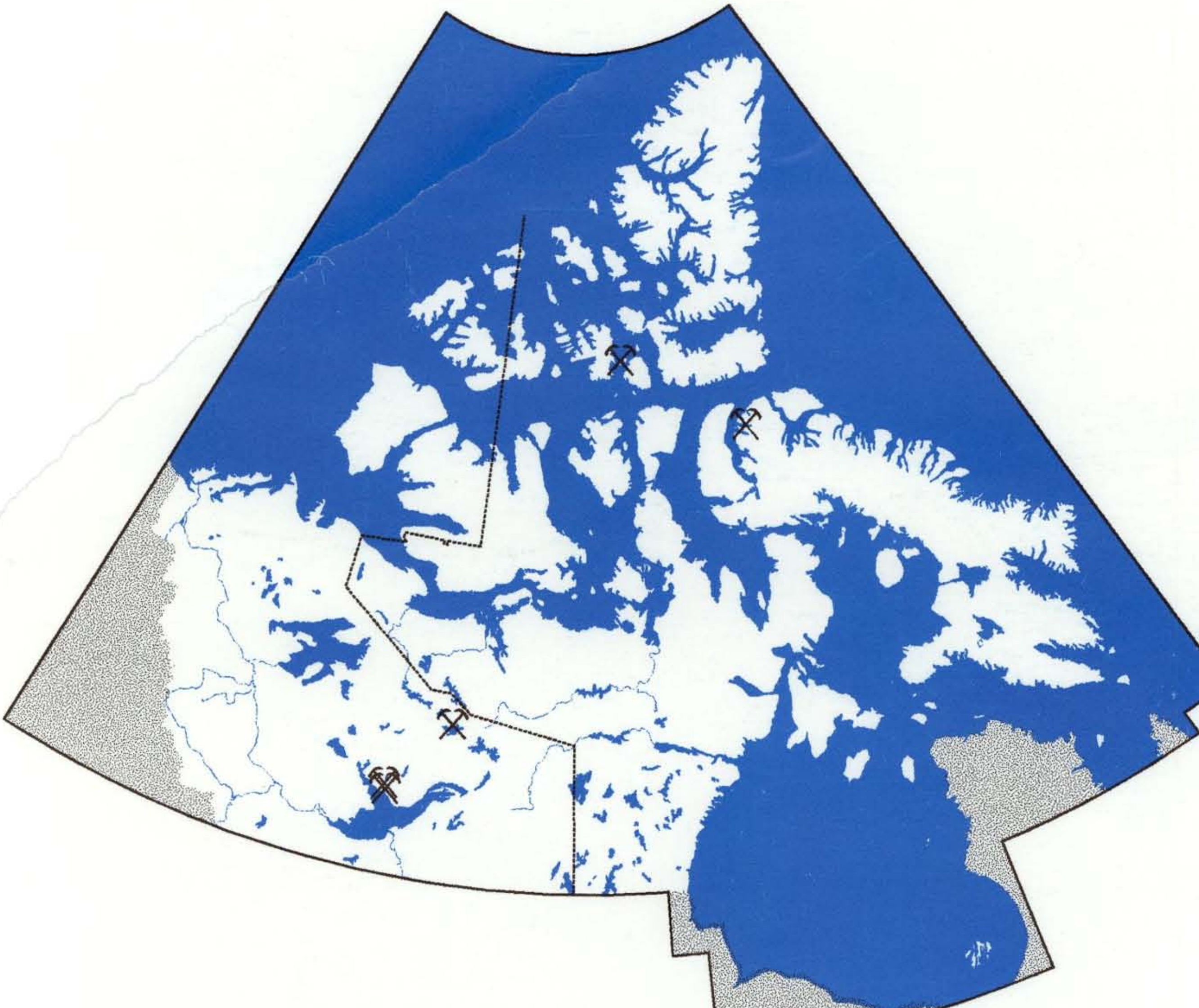
27th Yellowknife Geoscience Forum

Program & Abstracts of Talks & Posters

24 - 26 November 1999



Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

NWT Chamber of Mines

Resources, Wildlife & Economic Development
Government of the

1999 Geoscience Forum Technical Sessions
Explorer Hotel, Katimavik Rooms A & B

Thursday, November 25, 1999

Western Churchill NATMAP Session
Chair: Carolyn Relf

08:25	Simon Hanmer and C. Relf: Western Churchill NATMAP Project: the year in review.
08:40	Larry Aspler: Field studies of Archean and Paleoproterozoic supracrustal rocks in the Sealhole-Fitzpatrick lakes and Victory-Mackenzie lakes areas, Nunavut.
09:00	Kate MacLachlan et al.: U-Pb geochronological constraints on Archean and Proterozoic deformation: Yathkyed-Angikuni area, Western Churchill Province.
09:20	Rob Rainbird et al.: Progress toward a tectonostratigraphic model for the Paleoproterozoic Baker Lake Basin.
09:40	Penny Henderson: Drift Prospecting in the MacQuoid Lake greenstone belt, Kivalliq region, Nunavut.
10:00	Coffee Break
10:20	Subhas Tella et al.: Bedrock mapping studies in the Akunak Bay area, Kivalliq region, Nunavut: A progress report.
10:40	Hamish Sandeman et al.: Implications of geochemical and isotopic data for metavolcanic rocks of the MacQuoid-Gibson lakes area, Kivalliq region, Nunavut.
11:00	Jim Ryan et al.: Archean and Paleoproterozoic fault history of the Big Lake shear zone, MacQuoid-Gibson lakes area, Kivalliq region, Nunauvt.
11:20	Andrea Mills et al.: Investigation of the tectonometamorphic history of the Uvauk complex, Nunavut.
11:40	Eva Zaleski et al.: Lithostratigraphy, age relationships and structure of the Woodburn Lake Group, western Churchill Province, Nunavut.

Lunch: 12:00 to 13:30

New and Ongoing Government Geoscience Session
Chair: Dave Scott

13:30	Chris Harrison et al.: New mineral occurrences on northeastern Ellesmere Island and new opportunities for mineral exploration in northern Nunavut.
13:50	Wouter Bleeker et al.: Why the Slave Province got a little bigger.
14:10	John Ketchum et al.: Field relations and U-Pb geochronology of the Central Slave Cover Group in the Yellowknife greenstone belt and Central Slave Basement Complex at Point Lake.
14:30	Valerie Jackson: Snare River mapping project: Results from 1999.
14:45	Coffee Break
15:00	John Waldron et al.: Evolution of the Burwash sedimentary basin.
15:20	Keith Sircombe et al.: Detrital zircon geochronology of the Yellowknife Supergroup: Basement reconnaissance, sedimentary provenance and tectonic implications.
15:40	Carolyn Relf and J. Cusveller: C.S. Lord Northern Geoscience Centre: Past, present and future.
15:50	Dave Scott: The Canada-Nunavut Geoscience Office: An introduction to its mandate and geoscience program.

Posters:
Morning coffee break: Mineral Exploration, Oil and Gas, Western Churchill NATMAP
16:00 to 18:00 h: Government Geoscience, EXTECH, Diamonds (refreshments will be available)

1999 Geoscience Forum Technical Sessions
Explorer Hotel, Katimavik Rooms A & B

Friday, November 26, 1999

Yellowknife EXTECH Session
Chair: Karen Gochnauer & Lyn Anglin

08:30	Lyn Anglin: Introduction
08:40	Hendrik Falck et al.: Yet another new look at the Yellowknife stratigraphy: give me a break.
08:55	John Kerswill and H. Falck: Initial report of the Yellowknife EXTECH regional metallogeny project: Highlights and implications.
09:15	Cairns, S.: In-fill mapping in the Goodwin Lake - Thistlethwaite Lake map area: Progress and preliminary results.
09:30	Craig Finnigan and N. Duke: Recognition of quartz feldspar porphyry intrusions in the Yellowknife greenstone belt.
09:45	James Siddorn and A. Cruddon: A preliminary comparison of the structural geology of the Giant and Con gold deposits, Yellowknife, NWT.
10:05	Coffee Break
10:20	Peter Thompson: Metamorphism and the origin of gold deposits in the Yellowknife greenstone belt - Phase I.
10:40	John Katsube et al.: Electrical characteristics of mineralized and non-mineralized rocks from the Yellowknife area, Northwest Territories.
11:00	Brian Cousens et al.: Pb-Pb isotopic dating of sulphide mineralization in the Yellowknife volcanic belt.
11:20	Norm Duke: Evidence for and metallogenic significance of terminal Kenoran orogenic collapse in the Superior and Slave Provinces.
11:40	Ed van Hees et al.: Stable isotopes and fluid inclusion gases as exploration guides to ore in large-scale gold systems: Examples from the Slave and Superior Provinces.

Lunch: 12:00 to 13:15

Diamond Session
Chair: John Armstrong

13:15	John Armstrong: Kimberlite Indicator and Diamond Database (KIDD): A digital compilation of publically available till sampling results for the Slave Craton.
13:30	Bruce Jago: QC is more than just numbers.
13:50	Paul Davie: Summary of exploration results for Munn Lake and Yambe Lake.
14:10	Coffee Break
14:20	Andrea Noyes: Feasibility study of U-Pb ilmenite geochronology.
14:40	Alan Jones: Imaging Slave upper mantle heterogeneity using deep-probing electromagnetic experiments.
15:00	Winspear Resources (speaker TBA): Snap Lake developments.
15:30	John Armstrong et al.: Preliminary mineralogical and stable isotope geochemistry studies of the Leith Lake sövite dykes: An Archean mantle sample.

Posters:
Government Geoscience, EXTECH, Diamonds
(can be viewed during lunch and coffee breaks)

1999 Yellowknife Geoscience Forum at a Glance

Wednesday, November 24

	Explorer Hotel Kat A&B	Yk Inn, Garnet Room		
a.m.	Mineral Exploration	Drilling on Ice		
p.m.	Oil & Gas Exploration	Various		
	Poster Session (16:00-18:00)			
	19:30 - Charles Camsell Talk: Dr. Phil Currie, Tyrrel Museum			

Thursday, November 25

	Explorer Hotel Kat A&B	Yk Inn, Garnet Room	Yk Inn Silver Room	Yk Inn Copper Room
a.m.	Western Churchill NATMAP	MVRMA	EXTECH GIS workshop	Environmental Management
p.m.	Government Geoscience	Gwich'in and Sahtu Regulatory Boards		Environmental Management
	Poster Session (16:00-18:00)			

Friday, November 26

	Explorer Hotel Kat A&B	Yk Inn, Garnet Room		
a.m.	EXTECH Session	Nunavut Boards		
p.m.		Various		

Saturday, November 27

	Air Tindi Building, 3rd Floor
a.m.	CIM Short Course: Geophysical and geochemical imaging of Canada's upper mantle
p.m.	CIM Short Course: Geophysical and geochemical imaging of Canada's upper mantle

1999 Geoscience Forum Technical Sessions
Explorer Hotel, Katimavik Rooms A & B

Wednesday, November 24, 1999

Mineral Exploration Session
Chair: Steve Goff

08:15 Mike Vaydik, NWT Chamber of Mines: Introduction and Welcome

08:20 Jason Sharp: NWT and Nunavut Exploration Overview.

08:40 Robert Carpenter et al.: Geological setting of the lode gold deposits along the Meliadine trend, Rankin Inlet greenstone belt, Nunavut.

09:00 Brian Alexander et al.: Meadowbank gold deposits, Nunavut (NWT) Canada.

09:20 Al Turner et al.: Precious metal mineralization in the Mallery Lake epithermal system, Nunavut, Canada.

09:40 Stephanie Prior et al.: Geology and geochemistry of mineralized banded iron formation, Committee Bay Region, Nunavut.

10:00 Coffee Break

10:20 Carey Costello et al.: Geochemical and fluid inclusion studies of the Colomac Gold Mine, NWT, Canada

10:40 David Webb: An Archean volcanogenic massive sulphide deposit at Russell Lake.

11:00 Leon La Prairie: Darnley Bay Resources Limited - project highlights

Lunch: 11:40 to 14:00

Oil and Gas Session
Chairs: Todd Burlingame & Calvin Brackman

13:00 Todd Burlingame: Introduction and Welcome.

13:05 Mimi Fortier: Oil and Gas Exploration Overview.

13:20 David Morrow and B.C. MacLean: Regional geology and play opportunities in the Trout and Slave Plains, Liard Region, NWT.

13:40 Jim Good et al.: Northwest Territories oil and gas exploration by Canadian Forest Oil Ltd.

14:00 Kevin Heffernan, Trans Canada Pipeline Ltd.: Natural gas: Continental drivers.

14:20 Coffee Break: Adrienne Jones et al.: Beaufort-Mackenzie Mineral Development Area web site.

14:40 Jim Dixon: Hydrocarbon potential of the Mackenzie Delta and Tuktoyuktuk Penninsula, Northwest Territories.

15:00 Chevron Resources Ltd.: TBA.

15:20 Enbridge Pipelines (NW) Inc.: TBA.

15:40 Cal Brackman: Northwest Territories petroleum trends and development projections.

Posters:
16:00 to 18:00 h: Mineral Exploration, Oil and Gas, Western Churchill NATMAP
(refreshments will be available compliments of Kee Scarp Ltd.)

1999 Geoscience Forum Regulatory Sessions
Yellowknife Inn, Garnet Room

Wednesday, November 24, 1999

11:00 Anne Wilson, Dept. of Environment: Drilling on ice study results

12:00 Lunch

13:00 Robin Reilly, RWED: NWT Protected Areas Strategy (talk unconfirmed at time of printing).

14:00 George Govier, Sahtu Land and Water Board: Water licencing and land use permitting within the Sahtu Settlement Area.

15:00 Peter Bengts, WCB: Update on changes to the Mine Health and Safety Act.

16:00 Dave Nutter, DIAND: Update on arsenic at Giant Mine.

Thursday, November 25, 1999

09:00 Ken Weagle, Mackenzie Valley Land and Water Working Group: Land and water regulation under the MVRMA.

10:00 Heidi Klein, Mackenzie Valley Environmental Impact Review Board: Environmental Assessment under the MVRMA.

11:00 Aboriginal and Territorial Relations, DIAND (speaker TBA): Update on Land Claims in the NWT.

12:00 Lunch

13:00 Gwich'in Land Use Planning Board (speaker TBA): Land use planning in the Gwich'in Settlement Area.

14:00 Gwich'in Land and Water Board (speaker TBA): Water licencing and land use permitting within the Gwich'in Settlement Area.

15:00 Sahtu Land and Water Board (speaker TBA): Water licencing and land use permitting within the Sahtu Settlement Area.

16:00 Susan McKenzie, Sahtu Land Use Planning Board: Land use planning in the Sahtu Settlement Area.

Friday, November 26, 1999

09:00 Wayne Johnson/Keith Morrison, Nunavut Tunngavik Inc.: Mineral management on Inuit owned lands.

10:00 Dionne Filiatrault, Nunavut Water Board (talk unconfirmed at time of printing): Water licencing under the NLCA.

11:00 Jaida Edwards, Nunavut Impact Review Board (talk unconfirmed at time of printing): Environmental assessment under the NLCA.

12:00 Lunch

13:00 Anne Wilson, Dept. of Environment: Drilling on ice study results.

14:00 Charles Arnold, Prince of Wales Northern Heritage Centre: Identification of burial sties and other places of archeological significance.

15:00 Linda Graf, Environmental Impact Screening Committee: Environmental screening and review in the Inuvialuit Settlement Region.

1999 Geoscience Forum EXTECH GIS Workshop
Yellowknife Inn, Silver Room

Thursday, November 25, 1999

This session has been organized for people that have an interest in the Yellowknife EXTECH and digital geoscience information, dissemination and analysis. The objectives of the session are to demonstrate:

- the strengths and weaknesses of GIS;
- how GIS was used in EXTECH's I and II (Snow Lake, Manitoba and Bathurst, New Brunswick);
- specific applications using GIS-modelling for evaluating mineral potential; and
- provide an update on the current status of the 2D and 3D projects in the Yellowknife EXTECH.

08:30 Danny Wright and H.Falck: Welcome and Opening Remarks.

08:35 Danny Wright: GIS component of EXTECH I and EXTECH II.

08:55 Jeff Harris: GIS applications in the Swayze Belt, northern Ontario.

09:20 Lori Wilkinson: GIS and modelling for diamond exploration.

09:45 Garth Kirkham and M. Stoakes: 3D GIS and possibilities for the Yellowknife EXTECH.

10:10 Doug Irwin: 2D GIS and the Yellowknife EXTECH: An update.

10:35 Coffee Break

10:50 Danny Wright and Hendrik Falck: Open Discussion: GIS and the Yellowknife EXTECH.

12:00 Lunch

Yellowknife EXTECH Program (1999-2000) and Research Directions (2000-2001)

Con Mine Rec Hall

Friday, November 26, 1999

17:30 to 21:30 Meeting will cover summaries of progress on current projects, and discuss future directions/research priorities for ongoing work. Pizza and refreshments will be served.

Transportation will available from the Explorer Hotel - departing from front entrance at 17:00 and 17:30

1999 Geoscience Forum
Environmental Management and the NWT Resource Industry
Yellowknife Inn, Copper Room

Thursday, November 25, 1999

09:00-10:15
Approaches to Environmental Monitoring and Assessment

Speakers TBA

10:30-11:45
Management of Cumulative Environmental Effects

Speakers TBA

13:00-14:15
Environmental Management Tools

Speakers TBA

14:30-15:45
Environmental Protection and Remediation

Speakers TBA

Program incomplete at time of printing: a list of speakers in this session will be available at the Geoscience Forum Registration Desk.

Mineral Exploration, Oil & Gas and Western Churchill NATMAP Posters

Wednesday morning, November 24 to Thursday noon, November 25

Davis, W.J. et al.:
  Preliminary U-Pb geochronological results from the Gibson Lake-Cross Bay area, Kivalliq Region, Nunavut.

DIAND NWT Geology Division:
  New products and services.

Dumont, K. and Kiss, F.:
  GSC's aeromagnetic surveys north of sixty.

Greiner, E. et al.:
  A metallogenic evalution of the paleoplacer potential of the pyritic quartz-pebble conglomerates in the Woodburn Lake Group, Nunavut.

Hadlari, T. et al.:
  Sequence stratigraphy of the lower Baker Lake Group (Dubawnt Supergroup), Baker Lake Basin, Thirty Mile Lake area, Nunavut.

L'Heureux, R.L. et al:
  Evaluation of metamorphosed host rocks of multi-facies (auriferous) iron formations of the (southeastern) Woodburn Lake Group, Churchill Province, Nunavut.

MacLean, B.C. and Cook, D.C.:
  Evidence for mobile and shallow salt under the Franklin Mountains, GSC Contrib. # 1999165.

McMartin, I. and Henderson, P.:
  A photo gallery of small-scale erosional surface bedrock features interpreted as ice flow indicators, Kivalliq Region, Nunavut.

McMartin, I.:
  Distribution and character of Au and As in glacial sediments from the Meliadine Trend, Rankin Inlet area.

McMartin, I. et al.:
  MITE - Hg Project in the Kaminak Lake area, Kivalliq Region, Nunavut: A Progress Report.

Ryan, J.J. et al.:
  Sequence stratigraphy in the Archean Rankin Inlet greenstone belt, Rankin Inlet area, Kivalliq Region, Nunavut.

Ryan, J.J. et al.:
  Revision of Archean and Paleoproterozoic stratigraphy at Rankin Inlet: implications for the timing of multiple regional deformations, Kivalliq Region, Nunavut.

Sandeman, H. et al.:
  Petrochemical data from the Proterozoic MacQuoid and Kaminak dyke swarms, Hearne domain, Churchill Province, Nunavut.

Sharp, J.:
  Is there potential for epithermal gold in the Baker Lake Group?

Tella, S. et al.:
  Open file geological maps of the Akunak Bay area, Kivalliq Region, Nunavut.

terMeer, M. et al.:
  Tectonometamorphic history of the Nowyak complex, Nunavut, Canada.

Wilkinson, L.:
  Western Churchill NATMAP: Role of GIS in large, multi-agency, and multi-disciplinary projects.

Government Geoscience, EXTECH and Diamond Posters

Thursday noon, November 25 to Friday afternoon, November 26

Armstrong, J.:
Kimberlite Indicator and Diamond Database (KIDD): A digital compilation of publically available till sampling results from the Slave Craton.

Bennett, V.C.R.:
Preliminary results of the Kwejinne Lake supracrustal belt - Ghost Lake granulite domain geological transect: A well exposed example of an oblique crustal section, the first of its kind in the Slave Province, NWT.

Bleeker, W. et al.:
Meso- and paleoarchean basement rocks of the Slave Province: Distribution in space and time.

Cairns, S.R.:
In-fill mapping in the Goodwin Lake - Thistlethwaite Lake map area, Parts of 85 J/16, 85 O/1, 85 P/3,4 and 5: Progress and preliminary results.

Falck, H. et al.:
Yet another new look at the Yellowknife stratigraphy: Give me a break.

Gochnauer, K.:
Gold deposit studies along a NNE linear trend from the north end of the Yellowknife belt: Clan Lake to Nicholas Lake.

Goff, S.P. et al.:
Metallogeny of the SE Bear Province.

Jackson, V.:
The Snare River Project: Results from 1999 mapping.

Katsube, J. et al.:
Electrical characteristics of mineralized and non-mineralized rocks from the Yellowknife area, NWT.

Kerr, D. & Wilson, P.:
Preliminary surficial geology studies and mineral exploration considerations in the Yellowknife area, Northwest Territories.

Kerswill, J. and Falck, H.:
Initial report of the Yellowknife EXTECH regional metallogeny project: Highlights and implications.

King, J.B. and Ansdell, K.M.:
Amphibolite lithogeochemistry and stable isotope analysis of quartz veins at the Discovery Mine property, southern Slave Province, NWT: Preliminary results.

Martel-Amesse, R. et al.:
Structure, mineralized quartz veins and volcanology of the Clan Lake volcanic complex, NWT.

Nickerson, D.:
Biogeochemical survey - Yellowknife area.

Ootes, J. and Jackson, V.:
Sleeping Bear intrusion, Kwejinne Lake, southwestern Slave Province, NWT.

Renaud, J. et al.:
Petrogenetic study of variolitic pillow - massive variolitic - cherty tuff cycles within the Yellorex Flows.

Santaguida, F.:
Hydrothermal alteration in the Giant Mine area, Yellowknife, NWT.

Siddorn, J.P. and Cruden, A.R.:
A preliminary comparison of the structural geology of the Giant and Con gold depsoits, Yellowknife, Northwest Territories.

Strand, P. and Wyllie, R.:
2-D datamining - Lithogeochemical database, Yellowknife mining camp: Feasibility study for EXTECH 3.

1999 Geoscience Forum CIM Short Course
Geophysical and Geochemical Imaging of Canada's Upper Mantle
Air Tindi Building, 3rd Floor

Saturday 27 November 1999

08:40 Welcome

09:00 Michael Bostock (UBC): Imaging the lithospheric mantle using seismological methods

10:30 Coffee Break

11:00 Alan G. Jones (GSC): Information about the continental mantle from deep electromagnetic studies

Lunch: 12:00 to 13:30

13:30 Dante Canil (UVic): Petrological and geochemical investigations of cratonic mantle bearing on the origin and exploration of diamonds

14:30 Bill Davis (GSC): Geochronological and isotopic constraints on the formation and evolution of Archean cratons

15:30 Coffee Break

16:00 Don Francis (McGill): Cratonic Mantle Roots: the remnants of a chondritic Archean mantle

17:00 Dave Snyder (GSC): CUMIC: Canadian Upper Mantle Imaging Consortium plans

17:20 Discussion

MEADOWBANK GOLD DEPOSITS, NUNAVUT (N.W.T.) CANADA
CUMBERLAND RESOURCES LTD.

Alexander, B.
Cumberland Resources

The Meadowbank Gold Project is located 70 km north of the barge accessible community of Baker Lake, Nunavut.

Regional geology and prospecting led to the discovery of iron formation hosted gold on the property in 1989. A 1992 resource of 203,982 oz. was hosted in the Third Portage deposit.

In 1995 a renewed joint venture program operated by Cumberland outlined the Goose Island deposit and expanded the Third Portage deposit to a combined 805,000 oz. resource. Aggressive drilling in 1996 (11,000 m drilling) expanded resource estimates to over 1.1 million oz. The 1997 program (13,600 m drilling) resulted in a resource increase of 36% to 1.5 million oz. Cumberland also completed its 100% acquisition of the project.

Cumberland drilled 18,000 m in 97 holes in 1998 expanding all deposits. The Company also completed significant environmental work and in October announced pre-feasibility studies had begun. Independent geological resources in 1998 were 1.73 (cut) and 1.97(uncut) million ounces.

The Meadowbank gold deposits are hosted by iron formations of the Archean Woodburn Lake Group in the Churchill Supergroup. The property contains four closely spaced deposits: North Portage, Third Portage, Bay Zone and Goose Island, which occur along a 3 km by 1 km wide trend. The deposits are located within a structurally complex area in a narrow neck of supracrustal rocks, sandwiched between granite plutons. The distinct structural fabric imprints of three to four principle deformation increments are preserved throughout the property.

The Third Portage deposit is contained in an intercalated sequence of dominantly oxide facies iron formation, quartzo-feldspathic clastic and/or intermediate volcaniclastic rocks which are recumbently folded around an ultramafic core. Iron Formation in the Third Portage deposit area likely constitutes multiply transposed parallel sequences, generally dipping moderately to shallowly to the west, which are later refolded and metamorphosed at greenschist to granulite facies.

Gold mineralization in the Third Portage Deposit is intimately associated with sulphide mineralization (dominantly pyrrhotite/pyrite). These sulphides occur as a replacement of magnetite in the oxide iron formation in the plane of S0//S1, and as fracture fill +/- silica and disseminations in both the iron formation and surrounding clastic units. The bulk of the gold mineralization in the deposit is contained within the iron formations, with mineralization in the clastic/volcaniclastic units probably representing remobilization and secondary enrichment by gold-bearing fluids.

1999 activities included 6000 m of drilling and 400 meters of surface trenching to expose bedrock surfaces and contacts for detailed mapping, and to sample ore zones projected to surface from diamond drill hole data. A three dimensional model including specific gravity information is in progress. Revised resource estimates and pre-feasibility results are expected over the next 3 months.

PRELIMINARY MINERALOGICAL AND STABLE ISOTOPE GEOCHEMISTRY STUDIES OF THE LEITH LAKE SÖVITE DYKES: AN ARCHEAN MANTLE SAMPLE

[1]Armstrong, J.P.; [2]Barnett, R.L.; and [3]Longstaffe, F

[1]DIAND NWT Geology Division [2] RL Barnett Geological [3] Dept. Earth Sciences, University of Western Ontario

Field investigations of the late Archean Leith Alkaline complex during the summer of 1999 identified two further occurrences of sövite (calcitic carbonatite) dykes and constrained the extent of alkaline rocks and carbonatite on the southern exposure. The carbonatite magmatism occurs along the southern boundary of the Nardin Core Complex which was exhumed during late Archean extension in the southwestern portion of the Slave Province. Mineralogically the western and eastern most dykes are magnetite-augite sövites and the central dyke is a magnetite-sodic amphibole (winchite-magnesioriebeckite) sövite. Amphibole and clinopyroxene demonstrate normal zonation. All dykes contain accesssory REE enriched apatite and epidote, Ba-Sr-REE sulphates and biotite. Sr-calcite is the carbonate phase occurring with trace strontianite ($SrCO_3$) along late fractures and cleavage dislocation planes. Strontium enrichment (to > 3wt% SrO) suggests preservation of a primary magmatic signature; depletions in SrO occur at calcite-apatite and calcite-biotite grain contacts.

Carbon and oxygen isotope geochemical analyses were undertaken to determine the extent, if any, of contamination by organic or inorganic carbon during this Archean alkaline magmatic event. A total of eight calcite separates (at least 2 per dyke) were extracted from thin section slabs by a high speed precision drill equipped with a burr bit. Results form a tight cluster with $\delta^{18}O_{V\text{-}SMOW}$ ranging from 7.94 to 8.34‰ and $\delta^{13}C_{PDB}$ ranging from -8.85 to -8.21‰. These data are depleted in ^{13}C (~ 1‰) compared to the inferred mantle field values for carbon (-5 to -7‰ $\delta^{13}C$) and relative to other carbonatite occurrences worldwide. Oxygen results lie to the enriched side for the mantle "box" and are compatible with other carbonatite bodies. The shift toward isotopically light ^{13}C, away from the inferred mantle field, may indicate some contribution from an organic carbon source, further supporting radiogenic isotopic evidence for older continental crust beneath the southwestern Slave Province.

KIMBERLITE INDICATOR AND DIAMOND DATABASE (KIDD): A DIGITAL COMPILATION OF PUBLICALLY AVAILABLE TILL SAMPLING RESULTS FOR THE SLAVE CRATON

Armstrong, J.
DIAND NWT Geology Division

The presence, abundance, mineralogy, and spatial distribution of kimberlite and diamond indicators are fundamental to exploration for and the evaluation of primary diamond deposits. The purpose of KIDD is to create a digital database of kimberlite and diamond indicator sample locations and results, from data contained within hard-copy (paper) Assessment Reports submitted pursuant to the Canada Mining Regulations, and make it accessible to clients. Results from over 75 000 kimberlite indicator samples are currently recorded in a haphazard manner within various publically available Assessment Reports.

Hard copy information is transformed to digital data (KIDD) by scanning tabular sample picking results and locations (UTM or lat/long). For reports that do not contain tabular location information, sample locations (UTM's) are generated by digitising maps utilising an in-house Lisp-ACAD program. Locations are then merged with scanned picking results. Compilation has progressed by 1:250K NTS sheets; products include Excel spreadsheets and database (*.dbf) files for each quarter million NTS sheet. Data is checked by plotting and manipulation with ArcView. Roughly 35 000 samples covering the western and northern portions of the Slave craton have been compiled. Funding for the project expires March 31, 2000, by when it is hoped that all currently publically available till data will be converted to a digital format.

