TECHNICAL REPORT

SUBMARINE SEDIMENT DATA COLLECTION
AND MANAGEMENT AT THE
U. S. NAVAL OCEANOGRAPHIC OFFICE

JOHN K. DUNCAN

*Environment Branch
Oceanographic Analysis Division
Marine Sciences Department*

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A B S T R A C T

This report has been prepared for the use of persons studying the composition of the sea bottom. It describes the source, type, quantity, and geographic distribution of bottom sediment information available at the U. S. Naval Oceanographic Office and lists the principal types of charts which can be prepared from such information. It also describes the forms in which bottom sediment data appear and discusses their relative reliability in terms of the sampling device employed, the type of analysis made, and the classification or description of the sediment. Furthermore, this report describes the filing system used to organize, control, maintain, and retrieve the data.

FOREWORD

This technical report discusses the collection, use, relative reliability, and control of submarine sediment data at the U. S. Naval Oceanographic Office. Data sources are listed and their geographic distribution charted by one-degree quadrangles.

DENYS W. KNOLL
Rear Admiral, U. S. Navy
Commander
U. S. Naval Oceanographic Office

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SUBMARINE SEDIMENT DATA COLLECTION AND MANAGEMENT AT THE U. S. NAVAL OCEANOGRAPHIC OFFICE

I. Introduction

The primary purpose of establishing a bottom sediment data file is to collect in one place all pertinent data in a form suitable for rapid sorting and retrieval. It also unites on one card or series of cards all of the information describing a particular sample or locations, since the data may be scattered widely through many publications.

II. Major Sources of Submarine Sediment Data

There are three principal sources of bottom sediment information: unpublished survey data; published survey or laboratory data reports and data reported in the scientific literature, or in research reports; and nautical charts.

A. Unpublished Survey Data

Unpublished survey data are the most difficult to locate, acquire, or use. Their existence is discovered, often by hearsay, by personal contact with researchers in the field, and by conscientious and constant perusal of the scientific literature for clues. Careful search for the location of unpublished data and lengthy correspondence with the owners are usually required before they can be borrowed or copied. Finally, since such data often are incompletely analyzed, unchecked, handwritten and often illegible, and unsummarized, considerable labor and expense are required to put them in intelligible and usable form. The information about a single sample often is scattered through a large number of laboratory analysis sheets, each reporting a single operation or type of analysis such as organic carbon analysis; pipette division of the fine fractions; sieve separation of the coarse grains; mineral separation and identification; identification of foraminifera; measurements of wet density, plasticity, shear strength, chemical composition, and radioactivity; and many others. The field description, geographic location, water depth, and type of sampler often are recorded on separate forms. The great difficulty of acquiring and processing such unpublished data, except those available from Oceanographic Office surveys, has caused effort to be concentrated primarily on published data.

B. Published Survey or Laboratory Data

Descriptions and analyses of large numbers of sediment samples appear in scientific journals, cruise reports, progress reports of research contracts, and published data reports. Data are reported in an infinite variety of tables, lists, graphs, histograms, profiles, sections, summaries, and descriptions. The reported data often are incompatible because they have been derived through many different methods of analysis and are described in terms of different systems of classification and units of weights and measurement. One example is the basic classification of sediments in terms of mud, sand, gravel, and rock which is subject to the following difficulties:

1. These terms may describe quantitatively measured and computed grain size composition, or the observer's opinion based upon the appearance of the sample (wet or dry) or the feel of the sample, or both. If the classification is based upon appearance and feel, its accuracy depends upon many varying and indefinable factors such as the observer's bias, knowledge, and experience; the type and amount of organic material; and the homogeneity of the sample. Experiments have shown that even experienced geologists permit a small (less than 10 percent) proportion of clay, dark color, or stickiness to obscure the dominant coarseness of a sand sample and will classify it as mud or mud-sand.

2. If the grain size of the sediment is measured in the laboratory, classification of the sample still is complicated by determination of the range of grain sizes which defines a mud, sand, or gravel. Such definitions are arbitrary, and no single system of classification has become widely accepted. Attempts to equate English, metric, and logarithmic (ϕ) scales of measurement cause additional complications.

3. A third source of disagreement in sediment classification is in selection of the statistical parameters (mean, median, or mode of the frequency distribution of grain sizes) used to classify a sample, and the effect of the type and amount of deviation of the grain size distribution from the normal (sorting, skewness, kurtosis). Some geologists describe a sample composed of 70 percent sand sized grains and 30 percent or more silt as a silty sand, while others would classify the same sample as only a sand. Others adopt 20 or 10 percent as the minimum proportion of silt to be classified as silty sand. Some geologists use an elaborate descriptive system, using and often mixing English terms with others of Latin and Greek derivation such

as psammitic pellete (sandy clay), arenaceous lutaceous argillite (sandy silty clay), or psephitic argillaceous calcarenite (gravelly clayey calcareous sand), each denoting fairly specific proportions of each particle size class.

4. Confusion also arises in combining particle size classifications with ones which denote chemical or mineral composition or origin of the sediment. It is extremely difficult to determine exactly what is meant by "coral sand," i.e., whether it is coral (size of particle may range from clay size to massive reefs) and sand, or sand sized calcium carbonate grains of coral origin. Shell may describe mollusks as large as giant clams or microscopic skeletal remains of pelagic foraminifera. Rock and stone are very indefinite terms used to describe a wide range of particle sizes, as well as solid bedrock outcrops or reefs. Detritus, alluvium, and diluvium are terms which indicate origin or mode of deposition, but they are used by many authors to imply various particle size ranges. Volcanic ash and pumice indicate origin and composition with unspecific grain size implications. The terms mud and ooze are used in many different ways to indicate or only to imply fine grain size, or to indicate plasticity, origin, or composition.

