MAR 19690034: NORTHEASTERN ALBERTA

Received date: Dec 31, 1969

Public release date: Jan 01, 1971

DISCLAIMER

By accessing and using the Alberta Energy website to download or otherwise obtain a scanned mineral assessment report, you ("User") agree to be bound by the following terms and conditions:

a) Each scanned mineral assessment report that is downloaded or otherwise obtained from Alberta Energy is provided "AS IS", with no warranties or representations of any kind whatsoever from Her Majesty the Queen in Right of Alberta, as represented by the Minister of Energy ("Minister"), expressed or implied, including, but not limited to, no warranties or other representations from the Minister, regarding the content, accuracy, reliability, use or results from the use of or the integrity, completeness, quality or legibility of each such scanned mineral assessment report;

b) To the fullest extent permitted by applicable laws, the Minister hereby expressly disclaims, and is released from, liability and responsibility for all warranties and conditions, expressed or implied, in relation to each scanned mineral assessment report shown or displayed on the Alberta Energy website including but not limited to warranties as to the satisfactory quality of or the fitness of the scanned mineral assessment report for a particular purpose and warranties as to the non-infringement or other non-violation of the proprietary rights held by any third party in respect of the scanned mineral assessment report;

c) To the fullest extent permitted by applicable law, the Minister, and the Minister's employees and agents, exclude and disclaim liability to the User for losses and damages of whatsoever nature and howsoever arising including, without limitation, any direct, indirect, special, consequential, punitive or incidental damages, loss of use, loss of data, loss caused by a virus, loss of income or profit, claims of third parties, even if Alberta Energy have been advised of the possibility of such damages or losses, arising out of or in connection with the use of the Alberta Energy website, including the accessing or downloading of the scanned mineral assessment report and the use for any purpose of the scanned mineral assessment report so downloaded or retrieved.

d) User agrees to indemnify and hold harmless the Minister, and the Minister's employees and agents against and from any and all third party claims, losses, liabilities, demands, actions or proceedings related to the downloading, distribution, transmissions, storage, redistribution, reproduction or exploitation of each scanned mineral assessment report obtained by the User from Alberta Energy.

ECONOMIC MINERALS
FILE REPORT No.
U-AF-067(1)
U-AF-068(1)

REPORT

ON

QUARTZ MINERAL EXPLORATION PERMITS

No. 109 and No. 110

IN

NORTH EASTERN ALBERTA

PREPARED FOR

LEDO MINES LTD.,

BY

ABCON ENGINEERING (ALBERTA) LTD.,

CALGARY, ALBERTA.

ABCON ENGINEERING (ALBERTA) LTD.,

[redacted] P. Eng

July 23rd, 1969.

700112
INDEXING DOCUMENT NOS. 700113

REPORT

ON

QUARTZ MINERAL EXPLORATION PERMITS

No. 109 and No. 110

IN

NORTH EASTERN ALBERTA

INDEX

EXHIBITS:

Exhibit No. 1

Plan showing Quartz Mineral Exploration Permit No. 109

Scale 1" = 1 mile.

Exhibit No. 2

Plan showing Quartz Mineral Exploration Permit No. 110

Scale 1" = 1 mile.

ATTACHMENTS:

Drawing No. L.M.L. 69-01
Continental Location Map, showing Quartz Mineral Exploration Permits No. 109 and 110.
Scale 1" = 75 miles.

Drawing No. L.M.L. 69 - 02
Provincial Location Map, showing Quartz Mineral Exploration Permits No. 109 and 110
Scale 1" = 35 miles.

Drawing No. L.M.L. 69 - 03
Topographic Map, showing Quartz Mineral Exploration Permits No. 109 and 110
Scale 1" = 12 miles

Drawing No. L.M.L. 69 - 04
Geological Map, showing Quartz Mineral Exploration Permits No. 109 and 110
Scale 1" = 16 miles.

REPORT

ON

QUARTZ MINERAL EXPLORATION PERMITS

No. 109 AND No. 110

IN

NORTH EASTERN ALBERTA

INTRODUCTION:

This report is a preliminary appraisal of the potential of the Quartz Mineral Exploration Permits No. 109 and 110 held by Ledo Mines Limited. The lands are in reservation status and were acquired from the Alberta Government - Department of Mines and Minerals.

This report does not go into details with respect to the geology of the area but discusses the potential of the permit area from the standpoint of comparison with what is required to form an economic uranium deposit with that of what may be expected within the permit area.

GENERAL INFORMATION:

Ledo Mines Limited acquired Quartz Mineral Exploration Permits No. 109 and No. 110 from the Province of Alberta Department of Mines on December 20th, 1968.

Quartz Mineral Exploration Permit No. 109 is located in Township 102, Ranges 1 and 2, W. 4 Meridian and consists of 19,840 acres of mineral rights. (See Exhibit No. 1)

Quartz Mineral Exploration Permit No. 110 is located in Township 105 and 106, Range 5, W. 4 Meridian and consists of 19,840 acres of mineral rights. (See Exhibit No. 2)

GENERAL DISCUSSION OF URANIUM MINERALS

There are only a few uranium minerals which are economically attractive for mining and could thus be classified as uranium ores. Pitchblend and uranite theoretically contain 85% uranium but due to impurities, contain usually between 50% and 80%. Carnotile, torlurnite, tyuyamunite, autunite, uranophone and conniute 45 to 60%. In other minerals, uranium is an important but relatively minor constituent, as examples, the minerals davidite, samorskite and eunanite contain only 1 to 18%. The majority of the uranium bearing minerals contain uranium in small or trace amounts as an accessory to other major constituents.

The uranium content itself, however, does not determine whether it is a uranium ore mineral but a combination of the complicity of the mineral and percentage content. Economics of mining uranium are also dependant on the market and value of uranium from time to time. New extraction processes do of course, influence the economics of extracting uranium from a mineral. Most of the uranium in pegmatite and placers are refractory and extremely difficult to break down chemically. These minerals are also usually scattered unevenly throughout the deposit so that although the mineral may contain 50% uranium, the average content is much lower.

Only a few of the numerous uranium minerals qualify as a uranium ore mineral whereas uranium in small amounts is widely spread throughout the rocks of the earth's crust.

