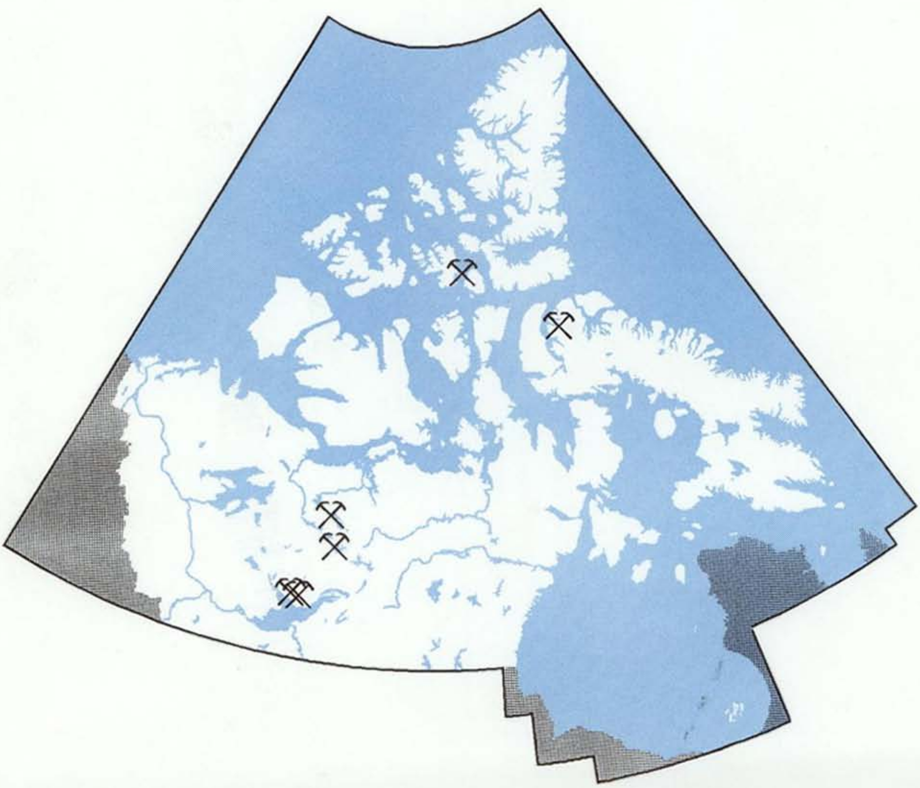
26th Yellowknife Geoscience Forum
25 - 27 November 1998

Program and Abstracts of Talks and Posters



Indian and Northern Affairs Canada
Affaires Indiennes et du Nord Canada

NWT Chamber of Mines

Northwest Territories

Resources, Wildlife & Economic Development
Government of the Northwest Territories

Wednesday November 25

	Explorer Hotel Kat A, B: Technical Talks	*Explorer Hotel Frobisher Rm:*	*Explorer Hotel Kat C Second Floor:*	
Morning	Diamond Session (08:40-14:00)	Regulatory Session	Commercial Displays, Core Displays (all day)	
Afternoon	Oil and Gas Session (14:00 - 16:20)			
Evening	Posters 16:00-17:00 Melville, Kat A,B Room			
	17:00-19:00 at Northern Frontier Regional Visitors Centre: Hospitality by Kee Scarp and Winspear Resources			
	19:30 - 21:00 at the Explorer Hotel Kat Rm. A, B: Charles Camsell Talk			

Thursday November 26

	Explorer Hotel Kat A, B: Technical Talks	*Explorer Hotel Frobisher Rm:*	*Explorer Hotel Kat C Second Floor:*	*Yk Inn Tungsten Rm:* Environmental Mgmt & the Mineral Industry
Morning	Cordillera, Baffin Session (08:20-09:00)	Regulatory Session	Commercial Displays, Core Displays (all day)	Approaches to monitoring and assessment
	Churchill Session (09:00 - 16:00)			Environmental protection & remediation
Aftnoon				Enviromental management tools
				Caribou research & the mineral industry
Evening	Posters 16:00-17:30 Melville, Kat A,B Room			
	17:00-19:00 at Northern Frontier Regional Visitors Centre: Hospitality by BHP Diamonds			

Friday November 27

	Explorer Hotel Kat A, B: Technical Talks	*Explorer Hotel Frobisher Rm:*	*Explorer Hotel Kat C Second Floor:*	*Yk Inn Tungsten Rm:*
Morning	Economic Development (08:50-10:10) Bear Session (10:20-12:00)	Regulatory Session	Commercial Displays, Core Displays (all day)	Archean Au Deposits Focus on Yellowknife Greenstone Belt
Aftnoon	Slave Session (13:40-14:20)			

Wednesday November 25, 1998
Explorer Hotel

* denotes speaker

Katimavik Rooms

8:15 Introduction: Mike Vaydik, NWT Chamber of Mines

Diamond Session
Chair: John Armstrong

8:40 Roger Clement, " Some Aspects of Monopros' Exploration Activities in Canada"

9:20 Alan Jones*, et. al., "Northern Lights and Diamonds: Imaging the Slave Cratonic Lithosphere Using Very Long Period Electromagnetic Experiments"

9:40 Kevin Kivi * and W.L. Griffin, "Lithospheric Mapping of the Slave Craton, NWT"

10:00-10:20 **Coffee**

10:20 DIAVIK: Project Update

10:40 DIAVIK

11:00 Todd McKinley, (Monopros), Hardy Lake Project

11:20 Winspear Resources, Snap Lake Project

11:40 - 1:40 **Lunch**

13:40 Lori Wilkinson, "Searching for Kimberlite: Use of Clay Fraction Till Geochemistry Data in the Lac De Gras Area, NWT"

Oil and Gas Session
Chairs:Todd Burlingame/ Calvin Brackman

14:00 Jim Dixon* and L.D. Stasiuk, "Hydrocarbon Potential of Cambrian Strata in the Northern Interior Plains, NWT"

14:20 David W. Morrow and Bernard C. Maclean,"Public Domain Seismic in the Southern NWT: Regional Interpretations and Hydrocarbon Plays."

14:40 M. P. Cecile, J. Bednarski, L. D. Currie, L. S. Lane, J. L. Nelson and Glen S. Stockmal*, "The Geological Survey of Canada's Central Foreland NATMAP Project: Implications for Petroleum Exploration in Southern Northwest and Yukon Territories and Northeastern British Columbia"

15:00 Monica Meding, "Hydrocarbon Potential of the Peel Plateau and Plain"

15:20 Giles Morrell, "Oil and Gas Exploration in the NWT - 1998 Update"

15:40 Bill Byrne, (Enbridge Pipelines (NW) Inc.), Pipeline Opportunities in the NWT

16:00 Greg Nyuli, (Dehton Cho Corp.)

16:00 - 17:00 **Poster Session (cash bar); Core Display; Prospector's Room**

19:30 - 21:00 Charles Camsell Talk in Kat A/B Rooms, Explorer Hotel. Dr James Basinger on Fossil Forests on Axel Heiberg Island.

Thursday November 26, 1998

Explorer Hotel

Katimavik Rooms

Cordillera/Baffin Session

Chair:Joe Heimbach

8:20 Velma Sterenberg, "Progress Report: Geoscience Studies in the Northern Cordillera"

8:40 David J. Scott, "The North Baffin Partnership Project: A Summary of Results"

Churchill Session

9:00 Carolyn Relf* and Simon Hanmer, "Overview and Highlights of the Western Churchill NATMAP Project to Date"

9:20 Isabel McMartin, "Surficial Mapping and Till Provenance Studies in the Meliadine Trend, Rankin Inlet Area: a Progress Report"

9:40 Eva Zaleski*,et. al., "Tectonostratigraphy of the Woodburn Lake Group, Western Churchill Province, Nunavut"

10:00-10:20 **Coffee**

Chair:Carolyn Relf

10:20 Rob Rainbird*, T. Hadlari and J.A Donaldson, "Stratigraphy and Paleogeography of the Paleoproterozoic Baker Lake Group, eastern Baker Lake Sub-Basin"

10:40 Bill Davis*,et.al.,"Preliminary U-Pb Geochronology of Volcanic Rocks in the Kaminak Belt, Western Churchill Province, Kivalliq Region"

11:00 Hamish Sandeman*,et. al., "Preliminary Petrochemistry of Archean Mafic Volcanic Rocks of the Heninga-to-Tavani Corridor of the Rankin-Ennadai Greenstone belt, Kivalliq Region, NWT"

11:20 Steve Goff*, and J. A. Kerswill, " Preliminary Investigation of Significant Mineral Occurrences in the Central Rankin-Ennadai Supracrustal Belt: Kaminak Lake Area"

Yellowknife Inn

Tungsten Room

Approaches to Monitoring and Assessment Session

8:30 J. David Tyson (Rescan Environmental Services Ltd.), "Aquatic Effects Monitoring Programs for Arctic Mines "

8:55 Alan Ehrlich (Geo North Ltd.), "The Practice of Cumulative Effects Assessment and the NWT Mining Industry"

9:20 Lisa Dechaine (EBA Engineering Consultants Ltd.), "Risk Assessment/Risk Management as an Option in the NWT"

9:45 Rick Robinson*, Brian Griffin and Robin Johnstone (Golder Associates Ltd.), "Application of Integrated Risk Management for Industry in the North"

10:10-10:25 **Coffee**

Environmental Protection and Remediation Session

10:25 John Clark (Vista Engineering), "Assessment and Remediation of Abandoned Mines"

10:50 Wayne Bryant (Bryant Environmental Consultants Ltd.), "Northern Environmental Protection Measures and the Mining Industry"

11:15 to be announced

11:40 to be announced

12:05 - 13:00 **Lunch**

Thursday November 26, 1998

Explorer Hotel

Katimavik Rooms

11:40 - 13:40 Lunch

Churchill Session

Chair: Scott Cairns

13:40 Simon Hanmer*,et.al., "Proterozoic Reworking in Western Churchill Province, Gibson Lake-Cross Bay Area, Kivalliq Region, NWT"

14:00 Larry Aspler*, Bruce A. Barham* and Jeffrey R. Chiarenzelli, "The Henik and Hurwitz groups, Noomut River: Results of Integrated Geologic and Aeromagnetic Mapping and Recent Exploration."

14:20 Larry Aspler*, et. al., "Archean and Proterozoic Geology of Northern Angikuni Lake and a Transect Across the Snowbird Tectonic Zone, Western Angikuni Lake."

14:40 Brian Cousens*, L. Aspler and J. Chiarenzelli, "Geochemistry and geologic setting of the Baker Lake Group, Angikuni Lake to Yathkyed Lake"

15:00 Alan Jones*,et al., "Seismic and Electromagnetic Experiments as Part of the Western Churchill NATMAP Program."

15:20 Hamish Sandeman, " Petrochemistry of Archean mafic Volcanic Rocks of the Heninga to Tavani corridor of the Rankin-Ennadai GSB, Kivalliq Region"

15:40 Kate MacLachlan* and Carolyn Relf, " Tectonic Assembly and Proterozoic Reworking of the Northern Yathkyed Greenstone Belt"

16:00- 17:30 Poster Session (cash bar); Core Display; Prospector's Room

Yellowknife Inn

Tungsten Room

Environmental Management Tools Session

13:00 Independent Environmental Monitoring Agency

13:25 Luci Davis (BHP Diamonds Inc.), "Environmental Management System and Its Implementation at the Ekati Diamond Mine, 1998"

13:50 Rob MacLean, Mike Tanguay and Zoe Wagenaar* (BHP Diamonds Inc.), "Data Management System at the Ekati Diamond Mine"

14:15 Lisa-Henri Kirkland* and Robin Johnstone (Golder Associates Ltd.), "Efficient and Effective Ways of Introducing and Implementing an Environmental Management System"

14:40 - 14:55 Coffee

Caribou Research and the Minerals Industry Session

14:55 Francois Messier (Independent Environmental Monitoring Agency), "Monitoring the Impacts of Mining and Road Infrastructures on Caribou Herds: The need for a multi-scale approach"

15:20 Anne Gunn (Government of the Northwest Territories), "Satellite Telemetry and Caribou: Uses and Abuses for Environmental management"

15:45 to be announced

16:10 to be announced

Friday November 27, 1998

Explorer Hotel

Katimavik Rooms

Economic Development Session
Chair: Ron Williams Deputy Minister, Dept. of Transportation, GNWT

8:30 John Hickes (Government of Nunavut), Nunavut: Our Future in the Canadian Mining Industry
8:50 Joint Aboriginal Industry Forum
9:10 Federal Northern Economic Development Strategy
9:25 GNWT Economic Development Strategy
9:40 Masood Hassan (Dept. Transportation GNWT), GNWT Highways Strategy
9:55 Charlie Lyall (Kitikmeot Corporation) Bathurst Inlet Port and Mining Development

10:10 - 10:20 Coffee

Bear Session
Chair: Steve Goff

10:20 Robin E. Goad, "The NICO and Sue-Dianne Proterozoic Iron Oxide-Hosted Polymetallic Deposits, Southern Great Bear Magmatic Zone. Northwest Territories, - A Summary of current Work and Deposit Model Development in Global Mineral Exploration"
11:00 Sunil S. Gandhi, J. K. Mortensen, N. Prasad, and O. van Breemen, " U-Pb Zircon Geochronology of the Southern Great Bear Magmatic Zone and its Implications to the Metallogenic Evolution"
11:20 to be announced

Yellowknife Inn

Tungsten Room

Archean Gold Deposits - Focus on Yellowknife Greenstone Belt Plenary Session

Chairs: Deb Archibald and Lyn Anglin

9:00 Herb Helmsteadt, Overview of Research Completed in Yellowknife Greenstone Belt and Bedrock Geology Compilation
9:20 Robert Hauser and Dean McDonald, "Geology of the Miramar Con Mine"
9:40 Malcolm Robb and Tim Canam, "Overview and History at Giant Mine"

10:00 - 10:30 Coffee

10:30 Benoit Dube, (Geological Survey of Canada) , "Overview of Styles of Archean Gold Deposits in Canada"
10:50 F. Corfu, (Royal Ontario Museum), "Geochronology of Archean Greenstone Belts and Gold Mineralization"
11:10 Michael Doggett,"Economics of Mineral Development in the Yellowknife Basin"
11:30 Jim M. Franklin, " Introduction to the Yellowknife EXTECH Geoscience Needs Assessment Meeting"

11:40 - 13:40 Lunch

Friday November 27, 1998
Explorer Hotel
Katimavik Rooms

Slave Session
Chair: Karen Gochnauer

13:40 Wouter Bleeker* and the Slave Province Working Group, "The Tectonic Evolution of the Slave Province"

14:00 Val Jackson*, "The Snare River Project: Objectives and Initial Results" / Vanessa Bennet* and G. R. Dunning, "Geological Transect across the Southern Indin Lake Supracrustal Belt to the Central Ghost Lake Granulite Domain."

14:20 Mark Ferguson, John Waldron*, and Wouter Bleeker , "Sedimentology and Tectonic Setting of the Burwash Formation, Hearne Lake - Gordon Lake area"

14:40 John Ketchum* and Wouter Bleeker, " Pre-2.8 Ga Rocks in the South-central Slave Province: Constraints on Their Distribution, Age, and Tectonometamorphic History"

15:00 Brian Roberts and David Snyder*, "Upper Crustal Structures in the Slave Craton near Yellowknife - Results from SNORCLE Line 1"

15:20 Wouter Bleeker and Joan Todd, "Aeromagnetic Surveys"

15:30 Norman Duke, "A Case for Multistage Upgrading of Gold in the Yellowknife Greenstone Belt"

15:50 Edmond H. P. van Hees et. al., "Metasedimentary Influence on Metavolcanic-hosted Greenstone Gold Deposits: Geochemistry of the Giant Mine, Yellowknife, N.W.T."

POSTER DISPLAYS, November 25-27
Explorer Hotel

Author(s)	Title/subject
J. Armstrong	Kimberlite Occurrences of the Northwest Territories
L. Aspler et al.	Precambrian Geology, Northern Angikuni Lake, Nunavut Territory, and a Transect Across the Snowbird Tectonic Zone, Western Angikuni Lake
S. Cairns	Preliminary Geology and Economic Potential of the Linklater Lake Area, NTS 65D/16
P. Corcoran	Subaqueous Volcanic Construction in the Peltier Formation and Beaulieu River Volcanic Belt: Proximal and Distal Facies and their Implications
DIAND Geology Division	Digital Products Available from DIAND Geology
L. A. Dredge, D. E. Kerr, and S. A. Wolfe	Ground Ice and Frost Action in Surficial Materials, Slave Geological Province, Northwestern Canadian Shield
N. Duke	The Significance of Detachment Fault Breccias Occurring at the Southern End of the Great Bear Magmatic Zone, Wopmay Orogen, N.W.T.
C. Finnigan	A Petrologic Study of the Townsite Formation in the Yellowknife Greenstone Belt
S. Goff and J. Kerswill	Highlights of Recent NATMAP Mineral Deposit/Metallogenic Investigations in the Kaminak Greenstone Belt
Gwich'in Land and Water Board	Gwich'in Land and Water Board
S. Hanmer et al	Preliminary Petrography of Current and Potential Carving Stone, Gibson Lake-Cross Bay Area, Kivalliq Region, Northwest Territories
S. Hanmer et al	New Map Releases in the Heninga-Kogtok and Carr-Kaminak-Quartzite Lake Areas, Western Churchill Province, Kivalliq Region, Northwest Territories

POSTER DISPLAYS, November 25-27
Explorer Hotel

Author(s)	Title/subject
H. Helmstaedt and G. Hounsell	Geology of the Yellowknife Greenstone Belt: Overview of Previous Work and Some Remaining Problems
K. Krey and N. Duke	Characterization of Host Rock Metasomatic and Metamorphic Mineral Parageneses Throughout the Giant Mine, Yellowknife, NWT
K. MacLachlan, C. Relf, D. Irwin and H. Sandeman,	Mineral Potential of the Northern Yathkyed Greenstone Belt
I. McMartin and P. J. Henderson	Multi-Directional Ice Flow Indicators in the Keewatin Ice Divide area, Nunavut
G. Morrell	Maps of Oil and Gas Disposition in Northern Canada
A. H. Mumin, J. Walden and R. E. Goad	The Sue Dianne Cu, Ag, Au and Fe-Oxide Rich Breccia Complex, Mazenod Lake District, Northwest Territories
C. Pickett and W. U. Mueller	Sedimentary Response Of A Platformal Succession To Archean Crustal Thinning: Evidence From The Archean Beniah Formation
R. Rainbird	Geological Compilation of the Northern Minto Inlier, Victoria Island, NWT
D. Scott and the North Baffin Partnership Project	The North Baffin Partnership Project: A Summary of Results
J. Sharp	Ground Truthing of Inferred Iron Formation near Arviat, NWT
J. Siddorn	Structural Geology of the Giant Gold Mine, Yellowknife, NWT
R. Spark, K. Benn and W. Bleeker	The Magnetic Fabric of Granitoid Plutons: Evidence for the Late Archean Tectono-magmatic History of the Slave Province
S. Tella, S. Hanmer, H. A. Sandeman, J. J. Ryan, and J. Kerswill	Open File Geological Maps of the MacQuoid-Gibson Lakes Area, Kivalliq Region, Nunavut
L. Wilkinson et al	Initial Digital Data CD-ROM Release for the Western Churchill NATMAP Project

Author(s)	Title/subject
L. Wilkinson et al	New Digital Data CD-ROM Release for the Slave NATMAP project
E. Zaleski, N. Duke, R. L'Heureux, B. Davis, L. Wilkinson, and J. Kerswill	Quartzites on Volcanic Basement, Geology of the Woodburn Lake Group, Meadowbank River Area, Western Churchill Province, Nunavut
E. Zaleski, R. L'Heureux, N. Duke, L. Wilkinson, B. Davis and J. Kerswill	Clastic and Chemical Sedimentary Sequences, Geology of the Woodburn Lake Group, Amarulik Lake to Tehek Lake, Western Churchill Province, Nunavut

Friday November 27 **14:30** TAKE DOWN DISPLAYS

Saturday, November 28

Geoscience Needs Assessment Workshop
for the Yellowknife EXTECH
Explorer Hotel, Frobisher Room
9:00 - 17:00
Moderators: Dr. Jim Franklin, Dr. Michael Doggett

PRECAMBRIAN GEOLOGY, NORTHERN ANGIKUNI LAKE, NUNAVUT TERRITORY, AND A TRANSECT ACROSS THE SNOWBIRD TECTONIC ZONE, WESTERN ANGIKUNI LAKE, NORTHWEST TERRITORIES

Lawrence B. Aspler (Consultant)[1], Jeffrey R. Chiarenzelli [1],Brian L . Cousens[2] , David Valentino[1]
[1]State University of New York at Oswego,
[2]Department of Earth Sciences, Carleton University

Near Angikuni Lake, mainly greenschist grade-remnants of ca. 2.68 Ga volcanic, siliciclastic, and carbonate sequences were deposited in relatively shallow water. Provenance data indicate subaerial exposure of a continental hinterland at the time of sedimentation. Shallow water rocks derived from a continental hinterland imply deposition on, or close to, continental crust. Furthermore, ca. 3.04 Ga xenocrystic zircon from a 2.68 Ga volcanic sample suggests subjacent Mesoarchean basement at the time of extrusion. The combination of shallow water deposition associated with continental crust, tholeiitic major element geochemistry, mainly MORB-like trace element geochemistry, and mainly positive e_{Nd} values (indicating depleted mantle derivation) implies that the supracrustal rocks most likely formed in a back-arc basin. Small enrichments in Ba, Rb and K may represent metasomatism due to nearby subduction.

An upper amphibolite- to granulite-grade granite, gabbro, orthogneiss and paragneiss complex contains supracrustal remnants likely derived from structural and plutonic disruption of volcano-sedimentary units better preserved in greenschist facies domains. Some of the gabbros were probably derived from depleted upper mantle that was isotopically variable (positive e_{Nd} values not correlated to SiO_2), but some of the granitic rocks display geochemical characteristics of crustal melts. We tentatively suggest intracontinental lithospheric shearing at ca. 2.61 Ga released gabbroic melts from the upper mantle and that crustal melting during shearing (possibly aided by heat related to release of these gabbroic melts) produced granitic magmas.

Amphibolite-grade tectonites are distributed throughout the Angikuni Lake region, continuing from southern Angikuni Lake across the

geophysically-defined Snowbird tectonic zone. In western Angikuni Lake, these rocks define a large shallowly- to moderately- north plunging antiform. This antiform is asymmetric: on the eastern flank and in the hinge region, extension lineations are down-dip; on the western flank (and west of the Snowbird zone) extension lineations are strike-parallel. Both the dip-lineated and strike-lineated tectonites display conflicting shear sense indicators, signifying large components of coaxial strain and marked strain partitioning. Apparent contrast in metamorphic grade between lithostructural domains suggests bulk north side-up transport. Zones of younger greenschist-grade cataclasites are also distributed throughout the region. Movement along some of these led to downdropping of domains with mainly greenschist-grade supracrustal rocks. One ca. 1 km wide belt of cataclasite occurs along the (geophysical) trace of the Snowbird zone. However, because tectonites underlie much of western Angikuni Lake and because Hearne Province rocks extend across the trace of the Snowbird zone, we suggest that Snowbird-related strain is distributed heterogeneously to at least the eastern shores of Angikuni Lake. A major point of uncertainty is the absolute time interval separating amphibolite-grade tectonites and greenschist grade cataclasites. Do the cataclasites represent changes in strain rate and/or temperature during a single Archean event or do they reflect significantly younger (Paleoproterozoic) rejuvenation? Any changes in structural level related to the two "events" occurred before volcanism in Baker Lake Basin (Christopher Island Formation), loosely dated at some time between ca. 1.88 Ga and 1.81 Ga.

At the base of the Baker Lake Group, the Angikuni Formation (conglomerate, arkose, redbed semi-pelite) reflects continental (alluvial and playa) sedimentation in an isolated fault-bounded trough tilted before deposition of the Christopher Island Formation. It is probably tectonostraphically equivalent to the South Channel and Kazan formations defined in the southeastern Baker Lake region.

THE HENIK AND HURWITZ GROUPS, NOOMUT RIVER, NUNAVUT TERRITORY: RESULTS OF INTEGRATED GEOLOGIC AND AEROMAGNETIC MAPPING, AND RECENT EXPLORATION

Lawrence B. Aspler[1], Bruce A. Barham[2], Jeffrey R. Chiarenzelli [3]Consultant[1], Comaplex Minerals Corp[2] , State University of New York at Oswego[3]

Iron formation horizons may the best substitute for regional marker units in Archean greenstone belts lacking a "layer cake" stratigraphy. They are distinctive, relatively continuous, and have a marked aeromagnetic expression that permits tracing through areas of poor outcrop, such as near Noomut River. New field mapping, and high-resolution aeromagnetic data (provided by Comaplex Minerals Corp.) indicate that Neoarchean rocks of the Henik Group were deposited in a continuous basin across a minimum area of 6,000 km^2 in central Ennadai-Rankin greenstone belt. Volcanic, volcaniclastic, siliciclastic rocks, and iron formation markers represent a deep water lava plain—slope—basin setting.

