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REPORT ON UNGAVA URANIUM PROSPECTS TO THE UNGAVA SYNDICATE

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REPORT ON
UNGAVA URANIUM PROSPECTS
TO THE
UNGAVA SYNDICATE
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Ministère des Richesses Naturelles, Québec

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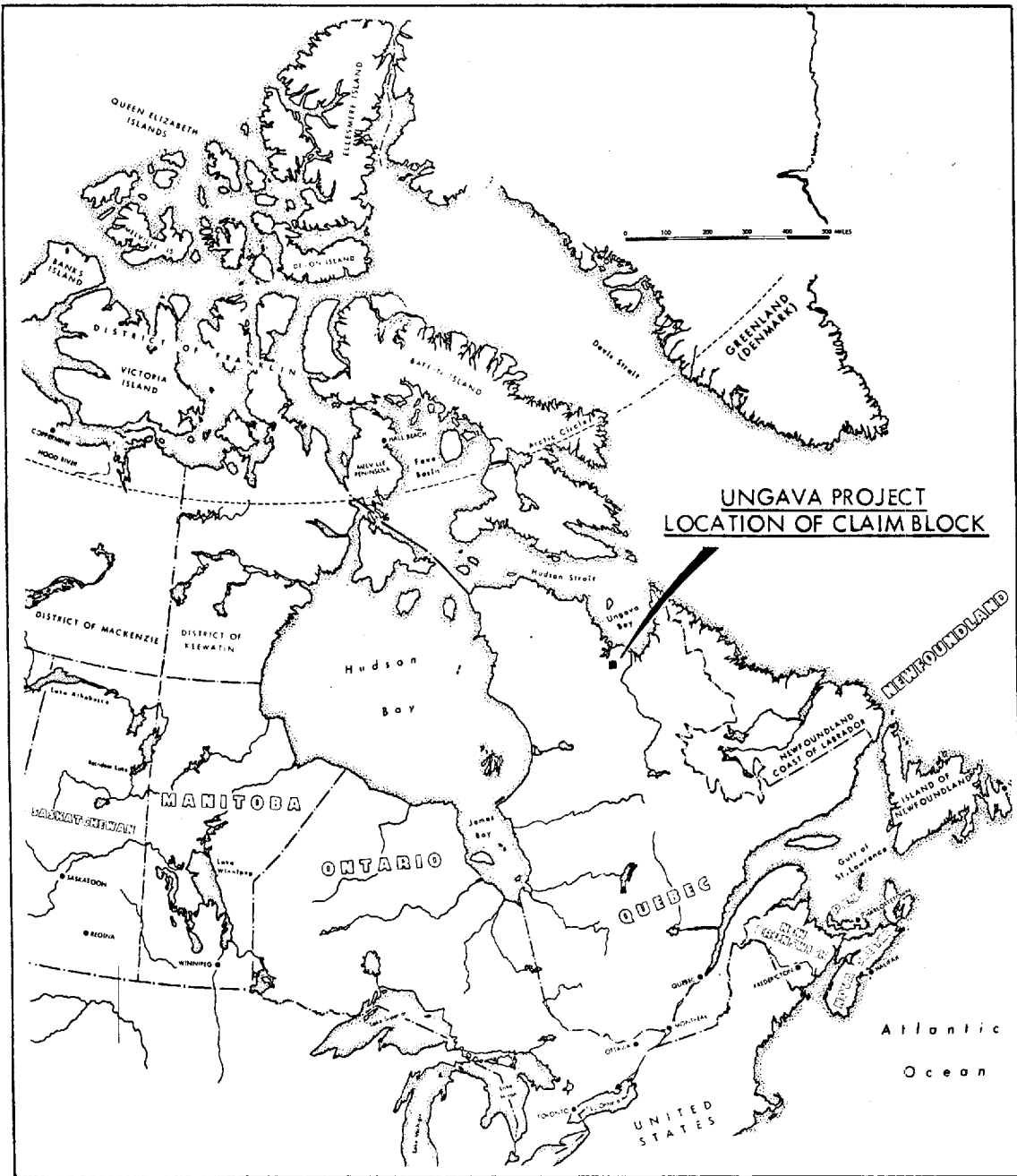
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REPORT ON URANIUM DEPOSITS
ON UNGAVA PENINSULA, QUEBEC
NORMAN H. URSEL ASSOCIATES LIMITED

HISTORY OF INVESTIGATIONS

In the summer of 1966, Mr. Ross Toms undertook airborne radiometric prospecting within portions of the Labrador Trough, a region in which uranium mineralization had not been reported. Under his supervision, the sources of anomalies detected were sought by radiometric prospecting on the ground. The present author, acting for Norman H. Ursel Associates Ltd., in the company of Mr. Toms examined some of these radioactive zones during the period April 25 to May 2, 1969. Some further airborne radiometric reconnaissance was done during flights between ground examination sites. An indication that radioactivity might be associated with iron formation in the area suggested that the scope of the investigation should be enlarged. Accordingly, ground radiometric prospecting of belts of iron formation was undertaken during the period May 12 to May 18, 1969. Extensive snow cover present during the first period of field work had partly diminished by the second period, but was still too extensive for satisfactory observations in many places. Another period of field work was undertaken at the beginning of breakup. The sought-for radioactivity in iron formation

had not been found during the second field period. A few more localities were checked, but during most of the third period emphasis was placed on examination of the Chioak formation, the host unit of the original radioactive showings.

Location

The subject of this preliminary report is a uranium prospect area approximately centered 63 miles due west of Fort Chimo, New Quebec. This region of the northern Quebec Arctic is southwest of Ungava Bay, in the southeastern portion of Ungava Peninsula. At this preliminary stage the area is not given explicit boundaries. Rather, it is operationally taken to be a strip lying east of the western margin of the Labrador Trough, and west of longitude $70^{\circ} 02'$. The area being considered lies within latitudes $58^{\circ} 28'$ and $57^{\circ} 45'$ and between longitudes $70^{\circ} 15'$ and $70^{\circ} 02'$. Latitude is slightly less than that of the Beaverlodge area in northern Saskatchewan, and 8° less than that of the Eldorado mine, N.W.T.

