MAR 19860001: FORT MACKAY

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Alberta

ENERGY AND
NATURAL RESOURCES
Mineral Resources Division

File No.: 6886020001

Petroleum Plaza, South Tower, 9915 - 108 Street, Edmonton, Alberta, Canada T5K 2C9 Telex 037-3676 427-7712

1986 July 28

Mr. John Wilson
Alberta Geological Survey
Alberta Research Council
3rd Floor, Terrace Plaza
4445 Calgary Trail South
EDMONTON, Alberta
T6H 5R7

Dear Mr. Wilson,

Re: Metallic Minerals Exploration Permit No. 6886020001
- Kenneth Richardson

Please find enclosed first term work report including expenditure statement sent in by Halferdahl & Associates Ltd. on behalf of the above-mentioned permittee.

The first term of the permit expires on 1989 February 03.

The confidentiality of the enclosed data expires on 1990 February 03.

You will be informed if the permit is cancelled, terminated, or surrendered prior to 1989 February 03.

Yours sincerely,

Eugene Saldanha
Manager
Coal Agreements

Enclosure

/dmb

19860001

1986 LATE WINTER DRILLING OF METALLIC MINERALS EXPLORATION PERMIT 6886020001 NEAR FORT MacKAY, NORTHEASTERN ALBERTA

Geographic Coordinates
57° 07'N
111° 35'W
NTS Sheet 74 E/4

by
L.B. Halferdahl, Ph.D., P.Eng.

1986 06 03

Work on Property Conducted 1986 02 21 to 1986 03 20
for Mr. Kenneth Richardson

Halferdahl & Associates Ltd.
18, 10509 - 81 Avenue
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SECTION 1.0 INTRODUCTION

A report by Allan (1920) indicating gold values in the Precambrian at the bottom of an oil well drilled in the 1910s on the east bank of Athabasca River in Tp. 96, R. 11 W4, Alberta interested Mr. Kenneth Richardson in the potential for gold in the area. Following airborne and surface surveys with a "supersensitive scintillation counter" (Appendix 1) in the fall and early winter of 1985, he, Dr. Armin Bickel, and assistants spotted two holes to be drilled for gold on the east side of Athabasca River south of the Fort MacKay bridge. A metallic minerals exploration permit covering the area was subsequently obtained. Halferdahl & Associates Ltd. was contracted to arrange for the drilling, log and sample the core, and interpret the results. This report describes the results of the drilling.

A contract for the diamond drilling of these two holes was let to Tonto Drilling (Alberta) Ltd. who had suitable diamond drills conveniently located at the nearby site of Syncrude Canada Ltd. The crew was based in the camp of MacKenzie Caterers Ltd. at the R. Angus compound a few kilometres north of the Syncrude site on highway 63. Plowing and where needed, construction of access trails to drill sites as well as required clearing and reclamation were contracted to Halonen Construction Ltd. of Redwater, Alberta. The project geologist and engineer used a rented 4x4 pick-up truck to reach the drillsites. Drilling started on March 9, 1986 and was completed on March 20, 1986. The core is presently in the core storage facility of the Alberta Research Council.

In this report the notation BV2 refers to Bear Vampire No. 2, a well drilled in 1949 by the Bear Oil Company Limited on the west side of Athabasca River across from the holes drilled in March 1986.

SECTION 2.0 SUMMARY OF RESULTS

1. Drilling in 1962-63 and 1986 at the sites of oil wells drilled in the 1910's did not encounter the gold reported by Allan (1920) in the Precambrian granite beneath Athabasca River in northeastern Alberta. A statement apparently sworn by one of the drillers of the early oil wells indicates that gold is present in two quartz veins in carbonates, here interpreted as being in the Methy Formation above the Precambrian.
2. The two holes drilled south of the Fort MacKay bridge penetrated the expected Devonian strata from the Moberly Member of the Waterways Formation at the surface down to the Precambrian basement at depths of 284 and 290 m. One penetrated 44.6 m and the other 60.2 m of Precambrian red granitic rocks.

3. All but one of the samples selected for analyses from the Devonian strata and the Precambrian contains background concentrations of gold from less than 1 to 60 ppb, with some of the higher concentrations in this range probably being due to differences between analyses from different laboratories, not because background concentrations have been exceeded. Most of the concentrations of other metals in these Precambrian rocks are near average levels for other granitic rocks, with lanthanum and cerium somewhat above. One composite sample of mylonitic rocks contains coincident higher concentrations of copper, yttrium, samarium, and ytterbium. None of the samples analyzed appears to contain economic concentrations of the metals determined.
4. One grab sample from the Methy Formation at a depth of 241.4 m in a drillhole assayed 0.063 oz/ton gold: not an economic grade. It came from almost 3 m below a fracture at which the drillers lost circulation and minor chalcopyrite and malachite are visible in the core. Samples from above and below this grab sample contain only background concentrations of gold.
5. The presence of gold and copper in or related to fractures in the Methy Formation and of chalcopyrite in the Precambrian suggests that mineralizing fluids may have deposited gold and possibly other economic metals in veins or similar structures in certain rocks near Athabasca River in northeastern Alberta. However, the high risks in exploring for economic deposits of gold and other metals in this area should be carefully considered because of the high costs of searching for such targets at the depths expected.

SECTION 3.0 PROPERTY

The property consists of a Metallic Minerals Exploration Permit under agreement 068 6886020001, dated 1986 02 03 with a term of three years to 1989 02 03, and renewable for up to four additional years. The property comprises the following area:

In Tp. 93, R. 10 W4

Sec. 14 Lsd. 12, 13
Sec. 15 NE¼ and Lsd. 11, 14
Sec. 21 Lsd. 8, 9, 15, 16
Sec. 22 all
Sec. 23 Lsd. 4, 5, 12
Sec. 27 SW¼ and Lsd. 2, 11, 12, 13
Sec. 28 N½, SE¼, and Lsd. 3, 5, 6
Sec. 29 Lsd. 9, 15, 16
Sec. 32 N½, SE¼, and Lsd. 6
Sec. 33 all
Sec. 34 Lsd. 4, 5,

In Tp. 94, R. 10 W4

Sec. 4 SW¼ and Lsd. 2, 12
Sec. 5 all
Sec. 6 Lsd. 1, 7, 8, 14.

It totals 1888 ha according to the legislated conversion factor used by Alberta Energy and Natural Resources. It is held in the name of Kenneth Richardson who was required to make a work-refundable deposit of $10 per hectare or $18 880 for the first three years of the Permit. If the Permit is renewed, assessment work at the rate of $20 per hectare is required in the first renewal period of two years, and $15 per hectare in each of the second and third renewal periods of one year each.

Sufficient work has been done to keep all the property in good standing until at least 1991 02 03, if the property is maintained. In the event that the area of this Metallic Minerals Exploration Permit were reduced, the work done might be sufficient to maintain the remaining part of the property for the full seven years permitted. At any time during the life of a Metallic Minerals Exploration Permit the holder may apply for a Metallic Minerals Lease, with initial assessment work requirements of $10 per hectare per year. Alberta Regulation 246/84 is silent on the subject of the carryover of excess work on a Metallic Minerals Exploration Permit to a Metallic Minerals Lease. It appears that the required assessment work can be minimized by obtaining a Metallic Minerals Lease during years 4 to 5 of a Metallic Minerals Exploration Permit. But unless the terms and conditions the Minister may prescribe on renewing a lease are known in advance, obtaining a Metallic Minerals Lease prior to the end of the seven years allowed for a Metallic Minerals Exploration Permit may be inadvisable.

SECTION 4.0 REGULATORY REGIME

In addition to the remarks concerning Alberta Regulation 246/84 in Section 3.0 in this report, this Regulation contains great deterrents to exploration for metallic minerals:

1) deposit for assessment work upon application for an exploration permit, even though all but $160 of such a deposit can apparently be recovered without doing the work by reducing the area of the permit to its minimum size of 16 ha (The requirement of a deposit up front is likely to hinder the acquisition of properties for exploration and the financing of such exploration by all but the affluent.),
2) the uncertain time before it is known whether an exploration permit will be issued, and the specific terms and conditions it may contain,
3) the short time (seven years) apparently allowed for exploration before either leasing or abandoning the ground. (In exploring for metallic

minerals the targets are elusive, and exploration funds fluctuate with metal prices so that failure of exploration based on an initial concept is more likely to result in abandoning the play.), and

4) the lack of provisions for grouping permits less than the maximum size and for grouping permits with leases.

The regulations regarding the actual conduct of the work should be clarified so that the explorationist knows whether he will be regulated under the Exploration Regulation, the Oil and Gas Conservation Regulations, or neither, in order that exploration approvals can be obtained with a minimum of paperwork and delay. The Exploration Regulation appears to lack provisions that technical data submitted will remain confidential for a specified period. Further, the requirement to submit technical data under both the Exploration Regulation and the Metallic Minerals Regulation appears redundant. Both the Exploration Regulation and the Oil and Gas Conservation Regulations appear designed for exploration for hydrocarbons and coal, not metallic minerals. Unless certain provisions are waived, drilling approvals under the Oil and Gas Conservation Regulations add considerably to the costs of exploring for metallic minerals compared to other jurisdictions. In practice, once the required approval was in hand, the inspectors of the Alberta Forest Service were very helpful.

SECTION 5.0 GEOGRAPHIC SETTING

5.1 Location and Access

The property lies in northeastern Alberta on the east side of Athabasca River and is centred about 40 km north of Fort McMurray (Fig. 5.1). The property may be reached by driving 46 km northerly from Fort McMurray along highway 63 across the Fort MacKay bridge. Parts of it may be reached from highway 63 by a winter road partly previously constructed and partly newly constructed in February and March 1986 (Fig. 5.2). In the winter its northern parts are accessible by walking from the gravel pit near the east bridge abutment just south of highway 63. Ground access in the summer is difficult because of swamps, but the part of the property adjacent to Athabasca River can be reached by boat.

5.2 Topography and Vegetation

The property lies mostly on a terrace at an elevation of about 270 m about 35 m above the level of Athabasca River. On the terrace are knobs and ridges rising

to perhaps 8 to 10 m above elongated swamps, which are probably remnants of stream channels related to glacial or preglacial processes or even earlier karsting. The knobs and ridges are covered by stands of small poplar, pine with minor spruce, or all three, most of the larger timber having been destroyed by forest fires several decades ago. The swampy valleys are partly open and partly covered with scrub spruce trees and other swamp bushes such as alder and willow. Construction of winter access trails along these swampy valleys results in minimal destruction of trees.

East from the terrace, the valley wall of Athabasca River rises steeply to an elevation of about 310 m, where the terrain is underlain by oil sand.

5.3 Infrastructure

Fort McMurray, a town of more than 35 000, lies about 375 km northeasterly from Edmonton, whence it is 437 km by paved highway. Fort McMurray is the northeastern terminus of a branch of the former Northern Alberta Railway, now Canadian National Railway, and is served by regularly scheduled airline flights from Edmonton. It is the only town in the area and is the base for the operations of Syncrude Canada Ltd. and the Oil Sands Division of Suncor Inc. Both of these operations are within 40 km from Fort McMurray by paved highway 63 which extends northerly along the west side of Athabasca River. From the Syncrude turnoff gravelled highways extend another 25 km to Fort MacKay, a settlement of perhaps 300, mostly natives.

R. Angus operates a camp along highway 63 a few kilometres north of the Syncrude turnoff, known as MacKenzie Caterers. Arrangements can be made to accommodate temporary workers, such as drillers, in this camp.

SECTION 6.0 GEOLOGICAL AND GEOPHYSICAL SETTINGS

The general features of the geology of the property and the surrounding area have been described by Carrigy (1959 and 1973) and Norris (1963 and 1973) with references to many other geological reports listed by these authors. More recent reports provide details mostly on the oil sands and their depositional environments, subjects not pertinent to this report and hence not included. Table 6.1 shows the bedrock stratigraphy. In the valley of Athabasca River where oil sand has been eroded away, the Precambrian basement lies at depths between 260 and 300 m depending partly on the surface elevations. Away from the valley, the depth to the Precambrian increases depending on the thickness of oil sands and formations above the oil sands.

TABLE 6.1 BEDROCK STRATIGRAPHY NEAR FORT MacKAY
(modified after Carrigy, 1959; Norris, 1963)

Period Group Formation Member	Dominant Lithology	Thickness (m)
Lower Cretaceous	Sandstone, shale, oil sand	130-350
	Erosional Unconformity	
Upper Devonian		
Waterways		
Mildred	eroded	0
Moberly	Limestone and shale	57-61
Christina	Shale and limestone	23-29
Calumet	Limestone and shale	27-31
Firebag	Shale, minor limestone	52-60
	Paraconformity	
Middle Devonian		
Slave Point	Limestone, locally brecciated	1.7-4.6
Upper Elk Point		
Prairie Evaporite	Salt, anhydrite (gypsum), shale, dolomite	47-237
Methy	Dolomite, argillaceous towards base	37-73
Lower Elk Point		
McLean River	Shale, mudstone	10-20
	Paraconformity ?	
Lower Paleozoic		
Granite Wash	Conglomerate, arkosic sandstone	2-6
	Erosional Unconformity	
Precambrian Aphebian	Granite, gneiss, cataclasite	very large

The spacing of wells or drillholes reaching the Precambrian is too great to provide much information on the relief on the Precambrian surface, but the major unconformity at it suggests that its relief is low. The Precambrian surface has a southwesterly regional slope of about 5½ m per km.

Aeromagnetic maps of the area near Fort MacKay depict features probably in the Precambrian basement. Prominent among these features are linear magnetic depressions trending generally northerly and spaced 12 to 16 km apart. These depressions probably mark the locations of faults in the Precambrian basement. One of these linear magnetic depressions extends from Beaver River to Ells River between 1½ and 4½ km west of Athabasca River, and continues both northerly and southerly beyond its crossing of these rivers. It is about 1.6 km west of the Fort MacKay bridge. The first magnetic linear depression east of the property is in the west part of R. 9 W4. The property lies mostly within a fairly uniform magnetic gradient on the west flank of the magnetic ridge between the two linear magnetic depressions just noted. The magnetic relief within the property approaches 500 gammas.

Overlying the Precambrian basement is a basal sandstone or conglomerate, overlain in turn by Devonian strata of the Elk Point Group and the Waterways Formation. In general the dips of these strata are similar to the slope of the underlying Precambrian surface, but strata above the salt formation in the Elk Point Group have been affected by the partial or complete dissolution of salt and other evaporites. This process has produced distinct flexures, some of which are visible in strata of the Waterways Formation along Athabasca River. In the subsurface, strata for some distance above dissolved evaporites are brecciated. The Lower Cretaceous strata, unconformably overlying the Devonian Formations and containing the well known oil sands, have a regional dip to the southwest of less than 1 m per km.

SECTION 7.0 PREVIOUS AND CONTEMPORARY DRILLING

By far the greatest amount of drilling in the area has been to test the oil sands, a subject beyond the scope of this report. A few wells were drilled to explore for oil in the underlying Paleozoic Formations with a few reaching the Precambrian; most of these wells are also beyond the scope of this report. However, one such well was drilled on the east side of Athabasca River at a surface elevation of 816 feet (248.7 m) in Lsd. 8, Sec. 2, Tp. 96, R. 11 W4. It is designated Athabasca Oils Ltd. No. 1. Certain details concerning it in a report by Allan (1920) differ from those in a report by Ells (1926).

	Allan (1920)	Ells (1926)
Date drilled	1911-12	1915
Depth to Precambrian	336.8 m (1105')	291.7 m (957')*
Total Depth	344.4 m (1130')	313.9 m (1030')

* reported as hard reddish flinty rock

In addition Allan (1920) reported that the 25 feet of Precambrian granite carried $13.00 per ton in gold. At the then prevailing price for gold, this works out to 0.63 oz/ton. A statement (Appendix 4) sworn on January 14, 1946 at Trumbull County, Courtland, Ohio apparently by one of the drillers of Athabaska Oils Ltd. No. 1 refers to two auriferous quartz veins 5 feet apart, 3 and 7½ feet thick, in limestone at a depth of 907 feet (276.5 m). Recent examinations of the area at the reported site of Athabaska Oils Ltd. No. 1 revealed casing from two wells: one (CD-1) less than 30 m and a second (CD-2) about 210 m, east of the bank of Athabasca River. CD-1 fits the location of Athabaska Oils Ltd. No. 1 as reported by Allan (1920), Ells (1926), and a photostat of a Dominion well card. CD-2 appears to be Athabaska Oils Ltd. No. 2 according to a photostat of Dominion well cards, but some of the information given differs from that of Ells (1926). In all Athabaska Oils Ltd. drilled five wells in Tp. 96, R. 11 W4, but only No. 1 appears to have penetrated below the oil sands.

During the period 1962 10 07 to 1963 01 09 four holes were drilled for Scurry-Rainbow Oil Limited (Elstone, 1963) near CD-2 in order to check for the gold reported by Allan (1920) in Athabasca Oils Ltd. No. 1; only three holes reached the Precambrian. Details from Scurry's drilling have been compiled in Appendix 5.

In March 1986 Tanner Arctic Oils Ltd. drilled a hole about 1.3 m south of CD-1 to a depth of 296.3 m (Appendix 6). It bottomed in 1 m of coarse-grained red Precambrian granite. As far as is known the upper part of this hole was triconed with the core point not stated, but core recovery was good below 277.1 m. Five samples from the cored interval are believed to have been submitted for assay with all gold concentrations in the low ppb range. No analytical results of samples of cuttings from above the known cored section have been reported; presumably none were sent for analyses

None of the depths to the Precambrian in the three 1962-63 holes and the one 1986 hole agrees with that reported by Allan (1920) for Athabaska Oils Ltd. No. 1, but are close to that reported by Ells (1926). If Bradley's sworn statement (Appendix 4), apparently referring to Athabaska Oils Ltd. No. 1, is accurate, the gold appears to be in the Methy Formation, not in the Precambrian as reported by Allan (1920)

SECTION 8.0 STRATIGRAPHY OF THE PROPERTY

The formations cored in drillholes 86-1R and 86-2R as correlated lithologically are listed in Table 8.1 and shown in Fig. 8.1 along with the

TABLE 8.1: THICKNESSES OF FORMATIONS IN DRILLHOLES 86-1R, 86-2R, AND BV2

Drillhole / Formation Member	86-1R Metrage	86-1R Interval	86-2R Metrage	86-2R Interval	BV2* Interval
Overburden	0 - 3.66	3.66	0 - 3.96	3.96	-
Waterways	3.66-142.55	138.89	3.96-156.61	152.65	127.42
Moberly	3.66- 40.77	37.11	3.96- 41.41	37.45	14.33
Christina	40.77- 65.58	24.81	41.41- 66.39	24.98	25.91
Calumet	65.58- 95.30	29.72	66.39- 96.67	30.28	27.74
Firebag	95.30-142.55	47.25	96.67-156.61	59.94	59.44
Slave Point	142.55-147.24	4.69	156.61-160.93	4.32	3.96
Prairie Evaporite	147.24-199.97	52.73	160.93-205.23	44.30	49.68
Methy	199.97-265.92	65.95	205.23-272.77	67.54	61.87
Unit 3	199.97-230.35	30.38	205.23-231.27	26.04	27.13
Unit 2	230.35-256.44	26.09	231.27-263.65	32.38	23.47
Unit 1	256.44-265.92	9.48	263.65-272.77	9.12	11.58
McLean River	265.92-282.41	16.49	272.77-287.10	14.33	15.54
Granite Wash	282.41-284.43	2.02	287.10-290.07	2.97	3.05
Precambrian	284.43-329.08	44.65	290.07-350.26	60.19	0.30

* after Norris (1963)

corresponding intervals in BV2. In general these correlations between 86-1R and 86-2R based on the detailed lithologies (Appendix 7) are excellent with few differences in thickness exceeding 1 m. The largest differences are near the base of the Firebag Member of the Waterways Formation and in the Slave Point Formation, where extensive solution of the Prairie Evaporite Formation has brecciated the strata in the Slave Point Formation and the lower part of the Firebag Member for as much as 20 m in 86-2R. Other differences in the thicknesses of the Moberly Member and the Waterways Formation are caused by variable amounts of erosion at the top of the Moberly Member.

