Québec exploration 2007

Abstracts of oral presentations and posters

November 26 to 29, 2007 ■ Château Frontenac, Québec

DV 2007-05

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Ressources naturelles et Faune
Québec

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Message from the Minister of Natural Resources and Wildlife

As the minister responsible for Ministère des Ressources naturelles et de la Faune, the event organizer, I am pleased to invite you to take part in Québec Exploration 2007. This annual convention is an excellent opportunity to underscore the importance of our mineral resources, communicate the latest geoscientific knowledge, and promote the mining sector to our youth, the leaders of tomorrow.

This year's theme, "Québec, the Right Place to Explore," is clear. The Québec mining industry is known the world over for its rich subsoil, its competent workforce, and the public support it receives.

In fact, Québec offers the best mining investment environment in Canada and one of the best in the world. According to preliminary data for 2006, Québec's performance in mineral exploration is remarkable, with investments of over $260 million.

With this in mind, Québec Exploration 2007 is a must-attend event for mining industry stakeholders to learn more about key issues, take advantage of current development opportunities, and prepare for the challenges faced by this constantly growing and evolving industry.

In 2007, this major event will bring together some 1,500 attendees from Canada, the United States, and Europe. I invite you to take active part in the convention's many exciting activities. And please accept my best wishes for exciting new partnerships and a wonderful stay in the historic capital of Québec.

Have a great convention!

Claude Béchard

Minister of Natural Resources and Wildlife

Message from the Chairman of the Québec Mineral Exploration Association



Association de l'exploration minière du Québec (AEMQ) is pleased to join Ministère des Ressources naturelles et de la Faune in presenting the fifth edition of Québec Exploration. On behalf of AEMQ, I am delighted to invite you to take part in one of the most important mining and geoscience conventions in Canada. This is a leading event in the industry, drawing 1,500 attendees from all mining sectors, primarily from Canada but from around the world as well.

Under the theme "The Right Place to Explore," the organizing committee has again put together a diverse program sure to interest you. The convention covers such topics as mineral and petroleum exploration, the environment, and investing in exploration companies. New and promising discoveries and developments in Québec are also on the agenda.

Moreover, for the first time this year, the Exploration/Investment Forum featuring financial industry speakers and stakeholders will be open to the general public for one day. In addition, I am extending a special invitation to interested youth who would like to take part in the day's various activities and further their knowledge of the mining industry.

And of course, I invite all AEMQ members to take part in the Annual General Meeting on November 28, where you will learn about the latest developments in your association. In addition, several administrative positions are currently open. I strongly encourage you to get involved and lend your talents to AEMQ so your association can meet the challenges associated with mining in Québec.

I look forward to seeing you in great numbers at Québec Exploration, the friendliest and largest of all the mining and geoscience conventions in Canada!

Marco Gagnon

President, Québec Mineral Exploration Association



Message from the Honorary Chairman of Québec Exploration 2007

As Chief Executive of Xstrata Nickel, I have the wonderful privilege of presiding as Honorary Chairperson of Québec Exploration 2007.

The global mining industry and mineral exploration in particular, have seen phenomenal, relentless growth in activity for more than four years. When it comes to mineral exploration, Québec has always been avant-garde with its modern and clear mining regulations, its attractive tax policies and its desire to offer effective services. The recent initiatives of our governments to gather new geoscientific knowledge will stimulate exploration efforts even more in the coming years.

Exploration is a crucial phase of the development and growth of the mining and metallurgical industry which currently employs over 50,000 people in Québec. It is estimated that more than 300 million dollars will be invested in exploration in the province in 2007, of which approximately 10% will stem from exploratory activities undertaken by Xstrata on our Raglan property in the Nunavik territories and in

the Matagami and Rouyn Noranda regions alongside our partners Donner Metals and Alexis Minerals. At Xstrata, we are committed to a focussed exploration approach in Québec, in alignment with our business objectives and believe it is one of the most promising areas for discovery in North America.

I invite all of you to join me and participate in Québec Exploration 2007, to exchange ideas and to see and hear about the energy being put into mineral exploration in Québec, which must be done with full respect for everyone's environment, health and safety.

Ian Pearce

CEO, Xstarta Nickel

Goldcorp Inc.

Abstracts of oral presentations and posters

Session 1

8:15

Official Opening
By the President of Québec mineral exploration Association and the Executive Director of Géologie Québec

Targeting Copper in Abitibi

Chair: Sylvain Lacroix (MRNF)

8:30

An overview of summer 2007 at Géologie Québec's activities
Robert Marquis (MRNF)

9:00 keynote speaker

E **Volcanogenic massive sulphide deposits: Essential attributes for discovery in Abitibi**
James M. Franklin (Franklin Geosciences)

9:30

The Noranda mining camp: Generating targets in a mature camp, methodology and results
Pierre Riopel, Mario Masson and Louis Martin (Xstrata Copper Canada)

9:50

New U-Pb geochronology from the TGI-3 Abitibi / Copper Plan project: Implications for geological interpretations and base metal exploration
Vicki McNicoll, Otto van Breemen (GSC-O), Benoît Dubé (GSC-Q), Jean Goutier (MRNF), Patrick Mercier-Langevin (GSC-Q), Claude Dion (MRNF), Pierre-Simon Ross (GSC-Q), Thomas Monecke, John Percival (GSC-O), Phil Thurston (LU), Marc Legault (MRNF), Harold Gibson (LU), John Ayer (OGS), Wouter Bleeker (GSC-O), Ben Berger (OGS),Pierre Pilote (MRNF), Jean Bédard (GSC-Q), François Leclerc (INRS-ETE) and Pierre Rhéaume (MRNF)

10:10

Units in the Blake River Group: Correlations, geometry and mineral potential
Jean Goutier, Claude Dion, Marc Legault (MRNF), Pierre-Simon Ross, Vicki McNicoll, Eric de Kemp, John Percival, Thomas Monecke, Gilles Bellefleur, Patrick Mercier- Langevin, Kathleen Lauzière (GSC), Phil Thurston (LU) and John Ayer (OGS)

10:30

E **Stratigraphy and metallogeny of the Kidd-Munro assemblage: New evidence from east of the Kidd Creek VMS deposit**
Ben Berger, John Ayer (OGS), Vicki McNicoll and Wouter Bleeker (GSC)

10:50

Geology of the western Malartic Group and correlations across the Abitibi Belt (2 of 3)
Pierre Pilote (MRNF), Vicki J. McNicoll (GSC), Réal Daigneault (UQAC) and James Moorhead (MRNF)

11:10

Geological mapping using drilling data and Quaternary sediment geochemistry, Lac Bigniba area (32F04-SE); Phase 1 of the Rivière Octave project, Abitibi, Québec
Pierre Rhéaume (MRNF), Michel Parent (GSC-Q), Charles Maurice (MRNF), Éric Boisvert and Vicki McNicoll (GSC)

Session 2

Oil and Gas Exploration in Québec: A Newly Emerging Hydrocarbon Producing Region?

Chair: Robert Thériault (MRNF)

1:30 keynote speaker

E **Trenton-Black River hydrothermal dolomite reservoirs of the Northeastern US, Ontario and Québec**
Langhorne Smith (New York State Museum)

2:20

E **St. Lawrence Lowlands Trenton/Black River potential: the past, the present and the future**
Stefan Seifert (Talisman Energy)

2:40

Structural evolution of the Appalachian front in southern Québec: Implications for oil and gas exploration
Stephan Séjourné, Michel Malo (INRS-ETE) and Martine M. Savard (GSC-Q)

3:00

Paleozoic hydrocarbon systems in Québec: Recent data and synthesis
Denis Lavoie (GSC-Q)

3:20

Shale gas in the spotlight
Virginie Lavoie and Jean-Sébastien Marcil (Junex)

3:40

Hydrocarbon exploration in Québec: Why look to the marine environment?
Mathieu J. Duchesne, Nicolas Pinet, Denis Lavoie, Andrée Bolduc (GSC-Q) and D. Calvin Campbell (GSC-A)

Session 3

James Bay: The Birth of New Mining Camps

Chair: Jean-François Ouellette (Services techniques Géonordic)

8:30 keynote speaker
History of exploration and metallogenic outlook in the James Bay region
Michel Gauthier (UQAM)

9:20
The Eleonore project: Summary of progress toward a feasibility study
Jacques Simoneau (Opinaca Mines)

9:40
E
The Renard Project: Québec's first diamond mine?
Matthew Manson (Stornoway Diamond Corporation)

10:00
Coulon Project: Emergence of a vast VMS system in James Bay
Mathieu Savard (Virginia Mines)

10:20
Recent geoscientific work and future perspectives for the James Bay region
Daniel Bandyayera, Sylvain Lacroix and Jean Goutier (MRNF)

10:40 keynote speaker
E
Conference by Québec Exploration 2007 honorary chair
Ian Pearce, CEO, Xstrata Nickel

Session 4

Promising Discoveries and New Developments

Chair: Michel Allard (Xstrata Zinc Canada)

1:30
The Scott Lake project: a promising volcanogenic mineralization system and new hope for the Chibougamau region
Gérald Riverin, Tony Brisson and Benoit Lafrance (Cogitore Resources)

1:50
E
Something old – something new: A new mine in a historic mining camp
David M. Rigg (Alexis Minerals Corporation)

2:10
Canadian Malartic: Impact of a porphyry gold model on an old mining camp
Robert Wares (Osisko Exploration), Cécile Noverraz, James Clark (McGill) and Christian Beaulieu (UQAM)

2:30
Matagami: Second birth of a prolific base metal camp
Robin Adair (Donner Metals), Gilles Roy and Michel Dessureault (Xstrata Zinc Canada)

Session 5

Uranium: The Gamma Effect on Exploration in Québec and Eastern Canada

Chair: Serge Perreault (MRNF)

8:30

Exploring for uranium: a radiant summer in Québec
Serge Perreault (MRNF)

8:40 keynote speaker

E **Exploration models for uranium deposits in Canadian Proterozoic basins**
Charles W. Jefferson, Robert Rainbird (GSC) and Ted O'Connor (Cameco)

9:30

The Matoush deposit: A new vision of the uranium potential in the Otish Basin of Québec
Jonathan Lafontaine and Jean-Pierre Lachance (Strateco Resources)

9:50

Toward the discovery of new uranium districts in Québec: Azimut's strategy and results
Jean-Marc Lulin (Azimut Exploration)

10:10

E **Uraniferous and thoriferous Y-REE-Nb granitic pegmatites in the Grenville Province: Understanding distribution, age, and genesis to aid in exploration**
David R. Lentz (UNB)

10:30

The geological setting of uranium in the Proterozoic rocks of Labrador
Andrew Kerr, Greg W. Sparkes (GSNL), Richard J. Wardle (NLDNR), Derek H. C. Wilton (MUN) and Alana M. Hinchey (GSNL)

10:50

E **Discovery and development in Canada's next uranium district, Central Mineral Belt, Labrador**
Christopher Lee, Chris Buchanan, Andrew Parmenter, Ian Cunningham-Dunlop, Matthew Lennox-King, Jim Lincoln, Mark O'Dea (AXU)

11:10

E **Exploration activity and setting of uranium in New Brunswick**
Malcolm McLeod and Susan Johnson (NBDNR)

Session 6

Exploration/Investment Forum

Chair: Jean-Pierre Thomassin

Including
Paul van Eeden
Chad Williams
David and Eric Coffin

Investment specialists will be on hand to give their take on the state of mining and metal exploration investing. Don't miss their most recent recommendations and predictions. A panel discussion following their short presentation will include a question and answer period for the public to interact with the specialists.

E **Conferences will be given in English**
Simutaneous interpretation will be available for all conferences.

Session 1 **9:00**

Volcanogenic massive sulphide deposits: Essential attributes for discovery in Abitibi

James M. Franklin (Franklin Geosciences)

Abitibi VMS deposits are all in the bimodal mafic-dominated group. Variations in form, composition, district tonnage and alteration assemblages are great but predictable. Volcanological attributes determine their composition and form. Copper-rich, lead-poor deposits formed in flow-dominated deep water regimes (>2000 m). Zinc(±silver)-rich deposits formed in volcaniclastic-dominated shallower water settings (1500-500 m). Noranda and Matagami Lake exemplify the former, whereas the Barville, Val-d'Or, Kidd Creek and possibly Bousquet districts exemplify the latter. District sizes and deposit distributions are controlled by the heat input into the upper 5 km of the crust, manifest by the size, composition and attitude of subvolcanic intrusions. Petrochemical data reflect temperature conditions of crustal melting (felsic melts) and melt contamination (andesite abundance), all related to the heat input needed to "drive" convective fluid flow and metal leaching within a hydrothermal reservoir.

District-scale lower "reaction" zones (albite-epidote-actinolite-quartz) are all similar, regardless of setting. The upper alteration assemblages depend on the regional volcanological characteristics. Flow-dominated systems have distinctive semiconformable reservoir caps consisting of silicified, locally albitized and Mg-chloritized strata, above which the rocks are relatively unaltered (e.g., Noranda, Matagami). Volcaniclastic-dominated regimes have widely distributed carbonate-impregnated strata in their upper 500 m, and less well-defined "caps". These relatively permeable strata underwent massive volumes of convective fluid circulation, causing stratigraphically extensive Na depletion, with the formation of aluminous assemblages (andalusite, chloritoid, pyrophyllite: Barville).

Alteration pipes in flow regimes are vertically extensive, aerially confined to the deposit footprint, and dominated by Mg-chlorite and sericite. Those in volcaniclastic regimes are laterally extensive zones (2-3x the footprint width) of silicified and sericitized strata with less chlorite.

The ore zones in flow regimes consist of sulphide mounds formed on the seafloor (e.g., Millenbach) although some may have formed within an earlier-formed hydrothermally generated stratum (talc mounds, cherty exhalite: Matagami). Those in volcaniclastic regimes formed sub-seafloor by replacement of clasts (Kidd).

Gold enrichment formed either by oxidative destruction of bisulphide-transported Au, requiring boiling conditions (shallow water) and probably an oxidative ocean, by secondary circulation of heated seawater through a pre-existing sulphide mound (oxidative precipitation?) or a second source of gold, such as a magmatic system (Bousquet, Horne?).

Determination of the volcanological attributes of various parts of the Abitibi is the most critical step in establishing additional VMS potential, as well as determining the key field characteristics to be measured by explorationists.

Session 1 **9:30**

The Noranda mining camp: Generating targets in a mature camp, methodology and results

Pierre Riopel, Mario Masson and Louis Martin
(Xstrata Copper Canada)

The Noranda mining camp, in the Blake River Group, hosts more than 20 volcanogenic massive sulphide (VMS) mines for a total historical production of 2.2 Mt Cu, 1.3 Mt Zn, and 500 t Au. Most of these ore deposits occur in the Central Camp, which covers a surface area of about 290 km2 to the east of the Flavrian Pluton and west of the Lac Dufault Pluton. Areas on either side of the Central Camp, namely to the west of the Flavrian Pluton and to the east of the Lac Dufault Pluton, cover roughly equivalent surface areas but host only a few ore deposits.

Various approaches and various tools are used in the Noranda mining camp to generate high-quality drilling targets. A Megatem geophysical anomaly is behind the discovery in 2004 of the Montbray showing (5.21% Cu over 5.16 m). The development of a 3D block model designed to allow quantitative queries within the block led to the discovery of West Ansil in 2005 (indicated resource: 0.53 Mt @ 3.4% Cu, 0.4% Zn, 1.4 g/t Au, 9.2 g/t Ag; inferred resource: 0.60 Mt @ 3.3% Cu, 0.2% Zn, 0.3 g/t Au, 5.9 g/t Ag). In 2006, the discovery of the Pinkos showing (8.11% Zn, 18.2 g/t Ag over 2.64 m) was the result of a compilation and summation of favourable criteria for VMS deposits.

These recent discoveries demonstrate the mineral potential still remaining in the Noranda mining camp, despite its maturity. Xstrata Copper Canada and its main partner Alexis Minerals Corporation remain on the lookout for the latest technology in the field of mineral exploration and support the various studies that will lead to a better understanding of Blake River geology.

Session 1 **9:50**

New U-Pb geochronology from the TGI-3 Abitibi / Copper Plan project: Implications for geological interpretations and base metal exploration

Vicki McNicoll, Otto van Breemen (GSC-O), Benoît Dubé (GSC-Q), Jean Goutier (MRNF), Patrick Mercier-Langevin (GSC-Q), Claude Dion (MRNF), Pierre-Simon Ross (GSC-Q), Thomas Monecke, John Percival (GSC-O), Phil Thurston (LU), Marc Legault (MRNF), Harold Gibson (LU), John Ayer (OGS), Wouter Bleeker (GSC-O), Ben Berger (OGS), Pierre Pilote (MRNF), Jean Bédard (GSC-Q), François Leclerc (INRS-ETE) and Pierre Rhéaume (MRNF)

The Abitibi Targeted Geoscience Initiative III (TGI-3) project is designed to improve and expand geoscience knowledge in areas of high base metal potential in established mining districts in the Abitibi, Québec and Ontario. A major targeted high-precision U-Pb dating program is associated with new geological mapping, geophysical, geochemical and till surveys, 3-D structural and stratigraphic model(s), and integrated compilations.

U-Pb geochronology is a key component of a multi-disciplinary project to better understand the geology of the Blake River Group (BRG) and parameters controlling formation of numerous base and precious metals deposits. Problems addressed with geochronology in the BRG include: (1) establishing age control on potentially synvolcanic plutons (2701-2696 Ma) and felsic volcanic centres (2702-2696 Ma) and (2) providing age constraints on different stratigraphic assemblages in order to assist in correlations between assemblages. These new data will help to better define the stratigraphy of mineralized sequences and their structural framework. The role of mafic/intermediate intrusions in the evolution of the BRG is also addressed; a mafic dyke has been dated at 2695 Ma. Ages of inherited zircons in BRG rocks provide information on the substrate to the BRG and constraints on crustal evolution.

The Abitibi TGI-3 project also focuses on the Kidd-Munro assemblage (2719-2711 Ma), host to the giant Kidd Creek VMS deposit in Ontario, constraining its internal stratigraphy and bounding assemblages. New age constraints on stratigraphy (2716 Ma) in the Malartic/Kinojévis groups in Québec aid in testing potentially correlative units of the Kidd-Munro assemblage.

Work in the Chibougamau area to refine the magmatic and structural history of this region is in progress. New U-Pb dating from the Gilman Formation (2727 Ma) suggests that refinements to stratigraphy are required. Future U-Pb geochronology in the Abitibi TGI-3 project will include dating of bedrock retrieved from outcrop and drill core from an ongoing Quaternary survey in the Lebel-sur-Quevillon region. New U-Pb dates obtained during Abitibi TGI-3 and their implications will enhance the understanding of Abitibi stratigraphical and structural framework and metallogeny.

Session 1 **10:10**

Units in the Blake River Group: Correlations, geometry and mineral potential

Jean Goutier, Claude Dion, Marc Legault (MRNF), Pierre-Simon Ross, Vicki McNicoll, Eric de Kemp, John Percival, Thomas Monecke, Gilles Bellefleur, Patrick Mercier-Langevin, Kathleen Lauzière (GSC), Phil Thurston (LU) and John Ayer (OGS)

The Blake River Group is an assemblage of Archean (2702-2696 Ma) subaqueous volcanic rocks of the Abitibi Subprovince. This group is known for its numerous massive sulphide deposits, some of which are world-class deposits (Horne, LaRonde). This geological update of the Blake River Group is conducted within the scope of the Copper Plan – TGI-3. The definition of Blake River units is based on mapping surveys (1987-2007), ongoing specific studies and numerous previous studies.

Five ore-forming episodes are recognized, from the oldest to the youngest: 1) Horne; 2) Aldermac; 3) Mine sequence (Amulet, etc.); 4) Delbridge-D'Eldona; 5) Bousquet-LaRonde, Bouchard-Hébert, Fabie Bay-Magusi. Ongoing work should help locate the Quemont and Gallen deposits in this framework, as well as new occurrences in the Cyprus rhyolite.

Seven major formations were recognized and are, from the oldest to the youngest: Hébécourt, Horne, Rouyn-Pelletier, Duprat-Montbray, Noranda, Bousquet and Reneault-Dufresnoy. Each formation shows distinctive physical characteristics, geochemistry and geographic position. The Hébécourt Formation and the lower Rouyn-Pelletier Formation are interpreted as the tholeiitic base upon which all other units developed. The Horne sequence, which hosts the massive sulphide ore deposit of the same name, is characterized by a pile of felsic volcaniclastic rocks and proximal vent facies; geochronology studies reveal it is the oldest felsic unit in the Blake River. The upper Rouyn-Pelletier Formation and the Duprat-Montbray Formation consist of bimodal volcanic assemblages that are probably contemporaneous and represent the base of the Blake River. The Duprat-Montbray Formation extends into Ontario to include rhyolites in Pontiac Township. The Noranda Formation, younger than the Duprat-Montbray, is divided into three sequences: 1) the *Mine sequence*, a bimodal sequence hosting numerous VMS deposits, 2) the *Héré sequence*, overlying the latter and hosting the Delbridge and D'Eldona gold-rich VMS ore deposits, and 3) the *Cyprus sequence*, the youngest and showing a strong tholeiitic affinity. Ongoing geochronology studies will confirm if the latter is coeval with tholeiitic rhyolites at the top of the Blake River (e.g., Cléricy hills). The Reneault-Dufresnoy

Formation forms the northern margin of the Blake River in Québec, and is interpreted to extend over much of the Blake River in Ontario, including the volcanic rocks in Ben Nevis Township. It stratigraphically overlies both the Hébécourt and Duprat-Montbray formations. It is characterized by plagioclase-phyric units, by a wide variety of volcanic facies, many types of volcaniclastic rocks, and highly vesicular layers. This marks a drastic change in Blake River volcanism, and a hiatus can probably be defined at the base of this formation. The Bouchard-Hébert and Fabie Bay-Magusi deposits occur in the upper part of this formation. Although partly coeval with the Reneault-Dufresnoy Formation, the Bousquet Formation is distinctive, due to its volcanic facies and a concentration of gold-rich VMS ore deposits (Bousquet and LaRonde Penna). The structure of the Blake River Group can be represented using a simplified image of a N-S flattened sombrero, where early units outcrop outside and in the centre. Younger units therefore occur along the brim. New potential zones for VMS deposits are: the top of the Noranda Formation, which shows a Matagami-style setting with spherulitic rhyolites of tholeiitic affinity (Cyprus) overlying a vast gabbro-anorthosite intrusion formerly interpreted as a simple diorite; the base of the Reneault-Dufresnoy Formation, which marks a change in volcanism; areas to the west of intermediate volcaniclastic rocks adjacent to rhyolites in the Reneault-Dufresnoy Formation (Fabie Bay-Magusi style). The central part of the Blake River is also worthy of interest given the presence of volcanic rocks nearly as old as those hosting the Horne ore deposit.

Session 1 **10:30**

Stratigraphy and metallogeny of the Kidd-Munro assemblage: New evidence from east of the Kidd Creek VMS deposit

Ben Berger, John Ayer (OGS), Vicki McNicoll and Wouter Bleeker (GSC)

The TGI-3 Kidd-Munro project is designed to examine the stratigraphy, structure, geochemistry and metallogeny of the Kidd-Munro assemblage (2719-2711 Ma), host to the giant Kidd Creek base metal deposit located 35 km NE of Timmins. New mapping in Prosser Township shows that the high-silica rhyolites hosting the deposit and the hanging wall mafic metavolcanic rocks at the Kidd Creek Mine extend over 10 km to the NE, but that the underlying ultramafic volcanic rocks are either absent or have been removed by faulting. Instead, here intermediate and mafic fragmental metavolcanic rocks commonly underlie the high-silica rhyolites and associated basalts. New geochemical analyses show that the high-silica rhyolites and hanging wall mafic metavolcanic rocks in Prosser are tholeiitic and the underlying intermediate and mafic metavolcanic rocks are calc-alkalic. Geochemistry and petrography show that VMS-related hydrothermal alteration has affected both the high-silica rhyolites and the calc-alkalic rocks; however, copper and zinc mineralization appears to be more abundant in the calc-alkalic rocks.

Four new U/Pb zircon age dates were obtained to better constrain the Kidd-Munro assemblage and to help define the bounding assemblages to the north and south. A sample of calc-alkalic dacite underlying previously dated high-silica rhyolites (2716 +0.5 Ma) in Prosser Township returned an age of 2728 +1.7 Ma, correlative with the Deloro assemblage. In addition, a sample of felsic tuff from central Lucas Township, approximately 20 km northeast of the Kidd Creek mine, returned an age of 2722 +1.7 Ma and confirms these rocks are correlated with the Stoughton-Roquemaure assemblage. These dates suggest the north boundary of the Kidd-Munro assemblage needs revision and is more structurally and stratigraphically complicated than was originally interpreted.

In the eastern part of the assemblage, a sample of high-silica rhyolite that hosts the Montclerg gold occurrence in Clergue Township returned an age of 2714 +0.8 Ma and confirms the eastward extension of the Kidd-Munro assemblage. In the northern part of the assemblage, a felsic tuff in Walker Township returned an imprecise age of 2700 +5 Ma, providing evidence that a younger assemblage (Blake River or Tisdale) bounds the Kidd-Munro in this part of Ontario and thus confirming the complicated nature of its northern boundary.

Session 1 **10:50**

Geology of the western Malartic Group and correlations across the Abitibi Belt (2 of 3)

Pierre Pilote (MRNF), Vicki J. McNicoll (GSC), Réal Daigneault (UQAC) and James Moorhead (MRNF)

Our objectives for the second year of this three-year geological update and compilation project are as follows: 1) extend to the west the stratigraphic scheme of the Malartic Group, recently developed by the MRNF in the Val-d'Or area; 2) examine at a larger scale possible correlations between lithologies in the Kidd-Munro Assemblage (KMA) of Ontario that host the renowned Kidd Creek VMS ore deposit, and certain formations in the Québec Abitibi with particular potential, namely the Destor area, the Lanaudière Formation (along Rivière Kinojévis) and the lower Malartic Group. The two latter units were examined this year.

The study area for this year covered the western half of NTS sheet 32D/08 (Lac Preissac) and the eastern half of map sheet 32D/07 (Cléricy and La Pause townships). The area is underlain by rocks of the Lanaudière Formation and the Malartic Group.

The Lanaudière Formation is composed of ultramafic, mafic and felsic lavas as well as numerous tonalitic to monzonitic intrusions. The formation is bounded by the Aiguebelle and Manneville North faults (shallowly dipping to the north) that represent possible subsidiaries of the regional Destor-Porcupine Fault, recognized further west. The intensity of the regional deformation is highly variable, becoming quite intense near these faults. One of its rhyolitic complexes, located near Lac Matissard, defines a tholeiitic suite and was dated at 2716 +/-1 Ma. This age, along with the close spatial association between ultramafic lavas and rhyolitic complexes, brings to mind significant analogies with the KMA. The Lanaudière Formation also contains other rhyolitic complexes to the east of the study area. Ag-Au showings were in fact recently discovered in these rocks.

