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Changes in water properties and microbial facies along a flow path of a travertine developed in northern Sumatra Island,

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Sumatra Island has many hot springs related with volcanoes belonged to the Ring of fire. Geothermal studies for these hot springs have been performed actively, but hot spring sediments including travertines have rarely been reported. Travertine is a useful modern analog for the Precambrian stromatolites (Takashima and Kano, 2008; Okumura et al., 2013).

We studied travertines at Sipoholon hot spring located about 30 km south from the Lake Toba which is the largest caldera lake in the world. The travertines spread in total area of 50,000 km^2, in which active deposition occurs mainly in three separated sites; Area A, B and C from north to south, respectively. This study focused on Area A that lacks artificial effect.

In this study, we measured chemical components and stable isotopes of water and observed textures and bacteria of the travertine. Based on these results, we cleared that relationship between water properties, travertine textures and distribution of bacteria.

The travertine deposit occurs along ˜35-m-long flow path. The water from the vent first flows 15 m on a narrow (50 cm) and gentle passage and then widely on a steep slope on the travertine dome. Below the dome, the water passes on terrace-like rim pools and finally flows into a pool about 5 m in diameter.

The water with sulfurous smell emits from a vent at a rate of 286 L/min. This water is high temperature (61.4 degree Celsius), neutral pH (6.48) and microaerobic (DO of 0.6 mg/L). The water is rich in Ca^{2+} and ${SO_4}^{2-}$, and poor in Mg^{2+} and Cl^{-}. To the downstream, the water temperature decreases, pH increase, and conversely alkalinity and Ca^{2+} concentration decrease. These and increased carbon isotope of dissolved inorganic carbon indicate that CO_2 degassing increased supersaturation and induced deposition of calcium.

The travertine in Sipoholon hot spring is mainly composed of aragonite, but in one place, calcite coexists. It tends to become softer from the upstream to the downstream. This may reflect difference in crystal shape and texture. The harder travertines consist of tightly packed spherical aggregates of aragonite needles, while softer travertines have loose textures containing dumbbell-shape crystals.

Microbial facies on the travertine surface changes obviously from the upstream to the downstream. A white sulfur-turf in upper stream is composed of sulfur oxidizing bacteria with sulfur particles (Maki et al., 2004). It is known that the sulfur-turf prefers in high temperature, neutral pH and rich in hydrogen sulfide, which corresponds the conditions of the upstream. On high flow parts of the travertine dome, the travertine colored in pale pink likely due to the occurrence of purple sulfur bacteria. Green microbial mat covers the travertine deposited in in lower part with low flow rate. The mat is composed of filamentous bacteria with photosynthesis pigment identified in fluorescence observation. These are cyanobacteria. Water temperatures on the mat are all below 45 degree Celsisu. Thus, color change of travertine surface reflect that of microbial composition responded to water properties, such as water temperature, flow rate, flow volume, nutrient.

[References]

Takashima, C. and Kano, A. (2008) Microbial processes forming daily lamination in a stromatolitic travertine. Sedimentary Geology, 208, 114-119.

Okumura, T., Takashima, C., Shiraishi, F., Nishida, S., Kano, A. (2013) Processes forming daily lamination in a microbe-rich travertine under low flow condition at the Nagano-yu Hot Spring, Southwestern Japan. Geomicrobiology Journal, 30, 910-927.

Maki, Y., Ogawa, K. and Shimizu, A. (2004) A model for syntrophic cooperations in microbial mats on pristine Earth: Structure-function relationship of sulfur-oxidation in sulfur-turf microbial mat vegetating in hot spring effluents. Viva Origino, 32, 96-108.

Keywords: travertine, aragonite, sulfur oxidizing bacteria, cyanobacteria