

Variations in Organic-Matter Productivity and Preservation through Time, Eocene Lake Uinta, Western Colorado and Eastern Utah

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The Eocene Green River Formation in the Piceance Basin of northwestern Colorado and the Uinta Basin of northeastern Utah and northwestern Colorado was deposited in Lake Uinta, a longlived lake in which the world's richest oil shale deposits accumulated. The Green River Formation is subdivided into 18 roughly time-stratigraphic zones of alternating rich and lean oil shale, each of which has been assessed by Fischer assay as to richness and amount of total oil in place. This process allowed determination of the variations in organic productivity and preservation across Lake Uinta through time. Total in-place oil for both basins is similar—1.5 billion barrels for the Piceance versus 1.3 billion for the Uinta, which is nearly three times larger than the Piceance.

The two basins are separated by the Douglas Creek arch, an area of comparatively low rates of subsidence during deposition of the Green River Formation, and it has been suggested that the arch formed a barrier in Lake Uinta, possibly dividing it into two separate lakes for most of its history. However, all 18 oil shale zones can be identified in both basins, indicating that Lake Uinta likely extended across the arch. This connection would have been along the northern part of the arch, but in an area where Green River strata were removed by erosion and thus cannot be studied directly. Oil yield trends indicate the presence of a single oil shale depocenter in the north-central part of the Piceance Basin, with oil yields decreasing in all directions away from this area. Oil yields in the Uinta Basin also appear to increase eastward toward the Piceance depocenter, and there is little evidence that a separate depocenter formed in the Uinta Basin until late in the history of Lake Uinta when the Piceance depocenter was filled. The Piceance depocenter contains far richer oil shale than the richest oil shale area in the northeastern part of the Uinta Basin with maximum oil yields for time-stratigraphic intervals generally from 1.2 to 3.5 times greater, and total oil per unit area from 1.75 to 7.5 times greater, than that of equivalent intervals in the Uinta Basin.

The Piceance depocenter contains large amounts of halite and nahcolite, a sodium carbonate mineral, and oil shale deposition there appears to have been complex. Oil shale is predominantly laminated around the margins of the depocenter, indicating slow deposition, but is predominantly “blebby and streaked” within the depocenter itself indicating some lateral transport of sediments prior to lithification. This lateral transport may in part be responsible for the high oil yields in this depocenter with some of the organic matter coming from more marginal areas.