Microstratigraphy of selected hydrogenetic ferromanganese crusts in the Northwest Pacific: Oceanographic and tectonic controls recorded as secular variations in microstructure, chemical and mineralogical compositions

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Hydrogenetic ferromanganese crusts are chemical sedimentary rocks composed mainly iron and manganese oxides and partly of detrital particles of various origins, and have continuously and widely precipitated on deep sea floors and rock outcrops for the last several million years at extremely slow growth rates of 1 to 10 mm/m.y. The crusts thus considered as condensed very long-term stratigraphic record of marine and geological environments in the region (e.g., Hein et al., 1992; Usui et al., 2017; Kisimoto et al., 2017).

Although the general distribution patterns of chemical and mineralogical compositions and growth rates is known in the Northwest Pacific, the secular variation trends among the crusts are not well understood. We describe microstructure, Be-10 age, chemical and mineralogical compositions of seven hydrogenetic ferromanganese crusts in the Northwest Pacific, to clarify the correlation of secular compositional and microstructural variations among the crusts. We attempt to correlate the regional and microstratigraphic variability with oceanographic and tectonic controls.

The Co/Mn ratio is clearly higher in the crusts from the Pacific Plate than from the Philippine Sea Plate, and the ratio increased from the past to the present among all crusts. Co is the most abundant redox-sensitive element derived from seawater that occurs in crusts, and is known to be concentrated within the Oxygen Minimum Zone (OMZ) (e.g., Usui et al., 2017). Our results suggest that the OMZ has been stronger in the Pacific Plate than in the Philippine Sea Plate, and that the OMZ has become stronger (or expanded) from the past to the present.

The phosphatized older growth generation (e.g., Halbach et al., 1989; Koschinsky et al., 1997) were found in the crusts from the Pacific Plate, but not in the crusts from the Philippine Sea Plate. This can be simply interpreted as the phosphate event ended before the Philippine Sea Plate expanded and the seafloor existed for the crusts to start growing.

Our results indicate that the chemical and mineralogical compositions of the crusts have changed over time, and some of these secular variation trends can correlated among the crusts, indicating significance of the crusts as chemical sedimentary rocks that record oceanographic and tectonic controls in the region.

Keywords: ferromanganese crust, Northwest Pacific, Oxygen Minimum Zone, phosphate, Be-10 age

