INVESTIGATION OF FOUR URANIUM SHOWINGS IN THE CENTRAL MINERAL BELT, LABRADOR

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INTRODUCTION

The Central Mineral Belt in Labrador was first recognized as a uraniferous province by Beavan (1958). Several studies have previously been carried out to determine the mode of uranium mineralization in different parts of the belt; these include the studies of Minatidis (1976), Spriggs (1969), Marten and Smyth (1975), Smyth and Ryan (1976) and Gandhi (1976). Although no uranium mines exist at present, the Kitts and Michelin deposits indicate the high potential of the belt (see Northern Miner, August 11, 1977).

During the 1977 field season four uranium occurrences in the Central Mineral Belt, namely, the Stormy Lake, Moran A and B Zones, and Burnt Lake areas were mapped in detail (Figure 1). The project was initiated in order to get a better understanding of the uranium mineralization, collect samples for U/Pb dating, and assess the potential of adjacent areas. In addition to this, five rock suites from the various groups within the belt were sampled for Rb/Sr radiometric dating. These are: **(i)** the Aillik Group felsic volcanic rocks (Watson-White, 1976), **(ii)** the Bruce River Group felsic volcanic rocks (Smyth *et al.*, 1975; Ryan, this volume), **(iii)** the Walker Lake granite (Smyth, 1976), and **(iv)** the Otter Lake granite (Smyth and Marten, 1975; Ryan, this volume).

REGIONAL SETTING OF THE CENTRAL MINERAL BELT

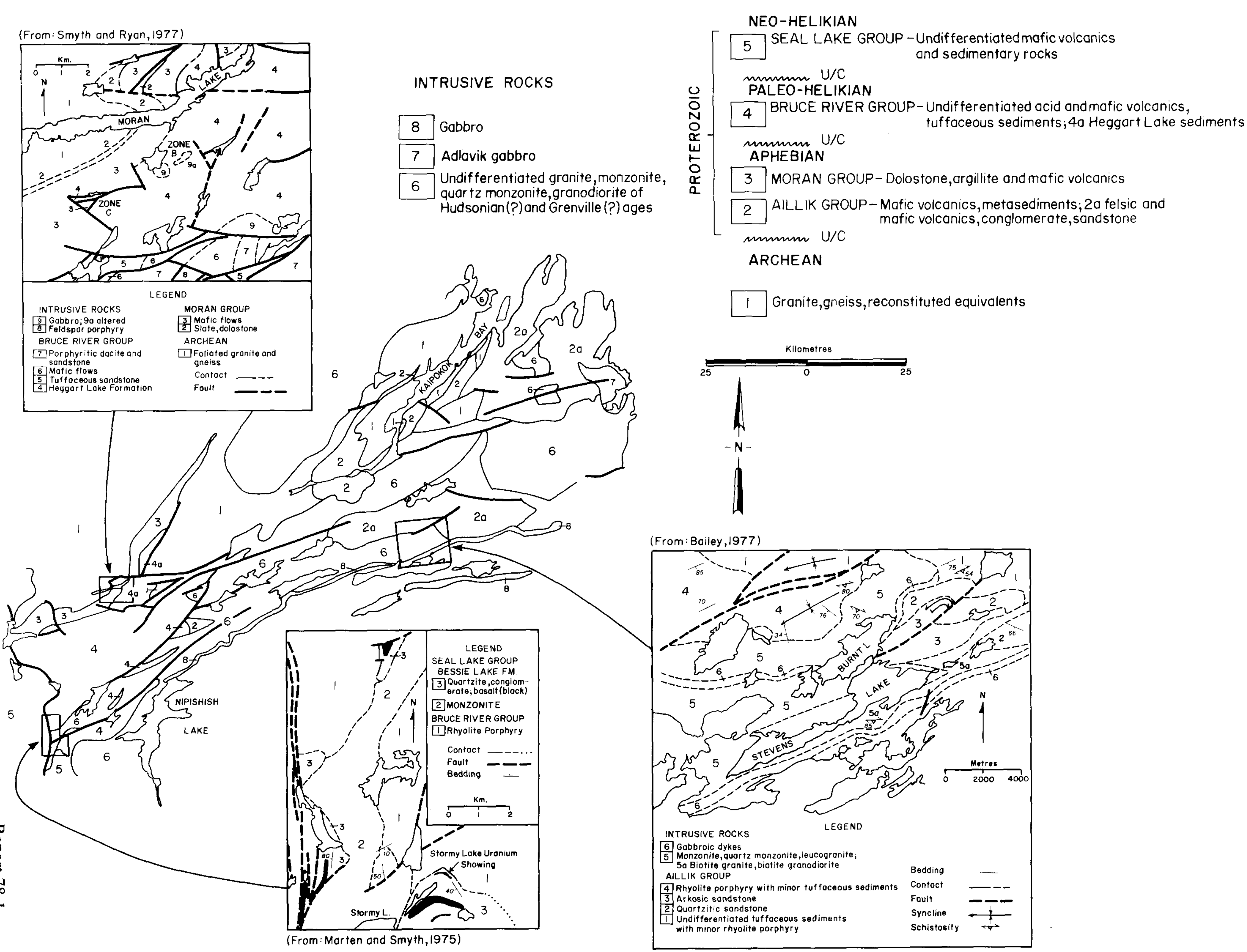
The Central Mineral Belt (figure 1), a lenticular belt (approximately 260 x 40 km) of Proterozoic supracrustal rocks, stretches from the Labrador coast at Makkovik southwestwards to the Smallwood Reservoir. It has been divided into four distinct geological groups - the Seal Group to the west, the Moran and Bruce River Groups in the central portion, and the Aillik Group to the east.

