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Distribution of hydrothermal clay minerals in cores obtained by TAIGA 11 cruise from the Middle Okinawa Trough

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Intense hydrothermal fluid-sediment interactions are expected to occur below seafloor of active hydrothermal fields in the Middle Okinawa Trough, since these fields are covered with thick volcanic sediment which consists mainly of hemipelagic mud and pumiceous sediment. We investigate distribution of hydrothermal clay minerals in the sediment layer at these areas, in order to discuss physical and chemical environment below the seafloor.

In June 2011, the TAIGA 11 cruse was conducted using the R/V Hakurei-maru No.2 (Japan Oil, Gas and Metals National Corporation (JOGMEC)). We drilled 7 holes using the Benthic Multicoring System (BMS) and collected 2 cores using a large-diameter gravity corer (LC) in the Iheya North Knoll and the Izena Cauldron. Sub-samples were collected from the obtained cores at 5 to 10 cm intervals. Mineralogy of the samples was studied by analyses using XRD (X-ray diffraction) and EPMA (Electron Probe Micro Analyzer). Clay fractions ($<$ 2 micrometer) were obtained from suspending bulk samples in distilled water and analyzed in detail. Oxygen and hydrogen isotope composition of the clay minerals was determined for some samples.

At the Iheya North Knoll, we drilled one hole using BMS (BMS-I-4. Drilling depth was 453 cmbsf). BMS-I-4 core comprised grayish white hydrothermal altered mud below 10 cmbsf. XRD and EPMA analysis indicated that the core was mainly composed of kaolin mineral. In addition to kaolin mineral, sphalerite and galena were found below 240 cmbsf, and sphalerite and dolomite were found in sediment plugged in a core catcher.

Occurrence of kaolin mineral has not been common in other seafloor hydrothermal active area and reported only at the Jade hydrothermal field in the Izena Cauldron by Marumo and Hattori (1999). However recently, kaolin mineral was dominantly found in a shallow depth at the Iheya North Knoll by drilling during the Integrated Ocean Drilling Program (IODP) Expedition 331 (Miyoshi et al, Clay Science Forum, 2011). These results suggest that kaolin mineral distributes laterally in a shallow depth below the seafloor at the Iheya North Knoll. Occurrence of kaolin mineral is rather common in onland geothermal areas, especially around acid springs caused by steam heating that is considered to be related with boiling of the deep hydrothermal fluid. In the Iheya North knoll, venting fluid chemistry was explained by boiling of deep hydrothermal fluid beneath the seafloor (Kawagucci et al., 2011). Based on this analogy, occurrence of kaolin mineral at the Iheya North Knoll would be attributed to acid condition caused by vapor-rich component deriving from boiling of deep hydrothermal fluid below the seafloor.

At the Izena Cauldron, we drilled one hole using BMS (BMS-J-2. Drilling depth was 530 cmbsf) and collected one core using LC (LC-J-2. 330 cmbsf) near the Biwako Vent site (BV site), which is located in the lower part of the slope in the Jade hydrothermal field. BMS-J-2 core comprised grayish white or gray hydrothermal altered mud below 380 cmbsf and XRD analysis found chlorite and sericite. LC-J-2 core comprised grayish gray hydrothermal altered mud below 280 cmbsf and was mainly composed of K-feldspar and chlorite below 300 cmbsf.

Chlorite and/or sericite were found in the BMS-J-2 and LC-J-2 cores collected near the BV site. This clay mineral assemblage near the BV site is different from that in the Black Smoker Chimney site (BSC site) which is located in the higher part of the slope in the Jade field. In the BSC site, kaolin mineral, smectite and sericite were found in surface sediment (Miyoshi et al., the Blue Earth Symposium, 2011). This different assemblage of clay minerals may reflect different physical and chemical environment below the seafloor of these two sites; for example low temperature and acid environment in BSC site and high temperature and alkaline environment in the area around BV site.

Keywords: Seafloor hydrothermal system, Iheya North Knoll, Izena Cauldron, Benthic Multicoring System (BMS), Hydrothermal alteration, Kaolin mineral