Resources and the Environment: Bridging two worlds

QUÉBEC GEOSCIENCE CENTRE

2018-2019 ANNUAL REPORT

30 years of partnership
1988-2018

INRS Institut national de la recherche scientifique

Canada

Annual report from May 1, 2018 to April 30, 2019

Available in electronic format: cgq-qgc.ca/en/annual-reviews

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QUÉBEC GEOSCIENCE CENTRE

2018-2019 ANNUAL REPORT

OUR MISSION

A unique example of partnership between a university and a governmental organization, the Québec Geoscience Center (QGC) brings together scientists from the Eau Terre Environnement Research Centre of the Institut national de la recherche scientifique (INRS) and the Québec Division of the Geological Survey of Canada (GSC-Québec), Natural Resources Canada. This collaboration constitutes one of the largest multidisciplinary Earth science research groups in Canada.

QGC researchers focus their activities on addressing relevant socio-economic issues by increasing knowledge related to regional geology, georesources and environmental geoscience.

OUR VISION

The aim of GSC-Québec and INRS is to make their collaboration a point of convergence and excellence in geoscience that is open to all, while ensuring the cooperation and participation of governments, organizations and universities in Canada.

OUR VALUES

One of the objectives of the QGC is to promote public interest in Earth sciences and to help generate interest among young people. To this end, it publishes outreach materials and organizes special events to raise and support students' interest in science.

Another objective is to train the next generation of geoscientists through the Earth Sciences inter-university graduate program jointly offered by INRS and Laval University's Department of Geology and Geological Engineering. GSC-Québec researchers also contribute to this offer by supervising students as associate professors at INRS.

Key strengths of this 30-year partnership

Unique strategic partnership

Complementary research activities

Inter-university graduate programs

Laboratories serving regional stakeholders

Public outreach activities

The Québec Geoscience Center

MESSAGE FROM THE DIRECTORS

A BANNER YEAR OF ACHIEVEMENTS

Andrée Bolduc

Director,
Geological Survey of Canada, Québec

Jean-François Blais

Director,
INRS Eau Terre Environnement Research Centre

For the past 30 years, the Québec Geoscience Centre has been conducting outreach activities in Canada and internationally through its members, scientific projects and joint visibility activities. This year, GSC-Québec and INRS have demonstrated inventiveness in guiding and ensuring the future of the centre. Both institutions have presented their strategic plan with common objectives for the next five years. Science at the QGC will continue to meet the current needs of our society by remaining at the forefront in the field of geosciences. To this end, several hiring processes have been conducted to ensure a dynamic new generation to pursue innovative and world-class geoscience activities.

Once again this year, QGC research teams have greatly contributed to the partnership by collaborating on multiple projects on various geoscientific issues. For example, projects surrounding the vulnerability of a regional shallow aquifer to gas operations in New Brunswick, or the evaluation of low-temperature geothermal potential using conventional methods, have brought about new knowledge in their respective fields. New collaborations have also emerged, notably to study the environmental impact of diluted bitumen from the oil sands, as well as counteracting urban heat islands through groundwater. These examples of projects, among many others, provide a sample of the expertise represented by the QGC and the vitality of the partnership.

The QGC also participated in several scientific conferences such as Québec Mines + Énergie in November 2018. The conference opened its doors to the general public for one day and to school children for three days during which members of the QGC shared their passion for geosciences through presentations and information kiosks. In August 2018 and May 2019, members of the Centre actively organized and co-organized two international and national conferences: the 20th International Sedimentological Congress and the GAC-MAC-IAH, respectively.

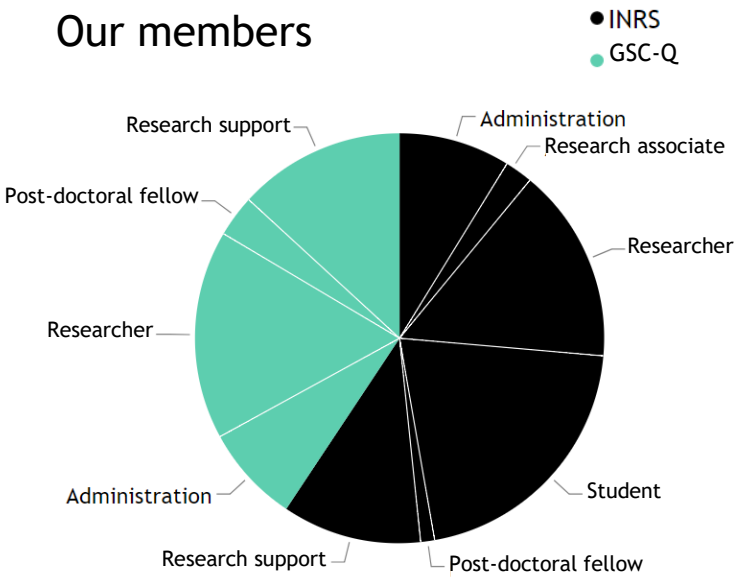
A UNIQUE 30-YEAR PARTNERSHIP

On September 30, 1988, the Geological Survey of Canada and the INRS Eau Terre Environnement Research Centre, formerly INRS-Géoressources, signed a five-year partnership agreement, thus creating the Québec Geoscience Centre (QGC). Heading the centre was entrusted to INRS professor Aïcha Achab, with the aim of developing a centre of convergence and excellence as well as a place of high-level collaboration and participation for governments and universities. Since then, renewals of the agreement have succeeded one another and here we are 30 years later, with Andrée Bolduc as Director of the Québec division of the GSC and Jean-François Blais as Director of the INRS Eau Terre Environnement Research Centre, as well as a one-of-a-kind partnership. Over the years, the vitality of the QGC has resulted in numerous projects between government and university researchers, as well as the training of many geoscience students. The renewal of cutting-edge expertise focused on constantly evolving needs has allowed the QGC to progress into what it is today.

