DISCLAIMER
This report contains data from various sources. The accuracy and reliability of these data depend entirely on these sources.
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An Invitation from the Minister for Natural Resources and Wildlife

As Minister for Natural Resources and Wildlife, I am delighted to invite you to the 2010 edition of Québec Exploration, the annual meeting of the mineral exploration industry. I am particularly pleased to extend the invitation this year because the theme of the event, “Creating Collective Wealth”, is one of the foundations of the Québec Mineral Strategy, launched in June 2009.

The Strategy was the outcome of a process of reflection and extensive consultations with a variety of mining sector partners, including regional stakeholders, environmental groups, government departments, and mining associations and companies. All the measures implemented in the wake of the Strategy are designed to create wealth while ensuring that the mining sector is developed with due regard for the environment, in partnership with the communities, and in harmony with the milieu.

This major shift in our approach was marked by the tabling of Bill 79 in the National Assembly in December 2009, the subsequent general consultations on the bill, and the reform of the mining rights regime introduced last spring. The new structure currently being put into place is designed to make Québec's vast mineral potential available to the mining companies on conditions that will allow them to be competitive. We believe mining development can and must be of benefit to all Québécois, and this is the goal to which we are committed.

Once again this year, Québec Exploration will be rich in content, meetings and discoveries, and – I am convinced – in opportunities to create wealth! It is up to you to take advantage of it!

Serge Simard

Minister for Natural Resources and Wildlife
An Invitation from the AEMQ President

For the eighth consecutive year, the Association de l’exploration minière du Québec (AEMQ) is pleased to join forces with the Ministère des Ressources naturelles et de la Faune for another edition of Québec Exploration. This major geoscientific conference attracts more than 2,000 participants from every sector of the mining industry in Québec, Canada and throughout the world.

Once again this year, the Organizing Committee has met the challenge of renewing the Québec Exploration program, through the theme of “Creating Collective Wealth”. On the menu: the geology and mineral potential of James Bay and Grenville, financing of exploration companies, innovation in mining exploration, and the social issues surrounding it. The ever-popular Core Shack will present the core samples obtained by several exploration companies. New commercial exhibition spaces will open the door to the presence of new suppliers. The Open House event, on the topic of earthquakes, should attract a good number of attendants. A special invitation is extended to schoolchildren!

Although 2009 was more difficult for exploration investments, the companies have returned to work in 2010 with even greater determination, and another record year for exploration is expected. Those investments are vital in renewing Québec’s mining resources. At the same time, Québec’s vast mineral potential continues to attract outside investors, and more than 200 junior exploration companies are currently active throughout Québec.

Obviously, I would like to invite all AEMQ members to attend not only Québec Exploration, but also the annual general meeting of their Association, which will be held on Monday, November 22. For the last 35 years, the Association has worked hard to promote and defend the collective interests of its members by encouraging the preparation, application and dissemination of leading-edge practices. Your support is vital in ensuring that it continues to be effective.

Come and meet us at Québec Exploration, Canada’s friendliest and best-attended geoscience conference!

Jean-Pierre Thomassin, M.B.A.
Executive Director
Association de l’exploration minière du Québec
An Invitation from the Honorary Chair of Québec Exploration 2009

The theme of Québec Exploration 2010, “Creating Collective Wealth”, is a timely one. As people continue to ask for a legitimate debate on the community’s share of Québec’s subsurface wealth, it is important to point out that this wealth must first be created before it can be shared.

Although Québec’s subsoil is indeed rich in minerals, those minerals are of no use or value until they have been released by the scientific knowledge and talents of geologists and engineers, the vision of entrepreneurs, the calculated risks of investors, and the energy and know-how of more than 50,000 skilled and courageous Québécois who work for the mining industry and its suppliers. In our industry, wealth cannot simply be harvested. The only wealth that exists is the wealth that we create.

The 2010 program of Québec Exploration reflects this. Some of the conferences will examine advances in territorial knowledge and Earth Science expertise. Others will address issues relating to the financing of mineral exploration and mine development, both of which are costly and risky, and the emergence of a new paradigm in relations between the mining industry and host communities. While it is true that the industry is now more attentive to the communities, it is equally important to note that the communities’ own expectations have increased.

This, then, is your industry in 2010: a responsible creator of value; an industry that generates 2.4% of Québec’s GDP and invests more than $300 million per year in the community, in the form of taxes and royalties, net of all subsidies received. Come and learn what it is, talk about what it will become, and reflect with us on how its extraordinary potential can be released.

I look forward to seeing many of you on November 22 to 25 at Québec Exploration 2010.

Sean Roosen
President and CEO
Osisko Mining Corporation
ORGANIZERS

Robert Marquis
Directeur général, Géologie Québec
Ministère des Ressources naturelles et de la Faune (MRNF)

Jean-Pierre Thomassin
Directeur général, Association de l’exploration minière du Québec (AEMQ)

Luc Charbonneau
Ministre des Ressources naturelles et de la Faune

Pierre Verpaelst
Ministre des Ressources naturelles et de la Faune

Christian Fortin
Ministre des Ressources naturelles et de la Faune

Marie-Pier Loiselle
Association de l’exploration minière du Québec

Michel Fontaine
Association de l’exploration minière du Québec

Marcel H. Jolicoeur
Genivar
Association de l’exploration minière du Québec

ORAL PRESENTATIONS PROGRAM

Sylvain Lacroix (MRNF)
Michel Allard (Xtrata Zinc / AEMQ)

Présidents de session
1 - Sylvain Lacroix (MRNF) and Michel Gauthier (UQAM)
2 - Jean-Yves Labbé and Olivier Rabeau (MRNF)
3 - Pierre Verpaelst (MRNF) and Michel Champagne (SIDEX)
4 - Serge Perreault (SOQUEM) and Abdelali Moukhsil (MRNF)
5 - Michel Allard (Xstrata Zinc) and Michel Jébrak (UGAM)
6 - Robert Giguère (MRNF) and André Gaumond (Mines Virginia)

EXPLORATION/INVESTISSEMENT FORUM,
ORAL PRESENTATIONS AND INVESTOR’S EVENING

Jean-Pierre Thomassin (AEMQ)
Marie-Pier Loiselle (AEMQ)

MANAGEMENT, REVIEW, PRINTING OF ABSTRACTS
AND PROGRAM DOCUMENTS

Marie-Eve Lagacé (MRNF) Joanne Nadeau (MRNF)
Michèle Mainville (traduction) Venetia Bodycomb (traduction)

VISUAL MANAGEMENT AND PRODUCTION
(POSTERS, SPONSORS, SIGNS)

Marie-Eve Lagacé (MRNF) Sonia Montambault (MRNF)
André Tremblay (MRNF) Charlotte Grenier (MRNF)

FINANCIAL ACCOUNTING

Christian Fortin (MRNF)
Caroline Nadeau (MRNF)

WORKSHOPS, INTERACTIVE SESSIONS AND FIELD TRIP

Valérie Fillion (AEMQ)

SPOUSE PROGRAM

Gilles Therrien (MRNF)
Abstracts of oral presentations and posters
<table>
<thead>
<tr>
<th>Time</th>
<th>Session/Event</th>
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<tbody>
<tr>
<td>8:15</td>
<td>Official Opening of Québec Exploration 2010</td>
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<tr>
<td></td>
<td>Ghislain Poirier, President of Québec Mineral Exploration Association (AEMQ)</td>
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<td></td>
<td>and Sylvain Lacroix, Director, Bureau de l’exploration géologique du Québec (MRNF)</td>
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<td>8:30</td>
<td>Géologie Québec</td>
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<td>Robert Marquis, Executive Director of Géologie Québec (MRNF)</td>
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<tr>
<td>9:00</td>
<td>New exploration targets from the re-analysis of lake-bottom sediments in the James Bay region</td>
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<td>Charles Maurice and Daniel Lamothe (MRNF)</td>
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<tr>
<td>9:20</td>
<td>Airborne geophysical surveys in James Bay – Impact on geoscientific knowledge and new horizons for mineral exploration</td>
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<td>Isabelle D’Amours and Daniel Bandyayera (MRNF)</td>
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<tr>
<td>9:40</td>
<td>Metamorphism and magmatism in the Opinaca metasediments, region north of the Éléonore property</td>
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<td>Samuel Morfin, Edward Sawyer (UQAC) and Daniel Bandyayera (MRNF)</td>
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<tr>
<td>10:00</td>
<td>Development of the Cyr-Lithium deposit, James Bay</td>
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<td>James McCann (Lithium One)</td>
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<td>10:20</td>
<td>A major project in the James Bay region: the Éléonore Project (Les Mines Opinaca)</td>
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<td>Jacques Simoneau, Luc Joncas and Guy Belleau (Les Mines Opinaca)</td>
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<tr>
<td>10:40</td>
<td>keynote speaker The Virginia Mines odyssey in the James Bay region: an overview of the first 15 years</td>
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<td>Paul Archer (Mines d’Or Virginia) and Jean-François Ouellette (Services techniques Géonordic)</td>
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<td>11:20</td>
<td>Major deposits on the horizon: the experience of Sirios and Dios in the James Bay region</td>
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<td></td>
<td>Dominique Doucet, Harold Desbiens and Marie-José Girard (Ressources Sirios and Exploration Dios)</td>
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<tr>
<td>1:30</td>
<td>keynote speaker SIGÉOM 2010 – A version with immediate benefits and geared toward building a new world...</td>
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<td>Charles Roy (MRNF)</td>
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<td>2:10</td>
<td>Quantification of the spatial associations between geoscientific data and mineralization</td>
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<tr>
<td></td>
<td>Sylvain Trépanier (CONSOREM)</td>
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<tr>
<td>2:30</td>
<td>Quantification of the spatial associations between geoscientific data and mineralization</td>
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<td></td>
<td>Olivier Rabeau (UQAT), Jean-Jacques Royer (ENSG/CRPG), Michel Jébrak (UQAM) and Alain Cheilletz (ENSG/CRPG)</td>
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<tr>
<td>2:50</td>
<td>Using 3D as a tool for geological visualization and interpretation at different scales</td>
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<td>Christian Beaulieu (VIASAT GeoTechnologies)</td>
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<td>3:10</td>
<td>Natural hazard vulnerability assessment in sustainable land management: case examples of the Portneuf RCM, city of Québec, and Salluit community</td>
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<td>Richard Fortier and Pierre Therrien (ULAVAL)</td>
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<td>3:30</td>
<td>Ethical questions arising from the production and use of geological 3D models: What do you think?</td>
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<td></td>
<td>Jacynthe Pouliot (ULAVAL), Hervé Halbout (Halbout Consultants, France) and Laurent Niggeler (Republic and canton of Geneva, Switzerland)</td>
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**ORAL PRESENTATIONS**

**Wednesday November 24**

### SESSION 3

Are you aware of all the financing sources for your mineral exploration and development projects?

**Chairs:** Pierre Verpaelst (MRNF) and Michel Champagne (SIDEX)

**Blakes AVOCATS**

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<thead>
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<th>Time</th>
<th>Title</th>
<th>Speaker(s)</th>
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<tbody>
<tr>
<td>9:00</td>
<td>Cree Mineral Exploration Board: a competitive organization at the service of Cree Nation</td>
<td>Jack R. Blacksmith (Cree Mineral Exploration Board)</td>
</tr>
<tr>
<td>9:20</td>
<td><strong>keynote speaker</strong> An Example of Chinese Investment in a Québec Mining Project (conference presented in chinese)</td>
<td>Wu Shu (Jilin Ji’en Nickel)</td>
</tr>
<tr>
<td>9:40</td>
<td><strong>keynote speaker</strong> JOGMEC’s Roles in Securing Strategic Mineral Commodities</td>
<td>Hiroyuki Katayama (JOGMEC)</td>
</tr>
<tr>
<td>10:00</td>
<td>Mining sector financing by Sentient, a private investment fund</td>
<td>Paul-Henri Couture (Gestion de Fonds Sentient Canada)</td>
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<tr>
<td>10:20</td>
<td>A broker – why not?</td>
<td>Pierre Colas (Industrielle Alliance)</td>
</tr>
<tr>
<td>10:40</td>
<td>The Fonds de solidarité FTQ in the mining sector: A long-term investor</td>
<td>Dany Pelletier (FTQ)</td>
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<tr>
<td>11:00</td>
<td>Honorary President’s Conference</td>
<td>Sean Roosen (President and CEO, Osisko Corporation)</td>
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</table>

### SESSION 4

New geological knowledge and mineral potential in the Grenville Province

**Chairs:** Abdelali Moukhsil (MRNF) and Serge Perreault (SOQUEM Inc.)

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<thead>
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<th>Time</th>
<th>Title</th>
<th>Speaker(s)</th>
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<tbody>
<tr>
<td>1:30</td>
<td>Impact of new geochronological data on the geodynamic evolution of the central part of the Grenville Province</td>
<td>Abdelali Moukhsil, Fabien Solgadi and Claude Hébert (MRNF)</td>
</tr>
<tr>
<td>2:50</td>
<td>Supracrustal sequences of volcanic origin in the central part of the Grenville Province, south of Manicouagan: identification criteria, characteristics, ages and implications</td>
<td>Aphrodis Indarès (Memorial University of Newfoundland)</td>
</tr>
<tr>
<td>2:10</td>
<td><strong>keynote speaker</strong> Multiple orogenesis, tectonic models and metallogeny for the eastern Grenville Province</td>
<td>Charles Gower (Geological Survey of Newfoundland and Labrador)</td>
</tr>
<tr>
<td>2:40</td>
<td>Metamorphosed hydrothermal alterations in the VMS, IOGG and epithermal systems: an indispensable exploration vector</td>
<td>Louise Corriiveau (GSC-Q), Anne-Laure Bonnet (consultant), Thomas Clark (MRNF) and Vladimir Antonoff (INRS-ETE)</td>
</tr>
<tr>
<td>3:00</td>
<td>Kipawa, an unexplained auriferous anomaly on the Grenville Front</td>
<td>Patrice Barbe, Martin Demers (Mines Aurizon) and Eric Ducharme (consultant)</td>
</tr>
<tr>
<td>3:20</td>
<td><strong>keynote speaker</strong> Till geochemistry as an efficient exploration tool in the Grenville: the Bruges (Cu-Ni) and Kekek (Au) showings</td>
<td>Philippe Berthelot (Cartier Resources) and Hugues Decorta (consultant)</td>
</tr>
<tr>
<td>3:20</td>
<td>Crevier: Quebec’s Next Niobium-Tantalum Producer</td>
<td>Serge Bureau (MDN)</td>
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**Conferences will be presented in English**

All talks are available with simultaneous translation.

**Place:** Salon Frontenac

**Reruns:** Salon Petit Frontenac
Thursday • November 25

**SESSION 5**

**Innovation in mineral exploration**

**Chairs:** Michel Allard (Xstrata Zinc Canada) and Michel Jébrak (UQAM)

**Partner:**

**SESSION 6**

**Social acceptability of mineral exploration and development projects**

**Chairs:** Robert Giguère (MRNF) and André Gaumont (Virginia Mines)

**Partner:**

**CONFERENCES**

All talks are available with simultaneous translation.

**Place:** Salon Frontenac

**Reruns:** Salon Petit Frontenac

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8:30 **Innovation in mineral exploration: observations and challenges**
Michel Jébrak (UQAM)

8:50 **What are the exploration innovation needs for the Canadian mining industry?**
Richard M. Tosdal (Canadian Mining Innovation Council) and François Robert (Barrick Gold)

9:10 **Geoscience collaboration: the critical means to deliver innovation in minerals exploration**
Ken Witherly (Condor Consulting)

9:30 **Innovation: a response to risk in mineral exploration**
Jean-Marc Lulin (Azimut Exploration)

10:00 **Ten years of research and innovation in mineral exploration: CONSOREM**
Réal Daigneault (CONSOREM, UQAC)

10:20 **A new mobile multiparametral analysis laboratory for core samples: a promising innovation for exploration**
Pierre-Simon Ross, Alexandre Bourke (INRS-ETE), Michel Allard (Xstrata Zinc), Michel Chouteau (École Polytechnique) and Sylvain Lacroix (MRNF)

11:00 **Innovation at the service of exploration**
Pierre Bérubé (Abitibi Géophysique)

1:30 **The mining industry in Québec: A mine of potential, if...**
Suzanne Méthot (Canadian Boreal Initiative)

1:45 **The ingredients promoting the social and environmental acceptability of projects**
Philippe Bourke (Regroupement national des Conseils régionaux de l’environnement)

2:00 **Developing for living ...the social acceptability of mining projects**
Stéphane McKenzie (James Bay Regional Conference of Elected Officers) and Sonia Marcoux (Regional Commission on natural resources and the territory of James Bay)

2:15 **Title to be confirmed**
Serge Lévesque (Mayor of Sept-Îles)

2:30 **Point of view of the Cree communities**
Matthew Coon Come (Grand Chief, Cree Regional Authority)

3:00 **Exploring a global development approach**
Martin Derners and Jacynthe Lafond (Mines Aurizon)

3:30 **Closing speech**
Robert Marquis, Executive Director of Géologie Québec (MRNF)
**ORAL PRESENTATIONS**

**Session 1  9:00**

**New exploration targets from the re-analysis of lake-bottom sediments in the James Bay region**

Charles Maurice and Daniel Lamothe (MRNF)

More than 27,000 lake-bottom sediment samples were re-analyzed in a region covering more than 182,000 km² within the Baie-James municipality. The data cover almost the entire La Grande and Opinaca subprovinces, as well as the southern Bienville Subprovince, the southwestern Ashuanipi Subprovince, and the east part of the Opinaca Subprovince. The samples were acquired during the 1970s (survey 1957001) and only those from the northern part of the survey were re-analyzed from 1995 to 2003. New results were obtained for a series of 53 elements using a single analytical method (inductively coupled mass spectrometry) with lower detection limits and better accuracies than those used before in this region (atomic absorption, neutron activation, and plasma emission).

