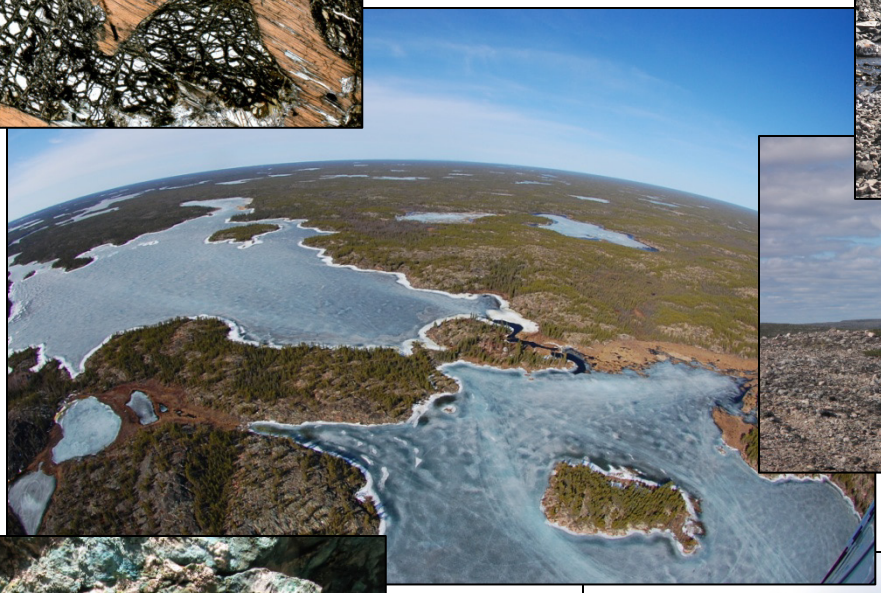
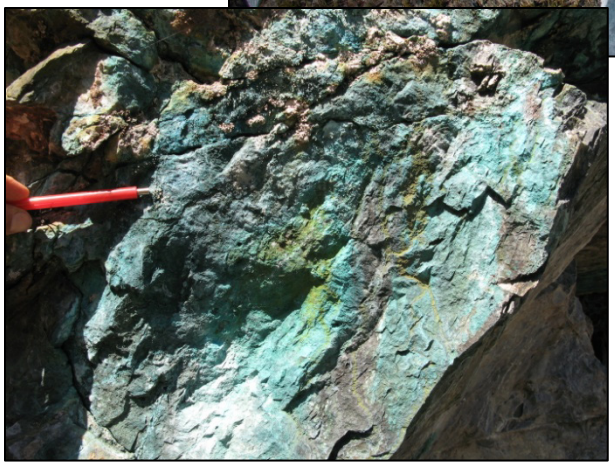
39th Annual Yellowknife Geoscience Forum Abstracts of Talks and Posters

November 15-17, 2011








Compiled by B.J. Fischer and D.M. Watson

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http://www.nwtgeoscience.ca/forum/

Cover photographs, clockwise from top right:
Creek running through the Natkusiak Formation basalts, Minto Inlier, Victoria Island; Luke Ootes , NTGO

Granite erratic on an esker at Daring Lake; Diane Baldwin , NTGO

Anticline in Sekwi Formation limestone, Source Peaks area, Mackenzie Mountains; Beth Fischer , NTGO

New (2011) copper showing in south-central Wopmay orogen; Val Jackson , NTGO

Photomicrograph of weakly serpentenized cumulate olivine (white) embayed in phlogopite (orange-brown), Arm Lake ultramafic intrustion, Coronation margin, Wopmay orogen; Luke Ootes, NTGO

centre:
Upper Baker Creek watershed, Yellowknife area; Paul Vecsei, Golder Associates

PROGRAM SCHEDULE

TUESDAY, NOVEMBER 15 (MORNING) - THEATRE 1

Geoscience & Exploration
Chairs: Edith Martel, Karen Gochnauer

08:40 **Health and Safety in Mineral Exploration - the Role of the PDAC** – Mercer, B.

09:00 **Overview of Activities, Northwest Territories Geoscience Office** - Ketchum, J. and Cairns, S.

09:20 **Canada-Nunavut Geoscience Office 2011 Activities** – Mate, D.

09:40 **Overview of Targeted Geoscience Initiative 4 (TGI-4) Ore System Projects: A National, Thematic Program to Enhance Effectiveness of Deep Exploration** - Villeneuve, M., Christine Hutton, C., Bjerkelund, C., and Paradis, S.J.

10:00 **Coffee** (sponsored by Discovery Mining Services Ltd, and Sub-Arctic Surveys Ltd.)

10:20 **Exploration in the Northwest Territories: 2011**- Falck, H.

10:40 **NUNAVUT 2011: Looking Below the Surface** - Senkow, M.D.

11:00 **Evolution of a Neoproterozoic Platform and Continental Flood Basalt Province - The Franklin Sills and Natkusiak Lavas of Victoria Island, Implications for Ni-PGE Mineralization -** Bédard, J.H., Rainbird, R., Dewing, K., Hadlari, T., Hayes, B., Naslund, H.R., Steigerwaldt, K., Macdonald, W., Carpenter, J., Hryciuk, M., Prince, J., Wing, B., Dell'Oro, T., Weis, D, Scoates, J., Williamson, N., Cousens, B., Nabelek, P., Winpenny, A., Beard, C., Ootes, L., Thomson, D., Mathieu, J., Durbano, A., Turner, E., Krapez, B., Pratt, B., Currie, L., Williamson, M.-C., and Girard, É.

11:20 **Sulphur Isotope Profiles of the Franklin Sills and Dykes in the Minto Inlier, Victoria Island -** Hryciuk, M., Bédard, J.H., and Wing, B.

11:40 **Coffee** (sponsored by Acme Labs Ltd.)

12:00 **The GEM - Minerals Program on Melville Peninsula: Summary of Bedrock Mapping Activites for 2011**- Corrigan, D., Nadeau, L., Machado, G., Wodicka, N., Houlé, M. and Brouillette, P.

12:20 **New Insights on the Surficial Geology of the Repulse Bay Area, Nunavut** - Campbell, J.E., McMartin, I., Tremblay, T., Wityk, U. and Dredge, L.A.

12:40 **Welcome** (Theatre 1)
Yellowknives Dene Drummers
Minister of Industry, Tourism and Investment

13:00 **Lunch** (sponsored by Golder Associates Ltd., and Nuna Group of Companies) – Weledeh and St. Patrick's School gymnasium

Cumulative Impact Monitoring (Community-based and Traditional Knowledge)
Chairs: Steve Kokelj, David Livingstone, Brenda Parlee

08:40 **The Cumulative Impact Monitoring Program/Pathways Approach: A Common Platform for Monitoring** – Lange, M. and Kokelj, S.

09:00 **Aquatic Research and Cumulative Impact Monitoring Studies in the Dehcho Region: A Pathways Analysis** - Low, G. and Townsend, B.

09:20 **The Role of Paleoecology in Environmental Monitoring Programs** - Vermaire, J., Kokelj, S., Pisaric, M., Thienpont, J., Blais, J., and Smol, J.

09:40 **Integrated Arctic and Sub-Arctic Vegetation Monitoring** - Marchildon, C., Lantz, T., Errington, R., Li, E., and Doyle, M.

10:00 **Coffee** (sponsored by Discovery Mining Services Ltd, and Sub-Arctic Surveys Ltd.)

10:20 **Community-based Environmental Monitoring in the Inuvialuit Settlement Region** - Lantz, T., Bennett, T., and Esagok, D.

10:40 **Community Monitoring of Great Slave Lake Ecosystem**: **First and Second Steps.** - Evans, M., Giroux, D., Bjorson, R., Fjordy, R., Simon, P. and Leonard, D.

11:00 **Keeping Thaidene Nene - The Ni hat'ni Dene Program** - Enzoe, G. and Ellis, S.

11:20 **PANEL DISCUSSION**

11:40 **Coffee** (sponsored by Acme Labs Ltd.)

12:00 **Traditional Knowledge and Cumulative Impact Monitoring in the NWT** - Parlee, B., Thompson, A., and Enzoe, G.

12:20 **Effects of Development on Caribou: Insight from TK and an Ecological Model** - Stevens, C., Thorpe, N., and Panayi, D.

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Energy in Canada's North Session
Chairs: Adrienne Jones, John Ketchum

09:00 **Canada's Oil and Gas Regime and Update on Recent Licencing in the Northwest Territories** - Morrell, G.R. and Geoffrion, K.

09:20 **Geo-Mapping for Energy and Minerals (Gem): Progress Report on Research in the Mackenzie Plain and Adjacent Mountain Ranges** - MacNaughton, R.B., Fallas, K.M., MacLean, B.C., Hadlari, T., Turner, E.C., Schneider, D.A., Acker, R.M., Hubbard, S.M., Pope, M.C., Leslie, S.A., Uyeno, T.T., Pratt, B.R., and Proks, T.

09:40 **Mackenzie Plain Petroleum Project: Devonian Horn River Group and Cambrian Clastic Play** - Pyle, L.J., Gal, L.P., and Jones, A.L.

10:00 **Coffee** (sponsored by Discovery Mining Services Ltd, and Sub-Arctic Surveys Ltd.)

10:20 **Windy Island J-39 – What has MGM Energy Learned from Drilling this Well?** - Price, P.R. and Enachescu, M.E.

10:40 **Middle Devonian Oil Shales in the Central Mackenzie Valley – A New Exploration Play in Canada's North** - Enachescu, M.E. and Price, P.R.

11:00 **Discovered Oil and Gas Resources of the Mackenzie Valley** – Drummond, K.J.

11:20 **Deep Water Seabed Geohazard Investigations in the Beaufort Sea Related to Offshore Hydrocarbon Development** - Blasco, S., Bennett, R., MacKillop, K., Campbell, P., Carr, E., and Hughes Clarke, J.

11:40 **Coffee** (sponsored by Acme Labs Ltd.)

12:00 **Lower Paleozoic Geology of Northwestern Victoria Island, Northwest Territories** - Dewing, K., Hadlari, T., Pratt, B.R., Durbano, A., Turner, E.C., Rainbird, R., and Bedard, J.

12:20 **Correlating Mid-Cretaceous Strata in the Canadian High Arctic using Palynology** - Galloway, J.M., Sweet, A.R., Pugh, A., Schröder-Adams, C.J., Swindles, G.T., Haggart, J.W., and Embry, A.F.

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Minister of Industry, Tourism and Investment

13:00 **Lunch** (sponsored by Golder Associates Ltd., and Nuna Group of Companies) – Weledeh and St. Patrick's School gymnasium

TUESDAY, NOVEMBER 15 (AFTERNOON) - THEATRE 1

Geoscience & Exploration
Chairs: Edith Martel, Hendrik Falck

12:30-19:00 Trade Show – Weledeh and St. Patrick's School gymnasium – Parking is available at 4503 52 Ave. (look for the Geoscience Forum signs)

14:50 Ever Expanding Zinc at Selwyn Project – Yukon & Northwest Territories – Dunning, J.K.

15:10 East-trending Thrusts in Lower Paleozoic Basinal Strata, and a New Volcanic Centre (?) within the Misty Creek Embayment (NTS 106B) - Fischer, B.J. and Gochnauer, K.

15:30 The Geology of the Redstone Copperbelt - Milton, J.E., Hickey, K.A. and Gleeson, S.A.

15:50 Constraints on Emerald Mineralization in the Mackenzie Mountains: Direct Evidence for a Major Palaeozoic Fluid-flow Event - Hewton, M., Marshall, D., Ootes, L., Loughrey, L., Creaser, R.

16:10 Reevaluating the Depositional Model and Iron Source of the Rapitan Iron Formation - Baldwin, G.J., Turner, E.C., Kamber, B.S.

16:30-19:00 Reception (sponsored by De Beers Canada Inc., and First Air, The Airline of the North) – Weledeh and St. Patrick's School gymnasium – please don't drink and drive. Complimentary rides home are provided by St. Patrick's SADD. Pick-up is in the Weledeh parking lot.

TUESDAY, NOVEMBER 15 (AFTERNOON) - THEATRE 2

Cumulative Impact Monitoring *(Interdisciplinary Studies)*
Chairs: Steve Kokelj, Trevor Lantz

14:50 Community-based Water Monitoring in Great Bear Lake - Nesbitt, L. and Bayha, C.

15:10 Evolution of Slave River and Delta Partnership - Kelly, E. and Carthew, K.

15:30 Implementation of Integrated Monitoring and Research at a Northern Research Basin - Spence, C., Kokelj, S.V., Kokelj, S. and Palmer, M.

15:50 Using Multidisciplinary Approaches to Investigate the Cumulative Impacts of Landscape Change on Terrestrial and Aquatic Ecosystems, Peel Plateau, NWT. - Kokelj, S., Lacelle, D., Lantz T., Ian, C., Lauriol , B., Pisaric, M., Joynt, A., and Maier, K.

16:10 Comparative Study of Degraded and Pristine Giant Lakes of North America using Ecopath - Tallman, R. and Janjua, Y.

16:30-19:00 Reception (sponsored by De Beers Canada Inc., and First Air, The Airline of the North) – Weledeh and St. Patrick's School gymnasium – please don't drink and drive. Complimentary rides home are provided by St. Patrick's SADD. Pick-up is in the Weledeh parking lot.

Energy in Canada's North Session
Chairs: Adrienne Jones, John Ketchum

14:50 New Understanding of Ordovician Stratigraphy and Oil Shale on Southern Baffin Island, Nunavut Territory: Preliminary Field Data - Zhang, S.

15:10 Hydrocarbons in the Western Canada Sedimentary Basin – Lessons for the North - Harper, J.D.

16:30-19:00 Reception (sponsored by De Beers Canada Inc., and First Air, The Airline of the North) – Weledeh and St. Patrick's School gymnasium – please don't drink and drive. Complimentary rides home are provided by St. Patrick's SADD. Pick-up is in the Weledeh parking lot.

Charles Camsell Talk
(sponsored by NAPEG) – open to the public (free)
Prince of Wales Northern Heritage Centre (PWNHC)

19:30 Dr. Geoff Plumlee, U.S. Geological Survey, Denver, Colorado, USA - 9/11 World Trade Centre, Hurricane Katrina, Gulf Oil Spill - A Report from Ground Zero: How Geoscientists can help in Environmental Disaster Response and Preparedness

Abstract - Many natural or human-caused disasters release hazardous materials that can threaten the environment and health. The U.S. Geological Survey (USGS) has helped assess potentially hazardous materials produced by a number of recent disasters, such as: dusts from the 2001 World Trade Center collapse; flood waters and sediments from hurricane Katrina; ash from wildfires at the wildland-urban interface; volcanic ash from numerous volcanic eruptions; the 2010 red sludge spill in Hungary; and the 2010 Gulf oil spill. These studies have demonstrated that geoscientists can play important roles in helping emergency responders and public health experts assess and understand environmental and environmental-health hazards of disasters.

Growing upon lessons learned from responses to past disasters, USGS scientists are also working with expert collaborators and stakeholders from many disciplines to estimate plausible environmental and environmental-health impacts of future disasters. Helping to predict the potential sources, types, environmental impacts, and health implications of hazardous materials released by different types of disasters will enhance preparedness for these disasters when they strike in the future.

Biography - Geoff Plumlee (Ph.D., Harvard University., 1989; B.S. University of New Mexico, 1980) is a research geochemist with the U.S. Geological Survey (USGS) specializing in environmental and human health research. Geoff devoted much of his past professional research to understanding the environmental geology and geochemistry of mineral deposits, and use of this information to better anticipate, mitigate, and remediate environmental and health impacts of mineral resource development worldwide. Geoff served as the Team Chief Scientist of the Central Region Mineral Resources Team (1996-1999) and the Crustal Imaging and Characterization Team (1999-2001). After he rotated out of management in 2001, Geoff's research has focused on issues involving geochemistry and public health, and the roles for environmental geochemistry in disaster response and planning. Geoff's current health-related research focuses primarily on the geochemical interactions of minerals with human body fluids, and their links to toxicity. He has also helped lead interdisciplinary teams that assessed mining-related environmental and health impacts in the Philippines, characterized dusts generated by the 9/11/2001 World Trade Center collapse, and characterized flood sediments left in New Orleans by 2005 hurricanes Katrina and Rita. Geoff has presented numerous invited, keynote, and plenary lectures to earth, environmental, and health scientists, and is lead or contributing author on over 200 scientific papers and abstracts. He has served as advisor to the U.S. Navy Lung Disease Assessment Program and the U.S. Federal Interagency Working Group on Asbestos, he is an expert member of the International Volcanic Health Hazards Network, and he was a member of the 1997 USGS GD Science Strategy Team. Geoff's research has received recognition via the Society of Economic Geologists' Lindgren Citation for his work in environmental geochemistry, the Organisation Mondiale de Mineralogie's Prix D'Excellence Pour Les Sciences de La Terre for his work in medical geochemistry, and the U.S. Department of the Interior's Superior Service Award.

Geoscience & Exploration
Chairs: Carl Ozyer, Karen Gochnauer

08:40 **Geological and Project Update: Jericho Diamond Mine, Nunavut** - Strand, P. and Lassonde.J.

09:00 **Talmora Diamond Inc. - Source of Lena West Diamonds?** - Davies, R. and Davies, A.W.

09:20 **Diavik Waste Rock Project: Geochemical and Mineralogical Characterization of Waste Rock Weathering at the Diavik Diamond Mine -** Hannam, S.,Bailey, B.L., Lindsay, M.B.J., Gibson, B., Blowes, D.W., Paktunc, A.D., Smith, L., and Sego, D.C.

09:40 **Diamond Exploration in Orogenic Settings: Lessons from Wawa Metaconglomerate** - Kopylova, M.G., Afanasiev, V.P., Bruce, L. F., and Ryder, J.

10:00 **Coffee** (sponsored by Acme Labs Ltd.)

10:20 **Age, Composition and Thermal history of Lower Crustal Xenoliths from the Slave Craton** - Coombs, S. and Chacko, T.

10:40 **Deep Lithosphere Beneath the Rae Craton: Peridotite Xenoliths from Repulse Bay, Nunavut** - Riches, A.J.V., Pearson, D.G., Kjarsgaard, B.A., Jackson, S.E., Stachel, T., and Armstrong, J.P..

11:00 **Vanished Diamondiferous Cratonic Root Below the Southern Superior Province** - Miller, C.E., Kopylova, M., and Ryder, J.

11:20 **Oxygen Isotope Survey of the Northern Canadian Lithospheric Mantle: Implications for the Evolution of Cratonic Roots** - Mišković, A., Ickert, R.B., Pearson, D.G. and Stern, R.A.

11:40 **Coffee** (sponsored by Peregrine Diamonds Ltd.)

12:00 **Predicting Lithology and Assessing the Potential for Base and Precious Metals, Uranium, Rare Earth and Platinum-Group Elements and Gold in the Nueltin Lake Area with New Regional Lake Sediment Geochemical Data** - McCurdy, M.W., Grunsky, E.C., and Pehrsson, S.J.

12:20 **Controls on the Formation of the Nechalacho Rare Metal Deposit, Thor Lake, Northwest Territories** - Möller, V. and Williams-Jones, A.E.

12:40 **Geology, Geochemistry, and Geochronology of the Moose II Lithium-Tantalum Pegmatite Deposit, NWT** - Anderson, M.O., Lentz, D., and Falck, H.

13:00 **Lunch** (sponsored by Yellowknife 2007) – Capitol Theatre

13:00 **NWT & Nunavut Chamber of Mines AGM** (ticket is required) – Yellowknife Inn, Copper Room

Research for Northern Decision Making
Chairs: Mike Palmer, Kathy Racher, Conrad Baetz

08:40 **Information Gaps and Research Priorities for Northern Decision Makers: Results of a Territory-Wide Questionnaire**- Lange, M., Racher, K., and Palmer, M.

09:00 **Decision Makers Atlas: A Tool to Facilitate the Transfer of Environmental Information to Northern Decision Makers** – Palmer, M., Kokelj, S., Irwin, D., and Sieben, B.

09:20 **A Tool for Cumulative Effects Assessment in the NWT**- Panayi, D. and Virgl, J.

09:40 **Improving Compliance, Capacity, and Communication: The Wek'èezhìi Land and Water Board`s Approach with Community Water Licences** – Wheler, B. and Cliff-Phillips, M.

10:00 **Coffee** (sponsored by Acme Labs Ltd.)

10:20 **Multi-Scale Geoscience Information for Decision-makers, Great Slave Region, NWT** - Wolfe, S., Stevens, C., Olthof, I., Short, N., and Avey, C.

10:40 **Current Northern Land Use Research for Decision-making**- Kanigan, J. and Kokelj, S.

11:00 **The Influence of Landscape Specific Ecological Responses to Oil and Gas Linear Disturbances in the North Yukon** – Simpson, K.

11:20 **Paleoclimatological assessment of the central Northwest Territories, Canada: Implications for the Long-term Viability of the Tibbett to Contwoyto Winter Road** - Patterson, T., Clark, I., Crann, C., Falck, H., Galloway, J., Gammon, P., and Griffith, F.

11:40 **Coffee** (sponsored by Peregrine Diamonds Ltd.)

12:00 **Developing a Standard Monitoring Framework for Assessing Great Slave Lake Fish and Fishery Changes** - Zhu, X., Toyne, M., Leonard, D., Taptuna, F., Howland, K., and Tallman, R.

12:20 **Community Based Monitoring of the Coastal Areas in the Communities of the Inuvialuit Settlement Region – Past Experience and Future Plans** – Walkusz, W., Loseto, L., Gillman, D. V., and Hansen-Craik, K.

12:40 **Monitoring the Cumulative Impacts of Harvesting Dolly Varden (*Salvelinus malma*)** - Gallagher, C. and Howland, K.

13:00 **Lunch** (sponsored by Yellowknife 2007) – Capitol Theatre

13:00 **NWT & Nunavut Chamber of Mines AGM** (ticket is required) – Yellowknife Inn, Copper Room

Industry and Communities
Chair: Tom Hoefer

08:40 **Updated Guidelines for Federal Officials on the Duty to Consult: Implications for Industry in the Northwest Territories** – Saikaley, M.

09:00 **Building a New Relationship: The Emerging Kwe Beh Approach to Development** - Blondin, T., Gibson, G., Chocolate, M., and Zoe, S.

09:20 **Traditional Ecological Knowledge (TEK)/Inuit Qaujimajatuqangit (IQ) & the Resource Sector -** English, C. and Thorpe, N.

09:40 **Aboriginal Mining Companies Helping Create Community Benefits** - Mackenzie, G.

10:00 **Coffee** (sponsored by Acme Labs Ltd.)

10:20 **Mackenzie Valley Environmental Impact Review Board Identifies Improvements to Regulatory Processes** - Christensen, V. and Lawson, N.

10:40 **Financing Market Trends – Who's Raising Money in NWT and at What Cost?** - Cox, B.

11:40 **Coffee** (sponsored by Peregrine Diamonds Ltd.)

13:00 **Lunch** (sponsored by Yellowknife 2007) – Capitol Theatre

13:00 **NWT & Nunavut Chamber of Mines AGM** (ticket is required) – Yellowknife Inn, Copper Room

14:00-14:50 Keynote Presentation (sponsored by Yellowknife 2007) - open to delegates
Dr. Sarah Gleeson, University of Alberta - The Genesis of the Carbonate Hosted Pb-Zn Deposits of the Mackenzie Platform, Northwest Territories

Biography- Dr. Sarah Gleeson is an economic geologist with a strong interest in hydrothermal ore deposits. Her research does not focus on a single commodity or deposit type, but rather, is more concerned with mineralizing processes. A primary interest is the use of halogen and chlorine isotopic analyses of fluid inclusions to trace the origin and evolution of hydrothermal systems. Sarah received a B.A. (mod) in Geology from Trinity College Dublin and a PhD. in geochemistry from the University of London (Imperial College) in 1996. Her thesis was concerned with the chemistry of formation waters and the origin of low temperature Pb-Zn deposits in Cornwall, U.K. Subsequently, she held post-doctoral positions at the Natural History Museum, London carrying out research on the Cerro Matoso nickel laterite deposit, Colombia and at the University of Leeds working on the migration of sedimentary brines into crystalline basement rocks. She moved to the University of Alberta to take up a position as an Assistant Professor in 2001 and became an Associate Professor in July 2007. For the past 5 years much of her field research has focussed on sediment hosted base metal and gold deposits in the Canadian Cordillera.

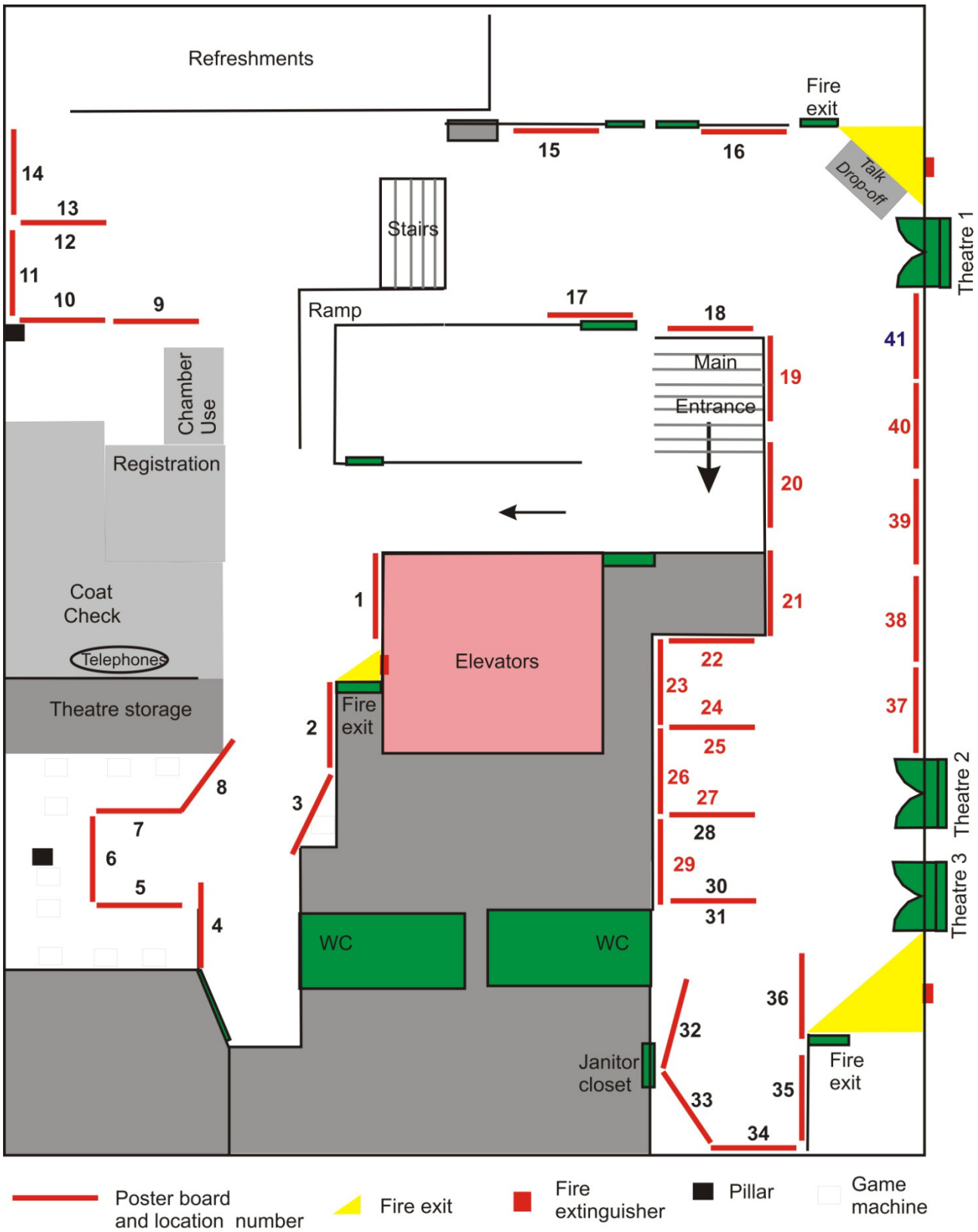
Dr. Gleeson is the current Howard Street Robinson Lecturer. The Howard Street Robinson Lecturer is chosen by the Mineral Deposits Division and the Precambrian Division of the Geological Association of Canada in alternate years. It is funded by the Robinson Fund of the GAC that was established in 1977, following the bequest to GAC from the estate of Howard Street Robinson, a founding member of GAC. The bequest was "for furtherance of scientific study of Precambrian Geology and Metal Mining."

14:00-19:00 Trade Show – Weledeh and St. Patrick's School gymnasium – Parking is available at 4503 52 Ave. (look for the Geoscience Forum signs)

14:50-16:30 Capitol Theatre Lobby – Posters and Soapbox Talks (Refreshments sponsored by Yellowknife 2007)

16:30- 19:00 Reception (sponsored by Diavik Diamond Mines (a Rio Tinto/Harry Winston joint venture), Foraco Canada Ltd., and Northern News Services Ltd.) – Weledeh and St. Patrick's School gymnasium – please don't drink and drive. Complimentary rides home are provided by St. Patrick's SADD. Pick-up is in the Weledeh parking lot.

Chairs: Doug Irwin, Val Jackson



17- Poster Number (**Red numbers** indicate Soapbox Talks)

Posters (by location)

Poster #	First Author	Title
1	Dubé, B.	TGI-4 Lode Gold Deposits in Ancient, Deformed and Metamorphosed Terranes; Footprints and Exploration Implications: A Preliminary Overview of Themes, Objectives and Targeted Areas
2	Schofield, L.	Wildlife Management Information System
3	Fallas, K.M.	New Bedrock Map Compilations for the Central Mackenzie Corridor
4	Tremblay, T.	Gold and Base Metals Potential from Glacial Sediments, Melville Peninsula (Nunavut)
5	Niemi, A.	Marine Ecosystem Study in the Tarium Niryutait Marine Protected Area: Establishing a Baseline for Cumulative Impact Monitoring
6	Wright, D. F.	Mineral and Energy Resource Assessment (MERA) for the Area of Interest for the Proposed Thaidene Nene National Park
7	Davies, R.	Kimberlite Indicator Minerals and “Laterite”, Canadian Arctic
8	Machado, G.	Geological Update of the Prince Albert Greenstone Belt, Western Melville Peninsula, Nunavut
9	Lesemann, J-E.	Increased Mineral Exploration Efficiency Through Integration of Novel Mapping Approaches, Improved Dispersal Models, and Field-Based Portable XRF Analyses
10	Russell, H.A.J.	An Emerging Paradigm for Surficial Geological Mapping of Arctic Canada at the Geological Survey of Canada
11	Cummings, D.I.	Eskers as Mineral Exploration Tools: How to Sample Eskers and Interpret Data
12	Low, G.	The CABiN Aquatic Biological Monitoring Program is an Element of the Dehcho First Nations' AAROM Community-based Monitoring Program
13	Jackson, V.A.	South Wopmay Bedrock Mapping Project: 2011 Update
14	Davis, W.	Timing of IOCG Mineralizing and Alteration Events within the Great Bear Magmatic Zone
15	Olthof, I.	Medium-resolution Land Cover Information from SPOT 4-5 across the Subarctic Treeline, Great Slave Region, NWT
16	Stevens, C.W.	Surficial Materials Mapping Using Landsat7 and Topographic CDED Data, Yellowknife NTS Map Sheet 85J, NWT
17	Kerr, D.	GEM Tri Territorial Surficial Database
18	Wolfe, S.A.	Great Slave TRACS Transportation Risk in the Arctic to Climatic Sensitivity
19	Nichols, K.*	A Study on Websterites from the Diavik Diamond Mine - Slave Craton, Canada
20	Muise, P.*	The Dendroclimatic Signal in White Spruce Ring Widths along the Tibbitt to Contwoyto Ice Road, Yellowknife, NWT
21	deMontigny, P.*	Lake Level Fluctuations and its Impact on Bison Habitat: A Climate Reconstruction of the Fort Providence Region, NWT
22	Mumford, T.R.*	Blachford Lake Intrusive Suite; Insight from Carbonatites and other Alkaline Intrusive Suites of the Southern Slave Craton
23	Snijders, M.*	NWT Land Information Related to Aboriginal Groups Map

24	Goldsmith, S.A. *	Late Holocene Palynological Investigation of Waite Lake, Central Northwest Territories
25	Macumber, A.L.*	Characterization of Lake Types along the Tibbitt to Contwoyto Winter Road: The Development of a Preliminary Thecamoebian-based Transfer Function to Access Climate Change
26	Walsh, N.J.*	Geochronology and Geochemistry of Precambrian Basement Rocks from the Vicinity of Fort McMurray, Alberta: A Geothermal Perspective
27	Neville, L.A.*	Utility of Temporal Environmental Proxies for Assessing 'Problem' Lakes along the Tibbitt to Contwoyto Winter Road
28	Hansen, E.*	Geochemical Studies of Gold Mineralizing Events in the Clan Lake and Discovery Areas of the Yellowknife Greenstone Belt
29	Griffith, F.*	A Paleoclimate Reconstruction of Lake Sediments from along the Tibbitt-to-Contwoyto Winter Road
30	Normandeau, P.X.*	Till Geochemical Signatures of Iron Oxide Copper-Gold Mineralization in the Great Bear Magmatic Zone, Northwest Territories, Canada
31	Pilkington, M.	Geological Significance of a New High Resolution Gravity Gradiometric and Magnetic Survey over the Blatchford Lake Complex
32	Galloway, J.M.	Source Rock Characterization and Biostratigraphy (Palynology) of Jurassic-Cretaceous Strata Preserved in the Hoodoo Dome H-37 Oil and Gas Well, Ellef Ringnes Island, Sverdrup Basin
33	English, M.C.	Quantifying Changes in Snowpack Water Equivalent Development in the Northern Boreal-Tundra Transition Zone
34	Harris, J.R.	The Central Baffin RPM Bedrock Mapping Initiative
35	Wenman, C.	My Community is My Classroom: Building Hands-on Learning for Youth and other Community Members to Engage in Community Water Monitoring
36	Boxwell, J.E.	Gwich'in Renewable Resources Board: Helping Gwich'in Communities Manage their Resources
37	Boyé, S.*	Petrology, Geochemistry, & U-Pb Geochronology of Archean Fertile Granitic Plutons and Associated Pegmatites in the Slave Province: Preliminary Results
38	Brin, L.E.*	Evaluating the Northerly Extent of the Slave Craton in the Canadian Arctic
39	Shakotko, P.*	A Quartz Arenite - Weathered Porphyry - Porphyry Succession at Beaverlodge Lake, Northwest Territories: Implications for Atmospheric Oxygen at ca. 1.9 Ga and Unconformity-Type Uranium Mineralization
40	Skeries, K.*	Geochemical and Mineralogical Controls on Metal Dispersal Downstream of Sulphide Deposits in the Prairie Creek Mine Area, Southern Mackenzie Mountains, NWT
41	Mvondo, H.	Geology, Partial Melting, and Mineralization Relationships in Hope Bay and Elu Greenstone Belts and Adjacent Granitoids: Insight from the Area East of the Boston Gold Deposit, NE Slave Craton

*Student Poster

Soapbox Talk

SOAPBOX TALK SCHEDULE (STUDENTS ONLY)

Poster #	First Author	Title	Time
19	Nichols, K.*	A Study on Websterites from the Diavik Diamond Mine - Slave Craton, Canada	3:00 PM
40	Skeries, K.*	Geochemical and Mineralogical Controls on Metal Dispersal Downstream of Sulphide Deposits in the Prairie Creek Mine area, Southern Mackenzie Mountains, NWT	3:07 PM
20	Muise, P.*	The Dendroclimatic Signal in White Spruce Ring Widths along the Tibbitt to Contwoyto Ice Road, Yellowknife, NWT	3:14 PM
39	Shakotko, P.*	A Quartz Arenite - Weathered Porphyry - Porphyry Succession at Beaverlodge Lake, Northwest Territories: Implications for Atmospheric Oxygen at ca. 1.9 Ga and Unconformity-Type Uranium Mineralization	3:21 PM
21	deMontigny, P.*	Lake Level Fluctuations and its Impact on Bison Habitat: A Climate Reconstruction of the Fort Providence Region, NWT.	3:28 PM
38	Brin, L.E.*	Evaluating the Northerly Extent of the Slave Craton in the Canadian Arctic	3:35 PM
37	Boyé, S.*	Petrology, Geochemistry, & U-Pb Geochronology of Archean Fertile Granitic Plutons and Associated Pegmatites in the Slave Province: Preliminary Results	3:42 PM
22	Mumford, T.R.*	Blachford Lake Intrusive Suite; Insight from Carbonatites and other Alkaline Intrusive Suites of the Southern Slave Craton	3:49 PM
23	Snijders, M.*	NWT Land Information Related to Aboriginal Groups Map	3:56 PM
24	Goldsmith, S.A. *	Late Holocene Palynological Investigation of Waite Lake, Central Northwest Territories	4:03 PM
25	Macumber, A.L.*	Characterization of Lake Types along the Tibbitt to Contwoyto Winter Road: The Development of a Preliminary Thecamoebian-based Transfer Function to Access Climate Change	4:10 PM
26	Walsh, N.J.*	Geochronology and Geochemistry of Precambrian Basement Rocks from the Vicinity of Fort McMurray, Alberta: A Geothermal Perspective.	4:17 PM
27	Neville, L.A.*	Utility of Temporal Environmental Proxies for Assessing 'Problem' Lakes along the Tibbitt to Contwoyto Winter Road	4:24 PM
29	Griffith, F.*	A Paleoclimate Reconstruction of Lake Sediments from along the Tibbitt-to-Contwoyto Winter Road	4:31 PM

Geoscience & Exploration
Chairs: Valerie Jackson, Luke Ootes

09:00 Tyhee Gold Corp's Yellowknife Gold Project – Pratico, V

09:20 The Beniah Fault Zone: Crustal Response to Protracted Activity within the Slave's Lithospheric Mantle - Stubley, M. P.

09:40 Does the Slave Craton Continue into Southern Siberia: Comparison of their Large Igneous Province (LIP) Records - Bleeker, W. and Ernst, R.E.

10:00 Coffee (sponsored by Rescan Environmental Services Ltd.)

10:20 Iron Oxide Copper-Gold Systems in the Great Bear Magmatic Zone: Setting the Stage for the Next Cycle of Exploration - Corriveau, L., Hayward, N., Craven, J., Montreuil, J.F., Enkin, R., Potter, E., Jackson V., Ootes, L., Lauzière, K., Roberts, B., Mumin, A.H.

10:40 Fingerprinting Iron Oxide Copper-Gold Mineralization in the Great Bear Magmatic Zone Using Indicator Mineral and Till Geochemical Methods: Highlights from the IOCG-Great Bear GEM Project - McMartin, I., Normandeau, P.X., Paquette, J., Beaudoin, G., and Corriveau, L.

11:00 Newly Identified Mineralization and Evaluation of Prospective Environments in the Central Wopmay Orogen: An Overview of Results from 2004-2011 - Ootes, L., Jackson, V.A., and Corriveau, L.

11:20 Geochronology of Detrital Zircon in Hottah Sedimentary Sequences: A Glimpse at the Enigmatic Hottah Basement, Wopmay Orogen - Davis, W.J., Ootes, L., Newton, L., and Jackson, V.

11:40 Coffee (sponsored by Rescan Environmental Services Ltd.)

12:00 Development Update for the Nico Gold-Cobalt-Bismuth Deposit, Northwest Territories – Rinaldi, T., Schryer, R., De Carlo, M., Mucklow, J., and Goad, R.

12:20 Environment and Permitting Update for the Nico Gold-Cobalt-Bismuth-Copper Deposit, Northwest Territories – Schryer, R., Rinaldi, T., De Carlo, M., Mucklow, J., and Goad, R.

12:40 Prairie Creek Mine: The Continuing Saga - Taylor, A.

13:00 Lunch (sponsored by First Air, The Airline of the North, and the NWT & Nunavut Chamber of Mines) – Weledeh and St. Patrick's School gymnasium

10:00-15:00 Trade Show – Weledeh and St. Patrick's School gymnasium. Parking is available at 4503 52 Ave. (look for the Geoscience Forum signs).

14:00 Business Card Draws, and Passport to Diamond Draw – Weledeh and St. Patrick's School gymnasium

Environment
Chairs: Julian Kanigan, Carl Ozyer

08:40 **Not All Protected Areas Are the Same: A Guide to Multiple Protected Areas Proposals in the NWT**- Hamre. K.

09:00 **The Sahtu Land Use Plan – A Piece of the Puzzle** - Wright-Bird, J., and Wiebe, H.

09:20 **Progress and Priorities Update: Standard Procedures and Consistency Working Groups, Land and Water Boards of the Mackenzie Valley** – Nevitt, Z.

09:40 **Implementing Northern Voices, Northern Waters: NWT Water Stewardship Strategy** - Culhane, M. and Kelly, E.

10:00 **Coffee** (sponsored by Rescan Environmental Services Ltd.)

10:20 **Raptor Occupancy and Productivity near a Diamond Mine** - Coulton, D.W., Virgl, J.A., and English, C.

10:40 **The Link between Tailings Pond Gas Generation and Unstable Ice Conditions: Colomac Mine Remediation Project, Northwest Territories** - Vanderspiegel, R., Breadmore, R., James, R., Bourke, R., and Salzsauler, K.

11:00 **Arsenic Mobility and Attenuation in a Natural Wetland at Terra Mine, Silver Bear, Northwest Territories** - Sealey, H. and Jamieson, H.

11:20 **Assessing Environmental Effects of Mining on the Ecological Integrity of Streams in the South Nahanni Watershed: Challenges and Potential Solutions** - Scrimgeour, G., Bailey, J., Reynoldson, T., Bowman, M., Thomas, K., Hall, R., Tate, D., and Suitor, M.

11:40 **Coffee** (sponsored by Rescan Environmental Services Ltd.)

12:00 **High Resolution Paleoclimatic Reconstruction of Lacustrine Sediments from the Tibbitt to Contwoyto Winter Road, NT, Canada** - Macumber, A., Patterson, R.T., Galloway, J.M., Falck, H., Prokoph, A., Swindles, G.T., and Neville, L.A.

12:20 **Projections of Relative Sea-Level Rise for the Northwest Territories and Nunavut** - James, T., Simon, K., Forbes, D., Dyke, A., Carriere, S., and Mate, D.

12:40 **Environmental Controls on Active-layer Freezeback in Continuous and Discontinuous Permafrost of the Slave Geological Province, Northwest Territories** - Karunaratne, K. and Burn, C.

13:00 **Lunch** (sponsored by First Air, The Airline of the North, and the NWT & Nunavut Chamber of Mines) – Weledeh and St. Patrick's School gymnasium

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THURSDAY, NOVEMBER 17 (AFTERNOON) - THEATRE 1

Geoscience & Exploration
Chairs: Hendrik Falck, Scott Cairns

15:10 Advancing Exploration through Web Portals - Gonzales, N.L.

15:30 NWT Centre for Geomatics – Online Maps, Viewer, and Data – Kirizopoulos, E. and Cameron, K.

15:50 Pine Point Update - Burns, R.F.

16:10 Heavy Lift Hybrid Air Vehicle Support to Mining - Newton, S.J.

16:30 Student Presentation Awards

THURSDAY, NOVEMBER 17 (AFTERNOON) - THEATRE 2

Environment
Chairs: Julian Kanigan, Carl Ozyer

15:10 Bowhead Whale Research and Seismic Mitigation in the SE Beaufort Sea, 2007-2010 - Harwood, L. and Joynt, A.

15:30 Population Trends of Birds in the Fort Liard Area and Implications for Broad-scale Monitoring - Machtans, C. and Kardynal, K.

