

Research Advances

Investigation of Controlling Factors for Growth in Stromatolites of the Tieling Formation, Jixian, Tianjin

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Objective

The Yan–Liao Aulacogen is located in the northern Sino-Korean Plate, buried under huge Meso–Neoproterozoic sedimentation, and is widely distributed in Beijing, Tianjin and Hebei. In these strata, several microbial mats occur, represented by four stromatolite assemblages within the Upper Precambrian stratotype section at Jixian, Tianjin. Stromatolites developed in the Mesoproterozoic strata of North China can provide good materials for investigating the controlling factors of their growth.

Our projects targeted the Tieling Formation stromatolites in Jixian of Tianjin in order to investigate their growth control factors. The Tieling Formation is located about 500 m east of Xiaolingzi Village, Jixian, Tianjin, and bears diverse stromatolites of perfect shape.

Methods

The distribution of living stromatolites is limited. Two of the well-known living stromatolites are located on Andros Island, Bahamas and in Shark Bay, West Australia. Using Charles Lyell's "the present is the key to the past" theory, we learn that the growth regularities of living stromatolites, as well as the relationships between their morphology and water flow and sunshine, allow us to acquire clues for studying fossil stromatolites. Eliminating growth factors such as growth velocity and respiration, stromatolite morphology is influenced by several external factors, such as sunshine, water depth, water currents, bedrock and sedimentation. All these can cause inclination of columns. Based on former paleomagnetic data, paleo-orientation and paleo-latitude of the North China Platform during the Tieling Formation period can be reconstructed, which can provide the source direction of sunshine. Additionally, the occurrences of stromatolites, the sedimentation environment and other related phenomena

give us more information on water depth, water currents and sedimentation.

Results

It is suggested that numerous stromatolites developed in the Tieling Formation probably grew up in the subtropical-temperate zone. Wu et al. (2005) recovered the drifting path of the North China Platform in the Meso–Neoproterozoic using paleomagnetic data. It is shown that the North China Platform was located between 15°N and 35°N, and rotated near 90° clockwise from the past to now, which means that the sunshine was coming from the south.

We investigated all stratum-imbedded stromatolites, and found one special in-situ well-preserved rock (Fig. 1a). This rock exposes three different sections, including one transverse section and two longitudinal sections, which expresses well the three-dimensional morphology of stromatolites. We found that in longitudinal section 1 (Fig. 1b), which is vertical to the direction of the paleocurrent (near E–W now, near N–S in the past), the stromatolites are in a regular column shape, with no change in width, whereas the West (former S) part of the laminae in the columns are higher than East (former N) part. It is suggested that sunshine came from the South at the time of the growth of the specimen. Furthermore, we speculate that sunshine could not only trigger higher growth but also wider towards water channels; however, due to water flow, such growth could not be preserved. In transverse section (Fig. 1c), concentric laminae in the West (former S) part are denser than in the East (former N) part, which is coincident with the phenomenon in longitudinal section 1. In longitudinal section 2 (Fig. 1d), which indicates the same paleocurrent direction (near N–S now, near E–W past), the stromatolites are remarkably elongated and inclined (to near S now, near E past). This phenomenon indicates the shape of the stromatolites is controlled

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Fig. 1. Photographs of in-situ rock (a), longitudinal section 1 (b), transverse section (c), longitudinal section 2 (d) of stromatolites in the Tieling Formation, Jixian, Tianjin.

mainly by the paleocurrent shown in this longitudinal section (near E-W formerly, and mainly from W to E).

Conclusions

In the condition of calm and wide water, stable and continuous sedimentation of the North China Platform, water flow and sunshine were two main controlling factors of stromatolite growth. Water flow could control the

morphology of the column, whereas, sunshine could only control the shape of the lamina.

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