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ABSTRACTS OF ORAL PRESENTATIONS AND POSTERS, QUEBEC EXPLORATION 2003

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Énergie et Ressources naturelles
Québec

QUÉBEC



EXPLORATION 2003

November 24 to 27, 2003
Château Frontenac, Québec

Abstracts of oral presentations and posters

DV 2003-10

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Message from the Minister of Natural Resources, Wildlife and Parks

Over the past few years, Québec has taken a leadership role in mineral exploration, both on the Canadian and the international scene. It firmly intends to remain at the forefront in many aspects, namely for data acquisition and diffusion as well as in terms of its legal and fiscal policies for companies and investors in the mineral industry.

Holding an event such as **Québec Exploration 2003** constitutes a first for the mining sector in Québec. It clearly illustrates the sustained efforts of our mineral industry and our government, in order to foster the development of mineral resources scattered throughout the province. Québec's success is largely based on the remarkable partnership that unites all the stakeholders in this field.

This unprecedented event provides a great opportunity to exchange on new discoveries and to witness the intense exploration activity currently taking place in Québec, thanks to high-calibre oral and poster presentations and a sizeable trade show. Diamond finds in northern Québec, new geophysical surveys in the Abitibi, oil & gas potential in the Gulf of St. Lawrence; these are just a few of the promising topics on the agenda.

It is with great pride and enthusiasm that I present to you **Québec Exploration 2003**, which constitutes the most important event in mineral exploration to date in Québec.

Sam Hamad

Minister of Natural Resources, Wildlife and Parks

Message from the Chairman of the Québec Mineral Exploration Association



The technical sessions to be presented during **Québec Exploration 2003** will demonstrate the innovative character and evolving expertise in mineral and oil and gas exploration. The organizing committee has put together a diversified program so that the delegates will learn about the latest developments concerning our industry. Quebec is a leader in mineral exploration, and expects to achieve a similar role in hydrocarbon exploration in a near future.

The work and discoveries achieved by the Quebec stakeholders confirm their leadership and entrepreneurship. The diversity of workshops, exhibits and presentations offered throughout this convention are designed for the delegates to learn about this expertise.

Québec remains an important player in mineral exploration, and expects to play a similar role in hydrocarbon exploration in the near future. Our work and our discoveries confirm the drive and entrepreneurship of stakeholders in Québec. The variety of workshops, exhibits and oral presentations offered throughout this meeting are designed to help you share this expertise and this dynamic approach.

I sincerely hope that the encounters meetings and exchanges that will take place during this event will be fruitful, and will pave open the way for new successful partnerships.

Should yourShould your presence at **Québec Exploration 2003** be rewarding!

Pierre Bérubé, President

Quebec Mineral Exploration Association



Message from the Honorary Chairman of Québec Exploration 2003

Québec is renowned for its tremendous mineral potential and for its pro-mining policies. Mineral exploration is a crucial phase in the mining process. Québec not only supports it, but is a leader when it comes to the acquisition and diffusion of new geological data, as well as its attractive tax measures and its modern mining regime.

I am convinced that **Québec Exploration 2003** will be an excellent opportunity to catch up on the latest discoveries, and to witness the dynamic energy that drives the exploration community in Québec.

I am proud to be a part of **Québec Exploration 2003**, and I am very pleased to invite all the players and stakeholders in the mining industry to attend this important event.

Pierre Lassonde

President of Newmont Mining Corporation

Honorary Chairman of Québec Exploration 2003

Message from the Secretary of State responsible of Canada Economic Development Honourable Claude Drouin



I am very proud, as Secretary of State responsible of Canada Economic Development, to be associated once again this year with the Quebec Mining Association Convention.

The mining industry is a very important sector in many Quebec regions and it makes a meaningful contribution to the Canadian economy. I am convinced that this meeting will help you continue to play a significant role by enabling you to acquire new knowledge and make new discoveries. The community as a whole will benefit from your drive and determination.

I wish participants a highly beneficial exchange of views. Enjoy the convention!



Claude Drouin

Secretary of State responsible of Canada Economic Development

List of organisers and their aids

Alain Simard
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Field Trips and Industrial Tours

Denis Raymond
SOQUEM Inc.

Investors Night

Glenn Mullan
Canadian Royalties Inc.

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Adstracts of oral presentations and posters

Oral Presentations

November 25

Session 1 - Appalachians

Chairman: **Denis Lavoie**
Geological Survey of Canada

8:15 **Opening address**

Alain Simard (Director, Géologie Québec)
Pierre Bérubé (Chairman, AEMQ)

8:30 **Ordovician-Devonian accretionary processes along the Laurentian margin**

Cees van Staal (Geological Survey of Canada)

9:20 **Architectural elements of the Humber Arm Allochthon in western Newfoundland**

James Bradley (University of Alberta), Chris Buchanan, Elliott Burden, Tom Calon (Memorial University of Newfoundland) and John Waldron (University of Alberta)

9:40 **Tectono-sedimentary evolution of the Gaspé Belt in northern New Brunswick**

R. A. Wilson and J. I. Carroll (New Brunswick Geological Surveys Branch)

10:00 **Evolution and geometry of the Gaspé Belt in the Gaspésie and Bas-Saint-Laurent regions**

Daniel Brisebois (MRNFP) and Michel Malo (INRS-ETE)

10:20 **New tectonic models for the Gaspé Belt**

D. Kirkwood, M. Lavoie, É. Desaulniers (Université Laval), M. Malo, C. Beausoleil (INRS-ETE), C. Morin (Hydro-Québec) and J-Y Laliberté (MRNFP)

10:40 **Preliminary stratigraphic and structural synthesis of the Laurentian margin, Québec Appalachians: Implications for hydrocarbon exploration**

Alain Tremblay (UQAM), Denis Lavoie, Sébastien Castonguay, Daniel Lebel (GSC-Québec) and Michel Malo (INRS-ETE)

11:00 **New look at the southern Québec Appalachian structural front and foreland belt using reprocessed seismic reflection data**

Sébastien Castonguay (GSC-Québec), Stephan Séjourné (INRS-ETE), Jim Dietrich (GSC-Calgary) and Jean-Yves Laliberté (MRNFP)

Session 2 - New Technologies, New Frontiers and Financing

Chairman: **Pierre Verpaelst**
ministère des Ressources naturelles, de la Faune et des Parcs

1:30 **The future of geophysical prospecting**

Gordon F. West (University of Toronto)

2:20 **New outlook on the geology of the northeastern Superior Province**

Alain Leclair, Alain Berclaz, Jean David, Serge Chevé, Jean-Yves Labbé, Pierre Lacoste, Charles Maurice, Martin Parent, Kamal Sharma, Martin Simard, Robert Thériault (MRNFP)

2:40 **New outlook on the metallogeny of the northeastern Superior Province**

Jean-Yves Labbé, Pierre Lacoste, Alain Berclaz, Serge Chevé, Jean David, Alain Leclair, Charles Maurice, Kamal Sharma, Martin Simard, Robert Thériault (MRNFP)

3:00 **Agreements between junior and major companies – The key to success**

Hervé Thiboutot (Placer Dome Canada)

3:20 **Impacts and benefits of agreements: A way towards lasting relationships between aboriginal peoples and the mining industry**

Anne Bigué (Partner McCarthy Tétrault)

3:40 **Global strength in mining**

Louis Doyle (Vice President Montréal - TSX Venture Exchange)

4:00 **Report card on the ITCE "super" flow-through share program**

C. David A. Comba (Prospectors and Developers Association of Canada)

4:20 **Overview of mining regulations in effect in Québec**

Pierre Godin (Commission des valeurs mobilières du Québec)

November 26

Session 3 - Oil & Gas

Chairman: **Jean-Yves Laliberté**
ministère des Ressources naturelles, de la Faune et des Parcs

8:30 **Energy supply/demand trends and forecasts: Implications for a sustainable energy future for Canada and the world**

J. David Hughes (Geological Survey of Canada)

9:20 **Hydrothermal dolomite development in the St. Lawrence Lowlands**

Michael Binnion (Questerre Energy Corporation)

9:40 **Commercial production of natural brine in the Bécancour area**

Jacques Raymond (Junex-Solnat Inc.)

10:00 **The discovery and development of the McCully natural gas field, southern New Brunswick**

Norm Miller and Paul Hopkins (Corridor Resources Inc.)

10:20 **Storage capacity development of the Saint-Flavien underground reservoir**

Glenn R. Kelly (Intragaz Inc.)

10:40 **Development of the first natural gas field in the Gaspésie region, Galt**

Jean-Yves Lavoie and Jean-Sébastien Marcil (Junex Inc.)

11:00 **Anticosti – The next Albion-Scipio?**

Claude Morin (Hydro-Québec Exploration Pétrole et gaz)

Session 4 - Mineral Deposits

Chairman: **Georges Beaudoin**
Université Laval

1:30 **Metallogenesis of Ni-Cu-PGE mineralization in mafic and ultramafic flows and sills**

C. M. Lesher (MERC, Laurentian University)

2:20 **Cu-Ni-PGE mineralization at the Expo-Ungava and Mesamax deposits, New-Quebec**

James Mungall (U. Toronto), Todd Keast (Canadian Royalties Inc.)

2:40 **Ni-Cu-PGE occurrences in the Gayot project, Venus Archean greenstone belt, Far North**

Michel Chapdelaine and Paul Archer (Virginia Gold Mines Inc.)

3:00 **Volcanic and metallogenic evolution of the Bousquet Formation, Blacke River Group, Abitibi**

Benoît Lafrance (MRNFP), Benoît Dubé, Alan G. Galley (GSC), Patrick-Mercier Langevin (INRS-ETE), Jocelyn Côté (Agnico-Eagle), Normand Bédard (Barrick Gold), Yueshi Lei (Cambior), Mark D. Hannington (GSC), Don W. Davis (ROM), James Moorhead, Pierre Pilote (MRNFP), Wulf U. Mueller (UQAC)

3:20 **The LaRonde ore deposit, Abitibi, Québec: Mineral deposit study of a world-class gold-rich massive sulphide ore deposit and implications for exploration**

Benoît Dubé (GSC), Patrick Mercier-Langevin (INRS-ETE), Mark Hannington (GSC), Benoît Lafrance (MRNFP) and Don Davis (ROM)

3:40 **3D common-earth modelling of the Bousquet Formation, Southern Volcanic Zone, Abitibi Subprovince, Québec**

Francine Fallara (URSTM-UQAT), Benoît Lafrance (MRNFP), Li Zhen Cheng (URSTM-UQAT), Geneviève Boudrias (MRNFP), Jocelyn Côté (Agnico-Eagle), Normand Bédard (Barrick Gold), Yueshi Lei (Cambior), Benoît Dubé, Alan G. Galley (GSC)

4:00 **Casa Berardi project: Past achievements and upcoming milestones**

Michel Gilbert (Aurizon)

Oral Presentations

November 27

Session 5 - New Technologies and New Frontiers

Chairman: **André Gaumont**
Virginia Gold Mines

8:30 **Surface geochemical exploration in thick overburden - Quantum leaps in both application and understanding**

Stewart M. Hamilton (Ontario Geological Survey)

9:15 **Indicator mineralogy: A tool for reviving mineral discoveries in the Abitibi**

Stuart Averill (Overburden Drilling Management Ltd.)

10:00 **Rutile as a potential indicator mineral for metamorphosed metallic ore deposits**

James R. Clark (McGill University) and A. E. Williams-Jones (Cygnus Consulting Inc.)

10:20 **Exploration outlook in Québec for a neglected commodity, SIDEX Strategic Diversification Newsletter**

Normand Grégoire (NGI Consultants inc.)

10:40 **The place of mineral deposits in the geological evolution of the Labrador Trough**

Thomas Clark (MRNFP) and Robert Wares (Osisko Exploration Ltd.)

11:00 **Industrial minerals in Québec: Our position on the world stage**

Serge Perreault and Henri-Louis Jacob (MRNFP)

Session 6 - Diamonds

Chairman: **Marc Beaumier**
ministère des Ressources naturelles, de la Faune et des Parcs

1:30 **Early-stage assessment of kimberlites using indicator minerals, petrography and microdiamonds**

H. Grutter, J. Gurney, T. Nowicki and R. Moore (Mineral Services)

2:20 **Kimberlites in Québec: Current status**

Réjean Girard (IOS Services Géoscientifiques Inc.), James Moorhead (MRNFP) and Pascal Marchand (IOS)

2:40 **Diamond potential of the Renard cluster, Foxtrot property, Monts Otish, Québec**

Ghislain Poirier, Pierre Bertrand and Tyson Birkett (SOQUEM Inc.), Brooke Clements and Robert Lucas (Ashton Mining Canada Inc.)

3:00 **Geology of the Victor kimberlite, Attawapiskat, northern Ontario: Cross-cutting and nested craters**

Kimberley J. Webb (DBC KPU), Barbara H. Scott Smith (SSP), Joanne L. Paul (DBCEI) and Casey H. Hetman (DBC KPU)

3:20 **The northern Alberta kimberlite Province: Geological overview and exploration update**

D. Roy Eccles (Alberta Geological Survey)

3:40 **An overview of Ontario diamond exploration 2003**

Brian T. Atkinson, Ann. C. Wilson and Gary. P. B. Grabowski (Ontario Ministry of Northern Development and Mines

4:00 **Diavik: Turning a project into reality**

Pierre-André Garneau (Les Entreprises Kiewit)

4:20 **Closing address**

Session 1 8:30 – 9:20

Ordovician-Devonian accretionary processes along the Laurentian margin

Cees val Stall (GSC)

The Northern Appalachians is an accretionary orogen with the Laurentian margin progressively expanding oceanwards over time due to the oblique docking of small oceanic terranes and four microcontinents (Dashwoods, Ganderia, Avalonia and Meguma). The successive arrival of the microcontinents correspond to the Early to Late Ordovician Taconic, Late Ordovician to Early Silurian Salinic, Early Devonian Acadian and Middle Devonian to Early Carboniferous Neoacadian orogenies respectively. The Appalachian cycle terminated with the Carboniferous to Permian Alleghenian Orogeny.

Closure of Iapetus started at c. 505-515 Ma when it was transformed from an Atlantic-type into a Pacific-type ocean with subduction initiation occurring coevally near the Laurentian and Gondwanan margins. The resultant suprasubduction zone oceanic lithosphere was accreted to the peri-Laurentian Dashwoods and peri-Gondwanan Ganderia microcontinents shortly after formation. These accretionary events were short-lived (3-5 my) and mainly represented by localized deformation and mélanges.

The collision of the Dashwoods with Laurentia was the principal cause of the Early to Middle Ordovician Taconic Orogeny. This collision was immediately preceded by the obduction of peri-cratonic, suprasubduction zone ophiolites onto the Laurentian margin. Loading of the Laurentian margin by the Dashwoods microcontinent led to formation of Late Ordovician foreland basins. Docking of the Dashwoods was rapidly followed by accretion of the east-facing Annieopsquotch accretionary tract and the west-facing Popelogan-Victoria arc (PVA), which was built on the leading edge of Ganderia, between 478 and 450 Ma. These two arc terranes are separated by the Red Indian Line, which represents the main Iapetus suture. Paleomagnetic evidence suggests that c. 3000 km of oceanic crust was consumed by subduction between these two opposing arcs. After accretion and partial subduction of the PVA, the west-dipping subduction zone stepped back into the Tetagouche-Exploits backarc basin (TEB), which separated the PVA from the remainder of Ganderia. Closure of the TEB by the Early Silurian (c. 425-430 Ma) accreted Ganderia firmly to Laurentia and led to the Salinic Orogeny.

While the western part of Ganderia was colliding with Laurentia, oceanic crust was subducting beneath it from the Avalon side. This produced Early Silurian arc-backarc magmatism along its eastern edge. Sinistral oblique accretion of Avalonia to Laurentia started at c. 420-423 Ma, heralding the start of the Acadian Orogeny. The Acadian was finished before the end of the Early Devonian. Middle Devonian to Early Carboniferous Neoacadian orogenesis is present throughout most of the northern Appalachians and is related to accretion of Meguma to Laurentia.

Session 1 9:20 – 9:40

Architectural elements of the Humber Arm Allochthon in western Newfoundland

James Bradley (University of Alberta), Chris Buchanan, Elliott Burden, Tom Calon (Memorial University of Newfoundland) and John Waldron (University of Alberta)

The area previously mapped as the Humber Arm Allochthon in western Newfoundland includes the Bay of Islands ophiolite, and deep-water sedimentary successions that were deformed in the Early to Middle Ordovician Taconian Orogeny. However, a new mapping effort, initiated in 1999 through NATMAP, indicates that previously unrecognized structural units are tectonically intercalated within this region. Along the east edge of the Allochthon, the Watsons Brook succession includes carbonates and shales of the Pinchgut Lake Group, regarded as representing shelf-edge environments. Farther west, the Corner Brook succession comprises clastics (Summerside, Irishtown formations) overlain by carbonates and shales (Cooks Brook, Middle Arm Point formations) representing rift, slope, and rise environments along the Iapetan margin of Laurentia. Overlying "flysch" (Eagle Island Formation, included here in the Goose Tickle Group) represents the onset of Taconian deformation. A third succession, in a structurally high position, includes lavas, minor limestones, and enigmatic Cambrian sandstones of the Blow Me Down Brook Formation.

Farther west, an extensive belt of outcrop lying along the shoreline from Deadmans Brook north to Little Port contains multiple thrust repeat cycles of black and brown shale and siltstone, ribbon limestones and intraformational conglomerate, and thick beds of medium through coarse-grained sandstones that locally smell petroliferous and may be saturated with dead oil. New acritarch and graptolite data indicate that at least some of these rocks are Llanvirn in age and correlative with the foreland basin deposits (Table Head and Goose Tickle groups) at the top of the Laurentian shelf succession.

Acritarch coloration indices for the most westerly rocks show most of the Cambro-Ordovician foreland basin units lie near the bottom of the oil window. So too, and farther inland, on the southern shore of the Bay of Islands, early Cambrian strata of the Blow Me Down Brook Formation contain distinctive assemblages of well-preserved acritarchs that also lie at the bottom of the oil window. In contrast, type Eagle Island strata of the Goose Tickle Group are thermally overmature, with acritarchs that are very dark and broken. Older Middle Arm Point, Cooks Brook and Irishtown strata of the Corner Brook succession collected farther east are also well outside the oil window. A pronounced break in the thermal maturity apparently lies in the area of Frenchman's Cove; strata to the west are generally less altered than those lying to the east.

From a practical standpoint, and given appropriate geology for reservoir and traps to form and to be preserved, there might still be petroleum prospects beneath the ophiolite complex and beneath the western reaches of the Bay of Islands, west of Woods Island.

Oral Presentations

Session 1 9:40 – 10:00

Tectono-sedimentary evolution of the Gaspé Belt in northern New Brunswick

R. A. Wilson and J. I. Carroll (New Brunswick Geological Surveys Branch)

The Restigouche area is underlain by Middle Paleozoic rocks of the Connecticut Valley–Gaspé Synclinorium (CVGS), Aroostook–Percé Anticlinorium (APA), and Chaleur Bay Synclinorium (CBS). In the APA, Upper Ordovician to Lower Silurian rocks comprise non-calcareous turbidites of the Grog Brook Group (Boland Brook and Whites Brook formations), overlain by calcareous turbidites of the Matapédia Group (Pabos and White Head formations). The CBS and CVGS, east and west of the APA respectively, can each be divided into three stratigraphic sequences. In the CBS, middle Llandoverian to early Wenlockian rocks of the Chaleurs Group (Upsalquitch and Limestone Point formations) conformably overlie the White Head Formation and define a shallowing-upward trend that culminated with carbonate platform development and regional uplift. Upper Silurian to Lower Devonian rocks of the Dalhousie Group overlie a regional (Salinic) disconformity, and include, from oldest to youngest, the West Point Formation (isolated reef mounds), Indian Point Formation (marine sedimentary rocks), and Val d'Amour Formation (new name; subaerial volcanic rocks). A brief hiatus separates the Dalhousie Group from overlying Emsian-Eifelian molasse of the Campbellton Formation (Gaspé Sandstone Group).

In the CVGS, Llandoverian to Ludlovian calcareous and quartzose sandstone and minor red shale of the Perham Group (Gounamitz Lake Formation) conformably overlies the White Head Formation. The Restigouche Fault juxtaposes the Perham Group against the Fortin Group, which comprises the Tracey Brook Formation and overlying Temiscouata Formation. The Tracey Brook Formation comprises thin-bedded calcareous sandstone and red shale, and contains graptolites and chitinozoa of Pridolian – Lochkovian age. The Temiscouata Formation consists of non-calcareous siltstone and sandstone overlain by strongly calcareous siltstone and minor sandstone. The Emsian York Lake Formation (Gaspé Sandstone Group) is juxtaposed against the Temiscouata Formation along the Sainte-Florence Fault, and comprises non-calcareous sandstone and siltstone with local terrigenous organic matter.

Two deformations are recognized in the study area. Early, northwest-trending open folds with local fracture cleavage are locally present in the Grog Brook and Matapédia groups. Overprinting by northeast-trending, open to locally isoclinal Acadian folds with penetrative axial cleavage, has produced doubly-plunging macrofolds and fold interference patterns in the APA. The early folds are associated with the Salinic Orogeny, which is also manifested in uplift and deep erosion of Upper Ordovician and Early Silurian rocks, and probable normal faulting on the McKenzie Gulch Fault. An extended period of uplift in parts of the Restigouche area is indicated by deep erosion (e.g., limestone conglomerate in the Indian Point Formation consists of White Head clasts), Early Devonian high-level intrusions in the Matapédia Group, and low thermal maturity of Devonian, Silurian, and in places even Upper Ordovician rocks.

Session 1 10:00 – 10:20

Evolution and geometry of the Gaspé Belt in the Gaspésie and Bas-Saint-Laurent regions

Daniel Brisebois (MRNFP) and Michel Malo (INRS-ETE)

The Gaspé Belt comprises a sequence of Late Ordovician to early Middle Devonian sedimentary and volcanic rocks. The first phase of sedimentation (Late Ordovician-Early Silurian), which corresponds to a successor basin of the Taconian Orogeny, was restricted to the southern part of the basin. It is represented by siliciclastic turbidites, the source of which is located in orogenic terrains to the north (Taconian nappes) and the south (Ordovician magmatic arcs). Lateral variations in the stratigraphy of formations suggest that the basin may have been subdivided into sub-basins, each with its own specific development. These siliciclastic rocks are gradually replaced by calcareous turbidites with an area of sedimentation that appears to extend northward. The source may be the Anticosti platform. A limestone cap marks the end of the first phase of sedimentation.

The second phase of sedimentation begins during the Early Silurian in a more extensive basin relative to the first phase. This basin is bounded to the north by the Taconian Orogen. Prior to Salinian and Acadian folding, thrusting and strike-slip movement, its width was probably double that of the current belt. This second phase comprises stratigraphic sequences that vary along a north-south direction, but are fairly constant parallel to the basin elongation axis. The northern sequence begins with shales and/or red beds, followed by arenites. In the central part of the basin, these rocks are laterally replaced by shales, and southward, by a set of clayey-sandy units. These rocks are overlain by a relatively homogeneous sequence formed at the base of shallow-water limestone along the northern and southern edges of the basin and of shales in the central part. The limestones are followed by fine siliciclastic rocks, locally overlain by an erosional disconformity (Salinian), reef limestones and basalts.

The third Early Devonian phase corresponds to the formation of the Acadian foreland basin. It consists, along the northern basin margin, of limestones, fine siliciclastic rocks and volcanic rocks typical of deep shelf settings; in the central part of the basin, deltaic siliciclastic rocks and volcanic rocks; and to the south, largely subaerial volcanic and epiclastic rocks. The last phase produced a thick basin-wide sequence of coarse siliciclastic rocks typical of shallow-marine followed by continental conditions.

Sesson 1 10:20 – 10:40

New tectonic models for the Gaspé Belt

D. Kirkwood, M. Lavoie, É. Desaulniers (Université Laval), M. Malo, C. Beausoleil (INRS-ETE), C. Morin (Hydro-Québec) and J-Y. Laliberté (MRNFP)

Since 1995, university and government scientists have expended considerable efforts to better define the hydrocarbon potential of the Gaspésie region. This work has generated an enormous amount of new data and new ideas concerning the tectonic evolution of the Appalachians.

The Gaspé Peninsula extends along the northeastern Québec Re-entrant, and comprises the most complete Middle Paleozoic stratigraphic sequence in the Canadian Appalachians. Upper Ordovician to Middle Devonian rocks unconformably overlie Cambrian-Ordovician rocks of the Humber and Dunnage zones, and are themselves unconformably overlain by Carboniferous rocks. Two orogenic phases have affected peninsula rocks: the Late Ordovician Taconian Orogeny and the Devonian Acadian Orogeny. Acadian structures therefore overprint Taconian nappe and foothill structures. Deep seismic reflection campaigns conducted by the MRNQ Direction du Gaz et Pétrole from 2000 to 2002 yielded exceptional profiles that proved quite valuable in defining the structural style of the subsurface in the Gaspésie region. Different time and depth processing sequences of seismic data and interpretation of the numerous resulting images outline the geometric complexity of the Appalachians, and provide images of thin-skinned tectonic structural features (blind thrusts, tectonic imbrications, stacked duplexes and triangle zones) both in the Taconian foothills and in the Acadian belt.

The integration of new geophysical data (seismic and other) and geological data (field studies, downhole measurements) has therefore led to a revision of the Acadian tectonic model. The structural history of the Acadian belt in the Gaspésie-Matapédia-Témiscouata segment began at the end of the Early Silurian and extended to the Middle Devonian. We have developed a new conceptual model for the structural development of the Acadian belt in two episodes, based partly on the evolutionary framework proposed by Kirkwood (1999) for the progressive deformation of Silurian-Devonian units of the Gaspésie region. The new model proposes an early episode of north-directed thrusting, with the development of a fold-and-thrust belt, followed by an episode of strike-slip tectonics, with the development of regional transcurrent faults mainly in the southern Gaspésie region. This global model involves the cohabitation of extensional and compressional phases during the first tectonic episode.

Session 1 10:40 – 11:00

Preliminary stratigraphic and structural synthesis of the Laurentian margin, Québec Appalachians: Implications for hydrocarbon exploration

Alain Tremblay (UQAM), Denis Lavoie, Sébastien Castonguay, Daniel Lebel, (GSC-Québec) and Michel Malo (INRS-ETE)

The Laurentian margin, known as the Humber zone, extends from the Québec-Vermont border to the Gaspésie region. It is divided into an external zone, characterized by monophase deformation and very low-grade metamorphism, and an internal zone where polyphase deformation and greenschist to amphibolite-facies metamorphism prevail. The margin consists of Late Proterozoic to Late Ordovician rocks forming three sedimentary series: (i) a rift series coeval with the opening of the Iapetus ocean, (ii) a passive margin series representing an episode of continental drift, and (iii) a syn-orogenic series coeval with its destruction during the Taconian Orogeny. Internal zone rocks are metamorphosed equivalents of series (i) and (ii).

The external zone forms a series of imbricated nappes thrust onto the St. Lawrence Lowlands (SLL). We propose the following correlation and structural stack, from the top down; (i) Oak Hill – Richardson nappes, (ii) Granby – Chaudière – Rivière Boyer – Rivière Ste-Anne nappes, and (iii) Stanbridge – Ste-Hénédine – Bacchus – Rivière Marsoui nappes. Late Ordovician (~455-445 Ma) regional structures, namely overturned folds and NW-verging thrusts locally form structural traps potentially sealing hydrocarbon reservoirs such as the St-Flavien reservoir, located in a detached platform slice. Internal zone rocks consist of the Sutton-Bennett schists and the Mont Logan nappe. In southern Québec, the external-internal transition is marked by the Bennett-Brome Fault, a backthrust fault overprinting thrust structures of the external zone. The eastern limit of the internal zone consists of a series of normal faults (St-Joseph and Shickshock-South faults, BBL), where external zone rocks are locally preserved in the hanging wall. $^{40}Ar/^{39}Ar$ ages suggest that Taconian metamorphism (470-455 Ma) is affected by a retrograde episode dated at 430-415 Ma. Structures attributable to the Acadian Orogeny (Middle Devonian) are recognized in the internal zone, but cannot be clearly identified in the external zone. Finally, structures related to normal faults bounding the SLL are locally present, and may have played a role in remobilizing pre-existing hydrocarbons.