GEOLOGY OF THE HENIK, MONTGOMERY AND HURWITZ GROUPS, SEALHOLE ANDFITZPATRICK LAKES AREA, NUNAVUT

[1]Aspler, L.B., [2]Höefer, C. and [3]Harvey, B.J.A.
[1]23 Newton St Ottawa ON, K1S 2S6; [2]Institut für Allgemeine und Angewandte Geologie; Ludwig Maximilians University, Munich; Germany; [3]905 Laflin Avenue, Cornwall, ON, K6J 5J3

Bimodal mafic-felsic volcanic rocks, consistent with rift and back-arc tectonic settings, form lenses in the lower Henik Group (Neoarchean). Emplacement of granitic bodies within the Henik Group was syn- to post-tectonic. Montgomery Group (age uncertain) conglomerates unconformably overlie Archean basement and are voluminous, suggesting fault-generated relief during sedimentation. Lower Hurwitz Group continental strata record progressive Paleoproterozoic intracratonic basin expansion; locally preserved dolostone beds near the base of the predominantly fluvial Maguse Member (Kinga Formation) reflect a short-lived marine incursion. Pebbly arkose beds between mature arenites of the Maguse and Whiterock members signify slope failure from basement monadnocks. Unusual feldspar megacryst-bearing gabbro sills in the Hurwitz Group were likely fed by hitherto unreported dykes which cut basement. Well-foliated basement clasts in Montgomery and Hurwitz group conglomerates imply deformation (likely Archean) before Paleoproterozoic dome and basin basement-cover infolding. Variably oriented folds and faults, including a duplex-like structure near the core of a basement-cover synclinorium, accommodated constrictions arising from Paleoproterozoic concentric infolding.

PRECAMBRIAN GEOLOGY, VICTORY AND MACKENZIE LAKES, NUNAVUT, AND SIGNIFICANCEOF "MACKENZIE LAKE METASEDIMENTS" (PALEOPROTEROZOIC HURWITZ GROUP)

[1]Aspler, L.B., [2]Armitage, A.E., [3]Ryan, J.J., [4]Hauseux, M. , [4]Surmacz, S., and [5]Harvey, B.J.A.
[1] 23 Newton St Ottawa ON, K1S 2S6; [2]Comaplex Minerals Corp., Suite 901, 1015 Fourth St. S.W., Calgary Alberta T2R 1J4; [3]Geological Survey of Canada; [4]Saminex, 25 Hobart Drive, North York, ON, M2J 3J6; [5]905 Laflin Avenue, Cornwall, ON, K6J 5J3

Previously enigmatic siliciclastic remnants comprising quartz arenites, quartz pebble conglomerates, conglomerates and arkoses ("Mackenzie Lake metasediments") in the Victory-Mackenzie lakes area correlate with the lower Hurwitz Group (Paleoproterozoic; Noomut and Padlei formations; Maguse Member, Kinga Formation) based on lithologic, sedimentologic and stratigraphic data. However, northwest of Mackenzie Lake, mafic volcanic, pelitic and psammitic rocks (± mature arenites) occurring as screens within leucogranites and previously mapped as "Mackenzie Lake metasediments" are likely part of the Kaminak Group (Neoarchean). A major structural difference accompanies lithological changes northwest of Mackenzie Lake. On the southeast, Archean and Proterozoic rocks are tightly to isoclinally folded about steeply-dipping axial surfaces and shallowly-plunging hinge lines, contain shallowly plunging stretching lineations and are cut by steeply dipping faults, whereas rocks to the northwest display intense folds, fabrics and shear zones that are shallowly-dipping, yet display similar shallowly plunging stretching lineations. We speculate that the lithologic and structural changes reflect a change in structural level, with rocks exposed on the southeast representing a suprastructure that preserves the Hurwitz Group in basement-cover infolds, and rocks on the northwest representing an infrastructure that balances shortening due to basement-cover infolding at shallow levels by shallowly dipping intrabasement high-strain zones and distributed ductile strain at depth. This infrastructure is inferred to emerge at the surface along postulated faults that may follow lineaments expressed by regional aeromagnetic data. Deformation occurred pre- ca. 1.85-1.83 Ga (age of pristine lamprophyre dykes), and post- ca. 2.45 Ga (age of foliated Kaminak dykes). Clasts in Hurwitz conglomerates lack internal tectonic fabrics despite penetratively deformed source rocks, hence the primary tectonic imprint was Paleoproterozoic. Base metal prospects discovered by Comaplex Minerals Corp. in Kaminak Group volcanogenic strata display features characteristic of volcanic massive sulphides.

PRELIMINARY RESULTS OF THE KWEJINNE LAKE SUPRACRUSTAL BELT - GHOST LAKE GRANULITE DOMAIN GEOLOGICAL TRANSECT; A WELL EXPOSED EXAMPLE OF AN OBLIQUE CRUSTAL SECTION, THE FIRST OF ITS KIND IN THE SLAVE PROVINCE, NWT.

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

Preliminary mapping results and field observations, that form the framework of a geochronological and tectonometamorphic Ph.D study of a well exposed, oblique crustal section in the SW Slave Province, are summarised here and on a poster presentation at this meeting.

The geological transect across this newly discovered crustal section is associated with a 3 year (1998-2001) DIAND mapping project (Jackson, 1998; Jackson, this volume) providing 1:50 000 coverage of the areas west, south and south west of the Wijinnedi Lake Area map sheet (Henderson, 1998). Mapping in 1998 revealed the presence of two distinct crustal domains within the transect; the greenschist to amphibolite facies Kwejinne Lake Supracrustal Belt (KLSB), and the Ghost Lake granulite Domain (GLD). The boundary between the two was initially postulated to be faultbound, however mapping this summer revealed that the boundary is, in fact, transitional and, hence, the KLSB - GLD transect represents a continuous, well exposed crustal section from lower amphibolite facies rocks, (indicator minerals: andalusite-muscovite-cordierite), to high temperature granulite facies rocks (indicator minerals: orthopyroxene-potassium feldspar-sillimanite). This exciting discovery represents the first of its kind in the Slave Province.

Other significant results from 1999 mapping are summarised below:

1. The transect records an eastward increase in crustal depth along which brittle, upright, isoclinally folded packages of amphibolite facies sedimentary and volcanic rocks give way to ductile, moderately dipping sheets of granitic rocks, disaggregated mafic to intermediate rocks and sedimentary rocks ranging from paragneisses to diatexites.

2. The transition from a brittle to ductile deformation regime is accompanied by an increase in metamorphic grade and degree of melting. Rarely, the transition from paragneiss to metasedimentary diatexite, (along with accompanying melting reactions), is preserved.

3. Granulites across the transect are characterised by two distinct deformation styles: Ductile deformation, manifested by 'soupy' accumulations of ascending and in situ melts, and brittle-ductile deformation, manifested by a broad structural dome. Detailed mapping of the dome revealed i) a concentric lithological pattern correlating well with residual total magnetic field data, and ii) an increase in metamorphic grade and degree of melting towards the core of the dome.

4. A metamorphic break was identified on the eastern boundary of the transect. A topographic lineament, interpreted by Hendersen (1998) to be a Proterozoic cataclastic fault zone, separates amphibolite facies rocks to the east from granulite facies rocks to the west.

The results summarised here are exciting and important, firstly, because they illustrate the presence of a continuous, oblique crustal section, akin to the Kapuskasing Structure in the Superior Province and unique to the Slave Craton and secondly, the results have significant ramifications on interpreting the Late Archaean tectonothermal history of the area and the Slave Province as a whole.

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WHY THE SLAVE PROVINCE GOT A LITTLE BIGGER

Bleeker, W., Stern, S. and Sircombe, K.
Geological Survey of Canada, 601 Booth Street, Ottawa, ON, K1A 0E8 (wbleeker@nrcan.gc.ca)

We present evidence (see also Bleeker et al., 2000) for extension of the Central Slave Cover Group (Bleeker et al., 1999) into the realm of the northwestern Slave Province, thus uniting all Meso- and Paleoarchean basement of the Slave into a single cratonic nucleus by 2.85 Ga. The diagnostic cover sequence overlies ca. 2.9 Ga basement in the Grenville Lake area and from there can be mapped on both limbs of the Emile River greenstone belt, around the Scotstoun Anticline, and further west into the immediate hanging wall of the Acasta Gneiss Complex.

In the Acasta area, and around the Exmouth Anticline, quartzites, BIF, and overlying mafic volcanic rocks have been previously misidentified as Paleoproterozoic Epworth Group. Detrital zircon data from two quartzite samples are presented to support our new interpretation that the quartzite and BIF sequence overlying Acasta basement correlates with the Central Slave Cover Group and that much of Central Wopmay is in fact Archean. Several greenstone belts are added to the inventory of the Slave Province, which may extend, at surface, as far west as the Wopmay fault zone.

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MESO- AND PALEOARCHEAN BASEMENT ROCKS OF THE SLAVE PROVINCE: DISTRIBUTION IN SPACE AND TIME

Bleeker[1], W., Ketchum[2], J., Stern[1], R., Sircombe[1], K. and Davis[1], B.
1Geological Survey of Canada, 601 Booth Street, Ottawa, ON, K1A 0E8
(wbleeker@nrcan.gc.ca)
[2]Memorial University of Newfoundland, St. John's, NF, A1B 3X5

The Slave craton of the Canadian Shield hosts the oldest terrestrial rocks yet identified (Bowring et al., 1989; Stern and Bleeker, 1998). Furthermore, no less than one third of the craton appears to be underlain by Paleo- and Mesoarchean crust. Arguably, the Slave is also one of the best exposed Archean cratons in the world, thus providing unique opportunities to study pre-2.7 Ga crustal evolution.

To gain a better understanding of Meso- and Paleoarchean rocks underlying parts of the Slave Province, all presently available U-Pb ages, other relevant age data, and some preliminary data sets have been compiled. These ages span a record from 4041±12 Ma, the oldest identified zircon in an Acasta gneiss (R. Stern and W. Bleeker, unpublished data), to 2734±2 Ma, the age of a mafic dyke swarm heralding the break-up of Mesoarchean crust in the southern Slave Province (Bleeker et al., 1999b). The age data, organized by age, location, and data type provide a fascinating record of episodic crustal growth and (or) crustal reworking. A minimum of eleven "events" (*I* to *IX*) can be recognized, with individual events typically lasting ca. 40-60 m.y. and being spaced at ca. 100 m.y. intervals. For example, some characteristic ages are: 4025±12 Ma, ca. 3729±5 Ma, ca. 3600 Ma, ca. 3350 Ma, 3250 Ma, 3155 Ma, 2950 Ma, 2880 Ma, 2835 Ma, and 2734 Ma.

The spatial distribution of many of these age groupings appear to outline overlapping patterns, except for those of a "ca. 2950 Ma tonalite event" and a "ca. 2880 Ma granite event". To date, the former event appears to be restricted to the Central Slave Basement Complex south of Point Lake (Bleeker et al., 1999a), whereas the latter has been recorded from the Acasta Gneiss Complex (R. Stern and W. Bleeker, unpublised data) to the Eokuk Uplift on the Coronation Gulf (e.g., Emon et al., 1999). A mutually exclusive age distribution may point at the presence of a cryptic domain or terrane boundary in Mesoarchean crust of the Slave craton. However, recent mapping (Bleeker et al., 2000) has extended the diagnostic cover sequence of the Central Slave Basement Complex into the northwestern part of the basement domain, thus uniting all Meso- and Paleoarchean rocks into a single basement complex by at least ca. 2.8 Ga.

With future addition of relevant age data, the eleven or so "events" may become more distinct or, alternatively, may blur into a single, more complex history.

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IN-FILL MAPPING IN THE GOODWIN LAKE THISTLETHWAITE LAKE MAP AREA, PARTS OF 85 J/16, 85 O/1, 85 P/3,4 and 5: PROGRESS AND PRELIMINARY RESULTS.

Cairns, S.R.,
NWT Geology Division, DIAND

The Goodwin-Thistlethwaite map area is centred 85 km north of Yellowknife on the southern flank of the Nardin Core Complex (Stubley 1995). Field mapping undertaken in the summer of 1999 was targeted to:

1) fill in gaps in previous 1:50K and smaller scale mapping by Stubley (1993, 1996, 1997, 1998) and others, (Hurdle 1983), (Kermeen 1990) and (Tremblay 1952) and to upgrade the structural, metamorphic, geochemical, and economic data-sets for these areas;

2) characterize the location and nature of the Ormsby Break (Stubley et al. 1997) between Rocky and Wagenitz Lakes;

3) provide further evidence for the detachment of and timing of exhumation of the Nardin Core Complex (NCC);

4) field check data of (Gebert and Johnstone 1988: unpublished data) and incorporate this data for release with this study;

Mapping commenced at Goodwin Lake in the poly-deformed biotite and cordierite grade turbidites of the Burwash Formation. Tight NNE-trending isoclinal folds are openly refolded about east-west axial surfaces. Here and throughout the map area, the dominant regional cleavage (S2) transects the isoclinal folds limbs (F1) at low angles typically 0 to 20 degrees. A quartz-feldspar porphyry dike identified NW of Goodwin Lake cross-cuts the dominant S2 cleavage, but is boudinaged along and exhibits a weak S2 fabric. A sample of this dike is being prepared for U-Pb dating to determine the age of D2 deformation in the area (Pueschel in progress; University of Alberta). Turbidites in the Goodwin Lake area are unusual in their high degree of calc-silicate alteration along fractures, S2 and later cleavage, and as rims on concretions. In the most intensely altered areas, all fabric in the turbidites has been destroyed indicating that alteration post-dated cleavage formation. A unit of massive and locally pillowed garnet-bearing mafic volcanic rocks at Goodwin Lake are intercalated with lenses and beds of intermediate to felsic lapilli tuff, crystal tuff and massive flows. Five to 100m thick, NNE-trending diorite sills cut the volcanic / turbidite package and separate the volcanics from the turbidites. The Goodwin volcanic package, which occurs on the east shore of Goodwin Lake, is contiguous with, although sinistrally offset by the Barker Fault from, the Clan Lake Volcanic Pile (Hurdle 1983). The Goodwin volcanic unit is on strike with the mafic bodies north of Goodwin Lake, including those at the Viking and Discovery past producing gold mines.

Mapping at Nicholas - Eclipse Lakes revealed fabrics, lithology and metamorphic conditions consistent with adjoining maps of (Stubley 1996) and (Tremblay 1952). The Nicholas Lake Fault (NLF) marks a break between NNE-trending F1 fold axial traces and S2 cleavage to the south, and WNW-trending F1 fold axial traces and S2 cleavage to the north. The regionally atypical WNW orientation of S2 cleavage and F1 fold axes north of the NLF is likely in response to the exhumation of the NCC, 4km to the north. The P-T conditions, calculated from almandine bearing turbidites collected various distances from the southern boundary of the NCC will provide further insight into the conditions associated with the exhumation and un-roofing of the NCC (Lewis, in progress: University of Alberta). F1 axial planes south of the NLF are typically flooded with quartz + sericite + chlorite +/- (pyrite, pyrrhotite, arsenopyrite) veins and an abundance of quartz, k-feldspar, muscovite pegmatite dikes.

Limited fieldwork surrounding Thistlethwaite Lake was completed to allow the incorporation of data of (Gebert and Johnstone 1988: unpublished data) into this study. Mapping on the McCrea River north of Thistlethwaite Lake extended detailed (1:50K) mapping of the ortho-, para-gneisses and later granitoid suite of the NCC eastward.

Economic Potential

Of fifty three assay samples collected during fieldwork, eleven contained >100ppb Au, three of these were >1000ppb Au. The three highest assays of 174.20, 116.20, and 1.62 ppm were all located in the Goodwin Lake area. Anomalous (>100 ppb) samples were also obtained south of Eclipse Lake and from the volcanic rocks in the Thistlethwaite Lake area. The number of prospects, and past producing mines in the area, coupled with the large percentage of samples returning anomalous gold grades, indicates the gold potential for this area is very high.

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GEOLOGICAL SETTING OF THE LODE GOLD DEPOSITS ALONG THE MELIADINE TREND, RANKIN INLET GREENSTONE BELT, NUNAVUT.

Carpenter, R.L. and Duke, N.A.
Dept. of Earth Sciences, University of Western Ontario, London, Ontario.
rcarpent@julian.uwo.ca

Several lode-type gold deposits are known along the >60km strike length of the ESE trending Pyke Break Deformation Zone (PBDZ), occurring in the northern portion of the ca. 2.66 Ga. Rankin Inlet Greenstone Belt. All known significant deposits to date are in the hangingwall of the north-dipping PBDZ, which is interpreted as an early F1 thrust that juxtaposes conformable panels of mixed greenschist grade metasediments and metavolcanics within an amphibolite facies dominated terrane.

The Meliadine deposits are hosted within a mixed metasedimentary / metavolcanic succession with multiple layers of iron formation. Graded metaturbidites of the northerly Sam Formation dominantly show south-facing tops, indicating an overturned succession. The Sam Formation is stratigraphically capped by the Upper Oxide Iron Formation and wackes / siltstones of the Tiriganiaq Formation. These metasedimentary units structurally overlay panels of mafic and ultramafic rocks inter-layered with lean iron formation (Wolf-Wesmeg Formation) and variolitic pillowed flows (Falcon Formation). South of the break, stratigraphy is again dominated by south facing siltstones and wackes (Sandhill Formation) and a lithologically diverse shale - iron formation - feldspathic arenite - polymictic conglomerate association (Sic Sic Formation). The Sic Sic Formation resembles Timiskiming-type sediments associated with regional breaks in the Superior Province. The earliest observed fabric is a penetrative ESE schistosity (S2a) which parallels S0 and the F1 trace of the PBDZ. A later, roughly EW cleavage (S2b) overprints the regional S2a fabric and is associated with dextral shearing causing the formation of kilometre scale Z-drag folds.

Gold mineralization is hosted in several different rock types, however, favoured lithologies are iron formation and associated metasediments (Tiriganiaq Upper Contact Zone), as well as along high strain zones at volcanic - sediment contacts (Tiriganiaq Lower Fault Zone). A dominant style of mineralization in all settings consists of quartz ± Fe-carbonate veins with accompanying pervasive sulphidation (arsenopyrite and pyrrhotite) and sericitization of wall rocks. Although the absolute age of gold mineralization remains unknown, field relations and previous geochronological studies indicate a significant Proterozoic overprinting. For example, sulphide and sericite replacement haloes overprint S2b fabrics, which in turn overprint Proterozoic gabbro dykes. Moreover, microscopic free gold grains commonly occur along late fractures within arsenopyrite, indicating late gold deposition. Detailed paragenetic studies currently underway are attempting to determine the extent of Proterozoic overprinting, and it's relationship to gold mineralization.

GEOCHEMICAL AND FLUID INCLUSION STUDIES OF THE COLOMAC GOLD MINE, N.W.T., CANADA

[1]Costello C.S., [1] Shelton, K.L. ,[2]E. H. van Hees, E.H., and [3]Robb, M.
[1]Dept. of Geological Sciences, U. of Missouri, Columbia, MO [2]Department of Earth Sciences, Carleton University, Ottawa, ON. [3] MRD-DIAND, Yellowknife, N.W.T.

The Colomac mine has produced 418,000 tr. oz. of gold, primarily from low-grade (0.047 tr. oz. gold/ton), high-tonnage, open-pit gold deposits hosted in Archean subvolcanic rocks. Two deposit types with distinct styles of gold-ore mineralization exist at Colomac: (1) shallow, low-grade, high-tonnage deposits with primarily sulfide-hosted gold mineralization, and (2) deep, localized, high-grade deposits with primarily native gold mineralization. Colomac provides a unique opportunity to address the basic question of what causes gold accumulation in the earth's crust by documenting processes leading to the formation of large, low-grade deposits and localized high-grade zones.

Within the shallow, low-grade, open-pit deposits, gold-ore-related quartz veins were deposited from H_2O-CO_2-NaCl±CH_4 fluids with T_h values of 200-375°C and salinities of 2-21 wt.% equiv. NaCl. Multiple mechanisms were responsible for gold deposition in the shallow deposits, primarily by reaction with Fe from wallrocks (resulting in sulfide-hosted mineralization), and less commonly via sporadic fluid unmixing and cooling.

Gold-bearing quartz veins within the deeper, localized, high-grade deposits formed from H_2O-CO_2-NaCl±CH_4 fluids with T_h values of 200-375°C at pressures of 1-2 kb, and salinities <4 wt.% equiv. NaCl. Gold-bearing veins have $\delta^{18}O_{quartz}$ values ≥10.5‰; whereas, barren veins have $\delta^{18}O_{quartz}$ values typically <10.5‰. Fluid inclusion evidence indicates that gold precipitation within the deeper deposits occurred as a result of unmixing of low salinity (~3 wt. % NaCl) H_2O-CO_2 fluids.

Within the deep, high-grade deposits, H_2O-CO_2-NaCl±CH_4 fluid inclusions in gold-bearing quartz veins have a wide range of XCO_2 (from <0.1 to ~0.8); whereas, barren quartz veins contain inclusions with XCO_2 contents typically <0.1. Documenting areas with H_2O-CO_2-NaCl±CH_4 fluid inclusions that have higher XCO_2 contents (0.2-0.8) in quartz veins with $\delta^{18}O_{quartz}$ values ≥10.5‰ may prove useful as an exploration tool and ore guide to other high-grade gold mineralization.

Barren quartz veins in the deeper portion of the mineralizing system were deposited from H_2O-CO_2-NaCl±CH_4 fluids with higher salinities (4 to 17 wt.% NaCl) than the gold-bearing veins. These fluids may represent (1) distinct fluids, unrelated to ore deposition, or (2) residual fluids from previously unmixed, high salinity H_2O-CO_2-NaCl fluids. If the latter is true, more gold could exist at depth where P-T conditions would be too high for unmixing of a H_2O-CO_2-3 wt.% NaCl fluid, but ideal for unmixing of a higher salinity H_2O-CO_2 fluid.

Both deposit types could be part of a single mineralizing system, with mechanisms of gold deposition dictating the style of mineralization. In the shallow, low-grade deposits, reaction with

Fe^{2+} from wallrocks resulted in dominantly sulfide-hosted mineralization. Within the deeper, localized, high-grade deposits, fluid unmixing was responsible for deposition of native gold.

Pb-Pb ISOTOPIC DATING OF SULPHIDE MINERALIZATION IN THE YELLOWKNIFE VOLCANIC BELT

[1]Cousens, B.L., [2] Gochnauer, K.,[3]Falck, H., [1]van Hees, E.H., [4]Shelton, K.
[1]Ottawa-Carleton Geoscience Centre, Carleton University, Ottawa, ON.;,[2] INAC Geology Division, Yellowknife, NT.; [3]RWED Minerals, Oil and Gas, GNWT, Yellowknife, NT.; [4]Dept. of Geological Sciences, University of Missouri, Columbia, MO.

A question that is of both economic and academic interest concerns the timing of gold mineralization in the Archean Yellowknife Belt, which hosts two world-class gold deposits and several smaller ones. Gold is either associated with, or included within, sulphide minerals such as arsenopyrite, sphalerite, galena, stibnite, chalcopyrite and pyrite. These minerals include high abundances of Pb scavenged from the crust by hydrothermal fluids. The isotopic composition of this Pb can be used to date the mineralization event, which allows for comparisons of the timing of mineralization within and between mining camps (e..g., Franklin and Thorpe 1982; Thorpe et al. 1992; Frei and Pettke 1996). The aim of this project is to determine the isotopic composition of sulphide minerals from various localities within the Yellowknife Belt, with the goals of: 1) determining whether mineralization in the belt was the result of a single pulse of hydrothermal activity or was a multi-stage process, 2) the age of the mineralizing event(s), and 3) working towards determining the source of the metals in the hydrothermal solutions, particularly given the recent proposal that fluids originated in the metasediments that overlie the host Kam Group volcanic rocks (van Hees et al. 1999).

Samples of sulphide minerals from various mines, prospects and showings from the Yellowknife Belt were collected in 1999, supplementing an existing sample collection, including Clan Lake, Viking Mine, Nicholas Lake, and the Discovery Mine. In most cases, more than one sample from each deposit was collected, and commonly including more than one sulphide mineral. Galena and sphalerite were collected, if present, but good results have been obtained from stibnite, arsenopyrite, chalcopyrite and pyrite. Analyses of the 1999 sample suite are ongoing. A preliminary study of mineralization at the Giant Mine suggests that sulphide minerals from different mineralization events have different Pb isotopic compositions, indicating a multi-stage fluid history (Shelton et al., 1999).

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SUMMARY OF EXPLORATION RESULTS FOR MUNN LAKE AND YAMBA LAKE

Davie, P
SouthernEra Resources Ltd.

Munn Lake is part of the Back Lake/Mackay Lake Property. It is situated 200km NE of Yellowknife, 50km E of Snap Lake, 100km SE of Lac de Gras and 50km NW of Kennedy Lake. The property was staked in 1992 and optioned to Kennecott Canada. They worked the ground until 1994 when SouthernEra optioned the property. Work included till sampling, geophysics, diamond drilling and sonic drilling.
This work led to the discovery of a diamondiferous sill on the south shore of the northeastern portion of Munn Lake. There are indicator mineral trains which still need follow up work to determine their sources.

The Yamba Lake Property lies 300km N of Yellowknife and 50km north of Lac de Gras. The southern boundary is shared with the Buffer Claims. Early work by Tanqueray Resources found five kimberlite pipes (Torrie, Sue, Eddie, Sputnik, and Ptarmigan). Work by Cypango uncovered another (T-10). SouthernEra has found one new pipe (S-141) and an extension or satellite pipe to the Ptarmigan pipe. The most recent work has included new airborne geophysics, till sampling and diamond drilling. There are a number of geophysical and indicator anomalies to follow up on in the years to come.

PRELIMINARY U-PB GEOCHRONOLOGICAL RESULTS FROM THE GIBSON LAKE-CROSS BAY AREA, KIVALLIQ REGION, NUNAVUT.

Davis, W.J., Tella, S., Hanmer, S., Ryan, J. and Sandeman, H.
Geological Survey of Canada, 601 Booth St. Ottawa, ON

Preliminary ages for plutonic and volcanic rocks from the Gibson Lake-Cross Bay area highlight a complex Archean and Proterozoic tectono-magmatic evolution. The area is divided into three geological domains: (1) a homoclinal panel of northwest-dipping metasedimentary rocks and gneissic tonalite in the south; (2) an overlying volcano-plutonic belt to the north and west; and (3) the Cross Bay plutonic complex in the northeast. Proterozoic granites intrude all three domains.

A rhyodacite tuff sample from the volcanic belt yielded a precise age of 2682 ± 2 Ma, significantly younger than a previously reported age of >2.72-2.75 Ga for a felsic volcanic unit in the MacQuoid Lake area to the west. This suggests at least two distinct ages of volcanism within the belt. Two samples of foliated tonalite within the homoclinal panel in the south yielded similar ages to the overlying volcanic rocks at ca. 2680 Ma. A third tonalite yields a younger age of 2655 Ma. The tonalites are characterized by complex zircon systematics consistent with significant Pb-loss during the Paleoproterozoic, Titanite yield significantly younger ages, highlighting both late Archean (ca. 2500 Ma), and Paleoproterozoic (ca. 1800 Ma) thermal events.

Two granitic phases from the Cross Bay plutonic complex yield ages of 2690 Ma for an augen granite and 2725 for a monzogranite dyke, both of which cross cut the dominant foliated tonalite.in the area. The relatively old ages for these intrusions indicate that the Cross Bay complex pre-dates the formation of the volcanic belt and the tonalites to the south and represent the oldest units in the area. The Big lake shear zone occurs along the southern part of the Cross Bay complex. Two granitoid samples were collected from the shear zone to bracket the timing of granulite grade mylonite development. An undeformed cross-cutting granite yielded a zircon age of ca. 1830 Ma, similar to other Proterozoic granites in the region. The pluton contains titanite with slightly younger, imprecise age of 1750 Ma., indicating later disturbance, possibly associated with a late brittle fault to the south. A deformed granite yielded a complex population of zircon with near concordant ages that spread along the concordia between 2690 and 2640 Ma, placing a maximum age for shear zone development at 2640 Ma. Additional work is in progress to better resolve the age of the shear zone.

Two Proterozoic granite dykes have been dated from the northeast part of the Cross Bay complex along Chesterfield inlet. The dykes cut foliated tonalite gneisses and relative intrusive relationships indicate the intrusions span a component of east-west shortening in the area at ca. 1.83 Ga to 1. 81 Ga.

EVIDENCE FOR AND METALLOGENIC SIGNIFICANCE OF TERMINAL KENORAN OROGENIC COLLAPSE IN THE SUPERIOR AND SLAVE PROVINCES

Duke, N.A.
Department of Earth Sciences, University of Western Ontario, London, N6A 5B7
nduke@julian.uwo.ca

The Kenoran Orogeny (2.7 - 2.5 Ga) is the major cratonization event in earth history and accounts for the stability of Archean shields. Although the Kenoran is best known as a time for widespread granite plutonism, I-type into greenstones and S-type into sediments, a series of phenomena relating to regionally persistent "stuctural breaks" may identify an important terminal stage of post-collisional tectonic collapse. By analogy to such younger orogens as the Cordilleran Larimide and the present day Himalayas, orogenic collapse focuses on segments of mountain chains which attain the highest elevations, i.e. those developing the thickest crust during collision. When collision terminates and the orogen is no longer held under compression, the ductile infrastructure flows laterally while the brittle upper crust is tectonically thinned by normal fault block rotation. The brittle/ductile transition is a mylonitic detachment fault which caps the upward migration of melts. Due to the magnitude of Kenoran granite magmatism, this crustal discontinuity was likely the upper barrier to a near complete layer of gravitationally unstable melt. The deeper seated segments of such detachments would be strongly disrupted by regional diapirism while their up-dip surface traces would be preferentially preserved.

