WHOI-83-16

USNS BARTLETT CRUISE 40-B
DATA REPORT

by

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June 1983

TECHNICAL REPORT

Prepared for the Office of Naval Research under Contract N00014-82-C-0019; NR 083-004.

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Abstract

A joint cruise with Dr. Michael Gregg of the Applied Physics Laboratory at the University of Washington was conducted from 8-24 January, 1983, aboard the USNS Bartlett to study the effects of wintertime cooling in a warm core ring. At the beginning of the cruise an XBT survey of ring 82I (found at 40°40'N, 66°W, east of the New England Seamounts) showed a rather confused pattern of surface temperature and salinity with the average depth of the mixed layer about 30 m. On January 16-17, a storm passed near the ring with winds to 45 knots and temperatures below 0°C. An XBT survey at the end of the cruise showed that vertical mixing and cooling during the outbreak of cold air resulted in a more coherent pattern in the surface temperature and salinity of the ring and an increase in the thickness of the mixed layer to 180 m.

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This report describes the expendable bathythermograph (XBT), surface salinity and temperature, meteorological and drogued buoy observations obtained during a study of a warm core ring during 8-24 January, 1983. The purpose of this investigation was to study the effect of wintertime convection upon a Gulf Stream warm core ring. Dr. Michael Gregg, of the Applied Physics Laboratory (APL) at the University of Washington, was the chief scientist during the cruise. Additional observations were made with his AMP (Advanced Microstructure Profiler) and CTD (conductivity, temperature, depth) and Dr. Thomas Sanford's Expendable Current Profiler (XCP). The results of these studies are presented in data reports prepared by members of the APL, University of Washington.

The ring selected for this study was designated 82I by the National Marine Fisheries Service and No. 25 by the U.S. Navy. When first surveyed (9-12 January 1983) with XBTs and XCPs, the warm core ring was located near 40°40'N, 66°W, south of Georges Bank and east of the New England Seamounts. At the end of the cruise another XBT/XCP survey (21-22 January) was conducted which showed the ring near 40°10'N, 66°50'W. During the period of the cruise, 9-24 January, the ring moved about 90 km toward the southwest in a direction parallel to the continental slope. The translational speed of the ring was about 6 cm sec^{-1} which is typical for warm core rings.

Between the two XBT/XCP surveys most of the work was conducted near the center of the ring using Gregg's AMP to measure turbulence and CTD to measure the vertical distribution of temperature and salinity. During this period XBTs No. 48-83 were deployed primarily to determine the ship's position relative to the center of the ring.

The sequence number, date-time and position at which each XBT was deployed is shown in Table 1. The surface temperature was measured with a bucket thermometer and a water sample was collected from the bucket for salinity analysis. The maximum depth each probe reached is also presented.

Table 2 lists the meteorological observations taken at approximately four-hour intervals during the cruise. Wind speed is in knots and, together with wind direction, was obtained from sensors mounted on the foremast at an elevation of about 16 m. Sail wind speed was measured with a vortex-shedding anemometer about 3 m below the ship's wind sensor. Wind direction and ship's heading are in degrees true, barometric pressure is in millibars and temperatures are in degrees Celsius. Barometric pressure was measured in the chart room (elevation about 8 m) and the wet and dry bulb readings were generally obtained on the flying bridge (elevation about 10 m).

On January 11, a drogued buoy system was launched near the center of the ring as a navigational aid during the AMP work and to provide a means of tracking the movement of the ring. The system consisted of an Argos satellite tracked buoy tethered to a radar transponder equipped surface float. The float was anchored to a 10' x 20' window-shade drogue deployed at a depth of 100 m. The buoys were tracked from 0520 January 11, until 0929 January 14, when both buoys stopped transmitting. During this period the buoys moved southwest at speeds up to 40 cm sec^{-1}. The net movement was toward 243°T at 18 cm sec^{-1}.

Figure 1 summarizes the meteorological observations presented in Table 2. The duration of each XBT/XCP survey is indicated by the bars along the top of the figure. The storm of January 16-18 is marked by the low pressures and high winds on these dates. During the storm winds reached 45 knots and air temperatures decreased from 13°C to below 0°C. The barometric pressure and air temperature records are best interpreted using the surface analysis charts presented in Figure 2. These charts show the distribution of barometric pressure (corrected to sea level) for the northeastern seaboard of the U.S. during the period of the cruise. The progression of winter storms is depicted by the movement of low pressure regions as they track across New England, Nova Scotia and the area of the Warm Core Ring at 40°N, 66°W. For instance, the low pressures recorded at the ship on 13 January are seen to result from a strong low which moved northeasterly from 45°N, 90°W on 10 January and across New England and maritime Canada on 11-12 January. This low was centered over Nova Scotia on 13 January only 450 km northeast of the ring. The strong low pressure area centered over Cape Cod in the surface analysis chart for 1200z, 16 January, is the storm which produced the outbreak of cold air on 19-20 January shown in Figure 1. During the outbreak there were frequent snow squalls, winds averaged 25 knots and sea smoke was common. As the low moved northeasterly the barometric pressure at the ship slowly increased though the temperature continued to decline with the strong (20-30 kt) northwest winds.

The results of the two XBT surveys are illustrated in Figures 3-8. Figures 3a and 3b are the positions at which the XBTs were deployed during each of the two surveys and where surface temperature and salinity data were obtained. The surface temperatures in and near the ring are presented in Figures 4a and 4b. During the initial survey, the area of $>13°C$ was slightly smaller and less clearly defined than during the second. Only small patches of $>14°C$ surface temperature remained during the latter and all traces of 15°C surface water were gone. During the Warm Core Rings Program, in the summer of 1982, streams of cool water were seen to spiral into the center of warm core rings from the surrounding slope water. The variability in surface temperature observed in the first survey may be attributed to the presence of such bands of cooler and fresher slope water. The intense vertical mixing which occurred between the two XBT surveys effectively homogenized the upper 50-150 m in the interior of the ring, thus more clearly defining the ring/slope water boundary as shown in Figure 4b. Contours of the surface salinities during each XBT survey are shown in Figures 5a and 5b. The evolution of the surface salinity in the ring parallels that of the surface temperature as described above. Figures 6a and 6b are the thickness of the mixed layer during each survey. These charts most clearly depict the results of the vertical mixing which took place during the storm and outbreak of cold air on 16-18 and 19-20 January, respectively. During the storm the winds veered from northerly to northwesterly and air temperatures dropped from 13°C to below zero. Snow squalls and sea smoke were common during this period and heat losses as large as 700 Watts m^{-2} were calculated. The AMP observations made during this time showed that turbulent convection deepened the mixed layer from 40 to 150 m.

The depth of the 10°C isotherm is an index of thermocline displacement for warm core rings and is typically used to define the size and shape of these features. Unlike other rings studied in the Warm Core Rings Program, ring 82I was relatively weak with only a 100 m depression of the thermocline compared to 300-500 m for more energetic rings. Contours of the depth of the 10°C isotherm for each survey are shown in Figures 7a and 7b. Although the area of > 300 m depth appears slightly smaller during the record survey, this apparent difference may be due to the absence of observations in the southwest portion of the ring. The 10°C isotherm in the central portion of the ring is deeper than the level affected by the vertical mixing described above.

Figure 8 shows the temperature/salinity relationship for the surface samples collected at the site of each XBT. The plusses are the observations made during the first XBT survey and the Xs are those made during the second survey. The remaining samples (filled circles) were collected when XBTs were deployed at various times during the AMP and CTD measurements. The 26.0 sigma-t surface is shown to illustrate the density differences between the samples. Those with densities greater than 26.0 were generally collected within the ring. Surface samples collected during the second survey are uniformly colder and more dense at salinities > 34.4°/₀₀ than those collected during the first survey.

Figures 9a-9e are the XBT temperature sections obtained during the first survey. Each of the sections shows a thick, well defined layer of 14-16°C (stippled region) water extending from the surface (or near the surface) to depths of 200 to 240 m. By the time of the second survey this extensive layer is considerably reduced as shown in Figures 10a-10e. During the latter survey only isolated parcels or thin layers of 14-15° water remain. Only one XBT (No. 97) had a temperature of 16° in this layer. The erosion of this layer is the result of the strong vertical mixing during the outbreak of cold air cited before.

Figure 11 presents selected XBT traces from the center of the ring during each survey. These temperature profiles illustrate the effect of the vertical mixing which occurred within the ring during the cruise. Before the outbreak of cold air XBT Nos. 16 and 47 show relatively thick layers of nearly isothermal water with a temperature of 14.8 to 15.2°C. At the position of XBT No. 47 this water is overlain by 30 m of cooler, fresher water. After the outbreak XBT Nos. 95 and 114 show thick (155 to 190 m) layers of isothermal water at temperatures of 14 and 13.5°C respectively. In both comparisons a net heat loss and mixed layer deepening has occurred, but it can be seen that a one-dimensional mixed layer budget of heat will give greatly different results. We expect that spatial averaging and analysis of the digital XBT data will be necessary before the change in total heat content can be meaningfully compared with the empirically calculated heat fluxes using the meteorological data in Table 2.

This work was supported by the Office of Naval Research contract No. N00014-82-C-0019, NR 083-004 with the Woods Hole Oceanographic Institution.

Figure Captions

Figure 1: A summary of the meteorological data collected during _Bartlett_ cruise 40-B, January 1983. The outbreak of cold air on 19-20 January can be seen in the record of dry bulb temperatures.

Figure 2: Fifteen surface analysis charts showing the weather patterns during _Bartlett_ cruise 40-B, January 1983. The storm which triggered the outbreak of cold air over the ring is shown in Figures 2i-2k on 16-17 January.

Figure 3a: The location of XBT Nos. 10-47 deployed on the first survey of ring 82I during _Bartlett_ cruise 40-B. This work was done during 9-11 January, 1983.

Figure 3b: The location of XBT Nos. 84-117 deployed during the second survey of ring 82I from 21-22 January, 1983.

Figure 4a: Contours of surface temperature (°C) measured at each XBT during the first survey.

Figure 4b: Contours of surface temperature (°C) measured at each XBT during the second survey.

Figure 5a: Contours of surface salinity (°/₀₀) from samples collected at each XBT during the first survey.

Figure 5b: Contours of surface salinity (°/₀₀) from samples collected at each XBT during the second survey.

Figure 6a: The thickness of the mixed layer (m) during the first survey.

Figure 6b: The thickness of the mixed layer (m) during the second survey.

Figure 7a: The depth (m) of the 10°C isotherm during the first XBT survey.

Figure 7b: The depth (m) of the 10°C isotherm during the second XBT survey.

Figure 8: A T/S diagram of surface samples collected in warm core ring 82I during _Bartlett_ cruise 40-B in January, 1983.

Figure 9a-9e: Temperature sections (°C) during the first XBT survey of warm core ring 82I. The stippled areas define the extent of the 14-16°C layer. The inset shows the position of the section relative to the survey.

Figure 10a-10e: Temperature sections (°C) during the second XBT survey. The stippled areas and inset are as in Figure 9.

Figure 11: Selected XBT profiles from warm core ring 82I. The mixed layer during the first survey is shown by profile Nos. 16 and 47 while Nos. 95 and 114 characterize the mixed layer during the second survey.

Table Captions

Table 1: Log of XBT data collected during USNS Bartlett cruise 40-B, January 1983. The position of each T-7 XBT is given in degrees and fractions of degrees, data is Julian day and time is GMT. The bucket temperature is in °Celsius and the maximum depth reached by the probe is in meters.

Table 2: Meteorological observations recorded during USNS Bartlett cruise 40-B. Wind and ship speeds are in knots, directions are °T, temperatures are °Celsius and positions are degrees and tenths (north and west are +).

Table 1

Log of XBT Data Collected During USNS Bartlett Cruise 40-B
January 1983

The position of each of the T-7 XBTs is given in degrees and fraction of degrees. Date is Julian day and time is GMT. The bucket temperature is in °Celsius and the maximum depth reached by the probe is in meters.

xbt#	date/time	latitude	longitude	bucket	salinity	max depth
1	90007	40.923	70.303	9.4		79
2	90900	40.013	68.117	9.6	33.433	850
3	91000	40.007	67.942	12.5	34.247	850
4	91100	40.05	67.758	11.3	33.923	850
5	91200					
6	91206	40.097	67.568	12.2	34.437	850
7	91303	40.135	67.375	15.0	35.472	850
8	91401	40.177	67.21	15.0	35.478	850
9	91459	40.253	67.07	10.1	33.509	850
10	91600	40.315	66.902	10.3	33.665	850
11	91700	40.362	66.715	13.5	34.676	850
12	91800	40.417	66.533	16.2	35.496	850
13	91900	40.465	66.38	10.2	34.246	850
14	92000	40.538	66.175	11.2	35.228	850
15	92100	40.648	66.045	14.2	35.211	810
16	92200	40.755	65.918	14.7	35.396	850
17	92300	40.875	65.772	15.5	35.316	850
18	100000	40.958	65.668	10.3	33.787	850
19	100105	41.068	65.567	7.4	32.384	600
20	100203	40.945	65.578	9.6	33.226	850
21	100302	40.833	65.592	10.1	33.603	850
22	100400	40.708	65.6	10.2	33.715	850
23	100500	40.56	65.627	10.3	33.784	850
24	100603	40.405	65.662		34.101	850
25	100700	40.268	65.697	10.9	34.167	850
26	100800	40.132	65.718	10.2	33.723	850
27	100900	39.995	65.737	8.6	33.201	850
28	101000	40.08	65.857	8.3	33.109	850
29	101100	40.18	65.957		34.110	850
30	101200	40.297	66.073	11.4	34.321	850
31	101334	40.45	66.197	10.9	34.237	850
32	101430	40.585	66.302	9.7	33.676	850
33	101530	40.702	66.388	9.6	33.585	850
34	101630	40.843	66.492	13.8	34.353	850
35	101730	40.928	66.395	7.8	33.101	850
36	101830	40.897	66.255	13.7	34.759	850
37	101945	40.862	66.068	12.6	34.531	850
38	102100	40.815	65.882	13.5	34.966	705
39	102255	40.752	65.695	13.7	35.060	850
40	110030	40.695	65.503	12.5	34.496	850
41	110200	40.655	65.295	9.8	33.578	850
42	110300	40.623	65.365	8.4	33.016	850
43	110400	40.568	65.597	14.3	35.154	850
44	110500	40.538	65.808	14.2	35.321	850
45	110535	40.528	65.825	14.2	35.222	850
46	110855	40.433	65.838	12.8	34.827	850
47	111000	40.54	65.988	11.8	34.356	850
48	121034	40.503	65.725	13.0	34.698	850
49	121205	40.417	65.887	12.2	34.305	850
50	122145	40.34	65.933	12.6	34.530	850
51	130630	40.29	66.078	13.2	34.766	770
52	131547	40.303	66.182	12.6	34.672	850
53	140015	40.35	66.237	12.3	34.627	850

xbt#	date/time	latitude	longitude	bucket	salinity	max depth
54	140929	40.327	66.237	12.6	34.621	850
55	141614	40.343	66.283	12.4	34.604	850
56	150232	40.285	66.298	12.0	34.440	850
57	151230	40.308	66.292	11.1	34.540	760
58	151405	40.327	66.195	13.1	34.872	850
59	151517	40.38	66.023	11.4	34.281	850
60	151628	40.398	65.835	11.2	34.041	800
61	161632	40.04	65.848	10.9	33.898	400
62	161730	40.133	65.98	14.0	34.820	760
63	161837	40.215	66.078	13.0	34.857	770
64	161930	40.297	66.137	12.6	34.660	850
65	16					
66	171745	40.082	66.788	13.0	34.753	850
67	171900	40.192	66.59	12.7	34.799	850
68	172025	40.287	66.392	12.6	34.745	830
69	180300	40.313	66.12	12.8	34.825	850
70	180451	40.305	66.053	13.1	33.908	850
71	180845	40.313	65.9	8.6	33.155	800
72	181230	40.33	65.72	10.5	33.887	800
73	190535	40.328	66.288	13.3	34.937	830
74	191050	40.327	66.292	13.3	34.970	830
75	191440	40.32	66.308	13.1	34.941	680
76						
77						
78	200115	40.257	66.393	13.2	35.104	830
79	200630	40.267	66.395	13.6	35.190	830
80	200945	40.248	66.44	13.7	35.212	830
81	201020	40.262	66.505	13.7	35.212	830
82	202015	40.252	66.493	13.9	35.250	840
83	202334	40.233	66.45	13.8	35.244	745
84	211440	40.585	67	11.2	34.425	830
85	211540	40.52	66.832	14.3	34.348	830
86	211640	40.457	66.65	13.5	35.115	830
87	211740	40.382	66.443	13.4	35.095	830
88	211840	40.31	66.272	7.2	32.794	850
89	211940	40.255	66.113	6.8	32.609	850
90	212040	40.2	66.932	8.3	33.238	850
91	212140	40.167	66.082	7.3	32.847	850
92	212240	40.143	66.263	6.8	32.579	850
93	212340	40.122	66.468	7.8	33.062	830
94	220040	40.087	66.668	13.7	35.249	850
95	220140	40.063	66.857	14.1	35.311	830
96	220240	40.055	67.05	12.8	34.899	830
97	220340	40.038	67.235	7.6	32.986	850
98	220440	40.127	67.147	13.1	34.882	850
99	220540	40.227	67.007	13.2	35.073	840
100	220640	40.327	66.86	13.6	35.189	850
101	220740	40.427	66.708	13.2	35.108	850
102	220840	40.522	66.582	13.5	35.144	850
103	220940	40.642	66.46	7.4	32.979	850
104	221040	40.742	66.34	7.8	33.152	850
105	221140	40.597	66.358	6.6	32.641	850
106	221240	40.435	66.363	7.7	33.275	830
107	221340	40.28	66.375	13.5	35.128	850
108	221440	40.132	66.41	7.6	33.063	850
109	221540	39.978	66.261	6.8	32.660	850
110	221640	39.813	66.477	7.4	32.852	850
111	221745	39.928	65.602	6.8	32.722	850
112	221850	40.055	66.712	13.7	35.327	850
113	221931	40.14	66.775	13.8	35.385	850
114	222015	40.23	66.847	13.5	35.256	850
115	222100	40.32	66.902	13.5	35.186	850
116	222200	40.458	66.972	13.1	35.074	850
117	222300	40.582	66.067	11.2	34.413	272

Table 2

Meteorological Observations Recorded During USNS Bartlett Cruise 40-B
9 - 23 January 1983

Wind and ship speeds are in knots, directions are °T, temperatures are °Celsius and positions are degrees and tenths (north and west are +).