Oral Presentations

Session 1 11:00 – 11:20

New look at the southern Québec Appalachian structural front and foreland belt using reprocessed seismic reflection data

Sébastien Castonguay (GSC-Québec), Stephan Séjourné (INRS-ETE), Jim Dietrich (GSC-Calgary), Jean-Yves Laliberté (MRNFP)

In southern Québec, the structural style, 3D architecture and hydrocarbon potential of the Appalachian foreland and St. Lawrence Lowlands (SLL) platform are relatively poorly known, due to the paucity of outcrops, to the biostratigraphic bias of previous regional mapping and the overall poor quality of available seismic data.

A reinterpretation of several reprocessed seismic profiles, namely profiles 2001, 2002 and 2003 (recorded in 1978 by the MRNFP) across the Appalachians and SLL and complementary fieldwork demonstrate that a complex tectonic history affects foreland and platform units, well beyond Logan's Line and the Aston fault. In fact, the foreland deformation domain appears to be much more extensive than indicated on current maps and significantly affects SLL units along the southeastern limb of the Chambly-Fortierville syncline, which is geometrically similar to classic foreland synclines. Its southeastern limb appears to have been tilted upright as a result of intercutaneous wedging of foreland units, thereby creating a triangle zone. In subsurface towards the northwest, the main Appalachian detachment appears to extend beneath the syncline, which gives it a geometry similar to ramp folds. The main detachment may outcrop along the northwestern limb of the syncline in the form of a thrust fault juxtaposing units of the Lorraine Group or may shift into an incipient triangle zone. The location of Logan's Line as well as its subsurface geometry remain, even after reprocessing, a challenge to interpret. On the other hand, in the hanging wall of Logan's Line, the St-Flavien structure, which hosts a commercial gas field now converted into a storage site, is clearly defined. This structure may be interpreted as a detached and folded slice of platform rocks that was transported along a thrust fault and progressed over a footwall ramp due to an abrupt step geometry along the Grenvillian basement.

These different types of structures are recognized along a number of orogenic fronts as structural traps favourable to hydrocarbon accumulation. The geological interpretation of reprocessed profiles improves our view of the three-dimensional architecture of the Appalachian front in southern Québec. This work will be useful to correlate orogen-wide structures along the Appalachian structural front that extend offshore in the Estuary and the Gulf of St. Lawrence.

Session 2 1:30 – 2:20

The future of geophysical prospecting

Gordon F. West (Geophysics Laboratory, Department of Physics, University of Toronto)

Finding new, economically exploitable, mineral and petroleum resources becomes more challenging with each passing decade. Because a geologist's unaided access to the rocks is so limited, success has become highly dependent on sophisticated techniques of exploration geochemistry and geophysics and on improvements in sampling and drilling technologies that extend the geologist's investigative reach to covered areas and to depth.

Geophysical methods of remote sensing have been known for decades. All the methods can be categorized into just six classes, and these were all in play before 1940. However, there has been enormous progress within each class; *i.e.*, a huge expansion in the variety of environments that can be investigated, in the depth of exploration, and in cost-effectiveness. This progress has been crucial to maintaining success rates. Furthermore, the advent of geophysical and/or geochemical search techniques that demonstrably work well in some prospective environment has often triggered surges in successful exploration. Examples from Canadian mineral exploration are the base metal massive sulphide rush precipitated by airborne EM, the still continuing diamond rush precipitated by the successful use of tracer minerals in combination with high-resolution aeromagnetics and aeroEM, and the intensive deep exploration in mining camps made possible by improved surface-to-borehole EM and deep drilling technology. In petroleum exploration, the dependence on geophysical sensing (mainly seismic reflection surveying) is more extreme than in mining. The east coast, offshore discoveries such as Hibernia had to wait until suitable high-quality marine 2D and 3D seismic reflection technology became available.

What coming geophysical developments can be expected to have an important impact soon, in eastern Canada or elsewhere? One is in marine seismic technology. Carbonate strata, especially in shallow water, have always been difficult to explore seismically because the deeper stratification is obscured by strong multiple reflection from shallow hard strata. New theoretical and computational approaches are beginning to solve this problem. This will make many, long known-but-neglected, prospective areas explorable. The trend towards intensive deep exploration in mining camps will continue as borehole-based technologies improve, diversify, and experimental ones like seismic methods become cheaper. Diamond exploration will become even more effective with the advent of even higher resolution aeromagnetics and aeroEM and an increased ability to work in rough terrain. Airborne gravity and gravity gradiometry could have a great impact on exploration for magmatic ores of several kinds.

Session 2 2:20 – 2:40

New outlook on the geology of the northeastern Superior Province

Alain Leclair, Alain Berclaz, Jean David, Serge Chevé, Jean-Yves Labbé, Pierre Lacoste, Charles Maurice, Martin Parent, Kamal Sharma, Martin Simard, Robert Thériault (MRNFP)

Since 1998, our knowledge of the geology of the northeastern Superior Province (NESP) has considerably improved thanks to systematic mapping (1 to 250,000) carried out within the scope of the Far North Project. This translates into a tremendous amount of new geological data on this long-neglected region, as well as important information on the nature and evolution of the Archean continental crust. A regional synthesis is currently underway in order to make the most of existing data and of ensuing interpretations. This presentation outlines the geological framework of the NESP and provides a brief overview of the major assemblages it contains.

Recent studies in the NESP have unveiled a complex geological evolution that took place over a billion years in the Archean eon. The region provides a remarkable record of the episodic growth of the Archean crust and its subsequent reworking in the 3.82 to 2.65 Ga interval. It contains Mesoarchean and Neoarchean units comprising a variety of plutonic rocks and scattered remains of supracrustal rocks generally metamorphosed to the amphibolite facies, as well as a Paleoarchean volcano-sedimentary sequence. The preferred model involves interaction between fragments of early crust (3.5-2.8 Ga) and younger magmatic suites (2.8-2.6 Ga), as well as important recycling during each episode of crustal growth. The evolutionary sequence has been subdivided on a preliminary basis into 10 tectono-magmatic "events", some of which exhibit a geographic distribution related to major NNW-SSE-trending geological assemblages. In the northeast, two ovoid charnockitic massifs (2.74-2.73 Ga) were emplaced in a tonalitic complex (2.88-2.77 Ga) that contains volcano-sedimentary rocks. The central zone is namely characterized by relatively young (< 2.74 Ga) intrusive rocks including a porphyritic granite suite. This zone separates two terrains that contain the remains of partially recycled early crust (> 2.80 Ga). The terrain immediately to the west, characterized by a major magnetic low, also features a number of volcano-sedimentary belts enclosed in tonalitic rocks (3.0-2.77 Ga). Further west, residual supracrustal fragments remaining from the partial melting and dismemberment of sedimentary sequences, which may have originally formed vast basins, are observed. Migmatitic paragneisses are found within intrusive complexes composed of enderbite, diatexite and granite (2.73-2.68 Ga). The western and southwestern areas are characterized by a series of enderbites and biotite-hornblende±clinopyroxene granitoids (2.75-2.69 Ga) that enclose tonalitic gneisses (2.84-2.81 Ga) and rare volcano-sedimentary bands. In the westernmost part of the region, a unique example of Paleoarchean (3.82 Ga) volcano-sedimentary sequence is exposed.

Session 2 2:40 – 3:00

New outlook on the metallogeny of the northeastern Superior Province

Jean-Yves Labbé, Pierre Lacoste, Alain Berclaz, Serge Chevé, Jean David, Alain Leclair, Charles Maurice, Kamal Sharma, Martin Simard, Robert Thériault (MRNFP)

The sixth field campaign of the Far North mapping program took place during the summer 2003. A metallogenic study was conducted in conjunction with mapping, and a synthesis of data collected since 1998 is currently underway. This presentation will provide an overview of our current knowledge of mineral deposits in the northeastern Superior Province. The various types of mineral occurrences will be reviewed, and a preliminary metallogenic synthesis will also be proposed.

Known mineral occurrences are subdivided into three major classes: occurrences associated with Archean volcano-sedimentary belts, occurrences associated with Archean intrusive rocks and occurrences associated with Proterozoic supracrustal rocks. Each of these three classes contains both syngenetic and epigenetic mineralization.

Several Archean volcano-sedimentary belts are known in the region. The latter host various types of syngenetic occurrences such as Algoma-type iron formations (Fe), volcanogenic sulphides (Cu-Zn±Au), komatiite-hosted Ni-Cu-PGE and porphyry-type polymetallic occurrences (Cu, Au, Ag, Mo). The potential for epithermal-type polymetallic deposits is also present. Epigenetic occurrences observed in Archean belts mainly consist of gold-bearing shear zones in iron formations, or locally, in metavolcanic rocks and paragneisses. Chalcopyrite veins cross-cutting ultramafic supracrustal rocks (Cu, Au, Ag) are also observed, as well as light rare earth occurrences in metasomatized marbles.

Syngenetic occurrences associated with Archean intrusive rocks primarily consist of Ni-Cu±PGE deposits hosted in mafic to ultramafic intrusions enclosed in vast granitoid assemblages. Epigenetic occurrences associated with Archean intrusive rocks consist of late veins, generally rectilinear, and most likely Proterozoic in age. Two types of veins are observed: magnetite-quartz-chalcopyrite veins (Cu, Co) associated with km-scale lineaments, and quartz-chalcopyrite-galena veins (Cu, Pb±Zn) with no apparent link to lineaments.

A few layers of Proterozoic volcano-sedimentary rocks are observed, unconformably overlying the Archean basement. The latter host stratiform uranium (in sandstones mainly) and copper-silver (redbed-type in volcanic rocks) occurrences. Mississipi Valley-type lead-zinc occurrences are also observed in a stromatolitic carbonate horizon.

Oral Presentations

Session 2 3:00 – 3:20

Agreements between junior and major companies – The key to success

Hervé Thiboutot (Exploration Manager, PDC)

Certain statistics recently published by the IGWG reveal that exploration expenditures remained stable in Canada, at about 500 million dollars per year (111 million dollars in Québec). Exploration expenditures incurred by junior companies increased, climbing from 35% in 2001 to 42% in 2002, whereas major company spending was generally reoriented. A shift in priority towards on- or near-minesite exploration by major companies has translated into a decrease in research efforts aimed at new discoveries. For example, since 1999 on a global scale, Placer Dome has cut its exploration budgets assigned to the search for new projects from 70 to 30%. On the other hand, the proportion of exploration budgets devoted to politically stable regions (Canada, Australia, United States) has substantially increased. This trend appears to prevail for most North American major companies.

This relative decrease in exploration spending represents a unique opportunity for junior companies to fill the gap. Overall, junior companies are better suited to rapidly seize new opportunities as they occur. They are able to minimize exploration costs while accepting high risk, and are able to obtain financing from the private and public sectors. Major companies, on the other hand, have the financial and technical ability required to develop projects to the mining phase. This means that junior and major companies need to join forces and draw on their respective strengths to ensure a stable rate of discovery and development projects.

Several factors must be taken into account for companies with different objectives and corporate needs to find a common ground. First of all, we believe that any agreement negotiation must start out on a stable footing, meaning open and honest relations, which have been maintained over the years if possible. Furthermore, junior and major companies must also understand the expectations, limits and needs of their potential partner, both from a corporate and technical standpoint. Each type of company has strengths and weaknesses that may provide an opportunity to form a symbiotic relationship. Finally, it is essential for all negotiations to remain positive (even if they do not lead to an agreement) rather than being confrontational, as the traditional model implied.

Session 2 3:20 – 3:40

Impacts and benefits of agreements: A way towards lasting relationships between aboriginal peoples and the mining industry

Ann Bigué (Partner, McCarthy Tétrault LLP)

The negotiation of Impacts and Benefits Agreements ("IBAs") in Canada has emerged in response to the effects of major mining projects located on or close to aboriginal lands and communities. Today, IBAs are increasingly becoming common practice to address socio-economic and cultural impacts of mining projects on aboriginal communities and to secure benefits for aboriginal people.

The negotiation of IBAs often results from the existence of aboriginal rights or treaty rights, including rights defined pursuant to various land claim agreements. Certain statutory requirements may also give rise to such agreements between mining companies and aboriginal groups. In certain circumstances, IBAs may involve governments as well.

IBAs address wide-ranging issues. They may include education, training and employment of aboriginal people, transportation and working conditions, business opportunities for aboriginal businesses related to the mining project, environmental protection, cultural protection, compensation for traditional hunting, fishing and trapping activities and other financial provisions. The particular circumstances of each aboriginal group and of each project influence the contents of these agreements.

IBAs are a positive way to build successful and lasting relationships between all parties involved since they are intended to address the obstacles related to mining developments in an aboriginal context.

Session 2 3:40 – 4:00

Global strength in mining

Louis Doyle (Vice President Montreal, TSX Venture Exchange)

Canadian Exchanges are first in global mining – more mining companies are listed on the Toronto Stock Exchange and TSX Venture Exchange that any other exchange in the world. As a result, we uniquely offer mining companies membership in the largest peer group of mining companies anywhere, providing the benefits of premium valuations, visibility for transactions, analyst coverage, specialized indices, liquidity and specifically tailored listing requirements.

The Toronto Stock Exchange provides superior access to equity capital, essential for growth-oriented companies anywhere in the world. Combined, the Toronto Stock Exchange and TSX Venture Exchange have a vibrant group of over 1,100 mining companies from grassroots explorers to world-class producers, valued at over $110 billion.

Toronto Stock Exchange mining companies raised an impressive $2.6 billion in 2002 – the largest amount raised compared with any other exchange in the world. North America's strong retail market provided excellent liquidity in the secondary market for our mining issuers, with Toronto Stock Exchange mining companies trading over 11 billion shares valued at $126 billion in 2002.

The Toronto Stock Exchange provides a strong destination market for senior issuers – 21 of our mining companies have over $1 billion in market capitalization. The TSX Venture Exchange nurtures early-stage exploration companies – an impressive $570 million was raised by TSX Venture mining companies in 2002.

Session 2 4:00 – 4:20

Report card on the ITCE "super" flow-through share program

C. David A. Comba (Prospectors and Developers Association of Canada)

The temporary 15% federal Investment Tax Credit for Exploration in Canada (ITCE) program of enhanced or "super" flow-through shares has been a lifeline for many PDAC member companies, consultants and service providers, and **has allowed a significant and successful exploration effort to be mounted during a down market cycle of exceptional duration**. PDAC estimates flow-through share financings have raised close to $500 million between October, 2000 and June, 2003. The resultant activity has added about 70 new mineral discoveries to the national inventory. This represents a discovery rate for flow-through related discoveries alone of a very respectable two per month. Canada has not experienced a similar flow-through discovery rate in over a decade.

A PDAC compilation of new discoveries related to flow-through share financed programs lists Québec as number one in Canada with 17 discoveries, narrowly ahead of Ontario (15) and Nunavut (13). In spite of reductions announced in June, 2003, Québec remains the leader in terms of offering the potentially lowest after-tax cost to a flow-through share investor paying taxes in Québec. Undoubtedly contributing to Québec's discovery successes are geoscience and other exploration incentive programs, which also hold first place in Canada.

Québec is alone in raising significant amounts of exploration capital through para- governmental providers of funds such as SIDEX and SODEMEX. Québec is also unique in having access to labour-sponsored venture capital funds such as the QFL Solidarity Fund. The level of government involvement and labour fund support is allowing Québec to phase out the sale of flow-through shares to individual investors by December 31, 2004.

Oral Presentations

Session 2 4:20 – 4:40

Overview of mining regulations in effect in Québec

Pierre Godin (President, Commission des valeurs mobilières du Québec)

The *Commission des valeurs mobilières du Québec* (CVMQ) is the watchdog agency for the Québec securities market. Its mission is to promote the efficiency of Québec's financial markets and protect investors. The CVMQ therefore regulates the public disclosure of information to titleholders by mineral exploration companies financed in Québec.

One of the objectives of the CVMQ is to secure the growth and reputation of Québec as a prime financing market for the mineral exploration industry, through the establishment of an equitable and favourable regulatory framework for issuers in the mining sector. In recent years, important amendments have been made to the existing regulatory framework. The purpose of this presentation is to review the changes that have taken place in mining regulations over the past few years, and to analyze the consequences of these amendments on the development of the mining industry in Québec and Canada.

The implementation of National Instrument 43-101 – **Standards of Disclosure for Mineral Projects** undoubtedly represents one of the most important changes to date. Based on a new formulation of former National Policy Statement n° C2-A and National Policy Statement n° C-22, this initiative of Canadian Securities Administrators (CSA) was devised in accordance with recommendations of the *Comité de réflexion sur le financement de l'industrie de l'exploration minière québécoise* as well as the Mining Standards Task Force of the Toronto Stock Exchange and the Ontario Securities Commission. Comments submitted by several stakeholders also influenced the final formulation of this disclosure standard.

In a globalization context, National Instrument 43-101 is designed to enhance the reliability and integrity of public information disclosed by members of the mineral industry. This standard is also part of a regulatory reform strategy launched by CSA throughout Canada (National Standards), the objective of which is to lighten the regulatory burden on market participants. The level of harmonization reached by CSA ensures the effectiveness of the current securities regulatory framework, while taking into consideration Québec's specificity.

Session 3 8:30 – 9:20

Energy supply/demand trends and forecasts: Implications for a sustainable energy future for Canada and the world

J. David Hughes (Geological Survey of Canada)

An analysis of world and North American energy production and consumption over the past several decades indicates strong growth. Even with the growth of "zero emission" nuclear and large hydro, hydrocarbons (oil, gas and coal) made up more than 85% of world primary energy consumption in 2002, and are forecast to make up more than 85% of a greatly expanded energy demand by 2025. Energy demand in the developing world is forecast by the Energy Information Administration to grow by 94% through 2025, when this region will account for nearly half of the world's energy consumption. The question is, are these forecast growth rates sustainable, given the magnitude and distribution of the world's remaining energy reserves, and what are some of the political and social ramifications of maintaining this rate of consumption? Natural gas in North America is of particular concern, as it is largely a captive market (with the exception of about 1% LNG at present) and demand, particularly for electricity generation, is forecast to grow dramatically over the next two decades. This talk focuses on the "Big Picture" and how Canada fits into it, as well as what must be considered going forward to assure a sustainable energy future.

Session 3 9:20 – 9:40

Hydrothermal dolomite development in the St. Lawrence Lowlands

Michael Binnion (Questerre Energy Corporation)

Questerre Energy Corporation and its partner Terrenex Acquisition Corporation were first interested in the potential of the St. Lawrence Lowlands in the late 1980's. Terrenex was responsible for forming a joint venture with Bow Valley Industries Ltd. (now Talisman) and Amerada Hess (now Petro-Canada) to drill two wells exploring for tilted fault blocks. While this venture did not discover commercial gas quantities it did confirm a deep gas source within the St. Lawrence Lowlands. It also garnered a significant amount of knowledge and data exclusive to the Questerre/Terrenex group.

In more recent times there has been a great deal of interest North America-wide in concepts surrounding the hydrothermal dolomitization process. This has led to significant discoveries in the Appalachian Basin and North East British Columbia, in particular the Columbia Gas discovery in West Virginia in 1999 and the LadyFern discovery in 2000.

The Columbia Gas discovery of 1999 re-invigorated the Appalachian Basin that had not seen a significant discovery for decades. LadyFern impacted North American gas markets and set off a new exploration boom in North East British Columbia.

From our past work, the Questerre/Terrenex group believed that the St. Lawrence Lowlands had an analogous geological setting to the Rome Trough in Appalachia.

Questerre has been working for the past few years to establish that the hydrothermal dolomite trend through the Appalachian basin has potential to continue in the St. Lawrence Lowlands. Further work has established that there are exciting opportunities to drill for reservoir structures that are even larger than those found so far in West Virginia and New York State.

Questerre's presentation details the work they carried out and their drilling prospect. Questerre and Terrenex have recently entered into a conditional farm-out arrangement with a local Québec natural gas company, Gastem, that would lead to drilling of the Questerre *et al.* St-Sophie well in the Becancour area in January of 2004.

Session 3 9:40 – 10:00

Commercial production of natural brine in the Bécancour area

Jacques Raymond, eng. (President Junex-Solnat inc)

Commercial production of natural brine is a first in Québec. Natural brine produced by JUNEX is marketed by JUNEX SOLNAT INC., a wholly-owned subsidiary of JUNEX Inc. The product, commercialized under the name SOLNAT, is currently sold as a de-icing agent and dust abatement product for roads in Québec, Ontario and the northeastern United States. Clients for these products mainly consist of government transport departments, municipalities as well as private industries that need to maintain gravel roads (ex: logging, mining, etc.).

JUNEX currently sells two types of brine extracted from two different wells; the first is located in the Bécancour industrial park, and the other is in Ste-Angèle-de-Laval. The first brine has a chloride content ranging from 27 to 29%, whereas the second ranges from 32 to 35% chloride. Both brines possess the qualities required to meet the needs of winter and summer markets. The Ste-Angèle brine (32-35%) is in the final phase of evaluation to receive provincial certification for use as a dust abatement product, whereas the Bécancour brine (27-29%) has just been approved by the *Ministère des Transports du Québec* for use as a de-icing aid for road salt.

With an initial output of 1,000 m^3 in 2001, JUNEX will produce over 15,000 m^3 in 2004, with a peak production rate of 40,000 m^3 in 2008.

Oral Presentations

Session 3 10:00 – 10:20

The discovery and development of the McCully natural gas field, southern New Brunswick

Norm Miller and Paul Hopkins (Corridor Resources Inc.)

In September 2000, Corridor Resources Inc. and Potash Corporation of Saskatchewan discovered natural gas while drilling the McCully A-67 exploration well located approximately 12 kilometers northeast of Sussex, New Brunswick. The well encountered a thick section of natural gas-bearing sands in the Albert Formation (Mississippian age). Since the discovery, six step-out wells have been drilled on the McCully structure, all encountering natural gas-bearing sands. In April, 2003, the first two McCully wells commenced gas production to the nearby potash mill at a combined rate of over 2 million cubic feet per day. The production performance to date has been excellent, and an independent petroleum engineering company has provided a recent assessment of the reserves and future production potential of these wells. Corridor is now in the planning process for expanding the project to develop sufficient reserves and production capacity to justify a pipeline lateral to tie in the field to the Maritimes & Northeast Pipeline, located approximately 45 kilometers to the north of McCully. The development expansion is expected to include a 3-D seismic survey and the drilling of 20 development wells over the next couple of years.

Session 3 10:20 – 10:40

Storage capacity development of the Saint-Flavien underground reservoir

Glenn Kelly (Intragaz Inc.)

Underground storage sites are key components in the natural gas supply chain, especially in Québec, given its location at the easternmost end of the *TransCanada Pipelines* network. Intragaz has developed and operates the only two underground storage sites in Québec, including the Saint-Flavien site.

Located in the St. Lawrence Lowlands, the Saint-Flavien structure is a thrust slice mainly composed of carbonates and sandstones. The Saint-Flavien reservoir or gas field occurs in unit B of the Beekmantown dolomites. The reservoir is characterized by its low and very heterogeneously distributed porosity and permeability, thereby making its conversion into an underground storage site a complex and risky venture.

To fully develop the potential of the Saint-Flavien reservoir, Intragaz had to innovate, using avant-garde drilling techniques. Four wells, with multiple horizontal wells, were drilled using a technique known as underbalanced drilling, with the emplacement of DDV deep well vents, a world premiere in the gas storage industry.

These four wells, with nearly 5,500 metres of horizontal wells, have allowed Intragaz to double the useful volume of the reservoir, and to increase its peak output fourfold.

Session 3 10:40 – 11:00

Development of the first natural gas field in the Gaspésie region, Galt

Jean-Yves Lavoie and Jean-Sébastien Marcil (Junex Inc.)

Commercial production began at the Galt natural gas and condensate field, located 15 km west of Gaspé, in February 2002 by Québec company JUNEX. The productive zone is a fractured Devonian limestone located at the base of the Forillon Formation. The start-up of this first operation is a direct result of numerous years of efforts by JUNEX and its precursors in the northeastern Gaspé Peninsula.

The first wells in the area were drilled in the 1950s, and demonstrated the presence of oil and gas in Devonian limestones. In the 1980s, SOQUIP and its partners, Petro-Canada and Imperial Oil, led an important geophysical campaign and completed a 2,500-metre well in the Galt structure. Important oil and gas shows were intersected. Production tests led by JUNEX established that the reservoir, located at 2,300 metres, was fractured with an initial pressure of 18,720 kPa. Natural gas extracted from the Galt field contains 89% methane and has a heating value of 1,154 BTU/cf.

Compression and trucking of natural gas have allowed JUNEX to deliver gas to its first customers, the Gaspé Smelter and Pêcheries Marinard. JUNEX ships 200,000 cubic feet of gas daily, but its facilities have an output capacity of 1.2 million cubic feet. The success of gas shipments makes several exploration zones more attractive, and has prompted JUNEX to increase the output capacity at Galt. Two new wells have already been completed in the reservoir, and more than 125 line kilometres of seismic data have been recorded by JUNEX since 2001.

The potential regional market is estimated at 5 BCF per year. The market is located along the coast, in the Gaspé and Chandler area. The recent involvement of Hydro-Québec in oil & gas exploration provides additional support and new impetus for JUNEX and its partner, Bernard Lemaire, to continue developing the gas potential of the Gaspésie region.

Session 3 11:00 – 11:20

Anticosti - The next Albion-Scipio?

Claude Morin (Senior Petroleum Geologist, Hydro-Québec Pétrole et gaz)

Anticosti is a vast island oriented ESE-WNW, located in the Gulf of St. Lawrence. Covering a surface area of 7,953 km^2 (222 km by 55 km), *i.e.* 17 times the size of the island of Montréal, Anticosti is part of a huge partly marine basin, essentially characterizing the Cambrian-Silurian carbonate platform.

Oil & gas exploration began on the island in the 1960s and 1970s, with Imperial Oil, ARCO and SOQUIP. A total of 8 wells were drilled on poorly defined targets or without seismic data. Oil discoveries west of Newfoundland (Port-au-Port) unequivocally demonstrate that the oil system works well east of the Anticosti platform. Intense exploration conducted by Corridor, Shell and Encal from 1996 to 2001 has confirmed the hydrocarbon potential of the Anticosti basin.

Hydrothermal dolomites of the Trenton Formation (SOQUIP in-house nomenclature) represent one of the targets of Hydro-Québec's exploration program. This oil target is comparable to the world-class Albion-Scipio oil field, located in the southeastern Michigan basin. The Anticosti platform is the same age (Ordovician) and represents the same depositional setting as this oil field, *i.e.* along the Cambrian-Ordovician paleo-shoreline. The Albion-Scipio field (124 MM barrels – 204 BCF) is a classic example of a dolomitic reservoir that developed and is controlled by fracturation. The Ordovician Trenton Formation consists of dense limestone with elongate (± 50 km) and narrow (± 1.6 km) alteration zones characterized by the development of a vuggy porosity, fractures and cavities. Albion-Scipio is a stratigraphic trap located above reactivated basement faults. The only detectable structural expression for this type of trap is the presence of a minor sag at the top of the Trenton. The internal seismic signature of Trenton dolomitization also translates either by the loss or the chaotic amplitude of the seismic signal. This type of reservoir is also characterized by abundant lost circulation during drilling.

