Natural Fracture Characterization of a Giant Unconventional Carbonate Reservoir, Grosmont Venture, Alberta, Canada: Implications for Recovery

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In 2006, Shell leased 490 square miles of Alberta Crown Land to pursue a very large unconventional hydrocarbon opportunity. The reservoir is composed of Upper Devonian, dolomitic, karstic, platform interior carbonates in northern Alberta. Reservoir depths are less than 400 meters. The resource is high-viscosity bitumen.

Initial work suggested that a relatively simple, unstructured geology characterized the lease. Subsequent detailed work indicates a very high degree of fracturing. High-viscosity bitumen acts as a pore-filling material that occludes or partially occludes both matrix and fracture pore spaces. The presence of bitumen greatly modifies effective permeability pathways throughout the reservoir. Future removal of bitumen through thermal production mechanisms is expected to cause extreme permeability increases as product is removed from both fractures and matrix. Effective vertical permeability in some parts of the lease is expected to increase from hundreds of millidarcies to hundreds of Darcies. Localized decreases in effective vertical permeability may also occur due to fracture closure during thermal treatment.

Structural patterns were defined in an integrated study incorporating core, log, hydrologic and seismic data. The updated structural-stratigraphic story has three spatial components: First, a genetic family of fractures is defined in the integrated data set that spans a vertical scale from sub-centimeter to several meters. Fractures are dominantly bed-bound over this spatial scale, and follow a consistent mechanical stratigraphy that extends across the lease.

Second, 3D seismic data resolve larger-scale planar features interpreted to be low-throw faults and/or fracture corridors. These larger-scale structural features range from about 5 to more than 100 meters.

Third, using fractal relationships, we modeled some aspects of intermediate-scale features such as vertical lengths and map-view spacing geometries. Intermediate-scale fractures are difficult to characterize because they are of a scale not directly observed by our smaller wellbore and larger geophysical data sets; but are particularly important because they are expected to be primary vertical permeability pathways for fluid movement during thermal treatment.