5. Determination of exact English equivalents of foreign language terms is difficult and often impossible. The term "wadden" often is used in European journals to describe tidal flat sediments, but some authors restrict it to mud or silts and clays, others include sand sized grains, and many use it without defining it. Russian scientists are not consistent in their use of terms such as mud, as the same author (M. V. Klenova) equates it with silt on one page, equates it with silt and clay on another, and uses it on a third page in a very general sense of a "muddy" sediment which may include large proportions of sand, gravel, pebbles, and shell. Thus, the lack of consistency in analysis, definition, and reporting of bottom sediment data makes it very difficult to adapt machine methods economically to their storage, retrieval, and analysis.

C. Nautical Charts

Abbreviated designations of bottom type appear on nearly all U. S. and foreign nautical charts. The notations of bottom material are made from field descriptions of samples obtained in the course of hydrographic surveys. Few of them are based upon laboratory analysis of samples. They are subject to all of the inconsistencies listed above. However, they are the only type of sediment information existent in

sufficient quantities to permit drawing boundaries between different sediment types. U. S. nautical chart notations of bottom material have been defined by W. H. Berninghausen* and his definitions are used as the basis for geologic interpretation of these data in the Naval Oceanographic Office.

The number of sediment notations on nautical charts varies geographically with water depth. Since hydrographic surveys are made primarily to locate dangers to navigation and to chart areas of shoal water having depths less than the draft of ships, most soundings and consequently bottom sediment notations are in shoal nearshore waters of 25 fathoms or less. The number of nautical chart notations also depends on the country which produces the chart. Japanese and Portuguese charts are remarkable for printing a notation of the bottom type for almost every sounding. On some Japanese and Portuguese large scale nearshore charts, notations exceed 50,000 per one-degree quadrangle. Such density of information permits highly exact and detailed delineation of sediment types.

The use of bottom notations on foreign nautical charts is complicated by the language barrier. Nautical chart notations appear in 16 major foreign languages (not including national variations such as between Spanish and Argentinian) and pose the dual problem of translation to English and of determining if the definition of the foreign term is fully equivalent to the definition of the English term. An example of this problem is "st." which is "stein" on German charts and "stone" on British Admiralty charts. It is difficult to determine whether the British use "stone" as synonymous with "rock" to denote a specific range of grain size, or generally to include material ranging from fine gravel through boulders to bedrock reefs, or possibly to indicate lack of specific knowledge of the bottom except that it is hard. It is even more difficult to determine if the German use of the term corresponds to the British use, and to equate both to some term in the U. S. classification of bottom materials, which does not include "stone" as a separate category.

III. Bottom Sediment Chart Compilation

Several types of bottom sediment charts can be prepared showing the geographic distribution of various properties of submarine surface sediments. However, only four major types of sediment charts can be

*BERNINGHAUSEN, W. H. The Quality of the Bottom, a Glossary of Terms, U. S. Navy Hydrographic Office, SP-56, 11 p., November 1961. Washington, D. C.

prepared from nautical chart notations of bottom type. One type shows bottom material classified descriptively as mud, sand, gravel, rock, coral, shell, and various combinations of these. Another can show the quality of the bottom in terms of hard, soft, sticky, rough, etc. The third can show sediments classed according to origin and composition, i.e., shell, coral, volcanic material, oozes (globigerina, radiolarian, diatom, pteropod), blue mud, and red clay. The fourth type of chart can show sediment color.

Charts can be prepared for limited areas showing the surface distribution of other properties of submarine sediments such as mineral composition, chemical composition, statistical grain size parameters, radioactivity, engineering properties, organic content, species of planktonic foraminifera, paleomagnetism, and many others. Other charts can show the vertical variations of these properties in the bottom. However, such charts require information from cores and carefully collected and analyzed sediment samples which are available in sufficient quantities only for small areas. For most of the oceans and seas such data can be presented only for widely scattered specific locations, and no meaningful boundaries can be drawn showing the extent of or change in any parameter except on very large scale charts of small areas.

IV. Relative Reliability of Data

The value of bottom sediment data depends upon how reliably the samples represent the population (sea floor) from which they are drawn. Sediment data reliability varies according to sampling design, type of sample, sampling instrument, accuracy of the ship's position, handling, movement and storage of sample, type of analysis, and initial purpose of collecting the sample. Rarely can the effect of all of these be evaluated for a particular sample or suite of samples. Usually only an estimate of how representative a sample is can be made.

Sediment data can be divided into three major reliability groups, which are relative and often overlap:

A. The best data are those obtained from laboratory analysis of core samples. These are usually less distorted in the sampling process than other types of samples and therefore more representative of the sediment as it exists on the sea floor. Core samples are usually more carefully handled and analyzed than other types because of the longer time requirements and greater expense of obtaining them. Considerable differences in reliability exist between different types of coring devices (gravity, piston, vibro-piston, hydrostatic) and the type of material sampled. Coarse grained and hard sediments such as coarse sand,

gravel, and rock are difficult to core, and often poor samples or none at all are obtained. For hard coarse materials (gravel, sand) a scoopfish or bucket dredge may obtain the most representative sample.

B. Generally less representative than cores are dredge, trawl, grab or snapper, and scoopfish samples, even when carefully analyzed by conscientious and competent persons. The grab and snapper samples usually destroy the structure of the sediment and often bias the grain size distribution toward coarser sizes by winnowing or washing in the sampling process. Trawls and dredges also may bias the size distribution by preferential selection of certain sizes. However, they provide composite samples of the submarine bottom material over an area or along a track. While such a composite sample is not representative of the material at any specific spot, it probably is more representative of the range of material in a region than one or even several cores. Therefore, one composite sample might better describe the bottom materials of a given area than one core sample, but ten core samples would describe more accurately the materials of the same area than would ten composite samples.

