# MAR 19770012: NORTHEASTERN ALBERTA

Received date: Dec 31, 1977

Public release date: Jan 01, 1979

NORCEN ENERGY RESOURCES LIMITED

# YEAR-END REPORT

# 1977 EXPLORATION PROGRAM

# QUARTZ MINERAL EXPLORATION PERMITS NORTHEASTERN ALBERTA

ORIGINAL

November, 1977

G. McWilliams
D. A. Sawyer, P. Geol.

## TABLE OF CONTENTS


| | Page No. |
|---|---|
| SUMMARY | 1 |
| INTRODUCTION | 3 |
| DRILLING SUMMARY | 6 |
| REGIONAL GEOLOGY | 8 |
| DESCRIPTION OF THE ATHABASCA FORMATION | 8 |
| DESCRIPTION OF THE PALEOZOIC FORMATIONS | 11 |
| CONCLUSIONS | 13 |
| RECOMMENDATIONS | 15 |

APPENDIX

1. Drill logs
2. Summary of Expenditures

MAPS

1. Location of Athabasca Type uranium Deposits (Figure 1)
2. Location of Drill Sites (Figure 2)
3. Cross Section of the Permit Areas (Figure 3)
4. Athabasca Sandstone Permits. (Figure 4)

## SUMMARY

Norcen Energy Resources Limited, on behalf of the uranium joint venture with Campbell Chibougamau Mines Limited, E & B Explorations Limited and Ontario Hydro holds two blocks of Quartz Mineral Exploration Permits in Northeastern Alberta. The Archer permits which cover 179,200 acres include permits 208, 209, 210 and 211 which were acquired on January 28, 1976. The five Richardson Permits totalling 229,600 acres include permits 6 876 120002 to 6 876 120006 acquired on December 23, 1976.

A surface prospecting and geochemical survey conducted over the Archer permits during the summer of 1976 indicated that the edge of the Athabasca Formation was further west than anticipated. This survey also revealed that the pervasive cover of glacial overburden in the area prevented the useful application of any further surface prospecting in the area. In evaluating the situation, the authors felt that present exploration techniques limited the search for unconformity type Athabasca sandstone uranium deposits to areas where the unconformity between the Athabasca Formation and the underlying basement was less than 152.5 metres (500 feet) below the topographic surface. As a result, 2 permits 212 and 213 were surrendered to the Crown and the five Richardson permits were acquired.

The lack of outcrop and the far travelled nature of the overburden in Northeastern Alberta coupled with the importance of locating the margin of the Athabasca Formation indicated to the authors that a reconnaissance stratigraphic drilling program would be required to narrow search area. The 1977 drilling program over the permit areas was designed to:

a) define the edge of the Athabasca Formation

b) outline the areas where the combined thickness of Athabasca sandstone and overburden was less than 152.5 metres (500 feet).

c) examine the unconformity at the base of the Athabasca Formation

d) determine whether the Athabasca Formation in Norcen permit areas contained a favourable physical and chemical environment for uranium deposition

e) determine whether the cause of the lake sediment anomaly on permit 210 was due to local mineralization or part of a halo "down ice" from the Cluff Lake Deposit.

f) examine the basement for its potential as a site for trapping uranium from supergene solutions percolating along the unconformity.

A total of 1245 metres (4082 feet) of BQ (1 3/8 inches in diameter) drilling in 8 holes was carried out between August 15 and October 2, 1977. Core recovery from all holes was near 100 percent with the exception of short sections of unconsolidated sand within the Athabasca Formation where recovery was approximately 50 percent.

Drilling results indicate that the combined thickness of the overburden and Athabasca Formation underlying the Archer permits exceeds 121.2 metres (500 feet). The Richardson permits lying to the west of the Richardson River, lie outside the margin of the Athabasca Formation. Drilling in these areas encountered 27.8 metres (91 feet) to 62.5 metres (205 feet) of overburden and 20.5 metres (74 feet) to 133 feet (70.6 metres) of Lower and Middle Devonian sandstone and mudstone overlying Archaean basement rocks. Thus the target area where the Athabasca Formation is less than 152.2 metres (500 feet) is that area lying to the west of the Maybelle River and east of the Richardson River. In the Norcen permit areas of 408,800 acres the 1977 drilling program has outlined an area of 47,200 acres in which uranium deposits located along unconformity underlying the Athabasca Formation could be detected with the present level of technology.

On the basis of the above information, no further work is recommended for the Archer permits and those Richardson Permits lying to the west of the Richardson River. These areas should be either optioned or returned to the Crown. The 76 sections of permit 687612002 and the 6 sections of permit 687612000 should be retained. On the basis of the success of the electromagnetic method in locating conductors associated with the uranium deposits at Key Lake, Maurice Bay either an airborne electromagnetic or reconnaissance ground electromagnetic survey is recommended for this area in 1978.

# INTRODUCTION

## History

Exploration for uranium in northeastern Alberta was sparked by the announcement by Gulf Minerals of their discovery of a uranium deposit at Rabbit Lake, Saskatchewan in 1968. A massive land acquisition covering most of the Athabasca Sandstone Basin attracted various companies to conduct airborne spectrometer surveys in northeastern Alberta. The absence of outcrop in this area produced discouraging results and very little ground follow-up was attempted. The following list of companies were active in the area:

R.H. King, 1969

Pacific Silver Mines & Oil Ltd., 1969

Fort Reliance Limited & Ensign Oils Ltd., 1969

National Nickel

Geo X

Velocity Surveys

Meyers & Paulson, 1970

MacIntyre Mines, 1969

Canada Southern Petroleum, 1969

Anco Exploration Ltd., 1968

North Canadian Oils Ltd., 1969

Leal Mines, 1969

Radex Minerals, 1969

In 1974 Eldorado Nuclear acquired several permits in northeastern Alberta initiating a second phase of uranium exploration and prospecting. Norcen, under the name of its wholly owned subsidiary, Great Plains Development Company Limited, acquired 6 permits in January of 1976. Several other companies acquired permits and by June, 1976 most of the area available for acquisition over the Athabasca Formation in northeastern Alberta was covered by exploration permits. (Consult the accompanying map for details on the land status in northeastern Alberta and northwestern Saskatchewan).

## Previous Exploration by Norcen

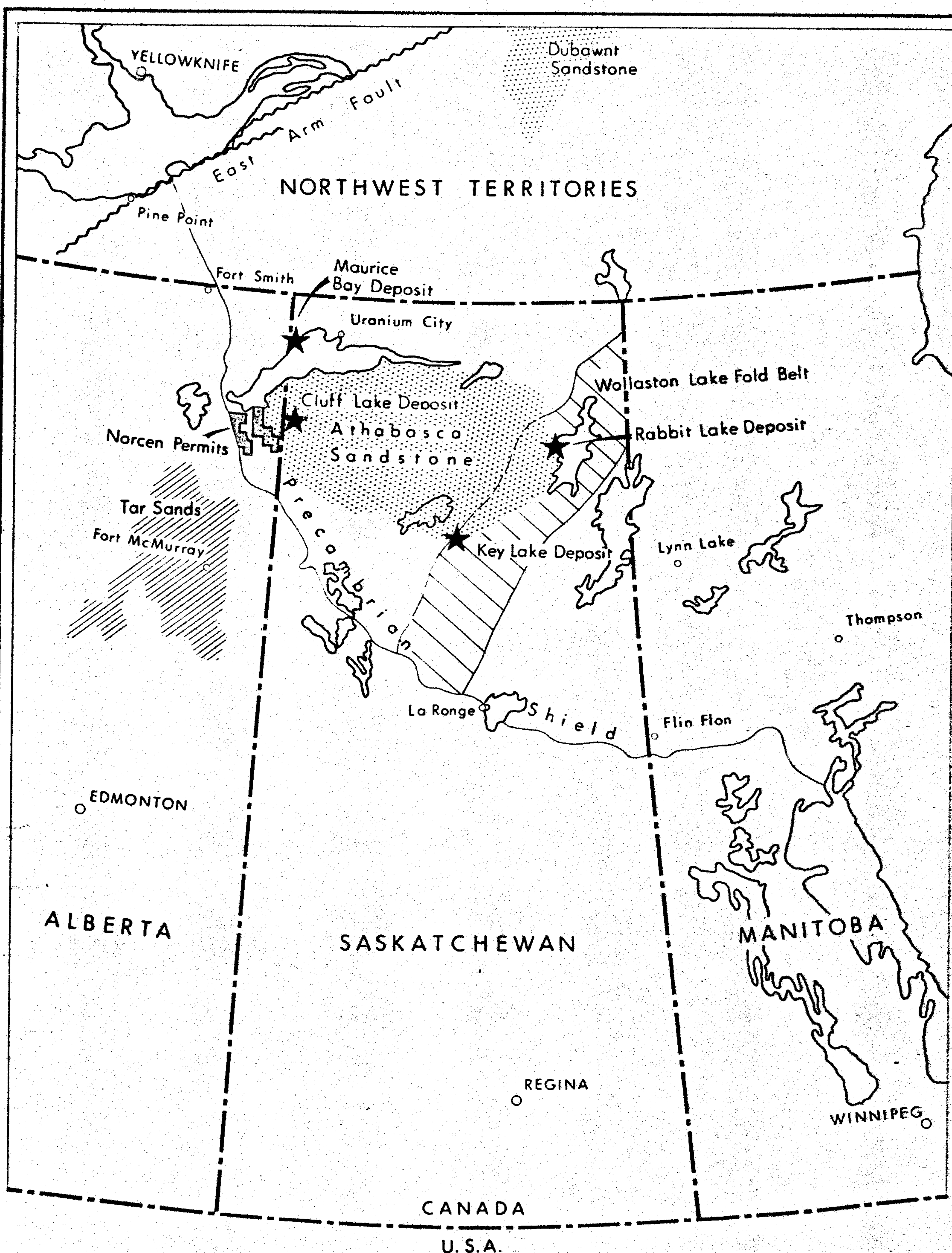
This report covers two blocks of permits which the authors, for the purpose of simplification, refer to as the Archer Permits and the Richardson permits. The Archer Permits, Quartz Mineral Exploration permits numbered 208, 209, 210, 211 are named after Archer Lake which, due to its central location, was the site of the camp used during the geochemical and surface prospecting program conducted during the summer of 1976. The Richardson Permits numbered 687612002 through 687612006 are named after the Richardson River which represents the dominant topographic feature of the area.

The Archer permits originally consisted of 6 permits covering the western margin of the Athabasca Formation as it is indicated on Research Council of Alberta, Map of Bedrock Geology of Alberta, 1970. During the summer of 1976 the author conducted a combined prospecting, surficial geology and lake bottom geochemical study over this area. The authors concluded from this study that the margin of the Athabasca Formation was located much further to the west than indicated on the geological map published by the Research Council of Alberta or indicated by the reconnaissance seismic study by Hobson and McAulay (1969). (For details on last year's exploration see Norcen Energy Resources Limited, 1976 yearend Report Quartz Mineral Exploration Permits NE Alberta and Athabasca River Areas by G. McWilliams and D.A. Sawyer). The recommendation by the authors in this report were that large sections of the permit area should be dropped and that additional permits south of Richardson Lake be acquired as soon as possible.

When the authors applied for the Richardson Permits they discovered that a large tract of land had been withdrawn from mineral acquisition by the Crown as a park reserve. This area contains local sand dunes which are considered to contain a delicate ecology. In talking with Paul Gibson of the Alberta Land Management Branch, the author was assured that an environmental study was to be conducted over this area and that sections of this reserve would be opened for acquisition when this study was completed.

