Deconvoluting Mixed Petroleum and the Effect of Oil and Gas-Condensate Mixtures on Identifying Petroleum Systems

Kenneth Peters[1], Andrew Murray[2]
[1]Schlumberger; [2]Murray Partners PPSA Pty. Ltd.

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

Abstract

Geochemical analyses of mixed petroleum commonly underestimate input from the more gas-prone source, e.g., inferred input from coaly Sleipner-Hugin source rock is anomalously low compared to that from the Draupne Formation in mixed fluids from the South Viking Graben (SVG; Patience, 2003; Cornford, 2018). We mathematically mixed various pairs of endmembers, including oil and gas condensate (3,000 scf/bbl, respectively), which we deconvoluted by alternating least squares regression of compound ratios (ALS-R) and concentrations (ALS-C) in the traditional C15+ range. Results show that ALS_R underestimates input of gas condensate while ALS-C correctly predicts the relative contributions of both endmembers. Furthermore, hierarchical cluster analysis (HCA) of compound ratios to establish genetic families can be misleading. Mixtures having major proportions of gas condensate can cluster with those dominated by the oil endmember. This work supports previous conclusions that ALS-C reliably predicts mix composition, while ALS-R does not (Peters et al., 2008). For example, ALS-R for mathematical mixtures of Draupne oil (SVG_o) and Sleipner-Hugin gas condensate (SVG_g) underestimates SVG_g by up to 82%. The 10:90 mix of SVG_o to SVG_g deconvolutes by ALS-R to 92:8 (severely underestimated SVG_g) and by ALS-C to 10:90. In the HCA dendrogram, mixtures with up to 75% SVG_g (GLR=1,070-9,734 scf/bbl) cluster with others dominated by SVG_o. A more distal cluster of mixtures contains 80-95% SVG_g (GLR=10,312-12,044 scf/bbl). The endmember SVG_g (0:100; GLR=12,622 scf/bbl) clusters as another distinct genetic group. Thus, many fluids assigned to the oil-prone

source rock by HCA have strong input from the gas-prone endmember. Unfortunately, many publications use ALS-R to deconvolute mixtures (e.g., Justwan et al., 2006). The large range of GLR for the above mixtures (1,070-12,622 scf/bbl) is unrelated to differential biodegradation or thermal maturation. In conclusion, compound ratios must cover the entire boiling range of mixed petroleum to avoid bias in HCA for genetic affinity of mixed oil and gas condensate. Deconvolution based on C15+ compound ratios underestimates input of gas condensate to such mixtures and compound concentrations are required.