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INFORMAL REPORT

THE U. S. NAVAL OCEANOGRAPHIC OFFICE'S DEEP OCEAN SURVEY PROJECT

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WASHINGTON, D. C. 20390

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ABSTRACT

The Deep Ocean Survey Project of the U. S. Naval Oceanographic Office is a multipurpose survey whose purpose is to obtain information in all strategic areas to support Navy requirements, and additionally, to contribute information beneficial to the scientific and economic community. Oceanographic, geophysical, and acoustic data are collected from ships operating in both the North Pacific and the North Atlantic Oceans. Major portions of the North Atlantic and the Western North Pacific have been surveyed under the two tasks within the Project, the Marine Geophysical Survey (MGS) performed by contractors, and the Anti Submarine Warfare/Undersea Warfare (ASW/USW Surveys) performed by Oceanographic Office personnel aboard Military Sea Transportation Service (MSTS) and charter vessels. Reports of the data are published within a year after completion of the surveys and the original data are forwarded to established data repositories after analyses are completed.

Deep Ocean Surveys Division
Oceanographic Surveys Department

This report has been reviewed and is approved for release as an unclassified Informal Report

C. H. CLINE
Director, Deep Ocean Surveys Division

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DEEP OCEAN SURVEY PROJECT

INTRODUCTION

The purpose of the Deep Ocean Survey Project is to obtain information in all strategic areas to support all Navy weapon systems which must operate in the ocean medium. Additionally, this information will support scientific and economic needs. In the past, oceanographic surveys obtained information to support a specific weapon system and provided a data base for small areas of the world. Resources were not available to meet all Navy requirements; thus, it was a case of doing the best possible with what was available to meet an immediate need. The immediate short-range problems of certain Navy systems had to be solved before long-range goals could be recognized, much less implemented. As sophisticated weapon systems were developed, emergency projects of limited scope were initiated to provide oceanographic information.

An analysis of requirements for oceanographic/acoustic data to support existing Navy warfare systems, as well as systems that are planned for development in the immediate future and which will be operational during the next ten years, indicates the urgent need for a model of all the ocean's essential environmental factors. The heavy political commitments of the United States military forces throughout the world clearly dictate the need for development of environmental models for all oceans. These models will include all possible parameters, so that we can fully understand the environment where our Naval forces will operate. Although no single Navy system has requirements in itself for the full spectrum of oceanographic data, all warfare systems as a group require the full spectrum of data being obtained by the Project.

BACKGROUND

Fifteen years ago no AGOR (Oceanographic Research) ships were available for research, and the AGS (Survey) ships had to be used for high priority research. Much needed basic information could not be acquired because of the shortage of oceanographic ships and reliable instruments. The effect of limited-scope project surveys and the time-sharing of oceanographic ships for both research and surveys is summarized as follows:

- Navy users of oceanographic data were provided minimum data at high cost. Several areas of the world have been resurveyed many times during the past fifteen years, but the total known requirement for data in these areas still has not been met.

- Capabilities of ships and personnel were not used to maximum potential.

- Immediate systems requirements for oceanographic data were sometimes met but, generally, the long range requirements for oceanographic data were not.

- Ships on many surveys were used for purposes other than oceanography.

- Most instruments supplied by projects were not installed permanently. Inadequate preventive maintenance, inadequate logistic support, and short equipment life accompanied this transient approach.

The expansion of Naval operations, globally and from ocean surface to bottom, has provided the impetus for acceleration of the Navy's oceanographic program. A thorough understanding of and familiarization with the marine environment has become essential to improvement of Navy sensor and weapon system effectiveness. New approaches to surveying strategic areas of the world have been made possible by several factors, the major ones of which include:

- An AGS (survey) ship construction program.

- An AGOR (research) ship construction program.

- Charter of ships to meet special needs.

- The advent of new documentation procedures associated with the Navy five-year plan has placed the oceanographic community in a position where the requirements for oceanographic support of new Navy systems can be predicted and planned well in advance.

- The state of the art of oceanographic instrumentation is experiencing major advances. Reliable equipment is increasingly available, and it is becoming practical to instrument an AGS permanently and conduct an efficient preventive maintenance program.

The Deep Ocean Survey Project contains within it two separate survey tasks: the Marine Geophysical Survey (MGS) Task which was performed for the Oceanographic Office by private industry under contract, and the Antisubmarine Warfare/Undersea Warfare Surveys (ASW/USW Surveys) which is performed by personnel of the Oceanographic Office aboard charter ships and ships operated by the Military Sea Transportation Service. Both survey tasks use the same techniques and rationale in their approach to the field work, although the MGS concentrated on geophysical and acoustic data and represented a transition from limited-scope project surveys to the true multi-purpose surveys represented by the ASW/USW Surveys.

SURVEY OBJECTIVE

The primary objective of the Deep Ocean Survey Project is to provide the Navy comprehensive, reliable information in strategic ocean areas at a faster rate and lower cost than has heretofore been done. Secondary objectives are to provide a data base for the design, development, and evaluation of new Navy ASW/USW systems and to increase Navy's contribution of oceanographic information to the scientific community and industry.

Survey plans related to Navy objectives have been developed to meet forseeable naval development needs and all known immediate needs in a strategic area. The surveys are designed to provide information pertinent to antisubmarine, search and rescue, striking force, logistic support, submarine, mining and mine countermeasures, and amphibious operations. In addition, they will give enough insight into the nature of ocean areas to explain many scientific anamolies and to provide preliminary assessment of economic potential. Considerations of urgency require that the surveys be reconnaissance in nature, to cover priority areas as quickly as possible. They are, however, systematic in nature and provide the skeletal framework for further and more intensive investigations.

For convenience sake in planning surveys, reporting data, and establishing discrete work units, the Northern Hemisphere oceans have been blocked into a series of "Task Areas." Each area is normally from one-half to one million square miles in size; forty such areas have been designated in the North Pacific and thirty-four in the North Atlantic. Figures 1 and 2 depict the Task Areas and their assigned numbers. The numbering sequence is for convenience only, and has no relation to any priority system; the outlines themselves are only to indicate the general survey area and are not expected to be rigidly adhered to. The plan is to sequentially survey each area with a team of two ships, alloting from 4 to 12 months in each area. Figures 3 and 4 show progress in the Project. Using existing and planned resources, the Project should complete surveys of the majority of the Northern Hemisphere oceans and peripheral seas during the 1970's as well as provide some initial coverage of Southern Hemisphere oceans.

DESCRIPTION OF THE SURVEY PROJECT

The work begins with a determination of what is known about an area; what we need to know; and how, when, and where to obtain the required information. The approach to providing the preliminary information required is to retrieve all available historical information pertinent to a specific strategic area in order to have a model from which to plan the survey.

The area study will include the historical model and a survey operational plan with detailed ship movement and scientific event schedules. The survey plan will be subdivided into a reconnaissance underway phase and an on-station phase. Sampling density, track spacing, and station locations will be derived from analysis of the historical model and will be revised as required throughout the survey.

The criteria for selection of measurements are primarily:

- defined Navy information requirements,
- defined data requirements of the researcher, other federal agencies, and Industry,
- state-of-the-art equipment, and
- state-of-the-art survey technique.

