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沖縄トラフ熱水活動域で実施された掘削同時検層の概要
Preliminary report on logging while drilling conducted at Iheya-North Knoll, Okinawa Trough

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In July 2014, a scientific drilling expedition, CK14-04/Expedition 907 was conducted at an active hydrothermal field on the Iheya-North Knoll by D/V Chikyu as a part of “Next-generation Technology for Ocean Resources Survey” of the Cross-ministerial Strategic Innovation Promotion Program (SIP). During the expedition logging while drilling (LWD) was deployed to constrain the area of the fluid reservoir beneath seafloor followed by three coring holes down to 150 meter below the seafloor (mbsf). The LWD system is composed of arcVISION for resistivity and natural gamma ray measurement and TeleScope for real-time transmission of drilling parameters and arcVISION data. Both tools also measure annular pressure and temperature at two different depths. To protect the LWD tools from the anticipated high temperature of hydrothermal fluids, exceeding 300 ℃, a continuous pumping system (Non Stop Driller) was applied to maintain fluid circulation continuously even during pipe connection.

Five sites (C9011-C9015) at the Iheya-North Original Site and one site (C9016) at Aki Site were drilled with LWD. At C9012 and C9016, the arcVISION detected temperature anomaly up to 84 ℃ at 234 mbsf and up to 39 ℃ at 80 mbsf, respectively. The temperature quickly increases at that depth and it would reflect the existence of high-temperature heat source along borehole. Due to the continuous fluid circulation during drilling, the measured temperature does not indicate in-situ temperature, but it reflects the heat disturbed by the cold circulated water instead.

High quality resistivity and natural gamma ray data were acquired at six sites. The log curves at Site C9016 show characteristic response; the natural gamma ray log exhibits extremely high radiation (>500 gAPI) at 7-13 and 23-31 mbsf (Zone A). In the underlying interval of 31-40 mbsf, the resistivity log exhibits extremely low value (<0.2 ohm-m) (Zone B). Then the resistivity log exhibits higher value (~10 ohm-m) and the natural gamma ray log shows very low radiation (<50 gAPI) at the interval of 41-48 mbsf (Zone C). The log characteristics in Zone A, B, and C can be interpreted as a series of K-rich alteration zone, sulfide zone, and low-K hard (silicified) sediments, respectively. The LWD-based lithological interpretation was confirmed by the following core description. Zones A and B can be correlated to altered clay zone and sulfide zone including sphalerite, galena, chalcopyrite, and pyrite. Our results show that LWD is a powerful tool for the scientific investigation of submarine hydrothermal deposits and LWD survey enhances the successful recovery of sulfide samples.

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