The Malartic Group is composed, in stratigraphic order, of the La Motte-Vassan (2714 +/-2 Ma), Dubuisson and Jacola (2704 +/-2 Ma) formations. Further east in the Val-d'Or area, these lithologies are overlain by the Val-d'Or (2705 to 2704 +/-2 Ma) and Héva formations. In the map area, the La Motte-Vassan Formation is mainly composed of ultramafic flows and sills, with basalt flows and volcaniclastic rocks. The Dubuisson Formation consists of equal proportions of ultramafic and epidotized basalt flows, with a variety of tuffs. Rhyolitic complexes occur in this formation, near Ruisseau Dunn and Lac Patris (Py-Po-Au showing). The Jacola Formation is composed of mafic volcanic rocks with a few thick layers of volcaniclastic rocks. Volcanic units in the Malartic Group form a steeply dipping, south-facing, broadly homoclinal sequence. These rocks are intruded by the synvolcanic La Pause pluton, dated at 2710 Ma. The latter, comprising a diorite-tonalite suite, appears to have been emplaced as stocks and multiple sills and is responsible for an early anticlinal structural ridge (the former "La Motte-Vassan Anticline"), where facing directions are reversed along the northern limb.

The Malartic Group is in faulted contact to the south (La Pause fault) with sedimentary units of the Kewagama Group (<2687 Ma). Along the contact, abundant tonalitic to monzonitic dykes are observed over several kilometres. Monzonitic dykes host many Au and Mo showings; they are most likely associated with the Preissac intrusive Complex (2681 to 2660 Ma). To the north, the Malartic Group is bordered by a zone of complex faulting (e.g., Manneville South), trending E-W to WNW-ESE and steeply north-dipping. These faults juxtapose sedimentary rocks of the Lac Caste Group (< 2691 +/- 8 Ma), volcanic units of the Lanaudière Formation and those of the Malartic Group. The regional S1 schistosity trends WNW-ESE; it is reworked by an S2 cleavage trending E-W, to produce Z folds at various scales. The plunge of these folds is nearly colinear with the plunge of stretching lineations associated with S1. The overall metamorphic grade is the upper greenschist facies, but locally reaches the amphibolite facies near the Preissac-La Corne batholith (2691 to 2640 Ma).

Session 1 **11:10**

Geological mapping using drilling data and Quaternary sediment geochemistry, Lac Bigniba area (32F04-SE); Phase 1 of the Rivière Octave project, Abitibi, Québec

Pierre Rhéaume (MRNF), Michel Parent (GSC-Q), Charles Maurice (MRNF), Éric Boisvert and Vicki. McNicoll (GSC)

The main objective of the Rivière Octave project is to compensate for the lack of knowledge of geological settings and exploration targets under the thick cover of glaciolacustrine sediments that extends from Normétal to Lebel-sur-Quévillon. The selected method, which consists in systematically sampling this environment in drillhole, will also lead to a characterization of tills and of underlying geological settings. The results of Phase 1 of this project, conducted under the MRNF Copper Plan and the GSC Targeted Geoscience Initiative, are presented here.

The study area in 2006-07 covers NTS sheet 32F04-101, located southeast of the Sleeping Giant mine. Supracrustal rocks in this area are bordered by the Marest and Bernetz plutons. A sequence of dominantly volcanic rocks cut by E-W to NW-SE-trending deformation zones was described. This sequence mainly consists of tholeiitic to transitional mafic and intermediate lavas, locally interbedded with tuffs and calc-alkaline felsic lavas. These volcanic rocks are locally overlain by a thick sedimentary unit composed of wacke and mudstone with graded bedding. This unit unconformably overlies the volcanic rocks and occupies the core of a regional west-plunging syncline. The youngest zircons recovered from a wacke sample from this unit yielded a TIMS age of 2700 Ma.

Under a variable thickness of glaciolacustrine silt, the 37 diamond drillholes (HQ-3) intersected 162.1 m of till, related glacial sediments or older Quaternary sediments; the average recovery rate was 63% (ranging from 0 to 100%; standard deviation = 22%). Given the proximity of the Harricana Moraine, drillholes frequently intersected, under the silt layer, variable thicknesses of proglacial sediments, mainly pebbly pavement, diamict with a washed-out matrix, and well-sorted sand and gravel. These proglacial facies were underlain by the basal till with a silty-sandy matrix or directly by the bedrock. Under the till, one drillhole intersected oxidized sandy sediments and an earlier till unit.

A total of 102 m of drill core was recovered, from which 130 samples of 400 to 800 g were collected for geochemical analyses (major and trace elements by ICP-AES and INA) and 128 samples weighing 1200 to 2000 g for heavy mineral concentrate studies and microprobe analyses of indicator minerals.

As a result, a certain number of targets were defined with potential for copper and gold deposits.

Session 2 **13:30**

Trenton-Black River hydrothermal dolomite reservoirs of the Northeastern US, Ontario and Québec

Langhorne Smith (New York State Museum)

Oil and gas have been produced from Upper Ordovician Trenton-Black River hydrothermal dolomite reservoirs in Ohio, Michigan and Ontario for the last 120 years. More recently, Trenton-Black River hydrothermal dolomite reservoirs have also been found in New York (multiple fields with up to 150 BCF gas) and Québec where there was a discovery in 2006.

These reservoirs form when high-pressure, high-temperature fluids flow up active faults until they hit a seal and then flow laterally into porous and permeable strata. Because the fault-derived fluids have a different pressure, temperature and composition than those residing in the formation, they have the capacity to alter the rock significantly in a short period of time. Fluids are thought to first leach the limestone, then dolomitize the leached matrix, and then precipitate saddle dolomite in fractures and vugs.

Geochemical and fluid inclusion analyses confirm that most or all dolomite found in the Trenton and upper parts of the Black River Group in the northern Appalachian Basin is of a structurally controlled hydrothermal origin. The dolomitized reservoirs mainly occur along fault-bounded margins with shale basins and in sags or structural lows associated with intra-platform wrench faults. The subtle structural lows are visible on seismic profiles, which is an essential tool for exploration. The faults commonly die out in the overlying Utica Shale suggesting that the structures and the dolomite formed during the Ordovician Taconic Orogeny, soon after deposition of the Trenton and Black River Groups.

These reservoirs are very heterogeneous and highly productive wells may occur within a very short distance from dry holes. For this reason horizontal drilling is probably the best approach. This play went undetected for many years because of its unintuitive structural expression and complex diagenesis. More hydrothermal dolomite reservoirs are likely to be found using the appropriate integrated structural-diagenetic-stratigraphic model.

Session 2 **14:20**

St. Lawrence Lowlands Trenton/Black River potential: the past, the present and the future

Stefan Seifert (Talisman Energy)

Comparisons are made between the recent drill results from the St. Lawrence Lowlands and the Ordovician Trenton/Black River hydrothermal dolomite (HTD) play that accounts for a significant portion of the New York State gas production. While there are general similarities to the New York TBR conceptual model, the Lowlands TBR is a complex, risky play.

The play concept is in the early stages of exploration throughout the St. Lawrence Lowlands of Québec. However, recent exploration drilling results at Gentilly offer encouragement for future TBR exploration. Extended production testing of the Talisman Energy Gentilly #1 well yielded initial gas rates ranging from 4.5 to 9.5 million cubic feet per day. However, during the subsequent more extensive five-day single-point deliverability test, the flow rates declined steadily to 0.6 million cubic feet per day with a resultant high water inflow exceeding 200 bbls/day.

The diagenetic history related to fractures and porosity enhancement is poorly understood. Trenton Group time structure maps derived from regional 2D seismic suggest the presence of extensional fairways (structural sags) throughout the area. The results, while encouraging, suggest that considerable further exploration effort is still required to better delineate and in time, develop these fairways.

Making this play an economic success requires considerable effort for ongoing regional appraisal and development, as well as additional capital for investment into equipment and infrastructure.

Session 2 **14:40**

Structural evolution of the Appalachian front in southern Québec: Implications for oil and gas exploration

Stephan Séjourné, Michel Malo (INRS-ETE) and Martine M. Savard (GSC-Q)

The Appalachian orogenic front represents a major target for hydrocarbons in southern Québec. In order to refine strategies already developed by the industry, the orogenic front between Drummondville and the Vermont border was the subject of a multidisciplinary geoscientific study designed to better understand its tectonic and diagenetic evolution (with emphasis on the carbonate slices) and to place this evolution in a regional context.

The overall architecture of the orogenic front – the autochthonous and parautochthonous domains – was elucidated by field observations and seismic interpretations. In the autochthonous domain, deformation appears restricted to pre- to early syn-orogenic normal faults in the platform, whereas the overlying flysches were affected by folds and reverse faults, such that the western edge of the front extends westward beneath the surface. The parautochthonous domain consists of imbricated shales and carbonate slices in a duplex geometry dipping towards the hinterland. The dominant structural style within the slices is characterized by thrust and reverse faults, minor backthrust faults, asymmetric folds, strike-slip faults and oblique ramps, and syn- to late-imbrication normal faults. The structural complexity and diversity are strongly dependent on lithology (thickness of the beds and clay content), and on the initial geometry of the basin. Finally, a major network of strike-slip faults parallel to the orogenic front developed in a late phase.

The Saint-Dominique slice, observable at the surface, was used as an example to illustrate the nature and evolution of fluids involved in the deformation of the carbonate slices. The diagenetic analysis (petrography, fluid inclusions, geochemistry) of structural cements reveals that the imbrication post-dated the first phase of liquid hydrocarbon generation and migration. The imbrication began with burial (to approx. 6 km), and the tectonic uplift of the slice was accompanied by a gradual decrease in temperature of the system, from about 245°C to 150°C. External fluids, of basinal and metamorphic origin, circulated during deformation. A second phase of maturation and migration followed imbrication, and the source of the hydrocarbons was likely in the footwall of the slice. Finally, the development of strike-slip faults parallel to the orogenic front promoted the mixing of residual waters with a magmatically-derived fluid related to Mesozoic intrusions. The development of these structures probably took place at shallow depth (about 2.5 km).

Session 2 **15:00**

Paleozoic hydrocarbon systems in Québec: Recent data and synthesis

Denis Lavoie (GSC-Q)

Three hydrocarbon systems are known in Québec: 1) Cambrian-Ordovician in southern and eastern Québec, 2) Silurian-Devonian in Gaspésie, and 3) Carboniferous-Permian in the Gulf of St. Lawrence.

Source rocks are found in Lower (TOC: 10.4%, HI: 759, Type II), Middle (TOC: 10.7%, HI: 266, Type I-II) and Upper Ordovician sequences (TOC: 14%, HI: 633, Type II). Hydrothermal dolomite (HTD) reservoirs are known in Lower and Middle/Upper Ordovician rocks. These HTD formed during shallow burial following the circulation of high-pressure, high-temperature (135-150°C) saline fluids (16-20 wt% $NaCl_{eq}$). Potential reservoirs are proposed in littoral and fluvial sandstones, and in turbidites and channel sandstones of the continental slope. Reservoirs are associated with a variety of stratigraphic and tectono-diagenetic traps in the St. Lawrence Platform and along the Appalachian front. Maturation data indicate that these successions are within the gas window, with some areas being favourable for oil preservation.

Silurian-Devonian successions have little source rock potential. Data indicate that oil in Devonian reservoirs can be correlated with Ordovician source rocks. Known reservoirs are in fluvial and deltaic sandstones, and in Lower Devonian HTD associated with major fractures. Other potential targets are Lower Silurian littoral sandstones and Silurian and lowermost Devonian HTD, which formed through the action of high-temperature (180-225°C) and very saline fluids (18-26 wt% $NaCl_{eq}$). These successions are associated with stratigraphic and tectono-diagenetic traps; a significant number of seismic anomalies and enhanced reflector zones are present in the Silurian successions. Maturation data indicate the system is favourable for the preservation of liquid and gaseous hydrocarbons.

With regards to Permian-Carboniferous successions, source rocks are known in Tournaisian lacustrine shales (TOC up to 30%, Types I and II). These source rocks generated the gas in the McCully field of New Brunswick. Pennsylvanian successions display numerous coal beds with strong gas potential. Known reservoirs (McCully, Stoney Creek, and East Point) consist of low-permeability Tournaisian fluvial sandstones and Pennsylvanian fluvial and deltaic sandstones. Clastic reservoirs are associated with many stratigraphic, tectonic and salt-bearing traps. Visean salt deposits form an extensive domain in the southern segment of the Gulf of St. Lawrence.

Session 2 **15:20**

Shale gas in the spotlight

Virginie Lavoie and Jean-Sébastien Marcil (Junex)

The development of shale gas deposits in the United States has revealed the presence of specific key elements that can be used for basin evaluation. For several years, JUNEX has endeavoured to demonstrate that the St. Lawrence Lowlands basin has the right features to warrant further investment in order to promote the development of the Utica and Lorraine shales. Their gas potential is currently attracting the attention of several players in the industry, and could become the centre of Québec's gas production in the medium term. This knowledge, acquired using publicly available data, will be presented.

Below are some of these key elements:

- Possible gas generation (two deposits are already known: Pointe-du-Lac, St-Flavien);
- The Lorraine and Utica shales cover a large surface area (around 5,000 km^2), and display considerable thicknesses (from 300 to 3,000 metres);
- An average TOC value above 1.20%;
- Thermal maturation values that fall within the gas window;
- Indications of gas during drilling, and gas in the cuttings;
- Ordovician shales, which are older and more mature than other North American shales, should be more responsive to fracture stimulation.

Currently available data support the conclusions made by the JUNEX team about the gas potential in shales of the St. Lawrence Lowlands, i.e., that this unconventional resource represents a major potential just waiting to be developed.

Session 2 **15:40**

Hydrocarbon exploration in Québec: why look to the marine environment?

Mathieu J. Duchesne, Nicolas Pinet, Denis Lavoie, Andrée Bolduc (GSC-Q) and D. Calvin Campbell (GSC-A)

Hydrocarbon exploration in Québec has experienced an upsurge in activity these past few years, spurred on by discoveries in adjacent sedimentary basins with comparable geological settings to the basins of Québec. Until now, recent exploration efforts have taken place onshore, within the Appalachians and the St. Lawrence Platform. The latter geological environment hosts world-class oil and gas fields in neighbouring New York and Ontario regions, and its potential in southern Québec is beginning to be better defined. In contrast, the offshore parts of the platform remain poorly known. Historically, the lack of interest for marine exploration in Québec can be partly explained by the poor quality of available geophysical data. Moreover, the high cost of exploration work at sea, maritime jurisdiction problems, and the complexity of environmental assessment procedures have hindered prospecting in the marine extension of this geological environment. Nevertheless, several geological arguments can be made to raise interest about the potential of the marine environment.

The Geological Survey of Canada and its partners have led various research projects in offshore regions of Québec to compensate for gaps in the geological knowledge base for the offshore environment, and to assess its hydrocarbon potential. So far, the submarine extension of the platform has been delineated and subdivided into a largely monoclinal zone (comprising younger rocks than those that outcrop on Anticosti), and a zone characterized by large open folds. Recent modeling of potential field data suggests the Taconian deformation front between Anticosti and Gaspésie lies further north than was generally believed.

The St. Lawrence Estuary is characterized by a number of vents, some of which are active and include carbonate crusts. These vents are preferentially rooted in the Paleozoic platform, suggesting that the gas is of thermogenic origin derived from open reservoirs in the platform. These vents reveal that the petroleum system is operational and that a source of mature hydrocarbons is present. The vents are very abundant in the upstream part of the estuary, but practically absent in the Honguedo Strait where an impermeable sediment cover (post-Lower Silurian) may be present. And finally, the presence of gas within Quaternary sediments suggests the existence of reservoirs, the thickness and lateral extent of which are still poorly constrained.

Session 3 **8:30**

History of exploration and metallogenic outlook in the James Bay region

Michel Gauthier (UQAM)

As early as the 18th century, prospecting was carried out from outposts of the Hudson Bay Company (Gauthier, 2000). In 1892, a gold showing was discovered along the Eastmain by a field crew of the Geological Survey of Canada. Since then, waves of prospecting have swept through the region: for gold in 1935, for iron in 1950, for copper, zinc and nickel in the 1960s and 70s, for uranium from 1972 to 1981. In the mid-1990s, gold and base metal explorationists came back for more and diamond prospectors appeared. Discoveries soon followed. Now, with the resource boom, those searching for uranium are coming back while the search for molybdenum has just started.

The regional metallogeny of molybdenum, gold and uranium provides numerous targets. The Archean foreland of the La Grande Subprovince offers an excellent setting for molybdenum, particularly with the presence of a graben. At least four distinct ore-forming episodes are recognized for uranium in the James Bay region: Mesoarchean pyritic paleoplacers, Neoarchean metamorphic pegmatites, Paleoproterozoic unconformity-associated uranium, and Mesoproterozoic uraniferous veins. The Eleonore gold deposit is related to Neoarchean dynamic metamorphism. This is also probably the case for most gold deposits in the region (Gauthier et al., 2007).

This extensive territory adjacent to the Abitibi is starting to yield its first crop. Unfortunately, regional geophysical and geochemical surveys needed to guide prospecting efforts were done forty years ago. A major effort must be expended by the State to renew these tools.

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Session 3 **9:20**

The Eleonore project: Summary of progress toward a feasibility study

Jacques Simoneau (Opinaca Mines)

Exploration on the Eleonore project is now in fast-track mode. A feasibility study should be completed by the end of 2008, with the objective of starting construction in 2009. Earlier this year, Goldcorp announced the results of its first resource estimate on the project. A mere 3 years after its discovery by Virginia in 2004, the Roberto deposit now contains a potential resource of more than 2.7 M oz. In Canada, such a significant discovery hasn't been seen in many years.

Based on exploration work by Opinaca Mines (Goldcorp subsidiary) and work by Jean-François Ravenelle within the scope of a Ph.D. thesis, the Roberto ore deposit and its immediate extensions were better defined, the deposit was delineated, and a 3D geological model was constructed to prepare a resource estimate.

In order to better understand the controls on gold mineralization, the sub-cropping Roberto zone was stripped over a strike length of more than 400 m by 125 m wide, thus exposing the main lithologies and ore zones. This stripped exposure led to a better understanding of the distribution of the various lithological units and the structural elements that affect ore zone geometry.

Ore zones are included within a sequence of turbiditic wackes composed of massive units and thinly bedded units. The fact that the ore zones are confined to thinly bedded horizons suggests that the rheology contrast between massive and thinly bedded sequences played a major role in the emplacement of gold mineralization. Ore zones are broadly conformable to bedding and are strongly transposed by the main foliation, which trends nearly perpendicular to bedding. The ore zones are affected by all the phases of deformation recognized on the property. At least two phases of deformation affected the ore deposit, to produce the folded geometry observed today.

Exploration efforts to discover Roberto-style gold deposits in the area are quite intense, and many companies have already released encouraging results. An ore deposit like Roberto is surely not unique, and Opinaca Mines is optimistic that the area will soon see many major discoveries.

Session 3 **9:40**

The Renard Project: Québec's first diamond mine?

Matthew Manson (Stornoway Diamond Corporation)

The Renard Project comprises nine diamondiferous kimberlite pipes and a proximal system of shallowly dipping kimberlite dykes located north of the Otish Mountains region of Québec. Renard was discovered in 2001 by Ashton Mining of Canada Ltd. and their 50% joint venture partner SOQUEM following five years of regional, grassroots sampling. A 10,000 tonne bulk sample program has recently been completed on three pipes and a pre-feasibility study has commenced. The project owners are optimistic that a mineable resource can be established at Renard that, with careful management and infrastructure support, will allow the development of Québec's first diamond mine.

Following several campaigns of exploration, delineation drilling and kimberlite sampling, the focus of work is now on four pipes, referred to as Renard 2, 3, 4 and 9. These pipes are "transitional" kimberlites, representing the mid-levels of larger, now eroded diatremes. The recent bulk sample program comprised surface trenching on Renard 4 and underground sampling on Renard 2 and 3. This has confirmed multiple, but coherent, units of fragmental kimberlite and hypabyssal breccias with diamond contents of between 40 and 50 carats per hundred tonnes (cpht) in breccias with a high country rock xenolith component, and up to 200 cpht in the more magmatic or hypabyssal-rich units. At time of writing, the results of a market valuation on the approximately 6,400 carats of diamonds recovered in the bulk sample program are outstanding. However, in a valuation on a smaller sample of diamonds in 2005, a modeled diamond price of $88/carat was obtained. The current pre-feasibility work is focused on developing a NI 43-101 compliant resource at Renard, with a mining scenario and cost profile that will allow the project partners to proceed to the permitting stage.

In the context of the formal, staged sampling protocols required to establish a diamond resource, a bulk sample program is undertaken primarily to obtain a statistically significant statement of average diamond value. In the case of Renard, the bulk sample program has also proven critical in improving the geological understanding of each pipe and in providing mineable grade validation for internal geologic units. It is common practice in diamond resource calculations to utilize grade and stone size parameters derived from valuation-stage bulk samples to adjust diamond resource grades calculated from earlier, smaller scale sampling programs. In Renard's case, this is a key issue given the complexity of each pipe's geology and the unusual incidence of large, high value diamonds that have been recovered at all levels of sampling to date. While these large stones complicate the assessment of the Renard pipes, they comprise a key value center in support to the project's otherwise modest resource economics. The opportunity at Renard is for a moderately sized mine operating efficiently to produce a higher than normal proportion of large diamonds, a product in increasing demand in the world's diamond markets.

Session 3 **10:00**

Coulon Project: Emergence of a vast VMS system in James Bay

Mathieu Savard (Virginia Mines)

The Coulon property is located 15 km NNW of Fontanges airport, near Caniapiscau in the James Bay region. The project began with the discovery of a Cu-Zn-Pb-Ag occurrence in 2003. At the time, grab samples from the DOM discovery showing yielded grades up to 22.37% Zn, 4.77% Pb, 1.62% Cu, 482 g/t Ag and 482 ppb Au. Subsequent drilling from 2004 to 2007 outlined four massive sulphide lenses with Cu-Zn-Pb-Ag mineralization, whereas geophysical surveys revealed the presence of another lens.

The Coulon Belt lies at the junction of four lithotectonic domains, namely the La Grande, Ashuanipi, Minto, and Bienville subprovinces. On the property, the volcano-sedimentary assemblage consists of quartz-plagioclase-biotite and sillimanite gneisses (felsic volcaniclastic rocks), mafic to intermediate orthogneisses (basalts, andesites), paragneisses (wackes, arenites), felsic orthogneisses (dacites, rhyolites) and iron formations. Polymetallic zones composed of pyrrhotite, pyrite, sphalerite, chalcopyrite and galena, form semi-massive to massive lenses several metres thick, or occur as disseminations and stringers in anthophyllite-tremolite-quartz-chlorite-phlogopite-cummingtonite-garnet-orthopyroxene-bearing rocks. The latter are interpreted as high-grade metamorphic equivalents of hydrothermal alteration zones.

All mineralized zones and alteration zones found on the Coulon property are hosted in sillimanite gneisses, interpreted as a lapilli tuff unit, within a bimodal volcanic sequence that extends for more than 20 km strike length.

To date, five massive sulphide lenses have been identified. The best intersections to date are: 8.39% Zn, 0.95% Cu and 47.83 g/t Ag over 10.50 m in lens 44; 7.54% Zn; 1.69% Cu, 0.37% Pb and 43.64 g/t Ag over 20.64 m in lens 9-25; 4.49% Zn, 0.60% Cu, 1.37% Pb and 59.20 g/t Ag over 3.50 m in lens 43; 8.12% Zn, 0.73% Cu, 1.77% Pb and 127.00 g/t Ag over 24.00 m in lens 16-17; and finally, 12.65% Zn, 1.36% Cu, 1.54% Pb and 125.00 g/t Ag over 4.70 m in lens 08. In 2008, Virginia Mines and Breakwater Resources intend to continue drilling, prospecting, mapping and geophysical surveying on the property.

Session 3 **10:20**

Recent geoscientific work and future perspectives for the James Bay region

Daniel Bandyayera, Sylvain Lacroix and Jean Goutier (MRNF)

From a historical perspective, geological surveys by the Québec government in the James Bay region can be divided into three important periods. The first period (1950-1960) covers mapping at 1:63,360 scale of the area between Lac Troilus and the Monts Otish. The second period (1970) concerns mapping coverage at 1:63,360 scale or 1:100,000 scale of extensive areas, prior to the creation of major hydroelectric reservoirs. In the 1980s, detailed work focused on the Troilus and Upper Eastmain areas. The third period began in the mid-1990s with the Near North project. During this time, the Frotet-Evans, Eastmain and La Grande volcanic belts were mapped at 1:50,000 scale, whereas the central part of the James Bay region (33B) and areas to the west of Caniapiscau (23E and 23L) were mapped at 1:250,000 scale.

Recently, the discovery in 2003 by Virginia Gold Mines of the **Roberto** gold deposit on the Eleonore property, northeast of Opinaca Reservoir, triggered a staking rush throughout the Eastmain Belt. Since the summer of 2006, Géologie Québec has launched a three-year mapping program at 1:50,000 scale of the Opinaca area, covering the transition zone between the Opinaca and La Grande subprovinces. Preliminary results indicate that metasomatized turbiditic sediments similar to those hosting the Roberto deposit extend for a significant distance to the west (bordering the Opinaca Reservoir Pluton). The discovery of new felsic centres and of mineralized hydrothermal breccias, and correlations of Algoma-type iron formations of regional extent are among the new mineral potential targets delineated as a result of these recent efforts.

Over the next few years, the BEGQ plans to intensify its geoscientific efforts in this emerging mining region of Québec, in order to support and further stimulate ongoing exploration work. The Opinaca mapping project should continue for another year, with the area located to the east of Eleonore targeted for 2008-2009. The BEGQ also plans to cover extensive portions of the James Bay region with aeromagnetic surveys to provide a regional coverage approaching what is available in the Abitibi. Finally, the BEGQ wants to support geoscientific activities that can lead to increased knowledge and better understanding of Quaternary deposits, namely by collaborating on projects proposed by regional stakeholders and universities. The BEGQ's definitive programming of future geoscience projects will be established following annual consultations with industry and regional stakeholders.

Session 4 **13:30**

The Scott Lake project: A promising volcanogenic mineralization system and new hope for the Chibougamau region

Gérald Riverin, Tony Brisson and Benoit Lafrance (Cogitore Resources)

The Scott Lake project, located approximately 25 kilometres west of Chibougamau, represents one of the most important exploration programs in the region. The Chibougamau area is known mainly for its copper and gold deposits associated with shear zones in the Lac Doré mafic Complex. Nevertheless, volcanogenic massive sulphide (VMS) deposits were also discovered in the 1970s, of which the former Lemoine mine is the most notable. Following the discovery of the Lemoine deposit in the Waconichi Formation in 1973, exploration work in the Chibougamau region was redirected towards VMS targets, and these efforts were successful in 1975 when the Selco-Scott zinc deposit was discovered just north of Lac Scott. The lens is 160 metres long with a vertical depth of 400 metres. Drill-indicated resources are estimated at approximately 700,000 tonnes grading 0.4% copper and 6.9% zinc, to the 375-metre level.

Four massive sulphide lenses have been identified to date on the Scott Lake property over a distance of about 2 kilometres, including the 800 Lens discovered by Cogitore in 2006. The lenses are associated with rhyolitic domes and lava flows of the Waconichi Formation, and are rich in zinc and silver. Recent work by Cogitore confirmed the presence of a strong and very extensive hydrothermal system, giving the impression that a larger-scale deposit may exist, in addition to the known lenses. This strong potential is also based on the presence of thick zones of sulphide stringers with locally economic concentrations of copper, and on the identification of at least 4 massive sulphide horizons and several horizons of sulphide-bearing chert stacked throughout the various rhyolite sequences. Hydrothermal alteration is characterized by the presence of abundant chlorite and sericite, forming subconcordant to locally discordant envelopes. Exploration of the entire Scott Lake mineralized system is still at the early stage, so far being concentrated on approximately 2.5 kilometres. Nevertheless, thanks to intensive exploration programs and the use of cutting-edge technology, significant new discoveries are possible, which would give new hope to a mining region that has up to now been underexplored for VMS.

