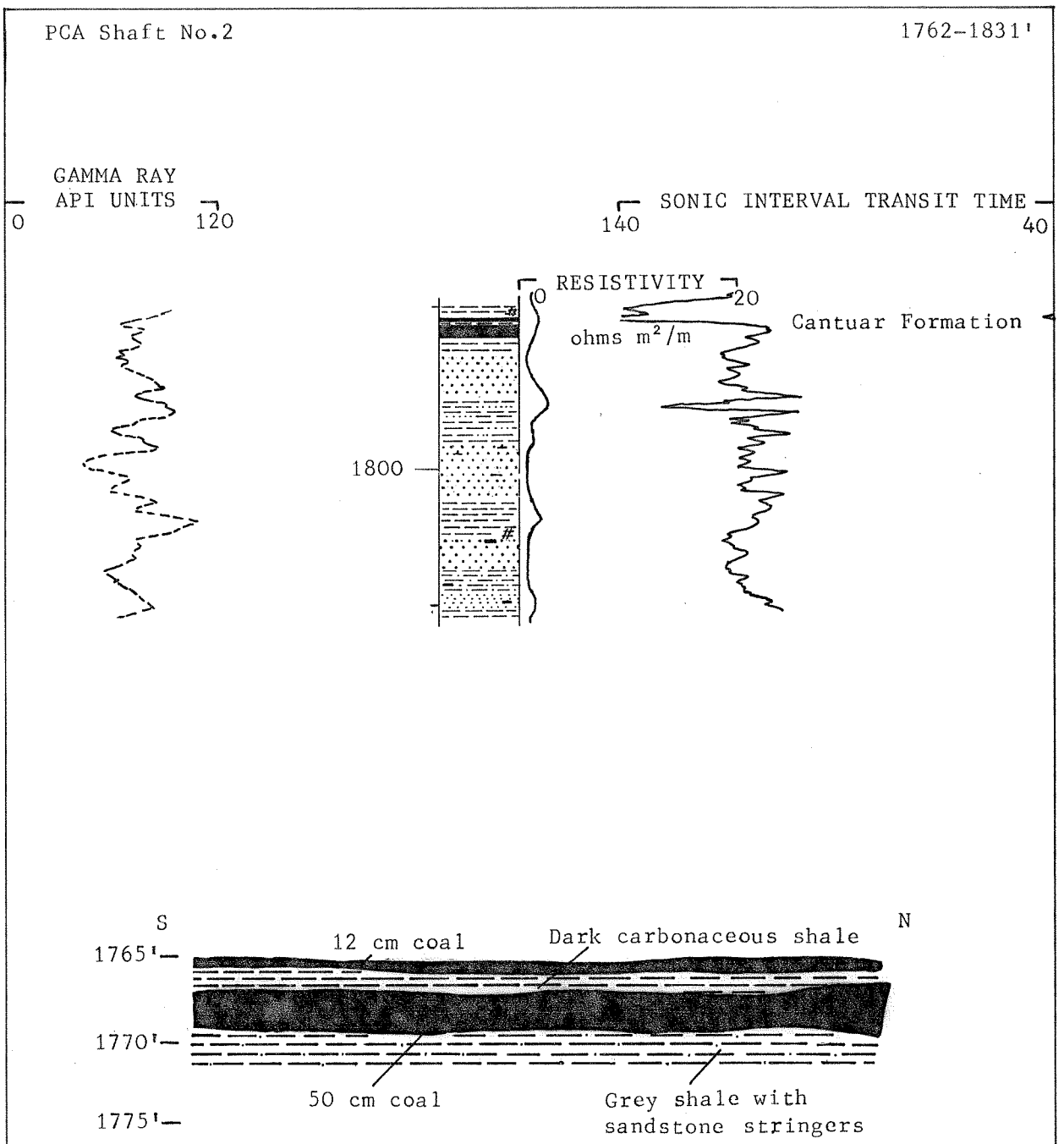
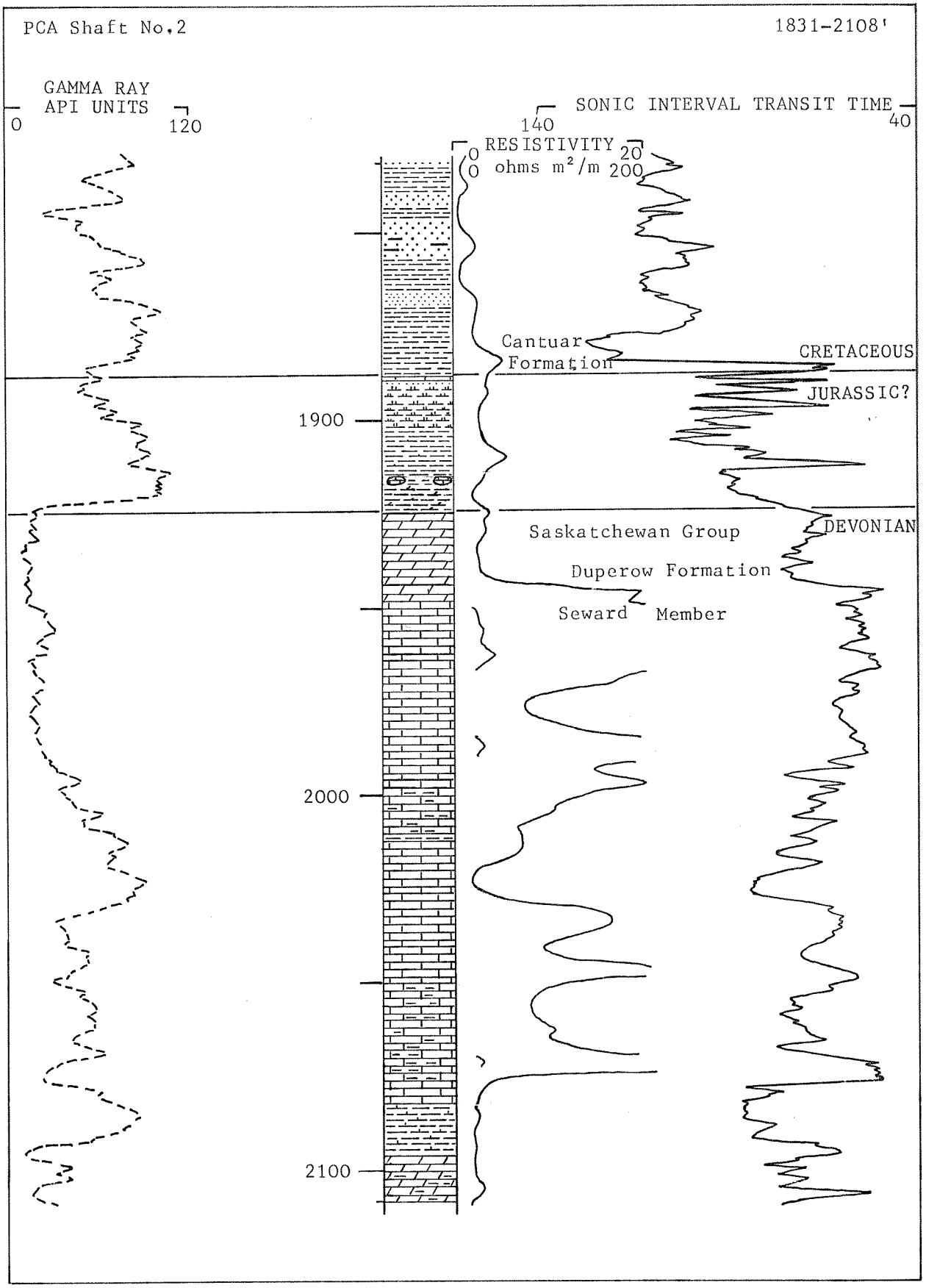
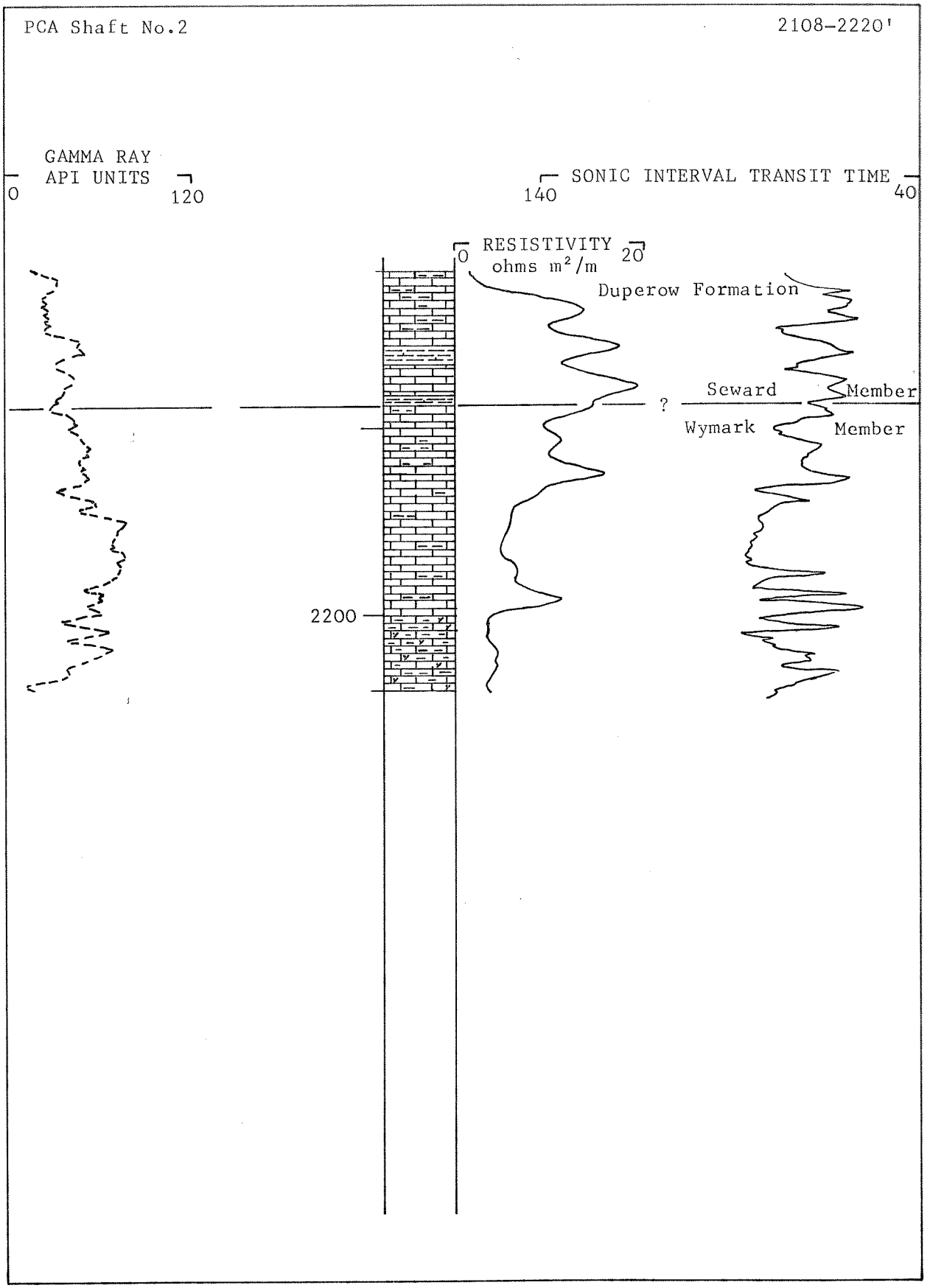
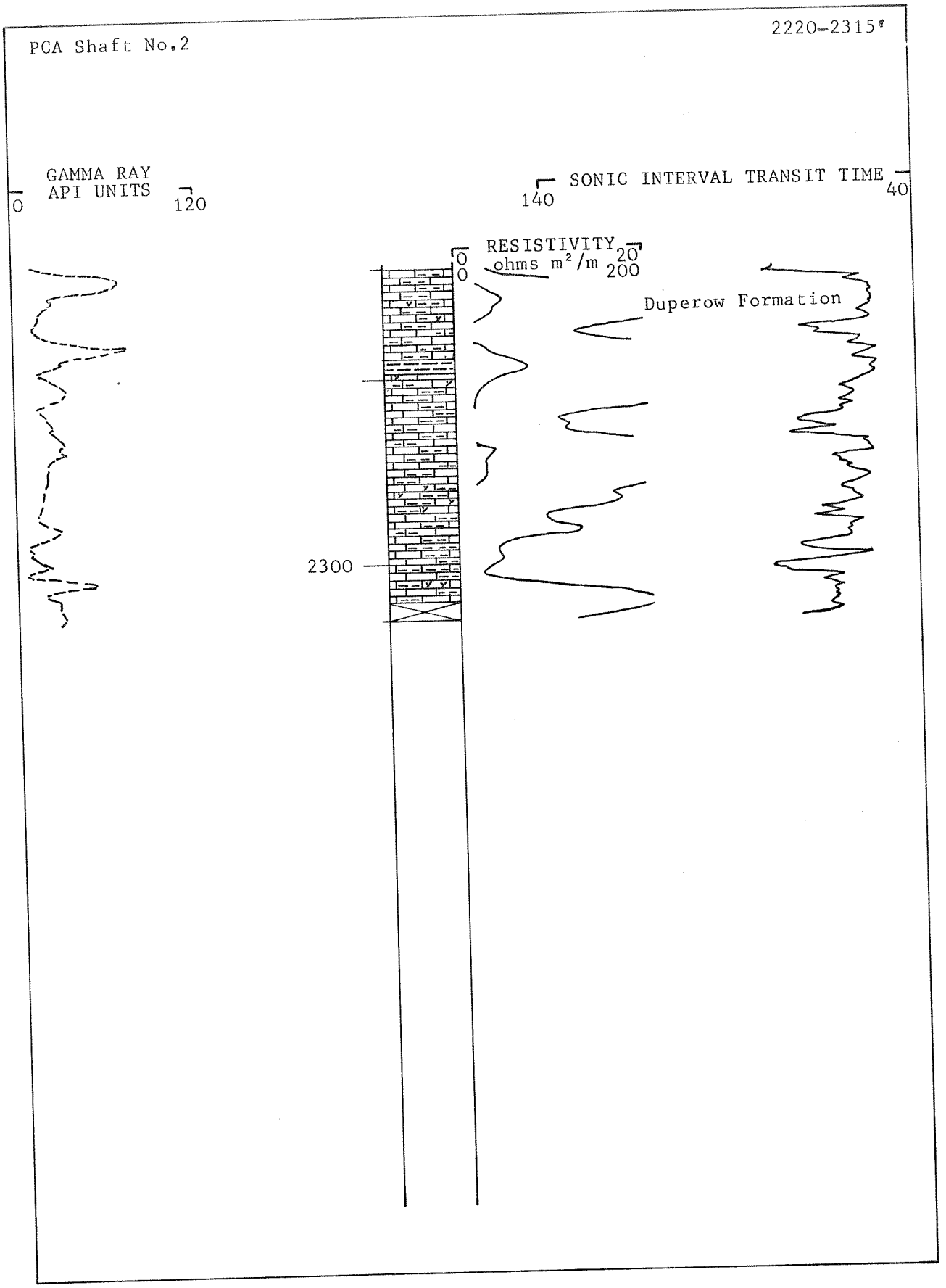



Figure 5. Coal seams, 1765 feet, Cantuar Formation, dip $1^0$- $2^0$ North.

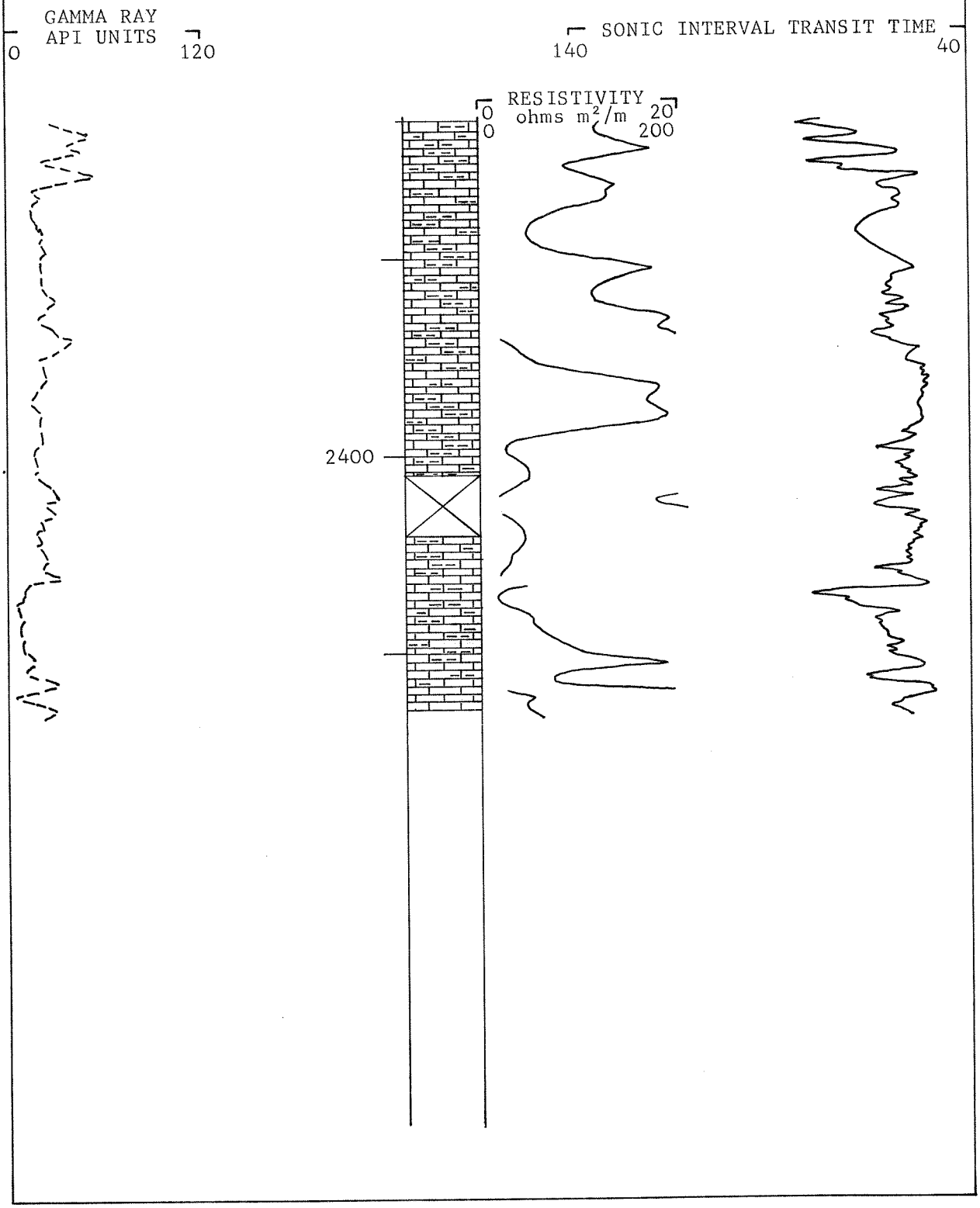

PCA Shaft No.2
1831-2108'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
0
0
ohms m²/m
20
200
Cantuar
Formation
CRETACEOUS
JURASSIC?
1900
Saskatchewan Group
DEVONIAN
Duperow Formation
Seward Member
2000
2100

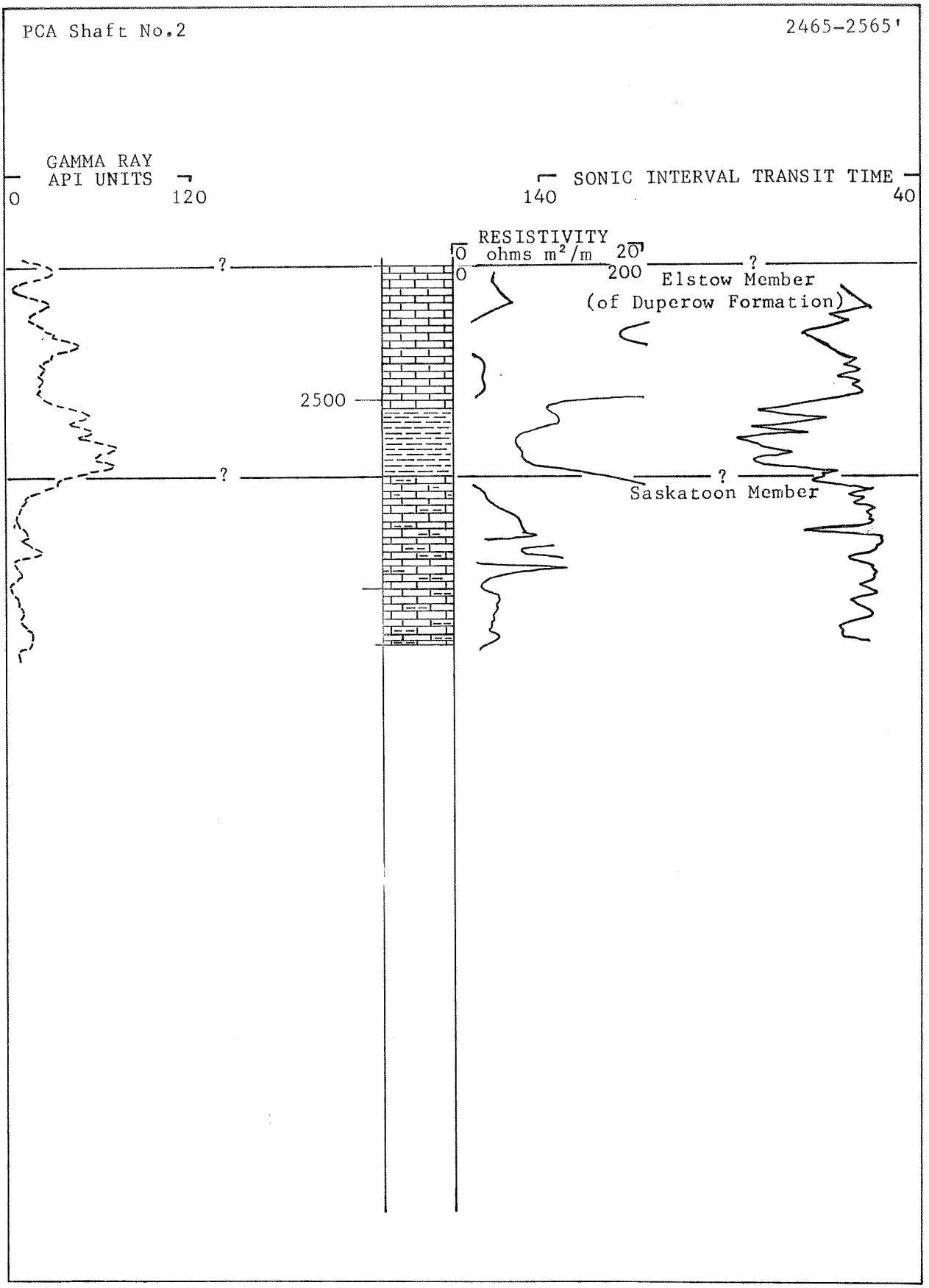

PCA Shaft No.2
2108-2220'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
ohms m²/m
0
20
Duperow Formation
Seward
Member
?
Wymark
Member
2200

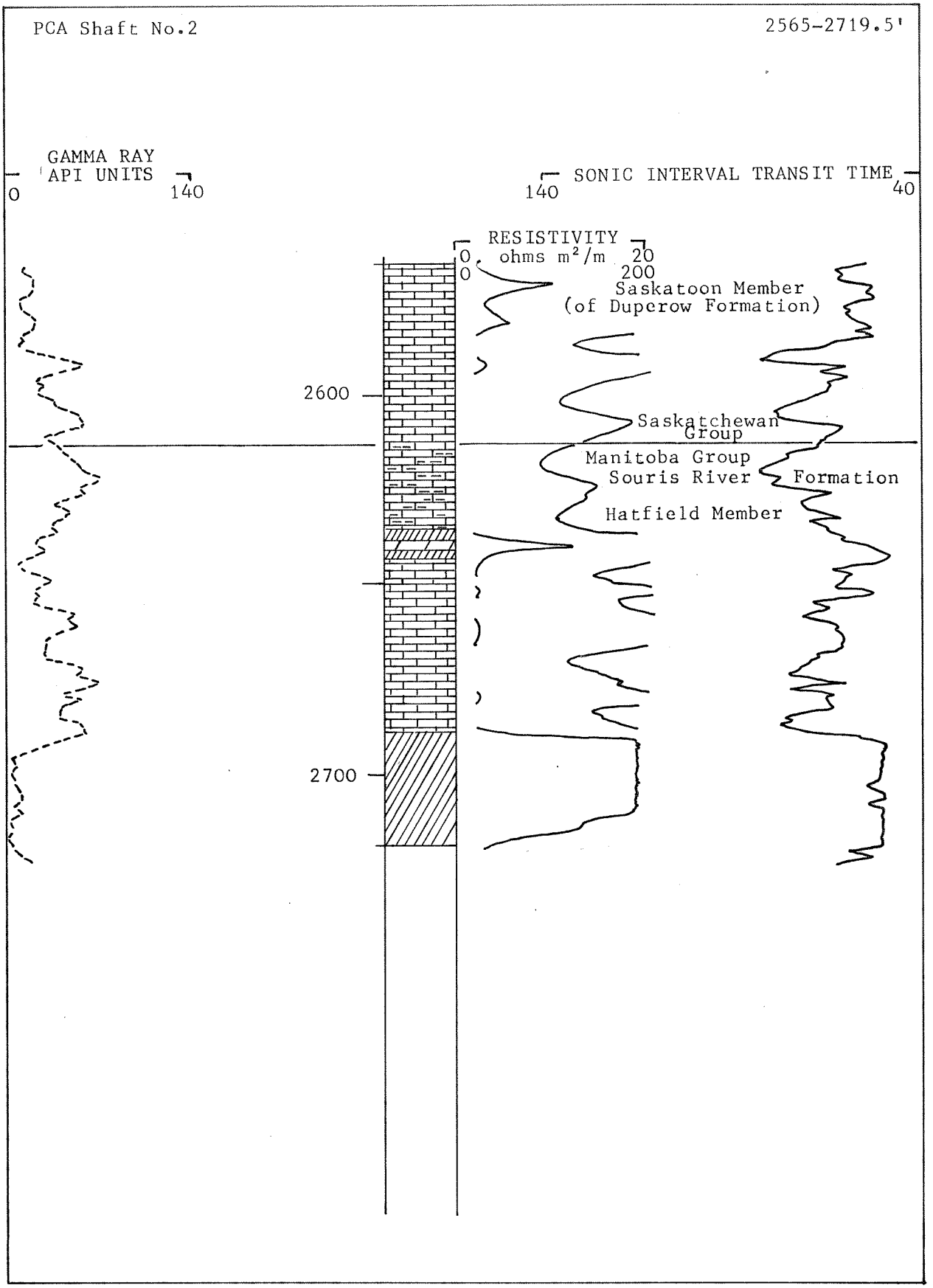

PCA Shaft No.2
2220-2315'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
ohms m²/m
0
0
20
200
Duperow Formation
2300

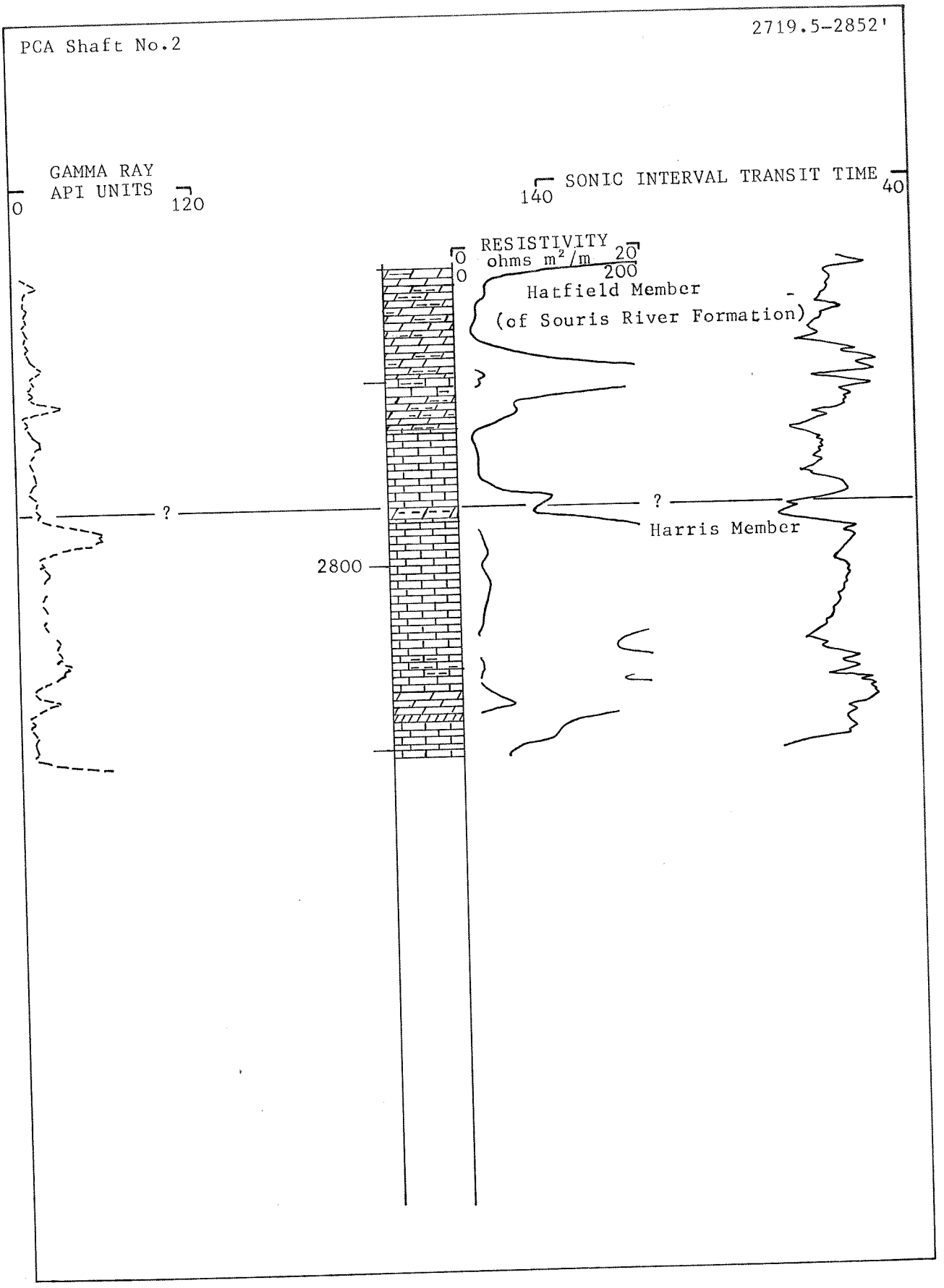
PCA Shaft No.2

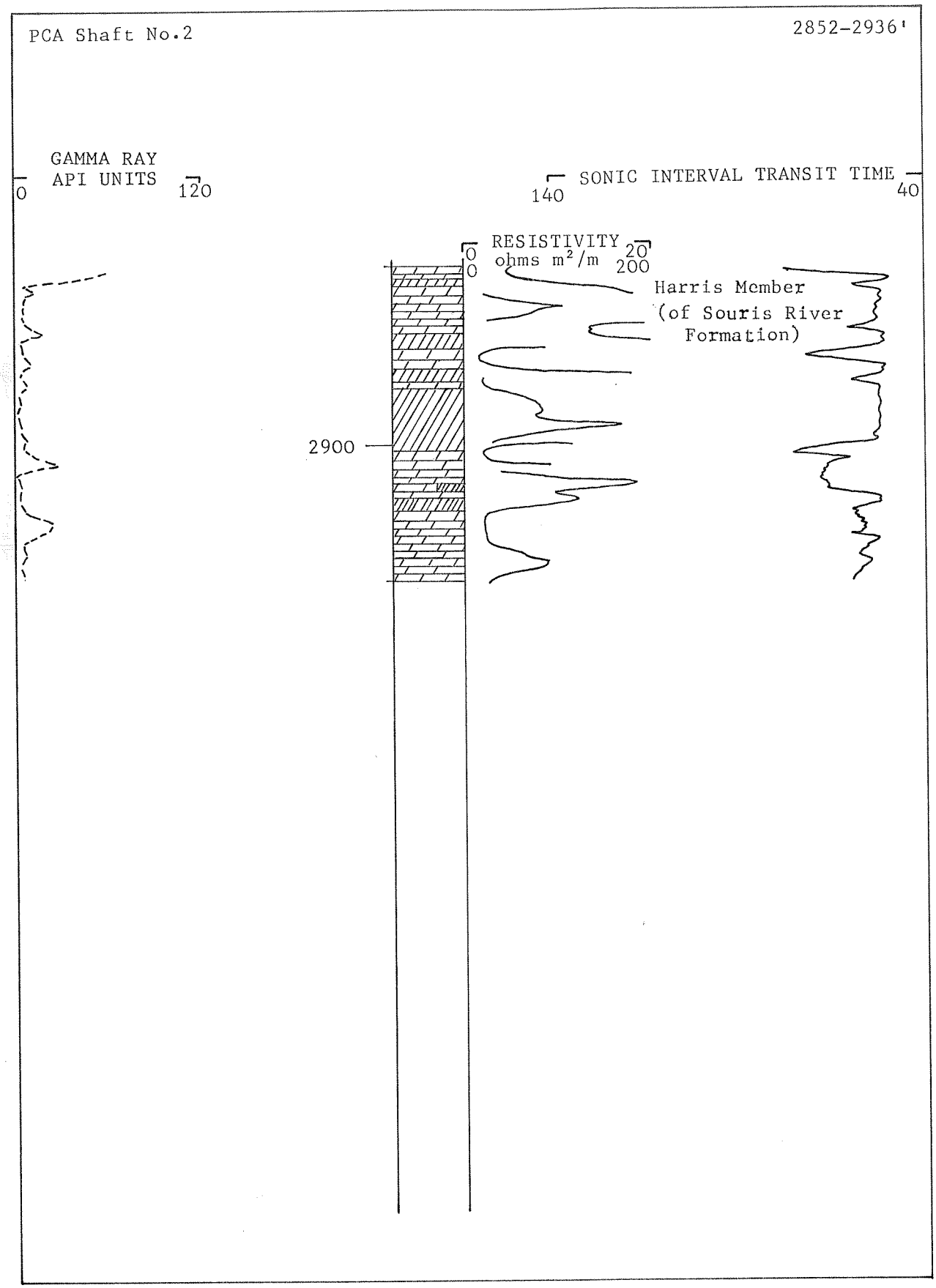
2315-2464'

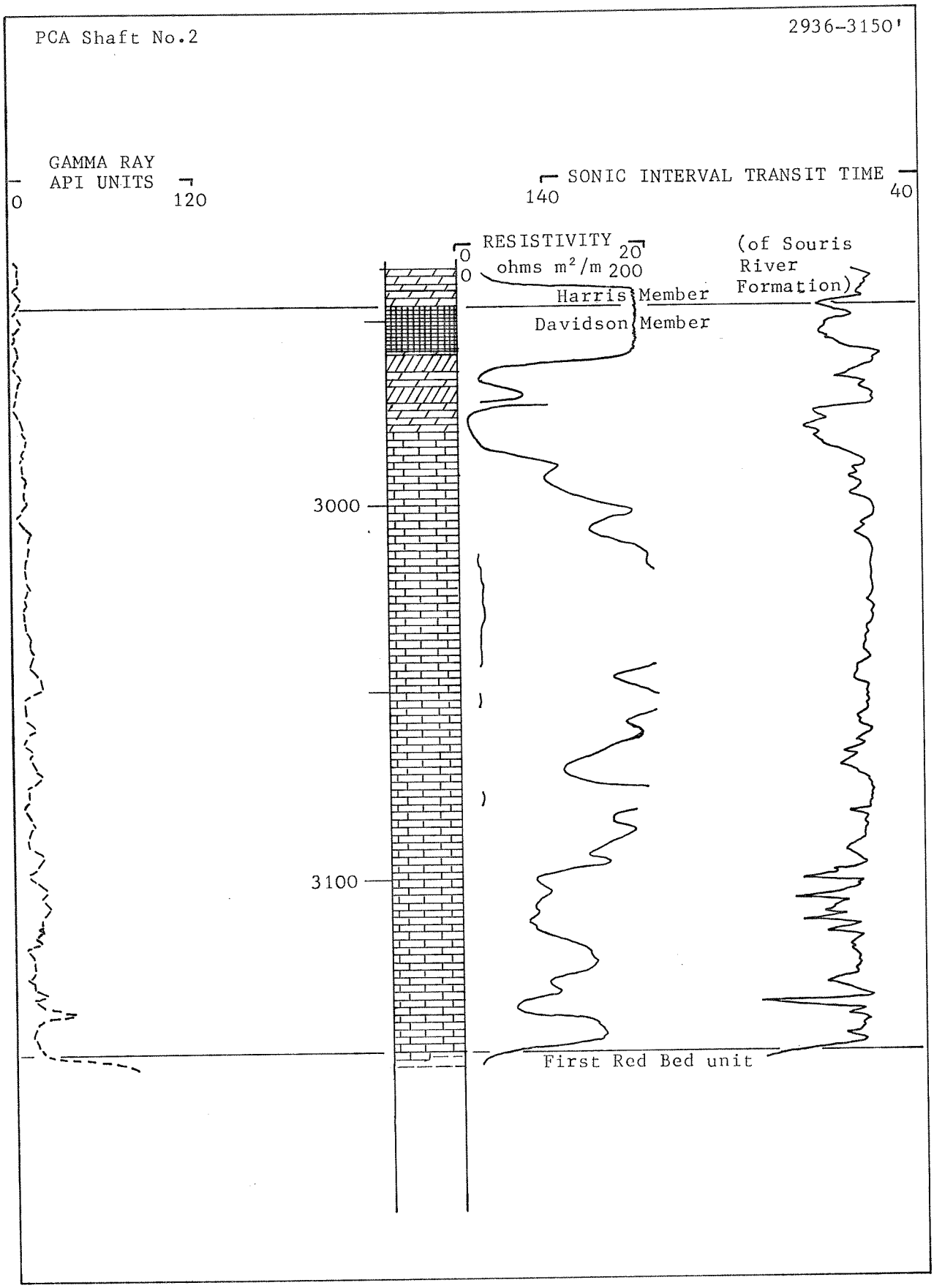



PCA Shaft No.2
2465-2565'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
0 ohms m²/m 200
0
200
Elstow Member
(of Duperow Formation)
2500
Saskatoon Member


PCA Shaft No.2
2565-2719.5'
GAMMA RAY
API UNITS
0
140
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
ohms m²/m
0
0
20
200
Saskatoon Member
(of Duperow Formation)
2600
Saskatchewan
Group
Manitoba Group
Souris River
Formation
Hatfield Member
2700


PCA Shaft No.2
2719.5-2852'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
ohms m²/m
0
0
20
200
Hatfield Member
(of Souris River Formation)
?
?
Harris Member
2800


PCA Shaft No.2
2852-2936'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
ohms m²/m
0
20
0
200
Harris Member
(of Souris River
Formation)
2900


PCA Shaft No.2
2936-3150'
GAMMA RAY
API UNITS
0
120
SONIC INTERVAL TRANSIT TIME
140
40
RESISTIVITY
ohms m²/m
0
0
20
200
(of Souris
River
Formation)
Harris Member
Davidson Member
3000
3100
First Red Bed unit

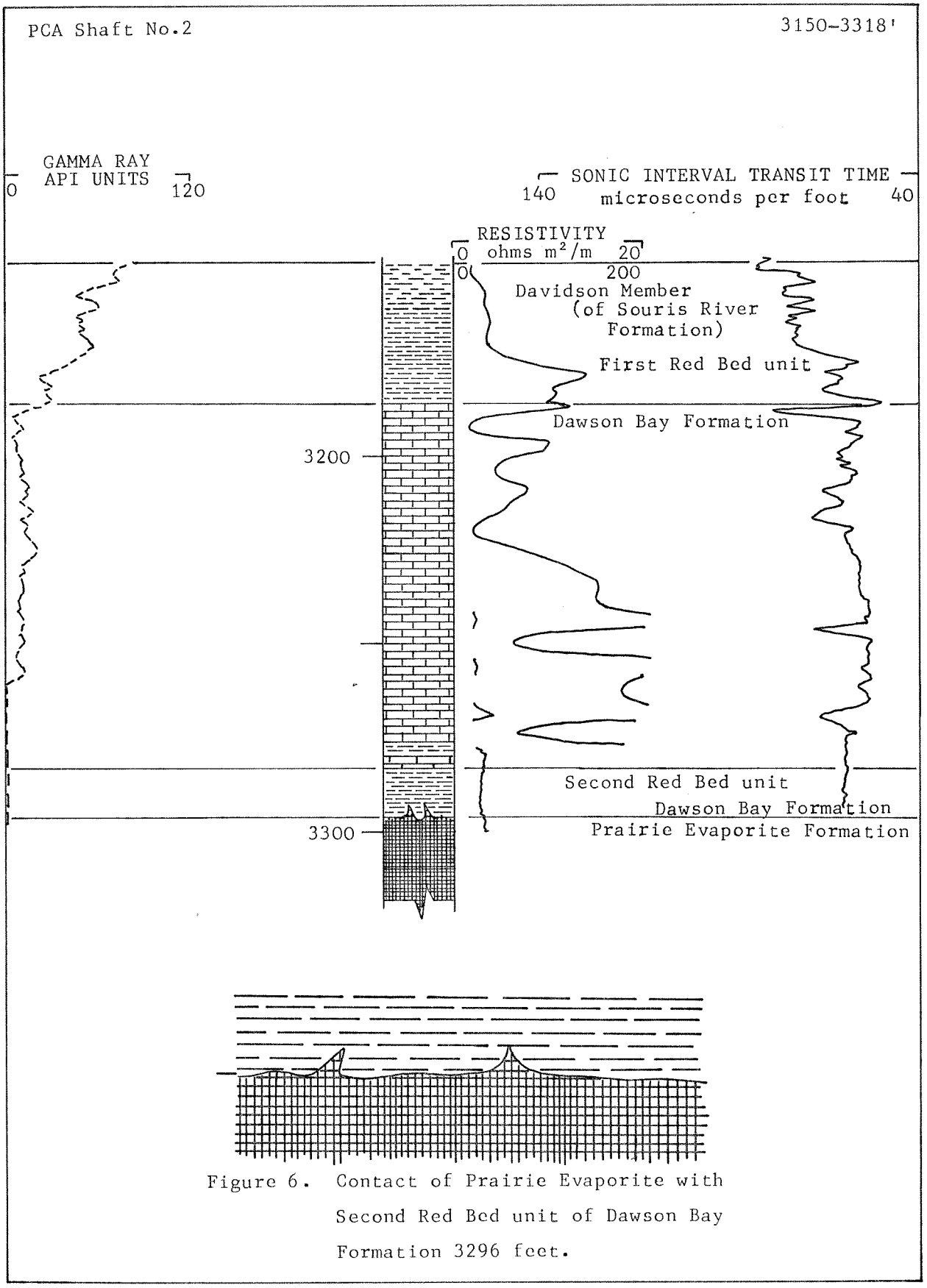



Figure 6. Contact of Prairie Evaporite with Second Red Bed unit of Dawson Bay Formation 3296 feet.