North of Noomut River and Ameto Lake, Archean supracrustal and plutonic rocks are unconformably overlain by Paleoproterozoic rocks of the Hurwitz Group. The Hurwitz Group is a ca. 2.45-2.1 Ga assemblage of siliciclastic and carbonate rocks thought to have been deposited in an intracratonic basin that occupied the interior of the Hearne Province during the protracted breakup of Kenorland, a speculative Neoarchean/earliest Paleoproterozoic supercontinent. Continental deposits from the lower Hurwitz Group exposed in the Noomut River area represent the initial sag stages of basin expansion that were terminated by abrupt basin-centre deepening and drowning.

Clear evidence of post ca. 2.1 Ga Paleoproterozoic deformation is provided by Hurwitz Group exposures which define a doubly-plunging, ENE-trending syncline, the core of which is cut by northwest-vergent thrusts. Adjacent to Hurwitz exposures, demonstrating Paleoproterozoic deformation of Archean rocks is straightforward: the basement-cover contact is folded; one of the thrust faults juxtaposes Henik Group above

Hurwitz Group; and numerous NW-trending cross faults which cut the Hurwitz Group also penetrate basement. Away from Hurwitz Group exposures, the timing of structures in Archean rocks is uncertain. They experienced syn-pluton emplacement folding, faulting and metamorphism (D1, probably Archean) and NNW-vergent dextral-oblique faulting and folding (D2) and cross faulting (D3). We tentatively suggest that D2 and D3 are post-Hurwitz Group. This may be tested by geochronologic study of distinctive plagioclase-megacryst gabbro dykes (post-D1, pre-D2).

Basal Hurwitz Group pyritic quartz pebble-rich conglomerates (Noomut Formation) have been historical gold targets in the belt extending from Noomut River to Kinga Lake. Many pebbles are pyrite-chert composites indistinguishable from Henik Group sulphidic iron formation, indicating, at least in part, a paleoplacer origin. Gold prospects recently discovered by Comaplex Minerals Corp. in the Henik Group are associated with zones of iron carbonate-sulphide alteration and quartz-carbonate-sulphide veins. Concentrations of alteration and veining occur within geochemically favoured competent host rocks, within or adjacent to D2 or later structures. Gold (with disseminated pyrite and pyrrhotite) is concentrated in: quartz veins and carbonate-pyrite alteration zones in gabbros ("Esker" prospect); quartz-carbonate-chlorite veins in magnetite iron formation interbedded with turbiditic semi-pelite ± felsic tuff ("Ironside" prospect); quartz-carbonate veins in iron carbonate-quartz-albite schists, apparently derived from metasomatism of pillow lavas ("Napartok" prospect); and quartz-carbonate-biotite veins in magnetite iron formation interbedded with turbiditic semi-pelite ("River" prospect).

GEOLOGICAL TRANSECT ACROSS THE SOUTHERN INDIN LAKE SUPRACRUSTAL BELT TO THE CENTRAL GHOST LAKE GRANULITE DOMAIN.

V.R.C. Bennett and G.R.Dunning
Department of Earth Sciences, Memorial University of Newfoundland, St Johns, NF, A1B 3X5

In recent years, work in the Slave Structural Province (SSP) has focused on the geochronology of several areas of, pre-Yellowknife Supergroup (YKS) 'basement', as well as the nature and extent of the basement - cover contact. To date, these basement rocks have yielded ages >2.73Ga and the basement - cover contacts represent unconformities (Ketchum and Bleeker, 1997).

The Ghost Lake Domain (GLD) is a newly recognised (Henderson and Schaan, 1993), extensive area of granulite grade rocks, previously mapped as undifferentiated Late Archean granitoids. The northern part of the domain was remapped at 1:50 000 scale by Henderson (1994), and Perks (1997) revealed some of the complexity of the GLD further south at Forked Lake.

In comparison to other granulite terrancs in the western SSP, the GLD can be considered anomalous on the basis of initial geochronological and isotopic work. Preliminary ages suggest metamorphism and magmatism are Late Archean or syn - post YKS in age (Henderson, 1998) and positive ϵNd values of Yamashita et al (1997) suggest the late Archean granitoids at McNaughton Lake are not underlain by basement. The following questions arise from these studies : Why is such a considerable area of granulite grade rocks (perhaps unique to this part of the western SSP?) exposed at the surface, that are apparently not basement and not pre-YKS in age? Present interpretation of the GLD is that it represents lower crustal equivalents of the YKS (Henderson, 1994, Perks, 1997). Why is it then, that these sorts of granulite terranes are not seen elsewhere in the Slave?

Young granitoids east of the GLD, but west of the Pb and Nd lines of

Thorpe et al. (1992) and Davis (1991), respectively, are thought to be underlain by basement. Why is it then, that the GLD is apparently not underlain by basement? Has this part of the SSP undergone a different tectonic evolution with respect to the rest of the province?

A PhD project in conjunction with a 3 year DIAND mapping project, will address these questions. The DIAND project is aimed at providing 1:50 000 coverage of the area west, south and south west of the Wijinnedi Lake Area map sheet (Henderson, 1998). The proposed project area was mapped previously at scales of 1 inch to 4 miles and 1 inch to 1 mile by Lord (1963) and Wright (1954), respectively.

The PhD project will concentrate on completing a detailed transect from the western boundary of the southern Indin Lake Supracrustal Belt (SILSB), to the eastern boundary of the central GLD. Preliminary reconnaissance during the summer of 1998 defined the most useful areas across which the transect will be completed. Within the transect are three distinct domains : 1) The SILSB, bounded on the west by the Proterozoic Wopmay Orogen, 2) a vast area of Late Archean (?) granitoid rocks, and 3) the central GLD, bounded on the east by a cataclastic Proterozoic Fault (Henderson, 1994).

The objectives of the project are: to better understand the chronology of deposition, deformation, metamorphism and subsequent magmatic events affecting the SILSB and compare its history to supracrustal belts elsewhere in the SSP; to better constrain the chronology of metamorphism, magmatism and uplift events of the GLD; and to understand the relationships and/or affinities between the SILSB and the GLD, in order to reconstruct the tectonic evolution of this part of the SSP.

References:

Davis, W.J., 1991: Ph.D. thesis, Memorial University of Newfoundland, 283 p.
Henderson, J.B., 1994: Current Research, GSC Paper1994-C, p.71-79.
Henderson, J.B., 1998. GSC, Open File 3609.
Henderson, J.B. and Schaan, S., 1993: Current Research, GSC Paper 1993-C, p. 83-91.

Lord, C.S. 1963: GSC Memoir 235, 55 p.
Ketchum J.W.F., and Bleeker, W., 1997: Lithoprobe Report. No. 56, 245 p.
Perks, M.A.,1997: M.Sc. thesis, University of Alberta, 95 p.
Thorpe, R.I., et al.,1992 : GSC Open File 2484, p.179 - 184.
Wright, G.M.,1954: GSC Map 1021A.
Yamashita, K. et al.,1997: Lithoprobe Report, No. 56, 245 p.

THE TECTONIC EVOLUTION OF THE SLAVE PROVINCE

Wouter Bleeker and the Slave Province Working Group
Geological Survey of Canada

The exact nature of geodynamic processes in the Archean Earth remains controversial. Did plate tectonics, analogous to that shaping the later Earth, operate in the Archean, perhaps in a context of smaller and faster moving plates or microplates driven by higher overall heatflow? Or were rigid plates not yet in existence, resulting in a fundamentally different style of interaction between lithosphere and mantle dominated by vertical rather than horizontal movements? Ultimately, the key to this important question lies in the complex geology of preserved Archean cratons. The Slave craton of the Canadian Shield holds particular promise in resolving this issue since it is well exposed and preserves an extensive rock record ranging from cryptic, >4.0 Ga metagabbros and tonalites, and a variety of younger Mesoarchean gneisses and supracrustal rocks, to voluminous 2.7-2.6 Ga supracrustal rocks and associated granitoids.

The main tectonostratigraphic framework of the Slave craton consists of a centrally situated Mesoarchean terrane, the Central Slave Basement Complex, that is surrounded by Neoarchean supracrustal domains. The detailed outline of the Mesoarchean basement terrane is becoming increasingly well-defined and is represented almost everywhere by significant high-strain zones. Hence, the important question of Archean tectonic evolution hinges to a large extent on a correct interpretation of these high-strain zones, and analogous high-strain zones in other Archean cratons.

Recent work in the Slave craton has shown that the basement/cover high-strain zones represent a single structure that can be correlated over strike-lengths of 100s of kilometers with all the characteristics of a basal décollement that accommodated thrusting of autochthonous to parautochthonous cover units over older basement. Development of the high-strain zone, constrained to about 2690 Ma or possibly slightly earlier, post-dated the apparent break-up of a Mesoarchean continental nucleus, but predated three phases of important regional folding. Unfolding of this high-strain zone suggests that it represents a regional thrust with northeast-to-southwest tectonic transport. This important regional structure clearly favours a scenario with significant horizontal tectonics and rigid plate-like behaviour. Development of the regional thrust predated calc-alkaline volcanism and the deposition of a widespread, ca. 2660-2685 Ma turbidite sequence. The turbidite sequence essentially represents an overlap sequence and, therefore, arguments that its structural style is inconsistent with an accretionary prism has no bearing on the interpretation of the older décollement.

The entire greenstone belt stratigraphy is deformed by three post-turbidite fold systems (F_1, F_2, F_3) and major strike-slip faults. Although abundant granitoid plutons locally cause complex structural patterns, the fold systems can be mapped and correlated as regional fold belts on scales approaching the dimensions of the craton, independent of the more random distribution, size and shape of granitoid plutons. F_1 deformation, which produced a northeast-trending fold belt of upright chevron folds, occurred prior to significant granitoid plutonism. In contrast. F_2 refolding, interpreted as a craton-wide transpressive event, was accompanied by voluminous granitoid magmatism. However, most granitoid plutons are deformed or folded by F_2 and evidently took part in the regional deformation. Granitoid emplacement appears to have been facilitated by F_2 rather than being the cause of the regional deformation. Finally, late-stage strike-slip faults developed after the peak of granitoid emplacement.

In conclusion, the structural record of the Slave craton suggests a number of discrete shortening events driven by horizontal rather than vertical tectonics. The coherent structural patterns on the scale of the craton suggest that horizontal shortening was driven by plate-size entities that behaved rigidly and analogous to modern (micro) plates.

GEOLOGY AND MINERAL POTENTIAL OF LINKLATER LAKE AREA NWT PARTS OF 65D/9 AND 65D/16

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The Linklater Lake map area is located 300 km northeast of Stony Rapids Saskatchewan. Mapping at approximately 1:30 000 scale during the 1998 field season was intended to assess the mineral potential of the area, resolve the stratigraphy of the volcanic rocks, the mafic and ultramafic intrusives, and the surrounding gneisses (Taylor 1963) bordering the east edge of the Selwynn Lozenge (Hamner 1993) of the Snowbird Tectonic Zone (STZ). Field investigations were hampered by a lack of outcrop, much of the area is covered by recent glacial sediments.

Archean volcanic rocks of the Linklater area are predominantly amphibole grade massive and pillowed mafic flows. Within the mafic volcanic rocks primary volcanic textures such as pillows, flow-top breccias and inter-flow sediment lenses are not common. Where present, these structures are invariably deformed, pillows showing a minimum of 5:1 aspect ratio throughout the map area. Numerous discrete 2cm to 2m wide, chlorite grade, shear zones are present within the volcanic rocks. Thin intermediate and felsic tuff layers occur throughout the sequence but are particularly abundant on the south-east shore of linklater west (informal name) where they comprise up to 30% of the outcrop. The intermediate and felsic flows weather cream or buff tan colored and occur as thin beds or elongate lenses in the mafic flows.

Biotite-hornblende tonalite, biotite-hornblende tonalitic gneiss and biotite+/-hornblende +/-garnet paragneiss occur in the eastern and northern portions of the map sheet. Textures vary from equigranular non-foliated tonalite to paragneiss with migmatitic schlieren and or nebulitic segregations of tonalite forming the leucosome . Migmatitic segregations as well as gradational contacts between the paragneiss, tonalitic gneiss, and igneous textured tonalite suggest tonalite to be at least in part derived from a partial melt of a sedimentary or paragneiss protolith. One tonalitic body, on the extreme western limit of mapping did not contain a tectonic fabric, this body may be unrelated to the paragneiss, tonalitic gneiss and tonalite unit despite a similar composition.

Pink and white weathering biotite granite and granodiorite vary in texture from fine to coarse grained and plagioclase porphyritic Deformation varies from igneous textures through to gneissic textured rocks, plagioclase porphyritic protolith forming augen gneisses. Locally, amphibolite xenoliths to several metres diameter are entrained in the granitoids. Contacts between granitoids and granitoid gneiss are generally transitional. Textures suggest stronger deformation in the western portion of the map area.

A swarm of medium to coarse-grained, rarely plagioclase porphyritic, weakly to strongly magnetic, gabbro dikes and/or sills cut all units described above. These vary in width from several centimetres to tens of metres, are quite continuous along strike, pinch and swell, and bifricate. The intrusions have well preserved chilled margins on their contacts with country rocks as well as internal chills. Xenoliths of country rock up to 1 metre are common, rarer lensoid xenoliths of pyroxenite and anorthosite to15cm in length also occur. Black very fine- grained to aphanitic mafic dikes, up to two metres wide, cut all units. These dikes generally have an east-west orientation, and often follow F3 fractures (below).

Pink and white weathering, fine- to medium-grained, magnetic pink granite occurs in the southwestern corner of the map area. While predominantly massive, a very weak NE-SW cleavage is locally preserved in the stock. The intrusion is coincident with a prominent magnetic high (GSC 1969), other small granite intrusions may account for two similar magnetic features in covered area. Late granitic muscovite, +/- tourmaline pegmatite dikes, found cutting all map units except fine- grained mafic dikes, may be related to the emplacement of these stocks.

Structure

The area is dominated by a map scale, tight, F2 fold which trends approximately northwest. In outcrop, isoclinal F1 folds with a steeply dipping north-northwest axial planar cleavage S1 plunge shallowly to the south-southeast. Open to isoclinical F1 folds are refolded by F2 having a locally developed axial planar northwest striking S2 cleavage, locally; S1 may be crenulated to produce a S2 crenulation cleavage. A third foliation, oriented roughly east-west, is commonly expressed as a spaced cleavage which forms small open and calcite+ pyrite filled fractures.

Within the volcanic rocks, orthogneiss, and paragneiss, S1 is the dominant cleavage, though S2 and S3 are locally developed. The gabbro dikes contain only a S2 and S3 fabrics. The massive granites are not foliated, nor are the east-west oriented mafic dikes.

Mineralization and alteration

Thirty samples were collected for 32 element ICP and Au fire assay from the Linklater area. Of these six assayed greater than 100ppb Au., four contained > 1 g/t Ag, and 2 contained >0.1%Cu. The best gold values from the Linklater area were from two areas of chlorite recrystalized sheared mafic volcanics at 6.200g/t Au (98SRC012B) and 1.560 g/t Au (98SMC529B).

The Linklater areas has undergone numerous stages of alteration and mineralization. Epidote, k-feldspar, quartz veins occur throughout amphibolitic mafic volcanic rocks, but do not return significant assays. Discrete, intensely foliated, chlorite grade shear zones in the volcanic rocks contain quartz, calcite,+/- pyrite, chalcopyrite, arsenopyrite veins and stringers arranged parallel to foliation. Assays from quartz veins and stringers in the sheared mafic volcanic rocks include 300ppb Au (98SMC540), 18.2g/t Ag and 1.48% Cu (98SMC513), 1.2g/t Ag and 0.185% Cu (98SRC002), 210ppb Au and 0.0453% Cu (98SRC009A), 110ppb Au (98SRC009B). Small mineralized shear zones in the area suggest potential for larger similar structures, and warrants further investigation. A larger, recrystallized, chloritic shear zone in the center of the map area has been altered to an assemblage of chlorite, quartz, pyrite, albite, with quartz, Fe-carbonate, tourmaline (var. schrol) +/- pyrite, veins. In outcrop this area has a similar appearance to chloritic shear zones described above, as quartz carbonate veins are arranged in a similar geometry . In thin section, chlorite has recrystalized in the groundmass of the rock without developing a preferential alignment. Radiating sprays of tourmaline are found growing preferentially on interfaces between the quartz carbonate stringers and the recrystalized matrix. This style of alteration and mineralization was only encountered in two outcrops, two mineralized samples returned 6.20 g/t and 1.56 g/t Au.

Pervasive F3 jointing and spaced cleavage commonly has a quartz, Fe-carbonate. +/-pyrite, chalcopyrite fill. This mineralization occurs in mafic volcanic rocks, the gneisses and related granitoids. and gabbro dikes and/or sills. The most significant assay results related to this style of mineralization is from the tonalitic gneiss complex (98SMC604) returning 260ppb Au.

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THE GEOLOGICAL SURVEY OF CANADA'S CENTRAL FORELAND NATMAP PROJECT: IMPLICATIONS FOR PETROLEUM EXPLORATION IN SOUTHERN NORTHWEST AND YUKON TERRITORIES AND NORTHEASTERN BRITISH COLUMBIA

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The GSC's Central Foreland NATMAP Project is a multidisciplinary project housed at GSC-Calgary. This collaborative project involves more than 27 government, industry, and university groups. It is designed to investigate the nature of regional variations in Cordilleran bedrock stratigraphy and structural style, as well as surficial geology, across two principal "transects" with a view toward spurring and aiding petroleum and mineral exploration in these areas. The northern transect is in the Mackenzie/Franklin Mountains of the Liard-La Biche region of Yukon and Northwest Territories (NTS sheets 95B and 95C); the southern transect is in the Rocky Mountains of northeastern British Columbia, at a latitude approximately half-way between Fort St. John and Fort Nelson (NTS sheet 94G) with lesser activity near Muncho Lake (NTS sheet 94N). Both areas extend across the Foothills and into the Front Ranges, from east of the front of deformation to the westward shale-out of Lower Paleozoic platform carbonates. The scale of bedrock and surficial mapping is 1:50,000 with compilation at 1:250,000.

At the largest scale of our inquiry, the two transect regions are hypothesized to have been separated by a crustal-scale transfer fault (the "Ancestral Liard Transfer Fault" of Cecile et al., 1997). This transfer fault, manifested today as the Liard Line, is hypothesized to be one of several that divided the Early Paleozoic passive margin into "upper plates" and "lower plates" reflecting varying degrees and polarities of asymmetric extension during rifting events. This deep-seated basement feature is expressed in the spatial and temporal distribution of sedimentary facies and depocentres, subsequent patterns and styles of Cordilleran deformation, and consequent distributions of economic resources. The Central Foreland Project therefore offers opportunities to not only unravel the histories of the transect regions, but also increase our understanding of the roles of regional extensional and subsequent compressional tectonics.

The bulk of activities in the northern Liard-La Biche transect are scheduled for 2000 and 2001, but targeted preliminary mapping and compilation began in the Kotaneelee and La Biche ranges in 1997 (Babiche Mountain and Chinkeh Creek map areas: Currie et al., 1998). The Liard-La Biche area includes the Beaver River, Kotaneelee, Pointed Mountain, and La Biche fields. Surface structures in the area of gas fields are complicated, often asymmetric, rounded to box-shaped, doubly plunging anticlines and synclines. The folds are apparently controlled by rigid upper Paleozoic formations and expose lower Paleozoic shales (Besa River Fm.) in their cores. Total shortening across this area is small, probably less than 20%.

The map pattern of the Babiche Mountain and Chinkeh Creek map areas is controlled by broad, west-verging detachment box-folds of the Kotaneelee and La Biche anticline-syncline pairs. New mapping highlighted problems with existing maps, in at least two significant areas demonstrating the non-existence of thrusts. Two structural styles contribute to the sinuous nature of the axial traces of these fold pairs. First, the axial planes are curved, and second, shortening is transferred along structural strike by en echelon steps. The sinuous traces of the axial surfaces may be a reflection of deep, basement-involved (reactivated?) structures, a result of more than one phase of deformation (perhaps even involving transpression), or be due to the amalgamation of separate isolated structures as they grew in amplitude.

The main objectives of the Quaternary geology component is to map the surficial deposits and to determine the stratigraphic relationships between successive Cordilleran and Laurentide glacial advances and related proglacial events. The project will include inventories of aggregate resources, natural hazards, and a till prospecting program.

Industry interest and direct involvement in field mapping activities have been excellent to date. The success of the Central Foreland Project depends to a significant degree on industry support, especially through access to subsurface information not in the public domain. The combination of new, detailed structural mapping and stratigraphic analysis with industry data will result in important and fundamental advances in our understanding of Cordilleran geology in this region.

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SOME ASPECTS OF MONOPROS' EXPLORATION ACTIVITIES IN CANADA

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Monopros Limited, a wholly owned Canadian subsidiary of De Beers Consolidated Mines Limited, is responsible for diamond exploration in Canada and Kalaallit Nunaat (Greenland). In addition, Monopros' Toronto headquarters facility serves as a regional exploration centre for De Beers. Since January 1996, all exploration activities in the Americas and Europe (including Russia) have been directed from the Toronto office.

In this talk the objectives, scale, scope, nature and modus operandi of Monopros' prospecting activities are summarized, the results obtained to date are reviewed and Monopros' past, present and ongoing commitment to prospecting in Canada is described. In addition, reference is made to two aspects of De Beers' global exploration activities which are in some respects unique and which are of immense value to Monopros and to all other De Beers prospecting companies. These are firstly, De Beers' in-house technical support and analytical laboratory facilities and, secondly, De Beers' extensive, exploration-related, proprietary technical data-bases. The range and diversity of the support and analytical services available to the "front-line" explorationists is demonstrated by some examples of the kind of work that can and is being carried out. The size and usefulness of the data bases is indicated by summaries of the extent of the data contained within some of them.

SUBAQUEOUS VOLCANIC CONSTRUCTION IN THE PELTIER FORMATION AND BEAULIEU RIVER VOLCANIC BELT: PROXIMAL AND DISTAL FACIES AND THEIR IMPLICATIONS

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The Archean Peltier Formation and Beaulieu River volcanic belt (BRVB), mafic-dominated volcanic sequences adjacent to the Beniah Lake fault in the central Slave Province, overlie older, 2.9-3.22 Ga granitoid basement and are unconformably overlain by late orogenic, ca. 2.6 Ga sedimentary successions unconformably. Both volcanic belts contain facies characteristic of proximal and distal parts of subaqueous volcanic edifices. important criteria in understanding volcanic facies architecture and in choosing potential sites for mineral exploration.

The BRVB in the study area is represented by five mafic volcanic facies, including: 1) pillowed flows, 2) pillow breccia, 3) massive flows, 4) lobate flows, and 5) mafic dykes. Contacts between facies are generally abrupt, but lobate flows laterally become pillowed and pillowed flows locally grade into pillow breccia. Pillowed flows, 3-15 m thick, contain 20-150 cm pillows, with 1-2 cm-thick chilled margins. Isolated pillows, <20 cm long are locally associated with <30 cm-thick hyaloclastite. Pillow breccia, 0.5-6 m thick, is composed of sub-spherical, 10-15 cm-long pillows, amoeboid, 10-25 cm-long pillows, and 1-18 cm, subangular to angular pillow fragments. Massive flows range from 6-20 m thick, whereas lobate flows are up to 6 m thick. Synvolcanic mafic dykes, 1-4.5 m long and 0.03-0.4 m wide, cut pillow breccia and pillowed flows.

Two study areas, "Section Hill" and "Pillow Ridge" in the Peltier Formation are represented by: 1) pillowed flows with or without hyaloclastite, 2) pillow breccia, 3) massive flows, and 4) mafic dykes and sills. At Section Hill, pillowed flows,1.5-6 m thick, grade vertically and laterally into pillow breccia and are sharply overlain by massive flows. Generally, pillows are 20-75 cm in size, but isolated subspherical or amoeboid varieties set in a matrix of hyaloclastite are 10-40 cm long. Pillow breccia, 10-40 m thick, is composed of 0.5-60 cm angular fragments and 20-75 cm amoeboid pillows. Massive flow units are 2-100 m thick and sharply overlie pillowed flows and pillow breccia. Composite pillowed flow units at Pillow Ridge, 32 m thick, are composed of 30-120 cm pillows. Pillowed flows are cut by 20-45 m-thick mafic sills and 2-15 m-thick mafic dykes.

