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δ13C of different size fractions of biomineral-bound organic matter in fossil diatom opal measured by means of Nano Elemental Analyzer-IRMS

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Diatoms of distinct cell sizes have different surface area to volume ratios resulting in differing diffusive supply of CO_2 and different needs for active carbon acquisition mechanisms. Large cells may be more sensitive to CO_2 depletion and additionally use a higher amount of HCO_3- as C source to increase C uptake efficiency at low CO_2 concentrations. This could result in different isotope fractionation of diatom opal-bound C of cells of variable sizes, which could change over time in response to variable atmospheric CO_2 concentrations.

The new technique of δ13C measurement using the Nano Elemental Analyzer-IRMS allows obtaining results from very small sample amounts (< 1 mg), making possible to acquire δ13C from fossil diatom opal of different size fractions, even in sediments of modest opal content of 30%.

Subsequent to decarbonation, opal of sediments from the Equatorial Pacific of the last 20 Ma was cleaned of clays and organics, and pennate and centric diatoms of sizes between 20-41, 41-70, 70-100 and 100-150 μm were separated to perform analysis. Reproducibility of replicates from the same size fraction analyzed over the course of a week averages 0.46 permil and the measured value is insensitive to the mass of analyzed opal in the range of 20 to 1000 μg.

The centric 40-70 μm diatoms feature δ13C values up to 5 permil higher than those of pennate diatoms from the same sample. These higher values, indicating less extreme fractionation during photosynthesis, could be consistent with higher use of HCO_3- as C source or fixation of greater fraction of total cellular C uptake by the larger cells. We will evaluate if this tendency continues in the largest sized diatoms up to 150 μm. Nonetheless the large differences already observed underscore the importance of measurement of diatom-bound organic matter on restricted size fractions in order to distinguish true temporal trends in δ13C of diatom-bound organic matter from changes in the size (or species) distribution of diatoms in bulk opal fractions.