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Ba/Ca ratios of stylasterid coral skeletons: implications for palaeoceanography and coral biomineralisation

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The concentration of dissolved Barium in seawater ($[Ba]_{SW}$) has a nutrient-like profile and is influenced by both primary productivity and ocean circulation patterns. Reconstructing variations in subsurface $[Ba]_{SW}$ throughout earth history can therefore provide important information on processes which regulate global climate. Previous work has shown that Ba/Ca ratios of deep-sea coral (DSC) skeletons are linearly related to $[Ba]_{SW}$ [e.g. 1]. However, skeletal Ba/Ca ratios of stylasterids - a group of widely distributed, azooxanthellate, hydrozoan coral – have not previously been studied.

Here, we present Ba/Ca ratios of modern stylasterid and scleractinian DSC skeletons collected from sites in the Southern and Atlantic Oceans, paired with hydrographic data including published $[Ba]_{SW}$ measurements. Stylasterid Ba/Ca ratios are dominantly controlled by two factors: specimen mineralogy and $[Ba]_{SW}$. Stylasterids build their skeletons from aragonite, high-Mg calcite, or a mixture of both polymorphs, and aragonitic stylasterids have higher Ba/Ca than high-Mg calcite forms. However, when considering each mineralogy separately, stylasterid Ba/Ca is strongly, linearly correlated with $[Ba]_{SW}$, facilitating its use as an archive of past ocean conditions.

Crucially, aragonitic stylasterid Ba/Ca is more sensitive (steeper slope) to changes in $[Ba]_{SW}$ than scleractinian skeletal Ba/Ca, representing a significant palaeoceanographic advantage. These differences may result from biological effects having more influence on Ba incorporation into scleractinian skeletons, compared to stylasterids. This interpretation is consistent with other aspects of stylasterid and scleractinian skeletal geochemistry [2, 3].

In addition to providing valuable insight into coral biomineralization, our work provides further evidence that stylasterid skeletal geochemistry has great potential as a palaeoceanographic tool, with robust temperature [2, 3] and $[Ba]_{SW}$ calibrations now established. The centennial timescale of stylasterid skeletal growth [4] and radial growth-banding found in some individuals gives modern stylasterids special utility as high-resolution archives of recent changes in ocean conditions. Additionally, the application of uranium-series dating to stylasterid carbonate may – if successful – permit the use of these proxies on longer timescales.

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[2] Stewart et al. (2020), *EPSL* 545, 116412
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[4] King et al. (2018), *Paleoceanography and Paleoclimatology* 33, 1306–1321