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MINERAL RESOURCE ASSESSMENT OF THE AREA IN THE EAST ARM (GREAT SLAVE LAKE) AND ARTILLERY LAKE REGION, N.W.T., PROPOSED AS A NATIONAL PARK (NTS 75 J, K, L, N, O)

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April, 1987 Ottawa.

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DEPARTMENT OF ENERGY, MINES AND RESOURCES
GEOLOGICAL SURVEY OF CANADA

MINISTERE DE L'ENERGIE, DES MINES ET DES RESSOURCES
COMMISSION GEOLOGIQUE DU CANADA

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Foreward

The new National Parks policy, introduced by the Government of Canada in early 1979, directs that "inventories" of mineral and fuel resource potential be made prior to setting aside lands for park purposes. Responsibility for implementing this policy rests with the Department of Indian and Northern Affairs.

A joint interdepartmental committee called the Working Committee for Northern Mineral and Energy Resource Assessment (MERA) was formed in early 1980 to conduct the required assessments. Committee membership includes representatives from the Department of Indian and Northern Affairs, the Department of Energy, Mines and Resources and Parks Canada Program of the Department of the Environment.

This report presents assessment results for the proposed National Park in the East Arm (Great Slave Lake)-Artillery Lake area, one of several northern areas currently being considered as potential parks. Earlier assessment reports have been completed on Northern Yukon, Northern Ellesmere Island and Bathurst Inlet area and work is in progress on Borden-Bylot Island (North Baffin Island), Banks Island, Wager Bay and proposed Nahanni National Park extensions.

The present report incorporates the results of the geological field investigations in 1983 and 1984 as well as compilations of relevant geological, geophysical and geochemical data available for the region from other sources.

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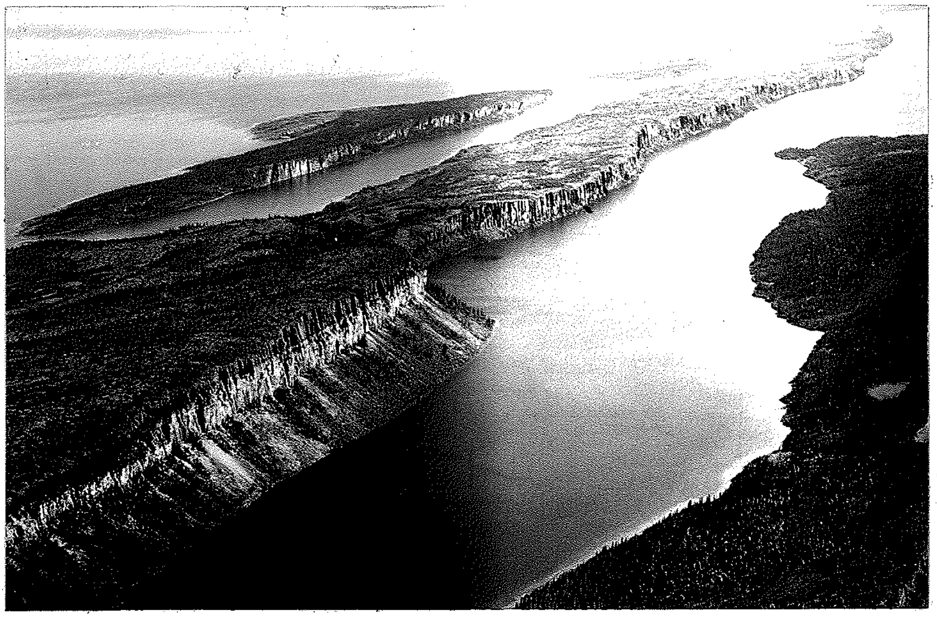
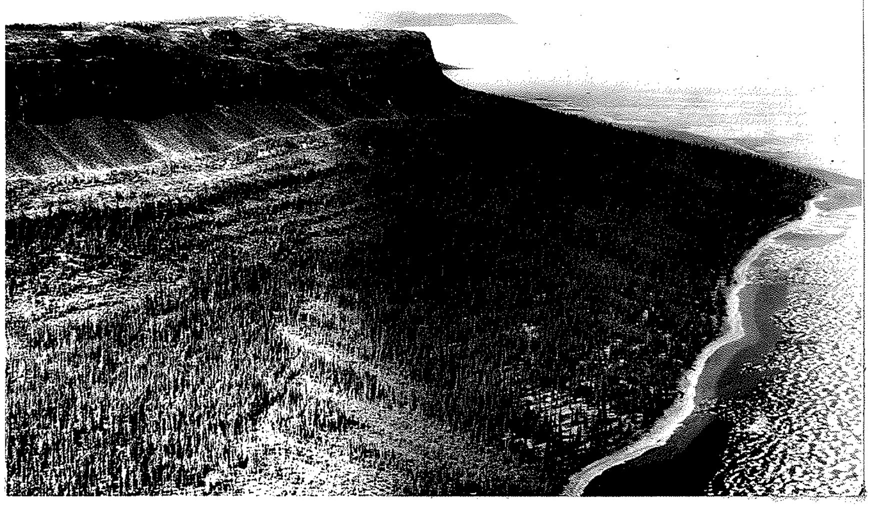


Photograph of Utsingi Point, southwestern end of Pethei Peninsula, looking south-southwest. Note cuesta formed by diabase sill dipping gently to southeast. . The underlying units are dolomite of the Pethei Group (light coloured scarp centre to bottom left) and shales of Kahochella Group (centre to top right-corner). Island on the top left-side of peninsula is of dolomite containing well developed stromatolites. Land right of the peninsula is Point Busse. (see Fig. 10)



Sentinel Point, McLeod Bay (62°49'50"N; 109°58'00"W) looking west. Note diabase sill capping the ridge. GSC Photo: 204136-I.

Artillery lake, southeast shore (sandbridge in foreground: 62°59'45"N; 108°02'10"W) looking northeast. Note dolomite outcrops on islands and shore in the foreground; gneissic terrain of low relief to the right. GSC Photo: 204136-K

SUMMARY

S.M. Roscoe and S.S. Gandhi

Since 1979 it has been government policy that, before a national park reserve can be established in the northern territories, an assessment of its non-renewable resource potential is required. The assessment is carried out by the Geological Survey of Canada under the guidance of a committee of senior representatives from the Department of Indian and Northern Affairs, Parks Canada, and the Department of Energy, Mines and Resources. This is a summary of the accompanying assessment of non-renewable resources in a proposed new national park in the vicinity of the East Arm of Great Slave Lake and Artillery Lake, N.W.T.

The study area consists of the lands and waters withdrawn under the Territorial Lands Act for National park purposes in 1970. Subsequent to the commissioning of this study, additional lands between Artillery Lake and the Hoarfrost River (near 63°N, 109°W) were incorporated into the park proposal (Parks Canada, 1985). These are not assessed in this open file report because Geological Survey priorities prevented additional field work therein.

The proposed park area comprises eastern and western sectors that are markedly dissimilar geologically as well as topographically and biologically (Fig. 1). The eastern sector, underlain by Proterozoic dolomite within the Artillery Lake basin and by older Archean granitic rocks, gneiss, and schist in surrounding areas, consists largely of boulder-strewn treeless terrain with low relief. The western sector in the East Arm of Great Slave Lake is characterized by steep cliffs and forested slopes with relief up to 300 m carved in gently-dipping layers of early Proterozoic sedimentary rocks intruded by sheets of gabbro.

Bases available for assessment of mineral resources also differ in the two sectors. Results of modern geological surveys were available for the western sector whereas no geological mapping had been done in the eastern sector for 3 decades prior to 1983 when the present resource assessment study was started. There is reason to believe that only negligible prospecting had been done in the eastern sector and that even in the western sector prospecting, which ceased after 1970, was inadequate to provide a credible reflection of the abundance, distribution and character of exposed or shallowly buried mineral concentrations. For example, one of us (SSG) found conspicuous beds of iron formation and veins containing copper sulphide on an island in the western sector and also some stratiform, stratabound, and granite or pegmatite-hosted concentrations of uranium elsewhere in the western sector. These are an important addition to a small number of copper, iron and uranium occurrences known previously. Along mainland and island shorelines in Artillery Lake, 19 zones containing lead-zinc-copper concentrations were found where only one had been reported previously.

A small sub-economic copper deposit has been outlined by diamond drilling in a vein system on Douglas Penninsula (Figure 1). Exploration along similar cupriferous veins outside the study area has also yielded indifferent results. Similarly, exploration of strata-bound uranium concentrations near Reliance within and adjacent to the study area failed to find any of potential economic importance; thus it seems unlikely that the very low concentrations of uranium known within the area would engender exploration interest in the future. Concentrations of lead and zinc at Artillery Lake are too narrow, discontinuous, and low in silver content (maximum 384 ppm) to be of interest at present, but they must be extremely abundant through extensive unexposed sections of dolomitic strata beneath the lake bed, and it is not inconceiveable that some economically significant zones might be present in buried host structures that are larger than those presently exposed.

The following considerations, based on geological relationships, on mineral deposits outside the study area, and on analogies with areas containing deposits of major economic importance, are more likely to attract the interest of mineral explorationists than are the known prospects mentioned above.

(1) The Walmsley Lake greenstone belt west of Artillery Lake and other belts of Archean metavolcanic and metasedimentary rocks north of McLeod Bay have the greatest potential of any rocks in the general East Arm – Artillery Lake district as hosts for economically important volcanogenic base metal deposits and gold deposits of various types. Gold and base metal prospects have been found in these belts and substantial tonnages of potential base metal ores have been outlined in two deposits 16 km north of the north boundary of the western sector of the study area. The belt containing these deposits and other narrow belts of Archean supracrustal rocks extend southward to the north boundary of the study area and no doubt also farther south into the area where they are covered by shallowly dipping Proterozoic strata beneath waters of McLeod Bay. "Blind" base metal ore deposits have been sought and found at considerable depths beneath younger cover rocks near some mining camps but buried portions of Archean greenstone belts in the Great Slave Lake area, which are not presently known to contain any major deposits, could hardly be considered attractive exploration targets.

The favourable Archean belts are relevant to this resource study even though no more than a small segment of one (the Walmsley Lake belt) has been recognized within the study area. The potential ore deposits and others that may be discovered in nearby parts of such belts are likely to require transporation routes and possible power generation sites within the area. Moreover, favourable rocks may yet be discovered in poorly mapped and poorly exposed Archean terranes within the study area. The part of the eastern sector that extends northwest of Artillery Lake may contain

narrow lenses of Archean supracrustal rocks. This is also true of a proposed extension of the park area north of the east end of McLeod Bay which has not been assessed under the terms of reference for the present study. Such possibilities could only be eliminated by special geological, geophysical and geochemical surveys which should be considered as a means of insuring that important resources are not included in Archean portions of the proposed park.

(2) Unconformity-related uranium occurrences, believed to be similar to the extremely important type that contains the remarkably rich major uranium resources of Saskatchewan, have been found in the East Arm outside the study area. These are small and non-economic (possibly because they have been largely destroyed by erosion) but their existence will very likely lead to searches in the future for larger and richer deposits of this type in places where they may be preserved beneath cover rocks. Redcliff Island (Figure 1) is such a place, and for this reason its mineral resource potential is rated as higher than that of much of the western (East Arm) sector of proposed park area.

(3) At Taltheilei Narrows, a strategic transporation corridor, there are a number of Proterozoic volcanic vents which were eruptive sources for volcanic rocks intercalated with shaly sedimentary rocks and lean iron formation beds that dip east under covering sedimentary strata. A significant, although sub-economic, concentration of copper minerals is present in breccia in one volcanic vent just outside the west boundary of the study area. Copper enrichments are present in other vents in the Narrows area and minute traces of copper minerals are present in some of the thin volcanic beds and associated shale and iron formation. This geological environment is one that could host important base metal deposits and evidently, processes capable of concentrating metals were active during volcanism. An appreciable area beneath the western part of Pethei Peninsula is underlain at explorable depth by a stratigraphic zone that some exploration geologists in the future might consider an especially interesting prospecting target.

(4) A large positive gravity anomaly is centered at the south shore of Pethei Peninsula in the middle of the East Arm sector. The cause of this feature near the junction between two tectonic provinces is a subject of great scientific interest. It is most likely due to the presence of heavy rock beneath gently dipping Proterozoic strata, at depths that might be as little as 1 km and therefore capable of being sampled by drilling. The heavy rock could be metabasalt or gabbro but a mafic-ultramafic intrusive complex prospective for platinum, chromium, vanadium, nickel and other metals is also a possibility in this tectonic setting. Another, surely much more remote, possibility will occur to some economic geolgists. The enormous, rich, copper-gold-uranium – rare earth – fluorite deposits at Olympic Dam in Australia is reflected by a positive gravity anomaly. It is situated at the margin of a platform and is covered by a thick sequence of sedimentary rocks. The Olympic Dam gravity anomaly, however, unlike that in the East Arm, is accompanied by a magnetic anomaly.

(5) The remarkable abundance of lead-zinc concentrations in the limited exposures of dolomite and subjacent paleoweathered Archean granite at Artillery Lake merits considerable attention. They cannot represent more than a small fraction of the total numbers of such concentration present in the lake basin at depths accessible to exploration and they are not likely to include the largest or richest of these. Larger or different host structures could well be present and contain significant deposits.

(6) Increased interest in seeking new sources for platinum group metals and rare metals, and current development of a beryllium mine 50 km west of the study area will draw attention to possibilities that favourable anorogenic intrusions in addition to the Blachford Lake alkaline intrusive complex may be present along a northeasterly trend in the East Arm and Artillery Lake area. One extensive area where it would be reasonable to search for such intrusions is situated east of McLeod Bay at the junction between the East Arm and the Artillery Lake sectors of the proposed park. This area is marked by an unexplained magnetic high about 25 km in diameter, a uranium anomaly along the only airborne radiometric survey line that crossed it, several known minor uranium concentrations, and numerous unexplained multielement lake bottom sediment geochemical anomalies. It would be desireable to carry out a program of detailed geological mapping in this area which is a particularly critical one as it separates the two segments of the proposed park.

INTRODUCTION

Location and Topographic Features

The area under consideration as a national park extends about 270 km northeasterly from Hearne Channel in the east arm of Great Slave Lake to a point about 30 km north-northwest of Artillery Lake (Fig. 1; Map 1 in pocket). It is 13 to 30 km wide and includes the Pethei, Kahochella and Douglas Peninsulas, Redcliff Island, various small islands and extensive water areas in McLeod and Christie Bays of Great Slave Lake as well as Artillery Lake and adjacent land areas. The irregularly shaped area is divided naturally into two sectors approximately at the location of Reliance, a meteorological station at the east end of Great Slave Lake. The western half is termed herein, the East Arm sector; the northeastern half, the Artillery Lake sector. High, scenically attractive cuestas on the peninsulas dominate the East Arm sector. The Artillery Lake sector extends northwards well beyond the tree line into lake-strewn areas with litle relief, few rock outcroppings, and abundant glacial deposits. A small area including Tyrrell Falls along the Lockhart River 25 km northeast of Reliance is excluded from the park proposal because of its hydroelectric potential.

Information Applicable to Mineral Resource Assessment

Only a few prospects, mainly of copper, have been explored by drilling within the proposed park area. More numerous occurrences of a variety of ore minerals, however, have been discovered (Map 1 in pocket; Appendix 1). Some types of occurrences found near the area but not within it, are in geological situations that exist also within the proposed park. As far as we can ascertain, prospecting activity in the proposed park area has been much less extensive than elsewhere in the Great Slave Lake area and in many other areas to the north of the lake. This is due in part at least, to the withdrawal of the area from staking in 1970 for the proposed park, and to a number of factors including perhaps, to perceptions that other areas are more favourable geologically. Remoteness, drift cover, and paucity of geological data (Fig. 2) are factors that have restricted exploration in the Artillery Lake sector. A number of concentrations of lead and zinc were, however, discovered during the fieldwork conducted in 1983 and 1984 for the present assessment report (Gandhi, 1984, 1985; Appendices 1 & 2) indicating scope for additional discoveries. Water cover and gentle dips of strata that result in limited exposures of stratigraphic units is a factor in the East Arm sector. Geological mapping in this sector however is more advanced (Fig. 2), and provides a sound basis for metallogenic interpretations. These are supported by field observations by S.S. Gandhi and S.M. Roscoe during 1983 in the sector as well as observations in the adjacent areas over several years.

In order to provide a better basis for qualitative assessments of possibilities that economically significant mineral deposits might be hidden at shallow depths beneath drift cover or shallowly dipping strata, several studies are included in this report. In the metallogeny sections, Roscoe and Gandhi review those stages in the geological development of the region that might have been accompanied by the formation not only of the various known mineral concentrations but also of types of deposits not yet recognized in the East Arm – Artillery Lake Area. Maurice presents and interprets results of regional geochemical surveys through parts of the area that are within NTS blocks 75K/9-16.* Charbonneau interprets results of airborne radiometric surveys over the area. Gibb considers a possible cause of a prominent gravity anomaly centred in Christie Bay. Aeromagnetic data have been used in geological interpretations and in assessments of geophysical and geochemical anomalies. Readers of this report would find G.S.C. Map 1566A, a regional magnetic map, a useful reference.

Scope of Report

This phase 1 assessment report provides guidance concerning the sorts of mineral deposits that might be considered worth seeking in the future within the area of concern. A few specific localities that warrant preliminary investigations are cited. The specific and hypothetical exploration targets are varied and dispersed through most parts of the area. These are assessed in terms of relative favourabilities of individual "domains" within the area.

An important consideration in this study is the location of the Artillery Lake sector near the Thelon Front, the junction between the Slave and Churchill Structural Provinces. This contact zone is cut and displaced by the

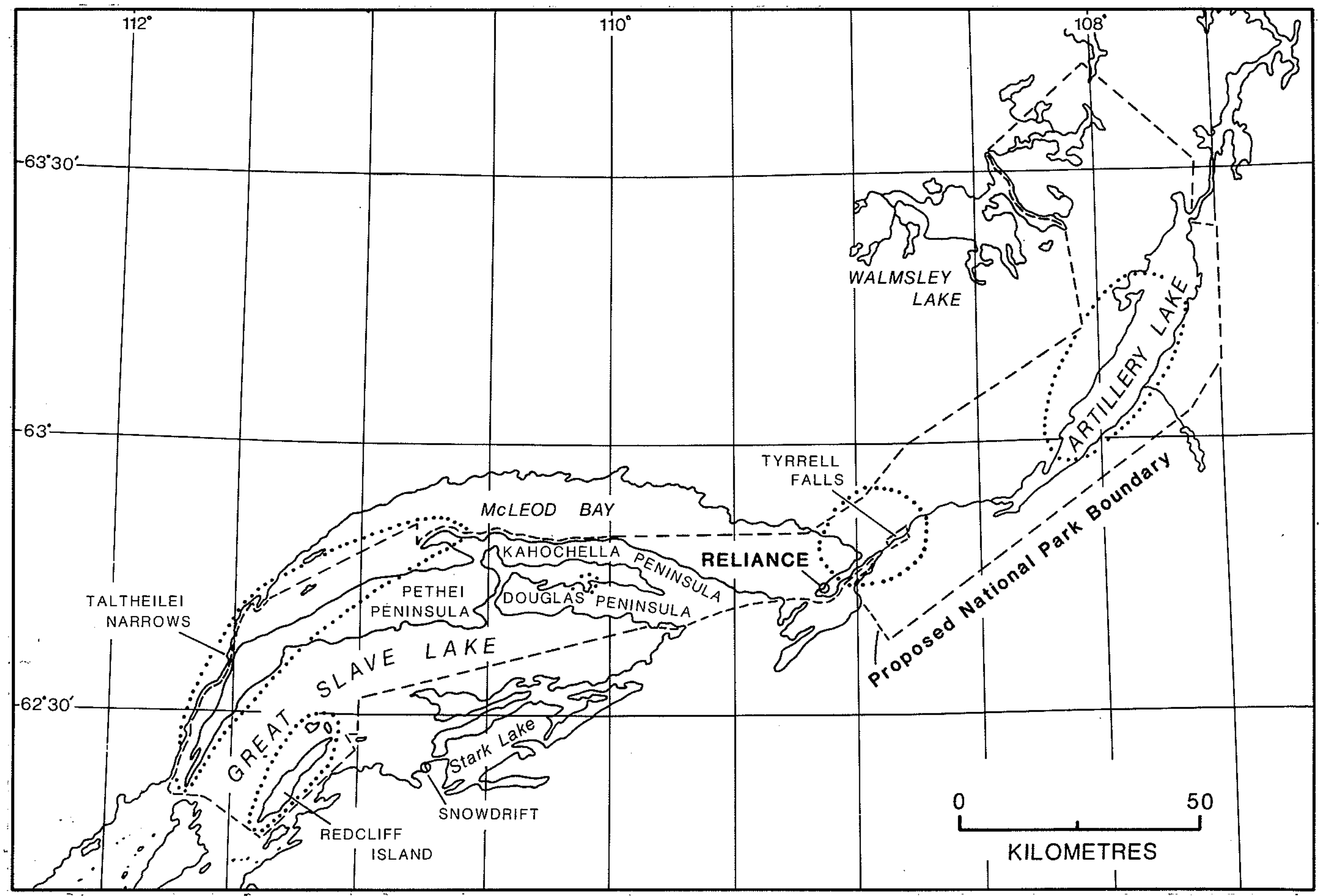
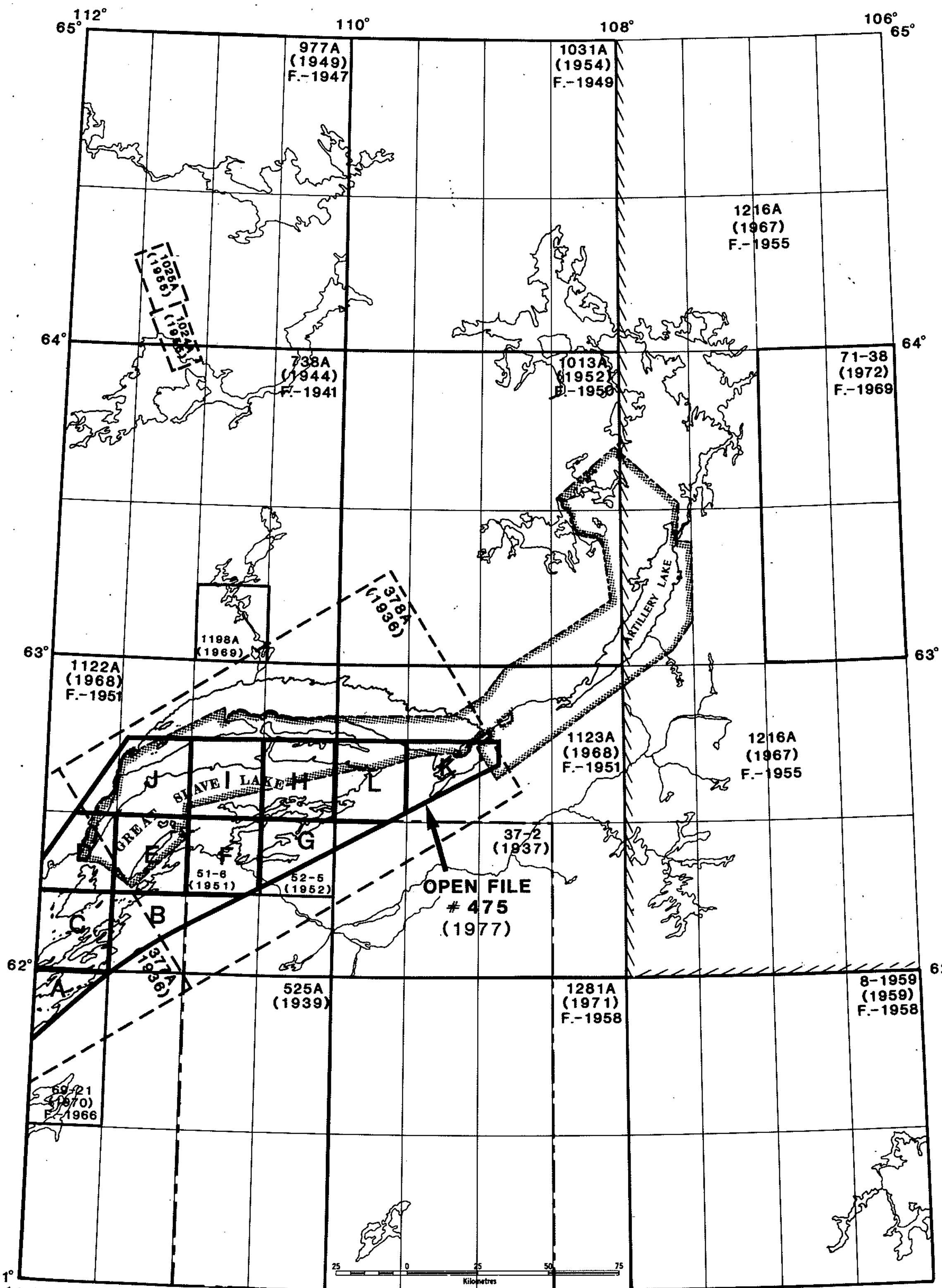


Figure 1. East Arm-Artillery Lake area proposed as a National Park, showing selected areas with relatively greater mineral potential, indicated by dotted line. A small internal section along the Lockhart River at Tyrrell Falls is excluded from the proposed park as reserve for possible future hydroelectric power development.

* Location of an area according to the National Topographic System (NTS).



MAP INDEX:

977A, Folinsbee, 1949; 1031A, Lord and Barnes, 1954; 1216A, Wright, 1967; 1025A, Moore, 1955; 1024A, Folinsbee and Moore, 1955; 738A, Henderson, 1944; 1013A, Folinsbee, 1952; 71-38, Fraser, 1972; 1198A, Heywood and Davidson, 1969; 378A, Stockwell, 1936b; 1122A, Stockwell et al., 1968a; 1123A, Stockwell et al., 1968b; 51-6, Barnes, 1951; 52-5, Barnes, 1952; 37-2, Henderson, 1937; Open File 475, Hoffman, 1977; 377A, Stockwell, 1936a; 525A, Henderson, 1939; 1281A, Taylor, 1974; 8-1959, Taylor, 1959; 69-21, Reinhardt, 1970.

Figure 2. Sources of regional geological information for the study area.

McDonald Fault system at the south end of the sector. Some major mining districts occur elsewhere near junctions between such major tectonic provinces. Most veins containing ore minerals in the East Arm area are in fractures developed in conjunction with movements along the McDonald Fault system. Current geological and geodynamic studies of these major tectonic features can be expected to shed light on the history of development of the northwestern part of the Canadian Shield and thereby clarify our ideas about potential mineral resources in the subject area. Such studies include regional geological mapping by the Geological Survey of Canada started in 1984 north of Artillery Lake.

METALLOGENY AND EXPLORATION POSSIBILITIES

Regional Geological Setting

Structural provinces

The proposed park area is situated near the southeast margin of the Slave Structural Province, a craton characterized by granitoid rocks, metamorphosed turbiditic sedimentary rocks and metavolcanic rocks that were formed and intensely deformed 2.7 to 2.6 billion years ago (Fig. 3).

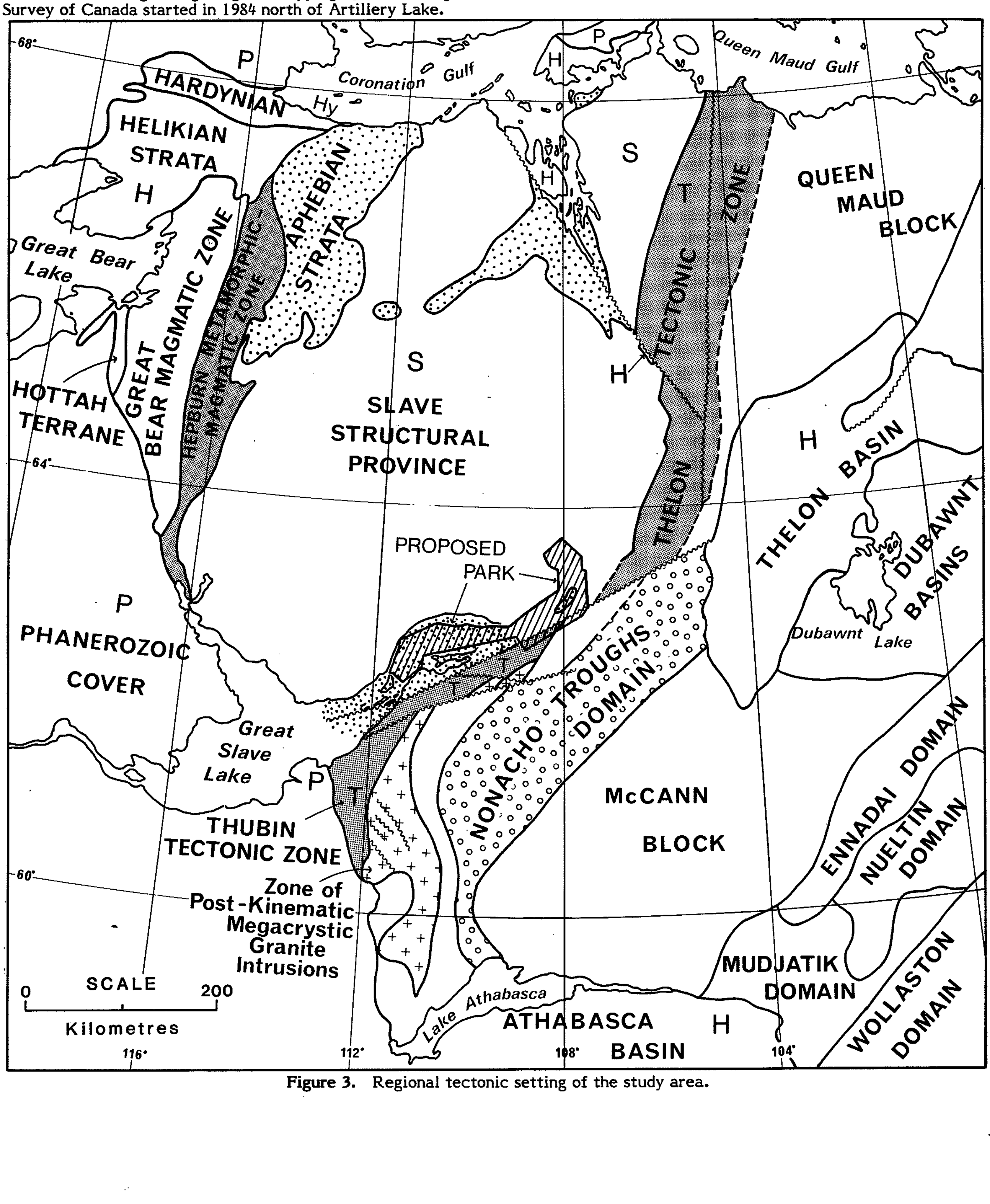


Figure 3. Regional tectonic setting of the study area.

The Churchill Structural Province to the east and south is marked by strongly linear patterns of structural elements, higher grades of metamorphism than in the Slave Structural Province, recognizeable later effects of deformation and metamorphism in Proterozoic time, and in some areas by undeformed Aphebian plutons or belts of infolded Proterozoic strata. Only the southeastern fringe of the study area south of McDonald Fault in NTS 75 K/11, K/10, K/16, J/13 and O/4 is unequivocally within the Churchill Province. This portion is 100 km in length and tapers northeasterly from a maximum width of 5 km. The Proterozoic strata in the East Arm of Great Slave were deposited on the south margin of the Archean Slave Craton. The most extensive sequence of these, the Great Slave Supergroup, was deposited 1.95 to 1.86 billion years ago (Bowring et al., 1984) together with equivalent strata, the Goulburn Group and the Epworth Group, on the northern side of the Slave Craton.

Slave-Churchill boundary

The position of the contact between the Slave and Churchill Structural provinces is important for this resource study as the two provinces differ metallogenically and, in particular, the contact zone between them – like that between the Superior and Churchill Provinces in Manitoba – may contain important metallotects for nickel-copper deposits. Some prospecting for such deposits has in fact been done east of Artillery Lake following discovery of very low concentrations of nickel in sulphides in pyroxenite

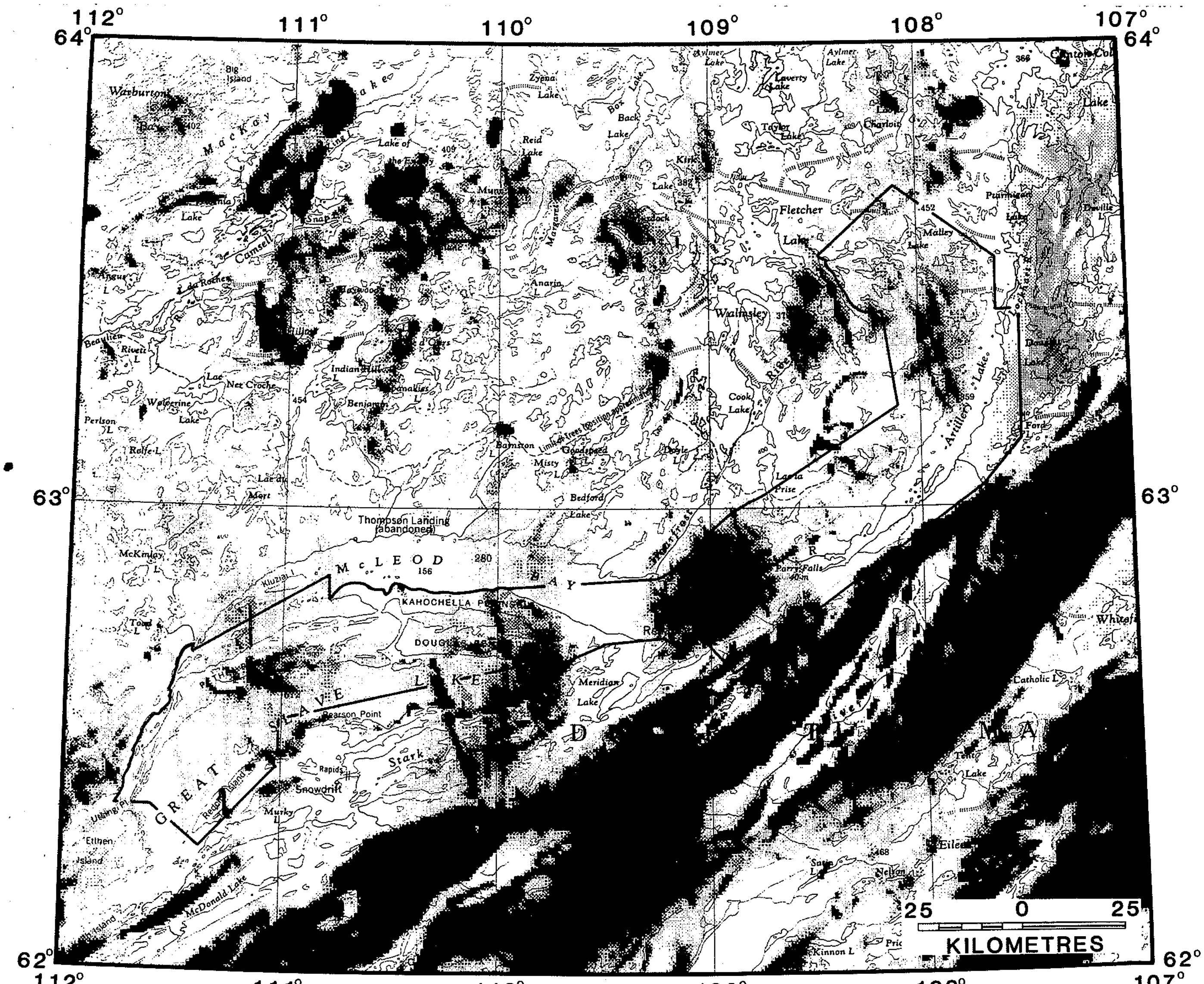


Figure 4. Aeromagnetic map of East Arm-Artillery Lake area (from GSC Map 1556A).

frost heaves at Smart Lake (NTS 75 O/07) in 1969. Other nickel prospects at Parry River (66M, N) and south of Great Slave Lake (75 E), together with geophysical and geochemical data support the concept that the western margin of the Churchill Province is prospective for nickel.

Wright (1967) considered that the contact between the two structural provinces was a metamorphic front where relatively intensely metamorphosed rocks of the Churchill Province abutted against the Slave Craton. He termed this contact the 'Thelon Front'. On the basis of reconnaissance helicopter mapping, he considered that Artillery Lake lies astride the front. Studies of the Thelon Front at Artillery Lake have not yet been completed but farther north Henderson and Thompson (1980) found that Archean rocks of the Slave Province could be traced into a broad zone of easterly increasing metamorphism and deformation near the front as located by Wright. The amphibolite and granulite facies show retrograde effects of overprinted Aphebian metamorphism and are traversed by broad mylonitized zones subparallel to the Thelon Front. The recent work, by Henderson et. al. (1982) and Henderson and Macfie (1985, 1986), indicating a more easterly position for the contact zone, downgrades possibilities that important Ni-Cu deposit may be present in that part of the study area that lies east of Artillery Lake and north of the McDonald Fault (Map 1 in pocket).

Strong, persistant linear magnetic (Fig. 4) and gravity anomalies (Hornal and Boyd, 1972) parallel the Thelon Front across a broad zone termed the Thelon Tectonic Zone by Thompson and Ashton (1984). Near the south end of Artillery Lake, the Thelon Front and associated geophysical anomalies are cut and displaced to the southwest by the northeasterly trending McDonald Fault system. The aeromagnetic anomalies are displaced 70 to 125 km dextrally according to correlations of these features on either side of the fault system by Thomas et al. (1976), but much greater displacements can be postulated as suggested in Figure 3.

Supracratonic rocks

Strata unconformably overlying Archean basement rocks in the East Arm and Artillery Lake sectors, and certain intrusive rocks provide metallogenic domains distinct from those in the Slave and Churchill Structural Provinces (Maps 1, 2 and 3 in pocket).

The East Arm of Great Slave Lake is underlain by Proterozoic sedimentary and volcanic rocks, including the Wilson Island Group, Great Slave Supergroup, Et-Then Group and, to the east, the Artillery Lake formation. All of these strata were deposited on older igneous and metamorphic rocks. Uplifted blocks of older granitoid basement rocks are exposed locally in the East Arm and the Aphebian strata are intruded by younger quartz diorite to quartz monzonite laccoliths, minor synvolcanic intrusions, and Helikian gabbro sheets and dykes. Wilson Island Group and the Great Slave Supergroup were deposited in a northeasterly trending trough between 1.93 and 1.87 Ga (Bowring et al., 1984) in response to rifting and repeated movements along northeasterly striking fractures including the McDonald Fault and related faults which also controlled later deposition of the Et-Then Group (Hoffman, 1981).

The peninsulas in the East Arm sector of the proposed park are capped by gabbro sills that intrude gently dipping Great Slave Supergroup strata that were deposited mainly in shallow water on a relatively stable platform. These platformal facies rocks are flanked to the south by correlative, thicker, basinal facies strata that include more abundant volcanic rocks. Rocks in the basinal zone are notably more deformed and are intruded by quartz monzonite laccoliths. The Et-Then Group unconformably overlies the Great Slave Supergroup and post-dates the above mentioned intrusions excepting the gabbro sills. It underlies Redcliff Island in the proposed park area. The gabbro sills together with northwesterly striking diabase dykes that cut them are believed to have been intruded during the widespread 1.25 Ga (approx.) Mackenzie igneous event. A strong positive gravity anomaly in Christie Bay near the south side of Pethei Peninsula (R.A. Gibb, this report; Cross-section A-B in pocket) is an important feature of the area. The cause of the anomaly is not yet established, but some possible interpretations are presented in this report.

Archean Rocks

Introduction

The principal types of mineral deposits found in the Slave Province are: (1) volcanogenic massive sulphide deposits containing zinc, copper, lead and silver; (2) auriferous quartz veins and shear zones in metavolcanic rocks, like those in the Con and Giant Yellowknife mines in the Yellowknife metavolcanic belt; (3) quartz veins containing relatively small but rich concentrations of gold in turbiditic metasedimentary rocks – e.g. Thompson Lundmark and Ptarmigan mines near Yellowknife; (4) gold concentrations in sulphidic and arsenical garnet-grunerite gneiss formed in beds of metamorphosed iron formation – e.g. Lupin gold mine at Contwoyto Lake; (5) gold deposits in felsic intrusions and (6) concentrations of lithium, beryllium, niobium, tantalum, and tin minerals in granite pegmatites. In the proposed park area, relatively unfavourable granitic rocks predominate over metavolcanic and metasedimentary rocks (Map 1 in pocket), but the magnetic data indicate that the latter may be more abundant than are known to date.

Metavolcanic and metasedimentary rocks

Numerous base metal-silver prospects of deposit type 1 (above) are present in 75M/2 in the Archean belt of metavolcanic and metasedimentary rocks that extends northward from McLeod Bay (about 4 km north of the proposed park boundary in 75L/15). Substantial tonnages of potential zinc-lead-silver "ore" and potential copper "ore" have been outlined in two Kennedy Lake deposits 15 km north of McLeod Bay. Possible future mining development here and elsewhere in the belt could involve a requirement for barge and winter road transport through Hearne Channel within the western fringe of the proposed park area.

Possible southerly extensions of the favourable belt in L/15, and of other belts to the east in L/16 and K/13, into the proposed park area are of academic interest only because their depths beneath convering Great Slave Supergroup strata would inhibit exploration. These older (Archean) belts could however be conceived to be sources for metals that might be concentrated in younger Proterozoic rocks. Maurice, in the section on regional geochemical surveys, notes a strong multielement anomaly (Cu, Zn, Co, Ni, Pb, As) associated with Archean metasedimentary rocks in 75K/13.

Several irregular belts of metavolcanic and metasedimentary rocks prospective for volcanogenic base metal deposits (type I) and gold deposits type 2 and 3, have been mapped (in early reconnaissance surveys) south of Wamsley Lake in 75 N 1, 2, 7, and 8 near the western boundary of the Artillery Lake sector of the study area. One of these belts contains a volcanogenic massive base metal-bearing sulphide deposit (Cavalier deposit) in the northwest corner of N/1 (63°14'N, 108°25'W). This belt extends into the proposed park area (Maps 1 and 3, in pocket). The Cavalier zones as explored to date are apparently rather narrow and low grade, but exploration possibilities there are by no means exhausted. Inco Limited carried out some exploration on the property in 1982.

In addition, the Artillery Lake sector contains areas of gneisses and migmatites derived largely from supracrustal rocks. It must be emphasized that the sector and surrounding areas were mapped geologically long ago (Folinsbee, 1952; Wright, 1952, 1967) in a reconnaissance manner that permitted observations only near major waterways. Experience elsewhere has shown that modern follow-up mapping, such as that carried out in 1984 and 1985 by Henderson and Macfie (1985, 1986) in the adjacent map-sheet to the east and northeast of Walmsley Lake, will almost certainly disclose the presence of currently unknown rock units that are possible hosts for gold, base metal and perhaps other types of mineral deposits. Accordingly, one must consider that possibilities for potentially mineable deposits in the sector cannot be ruled out. Based on the present evidence, however, it is reasonable to assume that such possibilities are low compared to most areas of equivalent extent in the Slave Province.

Exploration possibilities near either side of the Slave-Churchill boundary may differ somewhat from those outlined above for the Slave Province, and as noted earlier, are difficult to assess in view of uncertainties concerning the nature of the Thelon Front. Deposits similar to those found elsewhere in the Slave Province may be present although they may be highly metamorphosed, highly deformed and perhaps so attenuated that they would be unmineable. Deposits of types relatively rare in the Slave Province may also occur in these areas. For example, a rather extensive iron concentation, presumably a magnetite iron formation, has been reported a few kilometres south of French Lake in the northern part of K/10 and within the southern fringe of the Artillery Lake sector of the proposed park. It is within a belt of highly metamorphosed sedimentary rocks and near a small area mapped as metavolcanic rocks just south of the McDonald Fault.

Several copper prospects along the north shore of McLeod Bay, nickel arsenide veins north of Hearne Channel in L/5, and a copper and mercury geochemical anomaly at Hanbury Falls (K/15-16) are in Archean rocks in the Slave Province, but the concentrations are probably of Proterozoic age and are dealt with elsewhere in this report.

Granitic rocks

Gold deposits may occur in and adjacent to small felsic intrusions in the Archean strata. Larger granitic plutons near Yellowknife, in particular those of syenogranite and monzogranite composition, are parents of the pegmatites that carry a variety of minerals, including ones containing lithium, beryllium, niobium, tantalum and tin (Meintzer et al., 1984). The parent granites are S-type or two-mica granites that have anomalously high radioactivity with high U/Th ratios as detected by airborne radiometric surveys (Newton and Slaney, 1978). In comparison, granites in an extensive area northwest of McLeod Bay in anomalously high radioactive zone of Carp Lakes, have normal to low U/Th ration (B.W. Charbonneau, this report). However, these granites contain above average amounts of uranium, and several small occurrences of uranium in and near pegmatitic phases of the granites are present on the north shore of McLeod Bay. The uranium-enriched granites could provide a plausible source for uranium concentrations in the Proterozoic strata to the south, as also observed by Maurice and by Charbonneau (this report).

The presence of granites enriched in U and Th within the proposed park area is indicated by airborne radiometric and regional geochemical surveys (B.W. Charbonneau and Y.T. Maurice, this report). Two pegmatititic uranium occurrences, similar to those on north shore of McLeod Bay, were discovered by the writers in 1983 within an area at the east end of the bay (Map 1 in pocket; Appendix 1 75K/15-1, 2). Laboratory studies of a sample from one of these disclosed that the rock is quartz syenite containing radiometrically determined 9.3%K, 98 ppm U and 1.3 ppm Th along with an estimated 10% apatite. Pegmatites on the northwest shore of Artillery Lake contain abundant tourmaline (Map 3 in pocket), and high radioactivity is observed at a few spots in them.

As noted below, it is possible that some igneous rocks within areas presently mapped as Archean may be uncommon post-orogenic intrusions, similar to various phases of the Blachford Lake Intrusive Complex, which have significant to major economic importance. One such area, marked by an aeromagnetic high and numerous geochemical anomalies contains the two above mentioned newly discovered uranium occurrences one of which is known to be in a distinctive potash-rich, phosphate-rich rock.

Anorogenic Early Proterozoic Plutonic Rocks

Post-Archean mafic-ultramafic, alkaline and peralkaline intrusions, older than nearby Proterozoic supracrustal rocks, have been recognized in several localities within the Slave Structural Province. Such intrusions, in other areas, are important sources of an impressive variety of mineral commodities including platinum group elements (PGE), chromium (Cr), vanadium (V), niobium (Nb), tantalum (Ta), rare earth elements (REE), yttrium (Y), zirconium (Zr), hafnium (Hf), titanium (Ti), nickel (Ni), copper (Cu), gold (Au), tin (Sn), uranium (U), phosphate, fluorite, and refractory minerals. One group of post-Archean, pre-Great Slave Lake Supergroup, anorogenic intrusions, the Blachford Lake Complex (Davidson, 1978, 1982), is present 50 km southwest of the proposed park. It contains potentially very important deposits of beryllium (Be), tantalum (Ta), niobium (Nb), rare earth elements (REE), Lithium (Li), zirconium (Zr), and uranium (U). Another, probably related intrusion, the alkaline Easter Island Dyke (Burwash and Cavell, 1978; Badham, 1979), is present on Simpson Island in the western part of the East Arm south of the Blachford Lake Complex. Prior to faulting of East Arm rocks, this intrusion would have been emplaced south of the study area according to a reconstruction by Hoffman et al. (1977). Commonly, anorogenic intrusions occur in swarms along a zone of crustal weakness. Such a zone may have developed with a northeasterly trend in the East Arm area prior to depositon of Proterozoic sediments. Possibilities that some unmapped anorogenic intrusions may be present as suggested by Davidson (1978) within or adjacent to the study area must therefore be considered, particularly in view of the fact that geological details in these areas have not been mapped.

In order to appreciate the character of anorogenic intrusions that might be present in the study area, it is useful to review the geology of the Blachford Lake Complex as ascertained by Davidson (1978, 1982). It can be considered to consist of 3 component types of intrusions: early mafic intrusions, alkaline granite intrusions, and later peralkaline intrusions. The earliest Blachford intrusions, gabbro, norite, anothosite and diorite, at Caribou Lake were first mapped as Archean (Stockwell, 1932; Henderson, 1938). Only painstaking field work (Davidson, 1978) revealed that they are younger than Archean granitic rocks to the north and west. Concentrations of ilmenite, magnetite and of iron sulphide with very minor amounts of nickel and copper are present in the Caribou Lake Gabbro. The rocks should be prospected for PGE concentrations. They are intruded by the Whiteman Lake Quartz Syenite, the Hearne Channel Granite containing alkali hornblende, and the Mad Lake hornblende-biotite-perthite granite. These granitic rocks and their environs should be prospected for tin deposits. They are truncated by younger peralkaline units of the Blachford Lake Intrusive Suite, the Grace Lake Granite which contains a syenite core named the Thor Lake Syenite.

Late pegmatitic rocks and metasomatically altered zones within and near the margin of the Thor Lake Syenite contain the potentially most important mineral deposits that have been found in the east arm area. The Lake Zone, 2 km^2 in areal extent is reported to contain 0.03% Ta, 0.4% Nb, 0.1% Sm, 1% Ce, 0.6% La and 3.5% Zr in 63 million tonnes of rock and an inferred total tonnage of 200 million tonnes. The T Zone extends from the Lake Zone north through the contact between the Thor Lake Syenite and the Grace Lake Granite. It contains two beryllium-rich sections, one of which has been explored underground. The northern section contains 435,000 tonnes grading 1.4% BeO, the other 1,200,000 tonnes with 0.66% BeO. These sections and adjacent parts of the T Zone contain very important concentrations of Y, Nb, Nd, Sm, Ga, Ce, La, and Li (Trueman et al., 1984).

The Hearne Channel Granite has been dated at 2,175 ± 7 Ma (Bowring et al., 1984) by the U-Pb zircon method. Dates ranging from 2,170 to 2,130 Ma have been obtained by the K-Ar method on the Whiteman Lake Quartz Syenite, the Mad Lake Granite, the Grace Lake Granite, and the Thor Lake Syenite (Wanless et al., 1979). Dates by the Rb-Sr method are similar except that those on the peralkaline rocks, which are technically unreliable, could be as much as 200 Ma younger (Davidson, 1982). Bowring et al. (1984) obtained a date of 2,094 ± 10 Ma on zircon that comprises 10-20% of intensely altered rock within the Thor Lake Syenite. This may be construed as evidence that the mineralization is some 80 Ma younger than the Blachford Lake Complex, but, in view of the differences in character of the dated material, the apparent age difference is suspect. Lack of systematic differences in K-Ar dates make it less likely that the peralkaline host rocks themselves (Thor Lake Syenite and Grace Lake Granite) are as much as 80 Ma younger than the rest of the complex.

The early mafic units of the Blachford Lake Complex produce conspicuous aeromagnetic anomalies and the complex in general is marked by a magnetic high. A particularly prominent positive magnetic anomaly corresponds with the rim of the Thor Lake Syenite. The Thor Lake Syenite produced a radiometric anomaly on a regional airborne survey by the Geological Survey of Canada in 1971 (Open File 124-1973; Charbonneau, this report). Such anomalies thus may provide starting points for searches for anorogenic intrusions but unfortunately they are not diagnostic for these. Aeromagnetic maps show many magnetic features in the area north of McLeod Bay that have not been explained in terms of geological features. Elsewhere in this report Charbonneau discusses some radiometric anomalies and Maurice, geochemical anomalies, in this area. A most interesting magnetically high area 20 by 30 km in dimensions is centered at 62°52'N, 108°53'W, 9 km northeast of the east end of McLeod Bay and 15 km southeast of Hoarfrost River (map 1566A). It is similar in size and in magnetic relief to the magnetic high that marks the Blachford Lake Complex. Many of the lake bottom sediments sampled within this area and particularly near its margins (Maurice, this report) contain elevated or anomalous amounts of U (Fig. 15l), Cu (Fig. 15d), Pb (Fig. 15e) in one case, Zn (Fig. 15f), Ni (Fig. 15g), Co (Fig. 15h), Mo (Fig. 15j), As (Fig. 15i), and Hg (Fig. 15o). Most of the anomalous samples are anomalous for more than one of these elements.

Charbonneau (this report) notes a prominent uranium anomaly (Anomaly 6) that peaks at 62°45'N, 108°45'W, 20 km east of Reliance and 10 km southeast of Lockhart River. This is near the south margin of the magnetic anomaly mentioned above. The next flight line 30 km to the north passed north of the north margin of the magnetic anomaly and did not record any anomalous radioactivity. As outlined by Charbonneau, a number of ground checks were made in the vicinity of radiometric anomaly 6 as well as near several lakes where geochemically anomalous lake bottom sediments had been discovered. Maurice (1984 and this paper) found coarse grained white granites at the north side of the magnetic feature near Hoarfrost River that are up to 10 times more radioactive than common Archean granitic rocks in the region. Radioactive granites have also been found at the south margin of the magnetic feature near the uranium anomaly (Anomaly 6) identified by the airborne spectro-radiometric survey. One of two recently discovered occurrences of uranium-rich rock (75K/15-1 in Appendix) within the magnetic high 20 km north of Anomaly 6 is quartz syenite, an uncommon rock type in Archean terranes. It is potash-rich (9.3%K) and extraordinarly highly phosphatic, containing an estimated 10% apatite. It also has a remarkably high U/Th ratio (U-98 ppm, Th-1.3 ppm) not typical of pegmatitic uranium concentrations. Further investigations, are required to confirm or eliminate possibilities that this area between the East Arm and Artillery Lake Sectors of the proposed park with multiple anomalies may contain anorogenic or other intrusions with associated mineral deposits of economic significance.

Early northeasterly trending Hearne diabase dykes

Diabase dykes of the northeasterly trending Hearne dyke swarm occur along the length of the East Arm, and cut the Blatchford Lake intrusive suite but are overlain by the Union Island and Sosan Groups (Hoffman et al., 1977, p. 119; Hoffman, 1981b, p. 98). They are not known to intrude the Wilson Island Group and hence their age relative to it is uncertain. Within the proposed park area, they are exposed near Reliance and Artillery Lake (Maps 1, 2 and 3 in pocket). One of them forms the steep south wall of Parry Falls where it is in sheared contact with porphyritic granite. They are fine to coarse grained and commonly contain coarse feldspar phenocrysts. No direct association has been established between the dykes and any particular type of mineral concentration, but there is a general spatial relationship between the Hearne dyke swarm and a set of distinctive veins characterized by nickel arsenide. Most of these veins also trend northeast (Badham, 1978). The Sachowia niccolite veins northwest of McLeod Bay are near Hearne dykes and a vein at Easter Island southwest of Blatchford Lake cuts a Hearne dyke.

Wilson Island Group

The oldest Proterozoic group in the area, the Wilson Island Group, is exposed south of the proposed National park area. The nearest exposures of it are about 7 km south of Redcliff Island and it may extend into the park area underneath a thick cover of younger rocks. Where most extensively exposed to the southwest, the group is a steeply dipping, metamorphosed fault-bounded sequence intruded by granite dated at 1895 ± 8 Ma. It includes a felsite dyke or volcanic flow dated at 1928 ± 11 Ma (Bowring et al., 1984). The main lithologic units are fluvial sandstones, some of which are red. The red oxidized character indicates that they were deposited after the atmosphere became oxygen-bearing approximately 2300 Ma ago (Roscoe, 1973). Other lithologic units include magnetite-bearing siltstone-shale, dolomite and volcanic flows ranging from mafic to felsic and associated pyroclastic rocks. Silty dolomitic beds on Wilson Island are radioactive due to the presence of thorium, according to studies carried out by Roscoe and Gandhi. Highly radioactive zones contain 300 to 700 ppm Th and 25 to 75 ppm U. The metals occur in very fine grained unidentified mineral disseminated through the beds. The beds represent a low grade thorium resource. Sedimentary strata of the Wilson Island Group also host a deposit on Outpost Island containing copper, gold, tungsten and molybdenum. A 50 ton per day mining plant was constructed on Outpost Island and operated in 1941 and 1942. Concentrates and bullion produced from 20,324 tons of ore contained 9,905 oz Au, 75 oz Ag, 56 Tons Cu, and 14 tons WO_3. Reserves of 11,000 tons containing 0.6 oz per ton Au, 0.6% WO_3 and 0.7% Cu were reported (Lord, 1951). Some gold-bearing quartz veins have also been reported on Wilson Island.

If the Wilson Island Group extends northward beyond known outcrops, into the study area, it would only be present beneath cover rocks and lake water at depths that would preclude exploration and exploitation considering the nature of known mineral concentrations within it. Thus, no resource potential is attributed to the group within the study area.

Great Slave Supergroup

S.S. Gandhi

Introduction

The western sector of the proposed National Park in the East Arm of Great Slave Lake is underlain by little disturbed formations of the Great Slave Supergroup of early Proterozoic age which are intruded by sheets of gabbro (Map 1 in pocket). Cross-section AB (in pocket) shows the gently dipping sedimentary sequence and intrusive sheets, together some 1.2 to 1.4 km thick, that are exposed mainly on the peninsulas of the East Arm which form a crescent-shaped area about 140 km long and up to 20 km wide. The area represents the northern platform of the East Arm sedimentary basin. Lower parts of the sequence are exposed only locally on islands in McLeod Bay and at the southwest end of Pethei Peninsula (Map 1 in pocket). Along the north side of McLeod Bay, the basal sediments (Sosan Group) were deposited in stream beds and shallow water atop Archean granitic rocks and steeply-dipping metamorphosed volcanic and sedimentary rocks. South of the peninsular areas the sediments were deposited in deeper water in a less stable basinal environment and include shaly and turbiditic units not present in the platformal zone (Hoffman, 1974, 1981; Hoffman et. al., 1977). Strata in the basinal zone include volcanics and are more deformed than those on the platform. They are also intruded by quartz-monzonitic intrusions not known to be present in the study area. In addition to these proterozoic strata and intrusions therein, some older Proterozoic intrusive rocks have been recognized in the East Arm area.

Various types of mineral concentrations are known, or expected to be present, in veins, layers or impregnations in the Proterozoic rocks as illustrated in Figure 5. These are outlined below in ascending order of age of those rocks or structures, that are considered to have possible potential as mineral deposit hosts. The main mineral deposit types known or considered likely to have been formed are: sandstone-type U; vein-type U; unconformity-related U and Ag; silty dolomite-hosted disseminated Th; vein-type Cu, volcanogenic Cu; stratiform granular iron-formation; shale-hosted U and Cu, Pb, Zn; sandstone-type Pb; carbonate-hosted Pb-Zn; paleoplacer Au; and possibly brecciated sediment hosted Cu-U-Au. Some of the deposit types are represented by the known occurrences in the study area (Appendix 1) whereas the others are types for which favourable geological environments are observed or projected from the adjacent area or postulated.

Union Island Group

The Union Island Group is exposed only in the vicinity of Union Island, approximately 40 km southwest of west end of the proposed park area. It rests on the Archean basement, and is comprised of basal quartzite-quartz pebble conglomerate in topographic lows of the basement, overlain, in sequence, by lower massive dolomite, black carbonaceous mudstone, basaltic flows and tuffs and gabbro, upper bedded dolomite, red and green laminated mudstone, and red mudstone (Hoffman et al., 1977, p. 120). The strata of this group were deformed, eroded and unconformably overlain by more extensive units of the Great Slave Supergroup (Hoffman et al., ibid). Much of the sedimentation occurred in stagnant basin conditions, an environment favourable for syngenetic stratiform concentrations of uranium and base metals. The dolomitic Artillery Lake formation, hosting Pb-Zn-Cu concentrations (Appendix 1; Tables 1 & 2, Appendix 2), is believed to be correlative with the Union Island Group as discussed in a latter section. Both were deposited on predominantly granitic basement rocks. A few small occurrences of sphalerite and pyrobitumen were found in the basal dolomite of the group by S.S. Gandhi during 1986 checkwork. Several copper and uranium occurrences are also known in other units of the group and a few of them are intensively explored. They include those at the east end of Union Island, where folded and faulted Union Island Group rocks are unconformably overlain by the Et Then Group. These occurrences have distinctive assemblage of minerals containing uranium, silver, copper, cobalt, arsenic, selenium and lead, and they have been interpreted to be related to the unconformity (Gandhi, 1983).

Rocks of Union Island Group may be present in the proposed park area under a thick cover of younger sediments, but are unlikely to be of interest for exploration.

Sosan Group and basal unconformity

The Sosan Group is comprised of 4 sedimentary formations and is intercalated with volcanic rocks of the Seton Formation in the upper part (Figs. 5 and 6). The lower two formations, namely the Hornby Channel and Duhamel Formations, are coarse arkosic and dolomitic respectively. They pinch out to the northwest before reaching the southern boundary of the proposed park area (Cross-section AB in pocket), except in the vicinity of Reliance where the Hornby Channel Formation is present (Map 2 in pocket). The two formations may be present, however, on Redcliff Island underneath a thick sequence of younger formations. They are overlain paraconformably by the Kluziai Formation of non-marine, fine to medium-grained sandstone, which rests directly over the basement in much of the proposed park area and to the north. It is overlain by the Akaitcho River Formation of red, micaceous sandstone, siltstone and shale. The boundary between the two formations is sharply defined at most places.

