

ENV-406

Biomineralization: from nature to application

Adams Arthur, Meibom Anders

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
Hours	3 weekly
Lecture	2 weekly
Project	1 weekly
Number of positions	

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 insights into the study of fundamental processes that shape biominerals and determine their chemical and isotopic composition, from bacteria, to corals and vertebrates.

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.

Importantly, different biominerals continue to inspire e.g. material scientists and architects and examples of this will also be discussed.

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.

Biomineralization and material science.

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](#)

Moodle Link

- <https://go.epfl.ch/ENV-406>