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Monitoring Field Scale CO_2 Injection from Time-lapse Seismic and Well Log, Integrating with Advanced Rock Physics Model at Cranfield EOR Site

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Abstract

Causes and effects of global warming have been highly debated in recent years. Nonetheless, injection and storage of CO_2 (CO_2 sequestration) in the subsurface is becoming increasingly accepted as a viable tool to reduce the amount of CO_2 from the atmosphere, which is a primary contributor to global warming. Monitoring of CO_2 movement with time is essential to ascertain that sequestration is not hazardous. A method is proposed here to appraise CO_2 saturation from seismic attributes using differential effective medium theory modified for pressure (PDEM). The PDEM theory accounts pressure-induced fluid flow between cavities, which is a very important investigation in the CO_2-sequestered regime of heterogeneous microstructure. The study area is the lower Tuscaloosa formation at Cranfield in Mississippi, USA, which is one of the active enhanced oil recovery (EOR), and CO_2 capture and storage (CCS) fields. Injection well (F1) and two observation wells (F2 and F3) are present close (within 112 m) to the detailed area of study for this region. Since the three wells are closely situated, two wells, namely injection well F1 and the furthest observation well F3, have been focused on to monitor CO_2 movement. Time-lapse (pre- and post-injection) log, core and surface seismic data are used in the quantitative assessment of CO_2 saturation from the PDEM theory. It has been found that after approximately 9 months of injection, average CO_2 saturations in F1 and F3 are estimated as 50% in a zone of thickness ~ 25 m at a depth of ~ 3 km.

Key words: effective medium theory, time-lapse data, CO_2 movement, rock physics model, Cranfield.

Full text is available at
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