B101-010 Room: 302 Time: May 29 14:30-14:45

Phototrophic bacteria forming daily rings in aragonite travertine

Tomoyo Okumura[1]; Chizuru Takashima[2]

[1] Earth and Planetary sciences, Hiroshima Univ.; [2] Earth Science, Hiroshima Univ.

Travertines are carbonate (calcite and aragonite) precipitates in hot-spring water containing a sufficient amount of Ca and CO2 and widely distributed in Japan. Inorganic and organic processes, form sub-mm laminations in carbonate travertines that resemble to ancient stromatolites. Takashima and Kano (2006) reported that laminations in the calcite travertine were formed by daily cycle in cyanobacterial metabolism. Here, we study the aragonite travertine at Nagayu hot spring, Ohita Prefecture, which is alternation of N-layer consisting of long needle crystals and L-layer consisting of smaller sized needle crystals. We have already represented that the laminations are daily rings; N-layer was made in nighttime and L-layer was in daytime. An L-layer is further divided sub-layers. The process forming sub-layers can be explained that it could be inhibited crystal growth by extracellular polymeric substances (EPS) secreted by photosynthesis (Takashima et al., 2007), but the conclusive evidence was not provided yet. In order to understand processes forming dairy lamination, we apply FISH (Fluorescence in situ hybridization) method, which can provide spatial distribution of microorganisms in the travertine. We corrected two types of samples from Nagayu hot spring; one is a hard and lithified travertine formed at fast flowing site, and another is less consolidated soft specimen at slowly flowing site. After fixation, the specimens were stored in a dark cold place, stained applied FISH and histrogical dyes, and observed using comforcal laser scaning microscopy at Geoscience Center, University Goettingen, Germany.

The hard sample stained by Toluidine Blue O shows that EPS occur in L-layers. The result of FISH shows that the most common bacteria are beta-proteobacteria in the both specimens, and they occur in L-layers and vertical cracks. Cyanobacteria occur at only in the cracks.

The results indicate that beta-proteobacteria play a significant role in forming daily rings. Some purple bacteria belong to this group. They are heterotrophic bacteria using organic substances as carbon source and hydrogen donor. Judging from above, the formation of sub-layer in the L-layers was principally controlled by photosynsesis of the purple bacteria at surface of the travertine in daytime. EPS plays a crucial role in stabilizing and protecting of microbial mats, mainly contain acidic polysaccharides and protein. In recent years a considerable number of studies about stromatolite have been made on EPS because functional groups in the matrix bind cations and then saturation degree on calcium carbonate was changed. In the Nagayu travertine, EPS was secreted by cyanobacteria in a daytime, and when they covered the travertine surface, saturation degree locally decreased due to binding of calcium ion. However, once EPS were consumed by the purple bacteria, calcium ion was freely released and then aragonite crystals began to precipitate. In daytime, this repeated production-degradation of EPS formed the sub-layers. On the other hands, N-layer was formed at night because EPS were not provided to the travertine surface.

Size and morphology of the Nagayu aragonite travertine closely resemble to those of ministromatolite that commonly occur in the upper Archean to Proteozoic. If we assume that these stromatolites and travertines were formed same process, we can specify that the banded structure of that stromatolite was daily and the growth rate was extremely high.

Refarence

Takashima C. and Kano A. (2006) Depositional rate and daily lamination of Shionoha hot spring travertine. Jour. geol.Soc.Japan, 112 482-485

Takashima C., Okumura T. and Kano A. (2007) Processing forming daily rings controlled by EPS in aragonite travertine. Japan Geoscience Union 2007, Abstract.