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Field Scale Insight towards Understanding the Impact of Aquifer Properties on the Extent and Timeline of CO_2 Trapping

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Geologic CO_2 sequestration in porous saline aquifers is a promising approach to reduce atmospheric concentrations of CO_2 and provide large scale CO_2 storage. Once injected, CO_2 will dissolve into the brine to create an acidic environment, resulting in dissolution of primary formation minerals. Released ions can reprecipitate as secondary minerals, including carbonate minerals which securely trap injected CO_2. This mineral trapping is highly desirable as it is the most secure CO_2 trapping mechanism. Reactive transport simulations provide the opportunity to analyze the spectrum of factors that influence geochemical reactivity in the storage aquifer and understand which factors are most important for promoting mineral trapping. In this work, reactive transport simulations are leveraged to enhance understanding of the influence of varying aquifer properties on the overall CO_2 trapping potential. The aquifer properties considered here include porosity, permeability, depth, and carbonate composition. A controlled system of field scale simulations are carried out successively varying aquifer properties to understand the impact of each unique property on CO_2 sequestration. For each simulation, the amount of gaseous, aqueous, and mineralized CO_2 are tracked and compared. Simulations reveal that the considered aquifer properties impact the sequestration efficiency, defined as the rate at which the CO_2 injected into the aquifer is converted to aqueous or mineralized CO_2. Based on the studied properties, the aquifer carbonate composition has the least impact on sequestration efficiency while the depth of storage has the largest.