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WAVE INFORMATION STUDY FOR U. S. COASTLINES

Report 1

SURFACE PRESSURE FIELD RECONSTRUCTION FOR WAVE HINDCASTING PURPOSES

by

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Report 1 of a Series

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Two sources of sea-level pressure data were used to develop a valid pressure field for wave hindcasting purposes. The fundamental information was supplied by Meteorology International Inc. (MII) on a 63 by 63 grid covering the Northern Hemisphere. Supplemental data were taken from National Weather Service (NWS) synoptic surface charts. Comparisons of MII data and

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20. ABSTRACT (Continued).

NWS data indicated that the MII data are incompatible with pressure measurements near storm systems; therefore, the MII data were supplemented with NWS data in two specific areas. For storms within a specified area near the U. S. Atlantic coast, the pressure field was represented by NWS data in a fixed-area grid. For storms outside the fixed-area grid, the pressure field was reconstructed from MII data blended with NWS data.

PREFACE

In late 1976, a study to produce a wave climate for U. S. coastal waters was initiated at the U. S. Army Engineer Waterways Experiment Station (WES). This study was authorized by the Office, Chief of Engineers, U. S. Army, as a part of the Field Data Collection Program which is managed by the U. S. Army Coastal Engineering Research Center. The U. S. Army Engineer Division, South Atlantic, and the U. S. Army Engineer Division, New England, also authorized funds during the initial year of this study (FY 1978) to expedite execution of the Atlantic coast portion of this program.

This report is the first in a series of four reports and will examine available data and techniques for constructing pressure fields. The study was conducted in the Hydraulics Laboratory under the direction of Mr. H. B. Simmons, Chief of the Hydraulics Laboratory, Dr. R. W. Whalin, Chief of the Wave Dynamics Division, Mr. C. E. Chatham, Jr., Chief of the Wave Processes Branch, and Dr. D. T. Resio, Project Manager. This report was prepared by Messrs. W. D. Corson, D. T. Resio, and Dr. C. L. Vincent.

Commanders and Directors of WES during the conduct of the study and the preparation and publication of this report were COL John L. Cannon, CE, and COL Nelson P. Conover, CE. Technical Director was Mr. F. R. Brown.

SUMMARY

In late 1976 a study to produce a wave climate for U. S. coastal waters was initiated at the U. S. Army Engineer Waterways Experiment Station. This climatological information is to be produced by numerical simulation of wave growth, propagation, and decay under historical wind fields. It is imperative, if such an approach is to be used for applications of significant economic consequences, that the entire set of input data, all numerical techniques, and all general assumptions be thoroughly investigated and documented to determine the types and magnitudes of errors intrinsic to their use.

There are four basic steps in the calculation of waves from past meteorological data. First, pressure data must be assimilated into a pressure field that depicts all important synoptic weather features. Gradients of pressure in time and space, along with certain thermal characteristics of the planetary boundary layer, are then used to construct an estimate of a quasi-geostrophic wind speed and direction at some level where it is assumed that the frictional effects of the ocean surface on the atmosphere is negligible. Next, an analysis of the vertical variation of the wind in the planetary boundary layer is used to reduce this wind to a common 19.5-m level. Finally, these surface winds are input into a numerical wave model to simulate wave generation, propagation, and decay.

If any one of the above steps contributes significant bias (on a geographical basis, seasonally or overall), it can introduce errors into the results that are difficult or even impossible to remove. Similarly, if any step contains a large random error, certain statistics (such as duration curves, extremes, and conditional probabilities) can be seriously affected. Thus, each step must be checked independently where possible. This serves to substantiate the merit of the physics and data processing techniques used in each step and hence tends to lend support to the worth of the final product more so than the performance of only wave comparisons, regardless of how extensive these comparisons may be. Indeed, if each step is shown to be physically valid, it can be argued

that the results should be as accurate in sites where there are no wave data for verification as they are in areas where large amounts of gage data are available. Additionally, if all steps are modeled correctly, factors such as direction and angular spreading, which are not generally available for comparisons, can reasonably be assumed to be at least approximately correct.

There will be four reports in this series. The first will examine available data and techniques for constructing pressure fields. Since there are few sets of data available with large samples of wind speeds at the geostrophic level, particularly since this level fluctuates in accordance with the dynamics of winds in the planetary boundary layer, the second report combines the estimation of winds at the geostrophic level and the reduction of these winds to the surface level into one step which is then compared with observations of winds near the surface. The third report discusses the formulation of a wave hindcast model in terms of nondimensional growth characteristics and behavior under hypothetical wind fields. The final report will compare the hindcast waves, using the constructed oceanic wind fields, with measured wave spectra. This last report is consequently the report that documents the cumulative effects of the errors from all four steps in the hindcast procedure. It is our belief that numerical modeling of surface waves represents an evolution toward a more reliable means of obtaining wave information for climatological purposes. Coupled with the concurrent evolution of statistical methods, data processing technology, and planning and design capabilities, this tool offers vastly improved ability to deal with coastal problems. Furthermore, by relating data to physical processes, an underlying understanding of the wave phenomena is gained. This can increase confidence in recognizing the significance of trends, distributions, and correlations among various data elements, which can, in turn, increase confidence in many basic planning, design, construction, operation, and maintenance decisions.

CONTENTS

WAVE INFORMATION STUDY FOR U. S. COASTLINES

SURFACE PRESSURE FIELD RECONSTRUCTION FOR WAVE HINDCASTING PURPOSES

PART I: INTRODUCTION

1. In the derivation of wind fields from historical weather records, it is important to use all information available to the maximum extent possible, since data density in both time and space can be somewhat sparse. Simultaneously, economy of effort is important in a study such as this where a 20-year record of wind fields over the Atlantic and Pacific Oceans as well as the Gulf of Mexico is being reconstructed. Consequently, some specialized sources of information that are difficult to incorporate into a machine-oriented analysis are not considered as a part of this effort. For example, there is a small quantity of observations which has not been included either in the initial construction of the northern hemisphere pressure fields or the tape files containing data from ships. This a priori decision was made with the understanding that if it were determined at a later stage in the study that significant errors could be avoided by supplementing our analyses with these data, then these data would be added to the analyses. This report describes the procedures used in preparing surface pressure field data for numerical wave hindcasting purposes.

PART II: AVAILABLE DATA

2. Most of the machine processible weather records available for the simulation of surface wind fields over the sea come from one of the three data files: (a) MII pressure fields, (b) EDIS tape deck TDF-11, and (c) EDIS tape deck TDF-14.

a. MII pressure fields. The Fleet Numerical Weather Center (FNWC) has contracted with Meteorology International Inc. (MII) to complete a file of hemispheric atmospheric fields on a 63 by 63 grid which overlays polar projections of the Northern and Southern Hemispheres. Data obtained from many sources are blended together to form an integrated file. Four observations per day for a period of more than 20 years are available in this format. The data, as presented, are uniformly distributed on the polar projection. The observational data, on which the gridded data are based, are unequally distributed in time and space. The methods used for data blending are described by Holl and Mendenhall.*

b. EDIS Tape Deck TDF-11. The Environmental Data Information Service (EDIS) of the National Oceanic Atmospheric Administration (NOAA) collects shipboard weather observations, including air and sea temperature, wind speed and direction and surface atmospheric pressure, "obtained from ship logs, ship weather reporting forms, published ship observations, automatic observing buoys, teletype reports and ... from several foreign meteorological services." These data are sorted by Marsden squares (ten degrees of latitude by ten degrees of longitude) and subsquares (one degree of latitude by one degree of longitude) and by date and recorded on digital computer tape. Data are reported worldwide but are frequently sparce in many areas. There is some redundance in the information available from TDF-11 and MII. TDF-11, however, is the only source for the air and sea temperature data needed to define the thermal stability of the atmosphere.

c. EDIS tape deck TDF-14. This data file contains airway surface observations including air temperature, wind speed and direction and atmospheric pressure adjusted to sea level. All stations are on land and only a few are near the coast, hence much of the wind data is not representative of overwater conditions.

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* M. M. Holl and B. R. Mendenhall. 1971. "The FIB Methodology and Application: Fields by Information Blending Sea-Level Pressure Version," Meteorology International Inc. Report for Fleet Numerical Weather Center, Monterey, Calif., under Contract No. N66314-70-C-5226.

3. If an attempt were made to estimate marine wind fields solely from the wind reports contained in TDF-11 and/or TDF-14, the results would often be quite broadly interpolated and probably highly erroneous. This is due in part to the data sparseness, in part to the difficulty in interpolating/extrapolating a vector field, and in part to the over-reliance sometimes on single wind-speed observations to fill in large regions of wind field over an ocean.

4. An alternate approach in obtaining marine wind fields follows from the physical relationships between pressure fields and surface wind fields. On a synoptic time scale, the winds near the earth's surface are driven primarily by three factors:

- a. The quasi-geostrophic wind located at some level where frictional effects of the earth's surface are considered negligible.
- b. The three-dimensional wind field in the planetary boundary layer.
- c. The roughness of the surface over which the wind is flowing.

Mathematics that describe the relationships of a parcel of air "to the pressure gradient, gravity, and the earth's rotation"* can be used with an accurate representation of the surface pressure field to calculate viable quasi-geostrophic winds. The first of the factors mentioned above will be determined from data developed by procedures described in this report.** After a preview of the characteristics of the available data, the surface pressure data from MII were chosen as the most applicable for a starting point in reconstructing surface marine pressure fields. A detailed description of this data set is given by Holl and Mendenhall.†

5. In order to determine if the sea-level pressure information directly available from MII was adequate for the wave hindcasting

* S. L. Hess. 1959. Introduction to Theoretical Meteorology, Holt, Rinehart and Winston Publishing Co., New York, p 362.

** The second and third factors will be discussed in Report 2 of this series.

† See footnote on page 6.

purposes of this study, a series of comparisons between MII and National Weather Service (NWS) data were performed and are presented in this section. The pressure fields for 21 extratropical storm systems (Table 1) were analyzed to determine the types and magnitudes of discrepancies between the MII and NWS analyses.

6. The storm systems were selected using methods that should not have biased the comparison of pressure field representation. Storms 1-6 were the initial systems prepared for comparison and were chosen from NWS synoptic surface charts to represent storms generated in the Gulf of Mexico or the Atlantic Ocean, affecting the U. S. Atlantic coast, and formed during various seasons. The remaining 15 systems analyzed were selected as periods of high winds and/or waves from gage records for the stations indicated in Table 1 and shown in Figure 1.

7. MII data were available for a 63 by 63 grid covering a polar projection of the Northern Hemisphere (Figure 2) at 6- and 24-hr intervals. The types of NWS surface charts used were the 3-hr interval North American chart and the 24-hr interval Northern Hemisphere chart.

8. The NWS Northern Hemisphere or North American synoptic charts were printed from microfilm and the MII pressure data were contoured on a drum plotter. Since only 24-hr interval Northern Hemisphere synoptic charts were available for the periods studied in the ocean stations "India," "Juliett," and "Kilo" areas, only 24-hr intervals could be analyzed. Most other storms were studied at 6-hr intervals (Table 1). The parameters used to examine the pressure data were chosen to be readily available from MII sea-level pressure data and NWS synoptic surface charts. After contour maps of the MII data and reproductions of the NWS pressure contours were prepared at the same scale, the storm geometries and pressures were studied.

9. Storm geometry was compared by overlaying the MII contoured pressure plots on the NWS charts (Figures 3-6; Appendix B). As can be seen from Figure 2, the MII 63 by 63 grid spacing remains constant over the Northern Hemisphere. One grid space is approximately equal

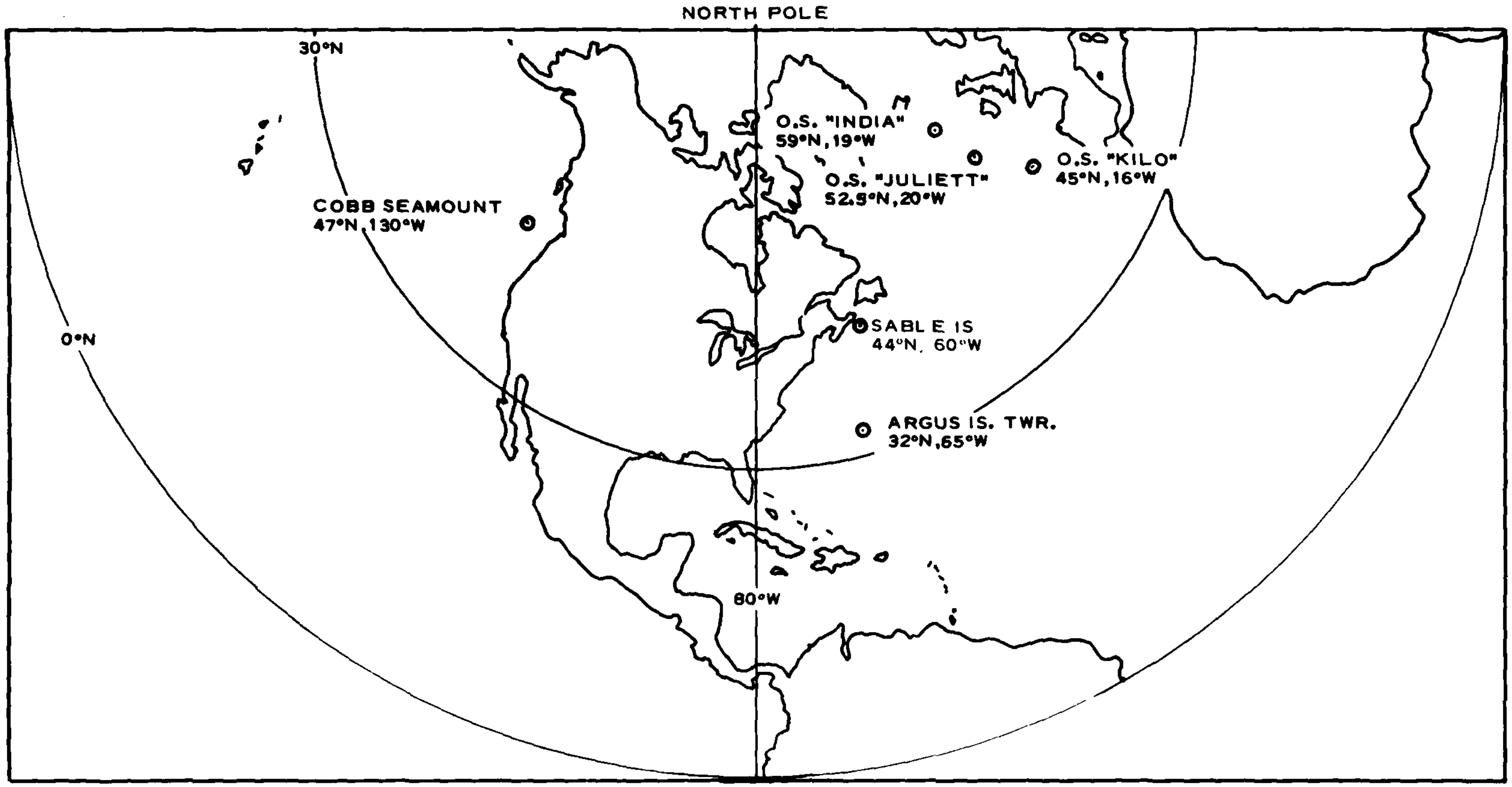


Figure 1. Location map of data stations

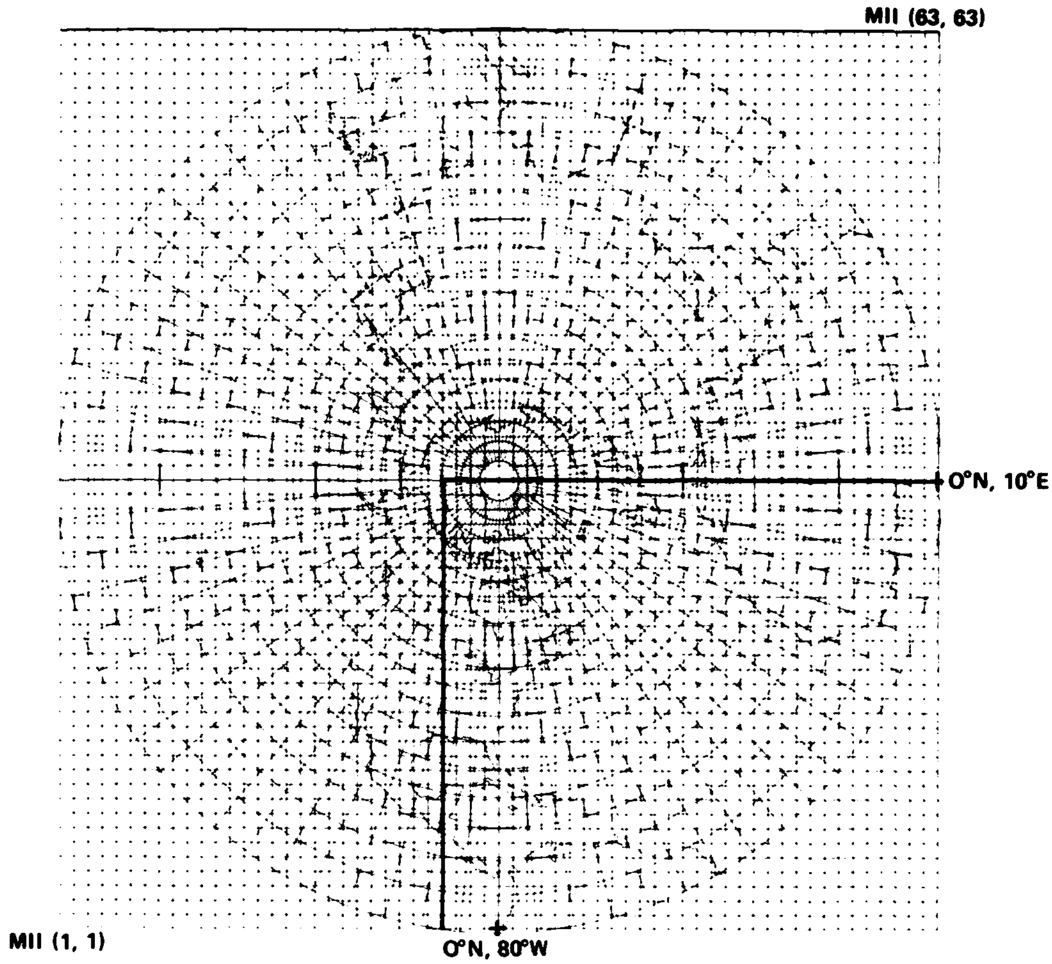


Figure 2. MII grid on polar projection of Northern Hemisphere

to 381 km at 60 deg north latitude.* After visual comparison of storm geometry, it became apparent that MII data consistently represented the interior portions of nearly all, and especially the more severe, storms as less intense than the NWS charts (Figures 3-6; Appendix B). The grid spacing of 381 km at 60 deg north latitude is too large to accurately depict the interior portions of the severe storms which are common in the higher latitudes. Due to the nature of the MII grid and to the

* Fleet Numerical Weather Center. 1974. "FNWC Computer User Guide," Monterey, Calif.

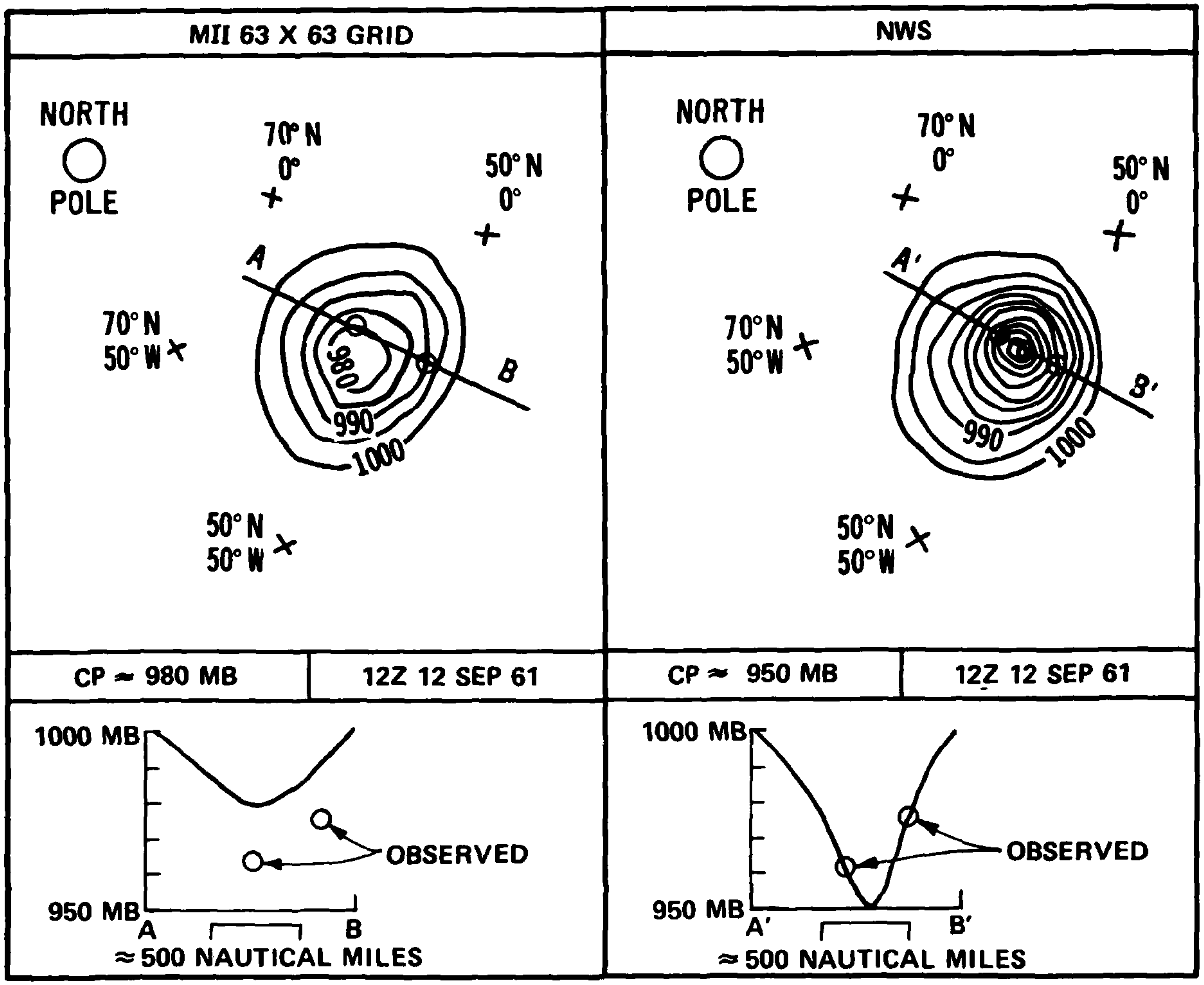


Figure 3. MII and NWS pressure field overlay with cross section and observed data for ocean station "Juliett" on 12Z 12SEP61

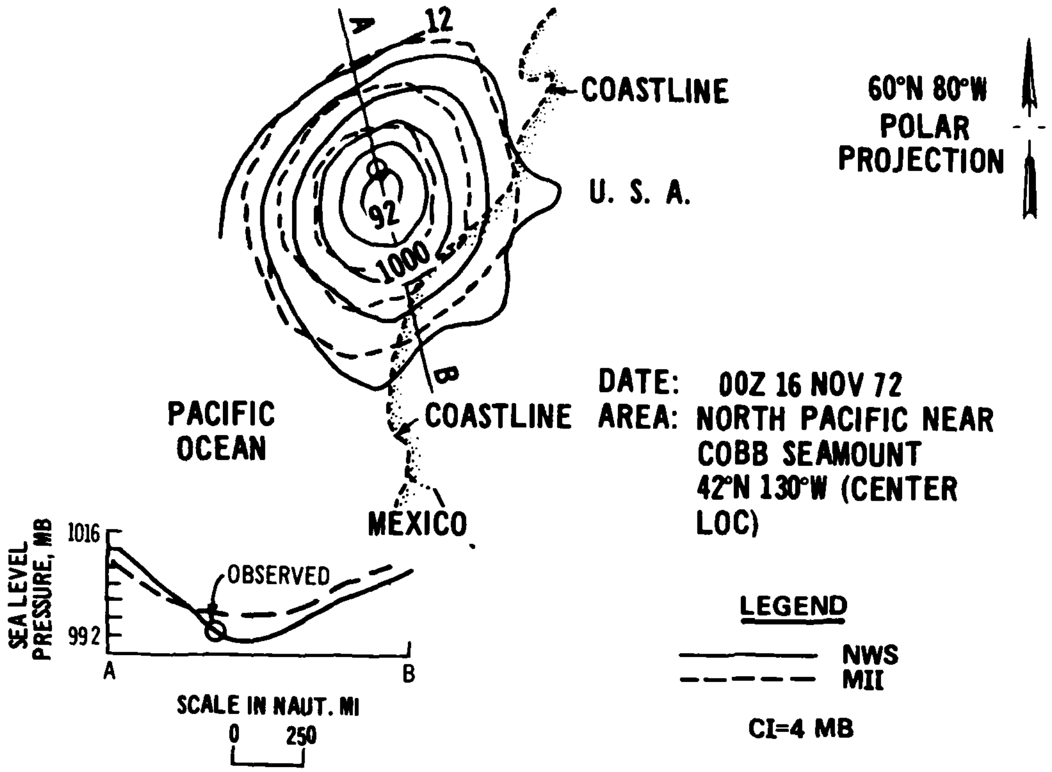


Figure 4. MII and NWS pressure field overlay with cross section and observed data for Pacific coast Cobb Seamount area on 00Z 16NOV72

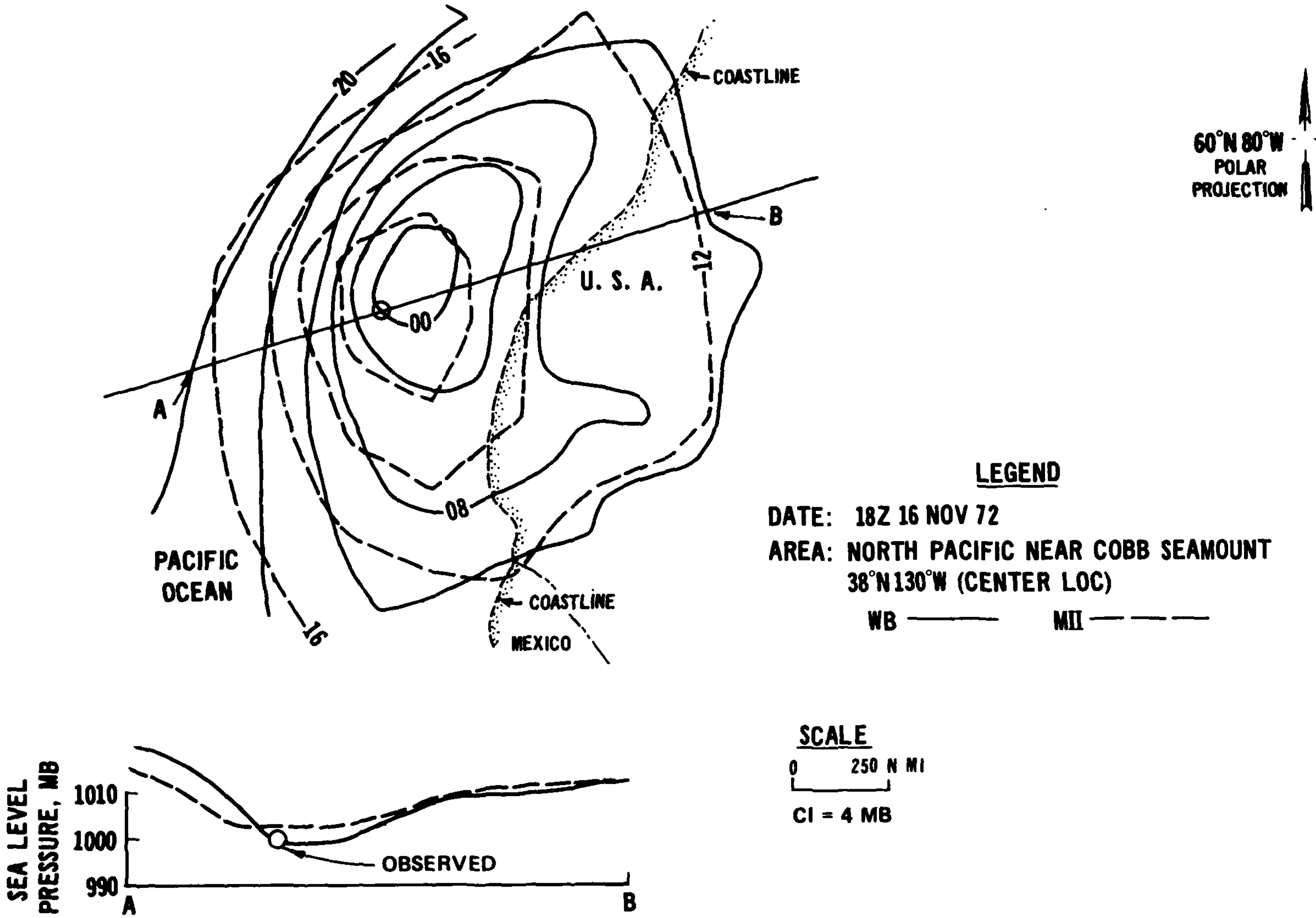


Figure 5. MII and NWS pressure field overlay with cross section and observed data for Pacific coast Cobb Seamount area on 18Z 16NOV72