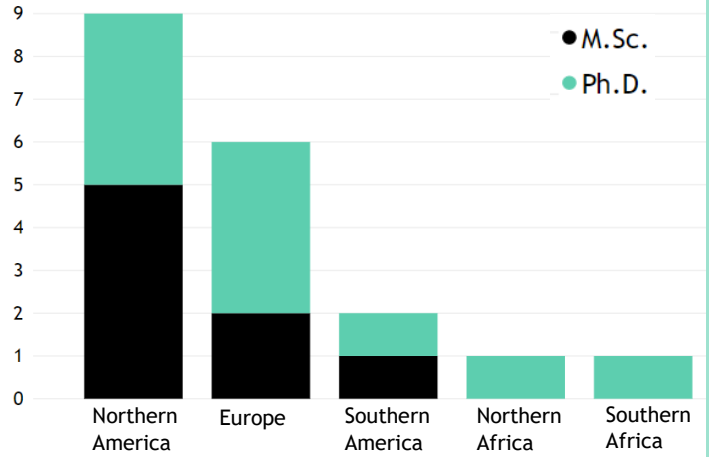
QGC team at the first renewal of the partnership agreement in 1992

THE QGC—FACTS & FIGURES

Our members



Country of origin of our students



REGIONAL GEOLOGY AND GEORESOURCES

SUPPORTING THE EXPLORATION OF MINERAL RESOURCES…

The focus of this theme is to define the regional geological framework and to study the parameters delineating the evolution of sedimentary basins. It provides a solid geological context for detailed metallogenic studies of gold deposits, volcanogenic massive sulphides and other types of polymetallic mineralization, as well as studies surrounding conventional and non-conventional hydrocarbons. Defining metallotects can increase the economic potential of a deposit and can guide the exploration of georesources.

GSC Team	INRS Team	Fields of Expertise	For more information
Jean H. Bédard	Marc Richer-Laflèche, Anne-Sophie Corriveau (M.Sc.)	Igneous petrology Geochemistry of igneous rock Tectonics	Corriveau, A-S. (2019) Caractérisation pétrologique et géochimique des roches mantelliques du terrane de Cache Creek Nord, Cordillère nord-américaine. Master's thesis. Institut national de la recherche scientifique – Centre Eau Terre Environnement, Québec, Quebec, 211 pages.
Jean Bédard	**Lyal Harris**	Tectonics	Harris, L. and Bédard, J. (2014) Crustal Evolution and Deformation in a Non-Plate-Tectonic Archaean Earth: Comparisons with Venus. In: Dilek Y., Furnes H. (eds) Evolution of Archean Crust and Early Life. Modern Approaches in Solid Earth Sciences, vol 7.
Denis Lavoie, Stéphanie Larmagnat	Jasmin Raymond, Michel Malo, Pierre Francus, Mathieu Des Roches, Louis-Frédéric Daigle, Mirah Rajaobelison (Ph.D.)	Sedimentology Stratigraphy Biostratigraphy Paleogeography Geochemistry of sedimentary rock	Larmagnat, S. *et al.* (2019) Geothermal assessment of a conventional hydrocarbon reservoir in eastern Quebec: Preliminary field and petrophysical data. Geological Survey of Canada, Open File 8597, 44 p. doi.org/10.4095/315028
Patrick Mercier-Langevin, Benoît Dubé, Sébastien Castonguay, Nicolas Pinet, Jean-Luc Pilote, Kathleen Lauzière, Valérie Bécu, Francis Aucoin	Pierre-Simon Ross, Michel Malo, Alexandre Krushnisky (M.Sc.), Émile Boily-Auclair (M.Sc.), Brayden St-Pierre (M.Sc.), William Oswald (Ph.D.), Arnaud Fontaine (Ph.D.)	Metallogeny Gitology Structural geology Tectonics	Castonguay, S. *et al.* (2019) Geological setting and mineralization styles of the Sunday Lake and Lower Detour 'gold trends', northwestern Abitibi greenstone belt, Ontario and Quebec; in Targeted Geoscience Initiative 2018 Report of Activities (ed.) N. Rogers; Geological Survey of Canada Open File 8549, p. 9-22. doi.org/10.4095/313625 Krushnisky, A. (2018) Controls on gold enrichment at the Horne 5 Archean VMS deposit, Abitibi greenstone belt, Quebec. Master's thesis. Institut national de la recherche scientifique – Centre Eau Terre Environnement, Québec, Quebec, 198 pages. Fontaine, A. (2019) Géologie des minéralisations aurifères de la mine Éléonore, Eeyou Istchee Baie-James, Province du Supérieur, Québec, Canada. Doctoral thesis. Institut national de la recherche scientifique – Centre Eau Terre Environnement, Québec, Quebec.