DAY	GMT TIME	WIND SPD.	WIND DIR.	SHIP SPD.	SHIP HDG.	BAR. PRS.	DRY BULB	WET BULB	SEA SURF	POSITION		SAIL WIND SPD
009	0910	15.0	330	10.0	102	1026	7.5	3.3	9.6	40 00.6	-68 06.3	15.2
009	1110	22.0	330	9.7	070	1029	6.2	3.2	15.0	40 08.1	-67 22.5	25.4
009	1458	17.0	327	9.7	067	1030	4.4	1.5	12.0	40 21.6	-66 43.4	25.0
009	2056	21.5	035	9.1	038	1032	2.1	0.0	13.6	40 37.9	-65 03.8	28.7
010	0100	16.0	035	2.0	044	1034.5	3.3	0.5	7.2	41 03.8	-65 33.7	23.6
010	0500	8.0	240	10.1	186	1033	7.0	4.1	9.6	40 32.8	-65 37.7	12.5
010	0600	13.0	290	10.5	180	1031.5	9.5	6.5	8.6	39 59.9	-65 44.3	15.7
010	1300	4.0	130	10.1	329	1033	11.3	7.9	12.8	40 22.5	-66 08.5	19.5
010	1700	23.0	050	9.6	050	1030.5	12.1	8.7	-9	40 53.7	-66 27.6	20.0
010	2100	34.0	010	8.3	112	1029	12.3	9.8	13.5	40 49.2	-65 53.7	34.0
011	0102	24.0	022	7.3	097	-9	12.6	11.0	-9	40 40.7	-65 25.8	29.0
011	0910	13.0	210	10.5	305	1018	14.8	13.5	-9	40 26.7	-65 51.9	13.6
011	1300	23.0	245	9.1	263	1010.5	16.8	15.9	15.7	40 35.5	-66 34.6	29.0
011	2120	5.0	130	0.9	105	1005	12.2	11.5	-9	40 34.9	-68 06.4	13.8
012	0055	3.0	125	10.5	095	1005	13.5	12.6	9.7	40 30.2	-67 32.4	8.0
012	0500	4.0	265	9.8	085	1003.5	13.0	12.0	13.1	40 30.9	-66 48.3	5.5
012	0900	7.0	180	9.9	100	1004.5	14.3	11.5	11.2	40 32.4	-66 01.3	7.9
012	1300	4.0	250	0.2	058	1007	12.2	9.7	12.1	40 24.4	-65 53.6	7.9
012	1701	2.0	040	1.3	158	-9	12.0	10.0	12.1	40 23.2	-65 52.8	4.7
012	2100	18.0	050	6.5	307	1004.5	10.6	8.4	12.5	40 18.6	-65 53.2	22.2
013	0100	23.0	310	2.1	120	1002	10.4	9.0	14.4	40 20.5	-66 02.2	34.0
013	0453	23.0	050	1.8	309	1000	9.7	8.6	13.5	40 16.0	-66 01.6	31.0
013	0902	31.0	345	1.4	000	1002	8.0	5.5	12.8	40 19.7	-66 06.3	32.4
013	1300	26.0	345	1.2	345	1008	8.0	6.8	12.2	40 24.4	-66 08.5	29.0
013	1700	16.0	070	1.2	205	1011	9.3	5.6	12.2	40 17.2	-65 11.3	23.5
013	2110	20.0	350	5.0	220	1012	8.7	5.5	12.3	40 19.2	-66 13.6	24.0
014	0100	4.0	256	0.9	046	1016.1	8.3	5.0	12.4	40 21.1	-66 13.7	13.7
014	0452	8.0	250	1.1	034	1015	7.7	4.1	12.3	40 20.4	-66 12.9	12.0
014	0905	4.5	110	1.0	200	1016	7.4	4.2	12.3	40 19.3	-66 13.2	19.4
014	1304	15.0	250	4.9	087	1019	7.1	4.5	12.1	40 18.8	-66 15.3	15.0
014	1647	9.0	100	1.3	220	1019	7.7	4.5	12.6	40 21.5	-66 17.0	24.6
014	2102	6.5	110	0.9	245	1020	6.6	4.4	12.6	40 19.9	-66 13.7	19.6
015	0048	4.5	120	0.8	242	1020	6.5	3.1	12.4	40 17.2	-66 16.1	17.3
015	0453	13.0	320	5.7	062	1020	6.0	2.7	11.8	40 17.9	-66 17.9	19.0
015	0859	6.0	120	1.3	280	1018	5.3	2.4	12.2	40 19.1	-66 14.3	10.6
015	1256	12.0	355	6.0	079	1019	6.3	3.3	12.4	40 18.8	-66 15.7	17.7
015	1700	24.0	010	9.3	077	1015	7.0	3.9	8.0	40 24.5	-65 44.3	30.0
015	2100	9.0	210	1.0	290	1012	9.0	7.0	10.3	40 26.4	-65 46.9	13.0
016	0059	21.0	055	1.5	054	1008	12.1	9.9	13.0	40 26.2	-65 53.5	29.0
016	0452	30.0	030	0.3	111	999.5	13.7	12.0	12.5	40 24.3	-65 57.2	39.0
016	0900	7.0	110	2.8	145	994	12.2	10.7	10.1	40 16.6	-65 48.3	10.8
016	1302	13.0	040	2.9	160	993	12.1	10.5	13.0	40 04.6	-65 44.8	15.8
016	1650	15.0	300	10.4	320	996	9.6	9.0	10.0	40 04.1	-65 53.4	14.9
016	2100	20.0	120	0.9	140	994	9.9	5.7	11.8	40 22.5	-66 10.6	28.8
017	0051	31.0	035	1.7	232	999	7.8	4.8	12.6	40 17.3	-66 11.9	35.4
017	0445	35.0	033	1.6	237	999	9.5	6.2	13.0	40 10.8	-66 15.3	33.0
017	0925	32.0	025	2.4	257	1002	9.1	5.9	13.0	40 04.9	-66 22.9	32.0
017	1308	28.0	028	1.9	265	1005	8.4	5.3	14.1	40 02.2	-66 34.6	29.0
017	1700	20.0	025	1.5	267	1006	8.1	4.3	13.1	40 03.2	-66 47.9	21.6
017	2100	4.0	130	3.0	150	1005	7.7	5.1	12.3	40 19.7	-66 16.8	11.4
018	0102	7.5	295	5.5	017	1006	8.2	4.5	12.3	40 19.5	-66 11.5	16.5
018	0446	17.0	300	5.2	015	-9	6.1	4.0	13.0	40 17.9	-66 03.6	16.5
018	0858	13.0	255	6.2	056	1006	4.9	1.9	8.6	40 19.0	-65 53.2	17.2
018	1303	22.0	130	1.1	193	1007	4.7	1.8	7.5	40 19.9	-65 40.0	26.0
018	1700	28.0	030	7.7	262	1008	4.5	1.4	8.2	40 10.8	-55 43.3	28.0
018	2100	8.0	200	3.4	130	1008	4.3	1.8	7.5	40 18.3	-66 00.6	10.5
019	0052	29.0	005	7.7	299	1006	2.3	-0.7	13.5	40 18.0	-66 11.7	33.8
019	0452	14.0	125	3.9	165	1006	2.0	0.7	13.4	40 16.0	-66 14.7	21.4
019	0845	20.0	115	0.9	195	1006.5	0.8	0.3	13.0	40 19.4	-66 16.8	25.0
019	1257	16.0	130	0.8	194	1008	0.7	0.1	13.3	40 16.7	-66 14.7	27.0
019	1645	28.0	355	7.3	325	1009	0.0	-0.7	13.0	40 16.6	-66 17.2	32.0
019	2047	15.0	135	0.7	208	1010	0.0	-0.3	13.0	40 15.2	-66 15.2	20.1
020	0053	24.5	355	4.6	320	1011	-0.1	0.1	13.1	40 13.9	-66 22.6	29.5
020	0450	14.0	120	0.3	225	1013.5	0.7	0.0	13.2	40 12.6	-65 22.2	21.0
020	0850	20.0	120	0.9	213	1013.5	1.0	-0.5	12.8	40 13.2	-66 22.8	27.6
020	1300	36.0	005	1.8	325	1018	0.7	-0.3	13.5	40 12.8	-66 32.6	37.0
020	1648	28.0	355	2.1	330	1022	-0.4	0.2	12.8	40 15.1	-66 34.9	30.0
020	2110	19.0	245	3.2	116	1022	2.3	0.0	13.4	40 13.2	-66 27.2	25.4
021	0048	26.0	335	4.9	017	1024	2.3	0.1	12.0	40 16.7	-66 20.9	32.7
021	0446	28.0	020	1.7	302	1023.5	0.7	-0.1	12.7	40 16.0	-66 31.8	27.5
021	0852	32.5	022	7.4	307	1022.5	3.3	-0.1	13.7	40 24.6	-66 41.2	32.9
021	1315	30.0	010	1.5	333	1026	1.4	0.0	14.4	40 33.3	-66 52.7	31.0
021	1455	10.0	250	9.3	110	1026	2.0	-0.4	13.5	40 26.1	-66 35.4	19.0
021	2100	10.0	050	9.3	262	1026	2.3	-0.4	7.8	40 11.3	-65 55.9	22.0
022	0055	10.0	045	9.3	260	1028	3.6	1.2	13.5	40 04.8	-65 43.0	18.0
022	0435	16.0	320	8.7	046	1029	2.1	-0.2	13.0	40 09.4	-67 06.4	19.9
022	0900	17.0	330	9.1	036	1026	2.5	0.0	13.4	40 33.4	-66 32.6	25.7
022	1300	4.0	150	10.2	180	1028	3.8	0.8	9.5	40 23.8	-65 21.8	5.5
022	1455	12.0	330	9.5	334	1027.3	4.0	1.2	7.1	40 49.4	-66 30.2	17.0
022	2100	15.0	035	9.4	333	1028.5	3.6	1.3	13.0	40 19.2	-66 54.1	29.2
023	0055	8.0	010	10.7	273	-9	2.8	0.3	7.8	40 34.5	-67 28.3	

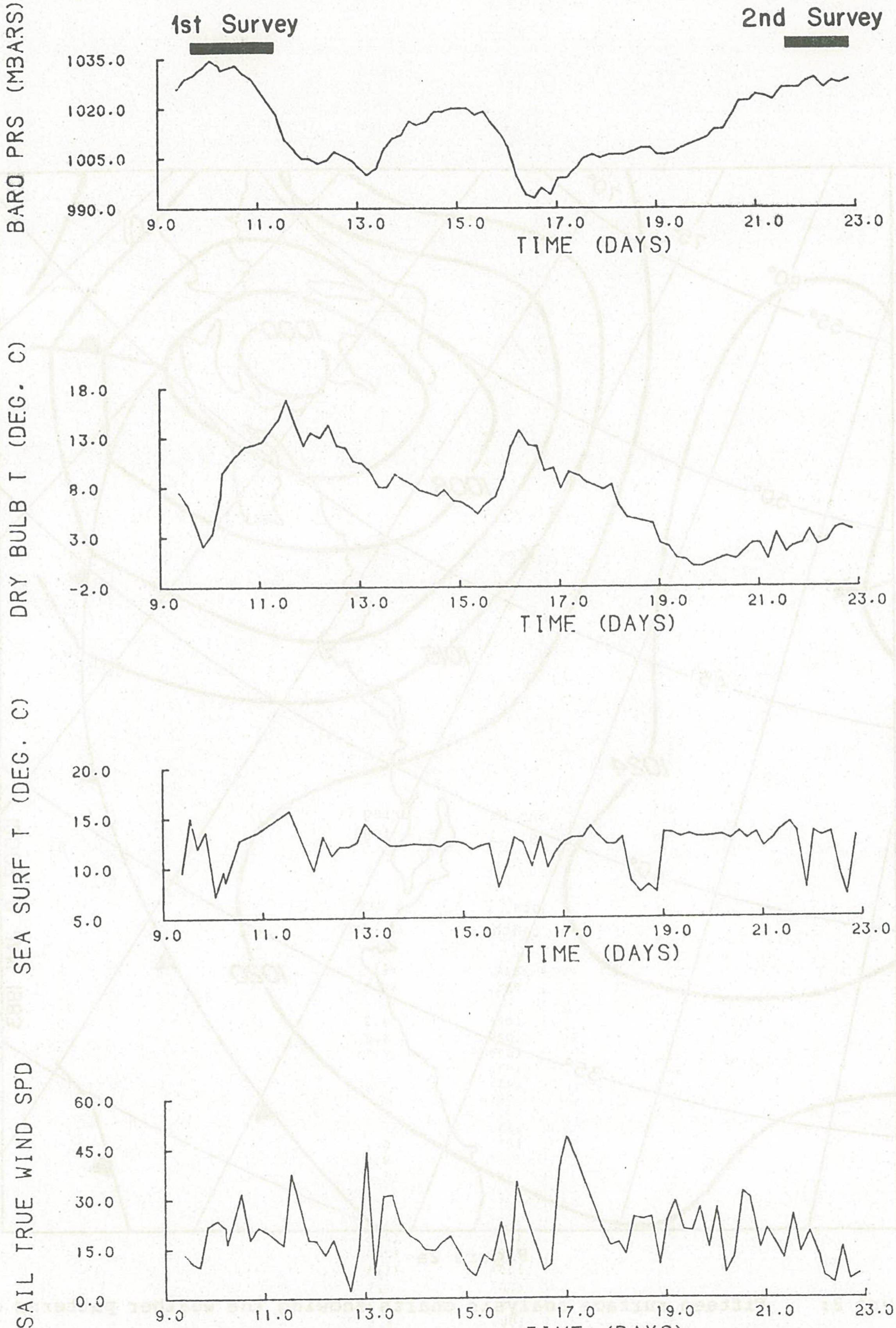


Figure 1: A summary of the meteorological data collected during <u>Bartlett</u> cruise 40-B, January 1983. The outbreak of cold air on 19-20 January can be seen in the record of dry bulb temperatures.

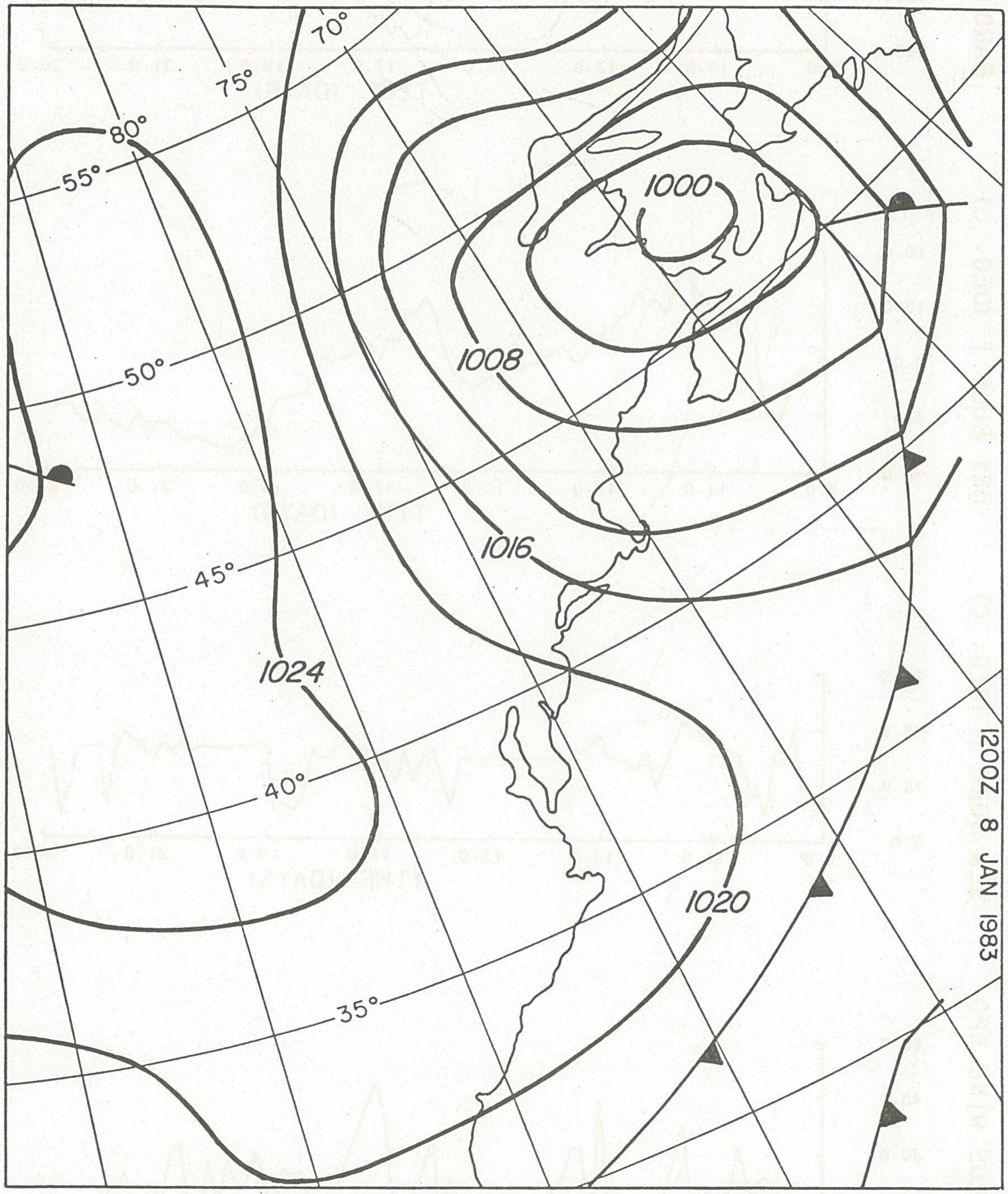


Figure 2a

Figure 2: Fifteen surface analysis charts showing the weather patterns during Bartlett cruise 40-B, January 1983. The storm which triggered the outbreak of cold air over the ring is shown in Figures 2i-2k on 16-17 January.

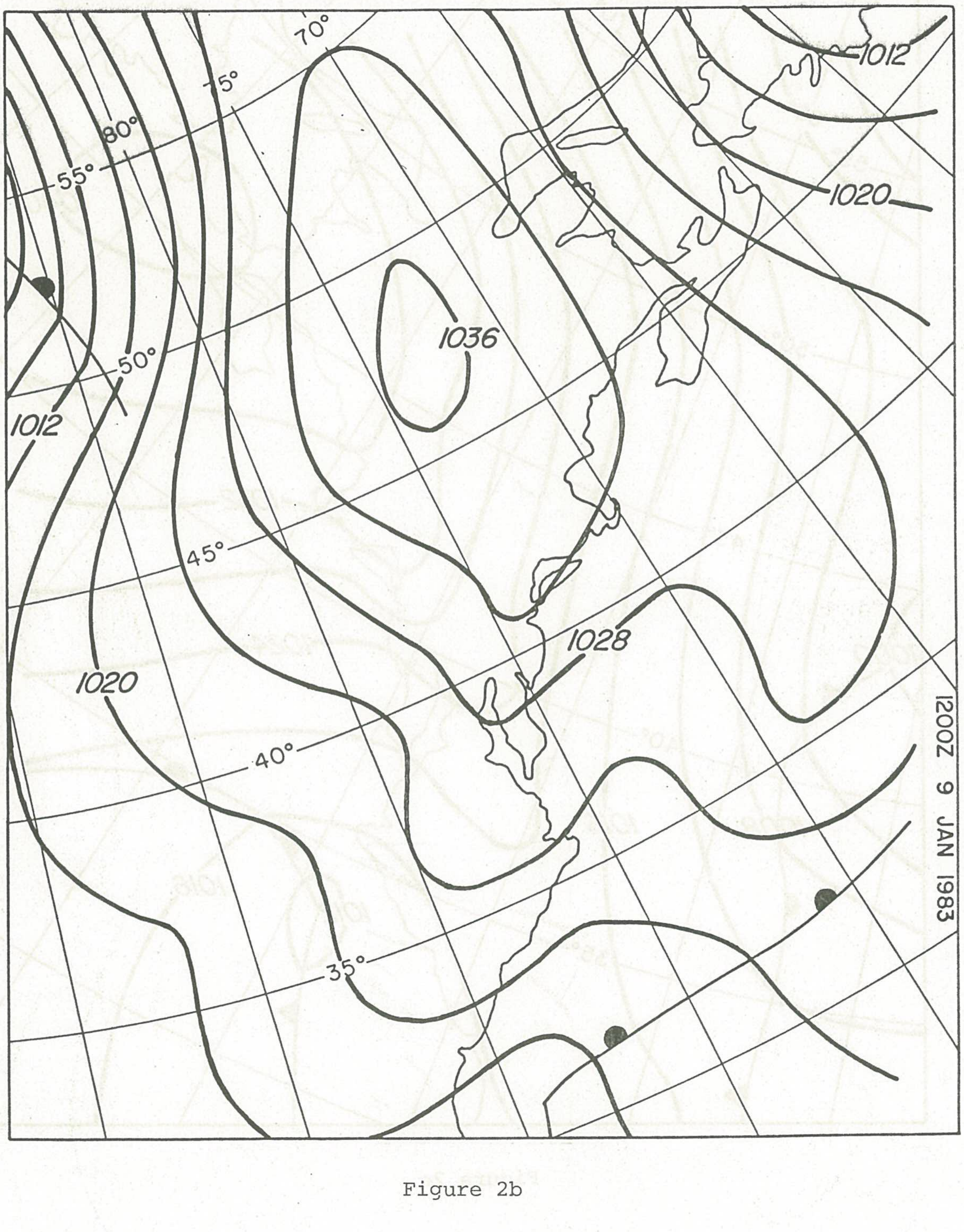
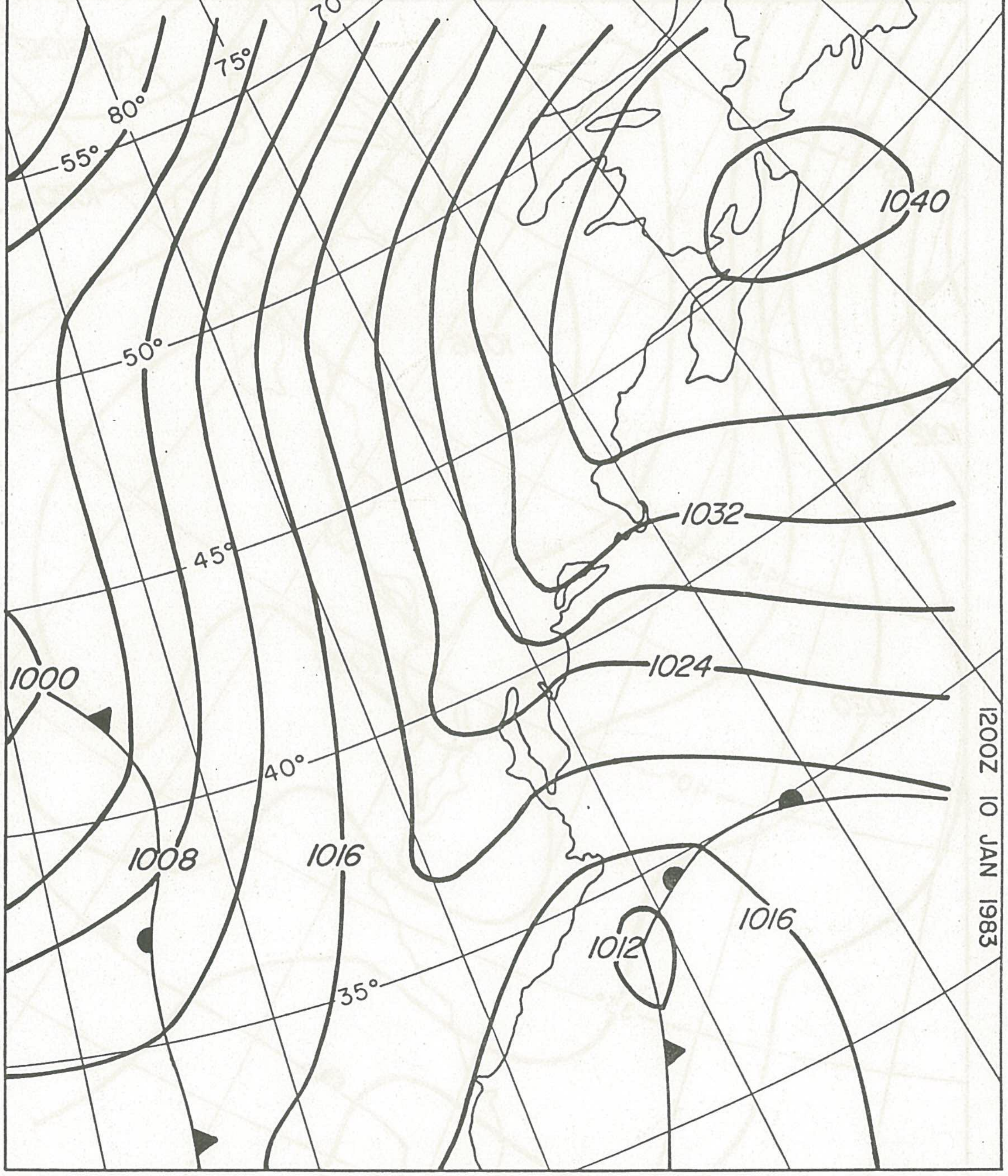

