

Changes in bacterial diversity and community structure within a geochemically variable uranium-mine water treatment plant

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Monitoring and treatment of mining waters, containing heavy metals and radionuclides, are essential throughout the uranium mining. In order to meet the increasingly demanding regulatory requirements, optimized treatment and remediation strategies must be developed through the use of comprehensive biogeochemical models. Since biotic factors have been described to play a key role in these processes, an exhaustive analysis of the microbial diversity emerges as an important prerequisite.

Therefore, this work aims to assess the bacterial diversity occurring along the drainage treatment settling ponds of a former uranium mine and to link it to the associated geochemical features. A set of four sediment samples were taken along the treatment facility (before treatment, in the two treatment ponds and after treatment).

Highly diverse bacterial communities were observed in all samples by analyzing a total of 400 clones through a PCR-RFLP approach targeting the 16S rRNA gene. The clone libraries were dominated mainly by sequences closely related to the phyla *Acidobacteria*, *Actinobacteria*, *Bacteroidetes*, *Firmicutes*, *Planctomycetes* and specially *Proteobacteria*. Within this predominant phylum, relative abundance of *Alpha*-, *Beta*-, *Delta*- and *Gammaproteobacteria* varied among the different samples indicating specific distribution of the different bacterial populations according to geochemical variations. Links between the bacterial diversity and the geochemistry of the sediments will be discussed. Moreover, detection of sequences affiliated with metal-reducing bacteria (e.g., *Rhodoferrax*, *Ferribacterium*, *Geobacter*, *Geothrix*, *Anaeromyxobacter*) in all four samples, suggests that there is an evident potential for the bioremediation of the studied site.

Raman spectroscopy evidence for the ikaite-calcite/Vaterite transformation

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Ikaite ($\text{CaCO}_3 \cdot 6\text{H}_2\text{O}$) is a metastable phase that crystallizes from alkaline waters with high phosphate concentrations at temperatures close to 0°C. Above 4°C ikaite crystals transform rapidly to produce calcite pseudomorphs which are considered a valuable paleoclimatic indicator. In this work synthetic ikaite crystals were grown at near-freezing temperatures using an experimental setup that involved the diffusion of CaCl_2 through a silica gel prepared using natural water from the Argentinian lake "Laguna Potrok Aike". After recovering the crystals from the gel, their transformation was monitored by in situ collecting Raman spectra. The spectra taken in the first stages of the transformation showed the characteristic carbonate vibration modes of ikaite at 1067 cm^{-1} (symmetric CO stretch) and 700 cm^{-1} (in plane band). The second most intense band is due to lattice vibrations and found at 200 cm^{-1} , with secondary peaks at 136, 216 and 265 cm^{-1} . Moreover, the ikaite spectra show good resolved OH modes at 3180, 3240 and 3424 cm^{-1} whose intensity changes could be followed. During the transformation new bands at 1081 and 1085 cm^{-1} , characteristic for vaterite and calcite, appeared in the spectra. After a few hours, the Raman spectrum obtained was identical to that of calcite. However, the external shape of ikaite crystals remained unchanged during the replacement. A mechanism involving the coupling of ikaite dissolution and calcite/vaterite crystallization and the generation of a large amount of porosity is proposed for this transformation.

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