

**I.O.S.**

LONG SEASOAR CTD SECTIONS  
IN THE NORTHEAST ATLANTIC OCEAN  
COLLECTED DURING RRS DISCOVERY CRUISE 114

BY  
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REPORT NO. 255  
1988

**INSTITUTE OF  
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*Natural Environment Research Council*

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Long SeaSoar CTD sections  
in the northeast Atlantic Ocean  
collected during RRS *Discovery* Cruise 114

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1988

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## DOCUMENT DATA SHEET

AUTHOR	POLLARD, R.T., COLLINS, D.S., COTTERALL, T.C., SHERROCKS, K. & SMITHERS, J.	PUBLICATION DATE 1988
TITLE	Long SeaSoar CTD sections in the northeast Atlantic Ocean collected during RRS <i>Discovery</i> Cruise 114.	
REFERENCE	Institute of Oceanographic Sciences Deacon Laboratory, Report, No.255, 99pp.	
ABSTRACT	<p>This report presents CTD data from RRS <i>Discovery</i> Cruise 114 (October 1980) collected in the northeast Atlantic Ocean between 46.0°N, 11.3°W and 33.0°N, 31.0°W. The CTD unit was mounted in a SeaSoar vehicle which undulated between the sea surface and 300m depth about once per km. The data thus comprise a vertical section of the top 300m over 2100km long, spanning 13 degrees of latitude. Data presentation consists of T/S plots and contoured sections.</p>	
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KEYWORDS	BOTTOM SALINITY    CTD DATA    SEASOAR T/S DIAGRAMS DISCOVERY/RRS - CRUISE(1980)(114)	CONTRACT
		PROJECT    PG25
		PRICE        £25.00

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## 1. INTRODUCTION

During 1980 and 1981 four long SeaSoar sections were obtained in the northeast Atlantic on passage legs of RRS Discovery. The sections, in October 1980 (Cruise 114), January 1981 (Cruise 116), April 1981 (Cruise 119) and July 1981 (Cruise 122) show the seasonal variation of the top 300m of the ocean over about 10 degrees of latitude and over a full annual cycle. The data will be summarized in four IOS Reports, of which this is the second to be produced, although the first in the series.

Cruise 114 was a joint biological and physical cruise (ANGEL et al., 1981) which began with a passage leg from the U.K. to the working area southwest of the Azores. SeaSoar data were collected on passage (Fig. 1) with gaps caused by CTD and computer malfunctions, described in the next section. In addition to normal pressure, temperature and salinity measurements, the Neil Brown CTD was fitted with a Beckman Oxygen Sensor, and chlorophyll a was measured with a Chelsea Instruments Fluorometer fitted in the SeaSoar.

Details of processing steps are given in COLLINS et al. (1983) (hereinafter SS116). Only departures from standard processing (as it was in 1980) will be discussed here, together with calibration problems and instrument malfunctions.

## 2. DATA COLLECTION AND REDUCTION

### Logging:

CTD data were logged in two forms on IOS cruises.

1. Raw data delivered by the NBIS deck unit were converted by an IOS-built interface (J. Smithers) into ASCII characters and written to an 800 bpi tape deck. Each 1960 character block contains time to the nearest second in an 80 character header, followed by raw data and synchronisation values (00015 or 000240, hex 0F and F0), all recorded as 5 character ASCII integers (I5).
2. The data were transferred to a PDP11/34 where they were archived in a hybrid ASCII and positive binary integer format at various stages of processing.

For much of the passage leg, the PDP11/34 operating and applications software was still under development, so only the ASCII backup was available. Occasional gaps are found when a tape has to be changed. Once PDP logging had begun, these gaps were eliminated because the archiving programme automatically switched to a second tape deck when necessary.

All data in this report have been recovered from full data rate raw data files archived by one of the two methods. Thus all processing has been done on land using a Honeywell 66/DPS-300 computer. The data reduction steps are nevertheless the same as described by SS116 so need not be described again here.

### **Navigation:**

For Cruise 114, navigation data have been obtained from 2-minute averaged values logged on an IBM1800 computer. Water velocities relative to the ship are read every second from a gyro and two component EM log and averaged every two minutes. These are later adjusted to fit accepted satellite fixes, assuming a constant current between fixes. Positions are thus as accurate as the transit fixes and the constant current assumption allows, typically within 1km of absolute position. Integration between two minute values gives Distance Run (km) from an arbitrary origin, which is used as the x-variable in this report. SeaSoar data were collected from a Distance Run value of 123km to 2461km (Table 1) with gaps totalling about 180km, giving data along over 2100km of track.

### **Chronology:**

For processing convenience, the data set has been divided into 26 runs (Table 1). Runs 1 to 17 correspond to an ASCII tape of data, so are often separated by short gaps during tape changes. From Run 18 on, data were processed in 6-hourly runs.

After a trial deployment on day 293 (19 October 1980) the SeaSoar was deployed at 0830/294 for Runs 1-4. The conductivity cell fouled severely soon after the start of Run 2, leaving a salinity gap of 86km (206-292km). In the absence of realtime plotting of derived variables, the fouling was unfortunately not spotted. The fluorometer failed at the start of Run 3 so the SeaSoar was recovered the next morning after Run 4 to remove and repair the fluorometer.

The SeaSoar was redeployed for Run 5 but had to be recovered after 5 hours because of a cable termination failure. The oxygen values during Run 5 are clearly biased by over 0.5 ml/l. The cause is not known, but probably relates to the long time constant of the Beckman sensor (POLLARD, 1985).

Time was pressing, so Discovery had to continue steaming during cable repair, resulting in a loss of 115km of data (557-672km) including a significant change in stratification between 42° and 43°N at 15°W.

The SeaSoar was again deployed at 0445/296 (22 October), and Runs 6-26 continued without further breaks for over five days until 1206/301 (27 October). The data presented in this report end at that point. Further SeaSoar runs across the frontal area southwest of the Azores have been analysed by Dr M.J. Fasham.

### 3. CALIBRATION

Pressure, temperature, conductivity and chlorophyll a were calibrated according to the formulae

$$P_{cal} = 0.005 * P_{raw} \quad (\text{default})$$

$$T_{cal} = 0.083 + 0.0004985 * T_{raw}$$

(from thermometer readings on 3 shallow casts)

$$C_{cal} = 0.001005 * C_{raw} \quad (\text{nominal})$$

$$F_{cal} = 0.007069 * \exp(0.000143 * F_{raw})$$

(supplied by M. Fasham)

To calculate salinity from conductivity and temperature, the temperatures were first speeded up (COLLINS et al.) using a time constant of 0.22 or 0.23 seconds.

Oxygen values were calculated using the formula given by POLLARD (1985), namely

$$O_{cal}(\text{ml/l}) = 0.00165 * O_{raw} * \exp(-0.036 * T_L - 0.000155 * P_{cal}) * O_{saturated}(T_{cal}, S_{cal})$$

where  $T_L$  is  $T_{cal}$  logged with a 300 second time constant and the oxygen cell temperature is not used. Samples were not available for absolute oxygen calibration, so the data should be examined for relative variations only.

After nominal conductivity calibration of salinities, these must be corrected for shifts using bottle samples and comparison of T/S curves.

The technique of examining T/S curves for sudden offsets indicating conductivity shifts is fully described by SS116. Absolute values were derived by comparing the envelope of T/S curves with that for Cruise 116 (SS116). The major corrections that were applied (excluding a few short duration offsets) are summarized in Table 2 in the column "correction applied". 72 samples drawn from the non-toxic supply over a 6-day period were later compared with near-surface SeaSoar salinities observed as nearly as possible at the point where the sample was taken (SS116). The corrections given by those differences are plotted in Fig. 2, and the actual corrections made (Table 2) are shown as lines.

Considerable scatter in the plotted values is caused by the difference in spatial positions of the observation and sample combined with horizontal and vertical salinity gradients. Nevertheless, there are indications that the "corrections applied" may be error for some periods. Early on day 298, there is no evidence that the correction dropped from .047 to 0.35 psu. On day 299 the correction applied appears to be about 0.020 psu too high for both the .073 and .085 values. A column of "estimated corrections" has been added to Table 2, and the difference between the "applied" and "estimated" corrections is given as the last column. Further corrections have not been made to the data plotted here, however.

Our conclusion is that salinities are in general correct to within 0.02 psu, and that more accurate corrections cannot be determined.

#### 4. DATA PRESENTATION

Three sets of plots are presented, T/S curves, contour plots of salinity, temperature and density, and contour plots of chlorophyll and oxygen.

In all cases the independent variable is Distance Run in km along track from an arbitrary origin. Latitude is also annotated on contour plots prior to the turn at 20°W at 298/0400, and longitude thereafter.

To reduce the number of points fed into plotting and gridding procedures, the merged, edited 1-second data were further reduced by averaging on pressure at 7.5 dbar intervals. T/S plots are drawn from the 7.5 dbar average files. Contour plots require a further gridding step (SS116) which effectively averages all data in a box 15 dbar by 8km to give the gridded value of the centre of the box.

The T/S plots combine all profiles in each 40km of Distance Run, offsetting by 0.2 psu at 40km intervals, and repeating the last 40km on a plot as the first 40km on the next, to aid continuity. The tight T/S relation of central water for temperatures below 12° or 13°C is clearly apparent. Marked changes in the T/S curves occur at frontal regions, such as 430km (44°N), in the gap between 560 and 670km (42°-43°N), 1200km (38°N), and most dramatically at 2260km (34°N, 29°W) where the Azores Front was crossed. Beyond that point, the T/S relation is tight for temperatures less than about 17°C.

## 5. ACKNOWLEDGEMENTS

Dr M.V. Angel was principal scientist on cruise 114. John Burnham and Professor M. Wells played major roles in making the computer system operational. Mike Fasham worked closely with Raymond Pollard in designing the applications software and ensuring the scientific goals were met.



## 6. REFERENCES

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- COLLINS, D.S., POLLARD, R.T. and PU, S. 1983 Long SeaSoar CTD sections in the northeast Atlantic Ocean collected during RRS Discovery Cruise 116. Institute of Oceanographic Sciences, Report, No.148, 77pp.
- POLLARD, R.T. 1985 CTD data from the Northeast Atlantic Ocean 40°-48°N, 12°-21°W collected on RRS Discovery Cruise 132 in February 1983. Institute of Oceanographic Sciences, Report, No.192, 99p.

TABLE 1

## Timetable of events for Cruise 114

Run	Time(GMT) day/HHMM	Lat (°N)	Long (°W)	Distrun (km)	Comments
1	294/0948	46.00	11.31	123	start 1, Scorr = .047 psu
2	294/1553	45.45	12.00	206	start 2
	294/1750			235	salinity severely fouled
	294/2124	45.06	12.55	267	end 2
3	294/2151	45.01	12.63	275	start 3, fluorometer fouled
				292	salinity recovers
4	295/0356	44.48	13.27	354	start 4
	295/1030	43.77	13.96	450	end 4, recover SeaSoar and remove fluorometer
5	295/1515	43.60	14.10	472	start 5, relaunch without fluorometer. Oxygen 0.6-1.0ml/l too high
	295/2050	42.99	14.72	557	end 5, recover SeaSoar, cable fault
6	296/0525	42.14	15.54	672	start 6, relaunch, with all sensors. Oxygen recovered
7	296/1107	41.58	16.06	748	start 7
8	296/1707	40.96	16.70	836	start 8
9	296/2324	40.29	17.36	929	start 9
10	297/0531	39.69	17.90	1011	start 10
11	297/1149	39.02	18.40	1100	start 11
12	297/1757	38.33	18.94	1190	start 12
	297/2329			1273	Scorr = .035 psu
13	297/2357	37.68	19.56	1280	start 13
	298/0400				alter course
14	298/0604	37.12	20.27	1371	start 14
	298/0642			1380	Scorr = .061 psu
15	298/1208	36.78	21.20	1462	start 15
	298/1744	36.53	22.00	1539	end 15?
16	298/1920	36.46	22.22	1560	start 16
	298/2128			1592	Scorr = .073 psu



17	299/0021 299/0547 299/0552	36.20	22.99	1635 1715 1716	start 17, start computer logging Scorr = .089 psu Scorr = .085 psu
18	299/0600	35.90	23.83	1718	start 18
19	299/1200	35.62	24.69	1802	start 19
20	299/1800 299/2227	35.28 35.03	25.53 26.10	1887 1946	start 20 end 20
21	299/2304 299/2337 300/0058	35.00	26.19	1954 1962 1983	start 21 Scorr = .141 psu Scorr = .067 psu
22	300/0659 300/1154	34.76	27.08	2041 2104	start 22 Scorr = .092 psu
23	300/1200	34.44	27.68	2106	start 23, Scorr = .067 psu
24	300/1800	34.07	28.53	2195	start 24
25	301/0000 301/0126	33.63	29.35	2286 2308	start 25, Scorr = .083 psu
26	301/0600 301/1206	33.31 33.03	30.18 30.99	2371 2461	start 26 end 26

TABLE 2

## Comparison of salinity corrections

Run	Date	Correction applied (psu)	Correction estimated (psu)	Implied additional correction (psu)
1	294/0948	.047	.047	.000
12	297/2329	.035	.047	+0.012
14	298/0642	.061	.067	+0.008
16	298/2128	.073	.051	-.022
18	299/0600	.085	.067	-.018
21	300/0058	.067	.067	.000
25	301/0126	.083	.083	.000

