



# Mercury (Hg) Isotopic Variations of Fishes from Coastal, Marginal, and Pelagic Marine Ecosystems within Exclusive Economic Zone (EEZ) of Japan

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## Introduction

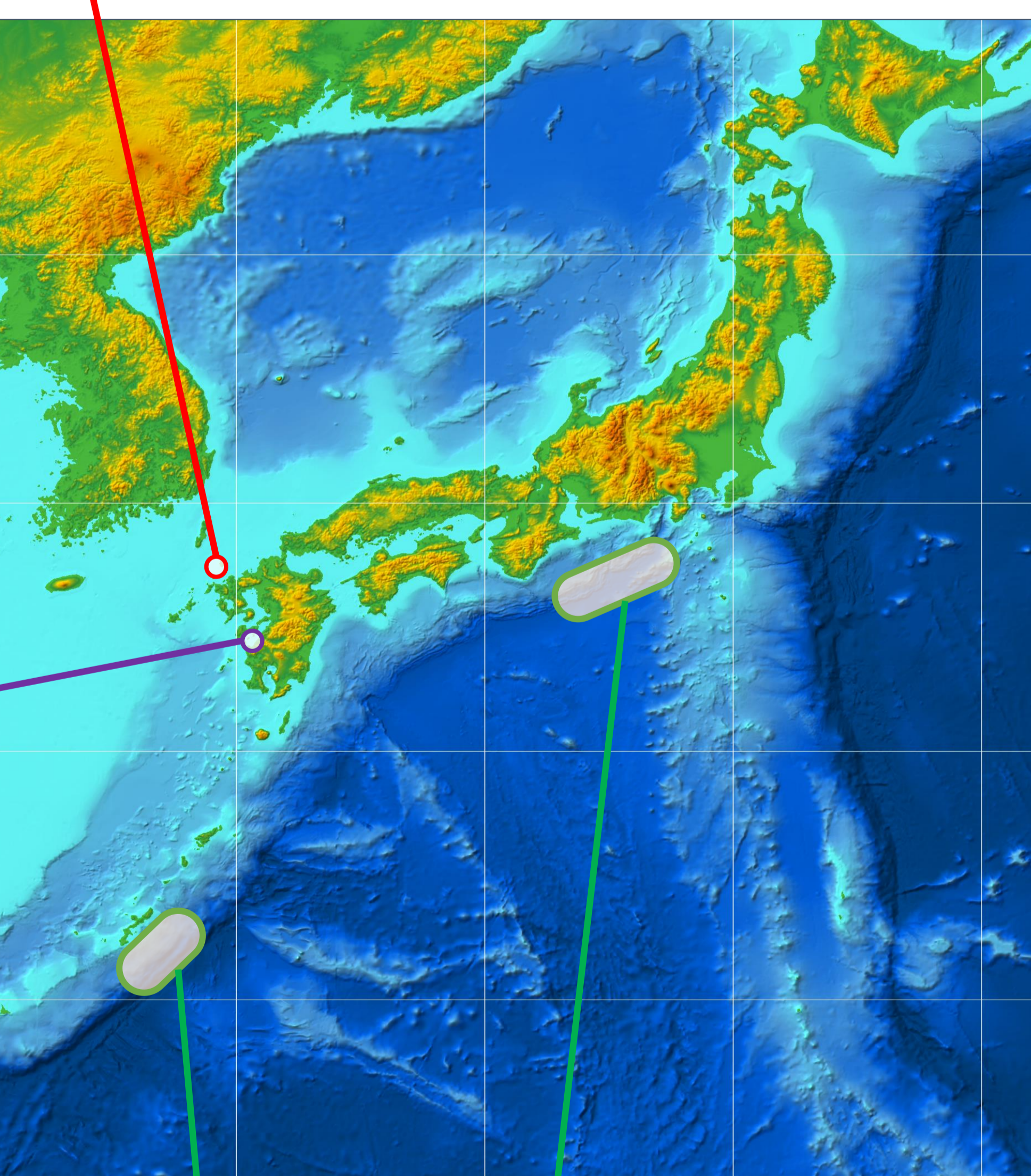
Mercury (Hg), a potent harmful trace metal, is a global pollutant and present in all environmental compartment. A large amount of Hg presents in the global ocean, and methylated form of mercury (MeHg), a highly toxic compound, can be bioaccumulated and biomagnified in marine food chains. Fishes are important protein sources in human and wildlife diets worldwide, and consumption of them can pose human and ecological health risks. In this study, Hg isotopic compositions of various fishes within exclusive economic zone of Japan were measured to distinguish different biogeochemical processes and sources of bioaccumulating Hg in different marine environmental settings.