# APPENDIX II (a)

## Allan Potash Mines

## Shaft No. 1 East

# ALLAN POTASH MINES (U.S. BORAX)

## SHAFT NO. 1 EAST

## ALLAN, SASKATCHEWAN

Location: Lsd. 5, Sec. 22, Tp. 34, Rge. 1, W3
Elevation of Shaft Collar (datum): 1721.5 feet
Observations: by R.D. Holmes

Note: Notes on observations of the shaft well and excavated material 155 to 1691 feet are by R.D. Holmes, 1967; notes from 1691 to 2486 feet are taken from a summary of a log of the continuous core from the pilot hole midway between Shafts 1 and 2. Notes from 2486 to 3086 feet are from excavated material collected from each shaft interval by R.W. Klaubert.

| Depth (feet) | Lithology |
|---|---|
| | CENOZOIC |
| | Quaternary Deposits |
| 155-163 | Glacial till: dark grey to black clay; abundant pebbles and cobbles (1/16"-8" diameter) (Sample 1)<br>-drift contact at 163 feet. |
| | MESOZOIC (Cretaceous) |
| | Lea Park Formation |
| | Upper marine shale |
| 163-166 | Clay: dark grey to black; distinct lack of pebbles; (Sample 2) |
| 166-170 | Clay: grey with green cast, dense, more strongly compacted than clay above: pyrite specks; fragments of small pelecypods; (Sample 3) |
| 170-180 | Clay: grey, more or less silty, blocky; worm burrows abundant; indeterminate pelecypods, GSC loc. 69324 |
| 180-188 | Shale: light to medium grey, smooth textured, little if any fissility; pyrite patches and streaks; worm burrows; indeterminate thick-shelled pelecypods; GSC loc. 69325 |

| Depth (feet) | Lithology |
|---|---|
| 188-210 | Shale: grey, silty in part, smooth textured, conchoidal fracturing, poor fissility; scattered pyrite, glauconite, ironstone, concretions; worm burrows filled with pyritic silt; abundant pelecypods, rare gastropods, *Inoceramus balticus* Böhm, (s. lato), *Pholadomya* sp. indet., *Astarte* sp. indet., GSC locs. 69326, 69327, 69328 |
| 210-218 | Shale: grey, blocky, smooth textured, with irregular silty patches, scattered pyrite; worm burrows; carbon specks; fish scales; few thick-shelled pelecypods |
| 218-228 | Shale: grey, blocky, silty in part, carbon specks; pyrite streaks; worm burrows; numerous ironstone concretions up to 1 foot diameter; *Scaphites (Hoploscaphites) gilli*, indeterminate gastropods, *Inoceramus balticus* Böhm (s. lato), *Pholadomya* sp. indet., *Astarte* sp. indet., pelecypods genus and sp. indet.; GSC locs. 69329, 70647 |
| 228-236 | Shale: grey, silty in part with thin silt lenses and partings; smooth textured, blocky, fish scales; worm burrows; carbon specks; thin band or lense of bentonite clay (3-4") in lower half of interval; thin band 2-3" of coarsely crystalline calcite; abundant pelecypods, ammonites, *Inoceramus balticus* Böhm cf. var. *Simpsoni* Meek, *Baculites* sp. indet., *Pholadomya* sp. indet., *Astarte* sp. indet., GSC locs. 70624, 69330 |
| 236-242 | Shale: grey, silty, soft, indefinite silt partings, worm burrows; carbon specks; thin,plastic,clay bands; "boulders" of dense grey limestone veined with coarsely crystalline,yellow calcite; few ammonites, pelecypods, *Baculites* sp. indet., *Inoceramus balticus* Böhm cf. var. *Simpsoni* Meek, GSC loc. 70619 |
| 242-248 | Shale: grey, with thin silt lenses, many worm burrows; pyrite streaks; carbon specks; a few pelecypods |
| 248-254 | Shale: grey, smooth textured, blocky, very little fissility; indefinite silt lenses; worm burrows; carbon specks; beds of plastic clay approximately 8" thick; few pelecypods |
| 254-260 | Shale: grey, smooth textured, blocky, worm burrows, slight fissility; carbon specks, ironstone concretions 2" diameter; few fossils |
| 260-266 | Shale: grey, smooth textured blocky, with partings of light grey silt; worm burrows; iron-claystone concretions up to 8" diameter; plastic clay bands; few fossils |
| 266-270 | Shale: grey, smooth textured, blocky to flaky, with partings of light grey silt; worm burrows; carbon specks; scattered pyrite; 2 foot band bentonitic clay in upper half of interval; fossils rare |
| 270-274 | Shale: silty, light grey brown, intergrading with shaly siltstone and 2-4" bands of shaly sandstone with abundant black chert and quartz grains, scattered pyrite; worm burrows; rare, pelecypods; (Sample is representative of different members in interval) |

| Depth (feet) | Lithology |
|---|---|
| 274-278 | Shale: very silty or shaly siltstone, light grey brown, massive; thin, carbonaceous shale interbeds; abundant, thin-shelled pelecypods; *Inoceramus balticus* Böhm (s. lato), indeterminate marine pelecypods, GSC loc. 70670 |
| 278-288 | Sandstone: very shaly, very fine grained, grey, massive, interbeds of silty shale; few pelecypods |
| 288-295 | Shale: silty grey, interbedding with light grey silt, interbeds thin and discontinuous; indeterminate marine pelecypods, GSC loc. 70666 |
| 295-305 | Shale: very silty to finely sandy, grey with green cast, chloritic?, massive with silt interbeds; grades into blocky, smooth-textured shale with abundant worm burrows in lower 4' of interval; *Pholadomya* cf. mclearni Landes, *Baculites* sp. indet, pelecypods sp. indet., GSC loc. 70631 |
| 305-307 | Shale: grey, smooth-textured, blocky, glauconites large (up to 4' diameter); grey, calcareous, dense concretions; grades into shaly sandstone, indeterminate marine pelecypods, GSC loc. 70667 |
| 307-312 | Sandstone: shaly, medium grained, light grey with green cast, glauconitic; massive, poorly indurated, abundant dark chert grains; few pelecypods |
| 312-317 | Shale: silty to finely sandy, with thin, sandy interbeds, grey with green cast, massive, glauconitic; indeterminate marine pelecypods, *Dentalium* sp., GSC loc. 70629 |
| 317-327 | Shale: silty to sandy, grey, with silt and sand partings and interbeds, massive; scattered pyrite; carbon specks; worm burrows; *Inoceramus balticus* Böhm (s. lato), indeterminate pelecypods, GSC loc. 70654 |
| 324-335 | Shale: silty to sandy, grey with discontinuous lenses and partings of light grey silt or very fine sand; massive, carbon specks; rare scattered carbonized plant remains; *Inoceramus balticus* Böhm, (s. lato) indeterminate pelecypods, GSC loc. 70641 |
| 335-341 | Shale: silty in part, grey, with discontinuous lenses and partings of light grey silt, smooth-textured, blocky to flaky, worm burrows; abundant carbonized plant fragments; 1" ironstone band near base of interval; rare pelecypods |
| 341-346 | Shale: grey, smooth-textured, flaky, with interbedded light grey silt, bands of carbon-rich shale; plant remains; 2-1" brown ironstone bands in upper 2 ft.; well developed, small scale current banding in silt bands |

| Depth (feet) | Lithology |
|---|---|
| 346-351 | Shale: smooth-textured, blocky to flaky, grey with lenses and interbeds of light grey silt; numerous bands of plant remains; worm burrows; well developed current bedding in silt bands; rare, small pelecypods; ammonite *Baculites*. |
| | Lower Birch Lake tongue |
| 351-351.5 | Shale: coaly, bentonitic, flaky |
| 351.5-351.8 | Carbonate: coarsely crystalline, splintery, light grey |
| 351.8-353.5 | Sandstone: light grey, medium grained, hard, massive, calcareous, carbon speckled |
| 353.5-354 | Shale: sandy, bentonitic, carbon speckled and streaked |
| 354-360 | Sandstone: light grey, massive, friable porous, carbon specked, medium grained, fissile ? bedded |
| 360-370 | Siltstone: light grey brown, with interbeds of grey shale; carbonaceous partings; current bedding; carbon specks and streaks |
| 370-379 | Sandstone: fine grained, light grey brown, poorly indurated, thinly bedded, carbon specks; thin, carbon-rich bands near top of interval; grades into shale in bottom foot of interval |
| 379-386 | Shale: grey, smooth-textured, blocky to flaky, with numerous interbeds and lenses of silt and sand; thin coaly bands; carbon specks and streaks, well developed current bedding in silt and sand bands; dolomitic concretions |
| 386-393 | Shale: grey, with thin interbeds and lenses of light grey-brown silt; shale smooth textured, flaky, slightly fissile; worm burrows; silt shows well developed current bedding and small slump structure; carbon streaks and patches |
| 393-398 | Shale: grey, with thin lenses and interbeds of silt and fine grained sandstone: shale, smooth-textured, flaky, slightly fissile; silt and sand shows well developed, small-scale, current bedding and miniature slump structure; 6" band of very fine grained, crystalline limestone near top of interval, unfossiliferous |
| 398-404 | Shale: with interbeds and lenses of silt and fine grained sandstone; shale, grey, smooth-textured, flaky, fissile; worm burrows; carbonaceous partings; silt and sandstone, light grey, thinly bedded, thin shale partings; current bedding |

| Depth (feet) | Lithology |
|---|---|
| 404-411 | Shale: silty, blocky in upper half of interval, smooth-textured, flaky, in bottom half; abundant carbon streaks (after plants) in silty upper half; silt partings; abundant, small, thin-shelled pelecypods in lower, fissile shale, *Nucula* (s. lato) sp. indet. GSC loc. 70622 |
| 411-421 | Shale: grey, silty, with numerous silt and sand lenses: silt, light grey brown with current bedding; sand lenses up to 1" thick; *Nucula* sp. indet. (s. lato), indeterminate, marine pelecypods, GSC loc. 70655 |
| 421-430 | Shale: grey, smooth-textured, slightly fissile, with numerous interbeds and lenses of light grey brown siltstone and fine grained sandstone, carbonaceous partings; siltstone and sandstone comprise approximately 30% of interval with siltstone predominant; well developed current bedding; soft, poorly indurated, porous; *Nucula* (s. lato) sp. indet., GSC loc. 70630 |
| 430-436 | Shale: grey, smooth-textured, flaky, fissile, with siltstone interbeds; grades into shaly siltstone and fine grained sandstone; sandstone impure, poorly sorted, well developed current bedding, soft, poorly indurated, porous; small, indeterminate, thin-shelled pelecypods (marine), GSC loc. 70623 |
| 436-444 | Sandstone: light grey, shaly, fine grained, thinly bedded, soft, poorly indurated, porous except where shaly, becoming less shaly in bottom 2' of interval; carbonaceous partings; wood fragments; indeterminate, marine pelecypods, GSC loc. 70632 |
| 444-451 | Sandstone: light grey, fine grained, thinly bedded, with lenses and interbeds of grey shale; small-scale current bedding; miniature slump structure; carbonaceous partings; soft, poorly indurated, porous; small, thin-shelled pelecypods |
| 451-458 | Sandstone: light grey, fine to medium grained, with thin interbeds and irregular lenses of medium to dark grey shale, thinly bedded, soft, porous; current bedding; abundant carbon specks; carbonized plant remains |
| 458-465 | Sandstone: light grey, fine to medium grained, thinly bedded, with thin interbeds and discontinuous lenses of light grey silt and medium to dark grey shale, soft, porous; carbon specks; carbonaceous partings; ironstone lenses, small, thin-shelled pelecypods; 460-462' sandstone, hard, calcareous, fossiliferous, massive; with numerous carbonaceous partings |
| 465-472 | Sandstone: light grey-brown, fine to medium grained, thinly bedded, with discontinuous lenses of medium to dark grey shale, soft poorly indurated, porous; carbon specks; current bedding; carbonaceous plant remains. |

| Depth (feet) | Lithology |
|---|---|
| | Lower marine shale |
| 472-480 | Shale: medium to dark grey, slightly fissile, with lenses and interbeds of light brown-grey silt and fine grained sandstone; carbonaceous partings; wood fragments; well developed, small scale cross-bedding in silt and sand; abundant carbon specks in silt and sand; small, thin-shelled pelecypods; rare gastropods, (indeterminate), indeterminate ammonite, GSC loc. 70625 |
| 480-486 | Shale: sandy or shaly sandstone, shale, smooth-textured, fissile, medium to dark grey; sandstone, light brown grey, fine grained, porous; current bedding; carbon specks, carbonized wood fragments |
| 486-494 | Shale: medium to dark grey, smooth-textured, somewhat fissile, with irregular lenses and interbeds of light grey brown, silt and fine grained sandstone; carbonaceous partings; wood fragments; current bedding in silt and sandstone; abundant carbon specks in silt and sand; plastic clay band 8" thick; slightly bentonitic ?; small, thin-shelled pelecypods |
| 494-500 | Shale: medium to dark grey, smooth-textured, slightly fissile with irregular lenses and interbeds of light brown-grey siltstone and fine grained sandstone; carbonized wood fragments; current bedding in silt and sandstone; abundant carbon specks in silt and sand; bands of siltstone which appear dotted with clay or shale pellets, indeterminate pelecypods, presumably marine, GSC loc. 70649 |
| 505-512 | Shale: medium to dark grey, silty in part, smooth-textured, blocky to flaky, with irregular lenses and interbeds of light grey silt and fine grained sandstone; carbonized wood fragments; bands of silt with clay pellets; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Inoceramus balticus* Böhm (s. lato), indeterminate pelecypods, GSC loc. 70660 |
| 512-518 | Shale: medium to dark grey, blocky to flaky, silty in part, with lenses of grey silt and fine grained sandstone; carbonized wood fragments; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Inoceramus balticus* Böhm (s. lato), *Pholadomya mclearni* Landes, *Baculites* sp. indet., GSC loc. 70668, lot collected from 510-533', GSC loc. 70652, collected from 512-518' |
| 518-524 | Shale: medium to dark grey, silty to finely sandy, massive, blocky; carbonized wood fragments; coiled ammonites; *Scaphites (Hoploscaphites) gilli*, *Inoceramus balticus* Böhm (s. lato), GSC loc. 70664, 70651 |
| 524-532 | Shale: silty to finely sandy, grey-brown with slight greenish cast, massive, blocky, irregular lenses of silt and sand; coiled ammonites; large, thick-shelled pelecypods |

| Depth (feet) | Lithology |
|---|---|
| 532-540 | Shale: grey-brown, mottled by silty to finely sandy zones, massive, blocky; brown ironstone "septarian" concretion up to 18" diameter; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Inoceramus balticus* Böhm (s. lato), indeterminate pelecypods, GSC loc. 70657 |
| 540-548 | Shale: medium to dark grey, mottled by silty to finely sandy zones, massive, moderately fissile; scattered pyrite; coiled ammonites; pelecypods |
| 548-555 | Shale: silty, medium to dark grey, mottled by silty zones, moderately fissile, massive; *Scaphites (Hoploscaphites)* cf. *gilli* Cobban and Jeletzky, *Baculites* cf. *gregoriensis* Cobban, *Inoceramus balticus* Böhm (s. lato), *Goniomya* sp. indet., GSC loc. 70683, 70640 |
| 555-566 | Shale: grey, slightly silty in part, good fissility, indefinite silt partings; worm burrows, 5" band of bentonitic clay associated with 4" band of splintery carbonate layer at 560'; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Ostrea* sp. indet., *anomia* sp. indet., GSC loc. 70627; *Modiolus* sp. indet., GSC loc. 70621 |
| 566-574 | Shale: grey, slightly silty, good fissility, indefinite silt partings; worm burrows; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Inoceramus balticus* Bohm (s. lato), *pteria* sp., pelecypods, sp. indet., gastropods, sp. indet., GSC loc. 70669, 70644 |
| 574-582 | Shale: grey, silty, good fissility, indefinite silt lenses; worm burrows; 6" band of bentonitic clay associated with 6-8" band of splintery carbonate at 581'; coiled ammonites; pelecypods; gastropods |
| 582-590 | Shale: grey, silty, good fissility, indefinite silt lenses; worm burrows; coiled ammonites |
| 590-596 | Shale: grey, silty to finely sandy, good fissility, indefinite sand and silt lenses; worm burrows filled with white silt; coiled ammonites, pelecypods; gastropods |
| 596-601 | Shale: silty to finely sandy, grey, mottled by indefinite silt lenses, moderately fissile; worm burrows; ironstone concretions, some with fossils; glauconite; *Inoceramus* cf. *balticus* Böhm, *Pholadomya* sp. indet., *Astarte* sp. indet., pelecypods, genus and sp. indet., GSC loc. 70628 |
| 601-608 | Shale: silty, brown-grey, mottled by irregular lenses of silt or fine sand, fissile; worm burrows; carbon specks; pyrite streaks; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, *Baculites* sp. indet., *Inoceramus balticus* Böhm (s. lato), indeterminate gastropods, GSC loc. 70684 |

| Depth (feet) | Lithology |
|---|---|
| 608-617 | Shale: silty, brown-grey, mottled by silty zones, massive, fissile, soft; pyritized worm or plant tubes; ironstone concretions 1½"; coiled and uncoiled ammonites |
| 617-627 | Shale: silty, brown-grey, mottled by silty zones, fissile, massive, soft, pyrite streaks; worm burrows; ironstone concretions up to 6" diameter; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, large, smooth *Baculites* sp. indet., *Pholadomya mclearni* Landes, GSC loc. 70643 |
| 627-637 | Shale: brown-grey, silty, massive, fissile, soft, worm burrows, pyrite streaks; pyrite ironstone concretions up to 2' diameter; coiled and uncoiled ammonites |
| 637-647 | Shale: grey, silty, mottled by silty zones, massive, fissile, soft; worm burrows; pyrite streaks; *Scaphites (Hoploscaphites)* n. sp. ex. aff. *gilli* Cobban and Jeletzky (large, nodose, and bullate form), *Baculites* sp. indet., GSC loc. 70665 |
| 647-655 | Shale: grey-brown silty, massive, fissile; scattered pyrite; worm trails; ironstone concretions up to 3" diameter; large, smooth *Baculites* sp. indet., GSC loc. 70638 |
| 655-664 | Shale: grey-brown, silty, massive fissile; worm trails; fish scales; pyrite; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, large, smooth *Baculites*, sp. indet., GSC loc. 70661 |
| 664-671 | Shale: grey, massive, good fissility; fish scales; worm burrows; scattered pyrite; ironstone concretions up to 1½" diameter; large, smooth *Baculites* sp. indet., *Pholadomya mclearni* Landes, indeterminate fragments of crab, GSC loc. 70659 (lot collected from 669-672) |
| 671-677 | Shale: grey, massive, fissile; silt partings; glauconitic; pyrite streaks and patches; glauconitic ironstone concretions; fish scales; worm burrows; uncoiled ammonites; thin-shelled pelecypods |
| 677-683 | Shale: grey, silty, massive, fissile; worm burrows; abundant pyrite patches; numerous glauconitic ? ironstone concretions 4" diameter; *Baculites* sp. indet. (large, smooth form), GSC loc. 70637 |
| 683-691 | Shale: grey, slightly silty, fissile, silt partings; worm tracks; abundant pyrite patches and streaks; pyritized plant or worm tubes; numerous ironstone concretions up to 10" diameter, many with uncoiled ammonites; glauconite(?); large, smooth *Baculites* sp. indet., GSC loc. 70653 |
| 691-700 | Shale: grey, mottled by lenses and partings of light grey silt, fissile; worm trails; scattered pyrite; slickensides; ironstone concretions many with fossils; thin zone of calcite veins; large, smooth *Baculites* sp. indet., GSC loc. 70645 |

| Depth (feet) | Lithology |
|---|---|
| 700-707 | Shale: grey, silty in part, mostly fissile; worm trails; zones of slickensides; two 2" bands of yellow-brown silt; indefinite silt partings; fossilized ironstone concretions; large, smooth *Baculites*, sp. indet., GSC loc. 70662 |
| 707-715 | Shale: grey mottled by silty zones, massive, mostly fissile; worm trails; interbeds of light grey silt, 8" band of bentonitic ? clay with much slickensiding and lenses of yellow-brown silt in the clay band; uncoiled ammonites |
| 715-722 | Shale: grey, massive, fissile, with partings of light grey silt; abundant worm tubes; slickensides; *Scaphites (Hoploscaphites)* cf. *gilli* Cobban and Jeletzky, *Baculites* cf. *asperiformis* Meek, large, smooth *Baculites*, sp. indet., GSC loc. 70663 |
| 722-728 | Shale: grey, silty in part, smooth-textured, fissile, partings of light grey silt; worm tubes; rare fish scales; uncoiled ammonites |
| 728-735 | Shale: grey, silty in part, smooth-textured soft, fissile, partings and lenses of light grey silt; ironstone concretions most with fossils, worm trails, large, smooth *Baculites*, sp. indet., GSC loc. 70656 |
| 735-742 | Shale: grey, silty in part, smooth-textured, fissile, soft, with partings of light grey silt; worm tubes; rare fish scales; ironstone concretions with fossils; 1 foot band of fine grained, calcareous silt; large, smooth *Baculites*, sp. indet., GSC loc. 70658 |
| 742-748 | Shale: grey, slightly silty, soft, smooth-textured, fissile, with partings of light grey silt; worm tubes; scattered fish scales; ironstone concretions up to 4" diameter; coiled and uncoiled ammonites; small, thin-shelled pelecypods |
| 748-754 | Shale: grey, silty in part, smooth-textured, fissile, with silt partings; worm trails; ironstone concretions, fish scales; *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, large, smooth *Baculites*, sp. indet., GSC loc. 70648 |
| 754-759 | Shale: grey, slightly silty in part, massive soft, fissile, with silt partings; fish scales; worm burrows filled with light brown pyritic silt; ironstone concretions |
| 759-775 | Shale: grey, slightly silty in part, with partings of light grey-brown silt, massive, soft, fissile; scattered fish scales; worm burrows; numerous ironstone concretions; large, smooth *Baculites*, sp. indet., GSC loc. 70642 |
| 775-779 | Shale: grey, smooth-textured, fissile, with partings and paper-thin interbeds of light grey-brown silt; partings of fine grained, greenish sandstone; band of ironstone 3" thick; numerous ironstone concretions; worm trails; scattered fish scales; few uncoiled ammonites; pelecypods |

| Depth (feet) | Lithology |
|---|---|
| 779-784 | Shale: grey, smooth-textured, soft, fissile, with partings and thin lenses of light grey silt; ironstone concretions; scattered fish scales; worm trails; few uncoiled ammonites |
| 784-803 | Shale: grey, smooth-textured, fissile, soft, with partings of light grey silt; irregular lenses of light brown siltstone; scattered fish scales, (Sample missed 795-803') |
| 803-814 | Shale: grey, smooth-textured, soft, fissile, with partings of light grey silt, irregular lenses of light brown, silty ironstone; fragment of uncoiled ammonites |
| 814-825 | Shale: grey, smooth-textured, fissile, soft, with silt partings; worm tracks; irregular lenses of light brown, silty ironstone |
| 825-837 | Shale: grey, smooth-textured soft, fissile; with partings of light grey silt; worm trails; irregular ironstone concretion; large, smooth *Baculites*, sp. indet., GSC loc. 70646 |
| 837-848 | Shale: grey, smooth-textured, fissile, soft, with silt partings; worm trails; ironstone concretions |
| 848-851 | Shale: (Sample missed) |
| 851-857 | Shale: grey, smooth-textured, soft, fissile, with silt partings; worm trails; ironstone concretions; scattered fish scales |
| 857-872 | Shale: grey, smooth-textured, soft, fissile, with partings of light grey silt; worm trails; ironstone |
| 872-881 | Shale: grey, soft, smooth-textured, fissile, with partings and irregular lenses of light grey silt and glauconitic, fine grained sandstone; scattered fish scales; worm trails |
| 881-888 | Shale: grey, soft, smooth-textured, flaky, good fissility, with partings and irregular lenses of light grey silt and very fine grained glauconitic sandstone; scattered fish scales; worm trails; ironstone concretions speckled with white fibrous material |
| 888-892 | Shale: grey, smooth-textured, soft, flaky, good fissility, with partings and irregular, thin lenses of light grey silt and glauconitic sandstone; scattered fish scales; ironstone concretions |
| 892-897 | Shale: grey, smooth-textured, soft, flaky, with partings of light grey silt and irregular lenses of glauconitic, fine grained sandstones; worm trails; fish scales; ironstone |
| 897-907 | Shale: grey, mottled slightly by silty zones smooth-textured, flaky, soft, with partings of light grey and brown silt and lenses of glauconitic, fine grained sandstone; worm trails; ironstone concretions; slickensides |

| Depth (feet) | Lithology |
|---|---|
| 907-913 | Shale: grey mottled slightly by silty zones, soft, smooth-textured, flaky, with partings of light grey and brown silt and lenses of glauconitic sandstone |
| 913-921 | Shale: grey, silty partings as above; slickensides; steeply dipping; ironstone |
| 921-933 | Shale: grey, smooth-textured, flaky, soft, with partings of light brown silt and irregular lenses of glauconitic, fine grained sandstone; slickensides |
| 933-944 | Shale: grey, smooth-textured, soft, flaky, with partings of light yellow-brown, calcareous mud and lenses of fine grained, glauconitic or chloritic sandstone |
| 944-953 | Shale: grey, smooth-textured, soft, good fissility, with silt partings and lenses of fine grained sandstone |
| 953-960 | Shale: grey, smooth-textured, soft, flaky, with partings of light grey silt |
| 960-970 | Shale: grey, smooth-textured as above, with silt partings and partings of light yellow-brown calcareous mud |
| 970-982 | Shale: grey, smooth-textured, soft, good fissility, with silt partings and partings of light yellow-brown, calcareous mud and lenses of chloritic, very fine grained sandstone |
| 982-990 | Shale: grey, smooth-textured, soft, good fissility, with silt partings; lenses of chloritic sandstones and partings of light yellow-brown calcareous mud |
| 990-1004 | Shale: grey, smooth-textured, soft, good fissility, with silt partings and partings of light brown, calcareous mud; scattered, rare fish scales |
| 1004-1011 | Shale: grey, silty in part, soft, good fissility, with partings of light grey silt; partings of yellow-brown mud; lenses of glauconitic or chloritic, fine grained sandstone |
| 1011-1022 | Shale: grey mottled by light brown bands, slightly silty, soft, good fissility with partings of light brown silt and lenses of fine grained sandstone |
| 1022-1036 | Shale: grey, becoming silty, soft, good fissility, with silt lenses and parting; partings of light brown silt, lenses of fine grained, glauconitic or chloritic sandstone |
| 1036-1046 | Shale: grey, slightly silty, good fissility with interbeds of fine grained sandstone |

| Depth (feet) | Lithology |
|---|---|
| 1046-1057 | Shale: grey, slightly silty in part, with paper-thin interbeds of light brown silt and thin interbeds (½") of glauconitic or chloritic fine grained sandstone; smooth-textured; good fissility |
| 1057-1069 | Shale: grey, smooth-textured as above, with interbeds of light brown silt and chloritic or glauconitic sandstone |
| 1069-1092 | Shale: grey, smooth-textured, slightly silty in part, good fissility, with thin (½") interbeds of fine grained sandstone |
| 1092-1103 | Shale: grey smooth-textured, silty in part, with interbeds of fine grained sandstone, good fissility, soft |
| 1103-1112 | Shale: grey, slightly silty in part, with interbeds of light grey, fine grained sandstone (½-3/4"), good fissility, soft; rare fish scales |
| 1112-1130 | Shale: grey, soft, fissile as above with thin sandstone interbeds |
| 1130-1141 | Shale: grey, silty in part, fissile, soft, with interbeds of silt and fine grained sandstone; scattered fish scales |
| 1141-1156 | Shale: grey, smooth-textured, soft, slightly silty in part, good fissility; worm trails; scattered pyrite; becoming irregularly bentonitic at base of interval |
| 1156-1170 | Shale: grey, waxy, soft, good fissility, silty in part; worm trails; scattered pyrite; rare fish scales; irregularly bentonitic |
| 1170-1179 | Shale: grey, smooth-textured, slightly silty in part, soft, scattered pyrite; worm trails; 6" band of bentonite at 1175' and 2-4" band of bentonitic clay at 1179' - aragonite associated with 1st bentonite; fragments of uncoiled ammonites |
| 1179-1188 | Shale: grey, smooth-textured, good fissility, soft, with silt partings; worm trails, abundant pyrite; ironstone concretions; hard, calcareous (sideritic ?) band; few ammonites |
| 1188-1200 | Shale: grey, smooth-textured, good fissility, soft; worm trails; abundant pyrite |
| 1200-1215 | Shale: grey, smooth-textured, good fissility, soft; pyrite; fish remains |
| 1215-1218 | Shale: grey, smooth-textured, good fissility; chonchoidal fracturing. |

| Depth (feet) | Lithology |
|---|---|
| | **Boyne Formation** |
| 1218-1228 | Shale: grey-brown, calcareous, with bands of white specks; pyrite; abundant fish remains |
| 1228-1243 | Shale: grey, with brown cast, calcareous, white speckled, hard, good fissility; scattered pyrite; fish remains; *Inoceramus* band; ½" band of light grey bentonite |
| 1243-1249 | Shale: grey-brown, white speckled, calcareous, hard, good fissility; pyrite; scattered fish remains; *Inoceramus* band, ½" bentonite band |
| 1249-1262 | Shale: grey-brown, white speckled, calcareous, hard, good fissility; fish remains; specks of brown organic matter; scattered pyrite; bands of light blue-grey bentonite (½-1"); ½" bands of "coquina-like" fossiliferous shale |
| 1262-1279 | Shale: grey-brown, white speckled, calcareous, hard, good fissility; fish scales; bands of light blue-grey bentonite (½"); band of "coquina-like" fossiliferous shale |
| 1279-1290 | Shale: grey-brown, white speckled, calcareous, hard, good fissility; fish remains; pyrite; bands of fossiliferous shale; *Inoceramus* |
| 1290-1300 | Shale: grey-brown, white speckled, calcareous; layer of non-calcareous shale speckled with blebs of pale grey bentonite, lenses of biotitic "winn-web" bentonite; *Baculites asper* Morton, *Scaphites (Lioscaphites)* cf. *montanensis* Cobban or *S. (C.) depressus* Reeside, *Inoceramus lesginensis* Dobzov, *Ostrea* sp. indet., *Pteria* sp. indet., GSC loc. 70726 |
| 1300-1314 | Conglomerate: chert pebbles, brown to black, elongate, smooth, up to 2.5 cm long, in calcareous matrix; calcareous, rounded pebbles of soft sandy siltstone having annular weathered appearance; silicified bone fragments up to 1 cm long, abundant. |
| | **Favel Formation** |
| 1314-1322 | Shale: grey-brown, white speckled, very hard, calcareous |
| 1322-1329 | Shale: grey-brown, calcareous, white speckled, many bands of pale grey bentonite associated with matted, fish bone fragments. |
| | **Lower Colorado (Ashville) Group** |
| | **Belle Fourche equivalent** |
| 1329-1335 | Shale: medium grey, blocky, noncalcareous; lenses of brown, elongate chert pebbles and abundant, silicified, fishbone fragments; small lense (10 mm white) of white silt |

| Depth (feet) | Lithology |
|---|---|
| 1335-1348 | Shale: medium to dark grey, smooth-textured, soft, good fissility, with partings of light grey to white siltstone or very fine grained sandstone; rare fish scales; scattered pyrite |
| 1348-1354 | Shale: medium to dark grey, smooth-textured, soft, good fissility, with partings of light grey to white siltstone or very fine grained sandstone; pyrite streak after plants or worms; rare fish scales |
| 1354-1359 | Shale: medium to dark grey, smooth-textured, soft, good fissility; with partings of light grey to white silt; slickensides; pyrite streaks; scattered fish scales; worm trails |
| 1359-1369 | Shale: medium to dark grey, smooth-textured, soft, flaky, with partings of light grey silt; scattered pyrite; slickensides steeply dipping |
| 1369-1382 | Shale: medium to dark grey, smooth-textured, soft, fissile; pyrite patches and streaks; numerous slickensides; steeply dipping; calcite veinlets; rare, scattered fish scales |
| 1382-1398 | Shale: medium to dark grey, smooth-textured, soft, fissile; micaceous; 4" band of medium to coarse grained, micaceous sandstone; worm trails filled with light grey to white silt |
| 1398-1414 | Shale: medium to dark grey, smooth-textured, soft, fissile; with partings of light grey silt; worm trails; scattered pyrite; micaceous |
| 1414-1425 | Shale: medium to dark grey, slightly silty, soft, fissile; micaceous with small, irregular lenses of light grey silt; worm trails filled with light grey silt; calcite veinlets; rare fish scales; scattered pyrite |
| 1425-1431 | Shale: medium to dark grey, slightly silty, micaceous, fissile, with partings of light grey silt; pyrite; scattered fish scales |
| 1431-1442 | Shale: "Fish Scales" equivalent and sandstone; medium to dark grey shale, silty to sandy in part, with bands of hard dark grey, medium to coarse grained sandstone; good fissility; numerous fish remains; calcite veinlets; ironstones, pyrite. |
| | Mowri Equivalent |
| 1442-1451 | Shale: medium to dark grey, smooth-textured, soft, good fissility, with partings of light grey silt; worm trails filled with light grey silt; calcite veinlets |
| 1451-1460 | Shale: medium to dark grey, smooth-textured, good fissility; worm tubes filled with white silt; scattered fish remains; slickensides |

| Depth (feet) | Lithology |
|---|---|
| 1460-1478 | Shale: medium to dark grey, smooth-textured, soft, good fissility; worm trails filled with white silt; scattered fish remains; band of bentonite 4-6" thick; grades into very shaly sandstone in bottom half of interval (approximately 3') grading back into shale as above |
| 1478-1490 | Shale: medium to dark grey, smooth-textured, soft, good fissility, with partings and interbeds (up to 3") of light grey siltstone; scattered fish scales; rare pyrite; worm trails |
| 1490-1499 | Shale: medium to dark grey, smooth-textured; soft, good fissility, with partings of light grey silt; scattered fish remains, worm trails; pyrite specks; ironstone concretions |
| 1499-1510 | Shale: medium to dark grey, smooth-textured, soft, good fissility, with partings of light grey silt; worm trails; rare, scattered fish remains; rare pyrite |
| 1510-1516 | Shale: medium to dark grey, smooth-textured, slightly silty in part, soft, good fissility; worm trails; scattered pyrite |
| 1516-1524 | Shale, medium to dark grey, smooth-textured, good fissility, becoming mottled by numerous small irregular bodies of light grey to white silt in lower part; 1' band of hard, calcareous, concretionary shale, abundant pyrite specks; rare fish scales; slickensides |
| 1524-1529 | Shale: medium to dark grey, smooth-textured, good fissility, with irregular, small, silt bodies; abundant pyrite; band of hard, dense, grey limestone (6"-1') |
| 1529-1537 | Shale: medium to dark grey, as above with partings of light grey silt |
| 1537-1545 | Shale: medium to dark grey, smooth-textured, soft fissility, with partings and irregular, thin lenses of light grey silt, ironstone concretions; 6" band of light grey, dense, very fine grained limestone. |
| | Viking Formation |
| 1545-1556 | Siltstone: light grey-brown, very fine grained sandstone, shaly, glauconitic in part; fine current bedding, 6" conglomerate band at base with many elongated pebbles of black chert. |
| | Joli Fou Formation |
| 1556-1569 | Shale; grey, smooth-textured, fissile, soft, with rare silt partings, worm trails |

| Depth (feet) | Lithology |
|---|---|
| 1569-1582 | Shale: grey, smooth-textured, fissile, soft, rare fish scales, worm trails |
| 1582-1590 | Shale: grey, smooth-textured, soft, fissile, silty in part; worm trails; lenses of light grey silt |
| 1590-1598 | Shale: grey, smooth-textured, slightly silty in part, fissile, with partings of light grey siltstone; irregular lenses of fine grained sandstone |
| 1598-1609 | Shale: grey, smooth-textured, soft, fissile; irregular, bentonitic ?; with lenses of light grey silt; worm trails |
| 1609-1619 | Shale: grey, smooth-textured, soft, fissile, with irregular lenses of silt and fine grained, glauconitic sandstone |
| 1619-1629 | Shale: grey, smooth-textured, soft, fissile, with indefinite, silty lenses; slickensides; worm trails |
| 1629-1638 | Shale: grey, smooth-textured, soft, fissile, with indefinite silt lenses; hard, ferruginous zone (concretionary ?) gypsum veinlets; worm trails; slickensides |
| 1638-1647 | Shale: grey, smooth-textured, soft, fissile, indefinite silty zones; irregular, thin, ferruginous band (¼"); zone of highly glauconitic shale; possible *Inoceramus* remains; slickensides |
| 1647-1655 | Shale: medium to dark grey, soft, fissile; scattered, pyrite worm trails; slickensides. |
| | Mannville Group |
| | Pense Formation |
| 1655-1658 | Siltstone or very fine grained sandstone: light grey banded, with numerous interbeds of grey shale, hard pyritic; indistinct current bedding |
| 1658-1661 | Sandstone: fine to medium grained, light grey, massive, poorly indurated, friable, pyritic, with interbeds of grey, silty shale; sand grains angular to subrounded, well sorted; approximately 10% impurities |
| 1661-1666 | Sandstone: light grey, massive, fine to medium grained, poorly indurated, friable, pyritic; with shale bands; coal (lignite) seams 2-5" thick from 1664-1665' |
| 1666-1671 | Sandstone: light grey, fine to medium grained, massive, poorly indurated, friable, pyritic, with shale interbeds; bands of hard, calcareous sandstone; fragments of carbonized wood |

| Depth (feet) | Lithology |
|---|---|
| 1671-1679 | Sandstone: light grey-brown, fine to medium grained, indistinctly banded, poorly indurated, friable, highly pyritic in part, with numerous, thin, shale interbeds |
| 1679-1685 | Sandstone: light grey-brown, very shaly in part, fine to medium grained, poorly indurated, pyritic, bands of hard, calcareous sandstone, numerous shale interbeds; current bedding |
| 1685-1691 | Shale: grey, smooth-textured, hard, mostly fissile, with thin, lenticular, silt zones; pyrite, slickensides |
| 1691-2486 | No observations: samples of shaft material available 1691-1802'; no samples 1802-2486' |

NOTE: Interval from 2486-3086 logged from samples taken from excavated material once per shift by R.W. Klaubert.

