

Spatial distribution of oxygen and hydrogen isotope ratios of seawater in the nascent Kuroshio of Lamon Bay

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The vertical and horizontal variations of oxygen ($\delta^{18}\text{O}$) and hydrogen ($\delta^2\text{H}$) isotopic composition of seawater were investigated in Lamon Bay and offshore waters, east of Luzon Island (14° - 19°N , 122° - 126°E ; Fig. 1a) during a research cruise of the R/V Roger Revelle in April/May 2012. The $\delta^{18}\text{O}$ increased with depth from the surface, reaching a maximum of +1.5‰ to +2.0‰ at the salinity maximum of North Pacific Tropical Water between 100 m and 200 m. Then, the $\delta^{18}\text{O}$ decreased toward the salinity minimum of North Pacific Intermediate Water near a depth of 500 m. Below this salinity minimum, the $\delta^{18}\text{O}$ remained within a narrow range between -1‰ and 0‰ to 4,000 m. The $\delta^{18}\text{O}$ of surface water showed a spatial gradient from the nearshore (southwest) area of the Bay (-0.3‰) to the offshore (northeast) waters (+0.6‰) and significantly correlated to the salinity ($p < 0.0001$; Fig. 1b), reflecting influence of freshwater input from the Island. By linear regression, the $\delta^{18}\text{O}$ of freshwaters supplied to Lamon Bay could be estimated to be around -5.3‰, which is consistent with the riverwater $\delta^{18}\text{O}$ found in the central Philippines. Variation of the $\delta^2\text{H}$ followed similar patterns as observed for $\delta^{18}\text{O}$, although relatively high $\delta^2\text{H}$ values compared to $\delta^{18}\text{O}$ were recorded in surface waters of nearshore area, reflecting the deuterium excess of freshwater supplied from the land. The $\delta^{18}\text{O}$ and the salinity were distinctly lower in the cyclonic dipole (see Gordon et al., 2014), corresponding to the part of Lamon Bay between the nascent Kuroshio and Luzon Island. The average pH in this area (8.114 ± 0.007) was also significantly ($p < 0.003$) lower than the other parts of the observed area (8.125-8.134; Fig. 1c). This spatial trend implies that the extent of freshwater inflow including lowered pH on Lamon Bay and offshore waters is constrained by the flow path of the nascent Kuroshio and its feeder current. On the other hand, the average pH of the nascent Kuroshio was slightly higher than the feeder current and the anticyclonic dipole waters (8.134 vs. 8.126, $p = 0.0329$), which suggests unexplored biogeochemical process that keeps pH in the Kuroshio high relative to that of the freshwater input.

Keywords: oxygen isotope ratio of seawater, vertical structure, freshwater input, pH, Lamon Bay