## Sampling Sites and Samples

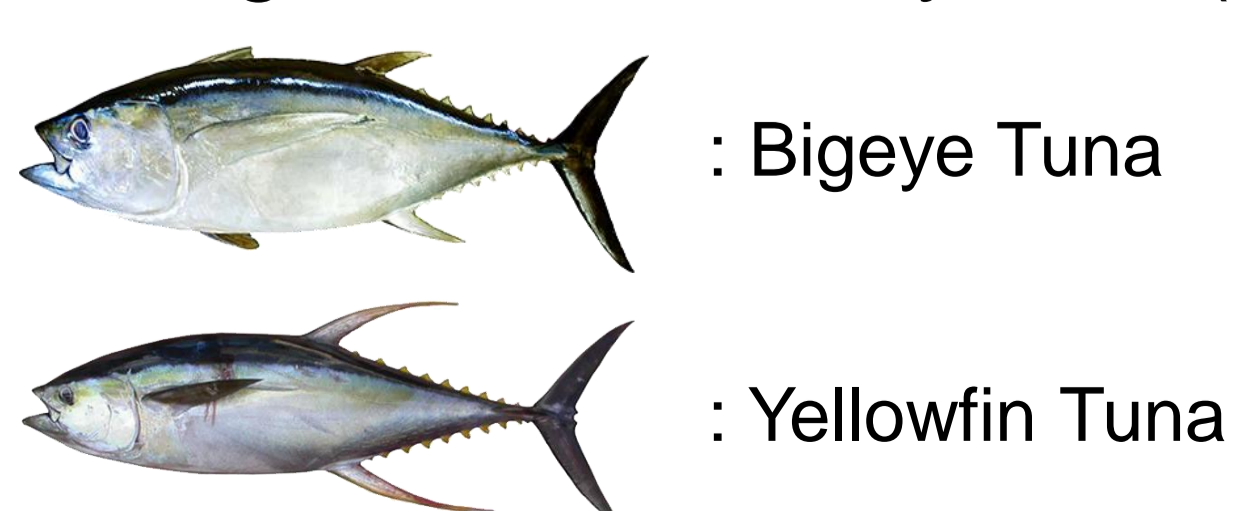
### Marginal Marine Ecosystem (Genkai Sea : < 150 m)



