

## Mineralogical and geochemical characterization of sedimentary sulfides from Lake Cadagno Sediments

**Contact persons:** *mentionner deux personnes (dont au moins un professeur/MER)*

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### Context

Lake Cadagno is a meromictic Alpine lake located at an altitude of 1,920 m in the Southern part of the Alps in Switzerland. The Lake is permanently stratified with a transition between oxygenic mixolimnion and anoxygenic monimolimnion. Lake Cadagno a unique natural laboratory to study variations in past redox conditions (e.g., S, Fe and Mn) and the link between redox conditions and microbial community evolution. In addition, due its sulfidic-rich character, Lake Cadagno is a good analogue for Early Earth redox cycle. This Lake has been studied extensively for microbial ecology, water chemistry and for redox evolution of biogeochemical cycles. Particularly the sulfur cycle has been studied in the water column and complex interplay between sulfate reduction and sulfide oxidation have been highlighted. Sediment cores covering the complete lacustrine record of the Lake Cadagno were retrieved in 2009 and have shown an early oxic intermediate sulfidic redox transition period shortly after lake formation at 12.5 kyr BP. This study proposes to characterize mineralogically and geochemically sulfide and Mn oxide minerals in the sediment core as well as in the lake sediment and microbial mats. This project will aim to characterize the redox evolution through the oxic-anoxic transition and associated mineralogical and S isotope signatures at the micrometer scale. This project could be done in team of two students where each student focuses either on different element (Mn or S) or on different methods. A CUSO field course is planned at the beginning of July at the Cadagno Lake that the student can attend in preparation for the Master project.

### Objectives and Methods

This project requires field work in the Cadagno Lake to sample sediments and microbial mats. Attending the CUSO course will be very beneficial.

Selected samples will be characterized by XRF and XRD. In situ mineralogical characterisation of the sulfides and Mn oxides will be obtained by SEM, Raman and EPMA analysis. Major elements can be measured by ICP-OES. On few selected samples, sulfur isotope compositions will be measured by SIMS.

### Literature

Canfield et al. (2010) High isotope fractionation during sulfate reduction in a low-sulfate euxinic ocean analog. *Geology*, 38, 415-418

Tonolla et al. (2004) Phototrophic sulfur and sulfate-reducing bacteria in the chemocline of meromictic Lake Cadagno, Switzerland, *Journal of Limnology*, 63, 161-170.

Dahl et al 2013 Molybdenum reduction in a sulfidic lake: evidence from X ray absorption fine structure spectroscopy and implications for the Mo paleoproxy.

Wirth et al. (2013) Combining sedimentological, trace metal (Mn, Mo) and molecular evidence for reconstructing past water-column redox conditions: The example of meromictic Lake Cadagno (Swiss Alps). *Geochimica and Cosmochimica Acta*, 120, 220-238

Ravasi et al. 2012 Development of a real time PCR method for the detection of fossil 16S rDNA fragments of phototrophic sulfur bacteria in the sediments of Lake Cadagno. *Geobiology*.



### Choice of orientation : (supprimer les orientations qui ne conviendraient pas)

1) Sedimentary, Environmental and Reservoir Geology / 2) Geochemistry, Alpine tectonics, Ore Deposits