Visualising fluid-rock interfaces using FIB-SEM

K. N. DALBY*, H. O. SØRENSEN, R. P. HARTI AND S. L. S STIPP

Nano-Science Center, Department of Chemistry, University of Copenhagen (*correspondence: kdalby@nano.ku.dk)

Development of marginal oil reservoirs and enhanced oil recovery from existing reservoirs requires fundamental information about fluid-rock interactions at a variety of scales. Our aim is to develop a set of relationships between rock micro and nanostructure that will allow rapid prediction of reservoir behaviour. Correlative tomography is an emerging technique [1], where 3D data sets are collected from the same region at different length scales. X-ray micro or nanotomography is often used to image fluids in pores, where there are no vacuum limitations. Focused ion beam scanning electron microscope (FIB-SEM) is used for non-wet samples, to obtain information at the nanometer scale. Using the FIB-SEM to image fluids will add value to a correlative work flow for fluid-rock interfaces.

We used FIB-SEM to create 3D image stacks of chalk, a fine grained rock with a complex microstructure; porosity is often very high (as much as 50%) but permeability is low (mD range). We exposed the sample to oil, then flushed with a low salinity solution and fixed the remaining oil in place. The nanometer resolution of the rock microstructure that is achievable with the FIB-SEM tomograms provides data that are high enough resolution for simulating fluid flow. Combined with chemical information from energy dispersive X-ray spectroscopy (EDXS), information about how to treat the fluid-solid interaction can be obtained.

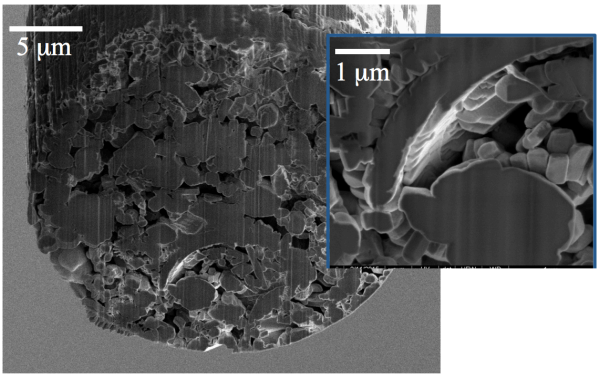

Figure 1: SEM images of chalk, that has been aged in oil, flushed with solution and the remaining oil has been fixed in place.

[1] Burnett *et al*. (2014) *Scientific Reports* **4**, 4711