The scale of coverage planned within each task area is at the reconnaissance level since the project is based on the tenet that enough ships and manpower cannot be mobilized to provide the world-wide coverage and precise detail of data desired. Hence, a balance must be made between the resources available for data acquisition, the size of the geographic area, and the amount of detail that a particular survey can yield. When precise detail is mandatory, detailed grid-type surveys are conducted; otherwise, the survey hypothesis is that the ocean is divided into water-masses and physiographic provinces that can be sampled and satisfactorily defined by statistical techniques to provide the information needed for most operational decisions.

Reconnaissance scale coverage in the terms of Deep Ocean Surveys means something more than a few transit lines through an area, yet far less than the coverage that would be provided by a closely spaced grid coverage. Total track mileage throughout each large area would be approximately equivalent to 20-30 miles line spacing. The tracks, however, are not run on a grid, but are based on existing data in such a manner as to gain the greatest definition of the area with the fewest number of track miles. Complete detail of the area under study is not expected. The main goal of the survey is to define the physiographic and oceanographic provinces of the area, to locate the limits of these provinces, and to point out those areas requiring more detailed survey efforts to fully define the region.

Field operations usually are conducted by two ships per area and begin with a preliminary survey or reconnaissance phase, utilizing underway geophysical, bathymetric, and oceanographic sensors along lines at optimum spacing as determined from the area study. Both ships independently follow tracks through the area collecting underway data from a variety of sensors including: magnetometer, sea surface temperature probe, subbottom profilers, short-pulse echo sounder and other sensors as they become available and operationally feasible. Notable early inclusions are expected to be: gravimeters, sea surface salinometers, wave recorders, and nutrient analysers. In some areas, depending upon existing data and operational considerations such as seasons and weather, buoyed thermistor and/or current meter arrays are planted prior to beginning the underway phase. After completion of the reconnaissance survey, both ships return to port. A planning conference is then held for the purpose of data review and validation and/or modification of the next phase of on-station work.

Station work consists of conducting acoustic, oceanographic, geological, biological, chemical, and radioisotopic measurements and/or sampling. Measurements at acoustic stations consist of reverberation, background noise,

and propagation loss as a function of frequency, range, and grazing angle. Ship-to-ship distances and water depths are determined with a precision necessary to assure adequate control over the geometry of the acoustic paths. Large volume water samples, bottom photographs, biological data, cores, Nansen casts, sound velocity data, light measurements, wave data, air-sea interface data, and meteorological data are obtained on station. Depending upon the emphasis necessary to complete the desired description of the area, acoustic, geological, biological, and/or physical oceanographic station work may be accomplished sequentially rather than simultaneously. Because of the general interdependence of the data, this is seldom necessary except for the acoustic measurements, although they too require some simultaneous measurements of the water column and bottom physics. Between acoustic stations and along acoustic source ship tracks, full underway measurements including acoustic normal incidence reflectivity are taken when the tracks are of sufficient duration to warrant streaming the equipment.

Sufficient data processing and analysis are accomplished continually at sea to assure that quality control is maintained. All recording and processing of multipurpose survey data is being automated in accordance with the state of the art. Emphasis is placed on automation of data processing in proper format to allow rapid statistical and theoretical computations in the analysis stage. At the conclusion of the survey effort, the Party Chief prepares three reports: (1) a TAD Report to the Oceanographic Office summarizing primarily the administrative aspects of the survey; (2) a Field Data Summary Sheet (FDSS), Figure 5, which summarizes for the National Oceanographic Data Center (NODC) the types and amount of data collected; and (3) an Oceanographic Cruise Summary (OCS) which is an informal report briefly describing the objectives and narrative of the cruise, the collection and analysis procedures, and the disposition of the data planned. It also provides preliminary analyses, particularly of significant findings. An outline of the standard OCS format is shown in Figure 6. The TAD and FDSS reports are normally completed within a few days of the completion of the survey; the OCS report is scheduled for completion within 3 months of the end of the survey and should be available for distribution within 6 months.

A final Oceanographic Survey Report will be compiled for each study area. A minimum of two volumes are prepared, one on acoustics and the second on oceanography and geophysics. Further breakdowns are made as necessary. These volumes will present an analysis of all the data collected and are the final and principal formal output from the survey group. The extent of the analysis performed will be directly related to the manpower and time available. In all cases, these reports are planned for completion within one year.

The original data and/or copies of the data collected on the survey are forwarded to cognizant Navy, DOD, and national data respositories after completion of the analyses. At the present time, sub-bottom profile records and all oceanographic data are forwarded to NODC. Bathymetric and magnetic

records are retained within the recognized repositories of the Oceanographic Office. Core samples and/or undisturbed core halves are stored in the newly established Oceanographic Office core library. Synoptic reports of BTs, surface weather, and other oceanographic data are forwarded, as directed, to the appropriate Fleet Weather Center.

The recently completed Sea of Japan survey represents an example of the actual survey of one of the assigned task areas. It was unique in that it was an enclosed sea and a great deal of data already existed. Although the survey began in October 1967 and was not completed until June 1968, the two ships did not remain in the Sea during that full period. Although twelve months of ship time are normally programmed for a task area, eight months of ship time were utilized here.

Figure 7 depicts the physiographic provinces determined from bottom topographic conditions known before the survey began. Over 7000 miles of underway tracks were run on the reconnaissance phase, and, as shown in Figure 8, 19,650 miles of underway track throughout the entire survey. Figure 9 shows the location of the oceanographic stations made. A composite Field Data Summary Sheet (same as Figure 2) for the entire survey is shown in Figure 10. Four Ocean Cruise Summaries (OCS) were completed for all cruises. The final Oceanographic Survey Reports summarizing the results of all data collected will be distributed in the autumn of 1969. The amounts and types of data collected and reports are representative of a Task Area even though this particular area is somewhat unique. Successive area reports will show the results of improvements already made in data collection techniques and instrumentation as well a data from additional parameters added to the survey. It is emphasized that the track and station densities shown for the Sea of Japan are not necessarily typical. In each area the number and spacing of tracks and stations are defined by analysis of the historical model. Procedures are varied, and measurements will be defined and modified in response to requirements arising from the presurvey planning and operational needs.

Table I outlines the overall measurement and sampling program and some of the applications of the Deep Ocean Survey Project. As new requirements are generated and new instruments produced, the measurement capability of ships assigned to the project will increase. Plans and studies for reducing data acquisition, processing time, and cost through development of new integrated techniques and systems are a continuing effort.

SUMMARY

The Deep Ocean Survey Project provides for the collection, processing, analysis, storage, display, and dissemination of oceanographic information to assist the U. S. Navy in fulfilling its mission of controlling the strategic ocean areas of the world. The general theme of the project is to conduct multipurpose surveys to support multiple Navy needs. The hypothesis is that

narrow scope oceanographic surveys, which were accomplished to support specific weapons, have been unresponsive to general Naval ASW/USW requirements in the same strategic area. The project employs AGS ships full time for the purpose for which they were designed, namely, survey. The plan further proposes to attempt to place data acquisition on a production basis at sea and to effectively utilize ships, facilities, manpower, and money.

