

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

Project Title: The role of asphaltenes in emulsion stabilisation formed by ocean oil spills
Host institution: Newcastle University
Supervisor 1: Dr. Geoffrey Abbott
Supervisor 2: Dr. Nicholas Parker

Project description: Ocean oil spills such as Deepwater Horizon (DWH) in the Gulf of Mexico threaten both marine and coastal life. The oil-water interface is by far the most important pathway for transporting the spilled crude into the water column where the asphaltene-rich fraction can form water-in-oil emulsions. The student will use organic geochemical methods (e.g. Muhammad and Abbott, 2013) as well as ultrasound spectrometry (Abbott and Povey, 2012) to probe into the mechanism of asphaltene aggregation from molecules through to clusters via nanoaggregates (see Figure below). The aims of this research will be i) to understand how the oil-water interfacial behaviour of the asphaltene aggregates contributes to emulsion stability and ii) to link emulsion characteristics to fluid chemistry. This will then enable us to find out how to disaggregate these emulsions. The objectives will be to probe how i) the chemical (e.g. presence of salts, ionic concentration) and ii) the physical (e.g. temperature, agitation) environments modify the aggregation and emulsification processes. The outcome of this work will be to propose strategies for the disaggregation of these emulsions if a spill on the scale of DWH were to occur in regions such as the deep waters west of Shetland, e.g. the Faroe Shetland Channel. This information could be provided to the EU, via the UK Marine Monitoring and Assessment Strategy committee to show that good environmental practise has been met on the UK continental shelf. References: Muhammad AB, Abbott GD (2012) The thermal evolution of asphaltene-bound biomarkers from coals of different rank. *International Journal of Coal Geology* **107**, 90-95; Abbott GD, Povey MJW (2012) The acoustic spectroscopy of asphaltene aggregation in petroleum. *Institute of Physics (IOP) Conference Series: Materials Science and Engineering* **42**, 012022

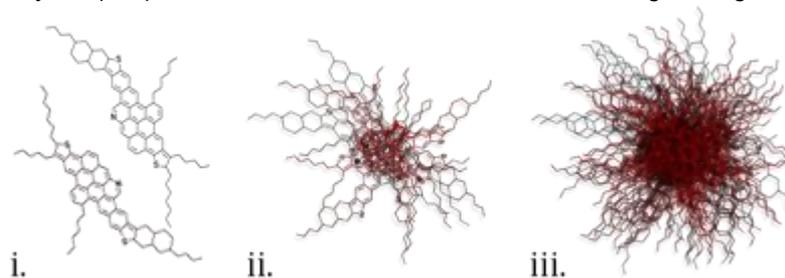


Figure (i) Monomers. (ii) Nanoaggregates. (iii) Nanoaggregate clusters.

CDT Research theme(s): This project relates strongly to theme 4 (Environmental Impact and Regulation); improved understanding of aggregation properties and efficient means to induce disaggregation would enhance our capability to remove oil following spills.

Research context: Abbott and Parker have a PhD student who is studying the structure and function of asphaltenes using ultrasound spectroscopy. The proposed project would naturally follow on from this by also relating the aggregation and emulsification properties of asphaltenes to the fluid chemistry.

Research costs: Main costs for molecular work will be supported by Abbott. Ultrasonic analysis will be performed on a high-precision ultrasound spectrometer (Parker), whose provision was funded by a Royal Society Seed-Corn Research Grant.

Career routes: With the opportunity to work with world-class geoscientists, the student will gain excellent experiences and training skills to subsequently pursue a career as: an independent or industry-based environmental consultant; a specialist researcher with an environmental government agency (e.g. SEPA); or an academic in a university.

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.