The geotectonic significance of terminal Kenoran structural breaks has been long debated, particularly in the southern Superior where they are the primary control for the regional distribution of lode gold camps. As the breaks generally separate disparate geological terranes, they must reactivate crustal discontinuities inherited from pre-Kenoran greenstone belt construction, i.e. the margins to old basement blocks, volcanic edifices and/or sedimentary basins. Spatially associated pre-Kenoran ferrogabbro sills and early-Kenoran sodic quartz feldspar porphyry bodies predating the emplacement of granite diapirs suggests that the breaks acted as long-lived igneous conduits. Fault-bounded intermontaine troughs, filled with Temiskaming molasse, preserved within broad zones of ductile shear (Cadillac - Bousquet, Dester - Porcupine), identify the roots of pullapart-basin depocenters. The more regional regressive sandstone/conglomerate Temiskaming successions (Geraldton/Beardmore) demonstrate extensive deposition of a post-accretionary "overlap assemblage". The alkaline volcanics occurring locally at the base of the Temiskaming sequences (Kirkland Lake - Springpole Lake) indicate rapid unroofing of A-type syenitic plugs which form "stitching plutons" at deeper levels. The rare carbonatite (Lac Shortt - Springpole Lake) and widespread lamprophyric dyking (Red Lake - Hemlo - Porcupine) indicate post-ductile tapping of "rebounded mantle" below the breaks. Occurrences of break-associated basement domes (Shaw dome at Timmins - Pukaskwa dome at Hemlo) suggest development of late thermal domes and exposure of Kenoran "metamorphic core complexes".

Excellent examples of late Archean structural breaks are also in evidence in the southern Slave. The Sleepy Dragon Complex, on the east margin of the Burwash Basin, is possibly the best documented candidate to date of a Kenoran metamorphic core complex, and is itself cored by a late Kenoran A-type granite with an affiliated REE pegmatite field. The Nardin Lake Complex, at the north margin of the Burwash Basin, is a deep-seated migmatite/basement gneiss domain, with tourmaline pegmatites and the Leith Lake Lamprophyre/Carbonatite intruding at the migmatite front. The enigmatic Orsmby Break, striking from the Clan volcanic center through the northwestern part of the Burwash Basin to the Discovery Mine, is cored by a highly-strained discontinuous panel of garnet amphibolite after pillowed volcanics within greenschist facies argillites. This particular structure may be a deeper seated analogue to the Abitibi breaks which juxtapose back to back synclines/ "detachments", but here exposing the missing anomalously metamorphosed high-grade anticlinal "accommodation zone". The highest level break in the southern Slave is at Yellowknife, where the Temiskaming-type Jackson Lake Formation occurs as fault slivers sandwiched between the Kam volcanic platform and the Banting /Burwash basinal succession. Although not well studied, the Jackson Lake Formation likely comprises a regressive crossbedded sandstone/polymictic conglomerate succession. At Giant, the "unconformity" truncates the gold-bearing shear system. At Con, Jackson Lake conglomerate occurs in the near footwall and enigmatic lamprophyric diatreme dykes with associated "fluorite carbonatite" and hosting old basement clasts occur in the immediate hangingwall of the gold-bearing Campbell Shear. Notably the Jackson Lake conglomerate itself is rich in vein quartz pebbles and has common green mica schist clasts, indicating a shear zone provenance and syn to post shear deposition.

When viewed collectively the evidence for a post-collisional stage of orogenic collapse is mounting for the Kenoran. Indeed, terminal extension not only provides a ready explanation for many of the unique geological attributes of the late Archean breaks themselves but accounts for such regional scale problems as room for diapirs and local preservation of sub-greenschist facies metamorphic domains, e.g. collapse of the southern Abitibi between the Destor/Porcupine and Kirkland /Larder Lake breaks could explain the zeolite facies volcanics of the Blake River Syncline. Should the model apply, it has major implications for the metallogeny of late Archean lode gold deposits. Most critical in defining the PTX conditions at any given deposit is the development of a variably telescoped and fluidized panel of crust sandwiched between long-lived metamorphic infrastuctures and the Temiskaming unconformity.

GSC'S AEROMAGNETIC SURVEYS NORTH OF SIXTY

Dumont, K. and Kiss, F.
Geological Survey of Canada, Ottawa, Ontario, K1A 0E9

The Geological Survey of Canada (GSC) together with a consortium of exploration companies have funded seven high-resolution aeromagnetic surveys in the Nunavut, Yukon and Northwest Territories in the last three years. These surveys total 400 000 line kilometres and represent an investment of 2 million dollars to increase the basic knowledge of Canada's landmass. The Regional Geophysics aeromagnetic group has been contracting the survey flying and supervising the data acquisition and compilation phases so that the highest quality standards are maintained across Canada. The survey results support a number of geological mapping programs and assist industry in oil, gas and base metal exploration. In sharing the cost for these surveys, industry participants normally receive the exclusive right of use of the data for a minimum period of one field season after which the data is released to the public. Two of the most recent surveys are located in the Mackenzie Valley Corridor. The GSC is planning to conduct additional surveys in the region extending north to the Mackenzie Delta.

YET ANOTHER NEW LOOK AT YELLOWKNIFE STRATIGRAPHY: GIVE ME A BREAK

[1]Falck, H., [2]Cousens, B., and [3]Isachsen, C.
[1]RWED Minerals, Oil and Gas, RWED, Government of the NWT, Yellowknife, NT., [2]Ottawa-Carleton Geoscience Centre, Carleton University, Ottawa, Ont., [3]Dept of Geosciences, University of Arizona, Tucson, Az.

The stratigraphy of the Yellowknife Greenstone Belt has seen a number of revisions, each reflecting a new generation of research. The stratigraphy was assembled by A. Jolliffe (1946), modified by Boyle (1961) and Henderson and Brown (1966), which was revised by J. Henderson (1970), whose work was in turn altered by H.Helmstaedt and W.A. Padgham (1986). Since this milestone paper, new data has lead to a re-examination of this much debated subject.

Geophysical studies through Lithoprobe have demonstrated the existence of a marked anisotropy between the Anton Terrane and the crust beneath the Yellowknife Basin. However, the question has remained where this line is drawn. Much effort was expended searching for a decollement beneath the volcanic belt, but a conformable sequence of volcanics and sediments on basement gneisses has been identified. The division is not at the top of the volcanic sequence either. The Burwash Group turbidites are interbedded with the underlying Prosperous Formation. The best location for a major break is at the Kam-Banting contact as marked by the Jackson Lake Formation.

This concept has been argued before and two reasons refuted the hypothesis. The first is that felsic dykes (#9) of similar age and composition to Banting Group rocks crosscut Kam mafic volcanics and feed the felsic volcanics, thus stitching the northern half of belt together. The second argument is that south of the West Bay fault, the Kam Group rocks are conformably overlain by Banting rocks and the gradational increase of the felsic composition precludes a major tectonic break.

New data has shed doubt on these arguments. While the felsic dykes in the northern belt can be traced from a porphyritic pluton near Ryan Lake, none are observed to reach the Banting Group. All dykes are truncated at the unconformity with the Jackson Lake Formation. The connection is supported only by the overlapping U-PB zircon ages of the dykes(2658±2Ma) and the Banting Group(2662±2Ma, 2667±4Ma). However, zircon ages from many felsic centres in Southern Slave province overlap the age of the dykes and have similar chemical compositions. Thus, the dykes could have fed the Banting Group, but they could also have fed the Clan Lake Complex (2661±1Ma) or the Russell Lake felsics (2658±1Ma) or the Turnback Lake felsics(2663±6Ma).

Trace element and isotope chemistry have also discounted the second argument. Mafic Kam volcanics share a common flat trace element signature. The isotopic data suggest that they are depleted upper mantle melts, but there is also evidence of contamination as the magmas evolve by interaction with sialic crust. The felsic rocks of the Banting Group have a strong light-REE enrichment and a depletion in the heavy-REEs; quite distinct from the Kam felsic rocks. The isotopic signature of Banting felsic rocks is consistent with a crustal melt. The rocks south of the West Bay fault and their correlatives at the top of the Giant Section, all have the geochemical signature of the Kam Group volcanics and should be re-classified as a new formation.

The Kamex formation is proposed as the upper most formation in the Kam Group, conformably overlying the Yellowknife Bay Formation and a lower contact marked by the Bode Tuff. Drilling by Miramar Mining and Royal Oak Mines beneath Yellowknife Bay have demonstrated that the Banting Group is intersected near the center of the bay and its lower contact is defined by a highly foliated deformation zone.

The break between the Kam/Banting groups, the Jolliffe Island Break, is recognized by the preservation of the Jackson Lake Formation and the age of this fault is constrained by a minimum zircon age of 2589 Ma from the Sub Islands. The break is stratigraphically at the same level as komatiitic flows beneath Yellowknife Bay and its presence may have had a strong influence on the movement of gold-bearing fluids in the Yellowknife Belt., as well as, the emplacement of diatremes and much younger kimberlites. The recognition of a major break in the Yellowknife belt has exciting ramifications on future mineral exploration in the Yellowknife area.

RECOGNITION OF QUARTZ FELDSPAR PORPHYRY INTRUSIONS IN THE YELLOWKNIFE GREENSTONE BELT

Finnigan, C., and Duke, N.A.
Dept. Of Earth Sciences, The University of Western Ontario, London N6A 5B7
csfinnig@julian.uwo.ca

Previous workers have identified the Townsite Formation as a felsic volcanic unit separating the Crestaurum and Yellowknife Bay Formations of the mafic dominated Kam Group. Due to offsets across Proterozoic faults, the Townsite Formation has been subdivided into the Niven, Brock, and Vee Lake lenticles. The detailed mapping (1:1200) carried out for the present study supports earlier lithological correlations, however, also demonstrates a complex intrusive history involving quartz feldspar porphyry injections related to gabbro silling events. The U-Pb geochronology which has been conducted on the Townsite to date identifies ages of ca. 2683 Ma for the felsic Niven Lake lenticle and ca. 2703 Ma for felsic units in the Brock and Vee Lake lenticles. Current remapping revealed the analyzed samples were selected from differing lithologies: the older dates relate to felsic tuffs in the Kam Group while the 20 m.y. younger dates identify the time of quartz feldspar porphyry intrusion.

Several lines of evidence support the occurrence of felsic intrusive phases in the Townsite Formation. The massive quartz feldspar porphyry bodies lack the bedding clearly displayed in the older felsic tuffs. Mafic pillowed units bordering on massive quartz feldspar porphyry are characteristically bleached (silicified-albitized) and commonly exhibit hydrothermal brecciation textures. Breccias are readily observed at the eastern end of the Niven Lake lenticle (behind the Racquet Club), through the southern and central portions of the Brock and are extensively developed in the central Vee Lake lenticle, although here are generally obscured due to later penetrative shear deformation and related quartz-carbonate-sericite alteration. Breccia types range from fragmented wall rocks with blocks hosted in hydrothermally cemented rock flour, through heterolithic mixes with both volcanic and porphyry blocks, to monolithic types where quartz feldspar porphyries have intruded their own carapace. Contact relations are diffuse as chill margins are not readily observed. Specific contact relationships with marginal gabbros suggests contemporaneity. Within the Brock and Niven Lake lenticles quartz feldspar porphyry back veins gabbro, clearly indicating low temperature felsic melts postdating the crystallization of gabbro. Some contacts show interfingering and together with lack of chills indicates the physical mixing of coexisting mafic and felsic magmas.

Bulk Chemical analyses of porphyry phases and wall rock volcanics within the Brock lenticle substantiates the lithologies defined during mapping. The pillowed dacites of previous investigators have basaltic chemistry. These flows have been silicified/albitized as a result of hydrothermal alteration during quartz feldspar porphyry injection and REE patterns reflect the degree of alteration. The intrusive porphyry phases include both dacite and andesite compositions and are characterized by marked LREE enrichment. Associated gabbro sills show flat to slightly LREE depletion patterns indicating a different magma source.

As the Townsite formation shows close spatial relation to mineralized segments of both the Campbell and Giant shear systems, it is likely that the intrusion of the quartz feldspar porphyries may have played a role in "early gold concentration" i.e. identification of felsic intrusive phases in the Townsite brings up the possibility of an early "quartz feldspar porphyry-Au" association in the Yellowknife camp.

GOLD DEPOSIT STUDIES ALONG A NNE LINEAR TREND FROM THE NORTH END OF THE YELLOWKNIFE BELT: CLAN LAKE TO NICHOLAS LAKE

Gochnauer, K. M.
DIAND, NWT Geology Division

This study was initiated to characterize gold showings/deposits within a 2-4 km corridor along a crustal scale break proposed by Stubley et al. (1997). Stubley et al. (ibid.) suggested that the Ormsby Break can be extrapolated southward to the Yellowknife Belt and that numerous gold occurrences including the Discovery Mine occur along the northwest margin of the break. This study incorporates field and petrographic comparisons of mineralization, Pb-Pb dating (Cousens et al,. this volume), alteration studies, and structural analysis. Cairns (this volume) located and characterized the Ormsby break as part of his 1:50,000 mapping study.

A preliminary map compilation of topographic lineaments, 1":1 mile government magnetic data, assessment report gold showings, and exploration geophysical data (EM, magnetics) was conducted for the study area. A number of structurally controlled gold showings and deposits at the north end of the Yellowknife Belt, including the MON property at Discovery Lake and NOSE property at Clan Lake, occur near the extension of the Hayduck fault. Significant gold deposits at Clan Lake, Johnston Lake, Morris Lake, Discovery Mine and Nicholas Lake line up along a NNE linear trend, and record a northward increase in deposit size (Beales, 1994). This trend transects a broader regional NNE magnetic low which roughly corresponds to regional greenschist facies bound by the cordierite isograd (Fyson, 1998). Discovery Mine to the north and Clan Lake to the south occur at the intersection of the cordierite isograd with the projection of the NNE break. Nicholas Lake, NNE of Discovery Mine occurs above the cordierite isograd. Windows above cordierite grade occur within the broader greenschist facies region.

A limited number of traverses were made in the Morris Lake, Goodwin Lake, and Discovery Mine area to determine structural, and stratigraphic setting, and collect unaltered samples to compare to showings sampled; site visits to the Mon, Clan Lake, and Nicholas Lake properties were made for sample collection.

Samples were collected for:
1) petrographic examinations of sulphide minerals and alteration, in most cases with accompanying 55-element geochemistry and gold analysis;
2) petrographic examination of altered and unaltered diorite and calc-silicate, metamorphosed concretions for comparison; and
3) Pb-Pb dating of the mineralization; galena, sphalerite and occasionally arsenopyrite.

A similar stratigraphic sequence of garnetiferous amphibolite, in part volcaniclastic, and insitu-brecciated pillows host both the Ormsby Zone and showings east of Goodwin Lake. Garnets increase in abundance towards the Ormsby break, reminiscent of hydrothermal alteration of the Austin "Tuff", along the Austin Shear Zone of the Madsen Mine, Red Lake (Cannon, pers. comm.).

Field relationships are in places ambiguous between calc-silicate assemblages of metamorphosed limey beds within greywacke and metamorphosed diorite. Metamorphism which produced calc-silicate assemblages created a competency contrast for quartz vein development and mineralization similar to that associated with the diorite at Viking Yellowknife, tonalite/granodiorite at Nicholas Lake, gabbro at MON, and dacite at Clan Lake.

Late, cross-cutting tension veins, commonly with moderate to shallow dips, host gold mineralization in the Ormsby Zone. Mineralized quartz veins at Clan Lake have been studied by Martel-Amesse (this volume). Hedenbergite, tentatively identified, with brown uralitized cores and dark amphibole borders occurs as an iron-rich alteration along the margins of local quartz-plagioclase veins, at all localities except Clan Lake. Gold is associated with quartz-feldspar- pyroxene veins at MON. Hedenbergite associated with quartz veins and auriferous sulphidized zones occurs at Lupin and at Ulu within upper greenschist to amphibolite metamorphism. Most late quartz veins in the study area have white plagioclase feldspar selvages.

Petrographic studies, age dating of sulphides, and geochemical analyses are ongoing.

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METALLOGENY OF THE SOUTH EAST BEAR STRUCTURAL PROVINCE

Goff, S.P., Gochnauer, K. and Bianchi, C.
NWT Geology Division, DIAND, Yellowknife

Apart from exploration of Cu-Co-Bi-Ag-Au-bearing, Fe-oxide-cemented breccias at Lou Lake and Dianne Lake by Fortune minerals, the southern Bear structural province has seen little recent mineral exploration. In addition, all recent exploration has been west of the Wopmay fault in the Great Bear magmatic zone (GBMZ). The present work, therefore, attempts to update the metallogeny of the SE Bear Province.

The SE Bear Province contains a plutonic zone composed of tonalite to granite, possibly Hottah terrain, plus associated clastics and mafic to felsic volcanic rocks (c.1.9 - 1.89Ga); and of tonalite to granodiorite of the Hepburn suite (c. 1.89 - 1.87Ga). This zone is bounded to the east by a fold belt of siltstone, slate dolomite and minor basalt of the Palaeoproterozoic Snare Group, which has beeen metamorphosed to garnet-amphibolite facies. Most significant mineral showings within the SE Bear have been mapped and sampled for lithogeochemistry.

Wacke to pelite sequences of the Snare Group contain zones, several km long, bearing accessory sulphides and showing anomalously high concentrations of Zn, Cr and Cu (Ingray Lake). Some of these zones are cut by quartz and quartz-Fe carbonate veins, containing pyrrhotite-sphalerite-arsenopyrite-galena-chalcopyrite and Au, which are associated with grey, clay-mineral alteration zones (Norris Lake). These veins, which are folded and recrystallised, predate the main deformation and metamorphism of the Snare Group. Secondary chalcopyrite occurs in magnetite-rich beds within wacke-argillite sequences of the Snare Group (Grizzly Lake) and of possible Hottah affinity (Crapeau Lake). Pyrite bearing diopside-wollastonite skarn in Snare Group dolomites are associated with gabbros of indeterminate age (Norris Lake).

Late NE and NW trending conjugate transcurrent faults in Hepburn and/or Hottah granitoid intrusions are associated with uraniferous veins (Acasta and Wopmay River areas). These faults are loci for hydrothermal breccias in which several generations of quartz-hematite precipitation occurs. A commonly seen pattern of mineralization involves hematite and quartz flooding associated with epidote-quartz and pyrite alteration zones, and followed by narrow, composite uraniferous veins containing quartz, calcite, dolomite, hematite, chalcopyrite and fluorite. Late chlorite-calcite-pyrite veins may also be radioactive. These radioactive fault breccias and vein stockworks can be traced into regionally extensive N and NE trending Giant Quartz Veins, which are post GBMZ in age (ie. <1.84 Ga), and which can also contain significant uranium concentrations (eg. Rayrock Mine). The associated carbonate and fluorite bearing veins are part of a regionally extensive mineralizing event, and analogues are widespread in both the Wopmay orogen and the East Arm graben.

NORTHWEST TERRITORIES OIL AND GAS EXPLORATION BY CANADIAN FOREST OIL LTD.

Good, J. Bachynski, B.*, Taylor, J. and Uffen, D.
Canadian Forest Oil Ltd., 600-800-6th Avenue SW, Calgary, Alberta T2P

*speaker

Canadian Forest Oil Ltd. (CFOL) and predecessor companies have been active in the Northwest Territories since the 1960's. CFOL holds interests in Exploration Licenses and Significant Discovery Licenses in the Ft. Liard, Hay River, Tulita, Mackenzie Delta and Beaufort Sea areas of the Northwest Territories. CFOL is a participant in two important recent discovery field areas in the Ft. Liard natural gas play. Two pipelines to transport gas to market are at the regulatory approvals stage. Additional seismic was shot in 1999. Delineation drilling is underway and additional drilling is planned for 2000.

The geology and terrain conditions are challenging in these areas. Exploration agreements are in place to fund addition oil and gas exploration into the new millennium.

A METALLOGENIC EVALUATION OF THE PALEOPLACER POTENTIAL OF THE PYRITIC QUARTZ-PEBBLE CONGLOMERATES IN THE WOODBURN LAKE GROUP, NUNAVUT.

Greiner E[1]., Duke, N.A.[1], Zaleski, E.[2]
[1] Dept. of Earth Sciences, University of Western Ontario, London, Canada, N6A 5B7. [2]Geological Survey of Canada, Ottawa, Ontario, Canada.
egreiner@julian.uwo.ca

The Woodburn Lake quartz-pebble conglomerate beds share many lithological similarities to such classic paleoplacer districts as the Witwatersrand of South Africa and Elliot Lake in northwestern Ontario. The Woodburn Lake group is an Archean supracrustal belt in the Rae Subprovince, of the Western Churchill Province. The group is composed of complexly deformed komatiite, intermediate to felsic volcanics, iron formation, greywacke and orthoquartzite assemblages intruded by 2.6 - 2.62 Ga granites. The stratigraphic relationships of the orthoquartzites to other assemblages has proven to be controversial. Locally the orthoquartzites demonstrate unconformable contacts on bimodal (komatiite/felsic tuff) volcanics with minor interlayered iron formation. The regionally extensive Woodburn orthoquartzite is interbedded with numerous pyritic quartz-pebble conglomerate units that range from meters up to 10's of meters in thickness. Although discontinuous lenses are common, conglomeratic strata can be traced along strike for several kilometers. The units are dominated by quartz clasts of pebble size. Pyrite is concentrated in the matrix, and is rarely present within clasts, suggesting a detrital origin for the pyrite. Both conglomerates and interbedded quartzites contain aluminosilicates (kyanite-pyrophyllite?) and disseminated fuchsite which locally gives them a pale green colour.

Intense polyphase deformation has obscured most primary structures and textures. However, locally preserved of crossbeds, ripple marks and channels imply fluvial-deltaic and shallow marine depositional settings. Recent geochronological work identifies a non-abraded euhedral zircon population derived form on old ~3.0 Ga basement that has not been recognized in the Woodburn Lake belt. In some areas the pyritic quartz-pebble conglomerates appear stratigraphically overlain by quartzite with occasional aluminous chloritiod-kyanite schist interlayers. Both quartz arenite and Al-shale protoliths suggest a chemically mature provinence area, implying deep chemical weathering or possibly extensive epithermal activity.

The exploratory work to date has shown the pyritic beds to be anomalous in gold, suggesting a potential for paleoplacer gold concentration. In areas of strong deformation, gossanous pods of near-massive kyanite with associated pyrite and fuchsite signifies secondary hydrothermal aluminosilicate replacement. It is not known at present whether gold was transported and upgraded at these sites. Future study will determine whether a characteristic heavy mineral suite (U-Th-Ti-Au-bearing minerals) accompanies the pyritic conglomerate horizons. Analysis of a pathfinder element suite (As-Sb-W-Au) will test whether hydrothermal lode gold concentrations are related to the domains of aluminosilicate replacement.

SEQUENCE STRATIGRAPHY OF THE LOWER BAKER LAKE GROUP (DUBAWNT SUPERGROUP), BAKER LAKE BASIN, THIRTY MILE LAKE AREA, NUNAVUT

[1]Hadlari , T., [2]Rainbird, R.H. and [1]Donaldson, J.A
[1]Ottawa-Carleton Geoscience Centre, Department of Earth Sciences, Carleton University, Ottawa, Ontario K1S 5B6 (hikintom@passport.ca); [2]Geological Survey of Canada, Ottawa, Ontario

Lithofacies assemblages representing alluvial fan, gravel-and sand-bed braided stream, lacustrine and ephemeral lacustrine depositional environments characterize the lower Baker Lake Group along the southern margin of the Baker Lake basin in the Thirty Mile Lake area. On the basis of a hierarchy of bounding surfaces and stratigraphic pattern, we recognize 4 third-order depositional sequences, or accommodation cycles. These accommodation cycles are characterized by: an initial drop and subsequent rise in base level, a pulse in accommodation space creation reflected by an increase in gradient, a decrease in gradient as accommodation space was filled, and continued base level rise.

With time, relative base level at the southern margin of the Baker Lake basin seems to have dropped, as indicated by an increase in eolian facies relative to fully lacustrine facies. Together these depositional sequences stack in a retrogradational pattern, indicating that for the interval recorded, sediment flux was exceeded by accommodation space creation, and that the basin was underfilled. These observations suggest that the primary subsidence mechanism on the southern margin of the

Baker Lake basin was normal faulting. This is supported by paleogeographic information such as paleocurrents directed northward into the basin, a linear basin margin, and high gradients recorded by alluvial fan deposits. The presence of K-feldspar porphyry clasts in the lower Baker Lake Group, interpreted to represent hypabyssal equivalents of volcanic rocks of the Christopher Formation Island, indicates that potassic volcanism occurred during the early depositional history of the Baker Lake basin.

WESTERN CHURCHILL NATMAP PROJECT: THE YEAR IN REVIEW

[1]Hanmer, S. and [2]Relf, C.
[1]Geological Survey of Canada, [2]DIAND NWT Geology Division

The Western Churchill NATMAP program is a multidisciplinary, multi-agency initiative launched in 1997 by the Geological Survey of Canada, Indian and Northern Affairs Canada, and the Government of the Northwest Territories. The third field season (1999) saw the successful completion of regional bedrock, surficial and ice flow indicator mapping, with activities in the Woodburn, Baker Lake, Thirty Mile Lake, MacQuoid-Gibson lakes and Mackenzie-Victory lakes areas, as well as strategically targeted thematic mapping and field studies in the Uvauk granulite complex, and the Sealhole-Fitzpatrick lakes, Yathkyed Lake, Quartzite Lake and Rankin Inlet areas. Principal highlights from the fieldwork include: (i) identification of potential paleoplacer deposits, a possible criterion for discriminating between Archean and Paleoproterozoic quartzite successions in the Woodburn area, (ii) correlation of the Mackenzie Lake sediments with the lower Hurwitz Group, and the host volcanics to the Victoria prospect with the Kaminak Group, (iii) recognition of extensive supracrustal units, and of regional-scale faults responsible for structural dislocation of the map pattern in the eastern MacQuoid-Gibson area, as well as a late Archean granulite facies history for the western segment of the Big lake shear zone, and (iv) redefinition of the Dubawnt Supergroup in the Baker Lake basin in terms of sequence stratigraphic principles. Geochronological and geochemical studies have made significant progress. New detrital zircon (SHRIMP) ages indicate that the upper Hurwitz Group is <1.97 Ga and separated by a significant hiatus from the lower Hurwitz. Zircon inheritance (SHRIMP) and Nd study of Proterozoic granitic plutons across the Hearne domain is helping to identify Archean crustal age domains of different age, with ~2.9-2.8 Ga to the southwest and ~2.8-2.7 Ga to the northeast. Magmatic ages obtained from the MacQuoid-Gibson lakes area indicate that early deformation of the Cross Bay structure is significantly older (pre-2.69 Ga) than that of the volcanic and sedimentary rocks beneath it (~2.68 Ga), suggesting that it has been thrust over its footwall. New geochronology from the Yathkyed-Angikuni lakes area highlights an Archean domain that escaped Paleoproterozoic reworking, but is flanked to the SE by the ~1.83 Ga Tyrrell shear zone and by folding and foliation of similar age to the NW.

New geochemistry discriminate between juvenile tholeiitic and calc-alkaline volcanic rocks in the MacQuoid-Gibson area and is compatible with a back-arc setting, and highlight significant differences between the Proterozoic Kaminak and MacQuoid mafic dyke swarms. Geochronologically supported metamorphic studies continue to establish the extent and significance of widespread tectonothermal events at ~2.5 Ga and 1.9 Ga across the Hearne domain. Processing of geophysical data obtained in 1998 continues to improve the resolution of a prominent conductive horizon, dipping moderately beneath the Hearne domain, and highlights the difference in electromagnetic and seismic properties of the mantle beneath the Rae and Hearne domains.

Petrographic examination of the Meadowbank deposit indicates 5 stages of gold mineralisation, including synsedimentary and diagenetic gold. Complex ice flow patterns were mapped in vicinity of the Keewatin Ice Divide in the Thirty Mile Lake area, and regional surficial and geochemical mapping over the MacQuoid and Rankin Inlet greenstone belts provided a framework for detailed drift prospecting programs and successfully defined the distribution and character of Au along the Meliadine Trend, in the Rankin Inlet area.

NEW MINERAL OCCURRENCES ON NORTHEASTERN ELLESMERE ISLAND AND NEW OPPORTUNITIES FOR MINERAL EXPLORATION IN NORTHERN NUNAVUT

Harrison, J.C., Dewing, K. and Lee, C.C.
Geological Survey of Canada, Calgary

The Geological Survey of Canada in co-operation with the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) of Hannover, Germany have recently completed the second of three planned field seasons intended to update and complete the bedrock geological mapping (to 1:125,000 scale) and to undertake supportive geological activities throughout coastal and inland northeastern Ellesmere Island between 79°00'N and approximately 81°33'N.

Reported here for the first time, and in a soon-to-be-released Geological Survey of Canada open file (Harrison et al., 1999), are geochemical indications of lead, zinc, cadmium and other metals from various localities in folded but unmetamorphosed shelf and slope facies strata of Cambrian and Ordovician age. Exploration for mineable quantities of these commodities is warranted in the immediate vicinity of the new occurrences including prospecting of the host strata, property-scale geological mapping, geochemistry and geophysical surveys.

Reconnaissance exploration for carbonate-hosted zinc and lead is recommended throughout the belt of Cambrian and Ordovician shelf carbonates. Similarly, the correlative portions of the slope facies Hazen Formation are worthy of exploration for the same commodities. Exploration techniques should include ground traverses and prospecting of favourable host units, aerial reconnaissance for and sampling of gossans. Special attention should be given to host rocks which are known to contain significant base metals with little or no pyrite, iron oxide alteration or gossan. Reconnaissance geochemical techniques, including stream silt and heavy mineral sampling, are recommended with special attention to minor tributaries. Promising associated elements include Pb, Zn, Cd, Cu, As, Sb, Mo and P but not Ag.