A brief description of the various uranium ore minerals is given below in order that an evaluation of the areas of the permits may be made.

PRIMARY URANIUM ORE MINERALS

Primary uranium minerals occur most commonly in veins or pegmatites, although in recent years flat lying deposits of pitchblende in sedimentary

rocks have also been discovered.

URANITE: is combined UO_2 and UO_3, 50%-85% U_3O_8 and is a naturally occurring uranium oxide. It's most widespread occurrence is in pegmatites in which it is found in small amounts throughout the world. However, it is an important constituant of all primary deposits occurring in it's massive variety - pitchblende. Uranite is not a refractory mineral and should not be confused with the many complex uranium minerals found in pegmatites. Uranite sometimes occurs as finely divided crystals within the host rock.

PITCHBLENDE: is the massive variety of uranite. It is without apparent crystal form and occurs most abundantly in the rich vein deposits of uranium. Pitchblende accounts for the majority of uranium production in the world.

Pitchblende is commonly associated with one or more of the primary ore minerals of iron, copper, cobalt, lead, silver and bismuth and the presence of these minerals is one indication for favourable conditions for deposition of pitchblende. Pitchblende is likely to be deposited in existing open spaces in rock formations rather than replacement of the rock. There are no imported replacement deposits as there are in other minerals.

Pitchblende has also been discovered in Sandstone and conglomerite where it has filled the spaces around the grains of rock.

DAVIDITE: is made up of rare earth-iron-tetonium oxide 7-10% U_3O_8. It occurs commonly in angular, irregular masses, sometimes with drystal outlines, but not in round leotryoidal shapes like pitchblende. Davidite is deposited in hydrothermal veins, presumably at higher temperatures and pressures than pitchblende. DAVIDITE is almost never found as the 'pure' mineral but rather in complex intergrowths with ilmenite which has very similar physical properties and chemical composition.

SECONDARY URANIUM ORE MINERALS

The secondary uranium ore minerals have represented only a small portion of the total world uranium production. Their deposits are, however, more numerous and as a result of intensive exploration activity, their importance is increasing. The secondary minerals have three major modes of occurrence:

(a) In the weathered or oxidized zones of primary deposits where they are formed by decomposition of the primary mineral in plan.

(b) As irregular, flat lying deposits in sedimentary rocks, primarily sandstones, but also conglomerates, shales and limestones formed by precipitation from solutions that may have carried the uranium some distance from the original source.

(c) Along with a large variety of other secondary uranium minerals, mainly the uranium phosphates, carbonates, sulphates, hydrous oxides and silicates. These may be referred to as oxidized deposits.

The flat lying deposits in sedementary rocks represent the most important occurrences of secondary minerals.

Seventy-five percent of the more than one hundred uranium minerals are secondary minerals but of these only six may be considered ore minerals. Most of the others, occur primarily as the weathering products in the oxidized zones of primary deposits.

CARNOTITE: is a potassium uranium vanadate containing 50-55% U_3O_8 and is the most important of the secondary uranium ore minerals. Deposits of this mineral have provided possibly 90% of the uranium from secondary deposits. It occurs in sandstones in flat lying, irregular, partially bedded ore bodies in sizes ranging from a few tons to a hundred thousand tons. In the higher grade deposits, containing more than 1% U_3O_8, the cornotite is present in sufficient quantity to colour the rock a bright yellow. But in poorer deposits it is often difficult to distinguish from the sandstone host rock.

Nearly twenty other secondary uranium minerals are found associated with carnotite. The most common non-uranium minerals found associated with

carnotite the most common being the various types of vanadium minerals.

Carnotite has also been noted to have an affinity for certain organic materials which has had some effect on its accumulation in almost all types of deposits. In a large number of carnotite deposits, the deposition is associated with silicofied or carbonized wood and a variety of coal like and asphaltic materials.

TYUYAMUNITE: is the same chemical structure as carnotite except calcium has been substituted for potassium. Tyuyamunite is found in small amounts in all carnotite deposits with its prescence increasing in amounts near a source of calcium.

TORBERNITE: is a lydrous copper uranium phosphate containing 60% $U_3 O_8$. Torbernite is the most common of the secondary uranium minerals that are found in association with primary deposits where oxidation has occurred. It is common in nearly all such deposits except pegmatites which usually do not contain the necessary copper to form it.

OUTUNITE: has the same chemical composition as torbernite but with calcium substituted for copper. It is commonly found in association with torbernite and the relative quantities dependant on the amount of copper available to the parent solutions. Outunite is found in varying amounts in almost all the other secondary uranium minerals. It is an oxidation product of pitchblende and uraninite and most of the other primary minerals.

URANOPHONE: is a hydrated calcium uranium silicate containing silica in place of the phosphate of outunite and contains about 65% $U_3 O_8$. It may occur as stains or coatings without apparent crystal form or as finely fibrous or radiating crystal aggregates.

SCHROECKINGERITE: is a complex hydrated sulfate, carbonate, and flouride of calcium, sodium and uranium containing about 30% $U_3 O_8$. It is very soft and

easily soluable in water. It occurs as globular coatings on rock fracture surfaces or as small rounded masses composed of aggregates of flaky drystals distributed through soft rocks or soil. It is the least important of the uranium minerals, and is rarely a significant constituent in the secondary ores of uranium.

RELEVANCE OF THE TYPICAL URANIUM MINERALIZATION TO THE PERMIT AREAS

From the preceding discussion it is evident that the prospector should concentrate firstly on primary mineral uranium ore deposits as these deposits offer the best opportunity for establishing an economic reserve, and, secondly on the secondary mineral uranium ore deposits where the extraction of other minerals in conjunction with uranium may make an economic mining operation.

POSSIBILITY OF DISCOVERING PRIMARY URANIUM MINERAL ORE DEPOSIT IN THE PERMIT AREAS.

Nearly all primary deposits are formed in the voids or open spaces caused by faults or at the intersection of faults. A highly faulted area is therefore the most likely place to find a primary deposit. Very little, if any, geological data is present within the areas of the two permits, however, it is expected that faulting is not as prevalent as it is farther east on trend with Lake Athabaska.

