TIDAL DATA FROM THE

BERING, CHUKCHI, ANO BEAUFORT SEAS

by

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Final Report
Outer Continental Shelf Environmental Assessment Program
Research **Unit 642**

May 1984

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INTRODUCTION

This report relates Brown and Caldwell's activities for the Outer Continental Shelf Environmental Assessment Program (OCSEAP) project entitled Oceanographic Data for the Bering, Chukchi and Beaufort Seas (WASC 8300114). The purpose of the project was to obtain and process measurements of tide along the Alaskan coast from Norton Sound north to Pt. Barrow and east of Pt. Barrow to the United States/Canada Border. Desired information from these measurements were amplitude and phase of astronomical tidal constituents at locations throughout the study area, which covers thousands of miles of the Alaskan coast. Tidal measurements are necessary to adapt a numerical model of deep-water tidal circulation to the relatively shallow continental shelf areas of potential petroleum exploration and development. The tidal circulation model is a sub-model of an oil-spill risk analysis, and knowledge of the tidal circulation is required in order to estimate oil spill transport. Since the study area is in the harsh Arctic environment, historical data is very limited, and simultaneous tidal measurements did not exist for this area prior to this study.

Scope of Work

This project involved collection and analyses of pressure data from bottom mounted sensors in order to determine amplitude and phase of major tidal constituents. Most of the study area is north of the Arctic Circle, and is covered by ice most of the year. Therefore, deployment and retrieval of in-situ recording pressure gauges was scheduled for the short period of ice breakup during the summer. A minimum of 29 days of measurement were required at each location in order to obtain the amplitude and phase of the tidal constituents by harmonic analysis. Additionally, a minimum overlap of 20 days of simultaneous measurements at all locations was required to allow estimation of tidal constituents at locations between measurement sites.

Brown and Caldwell (BC) was responsible for collection and analysis of data for determination of amplitude and phase of tidal constituents. OCSEAP supplied most of the instrumentation and logistical support for the project. The scope of work was separated into four major tasks: prefield work, field effort, data processing and analyses, and reporting and deliverables.

Prefield effort included: (1) final planning and coordination with NOAA agencies such as OCSEAP, Pacific Marine Center (PMC), Pacific Marine Environmental Laboratories (PMEL), and others, (2) check out of pressure gauges and acoustic releases supplied by PMEL and other equipment supplied by Brown and Caldwell (BC), (3) construction of moorings for instrumentation, and (4) initial data processing.

Field effort involved mobilization and demobilization of equipment and personnel to or from Prudhoe Bay, Dutch Harbor, Nome, and Barrow, Alaska, and deployment and retrieval of instrumentation. NOAA supplied logistical support for deployments in Norton Sound and Chukchi Sea from the R/V Discoverer. The R/V Surveyor was used for recoveries from these areas. Logistical support for Beaufort Sea deployments was provided by OCSEAP personnel and NOAA's helicopter group. Personnel from BC supervised deployment and retrieval of instrumentation.

Data processing and analysis tasks included: (1) preliminary processing to scale data to engineering units, (2) correcting absolute pressure data for the effects of barometric pressure, (3) conversion of pressure data to elevation of water over the pressure sensor, and (4) harmonic analysis of data to determine amplitude and phase of tidal constituents.

Reporting involved preparing work products for the study which included: (1) a field work report, (2) this final report, (3) a magnetic tape of all data, and (4) presentation of preliminary results at the Chukchi Sea Synthesis meeting, held in Aleyska in November 1983.

Station Locations and Measurement Periods

The eight measurement sites used in this project were selected by OCSEAP and the contractor responsible for modeling. Two of the sites were located in Norton Sound, two in the Chukchi Sea and four along the Beaufort Coast of the North Slope. Near shore measurements were required to adapt the deep water tidal circulation models to the shallow nearshore area. Station locations are shown on Figures 1 and 2.

The deployment and retrieval of pressure gauges along the northern Alaskan coast were accomplished during a severe year for ice. The late ice breakup along the Beaufort coast and the short ice free season did not allow the instruments to be deployed at the originally selected sites. Ice along most the Beaufort coast was against the outer edge of the barrier island Or up against the shore, with the only areas of open water being inside the barrier islands. After discussions with Dr. Liu of the Rand Corporation and Dr. Hameedi of OCSEAP, alternative sites were chosen for Stations 5 through 8. Most of these alternative sites were located along the inner edge of a barrier island at locations relatively protected from ice floes and close to major inlets in the barrier island chain. The original locations for pressure gauges are shown by the circled station numbers on Figure 2. Actual deployment locations are shown by the point of the arrow and on Figures 2-a through 2-d.

Deployments of instrumentation in the Beaufort and Chukchi Seas were carried out simultaneously between August 5 and August 8, 1983, as presented in Table 1. Instruments were recovered from the

Beaufort coast between September 8 and 10, 1983. Instruments in the Chukchi Sea and Norton Sound were recovered between September 15 and 19, 1983.

METHODS

This section relates instrumentation and methods used in the study. Pertinent information on predeployment planning and testing, the type of mooring used, deployment' and retrieval of instrumentation, and data processing and analyses is presented.

Instrumentation

Most of the instrumentation for this project was provided by the National Oceanographic and Atmospheric Administration (NOAA) through an agreement between OCSEAP and Pacific Marine Environmental Laboratories (PMEL). Eight Aanderaa pressure gauges and eight AMF acoustic releases were provided by PMEL. The Aanderaa pressure gauges included one model TG3, two model TG4A, and five model WLR-5. All of these models use a Paroscientific pressure sensor to sense absolute pressure by the variation in frequency of oscillations of a quartz crystal. A temperature sensor was included in all but one of the pressure instruments. The different models of pressure gauges were similar, but differed in the sample integration time, sampling interval, range of pressure measurement, and recording scheme.

The AMF acoustic releases supplied by PMEL included four squib fired releases (Model 242) and four solenoid actuated releases (Model 395). The acoustic releases were used to retrieve the pressure gauges from the ocean bottom atsamplinglocationsin Norton Sound and the Chukchi Sea. PMEL also provided the deck unit for the AMF releases. Model 395 acoustic releases were not used at Stations5 through 8, since these stations had to be moved to ice-free, shallow-water sites near the barrier islands.

Calibration and Testing Procedures

prior to deployment, instrumentation was shipped from PMEL to Brown and Caldwell's Costa Mesa test facility. Proper operation of instrumentation was verified in a relatively short period of time, between July 8 and 12, 1983. Proper operation of pressure gauges was tested by creating test tapes of barometric pressure and processing these data tapes. Pressure gauges had previously been calibrated at NOAA ' S Northwest Regional Calibration Center, and calibration reports were supplied to BC by PMEL. Barometric pressure data recorded by the Aanderaa instruments was compared to that of a precision mecury laboratory barometer. Upon receiving the deck unit for the acoustic releases, proper operation of the releases was verified by the system air acoustic check recommended by the manufacturer.

Mooring Design

The mooring design was a taut-leg, near-bottom mooring shown in

Figure 3. The height of this taut-leg mooring was kept to a minimum so that the mooring would not be destroyed by ice. The mooring design included a polypropylene tag line which could be used for recovery should the acoustic release fail.

Ice conditions on the Beaufort Coast during the summer of 1983 were quite severe and prevented deployment of pressure gauges at the water depth desired. Mooring design for Stations 5 through 8 had to be modified to allow the mooring to be placed in ice free areas inside of the barrier islands along the Beaufort coast. This mooring design consisted of the Aanderaa pressure gauge encased inside a PVC pipe, a small flotation ball, a chain anchor, and a tag line which was anchored on the beach of the barrier island using a Danforth anchor. This type of mooring is illustrated in Figure 4.

Deployment and Retrieval

Methods of deployment and retrieval differed for the Chukchi and Beaufort Sea deployment areas. Deployments in Norton Sound and Chukchi Sea were made from the NOAA Ship R/V Discoverer, and retrieval of instruments was accomplished from the R/V Surveyor. Beaufort Sea deployments and retrievals of pressure gauges was accomplished from a chartered sea plane and/or a NOAA helicopter.

Aboard the Discoverer, the taut leg moorings were assembled on deck. The AMF acoustic release was connected to the 28-inch diameter submerged float and anchor chain clump by a seized shackle. The 100-meter tag line was attached to the anchor chain clump. The pressure gauge, mounted inside a protective PVC tube, was attached to the stainless steel mooring rod of the AMF release. After the ship had been positioned on station by Loran C and/or satellite navigation equipment, the mooring was deployed. A crane was used to lift the mooring off the deck and lower it to the ocean floor. A gravity hook detached the mooring from the crane when the anchor reached the ocean floor. As the mooring was lowered over the side, the tag line was let out slowly to keep slight tension on the mooring. Once the mooring was on the bottom, the tag line was stretched out from the mooring on a known bearing and then deployed. After deployment of the instrumentation, a CTD cast was made to determine the density of the water column at the site.

Retrieval of instrumentation was accomplished from the NOAA ship R/V Surveyor. Upon arrival at the station, a CTD cast was obtained. An EG&G acoustic release deck unit and hydrophore were used to confirm that the acoustic release was operational and nearby. The release command was sent after receiving confirmation that the release was in the general vicinity and that the whale boat used for recovery was ready. The AMI? acoustic release disconnected itself from the clump of anchor chain and the submerged flotation ball brought the release and pressure gauge to the surface. The whale boat retrieved the instrumentation and brought it alongside the R/V Surveyor. A crane was used to lift the instrumentation aboard.

Beaufort Sea deployments were made from a charted sea plane

and/or NOAA helicopter. Ice conditions prevented deployment by vessel. Moorings were deployed along barrier islands in ice protected areas near major inlets in the barrier island chain. These moorings consisted of the Aanderaa pressure gauges in a PVC tube,

The pressure gauge and tube were supported by an 8-in submerged float attached to the top of the tube, and anchored by a 50-lb piece of chain attached to the bottom of the tube. A tag line was tied to this chain and led to a Danforth anchor which was buried on the beach of the barrier island. Pressure gauges along the coast were retrieved using a chartered helicopter.

Preliminary Data Processing

Preliminary data processing consisted of the steps necessary to get raw data ready for harmonic analysis. Raw data were transcribed from the internally-recorded, l/4-inch, reel-to-reel tape to Brown and Caldwell's computer system via the RS232C output port of an Aanderaa 2650 tape reader. Instruments recorded raw data as counts. Data were scaled to engineering units of degrees Celsius and pounds per square inch absolute (psia) using calibration coefficients determined by NOAA's Northwest Regional Calibration Center. Time history plots of the absolute pressure fluctuations about the mean were prepared for quality assurance checks of the data.

Barometric pressure data were subtracted from the absolute pressure records. Hourly records of barometric pressure from the following locations were obtained from the National Weather Service (NWS) for the deployment period: Unalakleet, Nome, Kotzebue, Cape Lisburne, Barrow, Deadhorse, and Barter Island. Measurements at Deadhorse and Unalakleet were available for approximately half the day. Barometric pressure data for periods of data gaps were determined from weather charts produced by the NWS Anchorage Forecast Center for the Alaskan region. These weather charts are produced at six-hour intervals. Since no barometric pressure records were readily available for locations close to Thetis Island, Flaxman Island, and Demarcation Bay, barometric pressure data for these stations were also determined from weather charts. Data were interpolated between the six-hour synoptic times of the weather charts.

Time history plots of barometric pressure and gauge pressures corrected for barometric pressure were created to allow quick quality assurance checks of the data. Pressure measurements were converted to the height of water above the pressure sensor by dividing the pressure by the product of a constant density times the acceleration of gravity. Density for the deployment period was estimated from density profile measurements during deployment and retrieval of instruments.

Harmonic Analyses

Harmonic analyses of these pressure records were performed on BC's computer system using a program developed by Dennis and Long

(1971) and adapted to a Digital Equipment Corporation computer system. This program performs harmonic analyses base on work by Schureman (1958). As originally presented in our proposal, Brown and Caldwell intended to perform the harmonic analyses with the aid of the Rapid Retrieval Data Display (R2D2) software on the Environmental Research Laboratories computer in Boulder Colorado. Since access to this computer system was not available to BC in a timely and cost-efficient manner, the analyses were performed on BC's computer with software very similar to that of the R2D2 system.

RESULTS

This section presents results of the project and discusses data recovery and quality. Data presented in graphical and tabular form in the report are contained on a magnetic tape transmitted with the final report.

Data Recovery and Quality

Each Aanderaa pressure gauge operated correctly during the entire deployment period and recorded accurate pressure data. Since simultaneous records of more than 29 days duration were obtained at each station, harmonic analyses were performed on the same 29-day period for each sampling location.

The instrument at Station 7, offshore of Flaxman Island, was deployed on August 5. The instrument was pulled ashore by someone on August 1'2. The instrument was returned to the shallow water intertidal area on August 20 and recorded tidal fluctuations through August 26. The data then became erratic and was not representative of tidal fluctuations after that date. Approximately 13 days of actual tidal data were recorded by this instrument.

Data from all other stations were valid and had durations of 32 to 35 days at Beaufort stations and 39 to 42 days at Chukchi and Norton stations. The interference with the instrument deployed offshore of Flaxman Island reduced valid data return from 100 to 93 percent.

Time history plots of corrected pressure measurements at Stations 1 through 4 in the Chukchi Sea and Norton Sound are presented on Figures 5 and 6, and similar plots for Stations 5 through 8 in the Beaufort Sea are presented on Figures 7 and 8. Time history plots of near bottom temperatures at these same locations are presented in Figures 9 through 12.

Time history plots show the fluctuations of temperature or pressure around the monthly mean of the data. Pressure plots for the various stations are offset by 2 psi from one another, and temperature plots are offset by 6 degrees C from one another.

Barometric Pressure Data

Measurements of absolute pressure near the ocean bottom were adjusted for barometric pressure. 'Time history plots of barometric pressure used to correct pressure records are presented in Figures 13 through 16. Actual barometric pressure records from Unalakleet, Nome, Kotzebue, Cape Lisburne, and Barrow were obtained from NWS. Since no weather stations were located near the other measurement sites on the Beaufort coast, barometric pressure data were determined from synoptic weather charts at six hour intervals.

Density Profiles

Density profiles were measured just after deployment and prior to recovery of pressure gauges at Stations 1 through 4. These density profiles were used to determine an average density for the deployment period. This density data were required to convert pressure measurements to a water depth. The average densities used for these conversions were as follows:

Station No.	Location	Density (Sigma-t)
1	Cape Denbigh	1.01750
2	Nome	1.02230
3	Kotzebue	1.02400
4	Ledyard Bay	1.02400
5	Cooper Is.	1.02486
6	Thetis Is.	1.02486
7	Flaxman Is.	1.02486
8	Demarcation Bay	1.02453

Actual density data measured at Stations 1 through 4 during deployment and retrieval cruises are presented in Tables 2 through 9* No density profile measurements were obtained for Stations 5 through 8 because water depths at these stations were very shallow. Density at Stations 5 through 8 were estimated from temperature measurements recorded by the instruments and an assumed salinity.

Harmonic Analysis

Results of harmonic analysis of pressure records are summarized in Table 10. Amplitudes and phases are presented for the primary, harmonic, and secondary tidal constituents. The amplitudes are in centimeters and Greenwich phases are in degrees.

DISCUSSION

The amplitude of tides in the study area were fairly small compared to that previously measured in the eastern Bering Sea, to the South of the present study area. In the eastern Bering Sea, the amplitude of tidal constituents generally ranged from tens of

centimeters to approximately a meter (Pearson et al. 1981). The amplitude of the primary tidal constituents for the present study area ranged from a few centimeters to tens of centimeters.

Tidal conditions were significantly different at the eight sampling stations. Tidal fluctuations were largest at Cape Denbigh and smallest at Ledyard Bay.

Tides at Cape Denbign were predominately diurnal with the Luni-solar (K1), principal lunar (01), and solar diurnal (Pi) having the larger amplitudes, as shown in Table 10. The principal semi-diurnal lunar component (M2) had a amplitude similar to that of the solar diurnal component. At Nome, tides were mixed. The principle semi-diurnal lunar component was approximately 10 cm in amplitude, but the three principal diurnal components were predominant, with amplitudes of 5 to 15 cm. In Kotzebue Sound tidal fluctuations were predominately semi-diurnal, with M2 having an average amplitude of 9.7 cm. The largest diurnal component was K1 and it's amplitude was only 2.9 cm.

In Ledyard Bay, tidal fluctuations were almost nil. The principal semi-diurnal lunar component had an amplitude of 3.0 cm, and the other constituents had even smaller amplitudes. As previously predicted by the tidal circulation model, an amphdromic point for M2 and other constituents are located in Ledyard Bay.

Tides along the entire Beaufort coast were also fairly small and predominantly semi-diurnal. The principal semi-diurnal lunar component (M2) was the largest tidal constituent at all stations on the Beaufort Coast. The amplitude of M2 ranged from 5.1 cm at Cooper Island to 7.2 cm at Demarcation Bay. The amplitude of the diurnal components 01 and K1 were also small at stations on the Beaufort Coast, ranging from 1.2 to 4.3 cm.

Significant nontidal fluctuations were observed in the pressure records. Many of the larger fluctuations with durations of 1 to 2 days were related to storm surge. The barometric pressure plots presented on Figures 13 through 16 illustrate the passage of low pressure systems on August 8 and 18, and 'September 7, 1983. Significant storm surges with magnitudes up to a meter in height were observed in the pressure records. Most of these storm surges were observed throughout the Chukchi and Beaufort Seas, but not in Norton Sound, especially during storms on August 18 and September 7, 1983. These storm surges were associated with the passage of arctic low pressure systems from west to east a couple of hundred miles offshore of the Beaufort coast. These summer storms were not as intense as many of the fall and winter storms which would probably cause larger storm surges.

The pressure records also exhibit longer period fluctuations, such as the general decrease in pressure from August 8 to 18 and the general increase in pressure on the Beaufort coasts and Chukchi Sea in late August. Temperature records also show significant changes during these general changes in pressure, suggesting changes in water characteristics. A cursory inspection of weather charts

suggest that these long term pressure fluctuations are related to large scale meteorological events throughout the Bering Sea and Chukchi Sea.

REFERENCES

Dennis, R.E., and E. E. Long. A Users Guide to a Computer Program for Harmonic Analysis of Data at Tidal Frequencies. NOAA Technical Report NOS 41 July 1971

Pearson, Carl A., Harold O. Mofjeld, and Richard B. Tripp. Tides of the Eastern Bering Sea Shelf The Eastern Bering Sea Shelf Oceanography and Resources. Volume 1, editied by Donald W. Hood and John A. Calder 1980

Schureman, Paul Manual of Harmonic Analysis and Prediction of Tides. Special Publication No. 98 Department of Commerce, October, 71

Table 1. Tide Sampling Locations and Times (GMT)

STA	LOCATION	LAT (N) DEG	MIN	LONG (W) DEG	MIN	DEPLOYMENT DATE	TIME	RECOVERY DATE	TIME
1	CAPE DENBIGH	64	20.2	161	30.7	AUG 6	1'718	SEP 16	0434
2	NOME	64	19.9	165	00.8	AUG 7	0218	SEP 15	0253
3	"KOTZEBUE SOUND	67	30.2	165	00.3	AUG 8	0301	SEP 19	0130
4	LEDYARD BAY	69	28.8	165	03.2	AUG 8	1838	SEP 19	1901
5	COOPER ISLAND	71	14.0	155	44*5	AUG 7	2103	SEP 9	1925
6	THETIS ISLAND	70	33.0	150	11.0	AUG 6	0057	SEP 10	0150
7	FLAXMAN ISLAND	70	11.0	145	57.7	AUG 5	2236	SEP 9	0140
8	DEMARCATION BAY	69	41.2	141	17.6	AUG 5	2032	SEP 8	2335

Table 2. Density Profile Data After Deployment of Instruments at Stat on 1

SDS-IIA Lister Program 8006.3

08-AUG-83 08:31:33 Data Base: CTD001.DBS

First Time Absolute Time= 218/ 17:59:10.1 Time Relative to 218/ 17:59:10

Time	CTD-TEMP DEG-C	CTD-DEPT METERS	CTD-COND MS-CM	SALINITY PPT	SIGMA-T G/CC-1
17:59:10.1	14.062	1.885	29.922	24.027	17.844
17:59:12.1	14.092	2.114	29.927	24.012	17.827
17:59:14.1	14.099	2.343	29.924	24.006	17.821
17:59:16.1	14.085	2.874	29.969	24.054	17.861
17:59:18.1	14.120	3.432	30.006	24.065	17.863
17:59:20.1	14.123	3.771	30.002	24.059	17.858
17:59:22.1	14.126	4.439	29.986	24.043	17.845
17:59:24.1	14.125	4.943	29.995	24.052	17.852
17:59:26.1	14.127	5.337	30.004	24.058	17.857
17:59:28.1	14.125	5.877	30.036	24.087	17.879
17:59:30.1	14.127	6.472	30.033	24.083	17.876
17:59:32.1	14.124	6.939	30.001	24.057	17.856
17:59:34.1	14.128	7.433	30.002	24.055	17.854
17:59:36.1	14.129	7.900	30.018	24.068	17.864
17:59:38.1	14.125	8.459	30.020	24.073	17.868
17:59:40.1	14.125	9.081	30.025	24.077	17.872
17:59:42.1	14.124	9.392	30.021	24.073	17.869
17:59:44.1	14.130	10.097	30.065	24.109	17.896
17:59:46.1	14.144	10.509	30.079	24.112	17.895
17:59:48.1	14.147	11.004	30.076	24.108	17.891
17:59:50.1	14.150	11.489	30.073	24.103	17.887
17:59:52.1	14.148	12.093	30.062	24.095	17.881
17:59:54.1	14.147	12.532	30.059	24.092	17.879
17:59:56.1	14.147	12.908	30.062	24.095	17.881
17:59:58.1	14.148	13.476	30.074	24.104	17.889
18:00:00.1	14.148	13.604	30.075	24.105	17.889

Table 3* Density Profile Data Before Retrieval of Instruments at Station 1

DIGITAL DATA LOGGER DUMP PAGE NO.

