The effect of residual organic material on the low salinity effect in limestone

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Enhanced oil recovery (EOR) by low salinity flooding is effective for sandstone reservoirs but in carbonate rocks, the evidence for its effectiveness varies. We studied the influence of residual organic material on the adhesion forces between a model oil droplet and reservoir limestone pore surfaces using atomic force microscopy (AFM) in chemical force mapping (CFM) mode (Figure 1). On samples, one taken from an original core plug and one that had been extensively treated with solvent, there was no convincing correlation between adhesion, i.e. wetting properties, and the salinity of the solution. However, a detailed analysis of the force maps from the original sample showed that adhesion forces in some quite local areas did respond to salinity changes. In some areas, adhesion increased in low salinity solutions whereas in others, it decreased. X-ray photoelectron spectroscopy (XPS) and energy dispersive X-ray spectroscopy (EDXS), provided supporting evidence. We conclude that the varied response to low salinity solutions that is reported in the literature for carbonate rocks results from local differences in the composition of the organic material on pore surfaces.

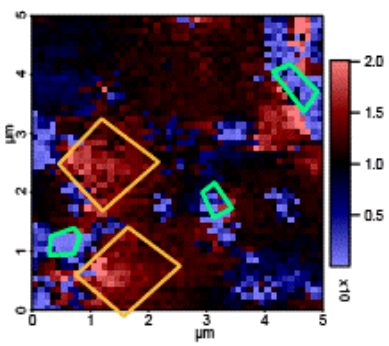

Figure 1: An AFM image from a sample of limestone showing adhesion between a pore surface and a tip functionalised with -CH_3 to represent a tiny oil droplet. Some areas are quite water wet (blue) whereas others are oil wet, with high adhesion (pink).