C. The poorest data and the most numerous are abbreviated notations of types and consistency of bottom materials which appear on boat sheets, compilation sheets, and printed nautical charts. Most of them are cursory identifications of small samples, often only a few grains, brought up on sounding leads in the course of hydrographic surveys. The identifications of these inadequate samples are made routinely by enlisted naval personnel who usually have little or no scientific training in sedimentary petrology or mineralogy. Navigational positioning errors are compounded by cartographic compilation and printing errors. Although some of the notations are highly reliable and accurate abbreviations of field descriptions of samples from the other two groups, they usually cannot be distinguished from the majority of less reliable data and must be classed with them. The total effect of all of these possible sources of errors significantly reduces the reliability of bottom sediment charts based solely upon nautical chart notations. The charts become much more reliable when chart notations are substantiated by numerous and well-distributed core and grab samples.

The bottom sediment data collection maintained by the U. S. Naval Oceanographic Office (apart from chart compilations) consists almost entirely of data of the first two classes. Data in the third class are included only when reported in professional journals (such as *Annalen der Hydrographie*, *Deutsches Hydrographisches Zeitschrift*, and *Annales*

Hydrographiques) or in the scientific literature, where exact positions are given and some evaluation can be made of their validity (Figures 1,2,3,4,10,11, and 12).

Nautical chart notations are compiled region by region from foreign and domestic charts of all scales from 1:5,000 harbor charts to 1:10,000,000 charts covering large ocean areas. The compilation bases are acetate or tissue overlays placed on large or medium scale nautical charts on which the notations are assembled from all available charts which cover portions of the area of the base chart. The numbers and nationality of the chart sources are listed on each overlay, and notes indicate overlaps on other compilation bases. When completed, photostatic reductions of the overlays are made. These are filed together with other miscellaneous geologic data numerically in folders, each of which corresponds to a single sheet of the worldwide strategic plotting chart series.

V. Collection, Filing, and Control of Bottom Sediment Data

Bottom sediment data are analyzed and published in such a great variety of forms that coding or conversion of data to machine punch cards is impractical until some international agreement is reached on uniformity in reporting geologic data. for this and other reasons, manual filing of data on 5" x 8" index cards was adopted.

A. Collection of data -- Bottom sediment data are assembled through systematic search of the published scientific literature and by acquisition, whenever possible, of unpublished data reports, field notes, laboratory analysis summary sheets, survey data records, intelligence reports, and ship logs. Progress in the search is recorded on a 3" x 5" card, one for each journal or series of reports examined which contains bottom sediment data. On the cards are listed the volumes, years, and issue numbers which have been searched and from which all data have been abstracted. The following journals often contain submarine geologic information and have been partially or completely searched to date. This is far from a complete list, and new ones are added when found. It does not include the many sources of data which are not published serially.

American Association of Petroleum Geologists, Bulletin
American Journal of Science
Antarctic Record (Japan)
Archiv der Deutschen Seewarte
Australian Journal of Marine and Freshwater Research

Centre de Recherches et d'Études Oceanographiques, Cahiers du
 Commercial Fisheries Review
 Consejo Oceanografico Ibero Americano, Memorias del
 Deep Sea Research
 Deutsche Hydrographische Zeitschrift
 Geographical Review
 Geographical Journal
 Geological Society of America, Bulletin of
 Geology, Journal of
 Geophysics
 Geophysical Research, Journal of
 Gosudarstvennogo Okeanograficheskogo Instituta, Trudy
 Grønland, Meddelelser om
 Hydrographie und Maritimen Meteorologie, Annalen der
 Hydrographiques, Annales
 Instituta Okeanologii, Trudy
 Institute Oceanographique (Monaco), Annales
 Institute Oceanographique (Monaco), Bulletin
 Instituto Español de Oceanografia, Boletín del
 Instituto Español de Oceanografia, Trabajos
 Japanese Journal of Geology and Geography
 Limnology and Oceanography
 Marine Biological Association (UK), Journal of
 Marine Research, Journal of
 New Zealand Oceanographic Committee, Publications
 Okeanologiya
 Oceanografiska Institutet i Göteborg, Meddelander från
 Oceanographical Society of Japan, Journal (Nippon Kaiyo Gakkai)
 Oceanologia et Limnologia Sinica
 Ozeanographie (Deutsches Hydrographische Institute)
 Records of Oceanographic Works in Japan
 Science
 Scottish Geographical Magazine
 Scripps Institution of Oceanography, Bulletins
 Scripps Institution of Oceanography, Contributions
 Sedimentary Petrology, Journal of
 Sedimentology
 Station Marine d'Endoume, Recueil de Travaux
 Vsesoyuz Nauchno-Issledovatel'skiy Instituta Morskogo
 Rybnogo Khozyaistva i Okeanografia, Trudy
 Woods Hole Oceanographic Institute (MIT) Papers in
 Physical Oceanography
 Woods Hole Oceanographic Institute, Technical Reports

Data from these sources are abstracted and recorded on the 5" x 8" data cards, or negative photostats are made of relevant tables, figures, or pages of text and stapled or glued to the cards. Usually only one sample is recorded on each card, front and rear; however, very detailed analyses sometimes require several cards which are clipped or stapled together. Where two or more samples are taken at a single location by the same ship, they may be recorded on a single card even if they are different types of samples (Figure 5). Occasionally, when a very close sampling design is followed on a survey, several samples are recorded on a single card, but only if they are located within a single degree of latitude and longitude (Figures 2,3, and 4).

Several representative examples of the types of data and forms in which bottom samples are recorded on data cards are shown in Figures 1 through 12. The U. S. Naval Oceanographic Office summarizes most of its sediment data as shown in Figure 1. Only the results of engineering tests (Atterberg limits, unconfined compression strength, vane shear strength, and consolidation rate), which are made on a few samples, are reported on a different form. A photostatic reduction of the summary sheet is made to mount it on the 5" x 8" data card.