The new data are presented in a series of maps levelled using the GSL module (CONSOREM) to show the distribution of values for 23 elements in lake sediments in Quebec. The new data were also used to generate discrete exploration targets by the multiple spatial regression method, which was recently used at the scale of the province for four metallogenic models (Cu, La, Ni, U or Zn mono-element; VMS-type Cu-Zn; magmatic-type Ni-Cu; and IOCG-type Cu-U-La; see report EP-2010-01). It was also possible to generate new exploration targets for the James Bay region (Baie-James municipality) in areas that could not be modelled in the EP-2010-01 report due to missing elements required for the statistical analysis of portions of the Bienville, La Grande and Opinaca subprovinces.

And lastly, the new database is a marked improvement due to the inclusion of elements that commonly fell below detection limits in earlier studies (e.g. Be, Bi, Cd, Cs, Sb, W), or that were never analyzed (e.g. Nb, Cs, Se, Sn, Ta). In addition to providing a tool for refining existing exploration models, the new data will soon be used to develop a model for assessing the exploration for rare earth element pegmatites (Li-Cs-Ta-Be-Sn) in the James Bay region.

**Session 1  9:20**

**Airborne geophysical surveys in the James Bay region – Impact on geoscientific knowledge and new horizons for mineral exploration**

Isabelle D’Amours and Daniel Bandyayera (MRNF)

Since 2007, Géologie Québec has completed extensive aeromagnetic and gamma-ray spectrometric geophysical survey programs over the James Bay region. To date, the new surveys total 98,000 km², representing 107 NTS sheets at a scale 1:50,000, of which 70 are covered by aeromagnetic surveys and the other 37 by both aeromagnetics and gamma-ray spectrometry. The goal of the surveys is to provide high-quality geophysical coverage for a region that has been experiencing a rise in exploration activity for several years now; more specifically, the area between the three advanced mining projects of Renard (diamonds), Éléonore (gold) and Coulon (zinc, copper). The part of the James Bay region covered by the geophysical surveys occupies the southern part of the Superior Province and totally or partially covers five geological subprovinces (from north to south): Bienville, La Grande, Ashuanipi, Opinaca and Nemiscau.

In parallel with these surveys, Géologie Québec is carrying out mapping programs at scales of 1:50,000 and 1:250,000. The new geological surveys and compilation work have revealed several zones with mineral potential. The aeromagnetic data can be used to refine field mapping work and help identify structures possibly associated with gold mineralization, whether the style is epigenetic, exhalative volcanogenic, porphyry, hosted by deformation/shear zones, or hosted by iron formations. The discovery of uranium mineralization in the Laguiche Basin by different exploration companies provides an example of the kind of favourable context for Rössing-type deposits that may generate a signature on gamma-ray spectrometry surveys. The high-resolution aeromagnetic surveys are also useful for identifying zones with a potential for Ni-Cu±PGE mineralization associated with ultramafic rocks.
Session 1 ■ 9:40

Metamorphism and magmatism in the Opinaca metasediments, region north of the Éléonore property

Samuel Morfin, Edward W. Sawyer (UQAC) and Daniel Bandyayera (MRNF)

The Opinaca Subprovince occupies a very large part of the Superior Province in Québec and is associated with some of the most promising targets in the James Bay region. Nevertheless, its metamorphic and magmatic history and their role in forming the subprovince are still poorly understood. Mapping work and subsequent petrologic and geochemical studies led to the following model.

The Opinaca Subprovince is mainly composed of metagreywackes and metapelites subjected to high-grade metamorphism. Most of the sediments melted or were injected by granitic mobilizates. A reconstruction of the metamorphic history indicates that all the pre- or syn-metamorphic units attained granulite facies with a peak temperature above 850°C. The majority of the lithologies therefore underwent partial melting, generating large quantities of felsic magmas. These magmas formed in the lower (probably thickened) crust and migrated pervasively towards the surface. During their migration, some magmas underwent fractional crystallization and became rich in fluids and incompatible elements. As they cooled down to sub-solidus conditions, the magmas crystallized, liberating fluids under upper amphibolite facies conditions. These high-temperature fluids reacted with the granulitic mineral assemblages (characterized by orthopyroxene) causing them to destabilize into rehydrated amphibole- and biotite-bearing parageneses.

The metamorphic assemblages observed in the Opinaca Subprovince and along its margin were not entirely controlled by peak pressure and temperature conditions. The presence of fluids allowed high-temperature retrograde reactions to take place.

Opinaca metamorphic gradients are thus partly controlled by structures that channelled fluids, like faults and folds. These types of structures have been described along the subprovince’s margin, at the contact with the La Grande Subprovince, and it is these zones that contain most of the economically interesting sites, notably the Éléonore property. Field work in the centre of the Opinaca Subprovince may uncover other such metamorphic gradients associated with fluid-channelling structures.

Session 1 ■ 10:00

Development of the Cyr-Lithium deposit

James McCann (Lithium One)

The Lithium One project in the James Bay region is advancing towards the development an old deposit known as Cyr-Lithium. The project now comprises 3 options totalling 52 contiguous claims for a total surface area of 1716 hectares. It is located 381.5 km north of Matagami on the James Bay Road. Spodumene-bearing pegmatites (the source of the lithium), dated at 2687 Ma (Mouksil et al. 2007), inject the metasedimentary Auclair Formation and are in contact with metavolcanic rocks of the Komo Formation. The pegmatites form about fifteen swarms of about 2 to 8 dykes each. The dykes are mutually parallel, oriented N350W to N20E with a dip of 50-75° to the west and southwest, and a plunge (rake) to the south-southwest of 55-60°. The surface projection of these pegmatites forms a N290W corridor that can be traced for almost 5 km.

In 2009, we drilled 84 holes totalling 12.4 km; 83 of the holes intersected spodumene pegmatites >5 m thick. According to the classification of Cerny, the mineralization belongs to the rare-element class, the LCT family (Li-Cs-Ta), and the albite spodumene type. The pegmatites have a relatively simple mineralogy: albite, spodumene, K-feldspar and quartz. Phlogopite, apatite and beryl are accessory minerals and yellow mica is an alteration product. There is very little deformation or alteration considering their age. Our goal is to identify an indicated resource, mineable by open pit, of more than 20,000,000 tonnes (depth of 225 m) at the highest grade possible. Work is currently underway to perform a resource calculation that would include all 485 metres of channels sampled this year. In parallel, we also carried out metallurgical tests that quickly demonstrated the ease of producing a concentrate.
A major project in the James Bay region: the Éléonore Project (Les Mines Opinaca)

Jacques Simoneau, Luc Joncas and Guy Belleau (Les Mines Opinaca)

Éléonore may become one of the big gold mines in Québec and Canada. An internal feasibility study is underway, the results of which will allow a decision to be made at the end of 2010 regarding the construction of the Éléonore mine. The present resource from surface to a depth of 650 m is sufficient to justify an operation of 3,500 tonnes per day. Mining operations are scheduled to start in early 2015. The sinking of an exploration shaft down to 700 m was started this year. This shaft is essential for advancing the exploration and definition of mineralized zones at depth. If a resource is confirmed below the 650-m level, it will be possible to simultaneously mine the upper and lower parts. This could potentially double the daily production.

In 2009, a new geological model allowed the project’s resource estimate to be revised upwards to more than 3.28 Moz Au at a grade of 11.94 g/t in the Measured and Indicated categories, and more than 6.25 Moz Au at a grade of 12.93 g/t Au in the Inferred category. The potential for increasing resources is excellent since more than 60% of the resource is above the 650 m level, and drill holes reveal that mineralized zones continue down to depths of around 1,300 m.

The mineralized zones of the Roberto ore deposit are contained within a sequence of turbiditic wacke consisting of massive and finely bedded units. The rheological contrast between the massive and finely bedded sequences played a major role in the emplacement of gold mineralization. The mineralized bodies are affected by all the deformation phases known on the project. At least two phases of deformation (F2 and F3) affected the ore deposit, producing the known folded geometry.

Exploration activities in 2010 advanced the work on mineralized zones associated with F3-related E-W shear zones near the site of the exploration shaft. Although these zones are relatively discontinuous, hole #662 intersected 14.89 g/t Au over 10.24 m, demonstrating the potential for adding tonnage to the resource in the hangingwall stratigraphy.

The Virginia Mines odyssey in the James Bay region: an overview of the first 15 years

Paul Archer (Mines Virginia) and Jean-François Ouellette (Services Techniques Géonordic)

Virginia Mines is a forerunner and uncontested leader in mineral exploration in the James Bay and Mid-North regions of Québec. Since its arrival in the James Bay territory in 1994, Virginia has made no less than six major discoveries, notably the Éléonore gold deposit that now contains 9.4 Moz, the Coulon volcanic belt with its resources of almost 14 Mt of Cu-Zn-Ag mineralization, the 32 (La Grande Sud), Orfée (Poste Lemoigne Extension) and Marco gold zones (Corvet Est) with their combined gold resources of more than 500,000 ounces of gold, and finally the considerable Ni-Pd-Pt resources in the Vénus ultramafic Belt (Gayot). Moreover, Virginia’s work in the James Bay region led to the discovery of a multitude of other mineralized showings of all types, and set the stage for a drastic revision of the region’s geological map.

During the period from 1994 to 2010, Virginia invested more than $80 M of its own funds into exploration work on this promising territory and in its wake, attracted more than $40 M in investments from partners. These investments resulted in major paybacks because the gross value of Virginia’s discoveries is estimated at more than $16 billion. Even bigger benefits lie ahead once the Éléonore deposit goes into production in 2014 and the Coulon Cu-Zn-Ag resources are eventually developed.

Virginia’s success in the James Bay region cannot be attributed to chance; instead, they represent the results of a judicious exploration strategy the rests on four main principles: 1) focus efforts on a territory that is promising and open to exploration; 2) acquire and diversify a major property portfolio; 3) create multiple partnerships to share the risks inherent to exploration and maintain a long-term presence in the region; and finally; and 4) develop a reputation for expertise in the territory. This strategy was extremely profitable for Virginia during the 1994-2010 period and its rigorous application over the upcoming years should lead to an equally promising future.
Major deposits on the horizon: the experience of Sirios and Dios in the James Bay region

Dominique Doucet, Harold Desbiens and Marie-José Girard (Ressources Sirios and Exploration Dios)

For more than 15 years, the Sirios–Dios exploration team has been exploring the vast James Bay region in Québec. Over that time, work carried out by the team and other explorers in the region has helped optimize known exploration methods, resulting in several discoveries that are potentially economic or with geological/metallogenic value. These showings represent a wide variety of mineral substances in highly varied geological contexts, reflecting the great diversity of the enormous metallogenic potential for the James Bay region. It is also explains why our company-dichotomy exists: Sirios is focused on precious and base metals, and Dios targets diamonds and uranium (and more recently, rare earths). As is the case elsewhere, exploration in the James Bay region is a long process that demands patience above all else, an open spirit, and the ability to adapt. These requirements hold true more than ever when one considers the immensity of the territory and the exploration effort needed per targeted substance. This talk will provide an overview of the progress made by Sirios–Dios geologists, who have their sights set on the next big deposits in the James Bay region.

SIGÉOM 2010 – A version with immediate benefits and geared toward building a new world...

Charles Roy (MRNF)

Today, Géologie Québec delivers a new version of its system, seventeen years after its debut. The computational restrictions encountered at the beginning have been gradually resolved, leaving more room for geological matters and making it easier for users to integrate government data into their own system.

SIGÉOM 2010 takes on a new direction that should allow users greater flexibility in obtaining information by reducing the number of restrictions related to NTS map sheet divisions and to the limitations of the data models.

Bit by bit, the duplication of large geological structures, like geological faults, will disappear. Take the Cadillac Fault as an example: it will become a single object in the database, which we can limit to one sheet for the purposes of map representation. The infamous “map edge faults” will disappear over time to provide a continuous geological image. Geological zones will no longer be bounded by map sheet divisions; instead, they will be treated as geological objects.

The database will still contain the most detailed and up-to-date version possible of the geology. The user may, depending on their need, generalize the information. This will eliminate ambiguities caused by representation at different scales.

For the first time, SIGÉOM’s model for descriptive data will be available in its entirety via File GeodataBase (FGDB) from the firm ESRI. By acquiring all of Géologie Québec’s geomatics data, a user will be able to access all the information in SIGÉOM. The user will thus have a complete view of electromagnetic anomalies in Québec on one layer, outcrops from assessment files on another, sediment samples on a third, etc. The best part is that there will be no issues with UTM zones in the ESRI-FGDB environment and that the descriptive model is complete. Picture this: it will be possible to run a provincial-scale search from your computer and combine the results with any other layer of information. SIGÉOM styles will also be integrated into our products so that Géologie Québec symbols can be easily reproduced. The date of first release will let users quickly discriminate elements according to date and thereby complete their version by making small selective purchases to fill in any missing information.

For those who still wish to use shapefiles, it will continue to be possible with the usual plug-ins available as a subset to the FGDB plug-ins. A new world awaits us, and SIGÉOM 2010 is striving to be a more flexible system, steadfastly focused on the field of geology and new trends in the computerized world of social networking.
**Session 2 ■ 2:10**

**Quantification of the spatial associations between geoscientific data and mineralization**

Sylvain Trépanier (CONSOREM)

Quantifying the spatial associations between mineralization and various exploration criteria is an often neglected aspect of metallogeny. Quantification is essential for determining the real effectiveness of exploration. For an exploration criterion to be truly useful at a given scale, it must be very frequently associated with mineralization at that scale and not often found in areas without mineralization.

Quantification presupposes the ability to associate mineralization with layers of the data to be tested. From a geomatics perspective, two approaches are illustrated: vector and matrix.

The matrix approach consists of discretizing the region of interest into fixed-size cells. Mineralizations (points or polygons) and each layer of data to be tested (polygons, lines, points or existing matrix layers) are transformed into same-format matrix layers. The steps involved in transforming vector data into matrix data depend on the hypothesis to be tested. The cell values in the data layers can now be compared to the cells containing mineralization.

The vector approach only applies if mineralization is represented as points. All the layers of data to be tested must therefore be transformed into polygons having a specific attribute. For example, faults represented by lines can be transformed into buffer zones representing different distance intervals to the faults; the distance interval thus becomes the polygon attribute. The different attribute values among the created polygons will become the individual classes to be compared to the mineralization.

The most commonly used statistical method for quantifying the spatial association between data layers and mineralization is based on conditional probabilities (Bayes' rule). The basic principle is to compare the overall probability of finding mineralization in a study area with the probability of finding mineralization given a specific value class for a layer of data. A set of association parameters can be calculated to quantify the strength of the association and whether it is significant or not.

Two types of software for making such calculations will be briefly presented: “ArcSDM” and “Évaluation de potentiel minéral” from CONSOREM.

The method will be illustrated by assessing geological controls (faults and lithologies) on orogenic gold mineralization in the Val-d’Or vein system.

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**Session 2 ■ 2:30**

**The spatial distribution of orogenic gold deposits: genetic implications and an exploration tool**

Olivier Rabeau (UQAT), Jean-Jacques Royer (ENSG-CRPG), Michel Jébrak (UQAM) and Alain Cheilletz (ENSG/CRPG)

This work concerns the spatial distribution of orogenic-type gold mineralization along Archean deformation corridors. Its main objective is to determine whether the position of each deposit is dependent on the positions of the other deposits in order to better understand the system responsible for the emplacement of the gold-bearing orebodies.

Our work focuses on the Cadillac–Larder Lake and Porcupine-Destor faults in the Abitibi greenstone belt. These faults represent major structures visible over dozens of kilometres that controlled the hydrothermal evolution of a significant part of the Archean crust. Seventy-two known deposits were used for the Cadillac–Larder Lake Fault and twenty for the Porcupine-Destor Fault. It was found that the inter-distances between the gold deposits follow a log-uniform distribution along both structures.