Session 4 **13:50**

Something old – something new: A new mine in a historic mining camp

David M. Rigg (Alexis Minerals Corporation)

Alexis Minerals Corporation has advanced two phases of surface drilling and a four-phase underground exploration program since December 2003 to advance the Lac Herbin Gold project in Val-d'Or, Québec towards production. The project is considered relatively typical of the larger and more complex gold deposits in the Val-d'Or Mining District where gold occurs in quartz-tourmaline-pyrite veins within a variety of inter-related structures and which cumulatively produced over 15 million ounces of gold. The depth potential of the deposit is considered significant. The geological environment of mineralization is relatively well known for the many gold deposits in the region, and many idioms applied at previous operations apply not only to the mining and geological approach to the deposit, but also to the manner in which the project is financed. Understanding the history of the region has assisted in developing geological models, financing, project development and approach to mining.

Lac Herbin has been advanced during a period when new innovative and supportive financing methods are available. In particular, flow-through financing and Québec rebates, combined with more traditional equity financing are leading to the success of the project. The deposit has also faced new public disclosure policies and regulations defined by National Instrument 43-101. Grade variability and character provide numerous examples that challenge these reporting requirements. It is equally important that the exploration technician or executive, as well as the investor, understand such challenges.

Lac Herbin has been advanced during a time of significant market and social change. The socio-economic environment in Val-d'Or, indeed the Abitibi and the mining industry worldwide, has changed substantially in the last 5 years. Alexis and Lac Herbin are rising to these challenges. New mining and development approaches to the deposit will focus on mechanized sub-level mining in contrast to the historic captive long-hole mining methods previously employed. This approach will provide for a safer working environment using a smaller work-force than traditionally employed, both of which are priorities in the current market place.

Alexis Minerals Corporation holds an outstanding portfolio of properties covering the Val-d'Or and Rouyn-Noranda Mining Camps in Québec. Alexis will initially focus cash flow from Lac Herbin into the development of the Lac Pelletier Project in Rouyn-Noranda, and into continuing exploration focused across these properties for both gold and base metals. Historical success with this approach has supported the origins for many of the major Canadian mining companies in our industry over the last 70 years.

Session 4 **14:10**

Canadian Malartic: Impact of a porphyry gold model on an old mining camp

Robert Wares (Osisko Exploration), Cécile Noverraz, James Clark (McGill) and Christian Beaulieu (UQAM)

The Canadian Malartic gold deposit, located near the town of Malartic in Québec's Abitibi region, was mined by underground methods between 1935 and 1965, producing 1,080,000 ounces of gold from 9.93 million tonnes grading 3 to 6 g/t Au. Gold mineralization mined at the time was not vein-type, typical of Abitibi lode gold deposits, but consisted rather of strongly silicified, partly brecciated replacement zones containing disseminated auriferous pyrite. These zones were hosted by clastic sedimentary rocks of the Pontiac Subprovince as well as porphyry intrusions of supposedly syenitic affinity.

More recent research work done by the MRNF in the Malartic camp (Fallara et al. 2000) outlined the presence of widespread potassic alteration in the sediments and porphyries hosting the deposit, this being an important characteristic of porphyry copper-gold systems. Furthermore, this work demonstrated that the Canadian Malartic mine as well as the adjacent Sladen mine exploited the same contiguous gold deposit that stretched over an east-west distance of at least two kilometres.

The presence of porphyritic intrusions and widespread potassic alteration in the Canadian Malartic deposit, the disseminated rather than vein-type nature of the mineralization, as well as the broad distribution of the mineralized system (more than 2 km) led Osisko to postulate the presence of a porphyry gold system, a poorly recognized type of gold deposit in Archean cratons of the world. Given the inherent nature of this type of deposit, it was concluded the Malartic area offered excellent potential for a large (more than 100 million tonnes), low-grade (about 1 g/t Au) deposit amenable to open pit mining, a choice exploration target for most major gold producers.

Less than three years after the acquisition of the Canadian Malartic property, Osisko has outlined, via the application of the porphyry gold model and an intensive drill program, a 43-101 compliant inferred resource of 286.2 million tonnes at an average grade of 0.92 g/t Au, representing 8.43 million ounces of gold. The deposit has been defined over an east-west direction of 1.8 km, a width of 100 to 700 metres and a depth of 370 metres. It is essentially characterized by a broad, potassic-altered and silicified body containing auriferous disseminated pyrite that is associated with an intrusion of sub-alkaline diorite porphyry. Preliminary scoping studies indicate the deposit could be mined economically by an open-pit operation of the order of 40,000 to 50,000 tonnes per day. Osisko anticipates completing a feasibility study by the end of 2008.

Session 4 **14:30**

Matagami: Second birth of a prolific base metal camp

Robin Adair (Donner Metals), Gilles Roy and Michel Dessureault (Xstrata Zinc Canada)

The Matagami Lake region holds a rich mining history that dates back to the late 1900s when Robert Bell first conducted exploration in the area. The region is covered by an extensive sheet of thick glacial till that made early exploration difficult and effectively hid the tremendous zinc and copper resources that were to become the prolific Matagami Mining Camp. The advent of airborne electromagnetic surveys in the mid-1950s provided a significant technological improvement to the ability to detect mineral deposits under cover. This new technology and the post-war demand for base metals led to the discovery of the first zinc-copper massive sulphide deposits at Matagami in 1956. With the opening of the first exploration office in 1979, came timely additional discoveries (Isle Dieu and Norita East – 1985, Bell Allard – 1992, Perseverance – 2001) that supported continuous production until 2003. Perseverance, the second largest deposit in the camp, remained undeveloped. In 2006 Donner Metals and Xstrata Zinc joined forces to continue exploration surrounding the Perseverance deposit. Donner can earn a 50% interest in the extensive Xstrata land package. This coincided with the announcement that Perseverance would be developed. The first discovery of the new joint exploration effort was made within the first ten drill holes of the program.

Matagami camp is characterized by VMS-type zinc and copper sulphides with eleven known deposits identified to date containing an estimated 10.2 billion lbs of zinc and 979 million lbs of copper metal with by-product silver and gold. The geological setting at Matagami is characterized by volcanic sequences that filled a large, regional synvolcanic basin within which second and third order sub-basins were developed and controlled by synvolcanic faulting. Stratigraphy is layer-cake with a marked change from lower most rhyolite/dacite volcanism (Watson Lake Formation) to andesite/basalt volcanism (Wabassee Formation). The first evidence of basin-wide hydrothermal systems that developed loci along synvolcanic faults is demonstrated by the extensive silica-rich Key Tuffite and locally, sulphide-bearing exhalative/replacement systems that are coeval with, or just following the deposition of, the Key Tuffite. This activity produced the majority of the deposits comprising the Matagami Camp. There are general similarities with the Noranda VMS Camp, typified by stacked horizons of tuffite/sulphide deposition, however significant mineralization at Matagami seemed restricted to the Key Tuffite until Xstrata Zinc and Donner Metals discovered the Bracemac Zone in late 2006.

Deposits of the Matagami Camp occur at, or immediately below, the Key Tuffite horizon and are typically underlain by strong, hydrothermal plumbing systems developed within the Watson Lake Formation. These hydrothermal systems are characterized by strong chlorite alteration with sulphide stringers proximal to the pipe, and acute chlorite development with magnetite, silica, talc and sulphides in the core of the pipe. The massive sulphide deposits of the Matagami Camp demonstrate a variety of geometries that indicate deposition as traditional exhalites on the sea floor and as replacement deposition in the throat of hydrothermal pipes, as demonstrated by substantial sulphide roots developed within the pipe immediately beneath the sea floor interface. Invariably, there is strong evidence of synvolcanic faulting that was exploited by the hydrothermal systems and along which hydrothermal activity was locally focused to produce sulphide deposits and their underlying pipe systems. Within the core of the sulphide-bearing vents, the Key Tuffite is often disrupted and may be strongly altered. It is also well demonstrated that multiple sulphide deposits occur along the trends of synvolcanic faults (e.g., Mattagami and Isle Dieu deposits).

The new exploration approach used by the Xstrata / Donner team is designed to continue the exploration of the Key Tuffite as well as to investigate potential for vertically stacked mineralized zones in tuffite horizons at higher stratigraphic levels. Moreover, any anomalous mineralization and/or alteration encountered within the Wabassee Formation has strongly positive implications for potential sulphide deposition at the Key Tuffite, following on evidence that hydrothermal cells capable of producing mineralization at the Key Tuffite can persist along reactivated synvolcanic faults. Using this approach, significant sulphide mineralization and an associated alteration pipe was initially discovered in late 2006 at the Bracemac tuffite level, which occurs within the Wabassee basalts 200 metres stratigraphically above the Key Tuffite (note that the sequence has been inflated by an additional 120 metres by later gabbro sills). Follow-up of this mineralization later resulted in the discovery of the Upper Bracemac Zone with its associated alteration pipe a further 100 metres above the Bracemac discovery. Reversing the traditional approach, the exploration team refocused efforts on the Key Tuffite below these upper sulphide occurrences, resulting in the recent discovery of massive sulphides and a related alteration pipe at the Key Tuffite at Bracemac. In addition, the same approach has led to the discovery of a new sulphide zone 1.2 kilometres to the southeast at McLeod.

Session 5 **8:30**

Exploring for uranium: A radiant summer in Québec

Serge Perreault (MRNF)

The mining community's interest in uranium has increased dramatically in Québec after 22 years of relative inactivity. This boom is directly related to uranium's spot market price, which has been on an upswing since 2004 to peak at US$138 per pound in July 2007.

Uranium exploration activities are divided among roughly fifty projects, located mainly in southwestern, northeastern and northern Québec:

- in the Grenville Province (Témiscamingue region, Upper Laurentians and the North Shore);
- in the Paleoproterozoic Otish and Labrador Trough sedimentary basins;
- in the Archean and Paleoproterozoic rocks of eastern Nunavik; and
- in the Late Archean and Paleoproterozoic (Sakami) rocks of the James Bay region.

The Otish Basin: The Athabasca of Québec?

The uranium potential of the Paleoproterozoic Otish sedimentary Basin is often compared to the Mesoproterozoic Athabasca sedimentary Basin of Saskatchewan. The Otish Basin contains several uranium showings that are typical of unconformity-associated uranium deposits. More than a dozen major and junior companies are active in the Monts Otish area. Promising results obtained by Strateco Resources on the Matoush property reveal the potential for vein-type mineralization hosted by shear zones in sedimentary rocks.

The George River region: A new Rössing?

The vast George River area, northeast of Schefferville, consists of metamorphosed Archean and Paleoproterozoic rocks. This territory was seen as a new exploration target for uranium following the discovery of anomalous concentrations of the metal in lake bottom sediments during a survey by the MRNF in 1997. In addition, new uranium showings – discovered in 2006 by mineral exploration companies active in the region – suggest that this vast area could become a uranium metallogenic province.

The vast George River region represents a fertile setting for several types of uranium mineralization, including:

- Rössing-type deposits associated with granitic intrusions (Rio Tinto Group's Rössing mine in Namibia produces 7.7% of the world's uranium production);
- Beaverlodge-type vein-hosted uranium in major shear zones.

Session 5 **8:40**

Exploration models for uranium deposits in Canadian Proterozoic basins

Charles W. Jefferson, Robert Rainbird (GSC) and Ted O'Connor (Cameco)

This review of the geological-geochemical-geophysical attributes of uranium deposits is based mainly on unconformity-associated deposits in the Athabasca Basin. Pods, veins, and semi-massive replacements of uraninite (var. pitchblende) are located close to unconformities between late Paleoproterozoic to Mesoproterozoic conglomeratic sandstone and metamorphosed basement. The Athabasca and Thelon basin strata are up to 1.5 km thick, subhorizontal, apparently unmetamorphosed but pervasively altered, mainly fluvial, red to pale tan quartzose sandstone, lesser conglomerate and mudstone. The underlying hematitic, clay-altered regolith grades down through chlorite-illite- and chlorite-altered rock to fresh basement protolith. The protolith is a gneiss composed of interleaved Archean to Paleoproterozoic granitoid and supracrustal rocks including graphitic metapelite that preferentially hosts reactivated shear zones and uranium deposits. Deposits range from polymetallic lenses at and above the unconformity, with variable Ni, Co, As, Pb and traces of Au, Pt, Cu, REEs and Fe, to near-monometallic and generally basement-hosted veins that in some cases are now recognized as 'blind' with few direct clues for exploration. Key geochemical/mineralogical anomalies for exploration include: illite, sudoïte, dravite, silicification, quartz dissolution, and >3 ppm U, as well as pathfinders such as B, Pb and Pb isotopes, Ni, Co, Cu and As in sandstone and overlying glacial till. Geophysical anomalies include low or high resistivity in sandstone related to clay alteration or silicification, respectively, high conductivity in basement graphitic metapelite, gravity lows related to quartz dissolution, and seismically detected offsets of the basal unconformity. Geological targets, based on integrated geophysics, multiparameter drill hole logging and lineament analysis of multiple media, include intersecting faults with specific geometries, favourable basement lithology and marked facies changes in the basal Athabasca Group. Other Proterozoic basins in Canada, such as Hornby Bay, Thelon, Otish, Sakami and Sims, are being explored mainly using the unconformity model, but the sandstone model that requires interfaces between oxidized and reduced strata within the basin is also being considered.

Session 5 **9:30**

The Matoush deposit: A new vision of the uranium potential in the Otish Basin of Québec

Jonathan Lafontaine and Jean-Pierre Lachance (Strateco Resources)

In the 1980s, a trail of radioactive blocks led Uranerz Exploration and Mining to discover uranium mineralization associated with the Matoush Fault in the heart of the sedimentary Otish Basin. A 16-m mineralized intersection in drill hole AM-15 graded 0.95% U_3O_8, including 20.4% U_3O_8 over 0.5 m, but could not be explored due to the collapse of uranium prices. In addition, the large "basement unconformity" deposits of Cigar Lake and MacArthur River in the Athabasca Basin eclipsed all uranium exploration in the Otish region since then.

However, the influence of a world population that is as hungry for energy as it is worried about the environment led to a dramatic rise in uranium prices during the last few years, drawing attention once again to the drill intercept of the AM-15 lens on the Matoush project, which is now held 100% by Strateco Resources Inc.

The AM-15 lens lies at the intersection between a 50-m thick sedimentary layer composed mainly of immature arkose (Active Channel Facies – ACF), and the Matoush Fault, a brittle subvertical strike-slip fault dipping to the east. The intersection is approximately 200 to 250 m below the surface, where ACF beds are intercalated with generally thicker beds dominated by a mature subarkosic component (Channel Bar Facies – CBF). The brittle Matoush basement fault has been confirmed by drilling over more than 9 kilometres strike length, and can be recognized by its geophysical signature for more than 20 kilometres across the entire Matoush property. A mafic intrusive body appears to be associated with the fault and the AM-15 lens. A m-scale alteration halo surrounds the mineralized zone, characterized by a muscovite-chlorite-fuchsite assemblage.

Given the differences between the AM-15 lens and other uranium deposits, including "basement unconformity" deposits, exploration models for deposits like AM-15 cannot be derived directly from classic uranium models, and a unique approach seems necessary to maximize the potential of the Matoush project.

Strateco drill holes have delineated the AM-15 Core Zone over a horizontal distance of 160 m, with grades on the order of 1.0% U_3O_8. Intervals with more than 2.00% U_3O_8 were obtained over substantial thicknesses of up to 16 metres.

Session 5 **9:50**

Toward the discovery of new uranium districts in Québec: Azimut's strategy and results

Jean-Marc Lulin (Azimut Exploration)

In 2004, Azimut Exploration began a provincial-scale targeting program of the uranium potential of Québec and, along with 8 partners, started extensive exploration work with the aim of discovering major deposits.

Uranium potential modeling

Uranium potential modeling was performed by numerically processing available geoscientific data. The mineral potential map, generated over a surface area of 1,140,000 km^2, covers a large part of Québec and Labrador. Known uranium districts are clearly distinguished on the map. Three other regions, which have seen little or no uranium exploration, are considered to have significant potential because they display comparable characteristics to the known districts. They are:

- an 80x220 km area east of Ungava Bay;
- a 350 km north-south trend in the central part of Québec (north of James Bay), referred to as the "Central Québec Uranium Lineament"; and
- a 60x320 km area on the lower North Shore.

The target deposit type is related to felsic intrusions associated with crustal faults in a high-grade metamorphic context. Azimut is focusing on large targets amenable to open pit mining. A well-known example of this type is the Rössing mine (150,000 t U), a world-class uranium deposit in Namibia.

Partnership development

All significant available targets were acquired by Azimut and now form 25 properties totalling more than 20,000 claims and 9,600 km^2. Concurrently, Azimut developed partnerships by signing 13 agreements for 16 of the properties. These agreements, which cover approximately 18,100 claims, represent an aggregate investment of $45 million in partner-funded exploration work, of which more than $7.6 million is allocated for 2007. The partners are Kennecott (Rio Tinto Group), within the framework of a strategic alliance, and seven other companies (Central Uranium Corporation, Channel Resources, Majescor Resources, NWT Uranium, Ressources d'Arianne, Rukwa Uranium and Silver Spruce Resources).

Results

In the Ungava Bay region, reconnaissance prospecting at **North Rae** with **NWT Uranium** led to the 2006 discovery of more than 20 uranium showings across the property. Uranium anomalies with a cumulative length of 28 km were later detected by a helicopter-borne survey. Since then, seven (7) kilometre-scale zones have been identified by further exploration work, including the **Rae-1**, **Tasialuk**, **Torrent** and **Tasik** zones. The best result obtained from rock samples in 2006 was 0.59% U3O8. At North Rae, the presence of a mineralized regional-scale system associated with a pegmatitic dyke swarm will, in all likelihood, be confirmed by the exploration work presently underway.

In 2007, a reconnaissance field program at **South Rae** with **Majescor Resources** revealed more than 100 outcrops with radiometric values ranging from 5,000 to 47,000 cps. The radioactive outcrops, commonly containing uranophane, were recognized over a distance of 35 km. These preliminary results, which were obtained before any geophysical surveying, are encouraging.

The 2006-2007 exploration work across Québec provided a wealth of new results, notably including more than 40,000 line-km of geophysical surveys, 8,000 lake bottom sediment samples and 1,300 rock samples. This new data will allow Azimut and its partners to focus on the targets with the best economic potential.

Session 5 **10:10**

Uraniferous and thoriferous Y-REE-Nb granitic pegmatites in the Grenville Province: Understanding distribution, age, and genesis to aid in exploration

David R. Lentz (UNB)

Keywords: uranium, contact metasomatism, hybrid, pegmatite, Grenville

The U-Th-Y-REE-Nb-enriched granitic pegmatite and aplite dykes, including alaskitic leucogranites, in the Grenville Province formed tectonically late (1010-1040 Ma) with respect to the Ottawan Orogeny of the Grenville Orogenic Cycle, based on U-Pb (zircon, monazite, titanite, uraninite) and Re-Os (molybdenite) ages. The former U mines in the Bancroft and Baie-Johan-Beetz areas have the youngest ages known to date, but other areas in the Grenville are now showing significant promise. The distribution of dykes and dyke swarms is typically controlled by later transtensional structures within the overall higher grade (amphibolitic) Grenville Province that are slowly undergoing uplift post peak metamorphism. This is not unlike the Rossing-type U deposit in alaskite (leucogranites & pegmatites) in Namibia. The enrichment of U and other elements is a function of: 1) the nature of the source region at depth within the Grenville Province and the degree of fractionation during initial water-undersaturated, low-degree partial melting in these source granulitic to amphibolitic gneisses, 2) the extent of crystal (quartz and feldspar) fractionation during ascent and coalescence of these NYF-type magmas to their emplacement depth, and 3) the extent of melt-fluid partitioning during fluid melt (resurgent boiling) saturation. These features are consistent with a rare-element abyssal class of pegmatite with both biotite and feldspar compositions best reflecting their fractionation history, but relative rare-element enrichment (U, Th, REE, Nb, etc.) is also an obvious indicator. Typically, an increase in U and Th (>10 and >40 ppm, respectively, is considered significant) coincides with a decrease in the Th/U ratio from a typical value of 3 to 4 to values of <1 with extreme igneous fractionation. Magmatic-hydrothermal processes (resurgent boiling) are usually responsible for much smaller Th/U ratios. Typically U grades greater than 0.01% are very significant with Bancroft hybrid pegmatite ores extending to greater than 0.5% locally.

Within a particular pegmatite field, dyke swarms will be locally controlled by the local structural evolution during melt intrusion and, of course, local rheologic aspects of the host Grenville rocks during deformation. These pegmatites are commonly confused with in situ anatectic pegmatitic leucosomes, however those are formed locally during peak metamorphism some 50 Ma earlier and have no economic potential. Contact metasomatism during emplacement (hybridization and skarnification) of the extremely fractionated NYF pegmatites are known to control saturation of rare-element minerals within these magmas, such that a hybridization index (CaO+MgO+FeOt) can be used to relate to saturation of these U-Th-Y-REE-Nb-rich minerals.

Session 5 **10:30**

The geological setting of uranium in the Proterozoic rocks of Labrador

Andrew Kerr, Greg W. Sparkes (GSNL), Richard J. Wardle (NLDNR), Derek H. C. Wilton (MUN) and Alana M. Hinchey (GSNL)

Rocks with uranium mineralization were first found in north-central Labrador in 1954, and the small but high-grade Kitts deposit was discovered soon after in 1956. Exploration efforts intensified in the 1960s, and the Michelin deposit – with its larger volume but lower grade – was delineated in 1968 and remains the single most important uranium resource in Labrador today. These two discoveries highlighted the region's potential, and many other mineralized zones were discovered over the years, notably the significant Moran Lake deposits. The Kitts and Michelin deposits were on the verge of going into production in 1976, but their development was abandoned when uranium prices collapsed on the global market. The upswing in uranium prices during the past few years has renewed interest in Labrador's uranium potential, and exploration activities have once again intensified since 2003. These activities are mostly focused on a region with complex and diversified geology, known as the Central Mineral Belt (CMB) of Labrador. The Michelin and Moran Lake deposits are presently at the advanced exploration stage, and the à resources for each have grown substantially. New mineralized zones have also been discovered as a result of regional exploration programs.

Potentially profitable uranium deposits in Labrador are mainly hosted in Paleoproterozoic and Mesoproterozoic supracrustal rocks; they are difficult to classify using traditional uranium deposit types. Mineralization appears to be dominantly epigenetic with respect to host rocks, but in some cases may be syngenetic to felsic metavolcanic sequences. Structures are significant in some cases where intense deformation is observed, but there is also empirical evidence of a primary link with U-enriched felsic volcanic sequences. Iron-rich alteration systems documented in many regions were interpreted as IOCG-type showings (iron oxide-copper-gold), suggesting that magmatic hydrothermal fluids played a role. The timing of mineralization with respect to the age of the host rocks and their deformation is not always evident, but regional patterns reveal that more than one episode of uranium mobilization and deposition probably took place. It seems likely that the complex and diversified metallogeny of the CMB of Labrador gave rise to repeated – and perhaps sequential – concentrations of uranium.

Session 5 **10:50**

Discovery and development in Canada's next uranium district, Central Mineral Belt, Labrador

Christopher Lee, Chris Buchanan, Andrew Parmenter, Ian Cunningham-Dunlop, Matthew Lennox-King, Jim Lincoln, Mark O'Dea (AXU)

Aurora Energy Resources 100%-owned CMB Uranium Property comprises 90,275 hectares of mineral claims located near the northeast coast of Labrador in proximity to the town of Postville on Kaipokok Bay. Most of the claims are contiguous and cover much of the historical Kitts-Michelin uranium district in the eastern part of the Central Mineral Belt.

Mineralization on the CMB Uranium Property is hosted by Paleoproterozoic supracrustal sequences of the Post Hill and Aillik groups and is represented by approximately forty uranium showings, including ten significant uranium deposits/prospects (Michelin, Jacques Lake, Kitts, Rainbow, Aurora Corridor, Burnt Lake, Gayle, Inda, Gear and Nash). The uranium mineralization is associated with magnetite + actinolite + calcite +/- pyrite veining and pervasive hematite alteration (+/- magnetite), in a variety of rock types, including: pelitic metasedimentary rocks of the Post Hill Group, or fine-grained felsic to intermediate metavolcanic rocks of the Aillik Group. Despite the variety of host rock types, each individual occurrence is preferentially concentrated within a restricted, locally stratabound, mineralized horizon that is strongly to intensely sheared and/or transposed. Recent diamond drilling and surface mapping has shown that many of the occurrences are found in close proximity to a heterolithic conglomerate unit that may be regionally developed above an angular unconformity. Definition of a new 'Michelin-style' uranium deposit model is in progress.

As of February 2007, Aurora's U_3O_8 resource stood at 58 M lbs measured and indicated, plus 38 M lbs inferred, in the two principal deposits: Michelin and Jacques Lake, and is expected to grow substantially with a minimum of 75,000 metres of diamond drilling to be completed this year. The current drill program is focusing on expansion and infill of the existing resources, confirmation and expansion of historical resources, and testing new targets. A pre-feasibility study has begun to look at development of the Michelin and Jacques Lake deposits, and inclusion of a number of satellite deposits is currently under consideration. Baseline studies in support of Aurora's environmental assessment program are also underway.

Session 5 **11:10**

Exploration activity and setting of uranium in New Brunswick

Malcolm McLeod and Susan Johnson (NBDNR)

This year, the total number of mineral claims held in New Brunswick is comparable to record levels attained during the 1950's following the discovery of the world-class base metal sulphide deposits in the Bathurst Mining Camp. The current staking rush is largely due to the rejuvenation of uranium exploration by numerous companies, particularly in the southern part of the province.

The main geological environments favourable for the formation of uranium deposits in New Brunswick were created in Late Paleozoic time during the waning stages of the Acadian Orogeny. In the wake of continental collisional events associated with the orogeny, late to post orogenic, uraniferous, felsic intrusive and extrusive activity related to evolved I-type and/or A-type granitoid magmatism was generated periodically from latest Silurian to Late Mississippian time. Extensive successor basins were filled with thick successions of alluvial, marine evaporite, and organic-rich and locally pyritiferous fluvial and lacustrine strata of Late Devonian and Carboniferous age. Throughout this period, these extensional basins were subjected to compressive and/or transpressive events resulting in periodic episodes of basin inversion and dismemberment, and a proliferation of faults throughout the section.

