29th Yellowknife Geoscience Forum

Program & Abstracts of Talks & Posters

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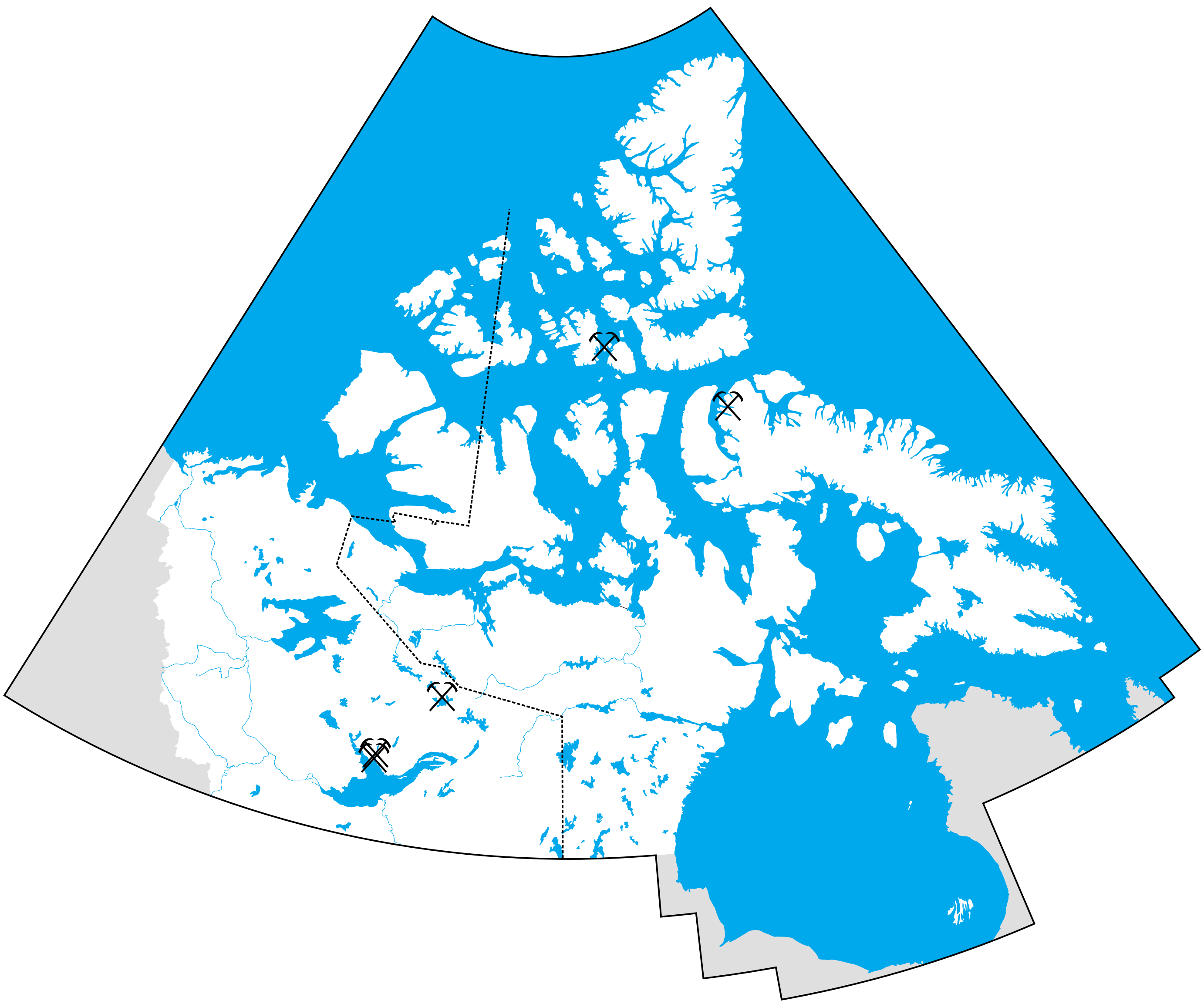

NWT and Nunavut
Chamber of Mines

A COMPARISON OF ZINCIAN SPINELS FROM SELECTED DIAMONDIFEROUS AND NON-DIAMONDIFEROUS ARCHEAN LAMPROPHYRE DYKES AND OTHER RELATED ROCKS

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A series of amphibole/phlogopite-bearing lamprophyre dykes, locally xenolith bearing, transect rocks of the Yellowknife Supergroup at Yellowknife. Lamprophyres in the Wawa area of the Michipicoten Greenstone belt in north central Ontario share some similarities to the Yellowknife lamprophyres. Some of the Wawa lamprophyres are known to be diamondiferous (Sage, 2000). Given the apparent similarities (mineralogy, age, geologic setting) between the Yellowknife and Wawa lamprophyres a small suite of Yellowknife lamprophyres was submitted for microdiamond analyses by caustic fusion at the Saskatchewan Research Council. A 7.15 kg sample from a lamprophyre at Dettah Point, a 5.75 kg composite grab of 3500Level Con Mine diatreme matrix, and a 11.70 kg outcrop sample of lamprophyre sampled approximately 20 km east of the Stagg River bridge (Rae lamprophyres) did not return any micro or macro diamonds. A 10.25 kg outcrop sample of lamprophyre dyke sampled above the Jackfish power plant in Yellowknife returned 2 clear yellow microdiamonds (0.20x0.16x0.14 and 0.14x0.14x0.10 mm), two subsequent outcrop samples (12.10 and 21.1 kg) did not return any microdiamonds.

Groundmass spinels in the Yellowknife lamprophyres locally display relict atoll textures with zinc cores (to 7-wt% ZnO) and Cr-magnetite rims. Anhedral groundmass spinels are also Zn-rich to 3wt% ZnO and display evolutionary trends toward Cr-magnetite. In addition to the enriched Zn contents the spinels are characterized by very low MgO (< 0.5 wt%), elevated MnO (1.5 - 2.1 wt%), low Al_2O_3 (< 10 wt%), low TiO_2 (< 1 wt%), and variable Cr_2O_3 (31 to 52 wt%). Magnetite rims on the atoll-textured grains may contain up to 1.9 wt% Cr_2O_3. Grains typically demonstrate a core-rim evolution of increasing Cr, Fe^{3+} with decreasing Al, Zn. The core to rim and gross evolutionary trends are well expressed in a compositional space defined by the ternary system: $Fe^{3+}/(Fe^{3+}+ Al^{3+})$ - $Fe^{3+}/(Fe^{3+}+ Cr^{3+})$ - $Al^{3+}/(Al^{3+}+ Cr^{3+})$.

Significantly the diamondiferous Sandor and Menzies dykes (Wawa) also contain groundmass spinels with elevated ZnO (to >4-wt%), MnO (to > 1.5 wt%), low MgO, low Al_2O_3, and moderate Cr_2O_3 (Sage, 2000 OGS OF6016). These compositions and the attendant evolutionary trends are very similar to spinels of the Yellowknife lamprophyres. However, in the compositional space defined by the $Fe3^{+}/(Fe^{3+}+ Al^{3+})$ - $Fe^{3+}/(Fe^{3+}+ Cr^{3+})$ - $Al^{3+}/(Al^{3+}+ Cr^{3+})$ ternary, Sandor and Menzies spinel compositions occupy compositional fields that only in part overlap the Yellowknife compositions. This distinction is further accentuated by incorporating zinc into the above noted ternary ($[Fe^{3+}/(Fe^{3+}+ Cr^{3+})]/Zn$). Zn-spinels from diamondiferous Wawa lamprophyres occupy compositional fields distinct from Zn-spinels from non-diamondiferous lamprophyres - a reflection of the oxidation state during late stage crystallization (spinel ferric iron content). For the most part - at any given Zn content spinel from Yellowknife lamprophyres have a greater Fe^{3+} content than a spinel from a Wawa dyke. Significantly it will be demonstrated that spinels from kimberlites and other lamprophyres appear to conform to these compositional fields reflecting the “relative” oxidation state of the sample.

ABSOLUTE TIMING OF ALTERATION AND GOLD MINERALISATION: FREE-MILLING, REFRACTORY, AND NEGUS ORE ZONES, CAMPBELL SHEAR, CON MINE - PRELIMINARY EMPA U-PB-TH STUDY OF HYDROTHERMAL MONAZITE

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Hydrothermal monazite has been identified in samples of gold-bearing alteration and vein material from the refractory 103 and 102 Zones, free-milling 101 Zone and “Negus” style veins hosted within and deformed by the Campbell Shear Zone, Con Mine. Monazite grains from the auriferous Negus vein alteration selvage are intimately associated with carbonate, chlorite, apatite, feldspar and sulphide. Refractory zone monazite grains are also intimately associated with carbonate, apatite, paragonitic-muscovite and may be hosted as inclusions within a sulphide host (pyrite, arsenopyrite) or intimate with sulphide. Monazite grains from the free-milling 101 Zone (5360M stope) are intergrown with chlorite and phengitic muscovite associated with pyrite within gold-bearing quartz vein material.

Grain size is generally less than 15 microns. A first pass EMP analysis of individual monazite grains will aid in identifying grains that may be suitable for further SHRIMP analyses. The selection of samples covers the significant ore trends within the Campbell Shear and the data collected will provide preliminary, yet critical information as to the absolute timing of alteration, mineralization, and deformation within the Campbell Shear Zone. Data will be presented during the Geoscience Forum.

KIMBERLITE ANOMALY DIAMOND DRILL HOLE COMPILATION - A GIS COMPATIBLE COMPILATION OF DRILLHOLE LOCATIONS AND LOGS SPECIFICALLY TARGETED ON KIMBERLITE ANOMALIES; NWT AND NUNAVUT CANADA

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The goal of this compilation was to create a digital database of diamond drill holes that tested “kimberlite anomalies’, from information contained within publicly available hard-copy Assessment Reports. Publicly available assessment filings specific to diamond exploration that contained diamond-drilling results were selected by searching the NORMIN database and the Geology Division archives. The ultimate product is a comprehensive compilation of drill collar locations and header data contained within a meta-database in association with scanned images of the drill logs as filed in the assessment report.

Two main processes were employed for the conversion of the hard copy drill information into a digital form:

1) scanning of individual drill logs from assessment reports
2) entering the drill hole number, the corresponding location coordinates, and header data (dip, azimuth, length of hole, kimberlite (yes/no)) into a spreadsheet format and subsequently converting the file to a database format file

Each of the individually scanned drill logs has been converted to and stored as an Adobe Acrobat formatted pdf file. Each file is labeled by its drill hole number and by its associated assessment report number (e.g. AMAD93-01_083197). The digital drill log file is housed within the folder of its corresponding assessment report number. The scanned (*.pdf) drill hole file name is identical to the drill hole number within the first column of the spreadsheet and database tables allowing for hot linking of the collar location and the drill log.

As of mid-October 2001 the compilation houses in excess of 1400 drill logs from over 80 assessment filings. The data is packaged as an Excel spreadsheet, an identical in content database file, and the corresponding drill logs as *.pdf files. The database and spreadsheet files are ordered by assessment report number and include the drill hole number, assessment report number, 1:50 000 NTS sheets, locations in both latitude/longitude and UTM coordinates, as well as the dip, azimuth and length of the holes, whether or not kimberlite was intersected and the nature of the anomaly tested.

This compilation is now available from the DIAND NWT Geology Division.

SLAVE MAGNETICS COMPILATION (SMAC). A DIGITAL IMAGE COMPILATION OF PUBLICALLY AVAILABLE TOTAL FIELD MAGNETICS DATA AS FILED UNDER THE CANADA MINING REGULATIONS: NORTHWEST TERRITORIES AND NUNAVUT.

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The purpose of SMAC was to create a GIS compatible digital image database of high resolution total field magnetic airborne geophysical surveys. Much of this data is contained as hard-copy (paper) maps within Assessment Reports submitted pursuant to the Canada Mining Regulations, some of the data has been filed in a digital form. For the initial phase total field magnetics data was accessed from public assessment filings for the period 1990-1998 that cover the Slave craton from the Arctic coast to Great Slave Lake. Digital data, where available, was reprocessed and gridded with Geosoft Montaj and 200 dpi geotiff images generated. Paper maps were scanned with an E-size drum scanner. The resulting TIFF image (400 dpi, CCITT Group 4 compression) was geo-referenced (indexed) with CAD Overlay. Colour maps were scanned with an indexed colour look up table comprised of 32 colours. Colour TIFF images are saved with Macpaint packbit compression. Images were cropped to only include the actual survey area. Multiple images from the same survey were merged together to form one image. All tiff files are accompanied by an associated world file (*.tfw). A polygon was created outlining the area for each survey. An accompanying table houses the following information: assessment report, property operator, geophysical contractor, survey platform (heli/fixed wing), line spacing, bird height, date of survey, digital data (yes/no), etc... The table is constructed in such a form to enable linkage between the individual images and the table.

The initial product is a colourful quilt of over 1000 images from 129 assessment filings. When plotted at an appropriate scale the user will note that individual contour lines are well preserved, fiducials readable, and flight lines in good form. The user will also in a rapid manner determine areas of the craton which have geophysical surveys publicly available and which surveys have data available in a digital form.

The compilation affords the opportunity to study in detail the distribution (temporal and spatial) of various dyke swarms, major and minor structural offsets, the magnetic characteristics of supracrustal belts, granitoids, and kimberlites. The product is sorted according to NTS Sheet and is available as 8 volume CD-ROM set.

EXPLORATION AND GEOLOGY OF THE ORO CLAIMS, HOPE BAY VOLCANIC BELT, NUNAVUT

Armstrong, K.A.[1] and Stubley, M.[2]
1. Navigator Exploration Corp.
2. Stubley Geoscience

The ORO claims cover the northernmost extent of the Hope Bay Volcanic Belt (HBVB), approximately 125km southwest of Cambridge Bay, Nunavut. The 4121ha property consists of 5 mineral claims surrounded on three sides by the waters of Melville Sound, and to the south by the mineral claims and concessions of the Hope Bay Joint Venture. A three week exploration program of 1:10,000 scale mapping and prospecting was conducted from July 20 through August 11, 2001.

Archean supracrustal rocks within the property are predominantly variably altered and strained massive to pillowed mafic volcanic flows. Associated medium to coarse grained gabbro sills and dykes are also common. Several units of variably magnetic thinly bedded to laminated siltstone and mudstone are intercalated with the mafic volcanic rocks of the ORO 5 claim. The sediments are primarily of mafic composition, with lesser siliceous arkosic layers. Mafic volcanic rocks throughout the property are cut by several generations of mafic, intermediate and felsic dykes. A medium grained equigranular tonalite intrusion, several hundred metres in diameter, is located at the north end of the property and a similar intrusive plug may occur in the north-central part of the ORO 2 claim. The volcanic rocks are bordered to the east by a series of syn- to post-volcanic granodiorite intrusions.

The Archean rocks of the property display complex structural relationships including at least three reversals in pillow younging directions measured across the northern end of the property. Pronounced lineaments separating rocks of contrasting strain intensity, fabric orientation, and lithology suggest juxtaposition of several fault-bounded blocks within the ORO 1 and ORO 2 claims. In the west-central part of the property, Proterozoic rocks of the Goulburn Supergroup and Franklin igneous event that cover the Archean rocks further complicate structural interpretations. The Goulburn Supergroup sediments consist of pink to red cross-bedded quartzites and related conglomerates, with lesser red to maroon siltstone. A gently eastward dipping Franklin diabase sill forms a prominent escarpment along the western edge of the ORO 3 and 4 claims, and flattens to cover a broad area in the centre of the property.

The majority of the mafic volcanic rocks are compositionally similar to the Mg-tholeiites described elsewhere in the HBVB (Gebert, 1993). However, the volcanic flows and gabbro sills hosting the metasedimentary rocks identified on the ORO 5 claim are compositionally distinct. These mafic rocks have a strong positive magnetic signature and contain elevated TiO_2, Fe_2O_3 (total), and P_2O_5 and lower CaO values with respect to adjacent non-magnetic basalts. These magnetic, Fe-rich tholeiites are located within an anticlinal structure, as inferred by opposing younging directions in adjacent pillowed lavas, and potentially represent the northern extension of the volcanic rocks hosting gold mineralisation at Doris Lake, 6000m to the south.

Gebert, J.S. 1993. EGS 1993-1.

INTERPRETING THE GEOCHRONOLOGY DATASET FOR THE POLYMETAMORPHIC SNARE RIVER TERRAIN, SW SLAVE PROVINCE

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2. C.S. Lord Northern Geoscience Centre.

Two factors in particular conspire against straightforward application of geochronology to high grade polymetamorphic terrains such as the Snare River Terrain (SRT), southwestern Slave

Province. Firstly, multiple episodes of thermal overprinting associated with plutonic and metamorphic events make selection of dating targets problematic due to the formation of several populations of dateable minerals within a sample. Secondly, the high temperature conditions attained during such events facilitate partial to complete diffusive resetting of isotopic clocks, significantly adding to the difficulties of age data interpretation.

Establishing the geochronological framework for the SRT has been succesfully achieved via thorough imaging of these ‘multi-populations’ in both plutonic and pelitic rocks, followed by isotopic analysis of the target populations using appropriate analytical tools. Conventional Thermal Ionisation Mass Sepctrometry (TIMS) of single grains of igneous zircon was the method chosen to establish the sequence of plutonism. Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA ICP-MS) of monazite and rutile (currently underway) was chosen to constrain the chronology of metamorphism. The high spatial resolution and insitu capability of the LA ICP-MS technique retains textural context of dateable grains and,thus, significantly enhances integration with P-T data. At the time of writing, only TIMS age data are available; metamorphic age determinations are in progress.

The SRT preserves a continuum from upper greenschist to granulite facies metamorphic conditions, with results reported here suggesting that tectonic assembly and associated magmatism took place in two distinct episodes over a period of at least 30 M.y. (~2610 - 2580Ma).

Formation of the SRT began with coupled mafic-silicic volcanism at ~2674 Ma, followed by the intrusion of the Hinscliffe plutonic complex at the base of the interleaved volcanic - plutonic - sedimentary pile at ~2654 Ma. A plutonic hiatus of ~40Ma ensued, eventually interrupted by emplacement of tonalitic/granodioritic plutons (~ 2611Ma) and ultramafic/mafic plutonic suites (~2608Ma) . This magmatic activity heralded the onset of the first tectonic event. Plutonism peaked ca. 2590 - 2585Ma with the intrusion of vast bodies of K-feldspar megacrystic granite (~2589 Ma), two mica granite (~2585 Ma) and orthopyroxene+garnet-bearing charnokite sheets. The second, overprinting event beginning at ~2578 Ma is recorded in crosscutting granodioritic/granitic leucosomes, intrusion of late (~2576 Ma) orthopyroxene-charnokite sheets into granulite regions of the SRT, and by the growth of metamorphic titanite (~2579Ma, Hyde, 2000) within metavolcanic rocks from the structurally highest part of the SRT.

Speculation on the possible origin of regional tectonism involves collision of a juvenile volcanic arc with a Mesoarchean basement block, followed by magmatic activity, generated from the base of the thickened pile. The absence of inherited Mesoarchean zircon within the oldest units, and its presence (~2700 Ma, ~2710Ma) as an inherited component in the youngest crosscutting pegmatitic dykes supports this hypothesis.

Hyde, D.J., 2000. Unpublished Honours Thesis, Memorial University of Newfoundland

APPLICATION OF NEW MAPPING TECHNIQUESTO THE INVESTIGATION OF SEABED GEOHAZARDS RELATED TO BEAUFORT SEA HYDROCARBON DEVELOPMENT

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For the first time since 1991 the Federal Government initiated a Beaufort Sea mapping program to investigate seabed geohazards related to offshore hydrocarbon development. This was a joint project among the Geological Survey of Canada, Canadian Hydrographic Service, Canadian Coast Guard, Indian and Northern Affairs Canada and the Inuvialuit Joint Secretariat. The field program was conducted in August 2001, onboard the vessel CCGS Nahidik. The study focused on specific geohazard issues related to both Arctic marine pipelines and exploration activities. Four issues were investigated: seabed scouring by ice keels, seabed granular resource assessment, base mapping for sensitive habitat assessment, and hydrographic charting. Seabed surveys were conducted using standard single-beam echo sounders, and sidescan sonar as well as new technologies including multibeam sonar and deep towed digital cameras. Results were impressive. The new technologies performed well in the unique Beaufort Shelf environment, which is dominated by outflow from the Mackenzie River. Ice scours were mapped with 100% coverage for the first time. A new scour 2.5-m deep was mapped in 38m of water. Artificial islands constructed as drilling platforms in the 1980's are still intact and represent a source of granular resources for future development. The multibeam sonar mapping techniques are sensitive to subtle changes in the character of the seabed and will be an effective tool for habitat mapping. Detailed charting of 12 of the 42 abandoned artificial islands revealed these islands have been eroded to 4 to 5 m below sea surface and are a navigation hazard only to deep draft vessels. It is anticipated the research will continue in 2002.

ECONOMIC EVALUATION OF MINERAL PROJECTS IN THE NWT – GOVERNMENT VERSUS CORPORATE PERSPECTIVE

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The GNWT and mining companies use the same economic criteria to evaluate mineral projects. However, they do so from two different perspectives. This is because revenue is derived by the two entities from different, albeit interrelated, sources – namely commodity sales in the case of corporations and taxes in the case of government.

Pre-production capital expenditures substantially reduce government income tax revenue during the first few years of a mine's life. Where capital expenditures relative to revenues are high, income taxes may be rendered minimal over the first ten years of the mining operation. Thus, a mining project that yields a high internal rate of return (IRR) and net present value (NPV) and is therefore attractive to investors, may in fact generate very little income for government.

From a mining company's perspective, all exploration expenditures incurred prior to the completion of a feasibility study are considered sunk, and are regarded as immaterial when deciding whether to build a mine. From the government's perspective, sunk costs cannot be ignored as they impact significantly on taxable income, and consequently on government revenue. Including sunk costs in the economic assessment of a mining project, as government must do, lowers the project's NPV. IRR's are not relevant to such assessments since government does not actually invest in mining projects.

In any event, IRR's provide little information as to the magnitude of income tax revenues that government can expect from a mining project. NPV's, on the other hand, provide at least some indication as to the magnitude of income tax revenues, but in a qualitative sense only. In general, the larger a mining project's NPV, the larger the income tax revenues that government can expect from it.

Government policies can have a direct and material impact on the NPV of a mining project. An example of this in the case of the NWT, might be the permitting process, both in terms of absolute costs (i.e. the actual cost of the permitting itself) and the time taken to issue these permits (i.e. the time value of money). Streamlining the process may shorten the pre-production development period of a mining project increasing its NPV – and hence government's income.

In corporate cash flow calculations, tax payments are included as a series of future values over the life of the mine. In general, the payments are aggregated and reported to government as a net future value. This is misleading, as government income tax revenues must be discounted to take into account the time value of money (using, for example, the long-term government bond rate as the discount rate). This will provide government with an indication of the actual worth of income tax revenues derived from mining projects in the NWT.

Generally, a minimum ten-year mine life is deemed necessary to determine reliable economic criteria at most costs of capital. Thus, for feasibility, a proven plus probable reserve of only ten years is required. Government, on the other hand, has a vested interest in seeing the life of a mining project extended as long as possible, as tax revenues increase accordingly. Therefore, government should encourage exploration programs that focus both on increasing the overall resource base and upgrading resources to reserves.

ABSTRACT FOR NORTHERN LATITUDES MINING RECLAMATION WORKSHOP

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The stabilization of mine tailings is an integral part of final mine reclamation requirement for mines in the Northwest Territories. Direct vegetation of kimberlite tailings is one option that the EKATI™ Diamond Mine is considering, in place of capping the tailings with waste rock and lake sediments (which are excavated from the top of the diamond-bearing kimberlite pipes). These processed kimberlite tailings are a fairly coarse-textured material, low in silt and clay-sized materials. Plant available moisture is low and similar to that of sand soil. Nutrient retention, indicated by cation exchange capacity, is poor due to the low concentrations of organic matter and soil fines. Vegetation research required that these conditions be ameliorated to provide a more favorable growth environment. This research commenced in the summer of 2000, with vegetation plots built on consolidated tailings and used to research combinations of the amendments peat moss (2 levels of concentration), lake sediment, and calcium, commercial fertilizers and biosolids. Local annual and perennial seeds were also tested for their adaptability to growth in processed kimberlite. Initial results indicate that the chemical characteristics of the kimberlite tailings did not appear to reduce first year plant growth potential. However, the amendment of processed kimberlite tailings with different sources of calcium appears to increase first year annual plant cover. Low peat moss concentrations proved more favorable than high concentrations for moisture retention, and the addition of biosolids also benefited plant nutrient availability. Greenhouse experiments on more combinations of these and other amendments continued over the winter and summer of 2001. In the summer of 2001 additional field plots were created to analyze more local plant species, and other amendment options.

METAMORPHISM AND PORPHYROBLAST-FABRIC RELATIONS IN METATURBIDITES IN THE WALMSLEY LAKE AREA, NORTHWEST TERRITORIES

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The Walmsley Lake area is located in the southeastern Slave Province and comprises late Archean supracrustal rocks intruded by syn- to post-tectonic granitoid plutons. Recent mapping in metaturbidites of the Yellowknife Supergroup has identified a new metamorphic isograd, a new, compositionally controlled mineral assemblage, and variations in the timing of porphyroblast growth relative to fabric formation.

The newly discovered iolite-in isograd occurs in melt-grade metaturbidites and is characterized by iolite porphyroblasts up to 1.5 centimetres in melt-bearing sillimanite, biotite, iolite ± garnet ± K-feldspar ± muscovite pelites. This assemblage is compatible with granulite facies conditions; however, petrographic work is required to determine if this is an equilibrium mineral assemblage.

Staurolite occurs in cordierite- and locally sillimanite-grade metaturbidites overlying volcanic rocks of the Aylmer Volcanic Belt, but is uncommon elsewhere in the area. The assemblage staurolite, cordierite, biotite, muscovite ± andalusite/sillimanite is confined to ca. 800 metres above the volcanic/sediment contact. The proximity of this assemblage to the volcanic belt suggests volcaniclastic input into the sediment package, supporting the interpretation that staurolite is controlled by bulk composition, rather than metamorphic grade.

Throughout most of the map area, the main foliation (S2) is defined by alignment of metamorphic minerals (micas ± other porphyroblasts), although variations in porphyroblast-S2 relations indicate protracted and/or diachronous peak thermal conditions across the northern Walmsley Lake sheet. Immediately adjacent to massive, late syn- to post-tectonic granite plutons, cordierite and sillimanite overgrow S2, suggesting porphyroblast growth outlasted or postdated S2. Elsewhere, cordierite and andalusite porphyroblasts are deformed by S2 and stretched into alignment on the fabric, suggesting growth early during (or even pre-) S2. Ongoing U-Pb geochronology studies (K. MacLachlan, in progress) will help to quantify the timing of metamorphism and deformation.

The first stringers of anatectic melt observed at the melt-in isograd form discrete strataform blebs parallel to bedding and/or S2. Up-grade from the isograd, the proportion of melt in pelitic layers increases steadily. Where it exceeds 15% (by volume), a number of non-regional deformation features can be attributed to melt migration. At this condition the blebs begin to move and coalesce, rupturing S2 and bedding, and forming small dikes. Collapse of melt-drained pelitic layers coupled with inflation of adjacent areas causes gentle to close folding of relict paleosome. Even higher degrees of partial melting generates further melt migration, causing further tightening of folds of restite.

Preliminary P-T data from samples collect in the northwestern part of the map sheet constrain the cordierite-in isograd to ca. 2.45 Kbar at 490°C, typical of rocks at this grade across the Slave Province. Two samples were analyzed from within a kilometer (cool side) of the sillimanite-in isograd and yielded P-T estimates of 5.5 Kbar/620°C and 5.0 Kbar/630°C. These results lie within the sillimanite field of most aluminosilicate petrogenetic grids, and are very similar to P-T conditions reported for sillimanite grade rocks in the central Slave Province. Further work may refine these data.

