DESCRIPTIVE NOTES

INTRODUCTION

In the central part of the Ennadai-Rankin belt, Neoarchean iron formation units of the Henik Group have been mapped from the Ducker Lake area ca. 35 km north to the area west of the Henik lakes (Fig. 1; Aspler and Chiarenzelli, 1997 a). New mapping in the Noomut River area (65 H10 and 11) confirm that these iron formations continue east for an additional 60 km, from Magnet Bay on South Henik Lake across the Noomut River area to Harling Lake. Paleoproterozoic rocks of the Hurwitz Group are infolded with the Henik Group north of Noomut River and Ameto Lake.

Henik Group: AmvAmvfAgbAfAiAitAitfAicgAipsAifAipgAip

The Henik Group is the local name for Archean supracrustal rocks in the central part of the Ennadai-Rankin greenstone belt (Eade, 1974). Herein we retain the informal subdivisions outlined in Aspler and Chiarenzelli (1996 a), however new data necessitate revision of provisional stratigraphic correlations (Fig. 3). In the Noomut River area, rocks previously considered part of "unit A" are now thought to be entirely within unit A, a mixed sedimentary-volcanic assemblage consisting of: mafic volcanic rocks (**Amv**) and related dykes, sills and stocks (**Agb**); felsic to intermediate volcanic rocks (**Af**); interfingering turbiditic sandstone/mudstone sets, felsic to intermediate tuffs, mafic flows and intraformational conglomerate (**Ai**); and magnetite-bearing iron formation (**Atif**). Adjacent to a pluton in the southern part of the map area is a zone of paragneiss (**Aip**) developed at the expense of unit **Ai**. Unit **A** subfacies in the Noomut River area are interpreted within the context of a subaqueous lava plain - slope - basin depositional model developed for the central part of the Ennadi-Rankin greenstone belt (Aspler et al., 1999). Recent mapping suggests deposition in a single basin that covered an area of at least 6,000 km2.

The lowermost subfacies in the Noomut River area is unit **Amv**. It consists of predominantly mafic volcanic flows cut by gabbroic dykes and sills. The flows are non-amygdaloidal, thickly bedded and display massive, pillowed, and sheet flood morphologies. Pillow breccia and variolitic horizons are common. Felsic flows (**Amvf**) form rare interbeds. Exposures of **Amv** in the northwestern part of 65 H11 are continuous with rocks previously mapped as part of unit **A** in the northeast corner of the adjacent sheet, 65 H12 (Aspler and Chiarenzelli, 1997 a, Aspler et al., 1997). New mapping demonstrates that this section underlies iron-formation unit **Aif** and is not part of unit **A**. In the northwestern part of the area, **Amv** is overlain by a wedge of felsic to intermediate volcanic flows, tuffs, breccias and agglomerates (**Af**). The breccias and agglomerates are monomictic, and form massive beds up to 10m thick. In the breccias, angular clasts up to 1m have sharp clast boundaries and are self-supporting; in the agglomerates, amoeboid clasts display indistinct boundaries and are supported by a crystal-rich matrix.

Elsewhere in the Noomut River area, **Amv** is overlain by unit **Ai**. Because of the discontinuous nature of subfacies in unit **Ai**, and because of outcrop limitations, unit subdivisions are indicated by letter designations (e.g. **Aixx**) without lithologic contacts. Turbiditic sandstone/mudstone sets (**Ait**) and intermediate to felsic tuffs (**Aitf**) are end member subfacies within **Ai**. The turbiditic rocks consist of laterally continuous dcm-scale sandstone to mudstone fining upward sequences and cm to mm-scale rhythmites. Rarely preserved are vertical profiles arranged in the sequence: sharp base - massive or graded arkose - parallel stratification (+/- ripple drift cross stratification) - siltstone - mudstone. Sandstone to pelite ratios within single sequences range from 3/7 to 9/1. However, for most of **Ai**, the sandstone component is predominant, particularly in the eastern Noomut River area where sandstones form amalgamated beds several metres thick (± pebbly sandstones, **Aips**) that are separated by thin mudstone partings. The turbiditic rocks also contain local lenses of conglomerate (**Aicg**) with intraformational clasts (chert, iron formation, mafic and felsic volcanic) and m-scale massive or parallel-stratified sandstone interbeds. In low strain zones, the tuff subfacies (**Aitf**) consists of dcm- to m -scale sheets of coarse zoned feldspar euhedra and broken euhedra and trace bipyramidal quartz. Juvenile feldspar-phyric fragments up to 10 cm (± distorted internal lamination) are locally abundant. Rarely, layering or graded bedding from variation in crystal size or concentration is developed. More typically, pervasive carbonate-alteration and a penetrative cleavage combine to obliterate primary textures, and the tuffs outcrop as sericite schists.

