# FIGURE 1 GEOLOGICAL MAP OF THE PADLEI BELT

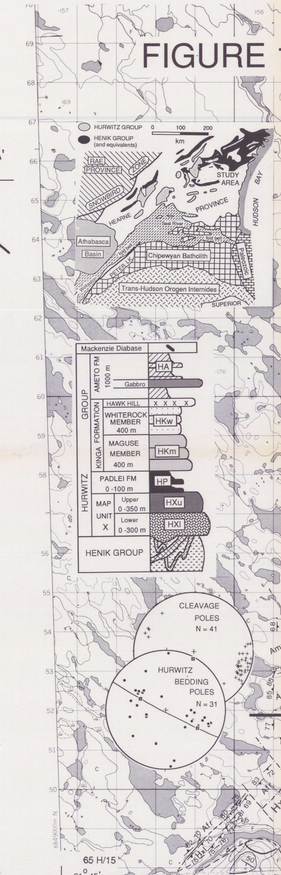
TABLE 1 DESCRIPTIONS AND PRELIMINARY INTERPRETATION OF MAP UNITS

| UNIT | | | | DESCRIPTION | COMMENT/INTERPRETATION |
|---|---|---|---|---|---|
| Mackenzie diabase | | | | Coarse-grained, massive, unmetamorphosed, northwest-trending. | 1267+/-2 ma baddeleyite; LeCheminant & Heaman, 1989 |
| HURWITZ GROUP | KINGA FORMATION | GABBRO HG | | Discontinuous gabbro sills emplaced at different levels within Ameto Formation. Green weathering, coarse-grained, poikilitic. Locally well-foliated; chloritic shear zones common. Local fine-grained sills (with chilled margins) within coarse-grained sills | Post Dunker Formation, pre Hurwitz Group folding. Baddeleyite: 2.09 Ga (Patterson and Heaman, 1991); 2.11 Ga (Heaman and LeCheminant in press). |
| | | AMETO FM HA | | At base: red, blue, green slate with mm-cm-scale parallel-stratified arkose. Up-section: cm-dm-scale arkose to slate fining-upward cycles. At top: 0.1-2m crystalgal laminites. Fine-grained, locally feldspar-phyric, 20 m thick, consistent marker; rests on 80 m above base at Ameto type section. | Below wave-base sedimentation interrupted by turbidity currents; shoaling upward to Watterson carbonate ramp. Mafic unit possibly volcanic. Stromatolites from Bell, 1970 at Ameto type section. |
| | | Hawk Hill Mbr | HKh | Discontinuous unit of bedded white chert, maroon chert and chert breccia conformable between the Whiterock Member and Ameto Formation. Discordant hematitic breccias at top of Whiterock Member. | Previously considered silcretes; re-interpreted as sinters formed by surface discharge of hot springs (Aspler, in prep) |
| | | Whiterock Mbr | HKw | Supermature quartz arenite exclusively. Lower part of section commonly massive; upper 200 m with ubiquitous wave ripples. Quantitative analysis of symmetric vortex orbital ripples yields paleodepths averaging < 2 m for the unit's entire thickness and lateral extent (Aspler et al., in prep.) No evidence of tidal or evaporitic conditions. | Vast, hydrographically-open, tide-free, non-vegetated swamp-like lake (cf. lack of lakes of Baker Lake) |
| | | Maguse Mbr | HKm | Maroon, pink, grey subarkose to quartz arenite; interbeds of white quartz arenite at top. Local black parallel and cross-stratified heavy mineral bands; quartz grit and pebble layers; rare mudstone packages and mud curls. | High-energy, unchannelled sheet floods draining low-relief paleotopography to form extensive sand plain (shed Reid fluvial style of Collor, 1979) |
