DESCRIPTIVE NOTES

INTRODUCTION

This 1:100 000 scale bedrock geology map of the MacQuoid Lake–Gibson Lake–Akunak Bay area is compiled from 14 previously released 1:50 000 scale digital open file maps (Tella et al., 1997c, 1999, 2000b; LeCheminant et al., 1997), and integrates results of bedrock mapping undertaken during 1996, 1998, 1999 with more recent data from topical studies on geochronology, petrology, and metamorphism. The map area represents a portion of the northern Hearne domain, western Churchill Province (Fig. 1). South of the Snowbird Tectonic Zone, the northern Hearne domain is predominantly composed of Archean juvenile crust which is interpreted to be underlain by continental crust of the Rae domain. The objectives of the mapping were to evaluate the nature of tectonic reworking of the Archean rocks during the Paleoproterozoic and to provide an improved tectonostratigraphic framework for mineral exploration. Detailed accounts of bedrock geology and of targeted studies on structure, metamorphism, petrology, and geochronology of this region were previously published (Tella et al., 1992, 1997a, b, c, 1999, 2000a, b; Davis et al., 1999; Hanmer et al., 1999a, b, c; Mills et al., 1999, 2000; Ryan et al., 1999, 2000a, b; Berman et al., 2000; and Sandeman et al., 2000a, b, c). For an overview of the bedrock geology of the surrounding regions and for additional reference material on previous work in the region, the reader is referred to the references listed below. Aspler and Chiarenzelli (1996) present a regional overview of the paleogeography of late Archean greenstone belts that includes the area covered by this map.

This compilation project is a part of the Western Churchill NATMAP Project, a collaborative initiative between the Geological Survey of Canada (GSC), the Government of the Northwest Territories (GNWT), Indian and Northern Affairs Canada (INAC), and industry.

LITHOLOGY

The map area is broadly divided into three lithological and structural subdivisions (Fig. 2): 1) the northwest-dipping MacQuoid Homocline, principally composed of Archean amphibolite-facies metasedimentary rocks (units As, Aq) and gneissic tonalite (unit At), structurally overlain by 2) a volcanic belt comprised of amphibolite-facies, juvenile arc-like mafic, intermediate, and felsic metavolcanic rocks (units Av, Afv) with U-Pb zircon magmatic crystallization ages of ca. 2655 Ma to ca. 2682 Ma and possibly as old as ca. 2720 (Table 1), and associated plutonic rocks (units Adt, Atp, Ag, Agb; ca. 2684–2656 Ma); and 3) the ca. 2700 Ma Cross Bay plutonic complex comprised of polydeformed and metamorphosed Archean tonalite gneiss (unit At), diorite and gabbro (unit Adi) that structurally overlies the MacQuoid Homocline with an interpreted, southeast-directed thrust relationship (Fig. 2). The volcanic rocks are predominantly tholeiitic basalts to basaltic andesites. Detailed geochemical characteristics of the volcanic and plutonic rocks are indicated in Figure 3 (*see* Sandeman et al., 1999, 2000a, b, c). All volcanic rocks are characterized by juvenile time corrected isotopic compositions with ϵ_{Nd} values ranging from +3.6 to +1.8.

The Cross Bay plutonic complex is bounded to the south by the Big lake shear zone (Blsz), a 50 km long, dextral strike-slip structure with a polyphase displacement history that spans from Neoarchean to Paleoproterozoic (Ryan et al., 2000a, b), the western segment of which is stitched by a ca. 1830 Ma isotropic granite (unit Pgr). Uranium-lead isotopic studies on zircon, titanite, and monazite (Table 1) from the supracrustal and granitoid rocks suggest that the Cross Bay plutonic complex was deformed at ca. 2695 Ma before the onset of ca. 2680 Ma volcanism in the volcanic belt and the MacQuoid Homocline, and highlight a complex Archean and Paleoproterozoic tectono-magmatic evolution. Metamorphosed and deformed ca. 2190 Ma mafic dykes (unit Pdm), and variably deformed ca. 1830–1820 Ma quartz monzonite to granite (unit Pgr), comagmatic mafic syenite (unit Py), diorite to gabbro (unit Pdi), and ultrapotassic lamprophyre dyke swarms (unit Pdl) represent Paleoproterozoic tectonothermal and magmatic events.

