Mineralogical, geochemical, and microbial characteristics of marine sediments at Tempelfjorden Fjords, Svalvard, Norway

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Svalvard fjords, affected by turbid overflow emanating from outlet glaciers, are modern analogues for Quaternary deglacial settings. To better understand the response of the discharge of glacial meltwater including suspended sediments to the mineralogy, geochemistry, and microbial community, we sampled the subsurface sediments at 8 stations along the axis of Tempelfjorden fjords. The sediment samples were obtained using a gravity core at 1 station and a giant box core at 7 stations. The sediment samples were used for geochemical and mineralogical characterizations as well as for microbial community by genomic analysis. Iron-oxidizing and -reducing bacteria were enriched from the marine sediments at 8°C and the development of bacterial and archaeal structures in the sediments of fjords was examined using cloning and denaturing gradient gel electrophoresis analysis of rRNA gene. The water mass and marine sediments are influenced by the runoff from the glaciers at the fjord head in Tempelfjorden. X-ray diffraction analysis of the sand and silt fraction of the sediments revealed the predominance of quartz, mica, calcite, and dolomite with lesser amounts of feldspars and chlorite. Their clay mineralogy was dominated with illite, kaolinite, chlorite, and dolomite with lesser amounts of quartz, feldspar, and iron oxides. Iron-oxidizing and -reducing bacteria enriched from the marine sediments showed active Fe(II) oxidation and Fe(III) reduction at 8°C and 25°C. Iron-reducing bacteria enriched from the sediments were formed nm-sized magnetite at both 8°C and 25°C using lactate as an electron donor and a ferric iron oxide, akaganeite, as an electron acceptor. Dynamic bacterial community succession was observed at 8 stations. Although only one type of archaeal community profile was observed, archaeal community was quite distinct in the sediments and affected by deglaciation compared to control sediments. This confirms previous study that arctic sediment microorganisms participate in biogeochemical cycles remain in active at low temperatures.

Developing extraction method for mercury analysis in soils with different mineral composition

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The toxicity of elements depends not only on their total concentrations but also on their chemical forms. In real environment where mercury was considered as contaminant, we often experience difficulty in measuring mobility of mecury from constituents soils. The final goal of this project is speciation of mercury in contaminated soils and sediments. Preliminary tests for reference materials were performed to find out simple and more efficiency method to extract mercury. The reference materials with different mineral composition were selected and used. One is composed of mostly with Al-silicate minerals and another is mostly composed with calcite and ferrosilite. Same extraction method was applied to reference material of two types. The extraction efficiency for three methods was compared with certified values of reference material. The two extraction methods of three were acid digestion with aqua regia and mixed acid. The other extracted with mixture solution methanol and HCl using microwave at 40W and 80W for 20min respectively. The most high efficiency of sample including Al-silicate mineral was microwave method using methanol and HCl, while the calcite-based sample was observed that the aqua regia extraction method is good than the others. But this sample wasn't detected with microwave method. The developing extraction method of the microwave using methanol and HCl will be possible to analysis of mercury more easily and rapidly. Also this can be applied to mercury speciation analysis in soils and sediments.