Any differences in thickness between the formations listed for 86-1R and 86-2R compared to those in BV2 not explainable by differences in sedimentation undoubtedly arise because the formation limits in BV2 are based primarily on fossils not lithologies.

The presence of gypsum with or without anhydrite in the Prairie Evaporite Formation and the stratigraphically lower McLean River Formation as well as along fractures in the Precambrian basement, may provide clues about the changes from one sulfate mineral to the other, both with depth and time. However, this subject is beyond the scope of this report.

In the following sections the thicknesses of the stratigraphic units are based on detailed measurements of the cores from 86-1R and 86-2R (Appendix 7).

8.1 Precambrian

The elevation of the Precambrian surface is almost the same in both drillholes; 26 to 27 m below sea level. Granites, granitic gneisses, and their cataclastic equivalents were cored. They are probably granitized sedimentary rocks, with their variations in mineral composition possibly reflecting original sedimentary layering. No specific units have been correlated in the drillholes; nor can structures present in one drillhole be traced to the other hole.

8.2 Granite Wash

Overlying the Precambrian basement is a conglomeratic unit composed of granite pebbles and fragments in a matrix of red-green mudstone, and ranging from 2 to 3 m thick. It grades upward into the mudstones of the McLean River Formation.

8.3 McLean River Formation

The McLean River Formation is composed of olive-green shale, red-brown argillaceous sandstone, brown argillaceous dolomite, and minor anhydrite. In the drillholes it ranges from 14½ to 16½ m thick with its top placed at the base of the first continuous anhydrite bed at the base of the Methy dolomites.

8.4 Methy Formation

Unit 1, the lowest unit of the Methy Formation, is about 9 m thick, and is composed from bottom to top of anhydrite, shale, dolomite, and 2 to almost 4 m of limestone. Unit 2 consists of dolomite from 26 to 32 m thick with argillaceous partings, generally conspicuous fossils, and local bitumen. Unit 3 consists of dolomite with less argillaceous material than Unit 2, some gypsum and anhydrite mostly in pores and vugs, and is from 26 to 30 m thick. Its top is placed below the 1-m anhydrite unit at the base of the Prairie Evaporite Formation. The three units comprising the Methy Formation total about 67 m in the two drillholes.

8.5 Prairie Evaporite Formation

The Prairie Evaporite Formation in the two drillholes consists mostly of gypsum and anhydrite with lesser shale and dolomite. Parts are brecciated from the solution of gypsum and anhydrite, or more probably salt - of which only very small amounts remain. Solution and brecciation probably account for the variations in thicknesses of the Prairie Evaporite Formation from about 53 m in 86-1R to about 44 m in 86-2R. Its top is placed below the base of the first overlying limestone unit.

8.6 Slave Point Formation

This distinctive unit of limestone or limestone and shale, about 4½ m thick, overlies the Prairie Evaporite Formation. It is brecciated in 86-2R. It is paraconformably overlain by the Waterways Formation.

8.7 Waterways Formation

The Firebag Member, the lowest member of the Waterways Formation, consists dominantly of shale with minor interbedded argillaceous limestone. Its thickness differs from about 47 to about 60 m in 86-1R and 86-2R, respectively, probably because of brecciation in the lower part of 86-2R. Its top is placed at the top of a distinctive unit of olive-green shale about 10½ m thick.

The Calumet Member is similar to the Firebag Member but with considerably more and thicker beds of argillaceous limestone in proportion to shale. It is about 30 m thick with its top placed at the base of a unit of dominantly shale or mudstone about 11 m thick.

The Christina Member is similar to the Firebag and Calumet Members, but with much more shale than limestone, so is more like the Firebag Member. It is about 25 m thick with its top placed at the base of a 3-m unit of limestone with 5 to 15 per cent partings of green mudstone.

The Moberly Member consists of limestone, argillaceous limestone, and shale similar to the other members of the Waterways Formation but with more limestone than shale in the part of it cored in the two drillholes. Its upper part has been eroded so only the bottom 37 m are present.

SECTION 9.0 SAMPLING AND ANALYSES OF SAMPLES FROM DRILLHOLES 86-1R AND 86-2R

All the samples selected for analyses are listed in Appendix 9 with the analytical reports in Appendix 10. All the core was checked with a scintillometer with no readings above background.

9.1 Sampling

During the drilling Mr. Kenneth Richardson selected 18 grab samples from the core, which he subsequently sent by air express to Loring Laboratories Ltd. (File 28425, Appendix 10). Later before detailed lithologging of the core, he selected 15 more grab samples which he delivered to Loring Laboratories Ltd. (File 28449, Appendix 10). Later during lithologging other samples were selected and split for analyses by Messrs. Gorham and Fluet.

9.2 Concentrations of Gold

The samples sent to Loring Laboratories Ltd. were analyzed for gold by atomic absorption with a detection limit of 5 ppb. Except for sample 792-R2, which is discussed later, the gold concentrations range from less than 5 to 60 ppb. Inspection (without statistical analysis) of the results as listed in Appendix 9 suggests that samples from the Precambrian have somewhat higher concentrations of gold than those from the overlying Paleozoic formations, but all samples but one are very far below economic concentrations, being mostly background.

The samples sent to Chemex Labs Ltd. were analyzed for gold by neutron activation with a detection limit of 1 ppb. The gold concentrations in them range from less than 1 to 17 ppb, far below economic grades. Any differences between the results from the two laboratories are probably due partly to apparent differences in background concentrations of gold in samples from Precambrian and Paleozoic formations, and partly to differences in the analytical procedures at each laboratory. The results from Chemex Labs are closer to the background concentrations of gold reported by others for similar lithologies (Wedepohl, 1969-78).

The gold concentration of 0.063 oz/ton in sample 792-R2 is surprising, but the assayer at Loring Laboratories carefully checked this sample more than once and was confident that it actually contains a much higher concentration of gold than the other samples, though it is still below an economic grade. This sample was collected from a depth of 241.4 m in 86-2R in the Methy Formation near a fractured zone at 238.4 m where the drillers lost circulation, and 2.3 m below where minor

TABLE 9:1 COMPOSITIONS OF PRECAMBRIAN GRANITIC ROCKS IN DRILLHOLES 86-1R AND 86-2R

Weight Per Cent or Parts Per Million

	1	2	3	4	5	6	7	8
SiO_2	57.40	70.80	66.70	73.50	64.40	63.00	65.70	-
TiO_2	0.23	0.35	0.42	0.24	0.49	0.30	0.50	-
Al_2O_3	10.92	13.09	16.34	12.49	16.59	17.53	14.91	-
Fe_2O_3	3.39	4.19	3.80	3.80	4.33	4.42	5.49	-
MgO	5.19	0.91	0.76	0.70	2.54	2.67	2.60	-
CaO	5.81	0.52	3.60	1.05	1.41	2.81	2.41	-
Na_2O	2.28	3.33	4.11	3.18	3.11	3.09	3.33	-
K_2O	6.28	5.40	3.65	4.69	5.38	5.26	4.25	-
P_2O_5	0.05	0.03	0.05	0.04	0.15	0.12	0.13	-
CO_2	8.28	0.44	0.37	0.51	0.62	0.44	0.62	-
MnO	0.05	0.02	0.04	0.03	0.04	0.05	0.08	-
BaO	0.06	0.05	0.05	0.06	0.12	0.11	0.09	-
Total	99.94	99.13	99.89	100.29	99.18	99.80	100.11	-
V	13	6	16	9	46	60	49	3-310 (72)
Cu	13	10	147	12	38	24	21	1-75 (20)
Ag	<0.2	<0.2	0.8	2.6	<0.2	<0.2	<0.2	0.03-0.05 (0.04)
Hg (ppb)	10	10	20	30	10	10	10	39-60 (57)
Pb	16	16	40	22	14	10	10	1-150 (24)
Sc	2.8	2.7	4.3	3.0	10.5	4.4	14.2	1-14 (6)
Y	20	20	83	20	24	20	28	2-160 (41)
La	122	240	280	225	134	112	29	7-260 (61)
Ce	126	437	479	397	230	146	44	60-430 (120)
Nd	105	180	120	100	65	60	35	6-170 (53)
Sm	9.0	18.1	24.3	13.9	11.2	8.7	5.9	1-52 (11)
Yb	1.0	1.0	4.0	1.0	1.2	1.2	1.8	0.2-18 (4)
B	70	20	50	30	150	100	30	1-300 (10)
Br	8.0	2.0	2.0	2.0	2.0	8.0	4.0	0.2-5 (0.5)
Zr	346	531	475	538	257	266	120	28-650 (162)

1) Sample 5770: 288.98-289.73 m in drillhole 86-2R (Granite Wash)
2) Composite of samples: 5769 303.81-304.77m, 5768 306.77-307.67 m, 5767 309.71-310.56 m in drillhole 86-2R
3) Composite of samples: 5766 322.26-323.19 m, 5765 325.73-326.56 m, 5764 330.36-331.27 m, in drillhole 86-2R
4) Composite of 5760-5762: 5762 340.84-341.65 m, 5761 343.51-344.58 m, 5760 346.56-347.55 m in drillhole 86-2R
5) Composite of 5776-5778: 5778 299.92-300.84 m, 5777 305.96-306.93 m, 5776 312.12-313.03 m in drillhole 86-1R
6) Composite of 5774-5775: 5775 316.38-317.30 m, 5774 318.82-320.04 m in drillhole 86-1R
7) Composite of 5771-5773: 5773 322.65-323.56 m, 5772 324.12-325.05 m, 5771 328.17-329.08 in drillhole 86-1R
8) Range (average) of concentration in granites (after Wedepohl, 1969-1978)

chalcopyrite and malachite were visible in the core (Appendix 7). Samples from core adjoining sample 792-R2 contain only a few ppb gold (Appendix 9). Thus, it appears probable that small amounts of gold have been deposited locally in fractures in the Methy Formation and possibly in other formations. Minor chalcopyrite was noted in the Precambrian in 86-1R at a depth of 318.2 to 320.3 m but samples from 316.4 to 320.0 m contain 30 ppb or less gold. The suggestion of the deposition of gold along some fractures in the Methy Formation near Fort MacKay is strengthened by the sworn statement of Homer Bradley (Appendix 4) which reports gold in veins apparently from Athabaska Oils Ltd. No. 1 at depths corresponding to those of the Methy Formation.

9.3 Concentrations of Other Metals

Some 17 samples of the Precambrian granitic rocks were composited into six samples, which along with one sample of Granite Wash (Appendix 9) were analyzed for 60 metals by techniques including atomic absorption, neutron activation, and inductively coupled argon plasma (Appendix 10).

Some of these analyses have been compiled in Table 9.1. The Precambrian rocks analyzed appear to have compositions fairly typical of granitic rocks with the most obvious difference in the major constituents in samples from drillholes 86-1R and 86-2R being the higher amounts of MgO in samples from 86-1R. Some of the trace metals in Table 9.1 were selected from those determined (Appendix 10) because on inspection their concentrations differ between the granitic rocks in the two holes. Samples from drillhole 86-1R contains higher concentrations of vanadium, scandium, boron, and bromine. Samples from drillhole 86-2R contain higher concentrations of lead, lanthanum, cerium, neodymium, samarium, and zirconium, with the concentrations of lanthanum, cerium, and some of the other rare earth metals being higher than the averages for granitic rocks (Wedepohl, 1969-78). Samples 5764-66 of mylonitic rocks show higher concentrations of copper, yttrium, samarium, ytterbium, and possibly boron, whereas the composite including sample 5774 with the visible chalcopyrite and malachite exhibits among the lower concentrations of copper. Silver may be correlated with mercury in the samples analyzed. The sample of Granite Wash was included for comparison.

SECTION 10.0 REFERENCES

Allan, J.A. (1920) The mineral resources of Alberta; Res. Coun. Alberta Rept. 1, p. 97.

Carrigy, M.A. (1959) Geology of the McMurray Formation: Part III General Geology of the McMurray area; Res. Coun. Alberta, Geol. Div. Mem. 1, 130 p.

_____ (1973) Mesozoic geology of the Fort McMurray area in Guide to the Athabasca oil sands area, editors M.A. Carrigy and J.W. Kramers; Alberta Res. Coun. Info. Ser. 65, p. 77-101.

Ells, S.C. (1926) Bituminous sands of northern Alberta; occurrence and economic possibilities; report on investigations to the end of 1924; Can. Mines Br. Rept. 632, 239 pages

Elstone, E.F. (1963) A memorandum report on the Athabasca gold project of Scurry-Rainbow Oil Ltd.; Scurry Rainbow Oil Limited, 11 p. including 6 fig., company report

Geological Survey of Canada (1957) Muskeg River, Fort MacKay, Bitumont McClelland Lake, West of Fourth Meridian, Alberta; Geophysics Papers 439, 440, 445, 446, advance editions

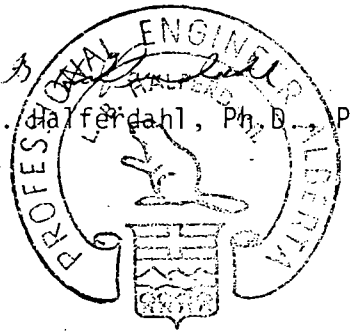
Norris, A.W. (1963) Devonian stratigraphy of northeastern Alberta and northwestern Saskatchewan; Geol. Surv. Can. Mem. 313, 168 p.

_____ (1973) Paleozoic (Devonian) geology of northeastern Alberta and northwestern Saskatchewan in Guide to the Athabasca oil sands area, editors M.A. Carrigy and J.W. Kramers; Alberta Res. Coun. Info. Ser. 65, p. 15-76.

Wedepohl, K.W. (editor) (1969-78) Handbook of Geochemistry; Springer-Verlag, Berlin, v. II.

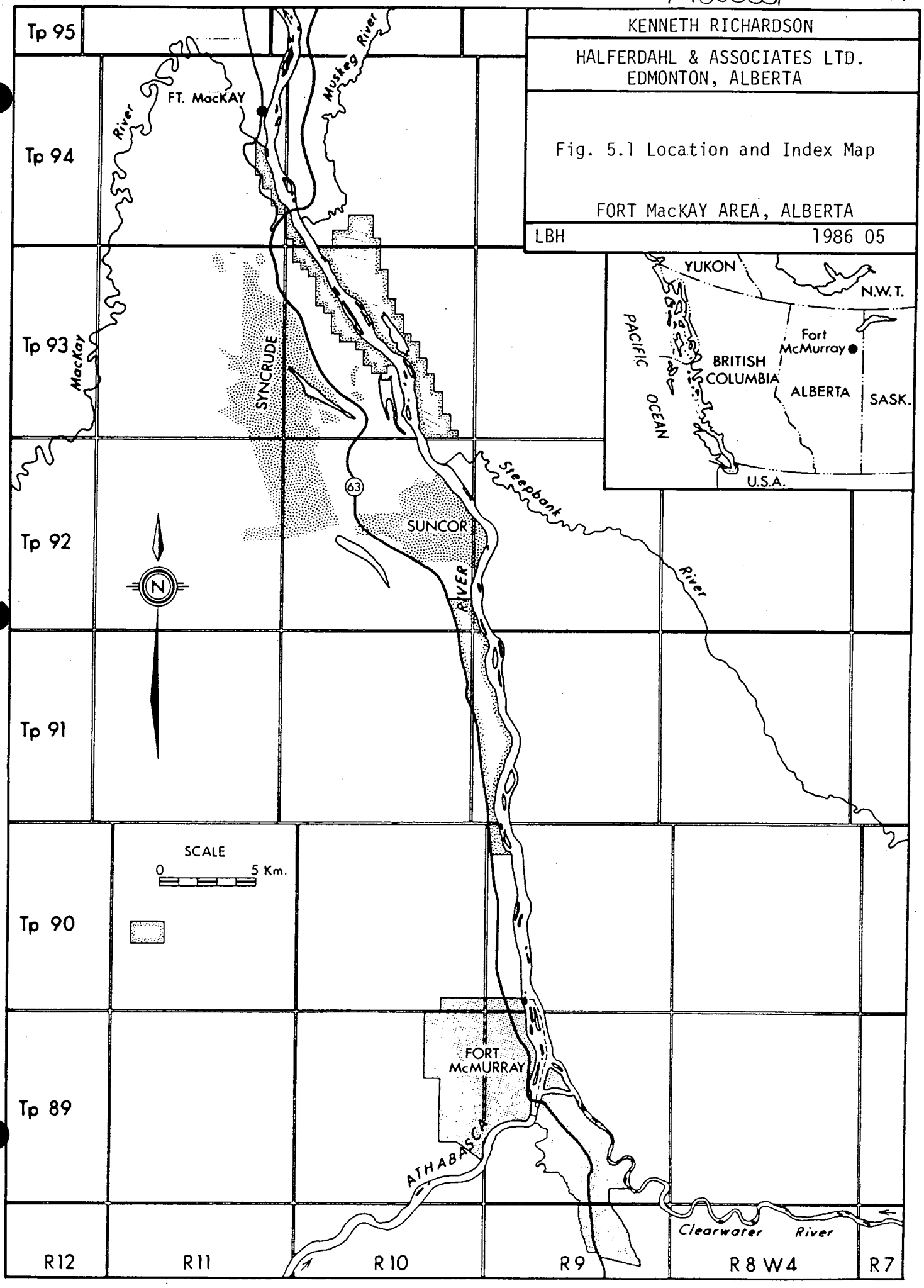
SECTION 11.0 CERTIFICATION

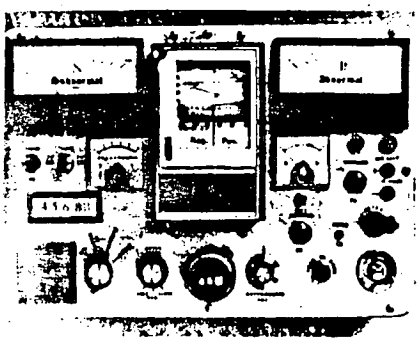
I, Laurence B. Halferdahl hereby certify that the foregoing report was prepared by me or under my supervision.



L.B. Halferdahl, Ph.D., P.Eng.

Edmonton, Alberta
1986 06 03


KENNETH RICHARDSON
HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA
Fig. 5.1 Location and Index Map
FORT MacKAY AREA, ALBERTA
LBH 1986 05
YUKON
N.W.T.
PACIFIC OCEAN
BRITISH COLUMBIA
Fort McMurray
ALBERTA
SASK.
U.S.A.
Tp 95
Tp 94
Tp 93
Tp 92
Tp 91
Tp 90
Tp 89
FT. MacKAY
Muskeg River
MacKay River
SYNCRUDE
63
SUNCOR
Steepbank River
N
SCALE
0 5 Km.
FORT McMURRAY
ATHABASCA
Clearwater River
R12
R11
R10
R9
R8 W4
R7



Face of Dr. Armin Bickel's instrument. (Photograph courtesy of Dr. Armin Bickel.)

