15.1

Spatial variability of oil shale grade within rich and lean oil shale zones, Green River Formation, Piceance Basin, Colorado

Jesse Yeakel, Nasser Mansoor

ExxonMobil Upstream Research Company, Houston, TX, United States

Understanding the spatial variability of oil shale properties such as grade, sulphur content, and metals content is critical to optimizing shale oil production from both *ex situ* and *in situ* recovery methods. The present work evaluates the spatial variability of oil shale grade within rich and lean layers of the Mahogany Zone of the Green River Formation. Although it is overall considered a rich oil shale zone of high grade, the Mahogany Zone is actually composed of numerous high grade (rich) and low grade (lean) stratigraphic intervals. We evaluated the spatial variability in grade within these intervals using 16 closely spaced wells. These wells have separations from less than 100 feet to more than 2000 feet. Each well had grade data from Fischer Assay at one foot intervals over the majority of the Mahogany Zone. The Mahogany Zone was divided into 11 stratigraphic units that could be correlated over the entire area around these wells. These zones have average grades from 40 gallons per ton [gpt] (Zone 6) to less than 10 gpt (Zone 11). Geostatistical (variogram) analyses performed on each individual zone as well as selected, combined adjacent zones revealed the following:

1. Oil shale grade is extremely variable in the vertical dimension within both rich and lean zones. For nearly all zones a pure nugget variogram model applies in the vertical dimension indicating that grade can vary significantly from one foot to the next.

2. The Mahogany Zone has impressive lateral grade homogeneity to distances of over 1000 feet. Rich and lean layers can be easily correlated over distances of several thousand feet.

This analysis suggests that on a scale of up to several thousand feet, oil shale properties can be estimated from a small number of wells with sufficient vertical sampling to generate valid statistics for grade in each zone to be correlated. This hypothesis was tested at another location within a second rich oil shale zone in the Piceance Basin, and results of that analysis will be presented.