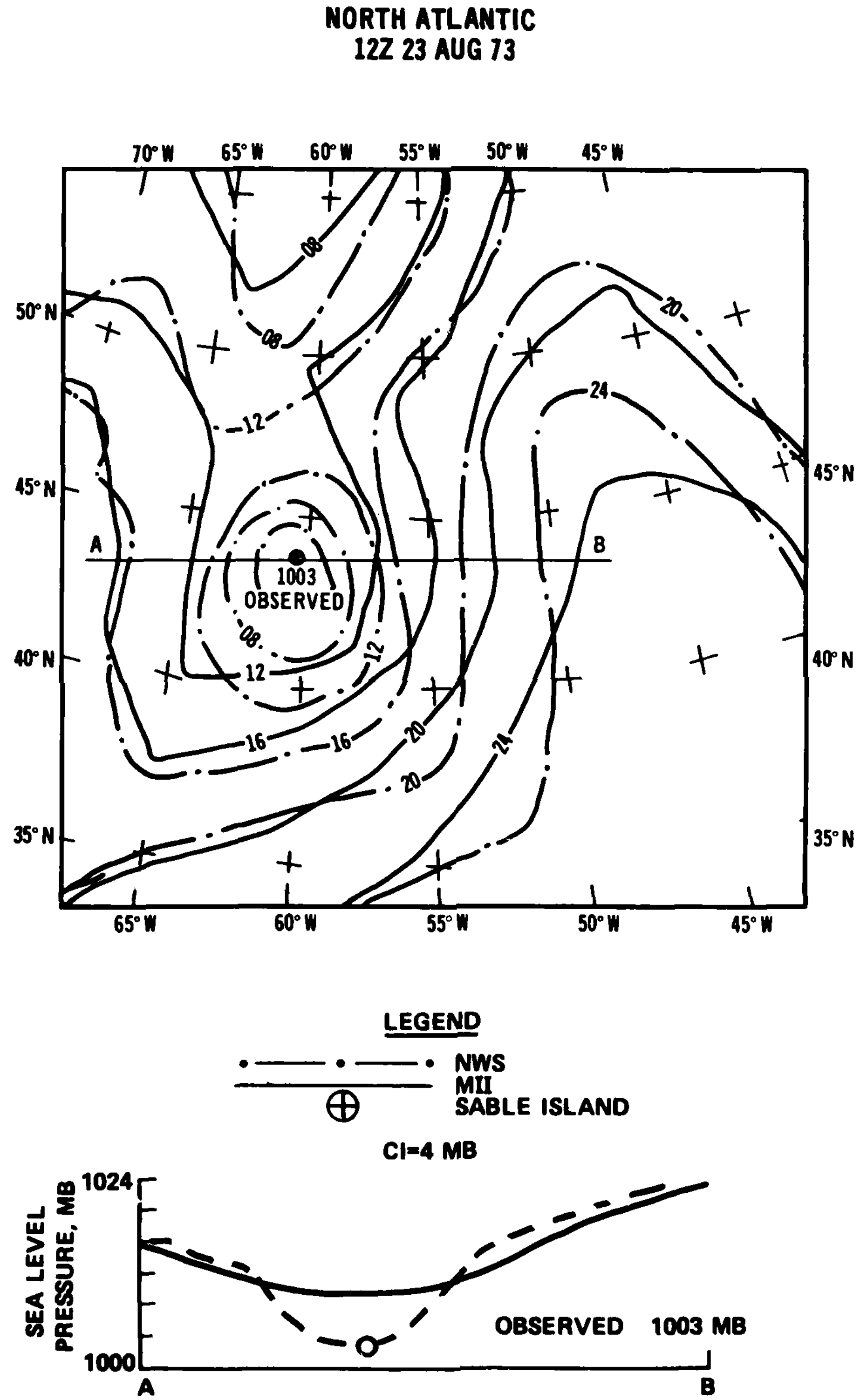


Figure 6. MII and NWS pressure field overlay with cross section and observed data for Atlantic coast Sable Island area, 12Z 23AUG73

typically less intense pressure gradients in lower latitudes, the MII data representation of storms in this region is more similar to the NWS representation than those in more northern latitudes (Appendix B, Plates B38-B42).

10. For MII and NWS data, the storms' lowest millibar contours were recorded as the central pressures (CP). Plots of the NWS CP versus MII CP show that MII consistently represents the storm central pressures higher than the NWS (Appendix C). During analysis of the central pressures, the observed sea-level pressure data presented on the NWS synoptic charts were compared with MII and NWS pressure field presentations (Figures 3-6). When possible, the history of the more severe storms was reviewed in the Mariners Weather Log and the Monthly Weather Review to discern if later analysis had changed the pressure field presented by the NWS. As seen in Figures 3-6, the NWS sea-level pressure data were consistently found to be compatible with observed data and hence are accepted as valid representations of storm pressure fields. On the other hand, MII discrepancies from the NWS pressure fields were found to be unsubstantiated and thus must be considered as a source of error in any geostrophic wind speeds calculated from these pressure fields.

PART III: DEVELOPMENT OF PRESSURE FIELDS FOR HINDCASTS

11. Once it was determined that the MII pressure fields did not suffice for a synoptic-scale representation of pressure gradients (and consequently not for an adequate wind field description for hindcasting), the question arose as to how to compensate for this problem in a manner that was both accurate and economical. After considerable effort in reviewing storms* in the Atlantic Ocean, it was determined that most of the problems with the MII pressure fields occurred in the western Atlantic near the east coast of the U. S. and Canada. The reason for this is that this region is one of rapid cyclogenesis, storm development, and storm movement; therefore, storm features tend to be smaller, more variable, and more changeable in time here than toward the eastern Atlantic. Since there did not appear to be a reliable means of transforming the MII pressure field into a NWS pressure field in this region, it was decided that the NWS pressure field would be digitized and that this digitized information would be overlaid on the MII data, with some blending on the edges to achieve some degree of continuity between the two fields. Figure 7 outlines the steps taken to produce the pressure field.

12. The base grid used in pressure field development is the area bounded by MII coordinates I (28 to 63) and J (1 to 32) on the 63 by 63 Northern Hemisphere grid (approximately the southeast quadrant shown in Figure 2). This grid area covers all of the North Atlantic and portions of the bordering continents.

13. As was shown in Part II, the spacing of the MII grid (381 km at 60 deg north latitude) is inadequate for the representation of important synoptic-scale storm features. As a first step in increasing the

* The term storm is used in this report when referring to extratropical cyclones (atmospheric depressions or low pressure systems) typically located along a front that separates two different air masses. No NWS pressure data from tropical cyclones (hurricanes or typhoons) are input into the pressure field. These storms will be treated in a separate analysis for wave heights and are thus excluded from entering into the pressure analysis here.

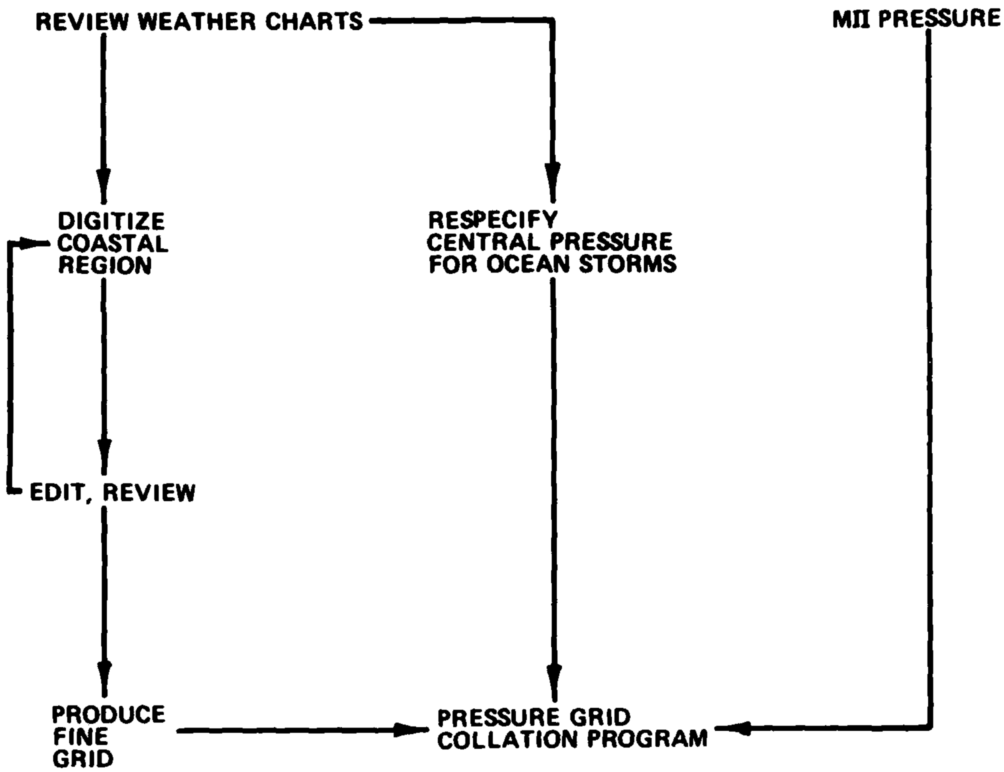


Figure 7. Pressure field development procedure

resolution of the pressure field, the 32 by 36 base grid is subdivided by a factor of 4 in both directions, creating a 125 by 141 grid into which additional information is blended (Figure 8).

14. Figure 9 shows that portion of the Atlantic in which storms appeared to have characteristics more appropriately represented by the NWS analyses (shown as Coastal Grid Border). This is also the region in the Atlantic in which storms affect the coastal U. S. in a local sense, i.e., through sea and not through swell. Consequently, this region is chosen as a fixed area that will be digitized if necessary. It is not necessary to digitize every weather map and blend this in, however, since not every day contains storm features of the type that are not well represented by the MII gridded pressures.

15. As noted previously, the MII pressure data become increasingly inaccurate as smaller scales are approached. Along the U. S. Atlantic coast, many small storms produce waves that can be significant

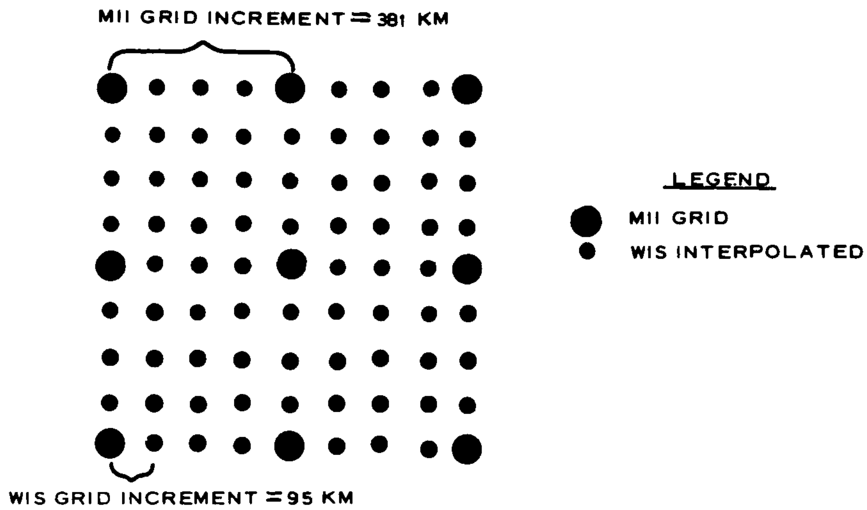


Figure 8. MII grid divided into $\frac{\text{MII}}{4}$ spacing

in terms of a climatological representation of coastal processes. In an effort to ensure an adequate description of these smaller storms as well as to achieve a better description of the larger storms, the following criterion was chosen as an objective guide to the selection of weather maps to be digitized.

16. The fixed area shown in Figure 9 would be digitized when a storm consisting of at least two closed isobars (at 4-mb intervals) was located with a center within this area. All storms of even moderate intensity that are overly smoothed by the MII analysis should be resolved in this process.

17. The fixed-area grid is aligned at 45 deg to the base grid in order to cover the area desired and to ease interpolation to a finer-than-MII grid spacing (Figures 9 and 10). NWS pressure data within the coastal grid are digitized from North American synoptic surface charts into a 33 by 21 array. However, this array does not have data points at all 1/4 MII grid locations. The array is interpolated to a 65 by 41 array that furnishes the data locations required to transfer the NWS data into the 1/4 MII grid system (Figure 10). Only NWS data are used within the fixed-area grid. Interpolation to MII data occurs only at the grid borders where the pressure data are linearly interpolated

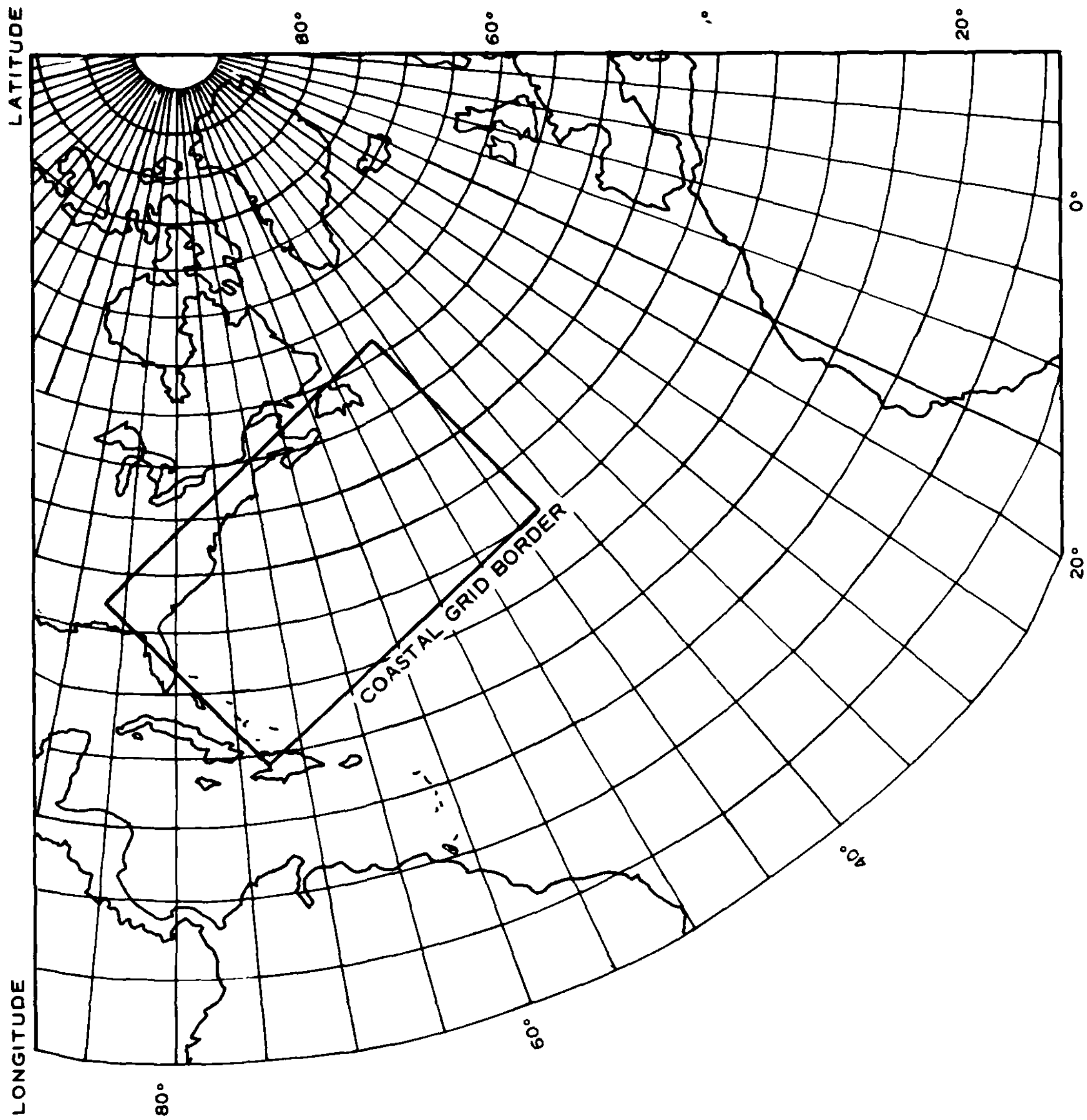


Figure 9. Coastal grid on polar projection

over one MII grid space from the fixed-area grid.

18. Digitization of the NWS pressure field provides a good representation of coastal storms in the Atlantic Ocean; however, storms outside of this area can be significantly weakened in the MII representation as compared with the NWS representation. In order to intensify storms in the MII representation in a simple manner to be consistent

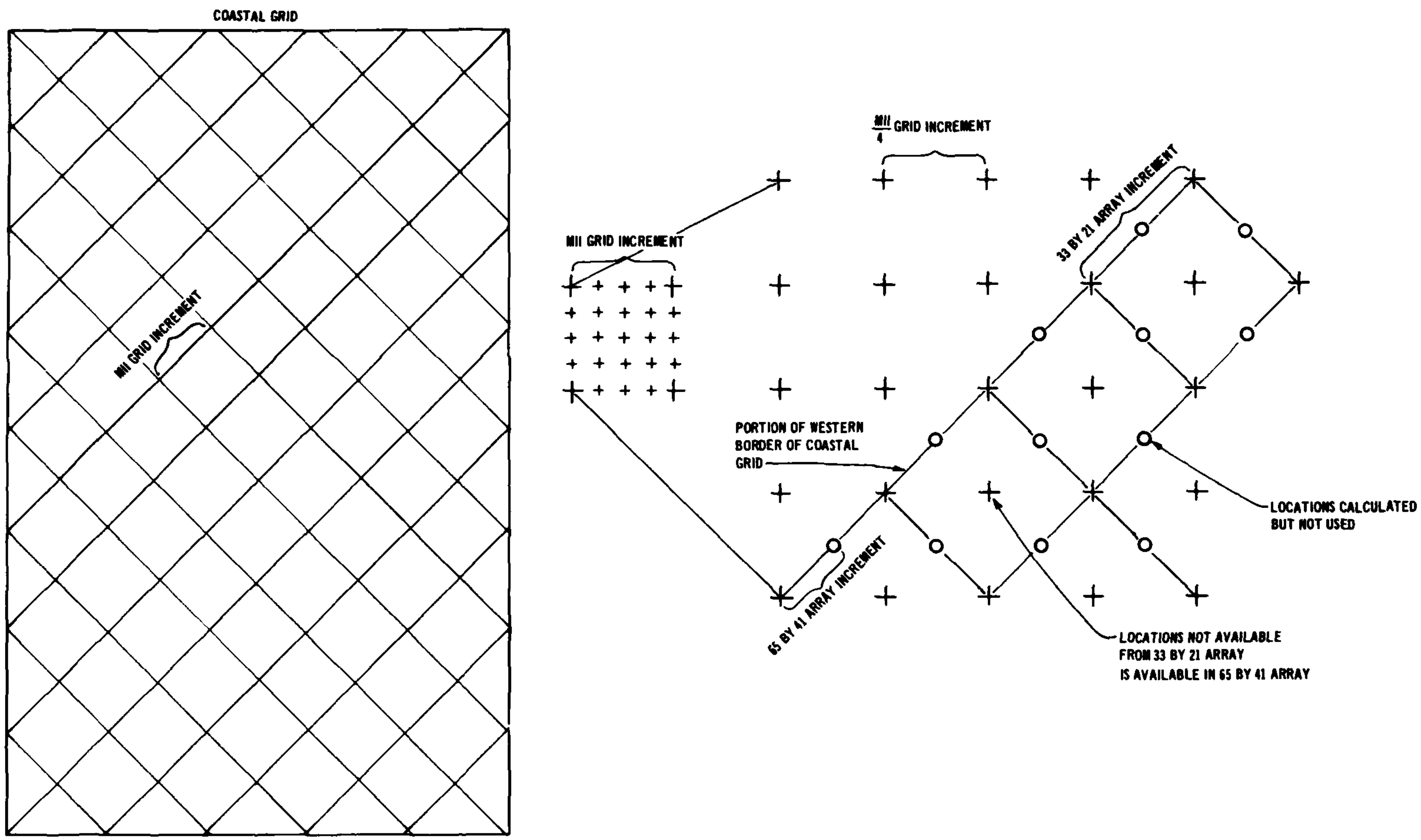


Figure 10. Coastal grid with subdivisions

with the NWS representation, Northern Hemisphere synoptic charts are reviewed for major storms not within the coastal grid. These storms are selected (or not selected) according to the storms' intensity inferred from central pressure recordings at various latitudes (Table 2). The selection process is designed to provide a simple, consistent method for selecting storms that may not have been represented by MII as severe as they should have been. This selection method should allow for the respecification of the more severe storms and some of the less severe storms. Crossplots of the selected MII CP versus the corresponding NWS CP for the first year analyzed show that most storms selected during the review process required intensification (Figure 11), which tends to validate the selection methodology.

19. Once the storms to be respecified in the Atlantic (outside of the coastal grid) have been selected, the central pressure from these storms is blended into the MII pressure field representation. This is accomplished by developing a 40 by 40 subgrid (in the expanded 1/4 MII scale) about the location of the MII minimum pressure (CP_{MII}) and symmetrically blending the NWS central pressure into the MII grid using the following algorithm:

$$P_B = \lambda_1 (CP_{NWS}) + \lambda_2 P_s$$

where

$\lambda_1 = (d_2/r)^2$

$\lambda_2 = (d_1/r)^2$

P_B = blended pressure for a given location

CP_{NWS} = central pressure reported by the NWS

P_s = pressure at a given location in the 1/4 MII grid system

d_1 = distance from the boundary radius where the deepening factor goes to zero (5 MII grid units) to the point

d_2 = distance from the location of the lowest MII pressure (the assumed center of the low) to the point

r = sum of $d_1 + d_2$ which must equal the total radius over which blendig is performed

Since d_2 goes to zero at the boundary radius the pressures become equal

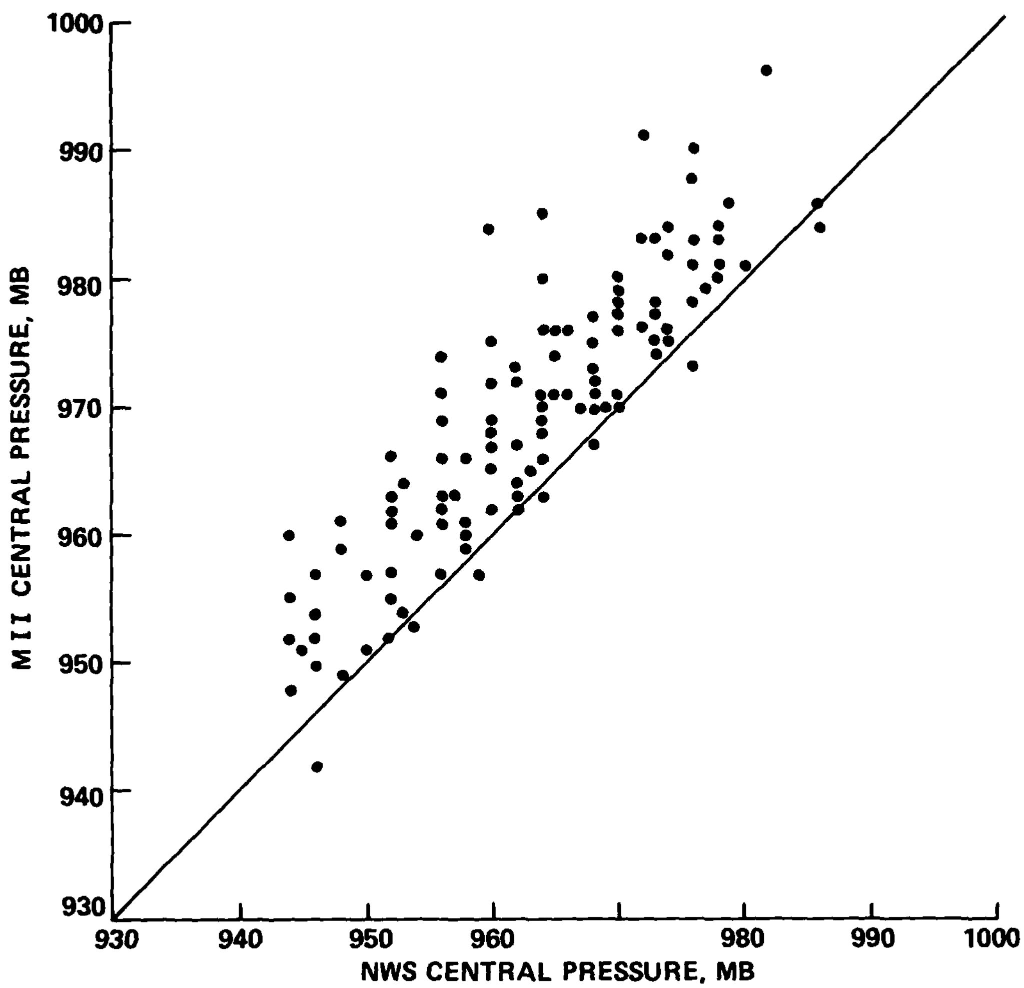


Figure 11. Crossplot of MII CP vs NWS CP for 1974

to the MII pressures there, and since d_1 goes to zero at the assumed center of the low, the pressures become equal to the NWS central pressure there; in between, a distance-squared interpolation is affected.

20. Figure 12 presents a sample of initial and blended pressure fields. The blended pressure field produces a steeper pressure gradient than that developed by the MII pressure field. Since the blended pressure field is dependent on the MII data for placement and field geometry, some misplacement (with respect to the NWS placement) of the blended pressure field does occur.

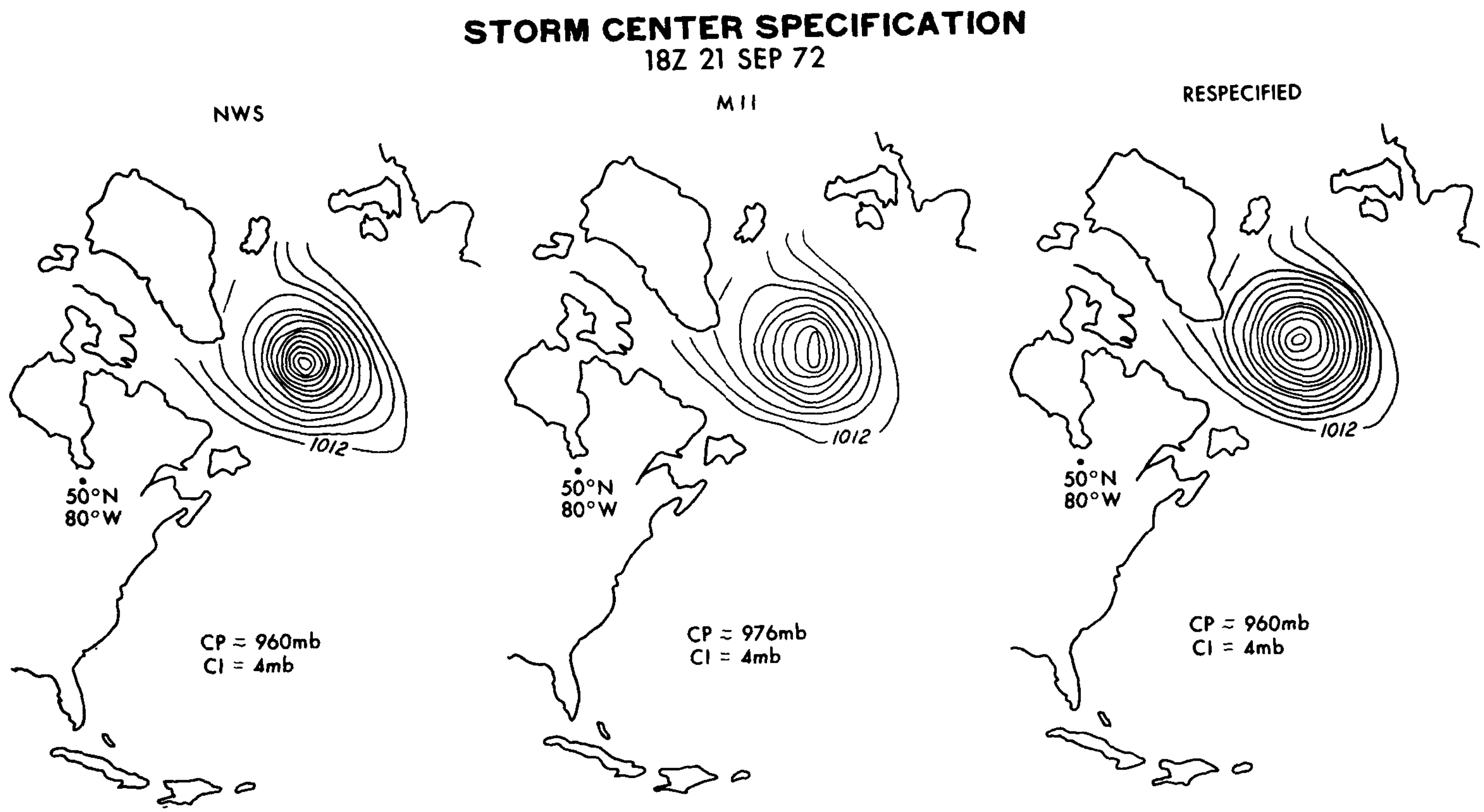


Figure 12. Example of storm central pressure respecification

PART IV: CONCLUSIONS

21. Based on analysis presented in PART II of this report, the sea-level pressure field developed by the NWS is accepted as a standard with which other data should be compatible. The pressure field developed from MII data is not usually as intense as the NWS pressure field in areas with steep pressure gradients. The grid system in which MII data are computed and stored does not appear to be able to depict the interior portions of severe storms. In order to develop a valid pressure field for use in the Atlantic Coast Wave Information Study, the MII pressure data are supplemented (when required) with NWS pressure data using two types of subgrid input systems: a fixed-area or coastal grid and a center respecified grid. Since our investigations show that the NWS pressure charts are consistently in agreement with historical observations, the resulting surface pressure fields from this procedure should constitute an excellent starting point for hindcasting oceanic wave climates.