15:50 Influence of Environmental Conditions on Beluga Whale Entrapments in the Husky Lakes, NWT: Baseline Data for Prediction and Monitoring - Higdon, J., Macklin, G., Harwood, L., and Ferguson, S.

16:10 An Exceptional Case Study of Lake Trout Diversity: The Coexistence of Multiple Shallow-water Forms in Great Bear Lake, NT. - Chavarie, L., Howland, K., and Tonn, W.

16:30 Student Presentation Awards (Theatre 1)

GEOLOGY, GEOCHEMISTRY, AND GEOCHRONOLOGY OF THE MOOSE II LITHIUM-TANTALUM PEGMATITE DEPOSIT, NWT

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The Moose II rare-metal-bearing granitic pegmatite is located approximately 115 km east-southeast of Yellowknife, NWT, along the north shore of the Hearne Channel of Great Slave Lake. The pegmatite forms a north-trending dyke, 430 m long and up to 61 m wide, dipping moderately to the west, discordantly hosted within metasedimentary rocks of the Archean Yellowknife Supergroup. This deposit is a historical producer of lithium and tantalum (1946 -1954). This study aims to examine the mechanisms of emplacement, evolution, and mineralization within the deposit, as well as contributing to the development of a useful tool for further pegmatite exploration using muscovite trace-element geochemistry.

Detailed mapping characterized the complex mineralogical and textural zonation of the dyke, with well-defined border, intermediate, and core zones. Whole-rock geochemical results of chip, channel, and bulk samples allowed the classification of the Moose II pegmatite as a spodumene-subtype of the complex family of rare-element pegmatites. Lithium (Li) concentration is the highest in the second intermediate zone, up to 2.73 wt.% Li_2O. The highest tantalum (Ta) and niobium (Nb) concentrations were found in the secondary muscovite-rich zones, up to 770 and 110 ppm, respectively.

The fractionation trends of muscovite were studied using laser ablation ICP-MS as petrogenetic indicators of pegmatite evolution. The results indicate that crystallization progressed from the margins inward, with the spodumene-bearing zones being the most evolved of the intermediate zones. These findings also reflect the highly evolved composition of the Moose II pegmatite, typical of advanced fractionation found throughout the Faulkner Lake pegmatite series.

The processes controlling the distribution and grade of Ta-Nb mineralization in pegmatites are poorly understood. Metal enrichment may occur by fractional crystallization alone, or possibly through high-T autometasomatic processes. To resolve this, Ta-Nb oxides throughout pegmatite were first analyzed by careful petrography, microprobe analyses, and SEM-backscattered electron imagery, revealing complex zoning patterns and mineralization styles. The chemistry of primary and secondary muscovite temporally associated with the Ta-Nb oxides was then analyzed by LA ICP-MS to help to understand the nature of the late-stage pegmatitic fluids, and therefore the controls on Ta-Nb mineralization. Magmatic-metasomatic processes dominated mineralization; however aqueous fluids were found to transport small amounts of Ta.

Finally, a cooling age was determined by $^{40}Ar/^{39}Ar$ dating of muscovite, yielding a plateau age of 2540 ± 9 Ma. This age will be further constrained by U-Pb tantalite geochronology by laser ablation ICP-MS, to determine the timing of emplacement relative to geodynamic evolution in the Slave Province.

Petrographic, geochemical, and isotopic investigations are ongoing, and will contribute to a better understanding of ore-forming processes and fluid-rock interactions in the Moose II

pegmatite. A tool for pegmatite exploration using the trace-element geochemistry of muscovite is under development, in association with regional sampling of the fertile Prosperous Suite and associated pegmatites.

REEVALUATING THE DEPOSITIONAL MODEL AND IRON SOURCE OF THE RAPITAN IRON FORMATION

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Neoproterozoic iron formations record an unusual and apparently final documented recurrence of this sediment type after a hiatus of more than one billion years. Despite the unusual environmental conditions that led to their formation, specifically their association with glaciogenic deposits, Neoproterozoic iron formations have strongly influenced models for the Precambrian Earth's surficial evolution and iron formation in general. One of the most archetypical of these iron formations is the Rapitan iron formation of the Northwest Territories and Yukon. Located in the the Mackenzie Mountains, this iron formation is associated with glacial and glaciomarine clastic sedimentary rocks of the Rapitan Group, lower Windermere Supergroup and comprises one of the largest untapped iron resources in North America. Extended trace element geochemistry combined with detailed stratigraphic control of the Rapitan iron formation can help shed new insight into the deposition of such deposits.

Complete REE+Y patterns demonstrate that the Rapitan basin was hydrologically connected to the open ocean, but that local catchments of an evolved, possibly granitic composition supplied dissolved REE+Y, suggesting partial basin restriction. A critical attribute of the REE+Y systematics is the lack of a positive Eu anomaly, an otherwise ubiquitous feature in older Precambrian iron formation. The Eu anomaly has traditionally been used as the principal evidence for a hydrothermal iron source for most iron formations, including those from the Neoproterozoic, despite their lack of a positive Eu anomaly. In light of the missing anomaly, alternative iron sources, and consequently alternative depositional models for the Rapitan iron formation must be explored.

Bacterial reduction of glacially-sourced iron oxy-hydroxides into a capped, anoxic basin could possibly generate sufficient iron in solution to generate large iron formation. Upon glacial retreat, exposure of the by then nutrient-rich basin to atmospheric oxygen and sunlight generated a major bloom in primary productivity and the oxidation of dissolved iron in the water column. Although large volumes of iron were deposited across the basin, true iron formation only formed in a few areas, and is only present in economic amounts in the Snake River region, whereas elsewhere it is contained within iron-rich glacioclastic sediments. Areas with significant clastic flux during deposition overwhelmed iron formation development. Isolated areas where clastic sediment was trapped nearshore during sealevel highstand allowed for the deposition of significant thickness of true chemogenic iron formation.

EVOLUTION OF A NEOPROTEROZOIC PLATFORM AND CONTINENTAL FLOOD BASALT PROVINCE - THE FRANKLIN SILLS AND NATKUSIAK LAVAS OF VICTORIA ISLAND, IMPLICATIONS FOR NI-PGE MINERALIZATION

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Parts of the Minto Inlier and surrounding area of western Victoria Island were mapped during the 2010 and 2011 seasons. The Minto Inlier comprises a 4-km thick succession of early Neoproterozoic sedimentary rocks (Shaler Supergroup) capped by basaltic lavas, and intruded by coeval diabase sills of the 720 Ma Franklin igneous episode. These rocks were broadly folded along an ENE-trending axis prior to deposition of unconformably overlying lower Cambrian to Ordovician sedimentary rocks that young to the north. The Proterozoic rocks are cut by NW-striking faults that appear to have controlled emplacement of the magmatic rocks. All rocks are cut by ENE-striking extensional block faults with displacements of up to 300 m.

The Franklin sills extend 10s of km along strike with little change in thickness or stratigraphic level. Field relationships show fault-guided transfer zones allowing magma to jump up-section, with associated skarns and intense contact metamorphic haloes. Feeder dyke propagator tips were emplaced into breccias (fault-related?) and may contain abundant sulphides, possibly related to assimilation of S-bearing hosts. Some feeders correspond to prominent NNW-trending magnetic anomalies, probably represent major upflow zones, and are plausible exploration targets. Residual fluids expelled from sills would have been channelled by the faults and reacted with contact-metamorphosed roof rocks to form oxide-sulphide skarns.

The thin basal member of the Natkusiak Formation has hyaloclastite, agglutinate(?), rubbly flows, and picritic lavas. It is not yet known if the picrites are primitive enough to have Ni potential. Paleovalleys were filled by lahars, after which the paroxysmal Natkusiak sheet flows erupted. The sheet flow lavas preserve two differentiation cycles, with vent complexes forming near the top of the first cycle, locally preserving unconsolidated scoria, spatter, and fumarolic deposits of native Cu-malachite. Preliminary data imply that the lavas from different sections have distinct trace element signatures, but similar major elements and phenocryst types. These subtly different trace element signatures may reflect a lack of inter-connectedness to the subvolcanic plumbing system, despite broadly reproducible differentiation histories.

Geochemical data show two populations of magma types in the Franklin sills. Diabasic sills with flat REE patterns similar to those of the lavas occur throughout the stratigraphy. Some sills emplaced within and below the Wynniatt Formation also contain primitive LREE-enriched magma types, some of which develop olivine-enriched bases. Intersections of these primitive magmatic intrusions with sulphate-bearing host rocks (Minto Inlet Formation) are potential targets for induced Ni-S immiscibility, and show

S-isotopic signatures indicating substantial contamination by host sulphates. Individual olivine-rich sills can be traced laterally for over 50 km, and become thinner and more evolved towards the west, suggesting a focus zone near the head of Minto Inlet. A major fault-guided feeder system appears to pass up through the sulphate-bearing Kilian Formation, and into a set of sills where basal sulphidic gossans are prominent. In addition to abundant pyrite (replacing original magmatic sulphide?), these gossans contain ovoid sulphide-bearing basaltic pods in a graphitic rheomorphic breccia. Analyses of 2011 samples will clarify whether primitive magmas with high Ni-S potential also occur in the upper Shaler Supergroup.

DEEP WATER SEABED GEOHAZARD INVESTIGATIONS IN THE BEAUFORT SEA RELATED TO OFFSHORE HYDROCARBON DEVELOPMENT

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Seabed mapping in support of a regional assessment of geohazards affecting deep water hydrocarbon development in the Beaufort Sea continued in 2011. The collaborative study among the GSC, ArcticNet, IOL, and BP began in 2009. This year, mapping technologies included multibeam sonar and a high resolution sub-bottom profiler used onboard the Canadian Coast Guard icebreaker Amundsen. The seabed, to depths of 100 m below seafloor, was investigated in water depths of 50 to 1300 m.

Research results to date indicate a variety of seabed in stability conditions exist along the outer shelf and upper slope region of the Beaufort Sea. The regional geohazard framework is largely controlled by processes associated with multiple glaciations: emergence of the shelf during sea level lowstands; permafrost aggradation; rapid deposition of glacial outwash; failure of outwash deposits down slope; and submergence of the shelf following the retreat of the ice sheet. Ice scouring due to sea-ice is observed on the upper slope to water depths of 150 m may be relict and related to historically more severe sea-ice regimes or to scouring during lower sea levels. Sub-seabed ice-bearing permafrost may only occur in areas of less than 100 m water depths where it was generated when the shelf was subaerially exposed during periods of glaciation. The shelf edge at 100 m is associated with concentrations of mud volcanoes and pockmarks. Gas venting in association with these features may result from gas migration from beneath the impermeable permafrost to the pinch-out of permafrost at shelf edge. Low-strength sediments that thicken down slope from the shelf edge may result from rapid deposition rates of distal glacial outwash. Submarine slides that occur at the shelf edge and down slope may be retrogressive in nature. Faulting in near surface sediments may relate to shelf edge insatiability processes. Gas hydrate has been observed in one sediment core down slope. Ongoing research will focus on continued mapping of the spatial distribution and temporal activity of geohazards. Relict instability features may not be relevant to offshore hydrocarbon development. Current research results are being considered as part of the ongoing NEB-led Arctic Drilling Review.

DOES THE SLAVE CRATON CONTINUE INTO SOUTHERN SIBERIA: COMPARISON OF THEIR LARGE IGNEOUS PROVINCE (LIP) RECORDS

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There are numerous matches in the Large Igneous Province (LIP) barcode record between

northern Laurentia (including the Slave craton) and southern Siberia, sufficient to argue for a nearest neighbor relationship between ca. 1900 and 725 Ma. We consider mafic magmatic events (mainly diabase dykes and sills) that match in age between the regions and then address non-matches. Ca. 1900 Ma The Snowbird event of Laurentia (includes Hearne and Chipman dykes, and Kramanituor and related intrusions) can be compared with the Angual dykes of the Irkutsk promontory, southern Siberia. 1880-1870 Ma The Ghost dykes, and Morel and Mara River sills/sheets of the Slave craton are approximately coeval with volcano-plutonic units along the Akitkan belt, associated NE-trending Kalaro-Nimnyrski dykes in the Aldan block, and the Kengurak-Sergachi gabbro-anorthosite and related massifs located in the Selenga-Stanovoy superterrane in southern Siberia. 1740-1750 Ma: Dyke swarms (Cleaver, McRae Lake, and Hadley Bay) in northern Laurentia can be matched with dykes in Siberia that may radiate from a potential plume centre in the eastern end of the Akitkan belt. Ca. 1700 Ma The Pelly Bay swarm of southern Boothia Peninsula is similar in age to the Ulkan-Bilyakchan rift magmatism of southeastern Siberia. 1640 Ma: The Melville Bugt swarm of western Greenland can be matched with some "Nersa" sills of the Irkutsk promontory. 1380 Ma The Midsommerso – Zig Zag Dal event of northern Greenland is exactly the same age as the Chieress dykes (northern Siberia) and probable equivalent dykes and sills in Sette Daban area of southeastern Siberia. 780 Ma: The Gunbarrel event (includes Hottah dykes and sheets of Slave craton) matches volcanics in the Yenesei uplift, southwestern Siberia. 725 Ma: The Franklin LIP is widespread in northern Canada, and is coeval with dykes and sills in the Irkutsk promontory (on the basis of Ar-Ar dating), and with bimodal volcanism in the Olokit graben near Lake Baikal. This link with the Franklin LIP is further strengthened by a 725 Ma U-Pb age for the Dovyren layered intrusion also of the Baikal region. A rifting event of 725-700 Ma is also identified in the Yenesei uplift. So there are strong LIP age matches between northern Laurentia (including the Slave craton) and southern Siberia that span the age range 1900 to 725 Ma and are evidence for a nearest neighbor relationship.

However, there are a few ages within this interval that do not yet match, most prominently at 1270 Ma: The extremely widespread 1270 Ma Mackenzie LIP of northern Canada has not yet been identified in Siberia. Similarly, equivalents to the 1000-970 Ma Sette Daban sills of southeastern Siberia have not been found in northeastern Laurentia. However, we predict that matches will be found for these ages as precise geochronology is obtained for the many magmatic units in Siberia, and northern Laurentia that are currently undated or poorly-dated.

BUILDING A NEW RELATIONSHIP: THE EMERGING KWE BEH APPROACH TO DEVELOPMENT

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KWE BEH WORKING GROUP, TLICHO GOVERNMENT, BEHCHOKÖ, NT

The Kwe Beh Working Group will present on the new relationship that the Tlicho Government has with developers in the Tlicho region. The Kwe Beh Working Group, inclusive of ten members from the Tlicho region and staff, is involved in managing relationships to the many developers in the north.

In this presentation, the Kwe Beh Group will talk about:
Relationships with developers in the north, Expectations of exploration companies, advanced exploration and senior mining companies;
Capacity building in key elements to prepare for engagement with the industry, such as closure, environmental assessment, and consultation,
Approaches to understanding the cumulative impact of development on citizens in the Tlicho communities.
New approaches to exploration agreements, and Impact and Benefit Agreements.

Emerging approaches to managing research for environmental impact assessment in the Tlicho region, including traditional knowledge and socio-economic and cultural impact assessment.

The Kwe Beh Working Group uses research for policy, planning and relationship building, and looks forward to a good engagement with the people who come to this session on how to build strong capacity for Aboriginal governments to engage in resource development.

PINE POINT UPDATE

BURNS, R.F.
TAMERLANE VENTURES INC., BLAINE, WA, USA

Tamerlane has been very active on the Pine Point Property during 2011 with over 5 million dollars being spent on engineering, geotech drilling, confirmation drilling and freeze ring test holes. The primary focus has been fine tuning the engineering with the geotechnical drilling providing data for the underground design, the freeze ring and the ramp design. The major change in the engineering has been the switch from long access drifts to individual ramps on each deposit. Engineering studies have shown this to be the most economic method for underground mining of the deposits. Confirmation drilling was completed on the W-85 deposit and a NI 43-101 report is anticipated that will move this deposit, which contains historic resources of 3.8 million tonnes at a grade of 6% lead-zinc, into compliant resources. It is contemplated that this deposit will be mined open pit. A compliant resource of 9 million tonnes was completed on the N-204 deposit in early 2011 and a feasibility study is being completed on it to move it from an indicated resource to a probable reserve.

NEW INSIGHTS ON THE SURFICIAL GEOLOGY OF THE REPULSE BAY AREA, NUNAVUT: IMPLICATIONS FOR MINERAL EXPLORATION

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The Geological Survey of Canada has initiated a multi-year Quaternary mapping activity in the Repulse Bay-Wager Bay area, mainland Nunavut, as part of the Multiple Metals-Melville Peninsula Project under Canada's Geomapping for Energy and Minerals (GEM) Program. The area lies within one of the most active precious and base metal exploration areas of the Western Churchill Geological Province and is heavily drift covered, yet the surficial geology in this area has never been field mapped. Therefore, the glacial history, regional drift provenance and Quaternary framework necessary for the implementation of successful drift exploration programs are lacking. Both remote predictive mapping and field based investigations are being used to fill in these knowledge gaps.

Fieldwork in 2010 and 2011 has focused on the region west of Repulse Bay, stretching from Committee Bay in the north (NTS 46M-East), to west (NTS 46 L & 56I-East) and south (NTS 46E-North) of Repulse Bay. 158 till samples (~ 7km spacing) have been collected for provenance studies including till geochemistry, various indicator mineral species and gold grains. Field observations indicate this region is key for the glacial history reconstruction of the northern part of Keewatin Ice Sector of the Laurentide Ice Sheet, and for understanding the interplay between Keewatin Sector - Foxe Basin/Melville ice. Multiple striation directions, superimposed streamlined landforms, and convergent ice-flow directions into Repulse Bay were recorded. At least 4 main phases of ice flow have been identified. A northwest flow

predates the dominant northward flow. The late convergent flow into Repulse Bay (Phase 3), in part reverse and oblique to the northward ice flow, resulted in a flow reversal over the southern part of the Rae Isthmus and has significant implications for following up indicator mineral dispersal trains. The final eastward flow is restricted to west-southwest of Repulse Bay. A previously unknown, exotic carbonate-rich till was discovered south of Repulse Bay which extends the limit of carbonate dispersal over 30 km to the south of Rae Isthmus. This discovery changes the interpretation of source location for the carbonate till and the ice-flow dynamics in the Repulse Bay – Southampton Island – southern Melville Peninsula area during deglaciation.

Diverse Quaternary sediments and depositional environments were observed and indicate a complex Quaternary geology and glacial history. Of particular interest are the east-flowing (46E and L) and north-flowing (56I) meltwater corridors with complex sediment-landform assemblages, prominent crag-and-tail landforms in 56I, and the major end moraines in 46M with divergent ice-flow directions on either side. These features have implications for understanding subglacial thermal conditions, glacial dynamics, and transport and depositional processes. Contrasting marine incursion limits north (240 m a.s.l.) and south of the end moraines (160-150 m a.s.l.), and further south of Repulse Bay (140 m a.s.l.), suggest the ice remained much longer over the Rae Isthmus and to the south. This confirms that paleo-Committee Bay must have been open and stable over a significant time period, likely related to the ice-front margin at the Chantrey-Melville moraine system. This has implications for regional post-glacial uplift patterns and paleoglaciological reconstruction.

THE EVOLUTION OF THE SLAVE RIVER AND DELTA PARTNERSHIP

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During the Autumn of 2010 representatives from federal (Aboriginal Affairs and Northern Development Canada, Fisheries and Oceans Canada, Environment Canada and Parks Canada) and territorial (Environment and Natural Resources and Municipal & Community Affairs) government agencies, with members of aboriginal organizations that live along the Slave River (NWT Métis Nation and Fort Resolution and Fort Smith Métis Councils, with Deninu K'ue, Smith's Landing and Salt River First Nations), academics (Aurora College, Aurora Research Institute, University of Waterloo, Wilfrid Laurier University), and non-governmental organizations (Center for Indigenous Environmental Resources) formed a collaboration to support community involvement in aquatic community-based monitoring. The goals and objectives of the collaboration are guided by the *Northern Voices, Northern Waters: NWT Water Stewardship Strategy* (released May 2010).

This collaboration, now called the Slave River and Delta Partnership (the Partnership), has quickly evolved to addresses community concerns, such as fish health, by providing support for local community members to become involved in water stewardship. Community members from Fort Resolution and Fort Smith identified several concerns and research and monitoring questions related to the Slave River and Delta during a workshop in early 2011. Whether the water was safe to drink, the fish safe to eat, or the ecosystem healthy were central questions that the came to light during the workshop. Soon after the workshop, members of the Partnership developed a relationship with a group of fish health researchers led by Dr. Paul Jones from the University of Saskatchewan. This new relationship resulted in "Community Fishing

Days", which were held during June 2011.Community members and scientists worked together to collect fish samples from the Slave River and the Slave River Delta for a fish health study. The Partnership is currently assessing the vulnerability of the Slave River and Delta (funded by NWT CIMP 2011/2012) to inform the Partnership's future activities by identifying monitoring and research priorities. The vulnerability assessment includes a State of the Slave River and Delta report, a vulnerability assessment workshop and a sediment contaminant study in the Slave River Delta.

The evolution of the Slave River and Delta Partnership has involved trust-building, concrete actions and results, and effective communication. This has allowed members of each organization to become invested in the Slave River and Delta Partnership by working together towards common water stewardship related goals and objectives. The important milestones of this collaboration, can serve as a model approach for supporting community involvement in water stewardship activities within the *NWT Water Stewardship: A Plan for Action 2011-2015* (May 2011).

AN EXCEPTIONAL CASE STUDY OF LAKE TROUT DIVERSITY: THE COEXISTENCE OF MULTIPLE SHALLOW-WATER FORMS IN GREAT BEAR LAKE, NT

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Great Bear Lake is the largest lake entirely within Canada and the most northerly lake of its size, which confers special ecological significance to its resident organisms. Moreover, Great Bear Lake plays an important role in the local economy, as it supports both a world class lake trout sport fishery, and a vital subsistence fishery for the community of Deline. As the major top predator, lake trout is a key component in maintaining a balanced and healthy aquatic foodweb in this lake. Lake trout populations are, however, particularly susceptible to over-exploitation and other impacts including climate change, due to their low productivity and requirements for cold, well-oxygenated water. Long-term biological and environmental data are of key importance in monitoring this resource. Recent assessment studies by the Department of Fisheries and Oceans provide an excellent baseline from which to monitor changes in the fish community of Great Bear Lake, however detailed information on the biology of most species, including lake trout, is lacking. In this study we combine continued environmental and biological monitoring with more directed research on lake trout variability, habitat use and food web relationships. Adequately accounting for variability within lake trout populations is critical to the development of management strategies that will maintain lake trout biodiversity in Great Bear Lake. This presentation will focus on our investigations of lake trout variability.

Intraspecific morphological variation is commonly observed among fishes in recently glaciated lakes of the Canadian Arctic. This variation within depauperate northern systems is likely due to a relaxation of competition in simple food webs, and the presence of open niches. In this study we are characterizing differences and investigating the basis and consequence for diversification among lake trout in Great Bear Lake using a combination of morphological and ecological approaches. More specifically, variation is being quantified with respect to morphology, feeding ecology, habitat use, and life-history of lake trout. This is being done using a combination of western scientific methods and Aboriginal Traditional Knowledge regarding different lake trout forms.

Our morphological analyses to date have distinguished three commonly occurring morphs, and a fourth rarer morph that co-exist in the shallow waters of Great Bear Lake. This unusual endemic diversity in shallow water

challenges the prevailing idea that lake trout forms are segregated primarily by depth and may represent a unique situation fostered by the abundance of suitable cool water habitat in the nearshore zone of this northernmost Great Lake. Work done in 2011 has been focused on a tagging component to look at variation in habitat use among morphs, a diet analysis to look at feeding ecology and a traditional knowledge component to supplement the above-described morphological findings. More detailed information on lake trout diversity, habitat use and food web relationships will be important in refining monitoring protocols and in helping us develop a better understanding of lake trout ecology, ultimately allowing for better prediction and mitigation of the potential impacts of harvest and development.

MACKENZIE VALLEY ENVIRONMENTAL IMPACT REVIEW BOARD IDENTIFIES IMPROVEMENTS TO REGULATORY PROCESSES

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In recent years, stakeholders have expressed concerns that environmental assessments in the Northwest Territories have become onerous for all participants from the perspective of work load and available resources and that the regulatory system governing land and water resources in the Mackenzie Valley has become increasingly complex and lengthy.

The Mackenzie Valley Environmental Impact Review Board (Review Board) has the responsibility for environmental assessments, and has acknowledged those concerns. In its most recent three year strategic plan it has made timeliness of the environmental assessment process the top priority. In addition, the Review Board commissioned Stantec Consulting Limited to investigate and address stakeholder concerns.

Findings of the Review Board's investigation were released to the public in fall 2011, through a report submitted by Stantec. The main recommendations focus on improving scoping efficiency, developing a defined process for referrals to environmental impact reviews, developing environmental assessment processes for large versus small projects, improving guidance materials and implementing rules based timelines.

Based on the report's finding and its own internal analysis, the Review Board will initiate improvements it feels are appropriate and within its authority to change. It is expected there will be improvements that can be implemented in the short term while others will require more time. The Review Board plans to share more information on the nature and timing of process improvements with stakeholders.

AGE, COMPOSITION AND THERMAL HISTORY OF LOWER CRUSTAL XENOLITHS FROM THE SLAVE CRATON

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Lower crustal xenoliths play a critical role in the study of crustal formation processes, particularly in Archean terrains where the lower crust is an important interface between the upper and middle crust and the cool lithospheric mantle keel underlying Archean cratons. Research on lower crustal xenoliths from the Slave craton provides an opportunity to gain insight into the age, composition and thermal history of this interface within the craton.
In this study we present data from three lower crustal xenoliths suites collected in a northeast to southwest transect across the Slave craton. The samples are from the Artemisia kimberlite, located in the Coronation diamond district of the northwestern Slave (Nunavut), the Ekati kimberlite from the central Slave (NWT) and the Munn Lake kimberlite of the southeastern Slave (NWT). Samples from the Artemisia Suite have a range of bulk composition, but the majority are intermediate in composition and compromise

Garnet + Plagioclase ± K-feldspar and significant amounts of retrograde hydrous minerals that likely pseudomorph orthopyroxene. As well, there are accessory grains of rutile, zircon and monazite in some samples. The garnet in these samples is characterized by relatively low grossular contents. One sample from this suite contains Garnet + Cordierite + Plagioclase + Biotite and is similar in mineralogy and appearance to metagreywackes that are widespread throughout the Slave. U-Pb ages of ~1900 Ma, ~2100 Ma and ~2400-2600 Ma were obtained by laser ablation ICP Mass Spectrometry of zircon and monazite grains from the Artemisia suite.
In contrast to the Artemisia xenoliths, the Ekati and Munn Lake samples are garnet-bearing mafic granulites with a primary mineralogy of Garnet + Clinopyroxene + Plagioclase ± Orthopyroxene ± Amphibole ± Rutile ± Ilmenite. Based on Fe-Mg geothermobarometry, it has been determined that all three suites equilibrated at a minimum temperature of ~700-800 °C. As well, pressure constraints of ~8-12 kbars have been determined for the pyroxene bearing samples of the Ekati and Munn Lake suites.

THE GEM-MINERALS PROGRAM ON MELVILLE PENINSULA: SUMMARY OF BEDROCK MAPPING ACTIVITIES FOR 2011

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The Melville Peninsula project, one of ten new geo-mapping projects that were initiated under the Federal Government Geo-mapping for Energy and Minerals (GEM) Program, has completed its third and final field season in 2011. Field activities in 2011 focussed on the Prince Albert Greenstone Belt in the type-locality Prince Albert Hills and in surrounding gneisses and granitoids in NTS map sheet 47B. The area was briefly visited during the summer 2009 and a rhyolite sampled at the time yielded a preliminary U-Pb zircon age of 2.97 Ga, providing substantial improvement on a previous, ca. 2.83 Ga imprecise zircon age generated in the late 1970's and published by Tom Frisch in a GSC Bulletin in 1982. The new 2.97 Ga age on the volcanic sequence, coupled with widespread occurrence of rocks with ancient (ca. 3.0 – 3.2 Ga) Nd model ages for the central Melville Peninsula region, requires that previously postulated correlations with ca. 2.73 – 2.70 Ga supracrustal rocks of the Committee Bay Belt and Woodburn Group be re-assessed. Correlations with the younger Mary River and Eqe Bay Groups on Baffin Island also need to be revised.

This presentation will highlight key observations as we progress towards the elaboration of a new stratigraphy for the ca. 2.97 Ga Prince Albert Greenstone Belt, a better understanding of its structural, metamorphic and plutonic evolution, as well an improved understanding of the mineral potential in NTS map sheet 47B. Overall, the results point to more complexities on the age and nature of rocks that form the Rae Province.

IRON OXIDE COPPER-GOLD SYSTEMS IN THE GREAT BEAR MAGMATIC ZONE: SETTING THE STAGE FOR THE NEXT CYCLE OF EXPLORATION

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Following new geological and geophysical observations and modelling across the Great Bear magmatic zone (GBmz), the Geomapping for Energy and Minerals program and its partners of the South Wopmay Bedrock Mapping Project are now in a position to predict the types of mineral deposits that may be associated with the iron oxide copper-gold (IOCG) alteration and mineralizing systems. Using the framework of an IOCG alteration-to-deposit evolution model, we highlight potential targets for magnetite- and hematite-group IOCG deposits, iron oxide-apatite, albitite-hosted uranium and other types of deposits affiliated with IOCG systems across the magmatic zone and document their current geochemical anomalies and fingerprints.

We illustrate the diverse relations among mineralization types and provide examples of how the GBmz IOCG systems rival those of world-class deposits. We show that alteration mapping protocols, semi-quantitative geophysical modelling (integrating newly acquired aeromagnetic data, rock physical property and archival magnetic and gravity data) and magnetotelluric surveys are efficient predictive tools for mineral exploration and geological mapping. For example, alteration mapping in the most explored system within the magmatic zone, the Au-Co-Bi-Cu NICO deposit, led to the discovery of a new and significant multi-metal exploration target consisting of U-Th-Mo-Cu mineralization (see Potter et al., this volume). Combined pseudo gravity-based modelling and apparent density-based modelling of NICO geology allows a refinement of the distribution of potential iron oxide-rich alteration and potential mineralization in the area. At the regional scale, the pseudo gravity-based model is effective at highlighting known IOCG systems and has been utilized to direct bedrock mapping towards new targets which has led to new IOCG-type alteration and mineralization occurrences. The model shows large anomalies beneath the Paleozoic cover to the west of NICO/Sue Dianne, WNW of Fab, and SW of Hottah Lake; these and many other anomalies remain to be tested. A recent magnetotelluric survey has defined a significant anomaly below the NICO deposit, beyond currently available drill information. By overlaying known bedrock geology and geophysical models, potential mineralization can be predicted in terms of either iron oxide-apatite or magnetite- to hematite-group IOCG mineralization. Physical properties of 510 oriented samples from IOCG systems across the GBmz show a similar magnitude of and relationship between magnetic susceptibility and density of known IOCG deposits.

Current findings demonstrate that the GBmz remains significantly under explored both within virgin territories and areas with past-producing and recent mining infrastructures. We believe that by framing currently known alteration and mineralization within the IOCG alteration-to-deposit evolution model, the GBmz is ready for a new cycle of mineral exploration.

RAPTOR OCCUPANCY AND PRODUCTIVITY NEAR A BARREN-GROUND DIAMOND MINE, NORTHWEST TERRITORIES

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Breeding raptors (falcons, hawks and owls) have been shown to be sensitive to industrial development and the barren-grounds in the Northwest Territories is an important and relatively undisturbed area within the raptor breeding range. The barren-ground landscape in the Northwest Territories has undergone mineral resource development since the mid-1990s. Previous research indicates that indirect negative effects occur to breeding raptors nesting within 7 km of industrial development. We monitored a sample of nests (n=20) of peregrine falcon (*Falco peregrins anatum-tundrius comples*), gyrfalcon (*Falco rusticolus*), and rough-legged hawk (*Buteo lagopus*) occurring within 47 km of the Diavik Diamond Mine (Mine) during 1998 to 2010 to test the relationship between distance from the Mine and probabilities of nest occupancy and breeding success. We also examined the effects of natural factors such as weather and prey abundance. An information-theoretic approach was used to test the relative support for candidate linear and non-linear logistic models containing a variety of these effects. Results from our study area were also compared to a sample of nests (n=12) monitored over the same time period in an adjacent and undeveloped area as a relative response control (Control). Finally, we examined whether nest success within 7 km of the Mine was correlated with activity levels at the Mine during the raptor breeding season.

Model selection results supported an effect of distance that indicated raptor nests within 13.9 km (95% CI: 11.5 to 16.3 km) of the Mine were more likely to be occupied. Selection results for nest success supported an effect of distance and weather where nest success increased with distance but decreased with greater spring rainfall. No unique patterns in annual nest productivity were observed between Mine and Control areas and both showed a similar decreasing annual trend in nest success. Mine activity level was not correlated with the success rates of nests within 7 km of the Mine site. Although generally weak and imprecise, spatial effects were found for both nest occupancy and success rates for raptors breeding in the Mine study area and indicate a negative effect on nest success. However, similar declines were found for Control nests over the same time period. Based on the body of evidence, we conclude that the observed patterns are likely the result of natural factors operating at a regional scale than more localized effects due to the presence of the Mine.

FINANCING MARKET TRENDS – WHO'S RAISING MONEY IN NWT AND AT WHAT COST?

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In 2010, approximately 1,400 companies completed around 2,500 mining equity financings. With such a large number of private placements taking place annually, it is difficult to keep track of which companies have raised money and in which sectors. As the founder of Oren Inc., I helped build the Oreninc Deal Log, a comprehensive database of all financing activity in the Canadian natural resources space that is updated daily.

I propose to discuss fundraising trends among NWT-focused junior mining companies, as well as the financing environment for companies working in NWT. The basic questions I will focus on are: how much and what type of money is raised for work in the territory? Which companies are raising money? What sectors are companies focusing on? Does the territory materially matter to the major banks as a source of deal flow?

Topics will include but will not be limited to: Which NWT companies raised money in 2011

Range of offering sizes
Number and types of offerings completed by companies operating in the NWT
Which brokers were involved and know the NWT market
Costs associated with raising money
Comparison of deal flow across different sectors
Cost of development in NWT versus other Canadian jurisdictions and consequences for companies doing development work in the NWT

Overall 2011 has been a weak year for fundraising, especially since March when the tsunami hit Japan. We have seen a seasonal slowdown due to effects of the tsunami, European debt, and fears of a double-dip recession in the U.S. I will present a detailed overview of not only the financing environment for NWT-based companies, but also the general financing market environment. Sectors covered will include gold, copper, zinc, oil & gas, silver, and iron ore.

IMPLEMENTING *NORTHERN VOICES, NORTHERN WATERS*: NWT WATER STEWARDSHIP STRATEGY

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Northern Voices, Northern Waters: NWT Water Stewardship Strategy (the Strategy), a made-in-the-North water strategy, will guide the long-term stewardship of the NWT's water resources. The Strategy's development was a commitment of the Government of the Northwest Territories (GNWT) and Aboriginal Affairs and Northern Development Canada (AANDC). It stemmed from Aboriginal peoples' and northern residents' concerns for water resource management; increasing water-related pressures from industrial development and transboundary influences; climate change; and a changing global economy. The Strategy, tabled at the GNWT Legislative Assembly on May 20th, 2010 was guided and supported by an Aboriginal Steering Committee comprising representatives from Aboriginal, territorial and federal governments.

The Strategy's vision, "*the waters of the Northwest Territories will remain clean, abundant and productive for all time",* was developed by the water partners. It is supported by a series of goals to assure that:

waters that flow into, within or through the NWT are substantially unaltered in quality, quantity and rates of flow.
residents have access to safe, clean and plentiful drinking water at all times.
aquatic ecosystems are healthy and diverse.
residents can rely on their water to sustain their communities and economies.
residents are involved in and knowledgeable about water stewardship.
all those making water stewardship decisions work together to communicate and share information.

Following the tabling of the Strategy, the GNWT, AANDC and the Aboriginal Steering Committee moved towards the development of the Strategy's action plan. As with the Strategy, input on the action plan was sought from water partners, including industry representatives from the Canadian Association of Petroleum Producers and the NWT Chamber of Mines, as well as Aboriginal governments, environmental non-government organizations, regulatory boards, communities and the general public.

Subsequently, the *NWT Water Stewardship: A Plan for Action 2011-2015* was tabled in the NWT Legislature on May 17, 2011. This detailed action plan outlines ongoing, short term, and long term actions grouped into four components: Work Together, Know and Plan, Use Responsibly and Check Our Progress. Organized around the four components, the

action plan highlights broad Keys to Success initially introduced in the Strategy and outlines action items, deliverable dates, lead agency/agencies, and partners who will work together to achieve these Keys to Success.

Completion of the Keys to Success will contribute to better management of water in the NWT and directly benefit the North's regulatory process. Examples include completion of guidelines and policies regarding protection of the aquatic environment; evaluating the need to amend existing legislation; and the development of consistent protocols for aquatic monitoring and data management that can be applied to water licences issued by regulatory boards.

As the action plan is subject to ongoing reviews and audits to ensure its implementation continues to advance the intent of the Strategy, we welcome further contributions from current or new water partners, and encourage all to work together to achieve the vision of the Strategy.

TALMORA DIAMOND INC. - SOURCE OF LENA WEST DIAMONDS?

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Darnley Bay found diamondiferous kimberlites near Paulatuk in 2000. In 2003 Talmora acquired three exploration permits at the start of a diamond rush that covered most of what is known as the Lena West Diamond area lying between Great Bear Lake and the Arctic coast and extending from the east side of Great Bear Lake to beyond the MacKenzie River.

The Talmora property was chosen on the basis of:
Anomalous stream sediment samples.
2 macro- and 1 near macro-diamond in tills down-ice of the property.
Improvement of mineral chemistry towards Talmora.
Being on the same structure or diabase dyke swarm as Darnley Bay.

Talmora completed an airborne magnetic survey and collected 350 till samples. The samples contain kimberlite indicator minerals (KIMs) that show a strong correlation with magnetic anomalies.

Other companies focused on large areas west of Talmora and found widespread KIMs with good diamond association chemistry and an unprecedented 15 diamonds. After seven years and spending $75 million the only new kimberlite is the small but very diamondiferous Dharma kimberlite SE of Talmora. Darnley Bay to the N of Talmora recently added three kimberlites to their original cluster of 10. Our neighbours to the west have moved on. It is significant that Darnley Bay, Dharma and Talmora lie on a favourable structure believed to be the northern extension of the Slave diamond corridor that includes all the territory's' economic diamond deposits.

The Lena West KIMs indicate the presence of a significant diamond field and show very little variation in mineral chemistry as if they were all from a single source. Diamondex eventually showed that many if not all of the Lena West KIMs were derived from the base of the Cretaceous sedimentary basin that covers most of the area and the KIMs entered the basin from the east or from the direction of the Talmora property. Talmora, Darnley Bay and Dharma are outside the basin and ice flowed from these properties on to the basin.

The KIMs west of Talmora have completely different chemistry to those of the Darnley Bay kimberlites. The Dharma KIMs match some of those from the west but do not match the full range of compositions and cannot be the source of them all. Diamondex showed early on that their KIMs were different to those of the Slave province.

The ilmenites and spinels of the Cretaceous basin perfectly match those of Talmora. Dharma ilmenites cannot account for the full range of compositions in the basin and its spinels are similar but have half the percentage grains with

>48% Cr2O3. Talmora's and Dharma's few chrome diopsides and eclogitic garnets are identical and their eclogitic garnets match those of the basin. Diamondex and Sanatana pyropes in the basin are identical but Darnley Bay and Dharma differ in having a significant number of high Cr2O3 grains. Talmora has too few pyropes to make a meaningful pyrope comparison.

Evidence points to Talmora being the source of the KIMs and diamonds of Lena West.

GEOCHRONOLOGY OF DETRITAL ZIRCON IN HOTTAH SEDIMENTARY SEQUENCES: A GLIMPSE AT THE ENIGMATIC HOTTAH BASEMENT, WOPMAY OROGEN

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The Hottah terrane is an enigmatic basement domain to the Great Bear magmatic zone and extends west from the Wopmay orogen beneath Paleozoic cover to the Fort Simpson terrane. The terrane is interpreted as a microcontinent with an associated arc that collided with the Slave craton as part of a series of Paleoproterozoic accretionary events on the western margin of Laurentia. Owing to very limited exposures, little is known about the origin of Hottah terrane and its subsequent involvement in the Wopmay Orogen.

Detrital zircon within sedimentary rocks derived from, and deposited on, the Hottah terrane provides an indirect way to sample a wide variety of zircon-bearing rocks within the Hottah basement and establish an age profile for the terrane. Samples of sedimentary rocks were analysed from different parts of the Hottah stratigraphy, including the ca. 1.9 Conjuror Bay Fm., Zebulon Fm., Beaverlodge Lake sandstone and a sample from the underlying Holly Lake metamorphic complex (HLMC). The detrital zircon population in most of these samples is dominated by ages similar to their estimated depositional age indicating that most were deposited in association with or shortly after magmatism. The detrital zircon record highlights two major characteristics of the Hottah terrane

1) The terrane experienced a protracted magmatic history between ca 2.0 Ga and 1.89 Ga with punctuated magmatism at 1.99, 1.97, 1.93, 1.91, and 1.90 Ga. Assuming that most of these rocks developed in a supracsubduction zone setting infers >100 Ma of subduction history, including deformation and metamorphism of the HLMC, prior to development of the Great Bear magmatic arc.

2) The pre-2.0 Ga basement to the Hottah magmatic rocks is dominated by material of Paleoproterozoic age. Archean zircon are not common and those that are present are relatively young with ages of <2650 Ma. Most of the Archean zircon have ages between 2.5 and 2.58 Ga, with one grain from HLMC >2.6 Ga. The relative proportions of basement ages recorded in different samples, most likely indicates variable protolith sampling due to local sedimentalogical factors. The most significant age peaks are at 2.03-2.09, 2.33-2.36, 2.42-2.46, and 2.52-2.58 Ga. This age profile is distinct from Slave craton to the east of the Wopmay fault. The results are comparable to previously published Paleoproteozoic basement ages documented in the Treasure Lake group in southern Wopmay Orogen (Gandhi and van Breemen, 2005). Where the Hottah terrane was ultimately derived from remains speculative. Paleoproterozic terranes with formation ages between 2.56 to 2.1 Ga are relatively uncommon globally. In western Laurentia they are known from the western Rae Province, Sask craton and the Buffalo Head terrane in NW Alberta. We are currently investigating Hf isotopic composition of the detrital zircon to establish if the Paleoproterozoic material represents juvenile material or includes reworked older Archean crustal components.

LOWER PALEOZOIC GEOLOGY OF NORTHWESTERN VICTORIA ISLAND, NORTHWEST TERRITORIES

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Mapping and stratigraphic studies of the lower Paleozoic succession on northwestern Victoria Island, NWT, were undertaken by the Geological Survey of Canada between 2009 and 2011 as part of the GEM (Geomapping for Energy and Minerals) program.