| | | PADLEI FM | HP | Discontinuous lenses of dm-m-scale pink, grey subarkose to quartz arenite with local mudcurls and mudchips, rare ripples; interbedded with dm-m-scale mudstone with 10-50% cm-scale, subarkose to quartz arenite lenses. Local mm-cm-scale very low sandstone-siltstone to mudstone rhythmites with micro cross stratification and graded bedding, coarse sand to pebble lensestones. Flute casts and tool marks on lonestone-bearing bedding surfaces. Rare polymictic granulestone and pebble conglomerate beds (framework-intact, coarse sand matrix). | Isolated small lakes on alluvial plain, with mixing of fluvial and lacustrine deposition. Lonestones likely from turbidity current deposition rather than from passive melt-out. |
| | | MAP UNIT X | Upper HXu | Beige, grey, green and red arkose, subarkose and quartz arenite. Local polymictic pebbly sandstones (<5-30% floating pebbles in coarse-to-very-coarse sand matrix) and polymictic granulestones (coarse sand matrix); local thin (<0.2 ft m) pyrite-bearing quartz grit and pebble beds, and pyrite-free quartz grit and pebble beds. | Fluvial plain on low-relief paleotopography |
| | | | Lower HXl | Lenses of massive and stratified cobble-boulder polymictic conglomerate; rare coarse sandstone interbeds. Framework-intact to disrupted; coarse sandstone (and locally mixtite) matrix. Clasts well-rounded; dominantly pebbly; felsic, mafic and mafic-dominic; quartz; jasper; BIF; quartzite. Grades conformably upsection to HXu pebbly sandstones. | Both fluvial (clast-supported, sand matrix conglomerate; rare coarse sandstone interbeds. Framework-intact to disrupted, coarse sandstone matrix) and locally debris flow (matrix-supported, conglomeratic) paleovalley fill. |
| Ag | | Granitoid | | Agg: Well-foliated granodiorite; Agd: well-foliated diorite; both with xenoliths of Henik Group at margins | 2512 +/- 112 Ma; Rb/Sr whole rock; Wanless and Eade 1975 |
| HENIK GROUP | Af | Felsic volcanic | | Afr: feldspar-phyric rhyolite. Afra: rhyolitic agglomerate with 30-80% amoboid-shaped clasts of rhyolite in coarse feldspar-quartz matrix | Flows and mafic sills are probably co-magmatic. |
| | Am | Pillow volcanic gabbro sill/dyke complex | | Amv: massive mafic volcanic; Amvp: with well-developed pillows; Amvf: mafic fragmental (tuff and agglomerate); Gd by Amgb : up to 200 m wide gabbro sills and dykes and Amf: 2 to 20 m wide fine-medium grained feldspar-hornblende quartz porphyry dykes (may be in part flows); Ampc: thinly-bedded pyrite chert. | |
| | As | Mixed sedimentary/ volcanic | | As: Dm-scale graded sandstone to mudstone; mm and cm-scale sandstone to magnetite iron formation rhythmites, locally graded. Asft: feldspar-quartz crystal tuff. Asftp: pebbly crystal tuff with 10-20% angular to subrounded felsic clasts in feldspar - quartz crystal matrix. Asftgb : medium to coarse - grained feldspar-quartz sills (flows?). | |

