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Peri-Gondwanan acritarchs and chitinozoans from the Lower–Middle Ordovician Lashkarak Formation in the Alborz Mountain Ranges, northern Iran: regional stratigraphical significance and palaeogeographical implications

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ABSTRACT

The Lashkarak Formation (Lower–Middle Ordovician) in the Gerdkuh locality, 10 km west of Damghan city, northern Iran, has been found to contain acritarchs and chitinozoans. This study aimed to understand these chitinozoan and acritarch successions as well as brachiopods in this part of the Alborz Mountains, in a novel manner. Ninety-seven surface samples from this succession were collected and analysed. Thirty samples yielded well-preserved palynomorph taxa such as acritarchs, chitinozoans, and scolecodonts, as well as graptolite remains. In total, 53 taxa were identified among the acritarchs (38 species belonging to 21 genera) and chitinozoans (15 species belonging to 10 genera). Although scolecodonts and graptolite remains were also observed, they were not studied in detail. The palynological analyses revealed the presence of several diagnostic acritarchs in the Lashkarak Formation, including *Vulcanisphaera simplex*, *Arbusculidium filamentosum*, *Coryphidium bohemicum*, *Dactylofusa velifera*, *Striatotheca mutua*, *Arkonia virgata*, and *Orthosphaeridium ternatum*. These acritarchs allowed the recognition of five acritarch assemblage zones. Similarly, seven chitinozoan biozones were recognised: *Eremochitina brevis*, *Desmochitina ornensis*, *Belonechitina henryi*, *Cyathochitina protocalix*, *Cyathochitina calix*, *Siphonochitina formosa*, and *Laufeldochitina clavata*. These findings confirm the inclusion of the Alborz Mountains in the peri-Gondwana palaeoprovince during the Early–Middle Ordovician. The co-occurrence of the acritarch and chitinozoan taxa with previously identified brachiopods allowed for the establishment of a more detailed Early–Middle Ordovician biozonation, demonstrating their potential usefulness for global chronostratigraphy. Based on palynological and brachiopod assemblages, a shallow marine inner shelf setting is suggested for the Early–Middle Ordovician at the Gerdkuh locality. Moreover, in this study, four new morphotype species were erected, consisting of one new chitinozoan (*Cyathochitina gerdkuhensis* sp. nov.) and three new acritarchs (*Baltisphaeridium razii* sp. nov., *Navifusa alborzensis* sp. nov., and *Orthosphaeridium iranense* sp. nov.). However, *Othosphaeridium* cf. *ternatum* was left in open nomenclature.

HIGHLIGHTS

- Palynomorphs from the Lower–Middle Ordovician (Lashkarak Formation) were recorded from the Alborz Mountains.
- 15 chitinozoan species (10 genera) were recorded from the Lashkarak Formation, S. Caspian Sea.
- 38 acritarch taxa (21 genera) were identified, indicating the N. Gondwanan Domain.
- The diagnostic acritarch taxa are *Arbusculidium*, *Coryphidium*, *Striatotheca*, and *Arkonia*.
- Chitinozoan biozones are *E. brevis*, *D. ornensis*, *B. henryi*, *C. protocalix*, *C. calix*, *S. formosa*, and *L. clavata*.
- *Baltisphaeridium razii* sp. nov., *Navifusa alborzensis* sp. nov., *Cyathochitina gerdkuhensis* sp. nov., and *Orthosphaeridium iranense* sp. nov. is recorded for the first time.
- A major hiatus corresponds to the Late Ordovician, Silurian, and Early–Middle Devonian.

KEYWORDS

Early Ordovician (Tremadocian–Floian); Peri-Gondwana; Lashkarak Formation; chitinozoan and acritarch biostratigraphy; Alborz Mountains; Middle Ordovician (Dapingian–Darriwilan); Northern Iran