30th Yellowknife Geoscience Forum

Abstracts of Talks & Posters

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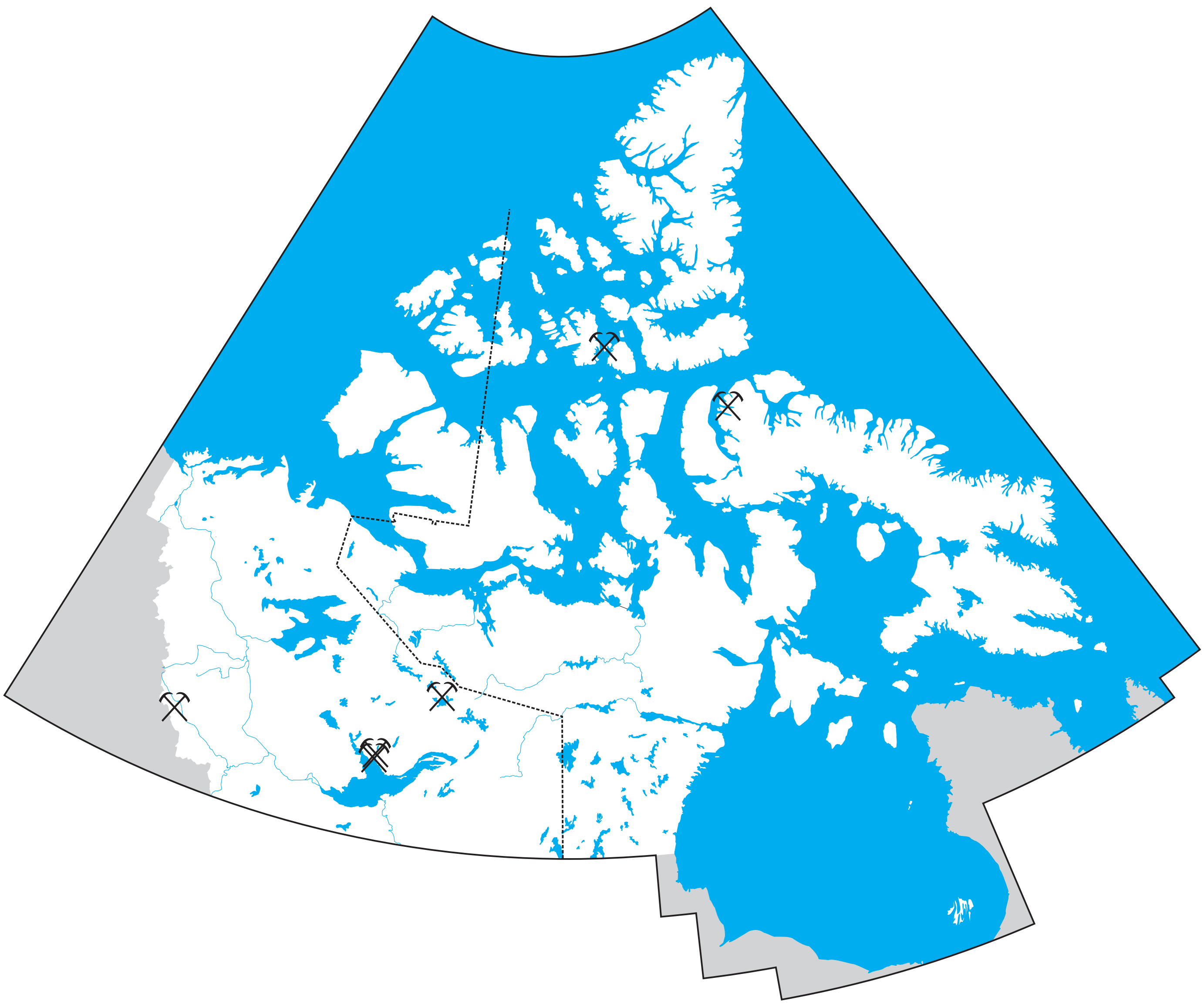

NWT and Nunavut
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Yellowknife Geoscience Forum 2002 Abstracts

Italics denote poster abstracts

A LINEAMENT STUDY OF THE SLAVE CRATON AND ENVIRONS, THE TALE OF A CRACKED CRATON: A WORK IN PROGRESS

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The Slave Craton is transected by numerous mafic dyke swarms of various orientations and emplacement ages, fault zones, and structural discontinuities. These features are evident through the examination of high resolution total field magnetic data. An effort is underway to document these features using the magnetic data compiled in the SMAC series of CD-ROMS (Armstrong and Kenny, 2001).

Mafic dyke swarms are identified and classified on the basis of orientation in conjunction (where possible) with accepted nomenclature (ie. Mackenzie dykes). Fault zones are interpreted from magnetic data and from 'ground-truthed' bedrock maps and grouped on the basis of orientation. Discontinuities are defined as magnetic breaks that are not readily reconciled as faults, but may cut or be cut by mafic dykes etcetera, and are grouped by orientation. For geographic regions not covered by detailed magnetic surveys linear features, where appropriate, are shown as inferred lines.

Preliminary work is underway for this GIS compilation. Early indications are that the compilation will demonstrate a complex and long lived structural and intrusive history for the Slave Craton both pre-and post-cratonization.

WHERE EAST MEETS WEST: FORMATION, GROWTH AND COLLAPSE OF THE SNARE RIVER TERRAIN, SOUTHWESTERN SLAVE PROVINCE

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Deciphering the unique spatial association among Meso-Archean basement complexes, granite-granulite blocks and juvenile supracrustal belts within the Snare River Terrain (SRT) has better defined the sequence of crust formation and evolution of the southwestern Slave Province (SP). Three distinct crustal levels have been identified within the SRT; an upper crustal, greenschist-amphibolite facies supracrustal belt, mid-upper crustal plutonic rocks and a block of mid-crustal granulites. Detailed field and analytical work has delineated 5 stages of evolution that account for formation, growth and collapse of the SRT;

- (i) 2674 – 2654 Ma: Formation and early dismemberment of an arc-related, juvenile crustal nucleus, coeval with ocean-basin turbidite sedimentation.
- (ii) 2654 – 2608 Ma: Imbrication of ocean-basin turbidites in a fold-thrust belt, amphibolite-facies metamorphic peak prior to ~ 2608 Ma. Two pulses of metaluminous magmatism (~ 2635 and 2608 Ma).
- (iii) 2608 – 2597 Ma: Rapid crustal thickening related to collision with Meso-Archean basement complex, granulite facies metamorphic peak at ~ 2597 Ma, synchronous with peraluminous and metaluminous plutonism.
- (iv) 2597 – 2586 Ma: Orogenic collapse.
- (v) Post 2586 Ma: Crustal stabilization followed by cross-folding and faulting related to the Palaeoproterozoic Wopmay Orogen.

Previous workers have divided the SP into eastern and western domains defined by variations in Pb and Nd isotopic signatures. The late Archean crust of the eastern domain was derived from juvenile source material, whereas formation of new crust within the western domain, which is underlain by pre-2.9 Ga crustal blocks, was due to recycling of material from mixed source regions. This isotopic division of the SP has been invaluable for understanding craton-scale assembly mechanisms, however, it does not readily apply to the southwestern SP. Field and analytical evidence from the SRT imply new crust was initially formed from juvenile source regions, as in the eastern SP, but at successively later times, crustal recycling, more typical of the western SP, became increasingly important.

Archean crustal evolution in the SRT and, more widely, in the southwestern SP can be understood in terms of new additions of late Archean, juvenile crust outboard of pre-2.9Ga crustal blocks. Collision at ~2.6 Ga between these juvenile and mature blocks resulted in crustal overthickening and formation of mid-crustal granite-granulite terrains. Subsequent orogenic collapse resulted in mid-crustal exhumation and a final high temperature - low pressure metamorphic episode. A similar process has been inferred from studies of Phanerozoic orogens, but evidence for its operation in Archean terrains[a,b,c] is more recent. Recognition that crust formation in southwestern SP is distinct, combining both eastern and western crust-forming mechanisms, is critical to understanding the evolution of the Slave Craton.

[a]Sandiford, M., 1989. Geology, 17, p. 449-452.
[b]Moses, D.E., et al., 1996. Tectonics, 15, no. 5, p. 1093-1109.
[c]Pehrsson, S.J. et al., 2000. Geology, 28, p. 1075-1078.

COMPOSITE GRANITOID-GNEISS DOMES, GREENSTONE SYNCLINES, LATE TECTONIC CONGLOMERATES, AND LATE ARCHEAN GOLD: A GENETIC CONNECTION?

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The late Archean represents an era of unparalleled crustal growth and reworking, and a singular period in terms of mesothermal gold mineralization. These characteristics go hand in hand with a general recognition that the geology of Archean granite-greenstone terrains differs qualitatively from that of modern terrains (e.g., Bleeker, 2002). The bulk of Archean gold is intimately associated with the late-stage evolution of mafic volcanic-dominated greenstone belts (mesothermal lode gold deposits, e.g. Timmins, Yellowknife, Kalgoorlie), or their erosional detritus (e.g., Witwatersrand basin), and mass balance considerations require the metamorphic, magmatic, and hydrothermal processing of large volumes of (mafic) crust to derive the contained gold.

In general, Archean granite-greenstone terrains are characterized by basalt-dominated volcanic packages (ca. 2.9-3.1 g/cm3) overlying a middle to lower crust dominated by gneisses and granitoids of felsic to intermediate composition (ca. 2.6-2.8 g/cm3). This broad stratification may arise from voluminous basalt extrusion across extended sialic basement (e.g., Slave craton) or, in the relative absence of older sialic basement, by syn- to late-volcanic intrusion of voluminous tonalite-trondhjemite-granodiorite plutons (e.g., parts of the Abitibi subprovince, Superior craton). Once established, this stratification represents a significant density inversion (0.1-0.3 g/cm3).

Unlike regional tectonic processes, which are activated depending on external boundary conditions, buoyancy-driven processes can merely be retarded by low temperature (i.e., high viscosity); they cannot be “switched off” as long as a significant density inversion remains. Higher heat production in the Archean (2-4 times present values) dictates that conditions for partial convective overturn were reached more readily in the Archean than in the Phanerozoic. Consequently, buoyant ascent of composite granitoid-gneiss domes, 40-60 km in diameter, and the relative sinking of greenstones in intervening synclines, was ubiquitous during the Archean, irrespective of the nature of externally imposed tectonic processes.

High-amplitude domes developed through an interplay between buoyancy-driven processes and regional deformation and, in most cases, dome amplification was most dramatic during intrusion of late-stage, crustally derived, granitoid magmas. The latter provide a diagnostic for when the mid- to lower crust attained its maximum temperature. Dome growth must have been balanced by coeval sinking of large volumes of dense mafic volcanic rocks and derived sediments, and their prograde metamorphism and partial melting. Predictive consequences of this process are: 1) excess uplift over the domes; 2) erosional unroofing of the domes (positive feedback!); 3) shedding of clastic detritus in accommodation space being created over the sinking flanks; 4) following a short conductive time lag, evolution of a major H2O-CO2 fluid pulse carrying gold; 5) lateral compression of the greenstones and formation of “inward-dipping” reverse shear zones; and 6) channeling of fluids and deposition of auriferous quartz-carbonate vein systems along the up-dip portions of the reverse shear zones.

Bleeker, W., 2002. Archaean tectonics: a review, with illustrations from the Slave craton; in Fowler, C.M.R. (ed.), The Early Earth: Physical, Chemical and Biological Development. Geological Society, London, Special Publications, 199, in press.

INTERPRETING GAS HYDRATE AND PERMAFROST ON LAND-BASED REFLECTION SEISMIC DATA: EXAMPLES IN ARCTIC CANADA

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Gas hydrates are globally occurring compounds of water and natural gas in an ice-like form. Constrained by temperature and pressure, hydrates occur naturally in the sediments of marine continental shelves at any latitude and also occur both within and below the permafrost of arctic continental areas. Hydrates form where sufficiently porous strata exist in concert with both a suitable geothermal condition, and a supply of water and gas. Hydrates are recognized as a significant variable in global climate change, a hazard to drilling and engineering, and as a potential energy resource. It is estimated that gas hydrates store more energy than do all other forms of conventional hydrocarbons combined, including coal, oil and natural gas. However, scientific and engineering knowledge about gas hydrates is limited. Marine hydrate deposits tend to be widely distributed, have relatively low hydrate saturations (~10% or less), and are under ~300 m or more of water. Permafrost-associated hydrates are generally less widespread, more concentrated and have saturations as high as 85% and will likely be the first to be commercially explored. The Mallik gas hydrate field, located on Canada's Mackenzie Delta, has seen a production research drilling program that is a diverse scientific and technical effort involving over 100 Canadian and international scientific participants. It has yielded substantive new data on gas hydrates and is widely recognized as an important first step in assessing commercial viability.

Gas hydrate and ice have similar acoustic properties. The base of ice may be expected to appear seismically similar to the base of gas hydrate. Compressional wave velocity of strata may substantially increase when ice or hydrate is present in its pore space. Industry acquired land-based reflection seismic data reveal phenomenon interpreted as the base of ice in bedrock ranging in age from Tertiary to Devonian and recognized on data through much of the Arctic islands and in the Mackenzie Delta. These images appear as near-horizontal reflections or subtle amplitude changes on reflectors passing an ice-water interface and put the base of permafrost up to 880 m below surface. Some of these permafrost images have been tied to well log responses, velocity surveys, temperature logs and have been seismically modeled suggesting the nature of the ice-water phase change may have potentially 40 m of relief. This calibration of the permafrost seismic expression allows a reasonable remote determination of the –1.5°C geotherm at many arctic island localities and can help estimate the depth to the theoretical base of hydrate stability. Hydrates and their base have also been seismically interpreted in a number of locations and correlated to estimates of the theoretical base of methane hydrate stability including porous sandstone beds within shales of the Christopher Formation on Ellef Ringnes Island. Elsewhere, unique seismic phenomenon may eventually be attributed to a setting of hydrates existing laterally around free gas created from localized geothermal disturbances produced from vertically migrating warm fluids.

ECONOMIC MODELING OF MINING PROJECTS IN THE NORTHWEST TERRITORIES – NEW TOOLS AND TECHNIQUES

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The government of the Northwest Territories (GNWT) constructs economic models of mining projects in the territories in order to:

- Evaluate the overall economics of each project.
- Validate economic models and criteria put forward by mining companies.
- Gauge whether the project is likely to advance to development.
- Determine the resource revenues (income and mining taxes) expected from the project.
- Provide information to assist government in impact benefit agreement negotiations.

The estimated input parameters used to construct the original models are notoriously difficult to quantify and always change, sometimes substantially, once mining commences. These parameters include head grades, mill throughput rates, recoveries, commodity prices, exchange rates, equipment replacement expenditures, and operating costs. As a result, actual resource revenues obtained during mining operations tend to deviate considerably from the original estimates contained in feasibility studies.

To mitigate this problem, economic models developed by the GNWT incorporate both past and future cash flows, since both impact on expected resource revenues over the life-of-mine. The models therefore have the ability to "look" back as well as forward. In contrast, economic models developed by mining companies are exclusively forward looking, that is they are concerned only with evaluating future cash flows. Past cash flows are excluded from the analyses, as they are deemed irrelevant for decision-making purposes.

In government models, past cash flows must be expressed in current money terms, since these are the dollar amounts that determine the resource revenues actually paid. Future cash flows on the other hand are captured in constant dollar terms, as per convention.

A problem therefore arises since economic analyses can be undertaken with cash flows expressed in constant or current money terms, but not in both. This is dealt with in the following manner (assuming a base year for evaluation of 2002):

- Financial values are entered into the model in current dollars up to year 2002, and in constant 2002 dollars thereafter.
- Values from year 2003 onwards are converted to current dollar equivalents using an estimated general inflation rate over the life-of-mine.
- Income and mining taxes for the project are determined in current money terms.
- Cash flows from year 2003 onwards, including taxes, are deflated to constant 2002 dollars.
- Finally, pre-2002 cash flows are inflated to constant 2002 dollars so that all cash flow components are expressed in constant 2002 terms.

The above methodology ensures that resource revenues are correctly calculated using the most up-to-date figures, and that all money values are expressed in constant dollar terms.

Commercial software that allows economic modeling of this form is not available. Consequently, staff at the Minerals, Oil and Gas Division of the Department of Resources, Wildlife and Economic Development have developed in-house computer applications that perform these functions.

METAMORPHISM OF ARCHEAN MAFIC ROCKS IN THE HIGH-GRADE TERRAIN OF THE SNARE RIVER AREA, SOUTHWESTERN SLAVE PROVINCE

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Archean supracrustal and intrusive rocks underlie the eastern part of the Snare River area. The Disco intrusive suite is composed mainly of granite, granodiorite, and tonalite and has intruded rocks that were regionally metamorphosed to amphibolite and granulite facies. This igneous suite contains numerous mafic rocks, which are found as both cohesive units (mappable at a scale of 1:50,000) and as sparsely to densely concentrated enclaves. Mafic enclaves range in size from a few centimeters to tens of meters and densely packed enclaves with blocky outlines that are separated by a thin granitoid leucosome, form agmatite. The mafic rocks are black, brown or green, medium- to coarse-grained and include massive, foliated, and gneissic varieties. The origin of the mafic rocks remains uncertain, but some are thought to represent highly deformed and metamorphosed volcanic rocks and others may be remnants of mafic to ultramafic intrusions, which are more abundant in western parts of the Snare River area.

The purpose of this undergraduate thesis is to establish the metamorphic mineral assemblages of the mafic rocks, to suggest the temperatures and pressures of metamorphism and to produce a map showing the metamorphic grade distribution of the mafic rocks. The geological map of Jackson[a] provided a base for sample selection. Mafic rock samples collected for this thesis span an area of about 2200 km^2.

Preliminary field and petrographic examination of the mafic rocks indicate that hornblende and plagioclase are widespread and that orthopyroxene and/or clinopyroxene are present in many of the samples. The presence of orthopyroxene suggests that granulite facies was at least locally attained. Leucosomes, which are present along the margins of, and as veins within some mafic enclaves, commonly contain large orthopyroxene and clinopyroxene crystals intergrown with plagioclase and quartz. These leucosomes may represent in-situ partial melting of the mafic enclaves or chemical interaction between the enclaves and the Disco granite magma.

[a] Jackson, V.A. (2002), NWT Open File 2002-02.

NEW BEDROCK MAPPING IN THE WALMSLEY LAKE AREA, NTS 75N

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The bedrock-mapping component of the three-year Walmsley Lake Targeted Geoscience Initiative (TGI) was completed in the summer of 2002. This poster provides a preliminary geological compilation of the three years of bedrock mapping, and will be used as a basis for a digital geological atlas of the Walmsley Lake area. Field-based data collection entailed using notebook computers, loaded with AutoCAD R14 and Fieldlog V3.0 software, for manual digital data entry during the 2000 field season. During the 2001 and 2002 field seasons, the field crew used Compaq iPAQ Pocket PCs (PPC) to collect field data. Loaded with ArcPAD 5.0.1, these PPCs enabled the geologist to enter data (point, line or polygon) as ESRI shape files onto a vector map or georeferenced image. Project-specific electronic data-entry forms allowed digital data capture in the field and direct download of daily traverse data into ArcView 3.2a GIS software for interpretation and compilation. Field geologists equipped with this system also had the advantage of being able to upload georeferenced digital images of total-field magnetic, LandSAT TM, or aerial photographic data for use in field data collection and traverse planning.

Work will continue on leveling the datasets from three years of bedrock mapping, and refining the geological interpretations, for the release of the Walmsley Lake Digital Atlas in 2003. In addition to the bedrock-mapping component, the digital atlas will include data on surficial geology, geochemistry, geochronology, and petrology collected as part of the TGI. Data extracts of existing C.S. Lord Northern Geoscience Centre digital databases (e.g. KIDD, SMAC, NORMIN.db) for NTS sheet 75N will also be included as data layers in the release.

HIGHLIGHTS OF NEW BEDROCK MAPPING, WALMSLEY LAKE AREA (NTS 75N). CONTRASTING STRUCTURAL STYLES AND METAMORPHIC TIMING RELATIVE TO CRUSTAL DEPTH

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The multidisciplinary Walmsley Lake project is a joint undertaking of the C.S. Lord Geoscience Centre in Yellowknife, and the Geological Survey of Canada, under the Targeted Geoscience Initiative. The bedrock mapping component of the project was initiated to upgrade the bedrock geology of the map sheet and integrate the geological history of the Walmsley Lake area with the rest of the Slave Province. Highlights of 2002 bedrock mapping include recognition of multiple textural styles in some Proterozoic mafic dike swarms, and the delineation of an Archean gabbro-anorthosite suite.

Proterozoic dikes are common in the map area, swarms occur with orientations of ca. 080^o, 050^o, 022^o and 340^o. Textural evidence indicates at least two dike swarms have seen multiple generations of intrusion, suggesting reactivation of the fracture systems that host them. However, there are potentially more than four generations of mafic dike swarms, grouping the mafic dikes solely by orientation may oversimplify the Proterozoic intrusive history.

Fieldwork delineated the Tap gabbro, an Archean gabbro-anorthosite suite. The suite locally contains up to 3% disseminated magmatic Fe and Cu sulfides, and may have economic potential. Assay analyses are pending. The suite is texturally and mineralogically similar to the Clinton-Colden gabbro-anorthosite[a] to the east.

New thermobarometery, geochronology, and structural field relationships indicate differing ages and grades of metamorphism are coincident with contrasting structural styles. Geothermobarometery suggests a smooth transition in metamorphic grade from upper- to mid-crustal levels across the map sheet. Down-grade of the melt-in isograd, metasedimentary rocks preserve two generations of deformation, both characterized by upright isoclinal folds of bedding, with associated axial planar cleavages. At these metamorphic grades, metamorphism is attributed to discrete thermal aureoles, from plutons of various ages, overprinting a regional PT gradient. As a result, peak metamorphism is diachronous down-grade of the melt-in isograd. Age data from plutons cutting the peak metamorphic fabric and the cordierite-in isograd indicate peak metamorphic conditions were established as early as ca. 2614 Ma[b], and continued as late as ca. 2589 Ma[b] below the melt-in isograd. The predominant structural style changes up-grade of the melt-in isograd, where tight to isoclinal, overturned to recumbent folds of compositional layering predominate. Metamorphic monazite age dates from paragneisses in the southern Walmsley Lake sheet show metamorphic conditions passing through monazite closure temperatures ca. 2585 Ma[b,c] .

[a]Macfie, R.I., Geol Survey of Canada, Current Research, 87-1A., pp. 681-698.
[b]MacLachlan et al. Geol. Survey of Canada, Current Research, C1, 2002.
[c]Schultz, M. Unpublished B.Sc. Thesis, University of Alberta, 2002.

METALLOGENY OF GOLD OCCURRENCES IN THE HEARNE DOMAIN, WESTERN CHURCHILL PROVINCE

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The Hearne Domain of the Western Churchill Province, classically referred to as that region lying south and east of the Snowbird Tectonic Zone, comprises approximately 150,000 square kilometres of ca. 2700 Ma Archean supracrustal and granitoid rocks. These are unconformably, and locally structurally overlain by 2450 to 1900 Ma, and ca.1850 Ma Paleoproterozoic sedimentary-volcanic basins. A bipartite subdivision of the Hearne Domain into northwestern and central sub-domains is based on an extensive database of field, geochronological, metamorphic, geochemical and isotopic data including, for example, the presence of ~2600 Ma granitoids and a ca. 2500 Ma cryptic metamorphism in the northwestern sub-domain, however, these events are apparently absent in the central sub-domain. Widespread Paleoproterozoic tectonothermal re-working of the northwestern Hearne sub-domain occurred between 1900 Ma and 1800 Ma and consisted of greenschist to granulite grade metamorphism and discrete shear zone development. In contrast, the central Hearne sub-domain apparently escaped Paleoproterozoic tectonic reworking and has remained tectonically stable since the Neoarchean.

Lode-type gold mineralization occurs in both the northwestern and central sub-domains, the distribution and age of the mineralization reflecting both Archean and Paleoproterozoic tectonic and orogenic events. For example, field evidence from the central Hearne sub-domain (Kaminak Lake area) suggests that gold mineralization exposed therein is Neoarchean in age. In contrast, field evidence and robust geochronology from several gold occurrences and deposits in the northwestern Hearne sub-domain confirm the presence of Paleoproterozoic gold mineralization (Cullaton Lake and West Meliadine). The most significant gold deposits known in the Hearne Domain occur within greenschist grade rocks that outcrop along the broadly defined boundary zone between the northwestern and central sub-domains and are cospatial with zones of significant Paleoproterozoic re-working.

GOLD DEPOSITS OF THE DORIS NORTH AREA, HOPE BAY BELT

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3. Department of Geological Sciences, Queen's University, Kingston, ON
4. Miramar Mining Corp., North Vancouver, BC

The Doris North area is host to significant gold mineralization and is located in the northern part of the Hope Bay volcanic belt, northeastern Slave Province. The deposits are hosted by an approximately 500 metre-wide, wedge-shaped, north-south striking package of mafic volcanic rocks, known as the “Doris Suite” basalts. These rocks are exposed mainly on the north shore of Doris Lake, extending north towards the Arctic Ocean. Doris suite basalts consist of a conformable succession of dark-coloured, variably magnetic, vesicular-amygdaloidal, massive and pillowed basalts folded around a central gabbroic-textured rock. Based on geochemical data, these volcanic rocks are Fe tholeiites. The Fe tholeiites are bounded by a visually distinct and non-magnetic package of Mg tholeiites.