Abundant pillowed flows, pillow breccia, and hyaloclastite in all study areas attest to a subaqueous environment. Pillowed flows and pillow breccia cut by dykes and sills at Pillow Ridge and in the BRVB define a proximal volcanic environment similar to pillow volcanoes or pillow-dominated seamounts. Dykes and sills generally act as principal conduits for hydrothermal solutions which precipitate mineralized fluids in porous pillow breccia or interstices of pillowed flows. Proximal parts of pillow volcanoes should be favourable sites for massive sulfide mineralization. At Section Hill, abundant pillow breccia and hyaloclastite are consistent with the distal part of a volcanic edifice. Individual pillow volcanoes are commonly separated by layers of hyaloclastites or pillow breccias.

Proper field identification of proximal-distal volcanic facies related to subaqueous volcanic construction is significant not only for the study of volcanology, but also for potential massive sulfide exploration.

GEOCHEMISTRY AND GEOLOGIC SETTING OF THE BAKER LAKE GROUP, ANGIKUNI LAKE TO YATHKYED LAKE

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Volcanogenic and siliciclastic rocks of the Baker Lake Group accumulated in numerous sub-basins in the interior of the western Churchill Province sometime between ca. 1.88 and 1.82 Ga. Basin subsidence was presumably in response to accretionary processes on the flanks of the western Churchill Province, related to Wopmay and Taltson/Thelon orogens (western margin) and/or Trans-Hudson orogen (eastern margin). Continental redbed sequences at the base of the Baker Lake Group (Angikuni Formation in Angikuni Lake area; South Channel and Kazan formations south of Baker Lake) were deposited in local fault-bounded basins before regional blanketing by Christopher Island Formation (CIF) alkaline volcanic rocks. CIF flows and chemically similar dikes, which extend over an area of ~ 100,000 km^2, record the Archean to Proterozoic evolution of the mantle beneath the Western Churchill Province. As part of the Western Churchill NATMAP program, the geochemistry of the Angikuni and Christopher Island formations and associated dikes in the Yathkyed-Angikuni lakes region is being investigated**.

The Angikuni Formation comprises a variably developed lower member of conglomerate and arkose, and an upper member of red siltstone, mudstone and fine-grained sandstone. Significantly, the conglomerate contains oxidized CIF-like lamprophyre fragments, and the pelites contain reworked tuff layers and display a geochemistry similar to overlying CIF volcanic rocks. This supports Donaldson's (1965) postulate of a pre-CIF episode of volcanism during initiation of Baker Lake Basin.

In the CIF, ultrapotassic volcanic rocks range from mafic lamprophyres with phenocrysts of phlogopite, clinopyroxene, apatite, magnetite and rare leucite, to feldspar-bearing felsic lavas and coarse-grained, feldspar-phlogopite intrusions (Martell Syenite).

Carbonate contents are variable and may be mostly primary in origin. Pyroclastic rocks consist of highly oxidized, angular fragments of CIF in a dense, commonly vesicular matrix. Dikes and flows are similar chemically, confirming that the dikes are feeders to the flows. They range in SiO_2 content from 42-67% (dry). Martell Syenite intrusive rocks are also indistinguishable chemically from CIF dikes and lavas. All CIF lavas, dikes, pyroclastic rocks and syenites are highly enriched in incompatible elements (Ba, Th, the rare earth elements) compared to local Archean volcanic rocks or to modern MORB. However, the abundances of these elements either remain constant or decrease with decreasing MgO contents due to their compatibility within fractionating mineral phases. The effect of crustal contamination would also be to lower incompatible element abundances. MORB-normalized incompatible element patterns for all the CIF volcanic rocks are extremely similar, as are Nd isotope ratios, suggesting a chemically and mineralogically similar source for all primary CIF magmas. This source is interpreted to be mantle which, over a large area, was metasomatized by subduction-related fluids. The metasomatism may be related to Paleoproterozoic closure of ocean basins around the Churchill Province (Peterson et al. 1994). Alternatively, the metasomatic event may have occurred as a result of Archean subduction between 2.7 and 2.8 Ga, as inferred from Nd model ages. Support for the latter interpretation comes from volcanic rocks of the Hurwitz Group and dike swarms emplaced between 2.45 and 2.11 Ga in the Churchill Province, which have incompatible element patterns and Nd isotope ratios that are intermediate between those of Archean mafic rocks and CIF lavas. Therefore the metasomatized source existed as early as 2.45 Ga.

*INAC Contract 98-0003. Thanks to L. Aspler and J. Chiarenzelli for field collaboration.

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PRELIMINARY U-PB GEOCHRONOLOGY OF VOLCANICROCKS IN THE KAMINAK BELT, WESTERN CHURCHILL PROVINCE, KIVALLIQ REGION, NORTHWEST TERRITORIES

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Preliminary U-Pb zircon ages are reported for volcanic rocks of the late Archean Kaminak Group in the Heninga-Kaminak lakes area of the Western Churchill Province. The dating program was undertaken in conjunction with field mapping carried out in 1997 to develop a tectono-stratigraphic model for the Kaminak greenstone belt, as part of the Western Churchill NATMAP program.

Two dominant periods of felsic volcanism are identified in the Kaminak group: one at ca 2706-2695 Ma; and a younger episode at 2687-2681 Ma. One felsic volcanic unit has an age intermediate to these groups (2691Ma[1]). The older sequence occurs throughout the belt and comprises dominantly mafic pillow lavas, massive flows and tuffs, with subordinate felsic volcanic rocks. Four felsic units within the mafic volcanic sequences between Quartzite and Carr Lakes yield ages of 2706 Ma, 2704 Ma, 2700 Ma.and 2695 Ma. The latter two were determined from thin (<1 m) felsic tuff layers which are common within the mafic sequence. Similar ages of 2700 and 2695 Ma were reported for volcanic rocks from the Tavani area at the eastern end of the greenstone belt (Davis and Peterson, 1998). Zircons from the volcanic rocks all have relatively simple U-Pb systematics with no indication of zircon inheritance. This, together with depleted ϵNd compositions, implies formation of the volcanic belt remote from significantly older crust. The younger volcanic cycle is best exposed in a section between Kaminak and Quartzite Lakes, north of the Kaminak tonalite. The section comprises mainly felsic volcanic rocks, including autoclastic rhyolite, rhyolitic tuffs, quartz-feldspar porphyry, and heterolithic conglomerates which grade upwards to sandstones. An age of 2681 ± 3 Ma[2] was previously reported for felsic volcanic rocks at the top of the section, north of the "Cache" Au showing. A quartz-feldspar porphyry south of "Cache" yielded an age of 2686 Ma. The 2686-2681 Ma felsic rocks overlie the older volcanic assemblage which was intruded by the Kaminak tonalite at 2679 Ma, suggesting that the younger sequence was deposited on the older assemblage. Magmatic activity of this age elsewhere in the belt includes a 2687 Ma felsic volcanic unit from the Maguse River area, NE of Heninga Lake, and the 2685 Ma[3] Last Lake pluton east of Quartzite Lake. The Kaminak group is intruded by a number of large tonalitic to granodioritic plutons compositionally similar to the Last Lake and Kaminak plutons. suggesting that at the present erosional level the younger magmatic cycle is chiefly represented as a plutonic suite.

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HYDROCARBON POTENTIAL OF CAMBRIAN STRATA IN THE NORTHERN INTERIOR PLAINS, NWT

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In the Anderson-Horton Plains area four gas discoveries, one associated with condensate, in Cambrian sandstone of the Mount Clark Formation point to significant hydrocarbon potential in these strata. The criteria for the Interior Plains being a hydrocarbon province worthy of exploration are met: the basal Cambrian sandstone (Mount Clark Formation) are excellent reservoir rocks; the overlying shale and salt deposits of the Mount Cap and Saline River formations provide top and lateral seals; alginite-rich layers in the Mount Cap Formation are potential source rocks, and structural and stratigraphic traps are present. Although all of the discoveries are in the northern part of the Cambrian basin other areas in the basin may be as prospective.

A number of low, broad positive elements divide the Cambrian basin into a series of depocentres. These positive features were gradually onlapped during the Early Cambrian transgression and may help form stratigraphic traps for hydrocarbons. During the transgressive phase algal blooms formed, leading to the development of thin organic rich layers. A late Early to early Middle Cambrian uplift created an unconformity between the Mount Cap and Saline River Formations. The Saline River Formation was deposited under strongly evaporative conditions, leading to the development of extensive salt deposits. There was a gradual return to normal salinity and the development of a vast carbonate platform (Franklin Mountain Formation).

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ECONOMIC OVERLAY FOR YELLOWKNIFE EXPLORATION SCIENCE AND TECHNOLOGY

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Improving the quality and quantity of geoscience information on the Yellowknife Greenstone Belt is an important first step toward the objective of finding new mineral deposits in the area. Exploration in the broadest sense is about determining what to explore for, where to explore, and how to explore. Decision making in exploration is a sequential process based on the assessment of available information at any point in time. The availability of high-quality, public-domain geoscience information at the beginning of an exploration program increases the effectiveness and decreases the cost of exploration. From a competitive advantage perspective, the availability of geoscience information is an essential factor in attracting private sector investment in exploration. This investment can provide important short-term benefits to the local and regional economies.

In the longer term, expenditures for geoscience information and private exploration represent only the investment side of the cost-benefit analysis of the exploration and mining industry. It is only when these expenditures lead to the discovery, development and production of *economic* mineral deposits that there is a return on investment. Thus, it is essential that any program which is setting out "to identify geoscience data needed to facilitate mineral resource development" needs to have an economic overlay. It is proposed that the EXTECH program include a component which would allow new geoscience and technology information to be analyzed in terms of minimum economic requirements. This would entail determining minimum tonnage grade conditions based on economic information about known deposits in relation to deposit type, infrastructure requirements, and other physical and geological characteristics.

GROUND ICE AND FROST ACTION IN SURFICIAL MATERIALS, SLAVE GEOLOGICAL PROVINCE, NORTHWESTERN CANADIAN SHIELD

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Ground ice is prevalent in surface materials in areas of current mining activity and proposed infrastructure development in the western Canadian Arctic mainland. Surficial geology mapping and detailed site investigations have shown that some relationships can be drawn between regionally mappable material types and certain ground ice conditions. The amount and type of ground ice, and resultant behavioural characteristics of materials, depend on rock types underlying and outcropping in the area, and the nature of unconsolidated surface deposits. The cryo-geotechnical properties of glacial and postglacial deposits depend on the provenance of materials, depositional conditions, and postglacial climatic history.

While ice contents in rock are generally low, significant frost heaving of bedrock is pervasive in extensive areas of Archean schist and along linear belts of Proterozoic argillite, where rocks are weaker and fractures are more abundant than in other rock types. Scattered rock burst features, resulting from excessive water pressure during freeze-back, are present where igneous rocks lie at the surface.

Glacial till is the most prevalent surface material, and most till veneers and blankets have low ground ice contents. Large solifluction lobes have developed on till blankets, but thermokarst features are absent. Till derived from granitic and gneissic sources is less frost-susceptible than siltier till derived from pelitic metasediments and dolomite. Well-defined belts of hummocky till have distinctive surface relief characterized by small kettle lakes or depressions, rim-ridges, and shallow thaw flowslides, which can be attributed to massive ice, possibly remnant glacial ice. Although most eskers appear to be well-drained near the surface and have low ice contents, massive ice in excess of 5 m thick can occur in eskers , and is responsible for regional occurrences of thermokarst, slope movement and collapse features in some features. Broad-crested eskers in the south are silty and contain both ice crystals and segregated ice laminations; these materials make poor aggregate sources. Outwash deltas and postglacial sandy raised marine deposits contain polygons that are in the order of 10 m diameter, with toughs about 0.5 m deep. Active ice wedges underlie the troughs, although ice contents are low in polygon centres. Larger polygons, up to 100 m diameter with troughs 2 m deep, appear to be relict features, although small active ice wedges are inset within them. Silty marine deposits inland from Coronation Gulf form surface deposits or underlie thin, sandy, marine sediments. They range from the coast up to an elevation of 170 m near Coppermine (Kugluktuk) in the west, to 210 m at Tree River in the east. These sediments contain segregated ice in the upper few metres of permafrost. Retrogressive thaw flowslides are common features along river banks and active layer detachment slides occur on moderate slopes where coarse littoral sand overlies frozen silty clay marine sediments. Slope stability problems are due to excessive ice.

Particular ground ice conditions give rise to distinctive surface features such as ice-wedge polygons, solifluction lobes, retrogressive thaw flowslides, thermokarst, and active layer detachments. Many features can be regionally mapped using air photographs, while others are too small, and require detailed ground observations. An understanding of glacial history, maps of surface materials, together with observations on small-scale surface features serve as a preliminary guide in assessing potential for ground ice and active periglacial processes prior to detailed geotechnical investigations wherever mining activities or infrastructure development are planned.

THE SIGNIFICANCE OF DETACHMENT FAULT BRECCIAS OCCURRING AT THE SOUTHERN END OF THE GREAT BEAR MAGMATIC ZONE, WOPMAY OROGEN, N.W.T.

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As best documented in the literature on the Cordilleran metamorphic core complexes of post-Laramide mid-Tertiary age occurring in the southwest U.S., low angle detachment faults are characteristic of extended terranes subject to post-orogenic collapse. The brittle crust above detachment faults is tectonically denuded by listric normal fault-block rotation while ductile crust beneath is thinned by mylonitic shearing. The isolated exposures of the seismically-traced regional detachments reveal development of variably thick micro to mega "detachment fault breccia." Vestiges of either brittle upper crust or detachment fault breccia are generally lacking in paleo-orogens due to rapid erosion. However, where domains of post-collisional collapse have attendant "continental-style" ash flow tuff volcanism, such high level/near surface crustal environments may be preserved beneath a thick volcanic cover.

Such is the case at the southern terminus of the Great Bear Magmatic Zone where teconic breccias are commonly developed between monoclinal volcanic successions, listric rotated fault blocks remnant from regional ash flow tuff fields, and infolded synclinal keels of basement Snare Group metasediment. The breccias are wholly protolithed in either Snare sediment or non-metamorphosed ignimbrite with mixed breccia masking the "unconformity." The widespread occurrence of tectonic breccia indicates that the terminal Bear Province felsic volcanism occurred not on a static unconformity surface but within an actively extending terrane with partially unroofed detachment faults. The identification of detachment fault breccia not only provides additional key evidence that post-collisional collapse played a pivotal role in forming the Great Bear Magmatic Zone coring the Wopmay Orogen but offers new insights into the nature of this setting at the time of formation of polymetallic sulphide mineralization associated with the widespread Olympic Dam/Kiruna-type iron-oxide breccia occurrences.

As detachment faulting telescopes the upper 15 km of crust, such faults can readily juxtapose ambient surface conditions against metamorphic/igneous infrastructural domains. A primary result of such telescoping in the Great Bear Magmatic Zone was extensive potassium feldspar metasomatism of the detachment interface. Flashing of meteoric (?) fluid filtering down listric normal faults promoted hydrothermal "diatremaceous" activity, a primary mechanism for detachment fault breccia development. The rapid unroofing of collisional melts gave rise to episodic fissure-style dyking and voluminous eruption of felsic ash tuff prior to cessation of detachment fault movement. Collectively the known iron oxide concentrations indicate early iron oxide melt/magnetite skarn generation, syndetachment magnetite ± hematite cemented breccia development, and late Fe-biotite ± chlorite alteration associated with polymetallic sulphide enrichment by coupled unconfromity/epithermal fluid convection through Fe-oxide rich breccias associated with volcanic vent systems.

A CASE FOR MULTISTAGE UPGRADING OF GOLD IN THE YELLOWKNIFE GREENSTONE BELT

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Prevailing opinion holds that gold is exotic and introduced late in terms of greenstone belt development and deformation. At Yellowknife a better case can be made for an endogenous gold source with multiple stages of beneficiation. Three stages of upgrading are in evidence, as follows.

Stage I: Stratigraphic Control
The Gold mineralization is confined to the Yellowknife Bay Formation, the uppermost member of the Kam Group. As is well exposed in the Giant Section and through Con Camp, variolitic lava flows capped by cherty tuff units figure prominently as immediate host strata. Significantly, variolitic lavas are common hosts to gold mineralization at other major camps as well; an example is the Vipond Formation at Timmins. Such gross stratigraphic control at the district scale points to the variolitic flow/cherty tuff association as a primary gold source. Locally at both Con and Giant, affiliated cherty tuffs host disseminated to massive bands of pyrite, suggesting an exhalative gold contribution. Significantly, the origin of the varioles, the origin of the "cherty tuff," and the origin (source) of the gold all remain outstanding — and probably connected — petrological problems.

Stage II: A Gabbro Sill/Quartz Feldspar Porphyry Connection
Layer-cake stratigraphic models of greenstone belt development are being increasingly challenged as high precision geochronological data becomes available. Although subtle, questions of stratigraphic relationships are raised in the Yellowknife greenstone belt with regard to (a) the timing of multiple generations of gabbro sills/dykes, and (b) the connections between the mafic dominated 2700 m.y. Kam Group and the felsic dominated ~2660 m.y. Banting Formation. These problematic relations are further reflected in the lithological makeup

of, and available age dates for, the Brock (2700 m.y.), Niven (2680 m.y.) and Vee Lake (2660 m.y.) lenticles of the Townsite Formation, historically identified as a felsic member within the Kam Group. Alternatively, the Townsite gabbro sill/quartz feldspar porphyry association may be attributed to voluminous post-Kam basaltic magma being emplaced high into the Kam platform and causing "wet melting" of bordering variolite/cherty tuff sequences to produce gabbro sills with affiliated "intrusive" quartz feldspar porphyry bodies. The differing lenticles of the "Townsite bimodal igneous suite" may signify an aborted rift assemblage at 2680 and/or may have vented at 2660, giving rise to the similarly bimodal Banting Formation. This alternative interpretation raises the spectre of the globally recognized Au-QFP association at Yellowknife. Although not well investigated, such an association could explain why the most economic segments of both the Con and Giant systems occur where these abut the Niven and Brock lenticles. It also raises the possibility for similar undiscovered gold mineralization at Vee Lake.

Stage III: The Role of Kenoran Metamorphism/Plutonism and the Temiskaming Unconformity
in Generating Gold-Bearing Shear Zones

The Yellowknife greenstone belt shows a strong thermal gradient from peripheral greenschist through epidote-, hornblende-, garnet-, and pyroxene-amphibolite metamorphic facies towards the 2620 m.y. Western Granodiorite. Although isolated gold-bearing quartz veins occur in high grade rocks, the main gold-mineralized shears (a) occur in the epidote-amphibolite facies domain and (b) show retrogression of peak metamorphic mineral assemblages to chlorite-calcite and sericite-ankerite-pyrite stable hydrothermal alteration assemblages. Two unique rock types accompany the economic shear strands — their proximity to gold ores is best displayed with respect to the Campbell Shear at the Con Mine. The first of these, sheeted lamprophyres including lamprophyric diatreme dykes, occurs in the immediate hangingwall. The presence of blocks of sheeted lamprophyre in pre-granite breccia and the apparent lack of granite clasts in diatreme breccia indicate that the injections were pre-granite emplacement. The second, the polymictic Jackson Lake Conglomerate with common granite cobbles and both quartz vein and green-mica schist clasts, occurs in the immediate footwall. The pre-granite lamprophyric injections could be affiliated with wholesale CO_2-H_2O-K_2O-SO_2 degassing along the outer margin of the thermal aureole, while the post-granite Jackson Lake Conglomerate indicates proximity to a Temiskaming-type paleosurface preserved as fault slivers within a reactivated structural break between the Kam Group and Banting Formation. Although the Yellowknife shear-hosted gold deposits are "mesothermal" in class, the collective aspects of the "Kenoran Event" suggest that gold was efficiently transported towards the outer margin of the metamorphic aureole of the Western Granodiorite *and* concentrated at quite high crustal levels, possibly accounting for the subtle "epithermal" metal signature as defined by zoning from a deeper free-milling pyrite/gold association to a shallower refractory arsenopyrite/gold association as is documented in the Con Mine.

Should this proposed multistage upgrading model for the Yellowknife gold ores stand up to further testing, it brings important new concepts to the exploration table. Rather than keying exploration simply to late shear strands, close attention should be paid to volcanic stratigraphy, proximity to bimodal intrusive suites, and metamorphic conditions in prioritizing targets.

SEDIMENTOLOGY AND TECTONIC SETTING OF THE BURWASH FORMATION, HEARNE LAKE - GORDON LAKE AREA

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The Burwash Formation is a thick slate-metagreywacke turbidite succession in the southern Slave Province. The Formation and underlying volcanics have been deformed by multiple generations of structures, and regionally metamorphosed. Although metamorphism reaches amphibolite facies near the Anton and Sleepy Dragon complexes, in other areas the formation is metamorphosed to greenschist facies and most sedimentary structures are preserved with relatively minor deformation. Interbedded tuff units have provided both an isotopic age (2661 +/- 2 Ma) and a means of correlating laterally within the thick package of sedimentary rocks.

Field work in the summers of 1996-98 provided evidence of the depositional environment, source area, and tectonic setting. Sedimentological work northwest of Hearne Lake has identified a channel-levee system involving thick bedded sandstone turbidites. Preliminary results from the summer of 1998 identified massive, deeply scoured, granule to conglomerate beds as channel fills. We interpret the depositional environment to involve channel-levee systems formed by high density turbidity currents, and debris flows. These systems appear similar in scale and proportions to those of modern submarine fan environments.

Previous work along the west coast of Yellowknife Bay indicated predominant eastward paleocurrents, and postulated a relatively symmetrical basin with sediment derivation from basement massifs to the east and west. Our preliminary paleocurrent data, from the Hearne lake and Gordon lake areas, are much more scattered, with an abundance of northward flow directions, parallel and oblique to the axes of F1 folds. This may indicate that the pattern of paleocurrents is cannot be related in a simple way to the present-day distribution of basement massifs.

Further work will involve more rigorous removal of tectonic strains from the paleocurrent distribution. Fieldwork east of Gordon lake planned for the summer of 1999 should clarify the structural complexities and aid in the interpretation of the sediment source and depositional environment.

A PETROLOGICAL STUDY OF THE TOWNSITE FORMATION IN THE YELLOWKNIFE GREENSTONE BELT

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The Townsite Formation of the mafic dominated Kam group is uniquely characterized by felsic lithologies intimately related to various generations of gabbro sills and dykes. As a result of Proterozoic faulting the formation has been divided into three separate segments which from north to south are referred to as the Niven Lake, Brock, and Vee Lake lenticles respectively. Previous workers in the belt have interpreted the Townsite Formation as a felsic volcanic member of the Kam successions. The present petrological study challenges this simple stratigraphic interpretation addressing the possibility that it may comprise a bimodal gabbro sill/quartz feldspar porphyry intrusive complex within the Yellowknife Greenstone Belt.

The primary goal is to critically document the lithologic makeup of the Brock, Niven and Vee Lake lenticles of The Townsite Formation. The detailed (1:1200) surface (re)mapping of the Brock lenticle carried out during the 1998- field season brings into question several past lithological interpretations. Additional work in the Niven and Vee Lake lenticles reveals similar lithological problems as those identified in the Brock. The "pillowed dacites" of previous workers have been re-interpreted as silicified/albitized variolitic pillowed flows which originated as variolitic flow units similar to those capping the underlying Crestaurum Formation and occurring within the overlying Yellowknife Bay Formation.

Remnants of cherty tuff occur on the margins of gabbro sills in all three lenticles. Also occurring marginal to gabbros but which are more obscure in origin due to diffuse contact relationships, chill margins are lacking, are feldspar and quartz feldspar porphyry phases of probable intrusive origin. These phases display classic porphyritic textures, host xenoliths of variolitic pillow lava and show no primary bedding features. Locally, these felsic phases host coarse 1-2cm quartz "pebbles" and/or 2-5mm lithic clasts. Previously identified as having volcanoclastic origin the absence of bedding and apparent crosscutting relationships indicate some such origin as hydrothermal fragmentation due to high water conditions at the level of emplacement.

Our working hypothesis for the generation of feldspar and quartz feldspar porphyry phases is linked to wet melting of variolitic flows and cherty tuff units at the time of gabbro sill emplacement. The conclusions reached in the investigation will help identify what role in, if any, a bimodal gabbro sill/quartz feldspar porphyry intrusive event (ie: the globally recognized gold/porphyry association) had the Yellowknife Camp.

U-PB ZIRCON GEOCHRONOLOGY OF THE SOUTHERN GREAT BEAR MAGMATIC ZONE AND ITS IMPLICATIONS TO THE METALLOGENIC EVOLUTION

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The Great Bear magmatic zone is a post-collisional, continental, calc-alkaline magmatic arc on the western margin of the ca. 1900 Ma Wopmay orogen. It is a 100 km wide zone of volcanic and plutonic rocks, exposed for 400 km from Great Bear Lake south to near Great Slave Lake. The southern part of the magmatic zone has attracted strong mineral exploration interest
recently because of the potential for large polymetallic deposits that was recognized by the geological mapping and metallogenic studies

carried out under the Canada-Northwest Territories Mineral Development and Minerals Initiative Programs during 1986-'91 and 1991-'96, respectively. The intensive exploration that followed has led to the definition of two potentially economic deposits, namely the Sue-Dianne and Lou Lake (NICO) deposits, and the discovery of several new occurrences and promising prospects. They comprise a group of iron oxide-rich polymetallic deposits referred to as the 'Olympic Dam-type', which shows a considerable variation in the deposit characteristics. The magmatic hydrothermal processes that formed them are related to the Great Bear volcano-plutonic activity.