Prevailing views for the formation of uranium deposits in the region contend that Devonian-aged magmatic systems provided the main source of uranium. Models invoked include: 1) mineralization directly associated with these granitoid intrusions and related volcanic rocks, and 2) uranium being transported by migrating groundwaters that derived uranium and thermal gradients from the older basement highs, especially those containing the Devonian uraniferous igneous rocks, and being deposited at unconformities, at reducing horizons within the sedimentary successions, or along faults containing reductants. Here, it is proposed that other possible sources for uranium may originate from within the sedimentary successions where uranium could have been initially concentrated *in situ* in phosphate- hydrocarbon- and/or carbonate-rich lacustrine deposits, in proximal coarse-grained facies that contain abundant erosional products of the surrounding basement highs, and in finer grained deposits containing silicic ash. Also, heat sources other than the basement and Devonian igneous suites likely provided thermal gradients to promote fluid migration within the basins, at least locally. These include at least two periods of Mississippian magmatism, one Early Pennsylvanian high-temperature hydrothermal event, and magmatism during Early Jurassic time. Further investigation of these factors may provide new models and targets for exploration.

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Geology of the Labrieville and Baie-Comeau areas (22F01, 22F02, 22F03, 22F04, 22F05 and 22F06)

Abdelali Moukhsil, Thomas Clark, Claude Hébert, Jean-Yves Labbé and Ghislain Roy (MRNF)

Mapping in these areas constitutes Phase II of an extensive regional mapping project, the purpose of which is to acquire new geological and metallogenic data in NTS sheet 22F, located in the eastern Grenville Province of the Côte-Nord region.

Mapping at 1:125,000 scale led to the definition of many lithological units. The bedrock in the Baie-Comeau area (map sheets 22F01 and 22F02) consists of migmatized paragneiss (injected with granitic material, locally pegmatitic) and quartzite layers. Porphyritic and porphyroblastic to megacrystic intrusive rocks, namely mangerite and monzonite, are also present. In the Labrieville area (map sheets 22F03, 22F04, 22F05, 22F06), the main lithologies are biotite ± garnet ± sillimanite ± clinopyroxene ± graphite paragneiss, quartzite, tonalitic to granitic gneiss, and mangerite, monzonite and charnockite with porphyritic or non porphyritic facies. Two anorthositic intrusions were mapped: 1) the Labrieville Alkaline Anorthositic Massif (LAAM; 1010-1008 Ma) and 2) the Vanel Anorthosite (VA; 1080-1059 Ma). The LAAM consists of anorthosite, lenses of leuconorite and layers of gabbronorite with apatite and iron-titanium oxides (hemo-ilmenite; OAGN = Oxide Apatite Gabbronorite). The anorthosite and leuconorite, with pink recrystallized andesine plagioclase, host hemo-ilmenite and magnetite veins and veinlets. The VA mainly consists of anorthosite and leuconorite with pink recrystallized labradorite and andesine plagioclase. Layers of gabbronorite with magnetite, ilmenite and apatite, or titanomagnetite and apatite are also present.

The regional metamorphic grade ranges from the lower amphibolite to the granulite facies (presence of orthopyroxene). The amphibolite facies is most commonly the result of retrograde metamorphism affecting granulitic rocks. Rocks of the charnockitic suite are generally retrograded to the upper amphibolite facies.

Evidence of at least two phases of deformation was observed. Deformation D1 is represented by a gneissosity or a strong and penetrative S1 foliation that affects most lithological assemblages in the area. This fabric was folded by phase of deformation D2, to which an axial S2 foliation, defined by an alignment of ferromagnesian minerals, is locally associated. This phase is responsible for the dominant structural trend of the area. The two fabrics are generally exposed in migmatitic rocks, where layers of mobilizate, with or without orthopyroxene, have recorded traces of both phases of deformation. Many faults and shear zones, some of which are associated with major structures that involve west-verging thrusting of the LAAM and VA, were mapped within the study area.

Known showings and occurrences uncovered during our fieldwork indicate that these areas contain many exploration targets with potential for the discovery of nickel-copper, uranium or iron and titanium deposits. Areas of interest for architectural stone were also identified.

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Mineral potential assessment project in the Saguenay–Lac-Saint-Jean region: Results of 2007 fieldwork

Yves Bellemare, André Brazeau, Pierre Buteau, Claude Hébert, Jean-Yves Labbé, Ghismond Martineau and N'Golo Togola (MRNF)

A pilot project was launched in the summer of 2007 in order to produce, in the spring of 2008, a series of thematic mineral potential assessment maps for many different resources (metallic deposits, industrial minerals, architectural stone, unconsolidated deposits, and peat) for the Saguenay–Lac-Saint-Jean administrative region. These maps will be useful to regional decision makers for land management purposes, and also for mineral exploration.

Thus, reconnaissance work was carried out in order to: 1) become familiar with geological settings in the region, 2) assess the reliability of the current geological database, and 3) update the database where necessary. Three teams of two geologists devoted between 2 and 5 weeks each to this project. This poster shows the results of their fieldwork.

For metallic minerals, special attention was paid to Ni-Cu occurrences and to mafic and ultramafic units likely to host this type of mineralization.

For industrial minerals, no new potential area was identified. Only a few garnet ± graphite paragneiss units were observed in NTS sheets 32H03, 32A02, 32A07 and 32A10. Near Saint-Thomas-Didyme (32A15), m-scale erratic boulders of sillimanite paragneiss with thin but very garnet-rich layers were noted.

For architectural stone, an inventory and potential assessment had already been carried out in NTS sheets 22D and 22E. Within the scope of this project, efforts were therefore concentrated in NTS sheets 32A and 32H. New exploration targets were defined in the southern half of NTS 32A. Although other geological settings may be favourable, rocks in granitic, charnockitic and anorthositic suites constitute high-priority exploration targets.

Unconsolidated deposits are abundant and diversified in the area. Deposits along the shores of Rivière Saguenay and around Lac Saint-Jean were mapped in detail in the 1970s and do not require new mapping. Along river valleys north of Lac Saint-Jean, huge accumulations of unconsolidated deposits, mainly sand, are present. Peat is already the focus of commercial harvesting in the region. In the northernmost part of the region, extensive wetlands were delineated based on satellite images.

Fieldwork conducted in 2007 outlined gaps in the geological mapping coverage, particularly in the western part of the region, where the Quaternary cover is significant. The mineral potential assessment of the region would be greatly improved by an update of the geological map as well as by regional lake sediment geochemistry surveys.

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U-Pb geochronology of the Cain Domain and the uraniferous Baker Domain, Central Metasedimentary Belt, Mont-Laurier region, Grenville Province

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The Cain Domain is bordered to the west by the Central Metasedimentary Belt Boundary Zone and to the east by the Lièvre shear zone. The latter also marks the western limit of the uraniferous Baker Domain, the eastern limit of which is marked by the Labelle shear zone. The metasedimentary rocks of these two domains consist of aluminous and micaceous paragneiss, quartzite, marble and calc-silicate rocks. The Baker Domain is distinguished by the presence of tourmaline-rich rocks, metapelites with nodules of fibrolite and muscovite, abundant feldspathic paragneiss, and uraniferous pegmatites. Based on detrital zircon ages, the most common source for metasedimentary rocks in the uraniferous Baker Domain is of Paleoproterozoic age (1846 Ma), whereas a Mesoproterozoic source (1427 Ma) dominates rocks of the Cain Domain and the Paleoproterozoic source is minor.

Mafic and tonalitic sills of the Lacoste Intrusive Suite were emplaced in Baker Domain metasedimentary rocks. The suite belongs to a continental magmatic arc with zircon ages of 1450±10 Ma and 1365±2 Ma. In the Cain Domain, where such sills are absent, the Lacoste Intrusive Suite is represented by tonalite plutons for which a sample yielded a Nd model age of 1.38 Ga and a magmatic zircon age of 1386±18 Ma. An orthogneiss from the Béthune Magmatic Suite, which caused contact metamorphism of the host Cain Domain marbles, yielded a magmatic zircon age of 1282±15 Ma. A metamorphic overprint of 1.16 Ga, based on the ages of monazites in orthogneisses of the Béthune Magmatic Suite and zircons from a tonalite in the Lacoste Intrusive Suite, is contemporaneous with the emplacement of monzonites, diorites and gabbros of the Chevreuil Intrusive Suite. A minette dyke and a monzonite pluton of the Kensington-Skootamatta Alkaline Suite provided magmatic zircon ages of 1080±2 Ma and 1071±1 Ma, respectively. The most recent magmatic event is marked by an intrusion and dykes of monzonite, quartz monzonite and syenite, with Cu-Au-Ag mineralization. These rocks belong to the Lesueur Alkaline Suite that was dated at 1000±6 Ma using zircons. Uraniferous dykes may also be related to this suite (Niogold, 2007/09/11).

The Brockaby Suite comprises metatexites, schlieren diatexites and massive diatexites. These rocks, outcrops of which are virtually restricted to the uraniferous Baker Domain, represent a major anatectic event at 1067±1 Ma based on the age of a massive diatexite. In the Baker Domain, metamorphic ages of 1084-1031 Ma (zircon) and 1083-1060 Ma (titanite) are attributed to the Ottawan phase of the Grenvillian orogeny. Finally, titanite ages of 1009-987 Ma suggest late-stage metamorphic activity in this domain.

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Geology of the western Malartic Group and correlations across the Abitibi Belt (2 of 3)

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Our objectives for the second year of this three-year geological update and compilation project are as follows: (1) extend to the west the stratigraphic scheme of the Malartic Group recently developed by the MRNF in the Val-d'Or area, and (2) examine at a larger scale possible correlations between lithologies in the Kidd-Munro Assemblage (KMA) of Ontario that host the renowned Kidd Creek VMS ore deposit, and certain areas in the Québec Abitibi with particular potential, namely the Destor area, the Lanaudière Formation (located along Rivière Kinojévis) and the lower part of the Malartic Group (MG). The two latter units were examined this year, in areas comprising the western half of NTS sheet 32D08 (Lac Preissac) and the eastern half of map sheet 32D07.

The Lanaudière Formation is composed of ultramafic, mafic and felsic lavas as well as numerous tonalitic to monzonitic intrusions. One of these rhyolitic complexes, located near Lac Matissard, defines a tholeiitic suite and was dated at 2716 +/- 1 Ma. This age, along with the close spatial association between ultramafic lavas and rhyolitic complexes, brings to mind significant analogies with the KMA. Ag-Au showings were also recently discovered in this location. The formation is bounded by the Aiguebelle and Manneville North faults (shallowly dipping to the north) that represent possible subsidiaries of the regional Destor-Porcupine Fault recognized further west.

The MG is composed, in stratigraphic order, of the La Motte-Vassan (2714 +/- 2 Ma), Dubuisson and Jacola (2704 +/- 2 Ma) formations. Further east in the Val-d'Or area, these lithologies are overlain by the Val-d'Or (2705 to 2704 +/- 2 Ma) and Héva formations. In the map area, the La Motte-Vassan Formation is mainly composed of ultramafic flows and sills, with basalt flows and volcaniclastic rocks. The Dubuisson Formation consists of equal proportions of ultramafic and epidotized basalt flows, with a variety of tuffs. Rhyolitic complexes occur in this formation near Ruisseau Dunn and Lac Patris (Py-Po-Au showings). The Jacola Formation is composed of mafic volcanic rocks with a few thick layers of volcaniclastic rocks. Volcanic units in the MG form a steeply dipping, south-facing, broadly homoclinal sequence. These rocks are intruded by the synvolcanic La Pause pluton, dated at 2710 Ma. The latter, comprising a diorite-tonalite suite, appears to have been emplaced as stocks and multiple sills and is responsible for an early anticlinal structural ridge, where facing directions are reversed along the northern limb.

The MG is in faulted contact to the south (La Pause fault) with sedimentary units of the Kewagama Group (< 2687 Ma). Along the contact, abundant tonalitic to monzonitic dykes are observed over several kilometres. Monzonitic dykes host many Au and Mo showings; they are most likely associated with the Preissac intrusive Complex (2681 to 2660 Ma). To the north, the Malartic Group is bounded by a zone of complex faulting (e.g. Manneville South), trending E-W to WNW-ESE and steeply north-dipping. These faults juxtapose sedimentary rocks of the Lac Caste Group (< 2691 +/- 8 Ma), volcanic units of the Lanaudière Formation and those of the MG. The regional S1 schistosity trends WNW-ESE, and is reworked by an S2 cleavage trending E-W, to produce Z folds at various scales. The overall metamorphic grade is the upper greenschist facies, but locally reaches the amphibolite facies near the Preissac-La Corne batholith (2691 to 2640 Ma).

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Metallogenic synthesis of the Doyon-Bousquet-LaRonde mining camp, Abitibi, Québec

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Ore deposits in the Doyon-Bousquet-LaRonde (DBL) mining camp are hosted in volcanic and intrusive rocks of the Bousquet Formation (2701-2696 Ma) at the top of the Blake River Group (BRG: 2703-2694 Ma), in the Abitibi Greenstone Belt. Total production, reserves and resources are estimated at 133 Mt of ore grading 5.23 g/t Au (694 t Au, or 22.3 M ounces). The DBL camp is the largest gold, copper, zinc and silver producer in Québec.

Three main Au ± Cu-Zn-Ag deposit types are recognized in the DBL mining camp: 1) Au-rich volcanogenic massive sulphides (LaRonde Penna, Bousquet 2-Dumagami, Bousquet 1, Westwood, Warrenmac, Ellison), 2) intrusion-related sulphide-rich Au-Cu epizonal vein systems (Doyon), and 3) sulphide-rich Au-Cu veins associated with shear zones (orogenic type: Mouska, Mic Mac, Mooshla), which exhibit similarities with the first two deposit types and which could represent, at least in part, late remobilization of synvolcanic systems.

Recent studies of the LaRonde Penna ore deposit and vein systems related to the Mooshla synvolcanic pluton, along with the geological synthesis of the DBL camp and ongoing thematic studies under the Targeted Geoscience Initiative TGI-3 Project (GSC) and the Copper Plan (MRNF) outline a few critical elements that support a synvolcanic or syngenetic model as the source of gold, highlighting the fact that deformation is not a determining factor in the formation of Doyon-Bousquet-LaRonde-type Au ± Cu-Zn-Ag deposits, as was previously suggested (e.g. multiphase and syndeformational models).

Ore typology and the nature of alteration zones (style, intensity, distribution) are widely variable from one ore deposit to another, from one lens to another, and even along the same lens, forming a vast and complex hydrothermal system. Moreover, ore zones within the camp broadly show an *en echelon* distribution along different stratigraphic levels within the transitional to calc-alkaline volcanic and intrusive rocks of the Bousquet Formation, i.e., ore zones gradually sit at higher stratigraphic levels going east, from the base of the Bousquet Formation (Mouska-Doyon) to the top of the Bousquet Formation (lens 20 South at LaRonde).

Exploration models based on notions acquired in the DBL camp should therefore take into consideration the wide variability in style of mineralization and the potential at different stratigraphic levels (stacking).

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Geology and metallogeny of the Blake River Group (Abitibi); Status report and results of a joint GSC (TGI-3) – MRNF (Copper Plan) – OGS – Industry – University effort

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The Blake River Group (BRG) is the focus of a major project involving geological mapping, compilation, modelling, geochemistry and a metallogenic synthesis, jointly undertaken by the GSC (Targeted Geoscience Initiative TGI-3), the MRNF (Copper Plan), the OGS, industry and universities. The purpose of this project, comprising various geoscience activities undertaken in symbiosis and in complementary fashion, is to increase our knowledge, and develop and apply new concepts for base metal exploration.

Geoscience activities taking place within the BRG are, for the most part, in their first or second year. Geological and structural mapping, backed by an intensive U-Pb isotope geochronology program and 3D modelling, lead to more detailed global and local lithostratigraphic and lithotectonic frameworks for the various formations and faults within the BRG, whereas the study of volcaniclastic rocks throughout the BRG gradually sheds light on the variable nature (in terms of composition and facies) of these units and their association with certain hydrothermal alteration zones. Oxygen isotope mapping at the scale of the BRG and more detailed work in high-potential zones help define hydrothermal vectors related to volcanogenic systems, in parallel with the synthesis of alteration patterns observed in the field and a sulphur isotope study of various ore deposits. The ongoing characterization of mafic dykes suggests a complex emplacement sequence for intrusions of variable composition and timing throughout the volcanic and tectonic evolution of the BRG.

The study of the Horne ore deposit and the Horne West area illustrates the complexity of the volcanic setting in which this exceptional orebody formed, and outlines fertile stratigraphic horizons along the extensions of the Horne host sequence and metal zoning patterns, in order to guide exploration in this area. Similarly, the study of alteration systems around the Delbridge, D'Eldona and Pinkos deposits reveals the existence of a major carbonatation event, possibly volcanogenic in origin. Moreover, the metallogenic synthesis of the Doyon-Bousquet-LaRonde (DBL) camp documents major variations, at different scales and along different stratigraphic levels, in style of mineralization and alteration within the same volcanogenic hydrothermal system, something every exploration model should take into account.

This multidisciplinary approach has outlined at least five major volcanogenic massive sulphide ore-forming episodes within the BRG, thanks to a better understanding of global and local geological settings in the BRG.

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Units in the Blake River Group: Correlations, geometry and mineral potential

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Seven major formations were recognized and are, from the oldest to the youngest: Hébécourt, Horne, Rouyn-Pelletier, Duprat-Montbray, Noranda, Bousquet, and Reneault-Dufresnoy. The Hébécourt Formation and the lower Rouyn-Pelletier Formation are interpreted as the tholeiitic base upon which all other units developed. The Horne sequence, which hosts the massive sulphide ore deposit of the same name, is characterized by a pile of felsic volcaniclastic rocks and proximal vent facies; geochronology studies reveal it is the oldest felsic unit in the Blake River. The upper Rouyn-Pelletier Formation and the Duprat-Montbray Formation consist of bimodal volcanic assemblages. The Duprat-Montbray Formation extends into Ontario to include rhyolites in Pontiac Township. The Noranda Formation, younger than the Duprat-Montbray, is divided into three sequences: 1) the *Mine sequence*, a bimodal sequence hosting numerous VMS deposits, 2) the *Héré sequence*, overlying the latter and hosting the Delbridge and D'Eldona gold-rich VMS ore deposits, and 3) the *Cyprus sequence*, the youngest and showing a strong tholeiitic affinity. The Reneault-Dufresnoy Formation forms the northern margin of the Blake River in Québec, and is interpreted to extend over much of the Blake River in Ontario, including the volcanic rocks in Ben Nevis Township. It stratigraphically overlies both the Hébécourt and Duprat-Montbray formations. It is characterized by plagioclase-phyric units, by a wide variety of volcanic facies, many types of volcaniclastic rocks, and vesicular layers. This marks a drastic change in Blake River volcanism, and a hiatus can probably be defined at the base of this formation. Although partly coeval with the Reneault-Dufresnoy Formation, the Bousquet Formation is distinctive, due to its volcanic facies and a concentration of gold-rich VMS ore deposits (Bousquet and LaRonde Penna). The structure of the Blake River Group can be represented using a simplified image of a N-S flattened sombrero, where early units outcrop outside and in the centre. Younger units therefore occur along the brim. New potential zones for VMS deposits are: the top of the Noranda Formation, which shows a Matagami-style setting with spherulitic rhyolites of tholeiitic affinity (Cyprus); the base of the Reneault-Dufresnoy Formation; areas to the west of intermediate volcaniclastic rocks adjacent to rhyolites in the Reneault-Dufresnoy Formation (Fabie Bay-Magusi style).

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New insight into the western segment of the Cadillac Fault at depth: A 3D geological model and metallogenic study

Marc Legault (MRNF), Olivier Rabeau (URSTM-UQAT), Li Zhen Cheng (URSTM-UQAT)

The Cadillac Fault (CF) in the Abitibi Subprovince represents a world-renowned gold metallotect that has produced more than 2,000 tonnes of orogenic gold along its periphery. In Québec, the western portion of this structure represents the least auriferous and most poorly known segment. The MRNF and UQAT have jointly undertaken a geological revision, a metallogenic study, and 3D modelling of the area between the Ontario border and the former McWatters mine, covering a distance of 50 km.

The geological revision mainly focuses on the western part of the Blake River Group to the north of the CF. The area is characterized by a high degree of structural complexity as well as the presence of several felsic centres and associated volcaniclastic units for which the VMS potential remains poorly known. The work of this past summer concentrated on assessing the potential of these felsic centres.

In the metallogenic study, local gold occurrences were subdivided into different deposit types. Quartz-carbonate veins, typical of orogenic deposits, are the most common (70%), along with replacement-type occurrences that show strong albitization (20%). Many VMS-type occurrences and late Cu-rich mineralization are also present throughout the area.

A 3D geological model covering 50 x 9 x 1 km was constructed along the CF using 25 structural sections. This work allowed us to realistically estimate the geometry of the geological entities and evaluate the nature of the Archean units underlying the Proterozoic sediments of the Cobalt Group. Gold grades from drill holes were integrated into the model so that the regional-scale spatial distribution of mineralized showings could be used to define the lithological and structural controls on gold deposit emplacement. This work led us to conclude that gold occurrences are strongly associated, at a regional scale, with ductile deformation zones and with specific competent lithologies.

Magnetic susceptibility was also measured as part of this project. The 3D interpretation of these data and the residual magnetic field validated the geometry of some of the large-scale structures in the geological model, such as the Horne Creek, Milky Creek and Beauchastel faults. Gravity data also allowed us to more precisely trace the CF under the Proterozoic cover.

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Seismic imaging of the Noranda Formation in the Amulet and Ribago areas: Signature of structures and geology associated with VMS mineralization, TGI-3 Abitibi Project

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Within the framework of the Targeted Geoscience Initiative (TGI-3), the Geological Survey of Canada obtained access to industry-acquired seismic reflection data along two profiles in the Noranda camp. The two seismic lines (Amulet and Ribago) pass through the mine sequence from east to west. The Amulet profile extends between the Flavrian and Dufault plutons at the level of the Amulet mine. The Ribago profile is located just north of the Powell pluton.

Xstrata Copper Canada also contributed a 3D geological model of the Noranda central camp to the TGI-3 Abitibi Project. The model, constructed using exploration drill holes, is an essential tool for interpreting seismic profiles. The model allows for the precise correlation between reflections and known geology at depth. The seismic data provide an additional control for regions that have not been drilled.

Exhalite horizons in the Noranda Formation are particularly important for guiding VMS exploration. Studies of physical properties reveal that the interface between mafic and felsic volcanic rocks where these horizons are found should produce good reflections. However, in the area of the Amulet profile, exhalite horizons do not coincide with continuous or clear reflections. It is likely that the geological contacts, which are commonly faulted near the profile, do not present a sufficiently large enough surface at the scale of the seismic waves to generate good reflections. One of the most significant reflections along the Amulet profile crosscuts part of the volcanic sequence almost perpendicularly. Its orientation and position could indicate the presence of a conduit that focused hydrothermal fluids. Several dykes of this nature were observed under deposits in the mine sequence. The generally felsic composition of these dykes could produce a reflection at their contacts with mafic volcanic rocks.

On the Ribago profile, the C contact exhalite horizon is represented by a strong reflector. The greater continuity of lithological contacts in this part of the Noranda Formation probably explains why this exhalite horizon is observable on the section. An unmigrated version of the profile reveals two diffractions near the C contact. These diffractions correspond to small, known mineralized zones that were intersected by drill holes. The integration of the two seismic profiles with the 3D geological model allowed us to determine the nature of specific reflections and to identify structures associated with VMS-type mineralization.

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Preliminary evaluation of lithogeochemical data from the Abitibi Greenstone Belt, TGI-3 Abitibi project

Eric Grunsky (CGC-O), Claude Dion (MRNF) et Ben Berger (OGS)

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3D Quaternary stratigraphy and till geochemistry in the Normétal / Lebel-sur-Quévillon area, TGI-3 Abitibi project – Results of 2006 drilling campaign

Michel Parent (CGC-Q), Pierre Rhéaume (MRNF), Éric Boisvert (CGC-Q), François Hardy (Polygéo) et Serge J. Paradis (CGC-Q)

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Geological mapping using drilling data and Quaternary sediment geochemistry, Lac Bigniba area (32F04-SE); Phase 1 of the Rivière Octave project, Abitibi, Québec

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The main objective of the Rivière Octave project is to compensate for the lack of knowledge of geological settings and exploration targets under the thick cover of glaciolacustrine sediments that extends from Normétal to Lebel-sur-Quévillon. The selected method, which consists in systematically sampling this environment in drillhole, will also lead to a characterization of tills and of underlying geological settings. The results of Phase 1 of this project, conducted under the MRNF Copper Plan and the GSC Targeted Geoscience Initiative, are presented here.

The study area in 2006-07 covers NTS sheet 32F04-101, located southeast of the Sleeping Giant mine. Supracrustal rocks in this area are bordered by the Marest and Bernetz plutons. A sequence of dominantly volcanic rocks cut by E-W to NW-SE-trending deformation zones was described. This sequence mainly consists of tholeiitic to transitional mafic and intermediate lavas, locally interbedded with tuffs and calc-alkaline felsic lavas. These volcanic rocks are locally overlain by a thick sedimentary unit composed of wacke and mudstone with graded bedding. This unit unconformably overlies the volcanic rocks and occupies the core of a regional west-plunging syncline. The youngest zircons recovered from a wacke sample from this unit yielded a TIMS age of 2700 Ma.

Under a variable thickness of glaciolacustrine silt, the 37 diamond drillholes (HQ-3) intersected 162.1 m of till, related glacial sediments or older Quaternary sediments; the average recovery rate was 63% (ranging from 0 to 100%; standard deviation = 22%). Given the proximity of the Harricana Moraine, drillholes frequently intersected, under the silt layer, variable thicknesses of proglacial sediments, mainly pebbly pavement, diamict with a washed-out matrix, and well-sorted sand and gravel. These proglacial facies were underlain by the basal till with a silty-sandy matrix or directly by the bedrock. Under the till, one drillhole intersected oxidized sandy sediments and an earlier till unit.

A total of 102 m of drill core was recovered, from which 130 samples of 400 to 800 g were collected for geochemical analyses (major and trace elements by ICP-AES and INA) and 128 samples weighing 1200 to 2000 g for heavy mineral concentrate studies and microprobe analyses of indicator minerals.

As a result, a certain number of targets were defined with potential for copper and gold deposits.

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Study of the south limb of the Lac Doré Complex, Chibougamau: Stratigraphy, Cu-Au veins and preliminary 3D model

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The geological synthesis and 3D modelling project focussing on the southern part of the Lac Doré Complex and volcanic rocks to the south continued in 2007. The objectives in 2007 were: 1) to refine the volcanic stratigraphy on either side of the Chapais syncline; 2) to clarify the setting of Chibougamau-type mineral occurrences in the Corner Bay area; and 3) to complete the preliminary 3D geological model.

Along the south limb of the Chapais syncline, at the base of the 1st volcanic cycle in the Roy Group, the Obatogamau Formation is composed of tholeiitic glomerophyric basalts. It is overlain by the Queylus Member, characterized by calc-alkaline felsic to intermediate volcaniclastic rocks and transitional basalts. Along the north limb of the syncline, the Obatogamau Formation is absent, and the Lac Doré Complex (2728 ± 1 Ma) is in contact with the Lemoine Member (2728 ± 1 Ma), a bimodal sequence composed of tholeiitic rhyolites and andesites at the base, overlain by transitional rhyodacites and basalts at the top. On both sides of the syncline, the felsic members are overlain by the second volcanic cycle comprising the Gilman Formation, composed of tholeiitic basalts, and the Blondeau Formation, composed of felsic volcanic rocks and graphitic sedimentary rocks. The sedimentary Opemisca Group unconformably overlies the Roy Group. It includes the Stella and Haüy (2691.7 ± 2.9 Ma) formations, mainly composed of sandstone and conglomerate.