Access

All points within this roadless area lie within a few miles of one of many lakes accessible by float or ski-plane. Local flying services operate year around out of Fort Chimo and Schefferville, except for the period of freeze-up and break-up.

Nordair provides regular air cargo and passenger service between Montreal and Fort Chimo.

Fort Chimo, located south of Ungava Bay on tidewater of the Koksoak River, is accessible to small sea-going vessels from mid-July to mid-October. Another seaboard access point is Leaf Bay, the estuary of the Leaf River, about 40 miles north of the center of the area. At Leaf Bay occur the highest tides in the world, up to 54 feet, so that currents of up to 13 knots virtually prohibit entry to the inner estuary during ebb tide.

From this bay the area may also be reached by canoe through north-south trending waterways. Another canoe route follows the Koksoak River from Fort Chimo southeast to the confluence of the Kaniapiskau and Larch Rivers, thence up the latter and one of its northern tributaries into the southern part of the area. On this route several portages are required. Freighter canoes can be rented at Fort Chimo and taken up the Koksoak as far as the Kaniapiskau-Larch junction. Internally, the eastern portion of the area is most suited for canoe travel, while lakes in the west for the most part lack suitable interconnecting streams. Overland travel across the north-south topographic grain is possible in winter when lakes and rivers are frozen. By snowmobile, the area is 1 or 2 days travel from Fort Chimo.

Map and Air-photo Coverage

The area is covered by one series of topographic maps produced by the Surveys and Mapping Branch, Federal Department of Energy, Mines and Resources on the scale of 1:50,000 and another series on the scale of 1:250,000. The area is about two-thirds covered by Berard Lake Area Geological Map No. 1472, published by the Quebec Department of Natural Resources on the scale of 1:63,360, to accompany Geological Report 111 by Jean Berard (1965). There appears to be no geological map coverage for the portion of the area south of latitude 58° 00', save for very large scale maps which merely set out the boundaries of the Labrador Trough.

Topography

The northeastern portion of North America historically designated as Labrador is the large peninsula whose neck lies between James Bay and the Gulf of St. Lawrence. This landmass, now also known as either Labrador Peninsula or Labrador-Ungava Plateau is physiographically a peneplain with a regional slope toward the peninsula neck, i.e. toward the west and southwest. Inland around Ungava Bay, and including the prospect area, there is an extensive area which in its general centripetal slope toward the Bay is one areally extensive exception to the general regional (west and southwest) slope of the plateau.

While drift-covered belts occur throughout Labrador, and are especially prominent in its south-central portion, the plateau surface consists largely of rock plains and hilly terrain developed on plutonic rocks. Within the plateau there are also some Appalachian-Type Uplands. Of these, the Labrador Trough is the most areally extensive. Its valley and ridge topography is bedrock-controlled by folded sediments, greenstones, and sills. This geological belt and physiographic unit averages about 45 miles in width, and extends continuously for over 500 miles to the northwest, from the headwaters of the Hamilton River in south-central Labrador, to the vicinity of Payne Bay which is located on the west side of Ungava Bay.

The prospect area lies in the northern part of the trough, along its western boundary with the rock plains and rolling hills plateau topography developed on older plutonic rocks. Most of this plateau surface lies between the 700 and 1,000 foot elevation contours. Within the Trough, most hill-tops and ridge summits fall between the same elevations.

A north-sloping pre-glacial valley (Merchere-Dusay) lies in the eastern part of the prospect area, extending south to Lake Bassignac in the vicinity of Lake Napier. For this

major valley system, variation in valley bottom elevations as indicated by lake levels is only about 300 feet over the length of the area, from 450 feet elevation in the south to 150 feet elevation in the north. Lake Napier occupies the northern end of another valley system which slopes south.

To the east of the area, in the middle and eastern portions of the Trough, typical valley and ridge topography is present. In the prospect area itself, however, while persistent valleys are well developed, the intervening high grounds are not topped by continuous ridges, but rather by various hills whose slopes are usually steeper on the west than on the east. Where the capping of these hills is resistant dolomite, as is the usual case in the eastern part of the area, or resistant sandstone for the western part, then western slopes are commonly cliffs several score feet high. Northern and southern slopes may be topped by cliffs or scarps of lesser heights. These landforms reflect the generally east-dipping monoclinal structure of the underlying strata. Dissected cuervas, or cuervaform hills is an appropriate term for these land forms.

To the west of the major valley, other north-south trending valleys occur near the trough margin, and in places one or two valleys also occur in the interior of the prospect area. A prominent example of the latter type is the valley

extending from Hamecon Lake to the middle arm of Berard Lake. None of these valleys approach the length of the major Merchere-Dusay valley to the east.

The northern part of the large peninsula lying between the middle and east arms of Berard Lake is dominated by a broad dome, with dimensions of about 3.5 x 4.5 miles, and elongation in a northeast-southwest direction. Inland, where the dome flattens, the highest point is about 250 feet above lake-level.

Drainage

Except for that originating in the southernmost end of the area, all runoff drains northward into Berard Lake, from which it continues northward via the Chioak River into the brackish tidewaters of the Leaf River. The northwestern part of the area drains to the middle arm of Berard Lake by way of the river which interconnects the lakes (Four Bears, Hamecon, Dragon) occupying the major north-south valley in that area. The other north-south trending valleys in the western part of the area are connected by east-west water gaps to the Merchere-Dusay valley. Thus the largest part of the area drains to the east arm of Berard Lake by flowing through the Berard River which interconnects the series of elongate lakes (Bassignac, Merchere, Abner, Bones, Gourdon, Dusay) occupying this valley.

The southern portion of the area extends into the Larch River drainage area. Here the drainage style is similar to that for the Leaf River drainage area. Not only is there a major eastern valley towards which western waters tend through a series of water gap connections between elongate north-south lakes, but also the main eastern valleys are moderately well aligned with one another across the divide. In this valley, Lake Napier is the major lake, and its outlet drains to Denis Lake which in turn drains by a small meandering river flowing south into the Larch River.

