ABSTRACT


Title: Biosedimentology of Thermal Features in the Uzon Caldera, Kamchatka, Russia: Implications for Biosignature Formation

Modern hot springs serve as a habitat for microorganisms similar in metabolism, morphology, and cellular structure to the microbes that existed relatively early in Earth history. To maximize our ability to interpret evidence for these microorganisms and their communities in the rock record, we need to understand how their biosignatures form and become preserved.

This biosedimentological study of four thermal features in the Uzon Caldera (K4 Well, Ochki Pool, Thermophile Spring, and Zavarzin Pool) focused on identifying how chemical, physical and biological inputs contribute to the characteristics of sinter biofabrics. The biofabrics of K4 Well outflow channel were studied in depth using a variety of microscopy techniques and a modeling approach due to excellent preservation in this deposit.

The laminar sinter facies at K4 Well was used as the basis to develop a model of seasonal silica deposition. This model supports a previously proposed hypothesis
that such laminae in high-latitude hot spring deposits form as the result of seasonal effects on cyanobacterial growth rates. The model also indicated that seasonal effects on silica deposition are key to laminae formation and preservation.

To assess how modern laminated siliceous sinters alter during diagenetic recrystallization, a geologically recent silica sinter collected from Yellowstone National Park was compared to the modern sinter that formed in the K4 Well outflow channel. The laminated character of the older sinter fabric was found to reflect differences in the porosity of the primary sinter deposit.

The utility of using the fractal dimension and compressibility of a variety of modern sinters, diagenetically altered sinter, and ancient stromatolites as a basis for comparison was evaluated, as such tools have recently been applied by others to assess the biogenicity of ancient stromatolites.

In summary, this study demonstrated that a mineralizing system with ubiquitous biofilms preserved biofabrics with a clear biogenic contribution; the seasonal relationship between cyanobacterial growth and silica deposition is key to the formation of a modern laminar sinter characterized by porous biotic layers and massive abiotic layers; and abiotic and biotic laminae were preserved as a result of the primary porosity of the original sinter deposit.