TABLE 2. GEOCHEMISTRY OF GRAB SAMPLES.
Analyses by X-Ray Assay Laboratories, Don Mills, Ontario

| | | | ELEMENT | Au | Co | Ni | Cu | Zn | As | Mo | Ag | Cd | Sb | W | Pb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | METHOD | NA | DCP | DCP | DCP | DCP | NA | DCP | DCP | DCP | NA | NA | DCP |
| | | | DETECTION LIMIT | 5 ppb | 1 ppm | 1 ppm | 5 ppm | 5 ppm | 2 ppm | 1 ppm | .5 ppm | 1 ppm | 5 ppm | 2 ppm | 2 ppm |
| GOSSAN | SAMPLE | UTM | LITHOLOGY / UNIT | | | | | | | | | | | | |
| 1 | 91-54-20 C | 65H/11; 039426 | Quartz vein in Hurwitz gabbro | 51 | 26 | 26 | 1410 | 43.7 | <2 | 3 | 0.9 | <1 | <0.5 | <2 | <2 |
| 2 | MS3-1 | 65H/10; 065307 | py in HXu qtz pebble conglomerate | 150 | 3 | 8 | 39.5 | 5.5 | 8 | 10 | <0.5 | <1 | 0.8 | <2 | <2 |
| | MS3-2 | 65H/10; 065308 | py in HXu qtz pebble conglomerate | 39 | <1 | 3 | 12.9 | 3.9 | 6 | 4 | <0.5 | <1 | 0.8 | <2 | <2 |
| 3 | 92-13-9 | 65H /15; 170523 | py in HXu qtz pebble conglomerate | 220 | 80 | 47 | 28.5 | 6.7 | 28 | 3 | <0.5 | <1 | 2.3 | <2 | <2 |
| 4 | 92-1-5 | 65H /15; 230626 | py in HXu qtz pebble conglomerate | 36 | 29 | 23 | 21.2 | 6.6 | 10 | 12 | <0.5 | <1 | 1.4 | <2 | <2 |
| 5 | 92-4-10 A | 65H/15; 227623 | py layers in HXu sandstone | 18 | 50 | 35 | 8.9 | 6.9 | 13 | <1 | <0.5 | <1 | 3.4 | 3 | <2 |
| | 92-4-10 B | | py in HXu qtz pebble conglomerate | 230 | 42 | 27 | 18.8 | 9.1 | 17 | 2 | <0.5 | <1 | 1.8 | <2 | <2 |
| | 92-4-10 C | | py in HXu granulestone | 38 | 33 | 26 | 14.3 | 7.3 | 11 | 2 | <0.5 | <1 | 1.2 | <2 | 3 |
| 6 | 92-18-25 | 65H/15; 184490 | sulphides in carbonish vein | <5 | 535 | 19 | 499 | 19.5 | 3 | <1 | <0.5 | <1 | <0.5 | <2 | <2 |
| 7 | 92-17-31 | 65H/15; 130491 | py in HXl polymictic conglomerate | 8700 | 130 | 45 | 447 | 8.7 | 210 | 8 | 3.7 | <1 | 14 | <2 | 21 |
| 8 | 92-19-19 A | 65H/15; 123551 | Ampc banded pyrite-chert | 790 | 62 | 109 | 151.1 | 11.4 | 2960 | 2 | <0.5 | <1 | 5.9 | <2 | <2 |
| | 92-19-19 B | | | 130 | 44 | 133 | 41.4 | 6.1 | 150 | 3 | <0.5 | <1 | 2.3 | <2 | <2 |
| | 92-19-19 C | " | | <5 | 5 | 8 | 38 | 14.6 | 4 | <1 | <0.5 | <1 | <0.5 | <2 | <2 |
| 9 | 92-14-18 | 65H/15; 215538 | Ampc banded pyrite-chert | 27 | 48 | 43 | 134.6 | 6.7 | 24 | <1 | <0.5 | <1 | 0.7 | <2 | <2 |
| 10 | 92-3-24 | 65H/15; 204591 | py disseminated in Am mafic rock | 8 | 13 | 29 | 8.4 | 61.9 | 3 | 2 | <0.5 | <1 | <0.5 | <2 | <2 |
| | 92-3-25 | | | 12 | 14 | 47 | 27.3 | 31.1 | 16 | 2 | 0.8 | <1 | 0.5 | <2 | <2 |
| 11 | 92-5-2 | 65H/15; 175635 | py clots in Am mafic volcanic | 46 | 63 | 71 | 783 | 75.1 | 2 | 2 | 0.8 | <1 | 0.7 | 3 | <2 |
| 12 | 91-92-25 | 65H/11; 016404 | cpy-py quartz vein; Af rhyolite | 1600 | 139 | 499 | 12360 | 3.2 | 3 | 3 | 2.3 | <1 | <0.5 | <2 | <2 |
| 13 | 92-28-20 | 65H/11; 867435 | sulphides in qtz vein; Am dacite | 180 | 15 | 18 | 933 | 4 | 3 | <1 | 0.5 | <1 | <0.5 | <2 | <2 |



## MARGINAL NOTES

This map presents the preliminary results of the second field season of a Canada-NWT Mineral Initiative (1991-1996) project that focuses on the geology of Archean and Proterozoic supracrustal rocks in the south-central District of Keewatin: the Henik Group (Archean, part of the Ennadai-Rankin greenstone belt); the Montgomery Lake Group (age uncertain; **in its type-area,** unconformably between the Henik and Hurwitz groups) and the Hurwitz Group (Early Proterozoic; Aspler et al., in press).

