The University of Oxford Department of Earth Sciences

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Mongolian fossils at the dawn of animal life on Earth

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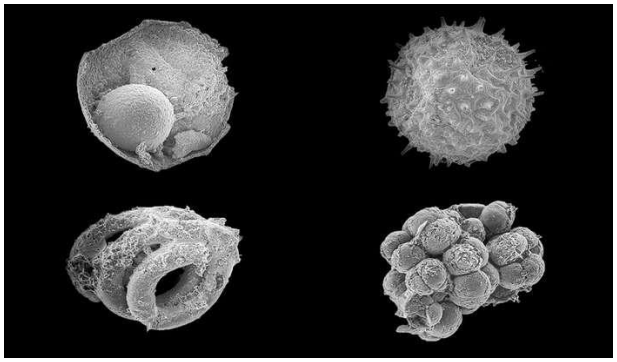
Overview

When and why did animals evolve on Earth? The Cambrian Explosion marks the appearance of many animal groups in the fossil record, but delve deeper and you find that animals likely existed earlier in Earth's history. Genetic data point to an origin of animals perhaps 800 million years ago, while the chemistry of rocks 640 million years ago suggests animals such as sponges were already making an impact on the geologic record. So where are the body fossils of these earliest animals?

In 1998, embryo-like microfossils phosphatised in the Doushantuo Formation, South China were interpreted as the oldest animal fossils. However, in the 20 years since that time, their phylogenetic affinity has been heavily disputed. They have been allied not only to animals, but also to organisms across the tree of life, including sulphur bacteria and eukaryotic algae. This DPhil project will use new fossils from Mongolia to shed light on the affinity of these iconic fossils, making fundamental contributions to our understanding of when animals evolved on Earth and the nature of the Ediacaran–Cambrian transition.



Ediacaran microfossils, each around 0.1mm in maximum dimension, from the Khesen Formation, Khuvsgul, northern Mongolia.

Methodology

Recently, embryo-like fossils similar to those found in South China have been uncovered in northern Mongolia. This new exceptional fossil locality (only the second outside China ever to produce Ediacaran animal-embryo like forms) provides the prospect of new data which could provide resolution to the 20-year debate of whether these iconic fossils really represent animals.

This DPhil project will undertake a thorough investigation of the palaeontology of the Mongolian sequence. It will involve the analysis of existing material and, funding permitting, collection of new material over two field seasons. Fossils will be extracted and examined with traditional microscopy, in addition to state-of-the-art techniques such as SEM and synchrotron-based computed tomography.

Collaborations with geologists and geochemists at the University of California Santa Barbara and Yale University will give access to a raft of contextual information on the palaeoenvironment of the Mongolian sequence, allowing questions of taphonomy and possible environmental drivers of evolution to be tested.

Other objectives of this project include the integration of Mongolian strata into a global biostratigraphic framework for Ediacaran rocks using the wide array of spiny Doushantuo-Pertatataka-type microfossils preserved. This research will be vital for ongoing efforts to subdivide Ediacaran time by the International Commission on Stratigraphy.

Timeline

Year 1: Training in fossil extraction and identification, and SEM operation. Possible fieldwork for sample acquisition.

Years 2 and 3: Sample analysis via fossil extraction and examination, both with traditional microscopy and SEM. Cutting-edge synchrotron-based computed tomography may also be employed. Possible continuation of field work.

Year 4: Data integration, thesis completion, papers for international journals/conference presentation.

Training & Skills

This project will provide the student with an interdisciplinary skillset in sedimentary geology and palaeontology. A significant portion of the project will be lab-based, where the primary skills acquired will by those of microfossil extraction and examination. The student will also become familiar with the use of state-of-the-art techniques currently employed in geobiology (e.g., SEM, synchrotron-based computed tomography). Funding permitting, the student will have the opportunity to spend significant time in the field in Mongolia where they will learn skills for rock identification, palaeoenvironmental reconstruction, and sample collection strategies. The student would be encouraged to present their research at major international conferences (e.g., PalAss, GSA).

References & Further Reading

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Further Information

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