STATION MAPS OF THE WORLD OCEAN-FERROMANGANESE-CRUST DATA BASE

By

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Introduction

Ferromanganese crusts in the world's oceans may serve as potential resources of cobalt and other metals (Halbach and others, 1982; Halbach, 1982; Manheim and others, 1982a; Halbach and Manheim, 1984; Cronan, 1984; Clark and others, 1984). Unlike manganese nodules, which usually form in areas with high sediment accumulation rates, ferromanganese crusts form semicontinuous layers on harder, steeper substrates such as those found on seamounts, island slopes, and other raised ocean-bottom areas that are too steep for permanent sediment accumulation. They may also form on plateaus that are swept free of sediment by strong, permanent, or episodic currents.

Commeau and others (1984) cited four factors that have prompted a general shift in interest from abyssal manganese nodules to crusts: 1) Bulk samples of seamount crusts and nodules may contain three to five times more cobalt than abyssal nodules; 2) Crusts are present in large volumes at depths shallower than 2500 m; 3) Recent studies document the presence of ferromanganese crusts on seamounts and plateaus within the U.S. Exclusive Economic Zone (EEZ) in the Pacific and Atlantic Oceans (Halbach and Manheim, 1984; Cronan, 1984; Craig and others, 1982; Frank and others, 1976; Manheim and others, 1982a; Manheim and others, 1983); and 4) Because the United States is largely dependent on foreign sources of cobalt and manganese for both civilian and military applications, an alternate source of these two metals within the EEZ would be of strategic importance to the government as well as a major impetus to U.S. mining and metallurgical industries.

A data base for these crust resources was begun in November 1982 by Manheim and others (1983). The information in this data base includes published and unpublished descriptions and analytical information from many sources. Collection and analysis of crust samples from existing oceanographic archives and from recent field investigations have provided descriptive and analytical data for periodic update of the data base.

The accompanying maps (sheets 1 and 2) show the position of stations and the sequence number of the samples collected at those stations. These maps are intended to be an index for locating data in areas of interest and to be an aid in planning research on the origin of ferromanganese crusts. Systematic publication of the data contained in the data base is planned. Part of the data have been published in Hein and others (1985) and Manheim (1986). All available data are on file at the U.S. Geological Survey (USGS) offices in Woods Hole, Mass.

Sources of samples and data

Station and chemical information selected from the Scripps Institution of Oceanography-U.S. Bureau of Mines Nodule Data Bank (C.T. Hillman, U.S. Bureau of Mines, written commun., 1983)—hereinafter referred to as the SIO Nodule Data Bank—provided the initial data for the crust data base.

Additional crust samples were collected for analysis from the following major repositories: Woods Hole Oceanographic Institution, Smithsonian Institution, Scripps Institution of Oceanography, University of Southern California, Rosenstiel Institute of the University of Miami, Florida State University, Hawaii Institute of Geophysics, Lamont-Doherty Geological Observatory, Oregon State University, University of Washington, University of Alaska, and U.S. Navy archives. Other samples were obtained from the following more recent cruises: RV *Sonne* (Midpac I 1981 cruise), RV *S.P. Lee* cruises 83-5 and 84-5 (Schwab and others, 1985), and 1984 University of Hawaii cruises sponsored by the U.S. Minerals Management Service.

Analysis of samples

Unanalyzed samples were submitted to USGS laboratories in Reston, Va. for major-element and trace-element analysis. Supplemental analyses for interlaboratory comparison were made by the USGS in Woods Hole, Mass., by the U.S. Bureau of Mines in Avondale, Md., and by the Geological Survey of the Federal Republic of Germany (Hein and others, 1985).

Structure of the data base

The world ocean-ferromanganese-crust data base is structured for use with the Geologic Retrieval and Synopsis Program (GRASP) (Bowen and Botbol, 1975) and is formatted for implementation using dBase III[1] data management software. The basic sample identifier that links all the data files is the sequence number, a unique number assigned to each sample. The sequence number is constructed from a number given to each 10-degree "square" (block) of latitude and longitude worldwide and from a serial number within each assigned block. Two different numbering systems for the 10-degree blocks are in use: the older Marsden, and the specially designed Frazer system (SIO Nodule Data Bank system; see Frazer and Fisk, 1978).

