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Cobalt-Rich Ferromanganese Crusts from Central Pacific

Ferromanganese crusts coat most hard-rock substrates on seamounts, ridges, and plateaus in the Central Pacific basin. Crusts from shallow water (< 2,500 m) are rich in the strategic and economically important metals manganese, cobalt, nickel, and platinum. We collected samples from the U.S. Exclusive Economic Zone surrounding the Hawaiian, Johnston, Palmyra, and Marshall Islands. Crust thicknesses are variable, Necker Ridge having the greatest average thickness of 4 cm. The dominant mineral in all crusts is δMnO_2 (vernadite); quartz, plagioclase, and apatite are minor phases. Substrate rocks are dominantly volcanic breccia, with lesser amounts of hyaloclastite, basalt, phosphorite, limestone, and volcanoclastic sandstone. Ferromanganese-encrusted volcanic breccias commonly show two or three stages of reworking. Sediment reworking either by gravity flow or bottom-current activity on the flanks of the submarine edifices partly controls the crust thicknesses by burial and dissolution, or by erosion, whereupon growth of the crusts begins again. Talus dredged from seamount slopes is coated with crusts half as thick as crusts on rocks recovered from nearby outcrops. Regional variations in crust chemistry and mineralogy can be related to various oceanographic and geologic conditions. For example, quartz content in the crusts varies with the zonal wind patterns and is eolian, whereas apatite is most common in crusts formed near zones of high biologic productivity. In the Line Islands, cobalt, nickel, and manganese increase and iron decreases with proximity to the equator in the outer layers of the crusts. Of the areas we studied, the Exclusive Economic Zones of Johnston Island and the Marshall Islands have the greatest economic potential.