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Development of observation method for seafloor hydrothermal flow based on acoustic image

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We have been developing a method of observation for seafloor hydrothermal flow. The system is based on acoustic video camera 'DIDON'. DIDSON (Dual-Frequency IDentification SONar) is acoustic lens-based sonar. It has sufficiently high resolution and rapid refresh rate that it can substitute for optical system in turbid or dark water where optical systems fail.

DIDSON equipped on the submersible Shinkai6500 could capture sliced images of the seafloor hydrothermal flows at the Rodriguez segment of the Central Indian ridge, in YK09-13 Leg.1 cruise. We could identify shadings inside the acoustic movie images of the hydrothermal flows. Silhouettes of the hydrothermal flows varied from second to second, and the shadings inside them also varied. These variations were thought to be corresponded to internal structures and flows of the plumes. These are only a few acoustic video images of the hydrothermal plumes. Results from this observation show that DIDSON has a potential of equipment for hydrothermal flow observation.

We performed a tank experiment so that we will have acoustic images of water flow under the control of flow rate. The purposes of the tank experiment were to delineate water flow images in the tank and to get clue to estimate the volume of the water flow.

Water was heated in the hot tub and pumped to the water tank through the silicon tube. We observed water flows discharging from the tip of the tube with DIDSON. Flow rate had been controlled and temperatures of the discharging water and background water had been measured. The proposed method to observe and measure hydrothermal flow is the one to utilize a sheet-like acoustic beam. Scanning with concentrated acoustic beam gives distances to the edges of the hydrothermal flows. And then, the shapes of the flows can be identified even in low and zero visibility conditions.

Preliminary result of the tank experiment showed that 3D images of water flows in the tank could be reconstructed with the proposed method. We have been trying to estimate the volumes of water flows based on the reconstructed images, on the assumption that the water flows were in a constant state of movement.

We will report the overview of the tank experiment and proposed observation method in this presentation.

Keywords: seafloor hydrothermal flow, acoustic video camera