



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

Project Title: An integrated remote sensing-numerical modelling approach for evaluation and optimization of hydrocarbon reservoir performance

Host institution: University of Exeter

Supervisor 1: Dr Mirko Francioni

Supervisor 2: Professor John Coggan

Project description:

Quantitative evaluation of the in-situ primary fragmentation or the connectivity of the target rock mass has a controlling influence on the engineering behaviour, potential exploitation and stability of non-conventional hydrocarbon reservoirs. Modification of this discrete fracture network, through introduction of secondary fragmentation, is often required to enhance exploitation and stimulate recovery of hydrocarbons. Improved hydrocarbon recovery requires a multidisciplinary approach taking into consideration knowledge of the geology, fracture mechanics of the host rock mass (particularly the influence of the discrete fracture network) and an understanding of the effects of the changing stress redistribution during extraction of the hydrocarbon reservoir. The student will develop an understanding of rock fracture through strategic rock testing (concentrating on brittle rock fracture characterisation of reservoir rocks) using existing rock testing facilities at the University of Exeter, develop an understanding of stochastic representation of a non-conventional hydrocarbon reservoir through discrete fracture network analysis and undertake numerical modelling to simulate hydrocarbon extraction. An integrated remote sensing-numerical modelling approach will be used to evaluate subsidence-related deformation of exploited non-conventional hydrocarbon reservoirs through analysis of case study data provided through the Simon Fraser University, Canada. This integrated approach will be used to validate and, importantly, calibrate numerical modelling of reservoir performance but also provide useful data for evaluation, monitoring and optimization of non-conventional hydrocarbon exploitation.

CDT Research theme(s):

- a. Effective production of unconventional hydrocarbons
- d. Environmental Impact and Regulation

Research context:

The studentship would take advantage of recently completed research on applications of remote data capture (ESF studentship) and complement an existing EPSRC DTA studentship on rock characterisation, Commonwealth PhD studentship on rock testing and previous PhD research on numerical modelling of rock fracture networks.

Research costs:

£20k over four years (£5k/annum): Travel costs to central Training Academy activities. Consumables for acoustic-related rock testing. Field visit(s) to case study location in North America. Access to satellite imagery. Participation at conferences.

Career routes:

The recipient of the award could have career routes that could be directly employed by the oil and gas sector in geology, reservoir engineering, geomechanics, environmental impact or regulation. Careers could also be explored with geomechanics consultants, specialising in numerical modelling of discrete fracture networks utilising this multi-disciplinary approach.