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Mn-carbonates, glauconites and phosphorites in the Upper Jurassic Georgiev Formation of the West Siberian marine basin

Yu. N. Zanin, V.G. Eder, A.G. Zamirailova

Institute of Petroleum Geology, Siberian Branch of the Russian Academy of Sciences

630090, Novosibirsk, Russia

Georgiev Formation is wide distributed in the area of the Mesozoic West Siberian marine basin. It is dated as upper Oxfordian, Kimmeridgian and lower Tithonian stages. In the most cases the thickness of the Formation is no more than 10 m. It includes terrigenous rocks from mudstones to sandstones and a great variety of carbonate rocks. Mn-carbonates, glauconites and phosphorites were mentioned in the Formation by many researchers who studied these deposits, but were never studied in detail. Mn-carbonates were discovered in the central and western-central parts of the Basin. In the last cases the thickness of their beds reaches up to 2.2 m and the content of MnO - up to 34 % and in the east direction the thickness of beds and the content of MnO are reduced. The Mn-carbonate minerals here are rhodochrosite, manganocalcite, manganous calcite, Mn-bearing siderite. The Mn-carbonate rocks are essentially enriched in authigenic quartz. The main petrographic forms of Mn-carbonates are massive, oncolithic and stromatolithic. In polarizing microscope microoncolithes and microstromatolithes are revealed as the main ingredients of the massive Mn - carbonates. The glauconite is observed in the Georgiev Formation everywhere in the different types of rocks and often as glauconitite. The thickest glauconitite and clayey-glauconite beds are revealed just as Mn-carbonate ones in the western part of the West Siberian Basin. The thickness of glauconitite and clayey-glauconite beds reaches here up to 5.6 m and these beds occur at the base of the Georgiev Formation. Structure of glauconite grains in SEM is different, but sometimes microbial forms – cocco-like and capsules of cyanobacterial threads – can be recognized. Highly evolved glauconite, characterized by high K_2O content, was

found in the central part of the Georgiev marine basin, while nascent glauconite, with lower K_2O content was revealed in the north of the basin. Phosphorites in Georgiev Formation are revealed as disseminated concretions in the huge area, often jointly with glauconite. Their peculiarities are the presence of the same microbial forms as in glauconite – cocco-like ones and capsules of the cyanobacterial threads. Phosphorites composed of carbonate-apatite, which is characterized by low content of CO_2 (e.g. P_2O_5-23.9 %, CO2 – 0.88 %). All studied rocks of Georgiev Formation were sampled from the depth of more than 2000-2500 m. The intensive bioturbation is observed often in the Georgiev Formation rocks. Such infauna traces as *Chondrites, Thalassinoides, Skolithos* are discovered here. It is possible to conclude:

1. The list of authigenic minerals and rocks of the Georgiev Formation which includes authigenic Mn-carbonates glauconite, phosphorites, authigenic quartz indicates their probable relation to the products which were carried to the marine basin from the simultaneously developed weathering crust on the adjacent continents. One of these areas could be Ural.

2. The presence of mineralized stromatolithic and oncolithic forms in Mn-carbonates and cocco-like forms and tubes of cyanobacterial threads in glauconite and phosphorites shows important role of the microbial (including cyanobacterial) activity in their genesis.

3 By our opinion, the Mn-carbonate rocks containing stromatolithes and oncolithes and authigenic quartz were formed in a rather shallow-water setting, and glauconite and related to it phosphorite - in deeper-water environments.

4. We relate the low content of CO_2in the Georgiev Formation phosphorites to the removal of the carbonate-ions from the crystalline structure of carbonate-apatite, as it was shown for the first time by Yu. Zanin and L. Krivoputskaya (1976).

5. It was revealed that during rewashing process of glauconite grains there was a removal of iron and potassium from the lattice of the mineral.