Shallow and deep geothermal resources assessment in northern communities of Québec: preliminary results from Kuujjuaq

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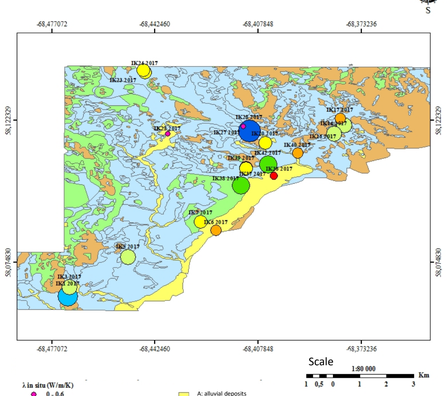
Objectives

Renewable and affordable energy production is a key aspect for the development of Canadian northern communities. In these remote areas, heat and electricity are mostly obtained by burning fossil fuels incurring high economical and environmental costs. Implementing geothermal technologies would diversify their energy sources while decreasing CO_2 emission.
The project's objectives are to determine the potential and viability of exploiting geothermal resources in the North of Québec, namely in the community of Kuujjuaq, by means of three main geothermal energy systems:

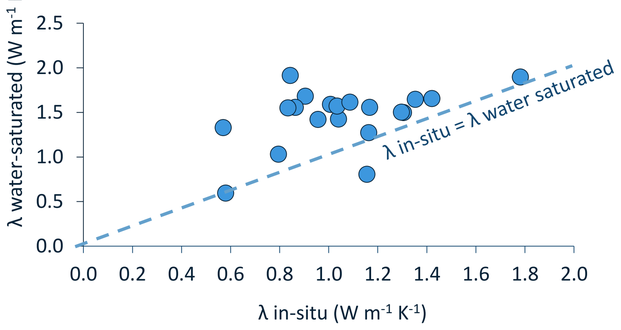
1) **Underground Thermal Energy Storage,**
2) **Shallow Ground-Source Heat Pumps,**
3) **Deep Geothermal Systems – Enhanced Geothermal Systems (EGS) and deep borehole heat exchangers.**

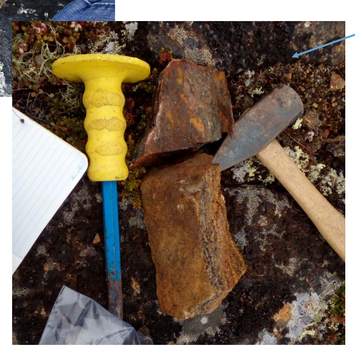
Rock and soil samples

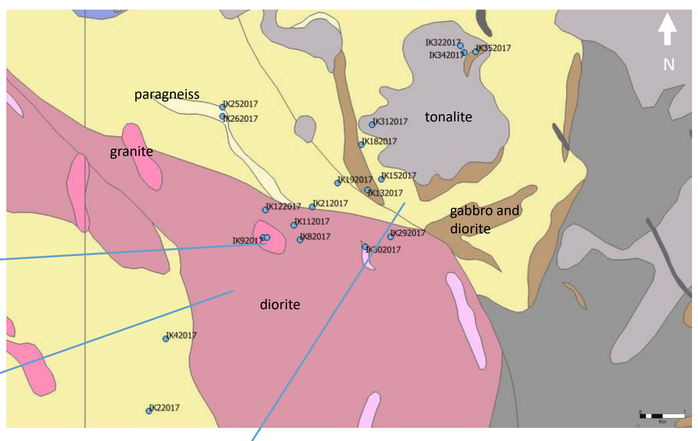
In-situ thermal conductivity map of soil samples



Comparison of thermal conductivities (λ) measured under in-situ and water-saturated conditions







Aims

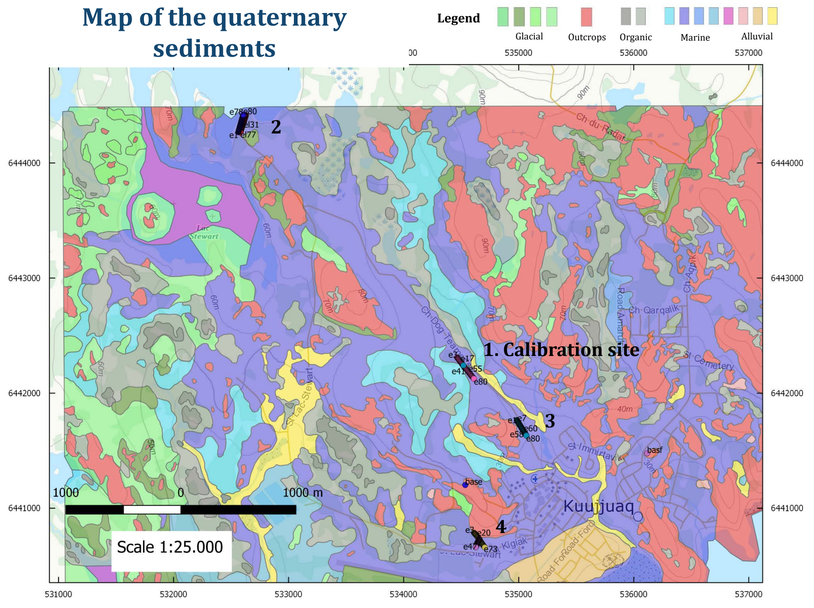
- Identification of bedrock depth
- Definition of permafrost state