Gold mineralization at Doris North is associated with quartz veins accompanied by variably thick hydrothermal alteration envelopes. Three approximately north-south trending and near vertically dipping, gold-bearing quartz vein systems are known in the Doris North area. From west to east these zones are: West Valley Wall veins, Central vein and Lakeshore vein. The relatively flat-lying and shallowly north-plunging Hinge Zone occurs where the Lakeshore and Central veins merge, resulting in a shallowly north-plunging “fish-hook” geometry. The West Valley Wall zone mineralization is hosted by strongly magnetic massive basalt, and is associated with a series of narrow (<30 centimetre) and discontinuous quartz veins clustered over 1-2 metres width. The Central vein is 70 metres east of the West Valley Wall veins at the westerly contact between vesicular-amygdaloidal basalt and gabbro. Surface exposures of the Central vein consist of a main 30 centimetre-wide north-south striking, vertically dipping quartz vein directly at the basalt and gabbro contact. The Lakeshore vein is 30 metres east of the Central vein, outcropping on the northwest shore of Doris Lake at the westerly contact between gabbro and amygdaloidal Fe tholeiite pillow basalt. This steeply west-dipping vein averages 4-5 metres in width and locally approaches 8 metres.

Economic widths of gold mineralization (typically >15 g/t Au) commonly occur near vein and wall-rock contact zones, however, significant mineralized intersections are also present throughout the veins. The timing of vein formation with respect to folding of the stratigraphic pile remains somewhat equivocal. The overall geometry of the vein systems closely mimics fold orientations mapped in basaltic and gabbroic rocks. Similarly, the wall-rock septa, which form parallel to a propagating quartz vein, are near-vertical in the Lakeshore vein, but swing to a sub horizontal orientation in the flat-lying Hinge Zone. These geometries can be explained by vein development in dilational sites created during folding in a scenario analogous to a saddle reef, during a progressive D_2 event.

U-Pb GEOCHRONOLOGY OF THE COMMITTEE BAY BELT: IMPLICATIONS FOR THE TECTONOTHERMAL HISTORY OF THE RAE DOMAIN

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The Committee Bay supracrustal belt (CBb) of the Rae Domain is characterised by narrow corridors of Neoarchean Prince Albert Group supracrustal rocks intruded by voluminous felsic intrusions. Until recently, few geochronological investigations had been attempted in the CBb and most previous work suggested a dominantly Archean history. However, an ongoing, 3-year multidisciplinary Canada-Nunavut Geoscience Office – Geological Survey of Canada TGI project in the CBb includes a multifaceted geochronological programme designed, in part, to elucidate the poly-metamorphic history of this region. Herein, we present the results of in-situ monazite U-Pb SHRIMP geochronology that allows timing constraints to be placed upon a major penetrative deformation event that has affected this area and which plays a significant role in localizing gold mineralization in the belt (see Sanborn-Barrie et al., this volume). In-situ ages were obtained by SHRIMP microbeam U-Pb dating of metamorphic monazite in samples cored (2 mm dia.) from thin sections thus preserving spatial relationships between metamorphic minerals and regional structural fabrics.

The Committee Bay region is dominated by a NE trending composite S1/S2 fabric that is axial planar to regional, tight, upright to overturned, shallowly east-plunging F2 folds. Within a lower-granulite facies paragneiss domain that flanks the CBb, type 1 garnet is enveloped by S2 that is generally defined by biotite and sillimanite. Cordierite and a second generation of garnet overprint S2 at lower-granulite grade conditions (~4.5 kbar and ~700 ºC). In order to constrain timing of mineralogical and structural features, we conducted in-situ U-Pb SHRIMP analysis on monazite residing in various critical textural settings; within type 1 garnet, S2 biotite, and the post-tectonic phases, type 2 garnet and cordierite.

Both garnet types host monazite inclusions with ~2.35 Ga cores and ~1.85 Ga rims, placing a maximum age on garnet growth and S2 at ~1.85 Ga. S2 is crosscut by undeformed ~1.82 Ga equigranular monzogranite (Skulski et al., this volume), constraining S2 development to between ~1.85 and ~1.82 Ga. Monazite inclusions within minerals aligned in S2 and within post-tectonic cordierite typically yield ~1.78 Ga ages, suggesting that the development of post-tectonic cordierite-garnet assemblages probably occurred at this time. Two ~1.78 Ga monazite inclusions occur within type 1 garnet, however, one of these examples shows textural evidence that suggests probable fluid-mediated resetting at ~1.78 Ga along penetrative internal fractures in garnet. We believe that metamorphism at ~1.78 Ga is not associated with S2 development, but instead resulted in isotopic resetting of monazite at this time. We conclude that penetrative D2 structural evolution in the Committee Bay region developed between ~1.85 Ga and 1.82 Ga, immediately prior to, or synchronous with, Tran-Hudson orogenesis in the south, with subsequent static localised granulite-grade metamorphism at ~1.78 Ga.

UPDATE ON KINROSS GOLD CORPORATION'S GOOSE LAKE – GEORGE LAKE GOLD PROJECT

Cater, D. and MacConnell, S.
Kinross Gold Corporation, Toronto, ON

The presentation will provide a broad geologic overview of Kinross Gold Corporation's ongoing gold exploration project at Goose and George Lakes, located near Bathurst Inlet, Nunavut. These gold deposits are hosted primarily in the Archean sulphidized banded-iron-formation of the north-central Slave Province and have been the focus of advanced exploration by Kinross Gold Corporation. The talk will outline exploration history, regional geology and the local deposit geology of the Goose Lake deposit, including drill data and a 3-D wireframe model of the deposit and is complemented by a core shack display of mineralized intervals.

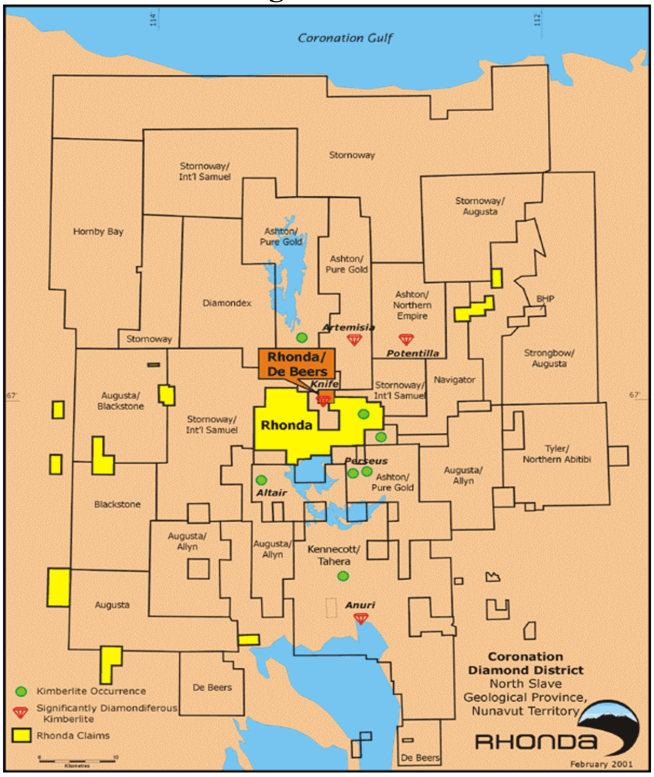
2000-2002 INULIK PROJECT EXPLORATION UPDATE CORONATION DIAMOND DISTRICT, NUNAVUT
RHONDA CORPORATION

Chartier, T.[1] and Stoeterau, J.[2]

1. Consulting Geologist
2. Vice President Exploration, Rhonda Corporation

During the mid-1990's, under a joint venture with Noranda Mining, Rhonda Corporation acquired large tracts of land in the Coronation Diamond District, as we know it today, to explore for base metals (Figure 1). By 2000, the property was reduced to approximately 80,000 acres and the joint venture was ended with Noranda transferring the claims to Rhonda.

Figure 1



Rhonda entered into diamond exploration business with discovery of the Knife kimberlite in the spring of 2000. A total of nine diamond drill holes were drilled and just under 1600 metres of kimberlite were collected by DeBeers Canada between 2000-2001. The 2000 drill program returned impressive initial results of 208 microdiamonds and 9 macrodiamonds (0.127 cts. of diamond) in 397 kilograms of core. (Macrodiamonds are defined as stones that are greater than 0.5mm in one dimension.) The drilling to date has determined the pipe to be a minimum of 14 acres (6 ha) although it has not been drill-defined on the east or south sides; therefore, has potential to be even larger. The results of the 2001 drilling program have never been reported due to a breakdown in the potential joint venture negotiations.

In addition to the Knife pipe, Rhonda has its 80,000 acre (36,000 ha) Inulik property in the center of the Coronation Diamond District. During the 2001 summer exploration program, Rhonda collected 571 till samples across this property and was successful in identifying a significant picro-ilmenite and eclogitic garnet indicator trail through the eastern portion as well as other lower magnitude mineral anomalies throughout.

In the spring of 2002, a detailed helicopter magnetic and electromagnetic survey was flown. In the summer of 2002, TeckCominco Limited entered into an agreement with Rhonda by initially purchasing $1.5 million Rhonda shares at $0.55 per share. Under the agreement, TeckCominco has the right to trigger an option to joint venture once Rhonda has completed its 2002 work commitment of $750,000. Tech Cominco can elect to earn a 51% interest in the property by incurring expenditures of $5,000,000 over four years.

Rhonda conducted an intensive three phase summer exploration program that focused on prospecting in areas of kimberlite indicator anomalies, ground checking priority geophysical anomalies, and the collection of additional till samples to improve sample density and to evaluate priority geophysical targets. The 2002 summer exploration program uncovered six separate kimberlite boulder trains on the eastern portion of the property. Over one tonne of macrocrystalline hypabyssal kimberlite boulders were collected and six separate, 40 kilogram samples have been submitted for microdiamond analysis. A total of 287 till samples were also collected during this program.

The geophysical interpretation and results of the 2002 till sampling will be used to plan a spring drilling program. Approximately 15 targets with geophysical signatures similar to that of known kimberlite pipes coupled with down-ice indicator mineral support will be drill tested.

BEDROCK GEOCHEMISTRY OF THE YELLOWKNIFE GREENSTONE BELT: TECTONIC SETTINGS, REGIONAL CORRELATIONS, AND STRATIGRAPHIC SOLUTIONS

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This study investigates the geochemistry and tectonic setting of volcanic rocks of the Yellowknife greenstone belt and considers similarities with other volcanic complexes of the southern Slave Province. The Yellowknife belt overlies > 3 Ga granitoids and ca. 2.8 Ga metasedimentary rocks of the Central Slave Basement Complex and Cover Groups. The Yellowknife belt includes the predominantly mafic, ~2.7 Ga tholeiitic Kam Group overlain by the bimodal 2.66 Ga Banting Group.

The Banting Group has been characterized as a series of felsic volcanic and volcaniclastic rocks, but mafic to intermediate volcanic rocks are common. Both Banting and Kam basalts are tholeiitic and are melts of Archean depleted upper mantle. Banting felsic volcanic rocks have much lower heavy rare earth element abundances and generally have higher initial 143Nd/144Nd than Kam felsic rocks, and thus the chemistry of felsic rocks distinguishes the stratigraphic groups. Kam felsic rocks evolved from mafic parents by assimilation of older granitoids and fractional crystallization processes, whereas Banting felsic rocks have compositions similar to modern adakites and appear to be melts of juvenile, hydrated mafic crust, possibly underplated Kam basalts. Rocks at Kam Point and the Giant Section are chemically part of the Kam Group, not the Banting Group as has been speculated. Offshore, the Kam/Banting contact has been delineated under Back Bay and southern Yellowknife Bay utilizing analyses from drill cores.

Syn-volcanic intrusions and dykes can also be classified. 2.66 Ga felsic dykes that cut across the Kam Group and the Ryan Lake Pluton are chemically identical to Banting felsic flows. Rare aplite and quartz-feldspar porphyry pods and dykes exposed in the northern Kam Group are chemically distinct from felsic rocks in both the Kam and Banting Group.

The nearby 2.66 Ga felsic complex at Clan Lake mimics the geochemical systematics of the Banting Group. The Banting Group and other 2.66 Ga felsic or bimodal volcanic complexes in the southern Slave Province, including those at Russell Lake and around southern margin of the Sleepy Dragon Complex, may all have formed as a result of a large-scale regional crustal melting event. Similar felsic rocks in the Western Churchill Province are also proposed to be melts of juvenile mafic crust, and the abundance of this lithochemical signature suggests that melting of mafic lower crust was a common, widespread process in the Late Archean.

In contrast, the Duck Formation volcanic and gabbroic rocks exposed on the southeast shores of Yellowknife Bay, thought to be coeval with the Clan Lake complex, are melts of enriched Archean upper mantle and are subtly distinct from mafic rocks in both the Kam and Banting Groups.

METALLOGENY OF THE POLARIS Pb-Zn-Cu DISTRICT, NUNAVUT

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The joint Canada-Nunavut Geoscience Office – Geological Survey of Canada project to determine the origin, timing, and structural controls of the Polaris Pb-Zn-Cu district is entering its final year. The Polaris District contains 25 clusters of showings, the most important of which was the Polaris Mine (1981-2002). Showings are present in a 450 x 130 km area, ranging from Zn&Cu-dominated showings on Somerset Island, to Zn-Pb showings on Cornwallis and Bathurst islands, to Zn-Pb and Fe-Zn showings on Grinnell Peninsula.

The complex distribution of rocks in the central Arctic Islands is the result of three superimposed structural events. (*1*) The oldest is an east-to-west compression in the Early Devonian (Boothia Uplift; Caledonian Orogeny). Mapping at Stanley Head, Rookery Creek, and Stuart River on Cornwallis Island shows that both east- and west-verging thrusts are present. This was followed by (*2*) a north-to-south compression in the Late Devonian-Early Carboniferous (Ellesmerian Orogeny). This event gently refolded the Boothia (Caledonian-aged) fold axes and created strike-slip faults. (*3*) Extensional event(s) of uncertain age(s) created normal faults and half-grabens. These could have formed as a result of either local trans-tensional conditions during the Ellesmerian Orogeny, or opening of the Sverdrup Basin in the middle Carboniferous.

Showings are present in three structural settings: 1) at the margins of the north-trending Boothia Uplift, where it is decoupled from younger, west-trending Ellesmerian folds; 2) in small structures attributed to later reactivation, that are distributed along the trend of the Boothia structures; and 3) near enigmatic normal faults perpendicular to the main Boothia structures.

Ore from the Polaris Mine is 366±15 Ma (Late Devonian; Rb/Sr on sphalerite), and the Somerset Island showings are about 352 Ma (Early Carboniferous; Rb/Sr), both of which are synchronous with the Ellesmerian Orogeny. Showings on Dundas Island, however, date at about 337±10 Ma, which is coeval with the opening of the Sverdrup Basin. The two separate events produced showings that have remarkably similar characteristics.

Sulphur isotopes may help to distinguish the two events. Polaris and nearby showings have sulphur isotope signatures that cluster around either +9 per mil or +28 per mil, whereas Dundas Island and nearby showings on southern Grinnell Peninsula have S*[34] of –5 % per mil, indicative of bacterial sulphate reduction.

On-going work includes fluid-inclusion microthermometry, and carbon and oxygen isotopes of carbonate phases. The results will help to characterise the two generations of fluids that formed these deposits.

THE POSITION OF LODE GOLD MINERALIZATION IN GLOBAL OROGENIC CYCLES: THE EVIDENCE FROM THE YELLOWKNIFE DOMAIN

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The study of lode gold deposits in the Yellowknife Domain (YkD) supplies a classic case history of the neoArchean Gold Event. Since the geotectonic evolution of the YkD is as well documented as any area of Archean shield entailing a world class gold camp, it establishes a critical metallogenic framework for lode gold mineralization of this age. The YkD comprises mesoArchean basement with its shoreline/shelf cover sequence, granite-greenstone and granite-metasediment terranes, as well as late high grade metamorphic complexes, making it ideal for Archean tectonic reconstructions. The gold occurrences within the YkD are directly related to the development of amphibolite facies thermal aureoles peripheral to neoArchean granite plutons, including the 2625 Ma I-type Defeat Suite, the 2595 Ma S-type Prosperous Suite, and the 2585 Ma A-type Morose Suite. The integration of studies on the timing of episodic plutonism, metamorphic overprinting, and development of structural fabrics with detailed paragenetic investigations of the gold ores specifically ties gold concentration to thermal peaks connecting regional ductile compression and brittle/ductile uplift regimes. The gold mineralizing systems prove key for demonstrating temporal coincidence of the termination of regional compression (D_2), the thermal peak (M), and the initiation of uplift attending the unroofing of the terminal Archean orogenic infrastructure (D_3).

The economic gold concentrations occur in structural traps proximal to fronts of amphibolitic recrystallization, indicating that ponding of metamorphic fluid derived through devolitilization plays the pivotal role in Thermal Aureole Gold (TAG) concentration. The primary TAG targets in the YkD include: 1) anastomosing chlorite-carbonate-sericite shears hosting multiple quartz vein generations at the epidote-flooded amphibolite/greenschist transition in the Defeat aureole; 2) saddle reef-style bonanaza-grade quartz veins with associated hedenbergite-hornblende-garnet-apatite-pyrrhotite selvages and lower tenor disseminated ores with associated cummingtonite-biotite-zoisite-chlorite-carbonate-sericite-arsenopyrite at the cordierite isograd in the Prosperous aureole; and 3) mylonitic sillimanite-andalusite-sericite schists developed marginal to the Nardin and Sleepy Dragon high grade gneiss complexes. The early higher temperature calcsilicate/aluminosilicate and later lower temperature carbonate/hydrothermal alteration assemblages accompanying gold attest to prolonged fluid/rock reactivity down the cooling gradient.

As a class, lode gold deposits have proven difficult to tie to any particular tectonic setting recurring in the geological record. This is even more true for the neoArchean mesothermal gold ores than it is for the midTertiary epithermal gold ores, the two main Gold Events in earth history. With improved understanding of the tectonic evolution of young orogens, the midTertiary deposits can now be linked to domains of orogenic collapse. The evidence from the YkD suggests that better understanding of this terminal orogenic stage may hold the key to deciphering the tectonics of gold throughout geological time.

AN ASSESSMENT OF THE VMS AND LODE GOLD POTENTIAL IN THE BACK RIVER -REGAN LAKE AREA OF THE EAST-CENTRAL SLAVE PROVINCE, NUNAVUT

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The volcanics of the Back River Complex and Regan Lake Arm are southerly exposures of the Hackett River arc terrane in the east-central Slave Province. Both are composed of upper Hackett River volcanic members exposed in structural highs. The domical Back River Complex has central felsic flow/domes bordered by mixed mafic/felsic debris flows and marginal pillowed andesites. The anticlinal Regan Lake Arm has the uppermost mixed mafic/felsic debris deposits again flanked by massive to pillowed andesites. Both the Back River and Regan Lake volcanics are conformably overlain by proximal carbonaceous mudstone and distal quartzo-feldspathic greywacke facies metaturbidites, respectively correlative to the Contwoyto and Itchen formations of the central Slave. Regional correlation of the Back River, Regan Lake and Hackett River volcanics identifies a continuous volcanic substrate to metasedimentary cover in the east-central Slave. A unique carbonate breccia at the volcanic/sediment interface at the Back River Complex suggests that atoll development attended deep marine transgression of some volcanic edifices.

As the Hackett River volcanics are host to the Bathurst-Norseman, Yava, and Musk polymetallic massive sulphide deposits, both the Back River and Regan Lake volcanics must be considered prospective for volcanogenic-style mineralization. Within the Back River Complex, pyritic massive sulphide locally caps the centrally exposed flow/domes, and massive basemetal-enriched pyrrhotitic and laminated barren pyritic sulphides are locally associated with the unit of carbonate breccia at the volcanic/sediment interface. Multifacies iron formation bands (BIFs) are hosted within the immediately overlying black mudstone. Airborne geophysics traces magnetic horizons from Gold Lake on the eastern margin of the Back River Complex into the Regan Lake embayment and thence along the northern flank of the Regan Lake volcanic arm. North of Regan Lake the mudstone-hosted BIFs transit from proximal volcanic oxide-carbonate to distal silicate-sulphide facies members. The sulphidic BIFs in the Back River-Regan Lake area have proven potential for Lupin-type lode gold concentrations. Strongly carbonated shears overprinting the northerly andesite and highly deformed quartz-feldspar porphyry bodies with associated disseminated arsenopyrite-stibnite occurring along the southerly volcanic/sediment contact supply additional targets favourable for gold at Regan Lake.

The 2002 fieldwork by the NTI/UWO partnership was carried out from camps on Regan and Gold lakes, from July 18 to August 14. The routine 1:50,000 scale geological mapping and sampling of mineralized sites (about 75 assays outstanding) was GPS-supported. The prospective Gold Lake segment of the Back River volcanic/sediment contact is the focus of a current BSc thesis by MacDonald at the University of Western Ontario.

METALLOGENY OF THE BIF-HOSTED LODE GOLD PROSPECTS IN THE BATHURST TERRANE, NORTHEASTERN SLAVE PROVINCE, NUNAVUT

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Banded iron formation (BIF)-hosted lode gold prospects are unusually widespread in the northeastern Slave Province east of Bathurst Inlet. This region is characterized by granites intruding high grade cordierite-sillimanite paragneiss and migmatite. The BIFs are dominantly preserved in nodular cordierite-bearing metagreywacke occurring exterior to sillimanitic paragneiss and migmatite coring the Crazy Bear Metamorphic Complex (CBMC). Chlorite-sericite retrograded mylonitic schist developed at the bounding cordierite-sillimanite isograd attests to updoming following the main regional deformation and granite emplacement event. Post this terminal Archean orogenic overprint, the region was reactivated by graben formation accompanying opening of the Kilohigok Rift. Mild folding of the Proterozoic sediments infilling outliers preserved across the area identifies the effects of the Slave/Churchill collision forming the Thelon Front. As a result of these paleoProterozoic rifting and collisional events, the Archean basement of the Bathurst terrane is more block-faulted than is typical of an Archean shield.

The BIFs occur within restricted stratigraphic intervals and have strike lengths in the order of 1 to 10 km. Silicate facies units dominate, and broad lithological similarities suggest that the individual segments (Hen, Char, Hunt, Bear, and Egg) may signify a unique marker within the regionally extensive metaturbiditic host rock package. Apparent preference for BIFs occurring on the margins of the late Archean CBMC implies preservation of original depositional settings. Deep burial and melting of an interior basin during the late Archean orogenic event culminated in structural doming over the course of unroofing. The gold enrichment is attributed to metamorphic fluidization of the margins of the rising plutonic infrastructure, as reflected in prograde sillimanite-andalusite growth and formation of retrograded mylonitic schist against bordering nodular cordierite schists. Gold is associated with extensive pyrrhotite in the adjacent silicate facies BIFs, and as is evident within the southern extension of the Hen, with zones of silicification in domains of late retrograde chloritization/carbonitization. Although there is local evidence for weathering in the vicinity of Proterozoic outliers, such as northeast of Crescent Lake, this is not considered a significant factor for further upgrading the BIF-hosted gold.

The exploratory work by the NTI/UWO/Shear Minerals partnership was conducted from two camps established on the northeast and southwest corners of the CBMC, from July13 to18 and August 14 to 27 respectively. The routine 1:50,000 scale geological mapping and sampling of mineralized sites (about 75 assays outstanding) was GPS-supported. The prograde/retrograde effects shown by gold-enriched BIFs at the cordierite/sillimanite isograd is the focus of a current BSc thesis by Therriault at the University of Western Ontario.

THE HISTORY OF MINING IN YELLOWKNIFE

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The development of the Northwest Territories in the 20th century has been inextricably linked to the development of natural resources, and the fate of its capital city. Yellowknife has depended for most of the century on small flakes of yellow found in the veins of quartz, which decorate the landscape on the northern shores of Great Slave Lake. More recently the development of the city has hinged on the growth of a northern government to administer this vast territory, but there can be little doubt that were it not for the gold rush of the 1930s and 1940s around Yellowknife Bay, the city itself and the personalities it attracted would never have flourished.

Although the first European explorers and Dene noted areas of mineral wealth such as the lead and zinc deposits at Pine Point, systematic gold exploration did not start until the 1930s. The exploration of the Yellowknife area reflects a global shift in mining exploration, from individual prospectors to corporate efforts. The depression displaced many young men, who following the gold rushes of the Klondike and Northern BC, traveled to Great Bear Lake to participate in the silver rush. Some of these intrepid but often inexperience prospectors were side tracked into Yellowknife Bay and remained to prospect; however, the majority of the prospectors and especially the more successful ones were "professional" prospectors hired and grub-staked by larger companies. The initial successes were had on the east side of Yellowknife Bay by Bear Exploration and Radium Limited where Major L. T. "Lockie" Burwash, C.J. Baker and H.M. Muir staked the Rich Claims. Rumors of gold on the west side of Yellowknife Bay were followed by the chance meeting between prospectors and A.W. Jolliffe and the disclosure of a discovery of gold-bearing veins. Acting on this information in late September 1935 Cominco field crews staked the area that became the Con Mine. Development work consisted of trenching and sinking of prospect shafts on narrow gold bearing veins exposed on surface, resulting in a series of small mines in the area, including the Con, Rycon and Negus in the southern part of the belt and the Brock and Crestaurum to the north. The first gold brick in the NWT was poured at the Con Mine on September 6, 1938.

