ZINC IN DIATOM FRUSTULES AS A PALEOCHEMICAL PROXY: AN INTEGRATED FIELD AND LABORATORY APPROACH

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Abstract
The concentration of individual elements contained in marine and freshwater phytoplankton is generally reflecting the elemental composition of the aquatic environment. This concentration further controls the input of recycled elements throughout remineralization. Combining special laboratory experiments with high-resolution field analyses we aim to identify and quantify the processes behind Zn incorporation in the frustules of living diatoms. These results will be further applied to reconstruct prevailing chemical conditions of the water column at various time windows within the geological record.
Keywords : Diatoms, Sediments, Zinc, Paleoceanography.

The last decades have been marked by a major revolution in our understanding of the Earth system. This has been partially associated with the use of more sophisticated technologies and both the development and calibration of new proxies or indicators of former environmental parameters such as temperature, pH, etc. These variables have an influence on the chemistry and biology of the natural environment and, thus the sedimentary record. Realistic reconstructions of the past environment and climate are, therefore, only possible using well-calibrated proxies. They provide us with quantitative indicators that respond systematically to changes in environmental variables. It still exists, however, a significant gap among the presently available paleoceanographic and limnogeological tools to reconstruct past changing water conditions. This is particularly clear concerning reliable weathering and paleochemical markers. Furthermore, most of the existing marine and lacustrine proxies for water column elemental concentrations have been developed on carbonate material (foraminifera, corals, ostracods, etc.). These organisms can be very scarce in critical areas of the globe that regulate the CO_2 budget of the atmosphere such as the southern ocean and the north Pacific. Therefore, there is an urgent need to develop new and independent indicators of former environmental conditions based on diatoms.

The concentration of individual elements contained in marine and freshwater phytoplankton is generally reflecting the elemental composition of the aquatic environment. These concentrations further control the input of recycled elements throughout remineralization. Laboratory and field studies have pointed out the importance of trace elements both controlling primary productivity as well as regulating the community structure of phytoplankton. Hence, the identification of these phenomena encouraged further research on the trace metal content of phytoplankton. Despite the growing interest in this field, however, there is still a clear lack of reliable tools to determine the ratio of trace elements during time intervals involving well-known environmental changes in both marine and freshwater systems.

In this framework we have designed a research strategy to identify and quantify the processes controlling Zn incorporation in the frustules of selected diatoms. The latter will allow us to reconstruct past Zn concentrations in waters. To achieve this task, we combine high-resolution field analyses with selected laboratory experiments.

Currently, culture experiments are performed with the freshwater diatom *Stephanodiscus hantzschii*. Long-term Zn uptake experiments in trace metal ion-buffered medium have been designed in order to evaluate the influence of the concentration of free Zn in the water on the composition of the opal $(Zn/Si)_{opal}$. Preliminary results seem to show a sigmoidal relationship between the Zn incorporated in the opal and the free Zn^{2+} concentration of the culture medium. The observed trend is very similar to the results of Ellwood and Hunter [1] in their study with the marine diatom *Thalassiosira pseudonana*. This similarity points towards a common mechanism of zinc deposition in the opal for these two diatom species.

These results will be coupled with elemental analyses of fossil diatom frustules isolated from recent Lake Geneva sediments in western Switzerland. The comparison of this dataset with the known environmental history of the lake will provide a unique opportunity to calibrate this proxy. Finally, diatom-rich marine sediments from sedimentary cores from the Southern Ocean will be analyzed and interpreted using the culture and lacustrine calibration datasets. The latter will provide the ultimate validation of the methodology and establishment of a proxy for former chemical conditions.

Reference

Ellwood M. J. and Hunter K. A., 2000. The incorporation of zinc and iron into the frustule of the marine diatom *Thalassiosira pseudonana*. *Limnol. Oceanogr.* 45: 1517-1524.