The main Chibougamau-type Cu-Au showings in the Corner Bay area are somewhat distinct from deposits in the central mining camp, with higher Cu grades but lower Au grades. They are hosted in rocks of the Lac Doré Complex. Occurrences are associated with QZ-CL-CP-PY veins that are coeval or late relative to the emplacement of tonalite and diorite dykes of the Chibougamau Pluton. Alteration patterns are dominated by chlorite and sericite, forming a thin halo around veins. However, a network of sulphide stringers develops over several metres near thicker ore-bearing veins. Late shear zones mainly trending N-S and NW-SE cross-cut the dykes and veins. A second set of gold occurrences with features comparable to orogenic deposits is associated with these shear zones.

The 3D model integrates new geological data collected through our work as well as data available in SIGEOM. This databank was put together with the cooperation of mining companies, who provided their own drilling and geochemistry data. These data will be used to define prospective zones for the discovery of volcanogenic massive sulphide deposits, porphyry Cu-Au deposits, Chibougamau-type Cu-Au veins, and orogenic gold deposits.

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New mapping, geochemistry and geochronology results in the Chibougamau area: Implications for the stratigraphic framework and for base metal exploration, TGI-3 Abitibi Project

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In the Chibougamau area (northeast Abitibi Subprovince), the Archean stratigraphy of the Roy Group as currently defined includes two mafic (tholeiitic) to felsic (calc-alkaline) volcano-sedimentary cycles. The first cycle includes the Waconichi and Obatogamau formations, and the second cycle comprises the Gilman and Blondeau formations. The objectives of the mapping project carried out during the 2005-2007 field seasons along the south limb of the Chibougamau syncline, north of the Lac Doré Complex (LDC), were to clarify the stratigraphy of the Gilman Formation and determine its potential for VMS-type deposits.

Three new members are now defined within the Gilman Formation. The David Member is tholeiitic (Zr/Y = 2.8-4.2; La/Yb_{pm} = 1.0-2.5). It consists of massive to pillowed basalts and andesitic basalts with flow breccias and hyalotuffs. The Allard Member comprises andesitic basalt flows and andesitic crystal tuffs of transitional affinity (Zr/Y = 3.8-5.3; La/Yb_{pm} = 3.8-6.2), overlain by calc-alkaline lapilli and block tuff, crystal tuff and rhyodacite (Zr/Y = 7.0-18.2; La/Yb_{pm} = 4.1-65.6). A sample of lapilli and block tuff from the Allard Member yielded a U-Pb zircon age of crystallization of ca. 2727 Ma. The Bruneau Member is tholeiitic (Zr/Y = 2.2-4.0; La/Yb_{pm} = 0.6-1.6). It is composed of massive to pillowed basalts and andesitic basalts, with a few local lenses of andesite and lapilli and block tuff. The transition to the Blondeau Formation is characterized by locally variolitic massive to pillowed andesites and spherulitic rhyolites interbedded with turbidites.

The age of the Allard Member is comparable to the age of the Lemoine Facies of the Waconichi Formation, located along the south limb of the LDC. This coeval timing reveals a problem with the inclusion of the Lemoine into a cycle underlying the Gilman. Geochemistry and geochronology studies are underway on the Queylus Facies and the type locality of the Waconichi Formation (north limb of the Chibougamau syncline) in order to address this issue. The Lemoine Facies is particularly important in terms of mineral potential, since it hosts the Lemoine mine, the 2nd richest VMS ore deposit in Canada (and 6th worldwide). The eventual correlation of the Allard Member with the Lemoine Facies implies a much greater potential for the Gilman and the Allard Member for VMS-type deposits.

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Petrogenetic and tectonic implications of the geochemistry of lavas and intrusions in the Roy Group, Chibougamau area

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Our new subdivision of the Gilman Formation includes at its base, tholeiitic (La/Yb_{pm} = 1.0-2.5) basalts and andesitic basalts of the David Member. Gabbroic to pyroxenitic sills are abundant in the David. These intrusions, with rare exceptions, have a tholeiitic affinity and inverse modelling suggests they may be comagmatic with the David Member. The overlying Allard Member comprises andesitic basalt flows and andesitic tuffs (La/Yb_{pm} = 3.8-6.2), overlain by calc-alkaline rhyodacitic flows and tuffs (La/Yb_{pm} = 4.1-65.6). The geochemistry of Allard rocks suggests an important crustal contribution, which becomes dominant for the more felsic members. The overlying Bruneau Member is composed of tholeiitic (La/Yb_{pm} = 0.6-1.6) basalts and andesitic basalts. The latter are more primitive than those of the David Member and do not represent a structural repetition, but rather the arrival of new primitive mantle-derived magmas. The overlying Blondeau Formation is composed of andesites, spherulitic rhyolites and turbidites. Swarms of sills are abundant along this transition zone (Cummings Complex). The Cummings consists of three thick sills, variably dissected by reverse faults. Chilled margins and metasedimentary septa prove their igneous origin. Inverse modelling indicates that two major magma suites were involved, one tholeiitic and one calc-alkaline, each giving rise to a complete lithological series (peridotite, pyroxenite, and gabbro). Rocks in the calc-alkaline suite occasionally contain igneous hornblende.

Field evidence clearly indicates the stratigraphy is largely intact near Chibougamau. The abundance of feeder sills implies a proximal magmatic source. Two mafic-felsic cycles are preserved, recording a changeover from mantle-derived magmas with little crustal interaction (David and Bruneau) to mixtures between mantle-derived magmas and magmas derived from the continental crust (Allard and ?Blondeau). The simplest model to explain these features would be that of a mafic lava plain emplaced in shallow water in an ensialic setting. During mafic eruption, huge volumes rapidly travel through the continental crust with little interaction. Part of the basaltic magma remains trapped at the base of the crust, where heat exchanges and crustal melting linked with basalt fractionation take place, to generate the Allard Member. The crustal magmatic system then dwindles, until it is reactivated by the arrival of new mantle-derived basaltic magma.

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Geology and metallogeny of the Opinaca area – Phase 2/3 (33C10, 33C11 and 33C15)

Daniel Bandyayera, Pierre Lacoste, Alexandra Fliszár and Charles Maurice (MRNF)

The Opinaca project covers the northern part of map sheets 33C and 33B. This area was selected based on: 1) the paucity of geological knowledge, 2) its strategic position to understand links between the La Grande and Opinaca subprovinces, and 3) its great mineral potential.

During the first phase of the project, mapping in sheets 33C09 and 33C16 outlined the Kasak volcano-sedimentary formation (>2709 Ma) draped around the Opinaca Reservoir Pluton, a multiphase intrusive dome (2703-2710 Ma) composed of diorite-granodiorite- porphyritic tonalite.

This second phase of the project consists in a mapping survey at 1:50,000 scale of NTS sheets 33C10, 33C11 and 33C15, to the west of Opinaca Reservoir. Our work traced the extension of the Kasak Formation to the west of Opinaca Reservoir, where sedimentary units locally show alumino-silicate alteration zones similar to those observed on the Eleonore property. In the south part of map sheet 33C11 and the west part of 33C10, another important volcano-sedimentary sequence, some 32 km long by 7 km wide, is defined and bounded to the south by a tonalite-quartz diorite pluton, and to the north by a granodiorite pluton. This sequence is formed of massive to pillowed, locally glomerophyric, basalts at the base, with crystal, lapilli and/or blocky volcaniclastic rocks at the top. Polygenic conglomerates, overlain by bedded or massive wacke and sandstone units, unconformably overlie the volcanic sequence. Remnants of Algoma-type iron formations are also observed at the top of the basalt sequence or intercalated with the sedimentary sequence.

North of map sheet 33C10, the metamorphic grade rapidly increases from the amphibolite facies to reach the granulite facies in map sheet 33C15. The current boundary between the La Grande and Opinaca subprovinces corresponds to the path of this metamorphic isograd. The boundary is locally characterized by late injections of pegmatite or massive to weakly foliated granodiorite. In the map area, the Opinaca Subprovince consists of bands of moderately to strongly migmatized paragneiss injected with pegmatitic migmatites.

Our work indicates promising potential for: a) porphyry-type occurrences, b) gold-rich volcanogenic massive sulphides, c) gold associated with deformation zones or contact zones between sedimentary and volcanic sequences, d) epigenetic occurrences associated with metasomatic vein networks, e) iron formation-hosted occurrences, and f) rare elements in white pegmatites.

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Geology of the Rivière Pons area, Far North (24C and 23N)

Martin Simard, Charles Gosselin, Isabelle Lafrance and Tom Clark (MRNF)

The mapping survey was carried out during the summer of 2007 at 1:250,000 scale in the Rivière Pons area (western 2/3 of 24C and northern 3/4 of 23N), located about 125 km northwest of Schefferville.

The area lies at the junction between three subprovinces of the Superior Province, namely the Minto to the north, the La Grande in the west-central part, and the Ashuanipi Subprovince to the south. Eastward, these Archean rocks are in contact with Proterozoic rocks of the Labrador Trough.

The Minto Subprovince is mainly composed of biotite-hornblende granitic, granodioritic or monzonitic intrusive rocks, with or without a porphyroid texture. The La Grande Subprovince consists of leucotonalites and an early volcano-sedimentary belt (Angilbert Belt) located in the westernmost part of the area. The Ashuanipi Subprovince is largely composed of diatexite and migmatitic paragneiss with or without orthopyroxene. It also includes tonalitic gneisses, amphibolite bands and numerous charnockitic intrusions. Note that rocks of the La Grande Subprovince were recognized within the Minto and Ashuanipi subprovinces, in the form of enclaves and outliers.

The regional metamorphic grade is generally the amphibolite facies, except in the Ashuanipi Subprovince where the granulite facies prevails. Near the Labrador Trough, Archean rocks are strongly hematized, chloritized and sericitized.

The structural trend shows two preferential orientations, controlled by faults and folds that affect the regional foliation. The first trends NNE-SSW and is well developed throughout the area. The second, trending NW-SE, is superimposed upon the first fabric and occurs within wide multi-km-scale corridors. Major regional faults trending NE-SW also cut across the area. These are the Vaujours and Châteauguay faults as well as the Saindon-Cambrien structural zone.

Silicified, rusty, and sulphide-rich zones and iron formations were observed in the Angilbert volcano-sedimentary belt, as well as in a few belts recognized within the Ashuanipi Subprovince. Many rusty zones and iron formations were also observed in migmatitic paragneisses of the Ashuanipi Subprovince. Proterozoic sandstone outliers of the Sakami Formation, occurring within the Saindon-Cambrien structural zone, show potential for uranium deposits. Kimberlite indicator minerals were found in a few locations along this structural zone, suggesting diamond potential within the structure.

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Age and distribution of Proterozoic mafic dykes in the NE Superior Province: Towards a better understanding of lithospheric fracture networks

Charles Maurice (MRNF) and Jean David (GEOTOP-UQAM-McGill)

The appearance of mafic dyke swarms at about 2.5 Ga suggests important changes in crust/mantle dynamics between the Archean and Proterozoic eons. Information in the SIGEOM database was used to produce a comprehensive compilation map of dykes in the NE part of the Superior Province, where several new swarms have now been documented.

Geochronology studies on ten different dykes all yielded Paleoproterozoic ages (Buchan *et al.*, 1998, this study, and unpublished work by S. Pehrsson). The oldest dykes were found in the eastern part of the region as part of the Ptarmigan swarm (*ca.* 2.51 Ga), which consists of NE-trending dykes. In the northwestern part, the Irsuaq swarm (*ca.* 2.48 Ga) consists of N- to NNW-trending dykes. Almost 300 Ma separates these two swarms from numerous others that were emplaced between 2.2 and 2.0 Ga. In the middle of the region, the Maguire dykes (*ca.* 2.23 Ga) trend W to NW. A subsequent major magmatic event at 2.21 Ga created the impressive Klotz swarm (WNW), as well as the less voluminous Anuc (NW) and Kogaluk Bay (ENE) swarms. In the northern part of the region, the Couture swarm (*ca.* 2.18 Ga) consists of a few dykes oriented WSW to W, and their emplacement was possibly related to the opening of the basin that formed prior to the emplacement of Ungava Trough rocks. Similarly, the Payne swarm (*ca.* 2.16-2.17 Ga) defines a dense population of NNW-trending dykes that run parallel to the rocks of the Labrador Trough. The Rivière du Gué dykes (*ca.* 2.14 Ga) trend ENE, parallel to the sandstones of the Sakami Formation. Finally, the Minto swarm (*ca.* 2.00 Ga) trends WNW to NW and represents the youngest known swarm in the region.

Dykes within the same swarm are generally associated with a single magmatic event. However, recent studies demonstrate that the same swarm may contain dykes of different ages, suggesting that the magmas accessed deep pre-existing lithospheric structures. While our compilation of the dykes has outlined distinct brittle deformation corridors, U-Pb dating will allow us to better delineate which of these corridors display evidence of recurrent magmatic activity. Identifying these corridors related to deep structures, in conjunction with the application of traditional prospecting methods, could contribute to the development of a new exploration model for kimberlites in the NE part of the Superior Province.

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Uranium in the Labrador Trough and surroundings: Exploration and metallogeny

Thomas Clark and Serge Perreault (MRNF)

Uranium deposits constitute a significant portion of the deposits inventoried by the MRNF in the Labrador Trough and its vicinity; for example, in the Trough *sensu stricto*, uranium deposits represent about 11% of all deposits, excluding iron. The region is experiencing renewed interest for uranium after the first rush that resulted in extensive exploration programs in the 1970s and 1980s.

Uranium deposits in the region are of syngenetic/diagenetic and/or epigenetic origin. The syngenetic/diagenetic deposits comprise the following types: (1) sedimentary uranium in mudstones and siltstones, (2) sedimentary uranium in sandstones, (3) sedimentary uranium in carbonates, (4) uranium in volcanics associated with red beds, (5) uraniferous phosphorite, and (6) uraniferous pegmatites and granites. The epigenetic deposits consist of uranium-bearing veins.

Exploration results thus far suggest that the most promising deposit type is sedimentary uranium in mudstones and siltstones (e.g., the Dieter Lake deposit in the Lac Gayot Paleoproterozoic sedimentary outlier; estimated at 50 Mt grading 0.1% U_3O_8). Paleoproterozoic carbonaceous pelites are known as potential hosts for large uranium deposits around the world. Some of the U-Co-Cu deposits hosted in sandstones from the lower part of the Trough sequence are similar to deposits in Zaire. Other syngenetic to diagenetic deposits with interesting potential have been discovered in sedimentary units intercalated with red and green arkosic sequences (e.g., near Lac Chioak). Uraniferous veins are exploration targets due to their locally high-grade uranium, gold and copper values. These veins can be distinguished by their association with strong metasomatic alteration, such as albitization, hematization, carbonatization and chloritization, and by the presence of elements like Ag, Se, Te, Pb, Mo, Y and REE (e.g., the Lac Mistamisk and Lac Romanet valley). In some ways, these deposits are comparable to those of Beaverlodge, Saskatchewan.

The vast territory along the George River, northeast of Schefferville, consists of metamorphosed Archean and Paleoproterozoic rocks. Most showings discovered in the last two years were associated with pegmatites or granitic intrusive bodies. This territory represents fertile terrain for various types of uranium occurrences, including those associated with granitic intrusions (Rössing or Madawaska types) and uraniferous veins related to major shear zones (Beaverlodge or Vendée (France) types).

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Industrial minerals, architectural stone and peat in Québec

N'golo Togola, Yves Bellemare, Pierre Buteau and Serge Perreault (MRNF)

Industrial minerals comprise more than fifty different types of rocks, commodities and non-metallic minerals, with physical or chemical properties that are put to contribution for various end uses, products or industrial processes. In order to raise awareness about these commodities, essential in our everyday lives, we have put together this poster showing the distribution of producing deposits, mines and quarries for industrial minerals, industrial stone, architectural stone, and peat. For economic and profitability reasons, most of these operations are generally located near major urban centres.

Industrial minerals are largely used for their physical or chemical properties such as hardness, whiteness, purity, chemical inertia, or thermal and electrical conductivity. They can be found in ceramics, glass, paper, plastic, chemical products, sorbents, electronics, optics, abrasives, friction products, construction materials, and environmental and agricultural agents. They can also be used as mineral fillers in various materials, or as filtering agents, refractories and flux in smelters. The industrial mineral sector in Québec is largely based on the extraction and processing of commodities mainly intended for export markets.

More than thirty industrial minerals are present in Québec. These consist of: varieties of industrial stone (limestone, dolomite, marble, silica), most non-metallic minerals (asbestos, graphite, halite, quartz, wollastonite, etc.) and a few metallic minerals (chromite, ilmenite, magnetite, hematite) used as chemical compounds, clay, gemstones and brine.

Since the early 19th century, architectural stone has been extracted in Québec from anorthositic, charnockitic and granitic suites. The latter account for most of the production of dimension stone and ashlar. Steatite, soapstone and serpentinite are used for sculptures and to produce refractory plates. Slate is used to manufacture roofing tiles and slabs. Limestone, dolomite, sandstone, siltstone, marble, quartzite, schist, and gneiss are processed into dimension stone, ashlar and landscaping stone.

In North America, peat is used in horticulture and agriculture. In Québec, it is mainly harvested in the Bas-Saint-Laurent, Côte-Nord and Saguenay–Lac-Saint-Jean regions.

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Exploration targets for architectural stone

Yves Bellemare (MRNF)

During the summer of 2007, the purpose of this project was to assess the potential for architectural, monumental and ornamental stone in four regions throughout the province. Fieldwork was carried out in the Portneuf regional county municipality (MRC), in the Côte-Nord region, the Bas-Saint-Laurent region, and in various parts of the Saguenay–Lac-Saint-Jean region.

In the Portneuf MRC, our work consisted in assessing the potential in specific areas where massive outcrops were identified during a geological mapping survey in 2006. Regional targets were: dark rocks of the Rivière-à-Pierre plutonic Suite, in various shades of blackish grey or greenish grey, dioritic and tonalitic orthogneisses of the La Bostonnais Complex, and augen gneisses of the Tourilli Pluton. Local targets were defined, particularly in the vicinity of lakes Dalila, Nollen, Rougon, Sirois and Potvin (NTS 21L13, 21M04 and 21M05).

In the Côte-Nord region, our attention focussed on outcrops of red granitic gneiss and to a lesser extent, on augen gneisses of the Saint-Paul-du-Nord Formation, located between Forestville and Les Escoumins. The greatest potential was found north of the municipality of Longue-Rive (22C11). Local targets were defined near the Petite rivière Noire and near Lac du Deux Milles, Lac de la Grosse Truite, and Lac Noir.

In the Bas-Saint-Laurent region, the most significant results were obtained near Saint-Guy and Saint-Mathieu-de-Rioux (22C02), where a few m-scale beds of red sandstone and conglomerate of the Robitaille Formation constitute local exploration targets for use as masonry and landscaping stone mostly.

In the Saguenay–Lac-Saint-Jean region, the potential for architectural, monumental and ornamental stone is excellent in rocks of the anorthositic suite (black, blue and purple varieties), rocks of the granitic suite (pink and red granite), and rocks of the charnockitic suite (green and brown varieties). Many regional and local targets warrant follow-up work to fully assess their potential. The main local targets that were defined are found near lakes Ouitouche (32A01), des Grandes Gueules (32A06), Touladi (32A07), à Boucher (32A08), Brûle-Neige (22E12), de la Cabane (22E15) and du Brochet (32H09).

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Inventory of aggregate resources in the réserve faunique des Laurentides (22D03)

André Brazeau and Ilias el Fechtali (MRNF)

Following the start-up of road repairs on Highway 175 between the towns of Québec and Saguenay, an ongoing inventory of aggregate resources was launched in 2003 in the réserve faunique des Laurentides. In 2007, this work covered NTS sheet 22D03. The results will help locate and characterize sources of aggregate in order to assess their importance.

Fieldwork mainly consisted in examining a total of 70 sand and gravel pits, as well as several natural cross-sections and road cuts. Moreover, 7 sand or gravel samples were collected and shipped to the laboratory to determine their physical and mechanical properties.

From a geomorphology standpoint, the area consists of a high inclined plateau, with altitudes ranging from 950 m in the south, to a little less than 350 m in the north. Deep valleys cut the plateau, namely along the Pikauba, Chicoutimi, Cyriac and à Mars rivers, creating escarpments of several tens to hundreds of metres. Many valleys are U-shaped, typical of valleys carved by the passage of glaciers.

The area is underlain by Precambrian rocks of the Grenville geological Province. These rocks include granitic gneisses and paragneisses intruded by granites, mangerites, gabbros and anorthosites. Local aggregates accurately reflect the composition of the underlying bedrock and are of good quality.

Most sand and gravel deposits were emplaced when the ice cap began to recede from the area about 12,500 years ago. A number of moraine ridges and many fluvioglacial deposits shape the landscape, in both valley and plateau settings. These deposits are much thicker and more abundant in valleys however, where they most often occur as outwash, esker and kame terrace deposits.

Sources of aggregate are fairly abundant within the study area. However, near the path of Highway 175, sources of aggregate are much scarcer and mainly consist of sand of variable grain size. Sources of natural gravel are not abundant. The most significant deposits often occur along the flanks of the main river valleys in the area.

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An exceptional concentration of mono-lithologic erratic blocks in Saguenay

Jean J. Veillette (GSC-UQAT), Jean-Claude Dionne (ULAVAL), André Brazeau and Ghismond Martineau (MRNF)

Recent glacial dispersion studies have revealed that erratic blocks sourced from various Lower Proterozoic formations in the Lac Mistassini Basin were sporadically distributed over about half the tectonic Grenville Province in Québec (Veillette, 2004). Their presence over such a large area reflects major changes in glacial ice-flow directions during the last cycle of glaciation. These far-travelled erratic blocks, including blocks of stromatolitic dolomite from the Albanel Formation, were originally documented by Dionne (1986, 1994) in several places along the banks of the St. Lawrence Estuary. Here we describe an exceptional concentration of blocks of stromatolitic dolomite that originated in the Lac Mistassini Basin and are now located at the northern limit of Parc des Laurentides, near Laterrière, Saguenay. Spread over an area of about 4 ha and along the surface of a ridge, almost 70% of the erratic blocks lying on the ground are fragments of stromatolitic dolomite, many of which measure more than 1 m in diameter. Some of the blocks even exceed 2 m in diameter, have tabular shapes, and display few signs of intense glacial abrasion. Unusual geometric shapes, visible on the surface of the blocks and caused by the presence of stromatolites and a long glacial transport distance, impart aesthetic appeal and a particularity to the blocks that generates a certain interest in the region. To our knowledge, this anomalous glacial dispersion constitutes a unique, or at the very least, rare example in Québec. The great concentration of mono-lithologic blocks suggests glacial transport processes similar to those that were invoked to explain the displacement of enormous sedimentary rock layers (megablocks) over long distances in southern Alberta (Stalker, 1976). Ripped-up slabs of subhorizontal dolomite strata from the Lac Mistassini Basin could have been incorporated into the glacier sole and transported over long distances, like the thin but continuous rock layers in Alberta that were detached by a glacier from their original bedrock source. We envision various transport mechanisms based on the characteristics of the Laterrière erratic boulder field, the Canadian Prairie megablocks, and the sequence of glacial ice-flow patterns that has been established for the entire region between Lac Mistassini and the St. Lawrence.

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Sculpted forms at Baie des Escoumins

Ghismond Martineau (MRNF)

Sculpted forms occur at a site within the municipality of Les Escoumins, 40 km east of Saguenay along Highway 138. Outcrops on a rocky islet in the heart of Baie des Escoumins are adorned with numerous glacial erosion features that formed during deglaciation of the region. It is possible to observe marks created by both the passage of debris-laden ice and the flow of subglacial meltwater. The latter impart an exceptional character to the site.

Extending from the Cross monument down to the low tide line, the rocks form a series of crests with asymmetric profiles. The surfaces of these rocky hillocks, particularly the stoss sides, display erosional micromarks, such as trails of chattermarks, trails of crescentic gouges, striae and glacial grooves. The spatial arrangement of these various glacial erosion features indicates an ice-flow movement toward the northeast, along the St. Lawrence axis.

Many sinuous shapes with smooth edges are visible on the surface of the asymmetrical mounds. These shapes, fashioned by subglacial meltwater, are known as "sculpted forms". Among those documented, curved grooves (Sichelwannen), cavettos, furrows, and U-shaped forms are the most common.

The movement of fast-flowing meltwater under the glacier was characterized by laminar flow. The boundary layer – the zone immediately above the rock-water interface – closely followed the gentle slope on the stoss side of the asymmetric hillocks. As it rose up the slope, the boundary layer could detach from the rocky surface and generate strong vortices. These eddies were carried to the lee side where they hit the next asymmetric rocky mound and carved the sculpted shapes we observe today. If the stoss side was irregular, turbulence would develop and the flow would change from laminar to turbulent, thereby preventing eddies from forming.

The sculpted forms at Baie des Escoumins have been declared an exceptional geological site as part of Québec's geological heritage.

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Québec's geological heritage

Louis Madore and André Tremblay (MRNF)

The concept of geodiversity is fairly new and not widely known. Yet, just imagine a uniform planet, composed of a single rock type, with no topography, no movement of the crust, no wind... Such a static and uneventful planet could obviously not shelter life. Our existence is intimately intertwined with the Earth's history. A fascinating history recorded within its rocks and its landscapes, shaped by geological events and which we can all learn from.

Québec's *Strategy for Protected Areas* was developed in the wake of the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992. Since then, Québec has committed to the protection of 8% of its territory, with a view toward the sustainable development of its natural resources. Geological heritage is an integral part of this strategy, and *geodiversity* is an important aspect of environmental protection.

Geodiversity is, along with biodiversity, a common asset that should be preserved and celebrated. Québec is particularly well endowed in this matter, and contains a number of geological riches that stand to be popularized.

These riches take on many different forms. There are *historical or cultural site*s consisting of a geological element linked to our social heritage and which has historical, archaeological, folkloric, spiritual or economic value. There are landscapes that offer an unusual or particularly beautiful viewpoint and that are shaped by their geology. There are also *ecosystems*, i.e., areas where wildlife and flora depend on the geological environment. Finally, there are geological curiosities that correspond to unique phenomena, or that are of interest for scientific, learning or aesthetic purposes.

Québec has implemented a mechanism to identify geological sites of interest for the community, to characterize the latter, assess their vulnerability and, if needed, to protect them from potential alienation due to human activity. Québec also has the ability to take specific measures to ensure the preservation or development of a *geosite* deemed of particular importance for our natural heritage.