## Drilling

The 1977 exploration program on the Norcen Quartz Mineral Exploration permits consisted of eight diamond drill holes totalling 1221.7 metres (4006 feet). One hole was drilled on each of the five Richardson Permits and three holes on the four Archer permits. Drilling commenced on August 18 and the last hole completed on September 29, 1977. The drill was mobilized from Leduc to Fort McMurray via truck and from Fort McMurray to Embarras via barge down the Athabasca River. The winter road southeast to Embarras provided good access to the first four drill sites. The drill mounted on a Nodwell trailer and a camp consisting of three 10 x 18 foot tents mounted on trailers provided good mobility. Moves and crew changes to the four holes not accessible by road were carried out with a Bell 206B helicopter from a base camp located at the Embarras air strip.




LOCATION OF ATHABASCA SANDSTONE TYPE URANIUM DEPOSITS

0 50 100 150
SCALE IN MILES

19770012

FIG. 1

## Drilling Summary

### Hole #1

Location: Tp. 107 R9 Sec. 4 NW West of the 4th Meridian
Permit No. 6876120003 N.T.S. Ref. 74L
Started: August 18, 1977 Completed: August 20, 1977

| | | | |
|---|---|---|---|
| 0-142 feet | 0-43.3 metres | - | overburden |
| 142-189 feet | 43.3-57.7 metres | - | dolomite |
| 189-275 feet | 57.7-83.9 metres | - | mudstone |
| 275-305 feet | 83.9-93.0 metres | - | granitic gneiss |

### Hole #2

Location: Tp 104 R6 Sec. 21 NW West of the 4th Meridian
Permit No. 687612005 N.T.S. Ref. 74L
Started: August 23, 1977 Completed: August 24, 1977

| | | | |
|---|---|---|---|
| 0-110 feet | 0-33.6 metres | - | overburden |
| 110-160 feet | 33.6-48.8 metres | - | mudstone dolomite |
| 160-184 feet | 48.8-56.1 metres | - | sandstone La Loche formation |
| 184-194 feet | 56.1-59.2 metres | - | paragneiss |

### Hole #3

Location: Tp. 103 R7 Sec. 35 NW West of the 4th Meridian
Permit No. 6876120006 N.T.S. Ref. 74E
Started: August 25, 1977 Completed: August 26, 1977

| | | | |
|---|---|---|---|
| 0-91 feet | 0-27.8 metres | - | overburden |
| 91-160 feet | 27.8-48.8 metres | - | dolomite |
| 160-172 feet | 48.8-52.5 metres | - | mudstone |
| 172-197 feet | 52.5-60.1 metres | - | mudstone sandstone |
| 197-225 feet | 60.1-68.6 metres | - | granitic gneiss |

### Hole #4

Location: Tp. 105 R6 Sec. 14 NW West of the 4th Meridian
Permit No. 687612004 N.T.S. 74L
Started: August 27, 1977 Completed: August 31, 1977

| | | | |
|---|---|---|---|
| 0-205 feet | 0-62.5 metres | - | overburden |
| 205-320 feet | 62.5-97.6 metres | - | sandstone mudstone |
| 320-337 feet | 97.6-102.8 metres | - | granodiorite |

Hole #5

Location: Tp. 107 R5 Sec. 28 SE West of the 4th Meridian
Permit No. 211 N.T.S. 74L
Started: September 3, 1977 Completed: September 10, 1977

| | | | |
|---|---|---|---|
| 0-115 feet | 0-35.1 metres | - | overburden |
| 115 827 feet | 35.1 252.2 metres | - | Athabasca sandstone |

Hole #6

Location: Tp. 107 R6 Sec. 27 NE West of the 4th Meridian
Permit No. 687612002 N.T.S. 74L
Started: September 13, 1977 Completed: September 19, 1977

| | | | |
|---|---|---|---|
| 0-45 feet | 0-12.8 metres | - | overburden |
| 45-578 feet | 12.8-176.4 metres | - | Athabasca sandstone |
| 578-721 feet | 176.4-220.1 metres | - | coarse Athabasca sandstone |
| 721-767 feet | 220.1-233.9 metres | - | altered granite |

Hole #7

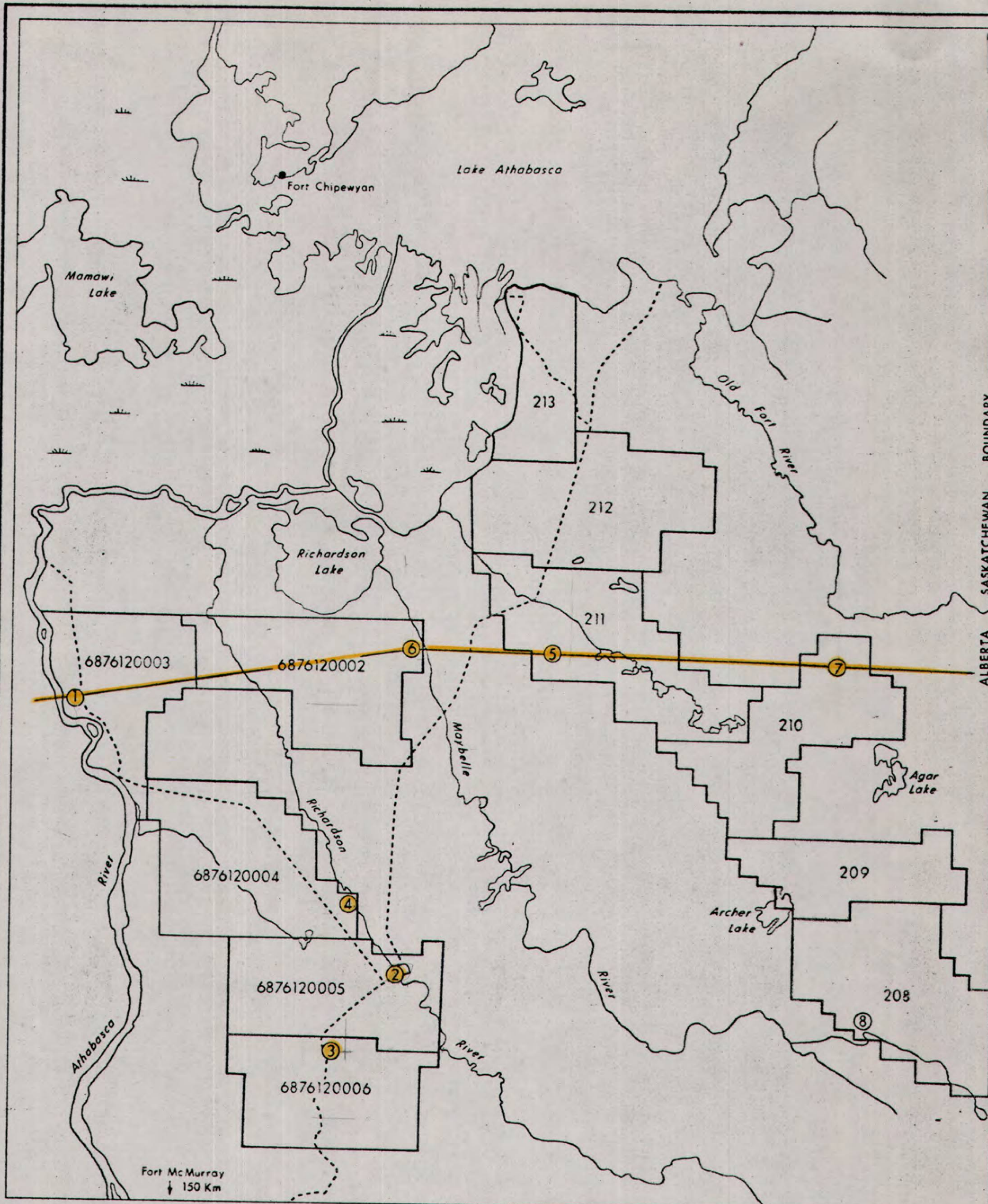
Location: Tp. 107 R2 Sec. 28 NE West of the 4th Meridian
Permit No. 210 N.T.S. 74I
Started: September 20, 1977 Completed: September 24, 1977

| | | | |
|---|---|---|---|
| 0-156 feet | 0-47.6 metres | - | overburden |
| 156 604 feet | 47.6 184.2 metres | - | Athabasca sandstone |

Hole #8

Location: Tp. 104 R2 Sec. 9 NE West of the 4th Meridian
Permit No. 208 N.T.S. 74L
Started: September 26, 1977 Completed: September 29, 1977

| | | | |
|---|---|---|---|
| 0-114 feet | 0-34.8 metres | - | overburden |
| 114 747 feet | 34.8 227.8 metres | - | Athabasca sandstone |




② DRILL SITES

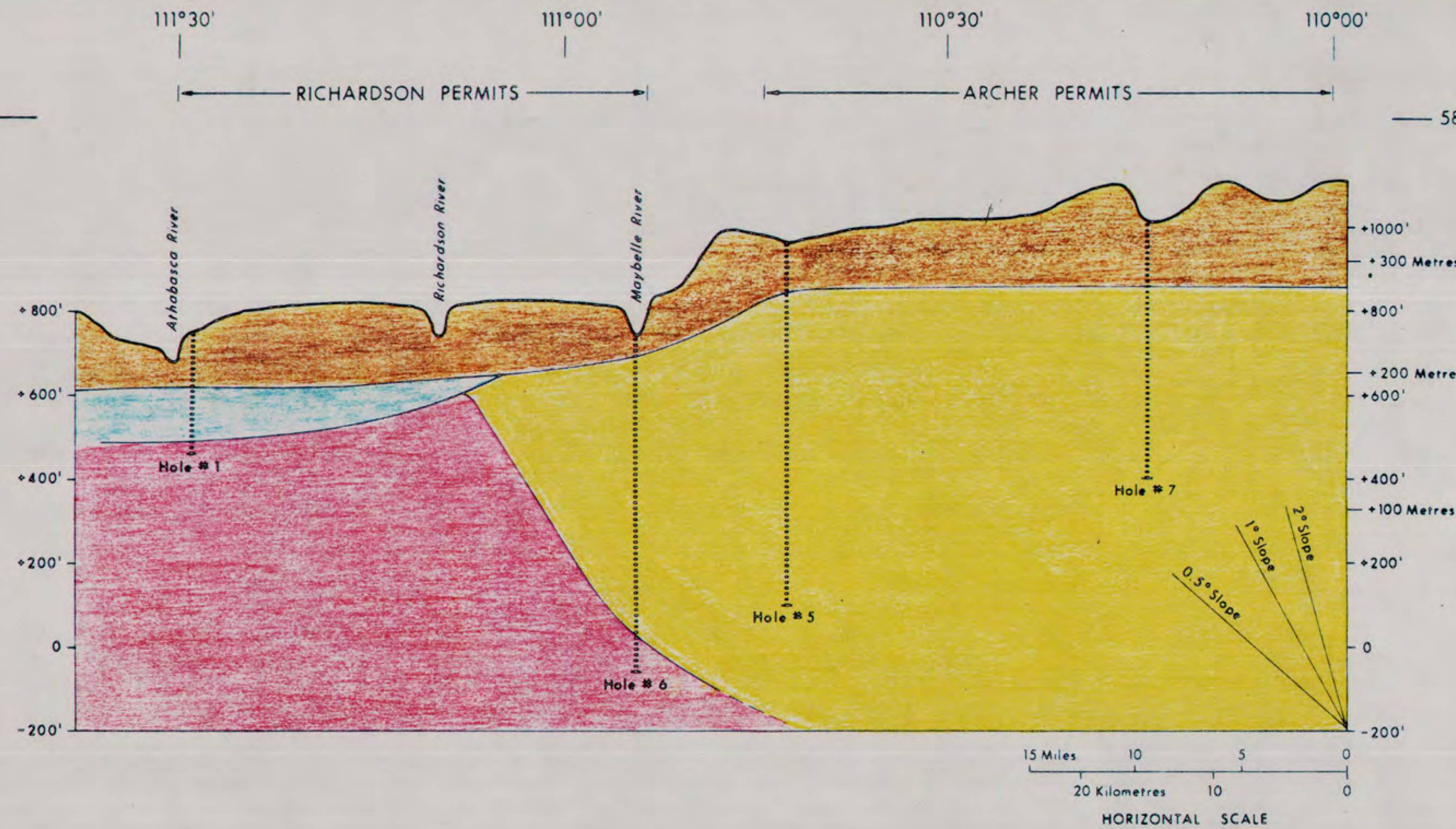
LINE OF CROSS SECTION

19770012

FIGURE 2

LOCATION OF DRILL SITES

19770012
Figure 3




*PLEISTOCENE*

*Glacial Sand & Boulders*

*DEVONIAN*

*Sandstone, Dolomite, Mudstone*

*PROTEROZOIC*

*Athabasca Sandstone*

*ARCHAEAN*

*Granite Paragneiss*

EAST - WEST CROSS SECTION

DRAWN ALONG 58°20'

FIG 3

## REGIONAL GEOLOGY

The northeast corner of Alberta is occupied by 6,000 square miles of the Canadian Shield, consisting of a complex of igneous, metamorphic and sedimentary rocks ranging in age from 1.7 to 2.3 billion years and forming part of the Churchill Structural Province.