NUNAVUT'S EMERGING GOLD DISTRICTS: EXAMPLES FROM THE SLAVE AND WESTERN CHURCHILL PROVINCES

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Although the Lupin Mine remains Nunavut's only producing gold mine, recent exploration activity has resulted in the discovery and/or upgrading of several gold districts across Nunavut. This renewed interest in gold exploration is, in part, due to favourable exploration criteria, including, the availability of large, under-explored land parcels in highly prospective Archean greenstone terranes that are capable of hosting high-grade, near surface deposits. Acquiring large land positions can significantly improve the overall effectiveness of exploration and increase chances of discovering sought-after world-class "districts" or "camps".

Significant gold exploration projects in the northern Slave Province, include the Hope Bay District (Hope Bay Joint Venture) and the Goose Lake-George Lake District (Kinross Gold Corp.). The Hope Bay District hosts a belt-parallel shear system with >70km strike length. Several high-grade gold deposits and numerous showings occur along the entire length of the belt. The Goose Lake-George Lake project is host to six known deposits that are related to quartz veining and Fe-sulphide mineralization within banded-iron-formation (BIF) host rocks. Advanced gold exploration projects in the Western Churchill Province, include, the East and West Meliadine Districts (Comaplex Minerals Corp., Cumberland Resources Ltd, and WMC Resources Ltd) and the Meadowbank District (Cumberland Resources Ltd.). At Meliadine, at least 5 significant gold deposits are known along a >65 km structural trend cutting the Rankin Inlet Greenstone Belt. Meadowbank hosts several closely spaced orebodies that are strongly associated with complexly deformed BIF and volcaniclastic host rocks. .

Gold mineralization at Hope Bay and Meliadine appears to broadly resemble classic "break-related" districts similar to the world-class gold camps in the Abitibi Greenstone Belt of Ontario and Quebec. In contrast, the overall setting of the banded-iron-formation related gold deposits at Goose Lake-George Lake and possibly Meadowbank, resembles the giant BIF-related deposits of Homestake, USA and Lupin, Nunavut.

Numerous greenstone terranes in Nunavut have received only minor exploration activity and could be targets for future camps and districts. For example, the Committee Bay Region of Kivalliq, represents a >100 km strike length of greenstone which is underlain by rocks that are likely correlative with rocks that host the Meadowbank gold deposits. Other prospective areas may be within greenstones of the central Hearne Domain (Yathkyed-Angikuni-Ennadai), and the northern Slave (High Lake - Anialik River). Furthermore, the recent discovery of the Naartok-Suluk Deposits (Hope Bay) and Vault Deposit (Meadowbank) illustrates the high-potential for further discoveries within known districts.

GEOLOGY OF THE NAARTOK GOLD DEPOSIT, MADRID AREA, HOPE BAY GREENSTONE BELT, NUNAVUT

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3. Hope Bay Joint Venture, North Vancouver, B.C.

The Naartok gold deposit is located in the northern segment of the Archean Hope Bay Greenstone Belt, and is one of several deposits that occur in the Madrid area. Gold mineralization at Naartok is spatially associated with a regional-scale structural discontinuity termed the Deformation Zone (DEFZ). Mineralization is hosted within the immediate hanging-wall of an east-west segment of the otherwise, north-south trending and steeply dipping DEFZ. At Naartok, the dip of the DEFZ shallows to ~70^0 and is comprised of a highly disrupted, quartz-iron-carbonate-sericite schist which juxtaposes a northerly, variolitic pillowed basalt sequence with a southerly, non-variolitic basaltic sequence.

Anomalous gold concentrations at Naartok are associated with quartz veining, iron-carbonate flooding, pyrite, silica replacement, and hydrothermal breccia textures. The auriferous mineralization is hosted by iron-carbonate-paragonite-sericite altered variolitic basalt and gabbro. Host rock textures can generally be recognized through alteration, however, determining rock types near the DEFZ is complicated by extensive alteration. Early, grey-white quartz veins (± pyrite) progress into stockwork veins and localized hydrothermal breccia with increasing proximity to ore zones. Several different vein types and textures are present, including, iron-carbonate veins, white quartz + iron-carbonate veins, quartz ± albite veins and late fibrous white ladder quartz veins. Crosscutting relations between vein types are ambiguous and complex, suggesting a progressive mineralizing event. Veins are typically narrow (<3 cm wide) and likely represent extension veins that formed in a stockwork pattern and are variably buckled and folded. Iron-carbonate and silica-flooded zones are typically less foliated than surrounding alteration and veins within foliated alteration zones are variably transposed into the main fabric. These observations are consistent with alteration and veining developing during a progressive deformation culminating in regional fabric development.

The Naartok deposit represents a unique mineralization style in the Hope Bay Greenstone Belt. East-west oriented ore zones and an apparent relationship of mineralization to stockwork development and complex hydrothermal breccias is significantly different from the belt-parallel quartz vein-shear zone systems present at the Boston Deposit and Doris Deposit.

GEOCHEMISTRY OF SLAVE AND SOMERSET ISLAND KIMBERLITES

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Kimberlites are the deepest derived volcanic rocks. As such they offer unique insight to the deep source regions of magmas. Geochemical work on kimberlites has been dominated by the study of southern African localities. New discoveries in NWT offer an unprecedented opportunity to establish a comparable body of data on fresh, uncontaminated kimberlites. Samples analysed to date are drawn from three kimberlite fields:

1. The Eocene-Cretaceous Lac de Gras field (Central Slave)
2. The Jurassic Contwoyto Lake field (Northern Slave)
3. Somerset Island (Churchill Province)

Re-Os dating of mantle xenoliths from beneath both these regions indicates the presence of Archean lithospheric mantle beneath them (Irvine et al. 1999 Goldschmidt). All kimberlites are hypabyssal facies. The majority are extremely fresh and have contamination indices (0.8 to 1.25). Fresh monticellite is typically preserved in the groundmass of Lac de Gras samples. These samples are best described as phlogopite-bearing monticellite kimberlite, petrographically similar to Kaapvaal Group 1 (KG1) or non-micaceous kimberlites.

Incompatible element abundances of Slave kimberlites are broadly consistent with those of KG1 and transitional samples, although notably enriched in barium, more akin to Kaapvaal Group 2 (KG2) samples. Average REE data support general similarities between Kaapvaal and Slave samples, although the magnitude of the M-H-REE depletion is significantly greater in the Slave samples. This could be explained by lower levels of crustal contamination in the Slave kimberlites. La/Nb vs Ba/Nb systematics show that Slave samples partially overlap KG1 samples, but in general have higher Ba/Nb ratios, similar to KG2 and transitional samples. Slave samples display a range of ε_{Sr} (0 to +25), consistent with KG1. Most samples have ε_{Nd} of 0 to –5, placing them clearly outside the KG1 field, with some trend towards the transitional domain. Exceptions are Jericho and Somerset Island (ε_{Nd} ~ +3) which plot within the KG1 field. Most Slave samples show a limited range of ε_{Hf} (-2 to +5) and ε_{Nd} (0 to –4), clustering loosely around the mantle array, outside the range observed in Kaapvaal Group I samples. Four samples have -ve ε_{Hf} (-6.5 to –13), placing them in the Kaapvaal transitional kimberlite field. Jericho and Somerset Island samples plot separately, within the Kaapvaal Group I field and marginal to the mantle array.

While there are petrographic and elemental similarities between Slave and southern African samples, there are clear differences, largely in the central Slave samples. The central Slave samples having lower g_{Nd}, more comparable to Kaapvaal transitional rather than Group I signatures. The most northerly samples, Jericho and Somerset Island, are more characteristic of Group I signatures and indicate significant differences in the sources of kimberlites in the central and marginal portions of the Slave craton. In addition, the sample from Nicholas Bay and a sample from Hardy Lake, the two most easterly samples, show the lowest g_{Hf}-g_{Nd} systematics of the central Slave samples. This may relate to kimberlite emplacement through the juvenile Neoarchean Hackett River Arc terrane.

We thank De Beers, BHP and Canamera Geological Ltd for access to samples and DIAND for logistical assistance.

DETACHMENT FAULT CONTROL OF IRON-OXIDE BRECCIAS IN THE SOUTHERN GREAT BEAR MAGMATIC ZONE (GBMZ)

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The GBMZ hosts widespread and diverse iron oxide deposits, ranging from iron formations, through Kiruna-type magmatic apatite-magnetite segregations and NICO-type metasomatic replacements, to Olympic Dam-type hydrothermal breccias. Fe-oxide breccias are best represented in the south, at the two most advanced exploration plays at Lou and Sue-Dianne lakes. Within this region, the Fe-oxide breccias are spatially related to strongly K-metasomatized detachment fault contacts between folded Snare Group metasediments and variably rotated but unmetamorphosed ash flow tuffs of the Faber Lake Group. At Lou Lake, heterolithic Fe-oxide cemented breccias occur at a shallow north-dipping volcanic-metasediment interface, while at Sue-Dianne an Fe-oxide breccia complex is hosted within steeply-dipping ash flow units at the intersection of two major mylonitic fault strands. Recent age dating identifies regional volcano-plutonic activity at 1866 m.y., followed by more localized A-type granite magmatism at 1856 m.y. (Gandhi et al. 2001). That A-type granite dykes crosscut Fe-oxide cemented breccias but do not themselves form breccia clasts identifies K-metasomatism, brecciation, and Fe-oxide cementing as the early manifestations of A-type granite emplacement.

Timing relationships between peak prograde regional metamorphic conditions and multiple stages of retrogressive metasomatic replacement focussed on detachments are particularly informative with respect to kinematic reconstructions within the 10 m.y. magmatic gap. The synclinal keels of Snare Group metasediment preserved within the Marian River Batholith show cordierite stable amphibolite facies regional metamorphic overprints. Peak metamorphism of these sediments must have coincided in time with surface volcanism at 1866 m.y. Juxtaposition of amphibolite grade metasediments against surface flows indicates several kilometers of crustal telescoping. Within post-peak metamorphic mylonitic shears, cordierite is replaced by chlorite-muscovite; near brittle detachments it is replaced by microcline-magnetite. At sites of A-type granite dyking, near-monomineralic microcline felsite caps the detachment surface and forms carrot-shaped alteration zones penetrating a few hundred meters into underlying Snare metasediment. Common microcline haloes on dykes indicate that they preferentially followed K-metasomatized fractures open to the detachment surface. Superjacent volcanics are strongly adularized, indicating lower temperature K-feldspar alteration. Magnetite cementing of detachment-fault breccias is spatially associated with domains of pervasive microcline replacement of Fe-rich metasediment, suggesting that Fe-oxide is a byproduct of wholesale feldspar metasomatism. Continued hydrothermal activity focussed along late brittle fault/fracture systems crosscutting detachments resulted in the sulphidizing of Fe-oxide-rich rocks. Associated polymetallic sulphide mineralization postdates feldspar porphyry dyking, showing that hydrothermal activity continued past 1856 m.y. Collapse of hydrothermal systems is indicated by late hematization, which is most pervasive in breccias within upper plate volcanics. Evolution from early magmatic/metasomatic to late crustal hydrothermal regimes accounts for the polymetallic ore signature. The link between detachment faulting and formation of Fe-oxide breccias evident in the southern GBMZ offers a new perspective on the origin of Olympic Dam-type Fe-oxide deposits globally. Association with Fe-rich sediments deposited along shelf/slope hingelines, affiliation with A-type granite magmatism, and involvement with mixed crustal brines are all features consistent with rapid tectonic denudation of upper crust, decompression melting of a mid-crustal infrastructure, and infiltration of surface water into telescoped brittle/ductile transitions (i.e., to detachment fault surfaces) within orogenic settings subject to post-collisional gravitational collapse.

EVIDENCE FOR BASEMENT STRUCTURAL CONTROL ON LODE GOLD AT THE TERMINATION OF THE ORMSBY BREAK AT THE NARDIN FRONT

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Neoarchean lode gold deposits show considerable diversity in setting even when related to the same lithotectonic element. Such diversity is well expressed by the numerous lode gold showings occurring along the northeasterly-trending Ormsby Break, the first order structural control for gold prospects between Clan and Nicholas lakes within the northwestern Yellowknife Basin. Among these occurrences, the northernmost intrusive-hosted Nicholas Lake deposit, located where the Ormsby gold trend terminates at the Nardin Front, appears most unique in setting.

The Ormsby Break is a highly strained, cross-folded deformation zone discontinuously exposing amphibolitic basement primarily after pillowed metavolcanic rocks. This basement “rise” juxtaposes western/proximal and eastern/distal facies turbidites, suggesting west side up-displacement of a volcanic horst in the primary architecture of the Yellowknife Basin. North of

Discovery, amphibolitic basement reappears between Maguire and Stockwork lakes. The bordering metasediments comprise sulphidic argillite interlayered with concretionary sandstone units, defining A/E bouma cycles typical of proximal fan to shoreline environments. Where argillite dominates, cordieritic beds are capped by near-monomineralic coarse andalusite, representing a clay-rich protolith possibly after distal waterlain tuff. This northern extension of the Ormsby Break shows an increase in Prosperous-age granite dykes and is truncated by the mylonitic east-west striking Kermeen fault zone paralleling the south border of the high grade Nardin Metamorphic Complex.

The southern margin of the Nardin Complex consists of flow-folded paragneiss with interfolds of granodioritic orthogneiss. Two intrusive phases postdate flow-folding: members of the Leith Lake Carbonatite and shallow south-dipping sheets of undeformed red K-granite. Tourmaline pegmatite bodies up to 100m in width concentrate at the Nardin Front. A 200m thick panel of massive strongly-lineated leucogneiss with trace relict sillimanite, lacking discernable sedimentary layering but hosting occasional sheets of leucogranite, forms the adjacent southern border zone. To the south is a 400m panel of retrograded cordierite schist with east-west transposed relict sedimentary layering. D_2-quartz veins in this domain are deformed by a penetrative east-west mylonitic D_3-shear fabric. Further south, primary bedding defining early F_1-isoclinal folds and a dominant S_2-schistocity are well preserved in non-retrograded cordieritic metaturbidites.

The Nardin Front is interpreted as a D_3-mylonitic fault zone that retrograded metasediments hangingwall to a shallow south-dipping Nardin detachment flooded by tourmaline pegmatite. The complex was unroofed by extreme extensional thinning within the south-bordering panels of metasediment. This front truncates the Ormsby Break at Nicholas Lake, where a mylonitized and chlorite-retrograded biotite quartz monzonite body hosts lode gold mineralization. Rather than invoking a simple granite-gold genetic model, we hypothesize that gold initially concentrated at F_2-hinges within the Ormsby setting after injection of Prosperous pegmatite at peak metamorphic conditions, and was again remobilized during D_3-retrograde mylonitic shearing. Numerous lamprophyre dykes in the Nicholas Lake area intrude structural sites similar to the one that hosts the gold, suggesting that the alkaline magmatism occurring along the Nardin Front may have played a role by supplying K-CO_2 into the retrograding hydrothermal system.

DETAILED MAPPING OF ALTERATION AT GOLD LAKE USING A PORTABLE GAMMA RAY SPECTROMETER

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Gamma ray spectrometry (GRS) has been used successfully to map geochemical variations associated with a wide variety of deposits, including gold. The relatively undisturbed nature of occurrences in the Gold Lake area, NWT, presents a unique opportunity to test the effectiveness of GRS and other geophysical techniques for mapping alteration that can not be readily distinguished by the naked eye.

The rocks immediately north of Gold Lake display a well-exposed section of the Giant shear system. This section lies at the base of the Yellowknife Bay Formation immediately above the Townsite Formation. Two gold-bearing zones have been explored by over 27 trenches and approximately 70 drillholes. Within the Gold Lake area, however, the Kidder and Lynx zones have been well sampled but there has been no development on this property.

The Kidder zone is hosted in a quartz-chlorite-carbonate shear zone, typical of many narrow shear zones north of the Akaitcho Fault. The best exposures are at the margins of narrow linear valleys. The entire width of the shear zone is not exposed with the foot-wall covered by muskeg or clay-rich till. The shear zone grades inwards from unaltered gabbro into a chlorite schist to a core of gossanous sericite schist with minor quartz veins. The gold mineralization is focused in and/or near the quartz veins.

In contrast, the Lynx zone is not nearly as well defined. The zone is marked by a broad area of foliated rocks approximately 50 metres wide and 300 metres along strike. The least altered rocks are commonly fractured massive mafic flows that grade into chlorite schist. Locally, the shear zone is interrupted by large lenses of unfoliated rock. The most apparent alteration occurs as patches of gossanous ankeritic dolomite, forming crude lenses up to 10 metres wide and 20 metres long, containing small ribbons of pyrite-sericite schist. Within, but not always restricted to the sericitic zones are silicified “veins” consisting largely of quartz with abundant fine grained sulphide minerals, predominantly arsenopyrite. The highest gold grades are associated with these veins but the veins are not laterally continuous.

An Exploranium GR-320 gamma ray spectrometer was used to conduct a 6-line survey across both the Lynx and Kidder zones. Measurements were taken approximately every meter along the lines in trenched areas and then the spacing increased to four metres in covered areas. The spectrometer uses a relatively large volume (0.35 litre) sodium iodide crystal to measure the energy of gamma rays emanating from roughly a cubic meter of rock and absorbed by the detector during a two minute counting interval. For each reading, the unit sorts the gamma ray energies into a 256-channel energy spectrum, and is calibrated to provide real-time estimates of the concentrations of the three most abundant, naturally occurring isotopes: potassium, uranium, thorium. By contouring the ratios of the three elements, a detailed chemical map can be drawn that illustrates some of the subtle, cryptic alteration patterns that could not be mapped by the naked eye. There is a strong spatial association between radiometric anomalies and areas of known gold-bearing veins in sericite schist. This clearly demonstrates the utility of the ground GRS method for gold exploration in the area and strongly suggests that detailed airborne GRS would delineate similar gold-related alteration at property and regional scales throughout the Yellowknife Gold Belt and elsewhere.

USING REMOTE SENSING TECHNIQUES TO EXPLORE FOR LEAD AND ZINC: PINE POINT, A CASE STUDY

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Studies of Mississippi Valley Type (MVT) lead and zinc deposits continually suggest basement structures and bedrock topography are critical factors in the concentration and formation of metallic mineral deposits. While the causal relationship between these factors may be open for debate, their statistical association cannot be denied. Pine Point is one example of this association where a large-scale structure, the McDonald fault, is apparent. The McDonald fault can be readily traced where it offsets Precambrian rocks. However, Phanerozoic and Quaternary cover obscure long sections of this fault and other large-scale basement features west of Great Slave Lake, to the point that they are unrecognizable by conventional mapping techniques.

Remote-sensing techniques, combining satellite imagery and regional scale geophysical surveys, are often able to detect faint traces of these buried features. Individual data types such as a single Landsat image may not be able to discern the entire length of the structures, but when a composite image composed of different data type is synthesized, the structures become much more apparent. Additionally, where the basement structures are long lived crustal-scale faults, the remote sensing data may be compared to isopach and basement structure maps to determine the longevity of the movements and possible metal accumulation locations. A study area from 62º N, 112ºW to 60ºN, 120ºW was chosen to test the effectiveness of these techniques.

Four LandSAT 7 scenes were purchased and an additional two scenes were obtained from Geogratis (http://www.geogratis.gc.ca), a public domain website operated by the Canadian Centre for Remote Sensing. The images were orthorectified at the NWT Centre for Remote Sensing using the Ground Control Database, an on-line display of geo-corrected aerial photographs published by the Canada Centre for Remote Sensing, GeoAccess Division, available on the Geogratis web site. While the covered basement structures may not be directly visible on LandSAT imagery, the structures may cause permeability differences in the overlying rocks, resulting in variations in surface vegetation that may be detected by satellite.

A digital elevation model (DEM) was constructed from the 1:250,000 data made available by the Centre for Topographic Information (NRCan). This data was then used to orthorectify Radarsat images purchased from the Canadian Space Agency. The combination of the DEM and Radarsat images will allow the construction of three-dimensional views of the study area with other data sets draped over the topographic relief. This is a valuable tool for accentuating the subtle topographic features.

Two further data sets were acquired from the Regional Geophysics Section of the Geological

Survey of Canada: a Bouguer gravity anomaly grid with a grid spacing of 2000m and the residual total magnetic field grid with a 200m grid spacing. These data sets were leveled and corrected by Warner Miles. As the covering sequences have relatively uniform magnetic and physical densities, variations in the magnetic field strength and the gravity may be attributed to differences in the basement rocks. The net effect of the cover sequences is to "blur" the small-scale variations such that, only large-scale variations are apparent. In effect the geophysics allows us to see through the cover sequences. In combination with the remote sensing data and the sparse well data, buried basement structures can be discerned and these offer important clues towards the exploration for new MVT deposits in the NWT.

PLATINUM STUDIES IN THE KIVALLIQ

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A two-day helicopter reconnaissance was conducted in the Kivalliq during the summer of 2001. The objective of this project was to collect some rock samples for platinum, palladium, gold and ICP analysis. This project focused on visiting mafic and ultramafic rock exposures - principally those known to contain nickel and copper mineralization. Altogether, ten general localities were visited. No mapping was performed. The Geoscience Forum will be the first venue for release of these results to the public.

As much as possible bedrock grab samples were collected, after a brief investigation indicated representative material was available. In total thirty two samples were collected and then analyzed by Bondar Clegg. Most samples were taken from open Crown Land. For interest, a few samples were submitted for analysis from claims held by companies. Results for the latter will only appear pending the permission of the claim owner.

A spreadsheet contains all the pertinent information, such as GPS location, rock description, and significant analyses. Handouts will be available at the poster display, as well as a computer disk with all the data.

DEVELOPMENT OF THE NICO COBALT-GOLD-BISMUTH DEPOSIT - A CASE STUDY FOR MINES BOTH DISCOVERED AND MADE

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NICO is a large, low-grade cobalt-gold-bismuth deposit located 160km northwest of

Yellowknife, NWT. It is 8km from the past producing Rayrock mine and access road and 20km from surplus power from the Snare Hydro complex. NICO, and the nearby Sue-Dianne copper-silver deposit, are the only known Canadian examples of the "Iron Oxide-Hosted Polymetallic class", commonly referred to as "Olympic Dam-type". They are hydrothermal replacement deposits situated in the southern part of the Great Bear magmatic zone within the Proterozoic Bear Province. Fortune Minerals discovered NICO in 1995 during a program of geological mapping and airborne and ground geophysical surveys. Between 1996 and 2000, 256 holes were drilled, totalling 51,020m. Sulphide mineralization is contained within a series of stacked, 40 to 50º dipping, stratabound lenses of ironstone. They can be traced 1.2km along strike, up to 500m in width, and with individual lenses up to 90m in thickness. There are three main ore lenses with an average bulk density of 3.15mt/m^3. Diluted, in-pit resources at cobalt prices of US$10 and US$12.50/lb, range from 40 to 55 million mt with average grades of 0.07 to 0.08% cobalt, 0.5 to 0.6g/t gold and 0.1% bismuth. Waste-to-ore ratios range from 1.5 to 1.8:1.

NICO is at the pre-feasibility stage of development and extensive work has been carried out evaluating recovery of the contained metals from a unique deposit and mineral assemblage. Open pit mining is contemplated at a rate of 10,000mt/day. Ores would be processed at the site by conventional crushing and grinding followed by flotation to generate a bulk concentrate from the 5% sulphide fraction. Second stage flotation separates an auriferous bismuth concentrate by depressing flotation of cobalt sulphides. Recovery of cobalt has been optimized at 85% in a concentrate grading 1.7 to 5%. The difference in grade results from the arsenic to cobalt ratio of ores from different parts of the deposit. Bismuth has a predicted recovery of 55% in a concentrate grading 40%. Gold reports to both the cobalt and bismuth concentrates with recovery ranging between 55 and 70%, increasing incrementally with head grades greater than 0.5g/t. Bismuth concentrates would be sold to smelters in Canada and Europe. Cobalt concentrates would be processed in Yellowknife by acid pressure oxidation. Autoclave operating conditions have been optimized at 160ºC with sufficient acid generated from the sulphide feed. Cobalt is precipitated as metal, carbonate or hydroxide compounds by solvent extraction electro-winning. Gold would be recovered by cyanidation of the residue to doré. Arsenic is stabilized as ferric arsenate during pressure oxidation for disposal in surface tailings.

NICO contains a long-life resource of specialty metals whose markets are expanding due to new technology and more stringent environmental regulations. Annual cobalt production is estimated at 2,000mt into a 40,840mt market growing at 4.5%/yr. NICO is the largest deposit of bismuth in the world and would produce 1,000mt/yr into a 7,300mt market growing annually at 15%. Gold production would vary from 12,000 to 100,000ozs/yr from a global resource of approximately one million ounces.

A DISCUSSION OF GOLD FINENESS VARIATION OF SHOWINGS FROM THE EXTECH-III AREA

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Gold fineness determinations ([Au/(Au+Ag)]*1000) for individual gold grains provides an opportunity to document Au/Ag variations independent of other Ag-bearing phases within a paragenetic context. Petrographic analyses including gold-sulphide and gold-silicate associations have been documented in conjunction with quantitative electron microprobe determinations of the Au, Ag and Hg content for individual gold grains. A gold fineness dataset was initiated in 2000 with analyses from the Con Mine within the Yellowknife Greenstone Belt (YGB), from showings along the northern extension of the belt, and along the Ormsby Break including the Mon, Nose, Ormsby and Nicholas Lake deposits and Goodwin Lake showings. In 2001, samples from the Quyta Lake showing, Mon and Ormsby deposits; Giant Mine, Brock Vein (Giant property), and High Grade Island of the YGB; Crestaurum Mine (past producer) and Homer Lake showing at the north end of YGB; and Camalaren Mine (past producer, Burwash Basin) were analyzed to increase the spectrum of mineralization styles, host rocks and localities in the Yellowknife Basin.

Samples analysed this year range in gold fineness from 545 (50.67 wt % Au) up to 989 (98.7 wt % Au). Gold from the Homer Lake base metal-gold showing contains up to 6.34 wt % mercury; consistent with volcanogenic massive sulphide associated gold. Inter-grain fineness varies of 545-734 occurs where gold-chalcopyrite-galena intergrowths replace arsenopyrite in a galena-sulphosalt vein; while intra-grain fineness varies from 675-734 within gold enclosed in chalcopyrite-galena. Excluding Homer Lake, gold grains analysed contain negligible mercury; intra-grain fineness is predominantly insignificant, and inter-sample variation ranges from 720-989. The Ormsby deposit demonstrates a bi-modal distribution of 720-730 and 894-922, consistent with previous work. Lower fineness gold is associated with chlorite-biotite-tourmaline-quartz-feldspar altered wallrock containing pyrrhotite and devoid of quartz veins. In the higher fineness population, gold is associated with a polygonized quartz-feldspar vein. High Grade Island gold occurs in a chlorite-epidote-quartz-arsenopyrite alteration zone, overlapping with the lower fineness population at Ormsby. In the Brock Vein, high fineness (893-911) is associated with gold ± Fe-chlorite along recrystallized quartz-feldspar grain boundaries, overlapping with the high fineness population at Ormsby. Analyses from Quyta Lake have a tight fineness around 761 associated with gold on arsenopyrite adjacent to a quartz vein. At Crestaurum, high fineness (860-989) gold, chalcopyrite, and telluride inclusions are associated with stibnite retrograde alteration rims on berthierite cores. The gold- pyrite association at Crestaurum has intra-grain fineness variation (860-989) whereas intra-grain variation of gold in stibnite is negligible (986-989). At Giant, high fineness gold is associated with Sb-sulphosalts pyrite, similar to Crestaurum. In addition, gold occurs as aurostibite. Gold with a narrow range in fineness (806-827) at the Mon Mine occurs along polygonized quartz grain boundaries ± galena ± pyrite, consistent with previous work. Camalaren, a turbidite-quartz vein hosted gold deposit, has a gold fineness range of 776-848 associated with mica-actinolite-pyrite-galena± Pb-Te-sphalerite stringers in quartz.

Patterns of gold fineness with respect to sulphides/sulposalts and silicates are emerging from this study. Further paragenetic analysis will help resolve these relationships and relative timing in the continuum of gold already examined.