A zircon geochronological study of nine representative volcanic and intrusive rocks from the southern Great Bear magmatic zone was undertaken by the Geological Survey of Canada to complement the geological mapping and metallogenic studies. The results provide age constraints for the volcanic activity, subvolcanic intrusions and emplacement of granitic batholiths, and
hence for the magmatic and metallogenic evolution.

The volcanic rocks of the study area comprise the Faber Group, exposed mainly in a belt 75 km long and 10 km wide. The belt trends north-northwest from Lou Lake in the south to Faber Lake in the north. The volcanic rocks were deposited on a previously folded metasedimentary sequence. The unconformity between them is exposed at Lou Lake, where the volcanic rocks dip gently to moderately to the north-northeast and the metasedimentary beds dip moderately to steeply to the northeast. The latter are exposed for more than 50 km to the southeast, and also occur as inclusions in granite to the east. They comprise an upward coarsening platform-type sequence of siltstone, argillite, dolomite, sandstone and some bedded iron formation. The basement on which the sequence was deposited is not exposed.

The volcanic and associated volcaniclastic rocks of the Faber Group are relatively little deformed, and show well preserved primary volcanic and volcaniclastic textures and structures. Their aggregate thickness is in the order of 5 km. They are broadly subdivided into three assemblages, namely the Lou Lake, Mazenod Lake and Bea Lake assemblages. The predominantly rhyolitic Lou Lake assemblage is the oldest. The Mazenod Lake assemblage to the north is dominated by rhyodacite ignimbrites. The Bea Lake assemblage is the youngest, and is exposed on the west side of the other two assemblages. It comprises an extensive volcaniclastic unit overlain by a thick and extensive quartz-feldspar porphyritic massive unit, which is in part intrusive. The volcanic assemblages are intruded by dykes and irregular bodies of monzonite-quartz monzonite, feldspar±quartz porphyries and granitic plutons. The latter include the Marian River granite-granodiorite batholith in the east and the Faber Lake rapakivi pluton in the north. A gneissic granodiorite body intrusive into the metasedimentary sequence was interpreted in the field as a syntectonic pluton emplaced before the Great Bear magmatic activity, but the zircon geochronological data presented below show that it postdates the volcanic activity.

The oldest age obtained during the present study is 1873 ± 2 Ma for a sodium-rich granite pluton intrusive into the metasedimentary sequence southeast of Lou Lake. A sample of the basal rhyolite at the unconformity to the north yielded an imprecise age of 1851 +18/-16 Ma. It is from the altered zone of the Lou Lake deposit, and is highly enriched in potassium. An unaltered rhyodacite ignimbrite unit in the middle part of the Mazenod Lake assemblage, and a weakly altered one in the upper part at the margin of the Sue-Dianne deposit, which is located 25 km north-northwest of the Lou Lake deposit, are dated at 1868.6 +1.3/-1.2 Ma and 1861.5 +8.7/-1.3 Ma respectively. Two subvolcanic intrusions in the volcanic rocks, a dacitic quartz-feldspar porphyry and a quartz monzonite, yielded ages of 1867.9 +2.9/-2.4 Ma and 1867.1 +1.6/-1.5 Ma old respectively. Two samples from the younger Marian River granodiorite-granite batholith, one gneissic and the other massive, yielded nearly identical ages of 1866 ± 2 Ma and 1866 +3/-2 Ma. The youngest age obtained is 1856 +2/-3 Ma for the Faber Lake rapakivi granite.

The geochronological data show that the sodic granite plutons were emplaced a few million years prior to the major episodes of volcanism, and provide a minimum time interval for the unconformity between the metasedimentary sequence and the volcanic rocks. The volcanic activity and emplacement of related subvolcanic intrusions occurred during the time range 1870 to 1867 Ma, The major Marian River granodiorite-granite batholith was emplaced within a few million years of the volcanic activity. There was, however, an interval of some 10 million years before the emplacement of the rapakivi granite. The geochronological data point to an overall petrochemical evolution of the magmatic source from sodic through calc-alkaline to highly potassic with time. These geochronological data are within the range of those from the northern part of the Great Bear magmatic zone. where indications of magmatic evolution from calc-alkaline to potassic is also noted.

Metallogenically two main styles of mineralization coeval with the magmatic activity are:

1) the iron oxide-rich pyrite-chalcopyrite-bornite bearing breccia fillings and veins, as seen at the Sue-Dianne deposit and the Mar. Nod, Fab. Brooke and Kim prospects. which are hosted by the volcanic rocks of the three assemblages, and 2) the arsenopyrite-pyrite-chalcopyrite-magnetite veins and disseminations, as seen at the Lou Lake deposit and Burke Lake showings, which occur mostly in the metasedimentary sequence at the unconformity with the volcanic rocks, although they do straddle the unconformity. Tourmaline and scheelite are common in occurrences of both groups: arsenopyrite, cobaltite and bismuthinite are relatively more abundant in the latter than in the former, and actinolite. apatite and epidote are more abundant in the former than in the latter. The Sue-Dianne deposit contains 13.5 million tonnes of drill indicated resources averaging 0.78 % Cu, 3.81 g/t Ag and 0.07 g/t Au, and the Lou Lake deposit contains drill indicated 128.6 million tonnes averaging 0.54 g/t Au, 0.07 % Co, 0.08 % Bi, 0.05 % Cu, and a notable amount of tungsten, according to the recent news releases by Fortune Minerals Ltd.. the company which is presently drilling the two deposits. Field observations show that both styles of mineralization postdate much of the volcanic and subvolcanic intrusive activity. The timing of the mineralization relative to the emplacement of major granitic plutons, however, remains uncertain. It is noted that potassium enrichment is associated with all the occurrences, and is very strong and extensive in the case of the Lou Lake deposit. This leads to the postulation that the mineralization represented by the Sue-Dianne deposit occurred early, during the

transition from calc-alkaline to relatively more potassic magmatism, and the Lou Lake style of mineralization is linked closely with a potassium-rich intrusion at depth during the late stage of the evolution of the magmatic zone. Some of the metals in the latter are believed to have been scavenged from the argillaceous beds in the metasedimentary sequence through which the mineralizing fluids ascended, and then deposited at the unconformity with the overlying volcanic assemblage which served as the cap rock.

THE NICO AND SUE-DIANNE PROTEROZOIC IRON OXIDE-HOSTED POLYMETALLIC DEPOSITS, SOUTHERN GREAT BEAR MAGMATIC ZONE, NORTHWEST TERRITORIES, - A SUMMARY OF CURRENT WORK AND DEPOSIT MODEL DEVELOPMENT IN GLOBAL MINERAL EXPLORATION

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The NICO and Sue-Dianne deposits are currently being delineated by Fortune Minerals Limited in the south part of the Great Bear magmatic zone, within the Proterozoic, Bear Structural Province of the Canadian Shield. The deposits are specifically located in the Mazenod Lake district near the Snare hydroelectric complex, 160 km northwest of Yellowknife, Northwest Territories. NICO contains an inferred mineral resource in the Bowl Zone totaling 128.6 million tonnes of which 88.6 million tonnes are measured and indicated. The inferred resource contains 198.4 million pounds of cobalt, 2.2 million ounces of gold, 221.1 million pounds of bismuth, and 147.4 million pounds of copper from a total of 102 drill holes completed in 1997. The Bowl Zone contains smaller resources of progressively higher grade mineralization within the central part of the deposit which can be selectively mined. An additional 114 holes were drilled at NICO in 1998, the results of which are not included in the current resource estimate. The deposit remains open along strike and at depth. Sue-Dianne is located 24 km north of the Bowl Zone and contains a measured and indicated mineral resource of 14.9 million tonnes, containing 255.9 million pounds of copper, 1.5 million ounces of silver, and 11 thousand ounces of gold. A total of 61 holes have been drilled at Sue-Dianne by Fortune and 50% joint venture partner Noranda to date, including 32 hole in 1998. Revised resource estimates from recent drilling are in preparation.

NICO and Sue-Dianne are the only known significant Canadian examples of Proterozoic iron oxide-hosted polymetallic deposits, also referred to as "Olympic Dam-type". Worldwide, this class includes the Olympic Dam, Ernest Henry, Kiruna-Aitik, and Salobo deposits in Australia, Sweden, and Brazil, respectively. These deposits are between 150 million and 2 billion tonnes in size and this together with their polymetallic ore assemblage makes them highly attractive targets for exploration. They are typically Early to Middle Proterozoic in age and are formed in cratonic settings with extensional rifting evolving from collisional tectonics. They occur along major structural lineaments within the aureoles of a distinctive suite of anorogenic potassium-rich "A-type" granite intrusions. Mixing of magmatic and meteoric fluids in the near surface environment had an important role in precipitating metals at redox boundaries. The deposits occur in diverse host rocks, but are otherwise characterized by a number of diagnostic regional and deposit-scale features which may be recognized in various geological and geophysical surveys.

Fortune Minerals Limited initiated exploration in the southern Great Bear magmatic zone because of its similar age, tectonic setting, and regional and local geological and geophysical characteristics to the area around the Olympic Dam deposit and its global analogues. Airborne and ground geophysical surveys identified coincident potassium, uranium, magnetic, resistivity, chargeability and gravity anomalies centred over the NICO claims. The anomalies occur within a regional, northwest-striking, arcuate trend of volcanic and sedimentary rocks characterized by significant positive Bouguer gravity and magnetic responses, indicative of a major basement discontinuity. The NICO anomalies are at the intersection of this regional trend with a major transverse fault through Lou Lake. Collectively, regional and local geophysical data indicate the presence of significant concentrations of iron oxide within a broad area of intense potassium metasomatism. Concurrent geological mapping identified cobalt, gold, bismuth, and copper mineralization in biotite-magnetite-amphibole-sulphide-rich ironstones and schists, referred to as "black rock alteration". This mineralization is localized at the unconformity between Snare Group sedimentary rocks and potassium feldspar-(± hematite and magnetite) altered rhyolite (felsite) of the Faber Lake volcanic belt. Diatreme and maar facies, iron oxide-cemented breccias below and at the unconformity indicate that mineralization formed in a near surface Olympic Dam-type geological setting.

The nearby Sue-Dianne deposit was discovered by Noranda in 1975 contemporaneous with the discovery of Olympic Dam in Australia by Western Mining Corporation. The model was therefore not used in early exploration because the analogy was not recognized. The Sue-Dianne deposit is a hematite- and magnetite-cemented diatreme complex enriched in copper, silver, gold and uranium within a broad zone of potassium and iron metasomatism and quartz-epidote veining. The diatreme is located at the intersection of two major faults at the north end of the regional, northwest-striking, arcuate basement discontinuity and is hosted in rhyodacite ignimbrite marginal to the Faber Lake rapakivi granite pluton. Snare Group sedimentary rocks exposed 2 km south of the deposit suggests proximity to the basal unconformity. Sue-Dianne is characterized by coincident uranium, potassium, magnetic, resistivity and chargeability anomalies which were instrumental in its discovery.

The near surface thick geometry of the NICO and Sue-Dianne deposits will facilitate low cost open pit mining with low stripping ratios. Extensive metallurgical testing at Lakefield Research indicates high recoveries for the economic metals in bulk sulphide flotation concentrates. Hydrometallurgical testing of the concentrates indicates low temperature (180°C) acid pressure oxidation, followed by cyanidation and solvent extraction produces very high recoveries of cobalt, copper and gold as saleable metal products in an on-site processing facility. Arsenic and iron are also rejected in the residue to produce a registerable non hazardous waste. Bismuth is recovered in a separate flotation concentrate which is 99.5% efficient in a ferric chloride leach. The economic feasibility of the NICO and Sue-Dianne deposits is currently being assessed in a detailed prefeasibility/scoping study by Kilborn SNC Lavalin.

Fortune Minerals Limited is continuing to successfully apply the Olympic Dam model in the southern Great Bear magmatic zone, refining its application through ongoing detailed exploration of NICO, Sue-Dianne and numerous other iron oxide-hosted prospects in the area.

Table 1 Mineral Resources of the NICO Bowl Zone and Sue Dianne Deposits

Tonnage (t) (thousands)	Class	Cobalt (%)	Gold (g/t)	Bismuth (%)	Copper (%)	Silver (g/t)NICO Deposit
128,600	31% Inferred 35% Measured 34% Indicated	0.071	0.543	0.078	0.052	-
88,600	51% Measured 49% Indicated	0.071	0.543	0.078	0.052	-
62,900	51% Measured 49% Indicated	0.094	0.740	0.094	0.050	-
41,600	52% Measured 48% Indicated	0.124	1.025	0.133	0.053	-
33,400	48% Measured 52% Indicated	0.140	1.167	0.154	0.052	-
9,100	51% Measured 49% Indicated	0.086	4.074	0.094	0.023	-
						Sue-Dianne Deposit
14,911	75% Measured 25% Indicated	-	0.023	-	0.78	3.22
9,665	75% Measured 25% Indicated	-	0.022	-	1.01	3.44

PRELIMINARY INVESTIGATION OF SIGNIFICANT MINERAL OCCURRENCES IN THE CENTRAL RANKIN-ENNADAI SUPRACRUSTAL BELT: KAMINAK LAKE AREA (NTS 55 E/13-14, 55 L/1-16, 65 H/15-16, 65 I/1-2)

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The Kaminak Lake greenstone belt is a metal-rich portion of the Western Churchill Province with significant exploration potential for gold and base metal deposits. Much previous work has been undertaken by government bedrock mappers and the exploration community. A digital compilation of information of more than 200 mineral occurrences has been recently published (Goff and Mills. 1998; DIAND EGS 1998-15).

This paper is a contribution to the mineral deposits/metallogenic component of the Western Churchill NATMAP program and is largely based on our work in the Kaminak belt in 1997 and previous investigations by Goff. It presents highlights of: a) the recent compilation of mineral occurrences, b) field visits to a number of mineral occurrences, and, c) lithogeochemical investigations of selected samples from the mineral occurrences. The overall objectives of this work are to: a) to help identify metallogenic domains most favourable for discovery of economic deposits. b) to develop better empirical exploration guidelines, c) to develop better genetic models for different deposit types, and d) to compare the geology and mineral occurrences of this area to other greenstone belts covered by the Western Churchill NATMAP program.

The Kaminak Lake to Heninga Lake area represents one of the best exposed areas in the central part of the Archean Rankin-Ennadai supracrustal sequence. Over 160 of the most significant metallic mineral occurrences were classified according to deposit type, as well as subdivided into gold (>2 ppm Au), base-metal (>1000 ppm Cu, Pb or Zn) or polymetallic (>2 ppm Au plus >1000 ppm Zn or Pb) to assist a genetic classification. Many of the showings were visited and sampled.

Most gold occurrences are linked to quartz-carbonate veins in a variety of host rocks. Auriferous veins commonly contain negligible Cu and are not anomalous in Ag. The more significant occurrences commonly involve several stages of pyrite-iron carbonate- quartz veining associated with east to northeast-trending shear zones in mafic to felsic volcanic and volcaniclastic rocks (e.g. Cache Zone deposit). Arsenopyrite-bearing veins are only prominent in northeast-trending shear zones at the SW end of the study area (e.g. Turquetil Lake deposit). Many of the gold-rich veins. (e.g. Mac occurrence), appear to be variably folded and overprinted by the main regional cleavage. Vein-related base metal occurrences are common in the vicinity of some gold occurrences. For example, veins carrying base metals, but poor in both carbonate and gold occur within the volcanic package which hosts the Cache deposit.

Polymetallic occurrences, mostly linked to quartz-carbonate veins and commonly anomalous in silver, are widely distributed, but are most abundant in a cluster, northeast of Kaminak Lake, at Happy Lake. These veins are localized in variably altered intermediate to felsic tuffs and sulphidised interflow "chert" within a package of sheared mafic to felsic volcanic and volcaniclastic rocks with interlayered rhyodacite sills. Many of the metalliferous veins and the associated quartz sericite schist appear to have been overprinted by penetrative deformation and metamorphism.

VMS occurrences are mainly in the thick felsic to intermediate volcaniclastic packages at the southwest end of the study area and form sheared podiform and stringer sulphide bodies of mainly massive pyrite-pyrrhotite-chalcopyrite and/or layered pyrite-sphalerite, in places associated with layered magnetite (e.g.. Heninga Lake deposit). However, the recent discovery of the Victory Lake massive sulphide in 55L/11 indicates that potential for discovery of VMS deposits is not restricted to the SW portion of the Kaminak greenstone belt. With rare exceptions, VMS occurrences have high silver concentrations and <2 ppm Au. Vein-related gold and base metal occurrences are common in the vicinity of some massive sulphide deposits.

Of the occurrences which clearly postdate Proterozoic Hurwitz Group strata (c.2.1 Ga), almost all are chalcopyrite-bearing quartz and quartz-carbonate veins with <300 ppb Au and no sphalerite nor galena. Similar and more numerous veins which cut Archean volcanic suites may also be of Proterozoic age.

Lithogeochemical data on samples collected by us from more than forty occurrences have been displayed on a variety of binary and ternary diagrams in an effort to better characterize the metal endowments of the different classes/types of mineral occurrences. Plots of Au vs. Ag, Au vs. Zn, Cu vs. Zn and Pb vs. Zn indicate that samples of base metal, gold and polymetallic occurrences commonly occupy different portions/fields on the diagrams. Most samples from gold occurrences possess Ag/Au ratios of about 0.10, whereas most samples from base metal occurrences have Ag/Au ratios greater than 100. Samples from polymetallic veins typically have intermediate Ag/Au ratios around 1.0. As expected, base metal contents are greatest in samples from volcanic-associated massive sulphide occurrences and polymetallic vein occurrences. However, several samples from the polymetallic Happy Lake occurrences have greater than 1 wt. % Zn.

Some samples from different deposit types plot in the same compositional fields on certain diagrams suggesting possible genetic links between some polymetallic vein and massive sulphide occurrences, and between some gold and some polymetallic vein occurrences. Different samples from the same occurrence sometimes plot in different areas of the same diagram suggesting several distinct styles/stages of mineralization. Samples from occurrences of uncertain deposit type commonly plot within the compositional fields of those from known deposit types, suggesting similar styles of mineralization. For example, several samples from the enigmatic Angus Island occurrence plot within the massive sulphide field defined by samples from Spi Lake, MAG and NORSIK.

Although enhanced concentrations of Ag, Zn and Pb may be the best indicators of a contribution by synvolcanic processes to metal concentration, a significant number of our samples from massive sulphide, polymetallic vein and vein-gold occurrences contain anomalous concentrations of one or more of Mo, Bi, Te, Se, W, Sb and As. These elements are commonly enriched in synvolcanic mineralization (massive sulphide/epithermal/porphyry/skarn deposits) at the global scale.

Lithogeochemical data permit recognition of alteration zones associated with different styles/stages of hydrothermal mineralization. Evidence for depletion of sodium and calcium during destruction of plagioclase is not restricted to massive sulphide occurrences. The zones of quartz-sericite schist that are present in some gold and polymetallic vein occurrences are characterized by anomalously high K/Na ratios and high Al contents. Work is in progress to better define the character and extent of hydrothermal alteration.

A growing body of evidence suggests that synvolcanic hydrothermal processes linked to felsic volcanic centres may have contributed to mineralization and alteration with epithermal/porphyry characteristics in the Happy Lake area and possibly elsewhere. The polymetallic character of most of the Happy Lake occurrences, widespread distribution of mineralization over an area exceeding 20 square kilometres, enhanced Ag contents of many samples, presence of significant sericite-pyrite alteration, and evidence of overprinting of at least some metal-bearing veins by deformation and metamorphism are consistent with this interpretation.

The polymetallic character of much of the probably synvolcanic epithermal/porphyry mineralization in the Happy Lake area suggests that the presence of polymetallic occurrences elsewhere may indicate additional areas of high exploration potential. (It is noteworthy that similar polymetallic vein occurrences are present in the vicinity of massive sulphide, vein gold, and BIF-hosted gold deposits in the Meadowbank area of the Woodburn Lake Group, north of Baker Lake).

Some of the vein-hosted occurrences of the gold and base metal classes may represent relatively shallow portions of large scale synvolcanic hydrothermal systems that generated massive sulphide deposits on the seafloor and porphyry deposits at greater depths. The deformed character of some metal-rich veins as well as apparent lithogeochemical similarities between some samples from gold and base metal vein occurrences and samples from polymetallic occurrences are consistent with this suggestion.

Much work remains to be done to better define the timing of metal deposition relative to volcanism, sedimentation, plutonism, deformation and metamorphism. If synvolcanic processes and early structures truly did make a significant contribution to metal concentration in occurrences additional to those of volcanic-associated massive sulphide affinity, then the chances of discovering economically significant gold and/or base metal deposits are considered to be greatly enhanced.

PROTEROZOIC REWORKING IN WESTERN CHURCHILL PROVINCE, GIBSON LAKE-CROSS BAY AREA, KIVALLIQ REGION, NUNAVUT

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The Western Churchill NATMAP project involves the Geological Survey of Canada (GSC), the Government of the Northwest Territories (GNWT), and Indian and Northern Affairs Canada (INAC). In 1998, the second phase of the GSC's three year field program, an investigation of the geology of parts of the MacQuoid Lake (NTS 55M) and Gibson Lake (NTS 55N) map areas
was undertaken between Gibson Lake and Chesterfield Inlet. Particular emphasis was placed on establishing the nature and extent of Paleoproterozoic tectonothermal reworking of older, Archean rocks.

Bedrock mapping was undertaken at 1:50,000 scale, building on the previous work of Tella et al. (1997a, b; LeCheminant et al., 1997). The map area contains the Sandhill Zn-Cu-Pb-Ag prospect, the Suluk Ni-Cu-Co occurrence, and the Akluilâk diamondiferous lamprophyre dyke.

The map area includes the eastern part of the Archean MacQuoid supracrustal belt, and the Cross Bay plutonic complex. The MacQuoid supracrustal belt is divided into (i) the predominantly metasedimentary, Gibson-MacQuoid D2 homocline, with panels of gneissic tonalite, overlain to the north, with possible structural discordance, by (ii) a predominantly volcanic belt intruded by Neoarchean, syn-D2, tonalite-granodiorite plutons. To the north and east, the oval-shaped Cross Bay plutonic complex is principally composed of tonalitic gneisses and the Primrose and South Channel granitic plutons. The complex comprises two structural domains, separated by the cryptic, post-F4, Cross Bay fault. In the western domain, S2 is deformed about south plunging F3 folds, associated with a coaxial L3 extension lineation. L3 is also present on the north limb of an F4 fold that deforms the entire eastern domain. The plutonic complex is bounded to the south by (iv) the pre-, syn- and post-D4, dextral, strike-slip Big lake shear zone, up to 2 km thick, composed of annealed porphyroclastic straight gneisses and ribbon mylonites.

Metamorphosed, ca. 2.19 Ga, MacQuoid dykes everywhere post-date S2, but within the Cross Bay complex and the Big lake shear zone they were folded and boudined during D3-D4; accordingly D3 and D4 are regional Paleoproterozoic events. South Channel and Primrose granitic plutons were intruded post-D2 and pre-D4 fabrics, respectively, and likely represent Paleoproterozoic magmatic events.

Reference:

LeCheminant, A. N. et al., 1997: GSC Open File Map 3405.
Tella, S. *et al.*, 1997: Current Research, GSC Paper, 1997-C, p. 123-132.
Tella, S. *et al.*, 1997: GSC Open File Map 3404.

PRELIMINARY PETROGRAPHY OF CURRENT AND POTENTIAL CARVING STONE, GIBSON LAKE-CROSS BAY AREA, KIVALLIQ REGION, NUNAVUT

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The Western Churchill NATMAP project involves the Geological Survey of Canada (GSC), the Government of the Northwest Territories (GNWT), and Indian and Northern Affairs Canada (INAC). In 1998, the second phase of the GSC's three year field program, an investigation of the geology of parts of the MacQuoid Lake (NTS 55M) and Gibson Lake (NTS 55N) map areas was undertaken between Gibson Lake and Chesterfield Inlet. Particular emphasis was placed on establishing the nature and extent of Paleoproterozoic tectonothermal reworking of older, Archean rocks. Bedrock mapping was undertaken at 1:50,000 scale, building on the earlier work of Tella et al. (1997a, b; LeCheminant et al., 1997). Carving stone, used by artisans in the hamlets of Rankin Inlet and Baker Lake, is quarried in a small-scale operation on the south side of Cross Bay. In this poster, we present a preliminary petrographical description and comparison of the currently quarried carving stone with similar materials from other sites identified in the course of our regional bedrock mapping during the 1998 field season. GPS (Global Positioning System) locations for the sites are given in UTM (Universal Transverse Mercator) coordinates.