A rectangular drainage pattern is present in the plutonic rocks west of the Trough. Streams flowing easterly enter the prospect area as small cataracts dropping down steep bedrock channels from incised hanging valleys above. This results from the presence along the Trough margin of moderately deep valleys which streams from the plutonic rock plateau must confront.

Vegetation and Wildlife

The area lies in a northern extremity of a forest tundra subzone of the Arctic tundra. Areas of lichen woodland intermingle with lichen-heath tundra. On some low ground and on some slopes, Black spruce and larch form thin woodlands

and local closed crown stands. Birch and poplar are the largest deciduous trees, but both these and the conifers are usually less than 20 feet tall. Extensive alder-willow thickets occur on low, wet ground in the main eastern valley, which is also the site of the most important stands of the larger trees.

Treeless barren land is present on virtually all high ground, on many slopes, and in many western valleys. On this tundra, lichens and moss are abundant. Various shrubs including flowering and edible berry types are common. This heath is usually thin and not dominant over the lichen-moss carpets. In summer, this cover in areas of dry tundra represents a fire hazard. On the other hand, firewood made from the larger trees tends to be low-sparking, so it burns evenly and quietly.

Fresh water fish, ptarmigan, and migratory water-fowl are plentiful in the area. A few caribou and bear are present, together with some smaller fur-bearing mammals.

Inhabitants, Settlement, and Natural Resource Development

About 1,900 Eskimos live along the shores of the Labrador Peninsula. Their traditional occupations are hunting and fishing but their adaptability to other types of work is well known. Many Eskimo families live in Fort Chimo which is the nearest settlement to the report area, and the most important Hudson's Bay post in northern Quebec, its origins

dating back to the Hendry expedition of 1828. Also present in Fort Chimo are a detachment of the Quebec Provincial Police, federal and provincial schools, a hospital, Department of Transport Meteorological station and public works administration, restaurant, transient lodgings, Eskimo Co-operative store, Anglican and Roman Catholic missions, an air line branch, a local flying service, and a former air base.

The provision of services for sport fishing contributes to the local economy. Commercial fishing is also done on a small scale which could be increased to supply an expanding local market. An experimental musk ox farm is operative near Fort Chimo, southeast of the Koksoak River. The combination of adverse climate and rocky or swampy ground is unfavourable for conventional crop growing, although from time to time certain vegetables have been grown outdoors in Fort Chimo. There, the Roman Catholic mission is planning to construct a greenhouse.

In the prospect area itself, a camp of five log cabins built from local timber by the Fenimore Iron Mines Ltd. has been acquired for the syndicate by staking. The camp sits on a peninsula on the east side of Bones Lake. These buildings are basically sound and require mainly chinking, and roofings of plastic sheeting for summer occupancy. For winter use, installation of plywood for flooring, inside walls, and low ceilings would make it possible to heat these buildings with oil stoves.

GEOLOGY

General:

Archean plutonic rocks outcrop to the west of the Labrador Trough. These form the basement which is unconformably overlain by the Proterozoic rocks of the Trough. The major units in the lower part of the Proterozoic sequence are quartzite and iron formation. These are separated by an unconformity from the overlying clastic, carbonate, and volcanic units. Lithic fragments found in the coarse clastic rocks (Chioak formation) include all of the underlying rock types. In the upper sequence, the boundary between the major lower clastic unit (Chioak formation) and the overlying carbonate unit (Abner dolomite) is transitional or oscillatory. Dolomite interbeds are also present in the thick marine accumulation of shale and siltstone (Larch River formation) occurring above the carbonate unit. Lavas (Hellancourt formation) overlie the sediments in the eastern part of the area, and there gabbro sills also occur.

The Proterozoic rocks are nearly horizontal near the basement contact. Monoclinial structure, with increasing steepness of dip to the east, underlies much of the area. A flexure located along the Merchere-Dusay Valley separates two monoclinial units. Folds, commonly open, are present in parts of the monoclinial terrain. They tend to be more

Table 1

| <u>Formation</u> | <u>Lithology</u> | <u>Notes</u> |
|------------------------|---|---|
| Recent and Pleistocene | Glacial deposits Erosion | |
| Proterozoic | | |
| Intrusives | Meta-gabbros Intrusive contact | |
| Metamorphic rocks | Phyllite, schist, various sandstones, Dolomite, Iron bearing rocks | Interstratified with gabbro sills, southeast of Berard Lake. |
| Hellancourt | Lavas Pyroclastic rocks Schists | |
| Larch River | Shale, siltstone Slate, phyllite, schist Sandstone and dolomite interbeds | Thickness: 25 to 150' + |
| Abner | Dolomite | Thickness: 100 to 400' (Thickness of beds generally decreases upwards) |
| Chioak | Shale Sandstone, siltstone Conglomerate | Thickness: 600 to 800' |
| | Discordance | |
| Dragon | Siltstone-shale Sandstone | Thickness: 115' |
| | Erosion and discordance | |
| Fenimore | Carbonate facies Oxide facies Sulphide facies | Thickness: 0 to 120' |
| Alison | Quartzite | Thickness: 40 to 50' (usually accompanies the Fenimore) |
| Lower Dolomite | Dolomite | Occurs in only 3 places, west of Merchere Lake. |

Proterozoic

Erosion and discordance

Archean

Dikes

Meta-diabase; ultrabasics

Intrusive contact

Granitic
Intrusions

Pink granite
Diorite, granodiorite

Intrusive contact

Ancient
Gneiss

Amphibole gneiss

abundant in the fine-grained rocks of the Chioak formation. Closed folds, overturned to the west, become common farther east.

The presence of argillites, phyllites, and chloritic schists indicates that low grade metamorphism has affected the Proterozoic rocks. Metamorphic grade is higher in Proterozoic rocks to the east and to the north of the area.

Table of Formations: Table 1 lists the major rock units, from youngest to oldest. It is slightly modified from Berard's Table of Formations (p. 10, 1965), which applied to an area larger than that of interest here.