Table 1

21 Extratropical Systems Analyzed

Storm No.	Storm Dates YRMODAHR*	Observation Interval, hours	Location
1	63102900-63103100	24	U. S. Atlantic Coast
2	63110700-63111000	24	U. S. Atlantic Coast
3	69071400-69071500	24	U. S. Atlantic Coast
4	71040612-71040706	6	U. S. Gulf and Atlantic Coasts
5	73011400	24	U. S. Atlantic Coast
6	73021100-73021200	24	U. S. Gulf and Atlantic Coasts
7	64021712-64021900	6	U. S. Atlantic Coast, Sable Is. Area
8	73082200-73082206	6	U. S. Atlantic Coast, Sable Is. Area
9	73082312-73082412	6	U. S. Atlantic Coast, Sable Is. Area
10	73100100-73100112	6	U. S. Atlantic Coast, Sable Is. Area
11	73102718-73102812	6	U. S. Atlantic Coast, Sable Is. Area
12	73122400-73122506	6	U. S. Atlantic Coast, Sable Is. Area
13	72111512-72111700	6	U. S. Pacific Coast, Cobb Seamount Area
14	73012000-73012100	6	U. S. Pacific Coast, Cobb Seamount Area
15	73031000-73031100	6	U. S. Pacific Coast, Cobb Seamount Area
16	54031912-56032212	24	North Atlantic, O. S. "Kilo" Area
17	56050912-56051312	24	North Atlantic, O. S. "India" Area
18	56111912-56112512	24	North Atlantic, O. S. "India" Area
19	62020912-62021512	24	North Atlantic, O. S. "India" Area
20	61091112-61091512	24	North Atlantic, O. S. "Juliett" Area
21	61112606-61112712	6	U. S. Atlantic Coast, Argus Is. Tower Area

* Year/month/day/hour.

Table 2

Selection Guidelines for Storms Not Within Coastal Grid

For North Latitude	Central Pressure
20° to 40°	≤990 mb
40° to 50°	≤980 mb
50° to 60°	≤970 mb
60° to 65°	≤960 mb

Note: No storms located over land or above 65° north latitude are selected.

APPENDIX A: SYSTEM HISTORY FOR SELECTED STORMS

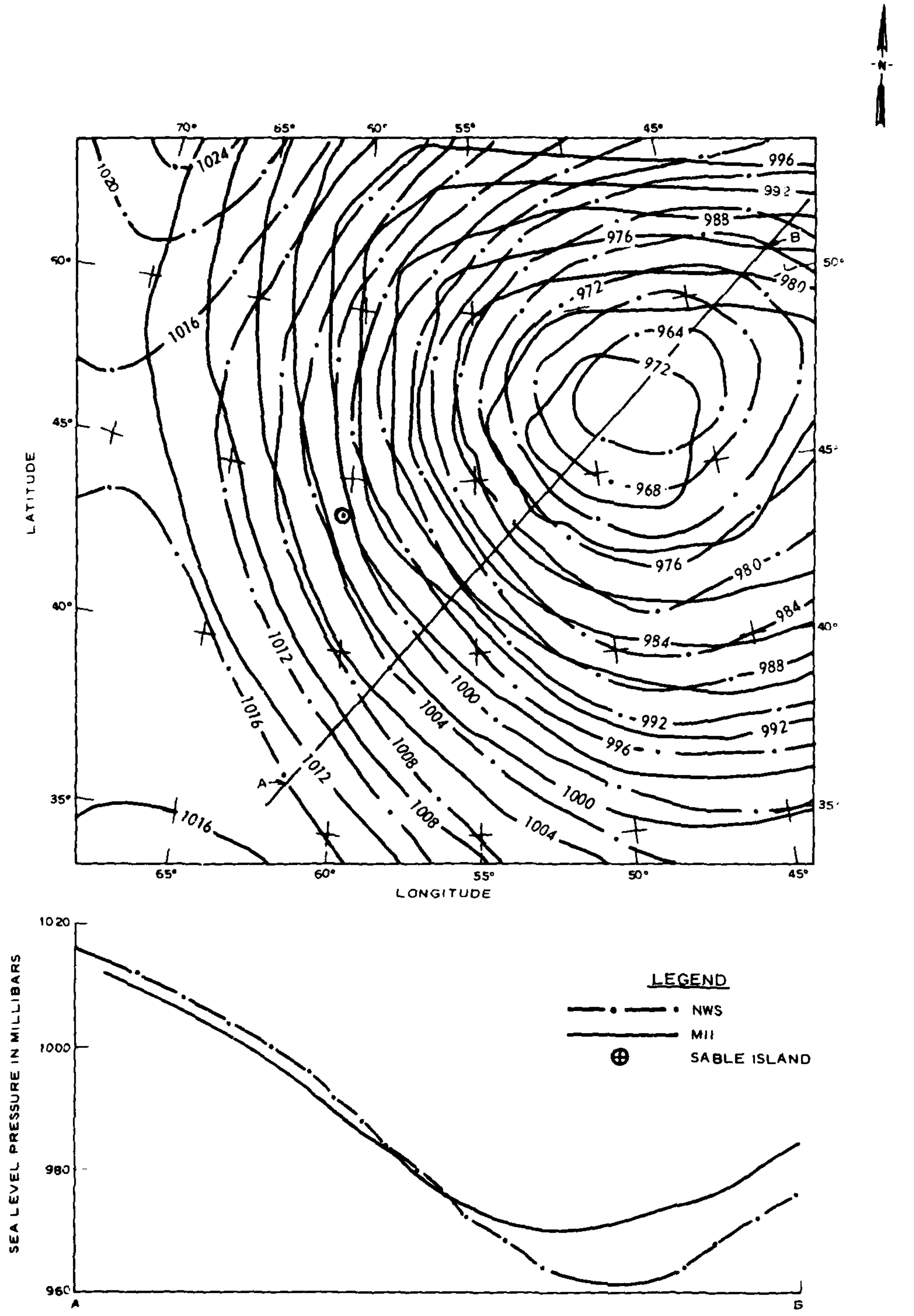
Source: National Weather Service North American Synoptic Surface Charts

Time GMT	Day	CP mb	Location Lat, Long.	Comments
	18-31 October 1963			
1200	18	1012	25°N,73°W	Attached to a warm front
0000	19	1008	27°N,72°W	
1800	20	992	32°N,75°W	
0000	21	984	34°N,75°W	4-mb contour spacing about 0.25° of latitude
0600	21	984	34°N,75°W	Storm assigned as Hurricane "Ginny"
1200	28	1000	34°N,75°W	4-mb contour spacing about 2° of latitude; still named "Ginny"
1200	29	984	41°N,67°W	"Ginny" attached to a cold front; 50+ knot wind speeds reported
1800	29	972	44°N,60°W and 36°N,70°W	Storm developed double low; no longer designated "Ginny"
0000	31	988		Southern low moved inland; contour spacing about 1° of latitude
	6-10 November 1963			
0000	6	1008	33°N,80°W	
1800	6	992	35°N,77°W	Area from 984 mb contour to 1012 contour covered U. S. Atlantic coast
1200	7	984	37°N,77°W	
0600	10	996	41°N,62°W	
	12-15 July 1969			
0000	12	1012	36°N,75°W	
1200	13	1000	42°N,68°W	
0000	15	1004	43°N,60°W	
	5-7 April 1971			
1800	5	1012	28°N,84°W	
0600	6	1008	32°N,79°W	

Time GMT	Day	CP mb	Location Lat,Long.	Comments
5-7 April 1971 (Continued)				
1200	6	1000	34°N,78°W	4-mb contour spacing from 1000 mb to 1012 mb was about 1° of latitude
0600	7	992	39°N,72°W	
13-14 January 1973				
0000	13	1012		Storm elongate (NE-SW) off southeast U. S. coast
0600	13	1004	30°N,75°W	
1800	13	996	31°N,71°W	25- to 30-knot wind speeds reported along North Carolina coast
0600	14	1000	34°N,64°W	30-knot wind speeds reported on Bermuda
9-12 February 1973				
1200	9	1008	26°N,90°W	
1800	9	1004	27°N,87°W	
0000	10	1004		Storm moved across Florida; 40-knot wind speeds reported off North Carolina coast
1200	10	992	32°N,77°W	50- to 75-knot wind speeds were reported along North Carolina coast
1800	10	988	32°N,77°W	
0600	12	992	39°N,67°W	

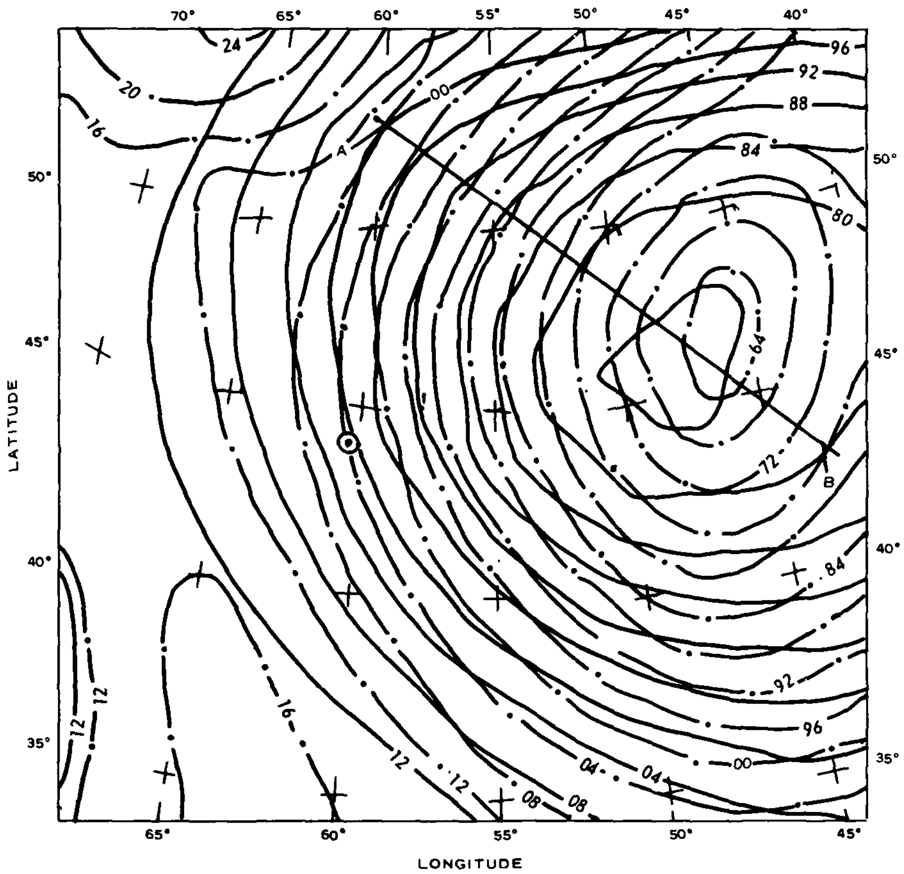
APPENDIX B: COMPARISONS OF MII PRESSURE FIELDS AND NWS PRESSURE FIELDS

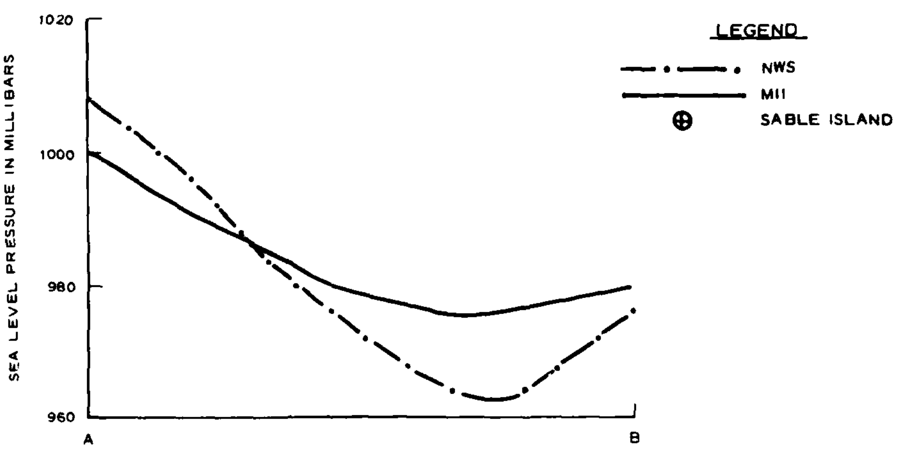
1. The contour interval for Plates B1-B14 is 4 mb.
2. The contour interval for Plates B15-B37 is 5 mb.
3. The contour interval for Plates B38-B42 is 4 mb.



SABLE ISLAND AREA NORTH ATLANTIC
18Z 18 FEB 64

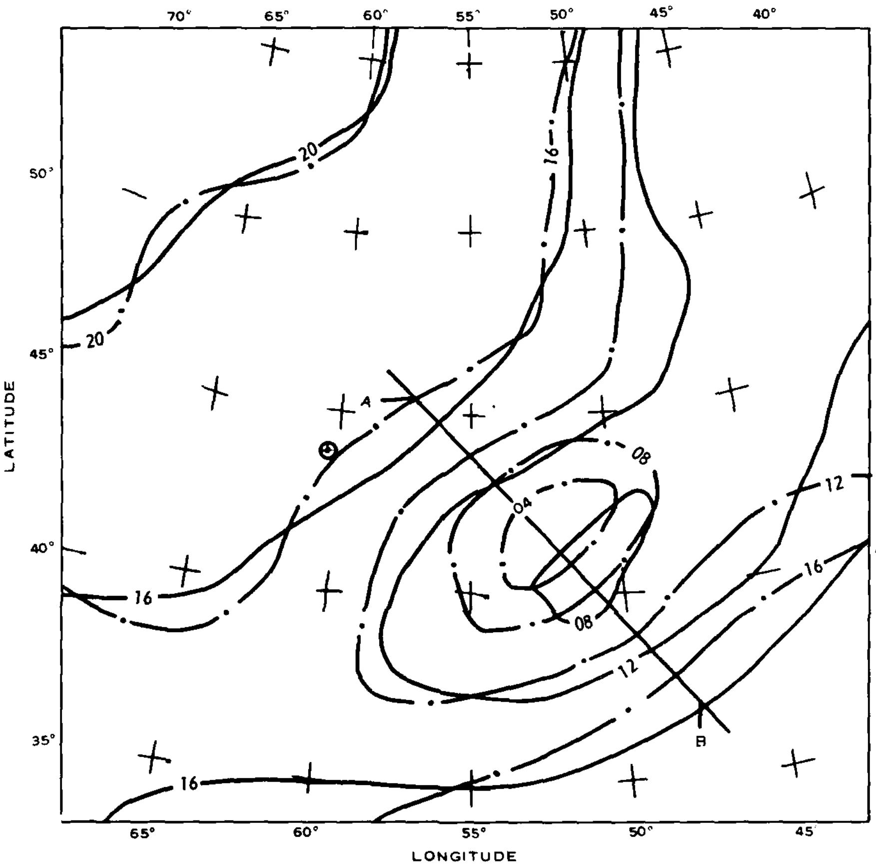
PLATE B1

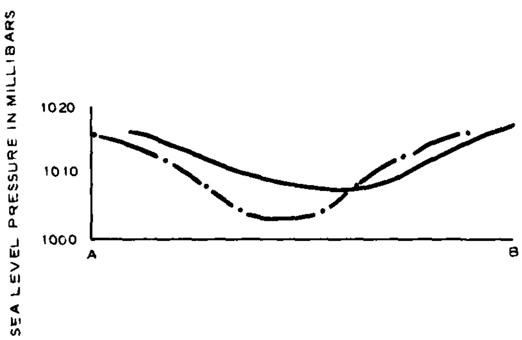




SABLE ISLAND AREA NORTH ATLANTIC
00Z 19 FEB 64

PLATE B2





LEGEND

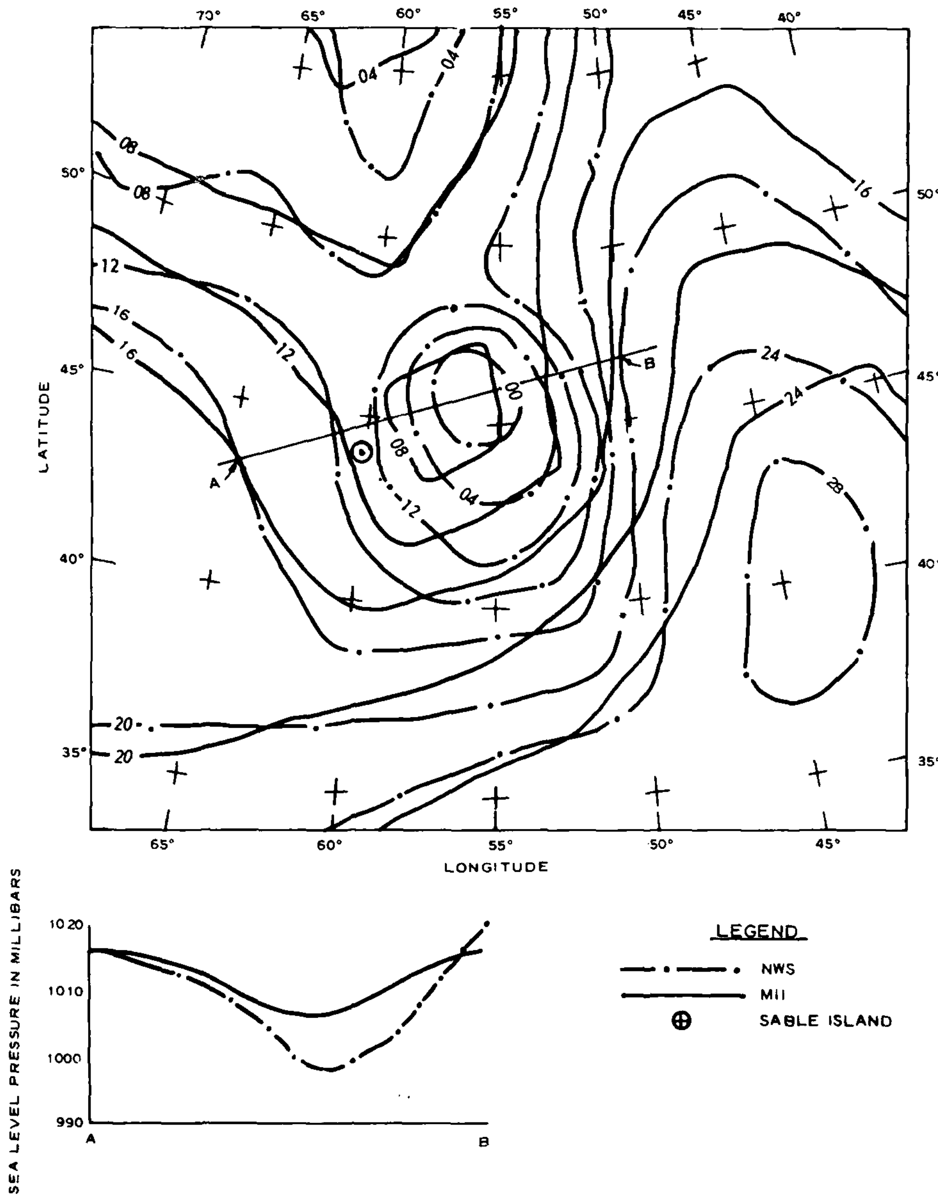
NWS

MII

SABLE ISLAND

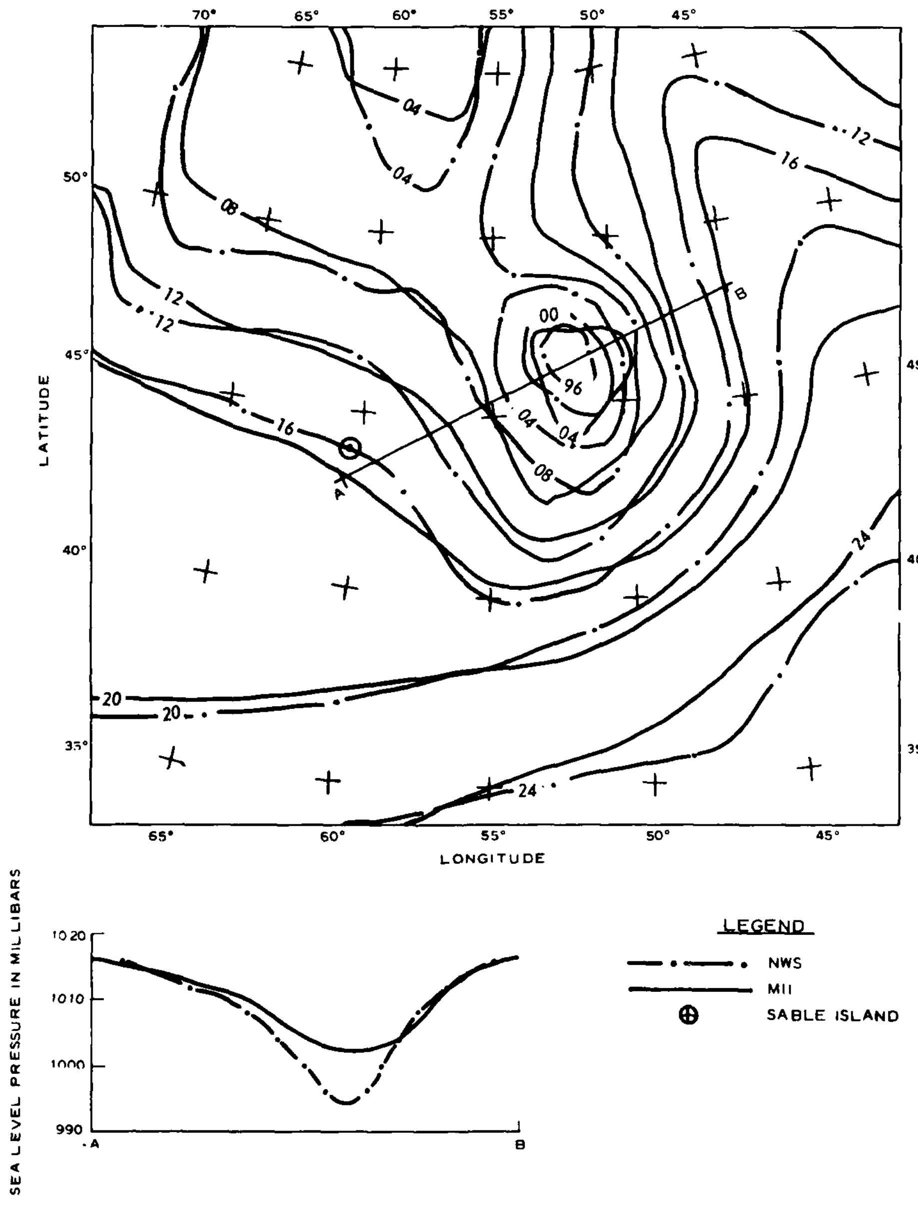
SABLE ISLAND AREA NORTH ATLANTIC
00Z 22 AUG 73

PLATE B3



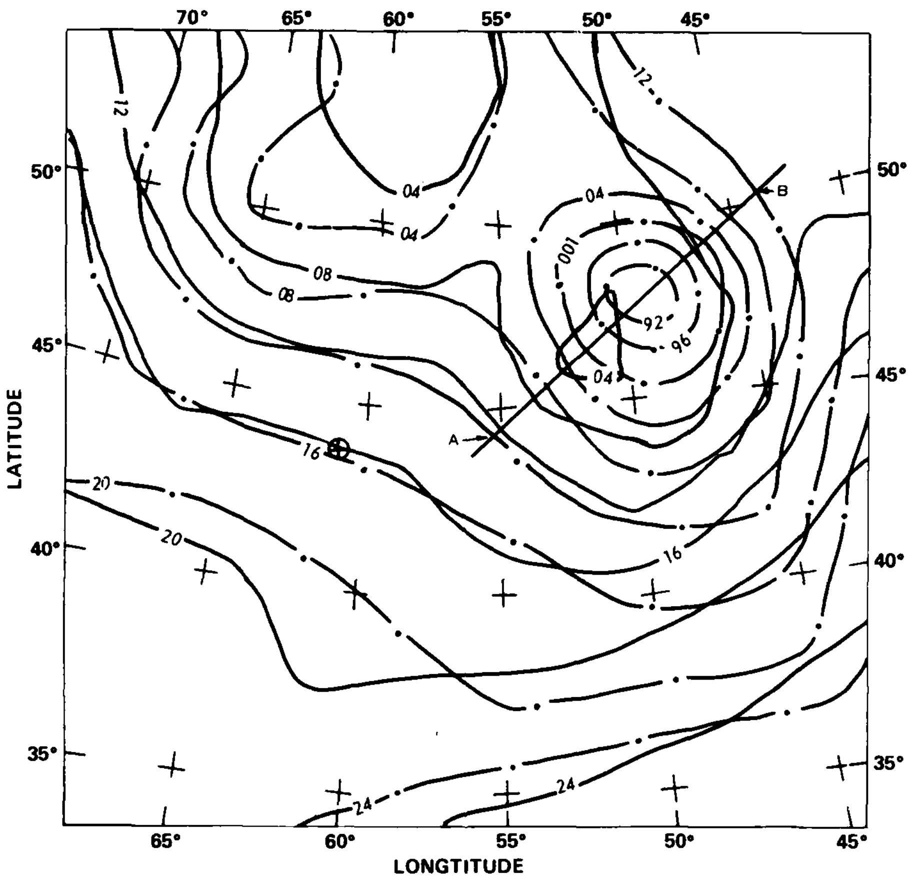
SABLE ISLAND AREA NORTH ATLANTIC
18Z 23 AUG 73