Areas close to the Cambrian and Ordovician shelf edge on Judge Daly Promontory appear to be especially worthy of regional evaluation. This study indicates that various dolomitized open marine carbonate formations may have been regionally significant aquifers; each enclosed by an effective aquitard. For this reason, the entire exposure belt containing these formations throughout the Arctic Islands is worthy of consideration for long term exploration planning.

Geological conditions also appear to have been favourable for sedimentary-exhalative deposits in Lower and Middle Cambrian portions of the Hazen Formation. Especially noteworthy are flat-laminated pyrite-rich mudrocks in Trettin's (1994) Subdivision C of this formation on Judge Daly Promontory. Although the depositional setting and general composition of these rocks is attractive, most analyzed samples contain neither significant nor anomalous base metal concentrations (apart from iron) and the potential for nearby mineral deposits within these strata would appear to be slight.

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DRIFT PROSPECTING IN THE MACQUOID LAKE GREENSTONE BELT, KIVALLIQ REGION, NUNAVUT

Henderson, P.
Terrain Sciences Division, Geological Survey of Canada, Ottawa, Ontario K1A 0E8

Effective drift prospecting in any area requires an understanding of the Quaternary geological history as interpreted from the preserved erosional and depositional record. In order to provide this geological framework, surficial geology mapping and till composition studies were undertaken as part of the Western Churchill NATMAP project. In the MacQuoid Lake greenstone belt, the work is focused in two map areas (55M/7 and 55M/10) that essentially cross-cut the main structural trend of the belt which, in this particular area, is oriented almost perpendicular to the dominant ice flow direction. This circumstance provides an excellent opportunity for developing exploration strategies that can serve as a basis for establishing fundamental principals for drift prospecting in the region. The study augments work undertaken in the Meliadine Trend as part of the NATMAP project (McMartin, 1998) and previous studies on drift composition and glacial dispersal in the region (Klassen, 1995; Shilts, 1971, 1973,1977; Kaszycki and Shilts, 1980).

Drift prospecting is used as a major exploration tool in the Kivalliq region primarily because large areas of the land are covered by thick deposits of Quaternary sediment deposited by the Laurentide Ice Sheet. The last vestiges of this ice sheet were situated over the area in a zone defined by the radial distribution of landforms, such as eskers and Rogen moraine (Aylsworth and Shilts, 1989). Sediments forming these deposits were eroded from the underlying rock by the ice and their composition reflects bedrock composition (including mineralization) modified by glacial and/or glaciofluvial transport and deposition.

In this presentation, the most relevant factors influencing drift prospecting in the MacQuoid Lake area will be briefly discussed. These include: (1) the ice flow history, as interpreted from the orientation and relative age of ice flow indicators such as roches moutonnées and striations (McMartin and Henderson, 1999), (2) sediment types, with comments on distribution and genesis, (3) the depositional history, as preserved in multiple-till sections exposed on the Kazan River, (4) sampling and analytical techniques, and (5) till composition, with emphasis on glacial dispersal of sediment derived from the Dubawnt Supergroup which outcrops north and west of the MacQuoid Lake area. This latter point has profound implications for drift prospecting in the area since Dubawnt-rich tills overlie the Archean greenstone belt and depress the geochemical signature from the local bedrock with relatively geochemically-inert exotic debris.

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THE SNARE RIVER PROJECT: RESULTS FROM 1999 MAPPING

Jackson, V.A.
DIAND, NWT Geology Division

In 1999 field work continued for the multi-year Snare River Project, in the southwestern Slave Province, N.W.T. (parts of 85N and 85O). The main aim of the project is to produce 1:50,000 scale geological maps (Jackson, 1998) of part of the area that was mapped in the late 1930's at 1:253,440 scale by Lord (1963). In 1999 the project is supporting two BSc. theses (Ootes and Jackson, this volume) and is continuing to collaborate with the more detailed investigations of Venessa Bennett (Ph.D. thesis, Memorial University of Newfoundland, see this volume).

In 1999 mapping was focussed at Bigspruce Lake (June; 85O/5, 12), Basler Lake (July; 85N/16, O/13) and in the area northwest of Cowan Lake (August; 85O/5,6,11,12).

Summary of 1999 Results:
Bigspruce Lake area is mainly underlain by several units of Archean granite, which may contain

minor inclusions of metasedimentary, mafic and granitoid rocks. Granites, commony rich in pegmatitic phases, are in sharp contact with greywacke-dominated lower amphiblite facies metasedimentary rocks of the Yellowknife Supergroup. Diffuse contacts between granite and amphibolite facies migmatitic metasedimentary xenoliths locally empart a gneissic or migmatitic texture to the granites. Uranium stain is noted in some of the granites. Near Bigspruce Lake granite is intruded by trachytic and mafic dikes, presumably related to the Proterozoic Bigspruce Lake alkaline complex. Adjacent to the main syenitic to gabbroic bodies of this complex, Archean granite may be altered (hematized) and/or assimilated into the alkaline rocks.

Basler Lake area is underlain by both Archean and Proterozoic supracrustal and granitic rocks. Proterozoic sandstone, siltstone and limestone (dolostone?) are folded about north- or south-striking, shallow-plunging axes and locally have been metamorphosed to greenschist facies (biotite zone). Archean supracrustals are mainly metagreywackes, metamorphosed to lower or middle amphibolite facies, cordierite ± andalusite ± sillimanite schists. These were folded about east- to northeast axial traces. Proterozoic strata near the Archean-Proterozoic unconformity may have steep or shallow inclinations. A narrow (<10 cm) basal conglomerate layer or paleoweathering zone may be preserved at the unconformity; however, the unconformity may be obscured by cm- to m-scale high strain (schist) zones developed within both Archean and Proterozoic rocks. Locally, Archean metagreywackes overlie Proterozoic strata, suggesting a component of reverse faulting. Unusual alteration of the Archean metagreywackes beneath Proterozoic strata was noted in two localities; at one the metagreywackes are altered to black, intergrown biotite and chlorite(?) and at the other chlorite ± sericite- altered metagreywackes are overlain and infilled (?) by a magnetite-rich rock of uncertain protolith. Near the north end of Basler Lake, Proterozoic granite is weakly to non-foliated and intrudes both Proterozoic strata and strongly foliated Archean granite. The western limit of Archean granitoids was not defined during the course of 1999 mapping.

Northwestern Cowan Lake area constitutes a complex terrane of Archean granitoid and supracrustal rocks (the latter undefined on Lord's (1963) map) which include middle-upper amphibolite to granulite facies migmatites correlative with Henderson's (1998) Ghost domain, as well as some greenschist-amphibolite and granulite facies granitic intrusions. Migmatitic metasedimentary rocks contain combinations of iolite ("high-grade" cordierite), biotite, muscovite, sillimanite, K-feldspar, garnet, graphite and orthopyroxene. These include both metatexites (partially melted, commonly layered rocks containing both paleosome and leucosome) and diatexites (complete melts lacking significant paleosome). Metavolcanic migmatites, including felsic, intermediate and mafic rocks, are preserved either as relatively cohesive units or as agmatites (> 50% metavolcanic blocks, forming the paleosome, set within a variable amount of leucosome). Typically, this leucosome contains combinations of plagioclase, quartz, K-feldspar, biotite, orthopyroxene, clinopyroxene, hornblende, grunerite(?) and magnetite. Gossanous pods, ≤2 m in length, are found within the migmatitic metavolcanic rocks. Gradational contacts between lithologies are common and may be a product of primary interlayering however, evidence for magmatic mixing and contamination of intrusive phases is extensive. The higher grade rocks have a prominent aeromagnetic signature that outlines patterns suggestive of map-scale interference folds (eg. basin and dome and possibly mushroom folds). Two distinct lithologies are represented by aeromagnetic highs; metasedimentary diatexite, which may contain blocks (paleosome) of a layered garnet-pyroxene-magnetite rock (banded iron formation?) and a magnetite-bearing granite which contains abundant magnetic mafic enclaves.

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QC IS MORE THAN JUST NUMBERS

Jago, B.C. Ph.D.
Lakefield Research Limited

Diamond exploration no longer is carried out by just a few major companies; the industry now includes junior, intermediate and major companies, all able to apply the latest exploration technology due to a world-wide network of applied researchers and specialised analytical facilities.

High calibre processing is demanded by an industry in which major discoveries can rest on the extraction and identification of a single, sand-sized particle. Laboratories should provide secure, chain of custody sample handling and documentable and reproducible sample processing and quality control techniques. ISO/IEC Guide 25 accredited laboratories provide the quality assurance that will be the standard for results reporting on stock exchanges and a solid link between independent and corporate labs.

Quality control is more than a review of numbers generated by quality control programs although most exploration clients rely almost exclusively on quality control reports that have some numerically, quantifiable basis. Strong Quality control programs are built on technically sound processing flow-sheets. However, the most up-to-date processing technology and flow-sheet design with fail miserably without proper emphasis on training, education and supervision.

Processing technology should be simple, based on physical and chemical attributes of the material being processed and as easy as possible to monitor. Laboratory and equipment design should lend themselves to easy dismantling and cleaning as well as on-stream quality control.

Sample processing flow-sheets also should be as simple as possible. It constantly must be recalled that the loss of a single grain can be potentially significant. As a result, over-handling of sample material and the generation of a multitude of processed fractions should be avoided at all costs.

Training and education of processing staff can not be over-emphasised. Staff should be trained on the proper and safe operation of all equipment in the process flow-sheet including the reasoning for the selection of a particular piece of equipment. Processing staff must be fully cognisant of the physical limitations of each piece of equipment and they must be thoroughly trained of what constitutes a good and a bad result. Processing staff must have some familiarity with the mineralogy of the sample at hand.

Properly trained staff can easily detect processing problems before they become processing disasters only when they fully understand how each piece of equipment works and how each step of the processing flow-sheet fits with the proceeding and following step.

BEAUFORT-MACKENZIE MINERAL DEVELOPMENT AREA WEB SITE

[1]Jones, A., [2]Muller, M. and [3]Udell, A.
[1] Minerals, Oil and Gas Division, RWED-GNWT [2] The Joint Secretariat - Inuvialuit Renewable Resource Committees [3] GDS and Associates Systems Limited

Minerals, Oil and Gas Division (MOG) continues to develop Web sites and Internet GIS applications that assist in resource development, following the success of the Coronation Gulf Mineral Development Area Web site (http://www.cgmda.nu.ca) in 1998 and the timely Fort Liard Resources Directory (http://www.liardresources.nt.ca) in April 1999.

MOG has recently partnered with the Joint Secretariat and Inuvialuit Regional Corporation to produce the Beaufort - Mackenzie Mineral Development Area (BMMDA) Web site at http://www.bmmda.nt.ca. This site is a comprehensive guide to the geology, hydrocarbon and mineral resources, environmental data, economic studies, and development processes in the Inuvialuit Settlement Region (ISR). Many organizations have contributed data to the project.

The site will be launched in October 1999 and features an interactive Geographic Information System (GIS) with improved functionality, searchable geoscience/geotechnical and environmental science reports, extensive Web site links, and economic models of known oil and gas pools.

The customized Online GIS application was developed with ESRI MapObjects and Microsoft Visual Studio software. It compiles spatial information (linking it to supporting documentation where applicable) detailing the physical environment, resource interests, and land uses in the area. These data include bedrock and surficial geology maps, geophysical surveys, wildlife management zones, Inuvialuit Private Lands, and community conservation plans for the six communities in the ISR.

Diverse datasets can be layered, viewed at various scales, queried, and navigated using the interactive tools in the GIS. Spatial relationships and attribute data among diverse information layers can also be studied over the Internet. This information assists petroleum and mining industry proponents and project reviewers in researching existing data and identifying needed information to move the development process forward in an informed manner.

The Beaufort Sea and Mackenzie Delta region was a centre for petroleum exploration in the 1970's and 1980's. Interest in the substantial resources of natural gas (6.57-12.2 Tcf) and oil (0.585-1.44 billion bbl; National Energy Board, 1998) has been renewed with the issuance of rights to four new parcels in September (winning exploration bids ranged from $35 to $53 million). Proponents of petroleum and mineral development projects, environmental assessors, resource managers, agencies in the ISR, and other interested parties will find the BMMDA site useful in their upcoming endeavours.

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IMAGING SLAVE UPPER MANTLE HETEROGENEITY USING DEEP-PROBING ELECTROMAGNETIC EXPERIMENTS

[1]Jones, A.G., [2]Ferguson, I.J., [3]Evans, R. and [3]Chave, A.D.
[1]Geological Survey of Canada,Ottawa, [2]Department of Geological Sciences, University of Manitoba, [3]Woods Hole Oceanographic Institution

Electromagnetic studies being carried out on the Slave craton are adding significantly to the paucity of knowledge on its mantle root. The two projects involve (a) making magnetotelluric (MT) recordings along the Lupin mine winter road, and (b) dropping special instrumentation to the bottoms of lakes to record MT signals over the course of a year. Two winters of acquisition along the ice road have resulted in coarse coverage (50 km station spacing) from Tibbit Lake to Lupin mine, with coverage also along the road to Kennady Lake. The first deployment of the ten lake-bottom systems was retrieved in July, and the instruments were re-deployed in nine further lakes in August. This paper will present the interpretation of the data from the winter road sites, and present an update on the status of the lake bottom experiment.

A plot of the long period MT phases from the ice road sites shows a local, well-defined phase maximum in the vicinity of Lac de Gras. This maximum is in excess of 78 degrees, compared to 68 degrees at Yellowknife and 70-72 degrees at Lupin mine and Kennady Lake. A higher phase indicates higher conductivity at depth, and a qualitative interpretation of this observation is that the lithosphere-asthenosphere boundary (LAB) is shallower beneath Lac de Gras than elsewhere along the ice road. Preliminary quantitative modelling supports this perhaps paradoxical feature.

The diamondiferous Eocene-aged kimberlite pipes are evidence that the centre of the craton had a thick root 50 Ma ago, with a LAB in excess of 150 km. These EM data imply that that root has been eroded since, with the corollary is that no younger kimberlites will be found.

ELECTRICAL CHARACTERISTICS OF MINERALIZED AND NON-MINERALIZED ROCKS FROM THE YELLOKNIFE AREA, NORTHWEST TERRITORIES

Katsube, T.J., Mwenifumbo, J., Kerswill, J., Connel, S. and Perez, N.
Geological Survey of Canada (GSC) Ottawa, Ontario, K1A 0E8

Electrical resistivity characteristics of a suite of 10 rock samples from the Giant Mine and Con Mine areas (Northwest Territories) have been investigated in order to provide information for development of exploration strategies and for aiding interpretation of down-hole, ground and airborne electromagnetic surveys. The samples include material from: 1) gold-bearing quartz veins from a mineralized shear zone, 2) sericite schist and 3) chlorite schist from alteration zones that parallel the gold-bearing vein, and, 5) basalt that constitutes the barren host to the shears and veins.

Preliminary results indicate that sulphide- and/or oxide-poor rocks generally display electrical resistivity (ρ_r) values in the range of 1,000-25,000 ohm-meters (Ωm); some samples show electrical anisotropy (λ) values of 4:1 to 7:1. Some sections of the mineralized material displayed ρ_r values as low as 30-100 Ωm, with relatively large λ values of 50:1 when sulphide minerals are relatively abundant. Several sericite and chloritic-sericite schist material show ρ_r values as low as 500-600 Ωm, with their λ values as high as 10:1, when sulphides are present.

Preliminary results also imply that certain sections of the gold-bearing quartz veins show good electrical conductivity but those conductivities are not continuous throughout the veins. In addition, the electrical resistivity is anisotropic so that electromagnetic surveys could miss the conductive targets, depending on the direction of the survey lines. The relatively good electrical conductivity (500-600 Ωm) of the sericite and chloritic-sericite schists, when sulphides are present, is continuous and may serve as an indirect indicator for mineralized quartz veins. However, the schists are also electrically anisotropic so that the direction of the electromagnetic survey lines could be an important factor in designing exploration programs. Further laboratory measurements and analyses are underway on additional samples.

FIELD RELATIONS AND U-PB GEOCHRONOLOGY OF THE CENTRAL SLAVE COVER GROUP IN THE YELLOWKNIFE GREENSTONE BELT AND CENTRAL SLAVE BASEMENT COMPLEX AT POINT LAKE

[1]Ketchum, K., [2]Bleeker, W. and [3]Jackson, V.
[1]Memorial University of Newfoundland, [2]Geological Survey of Canada, [3]DIAND NWT Geology Division

The deposition age of a dominantly siliciclastic succession at the base of the Yellowknife greenstone belt has long been a subject of speculation, and a previous U-Pb study gave a tentative age for associated felsic volcanism of 2835 Ma. EXTECH-funded U-Pb dating of felsic volcanic rocks in this succession, which is part of the Central Slave Cover Group, provides unequivocal age constraints for supracrustal deposition. A quartz-porphyritic felsic tuff overlying cross-bedded fuchsitic quartzite at Dwyer Lake is dated at 2853 +2/-1 Ma with no evidence of zircon inheritance or multistage Pb loss. At Bell Lake, a 3 m-wide layer of quartz-porphyritic felsic tuff within banded iron formation (BIF) is dated at 2826 +/- 1.5 Ma, again with simple zircon systematics. The age of a heterogeneous, strongly-sheared felsic volcanic unit beneath the BIF is not yet established, but a concordant, 2954 Ma zircon grain is similar in age to an underlying basement unit. The age data and the heterogeneity of the sample suggest that this volcanic unit is reworked. Preliminary age data for a fine-grained, bedded, siliceous unit (reworked felsic tuff?) within mafic volcanic rocks of the Octopus Formation on Great Slave Lake indicate that this formation is much younger than the Central Slave Cover Group. Correlation with the overlying Kam Group is tentatively indicated.

The Central Slave Basement Complex forms the depositional and structural basement to the Central Slave Cover Group. This basement complex is well exposed at Point Lake where it is overlain by the ca. 2.7 Ga Point Lake greenstone belt. Detailed mapping of the basement complex has revealed the presence of two distinctive early gneiss units separated by an up to 30 m-thick supracrustal package of amphibolite, ultramafic schist, quartzite, and quartzofeldspathic paragneiss. This thin supracrustal package can be traced discontinuously for at least 11 km and is inferred to be older than the greenstone belt. The gneissic substrate is in part dated at 3150 +/- 3 Ma and likely also includes a 3088 Ma component based on an earlier study. Younger events that influenced the basement complex include volumetrically significant granitoid plutonism, particularly along the present-daybasement-cover contact, and folding of the gneiss complex accompanied byheterogeneous structural reworking. The supracrustal marker unit between gneiss packages outlines broad NE-trending basement folds that mimic those in the Point Lake greenstone belt to the east. Reworking is related in part to west-directed thrusting of the greenstone belt over basement. These younger plutonic and tectonic events resulted in greatly-increased structural and lithologic diversity within the basement complex. A unit of migmatitic pelitic gneiss within this complex appears to be relatively old based on field characteristics. Monazite U-Pb data from this unit may potentially provide the age of an early, pre-greenstone belt metamorphism.

PRELIMINARY SURFICIAL GEOLOGY STUDIES AND MINERAL EXPLORATION CONSIDERATIONS IN THE YELLOWKNIFE AREA, NORTHWEST TERRITORIES.

[1]Kerr, D.E., and [2]Wilson, P.
[1]Terrain Sciences Division, G.S.C.; [2]Wilson Geo-Consulting, Courtenay, B.C.

Introduction

Through the Yellowknife EXTECH program, Terrain Sciences Division initiated regional surficial geology mapping to provide baseline data of surficial materials, ice flow history and soil geochemistry. Reconnaissance surficial geology mapping was undertaken in: NTS 85J/7, 8, 9, 10, 11, 16; 85I/ 4, 5, 12, 13; 85O/1 and 85P/4. Samples collected from 70 stations include: 58 2 kg soil samples for trace element and grain size analyses, and 60 litter fall and humus samples of 25 g to 100 g for trace element geochemistry determinations. Approximately 50 pebbles were collected from 47 sites for provenance determinations and glacial transport investigations. In addition, 12 10 kg soil samples, and 25 samples of 20 kg from the Drybones Bay area were collected to document the range and background concentrations of kimberlite indicator minerals.

Surficial sediments

Till, the most prevalent surficial sediment, consists of a loosely compact, stony, matrix-supported diamicton, with the matrix ranging from coarse to fine sand with minor silt. It is generally <2 m thick, and forms a discontinuous veneer over bedrock. Till is more extensive in the northern map area than in the central and southern part. Glaciofluvial sediments are relatively uncommon, and consist of fine sand to cobbles in the form of eskers, kames and subaqueous outwash. Lacustrine sediments associated with glacial Lake McConnell consist of sand, silt and clay estimated to be < 20 m thick, and preferentially in topographic lows. Stratigraphically, these sediments overlie till, outwash and bedrock, and be overlain by fluvial sand and gravel.

Glacial history

The Yellowknife region was ice covered to about 11 000 BP and became ice-free by about 10 000 BP. Ice flow indicators relate to the last, most prominent phases of ice movement towards the southwest, prior to and during deglaciation. In the northeastern and central-eastern areas, there are indications of a slightly west-southwest flow which gradually shifts to the more prevalent direction. Yellowknife Bay is characterized by a few examples of cross-cutting relationships of striae. In isolated localities, there is evidence of a south-southwest flow cross-cutting a southwest flow. Along the western margin of the retreating ice, glacial Lake McConnell, a large ice marginal lake occupied the combined basins of Great Bear, Great Slave and Athabasca lakes. Much of the study area was inundated up to an elevation of 280 m before lake level fell by about 8 500 BP.

Pebble lithology provenance studies

To illustrate patterns of glacial dispersal and to estimate transport distances as an aid to mineral exploration, granitoid rocks were chosen as an indicator lithology. The highest concentrations of granitoid clasts (up to 72 %) occur in 3 regions underlain by the largest granitoid bodies: the west-central, central, and the southeastern areas. Maximum granitic pebble content of 69 and 64 % decrease to 30 % with increasing distance of transport over 7 km or more in the down ice direction, even in areas where till cover is thin and granitoid outcrops are exposed for hundreds of km^2. Granitoid clast concentrations of up to 40 % occur as much as 25 km down-ice (SW) of their source, whereas some sample sites underlain by granite contain up to 70 % metasedimentary clasts, indicating transport distances of 25 km or more. The dilution of granitoid clasts by metasedimentary and volcanic clasts likely resulted from the greater ease at which metasedimentary and volcanic rocks were glacially eroded in the up-ice direction, contributing to their abundance and dominance in certain areas underlain by granitoid bedrock. The lowest concentrations of granitoid clasts in till (0 to <10 %) are found overlying volcanic and metasedimentary rock, between Yellowknife and Prosperous Lake, and south of the Discovery mine. Changes in pebble composition can thus be observed along the path of ice flow, indicating that there is an overlap in pebble lithologies between adjacent bedrock types.

INITIAL REPORT OF THE YELLOWKNIFE EXTECH REGIONAL METALLOGENY PROJECT: HIGHLIGHTS AND IMPLICATIONS

[1]Kerswill, J and [2]Falck, H
[1]Mineral Resources Division, Geological Survey of Canada, Ottawa, Ontario, K1A 0E8;
[2]Government of Northwest Territories, Yellowknife

Our talk and poster represent the first report of the new EXTECH III project entitled "Regional metallogeny of the area beyond the immediate Yellowknife area". The objectives of this project are to help provide regional-scale information that will facilitate discovery of new ore through: 1) the development of improved descriptive and genetic models for gold and/or base metal mineralization, and 2) the identification of new areas (metallogenic domains) with high exploration potential.

Work by a large number of contributors indicates that there are several styles/stages of gold mineralization within the Yellowknife region, including vein-hosted gold in mafic volcanic rocks as at Con and Giant and vein-hosted gold in turbidites as at Ruth and Camlaren. Falck (1992) identified five styles/stages of mineralization/alteration through investigations at more than 200 locales. These styles/stages include an early pyrite-pyrrhotite event, an arsenic-rich event, a sphalerite-galena event, a molybdenite-pyrite event and a late hematite-chalcopyrite event. Each of these styles/stages has influenced the total gold endowment, but the importance of each style appears to vary across the region. In some locales, only one style/stage is present; at others several different styles overlap.

The initial proposal for this project was to extend the previous work by Falck in active collaboration with other EXTECH participants involved in bedrock mapping and geochronology, surficial mapping and geochemistry, geophysics and other mineral deposit studies. The plan included: 1) review existing data, 2) refine, if possible, the character and regional distribution of the different styles/stages of gold "mineralization/alteration", 3) identify possible "additional" styles/stages and/or favourable areas, 4) select locales for further work, 5) undertake new field and laboratory work in selected locales to improve documentation of the character, timing and regional distribution of the different styles/stages of mineralization and alteration, 6) build empirical and genetic models for the different styles/stages of mineralization/alteration using existing and new data, 7) construct useful metallogenic maps which show the extent of individual styles/stages of mineralization/alteration throughout the

EXTECH area, and, 8) attempt to identify those areas most favourable for discovery of new ore, recognizing that such areas may occur within the Con and Giant mines, within former producers, near existing mines/past producers, or relatively distant from known economic mineralization.

New XY plots using data obtained by Falck in 1990 were constructed for different metals (Au vs Ag, Pb, Zn and As; Pb vs Zn, etc.) and for different sample populations (all samples vs individual occurrences). Plots for the composite population (n=220) indicate remarkably strong direct correlations between Pb and Zn and between Au and Ag, a moderately strong direct correlation between Au and Pb, somewhat strong correlations between Au and Zn and between Au and As, but no significant correlations between Au and Cu or between Au and Mo. Factor analyses of the composite population suggested the presence of six metal associations: Pb-Zn-Ag-Au, Ni-Co-Fe, Cu-Ag, Mn, Mo and As-Au. Despite the strong overall correlation between Au and Ag, Ag/Au ratios cover a broad range from greater than 100.0 to less than 0.10. These results are largely consistent with the presence of several different styles/stages of gold mineralization, including a major Pb-Zn-Ag-Au event and a major As-Au event.

Field activities included orientation visits to Con (Campbell and C4 Con zones), Giant (LAW, Supercrest and Brock zones), Crestaurum, Homer Lake, Discovery and Nicholas Lake in collaboration with other EXTECH participants. More than 100 rock samples were collected for petrographic and lithogeochemical investigations. Work on these samples is underway.

Work to date suggests that much of the gold in the Yellowknife domain is within a regionally extensive "corridor" that appears to extend from well south of the Con mine to north of Nicholas Lake, a distance of more than 100 km. Extensive hydrothermal alteration, including widespread silicification, is associated with this corridor, leading in many cases to difficulties in determining primary lithologies. Near Discovery, there is an ongoing debate as to whether some rocks are "pillowed volcanics" or "metasomatized turbidites". Near the Giant Mine silicified pillow basalts have been mapped as "dacites". Epidote within mafic volcanic rocks, reminiscent of that in the Noranda camp, is common in the vicinity of the Con and Giant mines and is present at Homer Lake.

Multiple generations of gold-bearing veins have been identified at most locales visited to date. At least some of these veins and their alteration zones (chlorite schists and sericite schists) are both strongly deformed and metamorphosed, indicating a component of "early" metal deposition. Different vein generations appear to have distinct metal endowments. Slabs of individual samples commonly reveal complex textures.

Many of the metal-rich veins are spatially associated with felsic volcanic rocks, felsic porphyry intrusions and/or granitoid plutons that range in age from greater than 2710 to about 2590 Ma. Significant work in this project will be directed towards testing a possible link between gold mineralization and felsic volcanism/granitoid plutonism.

Comparison with other Archean greenstone belts in Slave Province and elsewhere indicates that the Yellowknife EXTECH area includes rocks that may be favourable for discovery of a wide variety of mineral deposit types, including porphyry/epithermal ores and iron-formation-hosted gold. For example, the supracrustal rocks of the Bell, Dwyer and Patterson lake areas are somewhat similar to the quartzite/komatiite/felsic volcanic/BIF "package" that hosts the Meadowbank gold deposits in western Churchill Province.

AMPHIBOLITE LITHOGEOCHEMISTRY AND STABLE ISOTOPE ANALYSIS OF QUARTZ VEINS AT THE DISCOVERY MINE PROPERTY, SOUTHERN SLAVE PROVINCE, N.W.T.: PRELIMINARY RESULTS

King, J.B. and Ansdell, K.M.
Department of Geological Sciences, University of Saskatchewan, Saskatoon, SK Canada, S7N 5E2

The Discovery Mine property, located approximately 90km north of Yellowknife, represents one of the Slave Provinces richest past producers having produced $1*10^6$ oz of gold from approximately $1*10^6$ t of ore. The correlation of a number of gold prospects in the area with regional structural trends, including the recently recognized "Ormsby Fault Zone"(OFZ), suggest a possible relationship between gold mineralization at Discovery to the rich gold mines of Yellowknife.

Lithologically the area is divided into two domains separated by the NE-trending OFZ. The "Discovery Domain", to the southeast, is dominated by turbiditic metagreywackes and metamudstones whereas the "Ormsby Domain" is comprised of tuffaceous and clastic metasedimentary rocks and two elongate bodies of amphibolite. The amphibolites have been interpreted as basaltic to andesitic metavolcanic rocks, based on major element chemsitry. Similarly, immobile trace element classification of the amphibolites (Zr/TiO_2 * 0.0001 vs. Nb/Y) also suggest a basaltic-andesite to andesite protolith. The ultimate origin is complicated by gradational lithological contacts between the amphibolites and adjacent tuffaceous metasedimentary units suggesting a possible volcaniclastic character for the former.

Chrondrite-normalized trace and rare-earth element (REE) ratio analysis and subtle mineralogical differences are used to divide the amphibolite samples into two divisions namely an amphibole-feldspar-quartz ± biotite assemblage (Eu/Eu* = 0.69-0.73; $Zr/Y_{(N)}$ = 76.56-111.09) and a quartz-feldspar ± amphibole ± apatite assemblage (Eu/Eu* = 0.82-0.94; $Zr/Y_{(N)}$ = 14.63-24.50). The latter of these, in accord with sample proximity to mineralizing quartz veins, is tentatively interpreted as an alteration product of the former. Chondrite normalized REE patterns show similar overall trends for both altered and unaltered amphibolite assemblages and are characterized by LREE enrichment ($La/Lu_{(N)}$ = 1.79-3.48). These patterns in addition to other tectonic discrimination diagrams (e.g. Ti/100 vs. Zr vs. Y*3 and TiO_2 vs. MnO*10 vs. P_2O_5*10) indicate that the amphibolite unit was likely derived from a calc-alkaline, continental-arc related protolith.

