Evolution and High Dissolution Porosity of Woodbine Sandstones in a Slope Submarine Fan, Double A Wells Field, Polk County, Texas—A Deep Water Gulf of Mexico Model Onshore

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Abstract

Double A Wells Field, a gas condensate giant located 75 miles NE of Houston, Texas, will eventually produce close to ½ Trillion CFG and 20 Million BC. The gas is trapped in lenticular sandstones that pinch out or have reduced permeability updip along thinned edges. Buried near 14,000', the slightly over pressured, fine-grained quartz sandstones have unusually good reservoir quality, up to 23% porosity and one (1) darcy permeability.

The sandstones are the terminal fill of a submarine canyon, initially 700-800' deep and 4 ½ miles wide, which probably resulted from gravitational failure of oversteepened, progradational shales, seen as clinoform reflections on dip seismic lines, above the buried Sligo (Lower Cretaceous) shelf margin. The clinoform sequence is overridden by landward onlapping deposits of a major marine transgression (late Cenomanian-Turonian) consisting of Woodbine sandstones, Rapides shale, and Austin Chalk.

Sandstones of the submarine fan, referred to above as terminal canyon fill, are encased in organic rich source rocks including interfingering and underlying Eagle Ford shale and overlying Rapides shale and basal Austin Chalk. The source rocks are mature and presently discharging gas at a temperature of 325–350º Fahrenheit.

The exceptional reservoir quality of multiple field sandstones involves the early emplacement of pore-filling calcite cement, followed by cement dissolution by acidic CO_2 rich waters during deeper burial. Acidic waters are postulated from two sources: 1) organic rich proximal source rocks and 2) inorganic chemical reactions of kaolinite with carbonates in very thick, hot shale sections downdip, probably connected to field reservoirs by sandstone "pipelines." The latter inorganic source is favored to supply the greatest volume of acidic waters needed for cement removal.

After cement dissolution the restored pores, mimicking early primary porosity, were invaded by oil, then replaced by gas with increasing burial temperature. Since its discovery in 1986, the field has produced more than 305 Billion CFG and 15.5 Million BC. The gas contains 4–6% CO_2.

Hopefully, the model presented here, combined with 3-D seismic data, will lead to the discovery of more Woodbine "sweet spots" containing giant gas fields similar to Double A Wells Field.