### Coastal Ecosystem (Minamata Bay : < 20 m)



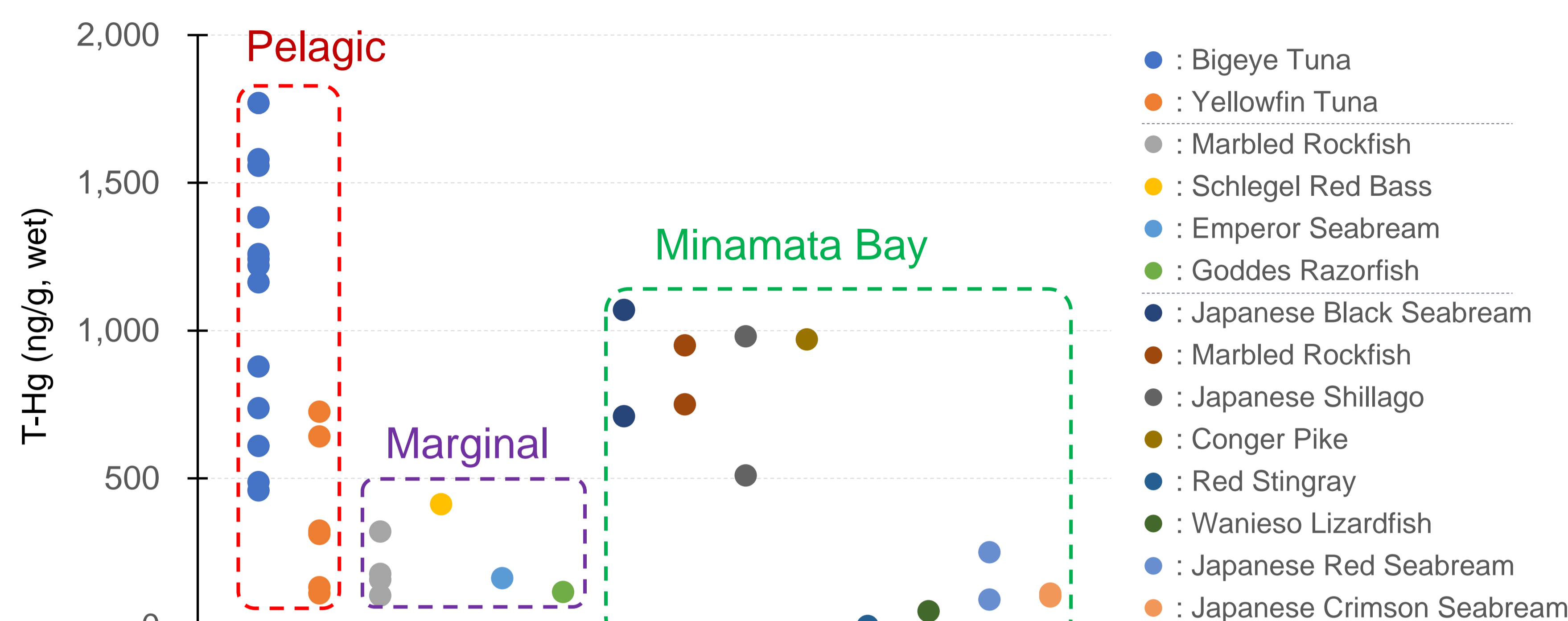
### Pelagic Marine Ecosystem (> 1,500 m)



• Approximately 3 – 5 g dorsal muscle of each sample was freeze-dried and pulverized.