South of Lake Athabasca lie rocks of the Athabasca Formation within the Athabasca intracratonic basin. This Formation covers an area of 40,000 square miles mainly in Saskatchewan and reaches a thickness of 6,000 feet. However, approximately 1,200 square miles of this Athabasca Sandstone occurs in Alberta and appears on islands in Lake Athabasca as well as small peninsula's located as Shelter Point and Fidler Point on the north shore of Lake Athabasca.

The Athabasca Formation is considered to belong to the Paleohelikian Era (1.3 - 1.7 billion years).

## DESCRIPTION OF THE ATHABASCA FORMATION

The formation consists of quartz sandstone with minor interbeds of shale and siltstone and a basal gritty sandstone conglomerate unit. The formation lies in an oval shaped basin coverin in excess of 98,800 square kilometres (38,000 square miles) in northwestern Saskatchewan and approximately 31,000 square kilometres (12,000 square miles) in northeastern Alberta. The formation dips toward the centre of the basin where it reaches a thickness of 1,800 metres (6,000 feet). A pronounced unconformity underlies the Athabasca Formation and in some localities probably depending on the composition of the Archaean basement rocks a regolith is developed.

## DESCRIPTION OF THE ATHABASCA FORMATION IN THE NORCEN CORE

### Composition

The sandstone is composed almost entirely of quartz grains bound together by silica and/or clay cement. Shale and argillaceous siltstone beds occur as minor interbeds of 1 to 20 centimetres (0.5 to 8 inches).

### Colour

The sandstone ranges in colour from a white buff colour to a dark maroon colour with light buff and pink, the most common. Colour banding is common with alternating pink white and maroon. Red and pink colours are due to a surface coating of hematite on the sand grains and on the cementing clay minerals. The dark maroon colour appears to be caused by a concentration of fine specular hematite grains in the matrix of the sand. There would appear to be an increase in hematite content with depth. In hole number 8, there was a distinct concentration of hematite in the sandstone above and at the basement unconformity. Dark grey colours are caused by tar and bitumen coating the sand grains. Dark grey coloured sand occurs in porous horizons adjacent to fractures.

The siltstone beds occur in tan buff colour, chlorite green colour or deep hematite red colour. Locally these beds are laminated with fine millimetre thick alternating laminations of dark red and light green.

## CEMENT HARDNESS AND PERMEABILITY

Both silica and clay cement occur in varying abundance. Where silica cement is present the sandstone is hard and non-friable, when clay minerals form the cement the sandstone is moderately friable and when little of either is present the sandstone is extremely friable or as in a short section of hole number 8, unconsolidated. The permeability of the sandstone is affected by the amount of cement present, the presence of impermeable siltstone beds and locally by secondary fracturing. Locally permeable horizons are clearly indicated by leaching of the hematite in the sandstone creating colour banding.

### Grain Size and Sorting

The sediments range from fine sand through fine pebbles, but medium grained sand is the most abundant. In holes 5 and 6 there appeared to be a gradual increase from fine to medium grained at the top to medium to coarse and coarse grained sand at depth. Locally some beds show distinct textural laminations in which there is a marked contrast and grain size in adjacent laminae and layers.

### Structures

Inclined and truncated laminae are prominant features and occur on a large scale and on a small scale as represented by festoon cross-laminations with individual laminations several millimetres thick. In hole number 5 a sandstone breccia unit 1.6 metres (5.2 feet) thick was intersected which showed distinctive intrusive relationship with the surrounding sandstone. Fractures in the sandstone above the breccia unit are filled with a mudstone identical to the matrix of the breccia. The breccia consists of extremely angular fragments of sandstone and siltstone up to 5 centimetres (2 inches) in diameter in brick red to orange sandy mudstone matrix.

Fractures in the sandstone are locally a prominent feature and intersect the core axis at 10 to 15 degrees. These fractures are filled with clay, silica or tar.

## Unconformity

6

The unconformity underlying the Athabasca Formation was only encountered in hole number 5. The unconformity was outlined by a concentration of hematite in the matrix of the sandstone and in the highly altered basement rock. The upper level of the granitic basement rock is highly altered by insitu chemical alteration of feldspars and micas and replacement by hematite. This zone of alteration and replacement gradually decreases downward over a depth of 10 metres (30 feet).

## Radioactivity

Background levels of radioactivity as measured with a hand held McPhar TV-1A spectrometer were low, less than 1,000 counts per minute, and no readings above 1.5 times background were over the sandstone or over the granitic basement rock.

## DESCRIPTION OF THE PALEOZOIC FORMATIONS OVERLAPPING THE PRECAMBRIAN SHIELD IN NORTHEASTERN ALBERTA

A wedge of middle and upper Devonian rock unconformably overlaps the edge of the Precambrian Shield in northeastern Alberta. These rocks are not found in outcroppings due to a thick blanket of glacial outwash which covers all of the Norcen permit areas. The closest exposure of these formations occur on the southwest shore of Lake Claire 25.6 kilometres (16 miles) to the northwest and along the banks of the Firebag River 16 kilometres (10 miles) south of the permit area. The author of this report is unfamiliar with Devonian stratigraphy and with the limited drill hole information available has made no attempt at correlating the Devonian rocks with the established stratigraphy of the area. A comprehensive report on the Devonian stratigraphy of northeastern Alberta and northwestern Saskatchewan has been compiled by A.W. Norris (1963).

### Description of the Paleozoic Formations in the Norcen Core.

The glacial outwash covering the Paleozoic rocks ranges in thickness from 27.8 metres (91 feet) to 62.5 metres (205 feet) with an average thickness over the four holes of 49 metres (146 feet). The thickness of Paleozoic rocks ranged from 22.6 metres (74 feet) to 40.5 metres (133 feet) with an average thickness of 32.4 metres (106.2 feet) in the four holes drilled. The strata encountered in the four holes varied considerably from one hole to the next. For details in the stratigraphy the reader should refer to the drill logs in the appendix. In general the sequence from top to bottom consists of dolomite, dolomitic mudstone, mudstone gypsum, mudstone sandstone grading down into a coarse rubbly sandstone unconformably overlying the granitic basement complex.

Dolomite is generally massive to laminated, brown in colour forming beds up to 4.3 metres (14 feet) thick. Locally the dolomite shows a wide range in colour from grey to dark brown. Fossils, although not prolific, do occur in the form of crinoid stems and brachiopods.

Mudstones show a considerable range in colour, colours include grey, grey brown, dark brown, red brown and green grey. Mudstones occur interbedded with sandstone, dolomite and gypsum in beds ranging from several centimetres (1 inch) to .3 metres (1 foot).

Gypsum, occurs within the mudstones in thin beds ranging from less than a centimetre (2.5 inches) up to 15 centimetres (6 inches).

Sandstones occur at the bottom of the sequence overlying the unconformity. The best section of the sandstone was encountered in hole number 2 where a sandstone mudstone unit graded down into a very coarse immature rubbly sandstone 4 metres (13 feet) thick. This coarse, grey, poorly sorted, unstratified unit is composed of angular to subrounded quartz and feldspar grains up to 5 millimetres (.2 inches) in diameter. This coarse sandstone unit grades down into a regolithic unit 3 metres (9.9 feet) thick composed of broken fragments of granite gneiss and chert in a coarse sandy matrix which overlies a weathered fractured paragneiss.

No anomalous radioactivity was encountered in the Paleozoic rocks, readings of 1.5 times background were recorded over the rubbly sandstone encountered in hole number 2.

CONCLUSIONS

The primary objective of the 1977 drilling project in northeastern Alberta was to outline the western margin of the Athabasca Formation. Eight holes were drilled in the Norcen permits and only hole number 6 intersected the basement unconformity underlying the Athabasca basin at a depth of 220.1 metres (721 feet). In objectively assessing the state of the art geophysical and geochemical methods, the authors estimate 152.5 metres (500 feet) is the maximum depth below the surface at which a uranium ore body could be detected. If we use this arbitrary depth limit to evaluate the Norcen permits, the four Archer permits are located too deep within the basin to have potential of detecting uranium ore zones located along the Athabasca Formation - Archaean basement unconformity. The four holes drilled on the Richardson permits west of the Richardson River encountered Paleozoic marine sediments unconformably overlying the Archean basement. This area may have, at one time, been part of the Athabasca basin and contain outliers of the Athabasca Formation, but there were no indications of this in our drilling and one must conclude that this area has a much lower exploration potential. The one Richardson Permit (687612002) in which hole number 6 was drilled covers the contact of the basin, warrants further investigation.

Drill hole number 7 was located within a lake sediment geochemical anomalous zone, with values of 18.8 parts per million uranium as compared to a regional background of less than 2 parts per million. This hole reached a depth of 184.2 metres (604 feet) without encountering any anomalous radioactivity. The author concludes that this anomaly is not due to local mineralization, but rather, is due to uranium in the glacial overburden which originated from the Amok uranium deposit at Cluff Lake, Saskatchewan.

Two holes (numbered 2 and 4) drilled adjacent to the Richardson river on our permits and outcroppings of granitic basement rocks along the Richardson River in the Eldorado Nuclear Permits to the south indicate that the western margin lies to the east of the river. Two holes were drilled along the Maybell River, which lies to the east and is oriented roughly parallel to the Richardson River. Hole 6 to the north intersected the basement unconformity at a depth of 220.1 metres (721 feet) and hole number 8 was abandoned after not reaching the coarse basal sandstone after 227 metres (747 feet). The parallel trend of these rivers is curvilinear oriented in a westerly direction at the Alberta Saskatchewan border and gradually shifting to a north north-west orientation, where they drain into the Athabasca River and Richardson Lake. The distance separating these rivers varies from 38.4 kilometres (24 miles) in the south to 25.6 kilometres (16 miles) in the area south of Richardson Lake. These rivers could be considered to form the boundary limits for exploration for unconformable uranium deposits along the margin of the Athabasca basin.

The unconformity underlying the Athabasca Formation was only observed at one location. The concentration of hematite along the unconformity and the deep chemical insitu weathering of the underlying granite indicate that the unconformity represents a natural channel for supergene solutions. The unconformity at hole number 6 does not contain a favourable physical or chemical environment for uranium deposition and no anomalous radioactivity was recorded. The deposits at Key Lake and Maurice Bay, Saskatchewan, which are found at the base of the Athabasca Formation, can be used as models for the type of structural and chemical trap favourable for uranium deposition. Faulting with graphite concentrations in the shear zone provides the reducing environment for the deposition of uranium in these deposits. These graphite shear zones are excellent conductors readily detectable with an electromagnetic survey. Now that we have narrowed down the location of the margin of Athabasca formation a detailed electromagnetic survey should be implemented to determine whether graphitic shear zones are present in the paragneisses of the Archaean basement complex.