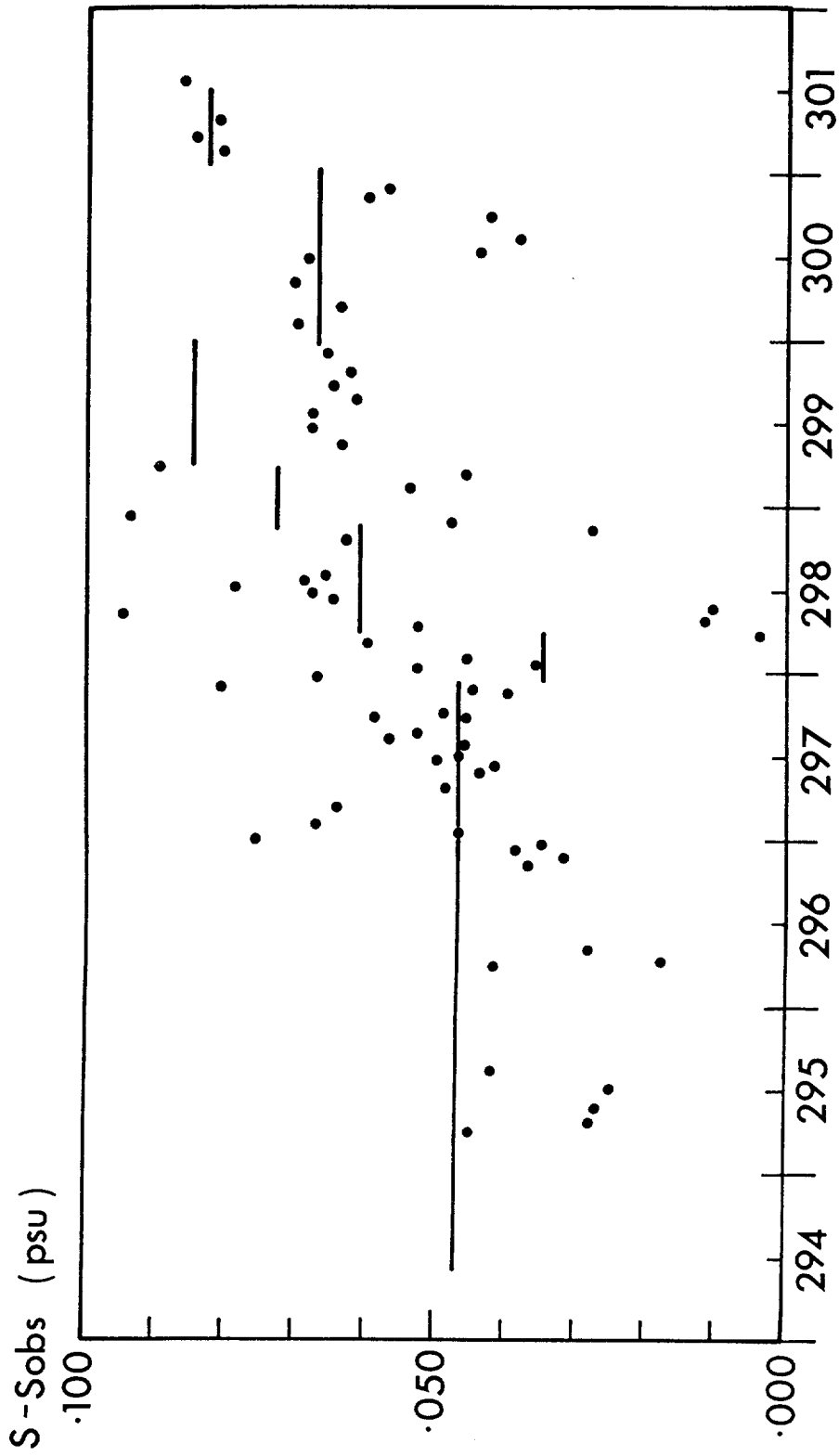
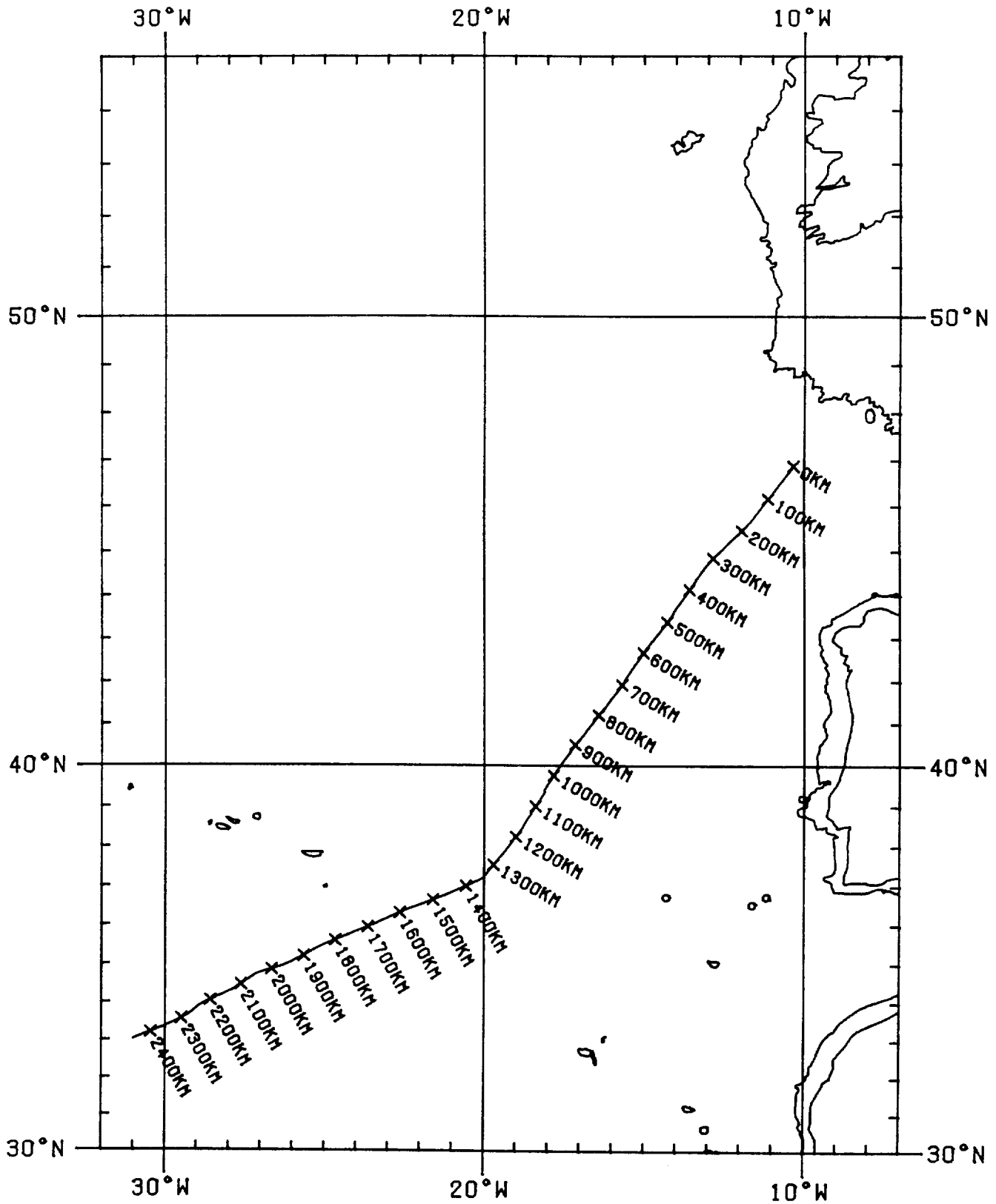
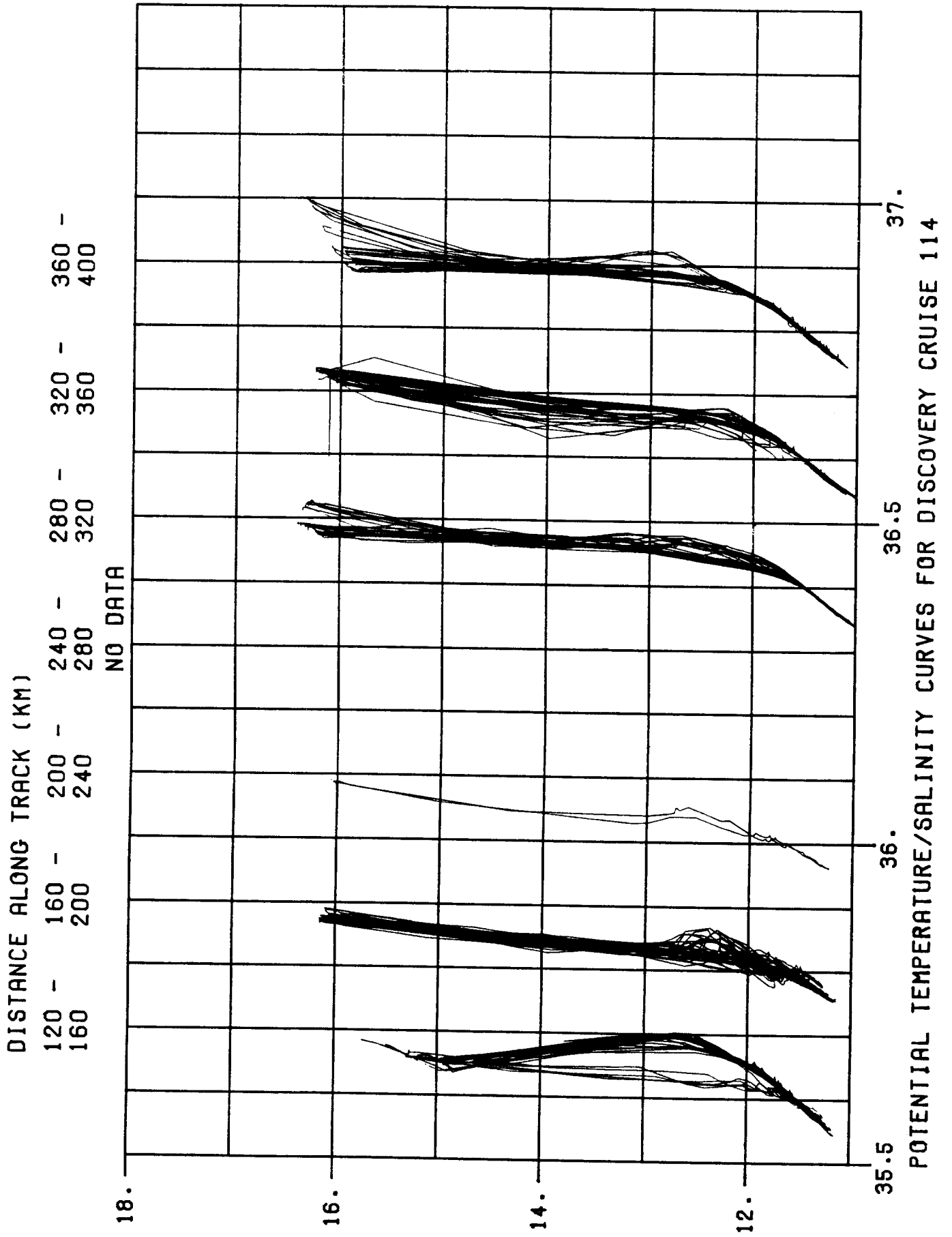


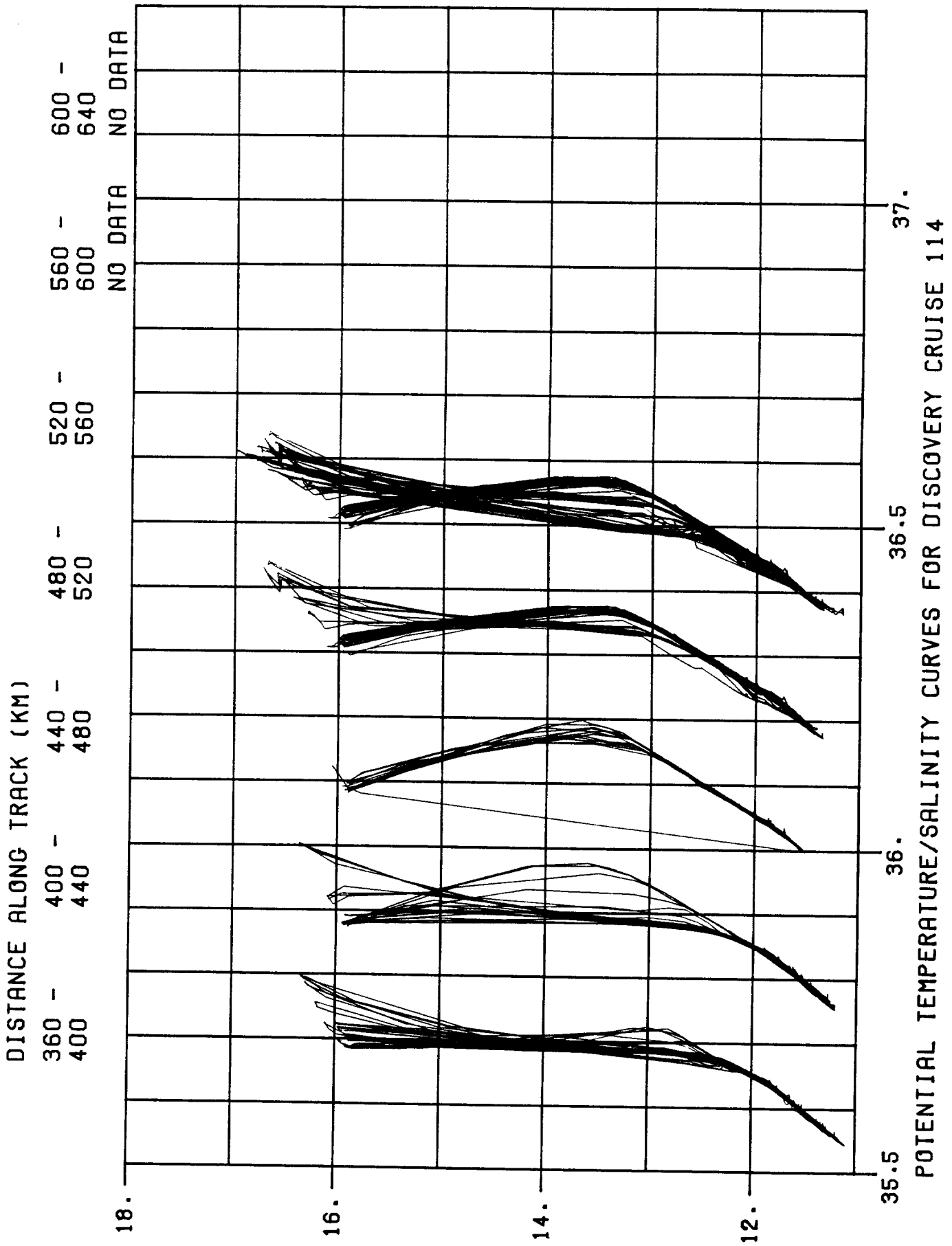
Fig.1

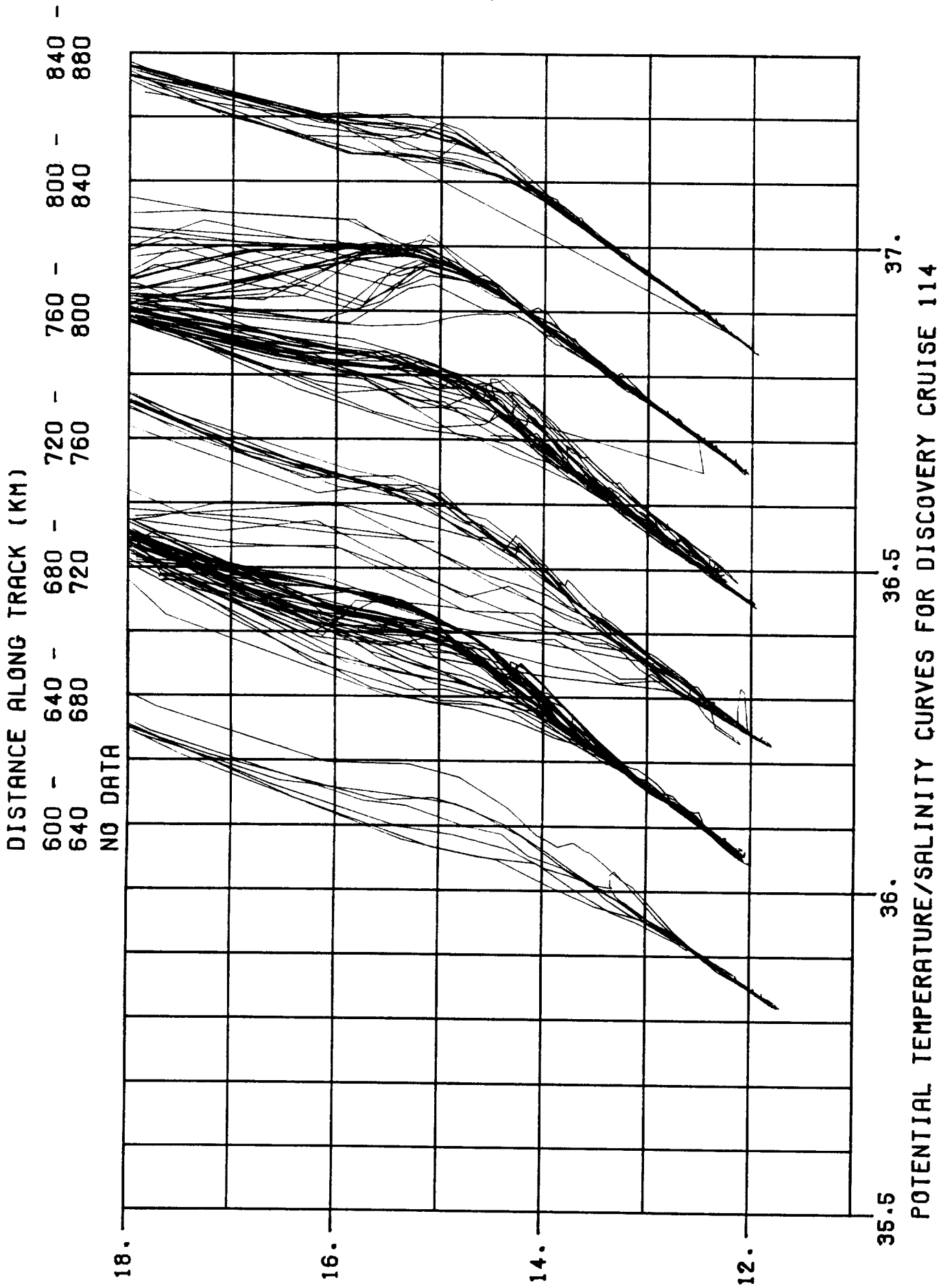
Plot of true salinity (S = bottle sample) minus SeaSoar salinity (Sobs) shows the wide scatter of the calibration technique. The final corrections used are shown as lines, and their accuracy is discussed in the text.