At this time, the Trenton target on Anticosti seems to show all the same characteristics as the Albion-Scipio oil field. Anticosti seismic profiles show sags at the top of the Trenton platform, associated with seismic signal losses within the Trenton. Drilling of the Chaloupe well (Shell, 1999) went through 70 m of porosity (fractures) and good permeability, in addition to recording, during drilling, a loss of 270 m^3 of drilling mud in the Trenton Formation. During the summer 2003, Hydro-Québec namely completed 2 seismic surveys totalling 325 km, in order to target this type of very promising trap on Anticosti.

Oral Presentations

Session 4 1:30 – 2:20

Metallogenesis of Ni-Cu-PGE mineralization in mafic and ultramafic flows and sills

C. Michael Lesher, (MERC, Department of Earth Sciences, Laurentian University)

Magmatic Fe-Ni-Cu-(PGE) sulphide deposits occur throughout geologic time, primarily in rifted, continent-related tectonic settings, associated with a wide variety of mantle-derived, mafic-ultramafic magma types. The ores are normally associated with the most magnesian cumulate rocks in the sequence, which are interpreted to represent lava channels or magma conduits. The parental magmas are undersaturated in sulfide, implying at least moderate degrees of partial melting, but the composition of the source, the precise degree of partial melting, and the depth of melt extraction do not appear to be critical in the genesis of economic deposits. The host rocks at most Archean and some Proterozoic deposits are derived from more magnesian magmas and are extrusive, whereas those at most Phanerozoic and some Proterozoic deposits are derived from less magnesian magmas and are intrusive. These evolutionary changes probably reflect fundamental and irreversible changes in the thermal structure of the Earth's mantle and crust. *Type I* stratiform basal massive/net-textured/disseminated sulfides formed early in the crystallization history of the host unit, *Type II* stratabound internal disseminated sulfides, *Type III* stratiform ("reef" style) internal disseminated sulfides, and *Type IV* sediment-associated and vein-type sulfides formed at an intermediate stage in the crystallization history of the host units, and *Type V* tectonic offset mineralization formed after crystallization of the host unit. The host units at Types I and II commonly exhibit geological, stratigraphic, geochemical and/or isotopic evidence of crustal contamination and in most cases the majority of the S appears to have been derived from crustal rocks via thermo-mechanical erosion and/or devolatilization. The compositions of the ores and the degrees of contamination and/or chalcophile element depletion in the host rocks vary with the stratigraphic and volcanic/sub-volcanic architecture of the system, the compositions of the magma and the contaminant, the partitioning behavior of the various elements at the prevailing T, P, fS_2, and fO_2, and the relative masses of silicate magma, sulphide melt, and other components (silicate xenomelts, residues, or crystalline solids) in the system. Ores in intrusive settings are often differentiated into Cu-PGE-rich and Cu-PGE-poor facies, probably reflecting a combination of fractional crystallization of MSS and remelting/zone refining during slow cooling, whereas those in volcanic settings are commonly less differentiated, reflecting a more rapid cooling history. Most deposits have been modified by hydrothermal alteration, deformation and/or metamorphism.

Session 4 2:20 – 2:40

Cu-Ni-PGE mineralization at the Expo-Ungava and Mesamax deposits, New Quebec

James Mungall (University of Toronto)and Todd Keast (Canadian Royalties Inc.)

The South Raglan trend constitutes a series of magmatic Ni-Cu-PGE sulfide deposits and showings along approximately 100 km strike length running parallel to the currently producing deposits of the main Raglan trend. The two most significant occurrences are the Expo-Ungava deposit and the Mesamax deposit. The Expo-Ungava deposit is a 15 Mt resource grading 0.6% Ni and 0.8% Cu and estimated to contain 1 to 3 g/t of Pd. The resource at Mesamax consists of 1.45 Mt of massive to disseminated sulfide mineralization hosted by pyroxenite and grading 2.1% Ni, 2.7% Cu, 0.3 g/t Au, 1.0 g/t Pt and 4.2 g/t Pd. Mineralization consists of massive pyrrhotite, pentlandite, chalcopyrite and magnetite, or of disseminated pyrrhotite, pentlandite and chalcopyrite. Evolution of the sulfides is consistent with nearly complete equilibrium crystallization of monosulfide solid solution from sulfide magma followed by outward migration of fractionated sulfide melts rich in Cu, Pd, and Au to form extremely Pd-rich selvedges around bodies of massive sulfide. Mineralization is hosted by irregularly zoned mafic to ultramafic intrusive bodies hosted by metasediments and metavolcanics of the Povungnituk Group in the New Quebec Orogen. Whereas preliminary fieldwork led to the interpretation that the mineralized ultramafic rocks were channelized flows belonging to the Povungnituk Group, extensive mapping in 2003 has shown that they are sharply discordant magmatic conduits in all cases. Mineral fabrics, metamorphic grades, detailed drill sections and map patterns show that the entire South Raglan trend can be interpreted as a series of en echelon or parallel dikes trending approximately N70E, which can collectively be termed the Expo Dikes. The Expo Dikes were emplaced into the New Quebec Orogen after the development of km-scale open folds in the metasedimentary and metavolcanic supracrustal succession and after their host rocks had cooled from peak metamorphic conditions. Post-emplacement metamorphism has largely replaced primary phases with a greenschist mineral assemblage, but some large masses of gabbro-norite and pyroxenite remain very fresh. Locally intense ductile shear produced greenschist facies assemblages and is associated with a later deformational episode. Although the overall similarity of the mineralization in the Expo Dikes invites correlation with the Raglan trend, the grossly different Cu/Ni ratios (1.0 in the Expo Dikes, 0.3 at Raglan) suggest that the two suites are unrelated. The timing of emplacement of the Expo Dikes is problematic and may require re-evaluation of the tectonic evolution of the New Quebec Orogen.

Session 4 2:40 – 3:00

Ni-Cu-PGE occurrences in the Gayot project, Venus Archean greenstone belt, Far North

Michel Chapdelaine and Paul Archer (Virginia Gold Mines Inc.)

The Gayot project is located in the Far North, 110 kilometres north of Caniapiscau reservoir, in NTS sheet 23M. The property, wholly owned by Virginia Gold Mines Inc., was acquired in 1997 and now covers a surface area of 270 square kilometres.

The Gayot area marks the junction between the La Grande, Ashuanipi, Minto and Bienville Archean subprovinces. The bedrock is dominated by undifferentiated tonalitic to granitic rocks that enclose many volcano-sedimentary belts from one to ten kilometres in size on average.

The Gayot project covers the most extensive belt in the area, the Venus Belt. The latter extends for 25 kilometres along strike and is more than 5 kilometres wide. Overall, the Venus Belt constitutes a south to southeast-facing overturned homoclinal sequence. The belt is dominated by a thick felsic volcano-sedimentary sequence with a synvolcanic tonalitic intrusion and conglomerate units near its base. In the upper part of the belt, a sulphide-rich exhalative horizon occurs, along with a pile (500 metres) of thin spinifex-textured ultramafic flows overlain by komatiitic basalts, basalts, oxide-facies iron formations and finally, a sequence of amphibolites and mafic gneisses.

A number of ultramafic units extend for several kilometres along strike within the felsic volcano-sedimentary sequence. Most of these thick olivine cumulates are interpreted as fractionated flows, based on geochemical and lithological evidence of differentiation within each flow and within the sequence itself, as well as their geological relationship with surrounding country rocks. They are often accompanied by thinner spinifex-textured ultramafic flows.

Exploration to date has uncovered several high-grade Ni-Cu-Co-PGE showings over a strike length of 25 kilometres within the Venus Belt. These showings mainly consist of variable proportions of massive, net-textured or disseminated sulphides (Po-Pn-Cpy) hosted at the base or within thick fractionated ultramafic flows and accompanying thin spinifex-textured flows.

Ni-Cu-PGE occurrences in the Venus Belt are similar in many ways to ore deposits found in Archean ultramafic belts in western Australia, or a little closer to home, to deposits in the Proterozoic Cape Smith Belt.

Session 4 3:00 – 3:20

Volcanic and metallogenic evolution of the Bousquet Formation, Blake River Group, Abitibi

Benoit Lafrance (MRNFP), Benoît Dubé, Alan G. Galley (GSC), Patrick-Mercier Langevin (INRS-ETE), Jocelyn Côté (Agnico-Eagle), Normand Bédard (Barrick Gold), Yueshi Lei (Cambior), Mark D. Hannington (GSC), Don W. Davis (ROM), James Moorhead, Pierre Pilote (MRNFP), Wulf U. Mueller (UQAC)

The Bousquet Formation forms the easternmost extension of the Blake River Group in the Abitibi region. A regional evolution model is proposed, based on the results of mapping and metallogenic studies carried out in partnership with mining companies Agnico-Eagle, Barrick Gold, Cambior and Yorbeau Resources as well as the Geological Survey of Canada within the scope of the "Synthesis of the Doyon-Bousquet-LaRonde mining camp" project.

This model, based on observations, deals with the construction of the Bousquet volcanic edifice (Bousquet Formation) and the emplacement of associated ore deposits. The volcanic pile is characterized by volcanic products alternately derived from explosive and effusive volcanism, interpreted as the result of a former composite volcano (stratovolcano) roughly 24 km in diameter at its base. The volcanic sequence is namely characterized by the considerable volume of volcaniclastic rocks, and the abundance of dacites-rhyodacites relative to rhyolites.

Mapping of the entire volcanic complex shows that sizeable ore deposits are located in what is interpreted as the central part of the volcanic edifice, *i.e.* where km-scale domes of calc-alkaline dacite-rhyodacite are present. This is also where the Mooshla synvolcanic pluton is found, and where eruptive centres associated with the various phases of volcano construction are recognized.

As the widely accepted model suggests, it appears that synvolcanic structures associated with eruptive centres also served to channel hydrothermal fluid circulation, since the ore deposits are clustered in the same area. We recognize three main episodes of gold-rich volcanogenic massive sulphide formation, occurring at different stratigraphic levels. This suggests an alternating volcanism/mineralization process during the construction of the former Bousquet volcano, in a gold-rich geodynamic setting.

Isotopic ages show that volcanism remained active over a time frame of roughly 5 Ma, from 2698.4±1.3 Ma (lower member) to 2697.8±1.0 Ma (upper member, LaRonde property) or as late as 2694.0±2.0 Ma (upper member, Doyon property). These results indicate that, although the volume of volcanic rock is relatively modest, the construction of the Bousquet Formation is similar to other units in the Blake River Group, both in terms of age and duration. The gold-rich nature of this area is therefore associated with a specific geodynamic setting rather than a particular gold-rich metallogenic event. Evidence of explosive volcanism, the important volume of calc-alkaline dacite-rhyodacite, the presence of acid and neutral epithermal-type gold-rich massive sulphide deposits all suggest that the Bousquet Formation is the product of volcanic activity at the leading edge of a mature volcanic arc.

Oral Presentations

Session 4 3:20 – 3:40

The LaRonde ore deposit, Abitibi, Québec: Mineral deposit study of a world-class gold-rich massive sulphide ore deposit and implications for exploration

Benoît Dubé (GSC), Patrick Mercier-Langevin (INRS-ETE), Mark Hannington (GSC), Benoît Lafrance (MRNFP) and Don Davis (ROM-U.T.)

The LaRonde mine (Penna shaft) is the largest gold mine currently in operation in Canada, with reserves and resources estimated at 59.3 Mt @ 4.24 g/t Au, 0.36% Cu and 2.15% Zn, for a total of 8.1 M oz Au. It is part of the Doyon-Bousquet-LaRonde gold district, the second most important gold district in Québec with over 21 M oz Au (production, reserves and resources). The LaRonde ore deposit is characterized by four main lenses of economic polymetallic massive sulphides stacked from north to south in a pile of felsic lavas located in the upper part of the Blake River Group (Bousquet Fm.). The succession defines a volcanic environment dominated by dacites-rhyodacites that form modest-sized domes and volcaniclastic deposits. The main lens (20N) formed by replacement in the upper part of a rhyodacitic volcaniclastic horizon. A gabbro sill (andesite) forms the hanging wall of lens 20N and the footwall of lens 20S. A Mn-garnet-biotite-chlorite alteration zone and a biotite-rutile/titanite zone with Po-Py stringers respectively form the footwall and hanging wall of lens 20N, whereas the presence of green mica and Po-Py characterizes the footwall of lens 20S. At depth, lens 20N grades into a gold-rich aluminous (high-sulphidation) zone with quartz-pyrite-kyanite-andalusite that hosts cm-scale to m-scale bands of semi-massive to massive sulphides, mainly Py-Cp and sphalerite. This mineralized zone is surrounded by quartz-garnet-sericite-paragonite-biotite-chlorite±staurolite schists. Massive sulphide lenses are mainly composed of recrystallized pyrite and sphalerite, as well as minor Cp-Po-Ga. The presence of a gold-rich aluminous zone at depth indicates a transition from a neutral (low-sulphidation) volcanogenic massive sulphide (VMS) to an acid (high-sulphidation) epithermal-type VMS. This variation is partly controlled by the proximity of depositional sites relative to the heat source and the (magmatic?) fluid. This proximity influenced the temperature of the fluid, its reduction by seawater and its ability to carry gold and copper. The LaRonde and Bousquet 2 ore deposits are interpreted as the expression of a single gold-rich VMS complex. Exploration-wise, it is important to note that gold-rich VMS deposits in the camp are not always associated with andalusite-bearing alteration zones, as lenses at LaRonde indicate.

Session 4 3:40 – 3:00

3D common-earth modelling of the Bousquet Formation, Southern Volcanic Zone, Abitibi Subprovince, Québec

Francine Fallara (URSTM-UQAT), Benoit Lafrance (MRNFP), Li Zhen Cheng (URSTM-UQAT), Geneviève Boudrias (MRNFP), Jocelyn Côté (Agnico-Eagle), Normand Bédard (Barrick Gold), Yueshi Lei (Cambior), Benoît Dubé, Alan G. Galley (GSC)

The purpose of this project is to create a regional 3D model for the Bousquet Formation, in the Doyon-Bousquet-LaRonde (DBL) mining camp. The 3D common-earth modelling approach will be used to complete the synthesis of the DBL mining camp, a project launched in the summer 2000 by the Ministère des Ressources naturelles, de la Faune et des Parcs with the close cooperation of mining companies Cambior, Barrick Gold, Agnico-Eagle and Yorbeau Resources, the Université du Québec en Abitibi-Témiscamingue, the Geological Survey of Canada and the Université du Québec à Chicoutimi. Databases (geology, lithogeochemistry, assays, drillholes and sections) used for 3D modelling in gOcad® were essentially supplied by mining companies involved in the DBL mining camp.

The first phase of 3D common-earth modelling began in September 2003, with the harmonization of available multidisciplinary data. As with all the other 3D modelling projects of the Ministère des Ressources naturelles, de la Faune et des Parcs, the purpose of this project is to promote the use of this new technology as an exploration tool. Objectives specific to the DBL mining camp are listed below:

1. Build a regional 3D common-earth model (12.8 x 3.5 x 2.0 km voxet) incorporating all available multidisciplinary data;

2. Perform unconstrained and constrained geophysical inversions to validate the geological 3D model;

3. Broadly define the relationship between the different stratigraphic units and altered and mineralized horizons.

Session 4 4:00 – 4:20

Casa Berardi project: Past achievements and upcoming milestones

Michel Gilbert (Aurizon)

The Casa Berardi project is one of three projects located in the Québec portion of the Abitibi belt, where aggressive development work has led to a significant increase in resources. The ore deposit may have yielded a historical output of 688,000 ounces prior to the end of operations but now, additional resources in excess of two million ounces have been identified.

Following an update on the latest information acquired during recent exploration programs and an overview of the work schedule proposed in the completed feasibility study, the speaker will demonstrate how Aurizon intends to reach each milestone leading up to a resumption of mining operations.

The selected approach is designed to lower financial and technical risks to a point where a positive decision to go ahead with production can be taken. A surface exploration program will be carried out to extend the expected mine life beyond ten years. An underground exploration program will be conducted to validate bedrock stability, ore zone geometry and grade continuity, and will provide a bulk sample to validate previous metallurgical tests. We believe that this work will enable us to upgrade current resources to reserve status.

Session 5 8:30 – 9:15

Surface geochemical exploration in thick overburden - Quantum leaps in both application and understanding

Stewart M. Hamilton (Ontario Geological Survey)

In the last 5 years, the Ontario Geological Survey, in conjunction with the Geological Survey of Canada and industry groups has carried out a series of projects, the purpose of which has been to find new ways of detecting deeply buried mineralization in areas of thick glacial drift. The success of these projects in detecting a surface geochemical signal over such features led to a second objective of accounting for the presence of these responses and determining the mechanism resulting in transport of the metals from mineralization through overburden to surface.

Three types of geological features were investigated: mineral deposits (including gold and VMS), kimberlites and "forest rings", which are large circular features in northern forests that we have shown to be centres of negative charge. Over all these features are "reduced chimneys", which are considered to be key evidence that the transport of metals occurs due to strong redox gradients above the buried feature. Surface chemical data include both commodity and indicator elements by both selective-leach and strong acid digestion techniques. Commodity-element responses include Zn, Cd and Pb over VMS and Ni, Cu, Ba and Ca over kimberlite. Indicator element responses include halos of Y, Br, and rare earth elements around the reduced chimneys, regardless of the source of the reduced conditions. In the case of VMS, strong low-pH responses are observed in the vadose zone above the reduced chimneys. The variation in pH and redox above the mineralization causes several secondary geochemical processes including carbonate remobilization. Several unexpected phenomena were also observed including temperature anomalies and bizarre "bulges" in the water table that occur at the strong redox boundaries over all features investigated. These latter features may be a previously undocumented form of electro-osmosis.

The concept of redox-gradient transport is not new but presents certain theoretical problems with respect to established equations in physics. Contrasting that with the weight of geological evidence supporting it reveals an enigma that leads us in a fascinating new research direction.

Oral Presentations

Session 5 9:15 – 10:00

Indicator mineralogy: A tool for reviving mineral discoveries in the Abitibi

Stuart A. Averill (Overburden Drilling Management Ltd.)

In the 1980s and early 1990s, the Abitibi region of Québec was being actively explored and many new mineral discoveries were being made. In the last ten years, however, exploration in the Abitibi has declined, exploration methods have changed and very few discoveries have been made. Has the mineral potential of this venerable mining region been exhausted or are we no longer exploring effectively – was the last decade just "Ten Lost Years"?

Most of the exploration successes of the 1980s were gold discoveries and many of these, beginning with Casa Berardi, were made by RC drilling on modest annual budgets of $4 million or less. RC drilling is a home-grown Abitibi exploration technique that was developed at the Kidd Creek open-pit mine in 1970 after glacially dispersed sulphide mineralization was observed in the till. It was designed to recover high-quality till samples from any depth. These samples were then processed for heavy minerals to concentrate the sulphides, making them detectable by geochemical analysis. Mineralization grading as little as 0.1% Cu or Zn became detectable at long range. The physical sulphide minerals and gold grains also proved to be useful; heavy mineral geochemistry began to evolve into indicator mineralogy.

In the 1990s, RC drilling fell from favour. The price of gold fell precipitously. In exploration tools, high tech was all that mattered. Astronomical leaps in computing capacity led to the development of more sensitive geophysical and geochemical instrumentation and 3D modelling software. The theory was that more sensitive instruments would readily find much deeper deposits. But where are the discoveries?

While all the RC drills were idle in the Abitibi, indicator mineralogy shifted into high gear elsewhere, mainly using surface samples in the search for diamonds. The results were astounding. At least eight new kimberlite fields were found and two major diamond mines were developed, dwarfing any geophysical or geochemical discoveries in the gold and base metal sectors. Chuck Fipke identified the Ekati mine from KIMs in till 600 km down-ice – a distance equal to the orbiting height of our remote sensing satellites. The power of indicator mineralogy had been graphically demonstrated! Geophysics played a follow-up role in identifying individual pipes within the kimberlite fields but geochemistry was ineffective because the elements of interest in KIMs – Mg and Cr – are too abundant in other, ordinary heavy minerals.

Predictably, indicator mineralogy was soon adapted to base metal exploration. Specialized indicator mineral suites were developed for Ni-Cu-PGE, porphyry Cu and metamorphosed VMS and BHT deposits. Like KIMs, most of these indicators are non-sulphide minerals containing elements such as Mg, Cr, Mn and Al that impart the chemical stability needed for surface sampling but are unuseable geochemically. Such minerals are present in the large alteration zones associated with many volcanogenic gold and base metal deposits in the Abitibi including Bousquet, Louvicourt and Lac Dufault. Using these alteration minerals in conjunction with gold grains and the base metal sulphide grains available in fresh till at depth would facilitate the discovery of subtler and deeper deposits in the Abitibi. After ten lost years, it's time to re-open the exploration toolbox and break out the RC drills!

RC: reverse circulation

KIM: kimberlite indicator mineral

BHT: Broken Hill-type

Session 5 10:00 – 10:20

Rutile as a potential indicator mineral for metamorphosed metallic ore deposits

James R. Clark (McGill University) and A. E. Williams-Jones (Cygnus Consulting Inc.)

Rutile occurs commonly in mineralized and altered rocks associated with relatively high-temperature hydrothermal and granitoid-related deposits, as well as deposits formed at lower temperature that have been metamorphosed to greenschist or higher grades. Such rutile typically has a composition that includes minor concentrations of ore-related metals. By contrast, rutile in unaltered and barren rocks tends to have a composition that is close to relatively pure TiO_2 with minor substitutions of host rock-related elements such as Fe, V and Nb.

Rutile from variably metamorphosed districts in the Canadian Shield has been evaluated by petrographic and electron microprobe studies. Deposits evaluated include Troilus (Au-Cu), Matagami (Cu-Zn; Bell-Allard, Norita, Radiore, Garon Lake), Montauban (Au-Cu), Horne (Cu-Au), Siscoe and E. Amphi (Au), Lac-des-Iles (Pd-Ni-Cu), Kidd Creek (Zn-Cu-Ag), and Hemlo and Red Lake (Au). Additional data has been collected from several unmetamorphosed Cu, Sn, W and Mo deposits that formed at elevated temperatures. Rutile occurs in significant abundance in most of these deposits and is present in at least minor amounts in all of them. Irrespective of metamorphic grade, rutile is most plentiful in zones of hydrothermal alteration where sulfide minerals are also abundant. In many ore deposits, rutile is characterized by significant concentrations of metallic elements such as W, Sb and Sn; subordinate Cu and Ni are also present in rutile in some deposits. Rutile from mesothermal and related gold deposits tends to contain W (and locally Sb and occasionally V), and that from volcanogenic massive sulfide Cu-Zn deposits contains Sn (and locally W and Cu). In at least some magmatic-hydrothermal Pd deposits, rutile contains Ni and Cu. Although clear relationships between metal substitution in rutile and ore grades are difficult to establish, it is apparent that there is at least a crude positive correlation in most deposits. Background metal concentrations in rutile have not yet been evaluated in detail, but in most deposits, rutile from unaltered wallrock or peripherally altered rocks has metal concentrations that are at or below lower detection limits.

We propose that minor/trace elements in rutile reflect metal associations of host ore deposits, and that rutile compositions from residual, fluvial and glacial sediments derived from weathering/erosion of these deposits can be used in geochemical exploration. Rutile has definite potential as an indicator mineral for a wide variety of metallic ore deposits hosted by metamorphosed terrains, and may also have widespread application in mineral exploration in other areas.

Session 5 10:20 – 10:40

Exploration Outlook in Québec for a neglected commodity, Sidex strategic diversification newsletter

Normand Grégoire (NGI Consultants inc.)

SIDEX, the **Diversification of Exploration Investment Partnership**, is sponsored by the Government of Québec and the Solidarity Fund QFL. Its mandate is to invest in the share capital of mining companies working on promising exploration projects in Québec that show a good potential for diversification.

SIDEX takes advantage of its presence at Québec Exploration - 2003 to release its fourth "Strategic Diversification Newsletter", this time in collaboration with the Ministère des Ressources naturelles, de la Faune et des Parcs (MNRFP). The objective of this newsletter is to give information on commodities that have been underexplored in Quebec but for which there exists a potential for discovery in the province. The newsletter will be accessible to all on the SIDEX website www.sidex.ca and on the MRNFP website www.mrnfp.gouv.qc.ca/mines/mineraux at the very same time as the oral presentation. The nature of the commodity will be disclosed at that time.

The newsletter and oral presentation will include: a market overview, principal types of economic deposits and their characteristics, preferred exploration methods and potential geologic environments in Québec with target areas.

The first diversification newsletters on tungsten, silica and lanthanides are available on the SIDEX website. The MRNFP website provides information documents on graphite and barite.

Oral Presentations

Session 5 10:40 – 11:00

The place of mineral deposits in the geological evolution of the Labrador Trough

Thomas Clark (MRNFP) and Robert Wares (Osisko Exploration Ltd.)

The Labrador Trough (or New Quebec Orogen) is a Paleoproterozoic fold and thrust belt along the NE margin of the Superior Province. The belt includes two volcano-sedimentary cycles (~2.17-2.14 Ga and ~1.88-1.87 Ga), separated by a 260 Ma hiatus, and a third cycle of molasse deposits. Eleven lithotectonic zones have been recognized, each limited by a major thrust fault or erosional unconformity. Each zone has its own lithological assemblage or structural style and a characteristic suite of mineral deposits. We have defined three autochthononous/parautochthonous zones of sedimentary rocks, three allochthonous sedimentary zones, and five allochthonous volcano-sedimentary zones.

A metallogenic and tectonic framework has been developed for all the mineral deposits in the area. Of the 337 deposits located in the orogen or in its immediate hinterland, 103 are Lake Superior-, Algoma-, or enriched-type iron formations, 111 (excluding iron) are of syn- to diagenetic origin, 112 are of epigenetic origin, and 11 are of undetermined origin. The most common syn- to diagenetic types are magmatic Cu-Ni-PGE (72), volcanogenic massive sulfides (VMS, 20), and sediment-hosted stratiform Cu (10). The most common epigenetic types are vein Cu (49), vein Cu-Ni-PGE (20), vein U (18), vein Au (8), and vein Ag-Pb-Zn (8).

Many of the syn- to diagenetic mineralizations in first-cycle rocks can be related to the rifting of the Archean craton, the subsequent filling of the rift, and the establishment of a marine platform. Stratiform Cu deposits in platform dolomite are typical of these mineralizations. Lake Superior-type iron formations were deposited during the platform stage of the second cycle. Algoma-type iron formations and associated VMS deposits were formed in deeper water, in a marine basin contemporaneous with the second-cycle platform. Magmatic Cu-Ni-PGE deposits, hosted mainly in mafic-ultramafic sills and locally in picritic flows, were formed at the beginning of the mafic volcanic episode that closed the second cycle. A carbonatite emplaced near the end of the second cycle is mineralized in Nb-Ta. Epigenetic base-metal mineralizations, which are commonly associated with regional and local faults, were deposited from tectonometamorphic fluids generated during the Hudsonian orogeny (~1.82-1.77 Ga). Some types of deposits that are now virtually unknown in the orogen may eventually be discovered, for example, black shales containing Au, PGE, Ni, Mo, etc.; SEDEX deposits; and paleoplacer Au deposits.

Session 5 11:00 – 11:20

Industrial minerals in Québec: Our position on the world stage

Serge Perreault and Henri-Louis Jacob (MRNFP)

Industrial minerals (and sand, gravel, stone and cement) are an important part of Québec's mineral economy. In 2002, the value of industrial mineral shipments stood at 646.4 million dollars, and represented nearly 18% of all mineral shipments in Québec. In Canada, the value of industrial mineral shipments amounted to 3.3 billion dollars ($G) in 2002, representing 18% of the total value of mineral shipments. In the United States, our greatest importer of mineral products, industrial mineral sales in 2002 reached $8.2G and 14% of the total value of mineral sales.

