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Solid Earth Discussions

Interactive comment on "From oil field to geothermal reservoir: First assessment for geothermal utilization of two regionally extensive Devonian carbonate aquifers in Alberta, Canada" *by* Leandra M. Weydt et al.

Anonymous Referee #2

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It is good paper which comes up with new data on the Upper Devonian aquifers potentially useful for the geothermal energy applications in the Western Canadian Sedimentary basin (WCSB) in its deep part area. Data from the outcrops are compared to deep drilling data . Important observations are made:

1. "As such, the outcrop analogues are no valid proxies for the buried reservoirs in the Alberta Basin. "

2. "the outcrop analogue samples have lower porosity and permeability, likely caused

by low-grade metamorphism and deformation during the Laramide Orogeny that formed the Rocky Mountains. As such, the outcrop analogues are no valid proxies for the buried reservoirs in the Alberta Basin. "

3. "Considering geothermal utilization, dolomitization enhanced all analyzed rock properties. "

I list below some comments to be considered by the Authors:

a) This paper gives new data on thermal conductivity & thermal diffusivity of carbonate rock samples. Thermal scanner was used (Popov et al., 1999). Some information on the samples prep. and orientation should be given (saturated or dry; whether or not the thermal conductivities are known to be the vertical (perpendicular thermal conductivity)? Authors also give results on density, porosity, permeability , etc.. As to compare above thermal conductivity , porosity new measurements with previously published results, I would recommend reference to Beach et al., Geothermics, Vol. 16, No. I, pp. 1-16, 1987 with averages based on hundreds of thermal conductivity and porosity for carbonates and other rock types from mainly Hinton- Edson area. Beach et al write : "The average thermal conductivity values for limestone, dolomite, shale, siltstone and sandstone were determined from analysis of measurements on drill-hole cores using divided-bar apparatus at UofA in the late 80th. . Table 1 in Beach et al (1987) gives the mean of the measured conductivities and uncertainties which are standard deviations from the means for the five rock types., ... Most of the samples were from the Hinton-Edson region of Alberta, " Some of the averages for the carbonate cores are: l Limestone 679 samples , thermal conductivity 2.42 +/- 0.88 ; porosity 3.2% ; Dolomite 254 samples, thermal conductivity 3.1 +/- 1.4, porosity 2.2 ; Anhydrite 7samples, thermal conductivity 5.8 +/- 1.1 – etc.,etc.

b) There are many statements related to an assessment of the geothermal energy potential of the carbonate aquifers and reefs in the study area. While porosity, permeanbility , temperature conditions, thermal conductivity ,diffusivity, are important to

such evaluation it is not possible to recommend geothermal energy potential without take on other parameters like the hydraulic head, piezometric surfaces, mineralization of aquifer fluids and most important estimate of potential flow rates at well head. In that sense cited by the authors paper by Jones and Lam Can. J. Earth Sci. 1985 went farther and gives such information (see their figs.10-12 and their Appendix figures). I recommend that their results be described, evaluated and briefly discussed in the scope of geothermal energy eval..

c) It is not entirely justified to make statements in the paper like this one : " great opportunities for further work toward potential geothermal utilization of its Devonian subsurface aquifers, especially because of the vast number of drillholes and attendant data bases, both public (AccuMap, Gescout, and others) as well as in the petroleum industry. Once promising aquifers or parts thereof have been identified, new economic strategies and industries could spring up in Alberta, for example by repurposing idle oil and gas wells for geothermal utilization. " There is no estimate of flow rates, energy to be produced and no economic evaluation of such projects given by the refereed paper!. I recommend to remove above over-optimistic statements and stick in to new findings on the aquifers and role of dolomitizantion in enhancing aquifer properties or the Authors should address other properties leading to estimate of potential flow rates which with temperature drop evaluation can give an estimates of energy available. At their paper The Autors do not address the issue of potential brine production as they do not address parameters needed to estimate it in their paper.

Re. References:

1.Majorowicz and Weides (2014) should be changed to Weides and Majorowicz (2014).

2. Reference to Beach et al is:

BEACH,R.D.W., JONES, F.W., MAJOROWICZ,J.A. (1987) HEAT FLOW AND HEAT GENERATION ESTIMATES FOR THE CHURCHILL BASEMENT OF THE WESTERN CANADIAN BASIN IN ALBERTA, CANADA, Geothermics, Vol. 16, No. I, pp. 1-16,

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