学 位 論 文 内 容 の 要 旨

博士（環境科学）

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学 位 論 文 題 名

Factors for controlling stable isotopic composition of amino acids of marine organisms: Implication to aquatic ecosystem studies

（海洋生物に含まれるアミノ酸の安定同位体比を変化させる要因の解明）

Marine ecosystems have been damaged by human activities, including the extinction of organisms by overfishing, the concentration of pollutants by biomagnification, and the acidification of ocean by CO_2 emission. For the Ph.D. study, we mainly focus on biomagnification and ocean acidification. Trophic position (TP) of organisms is a factor for determining biomagnification. However, there is an issue on the determination in previous studies, because calculation of the TP of organisms is challenging. Also, energy consumption of organisms is a factor for estimating the effect of ocean acidification. However, there is an issue on the estimation, because evaluation of the energy consumption is challenging. Compound-specific isotope analysis of amino acids (CSIA-AA) is one of potential powerful tools for solving these two issues through this analysis allows us accurately to calculate TP and evaluate energy consumption of organisms in environments.

1. Calculation of TP

Since 2009, CSIA-AA has been used to calculate TP of organisms in natural ecosystems. However, little is known the applicability of CSIA-AA for calculating TP of organisms in complex ecosystems with multiple nitrogen sources. In this study, we chose Sagami Bay, where is affected by Kuroshio Current, agriculture fertilization, and industrial nitrogen, as a site for the three following objectives: charactering food web structure for fish communities, comparing nitrogen isotope ratios ($\delta^{15}N$) between tissue types, and illustrating isoscape map of coastal areas. The results suggest that: 1) CSIA-AA is useful for calculating TP of organisms even in complex ecosystems; 2) scale, fin, shell, and yolk can be used as alternative samples to muscle in CSIA-AA, but other tissues (e.g., blood and bone) cannot; and 3) isoscape map illustrated clearly views variation in the $\delta^{15}N$ value of primary producers in the coastal areas. These studies thus further clarify how to apply CSIA-AA for the accurate calculation of TP of organisms in natural ecosystems.

2. Evaluation of energy consumption

The CO_2 released from the industrially decreases ocean pH by 0.1 during the last two century and will further by 0.2-0.3 at the end of 21 century (IPCC, 2007). In the low pH, organisms may receive stresses and therefore change energy consumption in the life. However, little is known whether or not the energy consumption of organisms changes with pH of seawater. In this study, we reared two fish in pH8.1 or pH7.3 for five months and measured the $\Delta\delta^{15}N$ ($\Delta\delta^{15}N = \delta^{15}N_{consumer} - \delta^{15}N_{diet}$) values of amino acids in these fish for evaluating the energy consumption. The results suggest that the energy consumption in pH7.3 is lower than that in pH8.1. This study firstly reveals that, in the end of energy consumption, acidified seawater shows apparently positive effect to fish compared to modern seawater (pH8.1).