. . . to Bickel

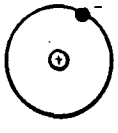
Dr. Armin Bickel and his instrument, Lompoc, California, 1977.

Unknown to Stängle, Dr. Armin Bickel, a German-born research engineer and scientist, who began his career at the German development center in Peenemunde where he worked on the V-2 rocket, and ended it at the NASA's Western Missile Test Range in Lompoc, California, was challenged after his retirement to develop instruments that could be of benefit to geological prospecting in the detection of water, oil, and minerals underground.

After two years of experimentation in his laboratory and tests in the field, Bickel came up with a black box, weighing no more than ten pounds, that compares to Stängle's instrument as the latest model Rolls Royce compares to a Model-T Ford. A supersensitive scintillation counter incorporating a built-in computer with more than 1,800 transistors designed by expert William Cunningham, it is assertedly able to pinpoint with uncanny accuracy the length, width, and dip of mineral deposits as well as their approximate quantity at depths as great as 1,000 feet and to detect oil-bearing strata down to 10,000 feet.

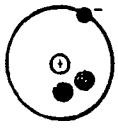
Two shots of large lemon grown by Dr. Armin Bickel compared with normal lemons. Bickel achieves this growth by treating the lemon tree's roots with a specific frequency of ultrasound. The tree then produces three to four lemon blossoms where only one would normally bloom. When all but one of the group of flowers are plucked, the remaining flower then produces an outsized lemon, the stalk of which is also apparently strengthened such that the lemon will not fall from the tree. Bickel has also produced sunflowers up to eighteen inches in diameter. A palmetto palm he treated ultra-sonically has grown more than twice the height of similar trees planted at the same time.

Hydrogen atom and isotopes.



Normal Hydrogen atom composed of one negatively charged electron and one positively charged proton

Hydrogen stable isotope, Deuterium with chargeless neutron



Hydrogen unstable isotope, Tritium, with additional neutron.

Equipped with a photomultiplier tube with a quantum efficiency of 35 percent, it can register information from an ore sample twenty-five feet distant which ordinary commercial scintillators of 5–10 percent efficiency can pick up only one foot away.

Bickel, who has also been able to perform such miracles as growing six-pound lemons by stimulating the roots of lemon trees with specific ultrasonic frequencies, says that his "Algor Super Scintillation Counter" depends on the fact that constant changes due to crystallization in geological formations that have been going on for half a billion years can, through the proper use of isotope detection, provide clues about what lies below ground.

Before 1913 it was believed that each and every atom of any element was identical in mass. Then it was discovered that an atom could, under certain natural conditions, lose or gain a particle, thereby altering its mass and energy state. These altered atoms, which were later produced artificially in atom-smashers, needed a new name. Called *isotopes*, their nuclei had the same number of protons but different numbers of neutrons.

By 1921 Francis William Aston in England had detected 202 isotopes in seventy-one elements. Today the number has risen to more than 1,500 with an average of four to each element. Only 10 percent of all known isotopes are found in nature where they can be produced by the interaction of radiations from radioactive substances in the interior of the earth or cosmic rays from outer space. The rest are engendered by artificial excitation. Thus, a normal gold atom represented as $_{79}Au^{197}$ (meaning that Au, short for the Latin word *Aurum*—gold—has 197 heavier particles in its nucleus of which 79 are charged protons and 118 uncharged neutrons), can be artificially altered to produce different isotopes from $_{79}Au^{185}$ to $_{79}Au^{203}$, only one of which, $_{79}Au^{196}$ is abundantly found in nature. It is the energy from this single natural isotope which is detectable by the Bickel invention.

In May 1974, Bickel was invited to explore the area around the Paul Isnard gold mine 150 kilometers from Saint Laurent du Maroni in French Guiana. Operating from an airplane, his machine recorded only average to below average readings for gold above the mine site. Above average readings indicated "h

spots" for gold in many places five to twenty kilometers from the mine in two directions. Copper mineralization was also located, says Bickel, near the town of Santonia.

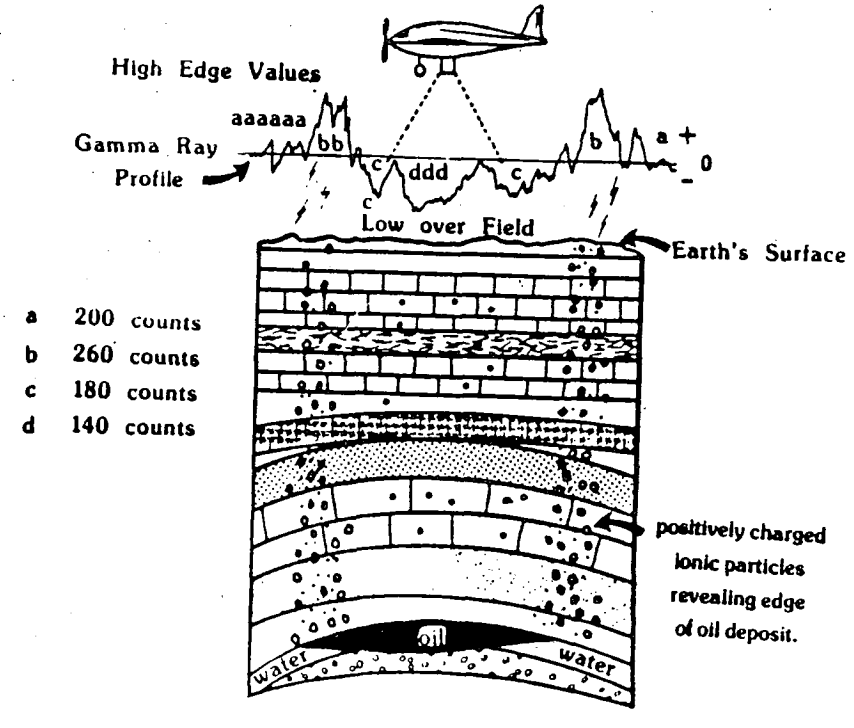
Given the near impossibility of surveying densely wooded terrain normally found in places like French Guiana, Bickel may be correct in stating that his super scintillation detector "is the only tool for exploring South American jungles."

Bickel reported that his scintillators are currently being used by diamond seekers in South Africa to search for undiscovered funnel-shaped bodies of bluish diamond-rich rock called "Kimberlite pipes." Volcanic in origin, Kimberlite ore has subnormally low radioactivity common to the basalt family of which it is a member. Therefore, when Bickel's counter provides a near zero negative reading, it indicates a likely place to find one of the "pipes."

Bickel asserts that he has twice detected a "complete blackout"—a zero negative reading—in California, one of which, he believes, indicates a thirty-foot diameter funnel on Figueroa Mountain fifty miles north of Santa Barbara. The blackouts, he says, can only be caused by Kimberlite ore deposits or pipes of active thermal steam. Intensive aerial search may locate many more of them.

Bickel is confident that his invention's greatest potential lies in its adaptability to oil search. Oil-bearing formations act as buffers to block the normal background radiation issuing from the rocks below them. When directly over a formation's edges, the positive needle on his machine climbs to a much higher reading than for the normal background, due to an anomalous condition in the interface between the oil and the surrounding material.

"While the instrument is carried by car or on foot squarely across an oil formation of a kind known to geologists as a closed



Aerial survey of Oil Deposit.

dome," reports Bickel, "the graph continuously traced on paper looks like a cross section of a volcanic crater. The raised rim corresponds to the halo" of the circle- or ellipse-shaped dome. The central depression, the lowest level of the negative reading on the graph, marks the most likely spot to drill an oil well.

Bickel's device may not entirely replace existing oil prospecting methods known to trained geologists and field engineers, but he has been told by petroleum experts that, when they first saw the device in action, they felt as if they had been looking for oil blindfolded in the past. According to Bickel, important sources of underground water are also detectable by this new device. Thirty-six producing water wells were located with it during the first three years of experimentation.

Bickel's inventions would have charmed Dr. Armand Viré who over thirty years ago prophetically wrote:

> We are not yet endowed with a means of mechanically controlling the dowsing signal, though this has been the dream of so many good-natured souls. But the idea is in the air and it is to be hoped that it will soon be realized. Contrary to what one might think, there are grounds to believe that many dowsers fear such a development. For among dowsers there are two categories: "professionals" and "theoreticians." The latter work and experiment in the laboratory or on the ground with the sole ambition of widening our scientific knowledge and developing our industrial potentials. They thus view the advent of such an apparatus with anticipation.
>
> Among the "professionals," on the contrary, there are those who cannot see beyond an egotistical goal, and a perfectly legitimate one at that, of increasing their own personal resources. These fear that any automatic dowsing apparatus will destroy the dowsing profession and cause its disappearance. In this they are completely wrong, for such an instrument can only increase the reliability of their prognoses and their very ability to furnish geology, engineering, and industry with thenceforth uncontestible and uncontested data.
>
> Has the telescope destroyed the astronomers? The stethoscope or antisepsis the physicians? The automatic calculator the mathematicians?

Today Bickel has developed two closely related models of his instrument. The "Algor Alpha," specially designed for the detection of ore bodies and mineralized zones, can be modified for water finding. The other, "Algor Explorer X," with the same basic specifications as its relative, is adapted for geological study and exploration because it can register any geological fault system or structural change and is therefore useful in checking ground formations prior to building or road construction.

Bickel is presently working on a new machine, the Explorer X100 which, using a 3-inch caesium-antimony photomultiplier tube with a sapphire window and a doped lithium-germanium crystal, will be able to record the whole spectrum of isotopes of precious metals through the use of a special computer. The machine's operator will see the word "gold," "silver," or the name of other elements appear in a "window" built into the instrument whenever considerable quantities of it are indicated underground.

"My new device is nothing short of an atomic age miracle tool for geologists and prospectors," boasts the former rocket engineer. "Perhaps I have created the first electronic dowser."

Alberta
ENERGY AND
NATURAL RESOURCES
Public Lands Division

File No. GT 93-10-4

Petroleum Plaza – South Tower, 9915 - 108 Street, Edmonton, Alberta, Canada T5K 2C9 Tel. No. 427-3570

February 19, 1986

Halferdahl & Associates Ltd.
#18, 10509 - 81 Ave.
Edmonton, Alberta
T6E 1X7

Attention: Mr. L.B. Halferdahl

Gentlemen:

Re: Metallic Minerals Test Holes and Access
Twp. 93-10-W4
93-10-4

Pursuant to Section 19, Subsection (1) (c) of the Public Lands Act, authority is hereby granted to enter upon the above described lands, as shown in red on the attached plan, for the purpose of test holes and access subject to the following conditions:

1. Have in possession, or have his contractor in possession of, a copy of this authorization which is to be retained on the job site during all phases of preparation, construction, development, maintenance and abandonment.

2. Contact and advise the Land Use Officer in Fort McMurray, Alberta (Phone: 743-7124), of your intentions prior to entry upon the lands and again at the completion of operations.

3. Not deposit or push debris, soil or other deleterious materials into or through any watercourses or on the ice of any watercourse.

4. Stream crossings must be constructed:

   (b) with the use of snow and ice materials only.

   OR

   (d) with the use of strapped or cabled log fills which must be removed following program completion or prior to spring breakup, whichever comes first. Logs must have roots, branches and tops removed.

. . . /2

5. Dispose of all woody debris in a manner as may be directed in writing by a Forest Officer.

6. Backslope all cuts and fills to a slope ratio of not less than 3:1.

7. Upon cancellation and abandonment, put the road to bed by levelling the roadbed to an acceptable landform, restoring the natural drainage by removing all culverts and fills and by taking adequate measures to avoid the inception of soil erosion and sedimentation of watercourses by cross ditching and establishing a growth of vegetation on all bare soil areas.

8. Utilize the approved access route/area only during frozen ground conditions.

9. Flag the access route/area and have its location approved in writing by a Forest Officer prior to commencement of construction.

10. Utilize impermeable tanks to collect all liquid effluents. Disposal shall be at a site and in a manner approved in writing by a Forest Officer.

11. If invert mud or any salt-based mud systems are to be used, a plan for disposal of sump fluids, drilling muds and cuttings must be submitted to the Forest Officer prior to lease construction.

12. Locate any disposal pit required in connection with this disposition in impermeable soil and backfill and level immediately upon completion of the operation.

13. A representative of your company must contact the registered trapper in your program area at least FIVE DAYS PRIOR TO INITIATING YOUR PROGRAM. This must be done by registered mail and we recommend personal communication follow-up. For information concerning registered traplines, contact the Licencing Section, Fish and Wildlife Division, Alberta Energy and Natural Resources, Edmonton, Alberta (Phone: 427-6729) upon receipt of this approval. Your company may be responsible for any damage to traps, snares or other improvements.

14. Drill site locations and size must be approved in writing by a Forest Officer.

15. The $2,000.00 security deposit submitted will be retained until all necessary restoration is completed.

. . . /3

This authorization is granted for a period of one year and will expire February 19, 1987.

Yours truly,

C.V. Bricker
Special Land Dispositions Section
Public Lands Division

CVB/mg
7954R

cc: Athabasca Forest

ERCB

Energy Resources Conservation Board

640 Fifth Avenue SW
Calgary, Alberta
Canada T2P 3G4

Telephone (403) 297-8
Telex 03-821717

19 February 1986

Mr. L. B. Halferdahl
Halferdahl and Associates Limited
18, 10509 - 81 Avenue
EDMONTON, Alberta
T6E 1X7

Dear Mr. Halferdahl:

DRILLING FOR METALLIC MINERALS
NW ¼-28-93-10W4
NE ¼-32-93-10W4

I apologize for the delay in responding to your 28 January 1986 letter. The staff have reviewed your letter and have evaluated the hydrocarbon potential in the area of interest. We agree that hydrocarbon will not be encountered and accordingly will not require that the wells be licensed by the E.R.C.B..

Yours truly,

Fred Sorenson
Development Department

FS/ch

APPENDIX 4: SWORN STATEMENT

The following is a log of a well in which I Homer Bradley and others were drilling for oil, the well was drilled with very little showing of water nor oil, but two veins of gold bearing quartz was discovered which was very rich.

The log of the well is as follows

WE ARE OMITTING PART OF THE LOG OF THE WELL AS IT HAS A TENDENCY TO LOCALIZE IT.
DEPTH COVERED BY THESE OMISSIONS TOTAL ABOUT FT.

10 ft. of lime.
3 ft. vein of quartz some gold present.
5 ft. of lime.
7½ ft. vein of quartz with a very rich gold content.

One run of a small pump yielded better than a half pound of gold.

The only persons other than myself that know the location of this deposit are ; [redacted]

I Homer Bradley [redacted] statement to the [redacted]

[redacted]

Signed and sworn to in my presence on the above date.
H. A. Diehl Justice of Peace Precinct Mecca Trumbull Co. O. My commission expires [illegible]

APPENDIX 5: SUMMARY OF 1962-63 DRILLING BY SCURRY-RAINBOW OIL LIMITED (after Elstone, 1963)

Lengths in Metres

	DD-1	DD-1-B	DD-2	DD-3
Elevation	267.3	267.3	264.4	266.2
Location from CD-2	12.2S	12.2 S; 3.0 W	48.2 S 61°W	21.3 N 4°E
Date started	1962-10-07	1962-10-23	1962-12-11	1962-12-27
Inclination	-90°	-90°	-90°	-86° at S 4°W
Triconed	0-65.5	0-200.6	0-253.9	0-259.1
Cored	65.5-201.2	200.6-331.9*	253.9-315.5	259.1-322.5
Stated or Interpreted Depths				
Bottom of oil sands	63.7	64.6	not stated	64.6
Top of Prairie Evaporite	128.0	not stated	not stated	not stated
Top of Methy	not reached	211.8	not stated	not stated
Top of McLean River	not reached	282.9	not stated	not stated
Top of Precambrain	not reached	310.3	304.5	312.42
End of hole	201.2	331.9	315.5	322.5

* Rods stuck at 289.9 m; 2½° wedge set at 259.2 m with core from 274.6-331.9 m in wedged hole.

Assays (oz./ton Au)

DD-1 No samples were taken.

DD-1-B 310.3-310.9 0.01; 310.9-311.5 trace; 311.5-312.1 trace

DD-2 No mineralization was visible; no samples were taken.

DD-3 No ore mineralization noted. "Some isolated crystals of steely pryite were visible in the hard, dense granite core near the contact."

312.0-312.4 trace; 312.4-312.7 trace; 312.7-313.0 trace

APPENDIX 6: PRESS RELEASES BY TANNER ARCTIC OIL LTD. ON MARCH 31 AND APRIL 7, 1986

TANNER ARCTIC OIL LTD.

PRESS RELEASE - MARCH 31, 1986

Tanner Arctic Oil Ltd.(ASE) reports Campbell Gold 2 Athabasca, the first drill hole, has been completed at a depth of 972 feet. As expected the hole successively intersected: cretaceous strata including oil sands and shale; a devonian sequence dominated by limestone, gypsum, and shale; and a precambrian crystalline basement.

Fresh course grained red granite of the basement grades upward through an alteration zone into the basal devonian.

Core recovery below 909 feet has been very good. The core is presently under examination and sections will be submitted for assay.

Break up conditions are being experienced in the Fort McMurray area and the rig has been released.

For further information contact:

Mr. B. C. Tanner, President
Tanner Arctic Oil Ltd.
11309 University Avenue
Edmonton, Alberta
T6G 1Y8

Telephone: (403) 436-2666
(403) 433-8642

TANNER ARCTIC OIL LTD.

PRESS RELEASE - APRIL 7, 1986

Tanner Arctic Oil Ltd. reports non-commercial values of gold encountered in cores.

Two samples assayed trace gold.

Campbell Gold 2 Athabasca drilled 4 ft. from original hole at surface believed to be as much as 50 ft. N. E. of target.

Plan to re-enter original hole, as per original plan, as soon as weather permits.