STRUCTURE

At least four deformation events affected the supracrustal units within the MacQuoid Homocline. D_1-D_2 are considered to be late Archean events. Fabric relations suggest that the regionally pervasive foliation in rock units As, Av, and At is a D_2 fabric element (Tella et al., 1997a, b, 1999, 2000a, b; Hanmer et al., 1999a, b; Ryan et al., 1999). In supracrustal units (As, Av), this fabric represents a composite S_2, developed from the transposition of an older S_0/S_1 fabric. Younger fabric elements and folds can not be simply correlated on the basis of geometry alone, but there is evidence for two post-D_2 regional deformation events (Hanmer et al., 1999b; Tella et al., 2000a). Linear fabrics are composite. The main fabrics in the Cross Bay plutonic complex predate the main fabrics in the MacQuoid Homocline. Younger Paleoproterozoic tectonothermal events only deformed the ca. 2190 Ma mafic dykes within the Cross Bay plutonic complex where they are commonly tightly folded (Hanmer et al., 1999a, b; Tella et al., 2000a, b).

West of Akunak Bay and south of Chesterfield Inlet, two contrasting structural domains are juxtaposed along a north-northwest-trending fault that extends from west of Butts Lake to the south shore of Chesterfield Inlet. In the eastern domain, dominated by supracrustal rock assemblages, the structural trends are predominantly northwest, whereas they are commonly northeast trending in the western tonalite-gneiss domain. The Akunak Bay shear zone cuts the D_2 fabrics in the supracrustal rocks and it is not offset by this north-northwest-trending fault. These field relationships suggest that the juxtaposition of the two domains occurred prior to the development of the Akunak Bay shear zone.

UVAUK COMPLEX (UNIT A'UCX)

North of Akunak Bay, across Chesterfield Inlet, a polydeformed and metamorphosed, layered gabbro-mafic granulite-anorthosite complex, the Uvauk complex (unit A'ucx; Tella et al., 1993; Tella and Schau, 1994; Mills et al., 1999, 2000), structurally overlies part of the orthogneiss (unit At) terrane. Relatively undeformed diorite (unit A'di) and gabbro (unit A'gb) intrusions of Neoarchean and/or Paleoproterozoic age occur within and adjacent to the complex. The Uvauk complex includes a ca. 2700 Ma anorthosite (Mills et al., 2000), and was affected by two granulite-facies mylonite events at ca. 2590 Ma (about 7–9 kbar) and ca. 1940 Ma (P > 12 kbar; Tella et al., 1994). Some anorthosite within the complex is apparently synkinematic with respect to the ca. 1940 Ma event (Mills et al., 1999, 2000).

Straight gneiss, mylonite (unit Pgm; Blsz, ABsz)

Recrystallized straight gneiss and mylonite form northeast- and east-trending linear belts. The Big lake shear zone (Blsz, Fig. 2), which coincides with the southern margin of the Cross Bay plutonic complex, is a steeply north-dipping zone of strike-lineated straight gneiss and mylonite predominantly derived from granitoid protoliths. The main segment of the shear zone records a Proterozoic dextral, strike-slip history, whereas its western segment is kinematically more complex and preserves Neoarchean, granulite-facies mylonite (Davis et al., 1999; Ryan et al., 2000a, b), and may represent the lateral ramp to south-directed thrusting (Fig. 2). The Akunak Bay shear zone (ABsz), exposed west of Akunak Bay, is an east-trending belt of straight gneiss and mylonite, anastomosing on a 5–10 m scale. Rare shear-sense indicators suggest an oblique, dextral movement. Its western extension links with a straight gneiss unit in the Cross Bay plutonic complex. Potential ca. 2190 Ma MacQuoid dykes cut the Akunak Bay shear zone, which is therefore older (Tella et al., 2000a).