PROGRAM: DDL2 8006.20 SHIP: S132 READ FROM MT0: FILE NO. 2 PFREQ: 16 00—00 00:01:5

RECORD	S1	DEPTH METERS	CONDUCTVTY M-MHO	TEMPERATURE DEG-C	SOUND VEL M/SECOND	SALINITY PER-MILLE	DENSITY SI GMA-T	SOUND VEL. METERS/SEC
1	11	2.45	24.89	9.444	14.811	22.202	17.096	1472.0
2	11	2.60	24.E1?	9.444	14.812	22.182	17.081	1472.0
3	11	2.60	24.S6	9.444	14.812	22.173	17.073	1471.9
4	11	2.60	24. 86	9.444	14.812	22.173	17.073	1471.9
5	11	2.75	24. 87	9.444	14.912	22.182	17.081	1472.0
6	11	2.90	24.87	9. 444	14.812	22.182	17.081	1472.0
7	11	2.75	24.87	9.444	14.812	22.182	17.081	1472.0
8	11	2.90	24.88	9.444	14.913	22.192	17.089	1472.0
9	11	2.75	24. 86	9.444	14.812	22.173	17.073	1471.9
10	11	2.75	24. 86	9. 444	14.912	22.173	17.073	1471.9
11	11	2.75	24. 85	9.444	14.813	22.163	17.065	1471.9
12	11	3.04	24.87	9.434	14.013	22.189	17.087	1471.9
13	11	2.90	24.86	9.444	14.813	22.173	17.073	1471.9
14	11	3.19	24.96	9.444	14.813	22.172	17.073	1471.9
15	11	3.94	24.89	9. 444	14. 814	22.202	17.095	1472.0
16	11	4.98	24.90	9.434	14.813	22.217	17.109	1472.0
17	11	6.22	24. 90	9. 424	14.814	22.223	17.115	1472.0
18	11	7.80	24. 95	9.404	14.814	22:284	17.165	1472.0
19	11	9.14	26. 03	9.474	14.913	23.302	17.945	14'73.6
20	11	10.63	26. 05	9.604	14.913	23.237	17.876	1474.0
21	11	10.93	26.06	9.654	14.814	23.215	17.851	1474.2
22	11	12.27	26.06	9.664	14.814	23.208	17.845	1474.2
23	11	12.12	26.07	9.664	14.814	23.219	17.852	1474.2
24	11	12.42	26 .07	9.664	14. 814	23.218	17.852	1474.2
25	11	12.42	26.08	9.664	14.814	23.227	17.860	1474.3
26	11	12.27	26.08	9.664	14.814	23.227	17.860	14'74.2
27	11	12.57	26. 08	9.664	14.6'1.4	23. 227	17.860	1474.3
28	11	12.42	26.07	9. 664	14.814	23.218	17.852	1474.2
29	11	12.42	26. 06	9.664	14.814	23.208	17.845	1474.2
30	11	12.42	26.07	9.664	14.914	23.218	17.852	1474.2
31	11	12.42	26.06	9. 664	14.914	23.209	17.845	1474.2
32	11	12.57	26.97	9. 664	14.914	23.217	17.852	1474.2

TAPE MARK

TAPE MARK

Table 4. Density Profile Data After Deployment of Instruments at Station 2

SDS-IIA Lister Program 8006.3

00--00 00:34:27 Data Base: CTD002.DBS

First Line Absolute Time= 219/ 2:40:42.0 Time Relative to: 219/ 2:40:42

Time	CTD-TEMP DEG-C	CTD-DEPT METERS	CTD-COND MS-CM	SALINITY PPT	SIGMA-T G/CC-1
02:40:42.0	11.648	1.702	33.751	29.259	22.321
02:40:44.0	11.588	2.004	33.765	29.319	22.378
02:40:46.0	11.639	1.501	33.668	29.186	22.266
02:40:48.0	11.720	1.180	33.633	29.089	22.177
02:40:50.0	11.674	1.739	33.724	29.212	22.280
02:40:52.0	11.626	1.849	33.688	29.215	22.291
02:40:54.0	11.710	1.382	33.615	29.079	22.171
02:40:56.0	11.754	1.400	33.552	28.985	22.090
02:40:58.0	11.817	1.839	33.616	28.997	22.090
02:41:00.0	11.739	1.592	33.655	29.095	22.179
02:41:02.0	11.724	1.482	33.572	29.027	22.128
02:41:04.0	11.738	1.519	33.580	29.025	22.124
02:41:06.0	11.721	1.775	33.618	29.074	22.166
02:41:08.0	11.720	1.546	33.542	29.002	22.109
02:41:10.0	11.729	1.491	33.569	29.021	22.122
02:41:12.0	11.756	1.574	33.565	28.995	22.098
02:41:14.0	11.768	2.196	33.649	29.067	22.152
02:41:16.0	11.651	2.434	33.839	29.341	22.385
02:41:18.0	11.516	2.993	33.865	29.473	22.510
02:41:20.0	11.504	3.661	33.898	29.514	22.543
02:41:22.0	11.453	4.210	33.937	29.592	22.613
02:41:24.0	11.435	4.577	33.944	29.613	22.632
02:41:26.0	11.457	5.740	33.954	29.604	22.621
02:41:28.0	11.455	6.921	34.008	29.658	22.664
02:41:30.0	11.445	7.534	34.049	29.706	22.703
02:41:32.0	11.486	8.724	34.270	29.886	22.836
02:41:34.0	11.554	10.024	34.447	30.002	22.916
02:41:36.0	11.582	10.802	34.471	30.002	22.912
02:41:38.0	11.577	11.644	34.486	30.004	22.911
02:41:40.0	11.604	12.835	34.546	30.056	22.951
02:41:42.0	11.575	13.677	34.561	30.094	22.985
02:41:44.0	11.565	14.885	34.545	30.086	22.980
02:41:46.0	11.540	15.700	34.513	30.075	22.975
02:41:48.0	11.498	16.414	34.504	30.101	23.002
02:41:50.0	11.497	17.650	34.489	30.086	22.991
02:41:52.0	11.479	18.914	34.489	30.099	23.004
02:41:54.0	11.474	19.362	34.489	30.104	23.009
02:41:56.0	11.447	20.214	34.494	30.130	23.034
02:41:58.0	11.427	21.687	34.513	30.164	23.063
02:42:00.0	11.452	22.685	34.545	30.174	23.067

Table 5. Density Profile Data Before Retrieval of Instruments at Station 2

DIGITAL DATA LOGGER DUMP PAGE NO.

PROGRAM: DDL2 8006.20 SHIP: S132 READ FROM MT0: FILE NO. 1 PFREQ: 16 00--00 00:01:36

RECORD	SI	DEPTH METERS	CONDUCTVTY M-MHO	TEMPERATURE DEG-C	SOUND VEL M/SECOND	SALINITY PER-MILLE	DENSITY SIGMA-T	SOUND VEL. METERS/SEC
1	11	2.45	30.82	9.904	14.810	27.747	21.327	1480.7
2	11	2.90	30.85	9.954	14.810	27.738	21.313	1480.9
3	11	2.75	30.85	9.944	14.811	27.746	21.320	1480.8
4	11	2.75	30.82	9.914	14.811	27.739	21.320	1480.7
5	11	2.90	30.82	9.904	14.811	27.747	21.327	1480.7
6	11	2.75	30.88	9.954	14.811	27.761	21.338	1480.9
7	11	2.90	30.82	9.904	14.811	27.747	21.327	1480.7
8	11	2.75	30.82	9.904	14.811	27.747	21.327	1480.7
9	11	3.04	30.81	9.914	14.811	27.729	21.312	1480.7
10	11	2.60	30.82	9.894	14.812	27.755	21.335	1480.6
11	11	2.90	30.83	9.944	14.812	27.726	21.305	1480.8
12	11	2.90	30.82	9.894	14.811	27.754	21.335	1480.7
13	11	2.60	30.82	9.894	14.811	27.755	21.335	1480.6
14	11	2.90	30.81	9.884	14.812	27.752	21.335	1480.6
15	11	3.04	30.82	9.884	14.812	27.762	21.342	1480.6
16	11	4.53	30.83	9.914	14.812	27.748	21.327	1480.7
17	11	5.42	30.83	9.934	14.811	27.733	21.311	1480.8
18	11	6.76	30.79	9.854	14.812	27.746	21.333	1480.6
19	11	7.80	30.82	9.854	14.812	27.783	21.363	1480.6
20	11	8.85	30.85	9.864	14.812	27.805	21.379	1480.7
21	11	10.04	30.91	9.884	14.812	27.849	21.410	1480.8
22	11	11.37	30.95	9.904	14.812	27.873	21.425	1481.0
23	11	12.86	30.97	9.904	14.812	27.892	21.440	1481.0
24	11	13.76	31.07	9.914	14.813	27.984	21.509	1481.2
25	11	15.24	31.10	9.934	14.812	27.998	21.517	1481.3
26	11	16.28	31.12	9.934	14.813	28.017	21.532	1481.3
27	11	17.77	31.33	9.984	14.812	28.187	21.656	1481.9
28	11	18.81	31.39	10.004	14.812	28.207	21.663	1482.0
29	11	20.45	31.50	10.034	14.812	28.316	21.748	1482.2
30	11	21.79	31.53	10.034	14.813	28.346	21.770	1482.2
31	11	23.13	31.54	10.034	14.813	28.355	21.778	1482.3
32	11	24.76	31.55	10.024	14.813	28.372	21.793	1482.3
33	11	25.66	31.56	10.034	14.813	28.374	21.792	1482.3
34	11	27.59	31.56	10.034	14.813	28.373	21.792	1482.3
35	11	28.63	31.57	10.034	14.812	28.383	21.799	1482.4
36	11	29.52	31.57	10.034	14.813	28.382	21.799	1482.4
37	11	31.46	31.62	10.044	14.813	28.423	21.829	1482.5
38	11	32.35	31.66	10.064	14.813	28.447	21.844	1482.6
39	11	33.84	31.67	10.064	14.814	28.457	21.852	1482.7
40	11	34.58	31.68	10.064	14.813	28.466	21.859	1482.7
41	11	34.88	31.68	10.064	14.813	28.466	21.859	1482.7
42	11	34.43	31.67	10.064	14.813	28.456	21.851	1482.7
43	11	34.58	31.67	10.064	14.813	28.456	21.851	1482.7

Table 6. **Density Profile Data After Deployment of Instruments at Station 3**

SDS-IIA Lister Program 8006.3

08-AUG-83 08:22:56 Data Base: CTD003.DBS

First Line Absolute Time- 220/ 3:18:12.0 Time Relative to: 220/ 3:18:12

Time	CTD-TEMP DEG-C	CTD-DEPT METERS	CTD-COND MS-CM	SALINITY PPT	SIGMA-T G/CC- 1
03: 19:02.0	11.109	1.592	35.019	30.929	23.712
03: 19:04.0	11.110	1.931	35.018	313.327	23.710
03:19:06.0	11.110	2.370	35.023	38.932	23.714
03:19:08.0	11.110	2.599	35.022	30.931	23.713
03:19:10.0	11.110	3.222	35.1321	30.930	23.712
03:19:12.0	11.110	3.835	35. 022	30.931	23.713
03:19:14.0	11.110	3.835	35.022	30.930	23.712
03:19:16.0	11.110	4.751	35.1323	30.931	23.713
03:19:18.0	11.110	5.373	35.025	30.934	23.715
03:19:20.0	11.110	5.758	35.023	30.931	23.713
03:19:22.0	11.110	6.518	35.025	30.933	23.715
03:19:24.0	11.111	7.360	35.023	30.930	23.713
03:19:26.0	11.111	7.781	35.026	30.933	23.714
03:19:28.0	11.109	8.568	35.031	30.938	23.719
03:19:30.0	11.109	9.466	35.832	30.940	23:720
03:19:32.0	11.102	9.758	35. 043	30.956	23.734
03:19:34.0	11.106	10.637	35. 0S6	30.995	23.764
03:19:36.0	11.109	11.599	35.115	31.020	23.783
03:19:38.0	11.109	11.846	35.115	31.020	23.783
03:19:40.0	11.107	13.009	35.123	31.1329	23.790
03:19:42.0	11.106	13.750	35.127	31.033	23.794

Table 7. Density Profile Data Before Retrieval of instruments at Station 3

DIGITAL DATA LOGGER DUMP

PAGE NO.

PROGRAM: DDL2 8006.20 SHIP: S132 READ FROM MT0: FILE NO. 3 PFREQ: 16 00--00 00:02:10

RECORD	SI	DEPTH METERS	CONDUCTVTY M-MHO	TEMPERATURE DEG-C	SOUND VEL M/SECOND	SALINITY PER-MILLE	DENSITY SIGMA-T	SOUND VEL. METERS/SEC
1	11	2.30	30.55	6.653	14.810	30.139	23.658	1471.2
2	11	2.45	30.54	6.653	14.810	30.128	23.649	1471.2
3	11	2.30	30.553	6.543	14.811	30. 126	23.649	1471.1
4	11	2.30	30.553	6,1543	14.810	30. 115	23.641	1471.1
5	11	2.15	30.55	6.643	14.s11	30. 115	23.641	1471.1
6	11	2.30	30.S2	6.633	14.810	30: 124	23.649	1471.1
7	11	2.30	30.55	6.633	14.811	30.124	23.649	1471.1
8	11	2.30	39.52	6.643	14.811	30. 115	23.641	1471.1
9	11	2.30	30.552	6.643	14.811	30.115	23:641	1471.1
10	11	2.15	30.55	6.633	14.811	30.124	23.643	1471 .1
11	11	2.30	30.52	6.633	14.811	30.124	23.649	1471.1
12	11	2.30	30.55	6.643	14.811	30.115	23.641	1471 , 1
13	11	2.45	30.556	6.633	14.812	30.124	23.649	1471.1
14	11	2.75	30.553	6.633	14.911	30.135	23.657	1471.1
15	11	4.38	30.S33	6.643	14.812	30. 125	23.648	1471. i
16	11	5.72	30.53	6.643	14.811	30.124	23.648	1471.2
17	11	6.91	30.533	6.643	14.811	30.124	23.647	1471 . 2
18	11	8.19	30.S33	6.643	14.811	30. 123	23.647	1471 . 2
19	11	9.74	30.S3	6.593	14.812	30.167	23.687	1471. 1
20	11	11.09	30. 49	6.5123	14.812	30.202	23.726	1470. 8
21	11	12.42	30.49	6.433	14.811	30.263	23.783	3.470.6
22	11	13.76	39.46	6.363	14.812	30. 292	23.814'	14'70.4
23	11	15.00	30.44	6.303	14.812	3%.323	23.846	1470.2
24	11	16.58	30.36	6.233	14.812	30.296	23.833	1469.9
25	11	17.77	30.14	5.622	140s1,2	30.600	24.146	1467.8
26	11	19.26	30.29	S. 242	14. 812	31.197	24.S5S	1467.0
27	11	20.45	30.32	5.322	14.812	31. 079	24.535	1467.3
28	11	21.79	30.26	5.282	14.812	31,046	24.535	1467. 1
29	11	23.13	30.26	5.252	14.812	31. 073	24.560	1467.0
30	11	24. 47	30.25	5.248	14.813	31. 071	24.559	1467.0
31	11	25.95	30.24	5.192	14. 912	31: 105	24. 582	1466.9
32	11	27.23	30.01	5.082	14.812	30. 945	24.477	1466.2
33	11	28.63	30.00	.4:852	14.812	31. 147	24.662	1465.6
34	11	29.50	30.00	4.922	14.813	31 . 175	24.687	1465.5
35	11	30.57	30.00	4.812	14.813	31. 184	24.695	146s.5
36	11	31.16	30.00	4.012	14.813	31.124	24.695	1465. 5
37	11	32.20	29.99	4.812	14.813	31.172	24.685	146s. 5
38	11	32.35	29. 33	4.802	14.812	31 .181	24.694	.146s, 5

Table 8. Density Profile Data After Deployment of Instruments at Station 4

SDS-IIA Lister Program 8006.3

08-AUG-83 00:02:09

Data Ease: CTD004.DBS

First Line Absolute Time= 220/ 20: 18:38.0 Time Relative to: 220/ 20: 18:38

Time	CTD-TEMP DEG-C	CTD-DEPT METERS	CTD-COND MS-CM	SALINITY PPT	SIGMA-T G/CC-1
20:18:38.0	7.507	2.343	30.686	29.546	23.135
20:18:40.0	7. 508	2.554	30.689	29.549	23.137
20:18:42.0	7.506	2.819	30.685	29.546	23.135
20:18:44.0	7. 506	3.084	30.689	29.550	23.138
20:18:46.0	7.507	3.487	30.689	29.549	23.137
20:18:48.0	7.511	3.579	30.687	29.544	23.133
20:18:50.0	7.5139	3.991	30.685	29.543	23.133
20: 18:52.0	7.5135	4.229	30.682	29.544	23.133
20: 18:54.0	7.504	4.467	30.684	29.546	23.135
20:18:56.0	7.503	4.842	30.683	29.545	23.135
20:18:58.0	7.503	5.108	30.679	29.542	23.132
20:19:00.0	7 , 487	5.346	30.677	29.553	23.143
20:19:02.0	7.486	5.602	30.676	29.552	23.142
20:19:04.0	7.485	5.932	30.679	29.556	23.145
20:19:06.0	7.487	6.206	30.678	29.553	23.143
20:19:08.0	7.486	6.573	30.680	29.556	23.145
20:19:10.0	7.490	6.655	30.682	29.554	23.143
20:19: 12.0	7.488	7.150	30.680	29.554	23.144
20: 19:14.0	7.488	7.396	30.680	29.554	23.144
20:19:16.0	7.489	7.662	30.681	29.554	23.143
20:19:18.0	7.488	7.882	30.680	29.554	23.143
20:19:20.0	7.487	8.275	30.677	29.552	23.142
20: 19:22.0	7.483	8.605	30.671	29.547	23.139
20: 19:24.0	7.4:2	8.770	30.669	29.590	23.178
20:19:26.0	7.427	9.145	30.666	29.590	23.179
20:19:28.0	7.407	9.328	30.657	29.598	23.188
20:19:30.0	7.423	9.621	30.650	29.576	23.169
20:19:32.0	7. 403	9.978	30.642	29.585	23.178
20:19:34.0	7.371	10.226	30.633	29.603	23.196
20: 19:36.0	7.336	10.436	30.618	29.617	23.211
20:19:38.0	7.237	10.931	30.598	29.679	23.272
20: 19:40.0	7.172	11.068	30.581	29.717	23.310
20: 19:42.0	7.123	11.470	30.649	29.832	23.405
20:19:44.0	7.087	11.608	30.721	29.941	23.496
20:19:46.0	7. 099	11.983	31.022	30.255	23.742
20:19:48.0	7 . 393	12.258	31.934	30.978	24.275
20: 19:50.0	7.826	12.478	32.180	30.856	24.125
20:19:52.0	8.002	12.743	32.044	30.557	23.867
20: 19:54.0	7.431	13.063	31.321	30.285	23.725
20:19:56.0	6.366	13.347	30.370	30.190	23.774
20:19:58.0	5.654	13.567	30.323	30.780	24.316
20:20:00.0	5.242	14.034	29.457	30.175	23.880
20:20:02.0	4.450	14.180	29.087	30.476	24.193
20:20:04.0	4.188	14.491	29.316	30.986	24.622
20:20:06.0	4.363	14.638	29.485	31.019	24.632
20:20:08.0	4.446	15.096	29.561	31.030	24.633

Table 8. Density Profile Data After Deployment of Instruments at Station 4 (cent'd)

SDS-119 Lister Program 8006.3

08-AUG-83 00:02:34 Data Base: CTD004.DBS

First Line Absolute Time= 220/ 20:20:10.0 Time Relative to: 220/ 20: 18:38

Time	CTD-TEMP DEG-C	CTD-DEPT METERS	CTD-COND MS-CM	SALINITY PPT	SIGMA-T G/CC- 1
20:20: 10.0	4.450	15.324	29.586	31.054	24.651
20:20:12.0	4.403	15.599	29.508	31.007	24.619
20:20: 14.0	4.324	15.901	29.461	31.027	24.642
20:20:16.0	4.205	16.143	29.332	30.989	24.622
20:20:18.0	4.146	16.368	29.322	31.033	24.662
20:20:20.0	4.076	16.771	29.278	31.047	24.680
20:20:22.0	4.977	16.945	29.293	31.064	24.693
20:20:24.0	4.071	17.211	29.277	31.051	24.683
20:20:26.0	4.065	17.677	29.288	31.067	24.697
20:20:28.0	4.066	17.696	29.307	31.090	24.714
20:20:30.0	4.050	18.172	29.286	31.080	24.708
20:20:32.0	4.067	18.337	29.292	31.071	24.700
20:20:34.0	4.059	18.712	29.328	31.121	24.739
20:20:36.0	4.066	18.978	29.331	31.118	24.737
20:20:38.0	4.066	19.216	23.387	31.1s3	24.789
20:20:40.0	4.043	19.527	29.381	31.194	24.799
20:20:42.0	4.010	19.737	29.296	31.129	24.751
20:20:44.0	3.897	20.004	28.957	30.923	24.605
20:20:46.0	3.614	20 .333	23.853	30.983	24.668
20:20:48.0	3.286	20.781	28.571	39. 960	24.677
20:20:50.0	3. 130	20.392	28.474	30.993	24.715
20:20:52.0	2.834	21.284	28.299	31.067	24-.796
20:20:54.0	2.643	21.468	28.167	31.087	24.826
20:20:56.0	2.550	21.413	28.156	31.1713	.24.899
20:20:58.0	2.253	22. 045	27.714	30.913	24.718,
20:21:00.0	2.027	22.374	27.519	30 .897	24.717
20:21:02.0	1.784	22.603	27.360	30.938	24.765
20:21:04.0	1.358	22.859	26 . 988	30.890	24.752
20:21:06.0	1.153	23.106	26.9136	30. 990	24.844
20:21:08.0	1. 005	23.518	26.782	30. 980	24.843
20:21:10.0	0.863	23.747	26.745	31, 076	24.928
20:21:12.0	0.785	.23.994	26.7134	31.102	24.952
20:21:14.0	0.768	24.315	26.694	31.105	24.956
20:21:16.0	*0.?64*	24.626	26.672	31.081	24.937
20:21:18.0	*0.?'17*	24.956	26.674	31.13a	24.978
20:21:20.0	0.699	25.056	26.654	31.124	24.974
20:21:22.0	0.687	25.322	26.611	31.080	24.940
20:21:24.0	0.686	25.624	26.614	31.085	24.944
20:21:26.0	0.687	25.826	26.622	31.094	24.951
20:21:28.0	0.683	26.027	26.614	31.088	24.946
20:21:30.0	0.627	26.443	26. 607	31.134	24.986
20:21:32.0	0.628	26.530	26.631	31.165	25.010
20:21:34.0	0.626	26.832	26.611	31.142	24.992

Table 9. Density Profile Data Before Retrieval of Instruments at Station 4

DIGITAL DATA LOGGER DUMP

PAGE NO.