The Uranium occurences reported to date in the immediate area of the subject permits have occurred within the geological formation known as the Athabaska Sandstone. The permits are plotted on the attached map No. L.M.L. 69-04 and do not occur within this formation area on the map.

Thus the possibility of radium occurences in the subject permits is very doubtful.

It is therefore not considered a prime area for uranium exploration. The possibility does exist however, that a primary deposit of uranium mineral ore exists within the pososity of sandstone lenses. This type of deposit is nevertheless relatively rare in nature and such a deposit cannot reasonably be expected within the permit areas.

POSSIBILITY OF DISCOVERING A SECONDARY URANIUM MINERAL ORE DEPOSIT IN THE PERMIT AREAS.

The economics of secondary uranium mineral ore deposits are usually associated with the economics of extracting other minerals along with uranium. Although such mineralization is far from rare, the number of locations where such deposits form an economically mineable ore body are few in number and such a prospect does not appear to provide any incentive to institute an extensive exploration program in the permit areas.

EFFECT OF THE MARKET ON THE VALUE OF URANIUM DEPOSITS.

As in any other commodity, the price received is a prime consideration in the investment of funds for exploration and development.

An over-riding consideration, however, is that rich deposits of any mineral ore often worth retaining is speculation of the market values increasing.

The permits under review, however, do not appear to warrant retention on the prospect of a change in market values and further do not appear to warrant a detailed exploration program.

CONCLUSION:

1. The permit areas do not appear to be well situated for the occurrence of an economically mineable uranium deposit.

2. The possibility of other minerals being present to enhance the economics of a secondary uranium deposit are rare in nature and not considered a likely possibility here.

RECOMMENDATIONS:

In view of the information submitted above the following recommendations are in order:

1. It is recommended that no further effort be expended in evaluating the subject permit areas.

2. Quartz Mineral Permit No. 109 and No. 110 should be surrendered immediately.

SELECTED REFERENCES

NININGER, Robert D. (1954)
Minerals for Atomic Energy.

LAMEY, Carl A. (1966)
Metallic and Industrial Mineral Deposits

TREMBLAY, L.P. (1967)
Geology of the Beaverlodge Mining Area,
Saskatchewan.
Geological Survey of Canada
Memoir 367

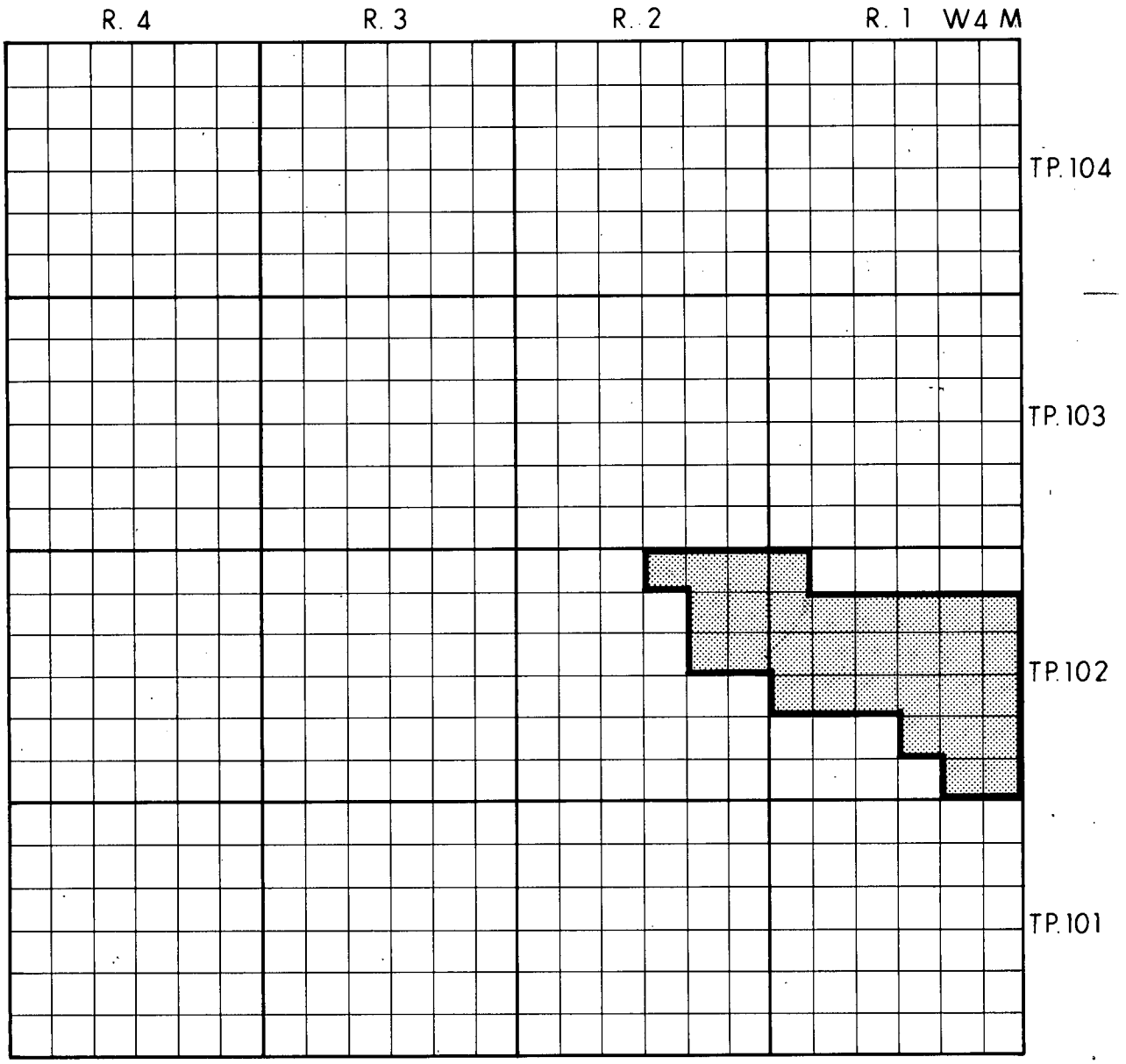
BLAKE, D.A.W. (1956)
Geological Notes on the Region South of Lake Athabasca and Black Lake
Saskatchewan and Alberta.
Geological Survey of Canada
Paper 55-33

CURRIE, K.L. (1969)
Geological Notes on the Carswell Circular Structure, Saskatchewan
Geological Survey of Canada
Paper 67-32

FAHRIG, W.F. (1961)
The Geology of the Athabasca Formation
Geological Survey of Canada
Bulletin 68

EXHIBIT 1

QUARTZ MINERAL EXPLORATION PERMIT No.109



ABCON ENGINEERING (ALBERTA) LTD.

