Pressure dependent permeability of chalk

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Is this a CASE studentship? YES

If so, please state intended CASE partner: Maersk

Introduction:

A significant amount of the hydrocarbon reservoirs in the North Sea are chalk (Megson, 1992). This chalk is often naturally fractured or has induced hydraulic fractures to increase production. Ultimately the rate of production is limited by the rate at which hydrocarbon can flow to the fractures from the pore spaces in the chalk. This will be governed by the permeability of the chalk which is ca. $1x10^{-18}$ m^2 or 1 µD. The permeability of chalk will be a nonlinear function of effective pressure where permeability $k=f(P_c-\alpha P_p)$ and α is not unity. So during production permeability will drop significantly as the pore pressure drops.

Project Summary:

This project will aim to define the effective pressure law for chalk samples taken from producing wells using techniques developed in Manchester to investigate the pressure dependent permeability of shale (McKernan et al., 2017; McKernan et al., 2014). Allied with the permeability measurements seismic velocity measurements will be made which will be used to invert for pore sizes and shapes. In association with the experimental measurements detailed microstructural analysis of the pore geometries will be conducted using state of the art imaging facilities in Manchester including X-ray tomography and FIB-SEM (Ma et al., 2016). By combining permeability measurements, seismic velocities and microstructural analysis with novel pore network models we aim to understand the microstructural controls on permeability and how changes in confining and pore pressure can change permeability in chalk.

Training provided will enable the student to continue in academia or work in the petrophysical support industries and with companies exploiting conventional and unconventional hydrocarbons within and outside the UK. The student will join the Rock Deformation Laboratory a world leading facility with over 40 years of experience in rock mechanics and petrophysics. The student will also use imaging facilities at the cutting edge of technology that are available in Manchester.

Chalk cliffs of the Needles, Isle of Wight, UK

References

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McKernan, R.E., Mecklenburgh, J., Rutter, E.H., Taylor, K.G., 2017. Microstructural controls on the pressure-dependent permeability of Whitby Mudstone. Geological Society, London, Special Publications in press.

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