High Resolution Sequence Stratigraphy of the Grayburg Formation (Permian) from Last Chance Canyon, New Mexico

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The Grayburg Formation outcrops in cliff exposures located within Lincoln National Forest, Eddy County, New Mexico. The formation is characterized by mixed siliciclastic and carbonate sediments deposited in three general platform environments: subtidal open shelf, subtidal and intertidal shallow shelf, and supratidal flats; and further subdivided into reservoir-prone vs. non reservoir-prone facies. Middle Shelf, Shelf Crest and Outer Shelf Facies Tracts are characterized by the vertical stacking of facies from the three general environments.

A high resolution sequence stratigraphic framework is developed for the Grayburg Formation (Lower Permian) based on outcrop data. Vertical stacking of lithofacies was analyzed to identify small-scale shoaling-upward cycles. These shoaling-upward cycles are related to high-frequency low-amplitude sea-level fluctuations that affected platform sedimentation. The Grayburg Formation is stratigraphically positioned within the highstand system tract of the third-order Guadalupian 3 depositional sequence. Grayburg composite parasequence-sets build into fourth-order high frequency sequences and show predominantly aggradational and progradational stacking patterns. Carbonate sedimentation dominated the platform during sea-level highstands, whereas prevailing tradewinds transported siliciclastic sediments onto the platform during sea-level lowstands.

This outcrop study offers a highly detailed reservoir analog that can be used to define the scales of geologic and petrophysical descriptions that best capture the flow unit structure of ooid grainstone reservoirs. Within a depositional sequence, the predictable vertical stacking-patterns of parasequences in different system tracts and of facies successions within parasequences provide the necessary geologic framework for improving the definition of RRT (Reservoir Rock Types) to aid in petrophysical quantification in 3D geologic models. Such detailed insights typically are not available from subsurface data. Integration of outcrop studies with subsurface data leads to more insightful and realistic geologic models of subsurface stratigraphy, facies distribution, geobody dimensions and reservoir connectivity required for object- and cellular-based modeling.