Five mappable informal stratigraphic units are recognized:

1) Clastic unit of Early Cambrian age that consists largely of fine to coarse quartz arenite deposited in a shallow-water tidal marine setting. (0-90 m)
2) Tan dolostone unit of Middle? Cambrian age that consists of dolomudstone to dolarenite with local thrombolite mounds and large-scale trough cross bedding. This unit was deposited in a shallow subtidal setting. (30-405 m)
3) Stripy unit of Middle Cambrian age that consists of alternating red and green shale, dolomudstone and siltstone with abundant shallow water sedimentary structures. A shallow subtidal to intertidal setting is inferred. (15-95 m)
4) Dolostone unit of Middle? Cambrian to Early Ordovician age that consists of fabric-destructive dolostone with poorly preserved shallow-water sedimentary features including cross-bedded oolitic grainstone and thrombolites that was deposited on a broad, shallow carbonate platform. (550 m)
5) Fossiliferous wackestone unit of Late Ordovician age containing faunal elements of the Arctic Ordovician fauna that was deposited in a subtidal setting.

Above these units are a series of poorly exposed carbonate units of probable Silurian age and uncertain thickness:

6) Burrow mottled dolomudstone unit that is thickly bedded and poorly fossiliferous.
7) Biohermal unit of coarsely crystalline dolomudstone with stromatolites.
8) Fossiliferous dolograinstone unit with abundant corals and stromatoporoids.

The Victoria Island F-34 well, drilled near the northwestern coast of Victoria Island, indicates 650 m of Silurian carbonate (units 6-8) overlain by 340 m of Silurian? shale and 875 m of Devonian carbonate.

Mapping and aeromagnetic data indicate that widespread ENE-WSW oriented normal faulting offset lower Paleozoic strata. At least some of these faults were active in the Early Cambrian and again in the Middle Cambrian as shown by thickness changes in the Clastic unit (1) and the Stripy unit (3). The faults cut the Late Ordovician Fossiliferous wackestone unit (5) indicating movement after that time.

DISCOVERED OIL AND GAS RESOURCES OF THE MACKENZIE VALLEY

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A number of sedimentary basins occur in the Mackenzie Valley, with a total area of 448 thousand square kilometres (173 thousand square miles). The Mackenzie Valley has a number of discovered oil and gas fields and a significant potential for future undiscovered oil and gas. Basins with production include the Southern Territories, the Liard Plateau, and the Mackenzie Plain. The total discovered recoverable oil and gas resource is 313 million barrels of oil and 1,963 billion cubic feet of natural gas. In addition to the discovered fields a number of wells have recorded flows of oil and/or gas.

A thick favorable stratigraphic section ranging from the Cambrian to the Tertiary occurs in the Mackenzie Valley, with discovered oil and gas fields in a variety of structural and stratigraphic settings. The primary reservoirs are in Cambrian sandstones, Middle Devonian carbonates and Cretaceous sandstones. Cambrian gas has been discovered in the Colville Hills, with recoverable gas resource of 848 billion cubic feet. Devonian oil and gas occurs in the Southern Territories and Liard Plateau, with 4.5 million barrels of recoverable oil and 961 billion cubic feet of recoverable gas. Discoveries in the Mackenzie Plain include Devonian oil at Norman Wells, Devonian gas and condensate at Summit Creek, and Upper Cretaceous gas at Stewart Lake, with a total discovered recoverable resource of 308 million barrels of oil and condensate and 155 billion cubic feet of gas.

Fields with oil production include Norman Wells, discovered in 1920, and Cameron Hills, discovered in 1968, with first production in 2002. Gas fields with production include Beaver River, Pointed Mountain, Kotaneelee, Liard K-29, Liard P-66, Fort Liard F-36, SE Fort Liard N-01, and Cameron Hills. Currently producing fields include Norman Wells, Cameron Hills, and Kotaneelee.

The most important oil discovery in the Mackenzie Valley is Norman Wells, discovered in 1920. The original recoverable oil is estimated at 302 million barrels, with cumulative production to July 31, 2011 of 264 million barrels. The only other oil production is at Cameron Hills, with original recoverable oil of 4.5 million barrels and cumulative production to July 31, 2011 of 2.3 million barrels.

The most important gas fields with production are in the Liard Fold Belt, with initial discovered recoverable resource of 846 billion cubic feet and cumulative production to July 31, 2011 of 720 billion cubic feet. The first discovery was Kotaneelee in 1964, with discovered recoverable gas resource of 246 billion cubic feet and cumulative production to July 31, 2011 of 233 billion cubic feet. The Colville Hills, with no production to date, has initial recoverable gas resources of 848 billion cubic feet.

EVER EXPANDING ZINC AT SELWYN PROJECT – YUKON & NORTHWEST TERRITORIES

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Since 2005, Selwyn Project has become the most significant zinc development opportunities in Canada, and the World. A total of $80.7Million has been directly spent on diamond drilling and other related exploration activities in the Yukon: however, significant funds have been also expended on environmental permitting and community relations work, as well as an ongoing Definitive Feasibility Study. Selwyn Chihong Mining Ltd. ("SCML") has completed 160,272 metres of diamond drilling defining what Brook Hunt calls in their September 2011 Metals Market Update Selwyn Project the second largest zinc deposit in the World with respect to contained zinc and lead metal in either reserves or resources, and the largest one that remains undeveloped. As such, Selwyn Project is a strategic mineral resource for Northern Canada

SCML has made 9 major deposit discoveries and the project now contains 14 drill defined deposits and zones that could be amenable to open pit and underground mining methods. The global Indicated mineral resources for 2011 are 180.69 million tonnes grading 5.25% zinc and 1.83% lead for a metal content of 20.91 pounds of zinc and 7.33 billion pounds of lead. The Inferred mineral resources for 2011 are 216.04 million tonnes grading 4.47% zinc and 1.38% lead for a metal content of 21.29 billion pounds of zinc and 6.57 billion pounds of lead.

Recent deep drilling in 2010 and 2011 has revealed two significant targets. At the Don deposit, drilling yielded think intercepts of high-grade zinc-lead mineralization below the previously known mineral resource for the Don deposit (see June 7, 2011 news release). A detailed review of the deep, thick intercepts of

zinc-lead mineralization of the Don deposit in respect to the geological model for Selwyn Project has defined an attractive conceptual target between the Don and Don East deposits. This new target lends credibility to linking the shallow dipping zinc-lead mineralization at a similar elevation in each of the Don and Don East deposits. It is conceptualized to have a minimum area of 900 by 250 metres that has an average thickness of 25 metres. Investors are cautioned that there has not been sufficient drilling to define a mineral resource to NI 43-101 standards, and it is unclear whether additional drilling will define a mineral resource between Don and Don East deposits.

Drilling in the structural panel between XY West and Brodel deposits has also confirmed the presence of high grade zinc-lead mineralization and the potential for defining of a large, new zone of high grade mineralization. The expansion area covered is a minimum area of 600 to 650 metres by 200 to 250 metres with the favourable strata having an average thickness of 15 to 25 metres. Investors are cautioned that there has not been sufficient drilling to define a mineral resource to NI 43-101 standards, and it is unclear whether additional drilling will define a mineral resource between XY West and Brodel deposits.

MIDDLE DEVONIAN OIL SHALES IN THE CENTRAL MACKENZIE VALLEY – A NEW EXPLORATION PLAY IN CANADA'S NORTH

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During the past year excitement has been building in the Central Mackenzie Valley following the announcement and then conclusion this past June of the 2011 Federal Petroleum Land Sale. This Landsale saw 11 parcels, totalling almost 900,000 ha (2.2 million acres or 96 Alberta townships), awarded to five companies for a combined work commitment in excess of $534 million. MGM Energy Corp was one of the successful bidders, securing three of the 11 parcels for a total new land position of over 27 Alberta Townships.

What then created the excitement within the Central Mackenzie Valley that resulted in over $500 million dollars of work commitments? Underlying the majority of the land sale blocks is a thick, world-class Devonian-aged shale basin with excellent potential for producing oil from the shales. Two Devonian intervals within this basin, the Canol and Bluefish Formations, show significant potential for Shale Oil Resource. Geochemistry, petrology and sedimentology combined with regional seismic analysis have allowed for a comprehensive integrated geological review of the exploration potential of these shales.

Plans are now under way by the some of the successful companies for acquisition of additional regional seismic programs and for the drilling of one or two wells during the upcoming 2012-2013 winter drilling season. With encouragement from drilling these world-class shale formations, an exciting future may be in the cards for the Central Mackenzie Valley.

TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK)/INUIT QAUJIMAJATUQANGIT (IQ) & THE RESOURCE SECTOR

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A literature review was undertaken in an effort to demonstrate where TEK/IQ has been meaningfully incorporated into industrial development, specifically focusing on mineral development in the circumpolar Arctic, in the areas of baseline data collection, monitoring and closure planning.

The review resulted in 160 references that were compiled into a database and categorized as baseline, monitoring, closure, recommendations, science or other. This review helped to identify some of the reasons why TEK is not systematically and frequently integrated into

mining and resource operations in a meaningful way. Eight key challenges to the integration of TEK into northern resource developments discussed in the literature and experienced as practitioners were identified and will be discussed in more detail.

KEEPING THAIDENE NENE: THE NI HAT'NI DENE PROGRAM

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The Lutsel K'e Dene First Nation (LKDFN) has been a leader in the development and implementation of rigorous community-based monitoring programs. The First Nation has designed and initially implemented a major multi-year environmental monitoring program through the West Kitikmeot Slave Study (*Traditional Knowledge in the Kache Kue Study Region,* which morphed into the more comprehensive *Ni hat'ni – Watching the Land* program). Through this study, the LKDFN designed traditional indicators of environmental change, as well as a culturally-relevant mechanism for gathering, organizing, analyzing, and communicating data and results.

The Lutsel K'e Dene First Nation is in discussions with the Government of Canada to establish a protected area under the *Canada National Parks Act* in a portion of their traditional territory. This area is called Thaidene Nene, or "Land of the Ancestors" when translated from Denesoline. For the LKDFN, conservation of Thaidene Nene means preserving the integrity of a homeland fundamental to a cultural identity. Thaidene Nene is where the ancestors of the LKDFN laid down the spiritual, ethical, and practical foundations of the Dene way of life.

As the land keepers and hosts of Thaidene Nene, the LKDFN envisions implementing a program modeled upon the *Haida Watchmen Program*, as successfully developed and administered by the Haida Nation in Gwaii Haanas National Park Reserve and Haida Heritage Site. In this program, the Haida Nation stations trained members ("Watchmen") in culturally-important strategic locations throughout Gwaii Haanas during the spring and summer months. The *Haida Watchmen Program* has proved to be effective in improving visitor experience, protecting cultural sites from damage, and providing an opportunity for Haida youth to discover their heritage. The LKDFN would like to build upon this success in its own territory, and has begun doing so by developing and beginning the implementation of a *Thaidene Nene Ni hatn'i Dene Program*.

Thaidene Nene Ni hatn'i Dene means "Dene Watching the Land within Thaidene Nene". The program has the broad mandate to promote LKDFN stewardship of Thaidene Nene, and has the following specific goals: maintaining the integrity of cultural sites and the natural beauty within Thaidene Nene; hosting and providing interpretive tours for visitors in the area; monitoring and documenting visitor activity, cultural features, and environmental/wildlife values; and transmitting cultural and scientific knowledge to younger generations.

The LKDFN sees the *Thaidene Nene Ni hat'ni Dene Program* as a necessary successor to the West Kitikmeot Slave Study project, using already confirmed traditional indicators to again monitor environmental change in the territory of the LKDFN.

Gloria Enzoe and Stephen Ellis describe the program, its vision, purpose, and implementation, and the challenges, including financing, building and securing capacity, and making the monitoring meaningful to decision-makers.

COMMUNITY MONITORING OF THE GREAT SLAVE LAKE ECOSYSTEM: FIRST AND SECOND STEPS

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In 2010, Environment Canada and the Deninu Kue began the first steps in a community-based program designed to monitor change in Great Slave Lake and to provide training in standard monitoring techniques. Temperature and water clarity were monitored at three locations in Resolution Bay between early August and early September 2010 along with weather. A YSI instrument, Secchi disc, and GPS were used. While the sampling was brief, the data showed the cooling of bay waters through the late summer; water clarity remained low. While attempts were made to monitor into the fall, this did not work well as time was needed for the ice to form and then it proved difficult to sample through the ice. Therefore, the monitoring was done at the water intake over February and March: pH, turbidity, colour, temperature and conductivity were recorded. Water was very cold with no sign of warming. In addition, a domestic fish harvest survey was conducted between February and March. Whitefish followed by suckers dominated the catch. Interestingly, burbot and inconnu appeared in the catch towards the end of the survey: lake trout were not caught. A traditional knowledge survey also was conducted with questions asked about the water, the weather and the fish. The monitors also visited Environment Canada (Saskatoon) and learned calibration procedures, simple data entry and graphing. They also visited the University including the Toxicology Centre (where they saw large holding tanks with sturgeon and trout) and Native Studies. This study is continuing this year with conductivity added to the measurements of Resolution Bay waters including offshore of the Little Buffalo River which is salty. There have been challenges in conducting studies where the researcher and community members are so far way from one another including difficulties in addressing questions when instruments need to be calibrated again and in discussing the results. New ways are being explored for better communication including more frequent visits to Saskatoon and possibly using Skype™.

EXPLORATION IN THE NORTHWEST TERRITORIES: 2011

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The presentation will offer a review of industry activities in the Northwest Territories since the beginning of 2011. In the popular media, there is much excitement about the highly publicized exploration efforts in the territories adjacent to the NWT, with a rejuvenation of gold exploration and accompanying "Staking Rush" in the Yukon, and extraordinary advances in iron, diamond, and gold projects in Nunavut. In contrast, the news from the Northwest Territories has been much more muted with the challenges to exploration and mining receiving far more prominence; this should not be interpreted as a sign of little activity.

Claim staking has increased in new regions of the NWT and returned to areas where it has been absent for over 20 years. Regions that have seen recent lapses of significant acreages have, in turn, seen a surge in staked claims as new players pick up open ground. Even in regions where large portions of crown lands are engaged in land claim withdrawals, numerous option agreements and exchanges of ownership of grandfathered claims have occurred this year.

Drilling also has fared well in 2011. While the number of drills on the ground did not change dramatically from 2010, the established properties were all busy with multiple drills turning. Companies moving properties through the feasibility stage of exploration have expended large efforts to upgrade reserve

estimates in order to meet securities exchange compliance standards. These efforts were not restricted to a single commodity but represent lead, zinc, gold, diamonds and rare earth minerals.

No new mines were opened in 2011, but existing diamond and tungsten mines have reported productions levels to be comparable to pre-recession times. An additional measure of confidence can also be interpreted from increases in "on-property" exploration efforts and large investments in infrastructure. While the Northwest Territories seemed like a quiet place in contrast to its neighbours, there certainly was a stir of activity in 2011.

EAST-TRENDING THRUSTS IN LOWER PALEOZOIC BASINAL STRATA, AND A NEW VOLCANIC CENTRE(?) WITHIN THE MISTY CREEK EMBAYMENT (NTS 106B)

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In August 2011, a two-person crew mapped 37 km^2 in the northern Misty Creek paleo-embayment (MCE). Maps of the area published by the GSC are 1:250,000 scale preliminary drafts, and do not incorporate recent stratigraphic divisions. The Selma project (or Selwyn-Mackenzie shale basins project) was initiated to address these deficiencies and determine the economic potential of the MCE. The primary focus is the Lower Paleozoic rocks of NTS map sheet 106B (64-65ºN, 130-132ºW), which are prospective for shale-hosted Zn-Pb deposits, carbonate-hosted Zn-Pb±Cu deposits, and gold. NTS 106B is just east of the east-trending Rackla gold belt, and contains the Gayna River MVT deposit. The area is underlain by the same regional strata that host the Howard's Pass Zn-Pb deposit 200 km to the SSE.

Regional stream sediment geochemical surveys by NTGO in 2007 and 2008 revealed base-metal and Au anomalies as well as gold grains in heavy separates. Some of these results were followed up in 2009, which resulted in discovery of the Dap carbonate-hosted Cu-Pb-Zn showing. The area mapped in 2011 (parts of 106B/6, 106B/7) adjoins three watersheds that were partially mapped during the 2009 follow-up.

The current published map shows five units within the area mapped in 2011. Our new, preliminary map recognizes 10 formation-level units in the same area. The greatest differences arise from the subdivision of a single former unit (mapped as Road River Group) into the Middle Cambrian Hess River Fm. (black shale and thin-bedded lime mudstone), Cambro-Ordovician Rabbitkettle Fm. (silty limestone), Ordovician-Silurian Duo Lake Fm. (graptolitic to cherty shale, siltstone, and platy limestone), Early Silurian Cloudy Fm. (thin-bedded, finely crystalline limestone, bioclastic limestone, and black shale), and Early Devonian Hailstone Fm. (black shale with thick intervals of bioclastic limestone). A unit of limestone breccia and silicified coral rudstone that lies in the succession above Duo Lake Fm. and below Hailstone Fm. has not been identified yet.

Mafic flows and volcaniclastic rocks (tuff, sandstone, conglomerate, autobreccia) of Marmot Fm. are interstratified with rocks from Rabbitkettle to Cloudy formations. The Marmot Fm. also includes sills, dykes, and diatremes; examples of the latter two were previously identified on the outskirts of the mapped area. The large volume of coarse, poorly sorted volcanic conglomerates with limestone and fossil clasts suggests that the area may preserve a volcanic centre.

The strata are in very tight, NW-trending, subvertical folds. Regional faults also trend NW. A major, E-striking, N-verging thrust fault repeats Rabbitkettle, Marmot, and Duo Lake formations in the southern part of the area. A second, E-striking thrust to its north is suspected to place Marmot over Marmot Fm. These structures are highly prospective for mineralization. The northern structure is adjacent to a 7 km-long, NW-trending magnetic

anomaly covered by Marmot Fm. volcanic rocks.

A preliminary bedrock map and assay results will be published in early 2012, as well as maps and data for a radiometric and magnetic survey commissioned by NTGO over much of 106B. Next season, pending sufficient funding, the bedrock map will be refined and expanded.

MONITORING THE CUMULATIVE IMPACTS OF HARVESTING DOLLY VARDEN (*SALVELINUS MALMA*)

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The subsistence harvest of anadromous Dolly Varden is an important cultural activity for the Inuvialuit and Gwich'in peoples in the Northwest Territories (NT). Dolly Varden is a species of fish that have variable life histories including anadromy whereby seasonal migrations between freshwater and marine ecosystems are undertaken. Dolly Varden spawn and overwinter in short stretches of rivers fed by perennial ground water springs that remain ice free during the winter. In Canada (NT and Yukon), there are six confirmed anadromous populations originating from rivers west of the Mackenzie River Delta. Currently, the majority of anadromous Dolly Varden in Canada are harvested during the summer along the Beaufort Sea coast, and in the fall in the West Channel of the Mackenzie River Delta, and the lower reaches of both the Rat and Peel rivers.

There have been declines in abundance observed in two of the six populations of Dolly Varden. The causes of these are unclear but are probably linked to the combined impacts of changes in habitat and harvest. The population dynamics of Dolly Varden are poorly understood including the interactions among natural mortality, changes in overwintering habitat relative to carrying capacity, and the effects of harvest on abundance. An uncertainty in evaluating the effects of harvest on populations is the relative contributions of each population to the mixed-stock fishery along the Beaufort Sea coast. In response to the creation of an Integrated Fisheries Management Plan and the listing of Dolly Varden as a 'species of special concern' by the Committee of Endangered Wildlife in Canada, DFO has initiated a comprehensive population assessment program for Dolly Varden with the goals of estimating population abundance, collecting biological and life history information, and determining harvest levels. Implementing a comprehensive harvest monitoring programs for the coastal fishery is a critical component in this approach.

Funding was provided by the Cumulative Impact Monitoring Program for the initiation of a harvest monitoring program during summer 2011 at Shingle Point, YT, an important fishing area for residents of Aklavik, NT. The objectives of the program are to determine the harvest levels and collect biological data from all harvested species, and obtain information to better understand the mixed-stock fishery for Dolly Varden using tag returns, fin clips for genetic stock discrimination, and otoliths to determine whether their elemental composition can be used to discriminate among stocks. The results from this program will be linked to harvest monitoring programs at Herschel Island and in the Mackenzie River Delta (Rat River). The results of these studies will inform the decision making process for co-management of Dolly Varden and assist in determining the cumulative impacts of harvest and environmental changes on this species.

CORRELATING MID-CRETACEOUS STRATA IN THE CANADIAN HIGH ARCTIC USING PALYNOLOGY

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Quantitative palynological analyses undertaken on the mid-Cretaceous Hassel Formation of Sverdrup Basin and reputedly equivalent rocks from Eclipse Trough, about 850 km east, provide convincing evidence that they are coeval and of Late Albian to Cenomanian age. We base this conclusion on statistical definition of two palynomorph populations that occur in both spot samples from Eclipse Trough and in samples from Ellef Ringnes Island in the central Sverdrup Basin and correlation to previously reported palyno-assemblages from North America. By applying ordination techniques, we demonstrate that the range of variability of palynomorph composition of samples from reputed Hassel Formation in Eclipse Trough are within the range of variability defined for samples from Hassel Formation, Ellef Ringnes Island. However, because it remains unknown whether the mid-Cretaceous basin was a continuous feature linking the western and eastern Canadian Arctic regions, we continue to consider the reputed Hassel Formation of Eclipse Trough as stratigraphically and genetically distinct from the Hassel Formation of Sverdrup Basin.

Comparable proportions of dicotyledonous angiosperm pollen characterize samples from both localities, but diversity and relative abundance are lower in both of the Canadian Arctic deposits than in more southern Middle and Late Albian to Cenomanian-aged rocks of North America and macrofloral evidence of diverse angiosperm-dominated mid-Cretaceous communities in northern Alaska and northeastern Asia. To explain this, we propose that restricted angiosperm diversity and continued dominance of gymnosperms and ferns into the Cenomanian in the Canadian Arctic reflected barriers to migration, such as the Western Interior Seaway, or the existence of relatively cool continental climate conditions.

ADVANCING EXPLORATION THROUGH WEB PORTALS

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Publicly available websites such as the Northwest Territories Geoscience Office (NTGO)'s NT GoMap, NT GoData and Gateway provide valuable tools for advancing geoscience knowledge of the Northwest Territories. The NTGO web applications can be accessed from http://www.nwtgeoscience.ca/ and enables users to discover, search, display, and download mineral occurrences (Showings), publications (References), digitally submitted geophysical and geochemical metadata (G-Meta), diamond sample data (Diamonds), kimberlite anomaly and drillhole data (KANDD), and surficial material geochemistry data (Till). Web portals are most valuable when the data they provide is comprehensive and current and if the portal evolves to meet the changing needs of users.

A large collection of Geographic Information System (GIS) data and geoscience-related information form the backbone of the NTGO web portal and are continually collected and compiled from field observation, research, analysis, and organized into themed collections. This past March, DPRA developed a mechanism to incorporate KANDD spreadsheets into the NTGO's data warehouse - a relational Oracle database which eliminated the arduous task of data compilation and production of NTGO publications. The mechanism allows rapid and timely updating of the databases and facilitates public distribution and dissemination of these databases via the NTGO web portal. In June, DPRA designed the TILL database within NTGO's data warehouse. TILL compiles sample

location, geochemical analysis, and sample media data for the Northwest Territories and has been initially populated with over 16,000 geochemical analyses obtained from publicly available mineral assessment reports. For KANDD and TILL data collections DPRA defined a data conversion methodology and developed automation tools for converting KANDD and TILL spreadsheet data to an Oracle relational database and populated the database. Detailed custom reports on the status of data conversion, errors encountered, and tracking reports showing the data set records in a standardized format were also developed. The final component was developing a relational data management system for archiving and accessing these data, and entering new data as required from Excel spreadsheets, including a spatial component consisting of points suitable for use in the map-based web query tool NT GoMap.

DPRA has continued to enhance NTGO's web applications to handle changing user requirements and newer technologies. To accommodate users that do not have broadband service, DPRA designed and developed NT GoData, the newest addition to NTGO's web application suite. Similar to NT GoMap in functionality but without the robust mapping interface, NT GoData provides the user with the ability to search, view and download, free of charge, information from NTGO's data warehouse while eliminating the requirement for broadband speeds.

DPRA has also worked with other federal and provincial agencies in the Northwest Territories, Nunavut and the Yukon to develop and implement websites for both public and internal use that assist in streamlining the regulatory process. These websites include document management systems that provide a central repository for storing, searching and retrieving documents along with regulatory process management systems to assist agencies in managing and processing regulatory related data. For further information on DPRA's broad range of consulting services please visit http://www.dpra.ca.

NOT ALL PROTECTED AREAS ARE THE SAME: A GUIDE TO MULTIPLE PROTECTED AREAS PROPOSALS IN THE NWT

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Protected areas are a key part of a sustainable future. But there is a broad range of what 'protected area' means in the NWT. Federal and territorial legislation and land claim agreements can be used to establish protected areas. The degree to which commercial development, such as oil and gas exploration and activities, forestry, sports hunting, or mining, is allowed will depend on the values being protected, the type of protected area established and its management plan.

The NWT Protected Areas Strategy (PAS) is one of the main processes for identifying, assessing and establishing protected areas in the NWT. The PAS process is being used for areas considered for protection under the *Canada Wildlife Act,* NWT's *Wildlife Act,* and the *Territorial Parks Act*. National Parks/Park Reserves proposed under the *Canada National Parks Act* and conservation zones proposed in regional land use plans can also add to the network of protected areas.

There are two similarities with all the protected areas designations. First, all areas respect Aboriginal rights. Second, values other than economic ones have been identified as being worthy of protection. After that, there is much potential variation in the designations and areas themselves. Tourism use and promotion, management intensity, and the degree areas are to remain natural or developed can all vary by agency mandate. Even within one designation, differences in the degree of development are possible.

Only the *Canada National Parks Act* combines surface and subsurface ownership and administration under one agency. Gwich'in conservation zones can combine various land

ownerships, but the designation is very restrictive on all development, no matter who the owner.

All other designations and legislation refer only to surface administration, so the subsurface administration remains to be determined in each case.

Management plans are not required for territorial designations (though encouraged), required by policy for National Wildlife Areas, and required by legislation for National Parks.

The PAS outlines an 8-step process guiding identification, assessment and creation of protected areas. The process is designed to be flexible. The path taken by each identified area may be slightly different, depending on where it is located and who is involved. The end product, an established and managed protected area, will be unique in each case. Hence involving stakeholders throughout the process is important.

The NWT-Nunavut Chamber of Mines and Canadian Association of Petroleum Producers are members of the PAS Steering Committee, which guides the implementation of the PAS. Those groups, and mining and oil and gas companies, are also invited to be on each PAS candidate working group. The working groups consult with communities, industry and the public throughout the process. They oversee assessment reports to better understand the cultural, ecological, and economic values of the area. The working groups make recommendations to the sponsoring agency as well as responsible Aboriginal, federal, and territorial government agencies on the final boundary and designation, as well as how the area should be managed. Industry, communities and the public are encouraged to participate throughout the PAS process.

DIAVIK WASTE ROCK PROJECT: GEOCHEMICAL AND MINERALOGICAL CHARACTERIZATION OF WASTE ROCK WEATHERING AT THE DIAVIK DIAMOND MINE

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Weathering of sulfide minerals contained within mine waste rock has the potential to generate acidity and produce elevated concentrations of metals within drainage waters. As mining activities in the north continue to expand, understanding the generation of these waters is increasingly important. This study focuses on the mineralogy of weathered sulfide mineral assemblages in waste rock, and the corresponding geochemical response measured in drainage waters from experimental waste rock piles at the Diavik diamond mine (Diavik).

Diavik is located 300 km northeast of Yellowknife, NT on a 20 km^2 island in Lac de Gras, which lies in the continuous permafrost region. Over the course of mine life, the operation is expected to generate a 120 Mt waste rock stockpile on surface. Diavik waste rock is segregated based on sulfur content into Type I (< 0.04 wt. % S), Type II (0.04-0.08 wt. % S) and Type III (> 0.08 wt. % S). The geochemical differences between effluent waters from Type I and Type III experimental, instrumented waste rock test piles (15m in height by 60m by 50m) will be discussed. The geochemical response of a third test pile was also examined. This test pile was constructed based on a reclamation concept which consists of a Type III core covered with a 1.5 m layer of lower permeability glacial till and a 3 m layer of non-acid generating Type I waste rock.

Thin sections of samples of the Type I and Type III waste rock were examined using optical microscopy and scanning electron microscopy (SEM). SEM images and mapping show the development of oxidation rims on many of the pyrrhotite grains seen in biotite schist xenoliths contained in Type III waste rock. A selection of samples showing visibly weathered grains was also analyzed at the Advanced Photon Source at the Argonne National Laboratory in Argonne, IL using µ-XRF and µ-XRD techniques. Correlations between the mineralogical and geochemical analysis will aid in understanding the effects of Arctic climatic conditions on stockpiled waste rock.

HYDROCARBONS IN THE WESTERN CANADA SEDIMENTARY BASIN – LESSONS FOR THE NORTH

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Access to data is critical for the analysis of basins for exploration and development purposes. Fluid data are often not available for inclusion in such analyses. The ERCB provides such data on a well-by-well basis and these data permit some novel approaches in support of regional and prospect studies. Well density in the North is considerably less than that in Alberta but an awareness of what can be done is quite useful.

Regional maps of API Gravity, Density of Raw Gas, Cumulative Production and Estimated Reserves-in-Place of hydrocarbon fields and producing wells by stratigraphic horizon are examples of useful maps. For example, if you had never drilled a well in Western Canada deeper than the Cretaceous to this point in time you could have discovered every Devonian reef belt by making an API Gravity map and a Raw Gas density map of the Mannville equivalents. The gas maps are less definitive than the oil maps but they still reflect structural relationships. Fluids reflect structure whereas Production and Reserves reflect facies to significant degree. These two maps can display significantly different patterns but provide very useful understanding of fluid movements. Similarly if structure is the dominant control on the migration of hydrocarbons such maps will identify that fact. These data can be integrated with gravity and magnetic data to determine coincidences and to extend mapping beyond the limits of the well data themselves.

Why does this happen? Carbonates in the WCSB and penecontemporaneous structure acted as rigid bodies over which compaction drape of younger sediments occurred. Even subsequent deposition was affected by concurrent structural growth which may have resulting in facies character differences and distributions. For example, Viking API Gravity data identify the Devonian reef belts but it is well known that Viking production occurs in NW-SE linear trends. What has previously not been recognized is a cyclicity of Viking production (low volume to high volume cycles) for the individual trends and the relationship of the cycles to the deeper Mississippian subcrops. Such information provides the opportunities to predict potential conventional and unconventional exploration possibilities when the mapping incorporates the element of time relative to exploration trend growth.

Application of the concepts to regional assessment of the Denver-Julesburg Basin, where drilling has been minimal deeper than the Cretaceous, has identified the Basin's deep failed-rift structure and has laid the basis for additional exploration. Application of the concepts to the deep water Ramsey Sand oil fields in the Delaware Basin made possible the development of a depositional model for the fields and suggested further prospect possibilities.

The character of hydrocarbon shows fits the regional distribution of the API of the oils and the Density of the raw gas. As a result there is often much more information regarding the fluids than initially meets the eye. These

concepts can be applied in the NWT in the extensions of the WCSB.

BOWHEAD WHALE RESEARCH AND SEISMIC MITIGATION IN THE SE BEAUFORT SEA, 2007-2010

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The bowhead whale (*Balaena mysticetus*) is a large, long-lived Arctic baleen whale. Bowheads of the Bering Sea population winter in the Bering Sea, and migrate annually to summer feeding areas in the Canadian Beaufort Sea and Amundsen Gulf. The stock is recovering from decimation by commercial whalers during 1848 to 1914, prior to which the stock is estimated to have 18,000. The current best estimate of stock size is 10,470, based on a census conducted in 2001.

Over the past decade, there has been renewed interest by the hydrocarbon industry in the Canadian Beaufort Sea, which has included marine seismic surveying in 2001-2002, and 2006-2010. The Marine Mammal Observer (MMO) program is the core approach used by industry for mitigating potential impacts of seismic underwater noise on whales of the Beaufort Sea. This involves trained, on-board observers invoking a shutdown of seismic operations if whales enter the prescribed Safety Zone. While the MMO program is effective during periods of good visibility, it was clear to all stakeholders that further measures were needed for periods when visibility was poor or nil during frequent periods of darkness, high sea states and/or fog.

While on their summer range, bowheads must seek out areas where oceanographic conditions concentrate their planktonic prey (crustaceous zooplankton), in order to meet their annual energy requirements. This well known behaviour of bowheads to aggregate during feeding, and a real-time knowledge of aggregation areas they use in a given season, are fundamental to a 'region-specific' component of the mitigation strategy now in place in the Canadian Beaufort Sea. Systematic aerial surveys were designed and conducted in August 2007-2010, to delineate feeding areas used by bowheads, on a regional, near real-time basis. Spatial and temporal restrictions around these important habitats were then developed and reviewed/agreed to by stakeholders (community representatives, co-managers, regulators, industry), with the main objective being to avoid the conduct of seismic surveys within bowhead feeding areas during times of poor visibility for the MMO's. Outside of the whale aggregation areas, migrating whales are still encountered, and standard national mitigation practices still apply. In many respects, this 'two-tier' strategy has allowed the conduct of seismic surveys in areas of the Arctic where the short operational season could have otherwise prevented it.

In August 2007-2010, we conducted region-wide systematic aerial surveys over the Beaufort Sea, to document the distribution and relative abundance of whales, and also worked on a cooperative project with Alaskan scientists and hunters to deploy satellite transmitters on bowheads to monitor the movements of individual whales. These studies contributed new scientific data for the seismic mitigation strategy, as well as addressing a range of other scientific objectives. Our results and how they were used in the seismic mitigation strategy will be presented.

CONSTRAINTS ON EMERALD MINERALIZATION IN THE MACKENZIE MOUNTAINS: DIRECT EVIDENCE FOR A MAJOR PALAEOZOIC FLUID-FLOW EVENT

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The majority of the world's emerald deposits are formed by the introduction of Be-rich fluids to Cr (±V)-rich host rocks, and can be classified into two major categories: type 1 emerald deposits are associated with granitic or pegmatitic intrusions into mafic or ultramafic host rocks, and type 2 deposits are formed in upper greenschist to amphibolite facies metamorphic environments coincident with major crustal breaks (ie. shear zones and thrusts) and metasomatism. A sub-type of type 2 emeralds, typified by the deposits of Colombia, involves the in-situ mobilization of hydrothermal sulphate brines to liberate and transport Be, V, and Cr in organic-rich black shales. The Mountain River emerald occurrence in the Mackenzie Mountains appears to have few geological similarities with the aforementioned models.

Emerald mineralization at the Mountain River occurrence in the Northwest Territories is associated with extensional quartz-carbonate veins hosted within organic-poor deepwater sandstones and siltstones of the Neoproterozoic Windermere Supergroup. The section hosting the veins is located within the hangingwall of a thrust fault that emplaced Neoproterozoic siliciclastics above Paleozoic carbonates. There exists no local evidence of felsic igneous activity or significant regional metamorphism. Hydrogen isotope compositions of water extracted from emerald range between -65‰ and -49‰ (V-SMOW). $\delta^{18}O_{V\text{-}SMOW}$ values for emerald and quartz range between 16.2‰ and 17.2‰, and 17.9‰ and 18.9‰, respectively. One dolomite sample returned a $\delta^{18}O_{V\text{-}SMOW}$ value of 18.1‰. Temperature of mineralization was determined by mineral pair $\delta^{18}O_{V\text{-}SMOW}$ equilibration (quartz-emerald, quartz-dolomite) to be in the range 379 to 405°C. Fluid inclusion analyses indicate saline (20 wt% NaCl equivalent) CO_2-bearing brines and homogenization temperatures between 200 and 250°C. Combining fluid inclusion isochores with isotope equilibration temperatures indicates fluid pressures on the order of 2.0 to 4.5 kbar, which correspond to depths between 6 and 12 km. Euhedral pyrite intergrown with emerald yields a Re-Os model 1 isochron age of 345 ± 20 Ma.

Isotopic, fluid inclusion, and geologic data indicate the Mountain River emeralds formed from non-magmatic fluids and are genetically most similar to the Colombian-type emerald mineralization model. We hypothesize that emerald formation resulted from the circulation of hydrothermal brines through basinal siliciclastic, carbonate and evaporitic rocks, scavenging Be, V, and Cr, during the late Paleozoic. The age is coincident with that of extensive base-metal mineralization throughout the northern Cordillera (carbonate-hosted lead-zinc, sedimentary exhalative and volcanogenic massive sulphide), and provides further and direct evidence for a large-scale hydrothermal brine movement event during the Late Devonian to Early Mississippian. Fluid movement may have been related to tectonic activity associated with the development of a back-arc basin.

INFLUENCE OF ENVIRONMENTAL CONDITIONS ON BELUGA WHALE ENTRAPMENTS IN THE HUSKY LAKES, NWT: BASELINE DATA FOR PREDICTION AND MONITORING

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Beluga whales (*Delphinapterus leucas*) from the Eastern Beaufort Sea (EBS) stock summer in the

Canadian Beaufort Sea, with many moving into Liverpool Bay in late July or early August, and occasionally as far inland as the Husky Lakes system. Belugas normally begin their westward fall migration to the Bering Sea by mid-August to early September, but some occasionally become entrapped in the various basins of Husky Lakes if they do not depart prior to freeze-up. Whales have become trapped in the Lakes seven times since the 1960s, with at least one event every decade (twice in the 1960s and 2000s). The EBS beluga stock is healthy, and entrapment-related mortality is not a conservation concern at the present time. The whales are an important cultural and nutritional resource of the Inuvialuit of the Western Arctic, and there is interest in understanding the conditions under which entrapments occur, to improve monitoring and guide management decisions. Research on the conditions leading to entrapment events is being undertaken to provide predictive capability and augment monitoring plans.

Models will examine the possible relationship of sea ice, weather and climate patterns on past beluga whale entrapment events, with the objective of being able to predict the likelihood of future entrapments. This requires a baseline of the environmental conditions generated through analyses of long-term time series. We are starting with characterization of long-term patterns in weekly sea ice concentration in the Mackenzie delta region (May to October, 1968-2010), weekly ice thickness at Tuktoyaktuk and Inuvik (1971-2010 with gaps), and monthly mean and minimum air temperature at Tuktoyaktuk (1957-2007). Time series analyses of these readily accessible archive data provide a general description of the baseline environmental conditions and will guide additional analyses, data collection, and modeling. The ice concentration data for the Mackenzie delta region provide a time and cost-effective way to determine if more detailed analyses are warranted. Inuvialuit elders have suggested that there may be a relationship between spring ice conditions in Liverpool Bay and fall entrapments in the Husky Lakes. Spatial ice cover data can be used to examine the influence of landfast ice cover on whale use of Liverpool Bay, and the regional data may provide guidance as to key temporal periods to examine. Ice conditions within the lake system are likely a critical factor, and analyses of satellite images will be used later in the project to provide information on sea ice in the lakes on a finer scale. Our hypothesis is that entrapments occur when sudden changes in air temperature result in unusually rapid freeze-up. Temperature data are available at different temporal scales (hourly, daily, etc.), and additional research can be conducted at finer temporal scales to link spatiotemporal variation in fall freeze-up to variation in air temperature, which would assist in monitoring by simplifying data collection needs.

SULPHUR ISOTOPE PROFILES OF THE FRANKLIN SILLS AND DYKES IN THE MINTO INLIER, VICTORIA ISLAND

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The Neoproterozoic Minto Inlier on Victoria Island contains the ca. 723 Ma Franklin intrusives. These diabasic to gabbroic sills and dykes are part of a large igneous province that also includes the Natkusiak flood basalts on Victoria Island, the Coronation sills and Brock Inlier on the mainland, and dyke swarms extending to Baffin Island. The intrusive complex is sill-dominated, with thicknesses ranging between several to 100m thick. A number of dykes and feeder complexes are located along syn-magmatic NNW-trending normal faults with minor E-side down offsets. The intrusives pass through a variety of host sedimentary rocks within the Shaler Supergroup including black shales, carbonates, sandstones and evaporites.

The Franklin intrusives have been macroscopically compared to those in the Noril'sk region of Russia, which contain large

basal deposits of Ni, Cu and PGE. The assimilation of crustal sulphides from organic-rich sedimentary rocks and sulphates from evaporites likely triggered the formation of these deposits. Sulphur isotopic examination of the Franklin Sills can help make this comparison more robust. In addition, sulphur isotopes are critical to understanding how fractional crystallization, assimilation, degassing, and diffusive exchange may have affected the chemical evolution of the Franklin intrusive complex. Quantifying these processes will also lead to better modelling of sulphide immiscibility and transport and therefore better mineral exploration strategies.

Samples collected from a dyke profile through limestone and 2 sill profiles through black shale and calcareous shale reveal different intrusive-host rock sulphur exchange systematics in the dyke compared to the sills. The sills intrude black shales and calcareous shales with $\delta^{34}S$ values between +2 and +9‰ and –8 to -10‰, respectively, yet have $\delta^{34}S$ values in a narrow range from +3.2 to +4.0‰. The dyke intrudes limestones with $\delta^{34}S$ values between –27 and +6‰ and has $\delta^{34}S$ values between –0.1 and +4.1‰. This implies that dykes are the zones with the greatest degree of country rock sulphur contamination, which could lead to sulphide immiscibility in the melt and make these potential mineral exploration targets.

A profile for a thin 5m thick sill intruding evaporites was also sampled. The host evaporites have $\delta^{34}S$ values between +15.9 and +16.2‰ and the sill had elevated $\delta^{34}S$ values between +11.4 and +12.9‰ but not at the very base of the sill. This means that some sulphate assimilation by the sill has occurred. Whether this occurred *in situ* from processes such as roof stoping or whether this occurred downstream in a feeder dyke is unclear, but the addition of significant amounts of sulphate to the melt is an important factor in causing sulphide immiscibility and the formation of orthomagmatic mineral deposits.

PROJECTIONS OF RELATIVE SEA-LEVEL RISE FOR THE NORTHWEST TERRITORIES AND NUNAVUT

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We present projections of relative sea-level rise in the 21st century for communities and existing and proposed resource ports in the Northwest Territories and Nunavut. The work is being carried out in the Coastal Infrastructure Project of the Earth Sciences Sector Climate Change Geoscience Program of Natural Resources Canada. Building on previously reported work for a small number of Nunavut communities, we determine the sea-level fingerprinting response from Antarctica, Greenland, and mountain glaciers and ice caps. Then, for various published projections of global sea-level change in the 21st century, we determine the local amount of "absolute" sea-level change. We next determine the vertical land motion arising from postglacial rebound (PGR) and incorporate this into the estimates of absolute sea-level change to obtain projections of relative sea-level change. The sea-level fingerprinting effect is especially important in northern Canada owing to the relative proximity to Arctic ice caps and especially to the Greenland ice sheet. Its effect is to reduce the range of projected relative sea-level change compared to the range of global sea-level projections. Vertical crustal motion is assessed through empirically derived regional isobases. Some Nunavut communities, where the land is rising rapidly, have large amounts of projected sea-level fall. For example, the sea-level projection for the community of Arviat on the west coast of Hudson ranges from 70 cm of sea-level fall to 25 cm of sea-level rise by the year 2100. In contrast, vertical land motion in coastal regions of the NWT features subsidence,

or, at most, small amounts of uplift. This leads to sea-level projections that predominantly feature sea-level rise. For example, the sea-level projection for Tuktoyaktuk ranges from about 20 cm to one meter of sea-level rise by the year 2100. The anticipated impacts of sea-level change depend on the magnitude and sign of the sea-level change and range from continued shoaling (shallowing) for sea-level fall to increased susceptibility to storm surges and inundation for large amounts of sea-level rise. Other climate change factors, such as increased air and water temperatures leading to permafrost thaw, and increased wave energy impinging shorelines due to increased storminess and reduced sea-ice extent, may have substantial impacts on coastlines and coastal infrastructure and they also require consideration.