Figure 2 presents an example of a core analysis (Code 47) which gives the representative median grain size and sorting coefficients; however, the water content is the only sediment property for which the vertical variation is given. In Figure 3 data from an Italian source (Code 276) shows field classifications of eight shallow water samples of the surface sediment which were obtained within the one-degree quadrangle 44°-45°N, 12°-13°E. Such data are more reliable than nautical chart notations only because the source is identified and a scientist (Mario Picotti) has classified the sediment samples. A third sample (Code 20, Murray and Chumley, 1924-1926) in Figure 4 classifies a pelagic sediment sample and reports its mineral composition and the relative proportions of various types of organic remains.

In Figure 10 a shallow water core sample obtained during ATLANTIS Cruise 21 (Code 172) gives a field description of the core, the median and mean grain size, the size sorting coefficient, and the percentage distribution of grain sizes using the phi notation for three representative subsamples. A summary description of a deepwater core (Figure 11) is reported from a French source (Code 138). A qualitative classification of a deepwater sample obtained by the ATLANTIS Cruise 151 is of limited value because of the paucity of information and no indication as to type of sample (Figure 12).

1. SAMPLE NUMBER 10 T.N. Gill			5. SAMPLER TYPE Orange Peel		
2. LATITUDE 29° 40' 00"			6. WATER DEPTH (fm.) 15'		
3. LONGITUDE 080° 45' 00"			7. CORE LENGTH (in.)		
4. DATE (Day, month, year) 26 April 1953			8. CORE PENETRATION (in.)		
9. LABORATORY NUMBERS					
10. SUBSAMPLE DEPTH IN CORE (in.)		Surface			
11. COLOR		Pale Olive 10 Y 6/2			
12. ODOR		None			
13. WET DENSITY (lb./ft ³)					
14. RIGIDENSE (mm)					
15. MAXIMUM POROSITY (%)		45			
16. MINIMUM POROSITY (%)		35			
17. WATER CONTENT (%)					
18. ORGANIC CARBON CONTENT (%)					
19. SIZE ANALYSIS AND STATISTICAL MEASURES					
a. < -2 _φ (%)		00 _φ .8		00 _φ	
b. -2 _φ to -1 _φ (%)		11 SK _φ .15		SK _φ	
c. -1 _φ to 0 _φ (%)		17 Md _φ .75		Md _φ	
d. 0 _φ to 1 _φ (%)		33 01 _φ .15		01 _φ	
e. 1 _φ to 2 _φ (%)		31 03 _φ 1.35		03 _φ	
f. 2 _φ to 3 _φ (%)		6			
g. 3 _φ to 4 _φ (%)		1			
h. 4 _φ to 6 _φ (%)		0			
i. 6 _φ to 8 _φ (%)					
j. > 8 _φ (%)					
20. SUBSAMPLE DRY WEIGHT (gm)					
21. SPHERICITY (avg.)		High			
22. ROUNDNESS (avg.)		Sub-angular			
23. SURFACE TEXTURE (avg.)					
24. DOMINANT MINERAL (%)		Qtz 80			
25. SECONDARY MINERAL (%)		Shell 20			
26. OTHER MINERALS (%)					
27. REMARKS:					

Gill II, Station No. 20—Regular

Large shell fragments up to 5 cm.

FIGURE 1 U. S. NAVAL OCEANOGRAPHIC OFFICE SEDIMENT ANALYSIS SUMMARY

CODE 47

MS 152

LATITUDE LONGITUDE
43°05'N 70°42'W
(APPROX)

BOTTOM SEDIMENTS OFF
PORTSMOUTH, NEW HAMPSHIRE
1947

WATER CONTENT AND LIQUID LIMIT RESULTS

STA.	WATER CONT. TOP	WATER CONT. MIDSEC.	WATER CONT. BOTTOM	WATER CONT. OF LIQ. LIMIT	MED. DIAM.	SORT. COEFF. SO	LOG SO
83	127.0	143.0	160.0	117.9	0.00295	2.9	0.46

FIGURE 2 SAMPLE ANALYSIS EMPHASIZING WATER CONTENT

CODE 276

PICOTTI, MARIO

MS 179

DATE: (9, 13) 16 8 55 (10) 17 8 55 (12, 14) 20 8 55 (10B, 12B, 12-15) 9 9 55

STA. NO.	LAT. N.			LONG. E.			DEPTH (M)	TYPE OF BOTTOM
	°	'	"	°	'	"		
9	44	58	00	12	35	00	24.5	FANGO
10	44	58	00	12	54	00	33	SABBIA FANGOSA CON ARGILLA
12	44	48	24	12	48	36	34.5	FANGO GRIGIO
13	44	44	18	12	38	30	30	FANGO GRIGIO
14	44	31	24	12	41	00	33	FANGO GRIGIO
10B	44	58	00	12	54	00	33	SABBIA FINE
12B	44	48	24	12	48	36	32	ARGILLA
12-15	44	43	54	12	55	00	37	FANGO POCA SABBIA

FIGURE 3 SAMPLE CLASSIFICATION REPORTED BY AN ITALIAN SOURCE

CODE 20

MS 146

1107

S. S. "BRITANNIA"

SOUNDING 396, JULY 18, 1899, LAT. 46°22'35"N., LONG. 18°51'56"W., 2522 FATHOMS.

GLOBIGERINA OOZE, LIGHT BROWN, SLIGHTLY COHERENT.

CALCIUM CARBONATE (82-65%), PELAGIC FORAMINIFERA (78%), BOTTOM FORAMINIFERA (2%), OTHER REMAINS (2-65%), INCLUDING OSTRACODS, ECHINOID SPINES, COCCOLITHS, RHABDOLITHS, COCCOSPHERES, FRAGMENTS OF LIMESTONE.

RESIDUE (17-35%), BROWN—

MINERALS (5%), M. DI. 0-08 MM., ROUNDED AND ANGULAR; PRINCIPALLY QUARTZ GRAINS, WITH ROCK FRAGMENTS, PUMICE, VOLCANIC GLASS ETC.