| Depth (feet) | Lithology |
|---|---|
| 2486-2489 | Limestone: dolomitic, grey to grey-brown, finely crystalline to cryptocrystalline; calcite inclusions |
| 2489-2511 | Limestone: as above, except grey to light brown or buff |
| 2511-2522 | Limestone: grey to brown or buff, shaly, finely crystalline to cryptocrystalline, finely (up to 1 mm) bedded in part; calcite inclusions |
| 2522-2528 | Limestone: argillaceous, grey, finely crystalline; narrow bands of calcite-replaced brachiopods, atrypid and other indet. fragments; GSC loc. C-3781. |
| | Saskatoon Member |
| 2528-2533 | Limestone: buff, fossiliferous, pyritic; stromatoporoids, *Atrypa* sp. ex. gr. *"A" Albertensis* Warren, GSC loc. C-3782 |
| 2533-2544 | Limestone: buff to grey, fossiliferous; calcite inclusions; *Mucrospirifer* sp. indet., ostracods, not studied, GSC loc. C-3783 |
| 2544-2550 | Not sampled |
| 2550-2555 | Anhydrite: brown, translucent, cryptocrystalline; interbedded with thin beds of buff to brown, crystalline limestone and grey dolomite |
| 2555-2561 | Anhydrite: brown to grey, cryptocrystalline, finely banded |
| 2561-2567 | Limestone: buff to tan, cryptocrystalline; calcite crystals; stromatoporoids; crinoid ossicles, age undetermined, GSC loc. C-3784 |
| | Contact at 2563' |
| | Anhydrite: tan, fine grained |
| 2567-2580 | Limestone: buff, fine grained; anhydrite blebs and bands in upper part, shaly bands in lower part |

| Depth (feet) | Lithology |
|---|---|
| 1727.5-1729.5 | Clay: silty, grey-brown; ferruginous lenses and nodules 1" diameter; ferruginous band 1" thick; silty interbeds near top of core with some siderite cement; 2 slickensides, dipping 75° |
| 1729.5-1732 | Sandstone: sideritic, grey-brown, hard, very fine grained, interfingering with brown-grey clay as above; specks of carbon |
| 1732-1734.5 | Clay: silty, intergrading with clayey-banded, very fine grained sandstone, (wavy current bedding); plant fragments; becomes more sandy in base of interval; slickensides |
| 1734.5-1736.4 | Clay: brown-grey, silty, massive; slickensides |
| 1736.4-1737 | Sandstone: pale grey-brown with fine current bedding |
| 1737-1738 | Clay: light brown-grey, silty, massive with some silt laminae; irregular dip up to 10° |
| 1738-1738.4 | Siltstone: clayey, laminated (current bedding); worm burrows in clay interbeds |
| 1738.4-1739 | Clay: grey-brown, smooth-textured; ferruginous nodules up to 1" diameter; slickensides |
| 1739-1740 | (?) No recovery |
| 1740-1751 | Clay: light brown-grey, slightly silty, lenses and scattered thin interbeds of light grey silt; abundant plant fragments; carbonized wood in 3" interbed of very fine grained, clayey-banded sandstone 1'6" from top of core; worm burrows; numerous slickensides, dipping 45°; becomes less silty in lower half of core |
| 1751-1753.3 | Clay: light brown-grey, slightly silty; abundant plant fragments; indefinite ferruginous nodules; lenses and laminae of silt in top 8" of core; curved slickensides; average dip about 60° |
| 1753.3-1761 | Clay as above: zones of thin silty interbeds largely flat-lying, but dipping about 60°, one foot from base of core; siderite cement in silt at top of interval; slickensides |
| 1761-1764 | Clay: brown-grey, slightly silty, massive; specks of carbon; slickensides |
| 1764-1765 | Clay: grey-brown, silty, with pebble-like ironstone nodules |
| 1765-1765.2 | Sandstone: fine grained, quartzose, largely cemented with pyrite, forming lens-like, pyritic body |
| 1765.2-1765.4 | Clay: as above, but silty-banded |

| Depth (feet) | Lithology |
|---|---|
| 1765.4-1765.7 | Sandstone: sideritic, yellow-brown, medium grained, slightly porous |
| 1765.7-1765.9 | Clay: grey-brown, interlaminated with silt and very fine grained sand, slightly porous with white clay, both interstitial and granular |
| 1765.9-1766.3 | Sandstone: ferruginous, as in 1'4"-1'7" |
| 1766.3-1766.4 | Clay and sand: interlaminated as in 1'7"-1'11" |
| 1766.4-1767.5 | Sandstone: quartzose, fine to medium grained, porous, grains angular with secondary crystal growth; abundant, pale brown, ferruginous (?), clay grains; zones with scattered dark grains of chert; rare carbon; current banding appears in zoning of clay grains and carbon specks |
| 1767.5-1774 | Sandstone: clayey, white; speckled with carbon; siderite grains; dark chert; rare, green, chloritic (?) grains (glauconite ?); much of clay appears to consist of altered grains of harder minerals; carbonaceous partings; zone of partings 6" thick 1'2" from base of core |
| 1774-1777 | (?) No recovery |
| 1777-1785 | Sandstone: clayey as above, (modified lithic sandstone ?); fine to medium grained, may be slightly glauconitic; zones of abundant siderite "spherules"; small, ironstone nodule, ½" diameter |
| 1788-1794 | Sandstone: lithic or greywacke as above |
| 1794-1795 | Clay: medium light grey, silty banded in part; massive conchoidal fracture; abundant carbon specks |
| 1795-1796.7 | Sandstone: lithic, or greywacke as above |
| 1796.7-1797.6 | Clay: slightly carbonaceous |
| 1797.6-1797.7 | Lignite |
| 1797.7-1798.2 | Clay: silty, grading downward to siltstone |
| 1798.2-1799.5 | Siltstone: clayey or shaly banded in part, grading to very fine grained sandstone; worm burrows |
| 1799.5-1801 | Siltstone or very fine grained sandstone: finely porous; abundant grains of clay; siderite; specks of carbon; rare glauconite (?) |
| 1801-1802.2 | Sandstone: very fine grained, porous as above |

| Depth (feet) | Lithology |
|---|---|
| 1802.2-1804.5 | Shale: dark to medium grey, with irregular laminae of light grey silt and abundant worm burrows |
| 1804.5-1807.7 | Siltstone or very fine grained sandstone: pale grey with brown cast, porous; minute specks of carbon; carbonaceous laminae at top of interval |
| 1807.7-1809 | Siltstone: clayey, becoming shaley with dark grey laminae in lower half of interval |
| 1809-1810.6 | Shale: dark grey, flaky, interlaminated with light grey silt; zones with varve-like beds |
| 1810.6-1812 | Clay; light grey-brown, massive; specks of carbon, slickensides |
| 1812-1820.5 | Clay: brown-grey, massive, much-slickensided; specks of carbon |
| 1820.5-1825 | Siltstone: sideritic in part, pale grey with brown cast, slightly porous with porosity increasing towards base |
| 1835-1848 | (Core #68, recovered 8'3") |
| 1825-1826.2 | Siltstone: pale brown-grey with wavy shale laminae |
| 1826.2-1827 | Shale: dark grey, carbonaceous, or carbonaceous clay; carbonized wood fragment 4" long |
| 1827-1832.9 | Siltstone or very fine grained sandstone: brownish white, moderately indurated, porous, becoming less indurated and more porous downward; carbonized vegetable matter at base |
| 1832.9-1833.2 | Clay: coaly |
| 1833.2-1838 | (?) No recovery |
| 1838-1839 | Siltstone: shaly, light to pale grey, with irregular shaly current laminae |
| 1839-1839.3 | Clay: dark grey, coaly in part |
| 1839.3-1841.5 | Siltstone: brown-white, with faint grey argillaceous banding, poorly indurated, porous; coarse, approaching very fine sandsize |
| 1841.5-1842 | Siltstone: argillaceous, slightly indurated, porous, light to dark grey with dark cement banding, containing abundant, finely divided carbon |
| 1842-1846 | Siltstone: poorly indurated as in 1'4"-3'6" above; argillaceous laminae are flay-lying or slightly undulating |

| Depth (feet) | Lithology |
|---|---|
| 1846-1846.5 | Mudstone or (blocky shale ?): possibly contamination from Upper Cretaceous |
| 1846.5-1848.8 | Sandstone: pale grey, very fine grained, poorly indurated, with indulating dark grey bands and laminae of shale |
| 1848.8-1853 | Shale: silty, medium light grey, ferruginous and hard in part, with abundant silt-filled worm burrows; zones of discontinuous laminae, pale grey silt; becomes more silty in basal 2" of core |
| 1853-1855 | (?) No recovery |
| 1855-1858.7 | Sandstone: very fine grained, argillaceous, brownish-white, with indefinite pale grey banding, containing specks of carbon and argillaceous material, porous and friable, poorly sorted with grains and lenses of fine sand size; grains of white clay; abundant mica |
| 1838.7-1863.3 | Siltstone: pale grey, with undulating laminae of dark shale, crossbedding, grading downward to shale with interlaminated sandstone; rare inclusions of carbonized wood |
| 1863.3-1864 | Siltstone: pale brown to grey, slightly ferruginous, hard, with light grey argillaceous banding and worm burrows |
| 1864-1868.5 | Siltstone: shaly-laminated, crossbedded, pale and dark grey; shale becoming more prominent downward |
| 1868.5-1875 | Siltstone: pale grey with indefinite undulating argillaceous laminae marked by carbon specks, highly porous, slightly indurated to friable, with abundant grains of siderite; zones of crossbedding and worm burrows; becomes more shaly towards base |
| 1875-1876 | Siltstone: pale grey, porous, friable, with faint argillaceous laminae and undulating stream bedding |
| 1876-1878 | Sandstone: brownish white, very fine grained, slightly sideritic, firm to hard, porous |
| 1878-1884.5 | Siltstone or very fine grained sandstone: brownish white, friable or slightly indurated, porous, slightly argillaceous, faintly laminated, thickly speckled with grains of white clay, micaceous; zones of comminuted carbonized plants, inclusion of pyrite ¼" long; 1'4" band of dark shale laminae 6" from base of interval |
| 1884.5-1887.7 | Shale: silty, carbonaceous, dark grey, interlaminated with pale grey silt, abundant crossbedding and cut-and-fill structures; 3/4" lense at base of carbonaceous dark grey flaky shale; worm burrows |

| Depth (feet) | Lithology |
|---|---|
| 1887.7-1888 | Siltstone or very fine grained sandstone: friable, porous, faintly banded, with zones of carbon specks |
| 1888-1899.8 | Sandstone: very fine grained, brownish white, friable, porous, faintly laminated with zones of carbonaceous specks |
| 1899.8-1900 | Shale: dark grey, carbonaceous, flaky, interlaminated with pale grey silt |
| 1900-1900.5 | Largely drilling mud: fragments of ironstone, brown-grey, silty-argillaceous, and of medium light grey shale with specks of carbon; contamination from Upper Cretaceous |
| 1900.5-1902 | Siltstone: argillaceous, pale to light grey, slightly ferruginous, indurated in part, porous |
| 1902-1905 | Siltstone: pale grey, interbedded and interlaminated with medium grey silty shale; ferruginous and indurated in part, largely porous |
| 1905-1907 | (?) No recovery |
| 1907-1907.5 | Drilling mud |
| 1907.5-1908.3 | Shale: medium grey and pale grey silt, interlaminated, crossbedded; worm burrows |
| 1908.3-1909.3 | Siltstone: pale brownish grey, argillaceous, laminated, porous, poorly indurated |
| 1909.3-1910 | (?) No recovery |
| 1910-1912 | Siltstone: pale grey, with light grey, argillaceous laminations, crossbedded, poorly indurated, porous |
| 1912-1913 | Shale: medium grey, interlaminated with light grey silt, lens with green cast ½" thick at centre of interval (ferruginous ?) |
| 1913-1915.3 | Siltstone: pale grey, shaly, laminated, intergrading with silty, laminated shale, massive argillaceous zone 4" thick, speckled with finely divided carbon 6" from top of interval |
| 1915.3-1920 | Shale: silty-laminated, medium to pale grey; crossbedding; worm burrows; becomes more massive with less definite bedding towards base |
| 1920-1922.5 | Clay: coaly and coal, brownish black to black, 4" band of carbonaceous light brown clay 1½" from top of interval |

| Depth (feet) | Lithology |
|---|---|
| 1922.5-1923 | (?) No recovery |
| 1923-1928 | Coal and carbonaceous clay: black to brown-black; coal comprises about 50% of recovery |
| 1928-1928.7 | Clay: very silty or finely sandy, light brown, massive, hard; specks of carbonized vegetable matter |
| 1928-1931 | (?) No recovery |
| 1931-1933 | Clay: finely sandy as above grading to clayey sandstone at base; inclusions of carbonized vegetable matter |
| 1933-1937.2 | Sandstone: clayey or very sandy clay, pale brown, firm, with faint irregular banding, non-porous |
| 1937.2-1940 | Clay: very sandy, grading almost to clayey sandstone, very fine grained, largely ferruginous and hard, finely mottled in part with current bedding |
| 1940-1941 | Sandstone: very clayey, pale brown, slightly porous, non-sideritic |
| 1941-1942 | (?) No recovery |
| 1942-1954 | Sandstone: clayey, pale brown, fine grained, porous, interstices in part incompletely filled with pale brown clay; amount of interstitial clay decreasing downward |
| 1954-1957.3 | Siltstone: clayey-banded, light to pale brown, grading downward to silty clay; thin band of pyrite specks in clay partly oxidized |
| 1957.3-1960.5 | Clay: grey-brown, dark to pale, silty in part grading at top and base to laminated siltstone; silt laminae dipping up to 25° in upper half of interval |
| 1960.5-1964 | Sandstone: clayey in part, more or less porous in part, brownish white, micaceous, quartzose<br><br>Note: "quartzose" refers here to composition of sand grains and excludes matrix material |
| 1964-1965 | Clay: medium light green grey, conchoidal fracturing, with irregular inclusions of chalcedonic chert with adhering silt or tripolitic chert containing oxidized siderite (?) spherule and pyrite; bright green earthy clay (or glauconite ?); bright green lenses in surrounding clay |
| 1965-1965.5 | Sandstone: clayey, coarse grained, with quartz and abundant grey chert and chalcedony (?) including dark grey, hollow, agate-like grains with concentric structure; possible siderite spherules; possible siliceous cement |

| Depth (feet) | Lithology |
|---|---|
| 1965.5-1967 | (?) No recovery |
| 1967-1968 | Sandstone: coarse grained with interstitial, powdery white clay; grains comprised largely of white to grey chalcedony; fragments of vuggy chalcedony up to 4" in diameter |
| 1968-1970.5 | Clay: grey-green to pale grey, finely sandy in part, waxy in part; abundant spherules of grey chalcedony; 2" band of sandy white clay at centre of interval with partly oxidized spherules of siderite; sideritic aggregates and scattered clear to grey chalcedony |
| 1970.5-1970.9 | Ironstone: microcrystalline, brown, with interstitial or intercrystalline grey clay |
| 1970.9-1971.5 | Clay: light grey with green to brown cast, conchoidal fracturing; discontinuous pyritic partings at base; non-dolomitic |
| 1971.5-1972.2 | Clay: brownish green-grey; finely laminated in part, slightly dolomitic; slickensides |
| | Jurassic |
| | (Post Watrous) |
| 1972.2-1975 | Dolomite: pale brown, chalky-compact, with interbeds of light brown grey, dolomitic mudstone, gradational contacts; dolomite is vuggy with irregular, vein-like inclusions of pyrite |
| 1975-1976 | Dolomite: pale tan, chalky-compact; irregular sandy laminae, medium to coarse grained; grading downward in basal 3" to dolomitic mudstone |
| 1976-1976.2 | Dolomite: argillaceous, light greyish tan; minute veinlets of secondary dolomite and (?) siderite; slightly brecciated, grades downward to dolomitic mudstone as above |
| 1976.2-1979.7 | Mudstone or blocky shale: dolomitic, medium grey with brown cast; lens of calcite crystals 1'6" from base of interval; tan inclusions in basal 8" giving finely mottled appearance |
| 1979.7-1980.5 | Dolomite: argillaceous, pale grey and tan, finely mottled with discontinuous lenses and irregular laminae; grades downward to mottled mudstone as above; inclusions and veinlets of coarsely crystalline brown calcite |

| Depth (feet) | Lithology |
|---|---|
| 1980.5-1985.4 | Mudstone: dolomitic, medium grey with brown cast, tan speckled in top 2"; inclusions and lenses of coarsely crystalline brown calcite, vertically to horizontally oriented with appearance of fracture fillings up to 1" thick; lenses of similar appearance 1" thick near base of interval with augen-like drape effect in surrounding mudstone |
| 1985.4-1986 | Limestone: silty to finely sandy, grey, coarsely crystalline |
| 1986-1988.5 | Limestone: silty, brownish grey as above; irregular, brown, shaly partings |
| 1988.5-1989.5 | Shale: dolomitic, medium light grey, smooth textured, flaky; scattered pyrite crystals. |
| | Watrous Formation |
| 1989.5-1990.2 | Dolomite: argillaceous, or "dolomitic marl", pale pinkish to greenish brown |
| 1990.2-1992.5 | Mudstone: dolomitic, light brownish red, massive, calcite veinlets 1/16" wide |
| 1992.5-1995 | Mudstone: dolomitic, pale grey with green cast, calcite veinlets as above |
| 1995-1996 | Mudstone: dolomitic, brown-red; calcite veinlets as above |
| 1996-1996.4 | Mudstone: dolomitic, silty, brown-red |
| 1996.4-1997.5 | Core missing (sample BBT 10) |
| 1997.5-1992.2 | Mudstone: dolomitic, silty, brown-red; veinlets and small lenses of clear gypsum, up to 1/8" wide, with random orientation |
| 1999.2-2004.7 | Mudstone: dolomitic, silty, brown-red, with 3 gradational light grey intervals up to 1' thick; gypsum as above in top 2' of interval |
| 2004.7-2005.7 | Core missing (sample BBT 9) |
| 2005.7-2006 | Mudstone: dolomitic, light grey |
| 2006-2016 | Mudstone: dolomitic, silty, light grey with indefinite reddish zones; irregular inclusions of gypsum, 5" long, 2½' from top of core (vug fillings); veinlets of gypsum |
| 2016-2026 | Mudstone: dolomitic, as in core above; silty in part; gypsum veinlets |

| Depth (feet) | Lithology |
|---|---|
| 2026-2036 | Mudstone: dolomitic, silty, light brown-grey, with indefinite red mottling, massive; grades to argillaceous silty dolomite in basal 1½" of core |
| 2036-2036.8 | Core missing |
| 2036.8-2042.8 | Mudstone: dolomitic, silty, light grey-brown, red mottled |
| 2042.8-2044.2 | Core missing (sample BBT 2) |
| 2044.2-2046 | Mudstone: dolomitic, silty, as above; discontinuous slickensides at top of interval |
| 2046-2054.5 | Mudstone: dolomitic, silty, red and grey mottled; zones of microbreccia with interstitial gypsum; zone of intraformational conglomerate or penecontemporaneous mud-slump 6' from top of core; discontinuous slickensides 8' from top of core; irregular interbeds of silt (stream bedding) in basal 1½' of interval |
| 2054.5-2056 | Siltstone: or very fine grained sandstone, dolomitic, argillaceous, pink, massive |
| 2056-2058 | Gap in core |
| 2058-2070 | Siltstone: dolomitic, pink, massive, as above; indefinite, highly argillaceous, red-mottled beds in basal 3' of core, dipping 20°; basal 6" of core more finely mottled |
| 2070-2080 | Siltstone: dolomitic, argillaceous, pink, with green-grey mottling and banding in top 3' due to argillaceous lenses; irregular "wavy" fine stream bedding |
| 2080-2082 | Siltstone: dolomitic, with irregular shaly interbeds and partings dipping up to 45°; pink, bands with greenish cast |
| 2082-2092 | Siltstone: dolomitic, argillaceous, pink, massive; colour deepens in basal 1½'; faint irregular banding |
| 2092-2099.5 | Siltstone: dolomitic, argillaceous, red-brown, massive |
| 2099.5-2104 | Siltstone: dolomitic, argillaceous, more argillaceous bands with green cast |
| 2104-2113 | Siltstone: dolomitic, argillaceous, coarse, grading to very fine grained sandstone; zone of scattered quartz grains, pitted or frosted, medium sand size (0.3 mm) |
| 2113-2114 | Shale: dolomitic, or shaly dolomite, pale grey; rare carbonaceous traces less than 1 mm long after fossils (?). |

| Depth (feet) | Lithology |
|---|---|
| | DEVONIAN |
| | Duperow Formation |
| 2114-2116 | Dolomite: silty, pale grey, massive, with abundant calcareous, finely striated brachiopods |
| 2116-2123 | Limestone: pale brown to grey, wavy banded, shaly in part; consists of cryptocrystalline, sub-lithographic limestone in irregular lenses between irregular bands of argillaceous or shaly, silty, and slightly dolomitic limestone; becomes more shaly downward; brachiopods; crinoid ossicles |
| 2123-2124 | Limestone: argillaceous, dolomitic, pale brown-grey, massive; gradational with shaly limestone, above; finely striated brachiopods |
| 2124-2128 | Dolomite: argillaceous in part, pale grey-brown, with brachiopods and crinoid fragments as above; intergrades near top of core with unfossiliferous, pale grey, dolomitic mudstone |
| 2128-2129 | Limestone: dolomitic, tan, chalky-compact (tight), with abundant small fragments of crinoids, brachiopods and (?) ostracods; finely striated brachiopods at base |
| 2129-2132 | Limestone: shaly banded; irregular lenses of tan, microcrystalline silty limestone with small fragments of crinoids, brachiopods; wavy banding of green-grey shale, less pronounced |
| 2132-2135 | Limestone: dolomitic, tan, chalky-compact; fossil fragments, finely striated brachiopods |
| 2135-2138 | Limestone: argillaceous, brown-grey wavy-banded; irregular lenses of less calcareous "marl" in wavy matrix of less calcareous "marl"; poorly differentiated in comparison to 5-8' above; zone with minute fossil fragments center of interval |
| 2138-2138.1 | Pyrite band: irregular, 15 mm thick |
| 2138.1-2142.4 | Limestone: argillaceous, wavy-banded, as above; a few well-differentiated lenses of aphanitic limestone with fossil fragments as above |
| 2142.4-2142.5 | Limestone: crinoidal, pyritic, grey to brown, coarsely crystalline in part |
| 2142.5-2149.5 | Dolomite: calcareous, argillaceous, pale grey-brown, chalky-compact (tight); finely striated brachiopods at top of interval |

| Depth (feet) | Lithology |
|---|---|
| 2149.5-2152 | Limestone: silty, slightly argillaceous, chalky-compact, with crystalline shell fragments (crinoids), brachiopods; dolomitic at top, gradational (?) with interval above; fossils at top appear to be pyritized |
| 2152-2157 | Limestone: muddy; irregular lenses of tan, chalky-compact to sublithographic limestone with sparry shell fragments in light grey calcareous mudstone |
| 2157-2173.5 | Mudstone: dolomite and (?) slightly calcareous, light brown-grey, massive; two slickensided fractures 5" apart, dipping 80°; fracture dipping 60° in opposite direction in upper 6' of interval; near-vertical fracture above basal 1/3 of interval |
| 2173.5-2176.5 | Limestone: tan, microcrystalline to chalky-compact, finely silty; fossil fragments |
| 2176.5-2180.5 | Mudstone: calcareous, light grey with green cast, with irregular lenses of tan sublithographic limestone; abundant brachiopods and bryozoans (?), unrecognized, resembling minute tabulate corals on surface |
| 2180.5-2182 | Limestone: dark tan, nearly lithographic, very hard and brittle |
| 2182-2187 | Dolomite: pale brown-grey, chalky-compact, microrhombic with irregular bands and interbeds; vug to 1' thick of dolomitic mudstone; thin lense or inclusion of sparry (microcrystalline-compact) tan limestone near base of interval |
| 2187-2187.5 | Dolomite: pale brown-grey, argillaceous, chalky-compact |
| 2187.5-2189.5 | Mudstone: dolomitic, light grey with indefinite contacts |
| 2189.5-2191 | Dolomite: pale brown, chalky, porous |
| 2191-2192 | Mudstone: dolomitic, pale grey |
| 2192-2199.5 | Dolomite: chalky, porous, becoming argillaceous, tight in basal 1½' of interval |
| 2199.5-2202 | Mudstone: dolomitic, light grey with green cast, interbedding, or intergrading with argillaceous dolomite in centre of interval |
| 2202-2203.5 | Mudstone: dolomitic, light greenish grey, with wavy more or less dolomitic banding; disseminated pyrite |
| 2203.5-2212 | Limestone: tan, nearly lithographic, with numerous veinlets of clear calcite, very hard and brittle, pyrite crystals; scattered large inclusions of grey dolomite mudstone, highly silty, apparently forming the matrix in small irregular zones of brecciated limestone |

| Depth (feet) | Lithology |
|---|---|
| 2212-2223 | Breccia: matrix of light grey dolomitic mudstone containing more or less abundant fragments of brittle limestone as above: 1 foot zone of unbrecciated limestone; fragments range from fraction of a mm to larger than core diameter |
| 2223-2230.5 | Limestone and breccia: limestone, pale brown, nearly lithographic, hard, brittle, as above, with zones of faint, wavy, brown, bituminous banding; largely brecciated, with matrix of darker brown, slightly silty, slightly bituminous limestone of similar texture; zones of breccia with grey dolomite mudstone matrix as in breccia above; veinlets of clear calcite in limestone; part of calcareous matrix is dark brown, and banded, dipping about 40°; several very rough, slickensided partings dipping 40° |
| 2230.5-2235.5 | Breccia: limestone, pale brown, nearly lithographic, in fragments mostly smaller than above; matrix of dark brown bituminous limestone, or calcareous mudstone; zones with fragments (?) up to 1 mm diameter of white chalky chert; stylolitic partings; slickensides dipping 40° near top of interval with rough appearance (partly stylolitic?) |
| 2235.5-2238 | Limestone: dolomitic, grading to calcareous dolomite, light brown to tan, slightly bituminous with regular, dark brown banding or laminations |
| 2238-2245 | Limestone: tan cryptocrystalline, chalky-compact, biostromal to scattered fossils, mostly with a little wavy brown banding; 1½' zone near top of interval with regular brown laminae or partings and abundant minute pelecypods; interval becomes slightly dolomitic, and contains calcite veinlets near base |
| 2245-2246.7 | Shale: dolomitic, medium grey, hard; slickensides |
| 2246.7-2251 | Limestone: medium to light brown, medium to coarsely crystalline, with high vuggy porosity; brown, bituminous staining in part; zone of undulating laminated porosity resembling altered stromatoporoid, but coarser; brecciated and less porous near base |
| 2251-2252 | Limestone: light grey-brown, finely crystalline-compact, brecciated in part, with fragments of cryptocrystalline to chalky tan, altered biostromal limestone; in brown bituminous matrix; possibly some large cavities |
| 2252-2254 | Limestone: as above, brecciated in part with bituminous, argillaceous matrix |
| 2254-2258 | Limestone: tan, nearly lithographic to chalky-compact; regular brown partings or bituminous laminae, some drying to produce a black powder |

| Depth (feet) | Lithology |
|---|---|
| 2258-2260.7 | Limestone: pale tan, chalky-compact to nearly lithographic; faint wavy bituminous bands and brown partings |
| 2260.7-2264.7 | Limestone: pale tan, chalky-compact to nearly lithographic as above, scattered fossils and veinlets in clear calcite; dark brown wavy banding and bituminous partings more prominent than above (limestone is slightly argillaceous, leaves brown residue in acid) |
| 2264.7-2266 | Limestone: pale tan, nearly lithographic as above, but without bituminous partings |
| 2266-2266.4 | Siltstone: highly calcareous, or silty limestone, light grey, shaly (very fine-grained silt) |
| 2266.4-2275.5 | Limestone: tan, chalky-compact to nearly lithographic; altered biostromal in part and dark, finely crystalline-compact, slightly bituminous zones near top and base of interval; several irregular (slightly stylolitic ?),brown,shaly partings; zone with abundant ostracods |
| 2275.5-2276 | Mudstone: calcareous, grading to calcareous siltstone, light grey, laminated in part; appear to form matrix, in part for intraformational breccia or conglomerate |
| 2276-2278 | Limestone: medium to pale brown, coarsely crystalline, vuggy, with vugs largely filled with sparry calcite; finely laminated, with brown bituminous partings; becomes more finely crystalline toward base of interval; may be slightly porous |
| 2278-2279.7 | Limestone: tan to grey-brown, very finely crystalline-compact to nearly lithographic; brown partings; becomes finer grained, grey, slightly argillaceous toward base of interval |
| 2279.7-2282 | Mudstone: calcareous, silty, medium grey, shaly, finely laminated (at top) in basal 1' of interval; forms matrix for fine intraformational breccia, which grades downward to finely crystalline, slightly argillaceous, grey-brown limestone; basal contact undulating, dips about 20° |
| 2282-2283 | Limestone: medium brown, medium crystalline-compact; (crystals 0-16 mm) |
| 2283-2284.2 | Dolomite: pale tan, chalky, very porous |
| 2284.2-2286.2 | Limestone: light brown, microcrystalline-compact to nearly lithographic; altered biostromal zones; brachiopod fragments |

| Depth (feet) | Lithology |
|---|---|
| 2286.2-2294 | Limestone: pale to light brown, slightly argillaceous or very finely silty in part, chalky-compact to nearly lithographic, faintly biostromal and slightly dolomitic in part with brown bituminous specks; (core barrel twisted off at 2294') |
| 2294-2298 | Fragments at base of core (from lost interval ?) indicate coarsely crystalline, brown laminated, possibly vuggy and fragile or brecciated, porous (?) limestone |
| 2298-2300.8 | No information |
| 2300.8-2301.3 | Milled fragments of core probably from lost interval above; in order in box: Limestone, medium (1 mm) crystalline, brown with darker brown bituminous zones; limestone, more or less argillaceous, light brown-grey, with macro appearance of mudstone; brown, bituminous specks; pyrite parting |
| 2301.3-2302 | Limestone: argillaceous, grey-brown to brown-grey, with irregular shaly lenses or bands in basal 3" of core; brown to black bituminous or carbonaceous specks; fossil fragments in least argillaceous material |
| 2302-2305 | Limestone: light grey-brown, finely crystalline-compact (crystals about .06 mm diameter); slightly dolomitic in part |
| 2305-2308 | Limestone: light grey-brown, very finely crystalline to aphanitic; brown stylolitic partings; exaggerated stylolites with amplitude of 1½", 1½' from top of core; stylolites occur in a direction that diverges a few degrees from axis of core; zone of vuggy porosity, but low permeability, below stylolites |
| 2308-2309 | Limestone: light grey-brown, very finely crystalline-compact, nearly lithographic; stylolitic; insoluble residue shows a small amount of very fine silt, a little brown argillaceous or bituminous material |
| 2309-2313.5 | Limestone: light-brown, with grey cast, very finely crystalline to lithographic; stylolitic brown partings |
| 2313.5-2320 | Limestone: tan, very finely crystalline to chalky-compact, lacking translucent appearance of limestone above; brown stylolitic partings |
| 2320-2331 | Limestone: dolomitic, tan, very finely crystalline, nearly chalky-compact, speckled with dolomite rhombs; texture faintly suggestive of altered bioclastic: non-dolomitic, zone about 1' thick, top of interval; becomes highly dolomitic in part, downward |
| 2331-2336 | Limestone: tan to pale brown, very finely crystalline to chalky-compact, non-dolomitic; brown stylolitic partings |

| Depth (feet) | Lithology |
|---|---|
| 2336-2348 | Limestone: tan, chalky-compact, faintly bioclastic (?); brown, stylolitic partings; becomes dolomitic in lower part of interval; irregular, near-vertical fracture from 7' to 9' from top of core |
| 2348-2355 | Limestone: tan, chalky-compact, platy, with many smooth, brown, argillaceous partings; very slightly dolomitic in part |
| 2355-2361 | Limestone: dolomitic, tan, chalky-compact, with abundant dolomite rhombs, faintly bioclastic, thin-bedded and platy, with numerous, smooth, brown partings |
| 2361-2368 | Limestone: biohermal, light brown to tan, finely crystalline-compact to nearly lithographic, coarse, clear, calcite-lines; vugs up to 1½" long, few with resemblance to fossil cavities; zones of limestone breccia in part with interstitial, finely crystalline calcite similar in texture to fragments, but of darker colour; algal nodules up to 2½" in diameter: faint resemblance of some vugs to fossil cavities is heavily masked by recrystallization; permeability very low |
| 2368-2369 | Dolomite: light brown, microsucrose, porous; basal contact dips 25° |
| 2364-2375.5 | Limestone: light brown, finely crystalline-compact to lithographic; stylolites and indefinite, chalky-textured, dolomitic bands near centre of interval; vugs partly filled with hollow rhomb-forms (0.3 mm diameter) of chalky dolomite as though altered and pseudomorphous after originally complete dolomite rhombs [or calcite ? - shape of rhombs differs from classic form of coarser clear calcite in vugs above (up to 4.0 mm in diameter)] |
| 2375.5-2376.5 | Dolomite: pale brown, microsucrose, brown-laminated in part; laminae and basal contact dip 30° |
| 2376.5-2377.5 | Limestone: dark brown, finely crystalline-compact; scattered vugs up to ½" diameter in upper part |
| 2377.5-2378 | Dolomite: brown-laminated as in 20'6"-21'6" above |
| 2378-2388 | Limestone: highly dolomitic intergrading with inclusions of dolomite; limestone, light brown, crystalline-compact with zone of chalky pseudo-oolites, dolomite-filled, irregular bands or inclusions of brown microsucrose to chalky dolomite; high vuggy porosity, probably some good permeability |
| 2388-2392 | (?) No recovery |

| Depth (feet) | Lithology |
|---|---|
| 2392-2404.5 | Limestone: altered biohermal as above, but more coarsely crystalline; vuggy, with chalky - microsucrose dolomitic bands and brown partings, and brown, crystalline matrix in zones of penecontemporaneous brecciation; less porous than core above; becomes increasingly dolomitic downward, grading in part to white, powdery dolomite with intergranular porosity |
| 2404.5-2508 | (?) No recovery |
| 2405-2409 | Drilling for Whipstock, no recovery |
| 2409-2410 | Limestone: dolomitic, altered biohermal as above, coarsely crystalline, vuggy, with brown, bituminous matter |
| 2410-2411 | Limestone: dolomitic in part, light brown, finely crystalline-compact; undulating, brown, shaly, laminae and partings, dipping up to 10° |
| 2411-2412 | Limestone: pale grey-brown, coarsely crystalline, vuggy |
| 2412-2413 | Limestone: medium brown, very slightly dolomitic, microcrystalline to chalky-compact; laminated with numerous regular or slightly undulating brown partings |
| 2413-2414 | Limestone: light brown, microcrystalline-compact, faintly bioclastic |
| 2414-2416 | Limestone: dolomitic, tan or pale brown, with shaly-brown laminations as above; altered biostrome; abundant ostracods |
| 2416-2417.2 | Limestone: gypsiferous, light brown, finely crystalline-compact, with original, extensive, fine, vuggy porosity entirely gypsum-filled |
| 2417.2-2419.3 | Limestone: tan, dark brown laminate, with undulating shaly parting |
| 2419.3-2420.2 | Limestone: light brown, microcrystalline-compact |
| 2420.2-2421 | Limestone: gypsiferous, brown-grey, coarsely crystalline; original vuggy porosity filled with clear gypsum; thin (¼") interbed of gypsum |
| 2421-2427.9 | Limestone: dolomitic, light to pale brown, microcrystalline to chalky-compact; small algal (?) nodule (rare); a few brown laminae; finely vuggy zone ½" thick with poor permeability 1' from top of core; altered biostrome |
| 2427.9-2433 | Limestone: dolomitic, microcrystalline-compact, speckled in mottled fashion with dolomitic rhombs; faintly altered bioclastic; zones of abundant algal (?) nodules up to 1" in diameter, forming poorly developed, augen-like structures and wavy, brown banding |

| Depth (feet) | Lithology |
|---|---|
| 2433-2439 | Limestone: tan, chalky-compact with abundant, fossil fragments cast in clear calcite |
| 2439-2439.5 | Mudstone: medium grey, dolomitic |
| 2439.5-2443 | Limestone: tan, lightly dolomitic, intergrading with chalky textured, non-dolomitic, fossiliferous limestone, centre of interval, and microsucrose, brown dolomite at base |
| 2443-2444 | Mudstone: anhydritic, light grey, containing penecontemporaneous breccia of more or less dolomitic mudstone |
| 2444-2447.5 | Anhydrite: light brown, white mottled |
| 2447.5-2453 | (?) No recovery |
| 2453-2454.2 | Anhydrite: brown, mottled as in core above |
| 2454.2-2455 | Anhydrite: with irregular bands or lenses of finely crystalline, brown dolomite |
| 2455-2461.5 | Dolomite and anhydrite: dolomite, tan, chalky, interlaminated and interbedded with brown to grey anhydrite; grade downward to dolomite with small anhydrite inclusion at centre of interval |
| 2461.5-2453.2 | Limestone: dolomitic in part, tan, chalky-compact, altered bioclastic in part with brown, bituminous laminae; gypsum-filled, vuggy porosity in basal 3" of interval |
| 2464.2-2468 | Limestone: medium brown, very finely crystalline-compact, nearly lithographic; laminae and thin (¼") interbeds of gypsum and white anhydrite (?) |
| 2468-2472.5 | Limestone: dolomitic in part, pale to light brown, chalky-compact to microcrystalline zones of original porosity "saturated" with clear gypsum, brown gypsum crystals; irregular inclusions of white anhydrite 4' from top of interval; 4" zone of anhydrite or gypsum laminations; may be altered, thin-bedded bioclastic in part |
| 2472.5-2475.5 | Limestone: dolomite, tan or pale brown, chalky-compact, speckled with dolomite rhombs |
| 2475.5-2478.2 | Limestone: highly dolomitic in part, pale to light grey-brown, chalky-compact, with dolomite rhombs; altered bioclastic |
| 2478.2-2485.5 | Limestone: dolomitic, tan, altered bioclastic, with abundant sparry shell fragments; grades in basal 5" to grey-brown dolomite of similar, shell-fragmental texture; core surface exhibits faint augen-like lense and wavy banding structure (due to algal nodules ?); dark grey-brown, shaly parting at base, dips 10° |

| Depth (feet) | Lithology |
|---|---|
| 2485.5-2489 | Dolomite. pale brown-grey laminated, chalky-compact; mottled in part with streaks of finely crystalline pyrite |
| 2489-2490.3 | Anhydrite. brown-white mottled, coarsely crystalline; dolomitic in part |
| 2490.3-2491.5 | Dolomite. tan to light brown, microsucrose, laminated, slightly porous |
| 2491.5-2502.5 | Dolomite. light brown, microsucrose, slightly finely porous; porosity gypsum-saturated in top 2' of interval |
| 2502.5-2505 | Mudstone. dolomitic and calcareous, brown grey, more calcareous at top. |
| | Elstow Member |
| 2505-2508 | Limestone. argillaceous, dolomitic in part, shaly in part, grey-brown to grey, asphanitic |
| 2508-2514 | Limestone. argillaceous, more or less dolomitic, brown-grey and tan, mottled, chalky-compact, mottling produced by variations in dolomitic and argillaceous content; faint suggestion of nodule- and wavy banding-structure. |
| 2415-2486 | No information |

Note: Notes from 1691-2486 feet are taken from a log by L.L. Price of the core of the Elstow 5-22A pilot hole, midway between shafts (shafts are about 500 feet apart)

| Depth (feet) | Lithology |
|---|---|
| 1691-1693.5 | Shale: dark grey, splintery, with fine laminae of white silt |
| 1693.5-1595.5 | Shale: dark grey as above with 2" band of ironstone at top of interval; shale is massive, and slightly ferruginous (?) in lower half of core |
| 1695.5-1698 | Shale: silty intergrading with siltstone, dark and light grey mottled, with abundant worm burrows |
| 1698-1699 | Siltstone: shaly, with worm burrows, porous in part |
| 1699-1701 | (?) No recovery |
| 1701-1702 | Siltstone: shaly, poorly indurated |
| 1702-1703 | Shale: silty, medium grey, with indefinite silt laminae |
| 1703-1704 | Siltstone or very fine grained sandstone: porous, partly cemented with siderite spherules |
| 1704-1706.4 | Sandstone: quartzose, laminated, very fine grained, with scattered, medium quartz grains; rare, red-stained grains; highly porous, with salty efflorescence on core surface; becomes slightly shaly and less porous towards base |
| 1706.4-1706.5 | Sandstone: pyritic, very fine grained; abundant carbon. |
| | Cantuar Formation |
| 1706.5-1718 | Siltstone: shaly, light grey with brown cast; tight; mottled with irregular lenses and laminae; carbonized wood fragment 4" long 4' from top of interval; worm burrows |
| 1718-1724 | Siltstone: clayey, medium light brownish grey, massive |
| 1724-1726.5 | Clay: medium grey-brown, slightly silty in part, with semi-waxy luster; slickensides, dipping up to 45°; zone with plant fragments |
| 1726.5-1727.2 | Sandstone: light grey, very fine grained, thin-bedded, poorly indurated, porous; zone of clayey laminae; specks of carbon |
| 1727.2-1727.5 | Clay: silty, brown-grey, massive, with carbonized vegetable matter |

| Depth (feet) | Lithology |
|---|---|
| 2580-2586 | Limestone: buff to brown, medium-grained; anhydrite blebs and bands; bands of calcite crystals |
| 2586-2595 | Not sampled |
| 2595-2609 | Limestone: grey to buff, cryptocrystalline to fine grained |
| 2609-2618 | Limestone: buff to grey, fine grained, broadly banded in part; buff limestone has inclusions of anhydrite and calcite |
| 2618-2623 | Limestone: as above |
| 2623-2627 | Limestone; as above; cryptocrystalline grey limestone. |
| | Manitoba Group |
| | Souris River Formation |
| | Hatfield Member |
| 2627-2637 | Limestone: grey, very argillaceous, breaks apart in water |
| 2637-2640 | Limestone: as above |
| 2640-2643 | Limestone: grey to buff, as above |
| 2643-2655 | Limestone: as above, calcitic |
| 2655-2659 | Limestone: buff to tan, broadly banded |
| 2659-2676 | Limestone: tan, argillaceous, breaks apart in water |
| 2676-2678 | Limestone: as above |
| 2678-2683 | Limestone: grey, cryptocrystalline, translucent |
| 2683-2690 | Limestone: as above |
| 2690-2694 | Limestone: as above |
| 2694-2704 | Limestone: as above |
| 2704-2709 | Limestone: as above |
| 2709-2719 | Limestone: as above, becoming more shaly |
| 2719-2722 | Anhydrite: brown to tan, cryptocrystalline, translucent |

| Depth (feet) | Lithology |
|---|---|
| 2722-2723 | Anhydrite: as above, dolomite blebs |
| 2723-2731 | Anhydrite and limestone: anhydrite as above; limestone, tan, calcitic, crystalline, porous; anhydrite crystals |
| 2731-2749 | Not sampled |
| 2749-2752 | Dolomite: tan to green, microcrystalline to crystalline; calcite blebs |
| 2752-2757 | Dolomite and anhydrite: dolomite as above (tan, crystalline) grading downwards to anhydrite, brown cryptocrystalline, with green, microcrystalline dolomite blebs |
| 2757-2771 | Limestone: tan to grey, microcrystalline; thinly banded |
| 2771-2774 | Limestone: tan to grey-brown; blebs of different colours; crystalline, porous, tan, limestone, microcrystalline, grey-brown limestone |
| 2774-2780 | Not sampled |
| 2780-2784 | Limestone: as above, with large, white calcite blebs |
| 2784-2790 | Not sampled |
| 2790-2806 | Limestone: grey, microcrystalline; small, cream-coloured calcite blebs |
| 2806-2863 | Not sampled. |
| | Harris Member (?) |
| 2863-2873 | Dolomite and halite: dolomite, grey to tan with grey blebs, porous, crystalline; halite, white, crystalline, transparent |
| 2873-2883 | Dolomite, halite and anhydrite: dolomite, tan, porous, crystalline, thinly banded; halite, as above, interbedded with dark grey anhydrite, cryptocrystalline, translucent |
| 2883-2893 | Dolomite and halite: halite, as above; dolomite, as above and grey, microcrystalline |
| 2893-2903 | Dolomite and anhydrite: dolomite, as above; anhydrite, grey to brown, cryptocrystalline |
| 2903-2913 | Dolomite: as above |
| 2913-2920 | Not sampled. |

| Depth (feet) | Lithology |
|---|---|
| | Davidson Member |
| 2920-2927 | Halite: white, crystalline; occasional, thin, tan, dolomite bands |
| 2927-2948 | Dolomite: anhydrite, and halite, dolomite, brown, microcrystalline, porous, thinly banded; anhydrite, brown to grey, cryptocrystalline, translucent; halite, crystalline, white to brown, transparent |
| 2948-2950 | Anhydrite: as above |
| 2950-2962 | Halite: black to tan to white; contact with anhydrite; whitish dolomite blebs |
| 2962-2966 | Halite: as above with thin tan anhydrite bands |
| 2966-2971 | Halite: white, translucent to transparent |
| 2971-2979 | Halite and anhydrite: halite, as above; anhydrite, tan to grey to brown, cryptocrystalline, translucent, thinly banded; occasional halite blebs and crystals; halite contact |
| 2979-2981 | Anhydrite and dolomite: anhydrite as above, without halite inclusions; dolomite, mottled brown to tan, microcrystalline, porous; thin calcite bands |
| 2981-3001 | Not sampled |
| 3001-3005 | Limestone: tan, microcrystalline, porous, finely banded |
| 3005-3027 | Not sampled |
| 3027-3034 | Limestone: tan, microcrystalline, porous |
| 3034-3045 | Limestone: grey-brown, cryptocrystalline, fossiliferous; calcite nodules |
| 3045-3081 | Not sampled |
| 3081-3086 | Limestone: tan, cryptocrystalline |
| 3086- | Not sampled. |