The geological setting of non-marine clastic sediments of the Hornby Channel and Kluziai Formations resting unconformably on predominantly granitic basement is similar to that of the Athabasca Group in Saskatchewan. It is favourable for the well-known unconformity-related sub-Athabasca uranium deposits (Tremblay, 1982), and for sandstone lead deposits, described by Bjorlykke and Sangster (1981).

The unconformity was examined during exploration of uranium prospects that are found within the Hornby Channel and Kluziai Formations in the structurally complex zone southeast of the proposed park area including Reliance (Maps 1 and 2 in pocket). It is generally sharply defined with little paleo-regolith. No significant uranium concentrations have been found at this unconformity. Near the north boundary of the proposed park area, a vertical drill hole 150 m long was drilled in 1971 by Shield Resources at the west end of Sosan Island (62°46'54"N; 110°13'49"W). The drill hole passed through nearly horizontal sandstone of Kluziai Formation and intersected a basal gritty bed and 3 m of granitic basement at the bottom, but no uranium values were encountered. The drill core was examined during the present study for signs of paleo-weathering and alteration

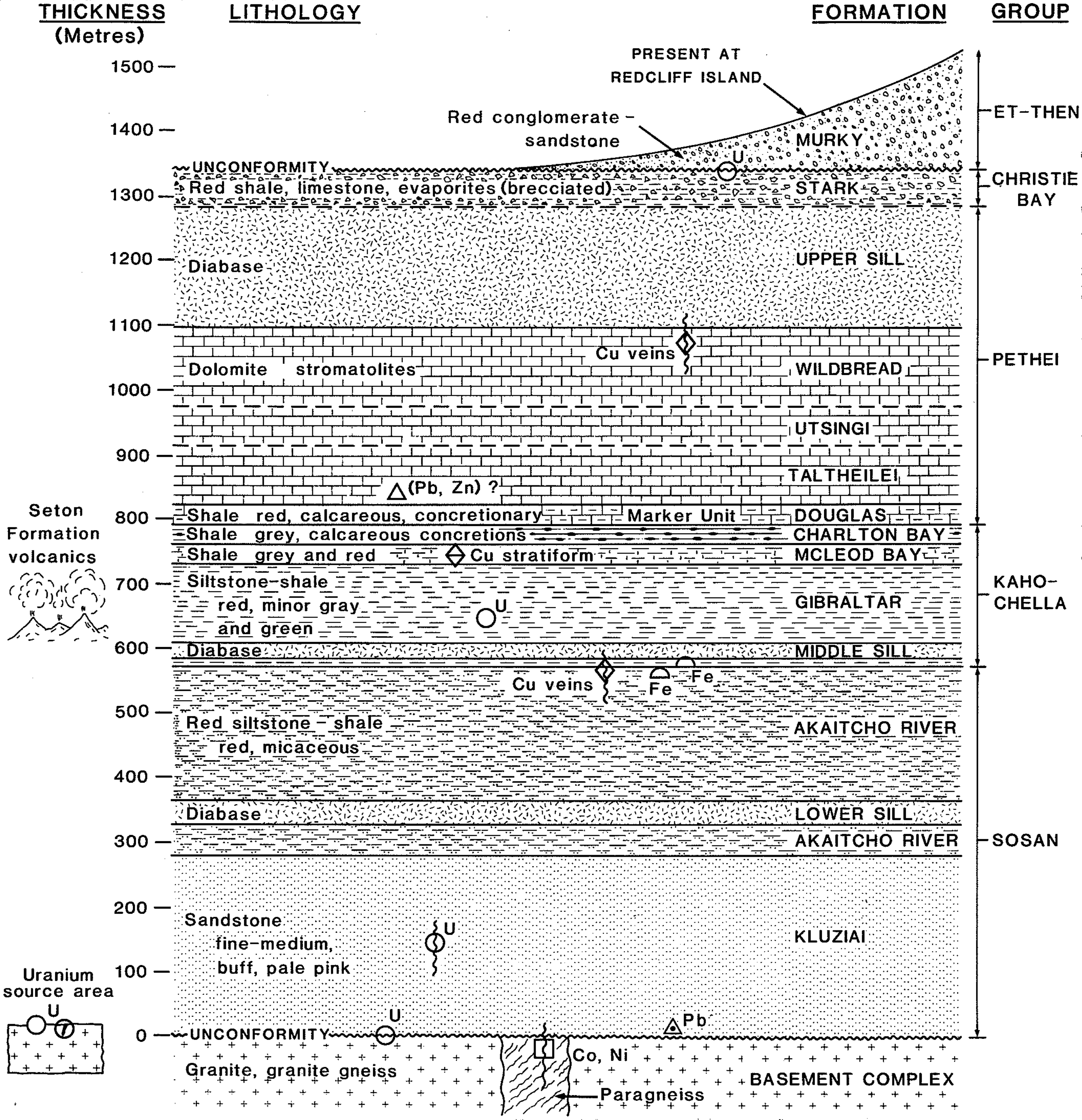


Figure 5. Mineral deposit types as related to the Aphebian platform sequence in the East Arm of Great Slave Lake (generalized from Map 1 and cross-section AB in pocket).

typical of unconformity-related deposits, but none was found. On the other hand, a uranium-rich hematite fracture occurs in granite near remnants of quartz-pebble conglomerate west of Sosan Island on EDE claims (62°45'53"W; 110°18'17"W, discovery by S.S. Gandhi, 1983). Furthermore, the source area of the clastic sediments includes abundant radioactive granites as pointed out by Charbonneau (this report) and illustrated in Figure 5. Hence the possibility of unconformity-related uranium deposits at the base of Sosan Group still remains open.

Hornby Channel Formation:

The arkosic sandstone of the Hornby Channel Formation has pebbly beds and heavy mineral layers and lenses. It was deposited by braided streams flowing southwestwards, and increases in thickness to the southwest where it is approximately 1600 m thick (Fig. 7; Hoffman, 1968). Among the heavy minerals, magnetite is predominant, and is partially altered to hematite. Weakly anomalous radioactivity associated with them is due to zircon and thorium-bearing minerals. These heavy mineral

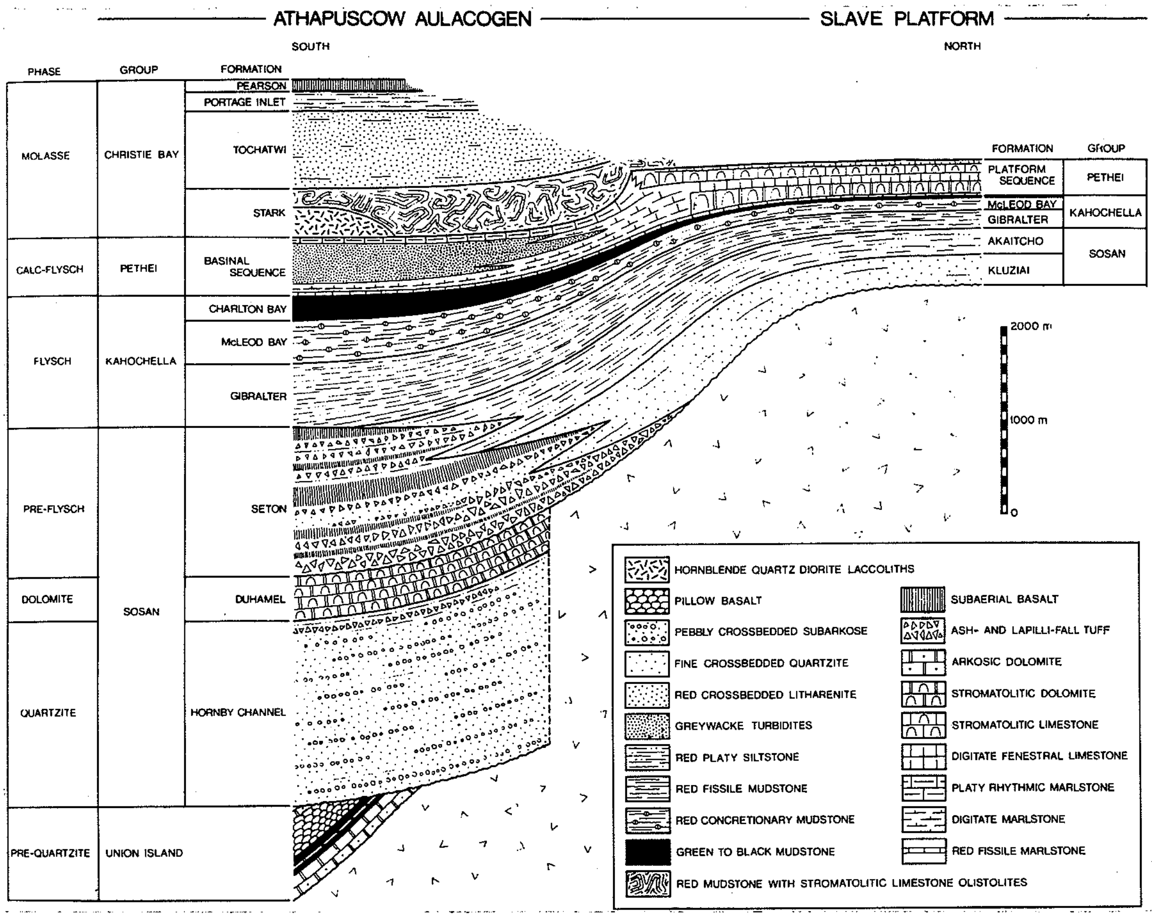


Figure 6. A north-south stratigraphic section of the East Arm basin and adjacent platform (from Hoffman, Dewey and Burke, 1974, p. 47).

concentrations are placers which could contain valuable minerals such as gold and cassiterite but none have been reported.

The Hornby Channel Formation hosts some 22 uranium occurrences, including one in the proposed park area near Reliance (Map 2; in pocket; Appendix 1, LID-HEB claims). These are commonly irregular and podiform with disseminated pitchblende interstitial to detrital grains, but a few are vein-type. Associated minerals are coffinite, hematite, pyrite, chalcopyrite, traces of galena, sphalerite, cobaltite, barite and U-Ti minerals (Morton, 1974). Pitchblendes from these occurrences have yielded discordant U-Pb isotopic dates ranging from 1715 to 1510 Ma (Gandhi, 1978; Bloy, 1979). The occurrences are interpreted variously, as metamorphogenic viz., derived from heavy minerals by fluids during burial metamorphism and deposited at the present sites (Morton, 1974), or sandstone-type, similar to the deposits in the southwestern U.S.A. (Gandhi, 1978), or related to unconformity at the base of the Et-Then Group (Walker, 1977, Gandhi, 1983). Fragments of the mineralized sandstone occur in the "exotic breccias", which post-date the Great Slave Supergroup, but are believed to predate the Et-Then Group (Reinhardt, 1972). The brecciation, however, may have occurred sometime during the depositon of the Et-Then Group so the possibility that at least some of them might be related to the sub-Et-Then unconformity cannot be ruled out.

Duhamel Formation:

The arenaceous dolomite beds of Duhamel Formation locally host low-grade concentrations of Th with lesser amounts of U in stratiform lenses (Lang, 1952; Lang et al., 1962). The metals are present in minute unidentified mineral grains dispersed through the rocks. The Duhamel Formation was deposited in littoral to shallow sub-littoral marine conditions (Hoffman, 1968, 1969). It probably pinches out to the north prior to reaching the proposed National Park area, as indicated in cross-section AB, but it may extend beneath Redcliff Island.

Kluziai Formation:

Hornby Channel and Duhamel Formations are overlain paraconformably by the Kluziai Formation. This mature sub-arkosic sandstone formation is found throughout the East Arm area including the western sector of the proposed park, except in the extreme southwest end of the area where it has presumably been removed by erosion. It is compositonally similar to the arkosic sandstone of the Hornby Channel Formation, but is finer grained and more even textured. It is ubiquitously cross-bedded and is fluviatile in origin. It hosts uranium occurrences in the Snowdrift area (Morton, 1974). The occurrences are similar to those in the Hornby Channel Formation. Lithologic distinction between the two formations is difficult at some places. Thus near Reliance,

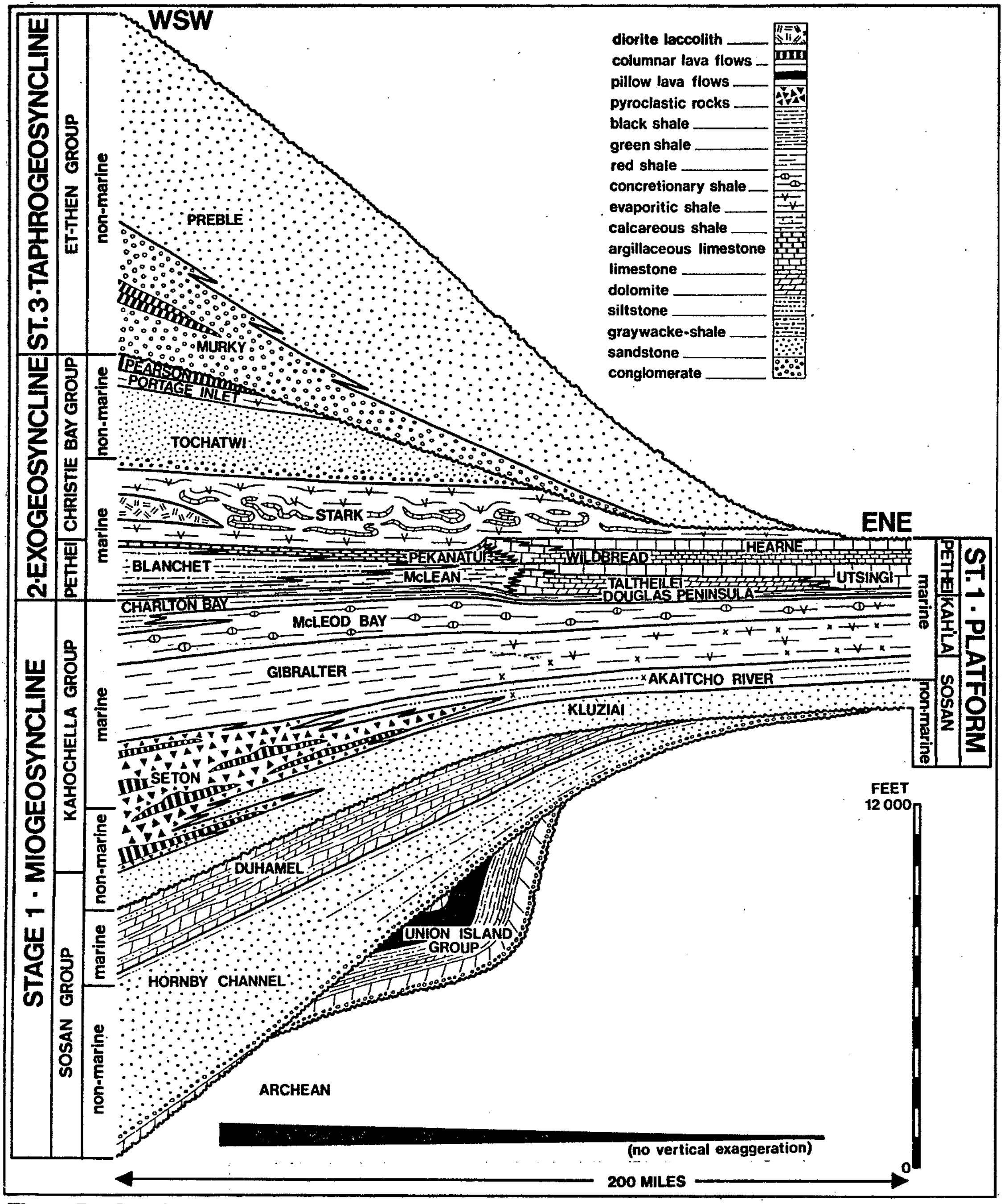


Figure 7. Stratigraphic cross-section of Proterozoic formations from the northeast to the southwest end of the East Arm fold belt (from Hoffman, 1969, p. 445).

some of the uranium occurrences are reportedly in the Kluziai Formation, but closer examination reveals that the host sandstone belongs to the Hornby Channel Formation (Map 2 in pocket). On the other hand, two new occurrences, discovered in 1979 by S.S. Gandhi, are hosted by the Kluziai Formation. These have pitchblende in fracture-fillings and associated disseminations. One of them is located on the Fairchild Peninsula within the proposed park area (Appendix 1), very close to an airborne radiometric anomaly discussed by Charbonneau (this report). The other one is 15.5 km to the southwest, on south shore of Charlton Bay. They occur at the boundary between buff sandstone of the Kluziai Formation and red micaceous sandstone of the overlying Akaitcho River Formation. The red to buff white colour change probably represents a change from oxidizing to reducing conditions favourable for precipitation of uranium from intrastratal waters.

Lithology and general geological setting of the Kluziai Formation resemble those of some sandstones that host disseminated galena deposits (Bjorlykke and Sangster, 1981). There is however no known occurrence of this type in the formation.

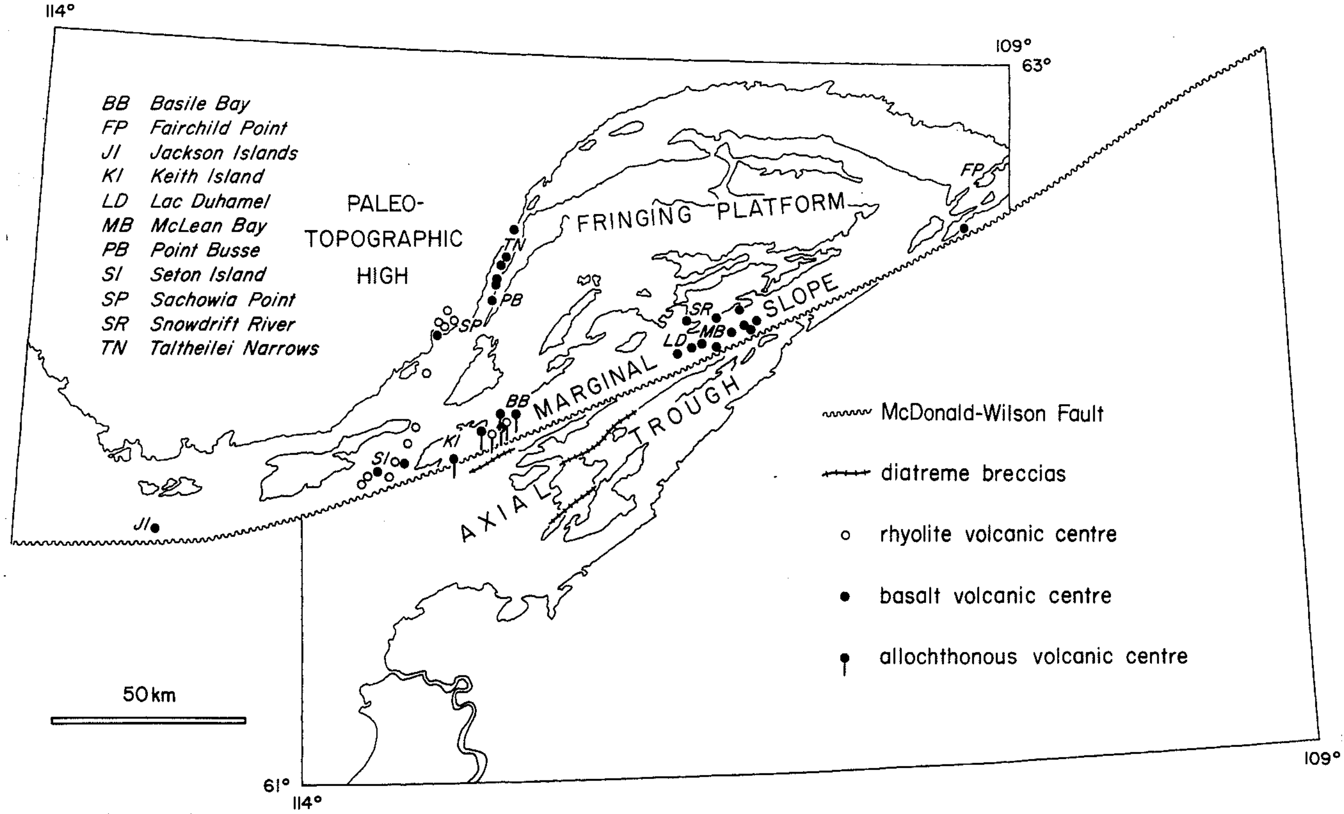


Figure 8. Regional distribution of Seton volcanic centres and their relation to major tectonic elements (from Hoffman et al., 1977, p. 122).

Although the Kluziai Formation must extend under most of the western sector of the proposed park area as illustrated in cross-section AB (in pocket), its exposures in the area are scarce and restricted to Taltheilei Narrows and Fairchild Peninsula (Hoffman, 1977). For this reason, and in veiw of the fact that the above mentioned uranium occurrences are too small to be of economic interest and that no lead occurrences have been found, the formation is unlikely to attract exploration interest, unless significant deposits are discovered in other parts of the formation lying outside the proposed park.

Akaitcho River Formation:

The Kluziai Formation is overlain by marine and deltaic beds of the Akaitcho River Formation. Constituent beds of red micaceous siltstone and red shale include 5 to 15 m thick lenses of white, cross-bedded, glauconitic, orthoquartzitic sandstone deposited in deltaic environment in the northeastern part of East Arm. The colour variations in the formation represent oxidizing and reducing environments that are favourable for uranium mineralization as discussed above, with an added probability of uranium source in volcanic rocks of the Seton Formation that are interbedded with it in the west in the Taltheilei Narrows region. This and other metallogenic possibilities are discussed further below.

Seton Formation:

Volcanic rocks were erupted during the deposition of the Kluziai and Akaitcho River Formations, along the northeast trending marginal slope of the East Arm trough and along a north-northeast striking zone at Taltheilei Narrows at the west end of the proposed park area (Fig. 8). Basaltic and rhyolitic flows, mostly subaerial, and pyroclastics are interbedded with the sediments of the two formations (Hoffman, 1969, Hoffman et al., 1977). The volcanic activity continued during the deposition of the lower part of the Kahochella Group. The volcanic rocks are grouped as the Seton Formation. Geographic restriction of these rocks along two zones may be apparent rather than real because of cover of younger strata. The volcanism and associated fumerolic activity may have been widespread. These have important metallogenic significance as sources of copper, lead, zinc, iron and uranium, deposited either at the volcanic centres or away from them in coeval sediments of the Sosan and Kahochella Groups.

Copper occurrences are common in the Seton volcanics, and one of them is a sizeable but subeconomic deposit in a breccia pipe (BBX claims; Fig. 9) near the west fringe of the proposed park area. Traces of uranium are associated with copper sulphide-rich zones at the outcrop of this deposit; this uranium could have been added later by supergene processes. The possibility that similar copper deposits may be present at accessible depths for exploration beneath the Pethei Peninsula may be considered an interesting exploration concept in the future. Furthermore, a larger more attractive target may be envisaged. Zinc, lead and copper rich layers may have been deposited in favourable beds of the Sosan and Kahochella Groups near fumerolic vents.

Kahochella Group

In addition to the geographically restricted volcanic rocks of the Seton Formation, outcrops of the Kahochella Group include 4 sedimentary formations, in ascending order Ogilvie, Gibraltar, McLeod Bay and Charlton Bay Formations (Hoffman, 1977). All four are present in the proposed park area and are exposed along the north side of Kahochella and Pethei Peninsulas. The Ogilvie Formation as distinguished by Hoffman (ibid) is restricted to Taltheilei Narrows

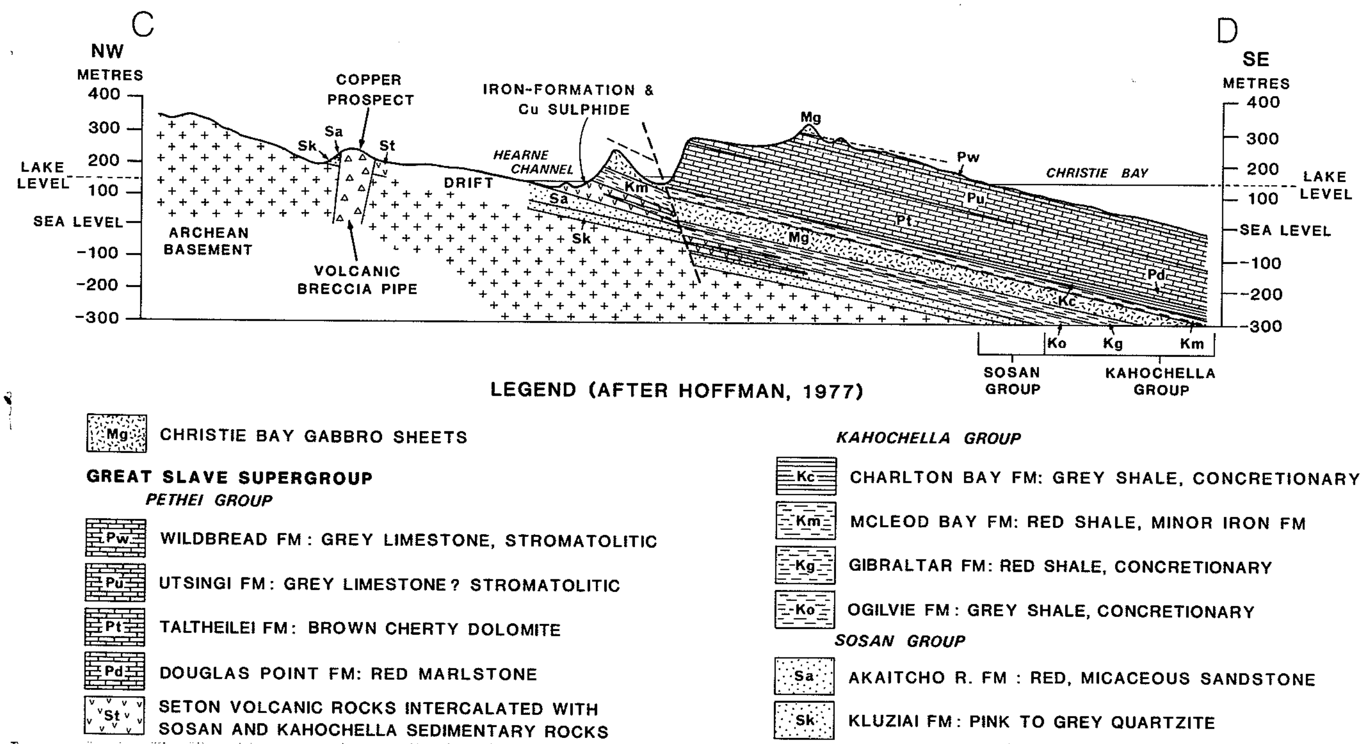


Figure 9. Cross-section at Taltheilei Narrows (section CD on Map 1 in pocket).

area, and is comprised of mostly of dark grey green shale with calcareous concretions and is locally tuffaceous. It is interbedded with Seton and Gibraltar Formations (Fig. 8) and is difficult to distinguish as a separate formation. Later more detailed mapping by Pelletier (1981) does not distinguish it as such. Red shales predominate in Gibraltar and McLeod Bay Formations, the younger being characterized by abundant calcareous concretions. The boundary between the two formations is not well defined in the proposed park area. In addition to shale, the formations contain thin beds of ripple-marked and cross-bedded granular or oolitic hematite, sandstone, flat-pebble intraformational conglomerate, conglomerate composed of reworked concretions, crystal casts after gypsum, digitate stromatolites, and tuffaceous beds. The formations have been interpreted by Hoffman (1968, 1969) as deposited in shallow marine environments, with periodic emergence in the northeast.

Gibraltar Formation:

The basal part of the Gibraltar Formation, interbedded with the Akaitcho River and Seton Formations, includes granular iron formations of Lake Superior-type, which includes the world's major iron deposits. Iron Formations are exposed at three localities in the proposed park area: Point Busse (Fig. 10), Viren Island and Shelter Bay (Appendix 1). They occur within a stratigraphic zone several tens of metres thick and 80 km in strike length. They contain granules of hematite, 0.5 to 1.5 mm long, set in recrystallized fine grained cherty matrix. Individual granular beds are only a few centimetres thick but several of them are closely spaced and are interbedded with ferruginous siltstones and shales, giving a few metres of aggregate thickness of iron-rich beds. Thus one of the two occurrences on the Viren Island discovered and sampled by S.S. Gandhi in 1983, has a total thickness of 2 m and contains on the average 19.86 per cent Fe and 0.12 per cent Mn (Appendix 1; additional analyses in Table 3, Appendix 2). A high grade grab sample from it has 38.3 per cent Fe and less than 0.008 per cent Mn. Other occurrences on the Viren Island and at Shelter Bay are thinner and/or leaner than the 2 m thick one. The occurrences at Point Busse, exposed at 6 localities on the west shore over a 7 km strike length, are described by Stockwell and Kidd (1931) as probably parts of a single bed of oolitic hematite associated with hematite-rich shales and jasper, upto 10 m thick. Examination of the northernmost of these exposures by S.S. Gandhi and S.M. Roscoe in 1984, revealed 15 iron-rich horizons within a stratigraphic thickness of 11 m (Fig. 10; Appendix 1). The horizons ranged in thickness between 5 and 36 cm, aggregating 2 m of high grade material. Analyses of samples from these beds are reported in Table 3 (Appendix 2). Additional iron formation beds may be present below the lake level. Interbedded lithologies are red-brown shale, dolomite, intraclast shale, and green tuffaceous and calcareous rocks. These are regarded as part of Gibraltar Formation interbedded with Seton Formation volcanics (Fig. 9; Pelletier, 1981).

It is suggested here that these iron formations were deposited from waters enriched in iron and silica as a result of contemporaneous volcanic activity that contributed heat to circulating meteoric water. The oolitic and granular character of the iron-rich beds probably resulted from their deposition in agitated shallow water as has been suggested in the case of similar beds elsewhere (Gross and Zajac, 1983). Iron formations can be expected to occur east of Point Busse

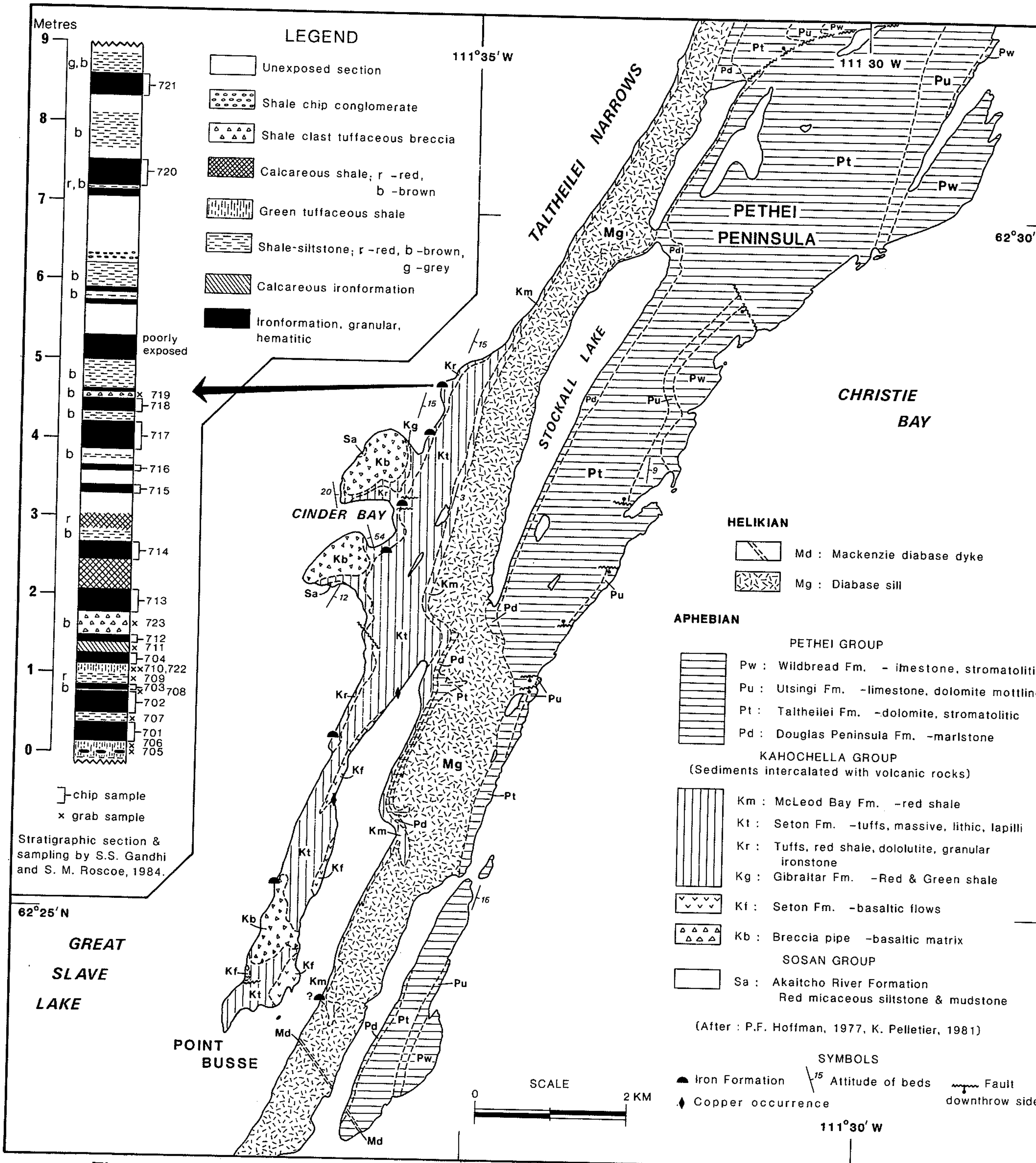


Figure 10. Geological map of part of Pethei Peninsula near Taltheilei Narrows, showing location of iron formation exposures and detailed stratigraphy of northern iron occurrence.

over a distance of several tens of kilometres. The known occurrences however are inconsequential in comparison with large ore tonnages required for iron mining. Chances of finding economically significant iron deposits in the proposed park area of East Arm are very slim.

In addition to the iron formations, the Gibraltar Formation has pale green shale lenses and thin beds enriched in uranium, as revealed by the 1983 fieldwork done by S.S. Gandhi. The highest uranium concentrations found are at Gibraltar Point, where total count readings on URTEC UG-135 minispec ranged from 600 to 2200 cps as compared to the background of 200 to 250 cps over red shale-siltstone which predominate over the light green shales (Appendix 1). Two representative chip samples from radioactive lenses up to 10 cm thick, yielded radiometric values of 552 and 582 ppm eU and 16.8 and 21.2 ppm eTh. Similar light green shales upto 25 cm thick occur elsewhere in the Gibraltar Formation and also in the Charlton Bay Formation and give readings up to 700 cps. The uranium is concentrated in finely disseminated minerals associated with clay minerals and is probably syngenetic. The host shale appears to be tuffaceous in origin. It was evidently deposited in reducing conditions in contrast to the red shales representing oxidizing conditions unfavourable for uranium precipitation. The source of uranium may be the tuffaceous shale or uraniferous granites in the provenance of the sediments of the Great Slave Supergroup. It is probable that larger syngenetic concentrations of uranium may occur in the proposed park area, but in general such deposits are of low grade and economically not as attractive as other types of uranium deposits.

McLeod Bay Formation:

The McLeod Bay Formation is well exposed on the north facing escarpments of the Pethei and Kahochella peninsulas, and in parts of Douglas and Fairchild peninsulas. It is comprised of laminated red shales, with abundant calcareous concretions that are commonly a few centimetres thick and elongate, and are arranged in rows parallel to bedding. Small crystal casts after gypsum occur in the shales in the Fairchild Peninsula region, indicating saline environment of deposition (Hoffman, 1969). The formation shows little evidence of metal concentrations during deposition.

Charlton Bay Formation:

The Charlton Bay Formation is comprised largely of dark green to grey shale or argillite with some beds of red to maroon shale and a few of pale green radioactive shale mentioned above. Hoffman (1968, p. 20) mentioned the presence of thin beds of bright apple green micaceous bentonite on Douglas Peninsula at east end of Wildbread Bay. These appear to be similar to the radioactive shale beds, according to field observations by S.S. Gandhi and S.M. Roscoe who did not encounter bentonite there. Calcareous concretions are abundant throughout the Charlton Bay Formation, except in the pale green beds and a few grey shale beds. They are widely spaced and range up to 50 cm in long diameter parallel to bedding, but most of them are 3 to 15 cm in diameter. Hoffman (ibid) has reported the presence of small nodules of pyrite or marcasite and of some concretions containing patches of jasper. These nodules and grey colour indicate reducing environments of deposition favourable for concentrations of base metals, uranium and associated elements. Traces of chalcopyrite were observed by S.S. Gandhi in some concretions at several localities, within a few metres from intrusive gabbro sheets. Recrystallization due to contact metametamorphism has produced distinctive coarse garnet-epidote-bearing reaction rim around the calcarous concretions. Copper in the rock is probably syngenetic as the depositional environment of this formation is favourable for concentration of the metal. Other metals may be associated with it. Uranium however, is not notably concentrated in this formation, excepting the pale green beds, according to the field observations made in 1983.

Pethei Group

The Pethei Group is the most prominent sedimentary assemblage exposed in the proposed park area. The predominant dolomitic strata are relatively more resistant to erosion than the shale of the underlying Kahochella Group, and form hog-back ridges all along the Pethei Peninsula and parts of Kahochella Peninsula, in part protected by the gabbro sills. The base of the group is marked by a distinctive thin bedded fissile red marlstone unit approximately 31 m thick, termed Douglas Peninsula Formation which is the only formation of the group that extends throughout the East Arm area. It contains numerous thin lenticles of calcareous material, and thus resembles the McLeod Bay Formation. The overlying stromatolitic carbonate sequence displays paleobathymetric zonation of platform, marginal slope and axial trough facies as shown in Fig. 11 (Hoffman, 1974, Hoffman et al., 1977). The platform facies includes the Taltheilei, Utsingi, and Wildbread Formations. The Taltheilei Formation is a shallow-water stromatolitic dolomite and limestone formation, and occurs on the flanks of the old structural high east of Taltheilei Narrows. It passes laterally into and in part is overlain, by the Utsingi Formation, which has blue-grey limestone beds in the lower part and massive white limestone in the upper part. The massive limestone forms a low ridge along the entire length of Pethei and Douglas Peninsulas. The Wildbread Formation is another shallow-water stromatolitic dolomite and extends over almost the entire length of the East Arm. The axial trough facies in the area south of the proposed park, on the other hand, has westerly derived greywacke turbidites of the Blanchet Formation interbedded with deepwater stromatolitic mudstone of McLean Formation and rhythmically laminated limestone of Pekanatui Point Formation. Between the platform and axial trough facies, the marginal slope facies is comprised of the McLean and Pekanatui Formations without greywacke turbidites, and are more calcareous than in the axial trough (Cross-section AB in pocket).

The facies change from the carbonate platform to the terrigenous basinal sequence is an example of a 'shale-out', commonly observed at the outer margins of Phanerozoic carbonate platforms or shelves (Hoffman, 1969). The Pb-Zn deposits of Pine Point on the south shore of Great Slave Lake are in a similar geological setting (Beales and Jackson, 1966; Skall, 1975; Kyle, 1980; Anderson and Macqueen, 1982; Rhodes et al., 1984). Similar deposits elsewhere in the world, referred to as the Mississippi Valley-type deposits (MVD), are aligned along facies changes such as reef to off-reef, shelf dolomite-basin limestone or carbonate to shale, and beneath paleo-unconformity (Ohle, 1980; Sangster, 1981). On local scale, the ore bodies are associated closely with bioherms. The geological setting of the Pethei Group thus appears to be one that is favourable for MVD. No important deposits of this type, however, have been found in early Proterozoic rocks. Vein-type Pb-Zn-Cu occurrences are present in early Proterozoic dolomites of the Artillery Lake formation, and are discussed in the following section in the context of genesis of the Mississippi Valley-type deposits.

The uppermost formation of the Pethei Group, namely the Hearne Formation is predominantly thick bedded, white to grey limestone with laminations and mottling of reddish limestone and dolomite. The lower part of the formation is exposed on the Pethei and Douglas Peninsulas beneath the gabbro sill. The upper part has been removed by erosion.

Contacts between limestone and igneous intrusions warrant attention as serpentine (soapstone suitable for carving) and mineralized skarns are commonly developed there. Skarn-type deposits containing tungsten, tin, lead, zinc or copper, however, are more commonly associated with felsic plutonic rocks than mafic intrusions, and none are known in the proposed park area.

Christie Bay Group

Overlying the Pethei Group is a complex assemblage of red beds approximately 1800 m thick, subdivided into Stark, Tochatwi, Portage Inlet, Pearson and Fortress Formations (Hoffman, 1969, 1977; Hoffman et al., 1977). Small exposures of Stark and Tochatwi Formations are found in the proposed park area near the west end of Pethei Peninsula and at the north end of Redcliff Island. The formations are probably present under the Et-Then Group on Redcliff Island. These and three other formations are preserved in the structurally complex axial zone to the southeast, but elsewhere the upper formations are stripped away by erosion.

The Stark Formation is a terrigenous mudstone formation over 600 m thick, with two extensive shallow-water carbonate units, each about 30 m thick, in the upper part. The formation is extensively brecciated, with chaotically disposed blocks of stromatolitic limestone and dolomite in a brecciated matrix of red mudstone, and it is referred to as megabreccia or as an olistostrome.

Because of the brecciated character, its thickness is not well-known. The mudstone is recessive and a profound deep in Christie Bay was probably caused at least partly, by glacial erosion of the Stark Formation. The maximum water depth is near line AB (Map 1 and Cross-section AB in pocket), on the west side of the line, and is 2000 ft or 610 m. Since the lake level is 156 m above the sea level, the bottom here is here 454 m below the sea level, the lowest point on the bedrock surface of any continent.

The reason for brecciation, postulated by Hoffman et al. (1977, p. 124-125), is the dissolution of a salt bed, probably several tens of metres thick, immediately below the mudstone. This is supported by the absence of blocks derived from underlying Pethei Group, presence of salt crystal clasts both above and below the megabreccia, and conformable relation with the overlying Tochatwi Formation.

The Tochatwi Formation is an 800 m thick sequence of immature, red, lithic and feldspathic sandstone, with minor siltstone and shale in fining upward cycles. It was deposited by rivers that flowed from southwest along the axis of the East Arm trough. The overlying Portage Inlet Formation is mainly red mud-cracked silstone, containing halite and gypsum clasts, and is approximatley 230 m thick. Minor sandstone and conglomeratic lenses are present. The sediments are overlain by columnar basalt flows of the Pearson Formation. They have a maximum thickness of 165 m, with interbedded grey and red shale. Some of the basalts are amygdaloidal. Plagioclase in them is albitic with more calcic core. In general, the mineral assemblage is typical of prehnite-pumpellyite facies indicating burial metamorphism in a temperature range of 100 to 250°C and pressures of 2 to 6 kilobars (McGlynn and Irving, 1978, p. 644). The Pearson Formation has limited present geographic distribution around Portage Inlet. The overlying Fortress Formation is even more restricted in its present areal distribution. It consists of buff feldspathic sandstone, with red mudstone at base, and is about 200 m thick.

The Christie Bay Group is of relatively little significance in terms of mineral resource potential of the proposed park because of the restricted geographic distribution and rarity of mineral occurrences in it. Evidence for the occurrence and dissolution of considerable salt within the group is interesting, however, as brines are potent solvents and transporting agents for metals which might have been redeposited as concentrations in favourable (reducing) environments in other formations.

Quartz-Monzonitic Intrusions (Compton laccoliths)

A string of more than 20 cogenetic intrusions of diorite-monzonite composition, extending all along 225 km length of the East Arm of Great Slave Lake, were emplaced prior to the deposition of Et-Then Group and major movements along the McDonald Fault System. The majority are elongate laccoliths floored by the top of the Pethei Group and have a discordant bulge upward into the Stark megabreccia. U-Pb zircon dating on two bodies yielded a mean of 1865 ± 15 million years as the time of their emplacement (Bowring et al., 1984).

The intrusions are located south of the proposed park area, but three of them are only 2.5 to 5 km south of Redcliff Island (Map 1 in pocket and Fig. 17). Two of these are partially covered by the Murky Formation, which extends over the island. It is thus probable that monzonitic intrusions are present in the Redcliff Island area, under the Murky Formation.

The intrusions host veins of actinolite, apatite and magnetite, and some of the veins contain minor amounts of uraninite closely associated with magnetite (Lang et al., 1962; Badham, 1978; Badham and Muda, 1980; Gandhi and Prasad, 1980, 1982). Some of the actinolite-apatite-magnetite veins carry minor amounts of nickel-cobalt arsendies, copper sulphides, pyrite, chlorite, quartz, calcite and dolomite as stringers, pods and disseminations (Badham, 1978; Harris and Thorpe, 1985), but these minerals are scarce, erratically distributed and younger than the actinolite-apatite-magnetite (Badham and Muda, 1980). The actinolite-apatite-magnetite veins are vertical or steeply dipping, and a majority of them strike between east and northeast. They range in width from a fraction of a centimetre to a metre, rarely up to 2 metres, and in length from a few centimetres to 150 m. Uranium also occurs in veins and disseminations without the other minerals in some Compton intrusions.

There is little doubt that the magnetite-apatite-actinolite veins are genetically related to the host intrusions. It is not certain, however, whether uranium, cobalt and nickel minerals were derived from the intrusions. Similar concentrations are found in veins cutting the Easter Island alkaline dyke, Archean greywacke and volcanics, and the Blachford Igneous Complex. Petrochemical studies of the Compton intrusions suggest that they are an unlikely source of these metals (Gandhi and Prasad, 1982). The concentrations, like other complex uranium concentrations described below, may be related to the unconformity at the base of the Et-Then Group. Brines derived from the Stark Formation intruded by the Compton laccoliths may have played a critical role in the formations of the mineral deposits.

The proposed park area is considered to have some potential for the Co-Ni-As-U-Ag type of mineralization even though no quartz-monzonitic intrusions are known within it. As outlined below, veins containing nickel arsenides and pitchblende are by no means restricted to the Compton intrusions.

Et-Then Group

Following the intrusions of laccoliths, fault movements occurred along the McDonald Fault system accompanied by non-marine sedimentation of the Et-Then Group. Three main periods of faulting have been recognized by Reinhardt (1969, 1972). The first one was essentially transcurrent dextral and of considerable magnitude, whereas two others were mainly vertical.

The Et-Then Group is a continental redbed sequence and includes intercalated basalts that have highly oxidized flow tops indicating subaerial extrusion. The basalts have been dated by Rb-Sr isotopic method at 1969 ± 82 Ma (Gandhi and Loveridge, 1982). This date, however is questionable as the basalts are younger than quartz-monzonitic intrusions dated at 1865 ± 15 Ma by U-Pb zircon method (Bowring et al., 1984). The group consists of an older Murky Formation and a younger Preble Formation, respectively approximately 1000 m and 3500 m in thickness (Stockwell, 1936a, b). The Murky Formation is interpreted by Hoffman (1969) and Hoffman et al. (1974), as a fanglomeratic sequence, deposited as alluvial fans growing northwestwards from scarps developed along the northeast-trending faults. Deposition proceeded contemporaneously with the fault movements. The fine grained northwestern facies is interpreted as lacustrine deposits formed at distal margin of the alluvial fans. The Murky Formation is cut by the major faults and their splays, but there are great changes in thickness across fault lines, and a sandstone high in the Preble Formation oversteps several splay faults (Hoffman et al., 1977). The sedimentary structures in the Preble Formation indicate deposition in fining upward fluvial cycles and sedimentary transport to the southwest, although the material may have been derived from the fault scarps (Hoffman, 1969). The faulting continued after the deposition of the Preble Formation, with transcurrent and some vertical movements, and resulted in local overturning of Preble beds, according to Reinhardt (1969, p. 180, and 1972, p. 29).

The Murky Formation is exposed only on Redcliff Island within the proposed park area; elsewhere in the area, most of it and the overlying Preble Formation are eroded away judging from the structure as shown in the representative cross-section (AB in pocket). A few pitchblende-bearing quartz and/or calcite veins are known in the Et-Then Group. These are however not as signficant as unconformity-related uranium deposits that might have been formed at the base of the group. Pitchblende veins in the Union Island area, which occur in fractured dolomite breccia of Union Island Group and in fractures subsidiary to a fault contact of phyllites of this group and arkosic quartzite of the Sosan Group, were interpreted to be related to the sub-Et-Then unconformity by Gandhi (1983). The interpretation is based mainly on the following: proximity of the veins to the unconformity; fluvial clastic and highly oxidized character of the Et-Then Group indicating environments favourable for mobilization of uranium from source rocks by circulating meteoric waters; low temperature mineral assemblage in the veins including colloform pitchblende, selenides and native silver; and lack of evidence for alternative magmatic or metamorphic hydrothermal sources as no intrusions cut the host rocks in the vicinity of the veins and the metamorphic grade of the host rocks is very low.

The genetic interpretation is similar to that proposed by Langford (1977, 1978) for the pitchblende veins in the Beaverlodge mining district in Saskatchewan, which occur close to the unconformity at the base of the Martin Formation. This formation is lithologically very similar to the Et-Then Group. It includes basalt flows and was deposited in fault-controlled basin at about the same time as the Et-Then Group. Hence the potential for economic uranium deposits at the base of the Et-Then Group is regarded as very good. Although the present areal extent of the group in the proposed park area is limited to Redcliff Island, it is probable that it extended at one time over much larger area, to the north and east, perhaps to Artillery Lake. Presence of favourable structural traps in the basement below it would permit formation of unconformity-related deposits. These may be preserved in downfaulted blocks or where erosion is not deep. From these standpoints however, the proposed park area is relatively less favourable than the area immediately to the south.

Genetic considerations analogous to those discussed above apply, in the writers' opinion, to the Ni-Co arsenide veins that occur at several localities to the south and west of the proposed park area and which can be expected to occur within the park area up to Artillery Lake. They carry a variety of other minerals (Badham, 1978; Badham and Muda, 1980; Harris and Thorpe, 1985). Mineralogically, they appear to be part of a spectrum of unconformity-related deposits, and some of them carry significant amounts of uranium and/or silver. They occur in a variety of host rocks: in alkaline gabbro at Easter Island; in Archean metasedimentary rocks at Francois Bay, in mafic and felsic phases of the Blatchford Lake alkaline suite, in Archean paragneiss and metavolcanic rocks, gabbro, felsic dykes and in or close to northeast-trending diabase dykes near Sachowia Point; in calcareous sediments of upper part of Pethei Group at the base of Blanchet Island quartz monzonitic intrusion, and in a quartz-monzonite laccolith near Snowdrift. Some of the veins have been mined on small scale: Easter Island veins for silver, Blanchet Island and Sachowia veins for nickel (Badham, 1978). The Sachowia or Copper Pass mine, dormant since 1970, was the closest mining operation to the proposed park area, located only 6.5 km west of the west end of the study area.

Comparisons of these veins and other arsenide-bearing veins in Northwest Territories, northern Saskatchewan, and Ontario suggest that all likely share some critical features in their genetic histories. The time of formation of the veins in the East Arm is not known, hence their relationship to the sub-Et-Then Group unconformity and to post-Et-Then events remains speculative. Possibly they formed, or achieved their present form from pre-existing metal concentrations, at about 1250 Ma ago when Mackenzie gabbro dykes and sills were intruded and at essentially the same time as pitchblende veins and unconformity-related deposits were formed in northern Saskatchewan.

Gabbro Sills and Dykes (Mackenzie dyke swarm)

Gabbro sills are prominent in the proposed park area, and they cap the Pethei and Kahochella peninsulas (Map 1 and Cross-section AB in pocket; Fig. 4). Samples of the sills collected by S.S. Gandhi during 1983 on cross-section AB were dated by whole-rock K-Ar method, and yielded the results (GSC-3575, 3571, 3572, 3573, unpublished) as follows: (a) coarse gabbro near base of upper sill, north slope of Pethei Peninsula 1115 ± 13 Ma; (b) 1.3 m thick subsidiary sill 2 m below the middle sill, west end of Viren Island, upper chilled margin 1249 ± 15 Ma; medium grained centre 1085 ± 34 Ma; and lower chilled margin 1219 ± 14 Ma. Dates on the chilled margin are believed to be the most reliable, hence the sills are regarded as approximately 1250 million years old. The results are similar to K-Ar dates for northwest trending, vertical, gabbro (or diabase) dykes of the Mackenzie dyke swarm some of which cut the sills (Fahrig and Jones, 1969). The dates on the sills and dykes corroberate paleomagnetic evidence that the two sets of intrusions belong to a single, approximately 1250 Ma old Mackenzie igneous event (Fahrig et al., 1965; Fahrig and Jones, ibid; Fahrig and West, 1986).

The sills and dykes are not differentiated, and hence cumulates of such minerals as magnetite, ilmenite, chromite and sulphides that may be of economic interest are not developed. Even the thickest upper sill, which caps the

Pethei Peninsula and is 190 m thick, shows only small variations in composition. Variations in grain size, however, are common and nearly horizontal alignment of crystals is present at several places along the cross-section line AB on the south side of the peninsula. The sill here encloses a large lens of recrystallized stromatolitic dolomite, approximately 10 m thick. A late stage, coarse felsic gabbro to diorite phase is developed in the sills at many places, and it forms irregular bodies up to several metres long, commonly with sharp contacts, and contains hornblende and/or actinolite as the main mafic silicate. Magnetite-rich veins up to a few centimetres wide occur sparsely in the sills, and are of no economic significance. In addition, there are actinolite-feldspar-quartz veins, and quartz-calcite veins with traces of chalcopyrite. These veins are also up to a few centimetres wide. They are well exposed on the north shore of Lost Channel near its east end, where magnetite-rich veins are also present. The quartz-calcite veins have wall-rock alteration zone up to 10 cm wide wherein the diabase is light grey and green coloured. The veins are apparently related to the larger vein-type copper deposits in early Proterozoic sediments. The deposits are discussed below.

Deeply weathered outcrops of possibly ultramafic rocks were reported by Hoffman et al. (1977, p. 128) near the west end of Pethei Peninsula (67°37'38"N; 111°16'W). Ultramafic phases were sought during the fieldwork by S.S. Gandhi and S.M. Roscoe in 1983, but none were encountered, although some deeply weathered exposures of relatively more mafic gabbro were found. Hoffman et al. (ibid) regarded the sills as part of a funnel-shaped intrusion centred at Christie Bay, and in agreement with Hornal and Boyd (1971), suggested that more extensive mafic and ultramafic rocks at depth might account for the 39 milligal positive gravity anomaly over Christie Bay. These interpretations, however, are not supported by convincing evidence (note cross-section AB in pocket).

Vein-type Copper Deposits

Two small deposits containing chalcopyrite in quartz-calcite-pyrite veins occur in the western sector of the proposed park area, and in addition there are six smaller occurrences of this type, in the study area (Appendix 1). The "G" claims deposit on the north shore of Douglas Peninsula is the most intensively explored prospect in the area. Seventeen holes totalling 1767 m were drilled in 1973 by Giant Yellowknife Mines Limited (Spence, 1973a; Appendix 1). The drilling indicated a nearly vertical zone aproximately 200 m long, 3 m wide and extending to depth of more than 60 m. The average copper content is less than 1 per cent, although higher grade intersections were obtained and some spectacular concentrations of chalcopyrite and minor bornite are seen in trenches. The deposit is too small to be economic. The second deposit, previously unreported, was discovered by S.S. Gandhi in 1983 and is located on cross-section AB at Viren Island (Appendix 1). It has a strike length of over 150 m and is open to the west. The vein zone is nearly vertical and up to 7 m wide, but coarse aggregates of chalcopyrite and minor bornite, are restricted to a narrower central part less than 1 m wide. The aggregates are discontinuous, and range in width up to 10 cm.

The deposits occur in northeast to east-trending veins in nearly flat lying sediments of the Kahochella and Pethei Groups. Normal faults are common at the "G" claims. The vein-type deposits occur in the normal faults or subsidiary fractures. The faults are most likely related to major northeast-trending faults that post-date the gabbro sills and have prominent topographic expression e.g. at the Gap between Wildbread Bay and Christie Bay, and at Shelter Bay. Other normal faults parallel to or at low angle to these can be inferred. One such fault is postulated to occur between Kluziai and Viren Islands (Cross-section AB in pocket). All these faults are potential exploration targets for the vein-type copper deposits.

The veins are believed to be moderate to low temperature hydrothermal. They post-date the gabbro sills which contain a number of small veins e.g. on the west shore of Viren Island. They cut a variety of rock types, including Sosan Group sediments near Reliance, basement granite at "EDE" claims on shore west of Sosan Island and in Archean rocks at Bigstone Point and Waldron River along the north shore of McLeod Bay. Proximity of gabbro sills to the veins suggests some genetic connection. The intrusions may have provided heat to circulating meteoric waters which leached copper from host rocks and eventually deposited it in open fractures.

Other deposits of this type are found in the East Arm area south of the proposed park, the most important group is along a zone extending several kilometres southwest of Maufelly Point near Reliance (McGlynn, 1971, p. 133-136; Thorpe, 1972, p. 27-34). More are probably present, but none of the deposits of this class is likely to be economically very significant unless it contains important amounts of precious metals in addition to copper. To date only one intersection with significant silver and gold contents has been encountered in a deposit located near Meridian Lake (Map 2 in pocket; ANN 1-16 claims, see Thorpe, 1972, p. 32); this is not considered sufficient evidence to ascribe more than a low economic potential to this deposit type in the East Arm region.

Possible metallogenic significence of East Arm gravity anomaly

R.A. Gibb (this report, Figs. 31 & 32) has provided a model interpretation of the large gravity anomaly centred near the south shore of Pethei Peninsula. He considered that the source of the strongly positive anomaly is most likely a body of mafic or ultramafic rock emplaced beneath strata of the Great Slave Supergroup. Such a body might be: (1) a lens of Archean mafic metavolcanic rocks, like the Yellowknife greenstone belt, that is unconformably overlain by the Proterozoic strata; (2) an early Proterozoic anorogenic intrusion like the Blachford Lake Complex (or its early mafic phases) that also predates the Great Slave Supergroup; (3) a pre- Great Slave Supergroup igneous body preserved along a suture that marks the zone of collision of Slave and Churchill continents; (4) a huge exotic deposit containing abundant iron oxide and perhaps associated copper, gold, uranium and rare earth concentrations, like the Olympic Dam deposit in South Australia which produces a very large gravity anomaly with an associated magnetic anomaly (Roberts and Hudson, 1983); (5) a post- Great Slave Supergroup intrusion, perhaps of Mackenzie age, like the Muskox intrusion near Coppermine. Each of these possibilities and others have different metallogenic implications. They have in common a probability that they are roofed by basal Great Slave Supergroup strata.

The model developed by Gibb (Fig. 32) allows for a thickness of 3 to 4 km with a local maximum of 7 km for the Great Slave Supergroup above the presumed mafic-ultramafic body, based on a section shown by Hoffman et al. (1974). If such thicknesses are considered valid, the heavy body would be inaccessible so that its character and that of possible associated mineral deposits would not warrant consideration in this report. A very much lesser thickness of Great Slave Supergroup strata, however, is indicated by the mapping done for this study. The cross-section A-B (in pocket) shows a projected thickness of 1.4 km of the Proterozoic strata beneath 0.6 km of water at the anomaly peak. It is possible in fact that the base of the sedimentary sequence could be as little as 1.2 km beneath the shoreline of the peninsula not far from the centre of the extensive gravity anomaly. Thus, the source of the excess gravity could very likely be ascertained by drilling. It would seem likely that someone would want to make such a drill test in the future for academic reasons or perhaps even in hopes of discovering deposits of platinum metals or other conceptualized deposits associated with the heavy rock.

Artillery Lake Formation

Introduction

Early Proterozoic dolomitic sediments resting on crystalline Archean basement are preserved in a 50 x 10 km area at Artillery Lake, and host numerous veins carrying galena, sphalerite and chalcopyrite (Fig. 12). Most of these occurrences were discovered, and most of the information on the geology of the area was gathered during the field work carried out by S.S. Gandhi in 1983 and 1984 towards the present mineral resource assessment (Gandhi, 1984, 1985). Earlier work by Tyrrell (1901), Wright (1952, 1957, 1967) and Folinsbee (1952) had reported dolomite outcrops in the area and also one chalcopyrite occurrence (Folinsbee, ibid; Showing A-4 of this study, Fig. 12), but their regional mapping provided little information on the areal extent, stratigraphy and strucutre of the carbonate rocks. These predominantly dolomitic beds and associated conglomerate, sandstone, shale and chert, preserved within a geographically restricted area of Artillery Lake (Fig. 12; Map 3 in pocket), have been collectively referred to as 'Artillery Lake formation' by Gandhi (1984).