SILICEOUS REMAINS (2%), RADIOLARIA, SPONGE SPICULES, DIATOMS, IMPERFECT CASTS.

FINE WASHINGS (10-35%), AMORPHOUS CLAYEY MATTER WITH FINE MINERAL PARTICLES.

FIGURE 4 BIOLOGICAL AND MINERAL COMPOSITION OF A SAMPLE REPORTED BY A BRITISH SOURCE

04°45'N., 128°08'E. WATER DEPTH 7710 METERS (MINDANAO TROUGH)

CORE NO. 108 CORE LENGTH—390 CM.

DEPTH IN
CORE CM.

0-3.5	GREY-BROWN SAND.	DEEPEST PART OF CORE PROBABLY A MUD
3.5-285.5	GREYISH GREEN CLAY AND SILT WITH SEVERAL DARK LAYERS.	FLOW. NEXT ABOVE ARE GRADED SAND LAYERS (TURBIDITY CURRENTS—KUENEN). THESE BEDS COVERED BY 3 METERS OF FINE-GRAINED TERRESTRIAL MUD WITH MINOR AMOUNTS OF VOLCANIC GLASS AND ORGANIC SILICA. A 3 CM. SAND LAYER IS ABOVE ALL. COARSE ROCK FRAGMENTS ARE UNWEATHERED AND DERIVED FROM ANDESITE OR BASALTIC ANDESITE.
285.5-360	SEVERAL LAYERS OF DARK SAND CONTAINING SILT AND CLAY. SOME LAYERS BECOME COARSER WITH DEPTH. COLOR—BLACK.	
360-389.5	IRREGULARLY MIXED SAND, SILT AND CLAY—LIGHT PARTS ARE FINER THAN THE DARK ONES.	

PARTICLE
SIZE MM.

SAMPLE DEPTH (CM.) WT. % OF DRY, SALT FREE SEDIMENT

	2	45	63	154	525	287	300	306	324	342	365	381	
<.006													
.006-.02	5.7	49.2		56.2	36.0		3.9				12.2	22.2	16.6
.02-.06	1.9	19.0		16.5	15.2		2.2		3.5	3.1	2.8	20.4	7.2
.06-.125	5.5	28.0	90.0	18.1	31.9	85.0	9.2	44.0					15.9
.125-.25	21.6	3.8	9.0	7.1	16.3	15.0	32.9	30.8	7.0	5.2	10.8	30.1	23.6
.25-.5	53.3	—	1.0	1.9	0.6		42.6	25.0	16.3	16.4	27.7	14.9	23.3
.5-1.0	11.5	—	—	0.2	—		9.1		59.1	34.4	25.6	12.4	10.2
1.0-2.0	0.5	—	—	—	—		0.1		14.1	29.0	11.6		3.2
72.0	—	—	—	—	—		—		—	9.0	9.3	—	—
	—	—	—	—	—		—		—	2.9	3.0	—	—

MANY
FORAMS.

FIGURE 5 DESCRIPTION AND GRAIN SIZE DISTRIBUTION OF A SAMPLE REPORTED BY A SWEDISH SOURCE

CODE 262

PERSEY

MS 283

78°37.3'N. 55°20'E.	STA. NO.	DEPTH (M)	ORG. C	MAT. N	% C/N	CO2	PETERSEN DREDGE BROWN SANDY MUD
1927-31	1261	207	.79	.11	7.1	.05	CORE 0-4 CM BROWN SANDY MUD 4-16 CM. GREENISH-GREY MUD 16-25 MM. DARK GREY CLAYEY MUD
		SURFACE SAMPLE GRAIN SIZE					
M.M.	%	M.M.					
>1	27	<0.01	16				
0.1	1	<0.01	30				
0.05	26						

FIGURE 6 DESCRIPTION, GRAIN SIZE, AND ORGANIC COMPOSITION OF A SAMPLE TRANSLATED FROM A RUSSIAN SOURCE

02° 59' N. 49° 20' W

NUMBER	DEPTH (M)	FR. GROSSA 40 MICRONS %	FR. FINA 40 MICRONS %	CALCÁRIO %	CARBONO ORGÂNICO %	NITROGENIO ORGÂNICO %	C/N	Q ₁	Q ₃	MEDIANA	SORTING	$\frac{Q_3 - Q_1}{2}$
311	71	83.4	16.6	16	0.979	0.061	16	0.174	0.265	0.210	1.23	0.045

311—AREIAS CONCHIFERAS DE CÔR CINZA E BEIGE, COM 84% DE AREIA E 16% DE CALCÁRIO.

NATUREZA MINERALÓGICA DOS GRÃOS:

NA MAIORIA QUARTZO CRISTALIZADO OU TRANSPARENTE, COM POUCAS MICAS BRANCAS E ALGUMAS BIOTITAS MARRON MAIS OU MENOS ALTERADAS.

GRÃOS DE ARENITO PARECENDO ANTIGO.

GRANDE ABUNDÂNCIA DE MINERAIS PESADOS.

MORFOLOGIA DOS GRÃOS:

OS GRÃOS SÃO TODOS UM POUCO DESGASTADOS, TENDO A FRAÇÃO GROSSA 20 ATÉ 30% DE "ARREDONDADOS BRILHANTES", SENDO ALGUNS FOSCOS.

ORGANISMOS:

GRANDE QUANTIDADE DE ORGANISMOS PLANETÔNICOS E BENTICOS.

CONCHAS DE LAMELIBRÂNQUIOS, GASTERÓPODES E LARVAS.

ECHINODERMOS-FRAGMENTOS DE ESPINAS E UM PEQUENO TIPO DE ECHINODERMO INTEIRO, DE 8 MM. DE DIÂMETRO.

ALGUNS COPRÓLITOS.