For further information contact:

Mr. B. C. Tanner, President
Tanner Arctic Oil Ltd.
11309 University Avenue
Edmonton, ALberta
T6G 1Y8

Telephone: (403) 436-2666
(403) 433-8642

APPENDIX 7: LITHOLOGICAL LOGS OF DRILLHOLES 86-1R AND 86-2R

Owner: Kenneth Richardson
Drillhole: 86-1R
Inclination: -90°
Length: 329.08 m
Core recovery: complete except as noted
Core size: HQ3
Downhole logs: none run

Property: Metallic Minerals Exploration Permit 068 6886020001
Location: 95 m W and 620 m S of NE corner of Sec. 6, Tp. 94, R. 11 W4, Alberta
Elevation: 257 m ± 2 (from 1:50 000 topo map)
Drilled: 1986 09 09 to 1986 03 14
Drilled by Tonto Drilling (Alberta) Ltd.
Logged by J.H. Gorham and D. Fluet

Purpose: To test for metallic minerals in the Precambrian and overlying strata

Note: Location by scaling from detailed map on which the drillsite had been located by topofil due north to trail along south side of Muskeg River and thence by topofil west along trail to Athabasca River

Metrage	Interval	Description
0-3.66	3.66	Overburden 0-3.35 m casing 3.35-3.66 m 0.31 m lost material
3.66-4.42	0.76	Limestone and Mudstone, interbedded - limestone: light-grey, argillaceous, micritic, nodular rubbly appearance; mudstone: grey-green, calcareous, poorly consolidated; interbedded in irregular layers 1-5 cm thick, basal contact sharp (core quite broken but appears to have been recovered completely)
4.42-7.88	3.46	Limestone, light-grey to grey-green, argillaceous, micritic, nodular masses 2-10 cm thick with irregular laminated olive-green calcareous mudstone partings to 1 cm thick, a few shell fragments altered to calcite, some stylolites, bitumen coatings on some fractures, basal contact abrupt
7.88-8.50	0.62	Mudstone, grey-green calcareous, finely laminated at 90°CA, mottled with lighter-colored more calcareous patches, grading to argillaceous limestone towards base, basal contact gradational
8.50-9.89	1.39	Limestone, grey-green, argillaceous, micritic, 2-4 cm thick nodules with olive-green calcareous mudstone partings making up 25% of rock: texture looks like load-cast development in soft sediments; basal contact intercalated
9.89-12.12	2.23	Limestone and Mudstone, interbedded, lithology as in previous unit: alternating layers about 1-2 cm thick with load casting similar to previous unit, slightly fissile laminated mudstone, some minor shell fragments and crinoid ossicles replaced by calcite, basal contact gradational, some fractures coated with bitumen

Owner: Kenneth Richardson
Drillhole: 86-1R

Property: Metallic Minerals Exploration
Permit 068 6886020001
Page: 2

Metrage	Interval	Description
12.12-12.45	0.33	Limestone, light-grey, argillaceous, micritic, with irregular grey-green argillaceous partings to 5 mm thick, basal contact gradational; this unit is a limestone-rich part of the preceeding unit: texturally it appears to be load casts of lime mud in a clay matrix
12.45-21.31	8.86	Limestone and Mudstone, as 9.89-12.12 m with more limestone than mudstone, shell fragments throughout, some fractures coated with bitumen
21.31-22.35	1.04	Limestone, grey to grey-green, argillaceous, fossiliferous: locally almost a coquina of shell fragments and crinoid ossicles, elsewhere nodular as 12.12-12.45 m with thin mudstone partings, basal contact gradational
22.35-24.28	1.93	Mudstone and Limestone, as 9.89-12.12 m but with mudstone predominating, limestone as discrete nodules 1-5 cm across floating in laminated, very soft, slightly fissile greenish-grey calcareous mudstone, shell fragments common, basal contact abrupt at 45°CA - possibly a fault 22.71-22.83 m grey-brown, micritic limestone with shell fragments possibly a larger cleaner limestone nodule 23.90-24.28 m very soft mudstone about 75% of rock
24.28-26.99	2.71	Limestone, cream to buff, micritic to very fine grained calcarenite, shell fragments of brachiopods, pelecypods, and some crinoids common, very minor grey-green mudstone partings in places, pores and fractures coated and filled with bitumen, a few laminae and blebs of fine-grained pyrite, locally fractured and brecciated with green bentonitic clay filling fractures and surrounding breccia fragments, basal contact gradational 25.97 m small sample removed by owner, probably less than 10 cm 26.43 m about 10 cm brecciated core with clay matrix
26.99-29.29	2.30	Limestone and Mudstone, as 9.89-12.12 m, gradational contacts with adjacent units
29.29-32.35	3.06	Limestone, cream to light-grey, argillaceous, with braided clay partings 1-5 mm thick, shell fragments and minor pyrite throughout with a few layers of abundant shell fragments, clay about 2-5% of rock, basal contact fairly sharp

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Metrage	Interval	Description
32.35-33.45	1.10	Limestone and Mudstone, as 9.89-12.12 m with mudstone 30-50% of rock, contacts gradational and arbitrary as all these units based on gradational variations of lithology from moderately pure limestone to mudstone, all with a similar load-cast texture
33.45-36.73	3.28	Limestone, as above, with calcareous mudstone partings comprising 5-20% of rock, minor pyrite, some shell fragments, lower contact gradational over 10 cm
36.73-37.75	1.02	Mudstone, grey-green, calcareous, very soft with nodules and layers of argillaceous limestone up to 1 cm thick comprising 10-20% of rock, few pelecypod shells and fragments, basal contact sharp
37.75-40.77	3.02	Limestone, buff-grey, argillaceous, micritic as in previous units; grey-green mudstone partings comprise 10-15% of rock; some accumulation of insolubles along stylolites and in more fossiliferous layers, very minor pyrite blebs up to 1 cm across 40.57-40.77 m medium-grained calcarenite composed of shell fragments with some disseminated pyrite foundering of limestone into underlying mudstone along basal contact
40.77-42.44	1.67	Mudstone, grey-green, calcareous, fairly fissile with more and less limy areas; some lighter-colored patches may be argillaceous limestone; becoming more calcareous towards base, basal contact gradational
42.44-43.11	0.67	Limestone, grey to grey-green, argillaceous, micritic to coarse-grained calcarenite, composed mainly of shell fragments and crinoid ossicles, with argillaceous partings up to 5 mm, load casts, basal contact intercalated
43.11-50.60	7.49	Mudstone and Limestone, grey-green calcareous mudstone and micritic argillaceous limestone interbedded in irregular layers 1-2 cm thick, soft-sediment deformation features such as load casts and flame structures, a few layers of calcarenite 1-5 cm thick composed of shell fragments, basal contact gradational
50.60-51.82	1.22	Limestone and Mudstone, as 9.89-12.12 m with mudstone comprising 20% of rock, bottom contact intercalated

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Metrage	Interval	Description
		50.60-50.80 m calcarenite similar to previous beds
		51.62-51.82 m calcarenite similar to previous beds
51.82-54.96	3.14	Mudstone, grey-green, calcareous, fairly fissile, with nodules and layers of grey-green argillaceous limestone up to 1 cm thick, decreasing downhole, grading into olive-green calcareous shale as fissility improves
		51.92 m 2-4 cm core removed by owner
		53.00 m 6 cm of calcarenite composed of shell fragments
		53.79 m 4 cm of shell fragments
54.96-65.58	10.62	Shale, grey-green to olive-green, calcareous, fissile, with few laminae of grey-green argillaceous limestone 1-5 mm thick, very sparse lenticular masses of fine-grained pyrite 1 mm thick by 10 mm long, basal contact abrupt: appears to be a fault contact with about 5 cm of soft green clay with limestone fragments and euhedral pyrite
65.58-68.24	2.66	Limestone, buff to grey-green, argillaceous, fine- to medium-grained calcarenite with abundant shells and shell fragments - locally 10% olive-green calcareous shale partings, upper contact brecciated: may be a fault or possibly a paraconformity as pyrite in the breccia matrix is contiguous with a vein of pyrite and calcite about 1 cm wide running downhole from the upper contact for about 40 cm, basal contact intercalated with load casts
		65.58-65.98 m buff, somewhat cleaner than farther downhole
		66.90-67.00 m much shalier
68.24-70.38	2.14	Shale, grey-green, calcareous, fissile, with lighter mottled areas of argillaceous limestone 1-1½ cm thick, basal contact sharp
70.38-76.46	6.08	Limestone, buff to light-grey-green, argillaceous, fine-grained calcarenite, with abundant irregular grey-green argillaceous partings up to 5 mm thick, abundant pelecypod and brachiopod shells and shell fragments and crinoid pieces, numerous 2-5 mm discontinuous calcite veins, basal contact gradational chosen somewhat arbitrarily at color change to a grey-green argillaceous limestone

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Metrage	Interval	Description
76.46-79.03	2.57	Limestone, grey-green to olive-green, argillaceous, fine-grained calcarenite with abundant shells, shell fragments, and crinoid ossicles making up to 30% of rock, texturally similar to previous unit, with very sparse disseminated fine-grained pyrite, becoming steadily more argillaceous downhole as it grades into calcareous shale, basal contact placed where fissility develops 78.88-79.05 m 0.17 m sampled by owner
79.03-84.43	5.40	Shale, olive-green, calcareous, fissile, mottled with lighter-colored more calcareous layers 1-2 cm thick, becoming argillaceous limestone at base of unit, a few fine-grained pyrite nodules and lenses 1-3 cm across by 2-5 mm thick, basal contact intercalated
84.43-85.62	1.19	Limestone and Shale, buff to olive-green, interbedded or as nodules of argillaceous limestone in calcareous shale, similar to previous units, sparse fine-grained pyrite in some layers, basal contact gradational 85.37-85.62 m fossiliferous
85.62-95.30	9.68	Shale and Limestone, grey-green to olive-green, calcareous shale with nodules and irregular layers of argillaceous limestone 1-2 cm thick, load casts and flow structures common, calcite-replaced brachiopod and pelecypod shells scattered throughout, a few ¼-½ cm thick calcite veins, scattered pyrite nodules 1-2 mm across in some limestone layers, basal contact gradational 86.16-86.60 m fossiliferous, argillaceous limestone with shale partings as in previous units, grades in and out of shale 86.70-89.31 m mislatch: core broken and ground, approximately 1.2 m lost
95.30-106.01	10.71	Shale, olive-green, calcareous, fissile, with a few beds of limestone mainly fossiliferous calcarenites 5-10 cm thick, with scattered pyrite nodules 2-5 mm in size 98.51-98.75 m fossiliferous limestone with shale partings 103.33-103.46 m fossiliferous limestone as above

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Metrage	Interval	Description
106.01-106.53	0.52	Limestone, grey-brown, argillaceous, fine-grained calcarenite with abundant small pelecypod shells, small blebs of green shale throughout, basal contact jumbled by flame structures as whisps of shale extend into limestone
106.53-107.21	0.68	Shale and Limestone, as in previous units, interbedded in layers 1-2 cm thick, grading downward into shale
107.21-108.05	0.84	Shale, olive-green, calcareous, fissile, similar to previous units, contacts gradational
108.05-108.89	0.84	Shale and Limestone, interbedded, as 106.53-107.21 m, sharp basal contact at a 3-cm shell bed with some fine-grained pyrite
108.89-111.63	2.74	Shale, olive-green, calcareous, fissile, with a few shells and very sparse nodules of fine-grained pyrite, few lighter-colored more calcareous bands, basal contact sharp 109.73 m small chip sampled by owner
111.63-112.17	0.54	Limestone, grey-green, argillaceous, with abundant shells, argillaceous partings as 106.01-106.53 m, gradational basal contact
112.17-116.58	4.41	Shale, olive-green, calcareous, fissile with limy mottles and minor interbedded argillaceous limestone and shell layers, minor nodular pyrite, basal contact gradational
116.58-118.52	1.94	Limestone and Shale, interbedded, similar to previous units, beds 1-3 cm, a few shaly layers with very minor pyrite, contacts gradational
118.52-120.23	1.71	Shale, as above, pyrite concentrated inside shells, basal contact gradational
120.23-129.13	8.90	Limestone, grey to grey-green, argillaceous, micritic, nodular, with irregular olive-green calcareous shale partings 2-5 mm thick, shells and shell fragments of brachiopods and pelecypods common, very sparse pyrite, a few shaly layers up to 10 cm thick 122.2-124.0 m mislatch: core broken and rounded, about 0.55 m lost few shell layers up to 10 cm thick, with fine-grained pyrite nodules up to 2 mm across, gradational basal contact placed below a shell bed in green shale

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Metrage	Interval	Description
129.13-129.71	0.58	Shale, grey-green, calcareous, similar to previous units, with well-preserved brachiopods filled with micritic limestone, at base grading into argillaceous nodular limestone with some brachiopods
129.71-131.47	1.76	Limestone, grey-green, argillaceous, nodular or lenticular blobs of micritic limestone with olive-green argillaceous partings up to 1 cm thick, brachiopod shells common, sparse pyrite, basal contact sharp
131.47-135.13	3.66	Shale, grey-green to grey, calcareous, very fissile, with a few interbedded limestone layers 1-10 cm thick similar to previous unit, core broken because of fissility, basal contact gradational
135.13-136.55	1.42	Limestone and Shale, similar to previous units, interbedded in irregular layers and nodules 1-4 cm thick, basal contact arbitrary: grades back into shale over 2 m; contact placed where shale forms 75% or rock
136.55-142.55	6.00	Shale, as 131.47-135.13 m, grey-green, calcareous, very fissile, limy bands and minor argillaceous limestone in layers 1-2 cm thick near top of unit grading up into previous limestone unit, basal 1.5 m very fissile and fractured, contact with underlying limestone sharp; fracture in the limestone contains shale similar to this unit, which is grey at the base, (core broken but recovery apparently complete)
142.55-147.24	4.69	Limestone, light-grey-brown, medium-grained calcarenite, slightly vuggy with abundant brachiopod shells, some coral and crinoid ossicles replaced by calcite, thin braided argillaceous partings and interbedded argillaceous limestone, bitumen on some fractures and in a few pores, few stylolites, very thin calcite veins along fractures, gradational basal contact 143.61-143.89 m dark-grey shaly limestone with shell fragments 144.14-144.20 m as 143.61-143.89 m
147.24-149.05	1.81	Shale, buff, grey, grey-green, and olive-green, calcareous, finely laminated with numerous minor faults, grading downwards into gypsum and anhydrite with shaly and dolomitic laminae with a few bituminous laminae

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Metrage	Interval	Description
149.05-154.15	5.10	Gypsum and Anhydrite, grey to blue-grey and white, medium- to coarse-grained, with fine partings of organic matter and clay, few laminae of interbedded grey-green shale and irregular mottled patches of laminated buff-colored calcareous dolomite, locally to 20% of rock, few cross-cutting gypsum veins, basal contact intercalated 153.16-153.32 m brecciated fragments of laminated buff-colored calcareous dolomite
154.15-160.58	6.43	Shale, buff to olive-green, dolomitic, slightly calcareous, laminated to massive, locally grading to argillaceous dolomite with fissility ranging inversely with dolomite content, several ½-1 cm gypsum veins, some interbedded dolomite and fissile shale with a nodular texture similar to the limestones and mudstones of the Waterways Formation uphole with soft-sediment deformation features: ball-and-pillow structures, flame structures, and small slips; basal contact sharp 158.80-159.10 m residual gypsum in breccia of grey-green shale, probably remnant of a thicker anhydrite bed
160.58-161.73	1.15	Shale, green, slightly calcareous, fissile, massive to laminated slightly dolomitic near base, with a few bituminous laminae, one gypsum vein, basal contact fairly sharp
161.73-172.14	10.41	Gypsum and Anhydrite, grey-blue to white, crystalline, coarse-grained, with laminae and 1-2 cm brecciated pieces of green shale and buff dolomite, lamination at about 80°CA, numerous gypsum veins and some stylolites indicating solution, several layers of brecciated dolomite and mudstone indicating solution collapse, anhydrite as discrete anhedral crystals or as laminae coated with gypsum 164.36 m small sample removed by owner 165.77-166.37 m breccia of angular mudstone, dolomite, and minor limestone from 1-10 cm across in calcareous green mudstone and gypsum matrix with several cross-cutting gypsum veins 1-2 cm thick, below small balls 1-1½ cm across with grey-green shale partings 167.08-167.13 m gypsum vein 167.64-168.69 m breccia fragments of green mudstone floating in gypsum matrix

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Metrage	Interval	Description
		169.94-171.15 m breccia: mudstone and dolomite fragments in gypsum and mudstone matrix as above
172.14-181.49	9.35	Breccia, as in previous unit, angular fragments and blocks of green and grey-green shale, buff laminated micritic dolomite in soft green clay matrix with interbedded gypsum and minor anhydrite, gypsum veins up to 5 cm thick common, sharp basal contact 178.98 m small sample removed by owner
181.49-182.02	0.53	Anhydrite and Shale, grey-green and blue-green, interlaminated, mottled with some gypsum veins up to 4 cm thick, sharp basal contact
182.02-184.51	2.49	Anhydrite, blue-grey, medium- to coarse-crystalline with some alteration to gypsum 183.51-184.51 m more interlaminated olive-green shale with laminae 1-2 mm thick, gradational lower contact
184.51 186.00	1.49	Dolomite, buff, micritic, massive to finely laminated, hard, with minor argillaceous partings and small lenses and veinl of gypsum up to 5 mm thick, fairly sharp basal contact
186.00-187.05	1.05	Anhydrite and Shale, blue-grey and olive-green as 181.49-182.02 m, gradational basal contact
187.05-197.56	10.51	Anhydrite, blue-grey, as 182.02-184.51 m, with minor interlaminated shale and buff dolomite, gypsum veins common 188.41 m 0.12 m split and sampled previously 191.06-196.40 m cream dolomite interbedded with anhydrite and minor olive-green shale, locally bituminous 194.50-197.56 m brown salt crystals increasing towards base, basal contact gradational over about 25 cm with underlying dolomite, few slightly vuggy masses in this interval
197.56-198.87	1.31	Dolomite, buff, medium-grained, crystalline, massive, slightly mottled, porous in places, sharp basal contact
198.87-199.97	1.10	Anhydrite, blue-grey to whitish-grey as above, with brown salt crystals up to 1 cm, considerable alteration to felted textured gypsum, two 10-cm beds of dolomite near base, sharp basal contact

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Metrage	Interval	Description
199.97-221.79	21.82	Dolomite, buff to grey-green, medium-grained, hard, massive to laminated, very thin argillaceous to bituminous laminae, few crinoid and sponge fragments, few irregular patches of gypsum and anhydrite up to 5 cm across, locally gradational to greyish or to more argillaceous grey-green areas 207.77-207.99 m greenish-grey, more argillaceous 208.96-209.38 m more argillaceous 214.57-215.95 m darker-brown, probably higher in organics, several vugs 5-10 cm across filled with clear to white gypsum 217.32-221.79 m clean and uniform, stromatoporoids scattered and concentrated in bands 5 to 10 cm wide
221.79-230.35	8.56	Dolomite, buff to grey-brown, medium-grained calcarenite, porous and vuggy, bleached patches, some gypsum veins and some vugs filled with gypsum, few minor argillaceous partings, darker color probably from increased organic content, cream-colored spots from recrystallization of sponges and corals, few scattered lenses of fine-grained pyrite 1 cm long by 1-2 mm thick, wavy argillaceous partings more numerous downhole, basal contact where laminated dolomite predominates 227.48 m about 0.05 m previously removed by owner
230.35-256.44	26.09	Dolomite, brown to dark-brown, finely laminated, slightly argillaceous, calcareous medium-grained porous calcarenite, scattered irregular bleached areas, some crinoid debris, minor gypsum veins, dark bituminous wavy laminae at average of about 85^{o}CA, few stylolites, widely scattered small nodules of fine-grained pyrite, few fractures coated with bitumen, few very bituminous layers 2-5 cm thick 248.50-256.44 m dark-brown, bituminous, with abundant crinoid ossicles scattered throughout and in beds 1-2 cm thick, some lenses of calcite 1-2 cm thick, few rugose corals, 10-cm calcareous crinoid-ossicle bed at sharp basal contact
256.44-260.30	3.86	Limestone, brownish-grey, fine-grained, dolomitic, calcarenite, slightly argillaceous, finely laminated to massive, abundant crinoid ossicles and shell fragments, texturally very similar to previous unit, gradational basal contact
260.30-262.76	2.46	Dolomite, buff to grey-brown, medium-grained calcarenite, massive to laminated, mottled, with some recrystallized shells and crinoid debris, gradational basal contact

