Structurally Influenced Plays Provide New Opportunities in a Mature Foreland Basin; Case Studies From the Alberta Basin, Canada

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ABSTRACT

Exploration and development in the prolific Alberta foreland basin have focussed traditionally on stratigraphic plays, with emphasis on sedimentological and stratigraphic data and interpretation. Pursuit of structural plays in Alberta has been limited mainly to the foothills of the Rocky Mountain fold-thrust belt immediately to the west. As production from long-exploited stratigraphic plays has matured, new successes in conventional and unconventional reservoirs have become increasingly dependent on understanding the nature and distribution of sometimes subtle structural elements in the foreland basin. Two conventional exploration case studies highlight the value of structural concepts in new play development and testing. EnCana's gas/condensate discovery at Ferrier, in lower Carboniferous dolomitized grainstone, was a significant discovery in a mature area. Previous drilling had focussed on traditional subcrop plays in overlying carbonates. A few wells had encountered dolomite porosity in the usually finer-grained, non-prospective Banff Fm., well down-dip from the subcrop edge, but there was poor geological context, high reservoir risk and no workable exploration model. Mapping of overlapping depositional facies belts, diagenetic pathways and subtle, potential trapping trends high-graded prospective areas. These features, including reservoir facies belts, are ultimately structurally controlled by a combination of reactivated basement structural trends, and Mississippian syn-depositional and Cretaceous post-depositional extensional faults. Merged 3D seismic data and a revised sequence stratigraphic model illustrate the context for the Ferrier discovery and the critical play elements. In a second case study from the Lower Cretaceous Mannville Gp., new opportunities were tested successfully by recognizing that subtle syn-depositional extensional faults controlled local sandstone reservoir distribution. Half-graben asymmetry controlled the position of low-stand fluvial/estuarine channels and high-stand shorefaces. It also controlled local sedimentary provenance and thus reservoir quality. Continued fault motion resulted in superposed incision of younger channels into the older sequences. The younger channels, however, contain lithic sandstones that act as important lateral seals. This geological model identified local prospects in previously unrecognized hangingwall tributary channels, and provided the basis for a more regional exploration model.