70°
75°
80°
55°
50°
45°
40°
35°
1012
1020
1036
1028
1020
1012
1200Z 9 JAN 1983

Figure 2b



70°
75°
80°
55°
50°
45°
40°
35°
1040
1032
1024
1000
1008
1016
1012
1016
1200Z 10 JAN 1983

Figure 2c

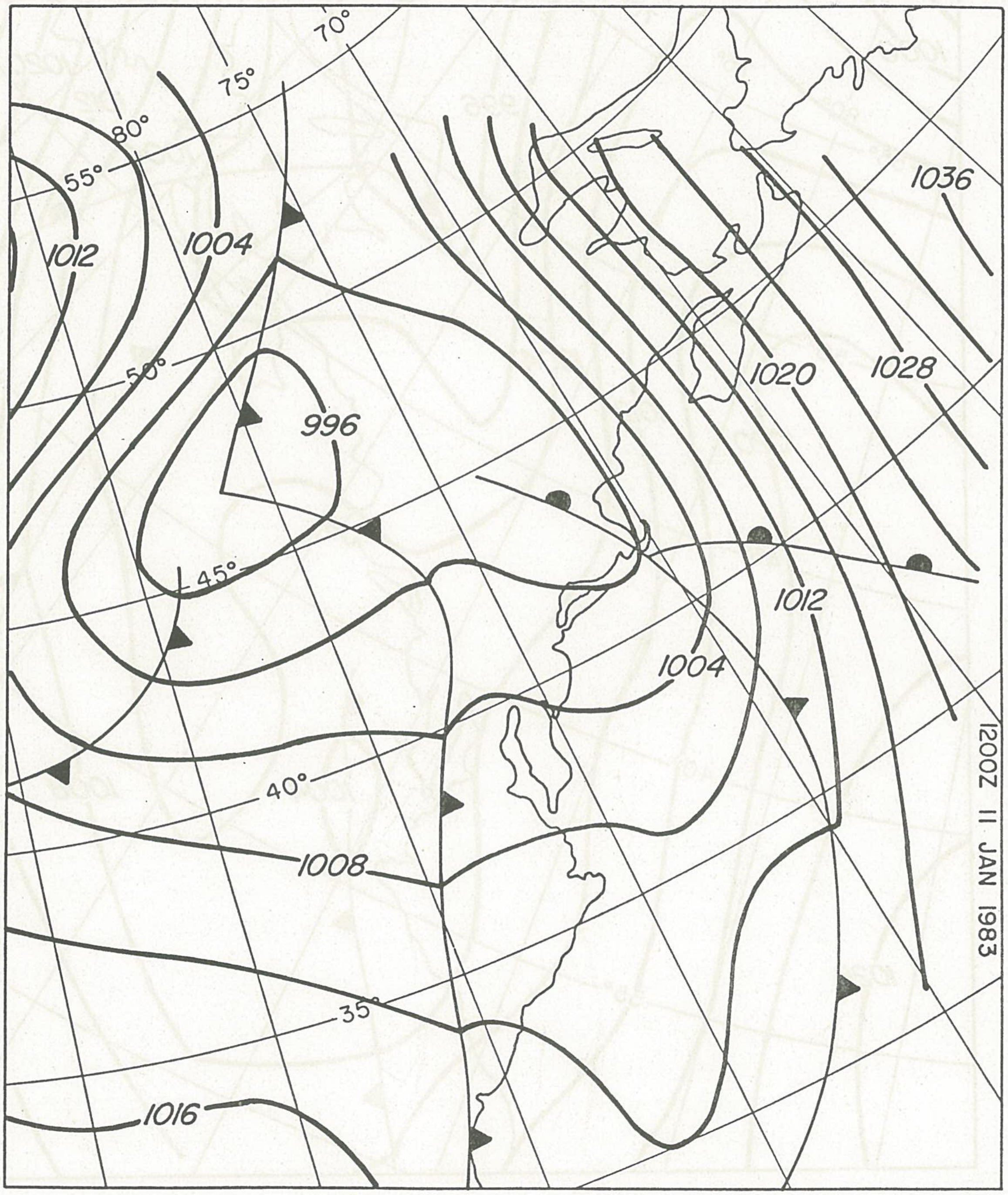

70°
75°
80°
55°
1012
1004
50°
996
45°
1036
1020
1028
1012
1004
40°
1008
35°
1016
1200Z 11 JAN 1983

Figure 2d

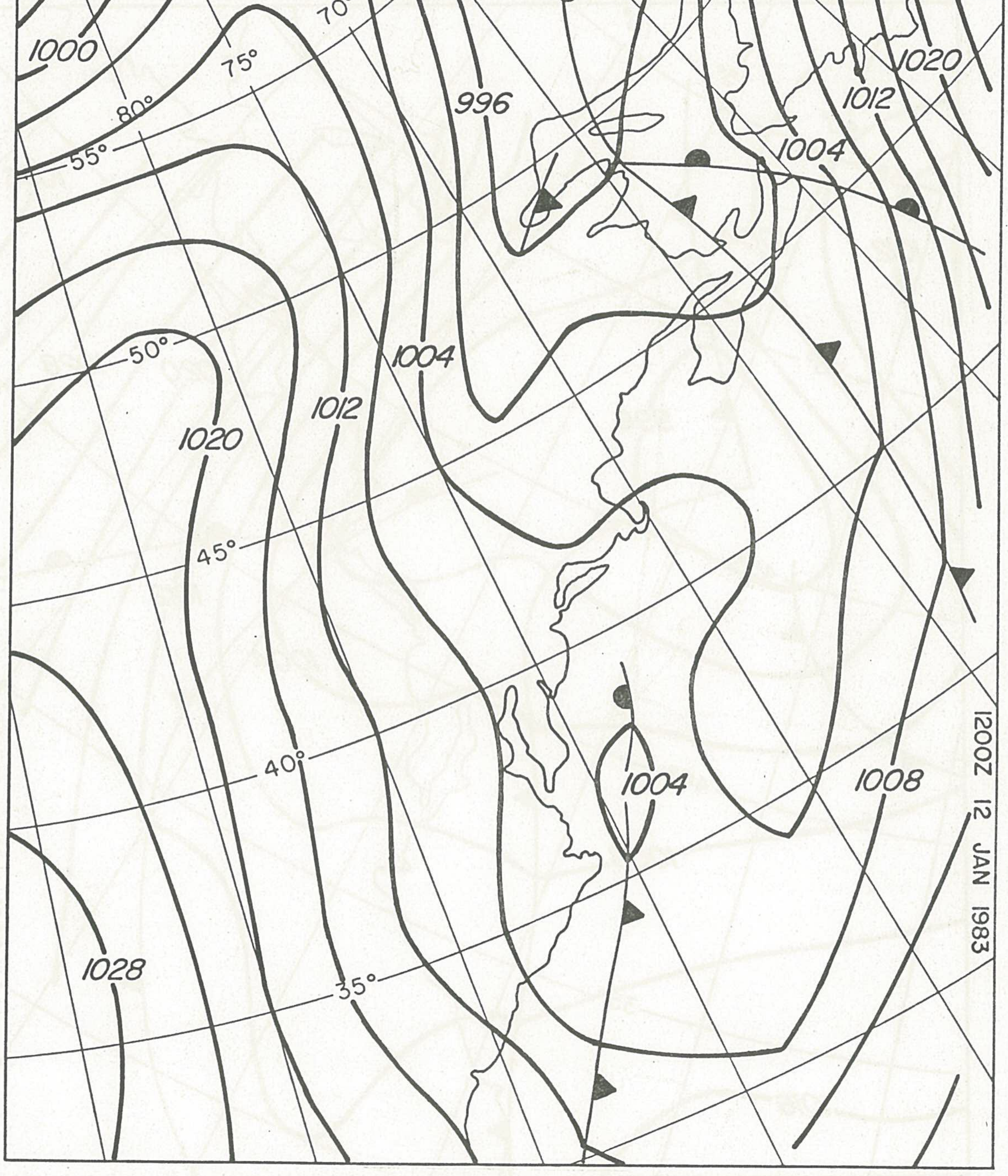

1000
80°
75°
70°
55°
996
1020
1012
1004
1004
50°
1012
1020
45°
40°
1004
1008
1200Z 12 JAN 1983
1028
35°

Figure 2e

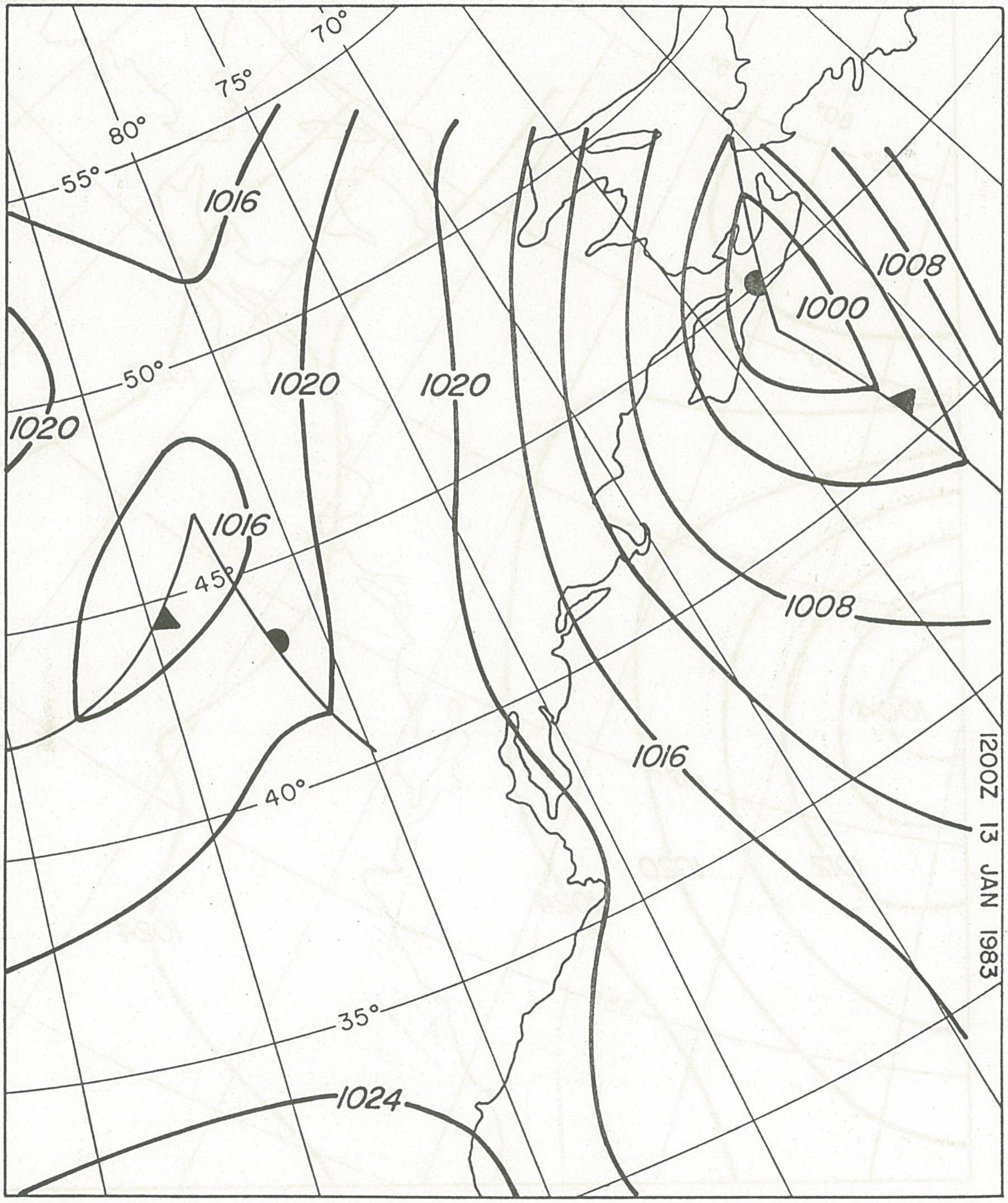
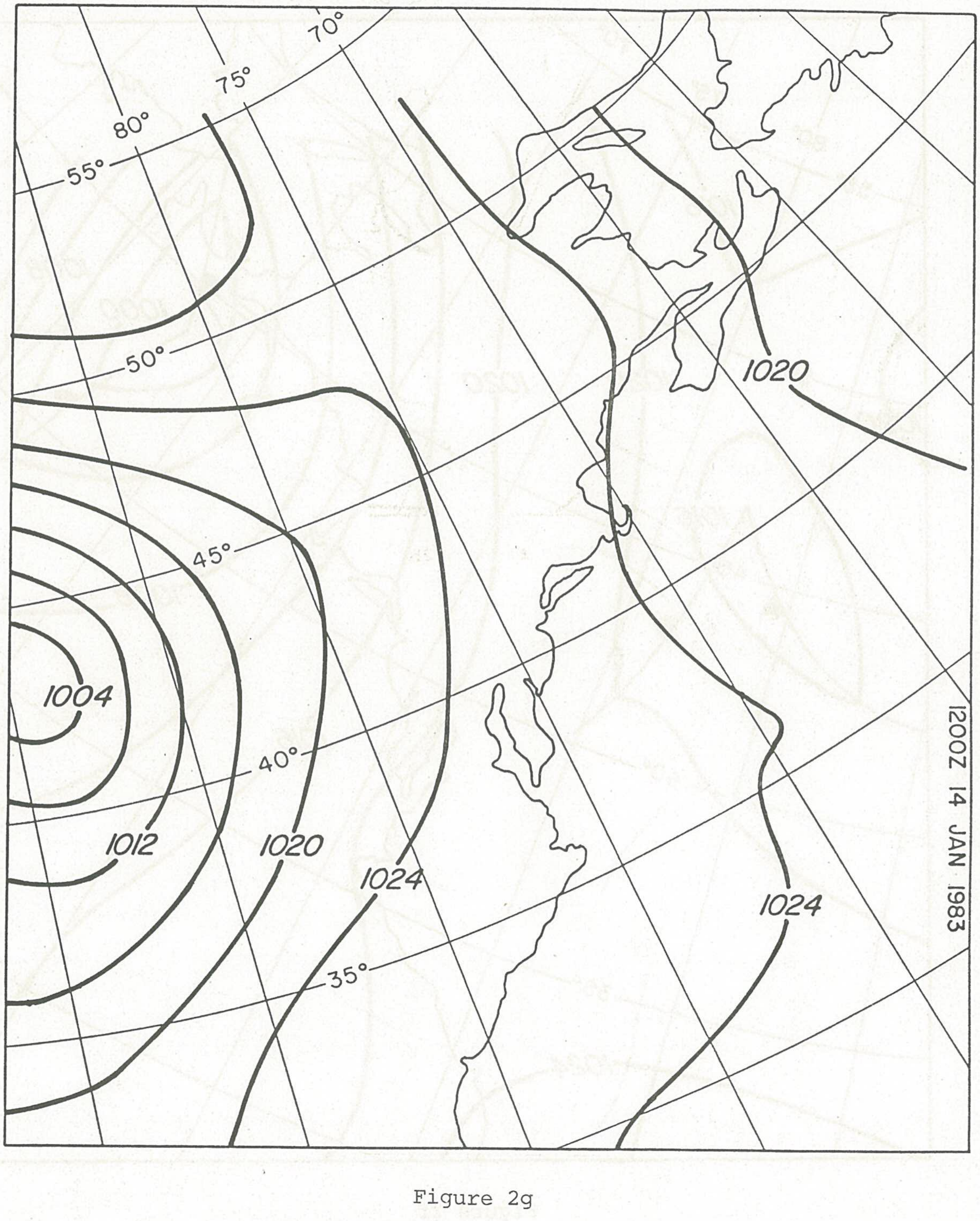

