MAR 19760010: OLD FORT BAY

Received date: Dec 31, 1976

Public release date: Jan 01, 1978

Alberta Mineral Assessment Reporting System

MATTAGAMI LAKE MINES LTD.

GEOLOGICAL, GEOPHYSICAL AND GEOCHEMICAL

REPORT

OLD FORT BAY PERMIT

ATHABASCA AREA, ALBERTA

PERMIT NO. 225

TWP 112, 113   R1, R2, R3 W4M

NTS 74L

DECEMBER 1976

W. MERCER, Ph.D.

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FIGURES

CHAPTER ONE

INTRODUCTION

The Old Fort Bay Permit area was obtained as an option
for one year from C. and E. Explorations of Calgary. The area
had been identified as a potential host of uranium deposits by
Demex of Denver, Colorado. Application of density slicing of
LANDSAT satellite images had suggested a concentration of zones
possessing similar reflectance to the Cluff Lake area. On the
basis of this work, C. and E. Explorations obtained permits
covering these zones.

The area is underlain by Athabasca sandstone, which has
proven to be the host to rich uranium deposits in the Cluff
Lake area. Mattagami Lake Mines Limited optioned the property
in 1976 with the purpose of conducting investigations to de-
termine whether uranium existed below the Athabasca sandstone,
and whether this uranium could be located with existing explo-
ration techniques.

The area is of great challenge to geological explora-
tion, as there appears to be promise of very rich uranium
deposits, but beneath seemingly impenetrable thicknesses of
sandstone. Blind drilling would be futile in such a large
area.

For bush work in June 1976, a camp of eight geologists
was established on Moose Point in Old Fort Bay by Twin Otter
of Wardair of Yellowknife. Crews were ferried to the work
area by Bell B2 helicopter of Shirley Helicopters of Edmonton

1.

piloted by Rod Wood.   The enthusiastic co-operation of Mr.
Wood is gratefully acknowledged.

A second camp of four geologists was established for a
short period on Agar Lake in July 1976, supported by Hiller
12E helicopter.   Thanks are due to pilot Ken Waines for his
consideration of our requirements.   This helicopter proved
particularly suitable for work in confined spaces.

The credit for the Quaternary section is due wholly to
G. Castles.   Partial credit for the text and for setting up
the programme must go to J. Helsen for the Track Etch survey
and M. Kreczmer for the geochemical surveys of uranium in
waters and lake sediments.

The conclusions are solely the responsibility of this
writer.

Location and Access (Figure 1)

The permit area, of some 30,000 acres, lies 30 air
miles due east of Fort Chipewyan, Alberta, and 80 air miles
southwest of Uranium City, Saskatchewan, at 58° 45' N, 110°
15' W.   The centre of the area is 8 miles northeast of Old
Fort Bay, Lake Athabasca.

At present the area is accessible only by helicopter,
except for one lake in the extreme north, which might permit
landing of float planes.   The shore of Lake Athabasca is
never more than 8 miles from any point in the permit area,
and although the lake is shallow it permits movement of large
barges.   There are two disused winter roads, one ending 20

2.
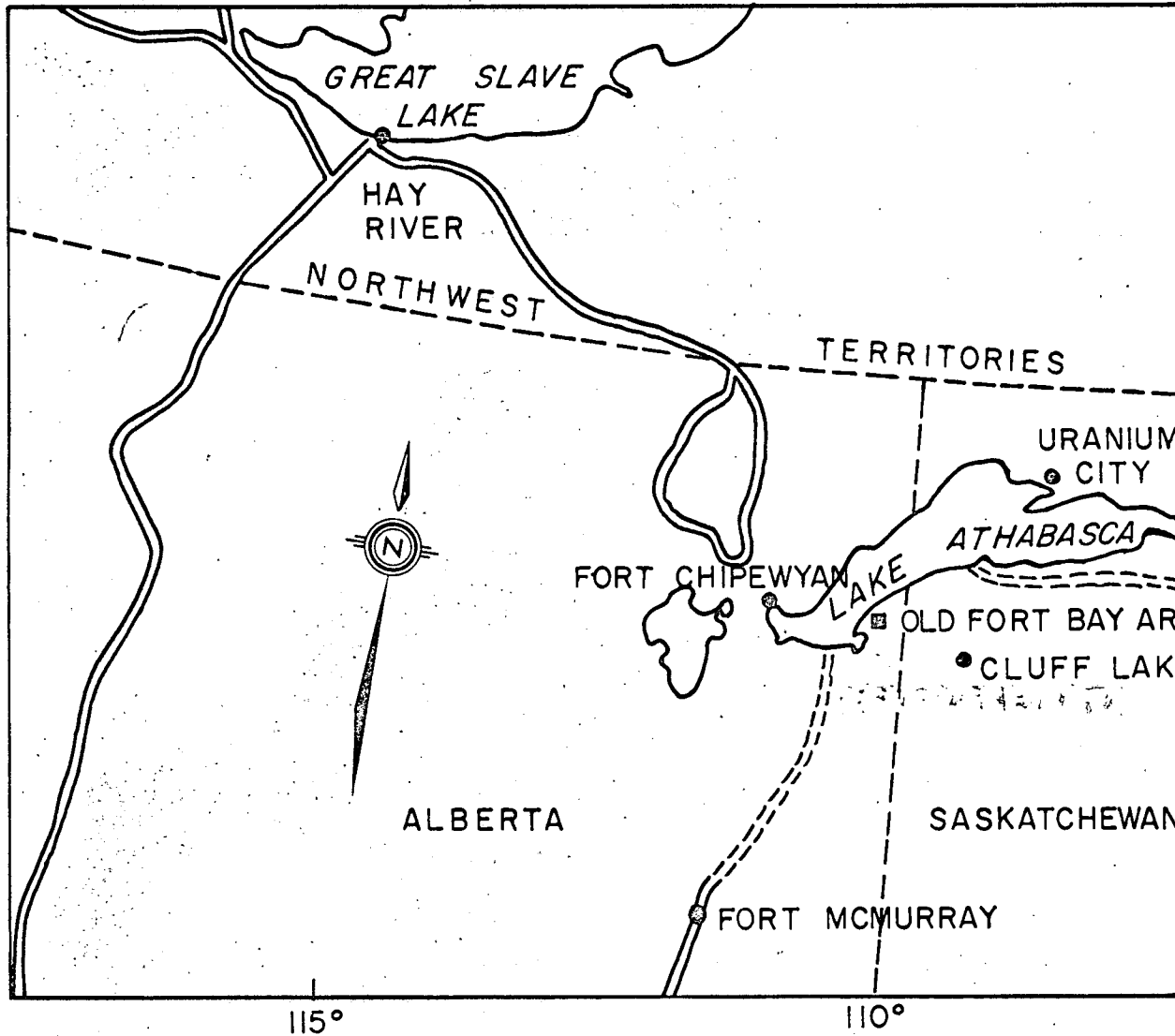
FIGURE 1.
LOCATION AND ACCESS
OLD FORT BAY AREA
ALBERTA

SCALE: 1:4,000,000

LEGEND

60° ═══ ROAD
═══ DISUSED WINTER
ROAD

GREAT SLAVE LAKE

HAY RIVER

NORTHWEST

TERRITORIES

URANIUM CITY

ATHABASCA

FORT CHIPEWYAN LAKE

OLD FORT BAY AREA

CLUFF LAKE

ALBERTA

SASKATCHEWAN

FORT MCMURRAY

115°

110°

miles southwest on the shore of Lake Athabasca, the other some 14 miles away northeast in Saskatchewan.

Physiography and Vegetation

The physiography of the area is dominated by the glacial deposits (see chapter below). Two main areas are present. In the west half the land is generally low-lying and swampy. In the east sand dunes predominate, some reaching 40 to 80 feet above the surrounding plain.

The climate has a tendency towards dryness compared to other parts of the north of Alberta. Consequently, this fact, combined with the well-drained nature of the ground, leads to a general predominance of pine (generally Jack Pine) over Black Spruce. White birch is common. Lakes, and Old Fort Bay itself, are generally shallow and become clogged with weed by the end of June.

CHAPTER TWO

QUATERNARY GEOLOGY

The Quaternary geology of the area is reviewed as no rock outcrop is present. Consequently any exploration technique must take into account the various surficial and glacial deposits and landforms. This applies in the sense that it is difficult to measure parameters related to bedrock through 100 feet of glacial deposits. Also, any geochemical survey of the surface material relates, not to the underlying bedrock, but to the area from which the surface material was derived. Thus, scintillometer readings off boulders are only significant if one knows where the latter are derived from. Also, exploration on surface material is unproductive if it has all been transported for some miles from outside the exploration permit area.

The surficial deposits and landforms result from geological processes associated with Pleistocene glaciation and Holocene fluvial and aeolian activity. The deposits are assumed to unconformably overlay the late Precambrian Athabasca Formation within the study area. Three major groups of surficial Quaternary deposits have been recognized in the region. The distinctions have been determined on the basis of the respective deposits' compositions, origins, and associated landforms (Figure 2, in pocket).

The oldest Quaternary surficial deposits observed are located within the eastern portion of the study area and consist of outwash sands and gravels deposited by large rivers

or streams. The source was the northeasterly retreating clas-
sical Wisconsin Laurentide Ice Sheet. The sands are very
coarse-grained and many large boulders are encountered within
these outwash materials. This implies rapid deposition near
the glacial source of these particular sediments. The sand
and gravel has moderate sorting and sphericity which also at-
tests to the form of depositional environment previously dis-
cussed. The sand grains themselves are comprised of sub-angu-
lar (sub-rounded) fragments of quartzose sandstone and occa-
sional crystalline shield rocks. The quartzose sandstone
(orthoquartzite) material likely represents eroded Athabasca
sandstone transported in a southwesterly direction by the
Laurentide Ice Sheet prior to subsequent by glacial outwash
streams. Cumulative thicknesses of the outwash do not exceed
60 feet (20 meters) within the general vicinity. Accordingly,
a gently, undulating, topographic surface is produced.

Glaciolacustrine sands, prevalent in the northern and
western portions of the Old Fort Bay area, represent the young-
est Pleistocene surficial deposits observed. These medium-
grained sands were likely produced in response to the reworking
of previously existing glacial outwash deposits by Lake Atha-
basca waters at a time when the lake level was approximately
300 feet (100 meters) above contemporary levels. Regional
deglaciation likely accounts for the increase in lake level.
The reworked outwash sands and gravels in question appear to
represent a westerly extension of those outwash deposits pre-
viously discussed as orthoquartzitic rock fragments prevail as

6.

the dominant sand-size component. Overall thicknesses appear
to vary between 2 and 5 feet (1 and 2 meters) on a rather lo-
calized scale.

