Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

BBG21-P13 Room:Convention Hall Time:May 21 10:45-12:15

Geochemisty of pore fluids collected from active hydrothermal fields in the mid-Okinawa Trough

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TAIGA11 Expedition was conducted in June, 2011 to investigate subseafloor environment below active hydrothermal fields by direct access using a shallow drilling system. Three active hydrothermal fields at Iheya North Knoll (27 47'N, 126 54'E), at Izena Cauldron Jade site (27 16'N, 127 05'E) and at Izena Cauldron Hakurei site (27 15'N, 127 04'E) were selected as exploration targets. The expedition focused on a subseafloor hydrothermal fluid circulation system that develops in sediment consists of volcaniclastic and hemipelagic materials. In this presentation, we will report geochemistry of pore fluids extracted from the obtained core samples and discuss evidence for intrusion of the hydrothermal component and for hydrothermal interactions.

Shallow drillings during TAIGA 11 Expedition was conducted using a BMS (Benthic Multi-coring System) that was loaded on R/V Hakurei-maru No.2. In addition to the BMS drilling, we also conducted coring using a large diameter gravity corer (abbreviated as LC) during bad sea condition. Pore fluid extraction from sub-sampled sediment was conducted onboard as soon as possible after core recovery. Three to eight sub-samples of 20 to 50 cm^3 in volume were collected every one meter from the core samples. The extracted pore fluid were divided into sub fluid samples and provided for analysis of major elements, trace elements, organic species, and specific isotope measurements. Sub sediment samples for gas species analysis were collected directly from the obtained core, those were kept in a glass vial and provided for headspace gas analysis. Chemical analysis of major species was conducted in following methods; Onboard colorimetry (molybdene blue method) for Si, ICP-AES after 200 times dilution of an acidified sample for Na, Mg, Ca, atomic absorption spectrophotometry after 200 times dilution of an acidified sample for K, ion chromatography after 300 times dilution for SO4, silver titration (Mohr method) for Cl, onboard electrode measurement for pH, onbaord acid titration for alkalinity, and onboard colorimetry (indo phenol method) for NH4.

In the Iheya North Knoll hydrothermal field, one BMS drilling and one LC coring were conducted. Core of BMS-I-4 (drilling depth: 453 cm) comprised grayish white hydrothermal altered mud that was identified as kaolin mineral, below 10 cmbsf (Miyoshi et al., this meeting). Pore fluid from the corresponding depth showed enrichment in major cations (Na, K, Ca and Mg), which may be explained by leaching during the hydrothermal alteration. Pore fluid chemistry also showed evidence for sulfate reduction in the sediment layer, such as high alkalinity and existence of hydrogen sulfide.

In the Jade site in the Izena Cauldron, three BMS drillings and one LC coring were conducted. Core of BMS-J-2 (drilling depth: 529 cm) comprised grayish white or gray hydrothermal altered mud below 370 cmbsf (Miyoshi et al., this meeting). Unfortunately, pore fluid could not be extracted from this alteration layer. Pore fluid collected from the shallower layer showed similar major element composition to that of seawater.

In the Hakurei site in the Izena Cauldron, two BMS drillings were conducted. Core of BMS-H-1 (drilling depth: 610 cm) showed evidence for sulfide/sulfate mineralization below 223 cmbsf. Pore fluid from corresponding depth show enrichement in Si, K, Ca and NH4, which could be attributed to intrusion of the hydrothermal component. This result suggests the mineralization is related with fluid mixing between the hydrothermal component and seawater component within the sediment layer beneath the seafloor.

Keywords: Seafloor hydrothermal activity, hydrothermal component, hydrothermal fluid interaction, ocean floor drilling, pore fluid