Geochemical characteristics and significance of heteroatom compounds in saline crude oils by Negative ion Fourier Transform Ion Cyclotron Resonance Mass

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Crude oils from Tertiary saline and freshwater lacustrine strata of the Dongpu Depression in the Bohai Bay basin (Eastern China) were investigated in detail by negative ion fourier transform ion cyclotron resonance mass spectrometry (FT–ICR MS) and gas chromatography-mass spectrometry (GC-MS). A total of nine classes (N_1, N_1O_1, N_1O_2, N_1O_3, O_1, O_2, O_3, O_3S_1, O_4) were detected in the crude oils and potential source rocks. Among which, the N_1, O_1 and O_2 species are the main classes. It was observed that the relative abundances of the O_1 and O_2 species in the immature oils are much higher than those of the mature oils whereas the relative abundance of the N_1 species in the immature oils is lower than those of the mature oils, suggesting controlling of maturity on relative distribution of the NO' compounds in the oils. Nitrogen and oxygen compounds themselves are significantly controlled by maturity, and therefore could be utilized as indicators of maturity. The immature oils carry abundant O_1 species with DBE of 4 (mainly alkylphenols)[1] and O_2 species with DBE of 5, 6 (mainly hopanic acids and seco-hopanic acids/steroid acids) [2] and 1 (mainly fatty acids with even–odd preference). These compounds and the related parameters could be used to recognize and reveal genetic mechanisms of the immature oils. We suggested that ratios of N_1 and O_1 species with specific DBEs and carbon numbers such as $DBE_{9–12}/DBE_{15–18}–N_1$, $C_{20–28}/C_{29–40}–DBE_{12}–N_1$, $C_{20–30}/C_{31–50}–DBE_{15}–N_1$ and $DBE_{9–12}/DBE_{4–20}–O_1$, $C_{20–30}/C_{31–50}–DBE_8–O_1$ could be effective thermal maturity indicators. The abundant O_1 and O_2 species with low thermal stability detected in the immature oils/rock-extracts in the Dongpu Depression suggest a good genetic relationship between the oxygen compounds and the immature oils in the depression.

[1] Kamga et al (2014). *Journal of The American Society for Mass Spectrometry*, 25, 880–890

[2] Barrow et al (2003). *Analytical Chemistry*, 75, 860–866.