Throughout the northern and western portions of the Old
Fort Bay area, numerous crevasse fillings are present, especi-
ally within the region overlain by the glaciolacustrine sands.
These distinctive landforms consist chiefly of large boulders
of Athabasca sandstone and occur as a series of southeast-
trending, discontinuous ridges approximately 5 to 10 feet (1.5
to 3 meters)-in height. These-crevasse fillings-likely formed
perpendicular to the direction of ice flow. The regular spac-
ing between successive ridges suggests that the rate of active
ice retreat was relatively constant during the time of deposi-
tion. The boulders may either have been washed into large
crevasses by superglacial streams- or fallen into-the-crevasses-
in response to processes related to glacial ablation. This
occurred as the Laurentide Ice Sheet retreated in a northeast-
erly direction across a wide, outwash plain. Following the
post-glacial rise of Lake Athabasca waters, glaciolacustrine
sands were deposited around these landforms.

The central portion of the study area is characterized
by the presence of aeolian deposits of Holocene age, consist-
ing essentially of sheet and dune sands. The sands are inva-
riably fine- to medium-grained. They likely represent glacio-
lacustrine deposits which have been reworked by a prevailing
northwesterly wind during the past few thousand years. The
nature of these prevailing winds accounts for the meagre

thicknesses of glaciolacustrine sands encountered further to the northwest as these sediments must have served as the source of sand supply. Most of the dunes have been stabilized by vegetation in recent times and attributable topographic relief ranges from 10 to 100 feet (3 to 30 meters).

In the southwesternmost portion of the study area recent deposits of stream alluvium are present. The alluvial material consists of silty sand deposited by streams and rivers entering Old Fort Bay from the east and southeast.

Muskeg, or accumulations of organic material, mantle a great portion of the surficial deposits in the permit area. Subsequently, the true extents and thicknesses of the various underlying Quaternary deposits are difficult to determine. However, in most cases, muskeg cover is relatively thin and is assumed to attain thicknesses greater than 20 feet (6 meters) in very localized instances only.

CHAPTER THREE

TRACK ETCH SURVEY

Theory (Figure 3)

Track Etch method is claimed to utilize small alpha-particle-track detectors to measure the radon gas emitted by uranium ore bodies. It is expected to detect uranium mineralization buried at depths too great to be measured with surface or airborne scintillometer techniques.

Uranium is a radioactive element that decays via a number of daughter products to radioactive lead. One of the intermediates is radon, a radioactive inert gas. Due to its inert nature but that it is soluble in water radon can migrate easily in the surficial environment. Hence the basis for the Track Etch method.

The method consists of emplacing plastic cups, the size of a 6 oz. drinking cup, face downwards in a hole 3 feet deep. The cup has a piece of plastic film on its bottom that is sensitive to alpha particles. Radon migrates through the soil and collects with soil gas in the cup. The number of alpha tracks left in the plastic film is proportional to the radon of the soil. The alpha tracks consist of damage to the molecular structure of the plastic where the alpha particle has travelled through. When the film is placed in a corrosive chemical, the alpha tracks are preferentially etched out and can then be counted under the microscope. In practice, about

Figure 3.   TRACK ETCH FIELD PROCEDURE

Sampling Cup with
Track Etch Detector

Typical Grid Layout 100-3000 ft centers

Ore Body
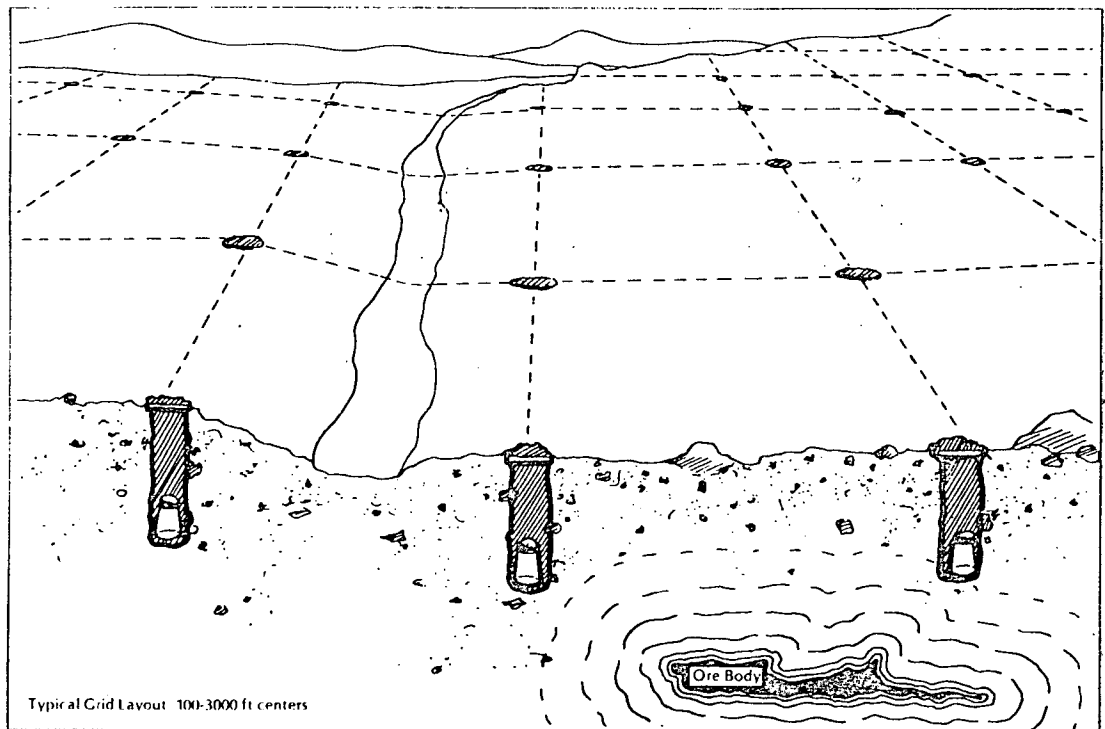
Typical Field Sampling Arrangement

10.

three weeks is required for the cups to accumulate enough tracks whilst in the ground.

There is some controversy between proponents of radon emanometers and the Track Etch technique and the relative merits of the two exploration methods.

Field Procedure

Starting on June 3rd, 1976, Track Etch cups were placed in the area. An attempt was made to use a grid pattern. It was soon realized that picking up these cups would involve several problems, including difficulties in finding them in dense forest, despite very obvious markings of the locations. Using a grid pattern also implies putting cups in swamps and other unsuitable terrains. For these reasons the grid pattern was abandoned. Instead, subsequent traverses were run following more obvious topographic features on the air photographs. For example, in several cases the boundary between high ground (moraines, dunes, drumlins, eskers, etc.) and low ground (swamps, river basins, etc.) was followed and track etch cups were placed in more easily recognizable spots.

The track etch cups were placed whenever possible at a depth of about 3 feet. In several cases, however, cups were placed at shallower levels because of presence of ground-water and/or boulders. The hole for the cup was made using a 4-inch diameter post-hole auger. Under most circumstances except for bouldery ground, this was sufficient. The location was marked with flagging tape, and recorded on air photograph overlays.

The placing of the cups was started with a team of four, but later on this team was divided into two teams of two in order to speed up the work as much as possible.

Placement of cups was terminated June 19th, a total of about 100 having been emplaced. Pickup of the cups was completed between July 7th and 18th, thus most cups were left in the ground for periods between 3 to 5 weeks.

Various difficulties were encountered when retrieving cups. The first one was finding them. This is partly due to the fact that much flagging tape had been removed by animals. A second problem was that many cup holes had been uncovered, either by animals or by rain or wind. This could possibly be avoided by use of very large plastic sheets for hole covers. Finally, a small number of cups were removed from the holes and smashed, presumably by bears.

Out of 100 cups, 40 had the plastic cover removed from the hole but were covered with up to one foot (0.3 meters) of sand. Three cups were smashed.

Results

The results of the Track Etch Survey, as summarized by Terradex of California*, are below:

"The Track Etch detector readings are reported in units of tracks per square millimeter (T/sq. mm) and they are normalized to equivalent 30-day exposures. The data have been tabulated in two different ways for easy use: firstly by

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*Letter from H. Ward Alter, President of Terradex, September 3rd, 1976.

ascending film serial numbers and secondly by ascending Track

Etch readings. The Track Etch radon contour maps were compu-

ter generated using a 6-point weighted average computer smooth-

ing routine and were drawn with a 2 T/sq. mm contour interval.

With this mapping technique some higher contour intervals may

be found between the actual data points but this is normal

since the computer attempts to interpolate intermediate values

based on the general average values measured in the area.

Short incomplete contour lines may also appear on the maps

without identifying numbers but their values can usually be

determined from adjacent contour values. The contour maps

show small +'s at the locations where the field samples were

located. Where the +'s do not appear the Track Etch films

were either lost or the readings were not used. The map was

drawn to the same scale as the field location map so it can

be easily used by overlaying on the base map.

On this project 92 Track Etch cups were used and the

readings ranged from 2.0 to 19.4 T/sq. mm with the mean of

the background distribution at 9 T/sq. mm and the standard

deviation of the mean at 4 T/sq. mm or 4%.

The background mean and its standard deviation are

normally related to shallow "mineralization" of uranium at

ppm levels. The value is in the range of other values in the

area. High ranking points may be expressed in terms of "Z",

the number of standard deviations above background. Rudimen-

tary statistics imply that Z values greater than three have a

very low probability of belonging to the background distribu-

tion and hence are anomalous. The ranges of Z for the high
ranking points in this survey are shown below together with
the more conventional ratio to background.

Range of Z	Number of Points	Range of T/sq. mm	Range of Ratio to Background
2 - 3	3	17.4 - 19.4	1.9 - 2.2
3 - 4	0	-	-
4 - 5	0	-	-

There are no points with Z values greater than 3. In
our experience this is not an indication of uranium minerali-
zation unless clustering of high points is apparent on the
map. The distribution of points looks like pure background.

The Track Etch contour map (Figure 4, in pocket) shows
little or no structure and is as expected from the background
statistics".

CHAPTER FOUR

RADON EMANOMETER SURVEYS

Theory

Radon emanometry (radon "sniffing" or radon counting) consists of counting radioactivity due to radon in soil gas or dissolved in water. This discussion is solely concerned with radon in soil gas, a method most suited to detailed studies of areas covered by overburden.