Industrial minerals extracted in Québec include ilmenite and titanium slag, chrysotile asbestos, silica, graphite, salt, mica (phlogopite), dolomite and limestone. The Tio mine, located in the Côte-Nord region, is the largest producer of hemo-ilmenite derived from consolidated rocks in the world. Lac Tio hemo-ilmenite is used to produce titanium slag and is also a source of flux. Québec ranks among the top chrysotile asbestos producers in the world since 1876, with three mines in operation. In 2002, it ranked second worldwide. Québec also hosts world-class graphite and phlogopite mica deposits. Recently, a few companies have announced major investments to process these minerals, thereby consolidating their position on the North American stage. Silica, dolomite, salt, limestone and high-purity calcitic or dolomitic marble are mainly destined for the domestic market.

The future of industrial minerals in Québec hinges on the development of new markets and the discovery of new ore deposits. With the emergence of new high-technology applications, fuel cells and nanoparticles, Québec, with its world-class graphite deposits, is in a good position to pick up a major share of this world market. The development of value-added silica-based products such as fumed silica, used in high-technology applications, also provides new opportunities for high-purity silica producers. Québec definitely has a strong potential for industrial minerals, and yet development opportunities are scarce because certain countries or oligopolies are in a position to control supply.

Session 6 1:30 – 2:20

Early-stage assessment of kimberlites using indicator minerals, petrography and microdiamonds

Herman Grütter (MSC), John Gurney (MSSA), Tom Nowicki, (MSC) and Rory Moore, (MSC)

This contribution discusses the effective application of indicator mineral, petrographic and microdiamond analysis in diamond exploration.

In the earliest stages of exploration programs, the distribution, abundance and surface textures of mantle-derived indicator minerals recovered from regional heavy mineral samples provides a means of locating likely kimberlite sources or source regions and, under favourable circumstances, help to "fingerprint" different source types. The compositions of the indicator minerals can be assessed in terms of the type (cratonic?), thermal state (hot or cold geotherm?) and diamond potential (diamond-associated mineral varieties present?) of the mantle material that they represent. The information obtained may be used to optimise follow-up sampling programs, prioritise targets or target areas and to fine-tune sample processing flow-sheets. Follow-up sampling and analysis supplements initial regional data, facilitating more confident evaluation of the above-described factors prior to discovery of a potential diamond source (e.g. by drilling, by pitting or in outcrop).

Core drilling and logging to identify and characterise visibly different geological units within a discovered body is extremely important, as it provides the basis for sampling in a systematic, representative manner. Important factors to assess include diamond carrying capacity, homogeneity and possible dilution of individual kimberlite phases. These factors may significantly influence the sampling strategy adopted for the discovery. Detailed petrographic analysis of representative samples is undertaken to accurately classify and describe the discovered body. Key questions to resolve include: is it a kimberlite?; is it magmatically evolved?; has it erupted?; was it contaminated by wall rock? Assessment of diamond potential additionally requires a quantitative determination of the abundance of specific, diamond-associated varieties of garnet and chromite, as well as a sound understanding of the likely depths and temperatures from which they originated. Complexities that need to be accounted for include "false" diamond indicator minerals; the relative contribution of peridotitic and eclogitic diamond sources; and unfavourable geothermal regimes. Microdiamond assays and associated grade predictions based on particle size distribution models are rapidly gaining popularity amongst diamond explorers. This assessment method is a key aspect of early-stage kimberlite evaluation but requires large samples to be processed destructively, provides no explanation for a negative result, and obviously cannot be applied to assess exploration projects in the pre-discovery phase. Careful integration of the above-described methods facilitates reliable assessment and prioritisation of kimberlite samples and hence kimberlite bodies prior to costly bulk sampling exercises.

Session 6 2:20 – 2:40

Kimberlites in Québec: Current status

Réjean Girard (IOS Services Géoscientifiques Inc.), James Moorhead (MRNFP) and Pascal Marchand (IOS)

Québec covers roughly 40% of the largest Archean craton on the planet, the Superior craton. This observation alone provides a quick glimpse of the province's diamond potential, where 28 kimberlite occurrences are distributed as follows: 4 pipes in the Témiscamingue region (Notre-Dame-du-Nord, Guigues, BT-44), 5 pipes and numerous dykes in the Desmaraisville area (Le Tac), 15 pipes and dykes in the Monts Otish area (Renard 1 to 9, Lac Beaver), and 1 sill in the Wemindji area. We can also add to this list diamond-bearing lamprophyre dykes in the James Bay region and in the Torngat area, both located outside of the Superior craton. Indicator mineral dispersal trains are also reported in the Matagami, Waskaganish, Caniapiscau, Fontanges and LG-3 areas.

A compilation of indicator mineral chemistry data available for these occurrences is used to identify parts of the craton characterized by fertile lithosphere. In the area north of the Monts Otish, the presence of fertile lithosphere, namely sampled by kimberlites of the Renard cluster (SOQUEM-Ashton, Birkett *et al.*, 2003), is shown by an abnormally high proportion of harzburgitic pyrope relative to lherzolitic pyrope. Eighty kilometres to the south, the lower chrome content of pyropes in the Lac Beaver kimberlite (Ditem Explorations) suggests that the portion of lithosphere typical of the diamond window has not been sampled extensively. In Témiscamingue kimberlites (Sage, 1996) and the Wemindji dyke (Letendre *et al.*, 2003), the low proportion of harzburgitic pyrope and very high-T geotherms corroborate observed modest diamond grades. The variability of the mantle signature is particularly well portrayed in the Témiscamingue field, where the mineralogy of the Notre-Dame-du-Nord, Guigues and BT-44 pipes was studied in detail (this study; Schulze *et al.*, 1999; Sage, 1996).

In parallel, thermobarometry studies and radiometric ages are used to link kimberlite occurrences in Québec to three major tectonic events: Cretaceous in the Témiscamingue region (Guigues: 142 Ma; Notre-Dame-du-Nord: 125 Ma), Late Precambrian in the James Bay region (Wemindji: 629 Ma; Renard: 630 Ma; Lac Beaver: 551 Ma) and Mesoproterozoic in the Desmaraisville area (Le Tac: 1.1 Ga). These dates are respectively related to the trace of the "Meteor" hot spot, to the opening of the Iapetus Ocean and to the opening of the Keweenawan rift. This approach provides valuable insight to identify high-potential zones associated with major corridors defined by Moorhead *et al.* (1999) and with major continental flexures.

Oral Presentations

Session 6 2:20 – 3:00

Diamond potential of the Renard cluster, Foxtrot property, Monts Otish, Québec

Ghislain Poirier, Pierre Bertrand and Tyson Birkett (SOQUEM Inc.), Brooke Clements and Robert T. Lucas (Ashton Mining Canada Inc.)

In September 2001, the SOQUEM-Ashton joint venture discovered in drillhole two kimberlitic bodies on its Foxtrot property. These discoveries are located in the James Bay region, about fifty kilometres north of the Monts Otish. Since then, eight kimberlitic bodies have been delineated on the property, thus forming a brand new kimberlite field in Canada: the Renard cluster. The estimated diamond content for each of these intrusions is very significant. To date, results of DMS processing on bulk samples totalling nearly 37 tonnes indicate diamond contents ranging from 0.33 to 1.34 carats per tonne. And in June 2003, the joint venture announced the discovery of a diamond weighing more than four carats in a core sample from the Renard 65 body. This is, by far, the largest diamond ever extracted from Québec's bedrock. The mere presence of this stone proves the tremendous diamond potential of the Foxtrot property as well as the strong probability of finding gem-quality diamonds in this part of the Superior craton in Québec. The joint venture's objectives are now to assess the economic potential of the Renard cluster while searching for additional kimberlite bodies on the Foxtrot property. Numerous trains of indicator minerals identified on the property strongly suggest the presence of kimberlitic sources distinct from those of the Renard cluster. The joint venture is also exploring several other properties on a regional scale.

Session 6 3:00 – 3:20

Geology of the Victor kimberlite, Attawapiskat, Northern Ontario, Canada: Cross-cutting and nested craters

Kimberley J. Webb (DBC KPU), Barbara H. Scott Smith (SSP), Joanne L. Paul (DBCEI) and Casey H. Hetman (DBC KPU)

The pipe shapes, kimberlite infills and thus emplacement processes of the Attawapiskat kimberlites, including Victor, contrast with most southern African kimberlite pipes. The Attawapiskat kimberlite pipes formed by an overall two-stage process of initial pipe excavation and subsequent pipe infilling. The Victor kimberlite comprises two adjacent pipes, Victor South and Victor North, which are infilled with two contrasting textural types of kimberlite: pyroclastic (PK) and hypabyssal-like kimberlite (HK). Victor South and much of Victor North comprise PKs that consist of clast-supported, discrete macrocrystal and phenocrystal olivine, juvenile lapilli, mantle-derived xenocrysts and minor country rock xenoliths set in serpentine/carbonate matrices. These partly bedded, juvenile lapilli-bearing olivine tuffs formed by subaerial fire-fountaining airfall processes.

The simple bowl-like shape of Victor South contrasts with the more complex pipe shape and internal geology of Victor North. The northwestern part of Victor North is dominated by dark competent rocks, which resemble fresh HK, but have unusual textures and are closely associated with pyroclastic juvenile lapilli tuffs and country rock breccias ± volcaniclastic kimberlite. Current evidence suggests that the HK is, in fact, not intrusive and that the northwestern part of Victor North represents an early-formed crater infilled with contrasting extrusive kimberlites and associated breccias. The remaining, main part of Victor North consists of macroscopically similar, but petrographically distinct, PKs that have contrasting macrodiamond sample grades. The nature and relative modal proportion of primary olivine phenocrysts in the juvenile lapilli are different, indicating derivation from different phases of kimberlite and thus separate eruptions. The initial excavation of a crater, cross-cutting the earlier northwestern crater, was followed by emplacement of a low-grade olivine phenocryst-rich PK, and the subsequent eruption of a high-grade olivine phenocryst-poor PK, as two separate vents nested within the original crater. The second eruption was accompanied by the formation of an intermediate mixed zone with moderate grade. The final pyroclastic infill of the main part of the Victor North pipe therefore appears to consist of at least three geological/grade zones.

Thus, the Victor kimberlite was formed by several eruptive events resulting in adjacent and cross-cutting craters infilled with either PK or HK, which is now interpreted to be of probable extrusive origin. Within the PKs are two nested vents, a feature seldom documented in kimberlites elsewhere. This study highlights the meaningful role of kimberlite petrography in the evaluation of diamond deposits and provides further insight into the emplacement and volcanic processes occurring in kimberlites.

Session 6 3:20 – 3:40

The northern Alberta kimberlite province: Geological overview and exploration update

D. Roy Eccles (Alberta Energy and Utilities Board, Alberta Geological Survey)

To September 2003, 48 kimberlitic pipes have been discovered in three separate areas of the northern Alberta kimberlite province (NAKP):

1. Mountain Lake cluster (ML): 2 pipes discovered in 1989-1990 by Monopros Limited (the then Canadian exploration subsidiary of De Beers)

2. Buffalo Head Hills field (BHH): 38 pipes discovered between 1997 and January 2003 by Ashton Mining of Canada Inc., in a joint venture with EnCana Corporation and Pure Gold Resources Ltd.

3. Birch Mountains field (BM): 8 pipes, which include 7 pipes discovered in 1998 by Kennecott Canada Exploration Inc., Montello Resources Ltd. and Redwood Resources Ltd., and 1 pipe discovered in December 2000 by New Blue Ribbon Resources Ltd.

The BHH area has the highest diamond content results to date. Twenty-six of the 48 pipes are diamondiferous, and at least three of the kimberlites (K14, K91 and K252) contain estimated diamond grades of >11 carats per hundred tonnes (cpht) with one BHH pipe (kimberlite K252) having preliminary mini-bulk (22.8 t) sample grades of 55 cpht.

The integration of petrography and whole-rock geochemistry of minimally contaminated volcaniclastic rocks, in conjunction with mantle xenocryst compositions, has been used to compare the three regions and aid in the classification of these ultramafic rocks in northern Alberta. The regions can be distinguished from one another by their non-archetypal kimberlite signature (ML) or, in the case of kimberlite fields, primitive (BHH) to evolved (BM) magmatic signatures. This contention is important from a diamond exploration viewpoint because the majority of the BHH kimberlites are diamondiferous, whereas the ML and BM pipes are for the most part barren of diamonds.

It is very likely that with continued exploration Alberta will have an important economic deposit in its future if explorers can discover:

- A "near-surface" pipe with diamond grades similar to, or better than the estimated 55 cpht in pipe K252 (other areas of northern Alberta with high indicator-mineral grain counts and excellent mantle xenocryst chemistry suggest this is possible)

- An economic pipe, or marginal-grade pipe, with stones of similar quality to some that have been found to date within Alberta (e.g., a gem quality, 0.76 c, yellow diamond from K6)

- A marginal-grade pipe, but with aerially extensive surface dimensions similar to many of the pipes discovered to date (e.g., the K5 pipe crops out and is approximately 45 ha.).

Session 6 3:40 – 4:00

An overview of Ontario diamond exploration 2003

Brian T. Atkinson, Ann. C. Wilson and Gary. P. B. Grabowski (Ontario Ministry of Northern Development and Mines)

Diamond exploration in Ontario remains very active with a number of senior and junior companies engaged in exploration throughout the Province. The most advanced project is in the James Bay Lowlands where De Beers Canada Inc. is completing a feasibility study on the Victor project. With an initial 10,000 tonne bulk sample completed with favourable results, the Victor project is shaping up to put Ontario in the league of diamond producers. Proterozoic diamondiferous kimberlites beneath the Paleozoic cover in the James Bay Lowlands attest to a prolonged history of kimberlite emplacement spanning Archean to Cretaceous times in Ontario. In the Lake Timiskaming Structural Zone, a number of companies are targeting a field of diamondiferous Jurassic aged kimberlites adjacent to the Québec border. Sudbury Contact Mines Limited is proceeding with a bulk sample on the 95-2 kimberlite in the area.

Near Wawa, heterolithic breccias of Archean age continue to yield diamonds. The discovery of the 0.72 carat "Big Goose" diamond on the Festival Property by Pele Mountain has maintained exploration interest in the area. Kimberlitic dikes associated with the Kapuskasing Structural Zone are also being explored. With good news on all fronts, this talk will present details from each area of active exploration and examine possible structural controls on kimberlite emplacement.

Oral Presentations

Session 6 4:00 – 4:20

Diavik: Turning a project into reality

Pierre-André Garneau (Les Entreprises Kiewit)

As early as the late 1980s, the Diavik Diamond Mines Inc. (DDMI) joint venture, formed of Rio Tinto PLC and Aber Diamond Mines Ltd, fast-tracked their diamond exploration program following the discovery of a diamond deposit on the shores of Lac de Gras by BHP. Evidence from geophysical surveys and drillcore samples from Diavik properties soon revealed the presence of high-grade kimberlite pipes. And thus, one of the richest kimberlite pipes in the world was discovered in the Northwest Territories in 1994, underneath Lac de Gras, 300 km north of Yellowknife. There are actually two pipes, respectively named A154 South and A154 North. Later on, 2 other pipes, A418 and A21, were also discovered. Following these discoveries, Diavik successfully extracted bulk samples from kimberlite pipes A154 South and A418 through a tunnel from the shoreline.

Given the porosity of these kimberlites, their geographic location under more than 25 metres of water, and the fact that the highest diamond contents were found along the surface of the kimberlite pipes, the need to build a dam around the main pipes (A154 North and South) soon became obvious. A cost analysis performed by the owner confirmed that the project, in the form of an open pit mine, could be viable and feasible. However, it called for innovative techniques, unique in Canada, involving the construction of a rock-fill dike and a containment wall made of plastic concrete.

The joint venture formed by Peter Kiewit & Sons and Nuna Logistics, called Lac de Gras Constructors, was selected to build the project. Lac de Gras Constructors took up the challenge, mobilized its equipment by winter road and took an active part in making its client's dream of opening the second diamond mine in Canada come true. In November 2002, *i.e.* 4 months ahead of schedule, DDMI extracted its first diamond.

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Abitibi and Near North geochronology

Claude Dion (MRNFP), Donald W. Davis (Univ. of Toronto) and SGNO team

This geochronology program supports geological surveys and studies conducted in the Abitibi and James Bay region. Following the 2003 field campaign, seven samples were shipped to the John Laherty laboratory. Preliminary results will be integrated to posters for each of these projects.

Lac Olga II project:

- SGNO-2003-03: a QZ-PG porphyry rhyolite of the Dussieux Formation: this felsic to intermediate volcanic unit overlies mafic lavas of the Wabassee Group, and is overlain by Morris turbidites. It is strongly altered to CB and SR, and hosts gold, silver and copper occurrences.

- SGNO-2003-07: The Berthiaume Syenite is a porphyritic intrusion with cm-scale microcline crystals. This dating analysis will help determine if this intrusion is coeval with vast weakly deformed intrusions in the Matagami area (2693-2694 Ma) or with northern Abitibi alkaline intrusions (Douay: 2676 Ma; Lac Shortt: 2661-2691 Ma; Dolodau: 2677 Ma).

Grenville Front project:

- SGNO-2003-04: A QZ-SR schist derived from a felsic lapilli tuff sampled underground at the Gonzague-Langlois mine, near Zone 97. Until recently, this volcanic sequence was correlated with the Obatogamau Formation (2727 Ma). Work in the Urban-Barry belt however suggests a possible correlation with the Urban Formation (2707-2714 Ma). This age dating analysis will help resolve this ambiguity.

- SGNO-2003-08: Leucosome from a migmatite sampled SE of Lac Larouche, in what is interpreted as the Grenville Parautochthonous Belt. This age dating analysis will help determine if the migmatization episode is associated with a Kenorean or a Grenvillian event.

- SGNO-2003-05: A BO-EP tonalite sample from the Boisvert Pluton is dated to dispel doubts about the synvolcanic or syntectonic origin of this intrusion. Furthermore, the Boisvert Pluton sits along the Grenville Front tectonic zone and is therefore a key element in understanding the Grenvillian orogeny and its effects on Archean terrains.

- SGNO-2003-06: A coarse-grained GR gabbro dyke. These intrusions, most likely Proterozoic in age, are metamorphosed to the amphibolite facies and weakly deformed compared to surrounding country rocks. They may nevertheless exhibit a planar fabric or be cut by shear zones. These dykes therefore appear to be a good marker to distinguish deformation and metamorphism associated with the Kenorean and Grenvillian events.

Metallogenic synthesis of the La Grande Belt:

- SGNO-2003-09: A rhyolitic block tuff located at the top of the Laguiche Group. This QZ porphyry tuff sample represents the unit enclosing gold-bearing iron formations on grid KM-85.

101 – 102

3D common-earth modelling of the Bousquet Formation, Southern Volcanic Zone, Abitibi Subprovince, Québec

Francine Fallara (URSTM-UQAT), Benoit Lafrance (MRNFP), Li Zhen Cheng (URSTM-UQAT), Geneviève Boudrias (MRNFP), Jocelyn Côté (Agnico-Eagle), Normand Bédard (Barrick Gold), Yueshi Lei (Cambior), Benoît Dubé, Alan G. Galley (CGC)

The purpose of this project is to create a regional 3D model for the Bousquet Formation, in the Doyon-Bousquet-LaRonde (DBL) mining camp. The results of 3D common-earth modelling will be used to complete the synthesis of the DBL mining camp, launched in the summer 2000 by the Ministère des Ressources naturelles, de la Faune et des Parcs (MRNFP), with the close cooperation of mining companies Cambior, Barrick Gold, Agnico-Eagle and Yorbeau Resources, along with the Geological Survey of Canada and the Université du Québec à Chicoutimi. Data used for 3D modelling in gOcad® (geology, lithogeochemistry, assays, drillholes and sections) were essentially supplied by mining companies involved in the DBL mining camp.

For the study area, the 3D common-earth modelling project began in September 2003, with the harmonization of multidisciplinary data. As with all the other 3D modelling projects of the MRNFP, the purpose of this project is to develop new exploration tools. The main objectives specific to the DBL camp are as follows:

1. Build a regional 3D common-earth model (12.8 x 3.5 x 2.0 km voxet) incorporating all available multidisciplinary data;

2. Perform unconstrained and constrained geophysical inversions to validate the geological 3D model of the DBL mining camp;

3. Broadly define the relationship between the different stratigraphic units and altered and mineralized horizons.

Posters

103 – 104

A new look at an old mining camp: The Destor-Porcupine Fault, Abitibi Subprovince (phase 2)

Marc Legault (MRNFP), Francine Fallara (URSTM-UQAT), Li Zhen Cheng (URSTM-UQAT), Georges Beaudoin (U. Laval), Jean Goutier (MRNFP), Gervais Perron (Mira Geoscience), Olivier Rabeau (URSTM-UQAT) and Martin Aucoin (U. Laval)

The Duparquet mining camp, where gold mining operations took place from 1933 to 1956 and from 1988 to 1991, is located along the Destor-Porcupine Fault. Several gold deposits and showings occurring along the Destor-Porcupine Fault show a wide range of ore styles, alteration, stratigraphic or structural controls and timing of emplacement.

The purpose of this project is to develop new tools for gold exploration, based on a regional metallogenic study and 3D modelling. The metallogenic study has outlined several types of gold mineralization. Quartz-carbonate vein occurrences are associated with strong iron carbonate alteration, and are similar to orogenic deposits. Disseminated sulphide occurrences are associated with calc-alkaline and alkaline intrusions, and display variable silica, carbonate and sericite alteration. Chalcedony vein occurrences show open-space filling textures as well as a distinct suite of metals compared to the other two types (Au-Ag-Zn-Pb-Sb-Hg). These veins show characteristics typical of neutral epithermal deposits. Isotopic ^{18}O and ^{13}C analyses of veins from these different ore types will be used to characterize hydrothermal fluids and determine if they are related. Furthermore, the presence of gold-bearing fragments in the Duparquet Formation suggests the presence of more than one gold ore-forming episode.

The main objectives of the 3D modelling component are:

1. To produce a regional 3D common-earth model (11.4 x 4.0 x 1.0 km voxet);
2. To describe the 3D distribution of auriferous halos;
3. To validate the geological 3D model with unconstrained and constrained geophysical inversions;
4. To define new gold exploration targets by building queries based on geoscience data.

The final 3D common-earth model contains 74 lithological surfaces and 77 fault surfaces for a total of 126 closed geological bodies, broken down into 20-m^3 cells. Overall, the generated voxet therefore contains 5.7 million cells.

Over 90,000 magnetic readings were processed to perform the geophysical inversions. Unconstrained inversion of magnetic data helped define the distribution of susceptibility measurements from the surface down to 1 km depth. These results indicate an excellent correlation between surface structures and their depth extensions. The results of constrained inversion as well as gravity data inversion are still to come.

105 – 106

Grenville Front (phase I) – Mapping of the Lac Lagacé area (32B14)

Daniel Bandyayera, Pierre Rhéaume, Sandrine Cadéron, Emmanuelle Giguère (MRNFP)

Geological surveys along the Grenville Front are conducted within the scope of the 2003-2006 three-year plan for the Abitibi and James Bay region. The objectives of the "Grenville Front Project" are to define the structural, stratigraphic and metamorphic relations of Archean Abitibi rocks in the Parautochthonous Belt, and to assess the mineral potential of the Grenville Front relative to Abitibi rocks.

The Lac Lagacé project is located 130 km south of Chapais. The northwestern part of the area consists of Archean rocks of the Abitibi Subprovince: the Barry intrusive Complex (tonalite and granodiorite), the Coursol Pluton (granodiorite) and the Lacroix Formation. The southeastern part of the area corresponds to the Parautochthonous Belt, defined as a transition zone where folded and migmatized lithologies of the Abitibi Subprovince progressively acquire a Grenvillian structural style.

The Lacroix Formation is a NW-SE to E-W-trending volcanic band exposed to the north and south of the Coursol Pluton. It mainly consists of locally glomerophyric tholeiitic basalts, strongly magnetic komatiites and minor intermediate ash, lapilli or block tuffs. These rocks are metamorphosed to the greenschist and lower amphibolite facies.

The Parautochthonous Belt is separated into two tectono-metamorphic domains by the NE-SW-trending Amiskotci fault, associated with a zone of sheath folds. The northern domain contains garnet-bearing glomerophyric amphibolites and ultramafic lavas that probably represent the eastern extension of the Lacroix Formation. Both Archean (E-W lineations) and Grenvillian (SE lineation) structural elements are recognized. In the southern domain, upper amphibolite-grade metamorphism has led to partial melting and migmatization. The migmatites contain amphibolite enclaves and show evidence of polyphase tectono-metamorphic evolution. They constitute a lithological equivalent to rocks of the northern domain, albeit metamorphosed to a deeper crustal level. They are intruded by NE-trending magnetic gabbro dykes. The Archean structural signature is still detectable, but Grenvillian structures are dominant. A small portion of the southern domain is characterized by alteration zones hosted in amphibolites similar to those of the northern domain, but affected by Grenvillian structural features.

Our work reveals an interesting potential for Cu-Ni-PGE deposits, volcanogenic exhalative deposits and mesothermal gold deposits. The Cu-Ni-PGE potential is associated with ultramafic lavas of the Lacroix Formation. The exhalative signature shows up as GR-SM-CD-AD-GH alteration zones in amphibolites of the Grenville Front. As for the gold potential, it is linked to major E-W structures such as the Frank fault, close to which gold veins of the Griffith showing occur.

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Grenville Front Project, phase 1: Geology of the Lac Charron area (NTS 32G09 and 32G08)

Patrice Roy, Sophie Turcotte, Sandrine Cadéron and Patrick Houle (MRNFP)

A geological survey at 1:50,000 scale was conducted during the summer 2003 in the Lac Charron area. The bedrock around lakes Obatogamau, Coquille and Nicabau was mapped within the scope of the first phase of the Grenville Front Project, a component of the 2003-2006 three-year action plan for the Abitibi and James Bay region. The objectives of this project are to better define the boundary between the Superior and the Grenville, and to highlight the economic potential of Archean rocks in the Parautochthonous Belt.

The NW et NE parts of the map area are respectively underlain by the La Dauversière Pluton (tonalite, diorite; 2720 Ma) and the Boisvert Pluton (tonalite), which intrude volcanic rocks of the Obatogamau Formation. The latter consists of massive to pillowed porphyritic basalt flows and co-magmatic gabbro sills. The SE part of the area is characterized by the presence of tonalitic gneiss, garnet amphibolite and banded amphibolite. These units are cross-cut by weakly deformed garnet-bearing gabbro dykes.

The metamorphic grade increases from the NW towards the SE, from the greenschist facies to the granulite facies. In the NW, ubiquitous chlorite occurs in greenschist-grade basalts of the Obatogamau Formation. The garnet isograd appears east of the La Dauversière Pluton, and is characterized by an amphibole + garnet assemblage. The upper amphibolite facies corresponds to the onset of partial melting and migmatization in Archean volcano-sedimentary sequences. In the southeasternmost part of the area, wollastonite-bearing calc-silicate rocks are metamorphosed to the granulite facies.

Rocks in the northern part of the area lie in the core of the La Dauversière anticline. An E-W-trending axial plane schistosity is well developed in the volcanic rocks. However, the foliation closely follows the shape of the La Dauversière and Boivert plutons, both within the plutons and along their edges. E-W to NE-SW shear zones cross-cut the regional foliation, and are particularly intense around the plutons. In the SE third of the area, the E-W-trending foliation seems to be related to Grenvillian events, since it affects tonalitic gneisses and banded amphibolites.

From an economic standpoint, we discovered new base and precious metal showings in a variety of lithological and structural settings, namely copper showings in the Boisvert Pluton and a poly-metallic showing in a unit of metavolcanic amphibolites.

