Stratigraphy, Facies, and Environment of Deposition of the Yates Formation, North Ward Estes Field, Ward County, Texas

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The Artesia group is an interbedded sequence of sandstone, shales, carbonates and evaporites that was deposited in back reef and lagoonal settings of the Permian Basin during Late Permian time. The environment of the carbonate and evaporites in this group are well established but questions about the origins of the clastics and the effects of sea level and sediment supply fluctuations on their accumulation persist. This study of core, well logs, and petrophysical data of the Yates formation or the Artesia group from North Ward Estes Field provides the opportunity to address these questions.

The Yates is composed of four clastic and one carbonate facies. Facies 1 consists of well sorted fine sandstone and coarse siltstones that are non-fossiliferous and contain wavy parallel laminations. This facies is interpreted as an eolian erg deposit. Facies 2 consists of fine sandstones and coarse siltstones with clay drapes, flaser beds and no bioturbation which are interpreted as fan-delta plain deposits. Facies 3 consists of reddish brown fine sandstones with bioturbated and haloturbated structures that are interpreted as clastic-dominated sabkha deposits. Facies 4 consists of fining-upward beds with pebbles at their bases and clay laminations atop which are interpreted as fluvial-channel deposits. Facies 5 consists of bioturbated carbonate mudstones that are interpreted as shallow marine deposits.

The deposition of the Yates clastics began during a sea level lowstand and continued during a subsequent sea level rise. This in indicated by the sharp basal contact between the clastic-rich Yates and the carbonate-rich upper Seven Rivers, and the thick anhydrite bed that marks the top of the Yates. In addition, there is evidence for cyclic deposition of the clastics and carbonates in the Yates that resulted from changes in sediment supply and the shifting of depocenters.

Determining Between-Well Reservoir Architecture in Deltaic Sandstones Using Only Well Data: Oligocene Frio Formation, Tijerina-Canales-Blucher Field, South Texas

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Accurate prediction of compartment architecture and intracompartment heterogeneity is necessary to locate and recover the estimated 15 billion barrels of mobile oil remaining in U.S. fluvial-dominated deltaic reservoirs. Complex architecture and rapid lateral variability in such reservoirs complicate subsurface prediction, particularly in mature fields where well logs are the only available subsurface data. A genetic-stratigraphy-based methodology has been developed that improves between-well prediction of deltaic reservoir architecture and, thus, reduces risks associated with infill-drilling.

In the area of Tijerina-Canales-Blucher (T-C-B) field, which lies on the northeast margin of the Oligocene-age Norias delta, the productive 3rd-order Lower Frio unit was subdivided into eight 4th-order genetic units. Delta-front positions were identified on the basis of regional and subregional cross sections. The 4th-order units (30 to 80 ft thick) were subdivided into two to five 5th-order units (10 to 30 ft thick). Log patterns and net sandstone maps were used to identify facies, which include (1) distributary channels (up to 25 ft thick, <1,000 to >8,000 ft wide, and commonly narrower than 40-acre well spacing), (2) mouth bars (up to 15 ft thick, ranging in size from 40 to 640 acres in area, commonly <320 acres), (3) bayfill splays (up to 10 ft thick, 20 to 700 acres in area, and commonly <160 acres), (4) wave-reworked delta fronts (up to 35 ft thick, and >5,000 ft wide), and (5) washover fans (up to 10 ft thick, and 7,000 ft wide). Many reservoir compartments, including the prolific 21-B interval, contain a significant degree of stratigraphic trapping caused by updip pinchout of delta front or washover sandstones or convex-updip segments of meandering distributary channel sandstones.

The methodology and results of this study are directly applicable to other Gulf Coast fluvial-deltaic reservoirs in the Frio Formation and Wilcox Group, as well as to deltaic reservoirs throughout the U.S. The general methodology should be applied to develop remaining reserves in mature fields where geophysical data are lacking. Further study of T-C-B reservoirs may include stratigraphic analysis of 3-D seismic data and infill drilling to confirm between-well interpretations.