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Radiolarian species-specific fractionation: insights from a Miocene sediment core

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On geologic time scales, the weathering of silicate rocks serves as a regulator of global climate by removing CO_2 from the atmosphere. This process releases dissolved silica (dSi) which will ultimately be precipitated by some marine organisms and buried in marine sediments. During the formation of biogenic silica (bSi), light Si isotopes are preferentially incorporated into the solid phase resulting in lighter isotopic composition of the solid phase and heavier dissolved phase. This signal is preserved in siliceous microfossils, creating a uniquely-place tool to unravel the dynamics of past silicon cycling and its evolution through time in relation with environmental changes.

While we can confidently explore the evolution of the deep ocean Si cycle with the help of sponge spicules, we still lack a robust proxy for Si cycling in the upper ocean through geologic time. Polycystine radiolarian (radiolarians with bSi tests) are receiving increasing attention as candidates to fill this role. However, little is known about what controls Si isotopic fractionation during the formation of radiolarian tests. Notably, uncertainty remains about the presence or absence of discrepancies between different radiolarian orders and/or species and the impact of environmental factors such as dSi concentration.

We isolated several species of polycystine radiolarian and mixed assemblages from marine sediments of Miocene age from the equatorial Pacific (ODP Leg 199 site 1219) and measured their Si isotopic composition. Our results indicate that there is no significant difference in the Si isotopic composition between various species of the order Nassellaria. However, there are significant differences when comparing them to species of the order Spumellaria. This indicates either differences in fractionation magnitude between the two orders or differences in depth habitat. In addition, the mixed assemblages deviate from the single species, emphasizing the importance of producing monospecific records to investigate past Si cycling.