SIMS measurements of Li/Ca, Na/Ca, and Mg/Ca ratios in scleractinian corals: towards a better understanding of their mechanisms of incorporation?

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Chemical compositions of aragonitic corals are widely used as proxies of paleonvironmental conditions (temperature, pH, salinity, productivity...). However, the mechanisms of calcification (ascribed as vital effects) complicate the use of these biocarbonates, which are more than the result of a simple inorganic precipitation. Recently, it was observed that Li/Mg ratios have the advantage to present minimal vital effects and could be proposed as proxy of temperature [1,2,3]. Here we explore, by *in situ* measurements of Li/Ca, Na/Ca and Mg/Ca, the possible controls on their incorporation in coral skeletons. We used three scleractian corals: two deep-sea corals (*Lophelia pertusa* and *Desmophyllum cristagalli*) and one tropical coral (*Porites lutea*).

We show that these ratios are systematically enriched in the Centres of Calcification (CoC) relative to the surrounding fibers. They are also positively correlated in the three studied species. Different mechanisms are explored to explain these features: (1) Rayleigh fractionation as proposed by [1, 3], (2) kinetic effects, (3) trapping in lattice defects as proposed by [4] for Na and Mg incorporation, (4) mixing of different carrier phases of these elements, i.e. organic matter and aragonite, (5) influence of specific ion pumps as Mg-ATPase and/or Na^+/K^+-ATPase [5].

In view of our results, the most likely mechanims of incorporation seems to be the increase of distorsions due to the increase of growth rate, which would explain the higher ratio values in CoC relative to fibres. Temperature would then have an indirect effect via its influence on growth rate.

[1] Case *et al* (2010) *EPSL* **300**, 215-225 [2] Hathorne *et al* (2013) *Paleoceanography* **28**, 143-152 [3] Raddatz *et al* (2013) *Chem Geol* **352**, 143-152 [4] Mitsugushi *et al* (2001) *GCA* **65**, 2865-2874 [5] Ip and Lim (1993) *J Exp Biol* **159**, 507-513.