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Geothermal investigation of Paleozoic formations in the Central Alberta Basin/Canada

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This study explores Paleozoic formations in the Central Alberta Basin with regard to their usability as geothermal reservoirs. The research area of this regional scale study is approx. 150 km * 200 km in size and located around the city of Edmonton.
A 3D geological model is developed based on stratigraphic picks of more than 7000 wells from the Alberta general well data file. The model consists of 20 different geological units, of which 14 belong to the Paleozoic succession. Spatial distribution and thickness of formations is analysed with help of the 3D modelling study. Due to its depth and its distribution throughout the whole study area, the Cambrian Basal Sandstone formation is the most promising horizon for a geothermal development.
Porosity and horizontal permeability of four Devonian carbonate formations – Cooking Lake, Leduc, Nisku and Wabamun – is mapped by reinvestigation of more than 50,000 core analyses from the Alberta general well data file. Average porosity of the Devonian ranges from 5.2 % (Nisku) to 10.4 % (Wabamun), average horizontal permeability is between 5 mD (Cooking Lake) and 142 mD (Leduc). In parts of the Devonian formations a vuggy porosity exists, as analysis of cores has shown. This locally high porosity and permeability zones are not fully covered by the core measurements. Since logging and core analysis data of the Cambrian Basal Sandstone are rare, properties of this formation are measured on core samples with probe permeametry, gas permeametry and helium pycnometry. First results show an average porosity of 11.1 % and an average horizontal permeability of 1.4 mD. Further investigation of the Cambrian Basal Sandstone in Central Alberta is planned, including analysis of thin sections and geomechanical testing.
Surface temperatures of Cambrian and Devonian strata are calculated, based on a newly calculated geothermal gradient and the reservoir depth range derived from the 3D model. Temperature in the Cambrian Basal Sandstone – formation ranges from 62°C in the shallower northeast to 121°C in the deeper southwest, surface temperatures in the Devonian strata are between 19° - 87°C. Especially for district heating this temperature range seems sufficient to exploit, but also industrial applications for oil sands extraction can be an option for geothermal use in Alberta.