

ENV-406

**Biomineralization: from nature to application**

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Cursus	Sem.	Type
Environmental Sciences and Engineering	MA1, MA3	Opt.
UNIL - Géosciences	H	Opt.

Language of teaching	English
Credits	4
Withdrawal Session	Unauthorized Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
<b>Hours</b>	<b>3 weekly</b>
Courses	2 weekly
Project	1 weekly

**Number of positions**

**It is not allowed to withdraw from this subject after the registration deadline.**

**Summary**

Understanding process and role of biomineralization (minerals formed by living organisms) in context of Earth's evolution, global chemical cycles, climatic changes and remediation.

**Content**

Biomineralization refers to the processes by which organisms form minerals. It is therefore, by definition, a highly multidisciplinary field that spans both the inorganic and the organic world. The phenomenon of biomineralization is relevant to the Earth, Environmental and Life Sciences on practically all length scales. From the immense scale of reef-systems and global ocean life-cycles to small bacterial communities, the impact of biomineralization spans length scales of at least 12 orders of magnitude and a large fraction of geological time! But despite the global environmental impact of biomineralization and its fundamental scientific importance, there are still many open questions about the basic biological mechanisms involved.

This class aims at giving the student an insight into the study of fundamental biological processes that shape biominerals and determine their chemical and isotopic composition. The physiology of biomineralization, matrix-mediated control of biominerals, cell-environment interface will be discussed for a number of organisms, including bacteria, corals, foraminifera and sponges.

The occurrence of biominerals in the geologic record and their use as paleo-climate recorders will be discussed together with biomineralization induced by bacteria, with important implications for mineral ore formation and remediation of contaminated sites. Different examples of how biomineralization has inspired e.g. the material sciences will also be given.

**Keywords**

General principles of biomineralization - controlled versus induced, properties, diversity

The origin of Biomineralization

Large scale biomineralization patterns through Earth history

Present day pattern of biomineralization

Biomineralization and global elemental cycles

Biomineralization and global environmental change (e.g. ocean acidification)

Biominerals as proxies for past environmental change

Carbonate biomineralization processes for specific organisms: corals, sponges, foraminifera

Silicon biomineralization

Biomineralization by bacteria and environmental applications

Bones and teeth and their applications to describe environmental conditions.

**Learning Prerequisites**

**Required courses**

Basic courses in mathematics, physics, chemistry and geology.

**Learning Outcomes**

By the end of the course, the student must be able to:

- Assess / Evaluate literature on biomineralization
- Choose a topic within the context provided by the lectures
- Compose a written review of the selected literature
- Defend the written text with an oral presentation

**Transversal skills**

- Summarize an article or a technical report.
- Access and evaluate appropriate sources of information.
- Make an oral presentation.
- Write a literature review which assesses the state of the art.

**Teaching methods**

The class will consist of lectures given by international experts in topics related to biomineralization. Students will prepare presentations of specific topics/papers for discussing

**Expected student activities**

Students will attend lectures and lab classes and participate in discussions. Students will write a project on a topic chosen in collaboration with the teachers and present the project at the end of the semester.

**Assessment methods**

Students will be evaluated for their written report (75%) and its presentation (25%).

**Resources****Bibliography**

Lectures notes, papers, and presentations to be handed out by the teacher(s).

**Références suggérées par la bibliothèque**

- [SIGEL, A. Biomineralization : from nature to application. Wiley, 2008](#)