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Metrage	Interval	Description
262.76-263.45	0.69	Shale, grey-green, dolomitic, massive to laminated, interlaminated dolomite and gypsum at base, intercalated basal contact
263.45-265.92	2.47	Anhydrite and Gypsum, white to blue-grey, crystalline, massive to banded, brown anhedral salt crystals scattered throughout, interlaminated olive-green dolomitic shale and buff argillaceous dolomite, few brecciated fragments of same near base of unit, intercalated basal contact
265.92-275.53	9.61	Shale, Dolomite, interbedded, with minor gypsum and anhydrite; shale: olive-green, dolomitic, laminated to massive, fairly fissile; dolomite: buff, micritic, laminated, beds up to 20 cm thick, laminae 1-5 mm, at top of unit some anhydrite and gypsum in several layers 10-20 cm thick interlayered with shale, common gypsum veins to 1 cm thick, intraformational conglomerate in some layers, scattered layers of dark-brown and heavily bituminous mudstone 2-10 cm thick 270.60 m short length previously removed by owner
275.53-278.42	2.89	Shale, green, not very fissile, massive to slightly laminated, few interlayered dolomite laminae, few beds of intraformational conglomerate with clasts less than 1 cm across and minor reddish-brown gypsum interstitially, several gypsum veins up to ½ cm along fractures, gradational basal contact
278.42-281.62	3.20	Shale and argillaceous Sandstone, reddish-brown and green, interbedded, coloring irregular; sandstones: fine- to medium-grained, abundant gypsum veins, minor intraformational conglomerate 278.54-278.62 m blue-grey anhydrite, altering to gypsum 281.31-281.62 m olive-green to brown argillaceous gypsum: brown-orange gypsum blebs with green shaly partings, shalier near base, gradational lower contact
281.62-282.41	0.79	Mudstone, dark-red-brown at top to brick-red at base, gypsum veinlets to 1 cm thick throughout, conglomeratic with 10% pebbles and fragments of white quartz to 1½ cm in size at base with increasing amounts of quartz grading into unit below
282.41-284.43	2.02	Conglomerate or Breccia, mottled red-brown and green matrix with 15-25% pebbles and fragments of quartz and fragments of granite

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Metrage	Interval	Description
		283.01-284.43 m dark-red-brown clayey matrix with white and red spots with fragments of granite and quartz, iron-stained and crumbly at base with abundant gypsum cement
284.43-297.12	12.69	Granite, light-red or pink, coarse-grained, 25-35% quartz, 50-60% pink-red feldspar, 10-15% biotite, highly fractured core with much rust on fractures, probably a granitized sediment
		285.45-286.51 m highly fractured with fragments cemented by gypsum, minor quartz veins to ½ cm wide
		286.51-287.53 m as 285.45-286.51 m but more highly fractured with abundant gypsum in fractures
		287.53-287.91 m quartz vein 15-25 cm thick in interval, other quartz grains to 1 cm in size with inclusions of rock fragments, minor gypsum along fractures
		287.91-289.33 m very hard, quartz 10-20%, feldspar 60-80%, biotite 10-15%, minor rust on fractures some with minor gypsum, minor quartz veins near base
		289.33-292.91 m grain size 2-3 mm mostly, quartz 20-25%, pink to red feldspar 70-80%, biotite 5-10% some aligned, quartz veins throughout to 2 cm wide
		292.91-297.12 m pink to reddish-brown, medium- to coarse-grained, pink feldspar 60-70%, quartz 20-30%, biotite 5-10%, grains subequant or anhedral, quartz veins to 1 cm with chlorite borders, gradational basal contact
297.12-312.42	15.30	Granite, reddish-brown to greyish-brown, similar to 292.91-297.12 m but with 30-40% quartz, 10-15% biotite, balance K-feldspar, biotite locally aligned near perpendicular CA, basal contact gradational over 20 cm
		300.99-301.30 m finer-grained more felspathic, with minor quartz veins
		301.30-301.90 m broken core some lost
		301.90-302.36 m broken core
		302.82-302.87 m coarse-grained pinker more feldspathic band perpendicular CA
		303.79-304.00 m as 302.82-302.87 m
		305.79 m barren quartz vein 1 cm thick at 20°CA
		307.48 m 4-cm barren quartz vein at 45°CA

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Metrage	Interval	Description
		308.76-310.90 m series of rusty fractures at 20-25°CA
		311.20-311.80 m 0.60 m missing core
312.42-314.19	1.77	Granite, reddish-brown, mylonitic, more feldspathic than previous units, fine- to medium-grained, biotites altering to chlorite, several bands of brecciated and chloritized fault gouge ½-2 cm across, core broken, gradational basal contact
314.19-316.08	1.89	Granite, as 297.12-312.42 m, core broken, gradational basal contact
316.08-320.34	4.26	Granite, as 312.42-314.19 m with a few very coarse grained mylonitic areas with quartz veins up to 1 cm across
		318.21-320.34 m more abundant quartz veining, widely disseminated minor chalcopyrite and malachite staining (core broken with about 0.75 m missing in this interval) (320.05-320.25 m green shale from Waterways Formation: spurious core)
320.34-322.78	2.44	Granite, as above, but extensively silicified, with alteratio to chlorite and epidote or diopside, gradational basal contact
322.78-329.08	6.30	Granite, black to reddish-brown, medium- to coarse-grained, grains anhedral to subequant, 30-50% K-feldspar, 15-60% biotite, 10-20% quartz in discrete grains and masses up to 10 cm across, several barren quartz veins to 4 cm wide
329.08	-	End of hole

Owner: Kenneth Richardson
Drillhole: 86-2R
Inclination: -90°
Length: 350.26 m
Core recovery: complete except as noted
Core size: HQ3
Casing: 5.18 m left in
Downhole logs: none run

Property: Metallic Minerals Exploration Permit 068 6886020001
Location: 1000 m W and 320 m S of NE corner of Sec. 32, Tp. 93, R. 104, Alberta
Elevation: 264m ± 2 (from 1:50 000 topo map)
Drilled: 1986 03 14 to 1986 03 20
Drilled by Tonto Drilling (Alberta) Ltd.
Logged by J.H. Gorham

Purpose: To test for metallic minerals in the Precambrian and overlying strata

Note: Location by scaling from detailed map from which the drillsite had been transferred from its spotted location on a 1:6 000 aerial photograph and checked by topofil measurements

Metrage	Interval	Description
0-3.96	3.96	Overburden 0-0.76 m cased 0.76-3.96 m fragments of grey argillaceous limestone, grey-green calcareous mudstone, clay, organic matter, (poor recovery)
3.96-5.49	1.53	Limestone, argillaceous, grey micritic, with irregular mudstone partings 1-5 mm thick, fragmented, bitumen coating some fracture faces, (fair recovery)
5.49-7.62	2.13	Limestone, argillaceous, grey to grey-green, micritic to slightly laminated with interbedded grey-green calcareous mudstone, layers ½-2 cm thick, a few lenticular grey limestone layers 1-2 cm thick, fractures coated with iron oxides and bitumen, more argillaceous through basal 30 cm, laminae at 78-80° CA, gradational contact
7.62-8.23	0.61	Limestone, slightly argillaceous, micritic, light-grey to grey-green with irregular dark-grey carbonaceous blebs 1-5 mm across, with irregular non-laminar partings of calcareous mudstone, a few small calcite-filled pelecypod shells, some stromatoporoid tubes, gradational contact
8.23-8.61	0.38	Mudstone, calcareous, grey-green, with lenticular masses of micritic grey limestone up to 1 cm across making up to 50% of rock, gradational contact
8.61-21.23	12.62	Limestone, argillaceous, micritic to vaguely laminated, as irregular masses from round to lenticular, ½-3 cm thick surrounded by light-grey-green calcareous argillite partings 1-10 mm thick comprising 20% of rock, minor stromatoporoids and small calcite-replaced pelecypods, minor amounts of bitumen on some fractures

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Metrage	Interval	Description
		9.91-10.67 m more argillaceous
		11.61-11.92 m more argillaceous
		12.50-13.49 m more argillaceous; some intraformational conglomerate and flame structures indicate soft-sediment deformation
		17.53-21.23 m more regular beds ½-2 cm thick with 1-5 mm mudstone partings, basal contact gradational
21.23-21.97	0.74	Limestone, light-grey, with minor irregular argillaceous partings 1-2 mm thick, abundant ½-1 cm pelecypod shells comprising up to 40% of rock, basal contact abrupt
		21.48 m ½-cm mudstone parting with bitumen
		21.69 m as above
		21.95 m as above
21.97-25.48	3.51	Mudstone, grey-green, calcareous, with irregular blobs of argillaceous limestone 1-10 cm across comprising 10-60% or rock, mudstone vaguely laminated in places with laminae bending around limestone clasts indicative of soft-sedimen deformation, both lithologies with a few calcite-replaced shell fragments, limestone clasts with 1-2 mm fractures filled with calcite which are cut off at mudstone contacts, becoming more argillaceous at base, lower contact gradational over 2 cm
25.48-26.70	1.22	Limestone, light-grey to cream-colored, micritic, with abundant pelecypod shells, some stromatoporoids near base, interbedded with irregular layers of olive-green mudstone containing some bitumen, some limestone layers vaguely laminated with very thin bitumen partings at about 85°CA, basal contact abrupt at 45°CA
26.70-26.86	0.16	Mudstone, grey-green, calcareous, with a few sandy layers up to 5 mm thick containing bitumen, basal contact abrupt at 45°CA, core partly broken
26.86-28.08	1.22	Limestone, cream-colored, micritic, quite clean, with abundant stromatoporoids and some pelecypod shells, some laminae containing bitumen at about 85°CA, basal contact gradational
28.08 29.31	1.23	Limestone, light-grey to cream-colored, micritic, as irregular blobs surrounded by 1-2 mm partings of grey-green calcareous mudstone, lower contact gradational

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Metrage	Interval	Description
		28.70-29.16 m band of grey-green limy argillaceous bituminous very fine grained sand cutting across at 25°CA
29.31-32.00	2.69	Limestone, light-grey-green, silty to argillaceous, as irregular shaped blobs with braided grey-green calcareous mudstone partings 1-2 mm thick comprising about 10% of rock, a few minor shell fragments, contact gradational, unit similar to previous unit but with more mudstone
32.00-33.18	1.18	Limestone, light-grey to creamy-grey with minor argillaceous partings as in previous unit, several bands a few centimetres thick with abundant calcite-replaced pelecypod shell fragments, minor ½-1 mm carbonaceous specks, few stylolites, contact intercalated 32.66-32.92 m more mudstone partings
33.18-34.06	0.88	Limestone, grey-green, mottled, argillaceous with irregularly shaped calcareous mudstone partings up to 1 cm thick as in previous unit but more abundant, lower contact gradational, core partly broken
34.06-37.49	3.43	Limestone, light-grey to creamy-grey, slightly argillaceous, mottled, irregular layers 1-5 cm thick with partings of soft olive-green calcareous silty to sandy mudstone 1-10 mm thick, some calcareous shell fragments and carbonaceous specks; mudstone comprises about 10% of rock; contact fairly abrupt
37.49-38.30	0.81	Mudstone, grey-green, calcareous, thinly interbedded with grey-green argillaceous limestone, laminae 1-5 mm, partly fissile, at about 85°CA, contact abrupt
38.30-41.41	3.11	Limestone, cream to light-grey, hard, micritic to finely crystalline, mottled in places, with minor carbonaceous specks and some pelecypod shell fragments, some fractures coated with bitumen, partings of olive-green calcareous mudstone making up about 5% of rock, lower contact intercalated over 10 cm 39.01-39.83 m brecciated, with more abundant green calcareous mudstone and some bitumen: possibly a minor fault or solution breccia
41.41-54.53	13.12	Mudstone and Limestone, grey-green, calcareous, fairly fissile mudstone thinly interbedded with grey-green micritic argillaceous limestone, beds ½-2 cm thick, laminar to very irregular at about 85°CA, a few layers with shell fragments and carbonaceous debris

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Metrage	Interval	Description
		46.68-46.86 m mainly argillaceous limestone with abundant shell fragments and carbonaceous debris
		47.06-47.18 m as above
		48.89-48.96 m breccia of angular limestone fragments up to 2 cm across in mudstone matrix, apparently intraformational
		52.43-52.91 m mainly argillaceous limestone with several layers of solution breccia
		53.57-53.76 m grey granular limestone bed with minor mudstone layers
		basal contact fairly abrupt; a few limestone layers persist for 1 m into next unit; contact placed where limestone percentage decreases abruptly
54.53-66.39	11.86	Mudstone, grey-green to olive-grey, calcareous, massive to laminated, a few argillaceous limestone beds up to 1 cm thick diminishing after 2 m, few stylolites, laminae at about 85°CA, few bands 1-5 mm thick of fine-grained pyrite, basal contact abrupt
		60.05-60.10 m solution breccia
		60.50-60.95 m partly brecciated and fractured, core broken
66.39-68.55	2.16	Limestone, buff to grey-green, argillaceous, fossiliferous with abundant pelecypods, few gastropod shells some replaced by calcite, with irregular olive-green calcareous mudstone partings up to 1 cm thick
68.55-68.85	0.30	Lost core
68.85-69.34	0.49	Mudstone, grey-green, calcareous, breccia of laminated mudstone fragments to 5 cm across in mudstone matrix; basal contact includes limestone fragments indicating a solution breccia
69.34-70.00	0.66	Limestone, buff to light-grey, similar to 66.39-68.55 m, fossiliferous, partly brecciated with grey-green mudstone matrix, bottom contact brecciated
70.00-71.90	1.90	Mudstone, grey-green to olive-green, calcareous, massive to laminated, mainly an intraformational breccia as 68.85-69.34 m, basal contact abrupt

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Metrage	Interval	Description
71.90-78.26	6.36	Limestone, buff to creamy-grey or grey-green, argillaceous and mottled in places, micritic to granular, with irregular olive-green calcareous mudstone partings 1-5 mm thick, shell fragments mainly replaced by calcite, common dark-grey carbonaceous specks and accumulations along stylolites, basal contact gradational 71.90-73.09 m brecciated, with calcareous mudstone surrounding 1-2 cm limestone clasts and filling fractures 74.37-74.50 m broken and rounded core with angular limestone pieces in grey-green clay - either a fault or shearing in core barrel - possibly a few centimetres of lost core 75.69 m 3-cm parting of soft olive-green calcareous clay at 55°CA - possibly a fault 76.25-76.34 m sheared and brecciated limestone in calcareous clay matrix 76.66 m fracture 2 cm wide at 20°CA containing olive-green calcareous mudstone with 1-5 mm angular limestone clasts - possibly a minor fault
78.26-80.66	2.40	Limestone, grey-green, argillaceous, micritic, with abundant calcite-replaced shell fragments, becoming greener and more argillaceous downhole, basal contact gradational
80.66-84.76	4.10	Mudstone, grey-green to olive-green, calcareous, soft, slightly laminated in places, poor fissility, sparse lenticular very fine grained pyrite nodules up to 1 cm thick by 3 cm long, sparse argillaceous limestone bands up to 2 cm thick, some parts with pelecypod shells and fragments, basal 1.5 m more fissile, basal contact intercalated
84.76-86.36	1.60	Mudstone, grey-green, calcareous, as in previous unit, interbedded with buff to brownish-grey argillaceous limestone in irregular layers 1-5 cm thick, with a few shell fragments, some lamination in mudstones at about 83°CA, basal contact abrupt
86.36-87.17	0.81	Limestone, buff to grey-green, micritic to granular, partly argillaceous with 1-5 mm thick irregular olive-green calcareous mudstone partings, shell fragments common, basal contact gradational 86.73-86.93 m abundant shell fragments mostly pelecypods replaced by calcite comprising up to 30% of rock, with a couple of ½-cm round very fine grained pyrite nodules

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Metrage	Interval	Description
87.17-87.63	0.46	Mudstone, as in 80.66-84.76 m basal contact abrupt
87.63-88.34	0.71	Limestone, buff to grey-green, argillaceous, abundant whole and fragmented brachiopod and pelecypod shells, interbedded calcareous mudstone increasing downhole, basal contact intercalated
88.34-96.67	8.33	Mudstone, olive-green, grey-green, buff, or brownish-grey, calcareous, laminated to massive, mottled or interbedded with argillaceous limestone; both lithologies fossiliferous, layered, or as irregular blobs 1-5 cm thick; with a few stylolites, basal contact gradational 94.76-94.91 m argillaceous limestone layer with numerous shells and thin bituminous laminae
96.67-106.91	10.24	Shale, grey-green to olive-green, calcareous, fissile, with a few layers of argillaceous limestone ½-2 cm thick, a few round very fine grained pyrite nodules 1-5 mm across, sparse shell fragments, basal contact abrupt, core locally broken because of fissility 100.48-100.63 m limestone bed with abundant calcite-replaced shell fragments and scattered pyrite cubes up to 1 mm across 101.94-104.32 m well-developed fissility, cleavage at 85°CA 104.32-104.50 m limestone bed similar to 100.48-100.63 m
106.91-107.49	0.58	Limestone, buff to grey-green, argillaceous, with abundant shell fragments, irregular partings of olive-green calcareous mudstone 1-5 mm thick, scattered pyrite cubes up to 1 mm across at top of unit, basal contact intercalated
107.49-109.77	2.28	Mudstone, olive-green to grey-green, calcareous, massive to laminated, interbedded with mottled layers and irregular blobs of argillaceous limestone ½-2 cm thick, with sparse shell fragments and disseminated very fine grained pyrite, basal contact intercalated
109.77-110.69	0.92	Shale, green to grey-green, calcareous fissile with a few ½-1 cm argillaceous limestone layers
110.69-113.69	3.00	Shale, as above, but badly broken except for 45 cm of grey-green argillaceous limestone with abundant shell fragments and 1-5 mm blebs of very fine grained pyrite; shale sheared and slickensided throughout, at least 1 m of section missing here (0.41 m lost core in run 110.64-113.69 m, 363'-373'; owner retained 0.15 m from middle of limestone bed)

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Metrage	Interval	Description
113.69-118.87	5.18	Shale, grey-green, calcareous, fissile, brecciated in places, with a few blebs of very fine grained pyrite, a few brachiopod shells, basal contact abrupt (possibly a few centimetres of lost core) 114.57-114.66 m abundant shell fragments and 1-4 mm blebs of very fine grained pyrite
118.87-119.74	0.87	Mudstone, grey-green, calcareous, interbedded with grey-brown argillaceous limestone in irregular beds 1-3 cm thick, very minor pyrite as before, basal contact abrupt
119.74-122.26	2.52	Shale, grey-green, calcareous, fairly fissile, a few calcite-filled brachiopod shells, very minor pyrite, basal contact abrupt 119.74-119.86 m broken core 121.95-122.05 m argillaceous limestone with abundant shells and minor very fine grained pyrite
122.26-131.03	8.77	Limestone, grey-green, argillaceous and grey-green calcareous mudstone, interbedded as 118.87-119.74 m but with limestone dominant, locally brecciated, minor nodular pyrite as above, limestone beds 1-10 cm, mudstone 1-10 cm becoming thinner downhole until just partings by 126.5 m, shell fragments sparse basal contact abrupt
131.03-131.98	0.95	Shale, grey-green, calcareous, very fissile, with abundant brachiopod and pelecypod shells filled with argillaceous limestone; shale splits at about 85°CA; basal contact abrupt
131.98-133.06	1.08	Limestone, grey-green, argillaceous, nodular, with olive-green calcareous shale partings 1-5 mm thick, basal contact abrupt
133.06-138.00	4.94	Shale, dark-grey-green, calcareous, very fissile and crumbly, with a few shell fragments, core reduced to chips except for a few 5-10 cm argillaceous limestone bands containing shells, basal contact abrupt 133.65 m 10 cm of argillaceous limestone 134.42 m 20 cm of argillaceous limestone 134.72 m 5 cm of argillaceous limestone

