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COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

This preliminary Open File geological map presents results of bedrock mapping undertaken in the region during 1985, 1991, 1992 and 1994 field seasons. The objectives of the mapping were to upgrade the reconnaissance database, and to address some of the outstanding structural, metamorphic, and metallogenic problems in the region, in order to provide a framework for regional correlation and tectonic synthesis of rock units of this part of the Churchill Structural Province. Detailed accounts of bedrock geology covering the region were published in numerous GSC publications. The reader is referred to the references cited here for a comprehensive overview of the geology of this region.

PREVIOUS GEOLOGICAL MAPPING

The Rankin Inlet-Falstaff Island-Quartzite Island area represents a portion of an Archean and Paleoproterozoic granite-greenstone-gneiss terrane within the Churchill Structural Province of the Canadian Shield. The region was previously mapped by Bannatyne (1958), Bell (1885,1887), Lord (1953), Tyrrell (1898), Weeks (1932), and Wright (1967); the latter at a scale of one inch to eight miles. The results of more recent regional bedrock mapping in the map area and in the surrounding region were reported by Armitage et al. (1993), Bell (1968), Heywood (1973), Laporte (1975, 1983), Laporte and Frape (1973), LeCheminant et al. (1987), Reinhardt and Chandler (1973), Reinhardt et al. (1980), Tella (1993, 1994), Tella and Annesley (1987,1988), and Tella et al. (1986, 1989, 1990, 1992, 1993, 1994). Previous structural, stratigraphic, and geochronological studies in this and in adjoining regions outlined several crustal-scale, ductile, high-strain zones that separate and expose different levels of crust (Tella, 1993, 1994; Tella et al. 1990, 1993, 1994). Tectonic juxtaposition of some of these crustal segments is believed to have occurred in the Paleoproterozoic prior to emplacement of ca 1850 Ma granites, and involved reactivation of Archean ductile, high-strain zones. The highlights of structural work were summarized previously (see transect A-B, Figures 1,2 in Tella et al. 1992).

LITHOLOGY

The Rankin Inlet (55K/16)-Falstaff Island (55J/13)-Quartzite Island (55J/11) region is underlain by an Archean polydeformed metavolcanic - metasedimentary sequence, the Rankin Inlet Group (**Av** to **Agb**) and its metamorphic equivalents (**As**), and by Archean and/or Paleoproterozoic layered gneiss and migmatite (**Agn**). A Paleoproterozoic quartz-arenite sequence (**Pqs, Pq**; correlative with the Hurwitz Group) unconformably overlies the gneissic rocks (**Agn**). Post-tectonic Paleoproterozoic intrusive activity is recorded by granite plutons (**Pgr, Pg**). SSE-trending biotite lamprophyre dykes (**Plp**) and NW-trending Mackenzie dykes (**Pgb**) are present in a few localities.

The polydeformed and metamorphosed supracrustal sequence of the Rankin Inlet Group (**Av** to **Agb**) is composed of massive and pillowed mafic volcanic flows, interflow sediments, quartz-magnetite iron formation, and minor mafic and felsic tuffs, pyroclastics, and volcanic breccia, and gabbro sills (**Agb**) (Tella et al. 1986). Two major cycles of volcanism with intervening conglomerate (**Acvg**) deposition are present within the maficvolcanic sequence. Chemically the volcanic rocks and associated gabbroic rocks are tholeiitic basalts. Ultramafic (komatiitic) sills (**Au**), in part containing Cu-Ni mineralization, occur within the mafic volcanic sequence. A U-Pb zircon age of 2665+/-3 Ma (J.C. Roddick, GSC, personal communication, 1993) from the felsic volcanics (**Afv**), and Re-Os isotope geochronology of the Rankin Inlet Ni-Cu-PGE ores from the ultramafics (**Au**) (2748+/-92 Ma, 2776+/-88 Ma; Hulbert and Gregoire, 1993) confirm an Archean age for the Rankin Inlet Group.