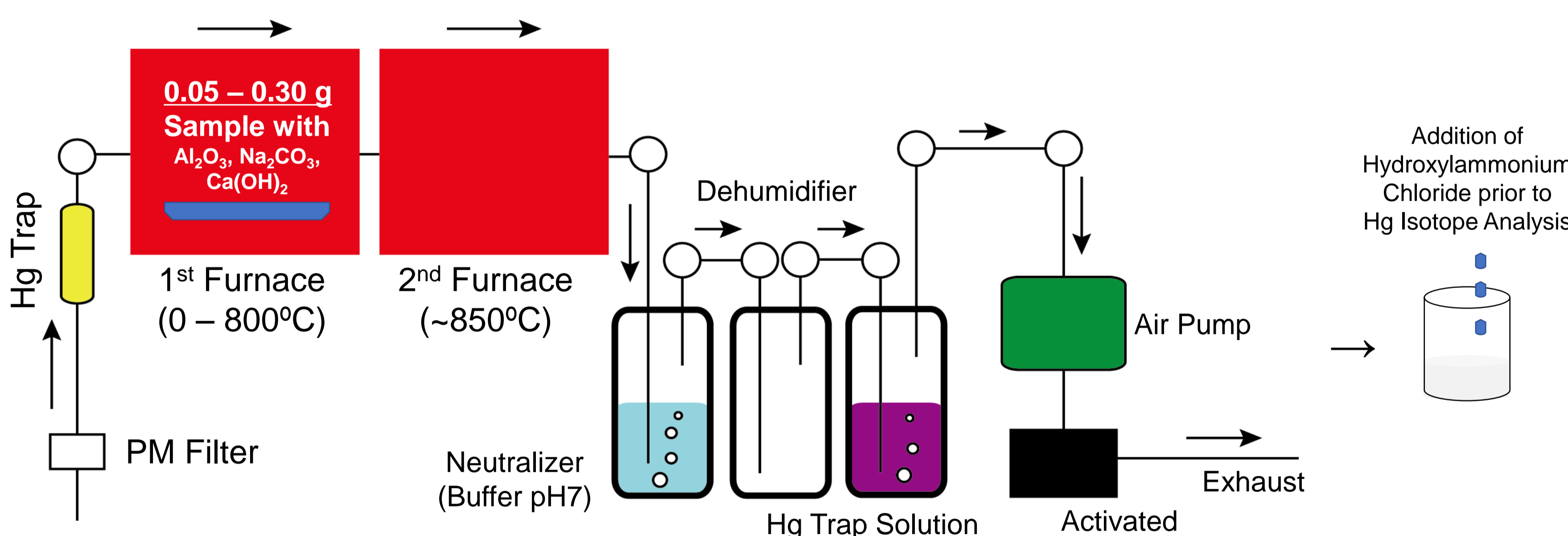
## Analytical Method

### 1. Total Hg (T-Hg) concentrations were determined by TD-AAS.



- Bigeye tuna T-Hg concentrations were the highest among all the species in this study, and they were higher than yellowfin tuna T-Hg concentrations associated with their foraging on deep water carnivorous fish.
- Some species from the coastal Minamata bay ecosystem were higher than the others in the same ecosystem and species from the marginal setting. Ones with the relatively high T-Hg concentrations tend to be carnivorous at relatively higher trophic position.

### 2. Thermal Decomposition & Hg Pre-concentration for Hg Isotope Analysis



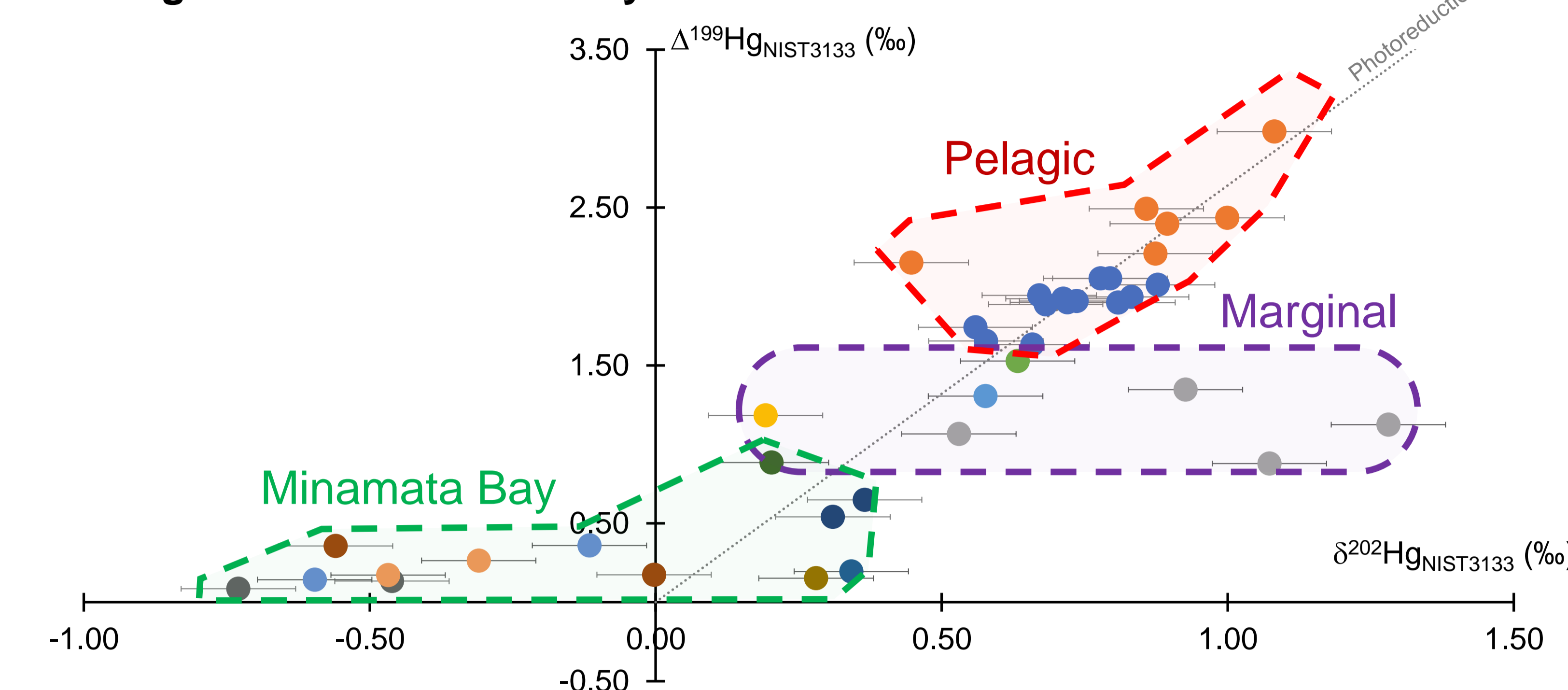
### 3. Hg Isotope Analysis & QAQC by CV-MC-ICPMS at NIES, Japan