The Aphebian Aillik Group, a bimodal volcanic-sedimentary assemblage (King, 1963; Gandhi *et al.*, 1969 Stevenson, 1970), unconformably overlies the Archean Hopedale Complex (Kranck, 1965; Sutton, 1972; Marten, 1972) and extends inland from the coast for 100 km before being truncated by post-Hudsonian granitic intrusions to the west (Smyth, 1977). These rocks were deformed by the Hudsonian orogeny, during which the basement-cover contact was modified and nearly completely obliterated (Gandhi *et al.*, 1969; Marten, 1972). Later Grenville deformation produced numerous subparallel shears in the Aillik Group and posttectonic granites (Bailey, this volume).

The Aphebian Moran Group (Smyth *et al.*, 1975; Ryan, 1977) rests unconformably on Archean gneisses, and is composed of a basal unit of slate, dolostone and quartzite overlain by pillowed and massive mafic lava flows. It was deformed by the Hudsonian orogeny, which locally produced a strong cleavage that obliterated many primary features.

The Paleohelikian Bruce River Group (Smyth *et al.*, 1975) consists of three major divisions; namely, **(i)** a lower division of coarse conglomerate, lesser sandstone and minor mafic lava flows, **(ii)** a middle division of varicolored tuffaceous sandstone and lesser conglomerate and quartzite, and **(iii)** a thick upper division composed of silicic and mafic lava flows. It unconformably overlies Archean granite and the Moran Group and is unconformably overlain by the Seal Group. Grenville deformation folded the Bruce River Group into an open syncline whose axis is continuous with the axis of the major Seal Lake fold structure (Smyth *et al.*, 1975).

Figure 1.


LEGEND
NEO-HELIKIAN
5 SEAL LAKE GROUP - Undifferentiated mafic volcanics and sedimentary rocks
U/C
PALEO-HELIKIAN
4 BRUCE RIVER GROUP - Undifferentiated acid and mafic volcanics, tuffaceous sediments; 4a Heggart Lake sediments
U/C
APHEBIAN
3 MORAN GROUP - Dolostone, argillite and mafic volcanics
2 AILLIK GROUP - Mafic volcanics, metasediments; 2a felsic and mafic volcanics, conglomerate, sandstone
U/C
ARCHEAN
1 Granite, gneiss, reconstituted equivalents
PROTEROZOIC
INTRUSIVE ROCKS
8 Gabbro
7 Adlavik gabbro
6 Undifferentiated granite, monzonite, quartz monzonite, granodiorite of Hudsonian (?) and Grenville (?) ages
Kilometres
25 0 25
N
KAIPOKOK BAY
NIPISHISH LAKE
(From: Smyth and Ryan, 1977)
Km.
MORAN
LAKE
ZONE B
ZONE C
LEGEND
INTRUSIVE ROCKS
9 Gabbro; 9a altered
8 Feldspar porphyry
BRUCE RIVER GROUP
7 Porphyritic dacite and sandstone
6 Mafic flows
5 Tuffaceous sandstone
4 Heggart Lake Formation
MORAN GROUP
3 Mafic flows
2 Slate, dolostone
ARCHEAN
1 Foliated granite and gneiss
Contact
Fault
(From: Bailey, 1977)
BURNT L.
LAKE
STEVENS
Metres
0 2000 4000
LEGEND
INTRUSIVE ROCKS
6 Gabbroic dykes
5 Monzonite, quartz monzonite, leucogranite; 5a Biotite granite, biotite granodiorite
AILLIK GROUP
4 Rhyolite porphyry with minor tuffaceous sediments
3 Arkosic sandstone
2 Quartzitic sandstone
1 Undifferentiated tuffaceous sediments with minor rhyolite porphyry
Bedding
Contact
Fault
Syncline
Schistosity
LEGEND
SEAL LAKE GROUP
BESSIE LAKE FM
3 Quartzite, conglomerate, basalt (black)
2 MONZONITE
BRUCE RIVER GROUP
1 Rhyolite Porphyry
Contact
Fault
Bedding
Km.
0 1 2
Stormy Lake Uranium Showing
Stormy L.
(From: Marten and Smyth, 1975)

The Neohelikian Seal Group (Brummer and Mann, 1961) consists of a series of clastic rocks, volcanic rocks, and mafic lava flows and sills which form a synclinorium at the western edge of the Central Mineral Belt. It rests unconformably upon Archean gneisses, the Harp Lake anorthosite and the Bruce River Group, and has been folded and modified by thrusting during the Grenville orogeny.

The Central Mineral Belt has been recognized as a uraniferous province since 1958 (Beavan, 1958). More than seventy uranium occurrences are known from a variety of geological environments. Although these occurrences are known from all the major groups (*i.e.* Aillik, Moran, Bruce River, Seal), it is the Aillik Group, host of the Kitts and Michelin deposits, which offers the most promise for future exploration. However, with recent theories of hydrothermal uranium ore genesis coming to the forefront and the recognition of the spatial association of uranium and unconformities, it is believed that the other groups also warrant serious consideration as exploration targets.

STORMY LAKE URANIUM SHOWING

Regional setting and previous work

The Stormy Lake uranium showing, discovered by Frobisher Limited in 1955 (Robinson, 1956), is within the Bessie Lake Formation, the basal member of the Seal Group (Brummer and Mann, 1961). The Stormy Lake area has been mapped previously by Piche (1956), Cote (1970), DeGrace (1969), and Marten and Smyth (1975). It is also included in the regional maps of Fahrig (1959) and Ryan (this volume).

At the Stormy Lake showing the sedimentary rocks of the Seal Group unconformably overlie porphyritic rhyolites of the Bruce River Group (Smyth *et al.*, 1975). North of the study area the volcanic rocks are intruded by a monzonitic phase of the Otter Lake granite (Marten and Smyth, 1975; Ryan, this volume), which also predates the deposition of the Seal Group. A zone of paleoweathering up to 30 m thick is developed in the monzonite below the Seal Group sedimentary rocks (Marten and Smyth, 1975). South of Stormy Lake there is a series of granitic, syenitic and gabbroic intrusive rocks (Cote, 1970; Piche, 1956), which occur in fault bounded blocks and also appear to predate the Seal Group (Smyth, personal communication).

