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

Project Title: **Integrated subsurface characterization of a basin-scale carbon reservoir target**
Host institution: University of Manchester
Supervisor 1: Mads Huuse
Supervisor 2: Jonathan Redfern
Additional Supervisor (s): Margaret Stewart, BGS; Christian Hermanrud, Statoil tbc

Project description:

Carbon capture and storage is crucial for reduction of the climate impact of fossil fuel consumption and the only way for the UK to retain energy security without breaching CO_2 quotas[1]. The Utsira sandstone is one of the largest and most widespread sand bodies in the North Sea basin and is identified as a prime target for carbon sequestration due to its large pore volume and ideal subsurface distribution some 800-1200 m beneath the North Sea[2]. However, its reservoir properties are relatively poorly documented and its top seal capacity to withhold a gas column over human or geological time scales is unknown beyond the immediate vicinity of the successful Sleipner CO_2 injection site[3]. Until 2015, thousands of wells drilled in the North Sea had not encountered any hydrocarbons in the Utsira sandstone raising doubts over its top seal integrity, also questioned by recent (local) studies of seal bypass systems[4] and sand injectites[5] that affect both the reservoir and its topseal. Existing models for the Utsira sandstone range from deep- to shallow marine and its environment is likely to vary across the basin. The North Sea has been explored for hydrocarbons for over 50 years resulting in a vast legacy database comprising thousands of wells and almost complete 3D seismic coverage allowing unprecedented insights into both reservoir architecture and facies and overburden properties and plumbing systems providing possible pathways for fluid escape into shallower aquifers and eventually to the seabed.

This study will leverage state of the art 3D seismic technology calibrated by wells to provide the first basinwide characterization of the Utsira sandstone and its overburden in order to provide a comprehensive inventory of viable carbon injection sites and top seal risk, which will be key to successful implementation of carbon storage for both UK and Norwegian carbon sources. Generic insights regarding the links between deeper structures, reservoir architecture and overburden leakage paths will be extracted to provide insights into the formation of seal bypass systems in general. Shallow gas reservoirs will be examined to avoid misinterpreting imaging artifacts as leakage paths. The methods and insights developed will have general applicability to basin analysis, petroleum exploration and carbon storage, and will yield crucial insights to inform future policy and implementation of carbon storage strategies. in the UK and Norway.

CDT Research theme(s): b) Extending the life of mature basins, d) Environmental Impact and Regulation, specifically CO_2 storage and geohazards

Research context: Fossil fuel consumption can only be sustained through carbon capture and storage. The Utsira aquifer is the largest and most readily available storage target in the North Sea. This project will provide a holistic analysis of its storage potential to inform policy and implementation of CCS and will develop new insights into the formation of seal bypass systems.

Research costs: It is envisaged that fieldwork studying detailed facies, facies associations and architectural elements of analogous reservoirs will be carried out to enhance the subsurface interpretation of the Utsira reservoir. Analogues for seal bypass systems will be examined at outcrop, possibly in Rhodes and/or NE Spain where pipes and gas escape structures have recently been identified. The costs for fieldwork should be covered by the normal project costs within the CDT programme.

Career routes: The candidate will develop extensive experience in state of the art subsurface characterization on a basin scale, readily applicable to careers in industry and academia.

Submissions must conform to this single-sided A4 format. The Awards Committee reserves the right not to consider submissions that do not adhere to this condition.