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Pathways for biosignature preservation during microbialite taphonomic evolution: Insights from Hamelin Pool (Western Australia)

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Various microbial metabolisms contribute to microbialite lithification, each of which can be based on biogeochemical cycling of elements capable of supporting life. These metabolisms can leave signatures of their activity in the geochemistry of accreted microbialites, which serve as archives of the dynamic interplay between microbes, minerals, and their environment. However, significant changes in the geochemical composition of microbialites occur during taphonomy[1]. Key insights from our previous work indicated that Arsenic (As) is initially incorporated into organic matter produced by the microbial communities responsible for the construction of microbial buildups in Hamelin Pool, Shark Bay (Australia). This As-based biosignature is later transferred to the carbonate fraction of the microbialites during early taphonomic evolution[2]. Taphonomic transfer likely impacts preservation of elemental concentrations, and thus may enhance their utility as chemical biosignatures. Consequently, improved characterization of the origin, timing, and rate of the taphonomic exchange of elements between the organic matter and carbonate minerals of microbialites is needed to better understand biosignatures in the geological record.

Motivated by these knowledge gaps, our goal is to evaluate the fate of geochemical biosignatures in the well-constrained modern microbialites of Hamelin Pool, where stepwise taphonomic modifications have previously been petrographically characterized[3]. We conducted a sequential leaching experiment to chemically isolate the organic matter and carbonate fractions within each stage of taphonomic evolution. Elemental composition of these stages was measured using an Agilent 8900 ICP-QQQ. Preliminary data indicate that additional elements experience a similar taphonomic transfer to As, while others exhibit the opposite behavior. These findings suggest that some chemical biosignatures are enhanced by taphonomic transfer to the carbonate fraction, while others may result from non-biological geochemical artifacts incorporated after accretion of the initial microbialite architecture. Some biosignatures may even be lost during early taphonomy. Improved characterization of the elemental exchange during early taphonomy of microbialites provides new insight into the pathways of chemical biosignature preservation and will enhance interpretations of biogenicity in the geological record of early Earth.

[1] Sforna, M.C. et al. (2017), Geobiology 15(2), 259-279.
[2] Pollier, C.G.L. et al. (2022), Goldschmidt Conference.
[3] Vitek, B.E. et al. (In review), The Depositional Record.