180 A

Quaternary maps of northwestern Québec

Jean J. Veillette and S.J. Paradis (GSC-Q)

This series comprises ten map sheets at 1:100,000 scale (48 sheets at 1:50,000) of surficial deposits covering most of northwestern Québec. These ten maps are located within the Abitibi Subprovince, in the Superior Province of the Canadian Shield, which forms the largest granite-greenstone terrain in the world. The study area covers part of the James Bay Municipality, between latitudes 49° N and 50° N and longitudes 76° W et 79° 30' W (Rivière Wawagosic, Rivière Harricana, Lac Matagami, Rivière Waswanipi, Rapide-des-Cèdres and Lebel-sur-Quévillon map sheets) and to the south, parts of the Abitibi, Abitibi-Ouest, Rouyn-Noranda, and Vallée-de-l'Or regional county municipalities (MRC), between latitudes 48° N and 49° N and longitudes 77° W and 79° 30' W (Cadillac, Lac Chicobi, Lac Castagnier and Lac Blouin map sheets). In addition to mapping and detailed descriptions of surficial units, each map contains, along its margins, a set of satellite maps including a small-scale map of bedrock lithologies and another of its magnetic signature, and four distinct blocks with field maps, sketches and photographs summarizing knowledge acquired in recent years on ice flow sequences, on major glacial transport directions, on glaciolacustrine submersion, and on Quaternary stratigraphy. A list of references adapted to each map lists relevant publications for a better understanding of the regional Quaternary study. This type of presentation showing the results of our regional studies is intended to be used as a tool by persons and organizations that want to learn about various aspects of the Quaternary geology of the area, in a simplified format, in the fields of mineral exploration, hydrogeology, regional planning, and forestry. More specific data on the regional glacial history, such as carbonate grades, till lithologies, sediment geochemistry and grain size (among others), acquired over the course of our mapping survey, will be released in complementary publications.

180 B

Metallogeny and structure of the Goldex Mine ore deposit, Val-d'Or (Qc)

Alexandre Aubin, Damien Gaboury and Réal Daigneault (UQAC)

The purpose of this study on the Goldex Mine ore deposit is to provide new data on the setting and timing of emplacement of lode gold systems, in order to develop exploration guides. The Goldex Mine is part of the Val-d'Or mining camp in the Abitibi Greenstone Belt. The ore deposit is located a few kilometres north of the Cadillac-Larder Lake Fault, near the Norbenite-Marbanite shear zone. The Goldex gold deposit is hosted in a granitic intrusion forming an elongate pluton steeply inclined to the north and broadly trending WNW-ESE. The pluton is intercalated with layers of deformed mafic to ultramafic volcanic rocks; it has a dioritic composition, with various mineralogical facies, namely biotite diorite, hornblende diorite and quartz diorite. Gold mineralization occurs in the latter phase and is associated with tourmaline-rich veining. Gold-bearing veins form stockworks, systems of steeply dipping veins and veinlets, and subhorizontal veins. These various forms are interconnected and show rare evidence of mutual cross-cutting relationships, indicating a single ore-forming episode. The ore system is accompanied by proximal and distal alteration zones. Distal alteration is penetrative and characterized by an assemblage of quartz, chlorite, carbonates and local pyrite. Proximal alteration is restricted to vein wall rocks and is characterized by the assemblage albite, carbonates and pyrite. Many features distinguish the Goldex Mine deposit from other orogenic gold deposits, namely the interconnected nature of the vein network, the scarce evidence of cross-cutting relationships, the significant amount of tourmaline in ore-bearing veins, the proximal alteration dominated by intense albitization, and the fact that the mineralized system is constrained within a specific phase in the host intrusion.

180 C

Generalization of symbols on Quaternary geology maps using an automated procedure developed in ArcGIS. Test area: Québec Abitibi, TGI-3 Abitibi Project

Serge J. Paradis (GSC-Q), Gabriel Huot-Vézina, (UdeS, GSC-Q) and Ruth Boivin (GSC-Q)

A cartographic generalization project is currently underway at the Geological Survey of Canada – Québec. Specifically, this generalization is applied to polygon layers of Quaternary geology. Various tests are being conducted to validate the recently developed method and apply it to transfer cartographic data from 1/100,000 scale to 1/250,000 scale in the Québec part of the Abitibi (Paradis *et al.*, 2006; Smirnoff *et al.*, manuscript under review).

This type of generalization loses its relevance if the set of symbols used on the map is not itself generalized. The purpose of this project is to obtain an adequate symbology specifically for the 1/250,000 scale following the development of an automatic procedure, to complement the procedure developed for polygon layers.

This type of procedure requires a fair amount of time to develop; first automatic methods must be constructed for each symbol separately. This step is necessary since each symbol represents in itself a distinct piece of information that, as the case may be, must be generalized in different ways.

First, the geometry of symbols must be established: point, line or zone; global methods will need to be adapted to each geometry. Then, we must determine if the symbol is linked to the polygon on which it is represented, because following the polygon generalization, the background geometry may be different, which would eliminate the symbol's significance as the latter may no longer appear on the right formation. The relationship between certain symbols is also an important criteria, as is their length, surface area, density, thickness, etc. It is therefore necessary to produce a list of symbols according to priority, since the generalization may be applied at varying degrees of intensity. For example, a generalization may be more significant and eliminate more symbols if the information attached to the latter has less value at the final scale. Finally, when the "layer by layer" generalization is complete, it is possible to proceed with the second phase, i.e., a generalization based on the three symbol geometries (point, line, zone). The goal is to eliminate overlapping symbols that could affect the quality and clarity of the map, for example where point symbols would overlap line symbols.

All automatic methods were developed using the ModelBuilder interface in ArcGIS 9.2. Python version 2.4 is the main programming language used to complete and fine-tune models built with ModelBuilder.

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A NEW DIRECTION FOR DIVEX'S RESEARCH NETWORK, AND VOLCANOLOGY DIVEX-STYLE

New scientific programming for the DIVEX network

Michel Malo (INRS-ETE) and Michel Jébrak (UQAM

The goal of the DIVEX network is to support and energize Québec efforts in R&D and technology transfer within the field of mineral exploration. In particular, its aim is to open new avenues for the mining industry by providing the means to innovate in exploration. DIVEX represents the first research structure to unite mineral exploration researchers from across Québec. During its first five years, twenty-eight projects were developed along four research themes: two that focused on underexplored geological environments in Québec (sedimentary and metamorphic), and two that focused on substances not yet mined in Québec (platinum group elements and diamonds). After its initial financing by the VRQ and the MDEIE, DIVEX will receive funding from the FQRNT for the next three years. The network will support large-scale research projects on themes that are relevant to exploration in Québec. These projects should involve at least two universities and be supported by at least two companies. The research themes to be studied could include: geochemical and mineralogical exploration indicators, Archean porphyry gold deposits, deep geophysical exploration methods, uranium in Québec, and structural controls on ore deposits.

Characteristics of the subaqueous Misema caldera, Blake River Group, Abitibi

Wulf Mueller and Claude Pilote (UQAC)

The Misema and other calderas, such as the New Senator caldera, are instrumental in understanding the evolution of the Blake River Group in the Abitibi greenstone belt and the formation of volcanic massive sulphide deposits. The 40- to 80-km diameter, E-W-trending Misema caldera is a coalescence of at least two large mafic shield volcanoes that formed prior to 2702.9±4.1 Ma (ca. 2703 Ma) based on the Cléricy gabbro complex. The margin of the Misema caldera displays a 10- to 15-km wide inner and outer ring zone, in which numerous mafic ring dyke structures (e.g., Montsabrais) and subaqueous pyroclastic deposits are observed. The mafic ring dyke complexes are considered to be deeper level expressions of summit calderas related to a shield volcano phase, and the pyroclastic debris may either be associated with the summit volcanoes and/or a product of Misema caldera collapse. The Montsabrais tonalite, with an age of 2696.3±1.3 Ma, shows that the Noranda caldera age volcanism and plutonism influenced older caldera structures. Claude Pilote (PhD, UQAC) is conducting detailed volcanic facies studies around the Mobrun area on the subaqueous pyroclastic deposits and effusive mafic-felsic sequence.

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Metallogeny of the Lapa gold ore deposit, Abitibi, Québec

Marjorie Simard, Réal Daigneault, Damien Gaboury (UQAC), Normand Bédard, Jocelyn Côté, Guy Gosselin (Agnico-Eagle Mines Ltd.) and Patrick Mercier-Langevin (GSC)

The Lapa gold ore deposit (4 Mt at 9 g/t Au, 1.2 M oz Au) is located about 40 km west of Val-d'Or and lies directly within the Cadillac-Larder Lake Fault Zone (CLLFZ), a regional structure to which many gold showings and ore deposits are spatially associated. Ore zones at the Lapa mine are located near a major inflection of the CLLFZ, the impact of which remains to be determined. Moreover, the spatial relationship between the Lapa ore deposit and mafic and ultramafic units of the Piché Group, associated with the CLLFZ, remains poorly understood. The Piché Group is bounded to the north by the Cadillac Group and to the south by the Pontiac Group. Units of the Piché Group, which host the mineralization, are strongly deformed and metamorphosed to the greenschist to amphibolite facies. Five gold zones make up the Lapa ore deposit and are hosted in (1) biotite-carbonate-talc schists with arsenopyrite-pyrrhotite, (2) mafic volcanic rocks strongly altered to biotite and carbonate with pyrrhotite-arsenopyrite ± pyrite, (3) sericite-biotite schists with arsenopyrite. These ore zones contain a series of strongly deformed quartz ± carbonate veins and veinlets transposed along a mylonitic deformation zone trending E-W and steeply dipping north (85°). Free gold is present, in quartz ± carbonate veins and disseminated in altered wall rocks bordering the veins. Based on the study of the Lapa ore deposit, new hypotheses are formulated to explain the nature of the relationship between gold-bearing zones and 1) the CLLFZ, 2) inflections along major deformation zones, and 3) ultramafic rocks of the Piché Group. A better understanding of the genesis of this ore deposit will contribute to the development of exploration guides and new targets within the CLLFZ.

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A MEGATEM II airborne survey in the Chibougameau – Lac-auxDoré area, Québec (32G16)

Frank Kiss (GSC-O)

A MEGATEM II airborne electromagnetic and magnetic survey, consisting of 1,033 line-kilometres of traverse and control lines flown by Fugro Airborne Surveys Ltd. in 2002, was provided free of charge by Québec's Campbell Resources Inc. to the Geological Survey of Canada for reprocessing and publication. Nominal line spacing was 200 m for the traverses and 2 km for the control lines, at a nominal ground clearance of 120 m. The complete publication, available since June 2007, consists of a magnetic isocontour map with electromagnetic anomalies at 1:20,000 scale detailing the Lac-aux-Dorés area. A series of 1:50,000 scale maps of NTS sheet 32G16 complement the coverage with surrounding electromagnetic and magnetic data. These surrounding data were acquired for the GSC by Fugro Airborne Surveys in 2006 through a joint project between the Geological Survey of Canada (TGI-3) and the Ministère des Ressources naturelles et de la Faune (Copper Plan).

The data from these surveys are jointly distributed by the GSC and the MNRF. Digital profile and gridded data, as well as associated maps in .pdf format, can be downloaded free of charge from the Geoscience Data Repository for ESS Geophysical and Geochemical Data, at http://gdr.nrcan.gc.ca/ (GSC OF5548 to 5552 and OF5238 to 5265). These data are also available from the MNRF (DP-2007-02 and DP-2006-03).

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DIVEX EXPLORATION TOOLS – GEOCHEMISTRY AND GLACIAL GEOLOGY

Selenium distribution in magmatic sulphide minerals

Richard Cox, Paul Bédard, Sarah-Jane Barnes (UQAC) and Marc Constantin (ULAVAL)

A method for in-situ analysis of low levels of selenium (Se) in sulphide minerals has been established and the selenium contents for the main sulphide phases determined in two magmatic ore deposits. Selenium is strongly associated with a group of elements commonly referred to as metalloid elements, i.e., As, Se, Sb, Te, Bi. Selenium strongly partitions into sulphide minerals. It is also commonly enriched in organic, sulphur-rich sediments and thus, it may be used to trace the source of crustal contaminants during sulphur enrichment of magmatic intrusions and the formation of certain ore deposits. The first step of this study was to establish a method for the in-situ analysis of Se and to confirm that the main sulphide phases do indeed host the majority of the Se budget. The laser ablation–inductively coupled plasma–mass spectrometry method (LA-ICP-MS) was developed using a collision cell to reduce interferences on the main Se isotopes. A series of NiS fire assay beads, doped with Se, were made to calibrate the ICP-MS. The Se contents were measured in both whole-rock samples and in the main sulphide phases of the Merensky Reef (Bushveld Complex, South Africa) and the J-M Reef (Stillwater Intrusion, Montana, USA). The resulting data were used to determine mass balance calculations, which confirmed that selenium is essentially contained entirely within the main sulphide minerals.

Glacial transport and ice-flow directions in the James Bay sector: Implications for mineral exploration in areas with thick sedimentary cover in the Abitibi-Jamesian region

Martin Roy, Guillaume Allard, Hugo Dubé-Loubert, Ross Stevenson (UQAM), Jean Veillette (GSC-O) and Michel Parent (GSC-Q)

Mineral exploration in the Abitibi and Jamesian regions is complicated by the presence of a thick Quaternary sediment cover that hides the bedrock in areas with strong diamond and mineral potential. Many exploration companies must therefore resort to sampling the Quaternary deposits. Interpreting the geochemical anomalies is, however, complex given the lack of detailed data on the number of glacial units present at depth, and the glacial ice-flow directions associated with such tills. This lack of knowledge regarding the regional stratigraphy is related to the absence of natural stratigraphic sections in this region of the Canadian Shield. This gap can be filled by studying the stratigraphy of adjacent regions, like the James Bay Lowlands where numerous sedimentary sequences have recorded the advances and retreats of the Laurentian ice cap. The 2006 field program focused on the Quaternary sedimentary sections exposed along the Harricana and Nottaway rivers. A sequence of at least four till units was documented. The sequence is underlain by a thick nonglacial unit consisting of ancient organic sediments. The goals of the project are to produce a detailed stratigraphic framework that will assist with the interpretation of regional exploration programs, and to provide critical information that will be useful when interpreting stratigraphic data exclusively derived from boreholes in northwestern Québec and northeastern Ontario.

182 B

Metallogeny of gold occurrences on the Opinaca property, James Bay, Québec

Sébastien Vigneau, Damien Gaboury (UQAC),
Bernard Lapointe and Daniel Boulianne (Ressources d'Arianne)

The Opinaca property, wholly owned by Ressources d'Arianne, is located in the James Bay region, south of Opinaca Reservoir. The property covers more than 15 km strike length along the Anatacau-Pivert volcano-sedimentary formation, dated at 2723 Ma. The south part is dominated by massive to pillowed basalts. The north part contains a sequence of fine-grained to conglomeratic sedimentary rocks. Many mafic sills occur throughout the property. Rocks are metamorphosed to the amphibolite facies, and deformation is expressed by a steeply dipping planar fabric trending 060°N. Many gold showings were discovered along the contact zone between volcanic and sedimentary rocks, namely the Contact Zone, Chino, Chino Est, De l'Aïeul, Isabelle and Bull occurrences. Gold mineralization occurs in deformed quartz veins with disseminated pyrrhotite, pyrite and arsenopyrite, and locally with massive arsenopyrite. The Bull showing consists of gold-bearing fine-grained pyrite disseminated in sedimentary rocks. It is also located near the sedimentary-volcanic contact. The contact zone between volcanic and sedimentary rocks has been traced over a strike length of a few tens of kilometres. The area is therefore particularly interesting based on the metallogenic model to be developed. First, in an orogenic deposit model, the contact zone could represent a major fault where several gold deposits would be hosted along its extensions. Second, in an early, pre-deformation deposit model, the contact zone could represent an unconformity where occurrences are associated with sedimentary rocks, their distribution being controlled by the source of mineralization.

182 C

Hydrothermal dolomitization at Anticosti: Fluid source and evolution

Denis Lavoie (GSC-Q) and Guoxiang Chi (U of R)

World-class hydrocarbon reservoirs are known in hydrothermal dolomites (HTD) of Ordovician age in the Appalachian and Michigan basins (Albion-Scipio and Gloades Corner, USA), of Devonian age in the Western Canada sedimentary basin (Ladyfern, British Columbia), and of Jurassic age on the Atlantic continental margin (Deep Panuke, Nova Scotia). Controversy continues to centre on the issue of recognizing hydrothermal processes in the carbonates. By definition, a hydrothermal fluid must have a temperature at least 15°C higher than the ambient fluids. Thus, although subsequent burial can subject a sedimentary succession to higher temperatures, the difference in temperature during the proposed hydrothermal event is the critical element for alteration processes.

In Québec, hydrothermal processes have been documented in virtually all the carbonate successions of lower Paleozoic age (Lower, Middle and Upper Ordovician, Lower and Upper Silurian, and Lower Devonian) in the geologic provinces of southern and eastern Québec.

One of the best-studied cases of HTD is seen in the Ordovician successions of Anticosti. The data from petrography, fluid inclusion (FI) microthermometry, and various geochemistry studies (trace elements, stable and radiogenic isotopes) on rocks of the Romaine (Lower Ordovician, passive margin) and Mingan formations (Middle Ordovician, foreland basin) have allowed us to establish a detailed alteration history.

The data suggest a minimum of two major fluid circulation events. Fluid circulation was related to the onset of active tectonics in the Taconian foreland basin, which coincided with a significant increase in geothermal gradients. In the Shell et al. Chaloupe #1 well, replacement dolomites in the Romaine Formation contain FI with elevated temperatures (max. of 134°C), very high radiogenic strontium ratios (average $^{87}Sr/^{86}Sr$ of 0.710200), and low Sr values (average of 117 ppm). In contrast, similar dolomites in the Mingan Formation are characterized by lower temperature FI (max. of 113°C), lower radiogenic strontium ratios (average $^{87}Sr/^{86}Sr$ of 0.708896), and high Sr values (average of 513 ppm). The proposed model invokes the flow of Lower or Middle Ordovician marine fluids along active faults under higher geothermal gradients; these fluids were modified as a result of more or less prolonged interaction with the Grenvillian basement and variable residency times in the carbonate successions.

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NEW MINERAL DEPOSIT TYPES IN THE JAMES BAY AND ABITIBI REGIONS – PORPHYRY DEPOSITS

Characterization of Cu-Au-Ag mineralization at the Ell Lake showing, Eleonore property, James Bay

Valérie Bécu, Jean-François Ravenelle, Michel Malo (INRS), Benoit Dubé (GSC-Q), Michel Gauthier (UQAM) and Jacques Simoneau (Goldcorp)

The Ell Lake intrusion is an important geological feature on the Eleonore property, where the Roberto gold ore deposit is hosted is siliciclastic sedimentary rocks peripheral to the intrusion. The intrusion hosts a Cu-Au-Ag showing, consisting of a network of veins and fractures constrained within a SW-trending corridor. A late shear zone borders the mineralized zone to the east and may have contributed to its dismemberment. For the first time, molybdenite, electrum, bismuth-molybdenum sulfosalts and tellurides were observed. The gold and silver potential of the showing has been confirmed, and a spatial correlation between high Au and Ag grades and the presence of quartz and molybdenite has been observed. The nature of the mineralization and the presence of breccias and strong potassic and propylitic alteration appear to confirm the interpretation that the Ell Lake showing is indeed a porphyry-type occurrence. However, the presence of porphyry-type mineralization at the Ell Lake showing does not necessarily imply that gold mineralization at the Roberto ore deposit is related to the same system. The Ell Lake intrusion exhibits heterogeneous deformation, an intrusive contact with the conglomerate, and a certain compositional variability, which may suggest the presence of more than one magmatic episode.

Porphyry gold occurrences in Malartic

Christian Beaulieu (UQAM), Cécile Noverraz (McGill), Michel Jébrak (UQAM), Anthony Williams-Jones (McGill) and Robert Wares (Osisko)

Porphyry gold occurrences in Malartic constitute a new style of mineralization in the Abitibi Subprovince. Under the DIVEX project, two themes were investigated in particular: first, the structural evolution, with emphasis on breccias (UQAM team), and second, the geochemistry of the plutonic stock and alteration zones (McGill team). Preliminary results of the structural study outline the presence of three types of breccias, corresponding to different cements. Biotite-calcite-quartz-cemented breccias are higher grade and are the only breccias present along the contact between the porphyry and country rocks. They show the greatest fragment complexity, indicative of strong exchanges between hydrothermal fluids and graywackes. Two other types of breccias were recognized but exhibit lower gold grades: silicified breccias, slightly enriched in gold, and stockworks that show no trace of corrosion. A statistical study of correlations between gold grades and macroscopic observations in alteration zones confirms the results of the breccia study, namely the correlation between calcite and gold.

183 B

Geology of the Roberto gold deposit, Eleonore property, James Bay, Québec

Jean-François Ravenelle (INRS), Benoît Dubé (GSC-Q), Michel Malo (INRS), Vicky McNicoll (GSC-O), Jacques Simoneau, Julie Doyon (Goldcorp / Opinaca Mines) and Valérie Bécu (INRS)

Detailed mapping of a very extensive trench (350 by 150 metres) exposing the core of the Roberto gold deposit was integrated within the local and regional geological setting in order to define the lithological, metallogenic and structural features that characterize the ore deposit. The primary emphasis is on the relative timing of elements potentially related to the emplacement of gold mineralization, namely hydrothermal activity, magmatic activity, metamorphism and episodes of deformation.

The Roberto ore deposit lies near the contact between the volcano-plutonic La Grande Subprovince and the metasedimentary Opinaca Subprovince. In the upper part of the La Grande, conglomeratic sequences overlie mafic volcanic units and could potentially mark an unconformity and thus represent "Timiskaming"-type sedimentary sequences. The metamorphic grade gradually increases from La Grande volcanic rocks toward the centre of the Opinaca basin; metamorphic isograds are discordant to stratigraphy. The Roberto ore deposit is located near an isograd that separates paragneiss units from sedimentary host rocks at lower metamorphic grade. Detailed mapping in the extensive trench indicates the presence of several mineralized zones, the distribution of which appears to be controlled by structural and rheological factors. Mineralized zones are dominated by quartz-tourmaline-actinolite-diopside-arsenopyrite-pyrrhotite stockworks associated with intense replacement zones that exhibit variable proportions of microcline, quartz, tourmaline (dravite), phlogopite, fine-grained arsenopyrite and pyrrhotite. Aluminosilicate-rich zones with retrograde andalusite and metasomatic replacement zones occur in the structural hanging wall of gold-bearing zones. A structural study of the area reveals the presence of at least three generations of structures. The bulk of gold mineralization is confined within a thinly bedded sedimentary sequence located in the hinge of an F2 fold, and appears to have been emplaced relatively early in the structural and metamorphic history of the region.

The Roberto ore deposit is located near the Ell Lake intrusion, which hosts copper-silver-gold mineral occurrences. Geochronology data show that the host sedimentary sequence is markedly younger than the dioritic phase of the Ell Lake intrusion, indicating that gold mineralization is not genetically related to the latter, despite its spatial association. Roberto is an epigenetic gold deposit analogous in many ways to non-carbonate disseminated replacement-type deposits. Although the deposit exhibits certain unique features, the spatial association of Au-As-B-Sb mineralization with a regional unconformity near the contact between two subprovinces indicates that the deposit also shares common attributes with other world-class Archean gold deposits.

183 C

The Cap-Chat mélange: Formation and collapse of the Taconic tectonic prism recorded in a folded deformation zone

Nicolas Pinet (GSC-Q)

The Cap-Chat mélange belongs to the frontal units of the Appalachian orogen. It outcrops in a discontinuous manner along the southern shore of the St. Lawrence for almost 175 km between Métis-sur-Mer and Marsoui. The mélange consists mainly of rocky units from the Rivière-Ouelle Formation (Lower to early Middle Ordovician), with a lesser component from overlying flysch rocks (Tourelle and Des Landes formations)

The level of deformation within the mélange varies considerably. It contains slightly deformed blocks, in which the internal stratigraphy is well preserved over a thickness of up to several hundred metres, bounded by intensely deformed zones. Despite the unequivocal presence of early-stage deformation (gravitational slides, sand and mud injections), the chaotic appearance of the mélange is mainly the result of several superimposed phases of tectonic deformation. D_1 (isoclinal folds and thrust faults) and D_3 structures (open folds) are correlated with deformation phases of regional extent (Taconian *sensu stricto* and Acadian, respectively). In contrast, the D_2 deformation phase seems to be mainly confined to the Cap-Chat mélange. This phase of deformation is characterized by structures showing evidence of both extension (anastomosing shear zones with dips to the south/southeast that delineate often lozenge-shaped angular blocks) and shortening (folds) along a plane parallel to the bedding. D_2 structures represent non-coaxial deformation reflecting hinterland-directed movement (extension with a strong strike-slip component). Locally, the reactivation of D_1 deformation planes by D_2 structures can be demonstrated.

The D_2 structures are interpreted at the regional scale to reflect the collapse of the Taconian tectonic prism along a pre-existing D_1 décollement. During D_2 deformation, such movements re-established the equilibrium slope of the tectonic prism, thereby contributing to the preservation of relatively superficial rocky units. Subsequent episodes of deformation (mainly D_3) substantially modified the internal geometry of the Cap-Chat mélange, rendering it more complex.

184 A

Application of multivariate statistics to the interpretation of geochemical signals in regional lake sediment surveys in Québec

Sylvain Trépanier, CONSOREM

Lake sediment data from survey 1997520 (Québec's Far North) were processed by factorial analysis using the elements Al, Ba, Ca, Cr, Cu, Fe, K, La, Mg, Mn, Ni, Th, Ti, U, V and Zn, the loss on ignition (LOI), and lake depth (DEP). The goal of this analysis is to recognize geochemical signals in lake sediments and to outline suitable methods for defining anomalies.

All the variables display linear interrelationships with the exception of LOI. The relationship between LOI and the element suite is positive at values below 18% LOI, whereas a negative relationship is observed above 18%. The LOI is proportional to the amount of organic matter and clay in the sediment, and is an important indicator of a lake's chemical characteristics. The samples were separated into two groups using the 18% LOI cutoff value (group A: >18%; group B: <= 18% LOI), and separate factorial analyses were applied to each group.

For group A lakes, the factor that is clearly the most important (43% of the variance) opposes LOI and Ca to Ti, Al, K, Mg, Zn, Cr, Ni, Mn, Th, V, Cu, Fe, DEP and P. This can be explained by the dilution of metal-bearing clastic material (clay or other) with a significant addition of calcium-bearing organic matter. The next four factors individually account for a much lower proportion of the total variance (10%, 9%, 7% and 5%, respectively).

For group B lakes, the dominant factor (51% of the variance) interconnects the entire element suite (except U and Ca) with correlations varying from 0.92 (Al) to 0.65 (La). The LOI and DEP also display significant associations with the factor (0.41 and 0.50). This factor is explained by an increase in the amount of clay capable of adsorbing the majority of the metals. The association with DEP may be due to a preferential accumulation of clay in larger columns of water. The next four factors individually represent less than 10% of the total variance.

These results suggest that the main causes of variation in sediment metal grades are due to sedimentological factors that can potentially change quite rapidly from one site to another. Exploration methods currently used to delineate geochemical anomalies should take this into account.

184 B

Structural control on uranium occurrences, Lac Minowean area, Labrador Trough, Québec

Carl Bilodeau, Normand Goulet (UQAM) and Nicolas Flotté (Areva Group)

Located in the central Labrador Trough, the Lac Minowean area hosts uranium occurrences known for nearly 30 years. The structural model of emplacement of these occurrences was elucidated following a recent exploration program by Areva Québec Inc. The area is located near the western limit of the allochthonous nappe domain, bounded to the east by the Argencourt fault. New field observations suggest the presence of a new nappe segment involving Paleoproterozoic volcanic rocks near Lac Minowean. A compilation of structural and stratigraphic data also suggests that this tectonic style played a major role in the genesis of U-Cu occurrences in the area.

