**Project Title**

Novel in situ sensing and chemical profiling of organic matter, nutrient and contaminant release from melting Himalayan Glaciers

**Lead Supervisor Name**

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**Lead Supervisor Location/Student Home Institution**

Institution: Bristol

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**Full Project Description**

Around 75 % of the Earth’s freshwater is locked up in mountain glaciers and ice sheets, where this quantity is highly sensitive to changes in future climate. Glaciers located within the Hindu-Kush Himalayan region represent the largest store of freshwater held in mountain glaciers globally, and many are predicted to either retreat or disappear this century. The impacts of these changes upon the flow regimes major Asian rivers, which supply > 1.4 billion people, are becoming better studied. However, a major research gap is the impact of Himalayan glacier melting upon on the quality of water in these rivers. This is important for two main reasons. First, glacier runoff is often found to be enriched in nutrient and bioavailable organic matter, which may be important in sustaining downstream ecosystems and ecosystem services (e.g. fisheries). However, glacial catchments also sequester pollutants from the atmosphere in snowfall and release trace metals from bedrock via erosion, both of which may be released to river systems. While these features of glacial runoff are becoming well established elsewhere (e.g. Alaska, European Alps, Greenland), determining the impacts of melting Himalayan glaciers upon downstream water quality is a relatively new field. It requires close cooperation with Himalayan host nations because of the remote nature of the field sites and requirement for governmental permission. This PhD project aims to employ novel in situ chemical sensing technologies developed via previous NERC funding (Discovery Grant “DELVE” to Wadham, Bagshaw, Beaton), in combination with molecular profiling of organic matter (Organic Geochemistry Unit, Prof. Richard Evershed), inorganic nutrients and contaminants (Prof. Jemma L Wadham, Prof. Laura Robinson) in runoff from Himalayan glaciers. It will be undertaken in collaboration with Prof. Al. Ramanathan at Jawarhalal Nehru University (JNU: New Delhi) who has developed several glacier field sites in the Indian Himalaya over the last 15 years. The project will specifically aim to determine the controls upon 1) nutrient and 2) organic carbon speciation and fluxes from Himalayan Glaciers and 3) concentrations, fate and fluxes of toxins (e.g. metals, microplastics) in glacier melt supply to Asian rivers. This will result in a ground-breaking assessment of the impact of a deglaciating Himalaya upon downstream river water quality in warming world. The student will be hosted in a supportive research group environment, linking to a wider research programme and the funding and collaborative opportunities that this offers. They will have the opportunity to work across several cutting edge laboratory facilities and to develop a range of inter-disciplinary skills. There is also an opportunity to join a high profile research expedition to the Indian Himalaya (suitable experience permitting).

**Real Life challenges this project will address**

Diatoms are used as bioindicators for water quality because species tolerate characteristic ranges of pH, concentrations of oxygen and dissolved organic matter, and many other important ecological parameters. Key species are typically identified by morphology (physical appearance), but this classification may be mislead by hidden genetic diversity, with important implications for management of freshwater environments. The project will help to improve identification by establishing the congruence (level of agreement) between genomic diversity and morphological classification and proposing revisions to bioindicator classification where needed.

**What you should know about this project**

Some of the most basic questions in evolution and ecology - where do organisms originate, how are they distributed in the environment, and how does their biodiversity contribute to ecosystem function - are unsolved for microbes, particularly those that are difficult to grow in the lab. This is a huge problem because microorganisms - particularly photosynthesisers such as diatoms - drive primary productivity and ecosystem function in many settings, including freshwater environments. To understand and protect the system, we need to understand its microbial component. This project aims to answer several very basic questions about freshwater diatoms: what factors determine their abundance and distribution; are there genome-level differences between endemic (localised) and cosmopolitan forms; and to what degree do the usual techniques used to identify and classify diatoms actually reflect their evolutionary history and ecosystem function - an important consideration for attempts to use particular species as hallmarks of healthy or damaged habitats? The project team is highly multidisciplinary and ideally placed to support the research. It brings together skills in bioinformatics, genomics and evolutionary biology (Dr. Tom Williams, Bristol) with expertise in microbial fieldwork and sampling (Dr. Bryony Williams, Exeter; Dr. Ingrid Juttner, National Museum of Wales), biogeochemistry and ecology (Dr. Patricia Sanchez-Baracaldo, Bristol) and diatom biology and taxonomy (Prof. Wim Vyverman, Ghent University). This range of skills will provide a very broad training base to equip the student for success both within academia and beyond.

**What expertise you will develop**

The student will develop a very broad range of skills in bioinformatics (genome assembly, analysis, phylogenetics and population genetics), protistology fieldwork (organism sampling, isolation), and molecular biology labwork (culturing and microscopy, genome sequencing).

**Why this project is novel**

This project will exploit a unique set of techniques cross-cutting the fields of chemistry, biogeochemistry, glaciology and engineering to tackle a virtually untouched topic. It benefits from the unique collaboration with Jawaharlal Nehru University in New Delhi, developed via funded UKIERI project to the PI.

**Rest of Supervisory Team:**

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