MODERN THROMBOLITES: WHAT DO WE ALREADY KNOW, WHAT DO WE NEED TO KNOW, AND WHY DON'T WE KNOW MORE? K. L. Myshrall[1], [1]University of Connecticut Center for Integrative Geoscience 354 Mansfield Rd U-2045 Storrs CT 06269 kristen.myshrall@uconn.edu.

Introduction:

Thrombolites and stromatolites are microbialites that have dissimilar internal structures. While stromatolites have attracted much attention, due primarily to their extensive fossil record, thrombolites have remained in the shadows. The decline of stromatolites in the end Proterozoic and the rise of thrombolites in the early Phanerozoic has been attributed to the evolution of more complex organisms and their burrowing and grazing behaviors. It was suggested early on that thrombolites were solely the result of metazoan bioturbation disrupting the laminar fabric of stromatolites[1]. More recent research suggests that thrombolites are unique structures, and while methods of formation have been suggested[2,3], we still do not have a clear understanding of thrombolite form and function. Researchers need to take a step back and evaluate what we do know about thrombolites, what is still needed to be known to fill in the gaps of knowledge, and ask why we don't know more at this point.

Discussion:

What do we know about thrombolites?

When examining what little research has been done on modern thrombolites, we can determine three key things: 1) Thrombolites are found in all kinds of modern, aquatic environments including freshwater[2,4], marine[5,6], and hypersaline[7,8]; 2) Contrary to what is commonly thought, thrombolites are almost as abundant and widespread in modern environments as stromatolites[7]; and 3) Thrombolites are created by intricate associations of various microbial groups, with complex metabolisms, that differ from stromatolite communities[5].

Thrombolites around the world range in size from small, golf-ball sized structures growing on fallen trees and other debris to large reef-sized platforms[4,5,8]. Thrombolitic fabrics are complex and vary greatly between environments, and even within the same locale. Depending on the environment, both coccoid and filamentous cyanobacteria have been targeted as crucial to precipitation of carbonate minerals, and potentially, to the formation of the clotted mesostructure[2,6,9].

What do we need to know?

A review of the literature shows that we still do not understand the basics of thrombolite formation. In fact, there is still argument over whether they are unique structures[2,4,5] or disrupted stromatolites[3].

We do not have a clear picture of the microbial community structure and the geochemistry of the system and how they relate to the precipitation of the minerals that comprise the structures. Understanding the biotic composition and precipitation of carbonate minerals in modern thrombolites is necessary if we hope to be able to interpret ancient microbialites.

Why don't we know more?

In general, scientists have looked at specific elements of thrombolite systems from an assortment of environments but we have yet to focus our efforts on a cohesive understanding of a particular system. The problem with our current approach is in the innate disparity of diverse aquatic environments. Mineralogy, microbial species present, and in result, the underlying framework of thrombolites varies depending on the surrounding water chemistry. Therefore, attempting to work on aspects of the thrombolite system from a variety of environments is not as effective as focusing on one location.

The understanding of stromatolites grew immensely from an intensive, collaborative effort undertaken at one particular location, Highborne Cay, Bahamas[10]. Similarly, the key to unlocking the mystery of thrombolites lies in a multidisciplinary effort to analyze specific thrombolites from the same locale. Utilizing a consortium of scientists from fields including microbiology, sedimentology, marine ecology, genomics, chemistry, and paleontology can allow us to interpret the various aspects of the microbialite system. Each of these fields can give us pieces of the puzzle, but only when we put them together and focus efforts on understanding a particular specimen, or group of specimens from the same locale, can we gain a unified picture.

In addition, we need to be sure to examine the thrombolites at all scale levels, as previously stressed by Shapiro[11], to truly understand their overall form and function. Examining thrombolites only at the mega- and macrostructural level does not give insight into biological entities present, the geochemistry of the system, or the mineralogy. On the other hand, only examining thrombolites at the meso- and microstructural level does not allow for examination of environments of deposition and associated faunas.

Conclusions:

Very little is known about how thrombolites form and behave as a system despite approximately 40 years of research on these structures. While we have pieces of information from a variety of environments, we have yet to undertake an extensive, collaborative effort on understanding a particular system. Only when we work collectively to put the pieces together can we begin to gain a clearer understanding of how thrombolites are created and function. If the present is the key to the past, completely understanding these modern relics is needed before we can hope to comprehend their fossil counterparts.

References:

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