70°
75°
80°
55°
1016
1008
1000
50°
1020
1020
1020
1016
45°
1008
1016
40°
35°
1024
1200Z 13 JAN 1983

Figure 2f



70°
75°
80°
55°
50°
45°
40°
35°
1004
1012
1020
1024
1020
1024
1200Z 14 JAN 1983

Figure 2g

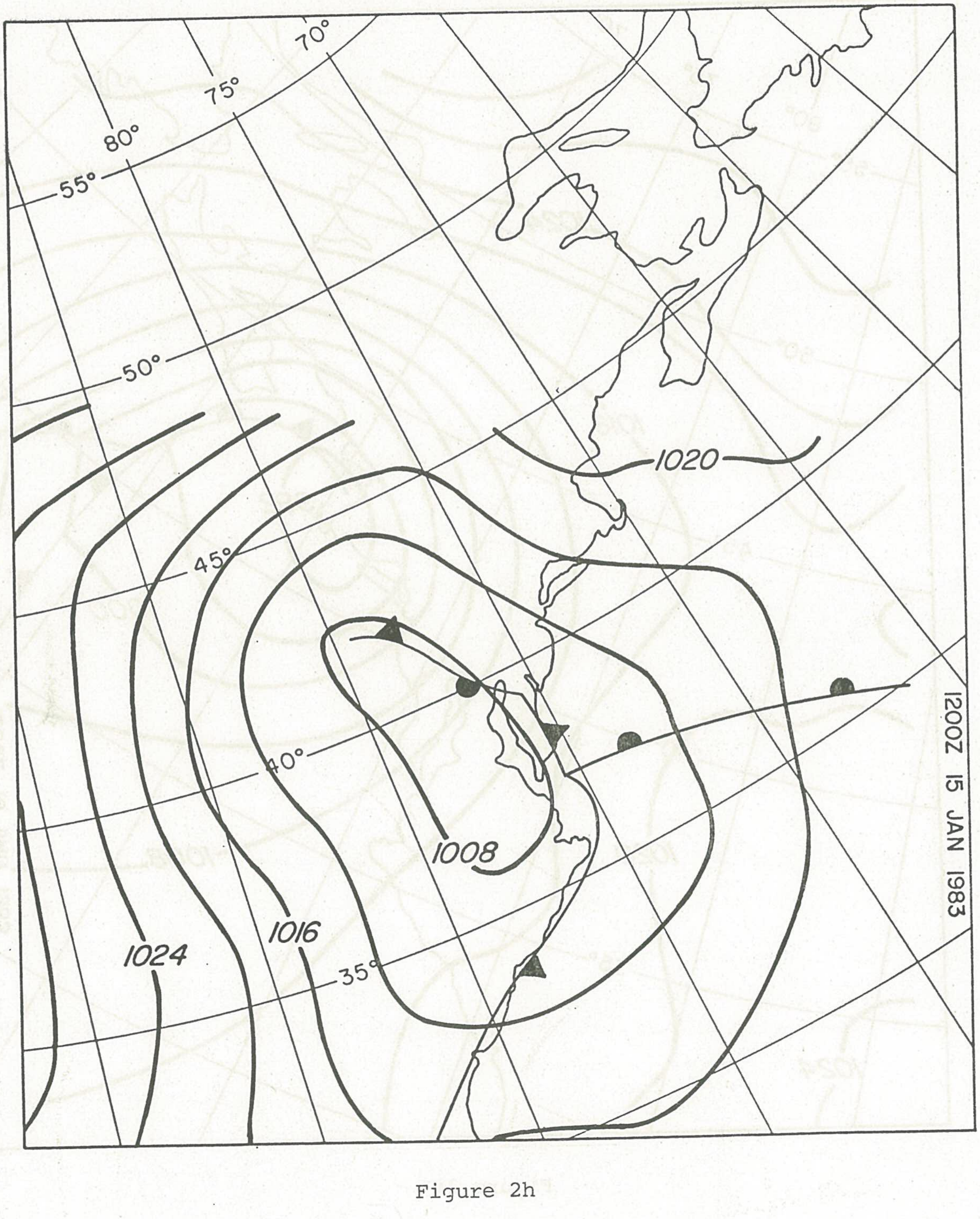


Figure 2h

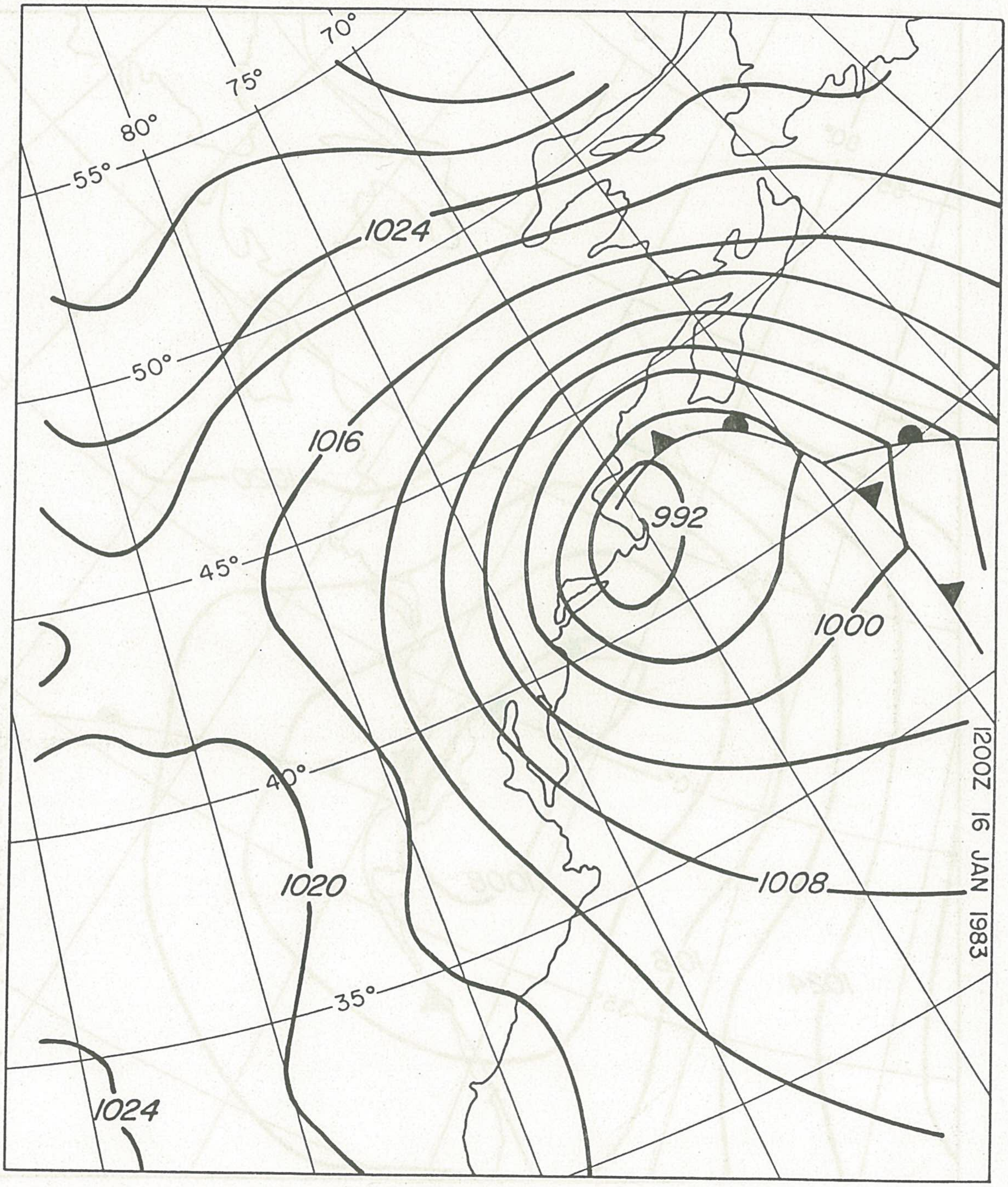

70°
75°
80°
55°
50°
45°
40°
35°
1024
1016
992
1000
1008
1020
1024
1200Z 16 JAN 1983

Figure 2i

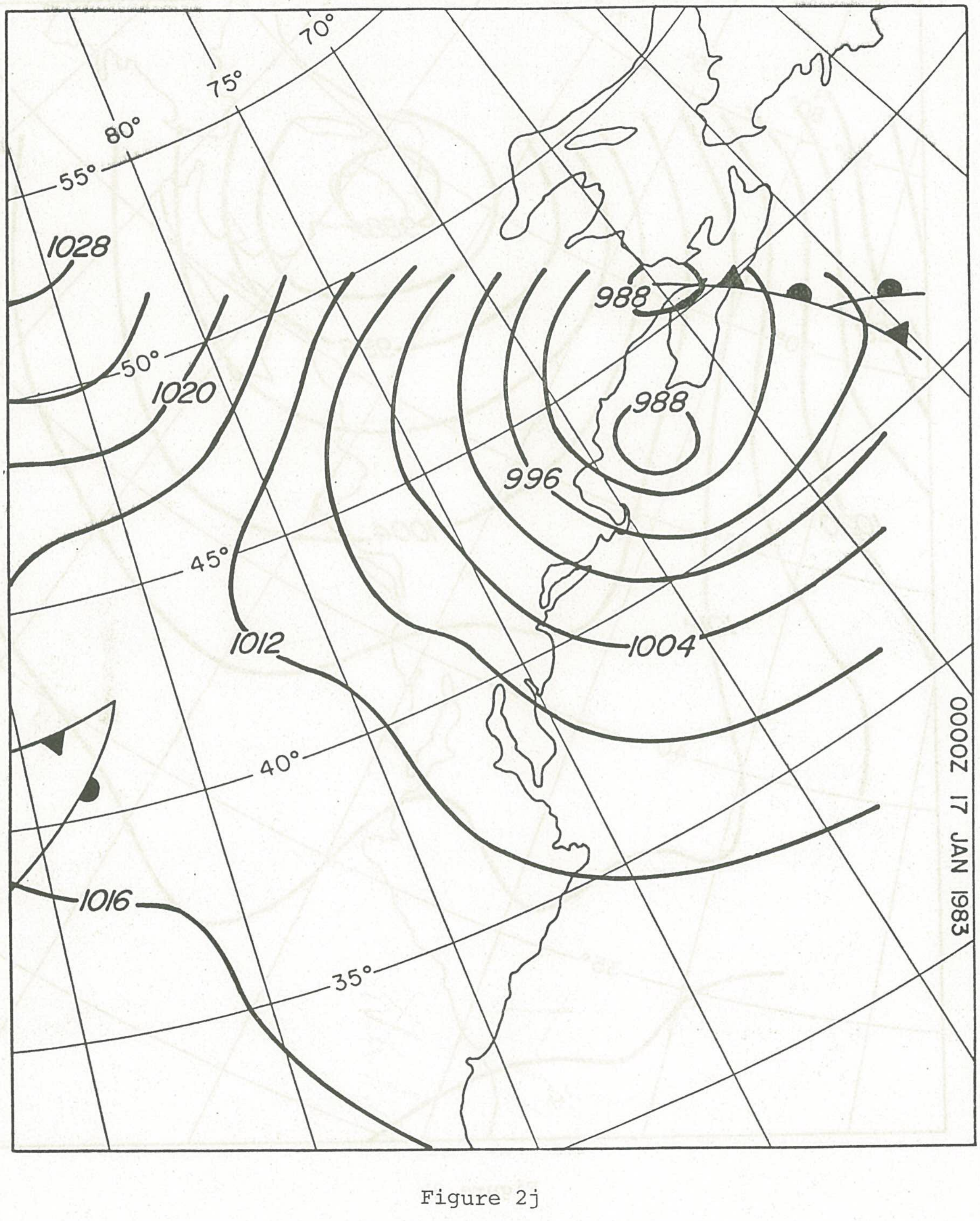
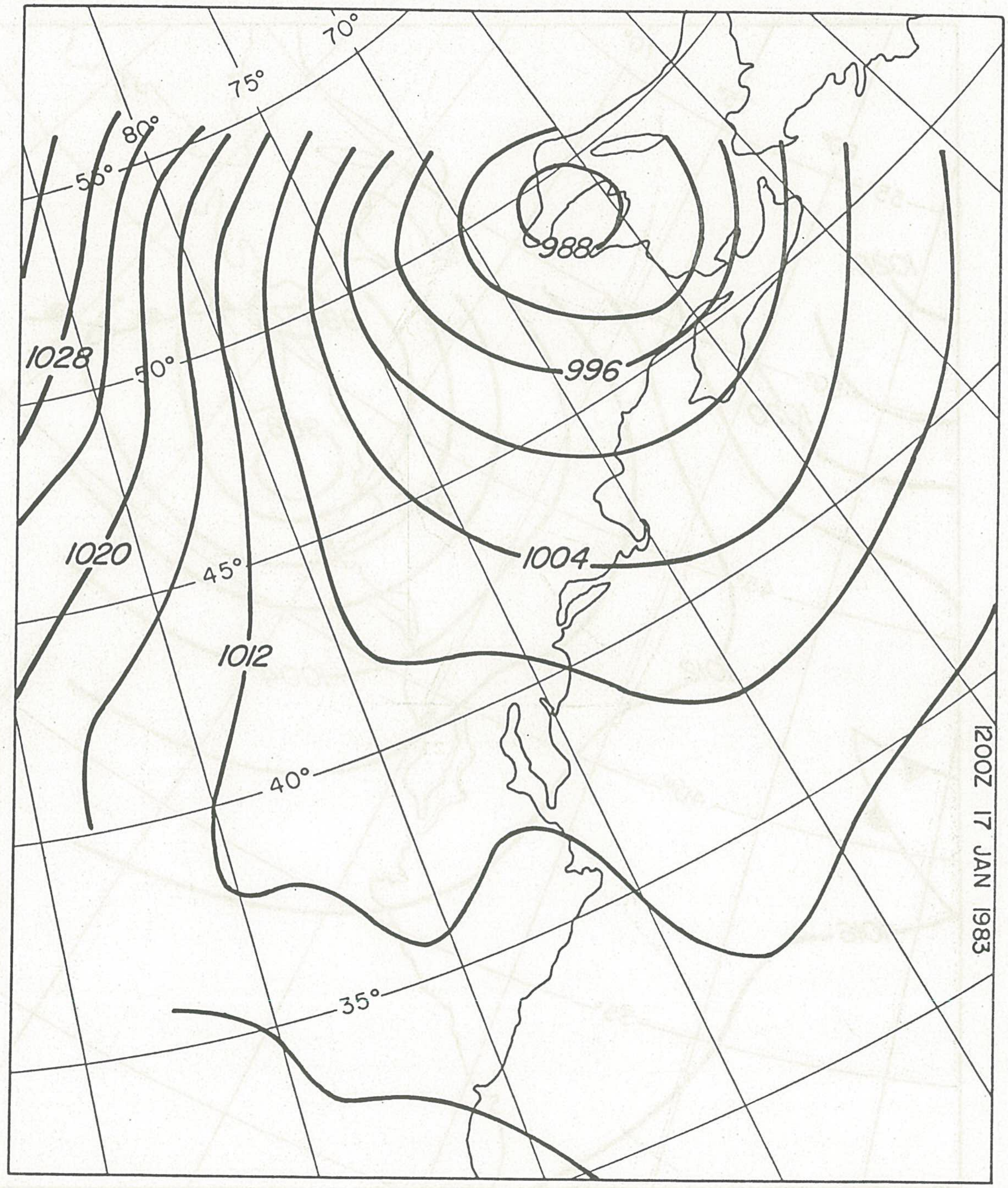
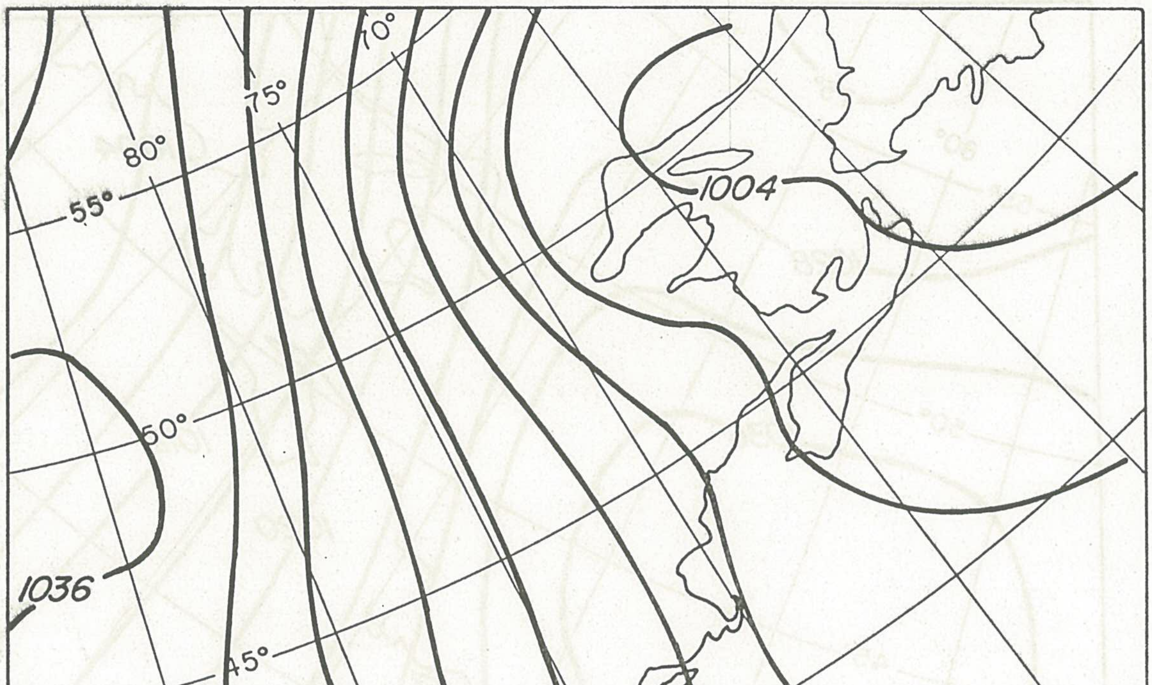

70°
75°
80°
55°
1028
50°
1020
45°
40°
35°
988
988
996
1004
1012
1016
0000Z 17 JAN 1983

Figure 2j



70°
75°
80°
55°
50°
45°
40°
35°
988
996
1004
1012
1020
1028
1200Z 17 JAN 1983

Figure 2k



70°
75°
80°
55°
50°
45°
40°
35°
1004
1012
1020
1028
1036
0000Z 19 JAN 1983

Figure 21

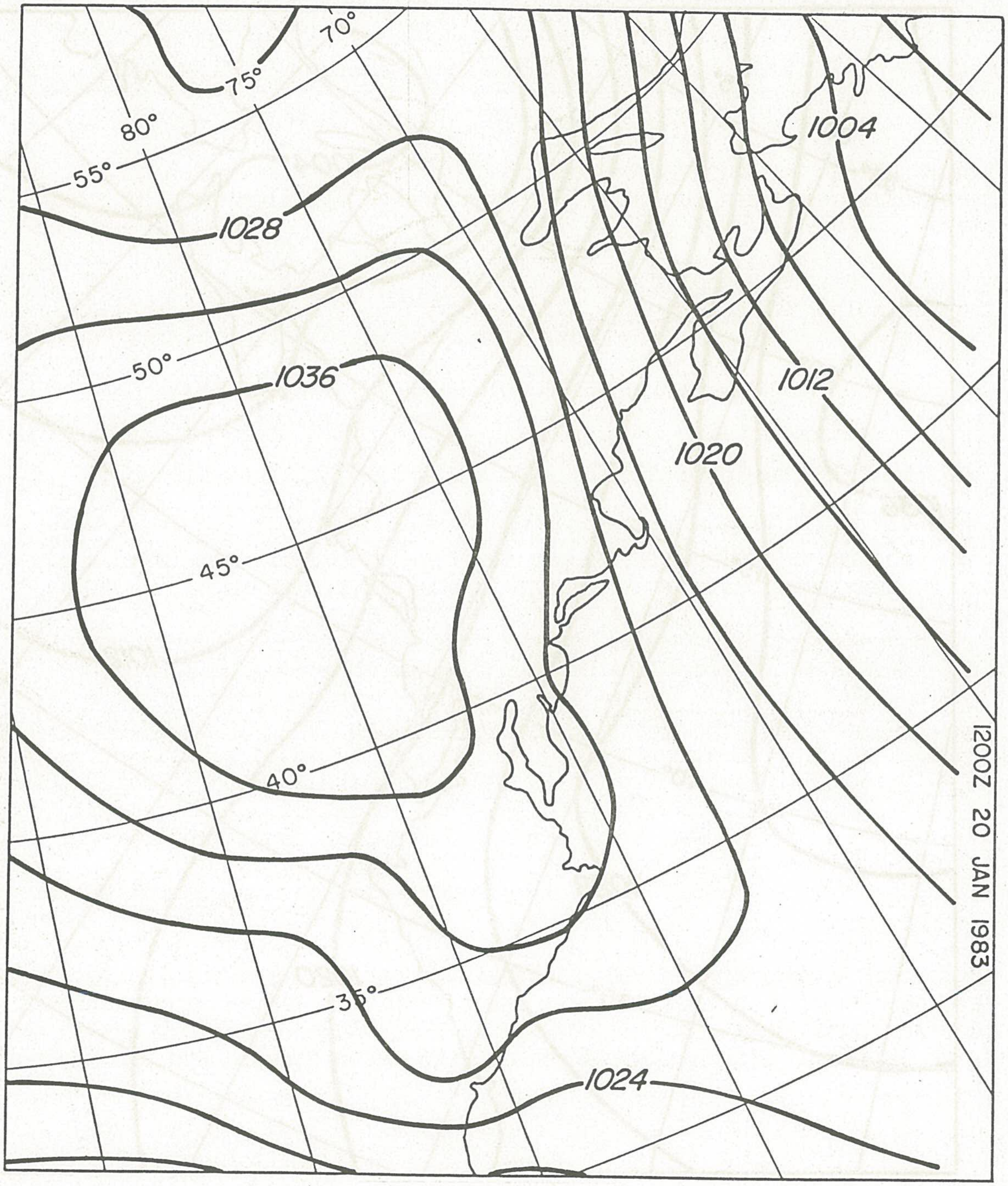

70°
75°
80°
55°
1028
50°
1036
45°
40°
35°
1024
1004
1012
1020
1200Z 20 JAN 1983

Figure 2m

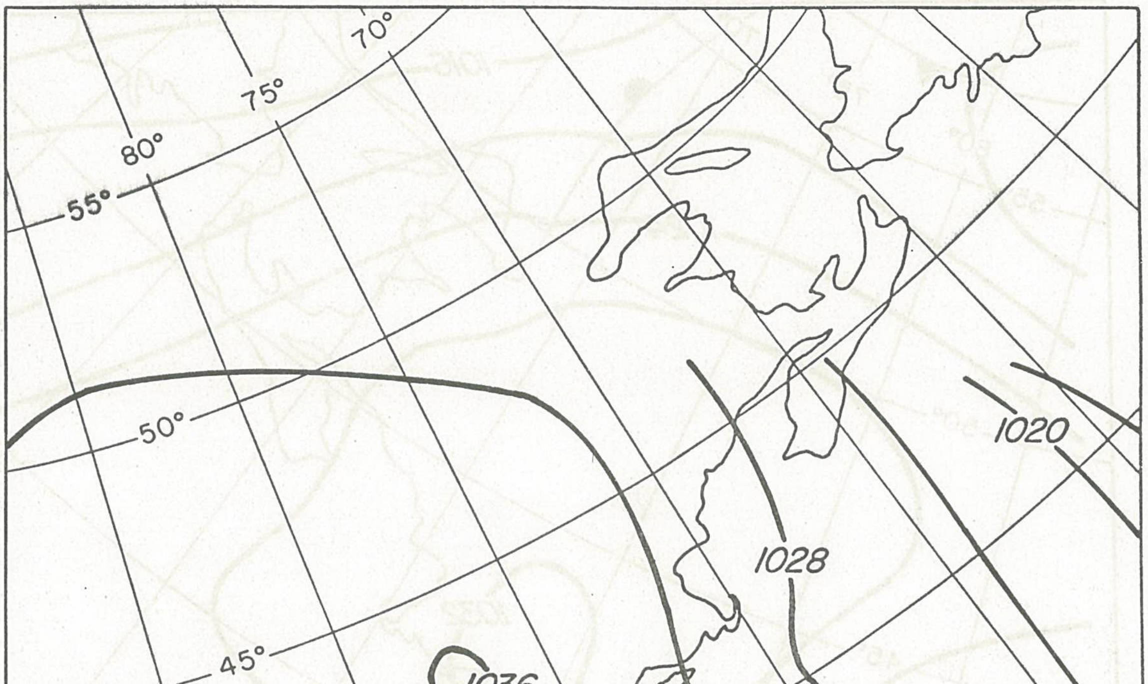
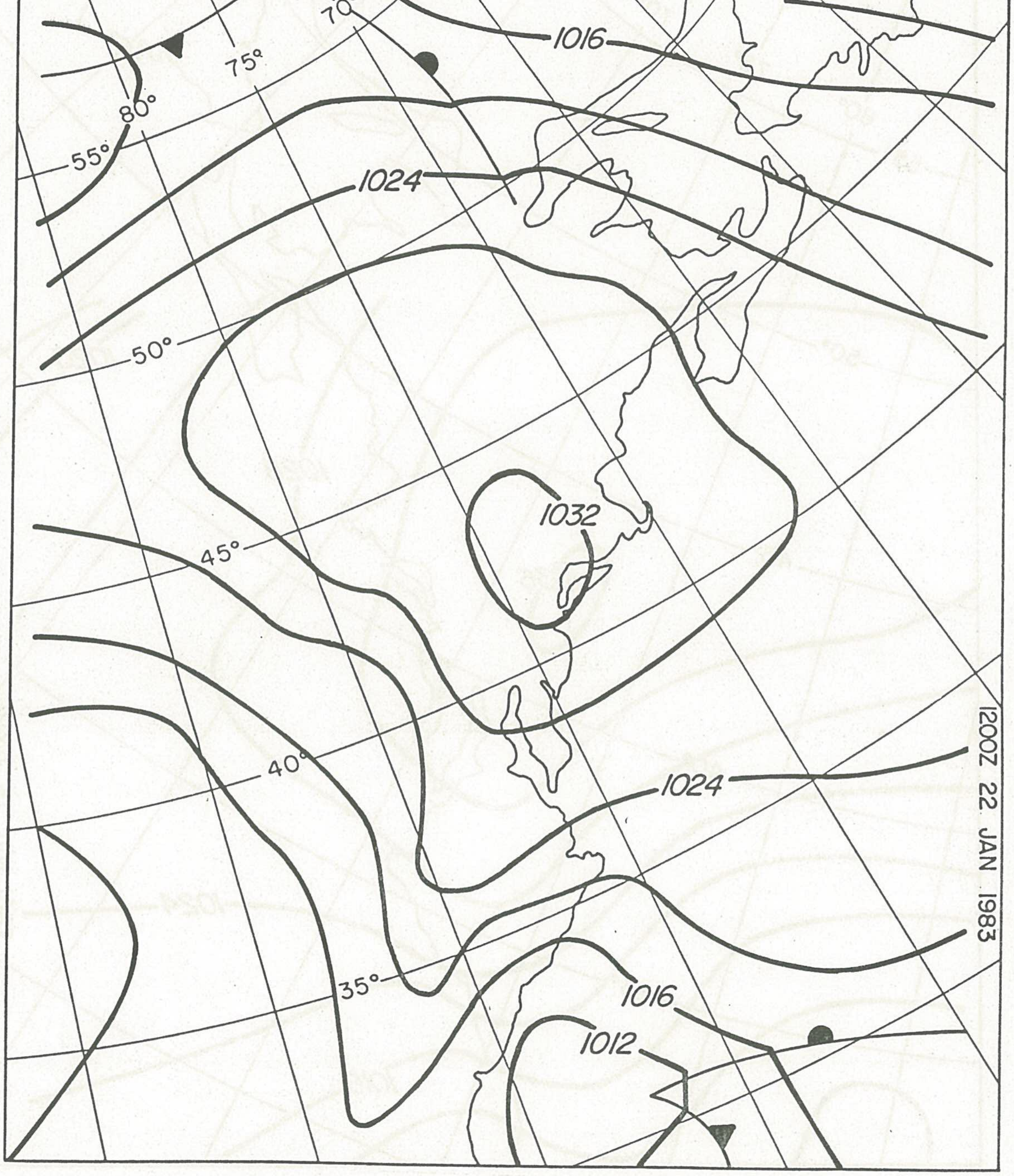