TABLE 1. ASW/USW MEASUREMENT PROGRAM

PROPERTY	NAVY APPLICATION	INSTRUMENT	INSTRUMENT ACCURACY
Acoustic Propagation loss	Fixed and mobile, short and long range sonar system performance prediction. Deployment of ASW systems. Future sonar design. Definition of acoustic domains.	Shooting ship: explosives and towed projectors. Receiving ship: hydrophones and acoustic recording system.	± 1 db
Normal incidence Acoustic bottom loss	Partial indicator of physiographic domains. Prediction of potential regional variation in bottom loss at grazing angles other than normal.	Normal incidence bottom reflectivity system including towed projector.	± 2 db
Ambient noise	Fixed and mobile, short and long range sonar system performance prediction. Future sonar design. Deployment of ASW systems.	Hydrophone array and acoustic recording system	± 3 db
Reverberation	Feasibility of acoustic detection of bottomed systems and vehicles. Prediction of sonar effectiveness. Prediction of signal-to-noise ratio. Prediction of anomalous propagation.	Explosives, projectors, hydrophones, and acoustic recording system.	± 3 db
Sound Velocity	Prediction of surface duct, convergence zone, and bottom bounce detection probabilities. Accuracy of echo sounding. Optimization of choice of sonar and mode of operation. Determination of acoustic paths.	Sound velocimeter.	± 0.3 meter/sec

TABLE 1. (CONT'D)

PROPERTY	NAVY APPLICATION	INSTRUMENT	INSTRUMENT ACCURACY
Surface temperature	Definition of oceanographic domains. Distribution of marine organisms. Environmental prediction.	Hull mounted or towed temperature probe.	± 0.1°C
Temperature	Sonar system effectiveness. Definition of oceanographic domains. Environmental prediction. Sea water density and conductivity.	STD Systems. Reversing thermometers Buoyed thermister arrays.	± .02°C ± .02°C ± .1°C
Salinity	Sound velocity, density, and conductivity determinations. Corrosion effects.	STD Systems. Salinometer.	± 0.02 °/.. ± 0.01 °/..
Chemical composition:	Biological productivity. Corrosion. Sound absorption.		
Dissolved O_2		Gas chromatograph	± 1%
Reactive phosphate		Spectrophotometer	± 1%
Reactive silicate		Spectrophotometer	± 1%
pH		pH meter	± .02 ph unit
CO and total alkalinity		Gas chromatograph	± 1%
Nitrate-Nitrite		Spectrophotometer	± 1%
Biological: Nekton Plankton Benthos Bacteria	Volume reverberation. False sonar targets. Biological productivity. Prediction of ambient noise. Prediction of fouling and corrosion. Prediction of bioluminescence.	Echo sounder. Nets, trawls, dredges, water samplers, and cameras.	± 2.5 fathoms

TABLE 1. (CONT'D)

PROPERTY	NAVY APPLICATION	INSTRUMENT	INSTRUMENT ACCURACY
Subsurface currents	Deep submergence. operations. Definition of oceanographic domains. Towed sonar operations. Prediction of dispersion of contaminants. Prediction of scour around bottomed objects.	Buoyed current meter arrays.	Speed ± .05 knot Direction ± 10°
Gravity	Inertial navigation	Gravimeter.	± 5 milligals
Total geomagnetic field	Magnetic detection system performance prediction. Mining and mine countermeasure operations. Definition of geophysical domains.	Magnetometer	± 1 gamma
Water depth	Sonar system prediction and effectiveness. Bottom reverberation. Maritime safety. Navigation. Cable routing and underwater site determinations.	Echo sounder.	± 1% of total depth
Bottom composition and structure	Sonar system performance prediction. Cable routing and site selection for underwater installations. Definition of physiographic domains. Prediction of bottom stability.	Seismic profiler. Cores and dredges Cameras	

TABLE 1. (CONT'D)

PROPERTY	NAVY APPLICATION	INSTRUMENT	INSTRUMENT ACCURACY
Sediment compressional wave velocity	Prediction of acoustic propagation loss, and bottom sound speed.	Sediment sound velocimeter.	± 25 ft/sec.
Heat Flow	Heat budget studies.	Thermistor probe.	± 0.1°C
Radioisotopic:	Nuclear weapon effects. Age and movement of water masses. Methods and location for radioactive waste disposal. Definition of radioactivity properties of the sea.	Large volume sea water sampler, plankton net tows, special corers, and samplers.	---
Surface weather and sea conditions	Synoptic forecast.	Visual observations, standard meteorological instruments.	---

