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Quantifying mesoscale isopycnal/diapycnal water mixing processes in the subtropical North Pacific and marginal seas using multiple trace elements and isotopes: Water composition and material exchange influenced by turbulence and eddy

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Mesoscale physical processes significantly affect material/energy exchange and contribute to CO_2 adsorption during primary production via diapycnal/isopycnal water mixing. These processes are widely present in the subtropical North Pacific and marginal seas. However, quantitative analysis based on multiple temporal-integrated chemical tracers was limited, though some trace elements have been reported as useful tracers. This study mainly focuses on the quantification of water composition and material exchange influenced by turbulent mixing and mesoscale eddies in the subtropical North Pacific and marginal seas. Data and seawater samples were collected from two GEOTRACES cruises (GP09 and GPpr15) and two research cruises (NN464 and KH-17-5).

(1) Subtropical mode water (STMW) plays a pivotal role in material exchange in the western Pacific boundary current area (WPBCA) and its distribution was influenced by turbulent mixing, which blurs the 'mode' of STMW and limits its observation. In this study, STMW-derived water (STMW*) was identified in a certain layer (σ_θ ~ 25.2-25.8 kg m^{-3}) by ^{137}Cs. Two different mixing strengths were quantified during the advection of STMW* from the North Pacific to the WPBCA. The results suggested a significant decrease in the STMW* signature (< 50%) in the layer of Luzon Strait, confirming strong vertical mixing due to topographic constraint. In contrast, in the same layer of Tsushima Strait, 57%±20% of the water comes from the STMW* of subtropical gyre, indicating weak mixing during the long-path transport.

(2) Based on two GEOTRACES cruises in spring and summer, effect of eddies was identified and nutrient contribution through diapycnal/isopycnal mixing was quantified by rare earth elements. Results show that (i) the North Equatorial Current is the dominated source of water (25%–91%), with Equatorial water (0–33%) and northern NPSG water (0–43%) partially influencing the water composition; (ii) although vertical mixing only explains an average of 8% of the water, the mean vertical fluxes of dissolved inorganic nitrogen were estimated as half of the total nitrogen supply at the eddy-affected stations, suggesting that vertical supply may be important for biological processes in the bottom euphotic layer.