Geochemistry of pore fluids collected from active hydrothermal fields in Iheya North Knoll, Okinawa Trough

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We investigated chemical composition of pore fluids extracted from sediment samples collected by scientific drilling from Iheya North Knoll hydrothermal field in mid-Okinawa Trough. Two drilling campaigns CK14-04 and CK16-01 were conducted employing Drilling Vessel Chikyu under the framework of the Next-generation Technology for Ocean Resources Exploration Project. Sediment cores were drilled from Site C9016 within the hydrothermal field of Aki Site, from Site C9021 about 1 km apart from Aki Site, and from Site C9023 drilled on an active hydrothermal mound of Aki Site (27˚46.1' N, 126˚54.1' E; water depth = 1070 m). Prior to these campaigns, another scientific drilling in Iheya North field was conducted as IODP (Integrated Ocean Drilling Program) Expedition 331, which targeted at Original Site (27˚47.5' N, 126˚53.8' E; water depth = 1000 m). After the pore fluid study reported as the result of Expedition 331, we document geochemical signature of pore fluids, to discuss fluid interactions and migrations within the sediment layer.

Pore fluid from Site C9021 away from the active field showed approximately same chemical composition as seawater for whole range of the sampled depth, from 0 to 66 mbsf (=meters below the seafloor). The exception was recognized in slight decrease of SO_4 and increase of alkalinity at the depth from 45 to 58 mbsf. Together with detection of H_2S in the same layer, this change is attributed to sulfate reduction within the sediment. Similar seawater entrainment was recognized in shallow layer (< 11 mbsf) at Site C9016 located within the active field. Whereas pore fluid in deep layer (>30 mbsf) showed distinctive chemical composition which showed similarity in several species rather to the vent fluid emanating from the hydrothermal mound. Pore fluid at Site C9023 collected directly from the active hydrothermal mound showed complicated profiles, but likely to converge to the vent fluid composition in deep layer (> 40 mbsf).

Occupation of pore fluid in deep sediment layer by the hydrothermal component of vent fluid composition was already recognized in the Original Site by the previous study. As well as seawater entrainment into a certain depth, extensive fluid migration would be attributed to distribution of porous pumiceous sediment piled on Iheya North Knoll. Combination of the lateral migration of the ascending hydrothermal component and seawater entrainment is responsible for the drastic change in pore fluid chemistry profiles in subseafloor region of the active hydrothermal field. Given that mixing between these two components is not obvious in the chemical profiles, separation by an impermeable layer would be inevitable. Pore fluid chemistry beneath active hydrothermal field in Iheya North Knoll would be controlled by geologic structure of a stratovolcano as well as hydrothermal structure.

Keywords: submarine hydrothermal system, hydrothermal alteration, volcanic sediment, fluid migration