This spatial distribution suggests the presence of a regional-scale mineralizing system. In addition, the distance over which this distribution occurs implies that geological features recognized as being favourable for the formation of a deposit, such as the nature of the lithologies or the presence of structural traps, only exert a very local influence on the location and geometry of the mineralization. The log-uniform distribution was interpreted as being the result of structural ruptures along the fault. These ruptures were the results of hydrostatic overpressure that created major structural permeability zones along which fluids circulated and mineralization was triggered by a release of pressure. These results suggest that the extent of the overpressure zones will diminish laterally in a logarithmic manner.

A probability of occurrence was estimated using the log-uniform distribution law to produce a map that can be used to target areas with the highest potential for mineralization. The map, which is based on the positions of known deposits, allows the user to adopt a predictive approach and work regionally with a wide range of geological environments.
Using 3D as a tool for geological visualization and interpretation at different scales
Christian Beaulieu (VIASAT GeoTechnologies)

Although tools for geological modelling in three dimensions have become more plentiful and readily available, the basic methodology remains fundamentally unchanged. Three cases will be presented to illustrate three different approaches to modelling. These examples demonstrate the importance of properly establishing an objective for the geological modelling work in order to avoid errors as much as to save time.

In the case of a mineable deposit, the great quantity of typically available data should guide the choice of methodology for achieving the final goal, which is a better understanding of structure and metallogeny. One of the methods that can be used in this context is scanning the available data (ex. lithological drill data) perpendicular to the main structural axes. This approach is very similar to the production of conventional geological sections. The resulting network of contact points based on the selected axes can then be used as a starting point for generating a surface. This method is particularly effective for producing complex surfaces using several dozen, or even several hundred, drill holes.

Structural modelling at the scale of an exploration licence demonstrates the complexity of producing a model using surface geological data and minimal subsurface data (ex. drill holes, trenches, seismic surveys). Priority must be given to the most reliable data when generating the three-dimensional interpretation, especially since the model may be used for planning exploration drill holes. In this type of modelling, surface information interpreted from satellite images and available geoscientific data is supported by a limited number of drill holes, and the collective data are used to develop a three-dimensional model based on selected geological sections. Seismic surveys can then be used to validate and improve the model.

Finally, at the scale of a sedimentary basin, the objective is sometimes the production of a simple yet comprehensive geological model that is easy for the general public to understand. Even though the model is simplified, the representation of sedimentary units at depth is nonetheless faithful to reality because it is based on interpreted data from exploration boreholes and some complementary studies. This type of modelling, however, cannot be used as an exploration tool or for drill hole planning due to its very regional-scale nature.

Natural hazard vulnerability assessment in sustainable land management: case examples of the Portneuf RCM, the city of Québec, and the Salluit community
Richard Fortier and Pierre Therrien (ULAVAL)

The concept of vulnerability is a fundamental consideration when taking natural hazards into account in the decision-making process of sustainable land management. A vulnerability study will identify a region’s vulnerable zones with respect to a particular natural hazard. A compilation of available geoscientific data is the first step in the assessment of a study area’s vulnerability. The second step is the spatial analysis of regionalized variables, which allows for interpolation of the variables and the production of corresponding interpolation maps. This set of primary layers of geoscientific information is then integrated in matrix format into a geographic information system (GIS). The layers are ranked and rated in the GIS as a function of vulnerability. Finally, the layers of ranked and rated geoscientific information are superimposed using a parametric method of weighted summing to produce a synthesis of geoscientific information for the land area to be managed in the form of a vulnerability index that varies spatially throughout the study area. The ranking and rating of a layer and the weighted summing of the ranked and rated layers can be done intuitively, empirically, by statistics, or analytically if the cause and effect relationships between the variables and the index to be evaluated are known. The last step is the identification of zones with low, medium or high levels of vulnerability in the study area.

We will present three case examples of natural hazard vulnerability mapping. The first example is the DRASTIC index that was used to assess vulnerability to groundwater contamination in the Portneuf regional county municipality (RCM). In the second example, a seismic risk map was produced for the city of Québec by superimposing the location of civil infrastructure over the vulnerability zoning map for the susceptibility of sandy formations to liquefaction during an earthquake. The third example is the Inuit community of Salluit in Nunavik. Thematic vulnerability index maps for landslides, permafrost thermal erosion, and thawing permafrost settlement were generated using primary maps of slopes, Quaternary deposits, surface water pathways, permafrost ice content, and microform indicators of permafrost degradation. A map was produced showing areas with the greatest vulnerability to permafrost degradation that must be avoided during land development.
Ethical questions arising from the production and use of geological 3D models: what do you think?

Jacynthe Pouliot (ULAVAL), Hervé Halbout (Halbout Consultants) and Laurent Niggeler (Republic and canton of Geneva)

Constructing 3D geologic models is an increasingly important part of the work of geologists and other geoscience specialists. Three-dimensional models also serve the needs of other professionals who are called upon to work on land-use planning, for example, or as a means of communication and collaboration with community groups and the general population when presenting mining or drilling projects.

Certain production standards already exist to assist professionals in building 3D models, but what about ethical standards relating to the distribution of (geological) 3D models? Ethics is concerned with good practices, a code of conduct, and respectful behaviour towards oneself and others. At first thought, one might expect ethical issues to be covered by the code of ethics to which engineers and members of professional orders must adhere, but it appears that a number of ethical issues are still relevant and not discussed enough, particularly during the production and use of 3D models.

A number of people tackled the issue of ethics while producing 3D urban models. This initiative developed into the Charter of 3D Ethics (www.3dok.ca), which is based on three fundamental principles: credibility, transparency and networking. The principle of credibility stipulates that 3D scenes should not tend to unknowingly influence the decision-maker, client or the general public. The principle of transparency recommends documenting the original data used to generate the 3D scene, specifying the objectives of the 3D scene, declaring any subjective elements, providing an accompanying legend for the 3D scene, mentioning any transformation of the data, and avoiding the use of any data that would infringe on personal privacy. Finally, the signatories are committed to supporting the creation of knowledge networks on the subject of 3D representation, and to encouraging education and research.

This talk will present the contents of the Charter and the current approach for its development and application. The presentation will then encourage a discussion by opening the forum to questions on the issue of ethics and 3D in the field of geosciences.

Cree Mineral Exploration Board: a competitive organization at the service of Cree Nation

Jack R. Blacksmith (Cree Mineral Exploration Board)

The Cree Mineral Exploration Board was born after the agreement between the government of Quebec and the Crees of Quebec called “La Paix des Braves”. Mining is not in the culture of the Cree nation and the mineral resources of Eeyou Istchee were all property of the mining industry. The Creation of the CMEB permits the participation of the Crees to the mining activity in the territories. Agreement concerning the mineral development in the James Bay Region has been executed between the CRA, CMEB and GOQ.

The main purposes of the Mineral Exploration Board consist of (a) assist the Crees in accessing mineral exploration opportunities, (b) facilitate the development of mineral exploration activities by Cree Enterprises, (c) facilitate and encourage the access by the Crees and Cree Enterprises to regular Quebec program funding and other encourage-ments for mineral exploration activities, (d) act as an entry mechanism for offers of services by Crees and Cree Enterprises in the field of mineral exploration.

Furthermore, the CMEB acts as an intermediate between the mining industry and the Crees to resolve matters concerning mineral resources and the land. The board has the mandate to develop the mining activity and answer to environmental needs of the Cree trapelines. It supports and funds also consistent projects for the all communities and specifically the Cree prospectors.

Concerned by the regional development, the CMEB collaborates with several entities, Cree and none Cree; and these collaborations are having a large success.

CMEB program and projects are managed by his board. This latest evaluates the administrative structure and also compares with what is known elsewhere in Canada and in the rest of the world in the trend to ameliorate and reach the excellence.
An Example of Chinese Investment in a Québec Mining Project
Wu Shu (Jilin Jien Nickel)

Since 2001, Canadian Royalties has discovered and delineated several potentially mineable nickel-copper-cobalt-platinum-palladium-gold deposits which collectively form the Nunavik Nickel Project. The Company currently has NI 43-101 compliant resource estimates on seven (7) of its deposits. Development of the project was initiated in 2007 and continued through mid-2008 when project development was halted as a result of the 2008 financial crisis. Historical site environmental clean-up activities were continued while the project was maintained on care and maintenance during 2009.

On January 13th, 2010, Jilin Jien Nickel Industry completed its acquisition of Canadian Royalties through its Canadian subsidiary. During 2010 a $122.4 M budget was approved to re-start construction and resume exploration of the property. Nickel and copper concentrate production is planned for mid-2012 and represents a tight project schedule with only one full season remaining for project construction. Development of the Nunavik Nickel Project will be funded entirely by Jilin Jien Nickel Industry.

The revised project includes the construction of a 4,500 tpd concentrator that will be fed by multiple mines. Current on-site work includes the installation of fuel storage capacity, completion of personnel accommodations, building the network of roads, construction of the Bombardier Lake dam and concurrent engineering work.

SNC-Lavalin was selected to provide engineering, procurement and construction management services (EPCM services) and began work in early June based on a letter-of-intent. Road construction and earthworks are being executed by Kiewit-Nuvumiut.

An integral part of the project is the Nunavik Nickel Agreement (NNA). The Nunavik Nickel Agreement is an Impact and Benefits agreement that was entered into between the Company, three (3) Inuit communities (Kangiqsujuaq, Puvirnituq and Salluit), and Makivik Corporation, the non-profit organization owned by the Inuit of Nunavik whose mandate is protecting the integrity of the James Bay and Northern Québec Agreement. The Nunavik Nickel Agreement constitutes the Company’s formal commitment to ensure a fair and sustainable distribution of the economic benefits stemming from the Project. The agreement was re-signed by Inuit leaders and senior staff from Jilin Jien Nickel Industry in Kuujjuaq on December 2009.

JOGMEC’s Roles in Securing Strategic Mineral Commodities
Hiroyuki Katayama (JOGMEC)

Japan, with relatively limited domestic natural resources, depends heavily on imports of crude oil, natural gas, non-ferrous metals and minerals. The vast majority of such resources—99.7% of crude oil, 96.3% of natural gas, 100% of copper and 97.1% of zinc—were imported for domestic supply as the 2006 statistics indicate.

In order to alleviate such imbalance and excessive reliance, JOGMEC was established by the Japanese government as an incorporated administrative agency with missions to seek to maintain a stable supply of natural resources and energy for Japan, to contribute to the development of the Japanese industry, and to improve the quality of the lives of people in Japan through its various activities involving oil, natural gas, non-ferrous metals, and minerals.

Such activities include JOGMEC’s support to companies that engage in exploration, development and production of energy and mineral resources through its financial and technical assistance as well as the provision of its knowledge and expertise in the resources field. JOGMEC also develops technology to help reduce carbon emissions and prevent mine pollution in Japan.

With regard to resources development, JOGMEC conducts conventional mineral exploration and functions as a risk-taker to reduce risks that private companies might otherwise have to take especially at the initial exploration stage. If successful results are obtained from JOGMEC’s mineral exploration projects, JOGMEC will transfer its interest to a Japanese company or Japanese companies, which can later receive financial and technical assistance from JOGMEC depending on their needs. JOGMEC actively implements projects and currently involves in more than 50 projects not only for non-ferrous metals but also for strategic commodities such as REE, PGE, and so on.

JOGMEC’s efforts are also placed on the development of technology that includes efficient exploration technique, and recovery and recycle processes for the user industries. For the recycle processes of REE, JOGMEC currently:

- researches on separation and recovery of neodymium and dysprosium from used rare earth magnets,
- regenerates cerium from used rare earth abrasives,
- extracts and recovers europium and yttrium from fluorescent material scraps, used fluorescent lights, and others.

For both resources development and technology development, JOGMEC is currently seeking a partnership, which may cover a wide range of such entities as national labs, private companies, major mining companies, universities among others. JOGMEC would like to promote those exploration activities and collaborated research work. Partners from overseas are also cordially invited.
Session 3 ■ 10:00

Mining sector financing by Sentient, a private investment fund
Paul-Henri Couture (Gestion de Fonds Sentient Canada)

Session 3 ■ 10:20

A broker…why not?
Pierre Colas (Industrial Alliance)

Our corporate financing team specializes in Canadian mining sector companies in need of private placements, initial public offerings, new share issues, convertible debentures, interim debt, mergers and acquisitions, as well as sponsorship for listing on the stock exchange. We are a well-established brokerage firm of national repute with a team of analysts who specialize in the mining sector and can offer innovative research coverage for your company. When dealing with equity offerings and private placements, we can assist in the preparation and publication of appropriate exchange documents, and we can establish a sales strategy and marketing for the offer. Following the offer, your broker will continue to fulfill his or her commitment by monitoring the liquidity of your outstanding shares. During mergers and acquisitions, your broker will act as counsel and provide a strategic approach. We will also be responsible for finding the necessary capital for the transaction and we will propose suitable financial arrangements in addition to ensuring that all required legal documents are properly prepared. Our client selection criteria emphasize an experienced management team, good industry prospects, and the company’s financing goal. Our skills and reputation allow us to meet the needs of our clients and provide them with superior value.
The Fonds de solidarité FTQ in the mining sector: A long-term investor
Dany Pelletier (FTQ)

Honorary President’s Conference
Sean Roosen (President and CEO, Osisko Corporation)
The rocks in the central Grenville (Saguenay–Lac-Saint-Jean and Baie-Comeau regions) are of Mesoproterozoic age and document several geological events. They formed during an interval from 1511 to 987 Ma and represent part of the evolution of Laurentia and the Grenvillian Orogeny. The oldest event documented in this region corresponds to a juvenile magmatic arc of Pinwarian age, defined in the region by the injection of several intrusions (the Petites-Bergeronnes Granite at 1511.7 Ma, quartz monzonite at 1491 Ma, tonalitic gneiss at 1495 Ma, and the Rouvray Gneissic Complex at 1484 Ma). This event was also associated with sediment deposition (the Bourdon Metasedimentary Complex at 1495 Ma). Following this, AMCG-type magmatism (anorthosite-mangerite-charnockite-granite) dominated during the Elsonian arc of Pinwarian age, defined in the region by the injection of several intrusions (ex: the Betsie Troctolite at 1002 Ma). These are the pre-Miocene remnants of an island arc and its primary characteristics are observed by the high degree of local metamorphism, although the eastern and northern extensions are obscured by intrusions of Grenvillian age (ex. Park des Laurentides). The potential correlation between the CDS and the Montauban Group reveals the possibility that the Montauban arc extended for several hundred kilometres into the central Grenville Province.
Multiple Orogenesis, Tectonic Models and Metallogeny for the eastern Grenville Province

Charles F. Gower (Geological Survey, Government of Newfoundland and Labrador)

The Grenville Province (excluding its pre-Late Paleoproterozoic foreland) is the result of multiple accretionary orogenic events, culminating and terminating in collisional orogenesis. In the eastern Grenville Province the major events are an unnamed pre-Labradorian event between 1810 and 1770 Ma, Labradorian orogenesis between 1700 and 1610 Ma, and Pinwarian orogenesis between 1520 and 1460 Ma. Between 1460 and 1090 Ma, no orogenic events have been clearly recognized, and, if they occurred, are manifest only as sporadic ‘in-board’ activity to accretionary orogenesis occurring well to the south of the present Grenville Province. The terminal collision, between 1090 and 985 Ma, was the Grenvillian orogeny, which dismembered, partially destroyed and re-arranged the arcs created during previous events.

Deciphering the metallogeny of the Grenville province in the context of this framework is challenging, but potentially rewarding. It begins with classification of types of mineralization, and is followed by relating the identified groups to their accretionary tectonic setting, and concludes with attempting to understand how they have been modified by Grenvillian collisional tectonism. It is argued that significant metallic mineralization can be condensed into four settings, namely 1) Cu, Au (Zn, Mo, U?) in a probable sedimentary exhalative setting, 2) Ni, Cu, PGE (Cr, V?) in an igneous mafic/ultramafic intrusive setting, 3) Fe-Ti (P,V?) in an anorthositic magmatic setting and 4) Cu, U, Mo, F, REE (Ag, Au?) in a felsic intrusive or extrusive hydrothermal setting.

Whereas the Cu, Au sedimentary exhalative setting appears to be restricted to the earliest stage of tectonism (1810 – 1770 Ma), all of the three igneous-process-related settings appear to have niches during Labradorian, Pinwarian and Grenvillian orogenesis. They seem to be mostly mid-to late-stage within those events, and thought of as being the metallogenic expression of the tripartite mafic-anorthositic-monzogranitic magmatism that is a re-occurring theme during the late Paleoproterozoic and Mesoproterozoic evolution of the Grenville Province.

Understanding how these metallogenic settings have been modified during Grenvillian orogenesis involves a general appreciation of Himalayan-type collisional architecture and a specific appreciation regarding how the eastern Grenville Province behaved during the Grenvillian orogeny, particularly with respect to lateral-ramp tectonism in its easternmost part, versus frontal ramp tectonism (with varied effects) elsewhere.

