Laboratory experimental study of CO_2-brine-synthetic sandstone core interaction under high P/T reservoir conditions

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To understand the interaction of CO_2 and sandstone after CO_2 injection under ultra-pressure reservoir conditions, we carried out CO_2-brine-rock experiments using a batch stainless steel reactor under high pressure/temperature reservoir conditions (150°C and 48 MPa, pressure coefficient=1.5). Six synthetic sandstone cores having the same mineral constituents with the real reservoir sandstone are used in the experment.

Changes in the ionic chemistry of the outlet solution, combined with core scanning electron microscopy (SEM) analysis of the core pre- and post-experiments reveal new insights into CO_2–brine–rock interactions. Minerals such as quartz, potassium (K) feldspar, albite, dolomite and calcite are variably dissolved after the experiments. Calcite is the mineral mostly affected by dissolution, secondly by dolomite, followed by the feldspar minerals, while dissolution of quartz is mimimal. Secondary porosity increased gradually with reaction time, whereas the primary porosity decreased. Core porosity increased substantially after the experiment. The increase in the porosity is primarily from the dissolution of carbonate minerals. No CO_2 sequestration minerals were precipitated after the experiment. Precipitation of carbonates related to CO_2 injection may have been inhibited if the solution did not attain the critical saturation state required for nucleation. The results provide some new insights into CO_2 trapping mechanisms in high pressure/temperature reservoirs, and into the understanding of geochemical reactions in CO_2-brine-rock systems that is particularly relevant to the geologic CO_2 sequestration.