Vertical profiles of Cerium and Neodymium Isotopic compositions and REEs pattern in the Ross Sea

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This study determined the $^{138}Ce/^{142}Ce$ ratio in the Ross Sea. The $^{138}Ce/^{142}Ce$ data, together with $^{143}Nd/^{144}Nd$ data, are discussed in terms of rare earth elements (REE) source and the fractionation between Ce and Nd in the marine environment. Natural variation of 143Nd/144Nd occurs between continental crust and mantle-like materials, which was used to constrain the source of REE and mixing within the ocean. Likewise, the $^{138}Ce/^{142}Ce$ ratio is expected as a powerful tool to constrain the source of cerium which is crustal-abundant but one of the trace elements in the ocean. In contrast to other trivalent REE such as Nd, which form stable carbonate complexes in seawater, only Ce is oxidized in oxic condition and easily removed by settling particles within the water column, which is reflected in the unique oceanic distributions of Ce concentration and its isotopic compositions.

By passing seawater through a MnO_2 fiber, Ce and Nd were collected during R/V Hakuho-Maru KH-04-5 in January 2005. For precise Ce isotopic measurement, other interfering REE, especially Pr, must be removed from Ce fraction. In this study, a new separation technique of Ce from other REE was developed by using a chelating resin column (Ln Resin; Eichrom Tech., Inc.). The REE fraction was passed through the Ln-Resin with potassium bromide solution in order to oxidized Ce and adsorb only Ce(IV) firmly onto the resin. By using mixture of hydrogen peroxide and hydrochloric acid, Ce was successfully eluted from the resin. Isotopic composition of Ce and Nd were measured with thermal ionization mass spectrometry (Thermo Finnigan MAT 262), respectively. By using thhis method, Ce isotope ratios in seawater were measured more precisely ($2\sigma_m$ = 0.4 - 0.7).

The isotope ratios of Ce were mostly continental-like and constant vales (ε_{Ce} = +1.4 ± 0.4) in the Ross Sea (SX-10; 67°13'S 172°39'W), which similar with those of Nd (ε_{Nd} = –8.9 ± 0.2) and REE patterns. Homogenous vertical profiles of Ce and Nd isotope ratios at SX-10 indicated that waster masses were well-mixed by deep water formation. Furthermore, hydrographic data indicates that bottom water (>2000 m) at SX-10 originate not from Antarctic Bottom Water (AABW) but from shelf water in the Ross Sea (Ross Sea Bottom Water: RSBW). Therefore, continental-like Ce isotopic composition in the bottom water at SX-10 reflects the averaged isotopic composition from the Antarctic continent.