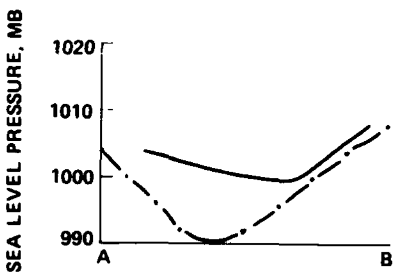
PLATE B4



SABLE ISLAND AREA NORTH ATLANTIC
00Z 24 AUG 73

PLATE B5

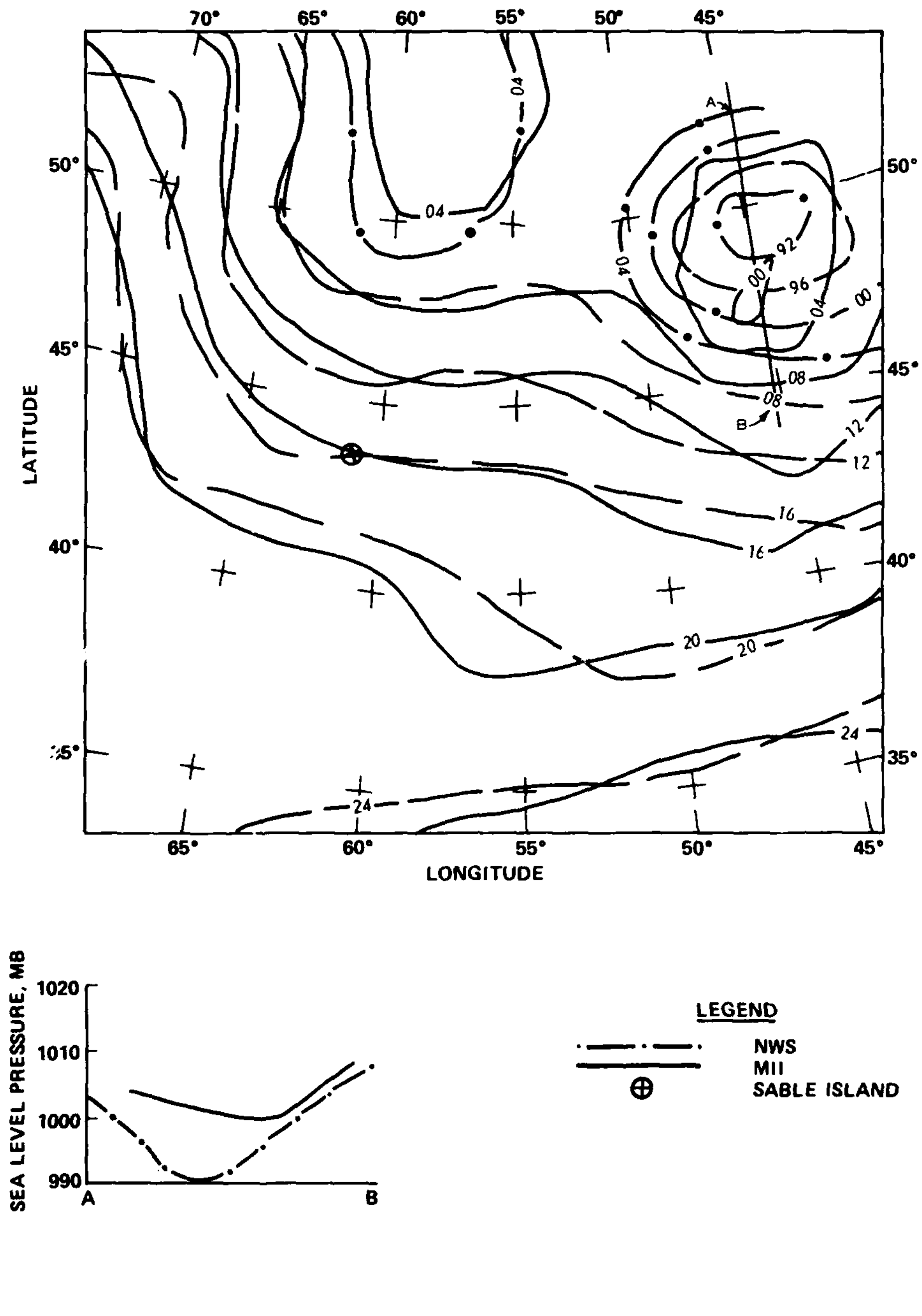




LEGEND
NWS
MII
SABLE ISLAND

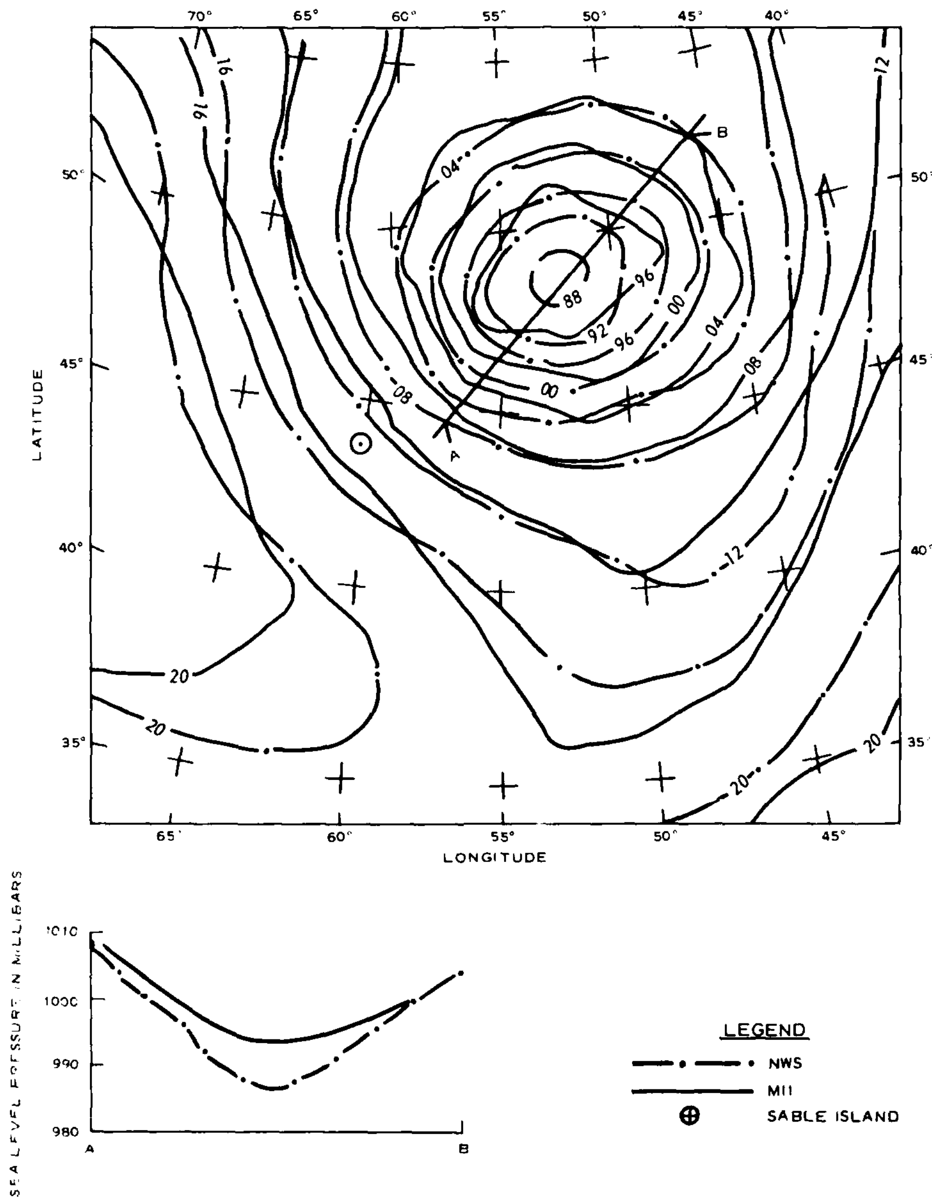
SABLE ISLAND AREA NORTH ATLANTIC
06Z 24 AUG 73

PLATE B6



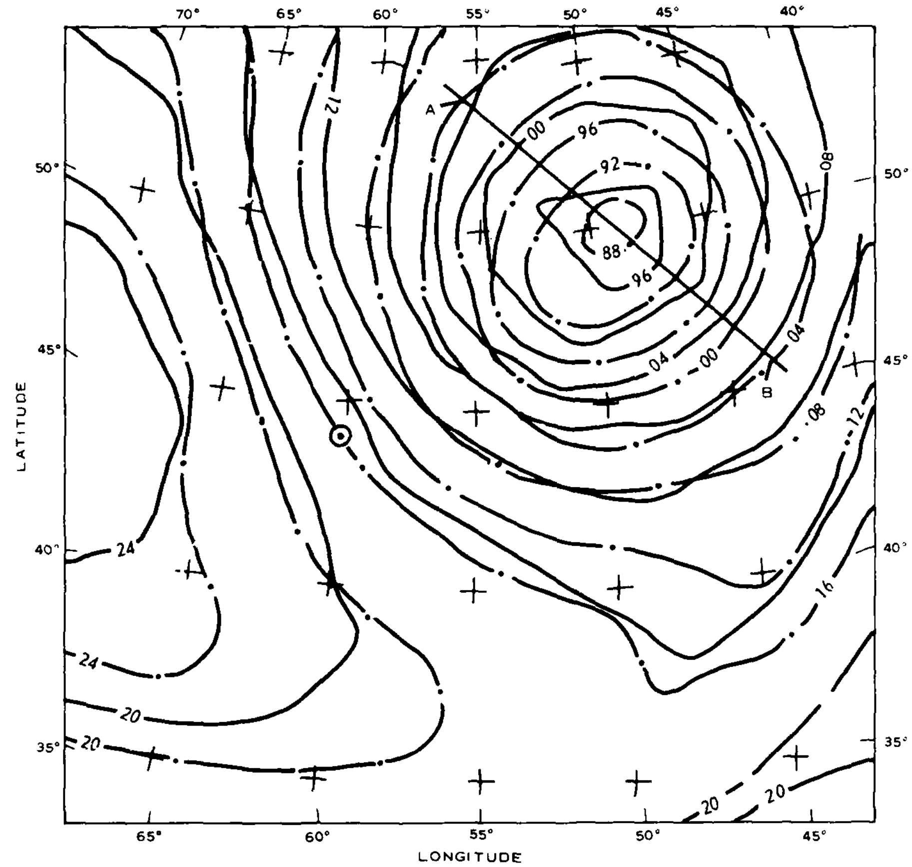
SABLE ISLAND AREA NORTH ATLANTIC
12Z 24 AUG 73

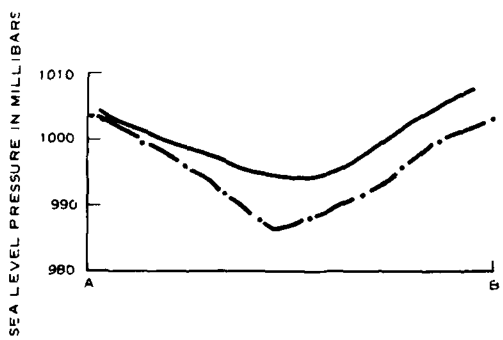
PLATE B7



SABLE ISLAND AREA NORTH ATLANTIC
00Z 01 OCT 73

PLATE B8



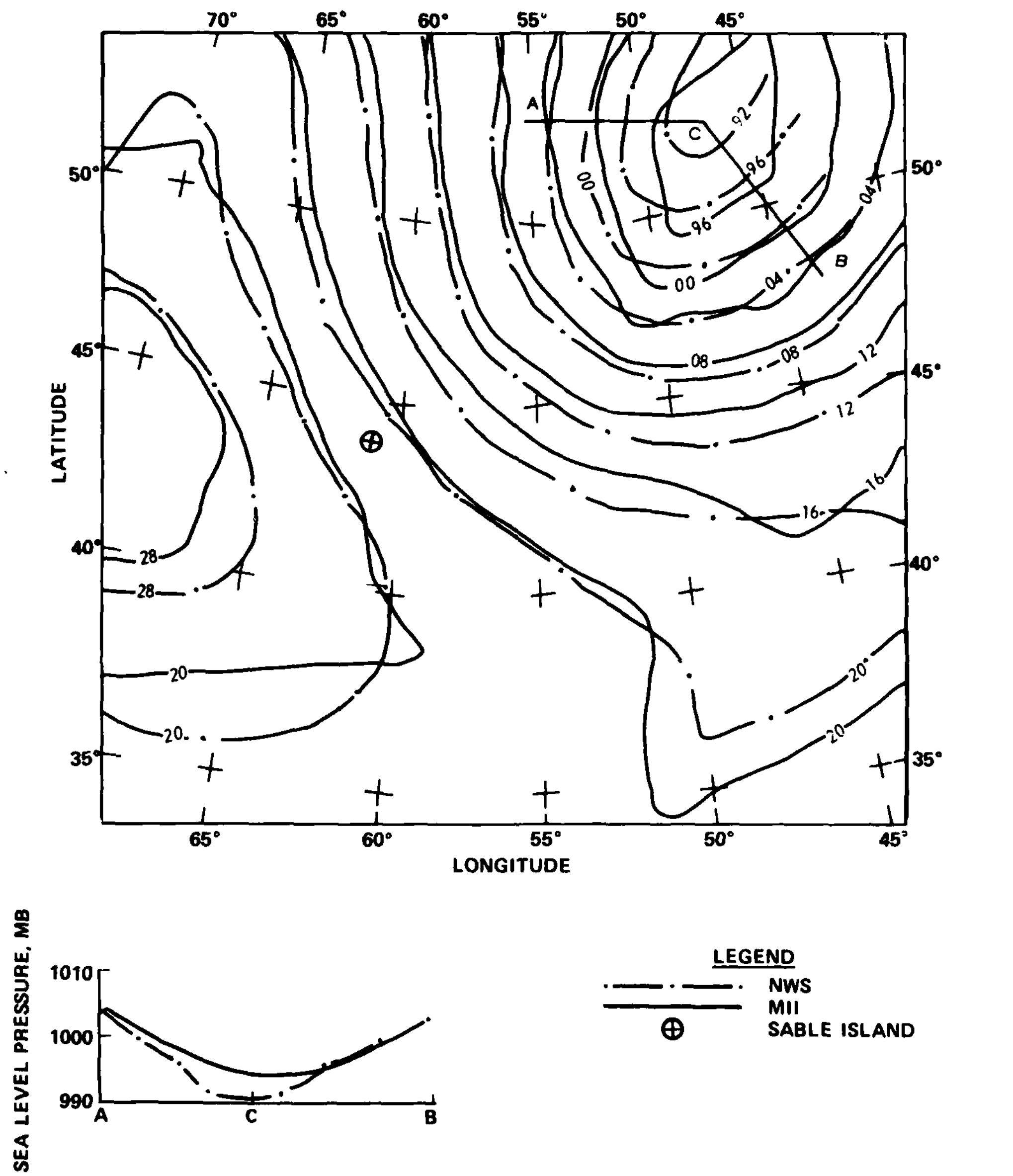


LEGEND

- NWS
- MII
- SABLE ISLAND

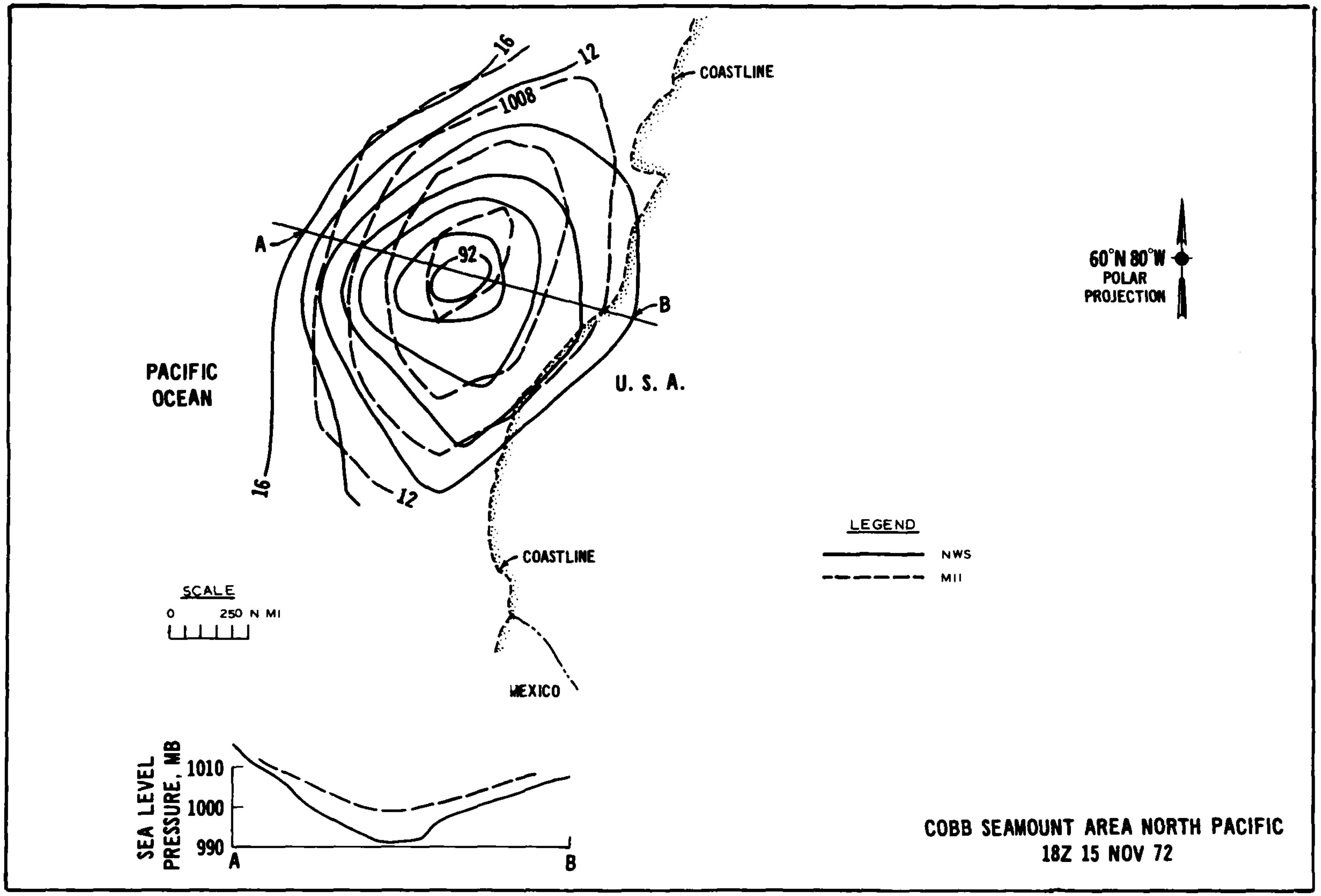
SABLE ISLAND AREA NORTH ATLANTIC
06Z 01 OCT 73

PLATE B9



SABLE ISLAND AREA NORTH ATLANTIC
12Z 01 OCT 73

PLATE B10



COBB SEAMOUNT AREA NORTH PACIFIC
18Z 15 NOV 72

PLATE B11

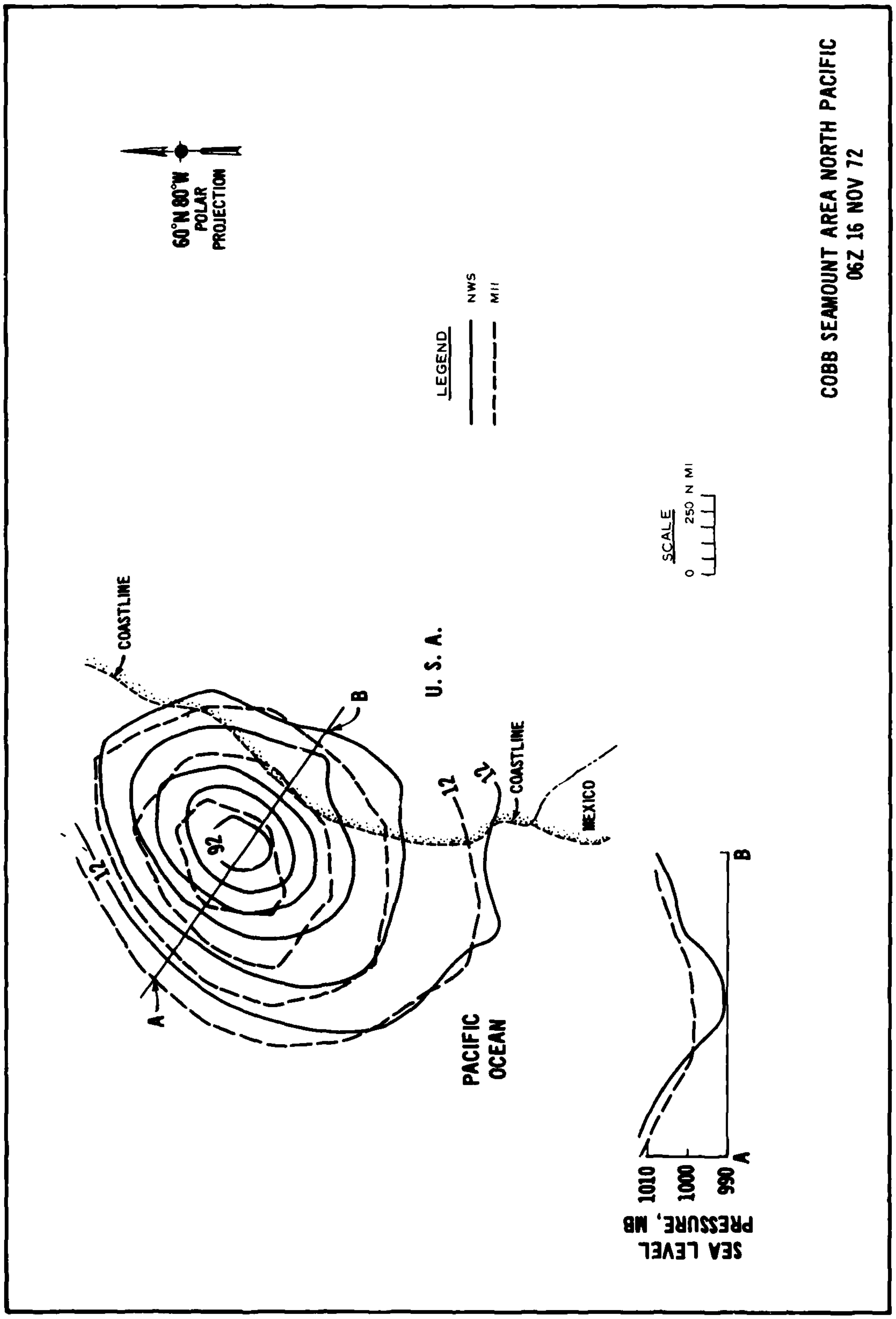

COBB SEAMOUNT AREA NORTH PACIFIC
06Z 16 NOV 72
60°N 80°W
POLAR
PROJECTION
LEGEND
NWS
MII
SCALE
0
250 N MI
COASTLINE
U. S. A.
COASTLINE
MEXICO
PACIFIC
OCEAN
12
12
12
92
A
B
SEA LEVEL
PRESSURE, MB
1010
1000
990
A
B

PLATE B12

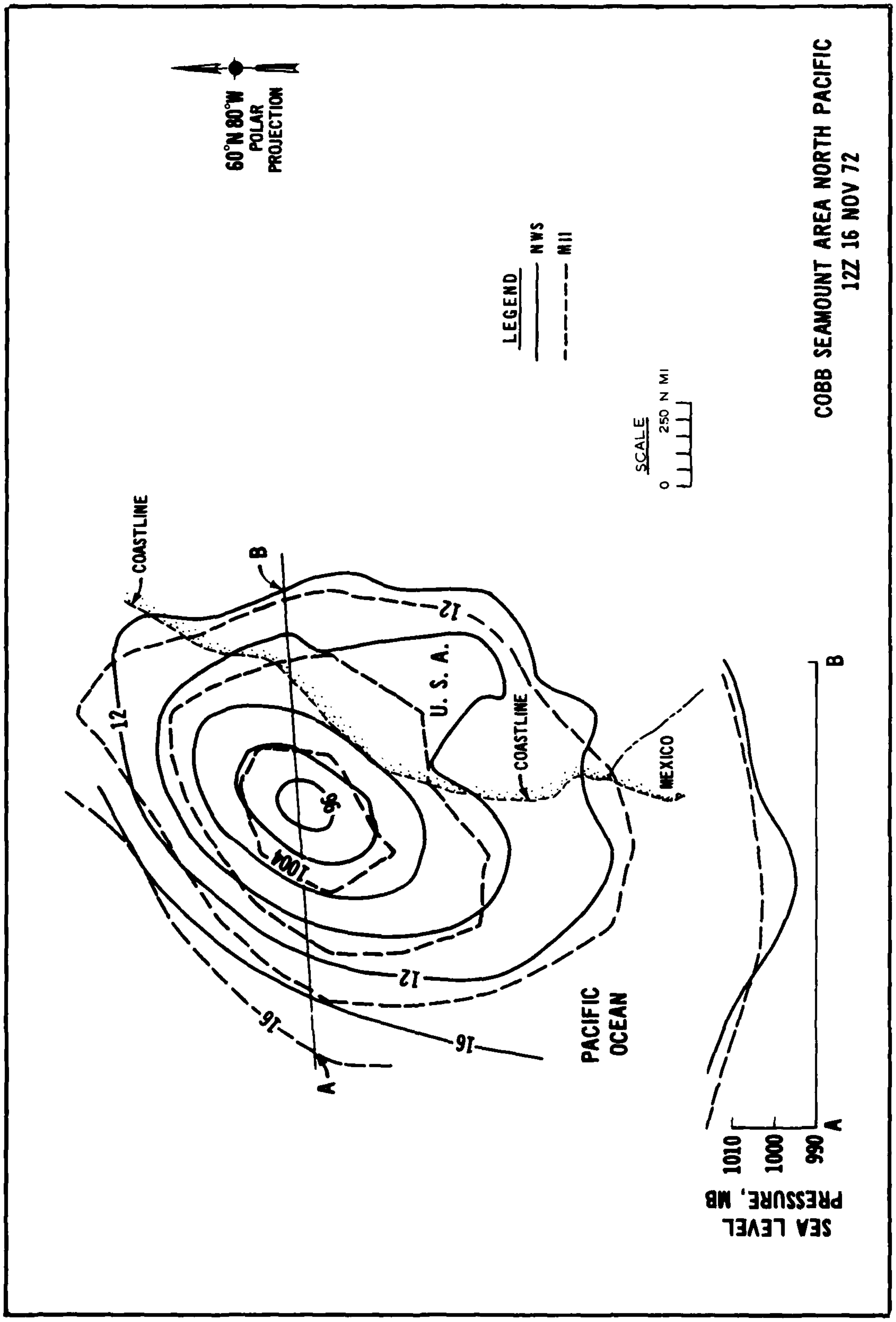

COBB SEAMOUNT AREA NORTH PACIFIC
12Z 16 NOV 72
60°N 80°W
POLAR
PROJECTION
LEGEND
NWS
MII
SCALE
0
250 N MI
COASTLINE
U. S. A.
MEXICO
PACIFIC
OCEAN
12
16
1004
96
A
B
SEA LEVEL
PRESSURE, MB
1010
1000
990