The main rock types, east of Meliadine Lake, are sheared and carbonatized mafic metavolcanics (chlorite schist, amphibolite), gabbro sills, and minor intercalated mafic tuffs, pyroclastics (**Amv**), and greywacke (**Agw**). All rock types are fine- to medium grained, well layered, and massive to well cleaved. Altered metamafic rocks contain blue-green amphibole, chlorite, biotite and carbonate. They are locally garnetiferous adjacent to granite intrusions (**Pgr**).

Metasedimentary paragneiss belt (**As**), consisting of garnet+biotite +/- staurolite +/- andalusite +/- muscovite + plagioclase + quartz assemblages, is restricted to the northern margin of the Falstaff Island map area (NTS 55J/13). The belt extends to the northeast into the adjoining Chesterfield Inlet region (Tella, 1993) where the rocks within the belt are commonly fine- to medium- grained iron-rich pelites that are compositionally well banded with quartz, quartz+feldspar, and garnet+biotite +/- staurolite +/- aluminosilicate rich layers. Several discontinuous interlayers of silicate iron formation consisting of magnetite, garnet, grunerite, and hornblende occur in the paragneiss belt. They show prominent aeromagnetic anomalies (Geological Survey of Canada, 1966b).

The rocks within unit (**Agn**) comprise mixed assemblages of polydeformed, amphibolite grade orthogneiss, migmatite, minor proportions of metagreywacke and metavolcanic schist. The layered gneiss unit is locally cut by pegmatite and granitoid veins and dykes, and by biotite lamprophyre dykes (**Plp**).

The Paleoproterozoic quartz-arenite sequence (**Pqs, Pq**) is predominantly exposed on the Quartzite Island (55J/11) and to a lesser extent on the mainland (55K/16, 55J/13;Tella et al., 1986). The orientations of current ripple-axes in quartz-arenites from the mainland and from the Marble Island suggest sediment transport direction from the southwest and southeast respectively (Bell, 1968; Laporte, 1983; Tella et al., 1986). A thin (< 2m thick) quartz-mica schist (**Pqs**) is locally present beneath the white quartz-arenite and adjacent to the layered gneiss basement (**Agn**). These rocks are tentatively correlated with the Whiterock Member of the Lower Proterozoic Hurwitz Group (Bell, 1968) on the basis of lithological similarities.

Paleoproterozoic post-tectonic granites (**Pgr, Pg**) are exposed in the northwestern parts of the Rankin Inlet map area (55K/16). They are massive to weakly cleaved, pink to grey, and locally contain disseminated magnetite. The magnetite-rich character is reflected in a pronounced aeromagnetic signature (Geological Survey of Canada, 1966b). Southwest of Meliadine Lake, one of the granite bodies (**Pgr**) contains disseminated magnetite (<2%) and a few mafic minerals (<10%), and is weakly foliated at the margins.

Lamprophyre dykes (**Plp**) are present throughout the region. They are dark grey to black, medium- to fine-grained rocks with large biotite/phlogopite phenocrysts (Tella et al. 1986; Digel, 1986). The dykes are locally folded adjacent to some of the late NW-trending brittle faults (Tella et al. 1986). They probably are related to the ca. 1.85 Ga alkaline igneous suite in the central Keewatin (LeCheminant et al. 1987).

Northwest trending gabbro dykes (**Pgb**), probably part of the 1.27 Ga Mackenzie swarm, were noted in a few localities. They are massive, unaltered, and coarse grained.

STRUCTURE AND METAMORPHISM

Previous stratigraphic and structural studies (Borradaile et al. 1989; Tella et al. 1986) in the Rankin Inlet Group established that the sequence forms an F1 homocline which is folded into a SE-plunging F2 syncline. Between Rankin Inlet and Thomson Island, stratigraphic and structural facing reversals suggest two structural discordances within the upper volcanic cycle of the Rankin Inlet Group (Tella et al. 1986). These discordances have been interpreted as two interleaving thrusts with opposing vergence (northeast and southwest). The orientation of regionally pervasive pre-F2 mineral stretching lineations supports the model. Strain estimates based on deformed lava pillows reveal that the Rankin Inlet Group stratigraphy is thinned to about 12-23% of its original thickness on the flanks of the major F2 fold (Tella et al., 1986; Borradaile et al., 1989).