PROGRAM: DDL2 B006.20 SHIP: S132 READ FROM MT0: FILE NO. 4 PFREQ: 16 00—00 00:02:32

RECORD	SI	DEPTH METERS	CONDUCTVTY M-MHO	TEMPERATURE DEG-C	SOUND VEL M/SECOND	SALINITY PER-MILLE	DENSITY S1 GM-T	SOUND VEL. METERS/SEC
1	11	2.45	29.57	5.502	14.807	29.995	23.663	1466.7
2	11	2.60	29.59	5.602	14.807	30.008	23.680	1466.7
3	11	2.75	29.59	5.612	14.807	29.999	23.672	1466.8
4	11	2.45	29.57	5.602	14.807	29.985	23.663	1466.7
5	11	2.45	29.57	5.602	14.807	29.995	23.663	1466.7
6	11	2.45	29.57	5.602	14.807	29.995	23.663	1466.7
7	11	2.60	29.50	5.632	14.808	29.992	23.665	1466.8
8	11	2.60	29.59	5.632	14.807	29.981	23.656	1466.8
9	11	2.75	29.57	5.622	14.807	29.957	23.646	1466.8
10	11	2.75	29.59	5.612	14.808	29.999	23.672	1466.8
11	11	3.64	29.77	5.682	14.808	30.137	23.773	1467.3
12	11	5.13	29.76	5.742	14.807	30.072	23.715	1467.4
13	11	6.61	29.79	5.762	14.808	30.087	23.724	1467.6
14	11	8.10	29.81	5.792	14.808	30.091	23.725	1467.7
15	11	9.74	29.83	5.802	14.809	30.094	23.726	1467.8
16	11	11.23	29.84	5.812	14.808	30.096	23.726	1467.9
17	11	12.71	29.84	5.812	14.808	30.095	23.725	1467.9
18	11	14.50	29.89	5.832	14.808	30.141	23.760	1468.0
19	11	16.59	29.91	5.832	14.809	30.154	23.769	1468.1
20	11	18.96	30.01	5.812	14.809	30.282	23.872	1463.2
21	11	20.90	30.12	5.882	14.808	30.341	23.911	1468.6
22	11	23.09	30.03	5.972	14.808	30.827	24.283	1469.7
23	11	25.21	30.01	6.273	14.808	30.753	24.188	1470.8
24	11	27.29	30.72	6.313	14.809	30.617	24.076	1470.8
25	11	28.93	30.66	6.193	14.808	30.658	24.123	1470.4
26	11	30.57	30.67	6.133	14.809	30.723	24.181	1470.3
27	11	31.61	30.66	6.123	14.809	30.720	24.180	1470.3
28	11	31.61	30.66	6.123	14.809	30.720	24.180	1470.3
29	11	31.76	30.65	6.113	14.808	30.718	24.180	1470.2
30	11	31.76	30.65	6.123	14.809	30.709	24.171	1470.2
31	11	31.76	30.65	6.123	14.809	30.709	24.171	1470.2
32	11	31.61	30.65	6.123	14.809	30.709	24.171	1470.2
33	11	31.61	30.66	6.123	14.808	30.720	24.180	1470.3
34	11	31.76	30.64	6.123	14.809	30.698	24.163	1470.2
35	11	31.61	30.65	6.123	14.809	30.709	24.171	1470.2
36	11	31.61	30.65	6.113	14.809	30.718	24.180	1470.2
37	11	31.61	30.55	6.123	14.809	30.709	24.171	1470.2

Table 10. Summary of harmonic analysis of pressure records. "
(Amplitude (H) in Centimeters and Greenwich Epoch (G)
in Degrees for Harmonic Constants)

STATION	1		2		3		4		5		6		8	
LOCATION	CAPE DENBIGH		NOME		KOTZEBUE SOUND		LEDYARD BAY		COOPER ISLAND		THETIS ISLAND		DEMARCATION BAY	
	DEG	MIN	DEG	MIN	DEG	MIN	DEG	MIN	DEG	MIN	DEG	MIN	DEG	MIN
LATITUDE (N)	64	20.2	64	19.9	67	30.2	69	28.8	71	14.0		33.0	69	41.2
LONGITUDE (W)	161	30.7	165	00.8	165	00.3	165	03.2	155	44.5	1;:	11.0	141	17.6
HARMONIC CONSTANTS	H	G	H	G	H	G	H	G	H	G	H	G	H	G
PRIMARY CONSTITUENTS														
M2	16.4	264	10.2	029	**9.7**	**274**	3.0	268	**5.1**	264	**6.5**	272	**7.2**	**266**
N2	**5.0**	212	**3.3**	346	**2.1**	**207**	1.9	246	**0.5**	232	**0.1**	**250**	**0.9**	**278**
S2	**3.6**	004	**2.2**	118	**2.5**	**348**	1.3	**192**	2.6	**325**	**3.3**	**316**	**3.1**	306
O1	25.4	077	10.0	073	**1.8**	**149**	0.4	167	1.2	182	**4.3**	180	**2.5**	162
	43.9	127	15.5	130	**2.9**	**058**	1.3	**085**	2.8	**210**	**2.2**	**148**	**3.0**	**126**
HARMON%														
M4	**0.3**	**279**	**0.4**	170	0.2	**009**	0.4	203	0.3	**339**	0.2	182	**0.1**	**180**
M6	**0.3**	029	**0.5**	075	0.2	316	0.0	085	0.1	**162**	**0.0**	284	**0.0**	259
M8	**0.0**	030	**0.1**	209	0.1	207	**0.0**	**168**	**0.1**	308	**0.1**	128	**0.1**	327
S4	**0.2**	**352**	**0.3**	267	0.1	058	**0.2**	**147**	**0.3**	080	0.3	**195**	**0.1**	050
S6	**0.1**	213	0.1	246	0.0	118	0.0	**135**	**0.1**	102	0.1	205	**0.1**	037
SECONDARY CONSTITUENTS														
J1	2.0	152	0.8	**157**	**0.1**	**013**	0.0	044	0.1	**225**	0.3	132	0.2	**108**
K2	**1.0**	004	0.6	**118**	0.7	**348**	0.3	192	**0.7**	**325**	0.9	316	0.9	**309**
L2	**0.5**	**315**	0.3	072	**0.3**	342	0.1	290	**0.1**	**295**	**0.2**	**293**	**0.2**	**274**
Mt	**1.8**	**102**	**0.7**	101	**0.1**	103	0.0	126	0.1	**196**	**0.3**	**164**	**0.2**	**144**
2N	**0.7**	**161**	**0.4**	304	**0.3**	**140**	0.3	**225**	0.1	**201**	**0.1**	**228**	**0.1**	250
OO	**1.0**	177	0.4	186	**0.1**	328	**0.0**	003	0.1	**239**	0.2	**116**	**0.1**	089
P1	**14.5**	**127**	**5.1**	**130**	**0.9**	058	0.4	085	**0.9**	210	0.7	**148**	**1.0**	**126**
Q1	**4.9**	**053**	**1.9**	045	**0.3**	194	0.1	208	**0.2**	167	0.8	**196**	**0.5**	180
2Q	**0.7**	**028**	**0.3**	017	**0.0**	239	**0.0**	250	**0.0**	308	**0.1**	**212**	**0.1**	196
R2	**0.0**	**004**	**0.0**	118	**0.0**	**348**	**0.0**	192	**0.0**	**325**	**0.0**	**316**	**0.0**	309
T2	**0.2**	**004**	0.1	118	**0.1**	348	**0.1**	**192**	0.2	325	**0.2**	**316**	**0.2**	309
LAMBDA	0.1	**310**	0.1	070	**0.1**	309	**0.0**	233	0.0	292	**0.0**	292	**0.1**	286
NU2	1.0	**219**	0.6	352	0.4	**216**	0.4	249	**0.1**	237	0.2	**253**	**0.2**	**259**
RHO 1	1.0	**217**	0.4	049	**0.1**	**187**	0.0	203	0.0	**169**	0.2	**194**	0.1	**319**