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Gold occurrences in the NE part of the La Dauversière Pluton: Emphasis on the Lac Dufresne deformation zone

Louis Grenier (UQAC), Patrice Roy (MRNFP), Réal Daigneault (CERM/UQAC), Sophie Turcotte and Patrick Houle (MRNFP)

The gold potential in the vicinity of the La Dauversière Pluton has been recognized for many years (Joe Mann mine, Chevrier deposit). However, the NE edge of the pluton has seen very little exploration, even though a number of copper-gold showings are known in this area, such as the R14 showing (142.29 g/t Au over 2.44 m) and the Conwest Exploration showing (13.22 g/t Au, 49.15 g/t Ag and 4.3% Cu in grab sample). These showings occur in E-W to NNE-SSW-trending shear zones. They are hosted in basalts of the Obatogamau Formation, cross-cut by dykes of porphyritic tonalite and fine-grained diorite. The mineralization consists of pyrite, pyrrhotite, chalcopyrite and gold. It occurs within fractures or in the wall rock adjacent to quartz-carbonate±tourmaline veins. The main alteration minerals are chlorite, sericite and iron carbonates.

The Lac Dufresne deformation zone, located between the La Dauversière and Boisvert plutons, is characterized by strong carbonate-sericite alteration, and marks the boundary between the greenschist and the amphibolite metamorphic facies. It also represents an important structural control for certain gold occurrences.

The Lac Dufresne property is located 35 km southeast of the town of Chibougamau, and 2 km north of Lac Dufresne. On the property, a 1.5-km-thick band of Obatogamau basalts is wedged between the La Dauversière and Boisvert plutons. The Lac Dufresne shear zone consists of a network of NE-trending anastomosing deformation corridors that transect the basalts and dykes derived from adjacent plutons. Stripped outcrops exposed in 1999 reveal the presence of a breccia, intimately associated with the mineralization, and characterized by heterogeneous deformation represented by irregular folding of the matrix and fragments. The mineralization, which consists of up to 10% pyrite, is associated with the schistose biotite-chlorite matrix. Grades of 1.6 and 2.5 g/t Au were obtained from grab samples. A quartz vein parallel to the breccia zone and hosted in a shear zone 70 cm-wide at the most, yielded 4.95 g/t Au in a grab sample. Strong biotite-chlorite-sericite alteration is associated with all mineralized zones on the property.

The purpose of this study, undertaken during the summer 2003 on the Lac Dufresne property, is to characterize and establish the timing of deformation episodes, and to determine the role of the La Dauversière and Boisvert plutons on ore emplacement.

Posters

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Geological map of the Gaspésie and Bas-Saint-Laurent regions

Daniel Brisebois, Joanne Nadeau, Gilles Bernier, Robert Carignan and Frédérick St-Pierre (MRNFP)

The Ministère des Ressources naturelles, de la Faune et des Parcs has released a new geological synthesis map of the Gaspésie and Bas-Saint-Laurent regions. The last synthesis map for the Gaspésie region dates back to 1991. Since then, compilation and fieldwork as well as biostratigraphy and geochronology studies have improved our understanding of the stratigraphy and structural geology of the western part of the peninsula, as well as certain small areas in the east and south. No previous synthesis maps exist for the Bas-Saint-Laurent region. Ongoing work in the various parts of the region should result in more frequent updates over the next few years.

The most important modifications brought to the map concern the stratigraphy of Silurian-Devonian rocks of the Gaspé Belt, where calls for attention from mineral and oil & gas exploration are focussed. The boundary between the Chaleurs Group and the Upper Gaspé Limestones has been standardized, using the same definition criterion everywhere. The subdivision of the Upper Gaspé Limestones into three formations (Forillon, Shiphead and Indian Cove) was extended throughout the belt to allow much more accurate comparisons between the different areas in the two administrative regions. Gaspé Sandstones in central Gaspésie were also the object of a major revision: formation boundaries were modified or specified and one unit, the Lake Branch Formation, was abandoned. The Fortin Group was subdivided into informal units where possible. New faults and new regional folds were also mapped.

Much of this new information and a certain number of updates are not sufficiently important to modify the 1:250,000 scale compilation map. However, 1:20,000 and 1:50,000 scale maps, that complement the compilation map and are also available, do show these modifications. The changes are obvious, particularly in the distribution and nomenclature of volcanic rocks and magmatic intrusive rocks.

111 – 112

Geology and mineral potential of the Lac Sainte-Anne area (NTS 22B16-0200-0102)

Pierre Pilote and Serge Lachance (MRNFP)

The 1:20,000 scale geological map of the Lac Sainte-Anne area was revised as part of a larger updating approach focussed on certain areas of north-central Gaspésie, with the added objective of supporting, within the scope of the three-year exploration plan for the Appalachians, a metallogenic study on the Lemieux Dome.

The Silurian-Devonian lithostratigraphic assemblage within the study area belongs to the Connecticut Valley-Gaspé Synclinorium, a major tectono-stratigraphic element of the northern Gaspé Belt. The northwesternmost part of the area includes Ordovician rocks of the Mont-Albert Complex, the Diable Amphibolite and the Ruisseau Isabelle Unit of the Québec Supergroup.

The main Lower Silurian to Lower Devonian sequence is formed of sedimentary rocks, essentially mudrocks, sandstones and limestones, intercalated with basaltic to rhyolitic volcanic sequences such as the Mont Lyall sequence. These rocks are grouped into different lithostratigraphic assemblages, namely: the Chaleurs Group, the Upper Gaspé Limestones and the Gaspé Sandstones. The rocks, folded and faulted during the Middle Devonian Acadian Orogeny, were locally invaded, along with Ordovician units, by felsic and mafic magmatic intrusive rocks (dykes, sills and stocks) of the Lemieux intrusive Suite.

From a metallogenic standpoint, the Lemieux Dome represents a sub-circular antiformal structure around which subhorizontal to shallowly dipping sedimentary and volcanic sequences are distributed. This structure is cored by a km-scale positive magnetic anomaly, and is transected by NNW and ENE-trending faults filled by various intrusions. This area hosts several vein-type Pb-Zn±Cu±Au showings, occurring in NNW to NE-trending fractures. The latter represent neutral epithermal-type mineralization (low-sulphidation), emplaced in an extensional structural setting less than 1 km from the paleosurface. Most of these showings are hosted in the Upper Gaspé Limestones. The veins, primarily composed of dolomite, purple amethyst, chalcedony and jasper, exhibit open-space filling textures, commonly symmetrical banding, cockade textures and multiple and repeated brecciation. Wall rocks are silicified and affected by a number of normal faults. This ore style commonly exhibits vertical metal zoning patterns over 250 to 350 metres, from a base metal-poor but Ag±Au-rich top, through an intermediate zone rich in Ag and base metals, and a lower part rich in base metals.

In the northern part of the dome, lode-type occurrences and hematite-magnetite-pyrite-chalcopyrite-quartz breccias cross-cut the epithermal veins and constitute a later mineralizing event, to which certain monzonitic intrusions are associated.

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Mineral potential of the Mistassini basin: A re-examination using tools borrowed from oil & gas exploration

Yvon Héroux, Bocar Diagana, André Chagnon, Marc Richer-Laflèche (INRS-ETE), Roger Moar (MGRC) and Patrick Houle (MRNFP)

The 6,000-km^2 Paleoproterozoic Mistassini basin is located roughly 70 km north of Chibougamau. Mineral exploration in this weakly metamorphosed sedimentary basin is difficult, since mineralized outcrops do not show any visible sign of alteration. The purpose of this project, jointly funded by the INRS, MRNFP, VRQ-DIVEX and MGRC, is to reassess the mineral potential of the basin.

This project is based on a novel approach, i.e. the use of tools borrowed from oil & gas exploration. These tools, sensitive to low-amplitude thermal and chemical variations, are used to identify visually undetectable alteration patterns.

The first phase of this project (summer 2002) consisted in identifying alteration signatures associated with each type of base metal sulphide mineralization (Cu, Pb and Zn). The most significant results are presented in this poster. The second phase (summer 2003) consisted in identifying the optimal sampling grid to map these alteration halos. The results will be released in a report slated for the summer 2004.

Four types of occurrences are described and sampled. Syngenetic copper hosted in Unit B bituminous shale of the Albanel Formation is intimately associated with bacterial organic matter (OM). Other types of occurrences, all epigenetic, include: 1- Mississippi Valley-type lead-zinc mineralization, represented by a dozen showings in Unit D brecciated dolomite, 2- copper mineralization hosted in quartz-carbonate sills in Unit B at the ICON mine (1.5 Mt at 3.06% Cu) and the Perch River deposit, and 3- late polymetallic veins that cross-cut the entire sequence. Copper showings in the Blondeau and Chibougamau formations, along the southwestern extension of the Mistassini fault, from the Icon mine to Lac Waconichi, are also included in the study.

Occurrences exhibit lithological and structural controls, corroborated by variations in OM contents and textures, wall rock geochemistry and zoning of mineral assemblages. Such variability within a single sedimentary formation requires several metasomatic processes leading to sulphide formation. Fluid inclusions and OM have preserved hydrothermal event signatures, useful to identify alteration halos associated with each type of epigenetic mineralization described above.

If a proper sample spacing can be established to map these alteration patterns, we will have succeeded in developing new tools to reassess the metalliferous potential of the Mistassini basin.

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Geochemical and isotopic evolution of volcanic and plutonic assemblages in the Bienville, Minto, Goudalie and Tikkerutuk subprovinces in the southwestern part of Québec's Far North (phase II)

Michel Boily (GÉON), Alain Leclair, Alain Berclaz, Jean David and Charles Maurice (MRNFP)

Phase II of the Far North geochemistry project is mainly focussed on NTS sheets 33O (Lac Montrochand), 34B and 34C (Lac à l'Eau Claire). The five plutonic megasuites defined by Boily *et al.* (2003) are observed in the area. The Melvin volcano-sedimentary Complex (Amel; map sheet 33B) contains dacites-rhyodacites (Amel1) that exhibit chemical characteristics typical of weakly differentiated felsic volcanic rocks derived from the base of the crust (Sr = 334-785 ppm and $[La/Yb]_{CN}$ = 8-23). A new megasuite of late ultramafic-mafic intrusive rocks (Qullinaaraaluk Suite; Aluk) is composed of pyroxenite-hornblendite (Aluk1) and gabbro-gabbronorite (Aluk2). This megasuite is strongly magnesian (Mg# = 36-78), enriched in light REE ($[La/Yb]_{CN}$ = 2-25), Ba, Sr and Th relative to Nb, Ta and shows Zr/Y (2-9) and Th/Hf (0.3-4.4) ratios suggesting an enriched subcontinental mantle source. The TTG megasuite (εNd_i = +2.0 to –2.7) comprises the Favard (Afav) and Coursolles (Acou) suites. Tonalites-trondhjemites exhibit characteristics typical of Archean TTG, namely high Al_2O_3 (10.4-19.9 weight %) content and Na_2O/K_2O (1.2-5.1), $[La/Yb]_{CN}$ (4-188) and Sr/Y (11-158) ratios, as well as important variations in these ratios when SiO_2 content exceeds 70 weight %. Dioritic rocks show greater enrichment in Ba (338-1427 ppm), REE (La = 29-110 ppm) and Zr (73-589 ppm) than tonalites. They may constitute a distinct suite, or form the parents of the TTG megasuite. The massive to foliated granodiorite megasuite (εNd_i = -0.1 to –2.4) is represented by HB-BO granodiorites and monzogranites of the Desbergères Suite (Adeb). This potassic megasuite (Na_2O/K_2O = 0.4-1.4) shows negative correlations between Na_2O, TiO_2, CaO, MgO, Al_2O_3, Zr, Nb, Ta, Yb, Y contents and silica. It shows a marked enrichment in light REE (La = 39-51 51 ppm), Ba (961-993 ppm), Th (18-23 ppm), and negative anomalies in Nb and Ta, typical of major continental batholith complexes. The Loups Marins Complex (Alma) represents the pyroxene-bearing granitoid megasuite (εNd_i = -0.4 to –1.9). Sub-units Alma1a (CX-bearing) and Alma2 (OX-bearing) constitute the high-temperature anhydrous equivalents of the TTG megasuite. They define a similar chemical evolution, and exhibit comparable $[La/Yb]_{CN}$ (24-160) and Na_2O/K_2O (0.8-4.0) ratios. CX-bearing monzonites, monzodiorites and syenites occur in sub-unit Alma1c. Their marked enrichment in Ba (708-1980 ppm), Rb (119-178 ppm), Sr (566-854 ppm) and Zr (143-745 ppm) indicates these intermediate rocks (SiO_2 = 51.3-60.4 weight %) may represent a distinct suite.

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Geology of the Lac au Goéland area (32F10 and 32F11)

Jean Goutier and Julie Doyon (MRNFP)

The Lac au Goéland area is located in the northern Abitibi Subprovince. This project is the continuation of a mapping survey covering the Lac Olga area. The study area is mainly underlain by Archean rocks and a few Proterozoic gabbro dykes. The specific objectives of the project are to determine the eastern extension of volcanic rocks of the Lac Watson Group, and to characterize the central and eastern parts of the Bell River Complex. The western part of the area is dominated by the synvolcanic Bell River Complex (2725 Ma), whereas the Waswanipi granite (2694 Ma) covers a vast surface area in the eastern part of the map area. A new syenite body (4 x 7 km^2) was delineated between the two major intrusions. The metamorphic grade in the area ranges from the greenschist facies in the northwest to the amphibolite facies in the south and west.

The Bell River Complex is a stratiform intrusion characterized by a highly variable gabbro succession. This complex contains very few layered horizons, plagioclase megacumulates, anorthosites *sensu stricto* or granophyric bands. Mesocratic and leucocratic gabbros are the dominant facies. Pyroxenites form lenses from one to ten metres in size, observed at various levels within the complex. Strongly magnetic layers in the central and eastern parts consist of magnetite-rich melanogabbro and pyroxenite, whereas magnetitite bands are restricted to the western part of the complex. Furthermore, the complex hosts three platinum group element showings (Pt+Pd), with best grades of 2.08 ppm to 3.6 ppm. Volcanic rocks in the area are divided into three assemblages. The oldest corresponds to the extension of the Lac Watson rhyodacite in the Lac au Goéland area. The presence of garnet and anthophyllite indicates this rock unit has been affected by a volcanogenic alteration system, thereby suggesting the Matagami mineralized (Zn-Cu-Ag) interface may extend over more than 30 kilometres along strike. The second most widespread assemblage is composed of amphibolites, derived from tholeiitic basalts, belonging to the Wabassee Group. The third southernmost assemblage consists of calc-alkaline intermediate tuff, andesite and dacite. Two sedimentary assemblages overlie the volcanic rocks, namely metamorphosed wackes of the Morris Formation to the north, and metamorphosed turbidites of the Taïbi Group to the south.

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Outstanding geological sites

Geological Heritage of Québec Workgroup (MRNFP)

In early 2002, the Ministère des Ressources naturelles (MRN) took up the task of identifying geological sites that deserve to be protected within the scope of Québec's Strategy for Protected Areas (Ministère de l'Environnement; 1999, 2002). This action stems from initiatives by the Professional Association of Geologists and Geophysicists of Québec (APGGQ) in 2001, and by the *Ordre des géologues du Québec* (OGQ) in 2002, calling for the MRN's involvement (Prichonnet, 2001 and Bouchard, 2002).

A workgroup was created to develop a strategy to designate geosites (outstanding or exceptional geological sites). This committee is formed of representatives from the mining industry, universities, professional organizations and the Ministère des Ressources naturelles, de la Faune et des Parcs (MRNFP). The objectives of the committee are to: 1) devise a plan of action, 2) develop a geosite designation process, 3) submit the process to consultation, and 4) implement it before 2004. Examples of outstanding geological sites and geoparks are suggested.

The plan and designation process are on track. Consultations are ongoing and site proposals are already being examined.

We will review the current status of the project, and outline the role of industry and government in protecting Québec's geological heritage.

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Dispersal of indicator minerals in the Ashuanipi area

Marc Beaumier (MRNFP)

The sampled area covers a vast landmass extending from Labrador to the 72°00", from Réservoir Manicouagan to Lac Plétipi, to the Kuujjuaq area. Most of this region is underlain by the Ashuanipi Terrane. This extensive area was sampled by BHP during the summer 1998. The results were reported in GM 59085 and 59086, and the digital data was released in 2002 (Beaumier, MRN DP-2002-02).

The purpose of this study is to make the most of these survey results and use them to identify diamond exploration targets. Thirteen sites are already known to contain classic kimberlite indicator minerals (Girard, 1999), namely G9 and eclogitic garnets, magnesian chromite, picroilmenite, perovskite or chrome spinel or both.

Table 1: Summary of kimberlite indicator minerals found in the area

Site	Easting UTM Z19 Nad83	Northing UTM Z19 Nad83	G9 Pyrope	Eclogitic garnet	Magnesian chromite	Picroilmenite	Perovskite	Chrome spinel
129	395567	5637924			1			
136	360396	5660791			1			
165	405227	5691218				1		
227	304877	5575111		1				
494	571965	5783658			1			
782	344329	6095739			1			
792	375973	5944029	1		1			2+1
830	608282	5962352				1		
910	442847	5918015					1	
1009	366293	6152154					1	
1287	464097	6213775					1	
1495	402052	6192600	1					
1506	457429	6000131			1			
1517	433959	6026619				1		

(Table modified after Girard, 1999)

Furthermore, Girard (1999) reported the presence of hundreds of chrome diopside grains, interpreting their provenance from eclogitic or granulitic mafic gneisses.

Simply by considering the possibility that sources other than kimberlites may be diamondiferous, our outlook on this data changes dramatically. In other source rocks, indicator minerals differ from those for kimberlite. Fipke *et al.* (1995) suggested a few minerals and their composition as potential indicators for lamproites.

The objective here is to re-examine the results now available in digital format in a new light, and make the most of this data by considering glacial dispersal orientations, the possibility that lamproites or orangeites may also be considered as diamond sources, average transport distances that can be interpreted, and links with lake sediment geochemistry data.

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Structural geology of the Murgor gold-bearing zone, Barry Township (NTS 32B13)

Aïssatou Diop (UQAC), Pierre Rhéaume (MRNFP), Réal Daigneault (UQAC)

The Murgor property is located in the Urban-Barry belt, 100 km south of Chibougamau. The Barry IV gold zone (610,000 t at 6.8 g/t Au) is hosted in massive, commonly pillowed or brecciated amygdaloidal mafic lavas transected by the Mazère fault. These lavas are intruded by quartz-feldspar porphyry (QFP) dykes, and a later series of gabbro dykes.

Deformation associated with the Mazère fault is characterized by a dominant N060° schistosity moderately dipping (50°) towards the SE. A stretching lineation plunges N090° to N125°, indicating NW-verging tectonic transport, in an inferred shortening tectonic regime. The stretching ratio of amygdules averages 3/1. The degree of deformation is moderate to weak, except in certain shear zones that generally do not exceed 3 m wide. Rocks are metamorphosed to the greenschist facies.

The mineralization occurs as quartz veins, generally striking N060° and dipping south at 65° on average. These veins share the same strike as the schistosity, but have steeper dips. They are generally several metres long (up to 10 m) with m-scale spacing, and an average thickness of 10 cm. The sulphide paragenesis consists of pyrite and pyrrhotite forming 5 to 6% of the vein. N060° veins are commonly boudinaged. A second marginal set of veins strikes N020°. These veins are thinner (a few cm) and shorter (less than 1 m). QFP dykes also host a stockwork of intersecting stringers. All these vein systems appear to be the product of a single hydrothermal event. A third family of N-S-striking cm-wide vertical veins is also recognized. These veins are interpreted as late extension veins compatible with N-S shortening.

Hydrothermal alteration is preferentially concentrated along the borders of the N060° vein set. It is characterized by intense carbonatization, probably ankeritic given the intense rusty colour. The visible alteration zone extends 10 to 25 cm away from vein walls.

Alteration patterns and the cross-cutting relationship of veins relative to the main schistosity indicate that ore emplacement at the Murgor showing is syn- to late deformational. The set of N060° veins is inferred to occur in the core of a shear zone.

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Gold and base metal occurrences in the Lac aux Loutres area (32B13), a case of polyphase metallogenesis – Metallogenic synthesis of the Urban-Barry belt (1/2)

Pierre Rhéaume, Sandrine Cadéron and Daniel Bandyayera (MRNFP)

The MRNFPQ has outlined in the Urban-Barry belt a series of distinct structural blocks each with their own internal stratigraphy. These blocks, imbricated by E-W to ENE-WSW faults, contain volcanic rocks younging from south to north.

Our work in 2003 in map sheet 32B/13 helped define the lithostratigraphic and metallogenic characteristics of these structural blocks. Gold emplacement in this area is marked by the superposition, on a wide variety of early Au±Ag±Cu±Zn occurrences, of mesothermal gold mineralization associated with syn- to late orogenic structural breaks. This recurring association suggests that early deposits played a role in pre-concentrating the gold later recycled by mesothermal processes.

Occurrences peripheral to the Mazère fault illustrate this superposition of late mineralization on early occurrences. This ENE-trending fault borders, to the south, a series of gold zones such as the Barry IV deposit (610,000 t at 6.80 g/t Au). These syn-orogenic gold zones are marked by intense AK-PY-CL alteration and QZ-CB-PY±AB veins associated with shear zones and fracturing in more competent lithologies such as QFP dykes. The Mazère fault juxtaposes Barry IV host rocks with basalts cut by a vast diorite and gabbro intrusion related to the Souart Pluton. These rocks are surrounded by a series of QZ-SF-FP-BO-CB veins associated with potassic alteration and Cu-Au±Ag±Zn±Pb mineralization. These polymetallic veins exhibit drusy and crustiform textures similar to epithermal-type veins and are most likely early.

Overlapping early and late mineralization is also observed along the Rouleau fault, where known occurrences are either synvolcanic or orogenic. Synvolcanic mineralization is associated with the Souart horizon, namely at the Lac aux Loutres showing. Volcanic rocks in this location are cut by hydrothermal feeder conduits of massive tourmaline, to which are associated brecciated tourmalinite horizons, small polymetallic massive sulphide lenses (Au, Ag, Cu, Zn) and a large stratabound zone of disseminated sulphides (Au, Ag, Cu). An intense alteration zone (TL-MG-GR-QZ-SF) centered on the feeder conduits affects country rocks. Six kilometres east of this showing, a stockwork of late gold-bearing QZ-PY veins (orogenic) cross-cuts the brecciated tourmalinite horizons as well as synvolcanic mineralization at the Sauder showing, where these late veins are an important component of the mineralization.

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Optimization of seismic data processing for a better geological interpretation: Line 2002 MRN-10b in the Gaspésie region

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The Gaspé Peninsula, which constitutes the northernmost extension of the Québec Appalachians, has been the focus of many new developments in hydrocarbon exploration. To support this renewed activity, the Direction des hydrocarbures of the Ministère des Ressources naturelles, de la Faune et des Parcs du Québec launched a vast seismic reflection campaign from 2000 to 2002, in order to obtain images of the subsurface geometry of the bedrock. This very high-quality seismic data will be used to image the structural style at depth, and may potentially help improve our global understanding of the petroleum system.

Reprocessing of line 2002 MRN-10b was carried out at the Institut Français du Pétrole in Rueil-Malmaison (France). The preferred geophysical approach is based on a number of different processing sequences. More specifically, pre-stack and post-stack time and depth migration of data was performed. For depth migration, a velocity model of the subsurface was built based on borehole logs and surface geology of the Gaspésie region. The four complementary images provide a better portrait of the overall subsurface geometry, resulting in a better definition of the structural style of Silurian-Devonian rocks, particularly along the Lac des Huit Milles syncline and the Causapscal anticline, and an improved geological interpretation of the Shickshock-South fault.

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Compilation and integration of geological base maps in SIGÉOM

Marie-Claude Ouellet, Joanne Nadeau, Maureen Grant, Louis Madore, Nelson Leblond and the digitization team (MRNFP)

Geological compilation maps in digital format are one of many products developed in the Geomining Information System (SIGÉOM) of the Ministère des Ressources naturelles, de la Faune et des Parcs. The complete geological coverage of Québec is available in digital format in one or more of the following scales: 1:20,000, 1:50,000 or 1:250,000.

The main types of data shown on geological compilation maps are as follows: regional-scale geological contacts, faults and fold axes, metamorphic isograds, lineaments, as well as the nominal designation of stratigraphic and lithologic units. On certain maps, outcrops, structural measurements and geochronology sample locations are also indicated. Having these elements digitized makes it possible to link each entity to a database that may be queried through SIGÉOM.

The digital geological coverage of Québec currently includes 499 maps at 1:20,000 scale, 1,068 maps at 1:50,000 scale and 122 maps at 1:250,000 scale; these cover the entire landmass of Québec. Among these, 177 1:20,000 scale maps, 390 1:50,000 scale maps and 38 1:250,000 scale maps contain partial or complete data from compilation outcrops or mapped outcrops. Since 2000, the Department also offers another product to its clients, which completes the geological compilation: a queryable colour map. Two hundred and fifty queryable colour maps are currently available in SIGÉOM, and another hundred maps are integrated annually (all scales).

Since geological maps are constantly evolving, a team of twenty staff members is responsible for the update and quality control of released products. The team is composed of geologists, mineral resource and GIS technicians, digitization assistants and an administrative analyst. These staff members are based in MRNFP offices in Québec, Montréal, Rouyn-Noranda, Val d'Or and Chibougamau. Geological compilations maps are updated by integrating new geological, geochemical and geophysical data collected during annual field campaigns, and by connecting map border units with adjacent maps.

Geological compilation products are sold in digital format or hard copy. They are available at the Centre de diffusion (1-800-363-7233), in all the regional offices or via the Department website (www.mrnfp.gouv.qc.ca).

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Potential for volcanogenic massive sulphide (VMS-type) deposits in the Lac Assinica (32J) and Lac Evans (32K) area

Claude Dion, Daniel Lamothe, Michel Leduc, Marc Beaumier, Denis-Jacques Dion (MRNFP)

The Mineral Potential Map Production System (MPMPS) is a computer tool that uses geomining data from SIGÉOM to generate mineral potential maps. The final product is a map at 1:250,000 scale available through SIGÉOM. These maps show prospective areas for the discovery of a specific type of ore deposit or substance, based on the application of one or several geological models. Target areas are selected based on a combination of various factors such as rock type, proximity to an intrusion, presence of faults, etc.

The VMS ore deposit model is based on four geological parameters (or sub-models) necessary to generate an ore deposit. These parameters are:

- High heat flow: VMS develop in areas of high heat flow able to sustain hydrothermal activity. It is in fact the driving force behind this hydrothermal activity.

- Plumbing or hydrothermal conduits: this sub-model identifies conduits through which mineralizing fluids circulated, more specifically synvolcanic structures.

- Stratigraphic control: VMS are proximal to volcanic centres. Hydrothermal activity develops during pauses in essentially submarine volcanism. The strategy consists in locating "favourable" stratigraphic horizons (pause or slowdown in volcanic activity) and locating volcanic centres.

- Direct or indirect evidence of VMS-type hydrothermal activity: this sub-model identifies evidence of hydrothermal fluid circulation associated with VMS formation.

These four parameters are considered essential for the formation of a VMS deposit. The absence of one of these factors reduces the probability of forming an economic deposit. Assessing the mineral potential for this type of deposit therefore consists in detecting, in the geodata, the presence of these four characteristic criteria and to map them in raster format using spatial analysis software. Each sub-model thus defined will be combined to generate a map showing the VMS potential of the study area.

Preliminary maps showing the potential for VMS-type deposits in map sheets 32J (Lac Assinica) and 32K (Lac Evans) will be on display during Québec Exploration 2003.

