Structure and function of microbial communities associated with low-temperature hydrothermal venting and formation of barite chimneys at Loki's Castle vent field

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Structure and function of microbial communities associated with barite chimneys in a low-temperature diffuse venting area at the Loki's Castle black smoker vent field at the Arctic Mid-Ocean Ridge (AMOR) were studied by 454-pyrosequencing of PCR amplified 16S rRNA gene sequences and total community cDNA (270 356 reads). White microbial mats present on the barite chimneys, and associated with sibolignid tubeworms directly on the seafloor, where dominated by Sulfurimonas comprising 86-96% of the rRNA-tags. mRNA-tags indicated that vent fluids rich in H_2S (and barium) discharged into the sulfate-rich seawater supported a chemolithoautotrophic lifestyle where reduced sulfur species were oxidized by oxygen or nitrate. CO_2-fixation proceeded via the rTCA-cycle. Scanning electron microscopy revealed that large amounts of thread-like extracellular polymeric material in the microbial mats acted as nucleation points for barite biomineralization. Anaerobic methanotrophs (ANME) of the ANME-1 clade (26%), and the GOM-arc1 group (14.3%) were dominating in the white chimney barite whereas the black flow channel harbored the most diverse microbial community including taxa such as Planctomycetales, 13.5%; Thiotrichales, 10.5%; Thaumarchaeota (MG 1.1. a), 9.4%; Pseudomonadales 7.2%; and Methylococcales, 3.5%. Hence, indicating methane (aerobic/anaerobic), sulfur and ammonia oxidation and heterotrophic metabolisms as dominating processes.

High pressure and high temperature effect on the structural stability of smectites doped with rare earth elements

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Smectites are phyllosilicates with high cation exchange capacity (CEC) in the interlayers. For these and other features, smectites have been used in various parts of the world as secondary barriers for possible leak of liquids that contain radioactive elements in definitive deposits of nuclear waste disposal. In such case, radioactive cation could be captured by smectite through cationic exchanges. However, very little is known about the stability of smectite under high pressures and high temperatures (HPHT). Preliminar studies developed by our group in dioctahedral calcium smectites showed that the smectite structure is stable, remaining dioctahedric after processing up to 7.7 GPa and at room temperature. This work intends to replace the calcium of the smectite for heavy rare earth elements (REE) using the CEC characteristic of the smectite. We have achieved a cation exchange in smectite using La^{+3} as REE so far. Results in SEM/EDS showed that there was not more evidence of calcium in the sample after CEC procedures; on the other hand, a large amount of lanthanum was present. Our next step is to submit La-rich smectite under extreme conditions of pressure and temperature in order to investigate the structure and chemical changes. To achieve high pressures, hydraulic presses with boards of anvils with toroidal profile and diamond anvil cell (DAC) is being used. SEM, X-ray diffraction and FTIR in situ analysis will be performed on all samples.