METAMORPHISM

The area has experienced multiple metamorphic events that range from greenschist to granulite facies (Berman et al., 2000; Stern and Berman, 2000; Table 2). The main Archean metamorphism (M_2) is thought to overprint a low-grade metamorphic event (M_1) associated with intrusion of 2680–2610 Ga plutons. Mid- to upper-amphibolite-facies conditions during M_2 occurred at ca. 2560–2500 Ma, and P-T conditions that ranged from about 5 kbar and 660°C in the southwest to about 9 kbar and 770°C in granulite-facies rocks (Uvauk complex, unit A'ucx) of the Chesterfield Inlet area to the northeast (Fig. 4; Table 2). Commonly observed M_2 assemblages include garnet, biotite ± aluminosilicate minerals (andalusite, sillimanite) in sedimentary rocks (unit As) and of garnet + biotite + plagioclase ± clinopyroxene assemblage in mafic volcanic rocks (units Av, Am). Porphyroblast-fabric relations indicate that M_2 was post-D_1, with peak metamorphism during early D_2 but outlasted by D_2.

A high-pressure metamorphic event (M_3) at ca. 1900 Ma ranged from about 10 kbar and 675°C in the southwest to more than 12 kbar north of Chesterfield Inlet. M_3 is manifested in pelitic rocks as small (<0.2 mm) garnet microporphyroblasts and overgrowths on M_2 garnet, and in ca. 2190 Ma mafic dykes as thin garnet coronae. Deformation is associated with M_3 only within the Cross Bay plutonic complex (folded mafic dykes) and the Uvauk complex (mylonite development). Widespread greenschist- to lower amphibolite-facies metamorphism (M_4) accompanied emplacement of the suite of ca. 1830 Ma granite plutons (unit Pgr) at about 15 km depth. Random needles of sillimanite that cut across D_2 fabrics in pelitic rocks likely grew during M_4.

ECONOMIC GEOLOGY

The region hosts several economic mineral occurrences and significant prospects: volcanic-associated massive sulphide (Armitage et al., 1995; Armitage, 1998), magmatic Ni-Cu (Armitage et al., 1997; Armitage, 1998), iron-formation-hosted Au (e.g. Hearn, 1990), diamonds (MacRae et al., 1995), and potential carving stone (Hanmer et al., 1999c). The base-metal occurrences include the stratabound accumulations of sphalerite, galena, and chalcopyrite spatially associated with siliceous zones within pyritic quartz muscovite-garnet-staurolite-gahnite schist (units Afv, As) at the Sandhill prospect (Armitage et al., 1995; Armitage, 1998). The massive sulphide at Suluk prospect (Armitage et al., 1997), spatially associated with a composite gabbro (unit A'di), is composed of nickeliferous pyrrhotite-pentlandite that contains abundant wall-rock xenoliths. It has been interpreted as a Paleoproterozoic magmatic sulphide deposit (Armitage et al., 1997). The gold occurrences are largely of structurally controlled vein type (e.g. Hearn, 1990) hosted by a variety of Archean rocks, including iron-formation.

Diamondiferous dykes (e.g. Akluilak, Thirsty Lake, V-Day; unit Pdl) are Paleoproterozoic and have been interpreted as linked to the widespread 1840–1830 Ma ultrapotassic magmatism in the central Churchill Province (LeCheminant et al., 1987; Peterson et al., 1994; Armitage et al., 1997). Carving stone is quarried in a small-scale operation on the south side of Cross Bay. There, the quarry pits appear to be located within large inclusions of ultramafic material, which represent hydrothermally altered pyroxenitic protoliths within gneissic tonalite (unit At) host rock. A detailed petrographic description of this and other potential carvingstone localities is given in Hanmer et al. (1999a).

