

Spatial distribution of Nd isotope ratio of seawater and its seasonality in Sendai Bay, Northeast Japan

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Nd isotope ratio has promise as a tracer of materials and animals in oceanic environments since Nd in seawater show wide isotopic variation in relation to places and water masses. (e.g., Lacan et al., 2012). However, its spatial and seasonal variation in the adjacent seas, where is the most active zone of fishery, is little examined. In this study, we measured Nd isotope ratio of seawater in Sendai bay, where is rich in fishery resources, aiming to reveal the degree of Nd isotopic variation. Seawater samples were taken from 10 m under the sea surface along a survey line drawn from a nearshore site (C1) to offshore site (C22) in July 2016, December 2016, April 2017, July 2017, and December 2017 (Fig. A). Deeper waters from 30 m, 50 m, and 100 m under the sea surface were also taken in July 2017 and December 2017 to draw vertical 2D profile. In addition, coastal water samples were periodically taken from alongshore 2 sites (“m” and “c” , Fig. A) near the mouth of Natori River in order to evaluate the Nd isotope ratio in terrestrial water and its temporal variation.

The results show that Nd isotope ratio of seawater in Sendai Bay varies widely from nearshore to offshore, and from surface to deeper layer, reflecting values of terrestrial water ($\epsilon_{Nd} = -2 \text{ --} +0.5$), Kuroshio Current ($\epsilon_{Nd} = \sim -6$) and Oyashio Current ($\epsilon_{Nd} = \sim -3$). Common trend among sampling periods is that, at the 10 m deep level, ϵ_{Nd} generally decreases from nearshore to offshore although it slightly increases at the most offshore site C22, at which seawater ϵ_{Nd} is close to that of Oyashio Current ($\epsilon_{Nd} = \sim -3$). In the vertical 2D profile, ϵ_{Nd} is high at nearshore surface layer and low at offshore deeper layer both in July and December of 2017 (Fig. B).

The range of spatial variation is wider in summer than in winter. In summer, ϵ_{Nd} of seawater ranges from -6 at the 100 m depth of C16 to -2 at the surface of C07, while it ranges from -5 at the 100 m depth of C16 to -3 at the surface of C07. Negative correlation of ϵ_{Nd} to salinity suggests that the high ϵ_{Nd} value in nearshore water derives from land water, while the low value in offshore deep water is from the Kuroshio Current in summer (Fig. C). On the other hand, in winter, except for seawater from 10 m depth of C01, salinity of all the other samples is high (>33.7) despite the generally high value of ϵ_{Nd} ($-4 \text{ --} -2$) (Fig. C). Oyashio Current is suggested to be prevailed in winter. In contrast with ϵ_{Nd} and salinity, $\delta^{18}O$ shows little variation spatially and temporally ranging from -0.6 to 0.1. Prominently slack mixing of Nd between different water masses compared to molecular of water is suggested to be the cause of wide variation in ϵ_{Nd} values.

キーワード：ネオジミウム同位体比、海水、海棲生物、海産物、黒潮、親潮

Keywords: Nd isotope ratio, seawater, marine animals, marine products, Kuroshio Current, Oyashio Current

