First Zn stable isotope results on cultured marine cyanobacteria

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Zinc (Zn) is an essential nutrient, taken up into marine phytoplankton. This uptake and burial of organic matter is a major driver of the oceanic Zn cycle. Laboratory culture experiments for two organisms have documented the uptake of, light Zn isotopes into phytoplankton cells [1,2]. The first data from the geological record has recently become available, and are now used to explore the Zn isotope composition of the oceans through time [3-5]. The observed isotope variability is currently interpreted in terms of the experimentally obtained fractionation of Zn isotopes upon uptake. But this interpretation is based on culture experiments with just two eukaryotic species, that both evolved rather late in Earth history: a marine diatom [1] and a green algae [2]. Other key phytoplankton groups, deeply rooted back in time, such as prokaryotes, have currently not been studied with respect to Zn isotopes.

Here we present the first culture experiments documenting Zn isotope fractionations between four distinct cyanobacteria strains and their artificial seawater solutions. We found their biomass to be 0.14 – 0.36 ‰ lighter than the bulk δ^{66}Zn of the medium. The strong organic chelator used to buffer trace metals is known to preferentially bind heavy Zn isotopes in the range of 0.16 – 0.33 ‰. The measured cells are thus not significantly different from bioavailable Zn. The degree to which light Zn is prefentially incorporated into the phytoplankton cell is thus not fundamentally different than previously reported for marine diatoms, grown at comparable bioavailable Zn levels.

Our findings, combined with our earlier results for different diatom strains [6], have two important implications. First, the isotope fractionation upon uptake of Zn to all organisms is small. Second, the molecular mechanisms governing the biologically mediated fractionation of Zn isotopes does not seem to be unique to the Eukaryota. Cyanobacteria, as important representatives of prokaryotes, may exhibit a simiar control.

[1] John et al. (2007), *Limnology and Oceanography* **52**, 2710-2714. [2] John & Conway (2014), *Earth and Planetary Science Letters* **394**, 159-167. [3] Kunzmann et al. (2013), *Geology* **41**, 27-30. [4] John et al. (2017), *Palaeogeography, Palaeoclimatology, Palaeoecology* **466**, 202-208. [5] Liu et al. (2017), *Geology* **45**, 343-346. [6] Köbberich & Vance (in press), *Geochimica et Cosmochimica Acta*.