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High-grade metamorphism of hydrothermal alteration zones: Characterization of an ore guide from the Abitibi to the Grenville

Sandrine Cadéron, Pierre Rhéaume, Daniel Bandyayera, and Patrice Roy (MRNFP)

The Parautochthonous Belt represents a vast transition zone between the Superior Province to the north and the Grenville Province to the south. During the summer 2003, the MRNFP launched a mapping program at 1:50,000 scale in the area (Lac Lagacé and Lac Charron projects) in order to better define the Grenville Front and to promote its mineral potential.

Geological interpretations derived from these two projects indicate a lateral continuity of Abitibi lithologies into the Parautochthonous Belt. The structural style is marked by the progressive reorientation of Archean structures and the gradual appearance of typically Grenvillian structures. NW-SE metamorphic sections show that greenschist-grade lithologies of the Abitibi Subprovince reach the upper amphibolite to granulite facies in the Parautochthonous Belt.

CL-SR±MG±alumino-silicate alteration zones constitute an important ore guide in the Abitibi belt for deposits associated with exhalative activity. Some of these have been documented near the study area. In the Parautochthonous Belt, they are progressively metamorphosed to the amphibolite facies. The new metamorphic assemblages consist of GR+CD+TM/AT/AC±GH±SM. Garnet grains are remarkable in their abundance, which sometimes exceeds 25% of the rock, their size, greater than 1 cm, and their peculiar "cauliflower" shape. These assemblages occur at very specific horizons within volcano-sedimentary sequences, and exhibit a stratiform character. These types of alteration zones were recognized in Bressani, Marceau and Perrier townships, where they are locally associated with pyrrhotite and chalcopyrite.

Another alteration zone, typical of a skarn setting, occurs in marbles in Ducharme Township. These calc-silicate rocks appear to belong to the Grenvillian Allochthonous Belt, although their stratigraphic position has yet to be determined. The characteristic assemblage consists of GR+DP+AM+CB, with a variable pyrrhotite and chalcopyrite content. The local presence of wollastonite indicates these marbles reached the upper amphibolite to granulite facies.

The identification and characterization of ore guides, such as the expression of alteration zones in high-grade metamorphic settings, is one way to make the Parautochthonous Belt more attractive and more accessible to mineral exploration. These alteration zones indicate the presence of hydrothermal activity, and are similar to those associated with exhalative polymetallic occurrences in Sweden, South Africa or Scandinavia. Dolomitic marbles in the Allochthonous Belt exhibit a mineral assemblage similar to high-tonnage Cu-Au ore deposits in Indonesia. They may therefore represent new exploration targets in the Grenville Province.

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Synthesis of the eastern Blake River Group: Segment east of the Ruisseau Davidson fault (32D07 SE)

Benoit Lafrance and Claude Dion (MRNFP)

A synthesis of the eastern Blake River Group was launched in the summer 2000, in parallel with the Doyon-Bousquet-LaRonde mining camp project. This project shares similar objectives since its purpose is to define the stratigraphy of Cycle 5 in the Blake River Group (Reneault-Dufresnoy Formation) and to locate the main volcanic centres in the area. The results will namely be used to determine if the geological setting of the Reneault-Dufresnoy Formation is similar to the setting of extensive gold ore deposits associated with the Bousquet Formation (Doyon-Bousquet-LaRonde mining camp). The geological setting of the Bouchard-Hébert mine, the only currently producing ore deposit in Cycle 5, will also be compared with that of the Doyon-Bousquet-LaRonde mining camp.

The Reneault-Dufresnoy Formation, traced from the Ontario border through to Joannès Township, groups all volcanic rocks occurring outside of the Noranda caldera. The Reneault-Dufresnoy Formation is recognized as a folded volcanic sequence, whereas the Bousquet Formation forms a homoclinal sequence. The purpose of this study is therefore to locate and define the nature of the contact between the two formations. The results will also be useful in identifying and tracing the horizon associated with the Bouchard-Hébert mine.

Fieldwork conducted this year covered the area between the Ruisseau Davidson fault and rocks immediately west of the Doyon mine. Preliminary evidence shows the Reneault-Dufresnoy Formation may be divided into 5 tholeiitic or transitional informal units. These units mainly consist of basalt, andesite and rhyolite, with minor dacite and rhyodacite. Fieldwork also outlined folding of these units, mainly shown by reversals of stratigraphic top directions in pillowed basalts and the presence of molar-shaped pillows. Next year's fieldwork will cover the area between the town of Clériсy and the Ruisseau Davidson fault. Work in this area should allow us to refine the stratigraphy of the Reneault-Dufresnoy Formation, to characterize the folding that affects it and to study the relationship between the Clériсy synvolcanic pluton, VMS-type occurrences and associated hydrothermal alteration.

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Geological synthesis of the Côte-Nord region: Words and images

André Gobeil, Daniel Brisebois, Thomas Clark (MRNFP), Natasha Wodicka (GSC), Serge Chevé, Louis Madore and Pierre Verpaelst (MRNFP)

The Côte-Nord region is underlain by magmatic and metasedimentary terrains, tectonized and amalgamated during the Pinwarian (1530-1450 Ma) and Grenvillian (1190-980 Ma) orogenies.

It is subdivided into three tectono-stratigraphic domains: the Lac-à-l'Aigle, Saint-Jean and Natashquan domains, affected by common magmatic, tectonic or sedimentary events. The domains are separated by major shear zones where NW-verging thrusts are observed.

The Wakeham Group (Natashquan Domain) was deposited between 1.63 and 1.50 Ga on the Labradorian continental margin. Sediments of the Manitou Complex (Saint-Jean Domain) may be coeval with Wakeham deposition. Granitoids and tectono-metamorphic complexes in the Natashquan Domain correspond to the Pinwarian event (1530-1450 Ma) related to the formation of a continental magmatic arc above a subduction zone. The onset of magmatic arc emplacement was probably coeval with at least part of the deposition of Wakeham sediments. The Matamec Complex in the Saint-Jean Domain (1378-1351 Ma) is characterized by bimodal magmatism (AMCG) associated with a back-arc basin setting.

Two episodes of anorthositic magmatism are identified, at 1.13 Ga and 1.06 Ga. The earliest anorthositic magmatism may be genetically and temporally related to mangerite-charnockite-granite (MCG)-type magmatism. A slightly earlier granitic magmatism (1180-1140 Ma) was recognized in the Lac-à-l'Aigle and Saint-Jean domains.

The peak of Grenvillian metamorphism took place between 1083 and 1078 Ma in the Saint-Jean Domain; it continued to roughly 1040 Ma in this domain, and to about 1000 Ma in the Natashquan Domain.

Two episodes of post-kinematic magmatism took place at about 1030 Ma, and between 995 and 974 Ma.

The region hosts a wide variety of mineral deposits. Among the most interesting are: 1) magmatic Cu-Ni (-Co-PGE-Au) (ex.: Lac Volant, Lac Méchant); 2) Olympic Dam/Kiruna-type hydrothermal Fe-Cu-REE (ex.: Josette, Fluorine, Malachite); 3) Zn-Cu-Au-Ag in metasedimentary and metavolcanic rocks (ex.: Lac Sanson); 4) epigenetic base and precious metals (ex.: Pelletier, Manitou, BJB, Mark); and 5) granite and pegmatite-hosted U±Th±REE (ex.: Lac Turgeon). The quality of many of these deposits is likely to attract explorationists searching for world-class ore deposits.

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The Labrieville anorthositic Suite, Saguenay – Lac-Saint-Jean region, Grenville Province

Claude Hébert, Anne-Marie- Cadieux (MRNFP), Otto van Breemen (GSC)

In the Saguenay – Lac-Saint-Jean region, the presence of three distinct AMCG-type (anorthosite-mangerite-charnockite-granite) magmatic events has already been established. The first event took place between 1160 and 1140 Ma. It corresponds to the emplacement of the Lac-Saint-Jean anorthositic Suite, which contains labradorite plagioclase. The second event, bracketed between 1080 and 1050 Ma, corresponds to the emplacement of the Saint-Urbain Anorthosite and various associated intrusive bodies. In the Saguenay – Lac-Saint-Jean region, the Chicoutimi Mangerite, the La Baie Granite, the Poulin-de-Courval Mangerite and the Taché Leucogabbro are all products of this event. The most recent magmatic event corresponds to the emplacement, from 1020 to 1010 Ma, of three distinct plutons, namely the Labrieville Anorthosite (1010-1008 Ma), which contains andesine plagioclase, the Labrieville Quartz Monzonite (1018+7/-3 Ma) and the Saint-Ambroise Intrusion (1020±4 Ma).

Following recent geological mapping and geochronology studies conducted in the Saguenay – Lac-Saint-Jean region, three other plutons can now be included in the most recent magmatic event. They are: the Mattawa Anorthosite, another andesine-bearing anorthosite (1012+6/-4 Ma), the Gouin Charnockite (1009±3 Ma) and the La Hache Monzonite (1010±5 Ma).

These six plutons are now grouped in a single lithodemic entity called the "Labrieville anorthositic Suite". This suite was emplaced between 1020 and 1008 Ma. In order to avoid confusion between the terms "Labrieville Anorthosite" and "Labrieville anorthositic Suite", we propose to abandon the term "Labrieville Anorthosite" and to restore the pluton's original name, which is the "Lac Brûlé anorthositic Massif".

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Geology of the Lac Pine area, northern Central Metasedimentary Belt, Grenville Province

Suzie Nantel and Francis Giroux (MRNFP)

Mapping at 1:50,000 scale in the southern part of the Lac Pine area (NTS 310/02) was carried out within the scope of a mineral potential assessment of the northern Central Metasedimentary Belt. The map area covers the northernmost part of this belt.

The western part of the area is underlain by a pink monzogranite intrusion (Brockaby intrusive Suite) that namely contains enclaves of marble and calc-silicate rocks locally associated with white granitic pegmatites that contain radioactive minerals. Scapolite-bearing rocks and garnetites outcrop along the edges of the intrusion, at the contact with metagabbros.

Eastward, a thick layer of dolomitic marble is flanked by biotite-muscovite quartzofeldspathic paragneisses with tourmaline-rich mobilizate. These paragneisses form thin layers interbedded with fine-grained quartz-rich paragneisses and a few beds of paragneiss with muscovite-fibrolite nodules. The marbles are also in contact with pyrite and pyrrhotite-rich rusty quartzofeldspathic paragneisses, garnet-sillimanite paragneisses and a few horizons of garnet amphibolite with disseminated sulphides. Tourmaline-bearing pegmatites intrude paragneiss units associated with these marbles.

In the eastern part of the area, biotite±garnet±sillimanite quartzofeldspathic paragneisses are exposed. These rocks also contain bands of anatectic monzogranite with regular sillimanite beds and a few thick quartzite horizons. Thick quartzites are also abundant in the northeastern part of the area, where they alternate with quartz-rich sillimanite-tourmaline paragneisses, sillimanite-biotite paragneisses, biotite-graphite±sillimanite quartzofeldspathic paragneisses, calcitic marbles and diopside-bearing calc-silicate rocks. All these rock types alternate with metagabbros.

Major sedimentary assemblages in the area are in contact with vast expanses of tonalite of the Lacoste intrusive Suite. All these rocks are affected by a phase of folding with NNE-SSW-trending hingelines and fold axes shallowly plunging to the south. This phase overprints another phase of folding with ESE-WNW-trending hingelines.

Previous exploration in the area was focussed on the search for uranium in white pegmatites. Throughout the area, several bands of diopside-bearing calc-silicate rocks are rich in pyrrhotite and a few also host chalcopyrite. Gabbros at the contact with scapolite-bearing rocks as well as garnet amphibolites in the vicinity of dolomitic marbles host disseminated chalcopyrite.

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Geology of the Lac Nadeau Ni-Cu-PGE showing, Portneuf area

Anne-Aurélie Sappin and Marc Constantin (Université Laval), Thomas Clark (MRNFP)

Ni-Cu-PGE showings at Lac Nadeau and Lac Long are located roughly 120 km west of Québec City and nearly 60 km north of Trois-Rivières (NTS 31I/16). Although these two showings have been known since the 1940s, modern-day exploration has been carried out only sporadically since 1972. These showings are currently being investigated by Mirabel Resources Inc., who confirmed the presence of base metals and platinum group elements.

Our knowledge of the geology of the Lac Nadeau and Lac Long showings was until now rudimentary at best. Mapping conducted this summer has considerably improved our knowledge of the area. The two disseminated sulphide showings (up to ~ 10% sulphides), located within the La Bostonnais Complex, are hosted in weakly deformed mafic to ultramafic bodies in contact with gneisses and a diorite intrusion. Three mafic-ultramafic intrusive bodies are exposed and physically separated on surface. They are composed of peridotite, pyroxenite and gabbro, the latter being largely predominant in the intrusions. The western intrusive body, measuring 290 m x 150 m, hosts the first mineralized zone; this zone is quite visible in the field thanks to the rusty weathered surface of the rock caused by sulphide alteration. The host unit is an olivine-rich pyroxenite to melagabbro, bounded on both sides by locally mineralized gabbro. The second mineralized zone, located along the eastern shore of Lac Nadeau, is hosted in an intrusive body measuring > 600 m x 300 m and composed of peridotite and gabbroic breccia, but its importance remains uncertain. As for the Lac Long showing, the mineralization is hosted in an intrusive body, 150 m wide and of undetermined length, composed of pyroxenite and gabbroic breccia.

The presence of a NW-SE-trending fault network may have played a major role in the emplacement of these mineralized zones, and so will be studied in detail.

Upcoming microscope studies and chemical analyses will help clarify preliminary field observations, better define the genesis of these showings and their host rocks, and finally, develop a metallogenic model applicable to other Ni-Cu-PGE showings in the Grenville.

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Geological synthesis of the Basse-Côte-Nord region, Grenville Province

Louis Madore, Serge Perreault (MRNFP), Léopold Nadeau and Pierre Brouillette (GSC)

This synthesis covers the eastern part of the Grenville Province, and corresponds to NTS sheets 12J, 12O and the western part of 12P. It integrates all published geological maps of this area as well as unpublished data from previous mapping projects. Legends and geological zones were standardized in light of newly acquired data. A Landsat-TM image and a magnetic field map were used to reinterpret the geology. Furthermore, detailed work recently carried out by the MRNFP and its collaborators provided valuable insight to improve our geological understanding of the area, thanks namely to new U-Pb isotopic ages. Known showings were re-examined and new zones of economic interest were uncovered during this work.

In the Basse-Côte-Nord region, Grenvillian rocks are divided into three major informal lithotectonic assemblages, which are from east to west: the Pinware Terrane, the Mecatina Domain and the La Romaine Domain; the latter is equivalent to the Natashquan Domain. The Pinware Terrane covers most of the study area. It groups several formal lithodemic units, namely the Saint-Augustin gneissic Complex composed of granitic, tonalitic or granulitic gneiss, as well as foliated granitoids that enclose bands of paragneiss, quartzite and amphibolite. This Paleoproterozoic to Mesoproterozoic gneissic unit is intruded by Mesoproterozoic tonalitic rocks of the Rivière-Saint-Paul plutonic Suite as well as mafic rocks of the Lourdes-de-Blanc-Sablon Suite, a small, layered gabbroic intrusion. It also contains Neoproterozoic intrusive rocks of the Vieux-Fort anorthositic Suite. The Mecatina Domain is essentially composed of weakly deformed plutonic rocks of the Mecatina anorthositic Suite. Finally, the La Romaine Domain, restricted to a small area in the western part of the region, is mainly composed of mixed gneisses of the Aguanish Complex. This lithodemic unit is comparable in many aspects to the Saint-Augustin gneissic Complex.

Small rounded granitic intrusions are characterized by their strongly positive magnetic signature. They are scattered throughout the study area, and extend to the west and north. They are part of the Neoproterozoic La Galissonière Suite. The Baie-des-Moutons Syenite and the Long Range diabase dyke swarm represent undeformed post-Grenvillian intrusions. They were emplaced from the Upper Neoproterozoic to the Lower Cambrian. In the Strait of Belle Isle area, sedimentary rocks of the Labrador Group unconformably overlie the Grenvillian basement. These Upper Neoproterozoic to Lower Cambrian sediments are part of the St. Lawrence Platform.

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Geological synthesis of the Minganie region, Grenville Province

Léopold Nadeau, Pierre Brouillette, Louise Corriveau (GSC), Louis Madore and Serge Perreault (MRNFP)

One of the objectives of the *Eastern Grenville Transect* is to tie the geology of southern Labrador with the Minganie region along a transect that extends from the Grenville Front to the Gulf of St. Lawrence. This project is carried out within the scope of the *Targeted Geoscience Initiative*, in partnership with the Ministère des Ressources naturelles, de la Faune et des Parcs du Québec (MRNFP) and the Geological Survey of Newfoundland and Labrador (GSNL).

The Minganie region lies at the junction of four first-order lithotectonic domains. To the west, the Havre-Saint-Pierre and Lac Fournier-Atikonac anorthosite-mangerite-charnockite-granite (AMCG) suites (Saint-Jean domain) separate the eastern and central parts of the Grenville Province. These very large-scale plutonic masses, emplaced between 1160 and 1080 Ma, were most likely thrust towards the west and northwest during the Grenvillian Orogeny.

The northern part of the area consists of early Paleoproterozoic orthogneisses and gneisses of the Mealy Mountains terrane. The contact between this terrane and the Mecatina domain, in the northeastern part of the region, appears to be intrusive. The latter domain is dominated by AMCG intrusions of the Mecatina Suite, of undetermined age.

The Natashquan domain, which forms the core of the Minganie region, contrasts with the rest of the Grenville Province given the presence of Mesoproterozoic supracrustal rocks of the Wakeham Group. Albeit essentially composed of supermature terrigenous metasediments (quartz arenite and feldspathic subarkose), this group also contains a small proportion of felsic metavolcanic rocks. These rocks are intercalated at all scales with metagabbros of the Robe-Noire Suite. Despite regional amphibolite-facies metamorphism, these metasediments and metagabbros show remarkably well-preserved primary structures in certain locations. The Natashquan domain also contains gneiss complexes that surround the main body of the Wakeham Group. The nature of contacts between the Wakeham Group and gneiss complexes is variable; generally clearly intrusive, although faulted contacts are also commonly observed.

Finally, the Natashquan and Mecatina domains and the Mealy Mountains terrane are cut by early Mesoproterozoic granitic intrusions correlative with those in the Pinware terrane to the east and with late Grenvillian intrusions of the La Galissonière Suite.

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Rare metal potential in the Near North, Québec

Charles Gosselin (MRNFP) and Michel Boily (GÉON)

Québec's Near North offers a favourable geological setting for the emplacement of peraluminous monzogranitic plutons and granitic pegmatite suites with a high rare metal content along the contacts between the La Grande volcano-plutonic Subprovince and the Opinaca and Nemiscau metasedimentary subprovinces. Furthermore, the Near North represents the eastern equivalent of Superior subprovinces in northern Ontario, where rare metal occurrences were recently discovered. To outline the potential of this area, we have inventoried all rare metal prospects and showings, and will discuss the main geological and metallogenic features of the most significant occurrences.

The Vieux-Comptoir monzogranitic pluton and its satellite intrusions outcrop in the Near North, along the contact between the La Grande and Opinaca subprovinces. A few Li, Be and Ta showings are known within its pegmatitic facies, which prompted us to conduct a geochemical study of the pluton in order to determine its potential to generate mineralized pegmatites. The Vieux-Comptoir Granite contains two dominant facies:

a) an early facies of pink, medium-grained, massive to weakly foliated biotite granodiorite to monzogranite, which constitutes the core of the pluton;

b) a late pinkish to whitish border facies, composed of medium to coarse-grained and even pegmatitic granite, with biotite ± muscovite ± garnet accompanied by tourmaline ± beryl.

The early monzogranites are moderately fractionated (Rb/Sr = 0.15-3.9) and show moderate to high $[La/Yb]_{CN}$ (14-106) and Zr/Y (4-52) ratios. On a Rb vs Sr diagram, these rocks plot at the edge of the "fertile" granite field, although rare metal contents are low (Li = 6-55 ppm, Be = 1-3 ppm and Ta = 0.1-0.5). However, late granites and pegmatitic granites are more fractionated (Rb/Sr = 0-48) and fertile. They show variable but commonly high Li (2-157 ppm), Be (1-6 ppm) and Ta (0.1-5.8 ppm) contents. These granites exhibit strong Eu anomalies, low REE contents and low to moderate $[La/Yb]_{CN}$ (0.2-45) ratios. Garnet-rich rocks are enriched in heavy REE ($[Gd/Yb]_{CN}$ = 0.1-0.2), which is typical of numerous fertile granites in the Superior. Spodumene-bearing pegmatites occurring in volcano-sedimentary country rocks show high Cs (42-305 ppm), Ta (17-96 ppm), Nb (63-112 ppm), Rb (534-4598 ppm) and Li (0.22-1.06 weight %) values.

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Gold potential in the Chibougamau area

Patrick Houle, Patrice Roy and Sophie Turcotte (MRNFP)

The potential of the Chibougamau area for base and precious metal deposits is well established. Located in the eastern part of the Archean Abitibi Subprovince, it is characterized by two volcano-sedimentary cycles invaded by vast mafic to ultramafic stratiform intrusions, the most important being the Lac Doré Complex and the Cummings Complex, and by numerous granitoid intrusions.

Historically focussed on the search for copper, exploration efforts were mainly concentrated around mines in the Chibougamau mining camp (Lac aux Dorés – Lac Chibougamau), the Chapais mining camp and the Joe Mann mine. However, these mines have respectively produced 3.0, 1.1 and 1.1 million ounces of gold. Despite low investment levels, several gold discoveries have occurred in recent years (Brosman structure, Chevrier, Baie Hématite Sud, Philibert, etc.). It is important to note that most of these new discoveries are on or near surface, and are the result of prospecting work, new high-resolution geophysical surveys and interpretation of new geological models.

Gold deposits (mesothermal) and related alteration zones in the area are mainly associated with regional E-W-trending syn-deformation zones or with NE and NW conjugate systems that represent subsidiary structures to E-W shear zones. Recent work by SOQUEM INC. north of Chibougamau has outlined multiple N-S-trending gold to polymetallic structures on surface. Finally, the potential to discover epithermal-type gold-rich polymetallic deposits remains excellent in the Chibougamau area, as confirmed by the presence of a Zn-Au correlation in certain areas such as the Lac Berrigan deposit (Pilote and Guha, 1998).

A summary compilation of SIGÉOM data, on display, provides a non-inclusive inventory of high-potential gold targets in the Chibougamau area. Given the impressive number (60) of mined orebodies and deposits with significant resources in the easternmost part of the Abitibi geological Subprovince, as well as the vast surface area remaining with a high discovery potential, the Chibougamau area still offers a large number of targets in the search for new gold mines.

Reference

Pilote, P. - Guha, J., 1998 - Métallogénie de l'extrémité est de la Sous-province de l'Abitibi. *In:* Géologie et métallogénie du district minier de Chapais-Chibougamau; Nouvelle vision du potentiel de découverte (*Editor:* Perre Pilote). Ministère des Ressources naturelles, Québec; DV 98-03, page 38-40.

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Copper and silver occurrences in Proterozoic rocks of the Lac Guillaume-Delisle area, Nouveau-Québec

Jean-Yves Labbé, Pierre Lacoste (MRNFP), Richard D. St-Cyr and Jean-Marc Séguin (N.M.E.F.)

The mission of the Nunavik Mineral Exploration Fund is to assist in developing the mineral resources of Québec's Far North by training native prospectors and performing exploration work. During a field training workshop in 2000, several previously unknown copper and silver showings were discovered along the shores of Lac Guillaume-Delisle (NTS 34C). These discoveries led to some prospecting work and the identification of additional significant showings. We re-examined most of these showings during the 2002 field season, in order to document this new type of mineralization.

These occurrences are found in Early Proterozoic rocks, within the Richmond Gulf graben. The Richmond Gulf Group unconformably overlies the Archean basement, and consists of sandstone, argillite, conglomerate, with a middle basaltic unit (the Persillon Formation; Chandler, 1988). These rocks are overlain by sandstones, argillites, stromatolitic carbonates and basalts of the Nastapoka Group. The copper and silver occurrences, typical of volcanic redbed deposits, were only observed in the Persillon Formation.

A total of twenty showings with greater than 1% Cu were discovered in different locations within the Persillon Formation, as well as several other anomalous zones with copper contents ranging from 0.3 to 1%. The mineralization generally consists of disseminated or amygdule-filling chalcocite, digenite and bornite. A few vein-type occurrences were also identified, namely south of Lac Guillaume-Delisle, where grab samples yielded up to 41.8% Cu and 417 g/t Ag. This type of mineralization is particularly inconspicuous in the field. Given the absence of iron sulphides and rusty zones, the only detectable expression of surface mineralization is the presence of malachite staining.

A fair portion of Richmond Gulf Group rocks outcrop within the Lacs-Guillaume-Delisle-et-à-l'Eau-Claire park, the creation of which was announced last July. However, most of the showings we examined are located south of Lac Guillaume-Delisle, on lands reserved to the State and where exploration work is allowed.

Reference

Chandler, F.W., 1988 – The Early Proterozoic Richmond Gulf graben, east coast of Hudson Bay, Quebec. Geological Survey of Canada, Bulletin 362, 76 pages.

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Geology and economic potential of the Lac Minto area, Far North

Martin Simard, Serge Chevé, Jean-Yves Labbé, Kamal Sharma and Jean David (MRNFP)

This new survey covers NTS sheet 34F, half of map sheet 34G, and integrates data from the northern half of map sheet 34, surveyed in the summer 2000 by the MRN (Leclair and Parent, 2000). This work was carried out within the scope of the Far North mapping program.

The area is mainly underlain by Archean rocks intruded by thin Proterozoic diabase dykes. The distribution of Archean units appears to delineate two domains roughly corresponding to the Lac Minto and Tikkerutuk domains defined by Percival and Card (1994) in the Minto Subprovince. The eastern and northeastern parts of the area (Lac Minto Domain) are characterized by the presence of garnet diatexites with paragneiss enclaves as well as units of granodiorite and granite. The western and southwestern parts of the area (Tikkerutuk Domain) mainly comprise tonalitic units injected with a considerable amount of granitic material, which gives them a heterogeneous aspect. Furthermore, these tonalites commonly contain burgundy-coloured plagioclase, which seems to be a distinctive feature of the Tikkerutuk Domain. Charnockitic units were observed in both domains.

The regional structural trend varies from NW-SE to N-S. Archean rocks are affected by faults broadly oriented NW-SE, identified by the presence of mylonitic zones a few hundred metres thick. Archean units are also transected by late brittle faults that produced cataclastic textures with associated hematite, epidote, chlorite and sericite alteration.

The area contains several massive mafic to ultramafic intrusions a few hundred metres to a few kilometres in diameter. The economic potential of these intrusions was confirmed by the discovery of the Qullinaaraaluk showing (Cu-Ni-Co-PGE), uncovered by the MRN in the summer 2000 north of Lac Minto. Grab samples from this showing yielded grades of 2.6% Ni, 1.8% Cu, 0.27% Co and 323 ppb Pt. This discovery attracted the attention of mining companies and led to the acquisition of several exploration licences in the area.

References

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Percival, J. A. – Card, K.D., 1994 – Geology Lac Minto – Rivière aux Feuilles, Québec; Geological Survey of Canada, map 1854A.

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Geology of the Kogaluk Bay area (NTS 34N and 34M)

Charles Maurice, Pierre Lacoste, Alain Berclaz, Jean David, Alain Leclair, Joanne Nadeau, Simon Gagné, Karine Lafrenière, Audrey Tremblay and Lev Vorobiev (MRNFP)

A new survey at 1:250,000 scale was conducted south of Puvirnituq, in Québec's Far North. Mapped units belong to the NE Superior Province, characterized by a dominant N-S to NW-SE structural trend.