# APPENDIX II (b)

## Allan Potash Mines

## Shaft No. 2 West

# ALLAN POTASH MINES (U.S. BORAX)

## SHAFT NO. 2

Location: Lsd. 5, Sec. 22, Tp. 34, Rge. 1, W3
Elevation of Shaft Collar: 1719.5 feet
Observations by: R.D. Holmes

| Depth (feet) | Lithology |
|---|---|
| | **CENOZOIC** |
| | **Quaternary Deposits** |
| 30-40 | Glacial till: numerous pebbles in dark grey, silty, clay; pebbles smooth, subrounded to rounded, 1/16" to 2½" diameter; boulders up to 20" x 12" x 8" noted in dump |
| 40-68 | Glacial drift (sample missed) |
| 68-74 | Glacial drift: pebbles and cobbles imbedded in grey-brown clay, some oxidation; (several taken from random depths) |
| 74-79 | Glacial drift: pebbles and cobbles imbedded in grey-brown clay; oxidation; several large boulders - one measuring approximately 30" x 24" x 24", (samples taken at random depths) |
| 79-86 | Glacial drift, as above: oxidation |
| 86-100 | Glacial drift: pebbles and cobbles in dark grey clay, only slightly oxidized |
| 100-110 | Glacial drift: pebbles and cobbles in dark grey clay |
| 110-125 | Glacial drift: pebbles and cobbles in dark grey, slightly silty clay |
| 125-135 | Glacial drift, (samples missed) |
| 135-145 | Glacial drift: pebbles in dark grey to black clay. |
| | **MESOZOIC** |
| | **Lea Park Formation** |
| 145-148 | Shale: grey, blocky, slightly silty; plastic clay at top grading to shale at bottom of interval; worm burrows; scattered, grey-white, calcareous, silt nodules; rare pelecypods |

# ALLAN POTASH MINES (U.S. BORAX)

## SHAFT NO. 2

Location: Lsd. 5, Sec. 22, Tp. 34, Rge. 1, W3
Elevation of Shaft Collar: 1719.5 feet
Observations by: R.D. Holmes

| Depth (feet) | Lithology |
|---|---|
| | **CENOZOIC** |
| | **Quaternary Deposits** |
| 30-40 | Glacial till: numerous pebbles in dark grey, silty, clay; pebbles smooth, subrounded to rounded, 1/16" to 2½" diameter; boulders up to 20" x 12" x 8" noted in dump |
| 40-68 | Glacial drift (sample missed) |
| 68-74 | Glacial drift: pebbles and cobbles imbedded in grey-brown clay, some oxidation; (several taken from random depths) |
| 74-79 | Glacial drift: pebbles and cobbles imbedded in grey-brown clay; oxidation; several large boulders - one measuring approximately 30" x 24" x 24", (samples taken at random depths) |
| 79-86 | Glacial drift, as above: oxidation |
| 86-100 | Glacial drift: pebbles and cobbles in dark grey clay, only slightly oxidized |
| 100-110 | Glacial drift: pebbles and cobbles in dark grey clay |
| 110-125 | Glacial drift: pebbles and cobbles in dark grey, slightly silty clay |
| 125-135 | Glacial drift, (samples missed) |
| 135-145 | Glacial drift: pebbles in dark grey to black clay. |
| | **MESOZOIC** |
| | **Lea Park Formation** |
| 145-148 | Shale: grey, blocky, slightly silty; plastic clay at top grading to shale at bottom of interval; worm burrows; scattered, grey-white, calcareous, silt nodules; rare pelecypods |

| Depth (feet) | Lithology |
|---|---|
| 148-156 | Shale: grey, silty in part, smooth-textured, blocky, worm burrows; glauconite; rare pelecypods, gastropods, (representative sample taken from random dumps from interval) |
| 156-160 | Shale |
| 160-169 | Shale: grey, smooth-textured, blocky, massive, silty in part; worm burrows; scattered pyrite; glauconite veins; large thick-shelled pelecypods |
| 169-180 | Shale: grey, smooth-textured, blocky, massive, silty; worm burrows, scattered pyrite |
| 180-188 | Shale: as above; fragments of large thick-shelled pelecypods |
| 188-196 | Shale: grey, smooth-textured, blocky, massive, little if any fissility; worm burrows; scattered pyrite; brown ironstone concretions; fragments of pelecypods |
| 196-204 | Shale: grey, smooth-textured, blocky, little if any fissility; worm burrows; scattered pyrite; brown ironstone concretions some with fossils; poorly-preserved fragments of large thick-shelled pelecypods |
| 204-218 | Shale: (sample missed) |
| 218-228 | Shale: grey-brown, slightly silty, massive, blocky, smooth-textured; worm burrows; plastic clay bands; calcareous septarian concretions |
| 228-238 | Shale: silty (samples missed) |
| 238-250 | Shale: grey-brown, very silty to finely sandy, massive blocky |
| 250-278 | Sandstone: very shaly or very sandy shale, fine grained, massive, blocky |
| 278-286 | Shale: grey-brown, very silty to finely sandy, massive, blocky; scattered pyrite; glauconite? |
| 286-293 | Sandstone: grey-brown, very shaly, or very sandy shale, fine grained, massive, soft, poorly indurated; fragments of large pelecypods |
| 293-299 | Shale: grey-brown, very silty to finely sandy or very shaly sandstone, massive, blocky, soft; septarian calcareous up to 2' diameter; fragments of pelecypods |
| 299-303 | Shale: grey-brown, very silty to finely sandy, massive, blocky, soft, carbon streaks |

| Depth (feet) | Lithology |
|---|---|
| 303-312 | Shale: grey-brown, very silty to finely sandy, massive, blocky; indistinct interbedding of silt and shale; carbon streaks |
| 312-320 | Shale: grey-brown, silty, with lenses and interbeds of light grey-brown silt, massive, blocky; worm trails; calcareous septarian concretions up to 2' diameter; carbon streaks |
| 320-328 | Shale: grey, silty to finely sandy, massive, light grey brown, mottled by zones of silt and sand; worm trails; grades into sandstones, light grey, thinly bedded, fine grained; poorly indurated, porous |
| 328-334 | Sandstone: grey-brown, shaly, medium to coarse grained, massive, soft, poorly indurated; indistinct bedding, 1½' band of hard calcareous sandstone at 329-330.5' |
| 334-410 | No information. |
| | Lower Birch Lake (?) tongue |
| 410-420 | Shale: silty in part, grey mottled by numerous interbeds of light grey brown siltstone and fine grained sandstone, massive, poor fissility; carbonaceous partings; current bedding in silt and sand |
| 420-430 | Shale: silty in part, grey mottled by silt lenses, poor fissility, grades into predominantly fine grained sandstone and siltstone; 2' band of hard, calcareous,fine grained sandstone; current bedding; carbonaceous partings |
| 430-444 | Shale: grey, hard, massive, with poor fissility and carbon streaks, interbedded with sandstone, light grey-brown, soft, poorly indurated, fine grained; current bedding, carbonaceous partings |
| 444-449 | Shale: sandstone, interbedded, as above: fragments of small pelecypods |
| 449-463 | Shale: grey, smooth-textured, hard, with carbon streaks, interbedded with sandstone, soft, fine grained, poorly indurated; light grey-brown, current bedding; carbonaceous partings |
| 463-470 | Shale: silty in part, grey mottled by interbeds of light grey-brown silt and sand, hard, blocky, with interbeds of siltstones and fine grained sandstone; carbon streaks and partings; current bedding in silt |

| Depth (feet) | Lithology |
|---|---|
| 470-476 | Shale: grey, silty in part, hard, blocky with numerous lenses and interbeds of light grey-brown siltstone and fine grained sandstone; carbon streaks and carbonaceous partings; current bedding in silt |
| 476-492 | Shale: silty to finely sandy, grey, mottled by silty zones, massive, blocky, with interbeds of light grey silt and sand; abundant carbon specks and streaks. |
| | Lower marine shale |
| 492-497 | Shale: grey, silty, massive, blocky, with lenses and interbeds of light grey silt and fine grained sandstone; abundant carbon; calcareous concretions up to 2' diameter; pellets of clay; fragments of coiled ammonites |
| 497-510 | Shale: grey, silty, massive, little if any fissility, blocky, with silt lenses; fragments of coiled ammonites |
| 510-519 | Shale: grey, silty to finely sandy, massive, blocky, little if any fissility; coiled ammonites; pelecypods |
| 519-528 | Shale: grey, silty to finely sandy, mottled by silty zones, massive, blocky, little if any fissility; coiled ammonites |
| 528-548 | Shale: silty to finely sandy as above, calcareous concretions up to 3' diameter, coiled ammonites; large, thick-shelled pelecypods |
| 548-555 | Shale: as above |
| 555-566 | Shale: silty to finely sandy, massive, blocky, little if any fissility, 1 foot band of bentonitic clay associated with light grey, crystalline, splintery carbonate; coiled ammonites |
| 566-574 | Shale: grey, silty to finely sandy, massive, blocky, little if any fissility, glauconitic; worm trails filled with white silt; coiled ammonites; large, thick shelled pelecypods |
| 574-580 | Shale: grey, silty to finely sandy, massive, blocky, glauconitic; worm trails; ironstone; coiled ammonites; pelecypods |
| 580-591 | Shale: grey, silty in part, mottled in silty zones; glauconitic, massive, blocky, worm trails; ironstone concretions, some with fossils; coiled and uncoiled ammonites; *Inoceramus balticus* Böhm (s. lato), *Scaphites (Hoploscaphites) gilli* Cobban and Jeletzky, GSC loc. 70636 (collected from 580-598') |

| Depth (feet) | Lithology |
|---|---|
| 591-598 | Shale: grey, silty to finely sandy, mottled by indefinite silt zones, slight fissility, worm burrows, glauconite veins; ironstone concretions; many with fossils; ammonite, pelecypods |
| 598-610 | Shale: grey, silty to finely sandy, with indefinite silt lenses, slightly fissile; worm trails; pyrite streaks; uncoiled ammonites; septarian concretions |
| 610-622 | Shale: grey, silty to finely sandy, slightly fissile, massive; worm trails; pyrite streaks; uncoiled ammonites; fragment of large, thick-shelled pelecypods |
| 622-632 | Shale: grey, silty, massive, slight fissility, worm trails; scattered pyrite; glauconite; uncoiled ammonites |
| 632-640 | Shale: as above, thin (2") band of calcareous shale; uncoiled ammonites |
| 640-658 | Shale: grey, silty, massive, slight fissility; worm trails; numerous glauconitic ironstone concretions, some with fossils; uncoiled ammonites |
| 658-668 | Shale: grey, slightly silty, massive, slight fissility; glauconitic ironstone concretions; scattered pyrite; worm trails; uncoiled ammonites; collected between depths of 668 and 740'; *Baculites* sp. indet., *Baculites* aff. *mclearni* Landes, GSC loc. 70620 |
| 668-682 | Shale: grey, silty, glauconitic, massive, blocky, slight fissility; ironstone concretions many as fossils; worm trails, pyritized plant or worm tubes; 8" band of aragonite associated with bentonitic clay band; uncoiled ammonites |
| 682-697 | Shale: grey, silty, massive, blocky; worm trails; pyrite streaks; ironstone concretions; calcareous concretionary bed about 2' thick; uncoiled ammonites |
| 697-710 | Shale: grey-brown, silty, massive, blocky, slight fissility; numerous ironstone concretions, many fossilized; worm trails; scattered pyrite; uncoiled ammonites |
| 710-725 | Shale: grey-brown, silty, blocky, massive, slight fissility, with silt partings; worm trails; few uncoiled ammonites |
| 725-740 | Shale: grey-brown, silty, blocky, massive, little fissility, with silt partings; worm trails; ironstone concretions, calcareous concretions up to 4' diameter; uncoiled ammonites |

| Depth (feet) | Lithology |
|---|---|
| 740-753 | Shale: grey, silty in part, blocky, slight fissility, with silt partings; worm trails; rare fish scales; *Baculites* cf. *mclearni* Landes, *Baculites* cf. *asper* Morton, GSC loc. 70633 |
| 753-760 | Shale: grey, silty, massive, slight fissility, with silt partings; worm trails; scattered pyrite; ironstone concretions mostly in fossils; uncoiled ammonites |
| 760-770 | Shale: grey, silty in part, massive, slight fissility, with silt partings; worm trails; ironstone concretions; rare, scattered fish scales, large, smooth *Baculites* sp. indet., GSC loc. 70635 (lot collected from 760'-775') |
| 770-781 | Shale: grey, silty in part, mottled in silty zones, moderate fissility; yellow-brown ironstone concretions; worm trails; rare fish scales; uncoiled ammonites |
| 781-787 | Shale: grey, slightly silty in part, mottled in silty zones, with partings of light grey siltstone; fissile; soft; worm trails; numerous ironstone concretions; few uncoiled ammonites |
| 787-799 | Shale: grey, smooth-textured, soft, good fissility, with partings of light grey silt and fine grained sandstone; worm trails filled with light brown, pyritic silt; numerous ironstone concretions; rare uncoiled ammonites |
| 799-824 | Shale: grey, smooth-textured, soft, good fissility, with partings of light grey silt and fine grained sandstone; worm trails; rare fish scales; numerous ironstone concretions |
| 824-845 | Shale: as above with concretions and fish scales; *Scaphites (Hoploscaphites)* cf. *gilli* Cobban and Jeletzky, *Baculites* sp. indet., GSC loc. 70634 |
| 845-861 | Shale: grey, smooth-textured, soft, good fissility, with partings of light grey silt and fine grained sandstone; worm trails; 6" band of light grey, fine grained, dense, arenaceous limestone; ironstone concretions |
| 861-872 | Shale: grey, smooth-textured, soft, good fissility; with partings of light grey silt; worm trails; scattered fish scales |
| 872-880 | Shale: grey, smooth-textured, soft, good fissility, with partings of light grey and light brown silt and fine grained sandstone; worm trails; rare fish scales |
| 880-891 | Shale: grey, smooth-textured, silty in part, soft, good fissility with partings of light grey silt and glauconitic, fine grained sandstone; partings of light brown silt; worm trails; rare, scattered fish scales; ironstone concretions |

| Depth (feet) | Lithology |
|---|---|
| 891-908 | Shale: grey, smooth-textured, silty in part, soft good fissility with partings and irregular lenses of light brown silt; partings of light grey silt and glauconitic, fine grained sandstone; white-speckled ironstone concretions |
| 908-916 | Shale: grey, smooth-textured, soft, good fissility, with partings of light grey silt and partings of light brown silt; irregular lenses of fine grained, glauconitic sandstone; worm trails, rare, scattered fish remains; white-speckled ironstone concretions |
| 916-923 | Shale: grey, smooth-textured, soft, good fissility, with partings of light grey and light brown silt; irregular lenses of fine grained, glauconitic sandstone; worm trails; white-speckled ironstone concretions; 8" band of impure limestone |
| 923-935 | Shale: grey, smooth-textured, good fissility, with partings of light grey silt and partings and interbeds of light brown silt; irregular lenses of fine grained, glauconitic sandstone |
| 935-949 | Shale: grey, smooth-textured, good fissility, soft, with partings of light grey silt; partings and thin interbeds of light brown silt; irregular lenses of fine grained, glauconitic sandstone; worm trails; slickensides; steeply dipping |
| 949-963 | Shale: grey, smooth-textured, soft, good fissility, with partings of light grey silt; partings and interbeds of light brown silt; irregular thin lenses of fine grained, glauconitic sandstone; scattered fish scales; worm trails; white-speckled ironstone concretions up to 1 foot diameter |
| 963-977 | Shale: grey, smooth-textured, silty in part, good fissility, with partings of light grey silt, partings and interbeds (¼") of light brown silt; irregular lenses of glauconitic fine grained sandstone; rare scattered fish scales |
| 977-993 | Shale: grey, smooth-textured, silty in part, with partings and interbeds (½") of light grey silt or fine grained sandstone; good fissility; thin (¼") interbeds of light brown silt |
| 993-998 | Shale: grey, smooth-textured, silty in part, with partings and thin interbeds of light grey siltstone and light brown siltstone - irregular lenses and interbeds of fine to medium grained sandstone; scattered fish scales |
| 998-1011 | Shale: grey, smooth-textured, slightly silty in part, with partings and thin (1/8") interbeds of light grey, fine grained sandstone, partings and interbeds of light brown silt; worm trails; scattered fish scales |

| Depth (feet) | Lithology |
|---|---|
| | Boyne Formation |
| 1250-1267 | Shale: medium to dark grey with brown cast, white-speckled, slightly silty, slight fissility, hard, calcareous; numerous fish remains and specks of brown organic matter; calcite veinlets |
| 1267-1284 | Shale: medium to dark grey-brown, white speckled, calcareous, fissile hard; scattered fish remains; thin bentonitic bands |
| 1284-1296 | Shale: medium to dark grey-brown, white speckled, calcareous; fissile, irregular bentonitic bands; scattered fish scales |
| 1296-1309 | Shale: medium to dark grey-brown, white-speckled, calcareous, fissile, scattered fish remains; *Inoceramus* bands, irregular bentonite |
| 1309-1317 | Shale: medium to dark grey-brown, calcareous, irregularly bentonitic in top 1 foot; good fissility; scattered fish scales; 4-5" band of glauconitic conglomerate containing fish teeth 1310'-1310'5". |
| | Favel Formation |
| 1317-1326 | Shale: medium to dark grey-brown, white-speckled, calcareous, fissile, hard; *Inoceramus* bands; scattered fish scales; specks of brown organic matter. |
| | Lower Colorado (Ashville) Group |
| | Belle Fourche equivalent |
| 1326-1335 | Shale: medium to dark grey, hard, fissile with partings of light grey silt; irregularly bentonitic; worm trails filled with light grey silt, scattered fish scales; pyrite streaks after worm trails |
| 1335-1343 | Shale: medium to dark grey, non-calcareous, soft, fissile; worm trails filled with light grey silt, rare, scattered fish scales; scattered pyrite |
| 1343-1351 | Shale: medium to dark grey, smooth-textured, soft, fissile, with partings of light grey silt; worm trails; scattered fish scales |
| 1351-1360 | Shale: medium to dark grey, smooth-textured, soft, fissile, with rare partings of light grey to white silt; large worm trails filled with light grey to white silt; scattered fish scales; slickensides |

| Depth (feet) | Lithology |
|---|---|
| 1011-1020 | Shale: grey, smooth-textured, silty in part, with numerous partings and thin interbeds of siltstone and fine grained, glauconitic sandstone; partings of light brown silt, good fissility, scattered fish scales |
| 1020-1029 | Shale: grey, smooth-textured, soft, good fissility, with numerous lenses and thin (½") interbeds of grey-green, medium to coarse grained sandstone |
| 1029-1044 | Shale: grey, smooth-textured, soft, good fissility, with numerous interbeds of siltstone and fine to medium grained sandstone; partings of light brown silt, sandstone interbeds up to 3" thick |
| 1044-1090 | Shale: grey, smooth-textured, soft, good fissility, with interbeds of light grey siltstone and fine grained,glauconitic sandstone, partings of light brown silt; worm trails |
| 1090-1104 | Shale: grey, smooth-textured, good fissility, slightly silty in part, with numerous partings, lenses and interbeds of light grey silt, light brown silt and greenish grey, fine grained, glauconitic sandstone |
| 1104-1124 | Shale: grey, smooth-textured, good fissility, silty in part, with partings and interbeds of light grey silt, light brown silt, greenish grey,glauconitic,fine grained sandstone; worm trails; scattered fish scales |
| 1124-1142 | Shale: grey, smooth-textured, fissile, with partings and thin interbeds of light grey silt and fine grained sandstone; worm trails; scattered pyrite |
| 1142-1160 | Shale: grey, slightly silty in part, fissile, smooth-textured, soft, with partings of light grey silt; worm trails; ironstone concretions; uncoiled ammonites |
| 1160-1177 | Shale: as above, (3-6", bands of bentonite at 1170'-1173'-1176' - U.S. Borax Engineers); ammonites (sample missed) |
| 1177-1195 | Shale: grey, smooth-textured, fissile, worm trails; 6" band of bentonite at 1179'; rare uncoiled ammonites |
| 1195-1226 | Shale: grey, smooth-textured, moderately fissile, with partings of light grey silt; rare pyrite patches; scattered fish scales |
| 1226-1232 | Shale: medium to dark grey with brown cast; hard, slight fissility, non-calcareous; ironstone concretion; 2" band of glauconitic conglomerate-like layer at top of interval (concretion) |
| 1232-1250 | No information. |

| Depth (feet) | Lithology |
|---|---|
| 1360-1367 | Shale: medium to dark grey, smooth-textured, slightly silty in part, soft, fissile; slickensides; worm trails |
| 1367-1378 | Shale: medium to dark grey, smooth-textured, slightly silty in part, fissile, soft; worm trails |
| 1378-1386 | Shale: medium to dark grey, smooth-textured, silty in part, fissile, soft; worm trails; rare fish scales |
| 1386-1394 | Shale: medium to dark grey, smooth-textured, soft, slightly silty in part, with thin, irregular lenses of light grey silt or a fine grained sandstone with current bedding; worm trails; scattered pyrite |
| 1394-1404 | Shale: medium to dark grey, smooth-textured, soft, slightly silty in part, fissile; worm trails; scattered pyrite |
| 1404-1415 | Shale: medium to dark grey, smooth-textured, soft, slightly silty in part, fissile; worm trails; rare fish scales; slickensides, gypsum veinlets |
| 1415-1425 | Shale: medium to dark grey, smooth-textured, soft, fissile, slightly silty in part; worm trails; scattered pyrite |
| 1425-1433 | Shale: medium to dark grey, smooth-textured, soft, fissile; worm trails; rare fish scales. |
| | "Fish Scales" equivalent |
| 1433-1443 | Shale and sandstone: grey, smooth-textured shale, fissile, slightly silty; numerous bands of grey-green, hard, fine grained, glauconitic sandstone; fish remains; abundant pyrite. |
| | Mowry equivalent |
| 1443-1454 | Shale: grey, smooth-textured, slightly silty in part, with rare silt bands, fissile; worm trails |
| 1454-1464 | Shale: grey, smooth-textured, soft, fissile, with silt partings; worm trails; fish scales; rare pyrite |
| 1464-1474 | Shale: grey, smooth-textured, silty in part, soft, moderately fissile; scattered fish scales; specks of brown organic matter; abundant pyrite |
| 1474-1484 | Shale: grey, smooth-textured, soft, with silt partings; worm trails; scattered pyrite; ironstone concretions |
| 1484-1500 | Shale: grey, smooth-textured, soft, fissile, silty in part; worm trails filled with pyritic silt; scattered fish remains; abundant pyrite |

| Depth (feet) | Lithology |
|---|---|
| 1500-1511 | Shale: grey, smooth-textured, soft, with partings and irregular lenses of light grey silt; worm trails; scattered fish remains; abundant pyrite |
| 1511-1516 | Shale: grey, smooth-textured, soft, fissile, with irregular, thin, silt lenses; worm trails; scattered pyrite; slickensides |
| 1516-1524 | Shale: grey, smooth-textured, silty in part, soft, fissile, with indefinite silt lenses; concretionary ironstone band; worm trails; scattered pyrite; rare fish scales |
| 1524-1529 | Shale: grey, smooth-textured, soft, fissile, with indefinite silty zones; worm trails; ironstone concretions; slickensides |
| 1529-1539 | Shale: grey, smooth-textured, soft, fissile, silty in part, with rare silt partings; worm trails; slickensides |
| 1539-1544 | Shale: grey, smooth-textured, silty in part, with partings and lenses of light grey silt, soft, fissile; worm trails; slickensides; scattered pyrite. |
| | Viking Formation |
| 1544-1556 | Siltstone: or very fine grained sandstone, light grey, banded, shaly in part; current bedding; scattered pyrite, 2-3" band of conglomerate containing numerous flattened, elongate pebbles of black chert at base of interval; slickensides. |
| | Joli Fou Formation |
| 1556-1565 | Shale: medium to dark grey, smooth-textured, soft, fissile; discontinuous silt lenses with small-scale current bedding; worm trails; scattered pyrite; small ironstone concretions |
| 1565-1570 | Shale: medium to dark grey, smooth-textured, soft, fissile, with discontinuous lenses of light grey siltstone and green grey, fine grained, glauconitic sandstone, abundant pyrite; worm trails; rare fish scales; ironstone |
| 1570-1577 | Shale: medium to dark grey, smooth-textured, soft, fissile, with irregular lenses of fine grained, glauconitic sandstone; worm trails; slickensides; scattered pyrite; bentonite band 3-4" thick |
| 1577-1587 | Shale: medium to dark grey, smooth-textured, soft, fissile, with rare soft lenses; slickensides; small ironstone concretions; rare fish scales |

| Depth (feet) | Lithology |
|---|---|
| 1587-1597 | Shale: medium to dark grey, smooth-textured, slightly silty in part, fissile, slickensides ironstone concretion band |
| 1597-1607 | Shale: grey, smooth-textured, fissile, with interfingering lenses of silt and fine grained sandstone |
| 1607-1616 | Shale: medium to dark grey, smooth-textured, hard, with thin lenses of fine grained sandstone, slickensides |
| 1616-1642 | Shale: silty, grey, blocky, with small irregular lenses of light grey siltstone, scattered pyrite |
| 1642-1650 | Shale: grey, smooth-textured, slightly silty, with occasional siltstone lenses and small lenses of calcareous sandstone |
| 1650-1656 | Shale: grey to dark grey, hard, blocky, with abundant pyrite; grades to highly argillaceous sandstone at base |
| | Mannville Group |
| | Pense Formation |
| 1656-1660 | Sandstone: light grey, fine grained, hard, massive, silica-cemented, with numerous, large, pyrite inclusions; becoming slightly friable with carbonaceous shale laminae at base |
| 1660-1670 | Sandstone: light grey to white, fine to medium grained, poorly consolidated, friable, shaly in part, with wavy, carbonaceous shale laminae |
| 1670-1677 | Sandstone: light grey, fine grained, friable, as above; carbon-aceous shale partings |
| 1677-1679 | Sandstone: light grey, fine to medium grained, hard, dense, calcareous, with wavy, black shale interbeds |
| 1679-1691 | Shale: dark grey, smooth-textured, soft, flaky, with thin irregular lenses of light grey, fine grained sandstone |
| 1691-1699 | Shale: as above |
| 1699-1711 | Sandstone: light grey to white, fine grained, soft, poorly indurated, porous, friable, with occasional clay partings; fragments of lignite |
| 1711-1724 | Sandstone: light grey, fine grained, poorly indurated, with thin interbeds and partings of dark grey shale and clay; shale becoming more dominant in bottom 3' of interval |

| Depth (feet) | Lithology |
|---|---|
| | Cantuar Formation |
| 1724-1732 | Shale, or clay: silty, light grey, soft, with occasional lenses or interbeds of light grey, fine grained sandstone; scattered pyrite; slickensides; ironstone concretions |
| 1732-1743 | Shale: light grey, silty, soft, massive, with occasional interbeds (up to 6") of light grey, fine grained sandstone and siltstone with lignite fragments; slickensides |
| 1743-1751 | Shale: light to medium grey, very slightly silty, smooth-textured, with scattered thin interbeds of light grey siltstone becoming numerous in bottom 2 feet; abundant, carbonized plant fragments; slickensides |
| 1751-1760 | Shale: as above; slickensides |
| 1760-1765 | Shale: grey, soft, smooth-textured; numerous thin interbeds of light grey siltstone or fine grained sandstone with scattered pyrite inclusions |
| 1765-1773 | Sandstone: light grey to white, quartzose, fine grained, in upper 3', becoming argillaceous with depth, soft, friable, poorly indurated, porous |
| 1773-1779 | Sandstone: light grey, slightly argillaceous, fine grained, massive, soft, friable, poorly indurated, porous, scattered pyrite inclusions |
| 1779-1791 | Sandstone: tan to light grey, medium grained, felspathic (?), calcareous, massive, porous, with carbonaceous shale partings; very slightly friable |
| 1791-1801 | Sandstone: feldspathic (?), calcareous, as above in upper 2' of interval becoming fine grained, massive, poorly indurated, friable and soft, with carbonaceous shale bands and thin lignite seams |
| 1801-1807 | Sandstone: light grey, fine grained massive, slightly micaceous, soft, friable, poorly indurated, porous, with occasional shale seams |
| 1807-1815 | Shale: grey to dark grey, smooth-textured, soft, flaky, with thin lenses of fine grained sandstone; numerous slickensides; scattered lignite fragments |
| 1815-1821 | Shale: grey, silty, massive, soft, with occasional silt interbeds; slickensides; scattered lignite fragments |

| Depth (feet) | Lithology |
|---|---|
| 1821-1832 | Sandstone: light grey to white, very fine grained, slightly argillaceous, massive, soft, friable, poorly indurated, porous; scattered carbonized plant fragments |
| 1832-1840 | Sandstone: grey, massive, fine grained, hard, with clay laminae; wavy current bedding |
| 1840-1850 | Sandstone: tan to light grey, very fine grained, slightly micaceous, soft, friable, poorly indurated, porous; pyrite inclusions; wavy current bedding;carbonaceous clay seams (2-3" thick) at 1847, 1847.5, 1848 and 1849'; becoming more argillaceous at 1849' |
| 1850-1861 | Sandstone: slightly argillaceous, fine grained, soft, poorly indurated, with 40% interbeds of black shale; pyrite inclusions; carbonized plant material |
| 1861-1869 | Sandstone: light grey, very fine grained, slightly micaceous, friable, poorly consolidated, with 25% black shale interbeds; pyrite inclusions; current bedding |
| 1869-1877 | Sandstone: light grey to white, fine grained, almost quartzose, soft, friable, poorly indurated, highly porous; 2-3" carbonaceous shale seam at 1871' |
| 1877-1881 | Shale: dark grey, smooth-textured, soft, with thin lenses of light grey, fine grained sandstone |
| 1881-1892 | Sandstone: light grey, fine grained, slightly micaceous, soft, friable, with numerous clay bands in upper 2' but very little clay below; large pyrite inclusions |
| 1892-1899 | Sandstone: as above, with clay seams |
| 1899-1904 | Shale: grey to dark grey, silty, blocky, with lenses of siltstone; carbon fragments |
| 1904-1913 | Shale: grey to dark grey, silty, blocky, hard, with lenses of argillaceous siltstone; numerous clay fragments; pyrite inclusions; becomes very carbonaceous at base |
| 1913-1918 | Lignite: black, shaly and silty in part, brittle and crumbly, with numerous pyrite inclusions |
| 1918-1920 | Shale or silt: highly carbonaceous |
| 1920-1925 | Shale: grey to grey-brown, slightly silty, relatively hard, blocky; numerous carbon fragments; much slickensided |
| 1925-1933 | Sandstone: tan to grey, fine grained, argillaceous, soft, friable, with irregular lenses and laminae of light grey soft, clay; some zones relatively hard and purple-spotted |

| Depth (feet) | Lithology |
|---|---|
| 1933-1936.5 | Shale: light to medium grey, black-speckled, becoming medium to dark green at 1935', finely silt banded; good fissility; scattered carbon fragments and numerous carbon specks; at 1935' becomes dark grey, hard with an oolitic texture and abundant pyrite; at 1935'4" passes into green shale with much slickensides. |

# APPENDIX III

(a) Lithologic log of Central Canada Potash Shaft No. 2, from depth 100 to 500 feet

(b) Log of core of alternate pilot hole Consolidated Morrison No. 5-33

CENTRAL CANADA POTASH

SHAFT NO. 2

Location: Lsd. 16, Sec. 21, Tp. 34, Rge. 27, W2
Elevation of Shaft Collar (datum): 790 feet

| Depth (feet) | Lithology |
|---|---|
| | QUATERNARY |
| 100-143 | Glacial drift: dark grey, clayey |
| 143-152 | Till - sand |
| 152-157 | Till - clay |
| 157-162 | Till: dark grey, very slightly silty, slightly calcareous, with numerous pebbles, cobbles and boulders up to 15 cm diameter; pebbles include granites, dolomites, black chert and quartz; amphibolite |
| 162-170 | Till: dark grey, slightly silty, calcareous, soft, with numerous pebbles and cobbles; several boulders up to 60 cm diameter, composition of pebbles; quartzite, chert, amphibolite, granite; dolomite |
| 170-177 | Till: dark grey, soft, slightly silty, calcareous with abundant pebbles and cobbles as above; a few boulders up to 90 cm diameter; pebble composition as above |
| 177-185 | Till: dark grey, soft, slightly silty, calcareous, with abundant pebbles and gravels; several boulders 20-40 cm diameter; large granite gneiss boulder 1.2-1.5 m diameter, others of dolomite, granite, gneiss; amphibolite schists |
| 185-192 | Till: grey-brown, very silty, calcareous, soft, with very abundant pebbles, cobbles and boulders; lenses of medium to coarse gravels 15-30 cm thick; pronounced oxidation especially in gravel lenses |
| 192-200 | Till: grey-brown, very silty, soft, calcareous, with abundant pebbles, cobbles and boulders; lenses of medium to coarse gravels 15-90 cm thick; pronounced oxidation particularly in gravel lenses |
| 200-208 | Till: grey-brown, silty, soft, calcareous, with abundant pebbles, cobbles and boulders; lenses of coarse gravels up to 60 cm thick; pronounced oxidation particularly in gravel lenses |
| 208-215 | Till: grey-brown, silty to sandy, soft, calcareous, with abundant pebbles and cobbles; lenses of coarse gravel, prominent oxidation |

| Depth (feet) | Lithology |
|---|---|
| 215-222 | Till: grey, slightly silty, soft, calcareous with abundant pebbles and cobbles; lenses of fine to medium grained unconsolidated sandstone up to 4.5 cm thick, no oxidation |
| 222-228 | Till: grey, slightly silty, soft, calcareous, with abundant pebbles; thin lenses of unconsolidated fine to medium grained sandstone; a few large boulders |
| 228-232 | Till: grey, slightly silty, soft, calcareous, with numerous pebbles and cobbles; a few boulders up to 60 cm diameter |
| 232-247 | Till: grey, silty, soft, calcareous as above; numerous pebbles; a few boulders |
| 247-251 | Till: grey, silty, soft, calcareous as above, with abundant pebbles and cobbles; lenses of fine to medium grained unconsolidated sandstone up to 20 cm, small pockets of fine to medium gravels |
| 251-255 | Till: grey, silty, soft, calcareous with abundant pebbles and cobbles; lenses of fine to medium grained, unconsolidated sandstone |
| 255-260 | Till: grey, silty, soft, calcareous with abundant pebbles and cobbles; lenses or pockets of medium to coarse gravels |
| 260-270 | Till: grey, slightly silty, soft, calcareous, with abundant pebbles and cobbles. |
| | MESOZOIC (Cretaceous) |
| | Upper marine shale |
| 270-274 | Stone: grey, soft, silty in part; pyrite streaks; rare pelecypods. Contact zone 270-272' with pockets of till in soft clay |
| 274-280 | Stone: grey, silty in part, soft, with pyrite streaks; grades into mudstone; *Inoceramus balticus* Böhm s. lato, *Inoceramus* sp. indet., GSC loc. C-3706 |
| 280-287 | Mudstone: grey, silty in part, blocky; pyrite specks and streaks; ironstone concretion (sausage shaped), a few pelecypods |
| 287-293 | Mudstone: grey, silty in part, blocky; pyrite specks and streaks; a few ironstone concretions, pocket of soft clay, a few pelecypods, rare uncoiled ammonites |
| 293-300 | Mudstone: grey, silty in part, blocky, pyrite streaks, ironstone concretions, a few pelecypods |

| Depth (feet) | Lithology |
|---|---|
| 300-308 | Mudstone: grey, soft, slightly silty, with some zones very silty, blocky; pyrite streaks and specks, *Inoceramus balticus* Böhm s. lato et var. *simpsoni* Meek, *Inoceramus* cf. *sublaevis* Meek, *Pholadomya* aff. *Ph. cupressensis* Landes, indeterminate pelecypods, GSC loc. C-3707 |
| 308-316 | Mudstone: grey, soft, slightly silty, with some zones very silty, blocky; pyrite specks and streaks; rare ironstone concretions, pelecypod, rare uncoiled ammonites |
| 316-320 | Mudstone: grey, soft, silty, blocky; pyrite specks and streaks, chlorite, pelecypods |
| 320-330 | Mudstone: grey, soft, silty, blocky; pyrite specks and streaks *Placenticeras* sp. indet. (ex aff. *P. planum* Hyatt)(solitary fragment), *Inoceramus pertenuis* Meek (relatively flat variants), *Inoceramus* cf. *sublaevis* Meek, *Inoceramus* sp. indet., *Pecten* (s. lato) cf. *assineboinensis* Landes, *?Protocardia* n. sp. indet. (? ex aff. *P. borealis* Whiteaves), indeterminate pelecypods, GSC loc. C-3708 |
| 330-339 | Mudstone: grey, very silty, massive, little if any cleavage, blocky; bands of soft bentonitic clay, "septarian" ironstone concretions, pyrite, rare pelecypods |
| 339-348 | Mudstone. grey, soft, smooth-textured, slightly silty, blocky with some zones flaky; pyrite; ironstone concretions; fish scales |
| 348-356 | Mudstone: grey, soft, very silty to finely sandy, blocky with some zones flaky; flaky zones only slightly silty; pyrite; fish scales |
| 356-365 | Mudstone: grey, smooth-textured, slightly silty, blocky to flaky with some zones very flaky, soft, with thin, irregular lenses of light grey silt, abundant pyrite, occasional fish scales, minute carbon specks. |
| | Lower Birch Lake tongue |
| 365-370 | Sandstone: light to medium grey, medium to coarse grained, shaly, massive, poorly consolidated, friable, glauconitic; rare carbonized plant fragments, several large pelecypods, small, brown pelecypods |
| 370-376 | Sandstone: as above, becoming more shaly with depth; 20 cm band of hard calcareous sandstone at base, carbon, several large pelecypods and small, brown pelecypods |
| 376-390 | Mudstone: grey, silty to finely sandy, blocky, soft, with thin irregular lenses of light grey silt, pyrite, fish scales, carbon, small, brown pelecypods |

| Depth (feet) | Lithology |
|---|---|
| 390-396 | Mudstone: grey, very silty or finely sandy, soft, blocky; pyrite, carbon specks, 15 cm band of hard, medium grained, calcareous sandstones at 392' (?) (approximately) |
| 396-403 | Sandstone: very shaly or mudstone very sandy, soft, blocky, grey, fine to medium grained; pyrite, minute carbon specks |
| 403-428 | Mudstone: grey, very sandy, soft, blocky; pyrite, minute carbon specks |
| 428-438 | Mudstone: grey, very sandy, block to flaky, pyrite; carbon specks |
| 438-448 | Mudstone: grey, silty to sandy in part, blocky; pyrite specks |
| 448-455 | Mudstone: grey, very sandy, blocky; pyrite |
| 455-461 | Mudstone: grey, very sandy, blocky; flaky zones, pyrite |
| 461-467 | Mudstone: grey, silty to sandy, blocky; pyrite |
| 467-473 | Sandstone: grey, medium to coarse grained, very argillaceous, blocky |
| 473-490 | No information |
| 490-500 | Sandstone: grey, medium to coarse grained, very argillaceous, blocky, massive. |
| | Lower marine shale |
| 500-510 | Mudstone: grey, flaky, with lenses of light grey siltstone |
| 510-529 | Mudstone: grey, smooth-textured, blocky to flaky, slightly silty, with thin irregular lenses of light grey siltstone |
| 529-538 | Mudstone: grey, smooth-textured, slightly silty, blocky; silt lenses. |

# APPENDIX III(b)

## CONSOLIDATED MORRISON COLONSAY #5-33

Location: Lsd. 5, Sec. 33, Tp. 34, Rge. 27 W 3rd Mer.
Elevation: K.B. 1789.4' (datum), Grd. 1778'
Core examined by L.L. Price, July 1963

Note: Where recovery of core is less than interval cut, missing core is assumed to come from base of interval.