From field and petrographic observations, it appears that the currently quarried carving stone, as well as similar materials from other sites, is derived from pyroxenitic to gabbroic protoliths that have experienced intensive hydrothermal alteration, locally associated with the introduction of calcite. Should they prove suitable for carving, the materials from sites 98TXJ159 and 98TXS208 are the most voluminous. The near-coastal 98TXJ159 site is readily accessible from Chesterfield Inlet, either by boat or snowmobile. The ridge of the 98TXS208 site should be free of snow in the Spring, while snowmobile travel is still feasible.

References:

LeCheminant, A. N. et al., 1997: GSC Open File Map 3405.
Tella, S. et al.,.1997a: Current Research, GSC Paper, 1997-C, p. 123-132.
Tella, S., et al., 1997b: GSC Open File Map 3404.

GEOLOGY OF THE MIRAMAR CON MINE

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The Miramar Con Mine occurs within the basaltic Yellowknife Bay Formation which is overprinted by metamorphism related to the Western Plutonic Complex. Metamorphic grade of the sequence decreases eastward from hornblende-amphibolite along the border of the batholith to greenschist facies. Metamorphic isogrades transect stratigraphy and on surface subparallel major gold bearing structures which contain retrograde greenschist facies assemblages.

Gold mineralization occurs in two major structures, the Con and Campbell shears, as well as several hanging wall veins. The structures are north striking, west dipping zones dominated by chlorite-carbonate schist. Economic concentration of gold occurs where these structures transect an east trending thermal corridor. The corridor is defined by granitic plugs and related breccia bodies, that can be traced outwards from the batholith across the greenstone belt.

A lamprophryic dyke, hosting granitic and gniessic basement fragments, occurs in the hanging wall of the Campbell Shear. The dyke subparallels the shear and mineralogical evidence indicates it intruded after peak metamorphism, but before retrograde metamorphism of the shears. Within the shear the intensely foliated dyke may host ore.

Gold occurs in quartz-ankerite veins associated with sericite-ankerite-sulphide alteration. Alteration envelopes around veins in the major shears decrease in intensity and size with depth. Ore zones commonly form steeply plunging trends extending over 300 metres vertically and less than 100 metres horizontally. Less common are trends formed from several parallel ore zones extending across the shear that are ovoid in longitudinal section. South raking trends parallel stratigraphy-shear intersection. while others show no apparent relation to external features. Each trend has unique combinations of sulphide mineralogy, quartz appearance and structural style.

Ore from the Con Shear and upper portion of the Campbell Shear is refractory while ore from hanging wall veins and lower portions of the Campbell Shear is freemilling. Gold recovery, using cyanidation. is less than 70% in refractory ores and greater than 90% in freemilling ores. Refractory ores tend to occur in separate trends though recently one freemilling trend has been found to be marginally refractory in the upper portion. Sodium-rich paragonitic muscovite has been identified in refractory ore, but not in freemilling ore.

Structures in the Campbell Shear, including folded quartz veins and steep plunging lineation, indicate reverse near vertical movement occurred in the shear after ore deposition. Offset of stratigraphic markers across the shear suggest a dextral movement of 600 metres.

Changes in alteration and milling characteristics with depth trace changing thermodynamic conditions during ore deposition. Variations in mineralogy and structural intensity among ore trends suggests several episodes of mineralization, some of which are contemporaneous with displacement on the shear. The current configuration of ore zones reflect multiple episodes of deformation post-mineralization

GEOLOGY OF THE YELLOWKNIFE GREENSTONE BELT: OVERVIEW OF PREVIOUS WORK AND SOME REMAINING PROBLEMS

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After more than 60 years of work by Geological Survey of Canada, DIAND, Company and University geologists, the Yellowknife belt is one of the most thoroughly mapped Archean greenstone belts and has provided much of the data for models of the geological evolution of the

Slave Structural Province. As part of the Yellowknife compilation project, funded by a grant from DIAND, previous geological maps are presently assembled into a single lithologic basemap in both digital and traditional map format. As the project is making use of Geographic Information System (GIS) techniques to compile existing data to consistent scale and level of detail, the end product will also include digital versions of the source maps as captured by digitizing at Queen's. The reconciliation of differences between these source maps, and the correction of inconsistencies, are the major purpose of the project. It is hoped that the new compilation map, to be printed at a scale of 1: 50 000, will help to refocus exploration and academic work in the belt and serve as a starting point for testing new geological ideas using both the GIS techniques and traditional methods.

The evolution of our understanding of the stratigraphy of the Archean supracrustal rocks, as it evolved from Jolliffe's initial 1 inch to 1 mile scale mapping through several generations of more detailed mapping, will be reviewed. The currently used stratigraphic names were introduced by J.B. Henderson (Geol. Surv. Canada, Paper 70-26, 1970) who established local formation and group names and assigned all supracrustal rocks to the Yellowknife Supergroup. A revised scheme by Helmstaedt and Padgham (Can. J. Earth Sci., vol. 23, p. 454-475, 1986), incorporating the results of detailed DIAND mapping in the 1970' and 1980's, was broadly confirmed by U-Pb zircon geochronology (e.g., Isachsen et al., J. Geology, vol. 97, p. 735-747, 1991), though problems remain, and more detailed geochronological studies are clearly in order, especially to refine stratigraphic correlations along strike and across the numerous Archean and Proterozoic faults. As presently known, the supracrustal succession of the Yellowknife belt consists of at least three, unconformity-bounded sequences (MacLachlan and Helmstaedt, 1995), one predating (Dwyer Group) and one postdating (Jackson Lake Formation) the volcanic-turbidite sequence, consisting of the Kam, Banting, and Duncan Lake groups. A significant hiatus between the mainly mafic volcanic Kam Group (ca. 2712-2702 Ma) and the predominantly intermediate to felsic volcanic Banting Group (ca. 2663 Ma) is expressed locally as disconformity and regionally as a low-angle unconformity.

Evidence for possible basement to supracrustal rocks of the Yellowknife belt came initially from pre-3 Ga U-Pb zircon ages of tonalite gneiss xenoliths from a minette diatreme intersected in the Con mine (Nikic et al., Geol. Soc. America, Special Paper 182, p. 169-175, 1980). Pre-3 Ga ages were also determined from gneisses within the Anton granite at the northern end of the belt (e.g., Isachsen, Ph.D. thesis, Washington University, 1992). Although these gneisses have been interpreted by Isachsen as depositional basement for the Dwyer Group, such contact relationships could not be confirmed at Dwyer Lake, where all lower contacts of the Dwyer Group quartzite are intrusive (MacLachlan and Helmstaedt (Can. J. Earth Sci., vol. 32, p. 614-630, 1995), and the basement-age zircons are inferred to come from a Dwyer Group quartzite xenolith within the ca. 2642 Ma Anton granite.

The understanding of the structural-metamorphic evolution and intrusive history of the Yellowknife greenstone belt evolved alongside stratigraphic and geochronologic studies. However, a generally accepted structural-metamorphic sequence has not been established, and many problems remain to be solved. These include the original relationships of the Dwyer Group rocks to basement, contact relationships between the top of the Dwyer Group and the base of the Kam Group, the extent of possible fault repetitions by thrusting within the volcanic sequence, distinction between early, synvolcanic fault displacements and those by later ductile shearing, and the extent of Proterozoic reactivation of Archean faults. Of special importance is the continued refinement of the relationships between alteration/gold mineralization and structural and intrusive events. This requires a detailed comparison and dating of structures within all gold-bearing volcanic, sedimentary and intrusive rocks. For such work to establish a time sequence of alteration, mineralization, and possible gold remobilization, it should go hand in hand with well-controlled geochemical and geochronological studies. The latter should concentrate not only on U-Pb zircon dating, but also involve the dating of sphene and other alteration minerals, as well as Ar/Ar studies to assess the fault reactivation and uplift history.

THE SNARE RIVER PROJECT: OBJECTIVES AND INITIAL RESULTS

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In 1998 field work was initiated for the multi-year Snare River Project, in the southwestern Slave Province (parts of 85N and 85O). Previous geological mapping of the project area was at a 1 inch to 4 mile scale and was completed in 1939 (Lord, 1963).

Objectives of Snare River Project are:

1. Produce 1:50,000 scale geological maps, linking the more recent 1:50,000 scale geological maps of the greenschist to amphibolite facies Archean rocks at Russell Lake (85O/4: Jackson, 1990) and Labrish Lake (85N/9; Brophy and Pell, unpublished) with the high-grade, including granulite facies, Archean rocks at Ghost Lake (85O/14 and part of 15; Henderson, 1998).
2. Define the extent of the high grade rocks and determine the nature of the boundaries between the eastern high-grade zone and the western lower grade rocks.
3. Propose a mechanism for the exhumation of the ca. 2600 Ma (Henderson, 1998) granulite facies Archean rocks.
4. Investigate the mineral potential.
5. Investigate the effects of Proterozoic deformation and metamorphism on the Archean rocks.

The objectives will be met through DIAND-supported regional mapping and more detailed investigations into the tectonometamorphic evolution of this part of the Slave Province. The latter will form part of a Ph.D. thesis by Venessa Bennett at Memorial University of Newfoundland.

In 1998 mapping was aimed at completing an approximately west to east transect across the project area and field work was focussed at Strutt Lake and Kwejinne Lake.

Summary of 1998 Results:

The lithotectonic domains defined by Henderson and Schaan (1993) are adopted in the following text.

1. Greenschist to middle amphibolite facies greywacke-mudstone turbidites are continuously exposed from Russell Lake along the Emile River and Snare River, through Strutt Lake to Labrish Lake and Kwejinne Lake. At Strutt Lake, the turbidites contain amphibolitic and garnetiferous banded magnetite iron formation (BIF). BIF was not observed within the turbidites at Kwejinne Lake, which form part of the Wijinnedi domain.
2. At Kwejinne Lake, the turbidites locally grade into migmatitic metasedimentary rocks. This transition is poorly understood at present because sillimanite does not appear to be widespread "down-grade" from the migmatitic rocks.
3. Felsic and mafic volcanic rocks, part of the Wijinnedi domain, are abundant near Kwejinne Lake. These contain gossanous zones near the contact with the overlying turbidites.
4. At Kwejinne Lake, the extension of the boundary between the ca. 2673 Ma Wijinnedi and ca. 2654 Ma Hinscliffe domains (Henderson, 1998) is marked by a zone of highly strained banded amphibolites and variably strained hornblende-bearing orthogneisses.
5. The complex rocks of the Ghost domain extend to the shorelines of Kwejinne Lake and possibly as far south as Strutt Lake, where they are preserved as rafts within younger granitoids. Within the Ghost domain are a variety of granitoids, including a distinctive megacrystic granite, that have intruded upper amphibolite to granulite facies migmatites. Contacts are poorly defined between the younger granitoids and the supracrustal and granitoid migmatites. Some granitoids within this domain have yielded ca. 2590-2605 Ma zircon ages (Henderson, 1998). Garnet-bearing migmatitic metasedimentary rocks may contain cordierite, andalusite or sillimanite. Within granulite facies they may contain the assemblages spinel-cordierite-sillimanite or garnet-cordierite (± orthopyroxene, graphite). Locally abundant rafts of BIF within migmatitic metasedimentary rocks suggest that these rocks were derived from BIF-bearing turbidites, such as those at Strutt Lake. Granulite facies granitoids are distinguished by the presence of orthopyroxene; these may also contain abundant magnetite.
6. Granulite facies rocks were found at the eastern limit of 1998 mapping. At present the nature of the western boundary of

these rocks is poorly understood: it may partly coincide with a NNW-striking, vertical Proterozoic fault, as was suggested by Henderson and Chacko (1995). In part the boundary appears to be gradational, although it is uncertain whether the western amphibolite facies migmatites were retrogressed from granulite facies or never underwent the highest grades of metamorphism.

7 Proterozoic strata, containing metamorphic muscovite and possibly biotite, maintain a consistent stratigraphy; basal quartz pebble conglomerate and quartz arenite are overlain by and interbedded with siltstones to mudstones. These have been intruded by intermediate (andesitic?) sills.

8. Proterozoic and Archean granitoids have yet to be definitively subdivided; the current working hypothesis is that granitoids lying east of Archean supracrustal rocks are likely Archean while those lying west of these rocks are suspect.

9. Many of the Archean rocks display evidence of a widespread retrograde metamorphic event of an uncertain age(s). For example, at Kwejinne Lake muscovite has overgrown both the cleavages and porphyroblasts in cordierite-bearing greywacke-mudstones. Within migmatitic metasedimentary rocks, cordierite and garnet are completely replaced by sericite and/or chlorite.

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SEISMIC AND ELECTROMAGNETIC EXPERIMENTS AS PART OF THE WESTERN CHURCHILL NATMAP PROGRAM

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One of the principle objectives of the Western Churchill NATMAP Program is investigating the evolution of the late Archean and Paleoproterozoic lower crust and upper mantle. A 400-km-long N-S rofile of eight teleseismic and magnetotelluric stations addresses this objective by providing a lithospheric geophysical cross-section across the Snowbird Tectonic Zone. The stations were located equidistantly about Baker Lake, from close to Whale Cove to beyond Woodburn Lake.

The eight teleseismic stations were operating from early-May until late-September, and during that time there was reasonable earthquake activity.

Magnetotelluric recordings were accomplished with four stations operating to the north of Baker Lake from early-July to early-August, and to the south of Baker Lake from early-August until late-September. Geomagnetic activity was high during this period, requiring care with MT response function estimation due to the effects of the no-uniform source-field contributions.

Both sets of instrumentation were the fond meeting location of plastic-chewing animals, resulting in interrupted data acquisition at four of the teleseismic sites, and total electric field data loss from one MT site. Protective covering alleviated most of these problems, but resulted in more innovative investigation by the animals.

A very preliminary analysis of the recorded teleseismic data indicates that 12 earthquakes were of sufficient magnitude and at appropriate distances to use in anisotropy studies. One event provided SKS splitting observed at seven stations, each of six other events provide estimates of much lower quality and at only a few of the stations. The tentative fast directions of observed anisotropy appear to group the stations on either side of Baker Lake. The four stations to the south have fast directions trending around 060 degrees; the stations to the north have a spread of fast directions but generally trend toward the northwest-southeast. The best-constrained delays range from 0.8 to 2.45 seconds.

The MT data are testimony to a crust and mantle that is absent of any major electrical features seen elsewhere in Canada and around the globe. This implies that there is not an anomalous zone of enhanced conductivity that can be readily associated with known anomaly generation. A minor effect at low periods is seen at Baker Lake, suggestive of a small, mid-crustal anomaly.

Further details will be presented.

PRE-2.8 GA ROCKS IN THE SOUTH-CENTRAL SLAVE PROVINCE: CONSTRAINTS ON THEIR DISTRIBUTION, AGE, AND TECTONOMETAMORPHIC HISTORY

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Pre-Yellowknife Supergroup rocks form a small but significant portion of the south-central Slave Province and record the pre-2.8 Ga history of this ancient Archean craton. This study makes use of detailed geological mapping and U-Pb geochronology to constrain this early history. A fundamental goal is to determine whether the south-central Slave Province is underlain by a collage of discrete basement blocks with unique geological characteristics, or by a single block with a more uniform history of plutonism, metamorphism, mafic dyke emplacement, and supracrustal deposition. Data obtained thus far, especially from detailed mapping in numerous localities where a thin, discontinuous, autochthonous sedimentary sequence (Central Slave Cover Group) overlies a dominantly tonalitic basement (Central Slave Basement Complex; Bleeker and Ketchum 1998), support the latter interpretation. The CSCG is the stratigraphically lowest unit of the Yellowknife Supergroup and is interpreted to mark shelf sedimentation following initial rifting of the CSBC (Bleeker et al. submitted).

Rocks of the CSCG and CSBC have been mapped in detail at Patterson Lake where the ca. 100 m-thick Patterson Lake Formation (Bleeker et al. 1997) overlies the Sleepy Dragon Basement Complex (SDC). The Patterson Lake Formation consists of quartz pebble conglomerate, polymictic conglomerate, quartzite, ultramafic flows or sills, banded iron formation, and graded grits. A lowermost, highly-deformed unit of amphibolite-facies pillow basalt, initially included in the Patterson Lake Formation, is now known to have been deposited before 2942 ± 3 Ma, the U-Pb age of titanite from this unit. Sleepy Dragon basement lithologies beneath the pillow basalt consist in part of interlayered 2936 +7/-6 Ma tonalite gneiss and 2933 +8/-7 Ma fine-grained tonalite gneiss. Field relationships, although highly modified by deformation, suggest that these basement units intrude the pillow basalt. Hence, evidence is accumulating for a supracrustal package that pre-dates the Patterson Lake Formation and is part of the basement to theYellowknife Supergroup in this region. This is broadly consistent with the presence of pre-Yellowknife Supergroup supracrustal packages elsewhere in the Slave Province (e.g., Winter Lake; Villeneuve et al. 1994).

Younger units of the SDC include a large body of foliated K-feldspar megacrystic granodiorite emplaced at 2726 ± 2 Ma, a tonalite gneiss enclave in the Morose Lake granite dated at 2683 ± 2 Ma, and a foliated tonalite-granodiorite plutonic complex with component crystallization ages of 2677 ± 2 Ma and 2672 +7/-6 Ma, respectively. A tectonically transposed mafic dyke swarm has a 2734 ± 2 Ma primary crystallization age, whereas the older of two cross-cutting mafic dyke swarms was intruded at 2687 ± 1 Ma (Bleeker et al. submitted). These dyke swarms constrain movement on the highly-strained basement/cover transition zone, which is interpreted as a regional décollement (Bleeker and Ketchum 1998, submitted), to between 2734 and 2687 Ma, and indicate that décollement development was essentially synchronous with early greenstone belt formation in the Slave Province. An even narrower interval of 2726-2687 Ma is suggested for this décollement given that K-feldspar megacrystic granodiorite of the SDC is also strongly deformed in the high-strain zone. All these data point to a complex, multistage development of the SDC and its volcano-sedimentary cover, and emphasize the need for detailed mapping and geochronology in other well-exposed basement-cover transition zones.

Other regions of the south-central Slave Province provide field and U-Pb evidence for even older basement exposures. At Mackay Lake, the protolith to a migmatitic granodiorite gneiss beneath the Courageous Lake greenstone belt was emplaced at 3325 ± 8 Ma, with subsequent metamorphism recorded by leucosome development and growth of new zircon at 2723 ± 3 Ma. Forty kilometres to the west, migmatitic tonalite gneiss structurally beneath a narrow, synclinally folded greenstone belt contains concordant 2939 ± 1 Ma zircon, but this result may record metamorphism rather than primary crystallization, with the latter tentatively indicated at ca. 3510 Ma. Additional results from this and other samples will be presented at the meeting. Both of these older gneiss occurrences are spatially associated with CSCG rocks like those at Patterson Lake. Although at a preliminary stage, our structural, lithologic, and U-Pb data support the idea of a single basement terrane in the south-central Slave Province, and call into question previous models that place a fundamental terrane boundary along the eastern edge of the SDC (e.g., Kusky 1989).

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LITHOSPHERIC MAPPING OF THE SLAVE CRATON, NWT, CANADA

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Mineralogical and geochemical work by Kennecott Canada Exploration Inc. (KCEI), R.L. Barnett Geological Consulting Inc. and GEMOC (Key Centre for Geochemical Evolution and Metallogeny of Continents), Macquarie University has provided increased understanding of mantle rocks beneath the Slave Craton. Geochemistry of heavy-mineral concentrates (garnets, chromites), xenoliths, and diamond inclusions have been used to determine the composition, structure and thermal state of the lithospheric mantle beneath the Slave Craton. Regional compilation of data is used to map the lithosphere laterally and with depth. The co-operation of Kretschmar Geoscience, Ashton Mining of Canada, and many individuals by donating samples and data from their discoveries has resulted in a wide-reaching lateral map of Slave lithosphere.

Heavy mineral concentrates from kimberlite and overburden samples provide a suite of mantle derived minerals that can be used to study the lithosphere. Garnets are analysed for nickel temperature (T_{Ni}), and chromites for zinc temperature (T_{Zn}) which place the grains at depth. Paleogeotherms derived from Lac De Gras concentrates are 35 mW/m^2 at T< 900°C, and 38mW/m^2 above this temperature. A two-layer structure is implied. The upper layer (<145km.) is ultradepleted in Y, Zr, Ti, and Ga and is similar to Archean mantle worldwide. The lower layer (to >200km.) is fertile lhertzolite, which may have been underplated on depleted mantle by a plume head rising from the deep (Griffin et al., 1998).

Xenolith studies confirm the stepped geotherm evident from heavy mineral concentrate data. More robust P/T calculations are possible using peridotitic xenoliths because coexisting minerals each provide geochemistry, pressures and temperatures that support one-another. Work on eclogites provide temperatures useful in understanding the distribution of this important rock type in the lithosphere. The temperature range present suggests that eclogitic rocks are dispersed throughout the lithosphere.

Diamond inclusion studies by GEMOC provide preliminary insight about diamond paragenesis in the Slave. From a small sample of diamonds from kimberlite DO27, paragenesis of diamond is suggested at 50% eclogitic, 25% peridotitic, and 25% super-deep origin. This distribution provides clear evidence that peridotitic indicators (such as G10's) may not necessarily be the best indicator of diamond potential in Slave kimberlites. This knowledge improves geochemical interpretation of overburden anomalies and kimberlites, and helps geologists focus exploration dollars on the most prospective targets.

Paleogeotherms can be established in any terrain with peridotitic indicator minerals (garnet and chromite). Accuracy of a heavy mineral concentrate geotherm is established from xenolith data, which allows more robust P/T calculations by using geochemistry of coexisting minerals. Diamond inclusion work then provides a layer of important information to help understand the source rocks of diamond in the mantle. Variability in mantle geochemistry and geology is evident in the Slave so far, and therefore it is important to continue this important research to further define the mantle map. Mining companies have much to gain with continued co-operation in this research.

Acknowledgements:

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CHARACTERIZATION OF HOST ROCK METASOMATIC AND METAMORPHIC MINERAL PARAGENESES THROUGHOUT THE GIANT MINE, YELLOWKNIFE, NWT

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The Giant Mine, located in the Yellowknife Greenstone Belt, has been in production for fifty years and has recovered approximately 6,894,000 ounces of gold to the end of June, 1998. The gold is hosted in rocks characterized by two distinct alteration types, namely silicified sericite schists of the main ASD and GB limbs to the south and central parts of the mine, and the shallow-dipping, narrow, composite quartz-carbonate veins of the LAW and SUPERCREST zones to the north. These ore zones contain varying amounts of disseminated arsenopyrite, pyrite, stibnite, chalcopyrite, sphalerite, pyrrhotite and sulphosalts. To the north gold is associated with high stibnite, arsenopyrite, and pyrite zones, whereas in the south , gold is associated with arsenopyrite but not with pyrite. The present petrological and mineral chemical investigation will focus on documenting the mineralogical variation between the Giant ore zones as well as between the ore zones and the host volcanics occurring eastward from the West Bay Fault to the Yellowknife Bay.

The primary objective of this study is to characterize host rock mineralogy throughout the mine in order to develop a better understanding of PTX variations between hydrothermal metasomatic and metamorphic mineral parageneses. Specifically, the objective is to identify the PTX conditions indicated by the alteration types which accompany the productive ore zones. Our overall aim is to develop a prograde-retrograde metallogenic history that is found on mineral chemical changes across producing shear/vein systems. A subsidiary objective of this study is to model the overall mineralizing system utilizing the 3-D LYNX software. Samples have been collected from diamond drill core, underground exposures and surface outcrops from above, below and between oreshoots and alteration zones. Core and surface sampling have been constrained to cross-sections at 00, 5000S and 5000N. Underground sampling incorporates the current mine workings across the length of the Giant system. Samples have been selected to represent ore and waste, thick vs thin alteration envelopes, gold in stibnite-rich alteration zones, high carbonate or high quartz rich or poor gold zones, etc.

Sample analysis will characterize silicate, carbonate and sulphide mineral chemistry especially plagioclase, amphibole and epidote species to establish background metamorphic rank, as well as chlorite and sericite to critically define alteration zoning patterns. Affiliated carbonates and sulphides will be probed to reveal any trace metal variability between ore and waste. The collective results will be integrated via 3-D modeling to demonstrate variations in PTX across the Giant ore system.