## RECOMMENDATIONS

The Athabasca Formation - Archean conformity underlies the Archer permits at depths in excess of 153 metres (500 feet). It is the understanding of the authors that the state of the art geochemical and geophysical tools are unable to detect uranium mineralization at this depth. Since the primary exploration target in the Athabasca basin is uranium mineralization located along the unconformity the chance of discovering uranium deposits in this area is remote. These permits should be surrendered to the crown on their January 28th anniversary date.

The Richardson permits west of the Richardson river are located beyond the western margin of the Athabasca basin and are not a good exploration target. These permits should be surrendered to the crown on their December 23rd anniversary date. Permit 687612002 is located between the Richardson and Maybell Rivers and the authors believe that this area has a good potential for discovering high grade uranium deposits. An airborne electromagnetic survey is proposed to evaluate this area. This survey would be extended to include the area of crown reserve to the south of the permit if there appeared to be any chance that this area would be opened for prospecting in the near future. A line spacing of ¼ mile is recommended for the permit area and possibly a larger spacing (0.5 miles) over the area of open ground. The cost of flying an airborne electromagnetic survey over the permit area at $35.00 per line mile is $28,000. The cost of including the crown reserve and the open ground to the north in the survey is $51,000.

# APPENDIX 1

## Drill Logs

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

PROPERTY: Richardson Quartz Mineral Permits

HOLE NO. 1

SHEET NUMBER 1

N.T.S. NO. 74 L

STARTED August 18, 1977

COLLAR TP 107 R9 Sec. 4NW
W of the 4th Meridian

CLAIM NO. Permit 687612003

COMPLETED August 20, 1977

BEARING

ULTIMATE DEPTH 305 ft./ 93.03 m

ELEVATION 750 ft./229 m

DIP .90

PROPOSED DEPTH

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 0-43.3 | Overburden - glacial outwash | | | | | | | |
| | 0-12.2 unconsolidated sand | | | | | | | |
| | 12.2 - 42.7 sand and clay | | | | | | | |
| | 42.7 - 43.3 sand pebbles and boulders | | | | | | | |
| | | | | | | | | |
| 43.3-48.2 | Dolomite - grey brown, massive beds | | 4.9 | | | | | |
| | local vugs carbonate filled | | | | | | | |
| | | | | | | | | |
| 48.2-48.5 | Dolomite - grey with light brown calcite | | 0.3 | | | | | |
| | blotches, local vugs | | | | | | | |
| | | | | | | | | |
| 48.5-51.2 | Dolomite - grey banded, dark brown (cont'd) | | 2.7 | | | | | |

LOGGED BY

DRILLED BY

CORE STORED

90' 6/7'

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 2 PROPERTY ______ HOLE NO. 1

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| | bands of organic matter vary in | | | | | | | |
| | thickness from a fraction of a mm to 7.5 cm | | | | | | | |
| 51.2-57.7 | Dolomite - grey massive, vugs filled with gypsum (selenite) | | 6.5 | | | | | |
| 57.7-58.0 | Calcareous Mudstone - banded | | 0.3 | | | | | |
| 58 - 59.1 | Mudstone Breccia - angular fragments of dolomite up to | | 1.1 | | | | | |
| | 3 cm diameter in a calcareous mudstone | | | | | | | |
| | matrix. | | | | | | | |
| 59.1-59.5 | Dolomite and Mudstone - interlayered with local gypsum | | 0.4 | | | | | |
| | laminations | | | | | | | |
| 59.5-70.2 | Mudstone and Gypsum - interbanded the gypsum beds up to | | 10.7 | | | | | |
| | 3 cm thick constitute 5% of the rock | | | | | | | |
| | at the top of the section increasing | | | | | | | |
| | to 60% of the rock by volume at the | | | | | | | |

(cont'd)

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

SHEET NO. 3 PROPERTY HOLE NO. 1

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| | bottom of the section, mudstone is grey to green grey and the gypsum is white or clear. | | | | | | | |
| 70.2-73.8 | Mudstone - green calcareous with 2% gypsum | | 3.6 | | | | | |
| 73.8-74.7 | Dolomite - light brown muddy | | 0.9 | | | | | |
| 74.7-83.1 | Mudstone - red brown with thin gypsum horizons, locally the reduced horizons and blotches are green | | 8.4 | | | | | |
| 83.1-83.9 | Unconformity - angular fragments of granitic gneiss in a matrix of mudstone and gypsum. | | 0.8 | | | | | |
| 83.9=93.3 | Paragneiss - biotite (25%) quartz (30%) feldspar (45%) gneissosity near vertical. | | 9.4 | | | | | |
| End | Dip test - 89$^{o}$ | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

PROPERTY: Richardson Quartz Mineral Permits | HOLE NO. 2

SHEET NUMBER 1 | N.T.S. NO. 74 L | STARTED August 23, 1977

COLLAR TP 104 R6 Sec. 21 NW W of the 4th Meridian | CLAIM NO. Permit 687612005 | COMPLETED August 24, 1977

BEARING | ULTIMATE DEPTH 194 ft./ 59.2 m

ELEVATION 940 ft./287 m | DIP .90 | PROPOSED DEPTH

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 0-33.6 | Overburden - glacial outwash | | | | | | | |
| | 0-26.2 sand | | | | | | | |
| | 26.2 - 33.6 sand and boulders, boulder | | | | | | | |
| | count (4 granite, 1 dolomite, | | | | | | | |
| | 16 sandstone) | | | | | | | |
| | | | | | | | | |
| 33.6-37.2 | Mudstone - grey, massive to weakly | | 1.8 | | | | | |
| | laminated; tar in fractures | | 50% | | | | | |
| | | | | | | | | |
| 37.2-38.1 | Mudstone - grey, massive, sandy | | 0.9 | | | | | |
| | | | | | | | | |
| 38.1-39.0 | Mudstone Sandstone - grey mudstone grading down to a light | | 0.9 | | | | | |

(cont'd)

LOGGED BY | DRILLED BY | CORE STORED

90' 6/77

NORCEN ENERGY RESOURCES LIMITED

**DIAMOND DRILL RECORD**

SHEET NO. 2 PROPERTY Richardson Quartz Mineral Permits HOLE NO. 2

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay |
|---|---|---|---|---|
| 39.0-39.4 | Mudstone - grey massive | | 0.4 | |
| 39.4-43.0 | Mudstone Sandstone - mudstone grading down into a sandstone with local laminations of sandstone and mudstone | | 3.6 | |
| 43.0-44.8 | Mudstone Sandstone - mudstone with laminations of fine sandstone, pyrite 2%. | | 1.8 | |
| 44.8 - 49.4 | Sandstone Mudstone - cycles of mudstone grading down into sandstone, beds vary from 7 to 15 cm thick pyrite occurs in fine stringers and disseminations | | 4.6 | |
| 49.4-53.4 | Sandstone - massive grey coarse immature sandstone consisting of angular to subrounded quartz and feldspar grains in a muddy matrix sequence coarsens down-ward. | | 4.0 | |
| 53.4-56.4 | Regolith - coarse sandstone with pebbles and cobbles of | | 3.0 | |

(cont'd)

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 3 PROPERTY Richardson Quartz Mineral Permits HOLE NO. 2

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| | granite gneiss and chert grading down into a | | | | | | | |
| | highly weathered fractured granite gneiss | | | | | | | |
| | | | | | | | | |
| 56.4-59.2 | Paragneiss - biotite quartz feldspar gneiss with dissemina- | | 2.8 | | | | | |
| | tions of pyrite dipping 65-75° | | | | | | | |
| | | | | | | | | |
| 59.2 End | Dip test - 89° | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

PROPERTY: Richardson Quartz Mineral Permits HOLE NO. R 4

SHEET NUMBER 1 N.T.S. NO. 74 L STARTED August 27, 1977

COLLAR TP 105 R6 Sec. 14 NW W of the 4th Meridian CLAIM NO. Permit 6876120004 COMPLETED August 31, 1977

BEARING ULTIMATE DEPTH 337 ft./ 102.8 metres

ELEVATION 925 ft./ 282 m DIP -90 PROPOSED DEPTH

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 0-62.5 | Overburden - glacial outwash | | | | | | | |
| | 0-59.5 sand | | | | | | | |
| | 59.5 - 62.5 sand and boulders | | | | | | | |
| | | | | | | | | |
| 62.5-66.5 | Gypsum Mudstone - alternating beds of white to transparent | | 4.0 | | | | | |
| | gypsum and brown mudstone, beds range from 1 cm to | | | | | | | |
| | 10 cm thick. | | | | | | | |
| | | | | | | | | |
| 66.5-72.3 | Mudstone - grey and green grey, very soft, local gypsum beds | | 5.8 | | | | | |
| | | | | | | | | |
| 72.3-77.9 | Mudstone Sandstone - grey green mudstone grading into fine | | 5.6 | | | | | |
| | gritty sandstone disseminations and blebs of | | | | | | | |

(cont'd)

LOGGED BY DRILLED BY CORE STORED

90' 6/77

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 2 PROPERTY ______ HOLE NO. R 4

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| | pyrite 1% thin intermittant beds of gypsum. | | | | | | | |
| 77.9-78.1 | Gypsum - white translucent gypsum bed. | | 0.2 | | | | | |
| 78.1-86.0 | Sandstone Mudstone - green grey mudstone grading into grey | | 7.9 | | | | | |
| | sandstone disseminated pyrite. | | | | | | | |
| 86.0-90.0 | Mudstone - green gritty mudstone, pyrite 2%. | | 4.0 | | | | | |
| 90.0-93.0 | Sandstone - grey fine grained sandstone with laminations | | 3.0 | | | | | |
| | of mudstone 5 mm thick. | | | | | | | |
| 93.0-93.6 | Mudstone - green massive mudstone. | | 0.6 | | | | | |
| 93.6-94.2 | Sandy Mudstone - green grey sandy mudstone | | 0.6 | | | | | |
| 94.2-95.2 | Mudstone - green mudstone disseminated pyrite. | | 1.0 | | | | | |

NORCEN ENERGY RESOURCES LIMITED
<u>DIAMOND DRILL RECORD</u>

SHEET NO. 3 PROPERTY ______ HOLE NO. 4

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 95.2-96.7 | Sandstone - grey green sandy mudstone to sandstone. | | 1.5 | | | | | |
| 96.7-97.6 | Unconformity - partially weathered granite gneiss. | | 0.9 | | | | | |
| 97.6-102.8 | Granodiorite - massive, local bands of chlorite indicate | | 4.2 | | | | | |
| | shearing pyrite concentrated in shear planes. | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

## DIAMOND DRILL RECORD

PROPERTY: Richardson Permits | HOLE NO. R 3

SHEET NUMBER 1 | N.T.S. NO. 74 E | STARTED August 25, 1977

COLLAR TP 103 R7 Sec. 35 NW W of the 4th Meridian | CLAIM NO. Permit 687612006 | COMPLETED August 26, 1977

BEARING | ULTIMATE DEPTH 225 ft./68.6

ELEVATION 945 ft./288 m | DIP -87 | PROPOSED DEPTH

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 0-27.8 | Overburden - glacial outwash | | | | | | | |
| | 0-24.7 sand | | | | | | | |
| | 24.7 - 27.8 sand and boulders | | | | | | | |
| | | | | | | | | |
| 27.8-34.2 | Dolomitized Mudstone - massive locally laminated brown, | | 6.4 | | | | | |
| | fossiliferous (crinoid stems) fractures filled | | | | | | | |
| | with tar. | | | | | | | |
| | | | | | | | | |
| 34.2-48.8 | Dolomite - laminated, grey brown muddy, tar in fractures | | 14.6 | | | | | |
| | and cavities | | | | | | | |
| | | | | | | | | |
| 48.8-51.6 | Mudstone - brecciated light grey and dark brown angular | | 2.8 | | | | | |