Iron formation horizons (**Aif**) are interbedded with unit **A** turbiditic and crystal tuff subfacies, both as thick (ca. 300 m) members and as thin (ca. 10 m) isolated layers. Magnetite is concentrated in the pelitic parts of dm-scale fining upward sequences and mm-scale sandstone-mudstone rhythmites, both microbanded with chert and at the top of graded siltstone layers. Magnetite-bearing rip-up clasts are common at the base of intercalated mass flow deposits. Soft sediment folds, faults, dykes, load casts and flame structures are also common.

Granite, granodiorite, diorite (Agdi)

Two felsic plutonic bodies are exposed in the Noomut River area (**Agdi**). In the south, pervasively foliated biotite-hornblende granodiorites cut turbiditic rocks, crystal tuffs and iron formation. Both the pluton and a ca. 2.5 km border zone of biotite-plagioclase-hornblende paragneiss (**Aipg**) contain variably oriented and deformed late-plutonic granitic sheets. Commonly cross-cutting the host fabric, these sheets also contain a foliation concordant to the host rocks and are folded. Although plutonism may have started before, and continued during deformation, late magmatic stages were likely late-syntectonic to post-tectonic.

In the northern part of the area, units **Amv** and **Af** are cut by rocks that constitute part of a large composite pluton that extends west into 65 H12 and north into 65 H14. The predominant lithology is locally foliated hornblende-biotite granodiorite, but dioritic to gabbroic phases are also represented. Near the margins of the pluton are supracrustal rafts which contain a pervasive internal fabric. However, both supracrustal and plutonic rocks are cut by late-stage granitic dykes that range from undeformed to well-foliated. Hence emplacement of the pluton was likely late syntectonic. Along its southern margin, the pluton is unconformably overlain by the Hurwitz Group.

Megacryst-bearing gabbro (A-Pgb)

Distinctive plagioclase megacryst-bearing northeast-trending gabbro dykes, up to 25 m wide, are sparsely distributed in the Noomut River area (**A-Pgb**). Although volumetrically insignificant, the dykes serve as important markers to distinguish local deformation events and will be valuable for testing structural correlations with other parts of the Ennadai-Rankin greenstone belt. In the south-central part of the area an undeformed dyke cuts cleanly across well-foliated granodiorite considered to have been deformed during "D_1" (see below). Farther north, megacryst-bearing dykes cut Henik Group strata that were previously tilted to near-vertical attitudes. However, these dykes also contain a penetrative fabric related to "D_2" (Fig. 5 in Aspler et al., 1999). Thus geochronologic study of the dykes could potentially establish the maximum age of D_1 and the minimum age of D_2. The relationship between the gabbro dykes and the Hurwitz Group is unknown.

Hurwitz Group (PHN; PHP; PHKm; PHkw; PHKh; PHA; PHg)

North of Noomut River and Ameto Lake, Archean supracrustal and plutonic rocks are unconformably overlain by Paleoproterozoic rocks of the Hurwitz Group. The Hurwitz Group is a ca. 2.45-2.1 Ga (Heaman and LeCheminant, 1993; Heaman, 1994) assemblage of siliciclastic and carbonate rocks thought to have been deposited in an intracratonic basin that occupied the interior of the Hearne Province during the protracted breakup of Kenorland, a speculative Neoarchean/earliest Paleoproterozoic supercontinent (Aspler and Chiarenzelli, 1998). Continental deposits from the lower Hurwitz Group exposed in the map area include: auriferous pyritic quartz pebble conglomerate and subarkose to quartz arenite (**PHN**, Noomut Formation; fluvial); semi-pelite (**PHP**; Padlei Formation; glacigenic/cold climate fluvial, lacustrine); subarkose to quartz arenite (**PHKm**; Maguse Member; fluvial); supermature quartz arenite (**PHKW**; Whiterock Member; lacustrine); and chert and chert breccia (**PHKh**; Hawk Hill Member; sinter). These rocks are considered to represent the initial sag stage of basin expansion. This was terminated by abrupt basin-centre deepening and drowning, and deposition of mudstone and arkose (± microbial laminate) of the Ameto Formation (**PHA**; for details see Aspler et al., 1994; Aspler and Chiarenzelli, 1996 b; 1997 b). Gabbro sills (**Phgb**) cut, and are folded with, the Hurwitz Group.

