B101-006 **Room: 303** **Time: May 24 10:15-10:30**

Processes forming daily rings controlled by EPS in aragonite travertines

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Travertines are carbonate sediments precipitated in hot-spring water containing a sufficient amount of Ca and CO_2 and widely distributed in Japan. Due to combining inorganic and organic processes, they display a wide range of unique structures, including sub-mm laminations that resemble to ancient marine stromatolites. This study focused on Nagayu hot-spring travertine and specifies timing and processes forming the laminations. Nagayu hot-spring is located in Takeda City (Ohita Prefecture), 25km SW from Beppu. The water is neutral pH Na-Mg-HCO_3 type and contains a high concentration of dissolved chemical components. Mineralogy of the travertine is aragonite that is likely related to the high Mg/Ca ratio of the water.

On the fast-flowing sites, the travertine normally show sub-mm order laminated textures consisting of two types of layers; a layer of long needle crystals (N-layer) and a laminated layer consisting of smaller sized aragonite needles (L-layer). An L-layer is further subdivided into porous and dense sub-layers of ˜10µm thick. The travertine appears vertical cracks of up to 1mm interval, in which filamentous cyanobacteria occur. To confirm that the laminations are daily, 33-hour observation was performed with sampling of the laminated travertine and measuring water chemistry. A series of the thin sections clearly shows that L-layers were formed in daytime and N-layers in nighttime. EPMA mapping of Mg and Ca shows a higher Mg/Ca ratio in L-layers. No significant difference between daytime and nighttime was found in chemical and physical conditions, except for luminosity.

These results show that the daily rings are principally controlled by photosynthesis of cyanobacteria. This is supported by observation using staining and fluorescence methods. The filamentous cyanobacteria moved up toward the surface of sediment in daytime, but stayed in cracks between aragonite clasts in nighttime. Images of DAPI and Toluidine Blue stained specimens show that extracelluler polymeric substances (EPS) and nucleic acids occurs in L-layers, especially concentrates in the porous sub-layers.

The EPS is a key substance forming daily rings. It is secreted by cyanobacteria in daytime and inhibits long crystal growth by elevated Mg/Ca ratio in a mucus diffusion limited film, where smaller Mg-rich aragonite needles formed an L-layer. Regular sub-layering in the L-layers is likely developed by temporal ejection of mucus EPS on the travertine surface. EPS secreted by cyanobacteria was initially held in a space between the aragonite clasts by surface tension. But once the tension was broken, mucus fluid containing EPS forms a film on the surface, and thickness of the film is regulated about10 micron under the constant flow velocity. Needles without preferential orientation were precipitated and formed the porous sub-layers within the film, while inorganic precipitation on the film forms the dense sub-layer.

In order to confirm the photosynthesis-controlled daily rhythm, we further performed an in-situ experiment that set an artificial shade on the travertine for two days. We expected the development of a thick N-layer, but obtained porous textures containing aragonite clasts of peculiar forms. They include spheroids and dumbbells, which have been reported in laboratory experiments with heterotrophic bacteria. Within two days or shorter, the microbial association became largely dominated by heterotrophs that inhibit inorganic aragonite precipitation forming long needle crystals.