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Use of Time-Lapse Shear Wave Anisotropy for Dynamic Characterization of the San Andres Carbonate Reservoir

Dynamic reservoir characterization is a term used to describe the behavior of a reservoir over time with the idea of improving or enhancing reservoir performance. Such behavior is controlled by production and injection that produce changes in pressure, saturation, viscosity and density of fluids present in the reservoir. At Vacuum Field a CO2 enhanced recovery program was conducted and time lapse, multicomponent seismic was the tool used to monitor the changes related to fluids within fractures and pore space due to the injection of CO2. In this study, changes in seismic velocities are analyzed; particularly, changes in the velocities of polarized shear waves. Polarization of shear waves happens due to the presence of oriented fractures or aligned low aspect ratio pores causing the effect of shear wave anisotropy. If fluid saturation, fluid type or pressure change within the fractures over time then the effect could be observed on both polarized waves as a time lapse shear wave anomaly. The time lapse anisotropy anomalies observed from shear data indicate that the flood bank tends to concentrate between the rows of CO2 injectors. The CO2 tertiary flood bank did not develop parallel to the line of injectors, instead follows the gradient of the porosity and permeability development as well as fracture trends parallel to a fault that runs across the area. Time lapse shear wave anisotropy anomalies are developed in the vicinity of two wells where CO2 breakthrough has already occurred.