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Distribution of minor elements within the unconsolidated sediments covered active shallow-seafloor hydrothermal system

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On the seafloor off northeast Sakurajima volcano in the innermost part of the Kagoshima bay, south Kyushu, Japan, an active volcano ”Wakamiko”is located, and the volcano is characterized by vigorous fumarolic activity. The ”Wakamiko” volcano is considered one of the craters of Aira caldera, which occupied the bay head area, and is formed small depression of 200 m in depth deeper than the caldera floor of about 140 m in depth. In the depression, i.e., Wakamiko crater, at least three active hydrothermal vents have been identified and maximum temperature emitting the vents reach 200 degC. In addition several hydrothermal fluid shimmering sites have been found, distribution of them have been continuously surveyed by ROV and AUV.

The coastal line is close to the crater, therefore, much clastic sediments include volcaniclastics emitted from surrounding volcanoes are filled the crater. The unconsolidated sediments in the crater is considered to reach up to 80 m by seismic observation. The venting and shimmering hydrothermal fluids penetrate the unconsolidated sediment layer, then several commercially important elements, it means rare metals, have been precipitated and condensed in the sedimentary layer. Actually, vein formed antimony sulfide, stibnite, has been often observed in the 5 - 6 m long core sediments obtained by piston coring. However, hydrothermal minerals currently precipitated from hydrothermal fluid are small grain and degree of crystallinity is still low. Therefore, it is difficult to find visible grain of such minerals and even to detect by XRD analysis. This study aim to clarify the distribution of minor elements, such as rare metals, in the bulk sediment samples obtained from the Wakamiko hydrothermal field using neutron activation analysis (NAA).

Sediment core samples obtained during KT08-9 cruise by RV/Tansei was provided for this study. Those sediment samples already have studied pore water chemistry and clay mineral compositions. We used two core samples, which are significantly affected by hydrothermal fluid. Subsamples picked up each 20 cm interval were freeze-dried and packed about 30 - 40 mg dried sediment into polyethylene bag. NAA was carried out at Kyoto University Research Reactor Institute.

In, Se, V, Mn, Au and so on in addition to As, Sb and Hg, which are previously reported anomalous condensation in this area, were detected by NAA. As, Sb, Hg and Au were condensed at the layer where present contribution of hydrothermal fluid was obvious. On the other hand, condensation of Mn, V and In was observed at about 50 cm depth below seafloor from the both core samples.

As, Sb and Hg are expected to precipitate directly from the hydrothermal fluid, while Mn, V and In were even condensed at the hydrothermal fluid-free layer. It may suggests that Mn, V, and In are precipitated from hydrothermal plume once emitted from the vents under suitable physicochemical condition.

Keywords: shallow-seafloor hydrothermal system, Wakamiko crater, neutron activation analysis, rare metals, unconsolidated sediments