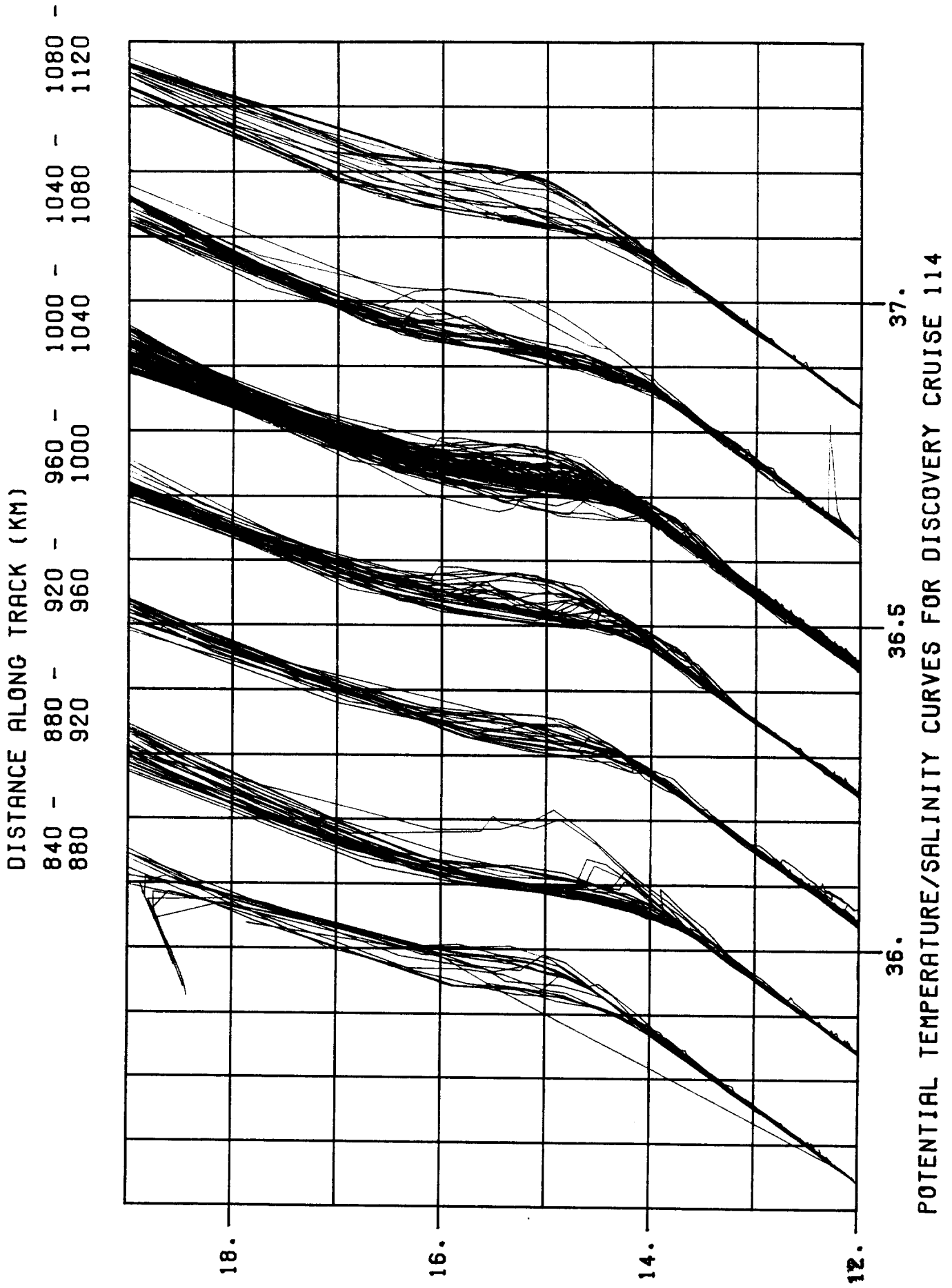


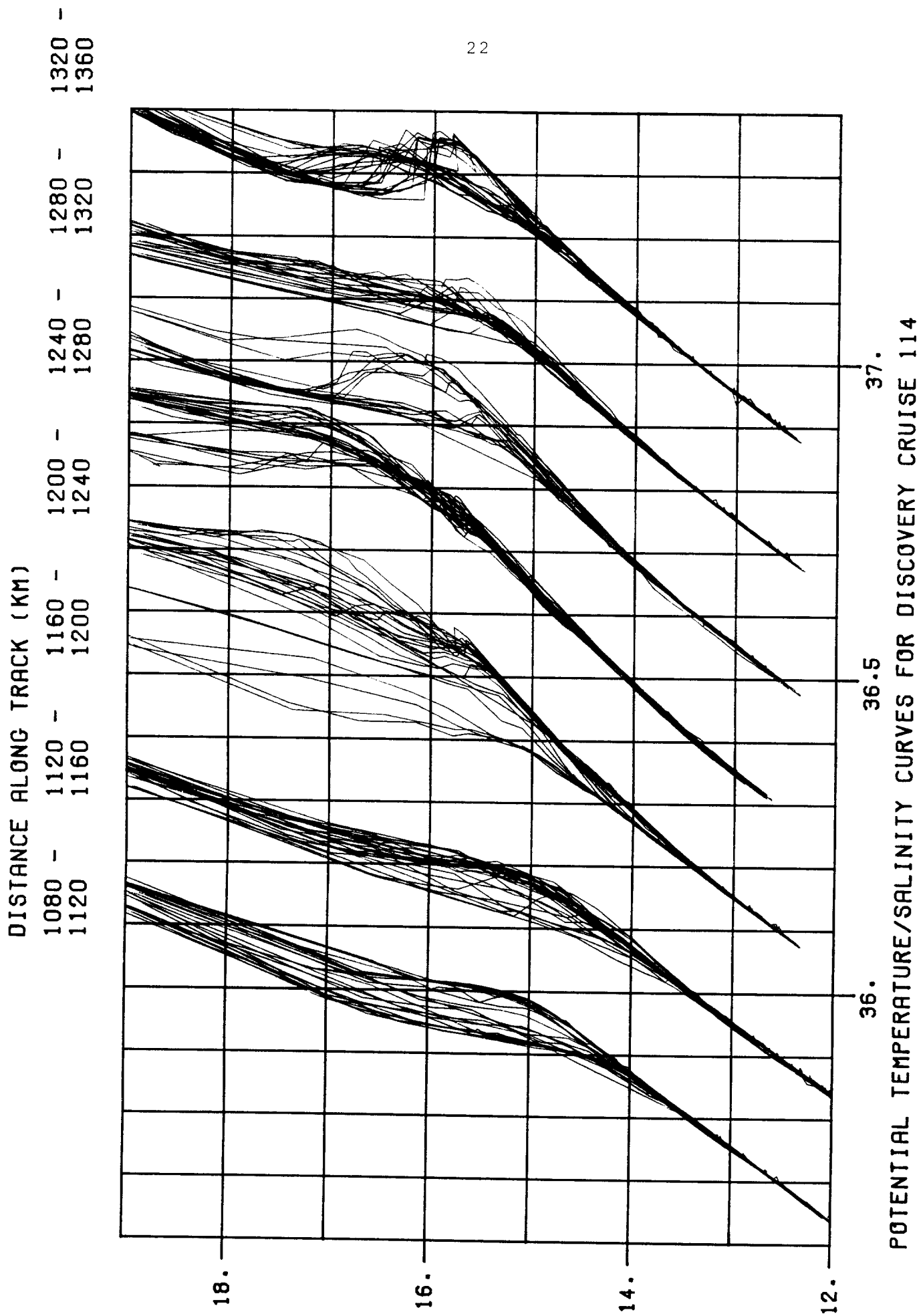
TRACK PLOT FOR DISCOVERY CRUISE 114  
\*\*\*\*\*  
MERCATOR PROJECTION WITH COASTLINE  
AND 100M DEPTH CONTOUR  
TRACK MARKS INDICATE DISTANCE RUN