An occurrence of sphalerite on Crystal Island was found, according to a verbal report, by INCO Limited in early 1950's, however no data on it was published or is available in the assessment files. The numerous discoveries made during the present study, at readily accessible localities on shore, therefore reflect a virtual absence of even casual prospection in the dolomite area, let alone any expensive mineral exploration venture. Withdrawal of the area from staking since 1970 for the proposed park must be considered as at least partly responsible for the lack of exploration activity.

General features of the formation and lead-zinc veins

Thicknesses of up to 10 m of basal beds of Artillery Lake formation unconformably overlying the Archean basement rocks are exposed along the northwest shore of the lake. Progressively greater thicknesses of the formation are preserved towards the southeast and south, according to the available structural data (Fig. 13). The thickest section is exposed on the south shore of Artillery Lake east of Crystal Island, where the beds are nearly vertical. They form the southeast limb of a synclinorium, and are downfaulted with respect to the basement gneissess on the southeast side along the Artillery Fault (Figs. 13 and 14). The section is approximately 300 m thick. The base of the formation is not exposed here nor is its top; hence the section represents a minimum thickness of the formation. It is regarded as the type section. A generalized stratigraphy of the formation is shown in Figure 14. Facies variations are difficult to establish because of scarcity of sectional exposures, lack of recognizeable marker units and complexity of structure.

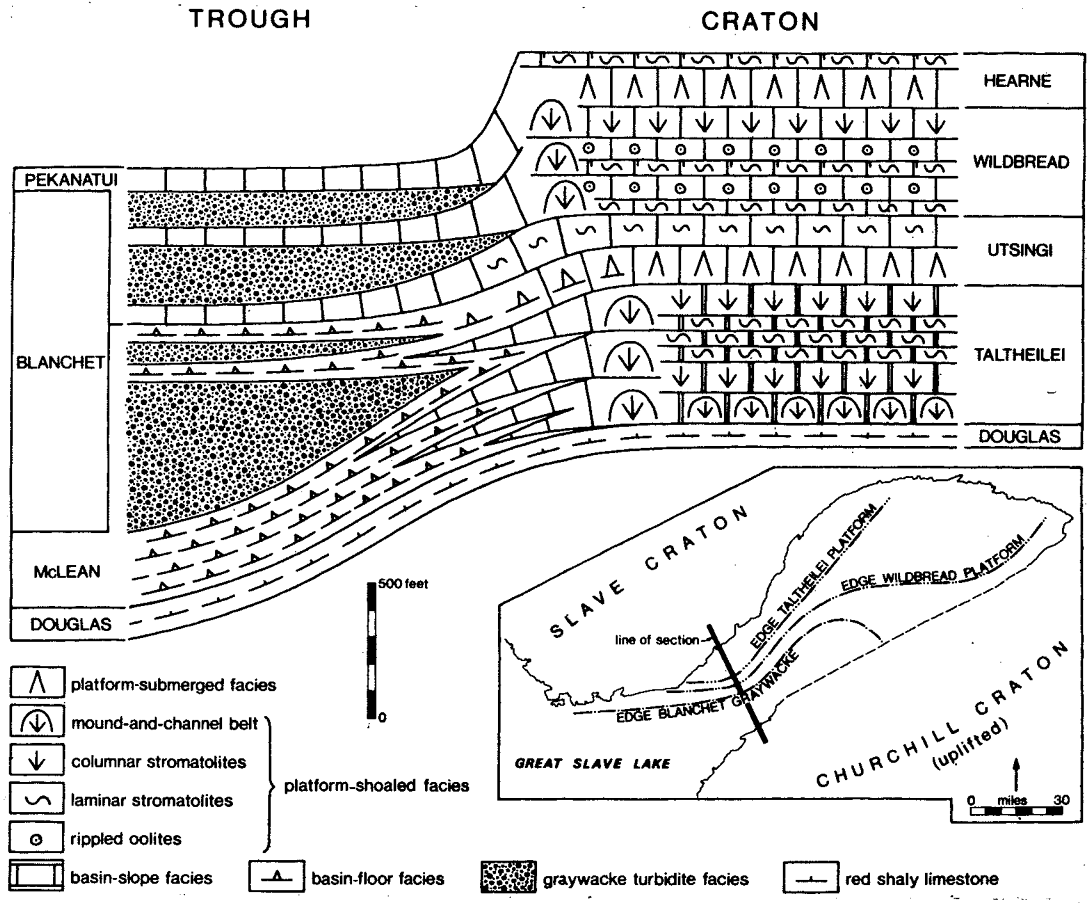


Figure 11. Facies relations of Pethei Group in southwest half of the East Arm Basin. Diagram is based on projection of measured sections onto single cross-section and confirmed by "walking out" facies changes. In northeast half of the basin, edges of Taltheilei and Wildbread platforms diverge, as shown inset/map (from Hoffman, 1974, p. 859).

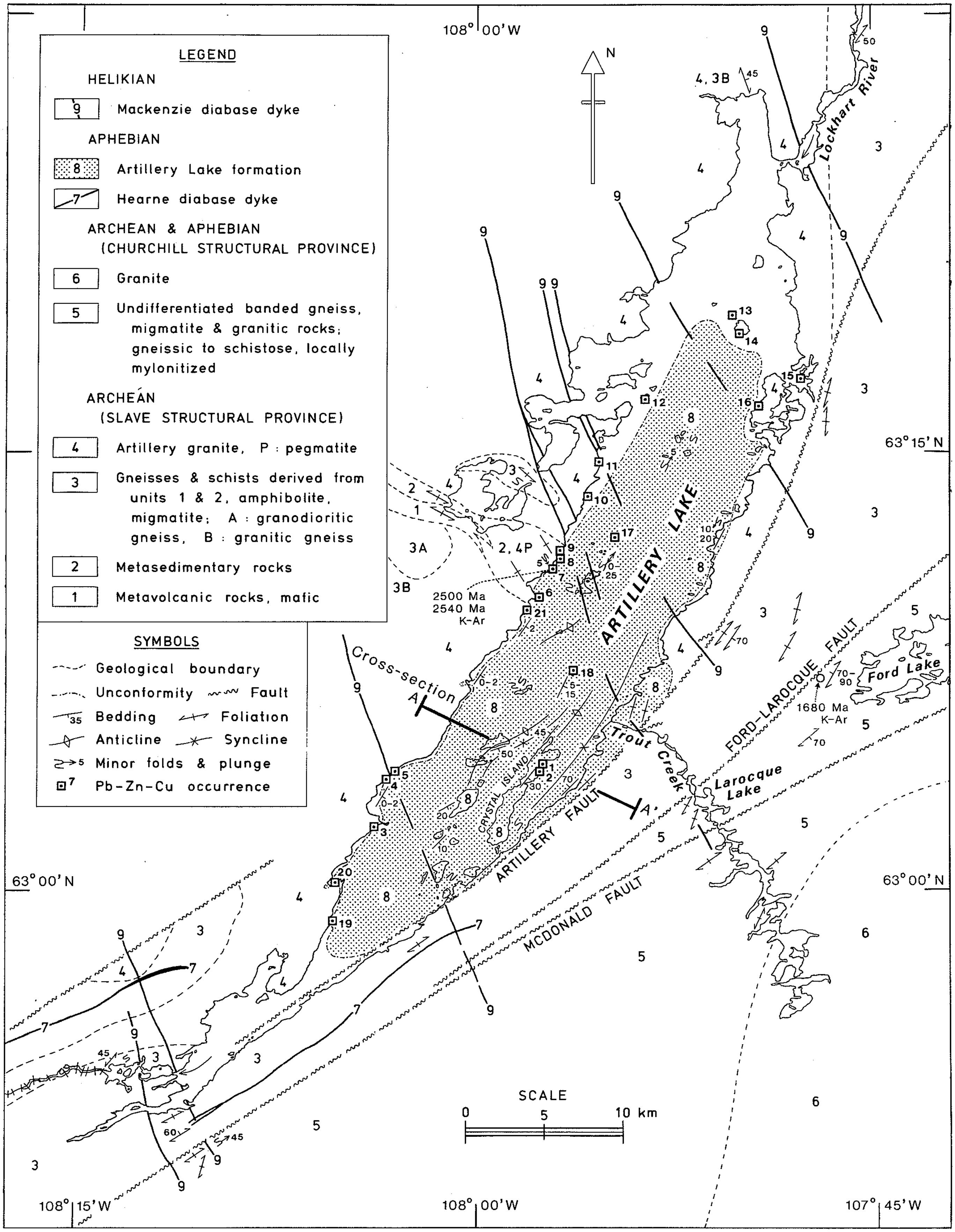


Figure 12. Geology and Pb-Zn-Cu occurrences of the Artillery Lake area, Northwest Territories (from Gandhi, 1985, p. 361). Cross-section A-A' illustrated in Fig. 13.

Massive and thick to thin bedded, buff weathering dolomite predominates in most of the outcrops of the formation. It contains numerous cherty lenses, and chert-filled polygonal mud cracks. It includes beds and lenses of grit and quartz pebble cemented by dolomite matrix. The largest one of these is near the top of the formation in the type section, and it is 15 m thick and over 50 m in strike length. It contains tightly packed quartz pebbles and coarse quartz grains, with rare dolomite fragments. Stromatolitic beds occur at many places in the southern part of Artillery Lake. The most common variety of stromatolite is columnar, up to a few centimetres in diameter and 2 m in height. Laterally linked small domal structures up to 0.5 m long, and some flat laminated beds are probably of organic origin. Intraclast dolomite beds and lenses, up to a few metres in thickness, occur at several places. Grey argillaceous sediments are found in some of the gritty lenses and dominate in a 20 m thick section exposed along a 1.5 km length of the southeast shore of Artillery Lake at longitude 107°47'W. This section is comprised of interbedded grey and red-maroon shales, dolomitic and argillaceous dolomite. Along the northwest shore of Artillery Lake, the basal beds include numerous lenses of chert, of pyrite-pyrobitumen-quartz, and of grit and pebbles cemented by dolomite. The lenses are up to 75 cm thick and several tens of metres in length. A few small pyritic lenses occur at stratigraphically higher levels. Spherulitic pyrite is observed in some places with vitreous black pyrobitumen and coarse quartz. The basement granite and paragneiss at several exposures of unconformity show saprolitic character due to paleoweathering, carbonatization of the weathered zone, dolomite cementation of loose fragments and lag gravel, and dolomite and chert veins along joints and fractures formed

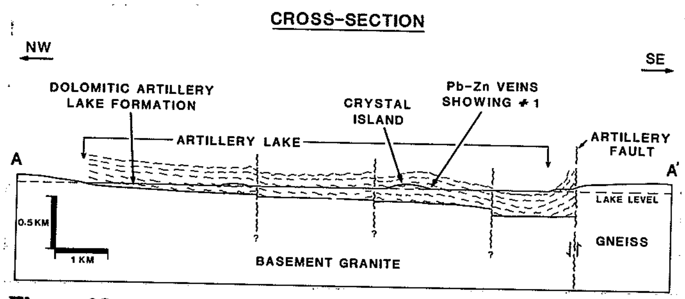


Figure 13. A section across Artillery Lake (section A-A' on Fig. 12).

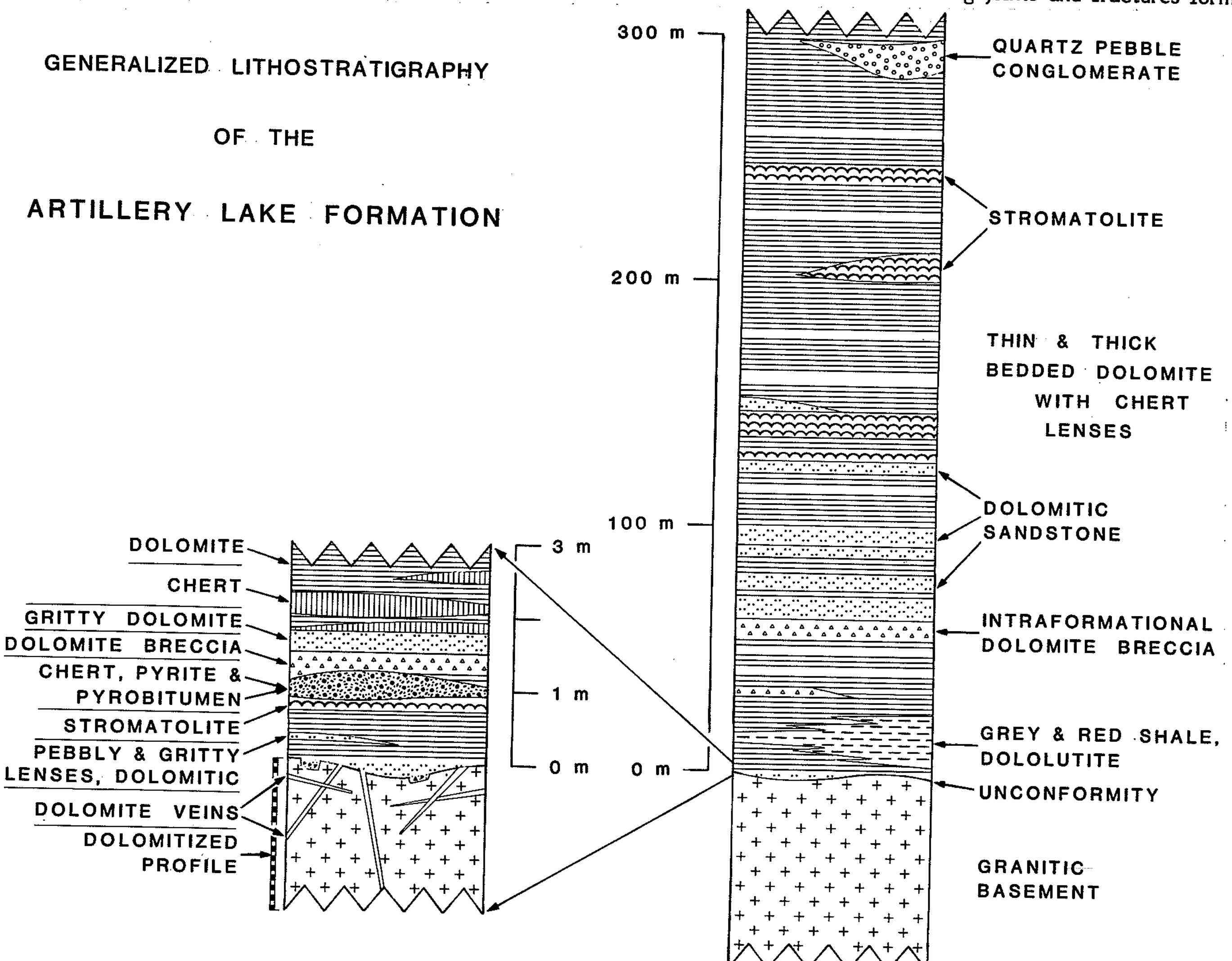


Figure 14. Generalized lithostratigraphy of the Artillery Lake formation, Northwest Territories. Approximately 300 m thickness of the formation is exposed on southeast shore of Artillery Lake (see Fig. 13). Detailed basal section based on the exposures on the northwestern shore of the Lake.

during sedimentation and diagenesis. Similar features are described by Chown and Caty (1973, 1983) in the basement below the early Proterozoic Mistassini Group in-Quebec, the lower formations of which are predominantly dolomitic and host several Pb-Zn occurrences. Some of these features are also seen at widely scattered localities in the basement several kilometres to the north, northwest and northeast of the present extent of the Artillery Lake formation. They indicate that the formation formerly extended considerable distances over the basement of low relief, and that the subsequent erosion here has not penetrated far below the basement-Artillery Lake formation unconformity. These features, however, are not found in the basement on the uplifted southeast side of the Artillery Fault, where the erosion level is well below the unconformity (Figs. 13 and 14).

The lithological features indicate that the Artillery Lake formation was deposited in intertidal to supratidal environments, in generally warm dry climate. The formation is traversed by numerous dolomite and chert veins, irregular patches of tan-weathering dolomite in brecciated buff-weathering dolomite, quartz-pyrobitumen veins, and the youngest quartz carbonate veins carrying galena, sphalerite and chalcopyrite. These features are the result of complex diagenesis, and later deformation and hydrothermal mineralization events. The deformation resulted in open to moderately tight folds trending northeasterly and ranging in amplitude from a few metres to a few hundred metres. Smaller subsidiary folds are developed in many places. Plunges of the folds are gentle to moderate and alternates in direction to give dome and saddle structures in the competent dolomite. Parts of the formation however are little disturbed, and show very gentle dips to the southeast. Breccias are developed along hinges of some tight folds in dolomite. The shales on the east shore of Artillery Lake show minor folds and axial cleavage dipping steeply to the southeast. The largest fold in the basin is a syncline southeast of Crystal Island (Figs. 13 and 14). It is bounded on the southeast side by the Artillery Fault which is nearly vertical and trends 055°. The fault apparently belongs to the northeast-trending McDonald Fault system with dominantly right-lateral displacements (Reinhardt, 1969; Hoffman, 1981). The amount of lateral displacement along the Artillery Fault is not known, but a vertical component of movement of at least 300 m is indicated by the uplift of gneissic basement against the Artillery Lake formation.

A few minor faults subparallel to the Artillery Fault are observed in the Artillery Lake area, and other similar faults are likely to be there. The northeast trend of a number of galena-sphalerite-chalcopyrite- bearing veins (Appendix 1) is interpreted as controlled by this set of faults and fractures in the basement (Gandhi, 1984, 1985). The parallel regional trends of the folds and faults are suggestive of their close relationship. It is probable that folding of the Artillery Lake formation was caused by predominantly vertical movements of the rigid basement blocks along the northeasterly trending faults, rather than by horizontally directed regional stress. A tendency of some fold axes to swing to the east may also be explained by this style of deformation. It is also supported by the absence of any significant compressive stress as indicated by the character of pyrobitumen. This has low atomic H/C ratio (0.20) typical of 'anthraxolite' rank but its reflectance values put it in much lower 'impsonite' rank. These features show a considerable thermal effect (below a maximum of 450°C), but a lack of any significant shear or compressive stress which would normally tend to align the molecular 'sheets' of fused aromatic carbon atoms (Gandhi, 1984). Diabase dykes of north-northwest trending Mackenzie swarm cut the folded Artillery Lake formation, but these have little contact metamorphic effects.

Lithological characteristics and the regional setting of the Artillery Lake formation suggest correlation with one of the dolomitic formations in the East Arm of Great Slave Lake as pointed out by Folinsbee (1952) and Wright (1952, 1967). Dolomite beds occur in the Wilson Island Group, Union Island Group, Duhamel Formation of the Sosan Group, and Pethei Group, as described earlier. Lithological features of the Artillery Lake formation resemble more closely to those of the Union Island Group than of the other dolomitic units of the East Arm area (P.F. Hoffman personal communication, 1985). Basal dolomite in the two sequences was deposited on Archean granite which is highly dolomitized at the unconformity and is cut by numerous dolomite and chert veins. Pebbly and sandy lenses are common in the dolomites of both sequences. Numerous chert veins and lenses occur in these dolomites. Red and grey shales are interbedded with the dolomites. A number of occurrences of galena, sphalerite, chalcopyrite, pyrite and pyrobitumen are found in and at the base of the Artillery Lake Formation as described below. A few occurrences of these minerals, with the exception of galena, were also encountered in the Union Island Group, during fieldwork for a comparative study by S.S. Gandhi in 1986. Basaltic flows are present in the Union Island Group, and are not known in the Artillery Lake Formation, but they are of localized occurrence and do not in themselves invalidate the proposed correlation. The Union Island Group, along with the rest of the Great Slave Supergroup, is bracketed between 1895 ± 8 and 1865 ± 15 Ma by U-Pb zircon dates on older and younger intrusions (Bowring et al., 1984). Lead isotopic data on 15 galena samples from the veins in the Artillery Lake area (Table 2, Appendix 2) are consistent with a date of lead mixing in the range of 1.89 to 1.99 Ga, given an initial radiogenic lead source date in the range of 2.67 to 2.59 Ga (Roscoe, 1984).

Metallogeny

Association of galena and sphalerite with platform carbonates is a common one in space and time, and the occurrences at Artillery Lake define a metallogenic district characterized by the association.

These occurrences are of vein-type (Appendix 1). Local brecciation of the host rock and some replacement of wall rock are associated features. Most of the veins are at or close to the unconformity at the base of the Artillery Lake formation but a few occur at stratigraphically higher levels. They post-date dolomitic and cherty veins, and some of them cut across minor folds in the formation. They range in size from stringers and small veins to larger veins up to a metre thick and several tens of metres long. Some closely spaced en echelon veins form zones extending several hundred metres along strike. Most veins trend northeasterly, subparallel to the regional trend of folds and faults. Dips of the larger veins are commonly steep. The smaller veins are more numerous and more variable in attitude, and commonly occur in stockworks and anastomosing clusters. They are rich in coarse galena and sphalerite whereas the larger ones commonly contain pockets of these minerals and chalcopyrite in more abundant quartz, pyrite and minor carbonates (calcite, siderite). Silver content is variable, ranging from a few ppm to 384 ppm (Table 1, Appendix 2). Pyrobitumen is present in some of these veins, but it is more common in quartz veins and aggregates that contain little or no sulphide, and in stratiform pyrite lenses that are virtually barren of base metal sulphides.

The known occurrences are small in terms of mineable tonnage and grade for base metals, even though some spectacular concentrations have been observed. The occurrences are widely distributed, and intervening areas are largely covered by lake water and overburden. It is reasonable to expect that more such occurrences as well as larger structures hosting economically interesting clusters of veins or sulphide-rich bodies of other shapes, may be found if exploration is undertaken. In this regard it may be pointed out that the geological setting of the Artillery Lake galena-sphalerite-chalcopyrite veins is similar to that of the galena-sphalerite-barite veins at the base of middle Proterozoic Sibley Group in Ontario, which have been mined on a small scale (Franklin and Mitchell, 1977).

It is apparent that the Artillery Lake occurrences are structurally controlled epigenetic veins. The mineralization is localized along fractures, faults and dilatant zones formed, during folding and faulting of the Artillery Lake formation (Gandhi, 1984, 1985). A preliminary study of primary fluid inclusions in quartz associated with coarse sphalerite of Showing A-1 on Crystal Island (Appendix 1), revealed homogenization of the gas and liquid phases at temperature close to 170°C.

Mineralogy, texture and environment of deposition of the veins are in many respects similar to those of the much larger Mississippi Valley-type carbonate-hosted stratabound deposits. They suggest that the genetic processes that led to the formation of the veins and the deposits are comparable. These deposits are epigenetic, precipitated from hydrothermal solutions in a temperature range of 80 to 200°C in open space, with some replacement of host carbonate rocks, in structurally passive regions (Jackson and Beales, 1967; Ohle, 1980; Sangster, 1981; Anderson and Macqueen, 1982). They are major source of world's lead and zinc e.g. deposits in Paleozoic strata at Pine Point located 400 km southwest of Artillery Lake (Skall, 1975; Kyle, 1980; Rhodes et al., 1984), at Cornwallis Island in the Arctic including the deposit at Polaris mine (Kerr, 1977), and in the type area in southeast Missouri (Gerdemann and Myers, 1972). Such deposits also occur in older strata as in the middle Proterozoic dolomite on Borden Peninsula including the one at Nanisivik mine (Olson, 1984), and in the early Proterozoic stromatolitic dolomite of the Richmond Gulf area which contains stratabound pyrite-sphalerite-galena deposits (Chandler, 1984) that probably represent a variation in the Mississippi Valley-type deposits. Furthermore, districts containing this type of deposits also have veins similar to those at Artillery Lake. To provide a perspective on the possibility that the Artillery Lake formation may host Mississippi Valley-type deposits, features of major deposits of this type are reviewed briefly.

The most favourable geological settings for the deposits are that of abrupt carbonate-shale facies change and of paleo-unconformity above the carbonate host rocks or a combination of the two. Example of the first type of environment is the barrier reef complex at Pine Point, and of the second type are the Cornwallis and Borden Peninsula districts. The ground preparation was by dissolution of carbonate host rocks along fractures and karsting. The open spaces thus created were the sites of deposition of sulphides of lead, zinc, iron and copper, along with quartz and carbonates. Pyrobitumen is associated with many deposits. The mineralization clearly post-dates the deposition and lithification of the host rocks, and in many cases also post-dates minor structural disturbances, uplifts, erosion and deposition of younger shaly beds over the host rocks. Depths at which the deposits were formed are less than 2 km. The source of metals is debatable. According to a widely favoured model of Jackson and Beales (1967) for the Pine Point deposits, the metals were leached from shale deposited in the deeper parts of the basin, by connate brines generated during compaction. Other metal sources such as crystalline basement, associated evaporites, and arkosic sediments however, have been suggested by other workers. It may be noted here that in case of the Artillery Lake occurrences, lead isotopic compositions of galenas (Table 2, Appendix 2) are indicative of granitic basement rocks as source of lead (Roscoe, 1984; Roscoe and Gandhi, in preparation). Sulphur is believed to have been derived from sulphates in the rocks traversed by the metalliferous fluids or in separate fluids that eventually mixed with the metalliferous fluid to precipitate sulphides under appropriate conditions.

Above mentioned conditions favourable for formation of Mississippi Valley-type deposits may well have existed at Artillery Lake. Depositon of carbonate here on crystalline basement of small relief is comparable to some extent with that of the host carbonate of the southeast Missouri district which surrounds crystalline basement highs and is overlapped by shale (Gerdemann and Myers, 1972; Ohle, 1980).

The preserved part of the Artillery Lake formation is small in area (50 x 10 km) compared to other extensive platform carbonates, but its thickness of 300 m or more is comparable to or greater than that of the carbonate strata that host major Pb-Zn deposits. With regard to the area, it may be pointed out here that the Mississippi Valley-type deposits tend to form clusters of ore bodies of various shape and size (tabular, prismatic, and irregular bodies, up to a few hundred metres in long dimension) within a small part of carbonate area. The Pine Point district for example has 36 orebodies in an area 65 x 24 km, each deposit containing between a fraction of a million to 3 million tonnes ore (Rhodes et al., 1984). The total resources are 75 million tonnes averaging approximately 3 percent Pb and 7 percent Zn. It is apparent that the Artillery Lake district has "room" for several deposits. The maximum thickness of the Artillery Lake formation is preserved in the region southeast of Crystal Island, which therefore may be regarded as having better potential than elsewhere. But in absence of relevant geological and exploration data, other parts of the formation can not be readily discounted as of low potential.

In view of the above, the whole of the Artillery Lake formation and the adjacent basement are regarded here as of considerable interest for exploration for base metals, particularly in comparison to much of the remainder of the proposed park area. Guides to exploration are the unconformity and the northeast trend of the veins, which are evidently important controlling factors in mineralization. A better understanding of the facies variation with the Artillery Lake formation can serve as a guide to Mississippi Valley-type deposits. Most of the prospective area is covered by Artillery Lake, but the lake is generaly shallow with numerous islands and is therefore amenable to normal exploration. Favourable host rocks are within depths common for exploration drilling, as seen from the available structural data (Fig. 13). Geophysical exploration techniques, in particular electrical methods, and lake sediment geochemical surveys should prove particularly useful.

REGIONAL GEOCHEMICAL SURVEYS

Y.T. Maurice

Introduction

In 1975, the Geological Survey of Canada carried out a reconnaissance geochemical survey based on sampling lake sediments from deep basins of lakes, over an area of approximately 35,000 km^2 comprising NTS maps 75C, F, and K. A total of 2,690 organic mud samples were collected using a float-equipped helicopter resulting in a sample density of about 1 sample every 13 km^2. The samples were analysed for U, Cu, Pb, Zn, Ni, Co, Mo, As, Ag, Hg, Fe, and Mn. Loss on ignition (LOI) was also determined to provide an estimate of the amount of organic matter in the samples.

The complete data set in the form of symbol maps at the scale of 1:250,000, data listings and basic statistics were published by Hornbrook et al. (1976) and a detailed interpretation of the data is also available (Maurice, 1984). The results for the northern half of NTS map 75K, which includes the central portion of the proposed park area, are shown in Figures 15a to 15o.

In addition to this reconnaissance survey, detailed follow-up work on some of the anomalies was carried out by the writer in 1976. This involved high density sampling of lake sediments and waters, and some ground traversing. The areas subjected to this work were generally of the order of 50 to 100 km^2 and, within the northern half of NTS map 75K, five such areas were examined:

1. in the northwestern corner of NTS map 75K, north of the copper occurrence at Bigstone Point in an area of strong base metal anomalies,
2. in an area of uranium anomalies between Meridian and Compton Lakes,
3. on Kahochella Peninsula north of Wildbread Bay, where base metals are enriched,
4. along Hoarfrost River north of McLeod Bay to examine uranium anomalies and,
5. east of Charlton Bay where a strong multielement anomaly occurs.

The procedures used in these surveys and the results were the subject of several publications (Maurice, 1976, 1977, and 1979) and the reader is invited to consult these for details.

The accompanying geochemical maps (Figs. 15b to 15o) were computer generated using a moving average technique to interpolate irregularly spaced data to a regular grid for which the unit cell is 800 m^2. This technique involved weighing using an inverse distance function ($1/d^3$) applied to the nearest five data points. The geographical features (coastline, etc.) appearing on these maps were obtained from World Data Bank II originally produced by the U.S. Central Intelligence Agency by digitizing maps ranging in scale from 1:1 million to 1:4 million. WDB II data are not intended to be used at scales greater than 1:1 million and at the scale used here, the correspondence is less than optimum.

Interpretation

The area under discussion contains a few known base metal (mostly copper) and uranium occurrences (Map 1 in pocket) all of which are too small to be of economic interest. The geochemical patterns that are associated with small mineral occurrences are generally very subtle even on the 1:250,000 individual sample plots which are normally used to interpret this type of data for mineral exploration purposes. The data averaging technique used in preparation of the maps accompanying this report also tends to suppress minor irregularites and emphasize broader scale features. Nevertheless, large economic deposits undergoing weathering would be expected to produce significant anomalies.

Several environmental and geological conditions may also affect the dispersal of metals at the surface and ultimately the ability of lake sediment geochemistry to detect their presence. For example, the copper map shows no anomaly related to a string of copper occurrences associated with a fault zone on the north side of Meridian Lake and Charlton Bay. The lack of response here is interpreted as being due to the prevailing alkaline conditions associated with the carbonate bedrock which reduces the mobility of copper, combined with a restricted exposure of the mineralization to weathering agents as a result of the deposits being contained in vertical fractures. On the other hand, a weak uranium anomaly on the south side of Charlton Bay may be interpreted as being caused by sandstone-type uranium occurrences in that area. Uranium is mobile under alkaline conditions and this type of mineralization may be more exposed to weathering than fracture-controlled mineralization.

The main source of trace elements in lake sediments is bedrock. Variations in the chemical composition of bedrock generally exerts a greater influence on the geochemical pattern than individual mineral occurrences. The ability of lake sediment geochemistry to detect the geochemical signature of various rock units combined with a thorough understanding by the interpreter of how different types of mineral deposits associate with rocks of different chemical characteristics, is where this technique is most useful as a mineral exploration tool.

In the following sections, anomalies in different parts of the area under investigation are interpreted in terms of the geology, and the discussion that follows this, focusses on the mineral potential of the area with emphasis on the zone included within the proposed park boundaries.

Anomalies in the Slave Province

Within NTS map 75K, the Slave Province includes the area located north and east of McLeod Bay and extends as far south as the McDonald Fault. It consists of granites, granitic gneisses, metasediments and minor gabbroic rocks. Much of the eastern part of the proposed park area is underlain by these rocks.

In the northwestern corner of NTS map 75K, the strong multielement anomaly (Cu, Zn, Co, Ni, Pb, As, Hg, and Mo) is interpreted as being related to two bands of metasediments belonging to the Yellowknife Supergroup. These rocks show intense rusty weathering with numerous gossans. Although the geochemical anomaly probably derives from metal contained in the rocks themselves, the intensity of the anomaly indicates that considerable amounts of metals are present in that area and it is probable that some have formed deposits. This interpretation is supported by the presence of numerous gossans and the occurrence of base metal sulphide veins at nearby Bigstone Point, along the shore of McLeod Bay.

A similar, though smaller, anomaly occurs to the northwest of Hoarfrost River, east of the previous anomaly. Here, however, Yellowknife Supergroup metasediments are not known to occur but the area would be expected to contain iron-rich rocks with gossans as described previously.

At Hanbury Falls, near the southern tip of Artillery Lake, there is a small but intense combined Cu-Hg anomaly. It occurs in an area where small bodies of basic intrusive are found, presumably associated with deep fractures. This anomaly could reflect fracture-controlled mineralization. The general area is also enriched in Ni, Co, and As; these metals may derive directly from the exposed basic rocks, but this association, as will be seen later, may also reflect a type of mineralization characteristic of the East Arm region.

The portion of the southern Slave Province included in the present investigation is considerably higher in uranium than the northern part of the Churchill Province, south of the McDonald Fault. Most of the uranium anomalies are associated with molybdenum. Anomalies of this type were examined on the ground near Hoarfrost River and were found to be related to coarse-grained white granites. In the areas of highest radioactivity, secondary uranium minerals can be found on the exposed bedrock.

The region east of Charlton Bay contains several of these anomalies. However, one of the them situated near the extremity of a band of Sosan Group sandstone, which forms part of the Great Slave Supergroup, is accompanied by high

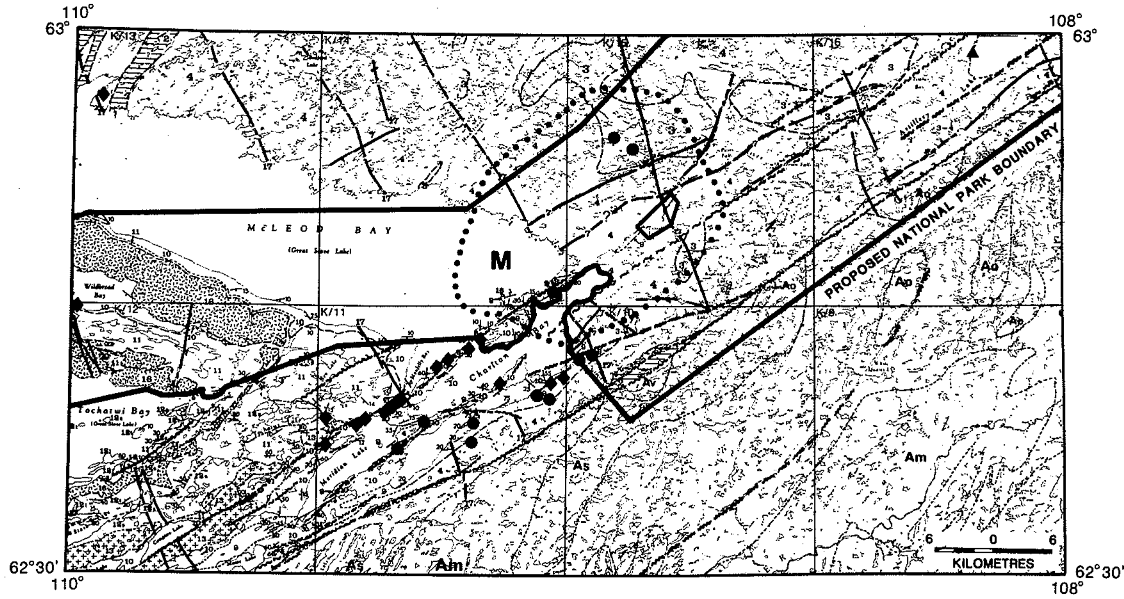


Figure 15. a. Area of survey, geologic features, and aeromagnetic anomaly (area M enclosed by dotted line).

Fig. 15b

SITES

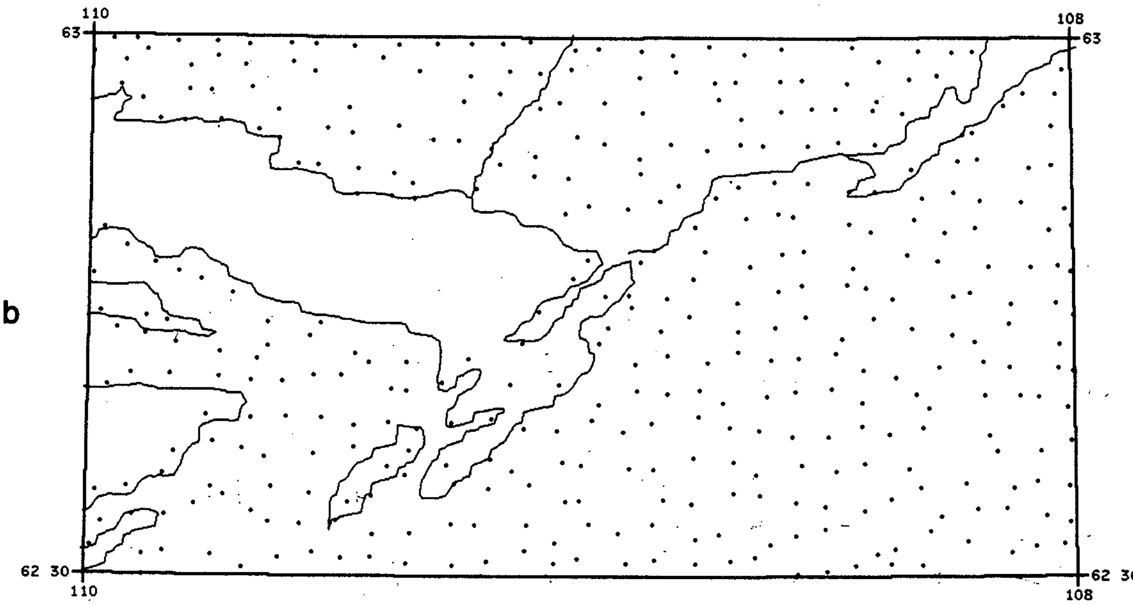


Fig. 15c

LOSS ON IGNITION
IN
LAKE SEDIMENTS

PCT	%TILE
81.3	MAX
71.7	99
70.1	98
64.0	95
56.0	90
41.0	75
23.2	50
7.5	25
0.5	MIN

391 SAMPLES

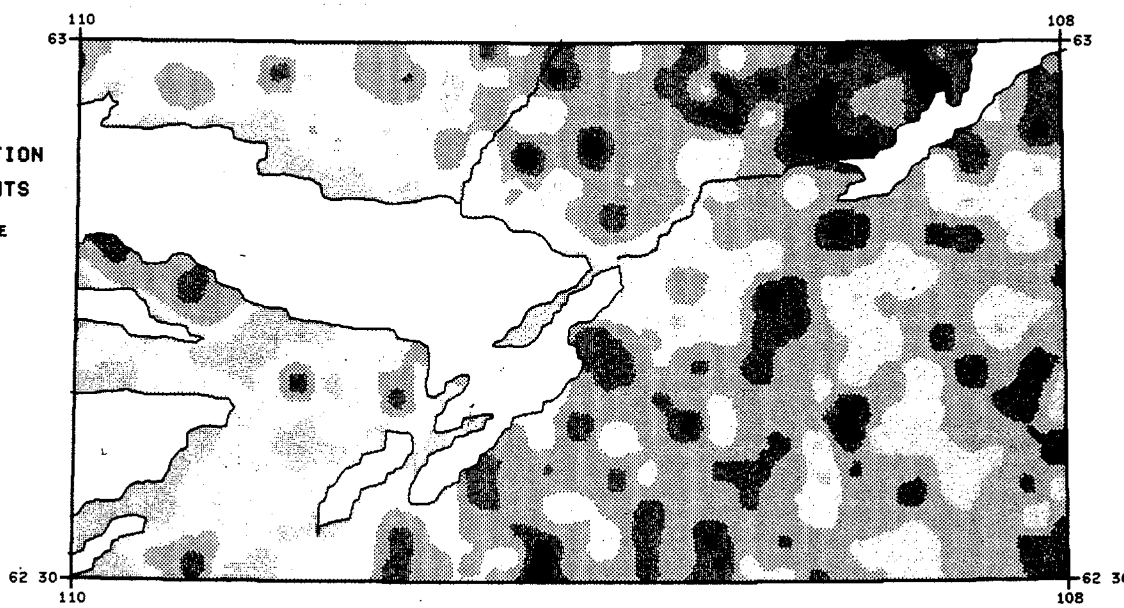


Fig. 15d

COPPER
IN
LAKE SEDIMENTS

PPM	%TILE
325	MAX
208	99
172	98
112	95
78	90
54	75
34	50
26	30
6	MIN

391 SAMPLES

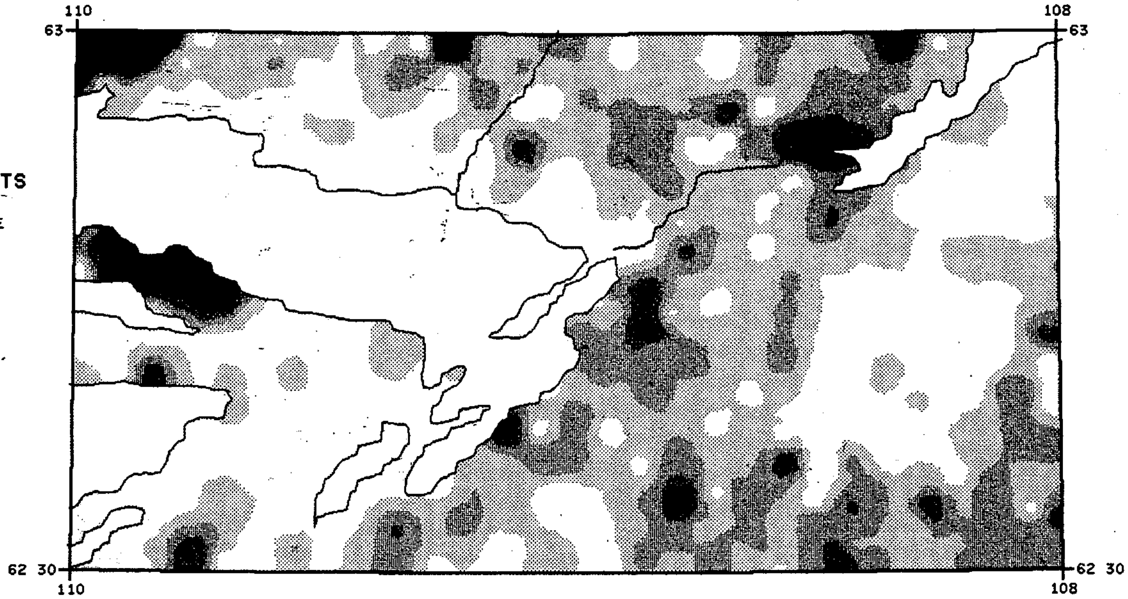


Fig. 15e

LEAD
IN
LAKE SEDIMENTS

PPM	%TILE
56	MAX
20	99
16	98
11	95
10	90
6	75
3	50
2	30
1	MIN

391 SAMPLES

Fig. 15f

ZINC
IN
LAKE SEDIMENTS

PPM	%TILE
510	MAX
350	99
284	98
200	95
174	90
130	75
88	50
68	25
20	MIN

391 SAMPLES

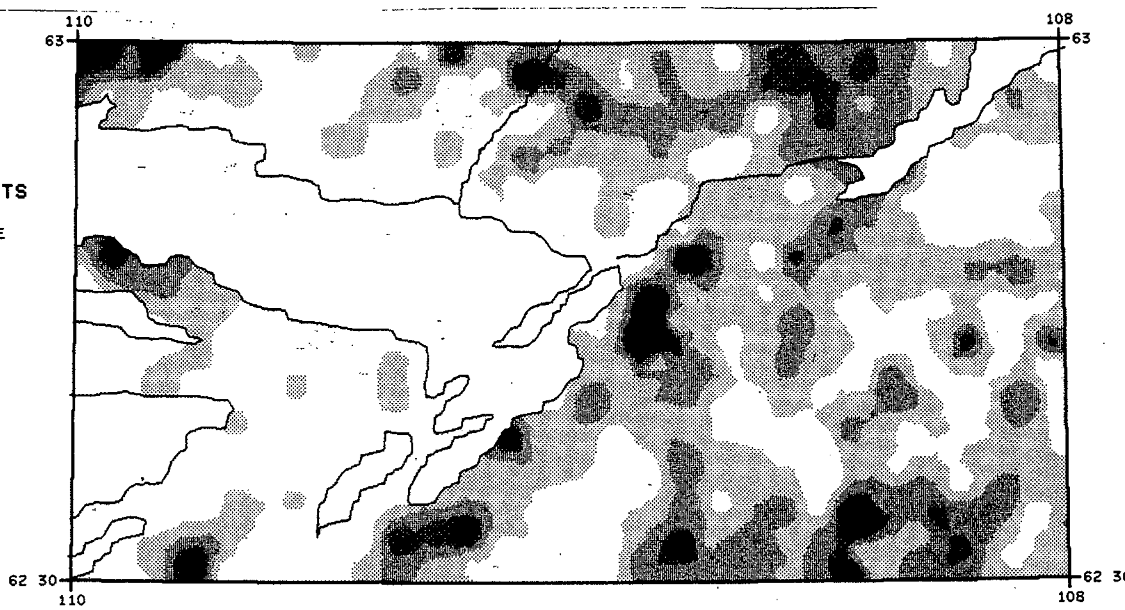
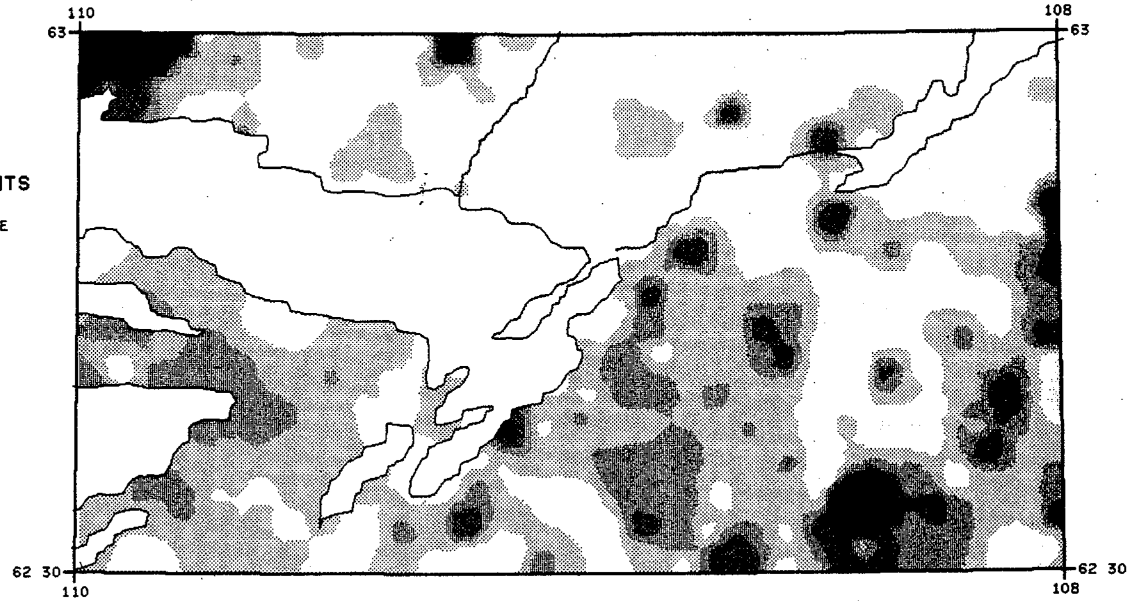


Fig. 15g

NICKEL IN LAKE SEDIMENTS

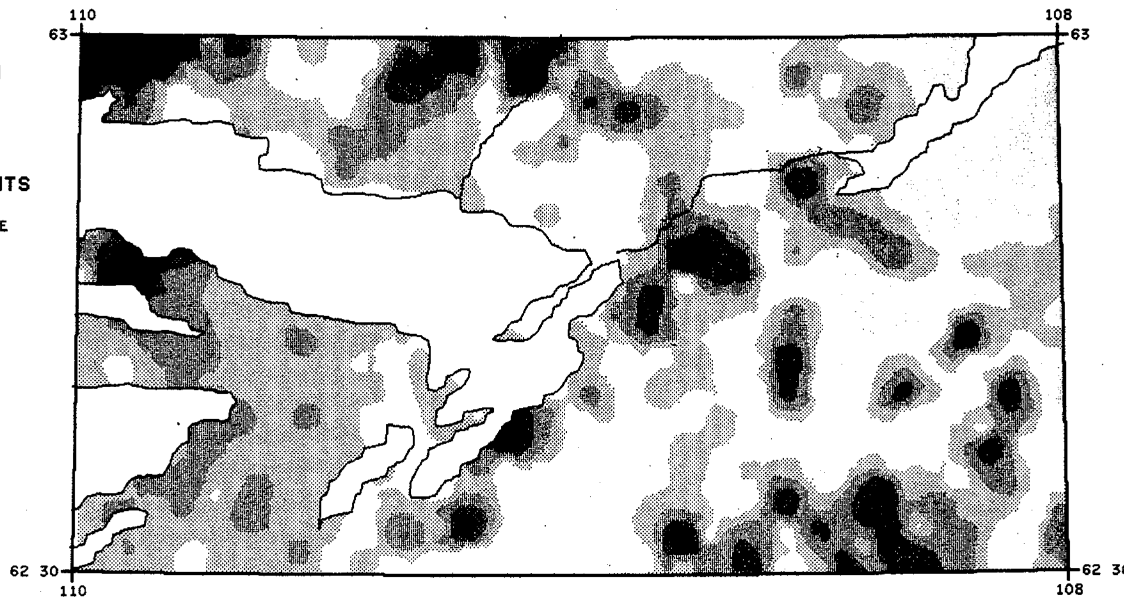


PPM	%TILE
200	MAX
90	99
50	98
41	95
30	90
24	75
18	50
14	30
5	MIN

391 SAMPLES

Fig. 15h

COBALT IN LAKE SEDIMENTS

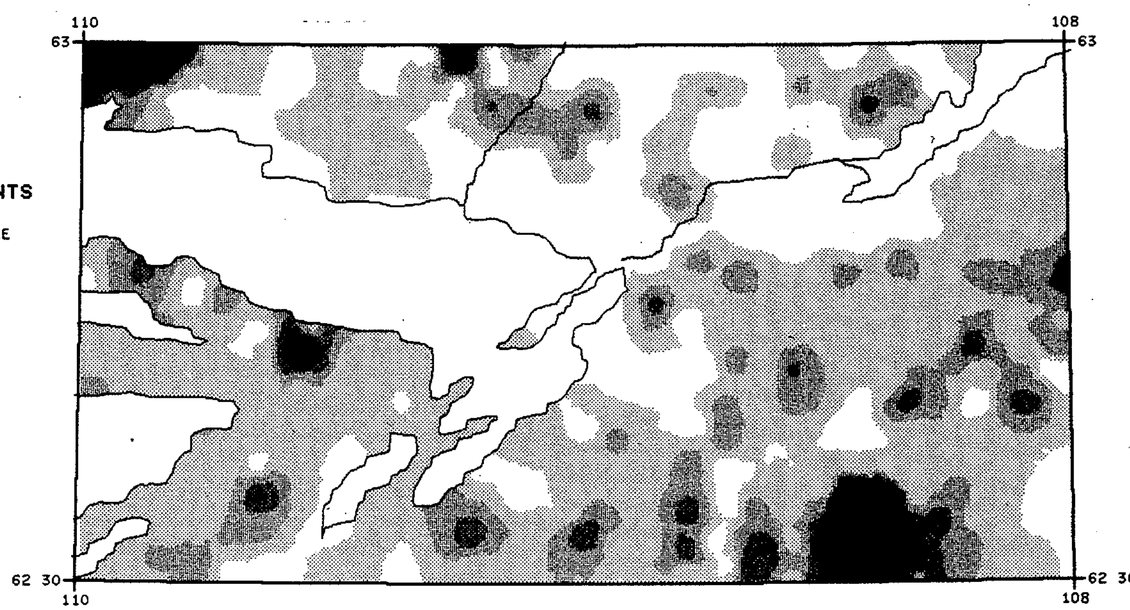


PPM	%TILE
223	MAX
80	99
40	98
24	95
16	90
11	75
8	50
6	30
1	MIN

391 SAMPLES

Fig. 15i

ARSENIC IN LAKE SEDIMENTS



PPM	%TILE
215.0	MAX
36.0	99
24.0	98
11.0	95
7.0	90
4.0	80
2.0	50
1.0	20
0.5	MIN

391 SAMPLES

Fig. 15j

MOLYBDENUM
IN
LAKE SEDIMENTS

PPM	%TILE
37	MAX
29	99
23	98
11	95
8	90
4	75
2	50
1	MIN

391 SAMPLES

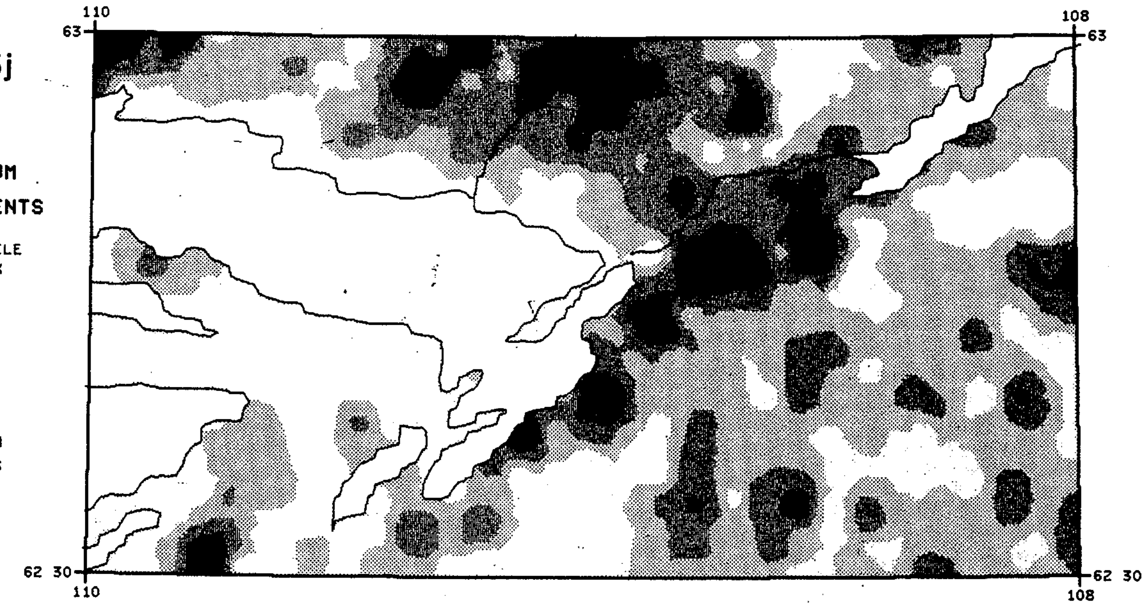


Fig. 15k

SILVER
IN
LAKE SEDIMENTS

PPM	%TILE
0.6	MAX
0.3	99
0.1	MIN

391 SAMPLES

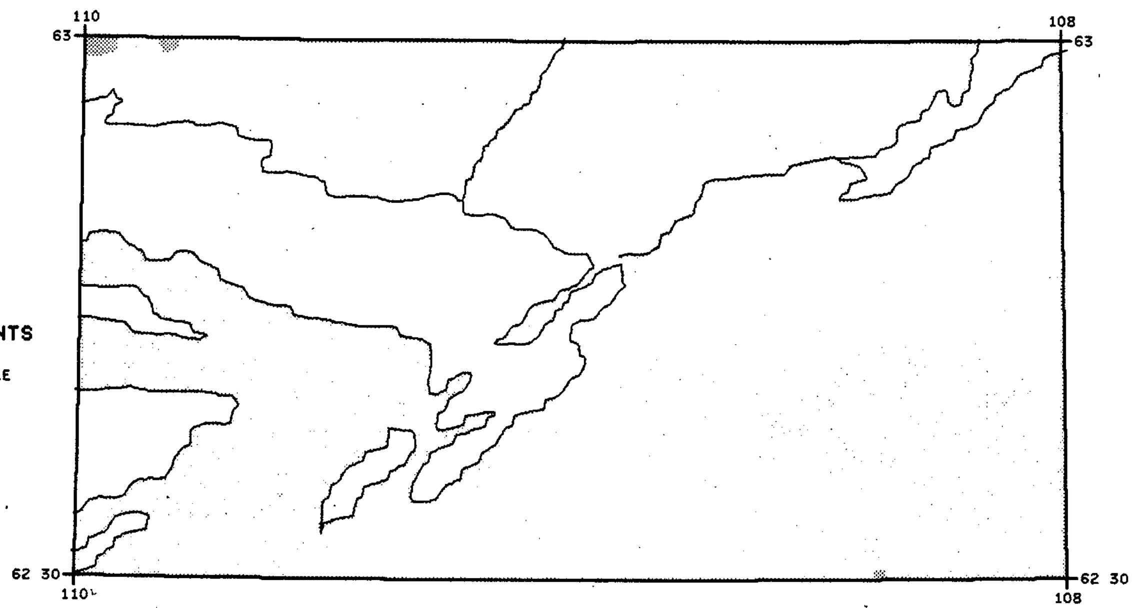


Fig. 15l

URANIUM
IN
LAKE SEDIMENTS

PPM	%TILE
208.8	MAX
105.0	99
79.0	98
53.1	95
31.9	90
14.2	75
5.5	50
3.4	25
0.7	MIN

391 SAMPLES

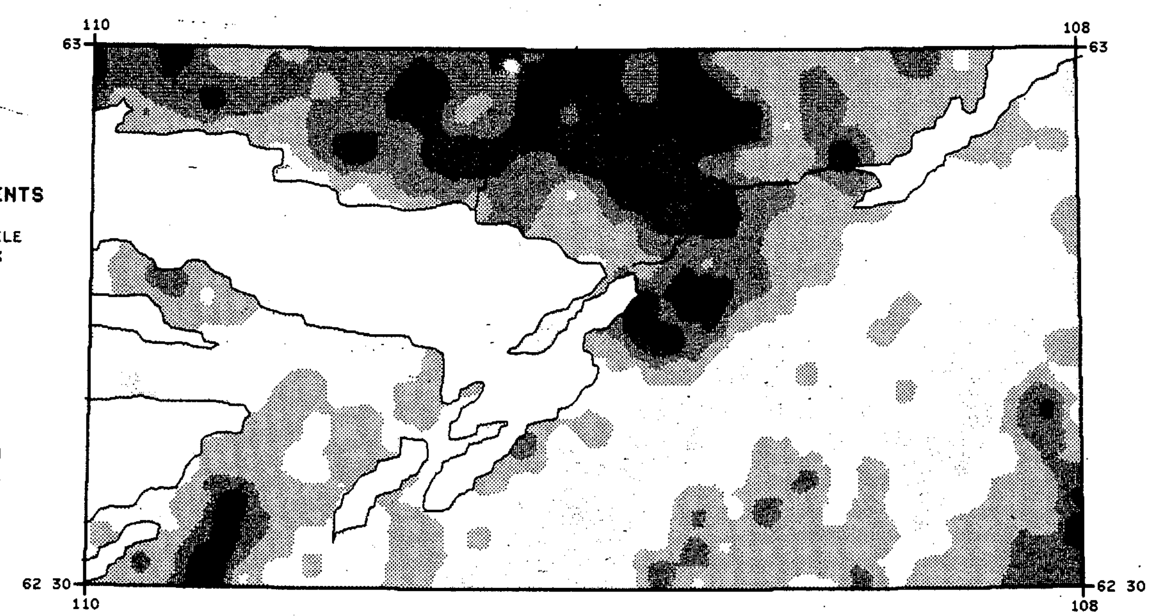


Fig.15m

IRON IN LAKE SEDIMENTS

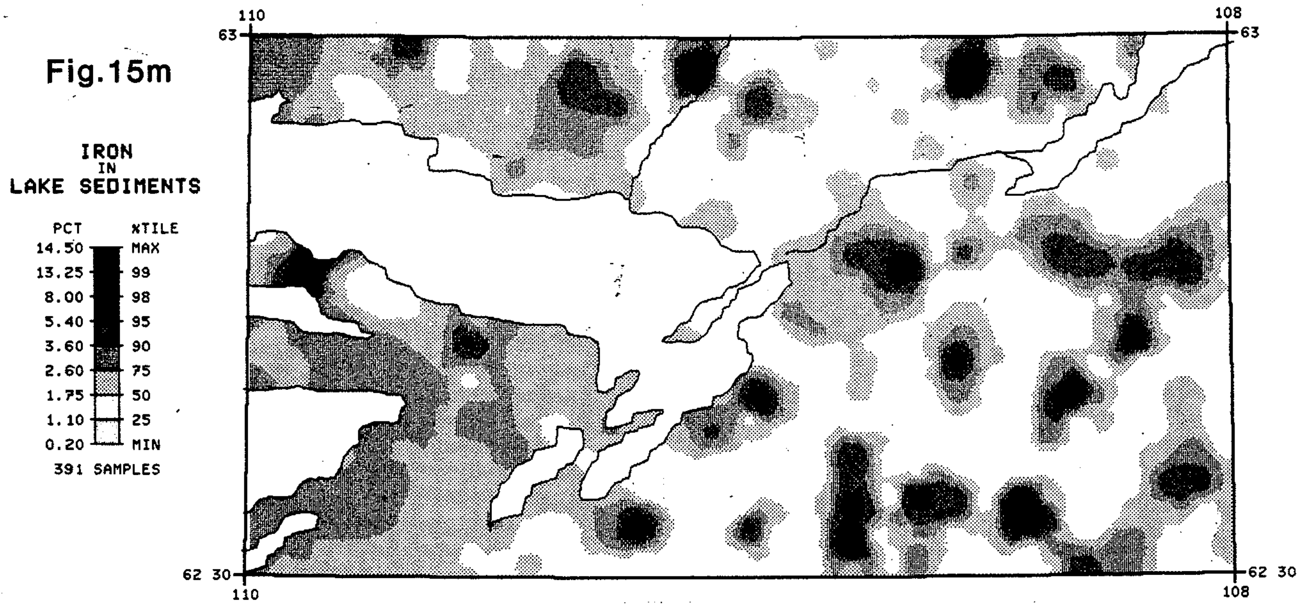


Fig.15n

MANGANESE IN LAKE SEDIMENTS

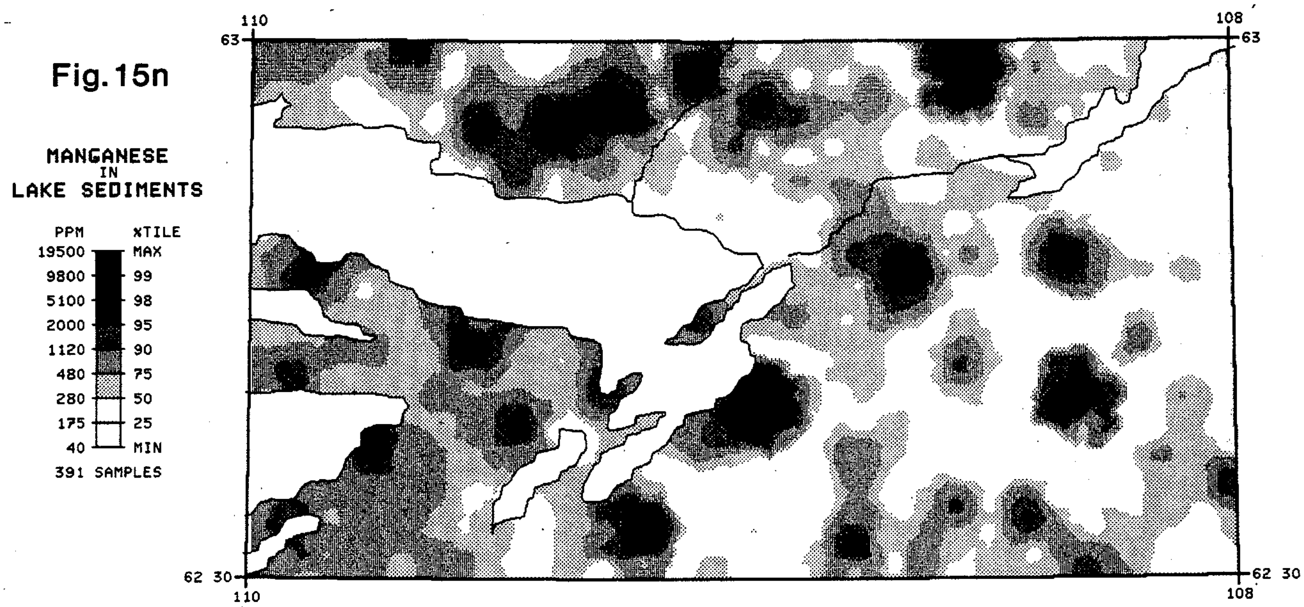
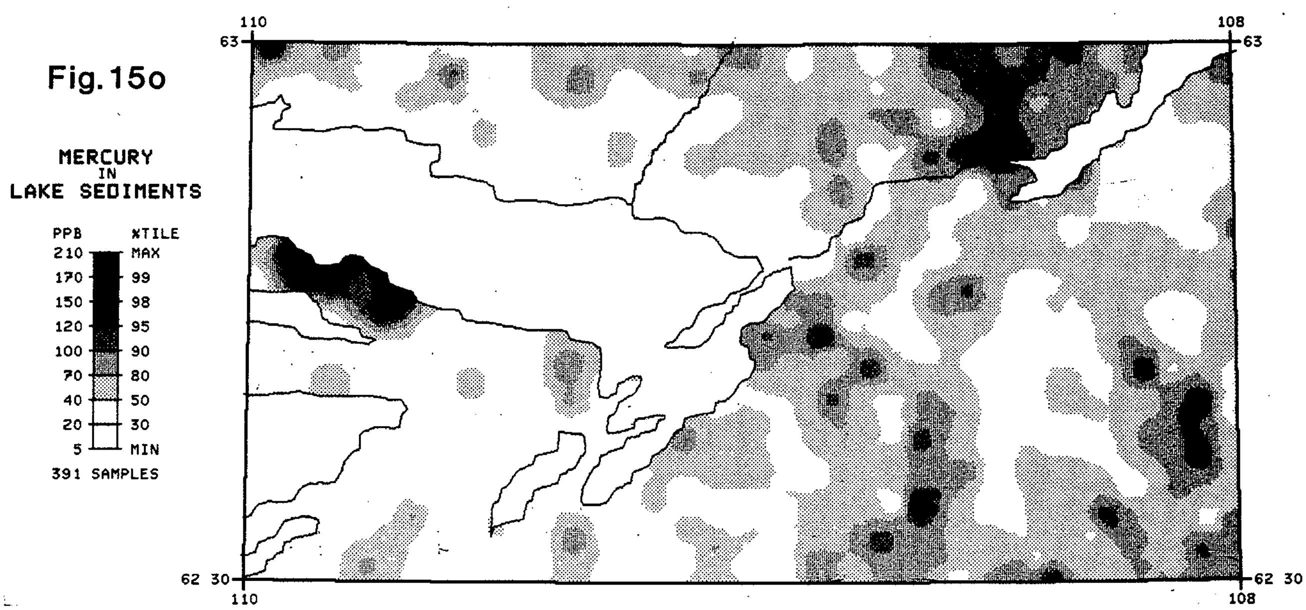


Fig.15o

MERCURY IN LAKE SEDIMENTS



zinc and moderately high copper. This same area has produced a high U/Th ratio airborne radiometric anomaly (B.W. Charbonneau, this report) and could contain multielement, possibly unconformity-related mineralization.

