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A Comparative Study of Three Types of Dasycladalean Algae (*Dasyporella*, *Vermiporella*, *Catenuporella gigantia*) Fossils from the Late Ordovician Beiguoshan Formation in Ordos

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Abstract

To explore the morphological characteristics and palaeoecological significance of Late Ordovician calcified dasycladalean algae, this study conducts a comparative analysis of *Dasyporella*, *Vermiporella* and *Catenuporella gigantia* based on field section data and thin-section rock samples collected from the southwestern margin of the Ordos Basin and Zhuzhai area in Yushan, northeastern Jiangxi. The results show that obvious differences exist among the three dasycladalean algae in thallus morphology, central cavity, calcified wall and living environment. Among them, *Catenuporella gigantia* is mainly distributed in high-energy reef facies environments; *Vermiporella* has a wide adaptive range; *Dasyporella* is mostly found in bank facies limestone. Different dasycladalean algal assemblages can reflect variations in hydrodynamic conditions and sedimentary environments, providing a basis for sedimentary facies identification and palaeoecological reconstruction of the Late Ordovician.

Keywords

Late Ordovician, calcified dasycladalean algae, morphological characteristics, palaeoecology

1. Introduction

Abundant calcified algal fossils are preserved in Late Ordovician carbonates on the western and southern margins of the Ordos Basin. Previous studies have systematically reported Late Ordovician calcified dasycladalean algae in this region. Nevertheless, regional palaeontological research has long focused more on reef-building organisms such as corals and stromatoporoids, while systematic studies on calcified algal groups remain relatively limited. Zhang Yueyang et al. performed systematic taxonomic and palaeoecological research on Late Ordovician calcified dasycladalean algae from the western and southern margins of the Ordos Basin, laying an important foundation for further understanding dasycladalean algal communities in this region [1].

In contrast, research on Ordovician calcareous algae in the Tarim Basin started earlier, with relatively systematic studies on the identification, classification and stratigraphic distribution of relevant genera and species. Liu Lijing et al. investigated calcareous algal fossils from the Upper Ordovician Lianglitage Formation

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in the Tarim Basin, further enriching taxonomic data of Ordovician calcareous algae in China [2]. A comparison indicates that there remains room for further research on morphological taxonomy, assemblage characteristics and palaeoecology of Late Ordovician dasycladalean algae in the Ordos Basin.

Combined with section data from the Ordos Basin, as well as field surveys and thin-section observations of the Zhuzhai Section in Yushan, northeastern Jiangxi, this study prepares thin sections and conducts microscopic identification on a large number of carbonate samples. It focuses on comparing the differences in morphological structure, occurrence characteristics and sedimentary environment among *Dasyporella*, *Vermiporella* and *Catenuporella gigantia*, and further discusses their implications for sedimentary facies identification and palaeoecological reconstruction.

2. Regional Geological Background and Stratigraphic Conditions

According to existing data, the Ordos Basin constituted the southwestern part of the North China Craton during the Early Paleozoic. Owing to intense regional plate movements in the Late Ordovician, the central basin was uplifted as a whole, while only its southwestern margin continued to subside, depositing carbonate-evaporite strata of the Pingliang Formation and Beiguoshan Formation. Thus, fossil samples in this study were collected from the Beiguoshan Formation.

The Beiguoshan Formation is dominated by carbonates of open platform and platform-margin shoal facies, with abundant reef-shoal biota. Fossils of corals, cyanobacteria and calcareous algae occur together, and the stratigraphic age corresponds to the early Katian of the Late Ordovician. Conodont and coral fossils provide reliable evidence for stratigraphic age determination.

Jiangshan and Changshan in western Zhejiang, as well as Yushan in northeastern Jiangxi, are collectively known as the “Three Mountain Area”. The Zhuzhai Village section represents a lithostratigraphic unit famous for Late Ordovician mud mounds and coral reefs, serving as a classic area for Ordovician research in China. Reef-building organisms of the Xiazhen Formation at Zhuzhai are mainly corals and stromatoporoids. The section consists of carbonates interbedded with clastic rocks, which is of great significance for studying marine biodiversity and palaeoecology during the Late Ordovician [3].

Comparative section studies reveal that subtle differentiation of sedimentary environments leads to obvious variations in enrichment degrees of the three dasycladalean algal fossils.

The Zhuzhai Section in Yushan, northeastern Jiangxi, is a classic Late Ordovician section in South China. Its strata belong to the Upper Ordovician Xiazhen Formation (formerly named Sanqushan Formation), consisting of interbedded carbonates and mud shales, with developed mud mounds and coral biostromes. Reef-building organisms are dominated by tabulate corals and stromatoporoids. Meanwhile, abundant dasycladalean algae (Chlorophyta) and calcified cyanobacteria (prokaryotes) are yielded. Its age corresponds to the late Katian of the Late Ordovician, close to that of the Beiguoshan Formation in Ordos, which enables palaeoecological comparison.

Based on cyanobacterial palaeoecology of the Zhuzhai Section, calcified cyanobacteria depend on light, indicating that the overall palaeowater depth of this section did not exceed 50 m. Among them, *Hedstroemia* and *Garwoodia* indicate restricted lagoon environments; *Girvanella* and *Rothpletzella* occur in coral biostromes, corresponding to shallow reef-shoal environments; *Acuasiphonoria* is found in limestone-shale interbeds in the lower part of the section, also indicating shallow water, which negates the previous view that these interbedded limestones belonged to deep-water facies [4]. This palaeoenvironmental proxy can assist in interpreting the occurrence environment of dasycladalean algae in the Beiguoshan Formation of Ordos.

