Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.21453

Can corals serve a palaeo proxy for C:N:P ratio in the ocean?

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Marine C:N:P ratios serves as an effective concept to understand the various contemporary marine-biogeochemical processes, such as primary productivity, nutrient limitation or availability, and are linked to the strength of the biological pump. Recent studies reveal that the C:N:P ratios in the global ocean vary regionally and their future projects are highly uncertain. To improve the future projections, understanding past C:N:P variability might be helpful. However, there is paleo proxy for C:N:P ratios at present. In this context, we conducted a preliminary analysis of C:N:P ratios of modern corals (including coral-mounted algal biofilms) and surrounding seawaters collected from the Gulf of Kutch located in the northern Arabian Sea. Various elements (C, N, P, and Si) and nitrogen isotopic composition ($\delta^{15}N$) in the different layers of coral samples were determined and analyzed with surrounding seawater composition. Observed N:P and Si:P ratios in the seawater were lower than the classical Redfield ratio (C:N:Si:P = 106:16:16:1), indicating that primary productivity is limited by N and Si. Overall, N and P in corals are significantly correlated to each other, and their content declines exponentially from the organic-rich outer layer to the inner inorganic-rich skeleton. In contrast, the $\delta^{15}N$ values increase as the N concentration drops towards the inner skeleton of the corals, indicating the N-loss during organic matter remineralization. The polyp-rich layer of corals has nearly identical $\delta^{15}N$ to the symbiotic algal biofilm and seawater particulate organic matter, signifying assimilation of the nutrients from the surrounding seawater. Further, the N:P ratios in seawater and particulate organic matter overlap with the outer polyp-rich layer, underscoring the efficiency of coral capturing the marine C:N:P signatures.