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Oil-Source Correlation in the Slope of the Qikou Depression in the Bohai Bay Basin with Discriminant Function Analysis

Liuping Zhang[1]*, Ziyi Wang[1], Shanshan Zhou[1], Guoping Bai[2], Xianzheng Zhao[3], Lihong Zhou[3] and **Wenya Jiang[3]**
[1]Chinese Academy of Science, China
[2]China University of Petroleum, China
[3]Dagang Oil field Company of Petro China, China

Commonly-used tools for oil-source correlation, such as mass chromatograms of biomarkers and bivariate cross-plots of geochemical parameters, cannot process multiple geochemical variables and plenty of samples simultaneously, leading to uncertainties in results and even failures. In contrast, multivariate statistical methods can simultaneously deal with plenty of samples and multiple geochemical variables. This problem in oil-source correlation can be solved when a suitable multivariate statistical method is applied properly. Based on theoretical analysis, discriminant function analysis (DFA) is selected in this study, as it is superior to the other multivariate statistical methods already used in oil-source correlation including principal component and hierarchical cluster analyses. In the slope of the Qikou Depression, the main source rocks in the Sha-3 (Es3) and Sha-1 Members (Es1) of the Paleogene Shahejie Formation were deposited in similar depositional environments. These source rocks cannot be distinguished with the commonly-used tools. We extended geochemical parameters to explore more useful information and used stepwise DFA to select informative parameters and to develop the discriminant model for oil-source correlation. Of 58 extended parameters, 23 were selected. This selection result is supported by the characteristics of geochemical parameters of the source rocks. The selected parameters were used to develop the discriminant model for oil-source correlation which achieved high correct rates of original validation (96.8%) and leave-one-out cross-validation (89.4%), indicating a sufficient discriminatory power. The oil-source correlation results with high posterior probabilities, showing strong similarity between the sources and oils, are consistent with geological conditions and illustrate that there is still a significant exploration potential in the study area, especially for the Sha-3 petroleum system. The case study further demonstrates that DFA is a very powerful tool for oil-source correlation with the accumulation of geochemical data of source rocks and oils.

Biography:

Dr. Liuping Zhang had received B.S. degree from Beijing University in 1983 and Ph.D. degree in Geochemistry from China University of Geosciences in 2000. He is currently works as a professor in Institute of Geology and Geophysics, Chinese Academy of Sciences and has more than 30 years' experience in studies of petroleum geology and organic geochemistry. His research interests include: (1) hydrocarbon origins, (2) unconventional hydrocarbon resources, (3) petroleum migration, accumulation and distribution pattern and (4) Petroleum seepage and prospecting methods.