NMR Petro analysis; Novel approach for rapid source rock evaluation in crude oils

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Organic compounds in crude oils provide information about source, maturity and depositional environment, namely petroleum systems. For this purpose, gas chromatography-mass spectrometry is widely used to measure although it is time consuming.

To speed up the analysis, nuclear magnetic resonance-metabolic profiling (NMR-MP) was tried and tested. The NMR-MP has been used in food and medical fields known as a part of metabolomics [1]. Nemoto et al. (2007) reported the difference of healthy/hypertensive rat using urines by principal component analysis (PCA) [2]. In the same way, NMR data from crude oils were directly visualized and evaluated.

In our study, crude oil samples were obtained from oil/gas fields in Japan. The source rock type of these samples has been already investigated by conventional methods. They were directly dissolved in NMR solvent without any separation and/or purification. Proton NMR spectrum at 500 MHz were obtained and then bucket-integrated to produce numerical data. Consequently, dataset was subjected to statistical pattern recognition by PCA.

The resulting variable of 1.26 corresponding to methylene signals, was remarkably contributed the alignment of the data points along the PC1 axis. The alignment shows source organic matter that indicate marine or terrestrial origins. We confirmed the NMR-MP results were consistent with those of conventional analysis. Two step PCA was carried out by removing variable of 1.26, the resulting score plot suggested locality of producing areas. Contributing variables in the resulting score plot were 0.86, 0.90 and 2.30 corresponding to aliphatic/aromatic methyl groups.

We will present “NMR-Petro analysis” as rapid and easy approach to elucidate characteristics of crude oil.

Reference

[1] Lindon et al. (2007) *The Handbook of Metabonomics and Metabolomics*, First Edition. Elsevier. 561p.
[2] Nemoto et al. (2007) *J. Toxicol. Sci.* **32**, 429-435.