Supercritical Geothermal Resources: Exploration and Development

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1. Introduction

The demand for clean, renewable energy is continuing to increase around the world. Much of that demand is being met with wind and solar power, but these resources are intermittent and therefore require balancing. Presently, developed geothermal resources are not adequate to provide the balancing that will be needed in the future thus attention is turning to supercritical geothermal resources.



Figure 1 Iceland Deep Drilling Project[1]

Utilizing supercritical fluids, geothermal could play an important role for carbon-zero energy future. These supercritical fluids provide much higher temperatures above 374 °C and pressure points above 22 MPa, providing much higher heat-content and lower density and so have the potential to generate around 10 times more energy than conventional geothermal for the same amount of extracted fluid [2].

Volcanic geothermal systems are associated with magmatic intrusions in the upper part of the Earth's crust characterized by increased temperature, specific fluid enthalpy, and convection of groundwater. Conventional exploitation of geothermal fluids from such systems typically produces an average of about 3-5 MW electric power per well with a world total exploitation of geothermal energy in 2018 corresponding to about 14.4GW [3]. Conductive heat transfer from a magmatic intrusion to the surrounding groundwater occurs in the roots of the geothermal system below the depth of typical conventional geothermal wells. Recent modelling suggests that supercritical fluids with temperatures and enthalpies exceeding 400°C and 3000 kJ kg^{-1}, respectively, exist at the boundary between geothermal systems and the magmatic heat source, with such fluids possibly capable of generating up to 30-50 MW of electricity from a single well or ten times more than conventional geothermal wells.

[1] https://interestingengineering.com/iddp-drills-into-new-era-steam-energy-potential

[2] http://www.thinkgeoenergy.com/utilising-supercritical-fluids-geothermal-could-play-a-crucial-role-for-nzs-carbon-zero-energy-future/

[3] A. Richter, *Global geothermal capacity reaches 14,369 MW – top 10 geothermal countries, Oct 2018*, Think GeoEnergy Geothermal Energy News, 2018.

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