PLATE B13

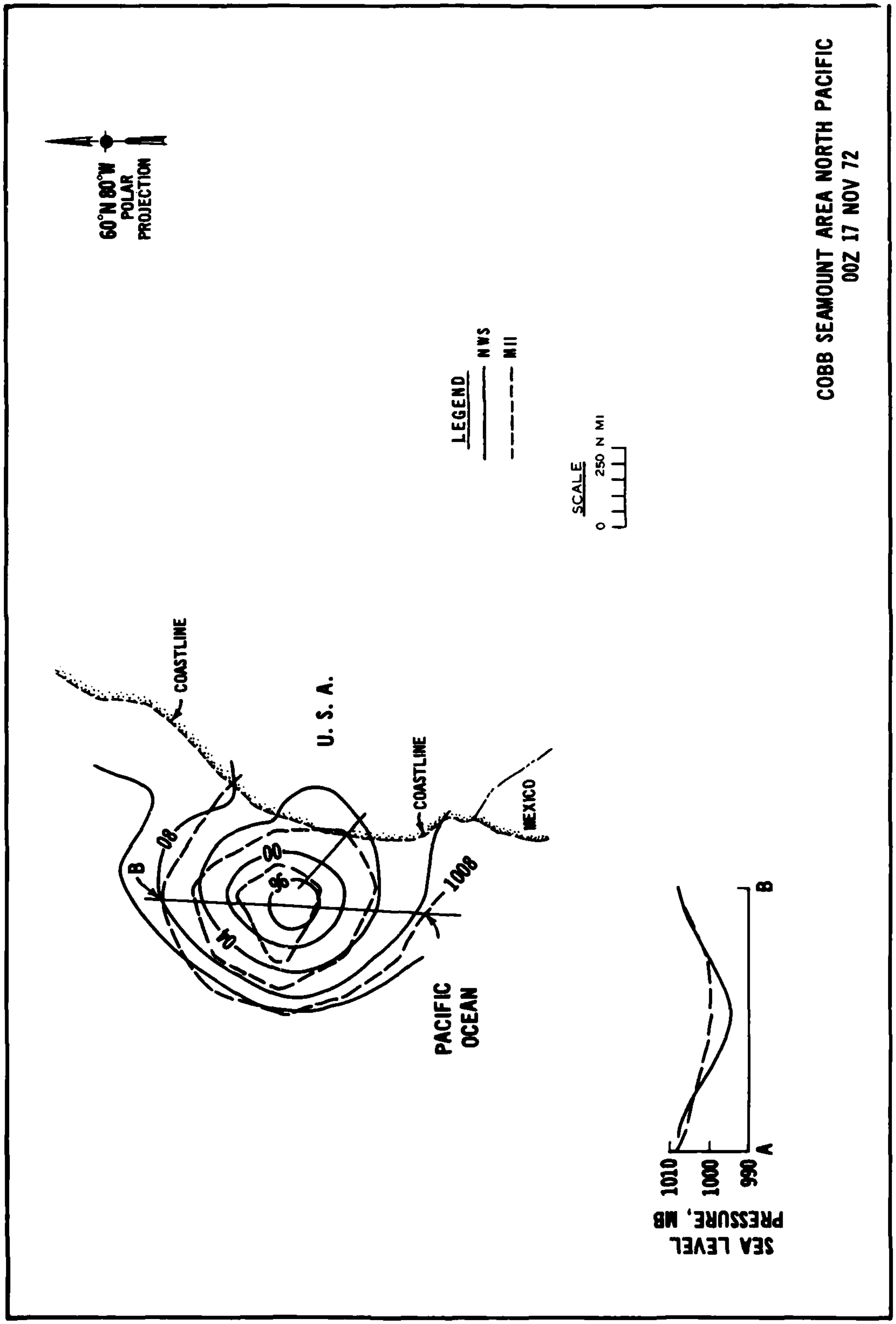
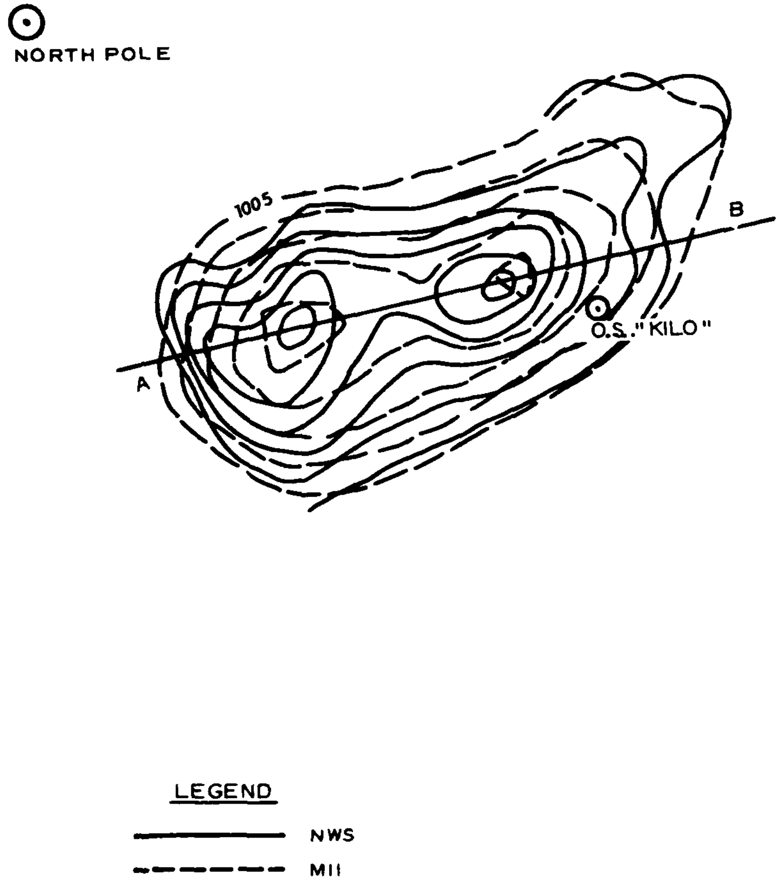
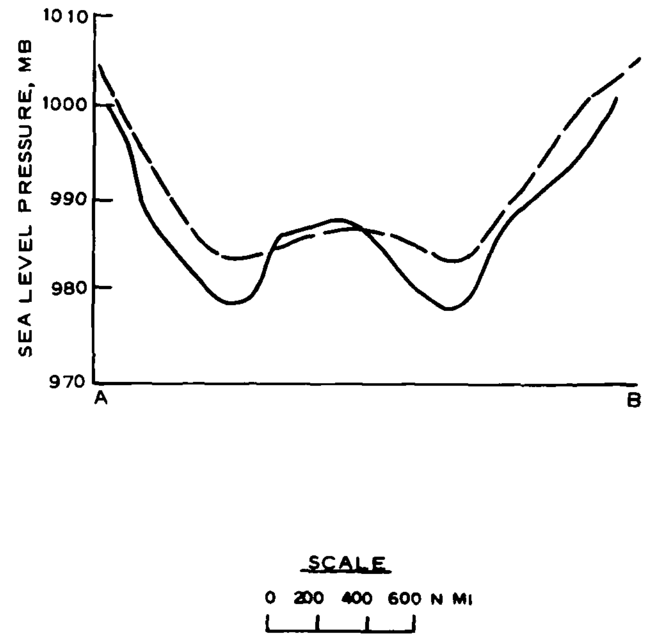

COBB SEAMOUNT AREA NORTH PACIFIC
00Z 17 NOV 72
60°N 80°W
POLAR
PROJECTION
LEGEND
NWS
MII
SCALE
0
250 N MI
U. S. A.
COASTLINE
COASTLINE
MEXICO
PACIFIC
OCEAN
1008
B
SEA LEVEL
PRESSURE, MB
1010
1000
990
A
B

PLATE B14

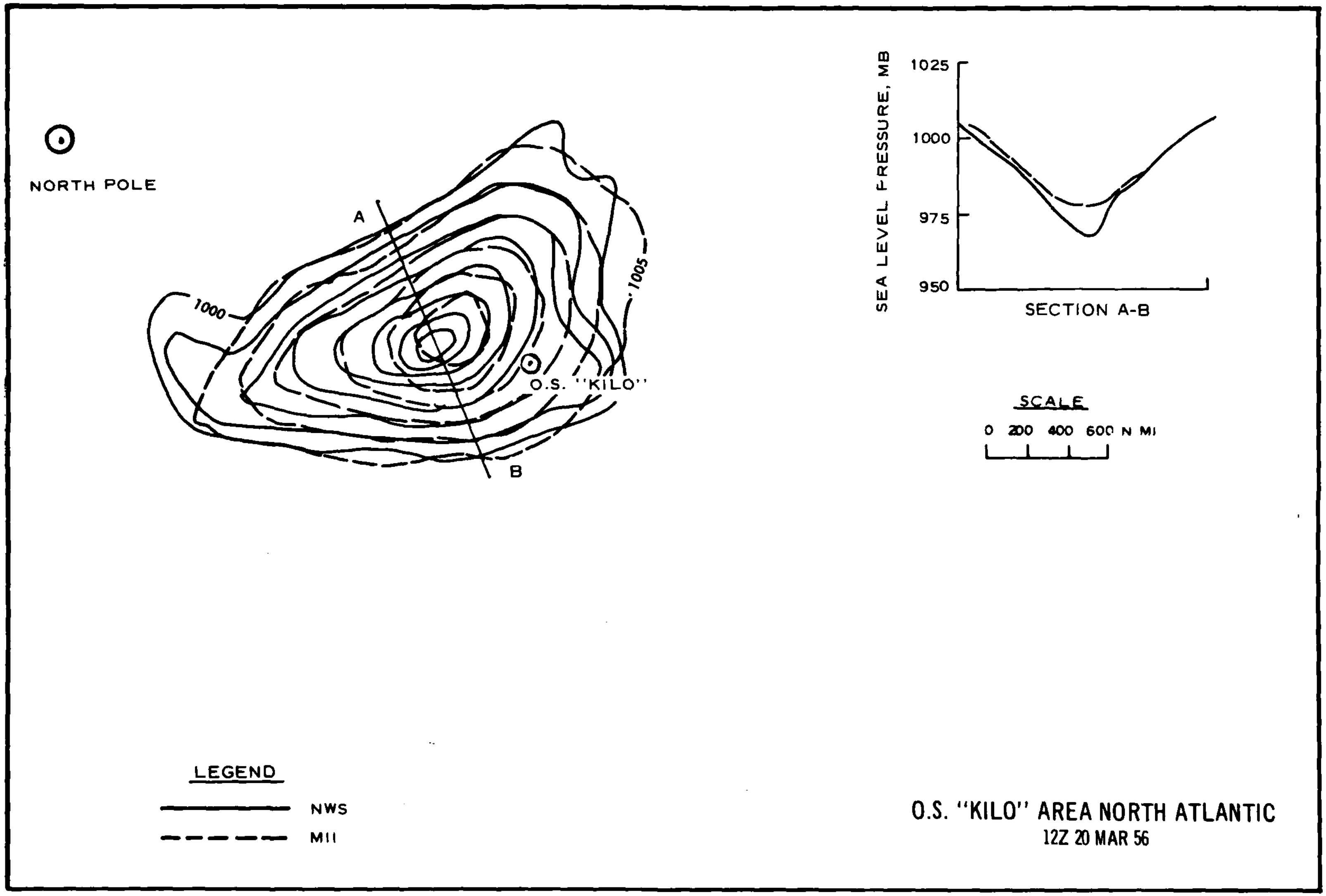




O.S. "KILO" AREA NORTH ATLANTIC

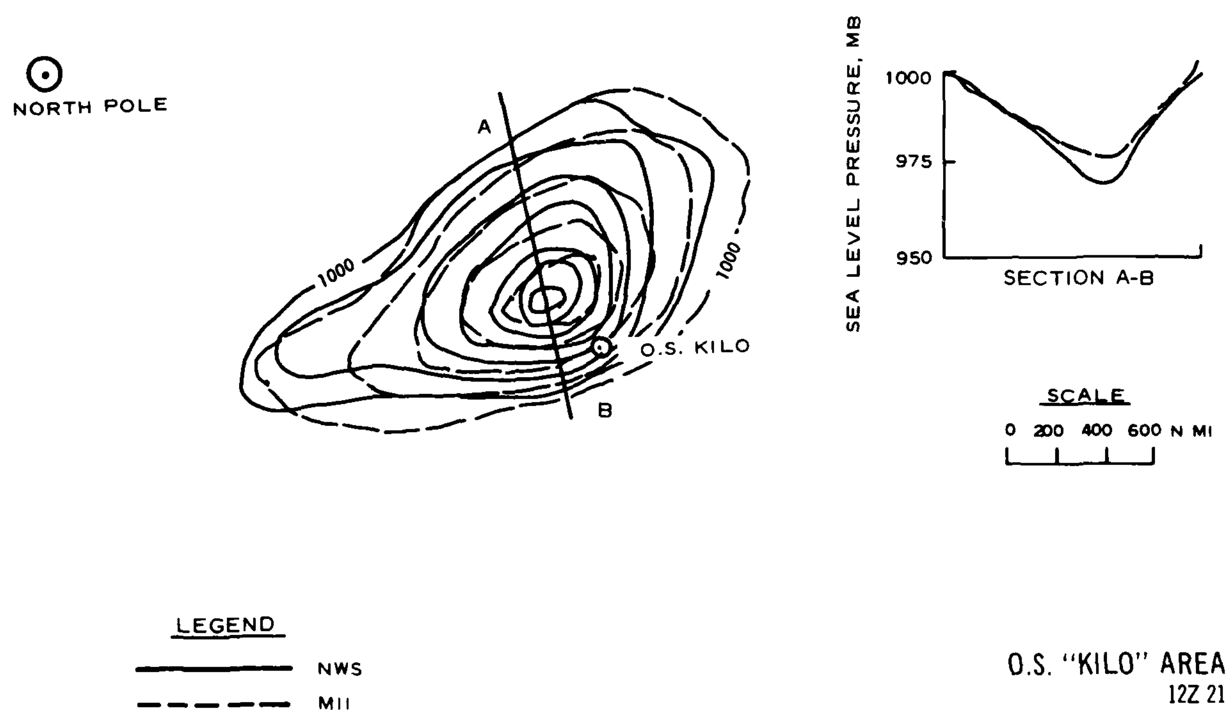
12Z 19 MAR 56

PLATE B15



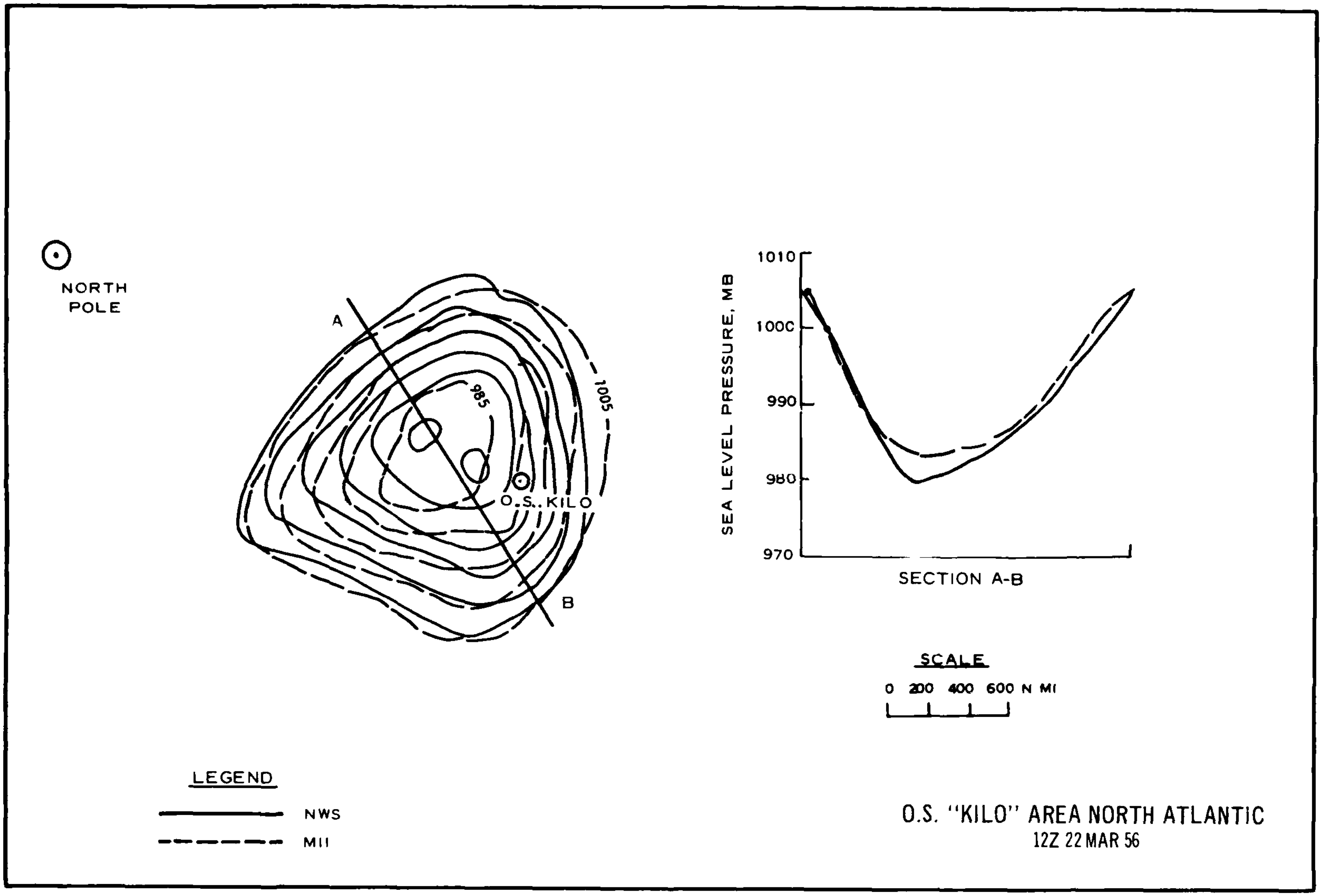
O.S. "KILO" AREA NORTH ATLANTIC
12Z 20 MAR 56

PLATE B16

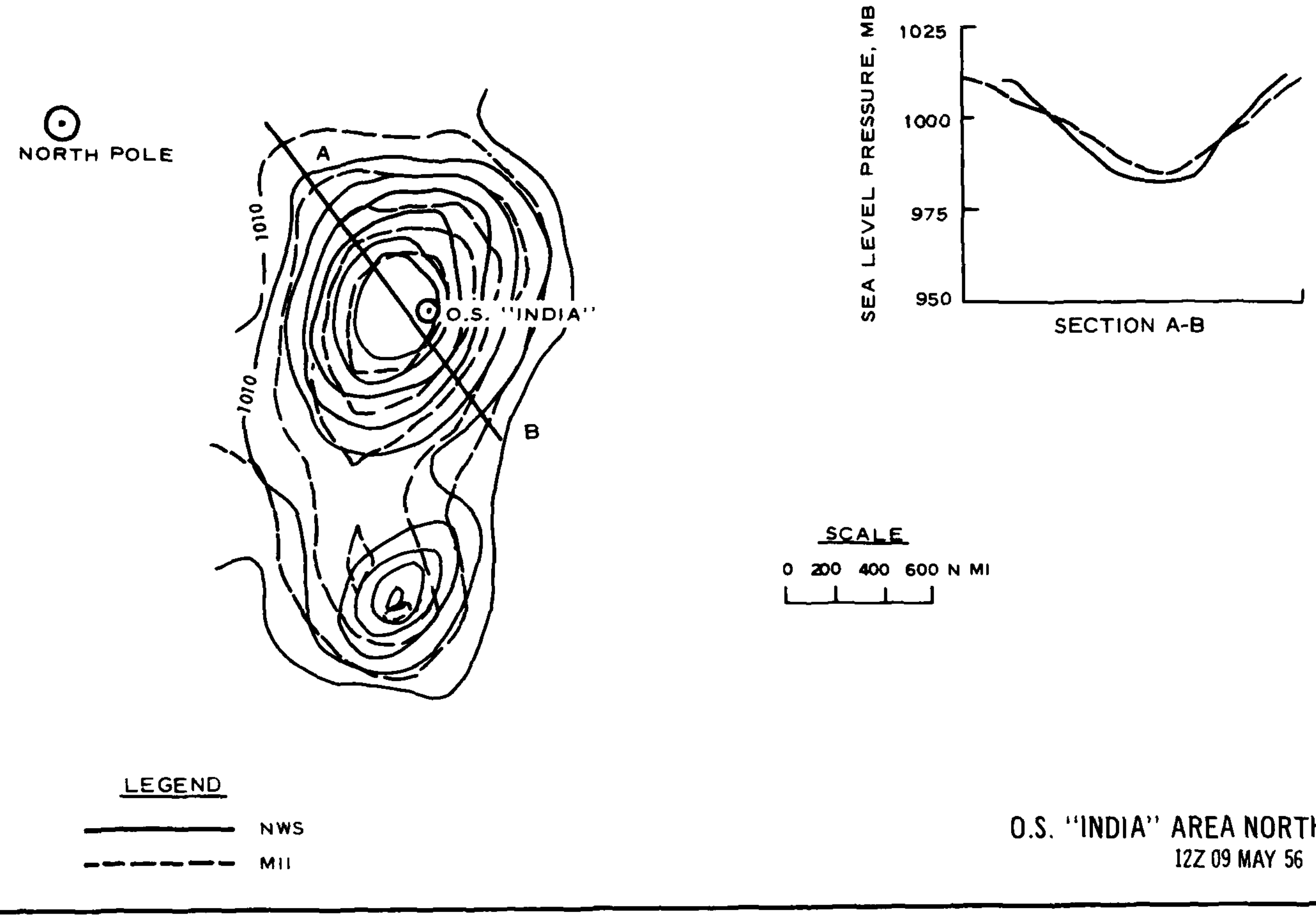


O.S. "KILO" AREA NORTH ATLANTIC
12Z 21 MAR 56

PLATE B17

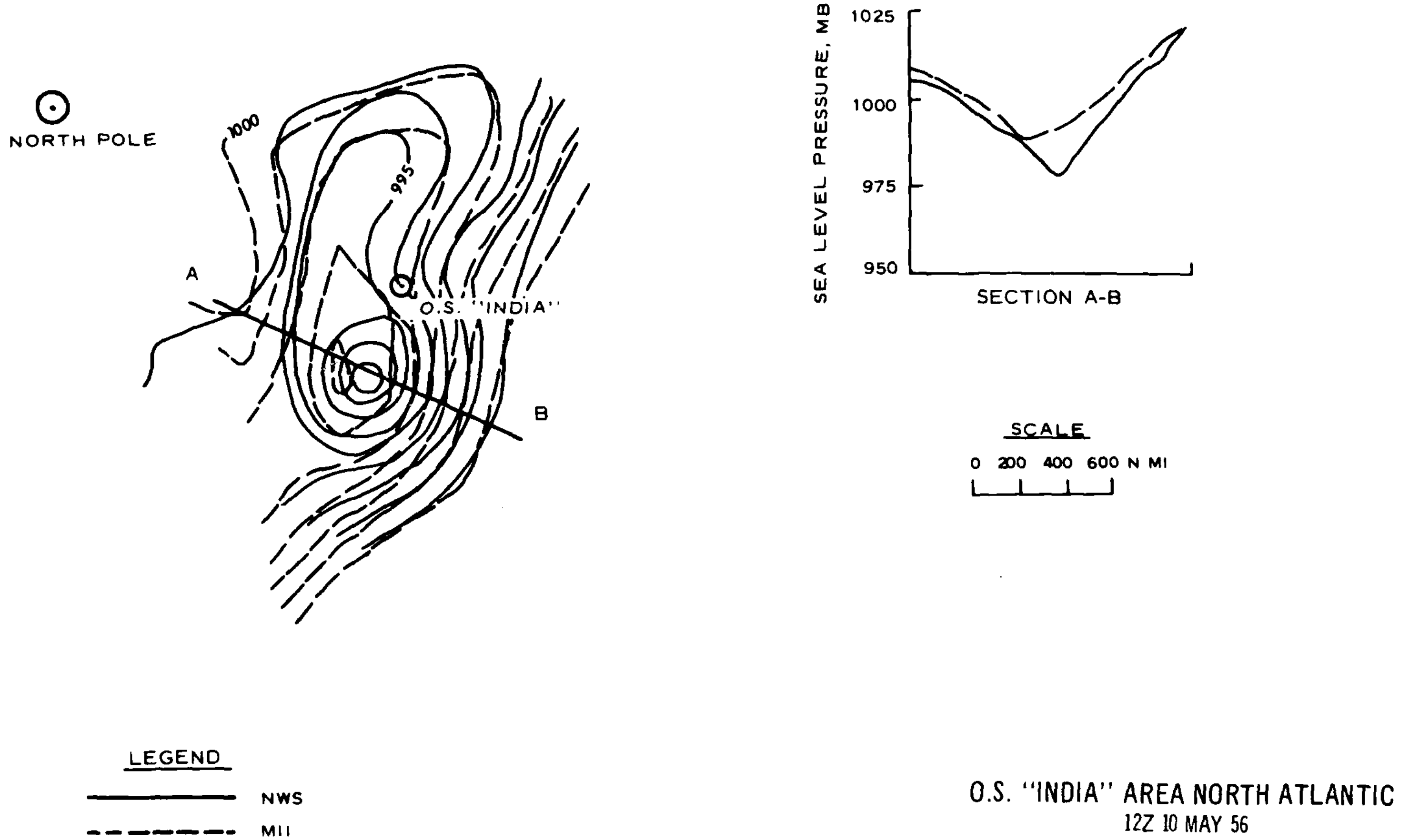


O.S. "KILO" AREA NORTH ATLANTIC
12Z 22 MAR 56



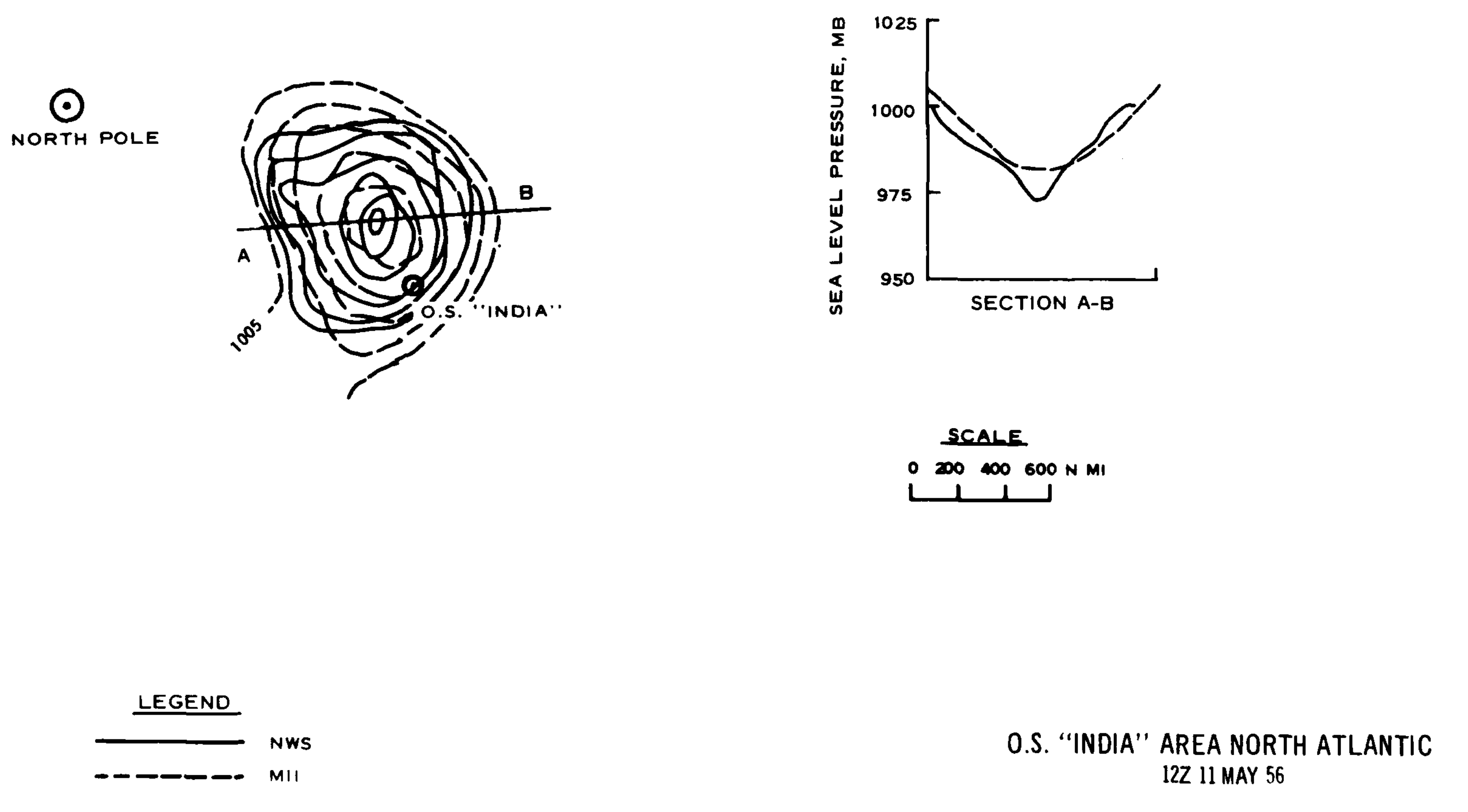
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 09 MAY 56