TANTALUM: A REVIEW

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Tantalum (Ta; atomic number 73; atomic weight 180.9479; melting point 2,996 ºC; specific gravity 16.65; valence +2, +3, +4, or +5) is a rare metal which saw a spectacular price rise in 2000-2001 from about $US50 per pound Ta_2O_5 concentrate (60% Ta_2O_5 basis) to a peak of $US400 on the spot market. The increase in price resulted from the preferred use of tantalum capacitors in cellular telephones and other electronic devices. These applications make use of a stable non-conducting layer of Ta_2O_5 that forms on the surface of the metal. Because of its high melting point and resistance to corrosion, tantalum metal is also used in chemical plant equipment. It is a common ingredient of superalloys, particularly those used for casting single-crystal turbine blades for aircraft engines. Because it is unaffected by body fluids and causes no adverse tissue reactions, tantalum is used in dental and surgical instruments and prostheses. Useful tantalum compounds include the carbide TaC_2, an abrasive almost as hard as diamond and used in cutting tools; and the oxide Ta_2O_5, used in making special highly refractive glass. Tantalum is considered critical to the United States because of its defense-related applications.

Tantalum is obtained chiefly from rare minerals such as tantalite [$(Fe,Mn)Ta_2O_6$]. Tantalum is almost always found in association with niobium (Nb), although the latter is far more abundant and has different applications. In 2000 tantalum-containing tin slags accounted for about 18% of the supply (compared to about 70% in 1980). Most tantalum is now produced from granitic pegmatites. Australia, Brazil, and Canada are the major producers of tantalum mineral concentrates. In 2000 production from the Greenbushes and Wodgina mines in Australia was 421 t tantalum oxide, or 25% of world requirements. In the same year Cabot Corporation's Tanco mine in Manitoba produced 64 t of tantalum oxide. Ore grades at these mines vary from 0.022 to 0.20% Ta_2O_5. It is interesting to note that tantalum and niobium are extracted from their ores (after concentration) by chemical means rather than by smelting.

Significant accumulations of rare elements such as lithium, rubidium, cesium, niobium, tin, and tantalum can result from the high degree of fractionation required to produce granitic pegmatites, which represent the end products of the magmatic stage in the evolution of granitic melts. "Fertile" granitoids parental to rare-element-enriched pegmatites have features that distinguish them from barren granitoids; these features serve both as a prospecting tool for selecting regions worthy of study, and are predictive of the degree of rare-element enrichment of associated pegmatites. The following indicators of fractionation are important when prospecting for Ta-bearing pegmatites: (1) mineralogical diversity; (2) the presence of rare-element indicator minerals; (3) geochemical enrichment, which may be monitored through fractionating element pairs, compatible/incompatible element variations, and isotope geochemistry.

Examples of rare-element-bearing pegmatites in the Northwest Territories include the Little Nahanni Pegmatite Group the O'Grady Aplite-Pegmatite Complex, and the Yellowknife Pegmatite Field. Tantalum is also found in the Blatchford Lake Plutonic Complex.

BLOCK FAULTING AND STRATIGRAPHIC RELATIONSHIPS IN THE PALEOPROTEROZOIC BAKER LAKE SUB-BASIN

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(1) Contribution to the Western Churchill NATMAP Project

The Paleoproterozoic intra-continental Baker Lake Basin consists of a series of northeast-trending sub-basins, including the Baker Lake sub-basin. Baker Lake sub-basin contains three unconformity-bounded sedimentary sequences: (1) Baker Lake Group (ca. 1.83 Ga Christopher Island Formation); (2) Wharton Group (ca. 1.76 Ga Pitz Formation); and (3) Barrensland Group (ca. 1.72 Ga Thelon Formation).

Basin analysis indicates that the Baker Lake Group was deposited in a northeast-trending half-graben with a bounding fault approximately parallel to the southern basin margin. Northwest trending dilational fault zones, with characteristic quartz veins and fault breccia, cross-cut volcanic rocks of the Baker Lake Group. Clasts of the breccia, quartz veins and fault breccia and coeval volcanic rocks occur in conglomerates of the uppermost Baker Lake Group.

An east-west trending (~100°) set of faults bound rotated fault blocks that repeat stratigraphy of the Baker Lake and Wharton groups. These fault blocks dip toward the axis of the basin; on the north side the faults are demonstrably north-dipping and therefore are normal faults. The dip direction on the south side of the basin is equivocal. Along the approximate axis of the basin strata are flat-lying, and the Wharton Group is absent such that the Baker Lake Group is unconformably overlain by the Barrensland Group. Fault geometry and stratigraphic relationships are consistent with a horst flanked by normal faults. Barrensland Group strata are flat-lying throughout the basin, indicating that this stage of faulting was post-(and possibly syn-)

Wharton Group, but pre-Barrensland Group.

The east-west trending normal faults are cross-cut by a conjugate set of northwest- (~340°) trending dextral, and northeast- (~040°) trending sinistral faults that occur throughout the basin from meso- to macro- scale (e.g. South Channel Fault with ~12 km of offset). These faults are interpreted to be predominantly strike-slip because map units of opposing dip are offset in the same direction. The Barrensland Group is cross-cut by faults of this trend, however offsets are minor (< 50m). These faults are parallel to at least one pre-existing fault set and are considered to have been active during and after deposition of the Wharton Group but before deposition of the Barrensland Group. Minor re-activation occurred subsequently.

The Baker Lake sub-basin is dissected by multiple brittle faults, which can be demarcated in time by their relations to stratigraphy. The Baker Lake Group (ca. 1.83 Ga) was deposited in a SE-facing half-graben cut by NW-trending faults. This phase of basin development was related to initial rifting. The Wharton Group (ca. 1.76 Ga) was deposited during active block faulting in a modified rift basin. This was followed by a phase of extension wherein fault blocks were rotated to their present attitudes prior to deposition of the Barrensland Group (ca. 1.72 Ga).

WELCOME TO THE DIAND NUNAVUT MINERAL RESOURCES SECTION

Ham, N. M.
DIAND Nunavut Mineral Resources Section

The DIAND Nunavut Mineral Resources Section, located in Iqaluit (Building 918) opened its doors to the public on April 1, 2001. Our office consists of four full time geologists, a small library containing geology books and journals, and the DIAND Geology Archives (including all released assessment reports) for Nunavut.

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GEOLOGICAL SETTING OF THE METAL POTENTIAL, WESTERN CHURCHILL PROVINCE, CANADIAN SHIELD, NUNAVUT: A NATMAP PERSPECTIVE

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As the Western Churchill NATMAP approaches the end of its 5-year mandate, what have we learned about the area's metal potential? Briefly, we envisage the following key geological events and settings: (1) Formation of a vast Neoarchean oceanic domain (~2720-2685 Ma; Hearne domain) in a broad, extensional, suprasubduction, pre-arc environment analogous to the SW Pacific Ocean during the Eocene, removed from extending continental crust (~2830-2710 Ma; Rae domain) located above a mantle-upwelling; (2) "Accretion" of the Western Churchill Province by tectonic juxtaposition of oceanic rocks over the continental margin accompanied by southeast-vergent thrusting at ~2660-2640 Ma; Renewed southeast-vergent thrusting at ~2550-2500 Ma (both NW Hearne); (3) Lithospheric extension with multiple mafic dyke swarms between ~2450-2100 Ma, and deposition of the "intracratonic" lower Hurwitz and Amer groups, culminating in the breakup of the Kenorland supercontinent; (4) A 150 m.y. lull, followed by "intracratonic" deposition of the upper Hurwitz and Amer groups after ~1950 Ma; (5) Province-wide diachronous northwest-vergent folding and thrusting, commencing in the Rae ($1850 Ma?) and migrating to the Hearne (~1830 Ma); (6) An ~1850-1830 Ma bloom of granitic melts across the Hearne and NE Rae; (7) Renewed lithospheric extension, intracratonic basin development and voluminous mantle-derived ultrapotassic magmatism (~1810-1785 Ma), lithospheric cooling and development of a thermal sag basin by ~1720 Ma (all Dubawnt Supergroup).

Selected potential economic implications:
i) One might expect an extensional, suprasubduction environment to be particularly propitious for large-scale metal deposition, but current knowledge does not suggest that this has been the case (cf. Heninga, Spi).
(ii) The hornblendite-gabbro host to the Ferguson Lake Ni-Cu-Co-PGE prospect appears to cut ~2550-2500 Ma thrust-related fabrics, but is locally thrusted and folded by likely ~1830 Ma deformation. We speculate that it may correlate with the ~2190 Ma Tulemalu-MacQuoid dyke swarm that cuts much of the NW Hearne.

(iii) The role of deformation in influencing the economic potential of some gold deposits and prospects in the Western Churchill is well known, e.g. the Meliadine and Meadowbank deposits. NATMAP results indicate that the structural influence at Meadowbank is a Paleoproterozoic rather than an Archean effect, and that faulting associated with Meliadine either accompanied ~1850-1830 Ma northwest-vergent folding and thrusting, or localized as regional shortening waned. Furthermore, VMS signatures have been identified by others in a number of base metal prospects, e.g. Sandhill and Victory. However, both are regionally associated with ductile thrust zones (~2500 and ~1830 Ma, respectively) and have potentially been remobilised by structurally channeled fluid flow. In addition, structurally remobilised gold of the Cullaton and Shear Lake deposits is associated with likely ~1830 Ma northwest-vergent folding and thrusting. From a NATMAP perspective these observations suggest that a period of crustal-scale fluid flow, such as might accompany a granitic bloom, associated with the focusing effect of deformation, e.g. regional-scale thrusting, might represent a highly prospective environment. In much of the Western Churchill Province, such a combination of events occurred at ~1850-1830 Ma.

POTENTIAL FOR CARBONATE-HOSTED MVT DEPOSITS IN NORTHERN ALBERTA AND SOUTHERN NWT – A TARGETED GEOSCIENCE INITIATIVE

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A joint project was initiated this year investigating the regional potential for carbonate-hosted lead-zinc or Mississippi Valley-type (MVT) deposits across a considerable area of northern Alberta and southern Northwest Territories. This two-year project was jointly conceived by the Geological Survey of Canada, the C. S. Lord Northern Geoscience Centre and the Alberta Geological Survey and is partly funded by GSC's Targeted Geoscience Initiative. The primary goal of the 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. By characterizing the geochemistry of each occurrence and relating their mineralization to the regional stratigraphy and structure, a better understanding of the petrogenesis of the MVT occurrences and their relation to the Pine Point deposit is achievable. The integrated geological investigation that will be utilized in this project will examine the relationship between stratabound Pb-Zn mineralization and its regional stratigraphic framework and will better characterize the structural features critical for fluid migration and ore deposition.

While a great deal of work has been done on the Pine Point district, new scientific approaches can build on the existing data sets and revitalize the district for further mineral exploration. Data gathered from hydrocarbon exploration will be integrated with existing data at Pine Point. The team will use satellite imagery, seismic sections, aeromagnetic and gravity interpretations, borehole geophysical information, and core samples, to: 1) establish the structural, stratigraphic, diagenetic, and geochemical conditions along the McDonald fault system at Pine Point, and 2) examine faults of similar trends for indications of migration of mineralizing fluids. Those faults exhibiting similar structural, diagenetic and geochemical characteristics as those at Pine Point would likely be considered as primary exploration targets. Dissolution, dolomitization, recrystallization and brecciation are common host-rock characteristics in MVT deposits. Clay mineral alteration patterns and anomalous reflectance patterns in organic matter are recognized in other carbonate-hosted lead-zinc deposits in the world and these potential alteration patterns will be examined.

MVT deposits exhibit some characteristics similar to hydrocarbon accumulations in that fluids involved in the formation of the host dolostones migrate in a similar manner- from source beds through permeable strata into various physical or chemical traps. Diagenetic alteration such as dolomitization, produces secondary porosity, an important consideration in both petroleum reservoirs and Mississippi Valley-type deposits. MVT deposits usually exhibit an association with organic matter, principally bitumen. Hydrothermal dolomite, recognized as an important exploration play-type in the oil and gas industry in the Western Canada Sedimentary Basin, is common in MVT deposits. Brines found in fluid inclusions of minerals in MVT deposits are similar to those found in petroleum exploration boreholes in sedimentary basins.

By the end of the project, substantial progress will have been achieved in attempting to answer the following questions: 1) What are the source and nature of dolomitizing and mineralizing fluids?, 2) What pathways did the fluids take and what is the regional extent of the fluids?, and 3) What were the interactions between fluids and rocks through which they flowed that led to ore localization?

THE NUNAVUT WATERS AND NUNAVUT SURFACE RIGHTS TRIBUNAL ACT: BETTER LATE THAN NEVER?

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On September 20, 2001, Parliament gave First Reading to Bill C-33, the *Nunavut Waters and Nunavut Surface Rights Tribunal Act.* Once passed, the proposed statute will partially fulfill Canada's long-standing obligation under the 1993 Nunavut Land Claims Agreement to define in statute the powers, functions, objectives and duties of the four principal institutions of public government established by the Agreement.

The draft legislation will establish a comprehensive regime for the management of water use and waste disposal in Nunavut, together with a statutory framework for the resolution of surface rights access issues and compensation claims for wildlife-related losses. It will provide statutory frameworks for the Nunavut Water Board (which has thus far operated under Article 13 of the

Nunavut Land Claims Agreement) and for the Nunavut Surface Rights Tribunal. The Agreement envisaged the implementation of this legislation not later than July 1996, and two previous attempts to establish it failed. Given its significance to exploration, mine development and mineral production in Nunavut, the progress of the draft legislation through Parliament will be closely monitored.

While many of the provisions of Bill C-33 are similar to those of the *Northwest Territories Waters Act,* others are based on specific requirements of the Nunavut Land Claims Agreement. This presentation reports on the current status of the legislation, reviews its principal features, and discusses the provisions that are particular to Nunavut.

CONTRASTS OF THE GLACIAL EROSION, TRANSPORT, AND SEDIMENTATION ON THE SLAVE CRATON, NORTHWEST TERRITORIES AND NUNAVUT

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The last glacial episode left a rather thin till coverage in the southern area of the Slave craton (Hardy, in prep.). Defined as being part of zones 3 and 4 of Aylsworth and Shilts (1989), this landscape seems to have acquired a "glaciodynamic" profile with regards to glacial erosion. After multiple glacial episodes during the Pleistocene, shouldn't it be the case for the rest of the Slave craton?

The results from the glacial geology mapping conducted during the Slave Natmap Program have defined multiple ice-flow episodes, and showed a rather thick till cover (Kerr et al 1994, Dredge et al, 1994) when compared to the southern portion of the craton. The ice-flow direction changes were most likely triggered by re-equilibration of the ice profile with regards to the advancing or retreating glacial margin, and by possible late local ice-streaming.

What is the resulting effect of strongly shifting ice-flows on the erosion, transport, and deposition of the overridden bedrock? How does the landscape respond to the history of ice-flow? The impact of these direction shifts is strongly felt by the dispersal patterns of any tracers, including but not limited to the kimberlitic mineral indicators. Another effect is the one from the inherited bed roughness to the bulk production of till by glacial action. It is suggested that the most intense erosion, and the resulting material transport, occurs in terrains of a non-acquired bedrock equilibrium profile with regards to the ice-flow direction. While feedback effects seem to preserve considerable drift thickness in the central Slave craton, relative erosional maturity seems to have been reached in the southern Slave craton.

GEOLOGICAL MAPPING IN THE ARCTIC USING REMOTELY SENSED DATA: BAFFIN ISLAND

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A study of the application of remote sensing technology for geologic mapping in Arctic terrain has been initiated as part of the Central Baffin mapping project in northern Canada by the Geological Survey of Canada (St-Onge et al., 2001; Corrigan et al., 2001). Good bedrock exposure and the lack of continuous vegetation cover in the Arctic Archipelago provide an ideal environment for the application of remote sensing, using both optical-infrared and radar sensors, to characterize lithology, structure and alteration patterns.

A test site in southern Baffin Island (Figure1), approximately 80 km. south of Iqaluit, has been selected for testing satellite, airborne and ground spectral data for characterizing different lithologic units and alteration targets. This area has a variety of lithologies ranging from gneissic/granitoid basement rocks to rift related volcanic and sedimentary rocks to younger overlying Paleozoic sediments, and has been mapped on a regional scale (1:100 k) by the Geological Survey of Canada (St-Onge et al., 2001).

Specifically, this project will: (1) develop new methodologies in support of the production f geological and mineral exploration maps using a variety of remotely sensed data and, (2) apply existing methodologies (classification using maximum likelihood and neural networks) for producing geological and mineral exploration maps

This paper presents preliminary results from visual inspection of enhanced Landsat TM, and hyperspectral remotely sensed data acquired over the test site as well as more advanced digital analysis. Initial field validation of the interpretation of the remotely sensed data will also be presented.

AGE, GEOCHEMICAL AND METALLOGENIC INVESTIGATIONS OF CRETACEOUS INTRUSIONS IN THE TINTINA GOLD BELT, SE YUKON AND SW NORTHWEST TERRITORIES: AN UPDATE

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The Tintina Gold Belt (TGB) in Yukon and east-central Alaska includes numerous styles of precious and base metal mineralization thought to be genetically associated with widespread Early to Mid-Cretaceous magmatism. Recent studies have led to the identification of numerous distinct plutonic suites in this region based on their lithological and geochemical characteristics, age, and their metallogenic associations. The scope of this project is a continuation of these studies focused on plutons comprising the southeastern extent of the TGB in SE Yukon and SW NT. On going research is aimed at identifying relationships between specific styles of mineralization and magmatism in the study area and includes the following main lines of investigation:

(1) Detailed U-Pb geochronology coupled with lithogeochemical analyses to delineate the age and petrochemistry of individual plutonic suites.
(2) Pb isotope studies of sulphide samples from mineral occurrences and feldspars from intrusions to test inferred genetic relationships between mineralization and magmatism.
(3) Trace isotope studies (Nd, Sr, Pb) to gain a better understanding of the nature of underlying basement rocks and their possible influence on both the magmatism and associated mineralization.

Here we report results and preliminary interpretations from initial dating, geochemical, and isotopic investigations.

MINE WASTE MANAGEMENT STRATEGY AT DIAVIK DIAMONDS MINE

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SNC - Lavalin

The Diavik Diamonds project site located on an island within pristine Lac de Gras, in NWT and Diavik's philosophy of being environmentally responsible, dictated the adoption of a creative design. This approach was also required because of limited space on, and the presence of the ice rich soil, on the island. The ice rich soil could lead to dump and dam slope instabilities if not properly dealt with.

The project consists of mining four kimberlite ore bodies that are located in the water of Lac de Gras and storing all the mine waste materials on the adjacent 17 km^2 island which also contains the plant and required infrastructures. The mining and processing of the ore bodies will produce soil overburden, waste rock and processed kimberlite that will have to be stored securely on the island. Environmental acceptable and economic solutions were developed by integrating: mining of the wastes, combined facilities design, material placement and progressive reclamation.

Some of the key components of the integrated design were: 1) segregation of waste rock into three groups for most efficient closure design of the rock (one rock type may have acid drainage potential), 2) combining the design of the waste rock, overburden and processed kimberlite to produce the smallest footprint, 3) using the local topography and project created features to store the waste rock in cells and place the acid potential rock into two ‘tub’ containments that would prevent seepage up to the time the rock is encased in permafrost, 4) schedule placement of rock to maintain cold foundation along the dump perimeter to maintain dump face stability, 5) develop cover designs to correspond to type of solid waste and keep the wastes permanently frozen and 6) adopt progressive reclamation with pit overburden stripping schedule to minimize the progressive and final reclamation costs.

The Diavik site allowed for optimum conditions in combining the above components to develop a good engineered, environmentally friendly, cost efficient operation and reclamation plan.

ALTERATION AND MINERALIZATION OF THE SUPERCREST DEPOSIT, GIANT MINE, YELLOWKNIFE, NWT.

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Gold mineralization of the Miramar Giant Mine area is the product of multi-staged alteration, mineralization and deformation. The currently active Supercrest Mine is the focus of this study. Unlike past producing deposits of the Giant Mine, Supercrest is dominated by refractory gold hosted in schists and breccias. Ores are distinct, with high arsenic and antimony concentrations relative to other regions of the Giant Mine, variable alteration assemblages, and multiple ore hosts. This project attempts to document and discuss the internal variations of mineral assemblages, fluid chemistry, ore morphologies and concentrations. Preliminary mapping and sampling of the Supercrest deposit on a stope scale has documented three gold mineralized assemblages and five mappable micaceous alteration assemblages.

Mineralization is not controlled by rock type, but is the product of at least three gold bearing alteration phases. Significant gold concentrations are associated with populations of arsenopyrite, sulphosalt and arsenopyrite – stibnite – sphalerite assemblages. Ore may be hosted within: (a) sericite schist, (b) crackle breccia, (c) chlorite schist, (d) quartz - dominated breccia, or (e) sericite – quartz breccia. Non mineralized ore type lithologies have also been observed.

Current alteration packages are based upon sericite, and green mica assemblage colour variations observed in hand samples. Three mappable sericite alteration shells and two green mica assemblages are spatially associated with gold mineralization. (1) Yellow sericites typically host ore, and/ or form regions of extensive alteration. The yellow sericite population is the dominant alteration assemblage and has been grouped into four sub classes: halos enveloping breccia veins, breccia clast type, extensive alteration zones, and host arsenopyrite mineralization. Breccia ore halos may contain local coarse grain pyrite, and may or may not host gold mineralization. Clasts of sericite and fine grain arsenopyrite mineralized sericite schists have been mapped in breccia ores. Crackle ore are typically hosted in a yellow sericite alteration pockets that has been brecciated by later sulphosalt and silica rich fluids. (2) Brown sericite populations are not as extensive as yellow populations. Contacts are sharp between brown and yellow sericites. Brown sericite alteration may host crackle ores or be found as breccia clasts. (3)The last major sericite alteration assemblage is a combination of yellow sericite and brown sericite stringers. The later assemblage may be several meters wide, marking the transition between pillow basalts and extensive alteration zones. Green micas are very localized around and within quartz breccias. (4) Chloritic schist hosts gold mineralization, proximal to sericite-quartz breccias. These zones host sulphosalt and arsenopyrite mineralization and lack sericitic alteration. (5) Finally a fuchsite like green mica assemblage that may contain up to 15% bright green micas, has also been noted, with an erratic distribution. All alteration assemblage contacts are sharp and irregular.

POCKET PCs AND GIS: EFFECTIVE TOOLS FOR FIELD DATA COLLECTION

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Computers have become increasingly more important for data collection in regional geological mapping and exploration programs. In earlier computer-based field data systems, data was entered in the evenings or on "office" days reducing effective time for geological discussion and compilation. An initial solution to this problem used Newton Handhelds in conjunction with GPS units and Fieldlog software. This allowed data collection on the outcrop and downloading at night into CAD-based systems.

Geology maps that are structured suitable for use in GIS versus CAD systems have become important due to the added functionality of modeling spatial attributes. In response, several agencies currently use Palmtops (or PDAs) and GPS units to enter field data in a dBase-compatible format, which is then downloaded and imported into a GIS. Recent new hardware technology known as Pocket PCs (PPC), that can run GIS software, has made field data collection into GIS-compatible format a one-step process.

This summer (2001), the bedrock mapping crew at Walmsley Lake used Compaq IPaq Pocket PCs (PPC) to collect field data. Loaded with ERSI's ArcPAD, these PPCs enable the geologist to enter data (point, line or polygon) as ESRI shape files onto a map (hydrology, geology, etc.) or georeferenced image (magnetics, LandSAT, airphoto, etc.). These shape files are completely compatible with Arcview GIS 3.x and need only be downloaded from the PPC.

The Walmsley Lake ArcPAD database is a series of shape files (with associated dbf files) modified from Fieldlog. Multiple data-entry forms were created for each shape file to aid in data entry and utilize the limited screen size of the PPC. A location or new record in the database is added by simply touching the user's location to the map or image on the PPC screen. A data entry form presents itself and a series of pulldowns, check boxes and text fields are used to enter field observations. A GPS can be used manually, via cable or PC card for a more precise allocation of data.

For the most part, the PPC is durable, provided they are handled with some care. Plastic cases were used to protect the PPC from damage caused by dropping and moisture. Data can be entered in poor weather using a transparent screen on the case front. Units were recharged nightly using a solar panel system, which was found to be effective.

Minimal training for the field geologists was required to operate the units. The PPCs, without ArcPAD, were given to the each geologists a few days before the field season so that they could become familiar with all the functionalities of the PPC and its the operating system. Less than one day was spent learning the ArcPAD interface, its data entry forms, the downloading process, and the uploading of data files, maps, and images. At the end of the season, all the geologists were quite comfortable with the PPC and there were no major concerns.

In addition to ArcPAD, the PPC ships with several programs that can be useful in the field. For instance, the "Notes" software allows for detailed field observations, and even includes sketch functionality. Excel can be used to describe lookup table codes for clarification. The picture viewer can be used to view scanned classification schemes or legends. The uses are only limited to the imagination, though the base memory capacity of 64 MB limits the amount of data.

THE 2001 SNARE RIVER PROJECT: MAPPING RESULTS WITH FOCUS ON THE HIGH GRADE ROCKS

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In 2001 field work continued for the multi-year Snare River Project, in the southwestern Slave Province, N.W.T. (parts of 85N and 85O). During the past field season, mapping was focussed in the low-grade rocks of the Emile River, Slemon Lake and Wheeler Lake areas and in the high-grade rocks between Cowan and Ghost lakes. The geology of the Slemon and Wheeler lakes area is presented in Stretch and Jackson (this volume).

The Emile River marks a major contact between Archean metasedimentary and granitic rocks in the east and mixed Proterozoic and Archean granitic, syenitic and gabbroic rocks in the west. The contact is interpreted as a fault. A narrow strip of Proterozoic carbonate strata preserved along the west side of the fault suggests west-side down displacement. Schistose to migmatitic Archean metagreywackes-mudstones to the east are more extensive than indicated on previous geological maps. These rocks are notably lacking in banded iron formation (BIF), although they are continuous with BIF-bearing metasedimentary rocks at Russell, Slemon and Labrish lakes. This may imply that the BIF-bearing sediments were deposited locally around the isolated volcanic centers developed at Russell and Labrish lakes.

Mapping in the high-grade rocks continues to confirm the consistency between bedrock geology and contacts interpreted from detailed aeromagnetic maps. Bulls-eye-shaped aeromagnetic patterns coincide with granitoid-cored structural domes; basins are cored by high-grade metasedimentary rocks. Megacrystic granite forms the core of most of the domes; exceptionally the dome at “Spirit” Lake is cored by a composite, enclave-rich granitoid (“Disco granite”) that is mantled by megacrystic granite. Megacrystic granite is expressed by both magnetic highs and lows, while metasedimentary rocks, whether they are BIF-bearing or not, are expressed as lows. “Disco granite” is typified by a high magnetic expression, consistent with the common occurrence of magnetite in the unit. Granitic phases in the high-grade terrane are interpreted as sheets or shallow lenses that were emplaced during or prior to the dome- and basin-forming event(s).

BIF-bearing metasedimentary rocks of northeastern Russell Lake have now been traced northeast of Cowan Lake into the high-grade terrane. In this area, the contact between the Disco granitoids and metasedimentary rocks is commonly marked by a thin, but persistent felsic gneiss unit, of probable volcanic derivation, that was identified during 2000 mapping. Structural trends and lithologic contacts define a large “s”-asymmetric structure and metasedimentary rocks outlining this structure appear to underlie rocks of the central granitoid complex.

Exotic enclaves within the “Disco granite”, consisting primarily of plagioclase and amphibole and locally exhibiting orbicular plagioclase aggregates, were given the field term “anorthositic”. These may be remnants of mafic to ultramafic intrusions that are found mainly near Kwejinne Lake.

The fault marking the eastern boundary of the high-grade rocks, although poorly exposed in the area, was found to juxtapose high-grade mafic gneisses, metasedimentary rocks and granitoids against K-feldspar porphyritic two-mica granite containing cataclastic features.

HISTORY OF HYDROCARBON EXPLORATION IN THE NORTHWEST TERRITORIES

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The north has had a long and colourful history of hydrocarbon exploration. Roughly 1900 wells have been drilled north of sixty with the great majority dating back 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.