### Stratigraphy and Sedimentation

The **Henik Group** (Eade, 1974) consists of : 1) unit As, a mixed sedimentary-felsic volcanic assemblage (bearing magnetite iron formation-bearing sandstone to mudstone turbidites) cut by assemblage (bearing magnetite iron formation-bearing sandstone to mudstone turbidites) cut by gabbro sills and dykes; 2) unit Am, a mafic volcanic/gabbro sill-dyke complex with local feldspar-quartz sills and dykes (in part flows?) and banded pyrite-chert horizons; and 3) unit Af, which includes feldspar-phyric rhyolite and rhyolitic agglomerate. These supracrustal rocks are cut by foliated diorite (unit Agd) and granodiorite (unit Agg) intrusions. The stratigraphic order of Henik Group map units is uncertain owing to a paucity of top indicators and poor exposure in critical contact areas.

In its type area, the **Montgomery Lake Group** records a westward-draining fluvial system that drapes a low-relief paleotopography cut into tilted Henik group strata (Bursey and Aspler, 1992). Mapping in the Montgomery Lake area supports Eade's (1974) conclusion of an angular unconformity separating the Montgomery Lake Group from the overlying Hurwitz Group (Bursey and Aspler, 1992; Aspler et al., 1992). In the Padlei belt, rocks immediately overlying the Henik Group were called the "Montgomery Lake sedimentary rocks" (Bell, 1970) and the Montgomery Lake Group (Young, 1975; Roscoe, 1981). Although Bell (1970) concluded that an unconformity separates these rocks from the Hurwitz Group, Young (1969; 1975) argued that the transition is conformable. From our initial mapping in the southern part of the Padlei belt, we questioned whether it was appropriate to designate these rocks as Montgomery Lake Group and tentatively concluded that they constitute a conformable part of the lower Hurwitz Group (Bursey and Aspler, 1992; Aspler et al.,1992). This conclusion is now extended to include the entire Padlei and lower Hurwitz Group (Bursey, in prep; Aspler et al. in press). In anticipation of future revisions in stratigraphic nomenclature, we have used the term "map unit X" for "the Montgomery Lake Group" in the Padlei belt.

The **Hurwitz Group** is inferred to have been deposited in an intracratonic basin formed due to compressive intraplate stress arising from the convergement of the Buffalo Head terrane with the western margin of the Churchill Province (Aspler et al., 1992; see Hoffman, 1990; Ross et al., 1991). The lower Hurwitz Group stratigraphy is arranged in a conformable onlap sequence of Ennadai-Rankin greenstone belt and the Hurwitz Group may indicate that initiation of basin subsidence was the result of stress-induced viscosity decreases in the lower crust; decreases that allowed relatively high-density Archean rocks to sink (uncompensated excess mass in the upper crust; see de Rito et al., 1983; Howell and van der Pluijm, 1990; Shaw et al., 1991).

Polymictic conglomerates in the lower part of map unit X (unit HXl) are exposed as isolated lenses considered to represent paleovalleys cut into Archean basement and preserved by regional subsidence of a moderate relief paleotopography rather than by rifting. Overlying subarkoses and quartz arenites with polymictic pebbly layers, local quartz pebble beds (both pyrite rich and pyrite-free) and rare polymictic conglomerate beds (unit HXu) are likely fluvial deposits. The pyrite-bearing quartz-pebble conglomerates have long been the target for paleoplacer gold and uranium (Roscoe, 1981). A paleoplacer origin is substantiated by structures such as pyrite concentrations in the lee-side scours of pebbles and by the presence of flutes on bedding surfaces bearing. This would signify pre-"oxyamnion" (Roscoe, 1973) deposition. Yet the data are contradictory: interfingering of redbed sandstones and pyrite-free quartz pebble conglomerate (with a red matrix) with the pyrite-rich beds denotes oxic sedimentation. Typically, pyritic sandstones and redbeds are mutually exclusive (e.g. Roscoe, 1973; 1981). We tentatively suggest that the interfingering in the present example indicates sedimentation at the oxyamnoversion transition and levels of atmospheric oxygen that fluctuated both in time and space, an interpretation that requires further substantiation. Also contradictory is the association of compositionally mature quartz pebble conglomerates with polymictic conglomerates. Lack of clast diversity and enrichment of pyrite in the quartz pebble beds may be due, in part, to local derivation from pyrite-chert horizons in basement (unit Ampc) and need not axiomatically imply intensive weathering and/or long transport distance.

