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Neodymium isotopes in biogenic carbonates: reliable archives of water mass circulation

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Neodymium isotopes (143Nd/144Nd) are increasingly employed to trace provenance and water mass mixing in the past, not being fractionated by biological processes in the water column and having a residence time in the order of 500-1000 years. In the modern ocean the different water masses ultimately derive their 143Nd/144Nd value through continental weathering, erosion and particle-seawater interactions. This geochemical tracer has been successfully applied to the dispersed authigenic ferromanganese oxide fraction in marine sediments, ferromanganese crusts, foraminiferal shells, fossil fish teeth and only very recently to scleractinian deep-water coral skeletons sourced from various sites and depths in the Atlantic ocean (van de Flierdt et al., 2010; Colin et al. 2010; Copard et al., 2010).
These aragonitic corals have the great advantage of being precisely dated by U-series, potentially providing century-long records of intermediate and bathyal oceanic variability at sub-decadal resolution. Motivated by these recent findings we have investigated the Nd isotopic composition of living specimens of deep-water corals and other calcifying organisms collected in two key locations of the Mediterranean Sea, in the Atlantic, Pacific and Southern Oceans. In particular, we analyzed several specimens of the aragonitic deep-water coral Desmophyllum dianthus, Lophelia pertusa, Madrepora oculata, Flabellum impensum, the temperate coral Cladocora caespitosa, the calcitic gorgonian coral Corallium rubrum, the bivalves Glans aculeata and Karnekampia bruei and the polychate Serpula vermicularis. Most of the samples were retrieved from the Strait of Sicily and the Southern Adriatic Sea at different water depths. Ten seawater samples from three new profiles in the Mediterranean were also collected at the same locations and depths, offering a unique opportunity to compare the Nd isotopic composition of biogenic carbonates directly with the surrounding ambient seawater. The Mediterranean Sea is particularly suited for this comparison exercise since it is characterized by water masses displaying a large range of 143Nd/144Nd. In addition, specimens of living and fossil Desmophyllum dianthus and Lophelia pertusa were analysed for Nd concentration at fine-scale resolution using a laser ablation ICP-MS, with the aim to understand the effect of the coral microstructures on the Nd distribution.
Results suggest that the Nd isotopes in modern biogenic carbonates match the surrounding seawater Nd isotopes proving that these calcifying organisms can serve as reliable archives for water mass circulation.

References

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