CURRENT NORTHERN LAND USE RESEARCH FOR DECISION-MAKING

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Northern land use managers require scientific information to make informed decisions about land use practices. In addition to baseline environmental monitoring, research that tests and evaluates land use practices is directly applicable to decision making. AANDC, as a northern regulator with a mandate to support arctic science hosts some of the north's limited science capacity. As such, AANDC is uniquely positioned to catalyze and carry out focused monitoring and research that supports northern regulatory needs.

Scientific research to support northern land use decision making was initially conducted in the 1970's through the Arctic Land Use Research Program, funded by AANDC. The results were used to craft standard land use permit conditions and northern land use guidelines. Though northern land use practices have continued to evolve with practical experience, relatively little research has been conducted in recent decades. The current pace of environmental and technological changes in the north suggests that ongoing research is urgently required. For example, new equipment and land use methods continue to be introduced, and climate change has in many cases altered the environmental conditions upon which standard land use practices were based. In addition, the long term environmental impacts of land use practices that have been in use for multiple decades require evaluation.

Over the past 4 years, AANDC has initiated several scientific studies to address questions specific to northern land use practices: In the Mackenzie Delta region, variability of active layer freezeback has been studied to support decisions with respect to the timing of winter overland vehicle access. Results show that freezeback dates vary by over a month between sites. A field-scale experiment was conducted to test the effectiveness of shrub removal on the maintenance of frozen conditions in historical drilling-mud sumps. Removal of the shrubs caused snow cover to decrease and had an immediate cooling effect on the sump cap. These studies were intentionally designed to provide results that will inform land use decision making.

ENVIRONMENTAL CONTROLS ON ACTIVE-LAYER FREEZEBACK IN CONTINUOUS AND DISCONTINUOUS PERMAFROST OF THE SLAVE GEOLOGICAL PROVINCE, NORTHWEST TERRITORIES

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The timing and duration of active-layer freezeback has important implications for northern land-use planning. Environmental disturbance due to overland travel, construction, and drilling is minimized when the active layer is frozen. Water and contaminants can migrate through the active layer when it is thawed or

partially frozen. The ability to predict where and when the active layer will freeze is of great use to regulators, and requires an understanding of the environmental conditions that control freezeback. This study assessed active-layer freezeback in three study areas near Yellowknife, Colomac, and Ekati, Northwest Territories. The Yellowknife and Colomac study areas lie south of treeline in the discontinuous permafrost zone, whereas Ekati lies north of treeline in the continuous permafrost zone. Air, ground surface, and permafrost temperatures were measured for two years at 24 peatlands in these study areas. Vegetation, snow, and soil surveys were conducted to determine the environmental controls of freezeback.

During freezeback, the ground and surface cannot cool substantially in response to declining air temperatures because latent heat is released in the active layer. At all sites, freezeback was characterised by daily mean surface and active-layer temperatures between 0 and -5 °C, and temperatures at the top of permafrost just below 0 °C. Once the active layer had frozen, sensible heat rather than latent heat was released and the ground cooled rapidly. The duration of the freezeback varied north and south of treeline. North of treeline in continuous permafrost, freezeback began before snow cover developed in September, took between 50 and 80 days to complete. South of treeline, the beginning of the freezeback period coincided with the first substantial snowfall in early October and took at least 70 days. At several sites south of treeline active-layer freezeback continued throughout the winter. In 2005-06 when the annual mean air temperature was 4 °C higher, freezeback lasted only 3 to 18 days longer at Ekati, but was 7 weeks to 4 months longer south of treeline.

In the past, snow cover has been invoked as the principal factor responsible for spatial variation near-surface temperatures. Indeed, there is a significant relation between snow depth and freezeback duration across all the study areas in the Slave Province, however the relation is scale-dependent. Snow cover controlled the spatial variability of freezeback duration north of treeline where snow was thin, but not in the boreal forest where snow was thicker. Instead, active-layer wetness controlled the spatial variability in the freezeback duration in the south because the thick snow covers there provided a spatially uniform and generous insulation. As a result, variation in freezeback duration was dependent on the water content of the active layer. Like the relation between freezeback duration and snow depth, the relation between freezeback duration and total active-layer water was scale dependent with a significant correlation across the Slave Province, but not at sites north of the treeline.

OVERVIEW OF ACTIVITIES, NORTHWEST TERRITORIES GEOSCIENCE OFFICE

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The Northwest Territories Geoscience Office (NTGO) is a partnership between Aboriginal Affairs and Northern Development Canada and the Department of Industry, Tourism and Investment. This federal – territorial collaboration is now in its second decade and allows the provision of provincial-style public geoscience services for the NWT. Some of these services are enhanced by the participation of external research partners. NTGO work and research directions are guided in part by feedback from an external technical advisory committee. The office has also recently completed a five-year strategic plan.

This presentation highlights a number of current activities. NTGO's Petroleum Group is studying the Mackenzie Plain area of the central Mackenzie Valley. This conventional oil-producing region has recently attracted considerable attention from exploration companies and may host unconventional resources. A broader assessment of NWT unconventional petroleum potential has also been recently published. The Minerals and Bedrock Mapping Group is currently active in

the Mackenzie Mountains, Wopmay Orogen, Slave Province, and on Victoria Island as part of a Geological Survey of Canada project. Studies range from regional bedrock mapping to detailed evaluation of mineral occurrences. A number of university-based partners are involved in, or are carrying out, some of this work.

NTGO also conducts non-renewable resource assessments for the NWT Protected Areas Strategy. Several mineral resource studies are underway in the Mackenzie Mountains and southern NWT. Environmental geoscience projects, in particular permafrost- and ice road-related studies, are also gaining a foothold at the NTGO as capacity expands in this area. All of NTGO's field-based activities are underpinned by public outreach efforts. Geoscience education initiatives also occur throughout the year.

Information management and services staff continue to play a vital role in addressing client needs and improving our collections. The Geomatics and IT Group similarly provide essential services to both staff and clients. NTGO activities are financed by both the federal and territorial governments, with significant project funding support from the Canadian Northern Economic Development Agency.

NWT Centre for Geomatics – Online Maps, Viewer, and Data

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The NWT Centre for Geomatics (NWTCG) provides geomatics services to the Government of the Northwest Territories and offers online geospatial products and services for the public. NWTCG is launching a new website designed to allow easy access to our geomatics services. The new website will be used to demonstrate the variety of maps, data and services that can be accessed online through the NWTCG.

The NWTCG website has been updated to reflect our new geospatial data infrastructure to give both GNWT employees and the public greater access to our services. The website allows the user an easy way to explore, visualize, and share GIS information. The website helps deliver authoritative GIS data to a broad audience.

With our website, we will demonstrate how you can
View, save and print current NWT maps
Access ready-to-use web mapping services
Fuse GNWT spatial data with map services to create custom maps
Download current NWT datasets
Use newly updated Map Viewers and other spatial tools such as NWT Discovery Portal
Access links to external data sources

There are a number of new and interesting products and services currently being offered by the NWTCG through our new website. Our demonstration will showcase how users can make the most of the variety of different ways that they can access, connect, and manipulate the data for their own needs.

Using Multidisciplinary Approaches to Investigate the Cumulative Impacts of Landscape Change on Terrestrial and Aquatic Ecosystems, Peel Plateau, NWT

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Vast areas of the Northwest Territories are underlain by ice-rich permafrost. These

environments have the potential to undergo dramatic modification in response to climate change. Detecting landscape change in these ecosystems and investigating their potential impacts on infrastructure are critical in developing planning adaptation strategies.

In this paper we describe a multidisciplinary approach investigating the remarkable changes impacting the landscape and rivers of the Peel Plateau in the northwestern NWT. This is an area of cultural and ecological significance, and may be one of the most rapidly changing landscapes in Canada. A collaborative research and monitoring program amongst governments, academic researchers and the Tetlit Gwich'in was initiated in response to community concerns and scientific interest related to the discovery of massive areas of permafrost thaw slumping. These "mega slump" disturbances have created crater like scars up to 50 ha in area and debris flows up to several km in length, which have infilled numerous stream valleys. In addition to monitoring the distribution and growth of these disturbances, the research team is evaluating ecological, hydrological and geochemical impacts to these streams and rivers. Since these stream catchments contain Char spawning and overwintering habitat, a component of the research has also focused on monitoring known fish spawning areas. Baseline monitoring sites maintained by Environment Canada's hydrometric and water quality network, and more recently permafrost and vegetation monitoring sites established in collaboration with the Tetlit Gwich'in, provide valuable context for ongoing and future research initiatives.

Multidisciplinary, regionally relevant and locally informed efforts are required to build a knowledge base sufficient to support the monitoring of cumulative impacts and informed northern decision making. The multidisciplinary approach implemented here has enabled our team to better understand the causes of increased slumping and the cumulative impacts that these changes have on physical and biological systems. By working closely with the community, local observers have provided real time observations, ensuring that additional disturbances are detected rapidly and potential ecosystem impacts are identified. The involvement of local governments and Renewable Resource Councils allows the project team to fine-tune project details to ensure that we are still asking the "right" questions. Linkages between the mutlidisciplinary research team and regulators, planners and ongoing planning initiatives (e.g.: Gwich'in Water Summit) allow for the continual flow of information between knowledge generators and information users and cuts down on duplication of consultative effort.

Developing and maintaining multidisciplinary teams come with several challenges. These include: a) managing a broad range of mandates and objectives; b) the time and effort required to capitalize on potential synergies; and c) clarifying the roles and responsibilities of team members. From a northern perspective the complexity of cumulative impact issues and the urgency to monitor and understand impacts of environmental change make multidisciplinary partnerships essential. Keys to success include the commitment of project partners, a focus on activities which relate directly to generating knowledge and the capacity to provide strong leadership from northern partners at the community and scientific levels.

DIAMOND EXPLORATION IN OROGENIC SETTINGS: LESSONS FROM WAWA METACONGLOMERATE

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Many alluvial diamond suites are found in off-cratonic tectonic settings (e.g. Kalimantan, SE Australia, Yukon, Burma, Sumatra, Ural, Vietnam). These diamonds are found in ancient or modern subduction settings and may not be

accompanied by indicator minerals prompting researchers to propose a subduction UHP origin for the enigmatic diamond suites. In many instances, Paragenetic indicator minerals had indeed been entirely abraded, but such extensive transport and erosion would result in a noticeable mechanical polish on diamond crystals. In many other occurrences where diamonds are not mechanically worn, paragenetic indicators simply may not have been found. Factors that contribute to the difficulty of finding indicators in folded belts are 1) metamorphism replacing indicator minerals; 2) small sizes of samples processed for heavy mineral extraction; 3) quick erosion of diamondiferous volcanic rock.

We demonstrate these three factors at work using Archean diamondiferous metaconglomerate as an example. We studied heavy minerals extracted from Wawa metaconglomerate that formed 2697-2701 Ma in a successor basin within the Michipicoten Greenstone Belt of the Wawa-Abitibi Terrane (Southern Superior Craton). The greenschist facies metaconglomerate contains mainly locally derived igneous mafic to felsic detritus, but also very minor components of medium grade metamorphic minerals, diamonds and paragenetic diamond indicator minerals. Comparison of the size distribution, resorption and N aggregation of diamonds in nearby Wawa lamprophyres and the metaconglomerate diamonds confirms that the latter were not derived from the proximal lamprophyric source. The heavy minerals in the conglomerate include diopside, olivine, corundum, chromite, almandine, pyrope with kelyphitic rims, picroilmenite, amphibole and anorthite. Low abundances of the heavy minerals (several grains per 4-70 tonnes of the metaconglomerate) are, in part, explained by their complete or partial replacement by the greenschist mineral assemblage. Detrital almandine and amphibole are inferred to originate in amphibolite facies rocks. Cr-diopside, olivine, chromite and anorthite were sourced from mafic-ultramafic anorthosite- and chromitite-bearing layered complexes mapped in the MGB. The presence of pyrope with more than 6 wt% Cr2O3 suggests derivation from a cratonic root. Picroilmenite has compositions typical of kimberlite and unlike that of ultramafic lamprophyres and other unconventional diamondiferous volcanics. The Wawa metaconglomerate, therefore, should be considered analogous to the Witwatersrand successor basin conglomerate in recording indirect evidence for Archean kimberlites. The tight localization of the diamondiferous conglomerate in time and space was controlled by a quick (~ 3 Ma) erosion of a source kimberlite body. The location of the kimberlite-bearing >2.7 Ga Superior protocraton was inferred from the provenance of the metaconglomerate detrital material. The clasts could have originated as close as the northern Wawa-Abitibi Terrane or as distant as the Opatica terrane.

The study highlights that 1) processing of ~ 300 tons of a paleoplacer rock may be necessary to yield the statistically significant population of kimberlite indicators; 2) relics of indicator minerals could survive the greenschist metamorphism; 3) primary volcanic sources for diamonds in orogenic belts and post-orogenic basins are unlikely to be preserved.

THE CUMULATIVE IMPACT MONITORING PROGRAM (CIMP) AND THE PATHWAYS APPROACH: A COMMON PLATFORM FOR MONITORING

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The Cumulative Impact Monitoring Program (CIMP) coordinates and supports monitoring initiatives that assess the cumulative effects of stressors on the Northwest Territories (NWT) environment and reports on the state of the environment. The program guides and supports the collection and analysis of environmental data relevant to northerners and will make that information accessible to decision-makers. The CIMP mission statement is "*To watch and understand the land and to use it respectfully*

forever". This broad objective will be recognized by supporting the following activities: A) Facilitating governance and partnerships including coordinating and supporting a network of public, private and community-based partners that conduct environmental monitoring and research, and providing oversight and administration of the CIMP program; B) supporting and guiding the collection, analysis and syntheses of environmental information and the delivery of workshops and training; C) developing and maintaining an Information Management System which includes developing an information portal; and D) reporting and communicating which includes the production of public reports, academic publications and the NWT Environmental Audit.

The Cumulative Impact Monitoring Program will play a key role in guiding and supporting the development of projects that integrate monitoring and research to address cumulative impact questions. The "Pathways Approach" will articulate the common steps required to develop effective cumulative impact monitoring and research programs in the NWT. This includes the basic principles and approaches for determining monitoring and research needs, assessing options, and then taking steps to implement activities that will generate information relevant to northern communities and decision makers. The CIMP Pathways Approach requires that the partners work together to identify: 1) Project goals and questions; 2) appropriate monitoring indicators and study design; 3) methods for data collection and management; and 4) plans for analysis and reporting techniques. These principles and the following steps are applicable to scientific, community based, and regulatory monitoring and research.

The Pathways Approach includes the following steps:
Step 1) Defining the purpose: Why are we monitoring?
Step 2) Developing the conceptual model: How does the world work and what do we need to look at?
Step 3) Conducting a review: What is already known?
Step 4) Developing a research question and hypothesis: A research question comes from thinking about - What are the questions that need to be answered?
Step 5) Designing the study: How will we find the answers?
Step 6) Data collection: Gathering the information
Step 7) Data management and analysis: Turning data into knowledge
Step 8) Reporting and publication: Telling the story
Step 9) Adapting: What has changed? Are we still asking the right questions?

These steps provide a framework within which to organize input from monitoring partners, including to document a range of options and to determine how to accomplish each step and who should be involved. CIMP is in the process of gathering input on the Pathways Approach. In the future we intend to produce a series of Pathways guidance documents that will be tailored to community based, regulatory and cumulative impact monitoring and research.

INFORMATION GAPS AND RESEARCH PRIORITIES FOR NORTHERN DECISION MAKERS: RESULTS OF A TERRITORY-WIDE QUESTIONNAIRE

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The Cumulative Impact Monitoring Program (CIMP) of Aboriginal Affairs and Northern Development (AANDC) now has a stable source of program funding and a broad mandate to facilitate the collection, analysis and dissemination of environmental and cumulative

impact monitoring throughout the NWT. While CIMP is housed within AANDC, the responsibility for delivering on its mandate is shared among a wide range of federal, territorial and community organizations.

CIMP set out to gather information on current information gaps and research priorities identified by NWT decision makers as part of its new phase in development and its relationship with other monitoring programs in the NWT. The central question of the questionnaire was:

"What are the recurring questions or information gaps that hinder your organization's ability to make environmental management decisions?"

Results from the questionnaire will be shared in addition to cursory analysis of the responses for the objective of working towards developing a shared understanding of cumulative impacts and identifying and confirming a set of shared priorities for cumulative impact monitoring for the next five to ten years in the NWT.

It was recognized in the questionnaire that research and monitoring priorities have previously been set by several individual organizations (ie. NWT Board Forum priorities document, CIMP Environmental Audit priorities). The objective of this exercise was to build on these initiatives to create a shared commitment to working collaboratively to improve environmental and cumulative impact monitoring in the NWT.

COMMUNITY-BASED ENVIRONMENTAL MONITORING IN THE INUVIALUIT SETTLEMENT REGION

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The Mackenzie Delta Region (MDR) is a dynamic environment that is ecologically and culturally significant. This area is experiencing environmental changes that are expected to increase in magnitude with continued climate warming and additional anthropogenic stressors. In some areas, changes in land cover are occurring so rapidly that maintaining an accurate inventory is problematic. In this context of environmental change and uncertainty, there is critical need to draw on local knowledge and observations to inform decision-making. In the Delta Region, Inuvialuit hunters and trappers are in a unique position to assess ongoing changes in the regional environment and to inventory cumulative impacts. Over the last three years, researchers at the University of Victoria and Aboriginal Affairs and Northern Development Canada (AANDC) have worked with the Hunters and Trappers Committees of Inuvik, Aklavik, and Tuktoyaktuk on several community-based monitoring initiatives.

Our efforts began in 2009 with workshops involving Inuvialuit experts, northern scientists, and local youth. The goal of these workshops was to discuss environmental issues in the region and facilitate knowledge exchange. To investigate the effects of a recent storm surge on the outer delta we also held winter meetings in Aklavik and a land-based knowledge exchange camp in the outer delta during the summer. These workshops made a vital contribution to our efforts to understand the ecological effects of storm surges and led to the development of a cumulative effects monitoring program organized around local observations.

In the summer of 2010, we field tested a protocol that uses participatory photography, video, and semi-structured interviews to record Inuvialuit observations. Observations of environmental conditions made during field outings with Inuvialuit experts and local youth were recorded using digital cameras, and hand-held GPS units. Subsequently, digital photographs and video became the focus of photo-elicitation interviews. The detailed narratives recorded in these interviews, along with geo-referenced photos, and video were entered into a web-based map. Interviews with monitors and a range of potential map users suggest that our protocol and web map is an

effective way to record and share observations and concerns related to the regional environment. Slow internet connection speeds, a complex web-based mapping interface, and technical demands of managing and organizing geo-referenced multi-media observations are key challenges that will need to be overcome before a photo monitoring protocol can be implemented widely.

This research highlights the effectiveness of using visual methods to document and share Inuvialuit observations. A monitoring program built around local observations that are linked to geo-referenced images (and other media) will significantly improve our capacity to detect the impacts of environmental change and facilitate the exchange of knowledge among traditional knowledge holders, youth, and scientists. By providing a record of the location and magnitude of anomalous environmental conditions, this monitoring initiative will also contribute to northern planning, decision-making and research.

AQUATIC RESEARCH AND CUMULATIVE IMPACT MONITORING STUDIES IN THE DEHCHO REGION: A PATHWAY ANALYSIS

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Dehcho First Nations Aboriginal Aquatic Resources and Ocean Management (DFN-AAROM) programming has recently shifted towards collaborative management initiatives designed to support community based aquatic research & monitoring efforts. Currently member communities are at various stages of implementing their programs: some having just started while others have been working for years in some capacity with the Department of Fisheries and Oceans Canada.

Although there is a diversity of concerns in the various Dehcho communities it became apparent that there was a need for a systematic approach to harmonize the design, conduct and reporting function of the various projects using a common platform to collect, analyse, report and publish community-generated data. The Cumulative Impact Monitoring Program (CIMP) "Pathways Model" was recognized as a powerful tool to review current monitoring and research activities and to explore restructuring and delivery options to better align both project and program infrastructure.

Based on the Pathways Model a questionnaire was developed and then used to collect information on selected monitoring, research, and cumulative impact studies within the Dehcho region. The questionnaire helped clarify the project purpose, partnerships, the variety of issues and concerns, the contributions of traditional knowledge and contemporary science, information gaps, training requirements, data management and communication protocols.

This presentation will describe how the pathways analysis was used to review the functionality of community-based and multidisciplinary projects and to better align and prioritize research & monitoring studies within the Dehcho. A variety of projects will be discussed to show the utility of multidisciplinary community-based programming and how it can be used to improve our understanding of the state of the NWT environment, cumulative environmental impacts and decision-making processes.

POPULATION TRENDS OF BIRDS IN THE FORT LIARD AREA AND IMPLICATIONS FOR BROAD-SCALE MONITORING

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Forest songbirds have been monitored periodically in the Fort Liard area since 1998. Population trends spanning the 14 years are being generated for 49 species using complex regression techniques to account for sources of variation including differences in observers. In addition to species that are increasing or

decreasing linearly, many species have non-linear quadratic relationships (inverted U-shaped), likely in response to a spruce budworm outbreak in the area that peaked in 2002. At the regional level, cyclic populations means it takes a long time (20 years+) to understand any long term increases or decreases. Overall, fewer birds are declining in Fort Liard than Alberta, and fewer again than in Canada (as calculated from roadside surveys called Breeding Bird Surveys). As other northern studies have found (e.g. Ekati bird monitoring program), understanding cumulative impacts requires both long time frames and context (how changes are happening near development compared to areas away from development). The potential of using birds as indicators for cumulative impacts and some complications will be discussed with considerations from this work.

ABORIGINAL MINING COMPANIES HELPING CREATE COMMUNITY BENEFITS

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Aboriginal companies created as a result of mine development in the Tli Cho region today are reducing the need for social assistance for Tli Cho peoples. The Tli Cho Investment Corporation with its diversity of companies has become effective in helping local communities in large part due to their ability to offer and support training and to develop community capacity.

GEO-MAPPING FOR ENERGY AND MINERALS (GEM): PROGRESS REPORT ON RESEARCH IN THE MACKENZIE PLAIN AND ADJACENT MOUNTAIN RANGES

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The Mackenzie Delta and Corridor Project of the Geological Survey of Canada (GSC) is in the fourth year of its five-year mandate. The project is part of the Geo-Mapping for Energy and Minerals (GEM) program, a Government of Canada program providing geoscience information to aid in new energy and mineral resource development in the North. This presentation will focus on activities in the Mackenzie Plain and adjacent mountains around Norman Wells and Tulita (NTS 96C, 96D, 96E, and 96F). Work includes bedrock and subsurface mapping, thermochronology, and stratigraphic studies. In the same area, allied work by the Northwest Territories Geoscience Office (NTGO) deals with the collection of data to help establish petroleum potential, including unconventional resources. Colleagues from NTGO contributed to stratigraphic studies in 2009 and bedrock mapping in 2010.

The project has completed a reconnaissance field season (2009) and two full field seasons (2010, 2011). GIS-enabled map products for the bedrock geology of the study area will be produced at 1:100 000 scale. In the eastern

Mackenzie Mountains, the new mapping has improved understanding of the distribution of Cambrian map units, confirming the presence in outcrop of the Mount Clark Formation. Structural interpretations have also been revised; notably, the Canyon Fault has been found to be a more significant structure than was suggested by previous work.

The project will also produce subsurface structure and isopach maps of Phanerozoic strata under the western plains and deformation front of the Northwest Territories. This work is based on public-domain reflection-seismic data and the resulting maps will be published as a GSC Open File report. This activity has generated reports (published or in press) that describe a central graben and pre-rift thermal uplift within the core of the Cambrian basin and discuss their possible effects on Cambrian stratigraphic evolution and reservoir rock distribution. Because the subsurface work overlaps with the bedrock mapping area, its results help to clarify surface geology and structure, particularly of Devonian and Cretaceous strata, in regions of poor or no outcrop exposure.

The project also includes field-based stratigraphic studies, most of which involve collaborations with university colleagues. Stratigraphic contributions completed or in progress include: publication of archival data on Proterozoic formations; Cambrian biostratigraphy; reassessment of the internal subdivisions of the Cambro-Ordovician Franklin Mountain Formation; sedimentology and biostratigraphy of the Ordovician-Silurian Mount Kindle Formation; conodont biostratigraphy of the Devonian Hume Formation; sedimentology and stratigraphy of the Devonian Imperial Formation, and; sedimentology and stratigraphy of Cretaceous formations.

During the 2011 field season, the Mackenzie Delta and Corridor Project collaborated with the TAFFEE (Thermochronologic Approaches for Fundamental Energy Exploration) project. This university-led initiative is developing innovative thermochronological techniques to use in testing whether foreland basin sediment burial and heating peaked during the Mesozoic, or possibly much earlier as suggested by preliminary fission track analyses. These results will bear on maturity development and hydrocarbon generation in the corridor. TAFFEE is already training two M.Sc. and one Honours B.Sc. students in thermochronology and basin dynamics.

HIGH RESOLUTION PALEOCLIMATIC RECONSTRUCTION OF LACUSTRINE SEDIMENTS FROM THE TIBBITT TO CONTWOYTO WINTER ROAD, NT, CANADA

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The Tibbitt to Contwoyto Winter Road (TCWR) is the sole means of ground transportation, and thus an *essential link* in the supply chain for goods and services destined for mines located north of Yellowknife. Traversing mostly frozen lakes the operation of the TCWR depends upon cold winter temperatures and clear weather. In 2006 abnormally warm conditions, associated with a strong El Niño/Southern Oscillation event, resulted in a significant shortening of the ice road season and significant financial losses. With a projected growth in truck traffic to 14,000 loads north by 2013, it is critical that policy planners, and mine developers have reasonable scientific data upon which to base economic forecasts.

Previous research suggests that cyclic climate phenomena, such as the decadal scale Pacific Decadal Oscillation (PDO), significantly impact western North America but little is known of their influence in the northern part of the continent. Unfortunately the instrument record is

short and most previous paleoclimate research in the NT has been conducted at a resolution insufficient to recognize PDO cycles. According to the Nyquist-Shannon sampling theorem down-core recognition of climate phenomena such as PDOs requires a sub-sampling resolution on the order of five to ten years.

Waite Lake (62.84^0N, 113.33^0W), located near the southern end of the TCWR, was selected for freeze coring and to undergo a high resolution multivariate quantitative paleoclimatic reconstruction. Based on our radioisotope chronology (^{14}C) millimetre-scale sub-samples are needed to capture the sub-decadal to decadal temporal resolution necessary. Accurately sub-sampling at such high resolution is only possible using a custom built sledge microtome developed at Carleton University. The two meter core represents 4,000 years and our 1 mm sub-samples represent 2-4 years of accumulation. This is the highest sampling resolution yet achieved in any paleolimnological analysis in the southern Northwest Territories.

Particle size analysis, a proxy for dynamics in catchment energy and precipitation, was carried out at mm-scale and coupled with time series analysis permitted recognition of trends and cycles that are similar to those of the PDO. Thecamoebians are primarily benthic protists that have been previously demonstrated to respond to climatically induced environmental changes. Enumeration of thecamoebian assemblages within the Waite Lake freeze core has revealed that they have also undergone significant population changes. Correlating these populations with present day populations, through the development of a transfer function, will allow for the reconstruction of specific environmental properties.

These findings indicate that the region has undergone significant climate variability, and identifies a potentially significant regional climatic driver. The results of this study will provide a sound scientific basis to inform policy planners of potential climate conditions that may prevail in the coming decades.

INTEGRATED ARCTIC AND SUB-ARCTIC VEGETATION MONITORING

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Recent research and traditional knowledge studies indicate that the vegetation conditions in the Western Arctic are changing. These changes have many important implications, ranging from the sensitivity of terrain for development to the impact on wildlife habitat. Understanding the rate and causes of these changes is also vital to distinguish between the impacts of climate change and the impacts of human-caused disturbance associated with northern development. The long-term goal of this program is to establish and maintain a network of sites to characterize regional environmental variability and serve as a baseline against which to measure changes resulting from the cumulative impacts of multiple natural and anthropogenic disturbances.

This project also involves the development of a protocol that can be implemented by individuals with varying degrees of technical training, allowing participation of communities, researchers, industry, AANDC inspectors, schools and non-government organizations to be incorporated along with technical scientific studies. This protocol and network will establish a reference, against which to assess temporal change and will facilitate more widespread environmental monitoring. Through a partnership with Environment Canada and the Canadian Forest Service, we are working to identify areas of overlap among this and other programs and, where possible, to develop common monitoring techniques. The ability to incorporate a wide range of studies would benefit ecological monitoring in the NWT by expanding the number of compatible monitoring sites, and would also benefit smaller or more localized monitoring programs by enabling their

findings to be placed into a larger geographic context.

In August 2011, a series of eight new monitoring plots were established in the mid Boreal environments of the Dehcho region in order to calibrate datasets from AANDC and the Canadian Forest Service monitoring networks, and to assist in the determination of optimal procedures for the integrated protocol. Both protocols were incorporated in these test plots and an overlapping plot design was used to account for the disparate plot sizes. Different methods of assessing plant community composition were also tested on a subset of sample locations to allow for a direct method comparison. Preliminary results indicate that while plot layout appears to have a minimal impact on the plant community data collected, different methods do yield substantially different results. Specifically, a direct comparison of % cover by species using visual estimation and point framing methods indicates that, for some functional groups, higher cover estimates were determined using the point frame, while a consistently greater number of species were detected using visual estimation.

It is hoped that this initial exercise to develop a common protocol will provide a valuable contribution to cumulative impact monitoring by ensuring that vegetation monitoring in the NWT is coordinated, collaborative and that the data collected by multiple programs are compatible.

CANADA-NUNAVUT GEOSCIENCE OFFICE 2011 ACTIVITIES

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The Canada-Nunavut Geoscience Office (CNGO) is a partnership between the Government of Nunavut, Natural Resources Canada and Aboriginal Affairs and Northern Development Canada. Nunavut Tunngavik Incorporated also sits on the management board as a non-voting member. CNGO's mandate is to provide accessible geoscience information and expertise to support responsible resource exploration and development, geoscience capacity building, education, training, geoscience awareness and outreach. CNGO delivers a diverse suite of geoscience activities in collaboration with universities, industry, other government organizations and NRCan's Geo-Mapping for Energy and Minerals (GEM) program.

In 2011, geoscience activities included mineral deposit studies in the Elu Belt and Borden Basin, detailed mapping of Prince Albert Group rocks on Melville Peninsula, reconnaissance mapping on Hall Peninsula, Paleozoic studies on southern Baffin Island to evaluate oil and gas potential in the Hudson Bay-Foxe Basin, aggregate assessments, climate change adaptation and permafrost research and enhancing online data dissemination through Nunavutgeoscience.ca. The intent of this presentation is to provide an overview of the activities noted above and discuss ideas for future geoscience work in the territory.

ASSESSING THE POTENTIAL FOR BASE AND PRECIOUS METALS, URANIUM, RARE EARTH AND PLATINUM-GROUP ELEMENTS AND GOLD IN THE NUELTIN LAKE AREA WITH NEW REGIONAL LAKE SEDIMENT GEOCHEMICAL DATA

WITHDRAWN

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Lake sediment and water samples were collected in 1976 from three contiguous NTS map sheets in a largely unexplored area of southern Nunavut adjacent to Nueltin Lake, north of the Nunavut-Manitoba border. Over an area of approximately 36,740 km^2, 2,526 samples of lake sediments were collected and analyzed for base metals, uranium and pathfinder elements using commercially available methods. Sediment samples archived in Ottawa were reanalyzed by currently available commercial methods and replace the 1976-vintage 12-element data set with a modern, precise data set of 60 elements

revealing new targets for base and precious metals, uranium, rare earths and platinum-group elements. Original data for base metals and U, as well as Ag, an important geochemical pathfinder element for Au, are augmented with new data with detection limits up to an order of magnitude more sensitive. Several areas within the boundaries of this survey warrant further exploration.

The re-analyzed lake sediment geochemistry were screened for values reported at less than the detection limit (censored). These censored values were replaced with estimated values using statistically-based methods. As the data are compositional in nature, there is the potential problem of the "closure" effect for which specific statistical methods have been developed for interpreting such data. A log-centred transform was applied followed by a principal component analysis from which features related to lithologic variability, surficial geology and mineral occurrences were shown to be evident.

For the lake sediment geochemistry over NTS sheets 65 A/B, existing geological maps were used to tag each sample with the geology. This tagged group of samples were used to carry out a linear discriminant analysis (using a logratio transform) from which the underlying geology could be predicted. The resulting linear discriminant functions were used to classify the lake sediment geochemistry from NTS sheet 65C. The resulting classifications enabled the creation of "predictive maps" in which each geological unit was predicted in terms of percentage probability of occurrence over the three NTS sheets.

The initial results and interpretation of the lake sediment geochemistry show a strong predictive capability for the known Archean and Proterozoic age supracrustal and intrusive units. There is a very significant predictive distinction between the intrusive units of the Nueltin and Hudson suites, which have their own distinctive metallogeny. The results also show a strong predictive ability to identify and differentiate between upper and lower tectono-stratigraphic supracrustal units of the Henik Group, including the ultramafic bearing Henik I sequence.

FINGERPRINTING IRON OXIDE COPPER-GOLD MINERALIZATION IN THE GREAT BEAR MAGMATIC ZONE USING INDICATOR MINERAL AND TILL GEOCHEMICAL METHODS: HIGHLIGHTS FROM THE IOCG-GREAT BEAR GEM PROJECT

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An applied Quaternary research activity was undertaken in the Great Bear magmatic zone (GBMZ) to evaluate whether iron oxide copper-gold (IOCG) deposits and other showings hosted within large IOCG-type alteration systems can be fingerprinted by drift prospecting methods. Bedrock (n=138) and till (n=111) samples were collected up-ice, proximal to, and down-ice from mineralization, host hydrothermal systems and least altered bedrock across the GBMZ. Till matrix geochemistry, combined with extensive lithogeochemical data collected as part of the IOCG-Great Bear Project, and the study of non-ferromagnetic and ferromagnetic minerals from bedrock and till samples, are used to document the dispersal from IOCG deposit mineralization or alteration in glacial sediments.

Results from an orientation study at the NICO Au-Co-Bi deposit, an atypical magnetite-group IOCG deposit with arsenopyrite mineralization, demonstrate one case where the non-ferromagnetic heavy minerals (0.25-2 mm; SG>3.2) are not particularly effective as indicator minerals of IOCG mineralization. However the abundance of pristine-shaped silt-sized gold grains in till collected immediately down-ice of NICO can be used to trace the

mineralization. In addition, the bulk of ferromagnetic grains from local tills collected over NICO shows elemental enrichments or depletions similar to those found in NICO bedrock ferromagnetic grains. Minor/trace elements in iron oxides (dominantly magnetite) from NICO are similar to pathfinder elements in till geochemistry and in bulk lithogeochemistry.

Results from bedrock and till samples collected near the Sue Dianne Cu-Ag-Au magnetite to hematite-group IOCG deposit and near other mineral showings across the GBMZ indicate the presence of chalcopyrite, apatite, pyrrhotite, andradite, Mn-epidote, bornite, allanite, ferroactinolite, fluorite and gold in various concentrations within the heavy mineral fraction. SEM examination of grains revealed trace amounts of iron oxides in gahnite, apatite, tourmaline and andradite grains from till samples collected down-ice of Sue-Dianne and other showings. Some chalcopyrite grains are found in association with specular hematite and/or REE-rich phases.

Geochemical analysis of the clay and silt+clay size fractions of till reveals a list of potential IOCG deposit pathfinder elements, including Cu, Mo, Bi, Co, and depletion of Ti. Principal component analysis performed on combined till geochemistry and lithogeochemistry datasets shows that the combined datasets variability is largely explained by the variability in the lithogeochemistry, therefore highlighting the role of bedrock-related geological processes within the till geochemical variability. Preliminary results show: 1) grouping of till samples according to their related IOCG showings; 2) simple differentiation of anomalous till samples based on multi-element enrichments, and, 3) potential to identify the nature of bedrock IOCG alteration type in overlying till samples. Petrographic study of collected bedrock samples, clay mineralogy of till samples, additional electron microprobe and LA-ICP-MS analysis, as well as further examination of selected non-ferromagnetic and ferromagnetic grains will help to improve discrimination criteria for the different types of mineralization, alteration and host rocks in the GBMZ.

HEALTH AND SAFETY IN MINERAL EXPLORATION - THE ROLE OF THE PROSPECTORS AND DEVELOPERS ASSOCIATION OF CANADA

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Mineral exploration has unique health and safety issues because working conditions are complex and often in remote regions subject to extremes of weather and terrain. The industry is increasingly dominated by junior companies and small contractors, which lack the internal health and safety resources of major companies. With the recent boom in mineral exploration there has been a significant increase in accidents and fatalities in Canada. Due to difficult access to advanced medical care while working in remote sites, minor accidents have the potential to become major issues.

The Prospectors and Developers Association recognizes that health and safety are integral parts of responsible mineral exploration (corporate social responsibility) and in 2005 formed a committee to assist industry achieve zero fatalities and to decrease accidents.

For five years the PDAC committee has assessed exploration safety performance through an annual Canadian national exploration accident survey by partnering with the Association for Mineral Exploration in British Columbia (AME BC). An overview of the results of these surveys will be presented, with recommendations to improve field safety. In addition, PDAC and AMEBC have generated a database of exploration industry fatalities from 1980 to the present. Field injuries and fatalities tend to have completely different root causes, with slips and falls dominating injuries and helicopter accidents dominating fatalities.

In addition to the survey, the PDAC has completed the most comprehensive 800 page global manual for exploration health and safety. It is freely available on the internet to anyone as part of PDAC's E3 Plus initiative. A pocket sized version is to be released shortly.

The presentation is part of PDAC's attempt to improve field safety through researching incidents, publishing procedure manuals and publicizing incident causes. The whole health and safety initiative is an integral part of PDAC's E3 Plus principles for responsible exploration, which comprises comprehensive material in the areas of community relations, environmental practice in the field and health and safety.

VANISHED DIAMONDIFEROUS CRATONIC ROOT BELOW THE SOUTHERN SUPERIOR PROVINCE

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Cold cratonic roots, as mapped by geophysical surveys and xenoliths, can grow or disappear with time. We show that the diamondiferous root below the Southern Superior was heated from the Neoarchean to Proterozoic and vanished by the Mesoproterozoic.

The evidence is based on the study of diamond inclusions (DI) from a 2.697-2.700 Ga sedimentary metaconglomerate 12 km northeast of the town of Wawa, Ontario (Southern Superior Craton). We identified DI of high-Cr, low-Ca pyrope garnet, low-Ti Mg-chromite, olivine (Fo_{93}), and orthopyroxene (En_{94}). Mineral chemistry indicates that these DI were in equilibrium with one another and originated from a depleted harzburgitic source, from the spinel-garnet and garnet-only depth facia. Carbon isotope data ($\delta^{13}C$ = -2.5 to -4.0 ‰) supports a peridotitic paragenesis with the mantle source of carbon.

The study of indicator minerals in the Wawa metaconglomerate suggests that the primary source for the metaconglomerate diamonds was located in either the northern Wawa subprovince greenstone belts or the Opatica subprovince to the northeast. Geothermobarometry on non-touching, coexisting garnet-olivine pairs and garnet-orthopyroxene pairs indicates a 39-41 mW/m^2 conductive geothermal gradient during the Neoarchean. Garnet-olivine thermometry shows that the thermal state of the mantle cannot be hotter than 41 mW/m^2 because it would place the diamonds outside the diamond stability field.

The pre-2.7 Ga depleted harzburgitic paragenesis equilibrated at a relatively cold geotherm suggest the presence of a cool, stable cratonic root protruding into the diamond stability field beneath the Wawa or Opatica terranes of the Southern Superior. The thermobarometry maps the root and the lithosphere-asthenosphere boundary down to the minimum depth of 200 km.
The seismic surveys of the Superior Province reveal an abrupt southern boundary for the modern low velocity cratonic root, corresponding to the southern border of the North Caribou terrane. The southern Superior Province, including the Wawa and Opatica terranes, where the Neoarchean root occurred, presently lacks the diamondiferous root. Non-diamondiferous kimberlite pipes in proximity to Wawa, as old as 1.1 Ga, suggest that the diamondiferous cratonic root was already destroyed by Mesoproterozoic time when the geothermal gradient had increased to 45 mW/m^2. Similar destruction of the Archean roots has also been noted for the North China craton and Dharwar cratons in India.

THE GEOLOGY OF THE REDSTONE COPPERBELT

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The Redstone Copperbelt comprises many showings and deposits that span an arcuate zone of approximately 300 km x 15 km within the Mackenzie Mountains, NWT. Neoproterozoic strata that host copper mineralization are part of a fold and thrust belt within the easternmost limit of deformation of the northern Cordillera. The Coates Lake deposit, the largest discovered deposit of the copperbelt, contains a NI-43-101 compliant inferred resource of 33.6 Mt @ 3.92% Cu, 9 g/t Ag. The Redstone Copperbelt has many similarities to the sedimentary rock-hosted copper deposits of the African Copperbelt or the European Kupferschiefer "red-bed" deposits. Fieldwork was completed in 2009, 2010 and 2011, comprising the field examination of 20 copper deposits or showings, supported by core-logging at the Coates Lake deposit and the Keele River showings. In 2010, nine weeks were spent mapping and measuring sections in the Coates Lake, Hayhook and Keele River basins. Detailed mapping of the Coates Lake deposit was carried out in 2011. This presentation summarizes the results of fieldwork, lithogeochemistry and isotope studies.

Stratiform, disseminated chalcocite-bornite-chalcopyrite and copper-bearing veins occur in the Transition Zone between the Redstone River Formation and the Coppercap Formation. Sulphide mineral assemblages are zoned across a reduction-oxidation front: from the oxidized to the reduced side of the front the zonation comprises chalcocite-bornite-chalcopyrite-pyrite. Fluid-flow relating to copper mineralization is controlled laterally by more permeable lithologies and vertically by structures, including syn-sedimentary faults and reverse faults. The orebodies are generally stratiform but can be pod-like, linear or sinuous and can show no stratigraphical control. A weak foliation is developed within ore zones and within the Redstone River Formation. This foliation controls the orientation of copper sulphides and we present evidence for growth of sulphide minerals during deformation. Previous workers have postulated an early diagenetic model for copper mineralization, however mineralization may be low-temperature hydrothermal or late diagenetic in origin.

Epigenetic, hydrothermal mineralization is observed over a wide stratigraphical interval encompassing significant regional unconformities. Chalcopyrite-tetrahedrite-bornite are hosted within veins, breccias or vuggy hydrothermal dolomites and are often found in structural or stratigraphical areas of relatively high permeability, including: unconformities; stratigraphical pinchouts; mega-conglomerates; fault zones; and within the hinge zones of antiforms. The relationship between hydrothermal styles of mineralization and Transition Zone hosted mineralization is explored in this talk. The Redstone Copperbelt shows a prolonged history of basin-development, fluid-flow and tectonism that relate to the generation of significant amounts of copper mineralization.

