**Project title:** The rocky road to recovery – The role of microbialites in coral reef recovery after abrupt environmental change *(Ref: OP19_28)*

**One Planet Research Theme:**
Climate & Climate Change ☒ | Earth System Processes ☒ | Anthropocene ☐ | Environmental Informatics ☐

**Lead Supervisor:**
Cees van der Land, School of Natural and Environmental Sciences, Newcastle University

**Key Research Gaps and Questions:**
- Tropical coral reefs are sensitive recorders of sea-level variability and investigating their fossil counterparts enables us to constrain the timing, rate, and amplitude of sea-level variability, allowing a definitive test of Milankovitch climate theory and an assessment of controversial abrupt sea level events (meltwater pulses) that occur on suborbital frequencies. Understanding historical changes and recovery processes on reefs in response to climate change is essential to inform conservation of reefs in the anthropocene. In particular, understanding the likely rates that corals have naturally adapted to change could help in understanding ways of assisting corals to adapt and acclimatise to anthropogenic climate change.
- Facing climate change, how resilient are coral reefs. What is the response of coral reef systems to abrupt sea-level and climate changes?
- What is the role of different modes of reef building (e.g. skeletal corals vs microbial crusts) in reef evolution and reef recovery after environmental perturbations?
- What processes determine changes in mean climate and high-frequency (seasonal-interannual) climate variability, especially during periods of reduced coral reef growth?

**Project Description:**
Microbialites are excellent recorders of past sea-level and water chemistry, especially during times of environmental stress when skeletal corals (normal reef builders) are less likely to survive. This is especially evident on rapidly subsiding margins such as Hawaii (IODP Expedition 389 [http://www.ecord.org/expedition389/](http://www.ecord.org/expedition389/)). Furthermore, microbial crusts play an essential role in the recovery of the coral reef after abrupt climate change. In this project we will work on cored material across a Hawaiian fossil reef that will provide a greatly expanded stratigraphic section and contain information on the role of microbialites in reef survival over the past 6 glacial cycles. Of specific interest would be a high resolution U-Th dating study across several microbialite-coral sections.

The cored material will provide complete sections across several types of biologically controlled/induced material (e.g. corals, thrombolites, red algae crusts, microbial crusts). In this project we would explore in-situ geochemical techniques such as XPS and ToF-SIMS (Purvis et al. 2017; Purvis, van der Land, et al. in press) to study the nature, habit and role of different types of bacteria in the different modes of carbonate lithification for microbialites. This would enable us to obtain an unprecedented high-frequency (seasonal-interannual) climate signal across periods of eustatic sea-level rise, improving global paleo climate models across these intervals.

**Prerequisites:** An excellent MSc degree in any of the following subjects: Biochemistry; Chemistry; Earth Sciences; Geology; Marine Sciences; Physical Geography. Material Science and Engineering students with experience in XPS and an interest in applying their knowledge to this subject area are especially encouraged to apply.

For more information, please contact Cees van der Land (cees.van.der.land@newcastle.ac.uk).