Sensitivity analysis of Tuscaloosa sandstones to CO2 saturation, Cranfield field, Cranfield, MS

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Abstract:
The study of the seismic response of reservoirs containing injected CO2 is important because it will improve monitoring and characterization of sites used for CO2 utilization and storage. We investigated the sensitivity of the seismic properties to CO2 saturation of the Cranfield injection site using rock physics modeling, fluid substitution, amplitude variation with angle (AVA), and statistical classification. Rock physics models quantitatively linked the elastic properties to variations of CO2 saturation, lithology, and cement content. We modeled velocity and density logs with different fluid compositions. With seismic properties from to these different fluid compositions, we computed (1) AVA responses through Monte Carlo simulations and (2) probability density functions for statistical classification. Rock physics modeling indicated that the upper reservoir is a cemented sandstone and the lower portion a poorly to well sorted mixed lithology sandstone. Consequently, AVA illustrated that the stiff reservoir masked the seismic response due to fluid changes. Statistical classification differentiated between CO2 and brine, with the ratio of compressional to shear wave velocity (Vp/Vs) used as a discerning parameter. Accordingly, these seismic-based tools, applied to relatively high-resolution data, showed the sensitivity of the elastic properties of the Cranfield reservoir to modeled changes of CO2 saturation.