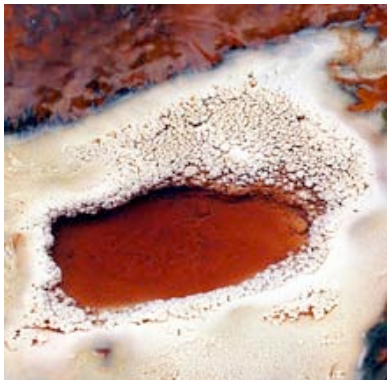
Credits
9 ECTS for full course (individual preparation before the course approx. 60 hours, six-day field course in the Eastern Swiss Alps (50 hrs), 40 hours literatur search and summary presentation)

Travertine terracetts



Carbonates around „Geysir“

Requirements for participation
The field course can take place between the end of April and the beginning of November. Please be equipped for rain, snow and UV-protection since the conditions can change abruptly in the mountains.
Fitness: Field work can last 8-10 hours daily and will take place at altitudes between 500 and 2500m. This requires endurance and a certain physical fitness. Participants need to be prepared for this.
Clothing: Sturdy, waterproof walking boots are a must since we will traverse rough mountainous terrains, rock fields, and sometimes snow.
Insurance: Health and accident insurance are the responsibility of the participant. Insurance policies have to be valid outside your country.

Contacts
Kurt Hanselmann
ETH Zürich, Department of Earth Sciences
Climate Geology and Geomicrobiology, NO G 54
Sonneggstr. 5
CH-8092 Zürich, Switzerland
Phone: +41 44 632 3673; mail to: kurt.hanselmann@erdw.ethz.ch
or
swiss | i-research & training
PO Box 1206, CH-8032 Zürich, Switzerland
Phone: +41 44 381 4087; mail to: i-research.training@hispeed.ch

University of Zurich
ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich
swiss | i-research & training

Subsurface Geo-Biochemistry

Geo-Biochemistry and Microbiology in Mineral-Springs and Mine Waters

Project Leader Kurt Hanselmann

Gonzen, „iron mountain“ near Sargans, a former iron mine

Target Groups
Field course module for the upper level base curriculum (Bachelor, 6th semester) and as a geo-biochemical specialty block course for advanced Master students.

Didactic Approach
Investigation of field sites, analyses in the laboratory, preparation lectures and papers on-line, exercises on concept formulation, thermodynamic calculations, presentation of experimental results. .5 days with excursions in the Eastern Swiss Alps: Sargans, Davos, Lower Engadine, Scuol-Tarasp-Ftan, and Albula

Context
The mineralized waters that emerge from rocks contain high concentrations of HCO_3^-, dissolved CO_2, SO_4^{2-}, Ca^{2+}, Mg^{2+} etc. Some contain dissolved Fe^{2+}, others HS^-, both of which can promote microbial growth and mineral precipitation.

Course objectives
During the field trips we will study the geological and hydrochemical settings, themodynaimcs and corresponding microbial life strategies.

Course contents
- Geology of the Lower Engadine Window (LEW). The LEW is a large tectonic opening into penninic sediments that originated in a former oceanic basin of the Alpine Tethys.
- How mineral waters are formed.
- How mineral water composition can be altered by microbes.
- Composition of the chemolithoautotrophic microbiota in highly mineralized springs.
- Subsurface mineral weathering mediated by chemical and microbial processes.
- Formation of “carbonate ice” and travertine at cold water springs.

Spring water composition in the LEW and in the carbonate and gypsum containing deposits in the Albula region and other nearby locations reflect a mirror image of the underground geochemistry and is dependent on the contact time between water and the bedrock. At the mouth of the springs the water contains the dissolved solutes from the various rock minerals. Dangerously large amounts of gaseous CO_2 are formed in some enclosed areas underground. When the carbonic acid / bicarbonate saturated aqueous solution reaches the surface the dissolved H_2CO_3 equilibrates with the CO_2 of the atmosphere. This can lead to the formation of „carbonate ice“ and small travertine terracettes.

Learning Environment
We will study phenomena which relate to underground and surface geochemical cycles of iron, sulfur and carbon. Often ferrous iron and sulfide oxidizing as well as oxygenic phototrophic bacteria develop in masses at redox transition zones of the springs. We will examine the conditions in these aquatic habitats that must prevail to select for biochemical pathways and the kind of microorganisms present.

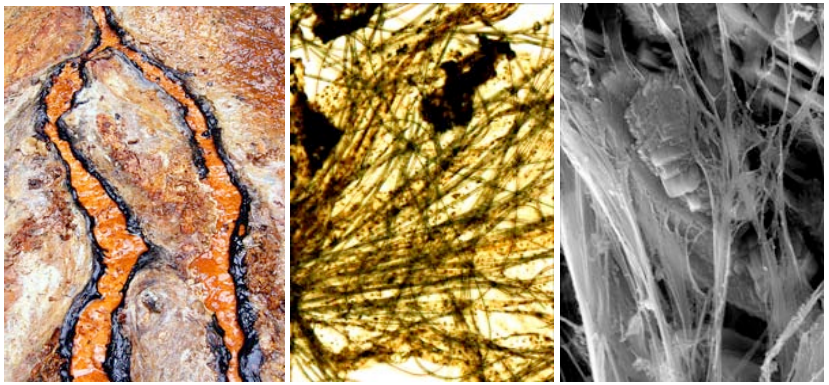
Knowledge assessment
Each course participant focuses on a scientific question of his / her interest, searches for details in the literature and presents a short summary of the course research.

Subsurface Geo-Biochemistry

Background and Learning Material
- Power point slides to the individual modules, partially available as recorded lectures online via OLAT.
- Book chapters and scientific papers to aspects of specific interest.

Gonzen iron mine: sequentially growing ferrous iron oxidizing bacteria (left) and carbonate stalaktites

Distance Learning
The preparation for the fiield work is designed as a partial distance learning course via the internet. Lectures along with other course-related material have to be reviewed before the field course. Students will need to complete a variety of assignments and participate at discussion fora on OLAT before being accepted to the field course.
Enrolment and library access required.



Cyanobacterial biofilms / Surrounding iron precipitates / Dense EPS networks