TECTONIC ASSEMBLY AND PROTEROZOIC REWORKING OF THE NORTHERN YATHKYED GREENSTONE BELT

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Regional 1:50,000 scale mapping in 1997 in the northern Yathkyed greenstone belt, western Churchill Province, revealed that the NE- to ENE-striking belt dips to the NW and is, at least in part, overturned. Continued mapping in 1998 has revealed two lithologically-distinct tectonostratigraphic units which are juxtaposed across a fault of uncertain age and displacement sense. The structurally lower, southeastern tectonostratigraphic unit consists mainly of amphibolite and monzogranite, whereas the upper unit, in the northwestern part of the belt, includes mixed volcanic and volcaniclastic rocks, psammites and pelites, and foliation-parallel sheets of tonalite. Both units sit in the hanging wall of a north- to northwest-dipping shear zone (the Tyrrell shear zone - TSZ), which constitutes the structural base of the belt. The TSZ records early reverse (Archean thrust?) displacement, followed by Paleoproterozoic (post 1.82 Ga.) dextral/normal movement. Rocks in the footwall of the Tyrrell shear zone include a supracrustal unit of unknown age and affinity intruded by mixed granitoid rocks. The regional (Archean ?) metamorphic grade is mid- to upper-amphibolite facies; however, there is also evidence of a Proterozoic metamorphic overprint.

Based on correlation with rocks farther south in the belt, the lower tectonostratigraphic package is interpreted to represent an overturned panel of mafic volcanic rocks that was thrust southeastward (present coordinates) along the TSZ, possibly at ca. 2.62 Ga. The upper tectonostratigraphic package records a complex fold interference pattern that appears to be absent in the lower panel, suggesting different tectonic histories for the two. The contact between these two units is marked by a shear zone of unknown displacement and regional significance, but is tentatively correlated with Paleoproterozoic movement along the TSZ. The footwall of the TSZ includes a supracrustal unit which contains a distinctive sequence of quartz arenites and calcsilicate rocks. This sequence has lithological similarities to parts of both the Paleoproterozoic Hurwitz Group and the enigmatic (Neoarchean-Paleoproterozoic ?) Montgomery Lake Group (Aspler et al., 1992) exposed to the south of this study area. The TSZ comprises a heterogeneous zone up to 2 km wide, of mixed psammites to semipelites, amphibolites and granitoid rocks, all variably sheared. The map pattern suggests the TSZ is composed of tectonic slivers of both footwall and hangingwall rocks intruded by syntectonic granitoids. Within some of the metasedimentary rocks of the TSZ, muscovite and cordierite were observed overgrowing dextral shear fabrics indicating that Proterozoic heating was significant and, at least locally, outlasted deformation. Thus, the Yathkyed greenstone belt preserves not only evidence of Archean tectonic assembly, but also extensive reworking during the Proterozoic.

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MINERAL POTENTIAL OF THE NORTHERN YATHKYED GREENSTONE BELT

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Regional 1:50,000 scale mapping during 1997, revealed that the Yathkyed greenstone belt is a NE-striking, NW-dipping supracrustal sequence, at least in part overturned. Continued mapping in the northernmost part of the belt in 1998 led to the recognition of two lithologically distinct tectonostratigraphic units in fault contact. The structurally upper unit, in the northwestern part of the map area, consists of a package of mixed volcanic rocks, associated volcaniclastic meta-sedimentary rocks, and psammites and pelites, all intruded by foliation-parallel sheets of tonalite. The lower, southeastern unit comprises mainly amphibolite and monzogranite. Both tectonostratigraphic units occur in the hanging wall of the Tyrrell shear zone which marks the structural base of the belt. This composite shear zone records early oblique reverse displacement, possibly Archean in age, followed by Paleoproterozoic dextral/normal movement.

Supracrustal rocks in the lower tectonostratigraphic package are predominantly well-foliated, amphibolite-facies mafic volcanic rocks. Mineralized zones consist of foliation-parallel gossans up to several metres thick and 100's of metres in length, consisting of 10-20% pyrite ± pyrrhotite ± chalcopyrite with abundant quartz veins. The mineralization is commonly associated with chloritization, sericitization, carbonatization and silicification. The origin of these gossans is unknown, although at one locality a thinly-banded quartz + magnetite unit was observed, suggesting that some of the mineralization may have originally been associated with banded iron formation (BIF). Analyses of selected grab samples yielded Cu contents £ 600 ppm and Zn £ 0.22%.

Supracrustal rocks of the upper tectonostratigraphic package include a unit of predominantly mafic volcanic rocks and a unit of mixed, thinly layered mafic to felsic volcanic/volcaniclastic rocks which grade into psammites and pelites. The psammite-pelite unit contains numerous foliation-parallel gossans typically associated with quartz veins, some of which have minor sulphides (< 5%, with Cu £ 900 ppm). Both units contain silicate-facies iron formations up to 5m wide and several 100's m long with pyrite ± pyrrhotite ± chalcopyrite ± magnetite ± marcasite. Within the mafic volcanic unit of the upper tectonostratigraphic package are numerous foliation-parallel quartz-sericite ± chlorite ± carbonate alteration zones commonly with vuggy quartz- and sulphide-rich patches containing up to 70% pyrite ± pyrrhotite ± chalcopyrite. Grab samples assayed contained £ 700 ppm Cu, and £ 350 ppm Zn. A unique feature of the mixed volcanic unit is the local occurrence of metamorphic mineral assemblages which suggest Fe + Mg enrichment and Na depletion prior to metamorphism. This type of alteration may be associated with volcanogenic massive sulphide mineralization.

In summary, iron formations are common in most volcanic rocks of the Yathkyed belt. Foliation-parallel gossans, with or without quartz veins, and associated alteration zones may be related to secondary fluid remobilization. The occurrence of alteration zones suggestive of volcanogenic massive sulphide mineralization associated with intermediate to felsic rocks is unique to the mixed volcanic rocks of the upper tectonostratigraphic package. Whole rock geochemical data from farther south in the belt suggests the intermediate to felsic volcanic rocks may have formed in a tectonic setting analogous to modern volcanic arcs, whereas mafic rocks of the lower unit appear to have compositions comparable to modern-day mid-ocean ridge basalts.

MULTI-DIRECTIONAL ICE FLOW INDICATORS IN THE AREA OF THE KEEWATIN ICE DIVIDE, KIVALLIQ REGION, NORTHWEST TERRITORIES

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Regional ice flow indicator mapping has been undertaken in the area occupied by the Keewatin Ice Divide, Kivalliq Region, Northwest Territories, by the Geological Survey of Canada as part of the Western Churchill NATMAP Program. This work was initiated to provide ice flow indicator maps (10 sheets, 1:250 000), based on systematic mapping of glacial striae and other ice-inscribed features on outcrops, and to build on the existing 1:125 000 scale GSC surficial geology maps (Arsenault et al., 1981; Aylsworth et al., 1981a, 1981b, 1984). Results are intended to improve the present glacial history framework for mineral exploration in an area of complex ice flow record and thick drift, and to test existing models on the inception, growth and disintegration of the Keewatin Sector of the Laurentide Ice Sheet.

Field investigations in the summers of 1997 and 1998 included systematic ice flow indicator mapping in the Kaminak (NTS 55L), Ferguson (NTS 65I), MacQuoid (NTS 55M) and Gibson (NTS 55N) Lakes areas, specifically seeking multi-directional faceted outcrops. Results suggest that there have been at least four distinct ice movements within the study area: 1) The earliest advance was to the southwest, from a centre of ice flow located at an unknown position northeast of the study area. 2) This was followed by a regional southward event that came from an undetermined position north of the study area, and 3) a regional east-southeastward flow. 4) Finally, the predominant southeastward event occurred throughout the study area, from a divide located north and west of the area, and northwest of the axis of the Keewatin Ice Divide. The Keewatin Ice Divide, as defined by Lee et al. (1957), represents the zone occupied by the last glacial remnants of the Laurentide Ice Sheet west of Hudson Bay. Ice flow from this divide was also to the southeast within the study area, as recorded by the spatial arrangements and orientations of striae, streamlined landforms and eskers. An old northward flow was recognized in the Yathkyed Lake area which suggests that a precursor of the Keewatin Ice Divide existed southeast of this lake.

The sequence of ice flow presented here shows that a zone of outflow within the Laurentide Ice Sheet existed in the Keewatin, possibly through much of its Wisconsinan history, as proposed by Shilts et al. (1979). However, the abundance of multi-faceted outcrops in the study area reflects the migration of a mobile ice divide, where relatively slight shifts in either the configuration or location of the zone of outflow, or both, produced large changes in ice flow directions (Boulton and Clark, 1990). With decreasing distance from the Keewatin Ice Divide, drift prospecting for mineral exploration can be complicated by the difficulty in determining glacial transport directions and distances. Ice flow indicator mapping and stratigraphic studies to the north and west of Yathkyed Lake will provide additional information to establish regional ice flow events in the area of the Keewatin Ice Divide.

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SURFICIAL MAPPING AND TILL PROVENANCE STUDIES IN THE MELIADINE TREND, RANKIN INLET AREA: A PROGRESS REPORT

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New surficial mapping (5 sheets. 1:50 000 scale) has been undertaken in the Meliadine Trend near Rankin Inlet by the Geological Survey of Canada as part of the Western Churchill NATMAP Program. This work was initiated to upgrade the existing 1:125 000 scale GSC maps (Aylsworth et al., 1981a, 1981b, 1984), and to provide a surficial materials database that would include compositional, textural and geotechnical properties of the major surficial units. Exploration by industry for both shear zone and iron-formation-hosted gold deposits is continuing along a 65 km long linear aeromagnetic anomaly, the Meliadine Trend (Miller et al., 1995). Regional geochemical mapping and glacial transport studies will provide a framework for interpreting till geochemical data collected by the industry. Results are intended to support mineral exploration in an area of thick drift, and to supply a baseline for environmental assessments in case of future development. Preliminary data and interpretations, arising from field work undertaken in 1997 and 1998, are presented here.

Within the study area, the dominant surficial sediment is till, and landforms composed of till include drumlins, ribbed moraines, DeGeer moraines and hummocky moraines. Other than by landform, till in the area can also be characterized by thickness, composition, periglacial development, and degree of marine reworking by the Tyrrell Sea. The Meliadine Lake and Peter Lake map sheets (55N/1 and N/2) are dominated by thick till, commonly drumlinized or ribbed, and weakly reworked by wave and current action. Along the coast, till is dominant above 100' a.s.l. in the Rankin Inlet area (55K/16) and above 200' a.s.l. east of Atulik Lake (55J/13 and J/14). In these areas, topographic lows are commonly filled with a veneer of marine sands and silts and the top of the landforms are locally reworked into beaches, terraces and spits. Below the till-dominated areas, marine littoral sand and gravel, nearshore and tidal sands are interspersed by bedrock outcrops. Till is preserved occasionally there, but is generally thinner and wave-washed. Four major continuous trunk eskers with tributaries joining at near 90° angles from the north traverse the area from west to east: Peter Lake, "Siksik", Meliadine Lake, and Parallel Lake eskers. These eskers are commonly beaded and aligned within major topographic lows. East of Atulik Lake, eskers are numerous, closely spaced, and discontinuous. The degree of marine reworking along these esker segments is very high and it becomes difficult to differentiate glaciofluvial landforms from extensively reworked glacial landforms (drumlins). Other minor surficial units in the study area include undifferentiated alluvium and fine grained marine sediments, thin peat, and glacial marine diamictons.

The dominant ice flow indicators in the area trend to the SE, parallel to the long axes of lakes, streamlined landforms and roches moutonnées. Directions shift slightly from west to east, from an average of 131° in the Peter Lake map area (55N/2) to 147° in the Scarab map sheet (55J/14). Two older ice flow events have been recognized in the Meliadine Trend: 1) a more south-southeasterly direction was observed at a few sites in the Meliadine West area and south of Rankin Inlet, with striae (149° to 152°) preserved on the lee-side of the regional SE trending indicators; 2) along the coast east of Rankin Inlet, the recently emerged bedrock outcrops show beautifully preserved surfaces with striae (114° to 122°) indicating an older event to the ESE. In the vicinity of the large eskers (<4 km), ice flow indicators are found at right angle or oblique to the esker direction suggesting lateral movements of ice towards the esker ridge. Within these corridors, the regional SE trending striae and drumlins are generally preserved. At several sites however, particularly to the north of the eskers, the late glacial convergence of flow towards the eskers dominates the landscape such that DeGeer moraines, and more rarely ribbed moraines, are reoriented obliquely to the SE trending drumlins. These relationships suggest that laterally restricted zones of convergent ice flow occurred along glacial conduits near the ice margin (Kaszycki and DiLabio, 1986; Shilts, 1984). Locally, this may have great implications for glacial transport directions and drift prospecting in the Meliadine Trend.

Till samples were collected in the Meliadine Trend in order to characterize regional glacial transport directions and distances. Regionally, over 200 samples were collected at an average spacing of 4 km. In the vicinity of selected gold deposits, 80 more samples were collected to provide models of gold dispersal and determine the analytical scheme for the regional samples. The till samples were analysed for geochemical, mineralogical and lithological composition. Esker samples were collected along the Peter Lake esker and parts of the

Meliadine Lake esker where it crosses the Pyke Fault Zone. Based on results from samples collected in 1997, preliminary interpretations are presented.

Acknowledgments:

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HYDROCARBON POTENTIAL OF THE PEEL PLATEAU AND PLAIN

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The hydrocarbon potential of the Peel Plateau and Plain is still largely unknown. Petroleum exploration in this remote and high cost area has not progressed beyond the preliminary stage, and has generally been restricted to relatively undeformed sedimentary rocks. There have been no discoveries of oil and gas to date within the Peel area proper, although 52 wells have been drilled.
All the conditions necessary for hydrocarbon accumulation exist in the form of ample reservoir, source beds, and oil and gas shows in the stratigraphic column.

Potential reservoir rocks of particularly interest are the clastics of the Upper Cambrian, the carbonates of the Devonian, and the Cretaceous sandstones. Because structures are not prominent and because the pooling of hydrocarbons largely will be dependent upon stratigraphic entrapment through porosity variability, the discovery of pools will be difficult.

Natural gas source rocks has been recognized in the Lower Paleozoic Prongs Creek Formation and an oil source is found in the Cambrian Mount Cap Formation. The Upper Devonian Canol Formation which is an excellent oil source in the Norman Wells region may have some potential in eastern Peel Plain.

Seismic coverage is sparse, and abundant opportunity for identification of more petroleum traps is present. Generally, the potential for gas increases from low to moderate in the northeast to moderate to high in the southwest.

Potential for oil accumulations are less likely due to possible eastward migration of the oil, and breaching of reservoirs. Oil potential is restricted to areas adjacent to the Eskimo Lakes Fault Zone in the far northwestern corner of the Peel area, and in Cretaceous sands in southwestern Peel Plateau close to Mississippian source rocks.

The well, IOE Tree River H-38, encountered a significant gas show (500 Mcf/day). Numerous other wells had gas shows, and a few had indications of bitumen.

Estimates of reserves in the order of 1200 million barrels of oil and 7.0 trillion cubic feet of gas have been made. Field size is expected to be in the intermediate category.

Potential petroleum exploration plays that have been recognized in the Peel Plateau and Plain include:

2. Lower Paleozoic platform carbonate play- characterized by patchy porosity development This play is poorly explored by drilling to date.

2. Lower Paleozoic carbonate transition zone from carbonate to shale paralleling the Richardson Mountains, where the

localization and stacking of platform edges and shelf margins create multiple potential targets adjacent to and interfingered with possible source rocks and seals. The conversion of limestone to dolomite with its increased porosity may occur at these shelf margins. These porous zones would more likely contain gas rather than oil.

3. Cretaceous sands trapped against the Eskimo Lakes Fault Zone in the extreme northwestern edge of the region, as it grades into the Mackenzie Delta Plays.

4. Miner Minor plays recognized in the area are Paleozoic deltaic and shelf sandstones.

5. Stratigraphic Mesozoic basal transgressive sands and unconformity traps throughout the Paleozoic carbonates. These plays may produce widely scattered small traps for gas pools. Oil accumulations are less likely to occur.

All the geological factors required in order to generate and preserve petroleum are present in the central, northern and eastern parts of the Peel Plateau and Plain. also in and adjacent to the Peel Plateau include known deposits of lead-zinc, iron, massive sulphides, and coal. Occurrences of uranium, copper, iron, barite, cobalt, gold, phosphatic iron including exotic phosphate minerals have been reported.

Adverse factors include migration of hydrocarbons eastward beyond the area, remoteness of the area, high operating costs, and long distance to markets.

OIL AND GAS EXPLORATION IN THE NORTHWEST TERRITORIES - 1998 UPDATE

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Oil and gas exploration has been active over the last two years in parts of the central and southern Mackenzie valley, spurred by the issuance of new petroleum exploration rights. Interest has also quickened in the Mackenzie Delta where an existing gas discovery is close to being developed for power generation and heating in the town of Inuvik.

Since 1994 and after a 20 year moratorium on the issuance of new exploration rights, three calls to industry to nominate lands of interest for oil and gas exploration in Central Mackenzie Valley have resulted in the issuance of 14 exploration licences (ELs). These calls have been issued after consultation and with the support of communities and land claim organizations of the Gwich'in and Sahtu Dene and Metis.

In recent calls. exploration licences in this region have been for an 8 year term, divided in two periods of 4 years. Licences are issued pursuant to an open bidding process: the winning bid is the dollar value of exploration work committed within the first period of the licence. In the last call exploration licences were designedly large (a maximum of six grids, approximately130 000 ha) to attract comprehensive exploration programs. A well must be commenced in the first period of the licence to continue the licence into the second period. So far a qualifying well has been drilled on three of 14 ELs.

Oil is the primary objective of exploration in this region to exploit spare capacity on the existing IPL pipeline and to offset future declines in production from the Norman Wells field. Three wells were also spudded by Ranger in the central Mackenzie Valley southeast of Norman Wells. These wells are located on each of Ranger's three exploration licences in the area. Unfortunately, the company reports that the Bear Rock O-20 well on EL 377 was junked and abandoned at shallow depth and failed to test the target. Ranger et al Little Bear M-39 on Exploration Licence 372 was suspended before reaching planned depth due to an early spring thaw. The company also reported testing the Nota Creek C-17 well on EL 390. This testing program was not completed and the company plans to re-enter the well. The single well drilled by Murphy Oil on EL 375 in 1997 was plugged and abandoned. A further well on the surrounding EL 388 is anticipated this winter with Imperial Oil as operator.

Calls for nominations were also issued in 1994 and 95 in the Fort Liard area of the southern Mackenzie Valley. In the absence of land claim negotiations in this region, renewed issuance was based on community support of the economic activity which exploration generates. This expectation has been well met with uptake by companies of 14 ELs. Exploration licences have terms of 7 years with a first period of 4 years. The surge in business opportunities to service and supply new exploration programs have been successfully captured by the Liard Valley Development Corporation owned by the Acho Dene Koe Band of Fort Liard, with a marked increase in job opportunities for Fort Liard and surrounding communities.

As in the central Mackenzie Valley, there is a requirement to commence a well within the first period of the licence to have the right to carry the licence to full term. Maximum size of exploration licences is 1 grid in this area (approx. 25 000 ha). This is still larger than in the adjacent areas of active exploration and development in northeastern British Columbia and northern Alberta, giving North of 60 a competitive edge. An active program of seismic and drilling has ensued, following the issuance of exploration licences. So far, qualifying wells have been drilled on 5 of 14 licences and a well has been commenced and suspended on a sixth.

Gas is the primary exploration objective in this region although several oil plays are also promising. The existing Westcoast sour gas pipeline from Pointed Mountain and Kotaneelee (Yukon) fields to Fort Nelson can accommodate significant additional volumes from new discoveries. Further east, new discoveries may supplement supply for new export pipelines from the Western Canada Sedimentary Basin to feed continent-wide markets in the United States. In the Fort Liard area, three new wells were commenced early this year in addition to the four wells spudded in 1997. Active operators included Paramount (five wells), Ranger (two deep wells drilled from the P-66 location), and

Ocelot (one well). This activity complements active gas drilling just south of 60 in the Maxhamish Lake area of northeastern British Columbia.

Ranger have announced a gas discovery at their P-66A well on Exploration Licence 363. According to the company, the geological structure holds at least 200 billion cubic feet (bcf) and potentially as much as 600 bcf, making it comparable in size to Amoco's Pointed Mountain field 25 km to the southwest. Paramount Resources announced that their Arrowhead N-65 well on EL 383 was a gas well with flow rates of 28 million cubic feet per day. The company also tested gas from a 58m zone in their Bovie C-76 well. Paramount's three other wells were curtailed by deteriorating land conditions in late March 1998, and suspended.

Exploration activity reflects a positive assessment of the commercial viability of the potential for new discoveries in regions of the north where production could rapidly follow discovery. Renewed exploration is occurring in a climate where the outlook for oil and gas prices is flat so profit is strongly linked to reducing operating costs. Both companies and northerners also face the challenges of strengthening the northern economy working within the new framework of land claims, and with the mutual recognition of the need to engage and empower northern communities. There is reason to hope that the return of the petroleum exploration to the North is based on robust economics and is for the long term.

PUBLIC DOMAIN SEISMIC IN THE SOUTHERN NWT: REGIONAL INTERPRETATIONS AND HYDROCARBON PLAYS

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Renewed industry interest in the Liard and Trout Plain regions north of 60E has prompted a re-appraisal of public domain reflection seismic in these areas. Although most of this seismic (Fig. 1) was acquired before 1980, few interpretations have been published. Interpretations of a selected lines may be found in publicly available company reports and representative lines across or near significant hydrocarbon accumulations may be found in the compilation of hydrocarbon pools of the Northwest Territories by Meding (1994). Very few of these lines have been used in the construction of published regional structural cross-sections across this region (see Douglas, 1976; Douglas and Norris, 1976; Douglas, 1974). Consequently, there is no published comprehensive and uniform interpretation incorporating the available regional seismic and well data. This study represents the beginning of such an interpretation.

Database and Methods

Figure 1 shows the public seismic database (National Energy Board) for the southern Northwest Territories superimposed on the Total Residual Magnetic Field. We have examined the available seismic west of longitude 120E in conjunction with data from wells to provide a consistent interpretation of the Phanerozoic and have focussed on Devonian strata which contain numerous gas accumulations (Meding, 1994).

Publically-available seismic lines usually illustrate only the Phanerozoic section despite, in many instances, having been recorded much deeper. The active cooperation of several companies has made it possible to reprocess a number of lines to their full depth. These lines, which are shown in Figure 1, were chosen because of they lay astride the eastern edge of Cordilleran deformation and across the boundary between the Nahanni and Fort Simpson basement terranes which may have influenced deposition of overlying gas-bearing strata.

Initial Findings

The seismic line shown in Figure 2 documents the influence of a Proterozoic to early Phanerozoic structure on Laramide-aged Cordilleran deformation across the Bovie Anticline. This line extends east-northeast across the Bovie Fault and the Bovie Lake Thrust (Douglas and Norris, 1976). Previously, the Bovie Fault was interpreted as a near-vertical, down-to-the-west, normal fault which extended to the surface and the Bovie Thrust as a high-angle reverse fault that extended upwards from Proterozoic strata through the entire Phanerozoic sequence (Structure section C-D in Douglas and Norris, 1976). Other authors have interpreted the Bovie Structure, in a seismic line 12 kilometres to the south near the Bovie Lake J-72 gas well, as simply a fault bounded, horst anticline (Meding, 1994). However, the line shown in Figure 2 reveals that the Bovie Structure developed in response to at least two events separated by a considerable time interval. The earlier structural event involved Proterozoic to mid-Paleozoic east-west compression that resulted in the westward-verging high angle reverse fault that extends upwards from the Proterozoic to the Upper Devonian Tetcho Formation. Higher in the sequence (Kotcho and Banff formations) this early event is manifested as a narrow west-dipping monocline. This was followed by the Laramide compressional event in Early Tertiary time that generated a thin-skinned eastward-verging thrust with a decollement horizon near the top of the Banff Formation. This thrust appears to have been deflected upwards where it encountered the west-facing Bovie monocline, causing the development of a thrust-front anticline, and ending any further eastward advance. This thin-skinned thrust plate is also seen on a parallel line to the north. This thrust plate is interpreted to extend eastward from the Liard Thrust which marks the traditional eastern limit of Cordilleran deformation in this area.

Farther east two lines, 25 to 30 kilometre long and reprocessed to 4 seconds, cross the western flank of the Fort Simpson Terrane (Ross, 1991) magnetic high (Fig. 1), or the Fort Simpson Anomaly (FSA of Cook and Van der Velden, 1993). The upper part of the west-facing Proterozoic ramp or monocline that marks the west flank of the FSA, as described by Cook and

Van der Velden (1993) for deep seismic lines north and south of this study area, can also be seen on these lines as a band of strong west-dipping reflectors.

Many gas pools and gas shows (Meding, 1994) within the Keg River to Slave Point interval have been found in the Devonian Arrowhead Salient region and adjacent to the Cordova Embayment. Most of these are small gas accumulations close to or at the basinward carbonate shelf-edge in a
northward continuation of the prolific shelf-edge gas fields of northeast British Columbia (Williams, 1981). Seismic has revealed a number of undrilled Slave Point anomalies similar to that from which Sun Netla C-07 tested gas. Seismic has also imaged buildups in the Jean Marie Formation.