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Metrage	Interval	Description
138.00 139.29	1.29	Limestone, grey-green, argillaceous, micritic, with some calcite-filled shells, upper 30 cm brecciated and sheared, basal contact abrupt, vague lamination and fractures at about 45°CA
139.29- 141.76	2.47	Shale, olive-green, calcareous, very fissile and crumbly, mostly sheared and brecciated; fissility splits at 45°CA; basal contact abrupt (possibly some lost core)
141.76- 142.37	0.61	Limestone, grey, argillaceous, micritic, beds 1-2 cm thick, irregular shapes or as discrete nodules, interlayered with grey-green calcareous shale, bedding at 45°CA, basal contact abrupt
142.37- 144.22	1.85	Shale, as 139.29-141.76 m, basal contact intercalated
144.22- 155.08	10.86	Limestone, as 141.76 to 142.37 m with minor shell fragments, few Lingula shells, core broken and brecciated in several places, bedding at about 45°CA 144.72-145.40 m brecciated - core intact 145.92-146.10 m brecciated, core crumbly 146.10-146.48 m bedding parallel CA - fault-rotated block? 146.48-148.21 m brecciated, core mainly intact 148.21-153.31 m core crumbly, more than 50% shale with angular limestone clasts 153.31-155.08 m core intact, brecciated limestone in shale matrix except for 10 cm of limestone, bedding at 45°CA
155.08- 155.60	0.52	Limestone, grey, micritic, beds 1-2 cm with green shale partings 1-2 cm thick at 45°CA, basal contact abrupt
155.60- 155.85	0.25	Shale, grey-green, calcareous, very fissile, crumbly, basal contact abrupt
155.85- 156.20	0.35	Limestone, as 155.08-155.60 m, basal contact abrupt
156.20- 156.61	0.41	Shale, as 155.60-155.85 m, basal contact abrupt, very crushed, slickensided
156.61- 157.23	0.62	Limestone, brown, with slight mauve tinge, fine-grained, with braided laminae of carbonaceous material at 55°CA; small rounded calcite grains may be shell fragments; contact abrupt

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Metrage	Interval	Description
157.23-157.38	0.15	Shale, grey-green, very soft and fissile, sheared, contact abrupt, core crumbled
157.38-157.84	0.46	Limestone, as 156.61 to 157.23 m, with a few shells and shell fragments, contact abrupt
157.84-158.19	0.35	Shale and Limestone, interbedded, as above, beds 5-10 cm thick, basal contact abrupt (maybe some lost core)
158.19-159.75	1.56	Limestone, as 156.61-157.23 m, laminated at 45°CA, a few slickensides, basal contact abrupt
159.75-160.17	0.42	Shale, as 157.23-157.38 m, crumbly and sheared
160.17-160.93	0.76	Limestone, as above
160.93-162.64	1.71	Breccia, angular fragments of overlying limestone in grey-green shale matrix, clasts up to 10 cm long; a few bedded limestone intervals appear to be slabs of limestone; some fragments look like mottled limestone and green mudstones of the Waterways Formation
162.64-164.59	1.95	Limestone, as 156.61-157.23 m, partly brecciated, lamination parallel CA in part - may just be a large breccia slab as it is sandwiched between substantial thicknesses of breccia
164.59-171.27	6.67	Breccia, angular fragments of limestone, dolomite, shale, mudstone up to 15 cm across in matrix of calcareous green or grey-green mudstone or clay, and gypsum, gypsum veins common, basal contact intercalated 166.27-166.97 m breccia about 50% gypsum
171.27-171.81	0.54	Gypsum, white to grey-green, felted crystalline to massive, with partings of grey-green mudstone and a few clasts and beds up to 1 cm thick of green mudstone; stylolites indicate significant solution has reduced the thickness of this bed; basal contact abrupt
171.81-176.17	4.36	Breccia, as 164.59-171.27 m with gypsum comprising 0-30% of interstitial fill, and as minor interbedded units up to 30 cm thick resembling the previous unit; a few beds of laminar mudstone about 10 cm thick are probably just larger clasts as angles of lamination CA are varied; basal contact abrupt

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Metrage	Interval	Description
176.17-179.22	3.05	Gypsum, white to grey-green as 171.27-171.81 m, as rounded masses with partings of clay and insolubles, with laminated grey-green calcareous mudstone interbeds up to 10 cm thick, a few gypsum veins, and minor anhydrite in the cores of gypsum masses near base of unit, basal contact gradational (core recovery complete although mudstone units are a bit broken)
179.22-182.44	3.22	Gypsum and Anhydrite, grey to whitish-grey, very similar to overlying unit but with anhydrite predominating still with veins of gypsum, appears to have mainly solution textures such as stylolites and brecciation of interbedded calcareous mudstones and dolomites: finely interlaminated, buff to grey-green, as partings and beds up to 10 cm thick, basal contact gradational (core recovery complete although some mudstone beds are broken up)
182.44-187.01	4.57	Anhydrite and Gypsum, blue-grey to whitish-grey, with interbedded and interlaminated grey-white gypsum, brown to grey-brown argillaceous and organic partings: varying from nodular to bedded, beds ½-1 cm thick; local brecciation and cross-cutting gypsum veins indicate solution but more primary structures visible; gypsum present mainly as alteration around anhydrite crystals giving unit a speckled look, basal contact gradational
187.01-188.60	1.59	Anhydrite, blue-grey, medium-grained, crystalline, with partings of buff dolomite, massive to thin-bedded, slightly calcareous, basal contact sharp (core recovery probably complete but some core apparently removed by owner from box 45) 187.91-188.30 m 0.39 m lost core or removed by owner
188.60-190.03	1.43	Dolomite, buff, slightly calcareous, micritic, massive to finely laminated, laminae wavy, tiny pits in places, minor anhydrite blebs, minor gypsum veins, basal contact intercalated
190.03-203.07	13.04	Anhydrite, blue-grey to greyish-white, as 187.01-188.60 m, with minor gypsum veining and alteration - varying from massive to laminated with thin dolomitic argillaceous partings commonly braided 193.55 m core rounded 194.69-194.84 m 0.15 m lost core 196.70-201.09 m minor bituminous and argillaceous partings 1-2 mm thick, also a few brown subhedral to euhedral salt crystals 2-3 mm across

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Metrage	Interval	Description
		201.02-201.77 m massive brownish-grey anhydrite impregnated with bitumen
		202.01-203.07 m brown salt crystals 1-5 mm isolated or as partially linked stringers approximately at right angles CA comprising up to 5% of rock, basal contact abrupt
203.07-204.19	1.12	Dolomite, buff, slightly calcareous, fine- to medium-grained, porous with pores filled with anhydrite and gypsum, basal contact sharp
204.19-205.23	1.04	Anhydrite, as 190.03-203.07 m, with interbedded buff dolomite as in previous unit with a few gypsum needles, veins, and a few bituminous partings, basal contact sharp
205.23-210.03	4.80	Dolomite, buff, slightly calcareous, crystalline, medium-grained, porous, massive to slightly laminated, a few needles and partings of gypsum and anhydrite as lenticular bodies of anhydrite altering to gypsum up to 2 cm by ½ cm parallel to lamination, some fractures coated with bitumen, basal 30 cm with numerous stylolites, basal contact gradational
210.03-210.39	0.36	Dolomite, grey, otherwise as above, with a few argillaceous partings 1-2 mm thick, possibly more argillaceous than previous unit, basal contact gradational
210.39-218.77	8.38	Dolomite, buff to grey-brown, slightly calcareous, crystalline: fine- to medium-grained, porous, massive to laminated, laminae mainly organic matter or bitumen, with minor argillaceous partings - irregular nodules of gypsum and anhydrite up to 5 cm across, a few minor gypsum veins, basal contact gradational
		212.67-212.82 m grey more calcareous porous layer with abrupt upper contact, gradational lower contact
		213.71-214.32 m greyish-brown, massive coarser-grained dolomite, grading downwards back to buff laminated dolomite
		214.77 m 1 cm of grey mudstone
		217.89-218.16 m greyish-brown, slightly more argillaceous partings
218.77-231.27	12.50	Dolomite, buff, slightly calcareous, crystalline, fine- to medium-grained, porous to slightly vuggy in places, vugs and pores filled with gypsum and anhydrite, massive to finely laminated, laminae commonly wavy or swirled, mottled: lighter patches up to 5 cm across with irregular shapes some with concentric rings like concretions - some possibly replaced

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Metrage	Interval	Description
		fossils with a few recognizable as crinoid fragments, very fine dark-brown needles probably gypsum near vugs or fractures filled with gypsum or anhydrite, basal contact arbitrarily at first appearance of more abundant bituminous laminae, actual contact intercalated over 2 m
231.27-244.71	13.44	Dolomite, buff to brown, calcareous, finely crystalline, hard, massive to very finely laminated, laminae wavy at about 85°CA, silty in places, corals and various shell fragments common including brachiopods and crinoid ossicles up to 2 cm in diameter, some extensively altered shells (brachiopods?) as nodules around which lamination bends, bitumen along some laminae and fracture surfaces, extremely sparse pyrite specks from ¼-1 mm scattered throughout, non-calcareous circular to lenticular concentrically-ringed bleached areas from 2-5 cm across, a few vugs some with subhedral dolomite crystals from 2-5 cm across some crossed by organic-rich laminae continuous with those in surrounding rock, a few beds of calcarenite up to 3-4 cm thick consisting mainly of crinoid ossicles and fragments, one or two argillaceous partings 2-5 mm across, a few thin layers of insolubles suggest some solution loss but no stylolites as such observed 239.13 m few specks of chalcopyrite and malachite in bleached patch 239.25 m some bleached spots with pyrite specks 1/10-¼ mm in size confined to zone of alteration, also very sparse gypsum veins in a few small fractures, a few grains of black mineral (magnetite) less than 0.1 mm scattered around, beds as parallel laminations to wavy to extremely contorted with small offsets indicative of soft-sediment deformation, few of the bleached areas surrounded by an accumulation of insolubles in very fine-grained pyrite - still crossed by laminae therefore obviously secondary 244.40-244.65 m massive bed
244.71-263.35	18.64	Dolomite, grey-brown to dark-grey-brown, hard, slightly calcareous, finely crystalline, locally porous to vuggy, fossiliferous with some sponge fragments, a few rugose corals and abundant crinoid debris, generally laminated with very fine bituminous partings much more abundant than in previous unit, less than 0.01% very fine grained pyrite as in previous unit, minor fine-grained pyrite along some bituminous partings, free bitumen in some vugs and pores, some very minor gypsum stringers along fractures, a few black organic chips resemble parts of trilobites, becoming gradually more bituminous downhole

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Metrage	Interval	Description
		259.18-259.28 m abundant crinoid ossicles 259.99-260.30 m very fossiliferous with fossils recrystallized, a couple of vugs filled with anhydite 260.50-260.70 m abundant crinoid ossicles 261.52 m from here downhole fossils mainly brachiopods and a few pelecypods, filled with micritic to fine-grained limestone, some mottled and bleached calcareous patches or probably dolomitic limestone 263.01-263.35 m abundant small pelecypod shells (Lingula sp.?) basal contact intercalated as limestone predominates over dolomite
263.65-265.65	2.00	Limestone, grey-brown, dolomitic in part, texturally same as previous unit, but not dolomitized, less bitumen than above, basal contact gradational back into dolomite of same character
265.65-268.48	2.83	Dolomite, buff to grey-brown, as 244.71-263.35 m, but not very bituminous, some argillaceous partings, minor anhydrite in vugs, basal contact gradational
268.48-268.83	0.35	Shale, grey, dolomitic, slightly calcareous, massive, mottled, basal contact sharp
268.83-269.18	0.35	Shale, green and grey-green, with interbedded gypsum, laminae 1-8 mm, with bituminous partings, basal contact intercalated
269.18-272.77	3.59	Anhydrite, blue-grey, laminated to massive, with scattered brown salt crystals 3-5 mm across, a few interbedded layers of grey-green laminated shale and dolomitic shale, several white gypsum veins about 1 cm wide at various angles, lamination at 85° to 90°CA, basal contact intercalated
272.77-282.21	9.44	Mudstone, Dolomite, and Anhydrite, interbedded; mudstone: green to grey-green or brownish-green, locally dolomitic or calcareous, laminated to massive; dolomite: buff to brown, slightly calcareous, micritic, laminated or as rounded masses suspended in mudstone or anhydrite; anhydrite: grey to blue-grey with brown salt crystals scattered throughout, massive or with interlaminated dolomite and mudstone; beds 10-40 cm thick, contacts gradational to intercalated, gypsum veins up to 1 cm thick common, a few bituminous layers a few centimetres thick

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Metrage	Interval	Description
282.21-285.29	3.08	Mudstone, green, very slightly calcareous, massive to slightly laminated, numerous gypsum veins ½ to 1 cm thick, normal or at high angles CA, very minor pyrite as specks up to ¼ mm across, basal contact gradational
285.29-286.92	1.63	Mudstone, reddish-brown and green, mottled, as above, with minor interlaminated gypsum as well as gypsum veins and nodules, basal contact abrupt
286.92-287.10	0.18	Gypsum and Anhydrite, blue-grey to white, anhedral, subequant crystalline to contorted acicular crystalline, with very minor mudstone partings, basal contact abrupt
287.10-290.07	2.97	Conglomerate, reddish-brown; angular to subangular clasts of potash feldspar, quartz, and granite up to 1 cm across in matrix of gypsum and red or green mudstone similar to that overlying this unit, silicified interval, basal contact in 1 cm red mudstone
290.07-291.39	1.32	Granite, reddish-brown, coarse-grained, K-feldspar, quartz, biotite, fractured, weathered and re-cemented, vuggy, with both quartz and gypsum infilling 290.47-291.39 m core badly broken, approximately 1.2 m of lost core; this unit appears to be the old weathered surface; no basal contact because of lost core
291.39-293.39	2.00	Granite, reddish-brown, coarse-grained, 40-60% K-feldspar, 30-50% quartz, 5-10% biotite, local gneissic texture, locally internally brecciated and silicified suggestive of cataclastic textures, few quartz veins ½-1 cm thick, basal contact gradational
293.39-295.25	1.86	Granite, pink to reddish-brown, coarse-grained with K-feldspar, quartz, biotite, brecciated and silicified, core pitted and cracked, feldspars cracked, rounded and re-cemented - good cataclastic textures, basal contact gradational (core recovery nearly complete) 294.41-295.10 m core broken, silicified 294.77-294.87 m 0.10 m removed by owner
295.25-299.35	4.10	Granite Cataclasite, dark-grey to reddish-grey or reddish-brown, coarse-grained granite breccia with mylonitic bands 5-10 cm wide, silicified and recrystallized, both white and grey micaceous quartz clasts surrounded by pink silicified K-

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Metrage	Interval	Description
		feldspar matrix with a few rounded biotite megacrysts in some places, fine- to medium-grained darker-grey bands of grey micaceous quartz with reddish-brown braided K-feldspar veinlets, few gypsum veins to 1 cm wide, basal contact gradational (core recovery nearly complete)
		297.87 m 5 cm of quartz-rich mylonite with quartz grains shattered and rounded
		298.57-298.67 m 0.10 m removed by owner
		298.67-299.35 m several per cent opaque minerals
299.35-301.01	0.66	Granite Cataclasite, grey-brown to reddish-brown, medium- to very coarse grained, 70% red and grey feldspar, 20% quartz, 10% biotite, hematite, magnetite; entire rock composed of rolled and rounded granite fragments to 10 mm across in matrix of very fine grained feldspar and quartz with interstitial hematite and magnetite, several fractures at 75°-80°CA altered to hematite-rich rock for about ½ cm on both sides, few minor veins of barren quartz to 1 cm thick, basal contact fairly abrupt at about 45°CA
301.01-303.35	2.34	Granite, reddish-brown to maroon, fine- to medium-grained, feldspar, quartz, biotite, cataclastic texture common, few opaques, minor fractures with alteration to epidote and hematite, some biotites aligned at about 45°CA forming vague gneissosity, basal contact gradational
303.35-310.56	7.21	Granite, reddish-brown, fine- to very coarse grained, quartz and K-feldspar about 45% each, biotite and iron oxides about 10%, mylonitic texture: rounded to subangular quartz, feldspar, and fragments of fine-grained granite in quartz-feldspar matrix with interstitial iron oxides in masses to 5 mm across, some minor fractures with rust coatings and very minor epidote, vague banding of biotite and opaques at about 60°CA few quartz veins to 1 cm continuous with matrix quartz, basal contact gradational
310.56-315.47	4.91	Mylonite, dark-grey, brown, or reddish-brown, very fine to fine-grained quartz, K-feldspar, and biotite in quartz-feldspar matrix, massive to banded, biotite altering to chlorite for most part, minor opaque minerals, locally very minor white mica in places (up to 1%), minor aplite veins 1-2 mm across at various angles, basal contact abrupt

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Metrage	Interval	Description
		310.90-311.12 m very coarse grained: cracked and rounded grey feldspar fragments to 1 cm in similar matrix
315.47-315.57	0.10	Mylonite, cream to reddish-brown, medium-grained, laminae 1-10 cm perpendicular CA, clasts of grey quartz to 2 mm in quartz-chlorite matrix and quartz veins 1-2 mm parallel to banding, basal contact gradational
315.57-336.65	21.08	Mylonite, dark-grey to reddish-brown as 310.36-315.47 m, coarse-grained reddish-brown layers with more biotite mostly altered to chlorite
		323.60-323.90 m very coarse grained phase, as 310.90-311.12 m
		325.98-326.54 m very coarse grained, pink to reddish-brown, with grey plagioclase porphyroblasts to 1 cm and rounded biotite porphyroblasts altered to chlorite, contacts gradational
		326.68-326.78 m as above
		327.49-327.60 m as above
		328.27-328.73 m as above
		330.04-330.75 m as above, core broken by longitudinal fracture, vague gneissosity at about 80° CA with cross-cutting color bands along small fractures
		333.05-333.23 m 0.18 m removed by owner
		334.34-334.45 m cream-colored mylonite as 315.47-315.57 m
		basal contact gradational over 20 cm
336.65-337.72	1.07	Granite Gneiss, red to reddish-brown, medium- to coarse-grained K-feldspar 40-60%, quartz 30-40% elongated at about 80°CA, biotite 5-10% altering to chlorite (core badly broken with about 0.45 m lost in this interval)
337.72-338.53	0.81	Granite, buff, fine- to medium-grained, mainly K-feldspar and biotite with 5-10% quartz, highly fractured and broken with chlorite and rusty clays on fractures, basal contact gradational (at least 0.25 m of lost core in this interval)
338.53-339.85	1.32	Granite Gneiss, red to reddish-brown, as 336.65-337.72 m (core badly broken with at least 0.40 m lost in this interval)

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Metrage	Interval	Description
		339.65-339.85 m quartz vein with minor chlorite and hematite along fractures (actual metrage within this interval uncertain because of broken and lost core)
339.85-340.30	0.45	Granite, buff to reddish-brown, fine- to medium-grained as 337.72-338.53 m, fractures coated with chlorite and reddish-brown clay (core badly broken with probably 0.10 m lost in this interval)
340.30-350.26	9.96	Granite Gneiss, pink to reddish-brown, medium- to very coarse grained, similar to 336.65-337.72 m mylonitic in places, biotite altered to chlorite, few fine-grained mylonite layers with up to 20% chlorite and biotite
		342.29-342.41 m 0.12 m lost core
		342.60-342.70 m 0.10 m lost core
		346.41-347.78 m mylonitic as 315.57-336.65 m, minor gypsum veins
350.26	-	End of hole

