Middle Permian Coarse-Crystalline Dolostone Reservoirs in the Northwest Sichuan Basin (Southwest China): Their Formation and Evolution

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Abstract

Middle Permian Coarse-crystalline Dolostone Reservoirs in the Northwest Sichuan Basin (Southwest China): their Formation and EvolutionThe Middle Permian dolostones in the northwest Sichuan Basin (Southwest China) represent significant exploration targets in recent years because commercial natural gas accumulations have been discovered therein. These coarse-crystalline dolostones, previously interpreted as hydrothermal dolomite (HTD) related to the end-Middle-Permian Emeishan Large Igneous Province (ELIP) volcanism, were selected for a combination of in situ U-Pb dating, clumped isotope (Δ47) thermometry, as well as carbon, oxygen, strontium isotope ($\delta^{13}C$, $\delta^{18}O$ and 87Sr/86Sr) and trace element analyses, with an attempt to correlate their formation and evolution to the geodynamic evolution of Sichuan Basin, thus better understanding the distribution of reservoir geobodies in the subsurface. The U-Pb ages of the replacive dolomites (240 to 233.8Ma) were significantly younger than the eruption of ELIP volcanism (~263 to 258Ma) impling that dolomitization was probably unrelated to this magmatic event as previously assumed. Instead, these younger ages point to a Middle to Late Triassic dolomitization event that was probably linked to the Late Triassic compression of the Northern Longmenshan Fold-Thrust Belt (LFTB). Integrated U-Pb ages and Δ47 thermometry, together with C-O-Sr isotope and trace element geochemistry, indicate that these coarse-crystalline replacive dolomites were formed at burial (~2.5 to 2.8km) by hot (100~120°C) fluids that

were derived from Middle Permian or younger seawater, and a later stage (~13 to 6.8Ma) saddle dolomite cements were precipitated from a hydrothermal fluid with elevated 87Sr/86Sr during the Cenozoic deformation of the Northern LFTB. Vugs and intercrystalline pores in the Middle Permian dolostones were interpreted to be inherited from the precursory limestones that had experienced meteoric leaching during the Late Permian uplift. This study demonstrates the potential of combined in-situ U-Pb geochronology, Δ47 , thermometry, as well as isotopic and trace element geochemistry for better understanding the formation and evolution of ancient dolostone reservoirs.

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