In contrast to the exploitation of gold-bearing, folded quartz veins hosted in metaturbidites of the original Discovery Mine, recent exploration in the area has focused on gold concentrated in veins within the amphibolites. These veins were emplaced in extensional structures resulting from dilation accompanying strike-slip movement along the OFZ. Quartz ± carbonate and quartz/carbonate ± feldspar ± biotite veins exist although the former has produced the highest gold concentrations. Free gold associated with arsenopyrite, pyrrhotite, pyrite and chalcopyrite is most common in these veins but sporadic concentrations are occasionally found in associated alteration halos. Oxygen isotope analysis of vein quartz has yielded $\delta^{18}O$ values ranging from 12.22-15.63 per mil, which are similar to $\delta^{18}O$ values from quartz in quartz/carbonate vein from the Yellowknife mines (approx. 11.6 to 14.1 per mil). Further stable isotope and fluid inclusion analysis will provide better constraints on the origin, temperature and composition of the mineralizing fluids and facilitate comparisons to hydrothermal processes operating at the Yellowknife gold deposits.

DARNLEY BAY RESOURCES LIMITED - PROJECT HIGHLIGHTS

La Prairie, L.
Darnley Bay Resources

Geological Survey of Canada

The Geological Survey of Canada has identified the Darnley Bay Anomaly as the strongest isolated gravity anomaly (130 mgls) in North America and has concluded that the combined gravity and magnetic components has a high rating to contain nickel, copper and the platinum group elements (PGE). Compared to world class nickel-copper deposits, the gravity Anomaly is:

a.. four times stronger than the gravity anomaly over the Sudbury Basin, the location of the world's largest economic nickel-copper sulfide deposit with total resources of 1,650 million tonnes @ 1.17% Ni, 1.02% Cu, 1 g/t PGE;

b. twice as strong as the Bushveld Complex gravity anomaly, host of 70% of the world's known platinum resources with a total of 11,549 million tonnes @ 5.44 g/t PGE; and

c. five time stronger than the gravity anomaly found over the Noril'sk deposit, host of today's highest grade producing nickel deposits, with total resources of over 900 million tonnes @ 2.7% Ni, 3.2% Cu, 12.8 g/t PGE.

Management

The management believes the Company's holdings host world-class mineral deposits, which could be the site of future major mining operations. Also, just as the Sudbury Basin was host to the world's largest production of nickel in the 20th century, the 21st century could well belong to Darnley Bay.

Falconbridge Limited

Falconbridge Limited has financially participated and is assisting the Company with a program to evaluate the mineral potential. In order for Falconbridge to remain a participant, it will contribute, on an ongoing basis, half of the exploration costs.

The 1997 Survey:

a. revealed that the Anomaly is of complex shape and may include at least four separate intrusives, possibly having more than one period of eruption;

b. revealed that the source of the Anomaly is a mafic-ultramafic intrusive, being a host rock for all major nickel-copper and PGE deposits;

c. identified five zones in the aeromagnetic data for first priority ground geophysical follow-up work: the Thrasher, Billy, Hornaday, Green and Ruben zones, all of which are in the Company's 1.1 million acres;

d. revealed nine isolated near-surface magnetic offshoots at economically viable depths and within the broad outline of the Anomaly, six of which are offshore, five within the areas of the Inuvialuit Mineral Rights and the Prospecting Permits, and one mostly within the Tuktut Nogait National Park.

e. revealed numerous discrete magnetic anomalies within and adjacent to the lands covered by the Concession Agreement. The discrete anomalies are similar to those found over kimberlite pipes that contain diamonds in the Lac de Gras area of the N.W.T.

The 1999 Surveys on the Thrasher Zone:

a. confirmed the presence of the large, deep-seated mafic-ultramafic intrusive;

b. confirmed broad residual gravity highs (e.g., sources at around 500 metres in depth), interrupted by sharp gravity lows (reflecting shallower sources); and

c. located five electromagnetic conductors; three are horizontal and two are vertical. Models of the two vertical conductors are 450 - 800 metres (1,476 - 2,625 feet) wide, 1,500 metres (4,592 feet) in length, are located 250 metres (820 feet) from the surface, extend to a depth of over 1,000 metres (3,281 feet), and coincide with two of the horizontal conductors.

EVALUATION OF METAMORPHOSED HOST ROCKS OF MULTI-FACIES (AURIFEROUS) IRON FORMATIONS OF THE (SOUTHEASTERN) WOODBURN LAKE GROUP, CHURCHILL PROVINCE, NUNAVUT.

[1] L'Heureux, R.L.,[1] Duke, N.A., [2] Zaleski, E.
[1]Dept. of Earth Sciences, University of Western Ontario, London, Ontario, N6A 5B7. [2] Geological Survey of Canada, Ottawa, Ontario, K1A 0E8

The Woodburn Lake group is a prime example of an Archean komatiite-quartzite-iron formation association. In the Meadowbank River-Tehek Lake area, iron formation occurs in multiple facies with oxide>>silicate>>carbonate>sulfide. Host lithologies include quartzite, greywacke, mafic to felsic volcanics and amphibolitic hornfels. Amphibolitic hornfels is postulated to represent a carbonated volcanic suite metamorphosed to low- to mid- amphibolite grade, driving calc-silicate reactions that resulted in the spotted amphibolitic texture. Between the northernmost of the Meadowbank gold deposits and the south end of Third Portage Lake, massive, carbonated mafic to intermediate volcanic rocks strike into amphibole hornfels units. Geochemical analyses of the hornfels support the correlation. Amphibole hornfels examined in the area of Third Portage Lake is invariably enriched in light rare earth elements, a characteristic typical of Archean calc-alkaline volcanic rocks. Preliminary interpretation suggests that the transition to amphibole hornfels represents a greenschist-amphibolite metamorphic isograd. Microprobe analyses of the mineral chemistry of amphiboles and garnets collected from drill core and surface samples will be used to test this interpretation. At present it appears that the Meadowbank deposit occurs at upper greenschist grade, a characteristic common to classic Archean lode-gold systems.

On a regional scale, comparisons will be made to iron formations and host rocks above and below the greenschist-amphibolite isograd. Iron formations south of the Meadowbank deposit occur in greywackes and garnet-bearing amphibole hornfels at mid-amphibolite facies. North of the deposit, iron formations are present at or near the contact between quartzites and mafic volcanic rocks at mid-greenschist grade. Work to date by exploration companies shows polarized gold distribution favouring mid- to upper-greenschist facies conditions suggesting metamorphic rather than primary setting controls determined mineralization localities.

U/PB GEOCHRONOLOGICAL CONSTRAINTS ON ARCHEAN AND PROTEROZOIC DEFORMATION: YATHKYED-ANGIKUNI AREA, WESTERN CHURCHILL PROVINCE

[1]MacLachlan, K.; [2]Relf, C., [1]Davis, B. and [1]Aspler, L.
[1]Geological Survey Of Canada
[2]DIAND, NWT Geology Division

It has long been recognized that much of the western Churchill Province experienced significant Paleoproterozoic tectonothermal reworking; however, until recently, geochronologic and field data required to address the precise nature of this reworking have been lacking. New U-Pb ages from the Yathkyed-Angikuni area in the northwestern Hearne domain indicate that Paleoproterozoic events as young as ca. 1.83 to 1.81 Ga resulted in juxtaposition of crustal blocks with contrasting Paleoproterozoic overprints.

The Yathkyed-Angikuni domain straddles the trace of the Snowbird Tectonic Zone, a geophysically defined crustal-scale structure separating the Hearne and Rae blocks. This domain has been relatively unaffected by Paleoproterozoic processes, and preserves Neoarchean structures and metamorphism. Greenschist to lower amphibolite facies supracrustal rocks, deposited ca. 2.7 Ga, are distributed around the margins of this domain, whereas mid- to upper-amphibolite facies gneisses derived from mixed supracrustal and plutonic rocks comprise the central part. The structural grain is dominated by a steeply northwest-dipping composite fabric (S_0, S_1 and S_2) defined by ca. 2.5 Ga amphibolite facies mineral assemblages. The composite S_1/S_0 fabric is distinguishable only in the hinge zones of tight, upright to moderately overturned F_2 folds. The F_2 folds are doubly plunging and define a regional, elongate dome and basin pattern which is cut by the west-northwest-striking, ca. 2.19 Ga (LeCheminant et al. 1997) Tulemalu dyke swarm. The Tulemalu dykes appear to be restricted to this block.

In contrast, shear zones and gneissic domains which bound this block have been significantly modified in the Proterozoic. On the southeast margin, the Tyrrell shear zone dips northwest and displays a moderately northwest-dipping foliation, a shallowly northeast-plunging mineral stretching lineation and dextral shear sense indicators. Tulemalu dykes adjacent to the Tyrrell shear zone are well foliated and crenulated. Deformation in the Tyrrell shear zone occurred mainly at ca. 1830 Ma, and appears to have been completed by ca. 1810 Ma. The northwestern margin is the Tulemalu fault zone, represented by a belt of a northeast-trending, near-vertical, stike-lineated mylonitic rocks with predominantly dextral strike-slip shear sense indicators. U/Pb ages from synkinematic strike-lineated leucosome indicate deformation after ca. 1825 Ma. Tulemaulu dykes near the northwestern margin are cut by west- northwest-striking, dip-lineated shear zones, which generally have a southwest-side-down displacement and may be related to the dextral shear zones that bound the domain.

We tentatively suggest that the Yathkyed-Angikuni domain was down-dropped relative to surrounding tectonothermally reworked domains during Proterozoic transpression that involved a significant component of north-south extension. The new ages for Proterozoic deformation in the area partly coincide with current estimates for magmatism in the Baker Lake Basin (ca. 1.85 to 1.82 Ga). Regional transpressional deformation at ca. 1.83 to 1.81 Ga, and transtensional sedimentation in Baker Lake Basin may be related to sideways escape of the western Churchill Province due to squeezing from both the southeast (terminal collision and post-collision convergence in Trans-Hudson orogen) and the northwest (accretion of Nahannni terrane on the western margin of Wopmay orogen).

EVIDENCE FOR MOBILE AND SHALLOW SALT UNDER THE FRANKLIN MOUNTAINS

MacLean, B.C. and Cook, D.C.
Geological Survey of Canada - Calgary
bmaclean@nrcan.gc.ca, dcook@nrcan.gc.ca; GSC Contribution No. 1999165

Petroleum exploration wells and reflection seismic reveal the presence of mobile Cambrian age salt (Fig. 1) in the Fort Norman area. A number of salt pillows and diapirs have been identified and one large pillow is shallow enough to come almost to surface.

The Upper Cambrian Saline River salt horizon is well accepted but the presence of Lower/Middle

Cambrian Mt. Cap salt, such as that encountered in the Shell Keele L-04 well, is less well known. Mobile salt is commonly found in eastern Canada and the Arctic Islands but we know of no other documented salt movement (other than dissolution) in western Canada.

Careful examination of unconformity and bed thickness relationships within areas flanking the diapirs reveals at least three, and possibly five, periods of movement. Well-documented phases include: post-Devonian - pre-Turonian; Late Cretaceous; and post Cretaceous (including post-Paleocene). Cambrian and pre-Devonian phases are deduced from equivocal data, and may have been related to epeirogenic events along the Keele Tectonic Zone. The pre-Turonian event was compressional and possibly related to Jurassic/Cretaceous compressional orogenesis in the cordillera. Post-Cretaceous salt tectonics is at least in part related to Laramide compressional tectonics that produced the Franklin Mountains. One Late Cretaceous diapir has no clear relationship to regional tectonic events.

A 30 km long zone of salt and deformed sediments, the Gambill Diapir / Zone (Fig. 2), marks right-lateral shear displacement during the Laramide orogeny. It links the southern end of the Norman Range to the Gambill Fault to the SW.

Sudden 'flips' of tectonic vergence along strike are a feature of the Franklin Mountains and their genesis have long posed a puzzle to structural geologists. Incorporation of deformed salt in the core of the mountains, such as is imaged on seismic across the East MacKay structure may provide a solution.

Not only do salt movements affect overlying and adjacent bed thicknesses and attitudes but salt is itself an efficient seal to hydrocarbon migration. Hydrocarbon exploration possibilities include essentially untested thick Lower and Middle Cambrian strata, possible basal sands at the sub-Devonian unconformity, and Paleozoic carbonate reservoirs in contact with Cretaceous source beds.*(Figures at back of volume)*

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STRUCTURE, MINERALISED QUARTZ VEINS, AND VOLCANOLOGY OF THE CLAN LAKE VOLCANIC COMPLEX, NORTHWEST TERRITORIES

[1]Martel-Amesse, R., [1]Mueller, W.U., [1]Daigneault, R. and [2]Corcoran, P.L.
[1]Sciences de la terre,Univ. du Québec à Chicoutimi, Québec, Canada, G7H 2B1,
[2]Dept. Earth Sciences, Dalhousie University, Nova Scotia, Canada B3H 3J5

The mafic-felsic Clan Lake volcanic complex (62°54'-63°20'N/114°05'-114°21'W), approximately 55 km north of Yellowknife, is located in the southwestern segment of the Slave craton. A detailed investigation conducted in the central and oldest part of the edifice (62°55'50"N/114°15'W), shows a complex evolution of contemporaneous mafic and felsic lava flows and synvolcanic dykes associated with quartz veining. Both the flows and dykes have been affected by regional and local deformation. Two distinct planar fabrics were recognized. An early S1 foliation trending E-W to SE with subvertical dips, is parallel to the pillow elongation in the mafic volcanic units. This foliation is associated with a D1 event which is the main deformational event in the study area. A prominent down-dip stretching lineation L1 is associated with the S1 fabric and plunges steeply to the northeast. This lineation is well developed in amygdules of pillowed units. A subvertical NE trending S2 fabric, forming a local pressure solution cleavage, is discrete in the mafic volcanic rocks but well developed in the felsic volcanic and sedimentary units (D2).

The overall geometry of the cm- to dm-thick auriferous quartz veins, as suggested by aerial photographs, appears to follow NW-SE trending corridors that are parallel to regional-scale lineaments. Two distinct sets, both of an extensional nature, with fibers developed perpendicular to the wallrock, were recognized. Vein Set 1, 5-10 m long, has a NW-SE trend and a subvertical dip with numerous veins displaying evidence of late shearing. In contrast, prominent Set 2 veins with a NE-SW-trend commonly form in an en-échelon array. Although vein strike differs, both sets develop in NW-SE corridors. Quartz veins of both sets, containing pyrite, arsenopyrite and gold, develop preferentially in competent massive felsic and mafic volcanic rocks. Non-mineralized veins inject the interface between volcanic flow forms or in volcaniclastic units and shale.

Central edifice construction displays a complex but homoclinal south younging stratigraphic sequence. Basal mafic massive, pillowed and pillow breccia flows with local abundance of amygdules, are overlain conformably by E-W-striking mafic hyaloclastite breccia, tuff/lapilli tuff turbidites and deep-water pelagic rocks. Aphanitic N-NNE-trending felsic dykes with chilled margins and local columnar joints, cut both mafic and felsic flows. In addition, NNE-oriented synvolcanic faults interpreted as contemporaneous cauldron sector collapse structures, are the locus of multiple mafic dyke injection. Locally, dykes grade into mafic pillow-breccia flows. Aphanitic, 60-80 m-thick felsic units with large metre-scale well-developed flow bands, abundant in situ brecciation, hyaloclastite, and lobate structures, represent viscous lobe-hyaloclastite flows. Subsequent eruptions and seismic activity triggered redistribution of autoclastic debris on a volcanic slope via high- and low-concentration sediment gravity flows. Shallow, subsurface emplacement of felsic lobes is locally inferred based on cross-cutting relationships and are suggestive of endogenic ballooning of the volcanic pile.

The association of synvolcanic structures and quartz vein emplacement is striking. Initial volcanic construction may have controlled overall vein geometry, but the timing remains problematic. The vein system experienced D2 deformation and minor-scale F2 folds affecting some veins are observed. Furthermore, quartz veins experienced the D1 event as indicated by prominent subvertical stretched quartz grains, suggesting either a possible synvolcanic emplacement history or a syn- D1 event with a quartz network exploiting pre-existing zones of weakness.

WEST KITIKMEOT/SLAVE STUDY SOCIETY

McCullum, J.
West Kitikmeot/Slave Study Society

The West Kitikmeot / Slave Study does scientific and traditional knowledge research on the regional effects of development in the Slave Geological Province. This research includes areas and communities potentially affected by such development. The Study is a Partnership of Industry, Aboriginal Organizations, Environmental Groups and federal and territorial governments. The Partnership developed over a 2 year period and was registered as a Society in early 1996. The Study will last for five years, ending on March 31, 2001.

Funding for the Study is through a three-way matched funding agreement in which contributions from industry, aboriginal organizations, environmental groups or non-government organizations are matched by each of the federal and territorial governments to a maximum of $750,000 per year.

Most of the research is focused on baseline information which can then be used for cumulative effects assessment and monitoring. The Partners developed a set of priority research questions early on, and all research projects must address at least one of those questions. The questions were developed through a number of steps: an assessment of existing information, consultation meetings among the Partners, a broad-based research priority setting exercise involving all stakeholders and a final workshop using cumulative effects assessment methodologies combined with the priorities, concerns and expertise of each of the Partners and the information gathered earlier.

The Partners' aim is to focus both scientific and traditional knowledge research on individual research questions to provide as comprehensive an information base as possible. Research proposals are received and reviewed by the Study Office, independent experts, a traditional knowledge steering committee and a project steering committee before a final Board decision.

Each project must provide an annual report on its research, and these are also reviewed by independent experts before being released. Once the reports have completed the review process they are loaded onto the WKSS website and are publicly available.

Research projects include: caribou migration patterns using satellite collars, Dogrib traditional knowledge of caribou behaviour, Bathurst caribou calving ground studies, Inuit traditional knowledge of Bathurst caribou calving, Dogrib traditional knowledge of habitat, vegetation classification using remote sensing, Grizzly bear ecology, wolverine ecology, physical characteristics of eskers, eskers as wolf denning habitat, aquatic impacts of on-ice exploratory drilling, historical lake water quality using sediment cores, traditional environmental knowledge of the Kache Kue area and community based monitoring of community health.

A PHOTO GALLERY OF SMALL-SCALE EROSIONAL SURFACE BEDROCK FEATURES INTERPRETED AS ICE FLOW INDICATORS, KIVALLIQ REGION, NUNAVUT

McMartin, I. and Henderson, P.
Terrain Sciences Division, Geological Survey of Canada

Regional ice flow indicator mapping has been completed in the Kivalliq Region, Nunavut, by the Geological Survey of Canada as part of the Western Churchill NATMAP Program. The interpretative ice flow indicator maps are presently under compilation (8 sheets, 1:250 000 scale), and will be released as digital and paper products. 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 (McMartin and Henderson, 1999).

The poster exhibits examples of the glacial erosional record such as striae, grooves, rat tails, crescentic gouges, crescentic fractures, chattermarks, and roches moutonnées. Selected photos of key, multi-directional, faceted outcrops are presented with comments on the criteria used to determine both the sense and the relative ages of the ice movements. These interpretations are crucial since the region was located near the zone occupied by the last glacial remnants of the LIS (Keewatin Ice Divide: Lee et al., 1957). A few examples of water erosional features observed in the study area are also shown to demonstrate the difference in morphology and significance.

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DISTRIBUTION AND CHARACTER OF AU AND AS IN GLACIAL SEDIMENTS FROM THE MELIADINE TREND, RANKIN INLET AREA

McMartin, I
Terrain Sciences Division, Geological Survey of Canada

Regional surficial and geochemical mapping has been completed in the Rankin Inlet area by the Geological Survey of Canada as part of the Western Churchill NATMAP Program. The area comprises the Meliadine Trend (Miller et al., 1995), a 65 km long linear aeromagnetic anomaly where significant shear zone and iron-formation-hosted gold occurrences have been found in recent years by industry. This poster summarizes the work done on the distribution and physical characteristics of gold and its major pathfinder, arsenic, in regional till samples and in samples collected near selected mineralization zones.

Results show that the area of highest Au concentrations is located along the western part of the Meliadine Trend south of Meliadine Lake, forming an extensive anomalous zone approximately 40 km long and 20 km wide. A second but smaller anomalous zone is found SE of Meliadine Lake near the Discovery Zone. The general trend of the main anomalous area suggests glacial dispersal in the direction of the main regional ice flow event (135°). Gold grain counts indicate that the bulk of the Au resides within the silt size fraction of till. The direct relationship between Au concentrations of the HMC and the number of gold grains reflects the common association of Au with sulphides, and, based on recent mineralogical work, the presence of fresh sulphides in till collected from mudboils near mineralization zones. However, there is a lack of correspondence between Au concentrations in the HMC and in the <63 µm fraction, which may indicate gold partitioning in different size fractions, and/or the fact that free gold also occurs in the gold occurrences, mostly in sulphide-bearing quartz-carbonate veins.

The regional distribution of As shows that till along the Meliadine Trend is extremely enriched in arsenic, reflecting the abundance of arsenopyrite in the auriferous banded oxide-iron formations and associated quartz-carbonate veins (Armitage et al., 1993). On a regional level, there is a good relationship between As and Au concentrations in the fine fraction of till, and most of the samples containing the highest As concentrations are anomalous with respect to Au. However locally, depending on the primary form and grain size fraction of gold in the different prospects, the patterns observed for As and Au may be indirectly related in terms of bedrock sources, as indicated by the presence of high Au - low As concentrations in some of the samples. Physical partitioning studies in samples collected near mineral occurrences were undertaken to determine the variations in fractionation of Au and As among the different styles of gold occurrences.

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MITE - HG PROJECT IN THE KAMINAK LAKE AREA, KIVALLIQ REGION, NUNAVUT: A PROGRESS REPORT

McMartin, I.; Hall, G.; Kerswill, J.; Sangster, A.; and Vaive, J.
Geological Survey of Canada

As part of the Metals In The Environment (MITE) Program initiated by the GSC in 1997, a project to study the cycling of Hg in the surficial environment was undertaken in the Kaminak Lake area. In the 1970s, lake fish were reported to contain high Hg levels (Sherbin, 1979), and as a result, a commercial fishery was abandoned and moved to a nearby lake. Furthermore, lake water sampled in 1970 and 1971 indicated that surface waters had relatively high Hg concentrations and that the variations were probably related to the presence of Hg-rich black shales (Ameto Fm - Hurwitz Group) and/or local sulphide mineralization in the Kaminak Group volcanic belt (Hornbrook and Jonasson, 1971; Shilts and Coker, 1995). The objectives of this project are to (1) evaluate the distribution of Hg in surficial sediments from permanently frozen soils, (2) determine the source(s) of Hg in Kaminak Lake and document Hg abundance in bedrock and sulphide mineralization, (3) examine the residence sites of mercury in surficial sediments collected in the active layer and shallow permafrost, and (4) determine the factors which control the observed concentrations of mercury in sediments and the pathways through which mercury becomes bioavailable.

In 1997, field work consisted of sampling till and humus in 10 mudboil profiles down to permafrost along one transect oriented parallel (SE) to the dominant ice flow direction, and where base metal mineralization and potential Hg-rich Hurwitz Group rocks outcrop. Bedrock and filtered water samples were also collected in the vicinity of the transect. In 1999, field work involved the completion of till and humus sampling near Hg-rich sources identified in 1997 (Kaminak, Spi and Happy Lakes), and sampling of peat from selected wetlands surrounding the northern part of Kaminak Lake. Filtered and unfiltered water samples were also collected in Kaminak Lake. The geochemical, mineralogical and lithological composition of the samples were determined. Results are available only for the 1997 samples.

In till, the highest Hg levels are concentrated in the clay fraction and are directly proportional to the content of organic matter. This suggests that Hg bound to humic matter (in till and humus) entering the lake through runoff, although in relatively low levels, may play an important role in methylation and concentration in the fish. The lithological analysis of till shows that glacial sediments have only about 20% of local Hurwitz/Kaminak Group rocks, and a high proportion of far-traveled debris (up to 25% Dubawnt Supergroup clasts) which probably depresses the local geochemical signature. In humus, Hg levels are up to 57x the concentrations in till. Various bedrock lithologies within the Hurwitz Group (including the shales from the Ameto Formation) were sampled and results show that they are not enriched in Hg. However, several bedrock samples collected near and from mineralized zones within the Kaminak Group are relatively high in Hg, and therefore the Hg sources likely reside in Zn-bearing massive sulphide accumulations and polymetallic veins that are distributed throughout the greenstone belt (Goff and Kerswill, 1999). Preliminary results from water samples indicate that filtering the samples only slightly reduces Hg concentrations, probably reflecting the low concentrations of dissolved matter in lake waters from the area (Klassen, 1975).

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INVESTIGATION OF THE TECTONOMETAMORPHIC HISTORY OF THE UVAUK COMPLEX, NUNAVUT[1]

Mills, A., [2]Berman, R., [2]Hanmer, S. and [2]Davis, B.
Department of Earth Sciences, Carleton University, Ottawa; [2]Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario, K1A 0E8

The Uvauk complex lies along the Snowbird tectonic zone (STZ), a regional geophysical lineament that separates the Rae and Hearne domains of the western Churchill Province. The significance of the STZ remains controversial, especially given contrasting geochronology along its length: ca. 2.6 Ga granulite grade mylonitization in the Striding-Athabasca segment in NW Saskatchewan (Hanmer et al., 1994), and ca. 1.9 Ga granulite grade mylonitization and anorthosite-gabbro intrusion in the Kramanituar complex, just NE of Baker Lake (Sanborn-Barrie, 1999). Reconnaissance work on the Uvauk complex (Tella et al., 1994) led to the suggestion that granulite grade mylonites of ca. 2.6 Ga and 1.94 Ga had been juxtaposed by a cryptic fault. The current project includes detailed mapping of critical portions of the Uvauk complex, geothermobarometry, and geochronology in order to understand further the significance of the STZ.

The western portion of the Uvauk complex, mapped at 1:25 000 in 1998, resembles an east-opening V-shape or westward thinning sheet, with steep, south-dipping foliations and dominantly gently east-plunging extension lineations. The complex comprises anorthosite, gabbroic anorthosite and mafic granulite rocks, which, together with dioritic and quartzofeldspathic country rocks, have been penetratively deformed at granulite grade. The occurrence of anorthosite veins in wall rocks as well as wall rock xenoliths within the anorthosite indicate that the anorthosite is intrusive into the wall rocks. The variation in deformation state, from undeformed to well foliated and lineated, as well as the preservation of cross-cutting relations and bayonet-like apophyses, demonstrate that mafic granulites represent dikes emplaced syn-kinematically, and suggest a similar origin for mafic granulites in the KC. The probability of a petrogenetic link between the anorthosite and associated dikes will be evaluated using geochemistry.

Fundamental questions that remain are a) whether anorthosite and associated mafic intrusions supplied all the heat for metamorphism of the complex at ca. 1.9 Ga or whether these intrusions represent the culmination of a regional tectonothermal event, and b) whether wall rocks had previously experienced granulite facies conditions during a late Archean event. Clarification of the polymetamorphic history will come from new geochronology of the quartzofeldspathic gneiss and tonalite ribbon mylonite wall rocks, as well as a coronitic garnet gabbroic anorthosite from the southern margin of the intrusion. Further insight should be gained from comparison of P-T conditions of the anorthosite/mafic granulite with granulite grade wall rocks. In addition, comparison of P-T conditions of amphibolite grade wall rocks south of the complex with rocks south of Chesterfield Inlet will test the suggestion that a major detachment fault, located in Chesterfield Inlet, may be responsible for exhumation of these STZ granulite complexes. Preliminary geochronological and P-T results will be reported.

[1]Contribution to the Western Churchill NATMAP Program

REGIONAL GEOLOGY AND PLAY OPPORTUNITIES IN THE TROUT AND SLAVE PLAINS, LIARD REGION, NWT

Morrow, D.W. and MacLean, B.C.
Geological Survey of Canada, Calgary

Introduction

Recent discoveries and industry interest in the Liard and Trout Plain regions north of 60 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) and there is no published comprehensive interpretation using the available regional seismic and well data.

Database, Methods and Objectives

Figure 1 shows the public seismic database (National Energy Board) for the southern Northwest Territories. We have examined the available seismic west of longitude 118 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 (e.g. Fig. 2 and Meding, 1994). As part of a regional structural and stratigraphic analysis of this region, a number of different play concepts have been developed particularly with regard to the Keg River-Slave Point-Nahanni interval and, to a lesser extent, the Jean Marie Formation. The active cooperation of several companies has made it possible to reprocess a number of lines to deeper horizons. This permitted interpretation of structures affecting the Precambrian and that may have influenced structural development of the overlying Phanerozoic succession.

Initial Findings

The seismic line shown in Figure 2 illustrates a typical platform shelf-edge reef gas pool discovered by Shell Canada along the subsurface Slave Point edge (Fig. 1). The Netla C-07 well penetrated the Slave Point slightly eastward of the shelf edge and slightly below the highest point of Slave Point carbonates along this seismic line. There are several other possible Slave Point shelf edges inboard of the Netla C-07 well that may be equally prospective for gas in a northward continuation of the prolific shelf-edge gas fields of northeast British Columbia (Williams, 1981).

Many of these shelf edge buildups along the Slave Point edge and shelf interior buildups are located above basement structures of uncertain orientation (Fig. 2). These structures may have played a role in the localization of Slave Point buildups. Gas-filled porosity in the Slave Point appears to be secondary, rather than primary in silicified and fractured limestones (e.g. Netla C-07) or in dolomitized Slave Point limestone along the west side of the Cordova Embayment (e.g. Island River M-41). Seismic has also imaged untested buildups in the Jean Marie Formation above the Slave Point.

