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3-D Stratigraphic Inversion of Mission Canyon Reservoirs, Little Knife and Billings Nose Trends, Williston Basin, USA: A New Technology for Reservoir Assessment

We have completed the industry's first 3-D stratigraphic inversion of a carbonate field data set. We selected an 80 X 80 km area around the Billing's Nose and Little Knife oilfields [Fryberg (Mohall) and Sherwood trends] in the Williston Basin. The stratigraphic interval extends from the Glenburn through the Mohall and into the Sherwood Members of the Mission Canyon (Mississippian) Formation. The interval contains 13 stratigraphic cycles, of which 9 were used in the modeling. Facies range from deep-water mudstones and wakestones, to shallow-water packstones and grainstones, to sabhka evaporites, although most of the section simulated comprised the deeper water facies. Reservoir facies are mudstones and skeletal wackestones with pinpoint vuggy and intercrystalline porosity. Reservoir facies are cyclically interlayered with nonporous mudstones. The progradational units of the Mission Canyon were deposited on a low-angle ramp with differential topography and subsidence induced by movement along deep-seated faults. Besides simulating a broad range of water-depth facies, a major challenge of this study was the simulation of this differential topography and subsidence.

Five cored wells in the study area, each separated by 12-20 miles, were used for inversion. An additional six cored wells were reserved for blind tests. The stratigraphic inverse model accurately simulated the successions and thickness of facies and the thickness of the stratigraphic cycles. Differences between observed and simulated facies intervals were <5 cm in 24% of the simulations, 5-10 cm in 16%, 10-20 cm in 20, and 20-50 cm in 30% of the simulations. Successions and thickness of facies intervals and cycle thickness in the six wells used for the blind tests were comparable to those wells used in the inversion. Stratigraphic inversion is additional technology for reservoir characterization and for creating accurate stratigraphic models for fluid-flow simulation.