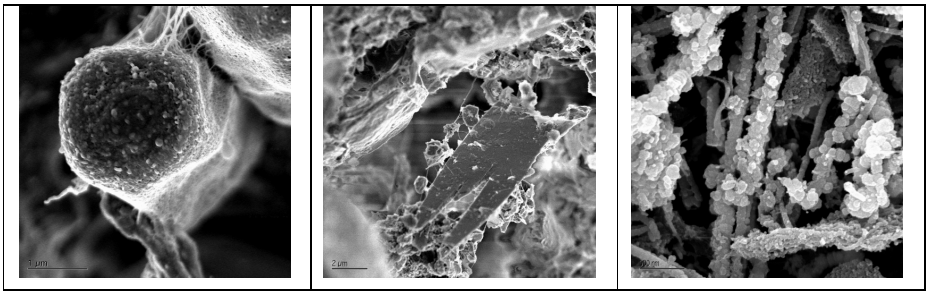
The Water-Microbe-Mineral Interface

A Course in Surface Chemistry and Environmental Mineralogy



Images by J. Peña

Instructor	Prof. Jasquelin Peña Email: Jasquelin.Pena@unil.ch
Teaching Assistant	Janine Halder Email: Janine.Halder@unil.ch
Meeting Time and Place	Mardi 8:00 – 12:00 (lecture + TP) Amphipole 459
Prerequisites	General Geochemistry, Mineralogy, Aquatic Chemistry, Introductory Physics
Recommended Texts	On reserve @ BiblioST Anthropole 1er etage
Course website	Moodle (instructions to be announced)

CONTACT

Please include the course title (W-M-M Interface) in the subject line of any email you send to me. I will hold regular office hours in Anthropole 4168 on Mondays and Tuesdays from 13:30 – 14:30 or by appointment.

COURSE DESCRIPTION

This 4 credit course is required for students completing the Masters in Environmental Geosciences, with mention in *Physical and Chemical Processes*. This course is also relevant to students completing the MSc in Biogeosciences and MSc in Geology. Reactions occurring at mineral and microbial surfaces govern the attenuation, release and cycling of the elements in aquatic and soil environments. This course draws on the fields of surface chemistry, mineralogy and environmental microbiology to develop an understanding of key (bio)geochemical reactions in natural environments, particularly those impacted by anthropogenic activities.

LEARNING OBJECTIVES

- To gain a molecular-scale perspective of reactions occurring at water-mineral, water-microbe, and microbe-mineral interfaces
- To become familiar with microscopic and spectroscopic techniques used to characterize natural particles and detect surface species
- To gain experience with the critical reading of the scientific literature

COURSE OUTLINE

WEEK	DATE	TOPIC
1	20 Sep 2011	Overview; Geosymbiotic Systems; Key Concepts from Aquatic Chemistry
2	27 Sep 2011	Microbes and Minerals as Reactive Surfaces
3	4 Oct 2011	Introduction to Adsorption and Electron Transfer Reactions
4	11 Oct 2011	Mineral Surface Reactivity
5	18 Oct 2011	Cell Surface Reactivy
6	25 Oct 2011	Biomineralization
7	1 Nov 2011	Microbial Weathering
8	8 Nov 2011	Microscopy (Part I: LM, FM and SEM)
9	15 Nov 2011	Microscopy (Part II: TEM and AFM)
10	22 Nov 2011	Spectroscopy (Part I: X-ray absorption)
11	29 Nov 2011	Spectroscopy (Part I: X-ray absorption, cont)
12	6 Dec 2011	Spectroscopy (Part II: FTIR, ESR and NMR)
13	13 Dec 2011	Case Studies
14	20 Dec 2011	Case Studies; Evaluations

READING AND RECOMMENDED TEXTS

Environmental Surfaces and Interfaces (2009) Patricia Maurice
Introduction to Geomicrobiology (2007) Kurt Konhauser
Chemistry of the Solid-Water Interface (1992) Werner Stumm
The Surface Chemistry of Natural Particles (2004) Garrison Sposito

Aquatic Chemistry (1996) Werner Stumm and James J. Morgan
The Chemistry of Soils (2008) Garrison Sposito

The books listed above are on reserve in the Earth Sciences Library. Readings from these texts or the primary literature will be assigned regularly; when possible, reading assignments will be emailed or posted on the course website. If you have not completed courses in *Aquatic Chemistry* and *Geochemistry*, I strongly recommend that you make use of the last two textbooks to get up to speed.

COURSE RESPONSABILITIES

I expect that you will **attend** all lectures and TPs. Attendance will be taken promptly at the beginning of class. If you are unable to attend class, please notify me via email.

I expect that you will **participate** in class activities and **complete** all homework and reading assignments by their due dates.

Your **grade (1 - 6)** will be based on attendance and participation (1 point), TPs and quizzes (2 points), and written assignments (3 points).

These are little packets of light & you need
to plant them early in the year &
remember to mark where they were
because lots of times they look like weeds
in the beginning & it's not until later that
you see how beautiful they really are.

-Brian Andreas, Story People