(cont'd)

LOGGED BY | DRILLED BY | CORE STORED

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 2 PROPERTY Richardson Permits HOLE NO. R 3

| Depth (~~ft~~/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| | fragments, dark brown colour due to organic debris | | | | | | | |
| | | | | | | | | |
| 51.6-52.5 | Mudstone - laminated light and dark brown laminations | | 0.9 | | | | | |
| | | | | | | | | |
| 52.5-60.1 | Mudstone Sandstone - grey massive mudstone grading into | | 7.6 | | | | | |
| | 3 to 25 cm thick beds of coarse gritty sandstone, | | | | | | | |
| | mudstone soft grey, sandstone angular quartz and | | | | | | | |
| | feldspar grains in a black matrix (colour due | | | | | | | |
| | to tar). | | | | | | | |
| | | | | | | | | |
| 60.1-60.7 | Unconformity - angular blocks of granite gneiss separated | | 0.6 | | | | | |
| | by bands of mudstone. | | | | | | | |
| | | | | | | | | |
| 60.7-68.6 | Granitic Gneiss - highly sheared gneiss shearing at 35° to | | 7.9 | | | | | |
| | core axis pyrite 3%, chloritic alteration calcite | | | | | | | |
| | and chlorite in shear planes rock appears to be | | | | | | | |
| | an altered diorite. | | | | | | | |
| 68.6 | End of hole dip test - 87° | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

PROPERTY: ARCHER QUARTZ MINERAL PERMITS

HOLE NO. R 5

SHEET NUMBER 1

N.T.S. NO. 74L

STARTED September 3, 1977

COLLAR Tp 107 R5 Sec 28 SE W of the 4th Meridian

CLAIM NO. Permit 211

COMPLETED September 10, 1977

BEARING

ULTIMATE DEPTH 827 feet/252.2 meters

ELEVATION 950 feet/390 meters

DIP - 88

PROPOSED DEPTH

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 0-35.1 | Overburden - glacial outwash | | | | | | | |
| | - sand with small boulders above outcrop | | | | | | | |
| | | | | | | | | |
| 35.1-36.0 | Sandstone-massive pink fine grained well sorted clay and silica | | 0.9 | | | | | |
| | cement | | | | | | | |
| | | | | | | | | |
| 36.0-37.2 | Sandstone-as above with maroon sections and brick red clay | | 1.2 | | | | | |
| | minerals in fractures | | | | | | | |
| | | | | | | | | |
| 37.2-38.1 | Sandstone-massive white medium grained silica cement | | 0.9 | | | | | |
| | | | | | | | | |
| | | | | | | | | |

LOGGED BY

DRILLED BY

CORE STORED

90' 6/77

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 2 PROPERTY ARCHER QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 38.1-44.5 | Sandstone-massive to weakly banded, white, textural laminations | | 6.4 | | | | | |
| | due to contrasts in grain size | | | | | | | |
| | | | | | | | | |
| 44.5-45.5 | Sandstone-cross-laminated, white to pink, cross-laminations are | | 1.0 | | | | | |
| | indicated by inclined truncated colour laminations | | | | | | | |
| | up to 4 cm apart | | | | | | | |
| | | | | | | | | |
| 45.5-58.6 | Sandstone-massive white grey, tar in fractures and in irregular | | 3.1 | | | | | |
| | blotches adjacent to fractures thin laminated beds of | | | | | | | |
| | siltstone claystone occur at 48.2 and 55.4 | | | | | | | |
| | | | | | | | | |
| 58.6-59.8 | Sandstone-massive to weakly banded pink fine grained, clay | | 1.2 | | | | | |
| | cemented, local bands of purple laminated siltstone | | | | | | | |
| | claystone. | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 3 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 59.8-60.7 | Sandstone-massive, white maroon | | 0.9 | | | | | |
| 60.7-63.6 | Sandstone-massive pink fine grained with local laminations purple siltstone claystone | | 2.9 | | | | | |
| 63.6-63.9 | Sandstone-massive white-grey medium grained | | 0.3 | | | | | |
| 63.9-64.1 | Sandstone-Siltstone laminated pink sandstone and light brown to yellow siltstone | | 0.2 | | | | | |
| 64.1-65.4 | Sandstone-massive white medium grained sandstone minor silt- stone | | 1.3 | | | | | |
| 65.4-66.5 | Sandstone-massive pink fine to medium grained tar in fractures and in adjacent sandstone | | 1.1 | | | | | |
| 66.5-68.6 | Sandstone Siltstone-pink sandstone and laminated yellow-brown siltstone | | 1.1 50% | | | | | |

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

SHEET NO. 4 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral- ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 68.6-69.2 | Sandstone-massive light grey medium grained | | 0.6 | | | | | |
| | | | | | | | | |
| 69.2-69.4 | Sandstone-Siltstone laminated grey, pink and maroon siltstone | | 0.2 | | | | | |
| | and fine pink and white sandstone | | | | | | | |
| | | | | | | | | |
| 69.4-70.9 | Sandstone-massive grey white | | 1.5 | | | | | |
| | | | | | | | | |
| 70.9-71.1 | Sandstone Siltstone-laminated grey and maroon siltstone and | | 0.2 | | | | | |
| | fine grey sandstone | | | | | | | |
| | | | | | | | | |
| 71.1-73.2 | Sandstone-massive to weakly banded grey white | | 2.1 | | | | | |
| | | | | | | | | |
| 73.2-75.3 | Sandstone-massive pink 50% recovery | | 2.1 | | | | | |
| | | | | | | | | |
| 75.3-75.6 | Sandstone-cross-laminated white pink | | 0.3 | | | | | |
| | | | | | | | | |
| 75.6-77.2 | Sandstone-massive to weakly banded pink-grey | | 1.6 | | | | | |
| | | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 5 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 77.2-79.9 | Sandstone-massive white medium to coarse grained with local cross-laminations | | 2.7 | | | | | |
| 79.9-82.4 | Sandstone-massive grey maroon medium grained | | 2.5 | | | | | |
| 82.4-83.3 | Sandstone-massive pink local cross-laminations | | 0.9 | | | | | |
| 83.3-83.7 | Sandstone-fractured. Cuts core axis at 15$^{\circ}$ carbonate and clay minerals on fracture surface | | 0.4 | | | | | |
| 83.7-85.9 | Sandstone - massive white grey | | 2.2 | | | | | |
| 85.9-86.5 | Sandstone-Siltstone-bedded pink white fine sandstone with local beds of siltstone | | 0.6 | | | | | |
| 86.5-93.0 | Sandstone-massive-grey white oil stains adjacent to fractures | | 6.5 | | | | | |

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

SHEET NO. 6 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 93.0-110.7 | Sandstone-massive pink irregular grey bands due to tar | | 17.7 | | | | | | |
| 110.7-110.9 | Sandstone-massive maroon coarse grained | | 0.2 | | | | | | |
| 110.9-112.6 | Sandstone-massive fractured white pink fractures filled with clay minerals | | 1.7 | | | | | | |
| 112.6-114.7 | Sandstone-graded bedding pink | | 2.1 | | | | | | |
| 114.7-125.4 | Sandstone-massive local cross-laminations pink turning grey or purple around fractures tar in fractures dark hematite staining occurs at 122.9 (8 cm); 123.0 (10 cm); 123.5 (5 cm) | | 10.7 | | | | | | |
| 125.4-126.0 | Sandstone-fracture zone light green clay minerals and tar in fractures. | | 0.6 | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 7 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 126.0-137.4 | Sandstone-banded pink with irregular purple hematite or grey tar bands | | 11.4 | | | | | |
| 137.4-138.8 | Sandstone-cross-laminated white pink | | 1.4 | | | | | |
| 138.8-142.4 | Sandstone-banded grey pink bands | | 3.6 | | | | | |
| 142.4-151.0 | Sandstone-cross-laminated pink and grey bands | | 9.6 | | | | | |
| 151.0-152.8 | Sandstone-banded pink and grey bands medium grained | | 1.8 | | | | | |
| 152.8-168.4 | Sandstone-cross-laminated pink with purple bands hamatite concentrated in beds 161.4 (15 cm); 161.6 (45 cm); 162 (20 cm) | | 15.6 | | | | | |
| 168.4-173.6 | Sandstone-banded white with irregular purple and grey bands | | 5.2 | | | | | |

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

SHEET NO. 8 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 173.6-184.2 | Sandstone-cross-laminated pink and white | | 10.6 | | | | | |
| 184.2-184.4 | Sandstone-Siltstone-laminated pink fine sandstone and green soapy siltstone | | 0.2 | | | | | |
| 184.4-195.2 | Sandstone-cross-laminated white pink with fracture zones with concentrations of tar and clay in fractures occurring at 188.8 to 189.1 and 190.2-190.3 | | 0.8 | | | | | |
| 195.2-195.5 | Siltstone-massive green soapy siltstone | | 0.3 | | | | | |
| 195.5-196.2 | Sandstone-massive grey black due to tar in matrix medium to coarse grained | | 0.7 | | | | | |
| 196.2-199.7 | Sandstone-banded pink white bands | | 3.5 | | | | | |
| 197.7-199.8 | Sandstone Siltstone-fine green sandstone and siltstone | | 0.1 | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 9 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 199.8-207.4 | Sandstone-cross-laminated pink white with bands of green silt- | | 7.6 | | | | | | |
| | stone occurring at 200.8 (3 cm); 201.4 (13 cm); 201.5 (13 | | | | | | | | |
| | cm); 203.3 (13 cm); 204.2 (5 cm); 206.1 (15 cm) | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 207.4-208.4 | Sandstone Siltstone-alternating beds of pink sandstone 60% | | 1.0 | | | | | | |
| | and green siltstone 40% beds vary from | | | | | | | | |
| | 2 mm to 10 cm | | | | | | | | |
| | | | | | | | | | |
| 208.4-223.3 | Sandstone-cross-laminated white pink, white siltstone at | | 14.9 | | | | | | |
| | 212 (23 cm), 214 (13 cm) tar filled fractures | | | | | | | | |
| | 214.6 (0.4 m) 221.7 (13 cm) | | | | | | | | |
| | | | | | | | | | |
| 223.3-226.3 | Sandstone massive white coarse grained with tar filling frac- | | 3.0 | | | | | | |
| | tures. | | | | | | | | |
| | | | | | | | | | |
| 226.3=228.5 | Siltstone Sandstone-interbedded, purple colour due to hematite | | 2.2 | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 10 PROPERTY ARCHER LAKE QUARTZ MINERAL PERMITS HOLE NO. R 5

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 228.5-230.1 | Sandstone-Breccia-very fine brick red to orange sandstone containing extremely angular clasts of siltstone and sandstone | | 1.6 | | | | | |
| 230.1-234.6 | Sandstone-massive, grey, medium to coarse grained sandstone, fractures filled with tar | | 4.5 | | | | | |
| 234.6-251.9 | Sandstone-massive to weakly banded, grey sandstone with abundant white or pink clay cement | | 17.3 | | | | | |
| 251.9-252.0 | Sandstone-highly fractured pink sandstone abundant tar in fractures | | 0.1 | | | | | |
| 252 END | Unconsolidated sand and tar in the hole halted drilling | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

PROPERTY: RICHARDSON QUARTZ MINERAL PERMIT HOLE NO. 6

SHEET NUMBER 1 N.T.S. NO. 74L STARTED Sept. 13, 1977.

