Geophysical Research Abstracts
Vol. 12, EGU2010-4405, 2010
EGU General Assembly 2010

Geothermal characteristic of the sandstone dating from Buntsandstein of Alsace, France

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This study is based on petrophysical analyses of sandstones from the Upper Rhine Graben, between France and Germany. These sandstones dating from Buntsandstein (lower Trias) appears to be an easy target for geothermal exploitation, linking sandstone and clay with the regional thermal anomaly. This sedimentary series is composed of different lithostratigraphic levels with coarse and fine grains or conglomerate with high content of clay at the base and the top of the series.
In order to characterize heat exchanges along the Buntsandstein sandstones, thermal conductivity profiles have been measured on cores samples from four boreholes. By optical scanning, it is possible to measure complete profiles with a resolution of one millimeter. With this method, it is possible to follow the variations of thermal conductivity along the sandstone series and to show variations inside one lithostratigraphic level. The results show variations of thermal conductivity between 1 to 9.5W/m/K. From the thermal conductivity and temperature data of one borehole, a heat flow profile has been built, and shows a global diminution along the sandstone with depth.
With optical scanning, it is possible to built local maps of thermal conductivity on cores samples. Three maps show the influence of local fractures and barite precipitation on thermal conductivity. From the measured thermal conductivity map of dry and wet samples, porosity maps have been built and show influence of the different structures on porosity variation.
Associated to thermal conductivity data, several porosities by mercury injection have been measured in order to study the porosity evolution with depth. The porosity ranges from 1 to 25%, with important variation inside lithostratigraphic levels. The free porosity is maximum 1% and good relations exist between trapped and total porosity.
Mineral analyses on several samples show the good relation between theoretical thermal conductivity of each mineral and porosity with the measured thermal conductivity, considering the porosity as a mineral with air thermal conductivity.
These results, associated with existing results, will enable the localization for geothermal exploitation in the sandstone dating Buntsandstein series in the Upper Rhine Graben.