Element partitioning in brachiopods – implications for proxy use and biomineralisation

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Brachiopods present a key taxon for Phanerozoic palaeo-environmental reconstructions owing to their good preservation and abundance in the geological record. Yet to date, geochemical proxies have been rarely calibrated in brachiopods grown under controlled conditions and a mechanistic understanding of the incorporation of key elements into their calcitic shells is still lacking. To evaluate the feasibility and robustness of multiple Element/Ca ratios as proxies, we investigated the incorporation of Li, B, Mg, Sr, Ba, and Na in brachiopods cultured under controlled laboratory settings comprising experiments where temperature, seawater and carbonate chemistry were manipulated [1]. Our results indicate that the incorporation of Li and Mg is strongly influenced by temperature, growth effects, as well as carbonate chemistry, complicating the use of their ratios as straightforward proxies. B incorporation varied greatly between treatments, without a clear link to carbonate system parameters or other environmental factors. Ba and Na were apparently not systematically affected by changes in the ambient conditions. We highlight Sr/Ca as a potential new carbonate system proxy, based on a positive trend between Sr partitioning and DIC in the culture medium. To explain the observed dependency and provide a quantitative framework for exploring elemental variations, we present the first biomineralisation model for brachiopods, with modelled and measured Sr paritioning coefficients resulting in a good agreement.

[1] Jurikova et al. (2019) *GCA* **248**, 370–386.