

## GEOCHEMISTRY OF BIOMARKERS FROM THE MESOPROTEROZOIC MALGINSKAYA FORMATION (SOUTH-EASTERN OF THE SIBERIAN PLATFORM)

E. Suslova<sup>1,2</sup>, T. Parfenova<sup>1</sup>, S. Saraev, K<sup>1</sup>. Nagovicin<sup>1</sup>

<sup>1</sup> Trofimuk Institute of Petroleum geology and Geophysics of Siberian Branch of Russian Academy of Sciences, Russia

<sup>2</sup> Novosibirsk State University, Russia

The Mesoproterozoic Malginskaya Formation is distributed in the Uchur-Maya region in the south-east of the Siberian platform. Among the rare microfossils preserved in the mudstones are *Leiosphaeridia crassa*, *L. Minutissima*, cf. *Leiosphaeridia tenuissima*, cf. *Glomovertella* and *Oscillatoriopis sp.* The upper part of the formation is composed of organic matter-rich rocks. The results of lithological and geochemical studies suggest that rock from Malginskaya Formation contains both autochthonous and migrated bitumens [1].

Autochthonous bitumens are found in rocks composed of gray and black thin-bedded mudstone, clayey limestones and dolomites. The amount of insoluble residue (IR) in rocks varies from 17 to 87 %, averaging 38 %; total organic carbon ( $C_{org}$ ) – from 1.9 to 12.7 %, averaging 6.2 %. The bitumen coefficient values ( $\beta = (b_{hl} * 100) / (C_{org} * 1.33)$ ) as a rule do not exceed 5 %. The hydrocarbons (HC) content ranging from 19 to 44 % constitutes on average 30 % in the autochthonous bitumens, and total concentration of resins and asphaltene components ranges between 56 and 81 % (on average, 70 %).

Among the alkanes with normal structure ( $C_{14-36}$ ) identified in the autochthonous bitumens, HC  $C_{16-20}$  is accounted for by maximum distribution. The values of pristane (Pr) / phytane (Ph) ratio lie in the range from 0.6 to 2, averaging at 1.5, while the  $n-C_{27} / n-C_{17}$  ratio varies from 0.05 to 0.38, averaging at 0.12. The relationship between normal alkanes and sum of isoprenoid alkanes varies from 2.4 to 16.3, averaging at 10.9. The carbon preference index (CPI) ranges from 0.9 to 1.4, averaging at 1.1. Remarkably, 12- and 13-monomethylalkanes are absent from all the analyzed bitumens. The m/z 191 chromatograms showed tricyclic terpanes with  $C_{19} - C_{31}$  in composition, with their content varying between 12.3 and 34.4 % (on average, 20.9 %) among all terpanes. The values of tricyclic terpanes index ( $I_{tc} = 2 * \Sigma C_{19-20} / \Sigma C_{23-26}$ ) ranges from 1.0 to 3.6, averaging at 2.2, and concentration of tetracyclic terpanes  $C_{24-27}$  – from 1.5 to 4.3 %, averaging 2.6 %. Hopanes with composition of  $C_{27-35}$  are bound to be prevailing among terpanes. The total content of hopanes and homohopanes constitutes 58.1 – 81.3 % of terpanes (72 %, on average). The trisnorhopane (Ts) to trisnorhopane (Tm) ratio varies over a wide range – from 0.16 to 0.86, averaging at 0.42. Homohopane coefficient  $C_{35}/C_{34}$  changes in the range of 0.4 – 0.7 (average – 0.6). The saturated fraction of autochthonous bitumens is marked by the presence of a specific biomarker 17 $\alpha$  (H) -diahopane that was previously discussed in the literature [2, etc.]. The total concentration of moretanes with  $C_{29-32}$  in composition range 2.7 – 8.5 % (average – 4.6 %) of the sum of terpanes. Ratio of S and R stereoisomers of moretanes with  $C_{32}$  composition vary between 0.3 – 0.9 (0.6 – average). As in the autochthonous, in migrated bitumens steranes HC are absent.

In platy, sometimes massive, gray dolomites and limestones with IR ranging from 5 to 12 % (on average, 8 %),  $C_{org}$  – from 0.04 to 1.1 % (on average, 0.31 %), the value of  $\beta$  tends to be greater than 5 % and may reach 20%. Most of bitumens derived from carbonate rocks are characterized by high content of HC (28 – 53 %). These bitumens-specific differences from the

autochthonous OM indicate that dolomites and limestones are enriched by migrated bitumens. The distribution of normal alkanes in the saturated fractions and the values of Pr/Ph ratio and CPI of these bitumens are similar to those in autochthonous bitumens. It should be noted values of Pr/n-C<sub>17</sub>, Ph/n-C<sub>18</sub> and n-C<sub>27</sub>/n-C<sub>17</sub> tend to increase and the relationship of normal alkanes to sum of isoprenoid alkanes varies from 5.2 to 13.1. These differences are likely to be associated with the biodegradation of HC. 12- and 13-monometilalkanes are absent. Analysis of m/z 191 chromatograms revealed no difference between total content of tricyclic and tetracyclic terpanes from those in the HC of autochthonous bitumens. The I<sub>tc</sub> values have considerably decreased from 0.6 to 2.7 (averaging at 1.5). The calculations of total content of hopanes and homohopanes, hopanes / tricyclic terpanes and hopanes / tetracyclic terpanes ratios did not show any differences. The values of Ts/Tm parameter have changed from 0.38 to 0.94, averaging at 0.62. The homohopanes C<sub>35</sub>/C<sub>34</sub> ratio showed no difference from its values for autochthonous bitumens. The presence of 17 $\alpha$  (H) -diahopane have been revealed in the samples. The similarity in molecular composition suggests that carbonate rocks contain exactly parautochthonous bitumens. The traces of primary migration have thereby been established in the Malginskaya Formation rocks.

## Conclusions

New information indicates that the high-carbon rocks from the Malginskaya Formation generated oil-like components in the south-east of the Siberian platform. Geochemical, lithological and paleontological study showed that the main source of organic matter was bacterial microcommunity and in a less degree eukaryotic microbes. Our observations complement the information that the simplest eukaryotes have become widely distributed in marine basins in the world within the Mesoproterozoic. It is assumed that high-carbon rocks were formed in noncompensated depressions in the sub-oxidizing environments of a shallow epicontinental marine basin.

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## References

1. Suslova, E.A., Parfenova, T.M., Saraev, S.V., Nagovicin, K.E., 2017. Organic geochemistry of oil shale, mudstone and carbonate rocks of Mesoproterozoic Malginskaya Formation and conditions of their formation (south-east of the Siberian platform) // *Geology and Geophysics*, No 2-3 (t/a).
2. Bazhenova, T.K., Dakhnova, M.V., Zheglova, T.P., Lebedev, V.S., Mozhegova, S.V., Larkin, V.N., Nazarova, E.S., Nechitailo, G.S., Grayzer, E.M., Kiselev, S.M., Kiseleva, Y.A., Goryunova, E.A., Borisova, L.B., 2014.–Oil source formations, oils and gases of Precambrian and Lower - Middle Cambrian of the Siberian Platform. VNIGNI, M., 128 p.