

PS Pennsylvanian and Wolfcampian Sequence Stratigraphy Using FMI and Log Analysis on the Western Edge of the Midland Basin: A Tool for Guiding Well Completions*

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Abstract

The Pennsylvanian and Permian (Wolfberry) tight carbonate and shale play in the Midland Basin is most often considered a cost play, resulting in a tendency to be parsimonious with the acquisition of formation evaluation data and other services that facilitate optimal completion, especially with “manufactured” wells. A sequence stratigraphic framework for the play in the western Midland Basin was constructed from Schlumberger high definition image logs (FMI-HD), wire line data, and core to predict lithofacies and reservoir characteristics. The stratigraphic framework has been linked to rock mechanic properties such as Poisson's ratio, Young's Moduli, and estimates horizontal stresses that affect the brittleness and frackability of these reservoirs. The framework describes 32 high-frequency sequences (4th and 5th order) that can be grouped into lower-order composite sequences and correlated for at least 10s of kilometers. Our model predicts both the distribution of brittle lithofacies that are conducive to hydraulic fracturing and the occurrence of favorable reservoir conditions, like porosity development. Porosity, brittleness, natural fracture development, and mud log shows are associated with carbonate-prone high stand (HST) systems tracts, while potential fracture baffles are associated with more siliciclastic-prone and ductile low stand (LST) systems tracts. Brittle and more organic rich mudstones occur in transgressive stand (TST) and lower HST systems tracts, with the best mud log shows often occurring near maximum flooding surfaces. The sequence stratigraphic framework provides excellent perspective for regional opportunity identification and helps to fill interpretive gaps when comprehensive formation evaluation data is not available. This predictive capability assists with all aspects of subsurface assessment from strategic opportunity identification to tactical decisions regarding completion design.

