STROMATOLITE TEXTURE ANALYSIS: HOT SPRING SPICULAR GEYSERITE. S. L. Kendall[1, 2], M. C. Storrie-Lombardi[3,4], and S. L. Cady[2], [1] Department of Geology, Portland State University, 1721 SW Broadway, Portland, OR 97201, [2] William R. Wiley Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory, Richland, WA 99352, [3] Harvey Mudd College Department of Physics, 301 Platt Blvd, Claremont, CA 91711, [4] Kinohi Institue, Inc., 530 S. Lake Avenue, Pasadena, CA 91101

Introduction: Unambiguous proof of microbial activity as the genesis of ancient, Archean and Proterozoic, stromatolites is a cause for debate of some laminated structures [1]. Stromatolites are defined as laminated organo-sedimentary structures formed by microbial trapping and binding of sediment or precipitation of dissolved minerals [2,3,4,5,6]. A multidisciplinary analysis gathering many lines of evidence is required to support the argument for their biogenic origin [7,8,9]. Analytical laboratory capabilites continue to advance, however at the field and optical microscope scales with respect to ancient stromatolites, the ability to recognize biogenicity has depended upon human visual obervations of differences in grain size, shape, depositional patterning and color as an indicator of chemical composition for delineation of biotic and abiotic laminae within stromatolites.

Texture analysis of regions of importance within optical microscope images of stromatatolites provides a means to quantify important visual characteristics within an image so that the results of image analysis can be compared [10]. Grey Level Co-occurrence Matrix (GLCM) is a popular statistical method to evaluate the texture of stromatolites spatially [11]. Plotting of the GLCM statistical results using hierarchical cluster analysis, principle component analysis, and k-means provide graphic illustrations of textural relationships within the regions of interest [12].

Research Focus: Texture analysis has proven useful in many disciplines as it can be used to determine biotic from abiotic deposits and ultimately be used in conjunction with other capabilities to determine whether laminated sedimentary deposits are of biogenic origin.

Reported here are the results of our application of texture analyses to optimize the ability to characterize the biogenic features of high temperature hot spring sinter stromatolites, also known as geyserites, collected from Yellowstone National Park. A spicular geyserite was cut perpendicular to the accretionary surface. Multpile growth cycles are recorded within each spicule; where a growth cycle consists of an abiotic deposit, an interface contact of the abiotic deposit and biotic colonization, and the mineralized biotic colony.

Imaging data were collected from a massive, abiotic white opaline silica lamina, a tan, biotic silica lamina, and the interface zone between the two types of laminae.

We found that the textural relationship evaluated with the use of hierarchical diagrams, principle component analysis and k-means plots reveal differences in the textural properties of the biotic, abiotic, and interface regions within the high temperature spicular geyserite studied and illustrate that texturally they are distinct from each other. This study lays the groundwork for a more sophisticated approach for determining whether the biogenicity of laminated sedimenys, such as hydrothermal sinters can be recognized remotely via automated biogenicity analysis.

References:

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