CORRELATION OF GEOCHEMICAL PARAMETERS OF CRUDE OILS BY COMPOSITIONS OF ALKYLBENZENES AND SATURATED HYDROCARBONS

Natalya VORONETSKAYA, Julia GOLOVKO, Galina PEVNEVA and Anatoly GOLOVKO

Institute of Petroleum Chemistry SB RAS, 3, Academichesky Avenue, 634021, Tomsk, Russia

Crude oils recovered from oil fields of West Siberia have been studied. They occur in Cretaceous (Nivagalskaya and Tagrinskaya), Upper Jurassic (Nivagalskaya and Severnaya), Lower Jurassic (Tolparovskaya) and Paleozoic (Severo-Kalinovaya) deposits at depths ranging from 1840 to 3227 m. For geochemical characteristic of oil samples we have studied distribution of n-alkanes, terpanes and n-alkylbenzenes and calculated geochemical parameters by their compositions. To reveal informative geochemical parameters based on alkylbenzene compositions we carried out comparative analysis with the parameters calculated by saturated hydrocarbon compositions.

Homologous series of n-alkylbenzenes, 1,2-, 1,3- and 1,4-methylalkylbenzenes and 1,3-, 1,4-ethylalkylbenzenes were identified in crude oils. Identified alkylbenzenes of each homologous series contained from 14 to 24 carbon atoms in a molecule. Maximum of alkylbenzene distribution in crude oils fell on low molecular homologues C_{14} – C_{16}. To determine both a type of the initial organic material and depositional environment we used Pr/Ph ratio and ratios of alkanes and alkylbenzenes with odd and even numbers of carbon atoms in a molecule as geochemical parameters (Ilyinskaya, 1985, Peters and Moldowan, 1993). Figure 1a presents a diagram plotted in the coordinates of the mentioned above parameters. As is seen from the diagram the distribution of oil samples by the composition of alkylbenzenes is similar to the distribution of oils by n-alkane composition.

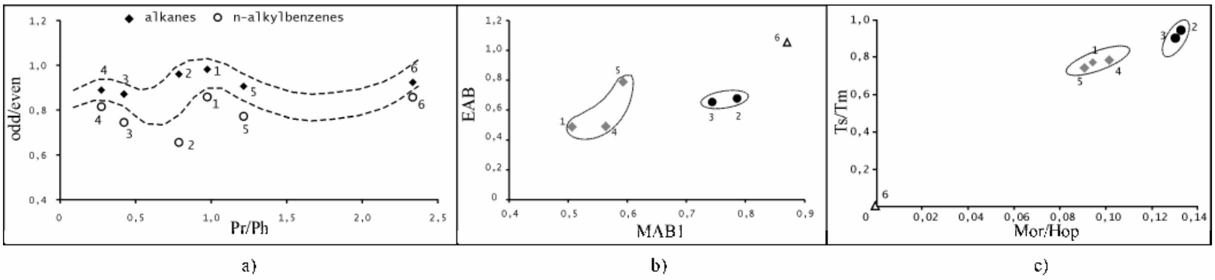
Nivagalskaya (Jurassic) and Severnaya oils are the most similar in depositional environment and a type of the initial OM. Crude oils recovered from Nivagalskoye (Cretaceous), Targinskoye and Severo-Kalinovoye oil fields form the second group. Depositional environment and a type of the initial OM in Tolparovskaya oil significantly differed from the conditions of other crude oils formation.

To estimate a degree of oil transformation we calculated geochemical parameters by compositions of alkylmonoarenes (MAB1 and EAB) and saturated cyclic hydrocarbons (Ts/Tm and Mor/Hop) (Peters and Moldowan, 1993, Golovko, 1997). The calculation of geochemical parameters by alkylbenzene compositions was based on ratios of the contents of the most and the least thermodynamically stable isomers. n-Alkylbenzenes and 1,3-, 1,4-

methylalkylbenzenes were accumulated at the increase in formation temperature and pressure (Golovko, 1997).

In the diagrams plotted in coordinates of geochemical parameters by the composition of saturated cyclic and alkylmonoaromatic hydrocarbons (Fig. 1b,c), reflecting thermal transformation of crude oils under study, one can see the division of oil samples into groups, which have a similar maturity degree. The first group combines the samples of Nivagalskaya (Cretaceous and Jurassic) and Severo-Kalinovaya crude oils, while the second group – the samples of Tagrinskaya and Severnaya crude oils. By the degree of thermal transformation crude oil recovered from Tolparovskoye oil field significantly differed from crude oils of both groups.

Thus we have revealed the parameters by alkylbenzenes compositions. They can be used in geochemical investigations both independently and coupled with the parameters calculated by alkanes and naphthenes compositions.



Oils: 1 - Nivagalskaya (Cretaceous); 2 - Tagrinskaya (Cretaceous); 3 - Nivagalskaya (Jurassic); 4- Severnaya (Jurassic); 5 - Severo-Kalinovaya (Palaeozoic); 6 - Tolparovskaya (Jurassic).

odd / even = Σ odd carbon-numbered homologues/ Σ even carbon-numbered homologues;
Pr/Ph = pristane /phytane = 2,6,10,14-tetramethylpentadecane/ 2,6,10,14-tetramethylhexadecane;
MAB_1 = Σ 1,3-methylalkylbenzenes (C_{13}-C_{24})/ Σ 1,2-methylalkylbenzenes (C_{13}-C_{24});
EAB = Σ 1,3-ethylalkylbenzenes (C_{13}-C_{21})/ Σ 1,4-ethylalkylbenzenes (C_{13}-C_{24});
Mor/Hop = C_{30} moretane / C_{30} homohopane = 17β (H),21α (H)–hopane/ 17α (H),21β (H)–hopane;
Ts/Tm = C_{27} 18α (H)-22,29,30-trisnorneohopane/ C_{27} 17α (H)-22,29,30-trisnorhopane.

Figure1. Oil distribution in the coordinates of geochemical parameters by saturated hydrocarbons and alkylbenzenes compositions

REFERENCES

Ilyinskaya, V. (1985) Genetic affinity of hydrocarbons in organic matter of rocks and oils. Nedra, Moscow (in Russian).

Peters, K.E., Moldowan, J.M. (1993) The biomarker guide: interpreting molecular fossils in petroleum and ancient sediments. Prentice Hall, New Jersey.

Golovko, A.K. (1997) Petroleum alkyl aromatic hydrocarbons: Abstract of thesis for a Doctor's degree on Chemistry. Tomsk: IPC SB RAS (in Russian).