On the multitude of niches for bacteria and archaea in an acidic biofilm

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We studied a microbial snottite biofilm in an abandoned pyrite mine. The organisms that build up the biofilm grow at pH about 2.3 and sulphate concentrations of up to 200 mM. The microorganisms are dependent on the oxidative dissolution of pyrite as the primary energy source and on CO_2 as the primary carbon source. We assessed the microbial diversity in the consortium using restriction fragment length polymorphism and subsequent sequencing. As expected, organisms belonging to the genera *Leptospirillum* represented the majority of bacterial species. Interestingly, we could furthermore identify archaeal sequences that are most closely related to the ARMAN (Archaeal Richmond Mine Acidophilic Nanoorganisms) group [1] as well as to so far uncultured members of the Thermoplasmatales. Using oxygen profiling we determined that the high oxygen demand of the microorganisms lead to a drop from 100% to 0% oxygen within 700 μm. Hence the internal part of the biofilm seems to be anoxic. Interestingly, we could show that bacteria populated the biofilm mostly at the oxygenated vicinity. MAR FISH experiments, using $^{14}CO_2$ revealed that this is also the center of primary production. However, archaea populated the anoxic core only. Currently, we investigate the archaeal niche in the biofilm.

[1] Baker *et al.* (2006) *Science* **314**: 1933-1935.

Developing a comprehensive approach to chamber studies of secondary organic aerosol formation

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Much of what is currently understood about the chemical and physical processes involved in the atmospheric oxidation of organic gases and particles and the formation of secondary organic aerosol (SOA) has been obtained from experiments carried out in environmental (smog) chambers. Achieving a level of understanding from such studies that is sufficient for extrapolating results to the atmosphere (with confidence) and the development of accurate models of SOA formation requires the acquisition of detailed information on a variety of gas and particle properties and processes, such as gas and particle-phase reaction kinetics, gas and particle composition, particle phase, compound vapor pressures, and gas-particle-wall interactions. Obtaining such data is a challenge, but in this talk I will show examples of studies carried out in our laboratory on selected aerosol-oxidant and VOC-oxidant systems in which this goal is close to being achieved. I will demonstrate that by using a diverse array of measurement techniques including mass spectrometry, nuclear magnetic resonance spectroscopy, gas and liquid chromatography, spectrophotometry (with and without compound derivatization), traditional elemental analysis, pycnometry, temperature-programmed thermal desorption, and scanning mobility particle sizing it is possible to develop full, quantitative mechanisms of organic gas and aerosol chemical reactions and models of SOA formation. Doing so, however, requires a more comprehensive approach to chamber studies that acknowledges the obvious: “The atmosphere does not have walls.”