The Bovie Fault is the site of several structural-stratigraphic plays. The Bovie Structure probably developed in response to at least two events separated by a considerable time interval. The earlier structural event was a mid-Paleozoic transpression that resulted in a 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 thrust plate is interpreted to extend eastward from the Liard Thrust which marks the traditional eastern limit of Cordilleran deformation in this area.

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. There are also many small normal faults that developed during this mid-to-late Paleozoic deformation

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, 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. *(Figures at back of volume)*

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BIOGEOCHEMICAL SURVEY - YELLOWKNIFE AREA

Dave Nickerson, P. Eng.
Yellowknife, NWT

Although rock outcrop is abundant in the Yellowknife area, potentially auriferous shear zones are often recessive and marked by overburden-covered linear features. The concept behind the current program was to test an inexpensive method of assessing such features to determine which sections might be worthy of further exploration work. The techniques used had been developed primarily by Colin E. Dunn who acted as advisor to this project.

During June and July 1999 samples of the outer bark of black spruce (*Picea mariana)* and the stems of labrador tea (*Ledum groenlandicum*) were collected from about 80 sites in the northern part of the Yellowknife greenstone belt. They were dried and ashed and the ash analysed for gold and numerous other elements both by INAA and ICP-OES.

At the time of writing the results have not yet been fully compiled but some preliminary observations can be made. Both species accumulate very high concentrations of both gold and arsenic in the immediate vicinity of the Giant Mine and this contamination, presumably from airborne sources, decreases northward for at least 20 kilometres. Despite this masking effect which would certainly limit the effectiveness of the technique close to the existing mine small known gold deposits did give rise to recognisable anomalies. The small known lead-zinc deposit at Homer Lake gave rise to a very evident anomaly thereby reinforcing the effectiveness of this type of biogeochemistry in base metal exploration.

FEASIBILITY STUDY OF U-PB ILMENITE GEOCHRONOLOGY

A.K. Noyes and L.M. Heaman
University of Alberta, Edmonton, Alberta, Canada

Emplacement ages of kimberlite provide us with knowledge on the timing of local and regional geotectonic controls associated with kimberlite formation and emplacement. Within a particular craton, varying emplacement ages may occur, providing information on the frequency and duration of magmatism for that region (Davis et al., 1996). Conventional isotopic techniques used to determine kimberlite emplacement ages include Rb-Sr analyses on phlogopite and whole rocks; K-Ar and $^{40}Ar/^{39}Ar$ analyses of phlogopite and U-Pb analyses of perovskite and mantle zircon. However, an increasing number of kimberlites discovered in North America do not contain the 'traditional' minerals (phlogopite, perovskite and mantle zircon) often used to determine pipe emplacement ages, therefore it is desirable to find alternative age dating techniques. Typically, kimberlite magmatism is Jurassic to Cretaceous in age, however, kimberlite emplacement ages in Southern Africa are known to occur over a long period of geologic time (50 to 1700 Ma) (Allsopp et al., 1986). Kimberlites in North America have emplacement ages ranging from 50 Ma (Davis and Kjarsgaard, 1997) to 1100 Ma (Watson, 1967) (Eocene to Mesoproterozoic).

Kimberlites are mineralogically heterogeneous containing a proportion of xenocrysts making identification of primary minerals that have crystallized directly from the kimberlite magma, difficult. Therefore, it is preferable to apply more than one isotopic technique whenever possible to a single kimberlite. One dating technique alone may yield geologically meaningless ages depending on such factors as alteration (surface weathering) and/or the presence of contaminants (calcite within fractures, xenocrystic mica, etc.). The purpose of this study is two fold. The first is to provide a comprehensive study of the various isotopic techniques on the Monastery kimberlite that has well constrained ages (Rb-Sr phlogopite and U-Pb zircon and perovskite). The second is to investigate new radiometric techniques that may also provide meaningful kimberlite emplacement ages.

The chemical and physical resistance of ilmenite makes it an important kimberlite indicator mineral. Ilmenite has the potential to be a powerful geochronometer because of its high concentration with kimberlites world wide. As well, extensive research regarding mineral chemistry and petrology have concluded that ilmenite is genetically linked to crystallization in kimberlitic or proto-kimberlitic magmas. The Monastery kimberlite, located in the Eastern Free State of South Africa, exhibits an abundance of ilmenite megacrysts and macrocrysts suitable for analysis and the emplacement history of this pipe has been investigated by several isotopic techniques.

Published ages of emplacement for the Monastery kimberlite range from 83±3 Ma (U-Pb perovskite, Kramers and Smith, 1983) to 90±4 Ma (Rb-Sr phlogopite, Allsopp and Barrett, 1975). The U and Pb concentrations obtained through ilmenite analyses are 0.02-0.17 ppm and 0.1-1.32 ppm respectively. The ^{238}U-^{204}Pb results for nine ilmenite fractions yields an isochron age of 95±14 Ma. We have demonstrated for the first time that ilmenite possesses varying parent/daughter ratios (39.8-311.4), allowing for precise U-Pb isochron age determinations. Most important is the fact that the U-Pb age obtained is within error of previously published data demonstrating the feasibility of U-Pb ilmenite geochronology.

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SLEEPING BEAR INTRUSION, KWEJINNE LAKE, SOUTHWESTERN SLAVE PROVINCE, NWT

L. Ootes and [1] V. Jackson
University of Saskatchewan, Department of Geological Sciences
[1]DIAND, NWT Geology Division

The Sleeping Bear intrusion underlies an area of about 1.5 km^2 and is the largest of nine mafic intrusions of similar composition and character that were emplaced along an arcuate zone within metavolcanic rocks and cordierite-bearing metagreywackes of the Archean Yellowknife Supergroup (Jackson, 1998: EGS 1998-18/19). The intrusions and host metasedimentary rocks are cross cut by the Proterozoic Indin gabbroic dykes.

Sleeping Bear intrusion is composed of five distinct lithological phases which, on the basis of mutually cross cutting relationships, can be placed in the following chronological order. Phase 1 includes coarse- to medium-grained mafic-ultramafic rocks, with well-preserved igneous textures, as well as gabbroic breccias. Most ferromagnesian minerals have been altered to actinolite-tremolite. In the least altered samples, large (up to 3 cm long) zoned crystals of hornblende, some of which may contain relict clinopyroxene in their cores, are set in a plagioclase and hornblende groundmass. Phase 2 is the highly chloritized and magnetite bearing equivalent of Phase 1. Biotite-hornblende granodiorite (Phase 3) contains abundant metagreywacke xenoliths. Biotite granodiorite (Phase 4) contains very little metasedimentary xenoliths. Phase 5 consists of fine-grained felsic dykes, which cross cut phases 1 to 4.

Detailed field mapping of the Sleeping Bear intrusion revealed that it was emplaced either during or immediately after the main phase of Archean deformation and regional metamorphism. In addition, mafic xenoliths that are comparable to the Sleeping Bear are found within a pre- to syntectonic Archean granite-granodiorite.

Ongoing petrological and geochemical analyses of the Sleeping Bear intrusion are aimed at deducing the source(s) and crystallization history of this and related mafic intrusions and at examining their possible genetic relationships to the adajacent metavolcanic rocks of the Yellowknife Supergroup.

GEOLOGY & GEOCHEMISTRY OF MINERALIZED BANDED IRON FORMATION, COMMITTEE BAY REGION, NUNAVUT

S. Prior, J.P., Richards, and T. Chacko
University of Alberta, Edmonton, Alberta, Canada

Petrological and geochemical examination of several mineralized banded iron formation samples from two gold prospects, Three Bluffs and Inuk, in the Prince Albert Group greenstone belt, Committee Bay, reveals a complex tectonic history. Mineralized pelitic and amphibolitic iron formation (PIF, AIF) at Three Bluffs is interbedded with metagreywackes and metapelites. Mineralized PIF and AIF at Inuk are interbedded with metakomatiites and infolded with a tonalitic granitoid. At least two metamorphic (M1, M2) and two deformational events (D1, D2) have affected the crustal package. The M1 assemblage in PIF at both locales is characterized by biotite, magnetite, pyrrhotite +/- pyrite, chalcopyrite, muscovite and cordierite. The AIF M1 mineral assemblage differs slightly between the two prospects: at Three Bluffs it is characterized by ferro hornblende, actinolitic hornblende, magnetite, pyrrhotite, pyrite +/- chalcopyrite, arsenopyrite and biotite; whereas at Inuk it includes ferro actinolitic hornblende, ferro hornblende, cummingtonite, magnetite, pyrrhotite, pyrite +/- chalcopyrite, arsenopyrite, biotite and plagioclase. Biotite flakes align to define a foliation, which is attributed to D1 recumbent, tight to isoclinal folding. This foliation has been crenulated to form a crenulation cleavage (~060/90 locally at Three Bluffs) which is interpreted to be parallel to the axial plane of D2 shallowly- to moderately-plunging, upright folds. Stress axes for Proterozoic regional ductile structures, including the Wager Bay (Henderson and Roddick, 1990), Amer (Tella, 1994), and Walker Lake shear zones, appear to be oriented sup-parallel to those for D2, suggesting D2 folding and regional shearing may be coeval. M2 minerals in PIF at both study areas include garnet, muscovite, epidote, clinozoisite and magnetite +/- staurolite and sericite. At Three Bluffs, the M2 assemblage in AIF is defined by ferro pargasite, ferri-grunerite +/- ferro actinolite. The AIF M2 assemblage at Inuk includes ferro pargasitic hornblende, ferric cummingtonite +/- ferri-grunerite and grunerite. M2 minerals either overgrow the M1-defined crenulated foliation or partially replace M1 minerals. M2 muscovite is weakly aligned parallel to the D2 axial planar crenulation cleavage. M2 is interpreted to be higher metamorphic grade than M1 and to have occurred during and outlasted D2.

M2 and D2 may be related to regional Proterozoic activity in the Churchill Structural Province (CSP). Evidence for Proterozoic activity includes the deformation of two calc-alkaline plutons from the Ford Lake Batholith (U-Pb crystallization ages: 1823+/-3 Ma and 1826 +4/-3 Ma; LeCheminant et al., 1987) by the Wager Bay shear zone, and the deformation of metamorphosed MacQuoid dykes (ca. 2.19 Ga; Hanmer, et al., 1999). In addition, preliminary ages from two BIF-hosted gold properties in the southern CSP, including metasomatic hornblende (^{40}Ar-^{39}Ar plateau age - 1780 +/-20 Ma) and galena (Pb-Pb model ages – 2140-2055 Ma) from Meliadine, and metasomatic biotite from Meadowbank (K-Ar – 1791 +/- 32 Ma), suggest a link between Proterozoic activity and gold mineralization (Armitage et al. 1996; Miller et al. 1995). Currently, M1 and M2 amphibole and biotite are being analysed using the ^{40}Ar-^{39}Ar dating technique to test this hypothesis.

Gold grains are included in M1 biotite, amphibole and plagioclase indicating gold mineralization occurred prior to or during M1. A sulphidation model, where gold is transported in a bi-sulphide complex and deposited in iron formation by the reaction of sulphur with magnetite and fe-silicates, is favoured. This model is supported by the following petrological and geochemical observations. The abundance of sulphides reaches up to 60 modal % in mineralized iron formation. Relict replacement textures of fe-rich amphiboles by fe-poor amphiboles and of magnetite by pyrrhotite have been documented in mineralized IF. Finally, M1 amphiboles have low X_{Fe} values, which are comparable to amphiboles in mineralized iron formation at Meadowbank (Armitage, et al., 1996). M2, which is interpreted to be the last regional metamorphic event, overprints alteration textures associated with mineralization.

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PROGRESS TOWARD A TECTONOSTRATIGRAPHIC MODEL FOR THE PALEOPROTEROZOIC BAKER LAKE BASIN

[1]Rainbird, R.H., [2]Hadlari , T. and [2]Donaldson, J.A
[1]Geological Survey of Canada, 615 Booth St, Ottawa, Ontario K1A 0E9; rrainbir@nrcan.gc.ca,
[2]Ottawa-Carleton Geoscience Centre, Carleton University, Ottawa, Ontario K1S 5B6

Stratigraphic and sedimentological studies of the lower Dubawnt Supergroup in eastern Bake Lake basin in 1998 (Rainbird et. al., 1999), represented the first step toward establishing a tectonostratigraphic framework for the development of Baker Lake basin. That work suggested that the existing formational ("layer cake") lithostratigraphic subdivision of these strata is inadequate for understanding the origin and evolution of the basin. Key to this realization was the recognition that widespread potassic volcanism (Christopher Island Formation) is contemporaneous with deposition of alluvial fan and fluvial sedimentary rocks of the "underlying" South Channel and Kazan formations and therefore must be accommodated in any model that we would propose for basin initiation. Follow-up stratigraphic and sedimentological studies in the central Baker Lake basin in 1999 support our initial assertions and have helped to elucidate our goals.

The stratigraphy of the Dubawnt Supergroup on the northwest side of Baker Lake basin differs significantly from that in the south and east. Here, volcanic rocks of the Christopher Island Formation were deposited directly onto basement gneisses along with less voluminous basin-margin alluvial fan and pyroclastic interflows. The Wharton and Barrensland groups are extensive in this region, whereas they are not preserved along the southern margin of the basin.

A previously unassigned sedimentary unit, the Amarook Formation, unconformably overlies the Christopher Island Formation and is included, together with the ca 1.76 Ga Pitz Formation, in the Wharton Group. The Amarook is a well-indurated sandstone of variable thickness (up to 1km), characterized by large-scale crossbedding of probable eolian origin interbedded with alluvial sandstone and conglomerate. It is exposed along the northwest margin of Baker Lake basin and correlates with similar strata recognized in outcrop and in drill core from the eastern Thelon Basin. The disconformably overlying Pitz Formation can be divided into several volcanic and sedimentary members that vary locally in character and stratigraphic position. An upper sedimentary member correlates with strata mapped previously as basal Thelon Formation in the Thelon Basin, south of Aberdeen Lake.

Along the northern margin of Baker Lake basin, Lower Dubawnt Supergroup rocks are offset at high angle by a set of NW-striking dextral faults that appear to predate deposition of the overlying Barrensland Group (ca 1.72 Ga Thelon Formation). These faults may be coeval with NW faults that offset Baker Lake Group rocks along the southern margin of the basin. Basin-parallel (ENE) faults are inferred from regional geological and geophysical map patterns and may have formed during basin initiation.

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CS LORD NORTHERN GEOSCIENCE CENTRE: PAST, PRESENT AND FUTURE

[1]Relf, C., and [2]Cusveller, J.,
[1]DIAND NWT Geology Division; [2]RWED Minerals, Oil and Gas Division, GNWT

In the spring of 1998, the GNWT's Department of Resources, Wildlife and Economic Development (RWED), and the federal departments of Indian Affairs and Northern Development (DIAND) and Natural Resources Canada (NRCan) signed a trilateral geoscience agreement. Under the agreement, the three agencies agreed to strive to deliver their different, yet complementary, geoscience programs in a collaborative, coordinated way, thereby increasing cost effectiveness and reducing overlap. The trilateral agreement cited the establishment of a shared geoscience office in Yellowknife as one means to this end. The C.S. Lord Northern Geoscience Centre, named after Clifford Lord who mapped for the Geological Survey of Canada in the NWT between 1937 and 1973, was informally set up in DIAND's Core Library the same spring.

To accommodate space problems and allow building upgrades, C.S. Lord staff were moved to temporary quarters in old town early in the fall of 1999. The Centre currently houses two Bedrock Mapping Geologists, a Mineral Deposit Geologist, and a GIS Specialist, and serves as the primary centre from which RWED's and DIAND's geoscience programs are delivered. The GSC supplied the Centre's server, and provides support through the provision of technical assistance and expert advice on geology and digital data management issues.

Two geoscience projects are currently underway by Centre staff. The Yellowknife EXTECH project is a joint GSC-RWED-DIAND study of the geologic setting and controls on gold mineralization in the Yellowknife area. C.S. Lord staff carried out bedrock mapping in the northern part of the EXTECH area, are involved in the compilation and management of EXTECH data, and are coordinating logistics for numerous GSC- and university-based researchers. The other project involves bedrock mapping and associated studies (geochemistry, geochronology, metamorphic petrology) of the Snare River area (southwestern Slave Province).

In the next year or so, the CS Lord Centre has plans to initiate a bedrock mapping/integrated geoscience project with the GSC in the Walmsley Lake area (75 N), and begin a compilation of mineral showings and geologic data in the western Bear Province (parts of 86 C, F, K and 85 N). Over the longer term, plans are being discussed to define a joint GSC-C.S. Lord project east of Fort Liard (parts of 95 A, B, 85 D) to study the setting of mineral occurrences, oil and gas in the northern part of the Western Canadian Sedimentary Basin, and to examine the gem potential of the Selwyn plutonic suite in the northeastern Cordillera (105 P). In addition, the Centre plans to generate a digital geologic compilation map of the NWT.

PETROGENETIC STUDY OF VARIOLITIC PILLOW-MASSIVE VARIOLITE-CHERTY TUFF CYCLES WITHIN THE YELLOREX FLOWS

Renaud, J.[1], Duke, N.A.[1] , and Armstrong, J[2].
[1] Dept. of Earth Sciences, University of Western Ontario, [2]DIAND NWT Geology Division

The Yellorex flows, outcropping between Negus and Kam Points, represent the upper member of the Yellowknife Bay Formation of the Kam Group. The Yellorex member consists of repeated cycles of variolitic pillows, massive variolites, and cherty tuffs. Due to exceptional exposure, the sequence offers an ideal opportunity to investigate the petrogenetic relationship of variolitic lava to the capping felsic material.

The cherty tuff bands have been used by previous workers (Henderson and Brown, 1966) as markers in defining the Kam Group stratigraphy. More recently, zircon dates of cherty tuff markers (Isachsen, 1992) has demonstrated their primary igneous origin, dating the Kam volcanics between 2712-2701 Ma. At present, it is generally assumed that the cherty tuff bands are the distal products of pyroclastic activity, although no felsic centres are known to occur in the Kam succession. This investigation will test an alternative hypothesis; that the felsic material originated through rapid segregation from variolitic melts (i.e. is of insitu flow origin rather than a result of exotic pyroclastic activity). If this can be proven then reworking of the felsic flow tops forms the cherty tuff bands with well preserved sedimentary layering. If the cherty tuff bands can be tied petrochemically to the variolitic lavas, it would indicate unusually rapid flow fractionation, thus supporting liquid immiscibilty being involved in variolite formation.

The study will utilize samples collected during the summer of 1999. Selected samples will be chosen for detailed petrographic examination, bulk rock geochemistry, and limited mineral chemical analyses. The bulk rock analysis will include high precision REE and inert traces useful for determining igneous fractionation. Detailed samples of individual variolitic pillows, will allow for comparison of intra-pillow differentiation to the overall fractionation shown by individual flow cycles.

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ARCHEAN AND PALEOPROTEROZOIC FAULT HISTORY OF THE BIG LAKE SHEAR ZONE, MACQUOID-GIBSON LAKES AREA, KIVALLIQ REGION, NUNAVUT

Ryan, J.J., Hanmer, S., Sandeman, H., Davis, W., Berman, R. and Tella, S.
Geological Survey of Canada, Ottawa, Ontario, Canada. K1A 0E8

The Big lake shear zone (Blsz) in the MacQuoid-Gibson Lakes area transects Archean gneisses derived from metavolcanic, metasedimentary, and diverse plutonic suites. The shear zone has an exposed strike length of 50 km, with abrupt termination to the west. Central and eastern segments of the shear zone consist of dextral, amphibolite facies, porphyroclastic, annealed mylonites and straight gneisses, derived largely from tonalite and monzogranite. The western segment of the Blsz is distinct because (i) it preserves granulite facies assemblages, (ii) it encompasses a wider compositional variety of rocks, (iii) the orientation of its fabric elements vary from those in the east, (iv) shear sense indicators show a more complex deformation history, and (v) the cross-cutting relationships of various intrusive bodies place better constraints on the timing of early displacement.

Rocks in the western segment, in order of decreasing abundance, include: tonalitic orthogneiss, homogeneous tonalite, paragneiss, augen monzogranite, mafic granulites (variably retrogressed to garnet-plagioclase amphibolite), anorthosite and diabase. The granulite facies mylonites (and their variably retrogressed equivalents) are thermally anomalous with respect to the amphibolite facies mylonites and wall rocks. The spatial association of granulites, anorthositic sheets and late-synkinematic diabases represents an anomalous magmatic suite, restricted to the western segment of the shear zone. We propose that these magmas were synkinematically intruded in the western segment of the Blsz, and that the residual heat from the intrusions induced the localized high-grade event. Thermal input from magma emplaced into a shear zone is likely to be a general principle, and not a phenomenon restricted to the Blsz. The ultramylonites are crosscut by undeformed *ca.* 2.19 Ga MacQuoid dykes, constraining the high-grade, high-strain event to have occurred prior to ca. 2.19 Ga.

The western segment of the Blsz terminates abruptly at a NW-trending, till-covered lineament, that is interpreted as a fault. On the basis of regional aeromagnetic data, we correlate this fault with a structure that trends along South Channel in Baker Lake (South Channel fault; SCF). The SCF dextrally offsets the basal unconformity of the Baker Lake Group by 10 km, and thus records Paleoproterozoic displacement. A NE-trending magnetic anomaly which coincides with the Ippijjuag Bay fault (IBF) is also dextrally offset by 10 km. Tectonic reconstruction of the aeromagnetic data, through moving the block on the NE side of the SCF by 10 km NW along the SCF, results in a flat, wedge-shaped magnetic low. The low is cored by a sharp magnetic high, that is distinct from the more complex high amplitude magnetic pattern throughout the rest of the region. We interpret this low as a down-dropped, wedge-shaped graben, and the IBF represents one of the bounding faults, possibly an ancestral portion of the ca. 1.90 Ga Baker Lake basin.

SEQUENCE STRATIGRAPHY IN THE ARCHEAN RANKIN INLET GREENSTONE BELT, RANKIN INLET AREA, KIVALLIQ REGION, NUNAVUT

Ryan, J.J., Studnicki-Gizbert, C., Tella, S. and Sandeman, H.
Geological Survey of Canada,Ottawa, Ontario K1A0E8

Detailed mapping of the Archean stratigraphy at Rankin Inlet focused on: 1) characterization of the previously described upper and lower volcanic cycles in order to determine whether or not such a distinction is warranted; 2) investigation of the stratigraphic or structural position a strongly deformed conglomerate that marks the boundary between the two cycles; and 3) strategic geochemical sampling to investigate the tectonic setting of the upper and lower cycles.

The upper cycle is exceptionally well exposed on Tudlik and Kudlulik peninsulas, and on the numerous islands neighbouring Rankin Inlet. It is dominated by a thick pillowed basaltic sequence, with subordinate interflow pillow breccias and epiclastic horizons, as well as rare turbidite horizons comprising rhythmically layered sandstones and shales (including black shales). The lower cycle is dominated by rhythmically layered turbiditic, volcanic-derived sedimentary rocks, and abundant mafic hypabyssal intrusions, whereas volcanic rocks are rare relative to the upper cycle, and are restricted to the bottom part of the lower cycle. The sedimentary rocks also include banded iron formation, chert horizons, greywacke, and a variety of coarse-grained, clastic sedimentary horizons within a prominent conglomeratic unit (discussed below) towards the top of the lower cycle. Sills are extremely difficult to distinguish from massive flows, except where cross-cutting relationships with the sedimentary layering are preserved. The lithological contrasts are important to the geochemical evaluation of the upper and lower cycles, because it is unclear whether the sills and dykes are feeders for lower and/or upper cycle volcanic rocks.

The conglomerate horizon separating the upper and lower cycles is strongly flattened and stretched, however, it exhibits a well-preserved internal coarsening upwards stratigraphy that caps the turbidite-dominated lower cycle. Consistent with the observations of Tella et al. (1986), the conglomerate is clearly conformably overlain by pillow lavas of the upper cycle, and thus evidence for a structural dislocation between the upper and lower cycles is lacking. A progressive eastward transition from conglomerate to black shale, over 10's of kilometers along strike, is interpreted as a lateral facies change, possibly indicating increasing distance from source areas. The paleogeographic position of these sources remains enigmatic because granitic rocks are generally absent in the neighbouring lower cycle. The abrupt change from siliciclastic rocks at the top of the lower cycle to volcanic rocks in the upper cycle resembles a Phanerozoic-style sequence boundary within this Archean package.

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REVISION OF ARCHEAN AND PALEOPROTEROZOIC STRATIGRAPHY AT RANKIN INLET: IMPLICATIONS FOR THE TIMING OF MULTIPLE REGIONAL DEFORMATIONS, KIVALLIQ REGION, NUNAVUT

Ryan, J.J., Aspler, L., Tella, T., Sandeman, H. and [1] Studnicki-Gizbert, C.
Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A0E8
[1]Dept of Geological Sciences, Carleton University, Ottawa, Ontario K1S5B6

Although outliers of ripple-marked supermature quartz arenites near Rankin Inlet have long-been considered part of the Hurwitz Group (Paleoproterozoic), an underlying mixed siliciclastic-carbonate cover sequence was previously thought to be within the Archean supracrustal section (see Tella et al., 1986, and references therein). New field work and regional stratigraphic comparisons suggest that this mixed siliciclastic-carbonate sequence is also Hurwitz Group. Accordingly, multiple fabric generations in these rocks signify that the principal structural patterns at Rankin Inlet reflect Paleoproterozoic deformation.

The mixed siliciclastic-carbonate sequence (up to 100 m thick) is separated from underlying Archean mafic volcanic rocks by a covered interval. At the base of the unit, decimetre-scale subarkose to quartz arenite sheets alternate with carbonate-bearing beds. The carbonates consist of grey to orange-buff weathering, pure dolomite (1 cm to 2 m thick), dolostone with irregular quartz-chlorite laminae (likely partially silicified microbial laminites) and intraformational dololutite breccia. Up section, these rocks grade to thickly bedded, hematite-stained, subarkose to quartz arenite that exhibit long-scale (2 to 5 m) trough cross-beds and contain local interbeds of phyllite, dolomite, and matrix-supported, quartz-clast pebbly sandstone. Across a well-exposed 2 metre interval, these rocks grade up section to white-weathering, supermature quartz arenites displaying short-wavelength (1-5 cm), multiply oriented ripple marks. The ripple-marked quartz arenites are indistinguishable from those of the Whiterock Member, a regionally extensive (>100,000 km^2) marker within the Hurwitz Group. However, the quartz arenites also contain a 2 m thick horizon of laminated dolomite and chloritic phyllite. Depositional interfingering implied by this horizon confirms a conformable contact with the underlying mixed siliciclastic-carbonate section.

Carbonate rocks in the lower Hurwitz Group are unusual, but have been reported from the Edehon Lake area and from near the base of the Maguse Member at Fitzpatrick Lake. The section at

Fitzpatrick Lake is remarkably similar to the mixed siliciclastic-carbonate sequence at Rankin inlet, and hence we assign the latter to the Maguse Member. These rocks are inferred to represent the remnants of a short-lived marine incursion of the Maguse fluvial plain. This incursion was likely regional, but because of reworking by subaerial processes, evidence of its former extent is only locally preserved.

Four generations of deformational fabrics are recorded in the cover sequence. S1 is observed only in phyllitic beds, where it is sub-parallel to bedding. S2 is more pervasively developed, commonly forms an axial planar fabric to 0.5-10 m scale folds having shallow axial surfaces, and at least locally, has opposite vergence to S1. An upright S3 fabric is axial-planar to the large, open F3 fold that controls the structural geometry at Rankin Inlet. S3 varies from an open crenulation cleavage in schistose rocks to pervasive grain-shape fabric in the quartzites. S4 is a northerly trending, finely spaced crenulation cleavage that is regionally widespread, but has no associated macroscopic folds. A suite of undeformed S- to SE-trending lamprophyre dykes, interpreted as part of the ca. 1.83 Ga Christopher Island Formation swarm, constrains the lower age of deformation. Although evidence exists for pre-Hurwitz Group deformation of the Archean sequence, four generations of regional fabrics in the Hurwitz Group indicate that structural patterns at Rankin Inlet are mainly a consequence of Paleoproterozoic deformation.

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IMPLICATIONS OF GEOCHEMICAL AND ISOTOPIC DATA FOR METAVOLCANIC ROCKS OF THE MACQUOID-GIBSON GREENSTONE BELT, KIVALLIQ REGION, NUNAVUT

Sandeman, H.A., Ryan, J.J., Tella, S., Davis, W.J. and Hanmer, S.
Geological Survey of Canada, 601 Booth St., Ottawa, Ontario, Canada. K1A 0E8

Field investigations in the MacQuoid-Gibson lakes area during summers of 1998 and 1999 have outlined three geographically separate panels of predominant volcanic rocks. The main panel comprises an E-W trending belt of typically highly-strained, amphibolite facies, mafic to intermediate volcanic rocks that are locally pillowed and are interlayered with subordinate felsic to intermediate pyroclastic flows and psammitic and pelitic metasedimentary rocks. In the MacQuoid-Gibson homocline, lying S of the main volcanic belt, a thick sequence of predominantly semipelitic rocks contains foliation-parallel amphibolites and tonalitic plutons. Primary textures are lacking in the amphibolites of the homocline, implying that they may represent either primary intercalated flows or later dykes. The rocks of the volcanic belt and the homocline are intruded by voluminous plutons of gabbro to tonalite with less common granite. In the north, a NE-trending package of predominantly intermediate volcanic and volcaniclastic rocks intercalated with semipelitic and psammitic sedimentary rocks crop-out on southern Bowell Island and on the southern side of the South Channel.

There, primary features are rarely preserved except in volcaniclastic units. This volcano-sedimentary package is in fault contact with tonalite and augen granite plutons. Lying between these two packages is a sequence of well preserved pillowed basalts, hornblende-phyric andesites and rhyodacitic lapilli and lithic tuffs of the informally named Brown Lake volcanic belt.

