

De-risking unconventional hydrocarbon exploration and production through novel biogeochemical approaches: towards a systematic understanding of organic matter processes in the subsurface environment.

The Lyell Centre, Heriot-Watt University

Understanding fluid-rock interactions within shale environments is critical for utilising and managing the subsurface. By characterising the dissolved organic carbon (DOC) of water extracts from a variety of black shales and coals the geological ages, source and depositional environments (kerogen types), and thermal maturation levels can be documented. Furthermore, shale environments subjected to hydraulic fracturing are able to host an active microbial community, despite the injection of biocides with drilling fluids. This microbial community may be stimulated by DOC and nutrients present in the leachates, potentially resulting in flow disruption/permeability loss, production of H₂S and other undesirable substances, biocorrosion of infrastructure, and degradation of reservoir hydrocarbons.

Using a systematic approach in partnership with leading industry partners, our pioneering work using world-leading geochemical facilities has demonstrated that the quantity, composition, molecular size and structure of the DOC from rock-water experiments allow improved understanding of these subsurface systems. This presents new opportunities for integrated research between fundamental science that is directly applicable to the energy industry and informs the environmental debate.

You will join the Lyell Centre, a research focussed centre of the British Geological Survey (BGS) and HWU in Edinburgh, Scotland (www.lyellcentre.ac.uk) where you will undertake a detailed study combining geochemistry and microbiology to improve our understanding of the immediate and long-term impact of subsurface fracking on multi-scale and -directional biogeochemical processes that ultimately affect the performance, duration and efficiency of unconventional energy production. With this agenda, the project has direct relevance to the UK grand challenge to develop a secure energy future. Fundamental questions that will be addressed include: what is leached from these source rocks and at what rate? How does burial depth affect what is leached? Does leached water have an effect on the subsequent formation they pass through? Does leached water help speed up primary migration? Do leachates stimulate unwanted microbial activity? How can this be mitigated? The proposed research will inform the assessment of production cost and potential environmental/HSE risks associated with subsurface fracking.

Please contact Dr Ryan Pereira (r.pereira@hw.ac.uk) for informal information.