Geophysical Research Abstracts
Vol. 19, EGU2017-10017, 2017
EGU General Assembly 2017

Numerical analysis of temperature distribution due to basement radiogenic heat production, St. Lawrence Lowlands, eastern Canada

Hejuan Liu (1), Bernard Giroux (1), Lyal B. Harris (1), and John Mansour (2)

(1) Institut national de la recherche scientifique, Québec, Canada (bernard.giroux@ete.inrs.ca), (2) School of Mathematical Sciences, Clayton, Monash University, Australia

Although eastern Canada is considered as having a low potential for high-temperature geothermal resources, the possibility for additional localized radioactive heat sources in Mesoproterozoic Grenvillian basement to parts of the Palaeozoic St. Lawrence Lowlands in Quebec, Canada, suggests that this potential should be reassessed. However, such a task remains hard to achieve due to scarcity of heat flow data and ambiguity about the nature of the basement. To get an appraisal, the impact of radiogenic heat production for different Grenville Province crystalline basement units on temperature distribution at depth was simulated using the Underworld Geothermal numerical modelling code. The region south of Trois-Rivières was selected as representative for the St. Lawrence Lowlands. An existing 3D geological model based on well log data, seismic profiles and surface geology was used to build a catalogue of plausible thermal models. Statistical analyses of radiogenic element (U, Th, K) concentrations from neighbouring outcropping Grenville domains indicate that the radiogenic heat production of rocks in the modelled region is in the range of 0.34-3.24 μW/m^3, with variations in the range of 0.94-5.83 μW/m^3 for the Portneuf-Mauricie (PM) Domain, 0.02-4.13 μW/m^3 for the Shawinigan Domain (Morin Terrane), and 0.34-1.96 μW/m^3 for the Parc des Laurentides (PDL) Domain. Various scenarios considering basement characteristics similar to the PM domain, Morin Terrane and PDL Domain were modelled. The results show that the temperature difference between the scenarios can be as much as 12 °C at a depth of 5 km. The results also show that the temperature distribution is strongly affected by both the concentration of radiogenic elements and the thermal conductivity of the basement rocks. The thermal conductivity in the basement affects the trend of temperature change between two different geological units, and the spatial extent of thermal anomalies. The validity of the results was assessed by comparing the modelled temperature and heat flow data with the available experimental data. The overall agreement is good, although some discrepancies appear at some wells. Hence, detailed investigations are needed to obtain a more reliable estimate of temperature distribution at a local scale.