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Geothermal Resource Characterization of the Slave Point Formation at Clarke Lake Field, Fort Nelson, B.C., Canada

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Middle Devonian hydrothermal dolomites of the Slave Point Formation have been host to significant gas reserves (3.57 TCF OGIP in the largest pool) since the discovery of Clarke Lake Field in 1957. The geothermal potential of the field was demonstrated by a 2005 to 2009 experiment in which Petro-Canada Oil and Gas attempted liberating trapped gas by pumping formation water out at rates of 2800m^3/day to reduce water cut; instead pressure only dropped marginally (100 kPa after one year) due to a strong water drive. High temperature water, a strong water drive and porous carbonate rock allow for a viable geothermal resource, giving the field the capability of producing 12 to 74 MW of geothermal energy for the Fort Nelson area.

Depositional and diagenetic facies are defined and related to porosity and permeability data in order to develop a static reservoir model for the formation that will be the basis for flow simulations. In the late Givetian, a relative sea level rise drowned the Keg River carbonate platform, which allowed small, laterally discontinuous patch reefs of the Slave Point Formation to develop on the flanks of the Horn River Basin. Five depositional facies are associated with a reefal to back reef setting where dolomitizing fluids preferentially altered high energy facies near the reef margin. Pervasive dolomitization occurred by long-distance migration of halite-saturated brines, whereas recrystallized matrix dolomite, replacive and cement saddle dolomites are products of hydrothermal alteration. More porous and permeable zones are related to development of gray matrix dolomite, enlarged vugs, and mouldic pores; unaltered limestone facies are considered non-reservoir. Brine movement may have been aided by adjacent faults at the reef margin. Mapping and modeling the spatial variability of dolomitization is a key objective concerning optimization of geothermal well targets.

Development of this geologically based geothermal reservoir model is feasible because of the availability of a large-scale oil and gas well data set. The data include direct permeability/porosity core measurements, well-logs, DSTs and eighteen core descriptions taken at the BC Oil & Gas Commission core research facility. As a part of the University of Alberta's Future Energy Systems research initiative, this research was made possible in part thanks to funding from the Canada First Research Excellence Fund.