

Microbial and chemical microplofiles on a travertine

Tomoyo Okumura^{1*}, Fumito Shiraishi¹, Akihiro Kano¹

¹Social & Cultural Studies, Kyushu Univ.

Travertines are carbonate precipitates in hot-spring water containing a sufficient amount of calcium and carbon dioxide, and consist of calcite or aragonite. The appearance of the travertines is variable depending on flow conditions. In a case of Nagayu hot spring, they are hard and crystalline at high flow passages, while at adjacent low flow sites, thick microbial mats of dark green color leave loosely consolidated deposits. Both types of the precipitates show clear sub-mm order lamination that can be observed with the naked eye. It was reported that lamination of the hard travertine was daily and formed by microbial activities triggered by photosynthesis (Okumura and Takashima, 2008). Here, we study the lamination of microbe-rich soft precipitates to elucidate the forming processes.

The soft precipitates show lamination consisting of filamentous cyanobacterial layers and crystalline layers. The thickness of these layers varied in the range of 0.2-0.6 mm. Comparing surface fabrics of the sample took in the daytime and night time showed that the lamination was daily; a cyanobacterial layer was formed in the daytime, a crystalline layer was formed in the night time. In addition, there is a depth variation in fabrics of the soft precipitates. The cyanobacterial layers were densely-packed within 0.5-1.0mm from the surface, however, the density gradually decreased with increasing depth, instead of increasing the proportion of void and crystal. Eubacteria including Proteobacteria detected by CARD-FISH (catalyzed reporter deposition - fluorescence in situ hybridization) were distributed on the cyanobacterial filament and interface of the cyanobacterial layer and the crystalline layer. Their diversity and abundance increased with depth. The calcium and pH profile measured by microelectrodes indicate different trend responding to the light intensity. Calcium concentration gradually decreased with increasing depth under the light and dark conditions with double rate under the light condition. pH also decreased, but under the light condition it increased until 0.2mm depth.

During the daytime, inorganic precipitation from saturated hot spring water might not occur on the surface, but within the mat. The crystalline layers gradually grow in the mat. The cyanobacterial layer, on the other hand, was progressively degraded of heterotrophs within several days. Finally, only the crystalline layers remain in the deeper part of the soft precipitates. Both soft and hard precipitates in the Nagayu hot spring share the daily laminated texture. However, the texture, the regularity of lamination and the microbial processes forming the lamination were different. The study focusing on lamina forming process in the sediment may improve understanding of stromatolite formation that has similar laminated textures.

Reference

Okumura T. and Takashima C. (2008) Processing forming daily rings controlled by EPS in aragonite travertine. Japan Geoscience Union 2008 Abstract.

Keywords: travertine, microbial mat, cyanobacteria, lamination, microelectrode