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Ediacaran diversity in space and time

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The Ediacaran Subcommission of the International Commission on Stratigraphy is diligently working toward the goal of subdividing the Ediacaran Period into precise and useful chronostratigraphic units. As emphasized by Xiao and colleagues in 2016, one of the most effective tools in this endeavor will be the use of index fossils. Our special issue serves as a presentation of ongoing research efforts aimed at advancing this task and contains explorations into taxonomy, taphonomy, and the diversity of life during the Ediacaran Period.

The fossils examined within this issue encompass the entire span of the Ediacaran Period, comprehensively represented by acritarchs from deposits from Brazil, China, and India; tubular fossils from Greenland and Mexico; and "vendobionts," or classic Ediacara biota, from Australia and China.

The distinctiveness of acanthomorphic acritarchs has long established them as valuable index fossils for stratigraphic correlation, and this is particularly true within the lower–middle Ediacaran System (Xiao et al., 2016). Herein, the Krol A Formation (northern India) microfossil assemblage is detailed, including the description of two novel species, *Cavaspina tiwariae* n. sp. and *Dictyotidium grazhdankinii* n. sp. Many of the taxa reported are also present in the Doushantuo Formation (South China), bolstering correlation with the earliest Doushantuo biozone (the *Appendisphaera grandis*–*Weissiella grandistella*–*Tianzhushania spinosa* Assemblage Zone) and expanding into the third biozone in the lower Doushantuo Formation when integrated with $\delta^{13}C$ chemostratigraphic data (Xiao et al., 2022). Notably, this work on the Krol A addresses critical assemblage gaps from lacking lithologies in South China, enabling the inter-basinal correlation of early Ediacaran strata between the Lesser Himalaya and the Yangtze Gorges regions. Previous investigations of the Doushantuo Formation have focused predominately on large acanthomorphic acritarchs, although new efforts considering smaller forms—those less than 200 µm in diameter—have identified seven biostratigraphically valuable species, five of which are reported for the first time from the Weng'an area (Wu et al., 2024). These smaller taxa not only facilitate enhanced correlations between the Doushantuo Formation of the Weng'an and Yangtze Gorges areas but may also be useful tools to validate proposed acritarch biozones in other Ediacaran localities, including Australia, Siberia, and the East European Platform. In addition, seven species of organic-walled microfossils are described for the first time from the Sete Lagoas Formation in the Januária area of Brazil, including the newly reported taxon *Ghoshia januarensis* n. sp. (Denezine et al., 2024). When combined with detrital zircon ages and previously described tubular taxa, these newly reported microfossils indicate a terminal Ediacaran age for the Sete Lagoas Formation.

The mid-Ediacaran is exemplified not by its microfossils, but by the global appearance of the complex, macroscopic vendobionts. These organisms, often called the "classic Ediacara biota," have been the subject of decades of study, yielding varied taxonomic assignments due to morphological variation and perhaps preservational influence, thereby hindering global correlation and underscoring the importance of taphonomic context. Here a reevaluation of elongate frond type materials from the Flinders Ranges reveals that taxonomic disparities stem from taphonomically induced morphological variation (Grimes et al., 2023). This work demonstrates that the studied arboreomorph specimens are conspecific and represent the full three-dimensional nature of the fossil frond across different preservational modes, designated herein as *Akrophyllas* n. gen. Further work from the Flinders Ranges reveals the new species *Tribrachidium gehlingi* n. sp. (Botha and García-Bellido, 2024), wherein the researchers demonstrate that this new species is found in the same beds as *T. heraldicum* Glaessner in Glaessner and Daily (1959) and shows statistically distinct morphological features. Moving into the late Ediacaran, a systematic report on *Charnia* from the Shibantan biota, Dengying Formation, South China, describes the new species *Charnia gracilis* n. sp. (Wu et al., 2022) and documents its potential two-stage growth model. Perhaps most important, this report expands both the paleogeographic and temporal ranges of the *Charnia* genus, as the first systematic description from the Shibantan biota and one of the youngest examples with the overlying Baimatuo Member having a recent radiometric date of ~543.4 ± 3.5 Ma.

Cloudinomorphs and other tubular forms have been identified as a primary tool for designating the terminal Ediacaran stage (e.g., Xiao et al., 2016; Selly et al., 2020). Modern analytical techniques have allowed for the reexamination of latest Ediacaran skeletal materials from the La Ciénega Formation, Mexico, yielding important new taxonomic, taphonomic, and paleoecological insights (Schiffbauer et al., 2023). These materials, formerly assessed by McMenamin (1985) nearly 40 years ago, now reveal a polytaxic assemblage preserved through two

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distinct mineralization pathways and provide novel insights into original shell rigidity and potential predator–prey interactions. Continued research on these materials holds promise for establishing clearer biostratigraphic correlations with deposits in the southwestern United States and elucidating predatory behaviors previously observed only from comparable Chinese and tentatively Brazilian fossils. New tubular forms have been described from the Portfjeld Formation of North Greenland. Although the affinity of these phosphatized tubular microfossils is uncertain, *Portfjeldia aestatis* n. gen. n. sp. exhibits comparable morphology to that of the larger *Ramitubus* from the Weng'an biota of South China (Willman and Peel, 2022).

The papers we have collected in this special issue provide a comprehensive overview that spans the entirety of the Ediacaran Period, not just in time but also in taxic groups from acritarchs and vendobionts to shelly tubes, and finally from globally distributed localities. This diverse body of research underscores the synergy of efforts needed to unveil the wealth of knowledge the Ediacaran Period still holds—including evolutionary dynamics, ecological interactions, and paleobiogeographic patterns—and reinforces the kinds of works needed to subdivide and facilitate global correlation of Ediacaran strata.

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Declaration of competing interests

The authors declare none.

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