Single cell imaging of microbial activity in the Ocean

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Microbial activity in marine environments controls to a large extent the chemistry of the Earth's oceans and atmosphere. A quantitative understanding of microbial cycling of bioactive elements, such as C, N, P, S and Fe, in the Ocean is imperative to predict the impact that human activities will have on our ocean and climate.

In our department we develop and apply correlative imaging methods that combine light-, ion-, laser- and electron microscopy. Nanoscale secondary ion mass spectrometry (nanoSIMS) is an indispensable tool for determining nutrient assimilation and turnover by single cells and for estimating contributions of individual microbial groups to nutrient fluxes. Our nanoSIMS was recently upgraded with a new and brighter RF plasma oxygen source allowing us to investigate electropositive elements such as metals with a similar spatial resolution as the electronegative elements C, N and S. Our single-cell imaging facility has also been enhanced by the acquisition of a fluorescence unit for our environmental scanning electron microscope (SEM). This upgrade allows for correlative fluorescence and SEM imaging. With these new instruments we perform high-resolution ultrastructural, morphological and chemical imaging on environmental and culture samples. We combine this single-cell approach with stable and radio-isotope experiments and DNA/RNA/protein-based molecular techniques.

I will present results of our correlative imaging studies of complex microbial communities in various marine environments.