Subvent hydrothermal mineralization and rare metal accumulation within the unconsolidated sediments of Wakamiko submarine crater in Aira Caldera, southern Kyushu, Japan

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On the seafloor off northeast Sakurajima volcano in the Kagoshima bay, south Kyushu, Japan, an active volcano "Wakamiko" is located, and the volcano is characterized by vigorous fumarolic and hydrothermal activity. The "Wakamiko" volcano is considered one of the active 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, hydrothermal vents have been identified and maximum temperature of emitting fluids reach 200℃. In addition several hydrothermal fluid shimmering sites have been found in the crater.

The coastal line is close to the crater, therefore, much clastic sediments include volcaniclastics emitted from surrounding volcanoes and its self 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 expected to precipitate and condense in the sedimentary layer.

Sediment core samples obtained in 2008 and 2012 were provided for this study and use to study pore water chemistry, clay mineral compositions, and bulk elemental analysis. Bulk elemental analysis was applied neutron activation analysis (NAA) and was carried out at Kyoto University Research Reactor Institute.

From the core (total length of 330 cm) collected in the vicinity of the active hydrothermal filed where high temperature fluid (T = 200℃) venting, two types of smectite were domoinantly observed as hydrothermal alteration minerals. While montmorillonite was found all over the core except for the surface, saponite (Mg-rich smectite) was found only in sediment from 270 to 300 cmbsf of the core, where relative amount of the saponite gradually increase downwards in replacement of the montmorillonite decrease. Profiles of the pore fluid chemistry indicated that the saponite layer corresponds to the boundary between sediment occupied with pore fluid of seawater composition (from 0 to 270 cmbsf) and of the hydrothermal component (from 300 to 330 cmbsf).

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 the bottom seawater containing hydrothermal components once emitted from the vents under suitable physicochemical condition.