Radon is found naturally as three radioactive isotopes: Rn^{219}, Rn^{220} and Rn^{222}. They are daughter products of uranium and thorium, as shown below:

Parent atom	U^{235}	Th^{232}	U^{238}
Daughter atom	Rn^{219}	Rn^{220}	Rn^{222}
1/2 life of daughter	3.9 secs	54.5 secs	3.82 days

The basic difference between the apparatus for radon emanometry and a field scintillometer is that the former is for measuring alpha activity of gases and the latter for measurement of gamma activity of solids. However, both methods are indirect with respect to uranium, that is they measure activity due to daughter products of uranium. The radon emanometer measures all radon activity and the scintillometer measures Bi^{214} activity.

Gamma scintillometry, in that it measures a solid pro-
duct of uranium decay, is limited effectively to the top few
inches of rock or soil, due to the strong shielding of gamma
rays by these materials, especially if damp. However, radon
emanometry measures the alpha radiation due to an inert gas
which has 20 days before its radioactivity is reduced by a
hundred-fold. Radon may migrate up to 23 feet (7 meters),
during the twenty days, to collect in the upper soil layers
(Miller and Ostle, 1973). It should be noted that radium,
which has a longer half-life (1620 years) may also migrate
in dissolved form and enhance radon values at the surface,
effectively increasing the depth of penetration of the method.
This has been suggested in the context of success with Track
Etch cups to depths of 300 feet, under favourable circumstances.

Field Procedure

The radon emanometer used (E.D.A., Ottawa, Model RD200)
consists of an alpha-detector (scintillometer) and a counting
cell lined with zinc sulphide. The latter chemical produces
scintillations (flashes of light) when bombarded by alpha
particles. The emanometer counts these scintillations. The
counting cell is the size of a cup and can be replaced in five
minutes. Soil gas is pumped into the cell by means of a rub-
ber bulb. There are inlet and outlet tubes inserted through
a rubber bung, one being attached to a 1.5-foot (0.5 meters),
metal probe, the other flush with the bung. The field pro-
cedure (Figure 5) is to make a hole 2 to 3 feet (0.6 to 0.9

FIGURE 5   RADON EMANOMETRY SKETCH OF FIELD TECHNIQUE FOR SOIL GAS
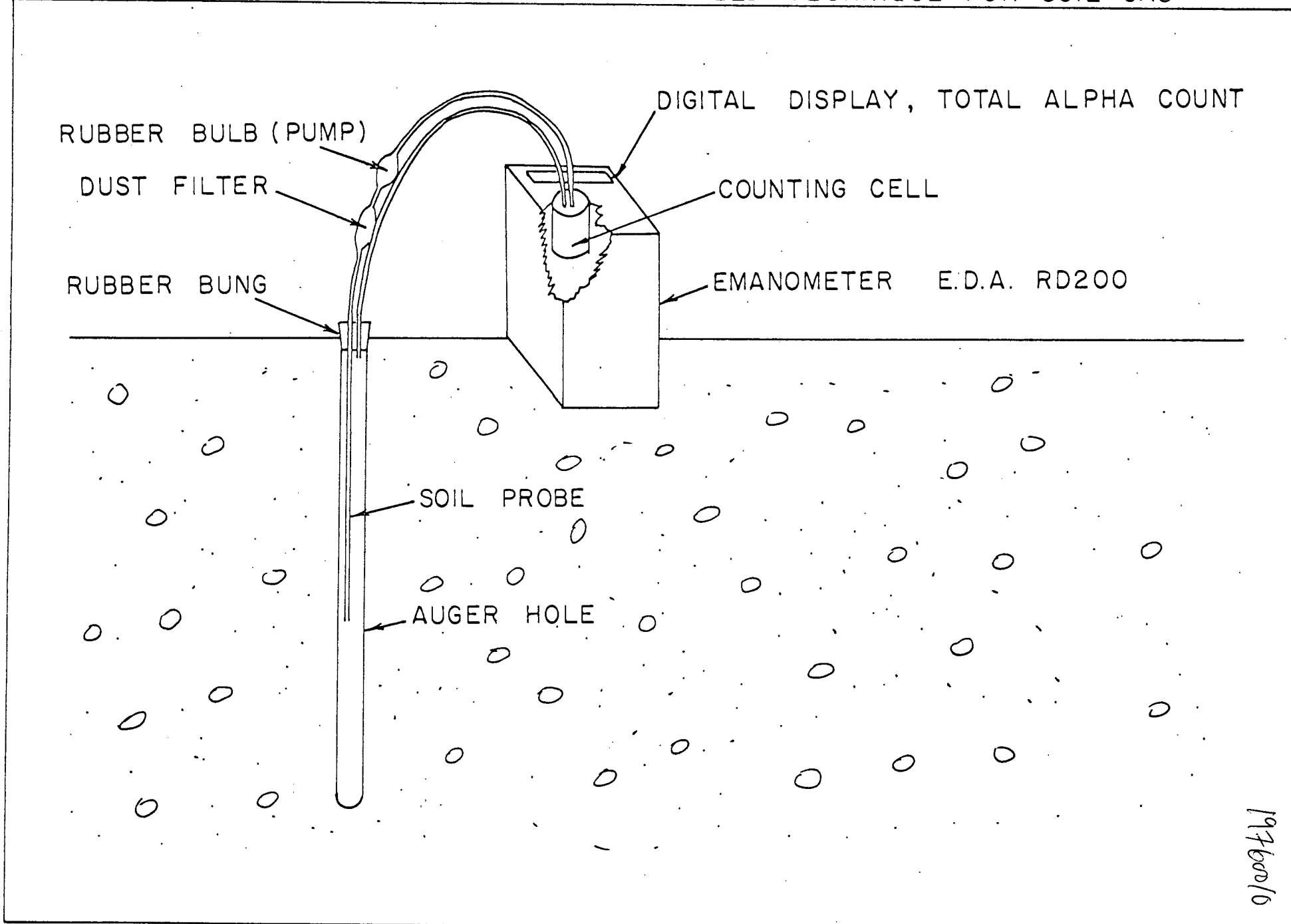
meters) deep and 0.75 inches (1.9 centimeters) in radius with a soil auger. The gas tube is immediately inserted into the hole, rubber bung being flush with the hole entrance. Soil gas is pumped into the counting cell and counting begins.

A crew of 2 can expect to perform between 20 and 80 determinations per day depending on conditions. The instrument operates for 3 to 5 days on 1 set of 8 alkaline C-cell batteries.

Factors Affecting Results

There are a great number of variables involved in controlling the radon content of soil. Among these are soil variables (e.g.: water, clay, organic and sand proportions), climatic variables (e.g.: relative amounts and frequency of rain during survey, effects of high ground winds and varying atmospheric pressure), and variables due to depth and mineralogical host of parent uranium atoms. Consequently, radon soil values should not be used in any quantitative context or to relate differing areas in terms of uranium potential.

As has been mentioned above, radon is also produced by decay of thorium. However, Rn^{220} from thorium has a half-life of only 54.5 seconds. Consequently, Rn^{220} cannot migrate any distance through soil and any anomaly due to it suggests thorium-rich material in the immediate vicinity of the hole. Thorium-derived radon can be distinguished from that derived from uranium by three successive one-minute counts. The activity due to thoron (Rn^{220}) will decay by half for each successive count. Thus the first-minute count would be about 2.5

times the third-minute count for activity due to thoron. Rn^{219}
is not of significance due to its short (3.9 seconds) half-life.

Results (Figure 6)

The results of the radon emanometer in the Old Fort Bay
area show a very low mean count rate of about one count per
minute, with a standard deviation of 1. Only one result showed
any significantly higher level, that of 7 counts per minute
(20 counts/3 minutes on map) and this is still a very low re-
sult.

The results probably have very little real significance,
and this is accented by the fact that there is almost no rela-
tionship between the radon emanometer and Track Etch results.
These methods both measure soil radon, however, the correlation
coefficient, r, is 0.15 for the Old Fort Bay area for 33 data
points. Correlation coefficient of zero means no correlation
and of one means perfect correlation.

The minimum error in radioactivity measurements is N
where N is the number of counts. That is a reading of 5 counts
per minute is in fact $5 \pm \sqrt{5}$ or 5 ± 2.3 counts per minute.
Thus there is no real difference between a measurement of 2
counts per minute and 8 counts per minute, or 6 and 14 counts
per minute. As most of the results are in the range of 0 to
3 counts per minute, these statistics must be borne in mind.

CHAPTER FIVE

HAMMER SEISMIC SURVEY

Theory

Following the suggestion of Hobson and MacAulay (1969)
hammer seismic technique was attempted on the Old Fort Bay
area. The instrument used was a HUNTEC FS-3 facsimile seis-
mograph rented from Kenting of Calgary. A consultant geophy-
sicist, Mr. Brian Henry, was hired from Kenting for 5 days to
help set up the methodology.

The HUNTEC FS-3 seismograph can be used in the refrac-
tion or reflection mode and is equipped with a variable gate
correlator that enables elimination of refractions from the
record. Refraction technique can be used with the hammer to
determine interfaces of depths of about 300 feet. Reflection,
on the other hand, theoretically enables depths of the order
of 1000 feet to be determined with the hammer seismograph.

The technique was first used to determine overburden
thicknesses by refraction. Reflection mode analysis was un-
successful in locating the Athabasca sandstone-basement con-
tact in the same locality. The GSC survey (Hobson and Mac-
Aulay, 1969) suggests depths of 500 to 2000 feet for this in-
terface. The reason for the lack of success of reflection
technique is partly due to the great depth present in the
area, and partly that the FS-3 supplied by Kenting was pos-
sibly not working properly in reflection mode. However, the

confidence of Hobson and MacAulay in hammer seismic work to depths of 1000 feet does not seem justified in the light of this work and their lack of good evidence for success.

Results

In the Old Fort Bay permit area, thickness of overburden is 20 to 110 feet. In the extreme north of the area, the sandstone-basement contact was identified by refraction at a depth of 300 feet.

Four shots and reverses were completed. In bush, a crew of two could complete two shots per day, when the method is developed for the area. This can be increased with more hammer-and-cable men.

The scope of the HUNTEC FS-3 would be considerably extended by the use of seismocaps. An explosives expert, costing $100 per day, would then be required. For the Old Fort Bay area, a survey using a 12-channel portable seismograph would be superior. This would enable detailed mapping of the Athabasca sandstone/basement contact.

