



## NERC Centre for Doctoral Training in Oil & Gas (2017 start)

**Project Title: Linking permeability and seismic properties of shales.**

**Host institution: The University of Manchester**

**Supervisor 1: Julian Mecklenburgh**

**Supervisor 2: Ernie Rutter**

**Additional Supervisor (s): Andrey Jivkov**

### **Project description:**

The production of gas from shale relies on hydraulic fracture to increase the surface area of the borehole to allow access a larger volume of the reservoir but hydraulic fracture does not affect the permeability of the rock between the fractures created. So ultimately the production rate from shale reservoirs will be limited by the rock permeability. In Manchester we have been measuring pressure dependent permeability of tight rocks for 25 years. Recently we have applied these techniques to shale. We have found that whilst shales are all slightly different there is a generic behaviour where permeability is strongly dependent on effective pressure – a drop of 100 times in permeability over 100 MPa – and the pore pressure can either be more or less effective at changing the permeability than the confining pressure. Also shales show permeability anisotropy being 10-100 times more permeable parallel to layering than across layering. The change in permeability with pressure is due to the closure of strongly oriented crack like pores. These crack like pores also have a profound effect on the seismic properties. By measuring how the seismic velocities and permeability changes with applied confining pressure and pore pressure we will be able to gain a greater understanding of how permeability varies in shales and what are the microstructural controls (e.g. pore widths, aspect ratio and porosity) on permeability. These experimental measurements will be allied with careful microstructural analysis of the samples to measure pore size and shape distributions using state of the art FIB-SEM techniques available in Manchester. Furthermore the experimental and microstructural observations will be linked together using innovative pore network models developed in Manchester.

### **CDT Research theme(s):**

Effective production of unconventional hydrocarbons

### **Research context:**

Application of experimental and theoretical petrophysics to optimising understanding of controls on shale matrix and fracture permeability, with modelling of expected reservoir behaviour. Intended as a CASE project with SHELL as project partner.

### **Research costs:**

£3000 per year

### **Career routes:**

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.