The inter-relationships between mineralization (essentially the expression of common geological processes taken to an extreme), the tectonic settings in which those processes occurred, and how later severe tectonism may have modified the resultant products are the subject of this address.

Metamorphosed hydrothermal alteration in VMS, IOCG and epithermal systems: an indispensable exploration vector

Louise Corriveau (GSC-Q), Anne-Laure Bonnet (consultant), Thomas Clark (MRNF) and Vladimir Antonoff (INRS-ETE)

Gneiss terranes in the Grenville Province comprise a variety of geotectonic environments that are potential hosts for hydrothermal metallic ore deposits, deformed and metamorphosed to upper amphibolite and granulite facies. The metamorphism and deformation of these deposits has drastically transformed the appearance, mineralogy, textures and spatial distribution of the usual metallocenetcts, and affected the interpretation of each deposit’s original shape and the pattern of its mineralogical and chemical variations. Nevertheless, by using exploration tools that focus on hydrothermal alteration zones, it is possible to identify high-grade metamorphosed hydrothermal systems and resolve any superimposed post-tectonic mineralization. In fact, the lithogeochemical signatures of pre- to syn-tectonic alteration zones and hydrothermal precipitations commonly transform into gneisses with atypical mineral parageneses, modal compositions and lithological associations (when compared to typical metasedimentary or meta-igneous rocks). The nature of these gneisses can be modelled by the conceptual metamorphism of various constituents in known deposits (e.g., the position of their compositions on AFM, ACF and AKF phase diagrams). Following this, a systemic mapping protocol can be employed for (1) gneisses; (2) their parageneses and modal proportions (which reflect the chemical composition of their protoliths and the physical conditions during metamorphism); (3) their textures or structures; (4) the various lithological associations; and (5) deformation zones (which may have channelled fluids), and the results used to characterize the metamorphosed hydrothermal systems, determine the general layout of their chemical zoning, properly direct lithogeochemical and geochemical studies, and establish exploration strategies based on a sound metallogenic working model. Field data, complemented by lithogeochemistry and U-Pb chronology, can be used to distinguish alteration zones from the metamorphosed sedimentary rocks and paleosoils they resemble. Three case studies in the Grenville Province will be presented: the Romaine Supracrustal Belt and the Bondy Gneissic Complex (affinities for hydrothermal systems hosting high-sulphidation volcanogenic massive sulphide deposits, iron oxide-Cu-Au deposits, and epithermal deposits), and the polyphased IOCG Kwyjibo deposit. Like their non-metamorphosed equivalents, these systems are associated with more than one deposit type. The proposed mapping protocols, supported by metamorphic petrology and metallogeny, will help diversify mineral exploration into the gneiss terranes of the Grenville Province and elsewhere.
ORAL PRESENTATIONS

Session 4 ■ 3:20

Till geochemistry as an efficient exploration tool in the Grenville: the Lac Bruges (Cu-Ni) and Kekek (Au) showings

Philippe Berthelot (Cartier Resources) and Hugues Decorta (consultant)

After several recent geoscientific studies and exploration programs that demonstrated the mineral potential of the Grenville Province east-southeast of Val-d’Or, Cartier Resources carried out a prospecting program in the area in the summer of 2009. The approach was based on the analysis of the secondary environment, essentially Quaternary unconsolidated deposits of glacial origin. The unconsolidated sediment cover is extensive in this area and even though the clayey member—so common elsewhere in the Abitibi region—is absent here, the cover represents a significant obstacle to traditional prospecting.

A regional till survey of 800 samples covered the parautochthonous Grenville region east-southeast of Val-d’Or, which consists of Archean Superior rocks that were deformed and metamorphosed during a Proterozoic orogeny. The till samples of about 10 to 30 kg each, depending on the facies, were processed at a heavy mineral concentrate laboratory. All the samples were collected along logging roads, which are abundant in the area. The fine fractions of the concentrates were chemically analyzed. A lithologic count was performed on the coarse fractions from the samples.

Significant results were obtained from Cartier’s 2009 regional till survey, notably the detection of two chemical dispersal trains. The first dispersal train revealed a copper-rich zone associated with a sulphide horizon that marks the contact between the layered Bouchette intrusion and the Cabonga terrane metasediments. Follow-up work led to the discovery of two nickel-mineralized boulder fields (0.40 % Cu – 0.50 % Ni – 0.05 % Co, 0.30 % Cu – 0.60 % Ni, and 0.23 % Cu – 0.64 % Ni – 0.04 % Co), as well as copper-mineralized outcrops (1% Cu over 6.0 metres; Bruges showing).

A second dispersal train marked by anomalous gold, arsenic and bismuth was detected in the area underlain by the presumed eastern extension of the Larder Lake–Cadillac Fault. Two of the samples are enriched in gold, one yielding 13.6 g/t Au in the concentrate (Kekek showing).

Session 4 ■ 3:00

Kipawa, an unexplained auriferous anomaly on the Grenville Front

Martin Demers, Patrice Barbe (Mines Aurizon) and Éric Ducharme (consultant)

Aurizon Mines Kipawa property, located in the southern portion of the Temiskaming region, was acquired in 2006 on the base of a regional gold anomaly within river sediments. The property covers the limit between Archean and Proterozoic rocks, both affected by the Grenvillian orogeny. The targeting of higher potential areas was made following the integration of geological data of the previous exploration campaign. Those kilometric scale areas were covered by extensive MMI type soil geochemistry during the summer of 2009, where close to 1800 samples were collected and analyzed for gold and other elements. The best anomalies were tested by drilling during the spring and summer of 2010. Favorable geological elements, never outcropping, were identified, such as multimeters wide calc-silication alteration composed of pyroxenes and biotite. Those zones of hydrothermal circulation are bounded by disseminated sulfides envelopes and show a weak but continuous gold enrichment, representing possibly a distal feature of a more significant gold enrichment zone.
The Crevier Nb-Ta project, a jointly-owned venture between MDN Inc. (67.5%) and IAMGOLD (32.5%), is located approximately 70 km NNW of Girardville, Lac-Saint-Jean, Québec near an all-season gravel highway. The property comprises 186 contiguous claims totalling 10416.49 ha in the townships of Crevier and Lagorce. Measured and indicated resources are evaluated at 25.4 Mt at 1960 g/t Nb₂O₅ and 234 g/t Ta₂O₅, with inferred resources of 15.4 Mt at 1700 g/t Nb₂O₅ and 252 g/t Ta₂O₅.

The Crevier deposit was discovered in 1975 by SOQUEM, who after several exploration programs transferred the property to Cambior in 1986 during the privatization of its assets. IAMGOLD acquired the deposit in 2006, with Les Minéraux Crevier Inc. becoming the sole owner in April of 2008. MDN Inc. now has the option of acquiring a majority equity interest in Crevier upon completion of a feasibility study.

The deposit occurs within the Crevier alkaline complex, an elongate intrusive body comprising nepheline syenite, biotite-carbonate syenite and syenite. This complex was emplaced in gneiss of Grenville Province along the Waswanipi-Saguenay corridor, a major structural lineament that also hosts the carbonatite of the Niobec Nb mine near Saint-Honoré.

The Crevier mineralization occurs in a pegmatic nepheline syenite dyke oriented 320° that intrudes the complex along its long axis. The dyke is over 3 km long with an average thickness of 20 m and steep dip to the NE. The Nb-Ta mineralization occurs from surface down to 300 m depth. Pyrochlore is the principal economic mineral at the Crevier deposit. Preliminary exploration in the northern part of the property indicates that Nb-Ta mineralization occurs up to 4 km north of the main body of the deposit.

An independent preliminary economic evaluation completed in 2010 concluded that with an open pit production rate of 4000 tonnes/day, the project has the potential to generate an average annual revenue of $125 M over a projected mine-life of 18 years. At a projected capital expenditure of $316 M, the average annual profit is estimated to be $57 M, representing a pre-tax net value of $272 M at a discount rate of 5%. MDN is very encouraged by the results of the independent economic evaluation and has invested in a feasibility study that will be completed in the first half of 2011. MDN is looking forward to becoming Québec’s next combined Nb-Ta producer.
Innovation in this context is defined to mean the development of concepts and processes which largely rely on existing technology to be implemented rather than hoped for big breakthroughs dependent on new developments in sensors or processing capability. While such developments are of benefit, the returns are often over a much longer term than required for the time needed for innovative approaches to be effected.

A major strategic driver for this need to change our approach is the increasing requirement to explore undercover at greater depths. While exploring at depth is not uncommon in brownfields settings, a number of industry pundits emphasize the need to push to greater depths in greenfields areas as these terrains offer the best promise of exceptional discoveries. The model most often cited is the means by which petroleum explorers conduct the search for new hydrocarbons where basically all new major discoveries are made many kms below the surface. In this style of exploration, the collaborative efforts of a number of geoscience and engineering disciplines is required in order to define and manage the high risk of finding and safely developing resources.

Major mining companies are preparing to mine deposits at great depths and the exploration industry needs to begin defining the processes to define these resources with confidence. Innovation driven by dynamic geoscience collaboration is seen as way forward.

Innovation: a response to risk in mineral exploration
Jean-Marc Lulin (Azimut Exploration)

The relationship between innovation and reduction of risk in mineral exploration becomes evident when analyzing mining discovery cycles. Innovations that were implemented during these periods led to better success rates (as measured by an increasing number of discoveries per unit of time) and thus a relative reduction in risk.

Innovation and discovery

A historical analysis of discoveries reveals that they are grouped into cycles directly related to three main sets of factors, the first two of which are closely tied to concept of innovation:
- the exploration of new spaces, represented by new lands and deep environments
- progress in scientific knowledge and technology as new concepts and tools are implemented; and
- an increasing demand for metals mainly related to phases of economic growth and reflected by rising market prices.

Even though discovery cycles are the products of several causes, it is possible to distinguish, within each cycle, the dominant role played by innovation. If the mining industry cannot exert any real control over the metal markets, it can at least concentrate its activities on new territories and establish new ways of identifying and developing their potential. In this sense, innovation and exploration are inextricably joined.

Innovation and risk

The relationship between innovation and risk becomes evident when examining the internal dynamics of a discovery cycle. Three phases are distinguished:
- a start-up phase, beginning exactly when an initial success validates a major innovation, leading to a drastic reduction in risk;
- a realization phase, marked by a number of significant subsequent discoveries linked to the same innovation, thus substantiating the reduction in risk;
- a slow-down phase, in which the targets that respond best to the innovation have already been identified, leading to an increase in risk.

During innovation-related discovery cycles that generate an exploration boom, most of the targets susceptible to detection by these innovations will be discovered at some point. There is thus a relative reduction in the effectiveness of innovations as a function of time, correlating to a reduction of the discovery potential. Toward the end of these cycles, and during the stagnation phase between two cycles, other innovations are developed. Those that are validated by major successes will trigger new cycles. In this sense, innovation is a structural response that leads to an overall reduction of risk in mineral exploration.

Ten years of research and innovation in mineral exploration at CONSOREM
Réal Daigneault (CONSOREM, UQAC)

Research and innovation in mineral exploration must be considered as an investment for which the objective is to generate economic development by increasing the number of significant discoveries. Many organizations, companies and individuals contribute toward this goal. Research in the university environment often touches upon more fundamental aspects, whereas companies may want to invest in applications with more immediate benefits. If the need for innovation is great, the main challenge is to create a link between research groups and companies. To ensure the effective and efficient flow of information, it is important to understand and define needs, carry out a directed research program, and transfer the results to users. Although this approach may seem obvious at first glance, the road to implementation is often riddled with obstacles.

After 10 years of work, CONSOREM has risen to the challenge of research partnerships with industry, universities and government agencies in the field of mineral exploration. In the beginning, the main issue was defining a common ground between the needs of companies, the requirements of government agencies, and the mission of university research. Funding from a research partner must come from a combination of public and private sources. The public contribution is necessary to 1) ensure a pre-competitive aspect to the research, 2) finance research with a high-risk component, and 3) generate results that can be shared between all players and publicly disseminated. But private funding is also indispensable because it ensures that companies will be involved and follow up on the projects.

Another challenge is defining an annual research program. The plan starts with a series of individual meetings with member companies to discuss issues, problems and proposals for research projects. The collection of proposals is used to generate a strategic working document that represents a snapshot of the opinions of exploration companies at that specific moment during the year. After the preliminary proposals have been documented by CONSOREM researchers, they are then submitted to a voting process that involves discussing and prioritizing the proposals. This process, which is always overseen by the companies, results in a preliminary program that will be entrusted to CONSOREM researchers, who will then perform a feasibility study for each of the projects. Once the projects are deemed feasible, the annual program is finalized, carried out, and the results evaluated at the end of the year.
A new mobile multiparametral laboratory for core samples: a promising innovation for exploration

Pierre-Simon Ross, Alexandre Bourke (INRS-ETE), Michel Allard (Xstrata Zinc), Michel Chouteau (École Polytechnique) and Sylvain Lacroix (MRNF)

An aspect of mineral exploration that needs improving is how much information and value we can derive from drill core. Diamond drilling is typically the most expensive part of an exploration program, but the resulting data is often limited to a geologist’s qualitative descriptions and the chemical analyses of specific elements and some metals of economic interest over selected intervals. It is also possible, however, to measure specific physical, chemical and mineralogical properties of core samples. Quantifying these parameters is essential for certain objectives; for example: (i) planning or interpreting geophysical surveys; (ii) modelling the geology or physical properties of rocks in three dimensions; and (iii) documenting hydrothermal alteration. Various pieces of equipment are available for measuring one of these properties at a time, but this approach makes it unrealistic to build a large multi-parameter database given the high cost of data acquisition, the time involved, and the destructive nature of several conventional analytical techniques.

The innovation proposed by INRS is an automated system that measures all the parameters simultaneously on core samples in a non-destructive manner. The system is part of a mobile laboratory designed to physically, mineralogically and chemically characterize rocks. The mobile laboratory is known by the French acronym LAMROC, and was inaugurated in 2010 thanks to a grant from the Canadian Foundation for Innovation. At the present time, the automated system can measure the density and magnetic susceptibility of rocks, detect and quantify more than 20 chemical elements, and characterize mineralogical assemblages by infrared spectrometry. The system can also acquire a continuous image of the core. Electrical conductivity and natural gamma radiation measurements may be added in the future.

LAMROC will be used in applied research projects in collaboration with industry and governments. The first project, a two-year study funded by the MRNF, is currently underway in Matagami in the northern Abitibi Subprovince in collaboration with Xstrata Zinc. The Matagami mining camp contains numerous volcanogenic massive sulphide deposits and has good potential for additional discoveries. Measurements of physical properties in drill core will make it possible to convert geophysical models into geological models. Moreover, high-resolution geochemical and mineralogical measurements on volcanic and intrusive rocks will lead to a better understanding of the volcanic stratigraphy, volcanic architecture and hydrothermal alteration in the Matagami area, which will assist an ongoing Ph.D. project at the INRS.

Innovation at the service of mineral exploration

Pierre Bérubé (Abitibi Géophysique)

The mining industry knows about innovation. Each mining operation presents a specific set of problems to work out in terms of profitability, safety, and environmental soundness. In exploration, on the other hand, the main issues to solve are the same as they were several decades ago: the depth and conductivity of the overburden. Why have we not figured out this problem sooner? Innovation in exploration is obviously crucial for renewing mineable resources. What approach must we adopt to reach this goal?

What can service providers do? A company like Abitibi Géophysique can rely on an ISO 9001-quality management system to cover its operational, OHS, and environmental aspects. This system provides a framework for continuous improvement of existing processes and constantly encourages employees to question how things are done. On the other hand, a continuous improvement process alone is not enough to take on the challenges of exploration in 2010. Innovation must come before improvement. For a service provider, innovation makes the difference between thriving and perishing. Keeping one foot on the accelerator while going around a curve (like in a time of crisis) takes guts, but is vital if we are to come out ahead of our competitors in the end.

To be successful in innovation, one must know how to observe, defy the status quo, network, experiment, and set things in motion, all within a favourable corporate and cooperative atmosphere. The answer to the following questions will help determine whether you are ready to head out on the road to innovation:

- Where will innovation fit into your business process?
- How will you create an environment that encourages innovation?
- What kind of assistance will be given for generating new ideas?
- How will promising projects be identified and prioritized?
- Are there any advantages to having partners (research centres, clients, suppliers)?
- How will the portfolio of innovation projects be managed?
- Will it be necessary to centralize or isolate innovation within the company?
- What are the advantages of innovation for employees?
- Will this influence how you recruit people?
- Will you patent or not?
- When will the product be launched?
- What is the role of marketing in innovation?

