

Title:

Sequence Stratigraphy of the Green River Formation – Key to Understanding Controls on Lacustrine Source Rocks

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The Green River Formation is a lacustrine depositional system that occupied several Rocky Mountain basins during the Early Eocene. These paleo-lakes contain the richest and thickest oil shale deposits in the world and therefore are of great interest as a future energy resource. This study focuses on the Piceance Creek Basin in Western Colorado which is a small foreland basin controlled by the White River uplift on its eastern margin. The depositional history of the lake was reconstructed by correlating depositional sequences at the basin margin to the basin center subsurface using well logs. The correlation is based on gamma ray signal which is controlled by the amount of K- feldspars U and Th that are delivered to the basin from the hinterlands. The sequences were picked in the subsurface by comparing the log signature of nearby wells and identifying the geometries of the depositional surfaces. The log characteristic of the typical sequence begins with a significant increase in the gamma signal that gradually decays upward. This indicates the increase of sediment supply that follows a lake-level fall and that brings the detrital rich sediments into the lake. The correlated surfaces are thus time significant. The facies distribution in the basin shows a direct connection between these reconstructed lake-levels and the geochemistry of the lake waters. As lake-level fell a sequence boundary formed and the lake water was restricted to the basin center. This increased salinity enabled the precipitation of halite, nahcolite and Dawsonite in the basin center. As lake-level rose, influx of fresh water diluted the upper part of the water column. Restricted bottom water provided the perfect conditions for organic matter preservation leading to the rich oil shale deposits. As lake-level reached the basin margin, shallow water carbonates were deposited. These transgressive carbonates are associated with oil shale rich beds toward the basin center.

The Green River Lake history shows lake-level variation along with increase salinity over time as a main control on the oil shale distribution in the basin. This demonstrates the connection between the mineralogical and chemical composition of the lake water to variation in lake-level and provide a tool for predicting facies and source rock position in many lacustrine systems in the world.

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