geoconvention
Calgary • Canada • May 13-17 2019

Analysis of Alberta Precambrian Basement core and modelling the fracture characteristics necessary for operating an Enhanced Geothermal System in the Alberta Precambrian Basement

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Summary

The Alberta Precambrian basement has a commercially significant amount of stored thermal energy and the potential to be a viable geothermal energy source. Due to the extremely low porosity and permeability of the basement, conventional heat extraction techniques may not be ideal. A proposed method for extracting this thermal energy is to fracture the rock and use the artificial or enhanced fracture network as a fluid pathway system. This process also creates a large heat transfer surface area. Such a system is known as an engineered or enhanced geothermal system (EGS). Current engineered geothermal systems utilize water as the primary geothermal fluid, however, carbon dioxide has recently been proposed as an alternative. At EGS conditions, CO2 becomes supercritical and has a demonstrated ability to extract more heat from the rock and reduce the amount of energy needed to pump the fluid back to the surface. Water is known to be a reactive solvent leading to extensive dissolution and precipitation of minerals in both the reservoir and piping. CO2 may be able to alleviate those issues. Due to the relatively impermeable nature of crystalline rock, the fracture network is important when dictating fluid flow in an EGS. Analysis and characterization of core from the Alberta Precambrian Basement is used to create a simple EGS model in order to explore the fracture characteristics necessary to flow enough fluid through the crystalline rock and create 1 MW(e) of power. Both water and CO2 are explored as potential candidates as the primary geothermal fluid. Ultimately, this basic model of an EGS demonstrates the importance of fracture connectivity over fracture density. The models also suggest that more sophisticated programming may be necessary to fully understand the dynamics of this type of system in the Alberta Precambrian Basement.