Evolution pattern and paleogeographic distribution of Lower Permian carbonate buildups: A case study in eastern Inner Mongolia, North China

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Abstract

The Lower Permian carbonate buildups in eastern Inner Mongolia, North China comprise Asselian–Sakmarian phylloid algal-microbial reefs and skeletal-microbial mounds and Sakmarian–Kungurian skeletal mounds. The phylloid algal-microbial reefs were constructed by microbes and phylloid algae. Accumulated phylloid algae provided the attachment sites for microbial growth rather than building frameworks. By contrast, microbes made a primary contribution to the framework construction by encrusting the surfaces of phylloid algae and by infilling the inter-phylloid algal spaces. The skeletal-microbial mounds were formed by microbes and skeletal grains through repeating the following steps: 1) skeletal grains accumulated in situ, or after short-distance transportation; 2) microbes grew on the surfaces of skeletal grains and inter-grains spaces, eroding skeletal grains, inducing the nucleation of CaCO3 crystallites near the cell surface, and trapping and binding suspended lime mud from ambient water; 3) some positive topographies slightly higher than adjacent sediments were formed; 4) most microbes were preserved as peloids due to incompletely calcification. Compared with the skeletal-microbial mounds, microbes also played a significant role in constructing skeletal mounds, however most microbes decayed before being calcified or were completely occluded by micrite after calcification of sheaths, resulting in little microbial-associated sediments being preserved.
As mentioned above, carbonate buildups in the subtropical North China are characterized by microbial sediment with various proportions of skeletal grains, such as phylloid algae. They have similar reef-building organisms to the typical Tethyan buildups, but have a different construction model, which is related to seawater temperature resulting from paleolatitude and warm currents. As such, the subtropical North China buildups are considered as a subtype of the tropical Tethyan buildups.

In the sense of the evolution pattern, Lower Permian carbonate buildups show three phases at the global scale. The first phase (Asselian-Sakmarian) is marked by carbonate buildups constructed by phylloid algae, *Palaeoaplysina*, *Shamovella*, sponges and bryozoans. The second one (Artinskian) is represented by the vanishing of phylloid algae and *Palaeoaplysina* from carbonate buildups, due to the paleoclimatic transition from an icehouse to a greenhouse. The third phase (Kungurian) is characterized by the drastic decline of carbonate

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buildups in the subtropical Pangean domain, but well development in North China and the tropical Tethyan domain.

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