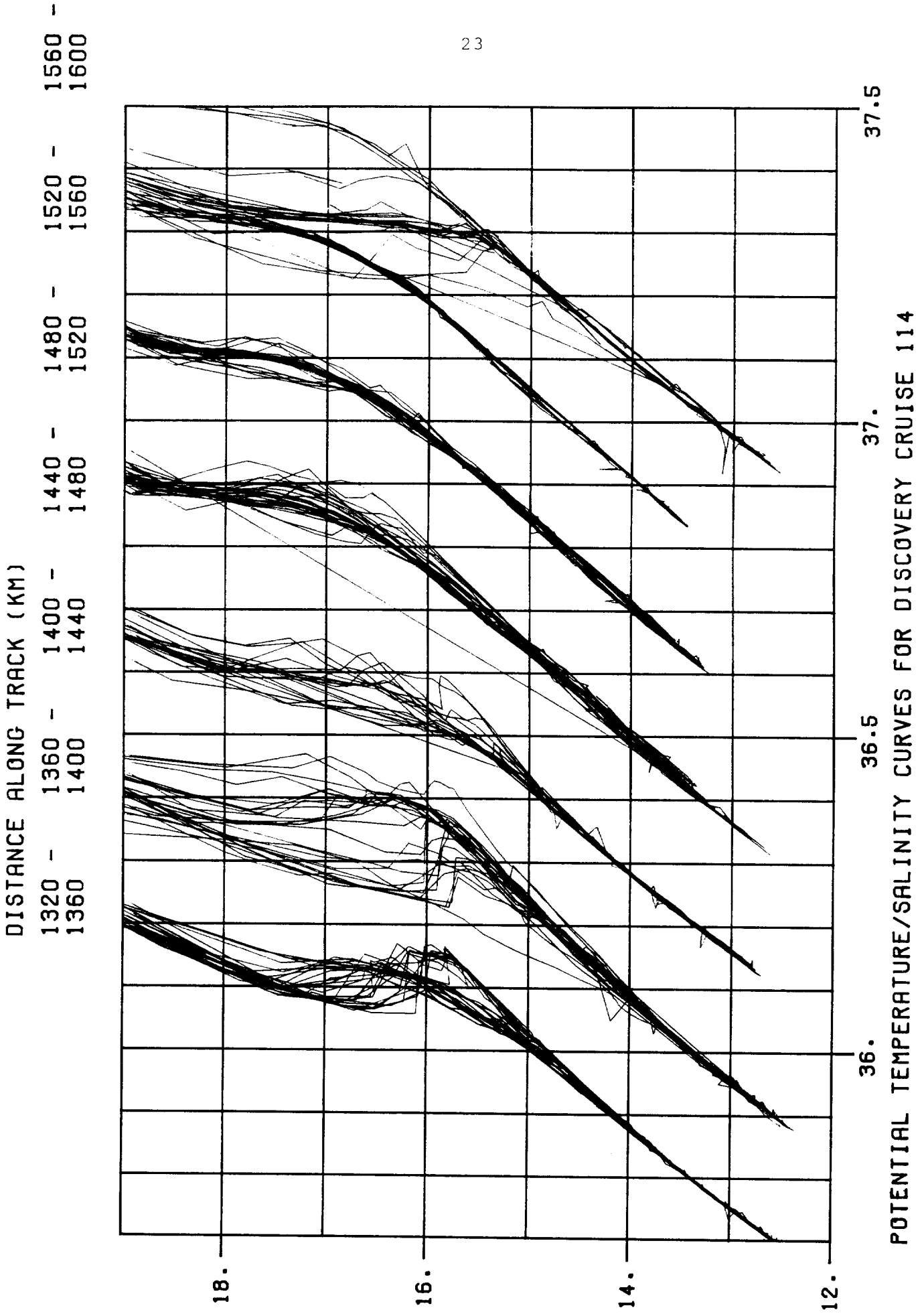


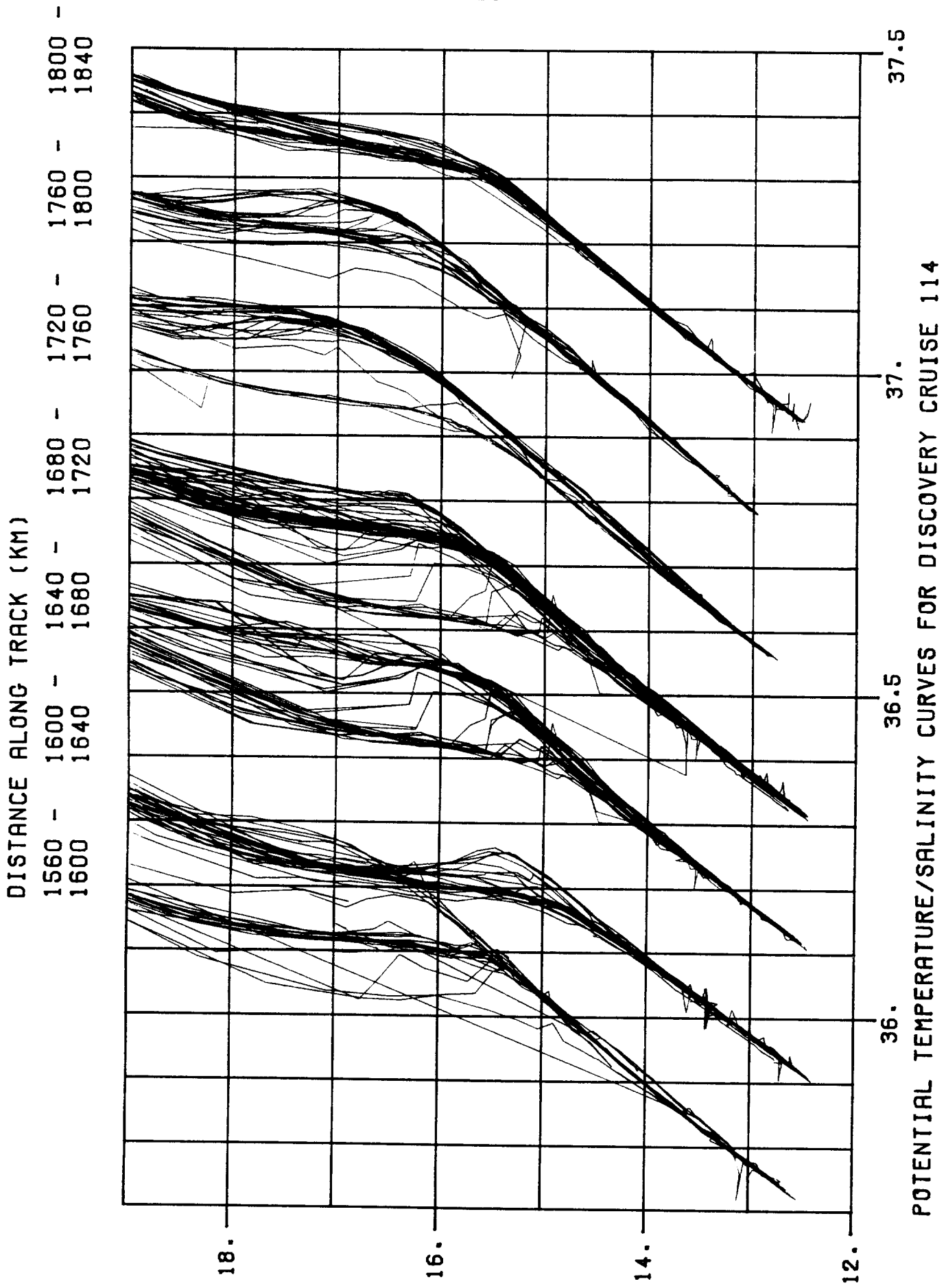






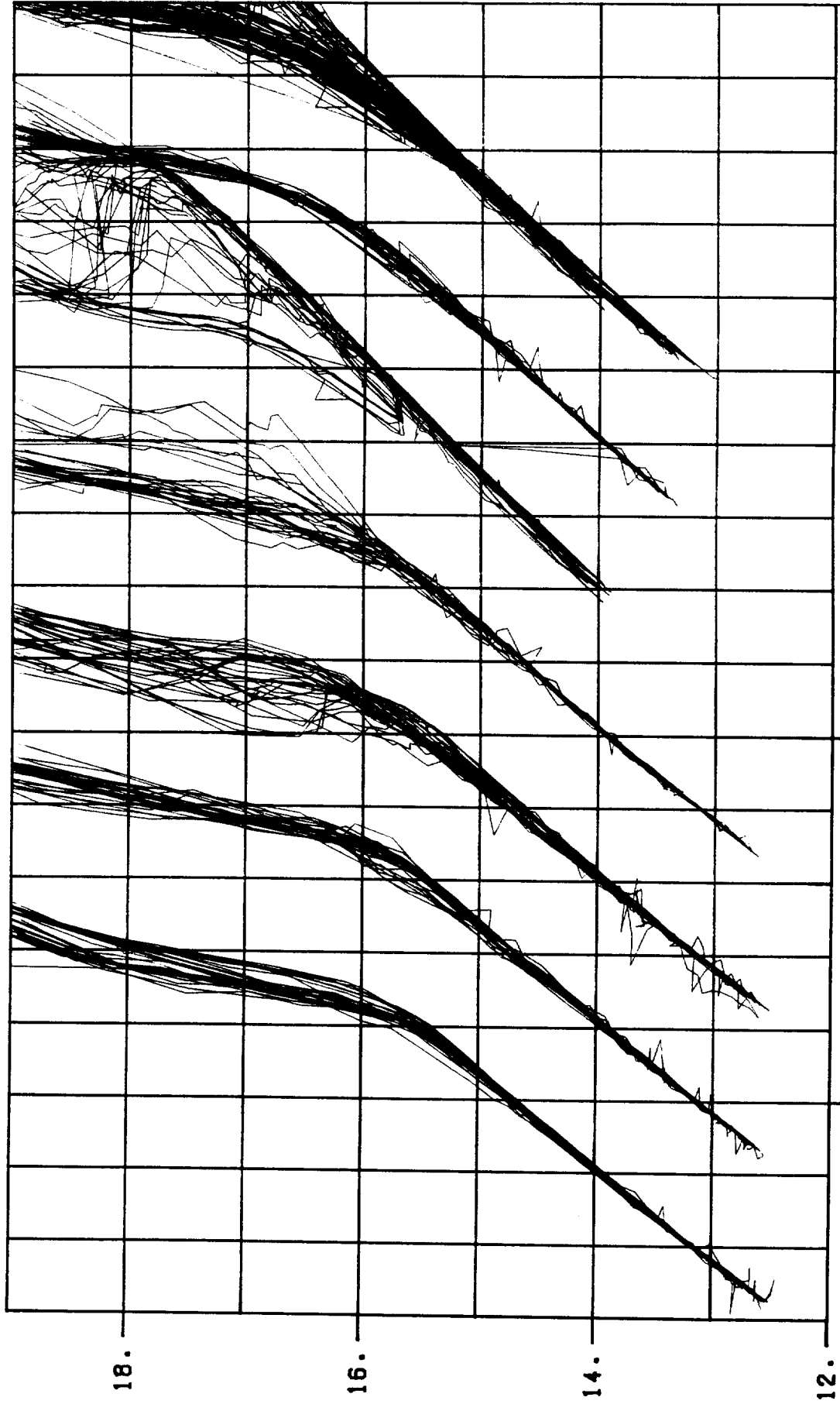






DISTANCE ALONG TRACK (KM)

1800 - 1840 - 1880 - 1920 - 1960 - 2000 - 2040 -  
1840 1880 1920 1960 2000 2040 2080



POTENTIAL TEMPERATURE/SALINITY CURVES FOR DISCOVERY CRUISE 114

37.5

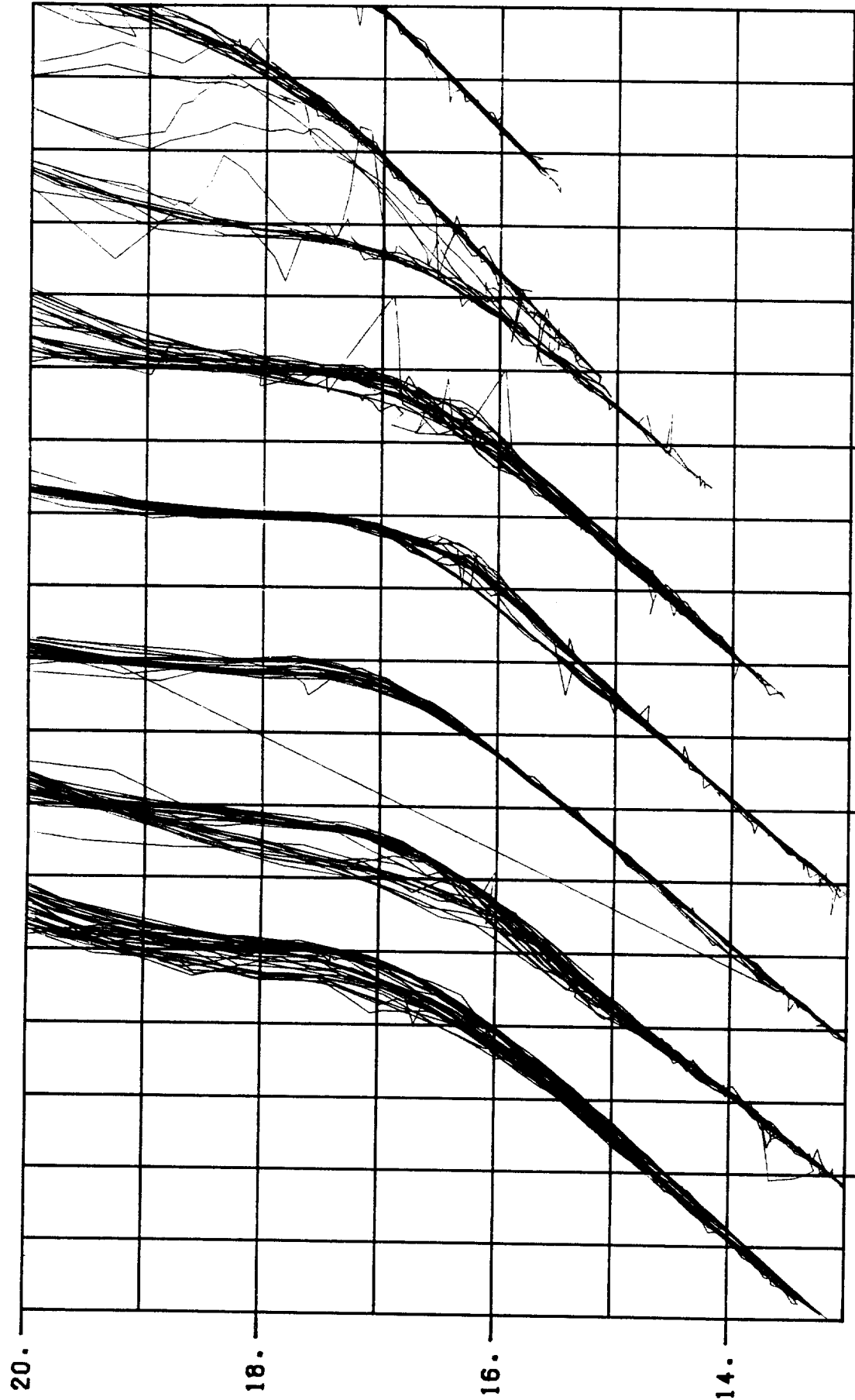
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36.5

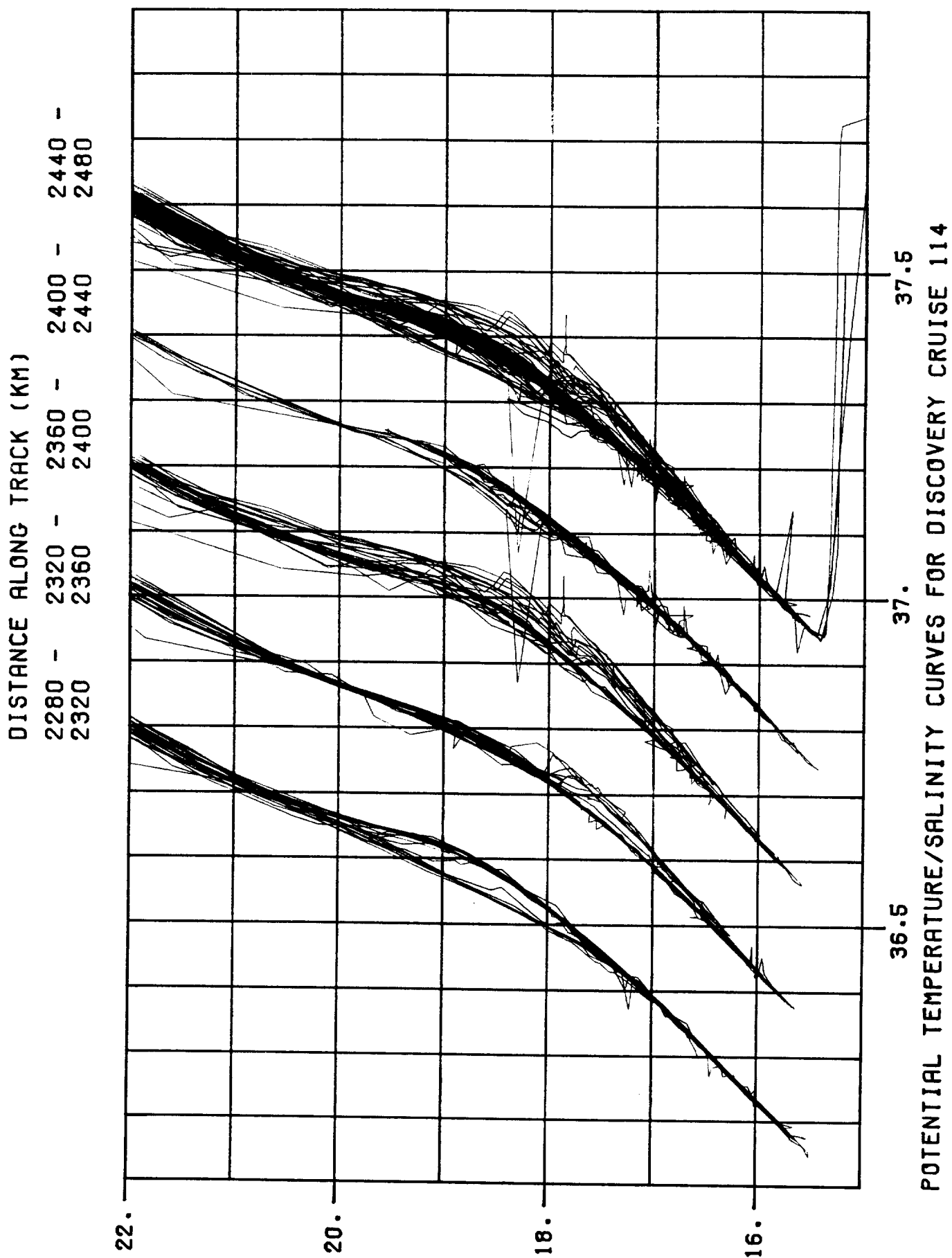
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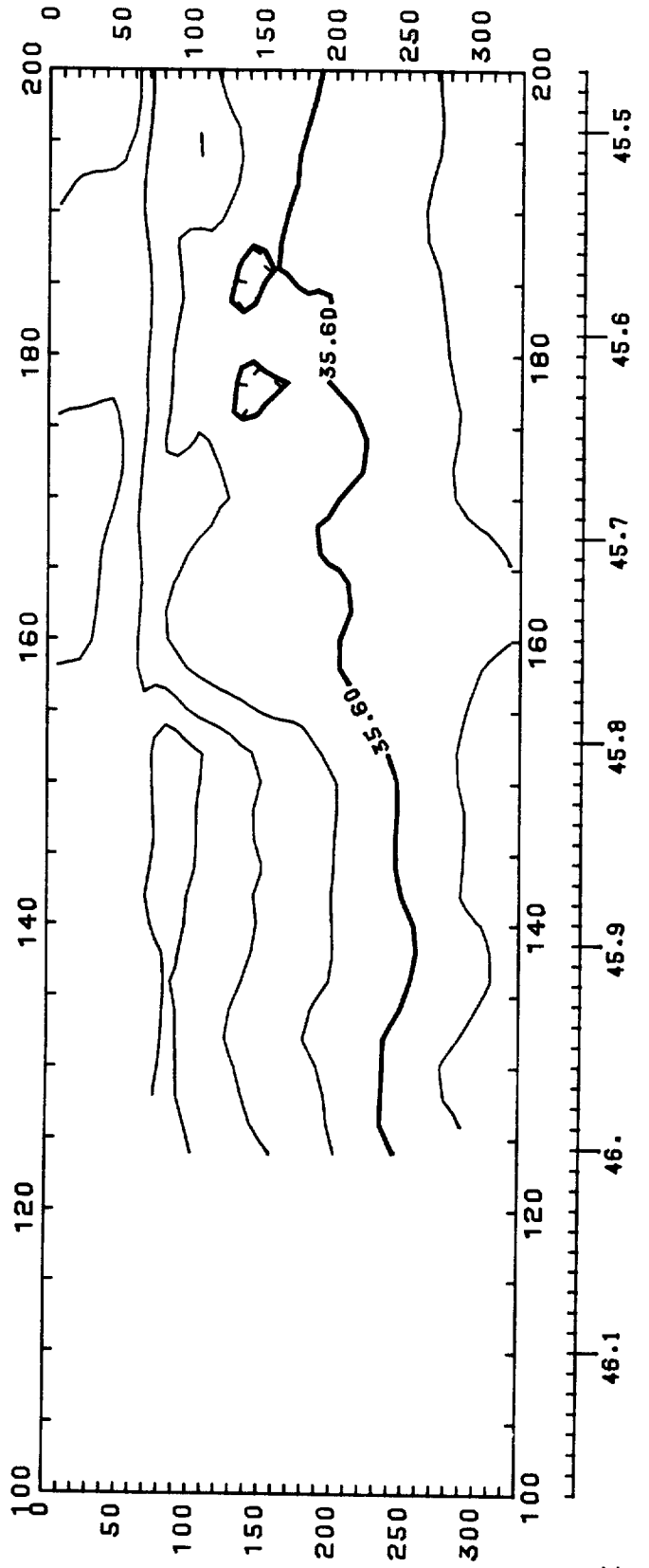
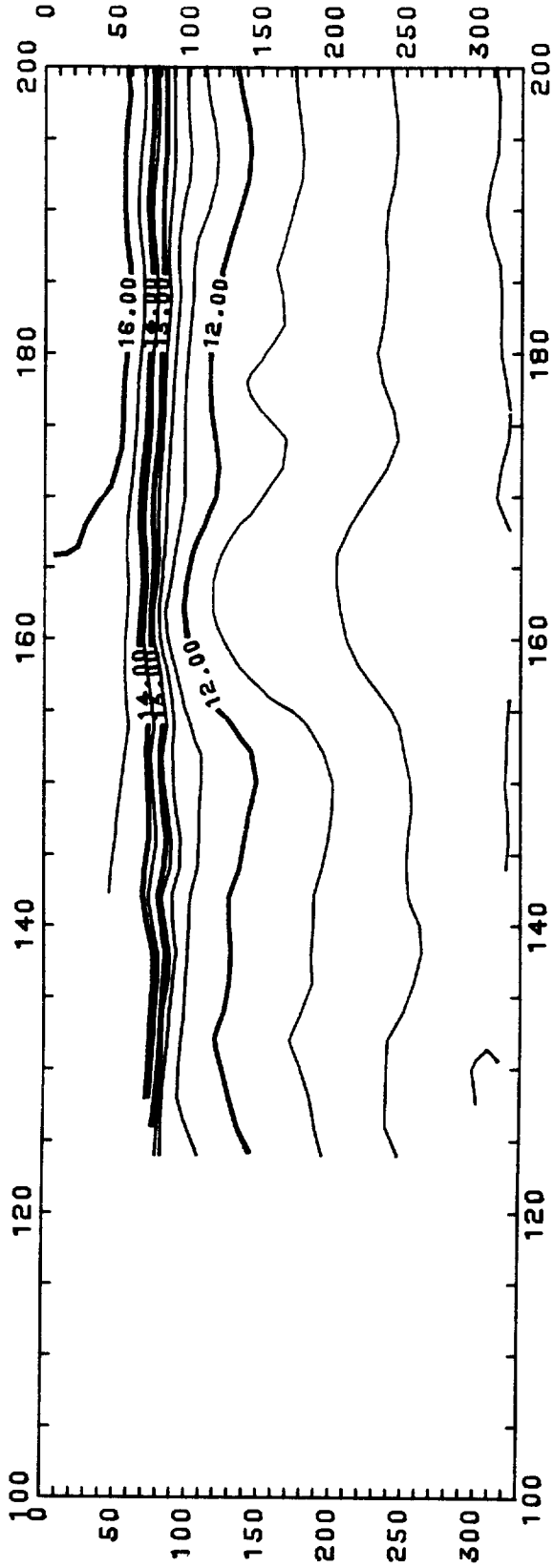
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2080 2120 2160 2200 2240 2280 2320