The diverse metal endowment of the MacQuoid Lake–Gibson Lake–Akunak Bay region suggests significant exploration potential. The timing of mineralization relative to volcanism, sedimentation, plutonism, deformation, and metamorphism remains to be established.

REFERENCES

Armitage, A.E

1998: Geology of the Sandhill Zn-Cu-Pb-Ag prospect and economic potential of the Gibson MacQuoid greenstone belt, District of Keewatin, N.W.T.; Ph.D. thesis, University of Western Ontario, London, Ontario, 254 p.

Armitage, A.E., Miller, A.R., and MacRae, N.D.

1997: Paleoproterozoic Ni-Cu-Co sulphide mineralization, Suluk occurrence, Gibson-MacQuoid Lake area, western Churchill Province, Northwest Territories; *in* Current Research 1997-C; Geological Survey of Canada, p. 61–70.

1995: Geological setting of the Sandhill Zn-Cu-Ag prospect in the Gibson-MacQuoid Lake area, District of Keewatin, Northwest Territories; *in* Current Research1995-C, p. 213–224.

Aspler, L.B. and Chiarenzelli, J.R.

1996: Stratigraphy, sedimentology and physical volcanology of the Henik Group, central Ennadai-Rankin greenstone belt, Northwest Territories, Canada: late Archean paleogeography of the Hearne Province and tectonic implications; Precambrian Research, v. 77, p. 59–89.

Berman, R.G., Ryan, J.J., Tella, S., and Stern, R.A.

2000: The case of multiple metamorphic events in the Western Churchill Province: evidence from linked thermobarometric and in-situ SHRIMP data, and jury deliberations; *in* GeoCanada 2000, Geological Association of Canada–Mineralogical Association of Canada Annual Meeting, The Millennium Geoscience Summit Conference, CD-ROM, Abstract no. 836.

Davis, W.J., Tella, S., Hanmer, S., Ryan, J.J., and Sandeman, H.A.

1999: Preliminary U-Pb geochronological results from the Gibson Lake-Cross Bay area, Kivalliq Region, Nunavut; *in* 27th Annual Geoscience Forum, Yellowknife, Program and Abstracts of Talks and Posters, N.W.T. Chamber of Mines, p. 13–14 (abstract).

Hanmer, S., Sandeman, H.A., Tella, S., Ryan, J.J., Hadlari, T., and Mills, A.

1999a: Preliminary petrography of current and potential carving stone, Gibson Lake-Cross Bay area, Kivalliq Region, Nunavut; *in* Current Research 1999-C; Geological Survey of Canada, p. 77–86.

Hanmer, S., Tella, S., Sandeman, H.A., Ryan, J.J., Hadlari, T., and Mills, A.

1999b: Proterozoic reworking in western Churchill Province, Gibson Lake-Cross Bay area, Northwest Territories (Kivalliq Region, Nunavut). Part 1: general geology; *in* Current Research 1999-C, Geological Survey of Canada, p. 55–64.

1999c: Proterozoic reworking in western Churchill Province, Gibson Lake-Cross Bay area, Northwest Territories (Kivalliq Region, Nunavut). Part 2: regional structural geology; *in* Current Research 1999-C, Geological Survey of Canada, p. 65–75.

Hearn, K.

1990: Parker Lake Project; *in* Keewatin Region, Mineral Industry Report 1986-87, N.W.T. Geology Division, Department of Indian Affairs and Northern Development, p. 86–87.

Irvine, T.N. and Baragar, W.R.A.

1971: A guide to the chemical classification of common volcanic rocks; Canadian Journal of Earth Sciences, v. 8, p. 523–548.

LeCheminant, A.N., Miller, A.R., and LeCheminant, G.M.

1987: Early Proterozoic alkaline igneous rocks, District of Keewatin, Canada: petrogenesis and mineralization; *in* Geochemistry and Mineralization of Proterozoic Volcanic Suites, (ed.) T.C. Pharaoh, R.D. Beckinsale, and D. Rickard; Geological Society of London, Special Publication, no. 33, p. 219–240.

