

Geological characterization of cobalt-rich ferromanganese crusts using deep-sea drill cores from NW Pacific seamounts

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Abstract

Hydrogenetic ferromanganese crusts have been noted as being the most abundant and having the highest cobalt-grade in Northwestern Pacific seamounts based on earlier reconnaissance regional on-site observations and sampling in the 1980s and 1990s. However, the patterns of compositional variation on a small-scale and in a range of water depths are not yet well documented. We focused on a microstratigraphic characterization of drill cores of ferromanganese crusts taken at 4-5 km intervals over the seamounts since the areal and internal variation patterns are basically controlled by their growth history and geological environment. The camera-monitored drill machine (BMS) was operated at rock outcrops, after full coverage of multi-narrow beam topographic mapping over the seamounts in the mid-Pacific seamount area, which started to grow since the subsidence of volcanic edifice and carbonate reef. The topographic mapping and BMS sampling have clearly shown a small-scale variation in thickness of crusts (up to 120 mm) basically controlled by their age, lapse time of growth, and a correlated growth history within the crusts. Our geological model indicates that the crusts have accumulated with temporal variations in mineralogy and chemistry as integrated layers of hydrogenetic precipitates over millions of years. The substrate petrology and topography, which are closely related with the geological evolution and non-tectonic movement of the seabed. A fine-scale (in millimeter) compositional and structural variations are also described and correlated among several nice drill cores. Thus, geochemical and mineralogical descriptions of full drill cores of the crusts is most important for characterizing their patterns of compositional variations within the crusts and their regional variability.

Keywords: ferromanganese crust, deep-sea drill, geological model, north Pacific, seamount

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Dr. Akira Usui is a geology professor at Kochi University, Japan. He worked at the Geological Survey of Japan since 1980, mainly in the field of geology, geochemistry, and mineralogy of marine ferromanganese deposits. He has published many scientific papers and maps jointly with domestic and international colleagues, based on shipboard investigations with R/V *Hakurei-maru*, *Hakuho-maru*, *Sonne*, *Farnella*, *Moana-Wave*, *Natusima*, *Kaiyo*, *Yokosuka*, and submersibles *Shinkai 2K*, *6K*. He is on the editorial board of *Marine Geology* and is on the editorial board of *Marine Georesources and Geotechnonology*. He spent one year at the Scripps Institution of Oceanography, supervised by Prof. Gustaf Arrhenius. He served as the President of the International Marine Mineral Society for 2007-2008, and now is an Executive Board Member. He has been an invited principal scientist of JAMSTEC since 2011, and a member of technical advisory committee for JOGMEC committee for marine mineral exploration since 2010. His recent focus is to establish a geological growth model for hydrogenetic ferromanganese crusts in the NW Pacific seamounts based on exploration by ROVs and submersibles.