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Experimental Observations of SC–CO_2 Injection and Reservoir Monitoring under Representative Reservoir Conditions

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ABSTRACT

Laboratory measurements that utilize supercritical CO_2 (SC–CO_2) are challenging due to its ability to permeate through commonly used sleeve materials. Additionally, stable temperatures and pressures are required to maintain super critical conditions. The described experimental design is tailored to simulate reservoir dynamics and suggest calibration measurements for modeling and monitoring of SC–CO_2 injection.

A Berea sandstone sample with a porosity range of 18–20% was saturated with 30,000 ppm brine to represent a low salinity, average quality sandstone reservoir. SC–CO_2 was injected into the brine-saturated Berea sandstone sample while maintaining an effective stress condition of 2500 psi. Experiments were carried out at both ambient and at high temperatures (120 Celsius) to observe variations on the SC–CO_2 flow. Resistivity and acoustic velocities were acquired over the length of the sample throughout the duration of the experiment to monitor the injection and saturation distribution of the fluids. Changes in the profiles of the velocity and the resistivity give an insight into the interaction between the SC–CO_2 and the brine under representative stress conditions. Initial observations indicate a SC–CO_2 breakthrough after 0.3 PV were injected at 0.128 cc/hr flow rate, where a sharp increase in resistivity as well as a decrease in compressional velocity measurements were observed.

Similar measurements performed through research projects have been used to demonstrate monitoring techniques, and to confirm the applicability of the Biot-Gassmann model to describe changes in the compressional velocity due to SC–CO_2 injection. The aim of this study is to observe SC–CO_2 flow behavior at different temperatures and at in-situ (high stress) conditions to validate applicable models for the compressional, shear wave and resistivity change. Published literature largely represents measurements performed at lower temperatures and pressures. The described experi-

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ments aim to deploy a commercially viable technique to use for CO_2 sequestration model calibration and subsequent monitoring validation.