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Conference Abstract

The Crucial Relationship: Reinforcing the Role of Microbial Mats in Early Animal Life

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Abstract

The stem-group eumetazoans, also known as basal animals, have been present on Earth since the Neoproterozoic era, as evidenced by the fossil record of the Ediacaran Period (Xiao and Laflamme 2009, Butterfield 2011, Darroch et al. 2018). Previously, it was thought that Ediacaran microbial mats (also called biomats) were a key factor for early animals, providing food resources and stimulating motility and burrowing strategies into the sediment (Seilacher 1999, Meyer et al. 2014, Buatois et al. 2014, Tarhan et al. 2017, Scott et al. 2020, Coutret and Néraudeau 2022). Other research has suggested that animals living within modern microbial mats could have used the latter as a source of O_2, and thus they were not reliant upon bottom water oxygenation (e.g., Gingras et al. (2007), Gingras et al. (2011)). This observation leads to the hypothesis that free dissolved O_2 within the microbial mats could have facilitated the evolution of primitive animals in the Ediacaran oceans (Gingras et al. 2011). This is significant because the low concentration of dissolved O_2 is often considered a significant environmental obstacle for complex animals (Lyons et al. 2014, Knoll and Sperling 2014, Boag 2018). On the other hand, it is frequently observed that microbial mats have the ability to trap and bind sediment, and in some cases, they can even induce mineral precipitation. Following the process of lithification, the once "soft" biofilms are transformed into biolaminated organosedimentary structures known as stromatolites (Konhauser 2009). Critically, the earliest biomineralized metazoans (e.g., *Cloudina* - *Namacalathus*) are found within biostromal carbonate reefs supported by

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microbialites (Hofmann and Mountjoy 2001, Penny et al. 2014; also illustrated in Fig. 1A, B: Byng Formation in the Mont Robson area (BC, Canada)). Characterized as sessile and gregarious, epibenthic filter feeders, we propose that the earliest biomineralized metazoans derived advantages from stromatolitic reefs by becoming encrusted or attached to them in shallow water environments (Fig. 1A, B: white arrows). Stromatolites are regarded as fossilized relics of microbial communities and occupied various subaqueous and shallow water environments, such as tidal flats, potentially dating back as far as 3.4 billion years ago (Gehling 1999, Walter et al. 1980). However, there is a lack of study regarding the role of stromatolites in the life of early animals. Recent field investgations, led by our group, in Cooking Lake (Canada) have demonstrated that animals are burrowing into sediments and actively exploiting the microbial mats not only for food resources, but also for oxygen (Fig. 1C-E). Other extensive Ediacaran microbialites (e.g., Fig. 1F) have been discovered in recent field studies in the Byng Formation from the Jasper area (AB, Canada). Interestingly, the earliest biomineralized metazoans were described from a similar depositional environment (Fig. 1A, B: Byng Formation in the Mont Robson area (BC, Canada). Consequently, we aim to reinterpret the role of microbial mats in early animal life by examining: 1) trace fossils associated with fossilized microbial textures; 2) modern 'soft' biofilms that produce O_2 with fresh bioturbations; and 3) mineralized bioconstructions (stromatolitic biostromes and thrombolitic reef-mound carbonates from the Ediacaran period). These reinterpretations will enable us to speculate about the significance of microbial communities, such as oxygenic photosynthetic cyanobacteria, on early animal evolution.

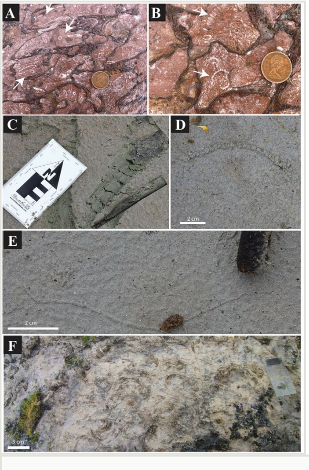

Figure 1. doi

(A, B) Pictures of the calcified-shelly macrofossils of *Cloudina* - *Namacalathus* in Ediacaran biostrom from the top of the Miette Group in the Mount Robson area (BC, Canada). Pictures are courtesy of Dr. Jon Husson from the University of Victoria. (C) Microbial mats in Cooking Lake sediments margin (Alberta, Canada). (D, E) Bioturbated sediments (back-filled burrow and elongated open-tunnel network) from Cooking Lake sediments margin. (F) Exemple of well-preserved stromatolite-reefs: large bedding plane displaying numerous stromatolites from the Ediacaran aged-Byng Formation in Jasper National Park (AB, Canada).

Keywords

Microbial Mats, Early animal life, Oxygen production, Stromatolites

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Conflicts of interest

The authors have declared that no competing interests exist.

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