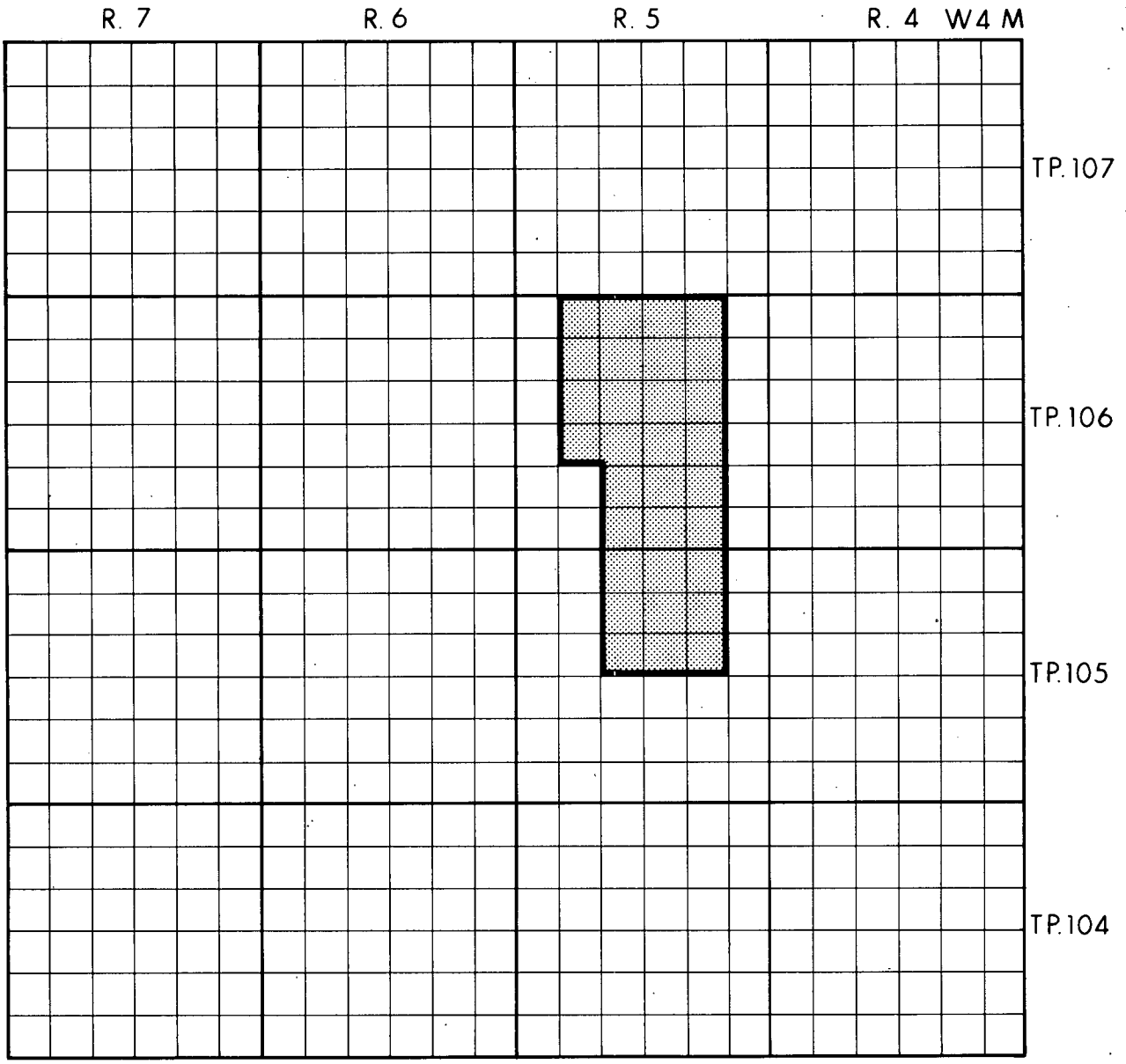
CALGARY ALBERTA

Scale: 1" = 4 miles

1969 0034

EXHIBIT 2

QUARTZ MINERAL EXPLORATION PERMIT No.110



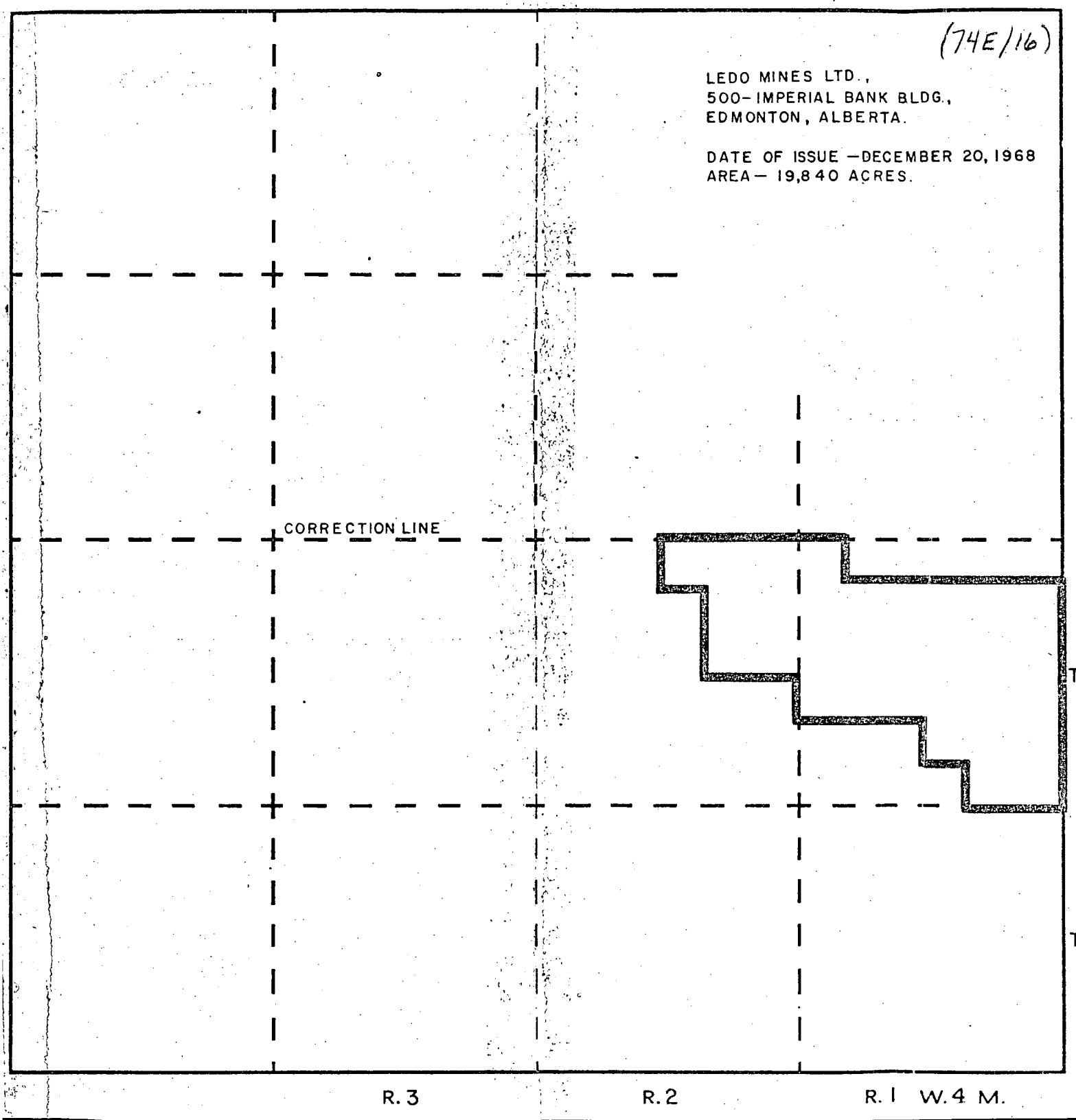
ABCON ENGINEERING (ALBERTA) LTD.

CALGARY ALBERTA

