INVESTIGATING THE IMPACT OF CO_2 ON SEISMIC WAVE ATTENUATION

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ABSTRACT

Carbon capture and storage (CCS) is an important process to reduce atmospheric CO_2 levels. Injection of CO_2 into subsurface units such as depleted hydrocarbon reservoirs or saline aquifers serves as the primary storage method in these CCS efforts. Time-lapse seismic data is required to track CO_2 plume migration and ensure containment. The waves in these seismic surveys experience attenuation while propagating through CO_2-saturated reservoirs, which is attributed to wave-induced fluid flow (WIFF) and wave-induced gas exsolution-dissolution (WIGED). Neglecting the impacts of this attenuation can cause inaccurate interpretations of the data used to monitor CO_2-injection sites. This study seeks to quantify the attenuation impacts caused by the WIGED mechanism, which has been neglected in many previous works. To investigate the WIGED mechanism, an experiment was conducted on a fluid mixture expected to represent the contents of a CO_2 plume. The results of this experiment supported the attenuation value assigned to rock units containing injected CO_2. A geologic model representing a CO_2-injection site in a saline aquifer capped by a structural trap was developed. Simulations were run on this geologic model using seismic modeling with finite differences (SOFI 2D). Viscoelastic simulations accounting for attenuation were compared to elastic simulations where no attenuation occurred. Cross-correlation analysis between elastic and viscoelastic datasets targeted reflections impacted by attenuation. Results show that waves traveling through the CO_2-saturated region exhibit reduced amplitudes and phase shifts relative to elastic datasets. This analysis highlights the need to incorporate attenuation in seismic-monitoring workflows to improve the accuracy of CO_2 plume storage assessments.

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