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Paul (Mitch) Harris[1] (1) ChevronTexaco E & P Technology Company, San Ramon, CA

Crosswell Seismic in Carbonate Reservoirs - Examples of High-Resolution Reservoir Delineation

Crosswell seismic tomography provides better reservoir resolution than surface 2D or even 3D data; therefore there should be value added in reservoir delineation. Examples of crosswell seismic data from two U.S. Permian Basin fields illustrate the resolution and some potential applications of this type of data: (1) defining greater geologic detail between wells (heterogeneity of reservoir), (2) recognizing laterally continuous zones for improved development (well positioning, completions, injection), and (3) input for reservoir models (layering and assigning porosity).

In the first example, the producing formation is limestone with minor dolomite and shale. 3D seismic and downhole log data suggest lateral discontinuities but details are ambiguous due to the poor resolution. Crosswell data defines the nature of some of the reservoir discontinuity, in that clinoforms which are imaged can potentially isolate reservoir compartments. A comparison with outcrop facies geometries provides some sense of the reservoir facies to be expected between wells.

The second example is a diagenetically complex cyclic shelf dolomite. Variations in amplitude on the crosswell data are the most striking lateral features, and nearly every positive-amplitude event coincides with a significant increase in velocity on sonic logs. Both the seismic and log data respond to the same diagenetic overprint and its resulting petrophysical characteristics; therefore log-derived facies relate to the crosswell data better than core lithofacies. Comparing crosswell data with geostatistical porosity models to further analyze the potential imaging of lateral porosity variation suggests lateral changes in porosity of less than 56 m but more than 15 m are being imaged.