Increased efficiencies in diamond drilling combined with an increase in labor costs following the Second World War brought about another major shift in exploration, with drill holes replacing trenching and testing deeper targets. Coincidently, prospecting by D.W. Cameron, north of Fault Lake identified a gold-rich quartz-carbonate shear zone that was a departure from the narrow ribboned quartz veins that had been previously exploited. Consolidation of these claims with the Giant Claims was followed by an extensive drill program run by Venture Exploration and supervised by A.S. Dadson that outlined the majority of the gold deposits that were to become the Giant Mine. At Con Mine, geological modeling by N. Campbell resulted in a solution for the West Bay Fault suggesting the Giant Shears could be located on Con Mine claims south of the fault. In 1946, a 2100 ft drill hole collared on the 10th level of the Negus Shaft was used to test the hypothesis resulting in the discovery of the Campbell Shear. The discovery of the Campbell Shear was followed in 1948 by pouring of the first gold brick at the Giant Mine and suddenly Yellowknife was no longer a mining camp on the shores of Latham Island but a growing town expanding into the “new” town.

The relationship between advances in mineral exploration, the development of new resources and the expansion of the city continues to the present day. While the current focus of the mineral exploration has shifted to the diamond mines in the tundra, the significance of the gold mines on creating a mining and government centre cannot be overstated.

YELLOWKNIFE STRATIGRAPHY: A RE-EXAMINATION OF THE KAM GROUP

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The stratigraphy of the Yellowknife Greenstone Belt (YGB) has seen a number of revisions, with the current standard by Helmstaedt and Padgham[a] (1986) remaining an important guide for researchers. This standard introduced the Octopus Formation and rocks at Dwyer Lake as sub-Kam deposits, overlain by the Kam Group consisting of the Chan, Crestaurum, Townsite and Yellowknife Bay formations. Based on advances in geochronology, Nd isotope analyses, and additional mapping since 1986, we propose that the Chan and lower Crestaurum formations should be re-assigned to the 2.85-2.80 Ga Central Slave Cover Group[b] (CSCG). Use of the Octopus Formation should be discontinued and the Kam Group now consists of the expanded Yellowknife Bay Formation with a Townsite member and Kamex formation.

Previous correlation between the Ranney Chert, south of the Akaitcho Fault, and the Crestaurum and Finger Lake tuffs, north of the Akaitcho Fault, is erroneous, as indicated by metamorphic isograds, geochronology, geochemistry, and Nd isotopes. The data suggest the Crestaurum and Finger Lake tuffs are the same age as the Central Slave Cover Group, and that the Chan Formation, north of the Akaitcho Fault, is a mafic member of the CSCG. This is consistent with recent mapping of the Bell Lake[c] and Beniah Lake[d] areas that suggest mafic volcanic rocks are intercalated with the CSCG. With the inclusion of the Crestaurum tuff in CSCG, a lower contact for the 2.72 Ga Kam Group rocks must be defined. A northeast-trending shear zone at Rater Lake, below the Cemetery tuff is a possible candidate and immediately below this suspected contact zone, a broad zone of alteration transects the YGB. Mapping and chemical analyses of this zone demonstrate that the alteration occurred on the seafloor prior to the intrusion of abundant unaltered Yellowknife Bay Formation feeder dykes, consistent with a 100 m.y. hiatus in volcanism in the YGB.

In addition to the re-classification of the lower Kam Group, new data with stratigraphic implications for the remainder of the Kam Group has been collected. Mapping of the Townsite Formation[e] demonstrated it is largely composed of ca. 2680 Ma gabbro and coeval feldspar porphyry intrusive units. Without the younger intrusions, the Yellowknife Bay Formation is a sequence of mafic pillowed and massive flows interbedded with an increasing proportion up-section of volcaniclastic sediments, deposited from 2722 to 2700 Ma, starting with the Cemetery Tuffs, culminating in the volcaniclastic/gabbro sill-dominated Kamex formation. Mapping and geochronology indicates that a suite of ca. 2710 Ma QFP dykes in the northern YGB may be feeder dykes to the coarser volcaniclastic sediments in the upper Kam Group.

Redefinition of the YGB stratigraphy is ongoing and will bring the nomenclature in line with our current understanding of its volcanology and absolute age data.

[a] Helmstaedt and Padgham, 1986, C.J.E.S. 23, 454-475.
[b] Bleeker et al., 1999, C.J.E.S. 36,1083-1109.
[c] Jackson, 1998, EGS Open File 1998-12.
[d] Pickett, 2002, M.Sc. Thesis University of Quebec, Chicoutimi.
[e] Finnigan, 2000, M.Sc. Thesis University of Western Ontario, London.

OIL AND GAS POTENTIAL OF THE YUKON TERRITORY

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There are eight petroleum regions in the Yukon Territory: North Coast; Old Crow Basin; Kandik Basin; Eagle Plain; Bonnet Plume Basin; Peel Plateau; Whitehorse Trough; and Liard Plateau. The Kotaneelee field in southeast Yukon has two active gas wells with cumulative production of 180 Bcf (5,100,000 $10^3 m^3$) for less than 160 months. There are 4 suspended oil and/or gas wells in Eagle Plain and numerous oil and gas shows throughout the regions.

The Yukon government has published assessments of conventional petroleum resources by both the NEB (1994, 1997, & 1999) and the GSC (1999, 2000 & 2001). These indicate the territory is generally gas prone, with about 9.6 Tcf (270,000,000 $10^3 m^3$) in-place gas and approximately 800 MMbbls (2,600,000 $x10^3$ m^3) in-place oil, including offshore plays. Specifically, median marketable gas resources are estimated at 0.84 Tcf, 1.57 Tcf and 2.36 Tcf for Eagle Plain, Liard Plateau and Peel Plateau respectively.

Coal-bed methane is another important resource in the Yukon, particularly in two areas, Bonnet Plume Basin, where an initial assessment suggests 5 Tcf in-place reserves, and Whitehorse Trough, where further work is currently underway.

The Oil and Gas Resources Branch has partnered with the Yukon Geology Program and the Geological Survey of Canada to further define and delineate the petroleum resources of the Yukon Territory. With the resolution of land claims and pipeline issues expected in early 2002, it is anticipated that petroleum exploration and development in the territory will be dramatically affected.

ELECTRON MICROPROBE DATING OF MAFIC TO ULTRAMAFIC IGNEOUS ROCKS

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The Electron Microprobe (EM) chemical U-Th-total Pb dating technique is now well established as a valuable contextural tool in reconnaissance geochronological investigations of monazite-bearing igneous and metamorphic rocks[a]. The main advantages of the technique are tied to the excellent spatial resolution of the EM (~1 μm), but also to the fact that it is relatively rapid and inexpensive when compared to conventional isotopic methods. As most EM chemical dating studies have focussed on the mineral monazite (and to a lesser extent zircon and xenotime), the technique has been used almost exclusively to obtain contextural age information from metasedimentary and granitoid rocks. Recent studies have shown that reliable first-order chemical age information can successfully be obtained by EM from the mineral baddeleyite (ZrO_2)[b], a mineral used commonly in conventional U-Pb dating of mafic dykes and sills. As such, there is great potential for incorporating this technique in geochronological investigations of mafic rocks, particularly in reconnaissance dating of crustal-scale mafic dyke swarms. Here we review tactics for EM chemical dating of mafic to ultramafic rocks, outline some fields of application, the advantages and limitations of the technique, and discuss case studies from the Slave Province.

The Zr-rich, U-bearing minerals baddeleyite (ZrO_2), zircon ($ZrSiO_4$), and zirconolite (~$CaZrTi_2O_7$), commonly occur in trace amounts in many gabbro dykes and sills, and in the ultramafic cumulates of layered mafic intrusions[c]. Of these accessory phases, zircon and baddeleyite are now well-established geochronometers in conventional U-Pb geochronological studies of mafic to ultramafic rocks[d]. In-situ chemical dating of baddeleyite by EM was recently carried out[b] and methods for improving the accuracy and precision of EM chemical ages determined from discordant zircon grains have been evaluated in detail[e]. Although zirconolite is known to occur in a wide range of rock types and geological environments and has been reported from a number of terrestrial and lunar mafic to ultramafic samples[f], the U-Pb systematics and typical common Pb contents of this mineral have not yet been evaluated. As the combined U + Th content in zirconolite from terrestrial mafic to ultramafic rocks is typically >5000 ppm (Williams and Giere[f]), there may be potential for development of this mineral as a new geochronometer for mafic to ultramafic rocks.

In one case study, EM chemical data are presented for baddeleyite and spatially associated zirconolite, originating from a shallow-dipping, ultramafic sheet (the Hay Duck sill) which intrudes the Burwash Formation near Yellowknife. The baddeleyite data yield a well-defined, 48 point U-Th-total Pb isochron age of 2080+/-50 Ma, which coincides closely with the upper limit of K-Ar ages[g] for that intrusive body (1925-2090 Ma). Preliminary EM analyses indicate that zirconolite from this sample contains >4.0 wt% ThO_2, and 0.7-1.6 wt% UO_2, and high PbO concentrations (>0.5 wt%), and may also have retained meaningful, and comparable chemical U-Th-total Pb age information.

[a]Cocherie et al. (1998), GCA 62, p.2475-2497.
[b]French et al. (2002), Chem.Geol.188, p.85-104.
[c]Heaman and LeCheminant (1993), Chem.Geol. 110, p.95-126.
[d]Krogh et al. (1987), In: Mafic Dyke Swarms, p. 147-152.
[e]Geisler and Schleicher (2000), Chem.Geol. 163, p.269-285.
[f]Williams and Giere (1996), Bull.Nat.Hist.Mus.Lond.(Geol.) 52, p.1-24.
[g]Leech (1966), CJES 3, p.389-412.

NON-RENEWABLE RESOURCE ASSESSMENTS – PROGRESS REPORT

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Non-renewable resource assessments (NRA) are informed evaluations of mineral and petroleum potential of areas, based on the geoscientific information available. The C.S. Lord Northern Geoscience Centre has undertaken NRAs as part of the NWT Protected Areas Strategy (PAS) (Sahyoue – Edacho, Edehzhie), land claims (Dogrib Refuge) and land use plans (Gwich'in Conservation Zones). The status and initial results of these NRAs are presented.

The Dogrib Refuge NRA report was completed in early 2002 and published as NWT Open File 2002-03. The result of this evaluation was the recognition of the high mineral potential in basement rocks underlying the eastern Refuge area. The eastern boundary of the Refuge proposed protected area has been modified, based on information provided by the NRA, to reflect this known mineral potential.

The Phase I NRA for Sahyoue – Edacho Candidate Protected Areas was released as NWT Open File 2002-04. The Phase I report is a compilation and assessment of existing information on the area. The information gaps were addressed partly through Phase II fieldwork. This comprised reconnaissance geochemical surveys and bedrock examination carried out at Sahyoue in summer 2002. Stream sediment samples and lithogeochemical data do not reveal any significant anomalies. Three stream drainages display weak multi-element anomalies, but these are not interpreted to indicate base or precious metal mineralization.

Heavy mineral concentrates (HMC) from six major drainages showed that the gravel and sand sampled is derived mainly from till that was glacially transported onto the peninsula from the exposed Precambrian Shield to the east rather than directly from the underlying Phanerozoic formations. The samples were analyzed for gold grains, kimberlite indicator minerals (KIM's) and magmatic/metamorphosed massive sulphide indicator minerals (MMSIM). The number of gold grains was very low (0-2 grains/sample). Some kimberlite-source KIM's were recovered but are interpreted to be from a distant source, based on low concentrations. A similar interpretation is proposed for the single anomalous MMSIM sample. In general, the results do not indicate the presence of significant mineralization in the Sahyoue area. The HMC methodology proved to be an effective tool and will be used in Edacho in 2003.

There is very little bedrock exposure at Sahyoue, comprising mostly gently-dipping Cretaceous shale on the northeast side of the peninsula, and flat-lying Paleozoic dolomite at Jupiter Point. The dipping Cretaceous beds may be due to large-scale slumping. Results of palynology (age dating) and pyrolysis (hydrocarbon potential) studies of the shales are pending.
The Phase I NRA for Edehzhie (Horn Plateau) PAS Candidate Protected Area is underway. A helicopter reconnaissance of the area was carried out in September. As well, the authors responded to community (PAS) requests for information on the Slave River delta, Blackwater Lake area (Pehdzeh Ki Deh) and the Aylmer Lake area (Waters of Desnedhe Che).

The Phase I NRA is underway for the Gwich'in Conservation Zones identified in the Gwich'in Land Use Plan. A helicopter reconnaissance of the Richardson Mountains and Traivaillant Lake areas was carried out in September 2002, at which time eight heavy mineral concentrate samples were also collected: results are pending.

THE COMPOSITION OF BASE METAL MINERALIZING AND NON-MINERALIZING FLUIDS, PINE POINT, SOUTHERN NORTHWEST TERRITORIES AND NORTHERN ALBERTA

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The Pine Point region is a classic metallogenic orefield that produced over 58 million short tons of Zn-Pb ore from approximately 40 base metal mineralized deposits hosted by Middle Devonian carbonates[a]. The ore deposits are localized in paleokarstic features found in the epigenetic Presqu'ile dolomite that preferentially replaces some of the upper barrier limestones. The main ore stage sulfides include galena, sphalerite, marcasite and pyrite and these are associated with ore stage saddle dolomites. Fluid inclusion data from ore stage sphalerite indicate the mineralizing fluids to be low temperature (>100°C), saline brines (<35wt% NaCl equivalent). Late stage calcite, native sulfur and bitumen are also commonly observed in the deposits. The deposits are considered by some authors to have formed from gravity driven flow of sedimentary brines in the Western Canadian Sedimentary Basin[b].

Although economic mineralization was concentrated at Pine Point, there are base metal mineralized occurrences over a much wider area. Equally, saddle dolomites are commonly reported from Devonian reservoirs in Alberta, British Colombia and Northwest Territories. It is likely, however, that these saddle dolomites document multiple flow events in the Western Canadian Sedimentary Basin[c] and that saddle dolomite cannot be uniformly used as an exploration tool for base metal mineralization.

This study forms part of the collaborative Targeted Geoscience Initiative that is attempting to assess the potential for undiscovered carbonate-hosted lead-zinc orebodies in southern Northwest Territories and northern Alberta. The primary aims of this part of the study is to characterize the chemistry of mineralizing brines responsible for base metal mineralization and hydrothermal carbonate phases in Northwest Territories and Alberta by carrying out crush-leach analyses of fluid inclusions. Halogen, major and trace cation data from sphalerite, saddle dolomite and late calcite from the Pine Point deposits will be presented. These data will then be compared with regional occurrences of sulfide, saddle dolomite, and calcite to ascertain if these phases are associated with the Pine Point mineralizing event. Halogen and cation geochemistry of all the samples will allow the origin and evolution of the mineralizing fluids to be constrained. These data can then be compared to modern formation waters from Devonian aquifers in the region.

[a]Rhodes, D., et al., 1984. Economic Geology, v. 79, pp. 991-1055.
[b]Garven, G., 1985. Economic Geology, v. 80, pp. 307-332.
[c]Al-Aasm et al., 2000. Journal of Geochemical Exploration, v. 69-70, 11-15.

POTENTIAL FOR CARBONATE-HOSTED MVT DEPOSITS IN NORTHERN ALBERTA AND SOUTHERN NWT: NEW DATA FROM THE TARGETED GEOSCIENCE INITIATIVE PROJECT

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The primary goal of this ongoing project is to delineate the distribution and describe the origin of known carbonate-hosted lead-zinc deposits in the project area, represented primarily by the world-class Pine Point deposit, and to investigate the potential for undiscovered occurrences of MVT mineralization elsewhere in the area. In order to reach this goal, a multi-partnered and multi-disciplinary project team was established to fulfill an integrated geological, geophysical, and geochemical investigation examining the relationship of stratabound Pb-Zn mineralization with its regional stratigraphic framework and characterizing the structural features critical for fluid migration and ore deposition. This presentation discusses GSC's contributions to the project.

Subsurface mapping indicate a discernable difference in structural development across the Great Slave Lake Shear Zone (GSLSZ). Northwest of the GSLSZ, relatively uniform northeast-trending faults cross abrupt inflections of contours on structural contour and isopach maps. Southeast of the shear zone, contours display fewer pronounced inflections and inferred faults except in the Peace River Arch area. Seismic interpretation show most faults have normal throw and are sub-parallel to time contours implying basinal subsidence rather than relationships to major NE-SW faults. The Middle Devonian strata display a disturbed stratigraphy which may represent suitable targets for MVT mineral exploration. Reprocessed aeromagnetic data with derivative products such as Instantaneous Phase or Tilt of the Magnetic Field which enhances weak surface anomalies or anomalies at depth was useful in possibly identifying additional structures.

Numerous carbonate and mineralized surface and subsurface samples were collected for thin section, fluid inclusion section, cathodaluminescence, isotope and crush-leach halogen chemical analyses. The characterization of isotopes of C, O, Sr, S and Pb of the carbonate-hosted Pb-Zn mineralization in the project area and comparison with hydrothermal dolomite isotopic characteristics elsewhere in the region provides a means of evaluating the tectonic and metallogenic relationships between mineralized and non-mineralized samples. Pine Point deposits show a distinct non-radiogenic Pb isotopic signature which contrasts with isotopes from subsurface Western Canada Sedimentary Basin and the exposed northern Rocky Mountains MVT belt. Several subsurface samples directly above the GSLSZ give uniform non-radiogenic lead isotope signatures similar to Pine Point which could imply the fault zone played a key role in Pine Point metallogenesis. Fluid inclusion microthermometry has identified three different aqueous fluids of primary and secondary origin as well as petroleum inclusions. Homogenization temperatures give a broad range of values and is of limited use to differentiate fluids. Melting temperatures and their associated salinities proved to be useful for differentiating fluids.

Geochemical analyses of spring and water samples indicate two end-members in the formation waters, a NaCl brine and $CaSO_4$ formation water. Mixing of these two formation water end-members occur and when one predominates, the other diminishes. Previous analyses of Devonian formation waters in northern Alberta show these waters to be Pb-rich and are thus not related to Pine Point because the deposit is Zn-rich. Our analyses, however, show that Zn values are orders of magnitude greater than Pb.

THE LEGAL BASIS OF THE DUTY TO CONSULT WITH ABORIGINAL PEOPLE - WHAT ARE THE COURTS NOW SAYING?

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Both government and private industry throughout Canada now accept the need to consult with and accommodate aboriginal people in relation to natural resource development initiatives.

Effective consultation requires that government and private industry recognize the inherent differences in their respective duties to consult, together with the consequences of changes to the legal basis of those duties resulting from recent court decisions.

For government, the basis of the duty has been the Crown's fiduciary relationship with aboriginal peoples as set out in s. 35(1) of the *Constitution Act, 1982.* For private industry, the duty to consult has a different basis. It typically flows from the requirements of environmental assessment, resource utilization and related statutes, or may arise under general principles of administrative law.

The B.C. Court of Appeal has recently cast considerable doubt on this distinction. In its two decisions in *Haida Nation v. British Columbia and Weyerhaeuser,* the Court has made legal history by imposing on Weyerhaeuser a duty to consult not only pursuant to the B.C. *Forest Act*, but also in fulfillment of the constitutional obligation to aboriginal people that historically has been the exclusive responsibility of government. The Court of Appeal decisions are at variance with earlier judicial findings, suggesting that the Supreme Court of Canada will ultimately answer this question.

In the interim, both private sector applicants and government agencies need practical guidance on how to conduct themselves. This presentation will discuss the implications of *Haida Nation*, and outline the main tests the courts have otherwise applied in order to determine whether government and private industry have properly fulfilled their respective duties to consult.

LITHOGEOCHEMICAL PROFILE OF THE SUPERCREST ZONE, MIRAMAR GIANT MINE, YELLOWKNIFE, NWT

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Miramar Giant mine is characterized by numerous complex alteration and mineralizing events. Seventeen active stopes in the Supercrest, LAW and Brock zones were mapped and sampled on a stope scale during 2001. From this work, three gold bearing assemblages, six distinct ore morphologies and four alteration assemblages are differentiated using petrography and geochemistry.

Ore Morphologies:
Six geochemically distinct, mappable ore morphologies occur within the shear system. These morphologies include: fractured white quartz – carbonate vein (a), breccia vein (b), breccia body (c), sericitic schist (d), chloritic schist (e) and crackle sericite schist (f).

Ore Assemblages:
Historical ore assemblages are; arsenopyrite, sulphosalt and arsenopyrite–stibnite–sphalerite (±galena). This study has identified a newer classification system for ore assemblages based on petrography and principal component analyses (PCA) of geochemical data. These are three arsenopyrite associations: arsenopyrite (A), arsenopyrite and sulphosalts with galena (B) and arsenopyrite with silver (C). There are four sulphosalt associations: Pb-Ag (D), Sb (E), Ag (F), Cu-Pb-Ag (G). The six gold associations are: native gold (H), gold and galena (J), electrum and chalcopyrite (K),gold and chalcopyrite (L), gold and sphalerite (M), and electrum (N).

Alteration Assemblages:
There are four alteration assemblages based on petrography and PCA. They are potassic, sodic, ankeritic and calcite alteration. Potassic alteration is commonly represented by abundant sericitic mica. Sodic alteration appears to be related to the presence of paragonitic mica and an absence of arsenopyrite. Ankeritic alteration correlates with the presence of a brownish carbonate in hand specimen and Fe and Mg using PCA. Calcite alteration correlates with abundant white carbonate in hand specimen and Ca using PCA.

Ore Assemblages	
A:	AsPy
B:	AsPy-Ssalts-Gn
C:	AsPy-Ag
D:	Ssalts-Gn-Ag
E:	Ssalts-stibnite
F:	Ssalts-Ag
G:	Ssalts-Cu-Gn-Ag
H:	Au
J:	Au-Gn
K:	Au-electrum-Cpy
L:	Au-Cpy
M:	Au-Sph
N:	Au-electrum

Ore Morphologies	
a:	Fractured qtz-carb
b:	Breccia vein
c:	Breccia body
d:	Sericite schist
e:	Chlorite schist
f:	Crackle sericite breccia

Alteration Assemblages	
I:	Potassic
II:	Sodic
III:	Ankeritic
IV:	Calcite

AsPy: Arsenopyrite, Ssalts: Sulphosalts, Gn: Galena, Cpy: Chalcopyrite, Sph: Sphalerite

Ore Zone Characteristics
The *LAW zone* commonly exhibits Ankeritic (III) alteration in fractured quartz-calcite veins (a) with thin potassic (I) alteration haloes. Typical ore assemblages in this zone include Au (H), Au-sphalerite (M) and sulphosalts-Cu-Gn-Ag (G).

The *Brock zone* displays weak potassic (I) alteration associated with fractured quartz-calcite veins (a) and ore assemblages consisting of Au (H) and Au-Gn (J).

The *Supercrest zone* is considerably more complicated consisting of all four major alteration assemblages. The potassic alteration is associated with three ore morphologies: breccia vein (b), breccia body (c) and crackle sericite breccia (f). The breccia vein (b) morphology is associated with ore assemblages AsPy (A) and AsPy-Ag (C). The breccia body (c) morphology is associated with ore assemblages AsPy (A) and AsPy-Ag (C). The crackle sericite breccia (f) is associated with AsPy-sulphoslats-Gn (B) and sulphosalts-Gn-Ag (D). Sodic alteration (II) in the Supercrest zone is associated with breccia veins (b) and the sulphosalts-Cu-Gn-Ag (G) ore assemblage. Ankeritic alteration (III) in the Supercrest zone is associated with breccia bodies (c) and the AsPy (A) ore assemblage, while breccia veins (b) are associated with the Au-sphalerite (M) ore assemblage. Calcite alteration (IV) and breccia veins in the Supercrest zone are associated with Au-electrum (N), Au-Gn (J) and Au-Cpy (L) ore assemblages, while calcite alteration (IV) and breccia bodies (c) are associated with the AsPy-Ag (C), AsPy (A) and sulphosalt-Gn-Ag (D) ore assemblages.

A BRIEF BUT HUMOROUS LOOK AT THE MINING HISTORY OF THE NWT

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1700 Martin Frobisher: was it a legitimate assaying mistake or the first mining scam in the NWT.
1800 Samuel Hearne takes a 3000 mile walk for a couple of pounds of copper.
1890 The Klondike Gold Rush: floating down the river. Possibly the wrong river and the wrong way but floating all the same.
1920s Wilson: The first shaft in the NWT was sunk. On the way home he drowns. Did he slip, did he jump or was he pushed.
1920-1930 Gilbert Labine: wrestles with the forces of darkness and saves mining in the NWT, forever changing its history.
1930 Gilbert finds radium at Great Bear Lake. Norman Wells, after seeping into the river for thousands of years oil production in the NWT begins and semi-organized northern transportation starts.
1933 Johnny Baker and Herb Dixon go on a four-month paddle and almost discover Yellowknife.
1934 Yellowknife discovers gold, hookers and gambling. Con, Rycon Negus.
1936 Joliffe Lake was discovered and renamed Gordon. Camlaren, Thomson Ludmark, Ptarmigan, Ruth
D'Arcy Arden senior and junior (sonny) walk from Great Bear Lake to Yellowknife on a misleading assay.
1939-1945 The War to end all wars. Mining tungsten, high-grading and hiding out. Building the canol road and a pipe line, without a land use permit.
After the War - a mining boom and exploration boom.
GIANT, DISCOVERY, CAMLAREN and TUNDRA.
Eldorado becomes Echo Bay and then moves to Lupin.
Pine Point. A staking rush starts at midnight.
Nanisivik and Polaris
Terra Firma and other fishing lodges at Great Bear Lake.

Can Tung: It glows in the dark under a black light.
1960s The Coppermine rush and the missing decimal place.
Exploration Sagas. A week living on peanut butter and lettuce.
1967 the government moves north or from 3000 to 17000 in thirty years. Where have all the civil servants gone.
1990s Diamonds, what diamonds.
Emeralds could they be the next northern gemstone and can rubies or opals be far behind.
What about territorialite?