Chioak formation: In terms of thickness and areal extent, the Chioak formation is the most important Proterozoic unit in the area. It contains a variety of detrital rocks, some of which Berard considered to be sufficiently distinctive and extensive to constitute lithologic members. These are not separately mapped or defined by reference to measured sections. Examples of these members include iron-bearing conglomerate, conglomerate with granite fragments, various sandstones, and black or red pelitic rocks. Berard noted that the grain size of exposed rocks generally decreases to the east, which represents a horizontal granular facies change. Compositional changes occur in a vertical direction, and despite the lack of horizon markers,

Berard was able to infer some compositional changes also in a longitudinal horizontal direction, because along the Trough there is some correspondence between the composition of basement rocks and that of Chioak sediments exposed to the east. For example, pink sandstone (arkose) occurring in the southwestern part of the area is apparently derived from pink granite present nearby in the basement.

The principal constituents which may occur in the main rock types recognized by Berard in the Chioak formation are listed in Table 2.

Table 2

Arkosic conglomerate with granite fragments

Coarse material : granite fragments
matrix : arkose
cement : calcite, argillaceous minerals

Iron-bearing conglomerate

coarse material : quartz, gneiss, dolomite,
siltstone, shale, quartzite,
jasper, iron-bearing rock,
black jasper, red conglomeratic
sandstone
(all usually well rounded)
matrix : ferruginous arkose
cement : secondary quartz, ferrodolomite,
hematite

Cherty conglomerate

coarse material : grey or black chert, quartz,
quartzite, granite, gneiss,
shale, jasper

matrix : arkose

cement : silica, chert, ferrodolomite,
argillite, authigenic chlorite

Pink sandstone (arkose)

main constituents : feldspars, quartz

cement : sericite with calcite and chlorite

Black sandstone (sub-greywacke)

main constituents : feldspars, quartz, chert,
rock fragments

cement : secondary chert, ferrodolomite,
authigenic chlorite, clay
minerals, quartz

Light grey sandstone

main constituents : feldspars, quartz

cement : sericite

Sandstone with ferrodolomitic cement

main constituents : quartz, feldspars, chert

cement : ferrodolomite

Sandstone with ferruginous cement (red sandstone)

composition similar to pink sandstone plus abundance
of disseminated iron oxides

Sandstone with siliceous cement

present as discontinuous portions of beds of other
sandstones

Red, green, black, and grey shales

mineralogically similar to the above sandstones and
conglomerates of which they are the "microgranular
facies", occurring as beds at many horizons in the
Chioak formation, and becoming more abundant to the east.

Berard (1965) made some generalizations about the stratigraphic relationships and areal distributions of the above rock types: Black sandstone "which is especially common to the west of Garigue (Bones), Gourdon, and Berard Lakes, is interbedded with black shales." The cherty conglomerate "is the most extensive and thickest of the conglomerates. It outcrops almost continuously along the contact with the basement rocks, from Alison Lake to north of Berard Lake." The arkosic conglomerate with granite fragments "is observed mainly to the southwest and west of Merchere Lake.", and red sandstone is also abundant here where "it alternates with the pink sandstone and arkosic conglomerate." The pink sandstone member "is not always observed in the same stratigraphic position At the north end of Merchere Lake, (it) lies above the black sandstone and below the red sandstone and iron-bearing conglomerate." The latter conglomerate "outcrops mainly west of Merchere Lake, north of the fault cutting the basement rocks and the overlying sedimentary rocks of that district." Both the light grey sandstone and the sandstone with ferrodolomitic cement are abundant west of Chioak Lake.

Chioak formation south of latitude 58°00': Reconnaissance observations were made in the southern part of the area, which is not covered by Berard's mapping. The Abner dolomite, with its distinctive rough weathered surface of

quartz vein networks, was recognized in places in the central part of this area. Between this unit and basement rocks to the west, there is a predominantly clastic sequence which appears to correlate with the Chioak formation to the north.

A basal arkosic conglomerate is present, which may be the same Chioak member described by Berard in the occurrence south of Merchere Lake. Boulders occurring on a hill east of Imbault Lake indicate that arkosic conglomerate with granite fragments is also present higher in the sequence. Still higher, other conglomerates (polymictic) occur east of Lower Imbault Lake. In these, a variety of coarse material is present, including quartz, grey chert, jasper, granite, and schist. A distinctive conglomeratic dolomite found east of the southern end of Lower Imbault Lake consists of red jasper pebbles in a matrix of green dolomite. Berard describes a similar rock, occurring west of Merchere Lake, where it is in a similar stratigraphic position near the top of the Chioak formation.

Between the conglomerates, the clastic sequences, which dip shallowly to the east, include pink sandstone, red sandstone, calcarenites, green, grey, and red shale, siltstone, and argillite. Cross beds are common in the sandstones. A stromatolitic red limestone bed, found at several places east of Imbault Lake, may be a useful marker horizon.

From reconnaissance, the stratigraphic succession in the Chioak formation in the Imbault Lake area appears to be cyclic. This is a characteristic of shallow water (deltaic coastal plain) deposition on an unstable shelf.

ECONOMIC GEOLOGY

Airborne and Ground Radiometric Prospecting

Method: During the third field period a large part of the area was flown with a scintillometer (Figures 1 and 2). The prospecting method of airborne radiometric reconnaissance was used, i.e., flying at less than 200 feet above the ground, with one man reading gamma-ray counts and another locating and plotting the readings along flight lines drawn on a topographic map. The flight lines were usually two miles apart, oriented east-west across the structural grain. A McPhar TV-5 scintillometer was used, its probe attached to the cargo rack frame of a G-4 helicopter.

As an aid to the interpretation of results, radioactivity was checked in various places on the ground, not only over areas of higher radioactivity, but also over some areas of low and/or fairly uniform airborne response. "Noise" superimposed on aereoradiometric data by abrupt ground clearance changes is not a serious problem, since reference to topography was readily made on the field-plotting maps. However, another topographic effect produced false anomalies not at first recognized as such. In the eastern part of the area, north of Couteau Lake and east of Abner Lake, a greenstone ridge rises steeply to the east from the adjacent gentle slopes underlain by slates of the Larch River formation.

