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Multiproxy approach linking the geochemical composition of stromatolite microfabrics to microbial surface mats in Hamelin Pool

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Ancient microbialites are critical evidence of the earliest traces of life on Earth, yet consensus has not been reached over the reliability of fossilized stromatolites to be biosignatures in the geological record. Variations in the internal fabric of stromatolites have been attributed to microbial formation processes [1], thus microfabrics have been interpreted to serve as a biosignature in the geological record. However, recent work suggests that similar structures can be formed by abiotic processes [2] creating debate in the community. Complimenting microfabric analysis, chemical biosignatures may provide an additional and independent verification of biological formation mechanisms, but they require careful analysis in modern analogue systems to confirm biological formation mechanisms and rule out abiogenic processes. Here, we aim to quantify the geochemical composition of actively accreting modern marine stromatolites characterized by distinct internal microfabrics. We apply a multiproxy approach to investigate variations in the geochemical (δ^{13}CÂ$_{carb,}$ $\delta^{13}C_{org}$, $\delta^{18}O$, and $\delta^{11}B$ values, as well as total organic carbon content) composition of stromatolites from Hamelin Pool, Shark Bay, Western Australia. Four types of surface mats have been identified in Hamelin Pool, including pustular, transitional, smooth, and colloform mats which have been interpreted to produce the observed range of stromatolite microfabrics when impacted by varying styles of diagenesis [3]. Our preliminary results suggest that pustular mats produce carbonate with the high δ^{13}CÂ$_{carb}$, $\delta^{11}B$, and $\delta^{18}O$ values, while smooth mats produce carbonate with the low δ^{13}CÂ$_{carb}$, $\delta^{11}B$, and $\delta^{18}O$ values, which may reflect the dominant metabolism and carbonate precipitation pathway of the microbial communities in each mat type. These results are a modern benchmark for the geochemical composition of stromatolites of known biogenic origin, providing a preliminary evaluation of the utility of these chemical biosignatures in the ancient geological record.

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[2] McLoughlin et al. (2008) *Geobiology,* 6(2): 95-105.

[3] Vitek, B.E., (in progress) *Doctoral Dissertation,* University of Miami.