THE SNARE RIVER PROJECT (PARTS OF 85N AND 85O): RESULTS FROM 2002 MAPPING, THE FINAL FIELD SEASON

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The Snare River area, in the southwestern Slave Province, N.W.T., preserves a well-exposed section of Archean supracrustal and granitoid rocks in which the metamorphic grade increases from greenschist facies to high temperature granulite facies. The Snare River Project was initiated in 1998 and fieldwork was completed in 2002. The goals for this past field season were to complete 1:30 000 scale mapping in widely dispersed "holes" in the project area and to verify the geology in some problematic areas. The geology from the last 5 seasons of mapping in the Snare River area has been compiled in a preliminary 1:100 000 scale map.

Some of the highlights and revelations from 2002 mapping are presented below.

High-grade Rocks:
As in the previous field seasons, additional supracrustal rocks were defined in the area ascribed to a granitoid terrane[a]. The proclaimed[b] consistency between bedrock geology and contacts, which were interpreted from detailed aeromagnetic maps, broke down. In particular, obscured contacts are indicated on the aeromagnetic maps in areas where multiple megacrystic granite sheets have invaded metasedimentary and tonalitic rocks.

Transitional and Low-grade Rocks:
South of Cowan Lake, the isograd between amphibolite facies cordierite-bearing metasedimentary schists and the higher-grade melt-bearing equivalents is complex and, because of differences in the initial bulk rock composition, the isograd is better defined as a transition zone.

The sedimentary rocks near "Lily" Lake (between Strutt and Labrish lakes) are amphibolite-grade greywacke-mudstones that lack banded iron formation units. On the last day of the season, a previously unrecognized, thin unit of felsic volcaniclastic and porphyritic rocks was found within these turbiditic sedimentary rocks. The felsic rocks may be the southern extension of volcanic rocks that occur near Labrish Lake.

Two days were taken to complete mapping of the spectacularly exposed volcanic pile in the area northeast of Kwejinne Lake. This volcanic accumulation includes complexly interstratified and folded mafic, intermediate, and felsic pyroclastic rocks, and mafic and intermediate pillow flows. The surrounding sedimentary rocks are interpreted to rest conformably on the volcanic pile, however, beds in the sedimentary rocks are locally oblique to, and appear to truncate the volcanic stratigraphy. The economic potential of the area is poorly understood, and several features suggest the volcanic rocks warrant further study. Primarily, the volcanic rocks contain numerous gossans in inter-flow sedimentary rocks and in zones that either parallel or cross stratigraphy. Secondly, mafic flows are locally intensely bleached (silicified?), which may be evidence of hydrothermal alteration. In addition, numerous quartz veins cross the volcanic and sedimentary rocks, particularly near the Snare River.

In 2002 the project is supporting two BSc. theses at the University of Alberta (S. Buse; D. White, see this volume) and is continuing to collaborate with V. Bennett (Ph.D. thesis, Memorial University of Newfoundland, see this volume).

[a]Lord, C.S. (1963): GSC Memoir 235, 55p.
[b]Jackson, V.A. (2001): DIAND, 2001 Geoscience Forum, Program and Abstracts.

DISTRIBUTION OF PRESQU'ILE DOLOMITE IN THE GREAT SLAVE PLAIN

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This study was initiated to map out the extent and gross thickness of Presqu'ile dolomite in the Great Slave Plain of the Northwest Territories. Presqu'ile refers to a white, very coarse, sparry dolomite associated with the lead-zinc deposits that were once mined at Pine Point, south of Great Slave Lake. An understanding of its distribution is fundamental to understanding the lead-zinc mineralization process, which is still a matter of some debate. It could also be useful for oil and gas exploration due to the high permeability of this dolomite. A similar dolomite, called the Manetoe, is very productive for gas further west in the foothills.
Drill cuttings and sample descriptions from petroleum exploration were examined to determine gross intervals of Presqu'ile dolomite. Results were plotted on a map and contoured.

A northeast-southwest trend of thick Presqu'ile dolomite development appears to be centered between the inferred Tathlina and Hay River fault zones. Its thickest occurrence is under Great Slave Lake and this appears to extend to the northeast for an undetermined distance. Three other thick trends occur: one that runs east-west through the Pine Point vicinity; a thinner east-west trend to the west of Tathlina Lake; and a separate, isolated thick west of Buffalo Lake.

Cross-sections show that Presqu'ile dolomite is generally thicker where it is closer to the surface and does not occur below 850 metres of depth. No Presqu'ile dolomite is found below the area of Cretaceous overburden. Abrupt changes in basement structural elevation – possibly caused by faults – appear to be close to Presqu'ile dolomite on the cross-sections.

Little mineralization was found in the drill cuttings, core or sample descriptions. However, the mud systems used for petroleum exploration may not have been effective for carrying significant traces of heavy minerals; and the core record is too spotty to be conclusive.

HISTORY OF HYDROCARBON EXPLORATION IN THE NORTHWEST TERRITORIES

Janicki, E.P.
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The north has had a long and colourful history of hydrocarbon exploration. Close to 1700 wells have been drilled north of sixty and roughly 1350 in the NWT itself. The great majority of wells were drilled before 1980.

Exploration for petroleum resources precedes the arrival of the first Europeans. Aboriginal people made use of gummy petroleum from oil seeps along the Deh Cho (Mackenzie River) for purposes such as pitching the seams of their canoes. Before the turn of the last century, geologists like R.G McConnell of the GSC foresaw the north's potential and suggested areas for further exploration.

Knowledge of seeps, combined with geologic mapping that highlighted structures, led to the drilling of the first oil wells near Norman Wells in the early 1920's. Initial development was slow but accelerated very rapidly during the Second World War when fears about energy security prompted the CANOL project. A pipeline constructed to Whitehorse pumped up to 3000 barrels of oil per day until it was abandoned at the end of the war.

Another wave of interest in the north took place in the late fifties and sixties when oil companies began to explore in various regions of the north. Initial regional geological mapping highlighted a number of interesting structures that led to discoveries in the Southern Territories, Colville Hills and the High Arctic. Geophysical exploration outlined prospects in the Mackenzie Delta and Beaufort Sea. The discovery of vast reserves of oil at Prudhoe Bay, Alaska in 1967 focussed interest on the north's now proven potential.

Following the "oil shock" of the early seventies, and aided by favourable tax incentives, exploration drilling picked up in the Mackenzie Delta/Beaufort Sea. A pipeline from the north to carry the huge amount of newly discovered gas was seriously considered until the Berger inquiry in 1977 recommended that it be put on hold until aboriginal land claims were settled.

Recent land claims with the Inuvialuit and Gwich'in, along with tightening energy supplies, have helped spur renewed interest in the Mackenzie Delta. In August of 2000, record land and exploration commitments of $1 Billion were made to the Canadian government. Serious consideration of the best route(s) to transport this gas to the south has been underway now for several years. Huge gas discoveries on the Liard Plateau in recent years have caught the attention of major players and gas is already being piped to the south from this region. The Cameron Hills discoveries were also brought "on stream" in 2002.

HYDROCARBON POTENTIAL OF THE BASAL CLASTIC DEPOSITS OF THE GREAT SLAVE PLAIN

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The objective of this study was to investigate the hydrocarbon potential of the pre-Devonian clastic deposits, often referred to as “Basal Clastics”, of the Great Slave Plain of the Northwest Territories. In northwestern Alberta, similar clastic sediments, known as “Granite Wash”, have proven to be very good oil producers. Basal clastics are often encountered by wells drilled for gas targeted in the overlying middle Devonian Keg River or Slave Point formations. So, the question of their potential as a secondary, or primary, target arises.

The Basal Clastic deposits were deposited on Precambrian rock over the Tathlina Arch, which is a large high uplifted sometime in the Precambrian or early Paleozoic. The Precambrian surface is highly irregular, which led to abrupt local variations for the earliest onlapping sediments. Three separate facies were recognized in this study: Fragmental, Detrital and Quartz Arenite.

The Fragmental facies originates from granitic parent material as a product of sub-aerial mass wasting or of highly eroded basement. It is poorly sorted and has little or no intergranular porosity. It often has an amorphous - almost fused - granular structure that is very tightly cemented.

The Detrital facies also originates from mass-wasting, or weathering, but its parent material is a complex melange of basic volcanics and metamorphics found in the south central part of the study area. It is poorly sorted, but some locations have zones of porosity of up to 10%.

The extent of the Quartz Arenite facies roughly conforms to a broad structural low trending northeast southwest. It is the thickest and most continuous of the facies. In places it is moderately well sorted and has zones of fair intergranular porosity. It was deposited rapidly under sub-aerial alluvial conditions.

Well logs, drill cuttings, drill stem test reports and existing sample descriptions were studied as the main sources of information. No evidence for hydrocarbons in the Basal Clastics was found in any of these sources.

A number of factors work against Basal Clastic hydrocarbon potential. The sediments are thin and discontinuous, and permeability is poor, so communication would be minimal. Porosity is generally poor and spotty. The rapid debris-flow, mass-wasting style of deposition for most of these sediments was not conducive for creating intergranular porosity. The overlying middle Devonian formations are extensive with good reservoir characteristics so, as a result, migrating hydrocarbons would preferentially migrate into these formations.

EXPLORATION AND EVALUATION OF THE FORT À LA CORNE DIAMOND FIELD, CENTRAL SASKATCHEWAN

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The Fort à la Corne kimberlite province of east-central Saskatchewan comprises some 74 volcaniclastic bodies located primarily within a narrow northwest-trending corridor, and within four subordinate satellite clusters. These kimberlites were emplaced proximal to the edge of the Cretaceous Western Canada Sedimentary Basin during cycles of marine transgression and regression. The bodies range up to 2000 metres in diameter and are mainly less than 200m thick.

Exploration of this province has been ongoing since 1989 with most work conducted by the Joint Venture composed of Kensington Resources, De Beers, Cameco, and UEM Inc. Integration of results from 219 drillholes and extensive geophysical surveys indicate kimberlite body outlines ranging from 2.7 to >200 ha based on 30 metre thickness cutoffs. Laterally extensive crater-facies kimberlites have minimal host rock dilution and range from simple mono-eruptive bodies to large multi-eruptive, layered edifices. Seventy-one percent of the bodies are diamond-bearing and recovery of 1,814 macrodiamonds (>0.8 mm) with a combined weight of 124.677 carats and individual stones ranging up to 3.335 carats in size presages the economic potential of this area.

A synthesis of forecast grades, diamond valuations, and body size was used to prioritize FalC kimberlite bodies for evaluation-stage investigation focused on delineating and refining estimates of revenue potential. Since 2000, the Joint Venture partners have conducted evaluation testing on three prioritized bodies. In particular, kimberlite 140/141 has been the target of extensive ground geophysics and drilling, which has increased the understanding of the internal geology and diamond distribution within the body. This multi-eruptive kimberlite is the largest delineated body in the province and is estimated to have an areal extent in excess of 250ha. A total of 741 macrodiamonds weighing 66.65 carats were recovered from the northwestern part of the body during 2000 and 2001, and drillholes from both sides of the body have yielded diamonds from throughout the kimberlite intersections. The combined sample grade using this data is 5.14 cpht, however, extrapolated grade forecasts are expected to be 2-3 times higher.

Kimberlite 141 has moderately low forecast grades, but excellent modeled stone values ranging up to US$ 150 (though tempered by low confidence levels at this time), and predicted large stone potential from analysis of diamond size distribution. Preliminary modeled revenues range from US$20 to $25 per tonne and estimated operating costs are in the US$8 to $10 per tonne range.

Testing continues on the 140/141 body to delineate the extent and quality of the diamond deposit. In 2002, 23 completed NQ coreholes provided kimberlite intervals for petrographic evaluation and several are pilot holes for three 914 mm, and five 610 mm, diameter reverse circulation boreholes. The three largest drillholes were targeted on the central part of the 141 part of the body in order to increase diamond inventories for valuation, while the smaller RC holes primarily will test diamond content of the 140 portion of the combined body.

STRUCTURAL CONTROLS OF Pb/Zn MINERALIZATION ON NE CORNWALLIS ISLAND, NUNAVUT

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Field studies on NE Cornwallis Island were carried out to determine the structural setting of several small Pb-Zn showings previously reported by TeckCominco Ltd., with mapping concentrated in the Stuart Bay and Caribou Lake areas over two summers. The most significant result is recognition of a complex belt of combined low-angle, bedding parallel thrust faulting and superposed folding to which mineralized sites have specific associations.

The stratigraphy of the study area is comprised of Ordovician and Devonian sedimentary successions separated by a sub-Devonian unconformity. Relatively rigid carbonate units within the upper part of Bay Fiord, Thumb Mountain, and the Disappointment Bay formations dominate the succession, interspersed with thinner, and mechanically weaker horizons of shales and calcareous mudstones, (especially the Irene Bay Formation). Of particular tectonic significance is a thick layer of evaporites in the Middle Ordovician lower Bay Fiord Formation.

A regional NNW-SSE trending anticline-syncline pair dominates the map area (~12km wide by 35 km long). Devonian strata are preserved within synclinal culminations of F1, F2 and possibly F3 - and in at least two separate areas overprint northerly trending structures within the Late Ordovician to Early Silurian units. This observation indicates a pre-Devonian folding event(s), (F1), with axial traces having an orientation similar to F2. The axial traces of the regional anticline-syncline pair are folded into a sinuous map pattern by F3. F3 structures occur in outcrop as shallow NW and SE plunging, broad, open folds. Field data suggests that thrust faulting accompanied all three folding events, and if so, has significant implications for interpretation of the structural geometry of the whole of Cornwallis Island.

Several Pb-Zn showings are dispersed within the hinges of the F3 structures. Whether F2 events affected the location of mineralization still remains unclear. There is no direct evidence of F1 having any structural control on Pb-Zn occurrences.

GEOPHYSICAL EXPERIMENTS IN BAFFIN ISLAND AS PART OF THE MULTI-DISCIPLINARY CENTRAL BAFFIN PROJECT

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The final phase of geophysical experiments took place on Baffin Island during Summer, 2002, as part of the Central Baffin multi-disciplinary 4-D geoscience project. The principle aim of the project is to understand the tectonic history of the northern margin of the 1.8 Ga Trans-Hudson Orogen. The primary objective of the gamma-ray spectrometry sub-component is to document the radioelement characteristics of the major lithologies as an aid to bedrock mapping, whereas the electromagnetic and teleseismic sub-components are tasked with establishing the 3-D architecture of this Himalayan-scale collisional belt.

Analysis of ground gamma-ray spectrometry data from the 2000 and 2001 field seasons shows that radioelement compositional differences between various Archean and Proterozoic units north of the Piling Group can be accurately and efficiently determined, thus providing an effective mapping and sampling technique. In particular the pegmatitic, muscovite/biotite monzogranites and Archean orthogneisses were shown to have radioelement characteristics that are distinct from each other and distinct from the remainder of the Archean and Proterozoic plutonic rocks. During the 2002 field season 230 additional ground gamma-ray spectrometry measurements were made, concentrated on the plutonic rocks in the Flint Lake area to evaluate the magnitude of compositional related variations within individual plutonic units. Laboratory gamma-ray spectrometry analyses of 409 till samples collected in 2001 were completed, and analyses of an additional 350 till samples collected in 2002 is planned for early 2003.

For the teleseismic sub-component, from summer, 2000, to summer 2002, five self-contained seismic stations were established and operated to study the lithospheric structure across the Proterozoic-Archean boundary. Crustal thickness estimates increase steadily from 40 (± 2) km in the SE to 37 (± 2) km beneath the Archean block in the NW. Prominent southward-dipping mantle discontinuities occur beneath the southeasternmost stations at about 100 and 140 km depth, defining a layer of increased seismic velocity. Crustal discontinuities occur at 2 and 15 km depths beneath these stations. Two layers with differing anisotropic properties are also indicated in the south from observed azimuthal variations in the splitting of teleseismic SKS-waves: probable axes of anisotropy strike at 82º and 41º. In the north, neither clear discontinuities nor anisotropy are observed, suggesting a heterogeneous lithosphere.

For the magnetotelluric sub-component, a 45 station, 500 km-long regional scale magnetotelluric profile was acquired over the last two summers. The profile crosses the northern margin of the Trans-Hudson Orogen and extends northwards onto the Archean Rae Craton for 200 km. The primary goal of the experiment is to determine the geometry of the major geological boundaries in the third dimension, depth. Analyses of the data demonstrate that the conductive Astarte River formation can be mapped and used as proxy for the base of the Piling Group. Another major feature in the data is a high conductivity contrast between the Piling Group metasediments and the northern Archean granites and gneissic complexes. Laboratory results indicate that the source of the conductivity in the Astarte River Formation is high content of interconnected graphite.

RELATIVE SEA LEVEL AND PALEOENVIRONMENTAL HISTORY OF THE SIKANNI AND SULLY FORMATIONS (ALBIAN-CENOMANIAN) IN THE LIARD BASIN

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The Liard basin preserves a thick succession of Albian-Cenomanian strata comprising the Chinkeh, Garbutt, Scatter, Lepine, Sikanni, Sully and Dunvegan formations. Renewed interest in the Lower Cretaceous package came with the gas production in northeastern British Columbia from the basal Cretaceous Chinkeh transgressive sandstones adjacent to the Bovie

Structure along the eastern margin of the basin. Although only sporadic wells have been drilled, three or four well-log markers have been consistently identified in the Albian-Cenomanian succession. West of the Bovie Structure, Cretaceous strata are very thick, but their thickness decreases eastwards over Bovie, and north and northeastwards into the Great Slave Plain and Cameron Hills areas of Northwest Territories. In the WCSB, a detailed paleogeographic and relative sea level history has been established for the Lower Cretaceous Spirit River, Peace River and Shaftesbury formations (and their equivalents), and it is important to attempt to correlate these events northwards into correlative strata of the Liard basin. The purpose of this study is to integrate foraminiferal biostratigraphy and paleoecology, which has been a critical tool in unraveling the history of the WCSB, with outcrop sedimentological analysis, digital well-log correlations, and geochemistry to understand the relative sea-level history of the Liard basin area. To date, a study of the Sikanni and Sully formations (latest Albian-Cenomanian) has been completed.

In the Steamboat Mountain area, west of Fort Nelson, the Sikanni Formation attains a thickness of some 400 m. A detailed analysis of the Steamboat outcrop indicates that four unconformity-bounded sequences are present, and lie within the late Albian *Miliammina manitobensis* foraminiferal Zone. These are developed in shelf, lower shoreface, coastal/delta plain, estuarine, and distributary channel facies that together indicate that the Sikanni consists of wave-dominated deltaic and shoreline deposits. The sequence boundaries are usually associated with transgressive surfaces of erosion, as chert pebble conglomerates overlie them. In some cases, distinct changes in the benthic foraminiferal faunas are associated with the sequence boundaries. The presence of chert pebble conglomerates overlying sequence boundaries indicates that the shoreline was once situated further basinward. Lowstand shorelines have not been observed in well-log data, but the density of the drilling is probably not sufficient to test if they are present. The history of relative sea level changes in Sikanni time has been strengthened by analysis of more northern outcrops in the Liard basin along the Liard River. Sections northeast of Lepine Creek and opposite Scatter River along the Liard River are only 130 m thick, but both contain these sequence boundaries as unconformities or correlative conformities. It is proposed that these four sequences are present in the Sikanni Formation from at least the Sikanni Chief River area northwards to the BC/NWT border.

In the Sully Formation opposite Scatter River, it has been possible to subdivide the formation into Lower Sully, Fish Scale Marker Bed (FSMB) with lower (BSF) and upper (FSU) markers, and Upper Sully, based on sedimentary and benthic foraminiferal characteristics of each member. The thick nature of the FSMB and Upper Sully in the Liard basin supports the interpretation of the FSU as a downlap surface that is overlain by the distal toes of the prograding Dunvegan clinoforms.

GOLD GRAIN AND SOIL GEOCHEMICAL INVESTIGATIONS, YELLOWKNIFE GREENSTONE BELT, NWT

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Preliminary results for gold grain counts suggest that the background value for till in granitic terrain is about 0-1 grains per 10 kg of till, whereas in areas underlain by volcanic rocks background values are about 0-5 grains per 10 kg of till. Sites with greater than 5-10 grains should be considered potentially anomalous, and those with >20 to 30 warrant further investigation. Till samples collected near Con, Giant and Discovery mines are highly anomalous with respect to both total number of gold grains and number of pristine grains. Till samples near Nicholas Lake and Mon Mine show no clear relationship to nearby mineralization. Sites with anomalous gold grain counts underlain by the Jackson Lake Formation should be considered highly significant and a viable exploration target, as should the Banting Lake and Burwash Formations, the latter being well known for its turbidite-hosted vein deposits. Although reshaped gold grains, which generally reflect some degree of glacial transport, are most common, grains with a pristine morphology, generally associated with little or no glacial transport, are also found in significant numbers.

Soil profiles developed in till, vegetation and humus were sampled for exploration and environmental purposes to document geochemical trends with depth of selected elements near the Con and Giant mine sites. Highest reported values are from the Con Mine sample site where Labrador tea produced almost 12000 ppb Au, and humus 3000 ppm As. Leaf litter produced 7300 ppb Au, spruce bark 5880 ppb Au and humus up to 4220 ppb Au. The dramatic decrease in Au (<30 ppb) and As (<50-100 ppm) in the underlying till, and general decreasing concentrations with depth, suggests important airborne contamination from the roasting stacks at both mines.

HIGHLIGHTS AND IMPLICATIONS OF RECENT INVESTIGATIONS IN THE YELLOWKNIFE EXTECH AREA; FINAL PROGRESS REPORT OF THE REGIONAL METALLOGENY PROJECT

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Investigations by participants of the Yellowknife EXTECH project and previous work by others indicate the presence of several different styles and stages of gold mineralization in a metal-rich domain with world-class gold deposits and high potential for discovery of new ores.

Evaluation of key features of more than forty locales across the EXTECH area suggests two principal styles of gold mineralization. These are a “refractory” style that characterizes much of the carbonate-rich ore with fine-grained pyrite, arsenopyrite and sulphosalts hosted by early veins and sericite schist alteration zones in the Giant-Con “system” (Con, Giant, Gold Lake and Crestaurum) and a “free-milling” style that is developed at the regional scale. The “free-milling” style includes: a) gold with sphalerite, galena and chalcopyrite in the later veins of the Con-Giant “system”, b) gold in veins with megacrystic sulphides, including pyrite and arsenopyrite (Nicholas Lake, Homer Lake, Ormsby and Duckfish), c) gold with sphalerite and galena in arsenopyrite-poor veins (Camlaren, Tom, Ptarmigan, Cassidy Point, Anne, Crestaurum and Rod), d) gold in chalcopyrite-rich veins (Chan Lake and Oro Lake), and, e) molybdenite-bearing auriferous veins (Crestaurum, Con, Duckfish and the South Islands). Superposition of different styles at numerous locales enhances the total metal endowment, but challenges the documentation and interpretation of the character, distribution and timing of the different styles.

Metal associations revealed by principal components analysis of the total sample population (n=418) include: a) Te-Bi-Au-Ag-As-Pb, characteristic of the “free-milling” veins with megacrystic sulphides, b) Zn-Pb-Ag-Hg-Au, characteristic of the “free-milling” veins with sphalerite and galena, c) Sb-As-Hg-Pb-Au, characteristic of the “refractory” style, and, d) a "new" Cu-Au factor. Samples that score highly on the Cu-Au factor are from Rater Lake, Dyke Lake, Homer Lake, Mon, Nicholas Lake, Rod, the C41 zone at Con, Negus-Rycon, Oro Lake and Chan Lake. On factor score plots, "free-milling" samples from the deeper Campbell Zone are distinct from "refractory" samples elsewhere in the Giant-Con “system”, but closely similar to "free-milling" samples at Ptarmigan, Camlaren, Nicholas Lake, Ormsby and Mon. This and apparent timing relationships suggest that some of the “free-milling” mineralization developed at the regional scale is coeval with the “free-milling” ores at Con.

Several key features of gold mineralization within the Archean rocks of the EXTECH area are remarkably similar to those that characterize synvolcanic epithermal and porphyry ores in relatively undeformed and unmetamorphosed Phanerozoic mobile belts. The extent, character, metal endowment, style of alteration (proximal "phyllic" vs. distal "propylitic") and geological setting of the “refractory” style are closely similar to some low sulphidation epithermal ores. With respect to the “free-milling” styles, the best match is probably with porphyry or intrusion-related deposits (Sillitoe, 1993; Sillitoe and Thompson, 1998). The Cu-Au association suggests an affinity with porphyry ores, as does the presence of auriferous molybdenite veins. The high Bi and Te and close direct correlation between Au and these metals are key features of intrusion-related deposits of the recently recognized W-Sn-Sb-As class (Thompson and others, 1999), some of which contain significant Zn, Pb and Ag.

Magmatic events that may have directly contributed metal-rich hydrothermal fluids include Townsite and Banting volcanism (circa 2700 to 2660 Ma), Defeat “suite” plutonism (circa 2645 to 2604 Ma), and possibly Prosperous suite plutonism (circa 2595 Ma). If synvolcanic/synplutonic processes did contribute significantly to gold deposition throughout the EXTECH area, the potential for discovery of additional world-class ores is probably greatly enhanced. This is because most world-class deposits, including many world-class gold ores, were formed largely by primary processes at or near the earth’s surface. Exploration strategies that include epithermal and porphyry targets may have an increased chance for success.