Scale: 1" = 4miles

19690034

QUARTZ MINERAL EXPLORATION PERMIT No. 109



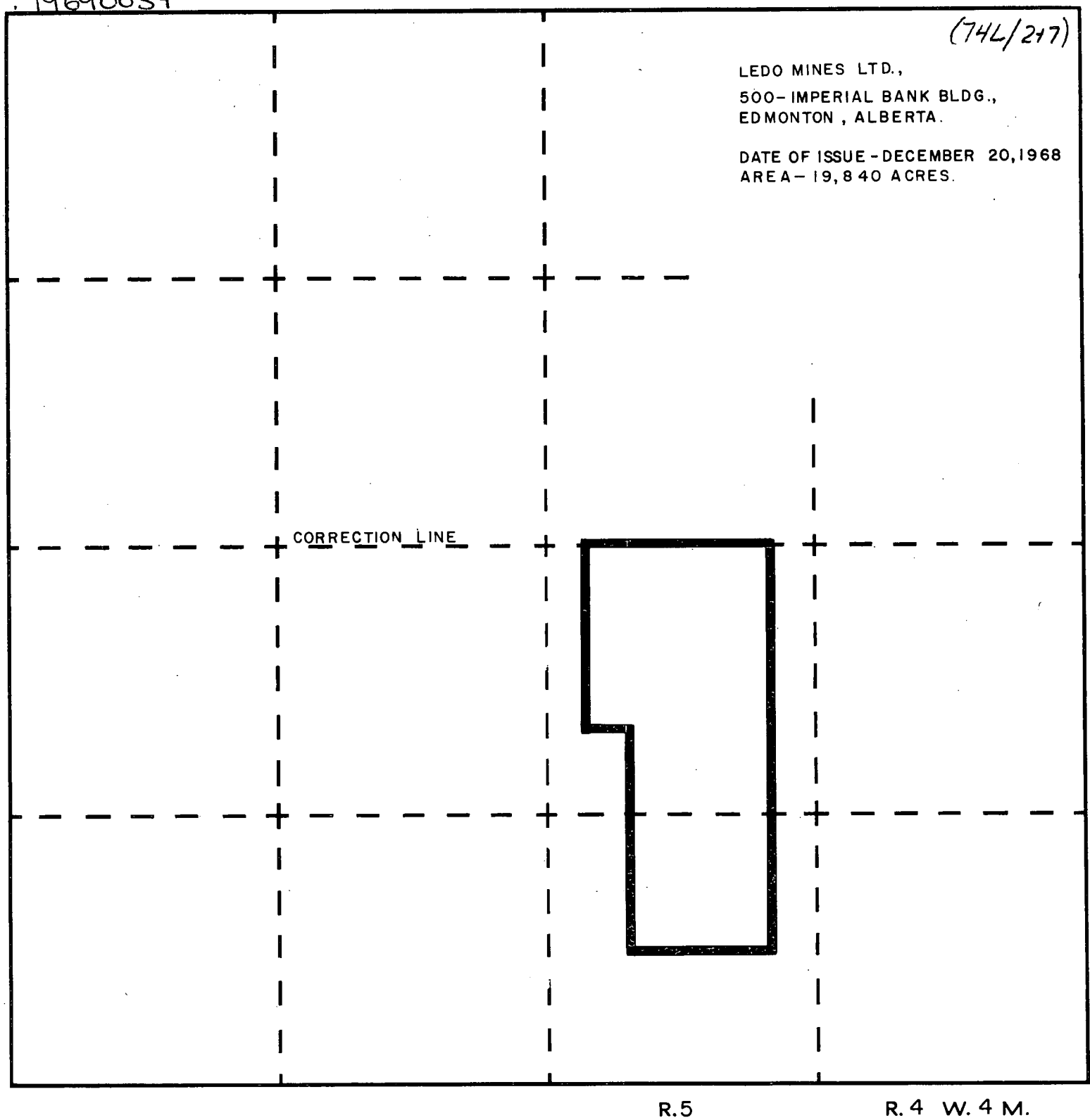
QUARTZ MINERAL EXPLORATION PERMIT No. 110

19690034

(74L/2+7)

LEDO MINES LTD.,
500- IMPERIAL BANK BLDG.,
EDMONTON, ALBERTA.

