Laminated textures of deposits in Shiohitari hot spring, Kagoshima Prefecture

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Fe-rich deposits and travertine (carbonate-rich deposits) are precipitated from hot springs containing amount of minerals. Some of these deposits have laminated textures and origins of laminated textures are explained by several papers. In terms of Fe-rich deposits, metabolism of iron-oxidizing bacteria and symbiosis of cyanobacteria and iron-oxidizing bacteria forms laminated textures (Takashima et al., 2008; Takashima et al., 2011). On the other hand, lamination of travertine are contributed by photosynthetic bacteria showing daily cycle (Takashima and Kano,, 2008; Okumura et al., 2013). This study focuses on laminated deposits in Shiohitari hot spring. Shiohitari hot spring is located at Kirishima city, Kagoshima Prefecture and emit naturally without artificial effects. This is registered in Kirishima Geopark.
The hot spring deposit occur along10-m-long flow path. The water from the vent first flows about 2 m on a narrow (30 cm) and gentle passage and then widely on a steep slope on the travertine dome. Below the dome, the water flows into Amafuri River. Unconsolidated Fe-rich deposit is precipitated at the vent is, and in the lower part, travertine covered by green colored biofilm is. Both deposits have laminated texture.
This water is 51.2 degree celsius, neutral pH and microaerobic. The water is rich in Ca^{2+}, Na^{+} and Cl^{-}, and poor in Mg^{2+} and SO_4^{2-}. To the downstream, the water temperature decreases, pH increase, and conversely alkalinity and Ca^{2+} concentration decrease. This is consisted with travertine deposition. Because an oxygen isotopic ratio of the water (-6.8 per mill) is similar to that of surface and shallow groundwater in southern Kyushu area (-7~-6 per mill; Mizota and Kusakabe, 1997), the origin of water may be fresh water. A carbon isotopic ratio of the water is -6.8 per mill which is similar in that of magmatic gases.
Mineralogy of the Fe-rich deposits in Shiohitari hot spring is ferrihydrite and exhibit micron order laminations which alternate with a dense part and a not dense part. The dense part is composed of dendritic structure ferrihydrite. In addition, meshwork atructure like organic matter is observed from specimens treated with citric acid. This possibly shows that precipitation of ferrihydrite is induced by bacterial metabolism.
The travertine in Shiohitari hot spring is mainly composed of aragonite forming dumbbell-shape and spherical crystals. Between crystals, organic matter like EPS is observed. The lamination of the travertine is likely formed by photosynthetic bacteria same as other travertine.
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