Restoring “Lost” Gas and Oil Contents in Unconventional Tight Oil Systems

Daniel Jarvie
Worldwide Geochemistry/TCU Energy Institute

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Determination of the amount and quality of petroleum in a tight oil system is important for risking a play and targeting a prospect as well as for engineering and facilities processing. Light volatile oils and condensates contain abundant gas and over 70% light hydrocarbons, which are generally the more producible petroleum in tight oil systems. Unless pressure core is taken, these light hydrocarbons are lost in retrieval, transport, and processing even if frozen at the well site. Evaporative loss of gas and light hydrocarbons occurs during retrieval and related pressure reduction, their low affinity for sorption, and during sample handling. The abundance of gas and light hydrocarbons determines key reservoir properties such as pressure, density-API gravity and gas-to-oil ratios (GOR) in undersaturated reservoirs. Using geochemical measurement of S1 oil on rock samples to determine total oil or total petroleum, is not realistic due to the loss of these volatiles. In the volatile, light oil window, hydrocarbon losses from rock samples range from 10 to 90% depending on a variety of reservoir rock properties including TOC, oil quality, pressure, porosity, permeability, and other factors. Utilizing high resolution gas chromatographic (HRGC) fingerprinting, the restoration of gas and light hydrocarbons may be achieved by a curve fitting approach of the unevaporated hydrocarbons. HRGC data are utilized to restore the total petroleum content to always understated, routinely measured S1 oil contents. As such, the restoration of the total oil fraction provides a measure of OOIP. When these results are combined with rapid laboratory measurement of porosity by helium pycnometry, gas, oil, and water saturations may be calculated. This approach may be checked by curve fitting of the partially evaporated hydrocarbons to see if they show an ambient evaporation profile.

Combining forward and reverse modeling (S1 oil=forward, S2 generation=reverse), the total generated, expelled, and retained petroleum may then be estimated. Because the restoration includes gas and oil, estimates of intrinsic GOR may be estimate and are usually somewhat lower than separator measurements. Data from various plays such as the Bakken, Eagle Ford, and Wolfcamp show greater than 0.90 correlation coefficients on calculated GORs to produced values. Of course, the presence of oil-based mud (OBM), polymer muds, and organic additives to water-based mud complicates geochemical analysis. Such contamination may affect some Dean Stark results as non-native oil from OBM imbibes core samples depending primarily on permeability. However, using the above approach, the presence of OBM can be eliminated and oil saturation calculated when porosity is measured. The limitations of this approach are primarily in its application to undersaturated reservoirs with high quality, light petroleum (>36°API) and no mixing or alteration processes.

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.