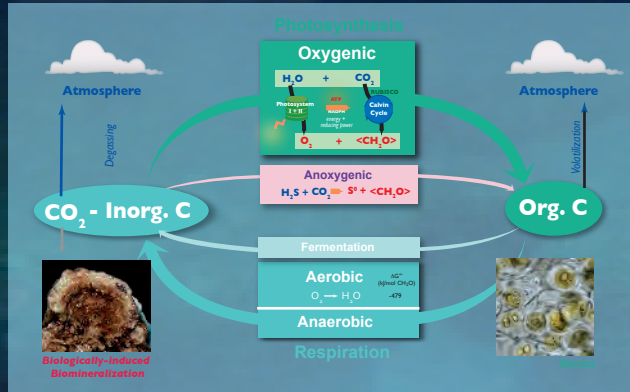


Microbial processes during early diagenesis of carbonate reservoirs: A laboratory approach

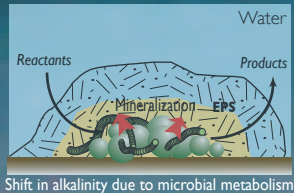
Christophe Dupraz, Marine Sciences/Geosciences, University of Connecticut

Microbially-mediated carbon cycle



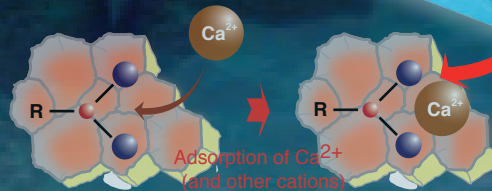
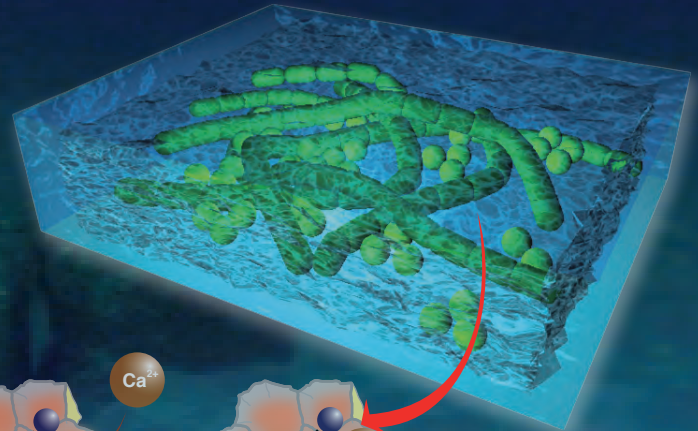
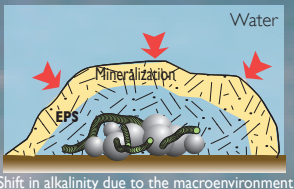
Microbially-induced precipitation

Metabolic activity
(Modification of the microenvironment)



Microbially-influenced precipitation

Environmental pressure
(Evaporation, Degassing, alkaline water input)



Microbial communities are situated at the interface between the biosphere, the lithosphere and the hydrosphere. These microbes are key players in the global carbon cycle, where they influence the balance between the organic and inorganic carbon reservoirs. Microbial populations can be organized in microbial mats, which can be defined as organosedimentary biofilms that are dominated by cyanobacteria, and exhibit tight coupling of element cycles. Complex interactions between mat microbes and their surrounding environment can result in the precipitation of carbonate minerals. This process refers as 'organomineralization', which differs from 'biomineralization' (e.g., in shells and bones) by lacking genetic control on the mineral product. Organomineralization can be: (1) active, when microbial metabolic reactions are responsible for the precipitation ("biologically-induced" mineralization) or (2) passive, when mineralization within a microbial organic matrix is environmentally driven (e.g., through degassing or desiccation) ("biologically-influenced" mineralization). Studying microbe-mineral interactions is essential to many emerging fields of the biogeoscience, such as the study of life in extreme environments (e.g. deep biosphere), the origin of life, the search for traces of extraterrestrial life or the seek of new carbon sink. This research approach combines sedimentology, biogeochemistry and microbiology.

Two tightly coupled components that control carbonate organomineralization s.l.: (1) the alkalinity engine and 2) the extracellular organic matter (EOM), which is ultimately the location of mineral nucleation. Carbonate alkalinity can be altered both by microbial metabolism and environmental factors. The EOM play a critical role in carbonate precipitation by providing Ca^{2+} and CO_3^{2-} as well as a nucleation template for mineral growth. Organomineralization is only possible if the inhibition potential is reduced through (1) oversaturation of the EOM binding capacity or (2) Organic matter degradation. This can be investigated using in laboratory experiments.