The area is underlain by rocks of the Seward and Pistolet groups, that correspond to the fluvial and platform sequences of the first of three volcano-sedimentary cycles in the Labrador Trough (2.17-2.14 Ga). The pile consists, from the base upwards, of red arkose and conglomerate (Chakonipau and Portage formations), overlain by grey siltstone and rare dolomite (Lace Lake Formation), followed by thick quartzitic or dolomitic sandstone and dolomite (Alder Formation). The shores of Lac Minowean and especially the topographic highs to the east are formed of basaltic and/or gabbroic rocks (Montagnais Group) and black argillaceous sediments of uncertain stratigraphic affinity (Uvé Formation). The relationship between continental platform rocks, volcanogenic sequences of deeper marine settings and associated breccias demonstrate the probable existence of a thrust nappe in the area. This hypothesis is now explained by a klippe of volcanic rocks and graphitic siltstones in the centre of Lac Minowean, with an extension possibly comprising mafic rocks known to outcrop more than 30 km further north.

The Trans-Hudson multiphase orogenic cycle that took place at about 1.84 Ga, initially generated the emplacement of a thrust sheet (D1) involving transport of mafic rocks and associated pelitic sediments from the NE onto continental platform units to the SW. This deformation is expressed by a very strong shallowly dipping schistosity restricted to these rocks (S1). This episode also led to a brecciation phenomenon under the sole (tectonic breccia) and the emplacement of hydraulic breccias due to dolomite injection. Nappe tectonics also resulted in the development of second-order thrust structures within platformal rocks, possibly contributing to a first mineralizing episode in U-Cu. The nappe is folded into synforms and antiforms with sequences located on the east shore of Lac Minowean, where U-Cu occurrences are found, being slightly overturned to the west. It is possible that this overturning may have been initiated by the imbrication of a large gabbroic body located to the east of the showings. The deformation is expressed here by a secondary schistosity (S2) trending NW-SE to NNW-SSE, in sandy and dolomitic sequences. This deformation is accompanied by a second episode of hydrothermal activity and associated brecciation. Uranium is thus associated with these faults, and earlier uranium trapped in syn-D1 breccias is probably remobilized. A late episode of brittle conjugate deformation at N40 and N100, affects the entire region and occasionally hosts minor occurrences. Uranium occurrences therefore seem to be intimately associated with the emplacement of a nappe essentially composed of volcanic rocks related to those occurring between the Argencourt fault and the Mistamisk window further east.

184 C

High-resolution bathymetry and subsurface of the Honguedo Strait: New geoscientific data

Andrée Bolduc, Mathieu J. Duchesne, Nicolas Pinet, Denis Lavoie (GSC-Q) and Roger Côté (CHS)

The Gulf of St. Lawrence is one of the rare offshore regions near industrial and residential markets for which the energy resource potential is not well known. This proximity to large population centres, however, also brings with it environmental issues. In order to improve the knowledge base necessary to properly evaluate the balance between conservation and development, the Honguedo Strait, north of the Gaspé Peninsula, was the subject of a high-resolution bathymetric survey.

The survey, conducted aboard the F.G. Creed, imaged the seafloor over a surface of 2,213 km^2. The survey was performed between the 30-m and 400-m isobaths (the Gaspesian edge of the strait and the middle of the Laurentian Channel, respectively) to complement pre-existing shallow-water surveys. In addition, marine magnetic and subsurface profiler data were also collected.

The Honguedo Strait is characterized by a relatively flat bottom (the Laurentian Channel) bordered by a steep slope and a narrow plateau towards the Gaspesian coast. A linear bulge, the nature of which is still unknown, is present in the middle of the channel. A number of troughs are also present, particularly downstream of the study area. Some of these troughs could have been dug by icebergs during deglaciation, which suggests a slow rate of sedimentation for the region. Other troughs, between depths of 250 and 300 m, instead suggest the presence of seabed instability.

Few vents are visible along the surface, particularly in the upstream part of the study area. The subsurface profiles nonetheless display seismic anomalies that suggest the presence of gas. This is in marked contrast with the St. Lawrence Estuary, where many vents have been documented. The variable distribution of vents along the St. Lawrence River could be related to the absence (upstream) or presence (downstream) of a sedimentary cover that traps gases.

It is clear from our preliminary work of 2007 that the combined study of subsurface data and geological, potential-field, and seismic data will lead to a better understanding of this poorly known domain.

185 A

Predictive geologic maps using neural networks: An application in the James Bay region

Stéphane Faure and Sylvain Trépanier (CONSOREM)

CONSOREM has developed a method of digital predictive mapping using neural networks and public data. The goal of the project is to better guide mapping priorities in regions that have poor map coverage. The method was applied in the James Bay region, 50 km south of the Eleonore deposit (2.7 M oz Au), in an area where recent mapping at a scale of 1:50,000 (maps 33B03 and 33B04) overlaps older maps at a scale of 1:250,000.

The principle is to start with a recent geological map to construct adjacent maps using multilayer data (geological map, outcrops, topography, geophysics, surficial deposit geochemistry). The process requires training the neural network to recognize a lithology or a variety of rocks on a training map (in this case, 33B/04). The "recipe" established by the neural network on the training map is then applied to the adjacent map (in this case, 33B03) to seek out the same characteristics for a specific lithology.

The results for the known map (33B04) were surprising. We were able to reproduce the map fairly accurately, particularly when we treated lithologic information in terms of relative composition (felsic, intermediate, mafic) or antagonistic criteria, such as intrusive versus volcanic rocks, or mafic versus felsic rocks. Some areas of the map showed differences when we compared the mapping model to the neural network prediction, which led us to reassess the accuracy of the geological interpretation and eventually modify the map. With respect to the prediction of the adjacent map (33B03), we were able to predict specific lithologies quite well, like basalt, as well as the intrusion versus volcano-sedimentary criterion. On this map, however, the presence of strongly magnetic iron formations impeded the recognition of some of the units, because the magnetic field was so different from that of the training map (33B04). Given that magnetic units were not among the units on the training map, the magnetic iron formations could not be recognized on the adjacent map. Some conditions therefore apply to the method, notably that the geology must be similar enough between maps, and that contrasts in the geoscientific data must be of the same order of magnitude.

An important conclusion for this project is that it is possible to better target geological problems and hypotheses right from the start using a predictive map, even before beginning fieldwork. This tool can also be used to cross-validate the mapping model for recently mapped areas.

185 B

Influence of early structures on the geometry of propagation folds: Reconstruction and direct kinematic modelling in 3D

Alexandre Aubiès-Trouilh (ULAVAL), Donna Kirkwood (GSC) and Jacynthe Pouliot (ULAVAL)

The San Corneli anticline in the Central Pyrenees of Spain is a folded and faulted structure within a foreland setting. This compressional structure was emplaced during the development of a thrust belt over the Iberian Plate during Mesocenozoic time. The geometry of the San Corneli anticline corresponds to a propagation fold that developed above the Boixòls thrust, which represents the most frontal structure in the Boixòls nappe. Pre-compression extensional structures were recognized within the anticline and consist of a network of normal faults and early fractures that were active during sedimentation in Mesozoic extensional basins.

The goal of our research is to determine the influence of these normal faults on the development of the San Corneli anticline and their effect on the distinctive geometry of this propagation fold. 3D modelling is an indispensable tool for better understanding the relationships between early faults and the geometry during fold generation. Moreover, the San Corneli anticline is exposed on surface, which makes is easier to model its geometry based on surface data.

Our approach will be to first apply inverse 3D modelling. The solid geological model will be reconstructed using the "3D Reconstruction" module of gOcad. Inverse 3D modelling is based on cross-sectional balancing. This technique will enable us to produce a paleogeographic 3D model that can be used to interpret the location and geometry of pre-existing normal faults during basin sedimentation. We can then begin a series of direct kinematic models that will test various hypotheses concerning the mode of anticline development. Three-dimensional direct kinematic modelling involves returning to the current state of deformation of the model. We can thus better establish the timing of events that affected the fold and determine if the faults influenced or not the evolution of these events.

185 C

Transfer zones and fault reactivation in inverted rift basins: Insights from physical modeling and implication for exploration

Elena A. Konstantinovskaya, Lyal B. Harris, Jimmy Poulin and Gennady M. Ivanov (INRS-ETE)

Lateral transfer zones of deformation and fault reactivation were investigated in multilayered silicone–sand models during extension and subsequent co-axial shortening. Model materials were selected to meet similarity criteria and for their ability to be distinguished on CT scans; this approach permitted non-destructive visualization of the progressive evolution of structures. Transfer zones were initiated by an orthogonal offset in the geometry of a basal mobile aluminum sheet and/or by variations of layer thickness or material rheology in basal layers. Transfer zones affected rift propagation and fault kinematics in models. Propagation and overlapping rift culminations occurred in transfer zones during extension. During shortening, deviation in the orientation of frontal thrusts and fold axes occurred within transfer zones in brittle and ductile layers, respectively. Frontal ramps propagated laterally past the transfer structure during shortening. CT scans showed that steep (58–67°) rift-margin normal faults were reactivated as reverse faults. The reactivated faults rotated to shallower dips (19–38°) with continuing shortening after 100% inversion. Rotation of rift phase faults appears to be due to deep-level folding and uplift during the inversion phase. New thrust faults with shallow dips (20–34°) formed outside the inverted graben at late stages of shortening. Sand marker layers in the inverted graben showed fold-like structures or rotation and tilting in the rifts and on the rift margins. During inversion, the layers filling the rift structures underwent lateral compression at depth, and the graben fill was pushed up and outwards creating local extension near the surface. The results of our experiments conform well to natural examples of inverted grabens. Inverted rift basins are structurally complex and often difficult to interpret in seismic data. The models may help unravel the structure and evolution of these systems, leading to improved hydrocarbon exploration assessments. Model results may also be used to help predict the location of basement discontinuities that may have focused hydrothermal fluids during basin formation and inversion.

186 A

A new tool for determining felsic rock fertility: PER-GH

Vital Pearson (CONSOREM)

A new tool developed by CONSOREM uses major elements to recognize and assess the fertility of felsic volcanic rocks. The traditional methods of classifying felsic rocks as a function of their association with volcanogenic massive sulphide-type mineralization use certain trace elements that are often absent from large lithogeochemistry databases.

Based on generally accepted hypotheses of felsic volcanic petrogenesis and on the "Pearce Element Ratio" (PER) theory, it has been demonstrated that the petrogenetic processes invoked to explain the fractionation of rare earth elements (i.e., garnet/hornblende) impose a recognizable geochemical signature on the major element suite. This signature is attributed to element mobility (hydrothermal alteration). Our proposed approach confirms that a non-negligible component of the geochemical changes follows a particular equation that respects the stoichiometry of the mineral phases (garnet/hornblende).

A new classification index for fertile environments is proposed. The PER-GH, a combined acronym for *Pearch Element Ratio and Garnet/Hornblende*, allows felsic rocks to be classified using a single number (continuous variable) for which certain thresholds were empirically defined as identifying non-fertile, fertile or very fertile environments. The index consists of seven major elements: Fe, Mg, Ca, Na, Si, Al and Ti.

The changes caused by element mobility during hydrothermalism coincide with those caused by fractionation. The effect of alteration therefore heightens the "favourability" criterion, which is desirable and does not hinder the use of the index for VMS exploration.

The particular interest of this tool resides in the fact that databases from companies and government (SIGEOM) contain a very large number of analyses that are limited to major elements. As a consequence, a significant portion of these databases cannot be used for certain tests that require trace elements (for example, FI-FII-FIII determination). It therefore appears that the development of a methodology based on major elements will add value to these large databases when targeting fertile areas for exploration.

186 C

Dynamic centrifuge modelling of folding in extensional regimes – Applications to the interpretation of structures during exploration in sedimentary basins and gneiss and greenstone belts

Lyal B. Harris (INRS-ETE), Eric L. Johnson (Hartwick College, U.S.A.), Audrey Lessard-Fontaine (INRS-ETE), Nicolas Thomas (Hartwick College, U.S.A.), Benjamin Carlier, Elena A. Konstantinovskaya and Jimmy Poulin (INRS-ETE)

By investigating the behaviour of rheologically and dynamically similar systems, simulations using the high-acceleration centrifuge in the new INRS-ETE laboratory provide innovative insights into the temporal and spatial evolution of geological structures. Centrifuge models are especially suited to study dynamic systems where body forces (such as those due to density differences) are important. A better understanding of the progressive development of complex structural geometries through physical modelling aids the interpretation of field, seismic, aeromagnetic and other remote-sensing data in sedimentary basins and gneiss and greenstone belts. Centrifuge models illustrate how folds may develop during rifting or post-orogenic collapse that otherwise may have been interpreted as forming during regional shortening. Re-interpretations of tectonic regime have important repercussions in exploration, allowing different exploration models to be applied and changing exploration strategies in targeting dilatant zones, etc.

The models illustrate a broad range of structural styles that form during layer-parallel extension. Upright open to tight folds locally folding isoclinal folds develop during boudinage of competent dense horizons. Such folds may develop in high-grade gneisses, such as between boudinaged mafic layers. Simple open folds develop in the footwall to extensional shear zones. Tighter, more complex folds develop in layers with strong mechanical anisotropy when competent dense horizons are displaced. Folds develop with axes both perpendicular and parallel to the transport direction during displacement between convergent lateral ramps. Similar structures develop in both sedimentary basins and metamorphic terrains. Diapirs fold the cover sequence on their margins. Diapirs emplaced along normal and transfer faults may produce folds with axial traces perpendicular and parallel to the bulk extension direction. Such folds may develop in Archaean greenstone belts and associated with salt diapirs in sedimentary basins. Their geometry may indicate the location of early extensional faults and transfer zones with implications for base metal and gold exploration.

187 A

Mafic Dykes in the Blake River Assemblage of the Abitibi Greenstone Belt

P.C. Thurston (LU) and Jean Goutier (MRNF)

Mafic dykes cut Blake River stratigraphy throughout its extent, however the dykes vary in composition, relationship to stratigraphy, and in timing based on field relationships. Most major mafic dykes are subparallel to stratigraphy with some dyke units in the southern part of the area (Séguin and Horseshoe gabbros) crosscutting stratigraphy. The dykes vary in timing from synvolcanic units that contain evidence of alteration related to nearby VMS deposits (e.g. Vauze area) or are folded with volcanic rocks, to units such as the Horseshoe gabbro that cuts folded volcanic stratigraphy. Generally the dykes are gabbroic to dioritic in composition with larger units preserving at least vestiges of primary pyroxene (both ortho- and clinopyroxene). However, the distinction between true gabbros and diorites is not consistently made on previous Blake River maps through lack of detailed mapping of the intrusions.

Relatively large dykes, such as the Dufresnoy diorite in the Central Camp, are subconformable to stratigraphy and have m-scale hybridized margins containing abundant xenoliths of adjacent volcanic units, grading inward to a marginal phase of hornblende gabbro to diorite cut by coarse pegmatitic hornblende quartz diorite, succeeded inward by a coarse, more leucocratic diorite phase. Similar rock types and relationships hold for dykes in the vicinity of the Ansil and Vauze deposits. But many of these dykes with this orientation are injected into east-dipping reverse faults. At a more detailed scale, dykes varying in width from centimeters to 300-400 m cut volcanic stratigraphy in the Central Camp area with examples including dykes cutting the Cap d'Ours breccia in Rouyn-Noranda and cutting basalts of the Noranda Formation near the west shore of Lac Dufault. These smaller scale dykes are gabbroic in composition and in both occurrences, two generations of gabbro occur. On the east margin of the Central Camp area some previously mapped "dykes" are a mix of pillowed mafic flows, mafic sills, and intermediate pyroclastic rocks.

The Dufault "diorite" of de Rosen-Spence and the Lac Séguin gabbro are considered, on the basis of reconnaissance mapping, to be differentiated mafic intrusions. The Séguin gabbro, also known as the Macfie dyke, has a pyroxenite base grading upward to gabbro followed by an upper leucogabbro over a total thickness of 300-400 m. The Dufault "diorite" is a north-trending intrusion consisting of medium to coarse-grained gabbro with cm-scale poikilitic pyroxenes succeeded by anorthositic gabbro with cm-scale plagioclase megacrysts. It is the largest mafic intrusion in the Blake River and represents a newly defined synvolcanic pluton spatially associated with the spherulitic, tholeiitic "Cyprus" rhyolite that contains Matagami-style Cu-Zn mineralization. Mafic intrusions cutting the Blake River in Ontario are largely coarse-grained sills and coarse massive portions of mafic flows that are largely tholeiitic in magmatic affinity. Many of the units in Ontario have limited lateral extent compared to those in Québec, possibly due to poorer exposure and a lack of emphasis in previous mapping. Some of these late, tholeiitic intrusions such as the Horseshoe gabbro and the Séguin gabbro (based on U-Pb zircon geochronology) carry Ni-Cu-PGE mineralization. Thus, "mafic dykes" cutting the Blake River represent a variety of rock types, relationships to country rocks and to syngenetic mineralization.

187 C

Geology, plutonism and structural evolution of the Aguanish area (12L08), Grenville Province

Léopold Nadeau and Pierre Brouillette (GSC-Q)

The Aguanish area straddles the eastern limb of the Davy synclinorium, consisting of metasedimentary rocks of the *Wakeham Group* and numerous metagabbro sills of the *Robe-Noire Suite*, and the type-region of the *Aguanish Complex*, comprising a suite of granitic orthogneisses with scattered screens of quartzite and paragneiss. These two lithological assemblages are separated by the *Lac Caron Shear Zone*, characterized by significant hydrothermal activity, and are intruded by late Grenvillian granitic dykes and stocks of the *La Galissonnière Suite*.

The *Wakeham Group*, where sedimentation took place at 1.5 Ga, is essentially composed of quartzites with a few thin layers of conglomerate. This lithological association is indicative of a high-energy, shallow-water, stable pericratonic depositional environment, with fluvial or deltaic input. Metagabbronoritic rocks of the *Robe-Noire Suite* occur as decametric sills and dykes. They exhibit relict textures and structures of plutonic origin. They generally contain both clino- and orthopyroxene as well as normative olivine; pyrite is widespread in trace amounts. Preliminary geochronology data indicate an age of intrusion that postdates Wakeham Group sedimentation by more than one hundred million years.

The *Aguanish Complex* mainly consists of variably recrystallized, gneissic and migmatitic monzogranitic gneisses and orthogneisses that locally exhibit flaser or augen structures. These rocks share common petrographic, geochemical and structural characteristics indicating they are closely related. This complex contains several comagmatic phases and exhibits complex subsolidus structures (reminiscent of migmatites) attributed to late-magmatic deformation. These rocks generally contain less than 7% normative mafic minerals. They have a subalkaline geochemical signature and plot along the metaluminous/peraluminous boundary. Samples from the *Pashashibou Suite* show a signature typical of mature Andean arc granitoids. In contrast, samples from the *Natashquan Suite* are more typical of intraplate granitoids. Overall, the suite of intrusive rocks in the *Aguanish Complex* deviates from calc-alkaline suites typical of Andean arc settings. These important lithological differences require adjustments to be made to the Andean margin model commonly invoked for the Pinwarian rocks of the *Aguanish Complex*.

188 A

Structural evolution of the Appalachian front in southern Québec: Implications for oil and gas exploration

Stephan Séjourné, Michel Malo (INRS-ETE) and Martine M. Savard (GSC-Q)

The Appalachian orogenic front represents a major target for hydrocarbons in southern Québec. In order to refine strategies already developed by the industry, the orogenic front between Drummondville and the Vermont border was the subject of a multidisciplinary geoscientific study designed to better understand its tectonic and diagenetic evolution (with emphasis on the carbonate slices) and to place this evolution in a regional context.

The overall architecture of the orogenic front – the autochthonous and parautochthonous domains – was elucidated by field observations and seismic interpretations. In the autochthonous domain, deformation appears restricted to pre- to early syn-orogenic normal faults in the platform, whereas the overlying flysches were affected by folds and reverse faults, such that the western edge of the front extends westward beneath the surface. The parautochthonous domain consists of imbricated shales and carbonate slices in a duplex geometry dipping towards the hinterland. The dominant structural style within the slices is characterized by thrust and reverse faults, minor backthrust faults, asymmetric folds, strike-slip faults and oblique ramps, and syn- to late-imbrication normal faults. The structural complexity and diversity are strongly dependent on lithology (thickness of the beds and clay content), and on the initial geometry of the basin. Finally, a major network of strike-slip faults parallel to the orogenic front developed in a late phase.

The Saint-Dominique slice, observable at the surface, was used as an example to illustrate the nature and evolution of fluids involved in the deformation of the carbonate slices. The diagenetic analysis (petrography, fluid inclusions, geochemistry) of structural cements reveals that the imbrication post-dated the first phase of liquid hydrocarbon generation and migration. The imbrication began with burial (to approx. 6 km), and the tectonic uplift of the slice was accompanied by a gradual decrease in temperature of the system, from about 245°C to 150°C. External fluids, of basinal and metamorphic origin, circulated during deformation. A second phase of maturation and migration followed imbrication, and the source of the hydrocarbons was likely in the footwall of the slice. Finally, the development of strike-slip faults parallel to the orogenic front promoted the mixing of residual waters with a magmatically-derived fluid related to Mesozoic intrusions. The development of these structures probably took place at shallow depth (about 2.5 km).

188 C

Recent gravity work in the Abitibi

Pierre Keating (GSC-CC), Pierre Brouillette (GSC-Q) and Diane Jobin (GC-GSD)

Gravity data available from the Geological Survey of Canada, the Ontario Geological Survey (including the Discover Abitibi data) and the Ministère des Ressources naturelles et de la Faune du Québec have been integrated into a homogeneous grid that covers the Abitibi greenstone belt from Timmins to Chibougamau. Airborne gravity data from Discover Abitibi were downward-continued to ground level before merging them with the ground gravity data. Station spacing is highly variable and varies from a few hundred metres to over 10 km. The new map is available in digital format, and as a GSC Open File at a scale of 1:750,000. This map leads to a better understanding of the three-dimensional structure of the region and allows deep crustal structures to be mapped.

In addition, a detailed gravity survey at a station spacing of 500 m was done west of the town of Matagami during the fall 2006 and winter 2007. The goal of the survey was to support mineral exploration and help identify favourable structures at depth. Some gravity targets were identified and suggest that the productive Key Tuffite stratigraphic package may be close to surface in areas not previously explored. The Key Tuffite is the main ore horizon in Matagami.

200 - 201

Archean rocks gold potential in the James Bay area

Daniel Lamothe (MRNF)

A favourability study of the potential for orogenic (or mesothermal) gold deposits in the James Bay region was completed. The study resulted in the definition of 644 high-favourability zones and 77 unstaked targets as of November 1, 2007. A gold favourability map at 1/250,000 scale was produced and is available on the MRNF website.

Data processing involved the use of a set of 23 geological parameters associated with the presence of orogenic gold deposits. The probability of spatial association was calculated for each parameter, using the *Weights of Evidence* method, and the results were converted to fuzzy values then combined using a fuzzy logic approach. To avoid overweighting the results, parameter combinations using various fuzzy operators were optimized to obtain a neutral background value (0.5).

The predictability of the map was calculated for a control set of mineral occurrences and validated with a certain number of deposits not used for data processing. The predictability and reliability of the map are comparable to those obtained in previous studies conducted by the author in the Abitibi region, despite the markedly lower amount of geological data available in the James Bay region.

A minimal favourability threshold was established by measuring the calculated favourability of various gold deposits in the region (excluding showings) and by determining on a normal probability plot the thresholds for various populations of mineral occurrences. By determining the minimal threshold for the best target population (93% of occurrences), high-favourability zones for gold deposits were then defined. Areas within these high-favourability zones that remained unstaked as of November 1, 2007 were then defined as targets.

These targets are by definition temporary since they are related to variations in the distribution of mining titles and essentially constitute a marketing tool. Since 2007, these types of targets are updated in real time in GESTIM, where high-favourability zones for gold deposits can be displayed, making it possible to stake open areas within these zones.

202 - 203

Geology of the Ungava Orogen

Daniel Lamothe (MRNF)

This document (DV 2007-03) consists of a compilation map at 1/250,000 scale of the Ungava Orogen and a stratigraphic lexicon of geological units. The map shows, for the first time, a comprehensive view of stratigraphic units based on correlations of stratigraphic formations and lithodemic units across different parts of the orogen mapped by the MRNF from 1983 to 1988 and by the GSC from 1985 to 1992. The stratigraphic lexicon lists in descriptive form the various geological units of the Ungava Orogen. Many new stratigraphic units are formally introduced in this reference work that will be very useful for those using SIGEOM digital products, particularly the geology polygon layers.

The new map is available on the MRNF website.

Tuesday, november 27

3D Geological Modeling in Support of Mineral Exploration: A Management Perspective

Eric de Kemp (Geological Survey of Canada)
Gervais Perron (Mira Geoscience)

Specially designed for mineral exploration project leaders, this workshop presents the various concepts associated with 3D geologic modeling for identifying target drillholes. The workshop will address key notions for developing this type of expertise in a mineral exploration company from a conceptual, technical, and labor standpoint.

Time:1:30 to 4:00 p.m.

Place: Québec Room E

November 27 and 28

The New Mining Restoration Guide in Québec

Direction du développement et du milieu minier (MRNF)

The 1997 report entitled *Guide et modalités de restauration des sites miniers au Québec* (Guide and Methods for Mining Site Restoration in Québec) has been updated and will be the subject of a presentation and discussion with industry players. The session will feature the restoration of abandoned sites such as Manitou, Eustis, and Aldermac.

Time: 11:00 a.m. to noon

Place: Saint-Louis Room

Wednesday, November, 28

Oil and Gas Interactive Session "Discoveries on the Horizon!" - Discussion Forum on Oil and Gas Exploration in Québec

Direction du développement et du milieu minier (MRNF)

This session will bring together Québec's oil and gas industries to share the results of their research in the past year. Themes will include oil and gas exploration and production in the St. Lawrence Lowlands, Gaspé Peninsula, and Lower St. Lawrence.

Time: 2:15 to 4:30 p.m.

Place: Des Gouverneurs Suite

November 28 and 29

New Interactive Services by GESTIM Plus

Direction des systèmes de gestion des lois (MRNF)

A presentation of new GESTIM Plus services: renewals, work declaration reports, digital data requests, and more.

Time: 11:00 a.m. to noon

Place: Québec Room

Thursday, november 29

The Geosciences: An Indispensable Tool for Sustainable Development and Ecosystem Preservation

Direction de l'information géologique du québec (MRNF)

The Ministère des Ressources naturelles et de la Faune (MRNF) and its partners will host a session on sustainable development, land use, and the mining environment. The MRNF wishes to explore available avenues for maximizing the potential applications of its store of knowledge and information.

Time: 1:30 to 3:30 p.m.

Place: Petit-Frontenac Room

The Conditions Governing Access and Exploration in Areas with Hydro-Québec Infrastructures

Hydro-Québec

Time: 2:00 to 4:00 p.m.

