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Insights from reaction-transport model on feldspar dissolution and secondary mineral precipitation mechanisms in deep coal measure tight sandstone reservoirs

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The effect of organic acids in coal measures on feldspar dissolution and secondary mineral precipitation in tight sandstone reservoirs of coal measures has not been quantitatively evaluated. The mechanism of feldspar dissolution and secondary mineral precipitation in the coal measure reservoir of Badaowan Formation are discussed by means of petrology, geochemistry and numerical simulation. The results of petrological analysis indicate that the sandstone near the coal seams exhibits strong feldspar dissolution, with minimal precipitation of kaolinite and quartz, suggesting that the coal-bearing sandstone reservoir has strong mass transfer characteristics. Simulation results show that widespread feldspar dissolution initiates within the temperature range of 50~80°C, while substantial precipitation of secondary minerals occurs between 80°C and 110°C. Secondary porosity are primarily formed during both these temperature ranges: 50~80°C and 80~110°C. The chelation of oxalic acid facilitates the dissolution of feldspar by forming Al chelates in solution. The formation of Al chelates inhibits the precipitation of kaolinite, indirectly promoting the precipitation of quartz. The dissolution rate of feldspar increases significantly with the increase of simulated temperature, which promotes the precipitation of secondary minerals in the fluid. The flow rate of formation water affects feldspar dissolution and secondary mineral precipitation by controlling the solute concentration in the fluid. In a low-temperature "open" diagenetic environment, rapid flow rates can transfer solutes over long distances, inhibiting the precipitation of secondary minerals. In a high-temperature "closed" diagenetic environment, solutes cannot be transported away, resulting in a gradual increase in solute concentration that inhibits feldspar dissolution and promotes the precipitation of secondary minerals. Considering the widespread occurrence of Jurassic coal measure reservoirs, this new model of feldspar dissolution and secondary mineral precipitation may provide insights into the mechanisms of secondary pore formation in coal-bearing tight sandstones in other basins.