OSTRÁCODES—ESPÍCULAS SILICOSAS DE ESPONJAS, FORAMINÍFEROS, ARENÁCEOS E PLANCTÔNICOS.

GLOBIGERINAS, ORBULINAS, ETC., SENDO ALGUMAS CHEIAS DE MATERIAL FERRUGINOSO OU PRETO.

NOTA:

OBSERVA-SE UMA CONCHA ANTIGA, CHEIA DE UM ARENITO CALCÁRIO ANTIGO, COM GRÃOS BEM ARREDONDADOS. SEM DÚVIDA O REVOLVIMENTO DE UMA FORMAÇÃO MAIS ANTIGO.

2—FRAÇÃO FINA:

ENCONTRA-SE SILTES, ARGILAS E MICAS EM FOLHETOS FINOS, ALGUMAS ESPÍCULAS SILICOSAS, COM CANAL CHEIO DE TERRA FERRUGINOSA. ALGUMAS VEZES OBSERVA-SE O INÍCIO DE RECRISTALIZAÇÃO DA SILICA AMORFA QUE COMEÇA A SE POLARIZAR. NOTA-SE TAMBÉM ALGUNS "COCOLITOS" SENDO UM PERFEITAMENTE CONSERVADO, ENQUANTO MUITOS OUTROS APRESENTAM-SE FRAGMENTADOS NA LÂMINA ESTUDADA.

FIGURE 7 EXAMPLE OF A DETAILED DESCRIPTION OF A SURFACE SEDIMENT SAMPLE REPORTED IN A PORTUGUESE PUBLICATION

An example of a sediment analysis that is primarily biological and consists of a listing of the species whose skeletal remains have been identified in the sample is provided by Figure 9.

Figure 6 provides examples of samples reported in Swedish and Russian publications. A long core from one of the deepest ocean trenches is reported by the Swedish Deep Sea Expedition (Code 214) and gives a field description of the color and grain size classification, a description of the origin of the material, and the percentage of grains in various size classes at different levels in the core. The Russian publication (Code 262) reports both a core and a dredge sample taken at the same location in the Barents Sea. In this example the information was abstracted from several widely separated pages in the publication, translated, and assembled on one card, a very laborious task.

Another example of treatment of Soviet data is shown in Figure 8. Here the Russian has been transliterated and translated for this report; however, on most of the data cards the information appears in the Cyrillic form and has been neither transliterated nor translated. The widespread ignorance of Russian among Americans greatly limits the use of such data except where translation facilities are available.

Figure 7 is an example of a long description of a sample in Portuguese. Here the language is less of a barrier to English speaking researchers than in Figure 8 but still may cause some difficulty for those unfamiliar with Romance languages.

Another problem in handling sediment data is the reproduction of graphic portrayals of samples (Figure 13). Placing such information on individual sample data cards is complicated further when the original is in color, which cannot be reproduced photostatically.

B. Organization of data file -- The data cards are filed geographically by using the Marsden square system (Figures 14 and 15). The first order division is by 10-degree squares, the second by 5-degree squares, and the third by 1-degree squares. Five-degree square divisions have been used to date in only a few 10-degree squares in which there are too many cards for convenient manual sorting. It has not been necessary as yet to use the 1-degree square breakdown. The Marsden square number is entered on the upper right-hand corner of the data card.

CORE NO. 10, DEPTH 1708 M. 42°30'N., 40°25'E.

DEPTH IN CORE (CM)	CHARACTERISTICS OF THE SEDIMENT	PERCENT ORGANIC CARBON, DEHYDRATED, DRY WEIGHT	SO ₄	SO ₄ / Cl	ALK	pH
20-30	IL GLINISTII, SERII S PROSLOYAMI. SOVREMENNIYE OTLOZHENIYA. (CLAYEY MUD, GREY, WITH LAYERS. CONTEMPORARY SEDIMENTS.)	0.87	0.445	0.038	17.86	8.2
90-100	IL GLINISTII, SERII S PROSLOYAMI, DREVNICHERNOMORSKIYE OTLOZHENIYA. (CLAYEY MUD, GREY WITH LAYERS. EARLY BLACK SEA SEDIMENTS.)	1.39	0.285	0.025	18.33	8.6
220-230	"	0.91	0.244	0.023	18.41	8.1
310-320	"	1.03	0.223	0.022	17.31	8.1
480-490	"	0.75	0.325	0.036	12.75	8.1
595-605	IL GLINISTII, SERII S PRIMEC'YU ALEVITA. NOVOYEVSINSKIYE OTLOZHENIYA. (CLAYEY MUD, GREY, WITH A MIXTURE OF SILT. NOVOYEVSINSK SEDIMENTS.)	0.79	0.184	0.021	10.17	8.0
710-721	IL GLINISTII, SERII, ODNORODNII. NOVOYEVSINSKIYE OTLOZHENIYA. (CLAYEY MUD, GREY, HOMOGENOUS. NOVOYEVSINSK SEDIMENTS.)	0.45	0.222	0.028	9.39	7.9

FIGURE 8 EXAMPLE OF FIELD CLASSIFICATION AND CHEMICAL ANALYSIS OF A CORE REPORTED IN A RUSSIAN PUBLICATION

CODE 125

MS 465

DATE—12TH DECEMBER, 1912

POSITION—LAT. 42°38'1/2'S. LONG. 148°41'1/2'E.

DEPTH—1,320 FATHOMS

DESCRIPTION—GREEN TERRIGENOUS MUD, WITH SPONGE-SPICULES AND FORAMINIFERA;
MUCH DECOMPOSING MATTER.

