The common presence of radial cracks, cross-cutting the oxide layers, and the high porosity and permeability of the nodules are evidences of somewhat open formation conditions. The primary manganese minerals (probably, manganite and vernadite) of the nodules have not been found yet and the occurrence of jacobsite in the Faizulino deposit points to some degree of postsedimentary alteration.

It is suggested that the volcanic glass is one of the main source of Fe and Mn owing to their correlation with high Ti and Al content. The biogenic (mainly radiolarian, some individual filaments, and spheroidal microforms) relics in the nodules are thought to play a vital role in the variation of chemical composition (possibly including radionuclide) in the internal part of the nodules, since plankton is known to scavenge the trace metals during the life cycles similar to the modern Fe-Mn nodules [Ehrlich, 1980]. An accumulation of some amount of $K^+$ in the filaments may be also related to the organic matter [Harder and Dijkhuisen, 1983].

Thus, the studied nodules are comparable to the modern counterparts by high grades of Ni, Co, Ba, Cu, and elevated of Fe contents. The depletion in ΣREE in the nodules may reflect diagenetic processes. The formation of Fe-Mn nodules could represent a combination of hydrogenetic and diagenetic conditions under important role of biogenic factor.

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## BIOMORPHIC SIGNATURES OF METALLIFEROUS FERRUGINOUS AND MANGANIFEROUS ROCKS FROM THE URALS VMS DEPOSITS

В оксидно-железистых и марганцевых продуктах придонных преобразований известково-сульфидно-гиалокластитовых осадков колчеданных месторождений Урала обнаружены бактериоморфные структуры, представленные нитчатыми и микротрубчатыми формами, и реликты микрофауны – трубчатых организмов, тентакулитов, радиолярий и фораминифер. В ассоциации с биогенными образованиями установлены аутигенные лейкоксен, титанит, рутил, хлорит, иллит, гематит, апатит и сульфидные минералы. Результаты ЛА-ИСП-МС анализов показывают, что в гематите биоморфоз наблюдается концентрация Mn (до 9393 г/т), Ti (до 528 г/т), As (до 1872 г/т), V (779 г/т), W (до 1091 г/т) и Mo (до 40 г/т), а также повышенные содержания Zn, Pb, Sb и U. Изотопный состав углерода $\delta^{13}C$ в карбонатах варьирует от –4 до –11 ‰ в отличие от $\delta^{13}C$ (от 0 до +2.64 ‰) надрудных известняков. Предполагается, что биологическая активность в совокупности с экстремальными условиями среды привели к ускоренной трансформации биогенного ОВ, создавая уникальные возможности для постседиментационных преобразований исходных компонентов осадка.

The brecciated proximal ferruginous and manganiferous rocks related to the Urals VMS deposits include jasperites, gossanites, and umbers, in addition to thin-bedded jaspers and cherts [Maslennikov et al., 2012]. An abundance of replacement textures of hyaloclastites and carbonates by hematite and silica is the most important feature of jasperites and umbers. The replacement of clastic sulfides by hematite and magnetite is characteristic of gossanites. These sedimentary rocks are accompanied by pseudomorphs of hematite and quartz after microplankton fossils and bacterial filaments [Maslennikov et al., 2012; Ayupova and Maslennikov, 2012].

In gossanites from the Talgan and Imeni XIX Parts'ezda deposits, widespread carbonate-hematite tube forms are hollow-centered or incrusted by concentric layers of microcrystalline hematite. Locally, the cavities of these worms are mineralized with sulfide minerals. The tube forms can be compared with the near vent tube worms discovered in the modern and ancient black smoker systems but of smaller diameter [Little et al., 1999]. Typical tentaculates from the Talgan, XIX Parts'ezd, Molodezhnoye, Alexandrinka, and Shemoor deposits have similar diameters of tube but are made up of calcite partly replaced by hematite. The authigenic leucoxene, titanite, chlorite, hematite, and apatite are often observed inside the shell of tentaculites. The spherical radiolarians of *Astroentactinia* 100–160 μm in size with a number of short thin outer needles are recognized in ferruginous and manganiferous rocks. Rare round or oval foraminifera shells are composed of quartz, albite, apatite, chlorite, and carbonate-cemented ferruginous material.

All varieties of ferruginous and manganiferous rocks from the Urals VMS deposits contain abundant silica-hematite filaments. Two types of filaments may be distinguished on the basis of their dimensions. The filaments of the larger diameter (6–16 μm) cross cut the clusters of filaments in calcareous gossanites from the Talgan VMS deposit. Much thinner (1–4 μm in diameter) filaments were found in hematite-chlorite gossanites from the Molodezhnoye and Alexandrinka deposits. The bulbous swelling is a common feature of the filaments. The numerous thick (20–30 μm) and thin (1–4 μm) filaments were revealed in jasperites from the hanging wall of the Saf'yanovka VMS deposit. Cylindrical to elliptical filaments are up to 500 μm long. They are coated by the red cryptocrystalline hematite and are filled with quartz. The network of numerous curved hematite filaments with a 1-μm axial hole is the most striking feature of jasperites from the Babaryk VMS deposit.

The inorganic self-organized processes may produce the patterns of silica and iron oxides that resemble bacterial filament structures [Hopkinson et al., 1998]. Notwithstanding, the studied filaments display no regular fractal or dendritic branches and may be found as a single fragment in the clastic matrix of ferruginous rocks. In comparison with fractal structures, the coating and infilling are common that is attributed to the near vent fauna fossilization [Little et al., 1999].

The diameters of the filaments are comparable with some varieties of hemoautotrophic bacteria found in the modern vent sites [Juniper and Fouquet, 1988]. More recent work on the ancient VMS deposits indicates an important role of similar biogenic processes in formation of silica-ferruginous rocks [Duhig et al., 1992; Greene, Slack, 2003; Little et al., 1999].

