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Research Advances

Discovery of *Shaanxilithes* from the Dengying Formation in the Yangtze Gorges area, South China, and its stratigraphic significance

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1. Objectives

Shaanxilithes is one of the potential biostratigraphic markers for the definition and correlation of terminal Ediacaran strata. They have been found in terminal Ediacaran siliciclastic successions from Shaanxi Province (Meyer M et al., 2012), Ningxia Hui Autonomous Region (Shen B et al., 2007), Qinghai Province (Shen B et al., 2007), Guizhou Province (Hua H et al., 2004), Yunnan Province (Zhang ZL et al., 2015) in China, and India (Tarhan LG et al., 2014), Siberia (Cai YP and Hua H, 2011) and Namibia (Darroch S et al., 2016). However, these fossils have never been found in the carbonate dominant Dengying Formation in the Yangtze Gorges area. Is the absence of *Shaanxilithes* in the Yangtze Gorges area due to the taphonomic biases? Or do these fossils occur in a certain horizon of the Dengying Formation whereas no one finds them? Whether *Shaanxilithes* exists in the Yangtze Gorges area or not is significant to interregional and intercontinental stratigraphic correlation and taphonomy. Here the authors present the new find of *Shaanxilithes ningqiangensis* in the Yangtze Gorges area (Fig. 1).

2. Methods

In order to find the *Shaanxilithes* in the Yangtze Gorges area, more than ten Late Ediacaran sections in the southeast of the Huangling anticline are investigated. Since the common occurrence of *Sinotubulithes* in Dengying Formation at the southern Shaanxi and the Yangtze Gorges area, the upper

Shibantan Member and the lower Baimatuo Member of Dengying Formation are the potential target beds. New road-cutting sections are better choices because the fresh outcrops are much easier to find the fossils.

3. Results

The new fossil site is beside a cement road at Zhelinziwan Village in the Yangtze Gorges area (Fig. 1b; E: 111°6'19.81", N: 30°48'37.80"). The Zhelinziwan section consists of the upper Shibantan Member and the lower Baimatuo Member of Dengying Formation. The Shibantan Member is dark thin-bedded limestone, and the Baimatuo Member is light massive dolostone. The fossils occur in the uppermost 3.1 m of Shibantan Member (Fig. 1c). Twenty-five slabs with several dozens of specimens are collected from the Zhelinziwan section. The specimens are repositied in the Wuhan Center of China Geological Survey, Wuhan City. The ribbon-shaped *Shaanxilithes ningqiangensis* preserved along the bedding planes (Fig. 1d–f). The color of the fossil body is black, while the matrix color is dark grey. There is no distinct initial or terminal part. Each *Shaanxilithes ningqiangensis* ribbon consists of a long set of closely spaced annulations. There are 10–15 annulations per centimeter. The widths of the annulations range from 0.9 mm to 4.4 mm. The lengths of the specimens can extend to 85 mm.

The occurrence of *Shaanxilithes ningqiangensis* in siliciclastic and carbonate successions indicates the *Shaanxilithes ningqiangensis* has a wide geographical distribution, making it a potential index fossil for biostratigraphic correlation of Late Ediacaran strata. The *Shaanxilithes ningqiangensis* also has the potential to improve the precision of the biostratigraphic correlation of terminal Ediacaran strata. For instance, based on the first appearance

