

Blind Thrusts and Fault-Propagation Folds in the Alberta Group, Deep Basin: Implications for Tight-Gas Reservoirs

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Abstract

Our 3-D seismic and log-based mapping of Upper Cretaceous units in the Deep Basin has revealed the presence of fault-propagation folds in the Cardium Formation and overlying units. The folds formed over reverse faults in shales of the Kaskapau Formation that sole out downward into a clay-rich layer in the lower part of that unit. Seismic data indicate a fold wavelength of approximately 5 km at the Cardium level, with fold axes striking NW-SE. Log-based stratigraphic analyses identified fault repeats of Kaskapau allomembers, whereas the 3-D seismic data show details of upward-branching fault splays that are interpreted as breakthrough structures. The faults also splay laterally, and transfer strain by overlapping. Post-stack processing of the original 3-D volume, including noise reduction and coherency processing, significantly improved our ability to image and map these structures.

The Cardium Formation produces oil in the study area from fields whose orientations are approximately parallel to the fold axes identified in this study. These production trends are thought to be primarily related to depositional trends that predate the structural deformation. Nevertheless, the structures we illustrate are fractured, and so they are good analogues for potential drilling targets in similarly deformed tight-gas reservoirs. Four-armed caliper logs from wells on the fold crests indicate the presence of fractures in clean, low-permeability Cardium sandstones. Depending on the structural position penetrated by a well, natural fractures with orientations both parallel and perpendicular to the fold axes might be expected. Previously published core and borehole breakout studies support these interpretations.