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The relationship between deep current and material circulation in Toyama Bay using nitrogen and carbon isotopes

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In Toyama area, large volumes of river water flow into Toyama Bay because of the steep slope from the mountains to the coast coupled with high precipitation. This phenomenon generates submarine groundwater discharge, which ranges widely on the steep continental shelf.
During a research cruise of the submersible SHINKAI 2K in 2001, mega-colonies of Megalodicopia hians (a predatory tunicate) were found in Toyama Bay and reported for the first time in the world. The colonies favored deep current for habitat because of associated high nutrient supply there in (Zhang 2008). This study investigates the food chain between Megalodicopia hians and zooplankton, in an effort to understand the formation of the mega-colonies and their relationship to the deep current.

On the 12th and 13th of September 2009, sixteen samples of the Megalodicopia hians were collected by ROV Hyper-Dolphin during cruise NT09-16 offshore Nanao Bay, and 8 samples were collected from the city of Uozu by netting of a local fisherman in 2008 and 2009. Zooplanktons ware collected monthly at the Nyuzen deep sea water plant by netting in 2008 and 2009. Other zooplankton was collected at different water depths from several stations in Toyama Bay in 2009. All these samples collected were analyzed for the stable isotope ratios of carbon and nitrogen. Moreover, videos from the dive of ROV Hyper-Dolphin during cruise NT09-16 were analyzed for formation of colonies, as a function of longitude, latitude, depth, landform, Megalodicopia hians bodies and directions of incurrent siphon.

From dive No.1045 of cruise NT09-16, a new colony of Megalodicopia hians was discovered at the Nanao site (in northwest Toyama Bay). For distribution of Megalodicopia hians, the dive video indicated that more than 1600 individuals lived along outcrops of a cliff, and it is found that the distribution style does not differ with the findings of Zhang (2008). The video from dive No.1047, revealed that the Megalodicopia hians preyed on copepods. From nitrogen and carbon isotopes results of Megalodicopia hians, samples from the Uozu site showed ranges in carbon and nitrogen of -19.0 permil to -18.3 permil and 12.7 permil to 13.2 permil, respectively. Samples from the Nanao site showed ranges in delta-13C and delta-15N of -19.3 permil to -18.9 permil and 11.6 permil to 12.0 permil, respectively. From a plot of delta-13C and delta-15N, each group of Megalodicopia hians clustered at specific point. The data suggest that there is continuous nutrient supply. Moreover, the corresponding zooplanktons data plotted below Megalodicopia hians as a function of nitrogen content.

Keywords: nitrogen and carbon isotope ratios, Toyama Bay, deep current, material circulation, predatory tunicate, zooplankton