GEOCHEMICAL MODELING OF EOR WITH CO_2 AT THE NORTHWEST MCGREGOR OIL FIELD

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ABSTRACT

Injection of carbon dioxide (CO_2) for the purpose of enhanced oil recovery is widely regarded as one of the key commercial applications of geological storage and provides valuable insight into other large-scale projects aimed at reducing CO_2 emissions to the atmosphere. The Plains CO_2 Reduction (PCOR) Partnership, one of the seven U.S. Department of Energy National Energy Technology Laboratory Regional Carbon Sequestration Partnerships, conducted a project in the Northwest McGregor oil field in North Dakota to determine the effects CO_2 has on the productivity of the reservoir, wellbore integrity, and the carbonate formation into which the CO_2 was injected. The method used in this project was huff 'n' puff, whereby 440 tons of supercritical CO_2 was injected into a well over a 2-day period and allowed to "soak" for a 2-week period. The well was subsequently put back into production to recover incremental oil. This paper outlines the approach and current observations derived from numerical modeling and laboratory simulations of potential geochemical reactions to evaluate the short-term risks for operations (e.g., porosity and permeability decrease) and long-term implications for CO_2 storage via mineralization. The integration of data obtained during mineralogical analyses, fluid sampling, and laboratory experiments proved to be key factors for the better understanding of the dynamic geochemical processes that happen in the reservoir after CO_2 injection. Numerical modeling results suggest that the already acidic and highly saline environment (pH <4.5 and total dissolved solids ~300,000 mg/kg) of the Northwest McGregor oil field should not experience any significant changes in mineralogy as a result of CO_2 injection, especially in the near term, which correlates with the postinjection field geochemical analyses.