P357-TH

THE APPLICATION OF AROMATIC HYDROCARBONS TO PETROLEUM SYSTEMS INTERPRETATION AND EVALUATION OF BASIN-SCALE PETROLEUM PROCESSES

Ronald HILL[1] and Ben VAN AARSSEN[2]

1. U.S. Geological Survey, Box 25046, Denver Federal Center, MS 939 Denver, CO 80225
2. Centre for Applied Organic Geochemistry, Curtin University of Technology, GPO Box U1987, Perth 6845, Australia

Definition of oil families in sedimentary basins, and inferences about the processes affecting petroleum composition are commonly made through the integration of bulk geochemical data such as weight percent sulfur, saturated and aromatic hydrocarbon $\delta^{13}C$, API gravity, and molecular geochemical data from gas chromatography of whole oils and gas chromatography mass spectrometry analysis of saturated hydrocarbon biomarkers. Although aromatic hydrocarbons are a significant component in any petroleum, they are underutilized in evaluating petroleum systems, including basin-scale processes, particularly mixing, affecting petroleum composition and distribution.

Tetramethylbenzenes (TeMB) and tetramethylnaphthalenes (TeMN) are useful in evaluating source and relative thermal maturity of petroleum (van Aarssen et al., 1999; Hill et al., 2004). In our study, TeMB and TeMN analysis of more than 250 Permian Basin oils was performed to differentiate oil families, evaluate relative thermal maturity, and interpret mixing processes that affect petroleum composition and distribution demonstrated. Analysis of the saturated hydrocarbon biomarkers was also performed and multivariate statistical methods were applied to define oil families (Zumberge, 1987). There is correspondence between oil families interpreted from TeMB and TeMN and those determined from multivariate statistical methods (Figure 1). However, the aromatic hydrocarbons provide greater resolution in evaluating mixing processes and show that some oils classified as family HCA 8 (Figure 1) from statistical analysis of the bulk and saturated biomarker data are actually mixtures. TeMB and TeMN also allow for determination of the relative thermal maturity of mixture end members, providing insight into generation and migration processes.

Aromatic hydrocarbons provide a framework for interpreting source, thermal maturity, and basin-scale processes that affect petroleum composition and distribution. The application of TeMB and TeMN to petroleum system and basin-scale process interpretation is complimentary to the commonly applied bulk and molecular geochemical methods, and provides greater resolution in many instances.

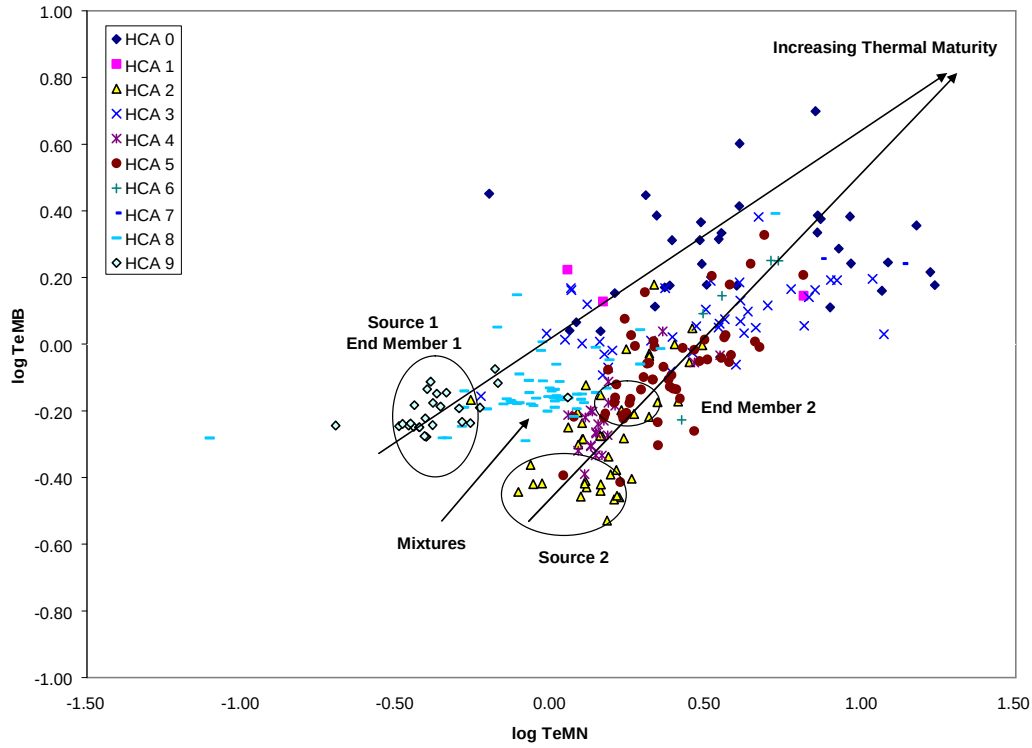

Figure 1. Plot of logTeMN (= log (1,3,6,7-TeMN / (1,2,5,6-TeMN + 1,2,3,5-TeMN)) vs. logTeMB (= log (1,2,3,5-TeMB / 1,2,3,4-TeMB)). Different markers represent oil families determined from statistical analysis. Correlation lines are plotted as guides only.

REFERENCES

van Aarssen, B.G.K., Bastow, T.P., Alexander, R., Kagi, R.I., 1999. Distribution of methylated naphthalenes in crude oils: indicators of maturity, biodegradation and mixing. Organic Geochemistry, 30, 1213-1227.

Hill, Ronald J., Tang, Y., Lu, Shan-tan and I. R. Kaplan, 2004. C_4-Benzene and C_4-Naphthalene Thermal Maturity Indicators for Pyrolysates, Oils and Condensates, in *Geochemical Investigations in Earth and Space Science: A tribute to Isaac R. Kaplan. Hill, Ronald, Leventhal, Joel, Aizenshtat, Zeev, Baedecker, Mary Jo, Claypool, George, Eganhouse, Robert, Goldhaber, Martin, Peters, Kenneth (Eds.) Geochemical Society Special Publication Series*, **8** (2004) 466p.

Zumberge, J. E., 1987. Prediction of source rock characteristics based on terpane biomarkers in crude oils: A multivariate statistical approach. Geochimica et Cosmochimica Acta 51, 1625-1637.