We hope this presentation can awaken the spirit and zeal of the explorer within, because there are many sleeping giants among us.
The Québec mining industry: a wealth of potential if...
Suzanne Méthot (Canadian Boreal Initiative)

The mining industry, despite its non-renewable nature, represents a wealth of potential in terms of sustainable development for local and native communities and for all of Québec. Although it continues to be a major player in the province’s economic development and a source of pride for its regions, the mining industry is currently experiencing an unprecedented lack of confidence from the general public. Why? Québec’s mining industry: a wealth of potential if... we re-build bridges with citizens. How? Let’s explore solutions!

The ingredients promoting the social and environmental acceptability of projects
Philippe Bourke (RNCREQ)

To provide the proper context, this talk will first address the way in which the social, environmental and economic aspects essential to sustainable development should be put into perspective. Sustainable development started out as a theoretical and abstract concept that gave way to very “flexible” interpretations, but is now seen as a necessity. In Québec in particular, the implementation of sustainable development is firmly entrenched by a law that provides a framework for public administrative activities, which makes the concept real and helps people understand it. Consequently, the expectations of the general public are becoming higher and higher. Socioeconomic agents and project promoters must therefore adjust and come to terms with this new paradigm.

Social and environmental acceptability requires that human and cultural aspects be taken into account, which means adopting a very different approach than a simple statement of compliance. Beyond techniques and processes, tact and foresight are needed to ensure that a project is implemented within a climate that supports reason and information more than emotions and perceptions. Nothing must be left to chance, and fundamental concepts—like transparency, public participation and the common good—must be clearly defined, understood, and wisely used.

Following this background discussion, we will identify the main obstacles to avoid and highlight conditions that lead to successful social and environmental acceptability.
Liveable development... the social acceptability of mining projects

Stéphane McKenzie (CRÉBJ) and Sonia Marcoux (CRRNTBJ)

The CRÉBJ’s approach to development can be summed up by the phrase “Development for living on the land”. Without development, living on the land becomes impossible. And if the land is developed but there are no inhabitants, what good is the development? Developing resources must, above all, benefit the host regions. By living in the region, people put down roots and thus become willing to protect and safeguard its wealth for current and future generations and participate in its development.

The Nord-du-Québec administrative region, which includes the James Bay territory, is recognized for its very high mineral potential. The CRÉBJ is convinced that developing this mineral potential could significantly contribute to the wealth of the region and the province as a whole. For this to happen, any mining and mineral exploration companies looking to become established in the territory must understand that the social acceptability of their projects will start at the local and regional scales.

Rightly or wrongly, the mining sector is finding itself at the centre of a public debate during the general consultation process for Bill 79 – An Act to Amend the Mining Act. This is why it has become so important to develop new ways of doing things. There are, of course, legislative and regulatory processes, but new approaches could help create partnerships with positive results for the industry and all of Québec.

In this context, both mining companies and communities can benefit by working together. The advantages for communities are considerable: economic and social benefits and the reassurance of environmental respect. The industry also profits from the arrangement. A great example of this new synergy between regions and the mining industry is the Otish Mountains road project. Without regional leadership, the project would not be this far advanced. The road will allow several projects to materialize and will open the area to mineral development. Without regional social acceptability of mining development in general, this type of partnership would not be possible.
Session 6 ■ 3:00

Exploring a global development approach
Martin Demers and Jacynthe Lafond (Mines Aurizon)

The global development of mineral resources takes place over a timescale that varies as a function of the geological context, available knowledge, technological advances, market fluctuations, and environmental conditions. Traditionally neglected, the social aspect has now become a fundamental factor when developing mining projects, which evolve according to their ability to adapt to the dynamics of their specific environments. Using concrete examples from accumulated experience, this talk will present conceptual stages in mineral exploration while taking into account the social dynamics particular to Aurizon’s projects. We acknowledge the importance of a mutual agreement between all concerned parties to voluntarily engage in, and maintain, a transparent dialogue. We will explain the challenges presented by the integration of specific issues, as well as the requisite flexibility in terms of human and financial resources, which must be present right from the start of exploration activities. Considering the very nature of the mining industry, we will see that achieving the goal of social integration relies on a clear understanding of the role that each party must play in the decision-making process, and on their access to adequate and relevant information. There are as many approaches to social acceptability—inclusive, participatory, transparent and constructive—as there are projects. However, the foundation and driving force common to all projects is a company’s formal commitment to social responsibility. For Aurizon Mines, this commitment translates into its application of global development principles as it carries out its mission.
Geology of the east part of the La Grande-3 Reservoir (NTS 33G09, 33G15 and 33G16), James Bay region

Daniel Bandyayera, Pénélope Burniaux (MRNF) and Baptiste Chapon (UQAM)

Géologie Québec recently completed an extensive and detailed aeromagnetic survey in the James Bay region east of the LG-3 Reservoir at a scale of 1:50,000. The coverage includes the Lac Magin (33G09) and Lac Fontay (33G16) regions, as well as Colline Captel (33G15). The goal of this project is to establish regional geological correlations and acquire new metallogenic knowledge.

The mapped area belongs to the La Grande Subprovince, bordered to the north by Bienville and to the south by Opinaca. The rocks in the Lac Magin region in the south are, from base to summit, tonalitic basement belonging to the Langelier Complex (gneiss, tonalite, 3360 to 2788 Ma), the Guyer Group (2820 Ma) and the Magin Formation. The Guyer Group is composed of tholeiitic basalt, felsic tuff and iron formation. Layered ultramafic sills are commonly encountered throughout the basaltic sequence. The Magin Formation, a new sedimentary sequence observed above the Guyer Group, consists of wacke and polygenic conglomerate. The northern half of the mapped area is part of a transitional zone between La Grande and Bienville; this region is characterized by a weak magnetic susceptibility and contains new volcano-sedimentary formations (Pie Formation and Mintisch Formation) composed of basalt, andesite, iron formation and ultramafic intrusions. The contact between this transitional zone and the La Grande Subprovince is a major regional fault marked by a topographic lineament and by a sharp truncation of the structural and magnetic grains. Also present in this transitional zone is the polyphased Tilly intrusion (tonalite, granodiorite, diorite), which hosts a significant Mo-Cu porphyry deposit, and Proterozoic sedimentary basins of the Sakami Formation, consisting of quartz arenite, mudrock and monogenic and polygenic conglomerate.

Known showings and those discovered during our work demonstrate that the region contains several exploration targets with potential for polymetallic VMS, gold and molybdenite deposits. The main types of mineralization observed in the volcano-sedimentary sequences of the Guyer Group and Pie Formation were associated with auriferous iron formations, volcanogenic alteration zones (Cu-Zn-Ag ± Au) and quartz-sulphide veins (Cu-Ag ± Au). Molybdenite and chalcopyrite mineralization (Mo-Cu) was also found in association with a white pegmatite in the Magin Formation. The volcano-sedimentary Mintisch Formation, north of the La Grande-3 Reservoir, is characterized by a number of polymetallic and auriferous mineralizations mainly associated with intrusive breccias, similar to the Fernande La Grande and Ouf showings.

Geology and economic potential of the Lac Kinglet region (NTS 33J)

Isabelle Lafrance and Martin Simard (MRNF)

A survey performed in the summer of 2010 at a scale of 1:250,000 in the Lac Kinglet area covered map sheet 33J and map sheets 33K01 and 33K02. The centre of the region is approximately 60 km NNE of the LG-3 hydro-electric station. The Lac Kinglet region is part of the Superior Province. It comprises mainly Archean granite, granodiorite and monzodiorite units belonging to the Bienville Domain of the Minto Subprovince and, along its southern margin, tonalite and volcano-sedimentary rocks of the La Grande Subprovince.

New volcano-sedimentary belts in the La Grande Subprovince were identified in the southeast part of the region. They comprise amphibolitized mafic lavas alternating with layers of felsic to intermediate lavas and tuffs and, in lesser amounts, horizons of paragneiss, iron formation and ultramafic rock. Several rusty and sulphide-bearing zones were observed within these belts, occurring mainly i) along the contacts between different units, ii) within an iron formation more than 200 metres thick, and iii) along the margins of quartz veins and veinlets injected into volcanic rocks.

Several targets of economic interest were also found in the Bienville Domain. Disseminated sulphide mineralization was observed within a slice of felsic to intermediate tuff measuring several hundred metres long, associated with a mylonitic deformation zone. Several breccia zones and stockwork zones up to 200 metres wide and marked by quartz and/or hematite veins and veindlets were identified in areas characterized by Mo ± U ± Cu lake sediment anomalies. A boulder with a breccia texture and cupriferous mineralization was found in one of these zones. It should be noted that breccias associated with Mo geochemical anomalies are one of the characteristics of the Tilly deposit—a Mo-Cu porphyry just south of our region. Another breccia zone with a hematite matrix is associated with U and Au anomalies. Prospecting work was performed in several areas of granitic intrusions associated with U lake anomalies. Finally, rusty, silicified and sulphidized zones of metre- to decametre-scale thickness were also observed within slices of paragneiss.
Improvement in prospecting techniques by pinpointing the source of metals in lake-bottom sediments

Jordi Turcotte, Pierre Cousineau, Murray Hay (UQAC), Réjean Girard (IOS) and Charles Maurice (MRNF)

A study of recent geochemistry databanks for secondary environments (lake bottoms, till, soils, etc.) suggests that metal concentrations in gyttja (the mud that accumulates under the hypolimnion in lakes) are influenced by the environment of the lake itself and by the proportions of the different types of constituent materials. New hypotheses to explain their contribution to the overall metal content must be tested because their influence could affect exploration programs:

- Certain correlations between elements suggest that a significant portion of the cationic charge bound in sediments comes from groundwater;
- It seems evident that different elements do not behave the same way in a given hydrous environment, and thus the problem of preferential metal partitioning must be addressed;
- It appears that the potential role played by lake-surface microorganisms in the selective pre-concentration of specific metals has been greatly underestimated.

Any exploration strategy seeking the same element associations found in ore deposits is thus invalid. When interpreting lake-bottom sediments, it is essential that the geochemical exploration process takes into account the distribution of metals in the sediments. These issues have never before been addressed by the industry.

The chosen methodology for achieving our goal is to sample three lakes, one of which is known to be anomalous, at several locations and pre-treat the samples by physically separating the different sediment fractions, and to then perform partial extraction analysis on each fraction to determine where the different metals reside and, finally, define a protocol of interpretation to weigh the effects of this partitioning. The idea is to improve our understanding of metal sequestration in the secondary lake environment and develop a deterministic approach to interpretation instead of a simple statistical treatment, no matter how powerful it may be.

The project is already underway. Samples have been collected and are currently being processed. Unfortunately, we are unable to present any results or conclusions at this time.

The distribution of pedogeochemical anomalies in relation to conductive geological bodies, Rivière Pontax area, James Bay region

Paméla Tremblay, Michael D. Higgins, Pierre A. Cousineau (UQAC), Réjean Girard (IOS) and Charles Maurice (MRNF)

Pedogeochemistry is a commonly used exploration tool in regions with thick glacial deposit cover, like much of the land in Québec. However, a better interpretation of pedogeochemical results is essential if we are to improve mineral exploration targeting. The goal of this project is to enhance our understanding of the underlying processes involved in the capture of trace metal elements (TME) in glacial deposits by studying the physico-chemical behaviour of its organic matter. In short, the project aims to determine the fixation sites for TME in humus and establish the relationship between these elements and the nature of the receiving environment and the presence of electric fields. This issue is of interest because conductors in basement rock generate spontaneous electric potentials, and it is this electric field that acts as the driving force for TME cation diffusion through glacial deposits, from the bedrock to the receiving environment. There should thus be a correlation between the geometry of conductive zones detected by electromagnetic (TDEM: Time Domain Electromagnetism, etc.) or electric methods (resistivity, self-potential, induced polarization) and the pedogeochemical footprint of the receiving environment.

A pedogeochemical survey was performed over the Chambois showing on the Pontax property belonging to Sirios Resources in the James Bay region of Québec. The showing contains early copper-zinc mineralization with distal VMS affinities, overprinted by later lead-silver remobilization. The pedogeochemical survey superimposes an induced polarization and resistivity survey. Mapping, channel sampling and drilling results provided the geological context. An arrangement of three comparable pedological sampling profiles was devised for our experiment: i) a control transect (without any conductors); ii) a transect over the showing; and iii) a transect under an artificial conductor (a high voltage power line with continuous current). In all, 200 samples of organic matter were taken along the three transects, and a self-potential survey was also completed in the field. Following this, the redox potential (Eh), potential of hydrogen (pH), buffering capacity (∆pH), colour, and the percentage of organic matter (% OM) were measured for the samples, in addition to subjecting them to sodium pyrophosphate and multi-acid chemical analyses. Our poster will describe the method and present the preliminary analyses processed to date.
Map revision work in the summer of 2010 covered the south-east quadrant of NTS map sheet 32F13 at a scale of 1:20,000. This area represents the North Flank of the Matagami mining camp and the eastern part of Lac Matagami. The work, which began in 2008, is part of a major multi-disciplinary project on the mining camp's geology and metallogenesis. The partnership project involves the MRNF, researchers and students from INRS, Université de Montréal, UQAC and URSTM, and the mining companies Xstrata Zinc, Donner Metals and SOQUEM.

The mapped region is underlain by volcanic rocks, a large subconcordant mafic intrusion (the Bell River Complex; BRC) and a narrow band of sedimentary rocks (Matagami Group; MaG), all of Archean age and belonging to the Abitibi Subprovince (ASP). These lithologies are cut by Proterozoic gabbro dykes. Two volcanic groups are present: the Lac Watson Group (WatG, 2725-2723 ±2 Ma) and the overlying Wabassee Group (WabG). The WatG mainly comprises rhyolite, rhyodacite and dacite. The Key Tuffite is positioned immediately above the WatG rhyolites. It is this group that contains most of the volcanogenic massive sulphide deposits in the region. The Key Tuffite consists of several tuffs of variable thickness and spacing, which collectively serve as a horizon for VMS mineralization in the mining camp. The WabG is dominated by andesites and by pillow-d, massive and/or brecciated basalts. This group combines the Bell River Volcanics (tholeiitic affinity) and the Allard River Volcanics (calc-alkaline affinity). The WatG is cut by the BRC (2724.6 ±2.5 Ma), a complex consisting mainly of gabbro, gabbronorite and norite. Anorthosites, pyroxenites and dunites are comparatively less common in the BRC than the Lac Doré Complex of Chibougamau. The MaG consists of wacke, siltstone, mudstone and conglomeratic sandstone with granitoid pebbles. It is in faulted contact with the Opatica Subprovince (OSP) to the north and the WabG volcanics to the south. The Galinée Anticline occurs in the southwest part of the map. Its pattern explains the reversal of younging directions on the north and south flanks of the mining camp. The core of the anticline is occupied by BRC intrusive rocks and both flanks contain WatG and WabG rocks affected by minor folding. Deformation of the Archean rocks was moderate to strong and expressed by schistosity with an overall ESE-WNW (285°) to E-W (260°) orientation. Stratification indicates younging to the north and dips are subvertical or inclined to the south, implying that these lithologies are overturned in some cases. The northern part of this region also reveals the tectonic contact between the ASP and OSP. The region is affected by several major deformation zones oriented E-W to ENE-WSW, including those of Lac Olga and Lac Matagami. Stretching lineations plunge moderately to the east in the southern half of the map, and plunge steeply to the west in the northern half (within the OSP, MaG and some WabG volcanics). Regional metamorphism attained greenschist facies, except along the margins of the larger intrusions where hornfels and amphibolite facies were noted. The Baie Dunlop Pluton cuts the WabG volcanics in the east-central part of the map. This pluton displays a multi-phase appearance and is interpreted as synvolcanic in age. It consists of an early quartz dioritic-monzodioritic phase cut by tonalitic-granodioritic phases. The pluton is well known for its numerous Au-Ag-Cu-Mo-Bi mineralized veins. In the south-central part of the map lies the syn- to late-tectonic Olga Pluton (2693.2 ±1.6 Ma) composed of homogenous, massive and medium-grained hornblende-biotite tonalite.

This region is renowned for its polymetallic (Zn-Cu-Ag-Au) VMS-type deposits and showings, hosted for the most part by WatG rhyolites. The biggest deposit on the North Flank of the camp is Norita (1976-1997, 3.89 Mt @ 3.94 % Zn, 1.83 % Cu, 0.59g/t Au and 25.84g/t Ag). At the conclusion of this project, we plan to produce a 3D geometric model for the region to better understand the stratigraphy, structural elements and controls on mineralization, and to reveal new VMS exploration targets.
Integration of geophysical data for the north flank of the Matagami camp and a 3D geological interpretation

Thibaut Astic, Michel Chouteau (Polytechnique), Isabelle D’Amours (MRNF) and Michel Allard (Xstrata Zinc)

The Matagami mining camp, in the Abitibi Subprovince, consists mainly of Archean felsic to mafic rocks metamorphosed to greenschist facies. The Galinée Anticline is the dominant structure of the region and its fold axis is oriented NW-SE to E-W. The deposit type present throughout the mining camp is volcanogenic massive sulphide (VMS). This project focuses on the north flank of the anticline, on map sheet 32F13. Eight mines predominantly located along a felsic band were active during the second half of the 20th century.