Should geochemical anomalies be found, a seismic survey would be an invaluable aid to locating drill targets.

Summary of Seismic Shots (Figure 8)

Shot No.	Date	Overburden Thickness	Athabasca Thickness	Depth to Basement
1	June 6	50-110 feet	Undetermined	200 feet min.
2	June 3	95-100 feet	Undetermined	230 feet min.
3	June 4	90 feet	Undetermined	180 feet min.
8,9	June 8	No good record		
14	June 13	30-60 feet	240-270 feet	300 feet
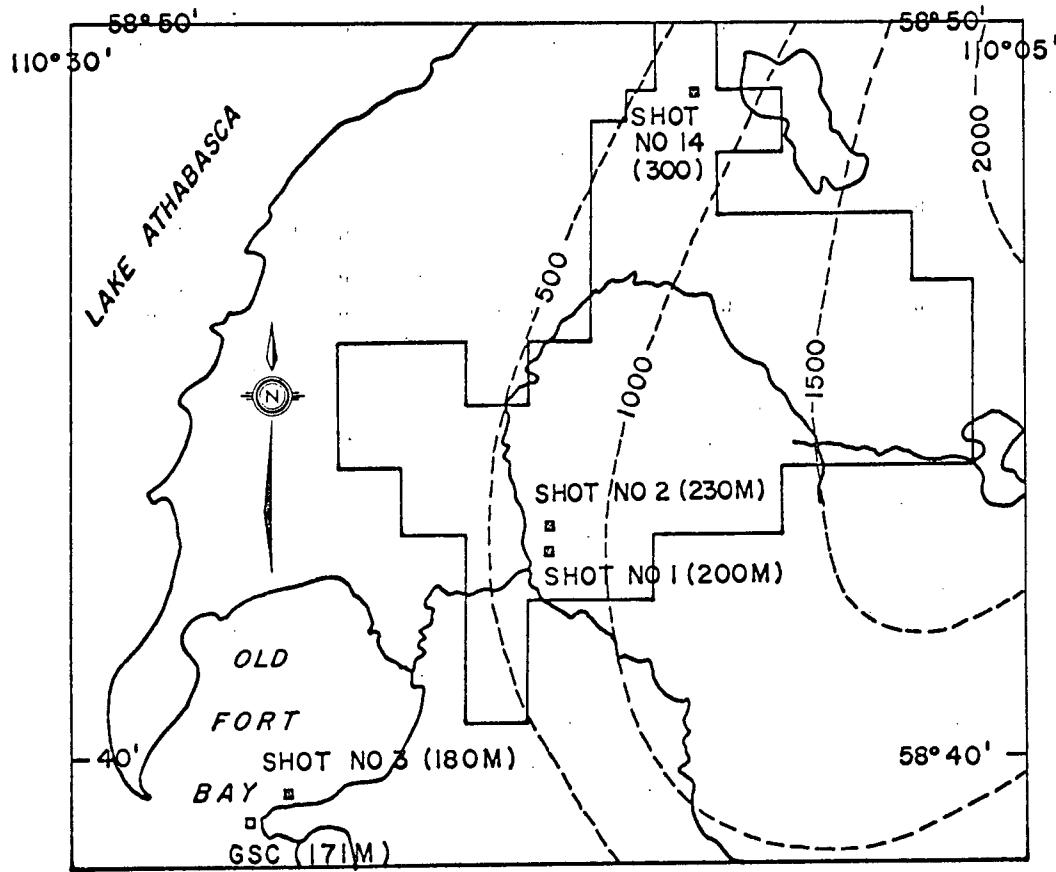
FIGURE 8.
HAMMER SEISMIC SHOT LOCATIONS
OLD FORT BAY AREA
JUNE 1976

LEGEND

▣ SHOT NO 3 (180M)	SHOT NUMBER AND LOCATION (DEPTH IN FEET) M = MINIMUM
--500--	GSC DEPTH TO BASEMENT APPROXIMATE DEPTH IN FEET
▫ GSC (171M)	GSC DEPTH TO BASEMENT (MINIMUM DEPTH IN FEET)

SCALE

M 1 0   5 M
KM 1 0   5   KM

197600l0
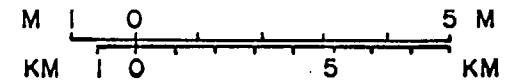
GEOCHEMICAL SURVEYS

Theory

The secondary environment media (lake, pond, stream water and sediments) commonly show extensive geochemical anomalies over uranium mineralization. The choice between water and sediment sampling is still a matter of heated debate among geochemists. In general, it depends upon the geochemical regime of the area concerned and therefore different terrains may require water and/or sediment sampling. In oxygenated environments (e.g. rivers), water has been shown to outline the anomalies better than sediments.

Uranium, being a very mobile element in the secondary environment, should always be considered with other lower solubility elements commonly associated with uranium mineralization, to delineate the anomaly. In Key Lake, Mo, Cu and Ni are commonly associated with uranium (Parslow, 1976). In the case of sediments, the knowledge of the amount of Fe, Mn and organic matter is critical as it is possible that they tend to "scavenge" uranium, resulting in false anomalies especially in oxygenated waters, where Fe and Mn are insoluble.

The solubility of uranium in water is strongly dependent upon pH, the knowledge of which can clearly validate the resulting analyses. For this reason water samples should be acified to prevent uranium precipitation on the walls of the container or on organic matter present.

Field Procedure

The geochemical survey for uranium on the Old Fort Bay permit area was undertaken during the first 3 weeks of June. A half-mile sampling grid was established over the permit area, on the 1:126,720 (1" = 2 miles) map. The survey extended to cover 192 sq. miles. As of June 15, samples were collected giving the average density of 1 sample/1.3 miles. At most sites both water and sediment samples were collected. Flying time averaged 1 water and sediment sample/6 minutes.

Where possible, the water and sediment samples were collected simultaneously. Water was hand-pumped into 100 m. hard plastic bottles. The lake sediments were collected into plastic bags, using the tube sampler designed by the GSC, attached to 70 feet of calibrated rope. This technique was inadequate when sampling lakes with a depth of 10 feet or less. On shallow lakes a jaw sampler should be used. Each of the samples collected were described to aid the interpretation of the results. The following parameters were noted: lake surface (indicating water movement); type of vegetation; type of lake; relief around the lake; colour of water; amount of suspended organic matter in water; depth at which sediment samples were collected. Finally, any possible contamination was noted. To make the results more meaningful, care was taken to sample small lakes in the middle and large lakes in the bays. The waters of Harrison and Clausen Creeks were also sampled.

The pH of selected samples was measured in camp using a Corning pH meter. Water samples were acidified with 0.5 ml.

of 10% HNO_3. Both water and sediment samples were shipped to Bondar-Clegg and Co. in Vancouver for analysis for U, Mo, Cu, Ni, and Mn contents and "loss-on-ignition" for sediments. "Loss-on-ignition" gives an estimate of the organic content of the sample.

It should be noted that sample localities in the middle part of the area are only approximate. At present time, the lakes are overgrown and have changed their shape.

Results - Water

The low content of uranium in the waters of the Old Fort Bay permit area is emphasized by the fact that uranium was below the detection limit of 0.1 ppb in every sample.

Results - Sediments (Figure 9)

The uranium content of 33 sediment samples is uniformly low, with a mean of 0.37 ppm. There are no exceptionally high results except for one isolated sample of 4 ppm. This is not sufficiently high in uranium to indicate mineralization.

It is apparent from the data (Appendix 1) that there is no relationship between any of the variables (metals and "loss-on-ignition") measured. It is sometimes suggested that manganese hydroxides or organic matter ("loss-on-ignition") can absorb or adsorb elements such as uranium or copper causing spurious anomalies. The absence of any correlations in the data presented implies the absence of any such processes.

This is presumably due to the extremely low levels of metals, such as uranium or copper, in the surface waters, as evidenced by the water geochemistry survey.

ASSESSMENT OF ANOMALIES FROM SATELLITE IMAGES

Introduction

The initial exploration area was defined on the basis of processing of LANDSAT images. The general area of the Cluff Lake uranium deposits of Mokta Ltd. was processed by density slicer to obtain a "ground truth" by Demex Corp. (For a general discussion of LANDSAT imagery and the density slicer see Inter-office Memorandum from W. Mercer to J.D. Harvey, November 4, 1975, page 4). The density slicer utilizes a black and white image and the operator can assign certain colours to certain reflectance levels. This is purely a technique for visual enhancement of certain features of a LANDSAT image. The density slicer was set in this investigation by Demex Corp. such that the area of interest - Cluff Lake region - shows a bright white colour.

The image of the area of exploration is then processed by density slicer at exactly the same settings, such that the areas of identical reflectance as the ground truth (Cluff Lake uranium deposits) show the same bright white colour (Figure 11).

The Old Fort Bay area was found to contain a particular concentration of areas of similar reflectivity to the vicinity of Cluff Lake.

LANDSAT Image Interpretation - Current Status

LANDSAT imagery and its application in mineral exploration has attracted considerable attention in recent years in the United States of America. Advances in the utilization of this advanced technology have been swift. In Canada, however, satellite imagery has not gained acceptance for a number of reasons, including: -

i) most of the country has been photographed from the air already;

ii) many areas where orebodies could be detected at the surface have already been explored by surface prospecting;

iii) Canada has few regions where abundant outcrop is coupled with lack of vegetation (as is found in the desert regions of the world) - in applying sophisticated techniques to LANDSAT images to distinguish areas of different bedrock types, even a cm-thick layer of lichen can obscure differences in reflectance.

In the USA, research by the Geological Survey has been directed towards the relationship between anomalous concentrations of metals in soil and bedrock ("mineralization") and health, or lack thereof, of vegetation. This has been done with a view to distinguishing healthy and sick vegetation on satellite images. The infrared part of the satellite image is particularly suited for this.

Sick plants are very distinctive in the infrared portion of the spectrum because of changes in the chlorophyll content, which has a marked effect on the absorbance of infra-

red light by plants. Unfortunately, attempts to use these factors in mineral exploration have so far been rather unsuccessful. This is largely due to different types of vegetation reacting differently to various metals and their contents in soil and rock. In most areas more than one species of tree, for example, is present and effects on individual species tend to canel one another out.

LANDSAT Image Anomalies - Evaluation for Old Fort Bay Area

In considering the Demex work discussed above we must focus attention on the following: -

i) what do the anomalies in the Cluff Lake area correspond to on the ground;

ii) what do the anomalies in the Old Fort Bay area correspond to on the ground;

iii) does it seem likely that the anomalies represent areas of high uranium content in soil or rocks, and if not, why not.