East of Meliadine Lake, the Archean sequence forms part of an ESE-trending northern limb of a regional F2 syncline. There the Pyke Fault Zone represents one of several limb-parallel, ductile, high-strain zones that shows apparent dextral sense of displacement. The aeromagnetic signature (Geological Survey of Canada, 1966b) associated with the Pyke Fault Zone wraps around the regional F2 syncline beyond the map area to the northwest, and is in part conformable with the F2 fold limbs. On the basis of structural similarities to the thrusts recognized in the upper volcanic cycle, the Pyke Fault Zone is interpreted as a pre-F2 ductile thrust that was subsequently folded by F2. Northeast plunging mineral stretching lineations together with apparent dextral strike-slip component of displacement suggest a northside-down dip-slip component of displacement on the fault zone.

The contacts between the Paleoproterozoic quartz-arenite sequence with the Rankin Inlet Group and with the orthogneiss and migmatite (**Agn**) are for the most part tectonic. On Marble Island, this contact is marked by east-trending, southerly directed, high angle imbricate thrusts, and the bedding is locally overturned to the south. Similar basement-cover contact relations have also been observed elsewhere on the mainland, especially east- and southeast of Atulik Lake. There the Archean metavolcanic rocks within the Pyke Fault Zone are in thrust contact with the Paleoproterozoic quartz-arenite sequence, suggesting Proterozoic reactivation of an Archean Fault Zone.

North- and northwest-trending brittle faults, some characterized by pronounced topographic lineaments, affected both Archean and Paleoproterozoic rock units.

The metamorphic grade of the Rankin Inlet Group is greenschist to lower amphibolite facies. The deformation and metamorphism are considered to be Archean. Rocks within unit (**As**) were metamorphosed under mid-amphibolite facies conditions. They are considered to be higher grade equivalents of aluminous and iron-rich sedimentary successions of the Rankin Inlet Group (Tella et al. 1986). Thermobarometric calculations from the Chesterfield Inlet region yielded P-T estimates of ca 3.4kb and 6350C for the assemblages in this unit (Tella et al., 1989). Paleoproterozoic supracrustal rocks are unmetamorphosed.

ECONOMIC GEOLOGY

Several quartz and quartz-carbonate-chlorite veins, some containing arsenopyrite, pyrite, and chalcopyrite mineralization, occur within and transecting the metamafic rocks of the Rankin Inlet Group. Pyritiferous gossans, with or without sphalerite, are spatially related to late NE- and E- trending brittle faults. Multiple bands of gold-bearing, quartz-magnetite iron formation (**Aif**) are present north of Atulik Lake. They show pronounced aeromagnetic signatures (Geological Survey of Canada, 1966 a,b). Numerous mineral exploration assessment reports on this region are available from DIAND office, NWT Geology Division, Yellowknife, NWT.

Active exploration for gold is being undertaken in the Meliadine Lake region (55K/16, 55J/13) approximately 20 km north of the settlement of Rankin Inlet. Several horizons of gold-bearing iron formation have been traced over a strike-length of 65 km along the Pyke Fault Zone within and beyond the map area. Two mineralogically distinct, and structurally controlled epigenetic lode gold deposit types have been recognized in lithologically and geophysically distinct oxide iron formation of the Rankin Inlet Group (Miller and Balog, 1993). They include: 1) pyrrhotite-rich lode gold in banded quartz-magnetite iron formation having a strong magnetic signature, and 2) pyrite+arsenopyrite lode gold in lean, siliceous iron formation which shows a lower magnetic susceptibility compared to the banded iron formation. Alteration associated with the pyrrhotite-rich lodes is signaled by the presence of discordant and concordant quartz+carbonate veins and by the overprinting hydrothermal minerals: hornblende, biotite, calcite, grunerite, and allanite. Partial to complete sulphidization (pyrrhotite after magnetite) accompanied replacement of iron oxide by Fe-Mg silicates. The alteration assemblage suggests that gold mineralization is associated with Ca, K, S, Au, As and minor Na and CO2 metasomatism (Armitage et al. 1993). Alteration associated with the pyrite+arsenopyrite-rich lodes is marked by calcite+quartz vein systems and replacement of oxide iron formation by hornblende, grunerite, calcite, biotite, and quartz. Sulphides + gold are present as disseminations and as vein systems in the iron formation and, less abundantly, in adjacent wallrocks. The metasomatic/hydrothermal fluid carried CO2, K, S, Au, and As (Miller and Balog, 1993). Preliminary gechronology of samples from one of the early thrust faults suggest reactivation of the fault and emplacement of gold-bearing fluids during Paleoproterozoic (ca 1780+/-25 Ma, hornblende; Miller et al. 1995). Tectonic juxtaposition of the Rankin Inlet Group metavolcanics with the Lower Proterozoic quartz-arenites east of Atulik Lake provides an independent structural evidence for Proterozoic reactivation of the Pyke Fault Zone.

