



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

**Project Title:** Do numerical models produce realistic fault evolution patterns?

**Host institution:** Imperial College London

**Supervisor 1:** Dr. Rebecca Bell

**Supervisor 2:** Prof. Chris Jackson

**Additional Supervisor (s):** Dr. John Naliboff (University of California, Davis)

### Project description:

Rifting of continents to produce new ocean basins is an important part of plate tectonics, and the geometry and magnitude of stretching has many implications for the development of hydrocarbon systems. Over the last decade numerical models have provided crucial insights into the rifting process, mainly using low-resolution 2D models. With advances in computational power it is now possible to numerically model rift evolution at a high-resolution in 3D to model how rift-scale fault arrays during rifting nucleate, propagate and grow through time. However, there are few observations of how normal fault arrays evolve at the rift scale to quantitatively test if the modern numerical models are producing fault array evolution predictions that are geologically realistic. This PhD will focus on quantifying the geometry and displacement history of fault arrays over complete rifts. This will be done using large compilations of 3D seismic reflection and well data from data-rich and well-studied rifts such as the North Sea and NW Shelf of Australia. The key outcome of the PhD will be a better understanding of how fault arrays during early continental rifting (beta factors  $< 1.5$ ) evolve at the rift scale. These observations will be compared with new high-resolution 3D numerical modelling outputs to investigate if the time-dependent faulting trends in nature match the results of the models. Seismic reflection data interpretation and quantitative fault analysis work will be conducted at Imperial and there will be the opportunity for a research visit to the University of California to examine the numerical modelling results.

### CDT Research theme(s):

The proposed project addresses two of the four key themes covered by NERC's Centre for Doctoral Training (CDT) in Oil and Gas: (i) *Extending the life of mature basins* – this project will utilise data from and has relevance to the Northern North Sea, a mature basin within which fault-related reservoirs and traps continue to play a key role in petroleum prospectivity; and (ii) *Exploitation in challenging environments* – this project focus on the geometry and kinematics of normal faults, which play a key role in the development of the subsalt petroleum system in, for example, HPHT regimes occurring in the Central Graben.

### Research context:

The PhD student will join the large Basins Research Group (8 staff and 12 post-graduate student members) with active interests and expertise in fault growth and petroleum systems of the North Sea and NW Shelf of Australia. Bell and Jackson have published widely on fault evolution and rift geometry in a number of tectonic settings, including the North Sea and NW Australia. External supervisor Naliboff is a world-leader in numerical rift modelling and is pioneering the use of 3D high-resolution extensional models. This PhD marks an exciting new collaboration between observational scientists (Bell, Jackson) and numerical modellers (Naliboff).

**Research costs:** PC for subsurface data interpretation = £3000; costs associated with conference attendance for presentation of results (1 international and 2 national conferences) = £2000; research visits to the University of California to discuss numerical model outputs with external project supervisor Dr. Naliboff = £3000.



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**Career routes:** Academic (e.g. structural geology, geophysical data analysis) or industrial (e.g. structural geologist, seismic interpreter)