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The analysis on trace compounds of aromatic steranes and terpanes in petroleum samples by comprehensive two-dimensional gas chromatography with time-of-flight mass spectrometry

HuiTong Wang
Institute of Petroleum Exploration & Development, China

The aromatic sterane and terpane compounds are the major biomarkers contained in aromatic fractions in petroleum samples. These compounds directly came from the bacterium precursors in bio-organization. They were formed via aromatization processing with various intermediate products by microbial agents. These aromatized sterane and terpane compounds are of the same sources to relevant sterane and terpane compounds, and are easily affected by some factors (such as sedimentary environment), therefore, they could provide important information such as organic matter input, sedimentary environment reflection and assistance of evaluation on maturity. They also provide more completed and integral information for studies by combining information of biomarkers in saturated hydrocarbon fractions. The analytical results of the crude oil samples of various biodegradation degrees which are located in Liaohe Basin, China, indicate that the relative contents of aromatic sterane and terpane compounds maybe change with the degradation degree according to a certain regulation. Therefore, it is significant practically to identify the biomarkers in aromatic fractions in petroleum samples. The conventional methods to detect aromatic sterane and terpane compounds are GC-MS and GC-MS-MS. However, these compounds are not easily detected because their relative contents are low and co-eluting compounds may be of the same characteristic ions. The conventional techniques have hindered the efforts on aromatic sterane and terpane compound analyses. Comprehensive Two-Dimensional Chromatography with Time-Of-Flight mass spectrometry (GC×GC-TOFMS) is a new technique for complex compounds analysis. Its orthogonal separation chromatographic column system could remove the effect of co-eluting peak. TOFMS could acquire relatively completed mass spectra information in the samples. GC×GC-TOFMS could reveal that aromatic steranes and terpanes with various structures are regularly aligned in GC×GC chromatograms (as shown in figure 1). In an ascending order of polarity, they are mono-aromatic sterane, mono-aromatic secohopane (secohopene), tri-aromatic sterane, aromatized pentacyclic triterpane (including bi-aromatic, tri-aromatic and tetra-aromatic hopanes) and benzo-hopanes, respectively. In summary, GC×GC-TOFMS is an effective method to qualitify and quantify aromatic sterane and terpane compounds. It could be a good technical support for investigating the application of these compounds in the conventional petroleum exploration.

wengna@petrochina.com.cn