

9.3 **The Unified Stratigraphy and Depositional Systems of the Green River Oil Shale in the Piceance and Greater Green River Basins, Colorado and Wyoming**

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The Green River Formation (Early Eocene) lacustrine depositional system contains the richest oil shale deposits in the world, and occupies three basins in the western United States, the Greater Green River basin in Wyoming, the Uinta basin in Utah, and the Piceance basin in Colorado. The depositional history and facies of the three basins are controlled by evolving regional drainage patterns that reflect the downstream record of weathering patterns controlled by tectonics and climate. Evaporative phases are deposited at different times, and the richness of the oil shale units appears to vary between them. To better understand how this tectonic-climatic controlled stratigraphy has influenced the variation between basins and oil shale quality, stratigraphic correlation between the basins has been initiated using new radio-isotopic ages, and sequence, bio-, and magnetostratigraphy.

In the Piceance basin, gamma ray logs permit correlation from outcrop to subsurface. Anomalously high gamma ray values are present at the tops of siltstone units, directly below sequence bounding surfaces. The Rich/Lean (R/L) zonation, established by the USGS in the 1970's, is in conformity with the gamma ray marker beds, as well as tuff beds, and the sodium-rich beds (nahcolite, and halite). Fourteen sequences, with probable duration of 400,000 years, have been identified, and correlated across the basin. At the lake margins, each sequence is composed of a basal siliciclastic sandstone unit deposited during periods when lake level was falling rapidly or was low. During low lake level times, salinity increased and evaporites were deposited in the lake center. Rising lake level is characterized by deposits of mixed limestone and oil shale. High lake levels are represented by thick oil shale units (R units) overlain by lean units of siltstone (L units).

New ⁴⁰Ar/³⁹Ar dates in the Piceance and Greater Green River basins have allowed a tentative correlation between these lacustrine systems. Each basin shows a history from overfill (Piceance sequences 1-4) to balanced-fill (Piceance sequences 5-6) to underfill (Piceance sequences 7-14). Evolving drainage patterns progressively returned each basin to a final overfill state. Each basin evolved from freshwater to hypersaline system, to a mesosaline state when the very organic-rich Mahogany oil shale unit was deposited.