High-angle westward-verging reverse faults of Paleozoic age underlie parts of the western side of the Arrowhead Salient and may have played a role in determining the shape of this paleogeographic feature. These reverse faults appear to be similar in style to those beneath the Bovie Structure.

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THE SUE-DIANNE CU, AG, AU AND FE-OXIDE RICH BRECCIA COMPLEX MAZENOD LAKE DISTRICT, NORTHWEST TERRITORIES

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The Sue-Dianne deposit is located in the Mazenod Lake district in the southern part of the Great Bear Magmatic Zone, Northwest Territories. The deposit is hosted in altered and brecciated rhyodacite ignimbrites and associated porphyritic felsic intrusions of the Faber Group. It contains approximately 14.9 million tonnes grading 0.78% Cu and 3.22 g/t Ag (under revision). Mineralization is contained within a hydrothermal diatreme breccia complex at the intersection of two major faults. The mineralized structures have marginal fracture zones that grade into intensely altered, Fe-oxide-cemented clast and matrix supported breccia.

Broad halos of hydrothermal alteration surround the deposit and intensify towards the center. A large area of K-feldspar altered ignimbrite grades progressively inwards through successive zones characterized by: 1) quartz and epidote flooding and stockwork veining, 2) pervasive hematite and K-feldspar altered breccias, and 3) a magnetite, hematite and flourite-rich core. Sulphide mineralization averages about 5% combined chalcopyrite, pyrite, bornite, chalcocite, and several other minor phases in a matrix of chlorite, magnetite, hematite, epidote, flourite and garnet. Chalcocite occurs in upper and marginal areas, with a gradational transition to bornite-rich zones, and then to chalcopyrite in the bulk of the deposit.

Potassium, uranium and Fe-oxide enrichment give the deposit distinct radiometric and magnetic signatures detected by both airborne and ground geophysical surveys. The similarities of host-rock geology, relationship to regional structures, mineralogy and zonation, geophysical signatures, diatreme breccias and magmatic affiliation demonstrate genetic similarities to the Olympic Dam deposit of Australia. The Sue-Dianne deposit is currently being delineated and evaluated for its economic potential by Fortune Minerals Limited under an option agreement with Noranda Mining and Exploration Inc.

SEDIMENTARY RESPONSE OF A PLATFORMAL SUCCESSION TO ARCHEAN CRUSTAL THINNING: EVIDENCE FROM THE ARCHEAN BENIAH FORMATION

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The 2.8-3.1Ga clastic-dominated, Beniah Formation ($63^{0}20^{1}$N/$112^{0}19^{1}$W), up to 1km-thick, is located in the south-central segment of the Slave Province. The formation contains minor felsic volcaniclastic units and displays, at one locality, a conformable contact between the volcaniclastic siltstones and mafic pillowed flows. The latter represents the summital part of the succession. The Beniah Formation is considered a lateral equivalent of the quartz-arenite sequences at Bell, Dwyer and Brown Lakes. Sedimentary rocks in the study area, adjacent to the N-trending, crustal-scale Beniah Lake fault, are inferred to overlie a mafic layered complex and a tonalitic gneiss unconformably. Five distinct sedimentary lithofacies define the formation and include: 1) 4-55m-thick (av. 19m) quartz-arenite 2) 3-12m-thick (av. 7m) quartz-pebble conglomerate (with minor sedimentary breccia sublithofacies), 3) a 3-30m-thick (av. 12m) sandstone-siltstone lithofacies 4) a 2-13m-thick (av. 6m) siltstone-sandstone lithofacies, and 5) 5-28m-thick (av. 14m) banded iron-formation. The metamorphic grade is greenschist to lower amphibolite, primary volcanic and sedimentary textures are readily identified.

Two well exposed clastic sequences 160m- and 75m-thick, display the salient sedimentary component of the Beniah Formation. The contact between the quartz-arenite and overlying siltstone-sandstone is sharp with local pebble to granule lag deposits at the base of the overlying lithofacies, whereas contacts between other lithofacies are sharp to gradational (over 1-2 metres). The quartz-arenite features 0.25-2m-thick tabular bedsets composed of planar beds, low-angle trough and local tabular crossbeds which collectively form composite cross-strata. Green, mica-rich and mud drapes locally lie on and between bedforms. A complex nearshore-shoreface setting with tide- and wave-influenced sandwaves is envisaged. The quartz-pebble conglomerate with well rounded quartz clasts, local clay drapes and a stratified nature is considered the high-energy subaerial to subaqueous coastal counterpart of the quartz-arenite. The 3-5m-thick sedimentary breccia sublithofacies, composed almost exclusively of angular sedimentary clasts (1-5cm) in 0.5-2m-thick massive beds, is interpreted as a mass flow deposit. The sandstone-siltstone lithofacies displays 5-30cm-thick cross-strata and planar beds with clay and siltstone drapes between bedforms. These features are suggestive of highly fluctuating wave energy conditions in a lower shoreface setting with possible tide-influence. The siltstone-sandstone lithofacies features 0.1-3m-thick laminated siltstone with local graded sandstone or siltstone-mudstone couplets and rippled horizons. Coarse-grained, 5-20cm-thick sandstone interbeds are planar bedded. A shallow water, proximal nearshore setting with local storm influence is probable. The banded iron-formation contains finely-laminated siltstone beds, 0.2-2cm-thick, alternating with laminated 0.5-2cm-thick iron-rich beds. Banded iron-formation is considered the lateral shallow-water, offshore equivalent of the siltstone-sandstone lithofacies in which suspension deposition was prevalent. The five lithofacies are consistent with a stable platformal setting.

A distinct lithofacies organization of the Beniah Formation is observed in the clastic sedimentary rock record. Sequential repetition of the siltstone-sandstone (banded iron-formation) to sandstone-siltstone to quartz-arenite lithofacies (quartz-pebble conglomerate) occurs in 5-85m-thick upward-coarsening sequences. This is consistent with large-scale, cyclic, transgressive-progradational events (eustatic changes) or may represent platformal rifting associated with attenuation of a tonalitic crust (tectonism). The latter is further supported by an abundance of quartz-arenite, but a combination of both is possible. The sedimentary response to basin subsidence is the repetition of upward coarsening sequences. Continued basin subsidence, caused by rifting, is indicated by the emplacement of mafic pillowed to brecciated flows as well as dykes at the top of the sequence. Similar sequences at Brown, Dwyer and Bell Lakes support the inference of crustal attenuation and possibly the breakup of an Archean proto-continent at 2.8Ga.

STRATIGRAPHY AND PALEOGEOGRAPHY OF THE PALEOPROTEROZOIC BAKER LAKE GROUP IN THE EASTERN BAKER LAKE BASIN, NUNAVUT TERRITORY

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The Baker Lake Group is the lowermost subdivision of the Dubawnt Supergroup (Gall, et al., 1992) and includes the South Channel, Kazan, Christopher Island and Kunwak formations (Donaldson, 1965; LeCheminant, et al, 1979). It outcrops in a series of sub-basins aligned along a corridor which extends northeast from Angikuni Lake to Baker Lake. Our study focuses
on the South Channel and Kazan formations, a conformable succession of coarse- to fine-grained continental clastic redbeds, exposed primarily in the eastern part of Baker Lake basin, at the northeastern end of the corridor. The South Channel and Kazan formations are disconformably overlain by the Christopher Island Formation (Donaldson, 1965; Blake, 1980), a sequence of subaerially erupted, alkalic volcanic flows and intercalated volcaniclastic rocks. In the main study area, at the east end of Baker Lake, the Baker Lake Group unconformably overlies mylonitic granitoid rocks, gabbro and associated anorthosite of the Paleoproterozoic Kramanituar Complex (Sanborn-Barrie, 1994).

Together, the South Channel and Kazan formations comprise four lithofacies assemblages that define a gradational continuum from coarse, proximal, alluvial fan deposits through medial braided stream facies into distal flood-plain playa deposits. Facies distribution, sedimentology and paleocurrents indicate that alluvium was derived from highlands to the east; clasts in assemblage 1 conglomerates came mainly from the immediately adjacent granulites of the Kramanituar Complex; clasts in assemblage 2 are from an as yet unrecognized granitic source.

Along the basal unconformity, abundant sediment-filled fractures in the basement, angularity of the basement surface and derived fragments, sporadic calcrete coatings (some of which have been broken and incorporated into an overlying paleosol) and widespread hematitization of the paleosol indicate that both mechanical and chemical weathering played important roles in providing detritus for infilling of the Baker Lake Basin. A desert setting in which frequent temperature fluctuations accomodated both freeze-thaw cycles and recurring hot arid conditions is inferred.

Soft-sediment deformation. sedimentary breccias in the Kazan Formation and an irregular contact between it and the overlying Christopher Island Formation indicate that alkalic volcanism interrupted alluvial sedimentation. Sedimentation style, asymmetric distribution of facies, recognition of possible basin margin faults and association with volcanism suggests that Baker Lake basin formed in a transtensional or continental rift setting.

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UPPER CRUSTAL STRUCTURES IN THE SLAVE CRATON NEAR YELLOWKNIFE RESULTS FROM SNORCLE LINE 1

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Seismic reflection data from corridor 1 of the SNORCLE transect (line 1) was acquired in October-November, 1996. The purpose of the profile is to investigate processes of tectonic accretion of progressively younger crustal blocks, beginning from the Archean Slave craton and working westward through Early Proterozoic (Great Bear and Hottah) and Middle Proterozoic (Fort Simpson and Nahanni) terranes.

The seismic section displays strong, coherent reflectivity throughout the crust except for the top 3 sec in the Anton Domain where we observe very few reflections, presumably due to the abundance of granitoid plutons. In the Yellowknife area, complex patterns of reflectivity occur below 3 s two-way travel time. A strong linear, eastward dipping reflection appears to define the base of the Yellowknife Basin. This linear reflection projects to the surface near, but west of, outcrops of mafic dikes, and can thus be correlated with metavolcanics of the Yellowknife Supergroup, a mafic sill or relate to sheared rocks along a detachment surface as suggested by Cook et al. (1998) (their reflection Y1). In order to better resolve some of the detailed features in the upper crust and perhaps provide better surface correlations, we have begun to reprocess the upper crustal data of the Yellowknife section at the GSC, starting from uncorrelated field records, using the ProMAX seismic processing package. We have focussed on some key processing steps including careful trace editing, cdp binning strategies, pre-stack filtering, and velocity analysis.

At this point we have been able to extend the prominent reflection referred to above closer to the surface (to ~ 100 ms) and enhance some of the reflectivity above that horizon. This enhanced reflectivity seems to outline fold structures which would be consistent with the movement of upper crustal material along a detachment surface. Perhaps the intrusion of mafic magma along this detachment surface has caused it to be such a sharp, reflective horizon. If such a detachement, or additional parallel detachments, exist at depths of a few kilometres further to the east. they would truncate mapped, steeply dipping structures such as those associated with the Sleeping Dragon Complex and similar structures to the west. This may fundamentally modify our view of the general importance of high-angle structures mapped at the surface.

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PRELIMINARY WHOLE-ROCK AND ND ISOTOPIC GEOCHEMISTRY OF ARCHEAN VOLCANIC ROCKS OF THE YATHKYED GREENSTONE BELT, KIVALLIQ REGION, NORTHWEST TERRITORIES

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Field work initiated in 1997 by a joint mission of the G.N.W.T. and I.N.A.C. as part of the Western Churchill NATMAP program was undertaken to better understand the geology of the late Archean Yathkyed greenstone belt. It comprises a ca. 7 km thick supracrustal sequence which is overturned, and ranges from greenschist facies in the structural base of the section to upper amphibolite in the uppermost part. Based on 1998 mapping in the northeastern part of the belt, two tectonostratigraphic units, separated by a mylonitic shear zone, have been distinguished. Both of these units occur in the hangingwall of the Tyrrell shear zone which marks the structural base of the belt. The lower unit is comprised of a package of mafic volcanic rocks that range from amphibolite in the NE to chlorite grade, pillowed volcanic rocks in the SW; intruded by biotite monzogranite along the structural top of the package. The upper unit is comprised of amphibolite grade mafic volcanic rocks at the base that grade into mixed mafic -to- felsic volcanic rocks and psammites and pelites; all intruded by foliation parallel sheets of tonalite.

Ten mafic volcanic rocks, all from the southwestern part of the belt where the tectonic stratigraphy is less clearly defined, were collected for whole-rock and Nd isotopic geochemistry. The analyses demonstrate that these are tholeiitic basalts except for Y-8505, a calc-alkaline andesite from the upper unit. Tectonic discrimination diagrams demonstrate that all mafic rocks except Y-8505 plot as ocean floor basalts and have MORB-like incompatible trace element compositions. Two of the samples from the upper unit exhibit Ti, Zr, Nb and Y compositions comparable to volcanic arc basalts but have higher Zr/Y and Ta/Yb values implying that these may represent melts derived from a more enriched mantle source. Extended rare earth element diagrams demonstrate that amphibolites from the upper unit are LREE enriched (La_N/Lu_N = 2.18 & 8.67) and are characterized by variable Nb, Ta and Ti troughs. The rocks from the lower package, however, are characterized by generally flat and mutually parallel, extended REE patterns (ca. 10-20 x chondrites and La_N/Lu_N =0.93-2.91) comparable to typical Archean MORB (AMORB), but exhibit increased LREE-enrichment and development of minor Ta, Nb and Ti troughs with increasing SiO_2 content. Two samples of volcaniclastic sedimentary rocks from the lower unit also have generally flat and mutually parallel, extended REE patterns (ca. 10-20 x chondrites and La_N/Lu_N =1.47 & 1.83) that are very similar to the basaltic rocks. Nd isotopic data indicate that all of the samples, including the sedimentary rocks, are isotopically juvenile in character, having ϵNd values ranging from +3.4 to +0.5 (n= 9; t=2.68 Ga). No correlation exists between SiO_2 content, the degree of LREE enrichment and the corresponding ϵNd values, implying that contamination by older crustal material was probably not significant.

PRELIMINARY PETROCHEMISTRY OF ARCHEAN MAFIC VOLCANIC ROCKS OF THE HENINGA -TO- TAVANI CORRIDOR OF THE RANKIN-ENNADAI GREENSTONE BELT, KIVALLIQ REGION, N.W.T.

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Fieldwork initiated in 1997 by the Geological Survey of Canada as part of the Western Churchill NATMAP program was undertaken to better understand the tectonostratigraphy and evolution of the late Archean Kaminak Group exposed in the Heninga Lake -to- Tavani segment (ca. 180 km along strike) of the Ennadai-Rankin greenstone belt. Comprehensive whole-rock geochemical data and Nd isotopic analyses, in conjunction with U-Pb geochronological studies (Davis, 1998) provide new constraints on the tectonomagmatic evolution of the belt.

Volcanic rocks in the Heninga Lake -to- Tavani corridor comprise mafic to intermediate pillow lavas and massive flows and tuffs, associated with volumetrically subordinate dacites and rhyolites. Pillowed and massive mafic volcanic sections throughout the belt were systematically sampled (pillowed horizons in particular) for petrochemical studies. Mafic volcanic rocks throughout the region comprise both tholeiitic and calc-alkaline basalts and correspond to two dominant geochemical groups. These occur together in close proximity, on the scale of 100's of metres, however, their mutual relationships are not well defined. Tholeiites exhibit flat (MORB normalized) extended REE patterns (La_N/Lu_N = 1.30-6.46) and have juvenile ϵNd values (t=2.685 Ma) of +2.0 to +3.5. The have immobile trace element characteristics similar to modern-day mid-ocean ridge basalts. Calc-alkaline basalts are characterized by Th and LREE-enriched (La_N/Lu_N =5.10-13.21) extended REE patterns having variably developed Nb, Ta and Ti troughs. These rocks are typified by slightly more evolved ϵNd values (t=2685 Ma) ranging from +1.2 to +2.3, and exhibit immobile trace element characteristics similar to modern day calc-alkaline basalts.

U-Pb (zircon) analyses of felsic volcanic units help to delimit two distinct volcanic cycles, emplaced at ca. 2705-2691 Ma and 2687-2681 Ma, respectively (Davis et al., this volume). With the present database, the temporal and geochemical relationships observed in mafic volcanic rocks of the Heninga Lake to Tavani corridor imply the coeval emplacement of tholeiitic, MORB-like and calc-alkaline, arc-like basaltic magmas at ca. 2705-2691 Ma, accompanied by calc-alkaline intermediate to felsic volcanism. Available geochronological data permit the interpretation that this may represent a progressive transition from predominantly MORB-like tholeiites at 2705 to 2697 to mainly calc-alkaline activity until 2691 Ma. This was followed at ca. 2687-2681 Ma by intrusion of voluminous tonalitic (diorite to granite) plutons and cogenetic, quartz-feldspar porphyries, autobrecciated rhyolites and rhyolitic tuffs and greatly subordinate basaltic volcanic rocks. The latter, comprising both tholeiitic and calc-alkaline compositions, unequivocally occur in only one lithological section.

THE NORTH BAFFIN PARTNERSHIP PROJECT: A SUMMARY OF RESULTS

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The North Baffin Partnership Project is collaborative geoscience initiative launched in September 1997 to develop a digital geoscience knowledge base and mineral potential assessment of northern Baffin Island and the northern Melville Peninsula. The goal of the project is to provide one-stop shopping for integrated geoscience information for the mineral exploration industry, land-use planning, as well as local communities and governments. Almost 3 billion years of Earth history is recorded in bedrock that comprises vast regions of Archean gneiss-greenstone terrane (Mary River Group), a Paleoproterozoic supracrustal sequence (Piling Group) preserved in a collisional thrust belt, the Mesoproterozoic Borden rift basin that hosts the Nanisivik lead-zinc mine, a Paleozoic platformal sedimentary sequence, and Tertiary rift-related deposits.

The primary products of the project are 1:500 000-scale maps of bedrock and surficial geology, 1:1 000 000-scale map of metallogenic domains and mineral occurrences, a digital knowledge base on CD-ROM, and a comprehensive report on the project area. The maps and CD-ROM will be on display at the Geoscience Forum, and available for sale December 1; the comprehensive report is scheduled for release early in the new year. The digital geoscience knowledge base CD-ROM contains a wide range of thematic information, accessible with included viewing software and exportable to GIS packages. Topographic and hydrographic information form the base for the overlying thematic layers that include aeromagnetic and gravity data, bedrock geology, structure, mineral occurrences, geochronology, surficial materials, and lake sediment geochemistry.

GROUND TRUTHING OF GEOPHYSICAL ANOMALIES NORTH AND WEST OF ARVIAT, NWT

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Nine geophysical anomalies to the north and west of Arviat were ground truthed in July 1998. These linear magnetic highs had been interpreted as banded iron formations by previous workers but little or no mineral exploration had been conducted over these potential gold targets. The goals of the program were to identify and outline any exposed iron formation, and to sample any mineralization contained within it.

Magnetic highs in NTS 55D and 55E were examined and selected based on the strength and extent of the anomalies and any structures implied by them, including faulting or folding. The nine anomalies selected were labelled, from south to north, C, F, H, I, J, K, L, M, and N. Since few outcrops were present in the area, most traverses were located about one kilometer down-ice of the anomalies. The few outcrops present were examined, and sampled if they appeared to be mineralized. Till samples were collected at regular intervals along the traverses and were analyzed for gold grain counts and morphology. Any other occurrences of mineralization were sampled, regardless of whether the source was outcrop or float.

Outcrop or subcrop of iron formation was found only at targets H, K, M, and N. Exposure on the other targets was extremely poor, with no outcrops at all on C or L. Iron formations were of the oxide facies, consisting of fine grained magnetite and chert, often interbedded with metasedimentary or metavolcanic rocks. On targets K and N these were limited to thin beds or small exposures of subcrop. Iron formation on target H was tens of meters wide, heavily contorted, and outcrops intermittently over several hundred meters of strike length. Quartz veining plus minor almandine, schorl, and grunerite were noted at H, particularly where wide quartz veins intersected the iron formations. Iron formation on M did not outcrop, but numerous boulders were located in topographic lows down-ice from the anomaly. No sulphide facies iron formation was detected during the program.

The highest gold value obtained from a grab or float sample was 32 ppb, collected from an iron formation outcrop as sample H5. Similar material from another nearby, slightly pyritic iron formation outcrop ran only 22 ppb, but contained 3 ppm Ag and 0.18% Cu.

Other interesting results were garnered from mafic volcanic float containing disseminated pyrite and chalcopyrite. Sample M5 ran 2.32% Cu, 0.92% Pb, 16 ppm Ag, and contained elevated Zn, Cr, Co, and Mo. Sample M3, collected over a kilometer away, graded 0.47% Cu, 0.18% Pb, 2.3 ppm Ag, with elevated Cr. Although not the objective of this program, these results do suggest the possibility of base metal mineralization located up-ice of anomaly M. Anomalous values of Ni, Co, As, Cr, and V were obtained from other samples.

Results from the till sampling will be released when available. The final product will be an EGS report summarizing this work as well as a compilation of previous exploration work in 55D and 55E. This should be released by January 1999.

STRUCTURAL GEOLOGY OF THE GIANT GOLD MINE, YELLOWKNIFE, NWT.

James Siddorn
University of Toronto

Gold at the Giant mine is hosted by a series of quartz-sericite schist zones and quartz veins surrounded by an envelope of chlorite (+/- sericite) schist, within the metavolcanics of the Kam Group, Yellowknife Greenstone Belt. Previous studies have described Giant as a classic "shear zone" hosted gold deposit dominated by simple shear. Recent re-examination shows schist zones, ore bodies and early quartz veins are boudinaged and crenulated by an axial planar S2 foliation, indicating that pure shear dominated at the time of schist formation (D2). In the centre of schist zones, the S2 foliation crenulates an S1 foliation (shown in sericite, sulphides, and quartz veins), which may have been the product of an early phase of minor simple shear (D2). In zones of high strain the S1 foliation is transposed into the S2 foliation. Strain partitioning is evident throughout the deposit, and surrounding country rock displays evidence of progressive shortening in the form of flattened pillow lavas and deformed quartz veins, but to a lesser degree than the schist zones. Within the schist zones the amount of strain varies between quartz rich, chlorite rich and sericite rich lithologies. The degree of strain in quartz veins also varies, the LAW area contains broad open folded quartz veins, with minor brecciation and inclusion of sericite schist. The ASD area contains broad zones of sericite-quartz schist, where original quartz veins have been brecciated and deformed into the S2 foliation. Schist samples are dominated by phyllonite minerals, the product of Diffusive Mass Transfer (DMT). DMT at greenschist facies temperatures only occurs when fluid assisted. Schist zones may have formed from brittle fault zones with a cataclasite which formed a pathway for fluid which initiated DMT.

Thin sections indicate that quartz deforms by crystal plasticity (undulose extinction) and dislocation glide (sub grain boundaries). The schist zones are displaced by later Proterozoic faults (D3), and the Giant system is dominated by NW sinistral faults and minor NE dextral faults. Oblique slip along the faults crenulated and formed shear bands in the existing S2 foliation, which indicate a transpressive principal stress direction up to the NW. Present indications suggest that the Giant and Con deposits may have formed from a single shear system. The Con deposit is dominated by simple shear. The difference in shear between Con and Giant may be accounted for by the attitude of the shear systems to the principal compressive stress during D2.

THE MAGNETIC FABRIC OF GRANITOID PLUTONS: EVIDENCE FOR THE LATE-ARCHEAN TECTONO-MAGMATIC HISTORY OF THE SLAVE PROVINCE

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The magnetic fabric of a rock, derived from the anisotropy of magnetic susceptibility (AMS), provides a useful method of measuring mineral fabrics in seemingly isotropic rocks. Where field measurements are scarce (such as within weakly deformed granitic plutons), AMS can provide information regarding the orientation and symmetry of rock fabric, and in some cases the intensity of strain.

The magnetization induced in a weak applied field is a function of the magnetic susceptibility (K) of a rock specimen. In practice, a specimen is represented by a 25mm diameter X 22mm long piece of drill core. Since all rock specimens are magnetically anisotropic, the susceptibility differs as a function of the specimen orientation within the applied field. By measuring K in several different orientations with respect to the specimen, the susceptibility ellipsoid is defined, with its principal axes (Kmax, Kint, Kmin) corresponding to the three eigenvectors of the susceptibility tensor. The net result is a bulk magnetic fabric description that incorporates all the Fe-bearing minerals (mostly ferrosilicates and magnetite). The usefulness of the AMS technique lies in the fact that the magnetic fabric tends to be coaxial to the mineral fabric, and to the finite strain ellipsoid. Hence the AMS allows the quantification of tectonic fabric that cannot be measured by standard field techniques.

In our studies, the magnetic fabric is being used to document the mineral fabric and strain histories preserved within different suites of syntectonic plutons of the southern Slave Province. The plutonic rocks have recently been dated using high-resolution U-Pb techniques (e.g. Davis and Bleeker, submitted). The magnetic fabric analyses, combined with field mapping of the plutons, will provide new constraints on the regional deformation patterns associated with transpressive tectonics concurrent with the different magmatic events (Benn et al., 1998), as well as on mechanisms of magma emplacement and exhumation of the plutons.