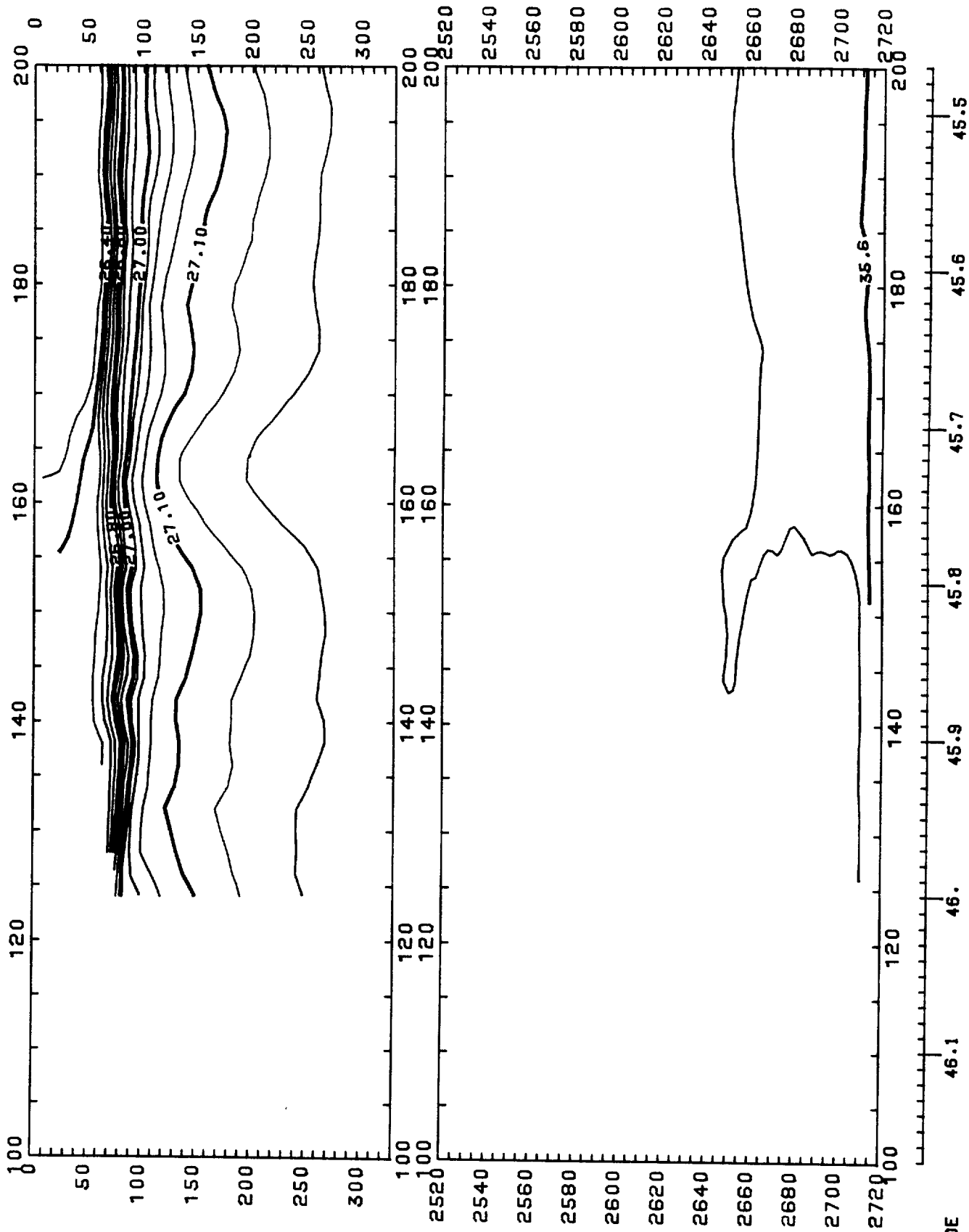
36. 36.5 37. 37.5





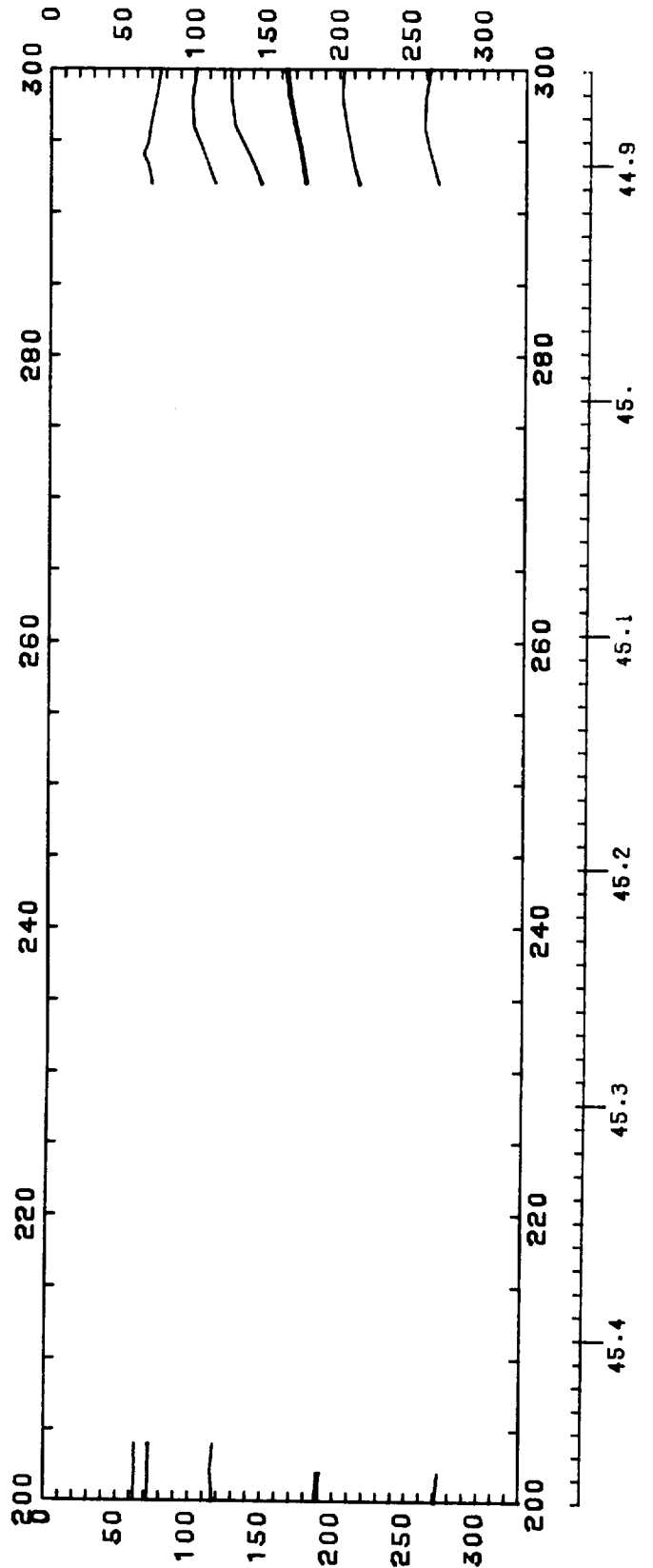
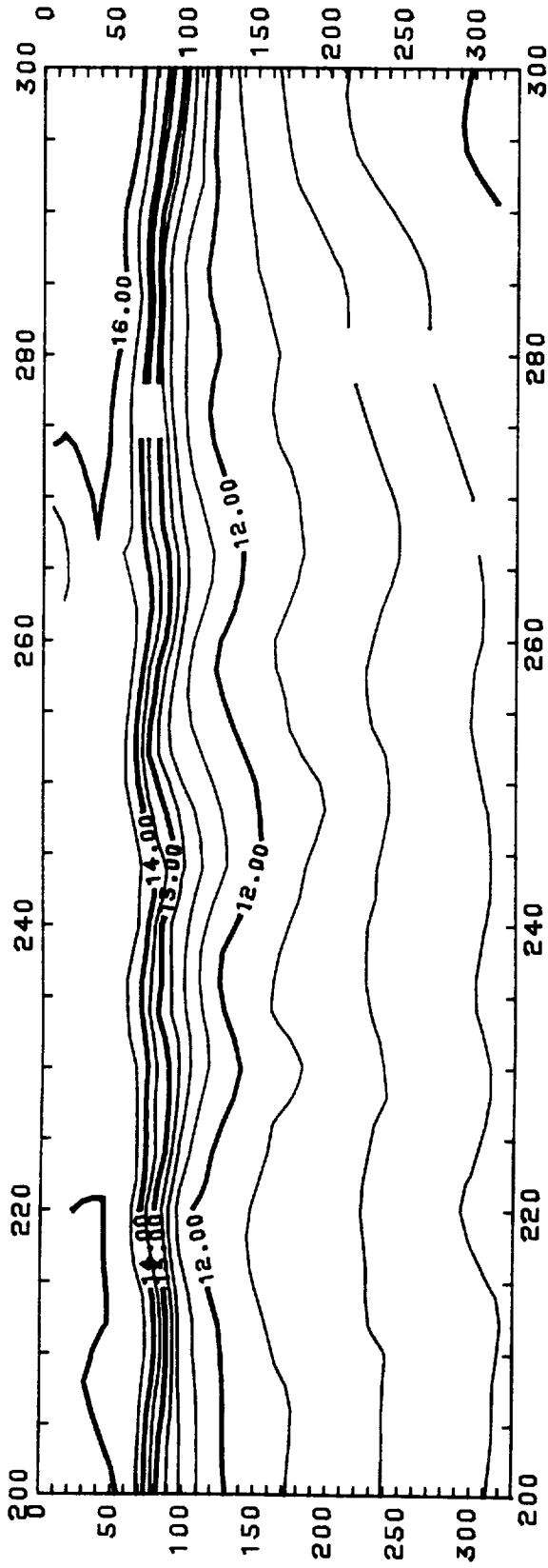
DISCOVERY 114 : OCT 1980 : 100-200 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) ; Y=PRESSURE(DB)

LATITUDE



DISCOVERY 114 : OCT 1980 : 100-200 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=C(S)

