Processes that impact the composition of FeMn crusts from the Pacific Ocean and their use in refining permissive criteria

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Ferromanganese (FeMn) crusts are of interest and importance both as unique paleoceanographic archives of seawater chemistry and as potential resources for valuable and critical metals. However, FeMn crusts have a high degree of compositional heterogeneity across spatial and temporal scales, and detailed research is still needed to address the geographic and oceanographic controls on FeMn crust composition. This will allow FeMn crust research to shift from purely exploration-based studies to more targeted expeditions that can precisely locate FeMn crusts with the characteristics (i.e. thickness, composition, substrate type) of interest. Here we present analyses of the uppermost layer of FeMn crusts from a continuous meridional transect of seamounts in the western equatorial Pacific, including the statistically significant variance of major and trace element concentrations as well as element correlations with a variety of oceanographic and geographic parameters. Seawater oxygen concentration exhibits the greatest control over Mn concentrations in FeMn crusts analyzed here, whereas water depth predominantly determined Fe contents. Silicon and Al showed meridional variations that indicate varied sources. Fe, Ba, and Mg are enriched in FeMn crusts below the equatorial upwelling zone associated with high biological particle flux from the surface waters. This talk includes a case study of the compositional variability of FeMn crusts from the Tuvalu EEZ in the southern equatorial Pacific, which provides an example of how FeMn crusts collected from reconnaissance expeditions can determine oceanographic controls on crusts in that region and help define permissive areas for more targeted future exploration. The case study also exhibits how bulk crusts, which integrate crust composition over millions of years, and their correlations with oceanographic parameters compare with recent crust growth from the same region.