LeCheminant, A.N., Tella, S., Sanborn-Barrie, M., and Venance, K.E.

1997: Geology, Parker Lake South (55M/6), District of Keewatin, Northwest Territories; Geological Survey of Canada, Open File 3405, scale 1:50 000.

MacRae, N.D., Armitage, A.E., Jones, A.L., and Miller, A.R.

1995: A diamondiferous lamprophyre dike, Gibson Lake area, Northwest Territories; International Geology Review, v. 37, p. 212–229.

Mills, A., Berman, R.G., and Hanmer, S.

1999: Geology of the Uvauk complex, Northwest Territories (Kivalliq Region, Nunavut); *in* Current Research 1999-C; Geological Survey of Canada, p. 97–106.

Mills, A., Berman, R.G., Hanmer, S., and Davis, W.J.

2000: New insights into the tectonometamorphic history of the Uvauk complex, Nunavut; *in* GeoCanada 2000, Geological Association of Canada–Mineralogical Association of Canada Annual Meeting, The Millenium Geoscience Summit Conference, CD-ROM, Abstract no. 733.

Peterson, T.D., Esperança, S., and LeCheminant, A.N.

1994: Geochemistry and origin of the Proterozoic ultrapotassic rocks of the Churchill Province, Canada; Contributions to Mineralogy and Petrology, v. 51, p. 251–276.

Ryan, J.J., Davis, W.J., Berman, R.G., Sandeman, H.A., Hanmer, S., and Tella, S.

2000a: 2.5 Ga granulite-facies activity and post-1.9 Ga low-grade reactivation along the Big lake shear zone, MacQuoid-Gibson lakes area (Nunavut): A fundamental boundary in the western Churchill Province; *in* GeoCanada 2000, Geological Association of Canada–Mineralogical Association of Canada Annual Meeting, The Millenium Geoscience Summit Conference, CD-ROM, Abstract no. 924.

Ryan, J.J., Hanmer, S., Sandeman, H.A., and Tella, S.

2000b: Anatomy and deformation history of the Big lake shear zone, MacQuoid-Gibson lakes area, Kivalliq Region, Nunavut; Geological Survey of Canada, Current Research 2000-C6, 11 p. (online; http://www.nrcan.gc.ca/gsc/bookstore).

Ryan, J.J., Hanmer, S., Tella, S., and Sandeman, H.A.

1999: Detailed structural studies, Gibson Lake-Cross Bay-MacQuoid Lake area, Northwest Territories (Kivalliq Region, Nunavut); *in* Current Research 1999-C; Geological Survey of Canada, p. 87–96.

Sandeman, H.A., Davis, W.J., Hanmer, S., MacLachlan, K., Peterson, T., Ryan, J.J., Tella, S., and Cousens, B.

2000a: Geochemistry of Neoarchean plutonic rocks of the Hearne Domain, Western Churchill Province, Nunavut: granitoids associated with the formation and stabilization of "arc-like" oceanic crust; *in* GeoCanada 2000, Geological Association of Canada–Mineralogical Association of Canada Annual Meeting, The Millenium Geoscience Summit Conference, CD-ROM, Abstract no. 810.

Sandeman, H.A., Davis, W.J., Hanmer, S., MacLachlan, K., Ryan, J.J., Kjarsgaard, B., Kerswill, J.A., Tella, S., Zaleski, E., and Cousens, B.

2000b: Archean volcanic sequences of the Western Churchill Province, Nunavut, Canada: three petrochemically distinct domains of non-plateau affinity; *in* GeoCanada 2000, Geological Association of Canada–Mineralogical Association of Canada Annual Meeting, The Millenium Geoscience Summit Conference, CD-ROM, Abstract no. 812.

Sandeman, H.A., Lepage, L., Ryan, J.J., and Tella, S.

2000c: Field evidence for commingling between ca. 1830 Ma lamprophyric, monzonitic, and monzogranitic magmas, MacQuoid-Gibson lakes area, Kivalliq Region, Nunavut; Geological Survey of Canada, Current Research 2000-C5, 11 p. (online; http://www.nrcan.gc.ca/gsc/bookstore).

