



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

Project Title: Good, bad and ugly: microbial mineralisation around hydrocarbon seeps and spills

Host institution: University of Aberdeen

Supervisor 1: Brasier

Supervisor 2: Bowden

Additional Supervisor (s): Graeme Paton (specialist in bioremediation, Biological sciences)

Project description:

Combating pollution around hydrocarbon spills through bioremediation can actually lead to rising atmospheric CO₂ through biotic respiration. Making bioremediation effective requires trapping the carbon in inorganic minerals, immobilizing heavy metals, and binding heavy hydrocarbons in place. Microbes are capable of all of these things. The UK has natural laboratories with potential for the study of biogeochemical processes that occur around hydrocarbon spills and seeps. Places where these processes occur have not been fully explored, particularly in Scotland. These sites include oil shales and natural seeps of migrated hydrocarbons in the Orcadian basin of Scotland, and gaseous coal quarries of Ireland.

~~We will~~ The first phase of the project will involve fieldwork to examine and collect organic carbon and mineralised samples from natural sites-seeps and spills around Scotland and Ireland. This will help to evaluate the capabilities of abiotic processes versus mineralising microbes to remove hazardous and harmful materials around hydrocarbon spills. We will then move on to The second step will be to conduct laboratory experiments using focussing on calcifying microorganisms found around the natural field sites, to test testing their capabilities to trapping of harmful compounds in both their cell walls and organic materials-secretions (such as EPS) and in inorganic the carbonate materials such as precipitates they produce-carbonate.

~~Chemical-Organic and elemental chemical~~ analysis will ~~thus~~ differentiate between materials bound within carbonate, extra-cellular materials and intra-cellular components using ~~methods-San approach we have AB has~~ previously applied to endostromatolites found in the Arctic, where petroleum-bearing bed rock was being weathered and the components incorporated within crusts. We also use a new surface enhanced Raman technique that can detect trace quantities of asphaltene – which is particularly important as asphaltene is most recalcitrant component of petroleum and the last to be degraded. Cultivation experiments in the laboratory will aim to recreate conditions recorded around natural hydrocarbon sites in the field (Orcadian Basin). Once stable cultivations are available microbial mats will be propagated and their response to influxes of heavy metals and asphaltene will be investigated.

CDT Research theme(s): This project aims directly at theme d: reducing the environmental impact of hydrocarbon exploration and exploitation.

Research context: This student would join an exciting new cross-disciplinary ‘geobiology centre’ at the University of Aberdeen, focussing on biosphere-geosphere interactions. This includes their training in the specialist laboratories for organic geochemistry (led by Bowden) and experimental geobiology (led by Brasier) in which the work would be undertaken.

Research costs: UoA facilities (e.g. microscopy; SEM) and a portion of the RTSG budgeted for geochemistry (GCMS, stable isotopes, elemental analyses), and microbe cultivation experiments, with fieldwork in the Orcadian Basin of Scotland.

Career routes: The student will be trained as an environmental geochemist, with knowledge of microbiology and bioremediation. This is combination of skills that are in strong demand in the

PhD Proposal: UK Oil and Gas Collaborative Doctoral Training Centre (2014 start)

hydrocarbon industry and wider environmental sector and academia, ensuring outstanding job opportunities.