In bold: Project leader(s)

ENVIRONMENTAL GEOSCIENCES

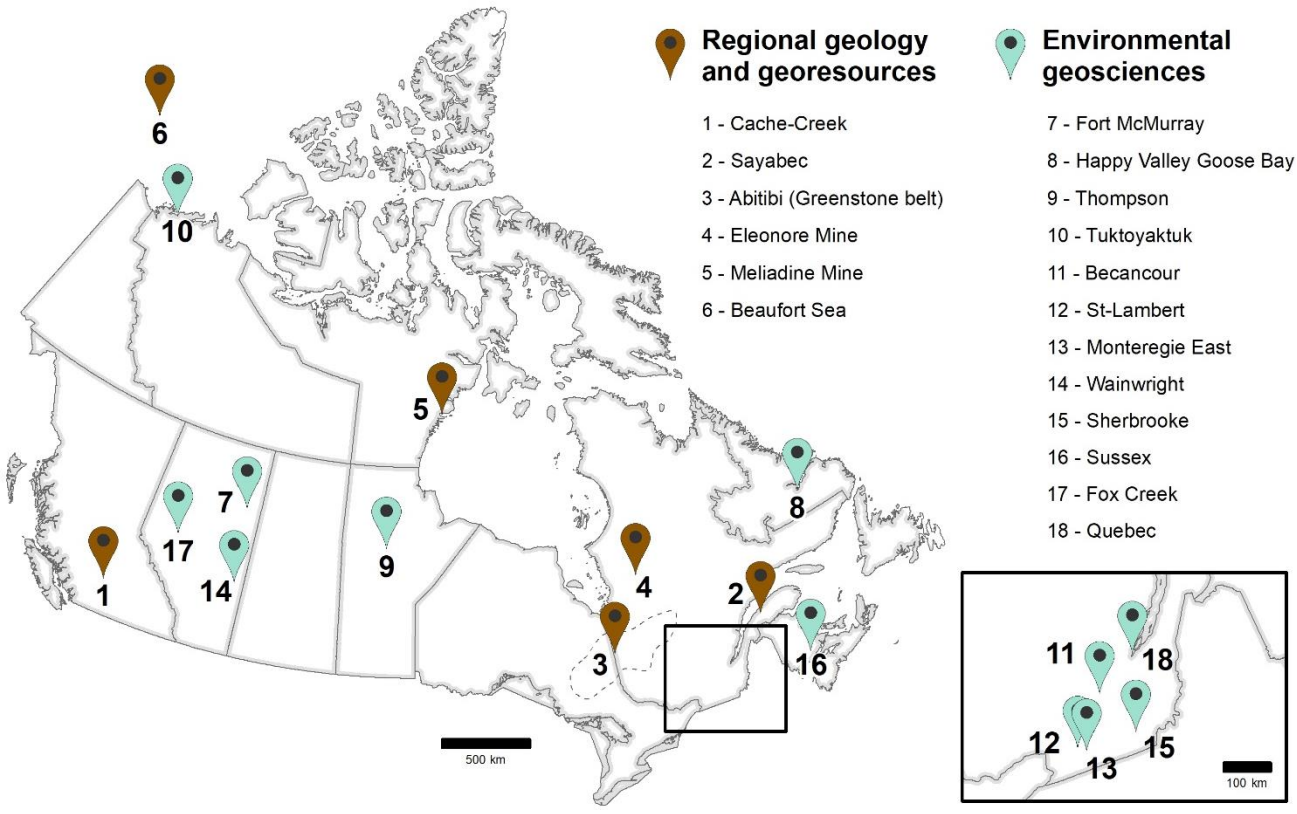
…WHILE CONTRIBUTING TO PROTECTING THE ENVIRONMENT

The activities under this theme include the characterization and dynamics of groundwater and regional aquifers, the study of geological risks, the dynamics of modern environments, the characterization and rehabilitation of contaminated sites and climate change, and issues linking the environment and the development of natural resources, including environmental geochemistry.