NOTE: ALL RECORDS BEGIN ON AUGUST 9, 1983 AT 1100 GMT AND ARE 29 DAYS IN DURATION

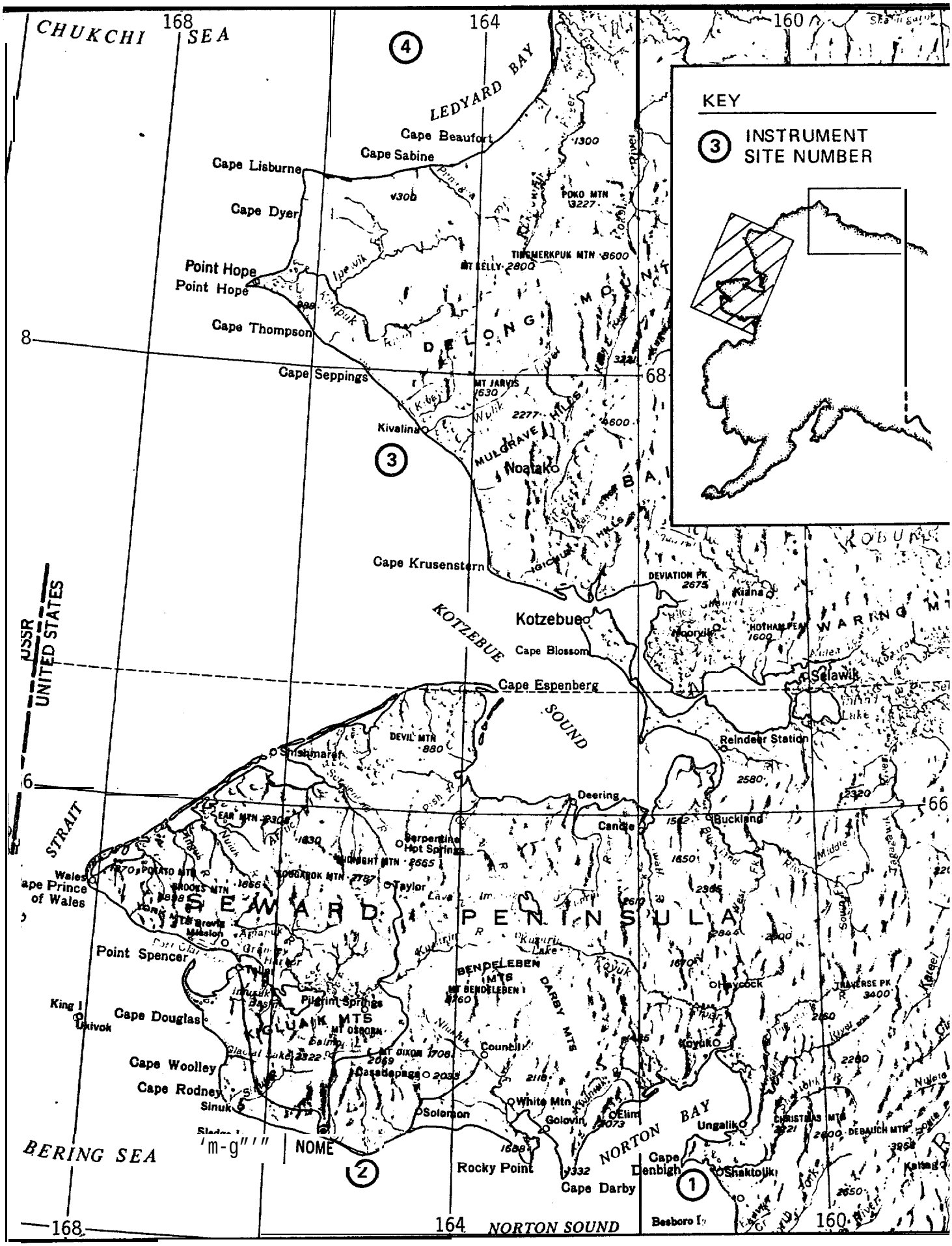

Figure 1 Norton Sound and Chukchi Sea Instrument Sites

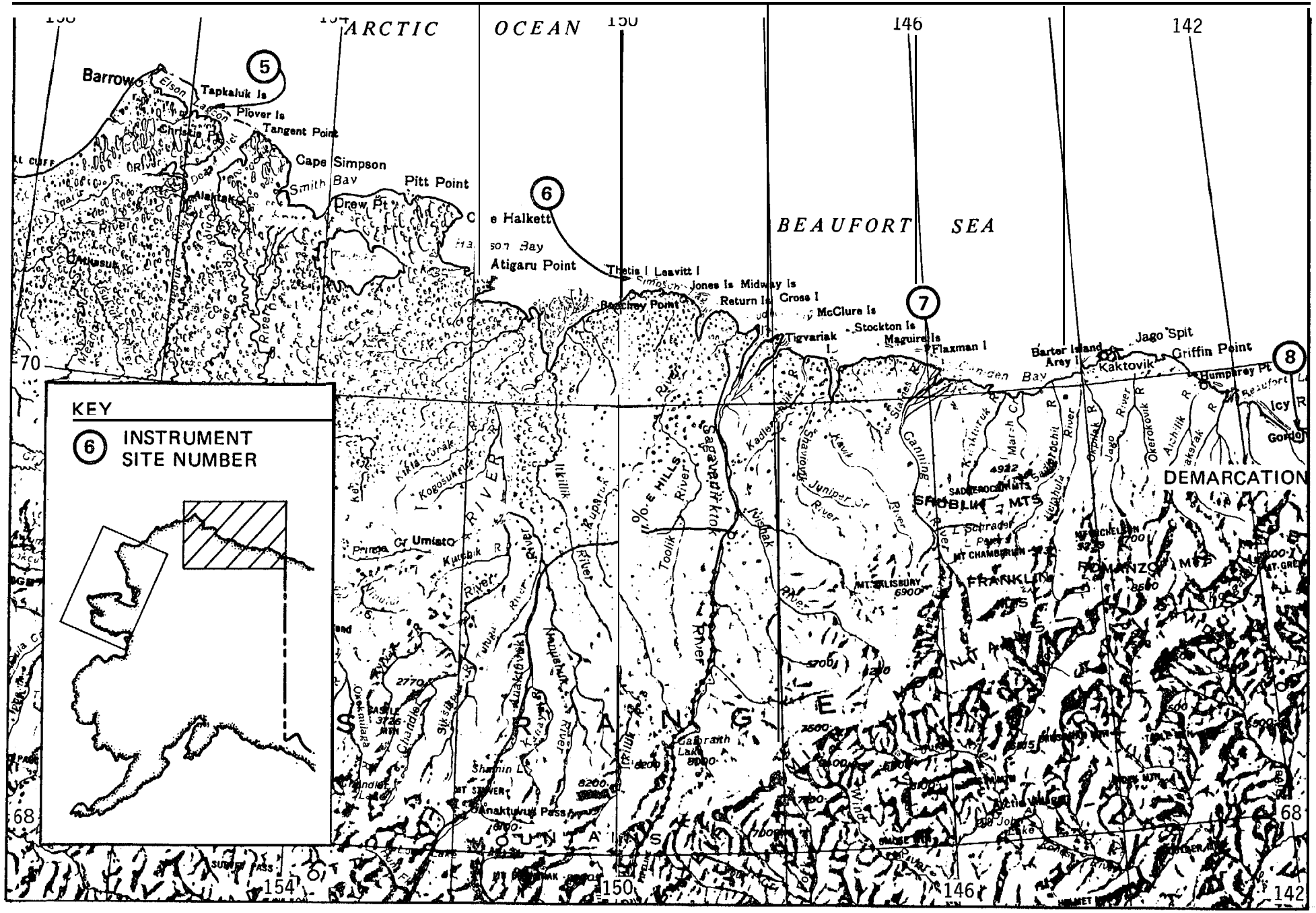

Figure 2 Beaufort Sea Instrument Sites

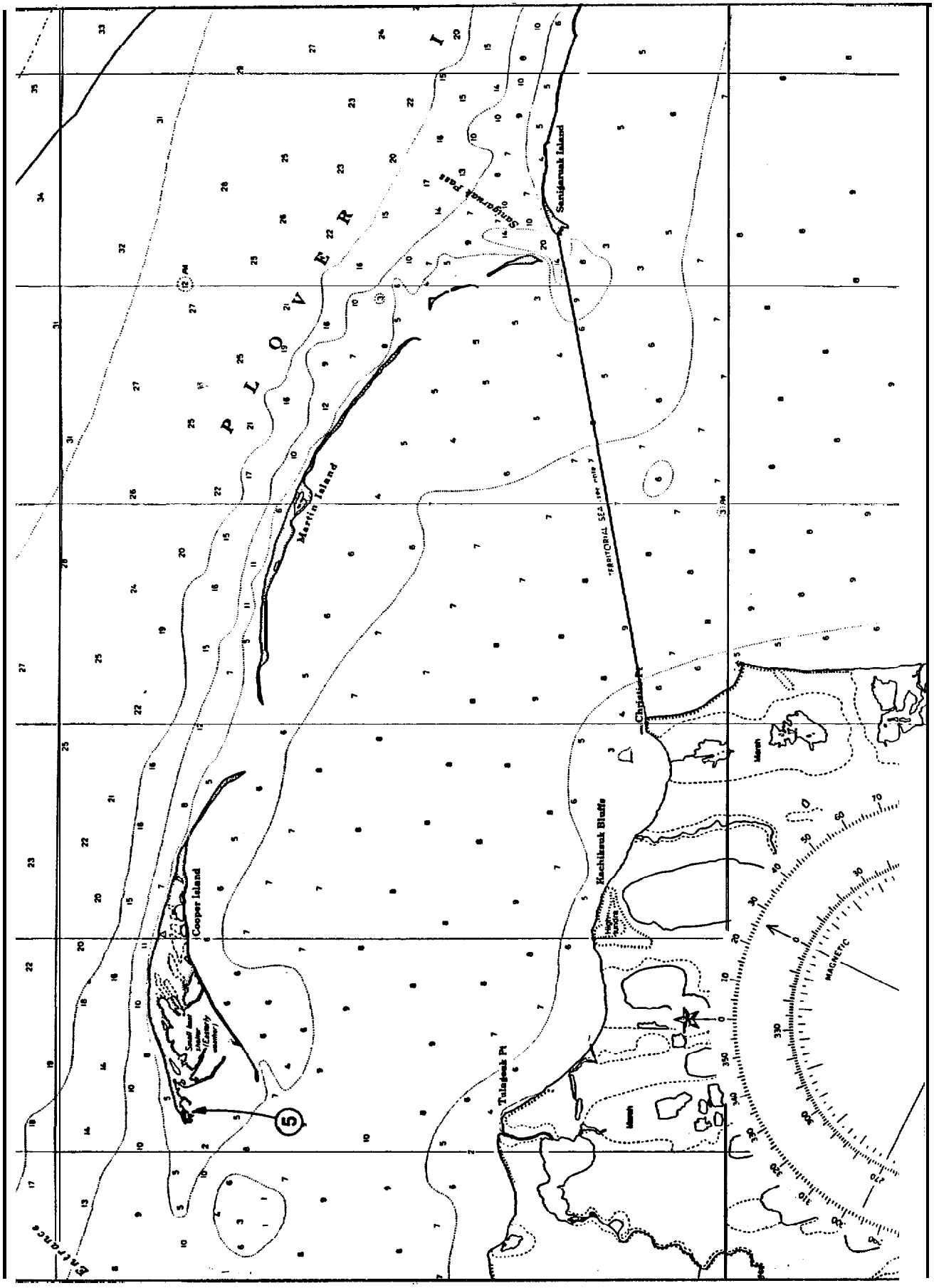

Fig. 2-a. Location of Station **5**

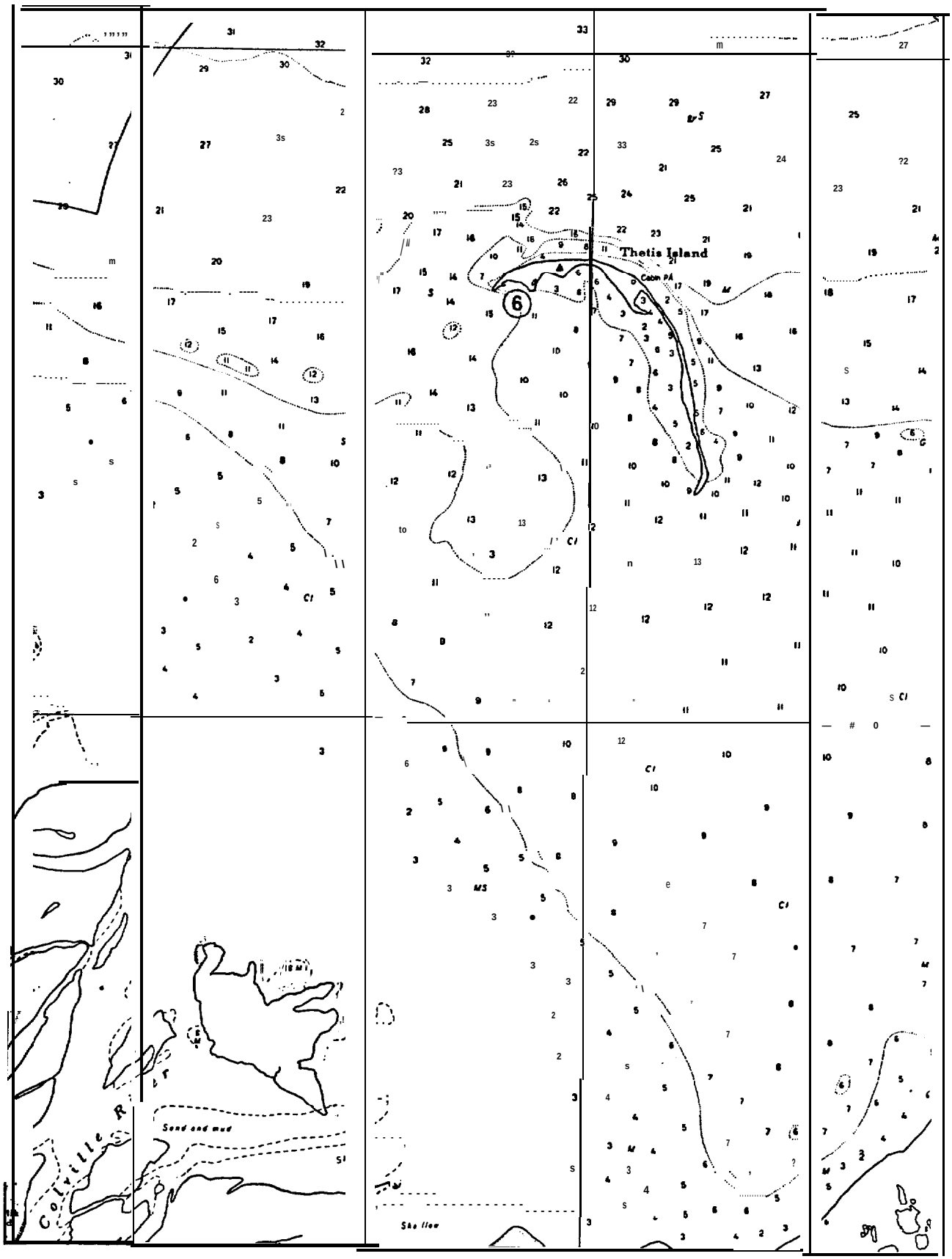

Fig. 2-b. Location of Station 6

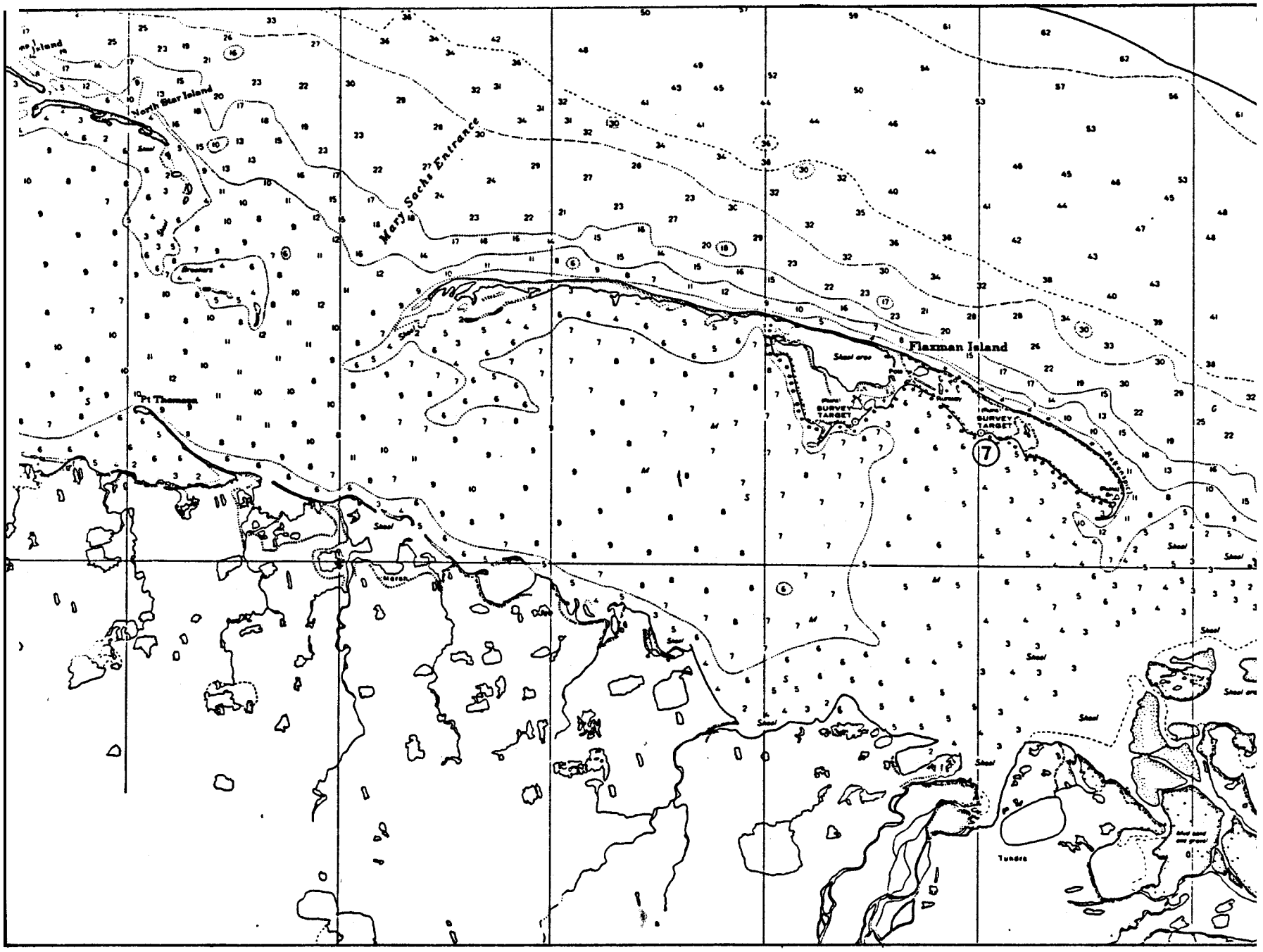

Fig. 2-c. Location of Station 7

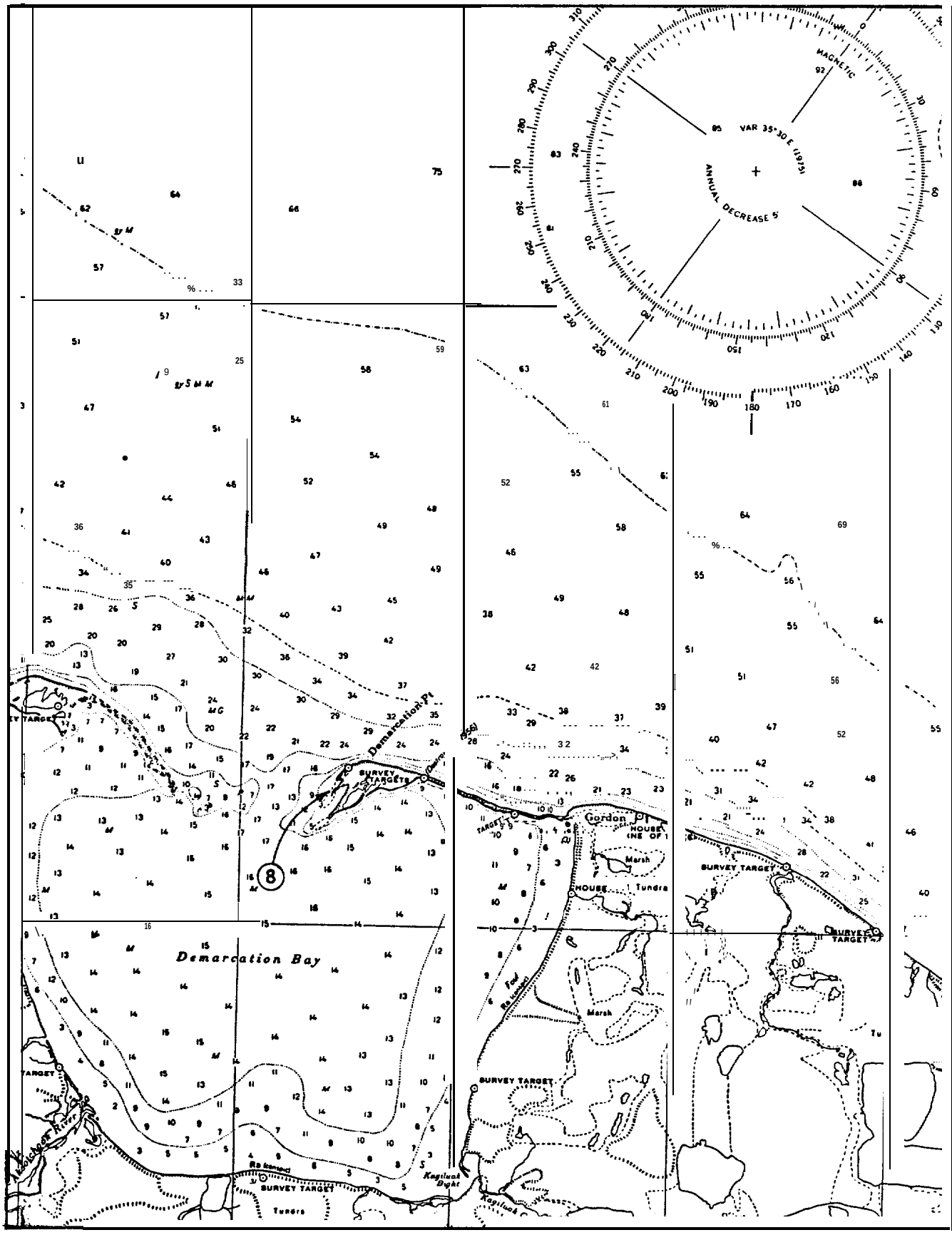

Fig. 2-d. Location of Station 8

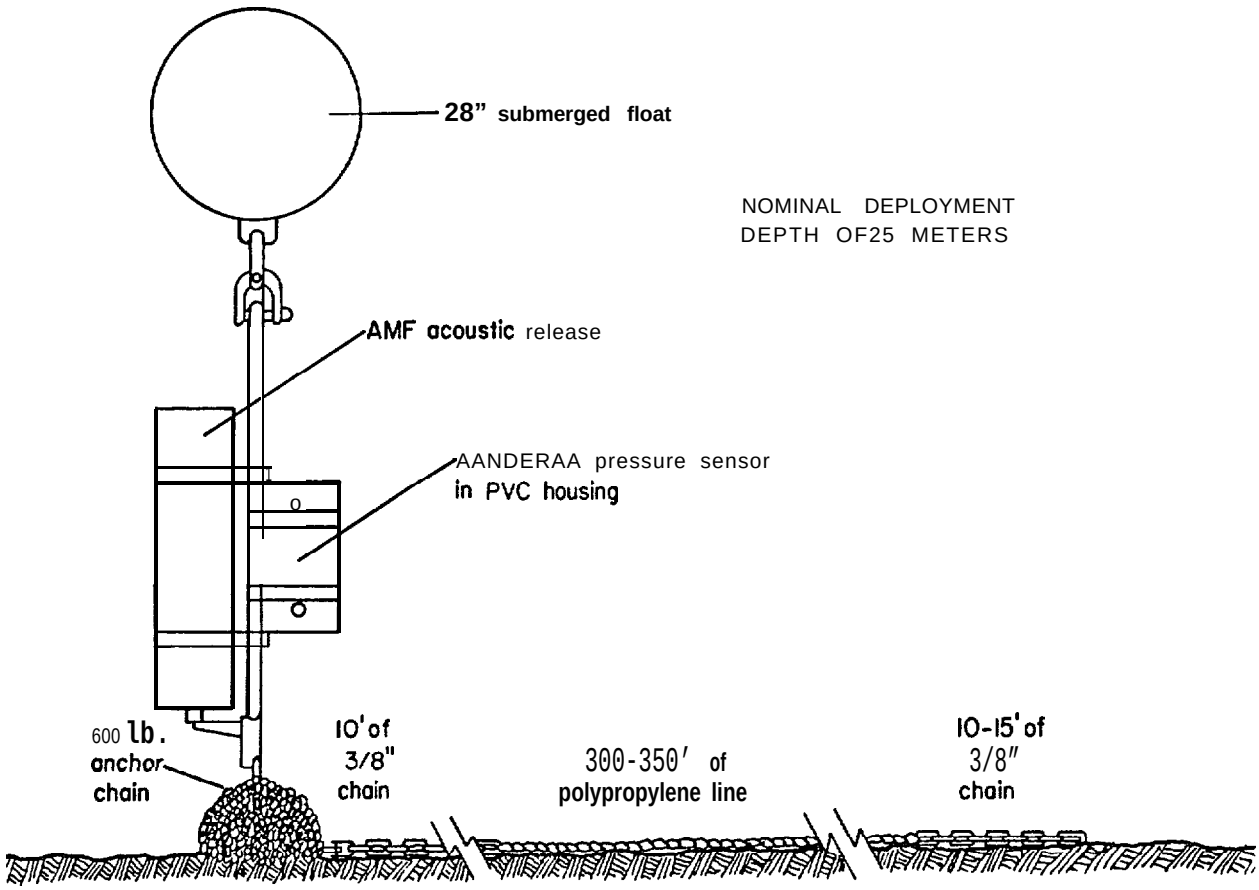

Figure 3 Mooring Design for Norton Sound and Chukchi Sea Deployments

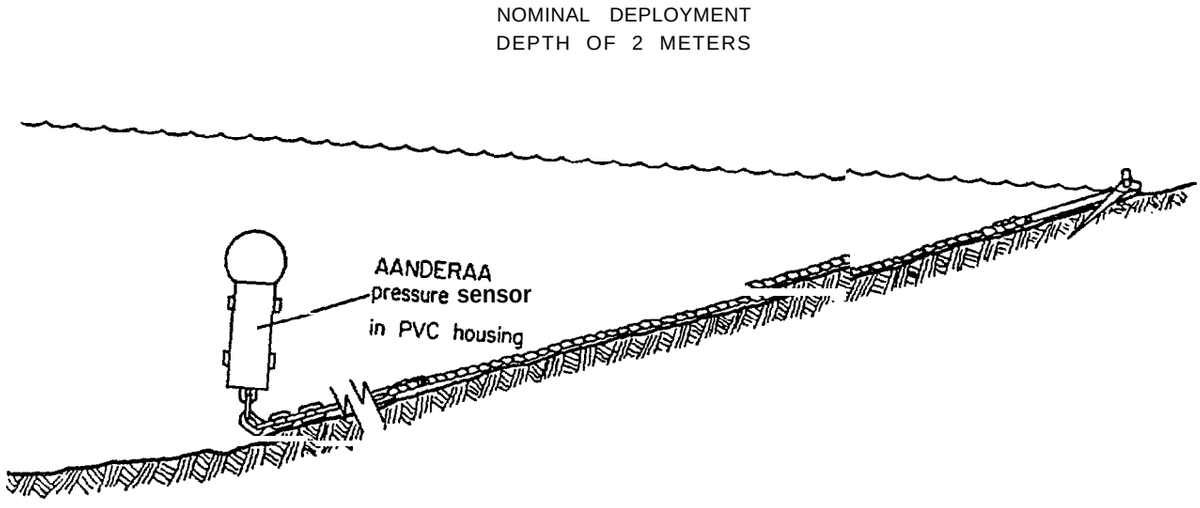

Figure 4 Mooring Design for Beaufort Sea Deployments

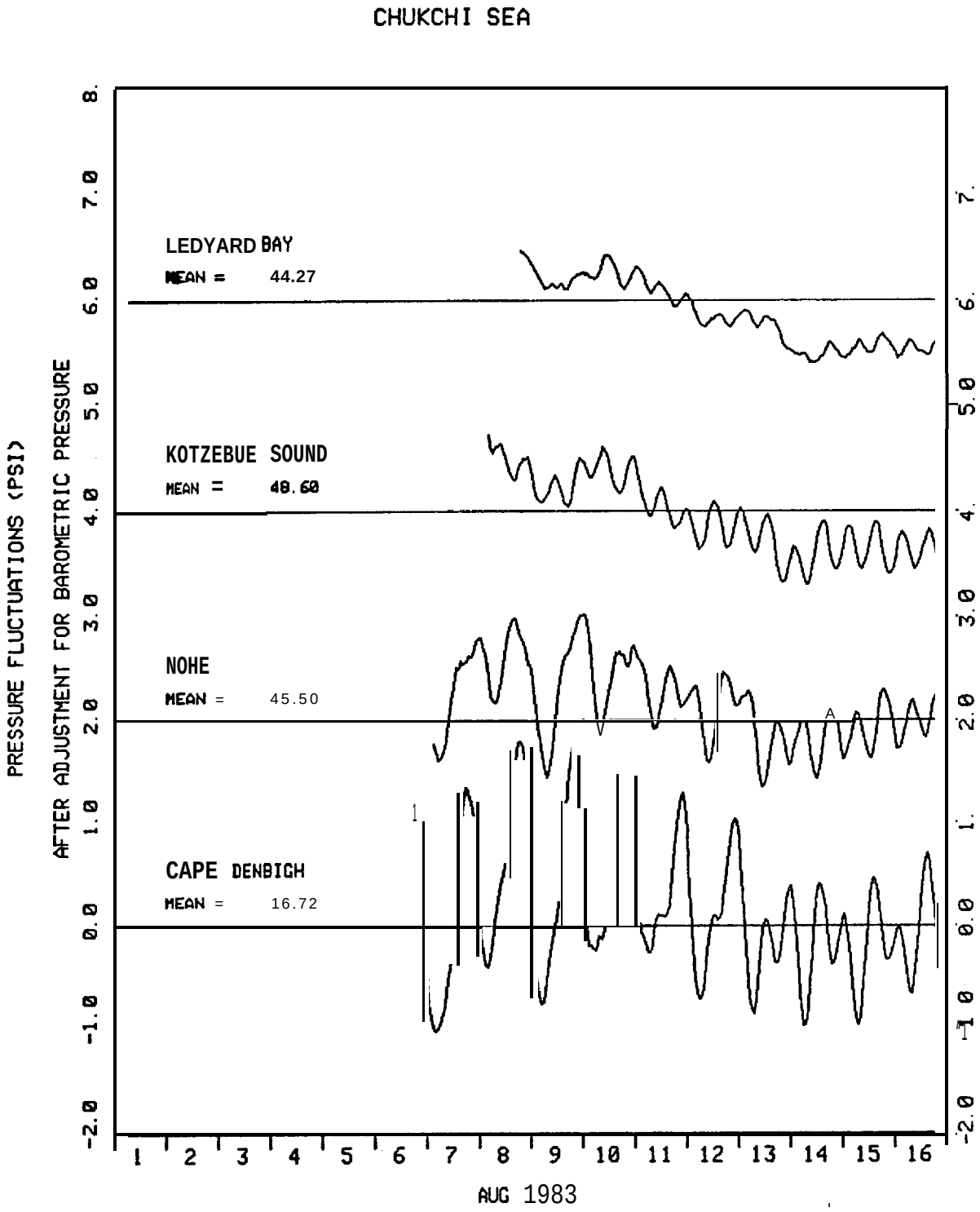

Fig. 5. Pressure Fluctuations About the Monthly Mean at Stations 1 through 4 in August 1983