This project falls within the scope of the larger Matagami Project that began in 2008, led mainly by the MRNF, Xstrata Zinc, École Polytechnique de Montréal, INRS and UQAC. Our project will use geophysics to determine, as best as possible, the behaviour at depth of geological structures in the region, such as the Dunlop and Olga plutons. The results of this work should reveal new potential exploration targets.

Multiple types of data are available: a geological map for the area, airborne gravimetric and magnetic surveys, logs for existing drill holes, geochemical analyses, measured or NORMAT densities (Piché, 2004), magnetic susceptibilities, etc. Magnetic susceptibility measurements made in situ, as well as magnetic susceptibility and density measurements on field samples and drill core, were performed during the MRNF’s 2010 mapping program (Pilote, 2010), which represented the third phase of the Matagami Project. Some of these samples were also geochemically analyzed by the MRNF.

The first phase of this study will be the statistical analysis of variations in physical properties for the different lithologies as a function of their chemical composition, degree of alteration, and geographic position. This should enable us to develop the best possible characterization and constraints for the various lithologies included in the model, and thus quantify their geophysical responses.

During the second phase, the geological, geochemical and geophysical data will be integrated into GoCAD. These data will be used to constrain the 3D inversion of the geophysical surveys.

The final phase will be the development of geological scenarios that fit both the existing geophysical data and the imposed constraints (inversion constraints). At the same time, geophysical responses will be modelled using the 3D model and the physical properties we defined during the first phase. These responses can then be compared with existing surveys or they can serve as a starting point for future surveys.

Volcanic architecture of the Matagami mining camp – Preliminary results

Julie-Anaïs Debreil, Pierre-Simon Ross (INRS-ETE), Vicki McNicoll (GSC-O), Gilles Roy (Xstrata Zinc) and Patrick Mercier-Langevin (GSC-Q)

The Matagami mining camp is located in the northern Abitibi Subprovince. The geology of the area is dominated by mafic to felsic volcanic rocks. The felsic rocks are organized into three bands: the two flanks of the Galinée Anticline and a third band to the west commonly referred to as the West Camp. Some 18 zinc-rich deposits are known in the camp, including the Lac Mattagami deposit (25.64 Mt @ 8.2 % Zn, 0.56 % Cu, 21 g/t Ag and 0.4 g/t Au), which was mined from 1963 to 1988, and the recently discovered Bracemac-McLeod deposit, which will start producing in 2013. The stratigraphy of the camp is divided into two groups: the Watson Group comprising the Watson Dacite and Watson Rhyolite, and the Wabassee Group consisting primarily of mafic to intermediate units and some minor felsic units. These two groups are separated by the Key Tuffite, a marker horizon along which most of the known deposits occur.

The Matagami camp was the subject of a multi-disciplinary study (universities and industry) with a component dedicated to reconstructing the volcanic architecture of the camp. This component, in the form of a Ph.D. project, aims to understand the volcanic architecture at the local (VMS orebody) and regional (mining camp) scales. This study is based on chemical stratigraphy established by studying variations in volcanic facies, with the goal of identifying synvolcanic faults and effusive centres that may have served as conduits for hydrothermal fluids. New chemical analyses, including trace elements and rare earths, led to the discrimination of five major groups in the mafic and intermediate units of the South Flank. These groups represent distinct volcanic events. The geochemical discrimination of these volcanic groups now allows us to correlate the different facies variations within each group.

In addition, a U-Pb isotope geochronology program undertaken within the framework of the camp’s volcanic architecture study provided six new ages that enabled us to date the main felsic volcanic units, to correlate the different areas, and to temporally constrain the formation of the volcanogenic massive sulphide deposits.

Reconstruction of the Matagami camp volcanic architecture began on the South Flank where the geology is better known and where a large amount of recent exploration and production work has taken place, effectively providing access to new information. The work will also extend to the West Camp, where the stratigraphy is more complex. It is interesting to note that a rhyolite discovered on the west side bears a similar age and geochemical signature to the Watson Rhyolite of the South Flank, suggesting a possible correlation between these two felsic bands.
3D modelling and lithogeochemical study of the Matagami mining camp (phase 1 of 2)

Olivier Rabeau (UQAT) and Pierre Pilote (MRNF)

A 3D modelling project for the Matagami mining camp was jointly undertaken by UQAT and the MRNF with the participation of Xstrata Zinc, Donner Metals and SOQUEM. The specific objectives of the project were to refine and deepen our understanding of the mining camp, to integrate the existing databases, and to reconcile surface interpretations with the available data in order to establish the geometry of the local stratigraphy in 3D. The west side of the mining camp is the first study area. This part of the mining camp hosts the Phelps-Dodge, Caber, Caber West, Cavalier and Lynx deposits. These deposits are small compared to the mines in the southern part. On the other hand, the west side represents a very promising area for new VMS discoveries. It also represents the least studied part of the mining camp and thus the least understood, despite the fact that the stratigraphy is almost identical to that of the southern part.

The approach of this study is based on volcanic unit geochemistry. We compiled a data bank of more than 5,000 analyses, including major elements, some trace elements (Nb, Zr, Y, Ba, Rb, Sr) and metals (Cu, Ni, Zn, Au, Pb, Ag). Immobile elements will be used to classify the samples based on lithological affinities and ultimately determine the lateral and vertical extensions of the units. Once classified, the analytical data points will form the basis for the 3D interpretation of the geometric model for the west side of the camp.

This poster presents the progress of the 3D modelling work, as well as the results obtained for the geochemical classification of the units in the western and southern parts of the mining camp. Upcoming work will focus on completing the model for the west side in early 2011, and modelling the rest of the camp by the end of 2012.

Petrological, mineralogical and geochemical study of the Beattie Syenite, Porcupine-Destor Fault, Abitibi, Québec

Julie Bourdeau, André E. Lalonde (University of Ottawa) and Jean Goutier (MRNF)

The Beattie Syenite is located 32 km north-northwest of Rouyn-Noranda. This intrusion, dated at 2682 ±1 Ma and 2682.9 ±1.1 Ma, lies immediately north of the Porcupine-Destor Fault and the village of Duparquet. The main intrusion is lenticular (3.3 km by 425 m). It is accompanied by two other small lenses to the south and southeast. Gold mineralization at the Beattie mine, which operated from 1933 to 1956 (9.66 Mt at 4.88 g/t Au), is partly hosted by the syenite. Four petrographic facies have been identified in the Beattie Syenite as follows:

1. Porphyritic facies. This facies contains 2 to 25% idiomorphic feldspar crystals (2-16 mm) in a red aphanitic matrix. The feldspar crystals in this facies become large and abundant in the eastern part of the study area. This rock displays multiple fractures and is highly altered and commonly cataclastic.

2. Megaphyric to glomerophyric facies (previously referred to as “plum porphyry”). This facies consists of large alkali feldspar phenocrysts (1 to 6 cm) in a red aphanitic matrix. It was emplaced immediately after the porphyritic facies, as indicated by the gradational contact between the two units.

3. Lath facies. This facies occurs in decametre-scale dykes that crosscut all other facies. It is characterized by the primary and trachytic alignment of alkali feldspar laths (1 to 3 cm) in a grey or reddish aphanitic matrix. The rare earth element distributions for samples from these first three facies indicate they are comagmatic.

4. Magnetic miniphyric facies. This facies contains 2 to 10% hypidiomorphic feldspar crystals (2 to 10 mm) in a fine-grained matrix. It represents the least altered syenite observed in the area. Compared to the other facies, the grains of pyroxene, amphibole, titanite and epidote in this unit are generally well preserved with little or no signs of alteration.

The preliminary results of a microscope and microprobe study of thin sections revealed numerous minerals associated with hydrothermal alteration, notably albite, sericite, chlorite and carbonates. The formation of these minerals was accompanied by sulphides and gold mineralization. Furthermore, the analyses also revealed a complex compositional zoning in the alkali feldspars. Collectively, these observations indicate a highly complex paragenesis.
Finding Invisible Gold In Pyrite Using Crystallography

Julia J. King, A.E. Williams-Jones and Vincent J. van Hinsberg (McGill)

Pyrite is a common mineral in many types of environments and is stable over a range of physicochemical conditions. Isotopic studies and fluid inclusion analyses are common ways of establishing the physicochemical conditions of deposition, but by understanding the crystallography of pyrite there is the potential to develop a new method of determining temperature, and perhaps other parameters. Using modern imaging and analytical techniques (Electron Microprobe (EMPA) and Secondary Ion Mass Spectroscopy (SIMS)) we can see both growth and sector zoning. Changes in trace element concentrations between growth zones record the physicochemical evolution of the hydrothermal system, whereas paired sector zones provide a measure of relative temperature, and perhaps pH.

We have applied this methodology to gold-bearing pyrite in the Bowone and Binebase high-sulphidation epithermal Au deposits on Sangihe Island, Indonesia, which display strong sector and growth zoning in ore stage pyrite (stage II) in backscatter images. Trace element analyses using EMPA and SIMS techniques show that this zoning is caused by variations in the concentration of Se, Te, Au, As and particularly Cu. Indeed, the concentration of copper varies from below detection limit to a maximum of 6 wt % (among the highest concentrations of copper reported for pyrite).

Partition coefficients have been determined to show the distribution of copper (and other elements of interest) between sectors. These coefficients vary from one growth zone to the next, indicating an evolution in temperature and possibly pH. This variation gives insight into the controls on the uptake of gold in the pyrite. Our data show that gold concentrations are highest when changes in physicochemical conditions from one zone to the next are relatively small. By contrast, gold concentrations are lowest when these changes are greatest. This indicates that adsorption of gold in pyrite is favoured by stable physicochemical conditions.

DIVEX: the network and current projects

Céline Dupuis, Georges Beaudoin (ULAVAL) and Michel Malo (INRS-ETE)

DIVEX is a research network focusing on the diversification of mineral exploration in Québec. It brings together geoscientists from all the universities in Québec and researchers from the Ministère des Ressources naturelles et de la Faune du Québec and the Geological Survey of Canada. DIVEX strives to develop new approaches, new methods, or new practical tools for mineral exploration by combining fundamental and applied research. Since 2002, 43 projects have been financed thanks to grants from VRQ, the MDEIE, and the FQRNT. Four main themes form the core of the scientific program:

1. The potential for discovering new substances in Québec;
2. Under-explored geological environments in Québec;
3. New metallogenic models;
4. New mineral exploration tools.

Twelve projects are currently financed by the DIVEX network:

SC29 – Applied mineralogy in mineral exploration; NSERC CRD-Vale-GSC;
SC30 – New VMS exploration concepts: the case of Matagami; NSERC CRD-Xstrata Zinc-Donner Metals-SOQEM-Breakwater;
SC31 – Characterization of crustal-scale structures interpreted from gravity “worms” and their relationships to hydrothermal alteration and mineralization, Grenville Province, SW Québec; in partnership with Richmond Minerals;
SC32 – The Misema and New Senator calderas: volcanology, volcano-tectonic structures and VMS mineralization, Blake River Group; in partnership with Xstrata Copper and Breakwater;
SC33 – The Tilly molybdenum porphyry system; in partnership with Sirios;
SC34 – Granitoids and lode gold deposits, Val-d’Or, Abitibi – Structural synthesis and contribution of 40Ar/39Ar dating; in partnership with Alexis;
SC36 – The Tilly molybdenum porphyry system; in partnership with Sirios;
SC37 – Inter-sector thermometry in pyrite: a new potential tool for metallogenesis studies; in partnership with Osisko and East Asia Minerals;
SC38 – Spatial distribution of orogenic deposits along major Archean faults;
SC40 – Nature of the association between pedo-geochemical signatures and high thermal conductivity zones; in partnership with IOS;
SC41 – High-resolution spatial determination of overburden thickness and the evaluation of its stratigraphy by geophysical means; in partnership with Xstrata Zinc and Fugro Airborne;
SC42 – The Montsabrais summit caldera: volcanology, volcano-tectonic ring-dyke structures, timing, and hydrothermal alteration of a potential VMS-deposit; in partnership with Alexis;
SC43 – The Re-Os system as a tracer and chronometer for metallic deposits.
Geochemical signals in fine fractions and heavy minerals from stream sediments in the southwest Grenville

Sylvain Trépanier (CONSOREM)

Regional stream sediment surveys constitute an important source of data for exploration, particularly in southern Québec. The geochemical signals recorded in the fine fractions and heavy minerals from these sediments are still poorly understood. Understanding these signals is important for distinguishing geochemical anomalies most likely caused by mineralization from those representing possible false anomalies.

The data bank for the southern Grenville (1987 to 1989 surveys; more than 5,000 samples) was chosen for this study. Survey analyses were performed by multi-element techniques (ICP-ES and neutron activation) and the samples included fine fractions and heavy minerals taken from the same sites. The geochemical data were analyzed using multivariate statistics. Geology and surface deposit maps, elevation data, regional radiometry, qualitative sampling information (colour, contamination), and topographic data were also compared to the geochemistry to better identify geochemical signals.

Values for the fine fractions were strongly influenced by the amount of organic matter, clay and secondary iron-manganese oxides in the original sediments. Lithological changes in the basement rock had a roughly uniform influence. The variations in the fine fraction values are produced by fundamentally different sediment types that are not comparable to each other in terms of "normal" metal values.

In contrast, values for the heavy mineral fractions were much less influenced by the secondary environment due to the absence of organic matter and clay minerals in this sample type. They correlate much better to lithological variations in the basement rock.

Heavy mineral geochemical signals are simpler and more directly related to basement lithologies than fine fraction signals. By concentrating the heavy minerals, organic matter and clay minerals are eliminated from the sample, and it is these constituents that appear to be responsible for the complexity in the fine fraction signals. Anomalies also emerge more distinctly from the background for heavy minerals than for fine fractions.

The fine fraction data would thus benefit from processing by multivariable statistics. One possible method would be to separate the samples into different types using cluster analysis and then calculate the different threshold values for each of the clusters. For heavy minerals, basic statistical calculations for each of the main lithological assemblages would probably suffice.

A new diagram for the Cu-Ni fertility of mafic and ultramafic intrusions

Hugues Longuépée (CONSOREM)

In Québec, mafic and ultramafic intrusions are targets for copper, nickel and platinum group element (PGE) deposits. However, not all such intrusions contain economic concentrations of these metals. The chemistry of fertile intrusions containing Ni-Cu and PGE sulphides has been the subject of several studies, but the results are often expressed as a series of binary graphs (Barnes and Lightfoot, 2005), the use of which is complicated by the complexity and plurality of the interpretations. In 2004, CONSOREM developed a tool for evaluating mafic and ultramafic intrusions for PGE ("RA-ÉGP"; Pearson, 2007), but this tool is not applicable for defining an intrusion’s Ni or Cu fertility.

Adding the ratio \( \Sigma \text{PGE} / (\text{Ni} + \text{Cu}) \) to the RA-ÉGP tool now makes it possible to predict whether an intrusion hosts Ni-Cu sulphides. The ratio was defined according to two principles. The first is that magmas forming Ni-Cu deposits are poor in PGE with respect to Ni and to Cu. The second is that the silicate liquid from which sulphides segregate is also PGE-poor. When compared to Pd/S and Ni/Pd ratios, the \( \Sigma \text{PGE} / (\text{Ni} + \text{Cu}) \) ratio is able to recognize the potential of an intrusion for Ni and Cu sulphides. Because the RA-ÉGP diagram and its improved version require values for Ir—an element that is rarely analyzed—a second graph uses Ni, S and major element analyses to achieve the desired goal. This graph is based on the partitioning of Ni between sulphides and silicates, and compares the Ni content to the Ni/S ratio. Four fertility fields were defined on this graph to take into account the felsic/mafic character of the studied intrusion. The four fertility fields allow fertile intrusions to be recognized even if the sample contains only 0.1% sulphides (about 300 ppm S) or if the nickel content is only 40 ppm. The success rate for recognizing fertile intrusions is 83% for the most felsic samples, and 100% for mafic to ultramafic samples.

References:


Characterization of carbonatization in volcanogenic and orogenic environments

Benoit Lafrance, Isabelle Lapointe and Hassan Nabil (CONSOREM)

A series of projects on carbonatization was carried out at CONSOREM. The starting objective was to develop a tool for discriminating different types of carbonate using a lithogeochemical data bank. The result was a carbonatization diagram relating saturation and discrimination indices (ISCB and IDCB). In addition to recognizing different types of carbonate minerals, the diagram also partly distinguishes orogenic and volcanogenic components, although the two trends show significant overlap. The main goal of this project was thus to improve the distinction between volcanogenic and orogenic carbonatization.

Various case studies were used to characterize carbonatization in orogenic and volcanogenic environments. The sites correspond to deposits or fault segments with known carbonatization and without any recognized or suspected juxtaposition of volcanogenic and orogenic systems.