Methodology

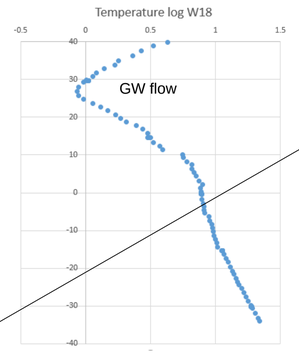
ERT surveys were carried out in 4 different sites selected by Kativik Regional Governement (KRG) as the most compelling to aim at reducing fossil fuel dependency: these are drinking water facilities (2, 3) and greenhouses (4) for local fruit and vegetable growing. Wenner-Schlumberger and Dipole-Dipole configurations were adopted with 2-3 m spacing depending on the local setting.

ERT (Electrical Resistivity Tomography)

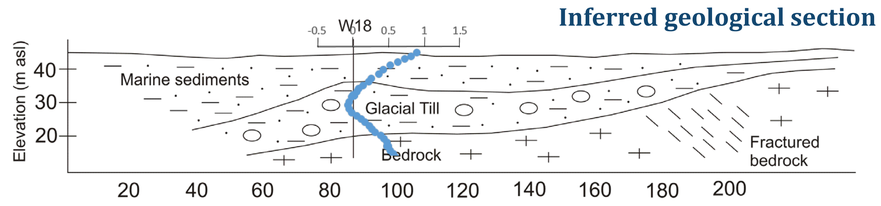
Map of the quaternary sediments



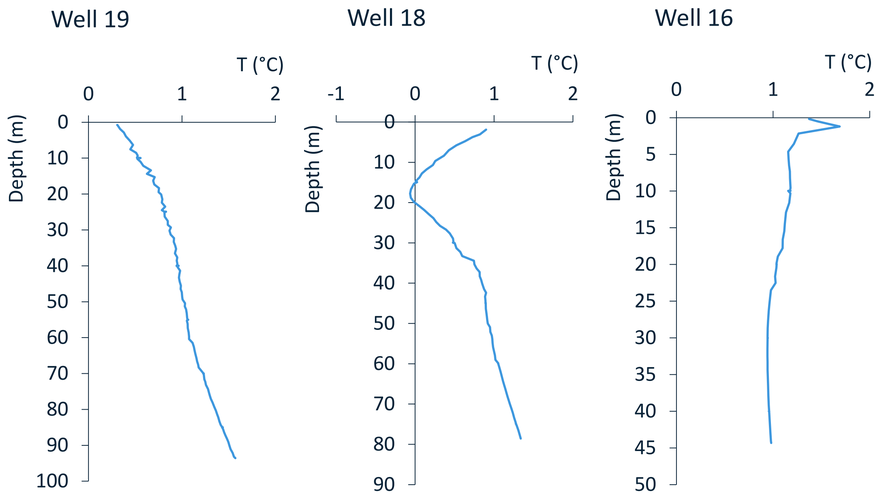
Calibration site

