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The controlling factors and mechanism of CO2 enhancing shale gas recovery and geological sequestration

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To explore the adsorption affinity of CO_2 relative to CH_4 in shale gas reservoir, the binary gas isothermal adsorption instrument is utilized to test the adsorption behavior of pure CH_4, CO_2, and their mixed gas, and selectivity coefficient (Sc) is used to represent the adsorption affinity of CO_2 relative to CH_4. Then, the influence of shale organic geochemical parameters, mineralogical composition, pore structure parameters, and feed gas composition on Sc are discussed. Sc ranges from 2.13 to 4.69 affected by feed gas composition and shale property. It decreases with higher CO_2 mole fraction, whereas it increases with higher TOC and clay content. A high CO_2 mole fraction leads to a reduction of Sc. TOC and clay content control the adsorption capacity and Sc by influencing the pore structure of shale. Both pore volume (PV) and specific surface area (SSA) have clear correlations with V_L and Sc, especially the former, and PV is dominated by micropores and mesopores. SSA is dominated by micropores, followed by mesopores. Furthermore, the contribution of ultra-micropores to PV and SSA is much higher than middle-micropores and super-micropores. The development of micropores and mesopores is controlled by TOC, one of the vital factors to improve CH_4 recovery and carbon sequestration capacity after CO_2 injection. The injection of CO_2 into shale gas reservoir show a promising application prospect in improving CH_4 recovery and carbon emission reduction, and the leakage risk is low after CO_2 sequestration.