Silicon isotope signatures of radiolaria and their potential to track changes in past seawater nutrient concentrations

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The global silicon (Si) cycle plays a critical role in regulating the biological pump and carbon cycling in the oceans. To recontruct the evolution of the Si cycle in the past the Si isotope compositions ($\delta^{30}Si$) of diatoms and sponges have been shown to be suitable indicators of Si utilization in surface waters and dissolved Si (DSi) concentrations in the deep sea, respectively. Another promising tool to study past DSi concentrations is the $\delta^{30}Si$ signature of radiolaria ($\delta^{30}Si_{rad}$), siliceous zooplankton that dwells in subsurface and intermediate waters. However, there are to date only few studies on the $\delta^{30}Si$ of radiolaria. To improve its application as a paleo proxy, we investigated the $\delta^{30}Si_{rad}$ of different radiolarian taxa and mixed radiolarian samples from surface sediments off Peru in comparison to the distinct DSi distribution along the coast. The different radiolarian taxa were selected according to their specific habitat depth of 10-50 m (*Acrosphaera sp.*), 10-100 m (*Dicytocoryne sp.*) and 100-400 m (*Stylochlamydium* sp.) water depth. We find distinct $\delta^{30}Si_{rad}$ mean values of +0.7±0.2‰ (*Acro*), +1.6±0.3‰ (*Dicyto*), +1.2±0.2‰ (*Stylo*) and +1.0±0.4‰ (mixed radiolaria). The calculated apparent Si fractionation factors between radiolaria and subsurface DSi ($\Delta^{30}Si=\delta^{30}Si_{rad} - \delta^{30}Si_{water}$) are accordingly: -0.8±0.2‰ (*Acro*), -0.2±0.2‰ (*Dictyo*), -0.4±0.2‰ (*Stylo*) and -0.6±0.4‰ (mixed radiolaria). This difference in $\Delta^{30}Si$ between *Acrosphaera* (Nassellaria) and *Dictyocoryne* and *Stylochlamydium* (Spumellaria) may be caused by different skeleton formation mechanisms. Comparion with modern water column data indicates that $\delta^{30}Si$ signatures of single radiolarian taxa may be a useful proxy to track past DSi concentrations ($\delta^{30}Si_{Dictyo}$) and/or the $\delta^{30}Si$ signatures ($\delta^{30}Si_{Acro}$+$\delta^{30}Si_{Stylo}$) of subsurface and intermediate water masses. Accordingly, when working with mixed radiolaria samples it is clearly crucial to consider changes of the species assemblage.