**High Resolution Imaging at ProVIS - Scanning Electron and Helium-Ion Microscopy**

Matthias Schmidt, Hryhoriy Stryhanyuk, Hans-Hermann Richnow and Niculina Musat

Helmholtz-Centre for Environmental Research (UFZ)  
Dept. Isotope Biogeochemistry, ProVIS – Centre for Chemical Microscopy, Permoserstraße 15, 04318 Leipzig

The ProVIS centre for chemical microscopy at the Helmholtz-Centre for Environmental Research (UFZ) Leipzig is dedicated to the visualisation of microbiological processes on microscopic scale. The centre comprises of light, electron and ion microscopes as well as (imaging) mass spectrometers.

Scanning electron (SEM) and helium-ion microscopy (HIM) are part of the correlative microscopy work-flows at ProVIS. We investigated different microbiological samples taken from the environment, e.g. microbial communities in mine tailings, or cultured in the laboratory, e.g. the chlorinated hydrocarbon degrading bacterium *Dehalococcoides mccartyi* strain BTF08. Prior to the SEM and/or HIM investigations the samples were chemically fixed, filtrated on gold-palladium coated filters and critical point or air-dried. High-resolution images of microbes were acquired by SEM as well as HIM which reveal details of their surfaces and morphology, e.g. structure of cell walls or pili, on nanometer-scale. Because of the lesser penetration depth of the helium-ions into the material compared to electrons the HIM is more surface sensitive than the SEM which makes the techniques complementary. Furthermore, elemental analysis of minerals and sediments in the samples by energy-dispersive X-ray analysis (EDX) can allow for first conclusions on the metabolism of the microbes.

In addition to imaging, HIM can be used for nano-fabrication applications. In that case the ion beam is generated from neon instead of helium. The heavier neon-ions have a significant sputtering effect on the sample such that material can be removed. This enabled us to cut a bacterium and image its interior. We expect this procedure combined with the EDX technique to become a powerful imaging tool for the investigation of halogen and metal uptake by bacteria in the environment.