Anomalously high values appear to straddle the contact. These could not be accounted for on the ground where the greenstones were found to be virtually non-radioactive, and the slate, although more radioactive than the average shale by a factor of 2 or 3, was not less radioactive away from the contact. It appears that the anomalies are produced by an approximate doubling of the mass effect when the probe is in a position to receive radiation from two sources, i.e., from the ground below and the steep slope ahead.

Results: In the instances followed up, and with the exception of the "noise" and false anomalies discussed above, the sources in areas of higher radioactivity indicated from the air were found on the ground. These are usually found in outcrop, but in drift-covered areas, radioactive boulders in some cases appear to be the sources. On the other hand, low radioactivity indicated from the air could also be confirmed on the ground.

Hellancourt formation, Abner dolomite, and Alison quartzite

The pillowed and massive greenstones of the Hellancourt formation, where tested on the ground over a 3 mile traverse north of Couteau Lake, gave values barely above natural radiation background. Slightly higher values were obtained on outcrops of the Abner dolomite and on the Alison quartzite at scattered localities.

Fenimore iron formation

Testing of the various facies of the Fenimore iron formation gave values comparable to those obtained for the latter two units. The Fenimore was prospected for radioactivity in the following areas:

- south and southwest of Merchere Lake
- north of Bones Lake
- west of the east arm of Berard Lake
- north of Berard Lake Peninsula
- south and west of Patino Lake

On the slope west of Patino Lake, surface concentrations of radioactivity were encountered intermittently for approximately one mile along the length of the lake. Lichen- and moss-covered, low, wet spots were favoured, but several vegetation-free patches of frost-heaved rock chips mixed with soil also gave moderately strong readings. The highest was comparable to that obtained on an outcrop of a rock which contains about 0.01% U_3O_8 . However, on the upper parts of the slope where outcrop is abundant, uniformly low readings were obtained on bedrock (cherty carbonate facies of iron formation), including places a few feet from loose surface material over which moderately strong radioactivity was observed.

Dragon formation and Larch River formation

The Larch River slate and the Dragon formation (siltstone-shale) were examined in only a few places on the ground. For both, scintillometer tests indicated a uranium

content of about 10 parts per million, which is about 2 to 3 times the content of an average shale, although not especially high for dark shales.

Chioak formation

Several radioactive occurrences have thus far been found in the Chioak formation. They are discussed in order of their location in the area, from north to south.

Berard Lake Peninsula: In the southwestern part of the Berard Lake Peninsula, on top of a hill about 500 feet north of Claim No. 9521, there is a steeply dipping, 25 to 35 foot thick sequence of radioactive, thin bedded and very thin bedded, dark grey shale lying between medium, thick, and very thick beds of grey sandstone. The succession strikes N 10°W, changing to due north towards the north, and dips 77°E. When examined, the unit was snow-covered both on the north and the south; radioactivity was fairly persistent for the then exposed strike length of about 300 feet. Across the unit, and along the exposed length, the least radioactivity was estimated to be usually not less than one-half the highest radioactivity. A grab sample assayed less than 0.01% U₃O₈ (TSL Assay No. 603) and less than 0.01% ThO₂. A rough estimate of the U₃O₈ content is possible since the instrument used in the field (McPhar TV-1) is capable of gamma-ray threshold energy discrimination. The

radioactivity due to uranium was about one-half that measured for assay sample No. 605 (Table 3, infra). Therefore, the estimated U_3O_8 content of the shale sample is 0.005%. The highest reported Canadian shale assay is 0.007% U_3O_8 for a sample of the Banff formation.

South shore of Four-Bears Lake: Weathered radioactive conglomerate boulders occur immediately south of Four-Bears Lake. This locality is about 8.5 miles south of the above radioactive shale occurrence. Rounded quartz and black chert pebbles, and white feldspar clasts occur in a grey sandy matrix. The presence in the matrix of ferrodolomite cement in variable amounts probably accounts for the buff weathering colours and the tendency of the weathered boulders to become accumulations of the loosened clastic constituents.

The conglomerate is interbedded with very coarse grained sandstone and conglomeratic sandstone of similar composition, but usually of lesser radioactivity. The conglomerate horizons which are rich in quartz pebbles, and poor in black chert pebbles, tend to be most radioactive. Readings obtained for these were slightly higher than those obtained at the above radioactive shale locality.

2.5 miles south of Four-Bears Lake: Radioactive horizons occur in a sequence of conglomerates, sandstones, and conglomeratic sandstones exposed in a series of low monoclinal ridges about 2.5 miles south of Four-Bears Lake, in the western portion of

the Chioak formation, near its unconformable contacts with basement, the Alison quartzite, and the Fenimore iron formation. From west to east, away from the contact, the first of the more radioactive units detected is approximately 0.2 miles away from the contact. The unit is a 3 to 4 foot thick conglomerate bed, striking N 5°W, dipping 7°NE, and underlain and overlain by coarse grained to very coarse grained flaggy sandstone. The conglomerate contains moderately well rounded quartz and chert pebbles (up to 2", mostly less than $\frac{1}{2}$ "), and feldspar clasts. The matrix contains some finer grained clastic material whose nature is not ascertainable in hand specimen because of a very fine grained dark grey cement (probably authigenic chlorite) which tightly coats all of the clastic material, including the pebbles. This rock type is apparently Berard's "cherty conglomerate" which he found to characteristically have an arkosic matrix.

The sandstone occurring above and below is feldspathic and biotite-rich. A radioactive horizon is present in the underlying sandstone, about one foot below the conglomerate.

Radioactivity in the conglomerate itself is approximately the same as that observed for the above ferrodolomitic conglomerate at Four-Bears Lake, and it persists, with local variation, for the exposed strike length of about 200 feet.

It exhibits 3 to 4 times the average radioactivity (value) of other units in the local sequence which were in themselves higher than normal background as measured over lake areas.

Another equally radioactive unit occurs on the next ridge, about 400 feet to the east. It is a resistant bed of grey conglomeratic sandstone, with poorly rounded quartz pebbles and few chert pebbles.

On a reconnaissance traverse from the last locality northeast toward the group of unnamed lakes in the center of the valley, several grey conglomerate beds were found to be radioactive (2 to 3 times average background of other beds). Dips flatten towards the east, becoming near horizontal in the central portion of the valley which the Chioak formation underlies. It is possible that some of the beds encountered on this downslope traverse may be the lateral equivalents of the above radioactive beds observed in east-dipping succession higher up on the valley slope.