Two phases of Grenville deformation can be recognized in the Seal Group of the Stormy Lake area, but only the second phase is recognized in the vicinity of the Stormy Lake showing. An early period of deformation was characterized by flat lying, recumbent folds overturned to the north, and an associated flat lying cleavage striking east-west and dipping to the south at 20° to 30°. A pervasive regional fabric is associated with the second, more prominent phase of deformation, which is expressed by moderate to tight isoclinal folds overturned to the north and steeply plunging to the southwest.

Geology of the Stormy Lake showing

Detailed mapping of the Stormy Lake showing (figure 2) was restricted to an area of 0.4 km^2. In the map area the following stratigraphy has been recognized: Bruce River Group porphyritic rhyolites unconformably overlain by a thin, polymictic, conglomeratic horizon of the basal Bessie Lake Formation. The conglomerate is composed largely of well rounded, elliptical shaped, quartz and porphyritic rhyolite pebbles and cobbles.

This conglomerate is in most places highly indurated as a result of strong deformation. It is in turn overlain by schistose, mafic volcanic rocks with intercalated lenses of blue-gray, well cross-bedded quartzite. The volcanic unit is overlain by a quartz cobble conglomerate which grades upwards into a quartz pebble conglomerate. Rodding of the quartz clasts, plunging 35° to 65° to the west or southwest, has been developed in this unit as a result of the second phase of deformation. This conglomerate, which is 75 m thick in the centre of the map area, pinches out along strike both to the northwest and to the southeast. It grades laterally and vertically into a thick unit composed predominantly of cross-bedded, blue-gray quartzites and coarse grained sandstones with lesser amounts of quartz pebble conglomerate, the youngest rock unit of the Seal Group in the map area. The cross-bedding is usually defined by heavy mineral (magnetite) laminations.

Mineralization

Uranium mineralization is confined to fractures in the basal conglomerate and the upper quartzite. The conglomerate hosts five of the seven occurrences seen; of these, four had visible pitchblende. Chalcopyrite, malachite, fluorite, specular hematite and quartz veining are associated with the uranium; Robinson (1956) also reported chalcocite and native silver from the Stormy Lake showing.

In three places the pitchblende was noted to be in the form of rods aligned along fractures, generally plunging to the south at 30° to 50°. In all cases secondary uranium minerals occur on fracture surfaces.

The mineral assemblage of the Stormy Lake showing is typical of hydrothermal associations such as those of the Beaverlodge area (Beavan, 1958); it also exhibits

LEGEND

SEAL LAKE GROUP

6	**BESSIE LAKE FORMATION:** *Quartzites, quartz pebble quartzites, grits;* **6a**, *quartz pebble conglomerate.*
5	*Quartz pebble conglomerate.*
4	*Quartzites, grits;* **4a**, *quartzites.*
3	*Mafic volcanic rocks.*
2	*Basal conglomerate and arkosic conglomerate.*

BRUCE RIVER GROUP

1	*Feldspar porphyry with minor quartz.*

SYMBOLS

Bedding (tops known, tops unknown) ....

Cleavage ....

Geological contact (defined, approximate, assumed) ....

Uranium showing .... ×

Outcrop ....

Swamp ....