A 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.
A more detailed history can be found in a paper by this author at
http://www.bmmda.nt.ca/what's_new.htm or http://www.liardresources.nt.ca/whatsnew.htm

HYDRODYNAMIC STUDY OF THE MIDDLE DEVONIAN OF THE SOUTHERN NORTHWEST TERRITORIES

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This study of hydrodynamic conditions in middle Devonian formations (Slave Point, Keg River, Sulphur Point, Pine Point) is a component of a broader study into Mississippi-Valley-Type

mineralization as found at Pine Point, Northwest Territories. It also provides fundamental background regarding potential hydrocarbon reservoirs in the region.
Important structural and stratigraphic features that likely influence the current flow of formation water within the middle Devonian include the block faulting of the Cameron Hills, the Tathlina Arch, the Hay River fault Zone and the eastward thinning of the Phanerozoic section. Data from drill stem tests and fluid analyses was used to construct a pressure elevation chart that shows all middle Devonian formations are essentially part of one aquifer system. Almost all points line up very close to an average water gradient of .47psi/foot indicating moderately saline formation water in a normally pressured basin where the rock framework supports itself and pressure is largely due to the weight of the water.

A potentiometric map indicates that flow is primarily to the northeast where the Precambrian outcrops. Widely spaced contours over most of the area indicate slow flow and uniform permeability for the gross middle Devonian section. The Cameron Hills area has a somewhat lower potential than the general trend. Downdip flow (dip is generally to the northeast) from east to west may have helped to trap the hydrocarbons found in that area.

More detail can be found in a paper by this author at: http://www.bmmda.nt.ca/what's_new.htm or http://www.liardresources.nt.ca/whatsnew.htm

HYDROCARBON POOLS OF THE NORTHWEST TERRITORIES: CAMERON HILLS (PARAMOUNT HB CAMERON HILLS M31-6010-11700)

Janicki, E.P.
C.S. Lord Northern Geoscience Centre

This is the first section in a series of informational articles on potential and producing hydrocarbon pools in the Northwest Territories. They will be posted as they are completed at: http://www.bmmda.nt.ca/what's_new.htm or http://www.liardresources.nt.ca/whatsnew.htm

The Northwest Territories will be divided into regions, and within each region there will be sections on individual discoveries or pools. This first section is on the Cameron Hills gas discovery within the region of the Southern Territories.

Each section will contain some or all of the following:

- A brief description of discovery details
- An outline of regional geology and stratigraphy
- A list of reservoir parameters
- Seismic discussion (where available)
- References
- Stratigraphic and structural cross-sections

A type log over the productive zone
Structure and isopach maps where applicable or informative

PARAMOUNT HB CAMERON HILLS M31-6010-11700

The Slave Point gas reservoir at M31-6010-11700 is developed near the top of the formation, below 6 metres of tight limestone in a fossilferous zone correlatable to other wells in the area. Lateral trapping at M31 is effected by juxtaposition, through faulting, with shales of the Waterways or dense limestones of the Slave Point.

The Keg River reservoir at M31-6010-11700 is developed in dolomite that exhibits streaky and patchy porosity overlying a bed of dense anhydritic dolomite. The lateral trap is formed by Muskeg anhydrites that have been brought into contact with the Keg River by block faulting.

SIGNIFICANCE OF WALKER LAKE SHEAR ZONE WITH RESPECT TO REGIONAL DEFORMATION IN THE COMMITTEE BAY BELT, CENTRAL MAINLAND, NUNAVUT

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The Committee Bay greenstone belt, NTS 56K and 56J, is composed of the Prince Albert group supracrustal belt and associated plutonic rocks which were mapped at a scale of 1:100,000 during the summers of 2000 and 2001. These rocks are deformed by the Walker Lake shear zone (WLSZ), an E-W trending dextral shear zone, which is over 80km long, and has been identified by field mapping and interpretation of regional aeromagnetic data. The WLSZ consists of two spatially separated segments with different characteristics (Western WLSZ and Eastern WLSZ). In the Western WLSZ and the Eastern WLSZ strain is concentrated at the boundary of rigid intrusive bodies, the VT tonalite (VTT) and Augen Granite respectively. Strain in the Western WLSZ is heterogeneous and localized in anastomosing zones of protomylonite several hundred metres wide, while strain in the Eastern WLSZ is much stronger and concentrated in one mylonitic zone ~2km wide.

Rocks in proximity to the WLSZ have experienced at least three episodes of deformation. D1 resulted in a strong, bedding-parallel foliation, S1. F1 folds are interpreted on the basis of younging direction reversals in komatiites and fold interference patterns in the strain shadow of the VTT. Open to tight F2 folds, shallowly plunging to the NE and the SW control the map pattern. S2 foliation is rarely developed in F2 hinges, but F2 limbs are strongly foliated with an S1/S2 composite foliation. F2 folds tighten towards the WLSZ and are observed within the shear zone, where the main fabric is L2, an F2 hinge parallel stretching lineation. The WLSZ is likely a D2 structure representing a zone in which D2 deformation is concentrated, although at this stage we cannot rule out the possibility that it is a post-D2 structure overprinting F2.

Preliminary U-Pb geochronological analysis of a syn-tectonic dyke indicates that there was ductile deformation along the WLSZ at ~1830 Ma, but ongoing geochronology will clarify deformation timing and the relationship between the WLSZ and D2. The WLSZ is deformed by D3 folds, which are open warps of the S1/S2 fabric.

GEOPHYSICAL EXPERIMENTS IN CENTRAL BAFFIN ISLAND

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Geophysical experiments are taking place on Baffin Island as part of the 4-D Central Baffin geoscience project. The project's principle aim is to understand the northern margin of this northeastern exposure of the 1.8 Ga Trans-Hudson Orogen. A 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.

Preliminary analyses of the gamma-ray spectrometry data from the 2000 season were published in Ford (2001). These analyses showed that the radioelement compositional differences within the supracrustal rocks of the Piling Group can be accurately and efficiently determined using a portable gamma-ray spectrometer thus providing an effective mapping and sampling technique at local, detailed scales. During the 2001 field season in excess of 400 additional ground gamma-ray spectrometry measurements were made. These were concentrated on the Archean othogneiss's and various Archean and Proterozoic intrusions north of the Piling Group. Analysis of these measurements is still in progress.

The teleseismic experiment began in July, 2000 with the installation of three solar- and wind-powered stations. Two of these were subsequently relocated in 2001, and a further three stations installed. All six sites will record seismic waves from distant earthquakes until August, 2002. Early results from two of the stations indicate unusually thick (or low velocity) crust beneath the central and southwest part of the mapping area (40-42 km). Also, seismic waves arriving at these stations from the northwest sense a different crustal structure from those arriving from the south.

The first phase of the magnetotelluric (MT) experiment took place during July-August 2001 with fifteen sites along an ~300-km-long NNW-SSE profile, and a sixteenth site located at the GSC

Camp for instrument testing and for three-dimensional control. The MT sites were located to be optimally positioned as far from seawater as possible, within helicopter range, and to obtain a profile that crossed the major geological structures in the mapping area. The most significant conclusion reached from preliminary analyses and modelling is that the highly conductive iron, sulphide and graphite-rich Astarte River formation, a distinctive stratigraphic marker horizon within the Paleoproterozoic Piling Group,is electrically disconnected to similar rocks found in the south. This could suggest that Archean rocks to the south are not related to Rae craton rocks to the north, or that tectonic imbrication has disconnected northern and southern segments. Either way, the results indicate that the Pilinggroup rocks do not sit within a synformal basin structure.

Ford, K.L., 2001. Reconnaisance gamma-ray spectrometry studies of the Paleoproterozoic Piling Group and adjacent Archean basement rocks, central Baffin Island, Nunavut. Geological Survey of Canada, Current Research 2001-E4, 12 p.

CARBON IN THE MANTLE?
THE ELECTROMAGNETIC RESPONSES OF THE SLAVE AND SUPERIOR CRATONS COMPARED AND CONTRASTED

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Long period magnetotellurics (MT), a deep-probing, natural-source electromagnetic geophysical method, offers a complementary technique to passive and active seismology for obtaining in-situ physical property information about the sub-continental lithosphere mantle (SCLM). Secondary electromagnetic fields, sensed at the surface of the Earth, are induced in vertical and lateral anomalies in electrical conductivity imposed by tectonic and magmatic processes during creation and subsequent evolution of the SCLM. The MT responses are modelled to image the geometry and conductivity of those anomalies, and appropriate conclusions can be drawn regarding their causative development. As an example of the contribution that deep MT studies can make, electrical conductivity is particularly sensitive to the onset of partial melt, and both laboratory and numerical model studies have demonstrated that even a small amount of melt (<0.1%) will connect efficiently and consequently increase conductivity by two or more orders of magnitude. Thus precise MT data offer the highest resolution possible of the depth to the lithosphere-asthenosphere boundary.

During the last five years there have been a series of deep-probing MT experiments performed on the Slave and Superior cratons as part of Lithoprobe and GSC activities along the SNORCLE (Slave-Northern Cordillera Lithospheric Evolution) and WS (Western Superior) transects. We report herein on the results of those experiments, comparing and contrasting the electrical images obtained of the two SCLMs.

The experiments on the Slave craton have revealed an anomalous region within the upper mantle beneath the central Slave (Jones et al. 2001). The Central Slave Mantle Conductor (CSMC) correlates spatially with the surface Eocene-aged kimberlite field, and in depth with a geochemically-imaged ultra-depleted harzburgitic region (Griffin et al. 1999). Its top is at 80-100 km depth with a minimum thickness of 20 km, and its internal isotropic conductivity is of the order of 0.03 S/m or greater. This conductivity is to be compared to silicate minerals (olivine) which have a conductivity of 0.0001 S/m or smaller at those P-T conditions. There is currently no evidence for anisotropic conductors within the Slave's SCLM.

In contrast, the most striking feature in the Western Superior dataset is the observed strong electrical anisotropy in the SCLM with correlation of electrical strike directions with the major syn- and post-Kenoran zones of transpression on either side of the Archean North Caribou terrane (NCT). Also evident in western Superior is a region, closely approximating the area of the NCT, where the MT data manifest a weak preference for electrical strike and the SCLM is predominantly 1-D or layered. This isotropic region is thus comparable to the isotropic CSMC.

Carbon-based conductors are an attractive explanation for the conductive features observed in the Slave and Superior lithospheres above the graphite-diamond stability field (~150 km depth). Carbon in graphite form behaves as a metal and therefore has high conductivity. Grain boundary carbon may also contribute to elevated conductivity in the SCLM (Duba & Shankland 1982). Graphite is an accessory phase in xenoliths observed worldwide (Pearson et al. 1994).

STRATIGRAPHY AND PALEOENVIRONMENTS OF LOWER CRETACEOUS STRATA IN THE LIARD BASIN

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Cretaceous strata of the Liard basin consist mainly of the Albian to Cenomanian Fort St. John Group and the Cenomanian Dunvegan Formation. This study, which extends north from Steamboat Mountain in Northeastern British Columbia (94J/12) and covers the 94N, 94O, and 95A-C map sheet areas, is being undertaken to produce the stratigraphic architecture and paleoenvironmental history of the Liard basin. The study is based on outcrop and core analysis, foraminiferal biostratigraphy, digital well log correlation and geochemistry (Rock-Eval). This interval, which is represented by the Chinkeh, Garbutt, Scatter, Lepine, Sikanni and Sully formations, records a variable sea-level history during Albian and Cenomanian time. The details of several transgressive-regressive cycles that have yet to be fully documented will be correlated with strata south of Fort Nelson.

More than 30 remote outcrop sections, along with core from northeastern B.C. and Northwest Territories, have been sampled for foraminifera and rock-eval pyrolysis in collaboration with the

GSC NATMAP project and the Northwest Territories Minerals, Oil & Gas Division for the Liard basin area. Initial foraminiferal studies indicate abundant assemblages, which will allow future correlation of strata throughout the basin. Increased foraminiferal numbers mark the distinct flooding surface at the base of the Garbutt shale, whereas the variable facies of the underlying Chinkeh Formation are impoverished in benthic foraminifera. Initial log correlations have shown a number of distinct markers, particularly within the lower Garbutt, the tops of the Scatter and Sikanni formations, and the Fish-Scales Marker Bed (FSMB) in the upper part of the Sully.

Objectives of this study include:

1) To date, the age of the lower Garbutt Formation is uncertain and has to be established in relationship to the initial lower Albian transgressive shales to the south.
2) A detailed comparison between microfossil assemblages, geochemical data, and log signatures will reveal the position and nature of maximum flooding surfaces and the nature of parasequences within this major shale package.
3) Faunal results of transgressive units will be compared with assemblage changes within the regressive strata seen in the Scatter and Sikanni formations. This will refine our understanding of the detailed sea-level history of the basin and provide a foraminiferal zonation that is new to this area.
4) Previous lithological studies in the area have documented drastically different geometries of clastic units. Foraminiferal evidence will further define facies change through time and space.
5) Work on the Sully Formation will look at the expression of the important basin-wide FSMB and the age of the erosive base of the Dunvegan Formation.

NEW VOLCANIC SEDIMENTARY BELT IN THE YUKON AND RELATED EXPLORATION OPPORTUNITIES

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Over the last three years of work in the Yukon, Manson Creek Resources has identified and documented a completely new geological environment prospective for the discovery of base and precious metal rich polymetallic volcanogenic massive sulphide deposits such as the Marg deposit, Mayo Mining district, Yukon Territories (5.53 Mt grading 1.76% Cu, 2.46 %Pb, 4.6% Zn, 62.7 gpt Ag and 1.0 gpt Au). Prospective volcano-sedimentary stratigraphy identified to date spans an irregular area of over 35 km by 35 km and, if extended to the known Marg deposit to the west, would have a total prospective strike length of over 60 kilometers in an east-west direction.

Previous work in the area had roughly outlined a geological environment believed to be dominated by carbonate rocks and minor shales (Hyland and Earn group). As such, the area was generally considered to be prospective for MVT style lead-zinc (+/- silver) mineralization. The discovery by Manson Creek of copper and copper-gold mineralization in association with volcanic rocks in the Nadaleen range in 1997 prompted a reassessment of the regional context and guided further fieldwork in 2000 and 2001.

Supportive geological elements observed to date on the various properties include the mapping of a well exposed shallow marine volcanic sequence dominated by basalts and minor komatiitic flows as well as volcaniclastic rocks and basaltic agglomerates with minor felsic clasts and bedded barite with minor basalts in black shales. Numerous gossans with anomalous water and stream geochemical signatures have been identified within this context.

As a result of the regional and detailed geological, geochemical and geophysical work undertaken by Manson Creek since 1997, three specific targets have been identified and surface assessed to the drill stage.

GEOPHYSICAL SURVEYS AT GOLD LAKE AND THEIR IMPLICATION FOR GOLD EXPLORATION IN THE YELLOWKNIFE MINING DISTRICT

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Geophysical surveys consisting of magnetics, electromagnetics (EM), very low frequency EM (VLF) and induced polarization (IP) have been carried out in the Gold Lake and Crestaurum areas, just north of the Supercrest deposit in the Yellowknife Mining District (YMD). The survey grid extends across two parallel NNE-trending mineralized zones (shear zones) developed in a mixed package of mafic and felsic volcanic rocks that were intruded by gabbro sills. These mineralized zones contain gold-bearing quartz veins within alteration zones of chlorite-rich and sericite-rich schists. An exploration model developed using results of previous petrophysical studies on rocks from Giant and Con mines showed electrical resistivity (ƒÏ) decreases from high (>10^4 Om) to relatively low values (30-100 Om) as the rock types progress from relatively fresh basalt distant from mineralization, through gold-poor chlorite-schist and auriferous sericite-rich schist to gold-rich quartz veins. However, the relatively low ƒÏ values of the gold ore is discontinuous with a very high ƒÏ value (>5×10^4 Om) representing the entire vein, so that the intermediate ƒÏ values (400-10^3 Om) of the sulphide-bearing sericite-rich schist in the direction parallel to foliation constitute a better exploration target. The ƒÏ values of the two schists are very anisotropic (1:5-50). The purpose of this survey was to test this exploration model.

Results of the EM-survey show that the two mineralized zones appear as relatively good conductors with their ƒÏ values tending to be the lowest at the surface and slightly increasing with depth. This is likely due to the fact that most structurally controlled gold-rich zones in the Yellowknife area occur in swampy topographic depressions in which the water content in the pores along foliation would decrease with depth. This survey shows that the zone in the western section of the survey area (Kidder Zone) tends to dip east, but the one in the eastern section (Lynz Zone) is more complex, possibly due to warping of the gold-bearing zone during regional compression. Both EM conductors were considerably stronger than expected. Recent petrophysical studies on rocks from the Lynz Zone suggest that this is due, in part, to arsenopyrite with good grain-to-grain inter-connectivity filling a later generation of fractures which, at least locally, cut across crenulated pyritic sericite-rich schist at a high angle to the earlier foliations. Although the crenulated sericite-rich foliation has relatively low ƒÏ values (30-100 Om) due to pyrite, the late generation fracture-filling arsenopyrite has significantly lower ƒÏ values (5-15 Om). The combination of widespread pyritic schist and local presence of arsenopyrite-filled fractures probably contribute to the strength of the EM conductors.

This study suggests a three-stage strategy for gold exploration by geophysical methods in this area. The first **(1)** is a multi-frequency EM survey to locate and obtain basic structural information on mineralized (shear) zones with potential gold-bearing targets. The second **(2)** is a multi-frequency EM or IP survey along the zones to identify the sulphide-rich portions within the targets. These two stages can be accomplished by existing instrumentation, but not necessarily with conventional application methods. The third **(3)** is to identify the gold rich portions of the target by identifying indicator minerals within the mineralized zones. Once the indicator minerals are determined, there are a number of geophysical methods that have potential for application. For example, there is a possibility of distinguishing between pyrite, arsenopyrite and galena by electrical methods, if one or more of these can be identified as effective indicator minerals. This area requires further study.

SPECTRAL-IP AND PETROPHYSICAL CHARACTERISTICS OF ROCKS FROM THE YELLOWKNIFE MINING DISTRICT: IMPLICATION FOR EXPLORATION

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Electrical resistivity and spectral-IP characteristics of rock samples from the Lynx Zone in the Gold Lake area north of Supercrest were measured as part of ongoing investigation of geophysical properties of rocks in the Yellowknife Mining District (YMD). The purpose of this study is to determine if a wide frequency band spectral-IP method has the possibility of discriminating gold indicator minerals from non-indicator minerals in the mineralized zones. Conventional IP methods, generally, use a very limited range (0.1-10 Hz) of the available frequencies. In addition, the pore-size distribution characteristics of these rocks have also been examined, in order to determine if they may assist the discrimination process.

Previous studies have indicated that sulphide bearing sericite schist that is typically associated with gold mineralization is a viable geophysical target during gold exploration. Such rocks possess moderate electrical resistivity (ρ) values ($300\text{-}10^3$ Ωm) parallel to foliation and relatively high ρ values ($10^3\text{-}10^4$ Ωm) perpendicular to foliation. Results of this study indicate that the sericite schist samples from the Lynx Zone display considerably lower ρ values (5-50 Ωm) in both directions. This is due to better than average sulphide grain-to-grain inter-connectivity. In particular, arsenopyrite filled fractures display low ρ values and strong IP signals in the $30\text{-}10^3$ Hz range, a frequency range generally outside that for conventional IP systems. Other spectral-IP studies have shown conductive mineral grain-size effects in the $10\text{-}10^5$ Hz range, with significant differences between pyrite, chalcopyrite, galena and iron oxides. In addition, pore-size distributions show that other YMD samples containing arsenopyrite tend to show a larger concentration of storage pores in the smaller pore-size rang (10-100 nm). These suggest that there is a possibility of identifying different types of sulphide minerals by geophysical techniques, but that further mineralogical studies are required to define the gold indicator minerals.

THE USE OF REGIONAL EXPLORATION GEOPHYSICAL DATA FOR ENVIRONMENTAL AND ENGINEERING INVESTIGATIONS: APPLICATIONS IN THE NORTH AND LESSONS FROM THE SOUTH

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In any region of the world with potential for mineral and hydrocarbon resources, large areas of terrain are investigated using a multitude of geological and geophysical methods.
Regional geophysical data including airborne geophysics, remote sensing images, seismic reflection sections, and well logs cover significant tracts of the Northwest Territories and Nunavut. These data are valuable not only for exploration and resource assessment, but also for a wide range of engineering and environmental applications. In provinces with mature exploration scenes (e.g. Alberta), some of these data sets are already viewed as a resource for continued use. The NWT and Nunavut are at a critical stage in their resource development strategies and need to consider the options for capturing as much data as possible to ensure its availability for a wider range of uses. In Europe, countries such as Denmark and Finland have realized the value of complete coverage of their territory with high-resolution geophysics to map aquifers, gravel

deposits, and to monitor changes to the near-surface environment. The costs of performing entirely new geophysical surveys, designed for environmental applications, is enormous even for a small country. Utilizing existing data and filling-in the areal coverage with new surveys is the only practical solution, particularly for territories as large as NWT and Nunavut.

Environmental and engineering projects in Alberta and the NWT that have used regional geophysical data to map the top 200 m of the subsurface include:

1) Groundwater exploration in Quaternary channels using oil industry seismic data;
2) Groundwater protection through the delineation of aquifers and aquitards using oil industry geophysical logs;
3) Regional permafrost investigations using airborne electromagnetics; and,
4) Large-scale aggregate and clay resource evaluation using remote sensing and airborne geophysics.

Further uses in the north include permafrost degradation monitoring for climate change investigations, DEW-line site clean up, mine closure, reclamation, and tailings studies, pipeline route delineation, and oilfield waste disposal and monitoring.

Significant challenges will be faced in obtaining the data needed to provide a usable resource. These challenges include: providing a mechanism for public release of proprietary data; close co-operation between the resource industry and government departments to guarantee data quality and consistency; having the resources to compile and store large data sets; and having the skills to provide value added products for the end users. In Alberta, a mixture of government regulations and commercial ventures (seismic brokers) ensure that certain data sets are available (e.g. well logs and seismic sections). Despite these efforts many valuable data sets not of direct interest to the oil and gas industry are being lost. A broader view of regional geophysical data, including the examples discussed above, would result in a huge increase in resources available for environmental management of Canada's north.

AN OVERVIEW OF GOLD GRAIN DISTRIBUTION AND GEOCHEMISTRY OF TILL, YELLOWKNIFE GREENSTONE BELT, NWT.

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Ongoing surficial geology studies and geochemical analyses of till and vegetation in the Yellowknife Greenstone Belt provide additional baseline data for mineral exploration and environmental studies. Soil profiles which incorporate biogeochemical data have the potential to differentiate between anthropogenic and natural sources of elements. Newly recorded ice flow indicators in areas of high mineral potential are consistent with the regional dominant southwestward ice movement of the last glaciation. Minor variations indicate local late-glacial flow ranging from 230 degrees to 255 degrees at the property-scale. Gold grain counts of the heavy mineral fraction of till indicate that background values over volcanic rocks are approximately 0-5 grains per 10 kg till sample. Over some past-producing mines significant concentrations of gold grains are present in till, which suggest that visible gold grain counts is a viable exploration method for the Yellowknife area. Anomalous concentrations of 20-30 gold grains per till sample is not uncommon, and reflect potential exploration targets. Of particular interest are high gold grain counts (up to 100-200 grains) at a number of locations underlain by metasedimentary terrain in the Banting and Walsh Lakes areas.

HIGHLIGHTS OF RECENT REGIONAL METALLOGENIC INVESTIGATIONS IN THE YELLOWKNIFE EXTECH AREA

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The goals of this ongoing project are to help identify the critical features of gold mineralization at the regional scale, incorporate these features within viable exploration and genetic models, and define metallogenic domains with high exploration potential. Work to date indicates several distinct styles and stages of gold mineralization within the EXTECH area (see Falck and Kerswill, 2000; Kerswill and Falck, 1999, 2000).

Recent lithogeochemical investigations have focused on samples from Ormsby, Discovery, Lynx, Camlaren, Ptarmigan, Tom, Cassidy Point, Anne and MOS. Field investigations were undertaken at Nicholas Lake, the Rod Claims, Clan Lake, Ptarmigan and Rater Lake. Evaluation of lithogeochemical data on the 226 samples analyzed since startup indicates that metal endowments and associations are more complex than previously recognized. Factor analysis of the composite population (n=226), indicates three independent metal associations: 1) Te + Bi + As + Au + Ag + Pb, 2) Zn + Ag + Pb + Hg + Au, and, 3) Sb + Hg + As + Pb + Au. On factor score plots, samples of similar character from different locales tend to plot in the same field; different styles of mineralization are characterized by their factor scores.

The metal associations identified by factor analysis suggest that Pb, Ag, Sb, As, Hg, Zn, Bi, and Te can be useful pathfinders for Au. However, as metal associations vary across different styles of mineralization, different indicators should be used for different targets. For example, Sb is a useful indicator for Giant-style "refractory ores" that are characterized by very fine to fine-grained sulphides in laminated veins and associated sericitic alteration zones, but is a poor indicator for turbidite-hosted veins.

Remarkably high gold assays were obtained from samples of sulphide-bearing turbidite-hosted veins that are rich in Zn and Pb, but poor in As; assays ranged from 70.6 to 1348.9 g/tonne Au at Camlaren, from 12.5 to 253.7 g/tonne Au at Tom, and from 48.6 to 239.7 g/tonne Au at Cassidy Point.

Two arsenopyrite-bearing samples collected from the Jackson Lake Formation on the largest sub-island returned Au assays of 228 and 133 ppb with anomalous Sb and Hg. These samples score highly on the third factor and have a metal endowment similar to Giant and Lynx. These results suggest that the Jackson Lake may be a favourable target for gold and are consistent with previous work that identified up to 230 ppb Au in radioactive layers at the base of the Jackson Lake near Giant (Roscoe, 1992).

The metal endowment, character of hydrothermal alteration and geological setting of the EXTECH area suggest that significant gold and other metals (Ag, Pb, Zn, Sb, Hg, As, Bi and Te) were concentrated at least partly by hydrothermal processes directly linked to intrusions and/or their coeval felsic volcanic rocks. Such processes have contributed to the formation of world-class VMS, epithermal and porphyry deposits in near-surface settings around the world, most commonly in the Phanerozoic, but also in the Archean (Horne, Doyon/Bousquet, Red Lake, Hemlo, Hollinger/McIntyre, Kiena, etc.). This working hypothesis for the Yellowknife EXTECH area, although compatible with the data and interpretations of several other EXTECH participants and some previous workers, requires much testing to determine its validity and effectiveness in the search for new ore.

THE 3D GIS MODEL OF THE YELLOWKNIFE CAMP- A WORK IN PROGRESS

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3D GIS

A 3D GIS model has been created of the known, or at least the better understood, structures around and between the two active mine sites in the Yellowknife camp. This will form an ideal basis for furthering the understanding of the genesis of the area along with complimenting and integrating other research projects. This in turn could result in improved targets for further exploration drilling and possibly increase in the potential of further gold mining in the Yellowknife area.

The 3D GIS model incorporates the following:

1) Surface features,
2) Surface geology,
3) Structural geology,

4) Current and historic mining areas,
5) Point sample data (geochemistry and rock chip), and
6) Exploration and production drilling.

Surface Features
3D GIS is used to display surface topography, lake bathymetry, surface features (townsite, roads, rivers, etc.), and in the future, satellite imagery (ortho-photo, raster images) for reference.

Surface Geology
Display surface geology, based on existing geological maps available from the GSC.

Structural Geology
A 3D model of the major structural units (especially faults & shears) is being developed from the existing surface geology maps, other data sources, and mine sections.

Current & Historical Mining
Historic mining patterns are generally a very accurate reflection of the mineralization trend, since mining follows the mineralization very closely. Viewing in 3D historic mining patterns, along with key geological structures, is often an effective method for displaying mineralization trends, particularly in areas where mineralization is not entirely controlled by geological structures.

Exploration Drilling
The extent of the surface and underground exploration drilling is included. This highlights, in 3D, gaps in the current exploration planning.