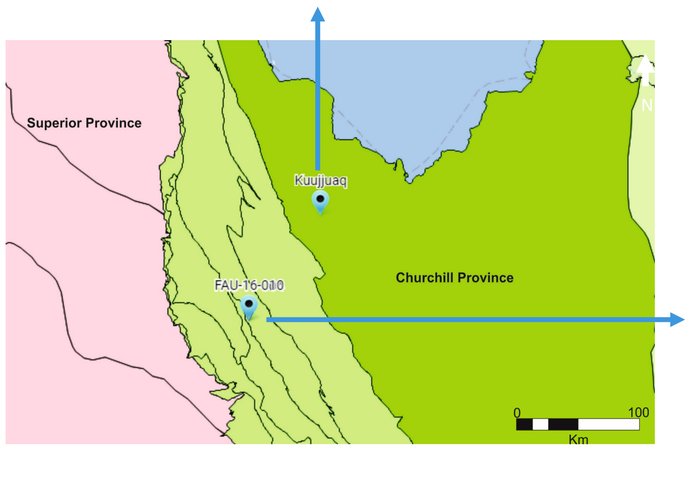


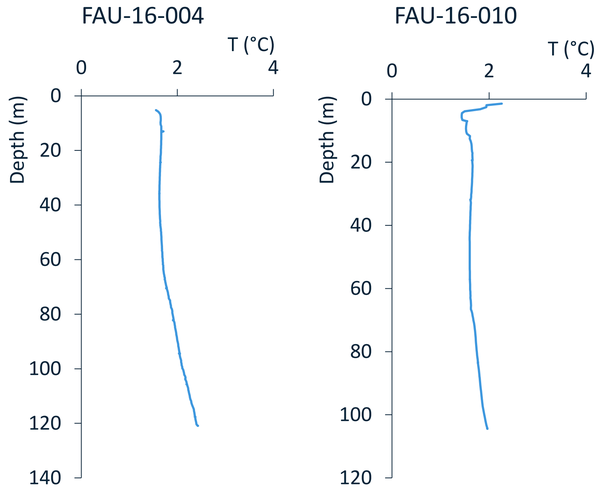
Inferred geological section



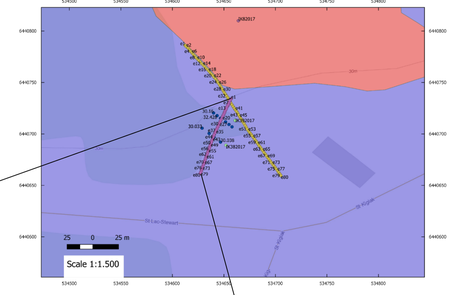
Temperature logs

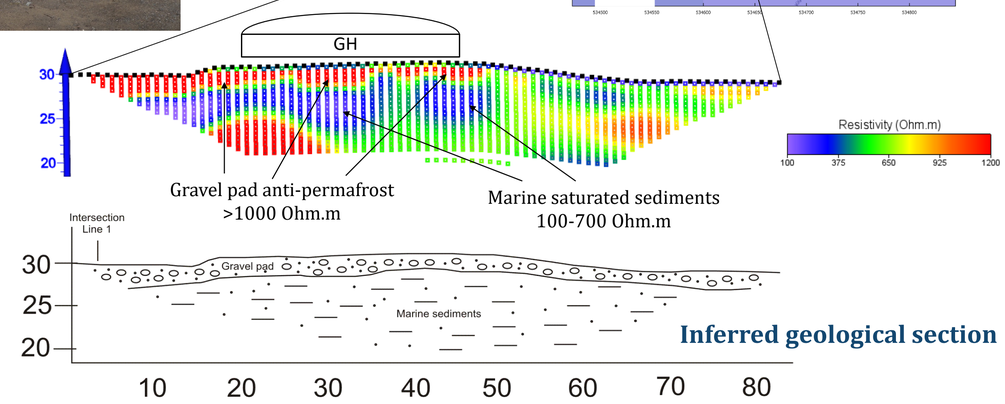






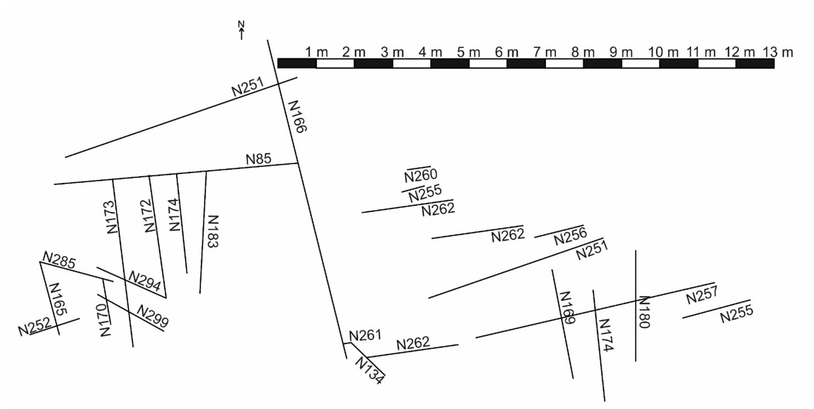
Greenhouses





Inferred geological section

Fracture analysis in scanlines



Further work

- **Thermal and hydraulic properties analysis of rock samples – surface and drilled core;**
- **Heat flow and temperature gradient estimations;**
- **Fracture network characterization;**
- **Borehole heat exchangers efficiency in permafrost;**
- **Economic viability of geothermal energy systems**