Anomalies in the East Arm Fold Belt

The East Arm fold belt includes that portion of the study area situated south of McLeod Bay and north of McDonald Fault, in which unmetamorphosed sedimentary rocks (shales, sandstones, limestones) of Aphebian Great Slave Supergroup were deposited (Hoffman et al., 1977). They are intruded by intermediate and basic rocks. The Kahochella and Douglas Peninsulas, which are part of this basin, are included within the proposed park area.

One of the most striking features of the East Arm fold belt from a geochemical point of view, is its relatively high levels of lead in the lake sediments. This probably reflects a higher lead content of the East Arm rocks combined with a higher proportion of clastic material in the samples as indicated by lower LOI and slightly higher Mn and Fe values.

The most intense anomaly in the East Arm fold belt occurs on Kahochella Peninsula near Sentinel Point and north of east end of Wildbread Bay, in a series of lakes that drain a wide exposure of gabbroic sill. All the elements analysed for excepting Ag, are enriched in these lakes but the elements that show greatest enhancement are Cu, Co, and Hg. A strong anomaly is not unexpected over such a rock-type although the intensity, the uneven distribution of the metals and the presence of mercury and lead suggest the possibility that some of these metals occur as sulphides in parts of the intrusive. An increase in uranium is unusual in this type of rock but in this case it may be significant because a high U/Th ratio airborne radiometric anomaly was also detected in the same area (B.W. Charbonneau, this report).

Near Compton Lake and extending NNE from it, there is a well defined U anomaly with some Mo, Cu, and Zn values. This anomaly occurs near a monzonitic laccolith similar to the one near Regina Bay which contains sub-economic actinolite-apatite-magnetite-uraninite veins (Badham, 1978). Detailed lake sediment geochemistry and ground work by the writer failed to detect any mineralization associated with those rocks near Compton Lake and the anomaly was interpreted as deriving from a slightly higher uranium content of the monzonite. However, Gandhi and Prasad (1982) have shown that there are no significant differences in the chemistries of mineralized and unmineralized laccoliths in the East Arm which suggests that they may be equally favourable hosts of mineralization. Uranium occurrences have been discovered recently by Home Oil Limited in the southwestern part of the intrusion, approximately 12 km southwest of the anomaly, on the south side of Wilson Lake (S.S. Gandhi, personal communication, 1983).

Anomalies in the Churchill Province

The part of the study area included in the Churchill Province is situated south of the McDonald Fault. Only a narrow strip, adjacent to the McDonald Fault in the eastern half of the area, falls within the limits of the proposed park area.

This part of the Churchill province includes a wide zone of mylonitized rocks related to an early period of movement along the McDonald Fault system (Reinhardt, 1969). This zone is comparatively enriched in Ni, Co, Cu, and As and impoverished in U, Pb, and Mo (see also Maurice, 1984, for a comparison of this area with other parts of the Churchill Province).

This area is underlain by a strong positive Bouguer gravity anomaly which is one of a series of such anomalies occurring throughout the East Arm region. Hornal and Boyd (1971) have suggested that the basic intrusives exposed in the East Arm may be connected to a large deep-seated body of basic or ultrabasic composition that would underlie this region causing the gravity anomalies. Maurice (1984) has suggested that a body akin to the one under the East Arm may be present at depth south of the McDonald Fault and that strong coincident Cu, Ni, Co, and As anomalies in that area could be related to unmapped basic rocks connected to this mass. In the East Arm and in the adjacent crystalline terrane of the Slave Province, nickel-cobalt arsenide mineralization is in many places associated with basic intrusives (Badham, 1978); it would thus appear reasonable to expect this type of mineralization to occur south of the McDonald Fault, particularly in view of the fact that the main chemical constituents of the mineralization are strongly enriched in the lakes of that region.

Discussion

In the northern half of NTS map 75K, there appears to be potential for the following types of mineral deposits:

1. Base metal sulphide veins in the Slave Province,
2. Base metal sulphide veins in the sediments of the East Arm fold belt,
3. Base metal sulphides associated with the gabbro sills in the East Arm fold belt,
4. Sandstone-hosted uranium mineralization in the East Arm fold belt,
5. Nickel-cobalt arsenide veins.

The high uranium content of lake sediments of the Slave Province reflects considerable uranium enrichment of the granitic rocks of that region but it is unlikely that these rocks host economic uranium deposits. One possible exception is the uranium anomaly to the east of Charlton Bay which, because of its association with other metals, its high U/Th ratio, and its position near a major unconformity, should be examined as a matter of precaution. It also falls within the boundaries of the proposed park.

Although the potential for economic uranium deposits occurring in the Slave granites is considered low, these rocks may have been the source of uranium concentrations in the East Arm fold belt. Indeed, because of this high uranium basement adjacent to the sedimentary basin of the East Arm, the latter should be considered as having a high potential for either sandstone-hosted or unconformity-related uranium deposits. The presence of sandstone-hosted uranium occurrences in various parts of the East Arm supports this view.

Lake sediment geochemistry does not point to any specific area within the proposed park boundaries where such deposits might occur. However the response of lake sediment geochemistry to these types of deposits may not be conclusive judging from the strength of the anomaly associated with the uranium mineralization south of Charlton Bay.

The strongest lake sediment base metals anomalies in the Slave Province occur west of the proposed park boundary. However, the Cu-Hg anomaly near the southern end of Artillery Lake within the proposed park area, could reflect the presence of mineralization. Furthermore, the Ni-Co-As enrichment in that same area could reflect the presence of Ni-Co arsenide mineralization, perhaps associated with the basic intrusives. As a matter of precaution, basic and

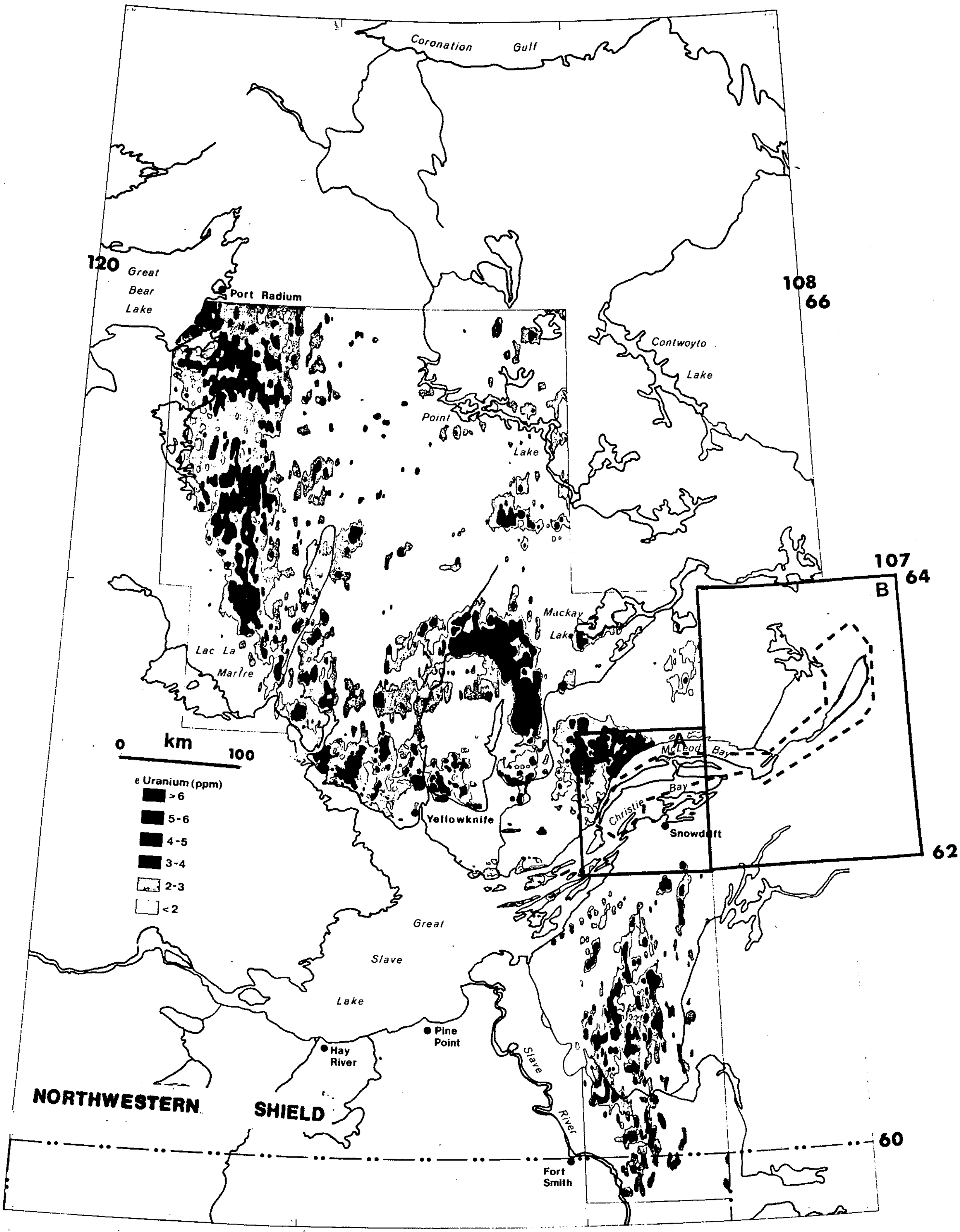


Figure 16. Regional pattern of uranium distribution in the northwestern Shield derived from compilation of airborne gamma spectrometry surveys.

intermediate intrusives and their host rocks throughout the proposed park area should be examined for Ni-Co arsenide mineralization particularly where these rocks are located near or over positive gravity anomalies. In areas where regional geochemistry is available, the presence of associated Ni, Co, and As anomalies may provide an additional clue to the presence of this type of mineralization.

The copper veins in the sedimentary rocks of the East Arm appear to have no geochemical expression. However, they occur throughout the East Arm and within NTS map 75K, significant concentration of this metal is found in fractures in the Charlton Bay-Meridian lake area (south of the proposed park area). The unusually high Pb content of the lake sediments in the East Arm could indicate a potential for lead deposits although no significant lead deposits have been discovered in the East Arm fold belt. The geochemical survey, however, does not point to any specific areas within the East Arm fold belt where lead deposits might occur.

The distribution of the base metals and the intensity of the anomalies over the gabbro sills on Kahochella Peninsula suggest that some form of mineralization could be present in these rocks. This should be verified, but in the writer's opinion, it is unlikely that economic sulphide deposits would be found.

AIRBORNE RADIOMETRIC SURVEYS

B.W. Charbonneau

Introduction

Three published radiometric surveys provide coverage of the East Arm – Artillery Lake area (Fig. 16). Block A is covered by portions of two maps, a contoured 5 km line spaced survey (Geological Survey of Canada, Open File 101, 1972) which terminates at the south shore of the East Arm, and by a 2 1/2 km line spaced survey (Geological Survey of Canada, Open File 124, 1973) which covers the East Arm and terrain to the north of the East Arm. In the area encompassed by Block B only uncontoured wide line spaced (25 km) coverage exists (Geological Survey of Canada Map 37075G, 1976). The published maps and profiles pertinent to the study area are reproduced in Figures 18 to 28, and are discussed here with emphasis on significant anomalies (Fig. 17). A brief account of radioactive satellite debris that fell over the area in 1978 is also included.

Survey Parameters and Equipment

The Block A survey was completed with the Geological Survey of Canada gamma ray spectrometer with a 50 litre NaI(Tl) detector crystal system. The Block B coverage was flown to the Geological Survey of Canada specifications under contract by Kenting Earth Sciences Limited with a detector system of 32 litres of sodium iodide crystal.

The surveys were compiled from airborne gamma ray spectrometric data recorded digitally along the flight lines. The spectrometers recorded gamma radiation in four windows, with the following energy ranges:

Energy Window (MeV)	Element Analysed	Nuclide Used	Gamma-Ray Energy (MeV)
1.37 - 1.57	Potassium	K-40	1.46
1.66 - 1.86	Uranium	Bi-214	1.76
2.41 - 2.81	Thorium	Tl-208	2.62
0.41 - 2.81	Total Count		

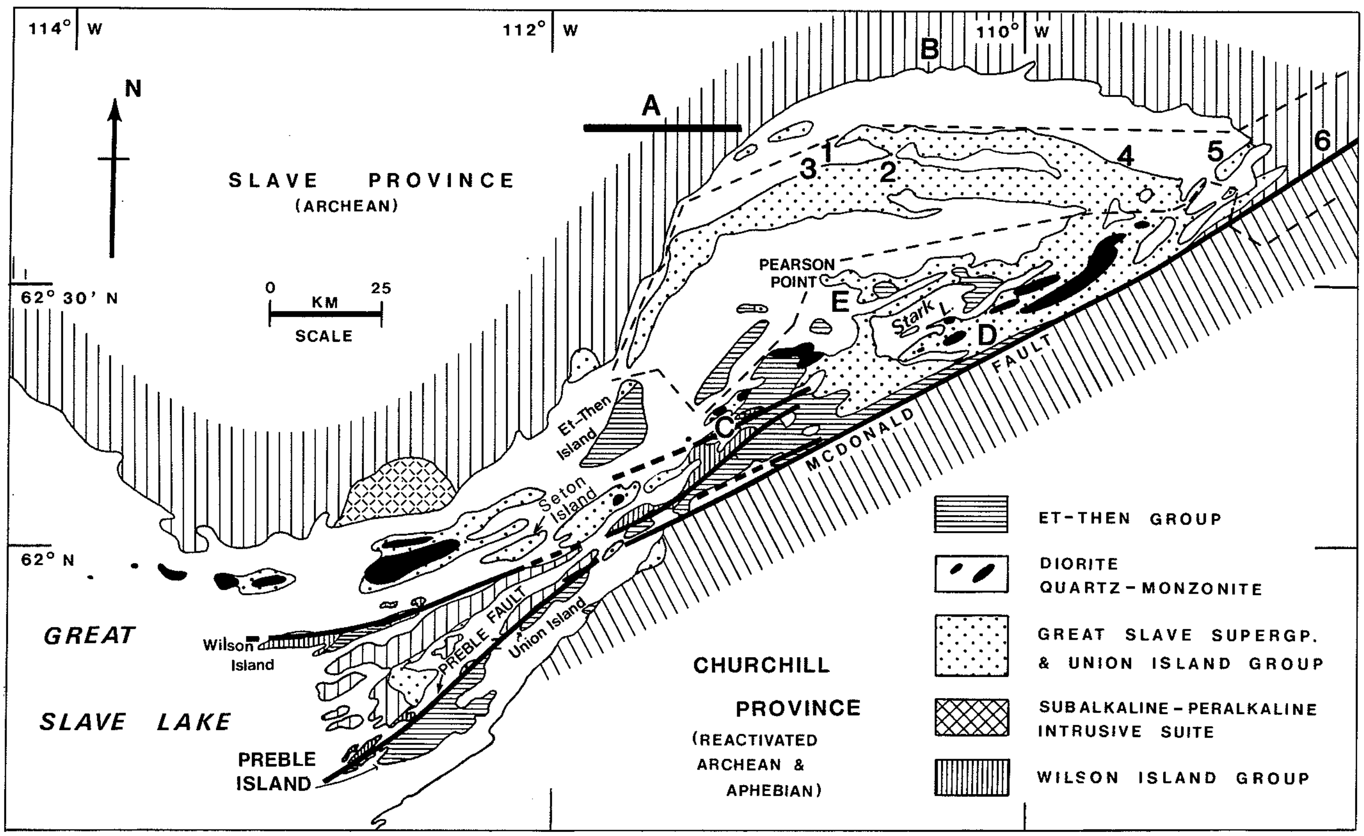


Figure 17. Airborne radiometric anomalies – A to E and 1 to 6 – in East Arm area with respect to main geological features.

The survey aircraft were flown at a planned survey altitude of 120 m, and at a ground speed between 190 km/hr and 240 km/hr. The data were corrected for background radiation, spectral scattering and deviations from the planned survey altitude. The corrected count rates can be converted to concentrations of potassium, equivalent uranium and equivalent thorium, using conversion factors derived from flights over a test strip near Ottawa, Ontario (Grasty and Charbonneau, 1974). The term "equivalent" in this context refers to the fact that uranium and thorium are calculated on the basis of radiation from decay products assuming radioactive equilibrium between parent and decay products.

The survey readings over Block A are presented as counts; they can however be converted to concentrations of potassium (K%), uranium (eU ppm) and thorium (eTh ppm) by application of the sensitivities quoted on the marginal notes of the contour maps viz., 22 counts/sec = 1 ppm eU, 9 counts/sec = 1 ppm eTh for the Open File 124. In latter segments of this report it is understood that uranium and thorium used in the radiometric context means equivalent uranium and/or equivalent thorium.

In Block A, data were then smoothed along the flight lines (rejecting values over water), gridded and contoured. Because of this averaging, the profiles which accompany the

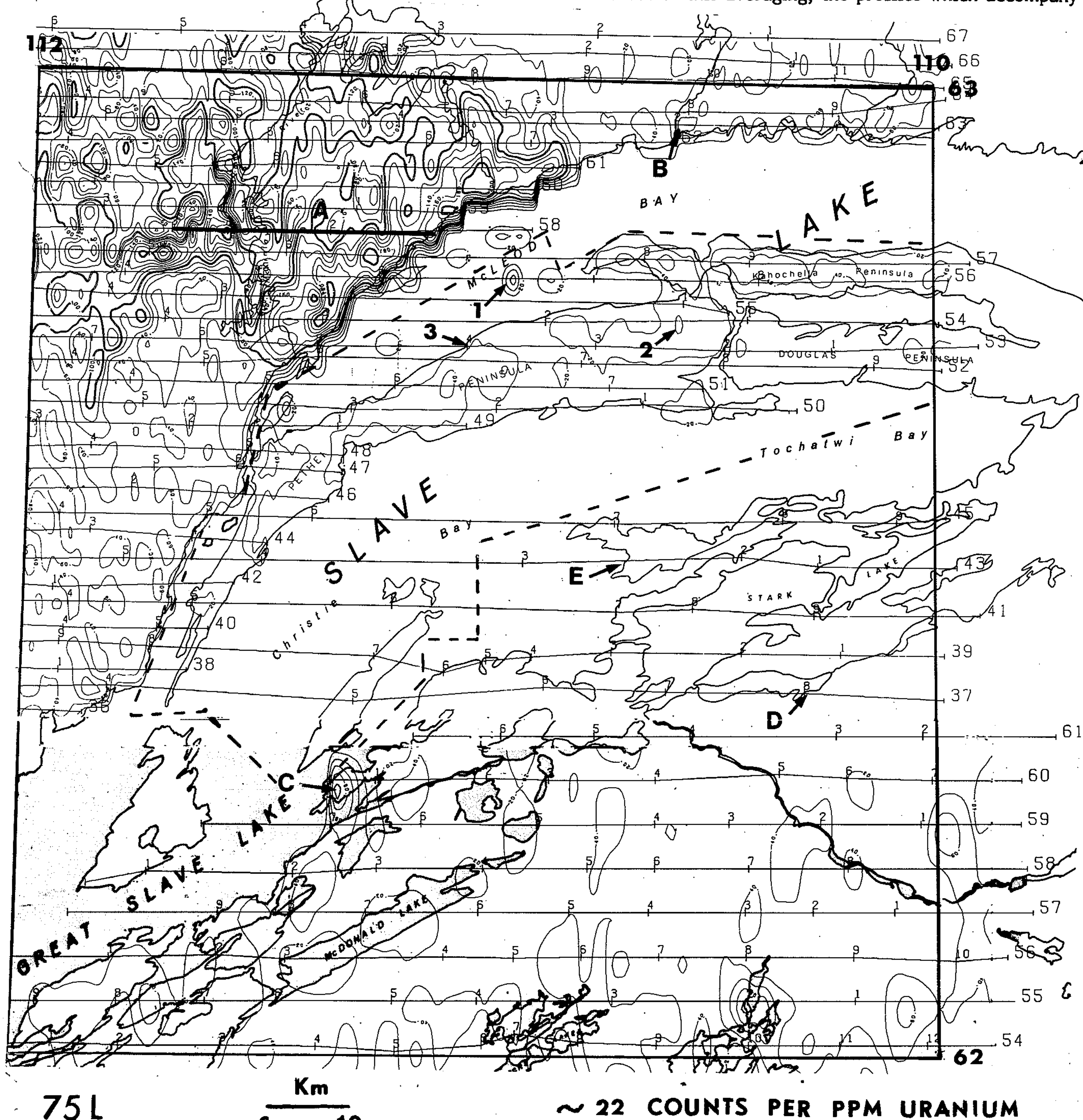


Figure 18. Uranium map derived from airborne gamma spectrometry for Block A. NTS Sheet 75L.

surveys must be examined to localize sharp features which may not be apparent on the contoured maps. Compilation procedures have been described by Grasty (1972). Seven parameters are compiled for each radiometric survey; total count, potassium, equivalent uranium, equivalent thorium and the three ratios eU/K, eU/eTh, eTh/K. Not all the maps and profiles have been included in this report because of space consideration and the reader is encouraged to examine the three surveys referenced for additional information.

The airborne values represent average surface radioelement concentrations over areas which generally include some outcrop, overburden, swamps and small bodies of water. Consequently the concentrations indicated by the maps or profiles are usually lower than the concentrations in the bedrock. However, the radioelement distribution patterns shown by the maps reflect the distribution of the elements in the bedrock and are useful for outlining various rock bodies (Charbonneau et al., 1976). High radioelement levels usually relate to felsic igneous rocks (Maurice and Charbonneau, 1983). Anomalous radioelement ratios may indicate unusual geochemical processes (Charbonneau 1982).

Radioelement Distribution in Northwestern Canadian Shield

The regional pattern of uranium distribution in the northwestern Canadian Shield can be seen on Figure 16. This regional distribution has been discussed by Darnley et al. (1977). The area proposed for a National park is also outlined

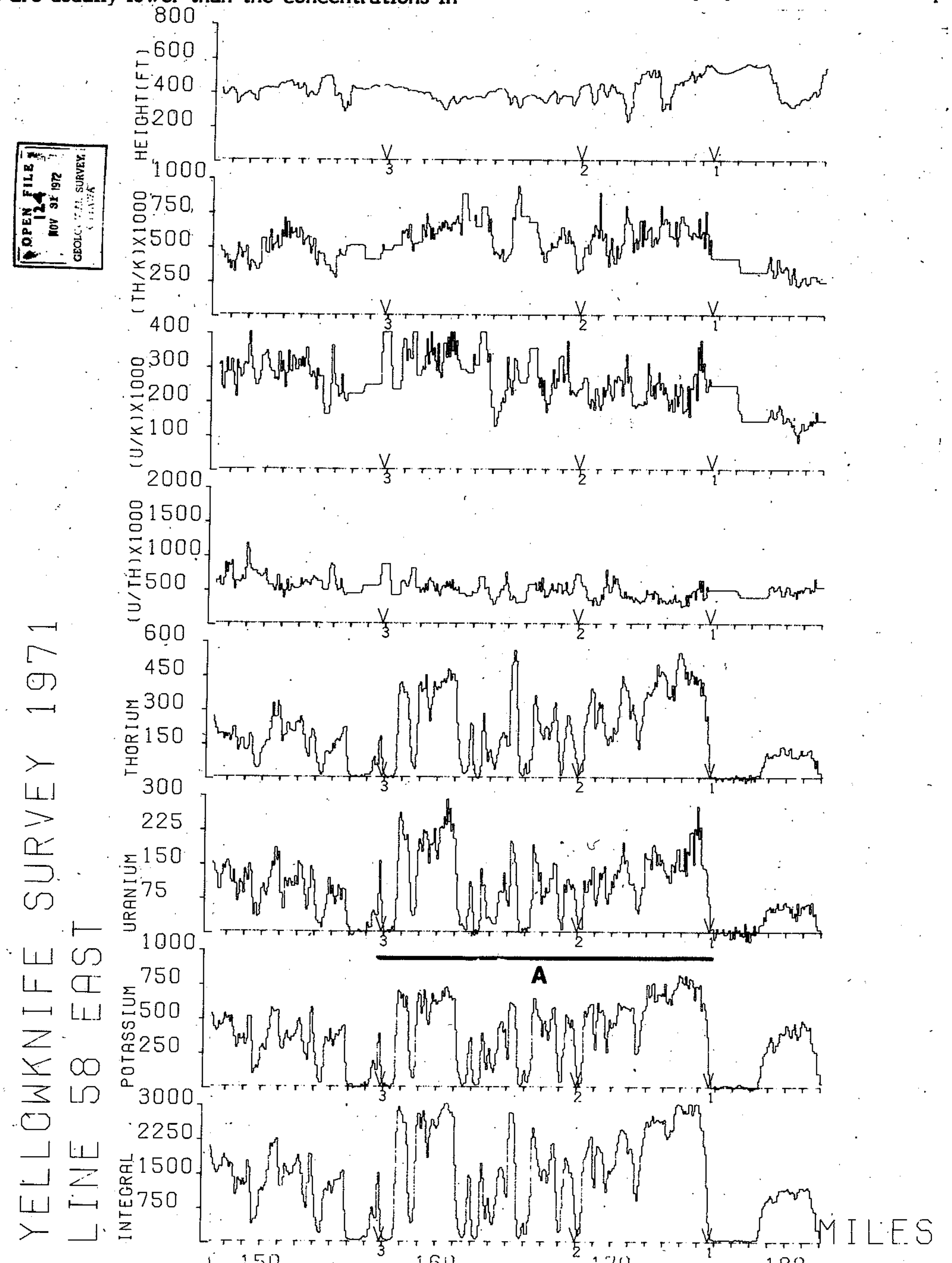


Figure 19. Anomaly A – airborne gamma spectrometry stacked profile across the regional uranium "high" north of the "East Arm".

on Figure 16. The regional uranium distribution can be compared to regional geology of the northwestern Canadian Shield presented on Figure 3. Figure 16 is a simplified geology of the East Arm and shows selected uranium anomalies. Geological maps of Reliance and Christie Bay sheets (NTS 75K and L) by Stockwell et al. (1968) provide more information on the area. In addition, a compilation geological map (Map 1 in pocket) can be referred to in examining the correlation of radiometric data. The boundary of the Slave and Churchill Structural Provinces (Fig. 3) trends approximately northeast-southwest dividing the study area within Blocks A and B.

The western margin of the exposed part of the Shield, from Lake Athabasca to Great Bear Lake, has a large zone of high uranium content that extends for approximately 800 km (Fig. 16). The area south of the East Arm of Great Slave Lake characterized by high uranium and very high thorium concentrations is a zone of porphyritic granitic rocks, named the Fort Smith Belt (Charbonneau, 1980). At the north shore of the East Arm, an anomalous zone relates predominantly to porphyritic pink granite (Richardson and Charbonneau, 1974). Northwest of it, the arcuate Carp Lakes zone has a mean surface uranium content of greater than 6 ppm eU. From Great Bear Lake south to Lac La Martre region, the broad uranium 'high' relates to the granitic and volcanic rocks of the Great Bear Batholith.

The regional anomaly which is nearest to the proposed park boundary (approximate boundary shown as dashed line on Figure 16), is the anomaly on the north side of the East Arm of Great Slave Lake, although the north terminus of the Fort Smith Belt south of the East Arm is also reasonably close to the southern boundary. The Fort Smith Belt averages approximately 11 ppm uranium and 77 ppm thorium (Charbonneau, 1980). The area north of the East Arm was briefly examined in the field by Richardson and Charbonneau (1974), and the anomaly was ascribed to porphyritic granitic rocks with high uranium and thorium concentrations. Average values for the area north of the East Arm were

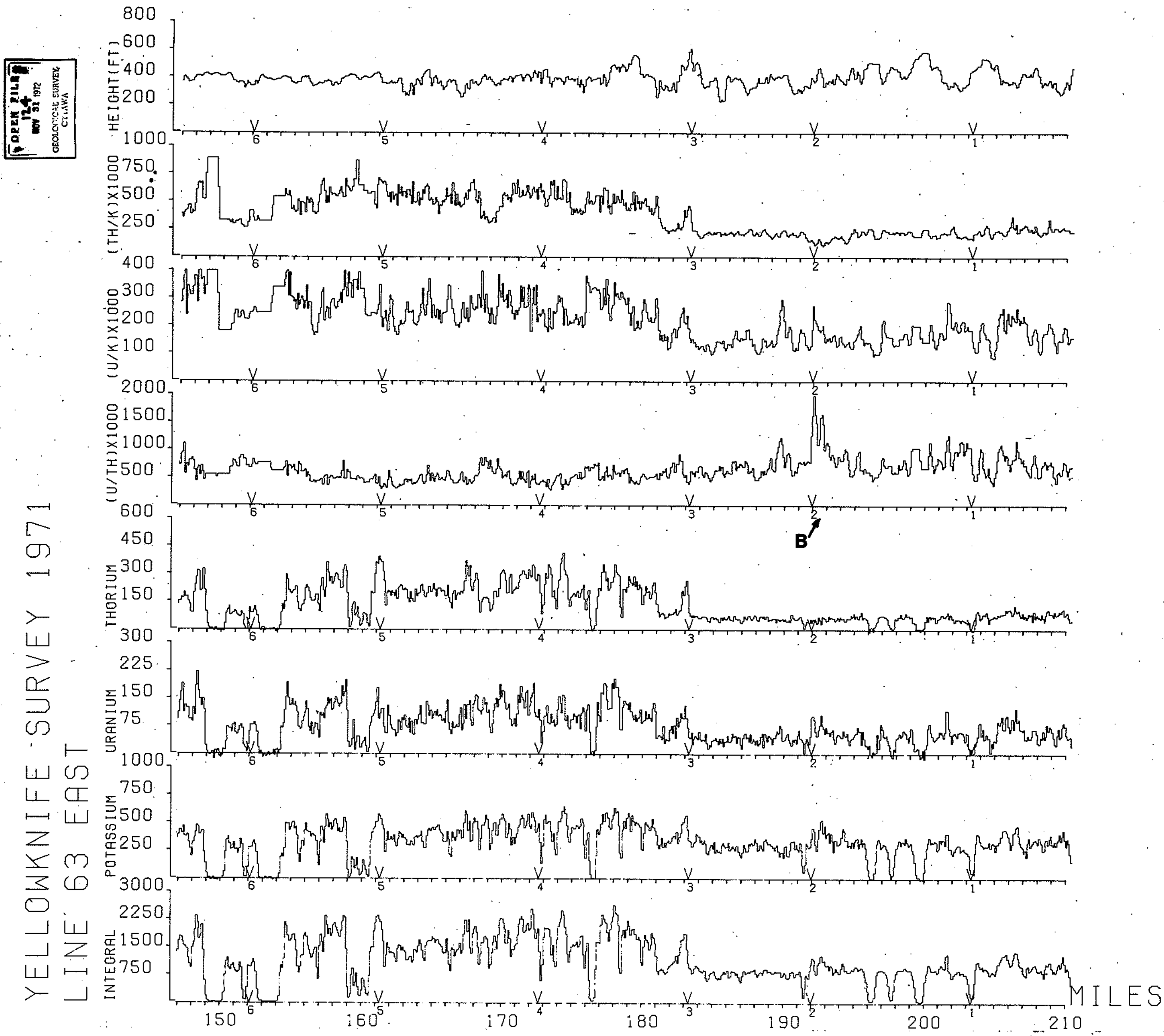


Figure 20. Anomaly B – airborne gamma spectrometry stacked profile across a pegmatite uranium occurrence north of the "East Arm".

found to be 4.4% K, 10 ppm eU, 36 ppm eTh, based on in-situ measurements (Richardson and Charbonneau, 1974; and unpublished data).

The major significance of the proximity of the two anomalous areas to the East Arm portion of the proposed National park area would be as possible "source rock" for uranium occurrences in younger sediments. Sediment transport for some of the Proterozoic formations of the East Arm however are generally regarded as being from the northeast (Hoffman, 1969), but there is apparently considerable variation in source direction for others.

Radiometric Features: East Arm-Artillery Lake Region

A contoured uranium map derived from airborne gamma ray spectrometric surveys for Block A (NTS sheet 75L) is shown on Figure 18. It shows the position and number of the flight lines and fiducial marks along the flight lines. These are important because sharp features that may relate to mineralization are usually best seen on the profiles (Figs. 19 to 26). Several examples are discussed later.

Figure 27 is a portion of the uranium profile map with 25 km line spacing derived from the survey coverage east of

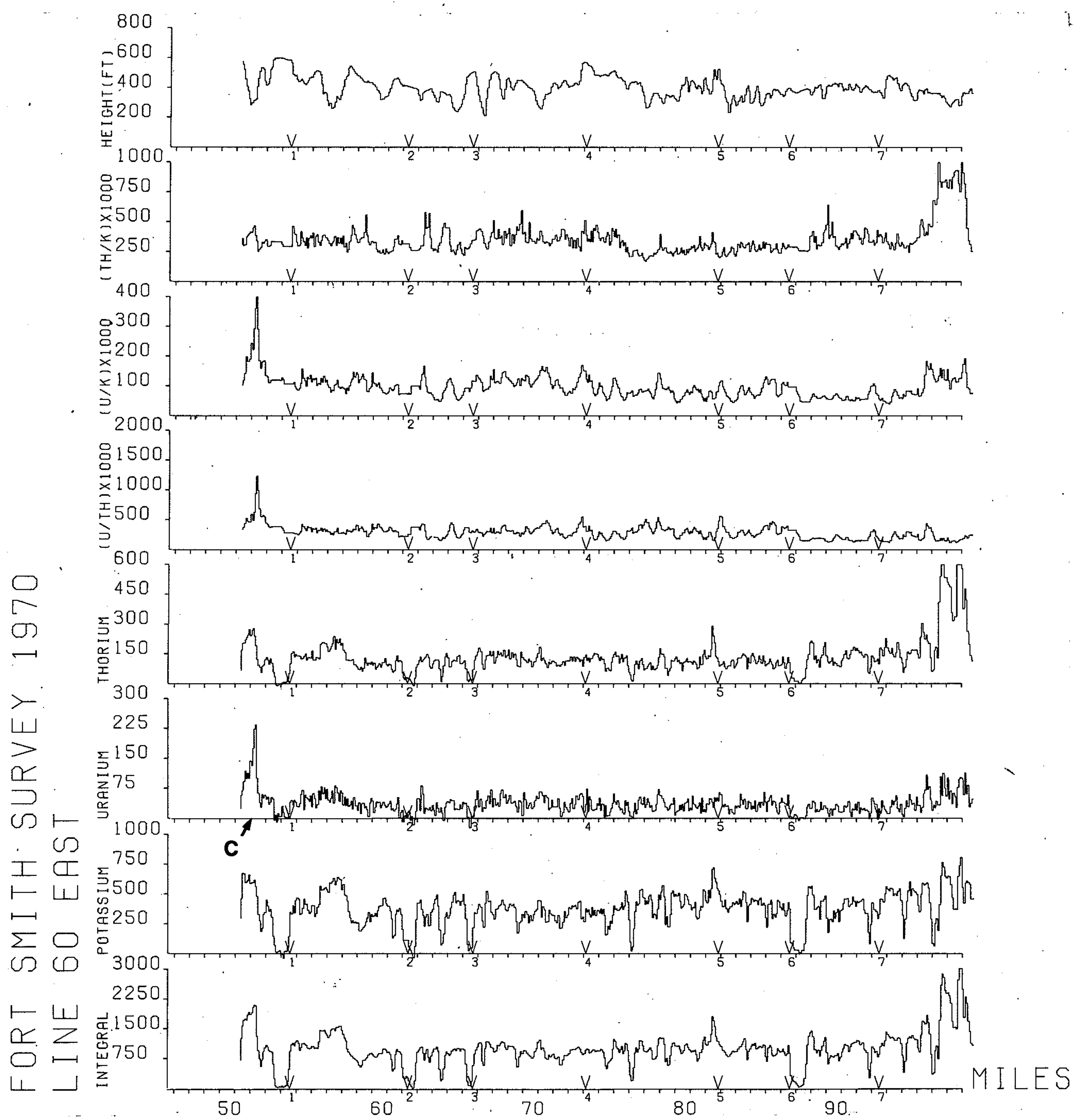


Figure 21. Anomaly C – airborne gamma spectrometry stacked profile across a quartz diorite intrusion hosting vein mineralization on the Labelle Peninsula.

110°W (Geological Survey of Canada Map 37075G). Several anomalous zones can be located on this map even though the wide line spacing would make it impossible to extrapolate radiometric patterns between the lines.

The principal regional anomaly visible on Figure 18 is the area north of the East Arm mentioned earlier. Smaller anomalous zones at the southern boundary of the map relate to the northern extent of the Fort Smith Belt of porphyritic granite (Charbonneau, 1980). Aside from these, the contoured pattern is quite flat. On the Pethei and Kahochella Peninsulas, the low level of radioactivity is attributed to areally extensive rocks of low radioelement concentrations, namely dolomite and gabbro sills (Map 1 in pocket). The contoured pattern indicates that the readings over the peninsulas are commonly 20 to 40 counts for uranium or between 1 and 2 ppm eU taking into account the uranium channel sensitivity of 22 counts per ppm eU. It thus reflects the very low uranium content of these two rock types. On the ground, they show total count readings close to the background viz., 40 to 50 cps for dolomite and 50 to 60 cps for gabbro sills on URTEC UG-135 minispec, whereas the background readings over the lake water are 30 to 40 cps. In comparison, other rock types exposed along north shore of the peninsulas at the base of steep north-facing cliffs of dolomite and gabbro sills, namely red and grey shale and siltstone, buff arkosic sandstone, red micaceous sandstone and siltstone, show readings in the range of 175 to 450 cps.

The wide line spaced survey of Block B indicates that uranium values are also in 1 to 2 ppm eU range in the Artillery Lake region, except for a broad anomaly south of Lockhart River (Anomaly 6, Figs. 27 and 28). At Artillery Lake, dolomite occurs along shore and on islands (Map 3 in pocket). Elsewhere in the region, the rocks are believed to be a complex of metasedimentary, metavolcanic and granitic rocks. The granitic rocks are predominant, and are likely to contain more uranium than indicated by the survey, but in this region masking of radiation due to extensive overburden and lakes must also be taken into consideration. The area is not mapped in detail and ground radiometric observations are few.

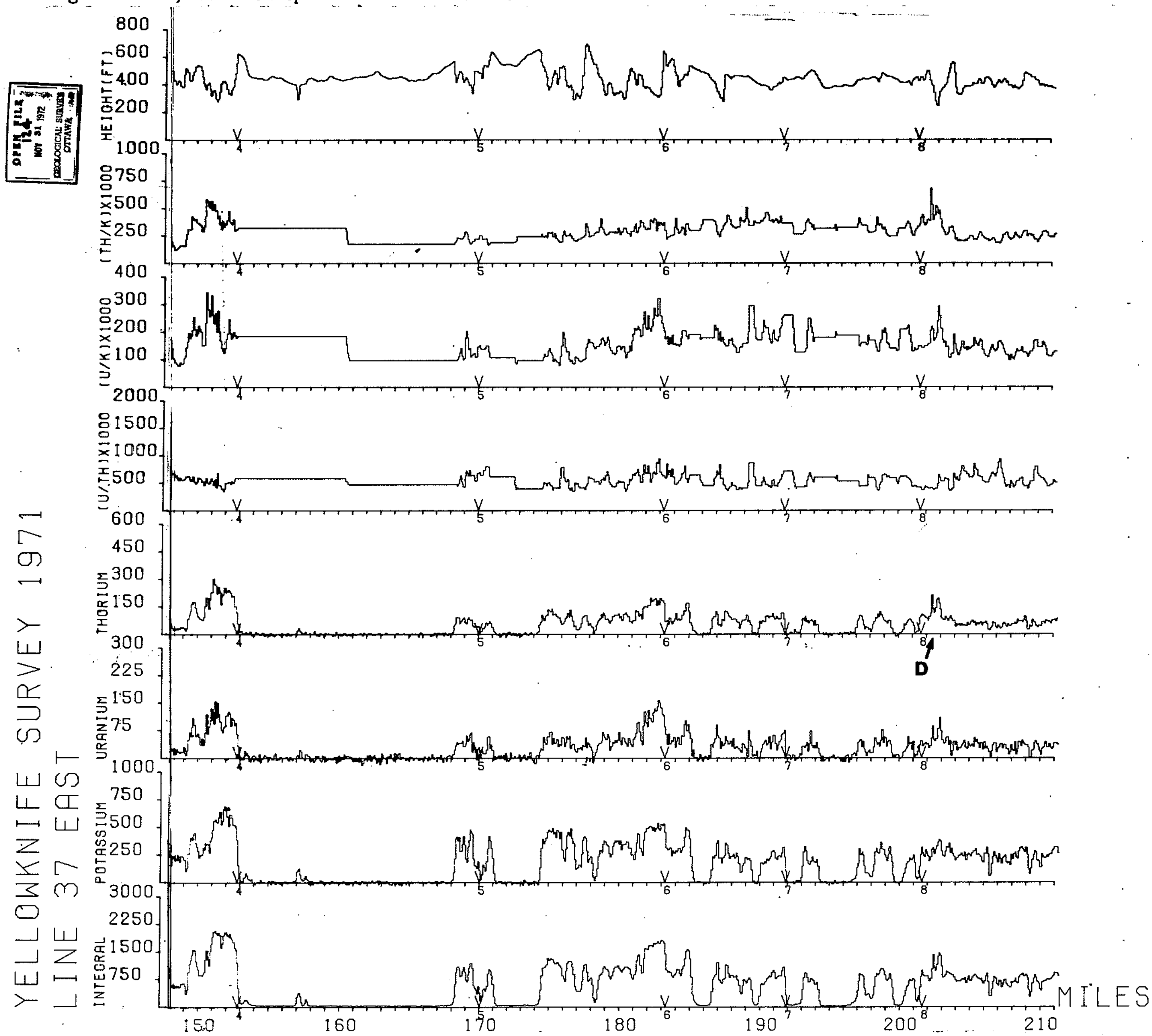


Figure 22. Anomaly D – airborne gamma spectrometry stacked profile across a large low grade sedimentary thorium-uranium occurrence at McLean Bay.

Selection of significant anomalies

As mentioned previously, the flight line stacked profiles must be examined in any attempt to reach conclusions about variations in radiometric signal that might relate to mineralized zones or localized concentrations of radioelements. Thirty-nine such profiles that cover the proposed park area in Block A have been examined (Fig. 18), and eight anomalies have been selected as significant ones. Five of these, designated A to E, are near the proposed park area less than 30 km from it, and three others numbered 1 to 3 are within the area (Figs. 17 and 18). In Block B, three anomalies of interest occur within the proposed park area, and are numbered 4 to 6 (Figs. 27 and 28). The anomalies within the area appear to have some potential for uranium mineralization judging from the magnitude of the anomalies and their U/Th ratio. Some ground follow-up on them was done in 1979 and 1983 by S.S. Gandhi. His field observations, and spectrometric laboratory determinations of eU, eTh and K on some of the samples collected by him, are incorporated in the following discussion of the selected anomalies.

Anomalies near the proposed park

Anomaly A:

This is a broad airborne profile (Fig. 19) which stands out above the regional uranium high north of the East Arm. Profile values in places exceed 225 counts which represent approximately 10 ppm eU (22 counts = 1 ppm eU). This anomalous zone is also high in thorium with values of 450 counts which equates to 50 ppm eTh based on sensitivity of 9 counts/ppm eTh. The uranium to thorium ratio is remarkably constant. This is seen even in a highly radioactive sample of coarse garnetiferous granite at cross-section AB on the north side of McLeod Bay. At the outcrop, up to 1100 total cps (counts per second) on URTEC UG-135 minispec were observed by S.S. Gandhi. A sample of it has contents of eU = 27.1 ppm, eTh = 243.1 and K = 2.9 per cent as determined spectrometrically in laboratory. The major significance of this anomalous area, as mentioned earlier, would be as a possible source of uranium that may have been concentrated in the East Arm Basin.

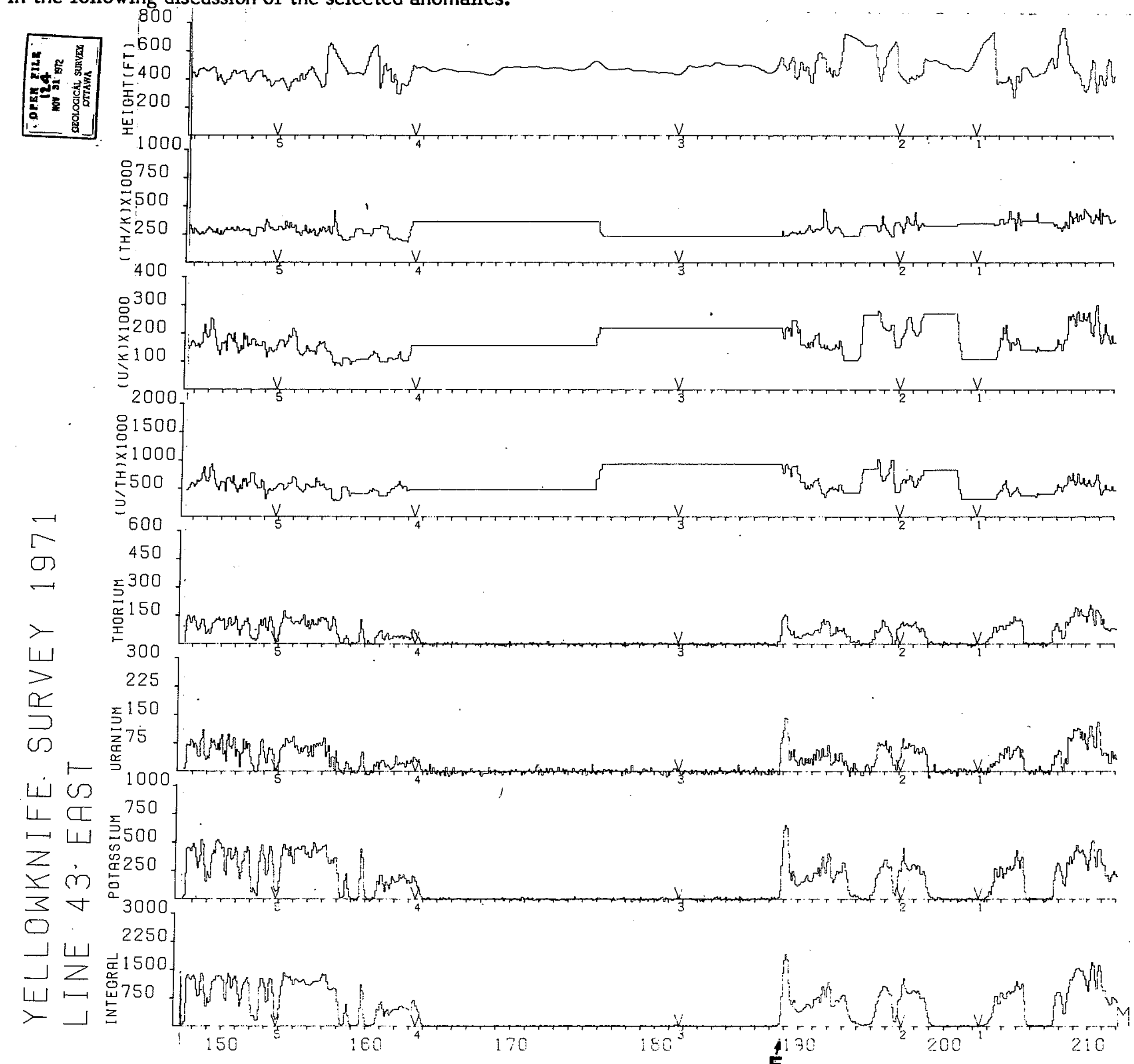


Figure 23. Anomaly E – airborne gamma spectrometry stacked profile across an unexplained anomalous feature.

Anomaly B:

This anomaly has a high U/Th ratio (Fig. 20), and relates to radioactive pegmatites associated with biotite schist in the basement complex north of the East Arm (Lang, 1952; Lang et al., 1962). Some of the associated fractures are highly radioactive due to the presence of pitchblende. One such occurrence was found at the mouth of Barnston River by S.S. Gandhi near previously reported weakly radioactive occurrences. The newly discovered occurrence is a metre long pitchblende-bearing fracture, which was covered by 15 cm of overburden. The maximum reading on URTEC UG-135 minispec was 6800 cps on total count channel, and on K, U and Th channels 100, 60 and 10 cps respectively (indicating the presence of U as well as some Th). It may be noted that two newly discovered pegmatitic occurrences northeast of McLeod Bay (Appendix 1) are in similar host rocks and are discussed further under Anomaly 6.

Anomaly C:

The radiometric response over a quartz diorite intrusion hosting vein mineralization on the Labelle Peninsula is shown on Figure 21. The mineralization is described by Gandhi and Prasad (1982). Instrusions in the central part of the East Arm of Great Slave Lake (between 110°15' and 111°30'W; Fig. 29) host veins of actinolite, apatite, magnetite, and hematite, some of which carry minor amounts of uraninite closely associated with the magnetite. The veins are vertical or steeply dipping, with the majority striking between east and northeast. They range in width from a fraction of a centimetre to a metre, rarely up to two metres, and their lengths range from a few centimetres up to 150 metres. The close spatial association of the veins with the intrusions, and their pegmatoid character suggested a genetic relationship between the veins and the laccoliths (Lang et al., 1962). The high uranium and high uranium/thorium ratio evident on Figure 21 at Anomaly C clearly reflects the nature of the mineralizataion.

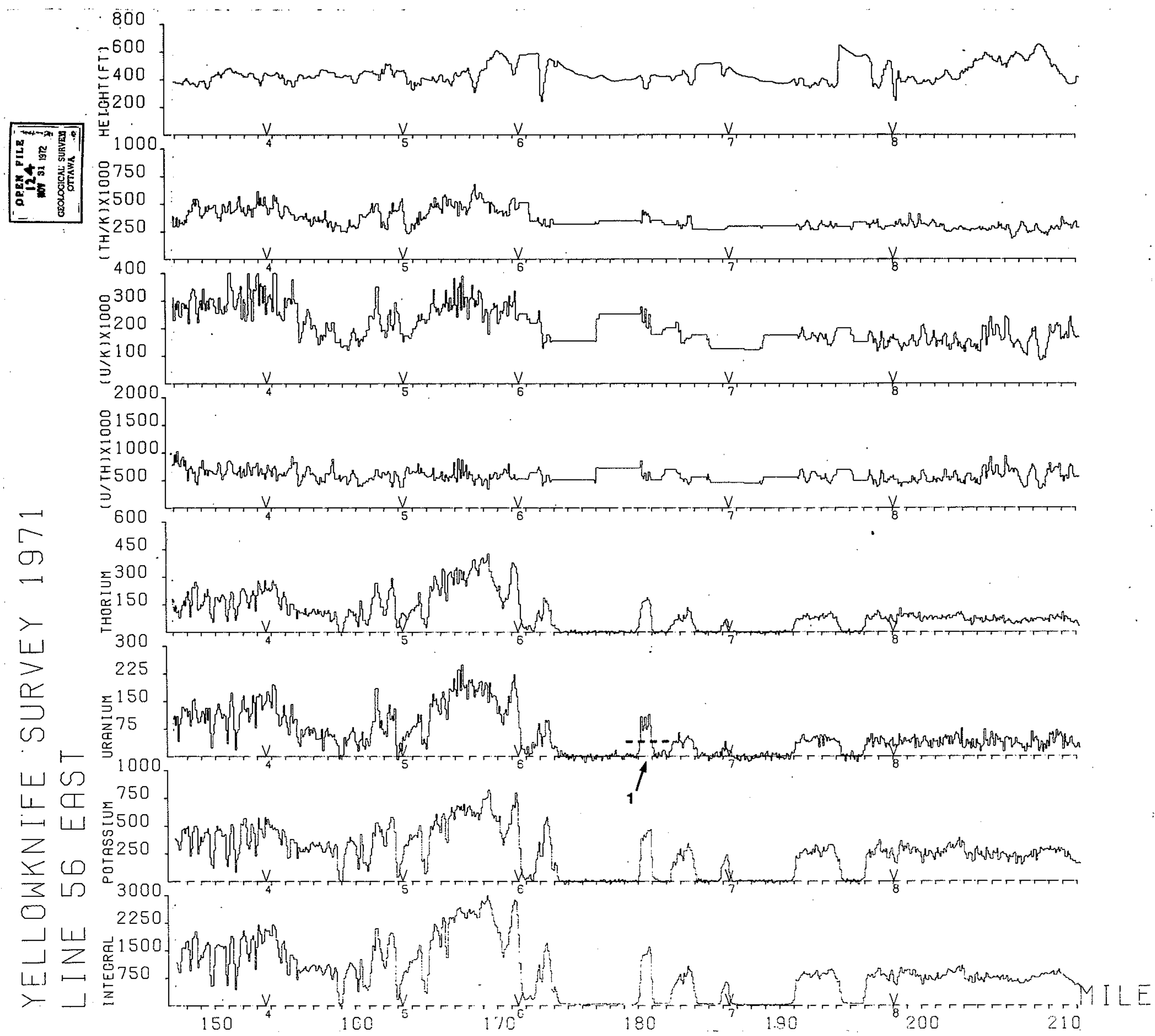


Figure 24. Anomaly 1 – airborne gamma spectrometry stacked profile across anomalous feature within Pethei Group near Gabbro sill.

Anomaly D:

This anomaly (Fig. 22) relates directly to a uranium-thorium occurrence described by Lang et al. (1962, p. 201-202 and 204). A fairly large, low-grade thorium/uranium deposit at McLean Bay of Stark Lake, was found by prospectors for Eldorado Mining and Refining Limited. This company examined it with considerable interest during the early days of intensive search for uranium deposits, before better ones were found in other districts. The deposits occur in dolomite mapped as part of the Kahochella Group, which is one of the groups of the lower part of the Great Slave Group (Supergroup) of early Proterozoic age. The dolomite is interbedded with quartzite, and the beds dip 45°SE. Most radioactivity was found in a bed that has an average width of 13.1 m (43 feet) and that contains concentric structures believed to be algal. Within this bed, two zones 3 and 1.8 m (10 and 6 feet) wide contain more radioactive minerals than the rest of the bed. These zones are brownish red at many places, because of the presence of hematite. Radioactive minerals cannot be seen in the field but laboratory work by S. Kaiman of the Mines Branch in Ottawa showed fine grained monazite and uraninite (or pitchblende), and the presence of monazite was confirmed by Steacy (Lang et al., ibid). The high contents of uranium and thorium and a lack of increase in uranium/thorium ratio are clearly evident on the radiometric profile (Fig. 22). The origin of the deposit is not well understood, but it appears to be synsedimentary. If so, the ultimate source of uranium and thorium is most likely the radioactive granites in the Archean basement.

