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Composition of the Fe-Mn nodules and associated microbial communities of the Kara Sea, Arctic Ocean

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This work is based on ferromanganese nodules, crusts and underlying sediments collected from the different parts of the Kara Sea shelf (Arctic). The geochemistry, morphology and organic matter content of nodules, crusts and sediments were determined with ICP-MS, SEM-EDS and GC/MS. The associated microbial communities were identified with 16S rRNA (gene) sequencing. Nodules from the Kara Sea shelf significantly differ from their more common abyssal analogues. These shelf nodules have an irregular tabular morphology and relatively low abundances of Mn (up to 19 wt.%), Fe (up to 24 wt.%), other trace metals and the REYs. The Kara Sea nodules show concentric layering that is also typical of deep-sea diagenetic nodules. Samples subdivided into two groups: Mn-rich (Mn/Fe = 0.35 on av.) and Fe-rich (Mn/Fe = 1.65 on av.). The negative Ce anomaly suggests a diagenetic origin of the nodules and crusts. The input of organic matter to the ore deposits in the study area has three main sources (according to n-alkane composition): 1) marine (planctonogenic); 2) low-transformed terrestrial organic matter derived from river run-off; 3) microbial-derived source. Microbial communities of nodules and crusts are substantially different from benthic microbial communities in sediments. They dominated by taxa involved in N cycle, particularly responsible for denitrification (*Cyclobacteriaceae* and *Kiloniellaceae*), nitrification ("*Candidatus Nitrosopumilus*" and *Nitrosomonas*), comammox (*Nitrospira*) and anammox (*Nitrosococcaceae*) [1]. Dissimilatory Fe(III)- and Mn(IV)-reducing Geopsychrobacter was identified in Fe-rich ore samples. This taxon can be involved in Fe(III)- and Mn(IV)-dependent anaerobic oxidation of methane [2]. In contrast, microbial community of underlying sediments dominated by sulfate-reducing bacteria (SRB). Some of the identified SRB (e.g. *Desulfobulbaceae* and *Desulfosarcinaceae*) are able to form syntrophic associations with anaerobic methanotrophic archaea [3]. Identified n-alkanes can be oxidized by *Anaerolineaceae* growing in syntrophic association with methanogens. Furthermore, we revealed that manganese nodules and crusts can be used potentially as important electron acceptors for oxidation of organic compounds by *Geopsychrobacter*, *Desulfuromonadales* and *Colwellia*. Applied multi-disciplinary approach to the study of the Fe-Mn nodules and crusts will help to determine their contribution in formation of unique biogeochemical environments in the Kara Sea.

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