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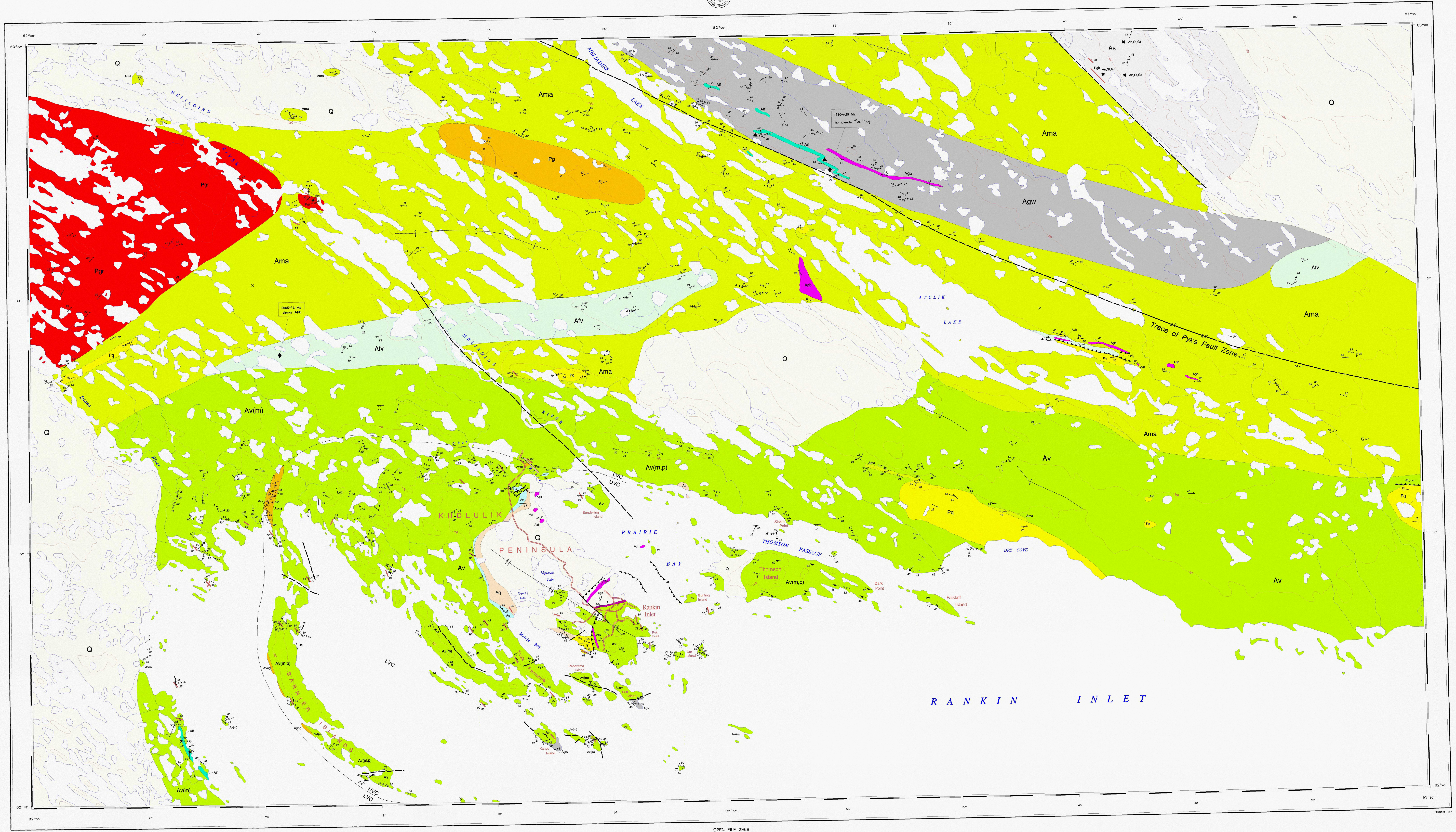