Anomaly E:

This rather sharp anomaly in potassium, uranium, and thorium has at present no explanation (Fig. 23). The anomaly appears to relate to the Tochatwi Formation (shale, argillite, siltstone) of the Christie Bay Group, the uppermost one of Great Slave Supergroup. It may be simply a result of rather large cliff exposure and may not represent appreciable

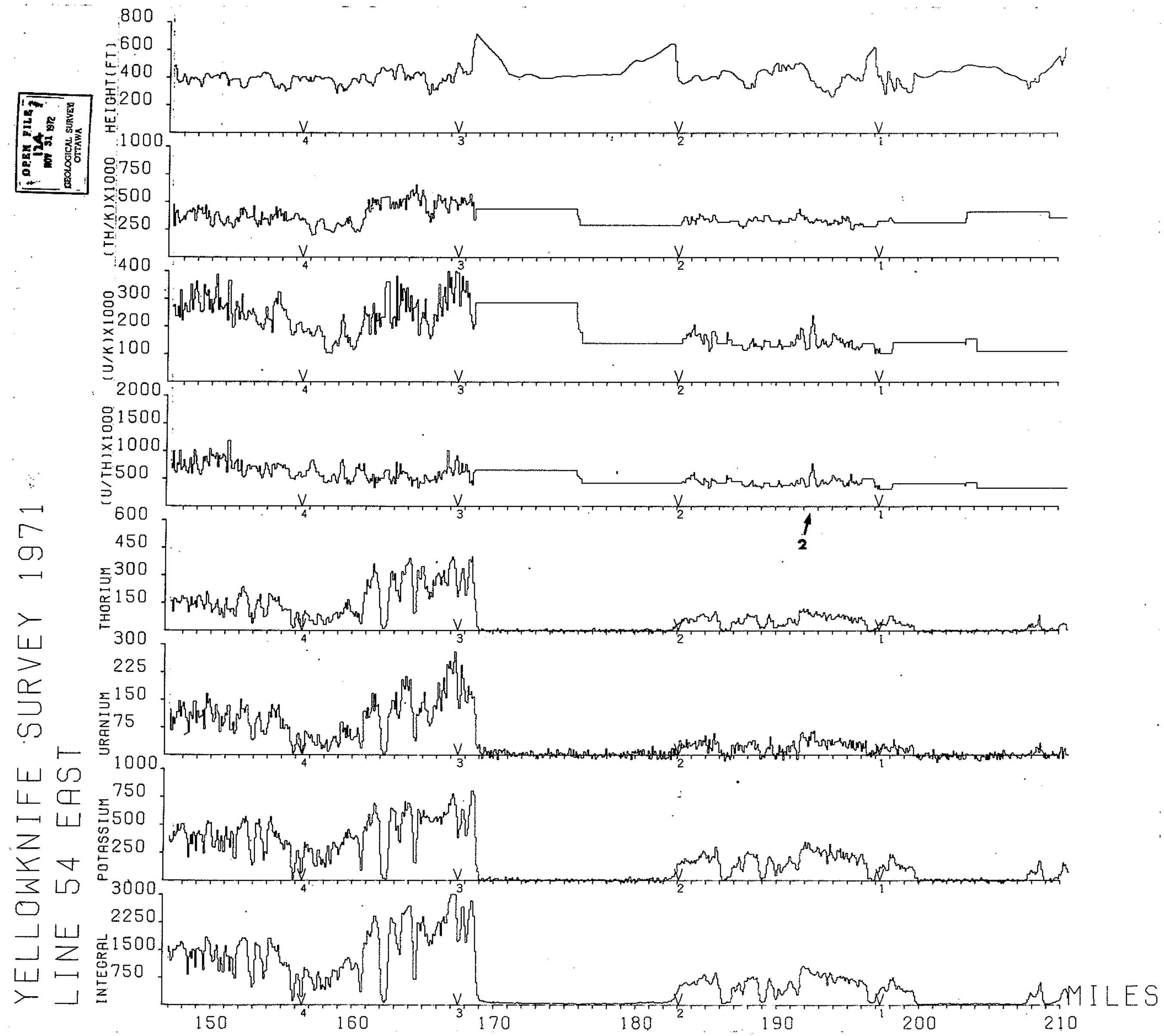


Figure 25. Anomaly 2 – airborne gamma spectrometry stacked profile across anomalous feature within Pethei Group near Gabbro sill (similar) stratigraphic location to Anomaly 1.

increases in potassium, uranium and thorium in the bedrock. The fact that the anomaly shows increase in all channels may support this latter explanation.

Anomalies within the proposed park

Anomaly 1:

This well defined uranium increase is located on a small island west of Gibraltar Point (Figs. 24 and 18). The island, referred to as Viren Island, lies on geological cross-section AB (in pocket) and was examined in 1983 by S.S. Gandhi (this report; Appendix 1). The source of radiometric anomaly is evidently the beds of Akaitcho River Formation which are well exposed in the northern part of the island. The southern part is capped by a gabbro sill. The Gibraltar Formation, overlies the Akaitcho River Formation and is interbedded with it in a transition zone which is exposed at the base of steep north-facing cliff of the sill. Total count readings on URTEC UG-135 minispec show the following ranges for the Akaitcho River Formation: predominant red micaceous sandstone and siltstone, 250-380 cps; buff sandstone 200-300 cps; thin granular iron-formations, 80-90 cps; and pale green shale bed up to 10 cm thick, 400 to 475 cps. A dark purplish grey siltstone of the formation from the southwest corner of the island contains 3.6 ppm eU, 23.6 ppm eTh and 2.9% K (laboratory and radiometric determinations). In comparison, the Gibraltar Formation containing abundant red shale-siltstone and some interbedded dark grey-green shale beds show 300 to 400 cps. The pale green shale beds are very interesting. Only two of them were found on the island, and these are approximately 3 cm and 10 cm thick, but they are lithologically very similar to those at the Gibraltar Point which are enriched in uranium. Two samples from the Gibralter Point showing contain 552 and 582 ppm eU, 16.8 and 21.2 ppm eTh, and 5.6 and 4.8 per cent K as determined radiometrically in laboratory (Appendix 1). It is possible that more such uranium-rich pale green shales are present on Viren Island but are not exposed due to their recessive character, and may have caused the radiometric anomaly. In absence of such a source, the anomaly would have to be attributed to mass effect of other beds on the small island isolated by a large body of water.

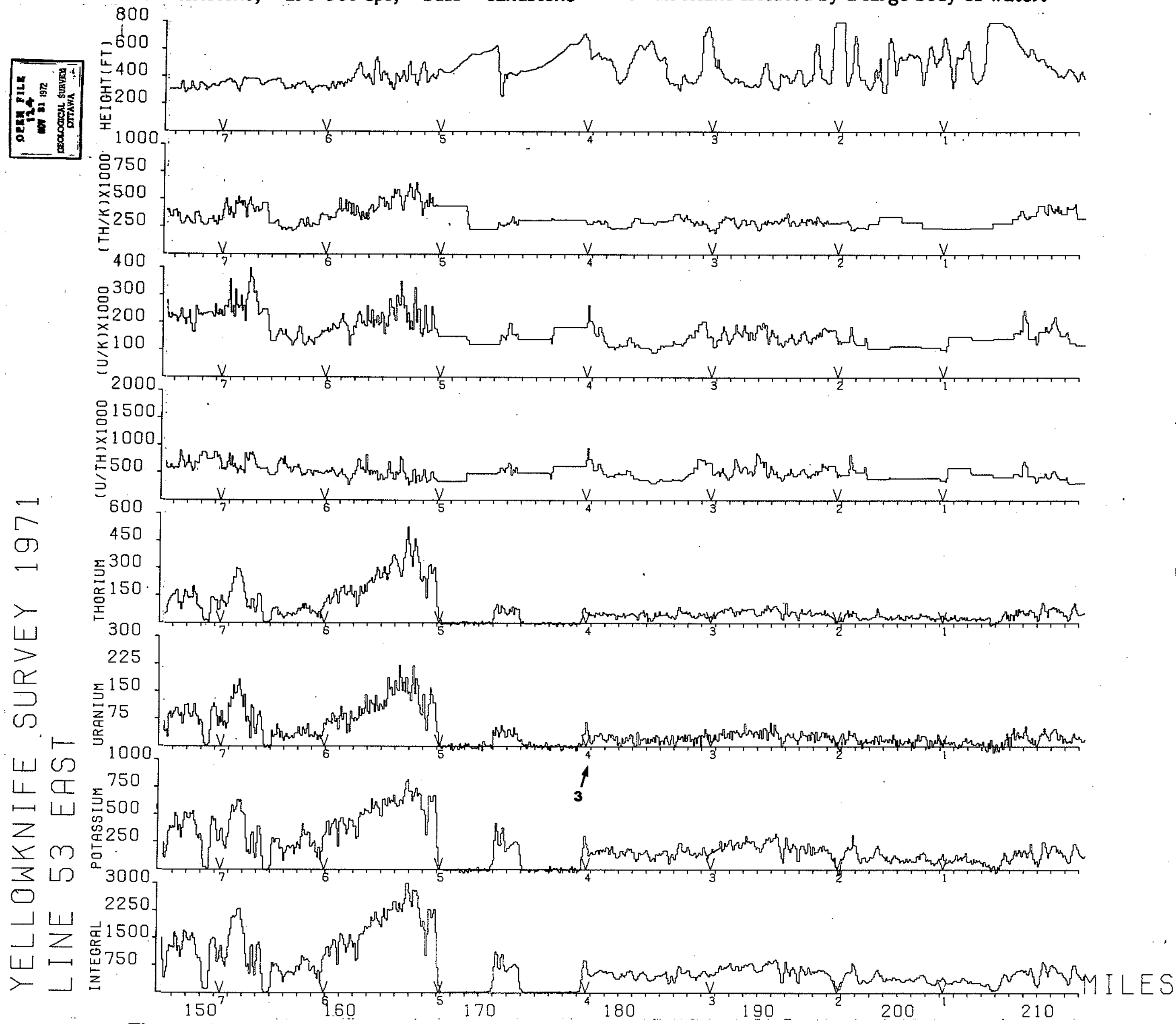
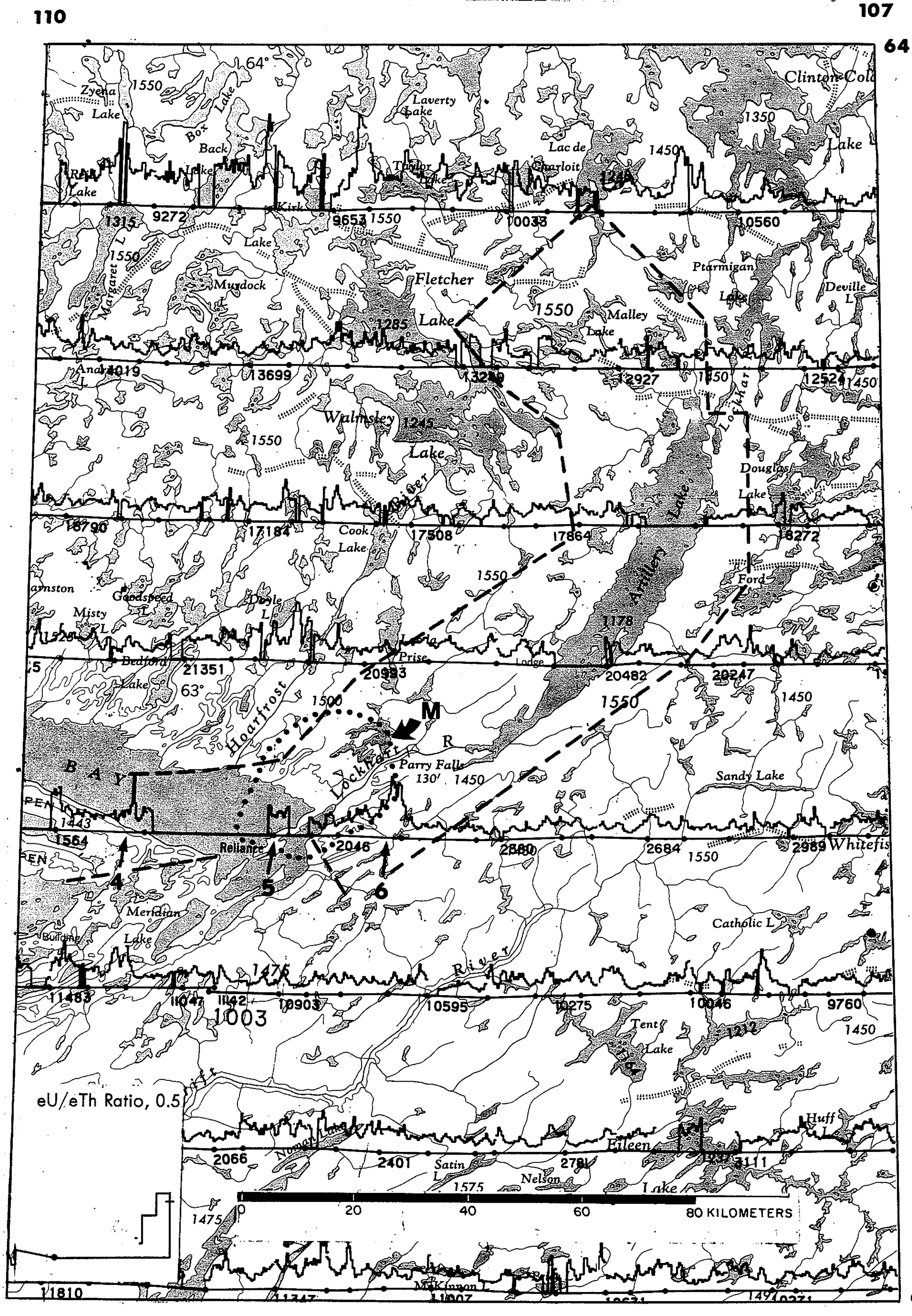
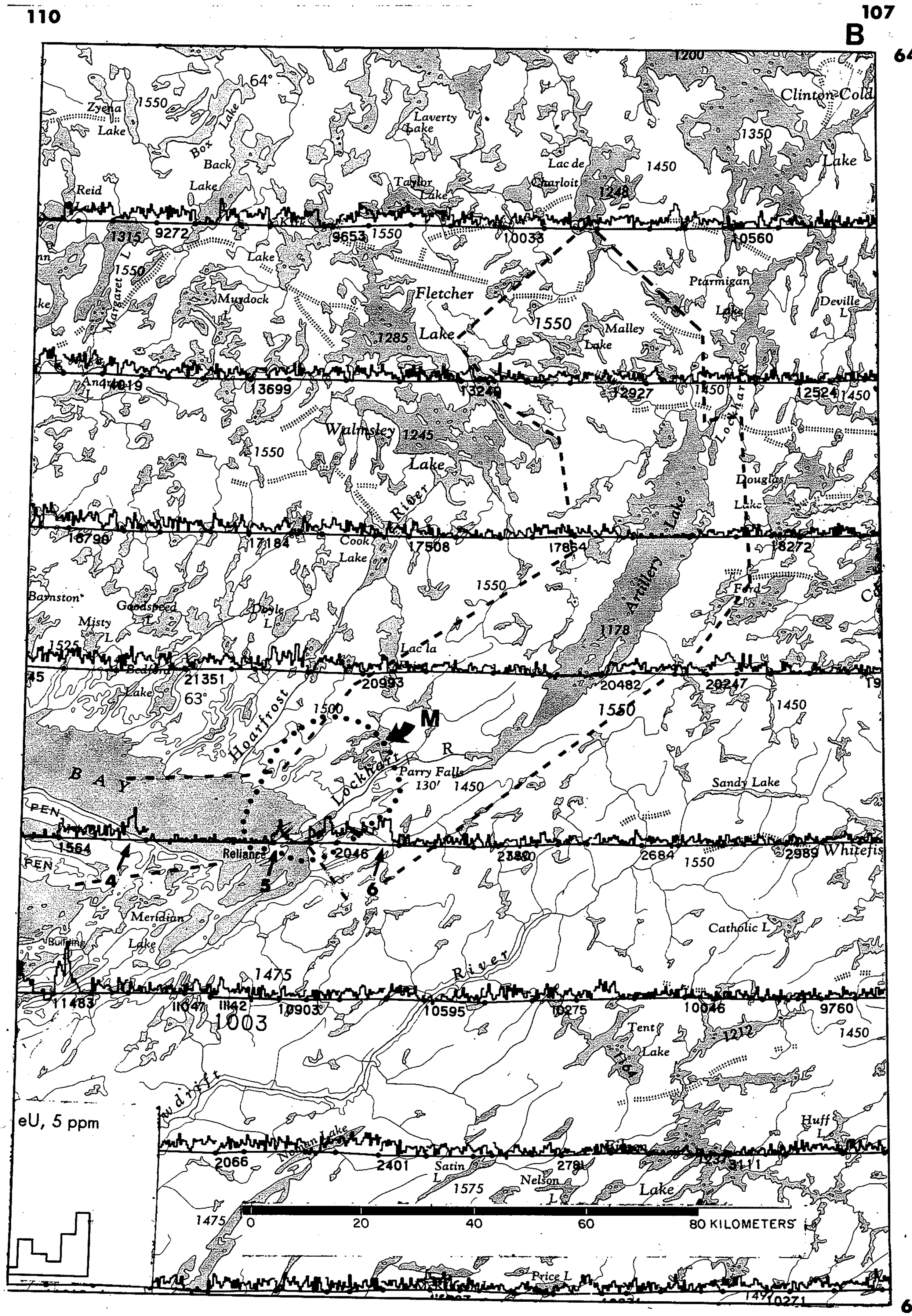


Figure 26. Anomaly 3 – airborne gamma spectrometry stacked profile across anomalous feature on the north shore of the Pethei Peninsula relating to Kahochella Group rocks.



eU/eTh RATIO

Figure 28. Airborne gamma ray spectrometry profile map equivalent uranium/equivalent thorium ratio illustrating the relatively high ratios associated with anomalies 4 and 6; dotted line (M) encloses a magnetically anomalous area.



EQUIVALENT URANIUM (eU)

Figure 27. Uranium profile map (25 km line spacing) derived from airborne gamma spectrometry; dotted line (M) encloses a magnetically anomalous area.

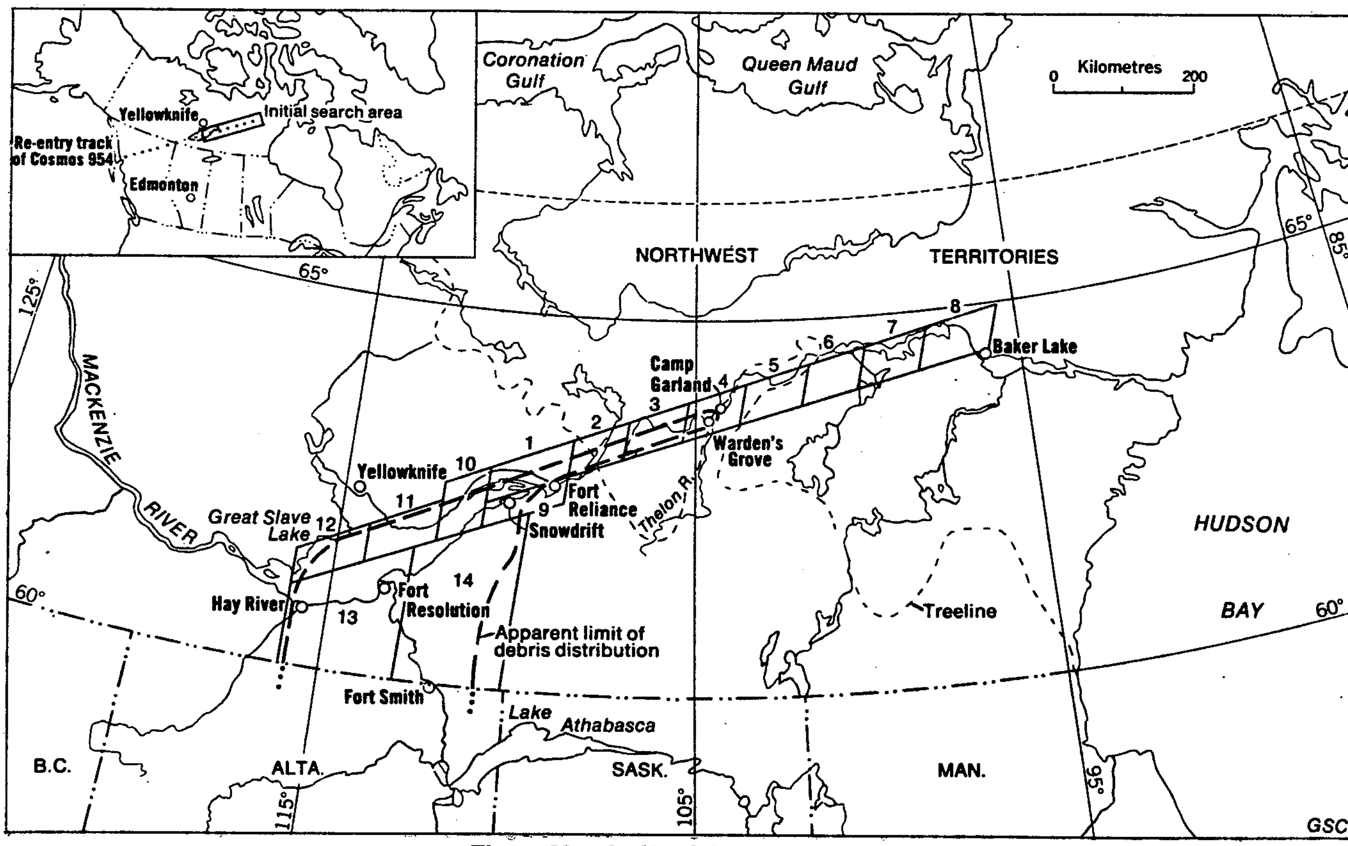


Figure 29. COSMOS 954 search area.

Anomaly 2:

This anomaly is characterized by a high U/Th ratio (Figs. 25 and 18) and is intriguing because it is located in an area underlain by extensive thick stromatolitic dolomite of Pethei Group which has low radioactivity background. Nearest other bedrock is a gabbro sill, approximately 1 km to the south of the anomaly, and it forms a steep north-facing escarpment. A traverse was taken by S.S. Gandhi in 1983 to check this anomaly on the ground. It is situated over a flooded creek in a low swampy ground traversed by a west flowing brook. Outcrops in and around the anomalous area are of dolomite of Utsingi Formation. The formation is nearly flat-lying, stromatolitic and gives 45 to 60 cps (total counts) on URTEC UG-135 minispec. Extensive overburden in the area however is clayey mud with scattered boulders, and shows readings of 80 to 150 cps, and up to 200 cps on some slabby boulders of micaceous red siltstone and rounded boulders of granitic rocks. The overburden is over a metre thick, and in relatively dry areas the mud forms numerous humps or mounds up to 1 m in diameter separated by water-logged holes up to 0.5 m deep. The overburden is interpreted as glacial lake bottom accumulation. It is possible that source of the airborne radiometric anomaly is the overburden, which evidently has a higher uranium content than the dolomite bedrock.

Anomaly 3:

This anomaly is small and discrete but has a high U/Th ratio which could indicate uranium concentration (Figs. 26 and 18). It is located on the north shore of Pethei Peninsula close to a steep, north-facing dolomite escarpment. It is in sparsely vegetated, overburden covered area, up-slope from a west-facing small beach. No radioactive source was found at the anomaly. Readings in the area ranged from 90 to 120 cps on URTEC UG-135 minispec (total counts), and over dolomite talus to the south, from 50 to 60 cps. On the beach where flat red-shale pebbles are abundant, readings were up to 200 cps. Approximately 100 m to the west, there are shore exposures of the Charlton Bay and Douglas Peninsula Formations, which gave readings of 180 to 250 cps. An exception however is a 15 cm thick distinctive pale green shale bed that read 400 to 450 cps. The bed is approximately 2 m below the Douglas Peninsula Formation, in a 3 m thick uppermost part of the Charlton Bay Formation, comprised of dark grey shales (slates; 200-250 cps) with rare calcareous concretions and a few thin beds of dark greenish grey shale. The underlying grey shale beds are typical of Charlton Bay Formation in that they contain abundant calcareous concretions up to 10 cm in diameter.

A representative chip sample from the relatively more radioactive pale green bed contains 14.0 ppm eU, 56.4 ppm eTh, and 7.3 per cent K (spectrometric analyses in laboratory). This is supported by two field readings on Scintrex GAD-6 spectrometer which are 25.8 and 28.8 cps on U-channel (approximately 80 ppm eU), and 5.8 and 6.2 cps on Th channel (approximately 55 ppm eTh) with 300 seconds count time. The higher U content shown by the field readings relative to the laboratory analysis of the sample probably indicates variable concentration of the metal in the bed and/or instrumental drift in the field. In comparison, the concretionary beds (2 readings) and red calcareous shale of Douglas Peninsula Formation (1 reading) ranged between 13.8 and 14.7 cps on U channel and 2.6 and 3.1 cps on Th channel. The background radiation for U was 1.6 cps and for Th 0.9 cps. A sample of the dark grey shale (slate), analyzed by gamma-ray spectrometer in laboratory, contains 5.2 ppm eU, 25.7 ppm eTh and 4.9% K.

Pale green beds are found at approximately the same stratigraphic level near cross-section AB, 5 to 6 km to the northeast of the anomaly. One 15 cm thick bed here gave a total count of 520 on URTEC UG-135 minispec, and a sample from it analyzed 11.3 ppm eU, 46.5 ppm eTh and 4.4% k in laboratory. The beds are lithologically similar to the uranium rich beds at Gibraltar Point mentioned earlier. Such beds and lenses are thus widely distributed through the Gibraltar and Charlton Bay Formations. If present in sufficient abundance near surface, they may account for the airborne radiometric anomaly.

Anomaly 4:

This is a relatively prominent uranium anomaly characterized by high U/Th ratio (Figs. 27 and 28). It is in an area of lake sediment geochemical anomalies of various metals including uranium (Y.T. Maurice, this report). The area includes a prominent east-west ridge 275 m high above McLeod Bay, with a steep north-facing escarpment and gentle south slope. The ridge is interrupted by a small north-trending valley at Anomaly 4 which is located on steep talus covered north slope. A larger northeast-trending valley is located approximately 5 km to the east of anomaly peak. The valleys are fault-controlled. The ridge is capped by a gabbro sill dipping gently to south. The underlying dolomite is exposed in the escarpment but the red and grey shales beneath it are poorly exposed, except near the north end of the larger valley (Map 2, in pocket). A traverse here by S.S. Gandhi in 1983 revealed readings of 200 to 350 cps (total count on URTEC UG-135 minispec) over 155 m thickness of Gibraltar Formation, in which red shales predominate. They contain thin beds, laminae and lenses of light green shale. The latter however are not significantly more radioactive than the red shales. Two representative samples of interbedded green shales were collected, one near the north end of a beach facing east from nearly vertical northeast-trending beds and the other 300 m to its southwest 50 m above lake level. They contain 5.9 and 5.5 ppm eU and 22.9 and 21.4 ppm eTh respectively and each contains 4.4 per cent K (spectrometric analyses in laboratory). Although these do not show significant uranium enrichment, possibility of presence of light green beds highly enriched in uranium, like the ones at Gibraltar Point showing mentioned earlier (Appendix 1), at Anomaly 4 in the Gibraltar and Charlton Bay Formations cannot be ruled out. It may be noted that the calcareous red shale beds of overlying McLeod Bay and Douglas Peninsula Formations are less radioactive than the beds of Gibraltar and Charlton Bay Formations, and are less likely source of the anomaly. Proximity of faults suggests a possibility of fracture controlled uranium mineralization at the anomaly.

Anomaly 5:

This is a prominent uranium anomaly near Reliance (Fig. 27 and 28). It is in an area of Sosan Group that hosts several uranium occurrences 15 km to the southwest and elsewhere (Maps 1 and 2 in pocket; Morton, 1974; Gandhi, 1978). A new showing was indeed discovered at the anomaly by S.S. Gandhi in 1979, although he was unaware of the anomaly at that time. Uranium mineralization occurs along, and in fractures at, the boundary of flat-lying red micaceous sandstone of Akaitcho River Formation overlying buff white sandstone of Kluziai Formation (Appendix 1, occurrence 75K/14-1; Map 2 in pocket). Readings of 800 to 900 cps (approximately 260 to 300 ppm eU on Scintrex BGS-1S scintillometer assuming most of the radiation is from uranium), were obtained at two places approximately 100 m apart along shore, and of 200 to 300 cps at a number of places in between. The background readings in the vicinity were 60 to 80 cps. A gritty sandstone sample with buff white and red beds near the west end of the showing contains 22.9 ppm eU, 46.1 ppm eTh and 3.5% K, and is representative of the weakly anomalous radioactivity common along this horizon. It must be noted that the showing is small and spotty, and is located a few hundred metres east-northeast of the peak of the airborne radiometric anomaly. Thus it is unlikely to be the sole cause of the anomaly. In fact, the strength and width of the anomaly indicates that additional similar uranium occurrences and/or a larger deposit may be present in the anomalous area.

Anomaly 6:

The flight line that crosses Fairchild peninsula and anomaly 5 near Reliance passed over relatively uraniferous granitic rocks between the shoreline of Charleton Bay and the McDonald Fault scarp respectively 7 and 24 km east of Reliance. The western half of this section, which crosses the south end of a magnetically anomalous area (Figs. 4, 27, 28), yielded a normal to moderately high U/Th ratio response. The eastern half of the radioactive section shows distinctly higher U/Th ratios rising to a peak marked as Anomaly 6 in Figures 27 and 28 a few km southeast of the southeast margin of the magnetic zone. Bottom sediments in lakes near Anomaly 6 contain anomalous contents of uranium and also zinc, copper, nickel, molybdenum and arsenic (Maurice, this report).

Ground checking in the immediate area of Anomaly 6, restricted to a few short traverses, is not adequate to fully evaluate this broad anomaly. The anomaly peak is near its east end, very close to 62°45'N and 108°45"W. Two traverses were made near the peak by Y.T. Maurice in 1976, one across the flight line and the other 3 km to the north. These revealed scintillometer readings 2-4 times the background in the southern traverse and up to 10 times the background in coarse granitic rocks on the northern traverse, near small ponds with sediments strongly anomalous in uranium. The latter are likely to have been eroded from favourable host rocks for uranium concentrations. Other checkwork was done to the west-southwest near longitude 108°52'W and 1.5 to 3 km south of the flight line. Here an area 2 x 3 km was examined in 1984 by S.S. Gandhi and D.C. Findlay of the Geological Survey of Canada. Three short traverses by them revealed the presence of granites showing scintillometer readings up to 4 times the background. A few spectrometer readings in the field and in the laboratory however show that Th predominates over U in the normal crustal ratio of about 5:1 (approximately 30 ppm Th vs 5 to 8 ppm U). K content is 4 to 5 per cent. This granite and its possible equivalent rocks along the flight line are therefore not the source of the U/Th ratio portion of Anomaly 6. Other rock types known in the area are much less radioactive, giving close to background readings. These are the granitic gneisses which are abundant and irregularly distributed in the area, and the biotite and amphibole rich gneisses that occur as small bands, and diabase dykes. An easterly extension of the Sosan Group sandstone in the 2 x 3 km area was shown on older geological maps, and it is a favourable host rock for uranium mineralization as mentioned earlier, but the checkwork by S.S. Gandhi showed that the sandstone does not extend this far east and the revised boundary is shown in Map 2 (in pocket).

Anomaly 6 is along the only radiometric survey flight line that crossed the extensive magnetically high area west of McLeod Bay, but there is other evidence that the area likely contains rocks that differ from most of those present in Archean granitoid terranes. A large proportion of all the lake bottom sediments sampled near and within the magnetic area were found to contain relatively high contents of several elements (Maurice, this report). Ground checks of some of molybdenum and uranium anomalies south of Hoarfrost River along the north side of the magnetic high (Area D, in Maurice, 1984) found bedrock that consists of coarse grained white granite that is distinctly radioactive. Gandhi and Roscoe discovered uranium concentrations farther southeast between Area D and Lockhart River. As mentioned elsewhere in this report, one of these is in apatite-rich alkaline quartz syenite – an uncommon rock, particularly in Archean terranes.

Because of the possible exploration significance of the situation at Anomaly 6, additional information has been sought concerning the shape of the causitive bodies that underlie the airborne magnetic anomaly. L.J. Kornik of the Lithospheric and Canadian Shield Division of the Geological Survey of Canada tested various possible models that could fit and explain magnetic features along two parallel 50 km magnetic profiles derived from published one mile to the inch aeromagnetic maps. This was done using the MAGRAV 2 modelling program developed by the Geological Survey (Broome, 1986). One profile is along the 109° W meridian, the other 5 km east of this. The modelling indicates that a separate magnetic body may be present in the vicinity of Anomaly 6 along the south margin of a 30 km wide magnetic body.

In summary, the six airborne radiometric anomalies within the proposed park area relate to various geological units, namely the basement complex, the Sosan Group, the Kahochella Group and the Pethei Group. One of them (No. 5) is directly related to epigenetic uranium mineralization in the Sosan Group. Of the four others checked on ground, three (Nos. 1, 3 and 4) have a possible bedrock source in light green shale beds of the Kahochella Group with syngenetic uranium enrichment. One in the Pethei Group area (No. 2) is probably due to overburden. The sixth anomaly is most likely related to granitic uranium concentrations in the Archean basement, similar to those discovered recently 20 km to the north. The regional radiometric surveys provide, in addition, basic data on natural radiation and on the metallogeny of uranium and thorium in the area.

COSMOS-954 Satellite Debris

Radioactive satellite debris was scattered over the proposed park area in 1978. The following account of this historic event and subsequent search is summarized from Grasty (1980).

On January 24th, 1978, COSMOS-954, a nuclear powered Russian satellite, disintegrated on reentering the earth's atmosphere and scattered radioactive debris over a large area of Canada's Northwest Territories. The U.S. Government offered the Canadian Nuclear Emergency Search Team (NEST) help in the search and recovery of any radioactive debris.

Based on computer reentry prediction, the probable impact zone was defined by a trajectory, and ballistic experts from the U.S. team outlined an area 800 km long by 50 km wide stretching from the east end of Great Slave Lake, northeast to Baker Lake near Hudson Bay (Fig. 29). The zone was sectored and search undertaken with a range of American and Canadian gamma-ray spectrometric survey installations. The Canadian spectrometer, while searching sector 1, detected a radioactive source on the ice at the east end of Great Slave Lake, 27 km north of Fort Reliance. Subsequent computer analysis of the data collected on magnetic tape confirmed the presence of gamma-ray characteristic of the products of nuclear fission. It was found that all radioactive fragments from the satellite had fallen within a narrow ten kilometer wide strip which extended part way along the center of the predicted reentry path.

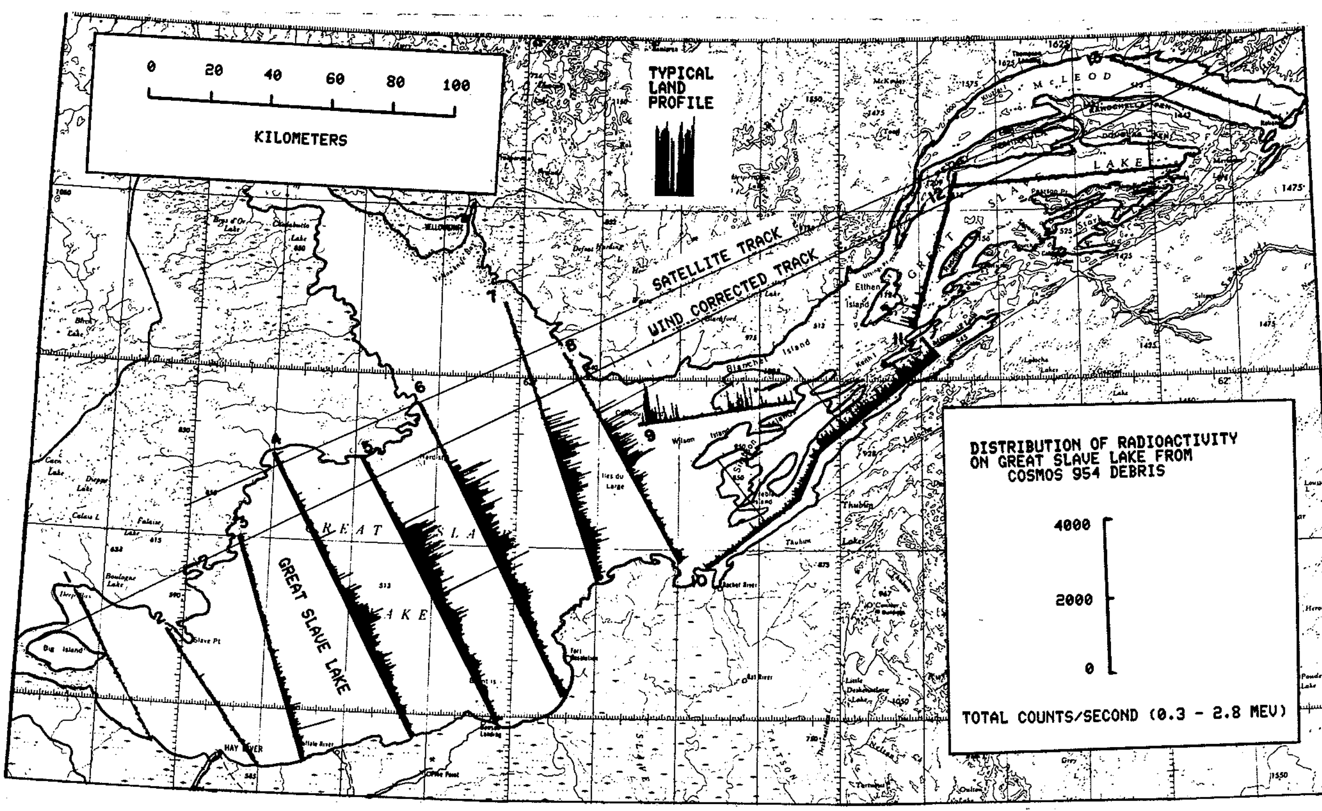


Figure 30. Distribution of radioactivity on Great Slave Lake from COSMOS 954 debris.

Later in the search, a helicopter with detection equipment on board discovered many radioactive sources on the ice near Snowdrift in sector 9 (Fig. 29). These sources were too weak to be detected at the altitude flown by the Hercules fixed-wing aircraft. Analysis of these minute pieces showed them to be part of the missing reactor core. In the next few days, other low flying helicopter flights detected many more radioactive particles along the south shore of Great Slave Lake. The reactor core had apparently disintegrated on entering the earth's atmosphere and minute pieces of the core, carried in the northerly winds of the morning of January 24th, had drifted southward to dust a large area south of the satellite track. The area extended from Hay River in the west to a line from Fort Smith to Fort Reliance in the east (Figure 30). During the early part of March, communities on the south shore of Great Slave Lake were surveyed by members of the NEST team and scientists from the AECB, and numerous radioactive particles were collected. At the end of March, a systematic gamma-ray helicopter survey was carried out over the ice of Great Slave Lake by commercially built Canadian equipment which replaced the American spectrometers. Figure 29 shows the distribution of radioactive debris on the ice, and also that the level of radioactivity decreases significantly at the south shore of the lake. Analysis of the data provide further evidence that the reactor core had completely disintegrated on entering the earth's atmosphere.

During the course of the summer of 1978, the AECB conducted a further monitoring and clean-up operation primarily to ensure that all hazardous material had been removed. Approximately 3,500 minute particles were collected from communities, including some as far as 300 miles south of the satellite track.

Fortunately, the satellite debris products have relatively short half-lives. Grasty (1980) pointed out that all the major emmitting isotopes have half-lives less than 300 days. They should have decayed down to low levels of activity after some five years. Nevertheless some caution should be exercised with regard to the possibility of some debris with residual activity still being present in the area.

THE EAST ARM GRAVITY ANOMALY: A GEOPHYSICAL INTERPRETATION

R.A. Gibb

A large positive Bouguer gravity anomaly is associated with the East Arm of Great Slave Lake (Fig. 31). It attains a peak amplitude of -19 mGal (i.e. 39 mGal relative to a background value of -58 mGal) in the vicinity of Christie Bay. Several smaller local maxima and minima occur within the positive anomaly to the southwest. The anomaly is clearly related to the East Arm structure as it corresponds very closely in area with the East Arm and the contained Proterozoic volcano-sedimentary succession. The sign of the anomaly and the relatively small proportion of dense volcanic and carbonate rocks preclude a source within the volcano-sedimentary succession which has an average thickness of between 3 and 4 km with a local maximum of about 7 km (Hoffman et al., 1974) and the amplitude of the anomaly precludes exposed diabase sheets as a possible source although there is some correspondence between the peak anomalies and the maximum surface distribution of diabasic sills on Pethei Peninsula.

The source is likely to be deeper than the sedimentary section and is most probably a mafic or ultramafic body within the upper crust. A body which could explain the observed anomaly is shown in cross-section P-P' in Figure 31. The upper surface of the body was fixed at 3 km depth and a density contrast of 0.2 g/cm^3 was assumed corresponding to a gabbroic body of density 2.9 g/cm^3 intruded into a granitic upper crust of density 2.70 g/cm^3. The lateral extent of the body is confined to the East Arm structure and the body thickens dramatically from relatively thin northerly and southerly margins to attain a maximum thickness of 10 km below Christie Bay.

Because of the non-uniqueness of gravity interpretaion, the model must be regarded as preliminary and as only one of several possible source bodies that could explain the anomaly. In this preliminary model no account has been taken of the small gravity effects of terrain, varying densities of the

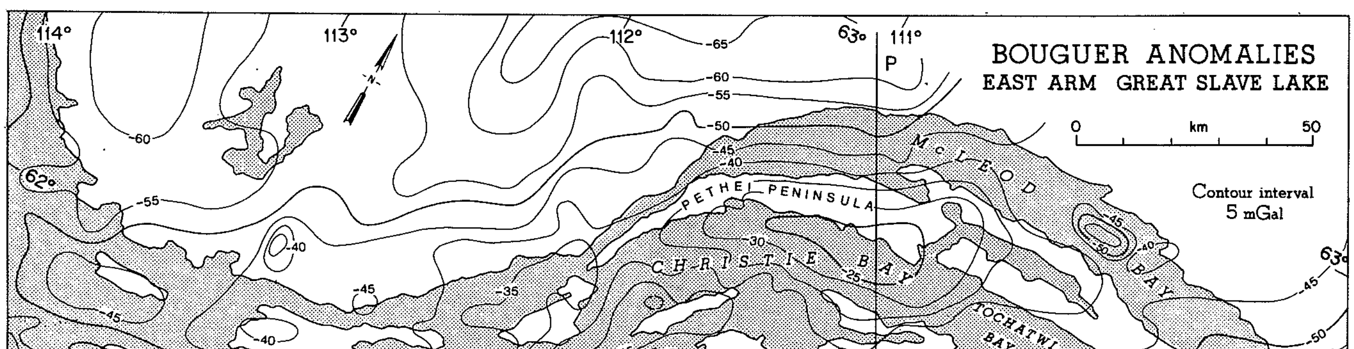


Figure 31. Bouguer gravity anomaly map of the East Arm, Great Slave Lake. Profile P-P' is shown in Fig. 32a.

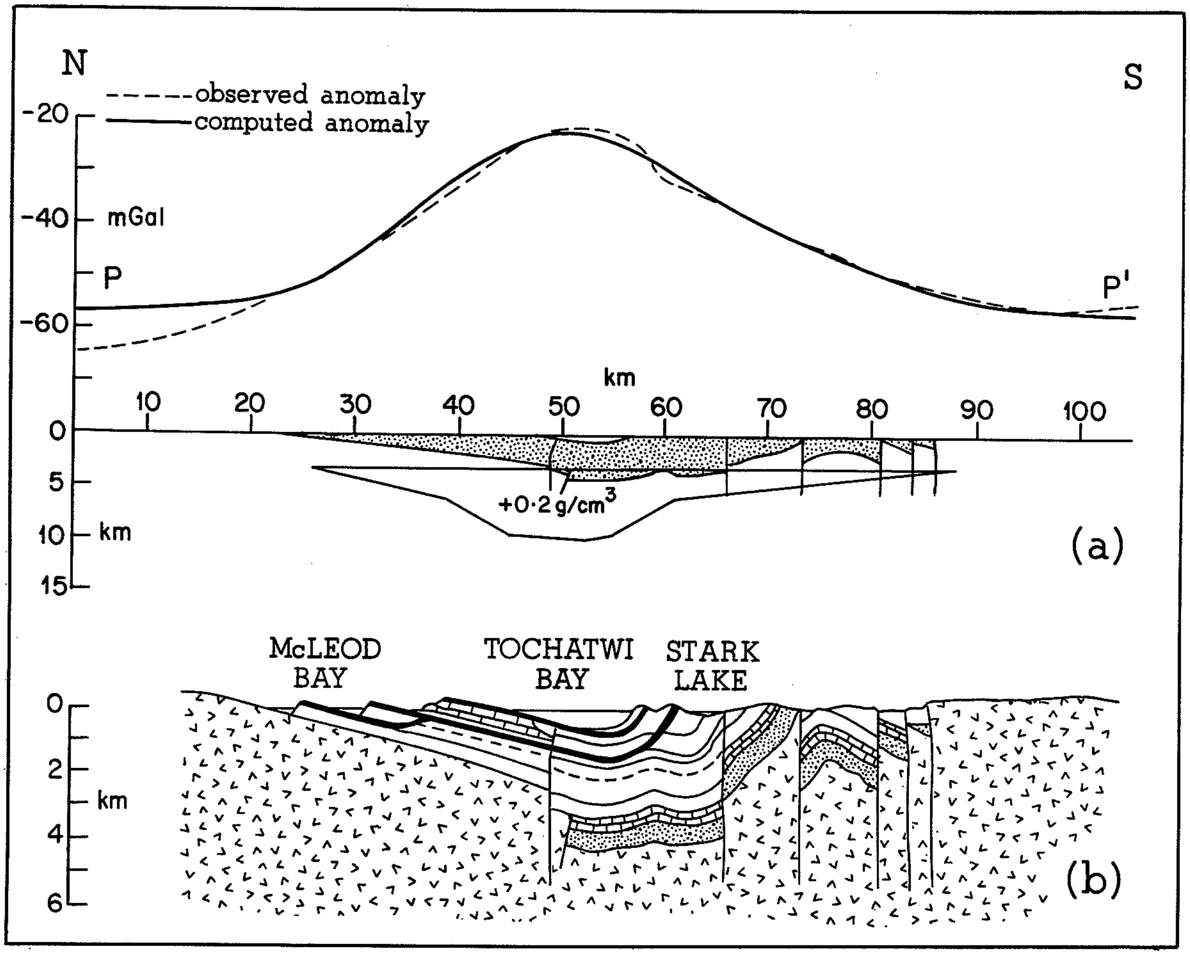


Figure 32. a) Preliminary interpretation of gravity profile P-P'. The source of the positive gravity anomaly is a large intrusive body of gabbroic composition below the volcano-sedimentary succession. b) Geological cross-section corresponding to profile P-P'. Volcano-sedimentary section (from Hoffman et al., 1974) comprises mainly subarkose, carbonate, volcanics, mudstone, quartzite, and sandstone.

volcano-sedimentary succession and the negative gravity effect of the waters of the lake which reach maximum depths of over 500 m in Christie Bay near the profile.

The body could be interpreted as the feeder body for the extensive dykes and sills associated with the East Arm. It may be related to aulacogen (failed arm) formation (Hoffman, 1973) or to continental collision (Gibb and Thomas, 1977) or to some other fundamental form of tectonism related to formation of the East Arm structure and the boundary between the Slave and Churchill structural provinces.

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APPENDIX 1

Mineral Occurrences in the Proposed National Park Area of East Arm (Great Slave Lake) - Artillery Lake, Northwest Territories

S.S. Gandhi

NTS and Index No.	Occurrence/Deposit Name	Commodity	Latitude N	Longitude W	Character
75K/10-1	French Lake	Fe, Ti	62°43'00"	108°47'00"	Magnetite-quartz iron formation
75K/10-2	LID-HEB	U	62°42'26"	108°58'32"	Dissemination in hematized sandstone
75K/11-1	TAT(Box) (Fairchild Point)	Cu	62°43'10"	109°10'50"	Quartz-carbonate-chalcopyrite veins
75K/12-1	Douglas Peninsula	Cu	62°45'00"	109°59'48"	Calcite-chalcopyrite vein in diabase
75K/14-1	Fairchild Peninsula	U	62°45'52"	109°02'03"	Veins and dissemination in sandstone
75K/15-1	McLeod Bay Northeast-1	U	62°55'21"	108°54'25"	Radioactive pegmatite
75K/15-2	McLeod Bay Northeast-2	U	62°53'55"	108°52'38"	Radioactive pegmatite
75K/16-1	A-19 (Artillery Lake)	Pb-Zn-Cu	62°58'54"	107°10'57"	Quartz veins in granite and dolomite
75L/5-1	Point Busse (Utsingi Point) (6 exposures along a 7 km strike length)	Fe	(i) 62°25'10" (ii) 62°26'11" (iii) 62°27'35" (iv) 62°27'54" (v) 62°28'25" (vi) 62°28'45"	111°38'55" 111°38'05" 111°37'30" 110°37'08" 110°36'45" 110°36'30"	Lake Superior-type iron formation in gently dipping varicoloured shale and tuff sequence
75L/5-2	'COUP' Claims	Cu	62°25'45"	111°38'00"	Quartz-carbonate-chalcopyrite veinlets
75L/5-3	'H' Claims	Cu	62°26'35"	111°37'00"	Quartz-carbonate-chalcopyrite veinlets
75L/9-1	'G' Claims	Cu	62°44'36"	110°04'12"	Quartz-chalcopyrite veins in dolomite
75L/11-1	'Bay' Claims	Cu	62°37'20"	111°28'10"	Quartz-carbonate-chalcopyrite veins
75L/11-2	'WOOEE' Claims	Cu	62°40'30"	111°24'00"	Quartz-carbonate-chalcopyrite veins
75L/15-1	Viren Island-1	Fe	62°47'39"	110°57'31"	Lake Superior-type iron formation
75L/15-2	Viren Island-2	Cu	62°47'32"	110°56'28"	Quartz-carbonate-chalcopyrite veins
75L/15-3	Gibraltar Point	U	62°48'28"	110°45'57"	Uraniferous pale green shale
75L/15-4	Shelter Bay	Fe	62°48'46"	110°31'15"	Lake Superior-type iron formation
75L/16-1	'GAP' Claims	Cu	62°46'10"	110°29'10"	Quartz-carbonate-chalcopyrite veins
75N/1-1	A-3 (Artillery Lake)	Cu	63°02'17"	108°07'19"	Quartz-carbonate-chalcopyrite veins
75N/1-2	A-4 (Artillery Lake)	Pb-Zn-Cu	63°04'08"	108°06'54"	Quartz-carbonate-sulphide veins
75N/1-3	A-5 (Artillery Lake)	Cu	63°04'01"	108°06'11"	Quartz-carbonate-chalcopyrite veins
75N/1-4	A-20 (Artillery Lake)	Cu	63°00'11"	108°10'45"	Quartz-carbonate-chalcopyrite veins
75O/4-1	A-1 (Artillery Lake)	Pb-Zn-Cu	63°04'10"	107°54'35"	Quartz-sulphide veins in dolomite
75O/4-2	A-2 (Artillery Lake)	Pb-Zn-Cu	63°04'00"	107°55'00"	Quartz-sulphide veins in dolomite
75O/4-3	A-6 (Artillery Lake)	Pb-Zn	63°10'00"	107°55'10"	Quartz-sulphide veins in dolomite
75O/4-4	A-7 (Artillery Lake)	Pb-Zn-Cu	63°11'00"	107°54'07"	Quartz-sulphide veins in metasediments
75O/4-5	A-8 (Artillery Lake)	Pb-Zn-Cu	63°11'25"	107°53'42"	Quartz-sulphide veins in metasediments
75O/4-6	A-9 (Artillery Lake)	Pb-Zn-Cu	63°11'35"	107°53'25"	Quartz-sulphide veins in metasediments
75O/4-7	A-10 (Artillery Lake)	Pb-Zn-Cu	63°13'24"	107°51'40"	Quartz-sulphide veins in granite
75O/4-8	A-11 (Artillery Lake)	Pb-Zn-Cu	63°14'20"	107°50'50"	Quartz-sulphide veins in granite
75O/4-9	A-17 (Artillery Lake)	Pb-Zn-Cu	63°12'00"	107°49'10"	Quartz-sulphide veins in dolomite
75O/4-10	A-18 (Artillery Lake)	Pb-Zn-Cu	63°07'24"	107°52'07"	Quartz-sulphide veins in dolomite
75O/4-11	A-21 (Artillery Lake)	Pb-Zn-Cu	63°09'35"	107°56'03"	Quartz-sulphide veins in dolomite
75O/5-1	A-12 (Artillery Lake)	Pb-Zn-Cu	63°16'47"	107°47'14"	Galena-quartz vein in granite
75O/5-2	A-13 (Artillery Lake)	Pb-Zn-Cu	63°19'38"	107°40'29"	Galena-sphalerite veins in granite
75O/5-3	A-14 (Artillery Lake)	Cu	63°18'53"	101°40'00"	Quartz-chalcopyrite veins in granite
75O/5-4	A-15 (Artillery Lake)	Pb-Zn-Cu	63°17'30"	107°35'12"	Galena-sphalerite veins in granite
75O/5-5	A-16 (Artillery Lake)	Pb-Zn-Cu	63°16'32"	107°38'26"	Galena-sphalerite veins in granite

NTS AREA-INDEX NO.: 75K/10-1

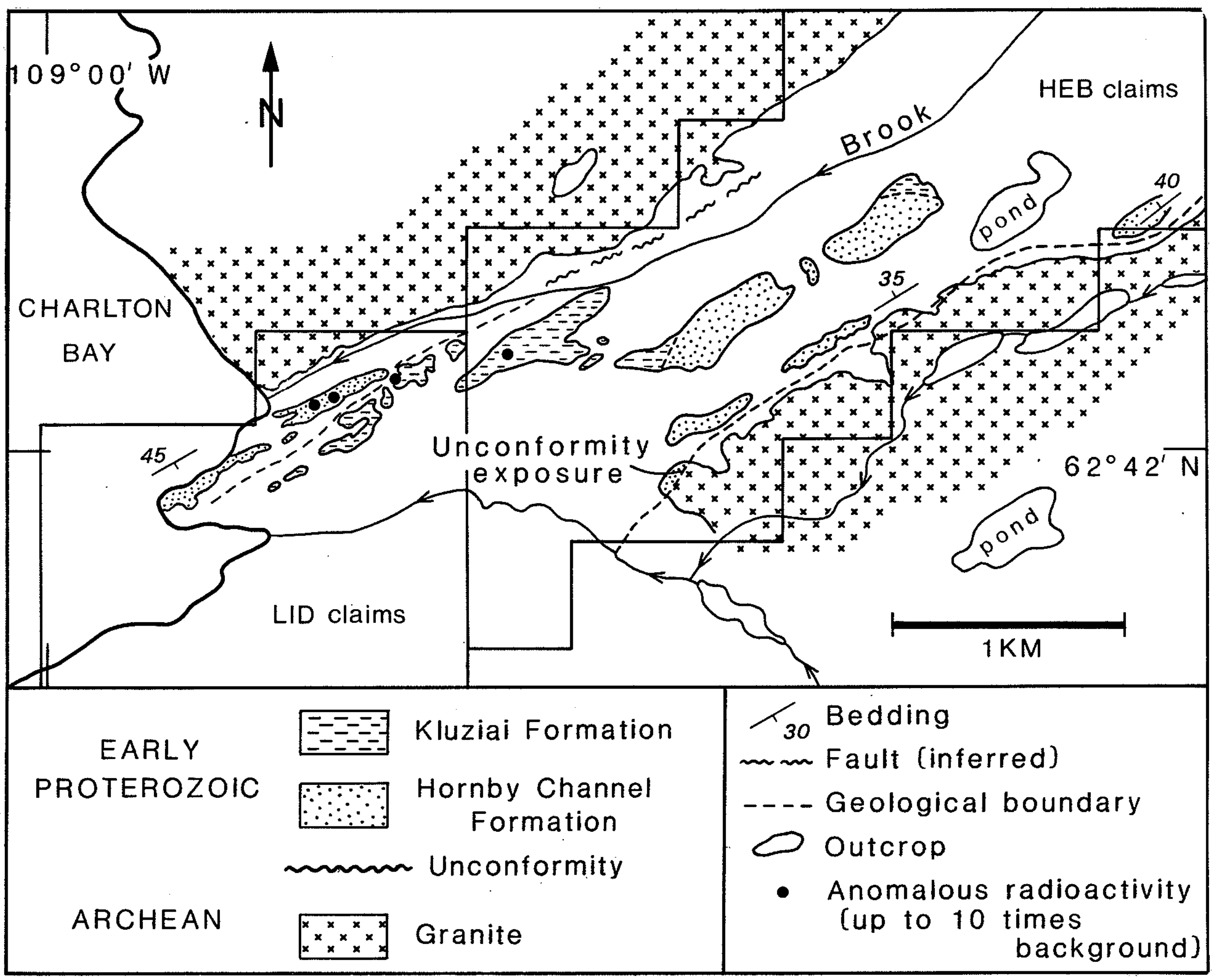
NAME: French Lake magnetite concentrations
COMMODITY: Iron, Titanium
LOCATION: Lat.:62°42'30"N, Long.:108°45'30"W
DESCRIPTION:

A pronounced aeromagnetic anomaly (GSC Map 1285 G) centered about 1 km southeast of French Lake reflects magnetite-rich gneiss exposed in several small separate outcrops on the north flank and near the top of a prominent hill. Fieldwork by S.M. Roscoe in 1984 revealed that the anomaly is caused by magnetite-rich rock. Magnetite, comprising up to 75% (weight) of the rock, is associated with quartz, pyrrhotite, mica and garnet. No pronounced compositional layering was noted. Calc-silicate rock and marble are associated with the iron-rich gneiss. Reconnaissance readings with a Conimag magnetometer suggest that individual magnetiferous layers, perhaps repeated in fold limbs, are not likely more than a few tens of metres thick. The aeromagnetic anomaly is the highest (7,500 gammas compared to a base level of about 3,300 gammas) and northernmost of a series of anomalies along a belt that strikes about 025°. The belt contains variably mylonitized garnetiferous, micaceous, graphitic and sulphidic pelitic gneisses, calc-silicate rocks and marble, quartz-rich gneiss and granite gneiss. It is truncated along the southeast side of French Lake by the McDonald Fault and associated mylonite zones trending 060°.

The occurrences are probably the same as the French Lake iron prospect misleadingly reported as located at approximately 62°43'N, 108°47'W. (NMI card from report filed with Department of Indian Affairs and Northern Development). This report states that 36 claims were staked in 1963 to cover the iron prospect and analysis of a sample showed 40.15% Fe, 0.23% Ti, 0.105% P, 0.23% S, and 36.08% SiO_2. The report added that occurrence represented magnetite-quartz iron formation and that it was within Yellowknife-type sedimentary rocks. The magnetite-rich rock probably does represent iron formation, although this could not be confirmed by the presence of sedimentary layering, but the possibility that the magnetite concentrations are skarns cannot be discounted. It is questionable that the host rocks can be appropriately described as Yellowknife-type rocks of Archean age, as they include non-turbiditic or shelf type sedimentary rocks rare in the Slave structural province.

EXPLORATION:

A group of 36 claims were staked in 1963 by Frank Avery of Yellowknife, N.W.T., and analysis of one sample from the property was reported as mentioned above. Precise location of the sample is not known and no other exploration work was reported on the property. The area was examined by S.M. Roscoe in 1984 during the course of a regional metallogenic study. It did not reveal any sign of trenching or drilling at the outcrops that he examined. The magnetite-rich rocks, however, are extensive in the area and the analyzed sample may have come from another outcrop.



75K/10-2

REMARKS:

French Lake is on the 'Pike's Portage' chains of lakes that lead from the east arm of Great Slave Lake to Artillery Lake bypassing the Lockhart River with its succession of waterfalls and rapids.

REFERENCES:

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Geological Survey of Canada, 1962, Aeromagnetic Series map 1285 G. 'Pike's Portage', sheet 75K/10, scale 1:63,360.

NTS AREA -INDEX NO.: 75K/10-2

NAME: LID and HEB claims
COMMODITY: Uranium
LOCATION: Lat.:62°42'26"N, Long.:108°58'32"W
DESCRIPTION:

A few spotty occurrences of anomalously high radioactivity, up to 10 times the background, are found in the early Proterozoic arkoses and orthoquartzites of the Hornby Channel and Kluziai Formations (accompanying sketch; Oladegbule, 1971; Morton, 1971). The mineralization is finely disseminated within irregular reddish coloured hematitic patches or zones in commonly buff white colored host units. The Hornby Channel Formation unconformably overlies the Archean granite basement. The unconformity is exposed at one locality in the claim group. The Kluziai Formation conformably overlies the Hornby Channel Formation and contains some quartz pebble conglomerate lenses.

EXPLORATION:

Claymore Resources Limited staked the claims in 1970 and transferred to Vestor Exploration Limited. Geological mapping and a scintillometer survey were carried out in 1970 by Vestor Explorations Limited.

