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EDITED AND REVIEWED BY
Bruce S. Lieberman,
University of Kansas, United States

*CORRESPONDENCE
Farid Saleh,
✉ farid.nassim.saleh@gmail.com

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Editorial: Insights on the rise of animal life from Cambrian and Ordovician Lagerstätten

Farid Saleh^{1*}, Allison C. Daley¹, Bertrand Lefebvre² and
Khadija El Hariri³

¹Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland, ²Université de Lyon, Université Claude Bernard Lyon 1, École Normale Supérieure de Lyon, CNRS, UMR5276, LGL-TPE, Villeurbanne, France, ³Laboratoire Laboratoire de Géoresources, Géoenvironnement et Génie Civil (L3G), Faculté des Sciences et Techniques, Université Cadi-Ayyad, Marrakesh, Morocco

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Editorial on the Research Topic

Insights on the rise of animal life from Cambrian and Ordovician Lagerstätten

The Early Palaeozoic witnessed the swift emergence and diversification of most animal phyla alongside the establishment of modern-style ecosystems. Exceptionally well-preserved fossils from various Cambrian and Ordovician Lagerstätten provide valuable insights into this pivotal evolutionary phase. Palaeontological investigations describe taxonomic occurrences, anatomical innovations, and developmental patterns, and link these biological observations with characterisations of the abiotic environmental conditions, to achieve a holistic understanding of this time period.

This special volume gathers together publications on Cambrian and Early Ordovician Lagerstätten and provides detailed fossil descriptions for a variety of animals including annelids, arthropods, bryozoans, cnidarians, echinoderms, and scalidophorans. These works showcase the breadth of different approaches that can be applied beyond the descriptive, for example, with evolutionary analyses and studies on ontogeny, development, functional morphology and palaeoecology.

Important new results are revealed from a series of publications studying material from several Cambrian Lagerstätten in China. A new primitive polychaete is described from the Guanshan Biota by Zhao *et al.*, who argue that this annelid likely possessed strong sensory abilities owing to its bicellular eyes and possible nuchal organs. Zhao *et al.* also describe new bryozoan and cnidarian taxa from the Guanshan Biota, demonstrating that the epibenthic diversity of this Lagerstätte is higher than previously thought. Our understanding of Cambrian ecosystems is also enhanced by the discovery of well-preserved microscopic medusozoans from the Zhangjiagou section. Zhang *et al.* describe the detailed three-dimensional morphology of multiple ontogenetic stages that allow for a complete reconstruction of anatomical shape change during the development of this early cnidarian. The ontogenetic sequence of scalidophorans from the same section is also established in more detail than possible previously based on the discovery of new material described by Qin *et al.* This study reveals that the sclerites of this undetermined worm became more numerous and increased in size during growth. Our knowledge of Cambrian diversity and development is further enriched by a study conducted by Ma *et al.*, investigating the growth and development of the arthropod *Isoxys* from the

Qingjiang Biota. Tens of specimens of this arthropod reveal that its valves gradually elongated, and the ratio of cardinal spines and spherical eyes relative to the valve length significantly decreased during postembryonic development. The presence of evidence of brood care in some small specimens suggests that *Isoxys* may have exhibited reproductive abilities in its early life stage.

The special volume also features several publications focused on fossils from the Ordovician Fezouata Shale Lagerstätte in Morocco, focusing on two animal phyla—echinoderms and arthropods—that are relatively abundant at this site. Dupichaud et al. provide a detailed taxonomic treatment of solutan echinoderms, showing that they were more diverse than previously envisaged and establishing a new genus and species. Novel information on exceptionally preserved arthropods from the Fezouata Biota is also revealed in a series of papers. Potin et al. investigated over a hundred specimens of radiodonts and showed that filter-feeding taxa are more abundant than sediment-sifting or raptorial predators, which is likely a result of the Ordovician plankton revolution. Marrellid arthropods from the Fezouata Biota are also investigated. An article by Drage et al. describes marrellid exuviae, identifies the moulting suture location and suggests that the Fezouata marrellid likely exited the exoskeleton using posterior and upward movements, in a similar fashion to modern lobsters. Laibl et al. explore the morphology of early and late developmental stages of this marrellid and show similar appendage morphology and differentiation along the body between these stages, suggesting a simple model of niche differentiation between juveniles and adults living in nearby environments. Finally, in a broader paper examining fossils from several Palaeozoic Lagerstätten, Lustri et al. show that the developmental changes in Xiphosura are correlated with the exploitation of different environments throughout their evolutionary history. Taken together, all the studies from this special volume highlight the importance of establishing a clear taxonomic framework and considering both developmental and environmental parameters during ecological and evolutionary investigations.

In conclusion, it is rather clear that new palaeontological discoveries from fossil Lagerstätten and the application of a variety of conceptual approaches are driving recent advances in our understanding of the Early Palaeozoic. This special volume has delved into the ecology and evolution of numerous animal groups from that time interval. From newly discovered micro- and macro-organisms, annelid eyes, and the intricacies of early arthropod development to the role of plankton in shaping radiodont diversity and the fascinating realm of marrellid arthropods, these findings significantly contribute to our understanding of the diversity and dynamics of life in the Early Palaeozoic. As we peer through the lens provided by exceptionally well-preserved fossil Lagerstätten, the intricate evolutionary processes that have shaped life on our planet come increasingly into focus.

Author contributions

FS: Writing—original draft, Writing—review and editing. AD: Writing—review and editing. BL: Writing—review and editing. KE: Writing—review and editing.

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Conflict of interest

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