Imogolites as a tool for evaluating the hazard of HARN

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Since the discovery of carbon nanotubes (NTs), there has been great interest in the synthesis and characterization of similar shaped structures like inorganic nanotubes, nanorods, or nanowires. Imogolites (Al_2SiO_3 $(OH)_4$) are natural aluminosilicate single wall nanotubes. To date, only Ge-Al imogolite analogues have been successfully synthesized 100 times more concentrated than Si-Al imogolites.

The growth mechanisms of imogolite-like alumino-germanate nanotubes were examined using a combination of local- (XAS at the Ge-Kedge and 27Al NMR) and semilocal scale techniques (in situ SAXS). A model is proposed for the precursors of the nanotubular structure and consist in rooftile-shaped particles, up to 5 nm in size, with ca. 26% of Ge vacancies and varying curvatures. These precursors assemble to form short nanotubes/nanorings observed during the aging process. The final products are most likely obtained by an edge-edge assembly of these short nanotube segments.

Two structures are revealed by SAXS: at 0.25M of Al the Al-Ge imogolite are double-walled NTs whereas at 0.5 M single-walled NTs are obtained.

First tests to reveal cyto and genotoxicity on various vertebrates cells (human fibroblasts and CHO-K1) are interesting. They show a genotoxicity for concentrations from 8 10^{-5} g/L and effects decreasing from proto-imogolite to long tubes

Fossilization of microaerophilic iron oxidizing bacteria from marine hydrothermal vents

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Iron oxidizing bacteria are common in modern marine and terrestrial systems, where they often display distinctive cell morphologies and are commonly encrusted by minerals, especially bacteriogenic iron oxides and silica. Putative microfossils of iron oxidizing bacteria have also been found in ancient Si-Fe deposits and iron oxidation may be an ancient and widespread metabolic pathway. Microaerophilic iron oxidizing bacteria, in particular, could have thrived on the early Earth in circumneutral environments containing small amounts of oxygen (i.e. 'oxygen oases') produced either by locally concentrated photosynthetic microorganisms (e.g. cyanobacteria) or by chemical reactions. This work seeks to better understand the fossilization and biomineral formation processes associated with these organisms. Understanding the interplay between silica precipitation and biologically induced iron mineral precipitation is a key objective of this work and is essential for understanding preserved Fe-rich biominerals and silica microfossils in the rock record on Earth and possibly on Mars, where Fe-Si-rich hydrothermal systems likely existed.

We have studied samples of Fe-Si-rich deposits from extinct hydrothermal vents along the Explorer Ridge, NE Pacific Ocean. In addition, we have performed silicification experiments using the microaerophilic iron oxidizing bacterium Mariprofundus ferrooxidans, isolated from low-temperature diffuse marine hydrothermal vents, in a Fe-enriched seawater medium at constant pH (6.5) and oxygen concentration (5%) in a controlled bioreactor system. We present the results of characterization of the ultrastructure and composition of the natural samples and experimental reaction products using optical and flurorescent microsocopy, VP-SEM-EDS, FIB milling and FEG-SEM-EDS, and TEM-EDS.