REMARKS:

Northern LID claims and all of the HEB claims are located within the proposed national park area. The showings and claims were examined by S.S. Gandhi in 1979.

REFERENCES:

Herzberg, C.T., 1970
Oladegbule, M.A., 1971
Morton, R.D., 1971
Padgham, W.A., et al, 1975.

NTS AREA-INDEX NO.: 75K/11-1

NAME: TAT Claims (Box) (Fairchild Point)
COMMODITY: Copper
LOCATION: Lat.: 62°43'10"N, Long.:109°10'50"W
DESCRIPTION:

The claims are underlain by rocks of the Proterozoic Kahochella and Sosan Groups, all of the mineralization being in the latter. These two formations are separated by the Murky Fault. Quartz-carbonate stockworks occur in a number of places within the micaceous red sandstone (Sosan Group) and often carry chalcopyrite mineralization in small amounts. The main mineralized zone is centered about a fault breccia which has been infused and cemented by a quartz-carbonate stockwork spreading out along fissures into the surrounding rocks (see the accompanying figure). The best assay, trench no. 5, averaged 0.43% copper over 15.24 m (50 feet; Thomas, 1967; Thorpe 1972, p. 28). The micaceous red sandstone south of pits no. 5 to 8 assayed 0.13% copper over 200 feet. The northeast-striking fault breccia and quartz stockwork zone occurs on claims TAT 1 and 3, and has been mapped for a length of 762 m (2,500 feet) on Fairchild Point. It has also been found on TAT 5 claim on Maufelly Point.

EXPLORATION:

This property is located on Fairchild Point in the east arm of Great Slave Lake. Most of the claim groups staked here have also included a showing on the tip of Maufelly Point, 0.8 km to the southwest, as shown in the figure below.

Claims were staked on Fairchild and Maufelly Points prior to 1950. The Box group of 17 claims, on Fairchild and Maufelly Points, was held by William Rossing, of Yellowknife, in 1957. The property was investigated by Giant Yellowknife Gold Mines Limited in September of that year; trenching had been done at that time. The property was examined by Cominco Limited in 1959, and by Giant Yellowknife Mines Limited in 1960.

The TAT group of 8 claims, a restaking of the Box group by Werner Brinsa of Yellowknife, was held under option by Giant Yellowknife Mines Limited in 1967; seven of the claims were on Fairchild Point and one, the TAT 5, on Maufelly Point. Work included mapping, sampling, and an electromagnetic reconnaissance survey. Weak mineralization was found across acceptable widths, but values were low and the option was dropped.

REMARKS:

The mineralization occurs in a major fault zone that extends for more than 12 km to the southwest near Meridian Lake, where it hosts other similar occurrences (Thorpe, 1972, p. 30-34).

REFERENCES:

Brown, I.C., 1950a.
Thomas, D.G., 1967.
Thorpe, R.I. 1972.

NTS AREA-INDEX NO.: 75K/12-1

NAME: Douglas Peninsula
COMMODITY: Copper
LOCATION: Lat.: 62°45'0"N, Long.:109°59'48"W
DESCRIPTION:

A calcite pocket containing chalcopyrite occurs in a diabase dyke on the north shore of Douglas Peninsula. The dyke strikes west of north. It is connected to, and is on the east side of a more extensively traceable NW-trending diabase dyke. The dykes belong to the Mackenzie swarm.

EXPLORATION:

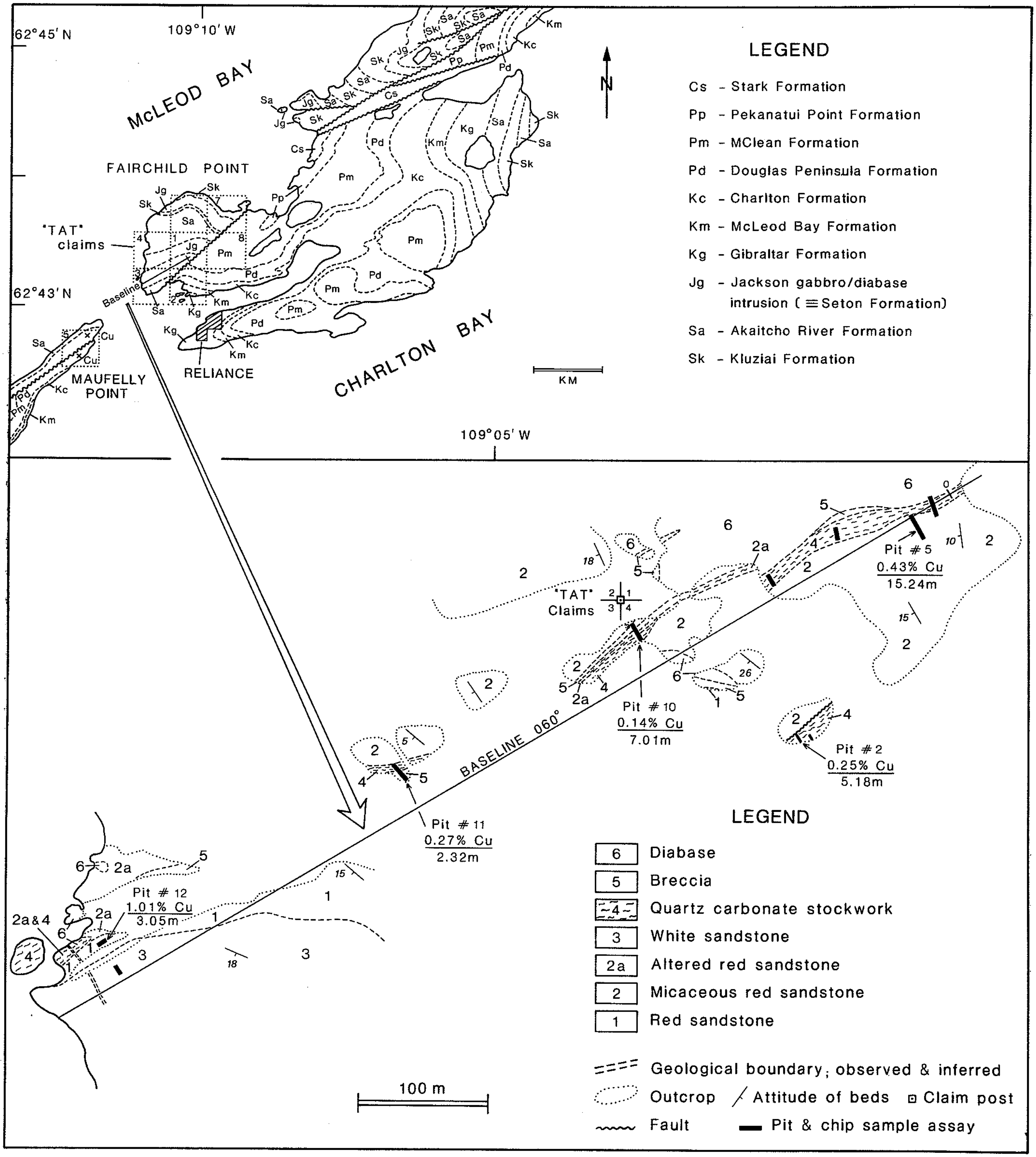
The showing was reported during the exploration of the area by Giant Yellowknife Mines Limited in 1970.

REMARKS:

The showing is located 3.5 km east of the drilled copper zone on 'G' claims (75L/9-1; see figure accompanying it).

REFERENCES:

Brown, I.C., 1950a.
Besau, D.M. and Spence, R.W., 1970.


62°45' N
109°10' W
McLEOD BAY
FAIRCHILD POINT
"TAT" claims
62°43' N
Baseline
MAUFELLY POINT
RELIANCE
CHARLTON BAY
KM
109°05' W
N
LEGEND
Cs - Stark Formation
Pp - Pekanatui Point Formation
Pm - MClean Formation
Pd - Douglas Peninsula Formation
Kc - Charlton Formation
Km - McLeod Bay Formation
Kg - Gibraltar Formation
Jg - Jackson gabbro/diabase intrusion (≡ Seton Formation)
Sa - Akaitcho River Formation
Sk - Kluziai Formation
"TAT" Claims
BASELINE 060°
Pit # 5
0.43% Cu
15.24m
Pit # 10
0.14% Cu
7.01m
Pit # 2
0.25% Cu
5.18m
Pit # 11
0.27% Cu
2.32m
Pit # 12
1.01% Cu
3.05m
2a & 4
LEGEND
6 Diabase
5 Breccia
4 Quartz carbonate stockwork
3 White sandstone
2a Altered red sandstone
2 Micaceous red sandstone
1 Red sandstone
Geological boundary; observed & inferred
Outcrop
Attitude of beds
Claim post
Fault
Pit & chip sample assay
100 m

75K/11-1

NTS AREA-INDEX NO.: 75K/14-1

NAME: Fairchild Peninsula
COMMODITY: Uranium
LOCATION: Lat.: 62°45'52"N, Long.:109°02'03"W
DESCRIPTION:

Uranium mineralization occurs along, and in fractures at, the boundary of gently-dipping red micaeous sandstone of Akaitcho River Formation overlying buff white Kluziai Formation, which are nearly flat-lying here. Readings of 800 to 900 cps (approximately 260 to 300 ppm eU) on Scintrex BGS-1S scintillometer were obtained at two places approximately 100 m apart along shore, and of 200 to 300 cps at a number of places inbetween (background reading 60 to 80 cps), as shown in the accompanying sketch.

There are a number of quartz veins, subparallel and anastomosing, up to 1 cm thick at the showing. They contain some calcite and some grey green chloritic alteration at high radioactive spots.

EXPLORATION:

The uranium showing was discovered by S.S. Gandhi in 1979. It is located near Reliance, on the south shore of the Fairchild Peninsula near the site of an airborne gamma-ray spectrometric anomaly on the Geological Survey of Canada Map 37075 G (1967); S.S. Gandhi however was unaware of the anomaly at time of discovery which was made during examination of the host beds in the area. Vestor Explorations Limited staked 'ZED' claims in early 1970's, which covered the area 300 m to the northeast, but no uranium occurrence was reported in the claims nor in the general area.

REMARKS:

Geology of the ZED claims as reported by Vestor Explorations Limited (Oladegbule, 1971) and reproduced in the accompanying sketch, is more detailed and somewhat different from that given by Hoffman (1977; see Map 2).

REFERENCES:

Oladegbule, M.A., 1971.
Hoffman, P.F., 1977.

NTS AREA-INDEX NO.: 75K/15-1

NAME: McLeod Bay Northeast-1
COMMODITY: Uranium
LOCATION: Lat.: 62°55'21"N, Long.:108°54'25"W
DESCRIPTION:

Radioactive pegmatite veins or zones are present in massive to gneissic coarse biotite granite. Largest zone is 30 m long and up to 2 m wide, trending 330° approximately and located 30 m inland from shore of a small lake and parallel to it. The pegmatite is a felsic phase of the biotite-bearing granitic rock and is somewhat coarser but gradational to the granite. Additional radioactive pegmatitic occurrence are present between the main one and the shore. Outcrops are glacially rounded and polished.

A biotite-bearing granitic rock at the boundary of the main pegmatite contains 98 ppm eU, 1.3 ppm eTh and 9.3 percent K according to spectrometric determination on a hand specimen (GFA-'83-297; 3300 cps). Petrographic examination revealed that the rock contains more than 50% potash feldspar (microcline and perthites), and approximately 20% sodic plagioclase, 10% quartz (including myrmetite), 7% biotite, 2% muscovite, and an unusually large amount of apatite, close to 10% of the rock. Other accessory minerals present are oxides, zircon and what appears to be sphene. Secondary minerals include fibrous amphibole along microfractures, chloritic alteration of biotite, and alteration products of oxides and sphene. Apatite tends to form aggregates with biotite interstitial to coarse feldspars, but it also occurs as disseminated crystals elsewhere in the rock. Composition of the rock is that of a quartz syenite with alkaline affinity. Radioluxograph and x-ray diffraction studies revealed the presence of discrete grains of uraninite, up to 300 microns in diameter, disseminated through the rock but relatively more concentrated in aggregates of biotite and apatite. The latter is identified as fluorapatite.

It is noteworthy that apatite is abundant in three other pegmatitic samples from the showing. Two of these are located 7 m to the north-northwest of sample GFA-83-297, and contain biotite aggregates up to 2 cm wide with 30 to 40 per cent apatite. The third sample is located 20 m to the east of it, and contains biotite, muscovite, and chlorite-mica alteration aggregates pseudomorphous after hornblende, and 5 to 8 per cent apatite. The apatite in the four samples occurs as pale green, euhedral crystals commonly ranging from 0.5 to 2 mm in length.

Field readings with URTEC UG-135 minispec on the pegmatite ranged from 500 to 3300 cps on total counts against background over lake water of 40 to 50 cps and over the granite of 175 cps. Readings in excess of 1000 cps are found at several places. The highest readings averaged as follows; Total counts (TCI): 3268, K channel: 40.2, U channel: 19.9, Th channel: 2.3. Hence much of the radioactivity is due to uranium.

The granitoid rocks contain an inclusion of amphibolitic lens trending 060° approximately.

EXPLORATION:

Discovery of the radiometric anomalies was made by S.M. Roscoe and S.S. Gandhi in 1983. They are located on northeast shore of a small lake, landable by small fixed-wing aircraft.

REMARKS:

The occurrences are similar to McLeod Bay Northeast – 2 uranium occurrence, located 2 km to the southeast. Similar pegmatitic occurrences are the likely source of uranium lake sediment geochemical anomalies in the area (Maurice, 1984). Geology of the area is known only from the early reconnaissance mapping by Wright (1952), who regarded the rocks in the area as Archean, but in view of the unusual composition of the radioactive sample described above, a possibility of anorogenic alkaline intrusion of Proterozoic age can not be ruled out. The rock is situated within the area of a circular aeromagnetic anomaly, approximately 30 km in diameter, which may be significant in this regard.

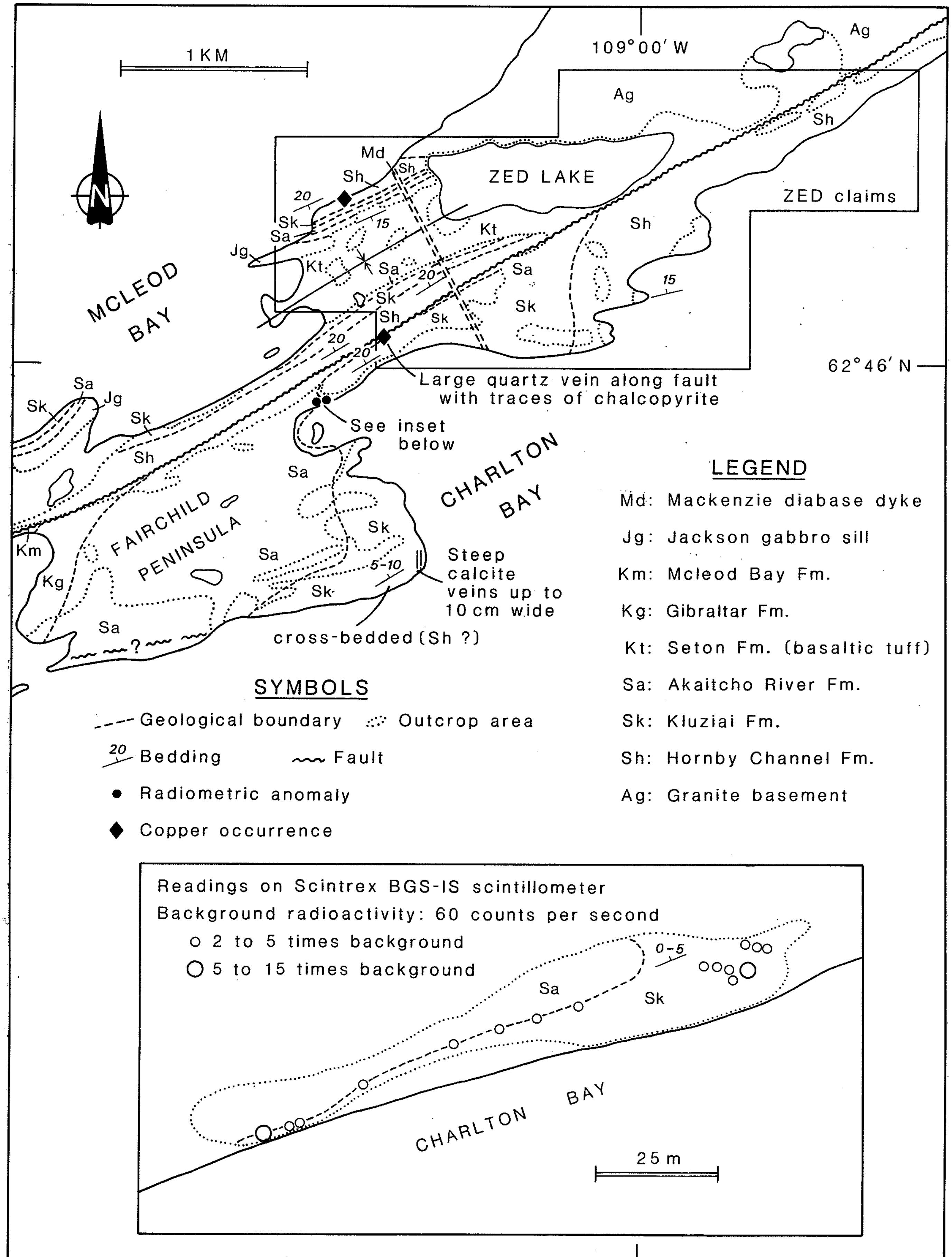
REFERENCES:

Wright, G.M., 1952.
Maurice, Y.T., 1984.

NTS AREA-INDEX NO.: 75K/15-2

NAME: McLeod Bay Northeast-2
COMMODITY: Uranium
LOCATION: Lat.: 62°53'55"N, Long.:108°52'38"W
DESCRIPTION:

Radioactive pegmatite veins cut massive coarse biotite-hornblende granite. Readings with URTEC UG-135 minispec are from 300 to 1200 total counts per second (TC-1 channel) compared with 150 to 175 cps on the granite and a


1 KM
109°00′ W
62°46′ N
Ag
Sh
ZED LAKE
ZED claims
Md
Kt
Sa
Sk
Jg
MCLEOD BAY
CHARLTON BAY
FAIRCHILD PENINSULA
Km
Kg
Large quartz vein along fault with traces of chalcopyrite
See inset below
Steep calcite veins up to 10 cm wide
cross-bedded (Sh ?)
SYMBOLS
Geological boundary
Outcrop area
Bedding
Fault
Radiometric anomaly
Copper occurrence
LEGEND
Md: Mackenzie diabase dyke
Jg: Jackson gabbro sill
Km: Mcleod Bay Fm.
Kg: Gibraltar Fm.
Kt: Seton Fm. (basaltic tuff)
Sa: Akaitcho River Fm.
Sk: Kluziai Fm.
Sh: Hornby Channel Fm.
Ag: Granite basement
Readings on Scintrex BGS-IS scintillometer
Background radioactivity: 60 counts per second
2 to 5 times background
5 to 15 times background
CHARLTON BAY
25 m

75K/14-1

background of 40 to 50 cps on lake water. Several hot spots are detected within a 25 m diameter area on the shore. Outcrop humps are a few metres high and are well rounded glacially.

EXPLORATION:

The radiometric anomalies were discovered by S.M. Roscoe and S.S. Gandhi in 1983. They are located on west shore of a small north-northwest trending bay of a lake, landable with a small fixed wing aircraft.

REMARKS:

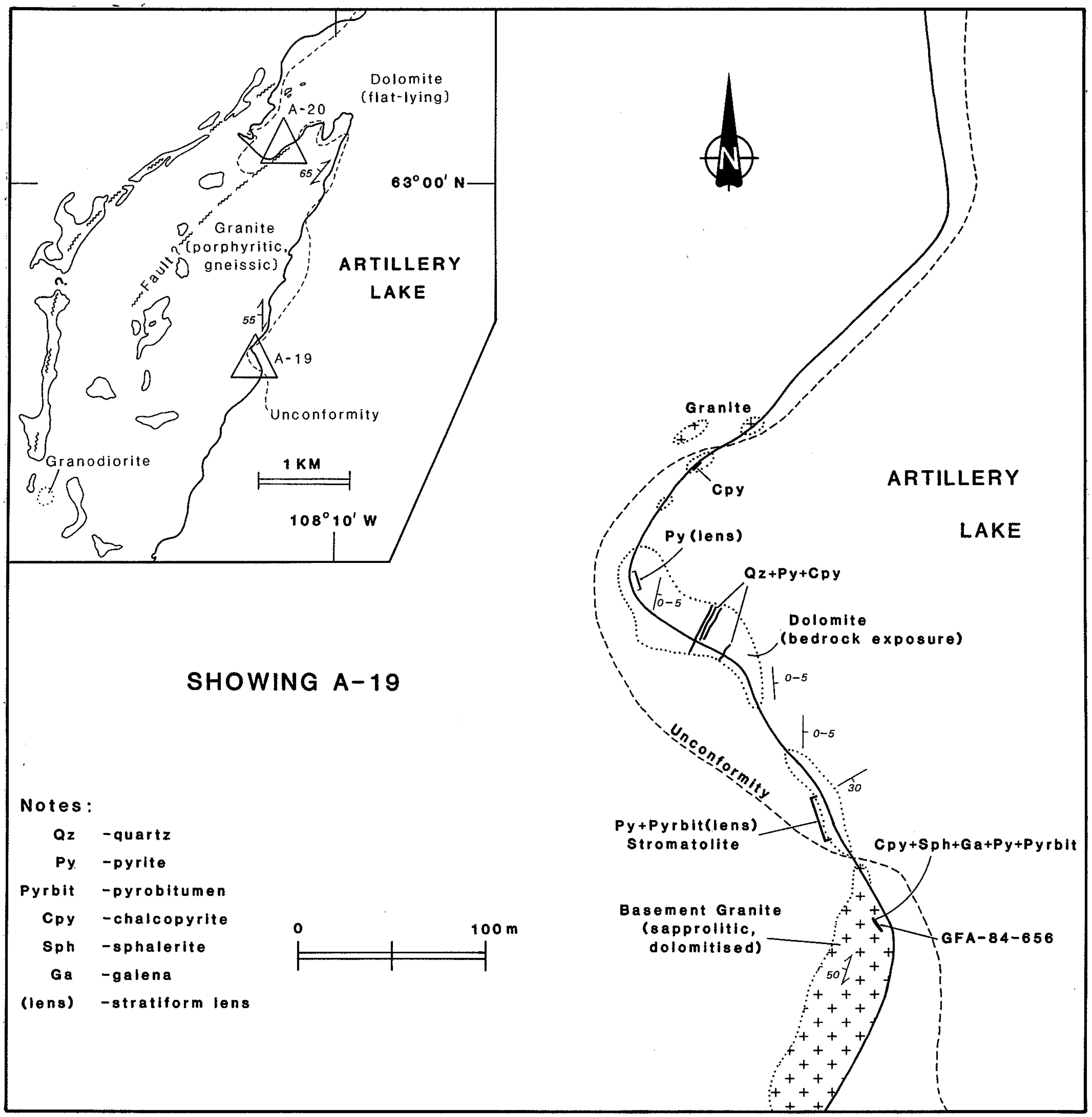
The granitic rocks of the area are mapped as Archean by Wright (1952). The showing is similar to McLeod Bay Northeast-1 occurrence, located 2 km to the northwest, although apatite-rich rocks were not encountered here during a relatively brief field examination. Other similar uranium occurrences in pegmatite can be expected in this little explored area. They may be the source of uranium geochemical anomaly in lake sediments of the area (Maurice, 1984).

REFERENCES:

Wright, G.M., 1952.
Maurice, Y.T., 1984.

NTS AREA-INDEX NO.: 75K/16-1

NAME: A-19 (Artillery Lake)
COMMODITY: Lead, zinc, copper
LOCATION: Lat.: 62°58'54"N, Long.: 107°10'57"W



DESCRIPTION:

Several quartz veins carrying chalcopyrite, including one containing galena, sphalerite, pyrite and pyrobitumen in addition to chalcopyrite, occur within a few metres of the unconformity between Archean granite and overlying basal beds of Early Proterozoic dolomitic Artillery Lake formation. The unconformity is not exposed but can be closely delineated near the shore of an east facing bay on the northwest shore of the lake. The main vein system has a group of steep veins trending approximately 025°, exposed in a 20 m wide zone, on the south shore of the bay and extends for 30 m underwater, visible at the bottom of 3 m deep water (see the accompanying sketch). The veins contain coarse crystalline quartz, massive pyrite aggregates and some chalcopyrite. They range in width from a few centimetres to 2 m. Similar veins also occur on the northwest shore of the bay, approximately 100 m to the north of the main system and they trend northeasterly parallel to shore.

All these veins are in nearly horizontal, thick to thin bedded dolomite. The beds contain stratiform lenses of pyrite-pyrobitumen, and of quartz pebbles and grit in dolomite cement. The lenses are up to 0.3 m thick and approximately 30 m in length. Pyritic lenses contain some spherulitic aggregates, with spherules of radiating acicular pyrite up to 1.5 cm long. A stromatolite bed up to 25 cm thick underlies the pyrite-pyrobitumen lens near the quartz vein system on south shore of the bay. The stromatolites are columnar, a few millimetres in diameter and a few centimetres in height.

The vein containing galena, sphalerite, chalcopyrite and pyrobitumen is in granite basement, approximately 100 m southeast of the main vein system. The vein is 10 cm thick and dips 15° to the southwest. The host granite is gritty and partially dolomitized. The vein is unusual among numerous veins of the Artillery Lake area in that all the sulphides including pyrite, occur as disseminated crystals, or small aggregates in quartz matrix which also contains globules of pyrobitumen up to 5 mm in diameter. Analyses of a sample from this vein (GFA-84-656) are given in Table 1, and lead isotpic ratios of galena separate from it are given in Table 2 (Appendix 2).

EXPLORATION:

The showing was discovered and mapped by S.S. Gandhi in 1984.

REMARKS:

Presence of dolomite at this locality was noted by Wright (1952), but no mineral occurrence was reported.

REFERENCES:

Wright, G.M., 1952.
Gandhi, S.S., 1985.

NTS AREA-INDEX NO.: 75L/5-1

NAME: Utsingi Point/Point Busse (west of Utsingi Point)
COMMODITY: Iron
LOCATION: Six localities along a 7 km long ENE trending strike zone, on east side of Taltheilei Narrows (i) 62°25'10"N; 111°38'55"W, (ii) 62°26'11"N; 111°38'05"W, (iii) 62°27'35"N; 111°37'30"W, (iv) 62°27'54"N; 110°37'08"W, (v) 62°28'25"N; 110°36'45"W and (vi) 62°28'45"N; 110°36'30"W.

DESCRIPTION:

Original description by Stockwell and Kidd (1932, p. 85) is as follows:

"Oolitic iron deposits occur in the sedimentary-volcanic series which overlies the granite and pre-granite rocks. None of the iron deposits is of economic value.

Oolitic hematite beds are best exposed at several localities along 5 miles of shore line on the east side of a narrows 5 miles north of Utsingi Point. The hematite beds occur in red and black shales that are associated with volcanics. The sediments strike north and dip from 5° to 15° to the east. Some of the hematite beds are only a foot or less thick, but several exposures, all probably parts of a single bed, show thicknesses of 10 to 30 feet of oolitic hematite associated with hematite-rich shales and jasper. The iron content is no doubt quite low. Oolitic iron deposits up to 20 feet thick occur at several other localities on the lake".

Stockwell (1936) included the beds in Kahochella Formation, which was elevated to 'Kahochella Group' by Hoffman (1968, p. 14-17) who distinguished predominantly volcaniclastic and associated tuffaceous sediments and granular hematite beds as 'Seton Formation'. The Utsingi Point-Taltheilei Narrows area was remapped by K.S. Pelletier in 1981 on scale 1:25,000, and she further refined the stratigraphic picture.

EXPLORATION:

The northernmost locality (62°28'45"N, 110°36'30"W) was sampled by S.S. Gandhi and S.M. Roscoe for a metallogenic study in 1984, and the stratigraphy of the iron formations encountered is illustrated in a figure in the section on the Proterozoic Metallogeny (Fig. 10). Analyses of 23 samples from this locality are presented in Table 3 (Appendix 2). Petrographic study of the samples revealed textures typical of the Lake Superior-type iron formation. Ooids or granules of hematite are commonly oval, 1 to 2 mm in length, and show synaeresis cracks. Some are calcareous or siliceous in part. Matrix is commonly siliceous. Some rocks show fragments or shards of granules, indicating redeposition in agitated waters. Similar textures are also observed in the Viren Island iron formations (75 L/15-1), located 50 km to the northeast in stratigraphically equivalent beds.

REMARKS:

'Christie Bay' map sheet on scale 1:253,440 (GSC Map 1122 A; Stockwell et al., 1968) shows only one iron occurrence, located on the east side of bay between Utsingi Point and Point Busse, at 62°24'22"N, 110°38'00"W. This location appears to be in error in terms of the localities described by Stockwell and Kidd (1932) as quoted above. The error probably comes from the phrase '5 miles north of Utsingi Point' without reference to '...several localities... on the east side of narrows...'. Later work, including checkwork by S.M. Roscoe in 1984, has not confirmed occurrence of iron formation at this locality, and the beds here are stratigraphically significantly higher than where the iron formations are found. Possibility of additional iron formation at this higher stratigraphic level however can not be ruled out.

REFERENCES:

Stockwell, C.H. and Kidd, D.F., 1932.
Stockwell, C.H., 1936.
Wright, G.M., 1951.
Stockwell, C.H., et al., 1968.
Hoffman, P.F., 1968. Pelletier, K.S., 1981.

NTS AREA - INDEX NO.: 75L/5-2

NAME: 'COUP' Claims
COMMODITY: Copper
LOCATION: 62°25'45"N, 111°38'00"W
DESCRIPTION:

Abundant copper stain on carbonatized volcanic rocks along the west shore of a narrow bay a few miles north of Utsingi Point, was reported by Wright (1951, p. 9). Two copper occurrences are shown on this shore in the map of Christie Bay by Stockwell et al. (1968; scale 1:253,440). The 'COUP' claims were staked on the southern occurrence and the 'H' claims on the other one located 1.75 km to the north-northeast (75L/5-3). No exploration data are available on the claims. Observations by S.M. Roscoe in 1984 confirmed the presence of some malachite stain and traces of chalcopyrite in quartz-carbonate veinlets and fractures, but he found that the abundant copper stain in the area reported by Wright (ibid) is mostly green chlorite in veinlets and fractures in volcaniclastic siltstone and sandstone. He also noted some thin iron formation beds and lenses in the sequence dipping gently to the southeast.

EXPLORATION:

Broken rock at a few spots indicate a small amount of trenching, according to observations by S.M. Roscoe, however no record of exploration work is found in the assessment files.

REMARKS:

Green chlorite alteration is commonly associated with quartz veins in the area, and it appears like malachite stain from distance.

REFERENCES:

Wright, G.M., 1951.
Stockwell, C.H., et al., 1968.

NTS AREA - INDEX NO.: 75L/5-3

NAME: 'H' Claims
COMMODITY: Copper
LOCATION: 62°26'35"N, 111°37'00"W
DESCRIPTION:

This occurrence is similar to the copper occurrence on the 'COUP' claims located 1.75 km to the south-southwest. Observations on the latter reported above (75L/5-2), apply to this occurrence.

EXPLORATION:

As noted above for the 'COUP' claims.

REMARKS:

Same as for the 'COUP' claims above.

REFERENCES:

Wright, G.M., 1951.
Stockwell, C.H., et al., 1968.

NTS AREA-INDEX NO.: 75L/9-1

NAME: 'G' Claims (Wildbread Bay)
COMMODITY: Copper
LOCATION: Lat.: 62°44'36"N, Long.:110°04'12"W

DESCRIPTION:

Mineralization on G8 and G9 claims occurs within an (interpreted) up-faulted block of the dolomitized limestone member of the Utsingi Formation of Pethei Group (see accompanying sketch). The fault-bounded block extends west-southwest and is up to 150 m wide. The dolomitized limestone, which has been traced for about 450 m along this structure, contains a number of vertical, east to northeast-trending, mineralized quartz-carbonate veins, in a zone generally less than 15 m wide. The veins contain disseminated, coarse grained chalcopyrite accompanied by minor bornite and magnetite.

EXPLORATION:

Copper showings were discovered in August 1969 near the north shore of Douglas Peninsula by prospectors from Giant Yellowknife Mines Limited. The 'G' group of 58 claims was staked around the showings, which are in claims G8 and G9. Detailed geological investigations were carried out in 1970. Copper values over widths of 1.5 and 6 m were intersected in two holes drilled in 1972; assay results indicate a grade of less than 1% Cu.

During 1973, 17 exploratory holes were drilled, having an aggregate length of 1767 m (see accompanying sketch). Several of the holes intersected low grade copper mineralization. A 14.33 m section, from 37.2 m to 51.5 m, in diamond drill hole 2 (claim G-9) returned an average grade of 1.5% Cu. On the basis of the drill program, it was decided that the deposit was too small and of too low grade to be economic at the time.

REMARKS:

The claims were allowed to lapse. The property was examined by S.S. Gandhi and S.M. Roscoe in 1983.

REFERENCES:

Besau, D.M. and Spence, R.W., 1970
Spence, R.W., 1973a
Padgham, W.A., et al, 1976.

NTS AREA-INDEX NO.: 75L/11-1

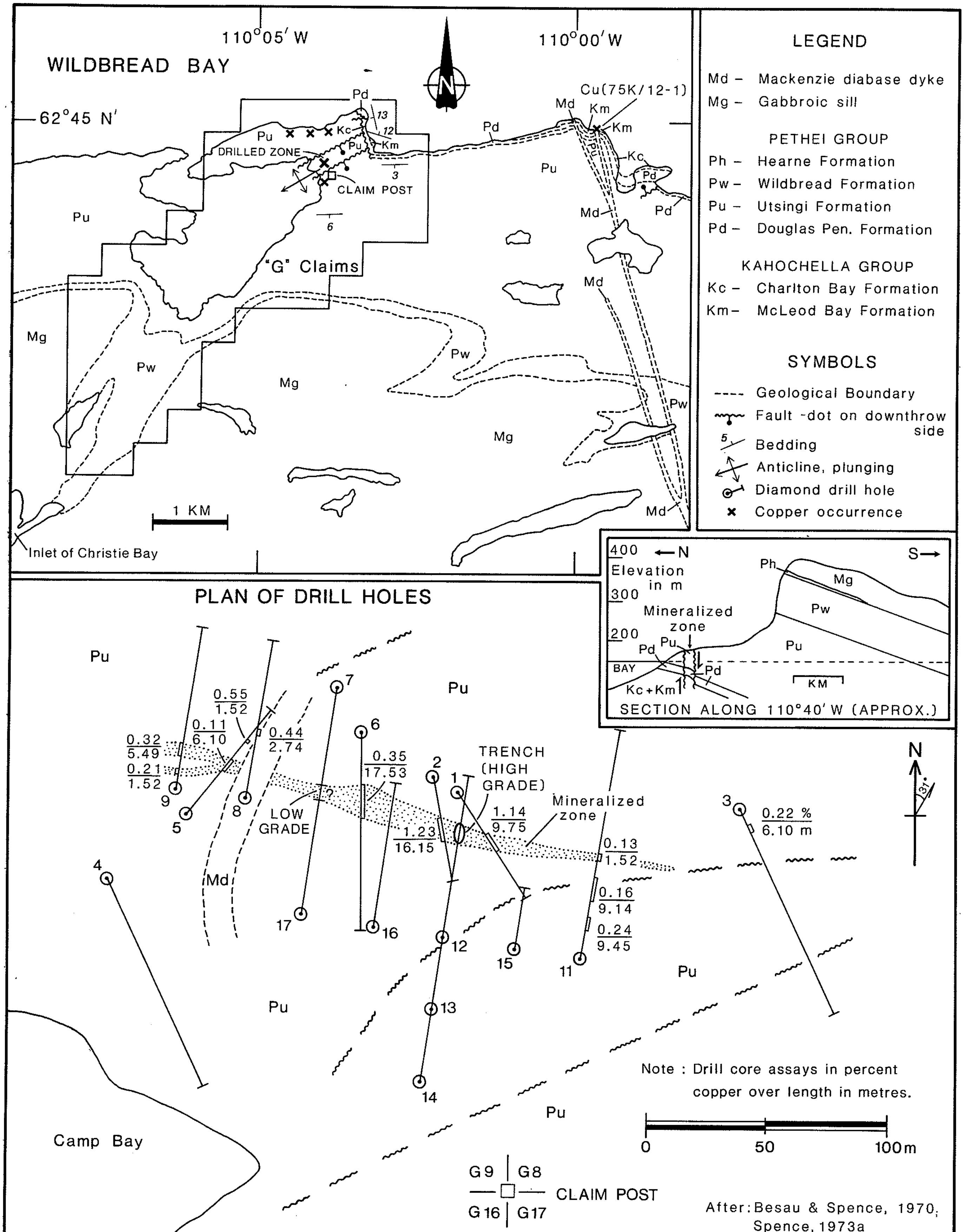
NAME: 'Bay' Claims
COMMODITY: Copper
LOCATION: Lat.: 62°37'20"N, Long.: 111°28'10"W
DESCRIPTION:

Early Proterozoic sediments of the Kahochella and Sosan Groups on the property are overlain by late Proterozoic diabase sills. In the mineralized area on the Bay claims, a system of fractures branch at various angles from a major fault cutting shale. Disseminated chalcopyrite is found in quartz-carbonate veins in shear and fracture zones that cut the red shale country rock. Three showings, approximately 1.25 km apart, occur on the south shore of Taltheilei Narrows as shown in the figure below.

A copper occurrence was described by Stockwell and Kidd (1932) at this locality, in contorted sandstone of the Sosan Formation, as a vein of carbonate and quartz varying in width from 3 to 15 m. No visible sulphides were reported except for a small amount of disseminated chalcopyrite in one place.

EXPLORATION:

A copper occurrence, on the west shore of Pethei Peninsula, at a point 3 km northeast of Taltheilei Narrows, was reported by Stockwell and Kidd (1932).


WILDBREAD BAY
110°05′ W
110°00′ W
62°45 N′
Pd
13
12
Kc
Km
Pu
DRILLED ZONE
3
CLAIM POST
6
Pu
"G" Claims
Cu(75K/12-1)
Md
Km
Km
Kc
Pd
Pd
Md
Md
Pw
Mg
Pw
Mg
Pw
Mg
Md
1 KM
Inlet of Christie Bay
LEGEND
Md – Mackenzie diabase dyke
Mg – Gabbroic sill
PETHEI GROUP
Ph – Hearne Formation
Pw – Wildbread Formation
Pu – Utsingi Formation
Pd – Douglas Pen. Formation
KAHOCHELLA GROUP
Kc – Charlton Bay Formation
Km – McLeod Bay Formation
SYMBOLS
Geological Boundary
Fault -dot on downthrow side
Bedding
Anticline, plunging
Diamond drill hole
Copper occurrence
400 Elevation in m
300
200
N
S
Ph
Mg
Pw
Pu
Mineralized zone
Pd
Pu
BAY
Pd
Kc+Km
KM
SECTION ALONG 110°40′ W (APPROX.)
PLAN OF DRILL HOLES
Pu
0.55 / 1.52
0.11 / 6.10
0.32 / 5.49
0.21 / 1.52
0.44 / 2.74
0.35 / 17.53
LOW GRADE
TRENCH (HIGH GRADE)
1.14 / 9.75
1.23 / 16.15
Mineralized zone
0.13 / 1.52
0.16 / 9.14
0.24 / 9.45
0.22 % / 6.10 m
Md
N
31°
Pu
Pu
Pu
Camp Bay
Note : Drill core assays in percent copper over length in metres.
0
50
100m
G9
G8
G16
G17
CLAIM POST
After: Besau & Spence, 1970; Spence, 1973a

75L/9-1

The Bay 1-39 claims were staked by Gordon McLellan, in this area, in May 1966 and minor trenching was carried out. After Mr. R.G. Perrier acquired the claims in June 1967, he allowed them to lapse and then restaked them in July 1969. Exploration work in 1970 consisted of blasting six trenches and 93.5 m (307 feet) of drilling in three holes. The first 4 m of core in vertical hole collared near a trench in the central showing assayed 0.44 percent copper. At the northeastern showing, a trench sample contained 1.36 percent copper and 0.1 oz/t of silver and traces of gold, nickel and cobalt. But the drill hole 75 m to its north (dip -65°, azimuth 090°) intersected only traces of chalcopyrite (up to 0.01% Cu) in numerous quartz-carbonate veins up to 2 cm thick. Another hole 12 m to the west of the trench also intersected similar veins, but did not encounter significant mineralization. The claims were allowed to lapse.

REMARKS:

Mineralization is similar to that on 'WOOEE' claims located 7 km to the northeast (75L/11-2).

REFERENCES:

Stockwell, C.H. and Kidd, D.F., 1932.
Lord, C.S., 1951.
Perrier, R.G., 1970.
Hoffman, P.F., 1977.
Padgham, T., et al, 1978.

NTS AREA-INDEX NO.: 75L/11-2

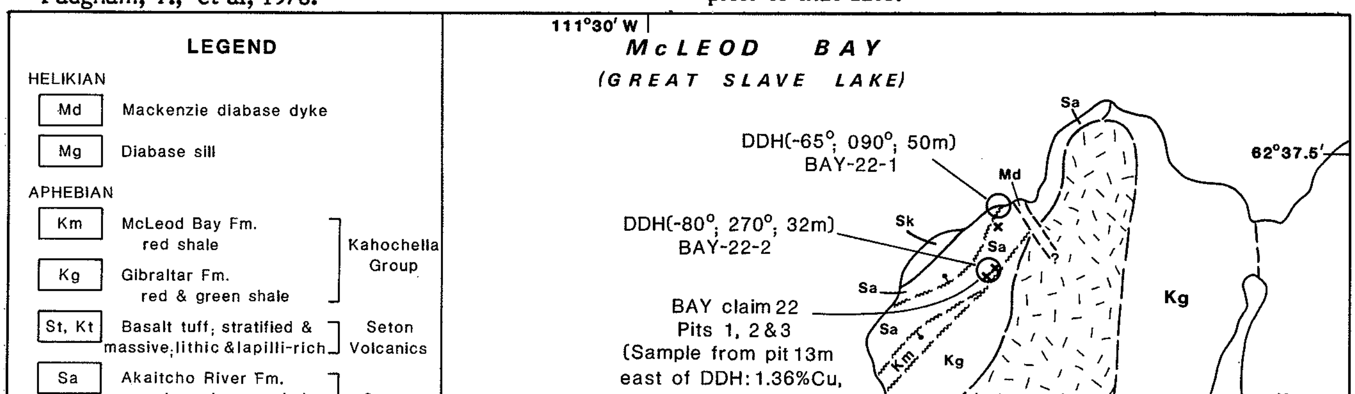
NAME: 'WOOEE' claims
COMMODITY: Copper
LOCATION: Lat.: 62°40'30"N, Long.:111°24'00"W
DESCRIPTION:

The bedrocks in the claims are quartzite and massive sandstone of early Proterozoic Sosan Group, as shown on the accompanying sketch. The sandstone dips at low angle to the southeast and is overlain by a thin discontinuous shale unit which, in turn, is capped by a relatively thick diabase sill that outcrops over most of the island. Disseminated chalcopyrite is present in quartz-carbonate veins which form a stockwork in a shear or breccia zone trending about N40°E in sandstone. The mineralized zone is exposed for a length of about 500 m along the northwest shore of an island, and passes into the lake at either end. Assays indicated 1.33% copper over a width of 1.52 m in a trench (Hudec, 1965).

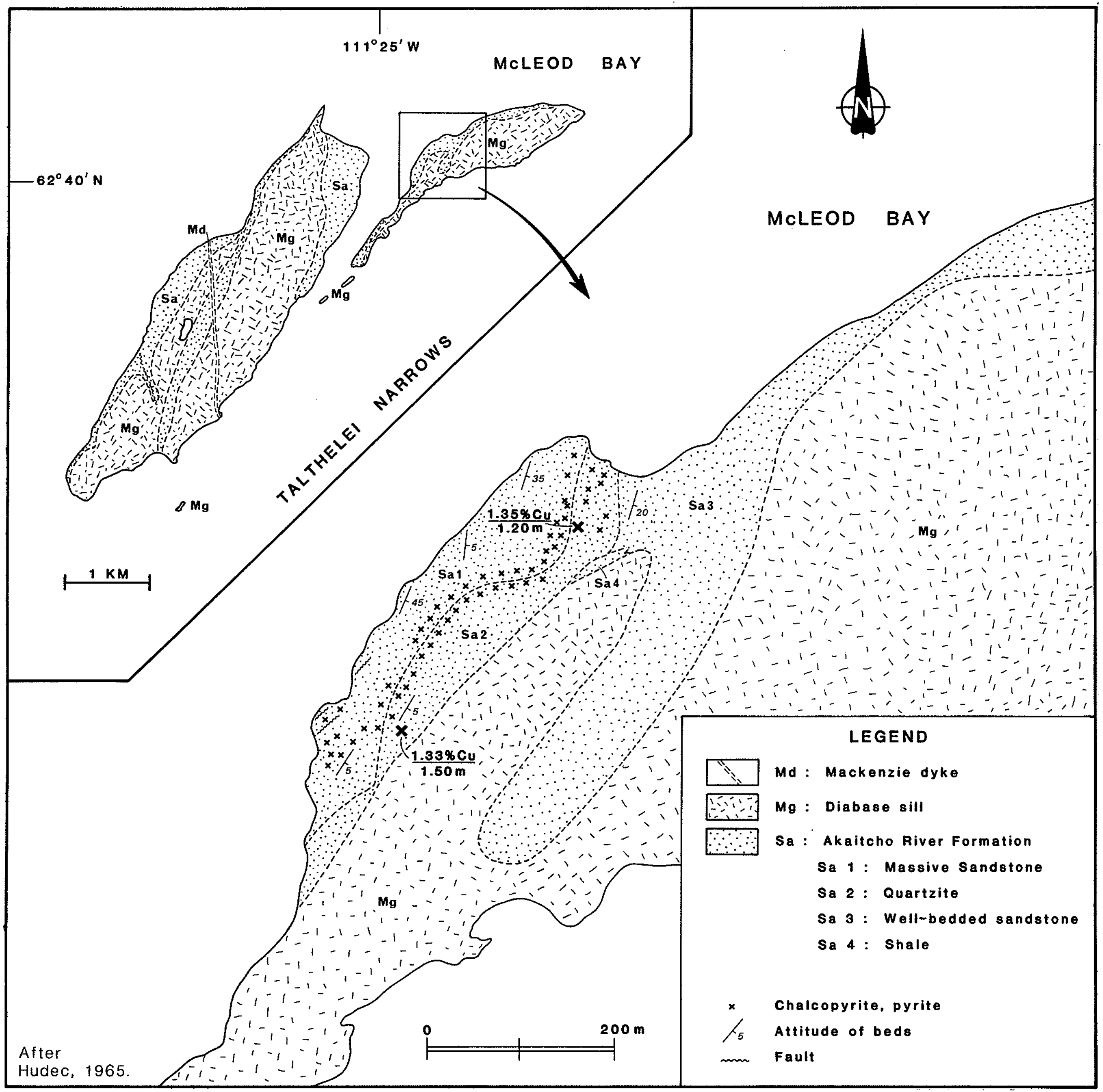
EXPLORATION:

This property is located on a small island about 10 km northeast of Taltheilei Narrows in McLeod Bay, east arm of Great Slave Lake.

The showing was described by Stockwell and Kidd (1932) but the date of discovery is not known. The 'WOOEE' group of 8 claims was staked on this showing by Nahanni Mines Limited in 1965. Trenching had been done on the showings prior to that date.



75L/11-1



75L/11-2

REMARKS:

The occurrences are similar to those on 'Bay' claims located 7 km to the southwest.

REFERENCES:

Stockwell, C.H., and Kidd, D.F., 1932.
Hudec, P.P., 1965.
Thorpe, R.I., 1966.
Hoffmann, P.F., 1977.

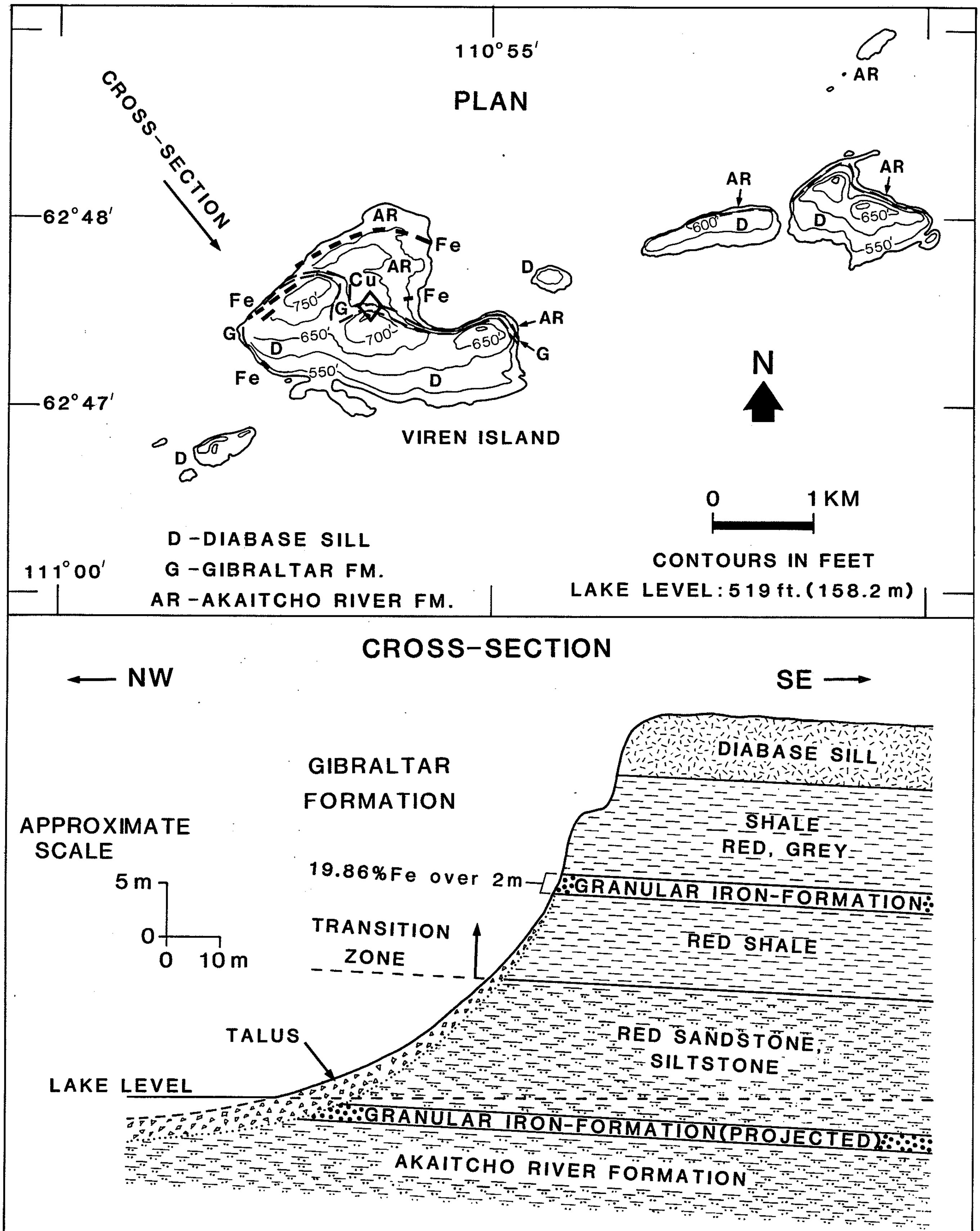
NTS AREA-INDEX NO.: 75L/15-1

NAME: Viren Island-1
COMMODITY: Iron

LOCATION: Main Showing:
Lat.: 62°47'39"N, Long.: 110°57'31"W;
Lower Horizon:
Lat.: 62°47'55"N, Long.: 110°55'55"W

DESCRIPTION

The main showing is exposed on a northwest-facing escarpment on the west side of a small island, near Lost Channel in McLeod Bay, east arm of Great Slave Lake (Figure below). The iron formation is up to 2 m thick and exposed for 50 m strike length, approximately 20 m above lake level. It is interbedded with red shale containing some grey shales and calcareous thin beds, dipping approximately 3° to the south. The escarpment is capped by a diabase sill. The iron formation includes thin beds of granular hematite,


110°55′
PLAN
CROSS-SECTION
62°48′
62°47′
111°00′
AR
Fe
Cu
G
D
750′
700′
650′
600′
550′
VIREN ISLAND
N
0 1 KM
D - DIABASE SILL
G - GIBRALTAR FM.
AR - AKAITCHO RIVER FM.
CONTOURS IN FEET
LAKE LEVEL: 519 ft. (158.2 m)
CROSS-SECTION
NW
SE
GIBRALTAR FORMATION
APPROXIMATE SCALE
5 m
0
0 10 m
19.86%Fe over 2m
TRANSITION ZONE
TALUS
LAKE LEVEL
DIABASE SILL
SHALE RED, GREY
GRANULAR IRON-FORMATION
RED SHALE
RED SANDSTONE, SILTSTONE
GRANULAR IRON-FORMATION (PROJECTED)
AKAITCHO RIVER FORMATION

75L/15-1

similar to the Lake Superior-type iron formation, and of hematite-rich shales. Stratigraphically it belongs to the transition zone between the Akaitcho River Formation of the Sosan Group and Gibraltar Formation of the Kahochella Group, which are early Proterozoic in age.

The lower horizon is poorly exposed but is represented by felsenmeer in the northeastern corner of the island close to lake level. It is probably a couple of metres thick, and contains calcareous ooids up to 8 mm in diameter, in hematite-rich silty to shaly matrix containing some hematite granules. It is stratigraphically approximately 20 m below the main showing.

EXPLORATION:

The occurrences were discovered, mapped and sampled in 1983 by S.S. Gandhi.

Analyses of two chip samples, each 1 m long and thus representing 2 m thickness of the main showing, gave 23.10 and 29.30 percent Fe_2O_3 and 2.40 and 1.50 percent FeO respectively (analyses by x-ray fluorescence method; Geological Survey of Canada, Ottawa). Three grab samples ranged from 29.70 to 53.90 percent Fe_2O_3 with FeO content between 0.7 and 1.2 percent (x-ray fluorescence analyses). Additional analyses of the samples by various methods are given in Table 3 (Appendix 2).

REMARKS:

The iron formations are texturally similar and stratigraphically equivalent to the iron formations of Point Busse (Utsingi Point-75L/5-1) located 50 km to the southwest. The shales on Viren Island are cut by quartz-carbonate veins carrying chalcopyrite (75L/15-2).

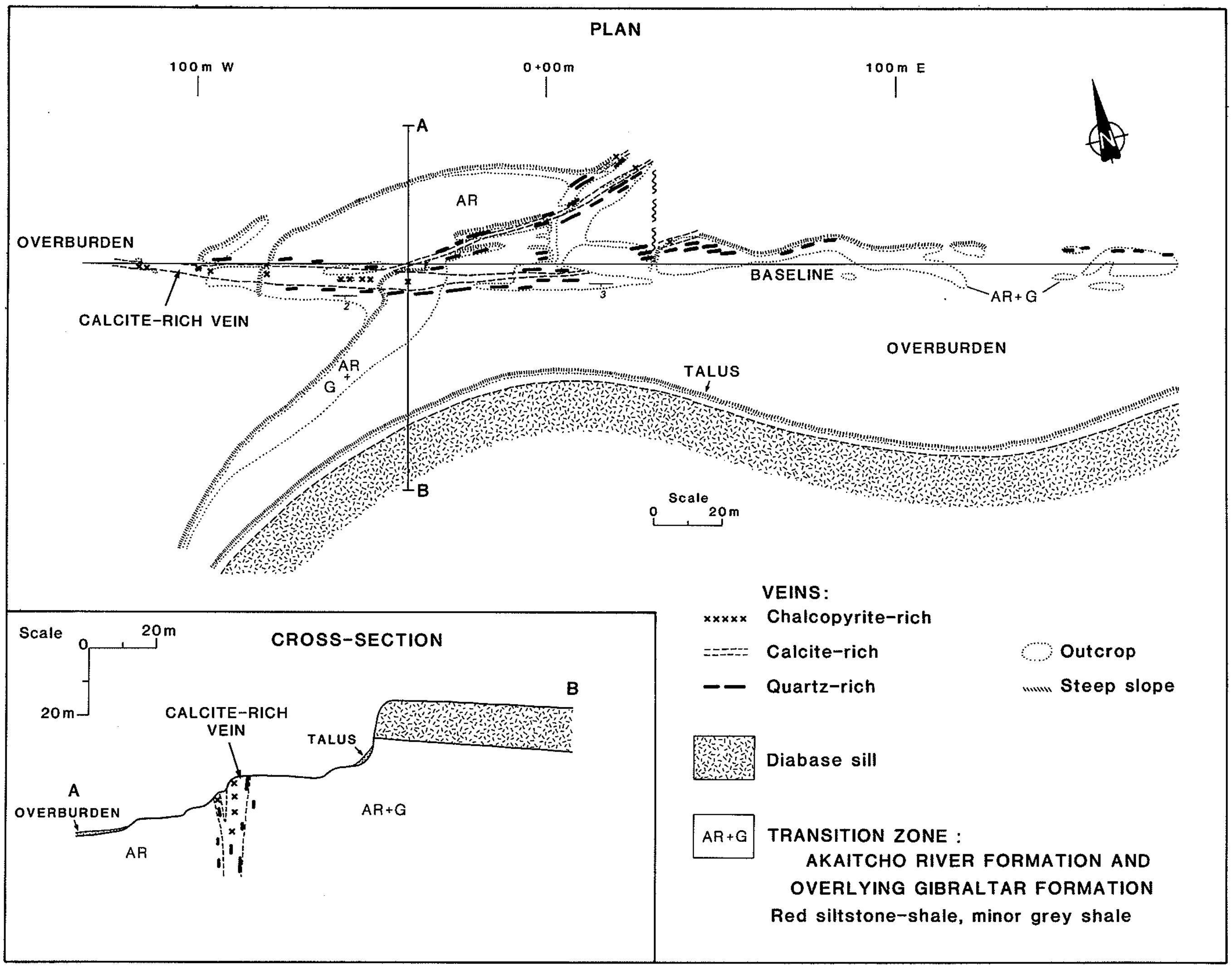
REFERENCES:

Stockwell, C.H., 1936.
Hoffman, P.F., 1968 and 1977.

NTS AREA-INDEX NO.: 75L/15-2

NAME: Viren Island-2
COMMODITY: Copper
LOCATION: Lat.: 62°47'32"N, Long.:110°56'28"W
DESCRIPTION:

An easterly trending zone of nearly vertical quartz-calcite veins carrying a number of coarse aggregates of chalcopyrite up to 25 cm wide, occur at the centre of a small island, informally referred to here as Viren Island, in McLeod Bay of the east arm of Great Slave Lake (see the accompanying sketch). Chalcopyrite is irregularly distributed and is most abundant in a 30 m long, 2 to 6 m wide zone in which calcite predominates over quartz. It forms coarse to very coarse aggregates in some parts of the veins up to



75L/15-2

1 m wide. The zone is open to the west where it is covered by overburden in a broad north trending valley. Several mineralized boulders are found in the valley for a few hundred metres from the showing, and are apparently derived from the local source. To the east, the chalcopyrite-calcite-rich veins apparently pinch out and/or grade into quartz-rich vein zone. However, an east-northeast trending calcite-rich subsidiary vein is exposed for 70 m from the east end, and contains a few chalcopyrite aggregates. Shorter veins with chalcopyrite and calcite also occur near its east end. Some very coarse quartz veins cut the calcopyrite bearing veins.

The host rocks are red siltstone-shale with minor grey shales of the upper part of Akaitcho River Formation and/or lower part of Gibraltar Formation, viz. of the transition zone between the two formations. The shales dip approximately 3 degrees to the south and are exposed on a north-facing steep slope of a cuesta capped by a diabase sill. The quartz-rich vein zone is well exposed due to differential erosion of shales. Approximately 1 km to the southwest of it, on the southwestern shore of Viren Island, the diabase sill is cut by veinlets of quartz and calcite, carrying chalcopyrite. The diabase sill has yielded K-Ar dates of 1249, 1219 and 1085 Ma as mentioned in the text (Gandhi, this report). The copper mineralization thus post-dates or is coeval with the Mackenzie igneous event.

EXPLORATION:

The vein zone was discovered by S.S. Gandhi in 1983, and was mapped on scale 1:1000. Two massive chalcopyrite samples from the west end of the showing were analyzed, and contained > 2% Cu, 20 and 10 ppb Au, 45 and 52 ppm Pb, 1380 and 1546 ppm Zn, 150 and 260 ppb Hg, less than 1 ppm Mo, 25 and 48 ppm Ba, less than 0.5 ppm Cd, 2.2 and 2.4 ppm Ag, less than 2 ppm Bi, 15 ppm and less than 5 ppm As, 4 ppm and less than 3 ppm Te, less than 1 ppm W, 45 and 29 ppm Se, and 5 and 4 ppm Sn.

