EARTHSCIENCES

The stars are out: a palaeontological perspective on the early evolution of the Asterozoa

Primary supervisor:	*Frankie Dunn* (Oxford University Museum of Natural History)
Co supervisor(s):	• *Luke Parry (Oxford Earth Sciences)* • *Imran Rahman (Natural History Museum, London)*
Key words:	Palaeozoic, Echinoderm, invertebrate morphology, computed tomography, Great Ordovician Biodiversification Event.
Research theme(s):	• Palaeobiology and Evolution
Eligible courses for this project:	• DPhil in Earth Sciences • Environmental Research (NERC DTP)

Overview

Echinoderms are one of the most morphologically distinctive animal phyla, including forms as varied as sea lilies, sea urchins and sea stars. Sea stars and brittle stars are, together, called the Asterozoa, and they represent the most abundant, taxonomically diverse and geographically widespread of all the living echinoderms. They are important seabed 'engineers' and are well-known keystone species. The fossil record of asterozoans stretches back around 480 million years to the Ordovician and includes disparate extinct forms which have historically proved challenging to place within the echinoderm tree of life. This continued uncertainty has resulted in significant gaps in our knowledge of the origin and early evolution of the iconic star-shaped asterozoan bodyplan.

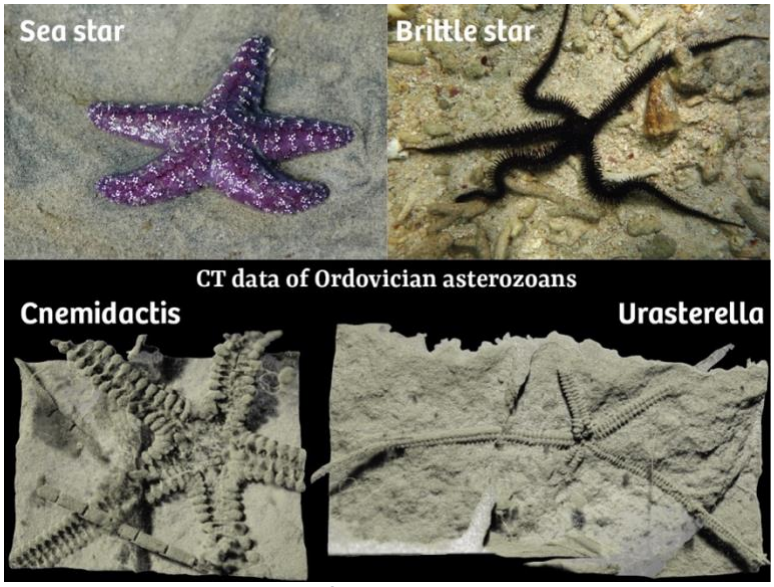

Figure 1- Showing examples of living asterozoans along with preliminary renders of microCT data from their Ordovician counterparts.

In this project, the student will re-examine historical museum specimens from the Ordovician and Silurian Periods, primarily of the UK, in order to piece together the early evolutionary history of the group. The student will use microCT data

to reveal the three-dimensional morphology of these fossils for the first time. This will be integrated into a comprehensive phylogenetic dataset encompassing both fossil and extant echinoderms, with morphological and molecular data, providing a new hypothesis for the emergence and diversification of the asterozoan body plan. Finally, the student will produce a time-calibrated evolutionary tree, allowing them to explore how asterozoans diversified across the Great Ordovician Biodiversification Event – one of the most significant and sustained increases in marine diversity in Earth history.

Methodology

The student will collect and analyse microCT data for relevant fossil specimens and select modern species for comparative purposes, and may have the opportunity to describe new taxa. This novel morphological information will be used, alongside existing morphological and genetic data from other echinoderm taxa, to perform phylogenetic analyses to assess the interrelationships of different living and fossil groups.

Timeline

Year 1: Doctoral training courses (10 weeks), literature review, training in microCT data processing, collection of microCT and other morphological data from specimens.

Years 2 and 3: Analysis of microCT data, description of new taxa and development of phylogenetic datasets.

Year 4: Final phylogenetic analyses, thesis and paper completion, conference presentations.

Training & Skills

Your supervisors at Oxford and the Natural History Museum (London) will offer expertise in comparative morphology, animal phylogeny and 3D morphology reconstruction. Your supervisors in Oxford will additionally offer expertise in phylogenetic and molecular clock analyses. Throughout the project you will learn to work with museum collections and will have the opportunity to visit domestic and international museums.

References & Further Reading

Telford, M.J., Lowe, C.J., Cameron, C.B., Ortega-Martinez, O., Aronowicz, J., Oliveri, P. and Copley, R.R., 2014. Phylogenomic analysis of echinoderm class relationships supports Asterozoa. *Proceedings of the Royal Society B: Biological Sciences*, *281*(1786), p.20140479.

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Further Information

Contact: Frankie Dunn (frances.dunn@oum.ox.ac.uk)