Modeling Physical and Chemical Processes in Environmental Science

Instructors	Jasquelin Peña (Jasquelin.Pena@unil.ch) Yury Podladchikov (yury.podladchikov@unil.ch)
Meeting Time and Place	Mecredi 08:00 – 12:00 (lecture + TP) Amphipole 201
Prerequisites	Aquatic Chemistry, General Geochemistry, (Calculus)
Recommended Texts	On reserve @ BiblioST Anthropole 1er etage
Course website	Moodle password to be announced

COURSE DESCRIPTION

This 4 credit course is required for students completing the Masters in Environmental Geosciences, with mention in 1) *Physical and Chemical Processes* or 2) *Analysis, Monitoring or Representation of Natural Hazards*. This course will provide an introduction to major physical processes (e.g., advection, diffusion, and dispersion) and chemical reactions (e.g., acid-base, complexation, dissolution/precipitation, adsorption, and redox) that impact environmental quality and ecosystem health. The focus of this course is on developing analytical and numerical models to describe the distributions and concentrations of chemical species in various environments.

LEARNING OBJECTIVES

- To understand the major chemical and physical processes controlling the fate and transport of chemical species in natural environments.
- To develop thermodynamic, kinetic and transport models using material balance principles.
- To become proficient with Matlab and MINEQL+ as tools for environmental data analysis and modeling.

COURSE OUTLINE

WEEK	DATE	TOPIC	
1	21 Sep 2011	Overview; Dealing with Data; Conservation Laws	JP/YP
2	28 Sep 2011	Chemical Thermodynamics (acid-base and aqueous complexation)	JP
3	5 Oct 2011	Phase changes and partitioning (dissolution/precipitation reactions; adsorption)	JP
4	12 Oct 2011	Electron transfer reactions (oxidation/reduction)	JP
5	19 Oct 2011	Reaction Kinetics	YP/JP
6	26 Oct 2011	Microbes as catalysts	JP
7	2 Nov 2011	Revisiting the Advection-Diffusion-Reaction Equation; Advective Flux (Homegenous reaction)	YP
8	9 Nov 2011	Revisiting the Advection-Diffusion-Reaction Equation; Advective Flux (Heterogeneous reactions)	YP
9	16 Nov 2011	Transport Processes in Lakes, Channels and Rivers: Diffusion vs. Dispersion	YP
10	23 Nov 2011	Reactive Transport Example -- Creating a working code	YP
11	30 Nov 2011	Evaluating waste repository sites -- Dimensional analysis and parameter uncertainties	YP
12	7 Dec 2011	Environmental regulatory limits	JP
13	14 Dec 2011	Student Projects	YP/JP
14	21 Dec 2011	Course Summary; Evaluations; Student Projects	JP/YP

CONTACT/OFFICE HOURS

Lundi et Mardi 13:00 – 14:00 or by appointment (JP, 4168 Anthropole)
By appointment (YP)

Please include ***Phys Chem Modeling*** in the subject line of any email you send to us.

COURSE RESPONSIBILITIES

We 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 us via email.

We expect that you will **participate** in class activities and **complete** all assignments by their due dates. Successful completion of your **final project** requires steady work throughout the semester.

Your **grade (1 - 6)** will be based on attendance and participation (1 point), exercises and quizzes (3 points), and final project (2 points).

READING AND RECOMMENDED TEXTS

Aquatic Chemistry (1996) Stumm and Morgan (available in French!)
Geochemistry, Groundwater and Pollution (2009) Appelo and Postman
The Chemistry of Soils (2008) Sposito
Matlab recipes for earth sciences (2010) Trauth

The books listed above can be found in the Earth Sciences Library. Readings from these texts will be assigned periodically; when possible, readings will be posted on the course website. If you have not completed courses in *Aquatic Chemistry* and *Geochemistry*, we strongly recommend that you use of these resources to get up to speed!

Stuart Lane on Winne l'orsoun (Overture de cours, 20.09.2011)