**High resolution correlative microscopy to study environmental microorganisms**

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Microbial processes drive the biogeochemical cycles of elements on Earth. Visualizing and identifying specific microbial populations living in various environmental niches, determining their metabolic function in those habitats and at the same time obtaining information on cells spatial organization (e.g biofilms, aggregates, symbiotic associations), remains the biggest challenge for environmental microbiologists. To obtain such physical and chemical information at a single cell level one would need to use high lateral resolution instruments in a correlative way. The study of single microbial cells in situ is mainly hindered by the relatively small cell size, the complexity of physicochemical and structural interactions between members of the microbial communities (i.e. cell to cell interactions) and due to the interactions between microbes and organic and inorganic components of their living environment. In the present work we show how stable isotope labelling in combination with Nano-scale Secondary Ion Mass Spectrometry (nanoSIMS), epifluorescence microscopy and high-resolution imaging by helium ion microscopy (HIM) and scanning electron microscopy (SEM) were correlatively used to identify specific groups of bacteria colonizing diatom cells, and to determine how much of the inorganic carbon assimilated by the diatom is transferred to the bacterial cells. These correlative anaylses revealed unprecedented information on the initiation of colonization and how this was structurally and chemically developed in time. This first application of high-resolution correlative microscopy will enable future comprehensive single cell studies on microorganism’s morphology, identity and activity in biofilms and aquifers, interaction of microbial cells with metals and minerals and further applications in life sciences.