The mafic rocks of the main panel and Brown Lake volcanic belts, and the massive amphibolites of the homocline comprise predominant tholeiitic basalts to basaltic andesites whereas all intermediate to felsic tuffs as well as the mafic volcanic rocks of Bowell Island are calc-alkaline. The tholeiitic basalts comprise two distinct geochemical groups: those characterized by flat to weakly LIL- and LREE-depleted patterns having incompatible trace element abundances of ca. 10-20 times primitive mantle and; those having flat patterns with very low abundances of the incompatible trace elements (ca. 5-10 times primitive mantle) and variably developed negative Nb anomalies. Calc-alkaline rocks have fractionated extended trace element plots characterized by prominent negative Nb, Ta and P anomalies. ϵNd values (t=2.68 Ga) for representative samples of all volcanic rocks range from +3.6 to +1.8. Although the calc-alkaline rocks exhibit slightly lower ϵNd values than the tholeiitic basalts, the data demonstrates that all are characterized by juvenile isotopic compositions, comparable to hypothetical depleted mantle of the time. The geochemical signatures of the mafic rocks in particular, in conjunction with observed lithological associations, are compatible with the formation of at least parts of the MacQuoid-Gibson greenstone belt in a back-arc basin, a model first advocated by Armitage (1998).

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PETROCHEMICAL DATA FOR THE PROTEROZOIC MACQUOID AND KAMINAK DYKE SWARMS, HEARNE DOMAIN, CHURCHILL PROVINCE, NUNAVUT

Sandeman, H.A., Ryan, J.J., Davis, W.J., Hanmer, S. and Tella, S.
Geological Survey of Canada, 601 Booth St., Ottawa, Ontario, Canada. K1A 0E8.

The Proterozoic (ca. 2450 Ma) Kaminak dyke swarm, exposed in the Kaminak greenstone belt of the western Churchill Province, comprises a set of NNE-trending, plagioclase megacrystic diabase dykes that cross-cut Archean units. They are up to 100 m thick and commonly preserve primary textures, but are thoroughly metamorphosed to amphibolite facies to the north and NE of the greenstone belt. The E to ESE-trending, MacQuoid dyke swarm, exposed in the MacQuoid-Gibson greenstone belt and tentatively correlated with the ca. 2190 Ma Tulemalu dyke swarm, are generally $\leq$ 50 m thick; rare examples up to 500 m thick are noteworthy. These are only locally plagioclase phyric and less commonly retain primary igneous features. Many MacQuoid dykes exposed in the Cross Bay complex are strongly N-S lineated, tightly folded and preserve upper amphibolite to granulite facies metamorphic assemblages.

Whole-rock geochemistry for both dyke sets demonstrates that they are Fe-rich, continental tholeiite diabase dykes having basaltic and basaltic andesitic compositions and varying moderately in their major element chemistry. The Kaminak dykes (n=60) form a very coherent data set, whereas the MacQuoid dykes (n=20) are significantly more heterogeneous. Both swarms are characterized by mg#'s, Cr and Ni contents that are generally too low for the magmas to have equilibrated with an asthenospheric mantle source, a feature characteristic of continental tholeiites. Dykes of both swarms have negatively-sloped, primitive-mantle normalized, extended incompatible trace element patterns with marked negative anomalies for Nb, Ta, P, and Ti, features compatible with either assimilation of continental crust or addition of a subduction component to their mantle source (i.e. melts of metasomatized, sub-continental lithospheric mantle). Time corrected ϵNd values for the Kaminak swarm form a tight cluster at near chondritic values (0 to -1.2), whereas those of the MacQuoid swarm exhibit highly variable ϵNd values ranging from -2.5 to -6.6. With the present data set it is not yet possible to clearly define different petrogenetic histories for the two swarms, however, the greater variability in the trace element and isotopic compositions of the MacQuoid swarm suggest that the primary magmas of these dykes may have interacted with continental crust distinct from that underlying much of the NeoArchean Hearne domain.

HYDROTHERMAL ALTERATION IN THE GIANT MINE AREA, YELLOWKNIFE, N.W.T.

Santaguida, F.
Department of Earth Sciences, Carleton University, Ottawa, ON, K1S 5B6

Systematic studies of hydrothermal alteration within the Yellowknife Greenstone Belt have been initiated to characterize mesothermal gold mineralization in the Giant Mine area. The Giant Mine alone has produced over 7 million ounces of Au and the immediate area contains several past-producing mines as well as several gold prospects. The focus of these studies is to identify the chemical and mineralogical signatures of hydrothermal alteration imparted on the volcanic rocks in the area which may be utilized in further exploration programs for gold mineralization throughout the Yellowknife Supergroup.

Previous work at the Giant Mine has recognized that gold mineralization is associated with deformation and intense hydrothermal alteration of the mafic volcanic rocks. General alteration mineral assemblage transitions consist of: (1) a quartz-carbonate-sulphide core that hosts Au mineralization, (2) a sericite-carbonate-quartz-chlorite schist and (3) a chlorite-carbonate-sericite wallrock mineral assemblage. These transitions are typically gradational and are variable in size around individual mineralized zones throughout the mine. Outside of the intensely deformed and altered rocks, the mafic volcanic rocks are composed of a chlorite-albite-quartz-actinolite-epidote-carbonate mineral assemblage that represent a typical seafloor metamorphic assemblage common in subaqueous mafic volcanic environments. The mineralogical transitions typify gold mineralization hosted by composite quartz-carbonate veins where alteration selvages around veins are discernible;

however, where gold mineralization coincides with quartz-carbonate-sericite breccias, alteration is diffuse and mineral transitions are not as obvious. Exceptions to these transitions, such as the high grade Au Brock Veins, which demonstrate only minor chlorite-carbonate alteration, further complicate the direct relationship between alteration mineralogy and gold mineralization at the Giant Mine. Post-mineralization deformation in the Giant Mine area has also affected alteration mineral textures, but has not been considered in evaluating the chemical trends in the volcanic wallrocks due to alteration.

Gold mineralization near Gold Lake occurs at the equivalent stratigraphic level as the Giant orebodies, north of the mine, and is well exposed at surface in a series of trenches. The deformation zone that hosts mineralization is discrete in outcrop exposures and constrains the extent of the alteration zone. Iron-rich carbonate is easily identified by the rust-staining of outcrops around the trenches. Within the trenches, sulphide mineralization in quartz-carbonate veins is accompanied by sericite and chlorite. The similarities in geologic setting, alteration mineralogy, and gold mineralization to the Giant Mine warrant further investigation at Gold Lake.

Due to the widespread occurrence of sericite, chlorite and carbonate minerals throughout the Giant Mine and at other Au deposits in the area, regardless of abundance, this study will concentrate on the chemical compositions of these minerals. Mineral chemistry data can then be related to (a) distribution around individual areas of Au mineralization, (b) textures of mineralization, (c) textures of alteration, (d) mineral paragenesis, (e) host rock compositions, and to (f) sulphide mineralogy. Consideration of all of these factors can be utilized to evaluate the physical and chemical conditions of hydrothermal fluids associated with gold mineralization in the Giant Mine area.

THE CANADA-NUNAVUT GEOSCIENCE OFFICE: AN INTRODUCTION TO ITS MANDATE AND GEOSCIENCE PROGRAM

Scott, D.J.
Chief Geologist,
Canada-Nunavut Geoscience Office, Iqaluit, Nunavut, X0A 0H0 djscott@NRCan.gc.ca

Geoscience will continue to play a key role in sustainable development in Nunavut by providing support for sound decision making, education and training, mineral exploration, environmental studies, land use planning, and the discovery of materials for local artisans. The capacity to generate and utilize modern geoscience information is needed in Nunavut. The Canada-Nunavut Geoscience Office, located in Iqaluit, is a step towards developing this capacity.

The Nunavut Department of Sustainable Development (NDSD), Natural Resources Canada (NRCan) through the Geological Survey of Canada, the Department of Indian Affairs and Northern Development (DIAND), and Nunavut Tunngavik Incorporated (NTI) each have ongoing programs, responsibilities and/or interests in geoscience in Nunavut. On September 29, 1999, NDSD, NRCan and DIAND signed a Memorandum of Agreement on geoscience to facilitate effective cooperation and collaboration in meeting the geoscience needs of Nunavut, the national responsibilities of the GSC, and the client needs of the organizations involved. Further, these agencies have worked together to create the collaborative Canada-Nunavut Geoscience Office (C-NGO), a partnership designed as a step towards developing geoscience capacity in Nunavut.

Mandate

The C-NGO will provide accessible geoscience information and expertise in Nunavut to support:
-sustainable development;
-education and training;
-awareness and outreach; and
-capacity building.

The C-NGO will operate with three immediate objectives: 1) to establish linkages to existing expertise, databases and ongoing mapping/scientific studies; 2) to provide accessible expertise in support of both capacity building and specific development opportunities in Nunavut; 3) to undertake geoscience mapping and research.

Program

The activities of the C-NGO will include:
- acquisition, analysis, interpretation and dissemination of regional and thematic geoscience data,
- geoscience information management and preparation of maps/reports for scientific purposes and the general public; and,
- community liaison activities designed to increase the awareness and understanding of geoscience in Nunavut and to integrate Nunavut traditional knowledge into geoscience activities.

In collaboration with the Geological Survey of Canada (various divisions based across the country), the C-NGO will initiate new integrated geoscience programs in the summer of 2000. The projects will map and examine the Au and base metal potential of Archean greenstones of the Prince Albert Group (north of Baker Lake, south of Pelly Bay), the Zn, Au and Ni-Cu potential of Paleoproterozoic sedimentary rocks of the Piling Group (central Baffin Island), and the Zn potential of Ordovician sedimentary rocks in the Arctic Islands in the Polaris district.

The C-NGO will be led by Dr. David Scott as Chief Geologist. The staff of the office will comprise a locally-hired Office Manager, a GIS Technologist, and Scientists with expertise in bedrock mapping, mineral deposits and economic geology, surficial mapping, and other capacities as funding allows. The office will be fully staffed and operational prior to the summer 2000 field season.

IS THERE POTENTIAL FOR EPITHERMAL GOLD IN THE BAKER LAKE GROUP?

Sharp, J
DIAND NWT Geology

Sites in the Proterozoic Baker Lake Basin were examined in an effort to evaluate the potential for epithermal gold mineralization in the Baker Lake Group. Previously known but separately reported evidence favoring such a model include:

-The mapping of volcanic centers in the Christopher Island Formation, sinter-like quartz-calcite veining in Pitz Formation volcanics, and kaolinitic replacement of feldspar porphyries in the Pitz Formation, observed by Blake during GSC mapping in 1980.

-Comaplex Minerals' 1986 determination that gold showings in the nearby Woodburn Lake Group contained high levels of boron, something also noted in epithermal gold showings in the Great Basin of the Nevada.

-Prospecting on Christopher Island by Comaplex Minerals in 1988 found a stockwork of possible epithermal origin. Here a set of banded chalcedonic quartz veins cutting the Kazan Formation returned assays of up to 3.27 g/t gold.

-In 1996, the GSC's Klassen and Knight reported on a till sample program encompassing the area south of Baker Lake. A major arsenic anomaly was found emanating from west of Pitz Lake, and lesser anomalies were found to the east. Localized elevated gold values coincide with the northern limits of the arsenic anomalies. No sources were identified but the mineralized trains terminate in Baker Lake Group rocks, in two cases near the volcanic centers of Blake.

-Geochemical and isotope work by Phelps Dodge of Canada in 1997-9 (see abstract by Allan Turner), demonstrated the epithermal characteristics of quartz stockworks at Mallery Lake. Several stockworks on the Mall claims are hosted in the Christopher Island and Pitz formations, and consist of numerous chalcedonic quartz veins up to fifteen meters wide. Assays from the "Chalcedonic Stockwork" returned up to 5 g/t gold.

Research consisted of compilation work based in Yellowknife and a brief field program based in Baker Lake. Field work included visits to Mallery Lake and Christopher Island, plus four traverses in areas suggested as favorable by the compilation work. Highlights of the program included:

-The discovery of a silicified zone of Christopher Island Formation volcanics. The zone is approximately 5 meters wide and 120 m long, and terminates on either end in a 2-3 m wide zone of open space white quartz veins. The silicified zone is located near two inferred volcanic centers and coincides with high gold, arsenic, and silver till sample values.

-Three large stockworks up to 250 m long in Christopher Island volcanics were examined near four inferred volcanic centers and a reported arsenic till anomaly. One stockwork contained up to 5% chalcocite with malachite and hematite, and had been trenched previously.

The final report will be released as a DIAND EGS report in early 2000 and will include assay results, photographs, and a compilation of evidence for epithermal gold in the Baker Lake Group.

A PRELIMINARY COMPARISON OF THE STRUCTURAL GEOLOGY OF THE GIANT AND CON GOLD DEPOSITS, YELLOWKNIFE, NORTHWEST TERRITORIES.

Siddorn, J.P. & Cruden, A.R.
Dept. of Geology, Erindale College, University of Toronto, Mississauga Rd. North, Mississauga. Ontario. L5L 1C6.

The Giant and Con gold deposits are hosted in a series of brittle-ductile deformation zones that cut across the stratigraphy of the Yellowknife Bay Fm., Kam Group (2.72-2.7 Ga.), Yellowknife greenstone belt. Although the deposits are now separated by an apparent sinistral strike slip displacement along the Proterozoic West Bay fault, previous models (e.g. Campbell, 1949) reconstruct the Giant deposit as an upward extension of the Campbell zone of the Con deposit.

The Giant deposit is dominated by refractory gold, hosted in quartz-sericite schist and quartz veins, formed within a complex system of linked quasi-planar deformation zones, to a depth of 600m. Auriferous quartz-sericite schist and quartz veins are associated with D1 deformation, which resulted in the formation of localised zones of schistosity (S1), ore bodies, and quartz veins. D1 structures were flattened, extended and folded during D2, which also resulted in the main S2 foliation in the deposit. Barren pink-white quartz veins and late, tensional quartz-calcite ladder veins also formed during D2. D2 structural elements are symmetrical at the deposit scale and are interpreted to have formed within a regime of NW-SE shortening, while D1 deformation appears to have been more localised, possibly associated with an early brittle-ductile fault system within the greenstone belt.

The Con deposit contains both refractory (hosted in quartz-sericite schist and quartz veins) and free-milling gold (hosted in quartz veins), formed within a geometrically simple system of moderately NW dipping planar deformation zones, to a depth of 1900m. Four types of veining associated with gold mineralisation may be associated with D1 deformation. Quartz-sericite schist and quartz veins (associated with refractory ore trends) are folded and boudinaged with an axial planar S2 foliation, and may represent pre-D2 mineralisation. Dark grey and white laminated quartz veins (associated with free-milling ore trends) are heavily transposed into an axial planar S2 foliation, and may also represent syn-D1 / early D2 gold mineralisation. Two types of mineralized quartz veins are associated with D2 deformation. White, sugary, less laminated and pink white quartz veins are folded and boudinaged by D2, but contain xenoliths of wall rock containing an S2 foliation, therefore representing syn-D2 gold mineralisation. Overall, D2 structural elements (boudins, folds, and S-C fabrics) in the Con deposit are assymmetrical and probably formed within a NW-SE reverse shear regime.

Both deposits contain several common elements: syn-D1 quartz-sericite schist and quartz veins associated with refractory ore trends; syn-D2 pink-white quartz veins that are abundant and auriferous in the Con deposit, but barren and less abundant in the Giant deposit; syn-D2 tensional quartz-calcite ladder veins; and high-grade brittle quartz veins (Negus-Rycon at Con, Brock at Giant). The transition from auriferous pink-white veins in the Con deposit to barren pink-white veins in the Giant deposit may be related to depth-dependent gold precipitation during the D2 event. Together with recent metamorphic evidence that the Giant deposit is situated in lower grade metamorphic rocks than the Con deposit (Thompson, 1999), and the known increase in pyrrhotite abundance with depth in both deposits, this supports the notion that the Giant deposit is the upward extension to the Con deposit. The other three sets (two syn-D1, one syn D2) of quartz veins associated with free-milling ore trends in the Campbell zone of the Con deposit may represent a phase of mineralisation not yet discovered in the Giant deposit.

The links between the Giant and Con deposits are complicated by marked differences in original D1 deformation zone geometries and D2 deformation regimes. At Con the original D1 structure appears to have been a relatively narrow, uniformly dipping zone of quartz veining and alteration that was reactivated as a reverse shear zone in response to D2 NW-SE shortening. On the other hand, Giant may represent a higher structural level of the original D1 brittle ductile fault system, displaying a more complex, anastamosing geometry and much wider zones of alteration. This part of the system responded to D2 NW-SE shortening by a combination of folding, boudinage and mullion development. Gold remobilisation at depth and hydrothermal activity during D2 produced auriferous quartz veins in the deeper Con deposit, but relatively minor, barren veins in the shallower Giant deposit.

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DETRITAL ZIRCON GEOCHRONOLOGY OF THE YELLOWKNIFE SUPERGROUP METASEDIMENTARY ROCKS: BASEMENT RECONNAISSANCE, SEDIMENTARY PROVENANCE AND TECTONIC IMPLICATIONS.

Sircombe, K., Bleeker, W. and Stern, R.
Continental Geoscience Division, Geological Survey of Canada, Ottawa

Systematic detrital zircon geochronology of (meta) sedimentary rocks in the complex terrane of the Archean Slave Province provides an opportunity to assemble, at least at an advanced reconnaissance level, the age of the principal elements that comprise the basement. Because these sedimentary units are in effect 'bulk' samples of the exposed crust at or near the time of deposition, this approach may provide more efficient insight into basement geochronology than selective direct sampling and analysis of basement units. Documenting detrital age modes may also contribute to intra- and inter-regional provenance correlations and potentially yield insight into orogenic activity.

In the Archean Slave Province, detrital zircons were analyzed from 12 samples at various geographic locations and across three main stratigraphic subdivisions of the Yellowknife Supergroup: (1) Basal fuchsitic quartzites of the Central Slave Cover Group which have recently been shown to be a significant regional marker horizon (Bleeker & Ketchum, 1998; Bleeker et al., 1999); (2) metaturbidites of the Burwash Formation and regional equivalents; and (3) conglomeratic units of the Jackson Lake and Beaulieu Rapids Formations.

To date, a total of over 800 single grain analyses have been obtained. There are a range of ages from ~2550 Ma to a singular 3918 ± 10 Ma (2s) grain reminiscent of the Acasta region in a sample from the Dwyer Lake quartzite. Five major age modes are recognized. The first is a ~3400 Ma mode in the midst of a 'background' of singular detrital zircon ages ranging from 3200 to 3900 Ma seen in the Exmouth quartzite. The spread of older ages are also seen at Dwyer Lake. The second age mode is a prominent 3150 Ma peak seen principally in the Point Lake and Loop Lake quartzites. The third and fourth age modes at 2950 and 2820 Ma are seen in the basal quartzites at Patterson Lake and Dwyer Lake. The modes in the quartzites tend to be strongly mono- or bi-modal at Point, Loop and Patterson Lake suggesting strong affinity with local sources and subdued regional scale mixing processes. Although intra-regional correlation is possible and confirms lithological evidence, the strong local provenance of the quartzites may limit their utility in broader inter-regional correlations with similar Archean quartzites.

The fifth mode is the most prominent at ca. 2700 Ma, almost uniformly dominating metagreywacke samples from various locations within the Burwash Formation and equivalents. This mode is also prominent in samples from the overlying conglomerates at Jackson Lake and Beaulieu Rapids along with a ~2600 Ma age mode. The dominance of the ~2700 mode indicates that the scale of orogenic activity and availability of volcanic/plutonic detritus around that time was probably extremely large and simply overwhelmed the pre-existing crust as a potential provenance.

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BEDROCK MAPPING STUDIES IN THE AKUNAK BAY AREA, KIVALLIQ REGION, NUNAVUT - A PROGRESS REPORT

Tella, S., Ryan, J.J., Sandeman, H., Hanmer, S., Mills, A. and Wilkinson, L.
Geological Survey of Canada, Ottawa, Ontario K1A0E8,

Neoarchean polydeformed lithologies in the Akunak Bay area comprise amphibolite facies sedimentary and mafic volcanic supracrustal rocks, tonalitic orthogneisses, and variably deformed gabbro to granite plutons. Metamorphosed ca. 2.19 Ga mafic dykes, and relatively undeformed ca. 1.83 Ga granite and co-magmatic(?) lamprophyre dyke-swarms record Proterozoic igneous events. A mylonitised layered anorthosite-gabbro-mafic granulite suite, the Uvauk complex, structurally overlies part of the orthogneiss terrane.

At least four deformation events (D_1-D_4) affected the supracrustal units and the tonalite orthogneiss. Field observations suggest that the regionally pervasive foliation in supracrustal rock units is an S_2 (D_2) developed from the transposition of an older S_0/S_1 fabric. The D_1-D_2 are considered to be Archean events. D_3-D_4 are Paleoproterozoic tectonothermal events because ca. 2.19 mafic dykes cut the D_2 fabrics and have been subsequently metamorphosed and deformed. These dykes provide a minimum age for S_2 fabric development and maximum age on the metamorphism which affected the dykes.

Recrystallized straight gneisses and mylonites, predominantly derived from granitoid protoliths, form NE- and E-trending linear belts. The Akunak Bay shear zone (ABsz), exposed west of Akunak Bay, is an E-trending belt of straight gneisses and mylonites, anastomosing on a 5-10 m scale. It separates the metasedimentary and metamafic supracrustal rock units in the south from the predominantly granitoid gneiss terrane in the north. Rarely preserved shear-sense indicators locally suggest an oblique, dextral shear sense, but overall shear sense is not clear. The eastern extension of the ABsz swings southeasterly towards Akunak Bay and appears to die out. The western extension links with a previously mapped straight gneiss unit in the Cross Bay plutonic complex. The precise age of the ABsz is unknown, but potential ca. 2.19 Ga MacQuoid dykes which cut the ABsz suggest that it predates dyke emplacement. Recrystallized straight gneisses and ribbon mylonites, exposed to the south of the ABsz, represent the eastern segment of the Big lake shear zone (Blsz) mapped previously to the west which coincides with the southern margin to the Cross Bay plutonic complex. In the Akunak Bay area, the foliation in the Blsz is steeply north-dipping and contains an east-west trending, subhorizontal lineation. Shear sense criteria suggest that the Blsz is a dextral, strike-slip structure. The easterly extension of the Blsz branches into several splays of discrete high-strain zones which appear to die out and/or are truncated by a north-northwest trending fault. East of this fault and west of Akunak Bay, the structural trends are dominantly towards the northwest.

The presence of garnet, biotite± aluminosilicates (andalusite, sillimanite) in sedimentary rocks, and of garnet + biotite + plagiclase ± clinopyroxene assemblage in metamafic rocks suggest amphibolite facies conditions of regional metamorphism for the supracrustal units. The porphyroblast-fabric relations in the Akunak Bay area suggest that the regional metamorphism in the supracrustal rocks was syn- to post-D_1 with peak conditions attained during early D_2 which outlasted peak metamorphic conditions. Random growth of a second sillimanite across the D_2 fabrics in the supracrustal rocks, suggest that a post-D_2 metamorphic event occurred at elevated temperatures.

OPEN FILE GEOLOGICAL MAPS OF THE AKUNAK BAY AREA, KIVALLIQ REGION, NUNAVUT

Tella, S., Ryan, J.J., Sandeman, H., Hanmer, S., Mills, A. and Wilkinson, L.
Geological Survey of Canada, Ottawa

GSC Open File Anticipated Release: March 2000)

The 1:50,000 scale coloured digital maps showing the bedrock geology of parts of Akunak Bay area (NTS 55N/10, 14, 15) are scheduled for open file release in March 2000. The data for these maps were compiled digitally using FIELDLOG and AutoCAD with final output generated through direct collaboration with the Cartography Unit, GICD using GIS software.

The geological maps present the results of bedrock mapping undertaken in the region during the 1999 field season. The principal objectives of the mapping were to upgrade the reconnaissance database, and to evaluate the nature and extent of Paleoproterozoic tectonothermal reworking of Archean lithologies in this portion of the western Churchill Province.

Archean polydeformed lithologies comprise amphibolite facies sedimentary and mafic volcanic supracrustal rocks, tonalitic orthogneisses, and variably deformed gabbro to granite plutons. Metamorphosed ca. 2.19 Ga mafic dykes, and relatively undeformed ca. 1.83 Ga granite and co-magmatic(?) lamprophyre dyke-swarms record Proterozoic igneous events. A mylonitised layered anorthosite-gabbro-mafic granulite suite, the Uvauk complex, structurally overlies part of the orthogneiss terrane.

At least four deformation events (D_1-D_4) are recognized. Associated structures include an isoclinal, doubly plunging, ESE-trending fold-set (F_1) which is coaxially refolded by open to tight folds (F_2). They are modified by NE-trending open F_3 and N-trending F_4 fold-sets. Amphibolite facies, E- and NNE-trending, high-strain zones, and E- and NW-trending faults transect the region. The ca. 2.19 Ga mafic dykes cut the D_2 fabrics and the Akunak Bay shear zone and were affected by D_3 and D_4 tectonothermal events that, in part, predate the ca. 1.83 Ga magmatism.

For a detailed account of bedrock geology and structure covering this and the surrounding area , the reader is referred to the marginal notes and references therein.

TECTONOMETAMORPHIC HISTORY OF THE NOWYAK COMPLEX, NUNAVUT, CANADA

terMeer, M., Berman, R.G. Relf, C., and Davis, W.D.

Preliminary geochronology within the Western Churchill NATMAP region has revealed a complex polymetamorphic history with tectonothermal events at ca. 2.57, 2.50, 1.91 Ga. Interpretation of the tectonic significance of these events is hampered by the limited recognition of structures associated with crustal thickening or exhumation, and by the lack of cooling constraints. This project is aimed at facilitating tectonic interpretations by characterizing the P-T-t history of rocks within a potentially important extensional structure; the Nowyak Complex.

The Nowyak complex is located 350 km west-southwest of Rankin Inlet, Nunavut. It is a domain of mid-amphibolite facies rocks exposed in the core of a structural dome bounded on all but the south side by the Nowyak shear zone. This curvilinear ductile shear zone is approximately 300m wide and shallowly north-dipping. It consists of strongly foliated, chlorite schist containing low strain amphibolite enclaves, both of which display a stong, shallowly north-plunging lineation, and top to the North kinematics. The shear zone may be linked with ca. 1.8 Ga north-south extensional displacements on the Tyrrell shear zone, approximately 60 km to the north (Relf et al., 1999; MacLachlan, unpublished data). It separates low grade, Archean, mafic volcanic rocks and Paleoproterozoic Hurwitz Group dolostones to the north (hanging wall) from a strongly E-W foliated, two mica syenogranite to the south (footwall; herein referred to as "the granite").

Within the granite, with unexposed contacts, are two large supracrustal enclaves, several hundred metres in length, that consist of garnet-kyanite-muscovite bearing pelite and garnet amphibolite. The supracrustal enclaves were originally mapped as rafts within the granite (Relf et al., 1997), but they could also be tectonically emplaced. Both the supracrustal rocks and the granite carry the same north plunging lineation that characterizes the chlorite schist of the Nowyak shear zone.

Down-dip extension lineations and north (low grade) side down kinematics (rotated augen, shear bands, and c-s fabrics) on the north, northwest, and northeast sides of the Nowyak shear zone suggest the Nowyak complex may represent a metamorphic core complex (Labelle, 1998). A low-strain carbonate enclave, interpreted to be derived from the Hurwitz Group, led Relf et al. (1997), to conclude that motion on the Nowyak shear zone was Proterozoic in age. However, preliminary geochronology gives conflicting age constraints: U-Pb data for zircon and titanite in the granite yield ca. 2.64 Ga, while reconnaissance SHRIMP data from one zircon within garnet from a pelite enclave yielded ca. 1.9 Ga. Preliminary P-T results suggest metamorphism of the supracrustal rocks at ~650 °C and 9 kbar.

Detailed P-T studies, combined with further SHRIMP and ^{40}Ar-^{39}Ar geochronology, should provide important insights into controls on titanite closure and resolve whether supracrustal enclaves are: (1) rafts within a ca. 2.64 Ga granite that underwent ca. 1.9-1.8 Ga metamorphism below titanite closure, or (2) tectonic slivers that were metamorphosed at ca. 1.9-1.8 Ga and ~650 °C / 9 kbar, and tectonically juxtaposed against an Archean granite that coincidentally carries the same fabric.

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METAMORPHISM AND THE ORIGIN OF GOLD DEPOSITS IN THE YELLOWKNIFE GREENSTONE BELT - PHASE I

Thompson, P.H.
Peter H. Thompson Geological Consulting Limited

The proposed study is based on the idea that comparison of the geological settings of known gold occurrences with each other and with the geological settings of barren zones is an essential step toward the discovery of new gold reserves in the Yellowknife Greenstone Belt. The focus is on the metamorphic component of the geological setting and on the spatial and temporal relationships between metamorphism and deformation, magmatism, exhumation, and gold mineralization.

Phase I, tests the viability and utility of a Yellowknife EXTECH Project proposal that comprises: 1) compilation of current knowledge of metamorphism of the Yellowknife Greenstone Belt; 2) upgrading and extension of the data base to cover the entire belt; 3) documentation, analysis and interpretation of belt scale variations of metamorphic grade in time and space and their relations to gold mineralization; 4) evaluation of metamorphic features as gold exploration tools. Phase I is based on three days of field work, reconnaissance petrography of 214 thin sections, a preliminary review of previously published work, and preparation of an interim map and report. Further work is clearly justified.

For more than forty years, metamorphism has been recognized to be a significant factor in the formation of gold deposits in the Yellowknife Greenstone Belt. Fluids generated by the process played an important role in the mobilization, transport, and concentration of gold. Metamorphic pressure-temperature regimes determined where gold went into solution and where it was deposited. The magnitude of geothermal gradients (increase of temperature with depth) and the shape and distribution of isothermal surfaces influenced fluid volumes and flow directions. Metamorphic zones, isograds, and textures impose useful constraints on the timing and influence of other aspects of the geological setting (deformation, magmatism, exhumation) that controlled the distribution of gold in the belt.