In the original report submitted by C. and E. Explorations Ltd. to Mattagami Lake Mines the density slicing data of the Cluff Lake area are presented. If one obtains maps showing the position of the Cluff Lake known uranium orebodies it is apparent that the anomalies indicated by Demex do not correspond to the position of the orebodies. Consequently, no simple explanation exists for the "anomalies" in relation to uranium, if they are related to it at all. This casts doubt on the validity of the Demex density slicing settings as used in the Old Fort Bay area.

Figures 10 and 11 show prints of the colour composite LANDSAT image and the density sliced image respectively for the Old Fort Bay area. A side-by-side comparison of the two images reveals some interesting features. Firstly, the "anomalous" areas on Figure 11 correspond to clearly visible yellow-to-salmon-pink areas on Figure 10. Secondly, the "anomalies" seem to correspond, not to a subtle change in vegetation due to anomalous uranium contents in the soil, but actually to abrupt, conspicuous changes in the vegetation. Inspection of black and white air photographs of the area reveal that the "anomalies" overlie damp low ground with muskeg and/or black spruce.

There seems to be no doubt that the Old Fort Bay area is underlain by at least 400 feet and possibly 2000 feet of Athabasca Sandstone (see Chapter Five, this study). Uranium orebodies are not expected to lie more than a few hundred feet above the Athabasca Sandstone - Archean basement contact and hence at least a few hundred feet below the present topographic surface. It is unlikely that uranium orebodies at such depths could have any effect on surface vegetation. Anomalous uranium in surface rock, soils, lake sediments or lake waters have not been found in the Old Fort Bay permit area by any of the exploration techniques used. Consequently, it is concluded that the "anomalies" cannot be due to anomalous uranium contents in the ground- or surface-water or soils.

Demex has implied the presence of lineaments in the Old Fort Bay area that can be distinguished on the density-sliced

image. Inspection of black and white air photographs shows
that lineations in the area are not due to any underlying
structure but firstly the action of the prevailing wind and
secondarily the direction of Pleistocene glacial movement.
The "anomalous", topographically low spots are in fact largely
between sand dunes, and such their shapes are controlled mainly
by the sand dunes.

Conclusions

1. The LANDSAT "anomalies" of Demex in the Cluff Lake area
    do not correspond to the location of known uranium ore-
    bodies.

2. LANDSAT "anomalies" of Demex in the Old Fort Bay area
    do not correspond to anomalous uranium in surface bed-
    rock, soils, surface waters or lake sediments, accord-
    ing to the geochemical investigations conducted in this
    study.

3. The above-mentioned "anomalies" of Demex appear to re-
    late to muskeg with or without black spruce.

4. Apparent lineations in the anomalies are in fact due
    to the combined actions firstly of prevailing winds
    (northwest) and secondarily, flow of the Pleistocene
    ice sheet (northeast). The low ground lies between
    sand dunes or glacially deposited ridges.

5. It is unfortunate indeed, if unscientific studies of
    satellite images combined with lack of knowledge of
    the nature of "ground truths" used and the geology and

vegetation of the area under investigation, combine to place LANDSAT imagery in disrepute among exploration geologists. This author believes that satellite data will be of great use to mineral exploration provided that the investigation of its possible applications is done in scientific manner.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

1. The Old Fort Bay permit area is difficult for mineral exploration due to absence of outcrop, depth of overburden and thickness of Athabasca Formation. No ideal reconnaissance techniques are available for this type of terrain.

2. Quaternary geology studies indicate that glacial sediments in the permit area are not of local origin and it is unlikely that the well-sorted dune sands would be of use in exploration.

3. Track Etch surveys are not ideally suited for reconnaissance exploration. However, no indication of anomalous values was found, to quote; "The Track Etch contour map shows little or no structure and is as expected from background statistics."

4. Radon emanometer survey was performed on a restricted scale but results are anyway all extremely low. Emanometer results are so low that little significance can be attached to individual results.

5. Hammer seismic surveys confirm the results of the GSC survey (Hobson and MacAulay, 1969) that the basement is at least 200 feet and maybe 2000 feet below the surface. Any uranium deposits present are expected to be either in the basement or close to the basement-Athabasca Formation unconformity.

6. Geochemical surveys for uranium in water indicates very low values. Comparison with geochemical surveys near Key Lake and Rabbit Lake result in the conclusion that there is no suggestion of uranium mineralization.

7. Geochemical surveys for uranium in lake sediments were restricted by the absence of many suitable lakes in the area. However, results are uniformly low and none suggest the presence of uranium mineralization.

8. The "anomalies" indicated by Demex to be in the permit area in fact appear to correlate with topographically low, muskeg areas. There is no indication of stressed vegetation resulting from high uranium contents in bedrock or soil.

9. None of the exploration techniques applied indicate the presence of economic uranium mineralization in the Old Fort Bay area.

10. It is concluded that the density slicing techniques of Demex do not distinguish areas of high uranium in the ground and consequently that present knowledge does not allow LANDSAT images to be used for detecting mineralization in vegetated terrains. This is confirmed by Canney et al. (1975).

11. Owing to the absence of any further possible exploration techniques short of blind drilling, it is recommended that Mattagami Lake Mines Ltd. should not retain the Old Fort Bay option.

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Respectfully submitted,

█████████████

William Mercer

Ph.D., M.G.A.C., M.C.I.M.M.

APPENDIX ONE

LAKE SEDIMENT RESULTS,

OLD FORT BAY PERMIT AREA

SAMPLE NUMBER	Cu ppm	Mo ppm	Mn ppm	W ppm	Fe %	CaF₂
46	2	ND	25	ND	30.3		
47	1	ND	28	0.2	16.4		
48	1	ND	40	0.4	41.9		
49	3	ND	52	ND	47.5		
50	3	ND	30	4	14.9		
51	4	ND	47	0.2	46.4		
52	3	ND	365	0.4	76.1		
53	2	ND	275	ND	68.0		
54	4	ND	120	0.2	58.9		
57	2	ND	130	ND	55.2		
58	3	ND	330	0.2	62.2		
59	3	ND	330	0.4	71.3		
60	2	ND	590	ND	30.9		
62	4	ND	225	0.2	59.8		
63	2	1	210	0.2	66.0		
64	3	ND	1300	0.2	66.3		
67	5	ND	685	0.2	62.9		
70	3	ND	48	0.2	60.1		
71	4	ND	50	0.4	75.7		
72	1	ND	25	ND	13.2		
73	1	ND	2	ND	2.6		
75	5	ND	92	1	82.8		
78	3	ND	20	0.4	42.6		
130	6	ND	40	0.4	86.7	₂F6	
131	6	ND	90	0.6	33.7		
133	4	ND	53	0.6	30.3		
134	3	ND	19	ND	15.4		
137	5	ND	175	ND	62.3		
139	1	ND	19	ND	2.7		
141	5	ND	325	0.2	65.7		
142	5	ND	365	0.4	74.0		
143	5	ND	505	ND	58.8	40.	
145	3	ND	32	ND	3.8		

APPENDIX TWO

TRACK ETCH DATA,
OLD FORT BAY PERMIT AREA

MATTAGAMI TRACK DENSITY (T/SQ. MM.)	NORTHERN FILM SERIAL NUMBER	FIELD NOTES AND DATA			
2. 007	85300.	U05	20	11001	0. 9
2. 302	85281.	000	16	42002	0. 9
2. 371	85277.	U00S	20	11001 BLDBURN	0. 9
2. 675	85303.	001	17	11001	0. 9
2. 820	85267.				
3. 525	85330.	U10	01	11	0. 9
3. 525	85328.	001	03	11	0. 9
3. 864	85240.	001	09	31001	0. 9
4. 682	85313.	U04	07	11001	0. 9
4. 935	85264.				
5. 351	85311.	U06	09	11001	0. 9
5. 492	85320.	U06	11	11	0. 9
5. 533	85289.	002	03	11001	0. 9
5. 533	85290.	001	07	31001	0. 9
5. 533	85296.	002	01	11001	0. 9
5. 640	85274.	U12	03	31001	0. 9
5. 797	85241.		03	31001	0. 9
6. 020	85286.	001	11	11003	0. 9
6. 020	85314.	U07	06	11001	0. 9
6. 020	85308.	U03	12	11001	0. 9
6. 173	85263.				
6. 296	85260.				
6. 324	85283.	002	14	11001	0. 9
6. 345	85327.	000	04	11	0. 9
6. 345	85270.				
6. 521	85255.				
6. 521	85254.				
6. 688	85310.	U02	10	11001	0. 9
6. 688	85316.	001	04	11001	0. 9
6. 688	85298.	U06	22	11001	0. 9
7. 196	85261.				
7. 196	85249.	002	14	11001	0. 9
7. 196	85253.				
7. 357	85301.	U04	19	11001	0. 9
7. 357	85302.	U12	18	11001	0. 9
7. 672	85280.	001	17	42002	0. 9
7. 729	85247.	U03	02	11001	0. 9
7. 729	85248.	003	01	11001	0. 9
7. 755	85275.	U15	02	11001 SWAMP BETWEEN	0. 9
7. 755	85268.				
7. 905	85285.	001	12	11001	0. 9
7. 905	85291.	000	06	11001	0. 9
7. 905	85279.	001	18	42002	0. 9
8. 026	85318.	002	02	11003	0. 9
8. 384	85252.				
8. 695	85297.	U12	23	11001	0. 9
8. 695	85299.	000	21	11001	0. 9
8. 695	85242.	001	07	11001	0. 9