STRUCTURAL GEOLOGY

A continuing theme of the Western Churchill NATMAP Project is to separate Archean and Proterozoic thermotectonic events. In the northern part of the map area, evidence of post ca. 2.1 Ga Paleoproterozoic deformation is provided by folded and faulted Hurwitz Group. North of Noomut River in 65 H/11, a northwest-vergent thrust fault juxtaposes Henik Group above Hurwitz Group. In the footwall of this thrust, Noomut Formation and Whiterock Member rocks form a panel that is overturned to the northwest. On the northwest margin of this panel, the Whiterock Member is juxtaposed above the Ameto Formation; farther north, the Hurwitz Group defines a gently south-dipping upright homocline. A thrusted Whiterock-Ameto contact, rather than a simple syncline cored by Ameto Formation, is indicated because gabbro sills within the Ameto Formation in the northeast corner of 65 H/10 continue across what would be the trace of a such a syncline.

In addition to the thrust which juxtaposes Henik Group above overturned Hurwitz Group, Paleoproterozoic deformation of Archean rocks is demonstrated by folding of the basement-cover contact and by numerous NW-trending cross faults (likely formed late in the folding history as space-accommodating structures) which cut the Hurwitz Group and penetrate basement. Pre-Hurwitz Group deformation of Archean rocks is demonstrated by foliated clasts in basal Hurwitz Group conglomerates, and structural discordance at the Hurwitz-Henik unconformity, where steeply-dipping Henik rocks are overlain by gently-dipping Hurwitz strata.

We recognize three structural generations in Archean rocks. The oldest ('D_1') is uniquely identifiable only in the southern part of the area, and is manifested by a pervasive foliation in the granodioritic pluton and in zones of paragneiss (**Aipg** and **Aip**) which flanks the pluton. A megacryst-bearing gabbro cuts cleanly across well-foliated granodiorite, separating 'D_1' from 'D_2'. Identification of large-scale D_1 structures is uncertain, but relationships between paragneiss units bordering the pluton may indicate D_1 faults. Northwest of the pluton, a zone of paragneiss containing abundant granitic sheets (**Aipg**) passes abruptly northwest to a wedge of paragneiss lacking such sheets (**Aip**). This wedge in turn passes abruptly to greenschist-grade protolith (**Ai**). The sharp transitions and wedge geometry suggest merging of a fault splay to a master (D_1) fault. Although outcrop is poor, this master fault is inferred to continue to the eastern limit of the map area. Elsewhere in the map area, we are generally unable to make the distinction between a D_1 foliation intensified during D_2 and a foliation originating during D_2. Hence foliation measurements are mainly of unknown generation.

Between the zone of paragneiss and Hurwitz Group exposures, the Henik Group is deformed by a series of tight to isoclinal east-northeast-trending folds with steeply-dipping axial surfaces. Although younging data demand fold closures, hinge zones are not well exposed and we have relied heavily on aeromagnetic data to interpret their geometry (see Aspler et al., 1999). We infer that these folds are D_2 structures because of evidence suggesting a previous episode of tilting: 1) at two localities, megacrystic gabbro dykes cut steeply-dipping Henik Group strata and, in contrast to the unfoliated dyke cutting the granodioritic pluton, these dykes contain a foliation; and 2) limbs of individual folds are inconsistently overturned, and fold hinges plunge steeply. However, we cannot rule out the possibility that some of the folds initiated during D_1 and were tightened during D_2. The rocks in the central part of the map area commonly contain a bedding-parallel cleavage, but because S_1-S_2 overprinting is only rarely preserved, we are generally unable to specify which generation of deformation this cleavage belongs to.