The Maguse Member represents fluvial, eolian and lacustrine sedimentation. During sedimentation of the Whiterock Member, Hurwitz Basin reached dimensions in excess of 500 by 200 km. Similar to other supermature quartz arenite sequences, the Whiterock Member is thick (to 400 m) and lacks mudrocks. Yet it differs by virtue of containing a suite of sedimentary structures that consists almost entirely of short-wavelength ripple marks and parallel stratification, both formed by oscillatory flow. Application of empirical (Tanner, 1971) and analytical (e.g. Clifton and Dingler, 1984) methods to symmetric, vortex (height/wavelength <0.1), orbital (wavelength/ grain diameter < 400) ripples yields average water depths in the range 2 cm to 2 m (maximum 5 m) for the entire thickness and lateral extent of the unit. We envisage sedimentation in a vast, hydrographically-open, tide-free, wind-driven lake in which lake levels were controlled by the long term water table, and in which continuously high rainfall in a wet equatorial climate and well-developed outlets combined to prevent raised salinities (Aspler et al., in prep.). Abrupt transition from flooding though gaps in basement arches. With the source of quartz sand effectively cut off by shallow-water quartz arenites to deep-water mudrocks and arkoses (Ameto Formation) is attributed to intraplate stress-induced deepening and arching (see Cloetingh, 1988), with marine waters drowning, the compositional maturity of arenites in overlying units decreased and carbonate rocks of the Watterson Formation were permitted to accumulate on ramps that prograded away from low relief arches.

### Structural Geology

The Proterozoic structural style of the Padlei belt is predominated by east-northeast and northeast-elongate, doubly-plunging basement-cover infolds that define a dome and basin interference pattern. Early, open, non-cleavage-bearing east-northeast and northeast-trending folds with steeply dipping axial surfaces are refolded by open, cleavage-bearing east-northeast and northeast-trending thrusts. Both sets of steeply-dipping axial surfaces and east-northeast and northeast-trending thrusts. Although Archean rocks were structures are cut by northwest-trending oblique-slip faults. Although Archean rocks were broadly coincident deformed with the Hurwitz Group, and cleavage trends in the Henik Group are broadly coincident with those of the Hurwitz Group, an earlier strain history is indicated by steep plunges of Henik Group folds (locally downward-facing) and by the presence of foliated Archean clasts in basal Hurwitz Group. The Hurwitz Group was deformed before ca. 1.75 Ga, the age of the Nueltin Granite (U/Pb, Loveridge et al., 1988; cf. Rb/Sr, Wanless and Eade, 1975). How long before is uncertain; a preliminary metamorphic zircon determination of ca. 1.83 Ga (L. Heaman p. comm. 1992) suggests that deformation of the Hurwitz Group may be related to collisional events in Trans-Hudson Orogen, signifying a large time gap between sedimentation (pre- ca. 2.1 Ga; Heaman and LeCheminant in press; Patterson and Heaman, 1991) and deformation.

### Economic Geology

Mineral occurrences are plotted on Figure 1; UTM co-ordinates and available analyses are given in Table 2. Gossans in the Henik Group consist primarily of massive and disseminated pyrite within mafic volcanic rocks, although the maximum gold value obtained is from a quartz vein cutting rhyolites of unit Af (1600 ppb Au, gossan 12). Of particular interest are pyrite-chert horizons that consist of mm-dcm-scale banded, nodular and colloform pyrite and chert (unit Ampc; gossans 8, 9). Similar horizons are probable source rocks to auriferous polymictic conglomerates mapped east of Bray Lake (to 1600 ppb Au; Gossan 21 in Aspler et al., 1992), and may have influenced the development of pyritic quartz-pebble paleoplacers in the lower Hurwitz Group. The maximum gold value from this study is from polymictic cobble-boulder conglomerate near the top of unit HXl: 8700 ppb Au (gossan 7). Pyritic quartz pebble conglomerate, granulestone and sandstone of unit HXu have elevated gold (to 230 ppb Au, Table 2).

Drilling was carried out near Gossan 2 by Selco Exploration Co. Ltd. (Skimming, 1961), in the vicinity of Gossan 3 by Denison Mines Ltd. (Roscoe, 1970) and in the vicinity of Gossans 4 and 5 by Falconbridge Nickel Mines Ltd (Meyer, 1970). More recent industry work was by Borealis Exploration Ltd. (see Hearn, 1990).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