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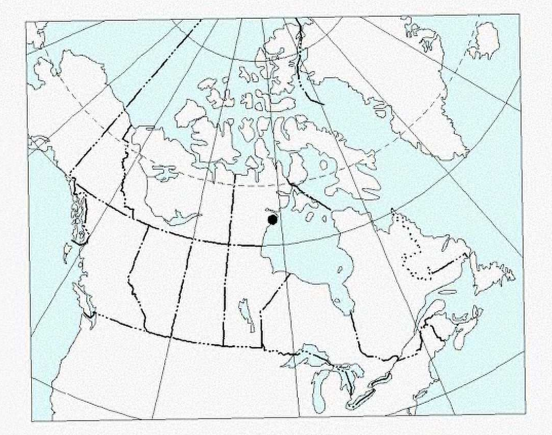

OPEN FILE 2968
(SHEET 1 OF 2)
GEOLOGY

RANKIN INLET (55K/16) AND FALSTAFF ISLAND (55J/13)

DISTRICT OF KEEWATIN
NORTHWEST TERRITORIES

Scale 1:50 000 - Échelle 1/50 000

Kilometres 1 0 1 2 3 4 Kilomètres

Transverse Mercator Projection
CM 92°00', Scale Factor 1

Projection transverse de Mercator
M.C. 92°00', facteur d'échelle 1

CANADA-NWT
MINERAL INITIATIVES
1991-1996
CANADA-NWT ECONOMIC DEVELOPMENT AGREEMENT

LEGEND

Note: This legend is common to sheet 1 and sheet 2, some units and symbols may not appear on this map

QUATERNARY

Q	*Glacial, fluvial, and marine deposits*

PALEOPROTEROZOIC

Pgb	*Gabbro dykes: massive to weakly foliated, coarse grained (Mackenzie swarm)*
Plp	*Biotite lamprophyre dykes*
Pg	*Granite; massive to weakly cleaved, leucocratic*
Pgr	*Granite; weakly to well foliated, pink to grey, locally contains fine grained disseminated magnetite*
Pq	*Quartz arenite; predominantly white, fine- to medium grained, thin- to thick bedded and ripple marked, grey-green to pink interbeds at the base*
Pqs	*Quartz sericite schist; in part sheared, forms a discontinuous basal unit to quartz-arenite (Pq); mostly exposed on Marble Island (NTS 55J/11, sheet 2)*

ARCHEAN AND/OR PALEOPROTEROZOIC

Agn	*Orthogneiss, migmatite; layered to banded hornblende-biotite (grey) includes minor amounts of metagreywacke, amphibolite, and inclusions of mafic volcanic schist. Locally cut by pegmatite and granitoid veins and dykes, and biotite lamprophyre dykes. (exposed on Marble Island, NTS 55J/11)*

ARCHEAN

As	*Paragneiss; garnet + biotite +/- staurolite +/- andalusite +/- muscovite. Rocks in this unit are considered as higher metamorphic grade equivalents of those in units Av and Agw*

RANKIN INLET GROUP (Av - Agb)

