Geophysical Research Abstracts
Vol. 18, EGU2016-15899, 2016
EGU General Assembly 2016

Predicting cement distribution in geothermal sandstone reservoirs based on estimates of precipitation temperatures

Mette Olivarius (1,2), Rikke Weibel (1), Martin Whitehouse (3), Lars Kristensen (1), Morten L. Hjuler (1), Anders Mathiesen (1), Adrian J. Boyce (4), and Lars H. Nielsen (1)

(1) Geological Survey of Denmark and Greenland (GEUS), Øster Voldgade 10, 1350 Copenhagen, Denmark, (2) Department of Geoscience, Aarhus University, Høegh-Guldbergs Gade 2, 8000 Aarhus, Denmark, (3) Swedish Museum of Natural History, 104 05 Stockholm, Sweden, (4) Scottish Universities Environmental Research Centre (SUERC), East Kilbride, Glasgow G75 0QF, UK

Exploitation of geothermal sandstone reservoirs is challenged by pore-cementing minerals since they reduce the fluid flow through the sandstones. Geothermal exploration aims at finding sandstone bodies located at depths that are adequate for sufficiently warm water to be extracted, but without being too cemented for warm water production. The amount of cement is highly variable in the Danish geothermal reservoirs which mainly comprise the Bunter Sandstone, Skagerrak and Gassum formations. The present study involves bulk and in situ stable isotope analyses of calcite, dolomite, ankerite, siderite and quartz in order to estimate at what depth they were formed and enable prediction of where they can be found. The δ18O values measured in the carbonate minerals and quartz overgrowths are related to depth since they are a result of the temperatures of the pore fluid. Thus the values indicate the precipitation temperatures and they fit the relative diagenetic timing identified by petrographical observations. The sandstones deposited during arid climatic conditions contain calcite and dolomite cement that formed during early diagenesis. These carbonate minerals precipitated as a response to different processes, and precipitation of macro-quartz took over at deeper burial. Siderite was the first carbonate mineral that formed in the sandstones that were deposited in a humid climate. Calcite began precipitating at increased burial depth and ankerite formed during deep burial and replaced some of the other phases. Ankerite and quartz formed in the same temperature interval so constrains on the isotopic composition of the pore fluid can be achieved. Differences in δ13C values exist between the sandstones that were deposited in arid versus humid environments, which suggest that different kinds of processes were active. The estimated precipitation temperatures of the different cement types are used to predict which of them are present in geothermal sandstone reservoirs in undrilled areas. Thus, the maximum burial depths that the sandstones have been subjected to prior to later structural inversion must be taken into account. The typical crystal size and estimated amount of the expected cement types in a given area will then be used as a significant input to the assessment of whether a prospect looks promising and if so then justifies further analyses. Thus, improved prediction of cementations in reservoir sandstones will facilitate the exploration for geothermal energy and the planning of new geothermal exploitation wells.