MATTAGAMI TRACK DENSITY (T/SQ. MM.)	NORTHERN FILM SERIAL NUMBER	FIELD NOTES AND DATA	
8. 695	85278. 001	19 43002	0. 9
8. 695	85282. 001	15 11001DRYLAKE	0. 9
8. 924	85265.		
9. 130	85324. 003	07 11	0. 9
9. 165	85272. U10	05 11001	0. 9
9. 316	85256.		
9. 364	85305. U03	15 11001	0. 9
9. 610	85271. 001	06 11001	0. 9
9. 610	85269.		
9. 610	85266.		
9. 870	85273. U02	04 11001	0. 9
9. 870	85276. 001	01 11001	0. 9
9. 894	85262.		
10. 033	85307. 000	13 11001	0. 9
10. 033	85319. U06	01 11001	0. 9
10. 033	85317. U10	03 21	0. 6
10. 297	85321. 002	10 42	0. 9
10. 297	85322. U03	09 11	0. 9
10. 702	85315. 002	05 11001	0. 9
10. 702	85287. 001	10 11002DRYLAKE	0. 9
10. 702	85309. 002	11 11001	0. 9
11. 179	85253.		
11. 280	85329. 000	02 11 CLOSE CREEK	0. 9
11. 280	85326. 001	05 11	0. 9
11. 370	85288. 001	09 31001	0. 9
11. 370	85306. U03	14 11001	0. 9
11. 593	85239. U06	10 31001	0. 9
11. 593	85244. 002	05 11001	0. 9
11. 670	85325. U02	06 11	0. 9
12. 647	85284. 002	13 11001	0. 9
13. 438	85295. 002	02 11001	0. 9
13. 438	85294. 002	03 11001	0. 9
13. 492	85250. 001	13 11001BETWEENSWAMP	0. 9
13. 729	85323. U12	03 11	0. 9
13. 974	85251.		
15. 291	85257.		
15. 458	85243. 001	06 11001	0. 9
16. 052	85312. U12	08 11001	0. 9
16. 191	85259.		
16. 424	85246. 002	03 11001	0. 9
16. 600	85292. 002	05 11002DRYLAKE	0. 9
17. 390	85293. 002	04 11001	0. 9
18. 356	85245. 000	04 11001	0. 9
19. 397	85304. 000	16 52001	0. 9

Figure 9. MATTAGAMI LAKE MINES LIMITED — URANIUM IN LAKE SEDIMENTS, OLD FORT BAY PERMIT AREA

LEGEND

• 0.2   URANIUM IN PPM AT SAMPLE
         (SEDIMENTS) LOCATION

ND   NOT DETECTED

SCALE

M 1 0 1 2 3 4 5 M

KM 1 0 1 2 3 4 5 6 7 8 KM

MATTAGAMI LAKE MINES LIMITED

URANIUM IN LAKE SEDIMENTS
OLD FORT BAY PERMIT AREA

NORTH EAST ALBERTA

AREA: 74L N.E.	SHEET: FIGURE 9
	DATE: SEPTEMBER 1976

LAKE ATHABASCA

OLD FORT BAY

110°30'   110°00'

58°50'   58°45'   58°40'

27.

1976010

LEGEND

x   TRACK ETCH CUP LOCATION

-x---x-   EMPLACEMENT TRAVERSE

—8—   TRACK ETCH CONTOUR

     (for 8 tracks / mm^2)
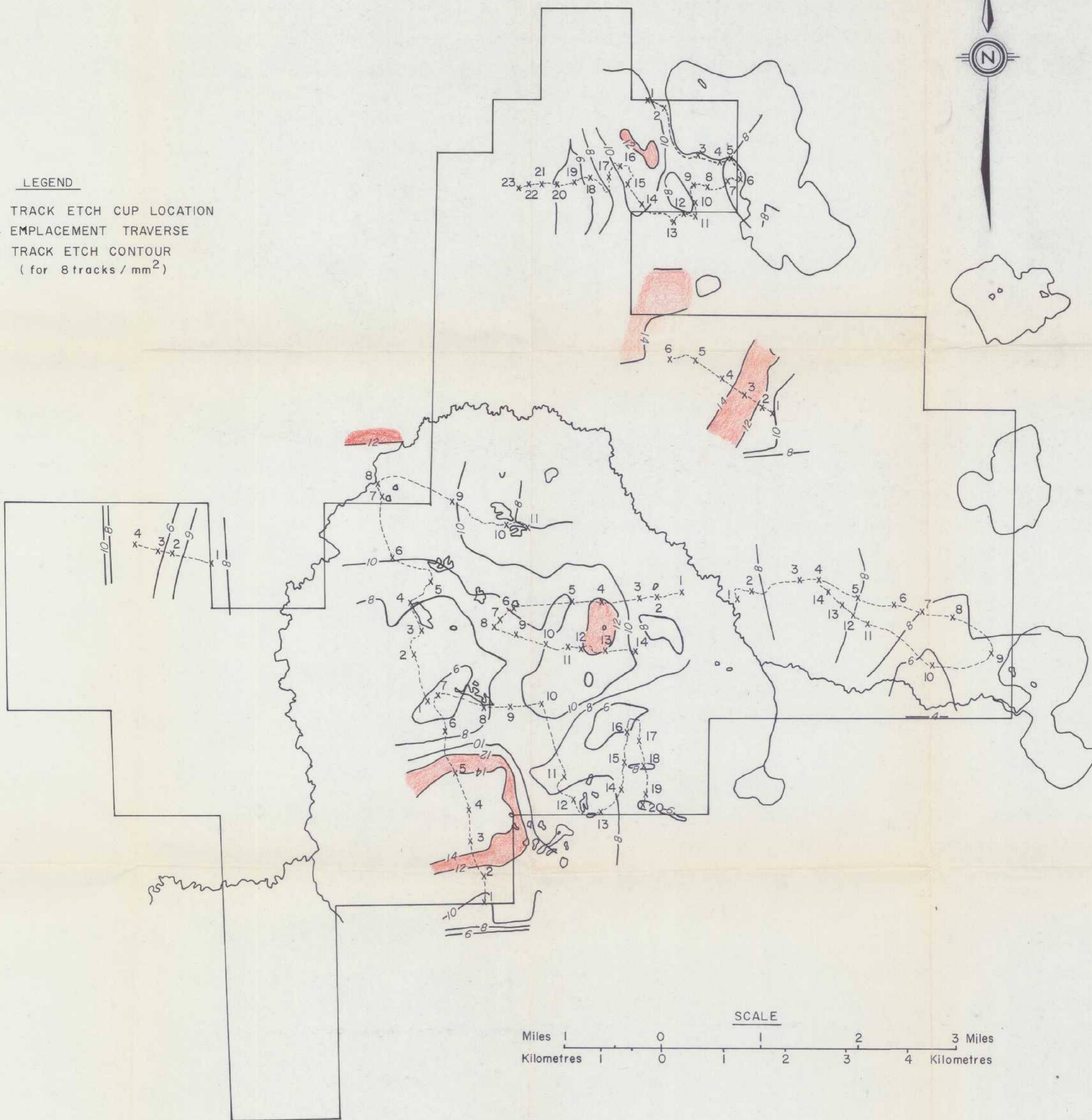
SCALE

| Miles | 1 | | 0 | | 1 | | 2 | | 3 Miles |

| Kilometres | 1 | | 0 | 1 | 2 | 3 | 4 | Kilometres |

| MATTAGAMI LAKE MINES LIMITED		
FIGURE 4 9760010. TRACK ETCH SURVEY CARD OPTIONS		
OLD FORT BAY AREA, ALBERTA		
TERRADEX CORP RADON	DWN BY: R.M.S.	
SCALE: AS SHOWN	DATE: OCTOBER 1976	

154

LEGEND

RECENT

EROSIONAL FEATURES

17 — Slump: mixed glacial and bedrock materials; unstable slope

16 — Gully, creek valley: thin colluvial cover on valley slopes; thin alluvial materials along streams

ALLUVIAL DEPOSITS

15 — Alluvial fan: bedded silt, sand and clay; variable thickness, overlying glacial deposits

14 — Stream alluvium: mainly sand along Athabasca River; sand and sandy silt along other streams

13 — Athabasca River delta: alluvial sand, silt and clay, calcareous

12 — Peace River delta: alluvial silt, sand and clay, calcareous

11 — Small stream delta: sand, silt and clay

10 — Early Athabasca River sediments and terraces: medium- to coarse-grained sand, overlying thin gravel and lag gravel

AEOLIAN DEPOSITS

9 — Aeolian sand, dunes: medium grained quartzitic sand in sheet and dune form; thick in dunes, 2 to 10 feet in sheet sand

PLEISTOCENE

GLACIOLACUSTRINE DEPOSITS

8 — Sand: thin, over glacial outwash sand and gravel

7 — Sand: thick, medium- to fine-grained sand with scattered silt and clay beds

GLACIOFLUVIAL DEPOSITS

6 — Meltwater channel sediment: medium- to coarse-grained sand, overlying thin gravel and lag gravel

5 — Outwash sand: medium- to coarse-grained sand with pebbles and small gravel lenses; surface level to gently undulating

4 — Outwash sand and gravel: medium- to coarse-grained sand and gravel, with many large boulders; generally thin with some outcrops of Athabasca sandstone; topography undulating to rolling

3 — Outwash sand and gravel overridden by glacier: fluted and drumlinized outwash of sand and gravel to gravel, with many large boulders; generally thick to very thick; topography undulating to rolling

2 — Ice-contact deposits: sand and gravel to gravel, numerous very large boulders; rolling topography, individual hills reach heights of several hundred feet; includes kame moraine, eskers, moulin kames, crevasse fillings, and other related ice-contact glaciofluvial deposits; form end moraines of glacier advances

PRECAMBRIAN

1 — Granite, gneiss and metasedimentary rocks: outcrops form hills and knolls; generally bare, locally covered with thin drift

Geological boundary: defined, approximate, assumed
Abandoned beach
Channel scarp (ticks indicate downslope side)
Athabasca sandstone outcrop
Crevasse filling
Drumlin (outline to scale)
Glacial fluting