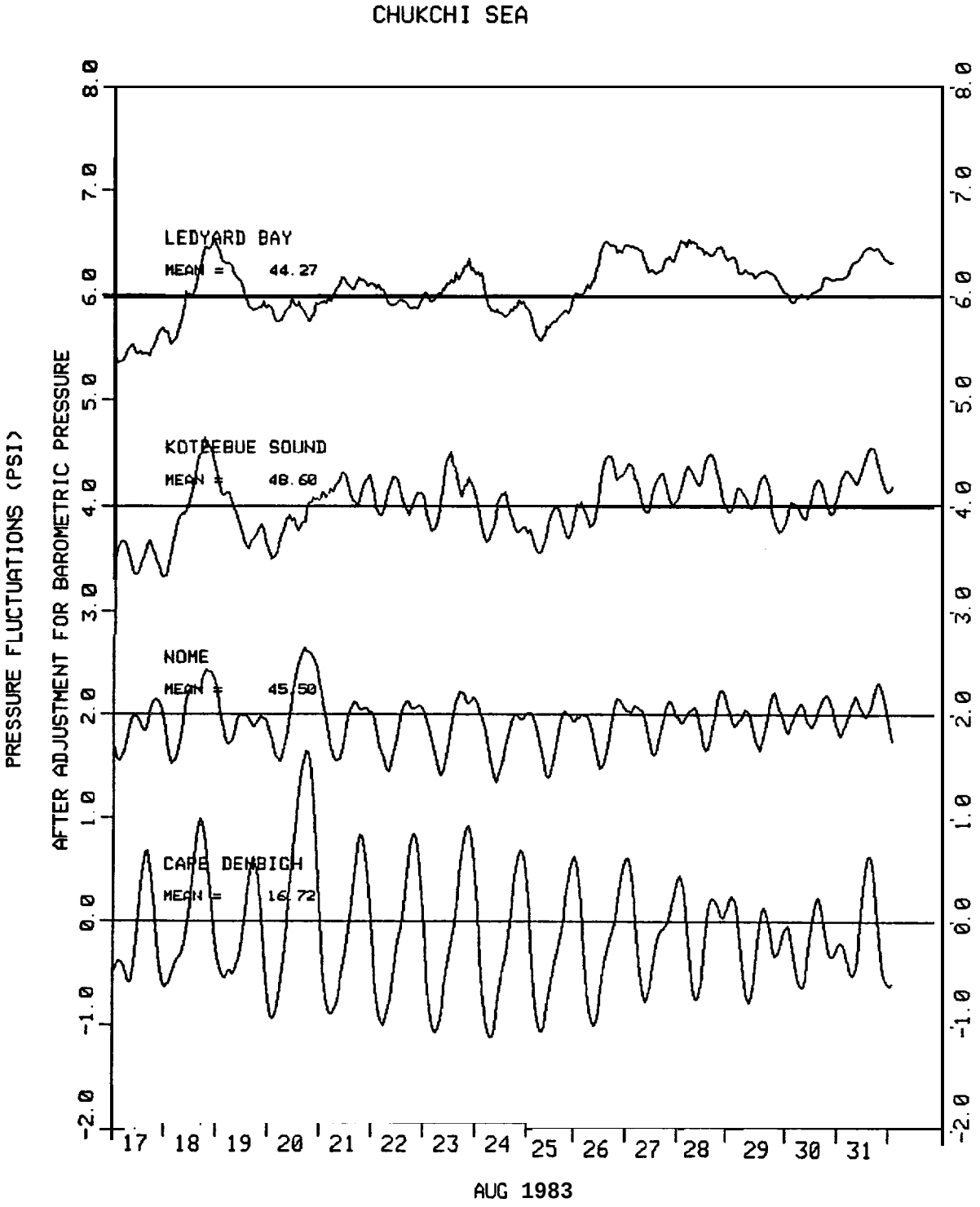

Fig. 5. Pressure Fluctuations About the Monthly Mean at Stations 1 through 4 in August 1983 (contd)

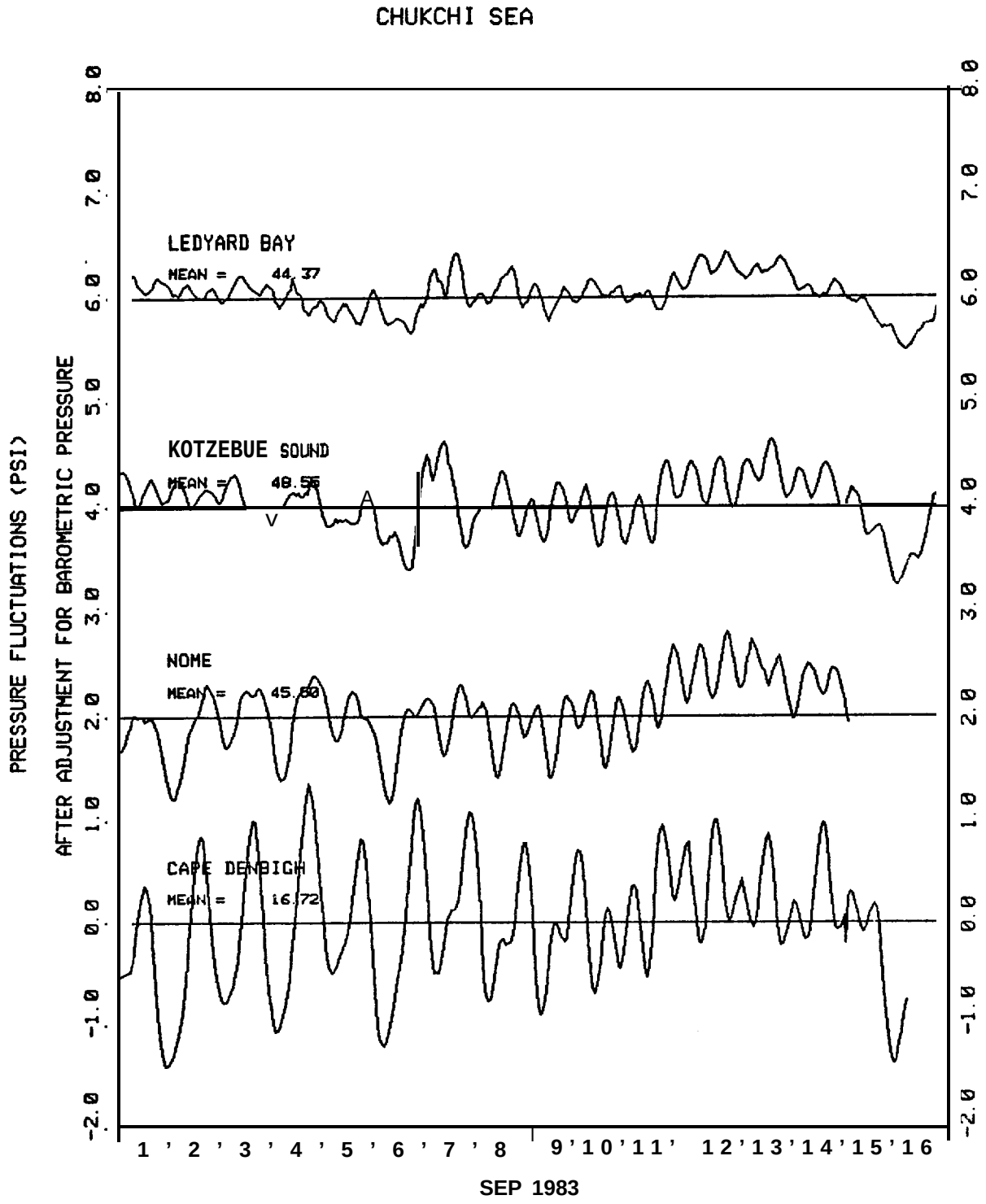

Fig. 6. Pressure Fluctuations About the Monthly Mean at Stations 1 through 4 in September 1983

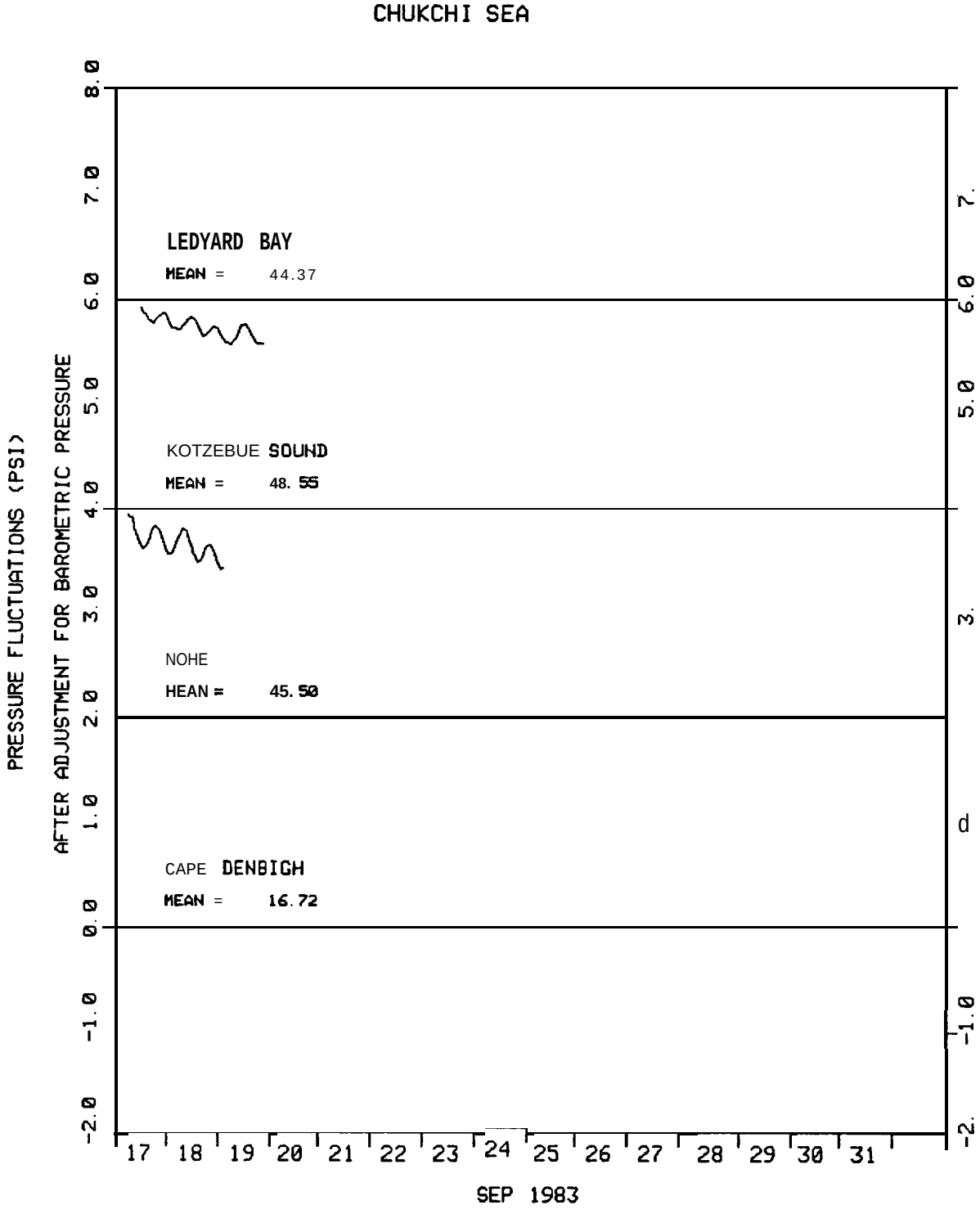

Fig. 6. Pressure Fluctuations About the Monthly Mean at Stations 1 through 4 in September 1983 (contd)

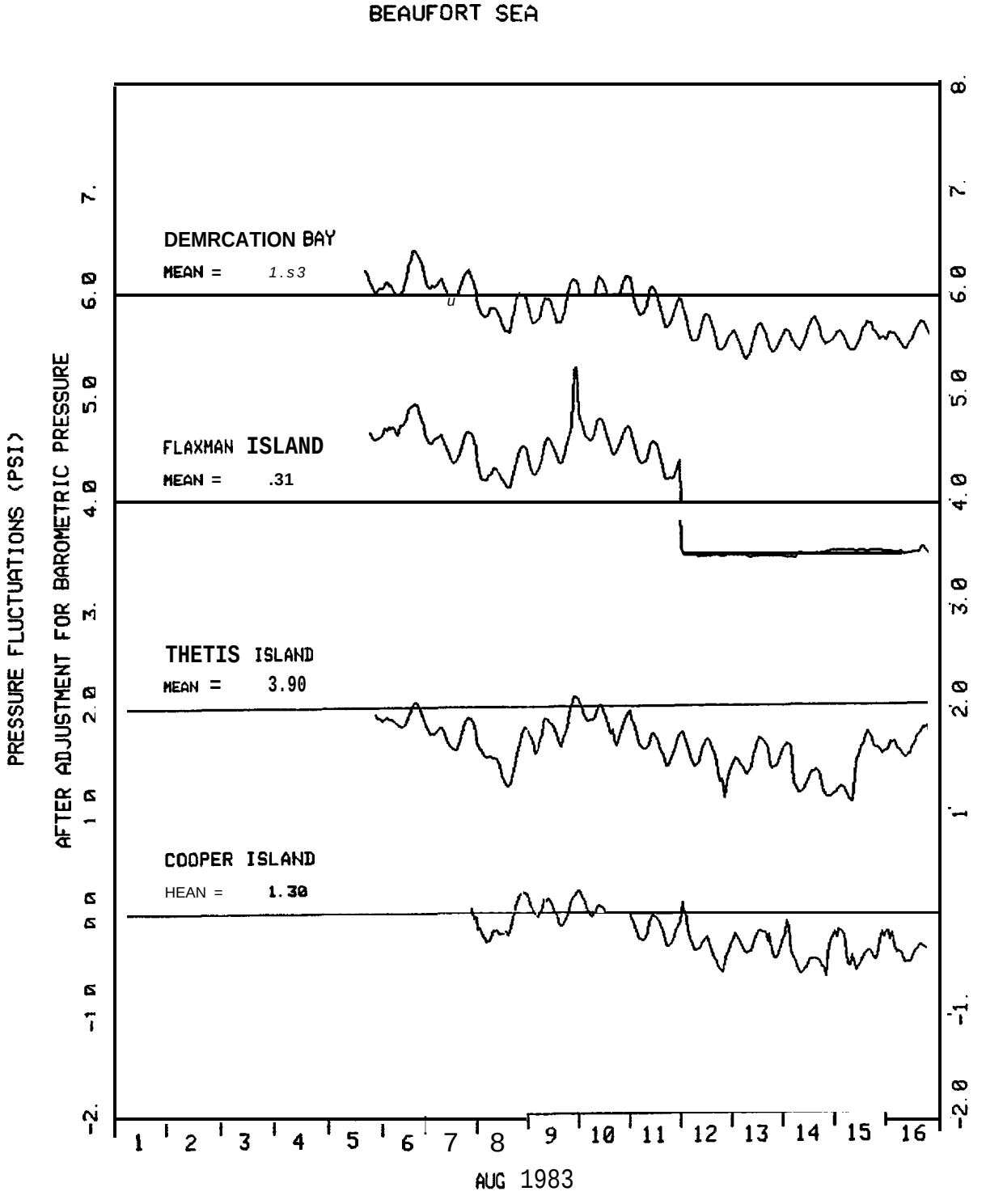

Fig. 7. Pressure Fluctuations About the Monthly Mean at Stations 5 through 8 in August 1983

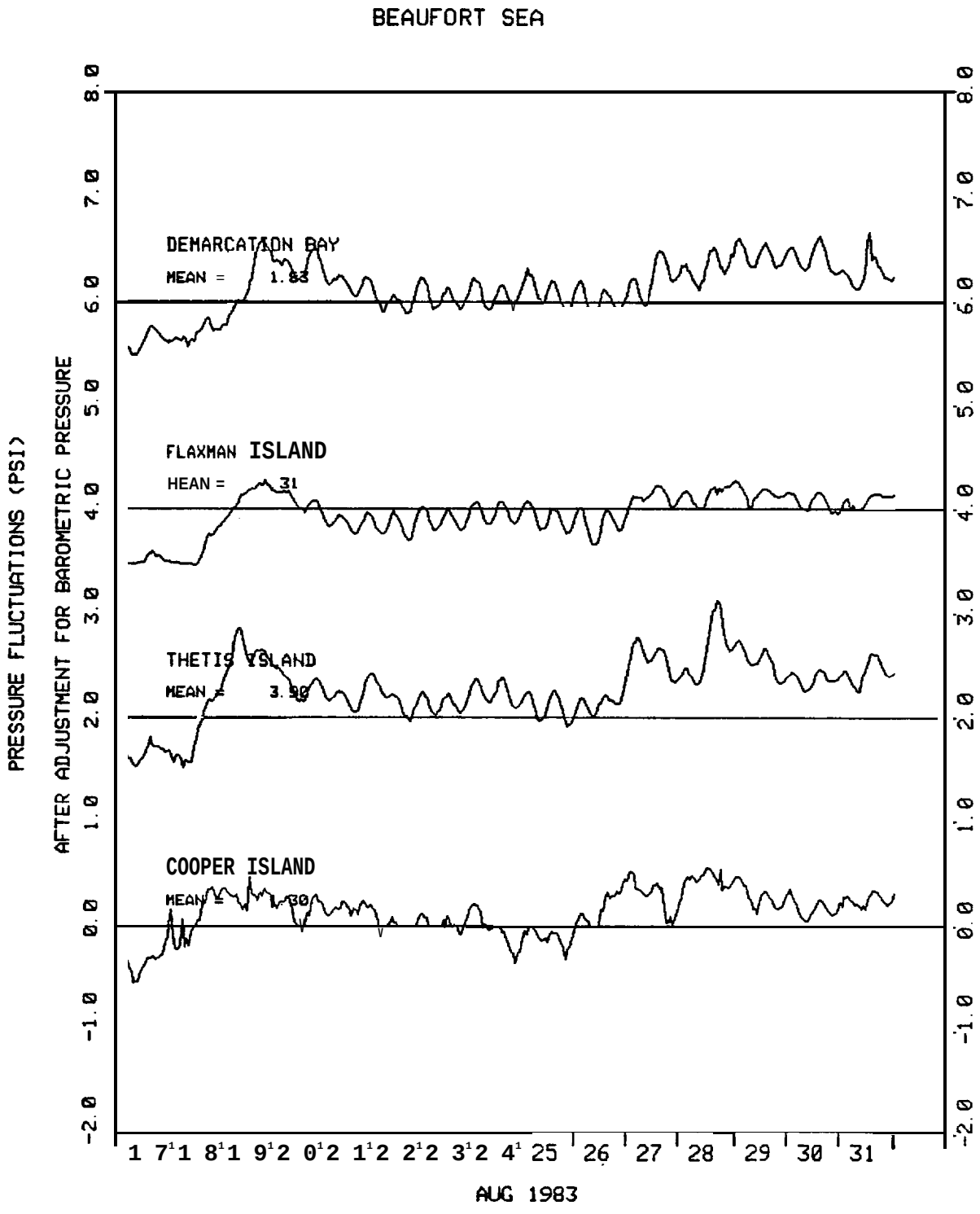

Fig. 7. Pressure Fluctuations About the Monthly Mean at Stations 5 through 8 in August 1983 (contd)

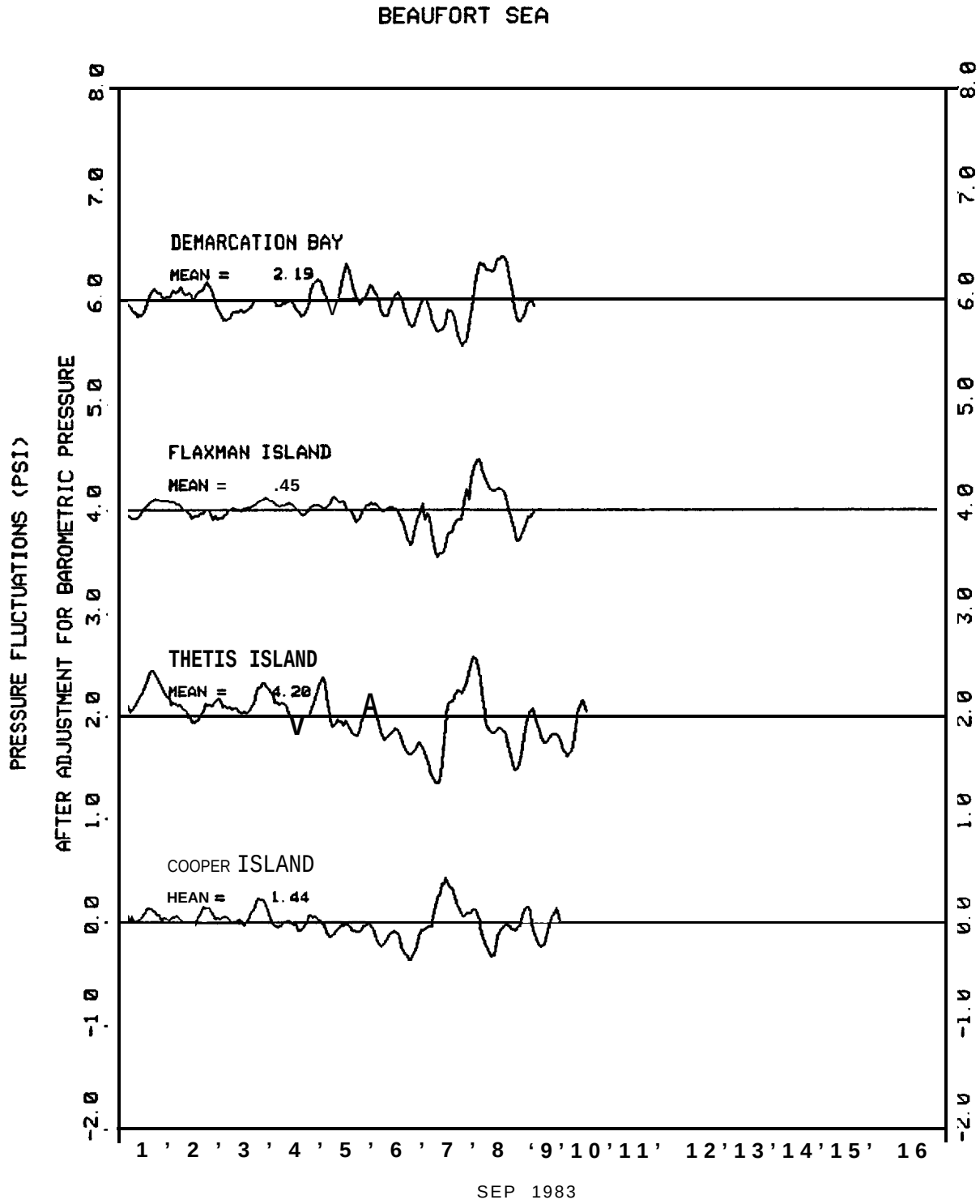

Fig. 8. Pressure Fluctuations About the Monthly Mean at Stations 5 through 8 in September 1983