Other Studies
In addition to the Extech III project, studies are currently underway by DIAND, Water Resources Division, on the possible clean-up or stabilisation of the arsenic trioxide underground storage chambers and stopes. 3D GIS models of the geological structures, excavations and drilling, in and around these areas, has been overlaid to better understand how the model flow paths are affected by the various structures and openings.

GSC AEROMAGNETIC SURVEY PROGRAM IN THE NORTHWEST TERRITORIES 2001-2002

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In 2001/02, 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. The proposed new survey area is to be flown over the region of the Peel Plain, NWT, west of the 132 degree longitude. As in the previous phases, the private industry is invited to participate and cost-share in this new survey. Participants receive exclusive use of the data for a limited period prior to release to the public. The survey results will be published to support ongoing geological mapping and hydrocarbon exploration.

The results for the Fort Good Hope area, were released to the public in June 2001. The total field 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/ .

GEOLOGY OF THE LAC DE GRAS KIMBERLITE FIELD, CENTRAL SLAVE PROVINCE, CANADA

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The richly diamondiferous Eocene (47 Ma) to Cretaceous (86 Ma) Lac de Gras (LDG) kimberlite field, consisting of >236 kimberlites bodies, is located within the central part of the Archean Slave Province, and hosts the Ekati and Diavik mines. Economic kimberlites appear to have been emplaced in a restricted time window, from 55 – 52 Ma. Some hypabyssal kimberlites in the LDG field have significantly disparate mineralogical and geochemical affinities to suggest that older (pre-Cretaceous) kimberlites may exist in the LDG field.

The Archean and Proterozoic rocks of the Lac de Gras kimberlite field have been compiled into a seamless geology map at 1:125,000 scale for NTS sheets 76C, 76D, 76E (south half) and 76F (south-west corner). The oldest bedrock units occur to the west of Lac de Gras and consist of 3.22 Ga Mesoarchean granitoid gneisses and migmatites, which form the Jolly Lake (basement) Complex. Geochronology studies of kimberlite-derived lower crustal xenoliths illustrate that Mesoarchean basement <u>also</u> underlies the LDG kimberlite field e.g. lower crust of 2.97 and 3.11 Ga at Torrie and Grizzly, respectively. Sulphide Re-Os geochronology studies indicate the lithospheric mantle below LDG (at A154) is 3.29 ± 0.24 Ga in age. Hence, at LDG the lithosphere and lower crust are of similar age.

Three Neoarchean Yellowknife Supergroup greenstone belts occur in the map area. The Courageous Lake belt (2729 – 2671 Ma) has been subdivided into older (west-side, VMS-rich), and younger (east-side, Au-rich) domains on the basis of metallogeny and lithology. The Central Volcanic belt formed at 2668 Ma. In contrast to the two western greenstone belts, the 2709 – 2637 Ma Back River complex is considered part of the eastern Slave “Hacket River Arc” juvenile terrane. North of Lac de Gras, subvolcanic dacite-rhyolite porphyries are dated at ca. 2616 Ma. Hence, the ages of volcanic/subvolcanic rocks in the map area range from 2729 to 2616 Ma, consistent with ages for other YKS greenstone belts in the Slave Province.

'Younger granitoid rocks' (post-YKS granites i.e. <2665 Ma, which intrude metasedimentary rocks) in the map area are quite variable in age/character. Granitic suites present include 2650 Ma tonalite; ca. 2625 Ma tonalite (Defeat-type); 2617 - 2613 Ma diorite-granodiorite (Tarantula-type); 2608 Ma diorite-granodiorite (Concession-type); 2605 – 2582 two mica and porphyritic biotite monzogranite (Prosperous- & Morose-types). The 'younger granitoids' are important for understanding the tectonomagmatic evolution of the central Slave Province Previously, Defeat-type plutons were unknown in the central Slave Province; Tarantula-type were plutons thought to be rare.

INFLUENCES ON STRUCTURAL GEOMETRY IN THE FORT LIARD REGION: NEW DATA FROM THE CENTRAL FORELAND NATMAP PROJECT

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After two years of concentrated fieldwork in the Fort Liard (95B) and La Biche (95C) map areas, the Geological Survey of Canada and its partners have published 5 Open File maps at 1:50,000 scale, and several more are in production. This first reassessment of the regional mapping since the early 1960's incorporates much recent stratigraphic information into the new maps. Although the overall regional geometry identified by previous regional maps remains valid, our more detailed mapping has resulted in revisions to key aspects of the structural geometry, with important implications for the resource industry.

The characteristic sigmoid geometry of structures in the area is achieved partly by curvature of axial surfaces, and partly by *en echelon* arrangement of structures. This geometry appears to reflect the interference between two structural trends. The north-northwest trending structures define the regional Cordilleran deformation trend. The interfering northeastward trend has been postulated previously to reflect the influence of a series of basement structures that make up the Liard Line. Together these trends create local culminations along individual structures. Thus individual large anticlines may contain several distinct and unconnected gas accumulations. Ongoing study of seismic transects and potential field data are being used to improve our understanding of the three-dimensional geometry of these complex interference structures.

The structures observed at the surface are dominated by large-scale folds with wavelengths of 10 to 25 km. The wavelength of these structures is mainly controlled by a thick, strong structural beam, comprising the Flett and Mattson Formations, bounded above and below by weaker shale. Folding style in the area varies from symmetrical to asymmetrical. On the Kotaneelee, La Biche, and Beavercrow structures a strong western vergence is developed, and minor west-directed thrust faults locally cut the west limbs of these structures. Thrust faults have subsidiary importance at surface and appear to be best developed as accommodation features in areas of localized high strain. Regionally, the structures are detached in the subsurface. On the basis of previous experience in adjacent northeastern British Columbia, the principal décollement horizon in the Liard-La Biche region is interpreted as the Besa River Formation, a thick shale succession of Late Devonian to Lower Carboniferous age. Because the Manetoe facies dolomite, occurring in carbonate strata below the Besa River Formation, is an important local reservoir in structural traps, additional décollements must occur beneath the lower Paleozoic carbonate succession and locally ramp upward through the carbonates.

SGH^{SM} GEOCHEMISTRY: PRECIOUS METAL AND BASE METAL EXPLORATION CASE STUDIES

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SGH^{SM} (Soil Gas Hydrocarbons) is a method of geochemical exploration that detects organic compounds adsorbed on *B*-horizon soils. Focusing on >150 compounds in the C5-C17 range allows for greater confidence in defining and confirming drill targets. Base and precious metal case studies involving SGH^{SM}, neutron activation and *aqua regia* provide a unique opportunity to compare and contrast the different methods. Base metal case studies (Birchtree – Northern Manitoba, Montcalm – Timmins, Hanson Lake - Saskatchewan) and precious metal case studies (Diana – Australia, Junction – Australia) showcase distinctly different soils, topography and locations. Conventional soil geochemistry often provides a hazy definition for drill targeting – new advances in geochemical exploration, including SGH^{SM} promise to reduce both risk and cost associated with drilling for deeply buried deposits.

THE COMMITTEE BAY DRIFT PROSPECTING SURVEY, CENTRAL MAINLAND NUNAVUT

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The Prince Albert Group (PAG) in northwestern Churchill Province occupies the central part of an Archean supracrustal terrane that extends discontinuously northeastward from Baker Lake to northern Baffin Island. Archean greenstones of the PAG, northeast of the Amer shear zone, have a high potential for Au, Ni-PGE and VMS mineralization. This region, however, lies near a zone occupied by the last remnants of the Laurentide Ice Sheet west of Hudson Bay (Keewatin Ice Divide). Extensive coverage of the belt (up to 90%) by thick Quaternary sedimentary deposits makes detailed bedrock mapping difficult. Therefore, drift prospecting represents an essential tool for mineral exploration in this extensively glaciated region.

To further evaluate the mineralization potential of the PAG, the Canada-Nunavut Geoscience Office (C-NGO) and Geological Survey of Canada (GSC) have initiated the Committee Bay Project, a multi-disciplinary integrated geophysical, bedrock and surficial geology mapping project. To complement these endeavors and to ensure that all aspects of mineral exploration are examined, a two-year drift sampling survey within four NTS 1:250k sheets (56J, K, O, and P) that cover the PAG in central Nunavut was initiated in 2001.

The main objective of the Targeted Geoscience Initiative-funded drift survey is to produce a reconnaissance-scale geochemical database related to the composition of glacially transported sediments over the drift-covered PAG. The survey includes: 1) the identification and distribution of chemical and mineralogical components of basal till associated with mineralization; 2) the establishment of a geochemical database as a means of determining background and threshold concentrations of those components; and, 3) the identification of those regions that may warrant future high-resolution drift prospecting surveys.

In 2001, helicopter-supported drift sampling of 56K was completed in targeted areas based on potential/known mineralization, bedrock and surficial mapping, and airborne geophysics. Till samples were collected along traverses perpendicular to the latest and predominant NNW direction of ice movement, with sample spacing along traverses varying from 2.5 km in the vicinity of known/potential mineralization occurrences, to 10 km over greenstone belt rocks. Sampling over the greenstone belt in 56J/9-16 and 56O/1-8 was done systematically at about 10 km spacing in order to optimize spatial distribution. Till was collected in frost boils, where relatively unweathered material is extruded to the surface for easy sampling, an excellent situation for drift prospecting in permafrost terrain. At all sites, a 2-3 kg sample was collected for trace and major element geochemistry, carbonate content, texture determinations and pebble counts (total of 309 sites). In addition, large 10-15 kg samples were collected for gold grain counts at 209 sites with the highest potential for mineralization. Results of available till compositional datasets will be released as a GSC Open File by the end of March 2002. During the summer of 2002, targeted till sampling (based on 2001 results) will be completed in 56O and 56J while systematic till sampling will be completed for 56P.

CUMULATIVE EFFECTS MONITORING, ASSESSMENT AND MANAGEMENT IN THE NWT - UPDATE

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CEAM Strategy and Framework
The Cumulative Effects Assessment and Management (CEAM) Strategy and Framework is being developed in response to increasing development pressures in the Northwest Territories. The Strategy and Framework will promote informed discussion and decision-making in environmental management by facilitating co-ordinated, clear, and certain approaches to the assessment and management of cumulative effects in the NWT. DIAND and Environment Canada are co-ordinating a multi-stakeholder CEAM Steering Committee which has been developing the strategy and framework since December 1999. The Steering Committee includes representatives from the federal and territorial governments, industry (mining and oil and gas), Aboriginal organizations, and environmental non-government organizations.

The CEAM Strategy has 5 steps:

1) Development of an 'ideal' or desired CEAM Framework
2) Description of the current CEAM framework in the NWT
3) Identification of the linkages and gaps in the current NWT CEAM Framework -
4) Identifying parties with responsibilities related to CEAM
5) Providing 'refusable advice' to decision-makers and facilitating the filling of gaps, building of linkages, and integration of current processes relevant to CEAM.

The Steering Committee has identified nine components of the CEAM Framework

1) Vision and Objectives
2) Land Use Planning
3) Baseline Studies and Monitoring
4) Research
5) Audit and Reporting
6) Project-specific Screening, Environmental Assessment, and Review
7) Regulation and Enforcement
8) Information Management
9) Coordination

Key principles include respect for and application of scientific and traditional knowledge, the precautionary principle, and adaptive management. Other questions currently being considered by the Steering Committee include thresholds and carrying capacities, and strategies for implementing the CEAM Strategy and Framework. Many of the key implementation activities will occur at the regional level, and discussions have begun to develop plans of action for the Slave Geological Province area and the Deh Cho region.

Mackenzie Valley Cumulative Impact Monitoring Program and Audit (MVCIMP)

A related but distinct activity currently being facilitated by DIAND is the completion of the design for the Mackenzie Valley Cumulative Impact Monitoring Program and Audit (MVCIMP). The program is required under the Gwich'in and Sahtu land claims as well as the Dogrib Agreement-in-Principle and Part 6 of the Mackenzie Valley Resource Management Act (MVRMA). This program will provide a community-based method of monitoring the cumulative impacts of the uses of land and water on the human and biophysical environment of the Mackenzie Valley. It will fill in the gaps in existing monitoring and facilitate coordinated reporting on the state of the environment in the NWT. The program will also include an independent audit at least once every five years of environmental quality and environmental management in the NWT. A Working Group composed of Aboriginal and government representatives is currently planning for implementation of the MVCIMP, and considering aspects of the program such as information management, priority valued ecosystem components, and institutional arrangements.

EXPLORATION UPDATE – HOPE BAY GOLD PROJECT, NUNAVUT, CANADA

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The Hope Bay Gold Project lies 745 km northeast of Yellowknife, N.W.T. and 160 km southwest of Ikaluktutiak (Cambridge Bay) within Nunavut. In the past two years Joint venture partners Miramar Mining Corporation and Hope Bay Gold Corporation have conducted a major exploration program including more than 85,000 m of drilling. In total, more than C$130 million has been expended to define significant gold resources in five separate deposits (Boston, Doris, Madrid, Naartok, Suluk) and evaluate numerous precious metal occurrences.

The Hope Bay belt comprises mafic meta-volcanic (mainly meta-basalts) and meta-sedimentary rocks that extend over 80 km in a north-south direction and are bound by Archean granite intrusives and gneisses. The greenstone package has been deformed during multiple deformation events and is transected by major north-south trending shear zones that appear to control the occurrence of mineralization, particularly where major flexures are apparent. Second-order shears branching off of the major shear also host significant gold mineralization.

The largest deposit, Boston, is located near the south end of the belt and is associated with a flexure in the Hope Bay regional structure. Gold is associated with sulphide mineralization (mostly pyrite) within the veins and as a halo in the wall rock around the veins. It is best developed in zones of extensive iron-rich carbonate alteration at the contact between sediments and mafic volcanics.

The Doris deposit consists of a steeply dipping, four km long quartz vein system in folded and metamorphosed pillow basalts. At the north end, the veins are folded over to create a high-grade anticlinal hinge zone lying close to surface (Doris North). One km to the south, an intersection of two quartz-bearing structures creates a high-grade zone (Doris Central). Alteration is defined by iron-carbonate, paragonite, pyrite and sericite. Most of the gold is found at quartz vein and wall rock contacts and is associated with dark-coloured tourmaline-pyrite septa or ribbons.

The Madrid deposit consists of three styles of veining and brecciation specific to zones (Matrim, Perrin, Rand). In all three zones visible gold is rare and gold grades appear to correspond with the abundance of fine-grained pyrite and intense iron carbonate alteration.

Two significant discoveries were made in 2001 in the Madrid area. The Naartok deposit is characterized by a west trending, steeply north-dipping zone of disseminated, stockwork, and breccia-style, gold-pyrite mineralization associated with dolomite-sericite-silica-albite alteration within mafic volcanic rocks. The gold mineralization lies structurally above a west trending zone of highly sheared rock called the Deformation Zone (DEFZ), which is composed of highly deformed quartz-dolomite breccia and porphyry.

Gold mineralization at Suluk to the southeast of Madrid is associated with brecciated, silicified, and sulphidized mafic and ultramafic volcanic rocks with intercalated carbonaceous and /or graphitic argillite. The better gold values seem to be associated with higher percentages (>5%) of fine-grained disseminated pyrite within the quartz-carbonate-sericite altered horizons. There are three separate, steeply west-dipping zones of mineralization that have a nearly vertical to slightly northerly plunge.

Numerous other exploration targets remain to be tested in the Hope Bay belt, including the Chicago, Kamik and South Patch areas.

ENVIRONMENTAL MANAGEMENT AND MONITORING - DIAVIK'S 2001 DIKE CONSTRUCTION

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Construction of Diavik's A154 Dike was a component of an Environmental Assessment and is regulated by a Water License and a Fisheries Authorization. The presentation will describe the monitoring results in comparison with Environmental Assessment predictions and regulatory requirements. It will also describe the environmental management process that was followed.

NEW RESULTS OF THE BEDROCK AND SURFICIAL MAPPING COMPONENTS OF THE WALMSLEY LAKE TGI PROJECT, SOUTHEASTERN SLAVE PROVINCE, NWT

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The multi-disciplinary Walmsley Lake project, southeastern Slave Province, is jointly undertaken by the Geological Survey of Canada, under the Targeted Geoscience Initiative, and the C.S. Lord Northern Geoscience Centre in Yellowknife. The objective is to link our understanding of mantle and crustal evolution in the southern Slave Province to develop a more comprehensive picture of lithospheric-scale tectonic controls on the formation and preservation of diamonds in the subcontinental mantle. The more immediate goals include: 1) providing 1:125,000 scale digital bedrock and surficial maps of the area (NTS 75N); 2) providing U/Pb age constraints to facilitate Slave-wide correlations; 3) supporting thematic studies such as the tectonometamorphic evolution, and petrogenesis of igneous rocks; 4) using U/Pb age and tracer isotope studies to refine models for crustal evolution; and 5) acquiring high-resolution magnetotelluric (Jones et al. this volume) and teleseismic (Snyder et al. this volume) data to image southern Slave Province deep crust and lithospheric mantle.

Bedrock mapping in 2001 resulted in the recognition of four phases of deformation and metamorphism. The first pre-dates peak metamorphism and may be correlative with D1 in the central Slave (Bleeker et al. 1999). The second episode of deformation (D2) overlapped with peak metamorphism and its nature and timing with respect to metamorphism suggest that D2 could be correlative across the southern Slave. However, preliminary U/Pb geochronology suggests greenschist to lower amphibolite-grade metamorphism is systematically older than migmatisation in the higher grade rocks. Higher-grade areas are affected by recumbent F3 folds of the S2 foliation, which may typify deeper structural levels. The final phase of deformation is characterized by upright NE and NW-trending cross folds. Locally overturned stratigraphy and the F4 folds of the melt-in isograd, suggest the possibility of downward-facing nappes.

New Sm/Nd and Pb/Pb tracer isotope data on granitoid rocks from the central and southern Slave Province support previous models for a north-south striking interface between Mesoarchean basement in the west and juvenile late Archean crust in the east. The surface trace of the eastern limit of this boundary at depth occurs west of the Walmsley Lake area, between 110º and 111ºW.

Glacial striation data for the area reveal three ice flow events, related to the early, penultimate, and late phases of the last glacial episode. The latest ice-flows are time-transgressive. Long subglacial tunnels have been mapped in many parts of the Walmsley area, and show similar features to other occurrences in the South Slave (e.g. Rampton, 2000). Successive glacial lakes have been dammed by the retreating ice from the west to the east. Raised beaches in the areas of Munn Lake and Lac de Charloit have been sampled for luminescence dating, from which the glacial retreat rate will be evaluated.

NEW MAPPING AND U/Pb GEOCHRONOLOGY IN THE WALMSLEY LAKE AREA: POST-METAMORPHIC, CRUSTAL OVERTURNING IN THE SOUTHEASTERN SLAVE PROVINCE?

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An important outstanding question in the Slave Province is: what is the relative importance of the ca. 2.7 Ga, north-trending boundary between the eastern and western domains, versus ca. 2.6 Ga (or younger) northeast-trending domains and boundaries, to the composite structural grain of the Province? In order to assess this question it is critical to understand regional variations in the tectonic history across the Slave Province. The best known area of the Slave Province is the Yellowknife domain, which is widely thought to typify the central Slave (e.g., Bleeker et al. 1999). Comparison of the late Archean evolution in the Walmsley Lake area, southeastern Slave Province, with that in the Yellowknife domain suggests that, although the early tectonic evolution may be correlative, deformation and metamorphism associated with the later stages are more pronounced in the southeast.

In the Walmsley Lake area, F1 folding pre-dates the thermal peak of metamorphism and S1 is rarely preserved. D2 structures are oriented NW-SE, and S2 is generally defined by the peak metamorphic assemblage. However, preliminary geochronology suggests the timing of peak metamorphism and D2 varies across the Walmsley area. In the northwest, granite plutons as old as ~2612 +5/-2 Ma cut S2 and the sillimanite isograd. A pre-to early-syn-D2 hornblende diorite provides a maximum age of ~2614 +5/-2 Ma for S2, and a tight age bracket on the duration of D2 and peak metamorphism in the northwest. In contrast, monazites in migmatized metaturbidites in the central Walmsley area, yield metamorphic ages of ~2585-2590 Ma, indicating either that peak metamorphism occurred 20 m.y. later there, or peak metamorphic conditions endured longer within the higher grade rocks. Areas of migmatized metaturbidites are also characterized by meter- to kilometer-scale recumbent, isoclinal, F3 folds of S2, and overall shallowly dipping structures, which may be representative of deeper structural levels. The latest deformation event (D4) is characterized by NW- and NE-trending, upright, open folds. The relative timing of D1 and D2 with respect to peak metamorphism, and the style and orientation of D2 structures in the Walmsley area allows correlation with D1 and D2 in the Yellowknife

domain. However, the nature and extent of F3 folds are not characteristic of D3 in the Yellowknife area.

The melt-in isograd, which defines a gently-dipping, undulating surface, has been affected by F4 folds. The fact that lower grade rocks are exposed in the cores of F4 antiforms, as defined by changes in plunge of F2 folds, suggests that the metamorphic gradient is upside down. Locally inverted stratigraphy, overturned by recumbent F3 folds, provides support for the interpretation that the isograd is in fact overturned. Considered in isolation, these pieces of evidence provide insufficient proof of regional-scale overturning; however, collectively they suggest the possibility of downward-facing nappes, a geometry that has not previously been reported in the Slave Province.

POTENTIAL FIELD MODELING OF A PROTEROZOIC HALF-GRABEN NEAR BLACKWATER LAKE, NORTHWEST TERRITORIES.

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A wedge of Proterozoic strata in the Blackwater Lake area of the Northwest Territories is preserved below the sub-Cambrian unconformity in a half-graben associated with a large normal fault. Reflection seismic data define the shape of the wedge but neither it nor drilling information is adequate for identifying the strata preserved within the half-graben. While these data permit either Tweed Lake Assemblage (D = 2730 – 2780 kg/m^3) or Mackenzie / Shaler Assemblage (D = 2580 kg/m^3) as the half-graben-fill, gravity and, to a lesser extent, magnetic modeling show Tweed Lake Assemblage (~1270 Ma) to be the more likely candidate. Inclusion of any appreciable amount of Mackenzie / Shaler Assemblage in the half-graben produces too low a gravity response and is therefore rejected.

Blackwater Fault was established no later than during Dismal Lakes Assemblage time (between 1663 and 1270 ma) and subsequently underwent a long history of reactivations, the most recent of which was probable right-lateral (i.e. west side moved northward) offset during the Laramide Orogeny. It is one of several large-offset Proterozoic faults that by reactivation have influenced Phanerozoic strata and thus created areas of economic interest.

CANADIAN CORDILLERAN EMERALDS: THE CROWN AND LENED SHOWINGS

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Emerald is green gem beryl ($Be_3Al_2Si_6O_{18}$) in which the chromophore is a trace amount of Cr or V. Emerald deposits are either related to granitic intrusions (Type I) or are associated with hydrothermal activity in tectonically active areas, where tectonic features such as shear zones and thrust faults control fluid circulation (Type II). In both types of deposits, the fluids responsible for emerald formation may be magmatic or metamorphic in origin. An alternative genetic model has been proposed which suggests that in some deposits emerald growth is a result of syn- to post-tectonic reactions under low-grade regional metamorphism.

A Type I deposit of V-dominant emeralds was discovered near the Lened tungsten showing in the southwestern Northwest Territories in 1997. The property is underlain by a rare-element enriched two-mica pluton and associated rare-element pegmatites, around which are developed significant amounts of W-bearing skarn. The emeralds occur in phlogopite schist developed along the contact zone between a rare-element pegmatite and Devonian-Mississippian black shales. The latter are enriched in platinum-group elements, V, and Cr. The emeralds are transparent to translucent and up to 2.0 cm in length.

A deposit with characteristics of both Types was discovered in the Finlayson Lake district of southeastern Yukon in 1998. The emeralds occur where quartz veins cut mica-rich layers in chlorite-mica schist. Most veins are surrounded by a zone of yellow sulfate mineralization and a more extensive, overlapping mass of fine tourmaline crystals, which locally contains minor amounts of scheelite. The emeralds occur in the sulfate and tourmaline zones and (rarely) in the quartz veins. The emeralds range in size from fractions of a millimeter to 4 cm. Some of the smaller crystals, and sections of larger crystals, are of gem quality, with excellent clarity and color. Electron microprobe analysis of 25 crystals averaged 3208 ppm Cr (maximum 7816 ppm). The mean and maximum V concentrations are 171 and 333 ppm, respectively. The presence of tourmaline may explain why high Fe concentrations, which would diminish the emerald-green color, are absent in the beryl; under high B activity, tourmaline acts as a sink for Fe, Mg and Mn. Fluid-inclusion results suggest that the emeralds precipitated from a low-salinity H_2O-CO_2-NaCl-CH_4 fluid at minimum temperatures of 260 to 340°C. Oxygen isotope data from coexisting quartz and tourmaline suggest formational temperatures of 365 to 498°C at pressures of 1.0 to 2.5 kb and inferred depths of 3 to 7.5 km. The fluid inclusion and stable isotope studies are consistent with a metamorphic origin with possible input from a magmatic system. A zoned granitoid pluton 600 m east of the emerald mineralization may be the source of the Be; although the Be content is average (12 ppm), the concentrations of other light elements (Li, B, F) and W are high. The schist contains 520 and 136 ppm Cr and V, respectively, which likely comes from the underlying serpentinitized mafic and ultramafic rocks. Much additional work must be completed before the economic potential of these emerald deposits can be assessed.

KINEMATIC OBSERVATIONS IN THE YELLOWKNIFE RIVER FAULT ZONE AND STRUCTURES IN THE JACKSON LAKE FORMATION, YELLOWKNIFE, NWT

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Preliminary results of detailed structural mapping indicate that most of the deformation in the Yellowknife greenstone belt is concentrated along the Yellowknife River Fault Zone. This north-south striking major Archean shear zone marks the contact between Kam Group volcanics and the Timiskaming-like sediments of the Jackson Lake Formation to the south, and between the Kam and Banting groups volcanics to the north. Structural analysis enabled the recognition of four generations of ductile structures (G_1 to G_4). Kinematics and regional significance G_1 are poorly understood. G_2 structures include an S_2 foliation oriented clockwise to the shear zone boundary, "S"-shaped F_2 folds, and a steeply plunging L_2 stretching lineation. G_2 is best explained by sinistral shear accompanied by east side up dip-slip movement as indicated by shear sense indicators along L_2. G_3 and G_4 structures are spatially associated with the Yellowknife River Fault Zone. S_3 is a strongly developed differentiated crenulation cleavage, oriented counterclockwise to S_1 and S_2, axial planar to "Z"-shaped F_3 folds. These structures indicate dextral shear during G_3. G_4 produced an S_4 foliation oriented parallel to the shear zone boundary and northeast away from the shear zone. Where the strain is most intense, C' shear bands associated with S_4 are observed, indicating sinistral shear during G_4.

The youngest formation of the greenstone belt, the Jackson Lake Formation, potentially records three generations (G_2, G_3 and G_4). The earliest deformation (G_1) is not present, and may represent the basin-forming event that led to the deposition of the Jackson Lake Formation.

A NEW COMPILATION OF AEROMAGNETIC DATA OVER AXEL HEIBERG ISLAND AND THE NORTHEASTERN CANADA BASIN

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Fourteen aeromagnetic surveys over Axel Heiberg Island and the northeastern part of the Canada Basin have been compiled into a continuous, seamless data set. The survey data required extensive remediation and leveling to the national datum. Digitized survey data covering Axel Heiberg Island required draping from the constant barometric altitude at which they were flown to an idealized flight surface at 305m mean terrain clearance. Three digitally acquired surveys to the north of Axel Heiberg were tie-line leveled to one set of control lines. A series of digitized surveys over the Canada Basin to the west of Axel Heiberg Island required data editing to correct digitizing errors and decorrugation (micro-leveling) to reduce line-to-line leveling problems and the effects of diurnal variation of the magnetic field. As these surveys were flown along Decca navigation lanes, a method to transform the hyperbolic flight paths to parallel pseudo-flight paths was developed and applied before decorrugation. All data were leveled to the national datum and to adjacent surveys. The result of this project is a continuous, realistic representation of the residual total magnetic field, free from survey boundary discontinuities, flight line leveling problems and the adverse affects of differing survey flight heights.