Imbault Lake: A radioactive, brick-red, fine grained, stromatolitic limestone bed occurs east of Imbault Lake in an east-dipping succession which includes argillites, sandstones, dolomitic sandstones, argillaceous and arenaceous dolomites, and conglomerate. The stromatolitic limestone has been seen in place at four localities (3, 4, 5, and 7, Figure 2), and

as float or frost heaved material at several others. The position of the float occurring at locality 9 may be explained by glacial transport, which in this area is generally to the northeast.

At localities 3 and 4 the bed is 3.5 to 4 feet thick, occurring in local sequence with argillaceous and arenaceous dolomites and dolomitic argillites and sandstones which dip 7° to the east. A well formed bulbous stromatolite at locality 3 indicates by its convex-upward attitude that the beds face east. The stromatolitic forms are well defined by resistant siliceous laminae which in addition usually exhibit fine crenulations. Thickness was not estimated at localities 5 and 7 which were poorly exposed due to snow cover. At locality 8, the unit is shown to be at least 3 feet thick in a large frost-heaved slab. In this slab, intraformational conglomerate is in contact with normal stromatolitic rock. The conglomerate contains some jasper clasts.

Except for an occasional lamina of white calcite, the stromatolitic limestone is brick-red throughout due to the presence of fine grained hematite and probably some fine grained jasper. Local variation occurs in the abundance of siliceous laminae (probably rich in fine grained quartz and jasper). With low abundance, lamination is less distinct, and the rock appears to be massive. Portions of the rock rich in

siliceous laminae tend to give higher radioactivity readings. Thus, although readings several times average background of other rocks in the area were obtained at all localities, local variation over short distances was always observed.

Grab samples of outcrop and float were assayed for uranium and thorium, with the results shown in Table 3.

Location numbers correspond to localities on Figure 2.

Table 3

| <u>Location No.</u> | <u>TSL Assay No.</u> | <u>U₃O₈%</u> | <u>ThO₂%</u> |
|---------------------|----------------------|------------------------------------|-------------------------|
| 4 | 607 | 0.02 | 0.03 |
| 6 | 602 | 0.01 | 0.07 |
| 6 | 605 | 0.01 | 0.01 |
| 9 | 606 | 0.02 | 0.05 |

A strike length of at least two miles is indicated by outcrop at localities 3 and 7, and float occurrences suggest further extension of the unit to the south and to the north. Thus, surface data indicate the presence of a stromatolitic limestone bed, with a strike length of at least two miles, thickness of 3 to 4 feet, and concentrations of U₃O₈ of up to 0.02% (0.4 lbs.) and ThO₂ up to 0.07%. The occurrence of uranium and thorium concentrations in a hematite-bearing, stromatolitic limestone constitutes an occurrence which differs from any of the producing types (vein, pegmatite, conglomerate) of Canadian uranium deposits. Therefore, detailed knowledge of

the characteristics of similar types of occurrences is not available as an aid to evaluation. Fortunately, a similar occurrence is reported. It is located in Proterozoic terrain, south of McLean Bay on Great Bear Lake, N.W.T. There, uranium and thorium mineralization is present in a stromatolitic dolomite unit, averaging 43 feet in thickness, and interbedded with quartzite in a sequence dipping 45° SE. The highest radioactivity is found in two hematite-bearing, brownish red zones. The width of one is 10 feet, and the other 6 feet. Fine grained uraninite (or pitchblende) and monazite have been identified. Eldorado Mining and Refining Limited explored the deposit along strike for 1,400'. Vertical depth of 200 feet was reached by diamond drilling. The average thorium to uranium ratio is 5:1, and an average U_3O_8 content of 0.005% was estimated.

Similarity of the major geologic features of this occurrence and of the present one presents us with a new type of uranium-thorium occurrence. Whereas previously the McLean Bay occurrence might be attributed to unique local conditions, e.g., pitchblende vein occurrences in the area, it is necessary to now consider the possibility that the same general processes, rather than unique local processes, operated in the formation of both the McLean Bay and Imbault Lake occurrences.

At Imbault Lake the tendency to find higher radioactivity associated with siliceous laminae-rich portions of the

bed indicates that uranium and thorium minerals are concentrated in the siliceous laminae, i.e., in the laminae inferred to be rich in quartz and jasper silt. This immediately suggests further that like these minerals, uranium and thorium minerals were originally deposited as fine-grained detrital material. The carbonate-bearing rocks occurring stratigraphically above and below the stromatolitic carbonate unit at Lake Imbault also contain siliceous detritus, yet they are much less radioactive. The concentration of radioactive minerals must be related to the particular sedimentary environmental conditions which resulted in the stromatolitic structures themselves.

Ordinary underwater "moss" can today be observed to produce stromatolitic structures. These colonial blue green and green algae form bottom mats which ordinarily have a planar to undulatory form in shallow water, becoming low domical with increasing water depth, and having bulbous, or cabbage-head shapes where water depth permits their tendency to grow upwards toward sunlight and yet remain below the water surface.

The jelly of the algal cell walls is sticky, with the result that any slime, silt and clay drifting by in suspension will stick to any part of the algal mat it happens to impinge upon. In this manner, during the accumulation of a stromatolitic bed, the layer of sediment which can be trapped during one period of continuous sedimentation is obviously thin. But the

algae can grow up through the trapped layer in a short time and trap another layer. Thus the essence of the stromatolitic structure is fine lamination which preserves the particular shape of the surface of the algal mat, which in turn depends on the characteristics of the local depositional environment, especially the depth of water. It apparently is an open field for experimental investigation as to whether or not the sediment trap effect is selective. Presumably minerals would differ in their tendency to stick to algal jelly, but the difference may not be significant. In any case, substances as different in hardness (and inferentially other surface properties) as lime and quartz detritus, both are trapped. It is not uncommon for a stromatolitic rock to consist of laminae rich in limy silt interlayered with laminae rich in quartz silt. The latter are probably deposited during seasonal or flood runoff from the source area, or after a period of turbulence elsewhere in the depositional basin itself, causing resuspension of unconsolidated sediment which is then moved by currents over the algal mats.