Geology by L. A. Bayrock, 1969, 1970

BEDROCK GEOLOGY

M.A. Carrigy and R. Green, 1965
L. A. Bayrock and J. D. Godfrey, 1969
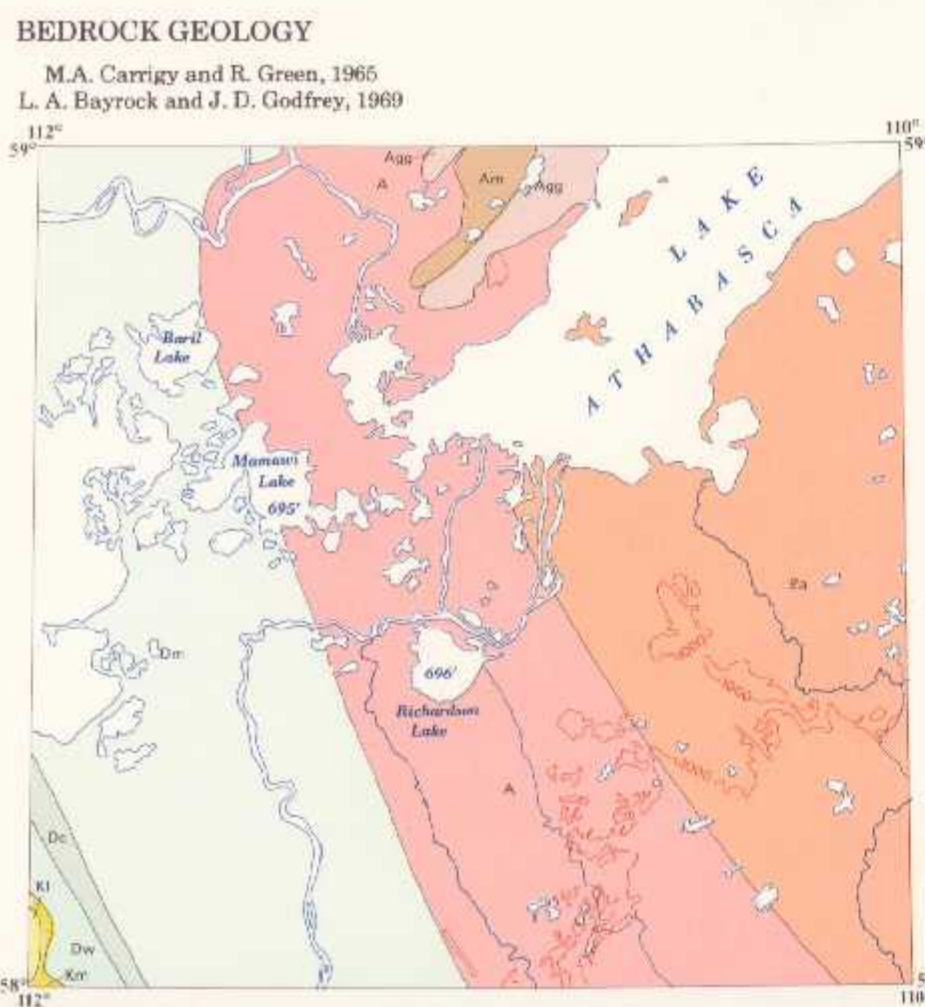
LEGEND

CRETACEOUS

Klr — Loon River Formation: dark grey shale

Km — McMurray Formation: oil-impregnated quartz sand

DEVONIAN

Dw — Waterways Formation: grey shale, argillaceous limestone

Dsp — Slave Point Formation: limestone and dolomitic limestone, minor shale and gypsum

Dm — Middle Devonian (undivided): dolomite, gypsum, anhydrite

PRECAMBRIAN

Pa — Athabasca Formation: quartzose sandstone, minor conglomerate and shale

Am — Metasedimentary rocks: quartzite, schist, phyllite

Agn — Granite gneiss

A — Granitic plutonic rocks

Geological boundary
Surface contour (contour interval 500 feet)
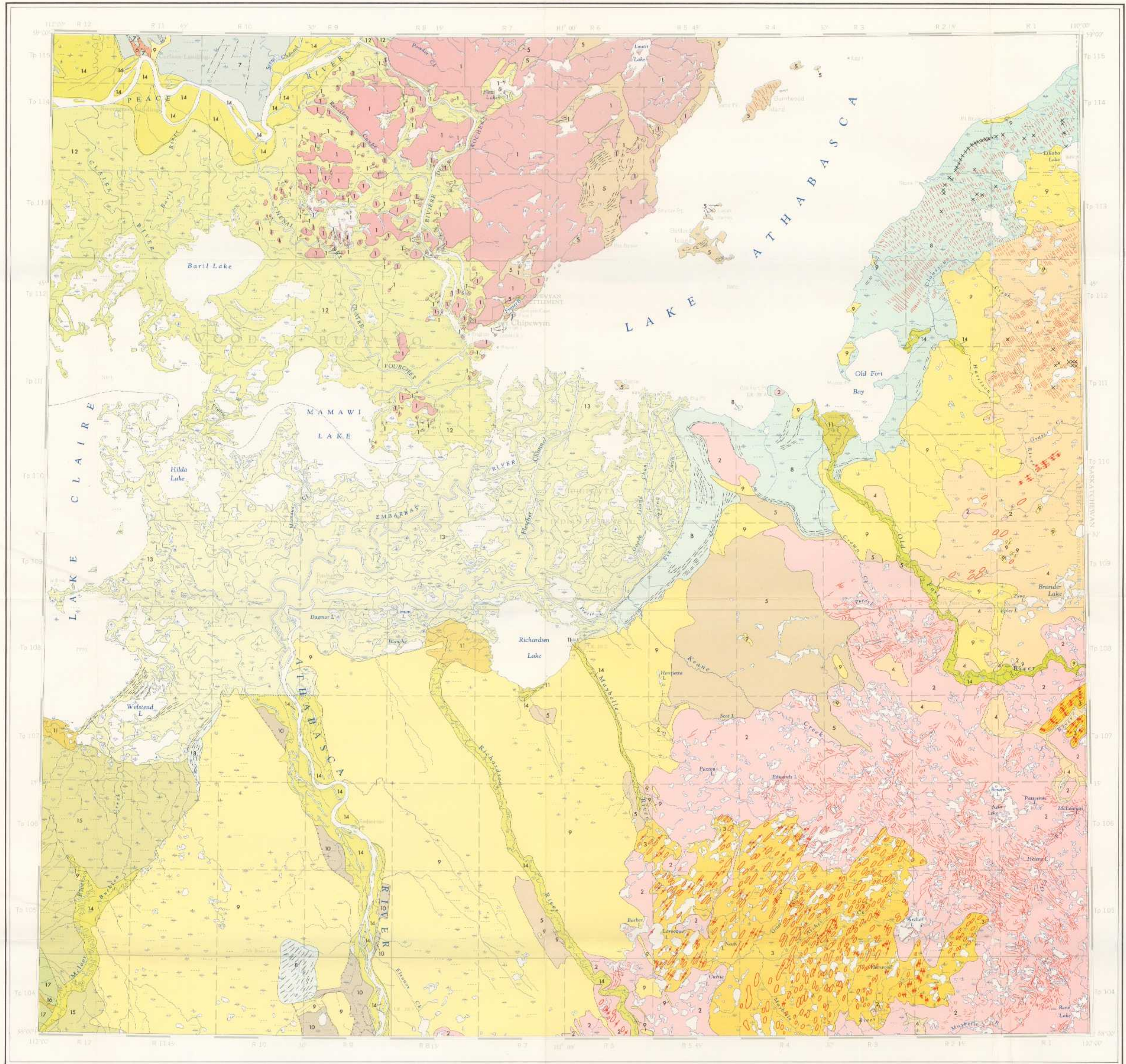
LEGEND

River or stream
Intermittent river or stream
Lake
Marsh or swamp
Township boundary; surveyed, unsurveyed
National Park boundary, Indian Reserve boundary

SURFICIAL GEOLOGY
FORT CHIPEWYAN
NTS 74L

FIGURE 2

1976 0010

DESCRIPTIVE NOTES

BEDROCK GEOLOGY

Precambrian rocks underlie the eastern two thirds of the area, although exposures in the heavily drift-covered terrain south of Lake Athabasca are few. The oldest rocks are crystalline Shield rocks which outcrop extensively in the Peace-Athabasca delta region and north of Lake Athabasca. They are divisible into three general types: granitic plutonic rocks, of various types, and metasedimentary quartzite, schist, and amphibolite. These rocks are overlain unconformably by nearly flat-lying quartzose sandstone and minor conglomerate of the Late Precambrian Athabasca Formation, which apparently extends under Lake Athabasca and the drift-covered area to the south-east.

Strata of Middle to Late Devonian ages are inferred to underlie the marshy lowlands along the western part of the region, although no outcrops were observed within the map area boundaries. From observations in nearby areas, the strata are assumed to comprise a succession of interbedded carbonate and evaporite deposits divisible into the three units described in the accompanying legend. They are overlain in the southwest corner of the area by Lower Cretaceous sandstone and shale exposed along the lower slopes of Birch Mountains.

SURFICIAL DEPOSITS AND LANDFORMS

Glaciofluvial Deposits

Ice-contact deposits form the surficial sediments in the southeast part of the map area, comprising a complex of kame moraines, eskers, moulin kames, and crevasse fillings. Kame deposits, with local relief ranging between 100 and 600 feet, are composed of sand and gravel to coarse boulder gravel, forming a series of northwest-trending end moraines in continuation with the Cree Lake Moraine of northwestern Saskatchewan. Crevasse fillings associated with kame moraines are relatively high and sinuous, grading into small eskers. Most are composed of gravel.

Centered in this complex of ice-contact deposits is a large area underlain by fluted and drumlinized outwash sand and gravel, containing materials overridden by a local advance of the glacier from the northeast. The drumlins, which trend northeast-southwest, are well shaped and mantled by a layer of large boulders. Flutings also are well developed and grade in places into drumlins; they extend together with gravel and drumlins onto the flat outwash plain south of Lake Athabasca. There, the outwash deposits cover an older drumlinized and fluted terrain, not entirely obscured by the younger sediments.

Outwash plains with nearly flat to gently undulating surfaces are widely exposed in the area south of Lake Athabasca, extending to the southeast under a cover of aeolian sand, adjacent to the Athabasca River delta. The outwash plain east of Old Fort River and extending to the Saskatchewan border is composed in places of large boulders of Athabasca Formation sandstone (quartzite) with the Shield erratics. It has little interstitial material and presumably overlies bedrock at shallow depths, in view of the frequency of bedrock outcrops in this area. Relatively short, straight crevasse fillings associated with the northern part of the outwash plain also are composed of large boulders of Athabasca Formation sandstone, among which bedrock outcrops of the same material are found. The outwash plain west of Old Fort River contains mainly medium- to coarse-grained sand derived from the Athabasca Formation. These deposits are thicker than those to the northeast; approximately 65 feet of outwash sand is exposed in the Athabasca River near Embarras airport, and similar thicknesses were observed on the Richardson and Maybelle Rivers to the east. Smaller bodies of outwash sand cover low areas in the Canadian Shield northeast of Fort Chipewyan as well as Bustard and Burntwood Islands in Lake Athabasca.

The high terraces along the Athabasca River and related channels adjacent to them, and small channels near Carlson Landing on the Peace River are interpreted here as *meltwater channel* landforms, although some of the associated sediments may have been deposited by nonglacial streams. The deposits are similar in that they contain a gravel layer at the base (thin or absent in places) overlain by variable thicknesses of fluvial sand. The channels are bounded by erosional scarps transected in places by the valleys of younger, postglacial streams.