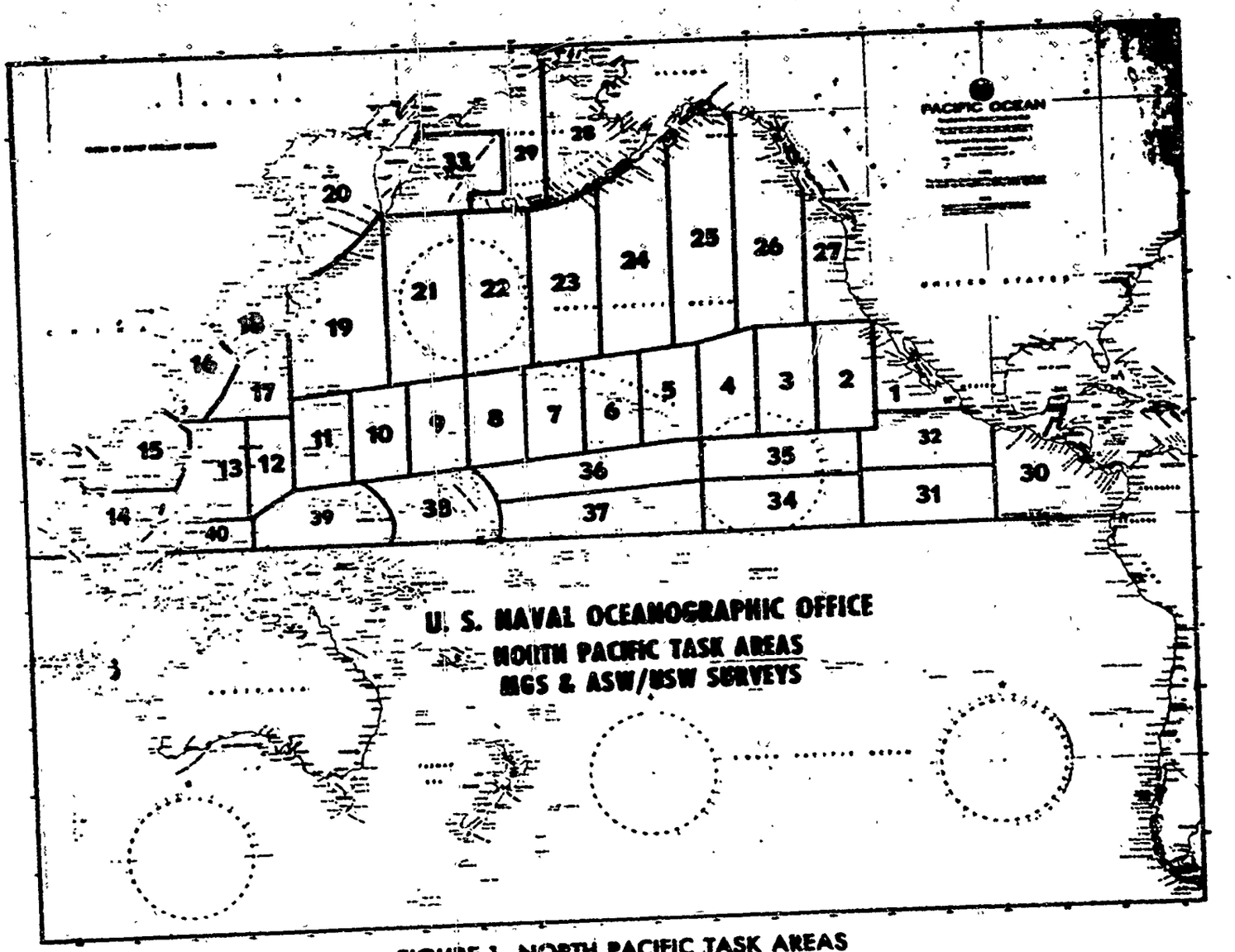


FIGURE 1 NORTH PACIFIC TASK AREAS

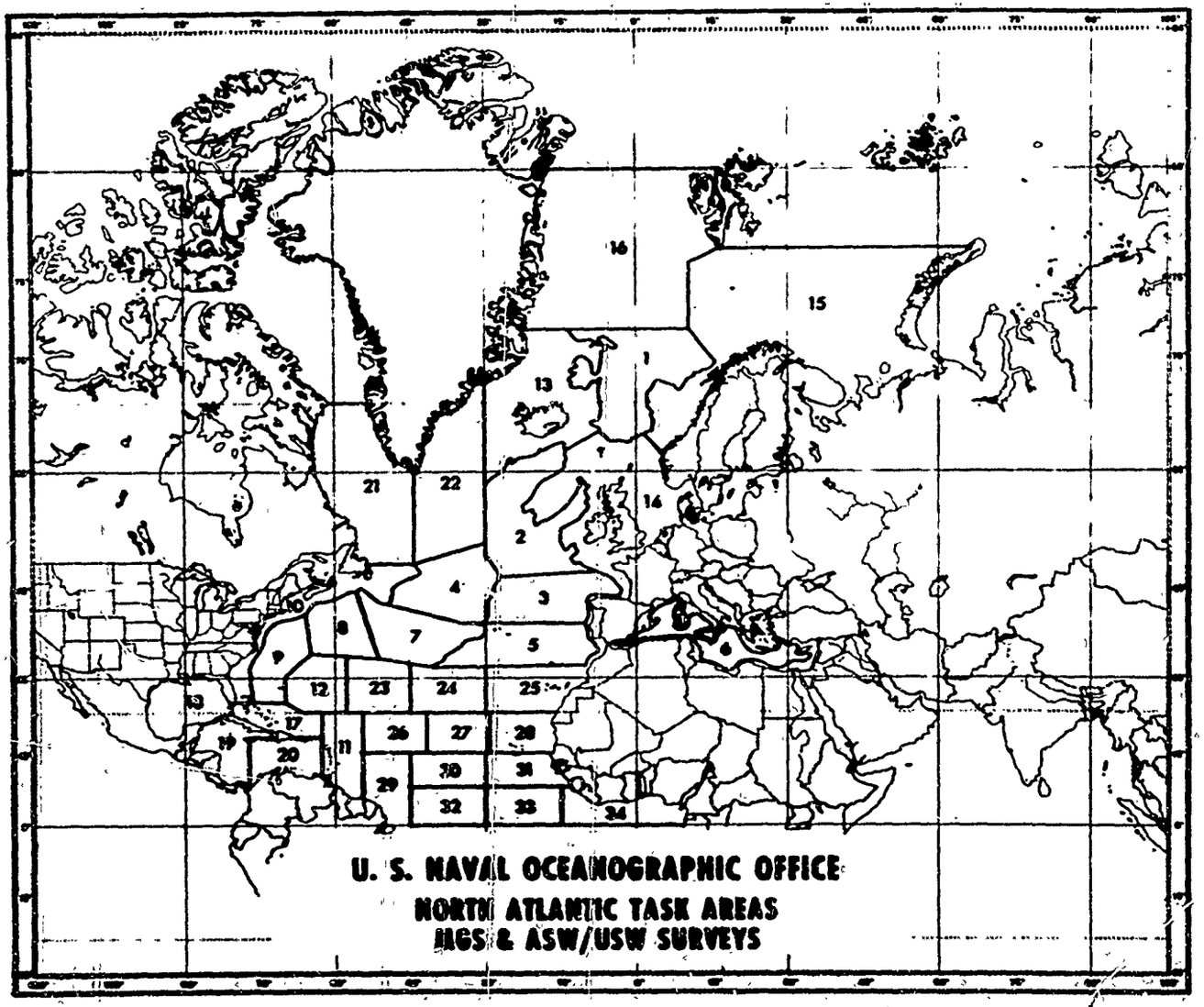


FIGURE 2 NORTH ATLANTIC TASK AREAS

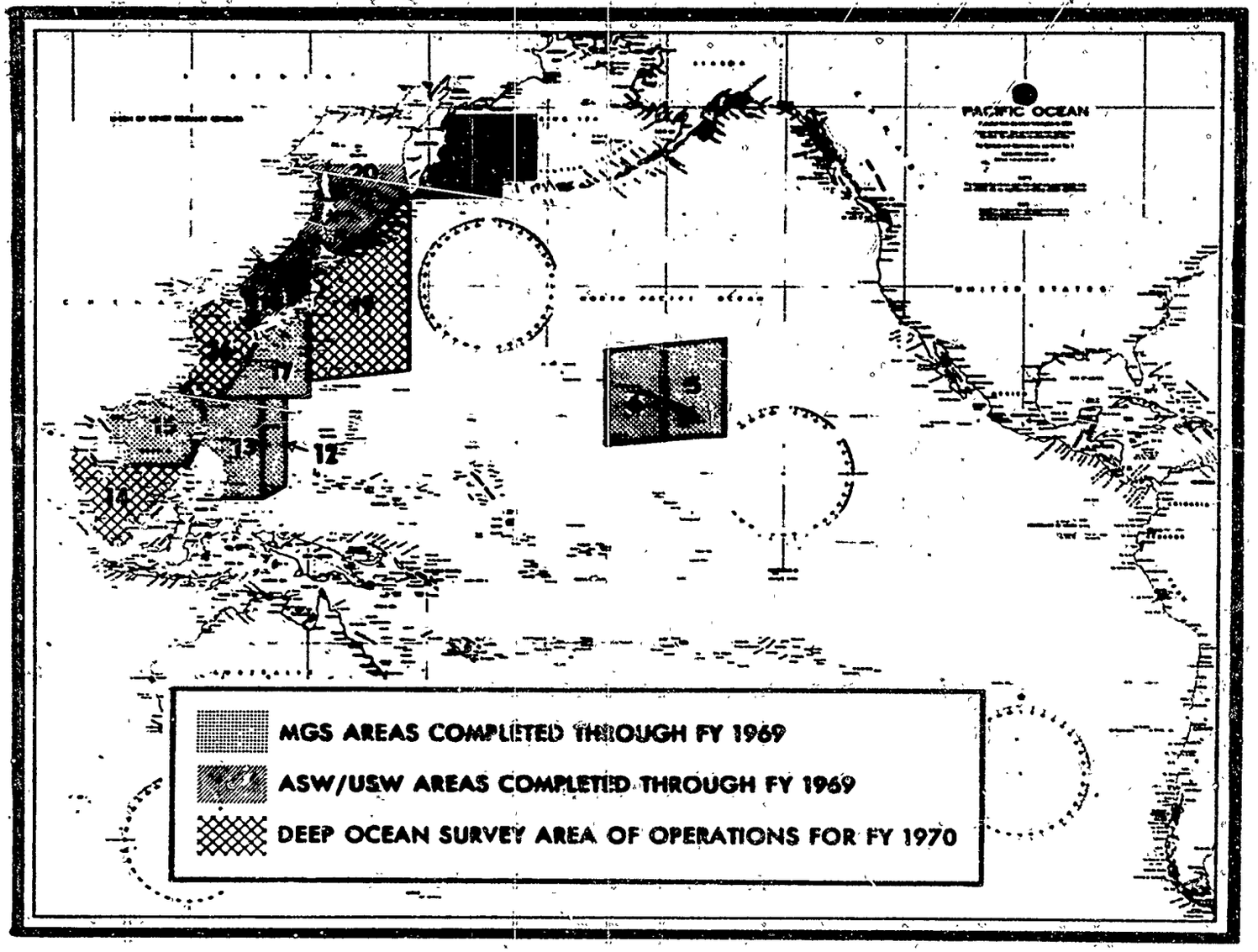


FIGURE 3 NORTH PACIFIC TASK AREAS STATUS CHART

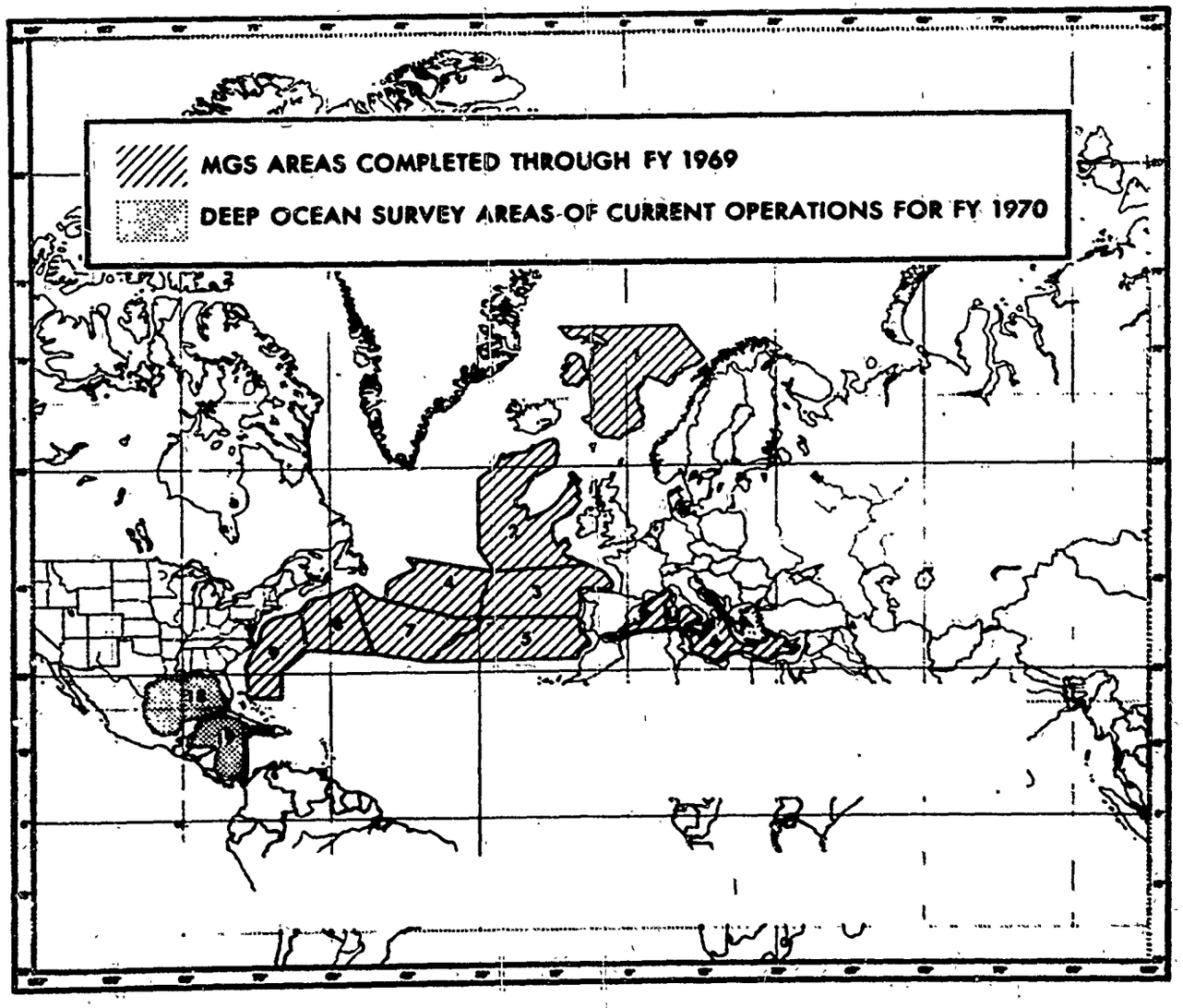


