

**NOTES TO ACCOMPANY MAP 93-16**

**Geological Summary**

The map area includes parts of the Grenville, Eastern Churchill and Nain structural provinces and contains rocks ranging in age from Archean to Tertiary.

The Nain Province comprises crust of ca. 3100 Ma age (Maggo gneiss) that is infolded with volcano-plutonic sequences of greenstone-belt affinity (Hunt River and Florence Lake groups) and intruded by tonalitic plutons of the ca. 2800 Ma Kanariktok Intrusive Suite (Ermanovics *et al.*, 1982). The Nain Province was subjected to deformation during the ca. 2500 Ma Hopedale event (northwest structural trends) and the ca. 2800 Ma Fjordian event (northeast trends). Early Proterozoic events are represented by the ca. 2200 Kikkertavak dyke swarm (Cadman, 1991) and deposition of the unconformably overlying Moran Lake Group.

The Makkovik Province is underlain in the northwest by an extensive area of structurally reworked Nain Province gneiss intruded by a ca. 1805 Ma tonalite-granodiorite pluton of the Island Harbour Bay Plutonic Suite (Ermanovics *et al.*, 1982). In the southeastern part of the Makkovik Province, the Archean rocks are both unconformably overlain by, and tectonically intercalated with, metasedimentary and metavolcanic rocks of the lower Allik and Moran Lake groups (2500 to 1900 Ma). In turn, these are structurally overlain by felsic volcanic and sedimentary rocks of the upper Allik Group (1880 to 1810 Ma). The gneissic and supracrustal rocks were intruded by granitoid plutons in two periods: an earlier period of intrusion between 1930 and 1890 Ma, and a later period, synchronous with Makkovikian deformation, in the interval 1810 to 1802 Ma (Ryan, 1984; Scharer *et al.*, 1987).

Deformation and metamorphism in the Makkovik Province occurred in at least two events. The first, the so-called Igloolik metamorphic event, occurred between 2000 and 1800 Ma and was associated with migmatization and mylonitic shear zone development. The second event, the Makkovikian Orogeny, involved widespread greenschist to amphibolite-facies metamorphism at ca. 1800 Ma. Makkovikian deformation was associated with thrust-related interleaving of Lower Proterozoic cover rocks and Archean basement, along a series of ductile shear zones extending southeast from Kanariktok Bay and along the Kaipokok River. The present northwestern limit of Igloolik and Makkovikian deformation is partly defined by the dextral wrench-fault system of the Kanariktok shear zone, a late fault extending along the south side of Kanariktok Bay.

The Eastern Churchill Province is broadly correlative with the Makkovik Province in terms of age, and similarly contains a substantial amount of Archean rocks. Dates Archean rocks are exposed as a sequence of metabasalt, metasedimentary schist and ca. 2570 Ma tonalitic gneiss in the Smallwood Reservoir area (Nunn *et al.*, 1990). Other rocks, including the pillow basalts of the Patsapiakau Group, and the gneissic and metagneissic rocks of the Eastern Churchill Province interior, may also be of Archean age. Lower Proterozoic rocks include the metasedimentary Tasluvak gneiss, a major feature of the Eastern Churchill Province that marks a major tectonic boundary (suture) with the reworked rocks of the Nain Province, and the greenschist-facies metavolcanic rocks of the Ingrid Group, which is inferred to be unconformable on the Nain Province gneiss (Ermanovics and Ryan, 1990). Granitoid intrusions include a late-kinematic series of tonalite-granodiorite-granite plutons intruding into Tasluvak gneiss, and a polyphase assemblage of gneissic plutons of possible mixed Archean and Early Proterozoic age (Hill, 1982; Thomas and Morrison, 1989). Terminal deformation in the Eastern Churchill Province occurred during the Hudsonian Orogeny ca. 1800 Ma.

The Grenville Province consists predominantly of rocks formed during the Labradorian Orogeny (1700 to 1630 Ma) as part of a major period of crustal accretion along the southeastern margin of the Precambrian Shield. The ca. 1650 Ma granitoid rocks of the Trans-Labrador batholith, together with its partially preserved volcanic capscap (Bruce River and Mackenzie Lake groups, Ryan, 1984 and Nunn and Noel, 1982) forms the northern margin of the Labradorian crust and is bounded to the south by high-grade metasedimentary and orthogneisses initially formed and metamorphosed between 1700 and 1670 Ma (Thomas, 1981; Gower, 1986).

Middle Proterozoic intrusive and sedimentary rocks are widespread within the map area and occur in all structural provinces. Major geological components are: (i) anorthosite-granite massifs, (ii) red beds and plateau basalts of the Seal Lake Group (Brunner and Mann, 1981), (iii) peralkaline volcano-plutonic suites of the Letitia Lake Group (Thomas, 1981) and Flowers River Igneous Suite (Hill, 1982), and (iv) gabbro-diorite dykes, including the Harp dyke swarm. The sequence of events is indicated in the table below.

U-Pb ZIRCON AGE	EVENT
1270 Ma	Flowers River peralkaline volcano-plutonic ring complex Deposition of Seal Lake Group and basalt magmatism
	Unconformity
1274	Harp Dykes
1253	Nain Plutonic Suite granitoid rocks
1327	Peralkaline volcano-plutonic activity and alkaline plutonism (Letitia Lake Group and Red Wine Alkaline Suite)
1426	Michael Gabbro sheets
ca. 1420	Mistastin batholith
1425-1428	Harp Lake Intrusive Suite granitoid rocks
1457	Michikamau Intrusion granitoid rocks

The ages for the various anorthosite-granite intrusions are based exclusively on the late granitoid components and are therefore minimum ages. Sm-Nd dating of the Flowers Bay leucotroctolite pluton (part of Nain Plutonic Suite) gave an age of 1411 ± 48 Ma (see Hill, 1982); however, gabbroic components of the Nain Plutonic Suite north of the map area have given U-Pb zircon ages of 1305 Ma (Ryan, 1990).

