

Microbial Biomineralization Processes Forming Stromatolitic Dolostone From the Ediacaran in the Sichuan Basin, Northeast China

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ABSTRACT

The extraordinary abundance of dolomite in the Ediacaran Period challenges our understanding of Precambrian marine environments. Here we show that syndimentary marine dolomite precipitation was pervasive within Sinian (Same age with Ediacaran) carbonates from the Sichuan Basin, Southwest China. The Dengying Formation of Ediacaran was divided to 4 members. All the rocks are dolostones except the thin clastic rocks in Member 3 because of short regression. The microbialitic dolostone of Dengying Fm. include: Stromatolitic dolostone, Laminae dolostone, Thrombolitic dolostone, Cystose dolostone and oncolitic dolostone. These microbial dolostone are also good reservoir, which develop abundant dissolution pores and framework pores. With the High-resolution Scanning Electronic Microscope, we studied the microstructure of stromatolitic dolostone and found abundant spherical, oval-like dolomites, the size of which are 5-15 microns. It is the first time that the spherical dolomites were discovered in Ediacaran stage in Sichuan Basin. The Mg/Ca ratios of these spherical dolomites are 0.65-1.11. There are many nanoglobules on the surface of these spherical dolomites. Some extracellular polymeric substances (EPS) were also found under the SEM. With the studies of petrology, sedimentology and geochemistry, these microstructures are inferred to be the products of microbial biomineralization processes. The microbes can promote the precipitation of dolomite with 3 aspects: (1) The metabolic processes of microbes can secrete EPS, which has abundant groups (including Carboxyl, hydroxyl, amino acid, sulfate, sulfoacid, sulfhydryl). These groups have strong ability of complexing metallic ions and other ions (Bianchi, 2007). They can absorb Mg^{2+} , Ca^{2+} , Si^{4+} and lead to the forming of dolomites. (2) The microbes can form protein layers on their cell surfaces, which could be the nucleation center of dolomite (Schultze-Lam, 1992; 1994). (3) The abundance of the microbes can change the physical and chemical characteristics of water bodies (like pH, element abundance, etc). Some silicons were also detected under SEM, which show that the early-stage silicification preserved the microbes' cell and ultra microstructures. The discoveries of these kind of ultra microstructures would provide some intuitive evidence for the microbial origin dolostones in ancient strata.