Wilcox Re-birth: South Louisiana 6.27.2013

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EXTENDED ABSTRACT

Since the early 1920's, the Wilcox Formation has been a heartbreaker and money-maker. After the easily identified structures had been drilled and commodity prices crashed in the mid-80's, the Wilcox took on the nickname "Won't-Cox" in some circles. However, in the past decade new technologies have breathed new life into the productivity of this mature formation. Questions remain though: Does it have enough repeatability to satisfy the Wall Street lemmings? Will petrophysicists find the magic (evaluation) bullet? Can management stomach a dry hole or two? Are horizontals the future?

At the time of this writing, the West Texas Intermediate oil price is in the mid-$90's. Should this price not dip below the mid-$60's for a sustained length of time, these key inquiries will hopefully all be determined in the short to intermediate future.

This extended abstract will overview Wilcox regional geology, drilling results since 2003, and exploration pitfalls.

The name "Wilcox" was selected by the United States Geological Survey in 1905 and was equivalent to an older term "lignitic" given by Hilgard in 1867 (Murray, 1947). The Wilcox clastic wedge has been interpreted as a prograding delta system with minor fluvial input (Fisher and McGowen, 1967) representing the first major marine regression of the Cenozoic age. The downdip topographic lows of the Cretaceous shelf edge provided accommodation space for the updip Wilcox sequence, while the downdip sediments prograded over a gently inclined, slowly subsiding shelf (Galloway et al., 2000).

Sediment sourcing for the Louisiana Wilcox was the adjacent Ouachita and Ozark highlands to the north and west by way of the Holly Springs deltaic system (Galloway, 2007). While the northwest Larimide Orogeny sourced much of the Texas coastal plain by way of the Houston deltaic system (formerly termed Rockdale by Galloway, 2000).

In addition, the possibility of major drawdown of water within the Gulf of Mexico due to basin isolation (Berman and Rosenfeld, 2007; Rosenfeld and Pindell, 2003) and the presence of Wilcox-aged large submarine canyons (Galloway, 2007; McDonnell et al., 2008) adds additional complexity to Wilcox sedimentation patterns. Regional log correlations suggest significant sea level drop occurred in or around the Middle Wilcox. This is supported by the basinward thinning of the Lower Wilcox and the basinward thickening of the Upper and Middle Wilcox intervals

coincidental with highly active basin-dipping extensional growth faults (Figure 1). While the chemical composition is generally similar for the two deltaic systems, Louisiana Wilcox reservoirs have a substantially lower GOR.

Although further research is required, organic fingerprint modeling by Wenger et al., (1994) and Hood et al., (2002) suggests the Wilcox Formation is self-sourcing within the nearshore and coastal environments, whereas; northerly fault blocks in the trend are potentially connected to the Smackover and Eagleford Formations (as cited by Swanson and Karlsen, 2009).

Highly variable salinities in the South Louisiana Wilcox are very problematic. Formation water resistivities range from 3-10 ohms through the trend, and in many cases, commerciality can only be confirmed by testing. Repeat formation tests, modular formation dynamics tests, and side wall cores can be inclusive. Normally pressured Wilcox is more susceptible than the pressured section, and Allen Parish is particularly susceptible to brackish (hyposaline) water. The source of the brackish water is highly controversial since they occur in marine sediments although salinities are less than that of seawater (35,000 mg/L) (Moran 2003). "These hyposaline waters have been proposed to have originated from 1) membrane filtration, 2) meteoric input, 3) shale dehydration, 4) mixing of hypersaline and fresh waters, and 5) any combination thereof (Land, 1997, Kharaka and Hanor, in press)." (Moran, 2003).

As mentioned previously, production from this formation has been established for quite some time (some active wells have been producing for over 60 years). From the early 1920's until the 1980's the Wilcox Formation of southern Louisiana was a very active exploration oil and gas play, producing over 180 MMbo and 1.13 Tcf (~285 Mbo + 1.3 Bcf/well). However, insufficient porosities in the Middle/Lower Wilcox and problematical petrophysical evaluations, combined with poor commodity prices, virtually eliminated the Wilcox as an exploration target throughout most of the 1980's and all of the 1990's. Nevertheless, fracture stimulation duplicated from successful South Texas Wilcox completions, combined with more favorable oil pricing caused southern Louisiana Wilcox activity to re-awaken in the early 2000's.

Since 2003, over 180 wells have been drilled in southern Louisiana for the Wilcox Formation with a completion rate greater than 90%. To date, these 180 wells have produced over 13 MMbo and 55 Bcf, with Estimated Ultimate Recovery (EUR) ranging from 100-500 Mboe/well (70-90% liquids). The low end of this spectrum was primarily associated with lower porosities, overly aggressive down spacings, and wells drilled too far off structure. Highly detailed subsurface/seismic mapping and properly planned completions can anticipate EUR's of 250-300 Mboe/well. To date, only four horizontal wells have 30+ days of production (Midstates Petroleum) and the 30 day average for these four wells range from 180 to 1215 Boe/d (65-75% liquids). Swift Energy is presently completing their first horizontal, and EP energy (formerly El Paso Corporation) has horizontals planned in the future. Although optimism is very high, the jury is still out for the ultimate economics of the horizontal drilling.

The three most active operators in the play, Midstates Petroleum, EP Energy, Halcon Resources, and Hilcorp jointly control over 500,000 acres. Since 2008, Midstates, EP, and Halcon have shot or are preparing to shoot almost 1800 square miles of 3D targeting Wilcox sands.

At the time of this writing, dry hole and completion expenditures (including frac) are $4-5,000,000/well for non-pressured Wilcox wells, $6.5-7,000,000/well pressured Wilcox wells and $9-11,000,000/well horizontal Wilcox wells.

Figure 2 compares Wilcox finding and developing (F&D) costs for the top tight oil plays in the U. S. lower 48 states. As the range of Wilcox F&D depicts, this trend is not for novices and the learning curve is ongoing.

Several factors play into this learning curve. Summarizing the key elements for success; 1) Maximize petrophysical evaluations on the first well in a field greatly facilitates all future developmental drilling. Clay analysis is critical for proper completion techniques and understanding the mineral compositions aids accurate water saturation calculations. 2) Low energy depositional environments are typically less favorable economically. Rapid, early migration via high perm rock (high energy environment) diminishes quartz overgrowths. 3) Structures should be well timed and fairly large. This is particularly true for fine grained sands in abnormally pressured fault blocks where low capillary pressures inhibit fluid flow. 4) Proximal water legs can be highly detrimental; therefore, structure matters. 5) Dissolve any old units and form large pre-drill units with large sand definitions. 6) *Generally speaking*, avoid completing sand with less than 12% porosity. 7) Although the majority of current operators drill with oil based mud, slow, controlled drilling through the objective section with water based mud has also been effective. 8) Recruit an experienced mudlogger.

In summary, South Louisiana oil commands premium liquid's pricing, a very mature mid-stream infrastructure, and favorable landowner terms ($150-300/ac bonuses). The Wilcox re-vitalization is based upon economically exploring oily conventional structures in a mature basin maximizing un-conventional completion techniques. Conventional exploration methods, combined with modern seismic, the newest available evaluation tools, and state of the art completion practices can contribute to a profitable and low risk exploration program in a very mature province.

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