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Cross-well Seismic Reservoir Characterization and Monitoring

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Recent cross-well seismic interpretation case studies indicate that seismic tomograms and high resolution reflection images can be used to quantitatively characterize and monitor reservoirs. The cross-well area/volume of numerous Oklahoma and West Texas carbonate and clastic reservoirs has been characterized using baseline cross-well seismic surveys and interdisciplinary interpretation based on geoscience/engineering data and reservoir models. Results define the cross-well structure, stratigraphy, reservoir versus nonreservoir facies, high-porosity zones, and fluid type and distribution. The time-lapse interpretation of twenty-seven cross-well seismic surveys acquired during a 3.5-month period across a California heavy oil sand steamflood indicates that cross-well seismic tomograms can be used to monitor the thermal recovery process. S-wave tomograms, which define reservoir structure, lithofacies, and porosity, do not change with time. The time-lapse P-wave tomograms, in contrast, define several areas where velocity decreased a small amount during an injection cycle and a larger amount after the injectors were shut in. These areas have been affected by the increasing temperature, formation of gas, and pressure changes due to the steam injection process. Application of the cross-well seismic reservoir characterization and monitoring results during operations should help optimize the location of infill wells, injection intervals, and completions. Improvements in acquisition tools, which have reduced acquisition time to as short as two hours, have helped minimize the impact on field operations and reduce costs. These developments suggest that cross-well seismic technology has the potential to develop into a cost-efficient technology for selected reservoir management applications.

Biographical Sketch

Mark E. Mathisen is a Geological Advisor in the Reservoir Characterization Group at Mobil Research and Development. He received a B.A. (1974) in geology from Augustana College followed by M.S. (1977) and Ph.D. (1981) degrees in geology from Iowa State University. Mark joined Mobil Research and Development in 1981 where he helped develop an integrated approach to seismic interpretation based on geologic characterization, rock physics, core analysis, and log data. In 1984 he transferred to Mobil Exploration Germany and worked on the geologic-seismic characterization and prediction of deep subsalt Permo-Carboniferous gas reservoirs. Since returning to Mobil Research in 1988, Mark has worked on a variety of reservoir geoscience projects including seismic tomography interpretation. His main interests are seismic reservoir characterization and prediction, sandstone sedimentology, and diagenesis. He is a member of AAPG, SEG, SEPM, IAS, and GSA.

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