

GEOCHEMICAL AND ISOTOPIC INTERPRETATIONS OF
FERROMANGANESE CRUSTS FROM THE PACIFIC OCEAN

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ABSTRACT

The goal of my doctoral dissertation was to determine if variations in geochemistry in hydrogenous ferromanganese deposits are principally governed by basin-wide ocean chemistry at the time of formation, or if local phenomenon affecting seamounts at different time periods were the primary determinant of the heterogeneity within these deposits. To investigate the growth rates and absolute time-stratigraphy of marine hydrogenous ferromanganese encrustations, we performed ^{10}Be profiling and "Co-chronometry" of crustal layers, as well as $^{87}\text{Sr}/^{86}\text{Sr}$ in the ferromanganese-oxides and carbonate fluorapatite within some typical ferromanganese deposits from the Hawaiian Archipelago. These methods produced differences in interpretation which arise from these factors: the limitation of the ^{10}Be technique to the last 15 Myr; the susceptibility of Sr isotopes in the ferromanganese-oxides to exchange with Sr from seawater; the secondary placement of the carbonate fluorapatite within the crust; and the inability of "Co-chronometry" to detect hiatuses and erosional events. The method which proved to be most successful in determining a growth stratigraphy was the application of a $^{187}\text{Os}/^{186}\text{Os}$ curve similar to the $^{87}\text{Sr}/^{86}\text{Sr}$ curve, both of which have been applied to sediments.

The Os isotope results showed evidence for variations in growth rates and corroborated significant periods of non-deposition or erosion within a ferromanganese crust from Schumann Seamount. The initiation of ferromanganese deposition appears to pre-date the curve, 70 Myr, providing

evidence for ferromanganese deposition much earlier than previously reported.

The Os isotope-based chronology for this crust has implications for the origin and timing of observed platinum group element (PGE) enrichments.

Although there are several sources of the PGE into seawater including extraterrestrial, terrigenous, hydrothermal, hydrogenous, and a biological component, most of the Os concentration data from the ferromanganese crust indicate an hydrogenous source. The chronology shows that there is no increase in the PGE at the Cretaceous-Tertiary boundary, nor do the ratios of the PGE indicate a cosmic source. Instead, much of the PGE enrichment in sediment deposits may be in response to changing redox conditions with degradation of organic matter during early diagenesis, or related to O₂ minimum zone processes, rather than from a cosmogenic or volcanic source.