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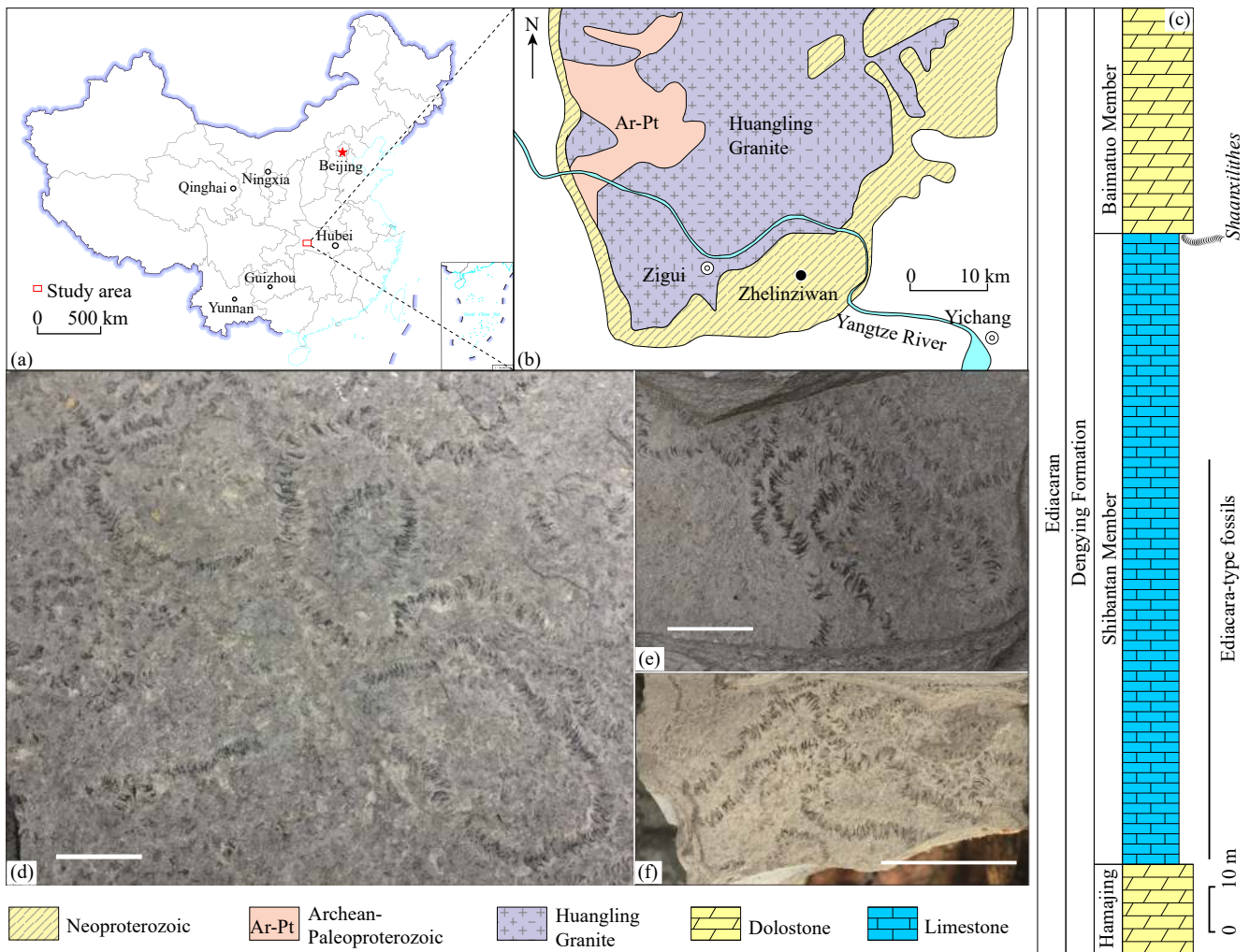


Fig. 1. Geological map, stratigraphic column, and hand specimen photograph of the *Shaanxilithes ningqiangensis*. a—study area in China; b—geological map of the Yangtze Gorges area showing the location of the Zhelinziwan section; c—stratigraphic column showing the fossil horizon of *Shaanxilithes ningqiangensis* and the stratigraphic range of Ediacara-type fossils; d–f—*Shaanxilithes ningqiangensis*, each white scale bar is 1 cm.

datum of *Shaanxilithes ningqiangensis*, the uppermost Shibantan Member of Dengying Formation in Yangtze Gorges area can correlate to the lower Gaojiashan Member of Dengying Formation in southern Shaanxi Province, the lower Taozhong Formation in Guizhou Province, as well as the middle Jiucheng Member of Yuhucun Formation in Yunnan Province. Additionally, the *Shaanxilithes ningqiangensis* in carbonate successions are appropriate for chemostratigraphic analysis. The integration of fossils and chemostratigraphic data in carbonate successions is beneficial to the Ediacaran subdivision and correlation.

4. Conclusion

The first discovery of *Shaanxilithes ningqiangensis* from the limestone of Shibantan Member of Dengying Formation at the Zhelinziwan section in the Yangtze Gorges area highlights the biostratigraphic significance of *Shaanxilithes* for the Late Ediacaran subdivision and correlation. *Shaanxilithes* is a potential index fossil to define the terminal Ediacaran stage.

CRediT authorship contribution statement

Zhi-hui An conceived of the presented idea. Zhi-hui An, Xiao-ming Zhao and Zhi-jun Niu developed the theory. Zhi-hui An and Zhi-hong Li collected the specimens and analyzed the fossils. Zhi-hui An wrote the original draft. Xiao-ming Zhao, Zhi-jun Niu, Zhi-hong Li and Qin Ye reviewed and edited the manuscript. All authors discussed the results and contributed to the final manuscript.

Declaration of competing interest

The authors declare no conflict of interest.

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