Assessment for geothermal utilization of the Upper Devonian Leduc and Nisku Formation in the Alberta Basin, Canada

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The Canadian province of Alberta has the highest per capita CO2-equivalent emissions in Canada, predominantly due to the industrial burning of coal for the generation of electricity and mining operations in the oil sand deposits. The use of Alberta’s geothermal potential could reduce CO2 emissions by substituting at least some reasonable amounts of fossil fuels.

Geothermal research in Alberta started back in the ’60s mainly focusing on the determination of heat flow, geothermal gradients and reservoir temperature in the basin. Based on recent feasibility studies, the Upper Devonian carbonate aquifer systems within the Alberta Basin were identified as promising target formations for geothermal energy. To assess their geothermal reservoir potential, detailed knowledge of the thermo- and petrophysical rock properties is needed. The presented analogue study compared drill core rock properties from the Southesk-Cairn Carbonate Complex and the Rimbey-Meadowbrook Reef Trend with selected outcrop samples from stratigraphically correlative outcrops in the Rocky Mountains. Samples from the Leduc and Nisku Formations were analyzed for thermal conductivity, thermal diffusivity and heat capacity, as well as density, porosity and permeability. These data suggest that the extensively dolomitized and highly fractured reef zones with permeabilities of up to 10−12 m2 and thermal conductivities of > 4 W m−1 K−1 are the most promising reservoirs for geothermal utilization.

Besides, our dataset is complemented by open-file core and reservoir data retrieved from the AccuMap database for mapping of reservoir temperature, TDS, sour gases (H2S, CO2, N2) and petrophysical core data (density, porosity and permeability). A preliminary 3D geological model of the Nisku and Leduc aquifers in the western part of the Rimbey-Meadowbrook reef trend was created with GOCAD/SKUA to determine the potential for geothermal utilization on a local scale (e. g. on the scale of a few townships). Preliminary findings confirm those from previous studies that the Upper Devonian carbonate aquifers are worth investigating as geothermal reservoirs.

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