70°
75°
80°
55°
50°
45°
40°
35°
1036
1028
1020
1024
1016
1200Z 21 JAN 1983

Figure 2n



1016
1024
1032
1024
1016
1012
55°
50°
45°
40°
35°
80°
75°
70°
1200Z 22 JAN 1983

Figure 2o

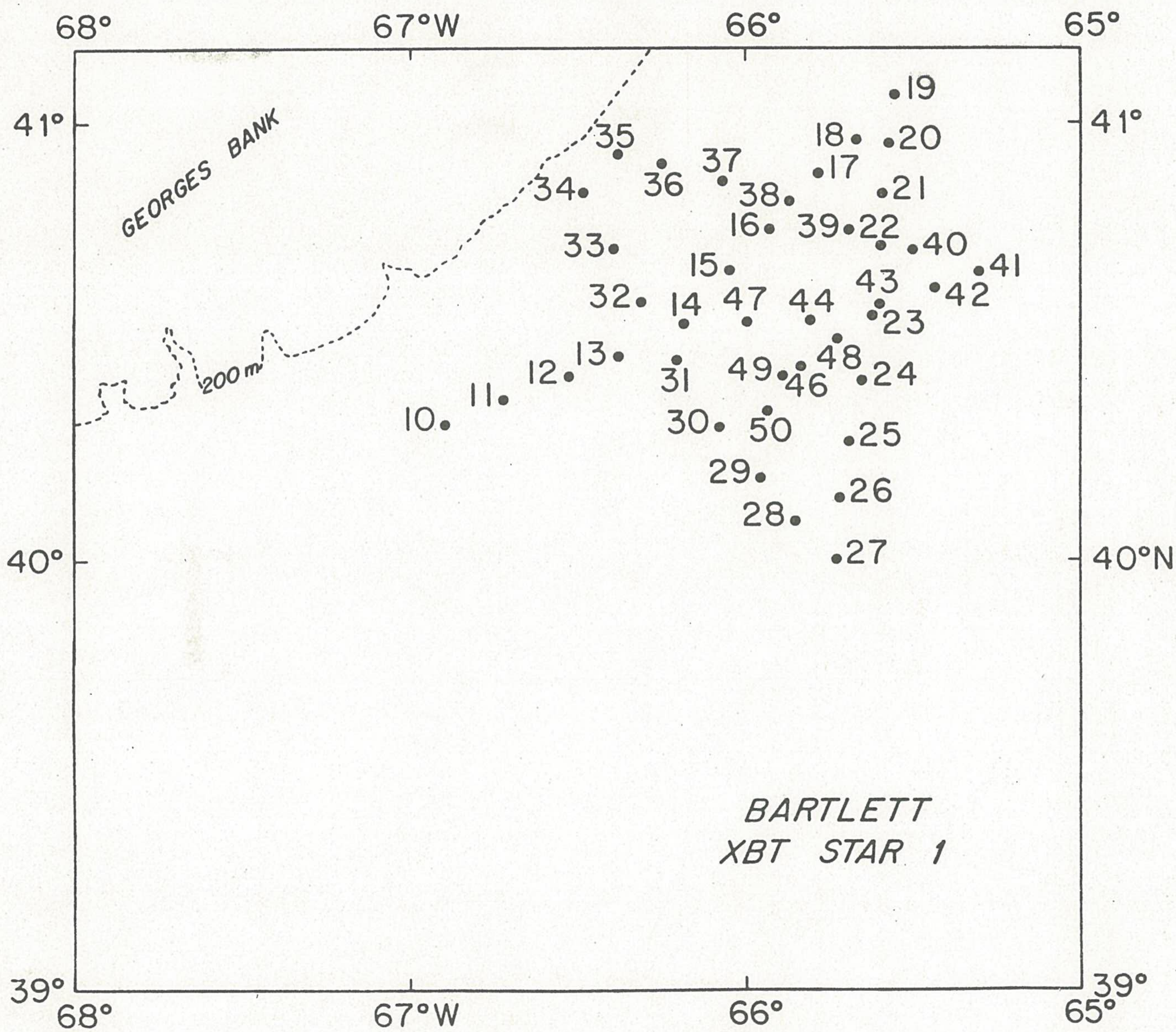


Figure 3a: The location of XBT Nos. 10-47 deployed on the first survey of ring 82I during Bartlett cruise 40-B. This work was done during 9-11 January, 1983.

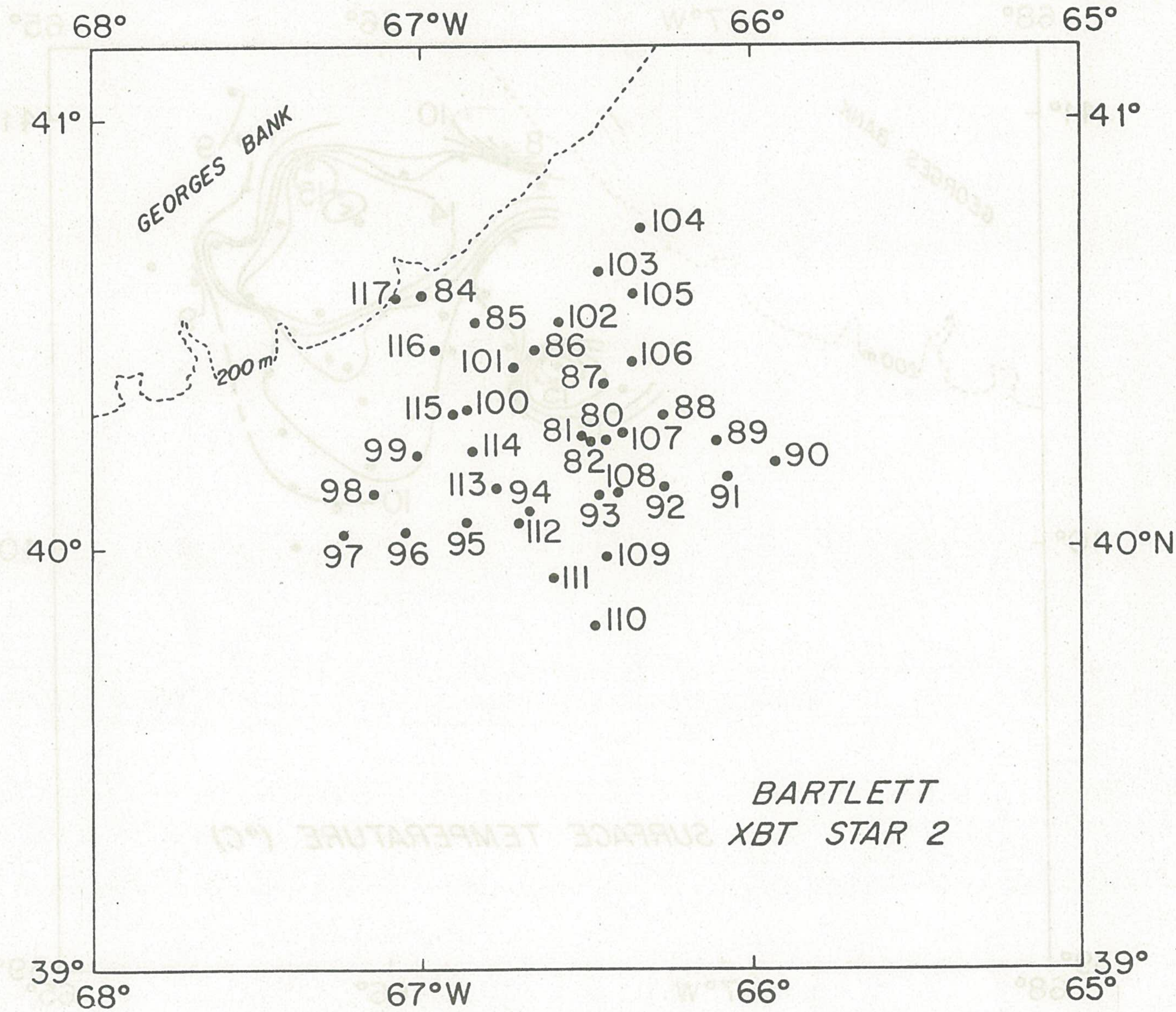


Figure 3b: The location of XBT Nos. 84-117 deployed during the second survey of ring 82I from 21-22 January, 1983.

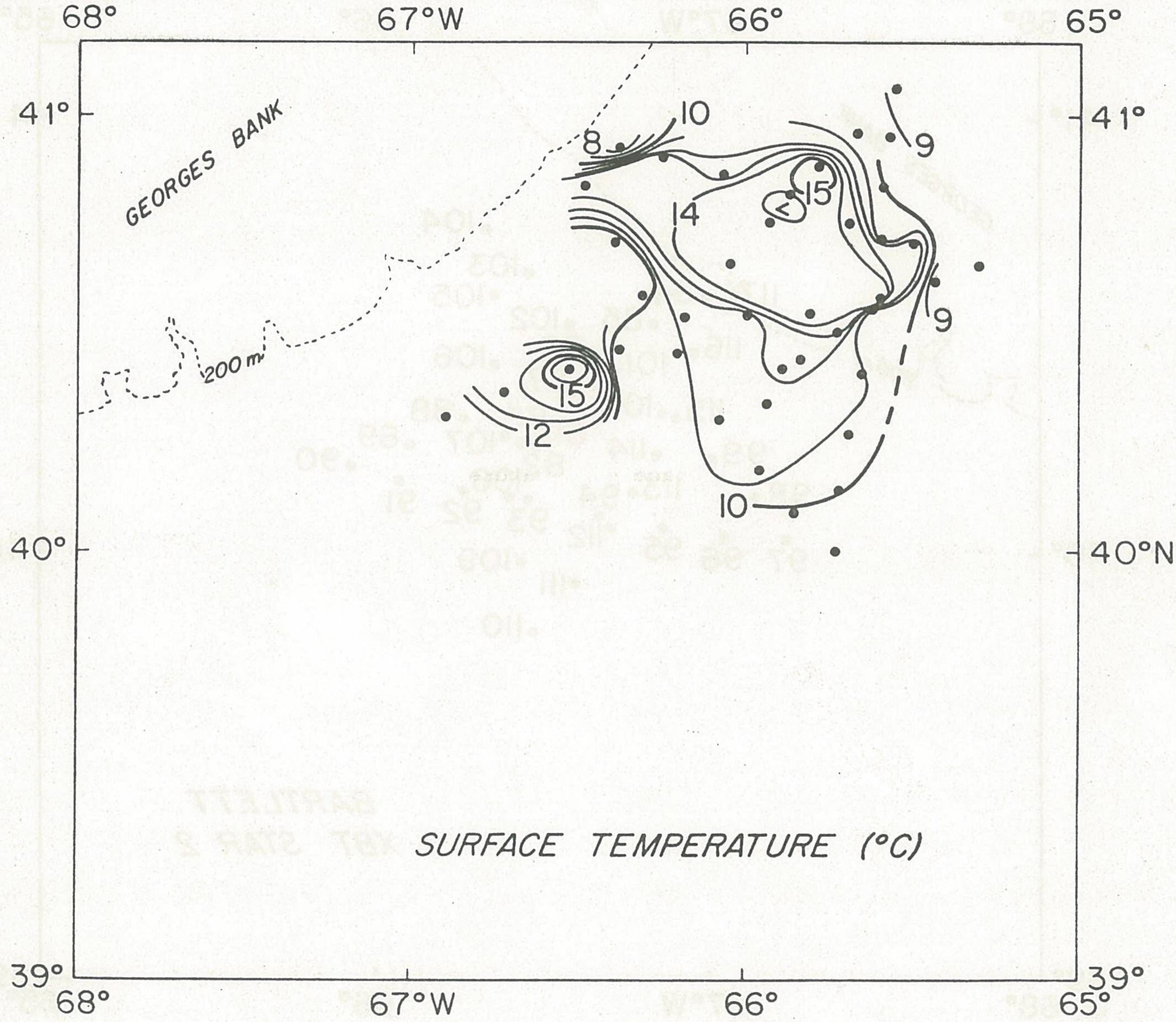


Figure 4a: Contours of surface temperature (°C) measured at each XBT during the first survey.

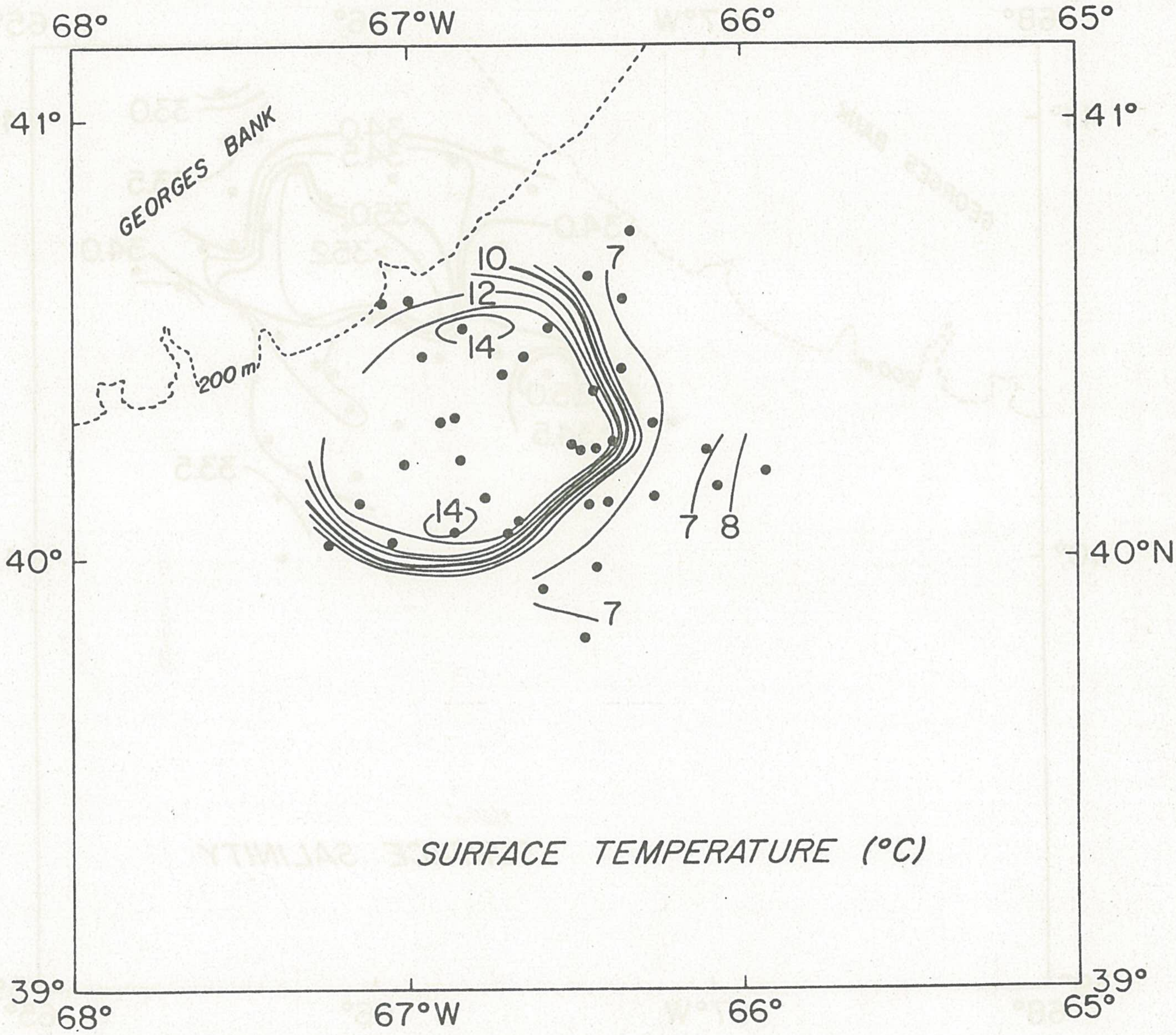


Figure 4b: Contours of surface temperature (°C) measured at each XBT during the second survey.

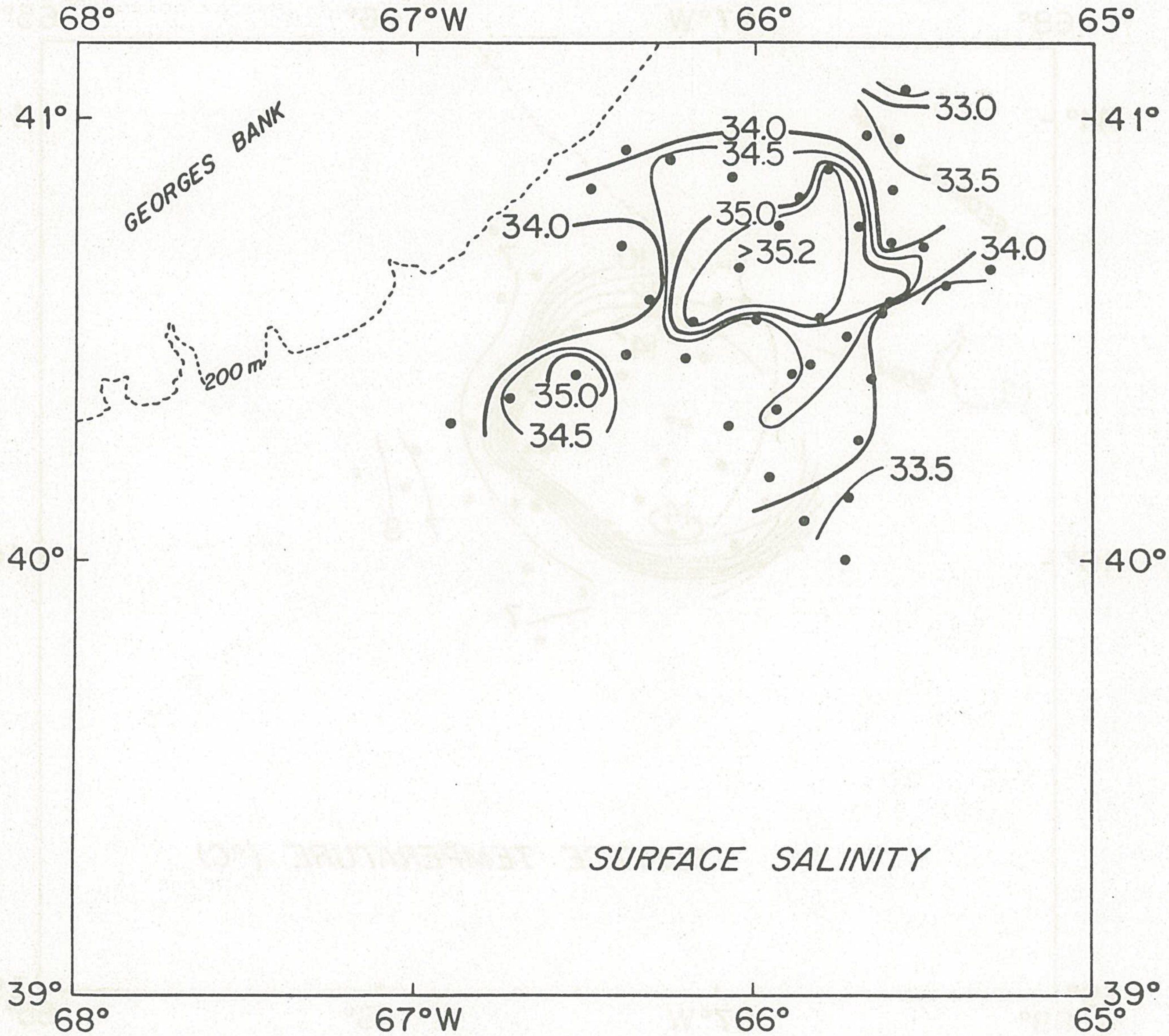


Figure 5a: Contours of surface salinity (°/$_{\circ\circ}$) from samples collected at each XBT during the first survey.

