Horizontally-elongated convection controlled by surface sediment: The northern Iheya hydrothermal field, mid-Okinawa trough

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The Okinawa Trough is located in northwestward of the Ryukyu arc, and is considered as in an initial rifting stage of the continental back arc basin. There are many volcanic outcrops interpreted as intrusion after rifting in the Trough of mid axis. The Iheya-north hydrothermal field is one of the most active sites, venting high-temperature, black smokers and biological communities. Various investigations have been carried out there. The Iheya-north is one of the site proposed for the IODP.

We obtained 78 heat flow data to infer the structure of teh hydrothermal circulation in the Iheya-north hydrothermal field with research vessels, submersible ships(JAMSTEC) and Navigable Sampling System(Ocean Research Institute, The University of Tokyo). As a result, the mean value of the outside of the hydrothermal field is 0.11 W/m^2 within 5-15km from teh t-shape of knoll. On the other hand, the active hydrothermal area observed over 10 W/m^2. The heat flow value of 1-10 W/m^2 was obtained within 500n east from the skirt of one slope in the hydrothermal field. The site where 1.5 km east of the hydrothermal field is 1-order less heat flow value 0.1 W/m^2 compared with the mean value of outside of the hydrothermal field. The origin of the very low heat flow value is considered to be recharge of the sea water into formation. Geochemical nomaly in the discharge area suggests that a large amount of fluid must be supplied, probably for outside the Iheya-north mound complex ˜5km away from the hydrothermal area.

To achieve this hydrothermal circulation, the product of the permeability and pressure gradient based on Darcy's law needs larger within 1.5km-5km from the hdyrothermal field. Although the major driving force for hydrothermal convection is the thermal buoyancy of the fluid, actual circulation pattern is affected by the heterogeneity and anisotropy of permeability. As a result of seafloor video images and side-scan image obtained by submersible dives and AUV Urashima, the permeability of the surface is inferred from the distribution of reflection intesity at the 1.5km eastern hydrothermal field. The horizontally elongated convection would need a large negative pressure to introduce cold fluid into the recharege area. Some attempts by the numerical simulation will be introduced to explain this anisotropic convection pattern.