Glaciolacustrine Deposits

Thin deposits of *glaciolacustrine* sand cover a wide expanse of flat ground along the south shore of Lake Athabasca, and flanking the east margin of the Athabasca River delta. Smaller areas of lacustrine sand are found west of the Athabasca River southeast of Lake Claire, and north of the Peace River in the vicinity of Carlson Landing. The deposits range from 2 to 5 feet thick and are associated in places with sandy beach ridges from 5 to 10 feet thick. The sediments were formed by reworking of older glacial deposits (mainly outwash) when Lake Athabasca covered a much larger area than at present, reaching elevations approximately 300 feet above the current lake level.

Aeolian Deposits

Aeolian sheet and dune sands derived from nearby outwash deposits cover a large area south of Lake Athabasca and the adjacent delta complex, extending from the Saskatchewan border in the northeast to the margin of the Birch Mountains in the southwest. Dunes are well developed in many parts of the area, although most are now stabilized by vegetation. Some dunes attain heights of more than 100 feet, and trend in a northwest-southeast direction. Two large active dunes are located in the vicinity of Richardson and Maybelle Rivers, and smaller active dunes are found along the shore of Lake Athabasca. Blowouts also are present on the crests of some of the larger stabilized dunes. In general, most of the dune sand is fine to medium grained, although coarse sand is present in the dunes in township 105, range 6.
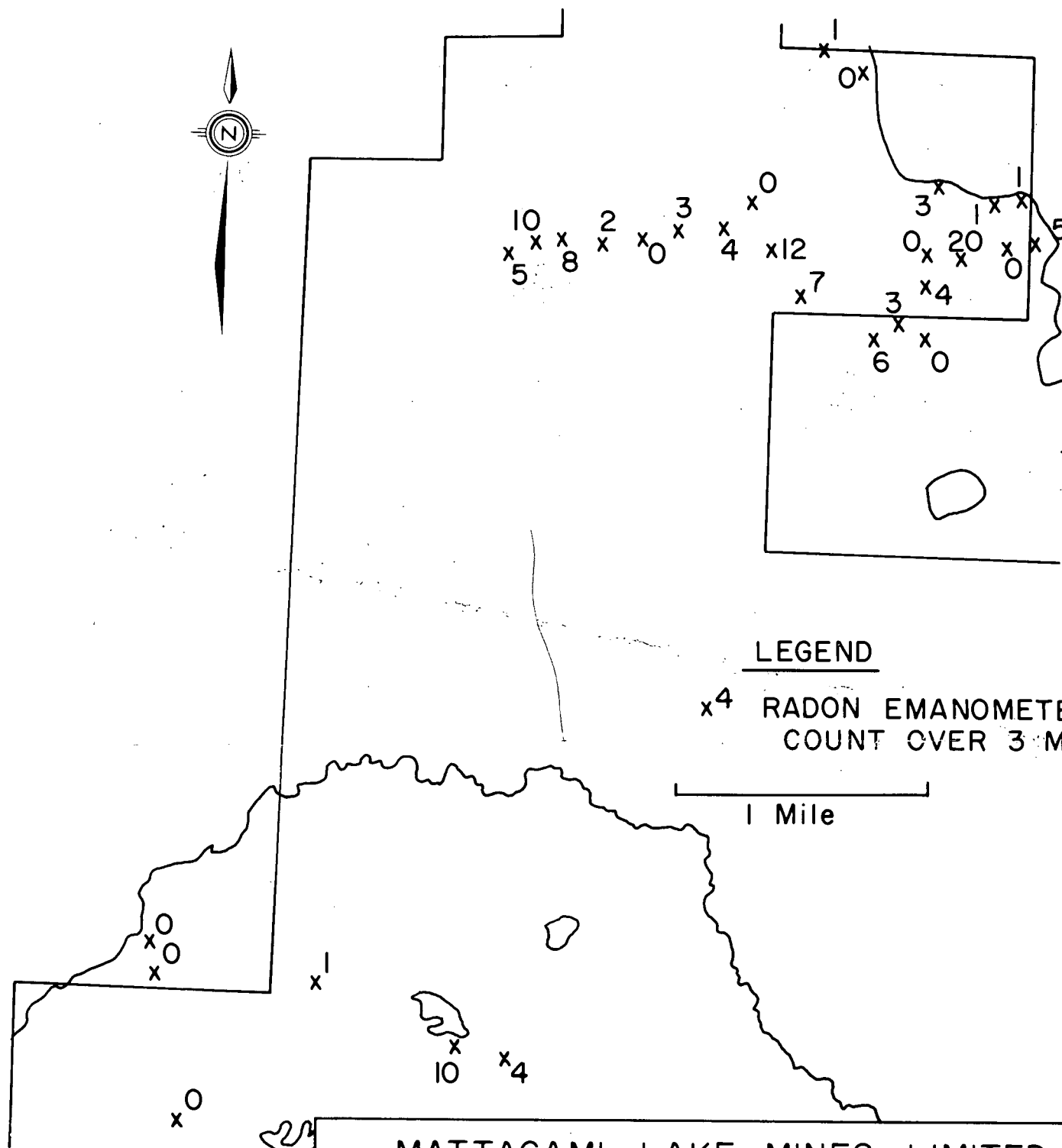
Alluvial Deposits

Deltaic sediments deposited by the Peace and Athabasca Rivers cover much of the lowlands adjacent to Lakes Athabasca and Claire in the west-central part of the map area. The deltas have converged, forming a continuous complex of sand, silt, clay, and organic deposits covered by a series of shallow lakes and swamps. Most of the Athabasca River bedload, composed mainly of silty sand, is deposited along the delta front near the distributary mouths. The silt and clay are deposited in the subaqueous part of the delta, although some material is carried to the Slave River through the Rivière des Rochers. In contrast, the Peace River delta contains much more silt and clay, for most of the bedload is carried downstream into the Slave River. Locally, the deltaic surficial deposits vary widely in sand, silt, and clay contents; generally the levees contain more sand than the interlevee areas, many of which contain shallow lakes and swamps.

Recent stream sediments occupy the valleys of the Peace, Athabasca, and smaller rivers. The floodplain sediments of the two larger rivers are predominantly silt and sand with a small amount of clay, whereas those of the smaller rivers (Richardson, Maybelle, and Old Fort Rivers) are mainly sand. An exception is the floodplain of the MeIvor River, which contains abundant silt and clay derived from the Birch Mountains to the southwest.

Alluvial fan sediments cover an area of approximately 100 square miles in the southwest corner of the area, skirting the flank of the Birch Mountains. They range in thickness from a few to more than 20 feet, thickening towards the Birch Mountains escarpment. Locally, the deposits are highly variable in texture, consisting of interbedded sand, silt, and clay derived from Cretaceous shales and sandstones underlying the upland to the southwest.

Erosional Features

Large-scale erosional features (slump, colluvium) are confined to the slopes of the Birch Mountains in the extreme southwest corner of the area.

Organic Deposits

Postglacial accumulations of organic materials, commonly called muskeg, mantle most of the surficial deposits described above. In general, these deposits are thin, although locally they may attain a thickness of 20 feet or more.
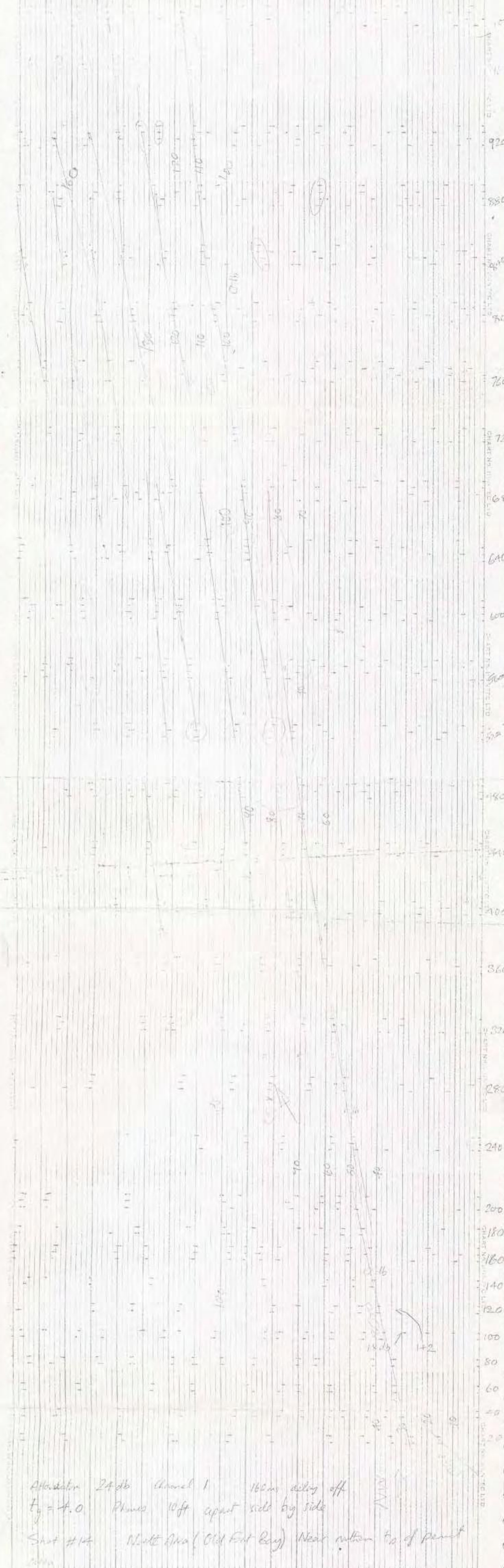
SCALE 1:250,000
1 inch to 4 Miles Approximately

KEY MAP

N

10
x   2   x   3
x   x   x   x   0
5   8   0   4   x12

x0
x
3
x   1
x   x   x   5
0   20   x
x   0

x7

3
x4

x   x   x
6   0

0x
x
1

x   1
x
3

LEGEND

x4   RADON EMANOMETER
     COUNT OVER 3 MINS

|————————————|
     1 Mile

x0
x   x0
x

x1

x
10   x4

x0

0   x

0   x

x   3

3   x

x8

| MATTAGAMI   LAKE   MINES   LIMITED |

| SURVEY FOR RADON IN SOIL GAS |
| ALBERTA |

| FIGURE   6 |

AREA NORTHERN	SHEET
SCALE 1:40,000	DATE JUNE 1976
W. MERCER AND PARTY	RMS

1976 0010

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