COLLAR Tp 107 R6 Sec.27 NE W of the 4th Meridian CLAIM NO. Permit 687612002 COMPLETED Sept. 19, 1977.

BEARING ULTIMATE DEPTH 767 feet/233.9 meters

ELEVATION 740 feet/226 meters DIP - 90 PROPOSED DEPTH

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0 -12.8 | Overburden - glacial outwash sand and some | | | | | | | | |
| | boulders | | | | | | | | |
| | | | | | | | | | |
| 12.8-13.7 | Subcropping Boulders - maroon and white sandstone | | | | | | | | |
| | boulders | | | | | | | | |
| | | | | | | | | | |
| 13.7-15.6 | Sandstone - cross-laminated, purple white | | 1.9 | | | | | | |
| | well cemented with silica cement | | | | | | | | |
| | | | | | | | | | |
| 15.6-17.8 | Sandstone - cross-laminated, white, medium | | 2.2 | | | | | | |
| | grained well sorted with local beds up to 1 cm | | | | | | | | |
| | thick of coarse sand | | | | | | | | |

LOGGED BY DRILLED BY CORE STORED

90' 6/77

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 2 PROPERTY RICHARDSON PERMITS HOLE NO. 6

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 17.8-18.1 | Sandstone - massive, fine to medium grained, | 0.3 | | | | | | |
| | with subrounded to angular fragments up to 6 cm | | | | | | | |
| | diameter of quartz, silstone and sandstone | | | | | | | |
| | | | | | | | | |
| 18.1-19.2 | Sandstone - banded, fine grained, purple | 1.1 | | | | | | |
| | | | | | | | | |
| 19.2-19.8 | Sandstone - massive poorly sorted, very coarse | 0.6 | | | | | | |
| | grains (1-7 mm) dispersed in fine sand silt | | | | | | | |
| | hematite rich matrix | | | | | | | |
| | | | | | | | | |
| 19.8-19.9 | Siltstone - banded green and purple | 0.1 | | | | | | |
| | | | | | | | | |
| 19.9-32.3 | Sandstone - massive, white and light purple | 12.4 | | | | | | |
| | colour banding, local cross-laminations, | | | | | | | |
| | bands of fine sandstone siltstone occur at | | | | | | | |
| | 20 (6 cm), 25.7 (18 cm), 26.1 (9 cm) | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 3 PROPERTY RICHARDSON PERMITS HOLE NO. 6

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 32.3-41.8 | Sandstone - cross-laminated, white with | 9.5 | | | | | | | |
| | pink or purple bands | | | | | | | | |
| 41.8-50.0 | Sandstone - massive, white with pink colour bands | 8.2 | | | | | | | |
| | | | | | | | | | |
| 50.0-56.7 | Sandstone - cross-laminated, pink white | 6.7 | | | | | | | |
| | 52.9-53.0 black band due to tar | | | | | | | | |
| | | | | | | | | | |
| 56.7-57.8 | Sandstone - massive, white | 1.1 | | | | | | | |
| | | | | | | | | | |
| 57.8-62.1 | Sandstone - cross-laminated, white-pink | 4.3 | | | | | | | |
| | | | | | | | | | |
| 62.1-62.2 | Sandstone - massive grey fine-medium grained | 0.1 | | | | | | | |
| | with clots of pyrite 1% of rock | | | | | | | | |
| | | | | | | | | | |
| 62.2-70.8 | Sandstone - massive to weakly banded with local | 8.6 | | | | | | | |
| | sections of cross-laminations | | | | | | | | |
| | Bands of tar occur at 66.0 (9 cm), 66.7 (9 cm) | | | | | | | | |
| | 69.6 (3 cm), 70 (3 cm) | | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 4 PROPERTY RICHARDSON PERMITS HOLE NO. 6

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 70.8-74.4 | Sandstone - massive to weakly banded, fine to | | 3.6 | | | | | |
| | medium grained, light green colour due to green | | | | | | | |
| | clay mineral in matrix, tar bands occur at | | | | | | | |
| | 71.1 (3 cm), 71.4 (3 cm), 71.7 (3 cm) | | | | | | | |
| | | | | | | | | |
| 74.4-86.0 | Sandstone - cross-laminated white pink | | 11.6 | | | | | |
| | | | | | | | | |
| 86.0-89.1 | Sandstone - massive, white with light green | | 3.1 | | | | | |
| | colour bands | | | | | | | |
| | | | | | | | | |
| 89.1-90.6 | Sandstone - massive, white pink colour bands | | 1.5 | | | | | |
| | thin irregular bands of tar <1 cm thick occur | | | | | | | |
| | between 89.4-90.3 | | | | | | | |
| | | | | | | | | |
| 90.6-94.1 | Sandstone - massive white with light green | | 3.5 | | | | | |
| | colour bands | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 5 PROPERTY RICHARDSON PERMITS HOLE NO. 6

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 94.1-130.2 | Sandstone - cross-laminated, white with pink, | | 36.2 | | | | | |
| | purple and green bands, local irregular bands | | | | | | | |
| | of tar stain occuring along and adjacent to | | | | | | | |
| | fractures at 100.8, 121.1, 124.8, 125.4, 126.6. | | | | | | | |
| | Thin green silty horizons at 107.4 (3 cm), | | | | | | | |
| | 107.6 (6 cm), 115.0 (3 cm) | | | | | | | |
| | | | | | | | | |
| 130.2-175.3 | Sandstone - massive, medium to coarse grained, | | 45.1 | | | | | |
| | angular grains, pink, purple and green colour | | | | | | | |
| | bands | | | | | | | |
| | | | | | | | | |
| 175.3-176.4 | Sandstone- Siltstone -fine to medium grained | | 1.1 | | | | | |
| | sandstone interbedded with purple hematite rich | | | | | | | |
| | siltstone | | | | | | | |
| | | | | | | | | |
| 176.4-181.5 | Sandstone - massive coarse grained light green, | | 5.1 | | | | | |
| | pink and purple bands | | | | | | | |
| | | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 6 PROPERTY RICHARDSON PERMITS HOLE NO. 6

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 181.5-205.4 | Sandstone - massive coarse grained with chert | | 24.9 | | | | | |
| | pebbles up to 4 cm in diameter, pebbles vary from | | | | | | | |
| | round to angular with moderate to high sphericity | | | | | | | |
| | | | | | | | | |
| 205.4-207.3 | Silstone-Sandstone - interbedded siltstone | | 1.9 | | | | | |
| | and sandstone with beds up to 5 cm thick, | | | | | | | |
| | the amount of sandstone increases downwards | | | | | | | |
| | | | | | | | | |
| 207.3-207.5 | Sandstone - very coarse, subangular quartz grains | | 0.2 | | | | | |
| | up to 5 mm in a grey brown mudstone matrix | | | | | | | |
| | | | | | | | | |
| 207.5-215.6 | Sandstone - massive, medium to coarse grained | | 8.1 | | | | | |
| | sandstone containing subrounded to angular grains | | | | | | | |
| | | | | | | | | |
| 215,6-216.1 | Sandstone-Siltstone - interbedded with fine | | 0.5 | | | | | |
| | sandstone and red siltstone | | | | | | | |
| | | | | | | | | |
| 216.1-216.5 | Sandstone - massive, coarse grained | | 0.5 | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 7 PROPERTY RICHARDSON PERMITS HOLE NO. 6

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 216.6-217.4 | Sandstone Siltstone - medium to coarse grained | | 6.8 | | | | | |
| | sandstone interbedded with red siltstone | | | | | | | |
| 217.4-217.8 | Sandstone - massive angular coarse grained | | 0.4 | | | | | |
| 217.8-218.9 | Sandstone Siltstone - fine grey red sandstone | | 1.1 | | | | | |
| | interlayered with red silstone | | | | | | | |
| 218.9-219.9 | Sandstone - medium to coarse grained sandstone | | 1.0 | | | | | |
| | interbedded with medium to fine grained red | | | | | | | |
| | sandstone | | | | | | | |
| 219.9-220.1 | Sandstone - fine sandstone in hematite rich matrix | | 0.2 | | | | | |
| 220.1-233.9 | Regolith-Granite - massive siliceous rock | | 13.8 | | | | | |
| | Most minerals have been leached out, leaving | | | | | | | |
| | intergrowths of quartz inclosed hematite; the | | | | | | | |
| | amount of hematite decreases down section, | | | | | | | |

tension fractures filled with quartz

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

PROPERTY: ARCHER QUARTZ MINERAL PERMITS

HOLE NO. R 7

SHEET NUMBER 1

N.T.S. NO. 74 L

STARTED September 20, 1977

COLLAR Tp 107 R2 Sec. 28 NE
West of the 4th Meridian

CLAIM NO. Permit 210

COMPLETED September 24, 1977

BEARING

ULTIMATE DEPTH 604 ft/184.2 m

ELEVATION 1000 ft/305 m

DIP

PROPOSED DEPTH

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 0-47.6 | Overburden - glacial outwash composed of sand with some boulders | | | | | | | |
| | above outcrop | | | | | | | |
| | | | | | | | | |
| 47.6-107.5 | Sandstone - massive, white, well cemented | | 59.9 | | | | | |
| | Cement consists of silica or white clay minerals, | | | | | | | |
| | locally rock is highly fractured some of these | | | | | | | |
| | annealed, fracture zones 48.8-49.1, 56.1-57.3, | | | | | | | |
| | 58.3-58.4, 64.4-64.6, 65.9-66.1, 73.8-74.4, | | | | | | | |
| | 83.3-84.2, 89.2-101.6 | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

LOGGED BY

DRILLED BY

CORE STORED

90' 6/77

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

SHEET NO. 2 PROPERTY ARCHER QUARTZ MINERAL PERMITS HOLE NO. R 7

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 107.5-108.0 | Sandstone Siltstone-laminated grey medium grained sandstone with yellow white siltstone | | 0.5 | | | | | |
| 108-108.8 | Sandstone Siltstone - as above except siltstone is red due to abundance of hematite | | 0.8 | | | | | |
| 108.8-109.2 | Sandstone - grey sandstone with thin <1 mm bands of fine grained hematite | | 0.4 | | | | | |
| 109.2-110.1 | Sandstone-banded red and white sandstone bands vary from 1 to 10 mm in width | | 0.9 | | | | | |
| 110.1-117.1 | Sandstone-massive white well cemented sandstone, local fractures trend $15^{o}$-$45^{0}$ to core axis | | 7.0 | | | | | |
| 117.1-117.2 | Siltstone-Mudstone - laminated green and red mudstone | | 0.1 | | | | | |

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

SHEET NO. 3 PROPERTY ARCHER QUARTZ MINERAL PERMITS HOLE NO. R 7

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 117.2-165.3 | Sandstone-massive fine to medium grained white, well cemented with yellow and white clay minerals, local fracture zones. | | 48.1 | | | | | |
| 165.3-179.0 | Sandstone - banded grey and maroon sandstone | | 13.7 | | | | | |
| 179.0-180.6 | Sandstone-cross-laminated, grey white | | 1.6 | | | | | |
| 180.6-181.5 | Sandstone-banded, red-maroon, bands up to 5 cm wide | | 0.9 | | | | | |
| 181.5-184.2 | Sandstone - festoon cross-laminations, grey white with outlining the cross-laminations, local spherical banding | | 2.7 | | | | | |
| 184.2 | END OF HOLE DIP TEST -88 | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