PLATE B19



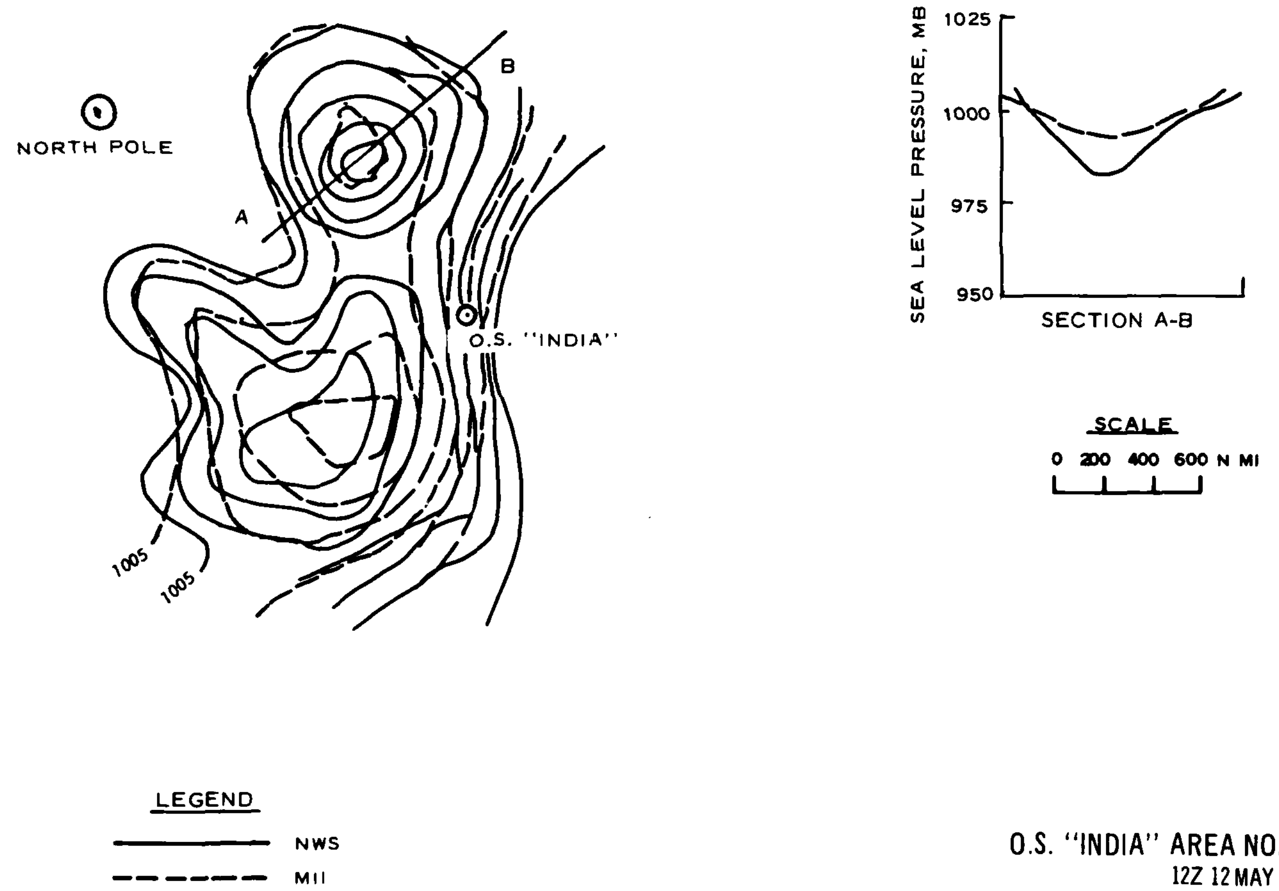
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 10 MAY 56

PLATE B20

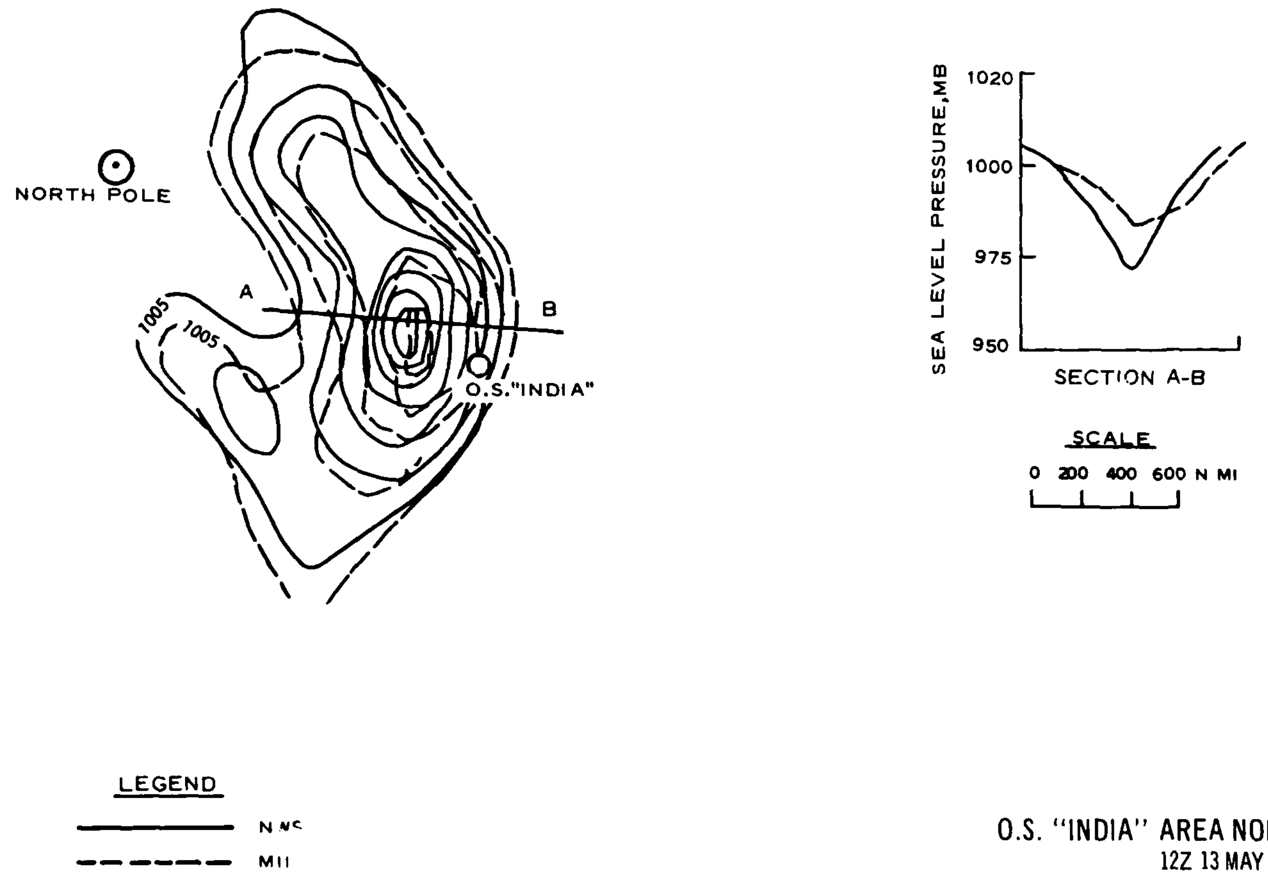


O.S. "INDIA" AREA NORTH ATLANTIC
12Z 11 MAY 56

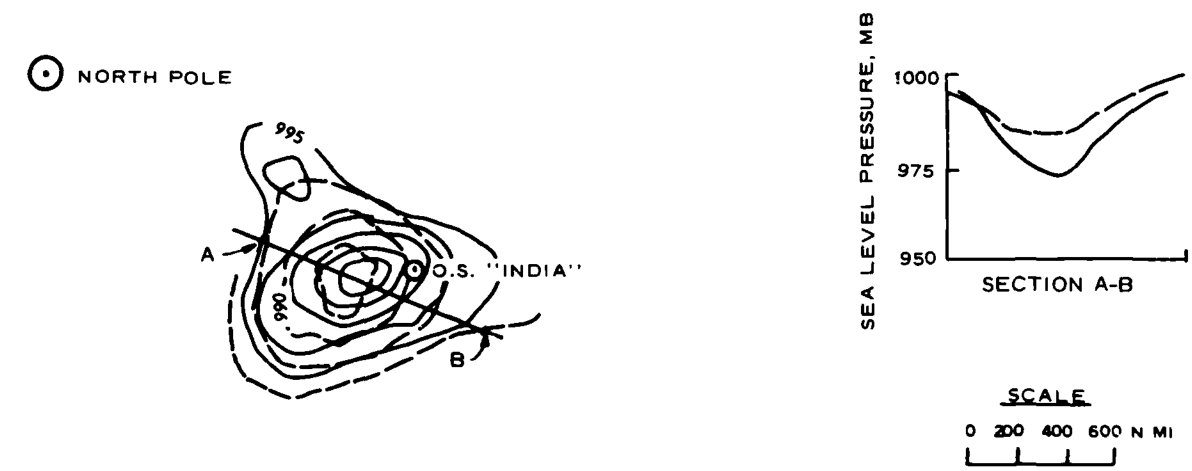
PLATE B22



O.S. "INDIA" AREA NORTH ATLANTIC
12Z 12 MAY 56

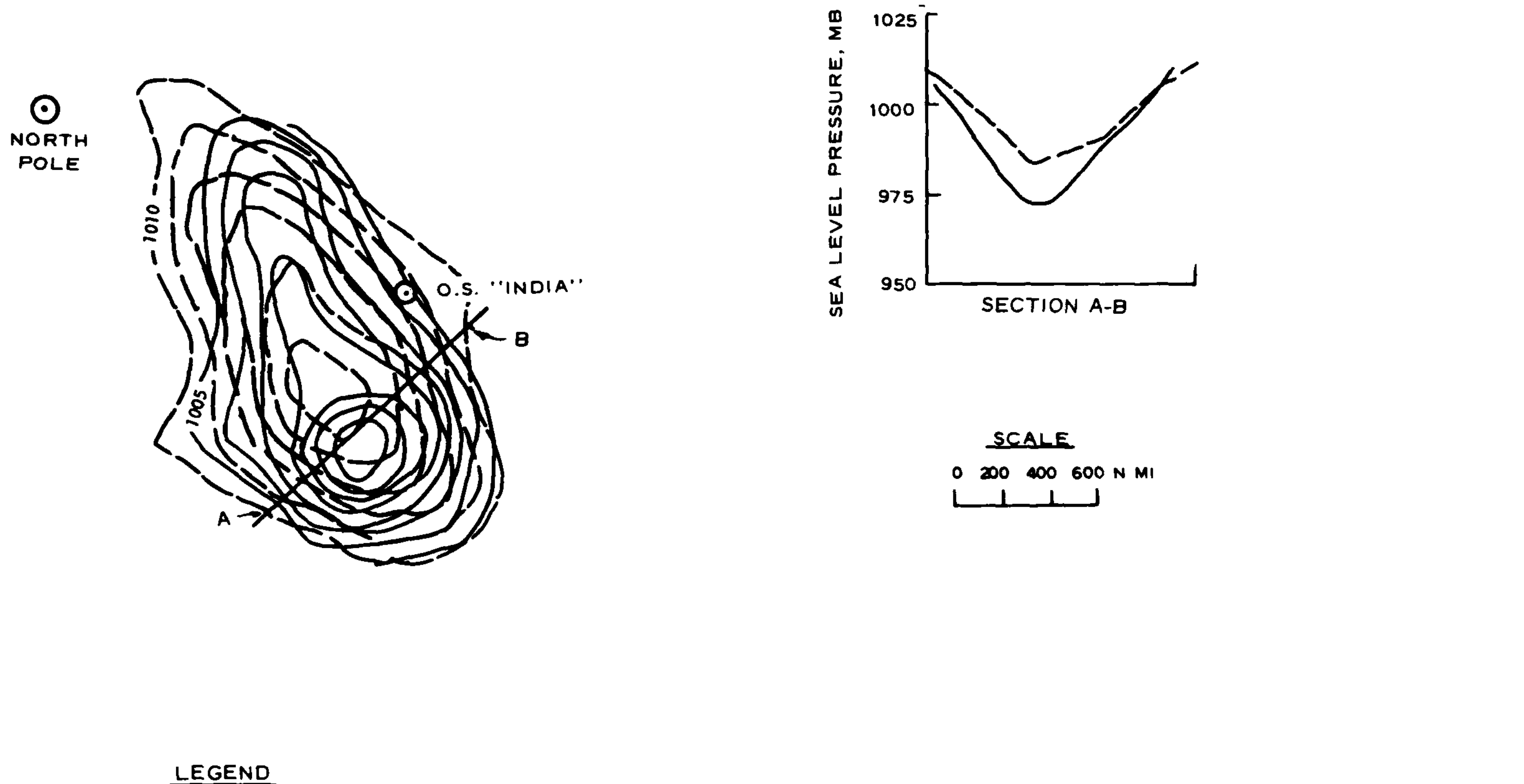


O.S. "INDIA" AREA NORTH ATLANTIC
12Z 13 MAY 56



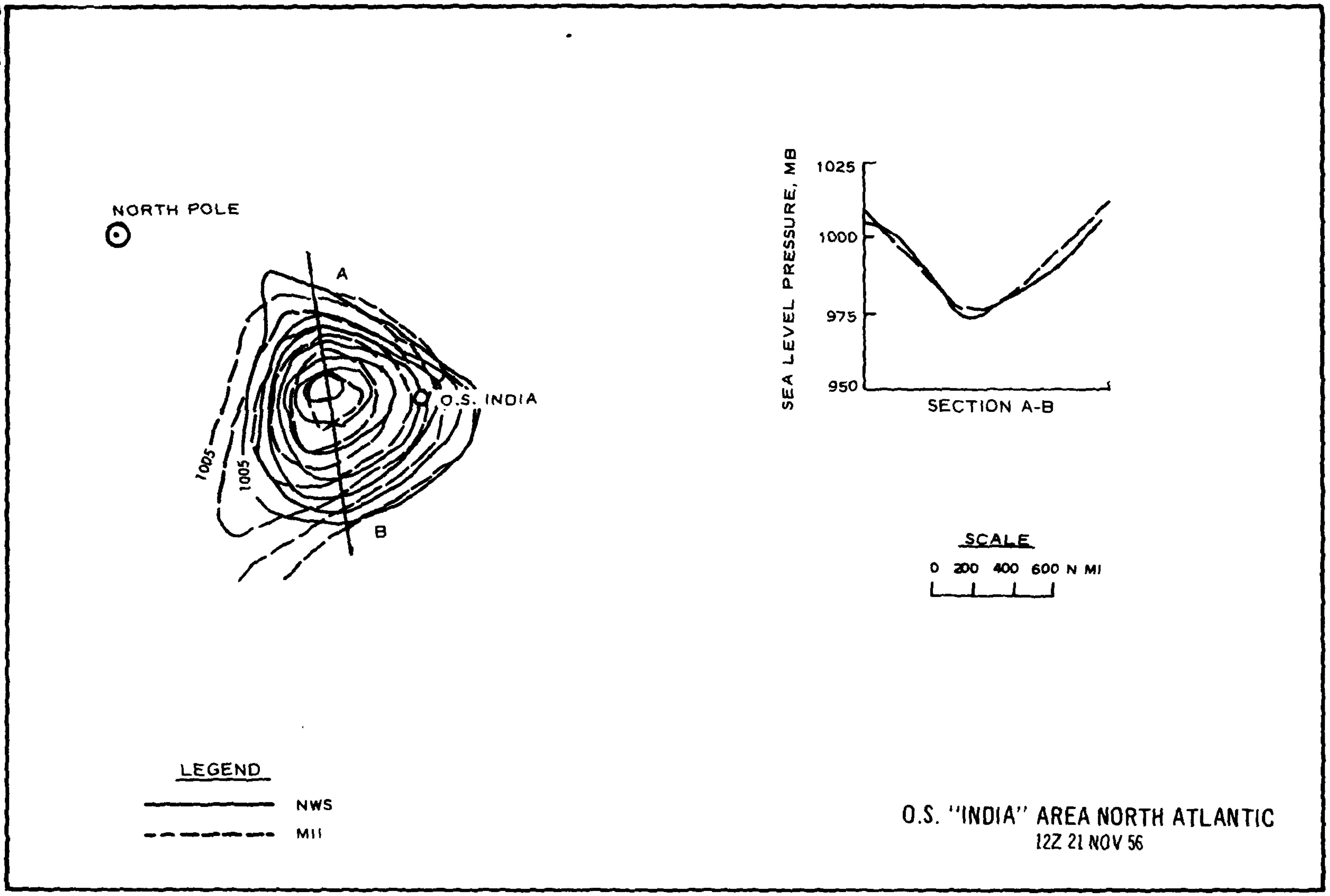
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 19 NOV 56

PLATE B24



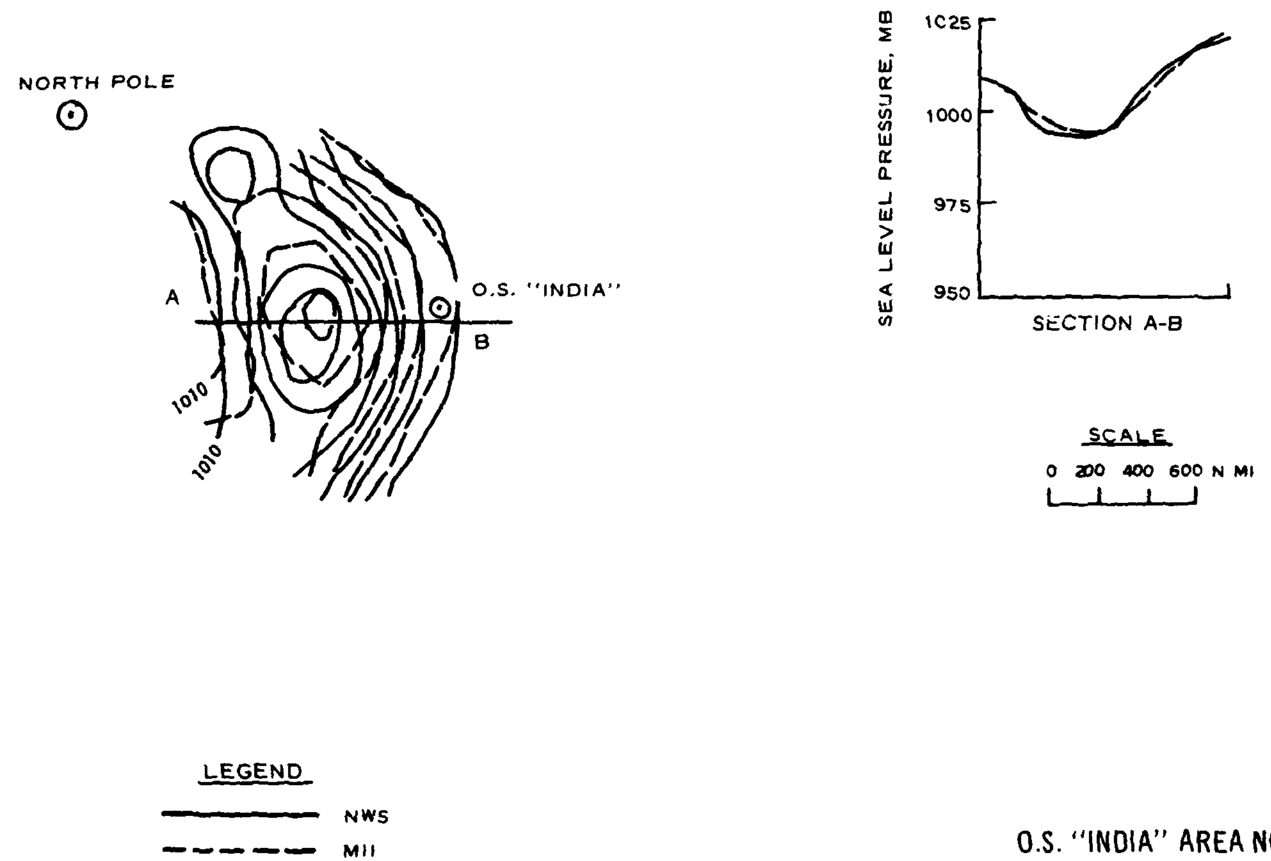
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 20 NOV 56

PLATE B25



O.S. "INDIA" AREA NORTH ATLANTIC
12Z 21 NOV 56

PLATE B26



O.S. "INDIA" AREA NORTH ATLANTIC
12Z 22 NOV 56

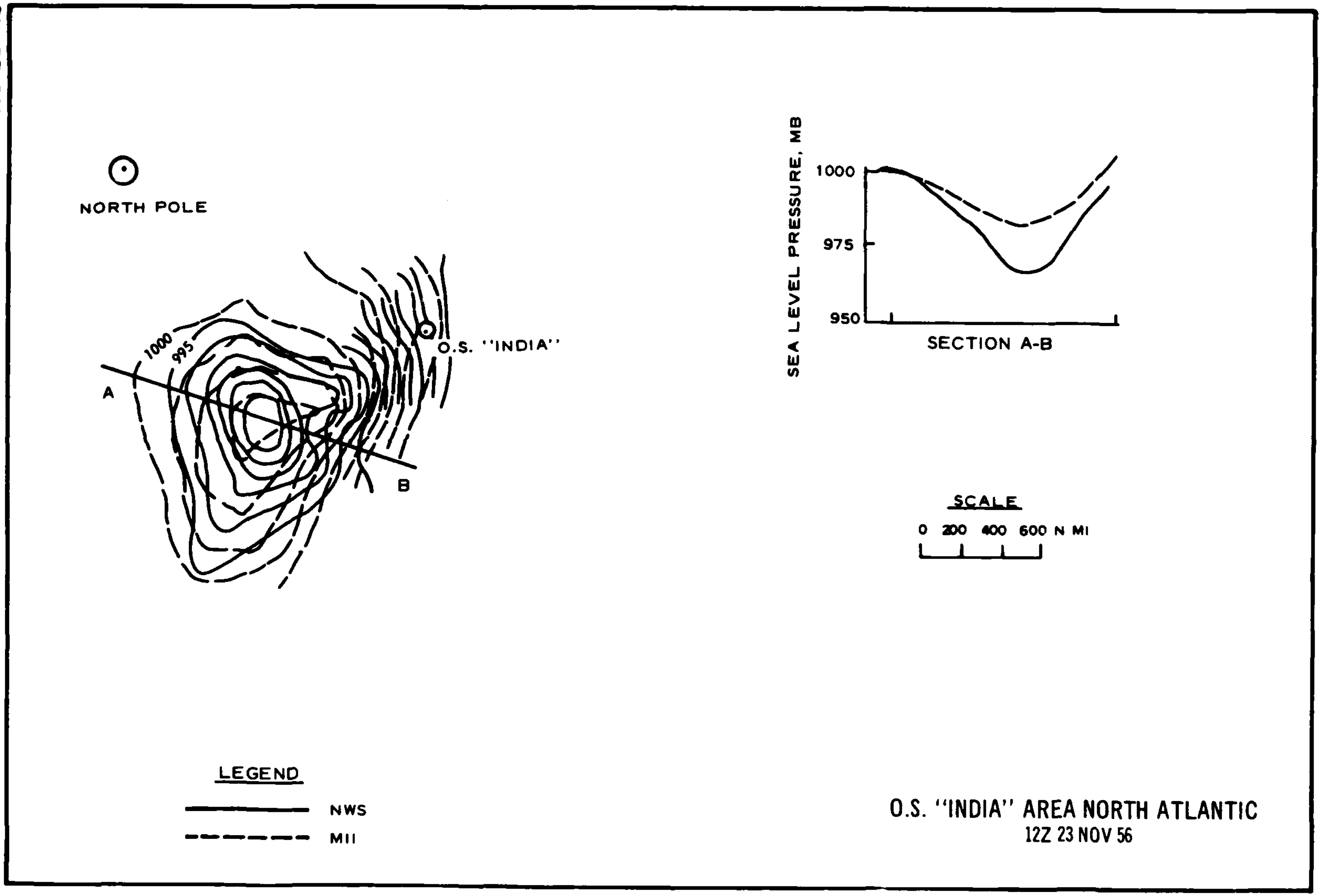
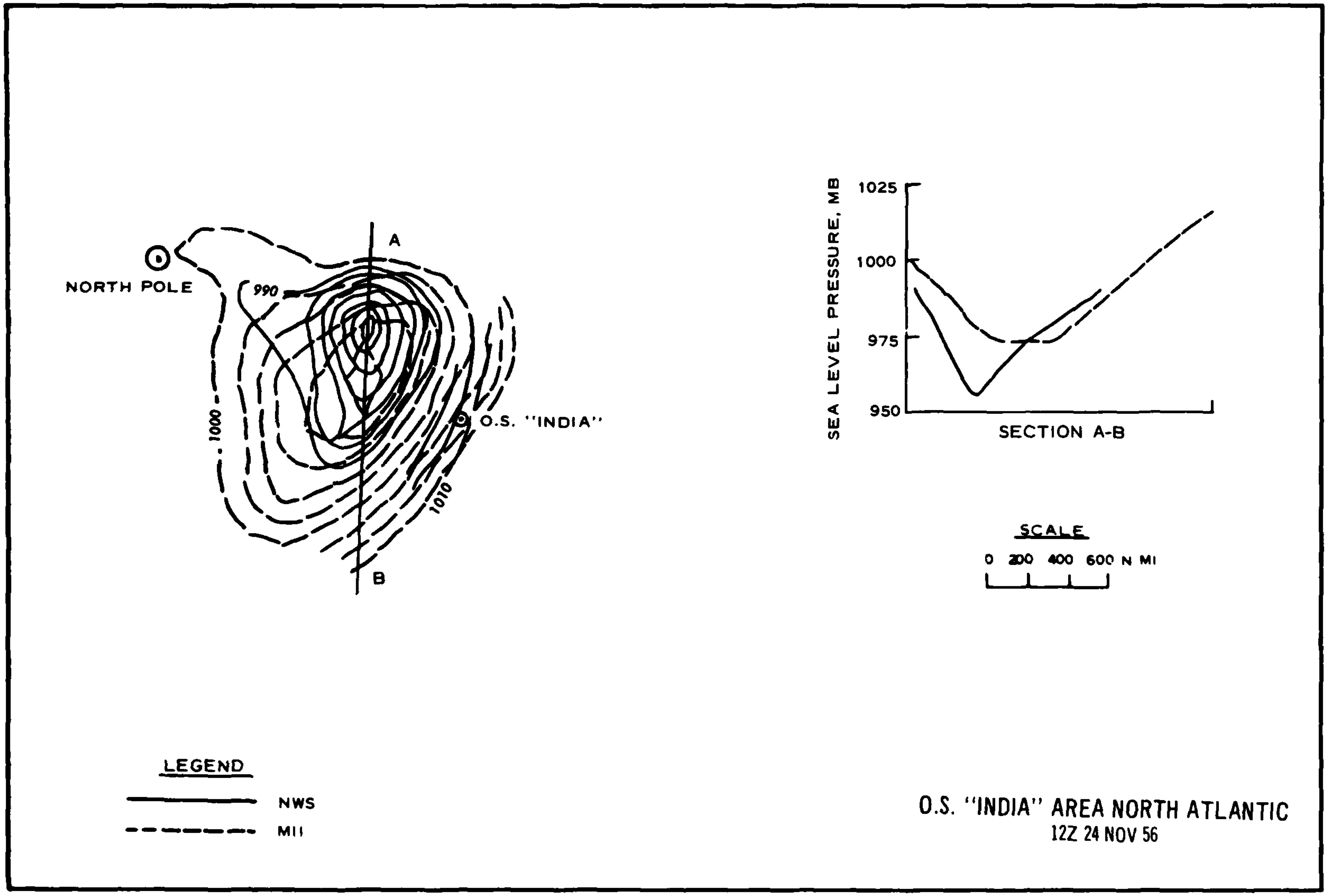
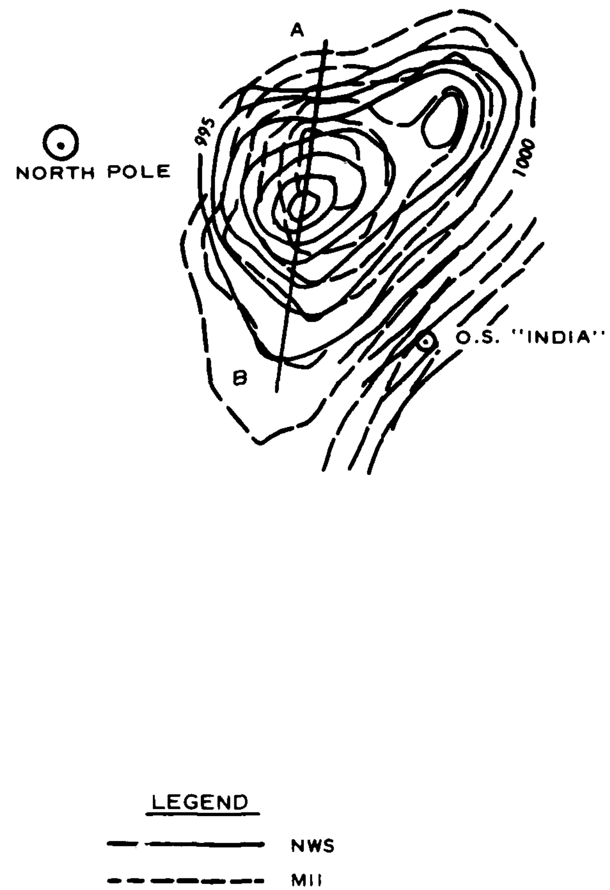

NORTH POLE
1000
995
A
B
O.S. "INDIA"
SEA LEVEL PRESSURE, MB
1000
975
950
SECTION A-B
SCALE
0 200 400 600 N MI
LEGEND
NWS
MII
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 23 NOV 56