3D GIS MODEL OF THE YELLOWKNIFE CAMP: A TOOL FOR FURTHER EXPLORATION AND SUPPORTING RELATED STUDIES

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Creating a 3D GIS model of the significant structures around and between the two active mine sites in the Yellowknife camp, has formed an ideal basis for improving the understanding of the genesis of the gold deposits in the area. This in turn has resulted in clearly defined targets for future exploration drilling and possible increases in the potential reserves of gold and extending the life of gold mining, in the Yellowknife area.

The primary objectives of the 3D GIS project have been:
- Build a framework for future modeling.
- Build a model that demonstrates the application of 3D GIS for large-scale modeling.
- Create a data archive for historic and future reference.
- Identify potential exploration targets to extend the life of the Yellowknife Camp.

In addition, the 3D GIS model has provided valuable support to other studies such as analysis of geochemical data (E.H. van Hees) and studies currently underway by DIAND, Water Resources Division, on the remediation of the arsenic trioxide underground storage chambers and stopes in the Giant Mine. Work has been completed on delineating the structural zones of influence and groundwater flow provinces overlaid on the 3D model and identified the drillholes that are possibly influencing groundwater flow. This is in addition to creating a detailed model of the arsenic chambers and stopes, excavations (drilling, development drifts, raises, shafts, accesses, etc.), detailed models of geology and structure, alternative arsenic sources along with modeling and volumetrics analysis of the tailing pond areas.

The 3D GIS model incorporates the following:
- Surface features such as topography, lake bathymetry, townsite, roads, vegetation, etc.;
- Surface geology based on existing geological maps;
- Structural geology major structural units (especially faults & shears, dykes) have been extrapolated from the existing surface geology maps, down hole picks from drillhole data, and mine sections & plans;
- Current and historic mining areas;
- Geochemical point data from over 5,000 analyses and geostatistical models created for visual display and analyses;
- Geostatistical models created using the drillhole information for %QTZ, %Sericite and Au at a variety of cut-off grades. In addition, an indicator type model of lithology, namely occurrences of quartz, chlorite schist, sericite schist, chlorite-sericite schist has been created as guide for further delineating the extent of subsurface shear zones.
- Exploration and production drilling for over 50,000 drillholes are included in the surface and underground exploration and production drilling are included in the 3D GIS model. This has highlighted, in 3D, potential gaps in the drilling and areas that might have exploration potential.

GSC AEROMAGNETIC SURVEY PROGRAM IN THE NORTHWEST TERRITORIES IN 2002

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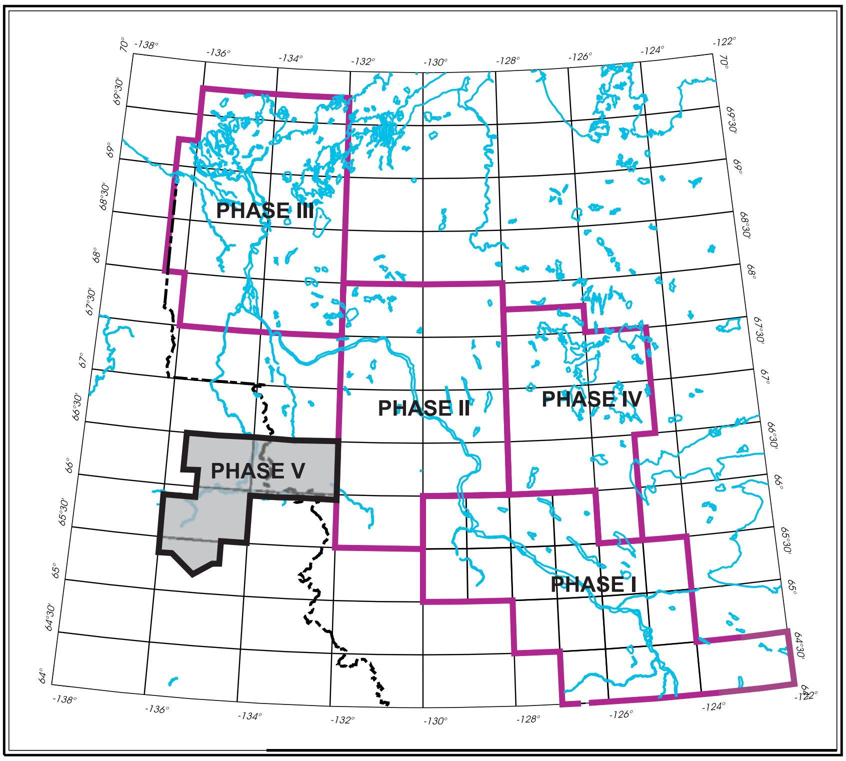
In 2002, Phase V of the GSC high resolution aeromagnetic (HRAM) survey program continues a multi-year acquisition project over the Mackenzie Corridor which commenced in 1998. This survey area was flown over the Peel Plain region, (106 K/South) Northwest Territories, extending westward into the Bonnet Plume area of Yukon (106 E, 106L/SW-SE). This Phase was cost-shared between the Geological survey of Canada, Yukon Territory and Northwest Territories. Technical specifications and contract supervision services were carried out by the GSC. The survey results will be published to support ongoing geological mapping and hydrocarbon exploration.

Phase I thorough IV have now been published. The results for Phase V are expected to be released in late 2002 or early 2003. The magnetic data are available from the GSC as published colour interval maps at 1:100 000 scale or as digital line and gridded data sets. The aeromagnetic data and the digital elevation model measured by the airborne instruments are provided as 200m grids. The line data acquired along flight lines at a spacing of 800 metres were sampled at 5 Hz, equivalent to approximately 15 metres on the ground. Details on ordering digital data sets can be found at the GSC Geophysical Data Centre web page at: http://gdcinfo.agg.NRCan.gc.ca/



STARFIELD RESOURCES INC

Robert G. Krause

SUMMARY

The Ferguson Lake nickel-copper-platinum-palladium-cobalt property represents a new mining camp by itself having a known mineralized strike length, as determined by bedrock exposures, diamond drilling and UTEM geophysics exceeding some 15 kilometres. To date 60,000,000 inferred tonnes have been identified by Starfield during the 1999, 2000 and 2001 exploration programs which included 43,600 meters of diamond drilling together with the 30,000 meters drilled by a subsidiary of Inco in the early 1950s. To date Starfield has expended in excess of $14,000,000 on exploration and Inco separately spent $2,500,000 in the 1950s. The 60,000,000 tonnes is categorized as follows:

Combined West Zone, East Zones I & II
Inferred Mineral Resource

Cutoff Grade	Tonnes (millions)	Copper (%)	Nickel (%)	Pd (g/t)	Pt (g/t)
1.0% Cu+Ni	60.1	0.93	0.59	1.32	0.19
1.5% Cu+Ni	30.6	1.17	0.77	1.69	0.25
2.0% Cu+Ni	12.7	1.39	0.85	1.92	0.28

The West Zone hosts 92% of the above resource and has only had 25% of its known target explored. UTEM interpretation and empirical drill results suggest that there could be 3-4 high-grade "ovids" at depth in the untested portion of the West Zone.

At the 2001 season's end a high-grade platinum-palladium horizon was encountered at depth that assayed 4 ounces per tonne and appears to be a discreet horizon from the sulphide system containing the inferred resource.

OBJECTIVES
The Company intends to continue to develop high-grade sulphide tonnage at depth while, at the same time, to define the recently discovered high-grade platinum-palladium horizon detected in the area around FL01-101 and FL01-104.

The specific priorities are:

1. Continue to trace the newly discovered high-grade PGE horizon further to the west.
2. Continue to explore the high-grade massive sulphides at depth and out further west (are we close to one of the feeder pipes??).
3. Confirm through drilling, the presence of the four high-grade zones identified by Western Mining and confirmed by our own interpretation.
4. In fill drill between Sections 40-50 West to increase and define the higher grades of platinum and palladium for a potential open pit.
5. Increase the overall tonnage to a minimum 20,000,000 tonnes in the 2-2½% cutoff category and to 50,000,000 tonnes in the 1½-2% cutoff category.
6. Complete UTEM geophysics a further 4 kilometres west where prospecting has observed sulphide "leakage" on surface. There is a possibility the West Zone continues past current geophysics and may come back to surface.

The budget for the above program will run approximately $3,500,000 and will have the minimum desired results to enable a further $3,500,000 program to be conducted June-November 2002.

GEOLOGY OF THE NORTHERN LIARD BASIN: CENTRAL FORELAND NATMAP PROJECT PROGRESS REPORT

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In 2002, the Central Foreland NATMAP Project completed its final year of fieldwork. Open File maps of the surficial and bedrock geology are currently in production. In the northern Liard Basin, 12 new bedrock geological maps at 1:50,000 scale are published or in production; of these 7 are substantially in the Yukon and 5 are in the NWT. New compilations of the Fort Liard (NTS 95B) and La Biche River (NTS 95C) 1:250,000 scale maps, and a project-wide compilation map at 1:500,000 scale will follow. More formal publications including fully functional GIS products are also in the compilation and production stream. These products, available on CD-ROM, contain georeferenced interactive maps supported by a relational database containing lithological, structural and sample data from each outcrop, as well as generalized polygon data.

Detailed mapping has clarified the geometry of apparently sinuous structural trends, as being the result of interference between northwest and northeast trends. These interference patterns probably result from the influence of deeper crustal structures. Whereas the reconnaissance maps inferred numerous thrust faults, our detailed mapping has shown that most of these structures consist of sharp-hinged box folds. Updated stratigraphy includes more detailed resolution of stratigraphic units throughout the Paleozoic, Triassic, Cretaceous and Tertiary.

Three new surficial geology Open File maps at 1:50,000 scale are now published. Compilation is also underway on an additional twenty 1:50,000 scale maps (Fort Liard 95B and La Biche River 95C). As final products, eight 1:100,000 scale A-series maps of the two map areas will be published. In addition, a new hybrid geological map is available for some areas, which shows landslide areas on a bedrock geology base. These permit an immediate visual correlation between areas of high landslide activity and individual geological units, and the identification of regions prone to future failure.

Surficial geology investigations have also focused on resolving the late Wisconsinan glacial history of the area, demonstrating a complete inundation of the landscape during the last glaciation. This represents a considerable increase in elevation (ice above 1800 m) and western extent (>80 km) of Laurentide (continental) ice than previously envisaged. Glacial flow histories will be utilized in interpreting regional drift geochemical surveys, the final samples for which were submitted for analyses this fall. Assessment of aggregate resources is also being undertaken as part of the surficial geology investigations, with the aim of facilitating future land use decisions in the area.

APPLICATION OF RADARSAT-1 IN MINERAL POTENTIAL EVALUATION, LAC GRANDIN AREA, NWT (DOGRIB REFUGE): IDENTIFYING GEOLOGIC FEATURES ASSOCIATED WITH MINERALIZATION

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The Dogrib Refuge Non-renewable Resource Assessment (NRA) was completed in 2002 and published as NWT Open File (OF) 2002-03. The result of this evaluation was the recognition of the high mineral potential in basement rocks underlying the eastern Refuge area. The east boundary of the Refuge proposed protected area has been modified, based on information provided by the NRA, to reflect this known mineral potential.

The purpose of using RADARSAT-1 for this mineral potential evaluation was to provide a means for acquiring quick and relatively inexpensive information about the study area. The problems faced in carrying out the mineral potential evaluation of this area were two-fold: 1) very limited geologic information exists on which to base a mineral assessment and 2) the rocks with the greatest mineral potential are overlain by younger flat-lying sedimentary rocks. The Lac Grandin area has never been flown by regional or industry geophysics, it has only seen very limited reconnaissance geological mapping, no geochemical data exists and no mineral exploration has been carried out over the area.

Flat-lying sedimentary rocks of the Phanerozoic Interior Platform underlie the Lac Grandin area. The Great Bear magmatic zone (GBmz) of the Proterozoic Bear Geological Province outcrops 30-50 km to the east and underlies the Phanerozoic sedimentary cover rocks of the Lac Grandin area. Depth to Proterozoic crystalline basement (GBmz) rocks in the study area has been determined to be less than 200 m. The GBmz is known to host significant mineral deposits including some past producing mines.

An industry aeromagnetic survey exists for the area immediately adjacent to the study area and was flown to fill in a gap in the regional geophysical database. It was hoped that structural patterns recognized from the aeromagnetic data could be extrapolated into the study area using the RADARSAT-1 images.

The RADARSAT-1 images acquired were Fine Mode, Beam 1 descending (f1d) and Standard Mode, Beam 4 descending (s4d), which partially overlap the study area and the adjacent area with industry aeromagnetic coverage. The images demonstrate that basement feature lineaments could be recognized through the sedimentary cover rock and continue beyond the aeromagnetic coverage area into the study area. The RADARSAT-1 images proved very effective as an ancillary tool to the aeromagnetic maps by aiding in locating and identifying structures thought to be important to the determination of areas of high mineral potential.

STRATIGRAPHIC RELATIONS BETWEEN BASALT, KOMATIITE AND QUARTZITE IN THE ARCHEAN PRINCE ALBERT GROUP, COMMITTEE BAY GREENSTONE BELT, CENTRAL MAINLAND NUNAVUT, CANADA

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The ca. 2.7 Ga Committee Bay granite-greenstone belt underlies a 650 km long, northeast trending corridor of the Rae province in central mainland Nunavut. The supracrustal assemblages, collectively know as the Prince Albert group are characterized by a distinctive quartzite-komatiite association. Here we present evidence for a close spatial-temporal relationship between mafic and ultramafic volcanism and the deposition of mature clastic sediments. The volcanic successions of the PAG are dominated by komatiite, lesser basalt, and rare komatiitic basalt and intermediate-felsic volcanics/volcaniclastics. Detailed mapping of two well-preserved komatiite sequences in the Laughland Lake area located on the southwest, and northeast margin of the central tonalite body, informally referred to as the southwest (SVZ) and northwest volcanic zones (NVZ) respectively, retain important stratigraphic information relating basaltic and komatiitic lavas and quartzite/quartz arenite. Most of the stratigraphic facing is derived from spinifex-textured komatiite.

Presently the lowest stratigraphic unit identified in the belt is a mafic volcano-plutonic complex, consisting mainly of basaltic flows (rarely identifiable pillows) with locally substantial amounts of crosscutting gabbroic bodies. In both the N and SVZ basalts are intercalated with minor amounts of semi-pelite and psammite. Capping the basaltic horizon in the SVZ is a series of mafic-felsic heterolithic tuffs containing abundant basaltic and dacitic fragments. An intermediate lapilli tuff collected within the NVZ basalt horizon yielded a U-Pb zircon age of 2732 Ma, currently the oldest age obtained within the belt.

Immediately overlying the basalts in both the N and SVZs are peridotitic komatiite flows. In the SVZ, komatiites are generally thin, ranging in thickness from < 50 cm to 10-15 m, with most within the 1-2 m range. Perhaps because of the larger arial extent of the komatiite horizon to the northeast, the amount of thick, spinifex-textured, pillowed, and cumulate dominated flows, is substantially greater, suggesting high eruption rates/volumes and proximity to a vent. However, thin spinifex-textured flows are also common and intercalated with the thick komatiitic flow units suggesting a dynamic volcanological setting. In both komatiitic horizons basalt and komatiitic basalt are rare, with intermediate-felsic volcanic/volcanicalstic found only within the NVZ.

Overlying the komatiite horizon in the SVZ is quartzite/quartz arenite, grey phyllite/argillite and oxide-facies banded Fe-formation. These three units are intimately associated and often occur together on the same outcrop. Intermediate volcanics/volcaniclastics are closely associated with quartzite in the SVZ. In the NVZ, quartz arenite, finely laminated mudstone and chert are interbedded with ultramafic schists above the main komatiite horizon. Detrital zircons from a cross-bedded quartzite collected from the main supracrustal belt in the Walker Lake area constrains the deposition of that quartzite to be younger than 2722 Ma. In the SVZ a hornblende-biotite-bearing granodiorite similar in composition to the central tonalite (ca. 2718 Ma) intrudes quartzite and komatiite, if co-eval with the central tonalite a tight constraint on quartzite deposition between ca. 2722-2718 Ma may be possible. The 2722 Ma maximum age on quartzite deposition, combined with the detailed mapping presented here suggests the main komatiite horizon erupted between ca. 2732 and 2722 Ma.

DISTRIBUTION OF MESOARCHEAN CRUST IN THE SOUTHERN SLAVE PROVINCE AS REVEALED BY THE Nd AND Pb ISOTOPIC COMPOSITION OF CA. 2.6 GA GRANITES

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Neodymium and lead isotopic compositions are reported for granitoid rocks from a broad area across the southern Slave craton. The isotopic composition of the granites serves as a probe for the presence of Mesoarchean crust in the granite source regions. Exposures of Mesoarchean crust are restricted to the western parts of the Slave structural province, west of the isotopic line defined by radiogenic Pb compositions in volcanogenic massive sulfide deposits[a]. Previous isotopic studies of granitoid rocks[b-d] and structural studies[e-f] indicated that Mesoarchean crust extends to the east beneath the central part of the craton, but is absent from the east-central Slave. We present new data that extends the eastern boundary through the southern part of the Slave province.

Data were collected primarily from ca. 2.62-2.58 Ga monzogranites thought to be derived by melting of dominantly, non-sedimentary protoliths. Granitoids from the western part of the Slave Province, in areas of known Mesoarchean basement (e.g., Sleepy Dragon), have non-radiogenic Nd and radiogenic Pb compositions indicative of derivation from >3.0 Ga crust. The Pb values are comparable to those previously reported for the Point Lake area[b]. In contrast, granitoids from the southeastern part of the province, east of ~111 W, have Nd and Pb compositions consistent with derivation from a more juvenile, Neoarchean crust, and show little indication of a Mesoarchean crustal component. An intervening, transitional zone of intermediate compositions occurs between the western and eastern isotopic domains. The transition can be modeled as varying degrees of mixing of the two crustal endmembers described above. The 'mixed' crustal signature in this intervening zone may reflect: 1) a progressive dilution of Mesoarchean crust by thinning and magmatic and/or sedimentary addition during ca 2.85 –2.65 Ga magmatism; 2) an east-dipping tectonic suture between Mesoarchean and an accreted, Neoarchean crustal block[e-f]; or 3) a basement domain of intermediate age. The spatial variation in isotopic composition suggests that Mesoarchean crust extends at depth as far as the western edge of the Walmsley Lake map sheet (~111 W). Thus, the N-S isotopic boundary previously delineated in the central Slave can be extended as a transitional zone through the southern Slave craton. The orientation of this boundary zone mimics but occurs east of the Pb-in-VMS boundary[a]. The distribution of Mesoarchean crust is at high angle to the post-2660 Ma structural grain of the craton indicating that this represents an earlier pre-2690 Ma feature of the craton[e-h].

[a]Thorpe, R.I. et al., 1992, GSC Open File Report 2484: 279-284.
[b]Davis, W. J. and Hegner, E., 1992. Contrib. Mineral. Petrol., 111: 493-503.
[c]Davis, W. J. et al., 1996. Chemical Geology 130, 255-269.
[d]Yamashita, K. et al., 1999. Can. J. Earth Sci. 36:1131-1147.
[e]Bleeker, W. et al., 1999a. Can. J. Earth Sci. 36: 1083-1109.
[f]Bleeker, W. et al., 1999b. Can. J. Earth Sci. 36: 1011-1130
[g]Bleeker, W., 2001. GSC Current Research 2001-C7.
[h]Grütter, H.S et al., 1999, Proceedings of the 7th international Kimberlite conference, 307-313.

BOVIE STRUCTURE AS A DECAPITATED THRUST BLOCK

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At surface, Bovie Structure is an isolated, 45 km long, resistant ridge of Mississippian Mattson and Flett formations surrounded by generally flat-lying Cretaceous strata. It extends a further 130 km to the south-southwest in the subsurface. It marks both the eastern limit of the thick Liard Basin and the abrupt eastern limit of thick Mississippian Mattson Formation strata.

Publicly available seismic across the area where Bovie Structure has surface expression provides evidence for a multi-phase development of Bovie (a.k.a. Bovie Fault Zone, Bovie Anticline, Bovie Trend). Removal of the horizontal Laramide component of deformation at Bovie reveals a pre-existing deep-rooted thrust block. The present day structure is therefore seen then as the product of a shallow Laramide detachment fault intersecting a pre-existing deep-rooted thrust block, decapitating its upper zone and then carrying this upper segment eastward and upward to its present location.

This interpretation is fundamentally different from a long-standing model that incorporated extension and a combination of west-dipping normal faults and prograding shelf edges.

Seismic sections image pre-Laramide shortening of bed-length and a west dipping monocline, with an east-plunging axial plane, within Devonian to Mississippian strata and the basement reflector. The monocline's east-dipping axial plane has been previously interpreted as evidence of a series of westward-prograding shelf edges on a subsiding margin. It is here interpreted as a product of compression rather than extension.

Structural restoration of the seismic by flattening shows no structural influences on deposition across the Bovie zone until possibly as late as immediately pre-Cretaceous time when a deep-rooted east-dipping thrust fault produced an uplifted hanging-wall block. Pre-Cretaceous erosion across this fault zone produced the abrupt eastward thinning of the Mississippian Mattson Formation that is found in the subsurface at Bovie today.

Laramide compression produced a shallow-detachment thrust in the upper Banff Fm that 'decapitated' the older hangingwall block. The severed block was then carried eastward approximately 4 km and upward to bring the sub-Mattson, Flett Formation to the surface where it today forms the present Bovie Anticline.

THE YELLOWKNIFE GREENSTONE BELT: A REVIEW OF ITS STRATIGRAPHY AND GEOMETRY, SLAVE PROVINCE, NWT, WITH EMPHASIS ON THE BANTING GROUP

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The Yellowknife greenstone belt has been extensively studied since it was first mapped by Jolliffe (1942). The interpretation of stratigraphic relations among the units has evolved considerably (e.g. Jolliffe, 1942, 1946; Boyle, 1961; Henderson and Brown, 1966; Hauer 1979; Helmstaedt et al 1980, 81; Easton and Jackson 1981; Helmstaedt and Padgham 1986). Recent field observations shed new lights on some of the stratigraphic relations.

The stratigraphic relations between the Banting Group and the Walsh and Burwash formations have been a subject of debate. Two major interpretations have been proposed to explain the present geometry, which consists of two packages of felsic volcanic rocks (Ingraham and Prosperous fm. of the Banting Group) with sedimentary rocks (Walsh Formation) in between: 1) the two felsic packages represents two opposing limbs on a syncline with the Walsh Formation in the core; 2) the sequence is an homoclinal sequence, east facing one with two cycles of felsic volcanism. Contrary to previous observations, the Walsh Formation is present both to the west and east of the Prosperous Formation and not only between the two Banting formations. We believe that the systematic repetition of the stratigraphy (Banting-Walsh-Banting-Walsh-Burwash) and the presence of ubiquitous sulphide-rich deformation zones along each contact result from either early tectonic juxtaposition (D1 or pre-D1?) or transposition and/or fold repetition (D2 and D3).

The Jackson Lake Formation unconformably overlies the Kam Group and is in faulted contact with the Banting Group. The formation was deposited syn- or post-D1, but prior to D2 regional compression in the Yellowknife greenstone belt. The fluvial-alluvial fan deposits, which are spatially associated with the Yellowknife River Fault Zone, may have been deposited in a fault-controlled basin (developed during D1?). However, it is possible that the spatial association with the fault zone is a result of later tectonic activity (D2), with the Jackson Lake Formation being preserved between the Kam and the Banting Group volcanic packages moving up relative to the formation.

The Kam-Banting Group contact, marked by an Archean high-strain zone (Yellowknife River Fault Zone), is partly covered by the late-Archean conglomerate of the Jackson Lake Formation (<2605 Ma.) and partly exposed at Quyta Lake. Where exposed, it is highly sheared and intermittently marked by a 10 m wide, strongly deformed conglomerate, which show all the generations of ductile structures (D1 to D4). This newly mapped unit is petrologically distinct from the Jackson Lake Formation and is a possible equivalent of the Raquette Lake or Detour Lake Formations (ca. 2680 Ma) documented in other greenstone belts of the Slave Province. It may represent a craton-scale marker horizon of 2690-2680 Ma.

HOPE BAY PROJECT UPDATE – WITH AN EMPHASIS ON THE DORIS NORTH AND REGIONAL DEFORMATION ZONE

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Prior to the 2002 drilling the Hope Bay project has measured and indicated resources of 3.36 million tonnes grading 15.4 g/t gold for a contained 1.66 million ounces, plus an additional 6.7 million tonnes grading 12.3 g/t gold, for an additional contained 2.65 million ounces of gold. Infill drilling in 2002 suggested that the mineralization at **Doris North** is narrower but higher grade than previously interpreted. Following completion of an infill-drilling program in 2002, geologic resources were updated as of August 2002 and a new mine plan for Doris Hinge completed. The results from this drilling have allowed an increase in the ounces in the updated mine plan to 323,900 ounces of gold for an additional 48,600 ounces of gold versus the resources contained in the mine plan outlined in the Preliminary Assessment announced February, 2002.

The more selective mining methods proposed in the new study are expected to result in higher per ton mining costs, which could be partially offset on a cost per ounce basis by the higher grade and increased number of ounces. A feasibility study is planned for completion by the end of 2002. Provided that the feasibility study is positive, and permits and financing are obtained in a timely manner, major equipment would be shipped to site in the summer of 2004 and production is targeted to commence by the end of 2004.