COMPOSITION:—

CARBONATE OF LIME		
PERCENTAGE	FORAMINIFERA	OTHER ORGANISMS
72-85	BILOCULINA, MILIOLINA, SIGMOILINA, PLANISPIRINA, BULIMINA, VIRGULINA, BOLIVINA, CASSIDULINA, EHRENBURGIA, LAGENA, NODOSARIA, TRIPLASIA, CRISTELLARIA, POLYMORPHINA, UVIGERINA, SAGRINA, GLOBIGERINA, ORBULINA, PULLENIA, SPIRILLINA, DISCORBINA, ANOMALINA, TRUNCATULINA, PULVINULINA, ROTALIA, NONIONINA, POLYSTOMELLA, AND HETEROSTEGINA.	A FEW LARGE COCCOLITHS, NUMEROUS ECHINOID SPINES. OSTRACODA ABUNDANT (AGLARIA, PONTOCYPRIS, ARGILAEZIA, MACROCYPIS, BYTHOCYPRIS, BAIRDIA, CYTHERE, KRITHE, LOXOCONCHA, XESTOLEBERIS, CYTHERURA, CYTHEROPTERON, BYTHOCYTHERE, PSEUDOCYTHERE, CYTHERIDEIS, XIPHICILUS AND CYTHERELLA.
RESIDUE		
PERCENTAGE	SILICEOUS ORGANISMS	FINE WASHINGS
27-15	ARENACEOUS FORAMINIFERA (PELOSINA, RHIZAMMINA, NOURIA, REOPHAX, HAPLOPHRAGMIUM, TEXTULARIA, GAUDRYNA, TROCHAMMINA AND CLAVULINA). SPONGE-SPICULES AND A FEW RADIOLARIA.	SPONGE-SPICULES AND TERRIGENOUS SAND.

FIGURE 9 EXAMPLE OF BIOLOGICAL OR MICROPALAEONTOLOGIC ANALYSIS OF A SEDIMENT SAMPLE

	CRUISE & STATION NUMBER		DATE	LATITUDE (N)		LONGITUDE (W)		WATER DEPTH (FT)	BOTTOM SEDIMENT SAMPLE					
	21	6-20-56	28° 57'	89° 07'		60	G(31)							
PHI Ø CLASSES (%)														
	0	1	2	3	4	5	6	7	8	9	10	MDØ	MØ	SOØ
21 #1	CUMULATIVE TO				5.24	1.28	10.03	19.12	15.37	11.61	37.33	8.0	7.7	1.7
#2	0.06	0.42	0.46	8.88	30.55	12.80	9.45	8.52	10.80	2.16	5.7	7.2	2.9	
#3	0.09	0.24	0.55	8.91	24.74	15.47	9.82	9.76	12.50	0.77	6.0	7.3	2.9	

CORE 56-14-21—PREDOMINANTLY TAN-GRAY CLAYEY SILT. TOP SEVEN INCHES THINLY LAYERED. REMAINDER OF CORE OF HOMOGENOUS SILT EXCEPT FOR THIN LAYER OF SILTY CLAY AND ORGANIC MATERIAL AT 20 INCHES. VERY FINE SAND 5% TO 10% IN SAMPLES. SAMPLES AT SURFACE, 13, AND 25 INCHES. LENGTH, 27 INCHES.

FIGURE 10 DESCRIPTION AND PHI GRAIN SIZE DISTRIBUTION OF A CORE SAMPLE

CODE 138

MS 004

CAROTTE 251 PROVENANCE: ATLANTIQUE EQUATORIAL
 STATION 356 POSITION 00°33'N.; 37°06.5'W.
 PROFONDEUR: 4,540 M.
 LONGUEUR: 940 CM.

ARGILE ROUGE CALCAIRE (DE 0% A 60% CO₃CA) AVEC, À CERTAINS NIVEAUX, DES QUANTITÉS PLUS OU MOINS IMPORTANTES DE BOUE BLEUE. LA TENEUR EN FER (FE 203 RAPPORTE AU SÉDIMENT SANS CALCAIRE) VARIE DE 4% A 8% AVEC UNE VALEUR MOYENNE DE 7%.

FIGURE 11 SAMPLE DESCRIPTION REPORTED IN FRENCH

CODE 51

ATLANTIS 151

MS 110-2

LATITUDE LONGITUDE
 30°07'N. 17°27'W.

ATLANTIS CRUISE 151
 ATLANTIC OCEAN 7/12/47— 6/ 18/48

DEPTH (FM)
 2387

SEDIMENT DESCRIPTION
 SOFT BROWN MUD

FIGURE 12 BRIEF FIELD CLASSIFICATION OF A CORE SAMPLE

FIGURE 13 EXAMPLE OF GRAPHIC REPRESENTATION OF CORE ANALYSIS

FIGURE 15 FIVE-AND ONE-DEGREE DIVISIONS OF MARSDEN SQUARES

C. Control of data -- Control of the data is accomplished by use of a card file of bibliographic sources, a tally card file, and a log book of sources coded and keyed to bibliographic and data cards.

The bibliographic file is a complete record of all sources, published and unpublished, from which data have been obtained. Each bibliographic card contains the complete bibliographic citation including the library which owns the reference; the ship, expedition, or operation which collected the samples; the date of the survey; the bibliographic code number; a list of cross references; and certain pertinent comments. The comments usually indicate the number and types of samples reported in the source and the numbers of the 10-degree Marsden squares in which the data are filed. The cross references are kept to a minimum and key the geographic area (sea, gulf, bay, etc.) of the survey (unless it is worldwide or oceanwide), the ship or ships, expedition, operation code names, and author(s) of the report to the bibliographic card. When small station location or sediment distribution charts appear in the sources, reduced copies are made and fastened to the bibliographic card.

The library from which the source publication was obtained is indicated on the card (preceding the call number) as follows: NAV OCEANO - Naval Oceanographic Office, USCGS - U. S. Coast and Geodetic Survey, LC - Library of Congress, USGS - U. S. Geological Survey, DI - Department of the Interior, SI - Smithsonian Institution (National Oceanographic Data Center, WB - Weather Bureau, DA - Department of Agriculture, and WHOI (Woods Hole Oceanographic Institute).