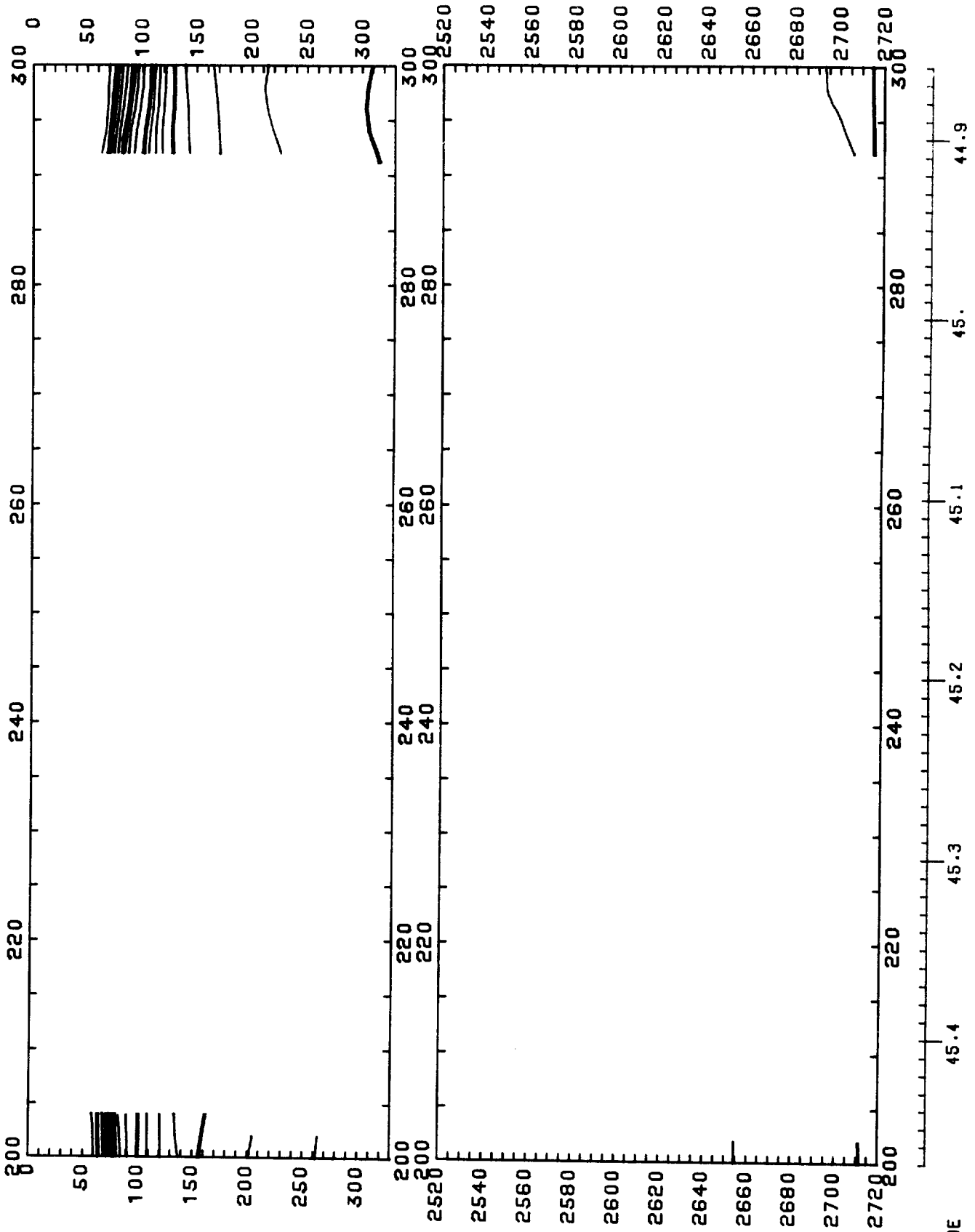
LATITUDE



DISCOVERY 114 : OCT 1980 : 200-300 KM  
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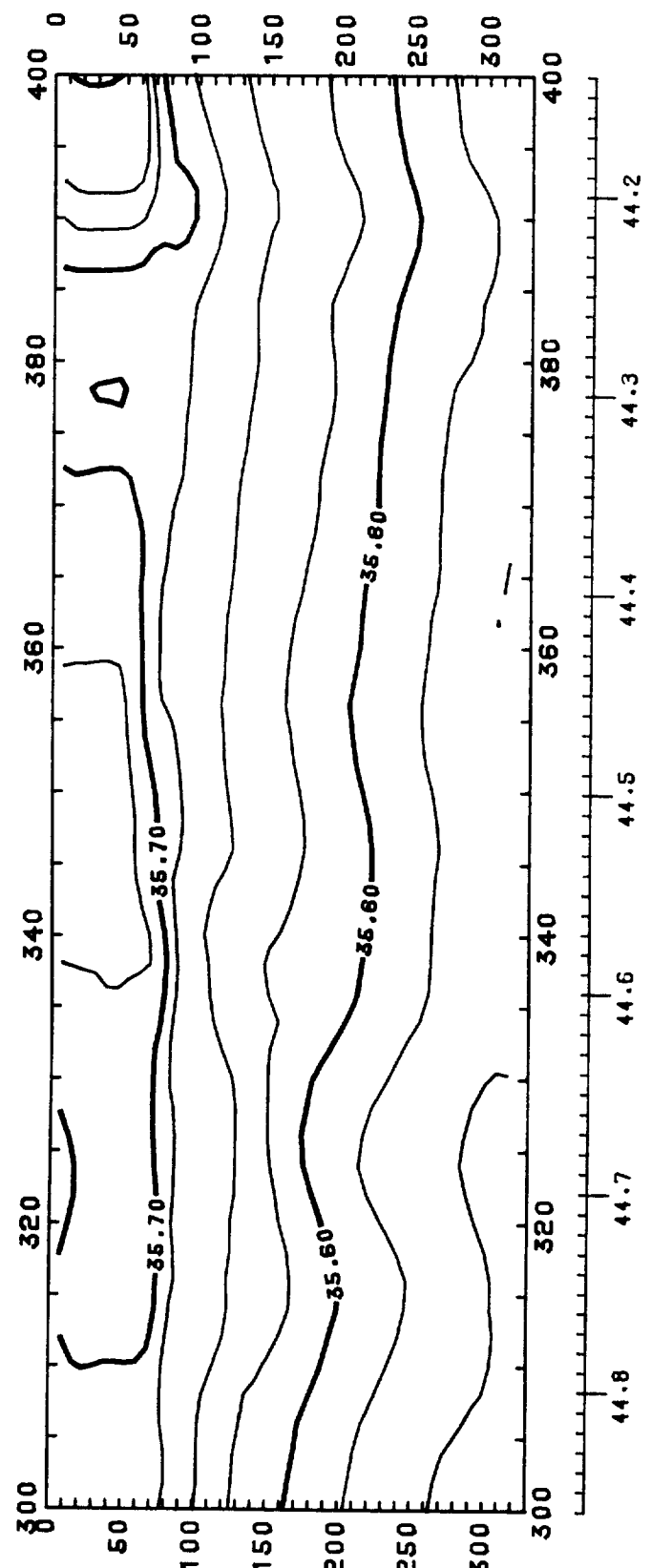
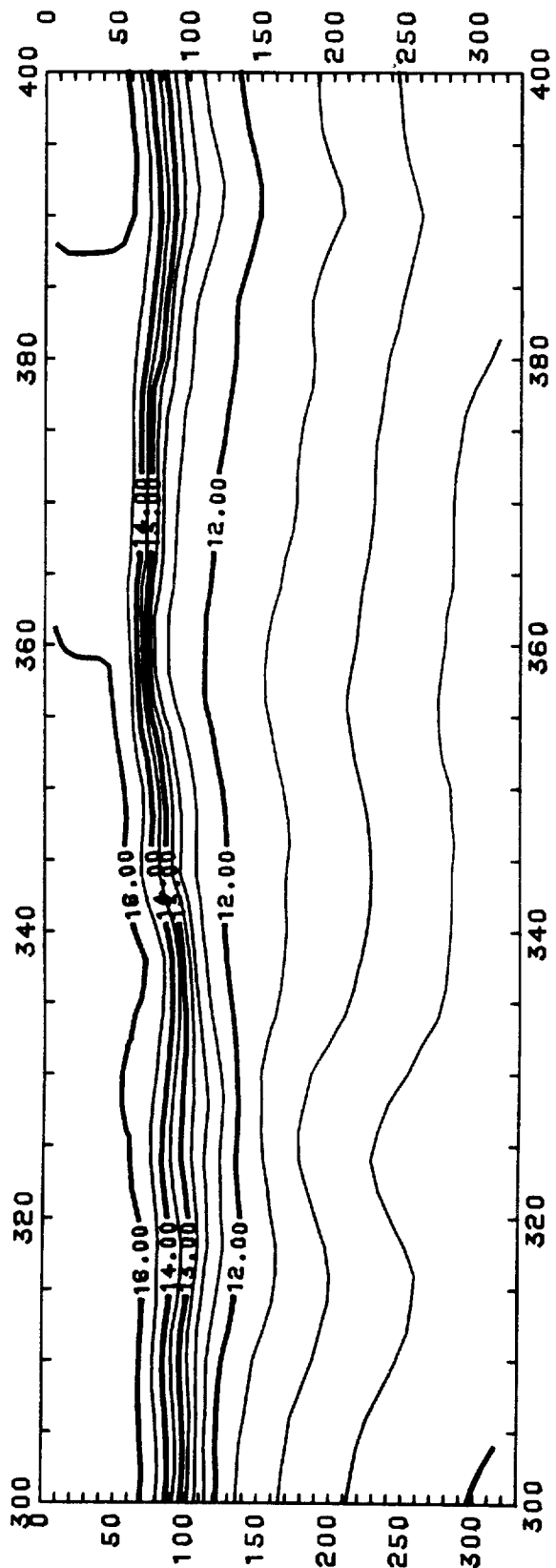
LATITUDE





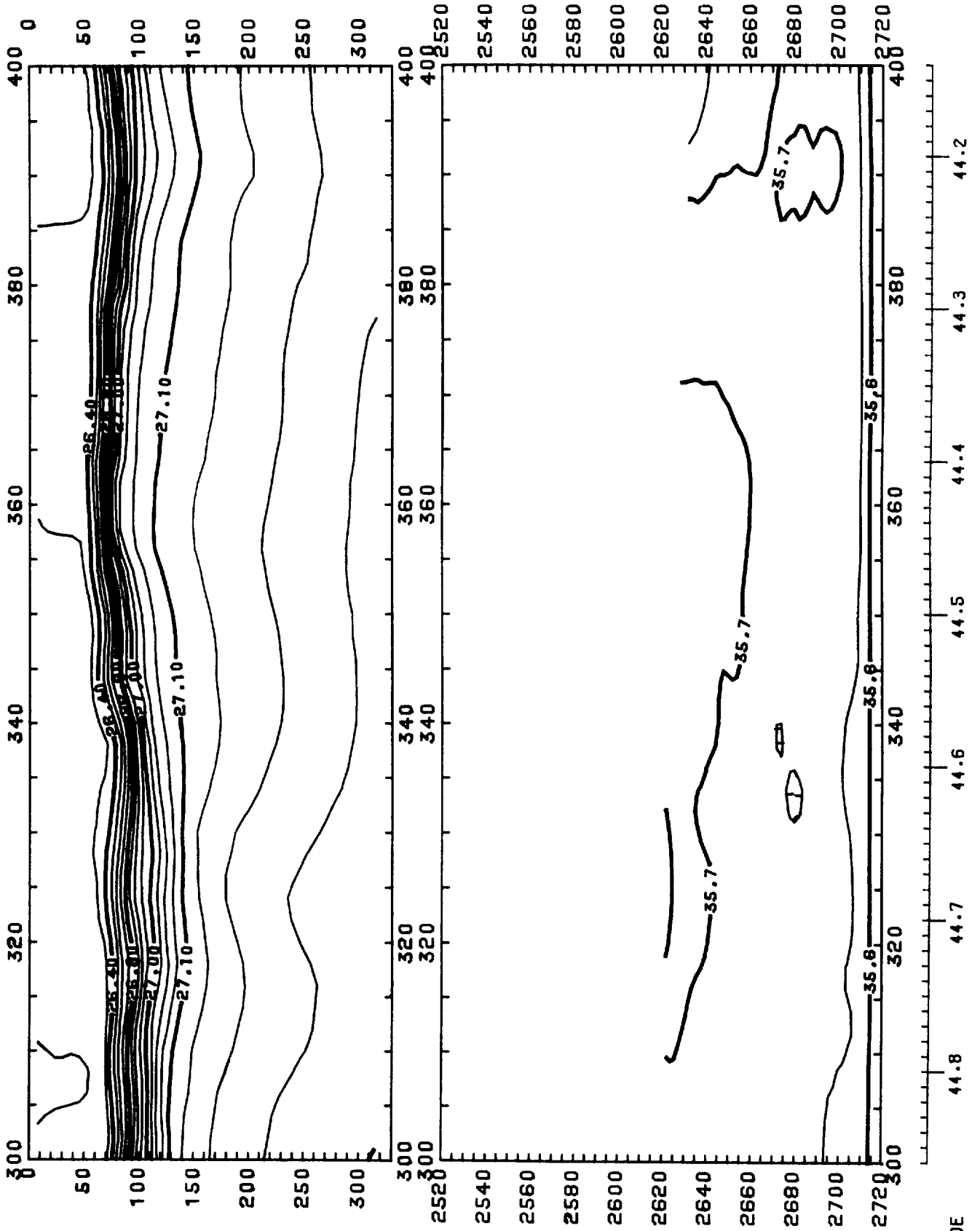
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 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LATITUDE



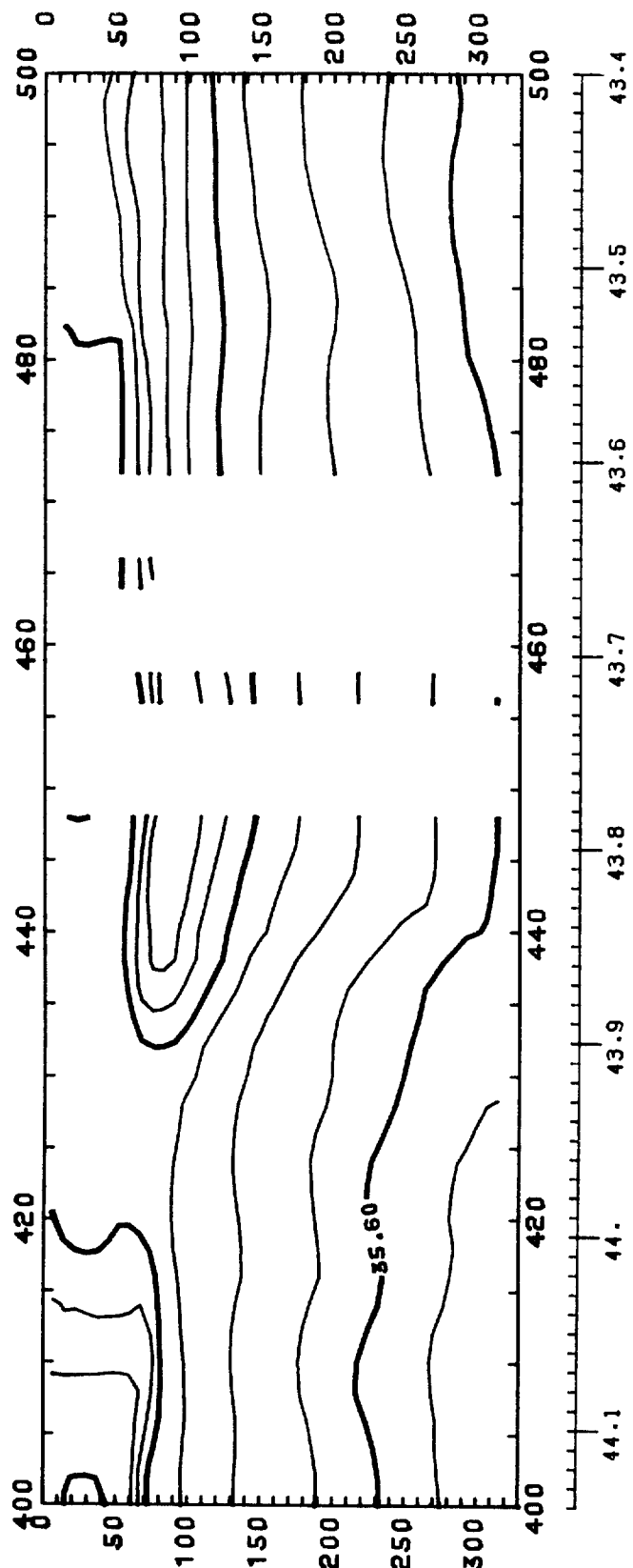
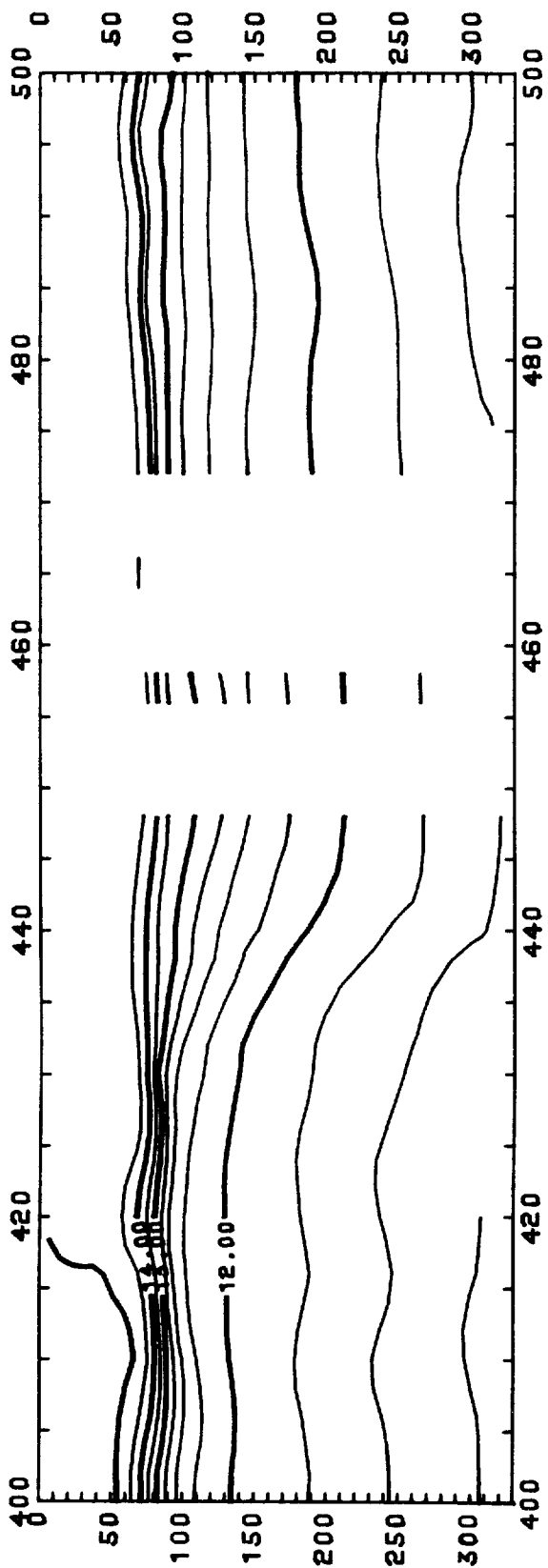
DISCOVERY 114 : OCT 1980 : 300-400 KM  
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 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE



DISCOVERY 114 : OCT 1980 : 300-400 KM  
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 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

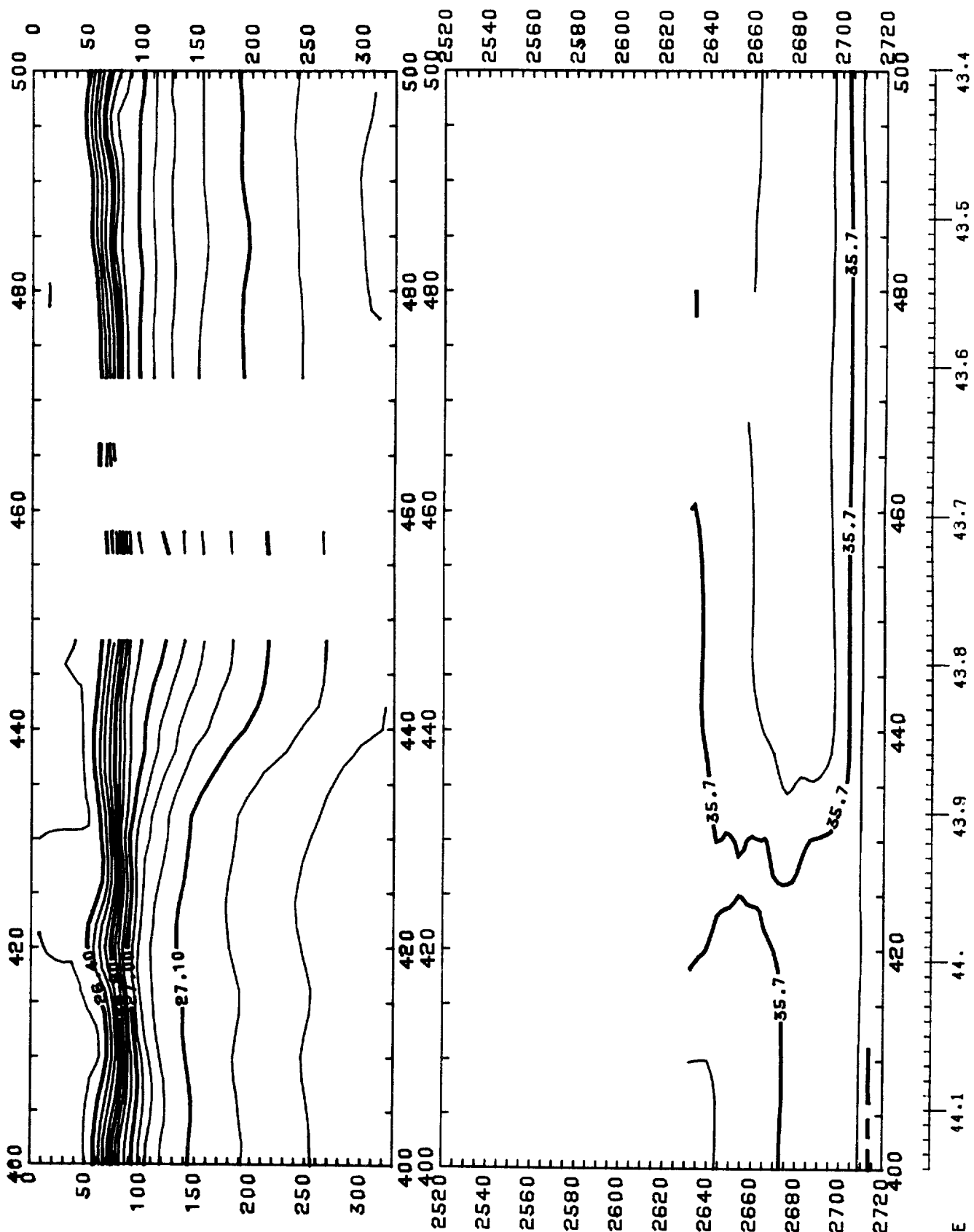
LATITUDE



DISCOVERY 114 : OCT 1980 : 400-500 KM  
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 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