OXYGEN ISOTOPE SURVEY OF THE NORTHERN CANADIAN LITHOSPHERIC MANTLE: IMPLICATIONS FOR THE EVOLUTION OF CRATONIC ROOTS

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The sub-continental lithospheric mantle (SCLM) is the source region for kimberlitic magmas and host to their precious cargo. It forms the roots to the earliest crust and represents the most ancient mantle domain on Earth. Hundreds of oxygen isotope data have been reported for various mantle domains in the past two decades, yet the full geodynamic significance of these data is still

largely unappreciated. When coupled to the major element systematics, the oxygen isotope data have the potential to illuminate the longstanding conundrum of the origin of highly depleted lithospheric roots beneath the Archean crust, specifically in the context of mantle geodynamics. The current debate is centered on quantifying the relative contributions of mantle plumes (asthenospheric source) and subduction zone processes (lithospheric source) in the SCLM genesis.

We present isotope analyses for 61 grains of olivines extracted from peridotite xenoliths entrained by kimberlites and pericratonic basalts worldwide; the most extensive high-precision *in situ* $\delta^{18}O$ database to date. Olivines analysed by multi-collector secondary ion spectrometry in this study come from the following localities: Paleogene to Jurassic Diavik and Jericho kimberlites (Slave Craton), Cretaceous Somerset Island kimberlites (Rae Craton), Late Neoproterozoic kimberlites of Western Greenland (North American Craton), Middle Cretaceous to Late Mesoproterozoic Kimberly, Finsch, Letseng-la-Terae and Premier kimberlites (Kaapvaal Craton), Early Carboniferous Udachnaya pipe (Siberian Platform), and its pericratonic alkaline olivine basalts erupted during Miocene (Vitim volcanic field).

The SCLM $\delta^{18}O$ data are normally distributed about the mean value of 5.30 ‰ (± 0.11; 2σ) and largely corroborate previous upper mantle compilations. However, there is no correlation between the oxygen isotope ratios and the whole-rock major or trace element chemistry, rhenium-depletion (TRD) ages (i.e. minimum age of lithosphere formation), nor equilibrium pressure-temperature conditions from which the mantle xenoliths were derived. Based on the new data we find no statistical difference between the oxygen isotope composition of cratonic peridotites and modern MORB-source mantle. These observations rule out an origin for SCLM via subcretion of serpentinised oceanic lithosphere. However, the data cannot discriminate between the subduction of relatively un-altered oceanic lithospheric mantle versus a plume origin. On the other hand, the overlap of the SCLM data with the mean global $\delta^{18}O$ value of mid-oceanic ridge basalts (5.11 ± 0.10 ‰; n = 144) has important implications for the long-term relationship between the convecting asthenospheric mantle and ancient refractory cratonic roots.

CONTROLS ON THE FORMATION OF THE NECHALACHO RARE METAL DEPOSIT, THOR LAKE, NORTHWEST TERRITORIES

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The Nechalacho rare metal deposit in the Northwest Territories is a world-class resource containing indicated reserves of 88.13 Mt grading 1.53 wt% total rare earth oxide (including Y), 2.68 wt% ZrO_2 and 0.37 wt% Nb_2O_5 as the minerals zircon, bastnäsite, allanite, fergusonite, monazite and columbite. The rare earth element (REE) and other high field strength element (HFSE) mineralization occurs in a large peralkaline syenite intrusion and is confined mainly to a laterally semi-continuous layer in the intensely altered, upper part of the intrusion. Based on geological relationships, bulk-rock and mineral chemistry, and textural relationships among minerals, we propose a preliminary genetic model for the deposit.

Located 100 km east of Yellowknife on the north shore of Great Slave Lake, the Nechalacho deposit is hosted by the Paleoproterozoic Nechalacho layered syenite suite (NLSS), which forms a chemically distinct, dome-shaped intrusive body in the centre of the Blachford Lake Intrusive Suite. In contrast to the surrounding Grace Lake Granite and Thor Lake quartz-syenite, which are dominated by riebeckite and hypersolvus K-feldspar, the NLSS is silica-undersaturated and contains primary end-member aegirine, nepheline, biotite, subsolvus and hypersolvus feldspars and a variety of REE- and HFSE-minerals. The latter

intrusion is at least 1100 m thick and consists from top to bottom of sodalite cumulate, feldspar-rich syenites containing rare villiaumite (NaF), aegirine-biotite foyaites which host the rare metal mineralization, micro-layered aegirine syenites, a biotite-sodalite-dominated sequence containing fluorite, pyrochlore, eudialyte and britholite and lower aegirine foyaites. Mineralogical layering is present on a macro- and micro-scale. Cryptic layering is manifested in systematic changes in clinopyroxene (from aegirine-augite to acmite) and biotite (phlogopitic to annite) composition. Trachytic textures are common throughout the sequence.

The potentially economic REE/HFSE mineralization is hosted in intensely altered aegirine-biotite foyaites in the upper 300 m of the intrusion and forms a semi-continuous layer that ranges up to 150 m in thickness. This layer is vertically zoned; the REE/HFSE are associated with large zircon euhedra of probable magmatic origin in the upper part and zircon-bearing pseudomorphs after probable magmatic eudialyte in the lower part. The heavy REE are preferentially enriched towards the base of the mineralized layer. The alteration assemblage consists of quartz, magnetite, albite, biotite, chlorite, fluorite, carbonates, secondary zircon, REE-fluorocarbonates and allanite.

The occurrences of villiaumite and eudialyte point to an unusually evolved, fluorine-rich, peralkaline magma, which would have had an enhanced capacity to dissolve REE and other HFSE in the source region. We propose that this magma underwent progressive upward in-situ fractional crystallization that led to the enrichment of incompatible elements in the aegirine-biotite foyaites of the upper part of the layered intrusion. The magma finally saturated with incompatible REE/HFSE, which crystallized initially as eudialyte-bearing assemblages and later as zircon-(REE-enriched)-bearing assemblages, forming agpaitic and miaskitic ores respectively. Layering in the NLSS was likely driven by density flotation and gravitational settling within the magma chamber. Subsequent exsolution of hydrothermal fluids altered the primary ore assemblages, leading to the formation of fergusonite, allanite, bastnäsite, monazite and other HFSE minerals.

CANADA'S OIL AND GAS REGIME AND UPDATE ON RECENT LICENCING IN THE NORTHWEST TERRITORIES

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The issuance of petroleum rights to industry in the Northwest Territories and adjacent waters is governed by the *Canada Petroleum Resources Act*. New exploration blocks are configured following the annual Call to industry to nominate lands of interest. In the subsequent Calls for Bids, companies bid the highest dollar value of exploration work to be conducted on the licence in the first period of the term of the licence.

Although exploration activity in the North peaked in the 1970s and 1980s, the Mackenzie Valley and Beaufort Sea has seen resurging industry interest since 1995. The 2010-2011 Calls for bids were no exception with a record land sale in the Central Mackenzie Valley. Indeed, the Central Mackenzie Valley Call for Bids that closed in June 2011 saw bidding for eleven exploration blocks, covering 900,000 hectares. The total value of winning bids for all blocks was $534 million, representing a major new commitment to exploration in this region. Winning bidders were Husky Oil Operations Limited, Shell Canada Limited, ConocoPhillips Canada Resources Corp., Imperial Oil Resources Ventures Limited and MGM Energy Corp.

In the Beaufort Sea & Mackenzie Delta region, two shallow water blocks were issued to Arctic Energy & Minerals Limited for total work expenditures bids of $2 million. This follows issuance of blocks in 2007, 2008 and 2010 in deep water in shelf margin and slope environments for much larger work commitments totalling $1.9 billion.

COMMUNITY-BASED WATER MONITORING IN GREAT BEAR LAKE

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Great Bear Lake ("Sahtu" in North Slavey) sits along the Arctic Circle, just below the tree line, in the eastern NWT. It is the ninth largest lake in the world and the largest lake situated exclusively within Canada. Great Bear Lake is one of the last relatively pristine large lakes in the world and is central to the culture of the Sahtugot'ine (the "people of Sahtu").

Northern Canada is experiencing a period of rapid climate change. These changes are likely to have impacts on the aquatic ecosystems of Great Bear Lake and its watershed. Climate change may increase the sensitivity of Great Bear Lake to the impacts of commercial development. The ecology of Great Bear Lake and its watershed make it unique and sensitive to disturbance. Despite its unique ecology, it has never been comprehensively studied. We need to better understand the aquatic ecology of Great Bear Lake and the impacts of climate change and commercial development so that it can be managed to maintain the integrity of its aquatic ecosystems.

In 2010/2011, the Déline Renewable Resources Council (DRRC) completed an assessment of the vulnerability of the aquatic ecosystems of Great Bear Lake to the impacts of climate change and commercial development. Building on this assessment, the DRRC is beginning a community-based water quality monitoring program in 2011/2012. The monitoring program complements ongoing water quality monitoring in the Great Bear River, fish population surveys, and lake trout research in Great Bear Lake. Together, information and data from these projects will provide us with a solid baseline from which to track changes to water quality, fish populations, and permafrost caused by climate change and/or commercial activities.

As this is the first year of the program, our focus in 2011/2012 is on monitor training and capacity building. Our presentation will briefly review the aquatic ecology of Great Bear Lake, describe the design of the water monitoring program, and discuss lessons learned to date in this project.

PROGRESS AND PRIORITIES UPDATE: STANDARD PROCEDURES AND CONSISTENCY WORKING GROUPS, LAND AND WATER BOARDS OF THE MACKENZIE VALLEY

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This presentation by Zabey Nevitt, the Executive Director of the Mackenzie Valley Land and Water Board (MVLWB), will provide Geoscience attendees with an update on progress made in the last year on the development, approval and release of policy and guidelines pursuant to s.106 of the *Mackenzie Valley Resources Management Act* (MVRMA). It will also outline priorities set by the Chairs of the Land and Water Boards of the Mackenzie Valley[a] (the Boards) for the following year, including progress updates on specific initiatives.

In March 2011, the MVLWB released its first policy and set of guidelines under the *Standard Procedures and Consistency Initiative* which is the mechanism the Boards have decided to employ to implement section 106 of the MVRMA. Section 106 of the MVRMA states, "The Board may issue directions on general policy matters or on matters concerning the use of land or waters or the deposit of waste that, in the Board's opinion, require consistent application throughout the Mackenzie Valley".

The MVLWB's *Water and Effluent Quality Management Policy* describes the approach the

a The Mackenzie Valley Land and Water Board, Wek'èezhìi Land and Water Board, Sahtu Land and Water Board and Gwichin Land and Water Board

Boards will use to set effluent quality criteria (EQC), on the amount of waste that can be discharged from a project into the environment. By describing a standard, transparent approach to setting EQC, the policy addresses concerns raised in several audits of the NWT regulatory system. The MVLWB's *Guidelines for Developing a Waste Management Plan* outlines the expectations of the Boards with respect to waste management plans. They will serve beneficial to all stakeholders to help ensure waste management plans are submitted in a consistent format, provide a template for proponents to write a plan, and act as a benchmark for reviewers to evaluate a proponent's plan.

The Boards' priorities for the upcoming year include finalizing its draft *Engagement Guidelines* for public review and the release of a draft policy on *Engagement and Consultation.* Concepts in these documents include clear engagement expectations for applicants in advance of any submission, and the concept of "life of project" engagement planning for applications related to anticipated mining, oil and gas and energy projects. The Boards are also examining, in collaboration with the Mackenzie Valley Environmental Impact Review Board (MVEIRB), how new common law is shaping its mandate in the area of Crown consultation.

Other priorities include: (a) Concluding a list of standardized terms and conditions for land use permits and water licences. In order to ensure that this exercise is a success, the Boards have decided to strike a number of working groups that would be comprised of Land and Water Board staff as well as staff from other agencies with jurisdiction and authorities in specific areas which often pose challenges to regulators due to mandate or jurisdictional gaps / overlap, including wildlife and air quality; (b) The creation of guidance documents for land use permits and water licence applications; and, (c) Standardized policy and guideline implementation frameworks, including consistent approaches to monitoring and evaluation of product effectiveness.

HEAVY LIFT HYBRID AIR VEHICLE SUPPORT TO MINING

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Discovery Air is Canada's second largest aircraft fleet operator in Canada and employs more than 800 personnel operating and supporting more than 150 aircraft from 30 plus locations in North and South America. Discovery Air Innovations (DAI) is engaged in delivering Heavy Lift Hybrid Air Vehicles (HLHAV) capabilities to our customers in Canada through the operation and maintenance of Heavy Lift HLHAVs. HLHAV are large aircraft capable of carrying loads up to 200 metric tons over ranges up to 3000 nautical miles. These paradigm changing air vehicles will replace expensive infrastructure such as seasonal and ice roads and enable a faster and more environmentally friendly resource site development. Available in three model sizes (20 tonnes, 50 tonnes and 200 tonnes), they range in size up to 200m long by 90m wide by 60m high. Given Canada's vast undeveloped spaces without existing transportation infrastructure, this is a special opportunity to lead the world in the commercialisation of this disruptive aerospace technology. Natural Resource companies, Mine Engineers and Operators and Engineering, Project and Construction Management companies can take advantage of HLHAV capabilities to improve efficiencies, take advantage of economies of scale and remove seasonal dependencies while presenting a greener and more environmentally friendly solution. Discovery Air Innovations is working with the world leader in heavy lift HLHAVs: Hybrid Air Vehicles Ltd. of the United Kingdom to establish a HLHAV Center of Excellence within Canada. We are currently researching locations to establish the centre and logistic network before we commence operations in 2014.

NEWLY IDENTIFIED MINERALIZATION AND EVALUATION OF PROSPECTIVE ENVIRONMENTS IN THE CENTRAL WOPMAY OROGEN: AN OVERVIEW OF RESULTS FROM 2004-2011

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Bedrock mapping of the south-central Wopmay orogen, from 64ºN to 65ºN and 115º30'W to 118º30'W (parts of NTS 86B, C, and D), began in 2004 and was completed during the summer of 2011. The main components of the south-central Wopmay orogen are: i) the eastern Archean Slave craton; ii) adjacent, extensively reworked Meso- through to Neoarchean Slave basement complex that is unconformably overlain by Paleoproterozoic metasedimentary rocks and intruded by 1870 to 1850 Ma composite plutons; iii) the Wopmay fault zone; and iv) the more westerly 1875 to 1850 Ma Great Bear magmatic zone volcanic and plutonic rocks and its complex basement known as the >1880 Ma Hottah terrane. Land holdings in the region include Crown Land (Wek'eezhii Management area) and the privately owned Tlicho Lands.

Mineral deposit studies in the south-central Wopmay orogen are divided into three categories: 1) investigation of previously documented mineral showings within or adjacent to the project area (NORMIN.db; accessible at http://ntgomap.nwtgeoscience.ca/); 2) identification of new mineral prospects that meet or exceed the minimum cut-off grade for the NORMIN.db, and; 3) recognizing environments that could be prospective to host undiscovered or unconsidered mineral deposits. These will be discussed with a focus on newly identified occurrences and prospective environments.

Previously recognized mineral showings east of Wopmay fault zone are almost entirely in the Archean Slave craton and are generally vein-hosted gold occurrences (± base-metal). The significant epithermal gold-silver ± base-metal prospect at Norris Lake is hosted within deformed Paleoproterozoic sedimentary rocks. West of Wopmay fault zone mineral occurrences are concentrated near DeVries, 'Fab', Hottah, and Bode lakes and west of the Wopmay River (JLD, Ham). These showings form two major classes; those at Fab, JLD, Ham, and some showings at DeVries Lake are related to Great Bear magmatic zone volcano-plutonic iron oxide copper-gold (IOCG) type mineralization. The second class is relatively later fracture-controlled uranium±copper occurrences that are ubiquitous throughout the magmatic zone and Hottah terrane.

Newly identified mineral occurrences east of Wopmay fault zone are hosted mainly in Paleoproterozoic sedimentary rocks and are generally volcanogenic copper prospects. New occurrences west of Wopmay fault zone include IOCG-like, quartz stockwork-hosted copper±uranium±tungsten and vein-hosted bismuth. During 2011, we identified a mafic volcanic outcrop that is cut by a 1m wide epithermal quartz vein with abundant chalcopyrite mineralization.

Prospective environments occur east and west of Wopmay fault zone, but mineralization remains undiscovered. In the east, Paleoproterozoic sedimentary rocks contain extensive gossans. While some of these are simply pyritic arenite, others may be related to yet unidentified massive sulphides that could indicate potential volcanogenic massive sulphide systems. In the west, field observations of actinolite-magnetite-apatite concentrations combined with remote predictive mapping techniques have identified environments that may be prospective for IOCG-like mineralization.

DECISION MAKERS ATLAS: A TOOL TO FACILITATE THE TRANSFER OF ENVIRONMENTAL INFORMATION TO NORTHERN DECISION MAKERS

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Decision makers require current and reliable environmental information in a format that is easily accessible and understandable to make sound environmental management and climate change adaptation decisions. A substantial amount of environmental information has been generated in the north by government and academic researchers, communities, industry and regulators. Unfortunately, much of this information is housed by these individual groups and is presented in formats that are not easily accessible or understandable to a broad audience.

The Cumulative Impact Monitoring Program (CIMP) has proposed a template for the compilation and presentation of regional datasets for specific valued ecosystem components (VEC) that can be updated regularly and housed in a central location so that decision makers can access this information. The "Decision Makers Atlas" presents environmental monitoring and research data in plain language using visual tools to make the information appeal to a wide audience. The concept will be developed in pilot form and presented to a range of decision makers for comment.

An example atlas is presented here using ground temperature information collected in the Mackenzie Delta area. This data highlights regional and local scale variation in ground temperatures and provides a brief synopsis of the factors controlling the variation in ground temperatures in the region. This data is vital for assessing and monitoring changes in permafrost and provides a summary for decision makers to use in their environmental management responsibilities. Links to additional information in scientific publications, databases and government reports are included in the atlas. It is proposed that contributors of data (government, researchers, industry) will be added as Map or Theme Authors. It is expected that this template could be adopted for other valued ecosystem components.

A TOOL FOR CUMULATIVE EFFECTS ASSESSMENT IN THE NWT

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Cumulative effects refer to the combined effects of all past, present and proposed developments. Thus, assessment of cumulative effects requires an understanding of current and historic development and human activity. Unfortunately, records have not been kept with this purpose in mind in the Northwest Territories. Further, there is little guidance for assessing cumulative effects in environmental assessment in the region.

We present a spatial database, created from a number of different information sources, that summarizes the location and nature of past development activities. Currently, the database includes the North and South Slave regions, and the Inuvialuit Settlement Region.

Developments often have multipile land use permits or water licences, resulting from changing plans, ownership, or operational status. A key feature of this database is that it attempts to consolidate these into a single feature to provide a clearer picture of what is occuring 'on the ground'. Information contained within this database includes the date when permits were issued, anticipated expiry, location and estimated accuracy of the location, presence of accomodations, type of activity, and whether or not the development remains active.

Examples of recent analytical results derived from this database for use in cumulative effects

assessment (such as estimates of habitat fragmentation and changes to habitat quality) are provided. The database can aid decision-making by providing a simple and high-level summary of existing and historic development and activity within an area of interest (such as within a watershed or wildlife population range). This provides information regarding the types of disturbances occuring in an area (such as dust, noise, effluent or habitat loss), from which decision-makers can draw conclusions regarding the potential for cumulative effects in an area, and the likely nature of these effects.

The proposed next steps to maintain and improve this database include expanding the geographic coverage, improvements to the accuracy of information collected at the permit application stage, delineation of project footprints, and most importantly recording the seasonal periodicity and overall duration of activity for each permit.

TRADITIONAL ECOLOGICAL KNOWLEDGE AND CUMULATIVE IMPACT MONITORING

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Dealing with cumulative effects in the Northwest Territories is highly complex, not only because of the numerous kinds of development activities that have had impact on ecosystem health over decades, but because of the diversity of views on what is a healthy ecosystem. For many Aboriginal peoples, whose food, shelter and other means of survival has always come from the environmental around them, knowing what is healthy matters, not as a technical exercise, but because it is fundamental to human health, culture and the economy of northern communities. The panel presentation includes three case studies on cumulative impact monitoring that draw on Traditional Ecological Knowledge of Sahtu, Gwich'in and Denesoline peoples. The research carried out in the three regions highlights the ways in which Traditional Ecological Knowledge can: i) inform the development of indicators and systems of monitoring fish health, caribou movements and landscape change and ii) contribute to processes of community learning. Key issues of discussion include: i) differentiations between natural and human impacts on the environment; ii) the interrelationships between social and ecological change; and iii) monitoring in the governance of valued natural resources.

PALEOCLIMATOLOGICAL ASSESSMENT OF THE CENTRAL NORTHWEST TERRITORIES, CANADA: IMPLICATIONS FOR THE LONG-TERM VIABILITY OF THE TIBBETT TO CONTWOYTO WINTER ROAD

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The Tibbitt to Contwoyto Winter Road (TCWR) is the world's longest heavy haul ice road extending 586 km north from Yellowknife. The TCWR is critical to the regional economy with more than $500 million/year in goods passing north to service diamond mines. This research is mandated to provide an assessment of the impact of climate change on the TCWR, as archived in late Holocene (last ~3500 years) lake sediments. Any change in ice stability, thickness, and duration of cover associated with climate

variability impacts use of the road. With projected future growth in truck traffic it is critical that policy makers, planners, and mine developers have reasonable data upon which to base economic forecasts, as alternate transportation costs (e.g. air transport) are prohibitively high. The short thermometer record from scattered stations in the region is inadequate to assess the nature of climate variability in the region so proxy data must be utilized. In support of our multi-disciplinary research samples from 96 lakes in a gradient spanning from the NT/AB border to the NT/NU border and encompassing the route of the TCWR have been analyzed for water property data (e.g. pH, conductivity), substrate characteristics (e.g. LOI, grain-size, magnetics), nutrient loading, water geochemistry (e.g. F/U, Fe/Mn, DIC/DOC) isotopes (C/N) and environmentally available metals. Twenty-nine Glew cores and 13 freeze cores have also been collected from a subset of the same lakes. Use of a freeze core microtome has permitted subsampling of freeze cores to mm-resolution (2-5 years). This data is being used to develop climate training sets and transfer functions to derive late Holocene climate variability based on thecamoebians, diatoms and chironomids. White spruce dendrochronological samples were also collected from 15 sites along the route of the TCWR within the tree line. Preliminary time series analyses results based on the limnological data indicates that throughout the late Holocene there has been considerable climate variability with winter and summer signals often becoming decoupled. The PDO seems to have contributed to step-wise temperature changes as these phenomena vary between positive and negative phases. There is also a correspondence between solar cycles and seasonal climate variability during negative PDO phases with solar cycle troughs corresponding to colder winters. A linkage between solar cycles and climate is not evident during positive PDO phases when generally warmer and dryer conditions prevail.

TYHEE GOLD CORP'S YELLOWKNIFE GOLD PROJECT

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Tyhee Gold Corp continued the exploration and development of its wholly-owned Yellowknife Gold Project, spanning 40 to 90 km north of Yellowknife in 2010 - 2011.

The company received a favourable Preliminary Feasibility Study of its wholly-owned Yellowknife Gold Project in 2010 and is engaged in a comprehensive development program aimed at initiating mine construction for the first new gold mine in the Northwest Territories in over 21 years. A Feasibility Study led by SRK Consulting commenced in August 2011 with anticipated completion by mid 2012.

The Mackenzie Valley Environmental Impact Review Board has moved the environmental assessment of the project to the Information Request phase. Tyhee anticipates the completion of this phase by mid 2012 and receipt of approvals to commence licensing for construction and operation shortly thereafter.

The company conducted geological mapping, prospecting and diamond drilling on the Clan Lake property with positive results. Continued activities are planned for 2012.

WINDY ISLAND J-39 –WHAT HAS MGM ENERGY LEARNED FROM DRILLING THIS WELL?

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During the 2010-2011 drilling season, MGM Energy and our partner drilled a 1300m hole, 10km north of the Hamlet of Tulita, to test two potential petroleum play concepts within Federal Petroleum Exploration License (EL) 454: 1) a structural-stratigraphic trap within a basal Cretaceous sand and 2) a stratigraphic trap at the middle Devonian carbonate subcrop.

Key to these concepts was the recognition within the Ft. Norman K-14 well by MGM during its regional reconnaissance of the existence of an unnamed basal Cretaceous sandstone above the pre-Cretaceous unconformity and above the sand an organic rich shale (high Gamma Ray log values). Regional seismic mapping of the sub-Cretaceous unconformity and the various formation subcrops associated with this unconformity highlighted several potential opportunities.

The regional early Cretaceous stratigraphy in the Peel Plateau and its extension into the Central Mackenzie Valley has been described by T. Hadlari et al. (NTGO Open File 2009-02, Chapter 9) to consist of two unconformity bound successions: 1) a basal stratigraphic succession of Albian age comprised of the Martin House Formation (including the recently described Tukweye member at its base) and the Arctic Red Formation (including the Mahoney Lake and Sans Sault members); and 2) an upper succession of Cenomanian to Turonian age comprised of the Slater River Formation (including the basal Slater River radioactive shale) and the Little Bear Formation. These successions record successive transitions from terrestrial clastics in the east and at the base of each succession to marine clastics in the west and at the top of the succession.

Although the highly porous sandstone was wet in the K-14 well, regional seismic mapping suggested that the sand in the K-14 well might be a localized sandstone and that the overlying radioactive shale might be in a position to act as a top seal to both this sandstone in an up-dip position and for the Devonian carbonate succession. If the sand was absent and the carbonate sub-cropped against the pre-Cretaceous unconformity, this would set up a significant potential trap for hydrocarbons within the sub-cropped Devonian carbonates. In this talk we will outline the drilling results of the J-39 well (with respect to the geology, geophysics and drilling operations) and the impact of these learnings on future exploration of conventional plays within the Cretaceous and Middle Devonian strata of the Central Mackenzie Valley.

MACKENZIE PLAIN PETROLEUM PROJECT: DEVONIAN HORN RIVER GROUP AND CAMBRIAN CLASTIC PLAY

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Mackenzie Plain is a petroleum producing and exploration area in the central Mackenzie Valley. Within this area, the reservoir for the oil fields at Norman Wells is a Middle Devonian reef within the Kee Scarp Member of the Ramparts Formation, which is part of the Horn River Group. The area has potential for additional discoveries of conventional and unconventional petroleum (shale gas, shale oil) resources. The 2011 field program in Mackenzie Plain, and Mackenzie Mountains to the south and west, built on the work completed in 2010 with emphasis on examining more sections of Horn River Group. The study, initiated by the Northwest Territories Geoscience Office (NTGO), is part of a five-year (2009-2014), field-based and subsurface project that is aimed at updating and improving geoscience knowledge of key petroleum plays. Field work in 2010 also focused on improving petroleum potential data for the Cambrian clastic play (Mount Clark and Mount Cap formations), and these results are now available as an Open Report from NTGO.

The Horn River Group in Mackenzie Plain is Givetian to Frasnian in age and includes Hare Indian Formation (with basal Bluefish Member), Ramparts Formation (Kee Scarp member), and Canol Formation. More than 20 outcrop sections and stations have been examined to characterize their source rock and unconventional petroleum potential. This included detailed measurement and description, spectral gamma ray measurements with a hand-held scintillometer, and outcrop chip sampling for the following

analyses: 1) evaluation of organic rich shale for source rock potential (Rock-Eval, total organic carbon, kerogen type, thermal maturity, and reflectance); 2) mineralogy (semi-quantitatively, using X-ray diffraction); and 3) whole rock geochemistry. Similar datasets are forthcoming from 27 wells that form 5 east-to-west transects across Mackenzie Plain, and these will be integrated with the outcrop studies. In addition, outcrop samples of overlying sandstone and shale of the Imperial Formation were collected for analysis of porosity/ permeability and Rock-Eval/total organic carbon (TOC). The underlying limestone and shale of the Hume Formation was also collected for oil analysis by solvent extraction, porosity/permeability and Rock-Eval/TOC.

Preliminary results from Rock-Eval and total organic carbon (TOC) analyses of outcrop samples indicate Canol Formation shale is a good to excellent quality source rock (TOC averages 5-6%) in Mackenzie Plain. Type II (oil-prone) kerogen is indicated, with a contribution from Type III kerogen. The Canol Formation is mature (within the oil window) through much of Mackenzie Plain, but more data are required to determine a regional maturity trend. Past and current work suggests Bluefish Member black shale of Hare Indian Formation and Carcajou facies of Ramparts Formation are equally rich potential source rocks. Canol Formation contains 82-90% average modal quartz, an important consideration in determining its potential for hydraulic fracturing.

The Cambrian Mount Clark and Mount Cap formation clastics extend throughout the northern Interior Plains and have proven oil, gas, and condensate discoveries in the Colville Hills area northeast of Mackenzie Plain. Petroleum potential data from Cambrian strata includes samples that yielded 2-10% porosity and permeabilities in the tens of millidarcies. Evaluation of organic rich shale for source rock potential resulted in one third of outcrop samples yielding greater than 1% total organic carbon, with a maximum of greater than 7% TOC. Rock-Eval pyrolysis suggests that the Mount Cap Formation is overmature (wet to dry gas zone) where sampled adjacent to western Mackenzie Plain, and Type III (gas-prone) kerogen is dominant; there was likely some contribution of Types II and/or I kerogen. These outcrop data improve the limited dataset from only 12 wells that intersect Cambrian units in Mackenzie Plain.

DEEP LITHOSPHERE BENEATH THE RAE CRATON: PERIDOTITE XENOLITHS FROM REPULSE BAY, NUNAVUT

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The composition, thermal history, and diamond potential of Canada's Arctic lithosphere beneath the Churchill Province is poorly constrained at this time. Economic interest in kimberlite occurrences (n>17) close to Repulse Bay (RB), including the largest kimberlite body of the Eastern Arctic (coalescing Q1-4 bodies), is supported by the identification of diamonds in bulk kimberlite samples (~27-33 cpht at a 0.85 mm mesh size). RB kimberlite intrusion ages are not well known, but are thought to be similar to the Aviat kimberlites (~560-500 Ma) located ~325 km to the North. We have conducted a mineralogical and in-situ trace-element study of RB peridotite xenoliths as part of the GEM Diamond and CERC Arctic Resources initiatives. This information is used to assess the composition and evolution of the sub-continental lithospheric mantle (SCLM) that underlies the Rae Domain of the Churchill Province.

Preliminary results show that our RB xenolith suite (n=34; <1g to 7g in mass) is dominated by coarse-grained Gt-harzburgites (± spinel) with both porphyroclastic (n=18) and protogranular textures (n=8), while porpyroclastic Gt-lherzolite (n=5) and websterite xenoliths (n=3)

occur in subordinate amounts. Garnets of five RB xenoliths ($Pyp_{63-76}Alm+Spes_{11-20}Gr_{11-16}$) classify as G9. Minimum pressure estimates derived from Cr-abundances in these garnets range from ~20 kbar (RB-7A) to 35 kbar (RB-8).

Garnets of the studied RB xenoliths are generally LREE-depleted with HREE abundances range from ~2.5-10*CI-chondrite. Xenolith RB-2 contains garnets with sinusoidal REE-patterns, and these grains have the highest CaO-content among the studied garnet-suite (up to 6.65 wt.%). The highest garnet HREE abundances (>100*CI-chondrite) are found in a modally banded xenolith that contains ilmenite and amphibole (RB-4).

Mineralogical and trace-element data for coexisting phases recovered from the interior portions of the RB xenolith suite, combined with textural analyses, will be used to; 1) place firmer constraints on the degree of inter- and intra-grain major- and minor-element equilibrium; 2) assess equilibration temperatures preserved within the central portions of RB mantle xenoliths; and 3) appraise petrological similarities and differences with Archaean SCLM of the Slave Craton and other portions of the Churchill Province. This information will be utilized to assess the role of the Proterozoic Trans-Hudson orogen in this region. Combined with studies of Snowy Owl (Victoria Island) and Darnley Bay (Parry Peninsula) xenoliths, the results of this work will significantly enhance our understanding of the nature, and diamond potential, of SCLM along a broad E-W traverse of Arctic Canada.

DEVELOPMENT UPDATE FOR THE NICO GOLD-COBALT-BISMUTH DEPOSIT, NORTHWEST TERRITORIES

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The NICO Project is a proposed mine and concentrator in the NWT, with a hydrometallurgical plant in Saskatchewan to process concentrates produced at the mine to gold doré, cobalt cathode, bismuth cathode or ingot and a nickel carbonate by-product. In the NWT, the NICO deposit is located in Tlicho Territory, approximately 160 km northwest of the City of Yellowknife and 50 km north of Whati. Current access is by winter road, but this road is planned to be re-aligned and upgraded to all-weather capability as part of Fortune's proposed development. The mine and Saskatchewan refinery are both in the environmental assessment (EA) process.

NICO and Fortune's nearby Sue-Dianne deposit are the only Canadian examples of IOCG (Olympic Dam) –type deposits. They are situated in the Proterozoic Bear Structural Province of the Canadian Shield near the south end of the Great Bear Magmatic Zone. The NI 43-101 compliant Mineral Reserves are 31 million tonnes containing 908,000 ozs of gold, 82 million lbs of cobalt, 109 million lbs of bismuth and 27 million lbs of copper. NICO will be mined using a combination of open pit and underground extraction methods to feed a conventional crushing and grinding plant and concentrator producing a bulk flotation concentrate from the <5% sulphide fraction. The concentrate will be trucked to the rail head at Hay River for loading onto rail and delivery to the refinery in Saskatchewan. This refinery further employs flotation at 12 µm following regrind to produce selective cobalt and bismuth concentrates, followed by acid leaching and electro-winning to high value metal products.

Additional infill drilling was performed during the summer of 2010 to better understand the deposit and improve gold grade within the deposit. Interim reclamation was completed during 2011 for areas that will not be in the disturbance footprint when the mine is developed.

The NICO deposit has been successfully test mined to verify the grade and continuity of the deposit and produce a large sample for pilot plant testing. The pilot plant verified the process flow sheet, production of high value metal

products, and improved the metal recoveries previously used in the Company's earlier positive bankable feasibility study.

While Fortune Minerals completes its EA for the NICO Project, several improvements have been made to the design of the development that will reduce potential impacts to the local environment while still increasing the efficiency of the overall operation. The Company is expecting to complete the EA process in 2012 for mine commissioning in 2014. NICO will provide business and employment opportunities for Tlicho and northern companies and diversify and sustain a mineral industry upon which the economy of the NWT is dependent.

UPDATED GUIDELINES FOR FEDERAL OFFICIALS ON THE DUTY TO CONSULT: IMPLICATIONS FOR INDUSTRY IN THE NORTHWEST TERRITORIES

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The Consultation and Accommodation Unit (CAU) was established in February 2008 and falls within the Litigation Management and Resolution Branch in the Policy and Strategic Direction Sector of Aboriginal Affairs and Northern Development Canada.

Knowledge about the duty to consult and awareness of consultation responsibilities and processes at the national, provincial and territorial levels are essential in supporting sound decision making and effective coordination across governments. The CAU's primary function is to lead a "whole of government" approach to Aboriginal consultation and accommodation.

The CAU advises and guides federal departments and agencies in addressing legal, policy and operational matters related to Aboriginal Consultation and Accommodation. Based on its *Updated Guidelines for Federal Officials on the Duty to Consult*, the CAU develops and delivers training to federal departments and agencies on the Crown's duty to consult and accommodate Aboriginal groups. As a result of a national engagement process on Aboriginal consultation and accommodation that occurred over two years (2008-2010), the input of Aboriginal groups, provinces and territories and industry were incorporated into the Guidelines.

During the engagement process we heard from various industry sectors that Aboriginal engagement is increasingly "part of doing business". Industry is looking for clarity and efficiency of regulatory/consultation processes, clearly defined roles and responsibilities, less duplication between federal and provincial processes, timely decisions, etc.

To address these issues, the CAU is focussed on building relationships with federal departments and agencies, provinces and territories, Aboriginal groups and industry to achieve more coordinated, efficient and effective consultation processes through various measures that will be presented at the conference.

ENVIRONMENT AND PERMITTING UPDATE FOR THE NICO GOLD-COBALT-BISMUTH-COPPER DEPOSIT, NORTHWEST TERRITORIES

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This presentation will focus how the changes in the design of the NICO Project have influenced environmental impact predictions presented in the Developer's Assessment Report (DAR) submitted to the Mackenzie Valley Review Board on May 20th, 2011. Fortune is currently in the process of responding to Information Requests. Specific items that will be discussed include 1) Cancellation of plans to build an airstrip at the Project site, 2) Selection of an RO/chemical treatment/biological effluent

treatment system; and 3) construction of co-disposal field cells at the NICO site.

Fortune can now confirm that it will not be constructing an airstrip at the NICO Project. Given the limited amount of air traffic the airstrip would support, Fortune concluded that the cost and environmental impacts associated with construction and maintenance of an airstrip were not warranted. As an alternative, Fortune would invest funds into the development of added infrastructure at the airport in Whati to accommodate the movement of staff and equipment for the NICO Project. Removal of the airstrip results in a considerable reduction in the project footprint reduces the potential for dust generation and eliminates one of the largest sources of noise associated with the development. In addition, the community of Whati would benefit from the increased infrastructure and employment opportunities at the airport during the Project life.

Fortune can now also confirm it will be using a Reverse Osmosis (RO)/chemical treatment/biological treatment system combined with chemical treatment and biological treatment for effluent water treatment. The RO system provides the best available technology for removing contaminants from water and concentrates the contaminants into a brine stream. The proposed system depends chemical precipitation to remove the majority of the metals and then on active biological treatment in a two step process that achieves selenium removal anaerobically and ammonia removal aerobically. With the change in treatment option to the RO treatment, all constituent concentrations, including selenium, are projected to be below the receiving water Site Specific Water Quality Objectives (SSWQO) value at the end of pipe. Comparing the two technologies, the IX system would produce an effluent quality that is lower in some metals than the RO option, however would did not meet the SSWQO for selenium. The RO/chemical treatment/biological treatment option produces an effluent quality that is projected to meet all limits, is more robust to changes in influent water quality than the IX system, and produces secondary waste form that is more stable and compatible for disposal at the site.

Co-disposed tailings and mine rock field test cells were constructed on July 19, 2011. Three co-disposal field cells were constructed: 1) Mine rock alone, which will serve as a control, 2) Co-disposed mine rock and tailings, intimately blended; and 3) Co-disposed mine rock constructed using a layered approach. Water draining through these field cells is being collected on a monthly basis and will be analyzed using the same protocols as the existing tailings, ore and waste rock field cells installed in 2008.

ASSESSING ENVIRONMENTAL EFFECTS OF MINING ON THE ECOLOGICAL INTEGRITY OF STREAMS IN THE SOUTH NAHANNI WATERSHED: CHALLENGES AND POTENTIAL SOLUTIONS

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Maintaining healthy ecosystems amidst increasing levels of industrial development is a central challenge to the management of Canada's north. Expansion of mining activities in northern latitudes has raised concerns about the cumulative environmental effects of increased loadings of pollutants, including metals and nutrients, to receiving waters and their subsequent effects on biological communities. The South Nahanni Watershed, located in the Northwest Territories of Canada, includes an operational tungsten mine, and an advanced lead-zinc exploration mine. Both operations discharge to tributaries of the South Nahanni River that eventually flow through

Nahanni National Park Reserve. Additional mines are scheduled for assessment and possible development.

With financial support from the Cumulative Impact Monitoring Program and others, we completed an extensive field program that comprised of collections of water, benthic macroinvertebrates and select habitat variables from 118 sites throughout the South Nahanni Watershed in 2008 and 2009. Using a Reference Condition Approach, we present an initial reference condition model that can be used to assess environmental effects of mining operations on the ecological integrity of streams and rivers. We also present recent advancements in the use of water, algae and mayfly larvae as potential surrogates to monitor metals in sedentary Slimy sculpin, which are often used to assess bioaccumulation of contaminants. Use of surrogate monitoring endpoints can reduce depletion of low abundance fish populations in the watershed.

ARSENIC MOBILITY AND ATTENUATION IN A NATURAL WETLAND AT TERRA MINE, SILVER BEAR, NORTHWEST TERRITORIES

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Elevated arsenic (As) concentrations in surface water from storing mine tailings in lakes can have a negative impact on local and downstream vegetation and aquatic life. At Terra Mine, an abandoned silver and copper mine in the Northwest Territories, tailings storage in Ho-Hum Lake has resulted in dissolved As concentrations of 50-80 µg/L, exceeding the 5 µg/L maximum guideline for aquatic life. A natural wetland located downstream appears to be attenuating As from surface water. The objective of this study was to understand the sources of As to the wetland, the effectiveness of the wetland to sequester As, the form and stability of As in the sediments, the processes controlling As mobility, and the effect of seasonal changes in the wetland. Surface and pore water was analyzed to identify how As was moving through the wetland in the dissolved phase. Arsenic bound to the sediments was determined by analyzing for bulk composition, and As speciation and element association were identified using synchrotron-based bulk XANES and ESEM analysis.

Arsenic enters the wetland by surface flow from Ho-Hum Lake, subsurface flow through the waste rock airstrip, and by windblown dust. In spring, dissolved As concentrations in surface water increased downstream. In late summer, a decrease in concentration was observed in the upstream portion of the wetland, however As returned to lake concentrations further downstream. Sediment As concentrations increased over the summer. ESEM and bulk XANES indicate that As was associated with (oxy)hydroxides and secondary sulphides. In the spring, when water levels were high from snow melt, (oxy)hydroxides formed and captured As, while sulphide oxidation in the sediments lead to the release of As into surface water. Over the summer, the onset of reducing conditions from microbial activity drove the formation of As-bearing sulphides and dissolution of (oxy)hydroxides.

While As was accumulating in the sediments at most sites in the wetland over the summer, these results suggest that the wetland was not effectively sequestering dissolved As from the surface water, and that sediment-water cycling of As in the wetland as a result of seasonal redox variations were contributing As to the surface water.

NUNAVUT 2011: LOOKING BELOW THE SURFACE

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In 2011, Nunavut enjoyed increased levels of mineral exploration spending due to strong activity from both major and junior operators in

the territory's three regions (Kitikmeot, Kivalliq and Qikiqtaaluk). Nunavut's mineral potential is demonstrated by new projects and increased involvement from major companies.

Exploration for gold and other precious metals was a key focus in Nunavut in 2011, with nearly half of the predicted spending devoted to it. Agnico-Eagle Mines Ltd. (AEM) controls the sole producing mine in Nunavut, Meadowbank, and the Meliadine project near Rankin Inlet. Meadowbank quickly resumed full production after a fire destroyed the kitchen and dining facilities in March. AEM conducted a large exploration program at Meliadine including a planned 95,000 m of drilling, underground development, and regional exploration. Hope Bay Mining Ltd. (HBML; a subsidiary of Newmont Mining Corporation) conducted a program of similar scale at its Hope Bay project, south of Cambridge Bay, which included plans for 90,000 m of drilling, mine development, and infrastructure construction. Aggressive exploration programs took place at the Back River project (Sabina Gold & Silver Corp.) and at the Committee Bay project (North Country Gold). One notable transaction took place: Elgin Mining Inc. acquired the Lupin and Ulu gold deposits from MMG Resources Inc.

Iron ore was another prime target with continued exploration at existing projects and new projects emerging. Baffinland Iron Mines Corporation, and its world-class Mary River iron ore deposit on northern Baffin Island, was purchased early in 2011 by ArcelorMittal S.A. and Nunavut Iron Ore Acquisitions. The Mary River project has entered the environmental assessment process, and the company is conducting geotechnical, engineering, and baseline studies needed to bring the deposit into production. Advanced Explorations Inc. conducted work at its Roche Bay and Tuktu projects, both located on the Melville Peninsula.

The Kivalliq region hosts all of the territory's active uranium exploration projects. AREVA Resources Canada Inc. controls the most advanced uranium project in Nunavut, Kiggavik, and expects to complete a draft environmental impact statement on the property by the end of the year. Cameco Corp. continued exploration at its Aberdeen and Turqavik uranium projects, as did Kivalliq Energy at its Angilak project.