GSC Team	INRS Team	Fields of Expertise	For more information
Jason Ahad, Jade Bergeron, Marc Luzincourt, Anna Smirnoff, Nicolas Benoit, Patrick Watt	Valérie Langlois, Richard Martel, Luc Trepanier, Scott Hepditch (Ph.D.)	Isotopic geochemistry Organic geochemistry	New project 2019-2024
Jason Ahad, Anna Smirnoff, Patrick Watt	**Pierre Francus**, Léo Chassiot	Sedimentology Geochemistry of metals Organic geochemistry	Chassiot, L. *et al.* (2019) Spatial and temporal patterns of metallic pollution in Québec City, Canada: Sources and hazard assessment from reservoir sediment records, Science of the Total Environment 673, 136-147. doi.org/10.1016/j.scitotenv.2019.04.021
Christian Bégin, Martine M. Savard, Lauriane Dinis, Joëlle Marion	**Pierre Francus**, Antoine Gagnon-Poirier (Ph.D.)	Dendrogeochemistry Paleolimnology Limnogeology	Dinis, L. *et al.* (2019) Tree-ring stable isotopes for regional discharge reconstruction in eastern Labrador and teleconnection with the Arctic Oscillation. Climate Dynamics 53:5, 3625-3640. doi.org/10.1007/s00382-019-04731-2
Mathieu J. Duchesne, Nicolas Pinet, Virginia Brake	Bernard Giroux	Sub-surface geophysics	New project 2019-2024
Daniel Paradis	**René Lefebvre**, Erwan Gloaguen, Abderrezak Bouchedda, Simon Gernez (Ph.D.), Aymen Nefzi (Ph.D.)	Hydrogeophysics Regional hydrogeology Sub-surface geophysics	Gernez, S. *et al.* (2019) Comparison between hydraulic conductivity anisotropy and electrical resistivity anisotropy from tomography inverse modeling. Frontiers in Environmental Science 7:67 doi: 10.3389/fenvs.2019.00067
Daniel Paradis	**René Lefebvre**, André St-Hilaire, Ronan Abhervé (M.Sc.)	Hydrogeophysics Regional hydrogeology Hydrology	Abhervé, R. *et al.* (2019) Impact of topographic resolution on simulated regional groundwater flow and residence time. GAC-MAC-IAH 2019, Québec, Canada
Daniel Paradis	**Erwan Gloaguen**, Maxime Claprood	Hydrogeophysics Geophysics	Claprood, M. *et al.* (2018) An integrated methodology for hydrogeological assessment of nuclear plant aquifer. DEM 2018 Avignon, France
Michel Parent	**Richard Martel**, Luc Trépanier, Marco Boutin, Annie Therrien, Thomas Robert	Quaternary geology Regional hydrogeology	Martel, R. *et al.* (2019) Complementary groundwater characterization in PDA2 and Betty Lake area, 3 Canadian Division Support Base Edmonton, Garrison Wainwright. Research report R1840. Institut national de la recherche scientifique – Centre Eau Terre Environnement, Québec, Quebec, 66 pages.

GSC Team	INRS Team	Fields of Expertise	For more information
Michel Parent	**René Lefebvre**, Mélanie Raynault, Jean-Marc Ballard, François Huchet	Quaternary geology Regional hydrogeology	New project 2018-2021
Christine Rivard, Denis Lavoie, Geneviève Bordeleau, Mathieu J. Duchesne, Nicolas Pinet, Virginia Brake, Xavier Malet, Vincent Tremblay	**René Lefebvre**, François Huchet (M.Sc.)	Regional hydrogeology Sub-surface geophysics Sedimentology	Brake, V. *et al.* (2019) New insight on the geometry and evolution of the Moncton sub-basin from 3D seismic reflection data in the McCully area, New Brunswick, Canada. Marine and Petroleum Geology 102, 363-376. doi.org/10.1016/j.marpetgeo.2018.12.048
Christine Rivard, Denis Lavoie, Geneviève Bordeleau	Erwan Gloaguen, Bernard Giroux, René Lefebvre, Claudio Paniconi, Laura Isabel Guarin-Martinez (M.Sc.)	Regional hydrogeology Sub-surface geophysics Sedimentology Geochemistry	New project 2019-2024
Christine Rivard, Denis Lavoie, Stéphanie Larmagnat	Jasmin Raymond, Felix-Antoine Corneau	Regional hydrogeology Geothermal energy	New project 2019-2024
Christine Rivard, Michel Parent, Geneviève Bordeleau	**Jasmin Raymond**, René Lefebvre, Jérôme Comte, Felix-Antoine Corneau, Violaine Gascuel (Ph.D.)	Regional hydrogeology Geothermal energy Geochemistry	New project 2019-2022

In bold: Project leader(s)

