

## **I-C<sub>16</sub>/(PR +PH) RATIO AS A NOVEL PARAMETER FOR ESTIMATION OF SEDIMENTARY OM THERMAL MATURITY**

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Light HCs of immature sediments are considered as redeposited; information about sedimentary isoprenoids (i-HCs) lighter than Pr and Ph is scanty (Barrick et al., 1981). They are found to be ubiquitous, minor, equally distributed all along a sedimentary basin. Recently (Kurakolova et al., 2005) we have discovered i-HCs C<sub>14</sub>-C<sub>20</sub> in bottom sediments of hypersaline Lake Karachi, Western Siberia. Their qualitative and quantitative compositions keep constancy in the sedimentary rock sequence, but greatly vary along the lateral section of bottom sediments with a large portion of i-C<sub>14</sub> by one of the lakeside and of i-C<sub>16</sub> - by another. At that time we failed to explain such an irregularity by impact of natural factors. As sterane and hopane distribute just as i-HCs, i.e. irregularly with mature structure prevalence in the sediments enriched with i-C<sub>14</sub>, lighter i-HCs are likely constituents of mature OM as well.

According to Kissin (1993), regular low-molecular i-HCs ranging from C<sub>9</sub> to C<sub>16</sub> are common to various geological specimens and formed by alteration of two predecessors, Pr and Ph. The only favourable factor to produce the lighter homologues is prolonged thermolysis. As a result, the equal distribution of isoprenoids, especially amongst C<sub>14</sub> - C<sub>16</sub>, occurs in crude oils of the same maturity, their geographical locations regardless.

Based on these findings and taking into account that Pr and Ph originate from chlorophylls in water column during sedimentation we suppose abundance of a single i-HC comparing to its predecessors may distinguish geological specimens of different maturity. i-C<sub>16</sub>/(Pr+Ph) ratio for objects studied by Kissin seem to be satisfactory: 0-0.2 - for oil shales, about 0.5 - for heavy naphthenic oils and up to 1.0 - for paraffinaceous oils or condensates. The results allow us to regard this ratio as a maturity parameter of sedimentary OM.

In the present work we have studied a random sampling of about a 100 crude oils and source rocks extracted from fields of the West Siberian region. The study is carried out in support of i-C<sub>16</sub>/(Pr+Ph) as a parameter for oil maturity level assessment. The oils and source rocks were divided into three groups according to their i-C<sub>16</sub>/(Pr+Ph) values: 1 - 0-0.25, 2 - 0.25-0.50 and 3 - 0.50-1.00, intended to correspond to concentrated OM, heavy naphthenic oils and paraffinaceous oils. The figure displays a clear-cut distinction in the averaged distribution of n-alkane quantities vs. carbon numbers among these three groups, with the increasing portion of low-molecular n-alkanes along with rising of i-C<sub>16</sub>/(Pr+Ph) values.

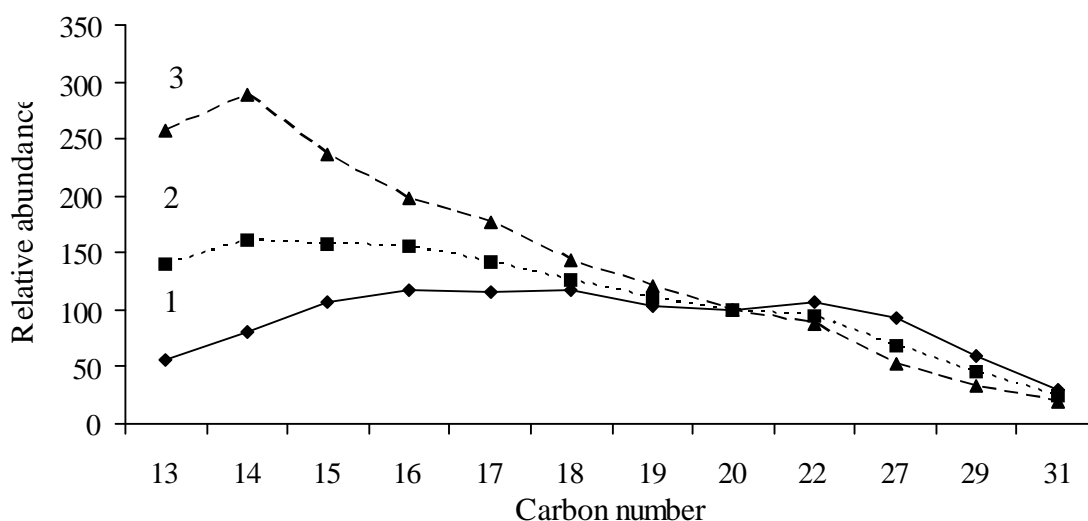


Figure 1. Averaged distribution of n-alkanes vs. carbon numbers

Mass-molecular redistribution of n-alkanes is known (Petrov, 1984) to accompany thermal maturation of sedimentary OM. Examining GLC data of crude oils and modeling experiments carried out by Al. A. Petrov we have found out that bacterial reworking of oils, which results in different chemical types, does not affect  $i\text{-C}_{16}/(\text{Pr}+\text{Ph})$  values. On the contrary, simulated thermolysis of oils of different chemical types as well as bitumen invariably leads to degradation of Pr and Ph into lighter i-HCs,  $\text{C}_{13}\text{-C}_{15}$ .

Nowadays lots of parameters have been worked out with a view to estimate maturity level of sedimentary OM. However, taken individually those parameters are limited in their ability to define petroleum compositional families or to predict oil-generating potential of source or oil-bearing rocks. Therefore N. Pasadakis et al. (2004) consider that it is desirable to use the abundant, simple compounds exhibiting characteristics and variations which are consistent with those of the less abundant, but structurally more complicated, compounds.

In our opinion  $i\text{-C}_{16}/(\text{Pr}+\text{Ph})$  ratio seems to satisfy those demands. There are some examples of this parameter applying to gas-chromatogram data available in literature. We have corroborated the definition of petroleum compositional families carried out on the base of principal component analysis (Pasadakis et al., 2004). In samples subjected to hydrous-pyrolysis at 330 °C for 72 hours it has been ascertained double augmentation of  $i\text{-C}_{16}/(\text{Pr}+\text{Ph})$  values, source-rocks characteristics regardless (Petersen et al., 2004).  $i\text{-C}_{16}/(\text{Pr}+\text{Ph})$  ratio amounts to 0.9 in an unusual oil containing n-alkenes as a result of rapid heating or radiation during its generation (Obermajer et al., 2004). The higher  $i\text{-C}_{16}/(\text{Pr}+\text{Ph})$  ratios have been observed in oils of the Baltic Syneclise (Zdanaviciute et al., 2004), which correspond with low- over high-molecular n-alkanes predominance.