Base metal exploration is focused in the Kitikmeot region. MMG Resources Inc. conducted drilling and surface exploration at its High Lake East and Izok projects; pending the outcome of the program, Izok will advance to a feasibility study and enter the permitting process in 2012. Sabina sold its Hackett River silver-rich volcanogenic massive sulphide (copper-zinc-lead-gold) deposit to Xstrata Zinc Canada Inc., along with those portions of the Wishbone property with base metal potential.

Diamonds are being explored for across the territory. Peregrine Diamonds Ltd. (with partner, BHP Billiton), discovered eight more kimberlite bodies at the Chidliak project on southern Baffin Island. Shear Diamonds Ltd. conducted an exploration program at the past-producing Jericho diamond mine as they evaluate the potential to bring it back into production.

Many projects returning positive results this field season suggests that activity will remain strong in Nunavut in 2012.

THE INFLUENCE OF LANDSCAPE SPECIFIC ECOLOGICAL RESPONSES TO OIL AND GAS LINEAR DISTURBANCES IN THE NORTH YUKON

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The return of oil and gas interest and activity in northern Canada will place increasing importance on the development and application of objectives-based guidelines and Best Management Practices (BMPs) for the petroleum industry.

BMPs are predominantly conceptual in approach, focusing on principles and objectives

and intended to manage risk. One of the values of objectives-based BMPs is to streamline the review of low risk activities and support a risk management framework. The corollary is that there must be a clear understanding of how to monitor effects of activities in a meaningful way that ensures that the BMP mitigation strategy is working and that the objectives set are the right ones.

In northern Canada and Alaska, evidence of seismic exploration remains from the 1960's and 70's. Many of these features still remain as visual scars and evidence that there has been a change of some sort on habitat and groundcover. The status of natural recovery varies with the conditions under which the lines were constructed in the first place. Although some studies have been carried out on the recovery of these lines in Alaska, none has been done until recently in the North Yukon.

A key question for this study was the definition of the words "disturbance" and "recovery". What do we use for criteria in the determination of whether a site is disturbed or not, and when do we consider that a site has recovered? A key tool that was considered was a comparison with natural disturbance regimes in the study area. Regardless of whether or not a linear feature is still visible, if the ecological function had not been affected and the successional trajectory follows that of the natural disturbances, is the site disturbed or recovered?

This presentation addresses the historical residual effects of oil and gas exploration activity from the 1960's and 70's in the north Yukon and the lessons that can be learned from understanding the ecological context as well as the anthropogenic influences behind the recovery successes and failures.

IMPLEMENTATION OF INTEGRATED MONITORING AND RESEARCH AT A NORTHERN RESEARCH BASIN

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Natural resource management in the North is complex as values associated with environmental sustainability are being considered in the context of increasingly valuable economic sectors competing for limited supplies. Monitoring is crucial to management because it permits characterization of the environmental component(s) of interest. Observing networks can no longer be satisfied with reporting on mere abundance as demand grows for information that can support decisions within the complexity and extensiveness of long term environmental and social change. The ability to generate the information necessary to meet societal needs, be they for environmental, planning or development purposes, requires multidisciplinary efforts to understand coupled biogeophysical processes. Developing the environmental science and monitoring capacity to be able to respond to this fundamental change in natural resource management will require a fresh approach to how research and monitoring are related in the North. This presentation addresses this subject by describing the necessary attributes of a framework of integration, using a northern Canadian research basin as an example. At the Baker Creek Research Basin, located 5 km north of Yellowknife, NWT, multidisciplinary research and monitoring has addressed questions regarding the impacts of climate change on taiga shield water resource management. In particular, a 1997 upward shift in winter streamflow can be attributed to a trend towards higher autumn rainfall. Furthermore, activation of runoff flow paths in deeper active layers associated with this upward shift in winter streamflow can impact aquatic chemistry.

EFFECTS OF DEVELOPMENT ON CARIBOU: INSIGHT FROM TK AND AN ECOLOGICAL MODEL

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Kugluktuk is situated on the Coppermine River downstream of the Ekati and Diavik mines. Within the traditional hunting area of Kugluktuk are mineral exploration camps and several mine developments in various stages of operation. Recognizing the social, cultural, and economic value of barren-ground caribou to Kugluktuk and responding to recent caribou population declines, the Kugluktuk Hunters and Trappers Organization worked with Golder Associates Ltd (Golder) to initiate a study considering traditional knowledge and existing science, funded and assisted by the Nunavut Wildlife Management Board.

The goal of the study was to use both 'ways of knowing' to investigate questions relating to the effects of development on caribou. This was completed using an energetics model, spatial data collected from long-term monitoring of collared animals and directed interviews with local elders and hunters from Kugluktuk. Through these processes we gained insight into if and how human developments in the Central Arctic are affecting caribou.

The ecological model and the TK information suggested that current development has a low impact to caribou. Most aspects of human activity are energetically costly to caribou in that caribou exhibit avoidance behaviour; however, caribou are also reported to be attracted to developments to seek refuge from predators, insects and the sun. The nature of these interactions is still not fully understood and some questions need to be better addressed in order to support management decisions regarding the coexistence of the developments and the caribou. Further, more interviews with community members must be carried out in light of the low numbers interviewed for this work. Our research shows that TK and science can both contribute meaningful input and are often complementary rather than overlapping. A full discussion of a topic such as caribou requires both ways of knowing. The training of two students was a key component of the completion of the project.

GEOLOGICAL AND PROJECT UPDATE: JERICHO DIAMOND MINE, NUNAVUT

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The 250,000 acre Jericho Project, is host to Nunavut's first and only diamond mine that was acquired by Shear Diamonds Ltd. in 2010. Shear's workplan includes the following 2011-2012 objectives: refinement of the geological model and current resource for the Jericho Kimberlite Complex, increased mineral processing improvements for diamond recovery and trial processing of high grade stockpiles, renewal of the full Type A water license, and exploration to discover new kimberlites. To fast track the project Shear has put in place an aggressive ongoing multidisciplinary program.

Geographically Jericho is located 420 km northeast of Yellowknife south of the communities of Cambridge Bay and Kugluktuk in the Kitikmeot region of Nunavut. Geologically the project is in the Slave Geological Province within the Contowyto-Itchen Lake region and is largely underlain by Archean granitoid rocks.

Jericho produced 780,000 carats of diamonds from 1.2 million tonnes of kimberlite mined from 2006 to 2008 from the open pit operation. In excess of $200 million in past investment includes a 2,000 tonne-per-day diamond recovery plant, maintenance plant, fuel farm, offices and accommodation for 225 staff. Shear's current NI 43-101 diamond resource (2010) totals 1.82 million carats Indicated and 1.13 million carats Inferred. An additional

65,000 carats is readily accessible in a 156,000 tonne surface stockpile.

In 2011 Shear developed a new geological and 3D model for the JRC, discovered in 1995. The 175 Ma JRC is interpreted as a series of pyroclastic kimberlite eruptions that were emplaced in a general south to north direction from two vents known as the South/Central and North Lobes. Geologic complexity arises from the mixing of these events as well as the presence of remnants of interpreted earlier phases found in areas not previously identified. The new interpretation uses all available historical drillcore complemented by petrographic sections resulting in 21 newly interpreted geological kimberlite phases and 12 main modeling domains.

Additionally, a comprehensive review of historic regional indicator mineral dispersion data from tills and historic kimberlites at the Jericho Project and surrounds has defined 20 unsourced indicator mineral dispersion trains. The diamond potential in the Jericho area is driven by the presence of diamond-associated low-chrome eclogitic and websteritic paragenesis in the garnet population. The presence of high-Cr G10 suggests phases not yet tested or not yet discovered kimberlites that have peridotitic diamond potential (G10 pyrope garnets). Ongoing exploration is focused on these high priority sources.

Shear also recovered an initial 200 carats of diamonds from 22 wet tonnes processed at the Jericho on site recovery circuit and trail tests continue. Previous audits conducted by Shear confirmed a sample grade from this recovery reject pile of 11.3 cpt, with an estimated at 18,000 tonnes.

This talk will highlight a summary of the project with focus on Shear's new geological model and regional work, concluded with future plans.

THE BENIAH FAULT ZONE: CRUSTAL RESPONSE TO PROTRACTED ACTIVITY WITHIN THE SLAVE'S LITHOSPHERIC MANTLE

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Two principal north-south features transect the crust of the central Archean Slave craton. The first is the eastern boundary of the Central Slave Superterrane (CSST) against more-juvenile terranes and an apparently congruous boundary based on Pb-isotope ratios in synvolcanic galena. This domain boundary transects the Lac de Gras (LDG) kimberlite field at depth and reveals minimal signature in the underlying lithospheric mantle. The second is the Beniah fault zone (BFZ) that, at surface in the southern craton, passes about 35 - 65 km west of the domain boundary. The BFZ is an anomalous and isolated feature that is constrained to a few kilometres width along much of its length, although it bifurcates into multiple strands over about 30 km width in the central craton. Similar rock types on both margins of the BFZ suggest apparent sinistral offsets of 8 – 15 km across the zone. Where documented, fault surfaces within the BFZ dip steeply eastward with moderate to shallow (17 - 36°) south-plunging lineations that suggest several kilometres of east-side-up displacement accompanied the sinistral offset. About 83% of the 2.57 – 2.60 Ga polymictic conglomerates of the Slave craton are preserved within the BFZ and this suggests tectonism along the BFZ at that time. The BFZ overlies a mantle discontinuity reflected in lithospheric "stratigraphy" determined from kimberlite-garnet xenocrysts and in various geophysical studies.

The principal foliation-forming deformation of the Slave crust at ca. 2.6 Ga is associated with intense shortening, over-thickening, and the peak of metamorphism. Comparable shortening and thickening of the underlying lithosphere is improbable, such that decoupling of the lithospheric mantle and the lower crust is inferred. Interpretations of the SNORCLE

seismic section across the southwest Slave craton suggest Archean lithospheric mantle extends about 120 km farther west than the overlying Archean crust, and this may reflect in part the proposed decoupling at or near the Moho.

A schematic cross section of the southern Slave lithosphere has the principal crustal boundary (eastern CCST) about 100 km east of the principal mantle discontinuity below the BFZ, and it is postulated that these two features were contiguous prior to the proposed decoupling at 2.6 Ga. The BFZ is viewed as the response in coherent crust to subsequent tectonic activity along a major boundary in the underlying mantle. The BFZ acted as a crustal "stress boundary" throughout much of the Proterozoic, as is suggested empirically by contrasting Paleoproterozoic fracture systems across the zone. Most spectacularly, the ca. 1170 Ma Munn diabase dyke, traceable for more than 300 km, has contrasting strike orientations and en echelon step-directions on opposing sides of the BFZ. The cross section also introduces the concept of Churchill lithospheric mantle below Slave crust. Employing the wedge-tectonics model observed in most Precambrian terranes where overthrust terranes are associated with similarly vergent subduction, the obduction of Churchill crust over the Slave craton during the Thelon orogeny suggests Churchill lithospheric mantle may be subcreted to Slave lithosphere. This concept may help explain the recovery of Mesoarchean diamonds and xenoliths from deep LDG samples.

COMPARATIVE STUDY OF DEGRADED AND PRISTINE GIANT LAKES OF NORTH AMERICA USING ECOPATH

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Sustainable use of fisheries resources is important for the Northern communities. An ecosystem approach to fisheries management is effective for maintaining sustainable fisheries and healthy ecosystems. Ecosystem health is comparatively a new approach used in environmental management and refers to the condition and functioning of an ecosystem in comparison to the normal conditions and functions. Deterioration of the major aquatic ecosystems due to cumulative effects has strengthened the need for the development of operational indicators of ecosystem health. The goal of our research is to develop relatively simple and robust models and metrics that fisheries managers can use to explore the whole system management strategy for fisheries and to determine the risk of degradation of ecosystem health.

Trophic network analysis can be used to quantify the health, integrity, and maturity of ecosystems and to evaluate the magnitude of stress imposed on an ecosystem by fisheries, other anthropogenic activities, and climate changes. A current method to analyze ecosystems is to use mass-balance and dynamic simulation modeling. Ecopath (a mass-balance modeling approach) is an important tool for exploring the ecological consequences of human activities, climate change and improving our knowledge of ecosystem functioning and health. It incorporates ecosystem considerations into fisheries management and provides a dynamic simulation capability at the ecosystem level using the biomass, production, consumptions and exploitation data for all the functional groups.

The main objectives of this research project are to develop trophic network models of Great Bear Lake and Great Slave Lake in NWT using Ecopath and available scientific and local environment & fisheries data. The project will also propose a series of ecosystem health metrics and indices taking into account the trophic models of other great lakes in Canada. The proposed project addresses not only the research on cumulative impact of fisheries exploitation, pollution, water quantity and climate change but also the community capacity building and takes into all the key activities identified in the NWT CIMP. It will help to evaluate the magnitude of stress imposed on the great lakes ecosystem by

fisheries and global changes. The project will also promote the sharing of knowledge between traditional knowledge holders and scientists and foster stewardship among the local communities.

PRAIRIE CREEK MINE: THE CONTINUING SAGA

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The challenges related to the development of any mining operation are many and the location of the Prairie Creek Mine adds some unique hurdles that needed to be overcome in order for it to become a future viable operation.

The Prairie Creek Mine is located in the Mackenzie Mountains, 200 kilometres west of Fort Simpson in the Northwest Territories. A high grade base metal Pb-Zn-Ag-Cu discovery in 1928, it has since become a significant project to the region through subsequent and successful exploration and underground development. In 1982 Prairie Creek mine was fully permitted and most of the mine infrastructure was built but the mine was never operated.

Prairie Creek hosts a NI 43-101 compliant Measured and Indicated mineral resource totalling 5.8 million tonnes grading 10.7% Zn, 9.93% Pb, 161 g/t Ag and 0.3% Cu. In addition there is an open-ended inferred mineral resource of similar tonnage and grade. This defined resource is sufficient enough to support a 20+year mine life and on this basis the company applied for operational permits to support a mine at Prairie Creek.

At the Prairie Creek Mine high grade base metal mineralization occurs within vein and stratabound-type geological settings. The high grade vein is located within a steeply dipping fault zone that cross-cuts carbonate sedimentary sequences in close proximity to the axial plane of a regional antiform. Diamond drill exploration in 2011 included an aggressive 1.6 kilometre step-out deep hole program to test for the down plunge extent of the vein structure.

The recently proposed underground mine plan includes milling rates of 1,000 tpd to produce lead and zinc concentrates to be trucked out on a winter road. Significant enhancements to the operation include installation of a new dense media separation plant, paste backfill plant, diesel generators and a new water treatment plant.

Operating applications for the Prairie Creek Mine were submitted to the MVLWB in June 2008 and were subsequently referred to Environmental Assessment under the Mackenzie Valley Environmental Review Board.

The Nahanni National Park surrounds the 300 square kilometre project area resulting in perhaps closer scrutiny of the project during the environmental assessment (EA) phase. The key line of enquiry of the EA is water quality management. A unique aspect of our management of this issue relates to the large variability in seasonal and daily flows experienced in the Creek. The Company is proposing a treated volume discharge strategy which is a load-based approach that is directly proportional to the flow volume in Prairie Creek at any given time. Maintaining a constant ratio of treated discharge versus creek flow will prevent any significant adverse environmental impacts occurring within the receiving waters. The public registry for the EA officially closed on September 22, 2011 and the Company is awaiting the Report of the Environmental Assessment from the Review Board.

THE LINK BETWEEN TAILINGS POND GAS GENERATION AND UNSTABLE ICE CONDITIONS: COLOMAC MINE REMEDIATION PROJECT, NORTHWEST TERRITORIES

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Aboriginal Affairs and Northern Development Canada (AANDC), formerly INAC, assumed responsibility for the Colomac Mine, a former gold mine, located approximately 220 km north of Yellowknife, NT in April 1999.

During mine operations (1990-1997), cyanide bearing tailings were deposited in Tailings Lake, located 5 km north of the main mine facilities. In 2002-2003 high cyanide concentrations in Tailings Lake were treated using an Enhanced Natural Remediation (ENR) process, which involved the addition of mono-ammonium phosphate (MAP) to Tailings Lake (and Zone 2 Pit) to facilitate bioremediation of cyanide by naturally occurring algae and bacteria. Exposed tailings beaches were capped with waste rock in 2006 to prevent wildlife exposure to the tailings via direct contact and dust inhalation.

As early as 2002, areas of gas generation have been observed in Tailings Lake resulting in development of areas with poor ice quality, some of which remain as open vents throughout the winter period.

In response to health and safety concerns associated with poor ice quality, an investigation was initiated in October 2009 to identify gas generating mechanisms in Tailings Lake. A two phase investigation, completed in October 2010, included the collection of gas, water quality, and sediment samples, bathymetry data, and isotopic analysis of gas samples (Golder, 2011).

The investigation indicated that gas generation was primarily associated with and/or immediately down gradient of capped tailings beaches located at the south end of Tailings Lake and to a lesser extent in the capped mid-lake tailings beach located on the east shore. Gas sample compositions were similar to atmospheric gas composition, with elevated carbon dioxide and methane concentrations, and possibly hydrogen gas. Multiple physical, chemical and biological mechanisms were hypothesized to be contributing to gas generation, including organic matter biochemical degradation, possible biochemical degradation of cyanide residuals in tailings underlying the waste rock cap, and reconsolidation/re-saturation of tailings beaches.

This investigation examines the link between gas generation in tailings lakes/ponds and the development of poor ice conditions, which constitutes a potential health and safety concern at mine remediation sites. Several health and safety measures to restrict access to Tailings Lake have been put into place including the placement of waste rock barriers to warn approaching snowmobilers, warning signs posted at the high water level mark, and dissemination of public safety announcements.

As similar processes may be active in other tailings ponds, mine and exploration project operators, environmental assessors, and mine remediation personnel need to be aware of the potential for weak ice formation in tailings ponds as a potential health risk when conducting work and post closure monitoring at these locations. Further research is required in order to better understand the processes that may contribute to the generation of gas in tailings ponds to determine if these processes are similar to or different than mechanisms that account for the generation of methane and hydrogen sulfide in anoxic water bodies and wetlands.

THE ROLE OF PALEOECOLOGY IN ENVIRONMENTAL MONITORING PROGRAMS

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Discriminating natural ecosystem variations from the influence of climate change and natural or anthropogenic disturbances is one of the central challenges of northern monitoring programs. Because the environmental impacts of human activities often manifest over decades or more, long-term monitoring data is typically needed to assess whether human activities are altering the ecosystem. In this regard, long-term data are often critical for defining baseline (pre-impact) ecosystem states. Paleoecological techniques can provide the means to track long-term environmental trends and disentangle the influence of multiple stressors on environmental change. By analyzing the environmental indicators preserved in tree-rings and lake sediment records, paleoecologists can reconstruct ecosystem change over multiple time scales, from annual to millennial. Paleoecological techniques can be used to extend modern environmental monitoring programs, compliment traditional knowledge records, and provide a historical context for modern environmental change. Paleoecological techniques have been used in numerous environmental monitoring programs, including: A) Assessing the impacts of acid rain; B) tracking changes water quality and quantity; and C) tracking contaminant levels in many regions of North America and Europe. Examples of ongoing paleoecological research in the Northwest Territories will focus on studies examining the impacts of natural climate variability and extreme weather events on the Mackenzie Delta ecosystem, and assessing the impacts of permafrost degradation on freshwater systems. This presentation is intended to provide those with an interest in environmental change and ecosystem monitoring with an overview of the science of paleoecology as well as the potential for utilizing paleoecological research in the monitoring of cumulative impacts in the north.

OVERVIEW OF TARGETED GEOSCIENCE INITIATIVE 4 (TGI-4) ORE SYSTEM PROJECTS: A NATIONAL, THEMATIC PROGRAM TO ENHANCE EFFECTIVENESS OF DEEP EXPLORATION

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Between 1980 to 2008, Canada's reserves of metals experienced a continuous decline, resulting in levels today that are less than half of those reported at the end of 1980. A key aspect contributing to this decline is the increasing rarity of surface discoveries in Canada forcing the exploration industry to explore even deeper for new resources. Even in established mining districts, there has not been substantive exploration below 300 m from surface due to limitations in geoscience knowledge of ore deposit and geochemical and geophysical methods. In light of this, NRCan renewed the Targeted Geoscience Initiative (TGI4) in 2010 for 5 years with a budget of $25M. The program focuses on providing industry with the next generation of innovative geoscience knowledge and analytical techniques that will result in more effective targeting of buried mineral deposits, thereby increasing discovery rates.

The first steps of TGI4 developed underpinning scientific hypotheses that define the critical knowledge gaps within ore systems of interest. These hypotheses, in turn, focus the collaborative efforts of geoscientists from the Geological Survey of Canada, provincial and territorial government surveys, industry and academia. In the summer of 2011, TGI4 launched its thematic, knowledge-driven

projects that are based around the following ore systems: 1) Lode Gold, 2) Nickel-Copper-PGE-Chrome, 3) Intrusion Related systems (e.g. porphyry), 4) SEDEX, 5) Volcanogenic Massive Sulphide systems, 6) Uranium and 7) Specialty Metals (e.g. Nb, REE). In addition, scientific studies within the fields of geophysics, geochronology and analytical geochemistry are being used to advance methodological development.

Unlike previous incarnations of TGI, the thematic nature of TGI4 means that individual projects are not centred on a geographic region, but instead integrate data and knowledge from multiple mining camps across Canada. In this way, the optimum deposits are used to support studies within a single ore system, in order to best achieve the program objectives.

COMMUNITY BASED MONITORING OF THE COASTAL AREAS IN THE COMMUNITIES OF THE INUVIALUIT SETTLEMENT REGION – PAST EXPERIENCE AND FUTURE PLANS

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The Arctic Coastal Ecosystem Studies (ACES) program is a Fisheries and Oceans Canada initiative that focuses on understanding of coastal ecosystem structure, functioning and health in the Canadian Beaufort Sea. ACES was launched in 2010 as an ecosystem approached pilot study in anticipation for the Tarium Niryutait Marine Protected Area (TN MPA). This study aimed at providing valuable baseline data on the ecosystem functioning that spanned from water geochemistry to fish dietary preferences. In 2011, in partnership with the community of Aklavik and Fisheries Joint Management Committee (FJMC), ACES carried out a second year of ecosystem based research and monitoring based out of Shingle Point. The program largely focused on the dietary preferences and energy pathways in the fish collected by both local fishermen and scientific fishing. With funding support from the Cumulative Impact Monitoring Program (CIMP) we collected data on 17 species of fish, including subsistently harvested Dolly Varden and whitefish. These samples are currently being analyzed for stable isotopes, lipids, fatty acids and contaminants. Knowledge of these parameters will be used to monitor ecosystem health in the coastal Beaufort Sea. These indicators of ecosystem function, structure and health will be assessed as potential long term indicators for community based monitoring at this site. In preparation for this the ACES program partnership with the community of Aklavik has helped to lay foundation for a long term monitoring program and has provided training and support while building links with local community members. We believe that data obtained from this kind of monitoring will serve as a valuable source of information on both natural ecosystem variability and human induced impacts. ACES serves as a model for a monitoring approach that may be used in other communities of the Inuvialuit Settlement Region (ISR). By combining information from all ISR monitoring programs we will build a stronger baseline understanding of the ecosystem that will better prepare us for potential threats to the environment including climate change, oil and gas development, increased shipping and occurrence of invasive species. The Fisheries Joint Management Committee (FJMC) is actively contributing to the design and development of the Inuvialuit Game Council (IGC) lead ISR wide community based monitoring program. This program will be guided by community concerns and priorities and integrate the management needs and priorities of the co-management committees. With a focus of building capacity within the communities to manage monitoring programs, the program will build on existing successful monitoring programs within the ISR while allowing for the incorporation of new monitoring efforts. Through this initiative we believe that a reliable and successful community based monitoring network can be achieved in the ISR.

IMPROVING COMPLIANCE, CAPACITY, AND COMMUNICATION: THE WEK'ÈEZHÌI LAND AND WATER BOARD`S APPROACH WITH COMMUNITY WATER LICENCES

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Water quality is an important issue for all NWT communities and is of special concern for aboriginal communities that engage in traditional land and water use activities. As the regulator mandated with providing for the conservation, development, and utilization of water resources in Wek'eezhii, the Wek'eezhii Land and Water Board (WLWB) requires detailed water-quality information in order to make responsible decisions regarding water and waste management. Monitoring is essential in order to understand background water quality, human and natural impacts on water quality, and the implications for aquatic ecosystems and human activities. Water-quality monitoring in and around the Tlicho communities of Wekweeti, Gameti, Whati, and Behchoko is a requirement of the municipal water licences administered by the Wek'eezhii Land and Water Board; however, adequate training and support to facilitate community-based water-quality monitoring has not been provided in the past. As a result, community-based water-quality monitoring has been intermittent or non-existent in recent years, limiting the ability of both the WLWB and the communities to make informed decisions related to water and waste management. To address this information gap, WLWB staff has been working collaboratively with the Tlicho communities to build local capacity for water-quality monitoring, focusing on the monitoring requirements of the community water licences, including: sampling procedures, reporting and record-keeping, communication and interpretation of results. Training workshops have been designed and delivered in three parts: the first is in the classroom discussing water licence requirements and water-sampling procedures, the second takes place in the field collecting water samples at SNP locations, and the third is a discussion of the results. Community staff members are provided with a field manual that describes the sampling locations, parameters, and procedures specific to the community, instructions for pre- and post-sampling logistics, and templates for record-keeping and annual reporting. To help foster understanding of water quality issues and to connect community staff with staff from the agencies responsible for various aspects of water management, the WLWB has worked collaboratively with other organizations, including: Environment Canada, GNWT – MACA, AANDC, and Ecology North. Community participants have included: community Senior Administrative Officers, foremen, land officers, water treatment plant operators, Chiefs and council members, and other interested community members. Early results of this initiative are encouraging. Although numerous challenges remain, regular water-quality monitoring was undertaken by community staff in Wekweeti and Behchoko during 2010, both of these communities submitted annual reports in 2011, and plans are in place for monitoring to begin in 2011 in Gameti and Whati.

MULTI-SCALE GEOSCIENCE INFORMATION FOR DECISION-MAKERS, GREAT SLAVE REGION, NWT

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Decision-makers typically require environmental geoscience information at range of spatial scales in order to accommodate their diverse needs. For example, broad, or region-scale information may be needed at an initial project scoping stage, local scale information at the planning, design and assessment stage, and site scale information at the licensing, construction, remediation and

reclamation stages. Thus, geoscience mapping information at various scales often forms and integral part of the knowledge base required by a suite of decision-makers. In many areas of the North, including the Great Slave region, this information is not available, which hinders the decision-making and regulatory process in the NWT.

Here, we present examples of geoscience information at three ranges of scale, which may be used for decision-making. Examples are drawn from research underway in the collaborative Great Slave – TRACS (Transportation Risk in the Arctic to Climatic Sensitivity) project. The examples shown draw upon the use of remote sensing methodologies, coupled with field validations and measurements, including Landsat and SPOT5 derived surficial and vegetation mapping, InSAR (interferometric synthetic aperture radar-derived subsidence, and LiDAR (light detection and ranging) derived topography and terrain analysis.

At a regional-scale, topographic data used to generate digital elevation models (DEMs) may be coupled with Landsat7 and SPOT5 imagery to derive regional surficial and vegetation cover maps, and to define potential permafrost and geotechnical conditions within the Great Slave region required at the initial phase of projects. This is illustrated with preliminary surficial and vegetation maps for the Yellowknife region applicable to scoping-level decision-making. At a local scale, topographic data at 1-4m spatial resolution are used to derive baseline DEMs to calculate surface subsidence at centimetre resolution from InSAR. Examples of InSAR derived subsidence maps for the Yellowknife area and NWT Highway 3 are shown as applicable to the planning-level stages of decision making. These data, in turn, may be validated with on-the-ground elevation surveys or from LiDAR which provide information at the local-level. An example of LiDAR derived site scale topographic information for Highway 3 is shown as applicable for remediation stage activities. These examples illustrate how multi-scale geoscience information provides input at all levels of decision-making and for meeting regulatory requirements.

THE SAHTU LAND USE PLAN – A PIECE OF THE PUZZLE

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The Sahtu Land Use Planning Board (SLUPB or "the Board") was established under the *Sahtu Dene and Metis Comprehensive Land Claim Agreement (SDMCLCA)* and the *Mackenzie Valley Resource Management Act (MVRMA)* to develop a land use plan for the Sahtu Settlement Area that provides for the conservation, development and use of land, waters and other resources of the settlement area.

The Board has been working with Sahtu communities, the Sahtu Secretariat Incorporated (SSI), government, regulators, industry, environmental organizations, and other parties for 15 years to develop the Sahtu Land Use Plan. We are nearing completion. The Board held a public hearing on Draft 3 of the Plan in May 2011. We are holding technical workshops this fall to work through outstanding process and implementation questions with all affected parties to enable a smooth implementation process. The Board will consider the results of these workshops, make final revisions to the Plan that it deems appropriate, and submit the Plan to SSI, the GNWT and AANDC for approval in the spring of 2012. All three Parties must approve the Plan. It becomes legally binding on the day it is approved by the Minister of AANDC.

Several reports have been written over the last decade highlighting issues with the northern regulatory system, including the 2005 NWT Environmental Audit, the 2005 Auditor General's Report, the McCrank Report. All have identified the lack of approved land use plans as an issue – they are an essential piece of the regulatory system needed to make it work

effectively. Land use plans lay out fundamental rules for development, through zoning and general conditions, which promote community values and interests as the communities have defined them. Setting these requirements at the outset of the regulatory process enables projects to be better designed to meet local needs and priorities, and reduces conflict in later stages of the regulatory process, which can delay approvals.

An approved Sahtu Land Use Plan will be a reality within the next few years. Like any new process, there will be some growing pains as all participants become accustomed to the Plan's implementation requirements. The current workshops are an attempt to reduce those issues as much as possible. The Plan includes a reasonable degree of flexibility within many of the conditions, as well as provisions for exceptions and amendments. A full review of the Plan is required after 5 years.

The Board has had excellent industry participation in the planning process and has worked diligently to address key issues that have been raised. We encourage those who are not yet familiar with the Plan to keep informed of the process (www.sahtulanduseplan.org) and begin reviewing the Final Plan once it is completed next spring. Once approved, all land use activities must comply with the Plan to get regulatory approval.

NEW UNDERSTANDING OF ORDOVICIAN STRATIGRAPHY AND OIL SHALE ON SOUTHERN BAFFIN ISLAND, NUNAVUT TERRITORY: PRELIMINARY FIELD DATA

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Southern Baffin Island retains part of Foxe Basin, one of the Paleozoic sedimentary basins in Canada. The Ordovician on southern Baffin Island is divided into Middle Ordovician Frobisher Bay Formation, and Upper Ordovician Amadjuak and Akpatok formations consisting mainly of carbonate with minor shale. The previously interpreted Forster Bay Formation overlaying Akpatok Formation is not preserved on southern Baffin Island. The stratigraphy and hydrocarbon potential of the Ordovician sequence in Foxe Basin are poorly understood. Over the past few decades there has been considerable debate on whether there is oil shale within the Ordovician on southern Baffin Island. If there is, where is its stratigraphic position? Is it geographically widely distributed? Does it have any petroleum potential?

Answers to these questions are part of the Hudson Bay – Foxe Basin project under the GEM program. Field studies in 2011 were designed to test the stratigraphic position, geographic distribution and petroleum potential of the oil shale on southern Baffin Island. One oil shale interval was sampled in a large Paleozoic outlier by the Jordan River, which is stratigraphically in the lower Amadjuak Formation, rather than between Amadjuak and Akpatok formations as previously interpreted. Owing to facies change, this oil shale laterally changed into non-oil shale, which is seen on the western shore of Amadjuak Lake.

Forty-six samples were collected from different localities for Rock Eval Pyrolysis. The preliminary data show:

1) A 2-m-thick outcrop of lower Amadjuak Formation by the Jordan River gradually changes from black laminated papery oil shale to grey mudstone upwards. This interval contains TOC ranging 1.68%–12.97%, with an average of 7.79%. It is primarily immature Type I marine oil shale.
2) The black laminated papery oil shale rubble samples from various locations with the same lithology as those at above locality contain 8.83%–14.91% TOC, with an average of 12.68%. All the oil shale rubble samples show an immature nature. When plotted on van Krevelen diagram, rubble samples exhibit a Type I-II kerogen, which may be a false impression caused by the oxidation that tends to remove hydrogen and add oxygen to the kerogen.

3) The grey shale and mudstone samples from a 2–3-m-thick outcrop of lower Amadjuak Formation on the western shore of Amadjuak Lake only contain 0.31%–0.76% TOC, showing no potential.
4) The brown flaggy argillaceous limestone rubble from various locations is either on the outcrop of Amadjuak or Akpatok Formation and most likely belongs to the Forster Bay Formation which has been totally eroded off in the study area. The rubble samples contain 2.82%–5.13% TOC, with an average of 4.21%. The brown argillaceous limestone might exist in the offshore area as another low yield source rock.

In conclusion, the 2011 field study: 1) established the stratigraphic position of the oil shale interval in the lower Amadjuak Formation, Upper Ordovician; 2) demonstrated the oil shale laterally changed into non-oil shale; and 3) recognized another low yield interval in a higher stratigraphic level that has been eroded off in the study area.

DEVELOPING A STANDARD MONITORING FRAMEWORK FOR ASSESSING GREAT SLAVE LAKE FISH AND FISHERY CHANGES

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Since the mid-1940s, Great Slave Lake has supported the largest freshwater fishery in the Northwest Territories, Canada. The annual commercial harvest for Lake Whitefish and Lake Trout combined was over 4200 tonnes in 1948-1949. A marked decline of Lake Trout in the main basin occurred in the early 1970's, and the recent downturn of Lake Whitefish fisheries, less than 500 tonnes since 2006, has prompted research related to the state of the fisheries production. Intuitively, there were growing challenges related to the assessment of the fish population sizes without information from long-term fishery-independent surveys and cumulative impacts monitoring. Under the support of AANDC-CIMP and DFO-AFS, this study aimed to obtain a representative sample with the full size range of Lake Whitefish, which is normally truncated by the single-mesh-size commercial gillnet sample. A secondary objective was to measure fish community diversity through multi-mesh sampling. Our study was initiated by means of multi-mesh gillnets configured with ten different mesh-size panels. A depth-stratified random sampling protocol was developed to deploy pelagic- (5-m below the surface) and bottom-set gillnets at the 21 pre-designated locations of the western basin (areas IW and IE) between July 10 and August 14, 2011. These data were collected in combination with limnological measurements, such as temperature, dissolved oxygen, depth, and pH, to allow for the identification of associations between the fish community and relevant environmental variables. Examination of these associations will provide a better understanding of how cumulative effects such as environmental variability can influence the stability of fish community and the sustainable fishery production. It may also facilitate the baseline of GSL fish and fisheries as a part of EA prior to economic development. Through this first-year of field sampling, we collected fish from 12 pelagic-and 14 bottom-sets, with a total of 17 species, 5272 individuals and 1.1 tonnes. Analysis of variance showed that fork length and round weight of Lake Whitefish statistically differed between areas and strata. Using an index of relative importance (IRI), the dominant species were found to be ciscoes and Lake Whitefish whose cumulative percentages made up >90% of the fish community. Between areas IW and IE, the species-specific individual compositions were similar, but somewhat different in biomass-based composition, especially for the spatial distribution of benthic Longnose Sucker. Multivariate statistical analyses showed that depth significantly influenced the biomass distribution in the benthic fish community, while temperature strongly dictated spatial distribution of the cold-

water fish community. There may be other abiotic variables or biological components that need to be integrated into future monitoring, but these preliminary results highlight the significance of the cumulative impacts of natural fluctuations, such as water level, water temperature, and exploitation. Within an aquatic ecosystem framework, these factors may dramatically affect the sustainability of fishery production and the stability of the fish community by influencing fish growth rate, prey-predator relationships, and habitat requirements.

GWICH'IN HARVEST STUDY: A TOOL FOR CUMULATIVE IMPACTS MONITORING

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The Gwich'in Harvest Study (GHS) administered by the Gwich'in Renewable Resources Board (GRRB) uses traditional and local community knowledge provided by harvesters to monitor impacts on wildlife populations due to anthropogenic and environmental pressures within the Gwich'in Settlement Area.

Harvesters are the ears and eyes on the land. In addition to collecting information on harvested animals and condition of wildlife harvested or seen, data provided by harvesters can also assist managers in assessing the cumulative impacts of land use (eg. proximity of harvest to roads) or access methods (eg. snowmachine, vehicle) to wildlife populations and through habitat and weather conditions reported by harvesters, can help to make inferences about other cumulative impacts to wildlife populations. Data collected is used to make wildlife management and land use planning decisions.

The original GHS was conducted from 1995-2004 to fulfill requirements under the Gwich'in Comprehensive Land Claim Agreement and collect information on resource use for the GRRB. Hunters were interviewed monthly and asked to recall their hunting, fishing or trapping activities for the previous month. Interviewers recorded the number of animals harvested, age class and sex of animals harvested. Harvest locations were recorded by name as well as by location using a map grid code. The GHS was conducted in the Gwich'in Settlement Area of the Northwest Territories, Canada in the communities of Aklavik, Inuvik, Fort McPherson and Tsiigehtchic. The target population was Gwich'in participants who were expected to hunt, trap or fish at least once in the upcoming year. Individual harvester's data is confidential. Methods and collated results are available in the Gwich'in Harvest Study Final Report published in 2009

The GHS was re-established in 2008 in order to continue collecting data on the frequency and type of harvest; age class and sex of animals harvested; and grid location. In addition, harvesters are asked to provide data on their observations of the condition of the animals harvested; unusual wildlife sightings, landscape or weather observations.

Changes in the land and species distribution are expected to impact Arctic regions rapidly due to changes in climate. In recent years, there has been increased interest in conducting scientific environmental monitoring projects in the north. However, many of these projects are administered and conducted by southern researchers focused on physical and biological scientific research. In many of these studies, critical information may be missed that can be provided by the observations and Traditional Knowledge of local residents who are familiar with the landscape and can readily identify and monitor changes.

Harvester observations and the use of Traditional Knowledge help us monitor changes in the environment due to climate change and development that may adversely impact species. The information derived from this study will be used by the GRRB and can be used by other wildlife managers to make resource management decisions in the GSA for CIMP Valued Component (VC) species including caribou, moose, Dall's sheep and musk-ox.This project also facilitates the creation of partnerships in cumulative impact monitoring research between various organizations, the government and communities.

PETROLOGY, GEOCHEMISTRY, AND U-PB GEOCHRONOLOGY OF ARCHEAN FERTILE GRANITIC PLUTONS AND ASSOCIATED PEGMATITES IN THE SLAVE PROVINCE: PRELIMINARY RESULTS

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The Prosperous granitic suite is a series of fertile plutons located approximately 40 km northeast of Yellowknife, and includes the Prosperous, Sparrow, Prelude, and Hidden Lake plutons. The plutons are discordantly hosted in metasediments of the Burwash Formation, Yellowknife Supergroup. This suite is characterized by increased levels of rare-metals, including tantalum, niobium, and tin. Simple zoned to unzoned pegmatites, centimetres to several metres in width, cross-cut these granites and their immediate hornfeled zones. Complex spodumene-tantalite-bearing pegmatites, including the Riber, Nite, and Pancho Villa pegmatites, are found proximal to these plutons, hosted in metasediments localized along structures. These dykes are thought to represent periodic discharges from an evolving (fractionating) magma chamber.

The objectives of this study include: (a) provide geochronological constraints on the Prosperous suite and associated pegmatites; (b) use muscovite trace-element geochemistry and *in situ* gamma-ray spectrometry to identify patterns throughout the plutons that may help to distinguish episodic magmatic injections; (c) characterize the mineralization potential of the plutons and pegmatites; (d) determine whether the complex pegmatites are genetically related to the Prosperous Suite; and (e) compile the muscovite trace-element geochemistry within across the pegmatites to contribute to the development of a geochemical tool for pegmatite exploration.

The Prosperous suite plutons were sampled and observed over a two week period in the fall of 2011. Field observations show that the granite is mainly a homogenous, equigranular muscovite leucogranite with varying percentages of biotite. Foliation of both micas exists in some areas The Prosperous suite plutons were sampled and observed over a two week period in the fall of 2011. Field observations show that the granite is mainly a homogenous, equigranular muscovite leucogranite with varying percentages of biotite. A flow (?) foliation of both micas exists in some areas. The simple pegmatites hosted within the granite are poorly zoned and comprised of quartz – albite – K-feldspar – muscovite ± tourmaline, beryl, fluor-apatite, and garnet. The complex pegmatites hosted by the metasediments are complexly zoned and are comprised of quartz – albite – K-feldspar – muscovite – tourmaline – spodumene ± columbite-tantalite, beryl, fluor-apatite, garnet, and cassiterite.

Gamma-ray spectrometry readings were systematically acquired *in situ* over the expanse of the plutons, and helped to identify targets for U-Pb geochronology. Equivalent uranium and thorium analyses ranged in value, up to 422 ppm eU and 143 ppm eTh. Previous dating of the Sparrow Lake Pluton by Davis and Bleeker (1999) showed an age of 2596±2 Ma (U-Pb zircon). This study will re-examine this age, provide further geochronological constraints, and ultimately a more complete model for the formation, emplacement, and extreme fractionation involved in the Prosperous granites and derivative pegmatitic bodies.

EVALUATING THE NORTHERLY EXTENT OF THE SLAVE CRATON IN THE CANADIAN ARCTIC

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There has been considerable economic and academic interest the central Slave Craton. In contrast, significant portions of sub-continental lithospheric mantle (SCLM) underlying northern Canada have not been subjected to extensive petrological, geochemical, and geochronological study. In particular, the northerly extent of deep Canadian cratonic lithosphere, especially of the Slave Craton, is poorly constrained at this time. Improved knowledge of the extent of cratonic mantle and its thermal history will have important implications for future diamond exploration in northern Canada.

We are conducting a study of coarse-grained kimberlite-borne peridotite xenoliths recovered from drill cores of; 1) the Snowy Owl (SnO) kimberlite field (257 ± 3.0 Ma to 271.2 ± 2.6 Ma; U-Pb perovskite and Ar-Ar phlogopite ages, respectively[b,c]) in central Victoria Island, and 2) Darnley Bay (DB) kimberlites of the Parry Peninsula (261.2 ± 8.7 Ma, isochron age). The majority (n = 11, 85 %,) of the studied suite of SnO xenoliths (n = 13; 1-11cm max. dimension) are garnet-harzburgites (+/- spinel, chromite, phlogopite and/or sulphides), with subordinate (n= 2; 15%) garnet-bearing websterites (+/- phlogopite). The DB xenoliths (n = 14, 1.5-8.5cm max. dimension) are relatively fresh, with glassy olivine fracture surfaces preserved. The DB xenolith suite is dominated by harzburgites (+/- chromite and/or sulphides, n = 13) with subordinate dunite (+/- minor sulphide; n = 1).

The SnO and DB xenoliths selected for this work will be subjected to mineralogical investigations to; 1) compare both suites with typical cratonic depleted residual mantle and evaluate the possible presence of Archean mantle in these areas, 2) appraise petrological similarities and differences with portions of mantle recovered from the central Slave Craton, 3) assess the composition and degree of lithological variation in SCLM underlying these regions, and 4) constrain the nature of the local geotherm. This information will be used to evaluate whether the deep lithosphere beneath these two regions represents; 1) northerly or northwesterly continuations of the Slave Craton, or 2) discrete cratonic blocks. The outcomes of this work are of major importance for understanding the tectonic evolution of Arctic Canada and the diamond potential of its mantle.