[1]Use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

The sequence numbers that represent sample-station data for samples obtained from the SIO Nodule Data Bank consist of the Frazer block number followed by a 4-digit serial number. For example, sequence number 4340358 identifies a sample collected in Frazer block 434 and having serial number 0358. The sequence numbers for all other samples use the Marsden block numbering system followed by a 3-digit serial number. For example, 127006 identifies a sample collected in Marsden block 127 and having serial number 006. On the maps of this report, the Marsden number identifying each 10-degree block is shown in italics directly above the nonitalicized Frazer number, typically in the northwest corner of each block.

Attributes included in the data base

The following attributes, if available, are included in the data base for each sample or station and are grouped in several files.

A.—SIO Nodule Data Bank Samples

Sampling-station data

Sequence number (first 3 digits are Frazer block number; last 4 digits are serial number)
Cruise identification number
Latitude, in decimal degrees
Longitude, in decimal degrees
Type of sampling device
Depth, in meters
Length of core, in centimeters
Institution affiliated with the sample
Reference number linkable with SIO Nodule Data Bank reference file
Type of surface lithology observed
Occurrence of ferromanganese oxide deposits (absent or present)
Surface sample, or below-surface sample
Percent of coverage on bottom
Source of percent estimate
Resource estimate, in kilograms per square meter

Major-element data

Sequence number
Analysis number (to distinguish between more than one analysis per sample)
Sample-type number
Sample-portion number
Sample diameter, in centimeters
Sample length, in centimeters
Sample width, in centimeters
Material description of core
Reference identification number for chemical analysis
Method of analysis
Concentration of the following elements in weight percent: Mn, Fe, Co, Ni, Cu, Zn, Pb, Al, Si, Ca, H_2O^-

Trace-element data

Sequence number
Analysis number (to distinguish between more than one analysis per sample)
Atomic number (Z) of the trace element being analyzed
Concentration in weight percent of trace element identified in previous attribute
Atomic number (Z) of the next trace element being analyzed
Concentration in weight percent of trace element identified in previous attribute

Note: This format continues in this manner with 132 characters per record. If there are more trace elements analyzed for the given sample than will fit on the first record, the sequence number and analysis number are repeated on the second record, and the atomic number of the next trace element is given followed by its concentration in weight percent, etc.

Concentrations of the trace elements listed below are contained in this file; for the majority of the samples, however, analyses are generally limited to Na, Mg, K, Ti, V, Cr, Mo, Cd, and Ba.

Li	P	Cr	Y	Sb	Sm	W
Be	S	Ga	Zr	Te	Eu	Hg
B	Cl	Ge	Nb	I	Tb	Tl
C	K	As	Mo	Ba	Yb	Pb
F	Sc	Se	Ag	La	Lu	Bi
Na	Ti	Rb	Cd	Ce	Hf	Th
Mg	V	Sr	Sn	Nd	Ta	U

B.—USGS-assembled data

Sampling-station data

Sequence number (first 3 digits are Marsden block number; last 3 digits are serial number)
Latitude on bottom[2], in decimal degrees
Latitude off bottom[2], in decimal degrees
Longitude on bottom, in decimal degrees
Longitude off bottom, in decimal degrees
Depth on bottom, in meters
Depth off bottom, in meters
Cruise identification number
Station number
Sample number
Month collected
Day collected
Year collected
Hour and minute collected
Second collected

[2]The terms "on bottom" and "off bottom" are used to denote the beginning and ending positions, respectively, of dredge hauls.

Phases collected
Sampling device
Amount collected
Units of amount collected
Institution affiliated with the sample
Photo available (yes or no)
Phase analyzed
Mean thickness of crust, in millimeters
Morphology of crust
Reference number (link to reference file)
Navigation-quality code
Comments

Chemical data

Sequence number
Analysis number (to distinguish between more than one analysis per sample)
Laboratory code
Month analyzed
Day analyzed
Year analyzed
Portion-of-sample-analyzed code
Brief description of substrate material
Method-of-analysis code
Error code (quality-of-analysis classification)
Water modification code
Thickness of sample portion analyzed, in millimeters

Chemical constituents are reported in the data base as element weight-percent for the following:

Ca	Ti	Fe	V	K	Zn	Pd
Mg	Al	P	Y	Ba	Ce	Rh
Co	As	Cu	Cd	Mn	W	
Ni	Nb	Pb	La	Sr	Pt	

Alternatively, for some samples chemical constituents were originally reported as oxides (H_2O^- is hygroscopic water, determined by drying overnight at 110°C; H_2O^+ is bound water).

SiO_2	Na_2O	CO_2	H_2O^-	H_2O^+	Al_2O_3
Fe_2O_3	MgO	K_2O	CaO	TiO_2	P_2O_5
MnO					

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