APPENDIX 8: CORE BOXES FOR DRILLHOLES 86-1R AND 86-2R

Box	Metrage	Feet/Inches
86-1R		
1	3.66- 7.72	12/0 - 25/4
2	7.72- 12.12	25/4 - 39/9
3	12.12- 16.46	39/9 - 54/0
4	16.46- 20.78	54/0 - 68/2
5	20.78- 25.07	68/2 - 82/3
6	25.07- 29.11	82/3 - 95/6
7	29.11- 33.45	95/6 -109/9
8	33.45- 37.69	109/9 -123/8
9	37.69- 42.04	123/8 -137/11
10	42.04- 46.43	137/11-152/4
11	46.43- 50.75	152/4 -166/6
12	50.75- 54.97	166/6 -180/4
13	54.97- 59.23	180/4 -194/4
14	59.23- 63.63	194/4 -208/9
15	63.63- 68.05	208/9 -223/3
16	68.05- 72.21	223/3 -236/11
17	72.21- 76.58	236/11-251/3
18	76.58- 80.90	251/3 -265/5
19	80.90- 85.32	265/5 -279/11
20	85.32- 90.40	279/11-296/7
21	90.40- 94.84	296/7 -311/2
22	94.84- 98.96	311/2 -324/8
23	98.96-103.28	324/8 -338/10
24	103.28-107.70	338/10-353/4
25	107.70-111.91	353/4 -367/2
26	111.91-116.21	367/2 -381/3
27	116.21-120.52	381/3 -395/5
28	120.52-125.53	395/5 -411/10
29	125.53-129.79	411/10-425/10
30	129.79-133.71	425/10-438/8
31	133.71-138.10	438/8 -453/1
32	138.10-141.88	453/1 -465/6
33	141.88-145.69	465/6 -478/0
34	145.69-149.86	478/0 -491/8
35	149.86-154.15	491/8 -505/9
36	154.15-158.45	505/9 -519/10
37	158.45-162.56	519/10-533/4
38	162.56-166.62	533/4 -546/8
39	166.62-170.84	546/8 -560/6
40	170.84-174.90	560/6 -573/10
41	174.90-179.02	573/10-587/4
42	179.02-183.34	587/4 -601/6
43	183.34-187.50	601/6 -615/2
44	187.50-191.82	615/2 -629/4
45	191.82-196.14	629/4 -643/6
46	196.14-200.41	643/6 -657/6
47	200.41-204.42	657/6 -670/8
48	204.42-208.61	670/8 -684/5
49	208.61-212.98	684/5 -698/9
50	212.98-217.20	698/9 -712/7
51	217.20-221.54	712/7 -726/10
52	221.54-225.76	726/10-740/8
53	225.76-229.84	740/8 -754/1
54	229.84-234.21	754/1 -768/5
55	234.21-238.63	768/5 -782/11
56	238.63-242.72	782/11-796/4
57	242.72-247.07	796/4 -810/7
58	247.07-251.41	810/7 -824/10
59	251.41-255.73	824/10-839/0
60	255.73-259.94	839/0 -852/10
61	259.94-264.34	852/10-867/3
62	264.34-268.61	867/3 -881/3
63	268.61-272.82	881/3 -895/1
64	272.82-277.09	895/1 -909/1
65	277.09-281.41	909/1 -923/3
66	281.41-286.05	923/3 -938/6
67	286.05-290.32	938/6 -952/6
68	290.32-292.91	952/6 -961/0
69	292.91-296.77	961/0 -973/8
70	296.77-299.92	973/8 -984/0
71	299.92-304.60	984/0 -999/4
72	304.60-308.76	999/4 -1013/0
73	308.76-313.03	1013/0 -1027/0
74	313.03-316.38	1027/0 -1038/0
75	316.38-320.80	1038/0 -1052/6
76	320.80-325.04	1052/6 -1066/5
77	325.04-329.08	1066/5 -1079/8

APPENDIX 8: CONTINUED

Box	Metrage	Feet/Inches	Box	Metrage	Feet/Inches
86-2R					
1	0.76- 6.71	2/6 - 22/0	43	179.53-183.69	589/0 -602/8
2	6.71- 10.80	22/0 - 35/5	44	183.69-187.88	602/8 -616/5
3	10.80- 15.16	35/5 - 49/9	45	187.88-192.33	616/5 -631/0
4	15.16- 19.38	49/9 - 63/7	46	192.33-196.70	631/0 -645/4
5	19.38- 23.72	63/7 - 77/10	47	196.70-201.09	645/4 -659/9
6	23.72- 28.09	77/10- 92/2	48	201.09-205.26	659/9 -673/5
7	28.09- 32.18	92/2 -105/7	49	205.26-209.65	673/5 -687/10
8	32.18- 36.22	105/7 -118/10	50	209.65-213.97	687/10-702/0
9	36.22- 40.34	118/10-132/4	51	213.97-218.16	702/0 -715/9
10	40.34- 44.68	132/4 -146/7	52	218.16-222.61	715/9 -730/4
11	44.68- 49.10	146/7 -161/1	53	222.61-226.92	730/4 -744/6
12	49.10- 53.31	161/1 -174/11	54	226.92-231.27	744/6 -758/9
13	53.31- 57.58	174/11-188/11	55	231.27-235.43	758/9 -772/5
14	57.58- 61.98	188/11-203/3	56	235.43-239.32	772/5 -785/2
15	61.98- 66.19	203/3 -217/2	57	239.32-243.74	785/2 -799/8
16	66.19- 70.66	217/2 -231/10	58	243.74-247.90	799/8 -813/4
17	70.66- 74.88	231/10-245/8	59	247.90-252.40	813/4 -828/1
18	74.88- 79.22	245/8 -259/11	60	252.40-256.67	828/1 -842/1
19	79.22- 83.26	259/11-273/2	61	256.67-260.83	842/1 -855/9
20	83.26- 87.53	273/2 -287/2	62	260.83-265.20	855/9 -870/1
21	87.53- 91.90	287/2 -301/6	63	265.20-269.42	870/1 -883/11
22	91.90- 96.09	301/6 -315/3	64	269.42-273.81	883/11-898/4
23	96.09-100.48	315/3 -329/8	65	273.81-278.18	898/4 -912/8
24	100.48-104.52	329/8 -342/11	66	278.18-282.45	912/8 -926/8
25	104.52-108.74	342/11-356/9	67	282.45-286.92	926/8 -941/4
26	108.74-113.77	356/9 -373/3	68	286.92-292.07	941/4 -958/3
27	113.77-118.44	373/3 -388/7	69	292.07-295.25	958/3 -968/8
28	118.44-122.30	388/7 -401/3	70	295.25-299.19	968/8 -981/7
29	122.30-126.59	401/3 -415/4	71	299.19-303.35	981/7 -995/3
30	126.59-130.84	415/4 -429/3	72	303.35-307.67	995/3 -1009/5
31	130.84-134.26	429/3 -440/6	73	307.67-311.91	1009/5 -1023/4
32	134.26-138.38	440/6 -454/0	74	311.91-315.90	1023/4 -1036/5
33	138.38-142.27	454/0 -466/9	75	315.90-320.14	1036/5 -1050/4
34	142.27-146.25	466/9 -479/10	76	320.14-324.48	1050/4 -1064/7
35	146.25-150.57	479/10-494/0	77	324.48-328.60	1064/7 -1078/1
36	150.57-154.97	494/0 -508/5	78	328.60-332.66	1078/1 -1091/5
37	154.97-159.11	508/5 -522/0	79	332.66-336.96	1091/5 -1105/6
38	159.11-162.64	522/0 -533/7	80	336.96-340.84	1105/6 -1118/3
39	162.64-166.98	533/7 -547/10	81	340.84-344.83	1118/3 -1131/4
40	166.98-171.25	547/10-561/10	82	344.83-348.92	1131/4 -1144/9
41	171.25-175.29	561/10-575/1	83	348.92-350.27	1144/9 -1149/2
42	175.29-179.53	575/1 -589/0			

APPENDIX 9: SAMPLES ANALYZED FOR GOLD FROM DRILLHOLES 86-1R AND 86-2R

Sample	Core Box	Metrage	Sampled Length (m)	Formation Member	Au (ppb)	Ag (ppm)	Description
Drillhole 86-1R							
6-88-R1	6	25.97	<0.1	Waterways Moberly	5	nil	Limestone, buff-cream with oil stains and minor pyrite blebs
12-172-R1	12	51.92	0.03	Christina	20	0.1	Mudstone, grey-green, minor argillaceous limestone
4868	15	65.56-66.03	0.47	Calumet	25	-	Limestone, buff-grey with calcite and pyrite veins
4869	18	77.00-78.00	1.00	Calumet	20	-	Limestone, grey-green with minor pyrite
18-259-R1	18	78.88-79.05	0.17	Calumet	10	nil	Limestone, grey-green with minor pyrite
4870	19	83.00-84.00	1.00	Calumet	25	-	Shale, olive-green with a few pyrite nodules
25-360-R1	25	109.73	grab	Firebag	nil	nil	Shale, olive-green with sparse pyrite nodules
38-538	38	164.36	grab	Pr. Evap.	10	nil	Gypsum and anhydrite, minor dolomite, brecciated
42-587-R1	42	179.98	grab	Pr. Evap.	20	nil	Breccia of shale, limestone, gypsum, and anhydrite
86-1R-618	44	188.41	0.12	Pr. Evap.	30	-	Anhydrite, minor shale and dolomite, gypsum veins
53-746-R1	53	227.48	0.05	Methy Unit 3	15	nil	Dolomite, rare pyrite lenses 10 x 2 mm
56-789-R1	56	240.5	grab	Unit 2	10	nil	Dolomite, argillaceous, rare pyrite nodules, minor gypsum veins
63-888-R1	63	270.60	grab	McLean River	5	0.1	Interbedded shale and dolomite, minor gypsum veins
921-65	65	280.7	grab	McLean River	20	-	Shale or sandstone, abundant gypsum veins
4854	65-66	281.33-281.62	0.29	McLean River	<1	-	Claystone, green and red, abundant gypsum veins and fracture fill
4855	66	281.62-282.41	0.79	McLean River	<1	-	Claystone, red with quartz pebbles at bottom
4856	66	281.65-281.73	0.08	McLean River	9	-	Claystone, red
69-3	66	281.7*	grab	McLean River	20	-	Claystone, red
4857	66	282.41-283.01	0.60	Granite Wash	2	-	Conglomerate, 25% quartz pebbles in red-green claystone matrix
4858	66	283.01-284.43	1.42	Granite Wash	<1	-	Conglomerate, quartz and granite pebbles in dark-red clayey matrix
4859	66	284.43-285.45	1.02	Precambrian	17	-	Granite, fractured and broken, rusty
4860	66-67	285.45-286.51	1.06	Precambrian	<1	-	Granite, fractured with gypsum on broken surfaces, minor quartz veins to ½ cm wide

* metrage approximate

APPENDIX 9: CONTINUED

Sample	Core Box	Metrage	Sampled Length (m)	Formation	Au (ppb)	Ag (ppm)	Description
67	67	286.0*	grab	Precambrian	40	-	Granite, as sample 4860
4861	67	286.51-287.53	1.02	Precambrian	<1	-	Granite, gypsum-coated fractures, very rusty
4862	67	287.53-287.91	0.38	Precambrian	2	-	Quartz vein in granite, no visible sulfides
4863	67	287.91-289.33	1.42	Precambrian	<1	-	Granite, little fractured, minor rust
4864	67, 68	289.33-291.12	1.79	Precambrian	<1	-	Granite, red with minor quartz veins
4866	67	289.85-290.00	0.15	Precambrian	<1	-	Granite, red with minor quartz veins
4867	68	290.90-291.10	0.20	Precambrian	<1	-	Quartz vein in granite
68	68	291.0*	grab	Precambrian	30	-	Granite with quartz veins
4865	68	291.12-292.91	1.79	Precambrian	<1	-	Granite, red with minor quartz veins
962-69	69	293.2	grab	Precambrian	60	-	Granite, pink with minor quartz veining
69-966-R1	69	294.4	grab	Precambrian	nil	nil	Granite, pink with minor quartz veining
983-70	70	299.6	grab	Precambrian	25	-	Granite, red-brown
5778	71	299.92-300.84	0.92	Precambrian	<1	<0.2	Granite, red-brown with minor quartz veining
999-71	71	304.5	grab	Precambrian	30	-	Granite, red-brown
5777	72	305.96-306.93	0.97	Precambrian	<1	<0.2	Granite, red-brown
1009-72	72	307.5	grab	Precambrian	30	-	Quartz vein about 4 cm wide, barren
1014-73	73	309.1	grab	Precambrian	30	-	Granite, red-brown, numerous rusty fractures
5776	73	312.12-313.03	0.91	Precambrian	<1	<0.2	Granite, red-brown, mylonitic
1033-74	74	314.9	grab	Precambrian	25	-	Granite, red-brown
5775	75	316.38-317.30	0.92	Precambrian	<1	<0.2	Granite, mylonitic with quartz veins to 1 cm
5774	75	318.82-320.04	1.22	Precambrian	<1	<0.2	Granite, mylonitic with abundant quartz veins, minor widely disseminated chalcopyrite and malachite stains
1049-75	75	319.7	grab	Precambrian	30	-	Granite, mylonitic with abundant quartz, minor chalcopyrite and malachite
5773	76	322.65-323.56	0.91	Precambrian	<1	<0.2	Granite, black to red with masses of quartz to 10 cm across
1062-76	76	323.7	grab	Precambrian	20	-	Granite as previous sample
5772	76	324.12-325.05	0.93	Precambrian	<1	<0.2	Granite as previous sample

* metrage approximate

Composited samples: 5778, 5777, 5776
5775, 5774

APPENDIX 9: CONTINUED

Sample	Core Box	Metrage	Sampled Length (m)	Formation Member	Au (ppb)	Ag (ppm)	Description
1069-77	77	325.8	grab	Precambrian	15	-	Granite, black to red with barren quartz masses and veins
5771	77	328.17-329.08	0.91	Precambrian	<1	<0.2	Granite as previous sample
Drillhole 86-2R							
5752	26	110.7	grab	Waterways Firebag	<1	-	Limestone, grey-green, argillaceous with rare pyrite blebs
5751	27	114.57-114.66	0.09	Firebag	<1	-	Shale, grey-green with small pyrite blebs
30-402-R2	29	122.5*	grab	Firebag	5	nil	Limestone, argillaceous, abundant fossil shells, fine-grained pyrite
20-420-R2	30	128.0*	grab	Firebag	5	nil	Limestone, argillaceous, with fine-grained nodular pyrite
36-502-R2	36	153.0	grab	Firebag	15	nil	Limestone, grey with about 50% shale
44-R2	44	187.0*	grab	Pr. Evap.	20	-	Anhydrite, blue-grey, partly altered to gypsum
622-R2	45	189.6*	grab	Pr. Evap.	5	-	Dolomite, buff with minor gypsum
46-639	46	194.8	grab	Pr. Evap.	5	nil	Anhydrite, blue-grey with gypsum veins
710-R2	51	216.4	grab	Methy Unit 3	15	0.1	Dolomite, buff-grey with gypsum and anhydrite nodules to 5 cm
B.O.T.-1	56	238.4	grab	Unit 2	20	-	'Pebbles' from fracture zone in argillaceous dolomite where circulation was lost
5753	56	238.35-239.31	0.96	Unit 2	2	-	Dolomite, argillaceous, brown-buff with minor pyrite flecks and a few specks of chalcopyrite and malachite in bleached patch
5754	57	239.31-240.06	0.75	Unit 2	<1	-	Dolomite, argillaceous, brown-buff with minor pyrite flecks and gypsum veins, minor magnetite(?)
5755	57	240.41-241.36	0.95	Unit 2	3	-	Dolomite, as sample 5754
792-R2	57	241.4	grab	Unit 2	0.63 oz	-	Dolomite, as sample 5754
5756	57	241.36-242.31	0.95	Unit 2	<1	-	Dolomite, as sample 5754

* metrage approximate

Composited samples: 5773, 5772, 5771

APPENDIX 9: CONTINUED

Sample	Core Box	Metrage	Sampled Length (m)	Formation Member	Au (ppb)	Ag (ppm)	Description
5757	58	243.74-244.71	0.97	Unit 2	<1	-	Dolomite, as sample 5754
5758	59	249.46-250.21	0.72	Unit 2	<1	-	Dolomite, grey-brown with very minor pyrite
5759	60	255.89-256.65	0.76	Unit 2	<1	-	Dolomite, grey-brown with very minor pyrite
5770	68	288.98-289.73	0.75	Granite Wash	<1	<0.2	Conglomerate, rusty, pebbles of granite and quartz in gypsum and clay matrix
5769	72	303.81-304.77	0.96	Precambrian	<1	<0.2	Granite, red-brown with faint banding of biotite and mylonitic textures
5768	72	306.77-307.67	0.90	Precambrian			
5767	73	309.71-310.56	0.85	Precambrian			
5766	76	322.26-323.19	0.93	Precambrian	<1	0.8	Mylonite, dark-red-brown with medium- and coarse-grained, bands 1-10 cm thick
5765	77	325.73-326.56	0.83	Precambrian			Mylonite as sample 5766, but very coarse grained
5764	78	330.36-331.27	0.91	Precambrian			Mylonite as sample 5766, but fractured and with slight gneissosity
5763	80	339.65-339.85	0.20	Precambrian	1	-	Quartz vein in granite gneiss, some hematite and chlorite
5762	81	340.84-341.65	0.81	Precambrian	<1	2.6	Granite gneiss, pink-red-brown with coarse-grained thin mylonitic zones
5761	81	343.51-344.58	1.07	Precambrian			Granite as sample 5762
5760	82	346.56-347.55	0.99	Precambrian			Mylonite with minor gypsum veins

Composited samples: 5769, 5768, 5767
5766, 5765, 5764
5762, 5761, 5760

APPENDIX 10: CERTIFICATES OF ANALYSES FOR CORE SAMPLES

To: HALFERDAHL & ASSOCIATES LTD
18, 10509 - 81 Avenue
Edmonton, Alberta T6E 1X7
Attn: L.B. Halferdahl

File No. 28425
Date April 4, 1986
Samples Core

Certificate of ASSAY

LORING LABORATORIES LTD.

Page # 1

SAMPLE No.	OZ./TON GOLD
"Core Sample"	
Control Analysis	
792-R2	.063

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

[redacted]
Assayer

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

To: HALFERDAHL & ASSOCIATES LTD
18, 10509 - 81 Avenue
Edmonton, Alberta T6E 1X7
Attn: L.B. Halferdahl

File No. 28425
Date April 4, 1986
Samples Core

Certificate of ASSAY

LORING LABORATORIES LTD.

SAMPLE No.	PPB Au
"Geochemical Analysis"	
B.O.T.-1	20
67	40
68	30
69-3	20
983-70	25
999-71	30
1009-72	30
1014-73	30
1033-74	25
1049-75	30
1062-76	20
1069-77	15
622	5
792-R2	+1000
921-65	20
962-69	60
86-1R-618	30
44-R2	20

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Assayer

To: HALFERDAHL & ASSOCIATES LTD
18, 10509 - 81 Avenue
Edmonton, Alberta T6E 1X7

File No. 28449
Date April 4, 1986
Samples Core

Certificate of ASSAY

LORING LABORATORIES LTD.

