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Silicon and oxygen isotopic trends in Mesozoic radiolarites

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Silicon and oxygen isotopes (δ^{30}Si and δ^{18}O) of siliceous tests (diatoms, sponges and radiolarians) preserve environmental signatures in unconsolidated sediments, but few studies show such signatures for ancient biosilicieous rocks. In Precambrian cherts from greenstone belts, small scaled isotopic variations were interpreted as a primary diagenetic feature. They were used, coupled to mean δ^{18}O, to reconstruct seawater temperature at which cherts precipitated. Here, we examine stable isotopes in Mesozoic biogenic cherts that may also preserve an environmental signature.

We measured δ^{30}Si and δ^{18}O *in situ* by SIMS, in the chalcedony of individual radiolarian tests preserved in Mesozoic radiolarites. Microanalysis of chalcedony, rather than the bulk rock isotopic composition, is likely to reveal a palaeoenvironmental signal, since it is derived from biogenic opal, the most mobile silica phase during earliest diagenesis. Our data reveal clear trends through several Mesozoic radiolarite sections from Panthalassa (Kiso River, Japan) and Western Tethys (Sogno, Italy).

δ^{18}O records measured in radiolarites show a relatively good correlation to δ^{18}O-variations of Mesozoic low magnesium calcite shells, which are commonly used as a palaeotemperature proxy. Once these variations, attributed to seawater temperature, are removed, the residual δ^{18}O trends are opposite to the δ^{30}Si trends. δ^{30}Si increases from Middle Triassic to Early Jurassic in the Kiso River sections and decrease during the Middle Jurassic in the Sogno section. The observed d^{30}Si-trends are likely to represent a palaeoenvironmental signal, because they are not compatible with simple models of progressive diagenesis along P/T-paths (or depth below sea bottom in drill holes).

Among the palaeoenvironmental factors that may have influenced these trends are the oceanic silica cycle changing though time, oceanic circulation and/or the palaeogeographic location of each studied site. Siliceous organisms are the main extractors of light silicon in the oceans and lead to a δ^{30}Si increase of the remaining ocean water reservoir. Rivers furnish the main supply of fresh silicon to the ocean but climate and exposed source rocks may determine the silicon isotopic composition of river water. Measurements of δ^{30}Si in ocean water depth profiles were successful in characterizing watermasses of the Antarctic Ocean. Finally, proximity from continents may also contribute to the observed trends. Near continents, high productivity may lead to high δ^{30}Si, whereas light, recycled silicon may be more important in locations far from continents. This recycled silicon should be relatively light considering that it results from biogenic and dissolution fractionation which are both negative. These factors might affect also the difference in δ^{30}Si-trends of radiolarites between Panthalassa and western Tethys.