PROPERTY: ARCHER QUARTZ MINERAL PERMITS HOLE NO. R 8

SHEET NUMBER 1 N.T.S. NO. 74 L STARTED September 26, 1977

COLLAR Tp 104 R2 Sec 9 NE CLAIM NO. Pemit 208 COMPLETED September 28, 1977

West of the 4th Meridian BEARING ULTIMATE DEPTH 747 feet/227.8 m

ELEVATION 1200 feet/366 m DIP -90 PROPOSED DEPTH

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 0-34.8 | Overburden - glacial outwash, sand with some boulders above | | | | | | | |
| | bedrock | | | | | | | |
| | | | | | | | | |
| 34.8-37.1 | Sandstone - cross-laminated, grey red thin beds | | 2.3 | | | | | |
| | | | | | | | | |
| 37.1-65.3 | Sandstone - cross-laminated, red white and pink, very friable, | | 28.2 | | | | | |
| | concentrations of hematite produce deep red-maroon | | | | | | | |
| | bands at 43.9 (9 cm, 46.2 (36 cm), 53.3 (9 cm), | | | | | | | |
| | 56.4 (6 cm); Sandstone Siltstone 47.0 to 48.2 | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

LOGGED BY DRILLED BY CORE STORED

NORCEN ENERGY RESOURCES LIMITED
DIAMOND DRILL RECORD

SHEET NO. 2 PROPERTY ARCHER QUARTZ MINERAL PERMITS - PERMIT 208 HOLE NO. R 8

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 65.3-77.8 | Sandstone - cross-laminations, grey white with hamatite outlining cross-laminations, beds thicker than previous unit | | 12.5 | | | | | |
| 77.8-80.2 | Sandstone - massive, grey, medium to coarse grained | | 2.4 | | | | | |
| 80.2-81.3 | Sandstone - cross-laminated, white and red, fractures filled with tar | | 1.1 | | | | | |
| 81.3-101.9 | Sandstone - massive with local cross-laminations, medium to coarse grained, pink white, local thin coarse grained horizons | | 20.6 | | | | | |
| 101.9-104.3 | Sandstone - cross-bedded, grey with fine hematite bands outlining cross-laminations festoon cross-laminations, eliptical banding | | 2.4 | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 3 PROPERTY ARCHER QUARTZ MINERAL PERMITS - PERMIT 208 HOLE NO. R 8

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 104.3-113.8 | Sandstone - massive, grey pink, weak colour banding medium to coarse grained, friable | | 9.5 | | | | | |
| 113.8-115.6 | Sandstone - cross-laminated, red pink colour very friable | | 1.8 | | | | | |
| 115.6-116.8 | Sandstone - massive, pink, beds up to 50 cm thick | | 1.2 | | | | | |
| 116.8-129.2 | Sandstone - festoon cross-laminations, white pink, very friable fine to medium grained | | 12.4 | | | | | |
| 129.2-130.0 | Sandstone - unconsolidated pink fine grained sand | | 0.8 | | | | | |
| 130.0-160.1 | Sandstone - cross-laminations, white pink very friable | | 30.1 | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 4 PROPERTY ARCHER QUARTZ MINERAL PERMITS - PERMIT 208 HOLE NO. R 8

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 160.1-160.7 | Sandstone - extremely friable, pink poor recovery 50% | | 50%<br>0.3 | | | | | |
| | | | | | | | | |
| 160.7-183.9 | Sandstone - cross-laminations, white-pink red hematite spots | | 23.2 | | | | | |
| | up to 2 cm diameter 163.4 (9 cm) band of white | | | | | | | |
| | siltstone; tar impregnates matrix of the sandstone | | | | | | | |
| | at 162.8 (3 cm), 164.1 (15 cm), 166.2 (3 cm), | | | | | | | |
| | 167.1 (3 cm), 168.2 (3 cm), 170.2 (3 cm) 171.0 | | | | | | | |
| | (3 cm), 172.7 (3 cm), 173.2 (15 cm) 174.5 (3 cm), | | | | | | | |
| | 175.5 (3 cm), 177.5 (6 cm), 177.8 (3 cm), 183.2 | | | | | | | |
| | (6 cm), 183.6 (6 cm) | | | | | | | |
| | | | | | | | | |
| 183.9-193.4 | Sandstone - massive, pink-white, local cross-laminations, red | | 9.5 | | | | | |
| | hematite spots up to 2 cm diameter, local sections | | | | | | | |
| | of tar impregnating matrix occur at 183.9 (3 cm), | | | | | | | |
| | 189.3 (3 cm) | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

NORCEN ENERGY RESOURCES LIMITED

DIAMOND DRILL RECORD

SHEET NO. 5 PROPERTY ARCHER QUARTZ MINERAL PERMITS - PERMIT 208 HOLE NO. R 8

| Depth (ft/m) | Description | Mineral-ization | Core Recov. | Assay | | | | |
|---|---|---|---|---|---|---|---|---|
| 193.4-227.8 | Sandstone - cross-laminations, pink white with red blotches, | | 34.4 | | | | | |
| | very friable grey bands containing tar occur at | | | | | | | |
| | 196.7 (3 cm), 197.2 (6 cm), 210.1 (3 cm) | | | | | | | |
| | | | | | | | | |
| 227.8 | DIP TEST $-89^{\circ}$ | | | | | | | |

# APPENDIX 2

## Summary of Expenditures

## SUMMARY OF EXPENDITURES (ESTIMATED)

### DRILLING COSTS

| | | |
|---|---|---|
| Mobilization and demobilization of drill | 4,500.00 | |
| Drilling Costs (4,082 feet) | 81,763.16 | |
| Overhead | 4,313.16 | 90,576.35 |

### TRANSPORTATION

| | | |
|---|---|---|
| Bell 206 B Helicopter 116.8 hrs at 295 | 34,546.41 | |
| Fuel for Helicopter | 2,442.29 | |
| Transportation of Fuel DC 3 Aircraft | 2,029.00 | |
| Drill move DC 3 Aircraft | 1,791.00 | |
| Commercial Air Transportation | 128.00 | |
| Shipping Core to Calgary Truck | 288.00 | |
| Overhead | 2,061.24 | 43,285.94 |

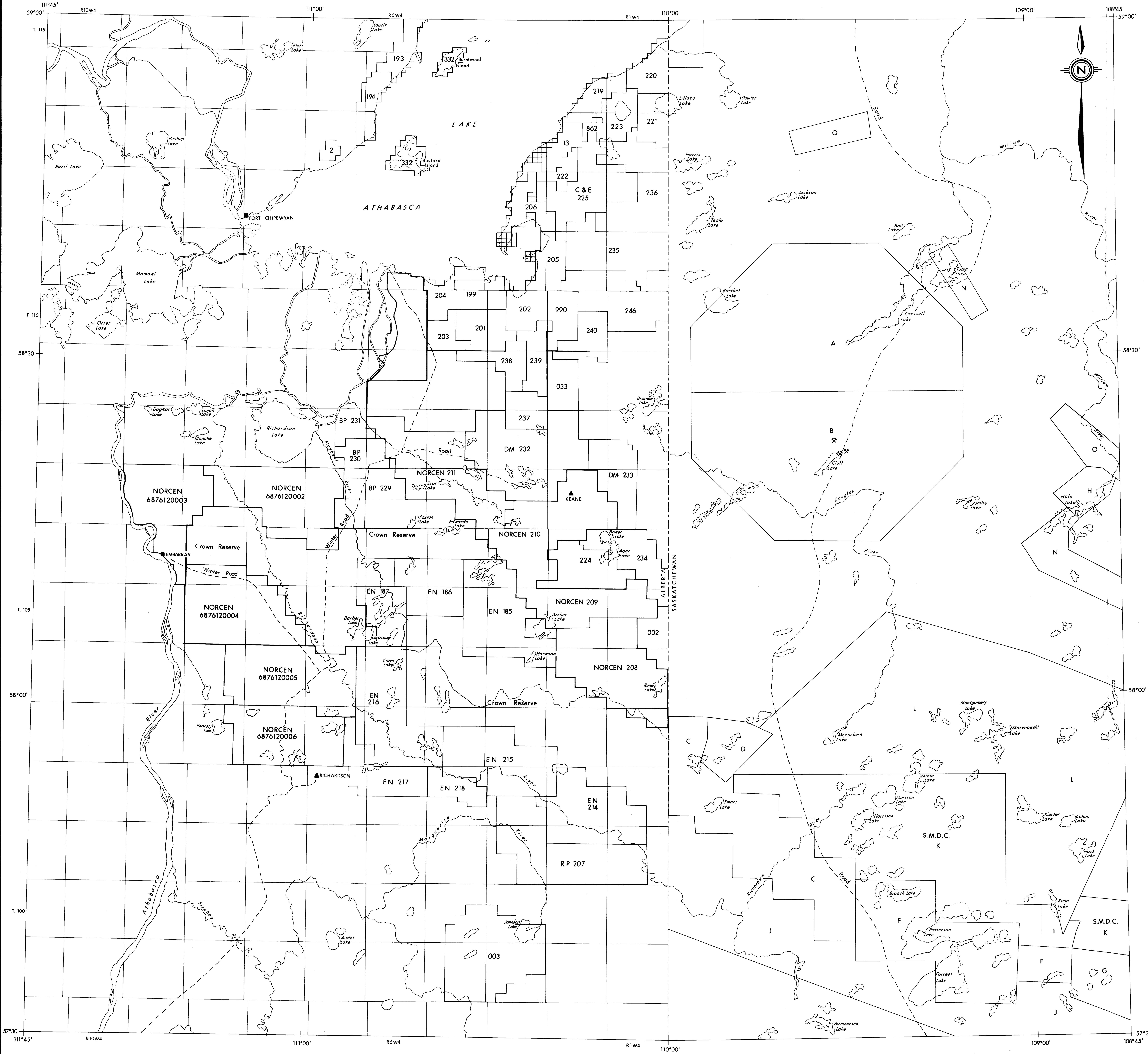
### SALARIES

| | | |
|---|---|---|
| Geologist 83 days @ $65/day | 5,395.00 | |
| Overhead | 539.50 | 5,934.50 |

### OTHER

| | | |
|---|---|---|
| Accommodation | 96.00 | |
| Spectrometer Rental | 165.00 | |
| Telephone Rental | 250.36 | |
| Expense Account Travel, Meals | 290.59 | |
| Overhead | 85.62 | 887.57 |

| | | |
|---|---|---|
| TOTAL | | 140,684.36 |




### ALBERTA QUARTZ MINERAL EXPLORATION PERMIT

| | |
|---|---|
| 185 - 187 | Eldorado Nuclear Limited |
| 188 | Urage Corporation Ltd. |
| 189 | S.M.D.C. |
| 190 | Uranerz Exploration & Mining Co. Ltd. |
| 191 - 194 | Uranerz Exploration & Mining Co. Ltd. |
| | Inexco Oil Company |
| | S.M.D.C. |
| 201 - 206 | George Albert Bleiler |
| 207 | Ram Petroleums Ltd., & |
| | Vipond Oil & Gas Ltd. |
| 208 - 213 | Norcen Energy Resources Limited |
| 214 - 218 | Eldorado Nuclear Ltd. |
| 219 - 223 | Flin Flon Mines Limited |
| 224 | Chevron Standard |
| 225 | C & E Exploration Limited |
| 226 | Enex Resources Limited |
| 229 - 231 | B.P. Minerals Limited |
| 232 - 233 | Dennison Minerals Limited |
| 234 | Chevron Standard |
| 235 - 236 | C & E Exploration Limited |
| 237 | Emil Krvsko |
| 238 | Stephen Yanik |
| 239 | Albert Alley |
| 240 | Milton Patton McDougal |
| 244 | C & E Exploration Ltd. |
| 246 | C & E Exploration Ltd. |
| 033 | Frank Albert Camsell |
| 002 - 003 | Taiga Consultants Ltd. |
| 68760002 - 0006 | Norcen Energy Resources Limited |