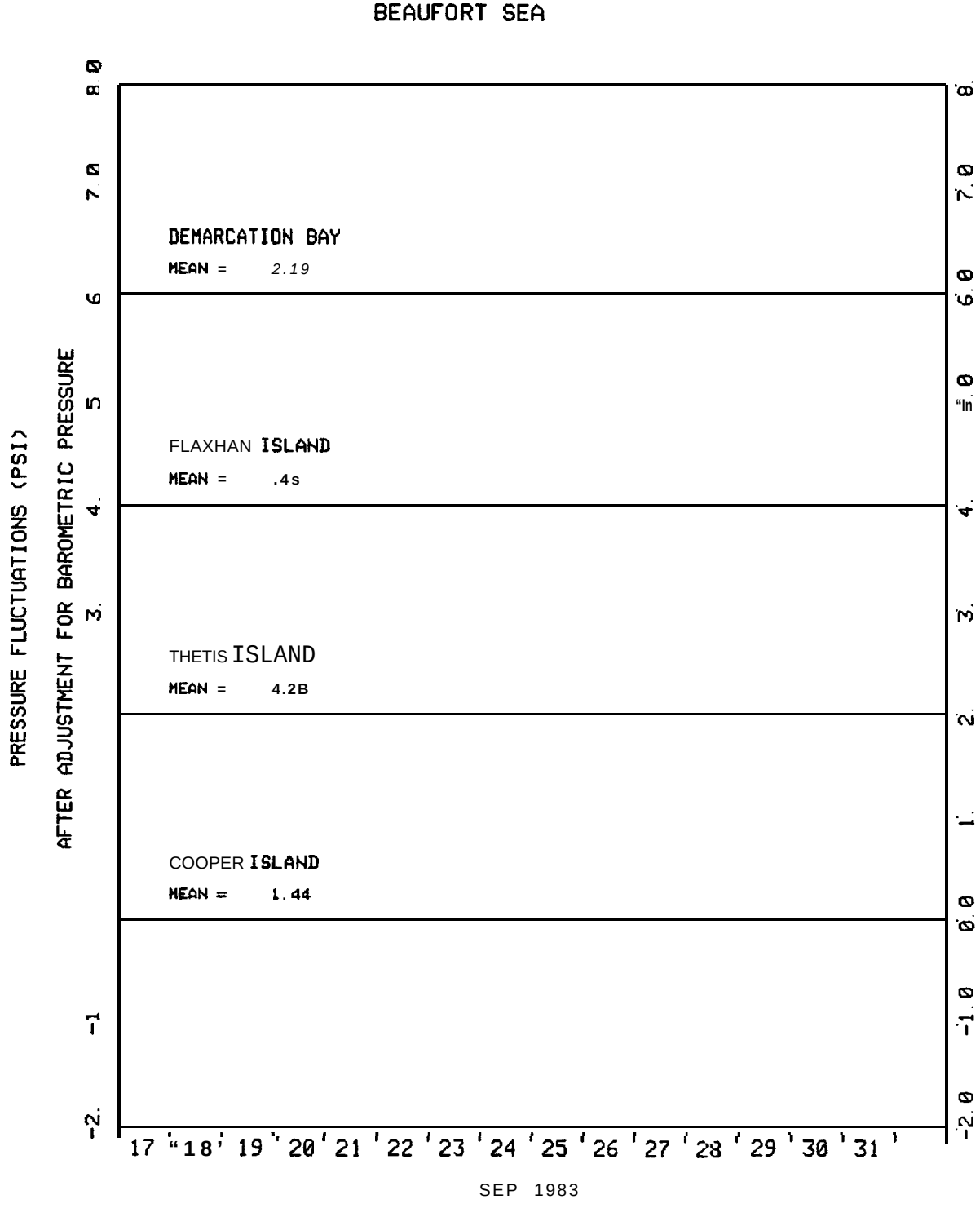

Fig. 8. Pressure Fluctuations About the Monthly Mean at Stations 5 through 8 in September 1983 (contd)

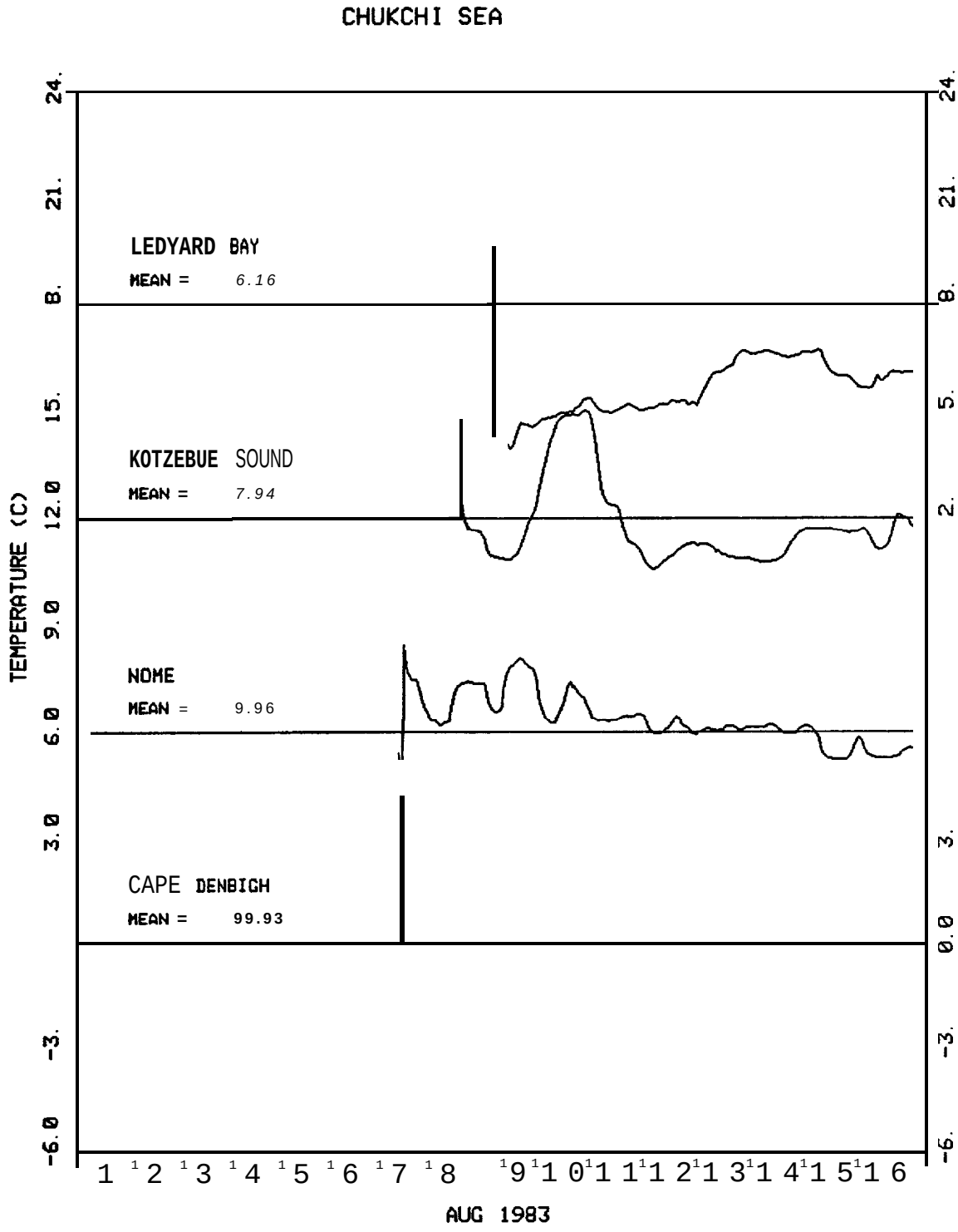

Fig. 9. Temperature Fluctuations About the Monthly Mean at Stations 1 through 4 in August 1983

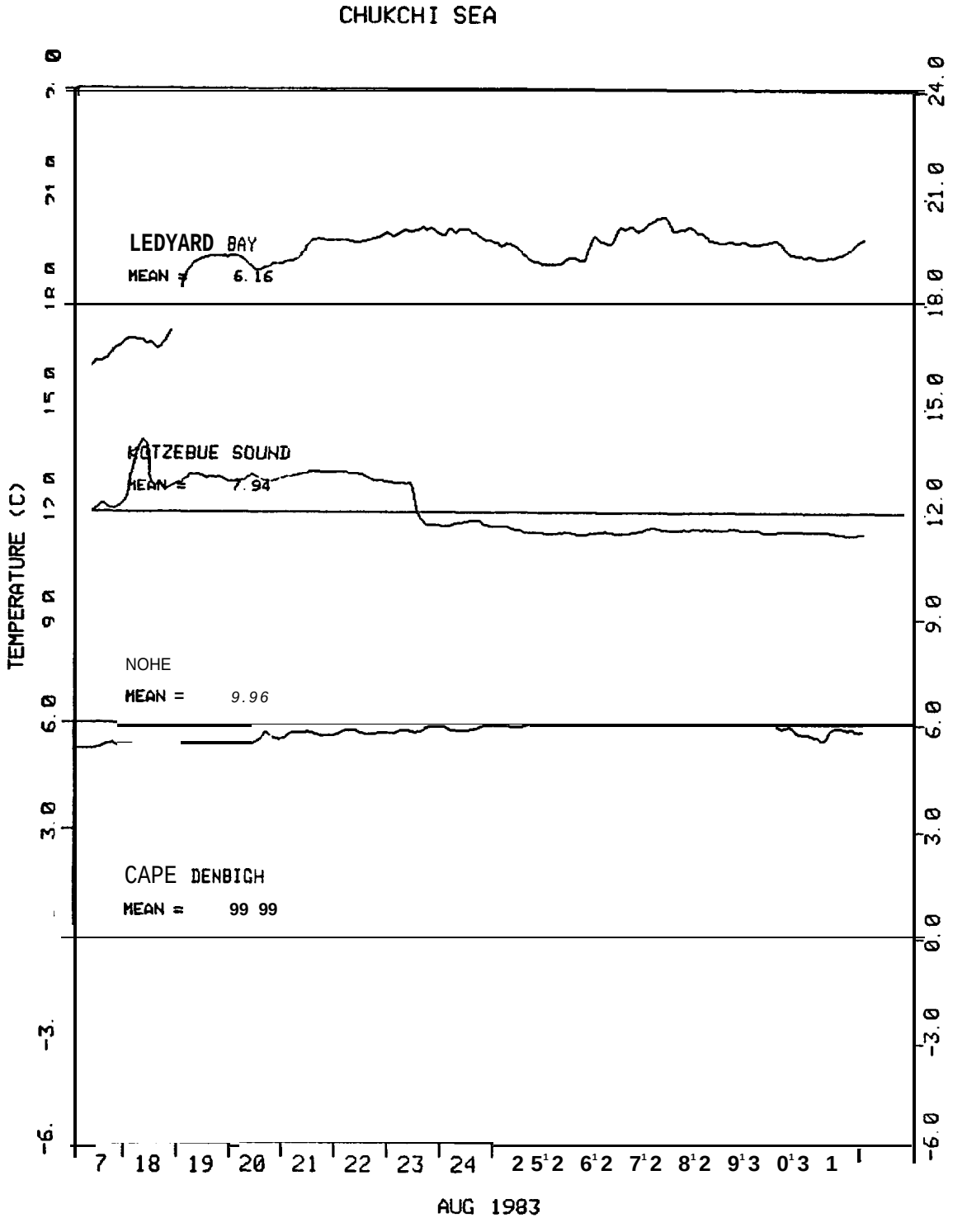

Fig. 9. Temperature Fluctuations About the Monthly Mean at Stations 1 through 4 in August 1983 (contd)

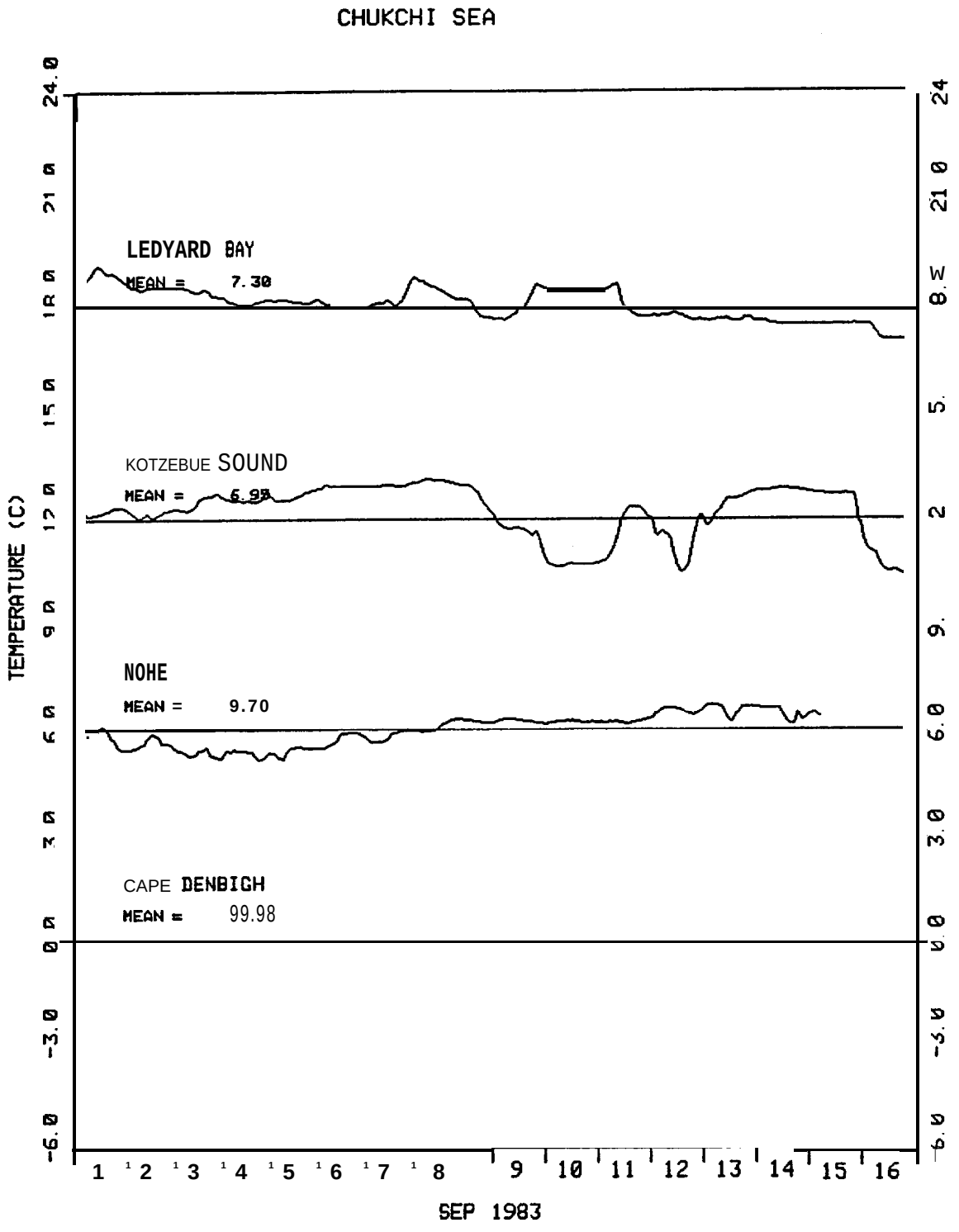

Fig. 10. Temperature Fluctuations About the Monthly Mean at Stations 1 through 4 in September 1983

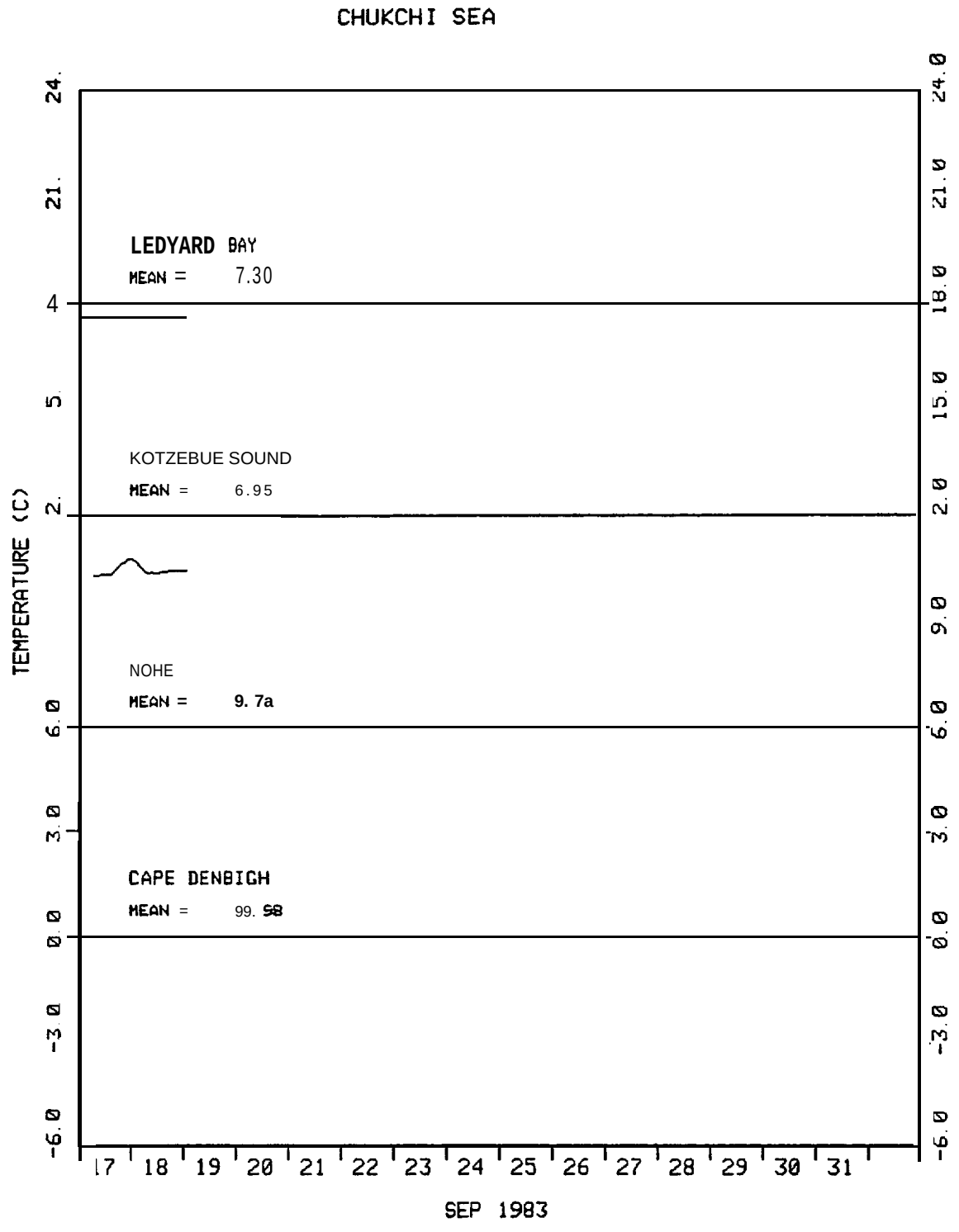

Fig. 10. Temperature Fluctuations About the Monthly Mean at Stations 1 through 4 in September 1983 (contd)

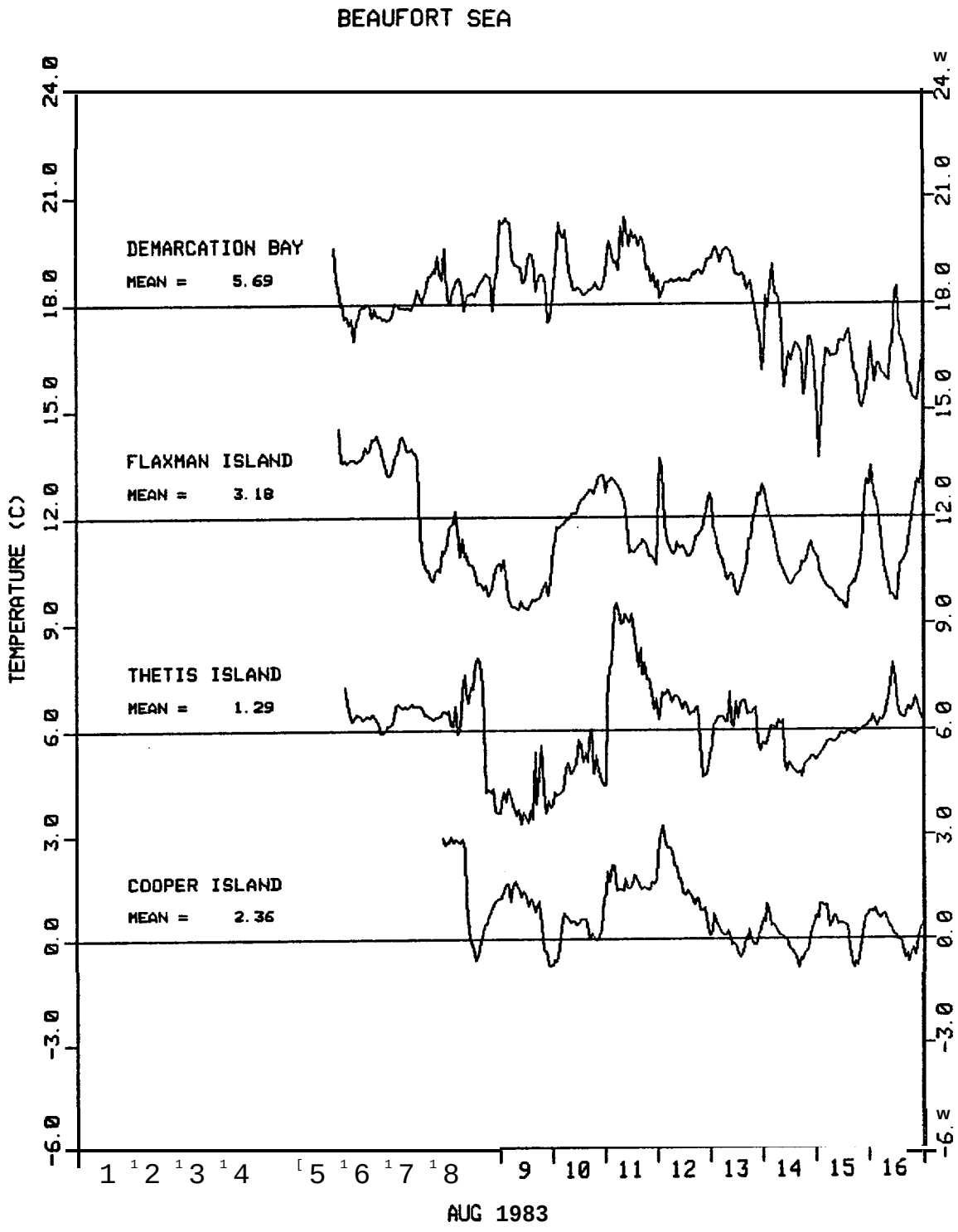

Fig. 11. Temperature Fluctuations About the Monthly Mean at Stations 5 through 8 in August 1983

