



## Earth Science

2019-2020

### Coastal erosion, groundwater, mining: Geoscientific issues are ubiquitous in the news

Sustainable management of groundwater and mineral, oil, and gas resources, investigation of natural hazards related to geological processes, and assessment of climate change impacts are all crucial issues for researchers in geological sciences.

The INRS Eau Terre Environnement Research Centre and the Quebec division of the Geological Survey of Canada work together under a scientific collaboration agreement between INRS and Natural Resources Canada. This university–government partnership has created one of the most important multidisciplinary research groups in earth sciences in Canada, the Quebec Geoscience Centre.

### Examples of research and training applied to current challenges

#### Tackle the storage challenge

Isolated northern communities depend on fossil fuels for energy production. The importance of reducing greenhouse gas emissions makes a transition to renewable energy desirable, but there are many challenges to overcome. An INRS research team has been carrying out research in northern Quebec over the past few years to demonstrate the feasibility of using thermal storage in permafrost to meet part of the community's energy needs. They have put forward an innovative solution to heat buildings in winter using the abundance of solar energy produced in summer. One of the goals of the ongoing research work is to solve the problem of long-term cold-climate energy storage.



#### Explore geological history

The Grenville geological province contains the roots of a mountain range comparable to the Himalayas, but one billion years old, which extends over 2000 km on the southeastern edge of the Canadian Shield. An INRS team is initiating a research project that will explore in detail a Grenville-aged shear zone in the Saguenay-Lac-Saint-Jean region recently identified by partners of Quebec's Department of Energy and Natural Resources. The study will characterize the structure of the shear zone, deformation and metamorphism conditions, potential correlations with other similar deformation zones, and the implications for the evolution of the Grenville province.



#### Anticipate natural hazards

The town of Baie-Saint-Paul is located at an abrupt transition zone between the mountains and the sea. It is subject to several natural hazards, including an active fault line, landslides, coastal erosion, and flooding. An INRS research team and its collaborators from the Geological Survey of Canada, Brock University, and the University of Ottawa are examining sustainable solutions to the vulnerability of this coastal area. Field work will be combined with numerical modelling and physical modelling in the INRS large wave flume to help the community better anticipate risks and identify best practices.



## Main study themes and researchers involved



### GROUNDWATER

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## Examples of recent publications

(Names of ETE Centre's authors are in **bold**)

- **Anterrieu O, Giroux B, Gloaguen E** & Carde C (2019). Non-destructive data assimilation as a tool to diagnose corrosion rate in reinforced concrete structures. *Journal of Building Engineering*, 23: 193-206. <http://dx.doi.org/10.1016/j.jobe.2019.01.033>
- Boujia N, Schmidt F, Chevalier C, Siegert D & **Pham Van Bang D** (2019). Effect of scour on the natural frequency responses of bridge piers: development of a scour depth sensor. *Infrastructures*, 4 (2): Art. 21. <http://dx.doi.org/10.3390/infrastructures4020021>
- Camporese M, **Paniconi C**, Putti M & McDonnell JJ (2019). Fill and spill hillslope runoff representation with a Richards equation-based model. *Water Resources Research*, 55 (11): 8445-8462. <http://dx.doi.org/10.1029/2019WR025726>
- **Chassiot L, Francus P, De Coninck A**, Lajeunesse P, Cloutier D & Labarre T (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. <http://dx.doi.org/10.1016/j.scitotenv.2019.04.021>
- **Giordano N & Raymond J** (2019). Alternative and sustainable heat production for drinking water needs in a subarctic climate (Nunavik, Canada): Borehole thermal energy storage to reduce fossil fuel dependency in off-grid communities. *Applied Energy*, 252: Art. 113463. <http://dx.doi.org/10.1016/j.apenergy.2019.113463>
- **Longpré-Girard M, Martel R, Robert T, Lefebvre R, Lauzon J-M & Thomson N** (2020). Surfactant foam selection for enhanced light non-aqueous phase liquids (LNAPL) recovery in contaminated aquifers. *Transport in Porous Media*, 131: 65-84. <http://dx.doi.org/10.1007/s11242-019-01292-0>
- Godin L, **Soucy La Roche R, Waffle L & Harris LB** (2019). Influence of inherited Indian basement faults on the evolution of the Himalayan orogen. *Geological Society*, 481: 251-276. <http://dx.doi.org/10.1144/SP481.4>
- **Ross P-S, Bourke A, Schnitzler N & Conly A** (2019). Exploration vectors from near infrared spectrometry near the McLeod volcanogenic massive sulfide deposit, Matagami district, Québec. *Economic Geology*, 117 (4): 613-638. <http://dx.doi.org/10.5382/econgeo.4656>

## Examples of research partners

- Électricité de France
- Ero Copper
- Institut nordique du Québec (INQ)
- Government of Canada (National Defence, Natural Resources)
- Government of Quebec (Energy and Natural Resources, Environment and Climate Change)
- Québec City
- Réseau Québec maritime (RQM)
- Vale Inco