

**Centre for Doctoral Training (CDT):
Geoscience and its Role in the Low Carbon Energy Transition
(2021 start)**

Project Title: Native Hydrogen Exploration

Host institution: Durham University

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Project description: A key part of decarbonisation in the UK and elsewhere is to transition from the use of methane to hydrogen as a fuel source to be supplied using the existing national gas grid. Native, molecular hydrogen is abundant in nature but has not been considered as an industrial target and has not been explored for. No strategy exists to find it. The aim of this research project is to understand the natural sources of hydrogen and then develop an exploration strategy.

Significant fluxes of hydrogen have been recorded in various places around the world emanating from faults, ore bodies, serpentinites, hot springs and petroleum accumulations. An accidental discovery in Mali is 98% hydrogen and natural seepage of hydrogen in Oman is at a rate of 70-150 m³ per day per km². Over geological timescales of as little as 1 million years, such rates would yield gas accumulations similar in size to any globally significant natural hydrocarbon fields.

The approach would be to develop a systematic catalogues of hydrogen occurrences and then understand the chemistry of the processes that could be responsible for hydrogen production. This approach would be complimented by experimental studies to replicate the hydrogen producing reactions and by studies of seeping fluids, their chemistry and isotopic composition. There are abundant sources of seeping hydrogen in Europe (Germany, France, Denmark). All will be reviewed and up to 5 sites chosen for field work and sampling. Efforts would be made to identify seeping hydrogen in the British Isles; candidate locations in England, Scotland and Ireland are known. Potential UK and Ireland sites will also be visited and sampled.

The source, maturation, migration and accumulation conditions of the hydrogen will be assessed and an exploration strategy built with prospectively ranked for the UK and elsewhere.

The UK currently has 37,000 people directly employed by the petroleum industry and a further 250,000 working in the supply chain or in supporting industries. This huge employment and skill base will be lost shortly and the (native) hydrogen economy could provide the opportunity for a just and seamless transition to a sustainable future.

Stated link to CDT theme: 1. repurposing exploration to meet the needs of society
2. use of geoscience to accelerate the decarbonisation of industrial clusters

Any Additional Research Costs: Field work and gas sampling £4000, gas analyses approx. £3000 experimental work approx. £3000, Conference £1000 Total about £11k.

Has access to data been secured? In part, Helium Resources Ltd, a company that also explores for hydrogen has agreed to share all data. We are also already in possession of the published material on hydrogen seepage and a modest amount of gas analytical data.

Career routes: if successful this work will initiate a new global industry and the PhD candidate would be much sought after. Alternative industrial career will exist in the CCS, geothermal, helium and even petroleum industries. Academia is always an option too. Given that the supervisors already lead on CCS, helium and geothermal in the UK we expect to deliver many career options.