The mechanical significance of the sediment trap function of colonial algae is that in the shallow water environment (not over a few tens of feet) they occupy because of their sunlight requirements, much of the fine material trapped would

probably not come to rest, but be carried to a deeper, less turbulent depositional environment. At the same time, the colonial mat is resting on the bottom so that above there is a finite column of water. In that column, density and size gradation of suspended fine sediment can occur, in which case, as the suspension moves over the bottom, the sediment trap mechanism will skim off the lower part of the suspension where the coarser grains and heavy minerals are concentrated.

The latter is a theoretical explanation, presented for the first time in this report, to account for the concentration of uranium and thorium minerals, and hematite, as heavy minerals in the stromatolitic limestone (dolomite) red beds of the McLean Bay and Imbault Lake type.

Natural concentrations of heavy minerals usually include a variety of mineral species. Laboratory petrographic work would be required to confirm their presence in the fine grained stromatolitic rocks. An Imbault Lake sample (TSL No. 607) was subjected to semiquantitative spectrographic analysis for several elements as given in Table 4:

Table 4

| | | | |
|----|--------|------------------|----------|
| Ba | 0.02% | Ni | 0.001% |
| Cr | 0.01% | Ti | 1% |
| Cu | 0.001% | Vd | 0.01% |
| Fe | 3% | ZrO ₂ | 0.1-0.2% |
| Mn | 0.1% | | |

The high titanium content suggests that one or more of the following heavy minerals are present: ilmenite, rutile, sphene. Some zircons, also a heavy mineral, appear to be present. Traces of chromite may be present. These data do not refute the heavy mineral concept, and the titanium datum supports it.

It is clear that one purpose of geological field work will be to determine the current directions which prevailed during the proposed deposition of heavy minerals in the Imbault Lake unit. This unit is thought to represent a placer deposit of a special kind, in which the gangue as well as the protore minerals are fine grained. The possibility therefore should not be over-looked that average uranium content may exhibit spatial trends, increasing in either the up-current or down-current direction. One bulbous stromatolitic form noted at Imbault Lake indicates a water depth below low water. It would be useful to observe other stromatolitic forms in the field, in an attempt to detect variation in water depth. This, together with field measurement of the attitudes of the cross-beds present in sandstone, above and below the stromatolitic unit, may indicate prevailing current directions. Cross-beds, although locally variable in attitude, have been shown in some basin studies to give a statistical average indication of current direction, since they tend to dip down-current. If

the prevailing currents were of the longshore type, then uranium content may increase along strike to the north or south where the unit has not yet been sought by a detailed ground search and/or where it may only be accessible by a subsurface probe. On the other hand, spatial trends in uranium content may occur down the present dip of the unit (1) if the unit lay directly offshore from a delta (offshore currents) or (2) if the non-carbonate detritus, including heavy minerals, were only washed over the algal mats during storms (onshore currents).

Most of the important primary uranium and thorium minerals are friable, and from mill experience, pitchblende is known to produce slimes during fine-grinding. This suggests as an exploration approach the search for fine-grained detrital heavy mineral concentrations, both in rocks representing the well known natural placer environments (river channels and beaches), and as well in rocks representing lower energy environments (shallow coastal waters), of which the stromatolitic limestone (dolomite) red beds are thought to be one new example..

SUMMARY AND CONCLUSIONS - ECONOMIC GEOLOGY

Airborne and ground radiometric reconnaissance work has been carried out over Proterozoic rocks in a uranium prospect area, about 40 miles in length, lying along the western margin of the Labrador Trough, about 63 miles due west of Fort Chimo, Quebec.

Interest was initially drawn to zones of radioactivity over portions of three sedimentary units, the Chioak formation, Larch River formation, and the Fenimore iron formation. Of these, the Fenimore iron formation is now not considered to be a favourable unit because at various localities checked on the ground, radioactivity over bedrock is low. The radioactivity of initial interest occurs in surficial concentrations.

The Larch River formation was examined on the ground at only a few localities, and the airborne radiometric readings obtained over a large area east of Merchere Lake should be followed-up by ground reconnaissance.

The Chioak formation is considered the most favourable unit in the area because radioactive beds have been found at widely separated localities examined on the ground. These beds include shale, conglomerate, sandstone, and a stromatolitic red limestone.

Because of the similarities between the Imbault Lake stromatolitic red limestone occurrence and one in the vicinity of Great Bear Lake, N.W.T., it appears that a new

type of radioactive occurrence can be recognized. For this type, a theoretical explanation of origin in terms of simple sedimentary processes is suggested. The theory can be summarized as follows: Algal mat sediment trap mechanism for preserving the natural heavy mineral concentrations at the base of flowing fine grained suspensions. An enlarged scope for uranium exploration in sedimentary rocks is suggested, namely, that concentration of detrital uranium minerals can be sought not only in conglomerates and sandstones, but also in certain types of fine grained clastic rocks. The brittleness of most primary uranium minerals and the consequent tendency of pitchblende to form slimes during fine comminution are points in favor of this expanded approach to uranium exploration. The siltstones of the Chioak and Larch River formations should be examined with the theory in mind.

Portions of the Chioak formation not checked on the ground exhibit airborne response comparable to, or higher than that obtained over the known radioactive beds. On the other hand, the presence of radioactive conglomerates and sandstone found on the ground was not indicated by airborne data because of the wide spacing of flight lines. This demonstrates the need for a ground radiometric survey of the Chioak formation.

Geologic mapping within the Chioak formation, based on measurement of stratigraphic sections, will be necessary both for exploration and for the planning of sampling programs (evaluation). Evaluation of the stromatolitic red limestone prospect at Imbault Lake can be started after preliminary geological mapping to locate the first diamond drill hole. A preliminary objective of subsurface work on this unit will be to determine if surface leaching of uranium values has occurred. In a carbonate unit, basic leaching is a possibility analogous to the acid leaching known to occur in some sulfide-bearing uranium deposits.

