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Biogeographic and Biological Comparisons Between the
Emu Bay Shale (Kangaroo Island, South Australia) and
Other Cambrian Burgess Shale-Type Biotas

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Abstract

Konservat-Lagerstätten, or fossil deposits exhibiting exceptional preservation of non-biomineralised material, are particularly prevalent in the Cambrian, and offer us great insight into the evolution and ecology of early animals and communities. The Emu Bay Shale (EBS) from the north coast of Kangaroo Island, South Australia, houses an early Cambrian (Series 3 – c. 514 Ma) Lagerstätte that contains over 50 species, including sponges, brachiopods, molluscs, annelids, priapulids, lobopodians, arthropods, vetulicolians, and several problematic taxa, making it the most diverse Burgess Shale-type (BST) biota in the southern hemisphere. While considerable work in describing taxa from the EBS Lagerstätte has been completed, less has been undertaken that focuses on the relationships between this and other Cambrian BST biotas. This project aims to examine some of the links between the EBS Lagerstätte and similar deposits from around the world, including the Burgess Shale (Canada), Chengjiang (China) and Sirius Passet (Greenland) biotas, amongst others. To this end, the project has two major parts.

The first section aims to examine the biogeographic relationships between major Cambrian BST biotas from a global perspective. A substantial database of generic occurrence was constructed from the published literature, and analysed using various multivariate techniques in order to examine the relationships between these exceptionally preserved assemblages. Results suggest that both geographic distance and differences in age have an effect on the composition of BST biotas, and that assemblage similarity appears to increase through the Cambrian. The EBS

biota is most closely related to other Gondwanan sites in South China, most likely reflecting a regional relationship.

The second section involves a more focused description and interpretation of a single element of the EBS biota, namely an examination of the moulting habits of two common trilobite species from the Emu Bay Shale, *Estaingia bilobata* Pocock, 1964 and *Redlichia takooensis* Lu, 1950, and how this compares with other BST assemblages. Specimens from the EBS were examined and arrangements of exoskeletal elements likely representing moult ensembles identified, from which moulting behaviour was then inferred and compared. Analysis reveals that the EBS preserves a record of trilobite moulting unparalleled within other exceptionally preserved assemblages, representing a range of trilobite moulting behaviours, likely due to minimal water movement and relatively rapid burial within the biota's unique inshore depositional setting.

The unusual depositional setting of the EBS Lagerstätte seems to have had a minimal effect on the types of organisms present with the assemblage compared to other BST biotas. In contrast, this setting seems to have facilitated the preservation of an exceptional moulting record not found at other sites, including BST deposits. This, coupled with the unique preservation of certain structures such as eyes, confirms that the EBS is of great importance in elucidating the evolution of early animals and communities.

Declaration

I, James Dougal Holmes, certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

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