The Harp dyke swarm (1274 Ma) is major feature of the area (Meyers and Emalie, 1977). Exposed dykes are mainly restricted to the Harp Lake Intrusive Suite and Nain Province gneisses but aeromagnetic maps indicate that they are widespread across the central and northern parts of the map area. They may be equivalent to the ca. 1280 Ma Nain dykes which are developed north of the map area (Wiebe, 1985; Gower *et al.*, 1990).

The Seal Lake Group lies unconformably upon oxidized and weathered rocks of the Letitia Lake Group, and upon the Harp Lake Intrusive Suite and Harp dykes, however, the period of uplift marked by this unconformity does not appear to have been associated with penetrative deformation. The Seal Lake Group has been dated by Rb-Sr technique at ca. 1320 Ma, however, the fact that it has been reported to unconformably overlie the 1274 Ma Harp dykes (Emalie, 1980), suggests that the Rb-Sr age is incorrect.

The anorthosite-granite massifs are thought to have a general topolith- or mushroom-shaped structure within which flat-lying anorthositic zones are completely or partially enveloped in granitoid rocks. Progressive levels of erosion in such structures may be marked, from higher to lower levels, by: (i) the Mistastin batholith (Emalie *et al.*, 1980), which consists of granite overlying anorthosite, (ii) the Harp Lake intrusion (Emalie, 1980), which is partially rimmed by granite and is interpreted to have the form of a flat sheet or topolith, and (iii) the Michikamau intrusion (Emalie, 1970), which contains very little granite and has a funnel-shaped profile suggesting that it forms the root zone of an anorthosite-granite massif.

The peralkaline pluton-volcanic suites are high-level crustal features. The Flowers River Igneous Suite is characterized by an annular aeromagnetic pattern suggestive of a ring complex (Hill, 1981) and contains a central core of subaerial volcanic rocks that probably originated as a caldera-fill sequence. The Letitia Lake Group likely formed in a similar environment, however the original intrusion geometry has been destroyed by Grenvillian deformation.

The Middle Proterozoic plutonic and volcanic rocks are part of a widespread belt of such rocks located along and within the northern margin of the Grenville Province, and have been widely interpreted to mark a period of prolonged crustal tension, anorogenic magmatism and possibly rifting (Emalie and Hunt, 1980). The anorthosite-granite intrusive suites form part of the well-known Elsonian (anorogenic) event (Emalie, 1978).

Grenvillian deformation of ca. 1000 Ma age has overprinted all rocks within the southern part of the area. The cover rocks of the Seal Lake and Bruce River groups have been deformed into overturned synclinoria associated with overthrusts along their southern margins. Deformation in the older plutonic and gneissic rocks is marked by reverse faulting, ductile shearing and foliation that increases in intensity to the south. Metamorphic grade similarly increases from greenschist facies near the Grenville Front, to amphibolite facies in the south.

The youngest rocks of the area are melt rocks and breccia associated with the 38 Ma Mistastin impact crater (Curtis, 1971; Mak *et al.*, 1976).

**Note on Economic Geology of the Area**

Copper occurs in the Seal Lake Group as native-copper-bearing quartz-carbonate veins and chalcocite-bornite stringers, and as epigenetic vein-hosted showings in the Bruce River Group (Gandhi and Brown, 1975; Wilton, 1989).

Lead and zinc occur as vein-hosted showings in the Moran Lake Group, zinc is also found as stratiform sphalerite within the sedimentary rocks of the group (Ryan, 1984; North and Wilton, 1988; Swindsen *et al.*, 1991). Nickel occurs (i) in association with copper in small, low-grade stratiform showings within the Harp Lake anorthosite; and (ii) in the metavolcanic and ultramafic rocks of the Florence Lake Group.

Platinum-Group Elements occur in minor amounts in association with nickel and iron sulphide in some of the Harp Lake anorthosite showings, and in the ultramafic rocks of the Florence Lake Group (Wardle, 1987). Uranium is found as epigenetic occurrences within the Moran Lake, Bruce River and Allik groups (Ryan, 1984).

Beryllium and rare metals (Niobium, Thorium, Rare Earths, Yttrium and Zirconium) are present in variable proportions in the peralkaline rocks of the Letitia Lake Group and its associated intrusions; and to a lesser extent as indications within the peralkaline Flowers River Suite (Miller, 1988).

Ferromagnesian magnetite disseminations are locally present within the Harp Lake anorthosite (and probably within the other gabbroid intrusions of the area). Pyrrhotite and asbestos occur within the Hunt River and Florence Lake groups.

There are no producing mines or major mineral deposits within the area, however, there are numerous prospects, showings and indications. All prospects and showings, but only selected indications, are shown on the map.

For further details of mineral occurrences, the reader should consult the following Mineral Occurrence Maps, available from the Publications and Information Section, Geological Survey Branch, Department of Mines and Energy, PO Box 8700, St. John's, NF, A1B 4J6:

Snegamook Lake (scale 1:250 000),	Map 83-36
Hopedale (scale 1:250 000),	Map 84-22
Wuchusuk Lake (scale 1:50 000),	Map 83-37

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