海底下高温流体の温度と流体量の推定：掘削同時検層と掘削パラメータからのアプローチ
Estimation of under-seafloor fluid on temperature and volume from the logging-while-drilling data in an active hydrothermal field

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In Jul. of 2014 and in Feb. –Mar. of 2016, offshore drillings on Iheya-North Knoll and Iheya minor ridge, Okinawa Trough, were executed as part of Next-generation technology for ocean resources survey, which is a research program in Cross-ministerial Strategic Innovation Promotion Program (SIP). In these expeditions, logging-while- drilling (LWD) and measuring-while-drilling (MWD) were conducted around Iheya area, including Iheya-North (original) site (C9011 –C9015) and in Iheya-North Aki site (C9016), to investigate spatial distribution of hydrothermal deposit and geothermal fluid reservoir. LWD tools are supplemented by a measurement-while-drilling tool that is located above the LWD tools in the bottom-hole-assembly. In this expedition, arcVISION and TeleScope were integrated as LWD and MWD respectively. The arcVISION obtained physical properties along borehole (resistivity, natural gamma-ray), and the TeleScope collected drilling mechanics data and transferred them to the surface by mud pulse telemetry. Both of these tools included annular pressure-while-drilling (APWD). Annular pressure and temperature were monitored by the APWD to detect possible exceedingly-high-temperature geofluid. In addition, drilling fluid was continuously circulated at sufficient flow rate to protect LWD tools against high temperature (non-stop driller system).
At C9012 and C9016, the arcVISION clearly detected temperature anomaly at 234 meter below the seafloor (mbsf) and 80 mbsf, respectively. Temperature quickly increases at that depth and it would reflect the existence of high-temperature heat source. During the drilling, however, drilling water was continuously circulated at high flow-rate (2600L/min) as stated above. Thus the measured temperature is not exactly in-situ temperature, but the profile of the temperature reflects the temperature variation of each stratigraphic layer of the bore hole.
To investigate the detail of the heat source, such as in-situ temperature and quantity of heat, we performed numerical analyses of thermal fluid and energy-balance assuming injection of high-temperature fluid. We combined pressure loss theory of double cylinders and temperature equation to replicate the fluid flow and its temperature between borehole wall and drilling pipe during the thermofluid injection. As the result, we estimated the temperature and the volume of injected fluid to be 115oC~ and 17.3 m3, respectively (at C9012) from the calculation. This temperature is lower than that of a hydrothermal vent which had been found near the hole (300oC). We will present preliminary results of the calculation for the newest cruise (CK16-01).

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