Geophysical Research Abstracts
Vol. 16, EGU2014-14488, 2014
EGU General Assembly 2014

Fluid flow related barite and high-Fe ankerite cementation of sandstones, Central North Sea

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A late diagenetic fracture fill comprising quartz overgrowths, high-Fe ankerite and barite fracture fill is related to late hydrothermal fluid flow in Upper Jurassic sandstones from the Central North Sea. Diagenetic ankerites related to very deep burial and high temperatures (190^{o}C) have previously been described from the Central North Sea (Hendry & Wilkinson, 2000), but the combination of relatively high Fe-content of the ankerites and lower reservoir temperature (approx. 150^{o}C) of the sandstones presented in this study could be explained by a hydrothermal origin of the ankerites.

The study includes three wells located on the southern Heno Plateau on Jurassic tilted fault blocks. One of the wells (well A) cut through a major basement attached fault zone, which was active during most of the Jurassic. Petrographical analyses of thin sections from cored well sections were carried out by transmitted light microscope, scanning electron microscopy and electron microprobe. In addition, Qemscan and X-ray diffraction analyses for the quantification of mineralogical phases were performed. The petrographical observations were related to carbonate isotope data (δ^{18}O and δ^{13}C) obtained by ion microprobe analysis.

All three wells contain sandstones with diagenetic Fe-dolomite and ankerite of increasing Fe-content which is commonly overgrowing detrital dolomites. A proposed late phase of high-Fe ankerite (Fe content up to $(Mg_{0.2}Fe_{0.8})Ca_{1.0}(CO_3)_2$) is present in at least two of the three wells. The well (well A) situated on the fault zone show late fracturing of the sandstone. The fractures are filled by barite and enclose late quartz and high-Fe ankerite overgrowths and ankerite cementation of the sandstone is pervasive in the vicinity of these fractures. Isotope analyses of carbonates show the lowest δ^{18}O and δ^{13}C values (PDB) for the high-Fe ankerites, which may indicate that these were precipitated from a warmer or more evolved fluid than the earlier cements. The sulphatic composition of the fluid flow, inferred from the precipitation of barite, suggests that the fluids may have been derived from underlying Permian evaporites.