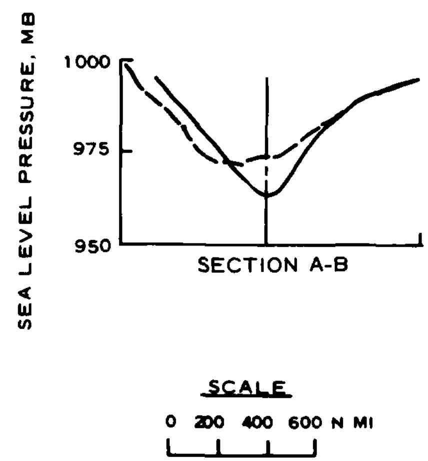
PLATE B28



O.S. "INDIA" AREA NORTH ATLANTIC
12Z 24 NOV 56

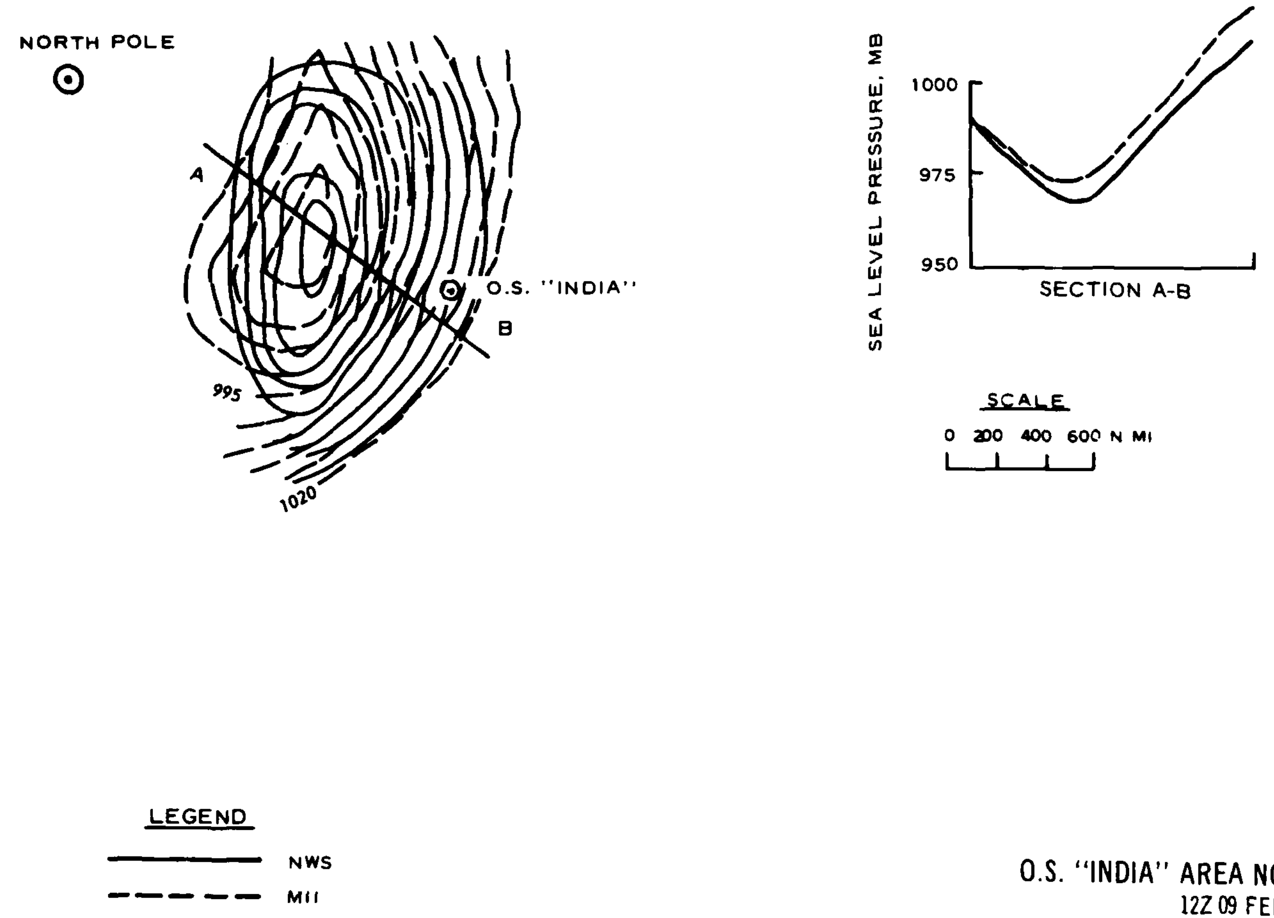
PLATE B29





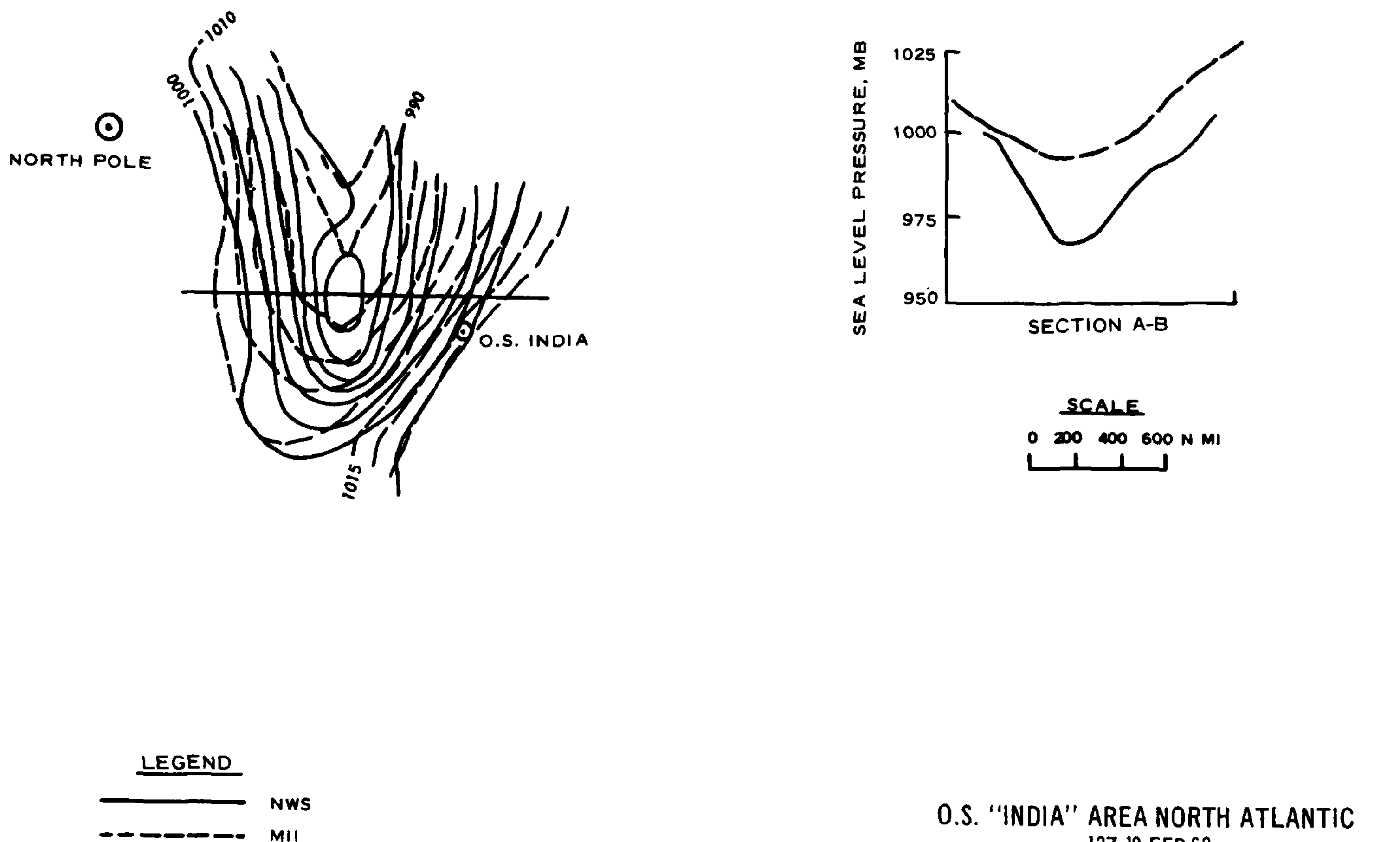
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 25 NOV 56

PLATE B30



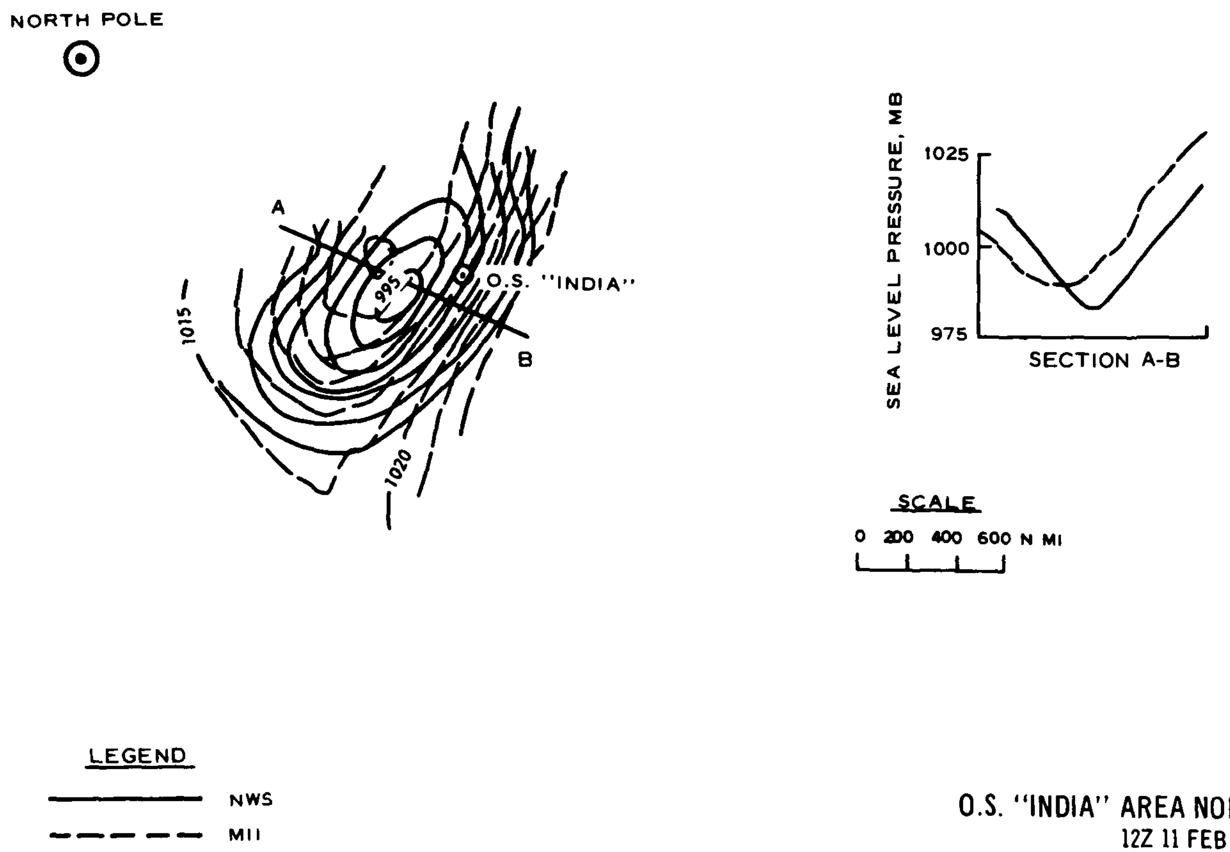
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 09 FEB 62

PLATE B31



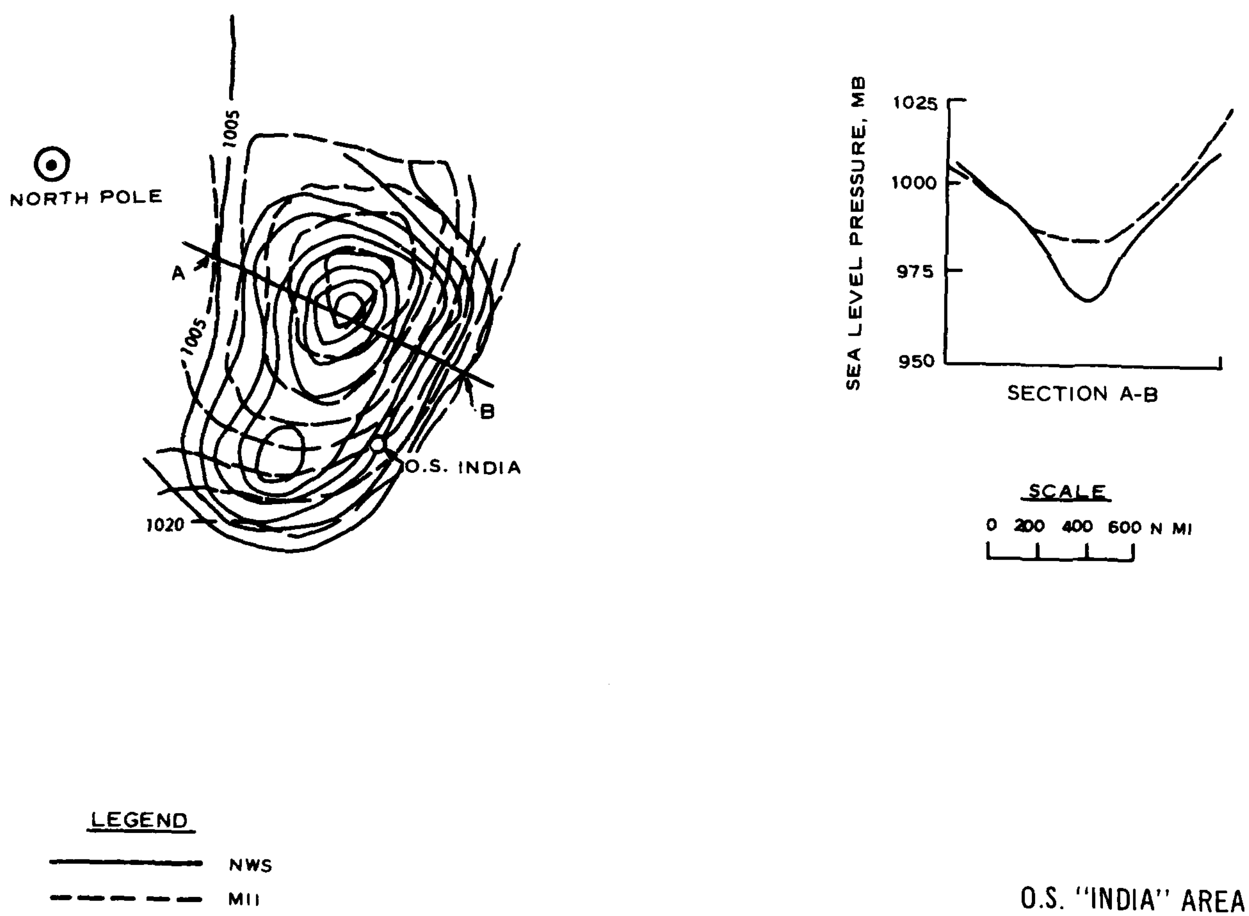
O.S. "INDIA" AREA NORTH ATLANTIC
12Z 10 FEB 62

PLATE B32

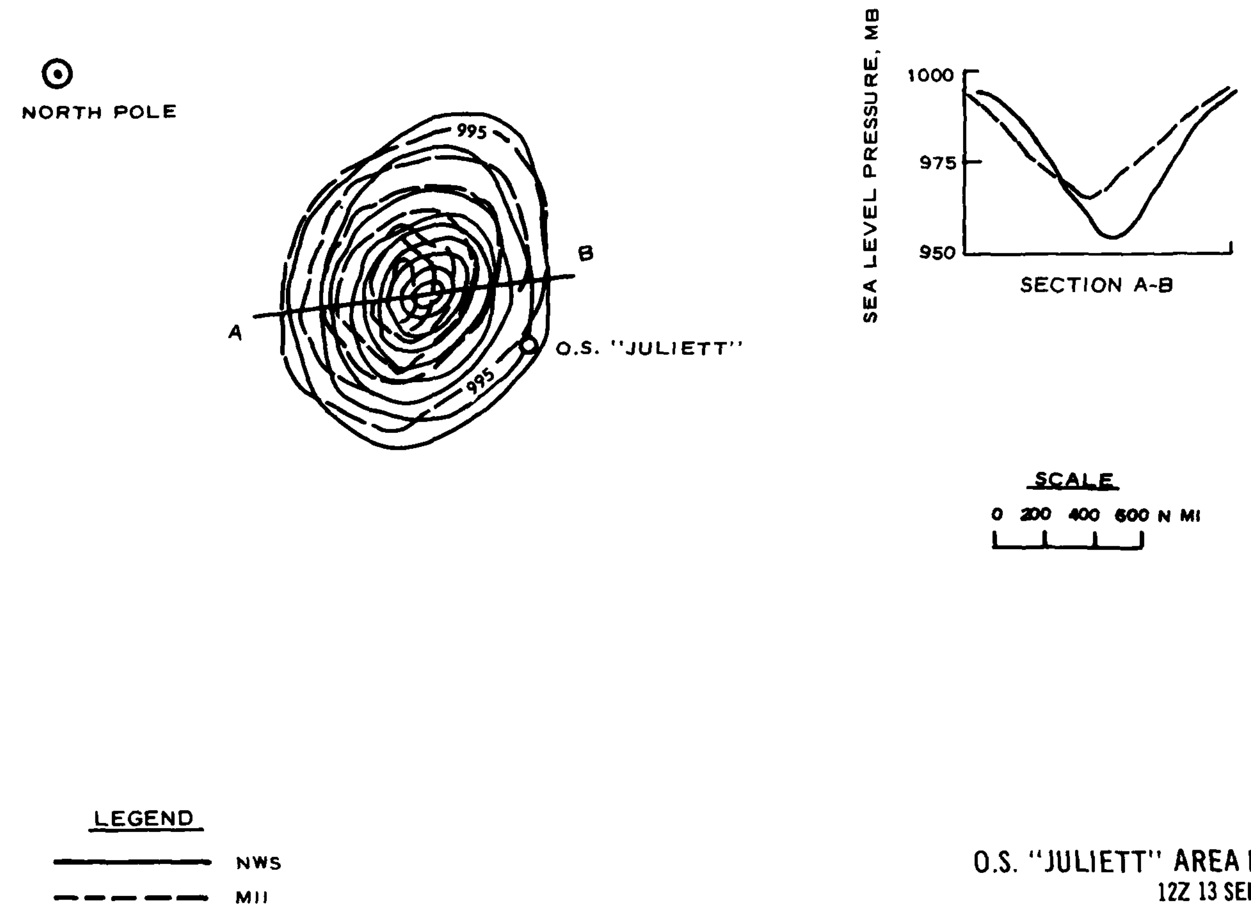


O.S. "INDIA" AREA NORTH ATLANTIC
12Z 11 FEB 62

PLATE B34

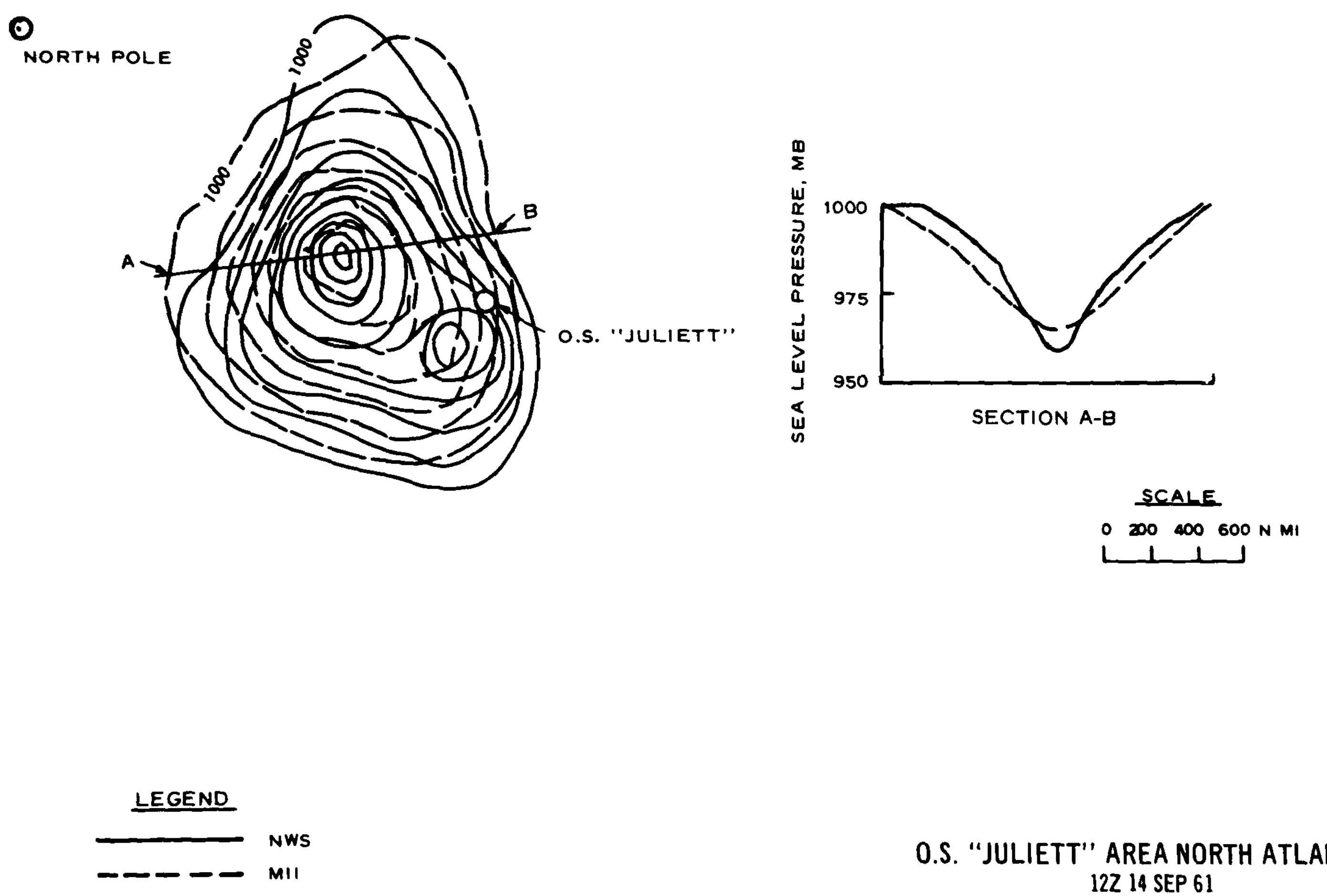


O.S. "INDIA" AREA NORTH ATLANTIC
12Z 15 FEB 62

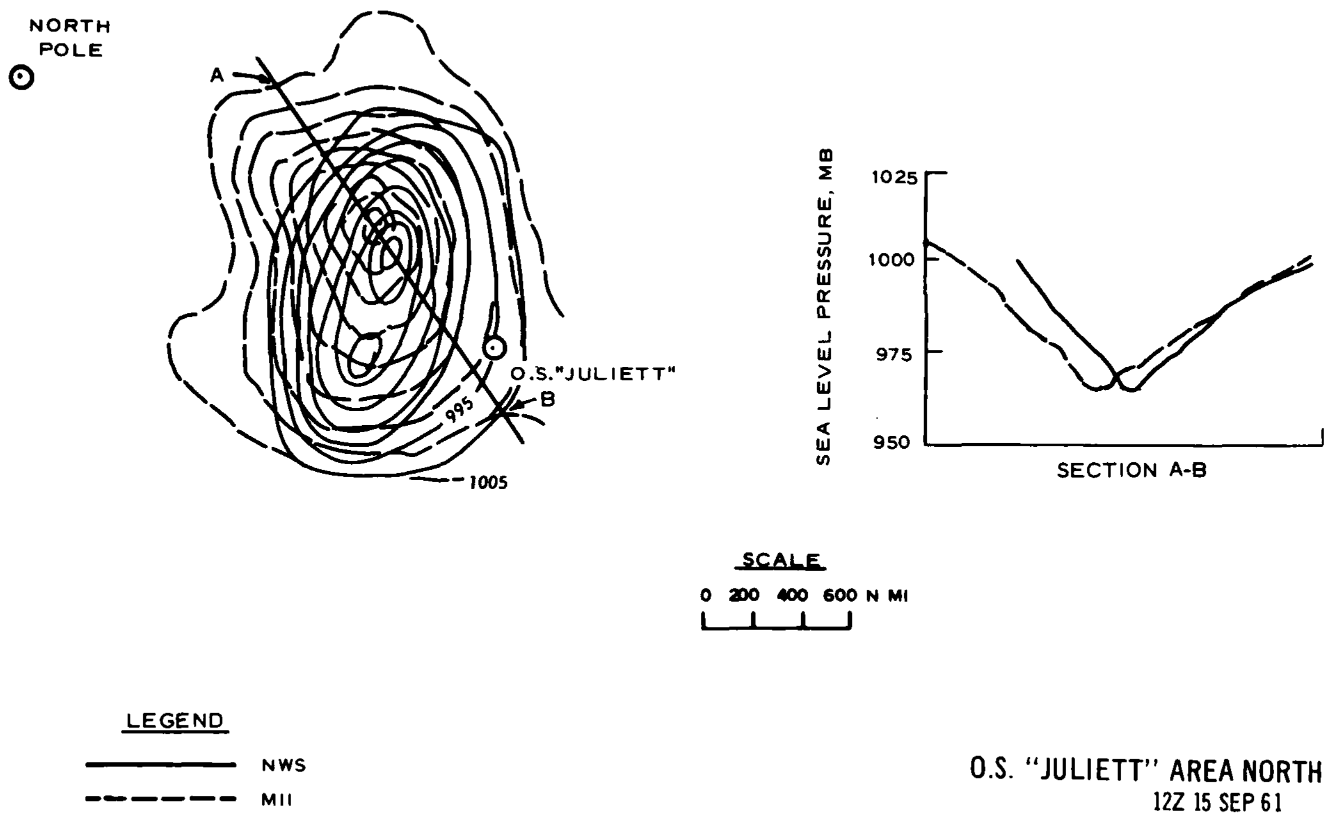


O.S. "JULIETT" AREA NORTH ATLANTIC
12Z 13 SEP 61

PLATE B36



O.S. "JULIETT" AREA NORTH ATLANTIC
12Z 14 SEP 61



O.S. "JULIETT" AREA NORTH ATLANTIC
12Z 15 SEP 61

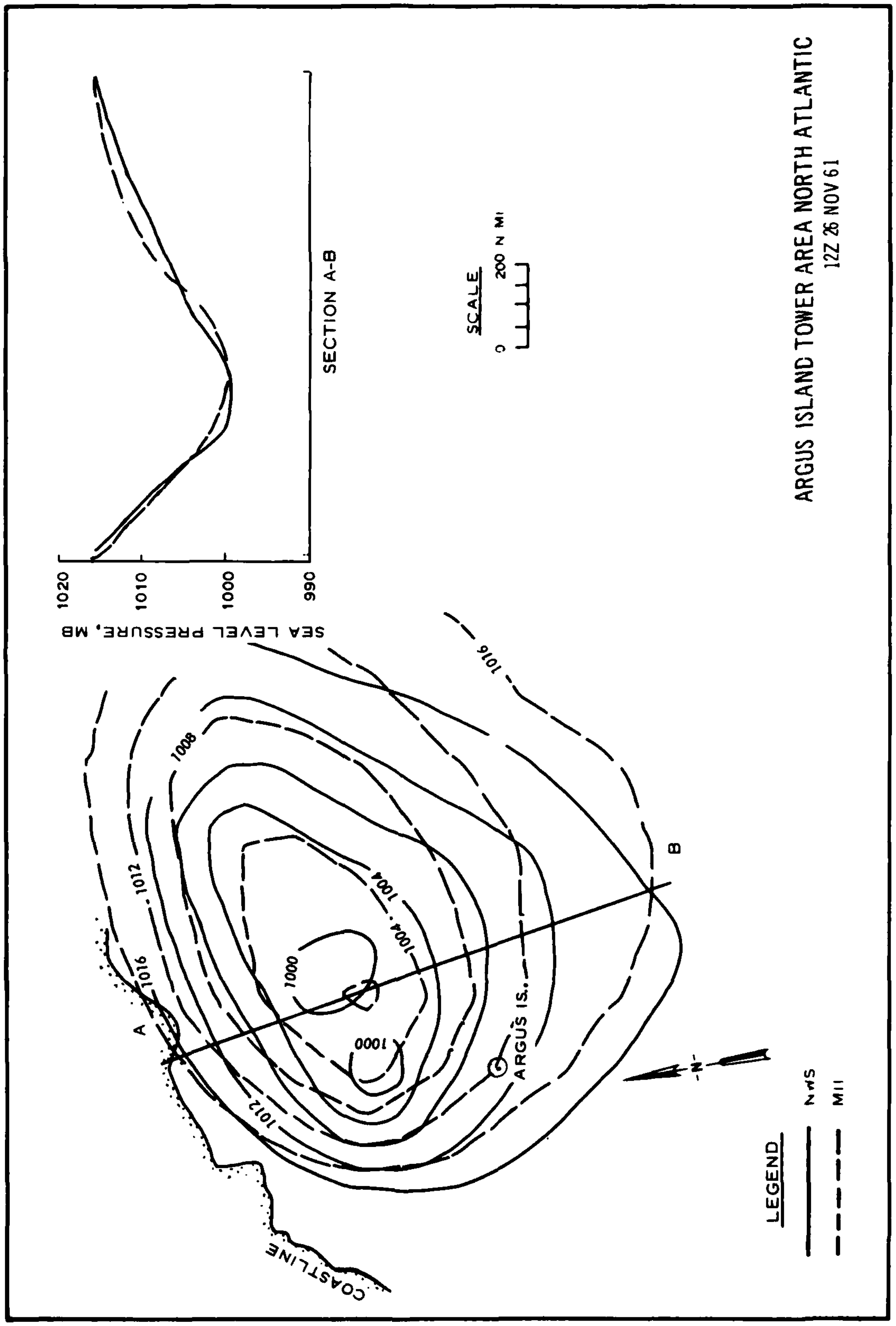

ARGUS ISLAND TOWER AREA NORTH ATLANTIC
12Z 26 NOV 61
SECTION A-B
SEA LEVEL PRESSURE, MB
1020
1010
1000
990
SCALE
0
200 N MI
LEGEND
NWS
MII
COASTLINE
ARGUS IS.
A
B
N
1016
1012
1008
1004
1000