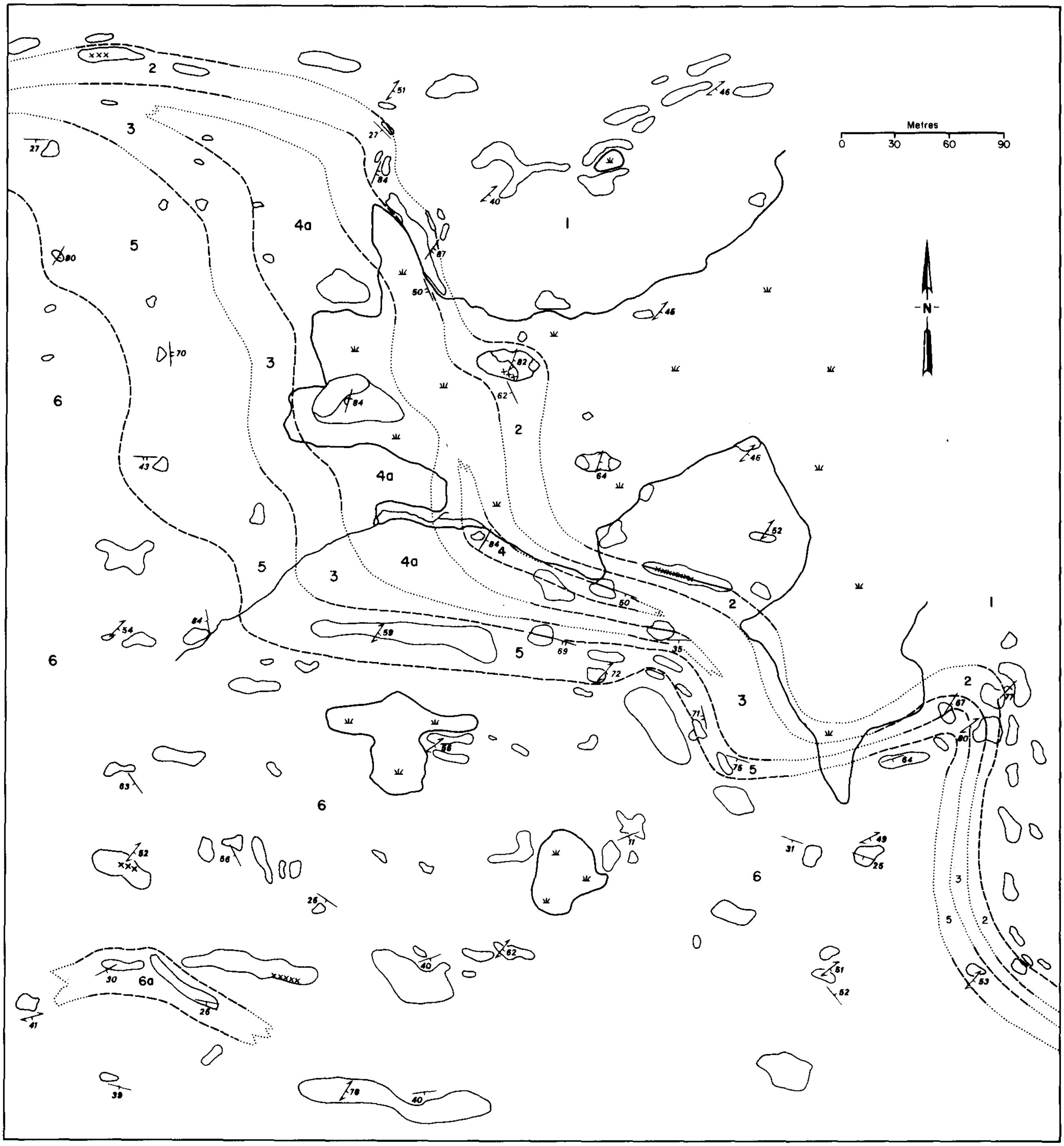


Figure 2. Geology of the Stormy Lake showing

affinities to Badham's (1974) U, Cu, Ag, Ni arsenides association. The mineralization appears to have been locally derived during the Grenville orogeny and precipitated along structurally favorable sites, the unconformity acting as a physiochemical boundary for such precipitation.

MORAN LAKE

Regional setting and previous work

The Moran Lake uranium showings, discovered by BRINEX in 1955 (Ellingwood, 1958), lie south of Moran Lake. They occur within sandstones and conglomerates of the Heggart Lake Formation of the Bruce River Group (Smyth *et al.*, 1975; Smyth and Ryan, 1976) where these rocks are cut by gabbroic intrusions. This paper describes the setting and possible origin of two of these showings (figure 1), referred to by BRINEX as the "Montague No. 1 and 2", and by Mokta (Bernazeaud, 1965) as the "B" and "C" zones. The latter terminology is applied in the descriptions below. The area is presently under investigation by Shell Canada Resources.

Previous work in the area included detailed mapping by Ellingwood (1958), Mann and Collins (1957), Corriveau (1958), Bernazeaud (1965), and Smyth and Ryan (1977), and regional mapping by Williams (1970), Smyth *et al.* (1975), and Ryan (1977). The regional stratigraphy has been described by Smyth *et al.* (1975).

The Moran Group consists of argillites and pillowed basalts which extend in a southwesterly trending belt across the area. It unconformably overlies foliated Archean granite and gneiss (Ryan, 1977) on its northwest side and is unconformably overlain by the sedimentary and volcanic rocks of the Bruce River Group to the southeast.

Two major periods of deformation have affected the area; namely, deformation associated with the Hudsonian (?) orogeny prior to deposition of the Bruce River Group and the Grenville deformation, which folded the Bruce River Group into a southwest plunging open syncline. Two periods of faulting associated with the Grenville event greatly modified the regional and local geology (Smyth and Ryan, 1977).

Moran Lake "B" Zone

The "B" Zone (figure 3) consists of Heggart Lake sandtones and conglomerates cut by gabbroic intrusive rocks of at least three ages. The uranium mineralization is associated with the oldest gabbros, which are readily distinguished by their alteration, texture and mineralization.

Sedimentary rocks occupy the northern part of the map area and consist of red to mauve, highly indurated and massive, siltstones to medium grained sandstones. Generally, these rocks do not contain good sedimentary structures, although some planar bedding and cross-stratification were seen. In the eastern part of the area silty mudstones occur which exhibit soft sediment deformation structures.

In the west the sandstones are highly feldspathic, and in some cases composed almost entirely of euhedral to subhedral feldspar crystals. The presence of lapilli tuffs and rocks exhibiting textures characteristic of ignimbrites suggests a volcanogenic origin for these feldspathic sandstones.

Disconformably overlying the sandstones is a polymictic, pebble to cobble conglomerate. The clasts are subangular to rounded, and comprise 60-75 percent of the rock. Clast types include greenstone, granite, granodiorite, chert, vein quartz, porphyritic rhyolite and intermediate volcanic rocks. The matrix is a pale green, coarse grained sandstone with variable amounts of quartz, feldspar, and rock fragments.

The conglomerate interfingers with the sandstones to the west and is overlain by sandstones to the south (Ellingwood, 1958). A more detailed description of these sedimentary rocks is given by Collins (*in* Mann and Collins, 1958).

The sediments are intruded by a series of mafic dikes and plugs which have been divided into three separate suites on the basis of texture and crosscutting relationships. The earliest dikes are leucogabbroic and are characterized by subophitic and phaneritic textures, hematitic and limonitic staining, a brecciated appearance, carbonate alteration, and uranium and sulphide mineralization. In thin section they consist of gabbroic fragments in a matrix of carbonate, opaques, and feldspar with associated chloritic and hematitic alteration. Carbonate replaces the feldspar crystals, which are intensely fractured and microfaulted (Smyth and Ryan, 1977).

These earlier dikes are cut by dark green, aphanitic dikes which contain actinolite pseudomorphs after pyroxene and are up to 0.5 m thick and by olive green, aphanitic, feldspar porphyry dikes which vary from 0.5 to 2 m in thickness. The dark green and olive green dikes are believed to be of the same age.

A plug of coarse to medium grained biotite gabbro which locally grades into biotite diorite intrudes the second generation dikes described above. Ellingwood (1958) reports that outcrops of syenite occur in the core of this body.

Mineralization

The uranium mineralization is associated with the leucogabbroic dikes. It is developed best where hematitic alteration is most intense and accompanied by carbonate alteration and sulphides (pyrite, chalcopyrite). Pitchblende was seen in only one occurrence; in that case it was associated with a red carbonate vein.

Radioactive occurrences are also found in the sedimentary rocks within fractures associated with hematitic and limonitic staining and, in some instances, chloritic staining.