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | | CENOZOIC |
| | | Quaternary deposits |
| 45 | 273.7-274.0 | Clay (till): pebbles up to 10 mm |
| 46 | 274.0-274.4 | Cobbles up to 10 cm: of pale brown dolomite |
| | 274.4-274.8 | Clay (till): dolomite pebbles |
| | 274.8-277.0 | Silt: argillaceous, or very fine grained sandstone, friable |
| 47 | 277.0-280.2 | Silt: clayey, soft, friable |
| | 280.2-281.2 | Pebbles up to 10 mm. |
| | | MESOZOIC (Cretaceous) |
| | | Lea Park Formation |
| | | Upper marine shale |
| | 281.2-282.0 | Shale: brownish grey, finely silty, blocky, soft, pyrite streaks; possibly brecciated and slightly reworked |
| 48 | 282.0-283.3 | Clay and a little shale: much mud |
| | 283.3-283.8 | Shale: slightly silty, with waxy appearance, medium grey, as above |
| | 283.8-287.0 | Shale: medium grey, blocky; spots of tarnished granular pyrite |
| 49 | 287.0-288.5 | Shale: medium grey, blocky, slightly silty |
| | 288.5-292.2 | Shale: silty to finely sandy, medium light grey; pyrite streaks |
| | 292.2-293.0 | Drilling mud |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 50 | 293.0-294.3 | Drilling mud: pebbles from surface |
| | 294.3-299.7 | Shale: medium grey, silty to sandy in part, blocky |
| 51 | 299.7-302.2 | Shale: grey, with brown cast, blocky, non silty in part, partings of light grey silt with dark grains, mica and specks of white clay |
| | 302.2-306.0 | (?) no recovery |
| 52 | 306.0-311.0 | Shale: finely sandy, or shaly sandstone; blocky, with irregular fine banding |
| 53 | 311.0-319.0 | Shale: highly silty to sandy, as above |
| 54 | 319.0-324.5 | Shale: silty, as above, becoming more silty downward. |
| | | Birch Lake Tongue |
| | 324.5-327.0 | Sandstone: very fine grained, argillaceous, friable; grains of dark chert, quartz, red-brown clay, matrix of light grey silt with specks of carbon |
| 55 | 327.0-333.0 | Sandstone: argillaceous, becoming more shaly in basal 30 cm; basal part retains moisture from the atmosphere while remainder of core is dry |
| 56 | 333.0-339.5 | Sandstone: shaly, very fine grained, with irregular shaly banding; zone of massive sandstone as above, one foot or 30 cm thick, near top of core |
| | 339.5-340.0 | (?) no recovery |
| 57 | 340.0-340.8 | Ironstone: brown, mottled, calcareous, sandy |
| | 340.8-346.0 | Sandstone: more or less shaly, fine grained; chalky pelecypod shell (disintegrated) 30 cm from top of core |
| 58 | 346.0-357.0 | Sandstone: shaly, grey with brown cast, mottled, greywacke type; grains of finely divided pyrite, small worm burrows |
| 59 | 357.0-359.5 | Shale: silty in part, brownish grey, smooth textured in part, with irregular fissility, specks of carbon, granular pyrite |
| | 359.5-365.0 | Siltstone: argillaceous, with small lenses of shale |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 365.0-366.4 | Shale: brownish grey, smooth textured, with irregular fissility |
| | 366.4-368.0 | Sandstone: shaly, fine grained, finely porous, subgreywacke type; minute lenses of shale |
| 60 | 368.0-377.0 | Sandstone: fine grained, blocky argillaceous, as above |
| 61 | 377.0-379.5 | Siltstone: shaly, as above |
| | 379.5-381.3 | Shale: very silty, with irregular banding |
| | 381.3-381.8 | Siltstone: shaly laminated |
| | 381.8-382.5 | Shale: light grey, smooth textured, with abundant carbonized vegetable matter and tarnished pyrite |
| | 382.5-384.0 | Siltstone: shaly laminated |
| | 384.0-386.0 | Shale: brownish grey, smooth textured, blocky; specks of carbon |
| 62 | 386.0-389.0 | Shale: silty in part, light grey, blocky, smooth textured, finely banded in part |
| | 389.0-391.0 | Shale: smooth textured, with specks of carbon; much shaly sandstone and sandy shale in irregular bands and lenses |
| | 391.0-395.0 | Siltstone: argillaceous, light grey, blocky |
| 63 | 395.0-396.2 | Siltstone: very argillaceous greywacke type (containing rock fragments), with irregular bands of silty shale |
| | 396.2-401.0 | Shale: very silty, with irregular bands of siltstone |
| | 401.0-407.0 | Shale: silty, light grey, blocky, massive; bands of siltstone laminations |
| 64 | 407.0-409.0 | Shale: silty, with intergrading bands and lenses of silt |
| | 409.0-419.0 | Sandstone: argillaceous, yellowish grey, fine grained, subgreywacke type; yellow-green glauconite |
| 65 | 419.0-421.3 | Shale: grey, smooth textured; streaks of pyrite, sandy lenses in upper half of interval |
| | 421.3-431.0 | Siltstone: light grey, interbedded with silty shale, and smooth textured shale in upper part |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 66 | 432.0-433.5 | Sandstone: fine grained shaly |
| | 433.5-434.5 | Shale: medium grey, slightly sandy |
| | 434.5-437.0 | Sandstone: shaly at top, argillaceous downward, grading to medium fine grained, poorly indurated sandstone, subgreywacke type, very porous toward base, dark grains, yellow-green glauconite |
| | 437.0-437.5 | Sandstone: calcareous, argillaceous, hard, medium fine grained, glauconitic |
| | 437.5-440.5 | Sandstone: argillaceous, medium fine grained, firm, porous, yellow-green glauconite, carbonized wood |
| | 440.5-441.0 | Sandstone: calcareous, as in 437-437.5 |
| 67 | 441.0-452.0 | Sandstone: argillaceous, pale grey very fine grained, blocky, finely porous; grains of dark chert, white clay and yellow-green glauconite |
| | 452.0-453.0 | (?) no recovery |
| 68 | 453.0-455.5 | Sandstone: argillaceous; fish bones, pyrite |
| | 455.5-456.8 | Siltstone: argillaceous, pale grey, shaly laminated, carbonized wood |
| | 456.8-458.0 | Ironstone: calcareous, grey, cryptocrystalline |
| 69 | 458.0-463.0 | Shale: light grey blocky, finely silty in part; specks of carbon, interbeds of grey siltstone |
| | 463.0-464.5 | Shale: medium brownish grey, smooth textured; carbonized vegetable matter, abundant lenses of light grey silt |
| | 464.5-465.0 | Shale: bentonitic (?), brownish grey, waxy textured |
| | 465.0-466.7 | Shale: silty laminated, grading to shaly siltstone; varve-like laminations, gradational upward, sharp at base |
| | 466.7-471.0 | Siltstone: coarse, argillaceous, light grey, massive; some irregular banding |
| 70 | 471.0-481.0 | Siltstone: very argillaceous, or silty mudstone, light grey, massive, faintly banded |
| | 481.0-485.0 | (?) no recovery |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 71 | 485.0-490.2 | Shale: silty, light grey intergrading with argillaceous siltstone; abundant carbonized vegetable matter, partings with plant fragments |
| | 490.2-492.0 | Shale: silty, light grey |
| 72 | 492.0-494.2 | Shale: silty, as above; chlorite, sericite flakes, abundant carbonized plant fragments |
| | 494.2-498.0 | Shale: brownish grey, slightly silty, blocky; more or less smooth textured zones, irregular bands of silt |
| 73 | 498.0-503.5 | Shale: medium grey, smooth textured, more or less silty |
| | 503.5-505.0 | Shale: finely silty, light grey, massive; plant fragments |
| 74 | 505.0-510.0 | Shale: finely silty as above |
| | 510.0-510.5 | Sandstone: argillaceous, medium fine grained, porous, subgreywacke type, gradational with interval above; yellow-green glauconite (?) |
| | 510.5-515.0 | Sandstone: mostly shaly, with irregular banding, becoming more shaly in basal 30 cm; carbonized vegetable matter |
| 75 | 515.0-516.0 | Shale: medium dark grey, mottled; irregular lenses of silt |
| | 516.0-518.5 | Siltstone: shaly, light grey, finely mottled from flattened pebble-like inclusions |
| | 518.5-520.3 | Shale: dark grey, silty, mottled as in 515-516.0 above |
| 76 | 520.3-527.3 | Sandstone: shaly, or sandy shale, brownish grey mottled; interdigitating bands of light grey, very fine grained sand and dark grey shale, granular pyrite, plant carbon |
| | 527.3-528.8 | Shale: finely sandy in part, brownish grey, blocky; plant carbon, pyrite |
| | 528.8-530.3 | Sandstone: argillaceous, very fine grained, subgreywacke type, intergrading with interval above |
| | 530.3-532.0 | (?) no recovery |
| 77 | 532.0-544.0 | Siltstone: very argillaceous, light grey, with brown cast, massive, chert grain, subgreywacke, or lithic, type |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 78 | 544.0-547.0 | Siltstone: more or less shaly, with irregular banding in shades of brownish grey, cone-in-cone calcite fragment (core broken) |
| | 547.0-549.0 | Core missing |
| 79 | 549.0-561.0 | Sandstone: very fine grained, or siltstone, very argillaceous, light grey massive |
| 80 | 561.0-573.0 | Siltstone: argillaceous, massive, as above; grades to silty, blocky shale in basal 60 cm |
| 81 | 573.0-585.5 | Siltstone: argillaceous, massive, as above |
| | 585.5-586.0 | (?) no recovery |
| 82 | 586.0-595.0 | Siltstone: muddy, massive, as above |
| 83 | 595.0-598.0 | Shale: silty, light grey, blocky; pyrite streaks |
| 84 | 598.0-602.0 | Shale: dark grey, smooth textured; fine silty mottling |
| | 602.0-604.0 | Shale: very silty, light grey, pyrite streaks |
| | 604.0-605.0 | (?) no recovery |
| 85 | 605.0-608.0 | Siltstone: shaly, massive |
| | 608.0-615.0 | Siltstone: shaly, massive, as above; pyrite streaks, light grey specks of carbon |
| 86 | 615.0-616.0 | Shale: very silty, as above |
| 87 | 616.0-624.0 | Siltstone: shaly, or silty shale, light grey, faintly mottled, massive |
| 88 | 624.0-630.0 | Siltstone: argillaceous, as above, grading to very fine grained, argillaceous sandstone; yellow-grey, ferruginous zones 7.5 cm thick, 2.5 cm from top of core |
| | 630.0-632.0 | Sandstone: shaly banded |
| 89 | 632.0-635.0 | Sandstone: light grey with brown cast, thinly interbedded and intergrading with laminated silty shale |
| | 635.0-637.5 | Shale: silty, brownish grey; fragments of minute plants, cast of pelecypod |
| | 637.5-638.0 | (?) no recovery |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 90 | 638.0-645.5 | Siltstone: argillaceous, intergrading with silty shale, light brownish grey, blocky |
| | 635.5-636.0 | Core missing |
| 91 | 646.0-655.0 | Siltstone: shaly, intergrading with silty shale; band of fine grained sandstone 2.5 cm thick 0.6 m from base of core |
| 92 | 655.0-664.0 | Siltstone: shaly, light brownish grey, intergrading with shaly mudstone as above; rare animal burrows |
| | 664.0-664.5 | Limestone or calcareous ironstone: grey, finely sandy, a few inclusions of pyrite |
| | 664.5-665.2 | Mudstone: silty |
| 93 | 665.2-670.2 | Siltstone: argillaceous, or silty shale; irregular finely sandy, sandy lenses (lithic); streaks of pyrite; minute shell fragments |
| | 670.2-670.4 | Ironstone: nodule, grey |
| | 670.4-673.5 | Siltstone: argillaceous |
| 94 | 673.5-680.0 | Siltstone: argillaceous, as above |
| 95 | 680.0-684.0 | Siltstone: shaly, or finely sandy mudstone, abundant dark grains in coarse fraction. |
| | | Lower marine shale |
| 96 | 684.0-689.5 | Shale: finely sandy |
| | 689.5-696.0 | Shale: silty, light grey with green cast; indefinite bands of argillaceous siltstone near centre of interval |
| 97 | 696.0-707.0 | Shale: silty, light brownish grey, blocky |
| | 707.0-709.0 | Shale: silty |
| 98 | 709.0-716.0 | Shale: silty; irregular sandy partings, a few with finely divided pyrite |
| 99 | 716.0-720.5 | Shale: silty to finely sandy, laminated in part, largely massive as above |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 100 | 720.5-726.0 | Shale: silty, as above |
| | 726.0-728.5 | Core missing |
| | 728.5-730.0 | Shale: silty, blocky; oxidized pyrite inclusions |
| 101 | 730.0-732.0 | Shale: silty, light grey with brown cast; oxidized pyrite inclusions |
| 102 | 732.0-742.0 | Shale: finely silty, blocky, light grey with brown cast; a few sandy partings with oxidized pyrite in upper half of core |
| 103 | 742.0-754.0 | Shale: silty in part, light brownish grey, largely smooth textured, minute lenses of fine grained sand; scattered carbonaceous inclusions with oxidized pyrite, 6 to 30 cm long, irregular |
| 104 | 754.0-757.0 | Shale: silty, as above |
| 105 | 757.0-758.0 | Shale: silty with minute sand lenses, as above |
| 106 | 758.0-762.0 | Shale: more or less silty, light grey with brown cast |
| 107 | 762.0-765.8 | Shale: more or less silty; zones with partings of very fine sand |
| | 765.8-767.4 | Core missing |
| | 767.4-773.0 | Shale: more or less silty, smooth textured, as above; non silty zones |
| 108 | 773.0-782.4 | Shale: silty in part; zones with finely sandy partings |
| | 782.4-783.0 | Core missing |
| 109 | 783.0-789.4 | Shale: silty, light brownish grey, to finely sandy; micaceous partings of very fine grained sandstone |
| | 789.4-791.0 | Ironstone: calcareous, grey; cone-in-cone in top and basal 15 cm, cubes of pyrite |
| 110 | 791.0-795.2 | Shale: silty to finely sandy; tarnished pyrite streaks, small *baculites* |
| | 795.2-796.0 | Core missing |
| 111 | 796.0-799.0 | Shale: more or less silty, with sandy partings as above |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 112 | 799.0-800.5 | Shale: very silty or very finely sandy |
| | 800.5-806.0 | Shale: silty in part, light grey with brown cast; iridescent shell fragment |
| 113 | 806.0-815.8 | Shale: silty as above, faintly laminated in basal 10 cm of interval |
| | 815.8-816.0 | Shale: dark grey, with smooth, waxy texture |
| 114 | 816.0-823.0 | Shale: very silty to sandy, medium light grey, silty to sandy, blocky |
| | 823.0-824.7 | Ironstone: calcareous, dark grey |
| | 824.7-826.0 | Shale: silty, blocky, as above |
| 115 | 826.0-835.0 | Shale: silty, medium grey, blocky; slickensides dip 50°, 30 cm from base of core |
| 116 | 835.0-846.0 | Shale: silty, medium grey, blocky |
| 117 | 846.0-853.0 | Shale: medium grey, blocky |
| 118 | 853.0-856.0 | Shale: silty, medium grey with brown cast |
| | 856.0-866.0 | Shale: silty to sandy, light grey with brown cast |
| 119 | 866.0-869.0 | Shale: medium light grey, coarsely silty, blocky |
| 120 | 869.0-869.7 | Shale: bentonitic in part, dark greyish brown, waxy |
| 121 | 869.7-873.1 | (?) no recovery |
| 122 | 873.1-879.0 | Shale: light grey with brown cast, silty as above |
| 123 | 879.0-879.5 | Shale: silty, light grey with brown cast |
| 124/125 | 879.5-887.5 | Shale: silty |
| 126 | 887.5-890.0 | Shale: silty |
| 127 | 890.0-896.5 | Shale: silty, light grey with brown cast |
| | 896.5-897.0 | Core missing |
| 128 | 897.0-906.0 | Shale: silty, light grey with brown cast |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 129 | 906.0-907.8 | Shale: silty |
| | 907.8-913.5 | Shale: silty, light grey with brown cast, blocky |
| 130 | 913.5-915.8 | Shale: silty, as above |
| | 915.8-916.0 | (?) no recovery |
| 131/132 | 916.0-919.5 | Shale: medium grey, silty, as above |
| 133 | 916.0-919.5 | Shale: very silty, medium grey, blocky |
| 134 | 919.5-928.0 | Shale: silty, medium grey |
| 135 | 930.7-942.0 | Shale: medium light grey as above, and smooth textured non-silty shale; *Baculites* |
| 136 | 942.0-952.0 | Shale: medium light grey, smooth textured; brown cast, pyrite streaks, zones with irregular silty partings |
| 137/138 | 952.0-957.0 | Shale: light grey with brown cast, smooth textured, very finely and slightly silty, spots of finely granular pyrite |
| 139 | 957.0-962.0 | Shale: light grey with brown cast, smooth textured, slightly silty, blocky |
| 140 | 962.0-972.0 | Shale: silty, as above, with rare small silty lenses; brown ironstone concretions 10 mm long near centre of core |
| 141 | 972.0- | Shale: light grey with brown cast, smooth textured; abundant slickensides from 975 to 984', dipping 80° to 30° |
| 142 | 984.0-993.0 | Shale: blocky, as above, ironstone band 5 cm thick near 988' |
| 143 | 993.0-1003.0 | Shale: light grey with brown cast, blocky; abundant pyrite streaks |
| 144 | 1003.0-1015.0 | Shale: medium light grey, blocky, smooth textured; pyrite streaks, slickensides dipping 50° at 1007 and 1011' |
| 145 | 1015.0-1025.0 | Shale: medium light grey, conchoidal fracture |
| 146 | 1025.0-1034.0 | Shale: medium light grey, blocky, fish remains |
| 147 | 1034.0-1041.0 | Shale: medium light grey, blocky; pyrite streaks |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 148 | 1041.0-1053.0 | Shale: medium light grey, blocky, smooth textured, conchoidal fracturing; band of bentonite 5 cm thick at 1043.5' |
| 149 | 1053.0-1065.0 | Shale: blocky, as above; band of bentonite 5 cm thick at 1059' |
| 150 | 1065.0-1078.0 | Shale: medium light grey, blocky, with pyrite streaks |
| 151 | 1078.0-1079.5 | Shale: medium light grey, blocky, conchoidal fracturing; spots of granular pyrite |
| | 1079.5-1086.0 | Core missing |
| 152 | 1086.0-1086.8 | Core missing |
| | 1086.8-1088.5 | Shale: medium grey, conchoidal fracturing; fish remains |
| | 1088.5-1090.0 | Core missing |
| 153 | 1090.0-1093.0 | Shale: medium light grey, blocky, darker shale has waxy, bentonitic appearance, fish bones |
| | 1093.0-1095.0 | Shale: medium light grey, blocky, scattered fish remains |
| 154 | 1095.0-1103.7 | Shale: medium light grey; specks of carbonized organic matter, widely scattered fish remains |
| | 1103.7-1105.0 | (?) no recovery |
| 155 | 1105.0-1107.5 | Shale: medium light grey, blocky, scattered fish remains |
| 156 | 1107.5-1108.3 | Shale: conchoidal fracturing as above |
| 157 | 1108.3-1118.5 | Shale: medium light grey, blocky, spots of finely granular pyrite, scattered fish remains, thin pelecypod shell, poorly preserved |
| 158/159 | 1118.5-1129.5 | Shale: medium light grey, blocky, fish remains, vertical fracture, 1123.5-1124' |
| 160 | 1129.5-1142.2 | Shale: medium light grey, blocky, fish remains, streaks of finely granular pyrite |
| 161 | 1142.2-1143.0 | No recovery |
| 162 | 1143.0-1147.8 | Shale: medium light grey, blocky, as above |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 163 | 1147.8-1149.0 | Shale: medium light grey, blocky |
| | 1149.0-1150.0 | Core missing |
| | 1150.0-1151.1 | Shale: medium grey, blocky |
| | 1151.1-1154.0 | (?) no recovery |
| 164 | 1154.0-1157.0 | Shale: medium grey, blocky, pyrite streaks, waxy, bentonitic bands 10 cm thick at 1154 and 1157', brown stained and ferruginous in part |
| 165 | 1157.0-1157.5 | Core missing |
| | 1157.5-1166.5 | Shale: medium light grey as above |
| | 1166.5-1167.0 | (?) no recovery |
| 166 | 1167.0-1171.5 | Shale: medium light grey, blocky, fish remains, granular pyrite |
| 167 | 1171.5-1181.0 | Shale with pyrite and fish remains, as above |
| 168 | 1181.0-1181.3 | No recovery |
| 169 | 1181.3-1193.5 | Shale: medium light grey, blocky ferruginous band 10 mm thick at 1190.5' contains white and yellow water soluble minerals |
| 170 | 1193.5-1194.0 | Shale: medium light grey, blocky, as above. |
| | | Boyne Formation |
| | 1194.0-1205.0 | Shale: calcareous, medium light grey, white speckled, flaky to blocky; specks of organic matter, widely scattered fish remains |
| 171 | 1205.0-1209.5 | Shale: calcareous, white speckled |
| | 1209.5-1210.0 | Core missing |
| | 1210.0-1213.0 | Shale: calcareous, white speckled; chalky inclusions up to 1 mm long at 1213' |
| 172 | 1213.0-1225.0 | Shale: calcareous, white speckled, medium light grey, flaky firm |
| 173 | 1225.0-1235.0 | Shale: calcareous, white speckled, as above |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 174 | 1235.0-1241.0 | Shale: calcareous, white speckled, flaky |
| 175 | 1241.0-1246.7 | Shale: calcareous, medium grey, white speckled |
| | 1246.7-1246.9 | Shale: medium dark grey, bentonitic (?); band of ferruginous (?) bentonite 10 mm thick, with water-soluble yellow and white minerals. |
| | | Favel Formation (?) |
| | 1246.9-1247.5 | Shale: calcareous, medium dark grey, white speckled; two bands of ferruginous material as above, *Inoceramus* fragments |
| | 1247.5-1250.0 | Shale: calcareous, dark grey, white speckled; flaky to blocky, harder than above |
| 176 | 1250.0-1262.0 | Shale: calcareous, dark grey, white speckled; sparsely speckled zones from 1260 to 1262' |
| 177 | 1262.0-1270.0 | Shale: medium dark grey, white speckled in part; calcareous and carbonaceous specks, brown organic matter |
| 178 | 1270.0-1277.8 | Shale: dark grey, flaky to blocky, calcareous in part; rare oysters, fish remains, zones with sparse white specks, sericite, biotite |
| | 1277.8-1284.0 | Shale: very calcareous, dark grey, white speckled; hard bands grading to argillaceous limestone; abundant *Inoceramus* lenses |
| 179 | 1284.0-1294.5 | Shale: calcareous, medium grey, white speckled. |
| | | Lower Colorado (Ashville) Group |
| | | Unnamed Beds |
| | 1294.5-1297.0 | Shale: medium dark grey, flaky and firm, slightly calcareous; abundant fish remains, scattered white specks |
| | 1297.0-1298.0 | Shale: medium dark grey, slightly calcareous, flaky to blocky, firm; scattered fish remains |
| 180 | 1298.0-1310.5 | Shale: dark grey, flaky, with dark carbonaceous specks; zones of silt laminae below 1304', zones with fish remains; highest "spearspore" elongate spore cases at 1306' |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 181 | 1310.5-1323.0 | Shale: medium grey, blocky to flaky, pyrite streaks and disseminated pyrite; no carbonaceous specks, no spear spores |
| 182 | 1323.0-1333.0 | Shale: medium grey, blocky, conchoidal fracturing, lighter grey silty laminae (varve type); irregular silt lenses below 1328' |
| 183 | 1333.0-1345.0 | Shale: medium grey, blocky as above; a few silty laminae |
| 184/185 | | No hole cut |
| 186 | 1345.0-1355.8 | Shale: medium grey, blocky; scattered silt laminae |
| | 1355.8-1358.0 | (?) no recovery |
| 187 | 1358.0-1358.5 | (?) shale: medium light grey, blocky, silty |
| 188 | 1358.5-1364.0 | Shale: medium light grey, blocky, silty; worm burrows, spots of tarnished granular pyrite |
| 189 | 1364.0-1370.0 | Shale: medium light grey, blocky |
| | 1370.0-1370.5 | Shale: silty lenses containing abundant globular agglutinated forams |
| | 1370.5-1376.0 | Fish scale marker beds, shale: medium light grey, as above; silty partings and burrows, intergrading highly silty bands up to 15 cm thick below 1374' |
| 190 | 1376.0-1383.0 | Shale: medium light grey, blocky, with silty burrows |
| 191 | 1383.0-1391.5 | Shale: medium grey blocky; silty burrows; irregular silty parting below 1388', vertical fracture from 1388 to 1389.5' filled with gypsum (?) |
| 192 | 1391.5-1398.0 | Shale: medium light grey, blocky, finely silty in part; burrows, irregular silt partings and lenses, scattered fish remains |
| 193 | 1398.0-1406.0 | Shale: medium light grey, blocky, slightly silty, with irregular silt lenses below 1402' |
| 194 | 1406.0-1418.0 | Shale: medium light grey, blocky |
| 195 | 1418.0-1426.0 | Shale: medium light grey blocky, as above; scattered fish remains; pyrite streaks; ferruginous zone about 156 m thick at 1423', containing abundant minute crystals of siderite |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 196 | 1426.0-1438.0 | Shale: medium light grey, blocky, as above; slightly silty below 1437' |
| | 1438.0-1448.0 | Whipstock |
| 197 | 1448.0-1452.0 | Shale: medium light grey, silty, with abundant silt partings and burrows |
| | 1452.0-1454.5 | Shale: dark grey bentonitic, blocky, slightly waxy |
| | 1454.5-1454.7 | Bentonite: light brownish grey |
| | 1454.7-1455.0 | Shale: light grey, bentonitic; granular pyrite, foraminifera |
| 198 | | No recovery |
| 198/199 | 1455.0-1460.5 | Shale: medium light grey, blocky silty to finely sandy in part; abundant, white, silty specks. |
| | 1460.5-1461.0 | Sandstone: argillaceous, sideritic, glauconitic, with abundant white clay matrix; dark chert grains, calcareous zones; disseminated pyrite. |
| 200 | 1461.0-1463.0 | Shale: medium grey, blocky |
| | | Core missing |
| | 1463.0-1470.0 | Whipstock |
| 201 | 1470.0-1478.0 | Shale: medium grey, blocky; zones of silt laminae; 2.5 cm ironstone band at 1472.5' |
| | 1478.0-1478.5 | Shale: silty banded |
| | 1478.5-1479.0 | Ironstone |
| | 1479.0-1480.0 | Shale: medium grey, blocky |
| 202 | 1480.0-1480.2 | Shale: medium grey, blocky; granular pyrite |
| | 1480.2-1480.4 | Shale: light grey blocky; abundant pyrite streaks |
| | 1480.4-1481.0 | Shale: medium dark grey, smooth textured, bentonitic (?) |
| | 1481.0-1481.1 | Bentonite: light grey, brown cast |
| | 1481.1-1488.0 | Shale: medium dark grey, blocky; faint silty banding below 1486' |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 203 | 1488.0-1491.5 | Shale: medium light grey, blocky, massive; pyrite streaks |
| | 1491.5-1498.0 | Shale: medium grey, blocky; zones with silt lenses, spots of granular pyrite |
| 204 | 1498.0-1505.5 | Shale: medium grey, blocky, finely sandy in part, micaceous; abundant granular pyrite |
| | | Viking Formation |
| | 1505.5-1510.0 | Shale: highly silty, or shaly siltstone, with abundant "blebs" of finely granular pyrite; fish bones, zone of pyrite nodules at 1506' in calcareous lenses; inclusions of waxy clay (?) after fish bones (?) |
| 205 | 1510.0-1519.5 | Siltstone: very shaly, or silty shale, medium to light grey, mottled and banded; granular pyrite, tarnished in part |
| | 1519.5-1522.0 | Shale: medium light grey, with silty laminae; highly glauconitic sand lenses at 1520.7' |
| | | Joli Formation |
| 206 | 1522.0-1534.0 | Shale: medium grey, blocky, slightly sandy zone; rare sandy partings with yellow green glauconite; disseminated pyrite, irregular silty lenses below 1532' |
| 207 | 1534.0-1545.0 | Shale: medium to light grey, flaky to blocky; slightly silty zones, some with irregular current banding |
| 208 | 1545.0-1556.0 | Shale: medium light grey, blocky to flaky; disseminated pyrite |
| 209 | 1556.0-1562.5 | Shale: medium light grey, with silty, slightly sideritic, indurated zones containing glauconite and with indefinite boundaries |
| | 1562.5-1564.5 | Shale: medium grey, slightly silty and (?) ferruginous four 2.5 cm bands of shaly siltstone, sideritic, slightly calcareous and glauconitic |
| | 1564.5-1571.0 | Shale: medium grey, finely silty in part; indurated ferruginous (siderite) zones, in part with abundant green glauconite |
| 210 | 1571.0-1581.0 | Shale: medium grey, firm blocky, massive; largely silty lenses of glauconitic siderite |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 211 | 1581.0-1586.0 | Shale: medium grey, blocky |
| | 1586.0-1589.5 | Shale: silty, medium light grey; lenses of green glauconite at base |
| | 1589.5-1593.0 | Shale: medium to dark grey; sideritic lenses and siderite with abundant glauconite |
| 212 | 1593.0-1603.0 | Shale: medium dark grey; ironstone band some with current bedding; beds with crushed oysters at 1599.5 and 1602' |
| | 1603.0-1605.0 | Shale: medium dark grey, blocky |
| 213 | 1605.0-1605.5 | Shale: medium dark grey, blocky |
| | 1605.5-1606.0 | "6 inches hard sandstone"; removed from core box - sample C-14 |
| | 1606.0-1606.3 | Shale: as above |
| | 1606.3-1606.4 | Conglomerate: phosphate (?) and clay pebbles in pyrite, matrix; fish bones (?), accretionary clay balls |
| | 1606.4-1609.3 | Shale: medium dark grey, blocky |
| | 1609.3-1609.7 | Siltstone: hard, calcareous in part, with irregular shaly banding |
| | 1609.7-1610.5 | Siltstone: abundant, grading downward to shale with silty current banding |
| | 1610.5-1611.3 | Shale: with silty banding |
| | 1611.3-1613.3 | Shale: medium dark grey, blocky to splintery |
| | 1613.3-1614.8 | Shale: silty, medium grey blocky |
| | | Mannville ("Blairmore") Group |
| | | Pense Formation |
| | 1614.8-1615.0 | Sandstone: pyritic, medium grained poorly sorted, quartzose; clear quartz grains, well rounded to subangular, polished in part |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 1615.0-1617.0 | Sandstone: quartzose, medium fined grained non-indurated rare grains of glauconite (?), scattered grains of dark and light clay |
| 214 | 1617.0-1629.0 | Sandstone: quartzose, medium fine grained, well sorted, loose; scattered dark grains of chert, angular to subrounded, most with low sphericity |
| 215 | 1629.0-1635.0 | Sandstone: quartzose, medium fine grained, largely non-indurated, slightly calcareous firm zone 10 cm thick at 1635' |
| 216 | 1635.0-1636.0 | Sandstone: loose with calcareous zones as above; coarse crossbedding |
| | 1636.0-1636.5 | Core missing |
| | 1636.5-1637.6 | Sandstone: calcareous, hard, fine grained quartzose |
| | 1637.6-1640.3 | Shale: dark grey, splintery; scattered lenses and partings of brownish grey silt, ferruginous in part |
| | 1640.3-1641.5 | Siltstone: light grey, sideritic; irregular, dark, shaly partings, firm |
| | 1641.5-1647.0 | (?) no recovery |
| 217 | 1647.0-1656.3 | Shale and siltstone: shaly, interlaminated and intergrading; shale dark grey, splintery |
| | 1656.3-1658.0 | |
| 218 | 1658.0-1662.5 | Shale: silty dark grey, firm, with irregular light grey silty banding |
| | 1662.5-1663.0 | Shale: medium grey, blocky |
| | 1663.0-1668.0 | Sandstone: very fine grained, shaly, banded, poorly indurated, or highly sandy shale; abundant small burrows |
| 219 | 1668.0-1673.0 | Sandstone: argillaceous, light brownish grey, firm, porous, finely banded in part; top 15 cm of interval highly shaly, with abundant, small burrows |
| | 1673.0-1675.0 | Core missing |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 1675.0-1675.3 | Shale: very sandy, with abundant burrows at 1668' |
| | 1675.3-1676.0 | Sandstone: very fine grained |
| | 1676.0-1680.0 | Shale: highly silty to sandy, or shaly sandstone, dark grey, finely mottled with abundant, small burrows |
| 220 | 1680.0-1683.3 | Sandstone: shaly, mottled as above, soft poorly indurated, porous in part; abundant burrows. |
| | | Cantuar Formation |
| | 1683.3-1690.0 | Clay: silty or silty mudstone; light brownish grey, becoming darker grey downward; abundant slickensides (wavy) below 1687', dipping horizontal to 20° |
| | 1690.0-1692.0 | Clay: tan, abundant nodules of siderite |
| 221 | 1692.0-1692.5 | Clay: with siderite nodules as above, medium brownish grey |
| | 1692.5-1701.3 | Clay: brownish grey to dark grey in part, with siderite nodules; a few slickensides |
| | 1701.3-1702.0 | (?) no recovery |
| 222 | 1702.0-1709.5 | Clay: more or less silty, integrating with clayey siltstone; ironstone lense 8 cm thick at 1705' |
| | 1709.5-1709.8 | Siltstone: light grey, shaly banded |
| | 1709.8-1709.9 | Mudstone: silty, or siltstone as above |
| | 1709.9-1714.0 | Sandstone: very fine grained, slightly clayey, poorly indurated and porous; partings with carbonized vegetable matter and fragments of plants 10 cm thick; indurated ferruginous bands; bed of shaly silt zone 5 cm thick at 1713.7' |
| 223 | 1714.0-1715.5 | Clay: silty, or silty mudstone, brownish grey, firm; yellow brown ferruginous zone 1714 to 1714.5' of interval |
| | 1715.5-1719.0 | Siltstone: clayey, interlaminated with silty clay; parting with plant fragments |
| | 1719.0-1723.4 | Clay: dark brown, waxy; carbonaceous inclusions, slickensides |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 1723.4-1724.6 | Siltstone: argillaceous |
| | 1724.6-1725.3 | Clay: slightly silty, brownish grey, with irregular fissility; carbon specks |
| | 1725.3-1726.0 | Sandstone: very fine grained, quartzose, porous, poorly indurated |
| 224 | 1726.0-1728.0 | Clay: highly silty, grading to clayey siltstone, yellow-stained, light grey, ferruginous and indurated in part |
| 225 | 1728.0-1729.2 | Clay: grey with brown cast |
| | 1729.2-1738.5 | Siltstone: sideritic to calcareous, firm to hard |
| | 1738.5-1739.3 | Siltstone: argillaceous, poorly indurated, varying amount of current banding |
| | 1739.3-1740.0 | (?) no recovery |
| 226 | 1740.0-1745.0 | Sandstone: very fine grained, clayey, firm, largely porous; brown ferruginous and pyritic bands near top and base of interval |
| | 1745.0-1752.0 | Sandstone: quartzose very fine grained, loose, porous; discontinuous carbonaceous partings from 1751 to 1752' |
| 227 | 1752.0-1758.0 | Sand: quartzose, fine grained, slightly indurated, in part; carbonaceous parting near top |
| | 1758.0-1760.0 | Core missing |
| | 1760.0-1763.0 | (described as sand on core box)<br>Sandstone: quartzose, medium fine grained, loose, yellow stained in part |
| | 1763.0-1764.0 | (?) no recovery |
| 228 | 1764.0-1765.8 | Sandstone: quartzose, medium fine grained, yellow-stained, porous |
| | 1765.8-1767.3 | Clay: medium grey; zones with abundant small silt lenses |
| | 1767.3-1773.0 | Siltstone: shaly banded, light grey, grading downward to dark grey shale with abundant lenses of silt |
| | 1773.0-1774.5 | Shale: dark grey carbonaceous, flaky to blocky |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 1774.5-1776.0 | |
| 229 | 1776.0-1771.0 | Clay: medium grey, smooth textured; slickensides |
| | 1771.0-1783.5 | Clay: black to dark brown, carbonaceous in part at top of interval |
| | 1783.5-1786.0 | Clay: silty light brownish grey |
| 230 | 1786.0-1789.0 | Clay: brownish grey, grading downward to fine grained clayey sandstone |
| | 1789.0-1792.0 | Sandstone: quartzose, fine grained, largely loose, but clayey and slightly carbonaceous at top of interval |
| | 1792.0-1794.0 | Core missing |
| | 1794.0-1798.0 | Siltstone: clayey; firm specks of carbon |
| 231 | 1798.0-1800.7 | Clay: greyish brown, slightly carbonaceous, and silty |
| | 1800.7-1802.0 | Shale: dark grey, interlaminated with silt; silt lenses |
| | 1802.0-1802.5 | Lignite |
| | 1802.5-1809.0 | Silt: shaly at top, grading downward to non-indurated siltstone; bands of black flaky shale |
| 232 | 1809.0-1813.3 | Siltstone: clayey, with fine current bedding, grading downward to silty clay |
| | 1813.3-1820.0 | Siltstone: or very fine grained sandstone, more or less interlaminated with dark grey shale; wavy banding; shaly bands give way to carbonaceous partings in lower part of interval |
| | 1820.0-1821.0 | Core missing |
| 233 | 1821.0-1825.5 | Sandstone: very fine grained, carbonaceous partings at 1821 and 1824' |
| | 1825.5-1829.0 | Siltstone: clayey in part; zones of dark grey shale laminae grading to shale with silt laminae |
| | 1829.0-1833.0 | Siltstone: with shaly laminae |
| 234 | 1833.0-1836.2 | Siltstone: with irregular shaly banding |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 1836.2-1837.0 | Sandstone: very fine grained, shaly banded in part, poorly indurated, porous |
| | 1837.0-1840.5 | Lignite and carbonaceous clay: minute crack fillings of white clayey silt |
| | 1840.5-1844.7 | Sandstone: very fine grained, quartzose, unindurated |
| | 1844.7-1845.0 | Coal, lignitic and carbonaceous shale |
| 235 | 1845.0-1848.4 | Sandstone: brown-black quartzose, medium grained, highly carbonaceous in part, with coaly bands, loose and porous, with some brown interstitial clay |
| | 1848.4-1854.0 | Sandstone: argillaceous banded, fine grained, loose, medium to light brown; marcasite band or nodule (broken) 3.5 cm thick at 1848.6' - siltstone with marcasite matrix |
| | 1854.0-1857.0 | Siltstone: light grey, finely mottled with carbon specks in some zones, very soft |
| 236 | 1857.0-1861.7 | Siltstone: or very fine grained sandstone, largely argillaceous; zones with carbonaceous laminae |
| | 1861.7-1863.0 | Core missing |
| | 1863.0-1865.8 | Siltstone: with carbonaceous and shaly laminae; zones of shale with silt laminae |
| | 1865.8-1869.0 | Siltstone: light grey with abundant carbonaceous laminae; no sign of crossbedding |
| 237 | 1869.0-1871.3 | Siltstone: light grey, argillaceous, laminated; carbonaceous partings |
| | 1871.3-1872.4 | Siltstone: light grey, firm, clayey, porous, hard |
| | 1872.4-1878.5 | Siltstone: with abundant shaly, carbonaceous laminae, grading downward to dark grey, silty carbonaceous shale |
| | 1878.5-1879.7 | Shale: black, flaky and carbonaceous |
| | 1879.9-1881.0 | Siltstone: highly argillaceous, dark grey mottled, with abundant small burrows |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 238 | 1881.0-1881.5 | Siltstone: shaly, or silty shale, dark and light grey mottled, with minute lenses and burrows; scattered phenoclasts of rounded quartz; weathered angular white chert (?) becoming more common downward, grades downward to poorly sorted, carbonaceous shaly sandstone with white inclusions of chalky chert (?) or clay |
| | 1881.5-1887.7 | Sandstone: pale brownish grey, clayey, poorly sorted; subangular, fine quartz grains with abundant, interstitial white clay, grains with red stain; zones of grey, sandy clay, rare nodules of marcasite or pyrite |
| | 1887.7-1888.0 | Clay: grey, sandy in part; siderite nodules, inclusions of carbon |
| 239 | 1888.0-1890.2 | Clay: light greyish brown, red and yellow mottled; siderite nodules |
| | 1890.2-1891.0 | (?) no recovery |
| 240 | 1891.0-1893.0 | Clay: yellow, red mottled, highly silty; slickensides dipping 10 to 45°; irregular band of calcareous siltstone at 1891.8' dips 20°, thicknesses 3.5 cm, poorly sorted quartzose; basal contact abrupt, smooth, dips 45°. |
| | | Cretaceous or Jurassic (weathered?) |
| | 1893.0-1896.5 | Sandstone: dolomitic in part, calcareous in part, white, quartzose, mostly with secondary interstitial carbonate; inclusions and lenses of green shale below 1895.5', basal band contains oolite-like, white, accretionary grains of chert (?) |
| | 1896.5-1899.0 | Clay: brown with red fissure fillings; siderite nodules |
| | 1899.0-1899.5 | Sandstone: clayey, dolomitic white, indurated, very fine grained, quartzose; abundant siderite nodules |
| | 1899.5-1901.3 | Sandstone: dolomitic, very fine grained; scattered siderite nodules |
| | 1901.3-1903.0 | Clay: greyish tan, with irregular red banding, yellow mottling, abundant siderite nodules |
| 241 | 1903.0-1904.2 | Sandstone: medium grained, porous, quartzose, slightly clayey; well sorted subrounded grains with secondary crystal growth, grains with red stains; green clay lenses near base of interval |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 1904.2-1904.3 | Sandstone: siliceous with irregular green shaly partings; concretionary oolites of white, chalky chert, euhedral quartz crystals |
| | 1904.3-1905.0 | Clay: green, lenses with oolitic, chalky chert and inclusions of chalcedonic chert |
| | 1905.0-1908.0 | Clay: green to red and purple; 15 cm zone of nodules containing pyrite and brown to clear chert at 1907.5' |
| 242 | 1908.0-1909.0 | Mudstone or clay: greenish grey to red mottled, slightly silty, blocky |
| 243 | 1909.0-1914.0 | Clay: silty (?), grey, with green cast; purplish red mottled zones with minute siderite crystals |
| 244 | 1914.0-1915.3 | Clay: light green, red mottled; zones of carbon specks, siderite crystals. |
| | | Jurassic (equivalent of post-Watrous Formations) |
| | 1915.3-1926.0 | Mudstone: dolomitic, finely silty; zones of waxy green clay partings and crystalline, altered, bioclastic limestone near top of interval; grades downward to dolomitic siltstone about centre of interval; partly calcareous zones with pyrite, zones of fissure filling calcite |
| 245 | 1926.0-1938.0 | Siltstone: dolomitic, calcareous, highly argillaceous, or silty mudstone, grey with green cast; faint pink mottling |
| 246 | 1938.0-1938.8 | Mudstone: dolomitic, silty, as above |
| | 1938.8-1948.0 | Mudstone: dolomitic, light grey, brownish red mottled, hair-like veinlets of gypsum(?) |
| 247 | 1948.0-1960.0 | Mudstone: dolomitic, reddish brown; grades to argillaceous dolomite in irregular bands up to .3 m thick near centre of interval; zones of wavy banding, steeply dipping in part. |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | | Jurassic and/or Triassic |
| | | Watrous Formation |
| 248 | 1960.0-1974.0 | Mudstone: dolomitic, brownish red mottled, light grey in part, massive |
| 249 | 1974.0-1983.5 | Mudstone: brownish red, largely silty; zones with small, green grey mottling, minute lenses of clear gypsum |
| 250 | 1983.5-1988.0 | Siltstone: dolomitic, argillaceous, dull red to reddish tan |
| | 1988.0-2002.0 | Siltstone: as above |
| 251 | 2002.0-2016.0 | Siltstone: dolomitic, light brownish red as above |
| 252 | 2016.0-2027.0 | Siltstone: dolomitic, light brownish red, finely mottled, basal contact indefinite |
| | 2027.0-2030.0 | Siltstone: dolomitic, tan; zone with green mottling and disseminated pyrite |
| 253 | 2030.0-2046.0 | Siltstone: pale brown, becoming greenish grey mottled and containing pitted, large, sand size quartz grains below 2043'. |
| | | PALEOZOIC (Devonian) |
| | | Duperow Formation |
| | | Seward Member |
| 254 | 2046.0-2046.7 | Dolomite: microrhombic (dolomicrite), finely porous |
| | 2046.7-2047.2 | Limestone: bioclastic, tan |
| | 2047.2-2050.7 | Dolomite: argillaceous, pale grey with green cast, in part, grey banded in part |
| | 2050.7-2058.5 | Dolomite: argillaceous, greenish grey, grading to dolomitic marl with pyrite crystals, angular inclusions and lenses of brownish white dolomicrite; zones with pitted quartz grains and(?) siderite nodules |
| 254 | 2058.5-2060.0 | Dolomite: pale brown, dolomicritic; scattered pyrite; brecciated zone with finely crystalline fragments and micritic matrix; altered bioclastic layer with fine porosity after coquina |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 255 | 2060.0-2065.0 | Limestone: argillaceous, green shaly zones; light grey micritic lenses of tan, dense limestone |
| | 2065.0-2069.0 | Limestone: tan to light brown micritic; shells replaced by clear calcite, thin, irregular bedding; green shaly partings and lenses from 2065 to 2065.5' |
| 256 | 2069.0-2072.5 | Limestone: light brown grey mottled, micritic to lithographic compact |
| | 2072.5-2076.5 | Limestone: lithographic, pale brown, scattered, fine grey mottling; crystals of clear calcite |
| | 2076.5-2078.0 | Shale: calcareous and shaly limestone, light to medium grey, more shaly downward |
| | 2078.0-2080.0 | (?) no recovery |
| 257 | 2080.0-2081.3 | Limestone: dolomitic, brown microcrystalline, with inclusions of coarsely crystalline calcite |
| | 2081.3-2085.8 | Dolomite: calcareous buff microsucrose to micritic; inclusions of coarsely crystalline calcite |
| | 2085.8-2089.0 | Dolomite: argillaceous, light grey, calcareous, nodular dolomicrite |
| | 2089.0-2090.0 | Limestone: dolomitic and calcareous, dolomite, brown to buff, dolomicritic, microcrystalline, tight to microsucrose and porous; veinlets of white calcite |
| 258 | 2090.0-2093.3 | Dolomite: pale brown dolomicrite |
| | 2093.3-2095.0 | Dolomite: shaly medium grey |
| | 2095.0-2099.0 | Dolomite: pale brown buff microsucrose dolomicrite |
| | 2099.0-2100.5 | Limestone: brown, microcrystalline, dense; veinlets of calcite; brown, stylolitic partings |
| | | Dolomite: tan (pale brown), microsucrose, finely porous |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 259 | 2100.5-2108.0 | Dolomite: tan dolomicrite |
| | 2108.0-2113.0 | Limestone: tan to dark brown dolomitic, micritic with fragments of dense crystalline; limestone and dolomite in argillaceous matrix brown and bituminous in part 1/2" bituminous band 6" from top |
| 260 | 2113.0-2117.0 | Dolomite: buff (pale yellow brown), with irregular crystalline banding; crystalline to microsucrose, highly porous |
| | 2117.0-2119.0 | Dolomite: argillaceous, tan to grey; zones of bituminous specks |
| | 2119.0-2121.0 | Dolomite: brownish white, dolomicrite |
| | 2121.0-2127.6 | Limestone: greyish brown, dark brown mottled due to stylolitic partings, micritic; dolomitic zones |
| | 2127.6-2134.5 | Dolomite: pale yellow-brown (buff), dolomicrite; zone of crystalline calcite inclusions 1' 6" from base |
| | 2134.5-2136.0 | (?) no recovery |
| 261 | 2136.0-2152.0 | Dolomite: buff dolomicrite, with voids after small fossils |
| | 2152.0-2153.0 | (?) no recovery |
| 262 | 2153.0-2160.5 | Dolomite: buff microsucrose to microcrystalline; hard zone of bituminous banding, brecciated in part, with interstitial voids |
| | 2160.5-2161.2 | Mudstone: dolomitic, or argillaceous dolomite, light grey |
| | 2161.2-2165.0 | (core broken) Dolomite: pale brown to buff, dolomicrite ("cryptophombic"), porous |
| 263 | 2165.0-2166.5 | Mudstone: dolomitic, anhydritic |
| | 2166.5-2172.0 | Dolomite: pale brown to buff; dolomicrite, porous zone with relict bioclastic texture at base of interval |
| | 2172.0-2179.7 | Dolomite: greyish brown, dolomicrite, porous to compact |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2197.7-2184.0 | Dolomite: argillaceous, brownish, grey, dolomicrite; microcrystalline with microsucrose bands; scattered stromatoporoids up to 4" long |
| | 2184.0-2196.0 | Dolomite: pale greyish brown microcrystalline; bituminous specks; relict shell fragment below 2191' |
| | 2196.0-2204.0 | Limestone: dolomitic, light brownish grey argillaceous, massive. |
| | | Wymark Member |
| | 2204.0-2208.2 | Limestone: dolomitic, light brown mottled, micritic, hard, brecciated |
| | 2208.2-2215.0 | Limestone: dolomitic, pale brown, micritic, slightly chalky appearance |
| 264 | 2215.0-2226.5 | Limestone: dolomitic, pale brown, micritic, tight to very finely porous; scattered bituminous partings; zones intergrading with slightly calcareous dolomite with coarse rhombs |
| | 2226.5-2229.0 | Dolomite: pale yellow-brown buff; sugary, porous |
| | 2229.0-2248.0 | Limestone: dolomitic, microcrystalline to granular intergrading with micritic limestone below 2235'; bituminous stylolitic partings; vuggy in basal 15 cm of interval |
| 265 | 2248.0-2248.7 | Limestone: grey pale brown, dolomitic, micritic, vuggy |
| | 2248.7-2258.0 | Limestone: pale brown, darker laminated, dolomitic, micritic with sugary (dolomitic) mottling; vuggy zones up to 15 cm thick near top of interval |
| | 2258.0-2260.0 | Dolomite: pale yellow-brown, microsucrose |
| | 2260.0-2264.0 | Limestone: dolomitic, pale brown, darker brown laminated, micritic |
| | 2264.0-2265.0 | Dolomite: very pale yellow brown, calcareous in part, sugary |
| 266 | 2265.0-2268.0 | Dolomite: pale yellow-brown, sugary porous, becoming calcareous and tight in basal 15 cm of interval |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2268.0-2305.5 | Limestone: dolomitic, pale brown to light brown, micritic, tight to slightly porous; brown-laminated zone of dolomite 25 cm thick at 2272' |
| | 2305.5-2314.0 | Dolomite: grey-brown, with irregular banding and inclusions of brown anhydrite, becoming more prominent toward base; anhydrite predominates below 2395', forms bands up to 30 cm thick |
| 267 | 2314.0-2323.7 | Anhydrite: grey to brown, with inclusions of finely banded, dark grey brown dolomite |
| | 2323.7-2340.0 | Anhydrite: dark brown mottled, grading downward to brownish white |
| 268 | 2340.0-2348.0 | Anhydrite: brownish white |
| | 2348.0-2376.0 | Limestone: largely dolomitic, medium to light brown, brown laminated anhydrite interbeds up to 1.5 m thick; appearance of flow structure and brecciation in top two feet |
| | 2376.0-2390.0 | Limestone: dolomitic, pale to medium brown; bituminous, wavy banding, abundant laminated algal structures with nuclei, up to 30 cm in diameter; bioclastic matrix, microgranular chalky compact (micritic with dolomite rhombs) |
| 269 | 2390.0-2391.5 | Limestone: wavy banded, pale brown, with lenticular bodies as above |
| | 2391.5-2394.0 | Dolomite: buff, finely microsucrose, grey, argillaceous in top 15 cm of interval |
| | 2394.0-2396.3 | Limestone: dolomitic, altered bioclastic, pale brown, micritic, speckled with dolomite rhombs; abundant crystalline dolomite with fossil fragments |
| | 2396.3-2404.0 | Anhydrite: dark grey, argillaceous above 2397.9', light pale brown with fine brown mottling below |
| | 2404.0-2407.5 | Dolomite: pale brown laminated; inclusions of anhydrite above 2406'; anhydrite banding at top, microsucrose with relict bioclastic texture; finely porous bituminous partings; secondary gypsum |
| | 2407.5-2410.0 | Limestone: tan, brown laminated, micritic, speckled with dolomite rhombs, altered bioclastic; brown gypsum |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2410.0-2412.7 | Limestone: medium brownish grey, lithographic, mottled with crystalline limestone; inclusions of anhydrite |
| | 2412.7-2415.0 | Limestone: brownish white, brown laminated, micritic speckled with dolomite rhombs |
| 270 | 2415.0-2423.2 | Limestone: dolomitic, tan, brown laminated, with porous banding, micritic with abundant dolomite rhombs, altered bioclastic in part |
| | 2423.7-2432.2 | Limestone: dolomitic, mottled, micritic, altered bioclastic; scattered, wavy brown banding |
| | 2432.2-2434.8 | Dolomite: pale brownish grey mottled, micritic |
| | 2434.8-2435.5 | Anhydrite: white, brown mottled |
| | 2435.5-2447.0 | Dolomite: sugary, light brown porous, with fine brown banding |
| | 2447.0-2448.0 | Dolomite: brownish grey, microsucrose compact (dolomicrite), slightly argillaceous; lenticular and nodular algal(?) structures |
| | 2448.0-2465.0 | Limestone: dolomitic, or calcareous dolomite, grey, argillaceous, grading downward to mottled brown, less argillaceous limestone, micritic; mottling caused by more or less dolomitic areas; slightly shaly and grey in basal 15 cm of interval; zones of fossil fragments, including crinoids |
| | | Equivalent of Beaverhill Lake Formation |
| 271 | 2465.0-2480.5 | Limestone: shaly, grading to calcareous shale, wavy banded with lenticular, calcareous inclusions; abundant brachiopods in basal 1 m of interval |
| | 2480.5-2504.0 | Limestone: tan, brown mottled, with shaly banding and lenses, micritic; intergrading, grey, argillaceous zone 1 m thick at 2483', micritic to lithographic; basal 15 cm grey and argillaceous with penecontemporaneous slump over uneven basal contact |
| | 2504.0-2507.0 | Dolomite: anhydritic, argillaceous in part |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2507.0-2511.2 | Anhydrite: brownish white |
| | 2511.2-2515.0 | Dolomite: anhydritic, light grey to grey brown |
| 272 | 2515.0-2515.1 | Limestone: light brown banded |
| | 2515.1-2515.7 | Dolomite: pale brown, microrhombic (dolomicrite) |
| | 2515.7-2517.7 | Limestone: pale brown micritic, speckled with dolomite rhombs; translucent (anhydritic?) speckling |
| | 2517.7-2522.5 | Limestone: dolomitic, light brown biomicrite |
| | 2522.5-2527.2 | Limestone: tan brown, laminated, micritic, with zones of anhydritic(?) speckling |
| | 2527.2-2540.0 | Limestone: dolomitic, pale brown, with nodules and brown, wavy banding, micritic; clear gypsum inclusions; intergrades with buff dolomite from 2533.7 to 2535.2'; lower part of dolomitic zone contains intraformational breccia overlying a laminated zone 0.3 m thick |
| | 2540.0-2545.0 | Anhydrite: light brown, interlaminated and interbedded with tan, brown, laminated dolomite |
| | 2545.0-2554.5 | Limestone: dolomitic, argillaceous in part, medium grey, brown, with wavy argillaceous banding and indefinite, calcareous nodules |
| | 2554.5-2557.5 | Dolomite: tan, microrhombic (dolomicrite), grading to aphanitic, grey, argillaceous dolomite. |
| | | Souris River Formation |
| | | Hatfield Member |
| 272 | 2557.5-2558.7 | Dolomite: calcareous, greyish brown, argillaceous, altered bioclastic |
| | 2558.7-2565.0 | Limestone: highly dolomitic, pale grey brown; abundant bituminous specks; faint wavy banding, altered bioclastic |
| 273 | 2565.0-2566.7 | Limestone: dolomitic; brachiopods |
| | 2566.7-2572.0 | Limestone: grey, tan, dolomitic, micritic; brown laminated zones with dark (anhydritic?) specks gradational to interval below |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2572.0-2578.6 | Limestone: argillaceous, dolomitic, brownish grey, aphanitic, becoming more argillaceous downward |
| | 2578.6-2606.4 | Limestone: argillaceous, grey tan grading to shaly limestone, medium grey wavy banded and mottled with less argillaceous lenses; broken algal inclusions 8 cm long at base of interval |
| | 2606.4-2611.0 | Dolomite: pale brown grey, cryptocrystalline massive (dolomicrite) |
| | 2611.0-2615.0 | Anhydrite: grey brown, banded in part; dolomite inclusions below 2613' |
| 274 | 2615.0-2615.5 | Dolomite: pale brown, laminated |
| | 2615.5-2616.9 | Dolomite: tan, grey, finely mottled |
| | 2616.9-2625.0 | Limestone: tan with brown, wavy banding, micritic lenses of compact material in wavy, dolomitic banding |
| | 2625.0-2626.5 | Dolomite: pale brown to grey, anhydritic in part, micritic; anhydrite inclusions at base of interval |
| | 2626.5-2647.5 | Limestone: shaly, brown-grey |
| | 2647.5-2650.0 | Limestone: dolomitic, argillaceous at top grading downward to brown, dolomitic biomicrite; with crystal inclusions |
| | 2650.0-2661.3 | Limestone: shaly, medium to light grey, laminated; regular shale partings, bituminous banding and shell fragments(?) at base of interval |
| | 2661.3-2665.0 | Dolomite: argillaceous, brown grey, laminated in part, micritic, anhydritic in part |
| 275 | 2665.0-2667.5 | Dolomite: anhydritic, shaly, medium grey, laminated in part |
| | 2667.5-2676.7 | Anhydrite: pale brown mottled |
| | 2676.7-2679.0 | Anhydrite: dolomitic in part, brown to grey, crystalline to micritic |
| | 2679.0-2681.8 | Dolomicrite: pale to light brown mottled and banded |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2681.8-2696.3 | Limestone: pale brown, dolomitic micritic, speckled with dolomite rhombs, brown, wavy banding; zones with poorly defined lenses; brachiopods in basal 5 cm of interval |
| | 2696.3-2697.5 | Dolomite: shaly, anhydritic; grey anhydrite |
| | 2697.5-2699.2 | Limestone: brown, with fine grey mottling, micritic |
| | 2699.2-2700.0 | Dolomite: shaly, grey inclusions of clear gypsum |
| | 2700.0-2702.5 | Dolomite: argillaceous, with anhydrite inclusions, grading downward to anhydrite with dolomite inclusions |
| | 2702.5-2708.5 | Dolomite: pale brown to pale yellow brown; microsucrose zone with calcarenite texture, highly porous, becomes calcareous toward base |
| | 2708.5-2710.0 | Limestone: dolomitic, altered calcarenite |
| | 2710.0-2111.3 | Dolomite: pale yellow brown microsucrose; salt filled porosity |
| | 2111.3-2715.0 | Limestone: argillaceous in part, light grey brown, highly dolomitic, cryptocrystalline, finely mottled in part |
| 276 | 2715.0-2734.0 | Limestone: argillaceous, light brownish grey, micritic; brown, bituminous laminations in basal 20 cm of interval |
| | | Harris Member |
| | 2734.0-2741.8 | Dolomite: argillaceous or dolomitic mudstone, light grey, soft (core broken); gypsum veinlets (horizontal); and anhydrite inclusions near base of interval |
| | 2741.8-2746.5 | Dolomite: tan to grey brown dolomicrite; wavy banding at top of interval |
| | 2746.5-2752.5 | Limestone: dolomitic, brown with grey cast, argillaceous micritic, gradational to lithology below |
| | 2752.5-2756.2 | Limestone: argillaceous, pale grey with brown cast, aphanitic; indefinite brown banding; intraformational breccia; partings with carbonized plant(?) fragments near top of interval |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2756.2-2765.0 | Limestone: argillaceous, pale grey with brown cast, micritic |
| 277 | 2765.0-2778.5 | Limestone: argillaceous as above gradational downward to lithology below |
| | 2778.5-2786.0 | Limestone: tan, dolomitic, with brownish grey wavy banding; calcareous lenses and bands becoming more prominent downward; grades downward to altered bioclastic limestone |
| | 2786.0-2788.0 | Limestone: highly dolomitic, grading to tan brown laminated dolomite |
| | 2788.0-2794.0 | Anhydrite: grey argillaceous in part; interbeds 30 cm thick of tan dolomicrite |
| | 2794.0-2798.2 | Dolomicrite: tan to brown |
| | 2798.2-2800.2 | Limestone: tan, micritic, slightly to highly dolomitic |
| | 2800.2-2803.2 | Dolomite: grey tan to pale yellow-brown, dolomicrite; shaly bands 15 cm from base of interval; basal 15 cm argillaceous in part; inclusions of anhydrite. |
| | 2803.2-2809.5 | Anhydrite: brown mottled |
| | 2809.5-2810.5 | Dolomite: pale brown dolomicrite |
| | 2810.5-2815.0 | Anhydrite: brown mottled |
| 278 | 2815.0-2820.0 | Anhydrite: pale brown |
| | 2820.0-2822.5 | Dolomite: pale to light brown, microsucrose with vuggy porosity, dolomicrite in part; finely laminated in basal 10 cm of interval |
| | 2822.5-2827.0 | Anhydrite: dolomitic, brown banded; irregular inclusions of tan, microcrystalline, altered bioclastic dolomite |
| | 2827.0-2829.0 | Dolomicrite: tan, grading downward to grey, finely microsucrose dolomite; pale yellow-brown, coarsely crystalline sugary zone; zone of brown gypsum laths; vertical fracture in basal 20 m of interval |
| | 2829.0-2848.3 | Anhydrite: pale grey and brown mottled |
| | 2848.3-2850.5 | Dolomite: pale yellow brown, porous |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2850.5-2851.5 | Mudstone: dolomitic, light grey |
| | 2851.5-2855.7 | Core missing |
| | 2855.7-2856.0 | Mudstone: dolomitic, anhydritic |
| | 2856.0-2858.3 | Anhydrite: brown |
| | | Davidson Member |
| | 2858.3-2863.0 | Brownish white; translucent crystals up to 10 mm |
| 279 | 2863.0-2881.6 | Halite: brownish white, clear to translucent |
| | 2881.6-2893.7 | Dolomite: brown to buff dolomicrite; salt filled porosity, interbedded anhydritic, mudstone and anhydrite |
| | 2893.7-2915.0 | Halite: brownish white |
| 280 | 2915.0-2941.5 | Halite |
| | 2941.5-2948.7 | Anhydrite: brown dolomitic(?) |
| | 2948.7-2950.4 | Dolomite: pale yellow brown microsucrose |
| | 2950.4-2952.8 | Anhydrite: brown |
| | 2952.8-2954.8 | Dolomite: pale brown dolomicrite, with irregular, brown, bituminous banding |
| | 2954.8-2960.0 | Anhydrite: brown zones of dolomitic banding |
| | 2960.0-2965.0 | Limestone: pale brown, tan, dolomitic at top, micritic, finely mottled in part; altered calcarenite in basal 35 cm |
| 281 | 2965.0-2970.0 | Limestone: pale brown, micritic to bioclastic; salt filled vugs |
| | 2970.0-2971.0 | Dolomicrite: brown, bituminous specks |
| | 2971.0-2972.8 | Limestone: brown, micritic |
| | 2972.8-2979.0 | Limestone: brown mottled biomicrite; salt filled vugs; abundant gastropods, corals |
| | 2979.0-2985.4 | Limestone: brown mottled, micritic, oolitic in part salt filled, porosity |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 2985.4-2992.0 | Limestone: argillaceous, brown with pale brown lenses and wavy banding; lenses show faint (algal?) lamination |
| | 2992.0-3015.0 | Limestone: argillaceous, brownish grey mottled, with lenses and banding; abundant brachiopods |
| 282 | 3015.0-3065.0 | Limestone: argillaceous, brown mottled; irregular smooth-boundaried inclusions of dense lithographic limestone in argillaceous, wavy banded matrix (about 15%); zones with voids after fossils, abundant brachiopods 3023 - 3023.5' |
| 283 | 3065.0-3078.5 | Limestone: mottled, light brown, sub-lithographic, to medium brown and shaly as above; brachiopods at base of interval |
| | 3078.5-3080.8 | Limestone: argillaceous, dark brown, massive |
| | 3080.8-3084.2 | Limestone: mottled, with brown banding as at 3065'; basal 5 cm contains abundant gastropods |
| | 3084.2-3087.7 | Limestone: brown, argillaceous, massive; short veinlets up to 10 mm wide, of calcite |
| | 3087.7-3106.2 | Limestone: pale brown; sub-lithographic nodular bodies and brown wavy banding |
| | 3106.2-3109.0 | Limestone: sub-lithographic, slightly argillaceous, grading to mudstone, pale to dark brown, massive |
| | 3109.0-3112.0 | Limestone: mottled, sub-lithographic and argillaceous |
| | 3112.0-3112.5 | Limestone: shaly, dark brown banded |
| | 3112.5-3115.0 | Limestone: sub-lithographic and argillaceous, mottled as above; brachiopods |
| 284 | 3115.0-3117.5 | Limestone: mottled, sub-lithographic and shaly, as above |
| | 3117.5-3120.1 | Dolomite: shaly, greenish grey, red banded |
| | 3120.1-3122.7 | Limestone: with lithographic-lenticular nodules and shaly (wavy) banding; brachiopods; dolomitic and highly argillaceous in basal 12 cm |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | | "First Redbeds Unit" (of Davidson Member) |
| | 3122.7-3158.5 | Mudstone: dolomitic, medium grey, with green or red cast, anhydritic toward base of interval. |
| | | Dawson Bay Formation 3158' 6" |
| | 3158.5-3159.7 | Limestone: pale brown, finely banded, altered calcarenite with salt filled porosity |
| | 3159.7-3161.7 | Anhydrite: brown, with dolomite inclusions |
| | 3161.7-3164.1 | Limestone: pale brown, altered calcarenite; salt filled porosity |
| | 3164.1-3164.5 | Limestone: tan, altered bioclastic; abundant small brachiopods |
| | 3164.5-3164.7 | Shaly: dark brown, bituminous, thamnoporoid corals |
| | 3164.7-3165.0 | Limestone: altered bioclastic, as above; ostracods and crystalline calcite replacing small brachiopods |
| 285 | 3165.0-3167.5 | Limestone: tan, cryptocrystalline, nodular in part with calcarenite matrix; salt filled porosity, brown shaly banding, gastropods and other shells in basal 15 cm of interval |
| | 3167.5-3170.0 | Limestone: pale brown, stromatolitic nodules up to 10 cm; zone with dark brown, argillaceous matrix |
| | 3170.0-3181.0 | Limestone: argillaceous, dark brown, micritic; scattered thamniporoid corals and algal or stromatolitic nodules |
| | 3181.0-3190.0 | Limestone: argillaceous, dark brown as above; abundant algal nodules up to 8 cm in diameter, thamniporoid corals |
| | 3190.0-3195.0 | Limestone: argillaceous, sub-lithographic zones with scattered fossil fragments |
| | 3195.0-3203.2 | Limestone: argillaceous; sub-lithographic light greyish brown; basal contact sharp with smooth U-shaped channel or hole |
| | 3203.2-3215.0 | Limestone: light brown, slightly argillaceous, sub-lithographic; crinoid ossicles |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 286 | 3215.0-3255.0 | Limestone: light brown, grey cast, sub-lithographic, silty argillaceous; scattered crinoid ossicles; fault dipping 50°; salt filled fracture at 3227' |
| 287 | 3255.0-3257.2 | Limestone: sub-lithographic as above |
| | 3257.2-3263.6 | Limestone: argillaceous, light grey brown mottled, sub-lithographic to micritic, massive; becomes dolomitic towards base |
| | 3263.6-3267.2 | Dolomite: or dolomitic mudstone, brown grey mottled, micritic, nearly identical to limestone above in appearance; salt filled horizontal slickensides(?) |
| | 3267.2-3270.2 | Dolomite: argillaceous, micritic as above, grading downward to dolomitic mudstone, brownish grey to grey |
| | 3270.2-3275.0 | Mudstone: dolomitic, grading downward from light grey to dark brownish red |
| 288 | 3275.0-3281.5 | Mudstone: dolomitic, dark brownish red with green mottled intervals. |
| | | Prairie Evaporite |
| | 3281.5-3286.0 | Salt: pink halite crystals up to 18 mm. |

