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CO_2-brine-rock interaction: Dissolution / Precipitation of carbonate minerals during geological sequestration

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Deep saline aquifers offer maximum storage potential and a promising sink for geo-sequestration of greenhouse gas CO_2. Therefore, a better understanding of CO_2-brine-rock interaction is needed to ensure safe and sustainable implementation of geological CO_2 sequestration in these formations. In this work, carbonate cores saturated with synthetic brine samples were exposed to supercritical CO_2 ($scCO_2$) in order to investigate the role of geochemical reactions during CO_2 sequestration. A series of laboratory experiments are conducted using core flooding apparatus at Texas University, Qatar (TAMUQ) under different salinity and pressure conditions. The laboratory study reported here investigated the changes in chemical composition of the carbonate formation upon injection of $scCO_2$ with help of XRD, FeSEM and TEM image analysis. Comparison of both pre and post flooding experiments revealed that porosity and permeability measurements of all core samples found to increase. Analysis of XRD showed intense peaks of post-flooded samples and FeSEM images showed that there was some dissolution and precipitation of minerals after the CO_2 flooding emphasizing on solubility trapping being the most dominant trapping mechanism. The results offer a new domain on the evolution of morphological changes on CO_2-brine-rock interface along with better contrast for understanding alterations in porosity and permeability of formation rocks at geo-sequestration sites. The crucial information obtained from this work can be utilized for instigating future development of full-field CO_2 geo-sequestration projects into saline carbonate aquifers.
Keywords: Global warming, geo-sequestration, CO_2-brine-rock interaction, morphological changes