Sample	Type	$\delta^{202}\text{Hg}$ (‰)	$\Delta^{199}\text{Hg}$ (‰)	Reference / Suggested Values
UM-Almaden (n = 6)	Hg STD Solution	-0.53 ± 0.06	-0.02 ± 0.04	$\delta^{202}\text{Hg}$ : -0.56 ± 0.03 $\Delta^{199}\text{Hg}$ : -0.03 ± 0.02 (NIST RM 8610)
ERM CE-464 (n = 3)	Fish Protein	0.71 ± 0.01	2.34 ± 0.04	$\delta^{202}\text{Hg}$ : 0.68 ± 0.06 $\Delta^{199}\text{Hg}$ : 2.21 ± 0.04 (Hintelmann, 2012)
NRCC DORM-4 (n = 4)	Fish Protein	0.46 ± 0.03	1.73 ± 0.07	$\delta^{202}\text{Hg}$ : 0.47 ± 0.03 $\Delta^{199}\text{Hg}$ : 1.80 ± 0.05 (Balogh et al., 2015)
NIST 1944 (n = 6)	Waterway Sediment	-0.43 ± 0.02	0.01 ± 0.02	$\delta^{202}\text{Hg}$ : -0.42 ± 0.07 $\Delta^{199}\text{Hg}$ : -0.02 ± 0.01 (Biswa et al., 2008)