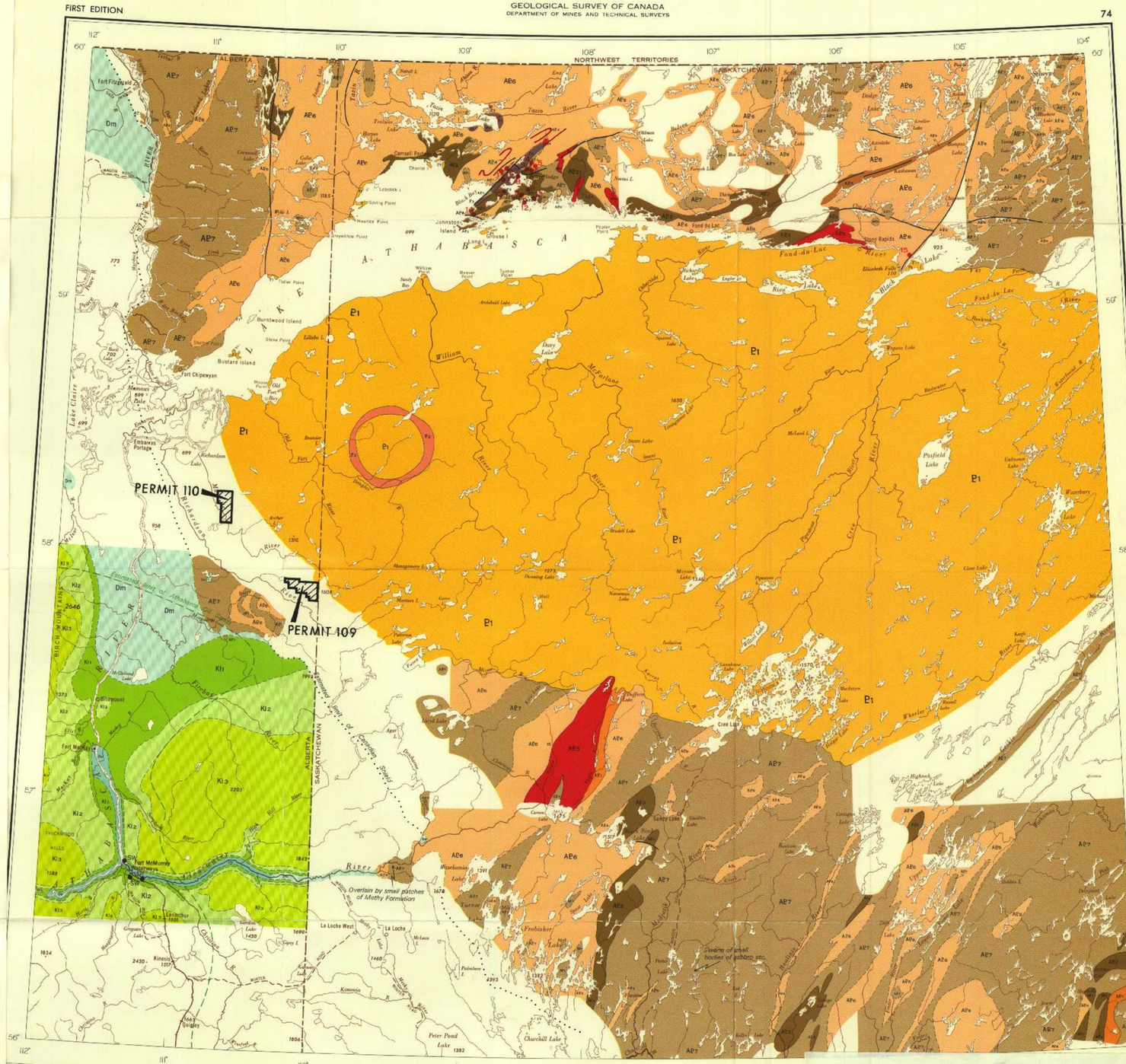
DATE OF ISSUE - DECEMBER 20, 1968
AREA - 19,840 ACRES.



FIRST EDITION

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

74



LEGEND

MESOZOIC

CRETACEOUS
LOWER CRETACEOUS

- Kl3 — *GRAND RAPIDS FORMATION: white and yellow sand and sandstone*
- Kl2 — *CLEARWATER FORMATION: grey and black shale; grey and green sandstone*
- Kl1 — *McMURRAY FORMATION: sandstone, shale, conglomerate. Parts impregnated with oil*

PALAEOZOIC

DEVONIAN
UPPER AND/OR MIDDLE DEVONIAN

- Du — *BEAVERHILL LAKE (Waterways) FORMATION: limestone, argillaceous limestone, shale*

MIDDLE DEVONIAN AND (?) OLDER

- Dm — *METHY FORMATION: dolomite, calcareous dolomite*
  LA BUTTE FORMATION: limestone
  McLEAN RIVER FORMATION: shale, sandy and silty shale, dolomite, sandy and calcareous dolomite
  FITZGERALD FORMATION: dolomite, dolomitic limestone, calcareous shale
  LA LOCHE FORMATION: arkosic sandstone

PROTEROZOIC

- P3 — *MARTIN LAKE FORMATION: arkose, sandstone, feldspathic siltstone, conglomerate, basalt*
- P2 — *CARSWELL FORMATION: dolomite*
- P1 — *ATHABASCA FORMATION: sandstone, grit, conglomerate, siltstone, shale*

