# Proteomic study of *Chlorobium clathratiforme* in Lago di Cadagno, Switzerland

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In the sulfide rich (meromictic) Lago di Cadagno, primary production is dominated by anoxygenic photosynthesis, and hence serves as a model system for an early prokaryote-domiated ocean. Organic matter produced in the anoxic part of the water column by the phototrophic S-bacteria can have large impact on how carbon and sulfur is recycled in the lake. The bacteriochlorophyll *e*-containing green sulfur bacterium *Chlorobium clathratiforme* is the most dominant anoxygenic phototrophic organisms in Lago di Cadagno, making up 95% of the anoxygenic phototrophic population. The vertical distribution of bacteriochlorophyll *e* and cell counts showed that *Chl. clathratiforme* is found not only in the chemocline where it oxidizes sulfide to elemental sulfur during photosynthesis but also below the photic zone. No green sulfur bacteria are known to fix carbon without light and it is therefore unknown how *Chl. clathratiforme* survives in the deep dark part of the lake. As the genome of *Chl. clathratiforme* has been fully sequenced it is potentially possible to identify the proteins of this organisms in an environmental proteomic study. We therefore collected cells from four different water depths in Lago di Cadagno in October 2008 with the aim to study the most important proteins associated the cycling of carbon and sulfur by *Chl. clathratiforme*. Proteins were extracted from the water samples and the trypsin-digested proteins were analyzed using liquid chormatography (LC) coupled to tandem mass spectrometry (MS/MS). The proteins where identified using Mascot and quantified using MaxQuant. We were able to identify 940 proteins that could be assigned to *Chl. clathratiforme*. Based on the relative distribution of the identified proteins at the different water depths we will show how the metabolism of *Chl. clathratifome* is regulated by different natural light conditions.

# Sequestering $CO_2$ in marine sediments – Geochemical insights from a natural case study

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Carbon dioxide capture and storage (CCS) has been recognized as one practical option for mitigating global climate change by stabilizing atmospheric $CO_2$ concentrations (IPCC, 2005). In the marine environment potential storage options arise from the unique pressure and temperature conditions: $CO_2$ can be stored in the sediments either as a dense liquid (>3000 m water depth) or as an ice-like solid (gas hydrate) below water depths of 300 m. However, the technical feasibility needs to be demonstrated and, most importantly, the long-term safety (i.e., >10,000 years) has to be assessed together with acceptable rates of $CO_2$ leakage into the marine environment.

Therefore, expedition SO196 with RV SONNE has visited the submarine $CO_2$ seeps in the Okinawa Trough, off Taiwan. Two seep sites in the Yonaguni Knoll area were investigated in detail: (a) Abyss vent, where vigorous emanations of supercritical $CO_2$ and low pH fluids have been observed, and (b) Swallow chimney, where the surface sediments harbour liquid $CO_2$ and $CO_2$ hydrate. First results from porewater and mineralogical analyses indicate intense reactions of the $CO_2$ with the sediments, in particular, complete dissolution of carbonates as well as weathering of plagioclases and pyroxenes.

In addition, high-pressure experiments have been conducted to determine the dissolution kinetics of liquid and gaseous $CO_2$ in pure water and seawater as well as the growth rate of $CO_2$ hydrate at the $CO_2$-water interface by means of Raman spectroscopy.

This integrated approach combining lab experiments and field studies will be complemented by numerical simulations and finally enable us to predict the processes and timescales involved in $CO_2$ sequestration.