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The structure of chimney at iron-silica rich hydrothermal environment in shallow marine, Satsuma Iwo-Jima, Kikai caldera

Takashi Kuratomi[1*], KIYOKAWA, Syoichi[1], IKEHARA, Minoru[2], GOTO, syusaku[3], IKEGAMI, Fumihiko[1], MINOWA, Yuto[1]

[1]Kyushu University, [2]Center for advanced marine core research, Kochi University, [3]Geological survey of Japan, AIST

Satsuma Iwo-Jima Island is a volcanic island in the northwestern rim of Kikai caldera. There are two post-caldera volcanoes in this island: the rhyolitic Iwo-dake and basaltic cone Inamura-dake. Iwo-dake has volcanic and hydrothermal activities at the present. Because of hydrothermal activity, seawater around the island is discolored to brownish and white color. Ferrous-rich hot spring (pH=5.5, 55-60 degree Celsius) discharges from the sea-floor at the Nagahama bay in the southwestern island. Brownish-color ferric particles that were produced by mixing of the hot spring water with seawater, discolor the seawater to brownish color (Shikaura and Tazaki, 2001). The bay is half-closed environment topography. There is a breakwater for a fishing port into two parts: East site and West site. Kiyokawa et al, (2012) indicated that the deposition rate of iron-rich sediments at West site is about 1 m per ten years. The deposition of sediment was influenced by tide, rain and wind. At East-site, the iron-rich chimney-complex mounds were found. The growth process of the chimney-complex mound is not studied so far. In order to understand the growth process of the chimney mounds, we observed structure of chimneys sampled from the chimney complex mounds at East-site.

Samples used in this study were massive chimneys (20-30cm). We observed the structure of chimneys with X-ray CT scan and FE-SEM and from the thin section samples, and analyzed the chemical composition with EDS. The massive chimney is classified into two parts seen with the naked eye: black high density-hard layer and brownish low-density soft layer. Additionally, we analyzed floating particles collected from seawater by a centrifugal separator.

The results of X-ray CT scan observation shows that the inside of chimney is constructed from the aggregation of convex structures (3-4cm). Low-density layers of the chimney have many pipe-like structures (typical radius: 1mm). Petrographic observations indicate that both high- and low-density layers have a filament-like form, however the form at the low-density layer are vertical to high-density layer. In the low -density layer, the number of particles attaching to the filament-like form increases toward the high-density layer. FE-SEM observation shows that filament-like form at the high-density layer consists of aggregation of bacillus-like form that is observed as the chain of particles (about 2um). At low-density layer, on the other hand, there is bacteria-like form with particles (<1um). Bacteria-like form could be classed into 3 types (helix, ribbon-like, twisted).

The floating particles were observed as an aggregation of fine particles (<0.5um). The particles show no bacteria-related form. EDS analysis shows that all particles are consist of Fe, Si and O, and are chemically homogeneous.

According to the observation results above, we present a hypothesis of growth process of a chimney-complex mound in Nagahama bay. The chimney was constructed form aggregation of convex structure with many pipes that probably work as the hydrothermal vent. All particles are consist of Fe, Si, and O. This suggests that the particles are silica rich iron-hydroxides. Bacteria-like structure may be Gallionella spp. known as iron-oxidizing bacteria because of those forms. This bacterium is known as neutrophilic bacteria that prefer an environment of redox interface (Weber et al., 2012). The increasing of the number of particles on filament-like form and the character of bacteria support that the activity of bacterium around hard rim makes high-density layer. The growth of chimney is likely to be influenced by microbes' activity.

<Reference>

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