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Trophic structure of planktonic community in hydrothermal vent field based on stable isotopes

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Primary production in marine ecosystems is through photosynthesis in the euphotic zone and chemosynthesis in the deeper zones. While the productivity due to chemosynthesis in the global ocean is less than that of photosynthesis, local productivity from chemical energy from sub-seafloor fluid flux may provide a significant amount of organic matter into deep-sea ecosystems. Hydrothermal systems in deep-sea areas can be powerful primary production sites, usually dominated by chemolithoautotrophic prokaryotes. The plume from a hydrothermal vent contains many potential sources of metabolic energy, e.g. hydrogen, methane, sulfur compounds, and iron. The primary production in the plume occurs mainly in the early stage of plume evolution, and then gradually spreads into the surrounding ecosystem. The planktonic community of hydrothermal vent fields, presumably is able to use at least some of the organic matter in the plume, and could therefore play a role in connecting the chemosynthesis-based and photosynthesis-based food chains in marine ecosystems.

To estimate the trophic dependence of plankton on the chemosynthetic products provided by hydrothermal vent plumes, research cruises to hydrothermal vent fields on the Indian Ocean Ridge (KH10-06), Izena Hole (KT10-24), Myojin-sho Caldera (KT11-29), and the Iheya North Knoll (KT12-07, NT12-27) were carried out and samples were collected. The samples were collected by plankton nets (MTD, VMPS, ORI) and/or an in-situ large volume pump-filtration system (WTS-LV 30, McLane Ltd.), and were preserved in a freezer (-30oC) until analysis. Nine samples of from the pump-filtration system and 167 samples of net-caught zooplankton, containing carnivores, filter-feeders, fish and jellies, were preserved for this study. After pre-analysis processing by freeze-drying, lyophilization and decarbonating, the stable isotope ratios of carbon and nitrogen in the samples were determined by the laboratory of the Japan Chemical Analysis Center using a Delta V advantage isotope ratio mass spectrometer coupled with an elemental analyzer via ConFlo IV interface.

The stable isotope ratios of nitrogen and carbon were analyzed with respect to the depth, site, and organism type to characterize the trophic structure of the planktonic communities at hydrothermal vent fields. In this presentation we will discuss trends seen in the trophic structure of communities at the research sites and consider the influence played by the surrounding environmental, geochemical and microbial conditions.

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Keywords: hydrothermal vent, trophic structure, stable isotope ecology, plankton