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Controls on stylasterid coral $\delta^{11}B$ and its utility as a seawater pH proxy

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Stylasterids are a group of azooxanthellate, hydrozoan coral which build carbonate skeletons from either aragonite, high-Mg calcite, or a mixture of the two. The geochemistry of stylasterid coral skeletons correlates with seawater conditions including temperature and $[Ba]_{SW}$, suggesting they may be valuable palaeoceanographic archives. Preliminary skeletal boron isotopic measurements of stylasterids ($\delta^{11}B_{styla.}$) suggest a close equilibrium with the boron isotopic composition of the borate ion in seawater ($\delta^{11}B_{borate}$) [1]. $\delta^{11}B_{styla.}$ could therefore be a novel archive of ocean pH. However, our understanding of the controls on $\delta^{11}B_{styla.}$ is currently based on a small number of samples, which span a restricted range of seawater conditions.

Here, we present new skeletal $\delta^{11}B$ and trace element concentrations of stylasterids collected from the Atlantic, Pacific and Southern Oceans. Coral collection sites span a wide range of ocean conditions ($13.5 < \delta^{11}B_{borate} < 18$). We show that high-Mg calcitic stylasterids have higher skeletal $\delta^{11}B$ than aragonitic stylasterids, consistent with a mineralogical control on boron isotope incorporation into marine carbonates [2]. $\delta^{11}B_{styla.}$ correlates strongly and linearly with $\delta^{11}B_{borate}$, suggesting that $\delta^{11}B_{styla.}$ is a robust and novel archive of past changes in ocean pH, and further illustrating the great potential of stylasterids as palaeoceanographic archives.

Our data also confirm the close similarity between $\delta^{11}B_{styla.}$ values and $\delta^{11}B_{borate}$, regardless of ambient seawater conditions [1]. If stylasterid skeletal $\delta^{11}B$ responds to calcifying fluid pH, this implies that stylasterids do not upregulate pH at the site of calcification, despite building carbonate skeletons in waters undersaturated with respect to aragonite. This strongly suggests that stylasterid corals employ highly contrasting biocalcification methods to scleractinian corals. Comparing the inorganic skeletal geochemistry of these coral groups can therefore provide insights into how stylasterid corals construct their skeletons, and how these processes influence the boron isotopic and trace element compositions of coral carbonate.

References

1. Stewart et al. (2022), *Scientific Reports* 12, 13105.
2. Noireaux et al. (2015), *Earth and Planetary Science Letters* 430, 398-407.