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The black shales of the Cambrian Kuonamka complex of the Siberian platform: chemofossils, microbio-community, facies

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In the Lower and Middle Cambrian, anomalously organic-rich sediments accumulated in the north and east of the Siberian Platform. They formed carbonaceous rocks of the Kuonamka complex (Shumnaya, Kuonamka, Inikan, Sekten, and Sinyaya Formations). The most of lipid matter of Cambrian black shales has been derived from remains of lower plants and bacteria. The contribution of macrofauna is much less. The known research results have been taken as a basis of diagnostics of microbiocommunity: steranes are biomarkers of eukaryotes, tricyclanes are biomarkers of leiosphaeridias (acritarchs) and algaes (prasinophyseaes) and hopanes are biomarkers of prokaryotes. Based on steranes/terpanes and tricyclenes/hopanes ratios, the communities have been divided into predominance of planktonic-algal microbiocenosis, community with predominance of bacterial organisms, and planktonic-bacterial microbiocenosis. The composition, distributions, and ratios of biomarkers from bitumen extracts of the Kuonamka, Sekten, Inikan, and Sinyaya Formations were studied by chromatography-mass spectrometry system Agilent 5973N.

The first biological community is characterized by the following parameters: steranes/terpanes ratio is higher or equal to 0.3; tricyclanes/hopanes ratio is higher than 1; steranes are generally dominated by cholestane and ethylcholestane; C29/C30 hopane ratio is less than 1. The C35/C34 homohopane index is lower than 1. This suggests that there was no anomalous hydrogen sulfide contamination of bottom water and sediments, from which the examined highly carbonaceous black shales formed. These characteristics are peculiar to the organic matter (OM) rocks of the Kuonamka Formation. The content of the total organic carbon (TOC) is more than 10%.

The molecular parameters of the second bio-community are as follows: steranes/terpanes ratio is lower or equal to 0.1–0.2; tricyclanes/hopanes ratio is lower than 1; steranes are dominated by ethylcholestane; C29/C30 hopane ratio is higher than 1. The homohopane index is higher than 1, which is indicative of hydrogen sulfide contamination of sediments and, possibly, bottom waters. These characteristics are peculiar to the OM of the Inikan Formation (TOC is lower than 10%).

The third bio-community: steranes/terpanes are at the level of 0.3; tricyclanes/hopanes are at the level of 1; steranes are dominated by ethylcholestane; C29/C30 hopane ratio is lower than 1. The homohopane index is lower than 1. These parameters are typical of the OM of the Kuonamka and Inikan Formations.

The fourth microbiocommunity: generally, steranes/terpanes ratio is equal to 0.1–0.2, and tricyclanes/hopanes ratio is lower than 0.1; steranes are generally dominated by ethylcholestane; lanostanes and 28,30-bisnorhopane have been identified; C29/C30 hopane ratio is less than 1. The homohopane index is greater than 1. These characteristics are typical of the OM of the Sinyaya Formation (TOC, generally, is lower than 5%).

The study of hydrocarbons from the shales of the Kuonamka complex has made it possible to identify four chemobiofacies in the Lower and Middle Cambrian deposits. It was established that amounts of the OM and the composition of hydrocarbons are controlled by the bio-productivity of diverse bio-communities and redox conditions characterized by lateral variability and temporal changes both in aquatic environments and sediments.

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