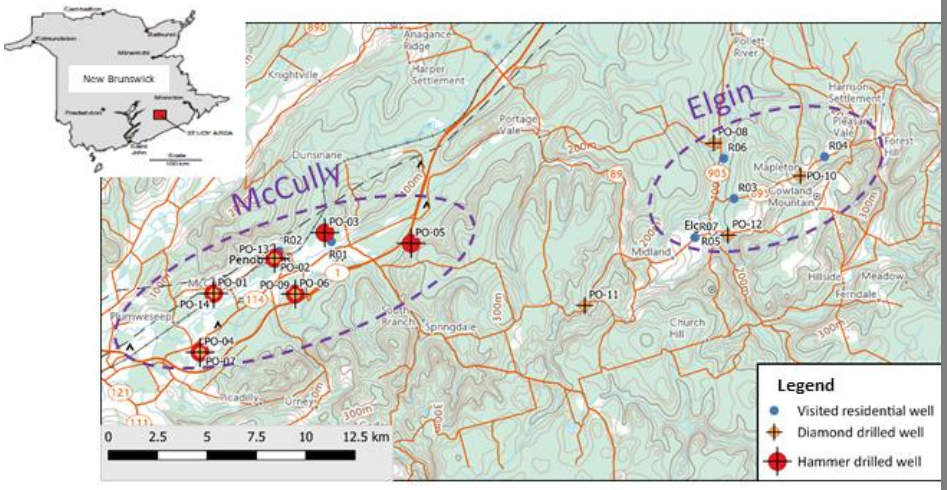


Location of QGC projects for the year 2018-2019

KNOWLEDGE DISSEMINATION

HYDROGEOLOGICAL CHARACTERIZATION IN THE CONTEXT OF HYDRAULIC FRACTURING

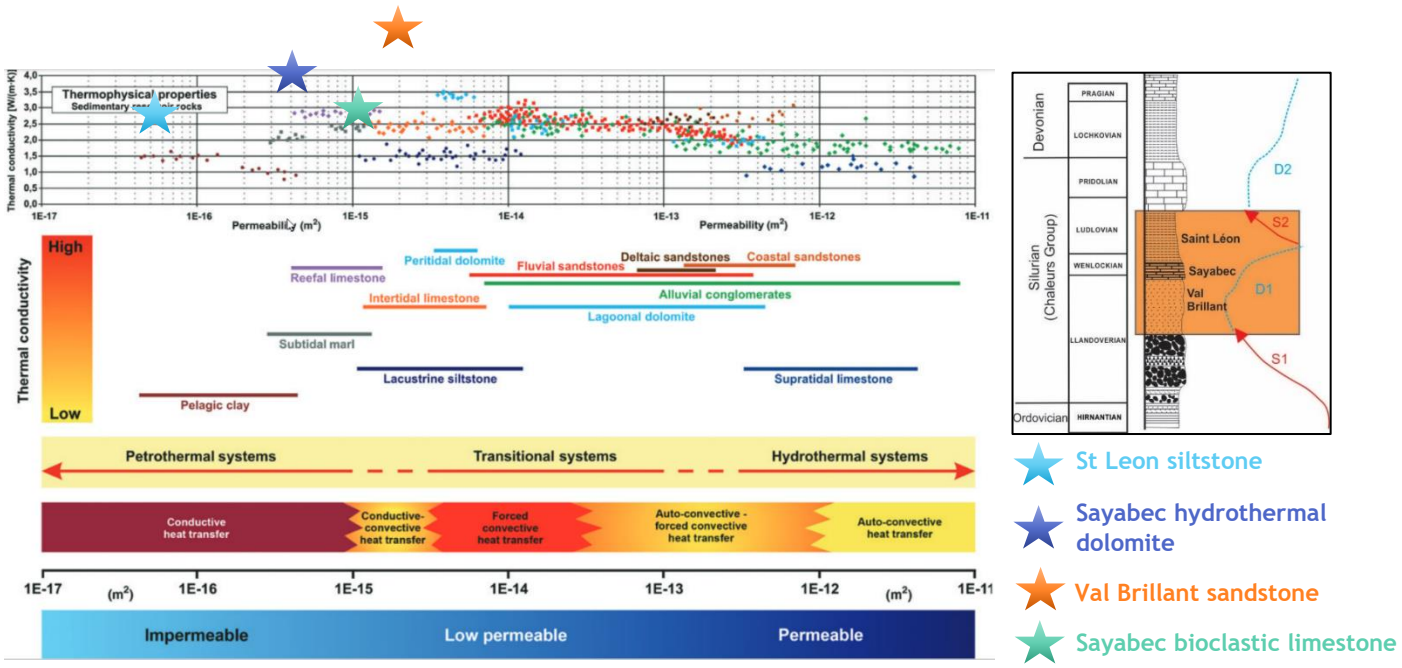
In southern New Brunswick, near Sussex, the development of mining techniques has led the gas industry to exploit new, unconventional resources such as shale gas from reservoirs more than 2 km in depth. These techniques require the use of hydraulic fracturing to extract the gas naturally trapped in the rock. Between April 2015 and March 2019, a GSC research team led by geoscientist Christine Rivard, in collaboration with INRS professor René Lefebvre , two provincial ministries, two other universities and industry, carried out a project on vulnerability of the regional shallow aquifer (<100 m) to these gas operations in the region of the McCully gas field and the Elgin field. In other words, this project aimed to study potential links between the units targeted by industry and the surface aquifers. These links are not well documented, mainly because the area between these two units, called the intermediate zone, is not of interest for water supply or hydrocarbon exploitation. However, the assessment of the presence or absence of potential links between the reservoirs and the aquifer is necessary to ensure that the gas is responsibly extracted. This project included field work (well drilling, logs, hydraulic testing, water and rock sampling), laboratory testing, data analysis and numerical modeling. The results provided no evidence of a preferential relationship between deep gas reservoirs and shallow aquifers. To the contrary, the intermediate zone appears to be an effective barrier to protect shallow groundwater from the potential migration of fluids from hydrocarbon reservoirs. The methodology developed under this project is expected to help support regulations to protect shallow groundwater in a context of non-conventional resource development.



