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

Project Title: Discerning halokinetic from autocyclic sequences in deep-marine sedimentary systems

Host institution: University of Manchester

Supervisor 1: Dr Ian Kane

Supervisor 2: Prof Steve Flint

Additional Supervisor (s): Prof Chris Jackson, Imperial College, Prof David Hodgson, University of Leeds

Project description: Geophysical flows in the submarine environment are the principal agent by which terrigenous sediment is transported from the continents and distributed in ocean basins. The sedimentary accumulations that develop can form favourable hydrocarbon systems, including source rocks, reservoirs and seals. In mature hydrocarbon basins, for example the Central Graben of the North Sea, attention is focused on more challenging play types. Many of the challenges associated with deep-water exploration are exemplified by basins affected by salt diapirism, where complex and evolving topography affects the incoming geophysical flows and accordingly the architecture of sedimentary systems around them. One such example occurs in the Central Graben, where sediment dispersal within and, ultimately, the reservoir architecture of, principally Paleocene deep-water systems are strongly by periodic deformation of the seabed, driven by inflation of underlying salt diapirs.

The key aim of this project is to determine the evolution of sedimentary sequences deposited above and adjacent to active salt diapirs, with the aim of discerning 'halokinetic sequences' (i.e., sedimentary units directly affected by salt movement) from 'autocyclic sequences' (i.e., lobes or other architectural elements reflecting autocyclic evolution of a sedimentary system).

Methods: Three strands: outcrop, subsurface and numerical modelling. The field study will focus on the Bakio salt diapir, which is a world-class, yet poorly-studied, example of a salt diaper which affected deep-marine sedimentation. Sections show the salt itself, and reveal the growth of the salt with progressive steepening of strata. Associated with this sedimentation there is considerable onlap-slope deformation, with slides, slumps and debris flows shed from the growing flanks. The study will examine the Bakio salt diapir and related normal faults to create detailed facies transition maps and record stratigraphic stacking patterns, utilizing aerial photography and on the ground mapping and logging. The subsurface case study will utilize core, well and seismic data form the UK Central Graben; together these data sets will be used in the geometric modelling of sedimentation adjacent to salt diapirs.

CDT Research theme(s): b. Extending the life of mature basins

Research context: This project will yield results directly applicable to the CDT theme of 'Extending the life of mature basins'. The principal results should be an enhanced understanding of the influence of salt on deep-marine systems, and provide a valuable insight into the meaning of stratigraphic packaging and the distribution of favourable reservoir quality around salt diapirs in mature hydrocarbon basins. The generic outcomes could also be applied to early-life, and future hydrocarbon plays where salt impacts the seismic reflection data (e.g. Palaeogene, Gulf of Mexico).

Research costs: Approx £3000 p.a. for fieldwork and associated costs (sample preparation etc). Minimal costs for Numerical modelling training. All facilities available at UOM. Conference attaendance.

Career routes: The student will develop a wide range of skills directly applicable to exploration and development geology in the Oil industry , as well as the potential to pursue an academic career.