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Daily lamina formation by a moderately thermophilic unicellular cyanobacteria

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Travertines are calcite or aragonite precipitates from hot spring water and generally exhibit sub-mm order laminations. The lamination has been considered to be formed daily cycle by comparison between lamina thickness and depositional rate (1). Our previous investigations of day/night monitoring of texture, water chemistry and distribution of microbes suggested two processes forming the lamination by daily activities of filamentous cyanobacteria (2, 3). The different processes were confirmed from a calcite and an aragonite travertine, in which exhibit different micro-textures. Further case studies are needed to identify the variation in processes controlling the diversified travertine textures. In this study, we investigated a laminated travertine in Myoken hot spring, Kagoshima Prefecture, southwestern Japan, for specify the processes forming the sub-mm order lamination.

Myoken hot spring is one of the springs discharging along the Amori River, where is located 10 km away from Kirishima volcanoes in northern Kagoshima Prefecture. Investigated travertine at Rakuenso occurred in a mound shape with 15 m width, which was precipitated from spring water directly flowing from a vent. Following procedures of the previous studies, eight series of water and sediment samples were collected every 4 hours from November 25-26, 2012 for describing the variation in texture, water chemistry and distribution of cyanobacteria trough a day and night.

Lamination of Rakuenso travertine consisted of the light colored layers of dendritic calcite crystals with 150-250 micrometer in thickness and the dark colored layers of micritic aragonite crystals with 50-100 micrometer in thickness. Sequence of the samples showed that the dark micrite layer was formed during daytime in 50-micrometer-thick biofilm of dominated by a unicellular cyanobacterium. The biofilm covered the travertine surface only during daytime, while embedded dendritic crystals during nighttime. The embedded cyanobacteria climbing to surface at next morning and started forming a new biofilm. Phylogenetic analysis on 16S rRNA gene showed that the unicellular cyanobacterium was relatives of *Thermosynechococcus elongatus* BP-1 that is moderately thermophile having phototactic motility (4, 5). Water at the sampling point had been stable in temperature (around 55 degree C), pH and ion concentration including Mg/Ca ratio, one of the controlling factors of $CaCO_3$ polymorph. Thus, the lamination in Rakuenso travertine was formed principally by daily activities of the unicellular cyanobacteria. Precipitation of aragonite in the cyanobacterial biofilm was consistent with the results of a previous study that showed the induction of aragonite precipitation by extracellular polymeric substances (6).

Microtexture, composition of the lamination, and cyanobacterial taxa in Rakuenso travertine were different from that in the previously reported travertines under lower temperature (<40 degree C). Travertine is a potential modern analog for some ancient stromatolites due to textural similarities (7). Geomicrobiological processes demonstrated in this study will provide new insights for understanding the ancient stromatolites.

[References]
1) Chafetz HS, Folk RL (1984) J. Sediment. Res. 54, 289-316.
2) Takashima C, and Kano A (2008) Sediment. Geol. 208, 114-119
3) Okumura T et al. (2011) Geomicrob. J. 28, 135-148
4) Yamaoka T et al. (1987) Plant and Cell Physiol. 19, 934-954
5) Namkamura Y et al. (2002) DNA Res. 9, 123-130
6) Riding R (2011) Lecture Notes in Earth Sciences 131, 29-74
7) Kawano M and Obokata S (2007) J. Clay Sci. Soc. Japan 46, 156-168

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