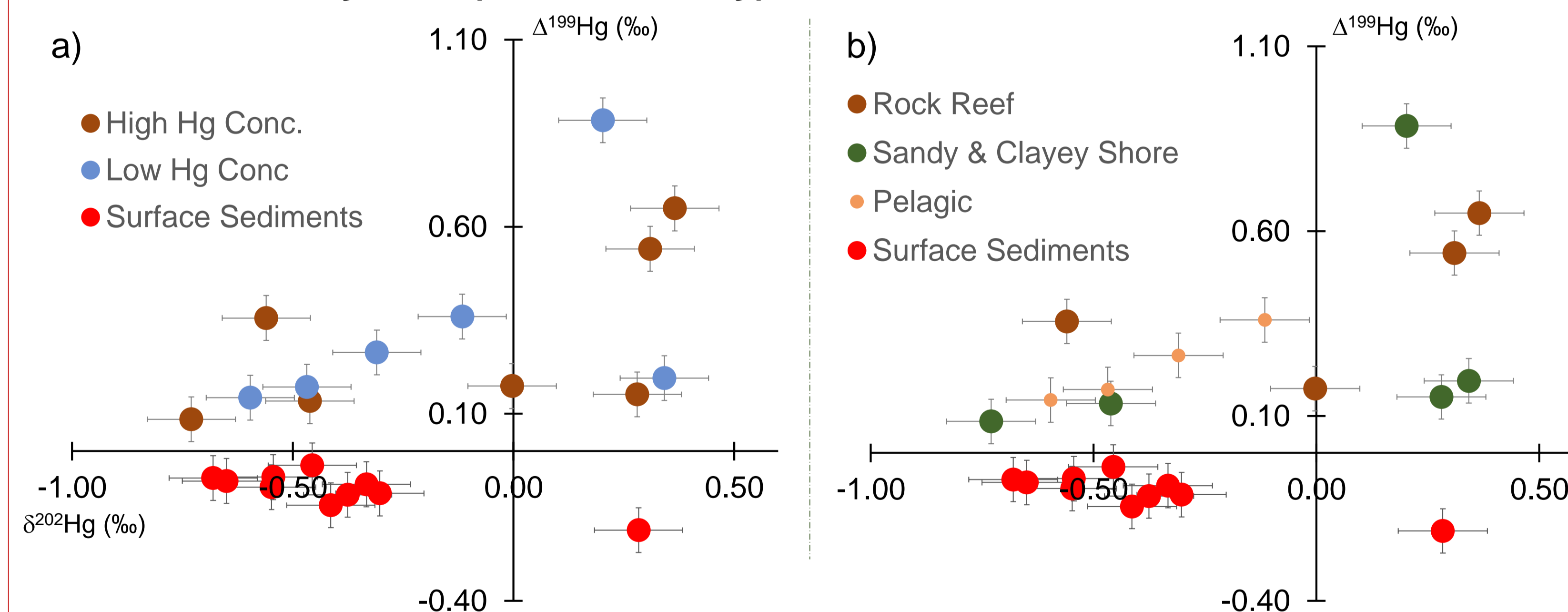
## Results & Discussion

### 1. Hg isotope variations as a result of different reducing processes of methyl-Hg among the three marine ecosystems.



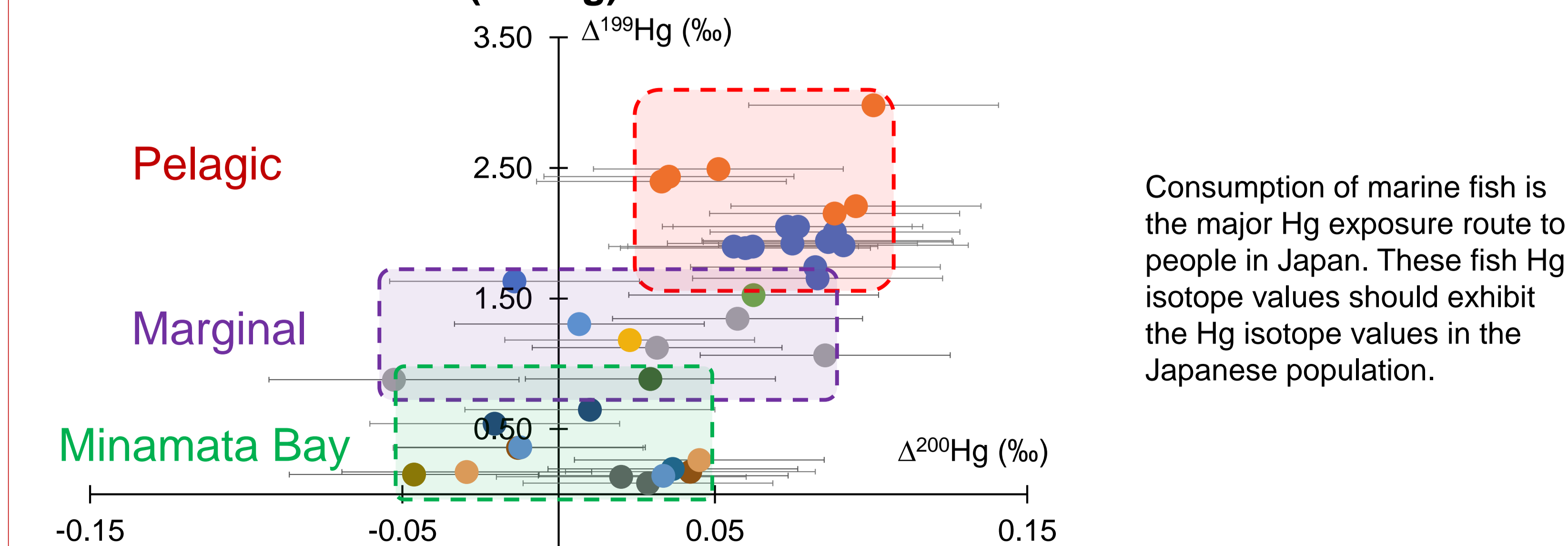
- The greater degree of photoreduced methyl-Hg is bioaccumulated in the pelagic ecosystem.
- Degree of photoreduction increases with increasing the general water depth in the ecosystems.

### 2. Hg isotope ratios are not correlated to a) T-Hg Conc. and b) Habitats in the Coastal Ecosystem (Minamata Bay)



The Hg isotope ratios cannot rule out the Hg processes involving the different Hg concentrations.

### 3. Atmospheric Hg Input to Pelagic Marine Ecosystem Recorded in the Even-mass MIF ( $\Delta^{200}\text{Hg}$ )



Consumption of marine fish is the major Hg exposure route to people in Japan. These fish Hg isotope values should exhibit the Hg isotope values in the Japanese population.

Statistically significant  $\Delta^{200}\text{Hg}$  anomaly induced by photo-oxidation of atmospheric  $\text{Hg}^0$  is recorded in the only pelagic marine fish.