An east-northeast-trending fault extends from South Henik Lake to the eastern limit of mapping. For two reasons, both tenuous, this fault may be Paleoproterozoic. First, it appears to represent the continuation of the Bray Thrust which, north of Montgomery Lake, juxtaposes Archean rocks above the Hurwitz Group (Aspler and Chiarenzelli, 1997 b). However, tracing the fault across the ca. 15 km width of South Henik Lake is uncertain. Second, the trend of the fault is subparallel to thrusts in the Hurwitz Group (see above), although similarity in trend may be coincidence. The fault cuts steeply plunging (D_2) folds in iron formation-bearing unit **Atif**. Although similar in trend, we cannot document that initiation of the folds was related to faulting and the cross-cutting relationships formed by fold breaching during progressive fault-related strain, or if the faulting was entirely younger ("D_3?").

Northeast- and northwest-trending cross-faults cut and deflect D_2 folds in Archean rocks. Locally adjacent to these faults, near-vertical bedding and cleavage are folded in a series of box and chevron cascade folds with shallowly-dipping axial surfaces. A cleavage related to these folds is only locally developed, but a cleavage-cleavage lineation is common. The cross-faults likely formed to accommodate constrictions related to D_2 folding, similar to those cutting the Hurwitz Group.

RECENT EXPLORATION

Pyritic quartz pebble-rich conglomerates at the base of the Hurwitz Group (Noomut Formation) have been historical targets for gold and uranium in the belt extending from north of Noomut River to Kinga Lake (Roscoe, 1981). Previously considered part of the Montgomery Lake Group (see Aspler and Chiarenzelli, 1996 b) the Noomut Formation has been recognized as far west as Oftedal Lake, where values of up to 4,212 ppb Au have been found (Aspler and Chiarenzelli, 1997 a). Gold is presumably carried in pyrite, considered to be, at least party, of paleoplacer origin. This interpretation is based on the observation that many of the pebbles are pyrite-chert composites indistinguishable from rocks mapped in the Henik Group.

Recent exploration in the Henik Group by Comaplex Minerals Corp. has identified several quartz-carbonate vein associated gold prospects (Table 1). At "Esker", gabbroic bodies cut, and are folded with, felsic rocks (quartz-sericite-carbonate schists) of both hypabyssal and extrusive origin. Gold occurs in quartz-carbonate veins and zones of carbonate-pyrite alteration, principally in the gabbros near lithologic contacts. The veins contain a late, moderately southwest-plunging mineral lineation (fibrous quartz and iron carbonate) that is found only in the Esker area. The best mineralization is in hinge zones of open to tight southwest-plunging folds. Nearby post-D_1/pre-D_2 megacrystic-bearing gabbros display pervasive sericitic alteration and a concordant penetrative fabric.

The "Ironside" and "Napartok" prospects are along the ENE-trending fault (D_3 ?) that extends across the center of the area. At Ironside, auriferous quartz-carbonate-chlorite veins are hosted by magnetite iron formation interbedded with turbiditic semi-pelite (± felsic tuff). Adjacent to well-mineralized veins, magnetite is replaced by a chlorite-pyrite-arsenopyrite assemblage. At Napartok, gold is in a subvertical zone of quartz-veined iron carbonate-quartz-albite-sulphide (pyrrhotite + pyrite + arsenopyrite) schist at the contact between variolitic mafic volcanic rocks and semi-pelite. Local preservation of variolites suggests derivation of the schist from mafic volcanic rocks. Thin lenses (<5 m) of graphitic pyrrhotite - bearing argillite are also present in the local stratigraphy. Exploration drilling has shown that these argillites thicken along strike (>30 m) to the NE and SW and are responsible for the weak magnetic linear features evident in the Napartok area (Fig. 2). In core samples, pyrrhotite pseudomorphs pyrite, and commonly displays pressure shadow textures. At "River", auriferous quartz-carbonate-biotite veins, associated with pyrrhotite and pyrite and rare massive pyrite seams, occur in magnetite iron formation intervals interbedded with turbiditic semi-pelites. The veins are associated with ENE-trending cross faults and shallowly SW plunging cascade folds that overprint moderately west-plunging tight to isoclinal D_2 (?) folds.

In summary, recently discovered gold prospects in the Henik Group are associated with zones of iron carbonate-sulphide alteration and quartz-carbonate-sulphide veins. Concentrations of alteration and veining occur within geochemically favoured competent host rocks, within or adjacent to D_2 or later structures. Dating of megacryst-bearing gabbros can test if these prospects are examples of Proterozoic gold in Archean rocks.

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