Previous mapping of metamorphic zones is limited to the central part of the belt. Boyle (1961) sketched three zones that do not correspond to the zonation mapped in more detail in the vicinity of the Miramar-Con Mine (e.g., McDonald, Duke and Hauser, 1993). At several localities, isograds cross Proterozoic faults without displacement. Elsewhere, isograds correspond to known faults. There are significant discrepancies between the petrography done for the current study and parts of the previously-mapped zones. Former owners of the Giant Mine, put together an important collection of thin sections spanning the entire belt outside the Miramar property. However, the understandable emphasis on major shear zones does not provide the comprehensive coverage required to document properly the metamorphic zonation of the Yellowknife Greenstone Belt. A systematic study of metamorphic pressure-temperature regimes within the belt has not been done. A belt-scale comparison of the distribution of gold occurrences with respect to metamorphic zoning is not yet possible. These shortcomings are not surprising in view of the patchy distribution of data and the evidence for as many as four metamorphic events, each with a different duration, spatial distribution, and set of pressure-temperature conditions.

Inconsistencies between existing isograd patterns and between these patterns and new petrographic observations should be addressed by application of one set of mineralogical criteria to the entire Yellowknife Greenstone Belt. This "one-set-of-eyes-sees-all" approach will produce an internally consistent set of isograds, a superior basis for estimating temperatures and pressures of metamorphic events and their spatial distribution in and around the metavolcanic belt. Phase II of the proposed study will comprise: 1) classification of mineral assemblages obtained from new and existing thin sections into three zones of increasing metamorphic grade - greenschist facies, transition zone, and amphibolite facies; 2) Measurement of metamorphic P-T conditions at different times throughout the belt using mineral assemblages, textures, and microproberу; 3) reconstruction of the thermal history of the YGB from the time of formation to exhumation at the earth's surface; 4) application of the metamorphic framework defined in time and space to help determine the optimum combinations of factors favourable to formation and enhancement of gold deposits; 5) integration of metamorphic data with other kinds of information derived from previous studies and from other EXTECH projects in order to define and prioritize exploration targets. Potential exploration targets include steep thermal gradients, sudden changes in the dip of isothermal surfaces, intersecting isograd patterns, and specific combinations of metamorphic and structural or igneous features.

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PRECIOUS METAL MINERALIZATION IN THE MALLERY LAKE EPITHERMAL SYSTEM, NUNAVUT, CANADA

[1]Turner, W.A., [1]Richards, J.P, and [2]Biczok, J.L,
[1]Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, T6G 2E3, wturner@gpu.srv.ualberta.ca; [2]Phelps Dodge Corporation of Canada, 223-530 Century St., Winnipeg, MB, R3H OY4

The Mallery Lake precious metal-bearing vein system is one of the oldest pristine epithermal systems in the world. Sm-Nd analyses of ten fluorite samples indicate an age of 1435±21Ma for the hydrothermal system. Typically, the veins are hosted by the Pitz Formation rhyolite flows (1706±7Ma), and display primary and secondary silica textures. Primary silica is commonly associated with micro- to macro- comb quartz that is either followed by, or intercalated with, gangue minerals such as fluorite, calcite, or adularia. The secondary silica textures include veins that have undergone a later stage of replacement or recrystallization. Precious metals are associated with the veins that display secondary textures in a locality known as the Chalcedonic Stockwork Zone. The Chalcedonic Stockwork Zone, which has an area of ~ 400m by 900m, is defined by the following alteration assemblage: a central zone of silicification associated with trace argillic (kaolinite) alteration, surrounded by a zone of phyllic alteration that is characterized by adularia, sericite, and clays such as illite, and an outer zone of propylitic alteration.

Two fluid inclusion populations (Type 1 and 2) were identified in the veins of the Mallery Lake epithermal system. The Type 1 fluid inclusions have moderate homogenization temperatures (typically between 160°C and 280°C) and low salinities (~ 1 wt. % NaCl equivalent), and show textural evidence of boiling and/or the presence of trace CO_2. Type 2 fluid inclusions are lower temperature (Th = 90°C to 150°C) but more saline (27 to 32 wt. % $CaCl_2$-NaCl) fluids, and are interpreted to be oxidized and slightly acidic from their occurrence in quartz-hematite veins and association with kaolinite alteration. Studies show that the physico-chemical conditions of the Type 2 fluids are conducive for the transport of precious metals as chloro-complexes. Semi-quantitative EDS microprobe analyses of Type 2 fluid inclusion decrepitation residues reveal the presence of Ag-, Au-, Cu-salts. Thus, the Type 2 fluids are argued to be responsible for the transport of metals in the Mallery Lake vein system.

The approximate 300 m.y. age difference between the hydrothermal event and the Pitz Formation host rocks suggests the involvement of a regional hydrothermal event rather than a relationship to the volcanic activity. The age of the Mallery Lake epithermal system is consistent with other hydrothermal events from the Thelon and Athabasca Basins, indicating widespread hydrothermal activity at this time. A drilling program may provide information about possible driving mechanisms for the fluid, as well as further insight into the physical and chemical conditions of the fluids that were involved in ore transport and deposition.

STABLE ISOTOPES AND FLUID INCLUSION GASES AS EXPLORATION GUIDES TO ORE IN LARGE-SCALE GOLD SYSTEMS: EXAMPLES FROM THE SLAVE AND SUPERIOR PROVINCES.

[1] van Hees, E., [2]Shelton, K.L., and [3]Falck, H.
[1]Department of Earth Sciences, Carleton University, Ottawa, ON. [2]Department of Geological Sciences, University of Missouri, Columbia, MO, [3]RWED Minerals, Oil and Gas, GNWT, Yellowknife, NT

Combined application of stable isotope techniques and quadrupole mass spectrometry, to vein quartz and their included fluids, can distinguish gold-bearing from barren vein systems at the district-wide scale, and may be useful as a guide to economic mineralization within a deposit.

Within the Yellowknife greenstone belt, the Giant Mine has anomalous $\delta^{18}O_{quartz}$ values of 11.7 to 14.1‰, that coincides with a zone enriched in Ag, As, S, Sb, and K, and depleted in Na, that extends from the ore into metasedimentary rocks east of the mine. These results indicate that the metasedimentary rocks were an important source of fluids, metals, and ore-forming constituents. Gold-bearing veins in the Colomac Mine (160 km north of Yellowknife), like those in the Giant Mine, can be distinguished from barren veins because they have $\delta^{18}O_{quartz}$ values >10.5‰. The gas compositions of individual fluid inclusions in mineralized veins also vary widely, whereas those in barren veins have constant compositions.

In the Porcupine mining camp, $\delta^{18}O$ values of quartz veins range between 11.1 and 17.5‰ with gold-bearing veins having $\delta^{18}O_{quartz}$ values >13.5‰. Within mineralized veins, decreases in CO_2+CH_4 and H_2S, as well as increases in the CO_2/CH_4 ratio of fluid inclusion gases, show particular promise as vectors toward higher-grade gold mineralization.

EVOLUTION OF THE BURWASH SEDIMENTARY BASIN

[1]Waldron, J.W.F., [2]Ferguson, M. and [3]Bleeker, M.
[1]Saint Mary's University, Halifax, NS., [2]Dalhousie University, Halifax, NS, [3]Geological Survey of Canada, Ottawa.

The Neoarchean Burwash Formation is a substantial package (~10 km) of variably metamorphosed siliciclastic sedimentary rocks that structurally and stratigraphically overlies volcanic rocks of the Yellowknife Supergroup. The base of the package is well exposed and has been examined close to the Sleepy Dragon basement massif, with reconnaissance in the Yellowknife and Clan Lake areas. More central, stratigraphically higher parts of the Burwash Formation were studied in the Hearne Lake area.

At the base of the succession, coarse clastic sedimentary units of the ca. 2683 Ma Raquette Lake Formation, locally interbedded with volcanics, include proximal volcanic-derived conglomerates, and carbonate-rich, locally matrix-supported conglomerates. Our observations adjacent to the Sleepy Dragon Complex indicate that sedimentary units are cut by wide (> 1 m) extensional fissures, and that the fissures are filled by sedimentary material originating higher in the succession. This indicates that the basal clastics were deposited in an environment of active extensional tectonism.

Siliceous black shales overlying basal coarse clastics probably record a transgression, and subsidence of local basement into deeper water, below wavebase. Overlying successions of interbedded sandstone and shale (Burwash Formation) were deposited by turbidity currents and other processes of sediment gravity flow. Sand-filled channels can be identified at a number of locations. Levees are marked by mud-dominated intervals, now highly compacted and often poorly exposed. Sheet sandstones representing escape of flows from channels are well exposed and are easily traced laterally. They are probably equivalent to high amplitude reflection packages (HARPs) observed in seismic profiles through some modern fans. Within these sandstones, a variety of sedimentary structures are developed, including water-escape sheets, lamination, and ripple cross-lamination. Distinctive larger scale bedforms are interpreted as dunes developed under conditions of rapid sedimentation. They superficially resemble hummocky cross-stratification but have a strong unidirectional character; closely comparable structures have been observed in the Paleozoic turbidites in the Appalachian region.

Continued volcanism is recorded by intervals of felsic tuff within the turbidite succession, which act as useful marker horizons. Volcanics apparently underlying the turbidites at Clan Lake are approximately contemporary with tuff layers well above the base of the succession at Watta Lake. The base of the Burwash basin may therefore be strongly diachronous, and turbidite deposition occurred concurrently with continued rifting and volcanism, over a time span of at least 20 million years.

AN ARCHEAN VOLCANOGENIC MASSIVE SULPHIDE DEPOSIT AT RUSSELL LAKE

D.R. Webb

A sequence of mafic, intermediate and felsic volcanic flows and tuffs are exposed along the western margin of a granitic intrusion, north of Mosher Lake, within the Russell Lake Supracrustal Domain. A sulphide-rich intermediate to felsic tuffaceous horizon, up to 200 meters thick occurs at the top of the volcanic sequence, and is overlain by argillite and greywacke metasediments. The volcanics consist of massive and pillowed flows, and ash-fall, and lapilli tuffs, and epiclasitic equivalents, strikes northerly. Facing directions have not been identified, but is inferred on the basis of stratigraphy to young to the west. The volcanics dip vertically to steeply overturned to the east. Minor intermediate dykes intrude the volcanic units, principally striking northwesterly. A equigranular felsic pluton, likely related to the Stagg Intrusive Complex intrudes in the east, and has apophyses and dykes exposed to the north and south of the volcanic sequence.

All rocks are metamorphosed to amphibolite facies, and except for some late granitic dykes, have been strongly lineated. Minor dextral faults strike northwesterly. This parallels the regional faults, but expresses an opposite sense of displacement.

Massive and disseminated pyrrhotite with minor pyrite and minor to rare chalcopyrite and sphalerite is exposed in 30 meters of ourcrop over a 50 meter thickness. The unit can be traced in discontinuous outcrops, and by magnetics and electromagnetics over 1,600 meters. The northern 600 meters contains enechelon domains of arsenopyrite, striking northwesterly within the overall northerly strike of the massive suphide horizon. Elevated gold values, to greater than 30 gpt and copper to 0.3% and zinc to 0.3% suggest economic potential occurs within the massive sulphides.

WESTERN CHURCHILL NATMAP: ROLE OF GIS IN LARGE, MULTI-AGENCY, AND MULTI-DISCIPLINARY PROJECTS

Wilkinson, L.
Geological Survey of Canada

Part of the mandate of the Geological Survey of Canada, is to provide geoscience knowledge, information access, and to support decision-making in resource exploration. Geographic Information System (GIS) tools are now used routinely to accomplish all of these goals within the framework of individual projects. The GIS is used as 1) a data archive, 2) a data query, display and plotting tool, and 3) a data analysis tool. The first two functions, the archive and display/query tool, are routinely incorporated into project goals to collect available digital data, generate new digital data, generate a georeferenced, accessible database, and to provide basic mapping support products (See GSC Open File CD-ROM release D3683). The last function, data analysis, is used in thematic studies within the larger overall project. This could be assessing the spatial distribution of the various tills in the area as they relate to topography, or this could be an assessment of the distribution of lithogeochemical anomalies. Within the Western Churchill NATMAP, such thematic studies have included an assessment of the spatial relationship between known mineral occurrences and magnetic iron formation, and the integration of magnetics and radar data to help define lithologic contacts. The generation of mineral favourability maps is one of the most common and important types of thematic studies within these larger projects, and this work is ideally suited to the use of GIS technology. The GIS is capable of storing and rapidly processing large volumes of data and allows the model to be re-run efficiently as input changes or model ideas change. However, since favourability map generation requires a georeferenced, reliable database of geologic information about an area, one of the goals of these large, multi-agency projects is to produce just such a database.

Although GIS is a relatively new tool to the exploration industry, it is now routinely used as a means of archiving data and to perform simple visualizations and queries. Now, these more basic GIS capabilities are giving way to more sophisticated uses of the software, such as spatial data analysis, and mineral favourability map generation. Projects, like the Western Churchill NATMAP, require proper data compilation and distribution of digital data so that the geoscience data is accessible to a large working group spread across the breadth of the country, and involved in varied disciplines and thematic studies within the overall project. Upon project completion, the database and results from use of the database are then redistributed to the exploration industry and the general public in the form of papers, talks, posters, seminars, WWW, and CD-ROM publications.

LITHOSTRATIGRAPHY, AGE RELATIONSHIPS AND STRUCTURE OF THE WOODBURN LAKE GROUP, WESTERN CHURCHILL PROVINCE, NUNAVUT

[1]Zaleski, E., [1]Davis, B.,[1] Pehrsson, S.,[1] Kerswill, J., [2]Duke, N., [2] L'Heureux, R., [2] Greiner, E
[1] Geological Survey of Canada ; [2]University of Western Ontario

Between the Paleoproterozoic Amer fold belt and the Baker Lake basin, the deformed volcanic and sedimentary rocks of the Woodburn Lake group comprise four main lithostratigraphic associations.

(A) Spinifex-textured komatiites interlayered with quartz-porphyritic felsic volcanic rocks and iron-formation represent two cycles or possibly a spectrum of volcanism at 2.72 and 2.71 Ga.

(B) Orthoquartzite is interbedded with slate, phyllite, and conglomerate, including pyritic quartz-clast conglomerate. Northwest of the Meadowbank River, orthoquartzite unconformably overlies 2.72 Ga felsic volcanic flows and komatiite, and polymictic basal conglomerate along the volcanic-quartzite contact contains 2.72 Ga detrital zircons. Between the Meadowbank River and the Meadowbank gold deposit, the depositional age of quartzite is bracketed by 2.81 Ga detrital zircon and 2620+3/-2 Ma intrusive porphyry (Davis and Zaleski, 1998). Polymictic conglomerate is present locally at the base of the quartzite, suggesting that the unconformity northwest of the River is again preserved to the south. However, south of the River, basal conglomerate overlies interbedded greywacke and iron-formation, rather than the komatiite-felsic substrate seen to the northwest.

(C) Felsic, intermediate and mafic volcanic rocks, volcanogenic wackes, iron-formation and cherty tuffs may represent multiple cycles of volcanism and sedimentation of significantly different ages. The only age determination currently available is from a volcano-sedimentary package that structurally overlies quartzite and, locally, a thin unit of intervening ultramafic and mafic rocks. Felsic lapilli tuff from the mixed volcanic, greywacke, iron-formation package gave an age of 2710+3.5/-2.1 Ma (Davis and Zaleski, 1998), within error of felsic rocks associated with komatiite. The ca.\ 2710 Ma volcano-sedimentary package is host to numerous gold showings. The Meadowbank gold deposit lies approximately along strike to the southwest, hosted by iron-formation associated with wacke, ultramafic rocks and quartzite.

(D) Arkosic wacke interbedded with thin iron-formation and associated with minor quartzite and possible volcanic rocks extends south to the volcanic rocks and quartzite of the Ketyet River group.

Ductile deformation (D1-D4) affected the Woodburn Lake group after the intrusion of 2620+3/-2 Ma porphyry (Davis and Zaleski, 1998). Evidence is accumulating to support an earlier, more cryptic episode of deformation. The regional structural grain trends east-northeastly to northeasterly, defined by schistosity and northwestward verging, tight to isoclinal, F1 and F2 folds. The dominant schistosity is axial planar to F1 folds, whereas F2 folds deform layer-parallel foliation. The similarity in style and orientation of D1 and D2 structures suggests that they may represent phases of a single progressive event. D3 structures comprise mesoscopic, open to tight folds of schistosity that verge southeastward and have subhorizontal to shallow southwesterly plunges. D4 structures, important in the geometry of the Meadowbank gold deposit, comprise open to tight, northerly to northeasterly trending, upright folds superimposed on earlier structures.

References

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EVIDENCE FOR MOBILE AND SHALLOW SALT UNDER THE FRANKLIN MOUNTAINS

B.C. MacLean and D.G. Cook, Geological Survey of Canada – Calgary

Figure 1:

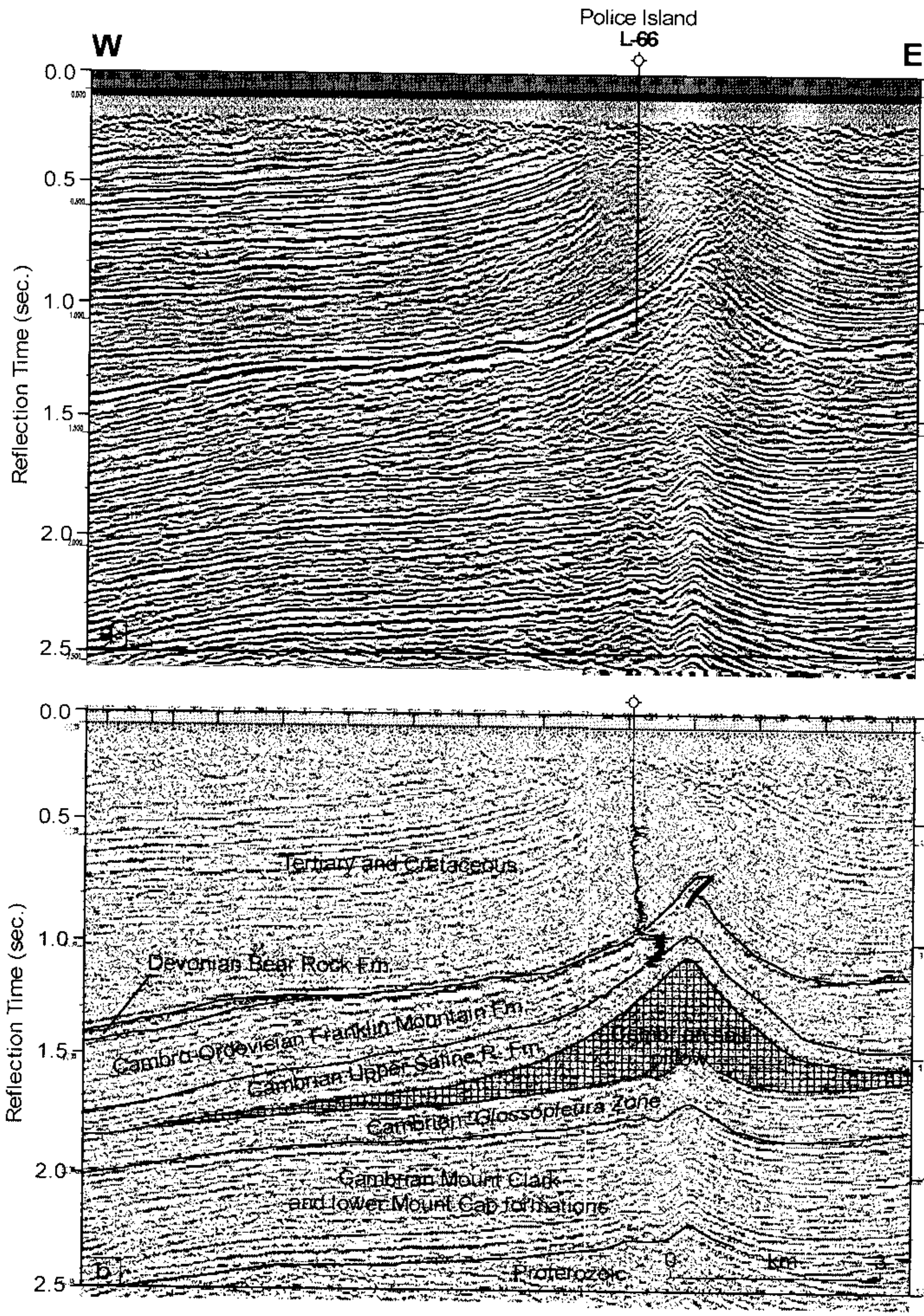
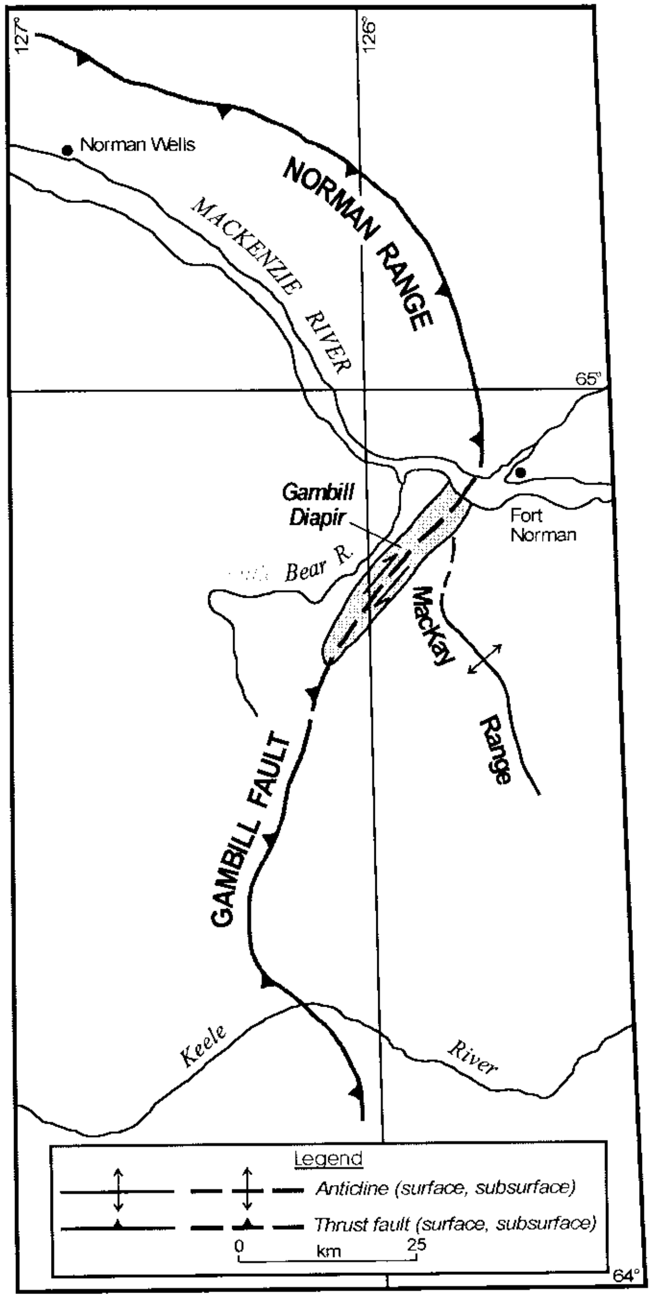


Figure 2:


127°
126°
Norman Wells
NORMAN RANGE
MACKENZIE RIVER
65°
Gambill Diapir
Fort Norman
Bear R.
MacKay
Range
GAMBILL FAULT
Keele
River
Legend
Anticline (surface, subsurface)
Thrust fault (surface, subsurface)
0 km 25
64°

REGIONAL GEOLOGY AND PLAY OPPORTUNITIES IN THE TROUT AND SLAVE PLAINS, LIARD REGION, NWT

David W. Morrow and Bernard C. MacLean; Geological Survey of Canada, Calgary

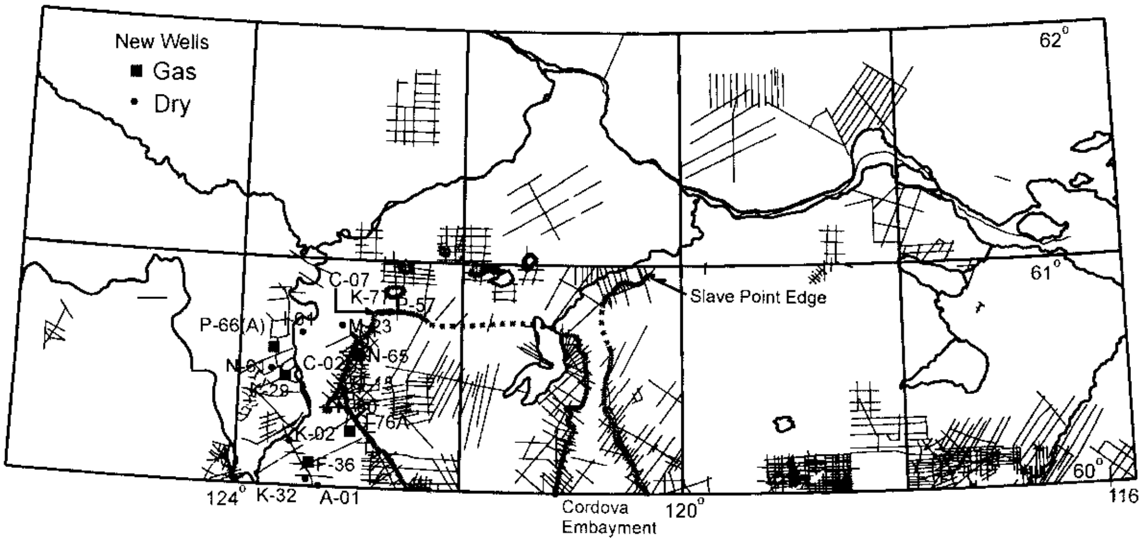


Figure 1. NEB seismic database for the Slave and Trout Plains of the Liard region. New well discoveries post-1997 are named. Many of these are in the Trout Plain east of Liard River with gas discoveries in Middle Devonian carbonates. Netla C-07 is an older (1961) well drilled along the Slave Point edge.

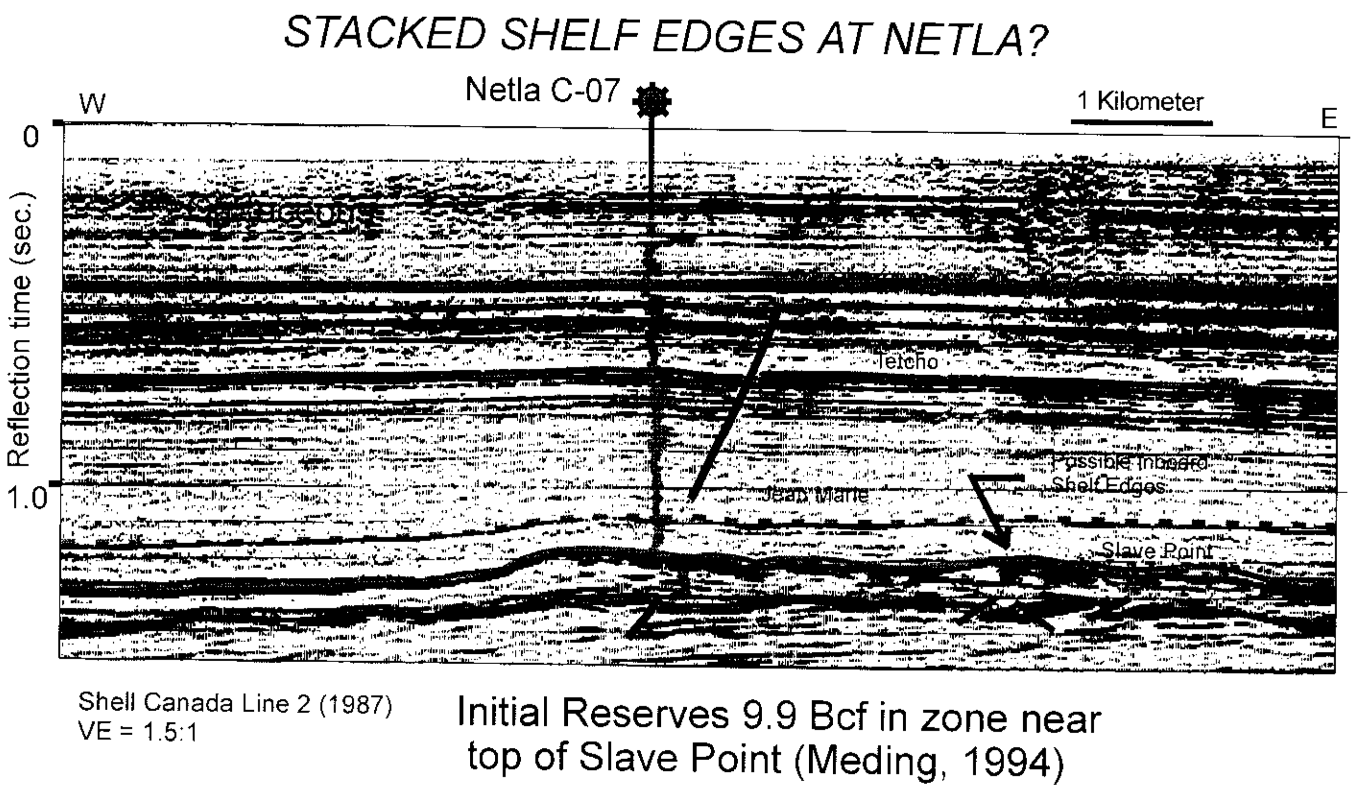


Figure 2. The Netla C-07 gas discovery at the northwest corner of the Slave Point edge in the Trout Plain (Fig. 1). Inboard shelf edges may also be prospective.

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