The uranium was possibly derived from the surrounding Heggart Lake sedimentary rocks, which are known to contain zones of anomalous radioactivity (Smyth and Ryan, 1977; Collins, 1958; Ellingwood, 1958). Since uranium mineralization is associated only with the early set of dikes, it is believed that the controlling factor may have been their intrusion into wet sediments. Soft sediment deformation structures in the mudstones and uranium mineralization associated with hematite and chlorite alteration in sandstones occurring near the altered gabbroic dikes suggests such a mechanism. The later dikes are interpreted to have intruded into lithified, dry sediments in which no hydrothermal system was developed to permit leaching of uranium.

Although the association of uranium with mafic dikes is rare, other occurrences have been noted. These include the "Madsen No. 1" showing in the Central Mineral Belt of Labrador, where a mafic dike cuts Bruce River volcanic rocks (Robinson, 1956; Piche, 1956), mafic dikes in the Athabasca sandstone in the Northwest Territories (Beck, 1970), and diabasic dikes cutting granite or gneiss at Theano Point, Ontario (Working Groups Report No. 4, 1970). In each case the uranium was apparently remobilized from the country rocks by mafic intrusive rocks.

Moran Lake "C" Zone

The "C" Zone (figure 4) is composed of Heggart Lake sedimentary and altered mafic volcanic rocks (?) bounded to the north and west by upfaulted blocks of Moran Group mafic volcanic rocks. The uranium mineralization is associated with intensely sheared Moran volcanics and with breccia horizons in the altered mafic volcanics (?) of the Heggart Lake Formation.

The Moran Group mafic volcanics are olive green, massive to pillowed lavas; they do not contain any well developed fabric except where faulting has occurred. In the fault zones they are intensely sheared and fractured; carbonate veining is common.

Near Lake 202 the Heggart Lake Formation consists of weakly cleaved, reddish brown, medium grained, feldspathic quartzites and arkoses. These grade upwards into highly siliceous, red, fine grained siltstones and mudstones which are overlain by an oligomictic conglomerate composed entirely of subangular to rounded pebble to cobble clasts of the underlying rock types. This is in turn overlain by a polymictic pebble to cobble conglomerate with intercalated lenses of medium grained, feldspathic to arkosic sandstones. The clasts of the latter conglomerate are composed of granite, granodiorite, porphyritic rhyolite, intermediate volcanics, sandstone, and conglomerate, in a pale green to gray, medium to coarse grained sandstone with variable amounts of quartz and rock fragments. A cleavage in the polymictic conglomerate, absent from the oligomictic conglomerate, is believed to be related to an east-west trending fault immediately south of the conglomerates which separate them from the overlying lithologies. As the vertical displacement of the fault is not known, the position of the overlying lithologies in the stratigraphic column is not certain, although displacement is not thought to be large (see later).

South of the east-west trending fault there is a unit composed of mafic volcanic rocks with intercalated lenses of breccia and sandstone. This unit has previously been mapped as an explosive breccia by Smyth and Ryan (1976), a volcanic breccia by both Ellingwood (1958) and Corriveau (1958), and a dolomitized sandstone by Bernazeaud (1965). The writer has reinterpreted this unit as being of extrusive volcanogenic origin for the following reasons:

1. Geometry of the unit (*i.e.* concordancy of the brecciated and sedimentary units intercalated with the mafic volcanics).
2. Existence of rare mafic volcanics elsewhere in the Heggart Lake Formation (Smyth *et al.*, 1975; Collins, 1958).
3. Possible igneous textures (*i.e.* welded and flattened fragments) which suggest an extrusive origin.
4. A sharp contact between a breccia lens and overlying conglomerate observed in one exposure.
5. Trachytic textures seen in thin sections of unaltered parts of the mafic unit.

However, textural similarities with mineralized zones in the "B" Zone, possible gas streaming textures and vertical alignment of clasts in some outcrops, and gradational contacts between altered and unaltered units may be cited in favor of an intrusive origin.

In view of the postulated extrusive nature of the breccia, the observed features could be attributed to extrusion of mafic lava, perhaps in the form of a phreatic explosion, which contained gabbroic fragments derived from depth (?) and minor, locally derived, sedimentary inclusions. Eutaxitic textures suggest tuffaceous origins for some of the sequence. The unaltered mafic volcanics

LEGEND

INTRUSIVE ROCKS

5	*Biotite gabbro and biotite diorite.*
4	*Green, aphanitic dikes, in places porphyritic (feldspar, pyroxene).*
3	*Altered gabbroic dikes.*

BRUCE RIVER GROUP

HEGGART LAKE FORMATION

2	*Polymictic conglomerate.*
1	*Red to mauve, fine to medium grained sandstone.*

SYMBOLS

Bedding (tops known, tops unknown) ....

Geological contact (defined, approximate, assumed) ....

Outcrop(large, small) ....

Swamp ....

Figure 3. Geology of the Moran Lake "B" zone

LEGEND

INTRUSIVE ROCKS

5	*Gabbroic dikes.*

BRUCE RIVER GROUP

HEGGART LAKE FORMATION

4	*Polymictic conglomerate with intercalated, red-brown feldspathic sandstone lenses.*
3	*Volcanic breccia unit;* **3**, *unaltered mafic flows;* **3a**, *red-brown to purple, highly indurated siltstone;* **3b**, *volcanic breccia (tuffaceous in part).*
2	*Red-brown arkose and red mudstones;* **2a**, *oligomictic and polymictic conglomerates.*

MORAN GROUP

1	*Mafic volcanic rocks (massive and pillowed).*

SYMBOLS

Bedding (tops known, tops unknown) ....

Cleavage ....

Fault ....

Geological contact (defined, approximate, assumed) ....

Outcrop ....

Swamp ....