PLATE B38

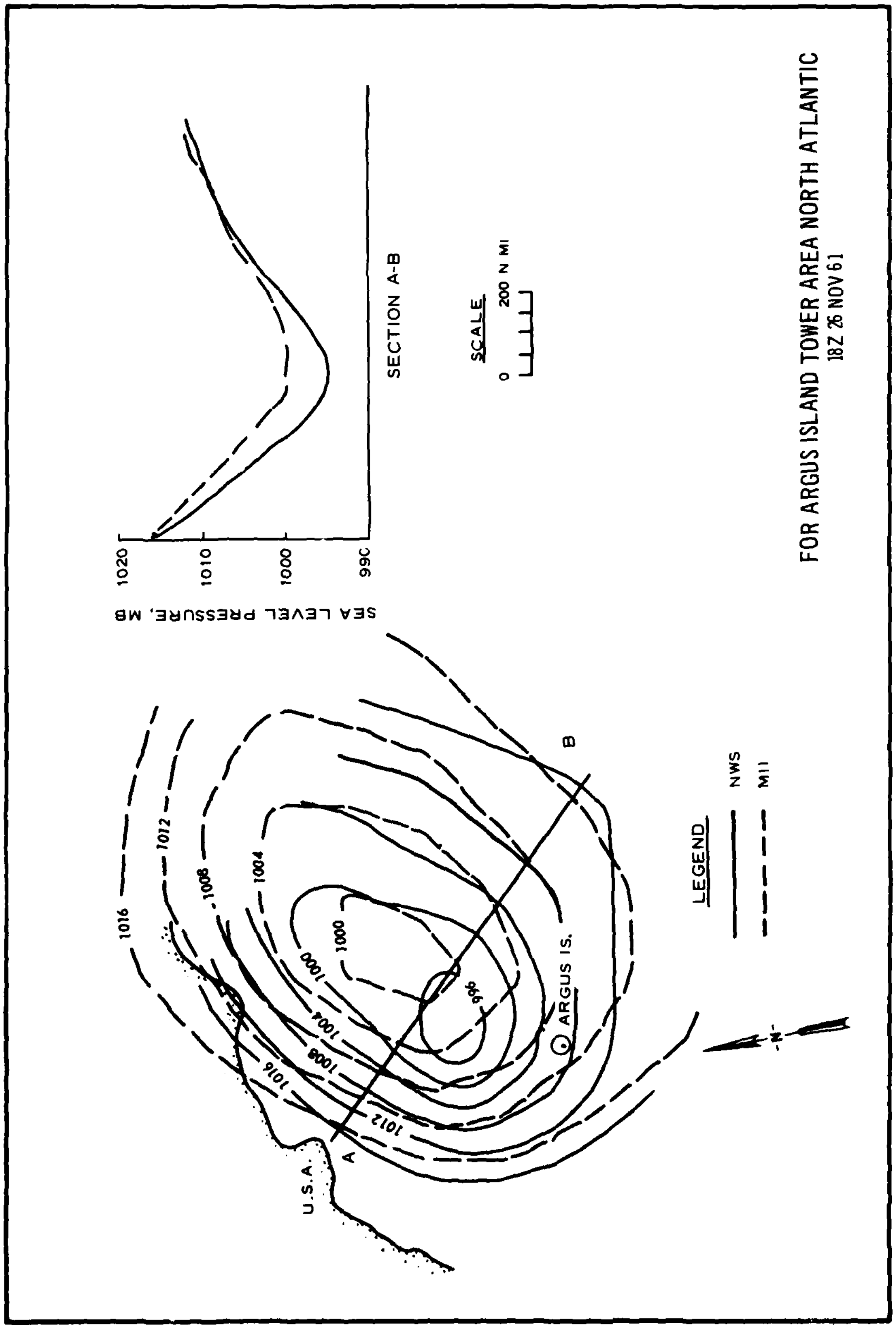
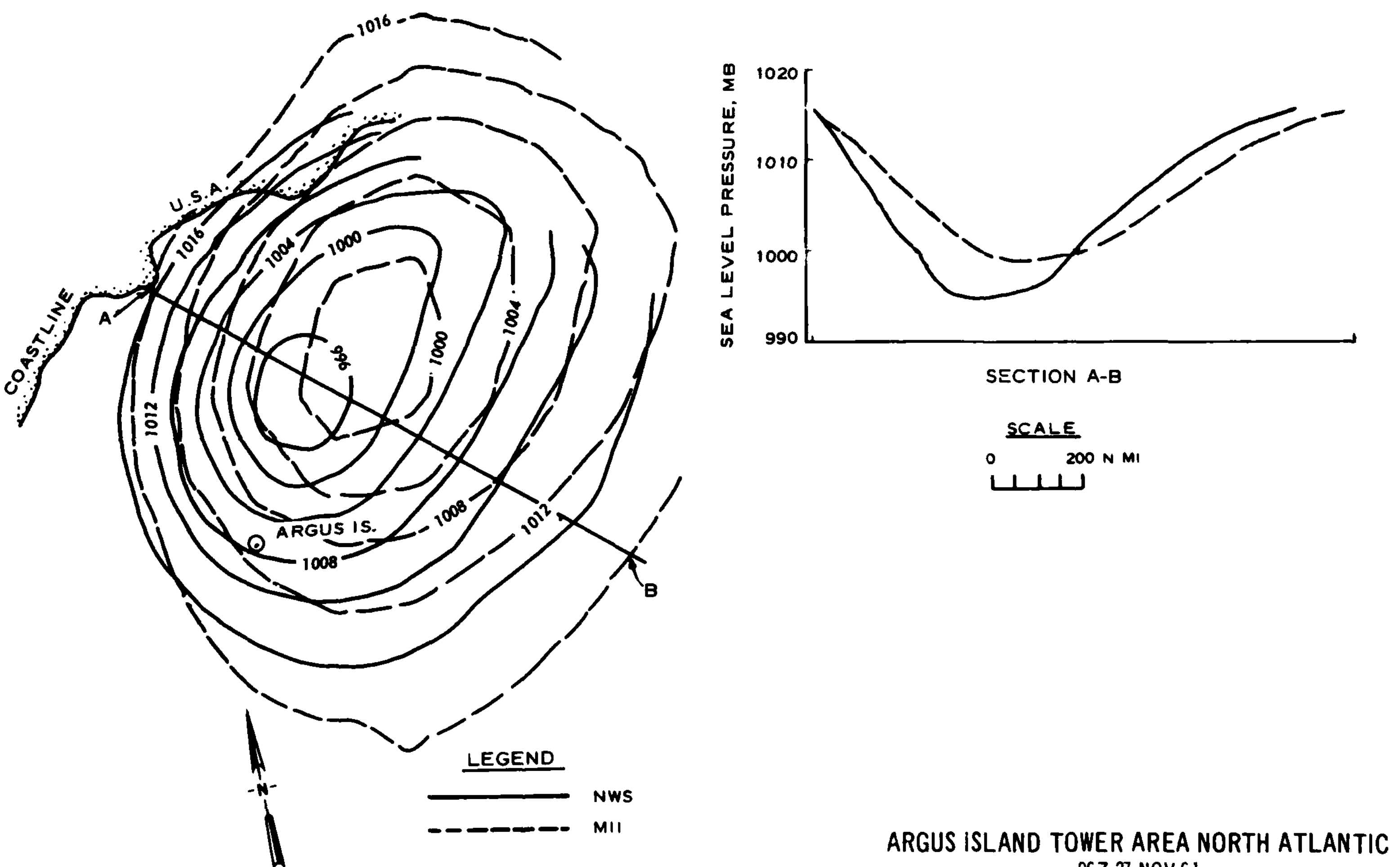
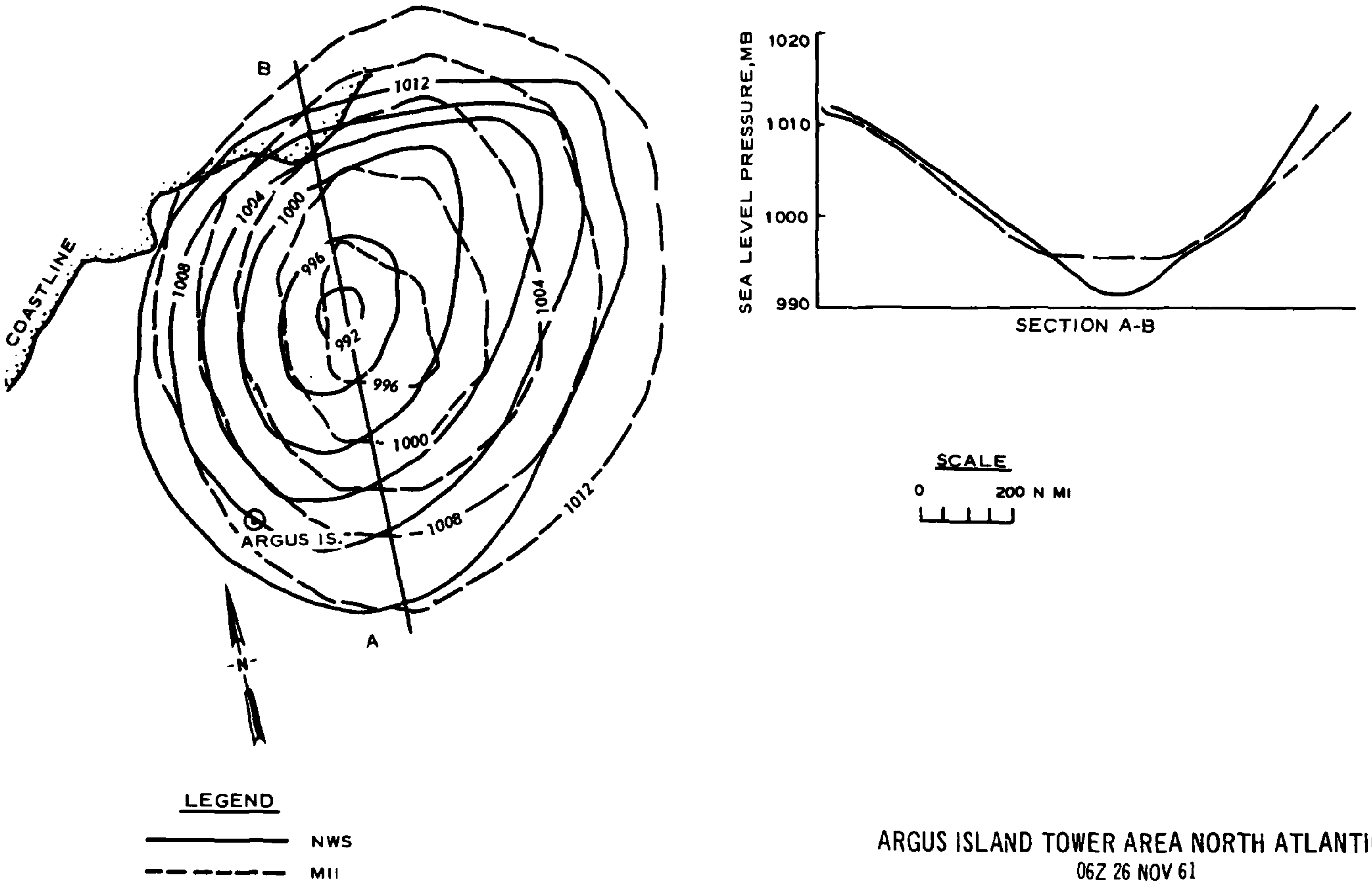

FOR ARGUS ISLAND TOWER AREA NORTH ATLANTIC
18Z 26 NOV 61
SECTION A-B
SEA LEVEL PRESSURE, MB
1020
1010
1000
990
SCALE
0
200 N MI
LEGEND
NWS
MII
ARGUS IS.
U.S.A.
A
B
N
1016
1012
1008
1004
1000
996

PLATE B39



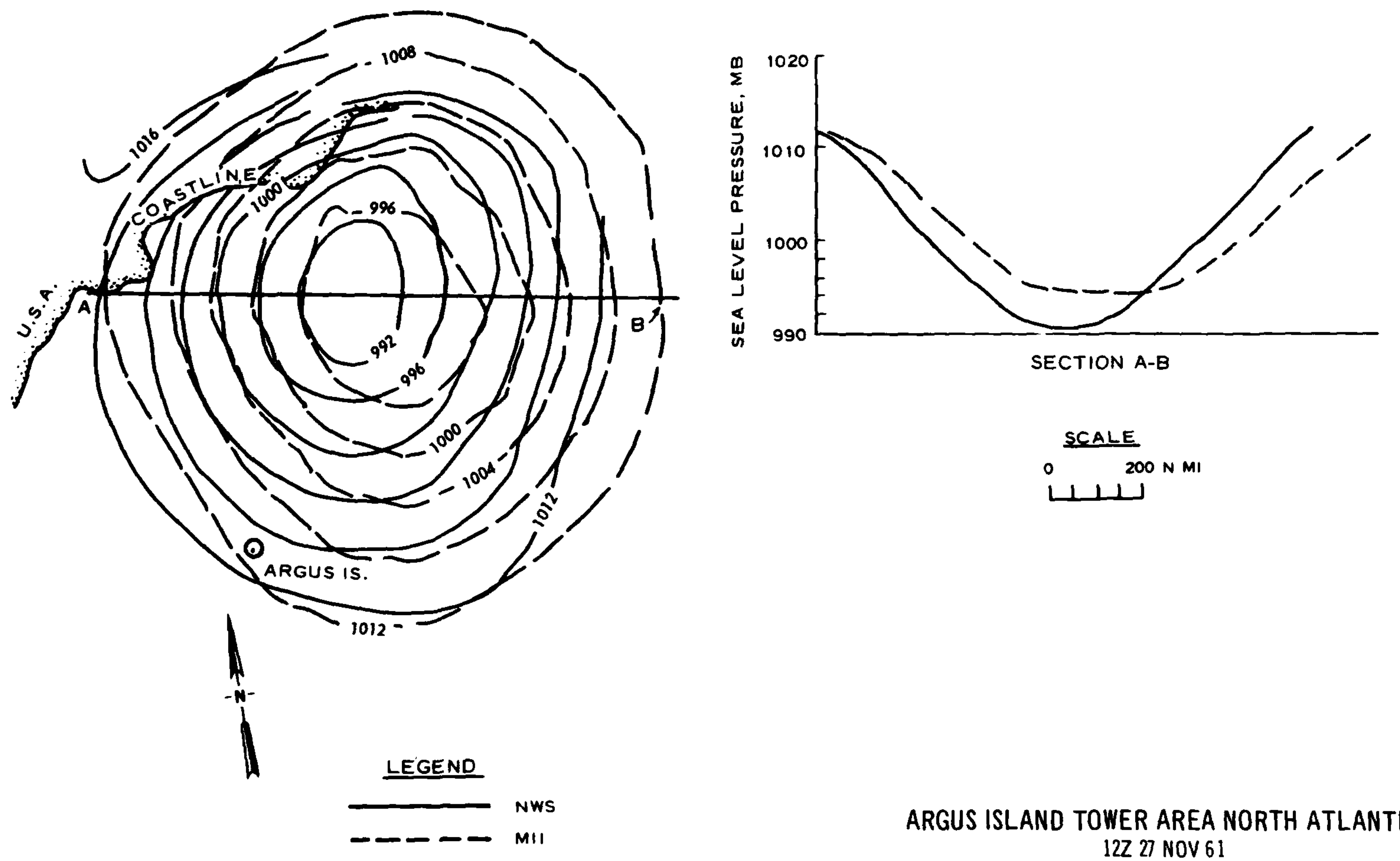
ARGUS ISLAND TOWER AREA NORTH ATLANTIC
06Z 27 NOV 61

PLATE B40



ARGUS ISLAND TOWER AREA NORTH ATLANTIC
06Z 26 NOV 61

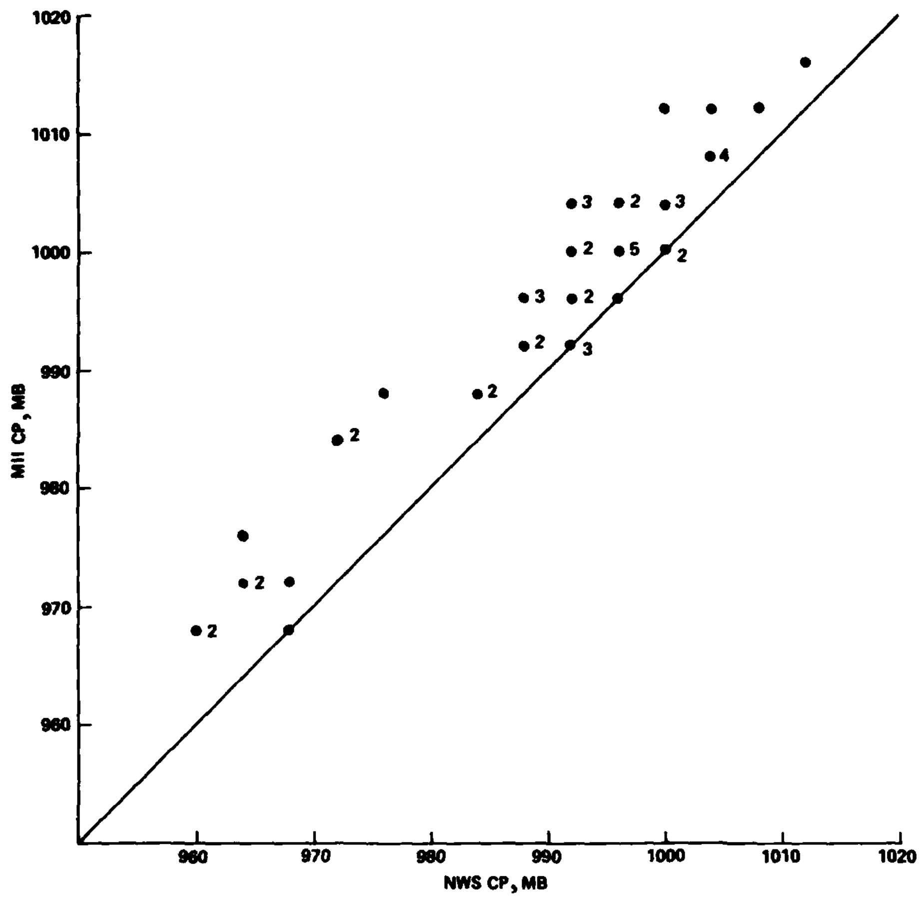
PLATE B41



ARGUS ISLAND TOWER AREA NORTH ATLANTIC
12Z 27 NOV 61

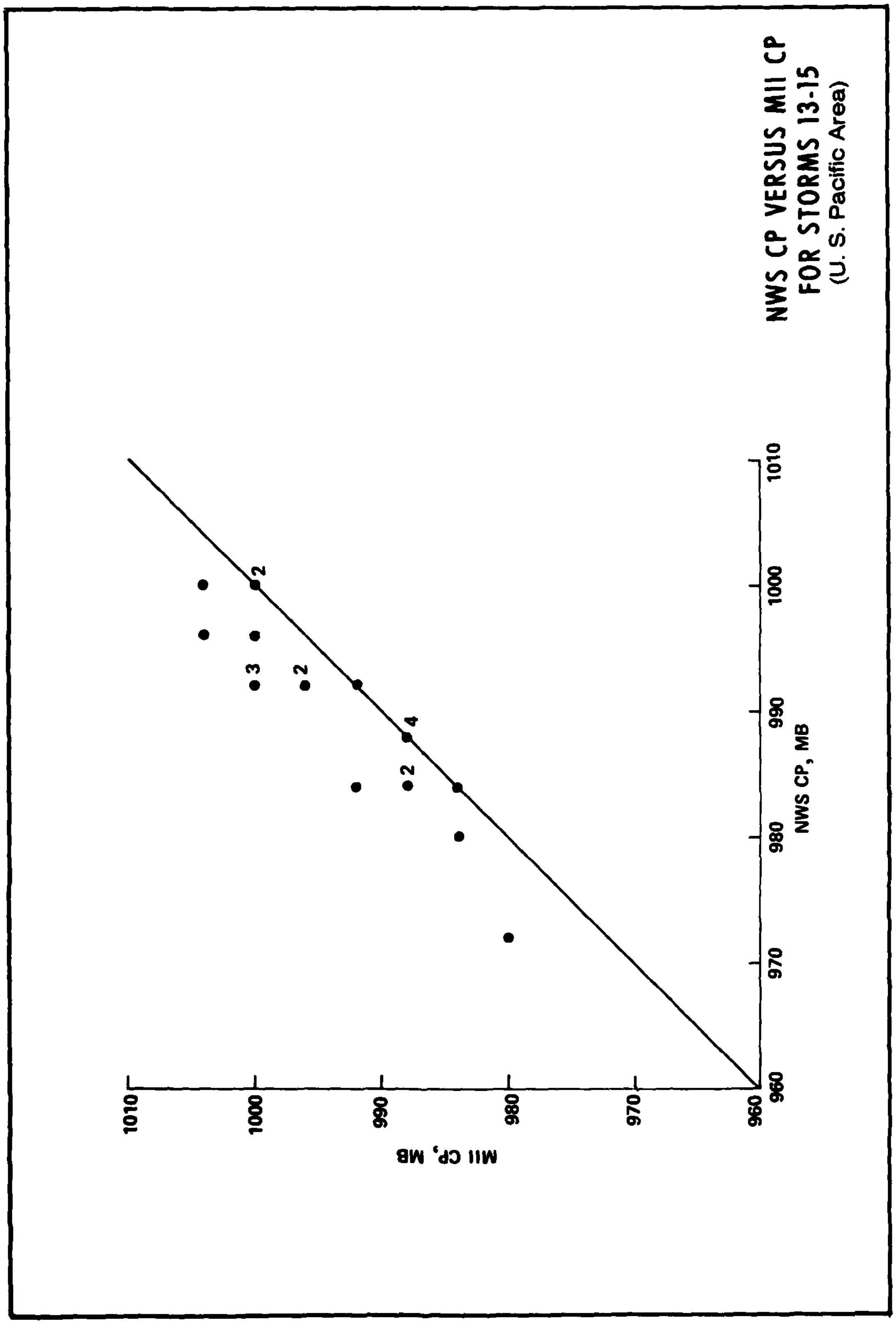
PLATE B42

APPENDIX C: CROSSPLOTS OF MII CENTRAL PRESSURES AND NWS CENTRAL PRESSURES



NWS CP VERSUS MII CP
FOR STORMS 1 - 12, & 21
(U. S. Atlantic Area)

PLATE C1


NWS CP VERSUS MII CP
FOR STORMS 13-15
(U. S. Pacific Area)
MII CP, MB
NWS CP, MB
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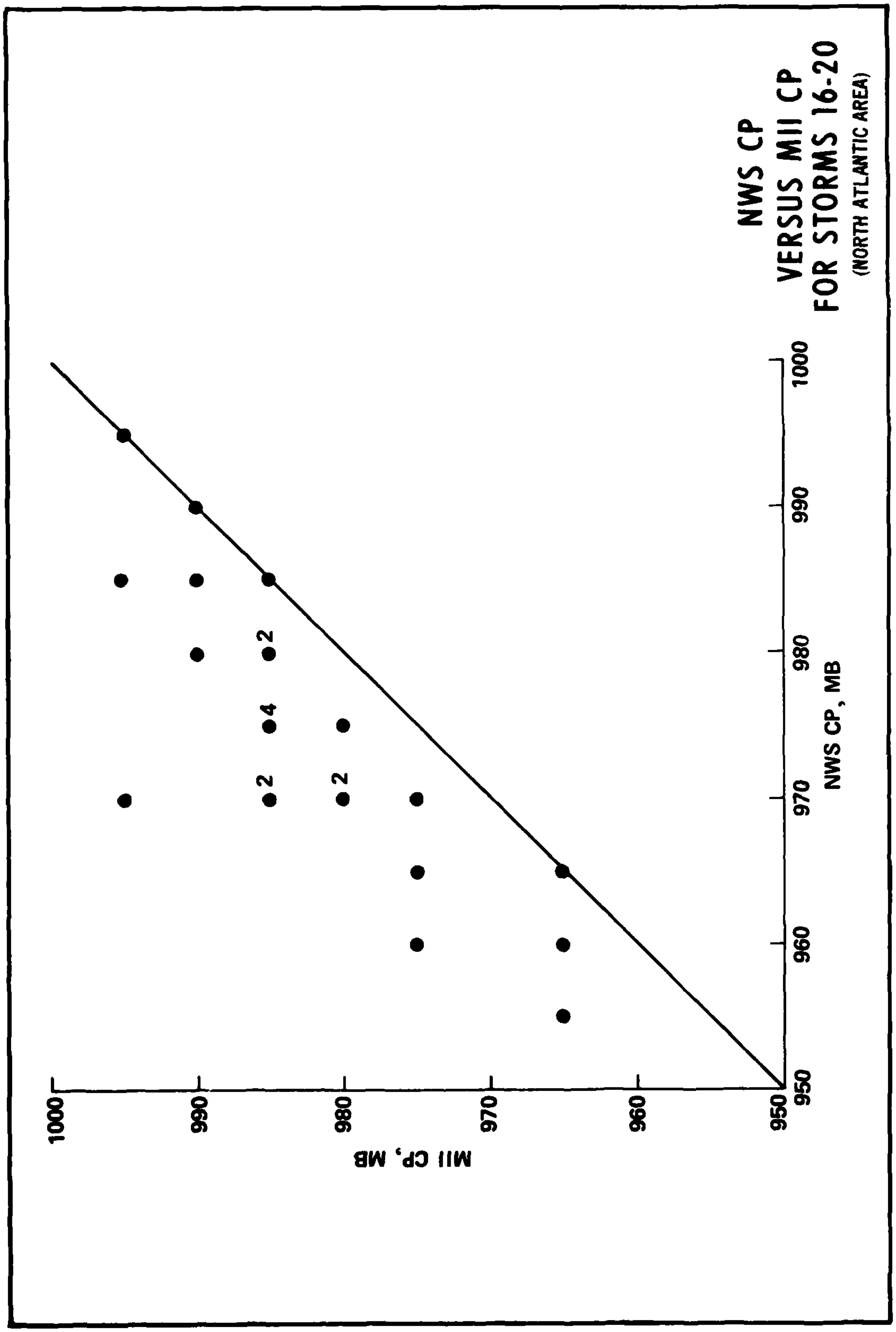
970
980
990
1000
1010
2
3
2
4
2

PLATE C2



NWS CP
VERSUS MII CP
FOR STORMS 16-20
(NORTH ATLANTIC AREA)
NWS CP, MB
MII CP, MB
950
960
970
980
990
1000
2
4
2
2

PLATE C3

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Corson, William D

Wave information study for U. S. coastlines; Report 1: Surface pressure field reconstruction for wave hindcasting purposes / by William D. Corson, Donald T. Resio, Charles L. Vincent. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1980.

24. [7] p., [23] leaves of plates : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; HL-80-11, Report 1)

Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C.

1. Atmospheric pressure. 2. Climatological data. 3. Mathematical models. 4. Meteorological data. 5. Numerical simulation. 6. Water wave hindcasting. 7. Water waves. I. Resio, Donald T., joint author. II. Vincent, Charles Linwood, joint author. III. United States. Army. Corps of Engineers. IV. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; HL-80-11, Report 1.

TA7.W34 no.HL-80-11 Report 1