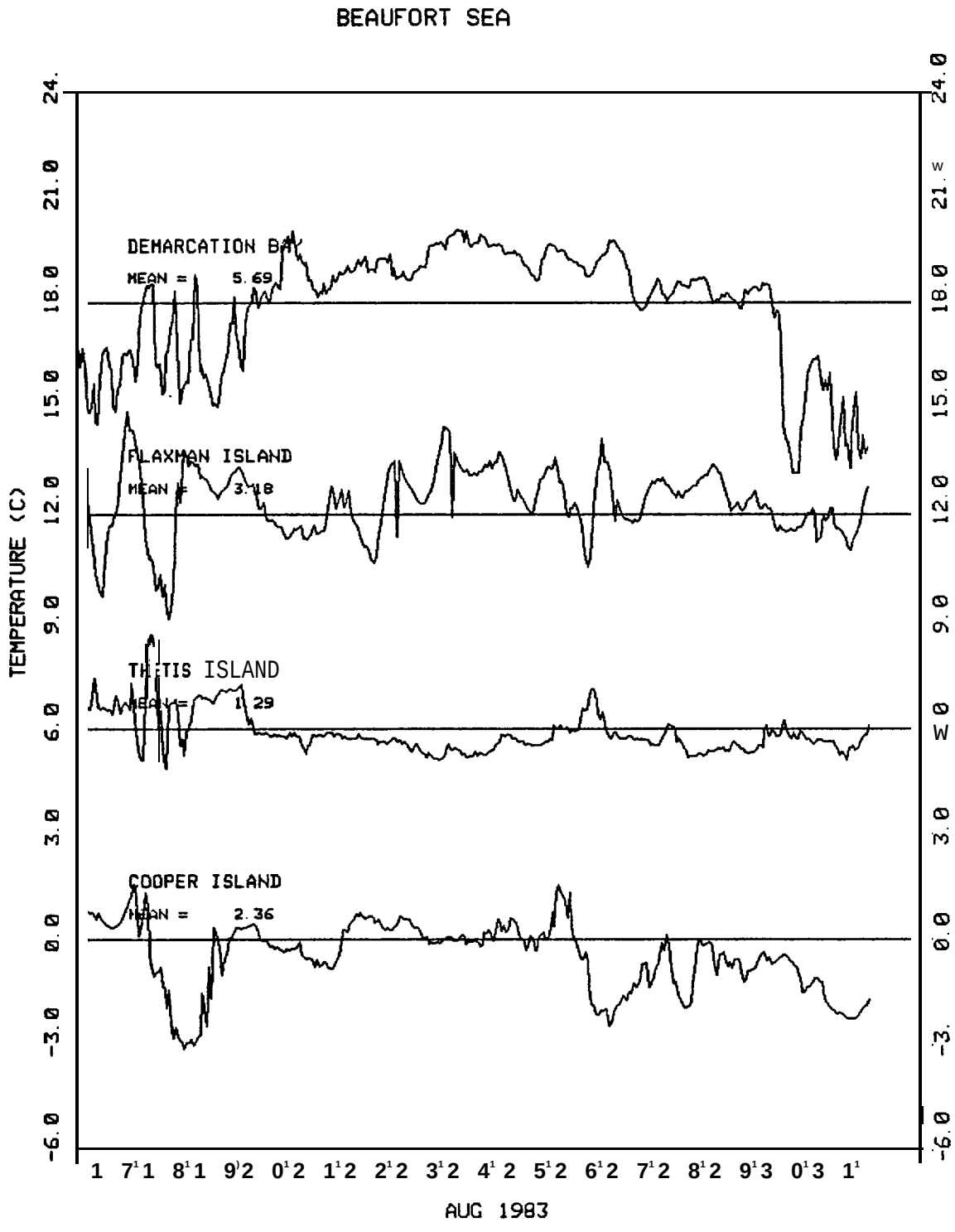

Fig. **11.** Temperature Fluctuations About the Monthly Mean at Stations 5 through 8 in August 1983 (contd)

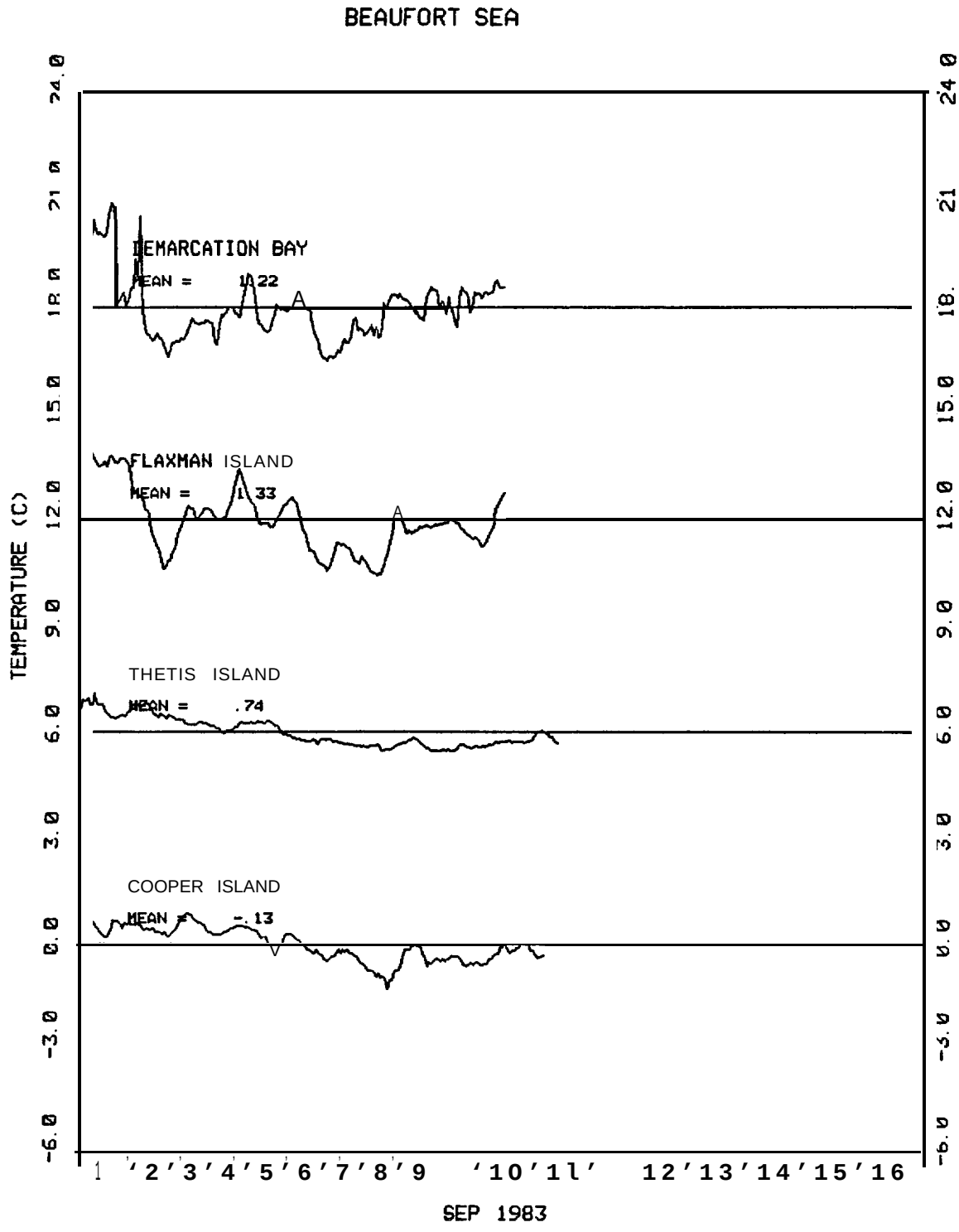

Fig. 12. Temperature Fluctuations About the Monthly Mean **at** Stations 5 through 8 in September 1983

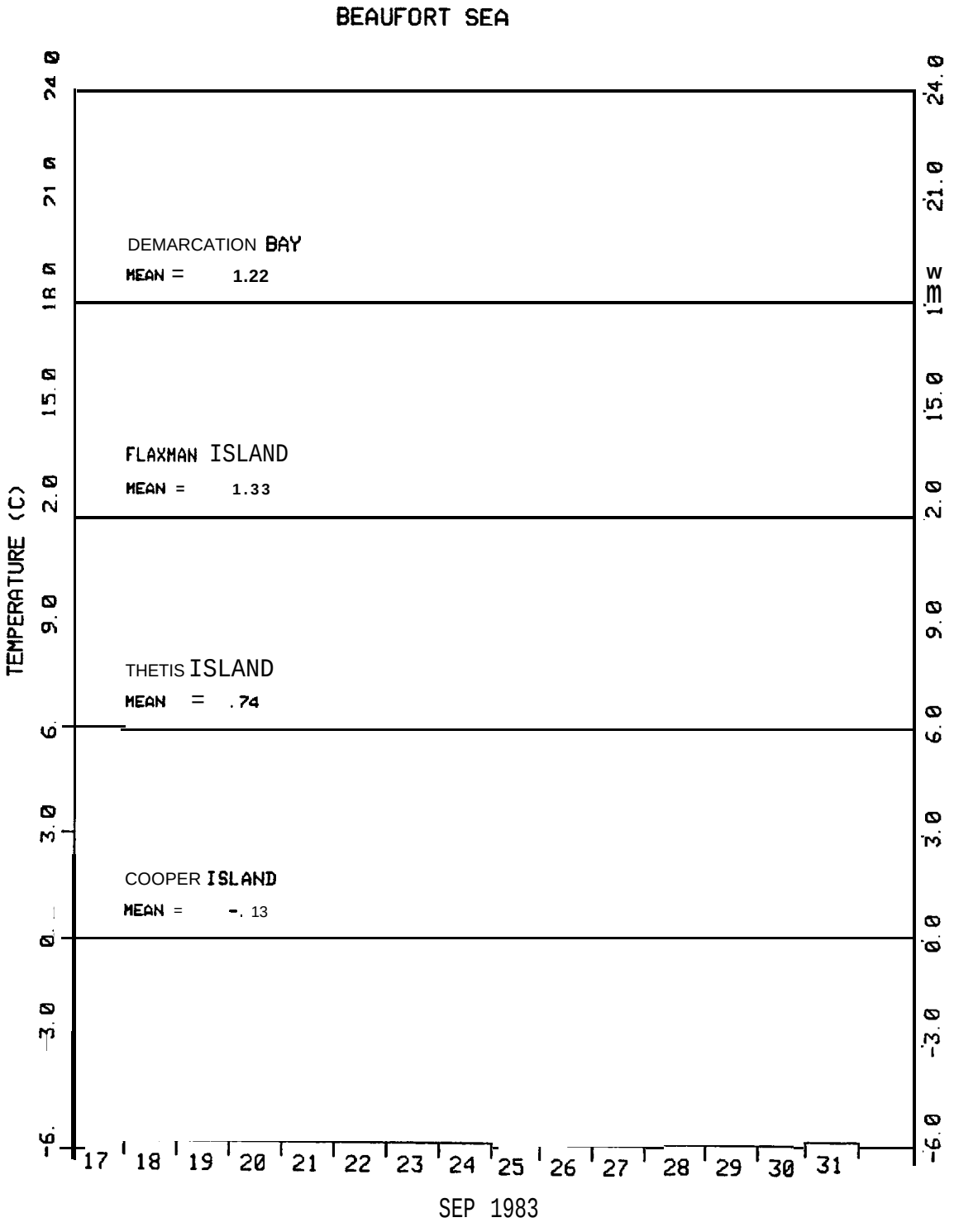

Fig. 12. **Temperature Fluctuations** About the Monthly Mean at Stations 5 through 8 in September 1983 (contd)

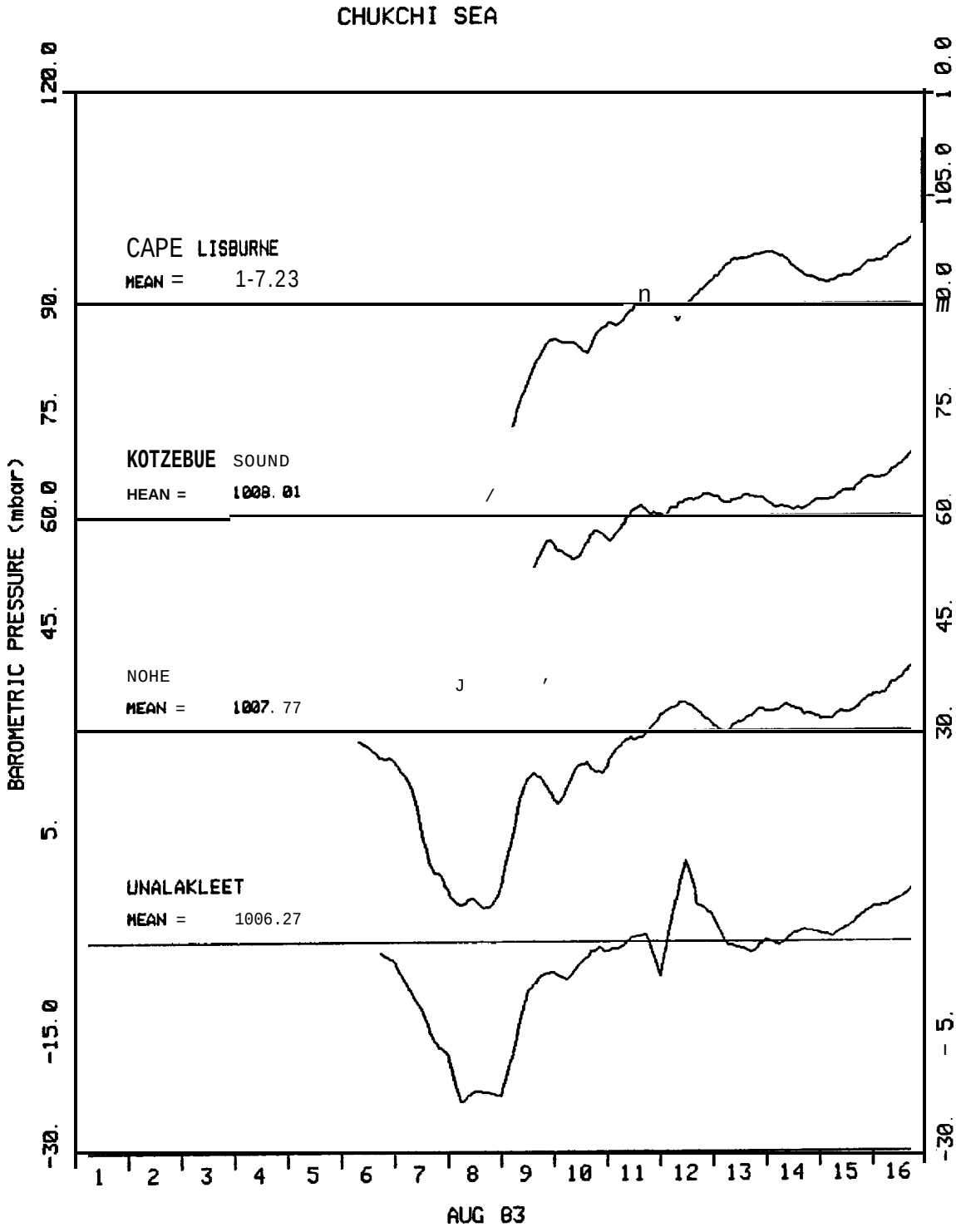

Fig. 13. Barometric Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 1 through 4 in August 1983

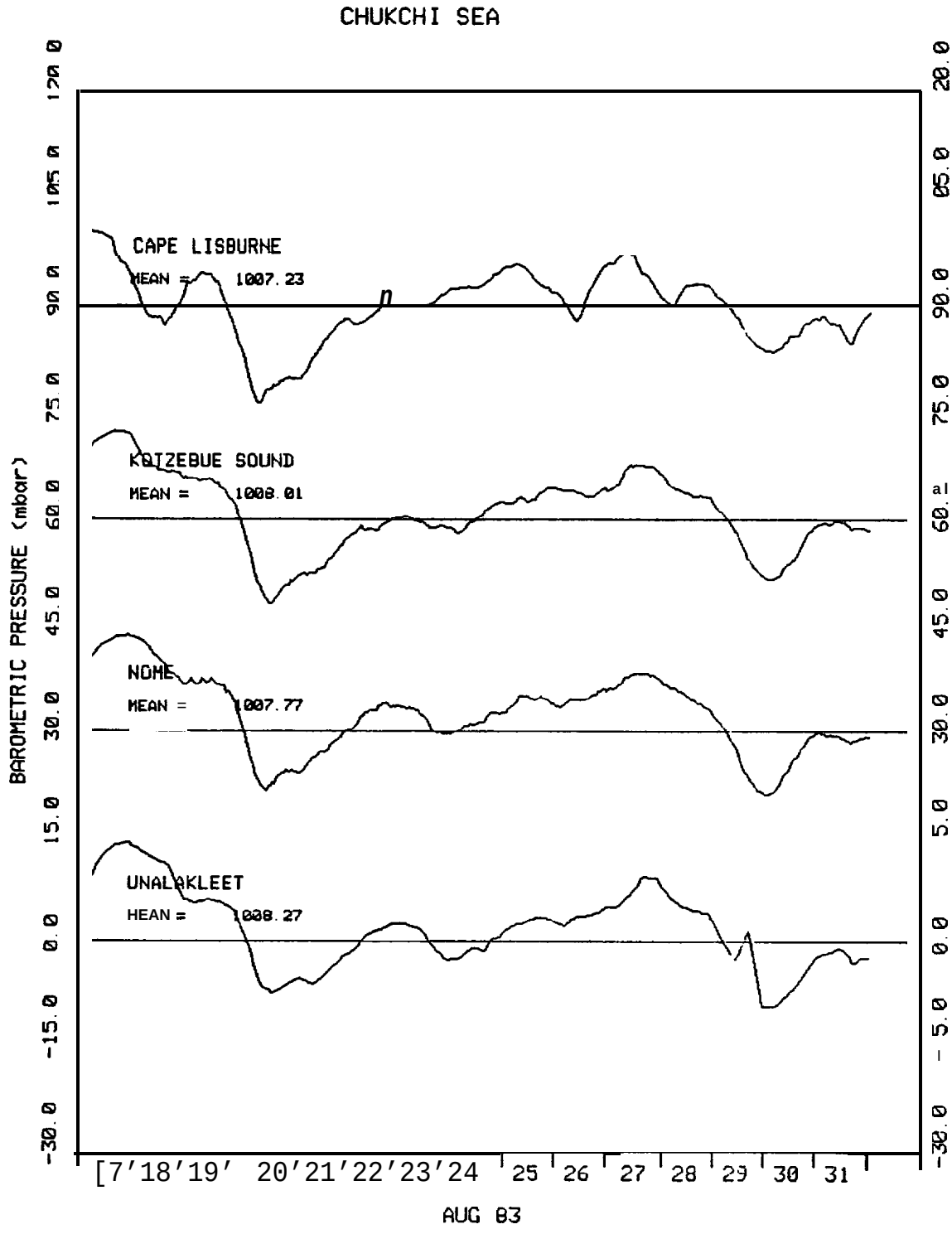

Fig. 13. Barometric Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 1 through 4 in August 1983 (contd)

