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Strontium isotopic (87Sr/86Sr, 87Sr/86Sr* and δ88/86Sr) variations in North Pacific

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Non-traditional stable strontium (Sr) isotope has been used as a new geochemical tracer to better constrain the oceanic Sr budget. In this study, we present a modified EEN (Empirical External Normalization) technique to improve the analytical precision of Sr isotopic ratios using MC-ICP-MS and further apply to analyze the 87Sr/86Sr, 87Sr/86Sr* and δ88/86Sr distribution in seawater profiles collected from North Pacific. The long-term external reproducibility of δ87/86Sr* and δ88/86Sr in our laboratory is better than $\pm$0.040 ‰ and $\pm$0.018 ‰ (2SD), respectively, which is about 2-fold improvement compared with published data by EEN technique. The IAPSO (OSIL) standard seawater was used as a reference standard and the obtained absolute isotope ratios of 0.709169 $\pm$ 0.000029, 0.709295 $\pm$ 0.000041 (2SD, n= 5) and 0.374 $\pm$ 0.025 ‰ (2σ, n=5) for 87Sr/86Sr, 87Sr/86Sr* and δ88/86Sr, respectively, were in good agreement with certified or published values. Several seawater profiles were selected to determine the Sr isotopic compositions near 0°N to 22°N, 158°W in the North Pacific. Slightly enriched δ87/86Sr* (+0.07$\sim$ 0.09 ‰ and δ88/86Sr (+0.06$\sim$ 0.07 ‰ in the surface (<200 m) and intermediate ($\sim$600 m) depths were observed. These T-S characteristics in seawaters suggest that the positive anomaly in δ87/86Sr* and δ88/86Sr were associated with the North Pacific Intermediate Water (NPIW). No detectable variation was found in the water mass at 1500-4000 m, but the 4500 m sample near the 8°N station showed slightly radiogenic 87Sr/86Sr and 87Sr/86Sr* ratios, probably due to seafloor alteration. Our preliminary results support that both stable and radiogenic Sr isotopes can be used as sensitive fingerprints for studying water mass exchange in the ocean. However, more detailed investigations on controlling mechanisms of Sr isotopic fractionation are necessary for future verification and utilization of this novel tracer.