The **Deformation Zone** is a major structure that appears to be the locus for significant gold mineralization in the Madrid area, including the Naartok and Suluk deposits discovered in 2001, which added more than one million ounces of gold to the resource base at Hope Bay. With the discovery of gold in the Marianas and Rand Spur areas and the extension of the South Patch Zone to depth a series of deposits and gold occurrences have now been identified that extend over a 6km area from Naartok in the north, through the Perrin, Perrin Bulge, Matrim areas, the Suluk discovery of 2001 and now the Marianas and South Patch areas. The Nexus drilling opens up an additional 5km of favourable strike to the south.

A series of splays and parallel structures identified to the north and east of the Deformation Zone host the Perrin, Rand and Rand Spur areas and offers potential for other discoveries along this trend. A third trend has been identified 700m to the east at Spots, on the east shore of Patch Lake. Each of the gold deposits and occurrences in the Madrid area has its own unique characteristics, varying from shear-hosted to stock work or breccia-hosted gold mineralization. Most of the deposits are on or near the hanging wall of the Deformation Zone or one of the parallel structures or splays, except at the southern end of Suluk and at South Patch where mineralization is contained within the Deformation Zone. Many of the deposits, except South Patch consist of high grade cores surrounded by large halos of lower grade mineralization.

The presence of multiple gold deposits and gold occurrences in a variety of host rocks and geologic settings in several parallel structures suggests that the Deformation Zone and the other structures have served as important pathways for gold mineralization covering an area at least 11km long by 1km wide. With drilling to date generally targeting shallow levels, and with substantial portions of these structures as yet untested by drilling there is significant potential for additional gold discoveries in the Madrid area and that this area will be a major focus for future exploration programs.

RE-INTERPRETATION OF THE ICE-FLOW HISTORY WITHIN THE KEEWATIN SECTOR OF THE LAURENTIDE ICE SHEET: RESULTS FROM THE WESTERN CHURCHILL NATMAP PROJECT

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Recent systematic mapping of ice-flow indicators on bedrock in the Kivalliq Region of Nunavut (NTS 55J, K, L, M, N, O and 65I, P) as part of the Western Churchill NATMAP Project has provided new evidence for major shifts in ice-flow within the Keewatin Sector of the Laurentide Ice Sheet (LIS). Field measurements from over 700 sites have been recorded in the area. Indicators of paleo-flow thought to have been formed by the scouring action of sliding basal ice on bedrock include mainly striae, grooves, crescentic gouges and fractures, chatter marks, rat tails and roches moutonnées.

The record of successive glacial flow, as indicated by cross-striations and other evidence of multiple ice flows, is particularly well preserved under the area of the Keewatin Ice Divide (KID), which is the zone occupied by the last remnants of the LIS west of Hudson Bay. A sequence of five distinct regional ice movements was established in the Kivalliq Region based on the regional association of sets having similar trends and same relative age relationships. At least four of these regional ice-flow events occurred prior to the final decay of the KID. This suggests that the dispersal centre in Keewatin was a highly mobile feature with major southeastward and northwestward shifts at least up to 200 km on either side of its final axis. The relative chronology determined from these data indicate that the ice flow record is more complex than previously reported and challenges the view that the KID was a static, long-lived feature of the LIS in central Keewatin during the Late Wisconsinan. Although the lack of absolute chronological indicators is a major constraint on regional interpretation, a comparison between the geological record presented here with existing models on the history of the Laurentide Ice Sheet is discussed. This work also has implications for mineral exploration as it allows for re-interpretation of large erratic dispersal patterns, such as the Dubawnt dispersal train, and local scale glacial dispersal trains from mineralized bedrock.

HIGHLIGHTS OF THE COMMITTEE BAY DRIFT PROSPECTING SURVEY, CENTRAL MAINLAND NUNAVUT: IMPLICATIONS FOR MINERAL EXPLORATION

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As part of the Geological Survey of Canada Targeted Geoscience Initiative (TGI) in the Committee Bay supracrustal belt, central mainland Nunavut, Quaternary studies were carried out through the 2000-2002 field seasons. Objectives of the Quaternary component are to: 1) compile surficial geology 1:100,000-scale maps for NTS 56K, J/9-16, O/1-8 and 56P; 2) interpret the glacial history at local and regional scales; and 3) initiate a reconnaissance-scale drift prospecting program to support mineral exploration. Presented here are interpretations of ice flow indicators observed in the field during the 2000-02 seasons, results from selected till compositional datasets collected in NTS 56K, J/9-16 and O/1-8 prior to the 2002 season (McMartin et al., 2002), and implications for mineral exploration.

Within the Committee Bay study area, over 1400 measurements at 326 sites have been made on small-scale ice-movement indicators. Together with large-scale oriented features, these data suggest a complicated ice-movement chronology. Three main phases of ice movement have been identified at the regional scale. The oldest of the phases is characterized by a northward movement that is ubiquitous. This was followed by a northeastward phase that dominates the northeastern part of the project area (mainly NTS 56 O/5-8 and P/5-16). Finally, there is a north to north-northwesterly phase of ice movement that is confined to the southern two thirds of the area (NTS 56K, J, O/1-4 and P/1-4). This last phase of ice movement maybe associated with ice flow from the Keewatin Ice Divide, located immediately southeast of NTS 56K. In addition, minor, more local phases of ice flow that pre- and post-date the three main events have been identified throughout the area.

A total of 309 small till samples were analyzed for trace and major element geochemistry on selected fractions; 213 large till samples were processed for lithological determinations and gold grain counts. Highlights of the results that have direct implications for mineral exploration include: 1) till geochemistry reflects a clear northerly direction of glacial transport, forming ribbon- to fan-shaped dispersal trains, for example from distinctive komatiite rocks (i.e. Cr, Co and Ni) in NTS 56K; 2) the poor association of As with Au in dispersal trains prevents the direct use of As in till as a pathfinder element for gold in the region as there are very rare occurrences of arsenopyrite, except west of the central tonalite in 56K where As values confirm the presence of known arsenopyrite related gold showings; 3) the bulk of the gold occurs as free silt size particles in till, although some of the gold appears to be present as inclusions in sulphides (<2 mm); and 4) most of the known gold showings are reflected in the gold grain counts and/or the Au values in till, but at least two previously unknown potentially Au-rich domains are noted in NTS 56K and O.

DEVELOPING NUNAVUT'S FIRST DIAMOND MINE, TAHERA CORPORATION

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Tahera Corporation is focused on exploration and development activities in western Nunavut and the Northwest Territories. The company has recently announced its intentions to complete the environmental review for the Jericho Diamond Project located at the north end of Contwoyto Lake in the Kitikmeot Region of Nunavut. The combination of open pit and underground mining would result in a minimum mine life of 8 years for the Jericho Kimberlite, producing in excess of three million carats of diamonds over the life of the project. The potential to increase the mine life exists, as +1.5 million tonnes of kimberlite resource will be mined and stockpiled as part of the mine plan. A portion or all of this material may be converted to reserve following further analysis. The Jericho Project is the only advanced stage diamond development project in Nunavut.

Tahera Corporation's joint venture partners have also conducted significant exploration in Nunavut during 2002. On the Rockinghorse property, home to the Anuri kimberlites, Kennecott Canada Exploration Inc. (Rio Tinto PLC) continued to evaluate the significantly diamondiferous Anuri kimberlites and surrounding area. Early microdiamond results from the Anuri kimberlites indicate their strong economic potential. Ongoing analysis will determine when a larger sample will be extracted from the Anuri kimberlites. Kennecott will also continue to conduct extensive exploration work on unresolved anomalies on the Rockinghorse property.

The Corporation also has a joint venture agreement with BHP Billiton, which is focused on the exploration of the + 40 million tonne Ranch Lake kimberlite pipe in the NWT. BHP Billiton reported encouraging results from the Ranch Lake kimberlite exploration program in 2002. Pursuant to the joint venture agreement, BHP Billiton is required to commence the extraction of a 200 tonne sample on the kimberlite in 2003.

Tahera Corporation is also very active in exploration activities throughout the Slave Craton. Tahera will focus its exploration efforts in the vicinity of the Jericho Kimberlite, which will include locating unresolved sources of kimberlitic float and indicator mineral trains. The company will also be actively exploring the Hood River property, located 150km NE of the Jericho property. The Tenacity kimberlite was discovered on the Hood River property in 2000, and significant exploration potential exists on the property. The company has also been active in new acquisitions of property in the Slave Craton, which will result in increased grass-roots exploration in 2003.

AN UPDATE ON SOUTHERNERA RESOURCES LTD. 2002 DIAMOND EXPLORATION PROGRAM IN THE NORTHWEST TERRITORIES

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SouthernEra Resources Ltd. is currently focusing on three main diamond exploration projects in the Northwest Territories: the Yamba Lake Project, the Back Lake Project and the Misty Lake Joint Venture. In addition, the Company is also participating in the WO, Monument, Commonwealth and Lac de Gras Block projects located within the immediate Lac de Gras area.

The Yamba claim block is located between the northeast end of Yamba Lake and the southwest end of Fry Inlet, approximately 40 km northwest of the Ekati Mine. To date seven diamondiferous kimberlite pipes have been discovered on the Yamba Property. In spring and summer 2002 SouthernEra spent a total of C$800,000.00 on exploration including detailed ground geophysics and a 13 hole diamond drill program. Six of the 13 drillholes re-tested the known Sue, Sputnik and Eddie kimberlites. These pipes were discovered in 1993 and grade, geometry and size of these bodies were never determined accurately. The 2002 drill program yielded wider intersections and the microdiamond results after caustic fusion analysis from samples of the drill core of the Sue and Sputnik pipes returned higher counts in comparison to samples that were tested during 1993 and 1994.

The Back Lake Project area is located 250 km northeast of Yellowknife, NWT and extends between Munn Lake and Back Lake. The diamondiferous Munn Lake sill is located in the central part of the Property. Several kimberlitic indicator trains have been discovered over the last 2 years and the current exploration focus is to locate the primary kimberlite sources to the indicator trains. In 2002 SouthernEra completed a 112 line km ground geophysical program on 20 grids and a 1500 line km Fugro airborne survey on the Property. Several high priority targets were located and will be drill tested in 2003.

The Misty Lake Project area is located 100 km north of the community of Snowdrift NWT, approximately 40km southwest of the Kennady Project. Two distinct indicator mineral trains transect the northern part of the property. In the fall of 2001 a 2972 line km DIGHEM airborne survey was flown over the project area. As follow up SouthernEra Resources completed ground geophysics on 13 grids on the Property. Several high priority targets were delineated and await drill testing in 2003.

U-Pb ZIRCON AND Re-Os MOLYBDENITE AGES FROM THE RYAN LAKE PLUTON AND DUCKFISH APLITE: RESULTS, IMPLICATIONS, AND POTENTIAL OF THE Re-Os CHRONOMETER IN THE YELLOWKNIFE GREENSTONE BELT

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Numerous geochronological studies have been carried out on the Archean rocks in and around the Yellowknife Greenstone Belt (YGB). The most successful and widely applied dating method has been U-Pb zircon with lesser amounts of data derived from U-Pb titanite, U-Pb monazite, Ar/Ar (amphiboles and micas), and Pb-Pb (sulphide minerals). The data have been used to develop evolutionary models of the YGB, including the definition of the Central Slave Basement Complex and the Central Slave Cover Group, refinement of the Yellowknife Supergroup stratigraphy, and relationships of pre-, syn-, and post-deformational granitoid plutons. Unfortunately, the absolute timing of gold mineralization in the Yellowknife Gold Camp has remained elusive. In this study we contribute data that moves towards resolving this issue by presenting the first Re-Os molybdenite ages from the YGB and comparing them with two new U-Pb zircon ages.

The first case is from the Ryan Lake Pluton, a quartz diorite to granodiorite located 15 kilometres north of Yellowknife. The pluton intrudes the >2.72 Ga Kam Group mafic volcanic rocks and lies within the amphibolite-grade contact metamorphic aureole of the Defeat Plutonic Suite. U-Pb zircon analyses define a crystallization age of 2671 +6/-5 Ma for the quartz diorite. Quartz veining with molybdenite mineralization and elevated gold (270 ppb) developed during crystallization of the pluton. This molybdenite yields a Re-Os model age of 2672 ± 10 Ma. The U-Pb zircon and Re-Os molybdenite ages are within assigned uncertainty and support field observations that suggest: 1) the pluton is a previously unrecognized synvolcanic Banting Group intrusion; 2) elevated gold values within the molybdenite bearing quartz vein indicate a previously unrecognized impregnation of plutonic associated gold into the YGB at ~2670 Ma, and; 3) the Re-Os chronometer survived amphibolite-grade contact metamorphism associated with the Defeat Plutonic Suite.

The second case is from a 20 centimetre wide aplitic dyke near Chan Lake, 30 kilometres north of Yellowknife. The aplite intrudes the Kam Group mafic volcanic rocks and is interpreted to be sourced from the nearby Duckfish granite (2608 ± 3 Ma, U-Pb titanite[a]). The U-Pb zircon data suggests a crystallization age of 2611 ± 1.5 Ma for the aplite dyke. Abundant fine- to medium-grained molybdenite occurs within the aplite and yields a Re-Os model age of 2608 ± 10 Ma. The U-Pb zircon, U-Pb titanite, and Re-Os molybdenite ages are within assigned uncertainty, further confirming the validity of the Re-Os molybdenite chronometer. This also shows the Re-Os chronometer survived both the hematite alteration that accompanied intrusion of the aplite and regional greenschist-grade metamorphism that post-dated the intrusion.

Agreement of U-Pb zircon and Re-Os molybdenite ages indicates the later technique has potential for further application in the YGB. Although molybdenite is rare in the Yellowknife gold deposits, recent advancements in the Re-Os method have permitted ore deposits to also be dated via arsenopyrite and pyrite isochrons. This suggests that it may be possible to determine the absolute ages of the 'refractory' and 'free-milling' ores in the Yellowknife Gold Camp using the Re-Os chronometer.

[a]van Breemen et al. 1992. *CJES*, 29: 2186-2199.

DEVELOPMENTS IN GROUND GEOPHYSICAL TECHNIQUES FOR KIMBERLITE EXPLORATION

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In kimberlite exploration, ground geophysical surveys are normally run to precisely locate and further investigate airborne geophysical anomalies. The range of tools employed in these surveys has expanded from magnetics and FDEM to include TDEM, gravity, ground radar and seismic surveys. This paper describes gravity, capacitive-coupled resistivity and ground radar field procedures, and new processing possibilities for FDEM, gravity and magnetics. Gravity survey accuracy and efficiency has been revolutionized by the combination of high accuracy carrier phase GPS systems, digital terrain models for local topography and automated gravimeters. Crater and diatreme facies kimberlite pipes often display diagnostic negative gravity anomalies. False anomalies can be created by lakes filled with anomalously thick overburden, local geology changes and by applying incorrect bathymetric corrections. A strategy for dealing with the latter problem is described. Capacitive-coupled resistivity surveys are a recent innovation imported from Russia which permit direct measurement of apparent resistivity without electrical ground contact. Ground penetrating radar (GPR) surveys can be used to define the limits of a pipe at depths from 5 to 50 m once the target has been identified by other surveys and confirmed to be kimberlite by drilling. This information can be used to optimize drilling strategies. As a stand alone tool, GPR surveys are limited due to the presence of other reflectors which can produce signatures similar to those expected from the top of a kimberlite pipe. In some cases, conductive overburden can screen out even low frequency GPR signals and in others, boulders can disrupt the signal to the point where it is difficult to image the kimberlite beneath. In exploring for kimberlite dykes, GPR surveys are proving to be very useful because targets can be discriminated on the basis of geometry. Strategies for improving the efficiency of preliminary reconnaissance surveys are also discussed.

CARBONATE-HOSTED PB-ZN (MVT) POTENTIAL OF NORTHERN ALBERTA – SUMMARY OF 2002 CORE EXAMINATION PROGRAM

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The MVT Pb-Zn 2002 core program examined 9,000 m of carbonate core representing 120 wells from two study areas in northern and northeastern Alberta. MVT relevant diagenetic features such as saddle dolomite and collapse breccia were not identified. However, a one metre intersection in the Upper Devonian Jean Marie Member, Redknife Formation in well 4-3-100-7W5 at 256 m depth does comprise fault brecciated dolostone with fragments rimmed initially by pyrite, followed by coarse calcite. This well location coincides with a possible surface fault. Examination of cuttings from several other wells on-strike with this fault failed to find additional sulfides or late diagenetic cements. Nevertheless, this does not necessarily negate the possibility of MVT Pb-Zn mineralized intervals because the percentage of rock volume available for examination from core and cuttings is extremely small. Examination of any geophysical information available for the area of the well and fault is recommended.

SUSTAINABLE DEVELOPMENT IN THE MINERALS INDUSTRY: AN ACHIEVABLE GOAL

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The Global Mining Initiative and its Mining, Minerals and Sustainable Development project have served to focus the minds of industry on much broader issues than those traditionally considered in company board rooms. This process, initiated by the CEOs of several of the world's largest mining companies, has been embraced widely in spirit, but putting these ideas into action requires significant investment of resources and expertise. It has been argued that

such spending is a trade-off against profits, which, if true, would make this a hard sell to shareholders whose motive is maximizing their return on investment. But, I argue, this perception is wrong on at least two counts.

Firstly, carefully researched investments in sustainable technologies and practices can not only produce cost savings, but may in fact return direct profits. An example is the development of environmentally low-impact hydrometallurgical extraction techniques, which permit low cost treatment of previously uneconomic materials. Cost savings may also accrue from reduced exposure to risk, both in the short and long terms. Such risks (e.g., post-closure liabilities) should be factored into project cost analyses during feasibility studies, and demonstrated mitigation of such risks should be a requirement of project financing by responsible banks; it should also reduce insurance costs.

Secondly, there is a growing market for "ethical funds" among socially-conscious investors, and mining stocks currently do not fall into this category. Investment in a sustainable image for the industry may yet halt its decline in value on stock markets.

Additionally, a less obvious factor is the recruitment of highly qualified personnel, for whom the prospects of working in a "dirty industry" currently holds little appeal. Industry must attract and retain the best people if it is to be competitive and profitable.

No one doubts that the impact of the mining industry today is much lower than even 20 years ago (the Sudbury region is an excellent example), but public awareness of this impact, both on the environment and affected populations, is now much higher. A single mining accident, such as a tailings dam burst or a cyanide spill, while often having minimal lasting effect, can overnight negate a multitude of improvements and the cumulative record of safe operations globally. Moreover, the contribution that the mining industry makes to society in terms of economic growth and the provision of the raw materials needed for that growth are completely overlooked. We may feel that these images are unfair, but it is the perception that counts.

As geoscientists, we have a central role to play both in changing public perception through our teaching and outreach activities, but also in changing the way in which the industry operates in order unquestionably to justify that change in perception. We can do this by directing exploration to new, low-impact (e.g., low-sulfur) ore types, predicting the locations of high-value, low-waste deposits, contributing geological knowledge on the expected behavior of mined materials, and advising on the geological stability and behavior of remediated sites. More broadly, however, geoscientists must become actively engaged as experts informing dialogue and decision-making across the full range of economic, social, and environmental issues affected by mining.

COMPILATION OF AIRBORNE TOTAL FIELD MAGNETIC GEOPHYSICAL DATA FOR THE YELLOWKNIFE BASIN; NTS 85 I, J, O, P

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The aim of this project was to locate and compile all of the publicly available airborne magnetic geophysical surveys conducted in the Yellowknife Basin area, create a usable data set from the various surveys, and plot the result on a colour contour map. Industry data sets from the public domain were used and permissions for publication were obtained for as many privately held data sets as possible. The data have been corrected, compiled, merged, and leveled, producing a total field magnetic contour map printed on a base hydrology map.

The available data sets consist of twenty-six surveys flown over a period of forty years using various airborne platforms, sensor types and data reduction protocols. The data sets were acquired by Aurora Geosciences Limited in the most raw form possible. All data were then treated by similar data reduction and leveling algorithms in Geosoft montaj™ to help ensure standardization between the data sets. The detailed exploration survey data were then merged with, and leveled to, a regional GSC NATMAP data set, using the Geosoft montaj™ Gridknit™ utility. The resulting data set was projected in NAD 83 Canada Mean, UTM zone 12N projection for ease of use as the survey area straddles the 11N/12N zone boundary.

A colour contoured total field magnetic map with an index of the included surveys was produced and displayed for comment and discussion at the Yellowknife Geoscience Forum in November 2000. Refinement of the map in the filtering and leveling of the data was made based on comments and suggestions. An additional survey covering a substantial portion of the map area was also acquired, fitting well with the previously acquired data.

NORTH BAFFIN AND KEEWATIN LAND USE PLAN CONFORMITY DETERMINATIONS THROUGH THE PLANNER INTERNET PERMITTING SYSTEM IN NUNAVUT

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Development project proponents, including mineral exploration proponents, applying to operate in the North Baffin and Keewatin (Kivalliq) regions of Nunavut need to have their application checked for conformity with the active Regional Land Use Plan (LUP) in effect for that region. These LUP's were developed by the Nunavut Planning Commission (NPC) and approved by both the federal and territorial governments. Nunavut's inter-agency Internet permitting system, PLANNER, was developed to assist in expediting and coordinating the land and water use permitting system in Nunavut. The NPC has now utilized the PLANNER system to handle conformity determinations for these 2 regions – extending the functionality and scope of the PLANNER permitting system. The intent of PLANNER was always to provide a "one-window approach" to land and water use permitting in Nunavut. This latest development is an important advancement of that approach.

STRUCTURAL GEOLOGY OF THE COMMITTEE BAY AREA AND IMPLICATIONS FOR GOLD LOCALIZATION, WESTERN CHURCHILL PROVINCE, NUNAVUT

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The Committee Bay Targeted Geoscience Initiative project represents a multi-disciplinary GSC-C-NGO partnership to map the Committee Bay area, central Nunavut. The area is centred on a *c*. 300 km long belt of supracrustal rocks, the Prince Albert Group (PAG), that occur as coherent northeast-striking strands, up to 15 km wide, and as northeast-trending lithons in plutonic rocks. Current constraints on the Prince Albert group (see also Skulski et al., this volume) indicate a lower volcanic-dominated sequence of intercalated basalt and *c*. 2.732 Ga felsic volcanic rocks overlain by a substantial thickness (~300 m thick) of komatiite. An upper sedimentary-dominated sequence of psammite, semi-pelite and quartzite was deposited between *c*. 2.72 Ga and 2.711 Ga, constrained by an overlying intermediate tuff. The uppermost part of the supracrustal sequence contains minor komatiite, iron formation and younger, <*c*. 2.69 Ga clastic rocks, the latter which locally attains granulite facies. Oxide- and silicate-facies iron formation appears to have been deposited at two major stratigraphic horizons interpreted to reflect subaqueous hydrothermal systems active between, and after, *c*. 2.73 Ga and *c*. 2.71 Ga volcanism.

The Committee Bay area has been affected by two penetrative deformation events, polymetamorphism and localized shortening (folding ±shearing). D1 involved development of north-northwest-trending, likely west-vergent folds and associated LS fabrics that affect both PAG stratigraphy and widespread c. 2.6 Ga plutonic rocks. D2 structures dominate the area and, in particular, are localized within the supracrustal belts. They include northeast-trending folds (F2), northeast-striking transposition foliation (S2±S1) and shallowly (<34o) plunging stretching lineations (L2±L1). F2 folds are commonly upright to northwest-verging, and plunge both to the northeast and southwest. S2 (±S1) planes are mainly southeast-dipping, consistent with northwest-directed shortening during D2.

Reworking of D2 structures, through continued NW-directed shortening, occurs within two east-striking fault zones: the dextral, oblique-slip Amer fault zone in the southwest part of the area, and the dextral strike-slip Walker Lake shear zone through its center. In contrast, reorientation of D2 structures during layer-parallel NE-directed shortening is best developed in the northeastern part of the area, where conjugate kink-style F3 folds and NNW-striking faults are well developed.

Gold mineralization within the Committee Bay area is typically hosted by sulphidized oxide and silicate facies iron formation that comprises part of the upper c. 2.71 Ga supracrustal sequence. Detailed mapping and sampling from numerous gold occurrences along the belt has highlighted a further association between auriferous iron formation and polydeformed rocks. In these areas, gold is localized within D2 structures, such as hinge zones of shallow-plunging F2 folds and/or shear zones parallel to northeast-striking F2 axial planes. Geochronological constraints indicate these structures formed between c. 1.86 Ga and 1.82 Ga (see also Carson et al., this volume). These findings, and comparable relationships from the Woodburn Lake area (Meadowbank Gold Deposit) to the SW, suggest that Paleoproterozoic deformation has played a significant role in the localization of gold mineralization in the Committee Bay area, and elsewhere throughout the western Churchill Province.

OVERVIEW OF THE BEDROCK GEOLOGY AND REGIONAL SETTING OF THE ARCHEAN, COMMITTEE BAY SUPRACRUSTAL-GRANITOID BELT, CENTRAL MAINLAND NUNAVUT

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The multiyear Committee Bay Integrated Geoscience Project, operated through the Canada-Nunavut Geoscience Office and Geological Survey of Canada (Targeted Geoscience Initiative), has completed regional mapping of the Committee Bay belt and surrounding plutonic rocks exposed in the north-central Rae domain of the Western Churchill Province. The NE part of the area, the focus of this year's mapping, is underlain by amphibolite-facies supracrustal and granitoid units comparable to those observed along strike to the SW. The region is broadly subdivided into three crustal domains including: (1) an axial domain of greenschist- to amphibolite-facies supracrustal units of the Prince Albert group (PAg: ca. 2706-2732 Ma), cogenetic plutonic rocks and, an extensive, cross-cutting suite of late Neoarchean (ca. 2600 Ma) granitoids; (2) a northern, generally upper amphibolite-facies metasedimentary (<2698 Ma) and locally peraluminous granitoid domain (ca. 2580 Ma) and; (3) a southern granitoid domain comprising voluminous, ca. 2600 Ma K-feldspar megacrystic granodiorite and ca. 1820 Ma monzogranite. Overlying these sequences are rare synformal keels of Paleoproterozoic metasedimentary rocks inferred to be correlative with the Chantrey Inlet and Penrhyn groups exposed to the NW and E, respectively.

