

Stromatolites are typically referred to as the oldest fossils of life on Earth, some dating in at around 3.5 Ga. These structures provide one of the only glimpses back to the first 7/8ths of life's history on Earth.¹ Stromatolites describe an interesting mix of biology and geology—layers of microorganisms embedded in sedimentary structures which result in a rock-like mound appearance, but with a soft, squishy texture.² Stromatolites are unlike most modern forms of life and the formation of their unique structure is not entirely understood. Because they are composed of both living and non-living components, it is debated whether they are formed through biogenic or abiogenic means. I will argue that stromatolites are formed through abiogenic means consisting primarily of chemical precipitation and sediment suspension.³

The layers that compose stromatolites are lithified sedimentary rocks mixed with microorganisms such as cyanobacteria. As more sediment comes to rest on existing layers, this provides more surface area for microorganisms to live. The formation of these layers, however, are not necessarily due to the organisms which inhabit them. According to Grotzinger and Rothman, the abiotic mechanisms which construct stromatolites consist of “(1) fallout of suspended sediment; (2) diffusive smoothing of the settled sediment (that is, sediment moves downhill at a rate proportional to slope) and surface tension effects in chemical precipitation; (3) surface-normal precipitation; and (4) uncorrelated random noise representative of surface heterogeneity and environmental fluctuations.”³ These processes can actually be modeled by mathematics and are capable of producing layered fractal patterns very similar to that of a stromatolite when viewed normal to its growth, providing evidence that their formation is abiotic in nature.

The 4 mechanisms stated above mainly rely on the free-floating sediment in the water which stromatolites inhabit and these sediments being precipitated out of the water solution. Precipitation is the formation of a solid from a solution. So, the sediments in the water become precipitated by random noise and environmental fluctuations which then, over time, settles into layers which microorganisms latch onto. This sequence is not necessarily influenced by the microorganisms as can be seen at “peaks” in the stromatolite layers. Grotzinger and Rothman state,

Some of the taller projections, however, are incompletely covered and influence the shape of overlying laminae, resulting in sharp peaks separated by concave-upward depressions. The irregular projections, which occur at a scale smaller than our resolution but which microscopically show no evidence for preservation of filament moulds or other biogenic microtextures, influenced the structure of the stromatolite reef over a broad range of length scales to generate its characteristic peaked structure. Thus, they constitute the building blocks of an iterative process.³

This process, being iterative, allows for layers upon layers to form which microorganisms can inhabit. Thus, the formation of stromatolites is abiogenic in nature.

¹ http://www.fossilmuseum.net/Tree_of_Life/Stromatolites.htm

² My geology professor – Dr. Marilyn Vogel

³ <https://www.nature.com/articles/383423a0.pdf>