# APPENDIX IV

Lithologic log of Potash Corporation of Saskatchewan

Lanigan Division (Alwinsal)

Shaft No. 1

POTASH CORPORATION OF SASKATCHEWAN

LANIGAN DIVISION

(ALWINSAL POTASH OF CANADA)

SHAFT NO. 1

LANIGAN, SASKATCHEWAN

Location: Lsd. 4, Sec. 28, Tp. 33, Rge. 23, W2
Elevation of Shaft Collar: 1757.2 feet, datum

NOTE: Notes from 22 to 523 feet are a summary of the core log of the Sarcee 4-28 pilot hole by L.L. Price, 1963; from 623 to 2605 feet observations from the shaft well and excavated material by R.D. Holmes, 1965-1967.

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | | CENOZOIC |
| | | Quaternary deposits |
| | 0-11 | No core |
| 1 | 11-16 | Clay (till): sandy, or clayey and calcareous sand; yellow-grey, with pebbles of dolomite; cobbles up to 2½" diameter of granite or gneiss |
| 2 | 16-16.8 | Clay: sandy, yellow-brown; pebbles of dolomite; cobble 5" long of banded sideritic, quartzose sandstone; pebbles of mafic rock |
| | 16.8-21 | No recovery |
| 3 | 21-22 | Clay (till): silty, medium light grey, calcareous; scattered pebbles of carbonates; fragments 8 cm long of buff,cryptocrystalline limestone |
| 4 | 22-25 | Clay (till): silty to sandy, medium light grey; abundant pebbles up to 5 mm diameter, largely of carbonates |
| 5 | 25-26 | No recovery |
| 6-12 | 26-33 | Clay: sandy and muddy sand (core broken and mangled) pebbles up to 4 mm in diameter of carbonates, cobble of gneiss 10 cm long |
| 12 | 33-36 | Gravel: coarse; largely carbonate pebbles; cobbles of diorite and quartzite |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 14, 15 | 36-38 | Gravel, mud and (?) clay: gravel, 6-20 mm in diameter, largely subangular, of carbon 8 cm in diameter, one of cryptocrystalline, dense, smooth-textured dolomite, one of diorite |
| 16-20 | 38-41 | Clay (till): silty to sandy, light grey, calcareous; scattered pebbles from 6 cm to cobble size, of carbonate and granite; abundant pebbles (gravel lense?) at base of interval |
| 21 | 46-46.5 | Gravel and clay: fine gravel |
| | 46.5-49 | (?) No recovery |
| 22 | 49-50 | Clay: silty, medium grey; abundant, small pebbles of carbonate |
| 23 | 50-52 | Clay: silty, abundant, subangular granules of carbonate; cobbles of gneiss and carbonate |
| 24 | 52-53 | Clay: silty, medium grey; pebbles and cobbles of carbonate |
| 25-35 | 53-70 | Clay: silty, some with pebbles and cobbles; thin lenses of gravel, muddy in part |
| 36-43 | 70-106 | Clay (till): silty, calcareous, medium grey, with fine pebbles and granules; scattered pebbles of carbonate up to 6 cm long |
| 44-50 | 106-138 | Clay: silty and coarsely sandy; fragments, at top, of jasper, and quartzite; cobbles and boulders of tan cryptocrystalline dolomite; pebbles of diorite |
| 51 | 138-143 | Clay: silty, with dolomite pebbles, predominating as above; angular pebble of grey calcarenite 1" in diameter, compact and coarsely crystalline, with abundant fish remains and *Inoceramus* fragments, probably from Favel Formation |
| 52-55 | 143-168 | Till: grey, silty as above, with dolomite pebbles |
| 56 | 168-168.8 | Sand: friable |
| 57 | 172-174 | Till: medium grey, with less sand or silt than above; zones with dolomite pebbles |
| 58-60 | 174-191 | Till: medium grey, becoming slightly more silty and sandy downward; boulders of diorite and gneiss |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 61-64 | 191-215 | Gravel: fine, porous in part with angular pebbles averaging about ¼" diameter, largely of dolomite; a little white chert and sandstone; salty efflorescence; clay, interbedded and interstitial in part |
| 64 | 215-217 | Till: grey, with pebbles and small cobbles of tan dolomite |
| 65 | 217-217.3 | Sand: coarse, possibly with some fine gravel; salty efflorescence; (core distorted and mixed with mud) |
| | 217.3-220.5 | (?) No recovery |
| | 220.5-223 | Till: medium grey, blocky, finely silty, with coarse quartz grains and small pebbles and cobbles of dolomite |
| 66 | 223-225 | Till: with abundant cobbles up to 3" long, possibly coarse gravel and sand beds |
| 67, 68 | 228-233.7 | Till: medium grey, silty to sandy; abundant grit size dolomite fragments; cobbles up to 2½" long of dolomite |
| 68 | 233.7-234 | Sand: coarse, loose |
| | 234-235 | (?) No recovery |
| | 235-237 | Clay: sandy, laminated in part, dipping about 25° |
| 69-73 | 237-262 | Till: silty to sandy, with abundant, small pebbles |
| 74 | 262-275 | Sand: coarse, loose, predominately of quartz grains up to 5 mm in diameter, fairly well sorted; a little clay and dark grains from granitic rocks; small cobbles of granite at top of core |
| 75-77 | 275-306 | Till: with small pebbles and scattered cobbles predominately of dolomite |
| 77 | 306-307.3 | Clay: coarsely sandy or gravelly; possible sandy porous matrix in top 4" |
| | 307.3-319 | Till: grey, massive, with small pebbles predominately of dolomite as above |
| 78 | 319-319.4 | Gravel: fine loose, with possible clayey matrix in part |
| | 319.4-325 | Till: grey, massive; cobbles of dark gneiss at base |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 325-334 | (?) No recovery |
| 79 | 334-334.5 | Gravel: fine, with matrix of coarse sand |
| | 334.5-335.4 | Gravel: coarse, with pebbles of gneiss and dolomite |
| | 335.4-336 | (?) No recovery |
| 80 | 336-336.3 | Sand: coarse, with fine pebbles |
| | 336.3-336.7 | Gravel: fine, with clay matrix grading downward to clay |
| | 336.7-351 | Till: grey, massive, with fine pebbles predominately of dolomite |
| 81 | 351-351.5 | Clay: with salty efflorescence |
| | 351.5-352 | Till: grey, massive, with fine dolomite pebbles |
| | 352-357 | No information |
| 82-84 | 357-382 | Till: grey, massive, with fine dolomite pebbles |
| 85 | 382-382.7 | Mud: with salty efflorescence |
| | 382.7-385 | Till: grey, as above |
| | 385-387 | Small boulder of porphyritic granite (gneiss ?) embedded in laminated fine sandstone |
| 86 | 387-394 | Till: grey, with embedded small pebbles |
| 87 | 394-395 | Gravel: fine, with clay matrix in part; core badly mangled |
| | 395-401 | Sand: medium grained, loose |
| | 401-404 | No information |
| 87-89 | 404-420 | Sand: medium grained, clayey in part, intergrading and interbedded with sandy clay; laminations in possible stream bedding |
| 90, 91 | 420-443 | Till: medium grey, with minute pebbles |
| 92 | 443-446.5 | Sand: medium grained, loose |
| | 446.5-451.5 | Sand: coarse grained, muddy, with muddy fragments of pale grey and green shale, near base of core; fragments or zones of coarse quartzose sand in middle 3' of interval |
| | 451.5-454 | (?) No recovery |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 93, 94 | 454-455.5 | Sand: coarse, with pebbles (?) and fine gravel, loose, possibly with zones of clay matrix |
| | 455.5-461.3 | Sand: medium to coarse grained, poorly sorted, loose, small pebbles of clay, cobble 5 cm long at base of interval |
| 95 | 461.3-485 | (?) No recovery |
| 96 | 485-490.5 | Sand: medium to coarse grained, loose; zone of cobbles near base; salt coating on sand fragments |
| 97 | 490.5-514 | (?) No recovery |
| 98 | 514-516 | Sand: clayey, interlaminated with sandy clay (basal half of core badly mutilated) |
| | 516-528 | (?) No recovery |
| 99 | 528-529 | Silt and sand: finely laminated |
| | 529-530.5 | Sand: fine to medium grained, loose, laminated in part |
| | 530.5-536 | (?) No recovery |
| 100 | 536-537 | Sand: medium grained, loose |
| | 537-538 | Gravel: very coarse, up to 3½" long, largely of quartzite; sandy clay at base |
| | 538-548.7 | (?) No recovery. |
| | | MESOZOIC (Cretaceous) |
| | | Lea Park Formation |
| 101 | 548.7-549 | Shale: very silty, blocky, micaceous; specks of carbon |
| 102 | 549-550.7 | Shale: medium grey, silty, blocky; specks of carbon |
| | 550.7-552 | No recovery |
| 103, 104 | 552-558.5 | Shale: medium light grey, more or less silty, blocky; specks of carbon, mica; vertical fracture in lower half of interval |
| 105 | 558.5-570 | No recovery (core 105 plus whipstock interval) |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| 106 | 570-582.5 | Shale: medium light grey, silty, blocky as above; fracture plane dipping 75°, centre of core |
| | 582.5-584 | Core missing |
| | 584-585 | Ironstone |
| 107 | 585-600 | Shale: medium light grey, more or less silty, blocky; carbon specks; biotite; sericite; plant remains, partly pyritized and oxidized |
| 108 | 600-609.7 | Shale: more or less silty, as above; core broken and mutilated in part |
| | 609.7-623 | (?) No recovery |
| | Observations by R.D. Holmes 1965-1967 | |
| | 623-625 | Shale: light to medium grey, silty to finely sandy, soft, massive, blocky; ironstone concretions; pyrite streaks; ammonites, uncoiled |
| | 625-630 | Shale: as above; ammonites, uncoiled |
| | 630-635 | Shale: light to medium grey-brown, soft, massive, blocky, with indefinite silty zones; carbon specks; slickensides; ammonites, uncoiled; large, thick-shelled pelecypods; a few coiled ammonites |
| | 635-640 | Shale: light to medium grey-brown, silty, soft, blocky, massive, with indefinite silty zones; numerous carbon specks; ammonites, uncoiled |
| | 640-650 | Shale: light to medium grey-brown, silty, soft, blocky, with indefinite silt lenses; carbon specks; ammonites, uncoiled; pelecypods |
| | 650-660 | Shale: light to medium grey-brown, silty, soft, blocky, with indefinite silt lenses; carbon specks; ironstone concretions up to 8" in diameter; joint, minor, in NW wall; strike approximately NNW dip 75° NE, cleavage poorly developed, more or less horizontal; ammonites, uncoiled |
| | 660-665 | Shale: light to medium grey, silty in part, soft, blocky; carbon specks; specks of ironstone; worm trails filled with light grey to white silt; ironstone concretions; cleavage poorly developed, horizontal |
| | 665-670 | Shale: light to medium grey, slightly silty, soft, blocky, with indefinite silt lenses; carbon specks; specks of ironstone; ironstone concretions up to 6" diameter, cleavage, poorly developed, more or less horizontal |

| Depth (feet) | Lithology |
|---|---|
| 670-675 | Shale: light to medium grey, silty, soft, blocky, with very small, irregular, silt lenses; carbon specks; worm trails filled with pyrite and silt; jointing plane, minor, striking approximately NW to NNW dip 75° NE; poorly developed, horizontal cleavage |
| 675-685 | Shale: light to medium grey, silty, soft, blocky with indefinite silt lenses; scattered pyrite; carbon specks; worm trails filled with light grey silt; cleavage, poorly developed, horizontal |
| 685-695 | Shale: as above (no samples taken) |
| 695-700 | Shale: light to medium grey, silty in part, soft, blocky, with indefinite silt lenses; carbon specks; scattered pyrite; cleavage, poorly developed, more or less horizontal |
| 700-710 | Shale: more or less silty, medium to light grey, blocky, with indefinite silt lenses, soft; scattered pyrite; carbon specks; cleavage, poorly developed, horizontal |
| 710-720 | Shale: light to medium grey, more or less silty, blocky, with indefinite silt lenses; scattered pyrite; carbon specks; ironstone concretions up to 16" in diameter; jointing plane, minor, on west wall strikes NNW, dips 70-80° NE; cleavage, poorly developed, more or less horizontal |
| 720-725 | Shale: light to medium grey, silty, blocky, with indefinite silt lenses; ironstone concretions up to 10" diameter; large, shaly limestone concretions in WSW wall 5" to 9" thick, becoming thicker westward, approximately 5-6' wide; cleavage, poorly developed, horizontal |
| 725-735 | Shale: light to medium grey, slightly silty in part, smooth-textured, blocky; numerous pyrite streaks (after plants or worms ?); numerous ironstone concretions ranging from 3" in diameter to 18" in diameter; large, shaly limestone concretion in SE wall at 730', 8-10" thick, 4-5' wide; joint, minor, in west wall strikes approximately WNW dips 70-80° N; cleavage, poorly developed |
| 735-740 | Shale: light to medium grey, smooth-textured, slightly silty in part, blocky; numerous pyrite streaks; ironstone concretions; cleavage, poorly developed, horizontal |

