Influence of hydrothermal-TSR processes on development of deep dolomite reservoir

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Co-occurrence of saddle dolomite, pyrite and pyrobitumen in dissolution pores of deep dolomite in Sinian Dengying Formation in Sichuan Basin, southern China, indicates the dolomite was altered by hydrothermal-TSR (thermochemical sulphate reduction) processes. However, characteristics and mechanism of the co-altering processes have yet not been elucidated. Our study shows that the peaks of homogenization temperatures (T_h) of the fluid inclusions in coarse crystalline dolomite filling in dissolution pores are between 220 °C and 230 °C. Most of the pore-filling dolomite has positive Eu anomaly with δEu values from 1.27 to 2.70. Oxygen isotope composition of the pore-filling dolomite is obviously light; and $\delta^{18}O_{PDB}$ values are between -12.8‰ to -7.2‰ and -10.1‰ on average. Fluid inclusions and geochemistry results indicate that the pore-filling dolomite is hydrothermal dolomite derived from hydrothermal fluid. Pyrite generally occurs as granular cubes and in symbiosis with the pore-filling dolomite. The $\delta^{34}S$ values of pyrite range from 8.9 ‰ to 23.4‰, with the average of 20.5‰, indicating that the reduced S^{2-} in pyrite was the result of TSR. Hydrothermal activity during the burial process of the Dengying Formation dolomite provided high temperature environment necessary for TSR to take place. The high temperature also accelerated petroleum in the pores thermally converted into scaly or sphere-shaped pyrobitumen with high reflectivity. H_2S and CO_2 derived from TSR could not only further dissolve the deep dolomite reservoir, but also help to maintain pre-existing reservoir space during deep burial diagenesis.