FIGURE 4 NORTH ATLANTIC TASK AREAS STATUS CHART

FIELD DATA SUMMARY SHEET
NAVOCEANO-3167/92 (Rev. 5-68)

These data (are) (are not) part of the U. S. Declared National Program.

U. S. NAVAL OCEANOGRAPHIC OFFICE
OCEANOGRAPHIC SURVEYS DEPARTMENT

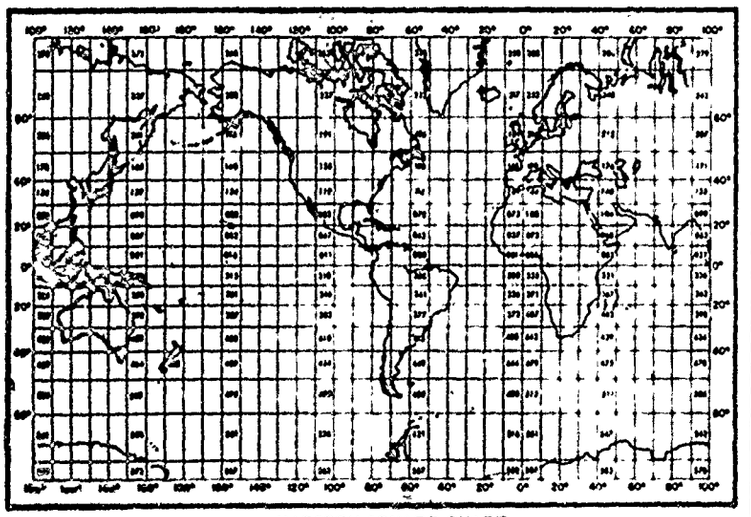
Security classification of this sheet. GR