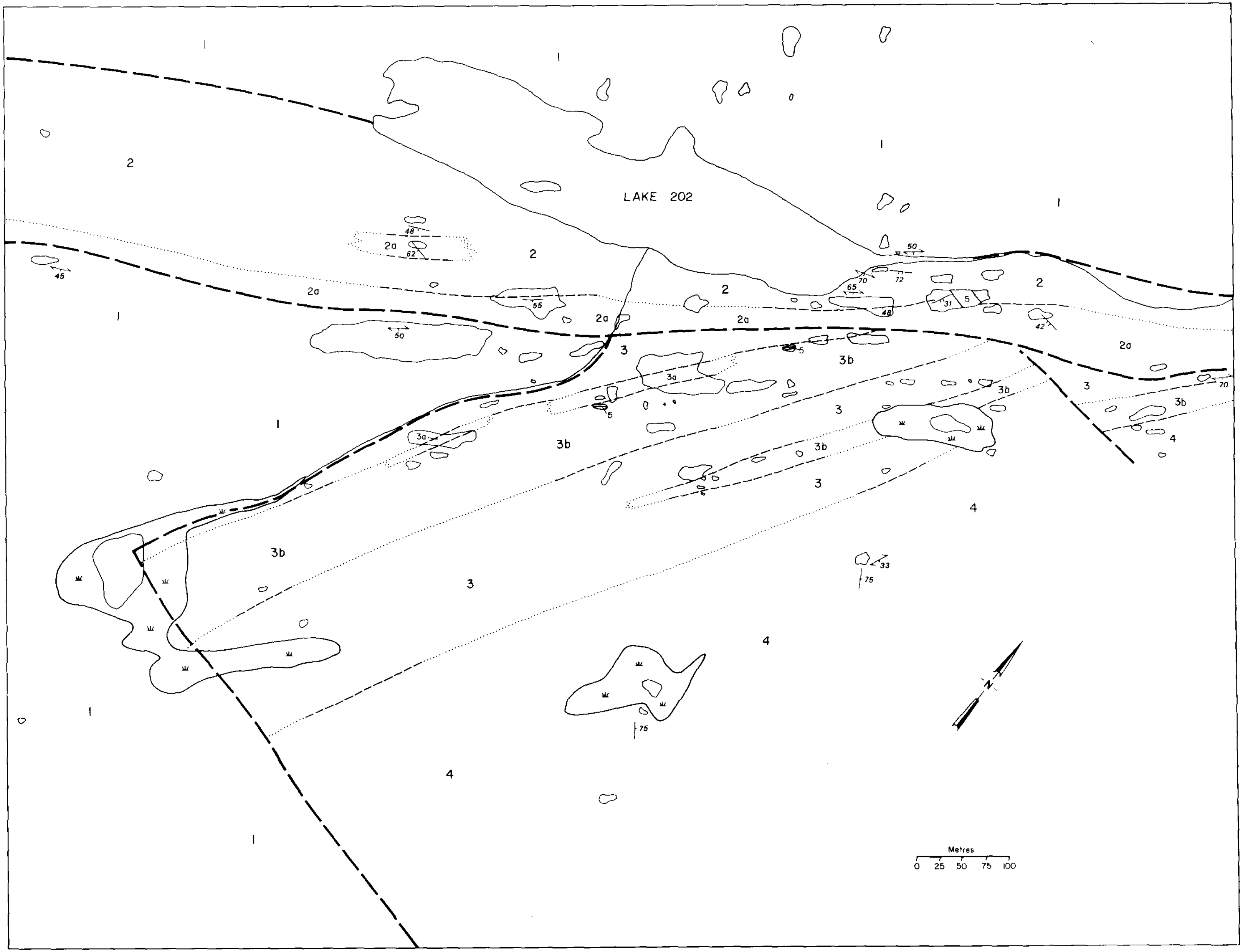


Figure 4. Geology of the Moran Lake "C" zone.

represent extrusion into subaerial conditions, the absence of water preventing phreatic activity.

Above the volcanic unit is a polymictic, pebble to cobble conglomerate with intercalated lenses of red-brown, fine to medium grained feldspathic sandstones. This unit is similar to the polymictic conglomerate unit described above.

From the regional mapping of Ellingwood (1958), displacement of the volcanic breccia unit with respect to the sandstones appears minor, the fault having rotated in a scissor like fashion with the greatest amount of displacement occurring to the west.

Mineralization

Uranium mineralization occurs in both the Moran Group volcanic rocks and the volcanic breccia unit of the lower Bruce River Group. No pitchblende was observed; however, secondary uranium products were seen along fractures in both areas.

In the Moran Group volcanic rocks along the north shore of Lake 202 high radioactivity is associated with carbonate veining and sulphides (chalcopyrite, pyrite) in intensely sheared mafic volcanic rocks near a fault. Mineralized fluids, probably generated during Grenville deformation, descended along the fault and precipitated uranium along shears and fractures in the mafic volcanic rocks.

High radioactivity occurs along the entire strike length of the volcanic breccia unit in the Bruce River Group. It is associated with carbonate and hematite alteration, sulphides, limonitic staining and brecciation. Locally, the unaltered mafic volcanic rocks are radioactive where sulphide mineralization and limonite staining are well developed. Parts of the sedimentary lens in the western part of the map area are also highly radioactive, in this case associated with abundant hematite alteration and sulphides (chalcopyrite, pyrite).

The mineralization of the "C" Zone breccia, therefore, appears to have been remobilized out of the sediments and concentrated in their extrusive equivalents, somewhat analogous to the origin of the "B" Zone.

Other areas which appear similar to the "C" Zone are the Mustang Lake area in the Aillik Group, where uranium mineralization occurs in calcite rich portions of a gray volcanic rock which has a fragmented appearance (Gandhi *et al.*, 1976), and the Dolores Creek area of the Yukon, where uranium mineralization associated with copper and cobalt occurs in brecciated sediments which have undergone extreme metasomatism (Laznicka, 1976).