Location of the study area

EVALUATING LOW-TEMPERATURE GEOTHERMAL POTENTIAL USING CONVENTIONAL METHODS

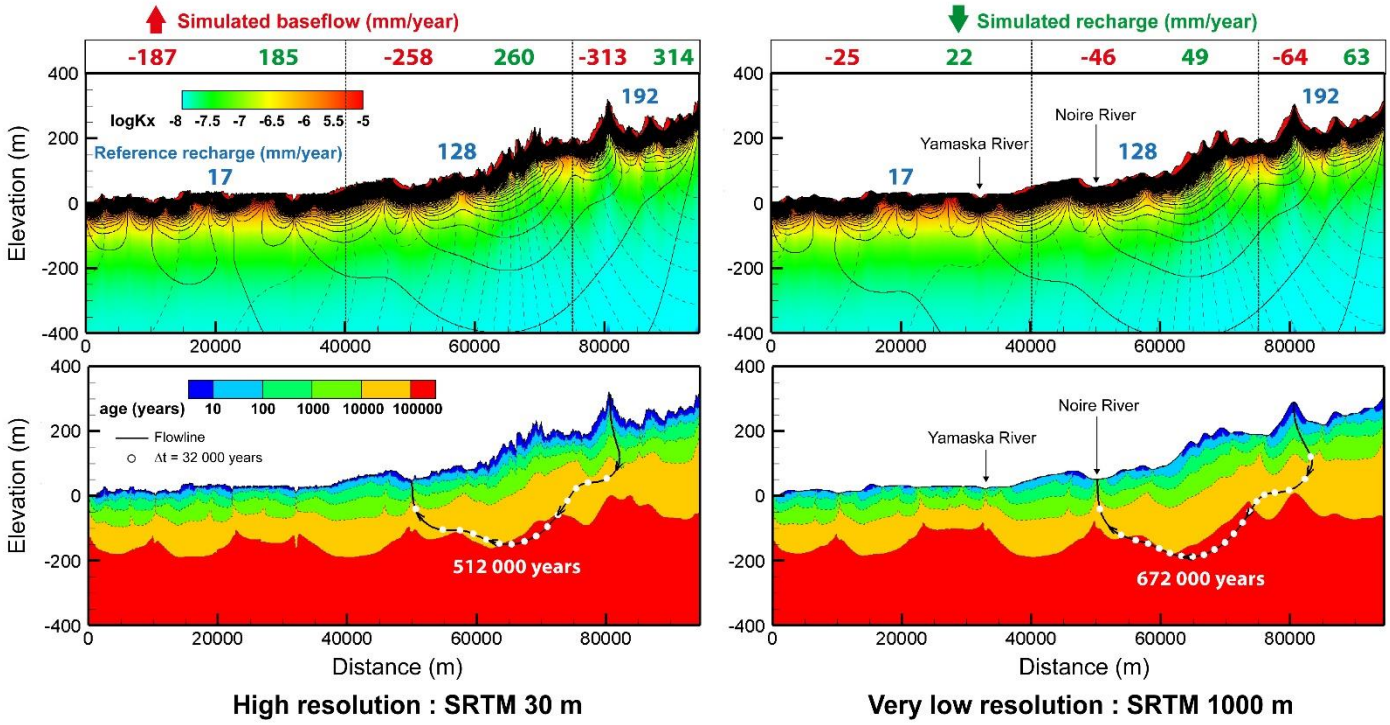
When we think of geothermal energy, we often think in terms of high-temperature geothermal resources for the production of electricity, or the potential exploitation of hot water from deep sedimentary basins. However, low-temperature (80 to 150°C) shallow systems have also shown their potential for heating or air-conditioning applications. At the Québec Geoscience Center, preliminary research studies have investigated the fine-scale thermophysical properties of various key Silurian-age facies (Sayabec Formation) in the Lower St. Lawrence region. Because this formation and its facies have already been studied for their potential to contain hydrocarbons, the geology was well defined and a large subsurface dataset (core and seismic) was available. By determining parameters such as permeability with a portable permeameter, or thermal conductivity and diffusivity using the infrared scanner from the Open Geothermal Laboratory (LOG), or porosity using the INRS CT scanner, the QGC researchers (Stéphanie Larmagnat, Denis Lavoie, Jasmin Raymond and Pierre Francus) have shown that the thermal conductivity of sedimentary rocks in the Lower Silurian succession in eastern Quebec is mainly controlled by mineral composition and porosity. They identified four interesting thermofacies, including the dolomite facies of hydrothermal origin favourable to conductive heat transfer mechanisms.



Thermophysical properties of the four thermofacies characterized in the Lower St. Lawrence region (adapted from Sass and Götz, 2012)

EFFECT OF TOPOGRAPHIC RESOLUTION ON REGIONAL NUMERICAL MODELS

As part of a Quebec groundwater resources synthesis project (PSyRESQ) funded by the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), researchers from INRS (René Lefebvre, André St-Hilaire) and the GSC (Daniel Paradis) are trying to assess the impact of climate change on groundwater for sustainable management of the resource. One of the objectives of this project is to develop an integrated numerical model of surface and groundwater flow on a supra-regional scale with a total area of 36 000 km^2, comprising 8 watersheds in southern Quebec. However, very often, the low spatial resolution of large regional numerical models results in a smoothing of the topography of the Earth's surface. For this reason, a 2D cross-sectional hydrogeological model was developed based on the topography of the eastern Montérégie region to evaluate the influence of topographic resolution on the flow estimation as well as on the age of the groundwater. The results show that simulated flows decrease significantly while residence times are longer with decreasing topographic resolution. This implies that a regional model using a resolution of the Earth's surface that is too low will have to be calibrated with hydraulic conductivities higher than the measured values in order to obtain a representative simulated base flow. These results provide a new perspective on the apparent scale effect on the hydraulic properties of aquifers.