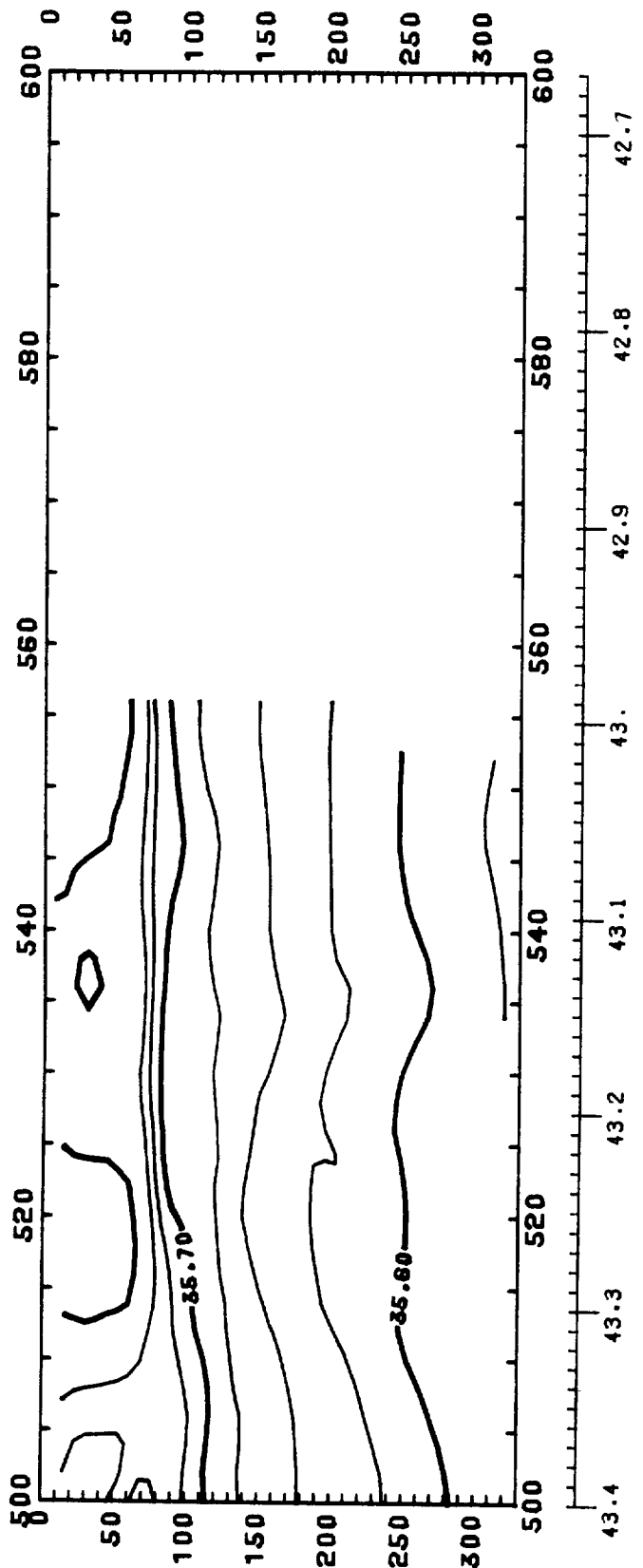
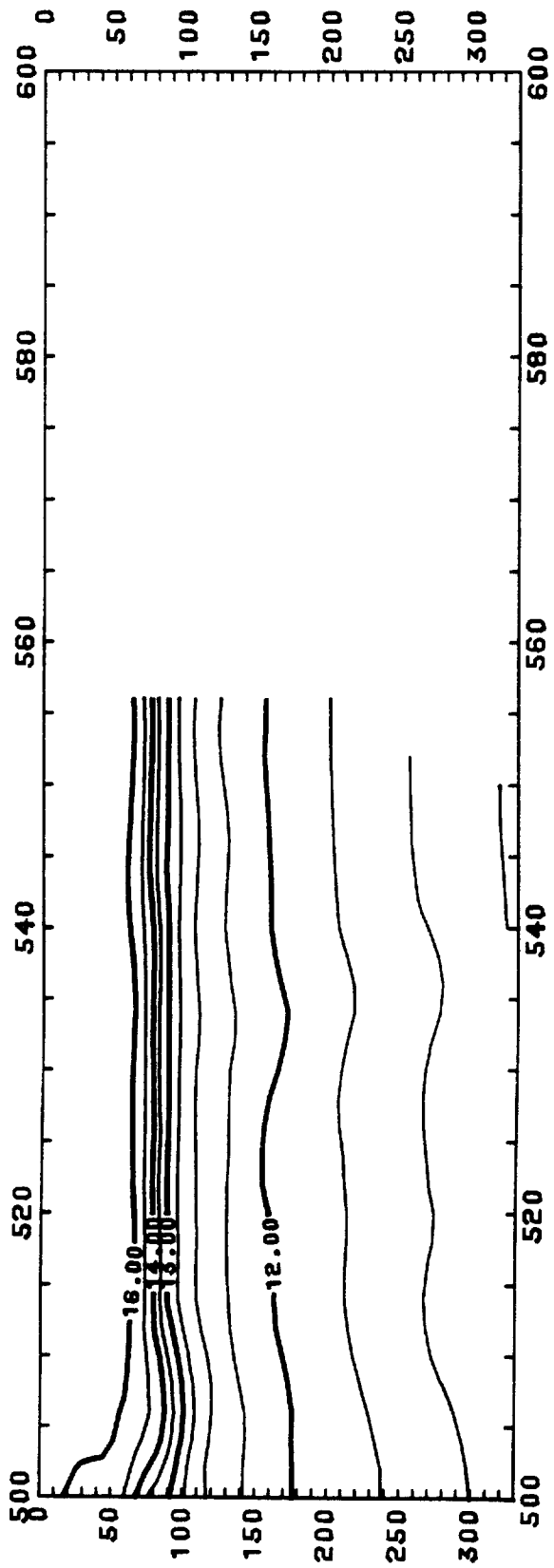
LATITUDE





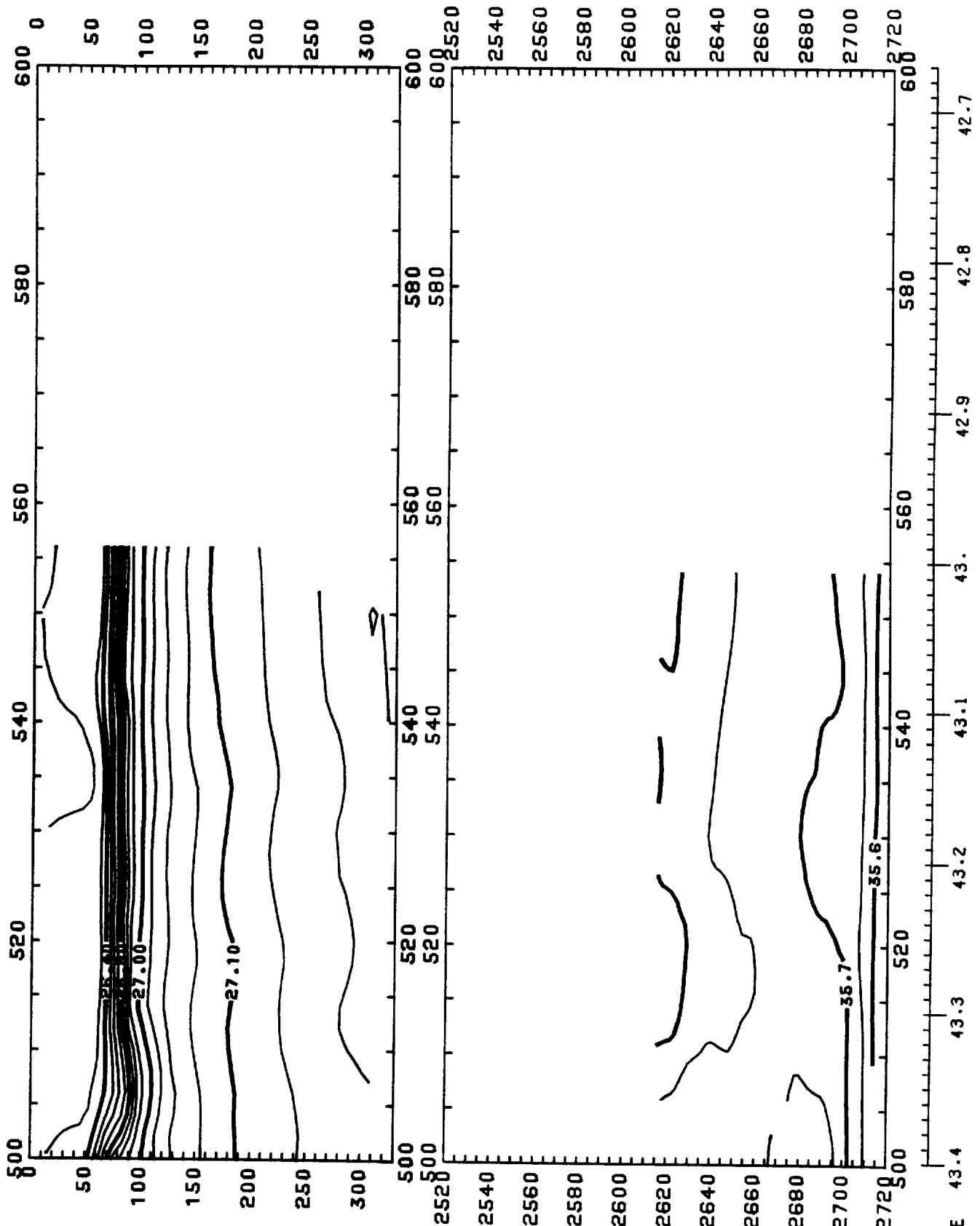
DISCOVERY 114 : OCT 1980 : 400-500 KM  
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 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LATITUDE



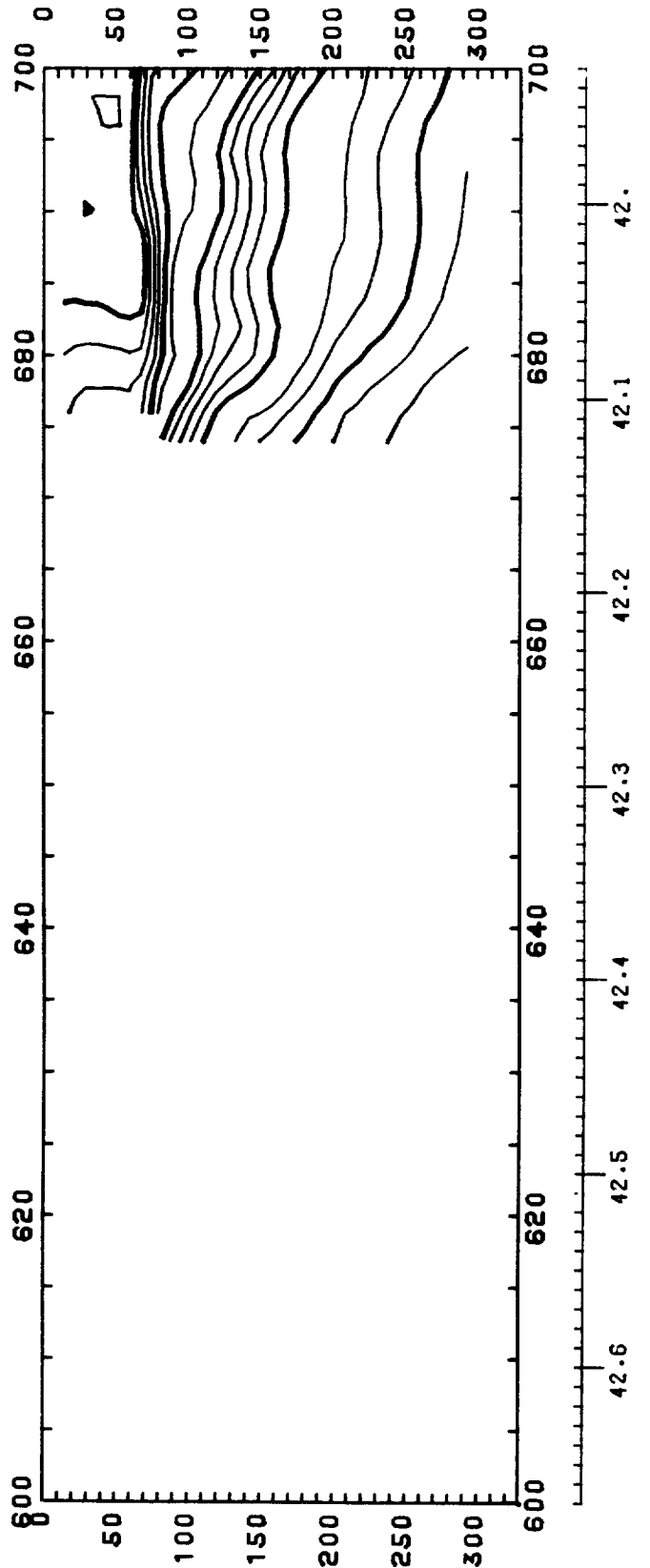
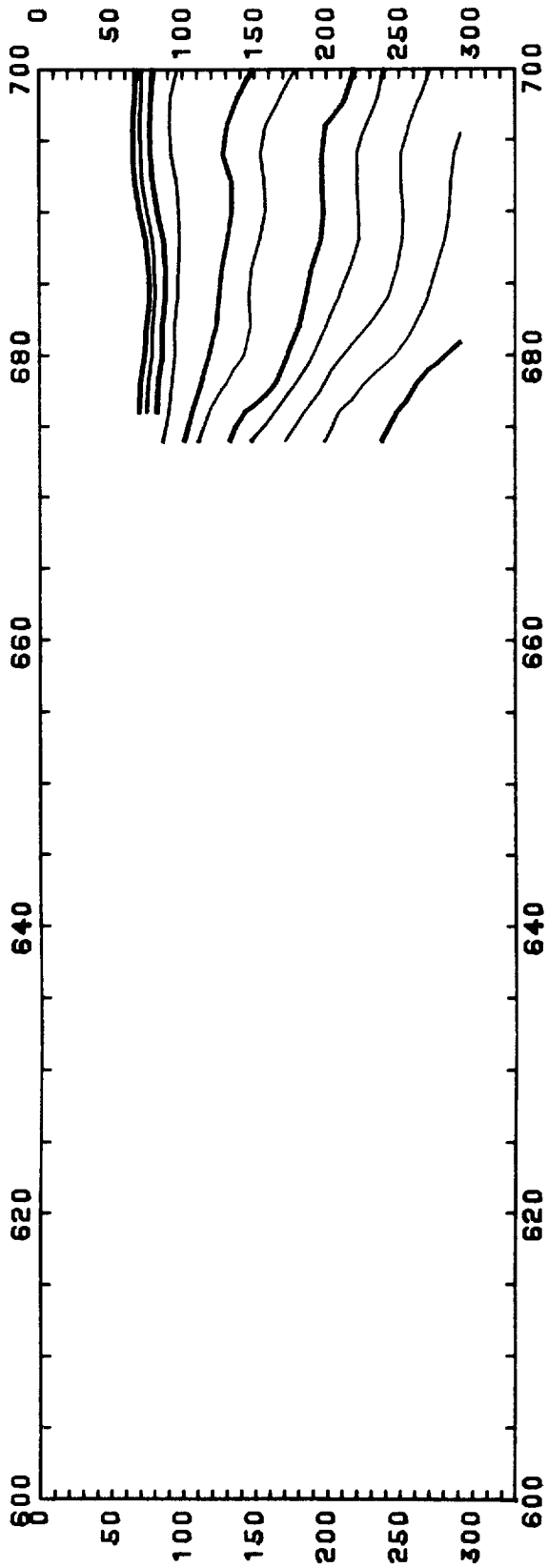
DISCOVERY 114 : OCT 1980 : 500-600 KM  
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 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE



