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Geothermal Energy Potential of Western Canadian Sedimentary Basin in the Athabasca Region, Northeast Alberta, Canada

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Summary

The Athabasca region located in northeast of Alberta, Canada, hosts many ongoing projects of bitumen extraction from oil sand and Devonian carbonate and siliciclastic reservoirs which requires a vast amount of thermal energy. Geothermal energy as a green renewable source of heat can help to reduce the amount of fossil fuels used to provide the required thermal energy for these projects and consequently decrease the greenhouse gas emission. In order to assess the geothermal development potential in this region, an integrated regional-scale 3D model is constructed with geologic and geophysical data (~7000 formation tops and ~800 km seismic 2D profiles). Incorporation of 2D seismic profiles that fill in the gaps between sparse geological tops particularly for deeper formations adds to structural details of the modeled formations. The temperature and porosity fields are simulated using the Sequential Gaussian Simulation approach within the modeled sedimentary formations. Based on spatial distribution, thickness, formation porosity and permeability analysis five Paleozoic formations of Keg River, Waterways, Cooking Lake, Leduc, and Grosmont, are identified as potential aquifers for geothermal development. These aquifers have enough coverage and thickness in the area and show high amount of thermal energy content. Since the sedimentary basin in the Athabasca region is quite shallow (less than 1400 m), these aquifers are all recognized as low enthalpy geothermal reservoirs with maximum of 40 °C temperature and hence direct heating applications are not feasible. Utilization of industrial scale heat-pump technologies that have long been employed in Northern Europe with high coefficients of performance would be recommended for heat extraction from these reservoirs.