

1231265: Petroleum Geology of Providence Oil Field, Central Utah Thrust Belt

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Providence field was discovered in 2008 and confirmed the hydrocarbon development potential in the central Utah thrust belt, or “Hingeline.” The producing reservoir at Providence field is the eolian, Jurassic Navajo Sandstone. The basic trap is an elongate, symmetric, northeast-trending fault-bend fold above a hanging wall splay off the Salina thrust. The Navajo is repeated by a splay and both the “First” and “Second” Navajo Sandstones are oil and gas productive. The trap for the First Navajo is formed by the main fault-bend fold along the thrust. The Second Navajo trap is a relatively small, isolated block under the main fault-bend fold.

In general, the Navajo Sandstone reservoir consists of very well to well-sorted, very fine to medium-grained, subangular to subrounded sand or silt grains cemented by silica. The typical sandstone is 97% white or clear quartz grains (most frosted) with varying amounts of K-feldspar and lithics. The porosity and permeability values are moderate to low; water saturation ranges from 33 to 49%.

Oil from the First Navajo is a reddish brown, low-volatile crude; the solution gas is composed of approximately 81% CO₂, 6% N₂, and only 13% hydrocarbons. The Second Navajo oil is a yellow, high-volatile crude; the gas is composed of approximately 80% methane and higher hydrocarbons, 12% N₂, and 8% CO₂. The hydrocarbons were generated from Carboniferous source rocks within the Salina thrust plate. Hydrocarbon migration occurred 70 to 80 Ma, concurrent with the creation of the Providence structure. Differential thermal stress accounts for variations between the hydrocarbon components of the First and Second Navajo Sandstones. The presence of non-hydrocarbon gases at Providence field suggests an independent source and migration event for the gases.

The original oil in place for the field is estimated at 10.7 million bbls; estimated in place gas reserves are nearly 32 BCF including the large component of CO₂ and N₂. Thus, the Providence discovery confirmed that the central Utah thrust belt contains the right components (trap, reservoir, seal, source, and migration history) for large accumulations of oil and gas, and proved that the 2004 Covenant field discovery 20 miles to the south was not just a “one field wonder.”