The oldest geological elements are broadly characterized by a weak magnetic gradient, and are represented by *(i)* volcano-sedimentary sequences enclosed in *(ii)* tonalites (> 2750 Ma), variably injected with granite. Volcano-sedimentary sequences metamorphosed to the amphibolite and granulite facies are represented by: the Roulier Belt in the central part of the area, the Povungnituk Complex to the northwest, Mézard Complex diatexites of sedimentary origin to the east, as well as a number of bands from 10 m to 1 km in size scattered throughout the map area. These rocks are intruded by plutonic assemblages characterized by positive magnetic anomalies. These plutonic rocks are composed of: *(iii)* porphyritic to porphyroclastic monzogranite bodies (ca. 2732 to 2727 Ma) associated with a minor proportion of monzonite to monzodiorite, *(iv)* enderbite-opdalite-charnockite units (ca. 2730 Ma) and *(v)* heterogeneous diatexite with a trondhjemitic to granodioritic composition (*ca.* 2737 to 2722 Ma).

The region has undergone polyphase deformation. A first phase of ductile deformation resulted in WNW-ESE-trending fabrics that are only locally preserved. This deformation was overprinted by a second phase of regional deformation, responsible for N-S to NNW-SSE-trending fabrics. A phase of NNW-SSE-directed mylonitic deformation mainly affects the central part of the map area. It is coeval with the emplacement of porphyroclastic granitoids, and therefore affects lithologies older than *ca.* 2725 Ma. These Archean deformation events were followed by a Paleoproterozoic anorogenic episode, during which diabase dyke swarms oriented NW-SE, NNW-SSE and N-S were emplaced along brittle faults.

The economic potential of the area is outlined by the presence of *a)* PY-PO zones in volcanic rocks and iron formations of the Roulier Belt (Au, Ag and base metals), *b)* mafic to ultramafic intrusions (Ni-Cu-PGE), and *c)* disseminated sulphides in paragneisses. Furthermore, carbonatite dykes encountered in the western part of the area may constitute an interesting ore guide.

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Platinum group elements in the northeastern Superior Province

Jean-Yves Labbé, Pierre Lacoste and Charles Maurice (MRNFP)

Since the start of the Far North mapping program in 1998, several units of mafic to ultramafic intrusive rocks have been identified. In order to assess the platinum group element (PGE) potential of these rocks, we conducted new whole-rock chemical analyses of nearly 500 samples (major elements, trace elements, rare earth elements and PGE). These samples may be divided into four distinct groups: mafic and ultramafic rocks associated with volcano-sedimentary belts, those associated with mafic and ultramafic intrusive suites, isolated mafic and ultramafic bands in granitic rocks (too small to be mapped at 1:250,000 scale) and finally, Proterozoic diabase dykes. In addition to the PGE potential assessment, these analytical results will also be used in a subsequent petrogenetic study.

Cu/Pd, Cu/Pt and Ni/Pd element ratios were used as suggested by Barnes *et al.* (1993), to discriminate rocks that exhibit favourable chemical characteristics for magmatic PGE mineralization. Rocks with Cu/Pd and Cu/Pt ratios lower than mantle ratios (respectively 6,000 and 3,000) show a relative enrichment in PGE, and represent magmas likely to form PGE deposits.

The results obtained are interesting, particularly in the case of many volcano-sedimentary belts, namely those of the Gayot, Qalluviartuuq-Payne, Faribault-Thury and Innuksuac complexes. The chemistry of certain intrusive suites such as the Couture, Lac Calme and Qullinaaraaluk suites is also favourable for the formation of PGE deposits. The same can be said for many isolated mafic or ultramafic bands enclosed in vast felsic intrusions, especially in the northern part of the area covered by the Far North project. Proterozoic diabase dykes, on the other hand, do not show favourable chemical characteristics for PGE deposit formation. Overall, favourable Cu/Pd, Cu/Pt and Ni/Pd ratios are primarily observed in ultramafic rocks, and appear to be less common in gabbroic rocks.

Reference

Barnes, S.-J. – Couture, J.-F. – Poitras, A. – Tremblay, C., 1993 – Les éléments du groupe du platine dans la partie québécoise de la ceinture de roches vertes de l'Abitibi. Ministère de l'Énergie et des Ressources, Québec; ET-91-04, 100 pages.

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Geochemical atlas of Québec: "The Trough"

Marc Beaumier (MRNFP)

A synthesis of lake sediment geochemistry covering the Labrador Trough juxtaposes six geochemical inventory projects carried out between 1982 and 1997. The sample spacing varies from one sample per 2.5 km^2 to one per 13 km^2. Seven chemical elements are discussed, namely: Cu, U, Au, As, Zn, Pb. Some of these elements were analyzed using different methodologies.

In two areas, overlapping surveys are used to establish a correlation to standardize data.

a) 1982 survey versus 1983 surveys:

$As_{1983_} = 4.8 + 0.88^* As_{1982}$ and the correlation coefficient (R) is 0.84.

$Pb_{1983_} = 2.4 + 0.18^* Pb_{1982}$ and the correlation coefficient (R) is 0.35.

$Ce_{1983_} = 6.0 + 0.84^* Ce_{1982}$. The correlation coefficient (R) is 0.76.

$Zn_{1983_} = 45.1 + 0.54^* Zn_{1982}$ and the correlation coefficient (R) is 0.68.

$Ni_{1983_} = 9.1 + 1.1^* Ni_{1982}$ and the correlation coefficient (R) is 0.85.

$U_{1983_} = 1.9 + 0.90^* U_{1982}$ and the correlation coefficient (R) is 0.88.

$Cu_{1983_} = 1.7 + 1.00^* Cu_{1982}$ and the correlation coefficient (R) is 0.85.

b) 1997 survey versus 1984 survey:

$As_{1984_} = 0.95 + 0.2^* As_{1997}$ and the correlation coefficient (R) is 0.94.

$Pb_{1984_} = 1.19 + 0.68^* Pb_{1997}$ and the correlation coefficient (R) is 0.75.

$Ce_{1984_} = 6.55 + 0.95^* Ce_{1997}$ and the correlation coefficient (R) is 0.86.

$Zn_{1984_} = 2.1 + 1.1^* Zn_{1997}$ and the correlation coefficient (R) is 0.90.

$Ni_{1984_} = 2.1 + 0.88^* Ni_{1997}$ and the correlation coefficient (R) is 0.78.

$U_{1984_} = -8.14 + 0.96^* U_{1997}$ and the correlation coefficient (R) is 0.96.

$Cu_{1984_} = 11.7 + 0.59^* Cu_{1997}$ and the correlation coefficient (R) is 0.80.

The following features are observed:

a) high copper and nickel values and the presence of mafic rocks;

b) high uranium, cerium and lead values and felsic intrusive rocks juxtaposing the Labrador Trough;

c) zinc anomalies and the Menihek Group;

d) arsenic anomalies over the Trough.

Variations observed between the different surveys are on the order of a few ppm. To observe broad correlations with the various lithologies, this type of variation is relatively minor. On the other hand, in the Voisey's Bay region in Labrador, the dispersal of nickel in lake sediments is equivalent to a few ppm, with nickel values going from 40 to 20 ppm. This demonstrates the need to standardize the data to help discover new mineral occurrences.

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Metallogeny of the New Québec Orogen from a lithotectonic perspective

Thomas Clark (MRNFP) and Robert Wares (Osisko Exploration Ltd.)

The Labrador Trough (or New Québec Orogen) is a Paleoproterozoic fold and thrust belt along the NE margin of the Superior Province. The belt includes two volcano-sedimentary cycles (~2.17-2.14 Ga and ~1.88-1.87 Ga), separated by a 260 Ma hiatus, and a third cycle of molasse deposits. Eleven lithotectonic zones have been recognized, each limited by a major thrust fault or erosional unconformity. Each zone has its own lithological assemblage or structural style and a characteristic suite of mineral deposits. We have defined three autochthonous/parautochthonous zones of sedimentary rocks, three allochthonous sedimentary zones and five allochthonous volcano-sedimentary zones.

A metallogenic and tectonic framework has been developed for all the mineral deposits in the area. Of the 337 deposits located in the orogen or in its immediate hinterland, 103 are Lake Superior-, Algoma- or enriched-type iron formations, 112 (excluding iron) are of syn- to diagenetic origin, 111 are of epigenetic origin, and 11 are of undetermined origin. The most common syn- to diagenetic types are magmatic Cu-Ni-PGE (72), volcanogenic massive sulphides (VMS, 20) and sediment-hosted stratiform Cu (11). The most common epigenetic types are vein Cu (49), vein Cu-Ni-PGE (20), vein U (17), vein Au (8) and vein Ag-Pb-Zn (8).

Many of the syn- to diagenetic mineralizations in first-cycle rocks can be related to the rifting of the Archean craton, the subsequent filling of the rift, and the establishment of a marine platform. Stratiform Cu deposits in platform dolomites are typical of these mineralizations. Lake Superior-type iron formations were deposited during the platform stage of the second cycle. Algoma-type iron formations and associated VMS deposits were formed in deeper water, in a marine basin contemporaneous with the second-cycle platform. Magmatic Cu-Ni-PGE deposits, hosted mainly in mafic-ultramafic sills and locally in picritic flows, were formed at the beginning of the mafic volcanic episode that closed the second cycle. A carbonatite emplaced near the end of the second cycle is mineralized in Nb-Ta. Epigenetic base metal mineralizations, which are commonly associated with regional and local faults, were deposited from tectono-metamorphic fluids generated during the Hudsonian Orogeny (~1.82-1.77 Ga). Some types of deposits that are now virtually unknown in the orogen may eventually be discovered, for example, black shales containing Au, PGE, Ni, Mo, etc; SEDEX deposits; and paleoplacer Au deposits.

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Geology of the Nuvvuagittuq Belt (ca. 3.8 Ga), northeastern Superior Province: Towards a multidisciplinary approach

Alain Berclaz (MRNFP), Laurent Godin (Queen's University), Jean David, Charles Maurice and Martin Parent (MRNFP), Don Francis (McGill University), Ross Stevenson (UQAM), Alain Leclair (MRNFP)

The Nuvvuagittuq Belt (previously known as the Porpoise Cove sequence, NTS 34K) was re-examined and mapped in detail during the summer 2003. The belt is formed of three lobes (A, B and C). Lobe A (mapped at 1:5,000 scale) corresponds to the volcano-sedimentary sequence studied by David *et al.* (2002). Lobe A represents a 3 x 3.5 km synform; it consists of essentially supracrustal lithologies grouped into three assemblages. The first assemblage contains volcanogenic material composed of massive, foliated to banded amphibolites and mafic to intermediate tuffs with associated ultramafic sills and thin bands of iron formation. This first assemblage is in mylonitic contact with gneissic tonalites that form a halo around the synform. The second assemblage is composed of volcano-sedimentary lithologies: iron formations, intermediate to felsic tuffs (3.825 Ga), polygenic conglomerates, biotite, biotite-garnet or biotite-sillimanite-cordierite paragneisses and schists, amphibole schists as well as a few horizons of amphibolite and quartzite. The third assemblage occurs in the core of the synform, and is dominated by strongly lineated lithologies: gneissic tonalites (similar to those forming the external and mylonitic border of the synform), gabbros and pegmatites (2.7 Ga).

Lobes B and C are contiguous, cover a surface area of 10.5 x < 4 km, are respectively located to the northeast and east of lobe A and are separated from the latter by a N-S-trending mylonitic zone <1 km wide. Mapped at 1:10,000 scale, they are dominated by foliated to banded amphibolites with strong lineations, that laterally grade into gneissic tonalites (similar to those along the border and in the core of lobe A), and are interbedded with dismembered ultramafic sills and grunerite iron formations associated with quartzites.

Detailed sampling was performed in order to better characterize the deformation, metamorphism, geochronology and geochemistry of the various lithological assemblages. Specific issues to be addressed include: the nature of the different phases of deformation and metamorphism recorded between 3.8 and 2.7 Ga; the geochemical and isotopic composition of amphibolites, volcanic rocks and ultramafic sills in order to better define the evolution of volcanism through time, to establish the composition of the 3.8 Ga mantle and to trace mantle and crust differentiation processes during the first phases of Earth evolution.

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Preliminary potential assessment for Olympic Dam-Kiruna-type deposits along the border of the Ashuanipi Subprovince

Daniel Lamothe (MRNFP)

This document is a 1:250,000 scale compilation of five NTS maps (23C, 23E, 23F, 23G, 23L) covering the southern half of the Ashuanipi Subprovince. The potential for Olympic Dam-Kiruna-type deposits was assessed for this region through a process of GIS data integration using spatial analysis software. This assessment project was carried out within the scope of the MPMPS.

The Mineral Potential Map Production System (MPMPS) is a computer tool designed to produce mineral potential maps using geomining data from SIGÉOM. The final product is a map at 1:250,000 scale available through SIGÉOM. These maps show prospective areas for the discovery of a specific type of ore deposit or commodity, based on the application of one or several geological models. Target areas are selected based on a combination of various relevant parameters such as rock type, proximity to an intrusion, nature of contacts, presence of faults, primary and secondary environment geochemistry, presence of lineaments, magnetic or gravity signature, etc. Assessing the mineral potential for a selected type of ore deposit therefore consists in detecting, in the geodata, various characteristic parameters, and mapping them in raster format using spatial analysis software. Through a process that involves weighing factors and parameter combinations, it is possible to generate, for the study area, a map showing zones with the greatest potential for Olympic Dam-Kiruna (ODK)-type deposits. Parameter definitions for the ODK model, and the processing methodology are detailed on a CD-ROM that accompanies the map.

The study area is located in the Superior Province, and straddles the Ashuanipi, La Grande and Opinaca subprovinces. This area was selected based on three criteria deemed favourable for the emplacement of ODK-type deposits: 1) the presence of two late or post-tectonic alkaline peraluminous granite suites (Lataigant and Viau suites), 2) the existence of single-metal or polymetallic Cu, U, Mo, Y or Ce anomaly zones, apparently associated with these suites, and 3) the presence of several major linear structures showing evidence of greenschist-facies hydrothermal alteration.

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Inventory of aggregate resources in the Réserve Faunique des Laurentides: 21M03, 21M06, 21M11

André Brazeau (MRNFP)

Following the start-up of road repairs on Hwy 175 between the towns of Québec and Saguenay, an inventory of aggregate resources was carried out in the summer 2003 in the Réserve Faunique des Laurentides. This work, at 1:50,000 scale, covered NTS sheets 21M/03, 21M/06 and 21M/11. The purpose of this study is to locate and characterize sources of aggregate and to assess their importance.

Fieldwork mainly consisted in examining a total of 146 sand and gravel pits, as well as several natural cross-sections and road cuts. Furthermore, 25 sand or gravel samples were collected and shipped to the laboratory to determine their physical and mechanical properties.

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. Some of the rocks in the area have undergone partial melting to form migmatites. The quality of aggregates in the area is good, and their composition closely reflects the composition of underlying rocks.

Geomorphologically, the area consists of a high plateau slightly inclined southward, where the altitude ranges from 1,100 m in the north to 200 m in the south. The average altitude varies from 700 to 900 m. Deep valleys incise the plateau, namely the Jacques-Cartier and Montmorency river valleys, creating steep escarpments of several hundred metres. A number of valleys are U-shaped, typical of glacier-carved valleys.

Sand and gravel deposits are abundant in the study area. Most of these were emplaced when the ice cap began to recede from the area, about 12,500 years ago. Many of these deposits are associated with the emplacement of the Saint-Narcisse moraine complex. Several moraine crests and many fluvio-glacial accumulations mark the landscape, both in 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. The most significant deposits are found in the Jacques-Cartier river valley area near Stoneham and Tewkesbury, as well as to the north and south of Lac Jacques-Cartier and in the Montmorency river valley near Laval Nord, Saint-Achillée and near the mouth of Rivière des Neiges.

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Glacial erosion features in Québec

Ghismond Martineau and Cathy Lapointe (MRNFP)

The project to integrate data related to glacial erosion microfeatures in SIGÉOM is well on the way to completion. A review of the geoscience literature is now complete, and all glacial features derived from this phase of the study have been integrated into the database. The compilation project is now in a follow-up/update phase, where glacial feature measurements made by Department geologists and those derived from studies conducted by our colleagues at the Québec Geoscience Centre (QGC) are added to the database at the end of each field season. The entire database will soon be available on the Internet, via SIGÉOM à la carte. Clients will have access to nearly twelve thousand striated outcrops.

We are now considering the production of a synthesis map showing glacial movements that have affected Québec's landmass throughout the Quaternary. This project will be carried out with the cooperation of Mr. Michel Parent of the QGC. Major ice-flow directions, their geographic location and their relative ages will appear on this map. Colour coding will be used to highlight major paleogeographic features of the Laurentide Ice Sheet such as ice streams, Cochrane surges and the maximum extent of Appalachian ice.

We believe that this type of synthesis work meets the mandate of both our respective organizations, the Ministère des Ressources naturelles, de la Faune et des Parcs (MRNFP) and the QGC.

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Geology in Québec: 120 years of success

Serge Perreault, James Moorhead (MRNFP)

For nearly 120 years, geologists working on behalf of the Québec government have been mapping and studying Québec's huge landmass. Work tools and geological concepts have considerably evolved over the years. However, the geologists' prime mandate has remained essentially the same, namely to perform a mineral inventory of the Province of Québec and to promote it. To acknowledge the achievements of Québec government geologists, we have put together a poster outlining the importance and economic benefits of the work accomplished by these professionals. Old and new discoveries will be mentioned, as well as mines that originate from mineral showing discoveries, from follow-ups of geochemistry and geophysical surveys or from the publication of geological reports or promotional documents by Québec government geologists.

Everyone remembers the discovery of the Lac Volant copper-nickel-cobalt showing, 60 km northeast of Sept-Îles. This discovery, made by a field crew from Géologie Québec, attracted a lot of media attention. This was not the first discovery made by Québec government geologists however. In 1942, Dr. Joseph Retty uncovered several massive ilmenite showings along the shores of Lac Allard and Lac Puyjalon in the Côte-Nord region. Later on, prospectors, then Kennecott Exploration conducted exploration in this area. This work led to the discovery in 1949 of the largest massive hemo-ilmenite ore deposit in the world. QIT Fer et Titane Inc. operates the Tio mine since 1950, and nearly 2,000 people work at its facilities in Havre-Saint-Pierre and Sorel-Tracy. Follow-ups on "INPUT" geophysical surveys carried out by the Ministère des Richesses naturelles in the Abitibi region in the early 1970s led to the discovery of the Lemoine mine (Cu-Zn-Au-Ag, 1975-1983). A more recent example is the Troilus mine, operated by Inmet Mining Corporation. Between 1978 and 1983, the Ministère de l'Énergie et des Ressources conducted a geological inventory, estimated at $700,000, in the Frotet-Troilus area. The publication of this inventory and promotion of prospective geological settings and ore guides attracted the attention of mining companies, thus leading to several exploration campaigns, the end result of which was the start-up of the Troilus mine, which currently employs nearly 325 workers.

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Exploration targets based on the Far North lake sediment survey

Marc Beaumier and Serge Perreault (MRNFP)

Lake sediment geochemistry over the Voisey's Bay Ni-Cu ore deposit in Labrador (McConnell and Davenport, 1996) shows a subtle response, representing the 80th percentile of Ni content distributions. The dispersal observed over a distance of more than 20 km is characterized by decreasing Ni values, from 40 to 20 ppm. It follows the ice flow direction, indicating that lake sediment chemistry is directly influenced by the mineralogy and lithologies sampled by tills (Davenport, Frisk and Beaumier, 1997).

The area between the Monts Torngat and Rivière George is characterized by an important Cu-Ni-Co geochemical domain in lake sediments. It is possible to discriminate between barren anomalies and those associated with copper-nickel mineralization related to the presence of mafic and ultramafic rocks that usually host this type of mineralization. The use of Mg to discriminate between so-called barren and fertile anomalies, associated with the presence of Cu-Ni-Co occurrences in mafic rocks, seems to work well in areas with lithological assemblages attributed to mafic volcanism (ex: occurrences near Lac Erikson in the Labrador Trough). On the other hand, in the vicinity of the Qullinaaraaluk Cu-Ni-Co showing, located in the western part of the Superior Province (Labbé *et al.*, 2001), this Mg discrimination is not valid. In the Kambalda region of Australia, Brand (1999) suggested using Ni/Cr*Cu/Zn ratios in order to discriminate anomalies related to barren vs nickel ore-bearing komatiitic rocks. Theoretically, whatever the type of Cu-Ni mineralization, this method should be successful.

The application of these methods in the Torngat area leads us to conclude that despite the presence of very strong Cu-Ni-Co anomalies in lake sediments, the latter may be explained by the presence of weakly differentiated rocks of the Nuvulialuk mafic Suite, and not by the presence of copper-nickel deposits.

Several Ce-Ba-Cr anomalies are the result of dispersal of these elements derived from granitic, charnockitic and mafic rocks of the Sukaliuk and Lomier complexes. These anomalies overlap nickel anomalies. The presence of magnetitite and of U anomalies in lake sediments appears, at first glance, to define a prospective area for Olympic Dam-type Cu-U-REE deposits in the northwestern part of map sheet 24I, between Rivière George and Rivière Koroc.

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Glacial dispersal and kimberlite indicator minerals in the Saindon-Cambrien corridor, northern Québec

Michel Parent (GSC-Q), Marc Beaumier (MRNFP) and Serge J. Paradis (GSC-Q)

Reconnaissance surveys of ice-flow indicators and kimberlite indicator minerals (KIM) in esker sediments were carried out along the entire Saindon-Cambrien corridor, a deeply fractured zone of the Archean basement, where several outliers of Proterozoic sediments are preserved, and where the diamond potential is very promising (Parent *et al.*, 2002). In this structural zone, extending for some 500 km along an east-west axis from the Labrador Trough to Richmond Gulf, Quaternary events are characterized by polyphase glacial dynamics. In the eastern part of the corridor, glacial flow and transport patterns are particularly complex, since the main glacial divide in northern Québec experienced important shifts and reorientations in this area.

Outliers of Sakami Formation exposed near the glacial divide mainly consist of very distinctive red sandstones and orange-coloured quartzites, such that their distribution in glacial and fluvio-glacial sediments in the area provides a unique opportunity to identify and characterize clastic dispersal patterns derived from this highly complex glacial dynamic system. Thus, clasts derived from Sakami rocks in the upper Petite Rivière à la Baleine river valley (33P/16) and from the Lac de la Bouteille outlier (34M/15, 16) were successively dispersed along three ice-flow directions; they form composite dispersal trains, composed of long ribbon-shaped trains and palimpsest trains. The last west-directed regional movement and the late-glacial reorientation towards the northeast both produced ribbon-shaped trains extending over some 200 km, but in almost diametrically opposite directions. Dispersal trains associated with earlier glacial movements, first towards the NNE then towards the NW, were reworked by subsequent movements, but remain clearly detectable in the form of palimpsest trains (Parent *et al.*, 1996). Finally, the eastward migration of the glacial divide associated with the last glacial maxima is demonstrated by the presence of a WSW-directed dispersal train extending for about 100 km from the Lac de la Bouteille Proterozoic outlier, which crosses the final position of the glacial divide.

Composite dispersal trains identified in this survey may serve as models for diamond exploration in glacial and fluvio-glacial sediments in the Saindon-Cambrien corridor. The results of new KIM surveys, not yet available at the time of writing, will be integrated to the regional results on display during Québec Exploration 2003.

References:

Parent, M., Paradis, S.J. and Doiron, A., 1996, Palimpsest glacial dispersal trains and their significance for drift prospecting. *Journal of Geochemical Exploration*, vol. 56, p. 123-140.

Parent, M., Beaumier, M. and Paradis, S.J., 2002, A new high-potential target for diamond exploration in northern Québec - Chromium picroilmenites in esker sediments of the Lac Bienville (33P) region. *Ressources naturelles Québec*, PRO 2002-03, 7 p.

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Diamonds and kimberlite pipes in Québec

N'Golo Togola, Marc Beaumier and James Moorhead (MRNFP)

Québec has become a major target area for diamond exploration in Canada since the discovery of diamond-bearing kimberlites north of the Monts Otish. Diamond exploration is namely concentrated in eight areas:

a) Monts Otish: the Otish field is located northwest of the Proterozoic Otish basin, and includes the Lac Beaver-Lac Tichégami area and the Renard-Portage area. In the *Beaver-Tichégami area*, Ditem Explorations Inc. reported the presence of a kimberlitic dyke swarm and a hypabyssal diamondiferous pipe, dated at 567 Ma. Furthermore, Ditem-Pure Gold also reported the presence of four kimberlites, and Dios Exploration Inc. the presence of another two. In the *Renard-Portage area*, located more than 90 km north of Lac Beaver, Ashton Mining of Canada Inc. and Soquem Inc. reported the presence of nine kimberlites, all diamond-bearing. One of these, pipe 65, covers a surface area of nearly 1.5 hectares and has yielded a diamond content greater than 33 c/ht and large four-carat stones. These are strong indications of the tremendous potential of this area.

b) Wemindji: the Wemindji field is located in the Wemindji-Caniapiscau corridor. Majescor Resources Inc. reports the presence of two kimberlite sills. South of LG2, Dianor Resources Inc. mentioned the presence of diamonds in mafic lamprophyre dykes previously mapped by the MRNFP.

c) Monts Torngat: the Torngat dyke field (dated at 550 Ma) located along the shores of Abloviak Fjord, was discovered by mapping jointly funded by the MRNFP. Twin Mining Corp. recovered 1,936 diamonds totalling 13.12 carats. Papillon Gemme Inc. used one of these stones to cut the first Québec diamond ever, exposed in 2001 at the Musée de la Civilisation in Québec City. Tandem Resources, Diamond Discoveries International, Dumont Nickel and the Nunavik Mineral Exploration Fund discovered a number of diamond-bearing dykes in this area.

d) Rivière Nottaway: in the **Nottaway area**, Poplar Resources reported the presence of kimberlite indicator minerals.

e) Caniapiscau: in the **Caniapiscau area**, BHP reported the presence of numerous indicator minerals. A network of NNE-trending faults marks a high-permeability zone associated with alkaline magmatism.

f) Lac Bienville: the **Bienville area** is located in the Saindon-Cambrien structural corridor identified by the MRNFP. An indicator mineral survey conducted by the GSC-MRNFP identified two anomaly zones.

g) Lac Aigneau: in the **Aigneau area**, MRNFP mapping uncovered a series of carbonatite and mafic and ultramafic lamprophyre dykes. Some of these dykes are kimberlitic.

h) Témiscamingue: the **Témiscamingue field** contains four weakly diamondiferous diatreme and hypabyssal kimberlite pipes. A diamond-bearing hypabyssal sill was identified by the MRNFP in Campeau Township. The Guigues and Notre-Dame-du-Nord-1 pipes were respectively dated at 142 and 125 Ma.

i) Desmaraisville: the **Desmaraisville field** is located in north-central Abitibi. It contains five diamond-bearing hypabyssal kimberlites and a number of dykes, dated at 1,100 Ma.

