UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES
Département des sciences de la Terre

Seminar of the Department of Earth Sciences, UNIGE
Friday, April 24, 11h15 in Room 001
Rue des Maraîchers 13, CH-1205 Genève or via Zoom

What controls coral skeletal chemistry? Life processes, environment or both?

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Marine calcifiers archive past ocean conditions in the chemical and isotopic composition of their calcium carbonate skeletons, providing essential quantitative constraints on Earth's climate beyond the instrumental era. However, these 'proxies' are influenced not only by the environment but also by organism-specific 'vital effects' arising from poorly defined biomineralisation processes. Scleractinian coral skeletons serve as key archives of the surface and deep ocean climate from seasonal to millennial timescales, yet vital effects can manifest as large temporally variable inter- and intra-colony differences and geochemical offsets between species. These complications place a limit on the accuracy of climate reconstructions, particularly prior to the instrumental era. Despite recognition of vital effects for more than 70 years, their mechanistic origins remain poorly constrained because multiple processes operate simultaneously during skeletal formation.

Here, I will synthesise recent advances in the understanding of coral biomineralisation and discuss a new framework we proposed categorising vital effects into four types: Physiological, Mineralogical, Microstructural, and Growth. Collectively, these describe the factors influencing skeletal trace element chemistry and isotope composition, including: the source of the ions required for biomineralisation, their transport, and the carbonate chemistry within the calcifying fluid; possible metastable precursor phases and the rate of biomineral growth; microstructural heterogeneity; and macro-scale growth dynamics. This framework serves to demonstrate how more targeted experimentation and proxy calibration can explicitly address individual vital-effect processes. To this end, I will also discuss here our efforts evaluating the influence of amorphous phases, growth rate and microstructural heterogeneity on coral skeletal chemistry.