ARCHAEAN AND/OR LOWER PROTEROZOIC

- AE7 — *Granite, granodiorite, and related rocks; and gneissic equivalents. Includes unseparated bodies of units AE1, AE2, and AE4*
- AE6 — *Gneisses, schists, migmatites, granitized rocks, and unseparated bodies of units AE1, AE2, AE4, and AE7*
- AE4 / AE4 — *AE4, Amphibolite and other metamorphosed mafic and ultramafic rocks of sedimentary, volcanic, and igneous origins. Includes unseparated bodies of AE5*
  AE5, Gabbro, norite, and other mafic or ultramafic intrusions
- AE2 — *Quartzite, ferruginous quartzite, dolomite, dolomitic quartzite, conglomerate, limestone, argillite, and gneissic and schistose equivalents. Includes part of TAZIN GROUP*
- AE3 — *Unseparated sedimentary, volcanic, and metamorphic rocks equivalent to units AE1 and AE2*
- AE1 — *Andesite, basalt, rhyolite, tuff, and metamorphic equivalents. Includes part of TAZIN GROUP*

Geological boundary (defined or approximate)
Geological boundary (inferred or gradational)
Principal fault
Estimated limit of Athabasca Oil Sands
Mine (gold, uranium). Au,U
Salt well SW

Geology compiled by A. H. Lang, 1962, from maps and reports published by the Geological Survey of Canada, the Saskatchewan Department of Mineral Resources, and the Research Council of Alberta

Base-map from Map 2141, "Clearwater River" by the Surveys and Mapping Branch, 1949, with minor revisions, 1964

INDEX TO MINES
*Former producer

1. *Rix (Rix-Athabaska Uranium Mines Ltd.) U
2. *Cayzor (Cayzor Athabaska Mines Ltd.) U
3. *Jam-Maj (Nesbitt—La Bine Uranium Mines Ltd.) U
4. *National Explorations (National Exploration Ltd.) U
5. Verna (Eldorado Mining and Refining Ltd.) U
6. Ace-Fay (Eldorado Mining and Refining Ltd.) U
7. *Lake Cinch (Lake Cinch Mines Ltd.) U
8. *Martin Lake (Eldoraco Mining and Refining Ltd.) U
9. *Gretta (Black Bay Uranium Ltd.) U
10. *Lorado (Lorado Uranium Mines Ltd.) U
11. *Box (The Consolidated Mining and Smelting Co. of Canada Ltd.) Au
12. *Athona (Athona Mines Ltd.) Au
13. *Nicholson (Consolidated Nicholson Mines Ltd.) U
14. Gunnar (Gunnar Mines Ltd.) U
15. *Nisto (Haymac Mines Ltd.) U

INDEX MAP

NOTES

GENERAL

Most of the map-area is in the Churchill 'province' of the Canadian Shield, but the eastern part is in the Interior Plains and Lowlands. Physiographically, the part in the Shield is divisible into two main areas. One is a flat area extending eastward from the mouth of Athabasca River to Wollaston Lake, and northward from Cree Lake to Lake Athabasca. It slopes gently northward from an elevation of about 1,600 feet along its southern limit to about 700 feet, the level of Lake Athabasca. It is underlain mainly by the Athabasca Formation, which is poorly exposed and covered mainly by sand and other glacial deposits. This area is flanked to the north and south by hilly areas containing elevations up to about 1,400 feet above sea-level, and underlain by older Precambrian rocks, which are fairly well exposed. The surface of the area within the Interior Plains and Lowlands varies from flat to hilly, with elevations up to about 2,800 feet above sea-level. It is underlain by flat-lying Palaeozoic and Mesozoic strata, exposures of which are virtually restricted to the banks of the larger streams.

Almost all the 'Precambrian' part of the map-area has been mapped geologically on the scale of 1 inch to 4 miles, much of it has also been mapped at 1 inch to 1 mile, and a large area extending from the vicinity of Johnston Island to a line about 5 miles north of Beaverlodge Lake has been mapped at 1 inch to 400 feet. As much of this detail cannot be shown at the scale of this map, it has been possible to illustrate only the larger geological features and a few smaller ones that illustrate structures or other phenomena particularly well.

PRECAMBRIAN

The older strata exposed are sedimentary and volcanic rocks exhibiting various degrees of metamorphism. It is not clear whether volcanic or sedimentary strata are the oldest, and it is possible that rocks of several ages are represented. North of Lake Athabasca these strata have been named the Tazin Group, to which at least some of the analogous strata in other parts of the area are probably related. The strata are intensely folded, generally along northeasterly trending axes. Evidence available at present from age determinations on samples from the Churchill province indicates that the orogenies within it took place in Proterozoic rather than Archaean times, but this does not preclude the possibility that some of the rocks involved may be Archaean. Much of the Precambrian terrane is composed of granites and related rocks, and of complexes made up of gneisses, migmatites, grentitized rocks, and small bodies of granite and other rocks. In areas that have been mapped at 1 inch to 1 mile or in greater detail the various components of the complexes have been separated and in some areas several varieties of gneisses have been mapped separately. It proved impossible to indicate these details on the present map, not only because of limitations of scale, but also because various workers used different classifications.

Also present are numerous bands of amphibolite of different sizes. Some of the narrower ones have been indicated symbolically because they illustrate the folding; many others had to be omitted.

In the large flat area south of Lake Athabasca the older rocks are overlain by the gently tilted Athabasca Formation, which was originally thought to be of Cambrian age but is now generally regarded as Proterozoic. At and near Carswell Lake several outcrops of dolomite in a circular pattern have been grouped as the Carswell Formation. The contact between these beds and the Athabasca Formation has not been found exposed, but nearby dips suggest that the Carswell overlies the the Athabasca and has been infolded in a domal structure. In the vicinity of Beaverlodge Lake beds of arkose and other sedimentary rocks interbedded with flows of basalt, which were formerly considered part of the Athabasca 'series' have recently been redefined as the Martin Lake Formation.

The older Precambrian rocks are traversed by numerous faults, many of which strike northeasterly. Only a few of the more prominent ones could be shown on this map. North of Lake Athabasca two main periods of faulting have been recognized. The older followed the granitization of rocks of the Tazin Group, and the younger took place after the deposition of the Martin Lake Formation. Wide zones of fracturing, brecciation, and mylonitization are believed to have resulted from still earlier deformation or faulting, rather than from faults that can now be mapped.