SAMPLE No.	PPM Ag	PPB Au
"Geochemical Analysis"		
710-R2	.1	15
6-88-R1	Nil	5
12-172-R1	.1	20
18-259-R1	Nil	10
20-420-R2	Nil	5
25-360-R1	Nil	Nil
30-402-R2	Nil	5
38-538	Nil	10
42-587-R1	Nil	20
46-639	Nil	5
53-746-R1	Nil	15
56-789-R1	Nil	10
63-888-R1	.1	5
69-966-R1	Nil	Nil
36-502-R2	Nil	15

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Assayer

Chemex Labs Ltd.

Analytical Chemists • Geochemists • Registered Assayers

212 Brooksbank Ave
North Vancouver, B.C
Canada V7J 2C

Phone: (604) [redacted]-022
Telex: 0[redacted]5259

CERTIFICATE OF ANALYSIS

TO : HALFERDAHL & ASSOC. LTD.,
DEPT. 18,
10509 - 81ST AVE.,
EDMONTON, ALTA.
T6E 1X7

CERT. # : A8612220-001
INVOICE # : I8612220
DATE : 30-APR-86
P.O. # : NONE

ATTN: L. B. HALFERDAHL

Sample description	Prep code	Au NAA ppb					
4854	205	<1	--	--	--	--	--
4855	205	<1	--	--	--	--	--
4856	205	9	--	--	--	--	--
4857	205	2	--	--	--	--	--
4858	205	<1	--	--	--	--	--
4859	205	17	--	--	--	--	--
4860	205	<1	--	--	--	--	--
4861	205	<1	--	--	--	--	--
4862	205	2	--	--	--	--	--
4863	205	<1	--	--	--	--	--
4864	205	<1	--	--	--	--	--
4865	205	<1	--	--	--	--	--
4866	205	<1	--	--	--	--	--
4867	205	<1	--	--	--	--	--
5751	205	<1	--	--	--	--	--
5752	205	<1	--	--	--	--	--
5753	205	2	--	--	--	--	--
5754	205	<1	--	--	--	--	--
5755	205	3	--	--	--	--	--
5756	205	<1	--	--	--	--	--
5757	205	<1	--	--	--	--	--
5758	205	<1	--	--	--	--	--
5759	205	<1	--	--	--	--	--
5763	205	1	--	--	--	--	--

Certified by [redacted].

To: HALFERDAHL & ASSOCIATES
18, 10509 - 81 Avenue
Edmonton, Alberta T6E 1X7
Attn: L.B. Halferdahl

File No. 28663
Date June 2, 1986
Samples Rock

Certificate of ASSAY

LORING LABORATORIES LTD.

SAMPLE No.	PPB Au	
"Geochemical Analysis"		
1	20	)
2	25	) Not on Metallic Minerals
3	20	) Exploration Permit 6886020001
4868	25	
4869	20	
4870	25	

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Assayer

Chemex Labs Ltd.

•Analytical Chemists •Geochemists •Registered Assayers

Brooksbank Ave.
North Vancouver, B.C.
Canada V7J 2C1

Telephone:(604) 984-0221
Telex: 043-52597

CERTIFICATE OF ANALYSIS

TO : HALFERDAHL & ASSOC. LTD.,
DEPT. 18,
10509 - 81ST AVE.,
EDMONTON, ALTA.
T6E 1X7

CERT. # : A8612221-001-A
INVOICE # : I8612221
DATE : 26-MAY-86
P.O. # : NONE

ATTN: L. B. HALFERDAHL

Sample description	Al % (ICP)	Sb ppm	As ppm	Ba ppm (ICP)	Be ppm	Bi ppm	B ppm	Br NAA ppm	Cd ppm	Ca % (ICP)	C %	Ce NAA ppm	Cs NAA ppm	Cr ppm (ICP)	Co ppm (ICP)	Cu ppm (ICP)	Dy NAA ppm	Eu NAA ppm	F ppm	Ga ppm	Ge ppm	Au NAA ppb	Hf NAA ppm	Fe % (ICP)
COMP 5760-5762	6.61	0.2	1	575	0.7	0.1	30	<2.0	0.4	0.75	0.14	397	<0.5	185	2	12	<1	<1.0	170	12	<5	<1	12	2.66
COMP 5764-5766	8.65	0.1	1	415	1.8	0.1	50	<2.0	0.5	2.57	0.10	479	<0.5	130	1	147	5	<1.0	220	14	<5	<1	9	2.66
COMP 5767-5769	6.93	0.1	1	410	0.6	0.1	20	<2.0	0.4	0.37	0.12	437	<0.5	150	2	10	2	<1.0	560	13	<5	<1	11	2.93
5770	5.78	0.2	2	500	0.6	0.1	70	8.0	0.2	4.15	2.26	126	<0.5	220	3	13	<1	<1.0	270	7	<5	<1	8	2.37
COMP 5771-5773	7.89	0.1	1	785	1.6	0.1	30	4.0	0.3	1.72	0.17	44	<0.5	155	10	21	1	<1.0	470	12	<5	<1	3	3.83
COMP 5774-5775	9.28	0.2	1	945	1.6	0.1	100	8.0	0.2	2.01	0.12	146	<0.5	120	6	24	<1	<1.0	530	20	<5	<1	6	3.09
COMP 5776-5778	8.78	0.2	1	1040	1.5	0.1	150	2.0	0.3	1.01	0.17	230	<0.5	135	8	38	1	<1.0	610	15	<5	<1	6	3.03

Certified by [redacted]

Chemex Labs Ltd.

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Brooksbank Ave.
North Vancouver, B.C.
Canada V7J 2C1

Telephone:(604) 984-0221
Telex: 043-52597

CERTIFICATE OF ANALYSIS

TO : HALFERDAHL & ASSOC. LTD.,
DEPT. 18,
10509 - 81ST AVE.,
EDMONTON, ALTA.
T6E 1X7

CERT. # : A8612221-001-B
INVOICE # : I8612221
DATE : 26-MAY-86
P.O. # : NONE

ATTN: L. B. HALFERDAHL

Sample description	La NAA ppm	Pb ppm (ICP)	Li ppm	Lu NAA ppm	Mg % (ICP)	Mn ppm (ICP)
COMP 5760-5762	225	22	8	0.4	0.42	201
COMP 5764-5766	280	40	11	0.7	0.46	334
COMP 5767-5769	240	16	8	0.2	0.55	145
5770	122	16	25	0.3	3.13	422
COMP 5771-5773	29	10	14	0.3	1.57	620
COMP 5774-5775	112	10	25	0.2	1.61	398
COMP 5776-5778	134	14	28	0.3	1.53	290

Certified by ..[redacted]..

Chemex Labs Ltd.

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CERTIFICATE OF ANALYSIS

TO : HALFERDAHL & ASSOC. LTD.,
DEPT. 18,
10509 - 81ST AVE.,
EDMONTON, ALTA.
T6E 1X7

CERT. # : A8612222-001-A
INVOICE # : I8612222
DATE : 26-MAY-86
P.O. # : NONE

ATTN: L. B. HALFERDAHL

Sample description	Hg ppb	Mo ppm (ICP)	Nd NAA ppm	Ni ppm (ICP)	Nb(XRF) ppm	P ppm (ICP)	K % (ICP)	Rb ppm	Sm NAA ppm	Sc NAA ppm	Se ppm	SiO2 % fusion	Ag ppm AAS	Na % (ICP)	Sr ppm (ICP)	S % (Leco)	Ta NAA ppm	Te ppm	Tb NAA ppm	Tl ppm	Th NAA ppm	Sn ppm	Ti % (ICP)	W ppm
COMP 5760-5762	30	<1	100	1	<20	170	3.89	98	13.9	3.0	0.1	73.50	2.6	2.36	225	0.02	<1	0.05	<1	0.5	33	1	0.143	1
COMP 5764-5766	20	<1	120	<1	23	220	3.03	53	24.3	4.3	0.1	66.70	0.8	3.05	529	<0.01	<1	<0.05	<1	0.2	29	1	0.254	1
COMP 5767-5769	10	<1	180	<1	<20	110	4.48	126	18.1	2.7	0.1	70.80	<0.2	2.47	82	<0.01	<1	<0.05	<1	0.6	26	1	0.208	1
5770	10	<1	105	7	<20	230	5.21	94	9.0	2.8	0.1	57.40	<0.2	1.69	99	0.21	<1	<0.05	<1	0.3	19	1	0.137	1
COMP 5771-5773	10	<1	35	8	<20	570	3.53	110	5.9	14.2	0.1	65.70	<0.2	2.47	261	<0.01	<1	<0.05	<1	0.5	16	1	0.300	1
COMP 5774-5775	10	<1	60	3	<20	540	4.37	135	8.7	4.4	0.1	63.00	<0.2	2.29	330	<0.01	<1	<0.05	<1	0.6	37	1	0.177	1
COMP 5776-5778	10	<1	65	4	<20	645	4.47	116	11.2	10.5	0.1	64.40	<0.2	2.31	228	0.02	<1	<0.05	<1	0.6	31	2	0.291	1

Certified by .. [redacted] ..

Chemex Labs Ltd.

•Analytical Chemists •Geochemists •Registered Assayers

212 Brooksbank Ave.
North Vancouver, B.C.
Canada V7J 2C1

Telephone:(604) 984-0221
Telex: 043-52597

CERTIFICATE OF ANALYSIS

TO : HALFERDAHL & ASSOC. LTD.,
DEPT. 18,
10509 - 81ST AVE.,
EDMONTON, ALTA.
T6E 1X7

CERT. # : A8612222-001-B
INVOICE # : I8612222
DATE : 26-MAY-86
P.O. # : NONE

ATTN: L. B. HALFERDAHL

Sample description	U fluor. ppm	V ppm (ICP)	Yb NAA ppm	Y (XRF) ppm	Zn ppm (ICP)	Zr(XRF) ppm																
COMP 5760-5762	0.2	9	1.0	20	24	538	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COMP 5764-5766	1.2	16	4.0	83	18	475	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COMP 5767-5769	0.6	6	1.0	20	18	531	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5770	0.6	13	1.0	<20	15	346	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COMP 5771-5773	1.5	49	1.8	28	62	120	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COMP 5774-5775	0.9	60	1.2	<20	33	266	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COMP 5776-5778	0.6	46	1.2	24	50	257	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Certified by ..[redacted]...

APPENDIX II COST STATEMENT

Personnel

[redacted]	supervising drilling, logging and sampling core, assisting in compiling report 17 days @ $260	$ 4,420.00	
[redacted]	logging and sampling core 10 days @ $350	3,500.00	
[redacted]	obtaining approvals, letting drill contract, supervision of drilling, logging, and sampling, preparing, checking, and submitting report 25 days @ $400	10,000.00	
[redacted]	plotting and drafting 23 hours @ $27	621.00	
			$18,541.00

Food and Accommodation

94½ person-days @ $50		4,725.00

Transportation

Rental of 4x4 pick-up and gas	1,052.36	
Aircraft charters	2,375.77	
Airline fares Edmonton-Fort McMurray	615.07	
Freight on samples	61.10	
		4,104.30

Drilling

679.34 m @ $77.60 (including metrage charges, hourly charges, mobilization and demobilization, downhole consumables, core boxes but not accommodation for drillcrew)		52,717.06

Trail plowing and clearing 2,500.00

Analyses

60 core samples prepared @ $2.50 and $2.75	156.00	
60 samples analyzed for gold @ $6.25 and $6.50	381.00	
15 samples analyzed for silver @ $1.90	28.50	
1 control gold assay	21.00	
7 composite core samples analyzed for 60 metals @ $95.00	665.00	
		1,251.00

Report typing, reproduction, and assembly		780.00
Other		
Long distance telephone	225.68	
Aerial photographs and topo maps	17.05	
		242.73
		$84,861.59

I, Laurence B. Halferdahl, Engineer of the City of Edmonton in the Province of Alberta

MAKE OATH AND SAY, THAT:

1. I have knowledge of the work done on Metallic Minerals Exploration Permit 6886020001 as described in the report of which this statement is part.

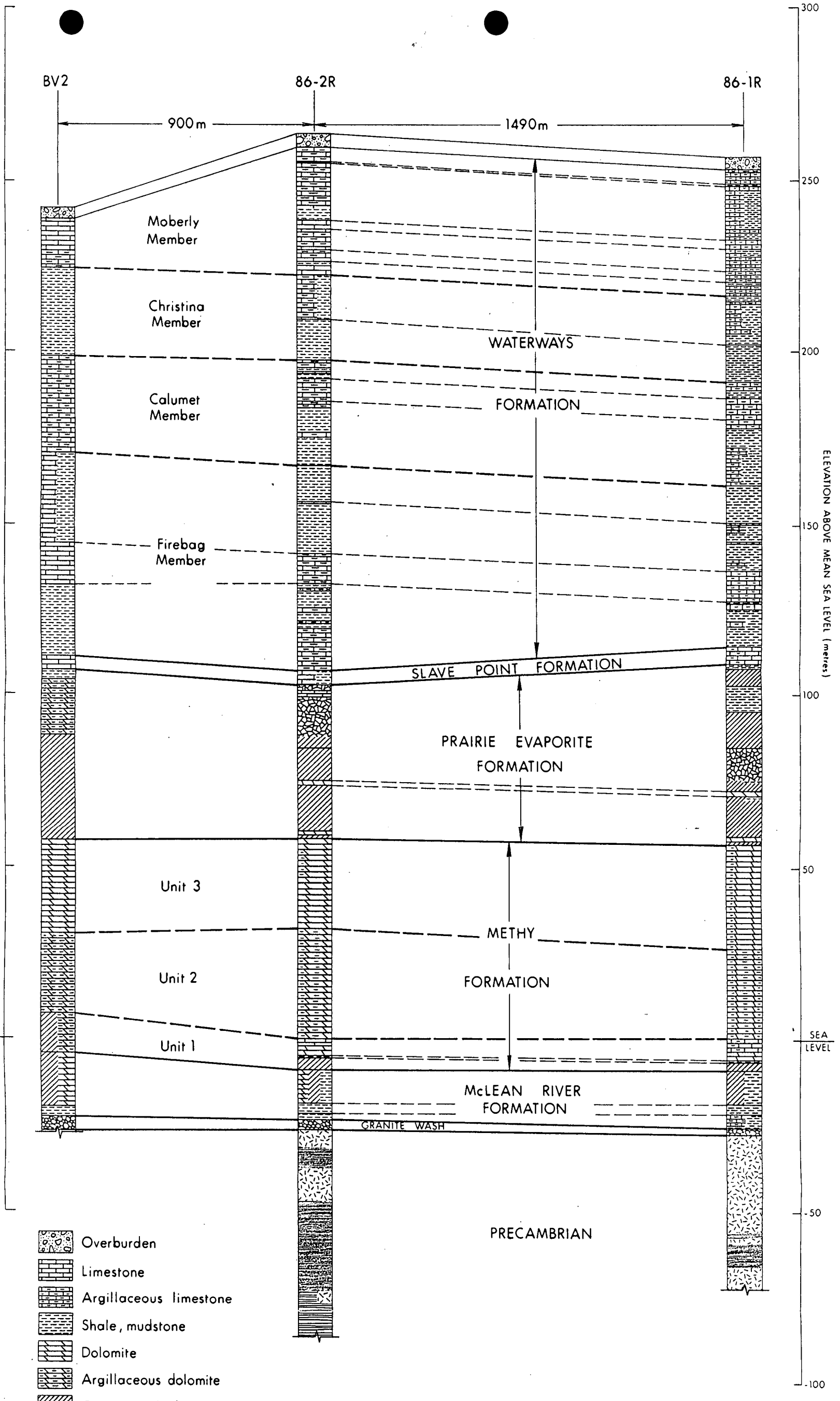
2. The expenses listed above were incurred in conducting work on Metallic Minerals Exploration Permit 6886020001.

Sworn before me at Edmonton, Alberta
this 6th day of June, 1986

Heather J. Murray

Notary Public
Heather J. Murray

[redacted]



19860001

KENNETH RICHARDSON

HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA

Fig. 8.1 Correlation of Strata in Drillholes 86-1R, 86-2R, and Bear Vampire No. 2.

FORT MacKAY AREA, ALBERTA

1986.04

Tp 94

Tp 93

Fort MacKay

TO BARGE TERMINAL

ATHABASCA

FORT McKAY IR 174

IR 174

Alexander Island

Muskeg River

Beaver River

86-1R

86-2R

BV2

Boundary of Metallic Minerals Exploration Permit 6886020001

RIVER

Morton Island

Saline Lake

Strip Mine

Strip Mines

Mildred Lake Airfield

Mildred Lake

Oil Sands Plant

Chys

Trans Sta

TO FORT McMURRAY

Twenty-fourth Baseline

R 10 W4

K Cretaceous strata

D Devonian strata

Geological boundary (approximate)...

Drillhole with number ..... ●86-2R

Line of section of Fig. 8.1 .....

New access road .....

0 1 2 3 km.

SCALE: 1:50 000

KENNETH RICHARDSON

HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA

19860001

Fig. 5.2 Property, Access, and Geology

FORT MacKAY AREA, ALBERTA

LBH 1986 05

FIRST ANNUAL REPORT

ON

THE MINERAL RESOURCES OF ALBERTA

BY

JOHN A. ALLAN, M.Sc., Ph.D.
PROFESSOR OF GEOLOGY
UNIVERSITY OF ALBERTA

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY

EDMONTON:
PRINTED BY J. W. JEFFERY, KING'S PRINTER
1920

Well No. 1, owned by the Athabaska Oils, Limited, is situated on the east bank of the river about 20 miles below Fort McKay, or 56 miles below Fort McMurray. This well, which was commenced in 1911 and finished in 1912, is 1130 feet deep. The last 25 feet is in Laurentian granite, which was reported to contain about $13.00 to the ton in gold. The log of this well is as follows:

Surface deposits	13 feet.
Bituminous sand	65 feet
Shale	20 feet
Bituminous sand	57 feet
Shale	175 feet
Limestone	65 feet
Shale	20 feet
Limestone	175 feet
Gypsum	130 feet
Limestone (containing a salt water stratum)	192 feet
Red Rock	63 feet
Hard reddish flinty sand (second salt water stratum)	130 feet
Reddish Granite (Containing gold)	25 feet

It is important to note that this well, which was drilled through the sedimentary rock into the pre-Cambrian granite, did not show any rock salt, but the log shows a stratum of gypsum 130 feet thick at a depth of about 580 feet.

A well drilled one mile north of Fort McKay on the west side of the river is reported to extend below the sedimentary formations, but no rock salt was encountered. There is a strong flow of sulphurous brine from this well casing and the analysis is given in No. 2 in the table above.

Two wells have been sunk by the Northern Alberta Exploration Company, between 1907 and August 1912, on the south of the town of McMurray. Well No. 1 is 50 feet from the edge of the Athabaska river, and Well No. 2 is 155 feet east of No. 1. It is reported that two beds of rock salt, or salt bearing formations, were encountered in both wells, the upper bed is shown to be 100 feet and the lower one 95 feet, making a total thickness of 195 feet of rock salt. Although the two wells are only 155 feet apart there is a marked lack of agreement in the formations as recorded in the following logs:

WELL NO. 1.

Loose surface material	0—	17 feet
Limestone	17—	117 feet
Soapstone and limestone	117—	520 feet
Salt	520—	620 feet
Limestone	620—	635 feet
Salt	635—	740 feet
Limestone	740—	770 feet
Sandstone	770—	1,475 feet