ANALYSIS OF CARBONATE DIAGENESIS ON THE GREAT BANK OF GUIZHOU (SOUTH CHINA) USING GEOCHEMICAL, GEOTHERMOMETRIC, AND GEOCHRONOLOGICAL TECHNIQUES

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The Great Bank of Guizhou is a 2.5 km-thick isolated carbonate platform that formed during the Triassic Period within the Nanpanjiang Basin. A steeply dipping syncline reveals exposures of Early to Middle Triassic carbonates that are partially dolomitized. Previous studies suggested multiple modes of dolomitization, including early low temperature dolomite and later dolomite that formed at elevated temperatures. Vug and fracture-filling calcite postdates most dolomite.

We used a variety of analytical tools including fluid-inclusion microthermometry, clumped isotopes, C and O stable isotopes, $^{87}Sr/^{86}Sr$, trace elements including REE, and U-Pb geochronology. Primary fluid-inclusion data suggest dolomitization occurred over a range of temperatures from 100°C to 180°C, increasing with time, in the presence of 5 to 17 wt. % brine. Calcite entrapment temperatures for primary fluid-inclusion assemblages varied from <~50°C to 108°C. Carbonate clumped isotope (Δ_{47}) measurements on replacive dolomite and vein calcite samples yielded temperatures of 144°C and 52°C, respectively. Fluid-inclusion and clumped isotope temperature estimates are consistent with burial reconstructions.

The $\delta^{18}O_{(VPDB)}$ values for dolomite range from -7.68‰ to -1.53‰, and $\delta^{13}C$ values range from 0.37‰ to 3.12‰. Vein and pore-fill calcite $\delta^{18}O$ values ranged from -17.64‰ to -1.53‰ and $\delta^{13}C$ values ranged from -1.67‰ to 3.33‰. For dolomite, calculated initial $\delta^{18}O_{(SMOW)}$ compositions for H_2O were +11 to +12‰, consistent with fluid inclusion salinities. Some calcite precipitated above 100°C and yielded similar $\delta^{18}O_{(SMOW)}$ compositions for H_2O, consistent with precipitation from a brine. Other lower temperature calcite yielded $\delta^{18}O_{(SMOW)}$ compositions for H_2O of –6‰, suggesting meteoric origin.

REE signatures are variable between samples and minerals, consistent with a diverse fluid history. LA-ICP-MS U-Pb geochronology using the Drost et al. (2018) approach of selecting pixels based on criteria in Iolite4 confirm that dolomitization occurred episodically during the Mesozoic Era. Some replacive dolomite formed during mid-late Triassic, while other replacive dolomite and dolomite cement formed as late as the Cretaceous Period (129 ± 30.9 Ma). Calcite yielded less reliable, but clearly younger Cenozoic age dates.