| Depth (feet) | Lithology |
|---|---|
| 740-745 | Shale: light to medium grey, smooth-textured, slightly silty in part, blocky; numerous pyrite streaks; ironstone concretions, joint striking approximately NW dips 85° NE; cleavage, poorly developed, horizontal |
| 745-755 | Shale: as above; (no samples taken); joint continuous with joint above disappears into North wall at approximately 752'; cleavage more pronounced than in shale above |
| 755-760 | Shale: light to medium grey, smooth-textured, blocky to flaky; pyrite streaks; worm trails filled with white silt; no distinct joints or fractures; fairly horizontal cleavage |
| 760-765 | Shale: light to medium grey, slightly silty, flaky; pyrite streaks; ironstone concretions; joint, minor, in North wall strikes NNW dips 75° NE; similar joint on NE wall strikes WNW dips 85° N; cleavage moderately well developed, more or less horizontal |
| 765-770 | Shale: medium grey, smooth-textured, slightly silty in part, blocky to flaky; pyrite streaks; numerous ironstone concretions; slickensides; cleavage, moderately well developed |
| 770-775 | Shale: light to medium grey, smooth-textured, slightly silty in part, blocky to flaky; pyrite streaks; ironstone concretions; rare fish remains; cleavage, moderately well developed, horizontal |
| 775-780 | Shale: medium grey, smooth-textured, slightly silty in part, blocky to flaky; pyrite streaks; ironstone concretions; fish remains |
| 780-785 | Shale: medium grey, smooth-textured, blocky to flaky, as above; pyrite streaks; ironstone concretions; joint in SW wall strikes due west, dips 85° north; moderately well developed, horizontal cleavage |
| 785-790 | Shale: medium grey, smooth-textured, slightly silty in part, with irregular silt partings; pyrite streaks; ironstone concretions; specks of siderite (?) |
| 790-790.5 | Carbonate: light grey, coarsely crystalline, (aragonite ?) with bentonite |
| 790.5-791 | Ironstone: light brown, massive; carbonate and ironstone band dips approximately 3° from NW to SE |

| Depth (feet) | Lithology |
|---|---|
| 791-795 | Shale: light to medium grey, smooth-textured, blocky to flaky, with irregular silt partings; pyrite streaks; rare fish remains; no distinct joints or fractures; moderately well developed cleavage |
| 795-800 | Shale: as above; (no sample taken) |
| 800-805 | Shale: light to medium grey, smooth-textured, blocky to flaky; pyrite streaks; iron concretions, joint in west wall strikes approximately NW dips 70° NE; cleavage, moderately well-developed, more or less horizontal |
| 805-810 | Shale: light to medium grey, smooth-textured, silty in part, with specks of light grey silt; pyrite streaks; rare fish scales; cleavage, moderately well-developed, horizontal |
| 810-815 | Shale: light to medium grey, smooth-textured, silty in part, with specks of brown silt or siderite (?), blocky to flaky; pyrite streaks; ironstone concretions; cleavage, moderately well-developed, more or less horizontal |
| 815-820 | Shale: light to medium grey, smooth-textured, blocky to flaky; pyrite streaks; worm trails filled with white silt; numerous ironstone concretions; cleavage, moderate, horizontal |
| 820-825 | Shale: light to medium grey, smooth-textured, blocky; pyrite streaks; worm trails filled with white silt; numerous ironstone concretions; cleavage, moderate |
| 825-830 | Shale: light to medium grey, smooth-textured, blocky to flaky; pyrite streaks; ironstone concretions, rare fish remains; cleavage, moderate, horizontal |
| 830-835 | Shale: light to medium grey, smooth-textured, blocky to slightly flaky; pyrite streaks; rare fish remains; cleavage as above |
| 835-840 | Shale: light to medium grey, smooth-textured, more or less silty in part, blocky; pyrite streaks; numerous ironstone concretions; cleavage moderately well-developed |
| 840-840.5 | Limestone: light grey, coarsely crystalline, shaly, lenticular but forming almost complete band around shaft wall, dips at approximately 2° from NW to SE |

| Depth (feet) | Lithology |
|---|---|
| 840.5-845 | Shale: light to medium grey, smooth-textured, blocky to slightly flaky; abundant pyrite streaks; numerous ironstone concretions many of which are sausage-shaped and polished on exterior; fault in SE wall strikes approximately NE dips 80° SE; slickensides |
| 845-850 | Shale: light to medium grey, smooth-textured, soft, blocky to flaky, with small silt specks; abundant pyrite streaks; numerous ironstone concretions |
| 850-855 | Shale: medium grey, smooth-textured, soft, blocky to flaky; abundant pyrite streaks; numerous ironstone concretions, cleavage moderately well developed, more or less horizontal |
| 855-865 | Shale: as above; ironstone concretions; no samples taken |
| 865-866 | Shale: medium grey, smooth-textured, slightly bentonitic in part, soft, blocky, with irregular silt partings; abundant pyrite streaks, ironstone concretions |
| 866-866.2 | Bentonite: light grey to white |
| 866.2-870 | Shale: as above |
| 870-875 | Shale: medium grey, smooth-textured, soft, blocky; abundant pyrite streaks; ironstone concretions; cleavage, moderately well developed, horizontal |
| 875-877 | Shale: medium grey, smooth-textured, soft, blocky; abundant pyrite streaks; numerous ironstone concretions |
| 877-877.2 | Bentonite: light grey to white |
| 877.2-880 | Shale: as above |
| 880-885 | Shale: medium grey, smooth-textured, soft, blocky; pyrite specks and streaks; ironstone concretions; cleavage, moderate, horizontal |
| 885-890 | Shale: medium grey, smooth-textured, soft, blocky to slightly flaky; specks and streaks of pyrite; rare fish remains; ironstone concretions; cleavage, moderately well developed, horizontal |
| 890-895 | Shale: medium grey, smooth-textured, soft, flaky; numerous pyrite streaks; fish remains; cleavage, well developed, horizontal |

| Depth (feet) | Lithology |
|---|---|
| 895-898 | Shale: medium grey, smooth-textured, soft, blocky; rare fish remains |
| 898-898.4 | Bentonite and aragonite |
| 898.4-900 | Shale: as above; cleavage, well developed, horizontal |
| 900-903.5 | Shale: medium grey, smooth-textured, soft, blocky; rare fish remains |
| 903.5-903.7 | Bentonite and aragonite |
| 903.7-905 | Shale: as above; cleavage, well developed as above |
| 905-915 | Shale: as above; no samples taken |
| 915-915.6 | Shale: medium grey, smooth-textured, soft, blocky; scattered fish remains |
| 915.6-915.8 | Bentonite: light grey to white |
| 915.8-918.5 | Shale: as above |
| 918.5-919 | Bentonite: pale grey |
| 919-920 | Shale: as above |
| 920-925 | Shale: medium grey, smooth-textured, soft, blocky to flaky; pyrite streaks; scattered fish remains; cleavage, moderate, horizontal |
| 925-930 | Shale: medium grey, smooth-textured, soft, blocky; pyrite streaks; scattered fish remains; 1" band of pale grey bentonite at base of interval; cleavage, well developed, more or less horizontal |
| 930-935 | Shale: medium grey, smooth-textured, soft, blocky; pyrite streaks, fish remains; cleavage, well developed, more or less horizontal |
| 935-936 | Shale: medium grey, smooth-textured, slightly silty in part, blocky, soft except where silty; scattered fish remains |
| 936-936.1 | Shale: as above; cleavage, poorly developed, more or less horizontal |
| 940-945 | Shale: medium grey, smooth-textured, slightly silty in part, with specks of light grey silt, blocky; scattered fish remains; cleavage moderately well developed, horizontal |

| Depth (feet) | Lithology |
|---|---|
| 945-947 | Shale: medium grey, smooth-textured, slightly silty, blocky; scattered fish remains; bentonite bed 5 mm thick at base, pale grey, with dip of approximately 1½° from NW to SE |
| 947-950 | Shale: as above; cleavage, poorly developed, more or less horizontal |
| 950-955 | Shale: medium grey, smooth-textured, soft, blocky; scattered fish remains; cleavage, poorly developed, horizontal |
| 955-960 | Shale: medium grey, smooth-textured, soft, blocky; scattered fish remains; cleavage, poorly developed as above |
| 960-963 | Shale: medium grey, smooth-textured, slightly silty in part, blocky to flaky; scattered fish remains |
| 963-963.5 | Shale: pale grey, highly bentonitic, dipping 1-2° SE |
| 963.5-965 | Shale: as in 0-3' above; cleavage, poorly developed |
| 965-965.2 | Carbonate (aragonite ?): light grey, coarsely crystalline; bentonite |
| 965.2-965.3 | Shale: medium grey, smooth-textured, slightly silty in part, blocky to flaky; pyrite streaks; scattered fish remains |
| 965.3-968.4 | Bentonite: pale grey |
| 968.4-968.6 | Shale: as above |
| 968.6-968.8 | Bentonite: pale grey |
| 968.8-970 | Shale: as above; cleavage, poorly developed, more or less horizontal; bentonite bands measure approximately 8" higher on NW wall than on SE to give approximate dip of 0°50' SE |
| 970-971 | Shale: medium grey, smooth-textured, blocky to flaky; scattered fish remains |
| 971-971.7 | Bentonite band: pale grey, dip approximately 0°50' SE |
| 971.7-975 | Shale: as above; cleavage, poorly developed, more or less horizontal |
| 975-975.3 | Bentonite: pale grey; dip 0°50' SE |
| 975.3-979 | Shale: medium grey, smooth-textured, slightly silty, blocky to flaky; patches and streaks of pyrite; scattered fish remains; carbon specks |

| Depth (feet) | Lithology |
|---|---|
| 979-979.4 | Bentonite: pale grey; dip 0°50' SE |
| 979.4-980 | Shale: as above; cleavage, poorly developed, more or less horizontal |
| 980-983 | Shale: medium grey, smooth-textured, slightly silty, blocky to flaky; abundant pyrite streaks; minute carbon specks |
| 983-983.5 | Bentonite: pale grey; dips approximately 1° SE |
| 983.5-983.8 | Shale: as above |
| 983.8-984.2 | Bentonite: pale grey, dips approximately 1° SE |
| 984.2-985 | Shale: as above; cleavage, poorly developed, more or less horizontal |
| 985-990 | Shale: medium grey, smooth-textured, slightly silty, flaky; scattered fish remains; cleavage, poorly developed, horizontal |
| 990-990.3 | Bentonite: pale grey; dips approximately 0°50' SE |
| 990.3-992.5 | Shale: medium grey, smooth-textured, slightly silty in part, blocky, conchoidal-fracturing; scattered fish remains |
| 992.5-992.6 | Bentonite: pale grey, dip 0°50' SE |
| 992.5-995 | Shale: as above; cleavage, poorly developed, more or less horizontal. |
| | VERMILION RIVER FORMATION |
| | Pembina Member (?) |
| 995-998 | Shale: medium grey becoming dark grey, and harder downward, with brown cast; contact between Lea Park and Vermilion River appears graditional; fish remains. |
| | Boyne Member |
| 998-1000 | Shale: dark grey with brown cast, lightly white-speckled, calcareous, blocky, hard; scattered fish remains; carbon specks; cleavage, poorly developed, more or less horizontal; contact between Lea Park and white specks completely gradational |

| Core No. | Depth (feet) | Lithology |
|---|---|---|
| | 1000-1005 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; scattered fish remains; carbon specks; calcite veinlets (*Inoceramus* bands ?); cleavage, moderately well-developed, more or less horizontal planes |
| | 1005-1010 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky with some zones very flaky, hard except where flaky; occasional ½" biotite-rich, bentonitic (?) bands; carbon specks; fish remains; cleavage, moderately well-developed, more or less horizontal; fragments of *Inoceramus* (?) |
| | 1010-1015 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky with some zones very flaky, hard except where flaky; fish remains; carbon specks; oily smell; cleavage, moderately well-developed, more or less horizontal |
| | 1015-1015.2 | Pyrite: massive. |
| | | Favel Formation |
| | 1015.2-1020 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; some thickly speckled zones; scattered fish remains; *Inoceramus* (?) bands; cleavage, moderately well-developed, horizontal; fragments of large pelecypods |
| | 1020-1025 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; scattered fish remains; *Inoceramus* (?) bands; carbon specks; oily smell; cleavage, moderately well-developed, horizontal planes; fragments of large pelecypods |
| | 1025-1030 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky with some zones very flaky; scattered fish remains; carbon specks; strong oil smell; cleavage, moderately well-developed, horizontal |
| | 1030-1035 | Shale: dark grey with brown cast, white speckled, calcareous, blocky, hard; scattered fish remains; carbon specks; strong oil smell; cleavage, moderately well-developed, more or less horizontal |

| Depth (feet) | Lithology |
|---|---|
| 1035-1040 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard, fish remains; carbon specks; shell fragments partially to completely replaced by pyrite; oil smell; irregular, heavily speckled bands; cleavage, moderately well-developed, horizontal, fragments of small pelecypods |
| 1040-1045 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; carbon specks; scattered fish remains; strong oil smell; irregular, heavily speckled bands; cleavage, moderately well developed, horizontal planes |
| 1045-1050 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; fish remains; wood fragments; carbon specks; oil smell; cleavage, moderately well developed, horizontal; small, thin-shelled pelecypods |
| 1050-1055 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; scattered fish remains, carbon specks; matted oyster beds; earthy nodules, light brown, soft, calcareous, (phosphatic ?); cleavage, moderately well-developed, horizontal; cylindrical bulge (1½- 2') diameter) developing on SE wall extending up approximately 10'; pelecypods, small, badly crushed |
| 1055-1058 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; fish remains; carbon specks; matted oyster beds; strong oil smell; bentonite bed, 10 mm thick at base of interval |
| 1058-1060 | Shale: white-speckled, hard, as above |
| 1060-1065 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; scattered fish remains; matted oyster beds; oil smell; joint in SE wall below bulge above; stable NE dip 87-88° SE; cleavage, moderately well-developed, more or less horizontal; pelecypods, thin shelled |
| 1065-1070 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky and hard, to fissile; scattered fish remains; oil smell; joint in SE wall continues with joint above; cleavage, moderately well developed, more or less horizontal |
| 1070-1075 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; scattered fish remains; oil smell; carbon specks; joint on SE to S wall continuous with joint above (may be due to closeness of errant freeze hole ?); cleavage, well-developed, horizontal |

| Depth (feet) | Lithology |
|---|---|
| 1075-1080 | Shale; dark grey with brown cast, white-speckled, calcareous, blocky, hard; scattered fish remains; cleavage, well developed, horizontal |
| 1080-1088 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; abundant fish remains; abundant biotite flakes; a few ¼" bands of bentonite; bedding or cleavage planes, well developed, more or less horizontal except in SE side where dip increases to about 5° SE |
| 1088-1088.5 | Shale: dark grey with brown cast, white-speckled, calcareous, highly biotitic, blocky to flaky, bentonitic in part; numerous fish remains |
| 1088.5-1089.2 | Bentonite: pale grey, abundant fish remains in overlying shale layer |
| 1089.2-1090 | Shale: as above; bedding or cleavage planes dip 38° SE in SE corner of shaft only; more or less horizontal elsewhere (believed to be effect of freeze hole) |
| 1090-1090.4 | Bentonite: pale grey; matted fish remains in shale immediately overlying |
| 1090.4-1092.8 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky; fish remains; biotite flakes; oil smell |
| 1092.8-1092.9 | Bentonite: pale grey |
| 1092.9-1094 | Shale: white-speckled, as above |
| 1094-1095 | Shale: dark grey, highly calcareous, hard, massive; with numerous, irregular, calcite veinlets; bedding or cleavage planes dip 51° SE in SE wall only - elsewhere more or less horizontal; shale in bottom foot does not appear to dip in SE corner |
| 1095-1098 | Shale: dark grey, highly calcareous, with irregular calcite veins, hard, massive, blocky; fish remains; oil smell; bentonite bed 12 mm thick at base |
| 1098-1099.5 | Shale: highly calcareous as above |
| 1099.5-1099.6 | Bentonite and ironstone |
| 1099.6-1100 | Shale: highly calcareous as above; cleavage indistinct |
| 1100-100.6 | Shale: highly calcareous, as above |

| Depth (feet) | Lithology |
|---|---|
| 1100.6-1104.5 | Shale: dark grey with brown cast, lightly white-speckled, calcareous, blocky; scattered fish remains; *Inoceramus* (?) bands; slight oil smell; carbon specks, bentonitie bed 12 mm thick at base, pale grey with overlying mat of fish remains |
| 1104.5-1105 | Shale: as above; cleavage or bedding planes, moderately well developed, horizontal |
| 1105-1110 | Shale: dark grey with brown cast, white-speckled, calcareous, blocky, hard; abundant fish remains; *Inoceramus* (?) bands; bedding or cleavage, moderately well-developed, more or less horizontal |
| 1110-1110.5 | Bentonite: pale grey; overlying mat of fish remains |
| 1110.5-1113 | Shale: dark grey, white-speckled, calcareous, blocky, hard, grading into bentonitic shale at base; ¼" mat of concentrated fish remains above bentonite |
| 1113-1113.6 | Bentonite, shale: grades into pale grey bentonite. |
| | Lower Colorado (Ashville) Group |
| | Belle Fourche equivalent |
| 1113.6-1115 | Shale: medium grey, smooth-textured, more or less silty, blocky to flaky, soft, with rare silt partings, non-calcareous; abundant fish remains; abundant carbon specks; cleavage, moderately well-developed, more or less horizontal bedding planes; contact well defined; dips < 1° SE |
| 1115-1115.5 | Shale: as above; concentrated fish remains at base |
| 1115.5-1115.7 | Bentonite: pale grey |
| 1115.7-1117 | Shale: medium grey, non-calcareous, smooth-textured, more or less silty, blocky to flaky, soft, with rare silt partings; fish remains |
| 1117-1117.1 | Bentonite: pale grey |
| 1117.1-1118.7 | Shale: as above; concentrated fish remains at base |
| 1118.7-1119.6 | Bentonite: pale grey |

| Depth (feet) | Lithology |
|---|---|
| 1119.6-1120 | Shale: as above |
| 1120-1122 | Shale: medium grey, smooth-textured, soft, blocky, to flaky, more or less silty; carbon specks; fish remains |
| 1122-1122.3 | Bentonite: pale grey |
| 1122.3-1122.8 | Shale: as above |
| 1122.8-1122.9 | Bentonite: pale grey |
| 1122.9-1125 | Shale: as above, with numerous, irregular interbeds of light grey silt; cleavage, moderately well developed, more or less horizontal |
| 1125-1130 | Shale: medium grey, smooth-textured, soft, blocky to flaky, with numerous, irregular interbeds of light grey silt; scattered fish remains; cleavage moderately well-developed |
| 1130-1135 | Shale: medium grey, smooth-textured, soft, blocky to flaky, with numerous, irregular interbeds of light grey silt; scattered fish remains; cleavage, moderately well developed |
| 1135-1137 | Shale: as above, with irregular silt interbeds disappearing at base of interval |
| 1137-1140 | Shale: medium grey, smooth-textured, more or less silty, soft, very flaky; pyrite streaks; cleavage, well developed, more or less horizontal |
| 1140-1145 | Shale: medium grey, slightly silty, soft, very flaky, with rare, silt partings; pyrite streaks after plants or worms (?); cleavage; well-developed, horizontal |
| 1145-1150 | Shale: medium grey, smooth-textured, soft, blocky; numerous pyrite streaks; joint in NW wall strikes approximately NE dips 85° NW; cleavage, moderately well-developed |
| 1150-1155 | Shale: medium grey, smooth textured, soft, slightly silty in part, very flaky; numerous pyrite streaks after plants or worms (?); rare fish remains; cleavage, well-developed, more or less horizontal |
| 1155-1160 | Shale: medium grey, smooth-textured, blocky, moderately hard, with partings and irregular lenses of light grey, biotitic siltstone or very fine grained sandstone; worm trails filled with light grey silt; cleavage, moderately well developed, horizontal |

| Depth (feet) | Lithology |
|---|---|
| 1160-1165 | Shale: medium grey, smooth-textured, blocky, moderately hard, with occasional partings and thin irregular lenses of light grey silt; worm trails filled with light grey silt; cleavage, moderately well developed |
| 1165-1170 | Shale: medium grey, smooth-textured, blocky, hard, with occasional partings and irregular lenses of light grey, biotitic silt; worm trails ¼" thick filled with light grey silt; cleavage; moderately well developed |
| 1170-1175 | Shale: medium grey, smooth-textured, blocky, moderately hard, slightly silty in part; pyrite specks; joint in SW wall strikes WNW dips 62° SW; cleavage, moderately well developed, more or less horizontal |
| 1175-1180 | Shale: medium grey, smooth-textured, blocky, moderately hard, more or less silty; pyrite specks; cleavage, moderately well-developed |
| 1180-1185 | Shale: medium grey, smooth-textured, blocky, moderately hard; pyrite specks; worm trails 3/8" wide filled with light grey silt; cleavage, moderately well-developed, horizontal |
| 1185-1190 | Shale: medium grey, smooth-textured, blocky to flaky, hard, slightly silty, pyrite streaks; worm trails ¼-3/8" wide filled with light grey silt; rare fish remains; cleavage, moderately well-developed |
| 1190-1195 | Shale: medium grey, smooth-textured, blocky to slightly flaky; pyrite streaks and specks; rare fish remains; worm trails filled with light grey silt; cleavage, moderately well-developed |
| 1195-1200 | Shale: as above; no sample taken |
| 1200-1205 | Shale: medium grey mottled by silty zones, silty, blocky to flaky, with irregular partings of light grey biotitic silt; scattered pyrite; abundant fish remains; shell fragments (?) |
| 1205-1210 | Shale: medium grey, slightly silty, smooth-textured, blocky, with thin, irregular lenses of light grey silt; scattered pyrite; rare fish remains; worm trails filled with light grey silt; cleavage, poor to moderately well developed |

| Depth (feet) | Lithology |
|---|---|
| 1210-1215 | Shale: medium grey, slightly silty, flaky, with occasional thin silt lenses; no sample taken; joint in SW wall strikes WNW dips 48° SW; cleavage, moderately well-developed |
| 1215-1220 | Shale: medium grey, slightly silty, flaky, with irregular lenses of light grey silt near bottom of interval; pyrite; worm trails filled with light grey silt; 5" calcareous band at base; cleavage, moderately well developed, more or less horizontal |
| 1220-1225 | Shale: medium grey, smooth-textured, slightly silty, flaky, soft; pyrite streaks; rare fish remains; cleavage, moderately well developed |
| 1225-1230 | Shale: medium grey, smooth-textured, very slightly silty, blocky; abundant pyrite specks and streaks; rare fish remains; cleavage, moderately well-developed |
| 1230-1235 | Shale: medium grey, smooth-textured, blocky, soft; scattered pyrite; scattered fish remains; large worm trails - ¼" - 3/8" wide - filled with light grey biotitic silt; cleavage, moderately well-developed |
| 1235-1240 | Shale: medium grey, smooth-textured, very slightly silty, flaky; pyrite streaks; scattered fish remains; worm trails; cleavage, moderately well-developed |
| 1240-1245 | Shale: medium grey, smooth-textured, flaky as above; worm trails; cleavage, moderate to good |
| 1245-1250 | Shale: medium grey, smooth-textured, soft, flaky, very slightly silty; pyrite streaks; worm trails filled with light grey silt; cleavage, moderate to good |
| 1250-1255 | Shale: medium grey, smooth-textured, soft, blocky, slightly silty; pyrite; worm trails; cleavage, moderate |
| 1255-1258.5 | Shale: medium grey, as above. |
| | "Fish scales" equivalent (?) |
| 1258.5-1259 | Sandstone: light grey, fine grained, massive, shaly in part; abundant black chert pebbles at base; pyrite nodules; thickness 13" on WNW wall, thinning to 6" on ESE wall; dips 0°55' to SE |

| Depth (feet) | Lithology |
|---|---|
| | Mowry equivalent |
| 1259-1260 | Shale: medium grey, as above |
| 1260-1265 | Shale: medium grey, smooth-textured, soft, flaky, bentonitic (?) with irregular partings and thin lenses of light grey, fine grained sandstone; pyrite specks; scattered fish remains; cleavage, moderate to good |
| 1265-1270 | Shale: medium grey, smooth-textured, soft, flaky to blocky, with small, irregular patches of light grey silt; scattered pyrite; cleavage, moderate to good |
| 1270-1275 | Shale: medium grey, smooth-textured, slightly silty in part, blocky, with irregular silt lenses; scattered fish remains; grades into shaly siltstone |
| 1273-1275 | Siltstone: light grey-brown, thinly shale banded, soft, friable, poorly indurated, with pyrite nodules; ironstone; joint in SE wall strikes NNW dips 57° SW; joint in NW wall strikes NE dips 41° NW; cleavage, moderately well-developed |
| 1275-1280 | Shale: medium grey, smooth-textured, soft, blocky, with irregular silt lenses in upper 1' of interval; pyrite; ironstone concretions; scattered fish remains; joint in SE wall continuous with joint above; cleavage, moderately well-developed |
| 1280-1283.5 | Shale: medium grey, smooth-textured, soft, blocky, with lenses and interbeds of light grey-brown silt or very fine grained sandstone; pyrite nodules in sandstone; scattered pyrite; fish remains |
| 1283.5-1283.8 | Ironstone |
| 1283.8-1285 | Shale: with silt as above; cleavage, well-developed |
| 1285-1287 | Shale: medium grey, smooth-textured, soft, blocky to flaky; abundant pyrite specks and streaks; scattered fish remains |
| 1287-1287.3 | Ironstone: silty |
| 1287.3-1290 | Shale: as above (0-2'); cleavage, moderate to good, more or less horizontal |
| 1290-1292.7 | Shale: medium grey, smooth-textured, soft, blocky to flaky; scattered pyrite specks |

| Depth (feet) | Lithology |
|---|---|
| 1292.7-1293.3 | Ironstone: dark grey, silty, massive, hard |
| 1293.3-1295 | Shale: as above; cleavage, moderate |
| 1295-1298.5 | Shale: medium grey, smooth-textured, soft, flaky; abundant pyrite specks |
| 1298.5-1298.7 | Ironstone: silty |
| 1298.7-1300 | Shale: as in interval above; cleavage, moderate to good |
| 1300-1305 | Shale: medium grey, smooth-textured, soft, blocky; scattered pyrite specks; cleavage, well developed, more or less horizontal |
| 1305-1308 | Shale: medium grey, smooth-textured, slightly silty, blocky, with irregular silt partings and thin silt lenses; pyrite nodules and specks |
| 1308-1310 | Shale: medium grey, mottled by silty zones, silty, blocky, with irregular lenses of light grey silt; pyrite nodules; joint in N wall strikes WNW dips 51° NE; cleavage, moderately well developed |
| 1310-1315 | Shale: medium grey, silty, blocky, with numerous, irregular, thin lenses and interbeds of light grey-brown silt; pyrite streaks and nodules; worm trails filled with light grey silt; scattered fish remains; joint continuous with joint above; cleavage, poorly developed, horizontal |
| 1315-1315.6 | Shale: silty, as above, grades into shaly siltstone. |
| | Viking Formation |
| 1315.6-1319.7 | Siltstone; or very fine grained sandstone, grey-brown, very shaly, glauconitic, pyritic, soft, poorly indurated, thinly banded; worm burrows, silt filled |
| 1319.7-1320 | Sandstone: fine grained, calcareous, hard, with shale partings |
| 1320-1325 | Shale: medium grey, silty in part, soft, blocky, with irregular lenses and interbeds of light grey-brown fine grained sandstone; scattered pyrite; ironstone concretions; pockets of pyritic sandstone containing flattened elongated black chert pebbles; shear zone in NE wall, much slickensided; strikes NNW; dips 81° NE; cleavage, well-developed, horizontal. |

| Depth (feet) | Lithology |
|---|---|
| | Joli Fou Formation |
| 1325-1330 | Shale: medium grey, smooth-textured, silty in part, blocky to flaky, with irregular silt lenses and interbeds; ironstone concretions; scattered pyrite; pockets of pyritic sandstone which contain pebbles of black chert; shear zone continuous with shear zone above; cleavage, moderately well developed, horizontal |
| 1330-1335 | Shale: medium grey, smooth-textured, soft, blocky to flaky, with a few irregular partings and lenses of light grey siltstone; ironstone concretions; pyrite specks; scattered fish remains; shear zone continuous with shear zone above; cleavage, moderate to good, horizontal |
| 1335-1340 | Shale: medium grey, smooth-textured, soft, blocky to flaky, with occasional small irregular lenses of light grey silt; pyrite specks; scattered fish remains; cleavage moderate to good, more or less horizontal |
| 1340-1345 | Shale: medium grey, smooth-textured, soft, slightly silty in part, blocky, with thin, irregular lenses and partings of light grey silt or very fine grained sandstone; pyrite specks |
| 1345-1347 | Shale: medium grey, smooth-textured, soft, flaky, with irregular lenses and partings of light grey silt or very fine grained sandstone |
| 1347-1347.6 | Bentonite: pale grey, abundant biotite flakes |
| 1347.6-1350 | Shale: medium grey, silty in part, blocky, with lenses and partings of light grey silt or fine sand; cleavage, moderately well-developed, more or less horizontal |
| 1350-1355 | Shale: medium grey, smooth-textured, silty in part, blocky to flaky, with partings and thin lenses of light grey silt or very fine grained sandstone; lenses of light buff, calcareous mudstone; pyrite specks; cleavage, moderate to good |
| 1355-1360 | Shale: medium grey, smooth-textured, silty in part, blocky, with irregular lenses of light green-grey, glauconitic, fine grained sandstone; pyrite nodules; cleavage, moderate to poor |

| Depth (feet) | Lithology |
|---|---|
| 1360-1365 | Shale: medium grey, smooth textured, slightly silty, flaky, soft, with thin silt lenses; pyrite specks; becoming very silty and glauconitic in bottom one foot of interval; cleavage, moderately well developed, more or less horizontal |
| 1365-1368.4 | Shale: medium grey, smooth textured, silty and hard in part, blocky; pyrite specks; calcareous mudstone concretions; thin, irregular silt lenses |
| 1368.4-1368.8 | Siltstone: ferruginous |
| 1368.8-1370 | Shale: as above; joint in west wall strikes NW dips 18° SW; cleavage, moderately well developed, horizontal |
| 1370-1375 | Shale: medium grey, smooth-textured, soft, blocky to flaky, silty in part, with irregular silt lenses; ironstone concretions; scattered pyrite; cleavage, moderately well developed, horizontal |
| 1375-1380 | Shale: medium grey, smooth-textured, soft, blocky, very silty and hard in places with calcite veinlets; irregular silt lenses; pyrite specks; cleavage, moderate, poor in silty zone |
| 1380-1385 | Shale: medium grey, smooth-textured, blocky, silty in part, with numerous, thin, irregular lenses of glauconitic siltstone or fine grained sandstone; silt lenses show small-scale current bedding and clump structures; cleavage, poorly developed, horizontal |
| 1385-1390 | Shale: medium grey, silty, blocky, hard, with numerous, thin, irregular lenses of light grey-green siltstone or fine grained sandstone; sandstone is glauconitic, often highly pyritic and calcareous and shows small scale current bedding; *Inoceramus* (?) remains; cleavage, poorly developed; pelecypods, large, fragmented *(Inceramus ?)* |
| 1390-1395 | Shale: medium grey, mottled by sandy zones, silty to finely sandy, blocky, hard, with irregular lenses of silt or fine grained sandstone; sandstone glauconitic; scattered pyrite; rare fish remains; joint in SE wall strikes S 35° W dips 88° NW |
| 1395-1400 | Shale: medium grey, silty, blocky with thin, irregular lenses and interbeds of green-grey, glauconitic siltstone or very fine grained sandstone; joint in SE wall continuous with joint above; cleavage, poorly developed; fragments of large pelecypods |

| Depth (feet) | Lithology |
|---|---|
| 1400-1405 | Shale: medium grey, smooth-textured, very slightly silty, blocky; scattered pyrite; cleavage, moderately well-developed, horizontal; pelecypods |
| 1405-1410 | Shale: as above; sample missed; pelecypods |
| 1410-1412.7 | Shale: medium grey, smooth-textured, blocky; scattered pyrite; matted oyster beds |
| 1412.7-1413 | Shale: silty, highly glauconitic and pyritic |
| 1413-1415 | Shale: medium grey, smooth-textured, as above; fragments of pelecypods |
| 1415-1420 | Shale: medium grey, smooth-textured, blocky, with silty zone associated with lenses of hard, very fine grained, glauconitic, pyritic, calcareous sandstone; irregular, lense-like body of dolomitic ironstone at 1421; barite along lowermost joint plane; 3 joints, almost parallel in SW wall strike N 55° W dip 73° SW; cleavage, moderately well-developed, except where silty |
| 1420-1425 | Shale: light to medium grey, silty, blocky, with twin interbeds of light grey silt; 1½" band of pyritic ironstone (1422'); irregular pockets of pyritic phosphatic (?) rock; close-spaced set of small joints, strike approximately WNW, dip 67-70° SW; cleavage, moderate to poor. |
| | SWAN RIVER "BLAIRMORE" GROUP |
| | Pense Formation 1425' (1427'6" Core) |
| 1425-1430 | Siltstone and fine grained sandstone: medium grey shaly, calcareous, blocky, very pyritic in part, massive; cleavage, poor |
| 1430-1432 | Siltstone: shaly as above |
| 1432-1434.5 | Shale: medium grey, smooth-textured, blocky, with interbeds of pyritic silt in bottom 6"; grades into shaly siltstone |
| 1434.5-1435 | Siltstone: medium grey, very shaly, pyritic, hard, blocky, with irregular lenses of pyritic ironstone; joints in closely-spaced series, strike N 30° W, dip 60-65° SW in shale zone only - die out in siltstone; cleavage, moderate to good in shale interval |

| Depth (feet) | Lithology |
|---|---|
| 1435-1440 | Siltstone: medium grey, very shaly, massive, blocky, very hard and pyritic at base of interval; cleavage, light |
| 1440-1441 | Siltstone: shaly, pyritic as above |
| 1441-1442.5 | Sandstone: light grey-buff, fine grained, massive, calcareous, hard, pyritic in part, with occasional, thin, shale interbeds |
| 1442.5-1445 | Sandstone: light grey, very fine grained, or siltstone, with numerous shale interbeds; current bedding; small scale slump structures |
| 1445-1450 | Sandstone: light grey, very fine grained, with numerous shale interbeds; current bedding; scattered pyrite; sand is two types; one hard and calcareous, the other consolidated but less hard and more or less non-calcareous |
| 1450-1451.3 | Sandstone: with numerous shale interbeds as above; passes into medium grey shale |
| 1451.3-1454.3 | Shale: medium grey, smooth-textured, with occasional thin sandstone interbeds |
| 1454.3-1454.6 | Ironstone: slightly pyritic |
| 1454.6-1455 | Shale: as above in interval 1'4"-4'4" |
| 1455-1460 | Shale: medium grey, smooth-textured, moderately hard with interbeds of fine grained sandstone; cleavage, moderately well-developed, more or less horizontal |
| 1460-1465 | Shale: medium grey, smooth-textured, with thin interbeds of sand and silt as above (no sample) |
| 1465-1467 | Shale: with sand interbeds as above; grades into very sandy shale |
| 1467-1470 | Shale: medium grey, mottled by sandy zones; very sandy, massive; pyrite nodules in sandy zones |
| 1470-1473.7 | Shale: medium grey, sandy, massive; scattered pyrite; grades into interbedded sands and shale at base |
| 1473.7-1475 | Sandstone: light buff, fine grained, slightly friable, porous, with interbeds of medium grey shale; current bedding; pyrite nodules in sandstone layers |

| Depth (feet) | Lithology |
|---|---|
| 1475-1478 | Sandstone: light grey, fine to medium grained, soft, poorly indurated, friable, porous, with thin shale interbeds |
| 1478-1478.3 | Pyrite: massive, in places up to 8" thick. |
| | Cantuar Formation |
| 1478.3-1479.2 | Sandstone: light creamy buff, medium grained, massive, hard, very calcareous |
| 1479.2-1480 | Sandstone: buff to dark brown, medium grained, friable, soft, poorly indurated, porous, with irregular, bituminous shale partings |
| 1480-1485 | Clay: light to medium grey, with irregularly shaped red patches, smooth-textured, soft, blocky; small pockets of bituminous material; slickensides |
| 1485-1490 | Clay: medium to dark grey, with red patches in places, soft, very slightly silty, blocky, becoming siltier towards bottom; cleavage; fairly well-developed, horizontal; near-vertical cleavage planes giving the effect of concentric rings which follow the contour of the shaft wall; thus cleavage planes appear circular and always dip from shaft middle to outside; possibly a freeze effect |
| 1490-1495 | Clay: light to medium grey, with irregular red spots, very silty, relatively hard, blocky; numerous slickensides with various degrees of dip; cleavage, good horizontal; near-vertical jointing as above |
| 1495-1500 | Clay: light grey, with numerous, irregularly shaped red patches, silty to strongly silty in part, blocky, massive; numerous slickensides; traces of lignite<br><br>No joints or fractures; good horizontal cleavage |
| 1500-1501 | Clay: light grey, red-spotted, as above |
| 1501-1505 | Clay: medium to dark grey, with irregular red patches in places, silty, blocky, massive; slickensides; traces of lignite |
| 1505-1508.8 | Clay: medium to dark grey, silty, blocky, massive; traces of lignite; becoming strongly silty to sandy near base of interval; some horizontal cleavage |

| Depth (feet) | Lithology |
|---|---|
| 1508.8-1510 | Clay: dark grey, mottled by silt and sand zones, very silty to sandy, with irregular lenses of grey-brown, medium grained sandstone; no cleavage |
| 1510-1510.7 | Clay: silty to sandy as above, with numerous, irregular lenses of medium grained sandstone, some hard and calcareous |
| 1510.7-1511 | Conglomerate (?) pebbles and cobbles of orange-red and yellow-brown clay in matrix of medium to coarse grained, clayey sandstone |
| 1511-1511.7 | Clay with specks of carbon and pyrite: light to medium grey, very silty to sandy, massive; traces of carbonized wood, pyritic in part |
| 1511.7-1515 | Clay: medium to dark grey, slightly silty in part, massive, blocky; numerous slickensides |
| 1515-1520 | Clay: medium to dark grey, slightly silty to strongly silty or sandy in part, blocky, relatively soft, with irregular lenses of medium grained sandstone which contain "pebbles" of iron oxide; irregular, small lenses of lignite, with pyrite; numerous slickensides |
| 1520-1525 | Clay: medium grey, very silty to sandy, massive, with irregular lenses of medium grained sandstone; sandstone hard and calcareous in part, non-calcareous and slightly friable in part; irregular lignite lenses at base of interval; abundant pyrite (marcasite ?) in sand above and throughout lignite lenses; lignite lenses irregular and discontinuous up to 3" thick in place |
| 1525-1527.5 | Clay: medium to dark grey, slightly silty, blocky, with occasional, thin, irregular sand lenses; traces of lignite |
| 1527.5-1528.2 | Lignite: with clay interbeds; pyrite with irregular thickness |
| 1528.2-1530 | Clay: light to medium grey, slightly silty, blocky, with occasional, thin, silt lenses; traces of lignite throughout (no sample taken 1525-1530') |
| 1530-1533 | Clay: silty as above; traces of lignite |

| Depth (feet) | Lithology |
|---|---|
| 1533-1533.7 | Ironstone: series of thin bands; 5 or 6 bands thickest of which is 3/4" to 1"; approximately 8-10" higher on NW wall than on SE, with shale or clay beds between |
| 1533.7-1534.4 | Clay: dark grey, silty, with abundant bituminous material; thin lignite lenses; pyrite nodules; slickensides |
| 1534.4-1535 | Sandstone: fine grained, light grey-brown, massive, pyritic in part with thin irregular shale lenses |
| 1535-1536 | Sandstone: light to medium grey, medium grained, slightly shaly, consolidated, slightly friable; pyrite nodules; traces and small lenses of lignite (?); inclusions of carbonaceous black shale |
| 1536-1537 | Sandstone: dark grey, fine to medium grained, shaly; pyrite nodules; thin lignite lenses |
| 1537-1538.7 | Sandstone: light grey, fine to medium grained, porous, friable, slightly indurated; traces of lignite; slightly ferruginous in upper 6" |
| 1538.7-1539.2 | Sandstone: as above, with numerous thin bituminous clay interbeds; small scale crossbedding |
| 1539.2-1540 | Sandstone: light grey, fine to medium grained, friable, fine porosity, with occasional thin clay seams |
| 1540-1545 | Sandstone: as above, with occasional thin clay seams 1" to 1½" thick; traces of lignite |
| 1545-1550 | Sandstone: light grey, with partings and occasional, thin lenses or interbeds of dark grey, silty clay; sandstone, fine grained, nearly quartzose, poorly indurated, friable, finely porous; indistinct fine banding; quartz grains subrounded and well sorted |
| 1550-1555 | Sandstone: light grey, fine grained, almost quartzose, poorly indurated, friable, finely porous, with partings and occasional thin interbeds of dark grey clay; small-scale current bedding |
| 1555-1555.5 | Sandstone: as above |