OPERATION NO.	SHIP/STA.	AREA
DATES START _____ END _____	PARTY CHIEF	COORDINATOR

OTHER LABORATORIES

DESCRIP. OCEAN.	NO.	F*	*	GEOL. & GEOPHYS.	NO.	F*	*	CURRENT MEAS.	NO.	F*	*	AIR-SEA INTER.	NO.	F*	*
Nansen <2000m				Susp Sed				Cur Drog				Sea/Swell			
Nansen >2000m				Cores				Cur Sta				Pyrheliom			
Mech BT				Grabs								Sea Sur T			
Expend BT				Dredges				BIOLOGY	NO.	F*	*	Ice Obs			
Bottom Temp				Camera TV				Plankton St							
S/V-D Sta				Camera Still				Fouling St							
S/V-D-T				Bottom Res				Trawls				VISIBILITY	NO.	F*	*
S/VDT Sal				Sathy Data								Turbidity			
Sal Sample				Gravity				OTHER	NO.	F*	*	Sec Disc			
Oxygen				Subbot Prof				Bot Pres Fl				Alphameter			
Phosphate				Magnetom				Heat Flow				Transp			
Nitrate												Water Color			
Nitrite															
Silicate				ACOUSTIC MEAS.	NO.	F*	*	Buoyed Arrays							
pH				Acoustic St				Hours current obs _____ Hours Temp obs _____							
Trace Elem								Other _____							
Radiolectops															

CRUISE NARRATIVE



MARSDEN SQUARE CHART

Schedule for reports publication:
IR _____
LTR _____
TR _____
OTHER _____

F* Final data format:
MT (BCD mag tape), PPT (BCD punched paper tape), AMT (Analog mag tape), AC (Analog strip chart), AS (Analog glass slide), ML (Manual log sheet), DP (Digital print out), LR (Lab report sheet), P (X, Y plots), TPT (Teletype coded punched paper tape), F (Film), or

XX:

YY:

* Final disposition of processed data other than reports: Enter N if to NODC; if not, enter B (Bathymetry), G (Gravity), M (Magnetics), S (Smithsonian Sorting Center), or

X:

Y:

Z:

FIGURE 5 FIELD DATA SUMMARY SHEET

OUTLINE FOR OCEANOGRAPHIC CRUISE SUMMARY

I. PREVIOUS KNOWLEDGE OF THE REGION
(Refer to appropriate document if published separately)

II. OBJECTIVES OF THE CRUISE
(In terms of why the data are needed, not merely what data will be collected.)

III. NARRATIVE OF THE CRUISE
(Include graphics showing tracks and working areas. Put location map on IR cover.)

IV. METHODS OF COLLECTION AND ANALYSIS

A. Physical Oceanography
B. Chemical Oceanography
C. Geological Oceanography
D. Biological Oceanography
E. Other Observations

V. DISPOSITION OF DATA
(When and Where Available: Categorize as in IV, A-E)

VI. PRELIMINARY ANALYSES

A. Description of Significant Findings
B. Station Summary (Table I)
C. Cross Sections (Temp., Sal., and S. V.)
D. Typical BT's
E. Bottom Sediment Sample Field Descriptions (M Sheet)
F. Investigation of Charted Doubtful Dangers to Navigation
G. Special Observations

