USING POLYCYCLIC AROMATIC HYDROCARBONS AS INDICATORS TO ASSESS THERMAL MATURITY OF CRUDE OILS AND ITS APPLICATION

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Thermal maturation evaluation of crude oils is the essential aspect of oil-source correlation, especially for oils accumulated in gypseous-salt strata. However, much more attentions were paid on saturate hydrocarbon parameters which could be out of action on elevated maturation level. Ratios of polycyclic aromatic hydrocarbons (PAHs) like naphthalenes (Alexander, et al. , 1984; van Aarssen, et al., 1999; Stojanović, et al., 2007), phenanthrenes (Budzinski, et al., 1995; Stojanovi, et al., 2001), and dibenzothiophenes (Schou and Myhr, 1988; Chakhmakhchev, et al., 1997) are at present attracting increasing attention as thermal maturity indicators in sedimentary rocks and crude oils. Generally, these indicators rely either on an increase with maturity in the degree of alkylation of a given parent compound or a shift in the isomer distribution of alkyl-aromatic homologues towards thermally more stable isomers and particularly useful in the maturity evaluation of post-mature crude oils and condensates.

A suite of 37 crude oils from Wenliu oilfield, where salt layers and faults were extensively developed, were analyzed using GC/MS to investigate relative distribution of aromatic compounds with respect to maturity. 18 series of aromatic compounds were detected with the naphthalenes and phenanthrenes to be dominated. A total of 9 concentration ratios of aromatic compounds, such as alkylnaphthalenes, alkylphenanthrenes, alkyldibenzothiophenes, and triaromatic steroid were calculated. These parameters revealed a higher thermal maturity of oils recovered from reservoirs below salt layers than those above salt layers. Calculated vitrinite reflectance values from the methylphenanthrenes index (MPI-1) and diamethyldibenzothiophene ratio (DMDBTr) for most of the oils above salt layers are in the range of 0.61~0.74, 0.65~0.74, respectively and that for oils below salt layers varied from 0.66~0.96, 0.67~1.38, respectively. This was consist with observation of homohopane cracking and high content of adamantane in some oils below salt layers. Thermal maturity of oil revealed by aromatic hydrocarbons suggests multiple charge stages of oils in Wenliu oilfield. Sealing capacity of salt and fault activities are the key controlling factors to oil migration and accumulation. This new understanding of oil maturity could be instructive to unravel the oil accumulation model in this area.

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