PROJECT TITLE: The Cambrian explosion of jawed invertebrates: the Gnathifera

Project Science Theme: Evolution and Biodiversity
Project keywords: Palaeontology, evolution, computational biology, taphonomy

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Co-Supervisor: Elaine Fileman, Plymouth Marine Laboratory, Marine Ecology & Biodiversity group
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Project description:

Bilaterian animals radiated into roughly 26 distinct phyla within a remarkably short span of Earth's history, around 540 million years ago. Among the most puzzling of these are the Spiralia, or Lophotrochozoa—sixteen phyla encompassing extraordinarily disparate body plans. The deepest-branching spiralians comprise chaetognaths and three further phyla collectively known as the Gnathifera. While chaetognaths bear external chitinous grasping spines, gnathiferans possess an internal jaw apparatus, likewise built of chitin. Recent fossil discoveries, chiefly from the Burgess Shale and Sirius Passet, have revealed a suite of stem-group chaetognaths bearing internal jaw structures strikingly reminiscent of gnathiferans—among them the iconic Cambrian fossil Nectocaris and the giant swimming worm Timorebestia. These fossils reveal that early chaetognaths occupied a crucial ecological role as apex predators.

This project will examine new fossils from Sirius Passet, including several undescribed species that help close key gaps in gnathiferan evolutionary history. By integrating this fossil record with molecular and morphological phylogenetics and molecular-clock methods, we can reconstruct a more accurate tempo and mode of gnathiferan evolution and explore the differing life-history trajectories taken by its various members, and when: Underpinning our understanding of early evolution and the first animal ecosystems.

The student will learn to analyse fossils using cutting-edge imaging techniques—including reflectance transformation imaging (RTI) and EPMA elemental mapping—to resolve anatomical detail at high fidelity. This evidence will then be integrated into a broader framework combining morphological and molecular data from living animals, to establish a phylogeny and timeline for gnathiferan evolution.

Through a joint supervisory team spanning Bath and Bristol, the student will learn to interpret fossils and run phylogenetic analyses on Bristol's supercomputers using command-line interfaces.

They will also benefit from a research stay at the Korean Polar Research Institute, gaining access to its state-of-the-art EPMA and imaging facilities and its extensive Sirius Passet collections.

CASE partner:

The Korean Polar Research Institute will provide analytical facilities, data, and reasonable accommodation when visiting and supervision. They will also pay for use of EPMA and support with accommodation and travel to Korea.

Useful recruitment links:

For information relating to the research project please contact the lead Supervisor via: jakob.vinther@bristol.ac.uk

Bristol NERC GW4+ DTP Prospectus:
https://www.bristol.ac.uk/study/postgraduate/research/great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

The application deadline is Thursday 7 January 2027 at 2359 GMT