A comparison of the two studied sections shows that the Beiguoshan Formation in Ordos represents platform-margin reef-shoal settings; the Xiazhen Formation at Zhuzhai contains multiple sub-environments including mud mounds, coral biostromes, lagoons and platforms. Subtle differences in sedimentary environments result in the differentiation of dasycladalean algae and cyanobacteria.

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3. Palaeontological Descriptions

3.1 Genus *Dasyporella* (*D. silurica*)

General morphology: Under thin-section microscopy, the thallus is straight cylindrical and mostly unbranched, occasionally with small protuberances. It is not twisted and interwoven like *Vermiporella*, which facilitates visual differentiation in thin sections. The outer diameter ranges approximately from 620 to 1000 μm, representing a medium size rather than the giant size of *Catenuporella gigantia*.

Internal structure: The central cavity is narrow, with a diameter ratio of inner cavity to outer thallus (d/D) of only 0.4–0.51, the minimum value among the three algal types. The calcified wall reaches 180–300 μm in thickness, showing a robust skeleton under microscopic observation. Lateral branches are slender and regularly arranged, obliquely penetrating the calcified wall. Lateral pores are small and uniform, with only primary branches and no secondary ramifications.

Occurrence: This genus can be observed in all four sections, but it is not highly abundant. It mostly occurs scattered in laminated shoal limestone and rarely accumulates individually in pure reef limestone. Straight thallus morphology enables rapid discrimination between *Dasyporella* and *Vermiporella*.

3.2 Genus *Vermiporella*

This genus is the most abundant in thin sections. Three species are identified in total, sharing unified general characteristics with minor dimensional variations.

Common morphology: Thalli are all curved tubes, commonly dichotomously branched. Some specimens interweave into a network, which serves as the core distinguishing feature from *Dasyporella*. Curved and intertwined thalli characterize *Vermiporella*. Lateral branches are short, oriented vertically or obliquely relative to the central cavity. The d/D ratio is generally above 0.55, much larger than that of *Dasyporella*, indicating a wider central cavity.

3.3 *Catenuporella gigantia* (New Genus and New Species)

Catenuporella gigantia is one of the key dasycladalean algal types observed in this study, with morphological features distinctly different from *Dasyporella* and *Vermiporella*.

Diagnostic features: The thallus is segmented, resembling connected thick pipe segments. Obvious segmentation notches can be seen in longitudinal sections. This unique structure is not developed in other Ordovician dasycladalean algae.

Size and internal structure: It is giant, with an outer diameter of 1000–3000 μm, the largest among the three algal types. The d/D ratio ranges from 0.63 to 0.67, with a broad central cavity. Lateral pores are wide and large; partial lateral branches develop small secondary ramifications. The calcified wall is 300–500 μm thick, the thickest of the three genera. Cross-sectional thin sections display dense honeycomb-like lateral pores.

Occurrence and distribution: It occurs abundantly only in reef facies limestone from the Shijiezi and Tiewadian sections, while sporadically present in shoal facies strata. This indicates that it prefers high-energy reef settings and requires stronger water disturbance.

4. Significance

This study demonstrates that sedimentary environments and stratigraphic correlation can be used to determine geological age and corresponding palaeontology. For example: *Catenuporella gigantia* only accumulates in reef limestone, representing well-circulated, high-hydrodynamic reef environments; *Vermiporella* has the widest adaptive range and survives in both reef and shoal settings, while fragile *Vermiporella* remains in low-energy mudflats; *Dasyporella* prefers laminated open shoals with moderate hydrodynamic conditions. Dominant algal taxa identified from field thin sections enable rapid discrimination between reef and shoal limestone, providing microfossil evidence for sedimentary facies division with strong practical value.

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References

[1] Zhang, Y. Y., Jiang, H. X., Wu, Y. S., Bao, H. P., Ren, J. F., & Huang, Z. L. (2020). Calcified dasycladalean algae fossils from the Late Ordovician on the western and southern margins of the Ordos Basin. Acta Micropalaeontologica Sinica, 37(3), 228–237. https://doi.org/10.16087/j.cnki.1000-0674.2020.03.003

[2] Liu, L. J., Yang, H. J., Pan, W. Q., & Wu, Y. S. (2012). Calcareous algal fossils from the Upper Ordovician Lianglitage Formation in Tarim Basin, Xinjiang, China. Acta Micropalaeontologica Sinica, 29(1), 18–38. https://doi.org/10.16087/j.cnki.1000-0674.2012.01.003

[3] Chen, Z. L., Yu, J. H., Jin, S. Y., Bian, L. Z., & Ju, T. Y. (1995). A new species of calcareous algae from the Upper Ordovician Sanqushan Formation in Huibu, Changshan, Zhejiang. Acta Micropalaeontologica Sinica, (2), 211–214. https://doi.org/10.16087/j.cnki.1000-0674.1995.02.010

[4] Wu, Y. S., Sun, X. F., Zhang, G. C., Qi, Y. A., Bao, H. P., Ren, J. F., & Huang, Z. L. (2020). Cyanobacterial fossils and their palaeoenvironmental significance from the Upper Ordovician Xiazhen Formation at Zhuzhai, Yushan, Jiangxi Province. Acta Micropalaeontologica Sinica, 37(1), 35–47. https://doi.org/10.16087/j.cnki.1000-0674.2020.01.003

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Conflicts of Interest

The author(s) declare no conflicts of interest.

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