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Experimental study on dynamic pore-fracture evolution and multiphase flow in sandstone reservoirs

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The CO_2 mineralization in sandstone is directly related to the CO_2 spatial distribution and multiphase flow behaviors in complex pore structure. In this study, the dynamic evolution of pore-fracture induced by stress disturbance and CO_2 spatial distribution and migration were investigated by a self-developed online LF-NMR triaxial stress system, the T_2 spectrum, NMRI and volume strain were monitored. The results show that dynamic variation, obvious change, and slight response occurred at the macropore (MP>50ms), mesopore (5ms < PP < 50ms), and micropore (AP<5ms) with the increase of loading stress, and CO_2 storage is mainly distributed in mesopore and macropore. The pore-fracture successively experienced compression, expansion and coalescence, in which mesopore and macropore controls the microcrack initialization and connection. The permeability is negatively correlated with the heterogeneity of the pore-fracture structure, and is exponentially related to the total porosity dominated by macropore porosity. Longitudinal shear cracks are not conducive to the CO_2 mineralization, which is mainly composed by the microcracks. The thief channel occurred at the plastic stage about 70-90% peak strength, which is decremental to CO_2 mineralization. The findings provide significant insight into the optimized design of CO_2 storage practice.