Posters

P 061*

New tectono-stratigraphic interpretation of the Cummings Complex in the Chibougamau area

F. Leclerc, N. Goulet (UQAM)

Detailed mapping along a new segment of road located about 15 km north of Chibougamau has shed new light on the structural and tectonic interpretation of the Cummings Complex and the second volcanic cycle of the Roy Group (Gilman and Blondeau formations). This new road cut is perpendicular to the dominant structural trend in the area (E-W) and reveals a nearly continuous section over close to 3 km. It exposes basaltic and dacitic lava units of the Gilman Formation, volcaniclastic sedimentary deposits of the Blondeau Formation as well as rocks of the Cummings Complex. This last unit was previously interpreted as a series of differentiated ultramafic intrusive sills (dunite, peridotite, pyroxenite, gabbro). Structural analysis completed in the summer 2002 and 2003 indicates that contacts between the main units are highly tectonized. These units are faulted and thrust southward, *i.e.* in the opposite direction from interpreted thrusts on current geological maps. Kinematic indicators clearly demonstrate the presence of a south-verging listric fault system. The different volcanic or volcano-sedimentary formations along with the Cummings Complex form a regional allochthonous zone. Seismic reflection data reveals the presence further west of a major break in the lower crust, near the boundary between the Opatica and Abitibi subprovinces. This suture zone may be represented, in the Chibougamau area, by a dismembered "ophiolitic nappe" transported to the south. Discordant mafic dykes in the Gilman and Blondeau formations may represent a feeder dyke system that fed overlying lavas. The lower contact of the Cummings Complex is also characterized by a chrome-rich garnet (uvarovite)-bearing horizon that extends for several kilometres along strike. Uvarovite is recognized as an indicator mineral for diamondiferous intrusions, emplaced along deep crustal breaks. If the Cummings Complex represents a preserved thrust fragment of the suture between the Opatica and Abitibi subprovinces, the presence of uvarovite constitutes an important element to develop the diamond potential of the Chibougamau area.

* Poster set up in the Jacques Cartier room

Acronyms, list of Exhibitors, floor plans of exhibit rooms and project location maps

Acronyms

APGGQ	Association professionnelle des géologues et géophysiciens du Québec
CERM	Centre d'études sur les ressources minérales
CGC	Commission géologique du Canada
CGQ	Centre géoscientifique de Québec
DBCEI	De Beers Canada Exploration Inc.
DBC KPU	De Beers Canada Kimberlite Petrology Unit
DDMI	Diavik Diamond Mines Inc.
DIVEX	Diversification de l'exploration minérale au Québec
FEMN	Fonds d'exploration minière du Nunavik
Géologie Québec	Direction de Géologie Québec (Ministère des Ressources naturelles, de la Faune et des Parcs)
GÉON	Firme géo-conseil
IGWG	Intergovernmental Working Group on the Mineral Industry
INRS	Institut national de la recherche scientifique
INRS-ETE	Institut national de la recherche scientifique - Eau, terre et environnement
IOS	IOS Services Géoscientifiques inc.
MERC	Mineral Exploration Research Centre
MGRC	Mistissini Geological Resources Centre
MRN	Ministère des Ressources naturelles
MRNFP	Ministère des Ressources naturelles, de la Faune et des Parcs
MSC	Mineral Services Canada Inc.
MSSA	Mineral Services South Africa (Pty) Ltd.
N.M.E.F	Nunavik Mineral Exploration Fund
OGQ	Ordre des géologues du Québec
PDC	Placer Dome Canada
ROM	Royal Ontario Museum, Toronto
U. Laval	Université Laval
UQAC	Université du Québec à Chicoutimi
UQAM	Université du Québec à Montréal
URQ	Université rurale québecoise
UQAT	Université du Québec en Abitibi-Témiscamingue
URSTM	Unité de recherche et de service en technologie minérale de l'Abitibi-Témiscamingue
U. Toronto	Université de Toronto
SSP	Scott-Smith Petrology Inc.
SGNO	Service géologique du Nord-Ouest (Ministère des ressources naturelles, de la Faune et des Parcs)

List of Exhibitors

Salle de Bal

1 Jaguar Nickel Inc.
2 L'Équipe Fabconcept inc.
3 CNW Telbec
4 Ressources Sirios inc. et Dios Exploration inc.
5 Les Ressources D'Arianne inc.
6 Mines Cancor inc.
7 Exploration Maude Lake
8 IOS services géoscientifiques inc.
9 Systèmes Géostat international inc.
10 Hélicoptères Canadiens ltée
11 Cambior inc.
12 Quinto Technology inc.
13 Prospectors & Developers Association of Canada
14 New Brunswick Natural Resources and Energy
15 Centre géoscientifique de Québec
16 Ontario Northern Developpement and Mines
17 Ontario Northern Developpement and Mines
18 Abitibi géophysique inc.
19 Marum Ressources inc.
20 SOQUEM inc. et Les mines Ashton du Canada inc.
21 MRNFP - Direction générale de l'information géographique
22 UQAT - FUGRO - NORANDA - École polytechnique
23 Niocan inc.
24 Fugro Airborne Surveys
25 Fugro Airborne Surveys
26 Mines d'Or Virginia inc.
27 MIR télédétection inc.
28 Junex inc.
29 Terraplus inc.
30 Fordia limitée
31 Ressources Appalaches inc.
32 Fonds de prospection minière jamésien et Société de développement de la Baie-James
33 ALS Chemex Chimitec
91 Exploration Typhon
92 Questerre Energy Corporation

Verchères

34 Instrumentation GDD inc.
35 Canadian Royalties Inc.
36 Ressources Majescor inc.

Place d'Armes

37 Fonds régional d'exploration minière de la Côte Nord
38 Géotic inc.
39 RSW-Béroma inc.
40 MRNFP - Direction du développement minéral
41 Wemindji Exploration inc.
42 Ressources Dianor inc.
43 Actlabs
44 SADC (Cégep de Matane)

Jacques Cartier

45 Université Laval
46 Université du Québec à Montréal
47 Queens University
48 Université McGill
49 Université du Québec en Abitibi-Témiscamingue
50 Université Laurentienne
51 Université Laval
52 Corporation Minéraux Alexandria
53 Géosig inc.
54 Camese
55 Institut national de la recherche scientifique
56 Commission géologique du Canada, CGC-QC
57 Commission géologique du Canada, CGC-QC
58 Institut national de la recherche scientifique
59 Omégalpha
60 Société de développement de la Baie-James
61 Université du Québec à Montréal
62 Instrumentation GDD Inc.
63 Université d'Ottawa
64 UQAC-Consorem
65 UQAC-Consorem
66 Université du Québec à Chicoutimi
67 CGM - École Polytechnique
68 University of Toronto
69 Fonds miniers du Saguenay – Lac-St-Jean
70 Fonds régional d'exploration minière de la Côte-Nord
71 Fonds de prospection minière Jamésien
72 Ressources Metco inc.
73 Ressources Metco inc.
74 GoldBrook Ventures Ltd.
75 GoldBrook Ventures Ltd.
76 Nunavik Mineral Exploration Fund
77 Fonds régional d'assistance à la prospection minière de la Gaspésie – Îles-de-la-Madeleine
78 Mira Geoscience
79 Acme Analytical labs
80 Association géologique du Canada
81 DIVEX
82 DIVEX
83 DIVEX
84 Knight Resources Ltd.
85 Knight Resources Ltd.
86 Conseil cri sur l'exploration minérale
93 SGS Minerals Services
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100 PROMINE

Salon Bellevue

101-102 3D common-earth modelling of the Bousquet Formation, Southern Volcanic Zone, Abitibi Subprovince, Québec
103-104 A new look at an old mining camp: The Destor-Porcupine Fault, Abitibi Subprovince (phase 2)
105-106 Grenville Front, phase 1 – Mapping of the Lac Lagacé area (32B/14)
107 Grenville Front, phase I: Geology of the Lac Charron area (NTS 32G/09 and 32G/08)
108 Gold occurrences in the NE part of the La Dauversière pluton: Emphasis on the Lac Dufresne deformation zone
109-110 Geological map of the Gaspésie and Bas-Saint-Laurent regions
111-112 Geology and mineral potential of the Lac Sainte-Anne area (22B/16-0200-0102)
113 Mineral potential of the Mistassini basin: A re-examination using tools borrowed from oil & gas exploration

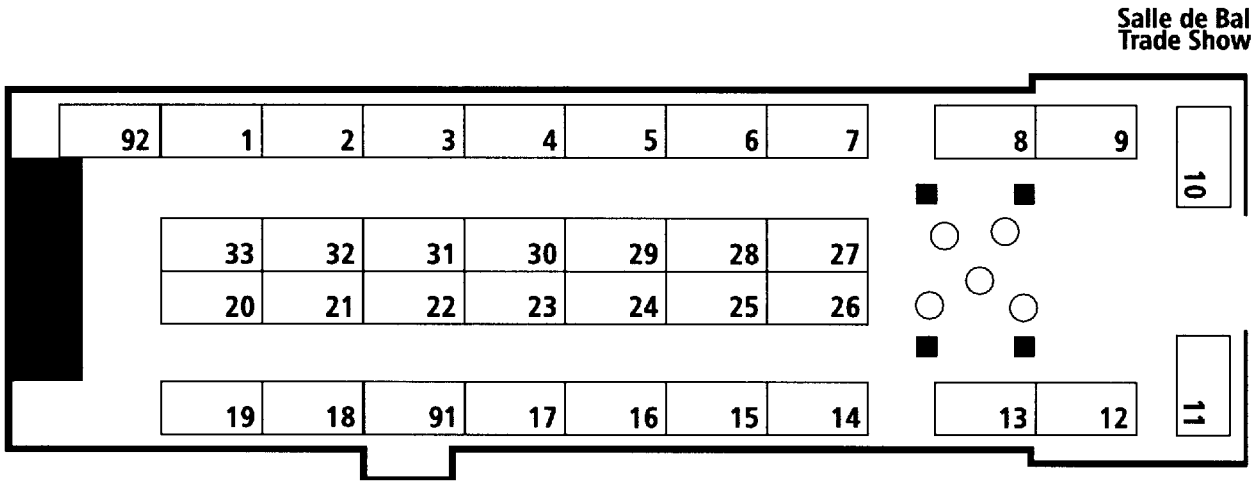
List of Exhibitors

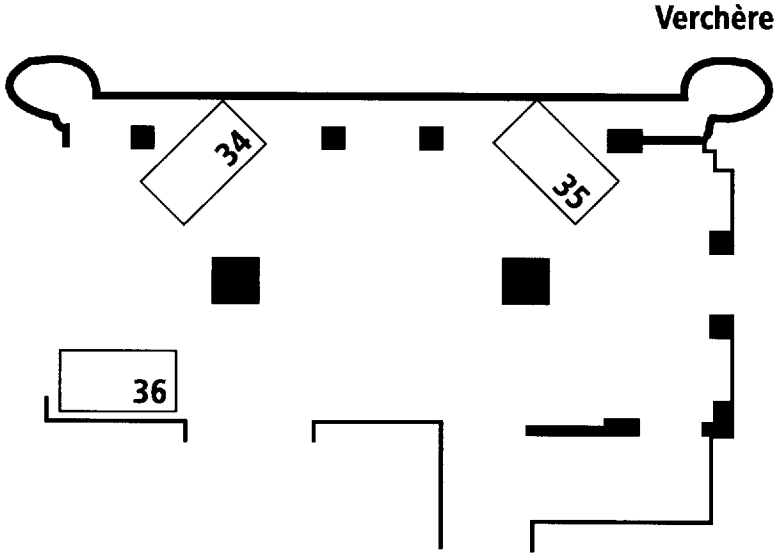
114 Geochemical and isotopic evolution of volcanic and plutonic assemblages in the Bienville, Minto, Goudalie and Tikkerutuk subprovinces in the southwestern part of Québec's Far North (phase II)
115 Geology of the Lac au Goéland area (32F/10 and 32F/11)
116 Outstanding geological sites
117 Dispersal of indicator minerals in the Ashuanipi area
118 Structural geology of the Murgor gold-bearing zone, Barry Township (32B/13)
119 Gold and base metal occurrences in the Lac aux Loutres area (32B/13), a case of polyphase metallogenesis – Metallogenic synthesis of the Urban-Barry belt (1/2)
120 Optimization of seismic data processing for a better geological interpretation: Line 2002-MRN-10b in the Gaspésie region
121 Compilation and integration of geological base maps in SIGÉOM
122 Potential for volcanogenic massive sulphide (VMS)-type deposits in the Lac Assinica (32J) and Lac Evans (32K) area
123 High-grade metamorphism of hydrothermal alteration zones: Characterization of an ore guide from the Abitibi to the Grenville
124 Synthesis of the eastern Blake River Group: Segment east of the Ruisseau Davidson fault (32D/07-SE)
125-126 Geological synthesis of the Côte-Nord region: Words and images
127 The Labrieville anorthositic Suite, Saguenay–Lac-Saint-Jean region, Grenville Province
128 Geology of the Lac Pine area, northern Central Metasedimentary Belt, Grenville Province
129 Geology of the Lac Nadeau Ni-Cu-PGE showing, Portneuf area
130 Geological synthesis of the Basse-Côte-Nord region, Grenville Province
131 Geological synthesis of the Minganie region, Grenville Province
132 Rare metal potential in the Near North, Québec
133 Gold potential in the Chibougamau area
134 Copper and silver occurrences in Proterozoic rocks of the Lac Guillaume-Delisle area, Nouveau-Québec
135-136 Geology and economic potential of the Lac Minto area, Far North
137 Geology of the Kogaluk Bay area (NTS 34N and 34M)
138 Platinum group elements in the northeastern Superior Province
139 Geochemical atlas of Québec: "The Trough"
140-141 Metallogeny of the New Québec Orogen from a lithotectonic perspective
142 Geology of the Nuvvuagittuq Belt (ca. 3.8 Ga), northeastern Superior Province: Towards a multidisciplinary approach

Salon Rose

143 Preliminary potential assessment for Olympic Dam-Kiruna-type deposits along the border of the Ashuanipi Subprovince (MPMPS)
144 Inventory of aggregate resources in the Réserve Faunique des Laurentides (21M/03, 21M/06 and 21M/11)
145 Glacial erosion features in Québec
146-147-148 Geology in Québec: 120 years of success
149 Exploration targets based on the Far North lake sediment survey
150 Glacial dispersal and kimberlite indicator minerals in the Saindon-Cambrien corridor, northern Québec
151 Diamonds and kimberlite pipes in Québec

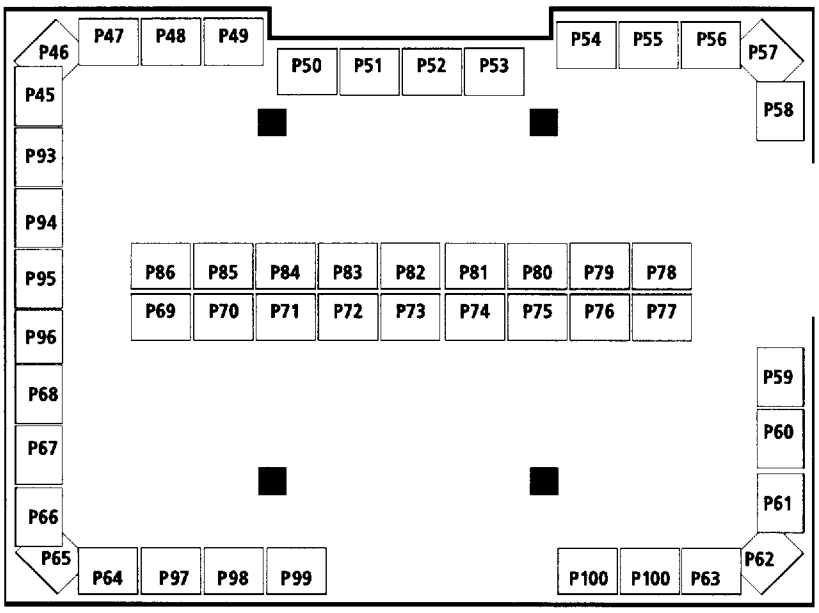
Floor plans of exhibit rooms



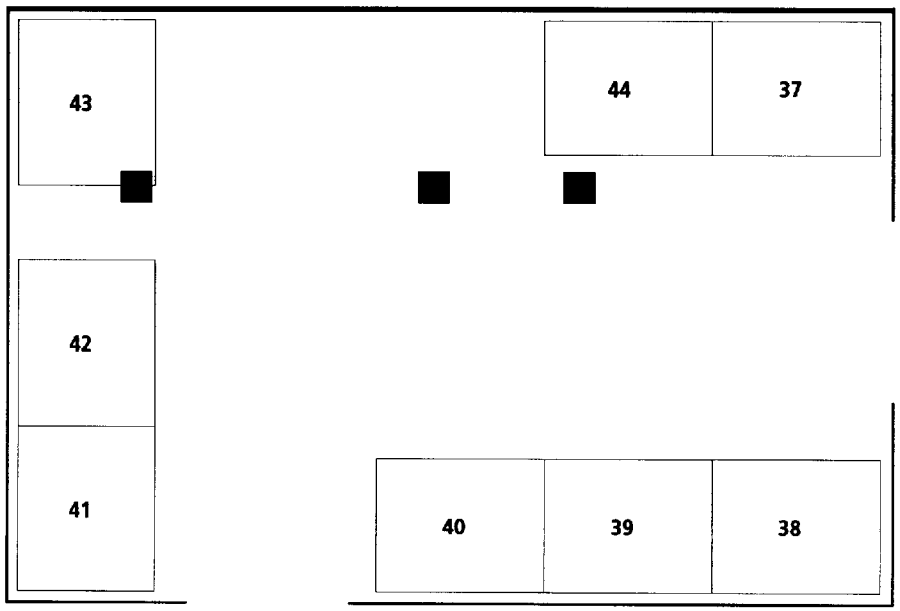


Floor plans of exhibit rooms

Jacques Cartier
Geoscientific exhibits

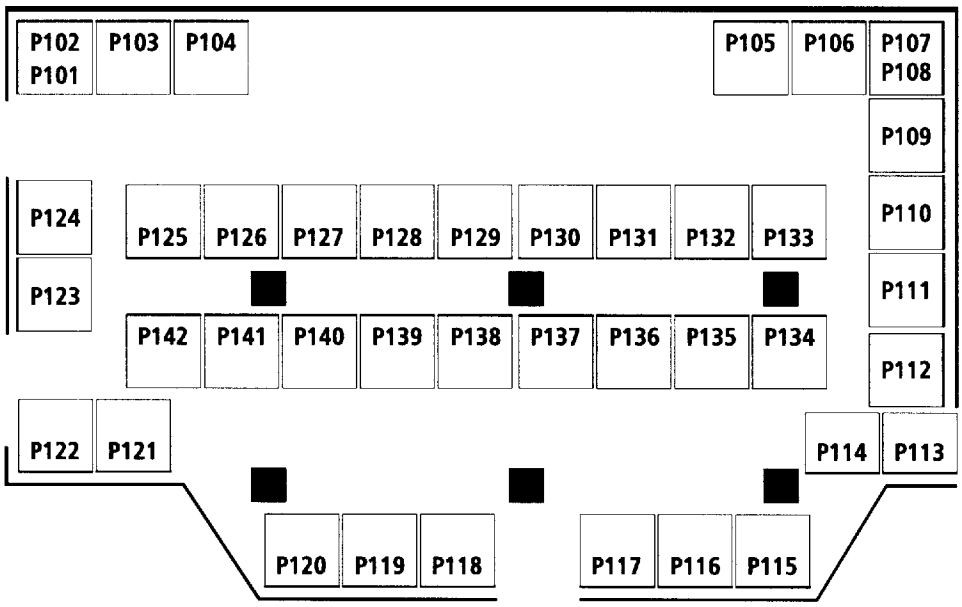


Place d'armes
Core shack

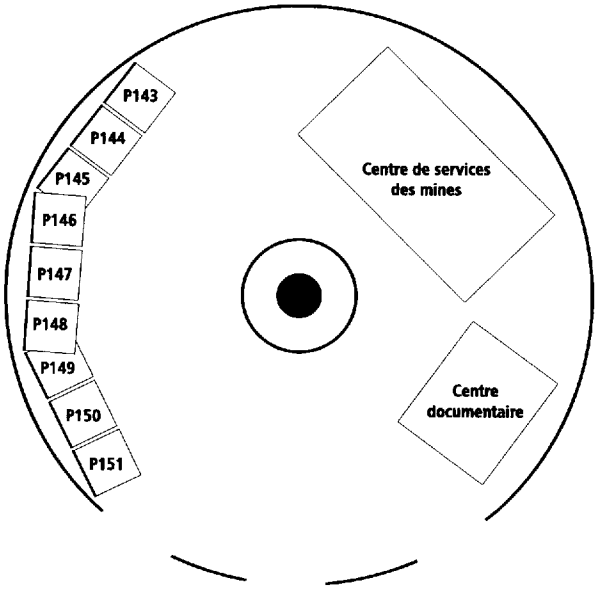


Floor plans of exhibit rooms

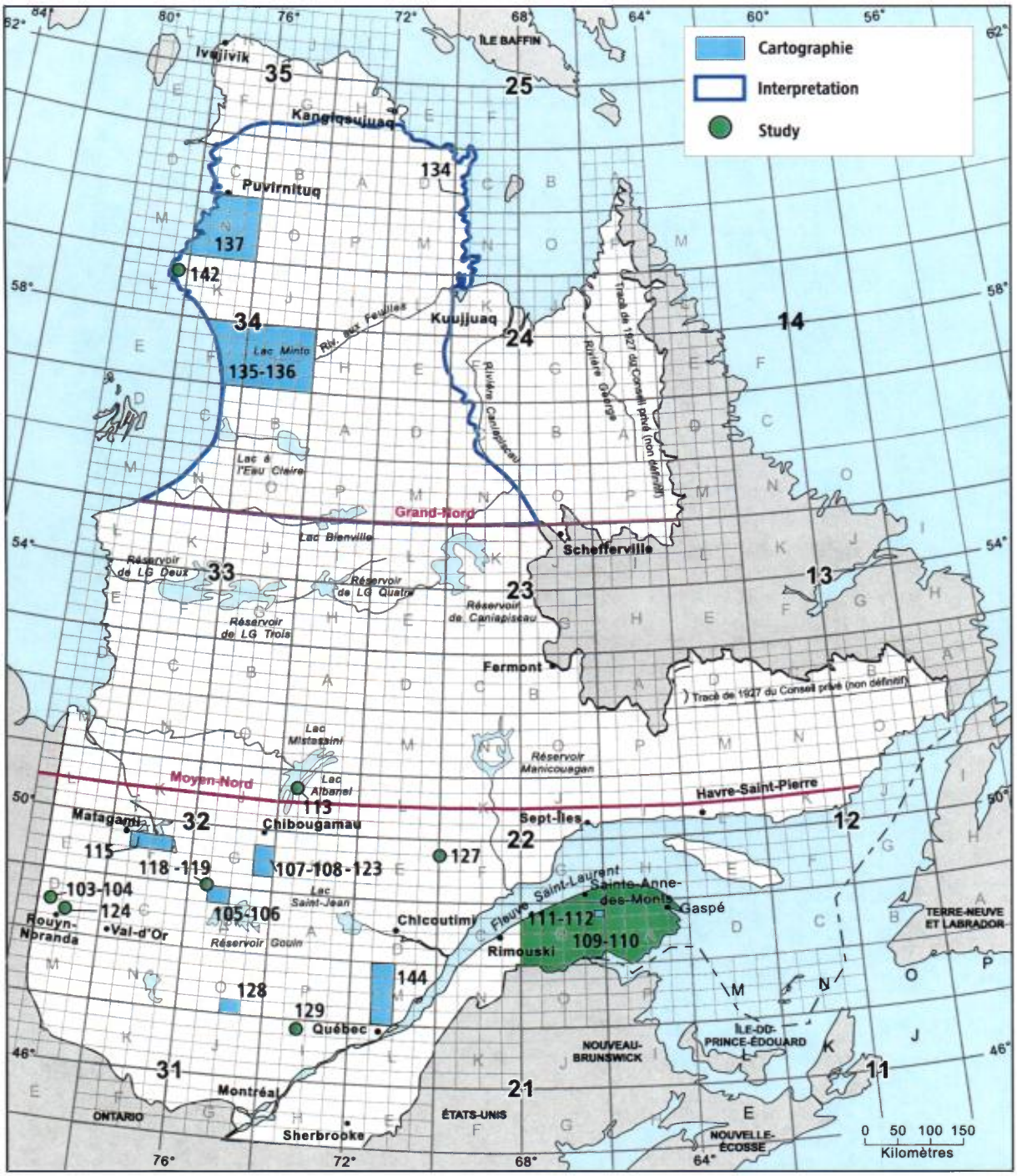
Bellevue
Geoscientific exhibits



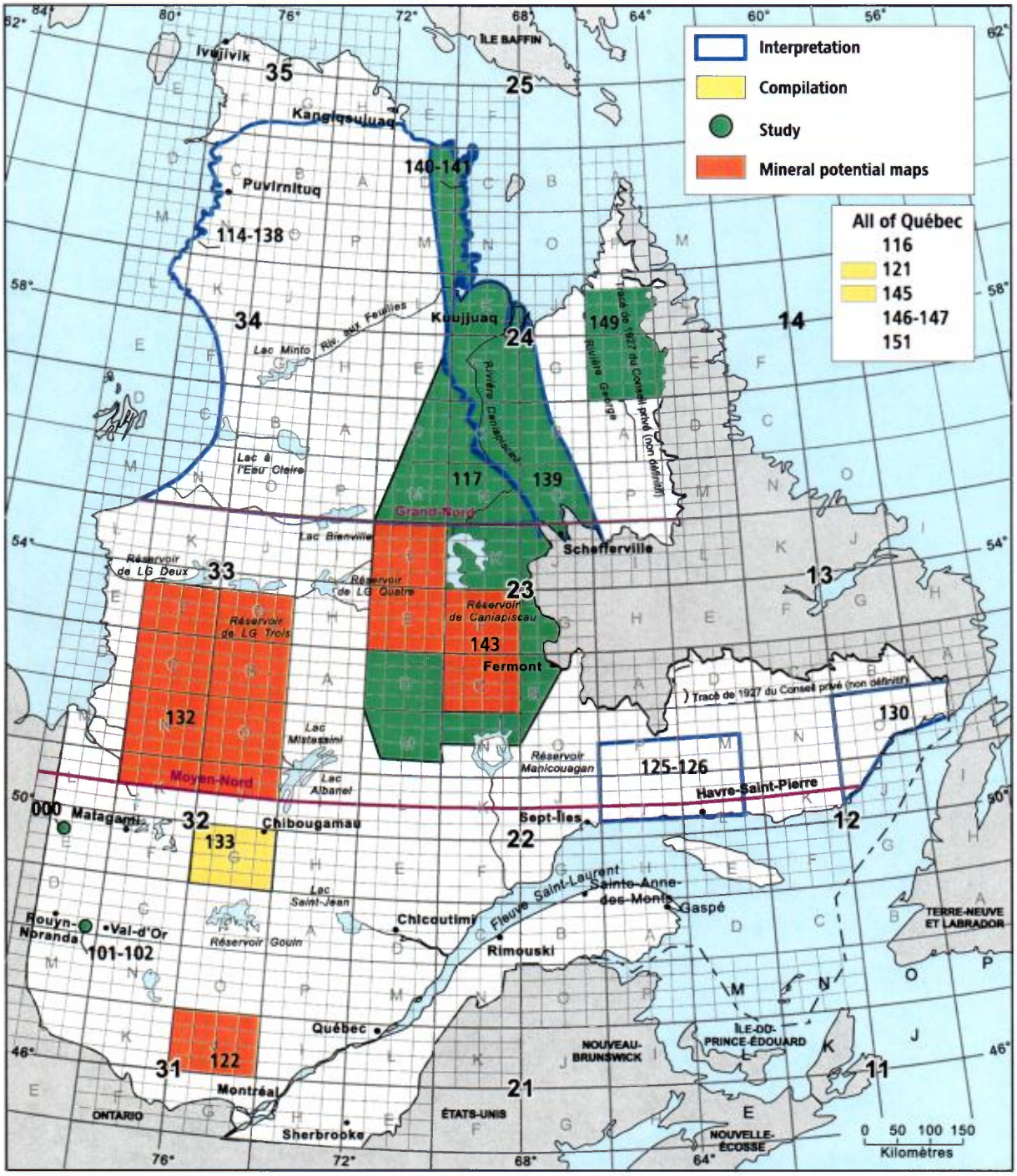
Salon Rose
Geoscientific exhibits



Field projects location map



Location map of data interpretation projects



Ressources naturelles, Faune et Parcs
Québec