Builders, tenants and squatters: organic matter preservation and its relationship to stromatolite formation

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Stromatolites are laminated structures commonly attributed to the activity of microbial mats. Given the advances in molecular and organic geochemical techniques, organic matter found in stromatolites can now be readily analyzed. However, determining whether microbes were directly or indirectly involved in the formation of structures like stromatolites can be difficult—an endeavor that becomes more difficult as geologic time passes and organic signals degrade. Organic matter can originate from three possible sources: 1. The "builder" community of microbes that is directly involved with the construction of the stromatolite; 2. The "tenant" community of microbes living in the stromatolite that are not responsible for its construction (some of which may colonize the structure long after its accretion); and 3. What we refer to as the "squatter" community – organic matter from the surrounding environment that is unrelated to either the builders or the tenants that is passively incorporated during construction. In order to assess our ability to decipher the role of microbes in stromatolite formation, we analyzed mineral-bound organic matter from three different lithifying environments; a siliciceous hot spring where modern, finely laminated biogenic stromatolties are being constructed; a mixed carbonate-silica hot spring with both biogenic and abiogenic features, and an alkaline lake with carbonate stromatolites of ambiguous biogenicity. Using both SSU rRNA gene sequencing and isotopic analysis of alkanes, we investigate the different paths of organic matter incorporation and early preservation in stromatolites.