UGRLS Project Proposal: Caribbean cold seeps – a multi-disciplinary study

1. Research Project Leader: Dr Fiona Gill

2. Scholarship Project Supervisor: Dr Fiona Gill, Dr Jason Harvey, Dr Crispin Little

3. Working title of Scholarship Project: Strontium isotope dating of methane seep carbonate from Barbados

4. Period of Scholarship Project Work (see note i): Summer (July-August) 2017 and 2018

5. Summary of the research to which the Scholar will contribute:

Cold seeps are environments where hydrocarbons, including methane, seep onto the sea floor and support dense communities of animals including clams, mussels, snails and tubeworms. Modern cold seeps were first discovered in 1984 and since then, many examples of fossil cold seep communities have been identified. Cenozoic fossil seeps are populated mainly by animals with relatives at modern seeps. Older seeps however, have a different faunal composition, with brachiopods, some extinct groups of bivalves and certain gastropod families dominating some Mesozoic and Palaeozoic seep communities.

Fossil cold seeps from the Caribbean region are the subject of a long-term multidisciplinary study, combining alpha taxonomy, mineralogy, organic geochemistry and radioisotopic dating. The aim of the overall project is to understand the diversity, palaeoecology and palaeogeography of these communities. The work undertaken by the scholar will provide a vital contribution to the project, by constraining the ages of cold seep communities from Barbados that occur in two contrasting stratigraphic and tectonic contexts and have previously been interpreted as Eocene to Miocene in age. This is essential to better understand the evolution of the Caribbean seep fauna and its relationship with regional events, such as the closing of the Isthmus of Panama.

6. Summary of the work to be undertaken by the Scholar:

Cold seeps are environments where hydrocarbons, including methane, seep onto the sea floor and support dense communities of animals including clams, mussels, snails and tubeworms. This project forms part of a larger project investigating fossil cold seeps in the Caribbean region. Working as part of an interdisciplinary team of palaeontologists and geochemists, the scholar will analyse rocks and fossils from Barbados fossil seeps to determine their $\text{Sr}^{87}/\text{Sr}^{86}$ ratio and use this to interpret an age for the seep fossils. This will involve sample preparation, wet chemistry and analysis using Thermal Ionization Mass Spectrometry (TIMS). The results of this project will be included in future publications, with the scholar as co-author. The scholar will also have the opportunity to present results at appropriate scientific meetings and to be involved in public engagement and education outreach activities.

7. Detail of the work to be undertaken by the Scholar: (see note ii):

The scholar will begin by becoming familiar with the tectonic and stratigraphic structure of Barbados and the occurrence and taxonomic composition of the cold seeps from 1) the Joe’s River Formation and 2) the Sub-Oceanic Fault Zone (~1 week). With guidance, the scholar will select 10 – 20 samples from the Joe’s River Formation, including shell material from bivalves and gastropods, authigenic carbonate and sediment matrix. The scholar will prepare these samples for analysis using appropriate cleaning techniques (~1 week). The samples will be dissolved in dilute acetic acid (~1 week). They will then be analysed by Thermal Ionisation Mass Spectrometry (TIMS) to determine their $\text{Sr}^{87}/\text{Sr}^{86}$ ratio (~2 weeks). The scholar will evaluate and interpret findings and produce an interim report (1 week).

In the following research period, the scholar will select and clean 10 – 20 samples of carbonate from the Sub-Oceanic Fault Zone (~1 week), prepare them for analysis (~1 week) and analyse them by TIMS as before (~2 weeks). The remainder of the research period will be devoted to analysing and interpreting the data generated and producing a final report.
In addition to the work outline above, which is essential to the project, the scholar will also have the opportunity to present findings at appropriate meetings and to be involved in outreach and public engagement activities, such as school visits and the Yorkshire Fossil Festival.

8. **Detail of the Leadership development to be undertaken as part of the project (see note iii)**

The scholar will be supported to develop leadership skills and will be responsible (with guidance) for managing the project, e.g. scheduling laboratory and instrument time. Further leadership opportunities are available if the scholar chooses to be involved with outreach and public engagement activities directly or indirectly linked to the research. For example, the scholar could design and present an activity based on the research to contribute to SEE’s exhibit at the Yorkshire Fossil Festival or other outreach events. There will also be the opportunity to present work at relevant scientific meetings, giving the scholar opportunities to enhance their communication skills.

9. **Outputs expected of the Scholar (200 words) including the final report (see note iv)**

As a minimum, the scholar will be expected to produce an interim report at the end of the first research period and a final report at the end of the final research period. The scholar will be strongly encouraged to present their work in a range of contexts, including SEE research group meetings, appropriate national or international meetings outlined previously and will be supported to prepare their findings for publication.

10. **Details of supervision arrangements (see note v)**

Dr Gill will oversee the research and be a regular point of contact for the scholar, with weekly meetings during the research periods to discuss progress. Dr Little will supervise the selection and cleaning of material for analysis and provide taxonomic expertise where relevant. Dr Harvey will supervise the laboratory preparation and TIMS analysis of the samples. All staff will contribute to interpretation of results and preparation of publications. The scholar will be encouraged to attend research group meetings and will therefore benefit from membership of the wider research community.