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Calcium isotope ratios in modern cold-water corals reveal significant internal variability: an insight into biomineralization?

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The isotope abundance ratio of calcium measured in biogenic carbonate, usually reported as $\delta^{44}Ca$, is an elusive proxy that has been suspected to record temperature, precipitation rate, alkalinity or carbonate ion concentration [e.g. 1,2], assuming a stable seawater $\delta^{44}Ca$ value. With a residence time in the ocean on the order of 1 Ma, changes in $\delta^{44}Ca$ of seawater is itself assumed to reflect variations in weathering rate and/or calcium carbonate deposition fluxes [e.g. 3, 4].

However, despite calcium being a major building block of biogenic carbonate, the extent biomineralizing organisms' active control over Ca transport to the site of mineralization and its implications for the $\delta^{44}Ca$ of the resulting calcium carbonate remain poorly understood.

To this day, only one study has investigated small scale variations of $\delta^{44}Ca$ within a biogenic calcium carbonate, revealing 1.7‰ of variability within a single test of the foraminifera *Globorotalia inflata* [5]. Such a result was unexpected, as fractionation between seawater and calcium carbonate in bulk organisms is within the range of -1 to -2‰ with very little variability [3], and was interpreted to reflect variation in precipitation rate.

Cold-water corals (CWC) can also be used as paleo-oceanographic archives [4]. In order to understand if they are a reliable recorder of past $\delta^{44}Ca$, we produced the first small-scale "in-situ" measurements of $\delta^{44}Ca$ using the IMS 1280 at CRPG, Nancy (France). We analyzed three aragonitic species: *Desmophyllum pertusum* (formerly called *Lophelia pertusa*), *Madrepora occulata* and *Desmophyllum cristagalli*. Our results reveal an internal reproducible pattern of measured $\delta^{44}Ca$ with an internal variability of ~2‰ in a single skeleton for each of the studied species. The results are discussed in terms of microstructure and chemical composition of the skeleton in order to understand which factors control the incorporation of calcium in CWC. This work was funded through the CNRS INSU LEFE/CYBER program.

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