Three generations of structures are recognized regionally. D1, observed only in Archean rocks, records development of a strong, moderate to shallow, bedding parallel foliation associated with widely spaced, NNW-trending upright to overturned F1 folds. These structures may have formed at ca. 2580-2600 Ma, possibly in a fold and thrust-style setting. The later two events appear to be Paleoproterozoic in age as they are recorded in both Archean and Paleoproterozoic rocks. D2, broadly constrained to ca. 1825-1850 Ma (see Carson et al., this volume), involved the formation of tight, upright to overturned, NE-trending, NW-vergent folds, mainly developed in supracrustal rocks, and widespread development of a NE-striking, moderate to shallow SE-dipping, S2 (∀S1) transposition foliation. This was followed by the formation of dextral, E-striking ductile shear zones. D2 structures appear to represent the products of a deformation continuum and, like the D1 event, probably formed in a NW-vergent fold and thrust regime. On the basis of regional correlation, D3 likely occurred at ca. 1780 Ma and resulted from NE-directed shortening. This generated open warps of F2 folds and resulted in kilometre to tens of kilometre-scale, dome and basin style geometries.

Supracrustal rocks and cogenetic granitoids of the PAg may represent a Neoarchean rift sequence developed on cryptic older crust. These were deformed and metamorphosed at ca. 2600 Ma accompanying the intrusion of voluminous granodioritic magmas into the middle crust. The subsequent Paleoproterozoic deformation that resulted in the dominant NE structural trends and the dome and basin geometry of the region was synchronous with Trans Hudson orogenesis and is tentatively attributed to it's far field effects.

Th-U- TOTAL Pb DATING OF A POLYGENETIC LATE ARCHEAN TERRANE WALMSLEY LAKE AREA NTS 75N

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With the success of *in-situ* chemical Th-U-total Pb dating by electron microprobe well established, a focused study was undertaken to address timing of polymetamorphism in the Walmsley Lake area of the Eastern Slave Province.

Regional bedrock mapping of supracrustal rocks in the Walmsley Lake area has identified 4 deformation events[a]. In conjunction with bedrock mapping, detailed mapping was completed on a paragneiss unit located south of Walmsley Lake. Metamorphism and deformation are interpreted to have occurred at mid-crustal levels. Metamorphic monazite grains within the paragneiss were analyzed *in-situ* using the electron microprobe.

Petrographic criteria based on monazite grain / fabric relationships allowed resolution of two separate ages. A ca. 2585 Ma age, prevalent in grains oriented parallel to the foliation, represents peak metamorphism and is identical to ages obtained using conventional isotopic dating. This age also corresponds to peak metamorphism in mid to lower crustal levels as identified throughout the southern Slave. A ca. 2555 Ma age is prevalent in grains oriented at a high angle to foliation. The post-peak metamorphic age, representing either a subsequent or prolonged metamorphic event, has previously been identified only in lower crustal sections of the Western Slave.

In addition to metamorphic ages, the study also identified monazite dated at ca. 2740 Ma, older than the oldest rocks yet known in the Eastern Slave Province. It is interesting to note this detrital grain approximates the age of tholeiitic sequences associated with break-up of the Central Slave Basement Complex (ca.2.73-2.70 Ga[b]), and a thermal event recorded in basement gneisses at MacKay Lake (ca. 2723 Ma[b]). Currently, the easternmost limit of Central Slave Basement Complex, based on isotopic data lies about 100 km west of the study area[c].

[a]MacLachlan et al., GSC Current Research 1-C, 2002.
[b]Bleeker et al., CJES V. 36, 1999 pp. 1083-1109.
[c]MacLachlan et al., Yellowknife Geoscience Forum Abstracts, 2001.

AN OVERVIEW OF THE JOINT GSC/C-NGO CENTRAL BAFFIN INTEGRATED GEOSCIENCE PROJECT

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The joint Canada-Nunavut Geoscience Office/ Geological Survey of Canada multidisciplinary geoscience project completed the third of three planned summers of fieldwork in 2002. Preliminary results from the bedrock and surficial mapping, geophysical (MT, teleseismic, gamma-ray spectrometric), geochronological, and 3-D modeling components are now available. Readers are directed to companion presentations for further detail on many of these components. Six graduate and numerous undergraduate theses that address a variety of themes, including regional metamorphism, structure, volcanic geochemistry, sediment-hosted mineralization and isotopic evolution of Paleoproterozoic clastic sediments are ongoing.

The project area contains orthogneisses and metasedimentary and metavolcanic rocks (Mary River group) that comprise the southern edge of the Archean Rae craton. These are overlain by the south-facing continental margin rocks of the Paleoproterozoic Piling group. The area is situated on the northern margin of the eastern segment of the ca. 1.8 Ga Trans-Hudson Orogen, a Himalayan-scale collisional mountain belt exposed from Greenland in the east, across Baffin Island and beneath Hudson Bay, to Manitoba and Saskatchewan in the west. The central part of the study area is underlain by siliciclastic, carbonate and mafic volcanic rocks of the Piling Group, rocks that have elevated potential for MVT, SEDEX, magmatic Ni-Cu-PGE, and Broken Hill-type Pb-Zn-Ag deposits. Various felsic plutonic rocks of the 1.86-1.85 Ga Cumberland batholith are exposed in the southern part of the area. Bedrock mapping efforts concentrated in the northeastern part of the area, completing systematic 1:100,000-scale coverage of NTS 37D and the west half of 27C, focused on refining the stratigraphic relationships within the Piling group in order to provide an improved context for mineral exploration. U-Pb geochronological investigations are underway to characterize the ages of formation, deformation and metamorphism of rocks across the area, as well as the provenance of detrital material that comprise both the Archean and Paleoproterozoic successions.

Surficial materials mapping concentrated on completing a transect of the eastern part of the area (NTS 27B, 27C) in order to interpret the glacial geology, distribution and nature of materials, determine ice flow directions and dynamics, the chronology of glaciation and deglaciation, and investigate sea level changes. A till geochemistry sampling program is underway, focussing on regional backgrounds, changes over the Piling Group, and correlation of till and lake geochemistry.

NUNAVUT MINING AND EXPLORATION OVERVIEW 2002 - TALK

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Exploration expenditures are expected to rise above last year’s $60 million mark, as a result of the staking rush of last winter, but metal production will decrease due to of mine closures.

Two of Nunavut's three mines closed this year. The Polaris zinc-lead mine ceased operations at the end of August due to orebody exhaustion, and the Nanisivik zinc-silver mine closed a month later due to low zinc prices. Both mines have begun reclamation activities. The Lupin gold mine remained operational but encountered lower grades that impacted on overall production.

Three projects are now in the environmental screening process. Miramar Mining's Doris Hinge gold mine will undergo a NIRB-led "Part 5" screening, while a ministerial decision is awaited on the level of screening required for the proposed Bathurst Inlet Road and Port development. Tahera Corporation has announced its intention to resume permitting of the Jericho diamond mine.

Diamond exploration took place right across the territory, but was most intense in the western Kitikmeot, between Kugluktuk and Lupin, where the diamond-bearing Anuri, Potentilla, and Artemisia kimberlites were discovered in 2001. Additional kimberlites were discovered by diamond drilling, and a number of newly staked properties were the focus of geophysical surveys, prospecting, and till sampling. Further north on Victoria Island, Diamonds North discovered several new kimberlites on its land package. Further east, Shear Minerals and Northern Empire Minerals reported finding kimberlite float in two locations on their ground near Rankin Inlet. Diamond exploration on Melville and northern Baffin Island was undertaken by Twin Mining, Kenncott Canada, De Beers, Stornoway Ventures, and Northern Empire Minerals.

Metal exploration included further work in the Hope Bay area by Miramar Mining and Kinross Gold's drilling at the Goose Lake deposit. Wolfden Resources encountered high-grade base metal intersections in its drilling at the High Lake deposit. In the Kivalliq, Cumberland Resources has initiated a feasibility study on its Meadowbank gold project, while Starfield's Ferguson Lake nickel-copper-PGE project encountered new zones of PGE-rich mineralization. Further north, Falconbridge and BHP explored on the Melville Peninsula; BHP also continued to examine prospecting permits on central Baffin Island.

GEOLOGIC AND GEOCHRONOLOGIC CONSTRAINTS ON THE TIMING OF MINERALIZATION AT THE NANISIVIK MINE, NORTHERN BAFFIN ISLAND, NUNAVUT

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The Nanisivik mine is located on Borden Peninsula, northern Baffin Island, about 750 km north of the Arctic Circle. The mine has been in operation since 1976 and has recently closed in the fall of 2002; having produced about 19 million tonnes of ore grading 8.7% Zn, 0.69% Pb and 41 g/t Ag. These base metal ores were produced from sulphide bodies that collectively total over 100 million tones of pyrite.

The Nanisivik mine is hosted by Mesoproterozoic sediments of the Bylot Supergroup, that rests unconformably on Archean to Proterozoic Rae Province basement complex of granites and gneisses, part of the Mary River Group. The sulphides at Nanisivik are hosted in petroliferous dolostones of the Society Cliffs Formation. Three subdivisions of the host formation have been identified and known sulphide deposits are hosted exclusively by the upper and uppermost middle subdivisions. A series of, long lived, east-west trending normal faults, some of which are syn-sedimentary, divide the Nanisivik area into a series of horst and grabens. The strata have also been folded into broad, open north south trending folds. All known sulphide bodies are associated with normal faults, particularly where they cut antiform fold axes.

The geometry of the main sulfide body clearly shows that sulfides were emplaced post-tilting and folding of the host strata. The sulfides show no displacement across the Keystone fault, although the fault has displaced the host stratigraphy by about 150 metres and likely has displaced the mine dyke by 10's of metres.

The main lens is bisected by the Mine Dye, a Franklin aged diabase (~723 Ma). This association has previously been used as a minimum age for sulphide emplacement. Recent mapping at the deposit has recognized a 2-3 meter wide alteration selvage to the Mine Dyke. This selvage is progressive and dominantly adularia indicating that the dyke has been subjected to hydrothermal alteration. An Ar-Ar age on this alteration assemblage indicates a mid-Ordovician age of mineralization. Textural evidence suggests that the adularia is syn-sulphide formation. In addition a second occurrence of adularia in the mine, that represents altered siliclatsic sediments shows a similar Ar-Ar age. These ages are supported by Rb-Sr systematics from sulphide mineral separates.

A mid-Ordovician age for sulphide mineralization is somewhat problematic in terms of identifying regional events to drive a hydrothermal system of the magnitude required to produce Nanisivik. During the early Paleozoic, the Nanisivik area was a stable carbonate platform. However, in the middle Ordovician anomalously thin stratigraphic sections indicate that the upper contact of the Ships Point Formation is a disconformity; attributed to uplift of the Navy Board high. Localized uplift may have been sufficient to initiate a gravity-driven fluid flow system. The local structural and stratigraphic framework, including antiform hinges, gas-water interfaces, normal faults controlled sulphide deposition.

D_1 (EXTENSION) AND D_2 (COMPRESSION) RELATED ROTATION AND STRATIGRAPHIC OFFSET OF THE YELLOWKNIFE GREENSTONE BELT: EVIDENCE FROM THE GIANT AND CON GOLD DEPOSITS

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The Giant and Con gold deposits represent a world-class Archean gold deposit, now offset by the Proterozoic West Bay fault. Giant and Con are hosted in deformation zones that cross-cut the stratigraphy of the Yellowknife Bay Fm., Kam Group, Yellowknife Greenstone belt (YGB). The deformation zones change in fault order across the YGB, related to the difference in structural height now preserved in segmented Proterozoic fault blocks (1st / 2nd order at Con, 3rd order at Giant, and 4th order at Crestaurum).

The Kam Group around Giant and Con displays evidence of two stages of rotation: 1) pre-Jackson Lake Fm. (D_1?) that formed the Jackson Lake Fm. angular unconformity[a]; and 2) post-Jackson Lake Fm. (D_2?) that steepend the entire stratigraphy of the Yellowknife Greenstone belt including the Jackson Lake Fm. (JLF). Giant and Con both display two phases of deformation that are related to the two stages of stratigraphic rotation: D_1 early extension, and D_2 compression (D_2 flattening: Giant; D_2 reverse-dextral shear: Con).

Both Giant and Con display evidence of D_1 extensional deformation synchronous with the early rotation of the YGB, and the formation of the JLF scarp surface. Giant and Con deformation zones and the JLF unconformity display a similar strike and truncation of Kam Group stratigraphy suggesting a genetic link. The Giant and Con deformation zones also offset the Kam Group as shown by their offset of the Townsite Fm. The Campbell zone at Con (NW dip) and the ASD zone at Giant (SE dip) display an opposing offset of the Townsite Fm: ~1,500 foot sinistral separation at Giant and ~1,000 foot dextral separation at Con. D_2 to D_4 deformation displayed at Giant and Con cannot account for this offset. For example, a calculation of the D_2 offset of the Townsite Fm. by the Campbell zone can be obtained using the present position of the metamorphic isograds and the Townsite Fm. in the Campbell zone hangingwall and footwall, and the average L_2 lineation. The L_2 lineation represents the transport direction of the hangingwall over footwall. A reconstruction of the metamorphic isograds across the Campbell zone shows that the hangingwall Townsite Fm. contacts has moved south ~4,000 feet relative to the footwall contacts during D_2. Therefore, prior to D_2, the Townsite Fm had a dextral separation across the Campbell zone of ~5,000 feet, related to early D_1 extensional offset. This would account for the opposing separation of the Townsite Fm. by the ASD and Campbell zones given their difference in orientation.

D_1 fabrics are preserved locally within the Giant deposit, where prograde metamorphism only reached greenschist grade and the transposition of D_1 fabrics by D_2 was not as intense as at Con. At Giant the enveloping surfaces of F_2 folds in S_1 have shallow dips compared to the steeper deformation zone boundaries, indicating D_1 was extensional.

Bulk rotations of the YGB stratigraphy display the possible geometry of the deformation zones prior to D_1 (pre-JLF) rotation and D_2 (post-JLF) rotation. D_2 rotation was removed by rotating the JLF back to paleo-horizontal. D_1 rotation was removed by then rotating the Kam Group back to paleo-horizontal. This does not account for any effects of internal strain within the YGB.

Prior to D_2 the Campbell zone (Con) dipped moderately east and the ASD zone at Giant dipped shallowly south-west. Significantly, the Yellowknife River Fault zone (YRFZ) dipped north-east, overlying the JLF. The JLF unconformity and associated YRFZ form the boundary between the Kam Group to the west and the Banting Group to the east. In the YGB the two Groups are never observed in true stratigraphic contact (V. Jackson, pers. comm. 2002). Kam Group and the Banting Group geochemistry is different[b] and during D_2 the YRFZ was reactivated as a reverse deformation zone[a]. Therefore, the YRFZ may represent the suture where the tectonic juxtaposition of the Kam Group and the therefore allochthonous Banting Group occurred.

[a]Martel, E., Lin, S. and Bleeker, W. 2002. The Yellowknife River Fault Zone; its kinematics, and implications for the tectonic evolution of the Yellowknife Greenstone Belt, Slave Province, NWT. 47th Annual GACMAC meeting, program and abstracts.
[b]Cousens, B.L. and Falck, H. 2002. Geochemistry and origin of the Banting Group, Yellowknife Greenstone Belt: A mafic crust melting event in the Southern Slave Province. 47th Annual GACMAC meeting, program and abstracts.

PETROGRAPHY AND GEOCHEMISTRY OF THE NICHOLAS BAY KIMBERLITE, LAC DE GRAS KIMBERLITE PROVINCE, NWT

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The Nicholas Bay kimberlite, belonging to the Lac de Gras kimberlite province, is located on the northwest shore of Aylmer Lake, near the eastern margin of the Slave Province. It represents the eastern most diamond-bearing kimberlite in the Slave Province. Shear Minerals Ltd. has been an active partner (with Diamondex Resources Ltd.) at the Aylmer Lake property since February 2002 and has donated samples, geophysical data and spatial data for a B.Sc. Thesis at Queen's University (Adam Simmons, Dr. H. Helmstaedt and Dr. K. Kyser). The kimberlite body is dyke-like, and drilling suggests that the shape of the intrusive complex resembles a kimberlite root zone. Two distinct kimberlite phases have been have been identified from drill core: I) a tuffisitic kimberlite breccia (TKB) phase containing numerous xenolithic fragments, and II) an olivine macrocrystic hypabyssal phase. Each of these phases may contain a wide range of textures.

The scope of the project is to describe the petrography and to characterize the geochemical features of the kimberlite complex. Samples include a complete section from drill hole AD2-1-2, as well as representative samples from other drill holes. The TBK phase is a pale green, brecciated soft rock with abundant exotic fragments (i.e. granitic rocks, metasedimentary rocks, pegmatites, quartz, serpentinite, well-rounded older kimberlitic phases and calcite-filled vesicles. The hypabyssal phase is a darker green, dense (competent) rock that lacks large xenolithic phases. Common to the hypabyssal phase are calcite-filled vesicles, large (up to.75-1cm) rounded olivine crystals (commonly serpentinized), dark 1cm fragments of an undefined material and a very fine-grained serpentine-phlogopite-calcite matrix.

Currently, petrographic analysis is underway and the tentative plans for the geochemical follow-up are as follows: I) Whole rock analysis; II) Mineral Chemistry (potentially pyrope garnet, chrome diopside, olivine, picroilmenite and chromite). The samples will be analyzed by both ICP-MS and electron microprobe.

The expected completion of this project is spring of 2003. Improved understanding of the petrographic relationships and geochemical characteristics of the Nicholas Bay kimberlites should help guide further exploration in the Lac de Gras area and further clarify the emplacement mechanisms of the Nicholas Bay kimberlite.

U/Pb AND Ar/Ar GEOCHRONOLOGICAL CONSTRAINTS ON THE TIMING OF VOLCANISM, SEDIMENTATION, PLUTONISM, AND TECTONOTHERMAL ACTIVITY IN THE COMMITTEE BAY AREA, NUNAVUT

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Geochronological studies aimed at constraining the timing of volcanism, sedimentation, plutonism and tectonothermal history have provided significant insight into the evolution of the Committee Bay area in the western Churchill Province. Archean supracrustal rocks of the Prince Albert Group (PAG) in this area include a lower sequence of basalt interbedded with felsic volcanic rocks, overlain by komatiite and komatiitic basalt; and an upper sequence of pelite, psammite, iron formation, quartzite, intermediate volcanic rocks, late komatiite and younger semipelite and wacke. Basaltic and komatiitic volcanism occurred between 2732 +8/-3 Ma (rhyolite lapilli tuff) and 2718 +/- 2 Ma (crosscutting tonalite). Quartzite in the upper sequence was deposited between 2722 +/- 11 Ma (detrital zircon) and 2711 +/- 3 Ma (overlying intermediate lapilli tuff). Older detrital zircons in quartzite have ages of c. 2745 to 3730 Ma. Upper PAG wacke was deposited after 2691 +/- 16 Ma, but prior to 2580 Ma (crosscutting granodiorite). Thin remnants of Paleoproterozoic sedimentary rocks, locally in tectonic contact with the PAG, include quartzite with detrital zircons that range in age from 2496 +/- 13 Ma to as old as 3560 Ma.

The PAG and associated synvolcanic plutons are cut by widespread, voluminous, 2610-2593 Ma granodiorite and tonalite plutons (lesser quartz diorite and monzogranite). The southeastern margin of the granite-greenstone terrain is dominated by the 2610 +/-4 Ma Walker Lake complex, a NE-striking, 300 km long, K-feldspar megacrystic, biotite-hornblende-magnetite granodiorite batholith.

Three phases of regional deformation are recognized in this area (Sanborn-Barrie et al. and Sandeman et al., this volume). D1 is <2600 Ma and is characterized by shallowly to moderately dipping, northwest-striking bedding-parallel foliation, and north-northwest-trending folds. D2 is characterized by northeast-striking, steeply to shallowly dipping folds and fabrics and is bracketed between c. 1850 Ma (syn- to pre-D2 monazite; Carson et al. this volume) and 1821+/- 5 Ma (post-D2 monzogranite). East-striking dextral shear zones rotate and transpose D2 structures. D3 deformation involved variably developed open folding possibly at c. 1780 Ma.

The timing of metamorphism is constrained by metamorphic zircon with ages of c. 2580 Ma and 1850 Ma, and by monazite with ages of c. 2350 Ma, 1850 Ma and 1780 Ma (Carson et al. this volume). Monazite at 1850 Ma coincides with D2 deformation fabrics that formed regionally under lower- to upper-amphibolite conditions. 1780 Ma monazite formed at lower-amphibolite to lower-granulite facies.

Argon-argon age spectra of igneous hornblende have flat to locally disturbed (excess Ar) profiles with plateau ages of c. 1780-1765 Ma (plateau ages of biotite and muscovite are 1730-1700 Ma). The absence of a pre-1780 Ma history in the Ar/Ar age spectra of hornblende indicates regional-scale, complete isotopic resetting of Ar (T>Tc of 450-525 degrees C) during 1780 Ma metamorphism.

MASS WASTING STUDIES AND THEIR APPLICATION TO RESOURCE DEVELOPMENT IN THE LA BICHE RIVER MAP AREA (NTS 95C), SOUTHWEST NORTHWEST TERRITORIES

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Mass wasting (including landslides) is widespread and ongoing throughout the study area, and represents a significant hazard to existing and future natural gas and other resource development. The nature and distribution of mass wasting in bedrock appears to be strongly correlated with specific rock types and geological structure. Poorly-indurated sandstone and shale members of the Lower Carboniferous Mattson Formation, and Permian Fantasque and Tika formations, are highly susceptible to aeolian, solution and periglacial weathering. The beds of these formations are moderate to steeply dipping (25-74°) along the flanks of the Liard, Kotaneelee, and La Biche ranges, and slumps and rock slides are prominent (many >5 km^2). In places, bedrock slumps/slides have initiated a cascade series of failures, triggering extensive debris slides and flows in overlying Quaternary sediment that extend up to 12 km downslope.

Within the north-south oriented valleys between ridges, ice and deglacial rivers have carved a series of peneplains into moderate to shallow-dipping (20-6°) shale, siltstone and sandstone of the Lower Cretaceous Sully Formation through to the Triassic Toad-Grayling Formation. Slumping and debris flows are extensive along the face of these peneplains. Other mass wasting in these strata tend to be smaller, more shallow-seated slumps, generated by undercutting along modern stream and river courses.

Mass wasting in Quaternary material is most commonly associated with thick accumulations of till and glaciolacustrine sediment in the valley bottoms. Areas of discontinuous permafrost and massive ground ice are also found in the study area, and are particularly sensitive to disturbance.

Recent activities have focused on integrating 1:50 000 scale maps of surficial geology (including evidence of mass wasting) with bedrock geology maps. This has permitted the identification of areas of significant landslide-bedrock geology association. It also serves as a basis for hazard classification of an area, which should be integrated into future development plans.

MANTLE LAYERS IN THE SLAVE CRATON

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Four years of recording global earthquakes using a broadband seismometers located near the Ekati diamond mine can be analyzed by several independent techniques to reveal information about layered structured within the mantle of the central Slave craton. Variations with earthquake azimuth in the arrival of SKS phases can be most easily modeled by assuming two distinct layers of anisotropy (seismic fabric or grain) within the lithosphere. The lower layer probably lies in the mantle and the anisotropy aligns with both North American plate motion and the strike of mantle structures identified by previous conductivity and geochemical analyses, at ~N50°E. The upper layer is more varied and hypothesized to result from regional fold structures in the upper crust; that are distinct from the mantle trends.

Joint deconvolution of P- and S-waves from several earthquakes located at the same general azimuth reveals discontinuities in seismic wave velocities or density below each seismic station. Traditionally, the sharp increase in both velocity and density at the Moho (roughly base of the crust) is the most prominent of these discontinuities. Its depth varies between 37 and 42 km near Ekati. Unusually, equally prominent discontinuities at 90-100 and 140-150 km depth indicate a layer of low velocity between these depths. These depths coincide with a very prominent regional conductor identified by recent magneto-telluric studies (A. Menzel-Jones) and an ultra-depleted harzburgite layer identified from studies of garnets extracted from xenoliths in kimberlite core (W. Griffin). The 95- and 145-km discontinuities are not typical of cratons globally; similar features are observed beneath the Yellowknife area and are there interpreted as a relic Proterozoic subduction or underthrust zone. One of these subduction zones may extend NW into the Ekati area or Ekati may be underlain by an older (2.6Ga) convergent zone. Another discontinuity is recognized globally and throughout the Slave craton at about 410 km depth. Beneath Ekati this feature is especially shallow (400 km) and thus may provide clues about the thermal state of the mantle at this depth, the hypothesized source region for Ekati kimberlites.

The seismic results aid us in constructing a NW-SE cross section of the Slave craton from the surface to 700 km depths and relate it to surface geology and other geophysical and petrological constraints on mantle composition. Continuing recording of earthquakes at 18 stations will enable other techniques and provide 3-D structure as well.

