GEOCHEMICAL SIGNATURES OF HAMELIN POOL STROMATOLITES

Amanda Oehlert, Erica Suosaari[1], Ingrid Izaguirre, Brooke Vitek, Sean Ahearn, Peter Swart and R. Pamela Reid
[1] *Smithsonian Institute*

PROJECT OBJECTIVES

- Characterize the geochemical signatures of microfabrics of Hamelin Pool stromatolites.
- Relate stable isotope, rare earth element and trace element geochemistry of stromatolite microfabrics to formation mechanism and environmental geochemistry.

PROJECT RATIONALE

Hamelin Pool stromatolites are a key living analogue for ancient microbialite deposits. Understanding the processes that contribute to the formation of the microfabrics, or internal structures of the stromatolites, should provide insight into the relative roles of environmental and microbial processes active in stromatolite accretion (Trompette, 1982; Ginsburg, 1991; Suosaari et al., 2019). Thirteen microfabrics have been identified in Hamelin Pool stromatolites and interpreted as fingerprints of the microbial mats that formed them (Hagan, 2015). Our recent work suggests that the stable isotope signatures of carbon and oxygen ($\delta^{13}C$ and $\delta^{18}O$) of these microfabrics exhibit trends that may be related to microbial metabolism, with more positive $\delta^{13}C$ and $\delta^{18}O$ values associated with unlaminated/clotted microfabrics (army green and gray), while more negative $\delta^{13}C$ and $\delta^{18}O$ values are associated with well-laminated microfabrics (red and yellow). The $\delta^{13}C$ and $\delta^{18}O$ values of well-laminated microfabrics are also associated with more trapped and bound grains, as evidenced by the overlap between $\delta^{13}C$ and $\delta^{18}O$ values for red and yellow

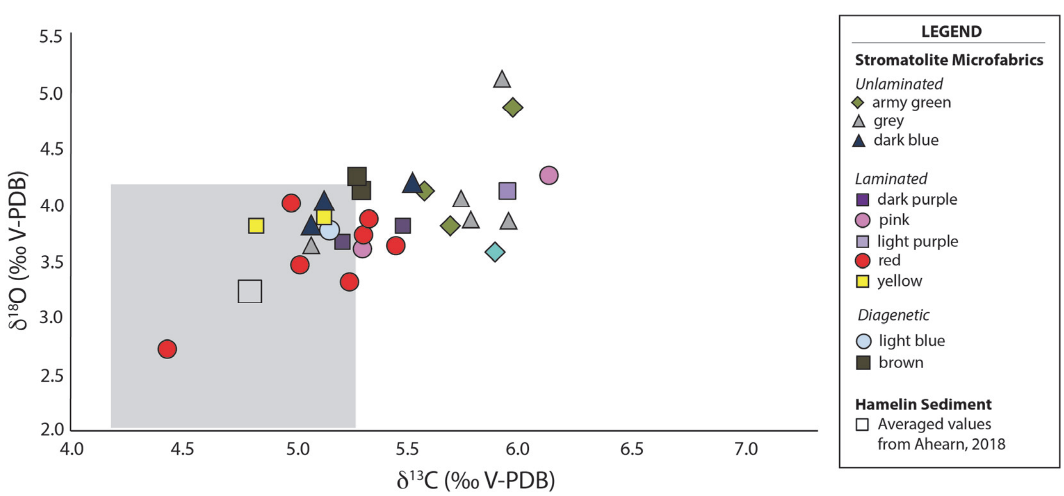

Figure 1: Cross-plot of $\delta^{13}C$ and $\delta^{18}O$ values of stromatolitic carbonate from Hamelin Pool. The large grey box represents the range and the small square is the average $\delta^{13}C$ and $\delta^{18}O$ composition of Hamelin Pool sediments from Ahearn (2018).

microfabrics and the range of sediment compositions in Hamelin Pool (Fig. 1, grey box). These observations are consistent with the interpretation that some of the Hamelin Pool stromatolites are formed by both trapping and binding as well as in situ precipitation of microbial carbonate (Reid et al., 2000; Hagan, 2015.

Recent studies suggest that specific patterns of rare earth element (REE) concentrations in stromatolites can indicate the role of life in the formation of laminated carbonate structures in the geological record (Corkeron et al., 2012). In contrast, other studies suggest that microbialites, such as stromatolites, record environmental REE concentrations allowing for paleoenvironmental reconstructions (Webb and Kamber, 2000), such as the oxygenation status of the water during the time of carbonate formation.

APPROACH

In this study, we expand the Hamelin Pool dataset by increasing the number of $\delta^{13}C$ and $\delta^{18}O$ measurements, and incorporate mineralogical (X-ray diffraction), trace element, and REE analyses of each microfabric.

SIGNIFICANCE

Better understanding of the geochemical characteristics of modern stromatolites formed by both trapping and binding, as well as direct precipitation in a well constrained depositional environment, will provide new insight into the significance of geochemical signatures in microbialites through geological time. If REE signatures in microbialites prove to record initial seawater chemistry, paleoenvironmental conditions can be reconstructed from stromatolites throughout geological time.

REFERENCES

Ahearn, S.P. (2018) A geochemical description of Shark Bay's Hamelin Pool, WA. *University of Miami MSc Thesis.*

Corkeron, M. *et al.* 2012. Discriminating stromatolite formation modes using rare earth element geochemistry: Trapping and binding versus in situ precipitation of stromatolites from the Neoproterozoic Bitter Springs Formation, Northern Territory, Australia. *Precambrian Research* 212-213: 194-206.

Trompette, R. 1982, Upper Proterozoic (1800-570 Ma) stratigraphy: a survey of lithostratigraphic, paleontological, radiochronological and magnetic correlations. *Precambrian Research*, 18: 27-52.

Ginsburg, R.N., 1991. Controversies about stromatolites: vices and virtues. In Muller, D.W., McKenzie, J.A., and Weissert, H., eds. Controversies in Modern Geology: London, Academic Press, 25-36.

Suosaari, E. et al., 2019. Stromatolite provinces of Hamelin Pool: physiographic controls on stromatolites and associated lithofacies. Journal of Sedimentary Research, *in press.*

Hagan, P.D. 2015. Internal fabrics and microbial precipitation in the stromatolites of Hamelin Pool, Western Australia. MSc Thesis, University of Miami, 1-138.

Reid, R.P. et al., 2000. The role of microbes in accretion, lamination, and early lithification of modern marine stromatolites. Nature, 406: 989-992.

Webb, G.E. and Kamber, B.S. 2000. Rare earth elements in Holocene reefal microbialites: a new shallow seawater proxy: *Geochimica et Cosmochimica Acta,* 64: 1557-1656.