VII. ADDITIONAL WORK NEEDED IN THE REGION

FIGURE 6 OCEAN CRUISE SUMMARY OUTLINE

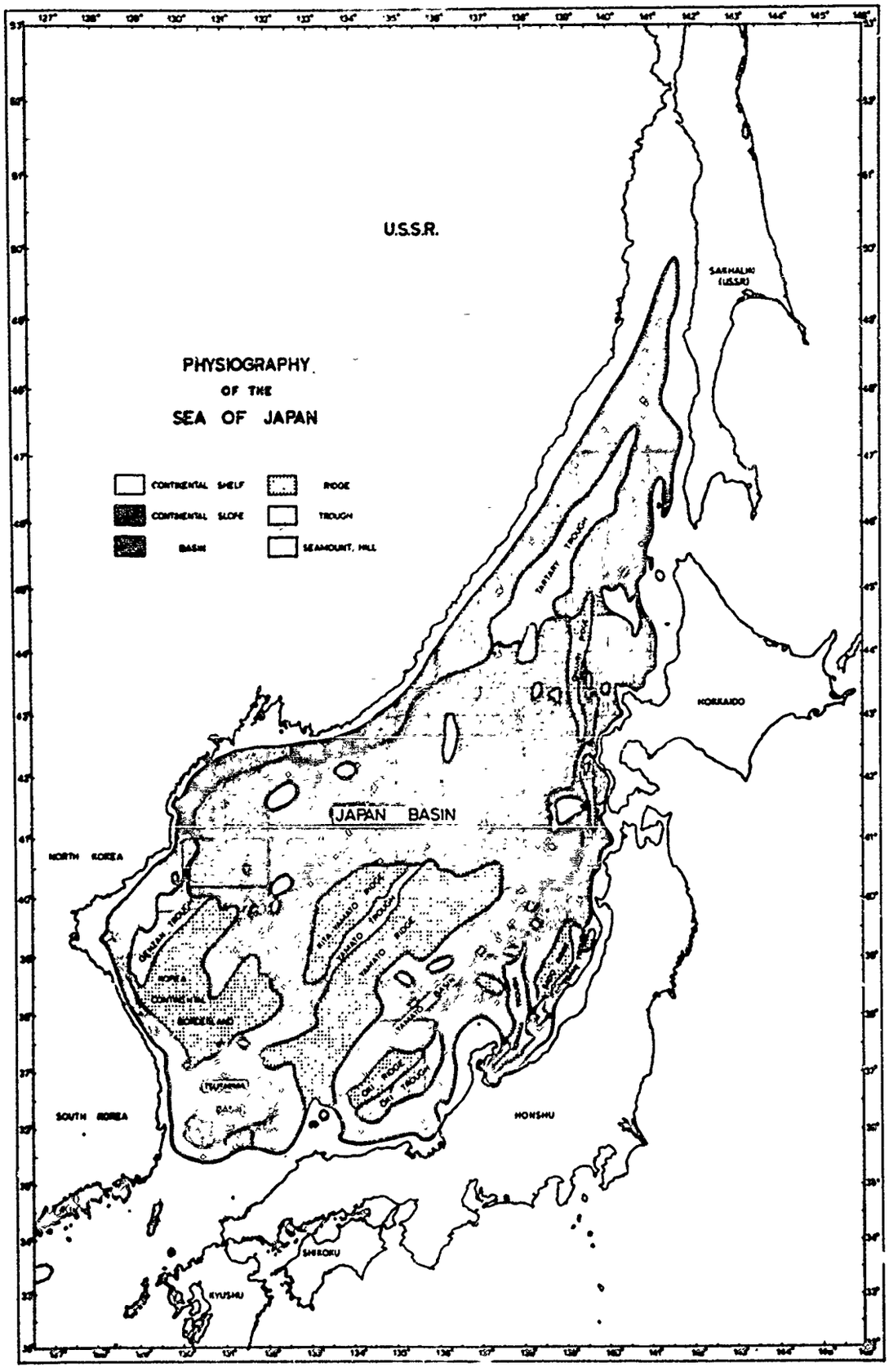


FIGURE 7 SEA OF JAPAN PHYSIOGRAPHIC PROVINCE CHART

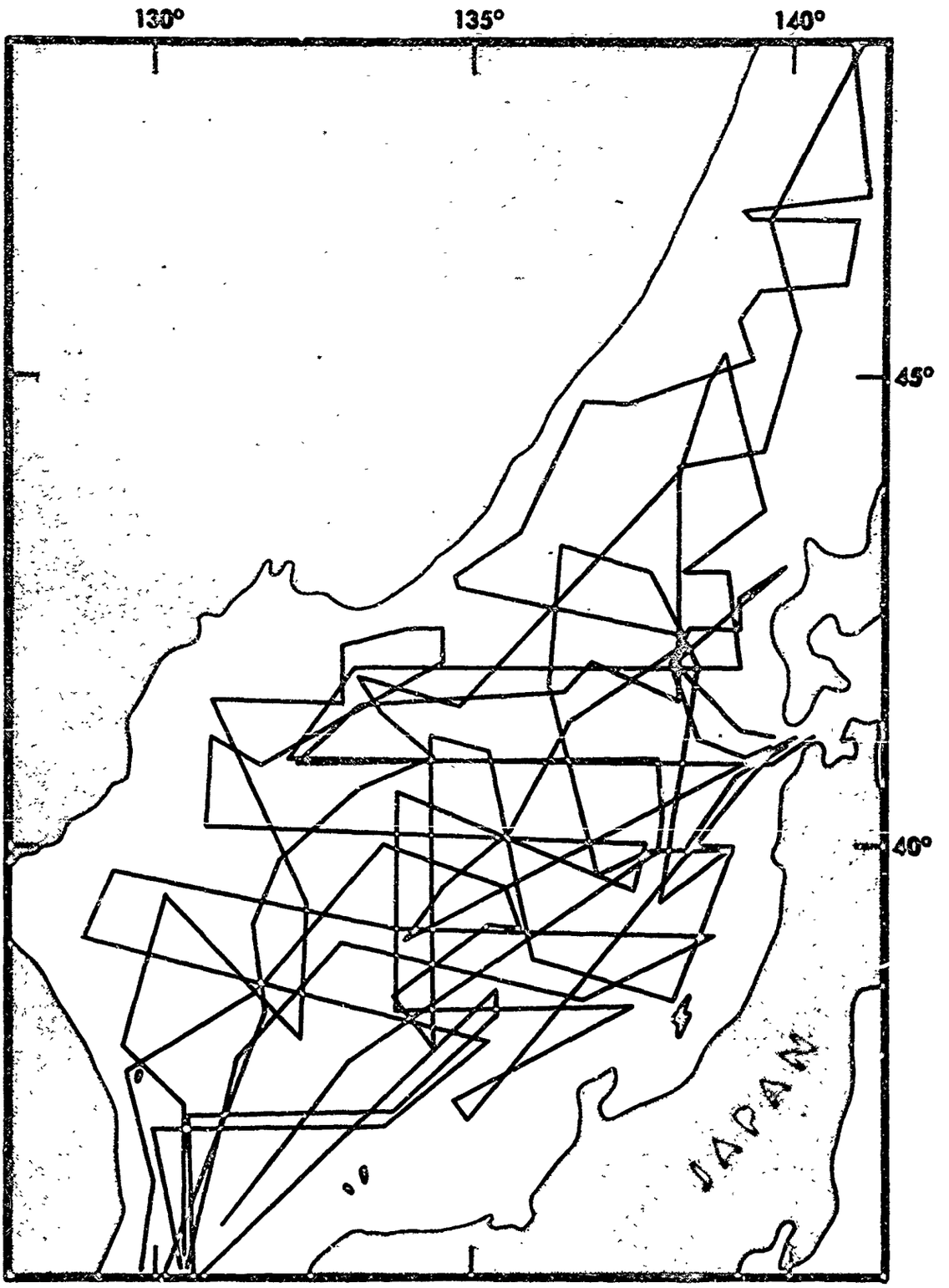


FIGURE 8 TRACK CHART, SEA OF JAPAN
OCTOBER 1967—JUNE 1968

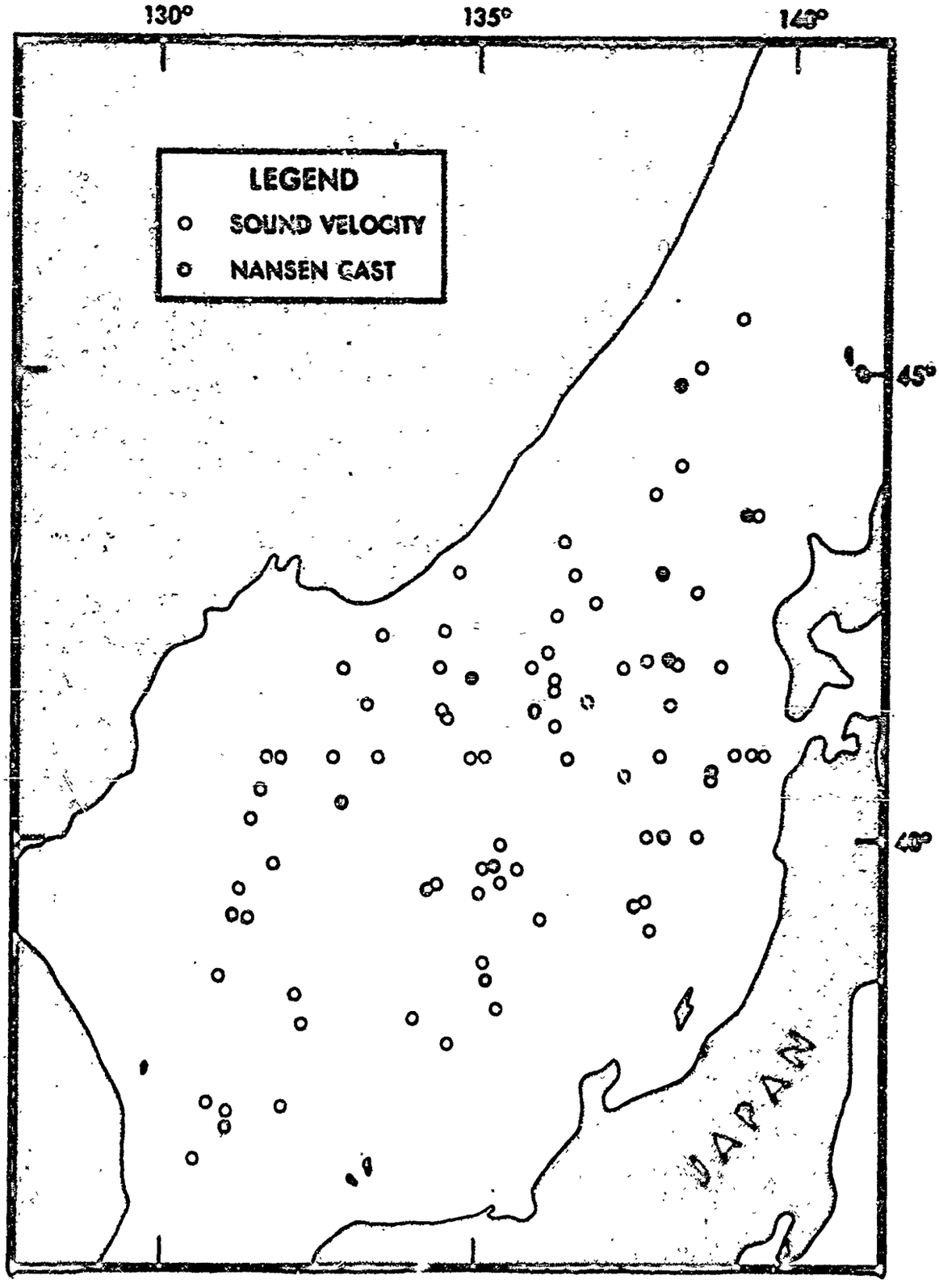


FIGURE 9 STATION LOCATIONS, SEA OF JAPAN, OCTOBER 1967—JUNE 1968

FIELD DATA SUMMARY SHEET
NAVOCEANO-3147/82 (Rev. 6-63)

These data (are/are not) part of the U. S. Declared National Program.

U. S. NAVAL OCEANOGRAPHIC OFFICE
OCEANOGRAPHIC SURVEYS DEPARTMENT

UNCLASSIFIED
Security classification of this sheet: CS

Operation No.: 938000 | Ship/Plane: USNS BENT/R/V EWNT | Area: Sea of Japan

Dates: Start 14 Sept 1967, 26 May 1968

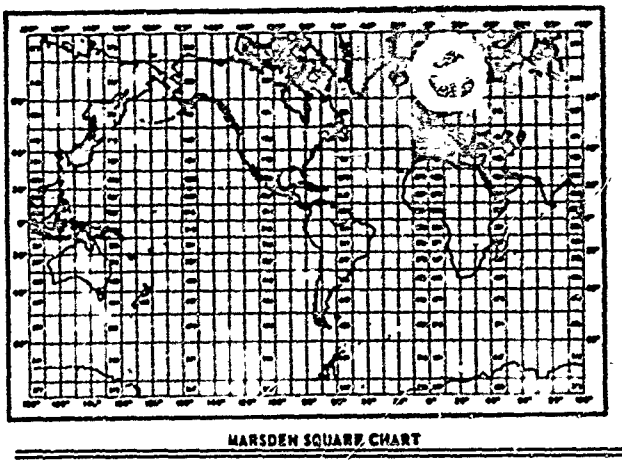
Other Laboratories:

DESCRIP. OCEAN.	NO.	F*	*	GEOL. & GEOPHYS.	NO.	F*	*	CURRENT MEAS.	NO.	F*	*	AIR-SEA INTER.	NO.	F*	*
Depths <2000m	10	XL	N	Scan Sos				Cur Drog				Sea/Swell			
Depths >2000m	5	MT	N	Cores	23	LR	N	Cur Sta				Pressure			
Bench ST				Grabs								Air Sur T	MACCOP		N
Expend ST	326	AC	N	Dredges	2	LR	N	BIOLOGY	NO.	F*	*	Ice Obs			
Bottom Temp				Camera TV				Plankton St							
S/V-D Sts				Camera Still				Fouling St							
S/V-D-T	75	EPT	N	Bottom Res				Travels				VISIBILITY	NO.	F*	*
S/VDT Sal	17	MT	N	Body Data	1680	AC	B					Turbidity			
Sal Sample	241	LR	N	Gravity				OTD	NO.	F*	*	Sec Disc			
Oxygen				Subbot Prof	32600	AC	N	Sur Prod Fl				Alphometer			
Phosphate	241	LR	N	Magnetom	4300	MT	N	Heat Flow				Transp			
Nitrate	241	LR	N									Baric Color			
Nitrite															
Silicate	241	LR	N	ACOUSTIC MEAS.	NO.	F*	*	Buoyed Arrays							
pH				Acoustic St	26	MT	X	Hours current obs 832				Hours Temp obs 636			
Trace Elem				Cont. N.I. Refl	8000	X		Other							
Radioisotope															

CRUISE NARRATIVE

