

## **Neoproterozoic Microbialite Reservoirs in the Giant Anyue Gas Field of Central Sichuan Basin (South West China)**

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### **ABSTRACT**

Carbonates of Neoproterozoic (Edicaran) Dengying Formation in central Sichuan Basin are significant reservoirs of the recently discovered Anyue gas field. Stromatolites, thrombolites and microbial-related grainstones are abundant in this succession. Although experienced deep burial (up to 8km) and complex diagenesis in the geologic history, many microbialites remain porous and have porosity in excess of 10%. These microbialites are inferred to have been deposited in shallow subtidal to intertidal environments, favorable for cyanobacteria growth as well as development of primary and early diagenetic freshwater-leaching cavities, such as microbial framework and intergranular pores, freshwater dissolution vugs, birdeyes, laminoid fenestrae, etc. Cavities of microbialites were partially filled by successive cements that include bladed dolomite, saddle dolomite, quartz, fluorite, pyrobitumen and sparry calcite. The bladed dolomites, forming isopachous fringes, are interpreted to have been precipitated from contemporaneous seawater, based on their early formation in diagenetic sequence,  $\delta^{13}\text{C}$  and  $^{87}\text{Sr}/^{86}\text{Sr}$  values (+0.5~+2‰VPDB and 0.7088~0.7093, respectively) that are compatible with Edicaran marine depositional components, and high Na concentrations (around 600ppm). Saddle dolomite, quartz and fluorite host two-phase aqueous fluid inclusions that yield homogenization temperatures (140~220 degree centigrade) much higher than burial-induced temperatures the strata had experienced before oil emplacement, suggesting invasions of hydrothermal fluids. Hydrothermal fluid flows generally caused occlusion rather than dissolution of these microbialites, although in some cases a silica-rich fluid replaced dolomites and created some intercrystalline pores. Thereafter, oil charge occurred and paleo-oil reservoirs could be formed as indicated by the widespread pyrobitumen. Organic acid related to oil charge resulted in dissolution of some saddle dolomite and quartz cements, but the scale could be negligible. Minor calcite cements, the latest diagenetic phase in these microbialites, seem to have been precipitated during the uplift in Cenozoic. The case study of Neoproterozoic microbialites in Central Sichuan Basin highlights the significance of favorable sedimentary environment and early freshwater leaching rather than burial (hydrothermal) dissolution on reservoir development in deep burial successions.