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Hydrothermal sulfide/sulfate and alteration minerals obtained by drilling below the Iheya North Knoll hydrothermal field

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Seafloor drilling through active hydrothermal fields at the Iheya North Knoll in the middle Okinawa Trough provided a unique opportunity to directly access the subseafloor structure. Following IODP (Integrated Ocean Drilling Program) Expedition 331 conducted in 2010, CK14-04 cruise was performed by D/V Chikyu in 2014. We will report occurrence and mineralogical characteristics of sulfide minerals and alteration minerals in obtained sediment core samples by these drilling expeditions.

Drilled sites have been laid out from the NBC mound associated with active venting of 311 C hydrothermal fluid (27 47.4'N, 126 53.86'E, depth=1000m). Among them, occurrence of ore forming sulfide minerals were identified in sediment collected from Site C0016 just beside the NBC mound, from Site C0013 (100 m east from the NBC mound), from Site C0014 (450 m east from the NBC mound), Site C9015 (another mound in the west side of the NBC mound), and Site C9016 (150 m apart from Aki hydrothermal field which is located about 3 km south of the NBC mound).

From Site C0016B beside the mound, massive sulfide ore of ˜60 cm length was recovered from the first core (0-9 mbsf=meters below the seafloor). The ore looked like "black ore" in appearance and was composed of euhedral sphalerite, galena, chalcopyrite and pyrite which grain size up to a few 100 m. It is notable to that the ore include significant amount of clay minerals in the matrix. At the same drilled site, silicified sediment associated with vein sulfide consisted mainly of pyrite and chalcopyrite was abundant in the third core (27-45 mbsf). Dominant clay minerals in sediment at this depth were chlorite and illite.

From Site C0013 located at 100 m east from the NBC mound, intensely altered sediment including sphalerite, galena and pyrite was obtained from 0-16 mbsf. In the same sediment layer, occurrence of copper sulfides showed variation from covellite and tetrahedrite at a few meters below the seafloor to chalcopyrite at ˜10 mbsf. These sulfides are euhedral which grain size increased toward deeper depth and usually surrounded by clay minerals and/or sulfate minerals. Dominant clay minerals showed change along depth from smectite at a few meters below the seafloor to chlorite and/or chlorite-smectite mixed layer minerals at a deeper depth.

From Site C9015 at another hydrothermal mound, sulfide mineral enriched veins were recognized in sediment from 18-23.5 mbsf. These portions included sulfide minerals such as sphalerite, chalcopyrite, pyrite and galena, sulfate minerals such an s anhydrite and/or barite, clay minerals and quartz.

From Site C9016 a few km away from the NBC mound, occurrence of sphalerite, galena and barite within altered sediment obtained from 9-11 mbsf was notable. Dominant clay minerals in the sediment were kaolin minerals, which variation along depth is discussed in Tsutsumi et al. (poster presentation in this meeting).

In summary, occurrence of sphalerite and/or galena was limited in rather shallow depth (0-24 mbsf), but ubiquitous for drilled sites located with intervals of a few hundred meters to a few kilometer. This distribution should be interpreted as related to hydrothermal structure below active hydrothermal fields. Mineralogical texture of these sulfides was characterized as surrounded by clay and/or sulfate minerals, which is quite distinctive from that recognized in typical "black ore". This difference would be one of important problems if we consider seafloor sulfide deposits are a modern analogue of kuroko-type ore deposits. Whether the mineralization center has not been drilled yet or the hydrothermal activity at the Iheya North Knoll has not reached yet to the main mineralization stage?

Keywords: Seafloor massive sulfide mineral deposits, seafloor drilling, kuroko-type ore deposits, hydrothermal clay mineral