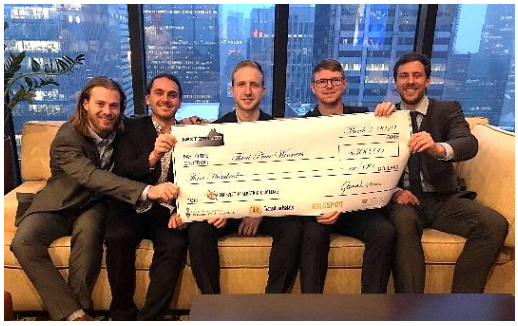
Modeling of incoming and outgoing flows and residence times of the groundwater flow system (adapted from Ronan Abhervé, Master's thesis, 2019)

20 YEARS OF GOLD RESEARCH THROUGH THE "TARGETED GEOSCIENCE INITIATIVE" PROGRAM

For almost twenty years, the numerous research activities developed under the federal Targeted Geoscience Initiative (TGI) program have been instrumental in advancing the understanding of the genetic processes that lead to gold deposits and the development of geological and exploratory models in ancient terranes. Conducted in close collaboration with INRS, as well as with industry, various Canadian universities and provincial and territorial geological departments, many of these activities included graduate projects and served as a driving force for the training of a brand new generation of metallogenists. The TGI program is currently in its fifth phase (2015-2020) and evolved from projects focused on specific mining camps to national thematic research. More than $75 million has been invested by the federal government in applied mineral resources research through this program.

The contributions and impact of the activities carried out as part of the TGI were highlighted this year as part of a symposium at the GAC-MAC-IAH Joint Conference in May. Some fifty collaborators, students and colleagues presented the results and recent advances in the study of gold deposits, reflecting the mobilizing effect and impact of the TGI over the years, both at the scientific level and for training purposes. At the QGC, a dozen researchers contributed to a multitude of research activities and participated in the training of twelve doctoral students, more than fifteen master's students and three post-doctoral researchers. Two students, enrolled in the Master of Earth Sciences program at INRS as part of TGI activities, stood out at the most recent PDAC (Prospectors & Developers Association of Canada) Conference as part of the team that placed 3rd in the "Prospect Generator Challenge". One of the goals was to engage students and new geoscientists in the mineral exploration industry and to bridge the gap between academia and industry. Participants were invited to showcase a mining property before a jury of professionals working in the field of mineral exploration.

The scientific leadership of GSC senior metallogenist Benoît Dubé was highlighted at a symposium marking 20 years of gold research under the TGI during the GAC-MAC-IAH Conference.



Émile Boily-Auclair and Brayden St-Pierre (2nd and 3rd from left) at the PDAC Prospect Generator Challenge

REGIONAL OUTREACH

For its 2018 edition, the Québec Mines + Énergie Conference proposed activities for the general public on November 18 and for schools from November 20 to 22. Dozens of GSC and INRS employees participated in these outreach events. They hosted six kiosks, including a joint kiosk on the general public day, to which more than 450 people attended. During the school days, INRS hosted a kiosk and presented two conferences, one on artificial intelligence applied to the Earth sciences, and the other on geothermal energy as a source of energy independence from the Earth. In total, over 2600 students from schools in the Capitale-Nationale and Chaudière-Appalaches regions participated in this fun and interactive event on Earth sciences, mining and energy.

GSC kiosk

GSC-INRS joint kiosk

NATIONAL OUTREACH

The GSC and INRS actively participated in the organization of the GAC-MAC-IAH Conference held in Québec City from May 12 to 15, 2019 under the theme "Where Geosciences Converge". The local organizing committee, chaired by INRS, proposed a solid and diversified scientific program including symposiums, special sessions, intensive courses and excursions, thus solidifying the success of the conference. In total, no less than 800 participants were able to attend conferences and exchange ideas on the following themes: "Geosystems and Hydrogeosystems", "Resources, Energy and Environment", "Data Science for Geosciences" and "Geosciences and Society". This year, the conference also had the opportunity to welcome the Canadian Museum of Nature's travelling minerals exhibition at the heart of the convention center, creating a main focal point for scientific meetings and discussions. This exhibition is one of the largest travelling across the country and includes more than 90 spectacular specimens as well as interactive interpretation stations. It also attracted more than 70 students from Québec City schools and onlookers during the discovery day on May 14, organized by 18 volunteers.

Coffee break for intensive course participants

Students using interactive interpretive stations at the Canadian Museum of Nature traveling exhibit

INTERNATIONAL OUTREACH

The 20th International Sedimentological Congress (ISC) was held from August 13 to 17, 2018 at the Québec City Convention Center. Co-organized by INRS, the GSC and Université Laval, the congress brought together more than 900 Earth science specialists under the theme "A sedimentary journey through 3 billions years in the New World". This was the second time that this international meeting was held in North America, the first having taken place in Hamilton in 1982. Several sessions, dealing with such topics as sedimentary processes, paleo-environments, or the deposition system of carbonates, in addition to intensive courses and workshops, formed the scientific program of the congress. Geological excursions allowed participants to discover the landscapes and sedimentary formations of the Québec City region as well as other Canadian provinces. These excursions were also used to present the geological and historical heritage of Québec City.