[b] Heaman, L., Kjarsgaard, B.A., and Creaser, R., 2003, Lithos, 71, 153-184
[c] Kolebaba, M., Read, G., Kahlert, B., and Kelsch, D., 2003, 8th Internat. Kimberlite Conf., 1.P8

ESKERS AS MINERAL EXPLORATION TOOLS: HOW TO SAMPLE ESKERS AND INTERPRET DATA

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Eskers on the Canadian Shield are commonly sampled during mineral exploration campaigns. This practice has led to the discovery of mineral deposits, including the Lac de Gras kimberlite field, NWT. Despite this, few non-proprietary studies have been conducted to help understand how to best sample eskers for indicator minerals and how to interpret esker data. To gain insight into this problem, we have reviewed over 100 years of esker-related literature. The review reveals that (1) mineral exploration companies commonly apply stream sampling guidelines to eskers, in that they target gravelly facies, the idea being that these facies are more likely to

contain more heavy minerals than sandy facies; and (2) indicator mineral dispersal trains in eskers are of similar length to those in the underlying till from which they were sourced, but are displaced downflow by one to several tens of kilometres.

Knowledge gaps identified during the review are being addressed by research at the Geological Survey of Canada under the Geomapping for Energy and Minerals (GEM) program. An integrated approach has been adopted in which esker dispersal trains are examined at all scales, from hundred-kilometre long tree-shaped esker networks to microscopic abrasion features on individual clasts. At the largest scale, a semi-automated technique for mapping eskers has been developed using digital elevation models and spectral remote sensed data that will help quantify esker dimensions (e.g., volumes) over large expanses of terrain. This could be used to accurately assess the amount of esker-related aggregate in northern Canada. In addition, it could provide insight into how eskers form—esker cross-sections might increase steadily downflow if the esker formed in a single long subglacial stream conduit, whereas such trends might be lacking if the esker formed in segments. At a regional scale, as part of a Mineral and Energy Resource Assessment project, 500 till and esker samples were collected near the East Arm of Great Slave Lake, NWT. Heavy minerals in the samples, interpreted to be derived from bedrock sources east of the study area, decrease in abundance in a nearly parallel fashion in eskers and till downflow (westward) across the study area. These trends are similar to those identified previously in eskers elsewhere, and reinforce the idea that indicator mineral dispersal trains in eskers generally do not extend far past those in the underlying till. At a local scale, heavy minerals in an esker in Northern Ontario occur in greater abundance in sandy than gravelly facies, which brings into question the common practice of targeting gravelly esker facies when sampling for indicator minerals. At the smallest scale, tumbling mill experiments have been carried out that show kimberlite clasts abrade (lose mass) 3 to 3500 times faster than typical Shield lithologies as they are transported across the landscape, which may explain the anomalously high concentrations of indicator minerals at the heads of some kimberlite dispersal trains. In concert, these research initiatives are helping provide mineral exploration companies with knowledge needed to increase exploration success while searching for mineral resources in Canada.

KIMBERLITE INDICATOR MINERALS AND "LATERITE", CANADIAN ARCTIC

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Talmora Diamond Inc. is exploring an upland plateau of flat lying Paleozoic dolomite in the Horton River area about 400 kilometers east of Inuvik and 100 kilometers south of Paulatuk on Canada's Arctic coast.

The dolomite shows up as a brown area on Google Earth and is surrounded by a green area underlain by Cretaceous mudstones. Till samples, from the Cretaceous area, contain the normal suite (ilmenite, spinel, garnet and chrome diopside) of kimberlite indicator minerals (KIMs) but those from the dolomite area are deficient in garnets and chrome diopside.

The Talmora property was selected on the basis of anomalous numbers of ilmenites and spinels in stream samples and the improvement of the mineral chemistry of kimberlitic garnets towards the Talmora property, at least to the edge of the brown area where the garnets become rare.

Ferricrete cobbles occur in tills of the dolomite area especially down-ice of magnetic targets and appear to be of local origin. The present land surface is the source of the ferricrete and KIMs, and proper interpretation of KIM recovery must consider the ferricrete. In humid tropical climates pyrope is readily decomposed by chemical weathering while ilmenite and spinel is resistant.

ODM laboratory noted that the first concentrates from the area contained "few heavy minerals and the KIMs are biased to the heaviest (oxide) species, indicating significant KIM loss" They noted goethite as a major constituent of many concentrates. HDM laboratory noted that the surface of the few garnets showed corrosion features and some oxides showed surface alteration. De Beers laboratory noted diagenetic rutile coatings on ilmenite and diagenetic alteration of pyrope grains (etch pits, colour leaching and weakening of grains). They noted "laterite" as a major constituent of the background mineralogy.

Sanatana explained magnetic anomalies west of Talmora as remnants of a flat-lying, iron-rich, paleo-weathered ("laterite") horizon just beneath the till cover. A fan of diminishing high Mg+Ca values down-ice of Talmora has high Fe values furthest down-ice. The Fe may represent an iron rich or "laterite" surface eroded first by the advancing ice. Absence of Fe nearest Talmora indicates almost complete removal of the "laterite" from the dolomite surface before the end of glaciation.

Sanatana noted that KIMs in the train down-ice of the Dharma kimberlite are underrepresented in G-10 garnets compared to the pipe suggesting a preferential destruction of the early G-10 garnets by diagenesis. Preferential destruction of G-10 garnets can also be seen down-ice of some Darnley Bay kimberlites.

Ferricrete ("laterite") provides evidence of a humid and tropical climate in the Talmora area that may have been the Eocene Thermal Maximum 55 million years ago. Silicate KIMs in exposed kimberlites, and G-10 garnets preferentially, would be destroyed. KIMs enclosed or covered by Cretaceous or older sediments would be protected.

Destruction of silicate KIMs and preferential destruction of G-10 garnets and perhaps other early forming KIMs eliminates an important tool used for prioritizing drill targets but does not eliminate the drill targets. Secondary KIMs protected from laterite will indicate area potential.

TIMING OF IOCG MINERALIZING AND ALTERATION EVENTS WITHIN THE GREAT BEAR MAGMATIC ZONE

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The formation of mineral deposits in subduction settings may be temporally associated with broad tectonic triggers (ridge subduction, plateau accretion, slab flattening, slab rollback) that occur at specific time intervals within the evolution of the arc system. For this reason certain time intervals in the evolution of arc systems may be more prospective for mineralization than others. We report new U-Pb zircon ages on igneous rocks associated with areas of known mineralization and/or alteration along the Great Bear magmatic zone (GBMZ) to bracket the timing of the principal mineral showings within the context of the regional tectonic framework of the GBMZ. Areas studied include, from north to south, Echo Bay, Terra Mine, Grouard Lake, Fab Lake, and NICO.

At Echo Bay, diorite intrusions of the Mystery Island suite are linked to sodic±calcic (albite±amphibole), calcic-iron±sodic (magnetite-actinolite-apatite±albite), high-temperature and low-temperature potassic-iron (K feldspar-biotite-magnetite and sericite-hematite respectively, ± local skarn alteration), phyllic (quartz-sericite-pyrite), propyllitic (chlorite-epidote-carbonate±sericite-albite) and distal to late epithermal quartz-carbonate-hematite veins. These intrusions have ages of

~1872 Ma. Hydrothermal zircon in associated albitite has a similar, although less precise age of 1869±9 Ma. The Rainy Lake pluton at the Terra mine has an age of 1873.8 ± 1.2 Ma, slightly older than at Echo Bay. Albitite, magnetite-actinolite-apatite, K-feldspar-magnetite and chlorite-hematite alteration zones associated with breccias and mineralization are contemporaneous with this magmatic event. At Grouard Lake a minimum age for the magnetite-amphibole alteration system is determined from cross-cutting feldspar quartz porphyry dykes at 1866 Ma. The minimum age constraint on alteration is similar to that obtained from the Fab lake area where a post-alteration two-feldspar porphyry dyke cross-cuts the main alteration phases comprised of high-temperature calcic-iron (amphibole-magnetite+/-apatite) and high-temperature potassic-iron (magnetite-K-feldspar) at 1867 Ma. At the Au-Co-Bi-Cu NICO deposit altered granites hosting the mineralization have ages of ~1872 Ma and are cut by post-mineralization porphyry dykes with ages of ca. 1869 Ma. This suggests that mineralization at NICO evolved within a 3 Ma period between 1872 and 1869 Ma. Late titanite-magnetite-calcite-chalcopyrite veins are younger (~1850 Ma) and contemporaneous with the younger granites in the area.

Collectively the new age data indicate that IOCG-type mineralization and alteration is intimately associated with high-level intrusive activity that precedes and continues post-mineralization. In all cases studied so far, the mineralizing systems were active during a relatively short time interval between 1873 and >1866 Ma. This is soon after initiation of the Great Bear magmatic arc following accretion of the Hottah basement to Slave craton.

LAKE LEVEL FLUCTUATIONS AND ITS IMPACT ON BISON HABITAT: A CLIMATE RECONSTRUCTION OF THE FORT PROVIDENCE REGION, NWT

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Lake area has dramatically increased in response to rising water levels in the Great Slave Lowlands north of Fort Providence, NWT. Situated in the southern part of the Mackenzie Bison Sanctuary (MBS), lake expansion has encroached on wood bison (*Bison bison athabascae*) habitat, forcing the bison to migrate out of the core area of the sanctuary. The MBS population is the largest free-ranging and disease-free bison herd in Canada. To the southeast in Wood Buffalo National Park, bison populations are infected with bovine brucellosis (*Brucella abortus*) and tuberculosis (*Mycobacterium bovis*). Interaction between these herds could introduce widespread infection into the MBS herd. The change in areal extent of several lakes was determined from Landsat and aerial photography imagery with water levels in some large lakes increasing dramatically. For example, Dieppe Lake originally had a surface area of 500 ha in 1984-87, but increased to more than 3,000 ha by 1991 and ~4,000 ha in 2010; an increase of 700 percent.

Lake level expansion is often driven by changes in precipitation or evaporation, however climate data for this region is very limited through time and spatially across the MBS. To better understand the possible climatic drivers of recent lake expansion in the MBS, longer climate records are needed. Dendrochronology (the study of tree rings) is a tool that can be used to develop proxy climate records that extend beyond the instrumental data records. To examine recent lake level fluctuations in the

MBS, we developed tree ring chronologies from five black spruce (*Picea mariana*) sites where trees have been impacted by recent lake expansion. Sites which showed the highest intercorrelations were averaged to develop a regional tree ring chronology, using a common overlap period (1940-2009). A comparison between the tree ring chronologies and climate records from Fort Providence and Hay River, suggested the growth of trees in this region was not strongly influenced by either temperature or precipitation but rather a combination of these. Based on these results, we also examined the correlation between tree growth and the Palmer Drought Severity Index (PDSI), which is a climate index that incorporates both temperature and precipitation. Although correlations are highest between the tree ring chronologies and the PDSI, the climate-growth relationship is convoluted in recent decades as many of our sampled trees have become submerged by rising water levels and their growth was impacted. We are now exploring these relationships over broader spatial scales by adding an additional 15 tree ring sites in the summer of 2011. These sites are situated in areas thought to be unaffected by rising lake levels which, as a result, may provide a more dependable climatic relationship. White spruce (*Picea glauca*), jack pine (*Pinus banksiana*), and tamarack (*Larix laricina*) were also sampled to examine climate-growth responses from different species. The cause of these rapid expansions remains unclear, however it may be possible that climate, subsurface or surficial geology, or beaver activity (as expressed by the community) may function as potential drivers of the observed landscape changes.

TGI-4 Lode Gold Deposits in Ancient, Deformed and Metamorphosed Terranes – Footprints and Exploration Implications: A Preliminary Overview of Themes, Objectives and Targeted Areas

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The Targeted Geoscience Initiative (TGI-4) program focuses on data-rich, established and emerging mining camps in Canada to optimize exploration-related geoscience knowledge development in order to enhance the effectiveness of exploration for hidden mineral deposits. The Lode Gold project is a multidisciplinary and collaboratively delivered federal-provincial-territorial geoscientific effort with strong participation from industry and universities. The project aims at improving geoscience-based gold exploration models where important gaps exist in our understanding of Canada's major gold-mineralized systems with respect to three main components: 1-footprint, 2-vectoring and 3-fertility.

Lode gold deposits or «bedrock» gold deposits consist of any style of gold mineralization hosted in consolidated rocks and formed at different crustal levels (e.g. greenstone-hosted quartz-carbonate vein; porphyry Cu-Au, banded-iron formation-hosted Au, Au-rich volcanogenic massive sulphides, etc). The lode gold project consists of detailed and integrated documentation of several selected gold deposits, their geological and hydrothermal footprints and camp-scale settings. The project will include

largely underexplored or new styles/types of gold mineralization including banded-iron formation (BIF)-hosted, and intrusion-related/hosted - stockwork-disseminated deposits, which are becoming increasingly more important in terms of gold content and discoveries made in Canada. The project will also include the study of the structural evolution, kinematics and tectonic significance of crustal fault zone(s) and associated Timiskaming-type sedimentary basins and their spatial, temporal and genetic relationships with the development and location of large gold deposits and districts. The distal and proximal geological and hydrothermal signatures, structural controls and absolute and relative timing of the mineralization with respect to the overall geologic evolution of their host sequences will be investigated to highlight the major controls on the location, distribution, geometry, footprint, genesis and evolution of large gold deposits.

The project is sub-divided into three main themes or sub-projects and will investigate a selected group of deposits in various settings: 1- BIF-hosted gold deposits (including the Meadowbank and Musselwhite mines); 2- Intrusion-related/hosted and/or stockwork-disseminated gold deposits in ancient terranes (including Côté Lake and Westwood deposits plus others to be determined) and 3-Large Archean gold districts and key parameters controlling the fertility of crustal-scale fault zones and the distribution of large gold deposits (including the Porcupine-Destor fault zone in Timmins).

A significant number of graduate and undergraduate theses will contribute to the project and will generate highly qualified personnel for the mineral industry and research institutions. The Lode gold project will also provide an opportunity to collaborate and develop a synergy with the Geo-mapping for Energy and Minerals (GEM) program of Natural Resources Canada. Discussions are underway to expand collaboration with provinces and territories, industry, academia and the Canadian Mining Innovation Council (CMIC - a network of industry, academic and government leaders), in a number of geoscience activities in order to further develop synergies and help the industry to renew and develop Canadian's mineral resources.

QUANTIFYING CHANGES IN SNOWPACK WATER EQUIVALENT DEVELOPMENT AND THE IMPORTANCE OF SNOWMELT IN THE NORTHERN BOREAL-TUNDRA TRANSITION ZONE

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Quantifying snowpack water equivalent (SWE) using field and remote sensing techniques has been done on many landscapes in Canada and thoroughout the world where snow is of significant ecological and economic value. In high latitude catchments snowmelt represents a significant portion of annual precipitation and annual runoff. Climatically this high albedo surface plays a vital role in global climate as the north-south pressure gradients are created, in large part, by differences in surface heating between high and low latitudes. With global warming the temporal and spatial distribution of the snowpack will change in response to a more energetic atmosphere. Impacts on the northern environment will include not only changes to the duration of the snowpack and SWE but will influence the fate of snowmelt water during the

snowmelt period and the thaw year once the snowpack has melted.

The objectives of this study are twofold. First of all we will utilize passive microwave radiation data from the Special Sensor Microwave Imager (SSM/I) and the Advanced Microwave Scanning Radiometer (AMSR) on a biweekly timestep to estimate SWE as it develops along a WSW-ENE transect extending from Wekweeti, NWT to the Coppermine River. Sampling along this transect by a field crew each two weeks will document the actual SWE that is on the ground surface. Coupling the ground data and the satellite imagery will assist in quantifying the real SWE transition from the northern boreal forest to the tundra.

The second objective of the study is to quantify changes in surface water chemistry from a northern boreal forest catchment and a tundra catchment from springmelt to the winter period when freeze-back has occurred in the active layer. Of interest here is to quantify the changes in surface water chemistry (cations, anions (including nutrients), trace metals) as the flowpathways within the terrestrial systems draining into surface waters change. As the active layer deepens the flowpathways of precipitation (including melted snow) will interact with different constituents of the regolith and the input of precipitation water into the soil will change the chemical environment for infiltrating water (i.e., switching from anaerobic to aerobic conditions). The northern boreal forest catchment will be located near Wekweeti, NWT and the tundra catchment will be located in the Yamba-Daring catchment located about 140km ENE of Wekweeti.

NEW BEDROCK MAP COMPILATIONS FOR THE CENTRAL MACKENZIE CORRIDOR

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Recent GSC mapping activities under the Mackenzie Delta and Corridor Project of the Geo-mapping for Energy and Minerals (GEM) Program are leading to new bedrock geology maps for the central Mackenzie Corridor (NTS map areas 96C, 96D, 96E, and 96F). Efforts have been made to combine several lines of evidence, including: historical field observations from the GSC's reconnaissance-scale Operation Norman (1968-1971); extensive new field observations made by participants in the Mackenzie Delta and Corridor Project (2009-2011); recent stratigraphic studies by government and university scientists; biostratigraphic data on record with the GSC; public domain seismic data; and petroleum well logs. This poster presentation includes portions of several draft bedrock geology maps, concentrating on the geology of the Mackenzie Plain, showing compilation progress to date. As compilations are completed, 12 to 14 maps are planned for publication as GIS-enabled datasets with a functional scale of 1:100 000.

Improvements in stratigraphic understanding, combined with well log and seismic data, have revealed more folding and faulting of Cretaceous strata within the Mackenzie Plain than was shown on Operation Norman maps. Interfering structural trends are now more apparent, and unconformable relationships associated with movement on specific structures provides additional constraints on the timing and sequence of deformation in the region. In particular, there is evidence for the development of north-trending folds in the Early Cretaceous, followed by erosion, then a second phase of folding and faulting involving Late Cretaceous and Paleocene strata. Variable erosion of Devonian and older strata on some of these structures will be of interest to petroleum

exploration companies targeting Middle Devonian strata for exploration in the region.

SOURCE ROCK CHARACTERIZATION AND BIOSTRATIGRAPHY (PALYNOLOGY) OF JURASSIC-CRETACEOUS STRATA PRESERVED IN THE HOODOO DOME H-37 OIL AND GAS WELL, ELLEF RINGNES ISLAND, SVERDRUP BASIN

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Hoodoo Dome H-37 is an oil and gas well drilled by Panarctic in 1970 adjacent to Hoodoo Dome, a salt-cored structure on southeastern Ellef Ringnes Island, Sverdrup Basin. Hoodoo Dome H-37 spudded in Cretaceous strata and intersects Romulus Member of Heiberg Formation (Late Triassic). Studied intervals within Hoodoo Dome H-37 are represented by Aalenian (Middle Jurassic) to Albian (Early Cretaceous) strata.

Cuttings samples were analyzed for Rock-Eval® 6 analysis, organic petrology, and palynology to better understand sources and maturity of organic matter and age of strata of the central Sverdrup Basin.

Total organic carbon (TOC) content of the shales, siltstones, and coals preserved in Hoodoo Dome H-37 vary from 0.84% to 6.0% (mean 2.31 ± 0.61 SD %). TOC reaches a maximum in the Walker Island Member of Isachsen Formation. Samples from the Paterson Island Member, Isachsen Formation, show high S2 values (mean 3.63 ± 0.98 SD mg HC/g rock), and consequently HI values (mean 165.07 ± 25.57 SD), compared to the whole well (mean HI 97.02 ± 57.12 SD). The majority of material preserved in Hoodoo Dome H-37 is immature (Tmax <435 ˚C, Ro < 0.6 %), although samples from the lower McConnell Island Formation have Tmax values between 439 and 440 ˚C. Tmax also exceeds 435 ˚C in the Paterson Island Member.

Palyno-assemblages preserved in Hoodoo Dome H-37 consist of a diversity of pollen and spore types attributable to bryophytes (mosses), lycopodiophytes, pteridophytes (ferns), and pinophytes (conifers) that change over time due to Mesozoic climate change. Q- and R-mode cluster analysis show that at least four informal palyno-assemblage zones occur. Non-metric multidimensional scaling ordination demonstrates that the assemblages fall into two main populations: Population One consists of samples from Jameson Bay, Sandy Point, McConnell Island, Ringnes, and Deer Bay Formations (Aalenian to Valanginian) while Population Two consists mainly of samples from Isachsen and Christopher Formations (Valanginian to Albian). Pteridophyte, lycopodiophyte, and bryophyte spores decline in importance in the Late Bathonian, suggesting that climate in Sverdrup Basin shifted form humid and warm to arid and warm. Expansion of Cheirolepdiaceans (indicated by *Classopollis* sp. pollen) indicates an increase of seasonal aridity. The largest change in palyno-flora occurred in the Late Valanginian when pollen from pinophytes, Cheirolepidaceans, and Cycadales/Ginkgoales/Bennettitales decline in abundance and are replaced by pollen attributable to Taxodiaceae-Cupressaceae-Taxaceae. Plants related to the Taxodiaceae, Cupressaceae, and/or Taxaceae may have expanded due to an increase in effective moisture and a decline in temperature. The response of vegetation in Sverdrup Basin to widespread climate changes provides a means for global correlation and identification of important biostratigraphic events.

LATE HOLOCENE PALYNOLOGICAL INVESTIGATION OF WAITE LAKE, CENTRAL NORTHWEST TERRITORIES

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Natural resource developments are an essential component of the economy of the Northwest Territories (NT), accounting for over 50% of the territorial real domestic product. Transportation of goods and services to and from mines and projects in the NT represents a major challenge due to a lack of infrastructure in Canada's territories and the remoteness of many industrial properties. A 568 km long winter road, called the Tibbitt to Contwoyto Winter Road (TCWR), is the only ground transportation route that services mines in the NT, including the Ekati Diamond Mine (BHP Billiton Inc.) and the Diavik Diamond Mine (Rio Tinto Group) and is thus the critical link in the supply chain. Cold winter temperatures are necessary for the continued viability of the TCWR as most of the road (495 km; 87%) is built over frozen lakes. Changing ice stability, thickness, and duration of cover associated with recent climate variability have impacted the use of the road.

The purpose of our project is to analyze lake sediments, natural archives of past climate, to quantify past climate cycles and analyze the response of climate in the central NT to periods of warmth, such as the Medieval Warm Period, as analogues for future climate scenarios. Waite Lake (12V 0381526, 6970997) was selected for detailed study because the ice of this lake freezes late in the season and breaks up early in spring relative to nearby lakes, and is thus a lake of concern for winter road operations.

A 2 m freeze core was collected from Waite Lake in March, 2009. This core was sub-sampled using a microtome at 1 mm intervals. We will analyze pollen, spores, and microscopic charcoal every 2 to 3 cm to describe the vegetation and regional fire regime spanning the last ca. 2300 calendar years. Age-depth relationships modelled for the Waite Lake freeze core, based on ^{14}C AMS dates on bulk sediments, suggest that our palynological analysis resolution corresponds to approximately 28 years.

A diversity of pollen and spore types are present in Waite Lake sediment samples, including *Picea mariana*, *Picea glauca*, *Pinus, Abies*, *Alnus*, *Betula*, and *Sphagnum*. Remains of the colonial green alga, *Pediastrum*, are well preserved.

A HIGH-RESOLUTION PALEOCLIMATIC RECONSTRUCTION USING BULK C AND N ISOTOPE ANALYSIS OF SEDIMENTS FROM A SUBARCTIC LAKE NORTHEAST OF YELLOWKNIFE, NORTHWEST TERRITORIES, CANADA

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The Tibbitt to Contwoyto Winter Road (TCWR) is the sole overland route that services diamond mines north of Yellowknife, and is therefore of vital economic importance. Since the majority of the TCWR traverses frozen lakes, late freezing or early thawing of these lakes can drastically shorten the transportation season and thus has a major economic impact on mine operations. Such was the case in 2006 when a warm and stormy winter season associated with an El Nino/Southern Oscillation resulted in a significant and costly reduction in shipments north. As the use of the TCWR is projected to grow in the coming years, policy makers and

planners require a sound scientific understanding of past regional climate variability to base their development strategies upon.

Previous research has been valuable in gaining a broad understanding of regional long-term climate change. Through the use of various proxies, a few major climate shifts have been identified throughout the Holocene. However, no research has provided a climate record with a resolution high enough to identify medium to short-term climate phenomenon that might be impacting this region (e.g. sub-decadal ENSO cycles and the decadal-scale Pacific Decadal Oscillation (PDO)).

In March of 2010, a 115-cm long freeze core was taken from Danny's Lake, located just south of the tree line along the TCWR (N63°28.547, W112°32.25). Surface and bottom water samples were also obtained and analyzed for dissolved inorganic carbon (DIC), dissolved organic carbon (DOC) and $\delta^{13}C$. The core was sliced at millimeter intervals using a custom-designed freeze core microtome, and sub-samples were prepared for bulk ^{13}C and ^{15}N isotopic analysis. Our chronology, based on both ^{14}C and ^{210}Pb isotopes, confirms that slicing at millimeter intervals, representing on average 9 years per slice, is sufficient to identify the presence of decadal-scale climate trends and cycles such as the PDO. ^{13}C and ^{15}N isotopes have not been extensively studied in this region and variations in these isotopes can be related to climatic variability. Carbon isotopes can vary with lake water DIC and DOC levels and isotopic values, which are frequently affected by DIC sources. Both C and N isotopes can also be influenced by lake conditions, through the fractionating effects of the various species which thrive under those conditions. Lakewater environments are often sensitive to climate, so variations in isotopic values can provide a great deal of insight into the regional paleoclimate.

This study will provide a climate record of greater detail than has ever been achieved employing isotopes in the region. The results will be compared to results of other proxies (e.g. diatoms, thecamoebians, pollen, grain size analysis, loss on ignition, and magnetic susceptibility) to generate a robust high-resolution multi-proxy paleoclimatic history of the tree line region.

GEOCHEMICAL STUDIES OF GOLD MINERALIZING EVENTS IN THE CLAN LAKE AND DISCOVERY AREAS OF THE YELLOWKNIFE GREENSTONE BELT

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The Slave Province hosts many prospective gold showings, however there are few active exploration projects in the Northwest Territories. Two of the exceptions are the Clan Lake and Discovery-Ormsby areas where Tyhee Gold Corp. has mounted a substantial exploration effort. These occurrences are hosted principally within metavolcanic rocks of the Banting Group (2.69-2.66 Ga). Clan Lake is a volcanic-volcaniclastic complex composed mainly of felsic to intermediate rocks, intercalated with mafic to intermediate flows. Ormsby is hosted in the mafic Giauque Lake Formation surrounded by a sea of metasedimentary rocks of the Burwash Formation. Discovery mine occurs within these metasedimentary rocks. These deposits occur along a N-NE trend associated with faulting. We hope to determine if the ore deposits at Clan Lake and Discovery-Ormsby are related to similar hydrothermal systems whose chemistry differs as a function of host lithology, or are instead indicative of distinct hydrothermal systems.

In the summer of 2011, 153 samples were collected from these areas (and from deposits at Goodwin Lake and Nicholas Lake), representing multiple types of quartz veins, sulfides, wall rocks, and associated alteration. Thin sections were prepared for petrography,

cathodoluminescence (CL) and scanning electron microscopy (SEM).

Results from Discovery indicate at least two episodes of gold introduction, the earlier of which is associated intimately with pyrrhotite and potassic alteration of plagioclase to biotite. SEM investigation of samples from Ormsby confirms a similar pyrrhotite-gold association, but surprisingly reveals another event involving apatite and scheelite mineralization. CL investigation of samples from Clan Lake and Ormsby indicates that apatite is a widespread feature of the ores and altered host rocks. A tungsten-phosphorous-potassium signature is consistent with felsic sources of metals and fluids, an unexpected complexity in the iron-rich lithologies at Ormsby.

Ongoing oxygen isotope studies allow us to evaluate the types of fluids involved in quartz veining, alteration, and ore deposition. Quartz veins from Ormsby and Discovery have $\delta^{18}O$ values of 13.2 to 15.1‰ V-SMOW (n=9), nearly identical to values from Banting Group-hosted showings 60 km to the south at Banting and Walsh lakes, which have been interpreted to reflect influence of metasedimentary fluid sources. However, Ormsby is hosted in mafic metavolcanic rocks, yet its quartz veins are isotopically similar to metasedimentary-hosted veins. Our future studies will address the complexities of the Ormsby fluid system, which appears to involve felsic- and mafic-related fluids as well as metasedimentary fluids from the surrounding Burwash Formation.

Quartz veins from Clan Lake have $\delta^{18}O$ values of 11.3 to 13.4‰ (n=9), similar to veins hosted in metavolcanic rocks throughout the Yellowknife greenstone belt, which reflect dominance of metavolcanic rocks and fluid sources. Unlike some other deposits in the north end of the Yellowknife greenstone belt, all of the rocks that we have observed at Clan Lake are extremely altered and we have not been able to define the size of the hydrothermal system responsible for ore deposition. Future petrologic and oxygen isotope studies will try to assess the size of the alteration zone created by fluid(s) in the Clan Lake hydrothermal system.

THE CENTRAL BAFFIN RPM BEDROCK MAPPING INITIATIVE

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The Remote Predictive Mapping Project (RPM), recently renamed to Systematic Mapping of Arctic Canada by Remote Techniques (aka SMART) is focused on developing efficient and timely mapping of large areas of the North that require up-dated and /or more detailed mapping (i.e. *white-spaces*). This poster demonstrates a step-by-step approach for accomplishing this task using an example from the Hall Peninsula in central Baffin Island. This area was last mapped in the 1950's and both bedrock and surficial geology requires updating. We are accomplishing this task by applying both visual and computer-assisted processing techniques to various geoscience data including remotely sensed (LANDSAT and SPOT), geophysical (magnetics) and topographic (DEM) data to extract both lithological and structural information. We incorporate legacy geological data (existing maps, field observations) to assist in geologically calibrating the predictive maps we produce.

The interpretation methods we are utilizing and developing as well as the technology we are employing are presented in this poster. In addition examples of the proto-type predictive bedrock maps we are producing are presented and discussed.

SOUTH WOPMAY BEDROCK MAPPING PROJECT: 2011 UPDATE

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The project area lies between latitude 64ºN and 65ºN and longitude 115º30'W and 118º30'W in the south-central Wopmay orogen and includes parts of NTS 86B, C, and D. Mapping and related studies began in 2004 and were completed during the summer of 2011. A compilation of all results and a final digital publication are underway; the status of this compilation and highlights from 2011 mapping are presented in poster format.

Tectonic domains of south-central Wopmay orogen are divided by the north-striking Wopmay fault zone. East of the fault zone, the ca. 1900 Ma sedimentary rocks of the Coronation margin unconformably overlie Neo- and Mesoarchean basement. The basement-cover sequence was extensively intruded by felsic to mafic plutons and penetratively deformed during development of Wopmay orogen. West of the fault zone, remnants of the complex 2400-1880 Ma Hottah Terrane comprise basement metamorphic and plutonic rocks and a cover sequence of rift-related bimodal volcanic and sedimentary rocks. Engulfing the Hottah Terrane are the ca. 1875-1855 Ma volcanic and plutonic rocks of the Great Bear magmatic zone (GBMZ). Further west, the cryptic Fort Simpson Terrane lies buried beneath the sedimentary rocks of the Interior Platform.

In 2011, mapping was focused on the central area, proximal to Wopmay fault zone. Some of the highlights from 2011 include: 1) at Rebesca Lake, we documented an extensive Neoarchean basement complex and its unconformity with basal quartzite, marble, banded amphibolites, and upper rusty pelitic and psammitic rocks; 2) volcanic, sedimentary and gabbroic rocks tentatively correlated with the Grant Group were traced northwards from the northwest arm of Rebesca Lake; 3) at 'Ham' Lake we recognized widespread magnetite alteration in chloritic schists that are tentatively correlated with Treasure Lake Group metasedimentary rocks; 4) east of 'Ham' Lake are locally concentrated northeasterly zones of albitization and silicification; 5) a new copper showing was found in Dumas Group mafic volcanic rocks along Wopmay fault zone, and; 6) a remote predictive mapping target in the GBMZ coincides with newly recognized occurrences of hypabyssal porphyry and rhyolitic volcanic rocks that are enriched in actinolite-apatite (± magnetite) veins over an area of several km^2 - the extensive nature of the veining and alteration is indicative of potential for iron oxide-copper-gold-like mineralization.

GEM TRI-TERRITORIAL SURFICIAL DATABASE

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The objective of the Tri-Territorial Surficial Database Project is to provide an accessible regional-scale surficial knowledge base to support northern exploration and economic development. This is accomplished through a digital compilation and queriable surficial database of new and existing surficial geology maps of Northwest Territories, Nunavut, and Yukon. The Project coordinates with ongoing Geo-mapping for Energy and Minerals (GEM) field mapping activities on Victoria Island, Wager Bay, Cumberland Peninsula, as well as other GEM and Climate Change Remote Predictive Mapping (RPM) initiatives in the Yellowknife area, Hall Peninsula, and MacKay Lake (NTS 75M).

The surficial database of 704 maps, representing 629 publications, includes 241 maps (in 152 publications) from the Northwest Territories (currently 106 maps in digital format), 303 maps from Nunavut (currently 211 in digital format), and 160 maps in digital format from the Yukon, compiled by the Yukon Geological Survey.

Within the Northwest Territories, about 52% by area is covered by reconnaissance maps at 1M scale with little or no field work, and therefore lacks sufficient surficial geology knowledge. Approximately 48% is covered by maps of adequate surficial knowledge. To date, 230 of the NWT legacy map legends have been captured in digital format in Excel tables.

A new Geological Survey of Canada (GSC) surficial geology legend has recently been developed to ensure the implementation of standard map units and symbols, and thus facilitate new Quaternary geology mapping and correlation of map units across all Territories and Canada. Conversion of legacy map units to the new legend is ongoing and will provide significant queriable advantages to the database.

The following summarizes the various stages in preparing legacy maps to digital format: base maps and imagery require assembly; imagery is georeferenced to base map; quality control by GSC to ensure georeferencing accuracy; abnormalities and interpretation issues are resolved either by data manager or geologist; final map geodatabase is quality checked for accurate contacts, attribution, direction and sense of features; final digital products are translated and converted into a standardized geodatabase. Legend translations provide the mechanism for mapping legacy map units to the new geodatabase. Tools, using ESRI toolboxes and Python scripting, are being developed to automate the conversion process and streamline the translation of legacy data complying with the Geological Map Flow (GMF) standards. Conversion is ongoing and digital legacy data are in various formats, including Shapefiles, CAD, non-standardized Geodatabases, Microstation, Coverages, and other legacy Arc formats.

An interactive web-based portal is being developed from which both the GEM Tri-Territorial Surficial and Bedrock databases will eventually be accessed, providing an effective communication tool for the exploration industry, land-use planners and policy-makers.

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INCREASED MINERAL EXPLORATION EFFICIENCY THROUGH INTEGRATION OF NOVEL MAPPING APPROACHES, IMPROVED DISPERSAL MODELS, AND FIELD-BASED PORTABLE XRF ANALYSES

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Drift prospecting has a long history in Canada. The current prospecting methodology (mapping from aerial photographs, field verification, geochemical and indicator mineral sampling, etc.) has proven successful in the past. However, physical processes governing mineral dispersal by glacial ice and meltwater are not fully understood. A better understanding of these processes will enhance the application of drift exploration methods.

A three-stage framework for improving prospecting methodologies is outlined below. This framework integrates the unrealized potential of digital datasets for quickly producing predictive surficial geology maps, with improved dispersal models, and field-based measurements.

1) Remote Predictive Mapping (RPM) techniques provide a rapid method to map the glacial geology and landforms in order to establish a framework for further exploration. This technique can produce map outputs within

a few weeks and at a fraction of the cost (low-cost to free digital imagery, automated processing) of traditional surficial mapping techniques or geophysical surveys. The RPM product does not replace air-photo based surficial geology maps. Rather, it forms a preliminary dataset that can be used to focus further mapping and identify potential exploration targets where sampling of glacial sediments can be completed. Within this RPM scheme, identification of surface materials is refined by integrating automated landform recognition (eskers, streamlined landforms), to improve inferences of surface materials.

2) Improved representation of subglacial processes and resulting dispersal patterns is achieved through development of a process-based dispersal model emphasizing basal freeze-on mechanisms, and particle diffusion as first-order controls on sediment dispersal. Theoretical estimates of basal ice temperature and flow velocities allow for estimates of sediment entrainment by freeze-on under steady-state and non steady-state conditions. These results allow for rudimentary representations of dispersal patterns and associated length scales of dispersal. Dispersal patterns extracted from the Kimberlite Indicator and Diamond Database (KIDD) are used to test the theoretical results. In addition, improved understanding of ice sheet hydrology and its role in sediment accretion by freeze-on leads to the recognition of a process continuum between the genesis of some tills and glaciofluvial sediments. Consequently, this work also aims to improve understanding of the transport vectors from till to eskers, and the downflow dispersal and indicator mineral concentration in eskers.

3) To further support this work and also to improve sample design efficiency work is being completed to compare various analytical methods of till matrix geochemistry and its relationships to indicator minerals. Use of portable x-ray fluorescence (pXRF) devices allows for rapid field-based analysis of the matrix (sand-silt-clay fraction) portion of till samples. These data may help further target indicator mineral sampling locations by highlighting relationships between till matrix geochemistry and indicator minerals in surrounding till. Comparison of pXRF data with lithium metaborate/tetraborate fusion and dilute nitric digestion (total digestion), 4-acid digestion, and aqua-regia analyses indicate the success of this approach and the high potential for improving sampling efficiency while reducing costs associated with collecting, shipping and processing field samples. Improved understanding of the relationship between till matrix geochemistry and indicator minerals also helps to better understand transport vectors to eskers.

THE CABIN AQUATIC BIOLOGICAL MONITORING PROGRAM IS AN ELEMENT OF THE DEHCHO FIRST NATIONS' AAROM COMMUNITY-BASED MONITORING PROGRAM

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The Canadian Aquatic Biomonitoring Network (CABiN) is an aquatic biological monitoring program for assessing the health of freshwater ecosystems in Canada. The program is maintained by Environment Canada (EC) to support the collection, assessment, reporting and distribution of biological monitoring information. CABiN allows partners to take their observations and make a formalized scientific assessment using nationally comparable standards. A set of national CABiN protocol are used for field collection, laboratory work, and analysis of biological monitoring data. A training program is available to certify participants in the standard national protocols. Training consists of online learning modules and a field training workshop." (EC website).

The Dehcho First Nations' Aboriginal Aquatic Resources and Oceans Management (AAROM) program continues to develop a community-based research and monitoring program with their member communities in the Dehcho. The CABiN program is an important element of our

monitoring program and is being developed in collaboration with Environment Canada and Aurora College and with funding from the AANDC CIMP program as well as the DFO, AAROM program. We completed a training session at Kakisa in August, 2010 resulting in thirteen of our community monitors and staff being certified in Module 1 which is the field work training session. (Unfortunately our second training session planned for August, 2011 was cancelled at the last minute due to recent cutback to Environment Canada by the federal government). The Dehcho AAROM Technical Advisor, Mike Low is presently completing the remaining online modules.

Many of the streams in the Dehcho are suitable for CABiN assessment. The Dehcho AAROM likes the program for the following reasons; i) it is a tool we can use to look at baseline conditions of Dehcho watersheds suitable to this type of assessment, ii) the protocol can be used to assess environmental damage to our streams due to development, and iii) CABiN provides a great forum for teaching our Dehcho monitors and members all about aquatic ecosystems.

We have already used the CABiN protocol to assess the effects of construction activities. We have assessed the effects of the redevelopment of the highway stream crossing of Axe Handle Creek. We are also assessing for the effects of contamination from a decommissioned highways camp near the Jean Marie River at the Liard Highway junction. This site is presently being remediated by AANDC and the Jean Marie River First Nation requested a stream assessment. In 2011, we surveyed the Cameron River and other tributaries of the Kakisa River watershed which flow into Tathlina Lake to see if they have suitable sites for a CABiN assessment project planned for 2012. The Ka'a'gee Tu First Nation is concerned about effects of oil and gas development in the Cameron Hills on the Kakisa River watershed.

GEOLOGICAL UPDATE OF THE PRINCE ALBERT GREENSTONE BELT, WESTERN MELVILLE PENINSULA, NUNAVUT

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The Prince Albert Group (PAG) was introduced in 1970s to correlate supracrutal rocks outcropping as semi-continuous, northeast-trending, komatiite-bearing greenstone belts. Located within the western Churchill Province these rocks extend over a thousand kilometres of strike-length between Baker Lake and Melville Peninsula. However, new geological mapping and U-Pb age dating by the Canada-Nunavut Geoscience Office (CNGO) and the Geological Survey of Canada (GSC), at the type locality in the Prince Albert Hills reveal that these rocks are significantly older (ca. 2970 Ma) than those of otherwise lithologically comparable sequences of the western Churchill Province (2770-2760 and 2740-2690 Ma). Therefore, the greenstone belt at the type locality is hereafter referred to as the Prince Albert greenstone belt (PAGB).

The mapping of the PAGB is part of the Melville Peninsula Project initiated under the Government of Canada's Geo-mapping for Energy and Minerals (GEM) program. It has benefitted greatly from Frisch's pioneering mapping (Bulletin 346) at 1:125 000 scale conducted in the 70s. His field data is being integrated into a new GIS-based geodatabase and underpins two new 1:25 000 scale geological maps of the PAGB (CGM 44; CGM in prep.).

The PAGB comprises a NNE-SSW trending volcano-sedimentary succession metamorphosed to upper greenschist up to amphibolite facies that has undergone at least two phases of deformation. The succession can be subdivided

into four supracrustal packages based on field relationships, lithological association, mineralogy and preservation of primary textures.

The *snake supracrustal package,* which comprises mainly of mafic to intermediate subaqueous metavolcanic rocks with lesser meta-ultramafic flows/sills and metavolcaniclastic rocks, outcrops at the base of the succession. The *Borealis supracrustal package* consists of felsic to intermediate, brecciated to massive metavolcanic rocks containing quartz phenocrysts and felsic to intermediate volcaniclastics. The *Triangle Lake supracrustal package* is dominated by mafic to intermediate metavolcanic rocks intercalated with banded iron-formation, subordinate felsic to intermediate metavolcaniclastic and metasedimentary rocks, and rare meta-ultramafic intrusions. Finally, the volcano-sedimentary *Mackar supracrustal package* sits uncomformably over the *Triangle Lake supracrustal package* and is characterized by a polymictic basal conglomerate containing, in part, iron formation clasts, other metasedimentary rocks and, subordinate felsic and mafic metavolcanic rocks.

Early mineral exploration (1960's) had been mostly geared towards iron ore mineralization, while other commodities including base metals, gold, and diamonds have been also explored over the years. Considering the overall geological context of the PAGB, the potential to find new mineralization is high. For example, the Adamson River Nickel showing (OF6729), discovered during present mapping, contains sulphide mineralization grading up to 8.0% Ni at the contact between a metaperidotite and mafic metavolcanic/metagabbroic rocks. In addition, a grab sample, collected in 2010, returned up to 85 g/t silver, >1% zinc, 0.1% copper, 0.1% lead, and 0.09 g/t gold from a gossan hosted in metavolcanic rocks. These highlight the prospectivity for volcanogenic massive sulphide (VMS) and nickel sulphide mineralization in the PAGB. Other types of mineralization should not be disregarded, namely gold associated with iron-formation.

