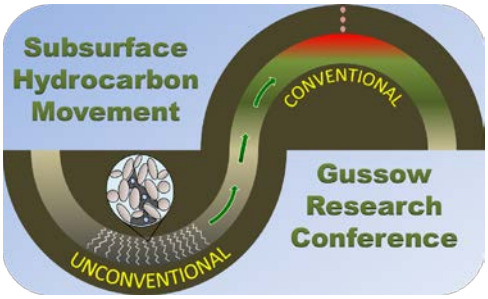

Petroleum Migration: How Do Laboratory Experiments Measure Up?

Barry Bennett
Schlumberger

Summary

Gussow (1954) proposed the concept of differential entrapment of oil and gas, whereby petroleum migration, driven by buoyancy, migrates via carrier beds to the closest trap that is filled. As more petroleum arrives at the trap the heaviest gravity oil is spilled up-dip into the next trap. The result is a decrease in gravity along the migration path toward the margins of a basin. Several case studies display sequential changes in fluid properties along migration pathways, where the farthest migrated oils are characterized by low gravity and relatively low levels of thermal maturity. Closer to the source, accumulations tend to be characterized as high-gravity oils with relatively advanced levels of thermal maturity.

Laboratory experiments simulating petroleum migration have been reported in the literature to investigate the changes in oil composition and distributions. Greibrokk et al. (1994) employed a 104-m coil tubing packed with glacimarine silt, while Bennett et al. (2001) subsequently described two experiments: a column (6 m × 0.5 cm) packed with clay:sand (50:50) and using real rock (1-m length siltstone core) with natural porosity and permeability properties. A suite of produced oils and core-extracted petroleum from the migration experiments was analyzed by Iatroscan and gas chromatography-mass spectrometry (GC-MS). Significant changes were observed in the composition and distributions of polar nonhydrocarbon compounds, confirming the capabilities of geochromatography. The results from simulation experiments and natural petroleum accumulations along migration fairways are compared to establish the role of geochromatography and thermal maturity on migration distance parameters.

References

Bennett B., Bowler B.F.J. Noke K.J. Otten G.A., Tseng H., Chong C. & Larter S.R. 2001. Geochromatography of C_0-C_3-alkylphenols during simulated petroleum migration. 20th International meeting on Organic Geochemistry, Nancy, France.

Greibrokk T., Lundanes E., Norli H.R., Dyrstad K. & Olsen S.D. 1994. Experimental simulation of oil migration – Distribution effects on organic compound groups and on metal/metal ratios. Chemical Geology, 116, p. 281-299.

Gussow W. C. 1954. Differential entrapment of oil and gas--A fundamental principle: American Association of Petroleum Geologists, Bulletin, v. 38, p. 816-853.