This was a multipurpose Deep Ocean Survey in Task Area 18, Sea of Japan with the USNS BENT and the R/V Z.V. EWNT. Both ships operated during various periods from October 1967 through June 1968 for a total of approximately eight months ship time. During the period April-May 1968, the ships operated together in the acoustic phase, collecting about 3500 miles of underway data during which some of the ship tracks have only slight separation. Navigation was primarily by Loran A, with checks made when possible by Loran C, radar and celestrial methods. Principal ports of call were Sasebo and Hokodate, Japan. All data are part of the U.S. Declared National Program except for the acoustic station data.

(This Field Data Summary Sheet is a composite of all or parts of Operation Numbers: 938005, 938010, 938019, 938021, 938023, 938025, & 938029.)



MARSDEN SQUARE CHART

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F* Final data format:
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FIGURE 10 COMPOSITE FIELD DATA SUMMARY SHEET, SEA OF JAPAN

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13. ABSTRACT

The DEEP OCEAN SURVEY PROJECT OF THE U. S. NAVAL OCEANOGRAPHIC OFFICE IS A MULTI-PURPOSE SURVEY WHOSE PURPOSE IS TO OBTAIN INFORMATION IN ALL STRATEGIC AREAS TO SUPPORT NAVY REQUIREMENTS, AND ADDITIONALLY, TO CONTRIBUTE INFORMATION BENEFICIAL TO THE SCIENTIFIC AND ECONOMIC COMMUNITY. OCEANOGRAPHIC, GEOPHYSICAL, AND ACOUSTIC DATA ARE COLLECTED FROM SHIPS OPERATING BOTH IN THE NORTH PACIFIC AND THE NORTH ATLANTIC OCEANS. MAJOR PORTIONS OF THE NORTH ATLANTIC AND THE WESTERN NORTH PACIFIC HAVE BEEN SURVEYED UNDER THE TWO TASKS WITHIN THE PROJECT, THE MARINE GEOPHYSICAL SURVEY (MGS) PERFORMED BY CONTRACTORS, AND THE ANTI-SUBMARINE WARFARE/UNDERSEA WARFARE SURVEYS (ASW/USW) PERFORMED BY OCEANOGRAPHIC OFFICE PERSONNEL ABOARD MILITARY SEA TRANSPORTATION SERVICE (MSTS) AND CHARTER VESSELS. REPORTS OF THE DATA ARE PUBLISHED WITHIN A YEAR AFTER COMPLETION OF THE SURVEYS AND THE ORIGINAL DATA ARE FORWARDED TO ESTABLISHED DATA REPOSITORIES AFTER ANALYSIS ARE COMPLETED.

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GEOPHYSICAL DATA						
ACOUSTICAL DATA						

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