References:

Benn, K. et al., 1998: J. Struct. Geol. 20.
W.J. Davis and Bleeker, W., paper submitted to CJES.

PROGRESS REPORT: GEOSCIENCE STUDIES IN THE NORTHERN CORDILLERA

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Studies initiated during 1998 in the Northwest Territories segment of the Canadian Cordillera are:

1. The investigation of possible relationships between gold, precious gems and Cretaceous granitoid intrusions.

2. The examination of barite-bearing black shale sequences from the Caribou River area for their SEDEX potential.

3. A geochemical sampling orientation survey in the Macmillan Pass area in preparation for a future regional sampling programme to cover NTS 105P, Sekwi Mountain Map Sheet.

I. Gold and Gems Associated With Selwyn Plutonic Suite.

Cretaceous plutons intruding the southeastern Selwyn Basin within the Northwest Territories have been divided by previous workers into three distinct plutonic suites based on mineralogy and geochemistry. The suites are named Tay River, Tombstone, and Tungsten. As part of a study encompassing similar Cretaceous plutons in Yukon and Alaska, Mortenson et al. conducted field, petrographic, geochemical and U-Pb geochronology studies of seven plutons from these suites near Macmillan Pass in the NWT in 1997, and further refined the distinction with regard to age of emplacement and metallogenic signature. Their work now suggests that the Tungsten suite, originally thought to be co-magmatic with Tombstone plutons, was emplaced over a protracted period, spanning the end of Tay River suite intrusion and overlapping with emplacement of Tombstone suite plutons to the west.

Gold mineralization is associated with the Tombstone suite in the Yukon and Alaska (e.g. Fort Knox, Brewery Creek, Scheelite Dome). Mortenson et al. reported significant gold values in 1997 from sheeted quartz veins cutting the Mactung and Mt. Wilson plutons in the Macmillan Pass area.

Gem quality red tourmaline (var. elbaite) and emerald have also been discovered by previous workers, in aplite-pegmatite dykes and quartz-calcite veins that cut or are associated with Tungsten suite plutons.

In 1998, DIAND began studies of other Cretaceous plutons south of Macmillan Pass, in order to further define the relationship between different suites and their potential for control on gold or gem mineralization. Preliminary findings are:

What appears to be a fourth mineralogically distinct intrusive suite of as yet undetermined age, is present in the northeastern Coal River map sheet. Here small plugs of fine to medium grained pyroxene-plagioclase porphyry intrude black shales of Ordovician or Devonian age.

The placer gold showings of the Flat River area may be associated with plutons currently thought to belong to the Tay River Suite.

Other gem quality minerals may be found in skarns related to these. Vesuvianite has been tentatively identified pending petrographic confirmation.

2. Barite-Bearing Black Shale Sequences and Their Potential For Base Metal Mineralization

During data review for intrusive-related mineralization, an area of black shales of uncertain age was noted in the Coal River map sheet.

The units outcrop near the southern boundary of the Mielleur River Embayment of the Selwyn Basin, immediately north of the Liard Line. The Liard Line is thought to represent a Proterozoic transform fault, reactivated during the Ordovician and at other times. The occurrence of both bedded and concretionary barite, and ribbon-banded, black cherty argillite within units mapped as Carboniferous, their proximity to units possibly equivalent to the Road River Formation or Earn Group, and similarities to strata hosting SEDEX deposits a minimum of 250 kilometres away, along strike both to north and south, warranted further investigation. Two days of field examination led to the following preliminary assessments:

Fossil evidence suggests the barite-bearing, ribbon-banded, black cherty argillite unit may be Ordovician in age and possibly equivalent to the Road River Group.

Over seventeen discrete occurrences of ferricrete were observed in an area underlain by both the Carboniferous clastic unit and a unit mapped by GSC as either Road River or Besa River Formation. Citing a cautionary note in regards to significance of ferricrete analyses, grab samples taken from springs and cemented material are all weakly to moderately anomalous in zinc (39 - 1036 ppm), and barium(13 - 942 ppm), with local weak anomalies of copper (112 ppm), cobalt (124 ppm) and silver (1.4 ppm). Although assessment report records indicate that this area has seen a moderate amount of exploration between 1960-1984, advances in the theory of SEDEX formation and emplacement might justify another pass.

3. Geochemical Orientation Survey, MacMillan Pass Area

This is a joint DIAND Geology Division and GNWT Minerals Oil & Gas project. Regional geochemical sediment sampling programmes carried out in the Yukon have proven to be a valuable tool for explorationists, researchers and other land use managers. To date, only one such survey has been carried out in the Northwest Territories Cordillera, for the Nahanni map sheet (NTS 105I). Although completed in 1981, the data was used as recently as this summer by a number of companies exploring for a variety of commodities.

Immediately to the north, the Sekwi Mountain map sheet (NTS 105P) hosts abundant and varied mineral occurrences, ranging from deposits with defined reserves to mineral showings of MVT, SEDEX-, skarn tungsten-, and stratiform sediment-hosted copper-type. An orientation survey was carried out in drainages occupied by selected mineral occurrences to determine optimum sample type and spacing for a future program. Separate samples of moss, silt and a bulk <1cm size fraction were collected and subject to multi-element analyses. Unfortunately, this year's extreme forest fire situation resulted in a loss of funds allocated for analysis of results. Data is expected to be available early next fiscal year.

OPEN FILE GEOLOGICAL MAPS OF THE MACQUOID-GIBSON LAKES AREA, KIVALLIQ REGION, NUNAVUT

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Geological Survey of Canada, Ottawa[1]
Department of Earth and Science, Carleton University, Ottawa[2]

The 1:50,000 scale coloured digital maps showing the bedrock geology of parts of MacQuoid -Gibson Lakes area (NTS 55M/9,16; 55N/11 to 14) are scheduled for open file release in January1999. The data for these maps were compiled digitally using FIELD LOG and AutoCAD with final output generated through direct collaboration with the Cartography Unit, GICD using GIS software.

The geological maps present results of bedrock mapping undertaken in the region during the 1998 field season. The principal objectives of the mapping were to upgrade reconnaissance database, and to address some of the structural, metamorphic, and metallogenic problems in the region. Particular emphasis was placed on establishing the nature and extent of Paleoproterozoic tectonothermal reworking of older, Archean lithologies. The MacQuoid-Gibson Lakes area contains the Sandhill

Zn-Cu-Pb-Ag prospect, the Suluk Ni-Cu-Co occurrence, and the Akluilak diamondiferous lamprophyre dyke.

Detailed accounts of bedrock geology and structure covering this and the surrounding area were published in numerous GSC publications. The reader is referred to the marginal notes and references therein for an overview of the geology and structure of this region.

METASEDIMENTARY INFLUENCE ON METAVOLCANIC-HOSTED GREENSTONE GOLD DEPOSITS: GEOCHEMISTRY OF THE GIANT MINE, YELLOWKNIFE, N.W.T., CANADA

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The Giant mine is a mesothermal, greenstone-hosted gold deposit that has produced ~250 tonnes of gold, principally from sulphide ores in altered metavolcanic rocks. Previous studies concluded that mineralizing fluids acquired metals and other ore-forming components from within the ore-hosting metavolcanic rocks and ascended a steep-dipping shear zone to the site of ore-deposition. Our studies indicate that although the metavolcanic host rocks were important geochemically in the precipitation of gold, extensive metasedimentary rocks to the east were a more important conduit and/or source of fluids, metals, and ore-forming constituents.

Geochemical analyses reveal an east-dipping Na-depletion zone extending from the ore zone to within the metasedimentary sequence that coincides with enrichments in Ag, As, S, and Sb and with $\delta^{18}O_{quartz}$ values of 11.7‰ to 14.1‰. These data indicate that wallrock-hosted gold mineralization was deposited where fluids emerging from metasedimentary rocks encountered highly reactive Ti-rich tholeiitic basalts. From a geochemical standpoint, this ore system represents a metasedimentary-type gold deposit hosted in metavolcanic rocks.

Documentation of a metasedimentary influence on formation of the Giant mine helps explain why smaller greenstone belts can host substantial economic gold mineralization and has important implications for exploration for giant (>150 tonnes) gold deposits.

INITIAL DIGITAL DATA CD-ROM RELEASE FOR THE WESTERN CHURCHILL NATMAP PROJECT.

Lori Wilkinson and Western Churchill NATMAP working group
Continental Geoscience Division, Geological Survey of Canada

The "*Selected Geoscience Data from the Western Churchill NATMAP Project, Kivalliq Region, Nunavut - Volume I*" CD-ROM release provides an initial archive of existing and new. digital Western Churchill (covering parts of 60-68N and 88-104W) data in standard, easy to use formats that allow both novice and expert GIS users to quickly extract and use the information they need. This release is part of the GIS component of the Western Churchill NATMAP (National Mapping Programmed) project.

The data contained on this CD-ROM incorporates Geological Survey of Canada (GSC), Resource, Wildlife and Economic Development (RWED) of the Government of the Northwest Territories (GNWT) and Department of Indian and Northern Affairs (DIAND) geoscience data compiled and re-formatted under the auspices of the Western Churchill NATMAP project. Each data set on the CD-ROM is an independent Open File (GSC) or EGS-series (GNWT or DIAND) data set previously published on paper by the authors noted in the user guide and metadata files. In all cases, the digital data presented on this CD-ROM are also available in analog format from the appropriate agency. Detailed information and references for each data set are provided on the CD-ROM. The data are provided in Arc/Info and common interchange formats (DXF and Arc/InfoÓE00, DBF, TIF, MicrosoftÓExcel) in a standard UTM zone 15, NAD 27 projection. ArcExplorerÓ is provided on the CD-ROM as a data viewer for PC-clients (see http://www.esri.com/software/ for more information). Although the CD-ROM conforms to the ISO-9660 system-independent standard and works identically on a PC, Macintosh or UNIX workstation, no viewer is provided for Macintosh or UNIX users.

Data sets provided include bedrock geology, surficial geology, till geochemistry, mineral occurrences, geochronology data, geophysical data and a grid of latitude and longitude lines:

Bedrock Geology

Directory	Number	First Author	Source
AMEROF	2696	Tella	GSC
ANGIKUNI	OF 3608	Aspler	GSC
CHESTER	OF 2756	Tella	GSC
CARRKAM	OF 3649	Irwin	GSC
DUBAWNT	OF 2922	Peterson	GSC
GIBSON	OF 2737	Tella	GSC
HALFWAY	Map 1602	Taylor	GSC
HAWKHIL	EGS 1898-22	Aspler	GNWT/ DIAND
HENINGA	OF 3648	Hanmer	GSC
KAMINAK	EGS 1998-08	Irwin	GNWT/ DIAND
MACQUOID	OF 3404	Tella	GSC
MAGUSE	NP 15/16	Tella	GSC
OFTEDAL	OF 3548	Aspler	GSC
OTTER	OF2766	Aspler	GSC
	OF 2428	Aspler	GSC
PARKER	OF 3405	Tella	GSC
POORFISH	EGS 1988-9	Aspler	GNWT/ DIAND
RANKIN	OF 2968	Tella	GSC
SCARAB	OF 3197	Tella	GSC
WALLACE	OF 3487	Peterson	GSC
WATTERSN	OF 2767	Aspler	GSC
WHITEHIL	OF 2923	Henderson	GSC
WOODBURN	OF 3461	Zaleski	GSC

Surficial Geology

Directory	Number	First Author	Source
CANADA	Map 1880A	Fulton	GSC
KEEW_ICE	Map 24-1987 (2)	Aylsworth	GSC

Till Geochemistry

Directory	NumberFirst	Author	Source
KAMINAK	OF 2132	Shilts	GSC
BAKER	OF 324	Klassen	GSC

Mineral Occurrences

Directory	NumberFirst	Author	Source
WOODBURN	OF 3461	Zaleski	GSC
MAGUSE	Map NP 15/16	Tella	GSC
KAMINAK	EGS 1998-15	Goff	DIAND

Geochronology Data

Directory	NumberFirst	Author	Source
MAGUSE	Map NP 15/16	Tella	GSC

Latitude/Longitude grid

Grid of latitude and longitude lines. Lines of longitude are separated by two degrees, while lines of latitude are separated by one degree, covering an area between 88-104°W and 60-68°N.

Geophysical Data

Aeromagnetic, gravity and DEM data on this CD-ROM, and for all of Canada, is available from the Geophysical Data Centre at the Geological Survey of Canada.

NEW DIGITAL DATA CD-ROM RELEASE FOR THE SLAVE NATMAP PROJECT.

Lori Wilkinson and Slave NATMAP working group
Continental Geoscience Division, Geological Survey of Canada

The "*Selected Geoscience Data from the Slave NATMAP Project, District of Mackenzie, Northwest Territories - Volume II*" CD-ROM release provides a second installment of digital Slave NATMAP data, building on the previous release of Bowie (1995). Data is provided in standard, easy to use formats that allow both novice and expert GIS users to quickly extract and use the information they need.

Under the auspices of the Slave NATMAP project, data was compiled from the Geological Survey of Canada (GSC), Resource, Wildlife and

Economic Development (RWED) of the Government of the Northwest Territories (GNWT) and Department of Indian and Northern Affairs (DIAND). Individual Open File (GSC) or EGS-series (GNWT or DIAND) data provided on the CD-ROM have been previously published on paper by the authors noted in the user guide and metadata files and are available in analog format from the appropriate agency. A user guide provides detailed information and references for each data set provided on the CD-ROM. The data are provided in a UTM zone 12, NAD 27 projection in Arc/Info and common interchange formats (DXF and Arc/InfoÓE00, DBF, MicrosoftÓExcel). ArcExplorerÓ is provided on the CD-ROM as a data viewer for PC-clients (see http://www.esri.com/software/ for more information). The CD-ROM conforms to the ISO-9660 system-independent standard and works identically on a PC, Macintosh or UNIX workstation, however, no viewer is provided for Macintosh or UNIX users.

Data sets provided include bedrock geology, surficial geology, till geochemistry, indicator minerals, bedrock whole rock geochemistry, bedrock assays, pressure-temperature data, geochronology data, mineral occurrences and a latitude/longitude grid:

Bedrock Geology

Directory	Number	First Author	Source
AMES	EGS 1994-11	Stubley	GNWT/ DIAND
ANIALIK	EGS 1996-01	Relf	GNWT/DIAND
ANIALIKS	EGS 1994-18	Relf	GNWT/DIAND
ANIALIKN	OF 2965	Relf	GSC
CAMSELL	EGS 1992-02	Johnston	GNWT/DIAND
CARP	EGS 1997-07	Stubley	GNWT/DIAND
CHALCO	OF 3395	Pehrsson	GSC
ENEMY	EGS 1992-18	Johnstone	GNWT/DIAND
EOKUK95	EGS 1995-09	Jackson	DIAND
EOKUK96	EGS 1996-09	Jackson	DIAND
HIGHLK	OF 3401	Henderson	GSC
HIGHLKN	OF 2970	Henderson	GSC
INULIK	EGS 1995-08	Jackson	DIAND
MACKAY	EGS 1993-09	Johnstone	GNWT/DIAND
NAPAK	EGS 1995-14	Jackson	DIAND
NARDIN	EGS 1995-04	Jackson	DIAND
NICHOLAS	EGS 1996-05	Stubley	GNWT/DIAND
POINTLK	EGS 1995-03	Gebert	GNWT/DIAND

RANJI	OF 3396	Pehrsson	GSC
SMOKY	EGS 1993-05	Stubley	GNWT/DIAND
SQUALUS	EGS 1992-10	Stubley	GNWT/DIAND
WIJINNED	OF 3609	Henderson	GSC

Surficial Geology

Directory	Number	First Author	Source
ALYMER	Map 1867A	Dredge	GSC
CANADA	Map 1880A	Fulton	GSC
COPPMINE	Map 1910A	Kerr	GSC
KIKERK	Map 1909A	Dredge	GSC
LACDEGRS	Map 1870A	Ward	GSC
NAPAK	Map 1889A	Kerr	GSC
POINTLK	Map 1890A	Dredge	GSC
WINTER	Map 1871A	Kerr	GSC

Till Geochemistry

Directory	Number	First Author	Source
AYLMER	OF 3120	Dredge	GSC
COPPMINE	OF 3412	Kerr	GSC
CONTWOYS	OF 3387	Ward	GSC
CONTWOYN	OF 3654	Kerr	GSC
KIKERK	OF 3360	Dredge	GSC
LACDEGRS	OF 3205	Ward	GSC
NAPAK	OF 3316	Kerr	GSC
POINTLK	OF 3317	Dredge	GSC
WINTER	OF 3206	Kerr	GSC

Indicator Minerals

Directory	Number	First Author	Source
AYLMER	OF 3080	Dredge	GSC
CONTWOYS	OF 3386	Ward	GSC
LACDEGRS	OF 3079	Ward	GSC
NAPAK	OF 3355	Kerr	GSC
POINTLK	OF 3341	Dredge	GSC
WINTER	OF 3081	Kerr	GSC

Bedrock Whole Rock Geochemistry

Directory	Number	First Author	Source
ANIALIK	EGS 1995-07	Relf	GNWT/DIAND

POINTLK	EGS 1995-03	Gebert	GNWT/DIAND
CARP	EGS 1997-07	Stubley	GNWT/DIAND

Bedrock Assays

Directory	Number	First Author	Source
ANIALIK	EGS 1995-07	Relf	GNWT/DIAND

Pressure-Temperature data

Directory	Number	First Author	Source
ANIALIK	EGS 1996-01	Relf	GNWT/DIAND

Geochronology data

Directory	Number	First Author	Source
ANIALIK	EGS 1996-01	Relf	GNWT/DIAND

Mineral Occurrences

Directory	Number	First Author	Source
KIMBERLT	EGS 1998-13	Armstrong	DIAND

Latitude and Longitude grid

Grid of lines of latitude and longitude covering an area between 88-104W and 60-69N. Each line of longitude is separated by two degrees, while each line of latitude is separated by a single degree.

SEARCHING FOR KIMBERLITE: USE OF CLAY FRACTION TILL GEOCHEMISTRY IN THE LAC DE GRAS AREA, NORTHWEST TERRITORIES.

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Diamond exploration in the Slave Province is hampered by thick, extensive till cover and expensive traditional exploration methods (heavy mineral studies). GIS analytical techniques have been used to identify kimberlite pathfinder elements, till geochemical anomalies in the clay fraction and to determine and quantify their possible spatial relationships to known kimberlite pipe occurrences using the "weights of evidence" technique, in the Lac de Gras area of the Northwest Territories. Although traditional single element pattern maps (e.g. proportional circle plots) indicate broad patterns of element distribution, the use of GIS tools allow multi-element comparisons and testing of spatial relationships between element anomalies and between element anomalies and known occurrences. This study is unique in that geochemical anomalies in the clay fraction of till are studied with respect to known kimberlites as opposed to coarser fractions.

Major and trace element concentrations in kimberlite (15 analyses) were compared to Archean host rock lithologies (64 analyses) resulting in the identification of 16 potential kimberlite pathfinder elements: Al_2O_3, K_2O, Na_2O and Pb which are present in lower concentrations in kimberlites than regional Archean rocks and CaO, Ba, Co, Cr, Fe_2O_3, La, MgO, MnO, Ni, Sb and Sr which are higher in kimberlites than regional Archean rocks. Poor precision of Pb, Sb and Sr in the clay fraction data however resulted in their elimination for further consideration.

The Lac de Gras region is covered by a single thin (<2 m) to very thick (30 m) till sheet. Ice flow indicators suggest an early southeast ice flow direction followed west and northwest flow directions, with dominant ice flow, in terms of glacial transport and definition, to the northwest. Semi-variograms were calculated for log-transformed clay fraction kimberlite pathfinder element concentrations to determine the maximum distance and direction of correlation between samples and this information was used to interpolate the data using kriging with a spherical model. Anomalous concentrations, identified from natural breakpoints in the probability plot for each element, and were used to create binary anomaly, or predictor maps.

In the clay fraction of till (177 samples), the abundance of Cr, Ba, Fe, K and Mg, and to a lesser extent Ni and Mn is enriched in the coarser-grained surficial unit T3 (hummocky till, 5-20 m thick). The bedrock units that these surficial units overlie are not however, significantly enriched or depleted in any of these 7 elements, suggesting a kimberlite-rich source for this surficial material.
An attempt was made to account for factors that may contribute to false anomalies due to Fe and Mn scavenging. Firstly, the role of Fe and Mn scavenging in concentrating kimberlite pathfinder elements was tested by calculating the correlation between Mn and Fe and kimberlite pathfinder element. Secondly, binary anomaly maps were constructed for Fe and Mn and subtracted from binary anomaly maps of the kimberlite pathfinder elements, thus screening out areas where Fe and Mn co-occur with pathfinder element anomalies.

In the "weights of evidence" method, the locations of known kimberlite pipes (44 in this case), each of which is assigned an area of 250 m^2 in this case, are used to assess the degree of spatial association between known kimberlites and each binary predictor map. Results indicate that Ni, Ba, Cr and to a lesser extent, K and Na are the only pathfinder elements in the clay-sized fraction of till that showed a significant spatial relationship with known kimberlites. Screening for scavenging effects due to Fe results in Cr, Ni and Ba anomalies which are slightly better predictors of known kimberlites.

Elements Al, K and Na (e.g. negative anomalies), are not correlated with known kimberlites. This is likely a result of lower kimberlite-derived clay fraction concentrations being overwhelmed by naturally higher regional Archean bedrock-derived clay fraction concentrations.

TECTONOSTRATIGRAPHY OF THE ARCHEAN WOODBURN LAKE GROUP, WESTERN CHURCHILL PROVINCE, NUNAVUT

Eva Zaleski[1], Norm Duke[2], Rob L'Heureux[2], Bill Davis[1], Lori Wilkinson[1] and John Kerswill[3]
[1]Continental Geoscience Division, Geological Survey of Canada
[2]University of Western Ontario, London, Ontario
[3]Mineral Resources Division, Geological Survey of Canada

The Woodburn Lake group (WLg) comprises a deformed sequence of Archean supracrustal rocks that includes several associations typical of Archean cratons, that is, komatiite-quartzite assemblages, greenstone-type volcanic and sedimentary sequences, and granulite paragneisses. The WLg crops out in a northeasterly trending belt at least 150 km in length north of the Snowbird tectonic zone. Regional correlations and determination of the stratigraphic sequence have been persistent problems. Orthoquartzites form a regional marker unit, and much effort has been directed at determining their stratigraphic position(s). The 1996 field program in the area of Pipedream and Third Portage lakes led to the recognition of the youngest rocks known in the WLg, 2.71 Ga felsic volcanic rocks. The 2.71 Ga felsic rocks were interpreted to stratigraphically overlie orthoquartzite and they are associated with komatiites. In 1998, mapping continued to the north (Meadowbank River) and south (Amarulik-Tehek Lakes), to establish relationships to older, 2.8 Ga volcanic suites reported in those areas.

In the Meadowbank River area, an upward-younging stratigraphic sequence comprising spinifex-textured komatiite flows and interlayered quartz-eye felsic volcanic rocks is unconformably overlain by conglomerate and orthoquartzite. The conglomerate grades from heterolithic to oligomictic toward the quartzite, and cross-bedding in the quartzite youngs upward away from the unconformable contact. The unconformity is repeated by upright folds, and both the folds and the unconformity are truncated by granite. An imprecise U-Pb zircon age of 2.8 Ga reported for the felsic rocks implies the presence of two ages (2.8 and 2.71 Ga) of komatiite-felsic volcanic suites in the WLg. However, the accuracy of the older age should be reevaluated. A more varied package of mafic, intermediate and felsic volcanic rocks associated with iron-formation and minor greywacke structurally overlies the quartzite, in what may be a stratigraphic relationship as well. The upper volcanic package also includes a unit of ultramafic rocks, but recrystallization to amphibolite-facies paragneisses has obliterated primary textures.

In the Amarulik-Tehek Lakes area, the WLg comprises psammitic greywackes interlayered with iron-formation and amphibole hornfels, the atter interpreted as metamorphosed rocks of mixed chemical and clastic sedimentary parentage. Amphibole hornfels extends northward to the Meadowbank iron-formation-hosted gold deposits and includes rocks previously mapped as intermediate volcanic rocks. The new mapping implies that an age of ca. 2.8 Ga reported for volcanic rocks south of Amarulik Lake is invalid, as the area is underlain by greywackes, albeit with volcanogenic components. An elliptical structural dome (ca. 20x30 km) is defined by outward-dipping bedding and schistosity, and encompasses smaller scale structural complexities such as concentric dip reversals. Orthoquartzite and metacarbonate lie near the eastern margin of the dome, and the distribution of lithological units suggests fold interference patterns. Mineral assemblages are typical of amphibolite-facies metamorphic grade, whereas to the north, chloritoid-bearing greenschist-facies parageneses prevail, suggesting that the Meadowbank gold deposits lie near the greenschist-amphibolite transition.