

Oil & Gas Training Academy: Studentship research proposal.

Imperial College funded - 4 years starting October 2018

Project title: Origins of deepwater anoxia in Lower Carboniferous basins of northern England

Supervisor 1: Prof Mark Sephton

Supervisor 2: Prof Alastair Fraser

#### Project description

Previous publications discussing the nature of the anoxia that led to the deposition and preservation of the organic rich Bowland and Edale shales in the Carboniferous of northern England were attributed to organic material sourced from the upper delta plain of large southerly prograding deltas. (Fraser *et al* 1990). The rationale was a clear stratigraphic relationship describing a southwards younging of the organic rich shales and the southwards progradation of the deltas. The Bowland and Edale shales were subsequently classed as mixed type II/III kerogens not optimal for shale gas fracking and production.

Recent geochemical analysis carried out by Fraser for an industry funded research project (in prep) has clearly demonstrated that a layering of carbonate, clay and silica rich mudstones make up the vertical stratigraphic section within the Bowland and Edale shales. The lower carbonate associated kerogens are rich in organic matter as well as thin (mm) carbonate layers. These have been typed using modern HAWK pyrolysis as type IIs. Excellent for shale gas exploration and exploitation. In order to predict the distribution of the type II kerogens both laterally and vertically within a Bowland and Edale shale source which can reach 1000m in thickness we will need to understand the physical and chemical mechanisms that led to the stratification of the water column in the Lower Carboniferous basins and subsequent preservation of organic matter. This project will work on selected core samples from the BGS archive in Nottinghamshire and new well data that will be made available by Cuadrilla, IGas and INEOS during the course of the 4 year project. The opportunity will be available for fieldwork in Derbyshire and Lancashire to examine the Bowland shale at outcrop and its structural/stratigraphic relationship to the carbonate platforms and advancing Pennine delta system. A fundamental understanding of the nature of the chemocline through the period of Bowland Shale deposition and its depth with respect to the photic zone will be undertaken by the student by examining remnants of aromatic and other carotenoids in the shale samples using similar techniques to those reported by Damste *et al* (1993) from the Black Sea. The student will also have the opportunity to work with existing 2D seismic and well data linked to the BGS stratigraphy project to determine the temporal variation in water chemistry through time and its link to the preservation of organic material.

Research context. The student will provide key data to the understanding of a key Shale Gas interval in northern England by identifying potential sweet spots for horizontal drilling and fracking that will impact resource and reserves estimation.

Research costs: Funding will be provided for a 4 year studentship starting October 2018 based at Imperial College London. Additionally the student will require a 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 BGS in Nottinghamshire to collect core material and collaborate with the BGS (Dr Ed Hough) Bowland shale stratigraphic project = £1500

## References

Fraser, A. J., Nash, D.F., Steele, R.P. & Ebdon, C.C. 1990. A regional assessment of the intra-Carboniferous play of northern England. In: BROOKS, J. (ed). *Classic Petroleum Provinces*. Geological Society, London, Special Publication, **50**, 417-440.

Damste, J. S., Wakeham, S.G., Kohen, M.E.L., Hayes, J.M. & de Leeuw, J.W. 1993. A 6,000-year sedimentary molecular record of chemocline excursions in the Black Sea. *Nature*, **362**, 827-829.