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REE Abundances and Nd Isotopic Ratios of Seawaters Around the Japanese Islands

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There are few, if any, available directly measured Nd isotopic data of Pacific seawaters. To understand how Nd behaves in the ocean circulation, we need more data on Nd isotopic ratios of the Pacific Ocean. This might be also a great help to reconstruct the palaeo-ocean circulation using the Pacific ferromanganese crusts. Here, we report the distribution of rare earth element (REE) abundances and Nd isotopic ratios of seawaters around the Japanese Islands and to understand the factors controlling such distribution. We have already reported the REE abundances and Nd isotopic ratios of seawaters from the stations in the Pacific Ocean (CM5), Okhotsk Sea (CM6) and Japan Sea (CM20) (Amakawa et al., 1999). We additionally analysed seawaters collected from three Pacific stations (LM2: 29º05'N, 142º51'E LM6: 34º11'N, 141º56'E LM9: 40º26'N, 144º30'E) along the Japan Trench and one Japan Sea station (CM19: 41 21'N, 137º20'E) near the Hokkaido Island. The REE abundances were determined using ICP-MS. The Nd isotopic ratios were determined using Finnigan MAT 262. The typical error for the Nd isotopic analysis was 0.2 to 0.4 in epsilon unit. Combined with previous data, it is revealed that the Pacific surface seawaters show a wider range in ε_{Nd} values (-5.6 ~ -2.2) compared with those of Japan Sea (-8.9 ~ -7.2). The variation in the surface Pacific Nd isotopic data seems to be due to the two major Currents with distinctive ε_{Nd} values, i.e., Kuroshio (ε_{Nd} <-4) and Oyashio (ε_{Nd} >-4). One Pacific station (40ºN, 145 ºE) was repeatedly occupied in 4 years interval, i.e., LM9 and CM22. The ε_{Nd} values of LM9 and CM22 show -4 and -4.9, respectively, which implies the temporal difference in mixing ratio of the Kuroshio to Oyashio in the station. This is also supported by the difference in REE patterns of surface seawaters of them. Two Nd isotopic depth profiles of the Japan Sea stations (CM19 and CM20) show quite different surface ε_{Nd} values (-8.9 and -7.2). However, below surface, they show almost identical profiles with relatively constant values (~-7). This fact suggests that the deep water of the Japan Sea close to the Japanese Islands is well mixed for Nd isotopic ratio. It should be noted that the depth profiles of Nd abundance are quite different for these stations. We deduce that the isotopically homogenized Nd is redistributed to the deep water masses of the Japan Sea. The range in ε_{Nd} values of the Pacific stations are as follows: LM2: -6.2 ~ -3.7, LM6: -6.2 ~ -3.8, LM9: -5.7 ~ -3.5. The most of the data show lower values compared with the previous North Pacific data reported by Piepgras and Jacobsen (1988) (-5.0 ~ -0.1) and Amakawa et al. (1999) (-3.9 ~ -1.9). However, LM2 and LM6 stations, which are prevailed by the Kuroshio Current, show some shift (~+1 in ε_{Nd} unit) in the depth profiles of ε_{Nd} values at ~1000 m. This feature is also observed for the data at the TPS 24 271-1 (24 17'N, 150 28'E) reported by Piepgras and Jacobsen. So, in the Kuroshio prevailed oceanic region, it seems likely that the water mass with high ε_{Nd} value can be found below the North Pacific Intermediate Water (NPIW). This water mass cannot be identified by the θ-S diagram. For all LM sites, shifts in ε_{Nd} values are also observed at the depth of 4000m. This seems to due to the limited water exchange between open ocean (depth above 4000m) and in the trench (depth below 4000m). This also implies that the flux from the slope of the trench might operate for determining the Nd isotopic distribution within in the trench.

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