Place: Québec Room

Acronyms, list of exhibitors, maps of exibit rooms and project location maps

Acronyms

- **AXU** : Aurora Energy Resources
- **BEGQ** : Bureau de l'exploration géologique du Québec (MRNF)
- **CGC** : Commission géologique du Canada
- **CGC-CC** : Commission géologique du Canada - Centre du Canada
- **CGC-O** : Commission géologique du Canada - Ottawa
- **CGC-Q** : Commission géologique du Canada - Québec
- **CGC-A** : Commission géologique du Canada - Atlantique
- **CHS** : Canadian Hydrographic Service
- **CONSOREM** : Consortium de recherche en exploration minérale
- **DIVEX** : Diversification de l'exploration minérale du Québec (Réseau de recherches géoscientifiques)
- **ESS** : Earth Sciences Sector – Department of Natural Resources of Canada
- **FQRNT** : Fonds québécois de recherche sur la nature et les technologies
- **GC-DLG** : Géomatique Canada - Division des levés géodésiques
- **GC-GSD** : Geomatic Canada - Geodesic Survey Division
- **GEOTOP – UQUAM – McGILL** : Centre de recherche en géochimie et en géodynamique de l'Université du Québec à Montréal et de l'Université McGill
- **GSC** : Geological Survey of Canada
- **GSC-A** : Geological Survey of Canada - Atlantic
- **GSC-CC** : Geological Survey of Canada - Central Canada
- **GSC-O** : Geological Survey of Canada - Ottawa
- **GSC-Q** : Geological Survey of Canada - Quebec
- **GSNL** : Geological Survey of Newfoundland and Labrador
- **IGC-3** : Initiative géoscientifique ciblée (2005-2010) de la CGC
- **INRS** : Institut national de la recherche scientifique
- **INRS-ETE** : Institut national de la recherche scientifique – Centre Eau, Terre et Environnement
- **LU** : Laurentian University
- **McGill** : Université McGill
- **MDEIE** : Ministère du Développement économique, de l'Innovation et de l'Exportation du Québec
- **MNRF** : Ministère des Ressources naturelles et de la Faune du Québec
- **MUN** : Memorial University of Newfoundland
- **MRNNB** : Ministère des Ressources naturelles du Nouveau-Brunswick
- **NBDNR** : New Brunswick Department of Natural Resources
- **NLDNR** : Newfoundland and Labrador Department of Natural Resources
- **NTS** : National Topographic Series
- **OF**: Open File
- **OGS** : Ontario Geological Survey
- **RSC** : Ressources Strateco
- **SHC** : Service hydrographique du Canada
- **TGI-3** : Targeted Geoscience Initiative (2005-2010) - GSC
- **U d'O** : Université d'Ottawa
- **UdeS** : Université de Sherbrooke
- **U of O** : University of Ottawa
- **U of R** : University of Regina
- **U of T** : University of Toronto
- **UL** : Université Laurentienne
- **ULAVAL** : Université Laval
- **UNB** : University of New Brunswick
- **UQAC** : Université du Québec à Chicoutimi
- **UQAM** : Université du Québec à Montréal (Département des Sciences de la Terre et de l'Atmosphère)
- **UQAT** : Université du Québec en Abitibi-Témiscamingue
- **URSTM-UQAT** : Unité de recherche et de service en technologie minérale de l'Université du Québec en Abitibi-Témiscamingue
- **VRQ** : Valorisation-Recherche Québec : un programme d'investissement du gouvernement du Québec destiné à la recherche universitaire

List of exhibitors

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2. Ressources Appalaches
3. Géophysique GPR International
4. Tres-Or Resources
5. Exploration Dios
6. Goldbrook Ventures
7. Osisko Exploration
8. Vior
9. IOS services géoscientifiques
10. Systèmes Géostat International
11. Hélicoptères Canadiens
12. Alexis Minerals Corporation
13. Quinto Mining Technology
14. Prospectors & Developpers Association of Canada
15. New Brunswick Natural Resources
16. Centre géoscientifique de Québec, GSC-Québec
17. Nova Scotia Department of Natural Resources
18. Activation Laboratories
19. Exploration Typhon
20. SRK Consulting
21. Mira Geoscience
22. Groupe Fordia
23. Soquem et Stornoway Diamonds
24. Exploration Midland
25. Université du Québec en Abitibi-Témiscamingue
26. Ressources Metco
27. Golden Valley Mines
28. Fugro Airborne Surveys Corp.
29. Newfounland and Labrador Dept. of Natural Resources
30. MIR Télédétection
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32. Terraplus
33. Exploration Azimut
34. Quantec Géosciences
35. Société de développement de la Baie-James
36. Als Chemex Chimitec
37. Ministère des Ressources naturelles et de la Faune
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62. Agnico Eagle
63. Geotech
64. Aeroquest
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91. G.E.S.S.T.
92. Royal Nickel Corporation
93. Le Groupe Système Forêt
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95. New Millennium Capital
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97. Ressources Cogitore
98. Maxwell Geoservices (Canada)

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102. CSST
103. Section de Québec, Société Pétrolière de l'ICM
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Glacial transport and ice-flow directions in the James Bay sector: Implications for mineral exploration in areas with thick sedimentary cover in the Abitibi-Jamesian region

183 A New mineral deposit types in the James Bay and Abitibi regions– Porphyry deposits

Characterization of Cu-Au-Ag mineralization at the Ell Lake showing, Eleonore property, James Bay

Porphyry gold occurrences in Malartic

184 A Application of multivariate statistics to the interpretation of geochemical signals in regional lake sediment surveys in Québec

185 A Predictive geologic maps using neural networks: An application in the James Bay region

186 A A new tool for determining felsic rock fertility: PER-GH

187 A Mafic Dykes in the Blake River Assemblage of the Abitibi Greenstone Belt

188 A Structural evolution of the Appalachian front in southern Québec: Implications for oil and gas exploration

180 B Metallogeny and structure of the Goldex Mine ore deposit, Val-d'Or (Qc)

181 B Metallogeny of the Lapa gold ore deposit, Abitibi, Québec

182 B Metallogeny of gold occurrences on the Opinaca property, James Bay, Québec

183 B Geology of the Roberto gold deposit, Eleonore property, James Bay, Québec

184 B Structural control on uranium occurrences, Lac Minowean area, Labrador Trough, Québec

185 B Influence of early structures on the geometry of propagation folds: Reconstruction and direct kinematic modelling in 3D

188 B AQUEST

180 C Generalization of symbols on Quaternary geology maps using an automated procedure developed in ArcGIS. Test area: Québec Abitibi, TGI-3 Abitibi Project

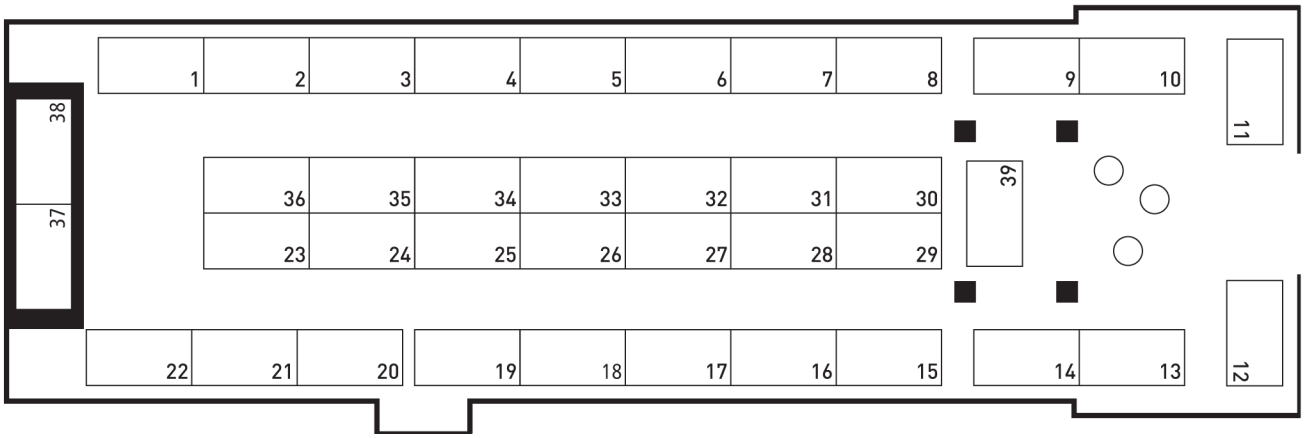
181 C	A MEGATEM II airborne survey in the Chibougamau - Lac-aux-Dorés Québec (32G16)
182 C	Hydrothermal dolomitization at Anticosti: Fluid source and evolution
183 C	The Cap-Chat mélange: Formation and collapse of the Taconic tectonic prism recorded in a folded deformation zone
184 C	High-resolution bathymetry and subsurface of the Honguedo Strait: New geoscientific data
185 C	Transfer zones and fault reactivation in inverted rift basins: Insights from physical modeling and implication for exploration
186 C	Dynamic centrifuge modelling of folding in extensional regimes – Applications to the interpretation of structures during exploration in sedimentary basins and gneiss and greenstone belts
187 C	Geology, plutonism and structural evolution of the Aguanish area (12L08), Grenville Province
188 C	Recent gravity work in the Abitibi
200-201	Archean rocks gold potential in the James Bay area
202-203	Geology of the Ungava Orogen

Salon des prospecteurs

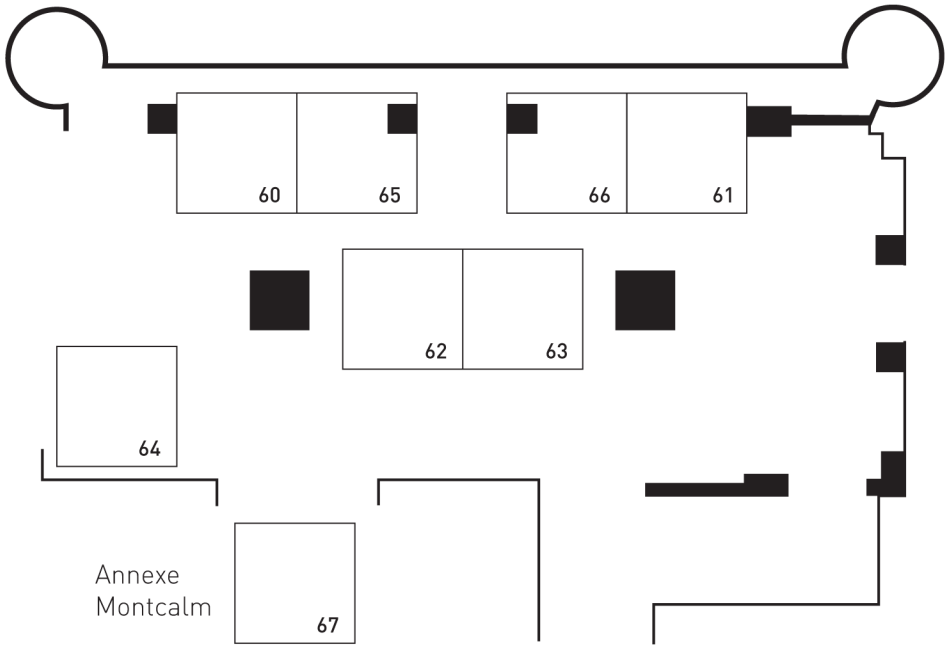
1	Table jamésienne de concertation minière
2	Fonds minier du Saguenay – Lac-St-Jean
3	Daniel Belley, Prospecteur
4	Nunavik Mineral Exploration Fund
5	Fonds régional d'assistance à la prospection minière Gaspésie – Iles-de-la-Madeleine
6	Marco Alain, Prospecteur
7	Conseil cri sur l'exploration minérale

Maps of exhibits

Salle de bal
exposition commerciale

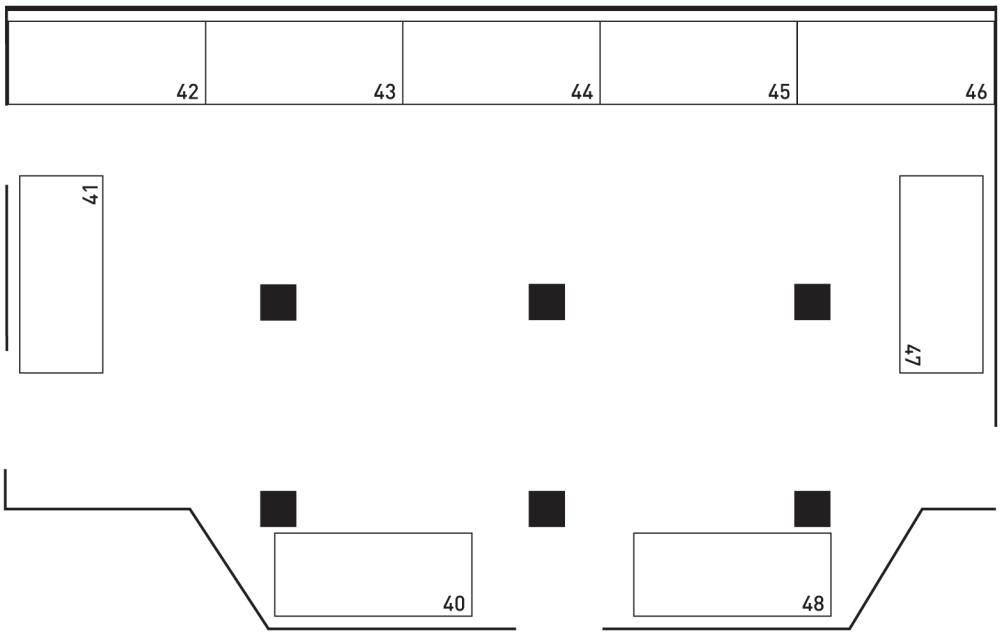


Verchères
Exposition commerciale

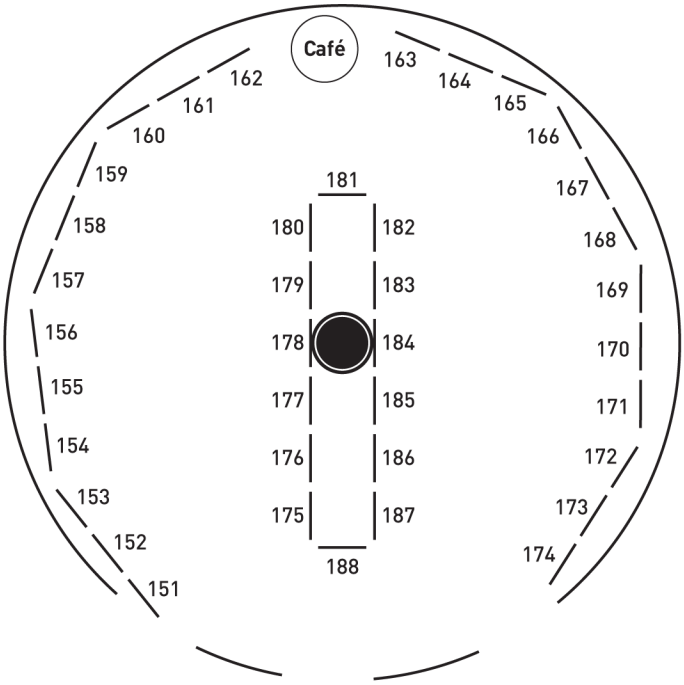


Maps of exhibits rooms

Bellevue
exposition commerciale

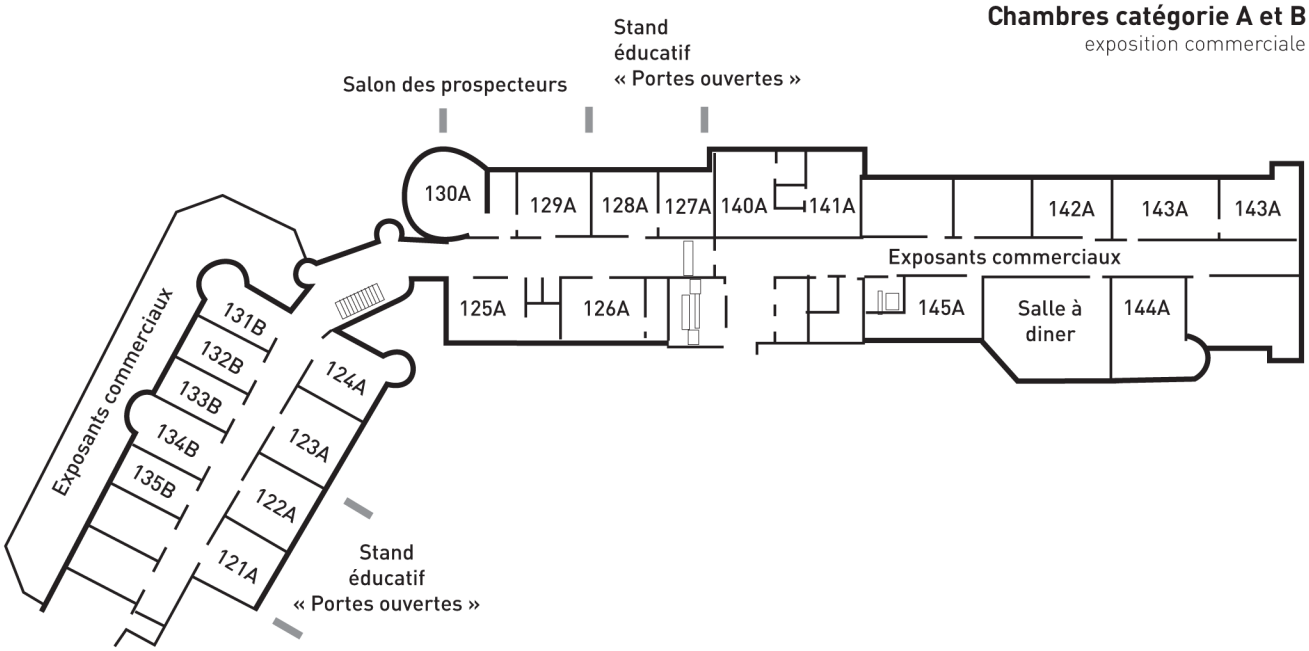


Salon Rose
exposition géoscientifique



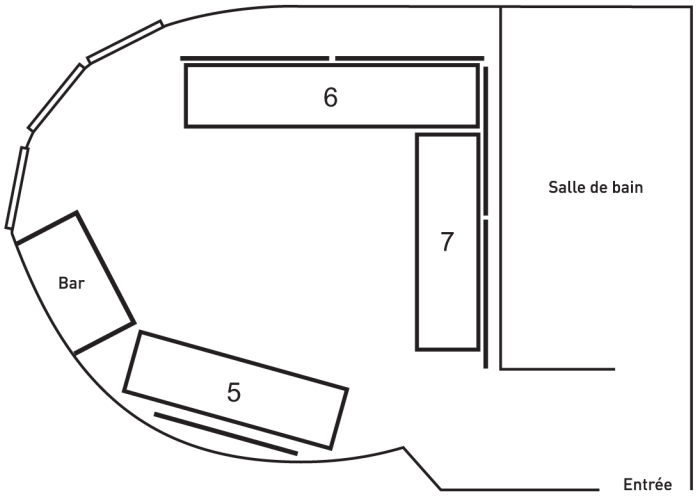
Maps of exhibits rooms

Chambres catégorie A et B
exposition commerciale

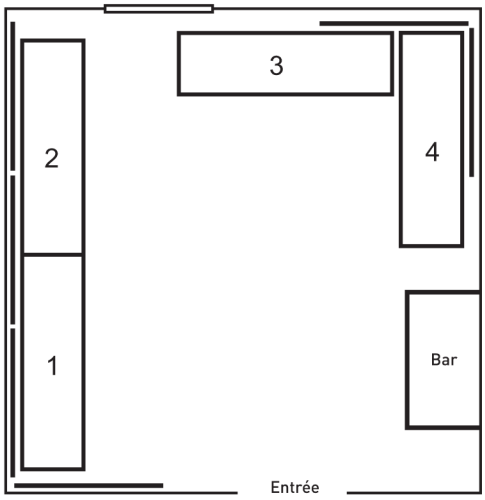


Salon des prospecteurs

Chambre130 A (2217)

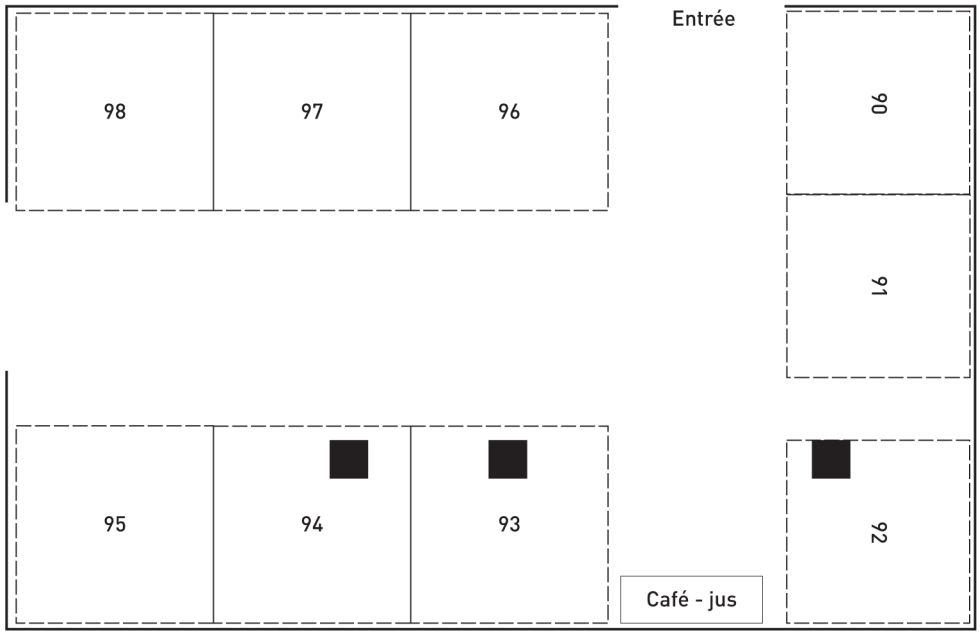


Chambre 129 A (2219)

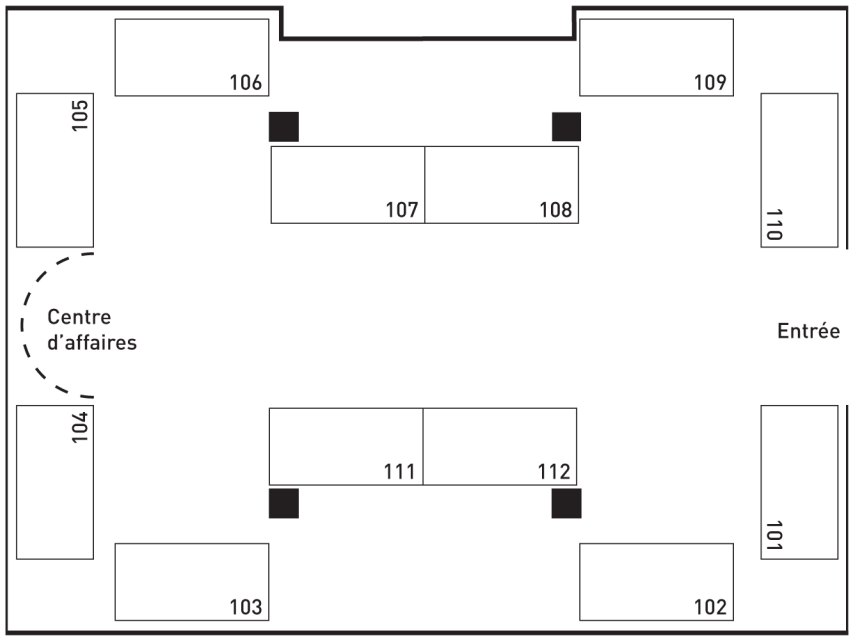


Maps of exhibits rooms

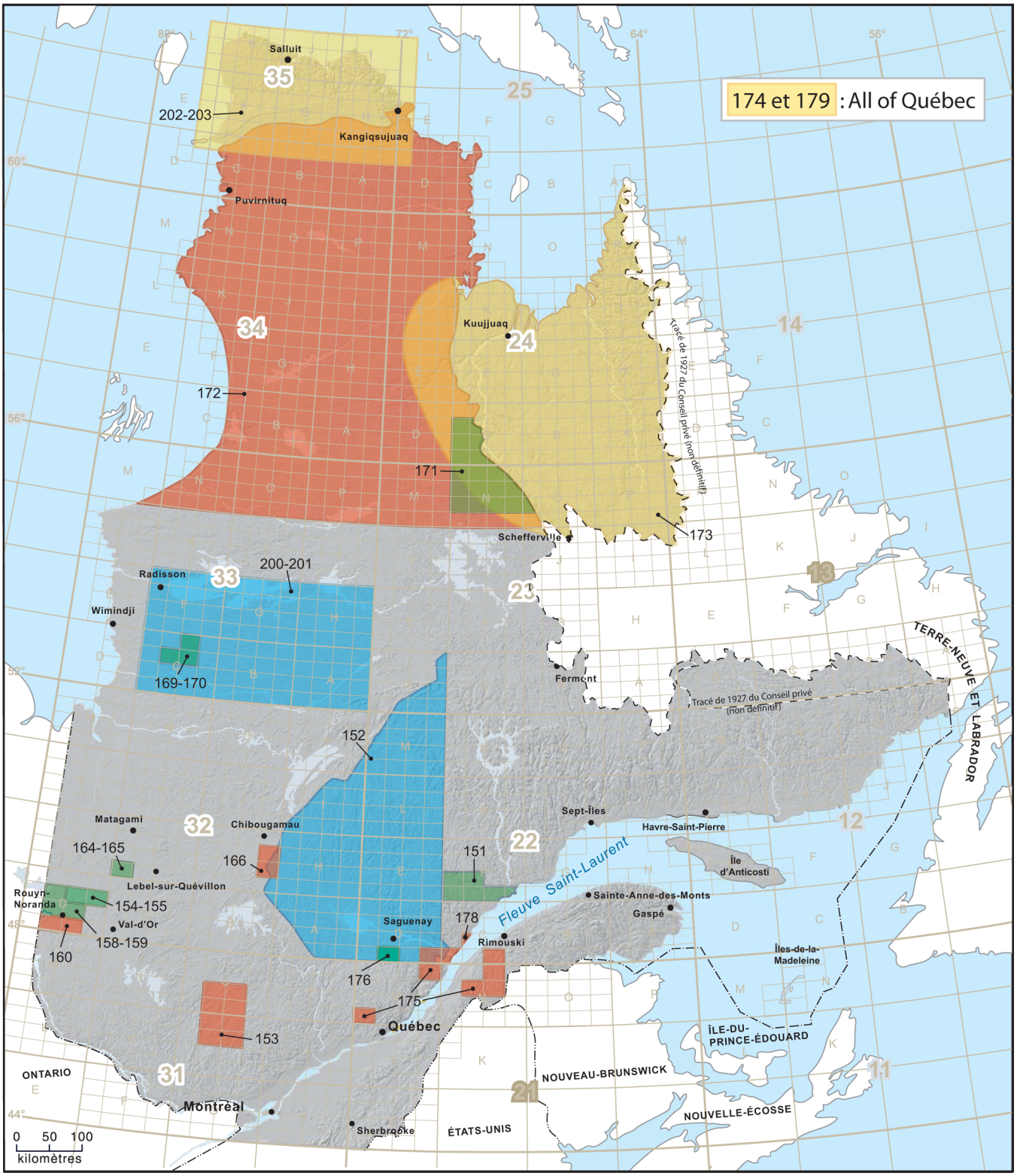
Place d'Armes
exposition commerciale



Jacques-Cartier
exposition gaz et pétrole



Projets location



Ressources naturelles
et Faune
Québec