Sandeman, H.A., Ryan, J.J., Tella, S., Davis, W.J., and Hanmer, S.

1999: Implications of geochemical and isotopic data for metavolcanic rocks of the MacQuoid-Gibson greenstone belt, Kivalliq region, Nunavut; *in* 27th Annual Geoscience Forum, Yellowknife, Program and Abstracts of Talks and Posters, N.W.T. Chamber of Mines, p. 61 (abstract).

Stern, R.A. and Berman, R.G.

2000: Monazite U-Pb and Th-Pb geochronology by ion microprobe, with an application to in situ dating of an Archean metasedimentary rock; Chemical Geology, v. 172, p. 113–130.

Sun, S.S. and McDonough, W.F.

1989: Chemical and isotopic systematics of oceanic basalts: implications for mantle compositions and processes; *in* Magmatism in the Ocean Basins, (ed.) A.D. Saunders and M.J. Norry; Geological Society of London, Special Publication 42, p. 313–345.

Tella, S. and Schau, M.

1994: Geology, Gibson Lake (east-half), District of Keewatin, Northwest Territories; Geological Survey of Canada, Open File 2737, scale 1:50 000.

Tella, S., Davis, W.J., Berman, R.G., Stern, R., and LeCheminant, A.N.

1997a: Tectonothermal history of the MacQuoid Lake supracrustal belt, District of Keewatin, Northwest Territories, Canada; Geological Society of America, Abstracts with Programs, v. 29, p. 277–278.

Tella, S., Hanmer, S., Sandeman, H.A., Ryan, J.J., Hadlari, T., Mills, A., and Kerswill, J.A.

1999: Geology, parts of MacQuoid-Gibson lakes area, Kivalliq Region, Nunavut; Geological Survey of Canada, Open File 3701, scale 1:50 000.

Tella, S., LeCheminant, A.N., Sanborn-Barrie, M., and Venance, K.E.

1997b: Geology and structure of parts of the MacQuoid Lake area, District of Keewatin, Northwest Territories; *in* Current Research 1997-C, Geological Survey of Canada, p. 123–132.

1997c: Geology, parts of MacQuoid Lake, District of Keewatin, Northwest Territories; Geological Survey of Canada, Open File 3404, scale 1:50 000.

Tella, S., Roddick, J.C., Schau, M., and Mader, U.

1994: Geochronological constraints on the tectono-metamorphic history of the allochthonous Uvauk gabbro-anorthosite-granulite complex, Central Churchill Province, District of Keewatin, N.W.T., Canada; *in* Geological Association of Canada–Mineralogical Association of Canada Program of Abstracts, Waterloo '94, p. A111 (abstract).

Tella, S., Ryan, J.J., Sandeman, H.A., Hanmer, S., Mills, A., and Wilkinson, L.

2000a: Proterozoic reworking in a portion of the western Churchill Province, Akunak Bay area, Kivalliq Region, Nunavut, Canada; Geological Survey of Canada, Current Research 2000-C11, 11 p. (online; http://www.nrcan.gc.ca/gsc/bookstore).

2000b: Geology, parts of Akunak Bay area, Kivalliq region, Nunavut; Geological Survey of Canada, Open File 3851, scale 1:50 000.

Tella, S., Schau, M., Armitage, A.E., and Loney, B.C.

1993: Precambrian geology and economic potential of the northeastern parts of Gibson Lake map area, District of Keewatin, Northwest Territories; *in* Current Research, Part C; Geological Survey of Canada, Paper 93-1C, p. 197–208.

Tella, S., Schau, M., Armitage, A.E., Seemayer, B.E., and Lemkow, D.

1992: Precambrian geology and economic potential of the Meliadine Lake–Barbour Bay region, District of Keewatin, Northwest Territories; *in* Current Research, Part C; Geological Survey of Canada, Paper 92-1C, p. 1–11.