Members of the ISC 2018 organizing committee

Lunch break for excursion participants in the Maritimes

COMMUNICATIONS AND ACTIVITIES

JOINT PARTICIPATION IN GEOSCIENCE CONFERENCES

August 13-17, 2018: 20th International Sedimentological Congress (co-organized by INRS and the GSC)

October 17-18, 2018: XPLOR 2018

November 4-6, 2018: Exploration, Mining and Petroleum New Brunswick Conference 2018

November 19-22, 2018: Québec Mines + Énergie 2018

May 12-15, 2019: GAC-MAC-IAH 2019 (co-organized by INRS and the GSC)

JOINT PARTICIPATION IN INTERNAL ACTIVITIES

September 28, 2018: Activity marking the 30th anniversary of the GSC-INRS partnership

November 3, 2018: INRS open house day for student recruitment at the Eau Terre Environnement Research Centre

November 18-22, 2018: Québec Mines + Énergie outreach activities

April 23, 2019: GSC-INRS annual partnership meeting

RESEARCH FACILITIES

A DIVERSIFIED RANGE OF FIRST-CLASS GEOSCIENCE LABORATORIES

Laboratory	Contact(s)	Expertise
Delta-Lab	Martine Savard, GSC	Analysis of stable isotopes (H, C, N and O) applied to hydrogeological, environmental and mineral studies.
Dendrochronology and Dendrogeochemistry	Christian Bégin, GSC	Analysis of the physical and geochemical parameters of tree ring sequences.
Geochemistry, Imagery and Radiography of Sediments (GIRAS)	Pierre Francus, INRS	Non-destructive radiography analyses coupled with micro-x-ray fluorescence chemical analysis of rocks, soil and sediment.
Contaminant Hydrogeology	Richard Martel, INRS	Study of soil and groundwater contaminants and development of *in situ* treatment processes at the intermediary level between the laboratory and the field.
Hydrogeology and Environmental Characterization	Daniel Paradis, GSC	Field equipment for groundwater characterization and numerical modeling equipment.
INRS-GSC joint laboratory	Stéfane Prémont, INRS Yves Michaud, GSC	Geochemical characterization of rocks, sediments, soil horizons and tree rings.
Physical, Chemical and Mineralogical Characterization of Rocks (LAMROC)	Pierre-Simon Ross, INRS	Mobile laboratory for non-destructive, high spatial resolution measurements of the physical, mineralogical and chemical parameters of drill cores.
Digital Cartography and Photogrammetry (LCNP)	Kathleen Lauzière, GSC	Acquisition, management, analysis and dissemination of geoscientific data.
Applied Geoscience (LGA)	Marc Richer-Laflèche, INRS	Geophysical studies applied to mineral, gas and oil exploration, geotechnics and archaeology.
Environmental Hydraulics (LHE)	Damien Pham Van Bang, INRS	Large-scale flume simulations of swells, tides and strong river currents for the development of sustainable approaches to coastal management.
Geophysical Imaging and Measurements (LIAMG)	Erwan Gloaguen, INRS	Applied work mainly in the characterization of reservoirs for CO_2 sequestration, hydrogeology and oil.
Geothermal Energy (LOG)	Jasmin Raymond, INRS	Open laboratory for measuring the thermal and hydraulic properties of geological materials.
Physical, Numerical and Geophysical Simulation	Lyal Harris, INRS	Numerical analyses combining CT-assisted analog simulation methods with geophysical, remote sensing and field data interpretations.
Multidisciplinary CT-Scan	Pierre Francus and Damien Pham Van Bang, INRS	Non-destructive dynamic 4D measurements of internal density variations on static bodies (internal structure, porosity, etc.) or of dynamic phenomena, mainly in hydrology.

For more information: cgq-qgc.ca/en/facilities

Management, knowledge dissemination and publications

INRS Eau Terre Environnement Research Centre

INRS Specialized Documentation and Information Service (SDIS)

sdis.inrs.ca

Reports and theses

espace.inrs.ca

Scientific articles (professor profiles)

ete.inrs.ca/les-professeurs/mosaique/3

Geological Survey of Canada

Federal Science Laboratory

fsl-bsf.scitech.gc.ca/eng/intranet/home/

Geoscan database

geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/geoscan_e.web

Natural Resources Canada publications and reports

nrcan.gc.ca/publications/1138

Directory of scientists and professionals

science.gc.ca/eic/site/063.nsf/eng/home

Student Portal

Inter-university programs in Earth Sciences

Graduate Studies

inrs.ca/english/research-centres/ete/graduate-studies

Postgraduate Research Projects

inrs.ca/english/graduate-studies/research-projects-graduate-postgraduate-students

University internships

Summer internships at INRS

inrs.ca/english/graduate-studies/summer-undergraduate-research-internships

Research internships at INRS

inrs.ca/english/graduate-studies/research-projects-graduate-postgraduate-students

Intensive course program in the field or in continuing education

ete.inrs.ca/ete/etudier/formation-intensive

Federal Student Work Experience Program

canada.ca/en/public-service-commission/jobs/services/recruitment/students/federal-student-work-program.html

Federal Research Affiliate Program

canada.ca/en/public-service-commission/jobs/services/recruitment/students/research-affiliate-program.html

Postdoctoral internships

INRS Postdoctoral Fellowships

inrs.ca/english/graduate-studies/postdoctoral-fellowship

Federal Postdoctoral Research Program

nrcan.gc.ca/careers/17880

INRS-GSC Graduates - Class of 2018-2019

Master

Anne-Marie Beauchamp (Benoît Dubé, Michel Malo)

François Huchet (René Lefebvre, Christine Rivard)

Sarane Sterckx (Pierre-Simon Ross, Patrick Mercier-Langevin)

Anne-Sophie Corriveau (Jean Bédard, Marc Richer-Laflèche)

PhD

Arnaud Fontaine (Patrick Mercier-Langevin, Michel Malo)

Marc Laurencelle (René Lefebvre, Michel Parent)

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