### QUARTZ MINERAL LEASE

| | |
|---|---|
| 1 - 2 | North Canadian Oils Ltd. |
| 4 | Athabasca Exploration & Mining |
| 13 | Pacific Silver Mines & Oils Ltd. |

### SASKATCHEWAN PERMITS

| | |
|---|---|
| A | Amok |
| B | Amok |
| C | Hudson Bay Exploration |
| D | Uranex |
| E | Canadian Occidental Petroleum |
| F | Uranerz, Inexco, SMPC |
| G | Kerr Addison |
| H | E Partridge |
| I | New Cinch |
| J | Hudson Bay Oil and Gas |
| K | S.M.D.C. |
| L | Imperial Oil |
| M | Flin Flon Mines |
| N | Wollex Exploration |

**Norcen**
Energy Resources Limited

CAMPBELL CHIBOUGAMAU MINES LTD. and E&B EXPLORATIONS LTD.
JOINT VENTURE

# ATHABASCA SANDSTONE PERMITS

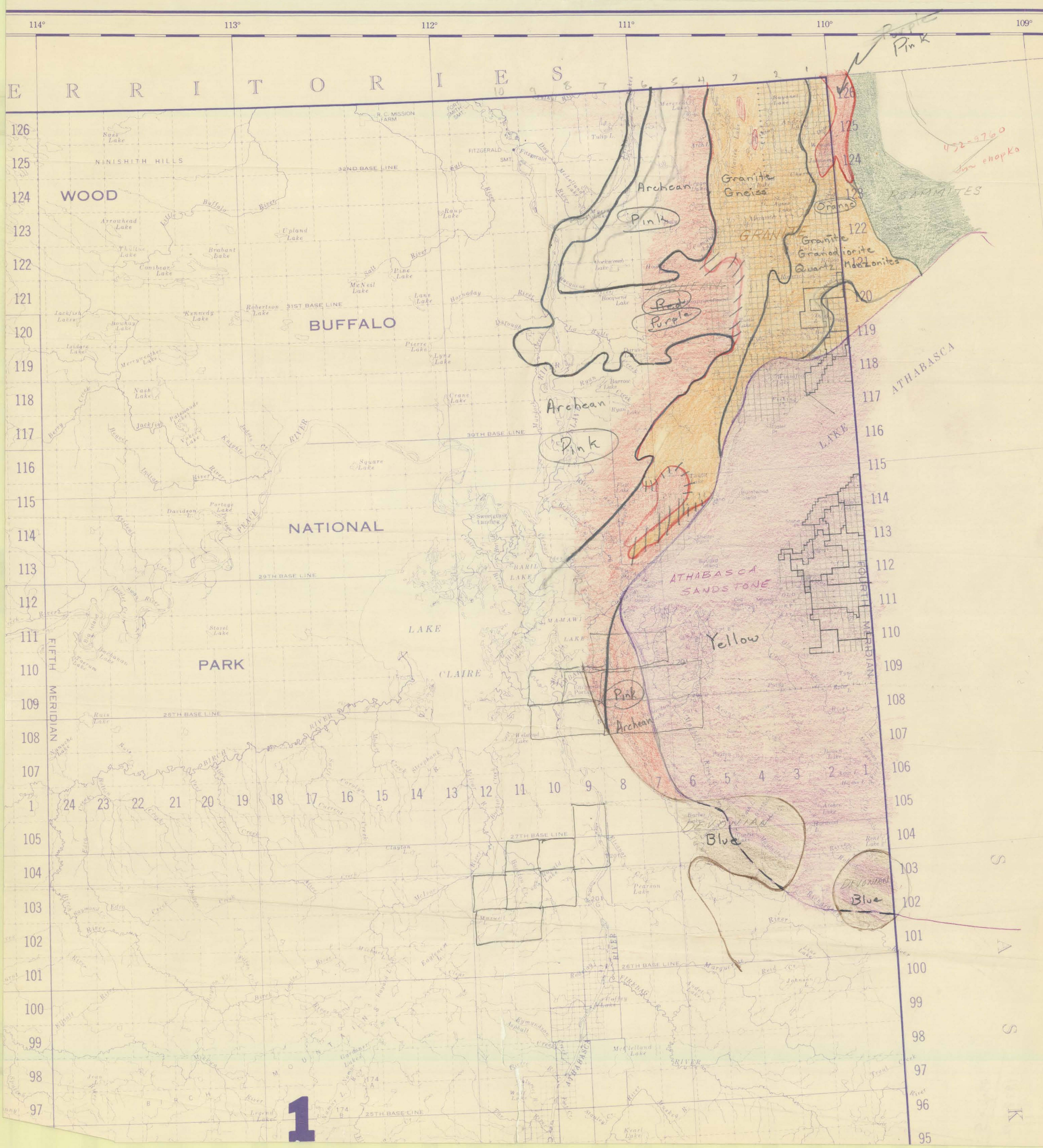
ALBERTA-SASKATCHEWAN

SCALE-1:250,000

10 0 10 Miles
10 0 10 Kilometers

NTS: 74 E, F, K, L

NOVEMBER, 1977



114°
113°
112°
111°
110°
109°
TERRITORIES
WOOD
BUFFALO
NATIONAL
PARK
NINISHITH HILLS
32ND BASE LINE
31ST BASE LINE
30TH BASE LINE
29TH BASE LINE
28TH BASE LINE
27TH BASE LINE
26TH BASE LINE
25TH BASE LINE
FIFTH MERIDIAN
FOURTH MERIDIAN
LAKE CLAIRE
LAKE ATHABASCA
MAMAWI LAKE
BARIL LAKE
FORT SMITH SMT.
FITZGERALD SMT.
R.C. MISSION FARM
Sweetgrass Landing
PEACE RIVER
BIRCH RIVER
ATHABASCA RIVER
FIREBAG RIVER
BIRCH MOUNTAINS
Archean
Pink
Granite Gneiss
GRANITE
Granite Granodiorite Quartz Monzonites
Orange
Red
Purple
PSAMMITES
ATHABASCA SANDSTONE
Yellow
DEVONIAN
Blue
Purple Pink
1

(50)

Atomic Energy Control Board | Commission de contrôle de l'énergie atomique
OPERATIONS DIRECTORATE
Safeguards & Nuclear
Materials Branch

Your file Votre référence

Our file Notre référence
22-N-65

April 21, 1978

Norcen Energy Resources Limited
Norcen Tower
715 - 5th Avenue S.W.
Calgary, Alberta
T2P 2X7

Attention: L. J. Smith
Uranium Exploration Geologist

Dear Sir:

This will acknowledge and thank you for your letter of April 19, 1978 with which you enclosed duplicate copies of the report of work carried out during 1977 under Surface Exploration Permit MX 13/77 (Northeastern Alberta).

As requested, this permit has now been re-issued under the new format, and I enclose herewith the original and a copy.

Yours sincerely,

N. S. Blackman

Mrs. N. S. Blackman
Licensing Officer

:sb
Encs.
cc: Geological Survey of Canada
Alberta Energy and Natural Resources

P.O. Box 1046 | C.P. 1046
Ottawa, Canada | Ottawa, Canada
K1P 5S9 | K1P 5S9

19770012

(51)

Atomic Energy Control Board | Commission de contrôle de l'énergie atomique

Directorate of Licensing
Safeguards & Nuclear Materials
Licensing Division

Your file Votre référence

Our file Notre référence 22-N-65
(Reissued)

April 21, 1978

URANIUM & THORIUM

SURFACE EXPLORATION PERMIT MX 13/77

Norcen Energy Resources Limited
715 - 5th Avenue S.W.
Calgary, Alberta
T2P 2X7

You are hereby authorized, provided you have the necessary proprietary rights, to explore for uranium/thorium on the property identified below, by diamond drilling, surface work, or test pitting to remove from the property samples for assay and analysis, hand samples for exhibition purposes and bulk samples the lesser of fifty megagrams of ore, or 100 kilograms of contained uranium for mill tests; and to make public any information you may receive from assays and analyses or from exploration work on the property. Samples from the property may be sent for assay, analysis or mill tests to any person in Canada, or subject to the granting of export permits therefore, out of Canada.

This permit is subject to the following conditions:

(1) That reports, in duplicate, of the progress and results of the work on the property be sent annually, within the first six months of each calendar year, to the Atomic Energy Control Board, Ottawa, Ontario. Each report is to include:

a) a brief description of each deposit, including its location, type (vein, pegmatite, conglomerate, etc.), mineralogy, nature of the enclosing rocks and the summary of the sampling results;

b) a statement of the kind and amount of work done and the results therefrom including geological, drilling, and other surface work of an exploratory nature;

P.O. Box 1046 | C.P. 1046
Ottawa, Canada | Ottawa, Canada
K1P 5S9 | K1P 5S9

19770012

(52)

c) results of any mill tests;

d) an outline of general health and safety principles implemented and measures to protect health and safety of employees from harmful effects of radiation;

(2) "Nil" reports are to be made if no work is done in a particular year, but if no work is to be done for an indefinite period, a report is to be sent within 30 days after cessation of work, covering the period from the end of the preceding year and advising of the cessation of work. The Permit will then be revoked. If it is determined at a later date to carry out further exploration activities on the property previously licensed, a new application must be submitted to the Atomic Energy Control Board.

(3) That all work on the property be conducted according to good standard mining practice and records kept so that the place of origin of all samples and other radioactive materials removed shall be clearly identified;

(4) That, subject to the Atomic Energy Control Regulations, any applicable provincial statutes and regulations, insofar as they deal with mine safety and cognate matters, are to be observed and complied with in relation to the property and to all operations undertaken in connection therewith;

(5) This permit shall expire March 31, 1980

and is otherwise subject to the Atomic Energy Control Regulations.

DATED at Ottawa this 21st day of April, 1978.
(Original Permit issued April 13, 1977)

ATOMIC ENERGY CONTROL BOARD

BY J.D. McManus
Chief
Safeguards & Nuclear Materials Licensing Division

Property Description:

Province of Alberta, Northeastern Area,
Permit Nos: 6876120004
6876120005
6876120002

19770012

# TRANSMITTAL NOTE AND RECEIPT
# NOTE D'ENVOI ET REÇU

GOVERNMENT OF CANADA – GOUVERNEMENT DU CANADA

| SECURITY CLASSIFICATION / *CLASSIFICATION DE SÉCURITÉ* |
|---|
| WITH ENCLOSURE(S) – *AVEC ANNEXE(S)*: RESTRICTED |
| WITHOUT ENCLOSURE(S) – *SANS ANNEXE(S)* |
| FILE OR SERIAL NO. – *Nº DE DOSSIER OU DE SÉRIE*: 22-N-65 |

TO / À: Geological Survey of Canada
Alberta Energy & Natural Resources

| QUANTITY *QUANTITÉ* | REFERENCE/COPY NO. *Nº DE RÉFÉRENCE* | *DESCRIPTION* |
|---|---|---|
| 1 | Norcen Energy Resources Limited | Annual Work Report under MX 13/77<br><br>1977 Exploration Program<br>Quartz Mineral Exploration Permits<br>Northeastern Alberta |

| SENT BY – *TRANSMIS PAR* | | RECEIVED BY – *REÇU PAR* | |
|---|---|---|---|
| S. Blackman | 21/04/78 | | |
| Signature | Date | Signature | Date |

Atomic Energy Control Board
P. O. Box 1046
Ottawa, Ontario
K1P 5S9

ORIGINATOR'S ADDRESS – *ADRESSE DU SIGNATAIRE*

[X] PLEASE SIGN AND RETURN TO ORIGINATOR
*PRIÈRE DE SIGNER ET DE RETOURNER AU SIGNATAIRE*

[ ] RECEIPT NOT REQUIRED
*REÇU NON REQUIS*



1977 0012

(49)