We have demonstrated that the ratio of the saturation and discrimination indices (ISCB/IDCB) significantly improves the distinction between orogenic and volcanogenic carbonatization on the carbonatization diagram. A principal components analysis was performed for each of the sites to reveal the relations between the two carbonatization indices and other common alteration indicators (ex. IFRAIS, Chlorite index, Hishikawa index, etc.). The objective was to add a third pole to the carbonatization diagram to discriminate the carbonatization signature using a ternary diagram. A ternary diagram combining the Normat IFRAIS index, the Chlorite index and the ISCB/IDCB ratio proved to be the best discriminator. For the Louvicourt mine, for example, 81% of the samples fall outside the field defined by samples from orogenic environments.

Outstanding geological sites – Protecting geodiversity

Philippe Ferron and André Tremblay (MRNF)

Geodiversity, much like biodiversity, is a common heritage that we must preserve and develop. Geodiversity encompasses a wide range of geological phenomena. It includes rocks, fossils, minerals, landscapes, soils and unconsolidated deposits, as well as many of the natural processes that shape our environment. Québec is particularly well endowed in this regard, hosting many geological sites that contribute to this geodiversity and should be taken into consideration in any conservation and development process.

In the fall of 2001, the provincial government unveiled Québec’s Strategy for Protected Areas (Ministère de l’Environnement, 1999, 2002). The foundations of sustainable development were laid out during this conference, and a proposal was made to protect 8% of the territory to help ensure a balanced future for our planet. The 8% goal was attained in March 2009, at which time another 4% was added to the total to reach 12% of the province’s surface area by 2015.

In 2005, Québec added measures to the Mining Act to protect geological sites of interest. Bill 121 introduced the notion of classification for outstanding geological sites (OGS) where mining activities would be prohibited according to section 30.1 of the Mining Act.

The legal classification of an OGS involves several consultation steps required by section 3050.1 of the Mining Act. These consultations, in additional to any initial requirements from the MRNF’s sectors, focus on affected municipalities and native or urban communities, as well as provincial mining industry associations and the province’s ministry of sustainable development and parks (Ministère du Développement durable, de l’Environnement et des Parcs). Since October 2009, 33 potential sites have entered into the process of legal recognition. A second contingent of 33 additional potential sites will soon be submitted for consultation.

The conservation of outstanding geological sites represents a major asset for science, education and the public’s awareness of geodiversity. The geology of Québec is markedly different from one region to another, and has thus influenced each region’s economic and—to a certain extent—cultural development in distinct ways. This is why, in addition to examining the situation at the provincial scale, it is important to consider regional specificity.

Through its wildlife and vegetation, Earth is the ultimate support system for life as we know it. To protect life itself, we must protect this life support system!
| 176 | Mining Activities, Côte-Nord Region  
Corporation de promotion du développement minéral de la Côte-Nord (MRNF) |
| 177 | Mineral carbonation coupled with geothermal energy production in magnesium-rich tailings  
Haute-Mauricie: An area to explore

Claude Hébert (CRÉ de la Mauricie)

The Haute-Mauricie is part of the Mauricie administrative region and is represented by the La Tuque agglomeration. It occupies an area that extends from La Tuque in the southeast, to just beyond Lac Kiskissink in the northeast toward Lac Saint-Jean, and just beyond the Gouin Reservoir in the northwest towards the Abitibi.

The geology in the east part of the La Tuque agglomeration is relatively well known thanks to access routes that have been developed over many years. Several mineralized showings have been documented, and there are active ornamental stone quarries and an old nickel-copper mine site (the Lac Édouard mine).

To the west and northwest, the railroad linking La Tuque to Abitibi and the road to the Gouin dam were the area’s only access routes for a very long time. A suzorite (phlogopite) mica deposit was discovered near the railroad and was intermittently mined. Difficulties accessing the area limited the number of known showings and the level of geological knowledge. Geological mapping was performed along the edges of the reservoir and the shores of other major waterways, as illustrated on the map compiled by Laurin (1965). Several mineralized showings were uncovered while investigating these accessible areas, including the Obedjiwan nepheline syenite, numerous magnetite or sulphide occurrences, and some nickel or molybdenum showings. Old geological maps also indicate the presence of milliophits, such as garnet-sillimanite paragneiss units, quartzite and amphibolite, as well as small bodies of mafic (gabbro, anorthosite) and olivine-bearing ultramafic rocks (…with some opaque minerals like magnetite, nickel and perhaps chromite; Laurin, 1965).

Recently, the MRNF published geochemical results for the secondary environment of a region that includes this area, providing a new exploration tool for the industry. Aeromagnetic maps strongly suggest the presence of mafic or ultramafic bodies other than those indicated on the old maps.

For several decades now, logging activities have dramatically improved access and several mining companies are consequently showing interest in exploring the area. This large expanse of land certainly has enough room to accommodate more.

Reference:


Geology of the Lac du Milieu region, Côte-Nord (NTS sheets 22O03, 22O04, 22O06, 22J13, 22J14)

Abdelali Moukhsil, Pierre Lacoste, Fabien Solgadi and Marianne Gagnon (MRNF)

The mapped region is located in the central part of the Grenville Province in the Côte-Nord administrative region. It covers NTS map sheets 22O03, 22O04, 22J13 and 22J14. The goal of the mapping work was to acquire new geologic and metallogenic knowledge.

Mapping revealed several different lithological units. The basement comprises migmatites of sedimentary and igneous origin of variable composition. The centre of the region is occupied by a metasedimentary complex consisting of a dominant biotitic quartzo-feldspathic paragneiss containing sillimanite, graphite and garnet, intercalated with an assemblage consisting of recurring impure quartzite layers (<6 m), fairly continuous to boudinaged layers of clinopyroxene-bearing calcisilicate rocks (<0.5 m), and layers of calcitic to dolomitic marble (<6 m).

Porphyritic to porphyroclastic intrusions of felsic (granite, charnockite) and intermediate composition (mangerite) were emplaced within the metasedimentary complex. Inclusions and dykes of mafic (gabbro, gabbronorite, lamprophyre) to ultramafic composition were recognized here and there throughout the region, in addition to granitic pegmatite dykes.

Different metamorphic parageneses were observed in the metasedimentary rocks (biotite-sillimanite-garnet [lilac colour], and sillimanite-cordierite). These parageneses, together with the presence of orthopyroxene, indicate that regional metamorphism varied from amphibolite to granulite faces. Amphibolite facies is more often than not the result of retrograde metamorphism affecting rocks already at the granulite facies.

The rocks of the region are generally highly deformed and display two types of folds. Isoclinal folds are the most commonly observed and are associated with D1 deformation, which produced a penetrative axial planar S1 foliation (G1) marked by the alignment of ferromagnesian minerals. D1 deformation is represented by gneissosity or a strong penetrative S1 foliation that affects the majority of the lithological assemblages in the northwest part of the region. Locally observed open folds and sheath folds are associated with non-penetrative S2 foliation (G2) of variable orientation. Several fault zones and major shear zones were mapped between the main assemblages in the region.

The region’s mineral potential is diverse. Nickel-copper showings are already known, and our work revealed that it also contains exploration targets with significant potential for industrial mineral (sillimanite-graphite) and rare earth deposits.
Petrographic and structural characterization of the Vallant Anorthositic Suite, Côte-Nord, Québec

Anouk Lemieux, Alain Tremblay (UQAM) and Abdelali Moukhsil (MRNF)

The Vallant Anorthositic Suite (VAS, 1148 Ma) is a Grenville Province massif in the Baie-Comeau region of eastern Québec. It consists of several facies: anorthosite, gabbro, leuconorite and leucotroctolite. This suite is also genetically associated with rocks of monzonitic affinity. The plagioclases range in composition from andesine to labradorite. The textures of the anorthosite facies are megacrystic and partially to strongly recrystallized. To the north, the VAS is in tectonic contact with the Baie-Comeau Complex, a unit of migmatitic orthogneisses dated at 1101 Ma. The contact between these two units dips to the south and is interpreted as a ductile thrust fault. To the south, the VAS is in presumed intrusive contact with the Varin Plutonic Suite, a series of monzonites with U/Pb zircon ages ranging from 1059 to 1019 Ma. In the west, the VAS is oriented east-west, parallel to the regional structural grain, but its orientation is approximately north-south in the east. In this area, the Vallant Suite is surrounded by various lithological units, notably the Belinda Plutonic Suite, which represents a monzonitic sequence that appears older than Vallant.

A series of transects were completed within the Vallant Anorthositic Suite in order to define its internal geometry and determine the nature of its contact with the surrounding rocks. The work to date has confirmed the presence of a fault contact to the north, most likely in the form of a thrust fault. Despite the presence of locally observed significant deformation, field observations suggest the southern contact is an intrusive contact where the Varin Plutonic Suite intrudes the Vallant. Due to strong mineral recrystallization, shear-sense indicators in the VAS facies and adjacent rocks are difficult to observe both in the field and in thin section. A microstructural analysis of oriented samples from different areas within the contact zones should help characterize the structures and determine the kinetics of deformation. In addition, it is likely that part of the deformation observed in the anorthositic rocks is of syn-magmatic origin. The ongoing work also focuses on determining the P-T conditions of regional metamorphism and the compositional variations of plagioclases within the anorthosite facies of this suite.

Geology of the Lac Scott region (32G15-200-0102) – Potential for gold vein and VHMS-type deposits

François Lederc, Patrick Houle (MRNF), Benoît Lafrance (CONSOREM), Tony Brisson and Gérald Riverin (Cogitore Resources)

Mapping of the Lac Scott region (32G15-200-0102) constitutes the third step in revising the existing map for sheet 32G15 in the Chapais region (Abitibi Subprovince, Québec), which also covers the Lac Barlow (2008) and Ville de Chapais areas (2009).

This project has two main objectives: a) investigate the potential for vein-type “orogenic gold” mineralization in rocks of the Lac Doré Complex (LDC) and the Chibougamau Pluton; and b) improve our understanding of the volcanic unit stratigraphy on the southwest flank of the LDC.

The oldest rocks in the area (Cycle 2 volcanic rocks of the Roy Group) are represented by mafic volcanic rocks of the Obatogamau Formation and felsic rocks of the Waconichi Formation, three members of which are exposed in the area:

- Lapilli tuffs of the Queylus Member, south of the Kapunapotagen Shear Zone;
- Rhyolites of the Scott Member north of the LDC, cut by LDC granophyres; this member contain the Lac Scott deposit, a massive sulphide orebody hosted in volcanic rocks (VHMS) that was recently estimated to contain 3.6 Mt @ 5.2 % Zn, 1.1 Cu, 0.3 g/t Au and 36 g/t Ag; the Gwillim Shear Zone marks the western limit of the rhyolites;
- Lapilli tuffs, block tuffs and rhyolites on the southwest flank of the LDC; these rocks have transitional to calc-alkaline affinities and trace element profiles similar to the Allard Member, which is recognized north of the Lac Sauvage Shear Zone (north of the LDC). Mineralization in the Lemoine mine area and the Lac Scott deposit area are in rocks of transitional affinity, like those at the base of the Allard Member, implying a strong potential for this type of mineralization in the zone between the felsic units and the Chibougamau Pluton.

Gangue in the gold-bearing veins consists of quartz-carbonate ± ankerite ± tourmaline ± chlorite, and the mineralization consists of pyrite ± chalcopyrite ± fuchsite ± magnetite ± gold. The veins are hosted by the LDC (anorthosite, gabbro, granophyre), the Chibougamau Pluton (tonalite, trondhjemite, diorite, aplite) and a breccia zone two kilometres wide that marks the contact between the Anorthositic Zone and the pluton. The veins have a slight to moderate dip and occur: a) along faults or early shear zones oriented NNW to NNE, where they display folding by regional deformation; and b) in shear zones oriented N115°E.
Exploration potential and distribution of rare metals in Québec

Charles Maurice and Patrice Roy (MRNF)

Rare metals (Nb, Ta, Li, Be, Zr, Hf, rare earths, Y and Sc) are elements that are present in very low concentrations in the Earth’s crust. A number of them are considered essential strategic substances in the high tech sector (energy, transport, telecommunications, ceramics). The balance of trade for several countries depends on the availability of rare metals to the point that they must find a stable supply at competitive prices. China, who produces more than 95% of the world’s rare earth supply, recently announced its intention to reduce its production and exports, which contributed to the increase in exploration activity for these substances.

Québec contains several favourable geological environments for discovering rare metal mineralization. A detailed compilation of showings, prospects and deposits at the scale of the province has led to a genetic classification divided into seven main types of mineralization (Gosselin et al., 2003; Boily and Gosselin, 2004). This classification now needs updating in light of the recent interest in rare metal exploration. Several new discoveries made by the industry and Géologie Québec will thus soon be compiled and then possibly integrated into a national database as part of a Targeted Geoscience Initiative project (TGI-4).

Regional work in the Churchill Province recently led to a better documentation of prospective signatures for rare metals associated with anorogenic alkaline plutonic rocks (rare earths, Y, Zr±Be, ±Nb). New aeromagnetic data (Dumont et al., 2010) improved the delineation of magmatic phases within these plutons, some of which contain rare earth mineralization. In addition, the reanalysis of lake sediments by the ICP-MS method (Maurice and Labbé, 2009) now makes it possible to identify concentrations of elements that were previously unavailable or undetectable, including beryllium (Be) which serves as an excellent tracer element for targetable alkaline intrusions. The application of these findings to the rest of Québec, notably in the Grenville Province, may eventually lead to the discovery of new rare metal mineralization.

References:


Geology of the Lac Zeni region, east of Schefferville (23P01, 23109, 23116, 13L12, 13L13, 13M03, 13M04)

Hanafi Hammouche (MRNF), Claire Legouix (URSTM), Jean Goutier, Claude Dion (MRNF) and Laura Petrella (McGill)

In the summer of 2010, geological mapping work was carried out in the Lac Zeni region, 180 km east of Schefferville. The goal of this work was to revise the region’s geology at the scale of 1:50,000.

The mapped area is the Core Zone of the SE part of the Churchill Province. It consists of two highly deformed lithotectonic domains of Archean to Proterozoic age cut by Mesoproterozoic intrusions. The domains are:

- The Mistinibi-Raude Domain, which includes the Lac Zeni Complex and is of very heterogeneous composition. It contains amphibolites of gabbro and likely basalt origin, generally mylonitized felsic and intermediate intrusive rocks, and felsic gneisses;
- The Orla Domain, located southwest of Mistinibi-Raude. It consists mainly of tonalitic to granitic gneiss, migmatized paragneiss, and porphyritic granite.

The main circular to elliptical late-stage intrusions are:

- The Mistastin Batholith, composed of granite, often alkaline, and syenite. These coarse-grained rocks locally display rapakivi texture;
- The Ramusio Granite, composed of homogenous, medium-grained biotite granite. Syenite and enclaves of rocks belonging to the Mistinibi-Raude Domain can be found along its margin;
- The Juillet Syenite, composed of pyroxene syenite and amphibole, biotite and magnetite syenite;
- The Michikamau intrusion, composed mainly of anorthosite and leuconorite.

The structural grain of the region is oriented ESE-WNW to NNW-SSE in the west part of the area. It is clearly cut by late intrusions showing little or no deformation. Wide mylonite zones are associated with numerous shear zones. Foliations are typically steep and mineral lineations display shallow plunges. Local variations are due to the effects of shearing and the emplacement of Mesoproterozoic intrusions. Metamorphism of the region varies from greenschist to granulite facies.

The potential for rare earth mineralization in the alkaline intrusions (Mistastin, Juillet) may prove to be interesting. Ongoing chemical analyses will be a determining factor for establishing this potential. It should be noted that the alkaline intrusions hosting the Misery and Lac Brisson–Strange Lake showings are near the study area. We also emphasize the presence of sulphide horizons in the Lac Zeni Complex, associated with paragneiss, as well as magmatic Cu-Ni mineralization in a gabbro-norite of the Michikamau intrusion.
Granites and syenites in the Lac Zeni region and their rare earth, Zr and Nb potential

Jean Goutier (MRNF), Laura Petrella (McGill), Hanafi Hammouche (MRNF), Claire Legouix (UQAT), Anthony Williams-Jones (McGill) and Claude Dion (MRNF)

The Lac Raulet region is located 180 km east of Schefferville. It is part of the southeast Churchill Province and is underlain by Archean and Paleoproterozoic rocks, as well as Mesoproterozoic intrusions. The objective of this study is to evaluate the mineral potential of the Mesoproterozoic intrusions for rare earths, Zr and Nb. These intrusions, which show little or no deformation, can be divided into three main lithological groups: anorthosite-gabbronorite-gabbro-norite-troctolite; granite; and a granite-syenite assemblage of alkaline affinity. They are easily recognized on aeromagnetic maps because they clearly cut across the tectonic grain. They occur as kilometre-scale circular anomalies representing weakly magnetic units, or as intrusions characterized by positive anomalies displaying a ring-shaped and concentric arrangement. The Misery, Juillet and Ramusio alkaline intrusions were mapped and sampled for U-Pb dating on zircons.

