Title: Evaluation of the silicon isotope fractionation of siliceous plankton (Radiolaria) in seawater

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Scientific context and objectives: Radiolarians are marine microorganisms (unicellular eukaryotes belonging to the supergroup *Rhizaria*) that can produce intricate skeletons of silica and are very sensitive to changes in environmental conditions[1,2,3]. They are common microfossils (0.1-0.2 mm) since the Cambrian and have provided rich palaeontological (principally biostratigraphic) records for a multitude of palaeoceanographic studies[1]. The resistant silica-based skeletons of radiolarians are particularly useful in regions of importance for global climate change where carbonate-based archives are poorly preserved (e.g. Southern Ocean), and offer a biogeochemical window into the mid-depth section (i.e. 30-500 m) of the marine environment[2].

The mid-depth zone in the marine environment is currently inaccessible for Si cycle palaeo-reconstructions and its characterization is pivotal to the detection of glacial–interglacial changes in water column stratification, which plays a critical role during periods of abrupt climate change[2,4]. Fortunately, radiolarians are common plankton found in this mid-depth zone[2,5]. However, in contrast to other silicifying organisms found in the palaeo-record, such as deep-water sponges and surface dwelling diatoms (unicellular silicifying micro-algae), the use of radiolarian geochemistry to describe palaeoceanographic variation in dissolved Si (DSi) is very much in its infancy largely due to the challenges associated with their growth under laboratory-controlled conditions and limited knowledge on the factors that govern their contemporary biogeographic distributions[2,6].

One key geochemical tool used to track relative differences in DSi is the variation in the natural abundances of stable isotopes of Si (expressed as $\delta^{30}Si$, the parts-per thousand variation in $^{30}Si/^{28}Si$). Essentially, variations in $\delta^{30}Si$ serve as a proxy to evaluate changes in DSi utilization in the surface ocean (<30m) by diatoms [7-9] and DSi concentration by deep-sea sponges[10] in the deep ocean (>500m). Quantitative use of this tool, however, requires precise understanding on how Si isotopes behave during silicic acid uptake and biogenic silica production. To our knowledge, the essential step of performing a modern calibration of $\delta^{30}Si$ for radiolarians has never been undertaken, casting doubt on the interpretation of previous palaeo-studies, and raises the question: "What processes influence the Si isotope composition of radiolarians?". In this context, the main objective of the research proposed is to investigate the silicon isotope fractionation of modern Radiolaria in seawater. In order to achieve our objective, we will (1) evaluate the silicon isotope composition of Radiolaria and the seawater in which they reside, (2) improve the method currently used for measuring small quantities of biogenic silica (i.e. Radiolaria).

The Master student will benefit from the expertise and facilities available at the LEMAR and Ifremer. The host institutions have extensive experience in sampling and analyzing major and minor elements and their isotopes in the dissolved and particulate fractions at (sub-) nano-molar concentrations using different techniques including inductively coupled plasma mass spectrometry (ICPMS). The LEMAR and

Ifremer (Brest) are equipped with several clean labs for trace metal and stable isotope preparation and single and multi-collector (Neptune) ICPMS instrument in order to conduct this work.

Literature Cited

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