LIARD PLATEAU AND TROUT PLAIN: TECTONIC EVOLUTION AND PETROLEUM POTENTIAL, NWT

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The dominant structural feature of the Liard Plateau-Trout Plain region is the north-trending Bovie Structure. This feature separates a thicker Paleozoic-Mesozoic succession in the Liard Basin to the west from a thinner succession in the Trout Plain. Some Paleozoic units, such as the Mattson and Fantasque formations, are almost entirely contained within Liard Basin. The recent discovery of significant gas reserves in the Mattson Formation at the Paramount et al. Liard F-36 strongly indicates the existence of gas in Mattson deltaic and shoreface sandstones in other parts of this basin. More brittle silicified units, such as the Fantasque, may have developed significant fracture porosity for potential gas reservoirs during burial and deformation.

Study of a seismic grid across Bovie Structure has revealed a multiphase history. The earliest event was the development of a westward-verging high angle reverse fault, the Bovie Fault, which extends upwards from the Proterozoic through to the Mississippian. Above the Banff, this early event is manifested as a narrow west-dipping monocline. The second structural event was Laramide compression in Early Tertiary time that generated a thin-skinned eastward-verging thrust with a decollement horizon within the Banff Formation. This thrust, the Bovie Thrust Fault, has been deflected upwards where it encountered the deeper, west-facing monocline above the deeper Bovie Fault causing the development of a shallow thrust-front anticline. The northern limit of the Bovie Fault and Bovie-related structures from surface mapping is about 60°40'. However, aeromagnetic data (first and second derivative total magnetic field maps) indicate that the deeper Bovie Fault continues northward in the subsurface to about 61° north latitude.

East of Bovie lies the Slave Point shelf edge play with numerous shelf edge gas pools. A typical platform shelf-edge reef gas pool occurs at the Shell Netla C-07 well outboard of several other Slave Point edges. Multiple shelf edges may be seen in seismic along most parts of the Slave Point shelf in the Trout Plain along the Arrowhead Salient and Cordova Embayment of the Presqu'ile Barrier. The recently completed Nahanni gas discovery at Paramount et al. Bovie C-76/C-76A at the western edge of the Arrowhead Salient is an example of this type of play.

Many of these shelf edge buildups and shelf interior buildups are located above basement structures, such as the Trout Lake fault zone. These structures may have played a role in the localization of Slave Point buildups. Farther west, the K-29 and M-25 wells are major gas discoveries in Manetoe hydrothermal dolomite in the Arnica, Headless and Nahanni formations. The great vertical extent of hydrothermal dolomite developed in these gas wells and in the Pointed Mountain, Kotaneelee and Beaver River fields may be related in part to the great depth range of hydrothermal fluid circulation in this part of Liard Basin.

GEOPHYSICAL CHARACTERISTICS OF THE CRESTAURUM GOLD DEPOSIT, YELLOWKNIFE

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Multi-sensor borehole geophysical measurements including natural γ-ray spectrometry, resistivity, induced polarization (IP), magnetic susceptibility, spectral γ-γ density, full waveform sonic and temperature were recorded in several boreholes at the Crestaurum Gold deposit. The purpose was to document the geophysical characteristics of the deposit and host rocks and to provide a database for understanding the best geophysical methods that will lead to the discovery of new ore bodies in the Yellowknife area. Gold mineralization at Crestaurum occurs in the Crestaurum Shear Zone, which contains chlorite schist with quartz-rich sections that are surrounded by chloritic and sericitic alteration. Gold occurs in quartz and is associated with carbonate, finely disseminated jamesonite, arsenopyrite, pyrite and stibnite. The host rocks are massive volcanic flows and minor pillow flows and tuffs that are locally cut by dykes of quartz-porphyry, meta-gabbro and diabase.

Analysis of the multi-sensor geophysical data shows that lithology and alteration (mainly sericite and pyrite) associated with auriferous shear zones, can be clearly defined. Several different units were identified on geophysical logs that were not indicated by the drill core geology. Also several of the units identified as meta-gabbros are actually meta-lamprophyre as indicated by the γ-ray spectrometry data. Resistivity and IP parameters identify pyrite and disseminated sulphide mineralization, while the natural γ-ray spectrometry logs show potassium enrichment due to sericitic alteration. Zones containing gold mineralization correlate with an increased IP effect and a lower resistivity due to the increase in pyrite. The geophysical signature in auriferous shear zones consists of lower potassium content in quartz-carbonate zones and a higher potassium enveloping halo from the development of sericite. The full waveform sonic data shows shear zones that are low in velocity and low amplitude.

THE CRESTAURUM GOLD MINE

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The Crestaurum gold mine is located fourteen kilometres north of Yellowknife, NWT, in the late Archean Yellowknife Greenstone Belt of the southwestern Slave Structural Province. The property has been tested by over 200 drill holes and a 420-foot shaft with two excavated crosscuts, however the property has never been put into production. A resource of approximately 150K tons at 0.3 ounces/ton has been calculated for the deposit, but it remains untested below 200 metres (F.A. Perrino, 1988; Giant Yellowknife Mines Internal Document). Rock types near the minesite include metabasalts, reworked volcaniclastic sediments, gabbro dykes, quartz-feldspar porphyry dykes, lamprophyre dykes, and a multiphase quartz diorite to granite pluton. The metamorphic grade ranges from amphibolite near the multiphase pluton to greenschist east of Daigle Lake. The majority of the mineralization is hosted within the chlorite-quartz-carbonate Crestaurum shear-zone, but five distinct styles of sulphide mineralization with elevated gold and base-metal values have been identified within the Crestaurum mine area.

The earliest styles of mineralization are syn-volcanic stockwork sulphides and syn-sedimentary banded iron formation (BIF). The stockwork sulphide has been identified in drill core (DDH-NB-94-4, from the north end of Daigle Lake). The stockwork sulphide consists of pyrite + pyrrhotite + magnetite + quartz + carbonate + actinolite with minor elevated Au (up to 85 ppb) and Zn (125 to 805 ppm). The banded iron formation outcrops east of the drill hole location and consists of magnetite + chlorite + quartz and has no significant base-metal or gold values.

The third style of mineralization occurs within the quartz diorite, fifty metres east of Ryan Lake. It includes molybdenite + pyrite ± chalcopyrite ± bismuthinite that is hosted within fault-controlled laminated quartz veins and extensively altered quartz diorite. The molybdenite mineralization also contains slightly elevated Au (270 ppb), As (51 ppm), and Sb (150 ppm).

The most significant ore mineralization is preserved within the early- to syn-D2, 035°/55°SE trending Crestaurum Shear Zone. The sulphide and gold mineralization is confined to extensively deformed quartz-carbonate veins. Mineralization includes pyrite + stibnite + arsenopyrite + sulfosalts + sphalerite + chalcopyrite + ilmenite + gold. Gold is found associated with stibnite, pyrite, and sulfosalts. Earlier metallurgical testing suggests that up to 25% of the gold may be bound in refractory arsenopyrite. Wall-rock alteration is zoned from chlorite + sericite + carbonate in the hangingwall of the shear zone and chlorite + biotite + carbonate ± sericite ± tourmaline within the shear zone, suggesting relatively high-temperature alteration during main stage mineralization.

The final style of mineralization is quartz-vein hosted massive sphalerite + galena ± chalcopyrite ± pyrite ± pyrrhotite ± arsenopyrite ± stibnite ± gold. The quartz veins are highly deformed and recrystallized and there is a significant lack of carbonate veining with these quartz veins, but their orientation tends to be strongly oblique to the main Crestaurum shear zone. Petrographically, sphalerite and galena infill open spaces, likely remobilized during folding and deformation of the quartz veins. Visible gold occurs in fractures. The timing relationship with respect to the Crestaurum shear zone is unclear.

NEW ISOTOPIC TECHNIQUES FOR DATING DIAMONDS: EXAMPLES FROM THE SIBERIAN CRATON

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Pioneering work in the late 70's and early 90's applied U-Pb and Sm-Nd radiometric dating techniques to syngenetic inclusions within diamonds to obtain crystallisation ages (Kramers 1979; Richardson et al. 1984). To obtain sufficient analyte for a precise isotopic analysis 10's to 100' of individual inclusions, of similar chemistry, had to be composited. This required large numbers of inclusion-bearing diamonds and is the approach is subject to the uncertainty of compositing samples that may be un-related (see review by Pearson and Shirey, 1999).

Recently, Pearson et al. (1998) developed a new approach involving application of the Re-Os isotope system to dating syngenetic sulphide inclusions within diamonds. This technique takes advantage of the high levels of Re and Os in sulphides, allowing analysis of single inclusions of less than 20 microns diameter and <1 pg Os using sensitive negative-ion thermal ionisation mass spectrometry (N-TMS). Using this approach isochron ages can be obtained on diamonds containing multiple inclusions (Pearson et al. 1998; Pearson et al. 1999) or from single inclusions in different diamonds (Pearson et al. 1998; Richardson et al. 2001). Diamond paragenesis (eclogitic or peridotitic) can be constrained from a combination of Ni and Re-Os contents and Re/Os ratios.

Recently, in-situ laser techniques have been developed that also allow analysis of single sulphides (Pearson et al. 2000). While useful for obtaining model age constraints, these techniques do not analyse the bulk sulphide grain and so any sub-solidus exsolution that may fractionate Re from Os is not accounted for. This may produce scatter on isochron plots and potential errors in model age calculations. In addition, sensitivity is not currently sufficient to analyse eclogitic suite inclusions.

Using the N-TIMS approach, a recent study of Siberian diamonds (Pearson et al. 2000) found P-type sulphides from Udachnaya diamonds with relatively uniform, unradiogenic Os isotope compositions ($^{187}Os/^{188}Os$ 0.1052 to 0.1089). Re-Os model ages (T_{MA} ages) range from 3.1 to 3.5 Ga. A P-type sulphide from Aikhal has more radiogenic Os ($^{187}Os/^{188}Os$ = 0.2255) giving a model age of 3.4 Ga. Regression of the entire suite of 10 separate inclusions from the 6 diamonds yields a model 3 isochron of 3480 +/- 210 Ma (2), with, $^{187}Os/^{188}Os_i$ = 0.1047 (MSWD = 26). E-type sulphide inclusions from Mir have $^{187}Os/^{188}Os$ from 0.42 to 1.46. Model ages are variable and generally very young for the E-type sulphides. Correlations on Re-Os isochron diagrams have slopes equivalent to young, Phanerozoic ages.

New micro-sampling techniques for dating of fibrous diamonds will be presented.

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THE RAE-HEARNE BOUNDARY ZONE IN THE BAKER LAKE AREA: WHERE ARE THE BREAKS?[1]

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A fundamental question arising from the Western Churchill Natmap concerns the architecture of the boundary zone between the Rae and Hearne domains. Recent models based on a magnetotelluric transect (stations 1-8: Jones et al. 2001) propose that the boundary represents a Neoarchean suture that accommodated southeastward underthrusting of the Rae domain beneath the Hearne, and which was reactivated in the Paleoproterozoic during uplift of the northwestern

Hearne domain. In order to clarify relationships that are critical to the interpretation of the boundary zone, we utilise existing data and re-examined archival material to present a schematic cross-section that extends from station 8 at Woodburn Lake to station 5 on the north shore of Baker Lake.

The area is underlain by two crustal blocks that are separated by the Quoich River fault (~15 km south of station 6), a major post-metamorphic peak structure which lies along strike of the NE-trending segment of the Snowbird Tectonic Zone. The northern block contains km-scale, *ca.* 1.8-1.9 Ga, NW-vergent folds of 4kbar, medium grade Archean Woodburn Lake group rocks and gneissic/granitic crust of unknown age and possibly moderate pressure. These structures progressively shallow to the south where they give way to dome-basin interference folds involving uppermost-amphibolite facies Woodburn Lake group rocks and sheets of Archean and Paleoproterozoic granite. Jones et al. (2001) suggested that a major conductivity break within the southern part of the block (~ 10 km north of station 6) represents the Rae-Hearne boundary. Presently compiled data in this area do not, however, support a major crustal break.

A major contrast does occur across the Quoich River fault, a steeply south-dipping structure with both thrust and extensional kinematics. It juxtaposes south-dipping, <4kb Ketyet group supracrustal rocks with shallowly north-dipping gneisses to the north. An older refolded thrust places Archean Akutuak gneisses (correlative with Cross Bay rocks, south of Chesterfield Inlet?) on the possibly Paleoproterozoic supracrustal sequence.

A significant break within the southern crustal block is the Chesterfield fault zone (Schau, 1983), a 2-10 km wide zone of variable high strain that separates the Akutuak gneisses from >10 kbar rocks that include the Kramanituar Complex (Sanborn-Barrie, 1999). This anastomosing zone of sheared and foliated granitoids, amphibolite and garnet-hornblende gneisses predominately dips moderately to steeply southward but contains packages of north-dipping foliation and ultramylonite. These may reflect progressive shear, multiple generations of deformation or overprinting younger folds. The kinematics of the zone are poorly known but appear to involve complex reworking, possibly of both Archean and Paleoproterozoic age (Schau, 1983).

Understanding the extent and kinematics of these major structural breaks will be critical to understanding the nature of Rae-Hearne boundary zone and the mechanism of Paleoproterozoic uplift of the high pressure northwestern Hearne domain.

1:20 000 SCALE BEDROCK GEOLOGY OF THE MEADOWBANK GOLD DEPOSIT AREA, NUNAVUT

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The map and accompanying report covers part of the Woodburn project area of the southern Rae domain, Nunavut. It presents results of multiscale bedrock mapping and integrates petrologic, structural, and geochemical data to provide the regional tectonothermal context to gold mineralization at the Meadowbank gold deposit.

Flanked by large Archean granitoid domains, metamorphosed and polydeformed supracrustal rocks of the Woodburn Lake group have been divided into at least three distinct packages: 1) ca. 2.72-2.71 Ga ultramafic through felsic volcanic and volcaniclastic rocks with associated iron-formation; 2) quartzites, phyllites, conglomerates, and quartz-feldspar porphyry; and 3) max. 2.7 Ga arkosic wackes and pelites also with interlayered iron-formation. Quartzites unconformably overlie the volcanic rocks and occur as units both stratigraphically and structurally interdigitated with the volcanic rocks and arkosic wackes.

The Woodburn Lake group has experienced at least four deformation events, resulting in strong transposition of fabrics, multiple repetition of units and a complex map pattern of mushroom fold interference. Early D1 deformation, accompanied by low grade M1 metamorphism, produced isoclinal folds and bedding subparallel foliation. D1 fabrics are present in all supracrustal rocks and to variable degrees the Archean granitoid domains, placing their maximum age at 2.62-2.599 Ga. The predominant regional structures, D2, comprise NW-vergent, tight to isoclinal folds, a composite foliation and reverse faults, and were broadly coeval with a low pressure metamorphic event (M2) that produced a zonation from mid-greenschist to amphibolite grade, north to south, across the map area. M2/D2 are constrained to be Paleoproterozoic in age, *ca.* 1.8-1.9 Ga, based on correlation with regional structures outside the map area. D3 structures, consisting of close, SE-vergent, dm-cm scale folds with an associated crenulation lineation, developed post-peak M2. D4 deformation produced upright, open folds and a non-penetrative, axial planar crenulation cleavage. Local overprinting of D4 structures by minor folds with a similar attitude to D3 may indicate that D3/D4 was part of a single continuous deformation event. A third low grade thermal event, M3, occurred ca. 1.79 Ga (Villeneuve, unpubl. data) and resulted in growth of new garnet, cummingtonite and biotite that overgrow S2 but are crenulated by S4.

The gold deposit is hosted in banded-iron-formation of the 2.71 Ga volcanic package. Early pyrrhotite is present as inclusions in secondary magnetite and in quartz-carbonate-epidote veins that are folded by F1 and obliquely cut S1. Syn-D2 pyrite, pyrrhotite and magnetite are present along S2 and in minor quartz-carbonate veins cutting S1 but boudined along S2. Gold is associated with the syn-D2 sulphides (Alexander, pers. comm.) and with late vuggy, quartz breccia zones, localized in part in the hinges of macroscopic F2 folds. Sulphides and pre-existing gold are locally remobilised along S4 and late quartz-chlorite veins that are axial planar to parasitic F4 folds.

TECTONOSTRATIGRAPHIC EVOLUTION OF THE PALEOPROTEROZOIC BAKER LAKE AND THELON BASINS, WESTERN CHURCHILL PROVINCE, CANADA

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The Baker Lake and Thelon basins are exposed over an area of approximately 200,000 km2 along the border between the Rae and Hearne domains of the Western Churchill Province west of Hudson Bay in Nunavut, Canada. Basin fill comprises the Dubawnt Supergroup, a ca. 1.83-1.70 Ga succession of predominantly continental clastic and intercalated volcanic rocks up to 15 km thick. It unconformably overlies granitoid and supracrustal rocks, most of late Archean age. The Dubawnt Supergroup comprises three second-order sedimentary sequences that record deposition within a rift basin, a modified rift basin and a thermal sag basin, respectively. The Baker Lake second-order sequence is inferred to represent the initial and principal phase of the development of Baker Lake Basin, a series of generally elongate, northeast-striking, half-graben and fault-bounded troughs filled with continental red-beds and coeval thick ultrapotassicvolcanic rocks. The nature and timing of basin development allows that it may represent a transtensional basin that formed in response to northeastward tectonic escape of the Hearne Domain, which was trapped in a tectonic vise between the Trans-Hudson Orogen on its southeast margin and the Rae Domain on its northwest margin ~1.85-1.75 Ga. The overlying Wharton second-order sequence was deposited in small basins formed by block-faulting and tilting of the Baker Lake sequence. It has a more restricted distribution and represents a northward shift in the locus of sedimentation. Basin fill comprises eolian and alluvial to lacustrine redbeds with intercalated rhyodacite flows and epiclastic rocks. Distribution of facies and stratigraphy within the fault-bounded domains suggests that faults were active throughout deposition, but the greatest offset and tilting occurred after deposition of the Wharton Sequence (~1.75Ga). Faulting ceased before deposition of the overlying Barrensland Sequence (Thelon Fm; ~1.72Ga); fault geometry suggests that the basins developed in response to regional episodes of N-S and E-W extension and subsidence. This deformation coincided with a regional episode of granite emplacement (Nueltin Suite) and associated regional thermal metamorphism (~1.76-1.75Ga).

The Barrensland second-order sequence represents deposition over a much broader area, primarily in the Thelon Basin, indicating a further northward shift in the locus of sedimentation. Strata generally are thinner and flatter than underlying sequences, and display lateral continuity with little facies variation or asymmetry, indicating a lack of influence from syndepositional faulting. The depositional record reflects progressive upward fining and eventually the first record of marine transgression within the Dubawnt Supergroup. Magmatism was minor compared with the underlying sequences. These features suggest that the Barrensland sequence was deposited over a broad region of thermal subsidence, likely related to cooling of previously attenuated continental lithosphere. Such sedimentation patterns are common in intracontinental sag basins.

The tripartite sequence evolution of the Baker Lake and Thelon basins represents a new framework for future sequence correlation among late Paleoproterozoic basins in Laurentia and shares characteristics with the evolution of contemporaneous intracratonic basins from north-central Australia, Baltica, Siberia and south-eastern Brazil.

COMPARATIVE ANALYSIS OF ULTIMATE NATURAL GAS RESOURCE POTENTIAL – LOUISIANA GULF COAST, MACKENZIE DELTA/BEAUFORT AND SCOTIAN SHELF BASINS

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Comparative analysis of estimates of ultimate natural gas resource potential in the Louisiana Gulf Coast Basin and Shelf, the Mackenzie Delta/Beaufort Basin and the Scotian Basin offshore Nova Scotia, invokes interesting comparisons with respect to geological play types and areas, trapping mechanisms and structural controls. The Louisiana Gulf Coast Basin is similar to the Mackenzie Delta in that both gas provinces occur in prograding fluvial-dominated deltaic sandstone reservoirs, primarily Tertiary in age. The traps are structural, formed through tectonic faulting during anticlinal compression and growth faulting due to sediment loading. Salt piercement also plays a major role in trap formation in the Louisiana Gulf Coast. The gas reservoirs in the Scotian Basin are similar both in depositional mode and structural style to those of the Mackenzie Delta and Gulf Coast regions, but the age of the reservoir sandstones range from late Jurassic to mid-Cretaceous.

With respect to ultimate potential, the Louisiana Gulf Coast province is estimated to contain an additional 30 TCF, the Mackenzie Delta province some 55 TCF and the Scotian Basin in the order of 13 TCF. These estimates point to the huge untapped potential of the Mackenzie Delta region, and probably indicate also that the Scotian Shelf estimate is low and should be re-evaluated. Our revised estimates indicate that much of the future gas supply for the North American continent may come from the Canadian Mackenzie Delta and Eastern Seaboard regions.

STRATIGRAPHIC RECONSTRUCTION AND GEOCHEMISTRY OF THE AYLMER LAKE VOLCANIC BELT, EAST-CENTRAL SLAVE PROVINCE, N.W.T.

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The Aylmer Lake Volcanic Belt (ALVB) is located 80km north of the treeline and 350km northeast of Yellowknife. Five weeks of field mapping at a scale of 1:30,000 has been completed over the 2000-2001 field seasons. Several sections across the belt, at a scale of 1:100 were constructed to provide details of the volcanic stratigraphy and contact relations with bordering granitoids and metaturbidites. High-resolution geophysical data supplied by Navigator Exploration Corporation was used to correlate stratigraphy through poorly exposed areas.

The ALVB forms an outward facing dome with a granitoid core and peripheral metaturbidites of the Yellowknife Supergroup. The structural base consists of banded amphibolite, thought to be highly strained equivalents of the overlying pillow basalts. Highly strained pillow basalts and andesites dominate the basal part of the section. Extensive units of felsic crystal tuffs are interlayered with the upper portion of the pillowed andesitic section, suggesting a change in extrusive activity from flows to pyroclastic eruptions. On the western side of the belt, andesite pillows are capped by a fragmental facies of mixed mafic/felsic volcaniclastic breccia and lapillistones suggesting deposition on the apron of a growing edifice. The fragmental facies is overlain by an iron-rich transition zone that grades into overlying metaturbidites. The transition zone includes biotite and white amphibole semi-pelite, gossanous, pyrrhotite-bearing two-amphibole iron-formation, and impure laminated carbonate that may be in part stromatolitic. The bordering metaturbidites are well-bedded cordierite- staurolite-biotite-muscovite-garnet-andalusite bearing psammites. Metaturbidites elsewhere in the map area lack staurolite: its presence here suggests iron enrichment from a mafic volcanic detritus.

Fifty-nine samples were analyzed for major elements, trace elements, and REE contents. Major element diagrams reveal basalts and andesites as the main component of the ALVB with minor constituents of dacite and rhyolite. Basal amphibolites and pillowed basalts have primitive LREE patterns. The most primitive rocks analyzed were gabbros with flat MORB-like tholeiitic basalt patterns. Andesites, dacites, and rhyolites have slightly higher overall REE abundance and enrichment in LREE compatible with their calc-alkaline major element character. The upper volcaniclastic package shows diverse REE patterns with mixed fragmentals and matrix material derived from a tholeiitic source. Grab samples of the gossanous two-amphibole iron-formation show LREE enrichment with a slight negative Eu anomaly.

Gossans occur both interior to the volcanic stratigraphy and at the volcanic-sediment interface. These pyrrhotite>pyrite units give rise to EM anomalies throughout the volcanic belt. To date, the maximum values for copper, zinc, lead, nickel, and gold are 356ppm; 1780ppm; 35ppm;

407ppm; and 22ppb, respectively. The Cu-Zn anomalies may be attributed to a VMS-style mineralization. The iron-formation at the volcanic-sediment interface can act as an excellent structural and chemical site for gold mineralization. Elevated nickel contents in mafic units suggests the possibility of hydrothermal PGE potential.

A POTENTIAL FOR MISSISSIPPI VALLEY-TYPE (MVT) PB-ZN MINERALIZATION, NORTHERN ALBERTA

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Occurrences of Pb and/or Zn mineralization, of possible Mississippi Valley Type origin, are known from bedrock and core in parts of the Middle and Upper Devonian carbonate sequence of northern Alberta. In general, the setting is similar to that which hosts the Pine Point MVT deposit in the southern Northwest Territories. Prior work by the Alberta government relates to varying degrees to MVT Pb-Zn mineralization in northern Alberta. The most encouraging report is of 3.1 % Zn over 22 m (with 0.05% Pb), including 5.1 % over 11 m, in well 16-34-118-21 W5 at 1279 to 1301 m from the Middle Devonian Keg River Formation near the Great Slave Lake Shear Zone in northwest Alberta. In bedrock, a galena occurrence has been observed in faulted and oxide altered parts of the Middle Devonian Methy Formation (Keg River equivalent) near Whitemud Falls on the Clearwater River east of Ft. McMurray. In addition to this a value of 0.1% Zn has been obtained from the Upper Devonian Grosmont Formation at Vermilion Chutes, Peace River in north-central Alberta by Gulf Minerals in 1977 during their Basin Rim Project.

Multidisciplinary fieldwork conducted in Ft. McMurray and Ft. Vermilion regions during summer 2001 lead to the tentative definition of areas with increased prospectivity for MVT mineralization in northern Alberta. New structural data indicate: 1) that NE-SW trending shear zones known from the shield area in the northeast extend through Wood Buffalo National Park into the Vermilion Chutes area; 2) that the roughly E-W faulting on Harper Creek west of Wood Buffalo National Park possibly represents a sub-parallel fault system to that at Vermilion Chutes, which reinforces the suggestion of regional fault systems traversing the park and 3) N-S and NE-SW trending faults are present at Whitemud Falls close to the reported galena occurrence. Saddle dolomite, which is commonly associated with MVT mineralization, was also identified at Whitemud Falls. Core studies planned for the fall-winter of 2001-02 may also reveal additional regions of increased prospectivity for MVT Pb-Zn mineralization in northern Alberta.

THE PLANNER PROJECT: INCORPORATING VARIOUS AGENCIES' REGULATORY ENVIRONMENTS INTO A SINGLE INTERNET PERMITTING APPLICATION

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Since its inception back in 1996, following through its developmental phases until its prototype release in 1999, the PLANNER (**P**ublic **L**and Use **A**pplication, **N**etwork **N**otification, and **E**nvironment **R**eporter) project has been working towards the integration of a number of regulatory agencies' permitting environments to make the entire application process more efficient. From April to June 1998, the Nunavut Planning Commission conducted an Application Discovery and Framework Design study to consult the various agencies who were interested in taking advantage of the Internet environment in accepting and evaluating their land use applications. The PLANNER application as it exists today (http://planner.nunavut.ca) has implemented those particular findings. It incorporates the requirements of the Nunavut Planning Commission, Nunavut Water Board, Nunavut Impact Review Board, Indian and Northern Affairs Canada, Nunavut Tunngavik Incorporated, and the Regional Inuit Associations. However, the regulatory dynamics in Nunavut have evolved since the initial study. Furthermore, additional agencies are interested in becoming involved with the online application, incorporating their forms and permitting processes. The PLANNER project faces a number of challenges in ensuring that it is representing current and future permitting environments, providing to project proponents a simplified and expedient land use application option. These challenges range in scope from software development troubleshooting and computer programming tasks to high-level organizational decision-making and inter-agency communications.

NORTHERN GAS PIPELINES – AN ENBRIDGE ALTERNATIVE

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Many technical challenges and opportunities lie ahead for the design and construction of the large diameter gas pipelines currently being studied from the Canadian Mackenzie Delta and the Alaskan North Slope. A number of northern pipeline design issues have been addressed, overcome and proven through the test of time by the construction and operation of the Enbridge Norman Wells crude oil pipeline. However, there are many new issues relating specifically to large diameter gas pipelines that will need to be considered in the planning phases of the next pipelines from the north.

