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Calcite cycling in benthic sediments of Lake Geneva

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Context

If inland waters have recently been acknowledged as significant reactors of the global carbon cycle, light has been essentially shed on wetlands, permafrost and humic lakes, under the overwhelming paradigm that lake supersaturation with CO_2 arises from metabolic processes. Within this picture, large and clearwater lakes have been largely overlooked, considered as neutral to the atmosphere. As a result, our knowledge about the carbon cycle in such lakes is clearly deficient. For instance, in Switzerland, a heuristic carbon budget attempted on the heavily studied and highly monitored Lake Geneva ended up unbalanced, C outputs being twice higher than the inputs. Estimated CO_2 outgassing reaches surprisingly high numbers. Rough estimates suggest that the 10 largest Swiss lakes emit as much CO_2 as fossil fuel combustion of total Swiss agriculture. The example of Switzerland shows that large and clearwater lakes could be a central feature of a national carbon budget and plead for a revision of our C conception in such environments.

Yet, in hard-water lakes such as Lake Geneva, the carbon pool is dominated by inorganic carbon. Thereby, the carbon cycle is expected to be dominated by the transformation of carbonates and bicarbonates to CO2, mediated by biological processes. Such a transformation is materialized by calcite precipitation in the lake, events when the lake turns “turquoise”, due to the presence of small calcite particles in the water. Yet, this sub-cycle is poorly understood.

Objectives and Methods

This subject aims at studying the sedimentation flux of calcite within Lake Geneva and its accumulation within benthic compartment. More specifically, we want to investigate the impact of the microbial decomposition of organic matter on CO_2 production in the hypolimnion and its consequence on $CaCO_3$ dissolution and corresponding fluxes of Ca^{2+} and alkalinity during Lake overturn. The realization of this topic will take advantage of having access to the unique LExplore floating laboratory and will involve sediment flux and composition characterization using sediment traps and corers, as well as incubation experiments in laboratory.

Literature

Nouchi, V., Kutser, T., Wüest, A. et al. Aquat Sci (2019) 81: 27. https://doi.org/10.1007/s00027-019-0626-3

WEBSITES

http://wp.unil.ch/lakes