COASTAL STABILITY IN THE BEAUFORT SEA/MACKENZIE DELTA REGION

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Recent oil industry activity in the Mackenzie Delta region of the Canadian Beaufort Sea has resulted in new demands on regulators to develop a framework for managing the coast. This requires updated data on coastal dynamics in the region. The Beaufort Sea coast is transgressive with typical average shoreline recession rates in the range of 1-2 m per year, however rates are known to be very variable both in space and in time. Past efforts used analog methods to analyze coastal change on a regional basis by comparing features on air photos taken in the late 1940s and early 1950s with an air photo survey from 1972. Since then regional air photo surveys were flown in 1985 and 2000. The 2000 survey used differential GPS for positioning and is therefore the most accurate base map available for updating measurements of coastal change. Digital orthoimages of the 2000 photos at a resolution 1.25 m were used to georeference 1985 photography and the shoreline and cliff edges were digitized for both years. Root mean square errors and comparison of features which were known to remain constant indicate that georeferencing was accurate to within 10 m. Measurements of coastal change were made every 100 m along the 2000 (Y2K) shoreline. Shoreline change along the exposed coastal areas varied from –338 m to +68 m (negative change refers to retreat or erosion) over the 15 year period. Much of the exposed coastal regions are experiencing average erosion rates of –1 to –5 m a^{-1}. A large zone of stable coast line is associated with an intertidal sand flat deposited in the lee of several islands at the mouth of one of the major Mackenzie distributaries. The nearshore in this region is shallow (< 2 m) and a series of 5 or more shoreface bars create an extremely dissipative environment despite exposure toward the NW storm direction. The highest rates of retreat (> 10 m a^{-1}) are associated with spits or low tundra bluffs which are directly exposed to waves and storm surges caused by the northwesterly wind storms. Shoreline retreat rates are also quite high (5-10 m a^{-1}) in areas where coastal mapping has identified high ground ice content. Long-term coastal retreat rates from this study are similar to previous estimates for the period from 1947-1972. This suggests that there are no long-term trends. However, detailed mapping at Tuktoyaktuk, North Head and the modern Delta front reveal variations in the magnitude of shoreline change for different shore types in responses to storms. Low delta bluffs composed of silt and peat erode at relatively high rates from year to year, whereas higher cliffs composed of frozen and sometimes ice-rich sand are relatively stable except during severe events.

HYDROCARBON EXPLORATION IN THE *NEAR NORTH* MACKENZIE AND LIARD VALLEYS, NWT

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The sedimentary rocks of the Northwest Territories (NWT) mainland are nominally a northern continuation of the Western Canada Sedimentary Basin. However, in many geological aspects, they constitute a different hydrocarbon province. The Mackenzie-Liard Valleys region has a series of superimposed sedimentary basins formed over the last 1,000 million years. The total thickness of the sedimentary section available for hydrocarbon generation and trapping has been previously underestimated.

Many of the Mackenzie-Liard superimposed basins have established hydrocarbon systems. Stacked reservoir rocks, trap seals and source rocks have been identified. A number of profound angular unconformities complicate the generation, timing and migration of hydrocarbons in the Paleozoic rocks. Early hydrocarbon generation requires early trapping and/or remigration into later traps.

Plate tectonic re-constructions, stratigraphic columns, time sequence maps, cross-sections, and Lopatin (burial history) plots illustrate critical exploration concepts.

METAMORPHISM AND GOLD EXPLORATION IN GREENSTONE BELTS FROM YELLOWKNIFE TO ABITIBI

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As ore deposits become more difficult to find, the importance of understanding all aspects of their geological setting increases. The fact that the textures and mineralogy of most rocks in greenstone belts have been completely transformed by changes in temperature and pressure during formation of the belt is often ignored. The full potential of applied metamorphic petrology as an exploration tool has yet to be realized.

Mapping of metamorphic data and application of concepts derived from metamorphic petrology contribute directly to the development of gold and base metal exploration models in four key areas. First, metamorphic mineral assemblages and textures constrain the timing, duration, and depth of deformation and plutonism, important factors in the formation of many ore deposits. Second, mapping and petrography provide a way of identifying original rock types, stratigraphy and halos related to pre-metamorphic hydrothermal alteration. Third, definition of the distribution and intensity of "background" metamorphic grade defines the limits and nature of alteration associated with syn- and post-metamorphic shear zone-hosted gold mineralization. Fourth, thermal anomalies outlined by the regional metamorphic pattern are prospective because they form around plutons or structures that can disrupt and focus flow of heat and mineralizing fluids.

A belt-scale study of metamorphism in the Yellowknife Greenstone Belt and a pilot study in the Ontario segment of the Abitibi Greenstone Belt illustrate the application of metamorphic data and concepts to gold exploration. Integration of metamorphic data with the results of geochemical and geophysical surveys and detailed lithologic and structural mapping outline a multi-parameter target area north of Yellowknife. Regional petrography across nine townships in northern Ontario mapped a variety of prospective metamorphic targets. Application to an Ontario-Quebec greenstone belt of expertise developed in the Slave Province revealed an isograd not previously mapped in either domain. The exploration potential of this metamorphic boundary in the NWT and Nunavut should be evaluated. The Yellowknife EXTECH III Project (Geological Survey of Canada – Resources, Wildlife and Economic Development (NWT) - Indian Affairs and Northern Development Canada – Miramar Mining Corporation) and the Collaborative Project Agreement (Ontario Geological Survey - Placer Dome Limited) demonstrate the value of technical and financial collaboration between government and industry in attempts to facilitate mineral exploration.

GREAT SLAVE REEF (GSR) PROJECT DRILLHOLE DATABASE (NTS 85B11 TO 14)

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The start of production at Pine Point mine in 1964 sparked a staking rush of the surrounding land. In 1966, Pyramid Mining discovered two ore bodies (X-15 and W-17) to the south of the Pine Point Property. Inspired by such discoveries, Westmin Resources Limited (operator), in association with Du Pont of Canada formed a joint venture exploration program in 1975 (joined by Philipp Brothers in 1977), that began to explore for carbonate-hosted lead-zinc mineralization along the barrier, to the west of Buffalo River. The area, which was systematically explored by the joint venture group until 1984, identified seven deposits. All of the identified deposits are located along the Main Trend; a term coined by Pine Point Mines to delineate a trend of ore bodies to the east of Buffalo River. All ore bodies discovered by the joint venture group were determined through drilling to conform to prismatic or tabular morphologies. As a group, the seven deposits had a drill indicated tonnage of 7.3 million metric tonnes grading 7.26% Zn and 3.59% Pb at a cut of 2% Pb+Zn. During this time, close to 900 drillholes were drilled by the joint venture that totalled approximately 500 000 feet, with total program expenditures in the nine million dollars range. These lead-zinc deposits were never mined.

This CD compilation includes the locations of the 900 drillholes in GIS format (ArcView), geochemical core (Pb, Zn, Fe, Sr, Ba, B) data (Excel and dbf format) and drill logs (in pdf format), and over 220 scanned cross-sectional and plan view (geochemical and drill collar location) maps (pdf). Other highlights of this compilation are historical reports that address the exploration potential of the area through integrated approaches, a journal publication that provides ore-reserve calculations for the R-190 and X-25 deposits, and the final joint venture report on the area released in 1989. The information presented in the CD was provided by Boliden as a contribution to the Targeted Geoscience Initiative titled "Potential for carbonate-hosted Pb-Zn (MVT) deposits in northern Alberta and southern NWT"; a collaborative project between C.S. Lord Northern Geoscience Centre, the Geological Survey of Canada, and the Alberta Geological Survey.

REGIONAL STRUCTURAL STUDY OF THE HAY RIVER AREA, NORTHWEST TERRITORIES; WITH EMPHASIS ON PINE POINT OREFIELD

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A regional reconnaissance survey of structural features was undertaken in the area south of Great Slave Lake, Northwest Territories by the C.S. Lord Northern Geoscience Centre during the 2002 field season. A key aspect of the survey was to study the open pits at the Pine Point lead–zinc minesite and to evaluate evidence for structural controls on mineralization. This study is part of Targeted Geoscience Initiative involving the C.S. Lord Northern Geoscience Centre, the Geological Survey of Canada, and the Alberta Geological Survey. The goals of this multidisciplinary project are to delineate the distribution and describe the origin of known Mississippi Valley-type lead-zinc deposits in the Pine Point orefields, and to investigate the potential for further undiscovered lead-zinc ore bodies in southern Northwest Territories and northern Alberta.

This study area spans from the southern shores of Great Slave Lake to the Northwest Territories/Alberta border, and from the Heart Lake Fire Tower (~ 50 km northwest of the Enterprise Junction) to the Little Buffalo River located west of Ft. Resolution. The aims of this study were: 1) to examine surface structures at a regional scale and deposit scale at the Pine Point minesite, and evaluate evidence for the involvement of basement structures on the formation of the observed surface structural features; and 2) to look for evidence of syn or epigenetic structures with respect to ore deposition at Pine Point.
Relatively consistent NW-SE (055°) and NE-SW (125°; 140°; 150°; 160°-165°) joint sets were observed within the study area. A dominant E-W (085°) joint set was observed in one domain. The 055° set is close to the orientation of the Great Slave Lake Shear Zone (045° at Pine Point), and the Hay River Fault (055°; west side of study area). Two Phanerozoic fault zones (McNallie Falls and Bell Rock), both previously mapped, were visited. Neither of these faults are associated with economic minerals, and their orientations are dissimilar to the ore trends at Pine Point.

No major structures were observed at the Pine Point minesite, and no obvious structural control on mineralization was apparent from examination of the accessible pits. The dominant joint sets crosscut hydrothermal dolomite, which is commonly associated with ore mineralization. One exception, the local occurrence of sulphide-bearing fractures, was seen in the X-15 pit. The only evidence of faulting or slip was observed at one locale in the N-32 pit, where dolomite slickensides were interpreted to have formed in response to collapse at the edge of a sinkhole.

Previous studies conducted on ore mineral paragenesis at Pine Point proved that hydrothermal dolomite occurred concurrently with the ore deposition event. This study demonstrates that fracturing at Pine Point pits largely post-dated dolomitization, and therefore ore deposition. Furthermore, as no evidence for significant structural controls on mineralization were observed in the pits, regional faults are not considered a primary mechanism for ore emplacement in the Pine Point orefields.

LITHOGEOCHEMICAL ALTERATION HALOS AROUND YELLOWKNIFE GOLD DEPOSITS: NATURE OF LARGE ALTERATION HALOS AND THEIR IMPLICATIONS

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Three-Dimensional (3-D) computer modeling of major, minor and trace element geochemical data for >5,000 wallrock samples, as well as geological and mining data, collected from the Con and Giant mines indicate that extensive alteration of the metavolcanic wallrocks occurred where gold-depositing fluids passed through the rocks. Geochemical data from a >10 km long, up to 2 km wide and up to 2 km deep volume of rock that hosts the Con and Giant deposits indicate that Na_2O and TiO_2 were leached and Ag, As, Sb, Pb and volatiles (LOI) have been added to the wallrocks, where gold-depositing fluids passed through the rocks. Wallrock alteration in the Giant mine also coincides with $\delta^{18}O_{quartz}$ values >11.5‰ in vein quartz. Alteration of the metavolcanic rocks that host the Con and Giant deposits differ from that in metasedimentary rocks adjacent to the Ptarmigan deposit. At Ptarmigan, strong Na_2O depletion, K_2O addition and Al_2O_3 concentrations in wallrocks appear to reflect the development of pervasive muscovite near the veins. TiO_2, Ag, As, Sb, and Pb contents of altered Ptarmigan wallrocks have low abundances or do not have a systematic relation with the veins as occurs in Con or Giant deposits.

Examination of 3-D models of the Con mine lithogeochemistry indicates that alteration halos dip steeply to the west, following the Campbell shear zone to a depth of ~2 km. Within this alteration zone there is no evidence of horizontal (north-south) chemical zonation reported by Myers (1974), although there may be vertical zonation. Wallrock alteration along the entire 5 km length of the Giant mine contrasts with that in the Con mine in that a single alteration zone dips east at ~45° to a depth of > 1 km. Examination of wallrock alteration at the south end of the Giant mine indicates that Na_2O loss and As addition appear at least in part to be associated with fluid movement through the West Bay Fault, rather than the possible presence of west-dipping structures as suggested earlier (van Hees et al., 2001). The different orientations of the alteration halos in the Con and Giant mines may indicate the presence of conjugate structures that permitted the passage of mineralizing fluids to form the deposits. The length, depth extent and orientation of the alteration zone in the Giant mine supports that some fluids and mineral components that formed the Giant deposit were derived from meta-sedimentary rocks located east of the mine.

IS THE PTARMIGAN MINE A MAGMATIC GOLD DEPOSIT?: INSIGHTS FROM FLUID INCLUSION GEOCHEMISTRY

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Wallrock petrography, stable isotope thermometry on quartz-tourmaline pairs and electron microprobe analyses of arsenopyrite in Ptarmigan vein samples support that the Ptarmigan gold deposit was formed by 550°C ± 50°C mineralizing fluids. These high fluid temperature estimates suggest that the Ptarmigan deposit was formed by either a high-temperature meta-morphic fluid or possibly a magmatic fluid, associated with emplacement of the nearby Prosperous granite. To test whether the Ptarmigan fluid is of magmatic or non-magmatic origin, aqueous fluid inclusions and the salts they contain were extracted from both gold-bearing and barren Ptarmigan quartz vein samples using a crush-leach technique (Bottrell, 1988). The leachates were analyzed for Li, Na, NH_4, K, Mg, Ca, F, Cl, Br, NO_3, PO_4 and SO_4 using an Ion Chromatograph. Preliminary petrographic and microthermometric analysis suggests that the quartz samples contain a saline H_2O-CO_2 primary fluid as well as several types of secondary fluids that may contribute variably to the analyzed composition of the bulk-fluid. Charge balance calculations confirm the completeness of most leachate analyses.

The composition of leachates extracted from Ptarmigan vein quartz samples are variable but well constrained along a mixing line between a "granitic" end-member, represented by leachate analyses of the Prosperous, Fern, and Pancho Villa pegmatite quartz samples, and a "non-granitic" end-member. The potential non-granitic end-member, represented by a meta-basalt-hosted gold-bearing Negus vein sample, is similar compositionally to modern seawater, 3.23 Ga seawater (Channer et al., 1997), and present day deep-seated Canadian Shield groundwaters (Con mine, Bottomley et al., 1999). An average Ptarmigan Li/Cl atomic ratio of 0.00198 is ~17 times higher than that in Con mine "Shield" water and ~44 times higher than that in modern seawater. The enrichment in Li suggests a granitic affiliation and possibly a magmatic origin for the Ptarmigan gold deposit. Analyses of additional quartz samples from gold-bearing veins in the Yellowknife and other Canadian gold camps are underway to further evaluate this possibility.

MINERALOGICAL CHARACTERIZATION OF ARSENIC IN SOILS AND MINE WASTE FROM YELLOWKNIFE, NWT

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The Yellowknife area has elevated levels of arsenic in soil, water and sediments as a consequence of the natural geological endowment as well as more than sixty years of mining and roasting arsenic-bearing gold ores. The mobility and toxicity of arsenic depend on its chemical species and oxidation state. As part of a study of the bioavailability of arsenic in the Yellowknife area (TSRI#295; Reimer, Cullen and Jamieson), the solid forms of arsenic in soils and fill materials from the Giant Mine Townsite were characterized.

Total arsenic concentrations were highest (1179±519 ppm) in crushed rock fill that likely originated as waste rock. Sequential selective extraction analysis indicated that most of the arsenic in the fill is contained in sulfides, although some samples also exhibited a significant portion of arsenic bound in the iron oxide fraction. Both arsenopyrite and arsenical pyrite are prevalent in these samples. However, most of the sulfide grains exhibit iron oxyhydroxide rims, indicating progressive oxidation or weathering of the sulphides, a process that tends to release arsenic to aqueous solution. Electron microprobe analyses of the weathered rims indicate that some of this arsenic (up to several wt%) is attenuated in the iron oxyhydroxide, including rims on non-arsenic sulfides such as pyrhhotite. The total arsenic concentration in playground sand (145 ppm) is less than the fill materials. The largest proportion is bound in the sulphide portion but 30% is present in the more available forms such as amorphous iron oxides and adsorbed or exchangable fraction. Synchrotron-generated X-ray absorption studies indicate that the arsenic associated with the iron oxyhydroxide is As^{5+}.

DEVELOPING HIGH-GRADE GOLD DEPOSITS IN THE YELLOWKNIFE GREENSTONE BELT

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The Yellowknife Greenstone Belt ("YGB") extends from beneath the waters of Great Slave Lake to Nicholas Lake, a distance of over 100 km to the north. The Con Mine and Giant Mines dominate the YGB production history, accounting for more than 5 million and 8 million ounces of gold from past production at half-ounce grades. The Discovery Mine has a past production history of 1 million ounces of gold at a 1 ounce grade. It is within this framework that Tyhee has initiated its Yellowknife Gold Project by acquiring the Discovery and the adjacent Nicholas Lake Mine.

All economically significant gold mineralization in the YGB is constrained within planar to curviplanar domains of brittle-ductile deformation. The larger gold deposits are hosted within or immediately adjacent to igneous rocks, principally mafic volcanic rocks. Orebodies are most abundant where the shear zones vary in strike and/or dip, typically associated with transitions in metamorphic facies.

Tyhee Development Corp completed 13 diamond drillholes totaling 3,843 metres in the Ormsby Zone on the Discovery Mine Property, and 7 diamond drillholes totaling 1,821 metres in the Main Zone on the Nicholas Lake Mine Property. The Ormsby Zone contains numerous late, quartz-rich ribbon-like volumes that formed late in the deformational history, aligned en-echelon, dipping to the southwest in metavolcanic rocks within the northeast-striking Discovery Shear Zone. These mineralized bodies consist of garnetiferous mafic amphibolite +/- carbonate with minor sulphides, (po>py>cpy>sph>gal) near the greenschist-amphibolite metamorphic transition. Diamond drilling has succeeded in identifying economically interesting gold values over a 3,000 metre strike-length. Recent assays from 2002 include 21.8 gpt gold over 1.5 metres in NDM 222, and 19.2 gpt gold over 6.0 meters in NDM 220.

The Nicholas Lake Mine Main Zone occurs within and proximal to a deformed, rod-like granodiorite stock in metasedimentary rocks. Numerous curviplanar quartz-sulphide veins strike +/- 30^{o} of due east and occur within and near the south contact of the granodiorite. These zones extend greater than 600 metres below surface and more than 270 metres along strike. Recent assays from 2002 include 52.79 grams per tonne (“gpt”) gold over 3.0 meters in N-02-95, 38.81 gpt gold over 1.5 metres in N-02-98, and 53.46 gpt gold over 1.0 metres in N-02-96.

HYDROTHERMAL MAGNETITE DEPOSITION AT BASLER LAKE, SOUTHWESTERN SLAVE PROVINCE, NORTHWEST TERRITORIES

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During the 2001 field season samples were collected from a magnetite deposit at Basler Lake (NTS 85N/16). This deposit was discovered in 2000, during mapping for the Snare River Project[a]. A detailed petrological, geochemical, and monazite chemical age dating study of the magnetite deposit is the basis for a B.Sc. thesis at the University of Alberta.

The deposit is up to 50 meters long and occurs at the Archean/Paleoproterozoic unconformity. Below the unconformity, Archean metasedimentary rocks have been chloritized and are weakly magnetic. Above the unconformity, the magnetite is concentrated in the slightly metamorphosed Paleoproterozoic, basal quartz-pebble conglomerate, quartzite, and siltstone. The maximum magnetite content is in the conglomerate; euhedral magnetite crystals occur in the matrix and ‘semi-cumulate’ aggregates of magnetite have formed in lithic clasts. Crystal size can be directly correlated to the host lithology, with the largest magnetite grains present in the conglomerate. Smaller, but more widely disseminated, magnetite grains occur in the siltstone.

There are two prevalent habits of monazite: monazite that is included in magnetite is irregular to subhedral and occurs along crystal fractures and; monazite that is interstitial to quartz and plagioclase (+/- muscovite, biotite) is irregular to rounded. Constraints on the timing of magnetite deposition were obtained using Th-U-Pb chemical dating of monazite on the electron microprobe. Initial age determinations indicate two distinct times of monazite crystallization, NeoArchean (ca. 2500 Ma) and Paleoproterozoic (ca. 1850 Ma).

We interpret the deposition of the magnetite to be controlled by permeability. Fluids have uniformly penetrated the conglomerate matrix and siltstone, while concentrating in the more permeable lithic clasts and quartzite. Deposition is also concentrated along the lithological contacts between the quartzite and siltstone, as these acted as planes of weakness and promoted fluid transport. The monazites of NeoArchean age are found in the Paleoproterozoic quartzite and are interpreted as detrital in origin. Paleoproterozoic monazites are commonly included in magnetite. We interpret these to be syn-depositional with the magnetite. The chloritization of the Archean metasedimentary rocks, as well as the fluid flow responsible for magnetite deposition, may be related to a NE/SW trending shear zone that acted as the down section limit of the magnetite-bearing lithologies. On the basis of our age dating, we propose that fluid flow at ca. 1850 Ma was related to deformation and metamorphism in the adjacent Wopmay orogen.

[a]Jackson, V.A. (2002), NWT Open File 2002-02.

GEOLOGICAL FIELD WORK ON INUIT-OWNED LANDS, KITIKMEOT REGION, NUNAVUT

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Two of Nunavut's three operating mines, Polaris and Nanisivik, are shutting down in 2002. During the summer of 2002, the Department of Lands and Resources of Nunavut Tunngavik Inc. (NTI) conducted field investigations of three areas comprising five parcels of Subsurface Inuit-Owned Land (IOL) in the Back River and Bathurst Inlet areas. The goal of the project is to encourage exploration activity that may lead to the development of new mines.

The field program was made possible through NTI's operational and logistical support, combined with technical and geoscience expertise provided by the University of Western Ontario. Shear Minerals of Edmonton provided assessment data to the UWO research team. NTI has created the University Partnership Program (UPP) in order to facilitate small-scale geoscience projects that can enhance the value of Nunavut's Subsurface IOL. The first UPP agreement exists between NTI and Dr. Norm Duke of the University of Western Ontario.

The 2002 summer program involved Dr. Duke, R. Wyllie, two undergraduate students from UWO (P. MacDonald and R. Therriault) and three high school students from Cambridge Bay (C. Gillis, D. Ehaloak and D. Tologanak). The crew mobilised to the field on July 18th and returned to Cambridge Bay on August 28th. While in the field, three base camps were operated at Regan Lake, Gold Lake and Crescent Lake. The first two were in the Back River region, the last near Bathurst Inlet. Portions of five Subsurface IOL parcels were mapped during the field work (CO-02, CO-03, BB-07, BB-22 and BB-24).

In the Back River region, structural culminations consisting of subaerial and subaqueous volcanic deposits overlain by metasedimentary sequences host the potential for both volcanogenic massive sulphides (VMS) and lode gold hosted in Banded Iron Formation

(BIF). The Bathurst Inlet area is predominantly metasediments with BIF. In all three areas, lithological, geochemical and assay samples were collected to characterise the local geology.

The undergraduate students returned to UWO at the end of the summer to work on B.Sc. topics related to the geological field work from the summer. One covers the Back River area and the other, Bathurst Inlet. The three high school students from Cambridge Bay also returned to school. One student is upgrading marks and planning to pursue geological studies in the near future.

NTI has Exploration Agreements covering Subsurface IOL parcels in the Northern Slave Province. The Agreements will promote the value of Subsurface IOL as exploration targets, and also facilitate the compilation of existing exploration and geoscience data for the region. NTI also has geoscience projects, planned or underway, for other regions of Nunavut.

3-D GEOLOGIC MODEL OF A FRACTURED CARBONATE RESERVOIR, NORMAN WELLS FIELD, NWT, CANADA

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2. Imperial Oil Resources Limited, Calgary AB
3. Esso Malaysia, Kuala Lumpur, Malaysia

Norman Wells is a Devonian-age (Givetian-Frasnian) carbonate bank complex located in the Northwest Territories, 60 kilometres south of the Arctic Circle. The bank complex reaches a maximum thickness of 130 metres across the bank interior and margin, thinning basin-ward due to a combination of bank-margin backsteps and depositional pinch-out. Norman Wells is an oil reservoir with approximately 108 km3 (680 million barrels) of oil in place. The limestone reservoir has very low matrix permeability (avg. 2 to 4 millidarcies) and is naturally fractured. Previous 3-D modelling efforts at Norman Wells did not attempt to quantify the effects of fracture permeability, resulting in discrepancies between reservoir models and historical field performance data. In the present study, a 3-D geologic model was constructed to quantify the combined affects of matrix and fracture properties on total, full-field permeability. Matrix and fracture properties were modelled separately, and then combined into a total permeability model. Matrix properties were modelled using core and log data combined with facies and stratigraphic information. Fracture properties were modelled using outcrop, core and image log data, with flow properties calibrated to injectivity-derived kh data. Structural, stratigraphic and facies information were used to guide the distribution of fracture permeability in the 3D model.

Modelling results show that fractures enhance matrix permeabilities and that, without fracture enhancement, significant areas of the Norman Wells reservoir would be non-commercial. Fracture properties vary in a partially predictable manner as a function of structural and stratigraphic position within the carbonate complex. Fracture influence is greatest along the bank margins and in the steeper dipping, updip (northeast) structural region of the reservoir. Using this new model, a history match of production performance was achieved. Benefits of incorporating dynamic data directly into the 3-D geologic model include: 1) reduced need for adjusting permeabilities in the flow simulator, resulting in increased consistency between the static and dynamic models, and 2) geologic information guides the distribution of the excess permeability rather than ad-hoc adjustments in the flow simulator. The new static and dynamic models are currently being used for reserves determination, production forecasts, opportunity identification, and field management.