CHARACTERIZATION OF LAKE TYPES ALONG THE TIBBITT TO CONTWOYTO WINTER ROAD: THE DEVELOPMENT OF A PRELIMINARY THECAMOEBIAN-BASED TRANSFER FUNCTION TO ACCESS CLIMATE CHANGE

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The Tibbitt to Contwoyto Winter Road (TCWR) is the world's longest heavy haul ice road extending 586 km north from Yellowknife. With more than $500 million per year in goods passing north to service mines along the TCWR, this route is critical to the economy of the Northwest Territories. Our research is mandated to provide a detailed assessment of the impact of climate change on the TCWR, as archived in Late Holocene (last ~3500 years) lake sediments. We are also characterizing lakes that were identified as 'problematic' in regards to the operation of the TCWR since they require more maintenance than other lakes. The ability to identify these lakes would enable TCWR planners to minimize their inclusion in the road. An initial step towards these goals is to understand and characterize lake types found along the TCWR.

Eighteen lakes were sampled during March 2010 when a total of twenty Glew cores, twenty sediment-water interface samples, twenty bottom and top water samples and twenty vertical lake profiles were collected. These lakes are spread along a latitudinal transect spanning the entire length of the TCWR that was open during 2010. Limnological water property data (physical and chemical) were analyzed in concert with data derived from the sediment-water interface to characterize lake types. Sediment core material was used to generate profiles of organic content (a proxy for lake productivity) and grain size distributions (a

proxy for precipitation). The results indicate that there are distinctive lake types, and their distribution seems to reflect their location in regards to the treeline. Whether variations in geology or vegetation cover also contributes to this characterization remains to be elucidated.

Thecamoebians are freshwater testate amoebae that have been demonstrated to be sensitive to variations in their bottom water habitats. Changes in water property character and sediments within a lake are often associated with changes in catchment and regional climate. Thecamoebian populations associated with particular lake types can be statistically enumerated to develop a bioindicator training set. A transfer function can be derived, which can be used to reconstruct temporal variation in environmental conditions within sediment cores. These transfer functions are invaluable as they permit us to reconstruct limnological and climate history of the route of the TCWR through the last 3000 years.

These results will provide TCWR policy makers and planners with a sound scientific background to access the viability of present and proposed infrastructure.

THE DENDROCLIMATIC SIGNAL IN WHITE SPRUCE RING WIDTHS ALONG THE TIBBITT TO CONTWOYTO ICE ROAD, YELLOWKNIFE, NWT

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Short instrumental records from northern regions limit our understanding of long-term climate variability and natural cycles especially in climatically sensitive northern regions. Therefore, there is a need to extend climate records using proxy data sources. Tree-ring growth records are widely used paleoenvironmental proxy data sources because they provide high resolution climate information due to their annual nature. Further, the wide spatial distribution of trees across circumpolar northern regions relative to the number and quality of instrumental data collection points makes tree rings an important source of information concerning the long-term variability of large scale climate variables such as temperature, precipitation, and drought.

White spruce *(Picea glauca)* is an important and common component of the boreal forest across the Northwest Territories, growing to the northernmost extent of tree line in the Northwest Territory. Since white spruce is a long-lived and widespread tree and is known to be sensitive to climate and fluctuations in ground water hydrology, it is an ideal species to examine for use in dendroclimatological studies in the north.

For the purpose of this study, white spruce samples were collected at 15 sites along a latitudinal gradient ranging from Tibbitt Lake (62°30' N, 113°26' W) in the south to Beniah Lake (63°22'' N, 112°35' W) at the northern limits of our sample sites. In total, over 440 living and dead trees were sampled. Slabs have been sanded, measured, and crossdated and site chronologies have been constructed. The chronologies range in length from 206 to 367 years with an average chronology length of 290 years.

The next project step is to identify the most significant relationship between tree-growth and climate. Preliminary analysis indicates that there is a climate-growth relationship between white spruce and moisture related parameters, such as the Palmer Drought Severity Index (PDSI), for the period of the 20th century. The PDSI in northwest North America is strongly correlated with the Pacific Decadal Oscillation (PDO) which indicates that climate variability in the Northwest Territories is influenced by synoptic scale circulation patterns.

BLACHFORD LAKE INTRUSIVE SUITE; INSIGHT FROM CARBONATITES AND OTHER ALKALINE INTRUSIVE SUITES OF THE SOUTHERN SLAVE CRATON

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Worldwide, there is a frequent association between large alkaline complexes and carbonatites, e.g. Khibina massif, Russia; Ice River Complex, Canada; Fen Complex, Norway. However, as of yet, there have been no carbonatite phases discovered within the Blachford Lake intrusive suite (BIS). Given the strong affinity of carbonatitic melts for light rare-earth elements (LREE), it has been suggested that the unusually low LREE/HREE ratio of rocks in the Nechalacho deposit could be linked to the existence of an as yet undiscovered carbonatite body. In addition carbonatites are often interpreted as representing direct mantle melts, and can therefore probe the mantle at their time of formation.

To address the possibility of a carbonatite phase in the BIS, and to gather information on comparable alkaline intrusions in the southern Slave craton, a two-fold approach was used during the 2011 field season: (1) sampling of carbonate veins and rocks within the BIS, (2) investigation and sampling of other alkaline complexes within the southern Slave, particularity those with associated carbonatites. By sampling other alkaline intrusive suites in the southern Slave, we gain insight into regional character of the mantle over time, which will advance our understanding of the genesis of the BIS. Alkaline intrusions sampled include the Paleoproterozoic Squalus Lake alkaline intrusion, Big Spruce alkaline complex, Duck Lake sill, and the Archean Leith Lake carbonatite.

Carbonate veining in the BIS was observed in a few localized regions within the Thor Lake syenite, along the shore of the Hearne Channel. The morphology of the veins was varied, ranging in size and morphology from simple grey planar 2cm wide veins, to brown-weathering complex crosscutting, multiphase stock works of >1.5m width. Associated with the areas of localized veining were numerous syenite pegmatitic pods (<1 m width), many which contained carbonate material in the core. Petrography and geochemical work are planned to determine if these veins are related to the BIS or the sedimentary carbonate sequences of the East Arm.

Previous work on the Squalus Lake alkaline intrusion identified the presence of a carbonatite boulder, assumed to belong to the Squalus Lake intrusion, but no in situ occurrences. Mapping during the 2011 field season identified a previously undocumented carbonatite dyke. The 25-40 cm wide dyke extends >3m in length, and crosscuts modal layering in the melanocratic alkali feldspar syenite units.

GEOLOGY, PARTIAL MELTING, AND MINERALIZATION RELATIONSHIPS IN HOPE BAY AND ELU GREENSTONE BELTS AND ADJACENT GRANITOIDS: INSIGHT FROM THE AREA EAST OF THE BOSTON GOLD DEPOSIT, NE SLAVE CRATON

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Hope Bay and Elu are structurally and stratigraphically connected Neoarchean (ca. 2800 – ca. 2500 Ma) greenstone belts in the NE Bathurst Block of the Slave Craton. The two belts are bounded to the east by migmatitic granitoids. The Boston gold deposit, hosted in the Hope Bay belt, is located at the triple point intersection of the belts flanked by the migmatitic complex. New mapping east of the Boston gold deposit provides insight on the geodynamics and timing of events at the triple point junction.

The eastern edge of the Hope Bay and Elu belts consists of lower amphibolite-grade, metabasalts with subordinate intercalations of felsic metavolcanic rocks, which are altogether affected by up to 3 phases (D_1-D_3) of ductile deformation. The bounding migmatitc complex whose apophytic dikes and sills occur locally in the belts is a syn- to late- (D_2+D_3) phaneritic and isogranular metatonalite complex. Decimeter- to meter-scale mafic rafts, subparallel to D_2 and D_3 structures and locally garnetiferous, occur with granitic melt within a 2 to 3 km wide zone between the amphibolitic metabasalts and the migmatitic complex. Although these rafts might include metabasalt xenoliths, the textural relationships with coexisting melt suggest that they are stretched and pull-apart restites derived from partial melting of the metatonalite protoliths. Indeed, the occurrence of leucosomes along the flattened fabric, as well as within subsequent extensional shear zones in the magmatic intrusions is suggestive of intensive syn- to late-tectonic anatexis. Late diabase and granitic dike swarms, together with unevenly distributed quartz veins cut the entire assemblage in N, NE, and E directions.

A pervasive bedding parallel foliation (S_0/S_1) is tightly folded around N- to NE-steeply plunging curvilinear F_2 folds showing a discrete S_2 axial planar cleavage in lower amphibolite metabasalts. Migmatitic metagranitoids exhibit an unfolded gneissic foliation inferred to be an S_2 fabric that is generally parallel to the dominant S_1/S_2 fabric observed in metabasalts. In both environments, a faint axial stretching lineation (L_2) is observed on S_2 foliation and relates to the normal sense of movement along marginal shear zones showing that the migmatitic complex was exhumed. Both D_1 and D_2 structures are refolded around F_3 folds. Up to 200 m wide, NE trending brittle faults of inferred Proterozoic age are crossing all rock sequences and pre-existent Archean structures. Sulphidic quartz veins and related hydrothermal alteration zones are primarily observed near the contact zone of migmatites and supracrustal rocks and relate to D_2+D_3 shear zones. In addition, mafic rafts within the migmatites contain noticeable sulfide occurrences showing that they could represent reliable indicators for exploration in these granitoid rocks. Sulfide rich veining occurs also along late brittle faults. New mapping indicates that Neoarchean to Proterozoic hydrothermalism and metal remobilization have been pervasive east of the Boston Gold deposit.

UTILITY OF TEMPORAL ENVIRONMENTAL PROXIES FOR ASSESSING 'PROBLEM' LAKES ALONG THE TIBBITT TO CONTWOYTO WINTER ROAD

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The diamond industry is an essential component of the economy of the Northwest Territories (NT) and the Tibbitt to Contwoyto Winter Road (TCWR) is the sole infrastructure for the transportation of goods and services to and from mines and other projects north of Yellowknife.

Reliable methods for lake selection are critical to the viability of the road because 87% of the TCWR's ~600 km length is across frozen lakes. Changing ice stability and thickness thus dramatically impacts the use of the road.

Lakes are abundant in the central NT's and their sediments contain continuous archives of biological, chemical, and physical proxies of recent and past environmental conditions. These sediments can be used to identify various lakes such as highly organic and productive versus less productive lakes. Therefore these sediments can be used to indicate which lakes might be preferred targets for winter road construction.

Two 'problem' lakes (P26 and P33) found on the route of the TCWR typically take longer to freeze in early winter and are the first lakes to

thaw in the spring as they are not only characterized by thinner ice but by high levels of gas. Gas buildup under the ice can be dangerous for users of the road as it can result in blowouts, which results when gas bubbles break through the ice surface.

To better understand the limnological character of P26 and P33 they were analyzed for microscopic bioindicators (thecamoebians), loss on ignition (organic and carbonate content), grain size and elemental makeup using ICP-MS. Water property data (e.g. pH, conductivity, dissolved oxygen) was also measured on site through the water column and at the sediment/water interface.

Thecamoebians are abundant in benthic lacustrine habitats and create tests that are well preserved in Holocene sediments, thus their fossilized populations document environmental conditions from when they were alive. Research on this group has shown that thecamoebians are excellent proxies for paleolimnological and paleoecological study because their populations respond rapidly to changes in trophic status, pH, temperature, nutrients, and oxygen levels that can in turn, be linked to climate change, contamination and various environment types. Preliminary results indicate that these lakes are distinctive in that they are highly biologically productive and have been so for much of the late Holocene. Further work is underway to determine why these lakes have evolved in such an atypical manner.

A Study on Websterites from the Diavik Diamond Mine – Slave Craton, Canada

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We studied garnet-websterite microxenoliths from the A154 South kimberlite pipe at the Diavik Diamond Mine. Diavik is located in the central Slave Craton, in the Northwest Territories, 300km northwest of Yellowknife. All samples were recovered from coarse (>5mm) heavy media concentrate. Websterites are a class of pyroxenite composed of clinopyroxene and orthopyroxene ± olivine; in the case of the studied samples garnet also is invariably present. The original sample set consisted of approximately 3000 microxenoliths and clinopyroxene megacrysts. Potential websterites were selected based on the presence of red garnet and/or a high modal abundance of emerald green clinopyroxene. After crushing, samples were picked again, to select the least altered fragments.

Garnet compositions (EPMA analyses) were filtered using the classification procedure of Grütter et al. (2004). In this scheme, pyroxenitic (G5) garnets are separated from low-Cr lherzolitic (G9) garnets based on molar Mg-numbers <70. Lherzolite with primitive mantle composition - resulting in garnet with ~2wt% Cr_2O_3 - is atypical for cratonic lithosphere, whilst pyroxenite xenoliths worldwide regularly yield garnets with Mg-numbers up to ~85. Therefore, for the purpose of this study, we removed the Mg-number constraint from the G5 definition. For a subset of the studied garnets there is a complete transition from G5 to marginal G1 garnets visible in classification diagrams such as TiO_2 versus Mg-number and Cr_2O_3 versus CaO and, as a consequence, these compositionally related "G1 garnets" were also included in the websteritic garnet set.

Based on our definitions above, the major element compositions of the websteritic garnets, clinopyroxenes, orthopyroxenes, and olivines indicate compositional overlap with fertile lherzolitic assemblages. Molar Mg-number ranges are between 80.6-83.6 for garnet, 90.7-92.4 for clinopyroxene, 91.4 to 91.6 for

orthopyroxene, and 89.5 to 91.2 for olivine. Cr_2O_3 ranges between 1.5-2.3 wt% in garnet and 0.8 to 1.0wt% in clinopyroxene. TiO_2 in garnet (0.3-0.5wt%) is significantly higher than typically found in depleted cratonic peridotites.

Temperatures of last equilibration were calculated based on the formulation of Krogh-Ravna (2000; garnet-clinopyroxene), simultaneous estimates of pressure and temperature were obtained with the single clinopyroxene thermobarometer of Nimis & Taylor (2000). These calculations constrained the conditions of last equilibration for the websterites to 46 to 56 kbar and 1040 to 1120 C.

Complimentary garnet and clinopyroxene REE_N patterns indicate that these minerals formed in equilibrium. LREE enrichment in some of the garnet samples and the presence of rare phlogopite possibly indicate a second stage of metasomatic overprint.

The similarities in mineral chemistry of the Diavik websterites to primitive lherzolite suggest that they may have originated from intense melt metasomatic overprint of originally depleted peridotitic sources. It is speculated that partial melting of subducted basaltic lithologies may have caused the observed melt metasomatism. Enrichment of LREE in some garnets likely relates to a second stage of less pervasive metasomatic overprint.

TILL GEOCHEMICAL SIGNATURES OF IRON OXIDE COPPER-GOLD MINERALIZATION IN THE GREAT BEAR MAGMATIC ZONE, NORTHWEST TERRITORIES, CANADA

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As a part of Canada's Geomapping for Energy and Minerals (GEM) Program, an applied Quaternary research activity under the IOCG-Great Bear Project was undertaken in the Great Bear magmatic zone (GBMZ) to provide a practical guide for geochemical and indicator mineral exploration targeting iron oxide copper-gold (IOCG) deposits in glaciated terrain. Detailed till sampling (n=111) was completed in the vicinity of the NICO Co-Au-Bi magnetite-group IOCG deposit as well as the Sue-Dianne Cu-Ag-Au magnetite to hematite-group IOCG deposit, and near showings hosted within other IOCG-type alteration systems in the GBMZ. Samples were collected up-ice, proximal to, and down-ice from mineralization, hydrothermally altered host rocks and least altered bedrock. Extensive lithogeochemical data of all studied showings and deposits are available through collaborations within the project.

Glacial sediments over the GBMZ consist of a single, thin till unit (< 2 m), characterized by a silty-sand matrix (40 to 60 % sand) and a local provenance (5 to 40 % of locally derived clasts). Ice flow indicators show 4 distinct phases. Phase 1 represents a flow towards 210°. Phases 2 (252°) and 3 (280°), respectively in the southern and northern parts of the GBMZ, are the dominant directions. Phase 4 represents a late reorientation towards 215° in the southern half of the GBMZ. Transport distances are short. For example, at the Sue Dianne deposit, the dispersal of heavily metasomatized clasts is less than 800 m. The Sue Dianne geochemical dispersal train appears to be less than 500 m, as delineated by a Cu anomaly in the clay-sized fraction. Dispersal train orientations are coherent with the dominant flow directions.

Lithogeochemical signatures of mineralization and/or alteration are reflected in the till (K, Na, Ca, Mg, Ti, Cu, Ba, Cr, Co, Th, Bi, Mo, U, As) despite variable degrees of post-glacial weathering and textural variability. Possible IOCG deposit pathfinder elements in till include Cu, Mo, Bi and Co (enrichments), as well as Ti (depletion). However, the high variability of

IOCG mineralization calls for a multivariate statistical approach based on their signature alterations. A principal component analysis (PCA) was performed on combined till geochemistry and lithogeochemistry datasets. The combined datasets' variability is largely explained by the variable lithogeochemistry. This approach helps to isolate the role of geological processes that influenced the bedrock from later processes that led to internal variability of the till geochemistry. Results so far show: 1) grouping of till samples according to their related IOCG showings; 2) simple differentiation of anomalous till samples based on multi-element enrichments, therefore decreasing the effect of the IOCG mineralization variation, and 3) potential to identify the nature of bedrock IOCG alteration type in overlying till samples. Petrographic study of collected bedrock samples and clay mineralogy of till samples will allow us to test the correlation of geochemical signatures to their mineralogical sources, shed light on processes responsible for alteration related elements (K, Na, Ca) behaviour as well as provide textural data relevant to the ongoing study of indicator minerals.

Medium-resolution Land Cover Information from SPOT 4-5 across the Subarctic Treeline, Great Slave Region, NWT

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The taiga-tundra ecotone represents a vast area where open forests transition to treeless tundra vegetation. This ecotone is of interest to climate research due to predicted climate-driven treeline advances and the fact that the area serves as a gateway to vast economic resources in the Arctic. Because this ecotone contains transitions from forest to tundra and from discontinuous to continuous permafrost, a small amount of climate warming may potentially produce significant changes to both soils and vegetation, presenting challenges for infrastructure development and maintenance. Baseline geospatial information at an appropriate scale for maintaining and planning current and future development is presently lacking over this ecotone. As part of the Great Slave TRACS (Transportation Risk in the Arctic to Climatic Sensitivity) project, we present methods used to generate baseline land cover and vegetation information across the taiga shield ecozone. Methods developed at the Canada Centre for Remote Sensing (CCRS) to balance radiometry of large-area medium resolution satellite image mosaics are illustrated. Reference data collected north of Yellowknife in the summer of 2011 are shown, along with classification methods and initial results. This initiative further assists in completing a national scale mapping effort using 20 m resolution SPOT 4-5 satellite data.

Geological Significance of a New High Resolution Gravity Gradiometric and Magnetic Survey over the Blatchford Lake Complex

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As part of phase 4 of the Targeted Geoscience Initiative, a combined airborne gravity gradiometric and magnetic survey was flown over the Blatchford Lake region. Data were collected at a mean terrain clearance of 100 m and line-spacing of 250 m. Compared to existing ground gravity measurements and previous aeromagnetic surveys, the new survey data provide greatly enhanced resolution of the gravity and magnetic fields over the Early Proterozoic Blatchford Lake alkaline igneous complex, a target of active mineral exploration. The complex includes a circular eastern lobe (Grace Lake granite cored by the Thor Lake syenite) and a flanking, arcuate western lobe (Caribou Lake gabbro, Whiteman Lake syenite, Mad Lake and Hearne Channel granites). Much

of the complex falls within the area of a broad gravity high that extends beyond the complex in several directions. Superimposed on this regional anomaly is a prominent elongate high following the western lobe and coinciding mainly with granitic and syenitic rocks, but undoubtedly related to the Caribou Lake gabbro. This high, which is coincident with high-amplitude magnetic anomalies, increases in amplitude towards the north end of the lobe attaining a peak value of about 18 mGal. This compares to values ranging generally from about 3 to 8 mGal over the eastern lobe. The regional gravity high culminates in a weak gravity high covering the northern half of the Thor Lake syenite, hosting the Nechalacho rare earth deposit, and adjacent portions of the Grace Lake granite to the west and northwest, where it also embraces two small dioritic/quartz dioritic intrusions of the Compton Intrusive Suite. Exploration indicates that a nepheline syenite hosting the rare earth mineralization, observed in a window within the Thor Lake syenite, extends beneath the Thor Lake syenite in all directions. It is speculated that this gravity high reflects the presence of the mineralized syenite, a possibility supported by an earlier exploration gravity survey that delineated a 1.4 mGal amplitude gravity high partially coincident with the Nechalacho deposit and modelled in terms of a 240 m thick basin-shaped body. Gravity gradient data provide high resolution information over the complex, clearly detailing anomalies over the western lobe and indicating a subtle high density zone on the eastern edge of the Thor Lake syenite. Magnetic data show coincident high-amplitude anomalies. Integral to interpretation of the new gravity and magnetic data has been the measurement of about 480 archived rock samples collected throughout the alkaline complex, results of which indicate higher densities within and immediately surrounding the mineralized portion of the Thor Lake syenite. Susceptibilities of samples were also measured and will be incorporated into modelling along selected profiles in the region.

AN EMERGING PARADIGM FOR SURFICIAL GEOLOGICAL MAPPING OF ARCTIC CANADA AT THE GEOLOGICAL SURVEY OF CANADA

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Terrain analysis of glaciated terrains is approaching a ”tipping point” as remotely sensed digital data and digital elevation models become more available and cost-effective alternatives to aerial photographs. The challenge in remote predictive mapping (RPM) of glaciated landscapes is recognition of the series of complex steps in the traditional cogitative terrain analysis process and encapsulating them within computational workflows based on image analysis and statistical modelling. Within the SMART (Systematic Mapping of Arctic Canada by Remote Techniques) project of Geo-Mapping for Energy and Minerals Program (GEM), a methodology and data handling framework is being developed to improve mapping productivity.

SMART mapping is a complex challenge that involves: i)development of a science language for glaciated terrain, ii) integration of expert knowledge and legacy datasets, iii) parsing knowledge into machine operable components (morphology, texture, shape etc.), iv) classification of attributes, v) evaluation of various geoscience data types (i.e. remotely sensed , topographic and various calculated derivative images) for surficial mapping, and vi) statistical analysis, modelling and expert systems integration of the diverse landscape attributes within a geoscience data stack. Morphology, for example, is being extracted through analysis of Digital Elevation Model data and derivatives. This work forms the basis for specific landform

analysis (e.g. eskers) and as a component of the data stack. Material (texture, lithology) types are primarily being captured using remotely sensed data (LANDSAT, Radar) in concert with pixel-to-pixel-based classification algorithms (e.g. Robust Classification Method (RCM)).

Lake shape and landforms are being analyzed using form statistics and object-orientated, landscape-segmentation techniques. Spatial association of various landform metrics provides a challenge that is being undertaken using density functions and integration of specific expert interpreted data layers (drumlin, esker, etc.). Integration of this diverse suite of data layers is being completed using several techniques, including: statistical approaches, decision trees, fuzzy sets, and expert system approaches.

Two specific case studies are highlighted that represent new approaches to surficial geological mapping depending upon terrain complexity, study area scale, data availability and study resources. The Central Baffin case study illustrates mapping a large area at a scale of 1: 500,000 from LANDSAT and DEM derivatives: it serves as a proto-type for the SMART "grey space" mapping initiative as well as the GEM Tri-Territorial Surficial Geology Compilation Project. A more detailed and modelling-intensive approach is being applied in the McKay Lake (NTS 75M) case study near Great Slave Lake using DEM, SPOT 4, LANDSAT data and a fuzzy set modelling approach. These examples illustrate the process from an initial predictive surficial materials map to a derivative predictive surficial geology map which can then be used as an aid to field-supported mapping. The transition from cognitive interpretation and recording of terrain elements to semi-automated approaches is a considerable challenge that requires careful consideration of the conceptual and semantic models employed by the geologists. The requirement to revisit the classification lexicon of glacial landscapes, landforms and geological legends will result in improved perspectives and understanding of the signatures and processes of the glaciated landscape of northern Canada derived from remote predictive mapping.

GOVERNMENT OF THE NORTHWEST TERRITORIES – WILDLIFE MANAGEMENT INFORMATION SYSTEM

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The Wildlife Management Information System (WMIS) is the Government of Northwest Territories' online, geo-referenced wildlife database. WMIS provides a central repository where government staff, industry, and public can store and access standardized raw wildlife location or other geo-referenced data to support the conservation and management of NWT wild species and their habitat. WMIS is supported by the Wildlife Division of the GNWT's Department of Environment and Natural Resources (ENR).

Data stored in WMIS are intended to support conservation and management of NWT wild species and their habitats. Data stored in WMIS originates from multiple sources including other government agencies, industry and researchers.

Data from WMIS are available to other agencies, organizations, and groups on an application basis. Applications are reviewed for their specific purpose as it relates to the conservation and management of NWT wildlife. Following accepted guidelines and standards, the locations of sensitive species at risk, or for species that may be at risk or sensitive may be kept secure. The specific locations of secured records are not published in any form without the express written consent of ENR. Redistribution of the data is prohibited. Data will not be provided to commercial firms for the creation of independent datasets. Source credit must be given with any data distributed from WMIS.

Many areas in the NWT have never been surveyed comprehensively, and the results of a data search of WMIS are not intended as a final

statement on the presence, absence, or status of species within a given area, or as a substitute for on-site surveys. It is hoped that non-GNWT organizations will submit all observations of wildlife occurrences from their research projects to WMIS.

A Quartz Arenite - Weathered Porphyry - Porphyry Succession at Beaverlodge Lake, Northwest Territories: Implications for Atmospheric Oxygen at ca. 1.9 Ga and Unconformity-Type Uranium Mineralization

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Paleoweathering, alteration events, and uranium mineralization are often preserved along unconformities. At Beaverlodge Lake, south of the Great Bear Lake, NWT, an 18 km long ridge has at least two unconformities preserved. This study focuses only on one of those unconformities. At this unconformity, historical uranium mineralization occurs and paleoweathering is preserved. The area around Beaverlodge Lake has been mapped extensively in the past by Kidd (1936), Henderson (1949), McGlynn (1979), Hildebrand and Roots (1985), and more recently re-examined by Jackson and Ootes (2011). These maps identify three distinct rock types: basement porphyry, a volcanic horizon, and quartz arenite, which all have been subjected to low-grade metamorphism. However, none of the pre-Jackson and Ootes maps recognized the extensive alteration in the porphyry underlying the unconformity and the likely associated uranium mineralization. Recent and historic U-Pb zircon geochronologic work has assigned ages to these distinct rock types: 1931 ± 1 Ma hypabyssal porphyry and K-feldspar phenocrystic granite; the bimodal volcanic horizon was emplaced unconformably on the porphyry at ca. 1898 Ma; and the mature quartz arenite was deposited unconformably on both after 1900 Ma (youngest zircon at 1900 ± 13 Ma). Elsewhere, 1892 Ma Bloom basalts overlay the quartz arenite.

Field work at the Beaverlodge Lake area in 2011 consisted of detailed sampling for petrographic and geochemical study along five traverses from the quartz arenite to apparent depths of 255 m. At the base of the Beaverlodge ridge, unaltered porphyry with phenocrysts of quartz and feldspar has a dark gray groundmass and is rhyolitic to dacitic in composition. Up the ridge, towards the unconformity, the porphyry appears leached, where altered porphyry is white in colour and has a dark gray groundmass. Closer to the unconformity the zone of leaching is followed by a zone of oxidation where altered porphyry is red in color and the groundmass of the porphyry turned light gray due to hematite staining. This zone of oxidation is unconformably overlain by pure white quartz arenite. Porphyry clasts with distinct weathering rims are common in the basal quartz arenite.

Preliminary petrographic observations and microprobe analyses of unaltered porphyry have confirmed phenocrysts of quartz, plagioclase feldspar, and occasionally magnetite. The fine groundmass is mostly composed of alkali feldspar, quartz, and chlorite. Accessory minerals in the porphyry include rutile, iron oxides and apatite. Further petrographic observations, microprobe analyses, and geochemical analyses are underway to examine the weathered porphyry and the porphyry blocks. These results are intended to provide insights into uranium mineralization along the unconformity and to shed light on atmospheric oxygen conditions at ca. 1.9 Ga.

GEOCHEMICAL AND MINERALOGICAL CONTROLS ON METAL DISPERSAL DOWNSTREAM OF SULPHIDE DEPOSITS IN THE PRAIRIE CREEK MINE AREA, SOUTHERN MACKENZIE MOUNTAINS, NWT

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The recently completed Mineral and Energy Resource Assessment (MERA) of the Nahanni National Park expansion has recognized many mineral occurrences in the Greater Nahanni Ecosystem of the Northern Cordillera, Northwest Territories. These sediment-hosted mineral occurrences have been broadly categorized as SEDEX, 'carbonate fault', 'intrusion related', and Carlin-type gold. The 'carbonate fault' model, based on the Prairie Creek deposits, tends to produce rather muted surficial geochemical signatures. Chemical analyses of stream water and sediments do not return anomalously high elemental concentration results, in areas where the rocks are known to contain mineralization with grades that make them potentially economic, as might be expected. The purpose of this study is to determine the mineralogical and geochemical controls on weathering and mobilization of the sulphide mineralization hosted within carbonate rock in the Prairie Creek area.

The Prairie Creek deposits, located in the Mackenzie Mountains of the Northwest Territories, are Lower Paleozoic carbonate-hosted sulphide deposits and consist of zinc, lead, silver, and copper sulphide vein systems and a stratabound zinc sulphide dominated zone. Galena, sphalerite, pyrite, and tennantite-tetrahedrite are present as massive-lenses to disseminated sulphides in the vein system; however, much of the uppermost portions of the deposit are highly oxidized, with smithsonite (zinc carbonate) and cerussite (lead carbonate) being the predominant minerals.

In the 2011 field season, samples of stream water, stream sediments (silt), bulk sediments (stream gravel), precipitated minerals, and sulphide and oxide mineralization were taken. These samples will be analysed using a variety of methods, including ICP-MS, micro-XRD, and heavy mineral analysis. Sampling locations were chosen to provide background levels of trace metals, as well as to monitor the geochemical gradient downstream of known mineralization. It is hoped that in tracing the form and speciation of the elements of interest along the stream and throughout the different media, it will be possible to gain an understanding of how these elements are being weathered, how they are transported, and ultimately, if and how they are being sequestered. Using the results, it may be possible to determine a specific geochemical fingerprint for carbonate-hosted sulphide deposits. This geochemical fingerprint may be used in exploration efforts to identify the subtle signatures that earlier efforts may have overlooked in the Mackenzie Mountains and carbonate platform rocks surrounding the Selwyn basin.

NWT LAND INFORMATION RELATED TO ABORIGINAL GROUPS MAP

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This poster presentation will provide an introduction to Aboriginal Affairs and Northern Development Canada's (AANDC) NWT Land Information Related to Aboriginal Groups Map. This map is a reference tool to help governments, Aboriginal representatives, regulators, explorers/developers, and others understand the lay of the land when it comes to

Aboriginal rights and related interests. Since Aboriginal consultation is intricately tied to the mining industry, this session will be a valuable opportunity to learn more about the context of land use, regulation and the resource industry.

Developed in the NT Regional office, the map provides a snapshot of the boundaries and delineations established as a result of settled comprehensive claims; ongoing land, resources and/or self-government negotiations; areas asserted by Aboriginal groups; parks and protected areas; and regulatory authorities. It includes spatial data sources that can be mined for more information as required.

AANDC has also developed an electronic PDF version of the map. By using this version with a downloadable extension for Adobe Acrobat Reader, users can turn different layers of information on or off depending on specific interests. A customized map can be printed based on the data chosen.

This map is intended to be used as an 'initial source' of information identifying which agreements, boundaries, assertions and/or other issues may need to be taken into account when working in the NWT. It can be used to flag any potential issues, however should not be relied upon as the only source of information. Boundaries shown are for information purposes only and are not ranked in any hierarchal order or to support any political agenda.

Since there are multiple data sources for this map, it is neither a precise technical tool nor a legal document, but rather the best un-biased information available at the time of production. For further information or to request a copy of the map, contact the Director of Aboriginal and Territorial Relations in Yellowknife at 867-669-2602 or James.Lawrance@aandc-aadnc.gc.ca.

SURFICIAL MATERIALS MAPPING USING LANDSAT7 AND TOPOGRAPHIC CDED DATA, YELLOWKNIFE NTS MAP SHEET 85J, NWT

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Despite the detailed knowledge of bedrock geology in the mineral-rich Yellowknife region, knowledge of surficial sediments, permafrost, land cover, and geotechnical conditions is still rudimentary. This lack of basic geoscience information hinders the understanding of present and future terrain risks to roads, airports and other infrastructure, which are vital to northern economic development.

We have generated a preliminary remote predictive surficial materials map for the Yellowknife NTS Map Sheet 85J using Landsat7 imagery (normalized bands 2,3,4,5 and 7 at 30 m spatial resolution) and 1:50 000 scale Canadian Digital Elevation Data (CDED). The spectral signatures associated with bedrock, clay, sand and organic units were established using "training areas" derived from traditional airphoto interpretation and field validation data. A high level of statistical separation among the training areas indicates that spectral differences exist for each surficial unit and a reasonable model can be built to map this region.

The preliminary map, focusing initially on the area north of the North Arm, Great Slave Lake, indicates widespread clay infilling bedrock depressions and topographic lows between 157 m (current elevation of Great Slave Lake) and 200 m asl. At elevations above 200 m, clay is less extensive and isolated deposits of coarse-grained sediment (sand and gravel) in the form of reworked eskers and beach deposits exist. The high spatial occurrence of clay below 200 m contributes to the understanding of former Glacial Lake McConnell (estimated maximum lake elevation of 280 m) and aids in identifying

the distribution of thaw-sensitive clay terrain. Exposed and vegetated sand and gravel deposits, potentially useful as granular resources, were also identified across previously unmapped terrain.

Remote predictive maps provide a first order assessment of surficial materials, which can guide traditional mapping efforts and offer regional information for geological interpretations and decision making processes related to infrastructure. From these maps, together with field data, predictive surficial geology maps can be generated and utilized as an aid to mineral exploration. Future versions of the Yellowknife map sheet 85J and surrounding NTS sheets (e.g. 85I, 85O, 85P, 86A, 76D and 75L) will integrate Landsat7 imagery, SPOT5 imagery and topographic characteristics calculated from CDED data, in order to improve mapping capabilities and accuracy.

GOLD AND BASE METALS POTENTIAL FROM GLACIAL SEDIMENTS, MELVILLE PENINSULA (NUNAVUT)

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New geochemical and mineralogical results from glacial sediments in Melville Peninsula indicate mineral potential for gold and base metals. Samples were collected in 2009 and 2010, as a component of the Geo-Mapping for Energy & Minerals (GEM) Melville Peninsula Project. This project is collaboration between the Geological Survey of Canada and the Canada-Nunavut Geoscience Office. An important component of the project is dedicated to adding new data to an already substantial amount of Quaternary glacial sediments (Dredge, 1995, 2002 and 2009) and lake sediments (Cameron et al, 1981; Day et al., 2009). 630 samples were collected for till matrix geochemistry, 420 samples for heavy mineral analysis (gold grains, MMSIMs and KIMs) and 102 samples for mineralized boulders geochemical assay. The sampling focused in the main areas of Archean greenstone belts (Prince Albert Group), and the Proterozoic Penrhyn Group. Gold mineral potential was assessed using matrix geochemistry and gold grain counting in till heavy minerals. Base metal potential has been detected using till matrix geochemistry, MMSIMs presence (locally gahnite) and heavy mineral non-ferromagnetic concentrate geochemistry (especially in carbonated till areas). Additionally, a detailed ice flow and ice dynamics map of the area has been updated.

GEOCHRONOLOGY AND GEOCHEMISTRY OF PRECAMBRIAN BASEMENT ROCKS FROM THE VICINITY OF FORT MCMURRAY, ALBERTA: A GEOTHERMAL PERSPECTIVE

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Oil sands processing in the Fort McMurray area accounts for ~6% of Canada's annual natural gas consumption (EMR, 2008 website). To reduce energy consumption and CO_2 emissions, a study was recently initiated under the auspices of the Helmholtz-Alberta Initiative to examine the possibility of a cheaper source of hot water for oil sands processing in northeastern Alberta by geothermal methods. The particular geothermal method being considered is known as Engineered Geothermal Systems (EGS), which aims to extract economic quantities of heat from low permeability and porosity rocks. EGS are currently being developed and tested in Europe, Australia, Japan, and the United States as alternative energy sources (MIT report, Tester et al., 2006). The present study is the geochemical/petrological component of a larger investigation into the feasibility of using EGS as a hot water source for oil sands processing in the Fort McMurray
area. Specifically, our aim is to document the rock types, mineralogy, crystallization ages and heat-producing element concentrations of 37 basement drill core samples recovered in 23

petroleum exploration wells drilled into Precambrian basement within a 125 km radius of Fort McMurray.

Most of the drill core samples are part of the Taltson Magmatic Zone (TMZ), a 500 km long, Paleoproterozoic orogenic belt, more than half of which is buried beneath Phanerozoic cover rocks. The investigated samples are mostly deformed granitoids but also include one amphibolite and one sample likely of metasedimentary origin. Preliminary U-Pb isotopic age determinations conducted on thin sections of these samples by laser-ablation, multi-collector ICP-MS yielded zircon crystallization ages ranging from 1.84 to 2.4 Ga. On the basis of these data, the samples can be divided into five age suites. The oldest suite yields relatively poorly constrained ages between 2.2 and 2.4 Ga (n=5). A second group of samples indicate ages of ~2.0 Ga (n=2). The samples from suites 3 (n=6) and 4 (n=6) record two separate periods of granitoid intrusion at 1.95-1.97 Ga and 1.925-1.935 Ga, respectively. The ages noted above correspond well with ages that have been previously reported from the exposed part of the TMZ. The 5th suite comprises the youngest dated sample (n=1), which yielded an age of ~1.84 Ga. This younger sample is from the Rimbey domain, the crustal domain that marks the southern boundary of the TMZ.

Heat-producing element concentrations (K, U, Th) are highly variable in different core samples but on average the younger granitoid suites have higher concentrations of these elements. The youngest suite (Suite 5) has by far the highest U content (13.6 ppm) of any of the rocks analyzed in the present study. The temperature recorded at the base of the 2.36 km deep Hunt Well, which is located near the Fort McMurray town site, is ~47°C (Majorowicz et al., 2011). Given that the Hunt Well is drilled in the older (ca. 2.2-2.4 Ga) and less radiogenic rock suite, it seems reasonable to conclude that geothermal gradients at other locations within the study area may be at least as high as those documented at the Hunt Well.

MY COMMUNITY IS MY CLASSROOM: BUILDING HANDS-ON LEARNING FOR YOUTH AND OTHER COMMUNITY MEMBERS TO ENGAGE IN COMMUNITY WATER MONITORING

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Communities throughout Northwest Territories are concerned about water contamination resulting from landfill leachate and sewage effluent. The concern was strongly voiced during recent community planning exercises facilitated by Ecology North (2009-2011) and in a March 2011 workshop on municipal water within the *Climate Change and Communities in the Northwest Territories Forum* hosted by the Northwest Territories Association of Communities, Pembina Institute and Ecology North.

Ecology North is collaborating with municipal governments, Land and Water Boards, Aboriginal Affairs and Northern Development Canada, Environment Canada, Department of Fisheries and Oceans, Government of Northwest Territories Municipal and Community Affairs and Environment and Natural Resources to create and deliver hands-on learning material that will involve a broad spectrum of community members including municipal staff, Elders, youth and other interested community members.

A principle focus of the project is education for youth. Available community data, both from municipal testing of source water and sewage lagoon effluent as well as other community water monitoring initiatives, are being used to create community-specific lesson plans for youth that will fit into existing curricula. In particular, the NWT Experiential Science Curriculum 10, 20 and 30 (for grades 10, 11 and 12) offer excellent windows for hands-on real life learning. Additional opportunities for lesson plan integration are evident in other middle school and high school science curricula.

The lesson plans will focus on interpretation of parameters used for routine water testing in the

community. By making existing data more accessible to more NWT residents, it is anticipated that residents will also be able to build the confidence and skills necessary to engage in monitoring initiatives beyond the municipal water and waste focus.

GREAT SLAVE TRACS – TRANSPORTATION RISK IN THE ARCTIC TO CLIMATIC SENSITIVITY

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Great Slave – TRACS (Transportation Risk in the Arctic to Climate Sensitivity) is a collaborative project established to reduce the costs and risk of transportation infrastructure in the resource-rich area of the Northwest Territories north of Yellowknife. Ground transportation infrastructure is critical to northern development. Economic development in the North is largely centred on mineral resources in the Slave Geological Province, north of Yellowknife, NWT. Ground transportation to the south requires all-weather road access across discontinuous permafrost terrain and winter-road access primarily across frozen lakes. Climate warming in the region poses risks to existing road and highway road infrastructure and requires adaptation measures to find alternatives to increasingly unreliable ice-roads.

Despite the mineral-rich nature of this region, surficial sediment maps, knowledge of permafrost, land cover, and geotechnical conditions are still rudimentary. This lack of basic geoscience information hinders the understanding of present and future terrain risks to roads, airports and other infrastructure which are vital to northern development. Through TRACS, federal, territorial, industry and academic collaborators will provide the geoscientific expertise to reduce risks and aid in adaptation solutions for land-based transportation infrastructure. This project aims to develop a geoscientific approach for terrain-climatic risk mapping to aid in maintenance and remediation of existing road infrastructure and land-based options to the present winter road corridor.

Four main activities represent the focus of TRACS over the next five years. These include a surficial geological context for terrain stability in the Great Slave region; land cover and change mapping for permafrost terrain conditions; permafrost sensitivity analysis to complex thermal and hydrological changes via modeling and field investigations; and risk assessments of highway infrastructure and proposed transportation corridors.

These activities require a range of geoscience data integration, including remote predictive mapping of surficial sediments and predictive ecological mapping using Landsat 7 and SPOT 5 satellite imagery; subsidence and lake ice mapping using RADARSAT-2; and detailed terrain mapping and using LiDAR and related optical imagery. These mapping initiatives are supported by field validations, geophysical surveys and measurements of permafrost geothermal and geotechnical characteristics to provide geoscience information needed for adaptation planning.

MINERAL AND ENERGY RESOURCE ASSESSMENT (MERA) FOR THE AREA OF INTEREST FOR THE PROPOSED THAIDENE NENE NATIONAL PARK

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The MERA process was established in 1980 as the mechanism to ensure that the economic and strategic significance of mineral and energy resource potential is duly considered in the national park establishment process in Federal lands north of the 60th parallel. In June 2007, at

the request of Parks Canada, the GSC initiated Phase I of the Thaidene Nene MERA process. This involved compiling an inventory of all existing public domain data in the study area and identifying data gaps. Phase 1 compilation results were used to design the Phase II field studies work plan, which was approved in February 2008. MERA Phase II studies involves five main types of field investigations: Quaternary, bedrock, geophysical, metallogeny and hydrocarbon. The majority of the field program was carried out in 2008, with fill-in and follow-up work undertaken in 2009. In 2010 and 2011, laboratory data acquisition and interpretation were undertaken, followed by mineral potential modelling and report writing. Deposit types that were identified and modelled in the Thaidene Nene area of interest include kimberlitic diamond, volcanogenic massive sulphide, magmatic sulphide, polymetallic veins, base metal veins, uranium-bearing veins, uranium in sandstone, IOCG-like, chromitite and Proterozoic rare metals in syenite and pegmatite. The final report, is expected to be completed by fall 2011.