BÔLE Maximilien (2018): The Mesozoic oceanic silica cycle – insights from silicon and oxygen isotopes of radiolarian silica measured *in situ* by SIMS (secondary ion mass spectrometry) in radiolarites

Abstract

Radiolarians, forming radiolarites, were the main silicon exporters in the Mesozoic oceans. Hence, they played an important role in the past and especially in the oceanic silicon cycle. During the Cainozoic, they were supplanted by diatoms who dominant siliceous organisms since then. Previous studies have revealed that diatoms extract preferentially light ^{28}Si over ^{30}Si. This behaviour is similar to the preferential ^{12}C extraction by photosynthetic organisms. The $\delta^{30}Si$ is thus a potential proxy of paleoproductivity and especially of the siliceous paleoproductivity. The $\delta^{30}Si$-composition of the diatom skeletons seems effectively to record their productivity and we wanted to check if this was also the case for past Mesozoic radiolarians.

For this purpose, we have checked the feasibility to measured in situ $\delta^{30}Si$ and $\delta^{18}O$ in radiolarites by SIMS and then the relevance of these measurements. As radiolarites are produced by diagenetic dissolution-precipitation processes, we firstly investigated the $\delta^{18}O$. We deciphered that the $\delta^{18}O$ measured in radiolarites preserved an environmental component. This preservation is important because it indicates that the isotopic signatures were not overprinted by hydrothermal fluids. Then, we investigated the preservation of the $\delta^{30}Si$ in radiolarites. Convergent $\delta^{30}Si$-results were observed through different sections indicating $\delta^{30}Si$-variations are rather global than local. We compared our $\delta^{30}Si$ with reference isotopic curves ($\delta^{18}O$, $\delta^{13}C$ and $^{87}Sr/^{86}Sr$) and with estimations of silicon burial rates to determine the causes of these variations.

These comparisons have confirmed that the oceanic silicon was in steady state in Mesozoic ocean. We observed low $\delta^{30}Si$ associated with high silicon burial rate and high $^{87}Sr/^{86}Sr$. This can be explained by fresh silicon supplied by rivers (low $\delta^{30}Si$ and high $^{87}Sr/^{86}Sr$). The riverine silicon inputs depend on climate but also on rocks exposed to weathering. On a section, we observed covariations between $\delta^{30}Si$ and trace elements supporting that low $\delta^{30}Si$ are associated with high marine paleoproductivity. This is coherent with a scaling of productivity with nutrient supplied by rivers. During our studies, we also noticed that when the radiolarian productivity drops without scaling with river supply, the $\delta^{30}Si$ drops due to lower silicon extraction.