REMARKS:

The showing is very similar to the 'G' claims showing located 45 km to the east on Douglas Peninsula (62°44'36"N, 110°04'12"W). Lake Superior-type iron formations occur on Viren Island (see mineral occurrence 75L/15-1).

REFERENCES:

Hoffman, P.F., 1977.

NTS AREA-INDEX NO.: 75L/15-3

NAME: Gibraltar Point
COMMODITY: Uranium
LOCATION: Lat.: 62°48'28"N, Long.: 110°45'57"W
DESCRIPTION:

Radioactive, pale green, thin shale beds and lenses occur at Gibraltar Point in predominantly red shale of Gibraltar Formation of the Kahochella Group, which is part of the early Proterozoic Great Slave Supergroup. The shales are exposed on north-facing shore, steep slope near approximately 100 to 150 m east of a west-facing shale-chip beach. They are capped by a diabase sill which is 20 m thick and 30 m above lake level. The shales and diabase dip very gently to the south.

Four hot spots in a 50 m strike length, 5 to 10 m above lake level, give readings of 500 to 2200 total counts per second on URTEC UG-135 minispec on pale green radioactive shales. These compare with 200 to 250 cps on the red shales, and 40 to 50 cps background on lake water. The pale green shales are discontinuous beds up to 5 cm thick and several metres in strike length, and occur sparsely over a few metres of stratigraphic thickness. Two chip samples of these radioactive shales (GFA-'83-111 and 112, approximately 30 m apart along strike and reading 2200 and 1100 cps maximum in the outcrop) contain 552 and 582 ppm eU, 16.8 and 21.2 ppm eTh, and 5.6 and 4.8 percent K as determined radiometrically in laboratory. The uranium enrichment is evidently synsedimentary or syndiagenetic.

EXPLORATION:

Discovery of the showing was made in 1983 by S.S. Gandhi.

REMARKS:

This type of uranium mineralization was previously unknown in the region. The pale green shales may be volcanogenic, related to the Seton Formation volcanics that occur 50 km to the southwest and are interbedded with the sediments of the Kahochella Group.

REFERENCES:

Stockwell, C.H., 1936 b.
Hoffman, P.F., 1968 and 1977.
Hoffman, P.F., et al, 1977.

NTS AREA-INDEX NO.: 75L/15-4

NAME: Shelter Bay
COMMODITY: Iron
LOCATION: Lat.: 62°48'46"N, Long.: 110°31'15"W
DESCRIPTION:

An iron-rich bed up to 30 cm thick, in red shale dipping approximately 3° to south, is exposed on southwest shore of Shelter Bay for a 25 m strike length (see accompanying sketch). The cherty (jasper-rich) red bed, as seen on the steep north side of the outcrop, is intruded by a 60 cm thick diabase sill. The sill, which is approximately 50 cm above the bed in the west half of the outcrop, steps sharply down about a metre at a fault which has displaced the bed approximately 50 cm upwards on the east side where the sill occurs a few centimetres below the bed. Near the east end, the sill again truncates the bed.

The bed belongs to Gibraltar Formation of early Proterozoic Kahochella Group.

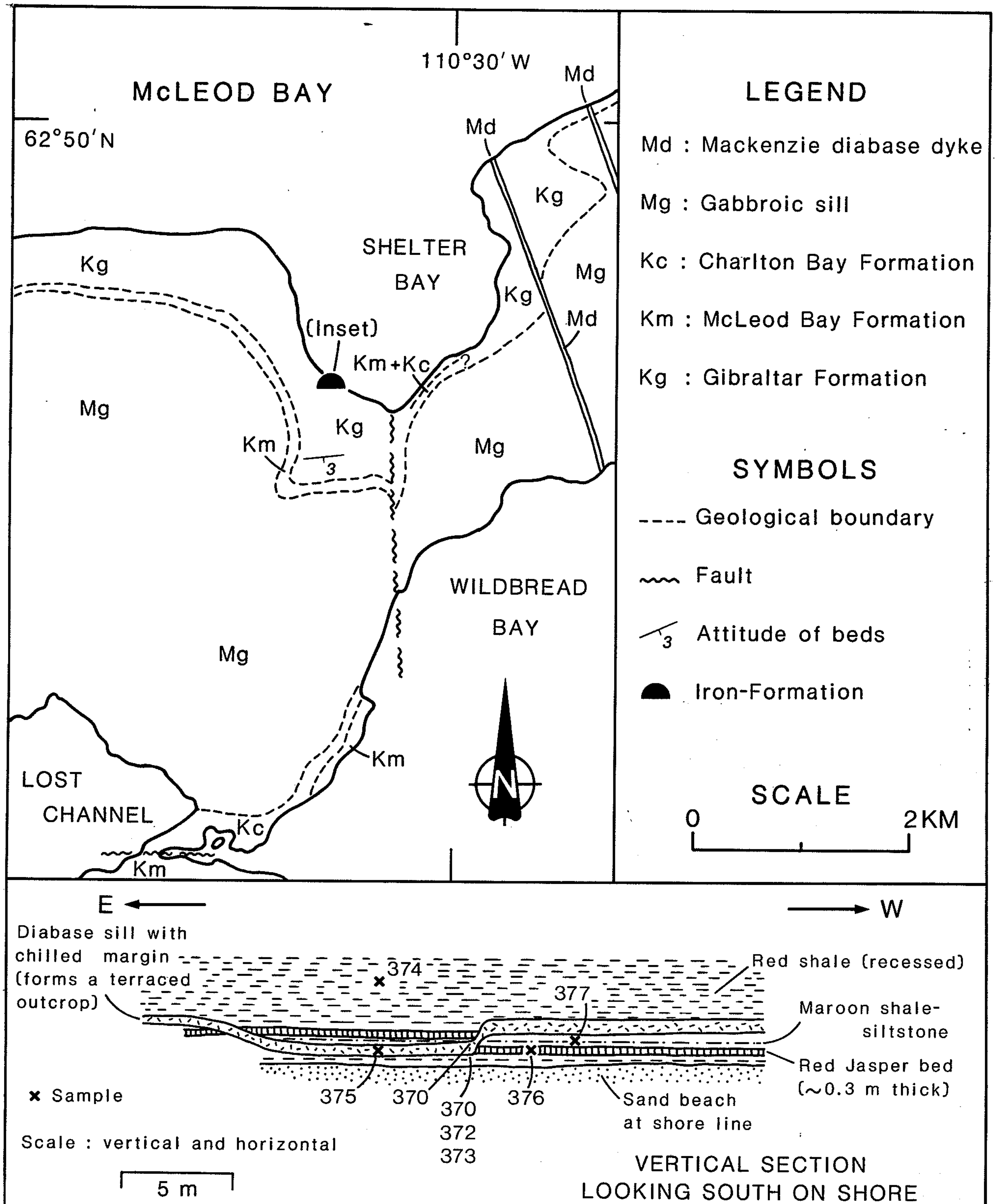
EXPLORATION:

A grab sample (GFA-'83-376) collected by S.S. Gandhi in 1983 contained 26.3% Fe_2O_3 2.1% FeO 4.29% CaO and 5.4% CO_2 (analyses by x-ray fluorescence and chemical methods; Geological Survey of Canada, Ottawa).

Another iron formation occurs approximately 100 m to the WSW and 30 m above the lake level, representing a higher stratigraphic horizon. It is a red jasper-rich layer in granular iron formation up to 0.3 m thick, interbedded with calcareous and red shale beds. A sample of jasper-rich layer (GFA-'83-367) analyzed 27.6% Fe_2O_3, 1.0% FeO, 3.46% CaO and 2.7% CO_2 (analyses as above). Manganese content in the two samples is low: 0.41 and 0.17% MnO respectively. Additional analyses of these two samples by various methods are given in Table 3 (Appendix 2).

REMARKS:

A hematitic red weathering calcareous and stromatolitic bed occurs between the two horizons represented by the analyzed samples. It is up to 25 cm thick,


110°30′ W
McLEOD BAY
62°50′ N
Md
Md
Kg
SHELTER
BAY
Mg
Kg
(Inset)
Km+Kc
?
Md
Mg
Kg
Km
3
Mg
WILDBREAD
BAY
Mg
Km
LOST
CHANNEL
Kc
Km
N
LEGEND
Md : Mackenzie diabase dyke
Mg : Gabbroic sill
Kc : Charlton Bay Formation
Km : McLeod Bay Formation
Kg : Gibraltar Formation
SYMBOLS
Geological boundary
Fault
Attitude of beds
3
Iron-Formation
SCALE
0
2KM
E
W
Diabase sill with chilled margin (forms a terraced outcrop)
374
377
Red shale (recessed)
Maroon shale-siltstone
Red Jasper bed (~0.3 m thick)
375
370
370
372
373
376
Sand beach at shore line
× Sample
Scale : vertical and horizontal
5 m
VERTICAL SECTION
LOOKING SOUTH ON SHORE

75L/15-4

overlain and underlain by red shale. It may be a caliche (?) horizon (Hoffman, 1968, p. 17 and 71).

The iron formations at Shelter Bay are similar to those on Viren Island (75L/15-1) and at Point Busse (Utsingi Point 75L/5-1), located approximately 25 and 70 km to the west and southwest respectively. Detailed stratigraphic correlation of the beds in the three localities is difficult because of scarcity of exposures and lack of marker units, but they all appear to be within a stratigraphic zone less than 100 m thick.

REFERENCES:

Stockwell, C.H., 1936 b.
Hoffman, P.F., 1968 and 1977.

NTS AREA-INDEX NO.: 75L/16-1

NAME: 'GAP' Claims
COMMODITY: Copper
LOCATION: Lat.: 62°46'10"N, Long.:110°29'10"W

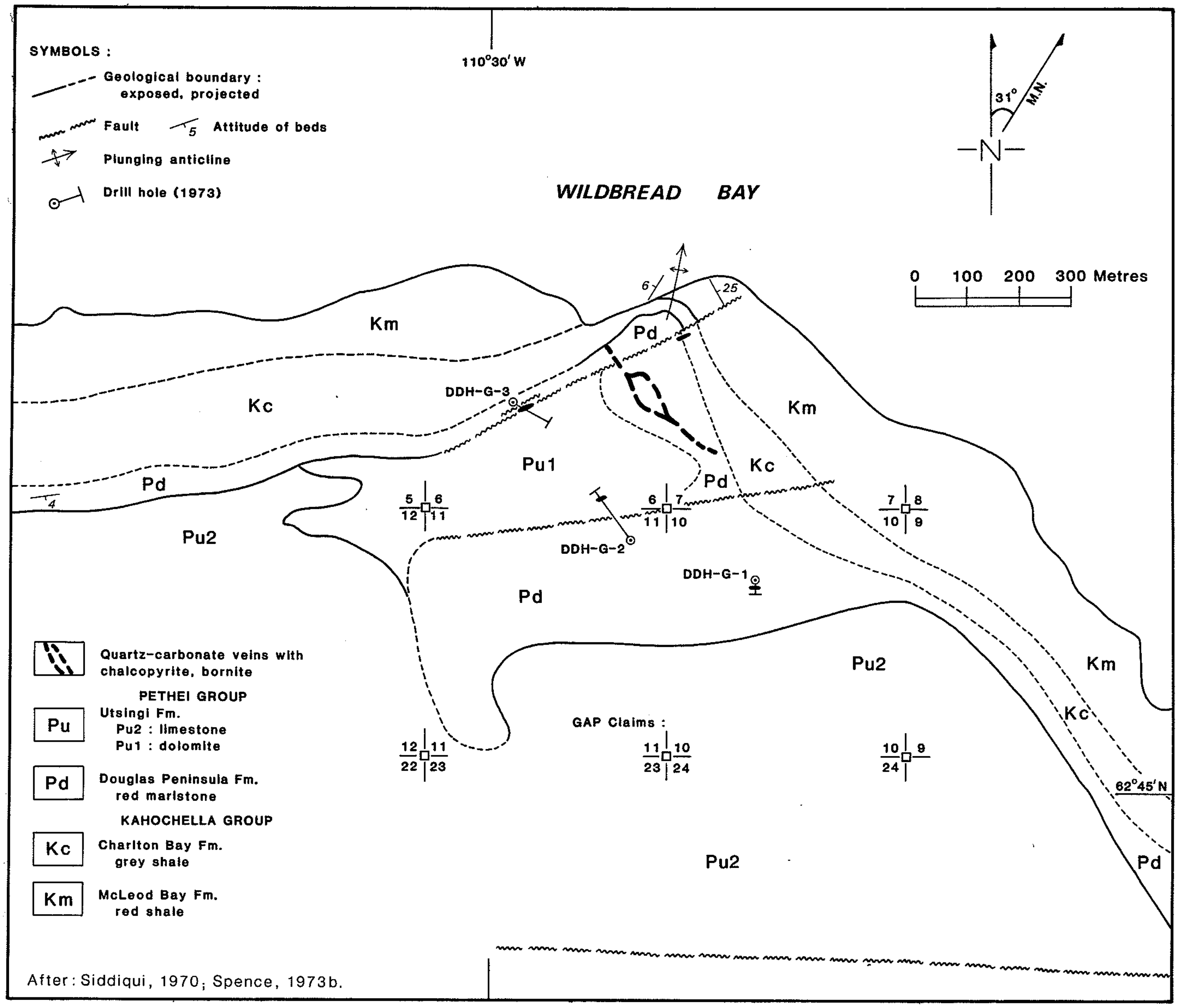
DESCRIPTION:

The Gap 1-16, 20-22 and 28-29 claims are located about 3.5 km west of "The Gap" which separates Pethei Peninsula and Douglas Peninsula, about 200 km ENE of Yellowknife.

Early Proterozoic sedimentary rocks of the Kahochella and Pethei Groups underlie the claims. About 300 m to the north of the claims, on Kahochella Peninsula, a diabase sill overlies the sediments.

Some chalcopyrite, bornite (plus chalcocite?), magnetite and pyrite occur in northeast-striking quartz-carbonate veins, within limestone and dolomite of the Utsingi Formation and to a lesser extent in the underlying red marlstones of the Douglas Peninsula Formation. These rocks dip gently to the south and southwest, and form a wedge between two ENE-striking faults that converge westward. The faults are located in the northeasterly part of the claim group (Figure below).

Mineralization intersected in hole 3, on claim GAP 6, occurs in a fracture zone in shale.



75L/16-1

EXPLORATION:

Prospectors working for Giant Yellowknife Mines Limited discovered copper showings in 1969 at the northeast end of Pethei Peninsula. The GAP 1-45 claims were staked to cover the ground. In 1970 the claim group was geologically mapped with the mineralized area mapped in detail.

In 1973, three holes, totalling 316.4 m of diamond drilling, were put down on claims GAP 6 and 10. Hole 3, on GAP 6, intersected 25 m of pyrite and chalcopyrite mineralization, but no assays are available.

REMARKS:

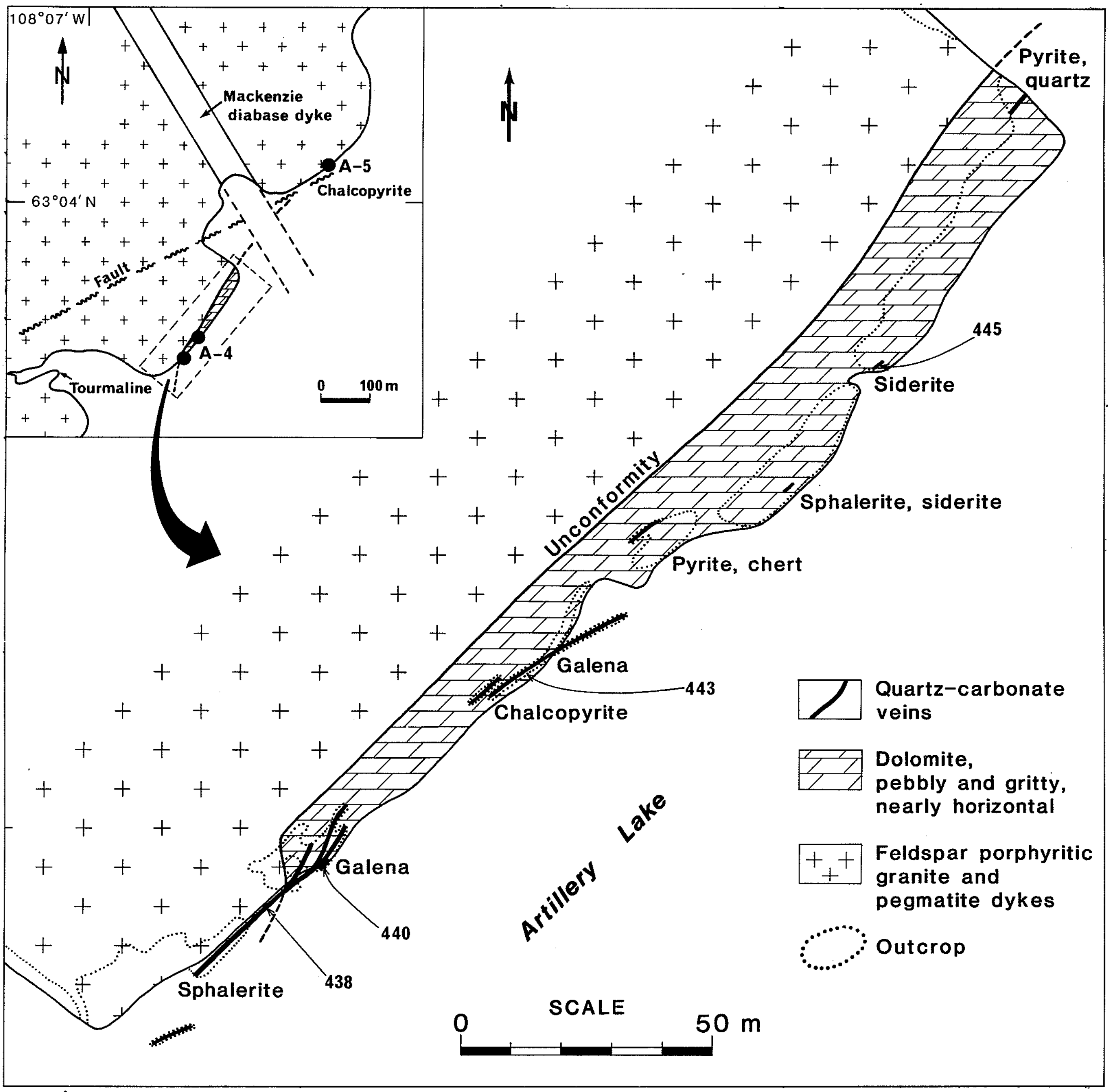
Observations by S.S. Gandhi in 1983 revealed some disseminated chalcopyrite in dolomite adjacent to and in the vicinity of quartz-carbonate veins. Quartz veins are numerous and at places form a stockwork. Most of them are steep and barren. The red shale-siltstone beds exposed on the north-facing escarpment near shore have dips up to 60° to southeast near a northeast-trending fault. Away from the fault, the beds dip gently, less than 10° to the south.

REFERENCES:

Siddiqui, M., 1970.
Spence, R.W., 1973 b.
Padgham, W.A., et al, 1976.

NTS AREA-INDEX NO.: 75N/1-1

NAME: A-3 (Artillery Lake)
COMMODITY: Copper
LOCATION: Lat.: 63°02'13"N, Long.: 108°07'39"W



75N/1-2

DESCRIPTION:

The showing is located at Rat Lodge on northwest shore of Artillery Lake. A chalcopyrite aggregate, 5 x 3 cm in surface area, occurs in a coarse quartz vein cutting buff- and tan-weathering dolomite. The vein is part of a stockwork of cherty to coarse quartz veins, which contains some pyrite and calcite. A few chalcopyrite grains and aggregates occur elsewhere in the stockwork and in the rubble nearby.

The host dolomite is thick-bedded, nearly horizontal and contains some gritty lenses. It is exposed in small outcrops between two sandy beaches along northeast-trending shore line. It forms the basal part of the early Proterozoic Artillery Lake formation resting on Archean granite (Gandhi, 1984, 1985). The unconformity is not exposed, but outcrops of granite are found approximately 200 m west of the showing and also on a small island 200 m to the east. The granite is feldspar porphyritic, with a crude alignment of crystals in east-northeast direction.

EXPLORATION:

The showing was discovered by S.S. Gandhi in 1983.

REMARKS:

The showing is similar to numerous Pb-Zn-Cu showings at Artilley Lake, and it is likely that galena and sphalerite are present in the vicinity.

REFERENCES:

Folinsbee, R.E., 1950.
Gandhi, S.S., 1984.

NTS AREA-INDEX NO.: 75N/1-2

NAME: A-4 (Artillery Lake)
COMMODITY: Lead-Zinc-Copper
LOCATION: Lat.: 63°03'52"N, Long.:108°06'40"W
DESCRIPTION:

The occurrence was first described by Folinsbee (1952), who reported the presence of chalcopyrite, but not of galena and sphalerite, as follows:

"Two parallel quartz veins occur in a fault zone along the contact between granite and Proterozoic, Great Slave Group, dolomite. These veins are 1 foot wide, 7 feet apart, and can be traced for 350 feet. Chalcopyrite fills vugs in the banded, comb-quartz veins. In places the veins may contain as much as 10 percent copper, but their average content is probably less than 0.5 percent."

In 1983, S.S. Gandhi discovered coarse galena and sphalerite in veins 50 m southwest of the chalcopyrite veins, and mapped all the veins (see accompanying sketch). According to him (Gandhi, 1984, p. 37) the veins are steep, en echelon, sinuous and up to 1 m wide. Galena, sphalerite and chalcopyrite vary in relative abundance along strike of the veins. At the southwest end of the showing area, a coarse quartz vein carries aggregates of very coarse dark brownish grey sphalerite, 1 to 4 cm long, for most of its 45 m strike length. Near its northeast end, where it bifurcates (sample locality 440 in the sketch) it contains scattered crystals of galena approximately 1 cm to a side. The dolomite wallrock here is altered to a medium grained aggregate of carbonate and quartz for a few centimetres from the vein. Near the centre of the showing area (sample locality 443) two chalcopyrite-pyrite-quartz veins are prominently exposed for about 10 m strike length. These are the ones that Folinsbee (1952) referred to; he, however, did not report the presence of galena and sphalerite in their vicinity. One of the two chalcopyrite-rich veins itself contains some coarse galena crystals in its northeastern part (sample locality 443), and it extends farther northeast for more than 30 m under the lake water. Quartz-pyrite veins are common on shore to the northeast for 150 m, as described by Folinsbee. They include a rare vein of red chert grading to white quartz, and cut by a dolomite vein. In addition, there are a few veins containing aggregates of coarse siderite crystals up to 2 cm long, with minor dark grey sphalerite, pyrite and chalcopyrite. Siderite is brownish white on fresh surface, and weathers dark red-brown.

The flat-lying dolomite beds are a few metres thick at the showing, and they unconformably overlie the granite which is dolomitized at the paleo-surface. Their boundary is thus not a fault zone as suggested by Folinsbee (1952), but is an unconformity. The trend of the veins, however, reflects fracture control of the mineralization.

EXPLORATION:

Detailed mapping and sampling were carried out by S.S. Gandhi in 1983. Multielement analyses of some of the samples are presented in Table 1 (Appendix 2).

REMARKS:

The galena sphalerite-bearing veins are covered by water when lake level is seasonally high, and this may be the reason why they were not found during the earlier reconnaissance work by Folinsbee (1952).

REFERENCES:

Folinsbee, R.E., 1952.
Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75N/1-3

NAME: A-5 (Artillery Lake)
COMMODITY: Copper
LOCATION: Lat.: 63°04'01"N, Long.: 108°06'11"W
DESCRIPTION:

A coarse quartz vein approximately 15 cm wide and exposed for 5 m strike length, contains coarse aggregates of chalcopyrite and pyrite up to 8 cm wide. It is vertical and trends northeast and is located on strike of the chalcopyrite-rich veins of Showing A-4 approximately 400 m to the southwest. Subsidiary veinlets are present in its vicinity. Younger, barren coarser quartz veins cut the chalcopyrite-bearing veins. The veins are surrounded by boulders and overburden on the lake shore. Their wall-rock is differentially eroded away at the exposure, and is most probably dolomite deposited on granite basement.

EXPLORATION:

The showing was discovered and sampled by S.S. Gandhi in 1983, and multielement analysis of a sample containing coarse pyrite, chalcopyrite and quartz is given in Table 1 (Appendix 2; sample GFA-'83-490A).

REMARKS:

Showings A-4 and A-5 are on the same vein system that trends northeasterly (see inset in sketch of showing A-4:75N/1-2). Galena and sphalerite are present in Showing A-4, hence it is most likely that these minerals are also present in the overburden-covered area of Showing A-5.

REFERENCES:

Folinsbee, R.E., 1952.
Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75N/1-4

NAME: A-20 (Artillery Lake)
COMMODITY: Copper
LOCATION: Lat.: 63°00'11"N, Long.: 108°10'45"W
DESCRIPTION:

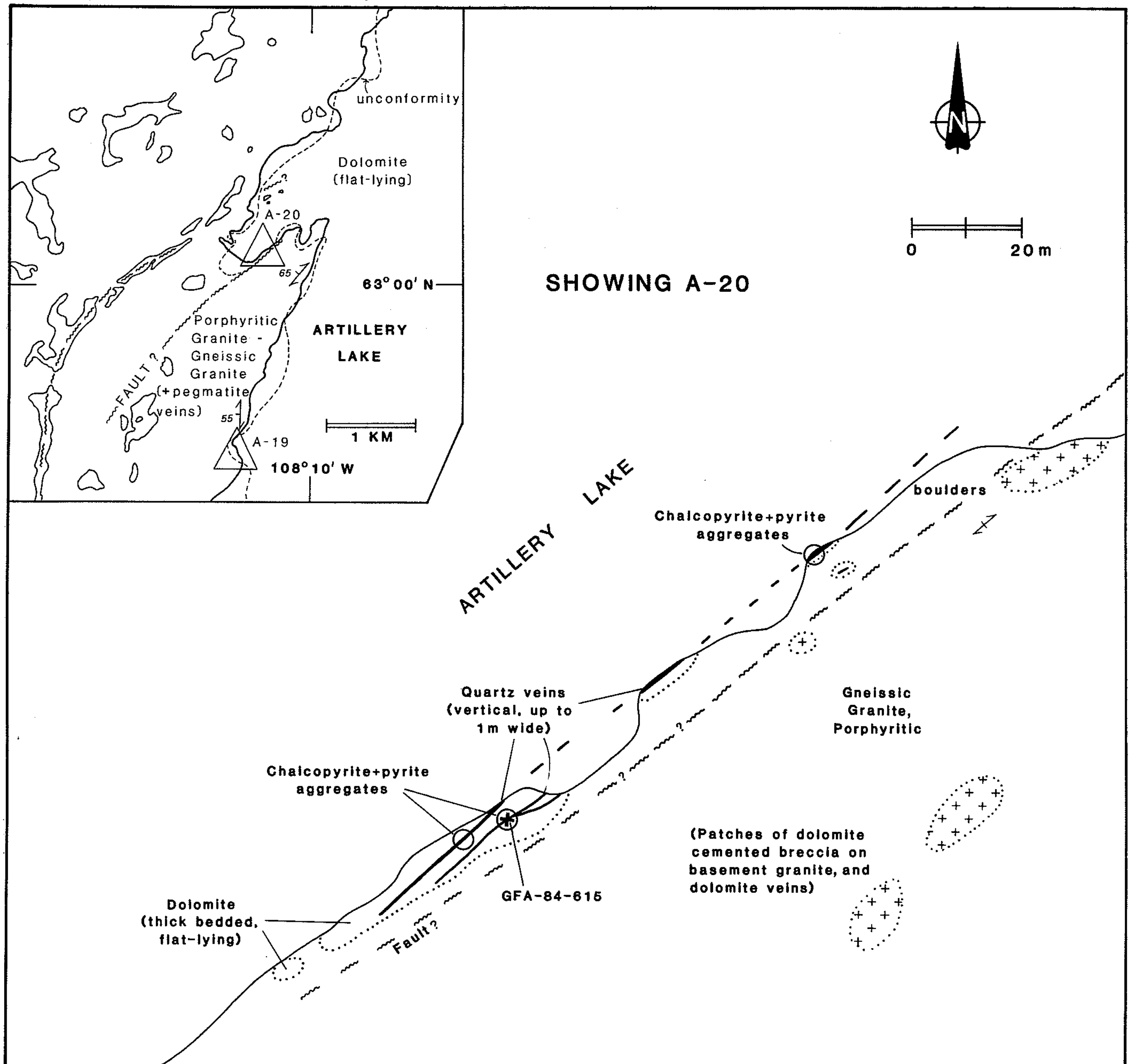
A quartz-pyrite-chalcopyrite vein up to 1 m wide and 100 m long, is exposed along the southeast shore of a 300 m wide rectangular bay facing northeast (Figure below). The vein is nearly vertical and trends 040° and is accompanied by subparallel subsidiary veins. The veins occur in nearly horizontal massive dolomite beds at the base of early Proterozoic Artillery Lake formation. The basement granite is exposed in outcrops a few metres to the southeast approximately 5 m above lake level. It is cut by veins of dolomite and chert, and is overlain by patches of dolomite-cemented, locally derived granitic gravel and fragments. The boundary between the dolomite and granite is a possible fault, with the dolomite down-dropped with respect to the basement granite. The fault is not exposed, but the vein may represent a parallel subsidiary tensional feature related to such a fault.

The veins carry aggregates of pyrite in quartz, some of which contain up to 50 percent chalcopyrite, and are up to 10 cm thick and 0.5 m long (e.g. near sample site GFA-84-615 in the accompanying figure). Galena and sphalerite have not been observed at this showing, but they may be present in this vein system, as is the case with similar veins at Showing A-4 which is located approximately 8 km to the north-northeast.

The following field observations are noteworthy:

(i) Massive dolomite host rock is light brownish buff weathering, and is brecciated with coarse sparry dolomite matrix which weathers dark brown (sideritic ?) and which also occurs as veins in the dolomite.

(ii) Quartz-pyrite-chalcopyrite veins post-date brecciation.



75N/1-4

(iii) A set of dark brown weathering coarse sparry dolomite veins (up to 2 cm thick) cut the quartz-pyrite-chalcopyrite veins. The younger veins contain quartz aggregates, and either accompany or are cut by a network of quartz veins. The latter range from fine to coarse grained, and the coarser ones contain carbonate core.

(iv) Pyrobitumen occurs in quartz-pyrite veins which may or may not contain chalcopyrite. A number of quartz-pyrite-pyrobitumen veins barren of other sulphides, occur in dolomite around the northeast point of the small peninsula of the showing. They commonly trend northeast, and are steep.

EXPLORATION:

The showing was discovered and mapped by S.S. Gandhi in 1984.

REMARKS:

Folinsbee (1952) reported the presence of dolomite in the small bay between two northeast-trending faults, but did not report any mineral occurrence here. The northwestern boundary of dolomite appears to be unconformity rather than a fault.

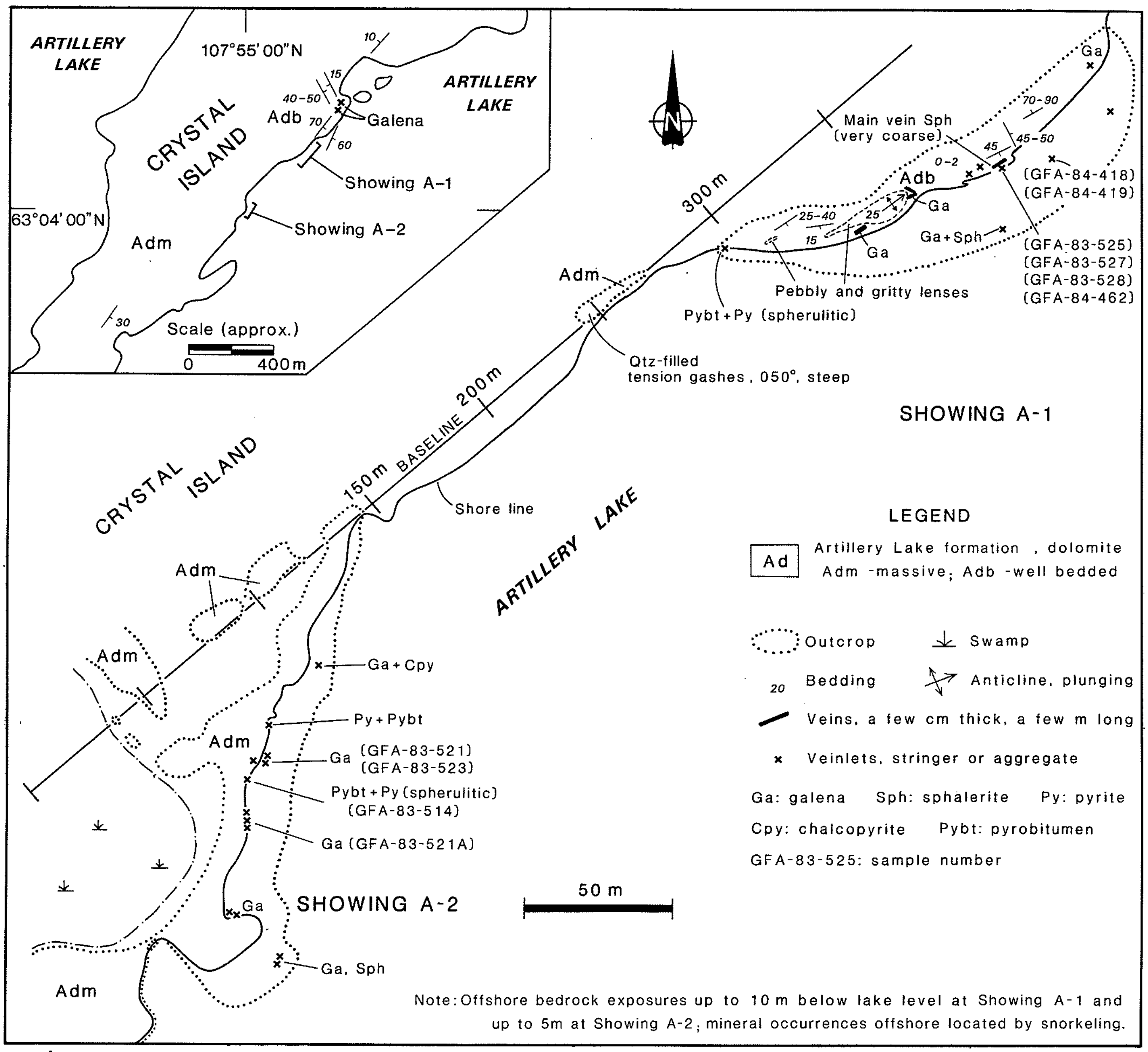
REFERENCES:

Folinsbee, R.E. (1952).
Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75O/4-1

NAME: A-1 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°04'10"N, Long.: 107°54'35"W
DESCRIPTION:

A number of sphalerite-rich and galena-rich quartz veins occur in dolomite along the east shore of Crystal Island in Artillery Lake as shown in the accompanying figure.



75O/4-1 & 2

Maximum concentration of the veins is in a northeast-trending zone up to 3 m wide, and 50 m long. The main vein is 30 cm wide and 5 m long. It is nearly vertical and trends 060°. It contains aggregates of coarse sphalerite crystals that are up to 10 cm long. The crystals are honey-coloured, and are associated with some galena, chalcopyrite, pyrite, calcite and fragments of dolomite wall rock. Smaller veins rich in galena and up to 3 cm thick, occur as subsidiary veins near the main vein, and also 10 m southwest of it in anastomosing clusters. They contain some sphalerite and rare chalcopyrite. Similar galena veins also occur at scattered localities along the shore and offshore northeast of the main vein.

The dolomite varies in attitude over short distances because of folding on metre-scale, but its regional dip is gentle to moderate towards southeast. Lenses of quartz pebble and quartz grit, up to 0.5 m thick and cemented by dolomite, are present. They are in places folded and/or brecciated. Galena veins cut one folded pebbly lens and pebbles in the lens, at a locality 30 m southwest of the main vein. The fold is a minor anticline plunging 25° to the northeast. A pyrite-pyrobitumen aggregate, 0.5 x 0.5 m in area, occurs approximately 75 m southwest of the main vein. Pyrite is spherulitic, up to 3 cm in diameter, with acicular radiating crystals. It is associated with quartz and black vitreous pyrobitumen. Multielement analyses of 4 samples and lead isotopic ratios of one sample, which contains 384 ppm Ag, are given in Tables 1 and 2 (Appendix 2).

EXPLORATION:

Discovery of sphalerite on Crystal Island in early 1950's by Inco Limited was reported verbally but no data on it is available. Showing A-1, located in 1983 by S.S. Gandhi and D. Broughton, may be the one that was verbally reported. It was mapped in 1984 by S.S. Gandhi and G. Philpott, and the offshore veins in its vicinity were found by S.M. Roscoe in 1984 by snorkeling.

REMARKS:

Veins of Showings A-1 and A-2 are on the same general strike zone (see accompanying sketch).

REFERENCES:

Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 750/4-2

NAME: A-2 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°04'00"N, Long.: 107°55'00"W
DESCRIPTION:

Showing A-2 is located approximately 300 m southwest of Showing A-1, along its general structural trend, on the east shore of Crystal Island (see the figure accompanying description of Showing A-1). There are several irregular veins distributed over 100 x 25 m area. The veins are rather irregular and steep, and commonly bifurcate and merge with adjacent ones. Some are gently dipping, exposing large surface area. Coarse galena predominates in the veins, but lesser amounts of sphalerite and chalcopyrite are associated with it. Quartz is the main gangue but some carbonate and pyrite are also present.

The host rock is gently dipping massive or thick bedded dolomite, with some lenses containing pebbles and grit cemented by dolomite matrix. The lenses are up to 0.5 m thick, and extend for several tens of metres. Aggregates of pyrite, pyrobitumen, chert and crystalline quartz form rusty weathered zones at and in the vicinity of the galena veins. Some of the galena veins cut these aggregates, and also the dolomite veins and patches that occur in them. The host dolomite is brecciated at several places and the breccia includes some fragments of grey argillaceous material, chert and pyrite-pyrobitumen. Pyrite forms spherulitic aggregates up to 25 cm long, with spherules up to 2 cm in diameter comprised of radiating acicular crystals. Study of a pyrobitumen sample from the showing (GFA-83-514) shows a low atomic ratio and low reflectance (Gandhi, 1984).

Analyses of a galena separate and a sphalerite-pyrite concentrate from the showing are given in Table 1 (Appendix 2). Lead isotopic analysis of the galena separate are given in Table 2 (Appendix 2).

EXPLORATION:

The showing was discovered in 1983 by S.S. Gandhi and D. Broughton. Mapping on it and Showing A-1 was carried out by S.S. Gandhi and G. Philpott in 1984. Some offshore veins were found by snorkeling in 1984 by S.M. Roscoe.

REMARKS:

Galena-rich veins contain relatively small amount of sphalerite and chalcopyrite as is the case with the subsidiary veins at Showing A-1.

REFERENCES:

Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 750/4-3

NAME: A-6 (Artillery Lake)
COMMODITY: Lead, Zinc
LOCATION: Lat.: 63°10'00"N, Long.: 107°55'10"W
DESCRIPTION:

The showing is located on a prominent peninsula 600 m long and 300 m wide, on the northwest shore of Artillery Lake (Figure below). Coarse galena-rich quartz veins up to 2 cm thick, and also coarse sphalerite-rich quartz veins, occur in dolomite and dolomitic sandstone with abundant rusty weathering pyritic pods. Galena cubes are up to 1 cm to a side. Minor pyrite and calcite are associated with them. The veins are irregular, generally steep, and randomly oriented. Analyses of a sphalerite separate are given in Table 1 (Appendix 2).

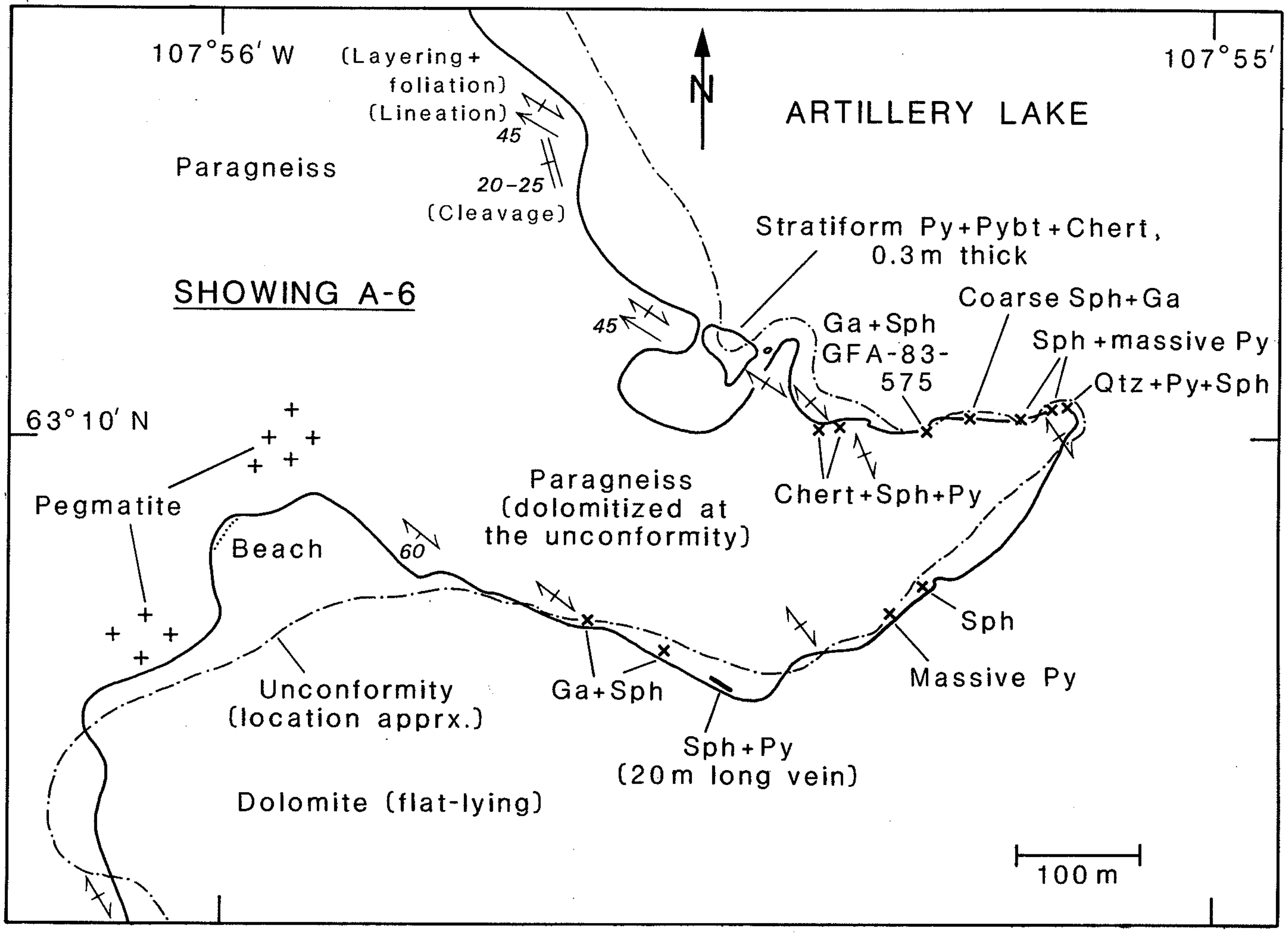
The veins are at the unconformity between Archean basement and early Proterozoic dolomite. Nearly horizontal beds of dolomite unconformably overlie paragneiss and pegmatite of the basement which is highly dolomitized at the unconformity. The paragneiss is derived from a greywacke sequence, and has felsic and mafic (hornblende plus biotite) bands that dip steeply and trend southeasterly. It is cut by pegmatite veins and pods. A pyrite-rich lens, approximately 50 m long and 0.5 m thick, occurs in the basal dolomite on shore about 300 m of the northeast point of the peninsula.

REMARKS:

Location given earlier by Gandhi (1984, 1985) is in error; it is 1 km southwest of the correct location. The erroneous location is the site of Showing A-21. The correct location was earlier assigned to Showing A-7 which is in fact located 2 km to the northeast.

REFERENCES:

Gandhi, S.S., 1984 and 1985.



750/4-3

NTS AREA-INDEX NO.: 75O/4-4

NAME: A-7 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°11'00"N, Long.: 107°54'07"W
DESCRIPTION:

Coarse galena aggregates with quartz and minor pyrite, sphalerite, chalcopyrite and calcite occur in veins that are a few centimetres wide. The veins are in tightly folded, southeasterly trending Archean metasediments (paragneiss) that are cut by pegmatites, and unconformably overlain by flat-lying remnants of gritty dolomite. The veins are irregular but have a general northeasterly trend, and are exposed at several localities along a 175 m long shore of a small peninsula (Figure below). The metasediments and pegmatites are also cut by nearly horizontal dolomitic veins. The galena-rich veins are younger than the dolomitic veins and patches. Analyses of a galena separate (GFA-'83-571) are given in Table 1 (Appendix 2).

Muscovite from two pegmatite lenses, one at the northeast tip of the peninsula (GFA-'83-571) and the other approximately 30 m to the southwest of it in a tight minor fold of the metasediments (GFA-'83-568), yielded K-Ar isotopic dates of 2500 ± 20 Ma and 2545 ± 20 Ma respectively (Gandhi, 1984). Larger outcrops of pegmatite with inclusions of metasediments occur on a broad low ridge northwest of the showing. The metasediments are well bedded greywacke type, and include some biotite-rich, amphibolitic and quartzose layers and lenses. They are highly dolomitized at the unconformity and some of the layers are almost completely replaced by dolomite. Flat-lying dolomite occurs on the north shore of the peninsula, and it contains massive aggregates of pyrite with some pyrobitumen and traces of sphalerite.

EXPLORATION:

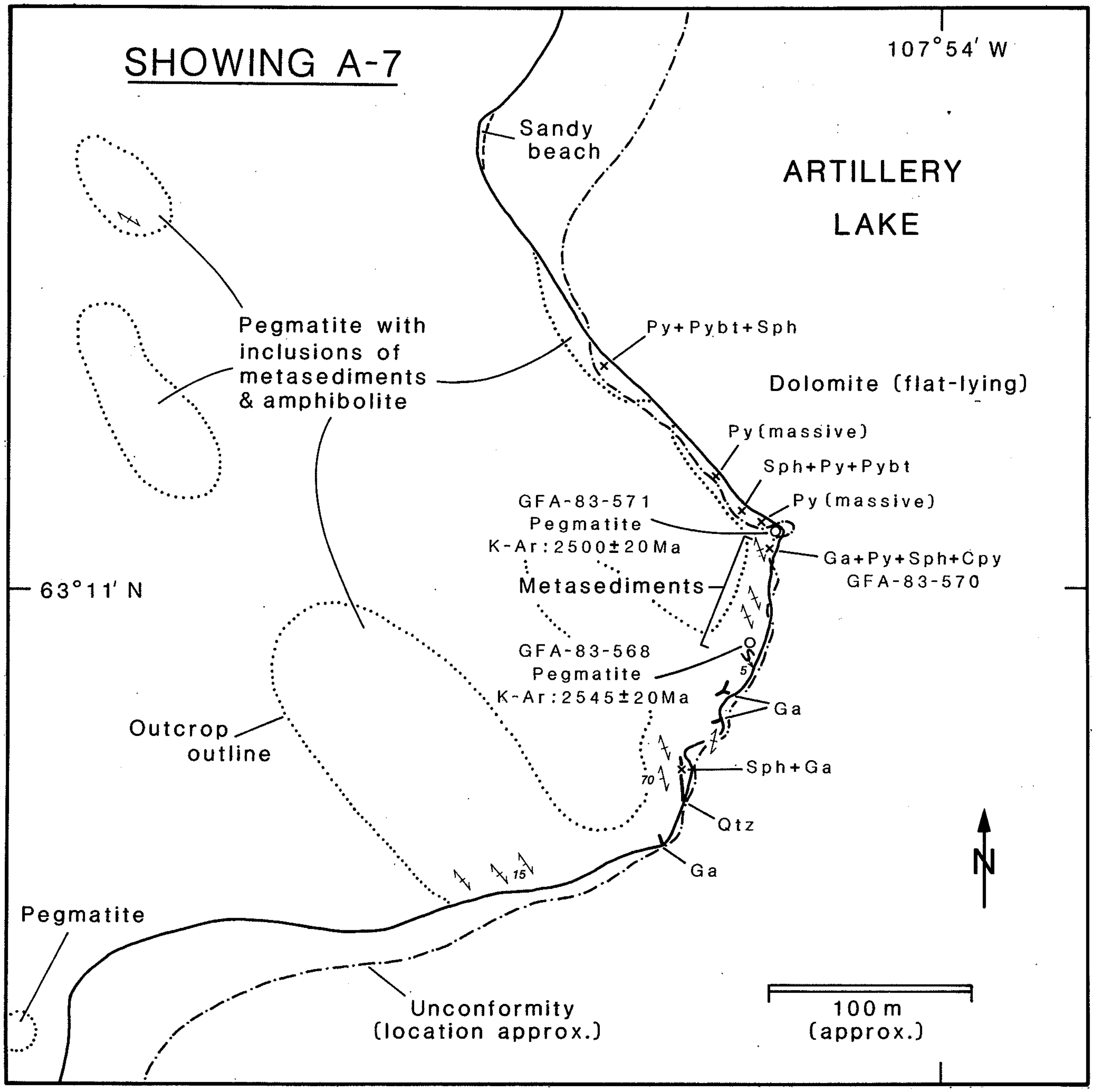
The showing was discovered in 1983 by S.S. Gandhi, and was mapped by him in 1984.

REMARKS:

Location of the showing reported earlier by Gandhi (1984, 1985) is erroneous, being 2 km southwest of the correct location. The Showings A-8 and A-9 are approximately 1 and 1.5 km respectively to the northeast of showing A-7, along the northwest shore of Artillery Lake.

REFERENCES:

Gandhi, S.S., 1984 and 1985.



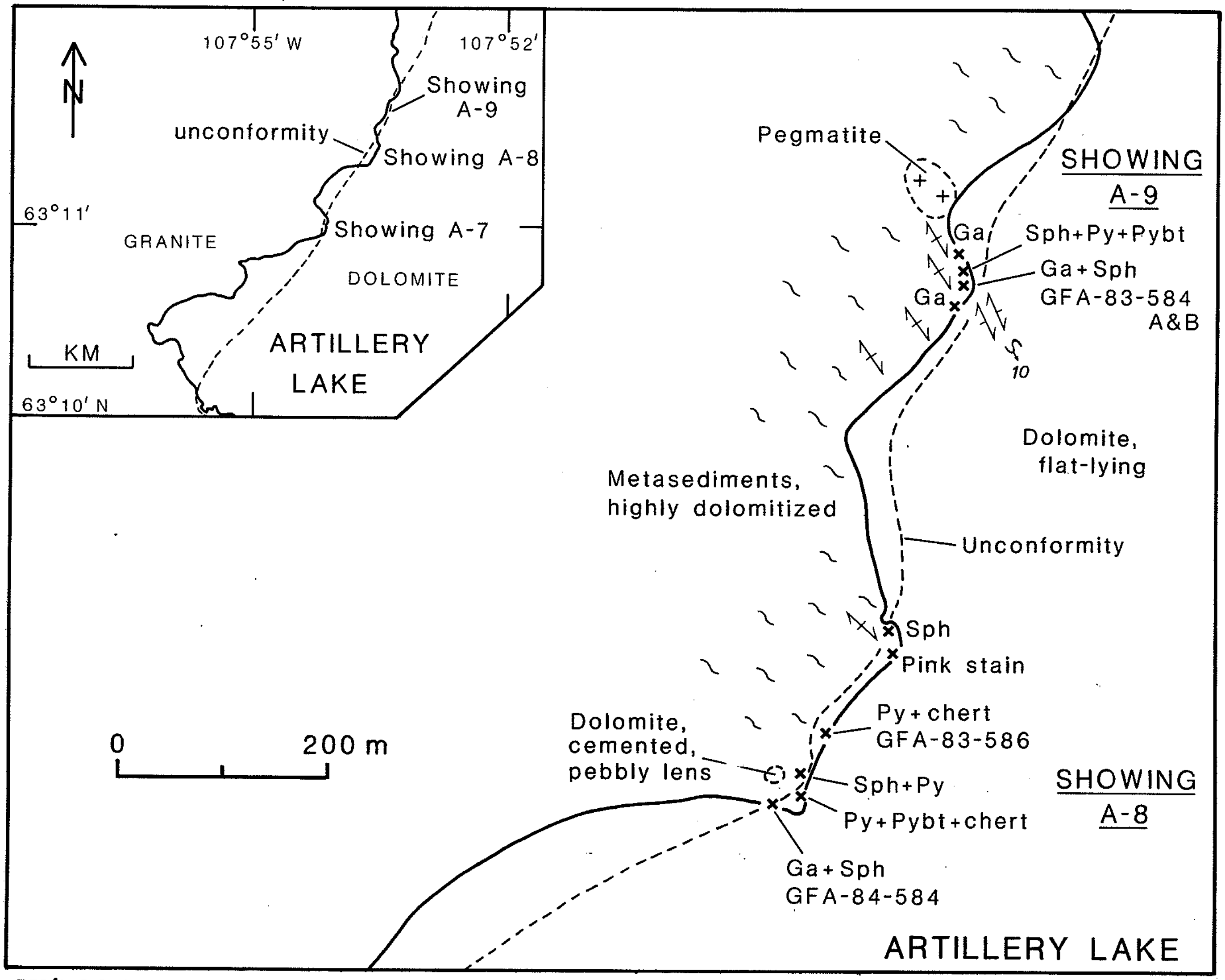
750/4-4

NTS AREA-INDEX NO.: 750/4-5

NAME: A-8 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°11'25"N, Long.: 107°53'42"W
DESCRIPTION:

Sphalerite-galena-bearing quartz veins are sparsely distributed at a few localities within a 200 m length of shore line of a small peninsula (Figure below). The veins are in folded, southeasterly trending Archean metasediments that are cut by dolomitic veins and overlain by gritty dolomite. The sphalerite-galena-bearing veins are a few centimetres wide and several metres long, and are irregular with a general northeasterly trend. They contain variable amounts of coarse, resinous yellow to brown sphalerite. Quartz ranges from thinly laminated agate to coarse crystals. Pyrite and calcite are present in small amounts. The veins are younger than the dolomitic veins as well as the massive pyrite-quartz veins and aggregates that cut the latter.

The veins occur at the basal unconformity of Aphebian dolomite, the remnants of which occur as flat-lying lenses and patches, containing pebbly and gritty material cemented by dolomite, resting on Archean metasediments that are moderately to steeply dipping and highly dolomitized (Gandhi, 1984, 1985). The metasediments (paragneiss) include



750/4-5 & 6

biotite-amphibole-rich layers, quartzo-feldspathic layers and lenses, and some highly dolomitized bands at the unconformity. Veins and aggregates of chert, quartz, pyrite, and pyrobitumen, containing traces of sphalerite, occur at the unconformity exposed on shore. Chemical analyses of a pyrite separate from a massive pyrite-chert vein are given in Table 1 (Appendix 2). Lead isotopic analyses of a galena sample are given in Table 2 (Appendix 2). Traces of pink stains are observed on dolomitized metasediments at the northeast end of the showing, and may represent presence of cobalt.

The metasediments are poorly exposed inland, and scattered outcrops up to 2 km to the west-northwest are of pegmatites with inclusions of the metasediments.

EXPLORATION:

The showing was discovered in 1983 by S.S. Gandhi, and was re-examined by him in 1984.

REMARKS:

The showing is located 700 m northeast of Showing A-7 and only 300 m south-southeast of Showing A-9. The three showings are geologically similar, and represent parts of a larger mineralized zone or area, seen in limited shoreline exposures.

REFERENCES:

Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75O/4-6

NAME: A-9 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°11'35"N, Long.: 107°53'25"W
DESCRIPTION:

Galena and sphalerite-bearing quartz-carbonate veins here are generally similar to those at Showing A-8 located 300 m to the south-southwest (Figure above). Galena crystals are up to 4 mm to a side. They occur as aggregates in the veins which are a few centimetres wide. The host rocks are Archean metasediments, tightly folded about south-southeasterly trending axes plunging gently to the southeast. They are similar to those at Showing A-8. Dolomite and chert veins cut the metasediments.

Lead isotopic analyses of a galena sample (GFA-83-584A) from this showing are given in Table 2 (Appendix 2).

EXPLORATION:

The showing was discovered by S.S. Gandhi in 1983, and was re-examined by him in 1984.

REMARKS:

The shore exposures between the Showings A-8 and A-9 are of highly dolomitized Archean metasedimentary rocks trending southeasterly and commonly dipping steeply. Minor folds plunging gently to the southeast are observed at a few localities in them. Outcrops are scarce north of Showing A-9.

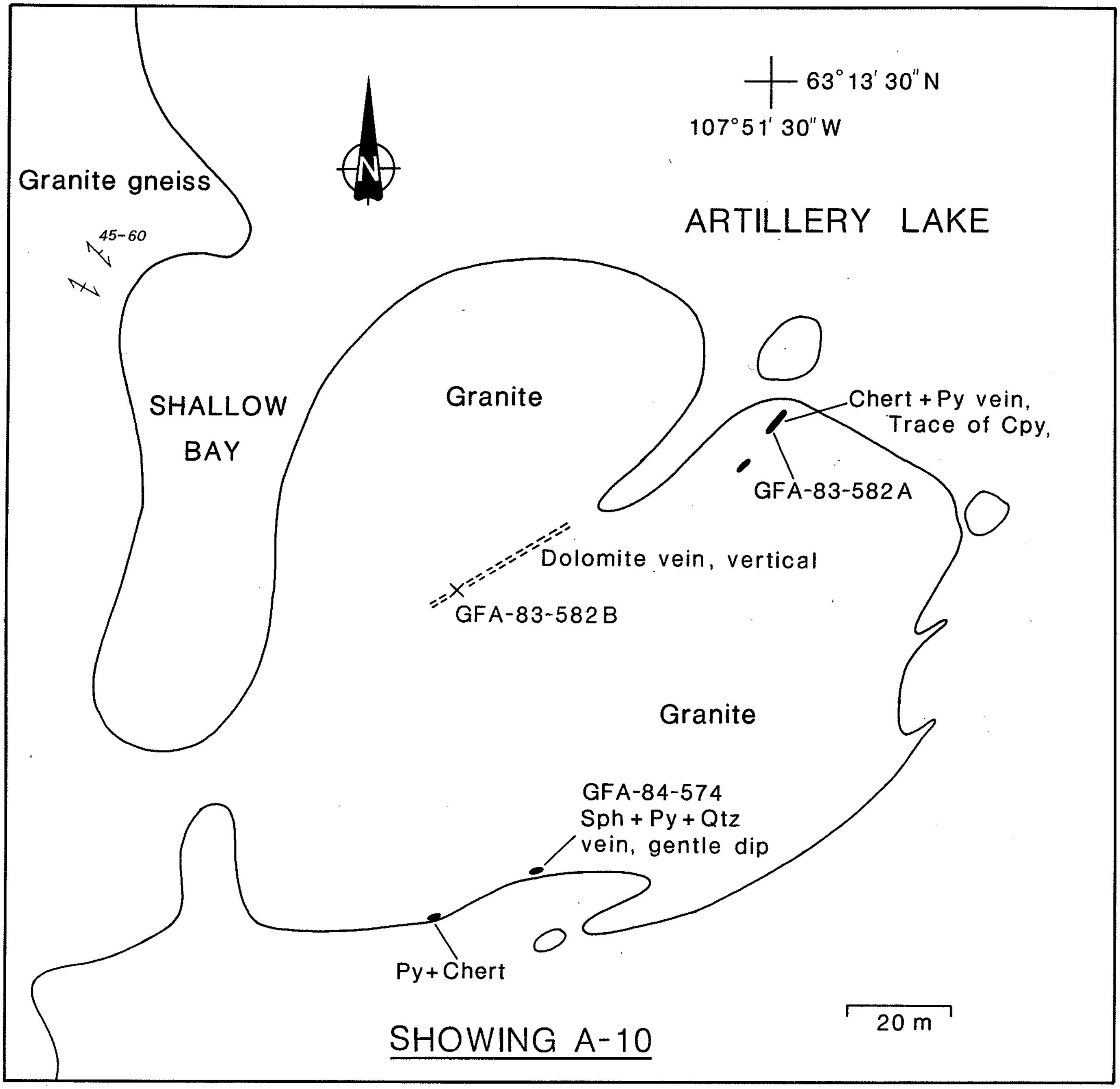
REFERENCES:

Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75O/4-7

NAME: A-10 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°13'24"N, Long.: 107°51'40"W
DESCRIPTION:

Nearly horizontal veins of agate-crystalline quartz-pyrite-calcite occur in Archean granite on an island-like peninsula approximately 120 m in diameter (Figure below). One of the veins, located on the south shore of the peninsula, contains medium to coarse sphalerite as aggregates and thin layers. It is a few centimetres thick, and is exposed for a few metres on shore. Pyrite predominates over sphalerite.