The carbon isotopic composition of limestones closely related to the sulfide orebodies at the Uzelga, Talgan, Yubileinoe, and Sibai VMS deposits varies from 0 up to + 2.64‰ [Maslennikov, 1999; Ayupova, Sadykov, 2013]. The $\delta^{13}C$ values of the authigenic carbonates from the metalliferous sediments are low (–4 to –11‰) and similar to those measured in gossanites, jasperites, and umbers [Ayupova, Sadykov, 2013]. In some cases, $\delta^{13}C$ values in carbonates from gossanites of the Molodezhnoye and jasperites of the Sibai deposits are extremely low (–19.5 and –13.0 ‰, respectively) [Maslennikov, 1999].

The average value is close to the $\delta^{13}C$ values of the vestimentiferas from the rift zones of the Pacific Ocean that in trophosome proved activity of chemoautotrophic bacterial-symbionts [Felbeck, 1983] and to the mean $\delta^{13}C$ value (–15.87 ‰ ± 4.96‰) determined for the organic constituents of the ferrihydrite samples from the Axial Volcano black-gray smoker hydrothermal field [Kennedy et al., 2010]. The direct relationship between the carbon isotopic values and presence of iron-oxidizing bacteria from natural and laboratory samples shows the ability of these microorganisms to fractionate the carbon [Kennedy et al., 2010; Konhaueser, 2006].

The results of LA-ICP-MS analyses show that the distribution of trace elements in hematite pseudomorphs after the tube worms is relatively uniform and stable. The hematite biomorphic structures concentrate Mn (up to 9393 ppm), Ti (up to 528 ppm), As (up to 1872 ppm), V (779 ppm), W (to 1091 ppm), and Mo (up to 40 ppm), indicating the biological mechanisms of accumulation and retention of these metals in the system. It should be emphasized that the elevated contents of these elements are typical of the modern vestimentiferas and polychaetes [Juniper et al., 1992; Demin et al, 2007], as well as mineralized fauna from the ancient hydrothermal systems [Maslennikov, 2006].

The finding of the filaments in the ferruginous and manganiferous sedimentary rocks suggests that they may be confirmed to the bacterial destruction of the volcanic glass [Thorseth et al., 1995] and/or the oxidation of previously formed sulfides [Konhauser, 2006]. It is likely that microbial activity, evidenced by the relic biomorphic textures, leads iron, manganese precipitation, and silica nucleation at sediment-water interface [Duhing et al., 1992]. Basically, bacteria and microorganisms create a local microenvironment as a result of their metabolic products. The bacterial activity in submarine transformations of initial sulfide, hyaloclastic, and carbonate sediments played a major role in the development of microfossils. The microbial alteration also results in formation of authigenic minerals and is accompanied by redistribution of elements. The chemical composition of biotic alteration products may strongly vary, indicating that different bacteria types should accumulate different elements. The mobility of elements during biotic alteration also seems to be significantly different relative to abiotic alteration. The accumulation of Mo, W, V, Mn, Ti and other elements and formation of titanite, hematite, chlorite, apatite, and illite are the early low-temperature process produced by microbial activity.

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## MINERALOGY OF OXIDIZED ORE OF IKRYANSKOYE GOLD DEPOSIT (SVERDLOVSK DISTRICT, RUSSIA)

Икрянское месторождения золота приурочено к зоне Егоршинского глубинного разлома и локализовано в рассланцованных метавулканитах и метаосадочных породах – эпидот-актинолит-хлоритовых, хлоритовых, кремнистых, глинисто-кремнистых и углеродисто-глинисто-кремнистых сланцах. Руды вкрапленные, прожилково-вкрапленные. Золото связано с пиритизацией, находится преимущественно в самородной форме, обычно содержит примесь ртути. Окисленные руды глинистые, при этом метавулканиты характеризуются высокими содержаниями хлорит-смектита, в то время как метаосадки обогащены слюдой и каолинитом. Наличие глинистых мирнералов с высокой сорбционной емкостью ухудшает технологические свойства руд, предполагаемых для гидрометаллургической переработки.

Due to the depletion of gravel and large gold deposits in the Urals in the last decade a small objects that are available for open-pit mining are involved to exploitation. As a rule, these deposits of oxidized ore with low grade of gold. Gold from ore is extracted by heap leaching cyanidation. The efficiency of this process is largely determined by the mineral composition of the ore: size and morphology of gold, clay content, the presence of fresh sulphides and copper minerals. The study of the mineral composition of oxidized ore was held in conjunction with the planned mining of the deposit ZAO Aurum. Currently Ikryanskoye deposit is excavated by shallow pit.

Ikryanskoye deposit is a part of larger Fevralskoye deposit, which belongs to submeridional Reft schist band of Sillurian–Lower Devonian volcanic-sedimantary rocks. Deposit locates in Yegorshinskiy regional fault. Ore zone is located within tectonic wedge, which contacts with Lower Carbon carbon-bearing sedimentary rock and limestone in East. In West direction schist band boardered with Low Carbon Reft gabbro-granite complex. Vein bodies of granite in schist band connect with this complex. There is regional weathering crust above deposit. Its thickness at the plane area is about 25–30 m. Linear weathering crust above tectonic zone spread deeper more, then 60 m [Koshkin et al., 2009].

Host rocks because of tectonic influence are schistose. There are metavolcanites (basalt with rare dacite), their clastic varieties, metasediments, and rare vein plagiogranite. Metavolcanic rocks were metamorphosed under epidote-amphibolite subfacie of green-schist facie. In ore zone they al-