BURNT LAKE PROSPECT

Regional Setting and Previous Work

The Burnt Lake uranium showing, discovered by BRINEX in 1967 (Gandhi *et al.*, 1973), lies within felsic volcanic rocks of the Aillik Group (Gandhi *et al.*, 1969; Stevenson, 1970; King, 1963; Watson-White, 1976). Several showings occur at Burnt Lake but only the main showing will be discussed here. The area is included in the detailed maps of Barua (1969) and Gandhi *et al.* (1976) and the regional maps of Gandhi *et al.* (1969), Watson-White (1976), Stevenson (1970), Krajewski (1976), and Bailey (this volume).

Although felsic volcanic rocks predominate in the Aillik Group at Burnt Lake, lower parts of the succession contain mafic volcanic rocks and tuffaceous sediments (Watson-White, 1976; Krajewski, 1976; Bailey, this volume). The volcanic rocks of the Burnt Lake area exhibit many features characteristic of the volcanic rocks of the southwestern United States as described by Ratte and Steven (1967), Steven and Lipman (1976) and Lipman (1975), and referred to by Smith (1960) as ash-flow tuffs or ignimbrites.

Granitic, syenitic, and dioritic rocks intrude the area, almost completely enclosing the volcanic-sedimentary sequence. Intruding both the volcanic and plutonic rocks are northeast trending gabbroic dikes, some of which have been dated by K-Ar at 1000 Ma (Gandhi *et al.*, 1969).

The area has undergone polyphase Hudsonian (?) deformation. Although two cleavage sets have been recognized in outcrop, only one megascopic fold pattern is apparent. This is a series of overturned to tightly isoclinal folds with a variably developed east-west trending axial planar cleavage. The second period of deformation can only be recognized by the development of a crenulation cleavage in the less competent mafic dikes and by local mesoscopic open folding of the first fabric in the volcanic rocks. The crenulation cleavage generally strikes east-west and dips steeply to the south in the Burnt Lake area. Grenville deformation is considered responsible for the numerous northeast-southwest trending shears transecting the area (Bailey, this volume).

Geology of the Burnt Lake Showing

Detailed mapping of the North Showing (figure 5) was restricted to an area 0.2 km^2 in size. The western portion of the map area is underlain by an undifferentiated unit consisting of quartz porphyry, feldspar porphyry, and quartz-feldspar porphyry. The quartz phenocrysts (1-4 mm) are characterized by their blue color and elliptical well rounded habit; the feldspar phenocrysts (3-8 mm) are euhedral to anhedral with rectangular and subrounded shapes. Phenocrysts comprise 10-50 percent of the rock and are set in a fine grained, quartz-sericite matrix with minor amounts of sulphides, magnetite, and biotite.

Overlying the porphyries is the mineralized unit, a predominantly feldspar porphyry characterized by the presence of chlorite-hematite alteration which mimics a primary igneous banding, lapilli tuffs, and tuffaceous horizons. The latter are commonly disrupted and incorporated into the overlying lithology as dikelets resembling ptygmatic veins. Within this unit are three lenses of feldspar porphyry and quartz-feldspar porphyry, free of the chlorite-hematite alteration which is so prevalent in the surrounding rocks. This unit has been tectonically thickened as a result of the very tight folding.

East of the mineralized unit there is a porphyry horizon with minor quartz phenocrysts. The characteristics of these rocks are similar to those described earlier for the other porphyry.

Intrusive into the feldspar porphyry unit in the east of the map area is a leucogranite, commonly grading into a monzonite or quartz monzonite away from the margins. The granite and the volcanics are cut by gabbroic dikes, now chlorite-biotite schists, which exhibit remnant ophitic textures.

Mineralization

The uranium mineralization of the Burnt Lake area is of stratiform type, associated with chlorite and hematite alteration, sulphides, magnetite, and minor amounts of fluorite, sphalerite, galena, and molybdenite. Generally, all the outcrops within the altered tuffaceous unit exhibit high radioactivity. The porphyries adjacent to radioactive outcrops are not anomalously radioactive. Gandhi *et al.* (1969) report uranium mineralization within feldspar porphyries with little or no hematite alteration.

A mineralized area 750 m west of the north showing was mapped to see if the characteristics and associations of the uranium mineralization varied. However, the two areas were identical in mineralization with the only apparent difference being that the host rock in the west is generally a quartz porphyry whereas that at the north showing is generally a feldspar porphyry.

The nonwelded character of the mineralized unit as compared to the welded and indurated nature of the unmineralized porphyries, including the lenses intercalated within the mineralized unit, is believed to have been an important control for the uranium mineralization. Uranium and thorium are fixed in the vitric matrix of lavas and ignimbrites (Sorensen, 1970). However, if the volcanic rock is porous enough to be permeated by hydrothermal solutions, then devitrification of the glass may occur (Williams *et al.*, 1953). Such a process may cause remobilization of uranium (Rosholt *et al.*, 1971 and its subsequent precipitation along favorable horizons resulting in higher concentrations of uranium then were initially present. However, in firmly welded tuffs of low porosity and permeability, this mechanism will be inhibited and reconcentration of uranium prevented.

DISCUSSION

The uranium occurrences discussed in this paper are of varied origins but indicate the potential for the Central Mineral Belt. The absence of thorium in each case suggests remobilization of symgenetic uranium into favorable host rocks and/or structures.

The Stormy Lake uranium showing is of the "unconformity type" in that the mineralization occurs just above the unconformity. Thus, the unconformity may represent a useful exploration target (*cf.* Cluff Lake, Rabbit Lake, and Key Lake in Saskatchewan). Since the uranium is believed to have originated from the Bruce River Group porphyritic rhyolites, the area east of the Pocketknife Lake fault zone, where such an unconformity exists, would appear to be favorable for exploration.

The Moran Lake uranium showings are restricted in both time and space due to the nature of the mineralization. The most favorable areas for future exploration would be along strike. However, due to the modification of the local geology by faulting this may be quite unpredictable as indicated by the "C" Zone. The volcanic breccia hosting the uranium mineralization in the "C" Zone is fault bounded to both the east and the west. Since the fault movement was essentially vertical rather than lateral, the remainder of this prospective unit has been destroyed by erosion. The possibility of finding more occurrences analogous to those of the "B" and "C" Zones east of the area remains feasible. However, if the interpretation suggested is erroneous, then the stratigraphic and time restrictions are no longer pertinent and all the Heggart Lake Formation becomes a prospect for uranium mineralization.

