Form 3

Annual Report

LaMer, Ehime University

Date (15 , March , 2017)

To Director of LaMer

Principle Investigator:

Affiliation Institut de recherche pour le développement

Position __Research Scientist___

Name in print ___DAVID POINT __ __ __

Include the report on the result of the project/meeting in a separate sheet.

1. Project / Meeting title

Source identification of ocean methylmercury incorporated into pelagic fishes using advanced compound specific stable isotope analyses

2. Members of project / meeting

Name	Affiliation	Position	Contribution part
PI	Institut de recherche pour le développement	Research Scientist	Research coordinator
LaMer Faculty member in charge	Takaaki Itai Tatsuya Kunisue	Senior Researcher Professor	Stable isotope analysis Sample coordinator

Source identification of ocean methylmercury incorporated into pelagic fishes using advanced compound specific stable isotope analyses

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Mercury (Hg) level in tuna is a valuable bioindicator of marine methylmercury (MeHg) since >90% of total Hg (THg) is in the form of MeHg. Application of Hg stable isotope to tuna highlight the potential of this tool as a unique geochemical tracer of MeHg. Recently, we have developed analytical method of carbon and mercury isotope ratio of methylmercury (Masbou et al., 2015). Application of this method for variety of tuna samples which show different ecological pattern should advances our understanding of MeHg dynamics in ocean. However, interpretation of stable isotope data in highly migratory species is still a matter of debate. In this fiscal year, we utilized LaMer funding to measure carbon and nitrogen stable isotope ratio to select suitable samples to be applied compounds specific isotope analysis. All samples used in this survey which had been archived in environmental specimen Bank, Ehime University were plotted on the map (Fig. 1). Bigeye tuna (n=9), yellowfin tuna (n=14), albacore (n=20), and skipjack tuna (n=63) collected from Pacific and Indian Ocean were selected. Muscle tissue of these samples were freeze dried then homogenized. Powdered samples were sent to Isotope Research Institute, Inc. to measure carbon and nitrogen stable isotope ratio.

The $\delta^{13}C$ were varied from -19.5 to -16.1‰. In northern hemisphere, there are the decreasing trends from north toward the equator for all species (Fig. 2). This is consistent with the global latitudinal trend of $\delta^{13}C_{POC}$ (Fig. 3, Tagliabue et al., 2008). Higher $\delta^{13}C$ of bigeye and yellowfin tunas in Indian Ocean than Pacific Ocean is also consistent with global model. However, comparing within same latitude, intra-species differences were observed. The order of $\delta^{13}C$ was as following order: skipjack > yellowfin = albacore > bigeye tuna. This is likely attributed to the distance from the coast. Most of the samples of skipjack and yellowfin tuna were collected from coastal ocean, while albacore and bigeye tuna were from open ocean. Generally, $\delta^{13}C$ elevates with increasing contribution of terrestrial and benthic carbons (France, 1995; Simenstad & Wissmar, 1985). Hence, $\delta^{13}C$ in tuna likely retains isotope signal of carbon source around sampling location. According to the bioenergetic model, rates of carbon turnover in fish muscle is negatively proportional to the fish size [$\log(\lambda) = -3.65 - 0.20 \log(\text{mass})$, where λ is turnover rates (Weidel et al., 2011)]. Applying this equation, average turnover rates of bigeye (mean: 29.3 kg), yellowfin (mean: 26.3 kg), albacore (mean: 23.9 kg), and skipjack tuna (mean: 2.80 kg) were 208, 204, 200, and 130 days, respectively. This means, isotope signal in muscle of tuna reflects integrated signal of past several months to year before caught. This limitation has to be taken into account to interpret the isotope data. Nevertheless, our dataset implies $\delta^{13}C$ reflect, at least partly, recent isotope signal before catching. The experimental study for farmed bluefin tuna examining temporal trend of the Hg stable isotope ratio after diet shift indicated that half-life of $\Delta^{199}Hg$ was similar to the carbon turnover rate (Kwon et al., 2016). Considering the geographical variation of carbon stable isotope, these samples are suitable to use for analysis of C and Hg stable isotopes in methylmercury.

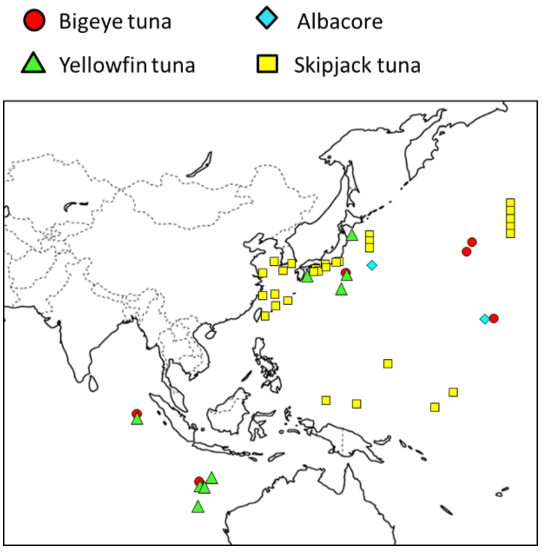

Fig. 1 The map of the distribution of tuna samples.

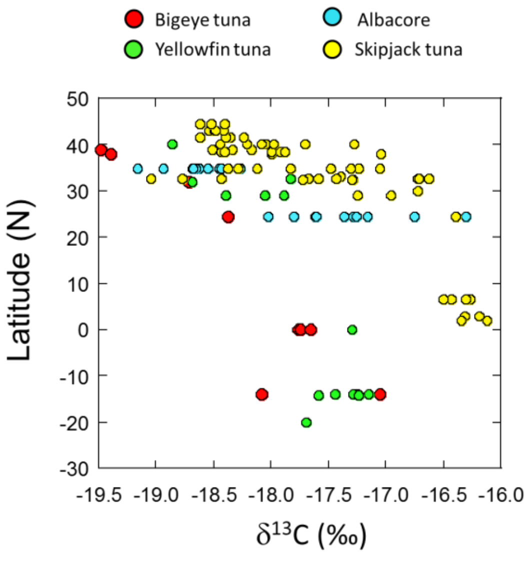

Fig. 2 Latitudinal trend of $\delta^{13}C$ in tuna species.

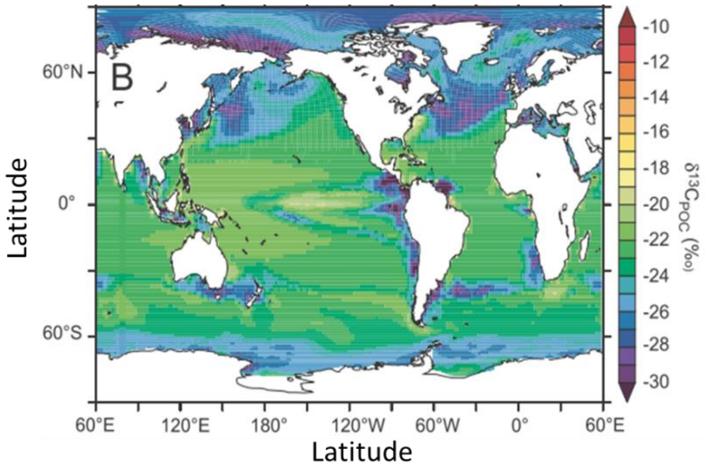

Fig. 3 The modeled annually averaged distribution of $\delta^{13}C_{POC}$ (‰) in surface waters by Tabliabue et al. (2008, Fig. 2b)

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