| Depth (feet) | Lithology |
|---|---|
| 1555.5-1555.6 | Clay: dark grey, with lenses of sandstone; dips 3° NW |
| 1555.6-1556.7 | Sandstone: as above with indistinct clay partings |
| 1556.7-1556.8 | Clay: dips 3° NW |
| 1556.8-1558.9 | Sandstone: as above, with occasional ½" clay bands; traces of lignite |
| 1558.9-1559 | Clay: specks of pyrite; dips 1-2° SE |
| 1559-1559.8 | Sandstone: light grey, very fine grained, poorly indurated, friable, porous, with irregular,thin lenses and partings of clay; traces of lignite associated with the clay |
| 1559.8-1560 | Clay: dips 1-2° SE; clay bands seem to mark large-scale crossbedding |
| 1560-1565 | Sandstone: light grey, fine grained, nearly quartzose, poorly indurated, friable, finely porous, with thin (½-1") bands and partings of dark grey clay; irregular lenses of light brown,ferruginous (?) siltstone in clay bands; carbonized and pyritized wood fragments; clay bands dip 1-2° SE in upper 3' of interval but 1-2° NW in lower 2' |
| 1565-1570 | Sandstone: light grey, fine grained as above, with thin, clay bands |
| 1570-1575 | Sandstone: fine grained, friable, as above with occasional, thin, clay bands |
| 1575-1580 | Sandstone: as above; clay bands |
| 1580-1580.5 | Clay: dark grey, with thin (¼") sandstone interbeds: hard, brown, fine grained sandstone in bottom 1" of interval |
| 1580.5-1582.3 | Sandstone: light grey, fine grained, poorly indurated, friable, porous, with faint clay partings; small-scale,current bedding |
| 1582.3-1582.6 | Clay: irregular sandstone lenses |
| 1582.6-1584.8 | Sandstone: fine grained, friable as above, with faint, clay partings |

| Depth (feet) | Lithology |
|---|---|
| 1584.8-1585 | Clay |
| 1585-1590 | Sandstone: fine grained, poorly indurated, friable, porous, with occasional clay laminae |
| 1590-1595 | Sandstone: as above; few clay laminae |
| 1595-1600 | Sandstone: light grey, fine grained, poorly indurated, porous, friable, with indistinct clay bands; faint carbonized roots |
| 1600-1605 | Sandstone: as above; indistinct clay partings |
| 1605-1610 | Sandstone: as above, without clay bands |
| 1610-1615 | Sandstone: as above |
| 1615-1620 | Sandstone: light grey, fine grained, almost quartzose, poorly indurated, friable, porous, with indistinct clay partings |
| 1620-1625 | Sandstone: as above |
| 1625-1630 | Sandstone; as above |
| 1630-1640 | Sandstone: light grey, fine grained, as above |
| 1640-1645 | Sandstone: light grey, fine grained, almost quartzose, poorly indurated, friable, porous, with indistinct clay partings |
| 1645-1645.9 | Sandstone: as above, with irregular lenses of clay and lignite |
| 1645.9-1647.3 | Lignite: black, flaky, with pyrite nodules and stringers; lenses of sand 5-6" thick at base. |
| | JURASSIC |
| | Post-Watrous beds, undivided |
| | - contact with Cantuar is very sharp and undulating; dip appears to be SE 1-3°, relief greater than 0.8 feet |
| 1647.3-1648.2 | Limestone: very shaly, slightly dolomitic, yellowish and cream, with small crystals of calcite with pyrite |

| Depth (feet) | Lithology |
|---|---|
| 1648.2-1648.5 | Limestone: dark brown, very fine grained, crystalline, hard, irregular in thickness |
| 1648.5-1649.2 | Limestone: strongly argillaceous, yellowish to brown, compact; lense of dark brown, fine grained dolomite at base |
| 1649.2-1649.6 | Clay: greenish grey, "soapy", soft, with numerous slickensides |
| 1649.6-1650 | Dolomite: argillaceous and calcareous, compact, fairly hard, yellow-brown and brown, with fragments of hard, chocolate-coloured dolomite in upper part |
| 1650-1655 | Dolomite: yellow-brown and brown with fragments of hard, chocolate-brown dolomite in upper part, shaly and calcareous, compact, fairly hard |
| 1655-1656 | Dolomite: yellow-brown as above |
| 1656-1660 | Dolomite: very shaly, dark grey, compact, very hard |
| 1660-1664 | Dolomite: shaly, dark grey as above |
| 1664-1665 | Dolomite: light creamy buff, slightly argillaceous, with occasional, small, irregular lenses; inclusions of medium to coarse grained limestone |
| 1665-1670 | Dolomite: creamy buff, slightly argillaceous, with occasional, small, irregular inclusions of medium-grained limestone<br><br>(Siliceous zone 1670-1684.5' possible equivalent of top of Lower Gravelbourg Formation) |
| 1670-1675 | Dolomite: light brown, argillaceous, hard, compact, with occasional, small inclusions and thin (2-3") bands of rose-coloured, medium to coarse grained limestone; vugs containing small quartz crystals |
| 1675-1680 | Dolomite: light brown, argillaceous, as above, with lenses and interbeds of limestone |
| 1680-1682 | Dolomite: as above |
| 1682-1684.5 | Dolomite: creamy buff, argillaceous, compact; vugs containing quartz crystals |
| 1684.5-1685 | Dolomite: calcareous, light brown with pink cast, massive, becoming clay-banded downward |
| 1685-1686.2 | Dolomite: calcareous, light brown with pink cast, massive, as above |

| Depth (feet) | Lithology |
|---|---|
| 1686.2-1686.4 | Clay: dark brown to black, bituminous |
| 1686.4-1686.7 | Limestone: rose, medium to coarse grained, with some intercalated clay |
| 1686.7-1687.6 | Clay: soft, dark grey, with limestone partings; carbonized plant remains |
| 1687.6-1688 | Limestone: rose becoming mottled grey and rose, medium to coarse grained, irregular in thickness; some clay |
| 1688-1688.6 | Shale: grey, soft, calcareous |
| 1688.6-1690 | Shale; medium grey to greenish grey, slightly harder than clay above, calcareous |
| 1690-1693 | Shale: light grey to greenish grey, compact, with some intercalated limestone; much-slickensided. |
| | Watrous Formation 1698' |
| 1693-1695 | Mudstone: brown-red, mottled by irregular, green-grey zones, slightly silty, slightly dolomitic, compact, relatively hard, with irregular, calcite veinlets; green-grey zones;highly calcareous |
| 1695-1700 | Mudstone: brown-red, mottled by irregular green-grey zones, slightly silty, dolomitic as above |
| 1700-1705 | Mudstone: red-brown, mottled by green-grey zones; compact, relatively hard, slightly dolomitic, very slightly silty; green-grey zones irregular, containing a core of crystalline calcite; a few irregular, limestone lenses |
| 1705-1710 | Mudstone: red-brown, mottled by green-grey zones, as above |
| 1710-1715 | Mudstone: red-brown, compact, relatively hard, slightly dolomitic, slightly silty and becoming more silty towards bottom of interval; irregular zones of green-grey shale with much crystalline calcite; slickensides |
| 1715-1720 | Mudstone: red-brown, with irregular, green-grey zones, compact, relatively hard, blocky, silty, slightly dolomitic, green grey zones; calcareous |
| 1720-1725 | Shale: blocky, red-brown, with irregular, calcareous, green-grey zones, as above |

| Depth (feet) | Lithology |
|---|---|
| 1725-1730 | Shale: blocky, red-brown, silty, with irregular, calcareous, green-grey zones, as above |
| 1730-1735 | Shale: blocky, red-brown silty, as above |
| 1735-1740 | Shale: blocky, red-brown, with occasional, irregular, green-grey zones, hard, compact, silty; slickensides; rose, crystalline gypsum |
| 1740-1745 | Shale: blocky, red-brown, as above; thin gypsum veinlets |
| 1745-1750 | Shale: blocky, red-brown, silty, relatively hard, compact, with occasional, green-grey, calcareous zones; gypsum occuring as fracture filling in near-vertical veinlets up to 2" thick. |
| | Lower Watrous Formation 1750' |
| 1750-1760 | Shale: blocky, silty or shaly siltstone, dark red-brown, as above, gypsum veinlets (no sample) |
| 1760-1765 | Siltstone: dark red-brown, shaly, slightly dolomitic, hard, massive, blocky, with occasional, irregular lenses of green-grey, calcareous, shaly siltstone; numerous veins and lenses of gypsum; gypsum along near-vertical fracture in north wall strikes NNE, dips 87° SE |
| 1765-1770 | Siltstone: dark red-brown, shaly, slightly dolomitic, hard, blocky, numerous veins and lenses of gypsum; large, gypsum-filled fracture continuous with fracture above |
| 1770-1775 | Siltstone: dark red-brown, very shaly, slightly dolomitic, hard, blocky; numerous veins and pockets of gypsum; gypsum-filled fracture continuous with fracture above |
| 1775-1780 | Siltstone: shaly, or very silty shale, dark brown-red, hard, blocky, with occasional, irregular lenses of slightly calcareous, green-grey, silty shale; abundant gypsum |
| 1780-1785 | Siltstone: shaly, or very silty shale, dark brown-red, dolomitic, hard, blocky, with occasional, irregular lenses of green-grey, slightly calcareous siltstone; abundant gypsum along fractures and disseminated; a few slickensides |

| Depth (feet) | Lithology |
|---|---|
| 1785-1790 | Shale, or mudstone: silty, dolomitic, dark red-brown, hard, blocky; gypsum along near-vertical fractures (strikes NE dips SE) and along numerous, small fractures of low dip; slickensides |
| 1790-1795 | Shale, mudstone: silty, dolomitic, red-brown, as above; slickensides; gypsum |
| 1795-1800 | Shale, or mudstone: as above; gypsum |
| 1800-1805 | Shale, or mudstone: red-brown, silty, dolomitic, as above; gypsum |
| 1805-1815 | Siltstone: shaly, or silty mudstone, dark red-brown, slightly dolomitic, hard, blocky; gypsum along near-vertical fracture (strikes NNE dips 86° SE); slickensides |
| 1815-1825 | Siltstone, shaly, or mudstone: dark red-brown, slightly calcareous, hard, blocky; abundant gypsum; slickensides |
| 1825-1830 | Siltstone: shaly, dark red-brown, as above; gypsum veinlets |
| 1830-1835 | Siltstone: shaly, red-brown, dolomitic, hard, blocky, with occasional, irregular lenses of green-grey, slightly calcareous siltstone; abundant gypsum along small, irregular fractures |
| 1835-1840 | Siltstone: shaly, red-brown, dolomitic, hard, blocky; gypsum along narrow, irregular fractures and disseminated slickensides; slide dolomite grains and (?) quartz 0.025 to 0.04 mm diameter; pattern of dolomite rhombs with coiled (spiral) pattern resembling foraminifer; matrix 40% red clay |
| 1840-1845 | Siltstone: shaly, red-brown, dolomitic, as above; abundant gypsum |
| 1845-1850 | Siltstone: shaly, red-brown, as above; abundant gypsum |
| 1850-1855 | Siltstone: shaly, dark red-brown, dolomitic, hard, blocky; abundant gypsum along narrow, irregular fractures; slickensides |
| 1855-1860 | Siltstone: red-brown, shaly, hard, compact, blocky, with abundant, disseminated calcite; gypsum; slickensides; thin section shows calcite in irregular masses between quartz grains, forming the principle cement; grain size 0.25 to 0.05 mm; much gypsum in minute veinlets |

| Depth (feet) | Lithology |
|---|---|
| 1860-1865 | Siltstone: red-brown, shaly, hard, blocky, with abundant disseminated calcite; gypsum; calcite in euhedral rhombs, possibly replacing dolomite, as pseudomorphs; grain size of quartz, dolomite and calcite, 0.25 to 0.05 mm; bedded red clay |
| 1865-1870 | Siltstone: red-brown, shaly, as above |
| 1870-1873.5 | Siltstone: red-brown, calcareous, hard, blocky; rare gypsum |
| 1873.5-1875 | Sandstone: red-brown, shaly, highly calcareous, medium to coarse grained, very hard, blocky; gypsum |
| 1875-1879.5 | Sandstone: calcareous, as above |
| 1879.5-1880 | Siltstone: shaly, red-brown, calcareous, hard |
| 1880-1884 | Siltstone: red-brown, as above, becoming pinkish red towards base |
| 1884-1884.5 | Breccia: fragments of pinkish red siltstone in matrix of red-brown, calcareous sandstone |
| 1884.5-1885 | Siltstone: dark pink, silty, hard, calcareous, banded |
| 1885-1890 | Siltstone: dark pinkish red, very argillaceous, calcareous, hard, banded in some zones, with occasional, thin, irregular lenses of green-grey silt |
| 1890-1890.8 | Siltstone: dark pinkish red, very argillaceous, calcareous, hard, banded |
| 1890.8-1891 | Gypsum: white to colourless, massive, coarse grained |
| 1891-1891.5 | Dolomite: light tan, medium to coarse grained, slightly argillaceous |
| 1891.5-1891.6 | Gypsum: coarse grained, white to colourless |
| 1891.6-1892 | Siltstone: dark pinkish red, very argillaceous, calcareous, hard, banded |
| 1892-1892.4 | Gypsum: coarse grained, crystalline, white to colourless |
| 1892.4-1895 | Siltstone: light pinkish-buff, argillaceous, dolomitic, hard |
| 1895-1900 | Siltstone: or mudstone, variegated, red, green and grey, dolomitic, argillaceous, hard |

| Depth (feet) | Lithology |
|---|---|
| 1900-1904.7 | Mudstone: variegated, red, brown and green, slightly silty, dolomitic, hard, with numerous veins of gypsum |
| 1904.7-1905 | Dolomite: pinkish red, silty, hard, compact, vuggy, with disseminated gypsum or anhydrite, passes into dolomitic sandstone |
| 1905-1905.2 | Dolomite: as above (4'8"-5") |
| 1905.2-1907 | Sandstone: light tan, fine grained, dolomitic, relatively hard, massive |
| 1907-1910 | Dolomite: tan to pink and green, massive, slightly silty, becoming less silty with depth; abundant, irregular lenses of gypsum or anhydrite |
| 1910-1914 | Dolomite: flesh-pink, with green tinge in places, massive, with irregular, small lenses of anhydrite or gypsum, becoming red-brown and argillaceous with depth |
| 1914-1914.5 | Dolomite: red-brown, argillaceous, softer than dolomite above, with occasional veins of gypsum or anhydrite |
| 1914.5-1915 | Dolomite: highly argillaceous, green, blocky |
| 1915-1915.7 | Dolomite: light grey-green, cryptocrystalline, with thin, irregular lenses of grey-green, dolomitic mudstone |
| 1915.7-1917.75 | Dolomite: dark pink-red, cryptocrystalline with lenses of dark red, dolomitic mudstone |
| 1917.75-1918.2 | Breccia: fragments/pebbles of cryptocrystalline dolomite in matrix of coarse grained dolomite; fragments lie parallel to bedding. |
| | PALEOZOIC (Devonian) |
| | Duperow Formation |
| 1918.2-1920 | Dolomite: light grey, medium to coarse grained, crystalline, with thin, irregular lenses of green-grey, microcrystalline dolomite; several gypsum veinlets in upper 8" of interval |
| 1920-1921.3 | Dolomite: light grey with green tinge, medium to coarse grained crystalline, with thin, irregular lenses of green-grey, microcrystalline dolomite |

| Depth (feet) | Lithology |
|---|---|
| 1921.3-1921.8 | Dolomite: coarse grained, as above, with numerous lenses of fine grained, dolomitic mudstone |
| 1921.8-1924.5 | Dolomite: very fine grained, light green-grey, calcareous, massive |
| 1924.5-1925 | Limestone: medium grey-green, dolomitic, massive |
| 1925-1930 | Limestone: mottled light brown, very fine grained, massive, dolomitic |
| 1930-1932.3 | Limestone: mottled light brown, very fine grained, massive, dolomite |
| 1932.3-1932.5 | Gypsum: pinkish white, coarse grained |
| 1932.5-1935 | Dolomite: light grey, very fine grained, silty |
| 1935-1935.75 | Mudstone: light grey, dolomitic, massive, relatively hard and compact; gypsum veinlets |
| 1935.75-1940 | Dolomite: light grey-brown, medium to coarse grained, crystalline, massive; intergrading with anhydrite |
| 1940-1944 | Limestone: light brown, fine grained, calcarenite, very silty, massive |
| 1944-1945 | Siltstone: light grey, slightly calcareous, massive, very argillaceous |
| 1945-1947 | Siltstone: light to medium grey, slightly calcareous, massive, hard, grades to tan dolomite, at base |
| 1947-1950 | Anhydrite: light grey-brown, medium to coarse grained, crystalline, massive |
| 1950-1952.2 | Dolomite: light-brown, mottled, silty, massive, with abundant nodules of gypsum or anhydrite |
| 1952.2-1955 | Anhydrite: light grey-brown, coarse grained, crystalline, with small, irregular lenses of light brown, micro-crystalline dolomite; anhydrite or gypsum nodules |
| 1955-1960 | Anhydrite: light grey-brown, coarse grained, crystalline, with irregular pockets of light brown, microcrystalline dolomite; becoming predominantly microcrystalline dolomite in bottom 8" |

| Depth (feet) | Lithology |
|---|---|
| 1960-1961 | Mudstone: light grey, silty, dolomitic, relatively hard; veinlets of gypsum or anhydrite |
| 1961-1965 | Anhydrite: grey-brown, coarse grained, crystalline, massive |
| 1965-1970 | Anhydrite: grey-brown, coarse grained, crystalline; massive |
| 1970-1972 | Anhydrite: grey-brown, coarsely crystalline, as above |
| 1972-1975 | Limestone: light brown, very fine grained to microcrystalline, silty in part, massive; (core shows one foot of dolomite with anhydrite inclusions in top of interval) |
| 1975-1976 | Dolomite: medium brown, very fine-grained, crystalline, (sparry-with relict bioclastic and (?) calcarenite supertexture) |
| 1976-1980 | Anhydrite: grey-brown, coarse grained, crystalline, massive, with dolomitic lenses |
| 1980-1981.5 | Anhydrite: as above |
| 1981.5-1983 | Dolomite: light to medium brown, massive, hard |
| 1983-1985 | Dolomite: light brown, sucrose, medium to coarse grained, slightly calcareous, fairly well indurated, porous, with luster mottling from partial infilling of secondary gypsum; finely banded in part |
| 1985-1986.3 | Dolomite: as above |
| 1986.3-1987 | Dolomite: calcareous, medium to coarse grained, hard, with bituminous partings; irregular lenses of dense, microcrystalline on lithographic limestone |
| 1987-1990 | Limestone: dolomitic, light brown, fine to medium grained, altered bioclastic, finely banded, with current bedding |
| 1990-1995 | Limestone: dolomitic, light brown, medium to coarse grained with dense, algal inclusions; fossiliferous; nodules of gypsum or anhydrite; brachiopods; corals |

| Depth (feet) | Lithology |
|---|---|
| 1995-2000 | Limestone: highly dolomitic, light brown, medium to coarse grained, heavily speckled with dolomite rhombs, massive, porous, altered calcarenite; nodules of gypsum or anhydrite; irregular inclusions, dense, microcrystalline limestone; bituminous partings |
| 2000-2005 | Limestone: dolomitic, light brown, medium to coarse grained calcarenite, porous in part, wet; fossiliferous; nodules of gypsum or anhydrite; lenses of microcrystalline limestone in part with luster-mottling from gypsum (?) -filled porosity |
| 2005-2010 | Limestone: dolomitic, light to medium brown, medium to coarse grained altered bioclastic, fossiliferous, slightly porous, with ovoid inclusions of microcrystalline limestone; anhydrite or gypsum nodules; bituminous partings |
| 2010-2012.5 | Limestone: as above |
| 2012.5-2013.7 | Limestone: dolomitic, light to medium grey, fine grained, altered, bioclastic calcarenite, massive |
| 2013.7-2015 | Limestone: dolomitic, light to medium brown, medium to coarse grained bioclastic, with micritic matrix, fossiliferous, with ovoid inclusion of micro-crystalline limestone; gypsum or anhydrite nodules; grey, dolomitic mudstone; bituminous partings |
| 2015-2020 | Limestone: dolomitic, light to medium brown, medium to coarse grained, bioclastic with micritic texture, calcarenite, and inclusions of micro-crystalline limestone; gypsum or anhydrite, numerous, wavy, bituminous partings |
| 2020-2023 | Limestone: dolomitic as above |
| 2023-2025 | Mudstone: (?) dolomitic, medium grey minutely mottled and banded, microcrystalline, with tan dolomite and gypsum interbeds in bottom 3" |
| 2025-2025.5 | Gypsum; or anhydrite, massive, coarse grained |
| 2025.5-2030 | Dolomite: light brown, microcrystalline, with irregular gypsum inclusions; intercalated zones of coarse grained dolomite |

| Depth (feet) | Lithology |
|---|---|
| 2030-2031 | Dolomite: light brown, microcrystalline, with intercalated zones of dark brown, coarse grained dolomite; gypsum or anhydrite nodules |
| 2031-2032.5 | Dolomite: light brown, fine grained, massive, with interbands of coarse grained, crystalline dolomite |
| 2032.5-2033.3 | Dolomite: grey-brown, coarse grained, crystalline, massive; gypsum or anhydrite nodules |
| 2033.3-2035 | Dolomite: light grey, microcrystalline, massive, with abundant gypsum bands in upper 1' of interval |
| 2035-2035.6 | Mudstone: dolomitic light grey, massive, micro-crystalline, as above; gypsum bands |
| 2035.6-2037 | Dolomite: light to medium grey, fine grained, massive; gypsum bands in bottom 6" |
| 2037-2040 | Limestone: dolomitic, medium grey-brown, fine grained, fossiliferous; bituminous partings; gypsum or anhydrite in bands and disseminated |
| 2040-2047 | Limestone: dolomitic, medium grey-brown, mottled, medium to coarse grained, bioclastic; intercalated gypsum or anhydrite; bituminous partings |
| 2047-2049.3 | Limestone: slightly dolomitic, light grey-brown, fine grained, altered bioclastic, with wavy, dark grey, bituminous partings |
| 2049.3-2049.75 | Conglomerate: pebbles or nodules of light brown-grey, dense, microcrystalline limestone in matrix of grey-brown, medium grained dolomite; bioclastic limestone; "pebbles" appear to have been weathered or to have an algal overgrowth |
| 2049.75-2050 | Mudstone: calcareous, medium grey, fine grained, with lenses of light grey-brown, microcrystalline limestone |
| 2050-2054 | Limestone: dolomitic, slightly argillaceous, light grey-brown, microcrystalline, with numerous lenses and interbeds of dark grey, highly argillaceous limestone; argillaceous bands 1/16"-3/4" thick; minute inclusions of clear calcite |

| Depth (feet) | Lithology |
|---|---|
| 2054-2057.7 | Limestone: dolomitic, slightly argillaceous, light to medium brown; mottled, fine to medium grained, biotitic; bituminous partings; brachiopods |
| 2057.7-2065 | Mudstone: calcareous, or argillaceous limestone, medium grey-brown banded, with irregular, shaly lenses; heavily jointed; strike approximately N 85° W; dip 55° NNE |
| 2065-2076 | Mudstone: calcareous, medium grey-brown, with dark grey, shaly lenses; regular, argillaceous banding at base; jointing as above |
| 2076-2085.5 | Limestone: dolomitic, light grey-brown, crypto-crystalline, fine grained, finely bioclastic; zones of stromatolites and fine algal (?) banding; dark brown, argillaceous banding and coarse crystals of gypsum in bottom 6" of interval |
| 2085.5-2090 | Mudstone: anhydritic, slightly dolomitic, pale grey brown, with coarse crystals of brown gypsum especially at top, and irregular, dolomite lenses |
| 2090-2095 | Anhydrite: argillaceous, pale brown-grey, massive, with scattered, coarse, brown crystals (of gypsum ?) |
| 2095-2110 | Anhydrite: as above: irregular stringers and inclusions of calcareous dolomite; zone of contorted, bituminous banding |
| 2110-2113 | Anhydrite: with irregular, indefinite inclusions of light brown, very slightly calcareous dolomite |
| 2113-2116.2 | Dolomite: light brown, microsucrose, with irregular, wavy, shaly (?) partings; anhydrite inclusions |
| 2116.2-2117.3 | Dolomite: medium brown, fine to medium crystalline, compact, massive, with bituminous specks |
| 2117.3-2118 | Dolomite: calcareous, medium grained, with lustre mottling of gypsum; relict bioclastic, porous, with rhomb-filled vugs containing calcite coating |
| 2118-2120 | Dolomite: pale brown, chalky-textured, microsucrose, porous, with zone of scattered, brown gypsum lustre mottling; bituminous partings |
| 2120-2125 | Dolomite: highly calcareous, pale brown, chalky-textured, microsucrose, banded with zones of irregular laminations; small, brown, gypsum nodules; porous, with calcite, interstitial and following fractures |

| Depth (feet) | Lithology |
|---|---|
| 2125-2130 | Limestone: highly dolomitic, or calcareous dolomite, thinly banded, with bands of light brown limestone and bituminous partings; brown gypsum nodules; tight, microcrystalline-compact; elezerine red S dye shows fine mottling by zones of dolomite with and without interstitial calcite; penecontemporaneous breccia with micritic limestone fragments |
| 2130-2135 | Limestone: highly dolomitic, pale brown, faintly banded, medium grained, chalky, compact, tight; nearly 50% interstitial calcite |
| 2135-2140 | Limestone: highly dolomitic, tan, chalky-compact, speckled with dolomite rhombs (nearly 50%); flattened vugs after fossils, some with bituminous material |
| 2140-2143.7 | Limestone: highly dolomitic as above, light brown, fine to medium grained calcarenite, faintly banded, becoming dolomitic towards base; bituminous zones; abundant gypsum or anhydrite |
| 2143.7-2150.5 | Dolomite: light brown, medium grained, crystalline, vuggy; abundant gypsum or anhydrite |
| 2150.5-2160 | Dolomite: light to medium brown grey, microcrystalline, massive, with indefinite and irregular argillaceous and faintly dolomitic, brown laminae |
| 2160-2162 | Dolomite: light grey, microcrystalline, with inclusions of pinkish grey, fine grained, dolomitic limestone |
| 2162-2165 | Limestone: dolomitic, light pink-grey, fine grained, with inclusions of microcrystalline dolomite; anhydrite in contorted inclusions covered with black bitumen, occurs in part as nodules in brown, argillaceous matrix; laminated algal (?) overgrowths of dolomite with botryoidal appearance; angular fragments of limestone; minute septarlan veinlets of gypsum or anhydrite |
| 2165-2180 | Limestone: dolomitic, cryptocrystalline, light to pale brown, with zones of medium brown calcarenite or pelletoid material; much bituminous material; inclusions of dolomite with similar texture to limestone; inclusions of anhydrite; zones of dolomite anhydrite |
| 2180-2190 | Limestone: dolomitic, cryptocrystalline, pelletoid, with zone of dolomitic anhydrite as above; inclusions of anhydrite with bituminous, brown, shaly coating |

| Depth (feet) | Lithology |
|---|---|
| 2190-2195 | Anhydrite: dolomitic, pale brown-grey, with small inclusions of dolomite |
| 2195-2205 | Anhydrite: dolomitic; with inclusions of pure anhydrite, as above; dolomite and brown dolomitic limestone associated with irregular, brown, bituminous partings |
| 2205-2236.5 | Anhydrite: grey-white, coarse-grained, crystalline, with numerous lenses of light brown, microsucrose dolomite |
| 2236.5-2242 | Dolomite: medium brown, cryptocrystalline, faintly porous, massive; numerous anhydrite lenses in upper 6" of interval banded, light, compact zone; altered bioclastic |
| 2242-2262 | Anhydrite: grey-white, coarse grained, crystalline, massive, with numerous, irregular lenses of dolomite in upper 1 foot of interval |
| 2262-2263.5 | Dolomite: pale brown, finely banded, altered calcarenite, cryptocrystalline, chalky-compact, grading to dolomitic limestone of similar texture; inclusions of brown limestone, finely crystalline, nearly lithographic, with brown, bituminous laminations |
| 2264.5-2268 | Anhydrite: grey-white, coarse grained, crystalline, massive, with lenses of dolomite |
| 2268-2272 | Limestone: dolomitic, dark brown banded, microcrystalline compact; abundant fine inclusions of anhydrite |
| 2272-2273.8 | Limestone: medium brown, cryptocrystalline, vuggy, impermeable, in contact with dolomitic, altered calcarenite |
| 2273.8-2275.5 | Limestone: slightly dolomitic, pale brown, chalky textured, micritic, tight |
| 2275.5-2276 | Limestone: dolomitic, pale brown as above, in part becoming calcarenitic to bioclastic, some with bituminous specks |
| 2276-2277 | Anhydrite: with brown, calcareous bands |

| Depth (feet) | Lithology |
|---|---|
| 2277-2782.7 | Limestone: dolomitic, pale to medium brown, finely banded in part, some with nearly lithographic bodies in more dolomitic, slightly sucrose matrix; undulating contact (1½" of relief) with anhydrite below |
| 2782.7-2285 | Anhydrite: grey-white, massive, coarse grained, crystalline, with indefinite, brown, calcareous inclusions or banding |
| 2285-2290 | Limestone: dolomitic, light brown, cryptocrystalline, with abundant, fine, dolomite rhombs, calcarenitic, with rounded lithographic inclusions up to 5 mm long; a little clear gypsum; brown-banded zone in contact with: limestone, dolomitic, tan, micritic (chalky-compact), very finely porous, with irregular, brown streaks |
| 2290-2295 | Limestone: dolomitic, light brown, cryptocrystalline, altered, coarse calcarenite, poorly sorted, with near lithographic rounded fragments in less dense matrix; tan limestone, dolomitic, micritic, with abundant dolomite rhombs and zones of wavy, brown laminae |
| 2295-2301.3 | Limestone: dolomitic, tan to grey brown, altered bioclastic (?); nucleated concentric growths up to 1" diameter, some with gypsum (?) centres (below 2297'8") |
| 2301.3-2305 | Limestone: dolomitic, grey-tan, cryptocrystalline, earthy-lustred, very slightly argillaceous in part, bioclastic, with rounded "pebbles" and shells with concentric over-growths; brown, bituminous, crinoid ossicles and brachiopods |
| 2305-2314.3 | Limestone: tan, dolomitic, in part, large bioclastic with micrite infill; micritic zone with penecontemporaneous breccia and wavy, brown laminae; gastropods, ostracods |
| 2314.3-2315.3 | Limestone (1 fragment): dolomitic, light brown, vuggy, microcrystalline, in 2" thick band in grey-brown mudstone |
| 2315.3-2316 | Mudstone: calcareous and dolomitic, grey, banded |
| 2316-2317.5 | Dolomite: medium to light brown, microcrystalline to sugary |
| 2317.5-2320 | Anhydrite: pale grey, mottled with radiating aggregates of brown gypsum |

| Depth (feet) | Lithology |
|---|---|
| 2320-2325 | Anhydrite: grey, brown-mottled, dolomitic in part, with irregular dolomite lenses |
| 2325-2325.5 | Anhydrite: dark brown, mottled |
| 2325.5-2328 | Dolomite: light brown, microcrystalline, finely banded with clear and brown gypsum, interlaminated and interstitial or filling vugs |
| 2328-2330 | Dolomite: massive, microsucrose, pale brown, altered bioclastic (?) |
| 2330-2335 | Limestone: dolomitic, tan, earthy, porous; brown gypsum-filled tight zone; finely banded in bottom 3 feet |
| 2335-2350 | Limestone: dolomitic, tan, laminated, microcrystalline, earthy, porous; scattered gypsum crystals |
| 2350-2355.7 | Limestone: dolomitic, laminated in part, as above; in part tan, earthy-lustred, tight, altered bioclastic; grey with slightly argillaceous (?) zone; brachiopods; grades to argillaceous limestone below |
| 2355.7-2360 | Limestone: micritic, slightly argillaceous, fossiliferous, grey-brown with brown, bituminous specks; vertical fracture with gypsum; intergrading with mudstone, calcareous, grey-brown, mottled with brachiopods |
| 2360-2364 | Limestone: slightly argillaceous zone with grey cast |
| 2364-2365 | Limestone; tan, earthy-lustred, tight, altered bioclastic; band of brown organic (?) laminae |
| 2365-2366.8 | Limestone: micritic, earthy-lustred, with wavy, brown, shaly laminae |
| 2366.8-2370 | Mudstone: calcareous, brown-grey mottled; brachiopods |
| 2370-2375 | Mudstone: or argillaceous limestone, grey-brown, silty, massive; carbon flecks |
| 2375-2378 | Limestone: tan, earthy-lustred, finely laminated, laminae marked by rows of gypsum-filled vugs |
| 2378-2380 | Limestone: tan to light brown; light brown limestone; cryptocrystalline, bioclastic to fossiliferous micrite |

| Depth (feet) | Lithology |
|---|---|
| 2380-2381.5 | Mudstone: calcareous, brown-grey, massive; more or less argillaceous interbeds; zones of brachiopods |
| 2381.5-2387.5 | Mudstone; calcareous, or shaly limestone, medium grey; abundant fossil fragments; and brachiopods in more argillaceous zones |
| 2387.5-2399.5 | Limestone: dolomitic, tan, cryptocrystalline, earthy-lustred, highly fossiliferous, with micrite matrix, grading to bioclastic |
| 2399.5-2401 | Mudstone; intergrading and interbedded with argillaceous, micritic limestone; zones of brown specks of organic matter |
| 2401-2405 | Limestone; light grey, microcrystalline, with veinlets of anhydrite and interbeds and lenses of medium grey, slickenside mudstone; shale lenses make this zone very incompetent and caves spalling from shaft wall |
| 2405-2409.5 | Limestone: tan, earthy-lustred, cryptocrystalline-compact, with clear calcite inclusions; micritic (?) with scattered fossil fragments; and occasional shaly partings in upper 2' |
| 2409.5-2410 | Limestone: light brown, fine to medium grained, bioclastic, slightly argillaceous; specks of bituminous material |
| 2410-2411 | Limestone; pale grey-brown, shaly in part, with irregular nodules and wavy banded structure; nodules of chalky-compact, cryptocrystalline limestone, with scattered crinoid ossicles, ostracod; altered bioclastic zones with interstitial, sparite calcite |
| 2411-2414 | Limestone: pale grey-brown, as above; less shaly than interval above |
| 2414-2415 | Limestone: as above, shaly as in interval 2410-2411' |
| 2415-2417.2 | Limestone: shaly in part as above |
| 2417.2-2420 | Limestone: as above; only faint shaly banding; brown, anhydrite crystals |
| 2420-2421.3 | Limestone; tan, cryptocrystalline, earthy, bioclastic; limestone, brown, cryptocrystalline-compact, stromatolitic; grades to calcareous mudstone |

| Depth (feet) | Lithology |
|---|---|
| 2421.3-2421.75 | Mudstone: calcareous, shaly, dark grey, with brachiopods; limestone, brown, cryptocrystalline; sparry, nearly lithographic; limestone, tan, cryptocrystalline, earth-lustred, altered bioclastic |
| 2421.75-2422.5 | Mudstone: dolomitic, anhydritic, grading to anhydrite at base |
| 2422.5-2425.5 | Anhydrite |
| 2425.5-2427.5 | Dolomite: light grey, mottled, in part banded with gypsum veinlets; anhydrite, grey, with well-defined lenses of brown dolomite |
| 2427.5-2429.5 | Dolomite: pale grey, very anhydritic, chalky, slightly argillaceous; veinlets of anhydrite ½" to 1" thick in basal 1' |
| 2429.5-2430 | Anhydrite |
| 2430-2437 | Limestone: dolomitic in part, tan, cryptocrystalline, earth-lustred, micritic, finely laminated to altered calcarenite, bioclastic in part; small anhydrite lenses; zones of brown, gypsum crystals in upper 1'; bituminous, brown partings in basal 3' |
| 2437-2438.5 | Dolomite, tan, faintly mottled with grey, very finely crystalline, tight, slight sucrosic texture |
| 2438.5-2440.3 | Dolomite: pale brown, microcrystalline, present with calcareous zones in bottom 10" |
| 2440.3-2442 | Anhydrite: grey, with brown, dolomitic mottling |
| 2442-2445 | Limestone: dolomitic, tan, earthy-lustred with penecontemporaneous fragmentation and fossil fragments, grading to bioclastic (biostrome); pebbles of micritic limestone |
| 2445-2449.3 | Limestone: dolomitic, argillaceous and bioclastic with micritic matrix, brown-grey; dolomite, microsucrose, tight, with abundant specks of brown, organic matter |
| 2449.3-2450 | Anhydrite: grey, with brown, dolomite lenses |

| Depth (feet) | Lithology |
|---|---|
| 2450-2452.7 | Limestone: dolomitic, pale brown, cryptocrystalline, earthy lustred; clear gypsum inclusions and gypsum-saturated 'pale spots'; zone with interfingering anhydrite |
| 2452.7-2455 | Dolomite: tan, microsucrose, faintly porous, finely laminated near contact with limestone marked by flat brown, 'bituminous' layer; anhydrite with indefinite, dolomite stringers |
| 2455-2461.5 | Anhydrite and dolomite: anhydrite, white, with lenses of brown, altered dolarenite; dolomite, tan, cryptocrystalline, earthy lustred with oval inclusions, crystals brown gypsum; fracture filling of gypsum (parallel to bedding ?) |
| 2461.5-2465 | Limestone and dolomite: limestone, dolomitic in part, microcrystalline, earthy-lustred, calcarenitic to bioclastic, with "pebbles" of (micritic ?) limestone showing surface zonation; zone of brown gypsum crystals in calcarenite; highly dolomitic, finely banded limestone; dolomite, tan, massive, with rare, irregular, brown partings |
| 2465-2470 | Limestone: dolomitic, microcrystalline, with earthy lustre, bioclastic, with abundant, brown, carbonaceous, organic specks |
| 2470-2475 | Limestone and dolomite: limestone, dolomitic in part, light grey-brown, slightly argillaceous, bioclastic with rounded "pebbles" of micritic limestone with concentric zonation; dolomite, or dolarenite, brown microcrystalline, with undulating banding and anhydrite laminations |
| 2475-2480 | Limestone and mudstone: limestone, very slightly dolomitic; tan, microcrystalline, earthy-lustred, bioclastic, massive in part, laminated and calcarenitic to micritic in part; mudstone, or "shale", calcareous, medium grey |
| 2480-2489 | Limestone: tan, with undulating laminations, micritic to faintly calcarenitic |
| 2489-2494 | Limestone: (argillaceous), light grey, microsucrose, with irregular lenses of non-argillaceous limestone, becoming less argillaceous with depth |
| 2494-2495 | Limestone: light grey-brown, microcrystalline, with thin, irregular, shaly partings |
| 2495-2500 | Limestone: shaly, medium brown-grey, with interdigitating, more or less argillaceous lenses; brachiopods |

| Depth (feet) | Lithology |
|---|---|
| 2500-2505 | Limestone: argillaceous, slightly shaly, grey-brown, mottled. |
| | Souris River Formation |
| 2505-2510 | Mudstone: grading to argillaceous limestone, light grey, micritic, grading vertically into dark grey mudstone bands with sharp contact below (or above) in cyclical manner; slight brecciation, narrow cracks filled with clear gypsum |
| 2510-2515 | Limestone: argillaceous, light grey-brown, micritic, with indefinite, irregular banding |
| 2515-2520.5 | Mudstone: dolomitic, or argillaceous dolomite, medium grey, faintly banded, massive |
| 2520.5-2525 | Dolomite: light brown, microsucrose, faintly banded, massive, tight |
| 2525-2532 | Dolomite: more or less argillaceous, grey-brown, faintly mottled and banded, massive |
| 2532-2532.7 | Dolomite: argillaceous, as above; zone with inclusions of white gypsum or anhydrite, in part speckled with gypsum (?) laths |
| 2532.7-2535 | Limestone: light brown, microcrystalline, earthy-lustred, bioclastic and calcarenitic to micritic; specks of carbonized,organic matter |
| 2535-2570 | Mudstone: calcareous, highly dolomitic, brown-grey, massive |
| 2570-2575 | Mudstone: calcareous and dolomitic, as above, grading to grey-brown, faintly laminated, slightly argillaceous dolomite |
| 2575-2576 | Mudstone: calcareous, brown-grey, laminated, with zone of micritic nodules, 4 mm in diameter |
| 2576-2577 | Mudstone: dolomitic, brown-grey, with faintly irregular laminae |
| 2577-2578 | Dolomite: argillaceous, grey-brown, irregularly laminate |
| 2578-2580 | Anhydrite: light grey-brown, mottled |
| 2580-2587 | Anhydrite: brown, mottled; zone with pale,dolomite inclusions |

| Depth (feet) | Lithology |
|---|---|
| 2587-2588.3 | Mudstone: dolomitic, grey, with green cast, containing large (3" diameter), brown crystal of gypsum |
| 2588.3-2592.8 | Anhydrite: brown, mottled |
| 2592.8-2595 | Dolomite: pale brown, cryptocrystalline, faintly laminated, earthy-lustred, with relict dolarenite texture; interstitial clear gypsum (?) in zone of ovoid gypsum pellets; limestone, dolomitic, pale brown, faintly laminated, cryptocrystalline, with earthy lustre |
| 2595-2605 | Limestone: tan, finely banded, cryptocrystalline, earthy-lustred, smooth-textured, micritic, with zones of brown gypsum laths. |