PhD Studentship Details

Lead organisation: University of Bristol

Collaborating organisations: Bangor University, UK Centre for Ecology and Hydrology (CEH)

Title: The biogeochemical pulse of water: Advancing natural dissolved organic matter (DOM) and nutrient monitoring for assessing the health freshwater ecosystems

Duration: 4 years

Start date: Ideally September 2025

We are seeking a highly capable analytical chemist for an exciting PhD opportunity developing and applying new instrument-based methods for the characterisation of natural organic compounds in freshwater ecosystems in the UK. This studentship is part of the large European Research Council-funded REFRESH project running for 5 years to research the role of dissolved organic matter (DOM) as a nutrient resource in freshwater systems, led by Professor Penny Johnes, at the University of Bristol.

Dissolved organic matter (DOM) is the principal form of organic matter in terrestrial freshwaters and is one of the largest fast-cycling reservoirs of organic matter globally. It has a carbon pool-size equal to the atmosphere and constitutes up 20% of the organic carbon budget of the Earth.[1] It is an operationally derived fraction defined by passing through a filter of size 0.2-0.7 µm, the remaining organic matter being particulate organic matter (POM).[2] It derives from a mixture of autochthonous (aquatic plants, algae) and allochthonous (soils, terrestrial plants) along with various anthropic loadings. Thus, at a molecular level the DOM pool comprises thousands of individual compounds including: pharmaceuticals (and their metabolites), personal care products, detergents, peptides, free amino acids, amino sugars, lipids, organophosphates, urea, N-bearing compounds and breakdown products from natural biopolymers such as chitin, lignin and suberin. [3,4] Despite having been the focus of research for nearly 100 years, **the functional roles and ecological impact that DOM has in aquatic ecosystems is still largely unknown**.

Target compound analysis is already widely deployed to quantify emerging contaminants in DOM, predominantly arising from pharmaceuticals, illicit drugs and personal care products, largely for regulatory purposes.[5] Methodologies for quantifying key anthropic chemicals are now highly refined, covering up to 100s of targets in a single analysis, and are deployed globally. However, methodological approaches that speak to the larger, natural fraction of DOM are less developed and analogous workflows for the simultaneous quantification of multiple compounds are virtually non-existent. Creating workflows for the large-scale quantification of non-anthropic compounds, that could be applied widely and at volume, would enable fundamental aspects of DOM such as its formation, molecular fate and interaction with living organisms to be better explored. The overarching goal being to **create a new means of assessing DOM to rapidly determine the ability of waters to support various ecosystem**

[**1**] Hedges, J.I. (1991) *Mar. Chem*. **39 (1–3),** 67–93. [**2**] Hartnett, H.E. (2018). In: White, W.M. (eds) *Encyclopedia of Geochemistry. Encyclopedia of Earth Sciences Series*. Springer, Cham. 375-378. [**3**] Pemberton, J.A., Lloyd, C.E.M., Arthur, C.J., Johnes, P.J., Evershed, R.P. (2019) *Rapid Commun. Mass Spectrom*. **11/19**:8618. [**4**] Lloyd, C.E.M., Nena-Rivera, L., Pemberton, J., Johnes, P.J., Jones, D.L., Yates, C.A., Evershed, R.P. (2022) *Biogeochem*. **164**, 29-52. [**5**] Petrie, B., Barden, R., Kasprzyk-Hordern, B. (2015) *Water Res*.**72**, 3-27.

services underpinning a healthy biome and, where such systems are failing, determine the underlying stressors responsible.

This opportunity will provide a prodigious level of training with access to state-of-the-art analytical facilities and instruction in advanced hyphenated mass spectrometric techniques (e.g. GC/Q-TOF MS, GC-Orbitrap MS, LC-QQQMS, LC-Orbitrap MS) and biogeochemical methods. The successful applicant will also gain experience in working within a large, multidisciplinary research team with opportunities to collaborate with international partners and present at national and international conferences.

You will be expected to meet the following criteria:

- hold or expect to obtain at least a first-class or upper second-class honours degree in, chemistry, environmental science or related discipline;
- have excellent laboratory skills and some experience with analytical techniques;
- demonstrate strong organisational and time management abilities;
- proficiency at analytical development, both instrumental and laboratory based; and,
- have good mathematical, coding and statistical skills.

This project will be supervised and led by Professor Ian Bull and co-supervised by Professor Penny Johnes, both at the University of Bristol. It will also benefit from collaboration with project partners across multiple institutions. The student will join a dynamic research environment, of international standing, based in the Organic Geochemistry Unit (OGU) in the School of Chemistry at the University of Bristol and will also visit Bangor University and UKCEH in Wallingford to take advantage of training and research opportunities.

For informal enquiries, please contact Professor Ian Bull (ian.d.bull@bristol.ac.uk).

Candidate Requirements

Applicants must have obtained, or be about to obtain, a First or Upper Second Class UK first degree, or the equivalent qualifications gained outside the UK, in chemistry or in a related discipline (biochemistry, biogeochemistry, environmental sciences).

How to Apply

Please make an online application for this project at the following page How to apply | Study at Bristol | University of Bristol.

Funding

A full studentship will cover UK tuition fees, a training support fee and a stipend (£19,237p.a. in 2024/25, updated each year) for 4 years.

Getting in Contact

[**1**] Hedges, J.I. (1991) *Mar. Chem*. **39 (1–3)**, 67–93. [**2**] Hartnett, H.E. (2018). In: White, W.M. (eds) *Encyclopedia of Geochemistry. Encyclopedia of Earth Sciences Series*. Springer, Cham. 375-378. [**3**] Pemberton, J.A., Lloyd, C.E.M., Arthur, C.J., Johnes, P.J., Evershed, R.P. (2019) *Rapid Commun. Mass Spectrom*. **11/19**:8618. [**4**] Lloyd, C.E.M., Nena-Rivera, L., Pemberton, J., Johnes, P.J., Jones, D.L., Yates, C.A., Evershed, R.P. (2022) *Biogeochem*. **164**, 29-52. [**5**] Petrie, B., Barden, R., Kasprzyk-Hordern, B. (2015) *Water Res*.**72**, 3-27.

We encourage you to make an informal enquiry to Ian Bull (ian.d.bull@bristol.ac.uk) if you have any queries or would like to discuss project.

[**1**] Hedges, J.I. (1991) *Mar. Chem*. **39 (1–3)**, 67–93. [**2**] Hartnett, H.E. (2018). In: White, W.M. (eds) *Encyclopedia of Geochemistry. Encyclopedia of Earth Sciences Series*. Springer, Cham. 375-378. [**3**] Pemberton, J.A., Lloyd, C.E.M., Arthur, C.J., Johnes, P.J., Evershed, R.P. (2019) *Rapid Commun*. *Mass Spectrom*. **11/19**:8618. [**4**] Lloyd, C.E.M., Nena-Rivera, L., Pemberton, J., Johnes, P.J., Jones, D.L., Yates, C.A., Evershed, R.P. (2022) *Biogeochem*. **164**, 29-52. [**5**] Petrie, B., Barden, R., Kasprzyk-Hordern, B. (2015) *Water Res*.**72**, 3-27.