The possibility of basic leaching also exists for the radioactive conglomerate with ferrodolomitic cement. This rock type is usually friable and poorly exposed. This points out that subsurface work is required to adequately explore the Chioak formation, as well as to evaluate prospects.

From this preliminary investigation one sedimentary radioactive occurrence ($U_3O_8 + ThO_2$ greater than 0.05%) is known, and the possibility of others in coarser grained rocks (conglomerates and sandstones) is favourably indicated. The approach to the exploration of the Chioak formation should be such that a low grade sedimentary deposit will not be overlooked, since for sedimentary deposits it is reasonable to anticipate that the advantages of continuity and size may offset the

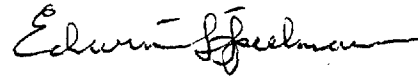
disadvantage of low grade. That one new type of radioactive occurrence is already in prospect is an indication that geologic control is important. Traverse spacing for geological and radiometric field work can be wide at first (1,000 feet), since areally extensive units are sought, but observations along the traverses should be unit-by-unit where exposure is available. In the case of the radiometric survey, this will mean leaving the instrument on between stations, to detect radioactive highs. At least one drill hole per 8 square miles, for an average depth of 400 feet, should be provided for in the outlay for subsurface work. The disposition of these exploratory holes will be determined by the results of the surface work.

RECOMMENDATIONS:

Mapping and radiometric survey work is recommended, to begin this summer (1969). A drilling program is recommended for the Imbault Lake prospect, also to begin this summer and to continue as fall weather permits.

In order to explore the Chioak formation for a north-south length of 40 miles and an average width of about 4 miles, the project should be resumed at the beginning of the 1970 field season. The exploratory drilling recommended for the Chioak formation can be started during the 1970 season, with planning for it based upon the surface work of 1969, and the continuing surface work of 1970.

The estimated cost of a two-year project is \$589,550 as detailed in the addendum to this report.

A handwritten signature in cursive script, appearing to read "Edwin L. Speelman".

Edwin L. Speelman

July 22, 1969.

ADDENDUM

BUDGET ESTIMATES 1969 & 1970
UNGAVA, QUEBEC

PROFESSIONAL STAFF

| | <u>1969</u> | <u>1970</u> | <u>Total</u> <u>1969-70</u> |
|----------------------------------|-------------|-------------|--------------------------------|
| <u>Field Staff</u> | | | |
| 1 Senior Geologist (Party Chief) | | | |
| 2 Geologists | | | |
| 2 Geophysicists | | | |
| 2 Assistants | | | |
| 1 Camp Organizer, cook, etc. | \$ 47,600 | \$ 71,000 | \$118,600 |

Consulting Service

| | | | |
|---------------------------------|--------|--------|--------|
| Norman H. Ursel Associates Ltd. | 11,000 | 15,500 | 26,500 |
|---------------------------------|--------|--------|--------|

TRAVEL

| | | | |
|------------------|-------|-------|-------|
| Field Staff | 2,650 | 2,100 | 4,750 |
| Consulting Staff | 1,050 | 2,450 | 3,500 |

DIAMOND DRILLING

| | | | |
|------------------|--------|---------|---------|
| 1969 - 3,000 ft. | | | |
| 1970 - 5,000 ft. | 75,000 | 125,000 | 200,000 |

TRANSPORTATION

| | | | |
|----------------------------------|--------|--------|--------|
| Fixed Wing Aircraft & Helicopter | 35,000 | 47,500 | 82,500 |
|----------------------------------|--------|--------|--------|

FREIGHT

| | | | |
|--|--------|--------|--------|
| | 13,000 | 13,000 | 26,000 |
|--|--------|--------|--------|

CAMP & PROJECT EQUIPMENT

| | | | |
|-------------------------|--------|-------|--------|
| <u>Purchases</u> | 17,200 | | 17,200 |
| <u>Equipment Rental</u> | 2,250 | 650 | 2,900 |
| <u>Gasoline and Oil</u> | 3,900 | 6,100 | 10,000 |

| | <u>1969</u> | <u>1970</u> | <u>Total</u> <u>1969-70</u> |
|--|------------------|------------------|--------------------------------|
| <u>CAMP OPERATION</u> | \$ 7,200 | \$ 8,400 | \$ 15,600 |
| <u>RESEARCH AND ASSAYS</u> | 4,000 | 6,000 | 10,000 |
| <u>DRAFTING AND REPORT PREPARATION</u> | 2,000 | 3,000 | 5,000 |
| <u>OTHER</u> | 6,000 | | 6,000 |
| <u>PROJECT PROMOTION</u> | 1,000 | 1,000 | 2,000 |
| <u>ADMINISTRATION</u> | <u>4,000</u> | <u>5,000</u> | <u>9,000</u> |
| SUB-TOTALS | 232,850 | 306,700 | 539,550 |
| <u>CONTINGENCIES</u> | <u>20,000</u> | <u>30,000</u> | <u>50,000</u> |
| TOTAL | <u>\$252,850</u> | <u>\$336,700</u> | <u>\$589,550</u> |

CERTIFICATE

I, Edwin Lloyd Speelman of Hamilton, Ontario,
hereby certify:

1. That I am a geologist, graduate of Montana College of Mineral Science and Technology (formerly Montana School of Mines), 1961.

2. That, having passed the examination, I hold a Professional Engineer-In-Training license from the Montana Board of Registration of Professional Engineers and Land Surveyors.

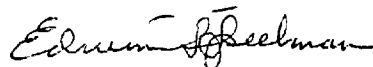
3. That I have had experience in exploration geology and engineering geology as a result of summer employment with the Bear Creek Mining Company and the U.S. Forest Service.

4. That I have been doing graduate geological research in the Haliburton-Bancroft-Madoc area of Ontario.

5. That I hold no interest, direct or indirect, in the properties described, nor do I expect to receive any interest; nor do I hold any of the securities, nor do I expect to receive any of the securities of any company that might acquire the properties.

6. That this report is based on my field observations made in 1969, and upon other sources of information, mainly government publications, believed to be reliable.

Dated at Toronto, Ontario, this 22nd day of July,
1969.


Edwin Lloyd Speelman