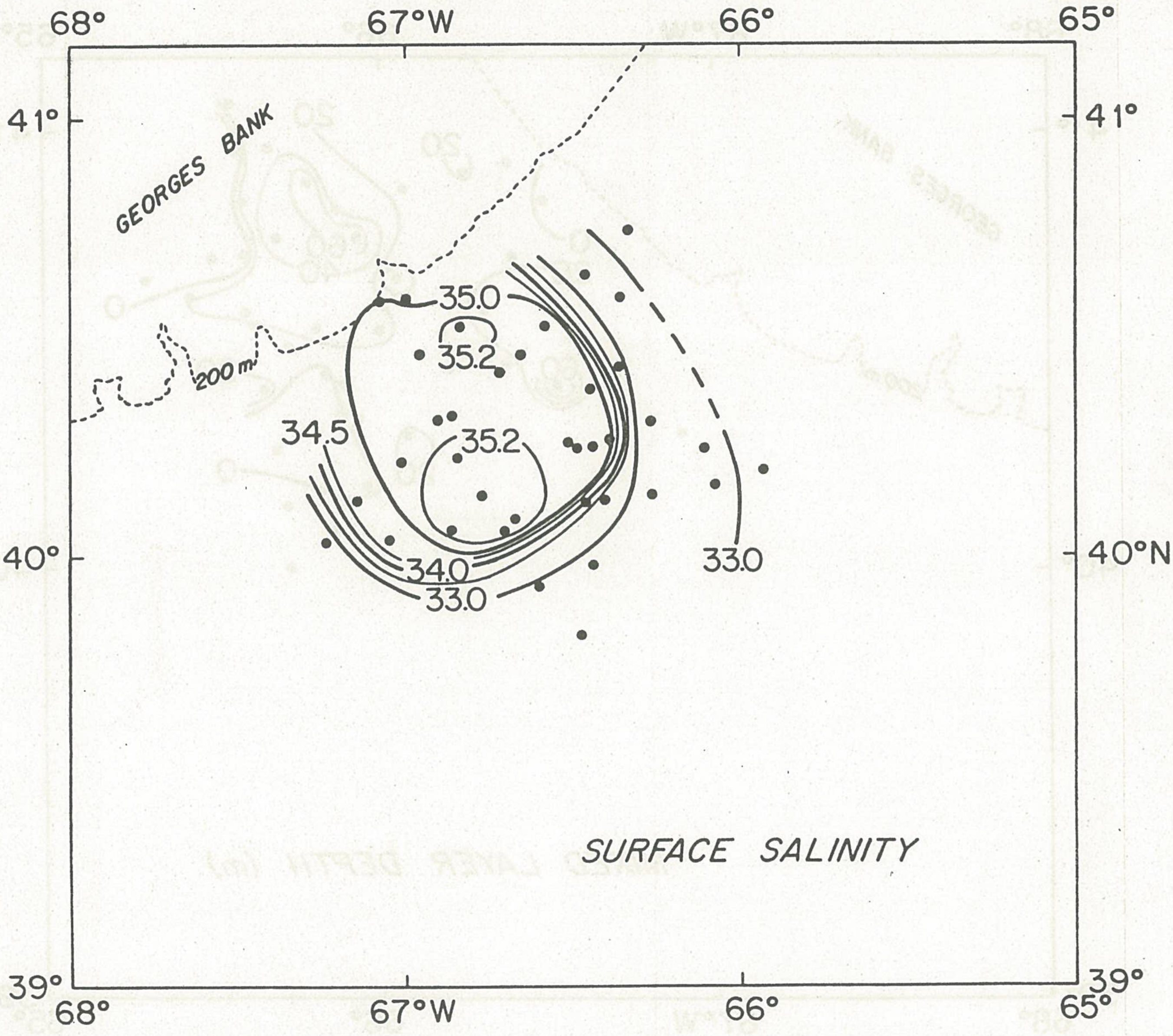


Figure 5b: Contours of surface salinity (°/₀₀) from samples collected at each XBT during the second survey.

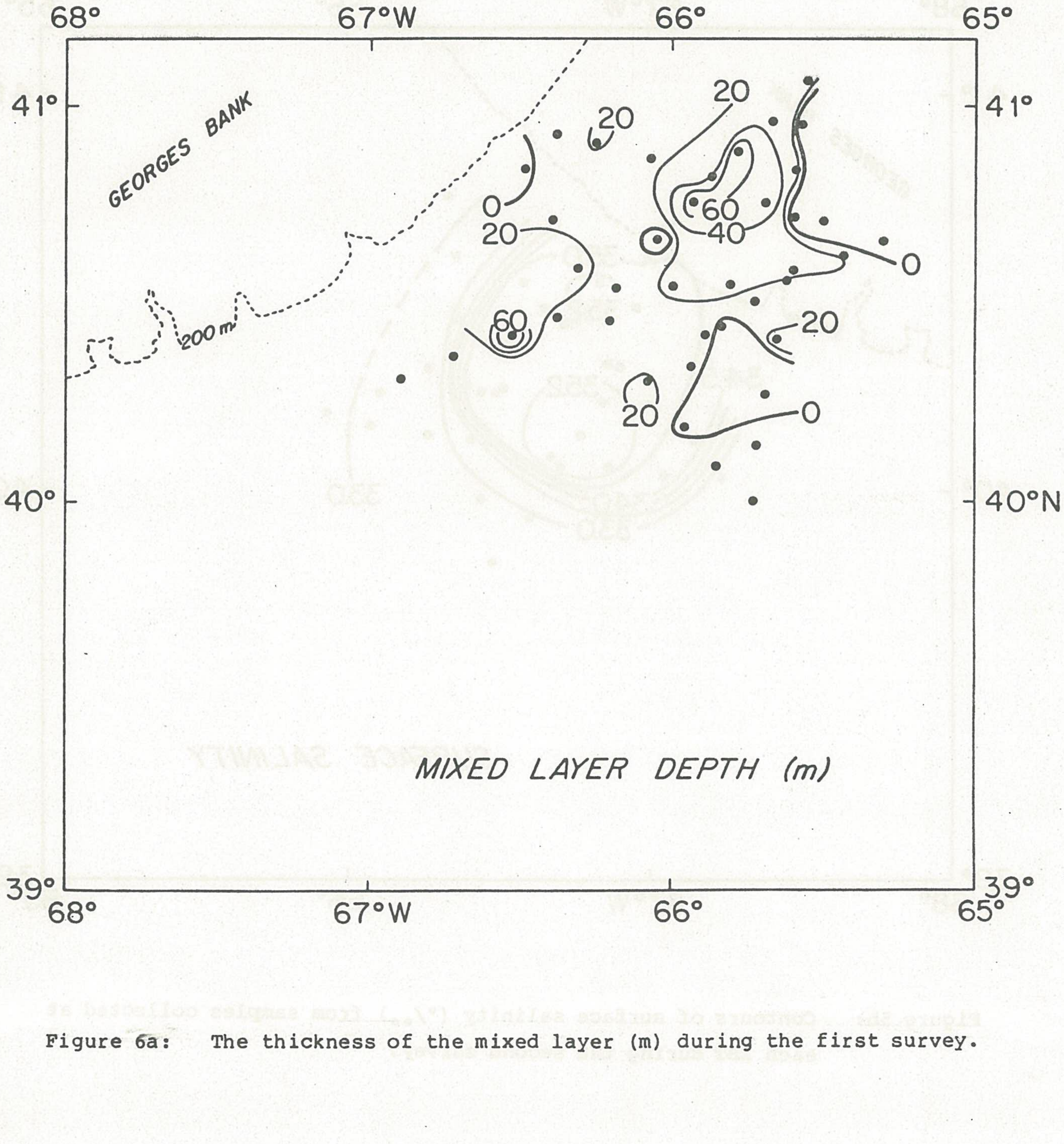


Figure 6a: The thickness of the mixed layer (m) during the first survey.

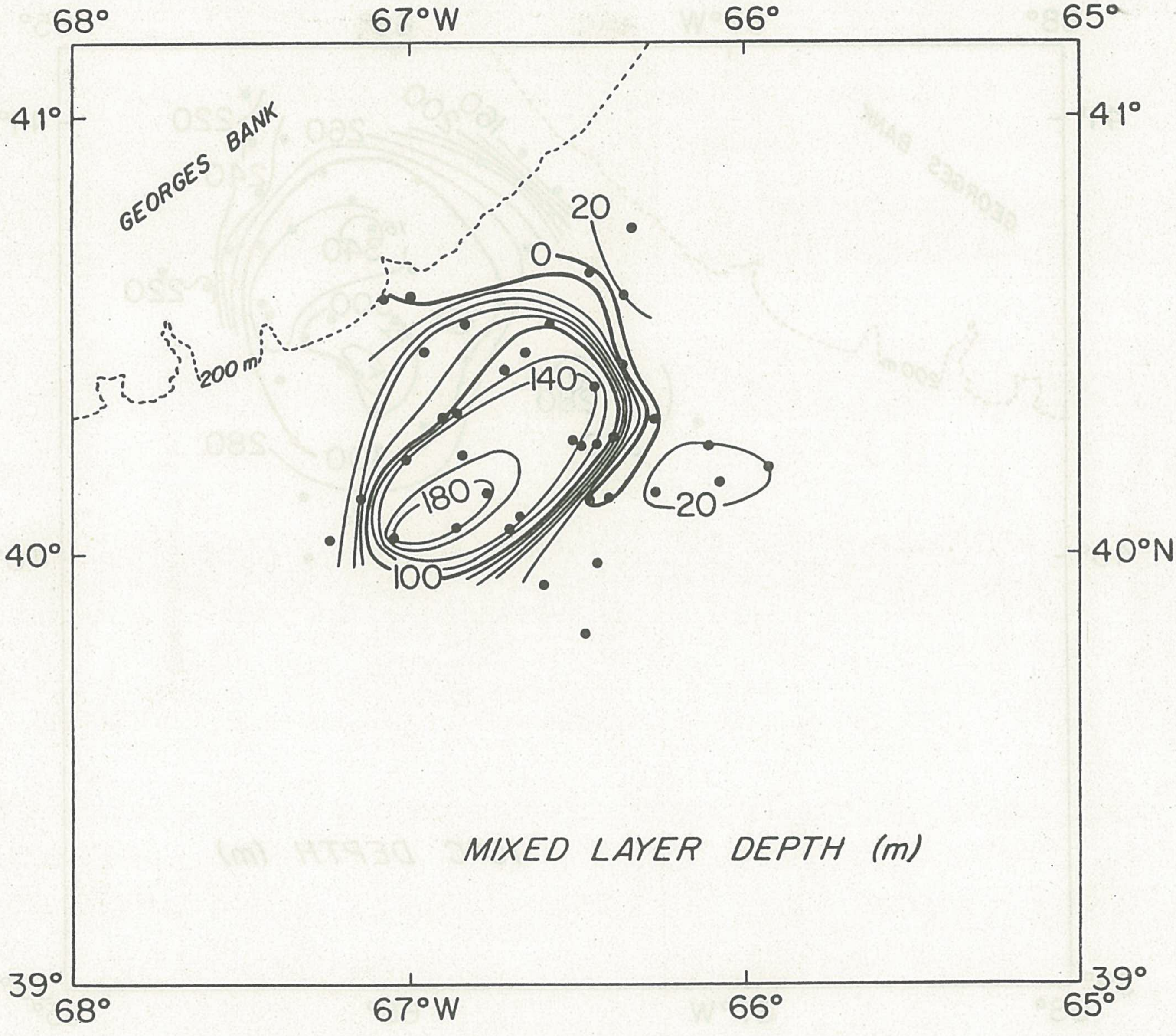


Figure 6b: The thickness of the mixed layer (m) during the second survey.

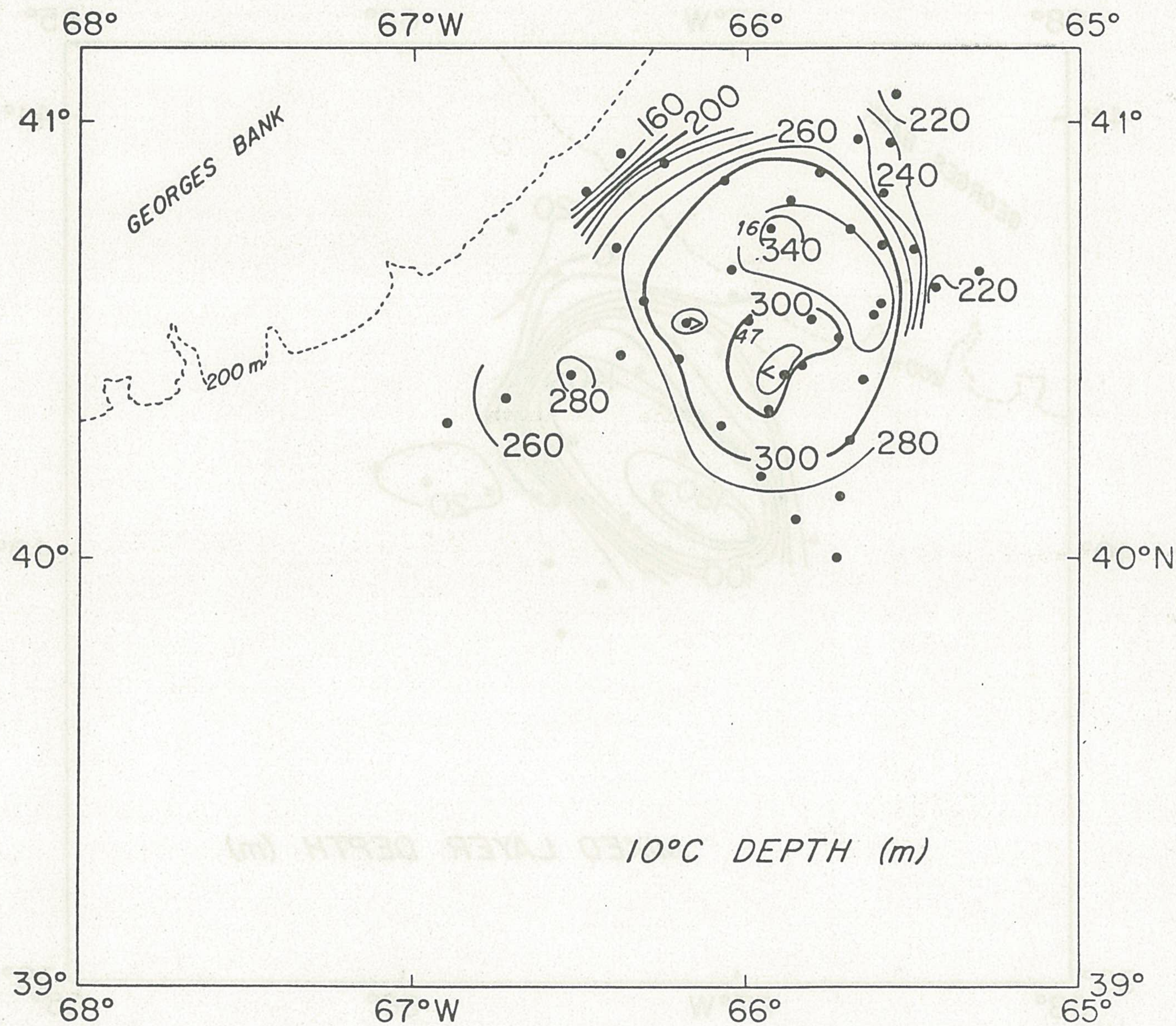


Figure 7a: The depth (m) of the 10°C isotherm during the first XBT survey.

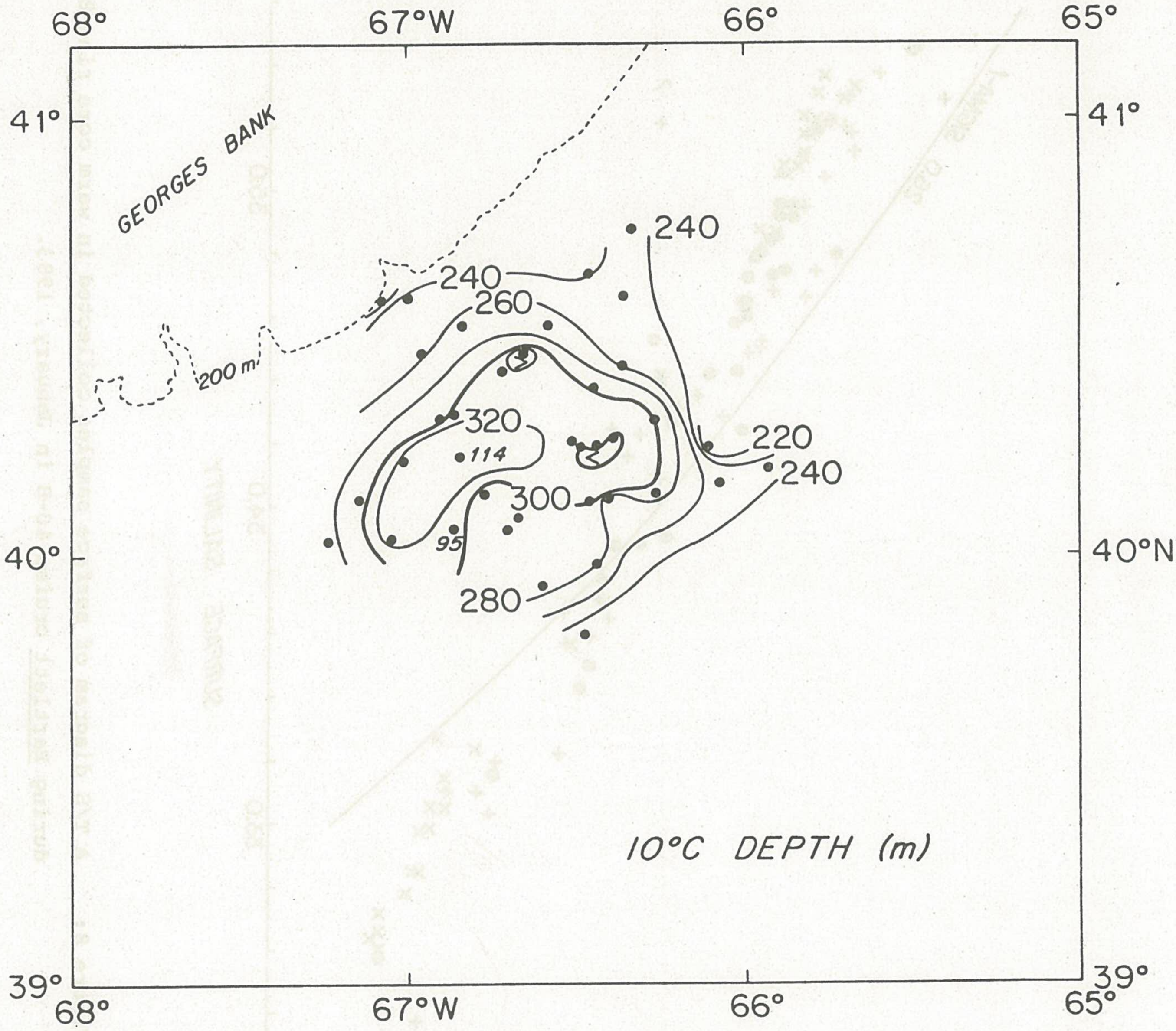


Figure 7b: The depth (m) of the 10°C isotherm during the second XBT survey.

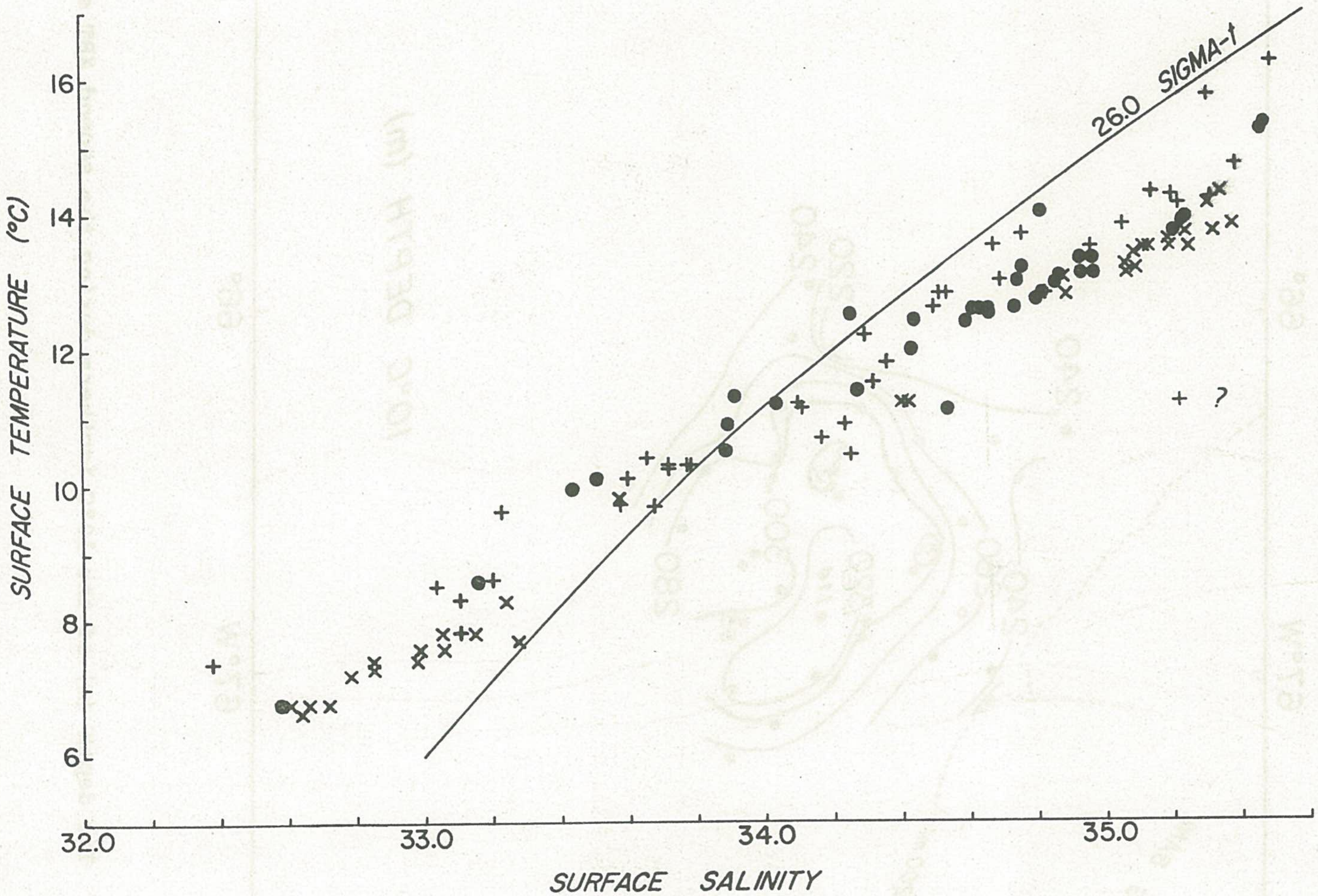


Figure 8: A T/S diagram of surface samples collected in warm core ring 82I during Bartlett cruise 40-B in January, 1983.