Agb	Gabbro
Au	*Ultramafic rocks, serpentinite; basaltic komatiite affinity*
Agw	*Greywacke; in part metamorphosed to biotite schist, and biotite -chlorite-andalusite schist*
Ama	*Mixed unit comprised of chlorite schist, actinolite-hornblende schist, mafic tuff, tuff breccia, intraformational polymictic conglomerate; mainly derived from unit Av; contact between Av and Ama appears gradational, and is poorly defined*
Afv	*Felsic volcanic rocks; dacite to rhyolite porphyry, felsic tuff; commonly sheared and metamorphosed to quartz-mica schist; mainly derived from unit Av*
Aq	*Impure quartzite, slate, argillite, and minor quartz-pebble conglomerate and calcareous sediments*
Ac	*Carbonate; buff weathering dolomite, siliceous dolomite; discontinuous interbeds*
Avcg	*Polymictic conglomerate; granitoid and blue-quartz eye clasts, matrix supported; a distinctive, but discontinuous, conformable marker unit between Upper Volcanic Cycle (UVC) and Lower Volcanic Cycle (LVC)*
Aif	*Banded iron formation; multiple bands of silicate- and oxide- facies iron formation; mostly turbidite-hosted (Agw); locally contain epigenetic gold mineralization*
Av	*Metavolcanic and metasedimentary rocks; basalt to andesite, massive(m) to pillowed(p) flows, intercalated with mafic and felsic tuffs, pyroclastics, pillow breccia; greywacke (Agw), thin interbeds of iron formation, gabbro sills, mafic volcanics in part metamorphosed to actinolite-hornblende and garnet-chlorite schists; UVC -Upper Volcanic Cycle LVC -Lower Volcanic Cycle*

Outcrop (observed) . . . . ×
Lithological boundary (approximate)
Bedding (tops known) 42
Pillow structure (top unknown, known) 25 20
Regional Foliation (S1, S2, S3, generation unknown) 20 80 10 80
Mineral Lineation (generation: unknown, 1st, 2nd, 3rd) 20 70 20 40
Intersection Lineation (generation: unknown, 1st[S0/S1], 2nd[S1/S2] 5 10 20
Fold Axis (generation: unknown, 1st, 2nd) 15 60 15
U-fold, S-fold, Z-fold 15 15 15
Fault (approximate, sinistral, dextral)
Thrust Fault (approximate; teeth on upthrown side)
Dyke (Lamprophyre) 75
Axial trace of F_1 - anticline (plunge indicated)
Axial trace of F_1 - syncline (plunge indicated)
Axial trace of F_2 - syncline (plunge indicated)
Slicken Striae 20
Gold occurrence ▲
Mineral occurrence ✖
Isotopic age (Ga)(zircon, hornblende) ◆
Volcanic cycle boundary

MINERAL OCCURENCES

Andalusite porphyroblasts in As	An
Staurolite porphyroblasts in As	St
Garnet porphyroblasts in As	Gt

Geology by S. Tella, J.R. Henderson and I.R. Annesley, Geological Survey of Canada; G.J. Borradaile, Lakehead University, Thunder Bay (1985); S. Tella and A.E. Armitage (1991-92), S. Tella (1993-94), Geological Survey of Canada

Digital map compilation by S. Tella, Geological Survey of Canada

Digital cartography by R.L. Allard, Geological Survey of Canada

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

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Copies of the topographical editions covering this map area may be obtained from the Canada Map Office, Department of Natural Resources Canada, Ottawa, Ontario, K1A 0E9

The proximity of the North Magnetic Pole causes the magnetic compass to be erratic in this area

Mean magnetic declination 1994, 8° 01' West, increasing 4.5' annually. Readings vary from 6° 47' W in the SW corner to 9° 07' W in the NE corner of the map

Elevations in feet above mean sea level

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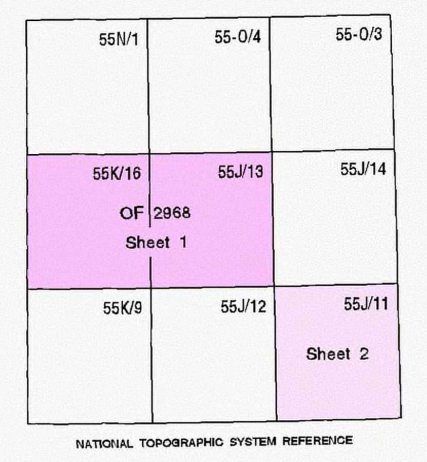

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Recommended citation:
Tella, S.
1994: Geology, Rankin Inlet (55K/16), Falstaff Island (55J/13) and Quartzite Island (55J/11), District of Keewatin, Northwest Territories, Geological Survey of Canada, Open File Map 2968, scale 1:50 000