The design, construction and 16 years of operation of the Norman Wells pipeline have resulted in the development of an extensive knowledge base of pipeline performance in permafrost. This information will be key to developing the next pipeline in a cost-effective manner. The Norman Wells Pipeline was the first long distance pipeline in North America to be designed for burial in permafrost. Most of the pipeline traverses areas of discontinuous permafrost, which, in Enbridge's view, is the area that will provide the greatest challenge for the design of new gas pipelines in the north. This presentation discusses some of Enbridge's findings from the design, construction and operation of the Norman Wells pipeline as well as highlights certain key planning considerations required of large diameter gas pipelines in the north.

In order to transport the significant volume of gas available from both the Alaskan North Slope and the Canadian Mackenzie Delta regions, pipe sizes, wall thicknesses and operating pressures necessarily become greater than most pipeline systems currently in-place in North America. Construction of such a large pipeline system in remote northern regions becomes a costly and time consuming undertaking. Enbridge has conducted studies for the northern gas transportation needs that indicate there is considerable risk of cost increases or schedule impacts from construction of such a large pipeline system in remote cold climate conditions. An alternative that Enbridge has investigated is to construct two smaller diameter pipelines consecutively in the same right of way. This presentation outlines Enbridge's views on this alternative project development plan.

VOLCANIC RELATIONSHIPS AND GOLD MINERALIZATION IN THE WOLVERINE-MADRID CORRIDOR, HOPE BAY BELT, NUNAVUT

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Gold deposits in the Hope Bay belt are among Nunavut's most advanced exploration projects and represent potential for near term production. Several different deposits have been outlined in the belt, since the inception of sustained precious metal exploration by BHP, in the early 1990's. These include the Boston, Doris and the Madrid Group of deposits (Naartok, Perrin, Suluk). All of these deposits are different in terms of their geologic setting, alteration characteristics and local controls on the distribution of gold. This diversity in gold mineralization along with the abundant outcrop and drill core, low metamorphic grades and overall low strain, makes the Hope Bay belt an ideal location to characterize the mineralizing events and place them in context of the geological evolution of the host terrane

The Wolverine-Madrid corridor, as defined here, is the belt of rocks between the southern end of Wolverine Lake and to the immediate northwest of Patch Lake. This area was selected for a detailed geology program since it includes the Naartok-Perrin-Suluk gold deposits at Madrid and a number of high-grade auriferous veins.

Geologic mapping and core logging in the Wolverine-Madrid corridor has demonstrated the presence of a well-defined volcanic stratigraphy. The lower stratigraphic sequence is a variolitic-pillowed basalt with interflow sediments. Overlying the variolitic suite are smaller, nonvariolitic pillows, without any recognized interflow sedimentary rocks (Wolverine suite). Both groups of mafic volcanic rocks in addition to various pillow forms, display rubbely flow breccias, quench breccias and locally sediment interaction textures. Felsic volcaniclastic and subvolcanic intrusives are interbedded with, and intrude into, the Wolverine suite of mafic volcanics. These provide excellent stratigraphic markers.

Gold mineralization developed in the Madrid area is represented by the Naartok deposit where gold occurs as a complex stockwork system developed in brecciated basalt with lesser altered gabbro and sedimentary rocks. The Naartok area is spatially associated with the hangingwall of the DEFZ that is a complex structure that juxtaposes different volcanic intervals.

In the Wolverine area, gold occurs in iron carbonate altered high strain zones with crack seal veins that have septa of tourmaline and or sheet silicates. The quartz-carbonate veins are generally deformed to some degree within the high strain zones. Kinematic indicators are rare in all but the largest of these zones, but where observed suggest sinistral offsets. These high strain zones and associated alteration and mineralization tend to be localized at lithologic contacts. The felsic – mafic volcanic contact are often preferentially mineralized as a result of the contrasting mechanical properties.

STRUCTURAL ANALYSIS AS AN AID TO EXPLORATION IN AND AROUND THE GIANT AND CON GOLD DEPOSITS, YELLOWKNIFE, CANADA

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The Giant and Con gold deposits represent different structural levels within a once-linked Archean gold system, now dismembered by Proterozoic faults. Both deposits experienced the same deformation history (D1 to D4): D1 early extensional deformation, D2 main compressional deformation, D3 late reactivation, and D4 Proterozoic faulting. However, the two deposits reacted differently to D2 deformation. Initially gently dipping alteration zones in the Giant deposit underwent layer-parallel shortening, producing a complex geometry of fold and mullion structures at the deposit scale. In contrast, initially moderate to steep dipping zones in the Con deposit were reactivated by reverse shear with a minor dextral component. This contribution will demonstrate how stope- to camp-scale mapping and 3D analysis (GOCAD) of the Giant and Con deposits can be integrated to develop new models for the structural controls on gold mineralisation, and to identify potential exploration targets at a variety of scales.

The prediction and understanding of the structural controls on ore zone plunge in both deposits is based on the structural analysis of ore zones, concentrating on the timing of mineralisation with respect to deformation events (pre/syn/post main deformation), the kinematics of deformation, and the structural style of vein formation. In general, ore plunges within the Giant and Con deposits are controlled by the orientation of D2 fold, boudin and mullion axes. Previous studies suggested that ore plunges within the Campbell zone, Con deposit, are sub-parallel to intersections between the hangingwall of the Campbell zone and the stratigraphy of the surrounding Kam Group. However, such a relationship does not account for the occurrence of sub-horizontal or the steep north ore plunges. Structural mapping indicates that the plunge of D2 fold and boudin axes strongly controls ore plunges in the Campbell zone. For example, steeply south plunging ore zones occur in narrow parts of the Campbell zone, in which strong D2 strain resulted in progressive rotation of D2 fold and boudin axes towards the L2 elongation lineation. In contrast, ore zones with sub-horizontal plunges occur in wider parts of the Campbell zone, where the intensity of D2 overprinting is less. Recent structural mapping in the steeply north plunging 102 ore zone has revealed F2 folds that plunge steeply north, with an L2 elongation lineation that still rakes south. Therefore, detailed structural analysis can help to predict the plunge of ore bodies in new areas of the existing deposits.

New insights have also been gained into the offset of ore-bearing deformation zones in Giant and Con deposits by Proterozoic faults. At the deposit scale, a new piercing point solution has been devised using the intersection of the footwall of the Campbell zone with the Jackson Lake Fm. unconformity to determine Proterozoic fault offsets on the Yellowrex and Pud faults. This solution has implications for exploration for new ore zones in the southern part of the Yellowknife belt, within the likely extension of the Campbell zone. At the camp scale, the piercing point solutions of Campbell (1949) and Brown (1955), combined with information on the strike and dip of the Townsite Fm., have been reevaluated to develop a new 3D interpretation of the relationship between the Giant and Campbell deformation zones. This interpretation predicts that the Giant deformation zones are NOT the upward extension of the Campbell zone, and that the Campbell zone most likely dips below the Giant deposit projecting to surface in the Back Bay-Fault Lake area.

BEDROCK GEOLOGY OF THE COMMITTEE BAY BELT, WALKER LAKE-ARROWSMITH RIVER AREA, NUNAVUT

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New bedrock geological mapping (1:100k scale) of the Committee Bay belt focused on the Walker Lake (NTS 56J (N-half)) and Arrowsmith River (NTS 56O (S-half)) map areas, extending coverage northeast of the Laughland Lake area (NTS 56K; Sandeman et al. 2001a,b). Bedrock mapping and ongoing structural, geochronological, and petrological investigations are part of an integrated three year (2000-03) Targeted Geoscience Initiative involving surficial mapping, drift prospecting, and a higher resolution aeromagnetic survey of the belt (400 m line spacing).

Three geological domains are recognized in the map area. The south and eastern domain is dominated by a foliated, northeast striking K-feldspar-biotite-magnetite granodiorite-granite batholith, cut by massive, likely Paleoproterozoic sills of biotite- (fluorite) granite. In the south, the batholith is cut by the east-trending, dextral-strike slip, Walker Lake shear zone.

The central granite-greenstone domain includes narrow (<2 km wide), northeast-striking, lower- to mid-amphibolite facies supracrustal belts cut by wide, (to 15 km) intermediate to felsic plutonic sheets that are folded into broad northeast-trending structures with shallow to moderate northeasterly plunge. Two types of supracrustal belts are recognized in the central domain. The quartzite-komatiite type includes: a lower sequence of komatiite locally interbedded with thin quartzite, overlain by psammite, semi-pelite and banded iron formation, in turn overlain by a thick quartzite (locally cross-bedded), intermediate volcaniclastic rocks, and an upper pelitic unit interlayered with komatiite. The basalt-dominated type includes: pillowed to massive basalt and gabbro with lesser komatiite, iron formation, and felsic hypabyssal rocks, but lacks quartzite. In the Laughland Lake map area, a potentially correlative pillow basalt sequence is associated with felsic lapilli tuff that has a preliminary zircon U/Pb age of 2.73 Ga (Sandeman and Skulski, in prep.). Six major plutonic types are recognized in the central domain. These include fine-medium grained biotite tonalite and hornblende-biotite tonalite, cut by biotite granodiorite, K-feldspar-biotite granodiorite, and younger biotite monzogranite. Biotite-hornblende tonalite from the Laughland Lake map area has a U/Pb zircon age of 2.72 Ga whereas biotite tonalite is ca. 2.59 Ga

The northern metasedimentary-plutonic domain includes upper amphibolite-facies metasediments cut by peraluminous granite, metaluminous granodiorite and tonalite. The metasediments include wacke, pelite, semi-pelite and rare quartzite. Textural preservation is variable from rare occurrences of bedded wacke, to voluminous metatexite and diatexite with migmatitic texture reflecting low-pressure anatexis (biotite-sillimanite-garnet-cordierite-melt). Several arcuate belts of highly strained rocks, 1-2 km wide, separate the central and northern domains. The high strain zones have moderate to shallow southward-dipping fabrics, strong down-dip to shallow west-plunging rodding lineations, and shear sense indicators collectively interpreted to reflect normal, southward-directed extensional displacement. These shear zones may have played a role in juxtaposing the granite-greenstone and mid-crustal paragneiss domains. Ongoing geochronological studies are aimed at assessing whether sedimentary rocks of the northern domain are broadly coeval with supracrustal rocks of the central granite-greenstone domain or, as is true for large metasedimentary terrains in the Superior and Slave province, were deposited synorogenically.

THE APPLICATION OF QUATERNARY SURFICIAL MAPPING TO THE INTERPRETATION OF HIGH DENSITY DRIFT GEOCHEMICAL RECORDS

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Drift geochemical records from four mineral claims in southeast Yukon are analyzed to assess the distribution of Pb and Zn (and limited records of Ag, Ba, Cu, F, Mo, and U) with respect to bedrock, versus glacial and other surficial deposits.

The upper Beaver River region of SE Yukon was the focus of a number of geological investigations aimed at discovering shale-hosted (sedex-type) base metal and carbonate-hosted lead-zinc mineralization in the late 1970's and early 1980's. Anomalous mineral concentrations that were reported in stream geochemical surveys spawned interest in areas of unusual vegetation cover, tufa and ferricrete gossans. In subsequently established mineral claims, drift samples were dug from the C or B soil horizon, and sampling was established along 200 x 50 or 100 m grid intervals (Ting and Beaver claims, respectively) or along arbitrarily defined linear paths and stream courses (Mars and Tranz claims). The Beaver claim has the densest network of sample points (1968 samples collected over 27 km^2), and is thus the focus of this poster.

Using GIS, mineral claim report maps showing sample sites and element concentrations were first digitized. This data was then used to construct isopatch maps illustrating concentration distributions and possible geochemical anomalies. Element anomalies are classified according to their percentile rank; background (0-75'th), threshold (75-95'th), definite (≥95'th). The isopatch maps were then overlain onto orthorectified stereopair airphotos on which the surficial geology had been mapped. This allows the viewer to identify the surficial material or landform with which each geochemical anomaly is associated.

The results confirm the relative mobility of different elements during weathering and erosion. While Zn and Ag can be relatively easily stripped from rocks and sediments under oxidizing and acidic to neutral conditions, Pb is fairly immobile under similar conditions. The drift geochemical records of these three elements clearly demonstrate which of the signals most strongly reflects the underlying bedrock (or migration along faults, i.e., a secondary halo) versus redeposition in glacial and/or alluvial sediment (i.e., concentration peaks associated with alluvial fans or at the apices of raised deltas). This method also allows for the assessment of possible false anomalies related to reprecipitation/seepage processes.

Combining the drift geochemical records with surficial mapping permits a greater understanding of the nature of individual geochemical anomalies, and allows better targeting of potential source-rocks for future exploration. By extension, this exercise also demonstrates how surficial mapping can be used to design and refine regional drift geochemical surveys through strategic sampling of deposits which integrate the bedrock geochemical signature of larger catchments.

ONGOING TELESEISMIC STUDIES OF THE SLAVE CRATON

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Teleseismic studies of the Slave craton are in their infancy. Michael Bostock and his students at the University of British Columbia established 13 teleseismic stations within the Slave craton between November 1996 and May 1998; their analysis included SKS anisotropy, receiver functions and tomography (Bank et al. 2000). The regional-scale results possible with these limited data indicated that fast anisotropy directions generally coincided with North American plate motion direction and a consistent, smoothly varying Moho depth of 37-46 km that is also consistent with broad variations in the observed gravity field. Tomography resolved higher velocities (<1% slowness perturbation) beneath the oldest core of the craton, the Central Slave Basement Complex (Bleeker et al. 1999), and indications of lower velocities directly beneath the Lac De Gras kimberlite field.

During the past year, five seismic stations operated on the Slave craton at the Ekati, Snap Lake and Kennady Lake mine/exploration sites. Early results from anisotropy and receiver function analysis are consistent with the previous results although two layers of anisotropy are now clearly indicated. A shallow layer occupying the upper crust shows trends that match the large-scale, first-order F1 structures mapped there (Bleeker et al. 1999). A deeper layer again matches North American plate motions. During the next three years an additional thirty stations will be installed as one part of the satellite-telemetred POLARIS network. At present, four of these stations are operational. Most of these stations will form a linear profile oriented NNW-SSE across the Lac de Gras field. Our goal is to further resolve some of the anomalies hinted at in the Banks et al. studies and resolve any variations within the lithosphere that might relate to conductive anomalies in the mantle, kimberlite intrusion or mantle chemistry.

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TECTONIC MODEL FOR THE UNROOFING OF THE NORTHEASTERN HEARNE DOMAIN BASED ON GEOPHYSICAL, PETROLOGICAL AND STRUCTURAL OBSERVATIONS

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The Western Churchill NATMAP project has resulted in a plethora of new, albeit diverse and discontinuous, observations relevant to the geology of the 100-km-wide Neoarchean Rae-Hearn boundary zone (called by some workers the northern Hearn domain). Among these observations are those recorded by a 360-km-long north-south line of eight magnetotelluric and teleseismic stations occupied during the summer of 1998. The geophysical records were modeled as a series of conductors and seismic discontinuities within the crust beneath the stations. Associated inferred structures were then correlated with available paleodepth measurements (pressure, temperature, age of mineral assemblages) to suggest a crustal section, and thus a tectonic history of this cryptic boundary zone. This new history provides an alternative history to an earlier one based primarily on the magnetotelluric observations. A prominent area of positive gravity anomalies coincides with the Chesterfield Inlet area where ca. 1.9 Ga paleopressures >10 kbar indicate rocks uplifted tens of kilometers; high-density granulite-facies rocks exposed in several places are assumed to be representative of rocks at greater depths beneath this region. Faults and extensional lineations mapped at the surface were combined with structures inferred from conductors and seismic discontinuities to build a 3-D geological model of a ca. 1.9 Ga "core complex". Regional north-south convergence and thrusting at 2.5 Ga was followed at 1.9 Ga by exhumation within a "horsetail" splay associated with trans-tensional deformation along the Snowbird tectonic zone. The former event produced a stack of thrust sheets that include the Cross Bay Complex and its bounding Big Lake shear zone. The latter event produced the majority of the observed uplift and may have also involved convergence at its inception. During extension, the hanging wall block generally moved toward present-day Hudson Bay allowing the unroofed footwall to rise along generally east-west to northeast-southwest striking normal faults, with the greatest differential uplift interpreted to have occurred along the Chesterfield fault zones. Although this model may not account for all available observations, it does explain the first-order observations of the gravity anomaly, the distribution of exposed high-pressure rocks, variations in Moho depth, mapped faults with some displacement indicators, most major crustal seismic discontinuities, and it is also consistent with the magnetotelluric observations.

INCLUSIONS IN DIAMONDS FROM THE PANDA KIMBERLITE

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Diamonds from the Panda kimberlite pipe (Ekati mine, Lac de Gras area) have been studied for their syngenetic mineral inclusions content. From 88 diamonds we released a total of 124 inclusions which were all analyzed for major and minor elements (electron microprobe). Excluding 5 diamonds, which only yielded altered or epigenetic inclusions, the Panda diamonds show a strong dominance of the peridotitic suite (87%) over eclogitic (85) and lower mantle (5%) inclusions parageneses.

Compared to peridotitic inclusions world-wide, pyrope garnets have high Ca and Cr contents and low Mg-numbers. This tendency to lower Mg/Fe ratios is also observed for the other peridotitic inclusions phases and therefore is not an effect of crystallization at unusually low temperatures but reflects a diamond source that is chemically more enriched than average. The high Cr contents of the pyrope garnets, however, indicate a source that experienced strong chemical depletion at low pressures (spinel peridotite stability field). This suggests that the diamondiferous lithospheric mantle beneath the Slave experienced a history of primary depletion and secondary re-enrichment, similar to other cratonic areas world-wide. The apparent fertility of Panda inclusions thus only indicates a stronger metasomatic overprint than commonly observed and does not necessarily require a major plume event.

Geothermobarometry of peridotitic inclusions indicates that equilibration took place under conditions typical for diamond formation world-wide (about 1150°C). However, both geothermobarometry on touching inclusion parageneses and in part very low aggregation levels of nitrogen impurities in diamond suggest that significant cooling of the deeper lithosphere by about 150°C occurred rapidly after diamond formation.
Inclusions of the eclogitic suite fall within the compositional ranges observed for other occurrences world-wide. Most eclogitic garnets are low in pyrope content, which may relate to the overall low Mg/Fe ratio found for peridotitic inclusions.

The four ultra deep diamonds from Panda contain combinations of ferropericlase with $CaSiO_3$, SiO_2, olivine and sulphide. Associations of ferropericlase with CaSi-perovskite and stishovite chemistries are not stable at upper mantle conditions and, therefore, are inferred to be derived from the lower mantle. Combinations of ferropericlase-olivine or ferropericlase-sulphide may also originate at lithospheric pressures in a reduced dunitic source. However, the circumstantial evidence of other lower mantle diamonds occurring in the same diatreme suggests an ultra deep origin for these inclusions as well.

UPDATE ON MULTIDISCIPLINARY STUDY OF SEDIMENTARY COVER SEQUENCE IN LAC DE GRAS KIMBERLITE FIELD, NORTHWEST TERRITORIES CANADA

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The Lac de Gras kimberlite field in the Northwest Territories of Canada is currently under study with the aim of better understanding the nature and extent of Cretaceous and Tertiary sediments within the region before, during and after kimberlite emplacement and associated volcanism. The nature of the sedimentary cover is being studied using organic petrology-geochemistry, palynology, petrophysical and sedimentology-stratigraphy as part of a multi-year Geological Survey of Canada Lac de Gras (LDG) kimberlite project. To date pre-existing organic petrology-geochemistry and palynological data sets from 13 kimberlite pipes have been compiled, and a suite of new samples (~ 200) from 7 other kimberlite occurrences has been collected, and, in part analyzed. Palynological analysis (see Sweet et al., this volume) show a range of ages from Albian (Cretaceous) to early Paleocene (Tertiary) for shale xenoliths in the LDG kimberlites, and Paleocene ages for 'surface' woods incorporated within kimberlites. Thermal maturity profiles through 12 different kimberlite occurrences show that there are distinct differences in the 'thermal environments' in which the organic matter was altered, or not altered, within kimberlite event or facies, and within volcaniclastic and/or pyroclastic 'facies'. Per cent reflectance in oil (%Ro) of huminite and vitrinite macerals within Cretaceous late Albian to Paleocene shale xenoliths and 'beds' (large xenoliths up to meters in diameter likely manifested as 'beds' in core; Doyle et al, 1998) in pipes, volcaniclastic and pyroclastic kimberlites show a %Ro range from 0.27 to 3.1. The lower end of the range is considered to represent unaltered Cretaceous-Tertiary shales with none of the marine or terrestrial dispersed organic matter showing any apparent thermal alteration effects such as dehydration-devolatilization features and high reflecting rims. The levels of thermal maturity and lack of anomalous thermal alteration for the lower end %Ro values are corroborated by Rock Eval pyrolysis experiments and microspectrometry of visible region fluorescence of dinoflagellate and sporinite/pollen macerals, with Lmax values on the order of 485 nm and 485-510 nm, respectively. Preliminary assessment of the data suggests that under 'normal' geothermal burial in an intracratonic basin, as much as 1 to 2 km of Cretaceous (Albian to Maastrichtian) to Tertiary (Paleocene) strata/cover may have been present in the LDG region prior to or at the time of kimberlite emplacement and associated volcanism. Porosity and permeability measurements completed on unaltered shale xenoliths also indicate a similar range of maximum burial depth of burial prior to inclusion into the kimberlites. Determining timing of erosion of this cover will be critical to evaluating the effect of the cover during emplacement. Optical properties of associated early to late Paleocene huminites ('woods') and palynomorphs show a range of thermal alteration from unaltered to rapid, intense alteration at temperatures exceeding 700°C. The unaltered Paleocene huminites have %Ro values similar to peat-brown coal level of coalification, with no significant burial.

Preliminary sedimentological analysis of reworked kimberlite volcaniclastics within the upper part of the Scorpion kimberlite show a paleodepositional system dominated by a series of 1 to 5 m thick, fining-upward, fine- to coarse-grained sandstones and pebbly sandstones interbedded with thinner, organic-enriched (up to 5.6 wt % total organic carbon) muddy siltstones. Some beds are massive and are interpreted as debris flow deposits, but most display poor to fair sorting and crude low-angle stratification, implying, within a conventional depositional setting, a dominance of unconfined sheetflood deposition.

AN OVERVIEW OF THE MULYIDISCIPLINARY CENTRAL BAFFIN PROJECT, NUNAVUT

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The geology of part of Central Baffin Island, Nunavut, is the subject of a 3-year multi-disciplinary investigation that is a collaboration of the Geological Survey of Canada, the Canada-Nunavut Geoscience Office, and the Polar Continental Shelf Project. The second field season is now complete, and 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 of the Archean Rae craton that 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 southern part of the area, completing systematic 1:100,000-scale coverage of NTS 37D and the west half of 27B, focused on delineating 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.

Surficial materials mapping concentrated on completing a transect of the western part of the area (NTS 37A, 37D) 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. The isotopic nature and paleoclimatic significance of the Barnes Ice Cap is under investigation, as are indicators of recent climate change. A till geochemistry sampling program is underway, focussing on regional backgrounds, changes over the Piling Group, and correlation of till and lake geochemistry.

Geophysical surveys will contribute to development of our understanding of the deeper crustal levels of the project area. A 5-station teleseismic transect across the area, initiated in 2000, was expanded in 2001; a 14-station hi- and low-frequency magnetotelluric profile was completed in 2001. Gamma-ray spectrometric measurements have been gathered in representative map units across the study area. Integration and interpretation of all of the above datasets will be facilitated by GIS-based 3-D modeling techniques.

A SECOND LOOK AT THE NICHOLAS BAY KIMBERLITE COMPLEX, NORTHWEST TERRITORIES.

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Shear Minerals Ltd. is currently exploring the Aylmer Lake West Property in partnership with Diamondex Resources Ltd. The claims, owned 51% by Diamondex and 49% by Shear, are strategically located to the east of Lac de Gras in the NWT, approximately 95-km southeast of the Ekati Mine, and 65-km southeast of the Diavik Project. To date, two diamondiferous kimberlites, the Nicholas Bay Kimberlite (NBK) and the NIC2 Kimberlite, have been discovered on the Property. These are the easternmost kimberlites in the Lac de Gras field.

In January 2001 a sample totaling 127.7kg was collected from previously unsplit and unanalysed kimberlite core from the NBK and was submitted to Saskatchewan Research Council (SRC) for caustic fusion analysis. 1,180 diamonds were recovered of which 6 were macrodiamonds (+ 0.5mm in at least one dimension). Of these 6 macrodiamonds two have an average dimension of greater than 0.5mm in all three directions with the largest diamond measuring 0.68x0.64x0.56mm. The highest number of stones from one sample totaled 110, from a 5.75kg sample. The SRC characterizes these diamonds as generally having well formed crystal structures and also being clear and colorless. These results indicate a greater abundance of diamonds than was previously reported from the NBK.

Two distinct kimberlite phases have been identified: a tuffisitic kimberlite breccia (TKB) phase containing numerous country rock fragments, and an olivine macrocrystic hypabyssal phase. Both phases have different geophysical signatures. Core length widths up to 90.7m of TKB and up to 56 m of hypabyssal kimberlite were logged from drill core. The geometry and size of the kimberlite is not known accurately.

Indicator mineral results for the NBK include G-9 lherzolitic pyrope garnets with >10% Cr_2O_3, chromites with in excess of 60% Cr_2O_3 and up to 66% Cr_2O_3 indicating a diamond inclusion field composition, chrome diopsides with up to 2.5%, Cr_2O_3 and olivine. Due to the small size of the sample analysed for indicator minerals and the high degree of alteration within the kimberlite, a larger sample should be processed to collect a more representative indicator mineral population.

In April 2001 ground geophysics was completed over ten high-priority target areas to delineate specific drill collar locations. Drill hole NIC-2 tested a coincident magnetic low and EM anomaly having dimensions 125m long and 50m wide, east of and subparallel to the NBK. This hole intersected a 1.6m wide olivine macrocrystic kimberlite of unknown geometry, possible a dyke or sill. Caustic fusion of a 4.85 kg kimberlite core sample by SRC reported two macrodiamonds (greater than 0.5mm in one dimension) and 25 microdiamonds (75 micron sieve).

Shear is very encouraged by these new discoveries. Several high priority geophysical targets remain to be drill-tested. Results from a September program are forthcoming as exploration continues on the property. The 2001 results indicate high potential for the discovery of additional kimberlites in the area and that the NBK is more complex than previously thought.

THE SNARE RIVER PROJECT, 2001: RESULTS FROM THE LOW-GRADE TERRANE AROUND SLEMON AND WHEELER LAKES

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In 2001, field work continued for the multi-year Snare River Project, in the southwestern Slave Province, N.W.T. (parts of 85N and 85O). Mapping was focussed on low-grade rocks of the Emile River, Slemon Lake and Wheeler Lake areas and on high-grade rocks between Cowan and Ghost lakes. The geology of the Emile River area and the high-grade rocks is outlined in Jackson (this volume).

NORTHWESTERN SLEMON LAKE AREA:
A west-northwest-striking domain of Archean metasedimentary rocks that is approximately 15 km long underlies the northern part of the area. These metagreywackes-mudstones locally contain banded iron formation (BIF) and are continuous with the BIF-bearing turbidite sequences at Russell Lake. The metasedimentary domain comprises a core of greenschist facies chlorite-

biotite slates that are mantled by lower amphibolite facies cordierite-biotite schists. West-northwest-striking cordierite isograds separate the two metamorphic zones. The metasedimentary rocks have been intruded by Archean granites to the south.

Structural elements in the Slemon Lake area follow the scheme of Fyson and Jackson (1991). Opposing stratigraphic topping directions over several kilometers mark a north-northwest trending F_0 syncline. F_1 axial traces generally follow the contact with the bounding southwestern granitoids. F_2 folds are best exposed in the area, usually tight with well-defined hinge zones, and distinctive S_2 axial planar segregation cleavages. F_3 folds are mainly asymmetrical folds with axial traces that strike approximately 45 degrees to bedding, and whose wavelengths are normally 1 to 15 cm long. S_3 slaty and crenulation cleavages have been imposed upon pre-existing F_2 folds. Northwest-striking S_3B cleavages predominate in the southeast part of the area, whereas northeast-striking S_3C cleavages dominate in the middle to western area, and north-striking S_3A cleavages are mainly developed in the eastern area.