The Misery intrusion was discovered in 2007 by Quest Rare Minerals and contains rare earth, Zr and Nb mineralization (ex. 8.56 % rare earth oxides and yttrium, 42.3 % Fe₂O₃, 7.12 % P₂O₅, 4.85 % TiO₂, 3.05 % ZrO₂ and 2.72 % Nb₂O₅). The dominant lithology is coarse- to very coarse-grained syenite containing idiomorphic alkali feldspars and 1 % to 10 % mafic and accessory minerals (pyroxenes, allanite, magnetite and zircons). The composition of the syenite varies from syenite without quartz or plagioclase at the centre, through increasing amounts of quartz and plagioclase, to quartz-syenite at the periphery. Locally, a melanocratic syenite facies and an ultramafic facies containing fresh olivine (7 %, 3 mm in diameter) were observed as enclaves in pegmatitic pyroxene-rich syenite containing millimetre-scale zircons.

The Juillet Syenite is mainly composed of medium- to coarse-grained pyroxene syenite. The more magnetic parts of the intrusion are directly associated with an increase in magnetite content. The central part of the syenite contains a coarser facies, which is richer in biotite, magnetite and amphibole. The presence of decametre-scale enclaves of metamorphosed basalt, iron formation and paragneiss, characterized by shallow dipping foliations, suggest that this area represents the upper part of the intrusion.

The Ramusio granite is a medium-grained pink biotite granite containing fluorite in places. It displays little lithological variation. A syenitic phase was observed locally along the western edge of the intrusion.

Analytical results will be important for evaluating the mineral potential. The heterogeneous pegmatitic phases and the very mafic phases of the syenitic intrusions represent, at the present time, the best metallotects for rare earths in the region.

The alteration-brecciation-mineralization zonation model for copper-gold iron oxide (IOCG) deposits and its application in Québec using case studies from the Great Bear Lake magmatic zone

Louise Corriveau (GSC-Q), Jean-François Montreuil (INRS-ETE) and Hamid Mumin (Brandon University)

Due to their extraordinary diversity and complexity, polymetallic copper-gold-iron oxide (IOCG) deposits are particularly difficult to explore and to explain scientifically. The fact that the host regions, whether in Québec or elsewhere, are often under-explored, under-mapped and metamorphosed to high grade, presents additional challenges. On the other hand, these environments may also contain porphyry copper and epithermal environments that enhance the mineral potential of the target regions. In addition, the hydrothermal signatures associated with IOCG deposits are diagnostic, strong and multi-kilometre in scale, which makes them easier to identify. An alteration-brecciation-mineralization zonation model would help demystify the complexity of IOCGs and simplify mapping by providing a framework for the nature and systemic paragenetic sequencing of alteration, the development of breccias, and the overall evolution of ore deposits belonging to diverse families. The model would also help in prioritizing the study regions. Sodic alteration (e.g., albitites) and calcium-iron alteration (magnetite-amphibole) are early and extensive. They delineate zones of interest at the regional scale and may culminate in the formation of magnetite-apatite (+ vanadium) ore deposits. Systems that evolve to the stage of high-temperature potassic alteration with the development of potassium feldspar/biotite and magnetite produce the family of magnetite-bearing IOCG deposits (copper, gold, cobalt, bismuth, etc.). Systems in which potassic alteration (sericite/potassium feldspar) develops with hematite at low temperature (+ chlorite, carbonate) may host polymetallic deposits (+ U, REE). And finally, where pre-existing calcic alteration or carbonates are present, skarns will form, commonly at the magnetite-to-hematite transition. The formation of albitites does not produce systemic hydrothermal brecciation, but iron oxide-bearing potassic alteration does and is accompanied by metal deposition. Albitites, felsites (intense potassic alteration) and late silicification all result in brittle rocks that are susceptible to tectonic brecciation, thus providing a site for subsequent mineralization. Although the alteration and brecciation sequence is systemic, the spatial distributions are less so, and the appearance of the rocks is highly variable because primary textures may be preserved or may be completely destroyed by recrystallization. The zonation model and its potential applications will be illustrated using case studies of IOCG systems in the Great Bear Lake magmatic zone in Québec, Canada, and the poster will thus complement the talk on IOCG systems in the Grenville Province.
New geophysical data available in SIGÉOM in 2010
Isabelle D’Amours (MRNF), Régis Dumont, Pierre Keating (GSC-O) and Camille St-Hilaire (consultant)

The year 2010 will certainly set a record for the acquisition of new public-domain geophysical data in Québec. Significant investment has been made at both the provincial and federal levels. These surveys will undoubtedly be of great use for geological mapping and identifying new potentially favourable exploration zones for precious metals, base metals, uranium and diamonds. As part of this work, Géologie Québec has published the following documents in 2010:

- **DP 2010-03** consisting of an aeromagnetic and spectrometric survey covering 13 sheets at a scale of 1:50,000, located southeast of previously covered zones in the James Bay territory
- **DP 2010-06** consisting of an aeromagnetic survey covering 13 sheets at a scale of 1:50,000 in the Radisson area
- **DP 2010-04** consisting of an aeromagnetic survey covering all or parts of 48 sheets at a scale of 1:50,000 in the Villebois and Senneterre areas

Also this year, the Geological Survey of Canada produced a synthesis grid for the high-resolution magnetic field of the Abitibi region as part of the TGI-3 (Targeted Geoscience Initiative) and Copper Plan programs. The compilation, published as **DP 2010-05** and **DP 2010-09**, includes the original GeoSoft data from the old surveys used to produce the grid.

Two new airborne surveys were completed in the area east of Schefferville, Québec, and in the adjacent region of Newfoundland and Labrador. The synthesis maps (1:250,000) for the residual component and first vertical derivative of the magnetic field integrate three areas and are available in **DP 2010-07**. Gamma-ray spectrometry data were acquired for the Lac Ramusio and Lac Attikamagen blocks. The databases containing the Lac Ramusio geophysical profiles are available in **DP 2010-01**, and those for Lac Attikamagen are in **DP 2010-02**.

Finally, **DP 2010-08** contains an aeromagnetic survey for the Kuujjuaq area in the Ungava Bay region. This work was completed as part of the Geo-mapping for Energy and Minerals (GEM) program of the Earth Sciences Sector, Natural Resources Canada.

A Quaternary mapping initiative as part of the regional characterization of aquifers in the contiguous basins of Rivière Richelieu, Rivière Yamaska and Baie de Missisquoi
Hugo Dubé-Loubert, André Brazeau (MRNF), Marie Pier Garneau (ULAVAL), Marili Vincent-Couture (Cégep de Thetford) and Michel Parent (GSC-Q)

On September 4, 2008, the ministère du Développement durable, de l’Environnement et des Parcs (MDDEP) launched Québec’s Groundwater Knowledge Acquisition Program to develop a global picture of groundwater resources for all of municipalized southern Québec with the ultimate goal of protecting and ensuring their sustainability. As with any hydrogeological project of this type, one of the premises is a solid understanding of surface deposits, however the surficial deposit maps for a good part of municipalized Québec are fragmental and thus inadequate for the needs of the project.

As a first step in resolving this problem, a surficial mapping program was completed this summer in the Montérégie Est administrative region. The program included all the land covered by the Conférence Régionale des Élus (CRÉ) de Montérégie Est, as well as the catchment basins of the Richelieu-Yamaska rivers and Baie de Missisquoi, for a total surface area of 9,218 km². This area represents about ten NTS map sheets at the scale of 1:50,000.

During this first program, the priority was placed on the northern part of the collective basin area where the surface geology is essentially characterized by large clayey plains and major sandy sequences that were produced during the land’s emergence. The predetermined objective was to cover about eight NTS map sheets at a scale of 1:50,000: 31I02, 31I03, 31H06, 31H09, 31H10, 31H11, 31H14, 31H15.

More than two thousand control points were described in order to refine the robustness of the existing mapping models. In addition, numerous sections were examined along the main rivers to acquire new lithostratigraphic data within the regional stratigraphic context. Several organic fragments and marine shells will be submitted for dating during the year, which will strengthen the chronology of certain events in the Quaternary geology of the Saint-Lawrence Lowlands.

The compilation of all this new information and its integration into existing data will allow us to consolidate and republish several map compilations, and to meet the needs of the groundwater knowledge acquisition program for the Montérégie Est region.
New targets for mineral exploration – 2010 geoscience projects
Claude Dion, Charles Gosselin and André Tremblay (MRNF)

Géologie Québec presents all the targets of economic interest identified during its 2010 geoscience projects. Geoscience knowledge acquisition is one of the main missions of Géologie Québec. This knowledge is acquired in order to encourage the mining industry to develop Québec’s mineral resources by increasing exploration activity and discovering new deposits.

During their fieldwork, geologists of the ministère des Ressources naturelles et de la Faune identified zones with a favourable geological setting for mineral exploration. These areas of interest have not been studied in detail but warrant further investigations by exploration companies. Newly acquired data on these areas of interest were processed in a preliminary fashion and will be made public during Québec Exploration 2010.

Advanced Exploration and Mining Development Highlights for 2010 in the Abitibi-Témiscamingue Region
Pierre Doucet and James Moorhead (MRNF)

Although we have not yet compiled all the projects in the region for 2010, we are expecting increased levels of mineral exploration activity compared to 2009. Here are the main highlights for advanced exploration and mining development projects in the Abitibi-Témiscamingue region:

Aurizon Mines Ltd continued work on its Joanna property east of Rouyn-Noranda. A new resource calculation was published this year: the Hosco orebody contains measured and indicated resources of 40.55 Mt at 1.33 g/t Au and an inferred resource of 23.17 Mt at 1.19 g/t Au (cut-off grade of 0.5 g/t Au).

West of Cadillac, IAMGOLD–Québec Management Inc has advanced the construction of surface infrastructure, the sinking of exploration shafts, and the underground lateral/vertical development at its Westwood project.

At the Kiena mine, Wesdome Gold Mines extended an exploration drift over a distance of 1 km on the 330 m level to perform definition drilling in the Dubuisson Zone, discovered in 2008. In addition, deep drill holes intersected the extension of the S-50 Zone, which has supplied most of the ore to date from the Kiena mine.

In Malartic, Osisko Mining Corporation plans to complete the construction of its Canadian Malartic mining project in the second quarter of 2011. Production should begin in May 2011. Proven and probable reserves for the Canadian Malartic and South Barnat deposits are 245.8 Mt at 1.13 g/t Au (8.97 Moz of gold).

Canada Lithium Corporation continued the appraisal work on its Québec Lithium project. Exploration holes were drilled during the summer. Geotechnical drill holes and metallurgical tests were also performed. A feasibility study was initiated and should be completed in early 2011.

In the Témiscamingue area, Exploration Matamec has advanced its Zeus REE project. A new resource calculation gave indicated resources of 2.51 Mt at 0.63 % TREO and 0.88 % ZrO₂, and inferred resources of 4.73 Mt at 0.66 % TREO and 0.97 % ZrO₂.

Mines Richmont performed work at the old Francoeur mine, west of Rouyn-Noranda, with the goal of putting the mine back into production in 2011. The 17 levels were dewatered and underground development work started during the summer.
ACRONYMS,
LIST OF EXHIBITORS,
MAPS OF EXHIBIT ROOMS AND
PROJECT LOCATION MAPS
ACRONYMS

- ACPE: Association canadienne des prospecteurs et entrepreneurs
- AEM: Agnico-Eagle Mines
- AEMQ: Association de l’exploration minière du Québec
- AMQ: Association minière du Québec
- BAPE: Bureau d’audiences publiques sur l’environnement (Gouvernement du Québec)
- CERM-UQAC: Centre d’étude sur les ressources minières de l’Université du Québec à Chicoutimi
- CGC: Commission géologique du Canada
- CGC-CC: Commission géologique du Canada - Centre du Canada
- CGC-O: Commission géologique du Canada - Ottawa
- CGC-Q: Commission géologique du Canada - Québec
- CGO: Commission géologique de l’Ontario
- CNRS: Centre national de la recherche scientifique
- CONSOREM: Consortium de recherche en exploration minérale
- CRÉ: Conférence régionale des élus
- CRPG: Centre de recherches pétrographiques et géochimiques, France
- CRSNG (RDC): Conseil de recherches en sciences naturelles et en génie du Canada (subventions de recherche et développement coopérative)
- CSM: Colorado School of Mines
- CSST: Commission de la santé et de la sécurité du travail
- CU: Carleton University
- DIVEX: Diversification de l’exploration minière du Québec (Réseau de recherches géoscientifiques)
- FQRNT: Fonds québécois de recherche sur la nature et les technologies
- GC-DLG: Géomatique Canada - Division des levés géodésiques
- GC-GSD: Geomatic Canada - Geodesic Survey Division
- GEOTOP UQAM-McGILL: Centre de recherche en géochimie et en géodynamique de l’Université du Québec à Montréal et de l’Université McGill
- GSC: Geological Survey of Canada
- GSC-O: Geological Survey of Canada - Ottawa
- GSC-Q: Geological Survey of Canada - Quebec
- IGC-3: Initiative géoscientifique ciblée (2005-2010) de la CGC
- INRS: Institut national de la recherche scientifique
- INRS-ETE: Institut national de la recherche scientifique – Centre Eau, Terre et Environnement
- LU: Laurentian University
- McGill: Université McGill
- MDDEP: Ministère du Développement durable, de l’Environnement et des Parcs
- MDEIE: Ministère du Développement économique, de l’Innovation et de l’Exportation du Québec
- MISA: Mines, innovations, solutions et applications
- MRNF: Ministère des Ressources naturelles et de la Faune du Québec
- MPMP: Mineral potential maps production system (MRNF)
- MTP: Miller Thomson Pouliot
- NTS: National Topographic Series
- OF: Open File
- OGS: Ontario Geological Survey
- PDAC: Prospects and Developers Association of Canada
- Poly: École Polytechnique de Montréal, Département des génies civil, géologique et des mines, Montréal
- RNC: Ressources naturelles Canada
- RSC: Ressources Stratèco
- SPCPM: Système de production des cartes de potentiel minéral (MRNF)
- U d’O: Université d’Ottawa
- U of A: University of Alberta
- U of O: University of Ottawa
- UL: Université Laurentienne
- ULAVAL: Université Laval
- UQAC: Université du Québec à Chicoutimi
- UQAM: Université du Québec à Montréal (Département des Sciences de la Terre et de l’Atmosphère)
- UQAT: Université du Québec en Abitibi-Témiscamingue
- URSTM-UQAT: Unité de recherche et de service en technologie minérale de l’Université du Québec en Abitibi-Témiscamingue
- VIASAT: VIASAT GeoTechnologies
- VRQ: Valorisation-Recherche Québec: un programme d’investissement du gouvernement du Québec destiné à la recherche universitaire
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164 Finding Invisible Gold In Pyrite Using Crystallography
165-167 DIVEX: the network and current projects
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191 Geology of the Lac du Milieu region, Côte-Nord (NTS sheets 22O03, 22O04, 22O06, 22J13, 22J14)
192 Petrographic and structural characterization of the Vallant Anorthositic Suite, Côte-Nord, Québec
193 Geology of the Lac Scott region (32G15-200-0102) – Potential for gold vein and VHMS-type deposits
194 Exploration potential and distribution of rare metals in Québec
195 Geology of the Lac Zeni region, east of Schefferville (23P01, 23I09, 23I16, 13L12, 13L13, 13M03, 13M04) and Granites and syenites in the Lac Zeni region and their rare earth, and Nb potential
196 The alteration-brecciation-mineralization zonation model for copper-gold iron oxide (IOCG) deposits and its application in Québec using case studies from the Great Bear Lake magmatic zone
197 New geophysical data available in SIGÉOM in 2010
198 A Quaternary mapping initiative as part of the regional characterization of aquifers in the contiguous basins of Rivière Richelieu, Rivière Yamaska and Baie de Missisquoi
199 New targets for mineral exploration – 2010 geoscience projects
200 Advanced Exploration and Mining Development Highlights for 2010 in the Abitibi-Témiscamingue Region
201 Programmation
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| **Mercredi 24 novembre** |
| C-1 | Ressources Abitex |
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| C-3 | Detour Gold |
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| **Jeudi 25 novembre** |
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MAPS OF EXHIBITS ROOMS

Verchères
Commercial exhibit

Bellevue
Geoscience Exhibit

P : Posters
0 : Computer + LCD

Breakfast
Booths 131, 133, 135 and 137
Prospectors’ Room

Place d’Armes
Commercial exhibit
Québec Exploration 2009 is going green!

In order to reduce the conference’s environmental footprint, the organizing committee has developed a number of interactive visibility tools. Plasma screens, digital displays, USB keys, eco-friendly bags, reusable water bottles… We’re using a host of innovative and reusable tools to provide quality visibility for partners and optimize information about conference activities.

Thanks to all our financial partners who have made the leap to go green!