PALAEOZOIC AND MESOZOIC

The Palaeozoic strata exposed in the area mainly contain fossils indicative of Middle and Upper Devonian ages. The Fitzgerald Formation found along Slave River was formerly considered to be Upper Silurian, and because the evidence available at present is uncertain its age is now stated as "Upper Silurian and/or Middle Devonian". In the south-western part of the map-area Lower Cretaceous strata rest on an erosion surface in the Devonian beds. The distribution of the Palaeozoic and Mesozoic formations is reasonably well known from exposures along streams and from drilling records, but the precise locations of the boundaries between them is in most places indefinite because of the extensive overburden of glacial and post-glacial deposits. Some additional formations have been recognized in drill sections but are not mappable from surface information.

ECONOMIC FEATURES

The map-area contains occurrences of a large variety of uranium discoveries to date being almost entirely confined to the earlier Precambrian rocks. The region first attracted prospectors in and following 1910 when interest was mainly in copper-nickel occurrences associated with norite, and in iron-bearing sedimentary rocks, neither of which were developed successfully. Gold discoveries in 1934 caused establishment of the town of Goldfields, near which two mines produced for a few years. An occurrence of pitchblende found at the Nicholson copper prospect near Goldfields in 1935 was not then of particular interest, but in and following 1942 it caused much prospecting for uranium in the area. This resulted in discovery of more than 3,000 occurrences of pitchblende in the general vicinity of Beaverlodge Lake, and establishment of 12 producing mines, the town of Uranium City, and several roads and airstrips. The larger pitchblende deposits consist of stringer-systems and disseminations in a variety of earlier Precambrian rocks and in the Martin Lake Formation; most are associated with prominent faults. Many additional uranium occurrences were found between Slave River and Beaverlodge area, and between that area and Porcupine River; some are of the pitchblende type described above, and most others contain crystalline uraninite in pegmatites, migmatites, and related rocks. Many occurrences of the latter type were also found in the general vicinity of Foster Lakes.

The map-area contains the northeastern part of the Athabasca Oil Sands, which in their entirety are considered to be the world's largest reserves of petroleum. They are mainly in the McMurray Formation, which is impregnated with viscous petroleum, and are regarded as an oil reservoir that was exposed sufficiently by erosion to permit escape of the more volatile constituents. Whether the oil originated in these beds, in the underlying Devonian strata, or in overlying Cretaceous formations has not yet been proved. Many investigations have been undertaken regarding the extent of the sands, and methods of exploiting them, but to date commerical production has not been achieved.

Devonian strata contain thick beds of salt, anhydrite, and gypsum. Salt was produced for several years from wells drilled near McMurray.

REFERENCES

The maps and reports used in this compilation are too numerous to be listed here. Most will be found in the Index to Publications of the Geological Survey of Canada (1845-1958) and its supplements, and in the lists of the Research Council of Alberta and the Saskatchewan Department of Mineral Resources.

ISHED, 1969
ES OF THIS MAP MAY BE OBTAINED FROM THE
CTOR, GEOLOGICAL SURVEY OF CANADA, OTTAWA

85 AVE RIVER	75 LOCKHART RIVER	65 DUBAWNT RIVER
84 1161A AY RIVER	74 1162A CLEARWATER RIVER	64 COCHRANE RIVER
83 THABASCA RIVER	73 1163A NORTH SASKATCHEWAN RIVER	63 1164A CARROT RIVER

INDEX TO ADJACENT SHEETS

ABCON ENGINEERING (ALBERTA) LTD.

GEOLOGICAL MAP SHOWING QUARTZ MINERAL EXPLORATION PERMITS No. 109 AND No. 110

SCALE : 1 Inch = 16 Miles

FEB. 1970

L.M.L. 69-04
19690037

Permit 109
(u-AF-067(1)
u-AF-068(1)

19690034

ABCON ENGINEERING (ALBERTA) LTD.

TOPOGRAPHIC MAP SHOWING QUARTZ MINERAL EXPLORATION PERMITS No. 109 AND No. 110

SCALE : 1 Inch = 12 Miles

FEB. 1970

L.M.L. 69-03

RLA0034

NORTHWEST TERRITORIES

EDGE OF ATHABASKA SANDSTONE FORMAT'N.

PERMIT 110

PERMIT 109

ALBERTA

Scale 1:2,217,600 or 35 Miles=1 Inch

Highways Surfaced

Improved Earth

ABCON ENGINEERING (ALBERTA) LTD.

PROVINCIAL LOCATION MAP SHOWING QUARTZ MINERAL EXPLORATION PERMITS No. 109 AND No. 110

SCALE: 1 Inch = 35 Miles

FEB. 1970

L.M.L. 69-02

19690034

BASE MAP FROM 1930 EDITION

Price 15 cents

PREPARED AND PRINTED AT THE OFFICE OF THE SURVEYOR GENERAL, OTTAWA, 1935.
REPRINTED WITH CORRECTIONS 1948.

ABCON ENGINEERING (ALBERTA) LTD.

CONTINENTAL LOCATION MAP SHOWING QUARTZ MINERAL EXPLORATION PERMITS No. 109 AND No. 110

SCALE : 1 Inch = 70 Miles

FEB. 1970

L.M.L. 69-01

1969003Y

PERMIT No. 110

PERMIT No. 109

BRITISH COLUMBIA

ALBERTA

SASKATCHEWAN

MANITOBA

HUDSON BAY

ONTARIO

QUEBEC

EDMONTON

SASKATOON

CALGARY

REGINA

BRANDON

WINNIPEG

VANCOUVER

VICTORIA

SEATTLE

TACOMA

OLYMPIA

WASHINGTON

PORTLAND

SALEM

OREGON

CANADA

U.S.A.

MONTANA

HELENA

BILLINGS

NORTH DAKOTA

BISMARCK

SOUTH DAKOTA

PIERRE

IDAHO

BOISE

WYOMING

MINNESOTA

ST PAUL

WISCONSIN

MADISON

MILWAUKEE

CHICAGO

IOWA

LAKE MICHIGAN

FORT WILLIAM

LAKE SUPERIOR

SUPERIOR

SAULT STE. MARIE

SUDBURY

LAKE HURON

PETERBOROUGH

LAKE ONTARIO

TORONTO

HAMILTON

BUFFALO

NEW YORK

LANSING

DETROIT

WINDSOR

LAKE ERIE

CLEVELAND

TOLEDO

OHIO

PENNSYLVANIA

PITTSBURG

MONTREAL

OTTAWA

1969003Y