WESTERN WHEELER LAKE AREA:
Part of the north-striking, Proterozoic West Bay-Indin Lake fault system transects the area. It occurs mainly under Wheeler Lake and marks the eastern limit of 2001 mapping. The area west of Wheeler Lake is underlain by predominantly granitoid, lesser metasedimentary, and rare metavolcanic rocks. Three different granitoid units were differentiated: coarse-grained, massive granite, feldspar porphyritic granite that is rich in metasedimentary xenoliths, and the multi-phase, typically magnetite-bearing “Disco granite”.

A northeast-striking fault, about 10 km west of Wheeler Lake, marks the eastern boundary of the high-grade rocks. “Disco granite” occurs on both sides of the fault, but its aeromagnetic signature is lower on the east side of the fault than on the west side.

The northeast-striking domain of metasedimentary rocks that straddles the O/5 and O/6 map sheets is continuous with the northeastern lobe of metagreywackes-mudstones at Russell Lake. This domain includes a western area of mainly garnet-cordierite-biotite schists to gneisses and an eastern area of cordierite-biotite schists. Bedding and foliation mainly conform to the margins of bounding granitoids.

Fyson, W.K. and Jackson, V. A., 1991: Can. J. Earth Sci., v 28, p. 126-135.

STRATIGRAPHY OF THE ERODED SEDIMENTARY COVER RECORDED BY XENOLITHS AND CRATER FILL SEDIMENTS ASSOCIATED WITH KIMBERLITES, LAC DE GRAS REGION, NORTHWEST TERRITORIES

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Previous studies have shown that, abundant plant microfossils (palynomorphs) in the xenoliths and crater fill sediments associated with kimberlites in the Lac De Gras region allow the determination of the age and depositional environments of the now eroded sedimentary cover (Nassichuk and McIntyre, 1995, 1996; Doyle et al., 1998; McKinlay et al., 1998). Information on paleoenvironments based on the types of microfossils present is complimented by the kinds of organic kerogen present in the palynological residues and observed in ongoing parallel organic petrology-geochemical studies. Terrestrially derived, pollen and spore-rich assemblages of Middle to Late Albian age (~100-105 Ma); marine, algal-rich (dinoflagellates and acritarchs) assemblages of Early to mid Cenomanian (~95-100 Ma), Late Cenomanian to Santonian (~84-95) and Campanian to earliest Maastrichtian (~71-84 Ma) ages, and terrestrially derived pollen and spores assemblages of Late Maastrichtian (65-67 Ma), Early Paleocene (61-65 Ma), mid Paleocene (58-61 Ma) and latest Paleocene (or possibly earliest Eocene) (~53-58 Ma) ages are present (absolute ages approximated from Berggren et al., 1995). These are recovered as either discrete assemblages from isolated xenoliths and crater fill sediments, or as mixed assemblages from composite volcaniclastic samples.

Early Paleocene samples commonly yield abundant recycled Maastrichtian (mostly late Maastrichtian) pollen, sparse earlier Cretaceous spores and dinoflagellates and rare Permo-Triassic pollen and Carboniferous spores, presumably derived from an uplifted western source. In particular, the Early Cretaceous and Carboniferous spores appear more organically mature than the remainder of the assemblage, a factor that may produce spurious organic maturity values (e.g. vitrinite /huminite reflectance). A similar range of reworking occurs in Early Paleocene rocks outcropping along the Mackenzie River south of Norman Wells.

The palynologically derived ages provide a means to assess the relationships between sediments preserved in association with kimberlites and formations/sequences present in the foreland basin adjacent to the western orogen.

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OIL AND GAS PROSPECTING: SURFACE GEOLOGY SAMPLING – MAPPING, NORTHWEST TERRITORIES & YUKON (RULES & REGS)

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Parts of the Northwest and Yukon Territories have been opened up to oil and gas exploration. Excellent Geological Survey of Canada maps and reports form the basis for "ground truthing" important exposures and structures which may provide clues to subsurface oil and gas traps.

Oil and Gas prospecting, surface sampling with hand tools and helicopter assisted structural mapping, has become very closely regulated compared to pre- moratorium days. Unfortunately this *no impact* geological activity gets classified with the more intrusive seismic activities, which involve tree felling and blasting, in the regulations of the National Energy Board (NEB) and the Yukon Oil and Gas Division (YOGD).

The Canadian Forest Oil Ltd. 2001 field party surveyed the excellent rock exposures along the drainage divide that forms the Yukon and Northwest Territories border south of Nahanni Park. This cross-border activity more than doubled the regulatory and consultation workload required to actually get out onto the rocks.

A checklist of licenses and permits required; government, private agencies and individuals that needed to be contacted; and required training and equipment is given below as a guide for others.

Land Use Letter: Hand tools for sampling and no remote fuel caches: *Falls below the thresh hold for licensing* but the National Energy Board (NEB) and Yukon Oil and Gas Division (YOGD) needed letters from each agency (DIAND Whitehorse and MVLWB Yellowknife) to the effect that a land use permit was not required.

Licenses: required from the NEB and the YOGD.
To obtain licenses we needed letters, faxes, e-mails to and from
First Nations (Ache Dene Koe at Fort Liard and the Kaska at Watson Lake).
Negotiate *benefits*. Helicopter franchise and a local Kaska hire.
Contact all concession holders (hunters and trappers) in the area.
Contact archeologists (Whitehorse and Yellowknife)
Contact local wildlife officers (Watson Lake and Ft. Simpson)
Contingency fuel spill plan from the helicopter firm
To obtain licenses had to have the following equipment.
Party member attended a first aid course
Satellite telephone carried at all times
Survival kit, firearm, bear spray
Written emergency plan and safety duties assigned to crewmembers

Permits: Scientific Research Permits (Whitehorse – no fee and Inuvik - $100 fee)
Other considerations: Workmen’s Compensation Boards, Insurance
License and Permit obligations:
Advance notice of commencement of field operation (NEB and YOGD)
Weekly reports (NEB and YOGD)
Technical reports due in 12 month with lab results (NEB and YOGD). Variable confidentiality provisions.
Reports due in 12 months (Scientific research Inuvik and Whitehorse)
No fly over or entry into Nahanni National Park (NEB)
Notify in case of incidents, accidents or spills (NEB and YOGD)
Minimize wildlife disturbance

Field checking can be wet and dirty work but the odd sunny day and the valuable geological information obtained makes it worthwhile. Safety is an important element of the field planning and project execution. Be careful out there.

1:100 000 SCALE BEDROCK GEOLOGY COMPILATION MAP OF THE MACQUOID LAKE-GIBSON LAKE-AKUNAK BAY AREA, NUNAVUT

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The map, which covers a portion of the northern Hearne domain, presents recent results of bedrock mapping and integrates data from topical studies on geochronology, geochemistry, petrology, structure, and metamorphism. The objectives of the mapping were to evaluate the nature of tectonothermal reworking of the Archean rocks during the Paleoproterozoic and to provide an improved tectonic framework for mineral exploration.

The map area is divided into three lithological and structural subdivisions: (1) the MacQuoid homocline comprised of northwest-dipping belts composed of Archean amphibolite facies sedimentary rocks and gneissic tonalite, structurally overlain by (2) a volcanic belt comprised of amphibolite facies juvenile mafic, intermediate, and felsic volcanic rocks (ca. 2682 to ca. 2655 Ma), and associated plutonic rocks (ca. 2684 to ca. 2656 Ma); and (3) the ca. 2700 Ma Cross Bay plutonic complex comprised of polydeformed and metamorphosed Archean tonalite gneiss, diorite and gabbro that structurally overlies the MacQuoid homocline. U-Pb isotopic studies (zircon, monazite, titanite) suggest that the Cross Bay complex was deformed at ca. 2695 Ma before the onset of ca. 2682 Ma volcanism in the MacQuoid homocline, and highlight a complex Archean and Paleoproterozoic tectono-magmatic evolution. The Big Lake shear zone (Blsz), which coincides with the southern margin of the Cross Bay plutonic complex, is a north-dipping zone of straight gneisses/mylonites predominantly derived from granitoid protoliths. Metamorphosed and deformed ca. 2190 Ma mafic dykes, and variably deformed ca. 1830 Ma granite and co-magmatic lamprophyre dyke-swarms represent Paleoproterozoic tectonothermal and magmatic events.

At least four deformation events affected the supracrustal units within the MacQuoid homocline and the volcanic belt. D_1-D_2 events are considered to be late Archean events. Fabric relations suggest that the regionally pervasive foliation in the supracrustal units is a composite S_2, developed from the transposition of an older S_0/S_1 fabric. Younger Paleoproterozoic tectonothermal events deform the ca. 2190 Ma mafic dykes.

The main Archean amphibolite to granulite facies metamorphism (M2) is thought to overprint a relatively lower grade metamorphic event (M1) associated with intrusion of ca. 2682-2610 Ga plutons. M2 occurred at ca. 2560-2500 Ma, and records P-T conditions that ranged from ~5 kbar – 660^{o}C to ~12 kbar - 770^{o} C. Porphyroblast-fabric relations indicate that M2 was post-D_1, with peak metamorphism during early D_2 but outlasted by D_2. A high-pressure granulite facies event (M3) at ca. 1900 Ma ranged from ~10 kbar–675^{o} C in the southwest to > 12 kbar north of Chesterfield Inlet. Widespread greenschist to lower amphibolite facies metamorphism (M4) accompanied emplacement of ca. 1830 Ma granite plutons.

The region hosts several economic mineral occurrences and significant prospects -- volcanic-associated massive sulphide, magmatic Ni-Cu, iron-formation-hosted Au, diamonds, and carvingstone. The diverse metal endowment of the region suggests continuing exploration potential.

METAMORPHISM AND THE ORIGIN OF GOLD DEPOSITS IN THE YELLOWKNIFE GREENSTONE BELT, PHASE 3 - FROM BELT-SCALE METAMORPHIC ZONES AND THIN SECTIONS TO EXPLORATION TARGETS

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With fieldwork complete and petrography two thirds done, the belt-scale metamorphic setting of the Yellowknife Greenstone Belt (YGB) is coming into focus. Application of a new three-zone system to the entire belt resolved inconsistencies between previously mapped isograd patterns and filled major gaps in the metamorphic database. Field and petrographic observations revealed that metamorphism and related flattening and rotation of the belt began before and continued after intrusion of the Defeat Suite plutons. Regional metamorphic conditions for rocks now at the surface peaked after the Defeat intrusive event (~2620 Ma) and before the intrusion of the Prosperous Suite (~2590 Ma). That is, the metamorphic zones were produced by a long duration regional metamorphism (tens of millions of years) punctuated by short duration contact metamorphic events (hundreds of thousands to millions of years) around intrusive granitoid plutons.

A combination of volcano-sedimentological and tectonic burial transported the volcanic belt to maximum pressures (2.5-4.0 kbars) and temperatures (350-640‹C) as the crust first thinned (basin formation) and then thickened to greater than normal thickness (orogenesis). Driven by the geodynamically unstable nature of overthickened crust, exhumation of the greenstone belt began before the peak regional thermal regime was attained and ended more than 150 Ma later. The high geothermal gradients characteristic of regional metamorphism in the Slave Province are attributed to inheritance of high geothermal gradients formed during lithospheric/crustal thinning and to the extra radiogenic heat generated during subsequent crustal thickening. Syn- to post orogenic plutonic magmatism is a product of the same thermal and crustal thickness anomalies that caused the regional metamorphism.

Ninety percent of the gold mined from metamorphic terranes was deposited in the range 250-450‹C, 1-3 kilobars (depth = 3.5-10.5 km). On a Depth-time diagram, YGB greenschist zone rocks spend tens of millions of years within the gold deposition zone. Amphibolite zone rocks pass through the zone twice, once on the way down to maximum pressure and temperature and again as exhumation brings the metamorphosed volcanic rocks and gabbro back to the surface.

As fluids tend to flow perpendicular to isotherms, and down temperature gradients, the distribution of isotherms in the crust is a key factor affecting the geometry of mineralising fluid flow, and, ultimately, where ore deposits form. Displacement of the new isograd pattern by the West Bay Fault is consistent with an east side down component only if the isograds dip west and north-west under the Western Plutonic Complex. Such a configuration would direct upward moving fluids eastward toward the mineralised deformation zones. The occurrence of higher maximum geothermal gradients in the metasedimentary domain than in the bordering greenstone belts implies the presence of a thermal dome with isothermal surfaces dipping toward the YGB. It is possible that fluids moving out of deepest parts of the high grade zone in metasedimentary rocks reached the YGB when it was still within the P-T conditions conducive to gold deposition. From the metamorphic perspective, at this stage of the project, the best exploration target is the greenschist zone mafic rocks that extend north of the Akaitcho Fault as far as Homer Lake. In addition to long exposure to the gold deposition zone and abundant chlorite-carbonate-quartz deformation zones, the higher potential for syn-volcanic mineralization at depth may enhance the potential for shear-hosted gold at higher levels in the crust.

THE POLARIS Zn-Pb DISTRICT, CENTRAL ARCTIC ISLANDS, NUNAVUT

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MVT Zn-Pb mineralization is known from the Cornwallis Zn belt on Devon, Bathurst, Cornwallis, Little Cornwallis, and Somerset islands. Polaris Mine (22 Mt at about 14% Zn+Pb) is the largest deposit, but about 25 other significant showings or clusters of showings are known. Ordovician through Devonian stratigraphic units are mineralized, with showings typically dominated by iron or zinc, with lesser lead.

Ordovician through Silurian platformal carbonates and evaporites represent a prolonged interval of slow subsidence on a passive margin. Progradation of reefal carbonates during latest Silurian time was propelled by the incipient development of the Cornwallis Uplift; deformation continued into the Early Devonian. Structures of the Cornwallis fold belt are northwest-southeast trending folds, presumably the result of basement-rooted, east-west compressional stress. Decollement is likely localised in Lower Ordovician evaporites, with blind thrusts at cores of anticlinoria mapped at surface.

The unconformity produced by subaerial exposure during uplift was covered regionally by carbonate rocks during the late Early Devonian. Overlying these are increasingly quartzose strata that result from progradation of a large clastic wedge that reflects the onset of north-south compression during the Late Devonian - Early Carboniferous Ellesmerian orogeny. The Cornwallis Uplift formed a structural buttress and hence did not experience the same degree of north-south shortening evident elsewhere. Shortening on the margins of the Cornwallis Uplift was taken up by large north-south strike-slip faults. Presumably, pre-existing thrusts of the Cornwallis Uplift were reactivated at this time as strike-slip faults, creating fluid conduits wherever local extension occurred.

The Ellesmerian age of mineralization in the district is supported by radiometric age dating of sphalerite at 355 to 365 Ma on Cornwallis and Little Cornwallis islands. Detailed mapping of selected showings indicates that mineralization is strongly controlled by faults, but that a combination of host rock composition, stratigraphy, facies distribution, and pre-mineralization diagenetic history are also critical. In the central part of the Cornwallis Uplift, Pb-Zn showings follow three structures: Stuart River-Snowblind, Eclipse-Abbott River, and Truro Island. Showings also are present along eastern Bathurst Island at the junction between the Ellesmerian fold belt and the Cornwallis Uplift. Showings seem to be developed at inflections in the trend of the Cornwallis fold belt. The working hypothesis is that mineralising fluids ascended where Cornwallis fold belt structures were reactivated as strike-slip faults in Late Devonian dilational openings. Smaller showing are found where discrete segments of the basement-cored Cornwallis Uplift were twisted or pulled apart during strike-slip motion (e.g., Rookery Creek). The largest deposits are where one basement-cored thrust of the Cornwallis Uplift ends, and strike-slip motion is forced over to a parallel Cornwallis thrust, creating a large dilational crack roughly perpendicular to the trend of the uplift (e.g., Truro, Polaris, Eclipse). Detailed mapping and re-examination of existing mapping should indicate where other dilational zones occur.

REFLECTANCE SPECTROSCOPY STUDY OF CARBONATE ALTERATION, NORTH TREND, PINE POINT, NWT

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C.S. Lord Northern Geoscience Centre (CSLNGC) is collaborating with the Earth Observation Systems Laboratory, University of Alberta (EOSL) to research the use of spectral reflectance to distinguish between hydrothermally altered and unaltered core samples from the Pine Point mining district. This study is part of a collaborative Targeted Geoscience Initiative (TGI) between CSLNGC, the Geological Survey of Canada, and the Alberta Geological Survey that is assessing the potential for Mississippi Valley-type (MVT) deposits in Northern Alberta and Southern Northwest Territories.

Reflectance spectroscopy, which employs the visible (VIS) and near-infrared (NIR) portion of the spectrum (0.35 to 2.55 µm), is a rapid, inexpensive, and nondestructive technique for determining mineralogy. Reflectance spectra (brightness as a function of wavelength) are excellent for detecting electronic transitions in minerals (e.g., iron oxides, Fe^{2+}-bearing minerals), and vibrational absorptions by lighter elements (e.g., OH, SO_4, CO_3).

This study has two primary objectives: 1) to obtain and compare reflectance spectra for unaltered and hydrothermally altered carbonate facies of the Sulphur Point and Pine Point Formations; and 2) to obtain and compare reflectance spectra for argillaceous-rich facies of the Slave Point

Formation, Watt Mountain Formation, Buffalo River Formation, and Windy Point Formation. Immediate benefits of this study potentially include: 1) the ability in the field to rapidly characterize carbonate alteration assemblages associated with MVT deposits during reconnaissance and advanced exploration programs; and 2) the potential to identify clay alteration minerals previously undocumented in the core from Pine Point that may provide evidence of hydrothermal fluid interaction with the host rocks distal to the Presqu'ilized karsts. Furthermore, if indicator minerals or mineral assemblages are identified by reflectance spectroscopy this study would have important implications for the potential use of airborne or spaceborne imaging spectroscopy for exploration of MVT deposits in the North.

The 2001 field season focussed on the sampling of core from two transects (54000 and 48000) drilled by Cominco, across the northern section of the North Trend, Pine Point mining district. Laboratory measurements of reflectance, conducted during September 2001 at the EOSL, partially addressed the first objective of the study. Preliminary results indicate that there are spectral differences in the altered carbonate signatures of the Sulphur Point and Pine Point Formations

LITHOGEOCHEMISTRY OF WALLROCKS IN THE PTARMIGAN DEPOSIT: PROJECT STATUS REPORT

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A lithogeochemical cross-section was constructed for the Ptarmigan Mine, a quartz-vein-hosted gold deposit located 11.6 km northeast of Yellowknife, by analyzing systematically collected wallrock and vein samples. Major, trace, REE and acid soluble elements contents were determined for wallrock samples collected at ~80 m (~250') intervals from drill core immediately south of the shaft, as well as surface outcrops. These analytical results may help establish what role wallrock alteration played in formation of the Ptarmigan gold deposit.

Long sections and mine plans with Ptarmigan mine stope-assay data (vein-width and grade) were collected from the Ptarmigan minesite, DIAND assessment files and Worker's Compensation Board records. Elevation and northing co-ordinates for some 500 samples recorded on these sections have been established. Long-sections showing the distribution of vein-width and grade will be constructed and used to evaluate what role vein structure had in concentrating gold in the Ptarmigan mine veins.

The combined lithogeochemical and structural results will shed light on formation of the Ptarmigan metasediment-hosted gold deposit. These results may provide further insight into the formation of other metasedimentary rock hosted deposits such the nearby Tom and Cassidy Point deposits, as well as the economically more significant Discovery and Camlaren deposits.

THE NORTH SLAVE CRATON REGION OF NUNAVUT: AN EMERGING DIAMOND DISTRICT

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The north Slave craton region of Nunavut is located approximately 450 km north of Yellowknife and 75 km south of the Coronation Gulf. Systematic diamond exploration was initiated in the region shortly after the initial discoveries at Lac de Gras in 1991. Diamond exploration efforts through 1999 resulted in the discovery of four kimberlites, all of which are thought to be barren or weakly diamondiferous. Exploration activity in the region increased dramatically in early 2000 and at least nine kimberlites have been discovered in 2000 and 2001 by Ashton and others. Several of the recent discoveries are significantly diamondiferous. Four kimberlite discoveries made by Ashton between 1999 and 2001 were the result of an integrated program of heavy mineral sampling, geophysics and prospecting. In all cases kimberlite float was discovered prior to drilling. Recent discoveries of diamondiferous kimberlites and the prospect of increased exploration activity in the region clearly demonstrate that a significant new Canadian diamond district is emerging in the north Slave craton.

DISCOVERIES: SERENDIPITY OR SWEAT
A CASE HISTORY FROM THE DISCOVERY MINE, NWT

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A review of the Discovery Mine's past is instructive, illustrating the adage that mines are made, not found. Specific aspects of Discovery's past are particularly appropriate and give insight into its future.

The staking rush following the gold discoveries at Giant in 1944 resulted in all of the nearby ground being staked, so novice prospector, Fred Giauque traveled north, and late in the summer of 1944 discovered gold in rusty rocks on the west-side of what became named Giauque Lake. Three blocks of claims, the Bruce, Lux, and Avis were staked. Initial exploration concentrated on a number of quartz veinlets in altered andesite where some high-grade intersections had been obtained, but nothing further was done until the fall of 1945. N.W. Byrne reported a number of observations in August 1945:

1) A wide shear zone has been located on the Bruce 7 mineral claim.

2) A series of irregular lenses and interlacing stringers of quartz, comprising up to 12% of the rock outcrops in a sheared and fractured zone for a length of 140 feet, and a width of 100 feet.
3) The full width of the main shear has not been explored in any point, and there is a strong suggestion that a number of individual showings occur in a major zone of considerable dimensions.
4) Some results of importance were obtained from Drill Hole No. 1, and the existing record indicates that no samples were taken on either side of the samples that showed ore grade. There is a strong possibility that the adjacent mineralized shear could contain mineralization.
5) It is apparent, therefore, that the wall rock adjacent to the quartz veins in the main shear will contain gold in mineable quantities.

Subsequently, veteran prospector Bert Wagenitz discovered a folded quartz vein in a swamp to the northeast of the known showings. Abundant visible gold led them to blast twenty seven trenches which defined a horseshoe shaped quartz vein, 400 feet long, between 1.5 and 18 feet in width averaging just over 3 ounces of gold per ton. A drilling program ensued, tracing the quartz vein to a depth of 400 feet. Shaft sinking commenced in November 1946. A shallow-dipping fault displaced the quartz vein at 375 below surface and the vein was lost. Detailed geological work by Jorelamon found the vein below the fault and work continued. Production continued from December 1948 until 1963. Plans for closing were being discussed when the discovery of an additional shoot of rich ore in December 1963 on the 2,950 foot level provided for an additional five years of production. The mine eventually shut down in the spring of 1969; the last few tons of ore trucked to Yellowknife for processing due to the destruction of the Discovery Mill in a fire earlier that spring. The low gold price, exhaustion of accessible reserves, and the lack of a mill ensured the shutdown, yet the original showings remain.

POSSIBLE STRUCTURAL CONTROLS OF KIMBERLITES IN THE LAC DE GRAS REGION, CENTRAL SLAVE PROVINCE, NORTHWEST TERRITORIES, CANADA

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The Lac de Gras kimberlite field of the Archaean Slave Province comprises over 100 kimberlites, many of them diamondiferous, and including Canada's first producing diamond mine, Ekati™. As in diamond-bearing kimberlite provinces occurring globally, many kimberlites of the Lac de Gras area are distributed along linear trends that can be correlated with craton- and local-scale structural features. Kimberlite localization in this area has different trends, depending on the scale at which it is viewed. These differences suggest that at least two different structural domains influence the trends seen at surface: (1) the mantle source region; and (2) the upper crust. The structures that trigger and generate kimberlite magmatism deep within the mantle are not the same as the structures in the upper crust that localize kimberlite emplacement. The northwesterly (335°) craton-scale localization trend reflects controls in the deep mantle region whereas the more easterly local-scale trends reflect the near-surface crustal controls. Of any given structure pre-existing in the upper crust at the time of emplacement, kimberlite magmas will utilize those that are favourably oriented with respect to the ambient stress fields. Intra-plate stresses from plate convergence in the Northern Cordillera, the nearest tectonically active region to the Slave Province at the time of Cretaceous-Tertiary kimberlite emplacement, were such that the presumed maximum horizontal stresses were oriented in 090 trend, with the minimum horizontal stresses oriented perpendicular to them at 000. Structures with azimuths parallel to 090 would have been reactivated and/or created at that time. These emplacement-aged structural dilatencies correspond with easterly trending local-scale kimberlite localization trends of the study area.

YELLOWKNIFE EXTECH 2D GIS DATA COMPILATION

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Over the two and a half years that the Yellowknife EXTECH project has been operating, new data has been collected by over 26 scientists within the framework of 18 different projects. This large amount of data is being added to an even larger existing database of geoscience data related to the Yellowknife Greenstone Belt (YGB). There are three main objectives of the 2D GIS data compilation component of the Yellowknife EXTECH project. The first is to compile a single comprehensive digital geoscience database with common data structures and formats that is suitable for use in a GIS. The second is to deliver this data to participating EXTECH scientists, and other researchers interested in the YGB in an easily accessible and timely fashion. The last is to integrate this data using spatial data analysis methods to investigate spatial patterns and correlations.

Two phases of data compilation have been completed. The initial phase, carried out during the first year of EXTECH, consisted of compiling predominantly existing data sets into an ArcView GIS database. Data layers included regional airborne radiometrics, bedrock geology compiled at 1:100000, surficial geology, mineral deposits, geochemistry, Landsat 5 TM imagery, geochronology and topographic data. The second phase, carried out last year, included new data collected by EXTECH participants including whole rock geochemistry on over 400 hand samples collected over the study area, gold grain data collected from tills, kimberlite indicator mineral data, and updated metamorphic isograd data. Remote sensed data added this year include radar (RADARSAT) data and Landsat 5 TM data. The 1:100000 bedrock geology has also been updated.

Two approaches have been taken to facilitate the dissemination and use of the data by EXTECH participants. The EXTECH data compilation was released on CD as digital GSC Open File (Wright et al., 2001). The CD includes a spatial data viewer (ArcMap) that will allow users to view and query the data without having access to a fully functional GIS. Meta data is included for each data layer. An updated CD release is expected to be released in February 2002. The data has also been made available on the Yellowknife EXTECH Website using map server technology (ArcIMS). Data can be viewed and queried interactively while on the Website. The data can be accessed through the general EXTECH Website
(http://www.nrcan.gc.ca/gsc/mrd/extech3/index.html)
One of the advantages of having a GIS database is the ease at which you can investigate and quantify spatial associations between different data layers. Weighted principal component analysis can be helpful to interpret multi-element geochemical surveys. Weights derived from proximity of geochemical samples to geological features such as faults or lithologic contacts are readily calculated using a GIS. This approach has been used on data covering the Con Mine where weighting of lithogeochemical samples by proximity to faults enhances the association of Au-As-Sb-Ag interpreted as a shear-zone-related gold mineralization factor. Initial results have been published by (Bonham-Carter et al., 2001)

ICE-MARGINAL STUDIES ON BARNES ICE CAP, BAFFIN ISLAND: CLUES TO THE HISTORY OF THE LAURENTIDE ICE SHEET.

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Barnes Ice Cap (Baffin Island) is a remnant of the Laurentide Ice Sheet that separated from it about 8500 years ago. Owing to recession of the ice cap during the Holocene, Pleistocene-age ice strata are now exposed along its margin in a distinctive white ice band with low d18O values. The mean ice crystal size and particulate impurity content in the white ice are noticeably smaller and greater, respectively, than in younger (Holocene) blue ice strata. The d18O profile across the white ice resembles pre-Holocene isotopic records in other Canadian Arctic ice caps, and suggests that the oldest strata in Barnes Ice Cap is of late Sangamonian age. A model reconstruction of the Laurentide Ice Sheet during the Last Glacial Maximum suggests that late glacial strata in Barnes Ice Cap originated high up (> 2400 m asl) and far "inland" on the ice sheet.