

Comparing rare earth elements in the surface layers of ferromanganese crusts and ambient seawater from the Takuyo Daigo

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Hydrogenetic ferromanganese (Fe-Mn) crusts are strongly enriched relative to the Earth's lithosphere in many rare and precious metals, including Co, Te, Mo, Bi, Pt, W, Zr, Nb, Y, and rare earth elements (REEs) (e.g. Hein et al., 2013). Accumulation of these trace metals from seawater is generally controlled by sorption (Koschinsky and Halbach, 1995; Koschinsky and Hein, 2003). REEs, except for Ce, behave as a dissolved trivalent cation in seawater and concentrated in the solid phase by adsorption (Nakada et al., 2013). Although a set of REE concentrations in Fe-Mn crusts is frequently used as a proxy to distinguish formation processes (e.g. Usui and Someya, 1997; Hein et al., 2000), it is not certain if REE concentrations in Fe-Mn crusts are correlated to those in surrounding seawater. In order to verify the correlation, REE concentrations in the outermost surface of Fe-Mn crusts and the surrounding seawater were directly compared at various depths (957-2987 m) on the Takuyo Daigo Seamount. We normalized the REE concentrations in the outermost surface of Fe-Mn crusts with its formation age, as the relative age of Fe-Mn crusts can be determined using osmium isotopic ratio (e.g. Klemm et al., 2005; 2008). For measurement of REE concentrations in seawater, inductively coupled plasma mass spectrometry (ICP-MS) was applied and solid phase extraction (SPE) techniques using chelating resins were conducted as pretreatment (Zhu et al., 2013). In this study, we compare depth profiles of the normalized REE concentrations in the outermost surface of Fe-Mn crusts and the REE concentrations in surrounding seawater.

Keywords: ferromanganese crust, seawater, Os isotope, rare earth elements, geochemistry