Utilizing Geochemical Analysis in Unconventional Reservoirs to Allocate Produced Oils to Stratigraphic Zone

Heather Lareau[1], Jeremy Dahl[2], Adam Clark[1], Bob Parney[1], and Scott Friedman[1]

[1]Noble Energy Inc
[2]Standford University

Abstract

The main goal of this work is to determine the relative contributions of multiple source intervals within an unconventional play to the resultant produced co-mingled oils. Such a determination is important for understanding induced fracture networks and devising optimal strategies for maximizing production. A wide variety of organic geochemical analyses were conducted on rocks, rock extracts and oil samples to delineate source contributions from different intervals. Further analysis was conducted to determine whether production allocation changed with time. Our approach was to construct template curves using isotope and biomarker signatures of rock extracts from a number of core samples, analyzing several samples from each of the intervals of interest. After screening hundreds of different GC and biomarker ratios we were able to derive several which varied consistently, monotonically increasing or decreasing with core depth. We then plotted produced oils from nearby wells onto these templates and were able to demonstrate that, in most wells, the majority of the oil is being produced from the upper part of the section. In fact, the results show that production is not only coming from our target units, but there is also significant contribution from an interval that was not previously recognized as a source to the unconventional hydrocarbon system. In addition to stratigraphic allocation, producing wells were monitored with time to observe changes in relative production from different zones. Two wells were monitored for over 1000 days. In spite of changes in GOR, most wells showed very little variation in zone contribution with time, indicating the fracture network had remained in communication with the wellbore. While our geochemical work successfully showed the relative contributions from various intervals in produced oils, it is important to note that there is a great amount of lateral and vertical variability in unconventional plays, e.g. facies and thermal maturity changes. Therefore, this methodology must be applied on a case by case basis, meaning that the analysis must be repeated consistently over the area of interest (AOI) to frame the variability across a play and integrate the data successfully.