The Burnt Lake uranium showing is but one of many found within the felsic volcanic rocks of the Aillik Group (others being the Michelin Deposit, M. Ben, Chitra, Rainbow and Mustang Lake). Although the Burnt Lake showing is essentially syngenetic, with later enrichment due to remobilization of local extent, the Michelin deposit indicates the potential for remobilized types where the uranium is reconcentrated along structurally favorable horizons. Thus, the felsic volcanic rocks

LEGEND

INTRUSIVE ROCKS

5	*Mafic dikes.*
4	**BURNT LAKE GRANITE**

AILLIK GROUP

3	*Feldspar porphyry with minor quartz.*
2	*Mineralized unit including feldspar porphyry, lapilli tuffs, tuffaceous horizons (in parts disrupted);* **2c**, *quartz-feldspar porphyry.*
1	*Undifferentiated (includes quartz porphyry, feldspar porphyry, and quartz-feldspar porphyry).*

SYMBOLS

Geological boundary (defined, approximate, assumed) ....

Igneous banding (undivided, vertical) ....

Cleavage (S_1, S_2) ....

Antiform (overturned) ....

Synform (overturned) ....

Outcrop ....

Swamp ....

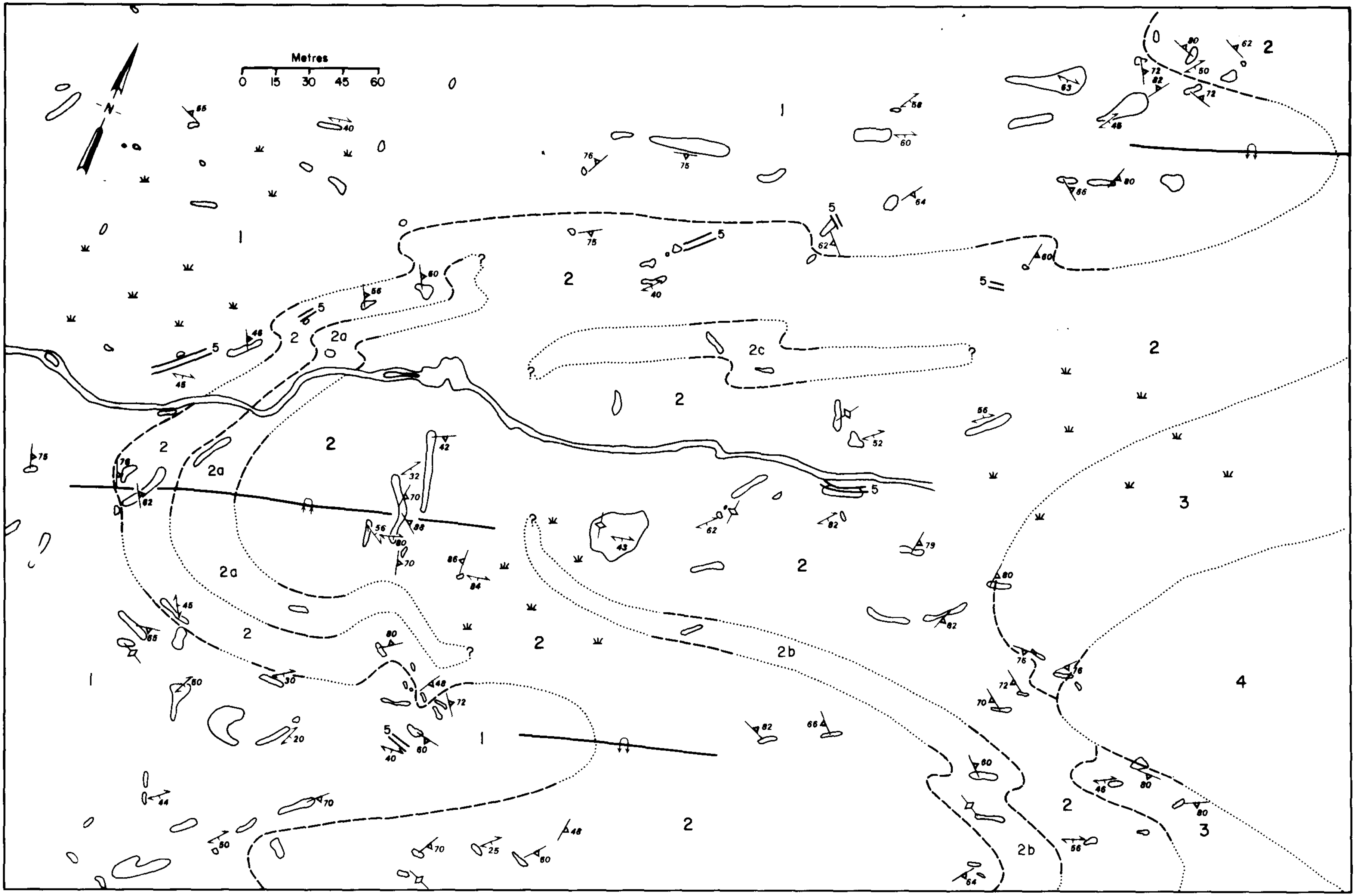


Figure 5. Geology of the Burnt Lake showing

of the Aillik Group are considered as targets of high priority for uranium mineralization.

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NOTE ADDED IN PROOF: A preliminary Rb/Sr whole rock age of 1496±37 Ma has been obtained from the Otter Lake granite using $\lambda = 1.42 \times 10^{-11}$ as the Rb decay constant. Applying the same decay constant, the G.S.C. age of 1474±42 Ma for the Bruce River Group volcanics recalculates at 1526 Ma, indicating a possible cogenetic intrusive-extrusive relationship.

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