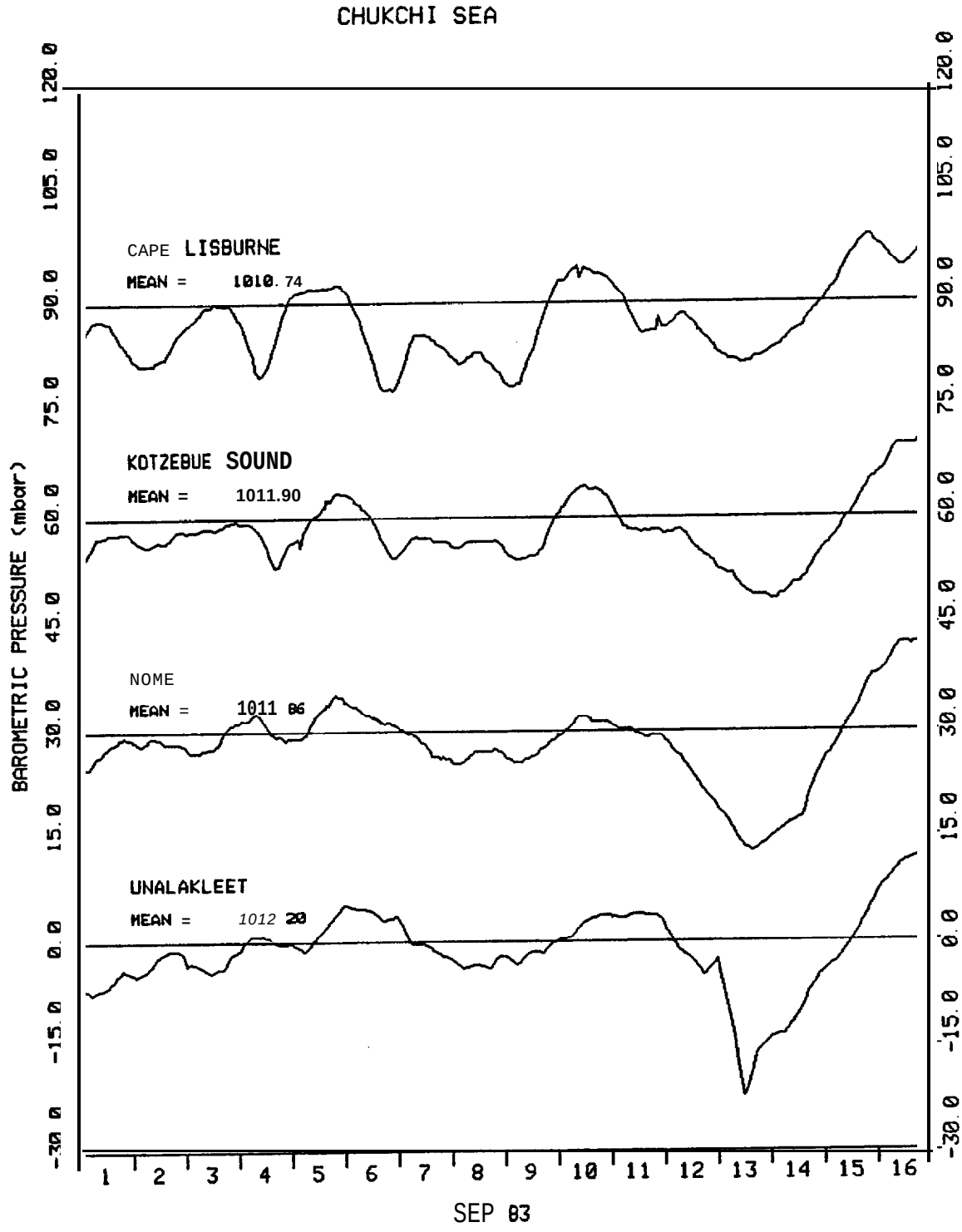

Fig. 14. **Barometric** Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 1 through 4 in September 1983

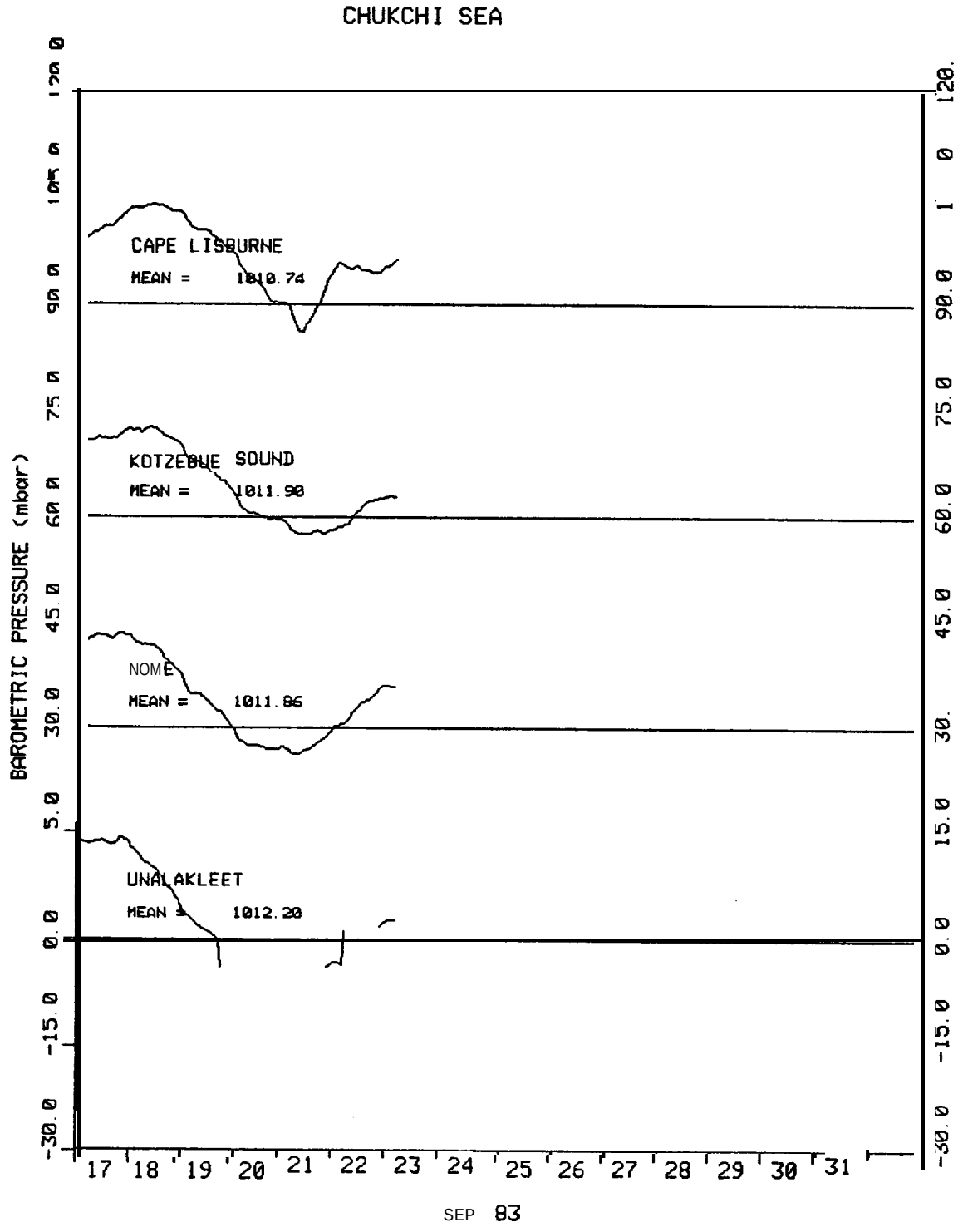

Fig. 14. Barometric Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 1 through 4 in September 1983 (contd)

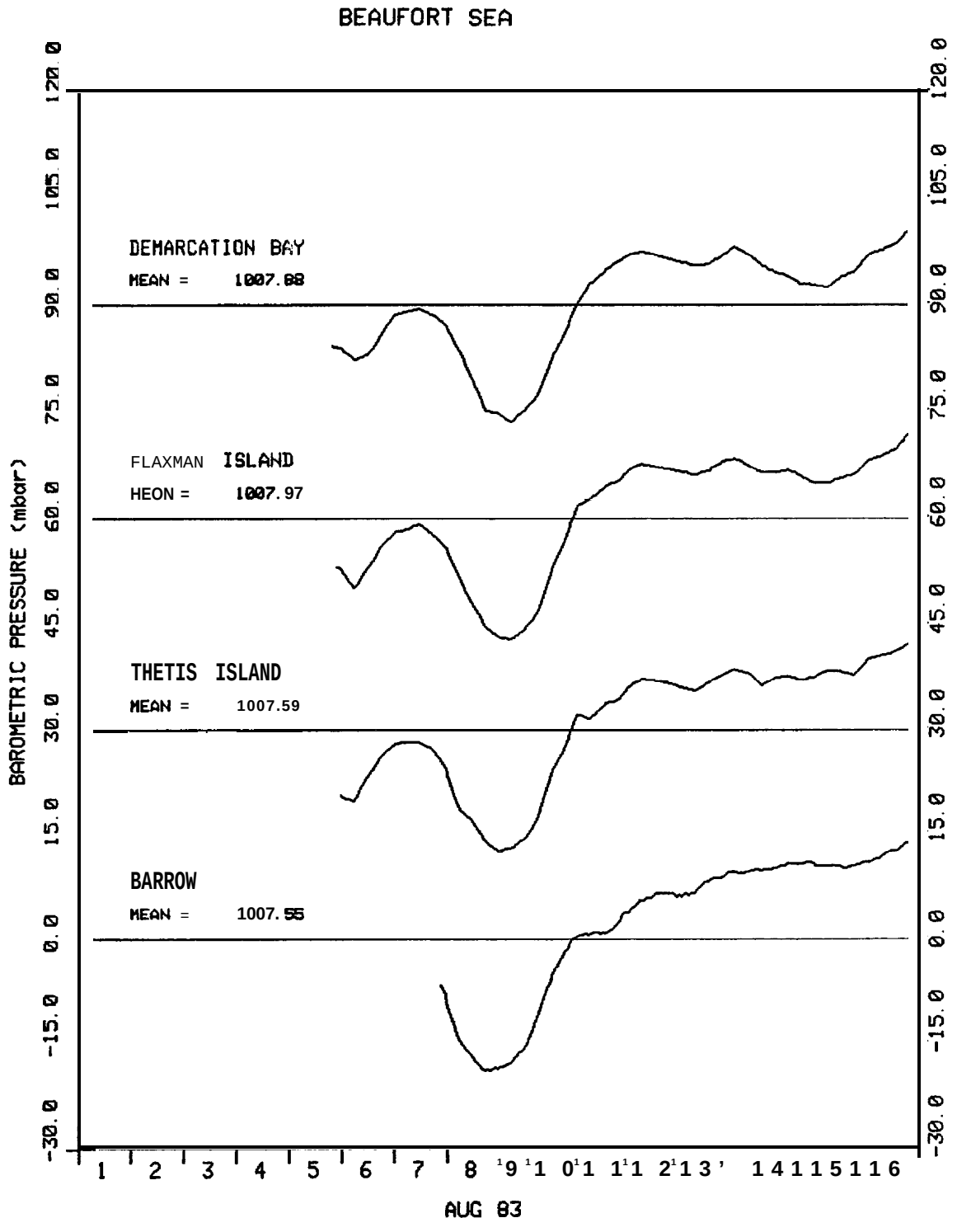

Fig. 15. Barometric Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 5 through 8 in August 1983

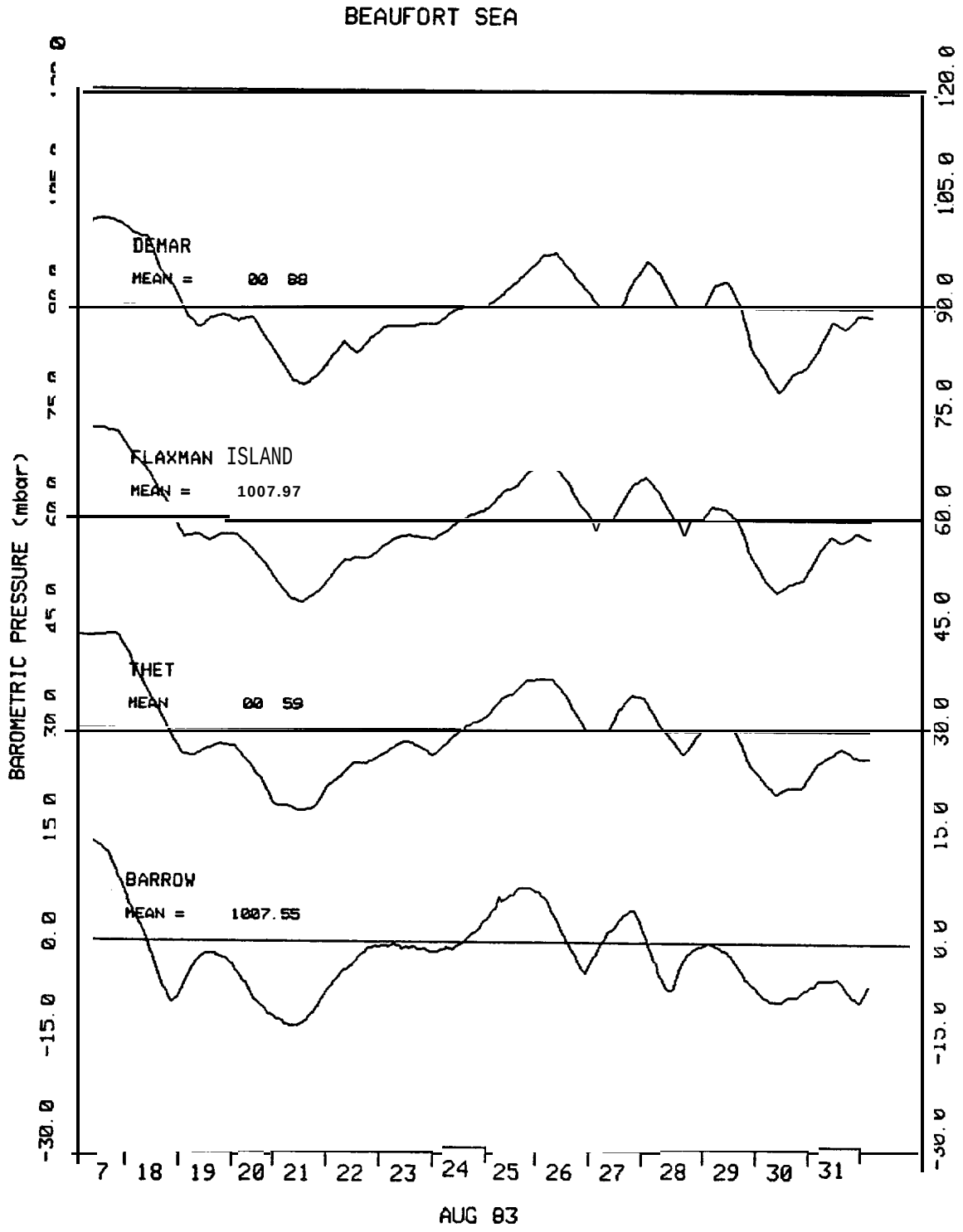

Fig. 15. Barometric Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 5 through 8 in August 1983 (contd)

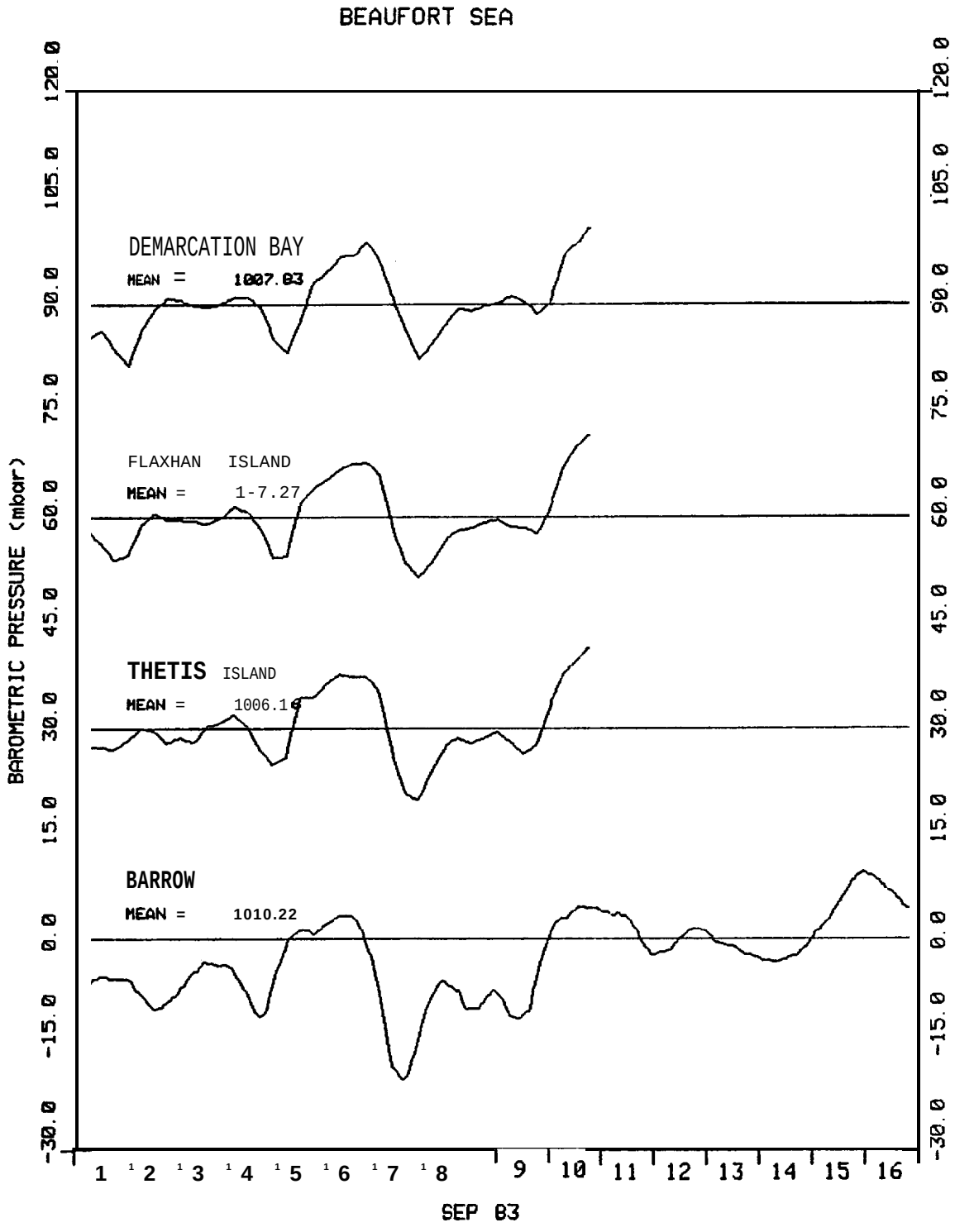

Fig. 16. Barometric Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 5 through 8 in September 1983

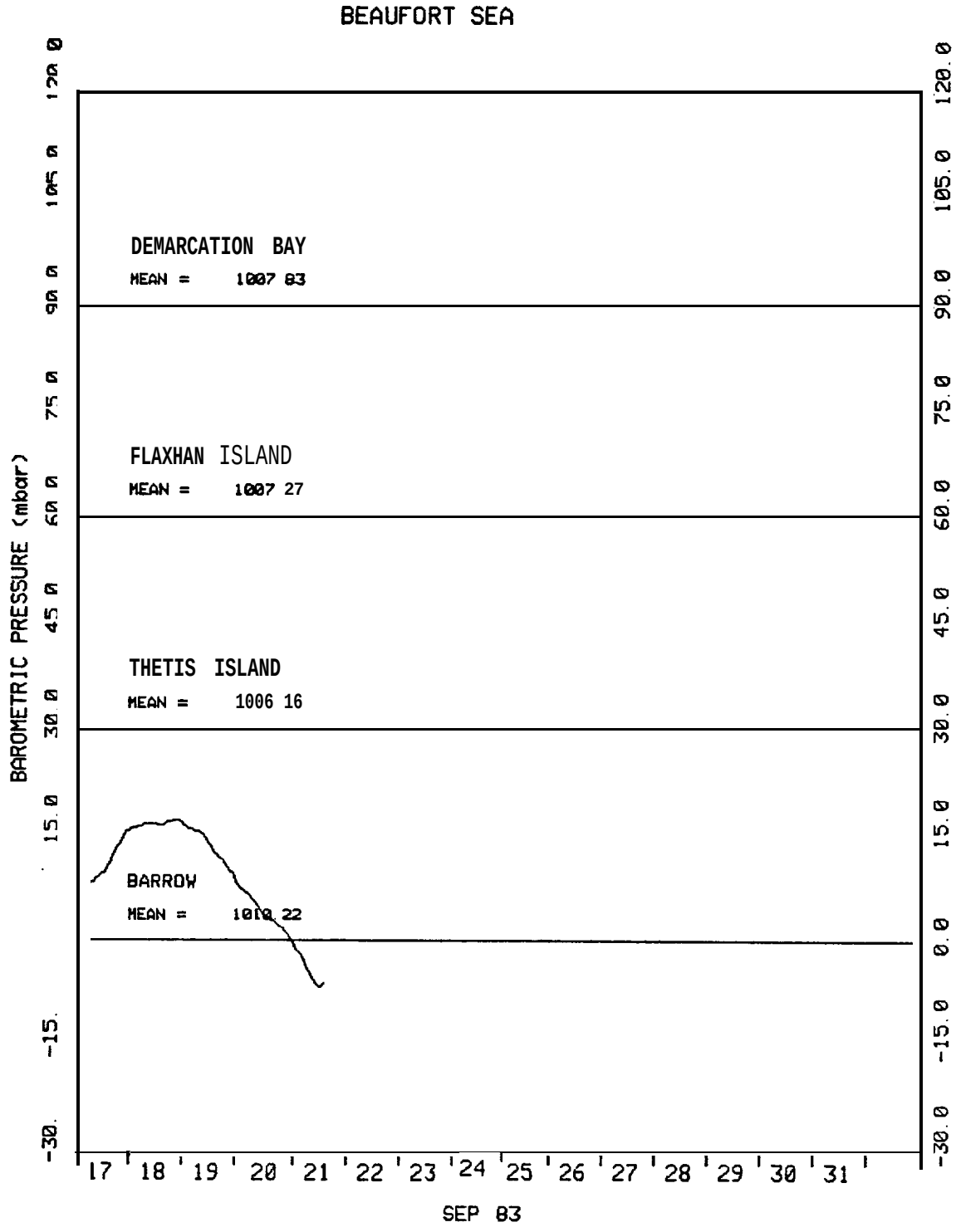

Fig. 16. Barometric Pressure Fluctuations Used to Correct Absolute Pressure Data from Stations 5 through 8 in September 1983 (contd)