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Oil-Shale Yield in the Green River Formation as a Proxy for Relative Lake-Depth

The Eocene Green River Formation is a classic example of cyclic lacustrine sediments, long inferred to contain orbitally forced, meter-scale cycles. A proxy that can be sampled at high-resolution is needed to test this hypothesis. In this study we show how published, oil-shale yield (from Fischer assays) records from the Green River and Piceance Creek basins can be used as a proxy for changes in lake depth, and to quantify the cyclicity present.

First we developed a new physical stratigraphy for the upper Wilkins Peak and Laney members of the Green River Formation in the Greater Green River Basin, based on time markers, mainly ash layers. The facies distribution between each pair of consecutive time markers was used to reconstruct depositional environments, and then the distribution of water-depth-sensitive facies was assigned a relative depth numerical scale, similar to depth ranks established for the Triassic and Jurassic Newark rift basins. The distribution of depth ranks in several cores is positively correlated with oil-shale yield values from the same cores. However, this correlation is not linear for all time intervals and locations, especially for records alternating between marginal to profundal end-member deposits. The lateral distribution of facies, combined with oil-yield records from the two basins is used to develop a conceptual model that accounts for the observed non-linearity. In addition, we are able to choose the cores, or partial time intervals, in which the correlation is linear, and this allows us to quantify the observed cyclicity in both basins.