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Specific hydrocarbon molecular markers in bottom sediments of Lake Baikal discharge zones

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Study of the molecular composition of the dispersed organic matter (OM) in bottom sediments of Lake Baikal was conducted (supported by RSF #19-17-00226). Sediments (11 gravity cores - 28 samples) were collected during research expeditions of the R/V "G.U. Vereschagin" (LIN SB RAS, Irkutsk) in 2016-2018.

Variations in composition and ratios of aliphatic and aromatic components reflect changes of OM sources. Most n-alkane profiles show the distinguishable predominance of terrigenous components C27-C31. The highest biodegradation degree and increased content of isoprenoids is detected near the Gorevoy cliff where the active oil discharge was observed. Biogenic hopanes ($\beta\beta$ -hopanes and hopenes) predominate in most samples and diagenetic type of distribution is identified only in sediments with oil inclusions. Steranes are the minor components with ethylcholestanes as the main peaks attesting to the input of land plants. Increased values of perylene and phenanthrene in polycyclic aromatic HCs composition indicate the mixed biogenic-petrogenic nature of OM of the studied Lake Baikal sediments, while the oily samples contain only trace amounts of perylene.

The branched 2,7-dimethyl alkanes (m/z 127) have been identified in mudstone samples from the Vendian Marna Formation from the Sayan-adjacent Biryusa area and in Permian and Upper Carboniferous coal-bearing rocks from superdeep well SV-27 (Vilui syncline) [1]. Their precursors most likely are the analogues of branched methylenated acids detected in lipids of modern bacteria (9,10-methylene hexadecane, 9,10-methylene octadecane, and 11,12-methylene octadecane acids). Decarboxylation of the methylenated acids branched at the second and seventh carbon atoms during diagenesis and catagenesis should have resulted in 2,7-dimethyl alkanes that were detected in all immersed sediments of the southern, central and northern parts of Lake Baikal.

Trace amounts of the other poorly studied group of compounds – monoaromatic steroids (MAS) were identified in bottom sediments near the mud volcano Kedr in the southern part of the lake. These structures can be formed during diagenetic transformations of sediments at the contacts of OM with clays (catalyzers) together with the formation of regular steranes and diasteranes

(C27-C29). They have been previously detected in apocatagenetic rocks of the East Siberian sedimentary basin (ultradeep hole SV-27 from the Middle Vilyui area of the Vilyui syncline) [2]. The absence of the main fragmental ion m/z 253 in the analyzed samples points to the migration of methyl alternate from C-17 to C-23 alkyl-chain position and agrees with distribution of the similar structures (m/z 281, 309, 366) in rocks of the hole SV-27. The detected 17-desmethyl-23-methylmonoaromatic steroids appear and exist at high temperatures and pressures and are very thermodynamically stable.

Thus, the input of the OM of catagenetic maturity degree to the bottom sediments of Lake Baikal is likely associated with the deep fluid migration and mud volcanic breccia uplift to the surface.

References

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