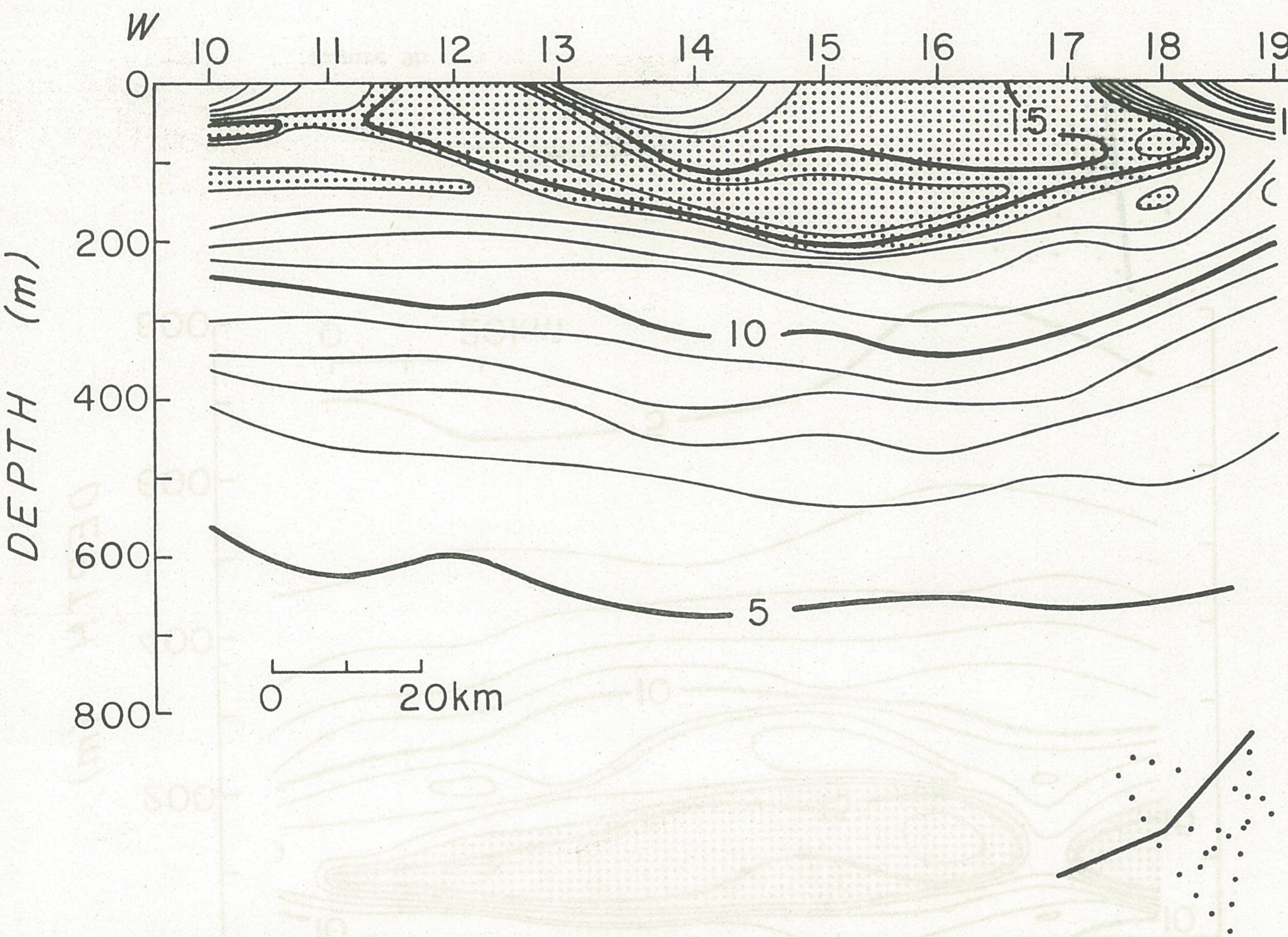


Figure 9a-9e: Temperature sections (°C) during the first XBT survey of warm core ring 82I. The stippled areas define the extent of the 14-16°C layer. The inset shows the position of the section relative to the survey.

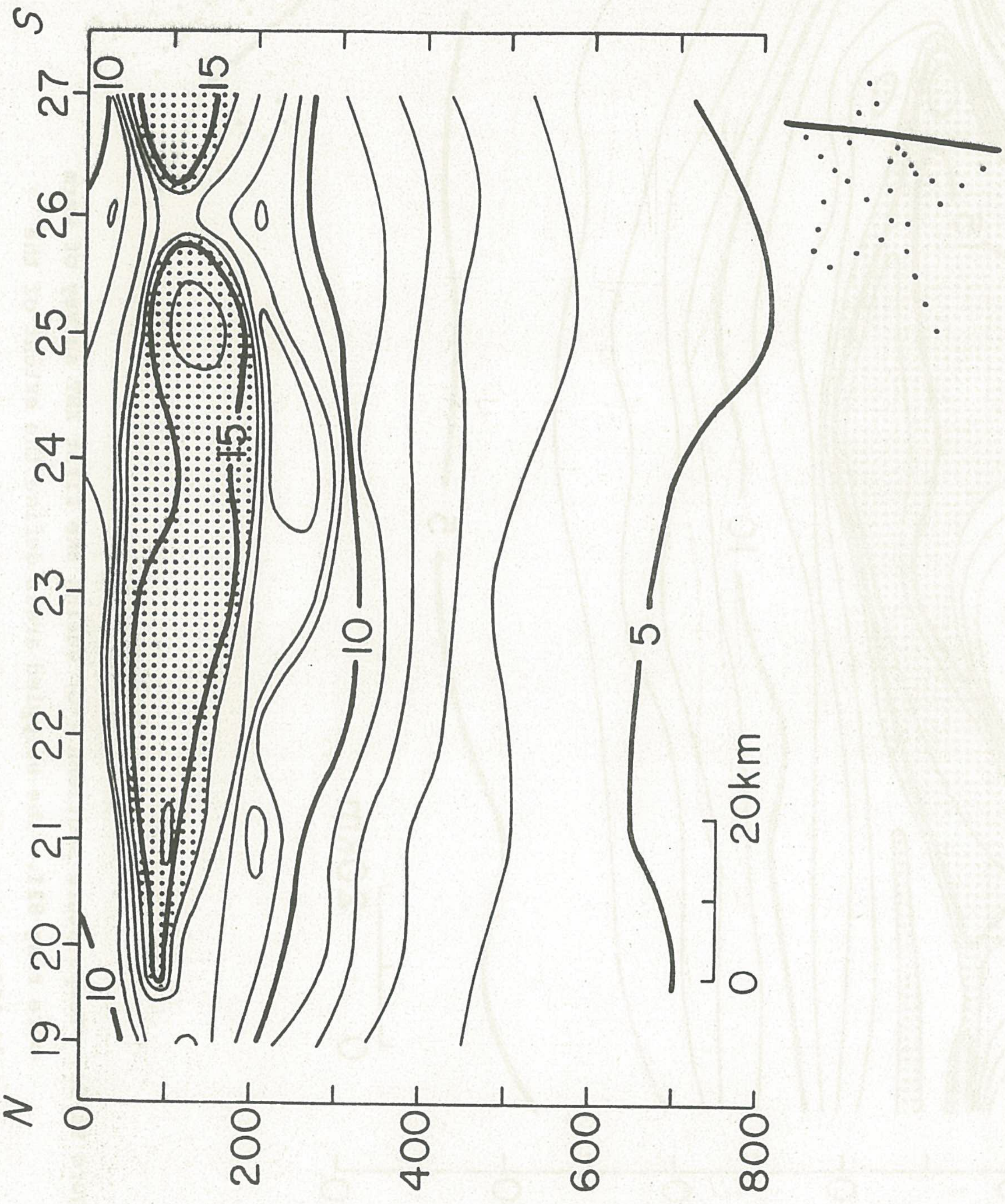


Figure 9b

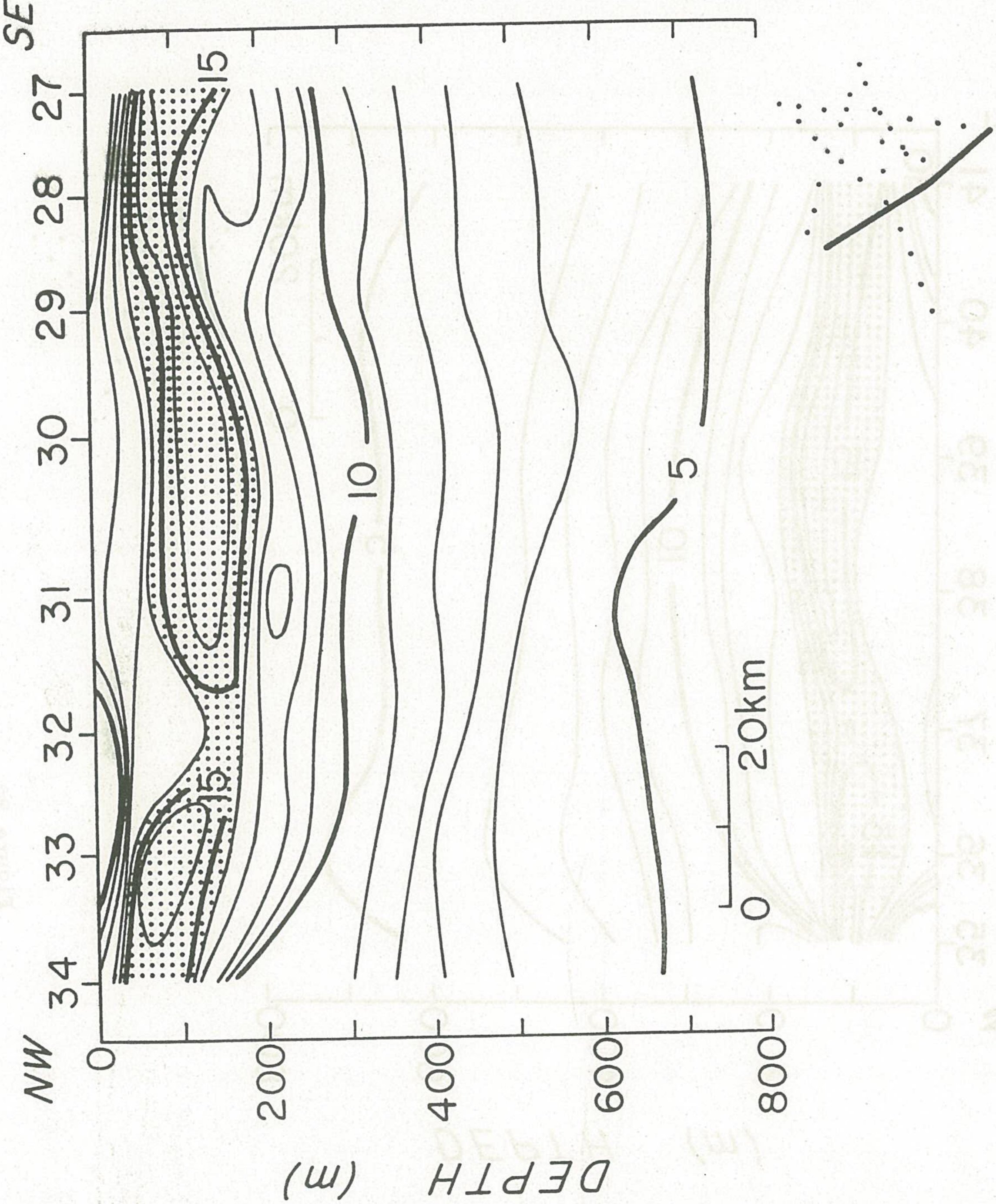

NW
SE
DEPTH (m)
0
200
400
600
800
27
28
29
30
31
32
33
34
15
15
10
5
0
20km

Figure 9c

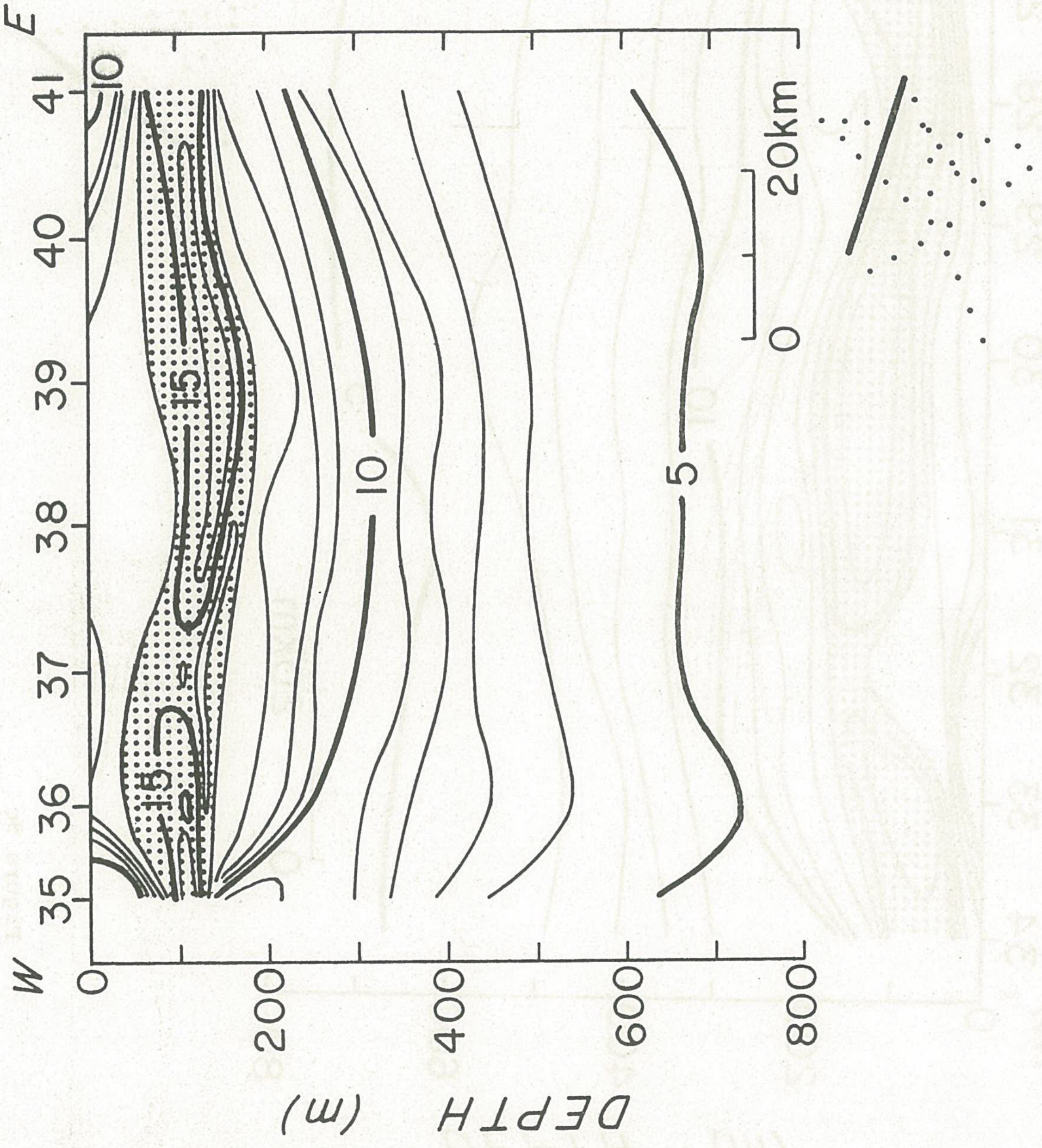


Figure 9d

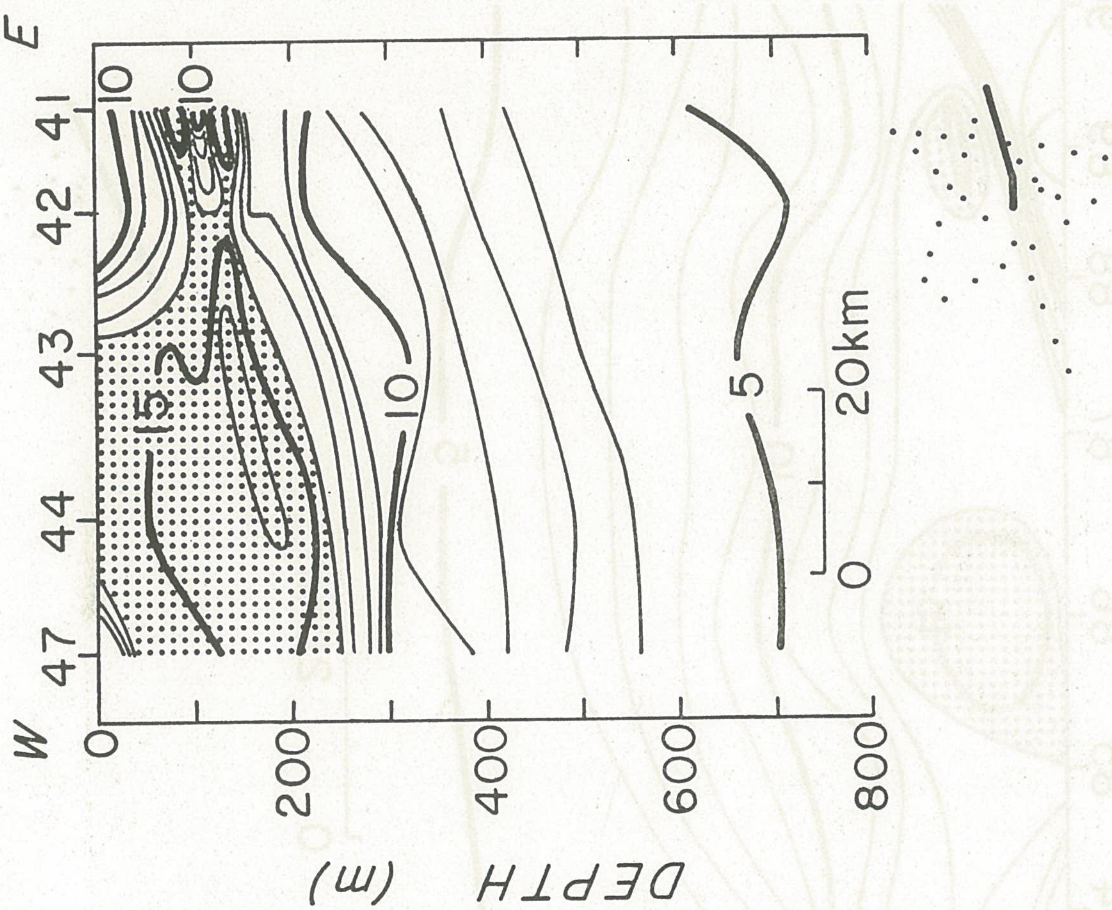


Figure 9e

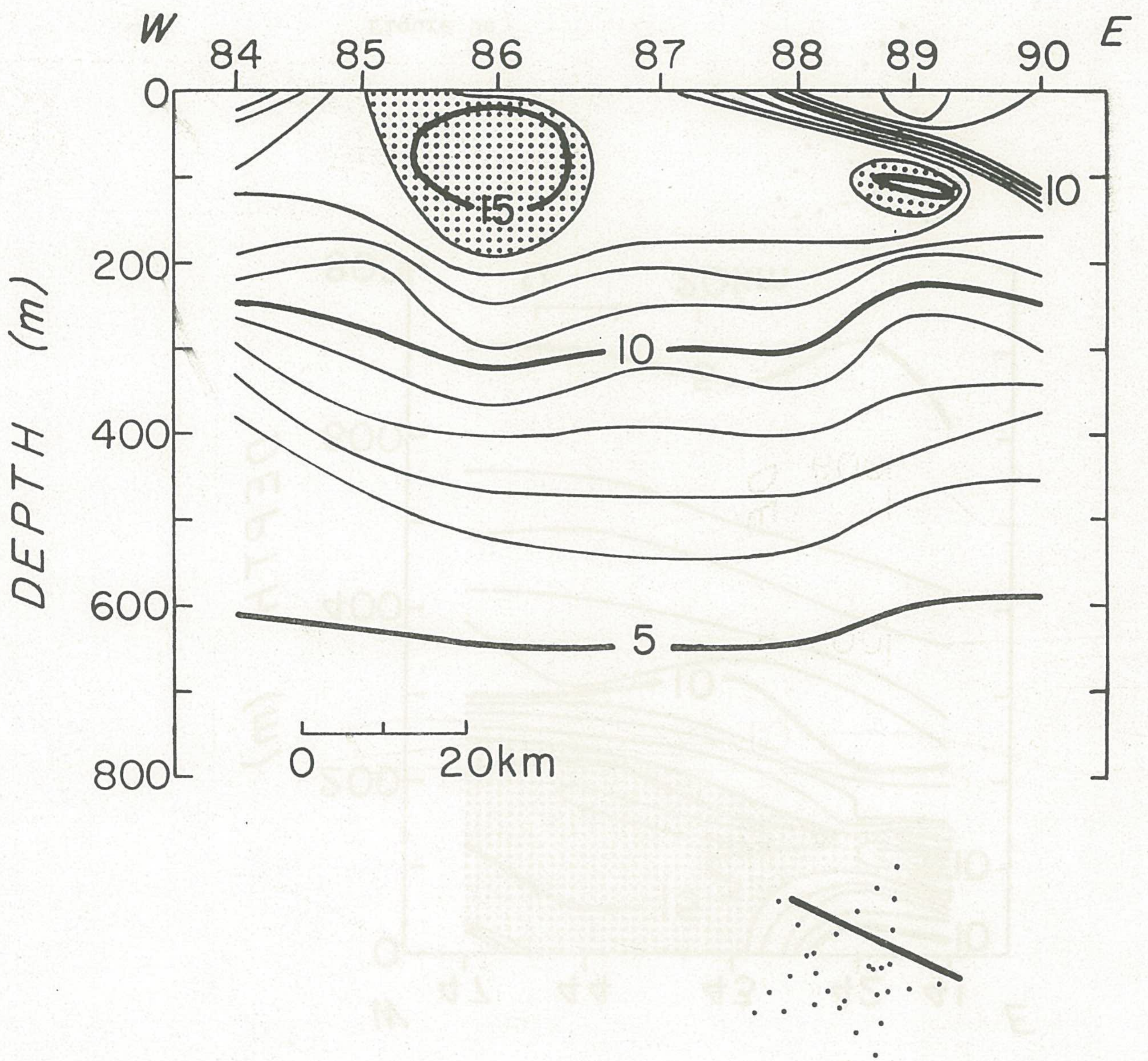


Figure 10a-10e: Temperature sections (°C) during the second XBT survey. The stippled areas and inset are as in Figure 9.

