

Raef, A. E., Miller, R. D., Byrnes, A. P., and Harrison, W. E., 2005, Rock physics and seismic-modeling-guided application of 4D-seismic attributes to monitoring enhanced oil recovery CO<sub>2</sub> flood in a thin carbonate reservoir, Hall–Gurney field, Kansas, U.S.A. [abs.]: American Association of Petroleum Geologists, June 19–22, Calgary, Alberta

The efficiency of enhanced oil recovery (EOR) programs in carbonate reservoirs rely heavily on having an accurate reservoir characterization. It is advantageous that we have accumulated reservoir knowledge inferred from production history and/or legacy 3D seismic data. 4D/time lapse seismic monitoring of a pilot carbon dioxide flood in a thin, shallow-shelf, oomoldic carbonate reservoir in Hall Gurney field, Kansas, has aided CO<sub>2</sub>-flood management and highlights the necessity of updating reservoir simulation models. Use of an unconventional approach to data acquisition, and interpretation of high-resolution time-lapse/4D seismic data effectively imaged movement of miscible CO<sub>2</sub> through a thin (about 5 m), shallow (about 900 m), oomoldic limestone reservoir during the on-going pilot EOR program. Extremely short survey-to-survey temporal separations (two months) of four high-resolution time-lapse surveys enabled the evaluation of high-resolution time-lapse seismic sensitivity to changes in pore-fluid composition. We adopted a non-conventional, weak anomaly-sensitive, interpretation approach of time-lapse seismic data. Simulations uniquely displaying reservoir heterogeneities using rock physics and seismic attributes clearly depict a well-constrained fluid flow scenario that is consistent with production data. Rock physics and seismic modeling aided the understanding of the response of selected seismic amplitude attributes to both effective pore-fluid and geometrical time-thickness variations in this thin carbonate target. The combined effect of pore-fluid and geometrical time-thickness variations reflects a highly non-linear amplitude response. Selected 4D-seismic attribute maps that have undergone weak-anomaly enhancement through color balancing successfully monitored the movement of the injected miscible EOR-CO<sub>2</sub> front and illuminated heterogeneities affecting/controlling flood bank expansion.