Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.26526

Impact of Temperature and Pressure on CO_2 Mineral Trapping in Arkosic Reservoir with $CaCl_2$ – type Formation Water

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The feasibility of CO_2 geological storage in arkosic sandstones has been investigated by short-term physical simulation experiments using six sandstone samples from the Eocene sandstone reservoir in the Bonan Subsag, Bohai Bay Basin, East China, under a range of temperature and pressure conditions. The aqueous solution used in the experiment mimics the elemental compositions of the present oilfield formation water. The reservoir sandstone samples were ground to powders prior to the experiment. Then 10mL aqueous solution and 2g sandstone powders were fully mixed and assembled in a high pressure, high temperature (HPHT) batch reactor. The experimental temperatures and corresponding pressures were set to 50°C/4 MPa, 100°C/6 MPa and 140°C/9 MPa, respectively. All experiments were carried out for 96 hours. Scanning Electron Microscopy (SEM) and energy dispersive spectroscopy (EDS) analysis of the samples after experiments show calcite precipitated whilst feldspar partly dissolved. Feldspar dissolution is likely to promote the calcite precipitation by continuously consuming acid in the aqueous solution. To rationalize the mechanism of mineral changes in the experiments, a three-stage chemical reaction process of CO_2 geological storage is proposed. In **Stage**Ⅰ, CO_2 dissolved and saturated in saline aqueous solution due to high pCO_2, producing $CO_{2\,(aq)}$, H^+, HCO_3^- and CO_3^{2-} for the subsequent reactions. In **Stage**Ⅱ, the original calcite cement was dissolved rapidly due to a decreasing pH, while the dissolution rate of ankerite and feldspar remained relatively slow. Acid was consumed in this stage and pH gradually became conducive to calcite reprecipitation. In **Stage** Ⅲ, feldspar continued to be dissolved while calcite and kaolinite precipitated from aqueous solution. Results of Thermal Gravimetric Analysis (TGA) and Scanning Electron Microscopy (SEM) of the experiments indicate that the sample YX981 obtained the greatest amount of carbonate precipitation, which was identified to increase at high temperatures and with high content of original silicate minerals, while pressure has no obvious effect on CO_2 mineral trapping. In summary, $Es3^2$ member layer where sample YX981 was collected was evaluated as a favorable CO_2 mineral trapping site in Bonan Subsag.