The bibliographic cards are filed alphabetically by name of the survey ship and cruise number; e.g., VEMA-6 follows VEMA-5. If the ship is not given, then the expedition, cruise, or operation name is used, e.g., Capricorn Expedition, DEEP FREEZE (operation), AMOS (project). If none of these is given, then the cards are filed alphabetically by senior author or occasionally by geographic area name if the source deals with a limited area such as the Sea of Azov.

The purposes of the bibliographic file are:

1. To direct users of data to the original source for information not supplied by the data card.
2. To prevent duplication of data by indicating if recently acquired data or sources already have been filed.

3. To provide bibliographic listings of marine geologic sources of information (not only bottom sediment samples) for specific areas through area cross references, and to provide lists of reports dealing with projects, operations, cruises, or expeditions.

4. To relate reports and analyses which come from several sources or authors but deal with the same samples. The ship, expedition, or project name with the date is most useful for this purpose.

5. To be able to enter on the cards additional information about the samples from new sources by using the list of Marsden squares given under comments on the bibliographic card.

The tally file is maintained to provide current listings of the numbers and geographic distributions of bottom sediment samples contained in the data collection. Eventually, it is hoped, the tally file will indicate the worldwide distribution of all published and much unpublished bottom sediment data. This file is used as a guide in planning oceanographic surveys by indicating regions for which data are lacking and where survey efforts should be concentrated. Charts prepared periodically from this file will indicate progress in the collection of submarine sediment information.

The tally cards also show the number of core samples and the number of samples of other types (designated surface samples) in each one-degree square. The code number of the source of each sample or the ship's name and date of collection are recorded on the tally card.

A log book is maintained in which all bibliographic sources of bottom sediment data are entered and numbered (code number) in the chronological order in which their data are added to the data file. Its major purpose is to serve as an additional record of sources and as a key to sources which may be indicated on data and tally cards only by code number

VI. Composition of Data Collection

The data file now contains analyses or descriptions of approximately 20,000 samples, of which about 17,000 are surface samples and 3,000 are core samples. Data for several thousand of the samples were obtained from foreign language sources, many of which have been partially translated. However, translation time and cost remain a restriction on full use of foreign sources. Russian, Japanese, Chinese, German, French, Spanish, Greek, Italian, Portuguese, Dutch, Finnish, Turkish,

Israeli, and Scandinavian as well as English language sources have supplied data for the collection.

The worldwide distribution of bottom sediment data in the Naval Oceanographic Office collection as of 1 January 1963 is shown in Figures 16 through 25. Two categories of data are shown for each one-degree quadrangle (note exception in North Pole Chart, Figure 24), namely the number of core samples and the number of surface samples of all other types (trawls, dredges, snappers, etc.).

To aid in adequate evaluation of relative density of data per unit area, the table on page 62 is included to show the latitudinal variation in area of 1° quadrangles.

VII. Bibliographic File

The bibliographic file on which this report is based consists of the following sources. Following each citation is a list of the ships and expeditions or project names involved, where appropriate. The library from which the referenced publication was obtained is indicated by abbreviations (identified on page 20) preceding the call number. Where no library is given the publication is in the Naval Oceanographic Office Library.

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ARCTIC 1958

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WESTWIND (USCGC) 1958

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ARCTIC 1959

Variation of Area of 1° Quadrangles with Latitude

Latitude(°)	Approximate Area of 1° Quadrangle ² (nautical miles ²)
0	3,768
10	3,534
20	3,377
30	3,118
40	2,763
45	2,555
50	2,324
55	2,079
60	1,813
65	1,533
70	1,241
75	941
80	631
85	317
89	63
90	0

FIGURE 16. EASTERN NORTH ATLANTIC OCEAN—DISTRIBUTION OF SUBMARINE SEDIMENT SAMPLE ANALYSES

FIGURE 17. WESTERN NORTH ATLANTIC OCEAN—DISTRIBUTION OF SUBMARINE SEDIMENT SAMPLE ANALYSES

LEGEND

3" CORE SAMPLE

1" SURFACE SEDIMENT SAMPLE

FIGURES INDICATE FOR EACH ONE-DEGREE
QUADRANGLE THE NUMBER OF ANALYSES FIRED
IN U.S. NAVAL OCEANOGRAPHIC OFFICE ON
1 JANUARY 1963

FIGURE 18 SOUTH ATLANTIC OCEAN—DISTRIBUTION OF SUBMARINE SEDIMENT SAMPLE ANALYSES

FIGURE 19. EASTERN NORTH PACIFIC OCEAN—DISTRIBUTION OF SUBMARINE SEDIMENT SAMPLE ANALYSES

FIGURE 20. WESTERN NORTH PACIFIC OCEAN—DISTRIBUTION OF SUBMARINE SEDIMENT SAMPLE ANALYSES

FIGURE 21. EASTERN SOUTH PACIFIC OCEAN—DISTRIBUTION OF SEABIRD SEDIMENT SAMPLE ANALYSES

FIGURE 22 WESTERN SOUTH PACIFIC OCEAN—DISTRIBUTION OF SUBMARINE SEDIMENT SAMPLE ANALYSES

FIGURE 23 INDIAN OCEAN—DISTRIBUTION OF SURFACINE SEDIMENT SAMPLE ANALYSES

FIGURE 24 ARCTIC OCEAN—DISTRIBUTION OF SURFACE SEDIMENT SAMPLE ANALYSES

FIGURE 23 SEAS AROUND ANTARCTICA—DISTRIBUTION OF SUBMARINE SEDIMENT SAMPLE ANALYSES

U. S. Naval Oceanographic Office
SUBMARINE SEDIMENT DATA COLLECTION AND MANAGEMENT AT THE U. S. NAVAL OCEANOGRAPHIC OFFICE by John K. Duncan, August 1964 . 88p. Including bibliographic file and figures.

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