75O/4-7

Another vein, located 100 m to the north-northeast of the sphalerite-bearing vein, contains traces of chalcopyrite but no visible sphalerite. It has a well developed laminated texture, with thin agate layers and lenses alternating with pyrite-rich ones, up to a few millimetres in thickness and dipping gently parallel to the walls. Some of the agate-crystalline quartz layers display irregularities, minor folds, and domal structures up to a centimetre in diameter that resembles botryoidal texture. Calcite occurs as irregular, medium-grained aggregates in the veins.

The host granite is equigranular to feldspar porphyritic, and contains some zones that are more mafic and gneissic. It is cut by dolomitic and cherty veins. A large dolomitic vein is up to 2 m wide, nearly vertical and trends 060°. It is exposed for 30 m, and contains rusty pyritic patches. Its presence suggests proximity to the dolomitic Artillery Lake formation that unconformably overlies the granite.

EXPLORATION:

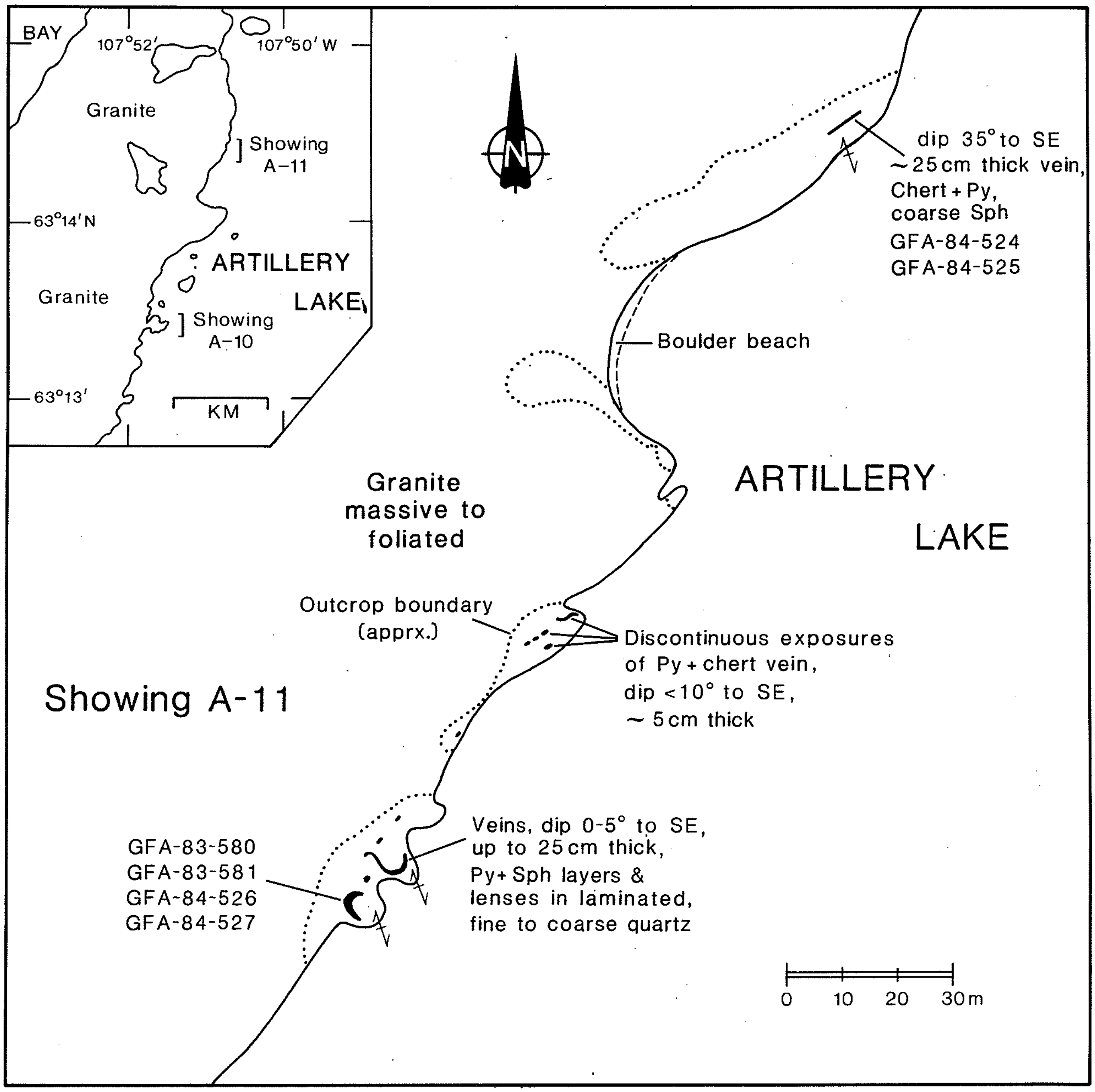
The showing was discovered in 1983 by S.S. Gandhi and was re-examined by him in 1984.

REMARKS:

This showing is very similar to Showing A-11 located 2 km to the north-northeast along the northwest shore of Artillery Lake. Description of a 25 cm thick sphalerite-rich vein given by S.S. Gandhi (1984, p. 38) refers to the Showing A-11, but its general laminated character and gentle dip are also seen in the veins at Showing A-10. There is no visible galena found in either showing. Such veins are rare at other Pb-Zn-Cu occurrences in the Artillery Lake area.

REFERENCES:

Gandhi, S.S., 1984 and 1985.

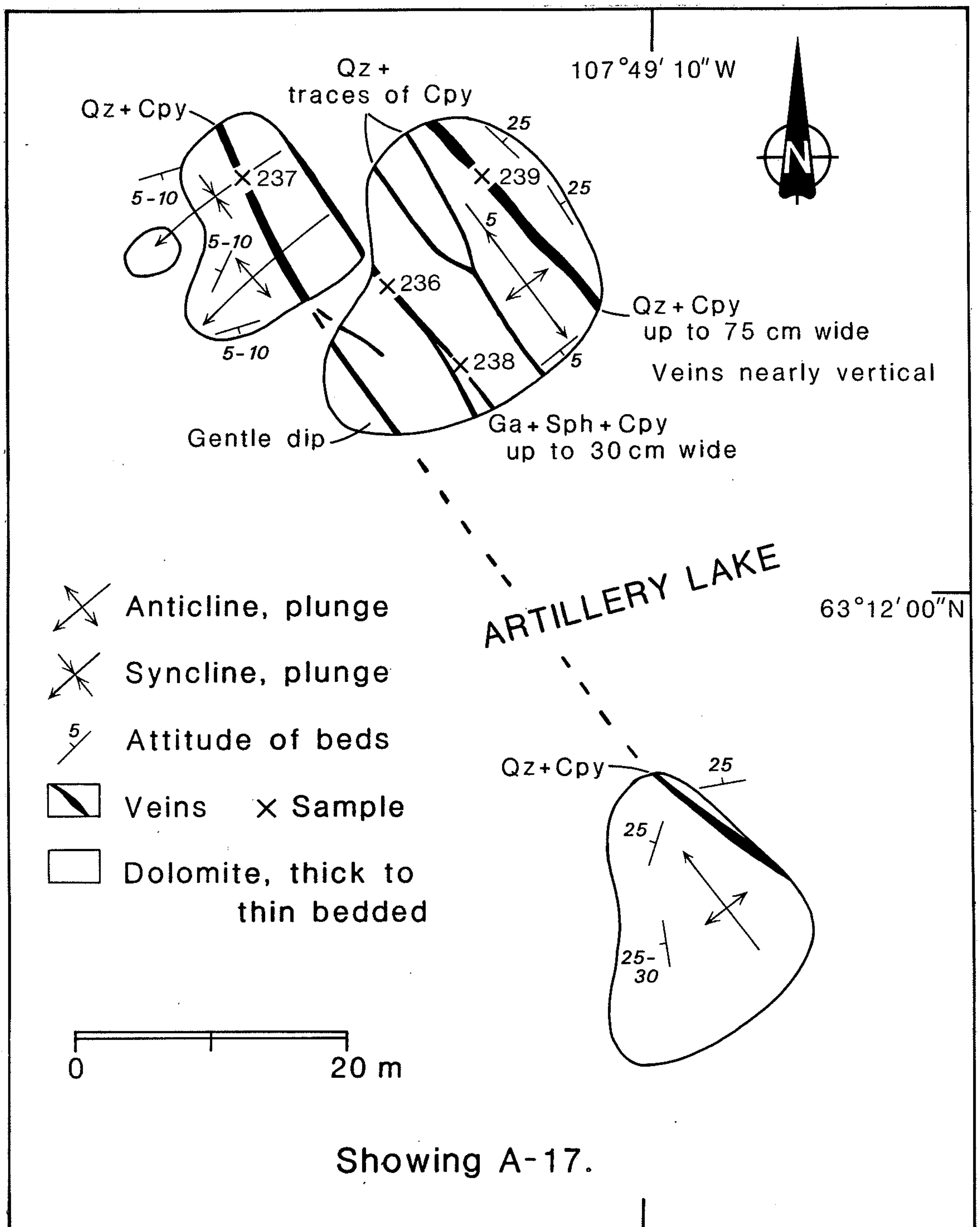


750/4-8

NTS AREA-INDEX NO.: 75O/4-8

NAME: A-11 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°14'20"N, Long.: 107°50'50"W
DESCRIPTION:

Gently dipping, laminated veins of agate, crystalline quartz, pyrite and sphalerite occur in Archean granite on the northwest shore of Artillery Lake. They are exposed at several localities along a 200 m length of the shoreline (Figure below). They are up to 25 cm thick, and commonly dip gently to the southeast. Their layering parallel to the walls reflects repeated successive deposition of thinly laminated agate, fine to medium grained quartz, pyrite and sphalerite. The laminae and lensoid aggregates of individual minerals are a fraction of a millimetre to several millimetres thick. The agate and quartz laminae tend to be more continuous than those of the sulphides which commonly pinch out or are disrupted within a distance of several centimetres. Minor folds and domal structures up to a centimetre in diameter are common. Repeated sequential deposition is evidenced by some fragments of earlier sequence covered by a later sequence. Thin sections show finegrained, acicular quartz crystals, arranged parallel to lamination in some layers and perpendicur to it in other layers, and in domal structures. Pyrite is more abundant than sphalerite, and forms layers up to 2 mm thick adjacent to the sphalerite aggregates, lenses, and layers that are relatively thinner and



75O/4-9

less continuous than those of pyrite. Pyrite also occurs as disseminations in a few cherty layers, and locally forms irregular aggregates. Coarse, randomly oriented quartz crystals occur as aggregates between pyrite layers, and also as patches and veins with fragments of layered material. Calcite is present locally as irregular to lensoid medium grained aggregates in the sulphide-bearing veins. The veins do not contain visible galena, but two samples analyzed contain 726 and 2090 ppm lead (Table 1, Appendix 2), and a small quantity of galena was separated from one of the samples for lead isotopic analyses (Table 2, Appendix 2).

The host rock is medium grained, hornblende (± biotite) granite, and grades into porphyritic and foliated varieties at many places. Some pegmatitic pods are also present. There are a few veinlets of chert and dolomite in the granite. Chert at one locality is red. Relationship of these veins with the sulphide-bearing veins is not evident at this showing, but observations at other showings in the Artillery Lake area show that the sulphide-bearing veins are younger.

EXPLORATION:

The showing was discovered in 1983 by S.S. Gandhi, and was mapped by him in 1984.

REMARKS:

This showing is similar in character to Showing A-10 located 2 km to the south-southwest.

REFERENCES:

Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75O/4-9

NAME: A-17 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°12'00"N, 107°49'10"W
DESCRIPTION:

A set of five north-northwest trending veins carrying galena, sphalerite, chalcopyrite, quartz and carbonate, occur on a group of small islands near the northwest shore of Artillery Lake. The veins are a few metres apart from each other within a 15 m wide zone. They are nearly vertical, gently undulating along strike, and have bifurcations in some places (see accompanying sketch). Two outer veins are quartz-rich with disseminated pyrite and chalcopyrite, and are 30 to 75 cm wide. The inner veins are narrower, only a few centimetres in width. One of them contains abundant galena and sphalerite. The other two are quartz chalcopyrite-pyrite veins. The occurrence of galena-sphalerite in narrow quartz-poor veins on one hand and chalcopyrite in wider quartz-pyrite veins on the other hand, is common in the Artillery Lake Pb-Zn-Cu district (Gandhi, 1985). They form, however, an interconnected vein system and are believed to be essentially coeval.

The host rock is dolomite of early Proterozoic Artillery Lake formation, which is thin to thick bedded. It is folded gently about two sets of axes, trending northeast and north-northwest, hence forming domes and saddle structures. The veins cut across the folds, and thus post-date the folding. A set of easterly trending quartz-filled tension gashes occurs in the dolomite, and they may be younger than the sulphide bearing veins.

Chemical analyses of one sample (GFA-'84-236) containing galena and sphalerite are given in Table 1 (Appendix 2). Lead isotopic analyses of the galena separate from the sample are given in Table 2 (Appendix 2). A pink stain was observed in the southern quartz-chalcopyrite-pyrite vein near its northwest end. The stain resembles cobalt bloom, but no cobalt mineral could be found in the vein.

EXPLORATION:

The showing was discovered and mapped by S.S. Gandhi in 1984.

REFERENCES:

Gandhi, S.S., 1985.

NTS AREA-INDEX NO.: 75O/4-10

NAME: A-18 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat: 63°07'24"N, Long.: 107°52'07"W
DESCRIPTION:

Galena and sphalerite occur in veins and as coarse aggregates with quartz at the northern tip of a triangular island near the centre of Artillery Lake. The island is 400 m long in a north-south direction, and is located 2.5 km north of Crystal Island.

The galena-sphalerite-bearing veins are up to 2 cm thick, nearly vertical, in thinly bedded dolomite and dolomite breccia bed that dip gently to the east (see accompanying sketch). They are exposed in a 75 x 10 m long zone on the shore. At the south end of the zone, they form a rectangular stockwork pattern, with one set trending 005 ± 5° and dipping 75° to the west, and the other set trending 095 ± 5° and dipping 85° to the south. Approximately 25 m to the southwest of the stockwork, quartz-filled tension gashes occur in the dolomite. These trend easterly and dip steeply. They are barren of sulphides. Their age relative to the galena-sphalerite-bearing veins is not known with certainty.

Coarse aggregates of galena and sphalerite occur at the north end of the zone. Three aggregates, 10 to 25 cm in length, are exposed over a 5 m length of an irregular quartz-rich zone. Sphalerite is dark brown, and forms crystals up to 5 cm long. Galena cubes are up to 3 cm to a side. Pyrite, chalcopyrite and calcite are associated with them.

Chemical analyses of a galena separate from sample GFA-'84-780 are given in Table 1 and its lead isotopic analyses are presented in Table 2 (Appendix 2).

Traces of sphalerite occur in quartz approximately 50 m to the west of the main occurrence on the west shore of the island. Traces of chalcopyrite occur in quartz stringers at the south end of the island.

EXPLORATION:

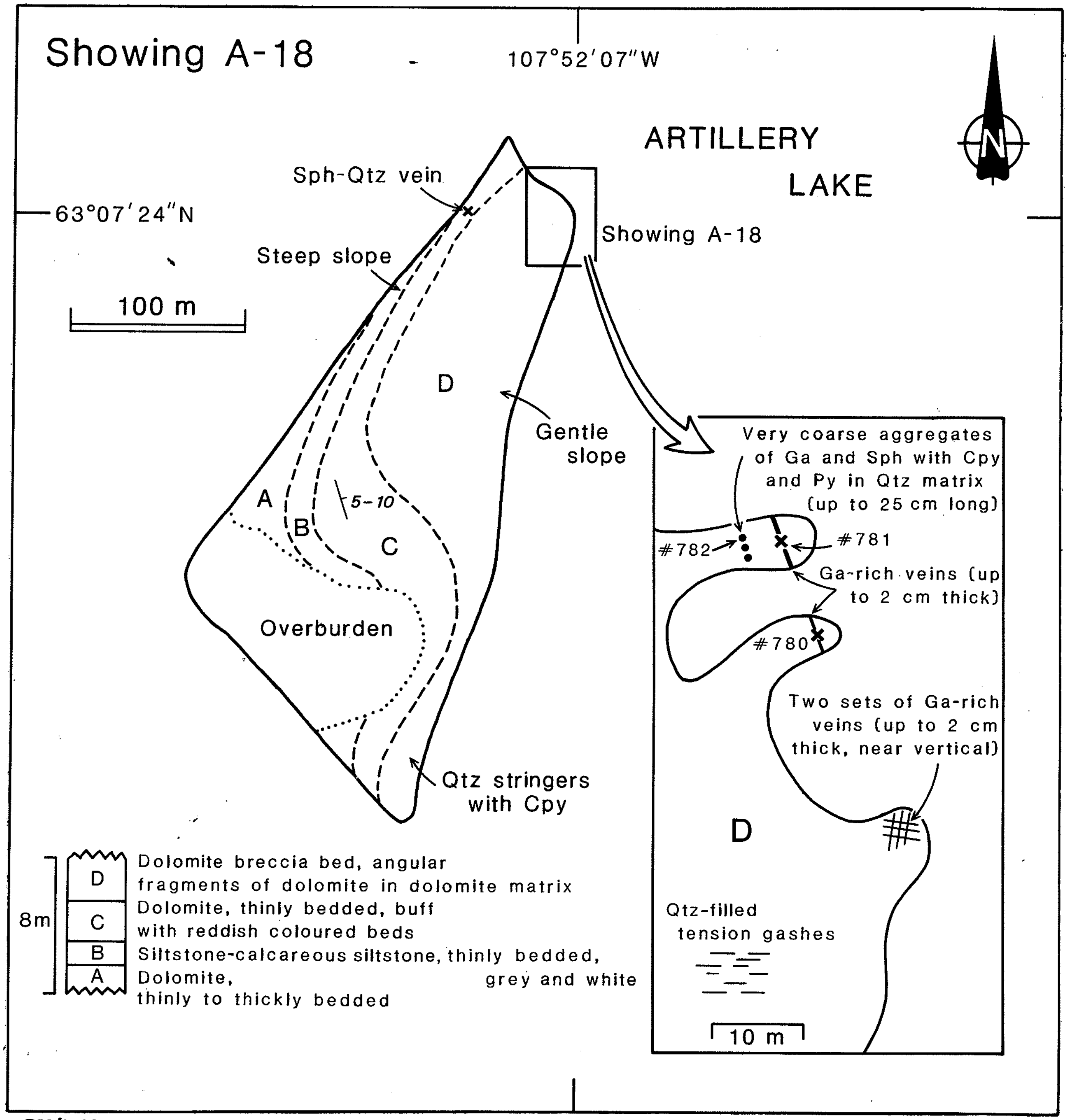
The showing was discovered and mapped by S.S. Gandhi in 1984.

REMARKS:

Showing A-18 and three other showings viz. A-1, A-2 and A-17, occur at stratigraphically higher level in the dolomitic Artillery Lake formation than the other 17 occurrences in the Artillery Lake area which are at or very close to the base of the formation (Gandhi, 1984, 1985).

REFERENCES:

Gandhi, S.S., 1984 and 1985.



750/4-10

NTS AREA-INDEX NO.: 75O/4-11

NAME: A-21 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°09'35"N, Long.: 107°56'03"W
DESCRIPTION:

Several high grade lead-zinc veins are exposed on the northwest shore of Artillery Lake in gently dipping basal beds of early Proterozoic Artillery Lake formation resting on the Archean granite and gneisses.

The veins are distributed along a 200 m length of the shore. They vary in width from a few centimetres to 35 cm, and are exposed for lengths up to 20 m. They are commonly steep, and trend between 050° to 060°, but some veins deviate up to 30° from this general trend. The largest cluster of the veins is in the north where six major veins and their branches occur within a 20 x 20 m area (see accompanying sketch). They contain coarse galena and sphalerite in quartz matrix. Pyrite, chalcopyrite and carbonates are present in smaller amounts, although at places chalcopyrite is abundant and forms aggregates several centimetres long.

Analyses of galena from sample GFA-'84-845 and of galena and sphalerite from sample GFA-'84-855 are given in Table 1 (Appendix 2).

The host beds are dolomite, gritty dolomite and chert with associated stratiform pyrite lenses. The chert is white or dark grey, and forms beds or lenses up to 75 cm thick. Pyritic lenses are also up to 75 cm thick and a few tens of metres in length. They contain chert, quartz and traces of pyrobitumen, but no galena, sphalerite or chalcopyrite are found in them.

The unconformity is not exposed, but a few outcrops of pegmatite and granite in the vicinity of Showing A-21 indicate that it is at a shallow depth within 100 m from the shore.

EXPLORATION:

The showing was discovered and mapped by S.S. Gandhi in 1984.

REMARKS:

The showing is located 1 km southwest of Showing A-6 (75O/4-3), which was erroneously shown at the site of Showing A-21 in earlier maps by Gandhi (1984, 1985). The two showings are separated by a bay, and apparently represent parts of a large mineralized zone or area.

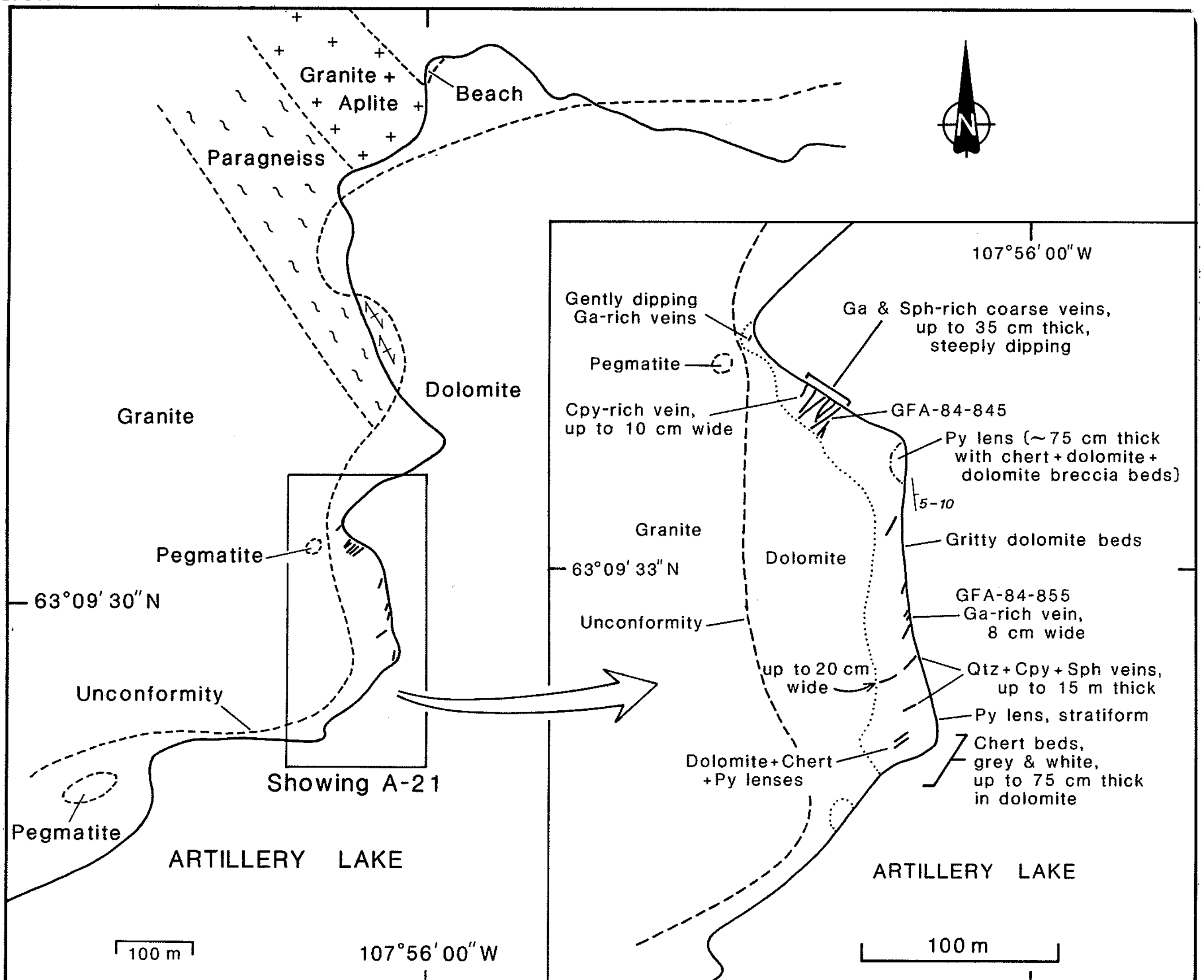
REFERENCES:

Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75O/5-1

NAME: A-12 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°16'47"N, Long.: 107°47'14"W
DESCRIPTION:

A massive galena aggregate, 5 cm x 2 cm in size, occurs in a quartz vein trending 350°. The vein is exposed on waterworn surface on the southeast side of a small island in Artillery Lake. The vein is nearly vertical, strikes across shore line and is covered by overburden to the north. The galena aggregate is in a gentle curve of the vein. Traces of chalcopyrite and galena are found in the vein away from the main aggregate. Traces of chalcopyrite also occur in coarse quartz veins several tens of metres to the east and on the north side of the island.



75O/4-11

The host rock is crudely gneissic porphyritic granite, locally megacrystic. At places the granite gneiss is strongly foliated and has diffuse banding of lighter and darker coloured phases, and contortions on metre scale. Muscovite-bearing pegmatite dykes are common. The granite is part of the Archean basement overlain by the dolomitic Artillery Lake formation of early Proterozoic age. Proximity to the unconformity is evident from the presence of neptunian dolomite veins up to 75 cm wide, with numerous angular fragments of wallrock granite. These dolomitic veins are cut by the quartz veins carrying galena and chalcopyrite.

Chemical and lead isotopic analyses of a galena separate from this showing (Sample GFA-84-12 B) are given in Tables 1 and 2 (Appendix 2).

EXPLORATION:

The showing was discovered by S.S. Gandhi in 1984.

REMARKS:

The showing is similar in character to the Showings A-13, A-15 and A-16 which are also hosted by the basement granite near the unconformity of the early Proterozoic dolomite (Gandhi, 1985).

REFERENCES:

Gandhi, S.S., 1985.

NTS AREA-INDEX NO.: 75O/5-2

NAME: A-13 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°19'38"N, Long.: 107°40'29"W
DESCRIPTION:

A vertical quartz-carbonate-galena-sphalerite vein trends 160°, and is up to 2 cm wide and over 4 m long. It is exposed on the south shore, near the northwest end of a 350 m long island in the northern part of Artillery Lake.

Galena occurs as coarse aggregates up to 5 mm wide. Calcite is abundant in the vein. Sphalerite is subordinate to galena in abundance.

The host rock of the vein is medium grained granite cut by muscovite-rich pegmatite dykes. These were at one time unconformably overlain by dolomite of the Artillery Lake formation, the remnants of which are preserved locally in hollows in paleo-surface and as sedimentary dyke-like pockets. The dolomite shows nearly horizontal bedding. Quartz-carbonate veins cut the dolomite, and also occur along north-northwest trending shear zones up to 10 cm wide in the granite basement. They contain pyrite in some places, but no other sulphides were found in them.

Multielement analyses of galena-rich and sphalerite-rich separates from a chip sample (No. GFA-84-52) are given in Table 1 (Appendix 2). They show 85.0 and 52.8 ppm Ag respectively. Lead isotopic analyses of the galena separate are given in Table 2 (Appendix 2).

EXPLORATION:

Discovery of the showing was made in 1984 by S.S. Gandhi.

REMARKS:

The showing is similar to Showings A-12, A-15 and A-16 which are hosted by granite in the vicinity of the unconformably overlying dolomite of the Artillery Lake formation (Gandhi, 1985).

REFERENCES:

Gandhi, S.S., 1985.

NTS AREA-INDEX NO.: 75O/5-3

NAME: A-14 (Artillery Lake)
COMMODITY: Copper
LOCATION: Lat.: 63°18'53"N, Long.: 107°40'00"W
DESCRIPTION:

Two nearly vertical quartz-pyrite-chalcopyrite veins, which are up to 30 cm wide and 20 m apart, occur on the south shore of an island in northern part of Artillery Lake. The island is approximately 1 km in diameter. The bedrock of the island is muscovite-rich, medium to coarse granite. Patches of dolomite overlying the granite, and veinlets of dolomite are common along the eastern and northeastern shore of the island. Some quartz-pyrite veins occur there, but no other sulphides are found in the veins.

The two chalcopyrite-bearing veins on the south shore trend 045° and 010°, and coalesce into one to the south several tens of metres from the shore, as can be seen through clear shallow water up to 15 m deep. They are exposed on the shore for approximately 25 m strike length, and are covered by overburden to the north. Chalcopyrite occurs as disseminated grains and aggregates in quartz. Green malachite stains are common at the surface. Pyrite is associated with, and is more abundant than chalcopyrite. It usually forms aggregates up to 3 cm wide and 10 cm long in the eastern vein trending 010°. Dolomite veins occur along side of the quartz veins, and are up to 20 cm wide.

EXPLORATION:

The showing was encountered during the course of fieldwork by S.S. Gandhi in 1984. Presence of broken pieces of chalcopyrite-bearing vein material at the site and of remnants of small camp nearby, show that a prospector or a hunter had seen the showing previously.

REMARKS:

The quartz-pyrite-chalcopyrite veins strongly resemble those of Showing A-4 in the southern part of Artillery Lake (75N/1-2) where galena--sphalerite-bearing veins also occur in the vicinity and in places grade into the quartz-pyrite-chalcopyrite veins (Gandhi, 1984). It is therefore possible that galena and sphalerite are present in the vein system of Showing A-14.

REFERENCES:

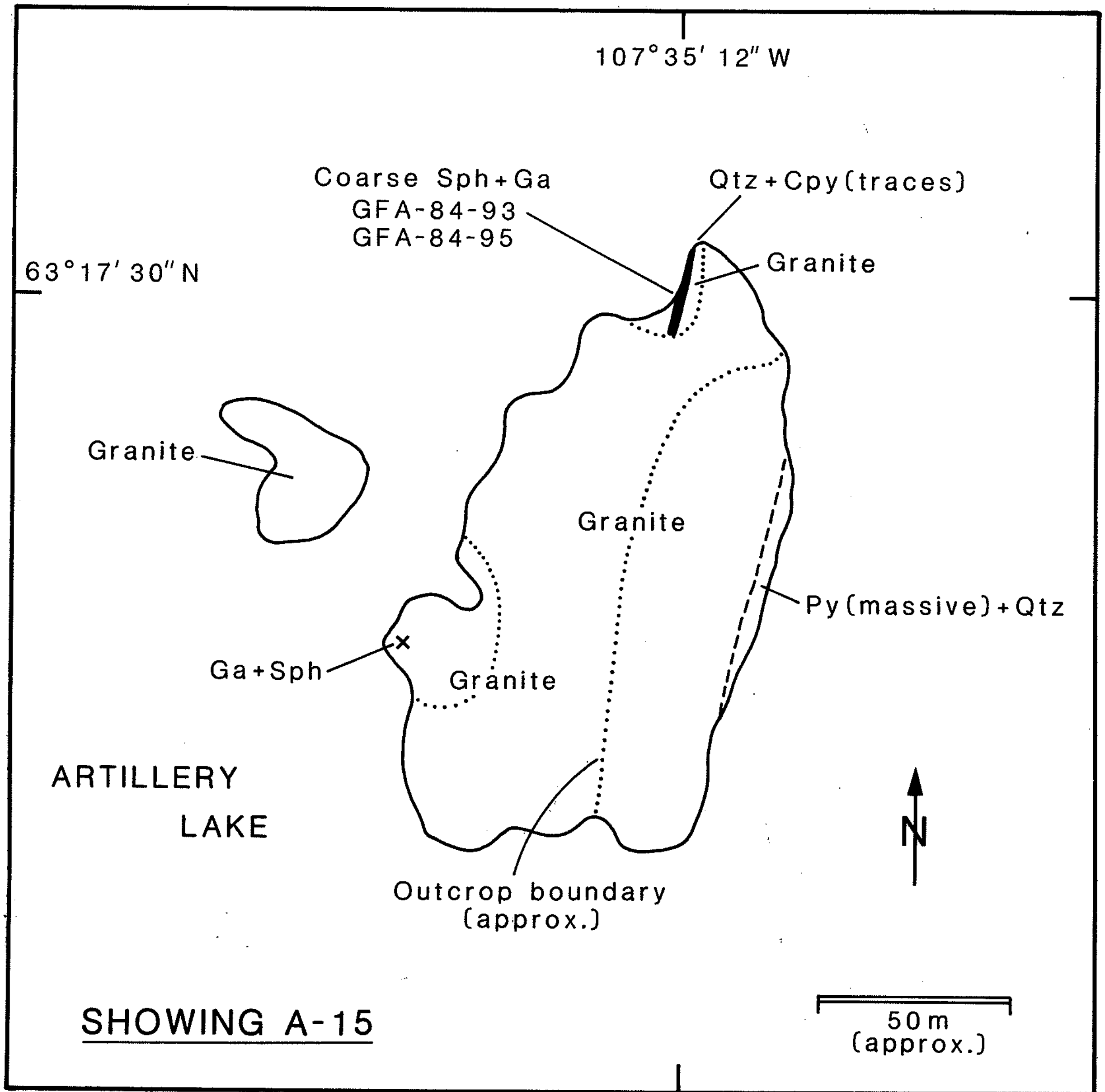
Gandhi, S.S., 1984 and 1985.

NTS AREA-INDEX NO.: 75O/5-4

NAME: A-15 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°17'30"N, Long.: 107°35'12"W
DESCRIPTION:

A rectangular island approximately 150 m long in N 10°E direction and 75 m wide, located on the east shore Artillery Lake, has galena and sphalerite in a large quartz vein at the north tip and in small veinlets in southwest corner (Figure below).

The large vein is vertical and trends approximately 010°, and is up to 0.5 m wide and over 25 m long, and is covered by overburden in the south. The southern part of the vein contains a spectacular concentration of very coarse sphalerite and galena in a pocket 0.3 m wide and 2 m long,



750/5-4

exposed on a west facing, nearly vertical, 2 m high, side of outcrop ridge. Sphalerite occurs as dark brown crystals up to 10 cm long, and galena cubes are up to 3 cm to a side. Interstitial material is quartz and minor calcite. Chemical analyses of galena and sphalerite separates from this lens are given in Table 1 (Sample Nos. GFA-84-93 and 95; Appendix 2). Chalcopyrite occurs in the northern part of the vein and is associated with pyrite. These sulphides form disseminations and small aggregates in quartz matrix.

The veinlets in the southwestern part of the island are randomly oriented. They are up to a few cm thick and several metres long.

The host rock is coarse granite containing biotite, muscovite and porphyritic feldspar. It underlies the whole island. The eastern shore of the island is conspicuous because of a rusty weathering pyrite-rich quartz-carbonate vein, exposed all along steep east-facing slope. It is up to a metre wide. There was no visible galena, sphalerite or chalcopyrite found in this pyrite-rich zone.

EXPLORATION:

The showing was found during 1984 by S.S. Gandhi.

REMARKS:

The vein-type base metal mineralization here in the basement granite, near the unconformity with early Proterozoic dolomite, is similar to that at Showings A-12, A-13 and A-16 except for the spectacular concentration of very coarse sphalerite and galena (Gandhi, 1985).

REFERENCES:

Gandhi, S.S., 1985.

NTS AREA-INDEX NO.: 75O/5-5

NAME: A-16 (Artillery Lake)
COMMODITY: Lead, Zinc, Copper
LOCATION: Lat.: 63°16'32"N, Long.: 107°38'26"W
DESCRIPTION:

Galena-rich quartz-calcite veins occur in megacrystic granite on the east shore of Artillery Lake (Figure below). Sphalerite is associated with galena but is subordinate to it. The veins are a fraction of a centimetre to 3 cm wide, nearly vertical and several metres long. One north-trending vein is exposed for 25 m. Others located 25 m to its south have an easterly trend. The galena veins clearly post-date the dolomite veins, which are neptunian veins filling cracks in the basement granite. Remnants of dolomitic Artillery Lake formation, unconformably overlying the granite, are preserved as pockets in some paleo-topographic lows in the basement. They contain angular fragments of granite.

Quartz-pyrite veins with traces of chalcopyrite occur 150 m to the south. These trend approximately east-northeast at low angle to a northeast-trending dolomite vein. The dolomite vein is probably the southwest extension of the one cut by the galena veins.

Chemical analyses of galena and sphalerite separates, and lead isotopic analyses of the galena from a sample (GFA-'85-35) of this showing are given in Tables 1 and 2 respectively (Appendix 2).

EXPLORATION:

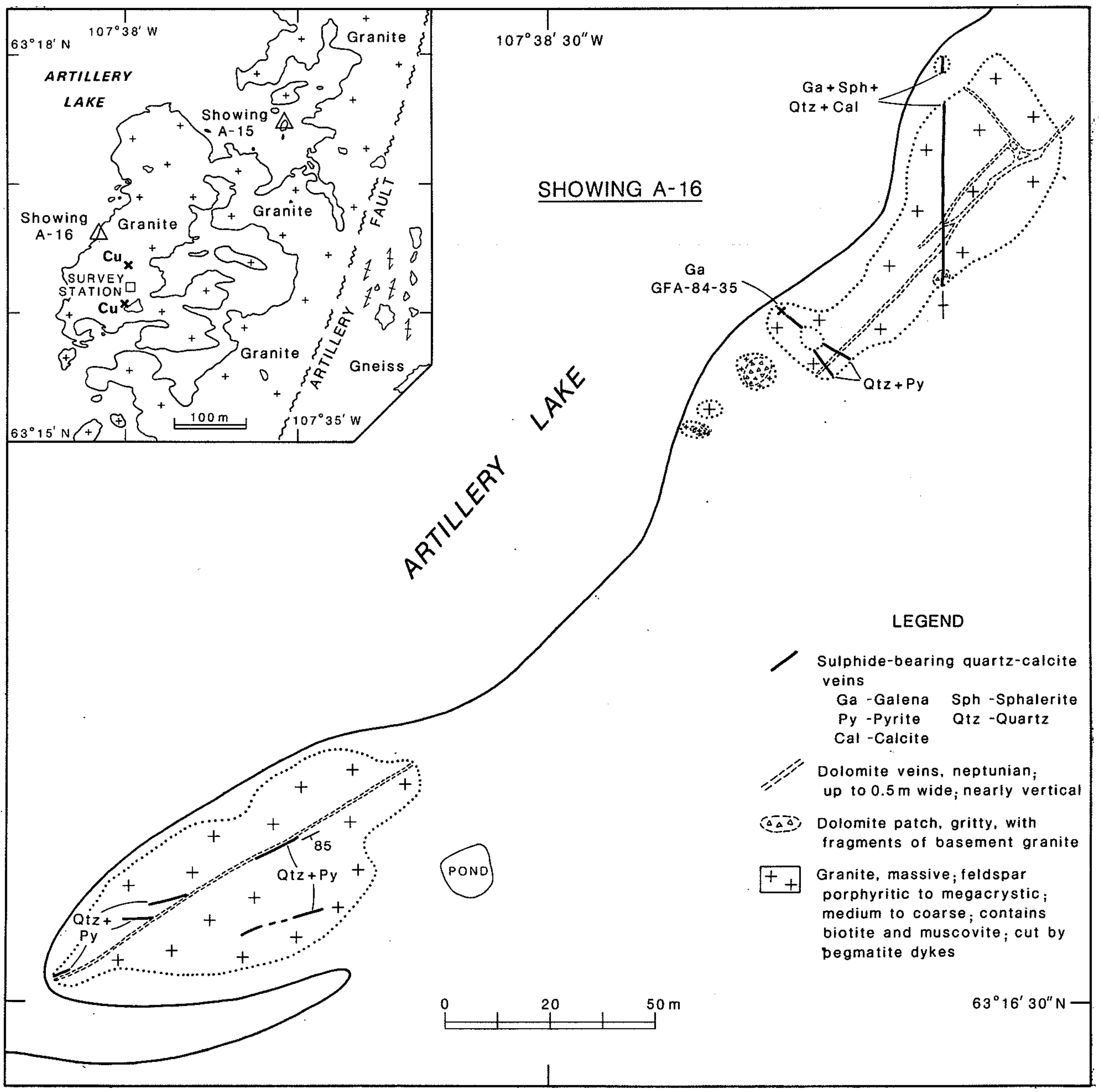
Discovery of this showing was made in 1984 during the course of fieldwork by S.S. Gandhi and G. Philpott.

REMARKS:

The galena-sphalerite veins are similar to those at Showings A-12, A-13 and A-15, all of which are in the basement granite. Scattered small occurrences of chalcopyrite-bearing quartz veins in the granite are found approximately 1/2 to 1 km to the southeast of Showing A-16.

REFERENCES:

Gandhi, S.S., 1985.



APPENDIX 2

Table 1: Analyses of whole rock samples and mineral separates from veins carrying galena, sphalerite, chalcopyrite, pyrite, quartz and carbonates; Artillery Lake, Northwest Territories.

Serial Number	Showing Number	Sample Number GFA-	Rock/ Mineral	Pb ppm	Zn ppm	Cu ppm	Ag ppm	Au ppb	Bi ppm	Cd ppm	Hg ppb	As ppm	Co ppm	Ni ppm	Sb ppm	Se ppm	Te ppm	Ba ppm	Mo ppm	Sn ppm	V ppm	W ppm	Fe percent	Mn ppm
1	A-1	83-527	Rock	9200	>20000	252	25.4		4	106.6		1451				7	<3		4	6		<1		
2	A-1	83-528	Galena				383.9		146			42			375	2030			<1					
3	A-1	83-525	Sphal				41.1		6	113.5		65			38								2	
4	A-1	84-462	Sulph	1358	>20000	688	84.7		6	444	>5000	>2000	336	536	66		<10						27.6	
5	A-2	83-523	Galena				124.1		3			58			200	<5			6					
6	A-2	83-521A	Py+Sph				24.0		<2	2.8		457			87								30.9	
7	A-4	83-438	Rock	8910	>20000	725	21.4	25	<2	118.5	5000	34				<5	<3	52	<1	14		<1		
8	A-4	83-438	Sphal				18.5		<1	135.3		22			42								2.1	
9	A-4	83-440	Galena				86.4		2			14			103	165			<1					
10	A-4	83-443	Rock	110	987	13640	10.2	15	<2	1.1	725	23				9	<3	101	4	8		<1		
11	A-4	83-445A	Side	52	248	207	1.2	5	2	0.5	70	117				<5	18	58	<1	<1		<1		
12	A-4	83-445B	Side	100	184	144	1.8	15	2	0.5	35	22				<5	20	<15	<1	<1		<1		
13	A-4	83-445C	Cpy						<1			3	3	9	10		26							
14	A-5	83-490A	Py+Cpy	90	211	>20000	8.8	40	<2	<0.5	220	309				20	7	135	<1	6		<1		
15	A-6	83-575	Sphal				46.6		<1	77.3		301			22								8.0	
16	A-7	83-570	Galena				74.0		<1			146			76	<5			<10					
17	A-8	83-586	Pyrite	215	253	104	4.7	15	<2	1.1	70	64				<5	11	35	8	<1		<1		
18	A-11	83-581	Rock	726	>20000	199	7.2	<10	<2	150.7	1635	100				<5	<3	194	42	<1		<1		
19	A-11	83-580	Rock	2090	9940	465	21.4	< 5	<2	32.4	545	415				<5	15	50	86	<1		<1		
20	A-11	83-580	Sphal				21.9		2	210.1		104			18								5.4	
21	A-11	83-580	Pyrite				<0.3		<1			727	60	151	26		28							
22	A-12	84-12B	Galena		48		117.9	12		85		<5	<1	<1	54	<5	<10	<1		<10	<1	<10		
23	A-13	84-52	Galena		>20000		85.0				610	62	14	14		<5	<10		4	<10	<1	<10		
24	A-13	84-52	Sphal	12740			52.8		<2	1164	>5000	172	40	38	14	<5			8		<1		4.0	166
25	A-15	84-93	Galena		70		91.2		10		105	<5	<1	<1	52	16	<10		<1	<10	<1	<10		
26	A-15	84-95	Sphal	176			22.3		<2	1092	>5000	<5	188	4	<5	<5			<1		<1		2.0	36
27	A-16	84-35	Galena		>20000		27.1				1745	<5	12	<1	12	38	<10		2	<10	<1	<10		
28	A-16	84-35	Sphal	3476			23.7		<2	1867	>5000	14	144	<1	20	<5			<1		<1		1.4	36
29	A-17	84-236	Rock	13160	>20000	1994	98.0		12	657	>5000	40	44	18	108	<5	<10						2.2	
30	A-18	84-780	Galena		5100		158.0		<2		>5000	78	6	8	188	<5	<10		3	<10	<1	<10		
31	A-19	84-656	Rock	5480	>20000	>20000	9.9		<2	765	>5000	1750	354	360	18		<10						7.8	
32	A-20	84-615	Py+Cpy	306	2054	>20000	7.2	40	<2	<1	215	>2000	1140	762	20	<5	<10						26.2	
33	A-21	84-845	Galena		1314		58.3		<2		170	32	6	10	58	<5	<10		5	<10	<1	<10		
34	A-21	84-855	Galena		4932		132.0		6		590	<5	6	2	128	48	<10		4	<10	<1	<10		
35	A-21	84-855	Sphal	5360			11.0		<2	1512	>5000	36	242	72	14	<5			<1		<1		1.8	204

Notes:
(1) Analyses by Bondar-Clegg & Company Limited, Ottawa, Ontario.
(2) Samples collected by and the showings described by S.S. Gandhi (1984, 1985) of the Geological Survey of Canada.
(3) Cpy: Chalcopyrite, Py; Pyrite, Side: Siderite, Sph: sphalerite and Sulph: Sulphides.
(4) Location of Showings A-1 to A-21 shown in Figure 11 and Map 3.
(5) Analytical methods: (a) Fire Assay - Classical Gravimetric for Ag in all samples except 8 listed under (c) below;
(b) Fire Assay - Atomic Absorption for Au;
(c) Direct Current Plasma for Ag in samples #7, 10, 11, 12, 14, 17, 18 & 19; for Pb, Zn, Cu, Bi, Cd, As, Co, Ni, Sb, Se, Te, Mo, Sn, V, W, Fe and Mn in all samples except those listed under (d) below;
(d) Atomic Absorpiton for Cd, Fe, Bi, As and Sb in 5 sphalerite samples #3, 6, 8, 15 and 19; for Mo and Bi in galena samples 2, 5, 9 and 16;
(e) Colourimetric for As and Te in 4 galena samples as above;
(f) X-ray Fluorescence for Sb and Se in 4 galena samples as above; for Sb in samples #13 and 21; for Ba;
(g) Cold Vapour - Atomic Absorption for Hg.
(6) <denotes less than viz. below detection limit of the analytical method used; >denotes more than viz. above the analytical range of the method used; Blanks represent the elements not analyzed for.

APPENDIX 2

Table 2. Pb isotope ratios in galena separates from veins in the Artillery Lake area, Northwest Territories.

Serial Number	Showing Number	Sample Number GFA-	Latitude N Longitude W	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
1	A-1	83-528	63°04'10" 107°54'35"	16.585	15.600	35.938
2	A-2	83-523	63°04'00" 107°55'00"	16.475	15.561	35.781
3	A-4	83-440	63°04'08" 108°06'54"	18.031	16.048	36.939
4	A-4	83-443	63°04'08" 108°06'54"	18.593	16.194	37.301
5	A-6	83-575	63°10'00" 107°55'10"	18.448	16.410	36.292
6	A-7	83-570	63°11'00" 107°54'07"	18.472	16.411	36.277
	(repeat)	(" ")	(" ")	(18.477)	(16.415)	(36.281)
7	A-8	84-584	63°11'25" 107°53'42"	17.896	16.067	36.146
8	A-9	83-584A	63°11'35" 107°53'25"	17.594	16.056	36.134
9	A-11	83-580B	63°14'20" 107°50'50"	17.001	15.766	36.282
10	A-12	84-12B	63°16'47" 107°47'14"	16.720	15.659	36.323
11	A-13	84-52	63°19'38" 107°40'29"	17.312	15.987	35.946
12	A-15	84-93	63°17'30" 107°35'12"	17.757	15.959	37.849
13	A-17	84-236	63°12'00" 107°49'10"	16.110	15.475	35.565
14	A-18	84-780	63°07'24" 107°52'07"	16.492	15.547	35.692
15	A-19	84-656	62°58'54" 107°10'57"	19.216*	16.403*	37.257*

Notes:

(1) Samples collected by, and the showings described by S.S. Gandhi (1984, 1985; Appendix 1).

(2) Analyses by Geospec Consultants Limited, Edmonton, Alberta.

(3) Uncertainty limits are 0.042%, 0.052% and 0.058% for the ratios $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$ respectively. Asterisk indicates that the uncertainty limits for this sample are approximately three times these values.

APPENDIX 2

Table 3: Analyses of iron formations and associated rocks in the McLeod Bay area, East Arm of Great Slave Lake, Northwest Territories

Location	Viren Island					Shelter Bay		Taltheilei Narrows							
Serial No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sample No.	GFA-83 -331	" -337	" -357	" -358	" -359	" -367	GFA-83 -376	GFA-84 -701	" -702	" -703	" -704	" -705	" -706	" -707	" -708
Thickness/	–	–	–	100 cm	100 cm	–	–	23 cm	26 cm	5 cm	12 cm	–	–	–	–
Hand Sample	HS	HS	HS	–	–	HS	HS	–	–	–	–	HS	HS	HS	HS
SiO_2 %	58.9	43.5	67.8	53.2	59.4	61.9	57.8	81.1	62.9	82.5	68.8	53.1	51.3	50.1	45.9
TiO_2 %	0.02	0.01	0.01	0.05	0.02	0.07	0.01	0.01	0.02	0.01	0.01	0.46	1.25	0.76	0.71
Al_2O_3 %	1.23	0.44	0.68	1.43	0.76	1.80	1.42	0.44	1.05	0.58	0.72	6.85	12.8	13.8	8.25
Fe_2O_3 %	34.6	54.2	30.9	23.3	31.1	29.1	27.8	10.4	22.7	16.2	21.5	20.4	4.6	8.6	11.2
FeO %	0.1	0.0	0.1	1.8	1.0	0.3	1.1	0.5	1.8	0.1	1.2	4.6	8.4	6.6	6.7
MnO %	0.02	0.01	0.01	0.20	0.07	0.15	0.36	0.18	0.30	0.02	0.23	0.23	0.25	0.17	0.47
MgO %	0.89	0.17	0.30	3.52	1.82	0.45	2.30	1.02	2.06	0.18	1.39	3.03	4.85	4.65	5.09
CaO %	0.59	0.11	0.33	5.17	2.62	3.23	4.07	1.95	3.58	0.17	2.43	2.46	2.77	2.08	5.47
Na_2O %	0.03	0.04	0.05	0.06	0.04	0.18	0.05	0.10	0.07	0.09	0.06	0.43	0.95	0.56	0.42
K_2O %	0.06	0.03	0.05	0.14	0.04	0.23	0.02	0.02	0.04	0.05	0.02	1.89	4.02	4.39	2.72
H_2OT %	0.8	0.3	0.5	1.1	0.9	0.8	0.9	0.7	0.9	0.6	0.8	2.2	3.8	4.1	2.6
CO_2T %	1.0	0.3	0.8	8.4	4.1	2.8	5.6	3.2	5.6	0.5	4.1	4.0	4.0	3.3	9.5
P_2O_5 %	0.03	0.01	0.01	0.02	0.02	0.02	0.01	0.03	0.02	0.02	0.02	0.09	0.29	0.15	0.15
S %	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.03	0.00	0.00	0.03	0.00	0.04	0.04	0.00
Total	98.30	99.12	101.54	98.39	101.89	101.07	101.44	99.68	101.04	101.02	101.31	99.74	99.32	99.30	99.18
Ba ppm	30	30	10	30	40	700	230	0	40	10	30	190	260	380	220
Be ppm	1.3	1.2	1.5	1.2	0.9	0.8	0.5	0.5	0.6	0.6	0.7	1.2	1.7	3.0	1.6
Co ppm	7	3	4	11	6	6	7	3	5	2	5	15	22	23	24
Cr ppm	7	0	9	25	10	22	18	27	19	16	12	59	150	96	100
Cu ppm	11	15	10	12	12	21	20	32	13	5	140	15	48	17	16
La ppm	2	1	1	4	3	13	6	3	5	1	4	30	36	40	29
Ni ppm	9	5	6	13	9	26	16	9	11	5	11	39	67	72	51
V ppm	19	11	13	35	13	27	48	12	20	12	23	110	110	85	64
Yb ppm	0.0	0.0	0.0	0.4	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.8	1.9	1.7	1.4
Zn ppm	9	7	8	14	8	20	37	6	25	4	15	52	74	73	55
U ppm	1.4	1.0	0.8	1.6	1.1	3.2	1.2	0.5	0.3	0.4	0.7	1.9	3.0	2.4	2.2
Th ppm				4.0	2.5			0.2			0.3		11.0		
Au ppb				<1	2			<1			< 1		2		
Ag ppm				<0.5	< 0.5			<0.5			< 0.5		2.0		
As ppm				18	26			8			13		4		
Mo ppm				<1	< 1			1			< 1		3		
Pb ppm	(0)	(3)	(6)	<2	< 2	(14)	(12)	2	(8)	(5)	< 4	(11)	8	(16)	(15)
Sb ppm				1.2	1.3			1.0			0.7		0.7		
Sc ppm				1.8	1.1			0.9			1.7		17.3		
Sn ppm				<3	< 3			<3			< 3		< 3		
W ppm				3	3			<1			1		3		

Location	Taltheilei Narrows														
Serial No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sample No.	" -709	" -710	" -711	" -712	" -713	" -714	" -715	" -716	" -717	" -717A	" -718	" -720	" -721	" -722	GFA-84 -723
Thickness/	–	–	–	8 cm	27 cm	22 cm	10 cm	5 cm	10 cm	–	15 cm	30 cm	25 cm	–	–
Hand Sample	HS	HS	HS	–	–	–	–	–	–	HS	–	–	–	HS	HS
SiO_2 %	49.5	13.5	43.7	61.3	63.9	72.0	71.3	58.6	66.6	23.4	57.5	39.3	32.9	48.2	51.1
TiO_2 %	0.42	0.11	0.37	0.03	0.02	0.01	0.02	0.01	0.01	0.01	0.10	0.10	0.09	1.54	1.38
Al_2O_3 %	12.1	3.03	11.1	1.56	1.06	0.53	0.84	0.34	0.30	0.37	1.82	3.02	2.34	13.5	13.2
Fe_2O_3 %	11.4	4.2	4.8	29.9	29.4	11.5	25.6	4.1	10.2	2.9	28.0	7.8	12.2	3.8	4.2
FeO %	5.5	8.2	6.7	1.0	0.9	1.7	0.4	3.1	3.1	5.8	1.7	3.9	4.2	10.3	5.6
MnO %	0.25	1.11	0.48	0.10	0.12	0.30	0.04	0.65	0.42	1.21	0.20	0.61	0.76	0.16	0.26
MgO %	4.72	11.4	6.46	1.09	1.05	2.35	0.48	5.51	3.29	11.4	2.05	7.91	8.34	6.26	4.56
CaO %	3.15	21.1	7.56	1.33	1.50	4.41	0.51	10.6	5.77	22.1	3.21	14.1	14.6	1.87	3.13
Na_2O %	0.67	0.14	0.61	0.05	0.05	0.04	0.06	0.04	0.03	0.03	0.06	0.09	0.11	0.57	0.59
K_2O %	3.77	0.64	3.47	0.17	0.10	0.07	0.06	0.02	0.05	0.07	0.46	1.09	0.64	3.78	5.80
H_2OT %	3.6	1.5	3.1	0.8	0.7	0.6	0.5	0.6	0.4	0.5	0.8	1.0	1.0	5.0	2.8
CO_2T %	4.9	33.6	11.5	2.3	2.5	7.1	0.9	17.0	10.3	33.8	5.0	22.1	23.0	2.7	8.8
P_2O_5 %	0.08	0.04	0.08	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.06	0.06	0.30	0.23
S %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Total	100.06	98.57	99.93	99.65	101.32	100.63	100.73	100.63	100.49	101.61	100.94	101.08	100.24	98.00	101.65
Ba ppm	350	80	290	60	60	10	40	20	0	20	70	60	70	260	290
Be ppm	2.7	0.9	2.4	0.8	0.7	0.6	0.7	0.5	0.5	0.6	0.9	1.3	1.1	2.3	2.8
Co ppm	23	16	15	7	8	7	5	9	10	11	8	10	12	40	29
Cr ppm	55	43	70	2	11	23	9	27	22	39	13	33	34	160	110
Cu ppm	13	33	14	15	16	25	25	11	23	14	22	16	20	22	13
La ppm	42	20	35	6	6	5	7	7	4	7	11	14	16	32	42
Ni ppm	62	28	46	23	27	15	20	15	16	17	25	22	31	120	95
V ppm	64	26	61	31	24	22	12	10	11	13	22	19	25	150	120
Yb ppm	1.4	1.1	1.6	0.0	0.0	0.8	0.6	0.3	0.0	0.3	0.1	0.7	1.5	1.7	1.9
Zn ppm	69	38	68	12	13	10	11	12	11	17	14	17	21	94	37
U ppm	2.2	0.8	3.1	1.2	1.1	0.8	0.6	0.1	< 0.1	< 0.1	0.7	1.0	0.7	2.5	3.2
Th ppm	18.0		14.0		0.4						1.9	4.0			
Au ppb	< 1		< 1		< 1						< 1	< 1			
Ag ppm	1.0		1.0		0.5						0.5	0.5			
As ppm	9		3		24						16	5			
Mo ppm	1		< 1		3						1	< 1			
Pb ppm	6	(9)	6	(12)	< 2	(9)	(9)	(10)	(13)	(10)	< 2	< 2	(9)	(16)	(16)
Sb ppm	1.3		0.7		0.9						0.7	0.4			
Sc ppm	13.5		13.7		1.4						2.7	2.4			
Sn ppm	< 3		< 3		< 3						< 3	3			
W ppm	1		1		3						3	3			

Notes:

(A) Samples

i) Viren Island samples from the main showing on the island, at 62°47'39"N, 110°57'03"W; GFA-83-331, 357 and 358 from the upper 1 m thick part of the iron formation and GFA-83-337 and 359 from the lower 1 m thick part of it; Mineral Occurrence 75 L/5-1 in Appendix 1, with figure.

ii) Shelter Bay samples located at 62°48'46"N, 110°31'15"W, on the north shore of Pethei Peninsula; GFA-83-376 from the shore exposure and GFA-83-367 approximately 100 m west-southwest of it at higher stratigraphic level; Mineral Occurrence 75 L/15-4 in Appendix 1, with figure.

iii) Taltheilei Narrows samples from shore exposures at 62°28'45"N, 110°36'30"W, on the west side of Pethei Peninsula, 9 km north of Point Busse; stratigraphic position of the samples shown in Figure 10; Mineral Occurrence 75 L/5-1, Appendix 1.

iv) 'Thickness' refers to chip sample length across bedding viz. true stratigraphic thickness of the sampled horizon or beds; 'Hand Sample' is a selected representative sample from a horizon or thin unit, less than 10 cm thick.

(B) Analyses

i) SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O and K_2O by inductively coupled plasma method, and FeO, H_2O (Total), CO_2 (Total), P_2O_5 and S by chemical methods; Geological Survey of Canada, Ottawa.

ii) Fe_2O_3 calculated using formula Fe_2O_3 = Fe_2O_3 Total (ICP method) – 1.11134 x FeO (volumetric method).

iii) Ba, Be, Co, Cr, Cu, La, Ni, V, Yb, Zn and Pb (numbers quoted in bracket) by inductively coupled plasma method; Geological Survey of Canada, Ottawa; Estimate of validity of results: Ba and Pb ± 20 ppm; Cr, Cu, La and Ni ± 10 ppm; Co, V and Zn ± 5 ppm; Be and Yb ± 0.5 ppm, and in addition, for each of these elements, 5 per cent of concentration except for 10 per cent concentration in case of Pb.

iv) U by delayed neutron counting; Atomic Energy of Canada Limited, Ottawa, except for the results under serial numbers 4, 5, 8, 11, 13, 16, 18, 20, 26 and 27 which were reported by X-ray Assay Laboratories, Toronto, using the same method, with a detection limit of 0.100 ppm.

v) Other elements by various methods as follows (with detection limits in brackets): Au – Fire assay and neutron activation (1.00 ppb); Th, As, Sb, Se and W by neutron activation (0.100, 1.00, 0.200, 0.100, and 1.00 ppm respectively); Ag, Mo and Pb by direct current plasma (0.50, 1.00 and 2.00 ppm respectively); and Sn by X-ray fluorescence (3.00 ppm); X-ray Assay Laboratories Limited, Toronto.