Dynamics of Calcite Cementation in Response to Oil Charge and Reservoir Evolution: Thamama, Group, UAE

Amena Alharthi[1], Rachel Wood[1]

[1]University of Edinburgh, EDINBURGH, United Kingdom.

ABSTRACT

The Lower Cretaceous Thamama Group hosts important oil reservoirs in offshore and onshore Abu Dhabi, UAE. It has been widely reported that porosity varies dramatically across the anticlinal field structures, where the crest rocks hold higher porosity compared to those in the flank. The controls on final porosity and permeability in the Lower Cretaceous Thamama Group oilfields, however, are still poorly understood. In particular, it is uncertain if several episodes of oil charge and leakage have preserved porosity in some areas whilst permitting cementation to destroy reservoir quality in others. This project will undertake a study of the Group in an onshore field in U.A.E to discriminate between these hypotheses by quantifying the dynamics of the calcite cementation and constraining the conditions under which cements in the oil and water zones were precipitated. In another words, how much has cement been precipitated where and when? This will enable the dynamics of cementation and evolution of flow properties through time to be quantified, in turn creating better reservoir models. This project will 1) quantify volumes of calcite cementation in response to oil charge using petrography, 2) unravel the chemical composition and origin of pore fluids corresponding to precipitation of different cements using redox elements sensitivity Fe, Mn and Sr, and in-situ sampling of d18O, 3) investigate palaeotemperature of the fluids of the precipitated cements using mMg/mCa molar ratio and d18O, 4) construct 3D volumetric models to ‘diagenetically back-strip’ following the technique of Van der Land et al. (2103) in order to model the evolution of porosity and permeability through burial. According to the petrographic work, cement volume in the water zone is higher than in the oil zone which explains the higher porosity and permeability in the oil zone. Calcite cements in the shallower reservoir units reflect precipitation fluids of low mMg/mCa, Sr, Mn and Fe. While calcite cements in the deeper reservoir units, show composition of higher mMg/mCa, Sr, Mn and Fe fluids. Comparing mMg/mCa ratio and d18O in oil versus water zones, it can be found that most cements in oil zone continued to precipitate at higher temperature than in water zone. This may suggest that most cements in oil zone continued to precipitate with oil migration whereas cementation may have ceased in water zone prior to oil migration.