CENOZOIC PALEOCEANOGRAPHIC HISTORY DERIVED FROM FE-MN OXYHYDROXIDE CRUSTS

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Fe-Mn crusts precipitate from cold ambient seawater onto rock substrates on seamounts within the ocean basins. Crusts are condensed stratigraphic sections up to 25 cm thick, in which one mm represents 10(5) to 10(6) years, depending on growth rate. Crust composition reflects that of seawater at the time the metals precipitated. Crust textures and chemical composition reflect local to regional oceanic conditions, whereas their isotopic composition reflects regional to global oceanic conditions. Our ability to use crusts for paleoceanography depends on the accuracy of dating techniques, which include U-series isotopes for the outermost millimeters, Be isotopes for the outermost centimeters, and nannofossil biostratigraphy. Initiation of crust growth began as early as 60 Ma for the thickest crusts. Detailed sampling of crusts can yield resolutions of 3000 y, but more commonly resolutions are 10(5) to 10(6) years. Crusts store a variety of oceanic and depositional records including paleoseawater chemistry and isotopes, paleocirculation (isotopic tracers), paleowinds from incorporated eolian grains, paleoerosion rates of continents (isotopic tracers), history of hydrothermal input (isotopic and chemical tracers), paleo-pH and temperature (isotopic tracers), and history of extraterrestrial input (isotopic and chemical tracers). Tracers that have been used include Be, Nd, Pb, Hf, Os, Li, B, and U-series isotopes, and chemical tracers such as Ba, Co, and Pt. For example, deep-ocean circulation today is characterized by creation of deep water in the north Atlantic that has characteristic Pb, Nd, Be, and Hf isotopic compositions. That deep water travels south and then east into the Indian Ocean and finally farther east into the Pacific Ocean. The isotopic compositions of those elements change along that route, and temporal changes in the pattern of deep-water flow can then be mapped via isotopic signatures in crusts distributed globally.