



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

Project Title: : Calcite-Aragonite Seas and porosity prediction: A New Approach

Host institution: University of Oxford

Supervisor 1: Rosalind Rickaby

Supervisor 2: Hugh Jenkyns (Oxford) and Andy Gale (University of Portsmouth)

Additional Supervisor (s):

Project description: The oscillating nature of major ions (primarily Mg/Ca) in seawater between states that induce dominantly calcitic and aragonitic primary precipitates has led to the paradigm of the “Calcite-Aragonite Sea”. Yet the precise history of seawater chemistry and the fluctuations in the mineralogy of the primary precipitates are known with very poor resolution. We aim to recognise at a high resolution key intervals conducive to precipitation of either calcite or aragonite and associated dominant skeletal mineralogy. The rapid loss of aragonite particularly under meteoric-water diagenesis shows how the presence of this mineral in original sediment is a key to early generation of porosity. Defining which intervals of geological time favour sediments that are aragonite-rich and which are aragonite-poor, with clear implications for potential reservoir characteristics, is key for de-risking of shallow-marine carbonate drilling targets.

Deliverables:

- 1) New compilation to resolve timing of major transition between calcite and aragonite seas based on primary inorganic precipitates and biominerals, and hitherto undocumented higher frequency fluctuations between the two states
- 2) Generation of a high-resolution record of seawater chemistry change in Mg/Ca from well-preserved and stratigraphically constrained echinoderm fossils
- 3) Test the new seawater record of Mg/Ca against the new mineralogical compilation and refined knowledge of chemical thresholds to provide a high-resolution Meso-Cenozoic stratigraphic predictor of likely pre-burial porosity of carbonate reservoirs.

CDT Research theme(s): Effective production of unconventional hydrocarbons. The project will add to our understanding of tight carbonate reservoirs.

Research context: There are geochemical and palaeoceanographic elements which overlap with existing expertise amongst our existing PhD students. This studentship develops specialist carbonate expertise.

Research costs: Largest Budget item is electron probe analyses of the echinoderm calcite (~£2k; and fieldwork costs up to £1k + stable isotope costs £2k which will come from allied research grants.

Career routes:

Specialist research (but importantly marine carbonate petrology, preservation and diagenesis)