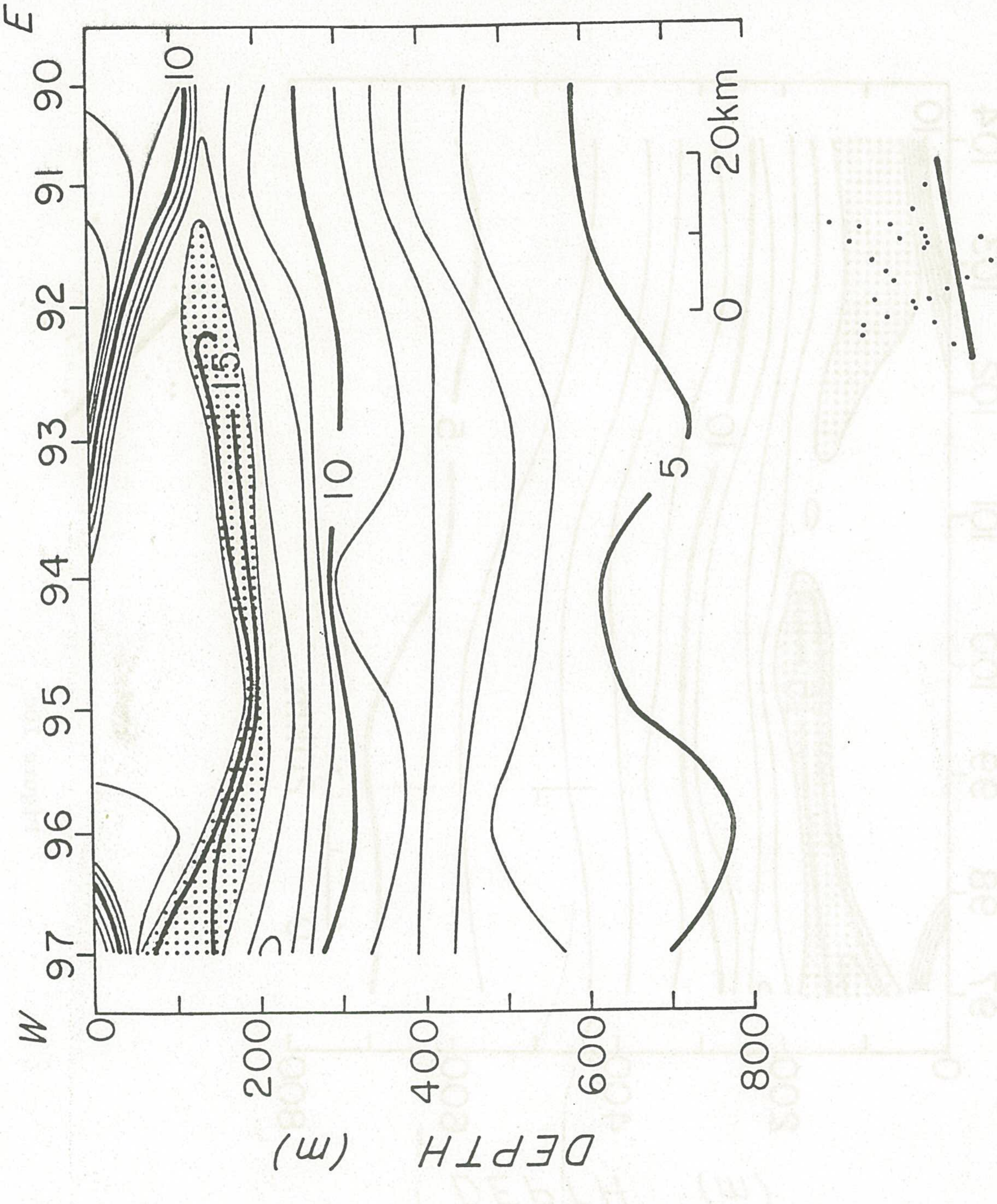


Figure 10b

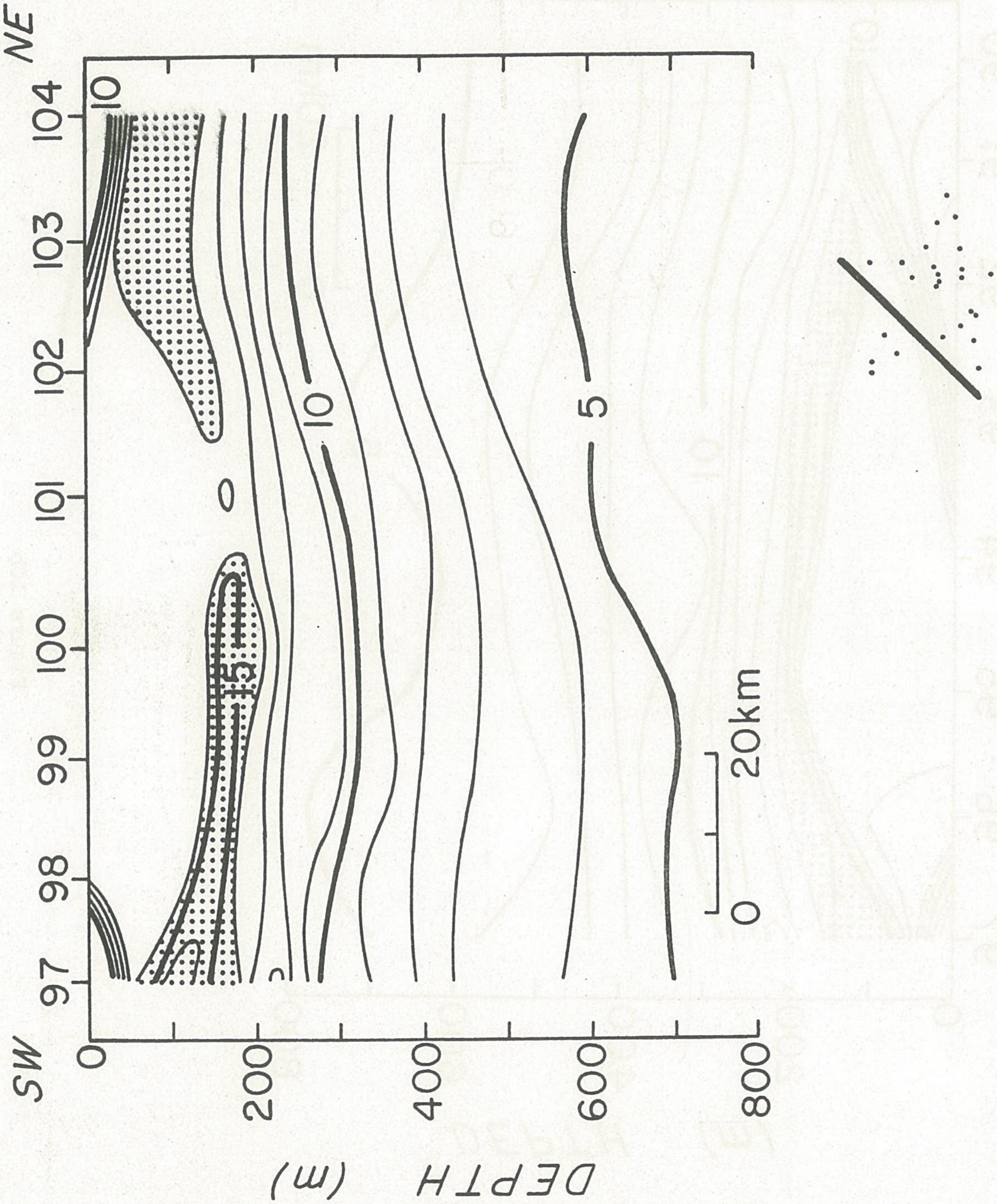

SW
NE
97
98
99
100
101
102
103
104
0
200
400
600
800
DEPTH (m)
10
15
0
10
5
0
20km

Figure 10c

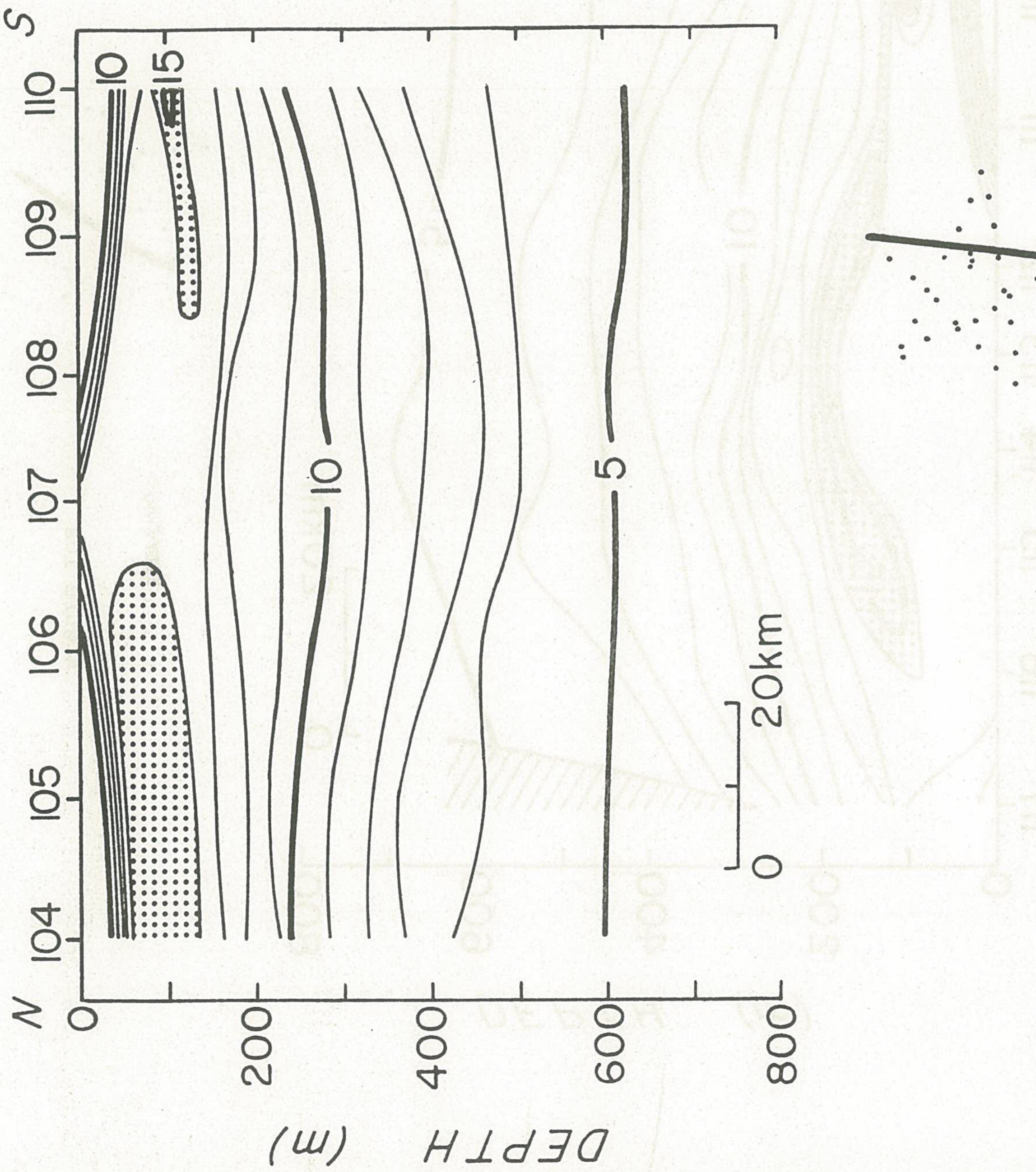

N
S
104
105
106
107
108
109
110
0
200
400
600
800
DEPTH (m)
10
15
10
5
0
20km

Figure 10d

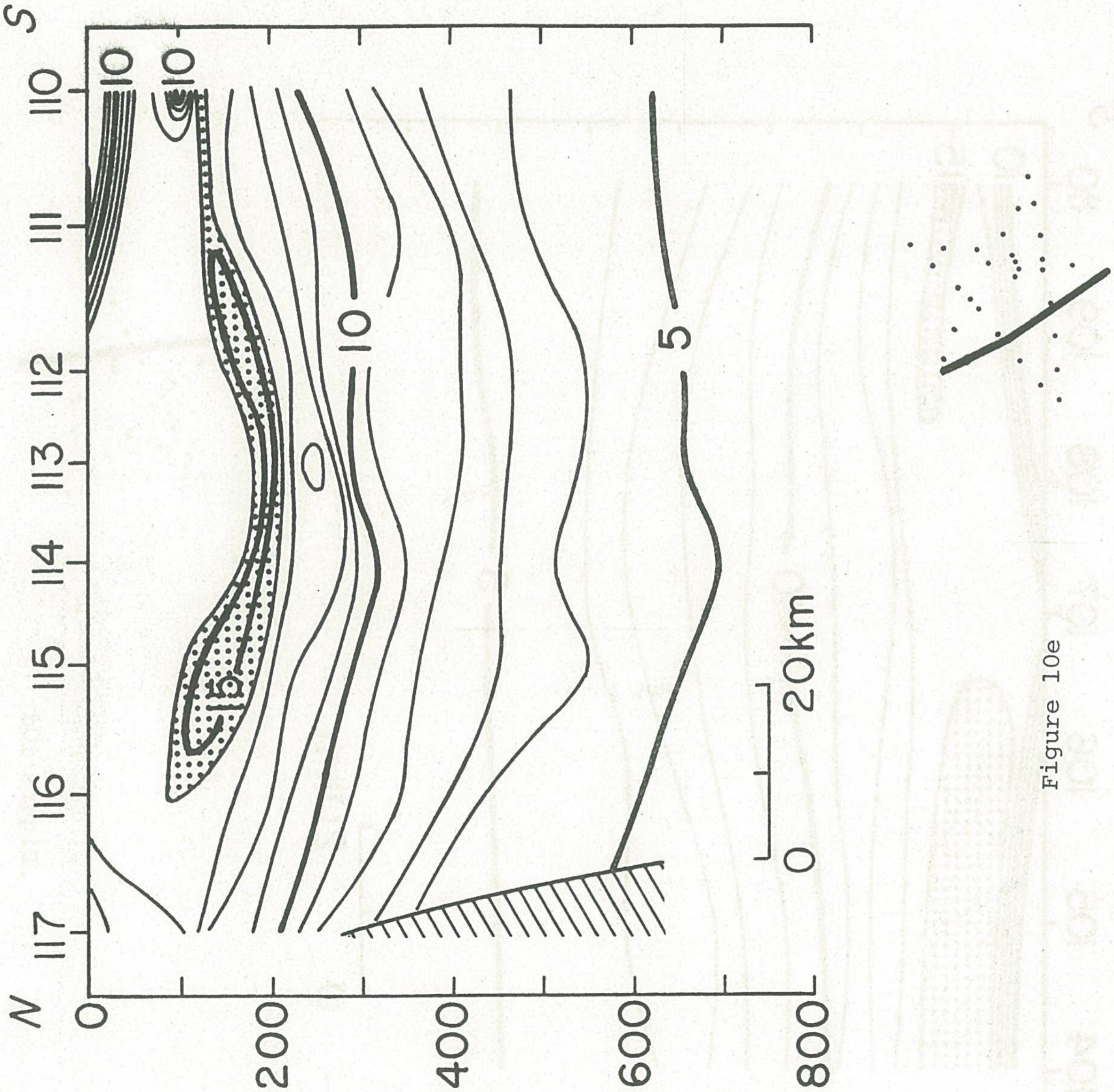

N
S
110
111
112
113
114
115
116
117
DEPTH (m)
0
200
400
600
800
10
10
10
15
5
0
20km

Figure 10e

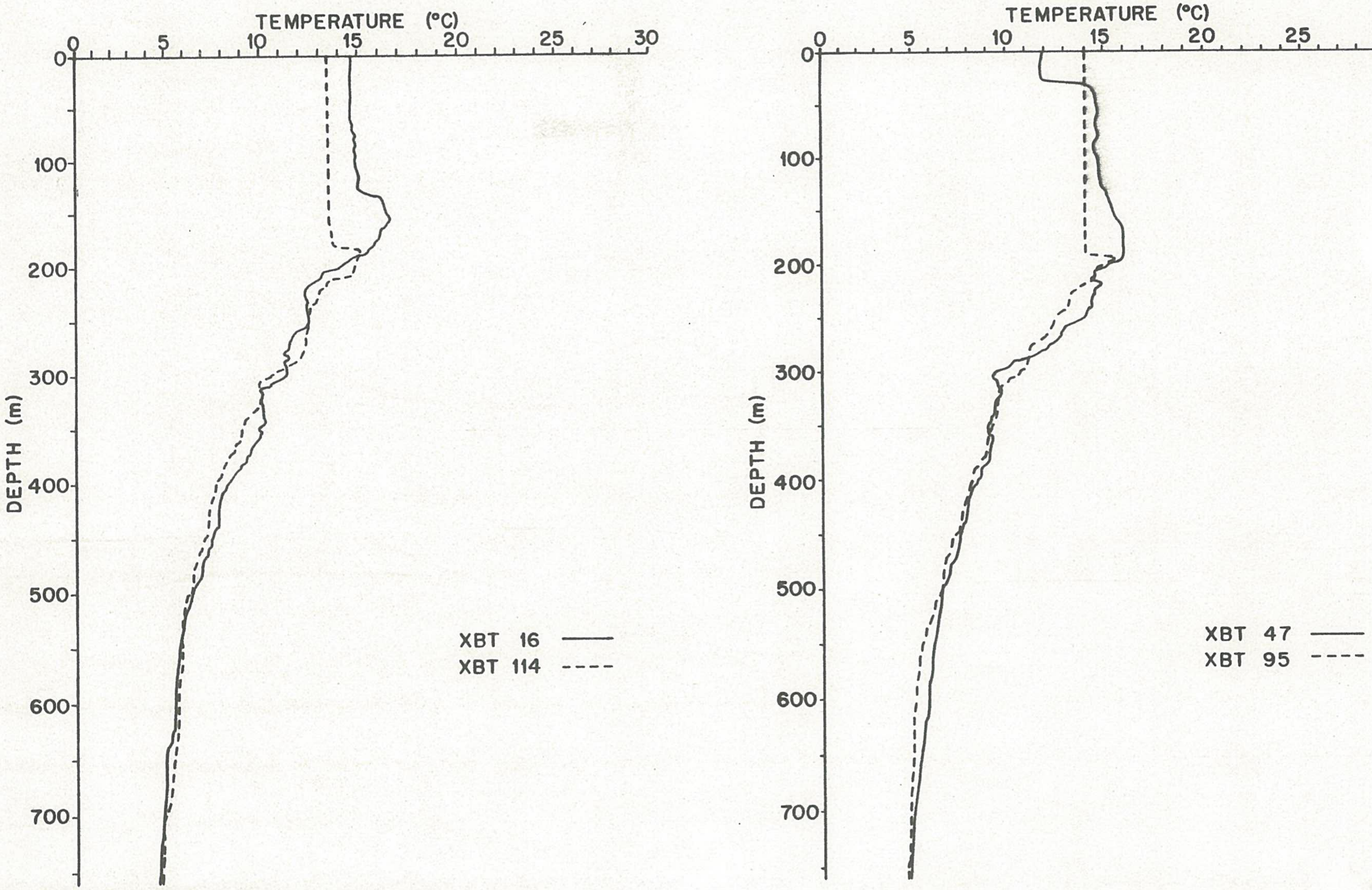


Figure 11: Selected XBT profiles from warm core ring 82I. The mixed layer during the first survey is shown by profile Nos. 16 and 47 while Nos. 95 and 114 characterize the mixed layer during the second survey.

REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER WHOI-83-16	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) USNS BARTLETT CRUISE 40-B - DATA REPORT		5. TYPE OF REPORT & PERIOD COVERED Technical
		6. PERFORMING ORG. REPORT NUMBER WHOI-83-16
7. AUTHOR(s) M.C. Stalcup, T.M. Joyce and R.L. Barbour		8. CONTRACT OR GRANT NUMBER(s) N00014-82-C-0019;
9. PERFORMING ORGANIZATION NAME AND ADDRESS Woods Hole Oceanographic Institution Woods Hole, Massachusetts 02543		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NR-083-004
11. CONTROLLING OFFICE NAME AND ADDRESS NORDA/National Space Technology Laboratory Bay St. Louis, MS 39529		12. REPORT DATE June 1983
		13. NUMBER OF PAGES 43
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This report should be cited as: Woods Hole Oceanog. Inst. Tech. Rept. WHOI-83-16.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

1. XBT Survey
2. Warm Core Ring 82I
3. Wintertime convection

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Please see reverse side.

20.

ABSTRACT

A joint cruise with Dr. Michael Gregg of the Applied Physics Laboratory at the University of Washington was conducted from 8-24 January, 1983, aboard the USNS *Bartlett* to study the effects of wintertime cooling in a warm core ring. At the beginning of the cruise an XBT survey of ring 82I (found at 40°40'N, 66°W, east of the New England Seamounts) showed a rather confused pattern of surface temperature and salinity with the average depth of the mixed layer about 30 m. On January 16-17, a storm passed near the ring with winds to 45 knots and temperatures below 0°C. An XBT survey at the end of the cruise showed that vertical mixing and cooling during the outbreak of cold air resulted in a more coherent pattern in the surface temperature and salinity of the ring and an increase in the thickness of the mixed layer to 180 m.

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(REVISED NOVEMBER 1978)

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