DISCOVERY 114 : OCT 1980 : 500-600 KM  
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 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

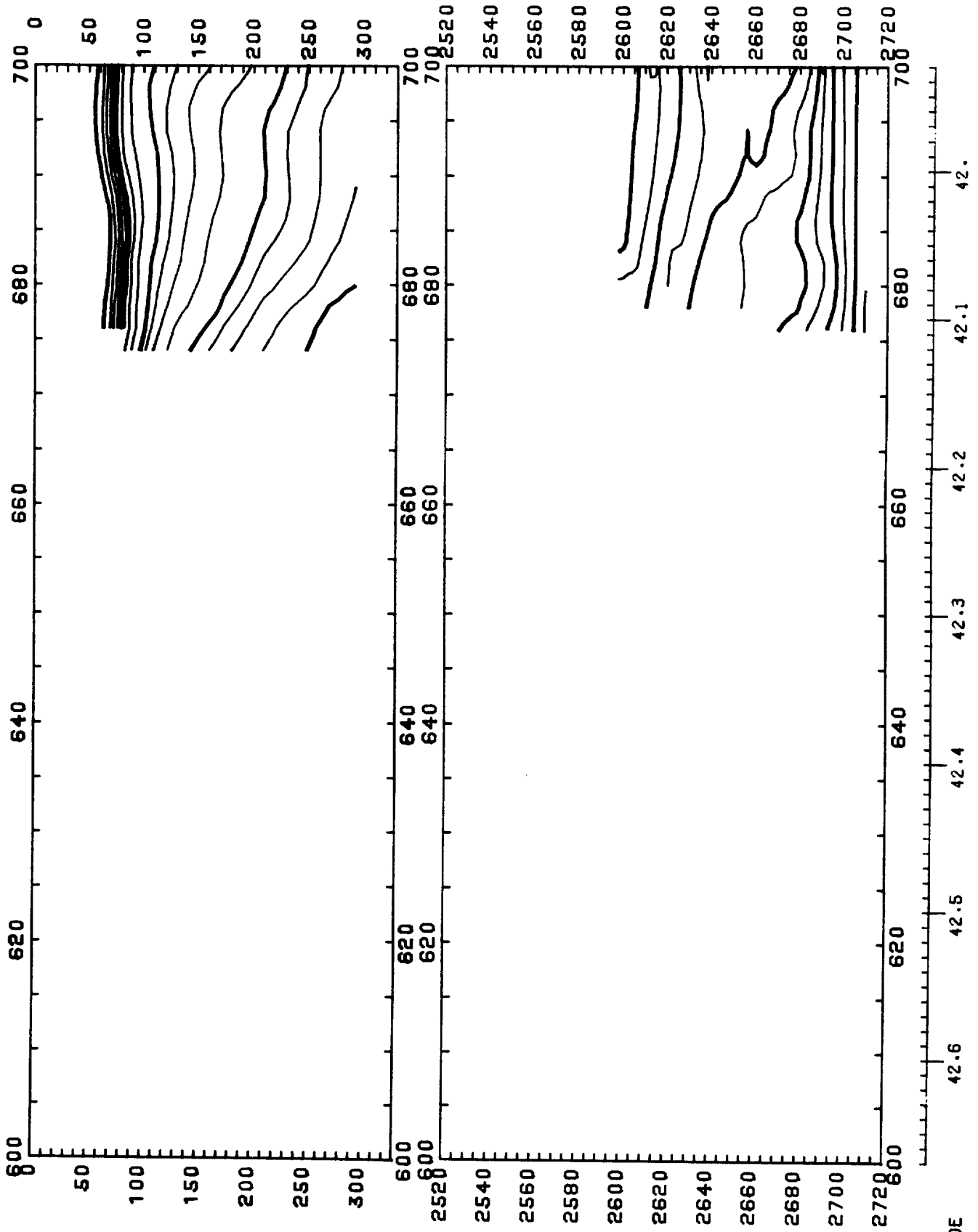
LATITUDE 43.4 43.3 43.2 43.1 42.9 42.8 42.7



DISCOVERY 114 : OCT 1980 : 600-700 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

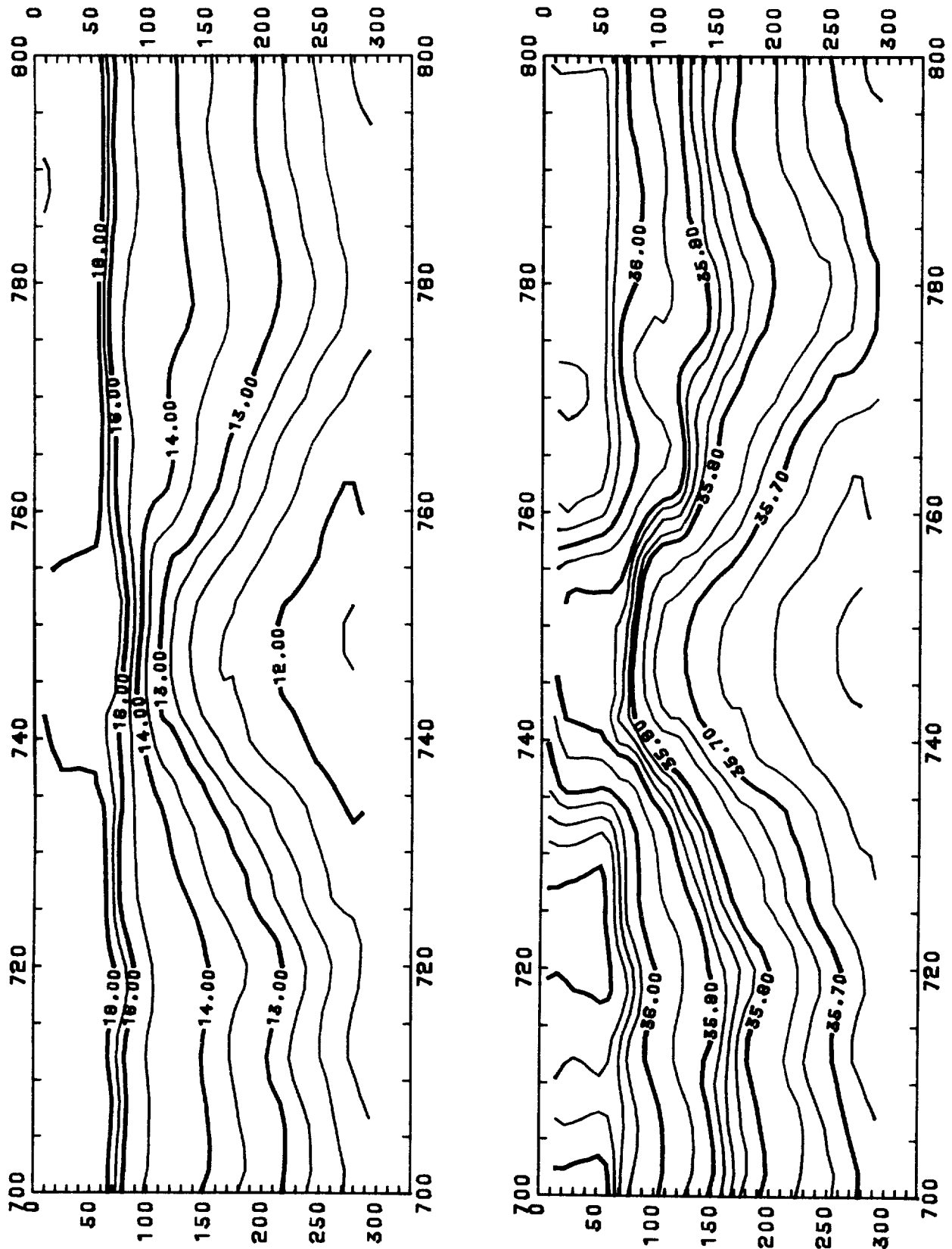
LATITUDE





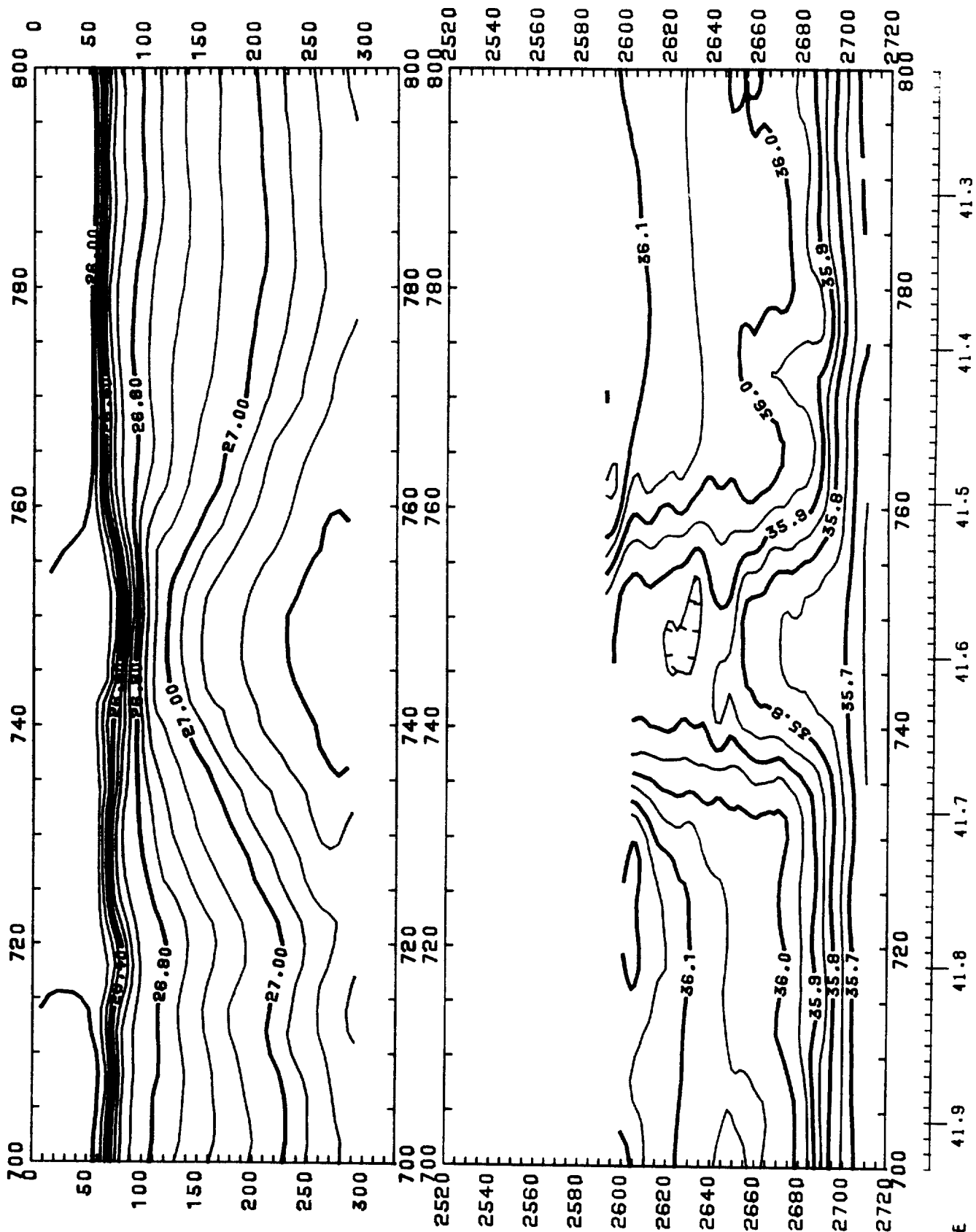
DISCOVERY 114 : OCT 1980 : 600-700 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LATITUDE



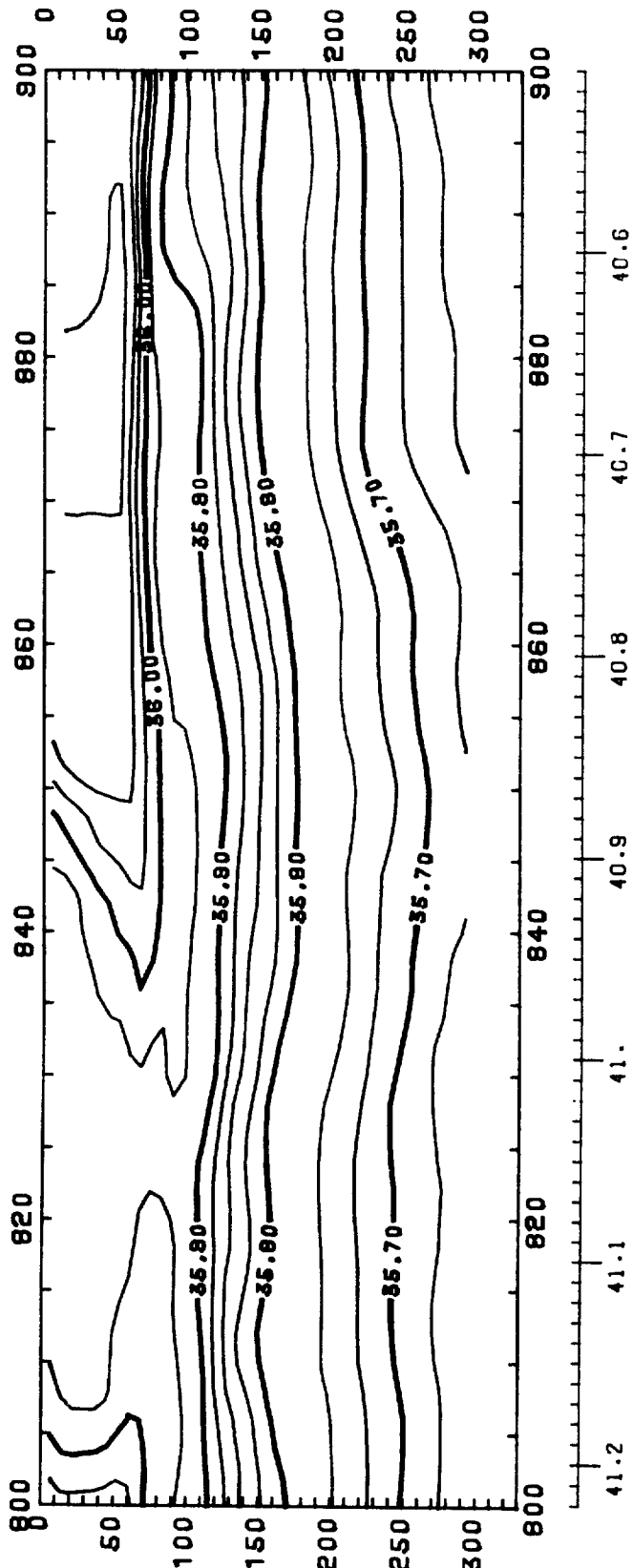
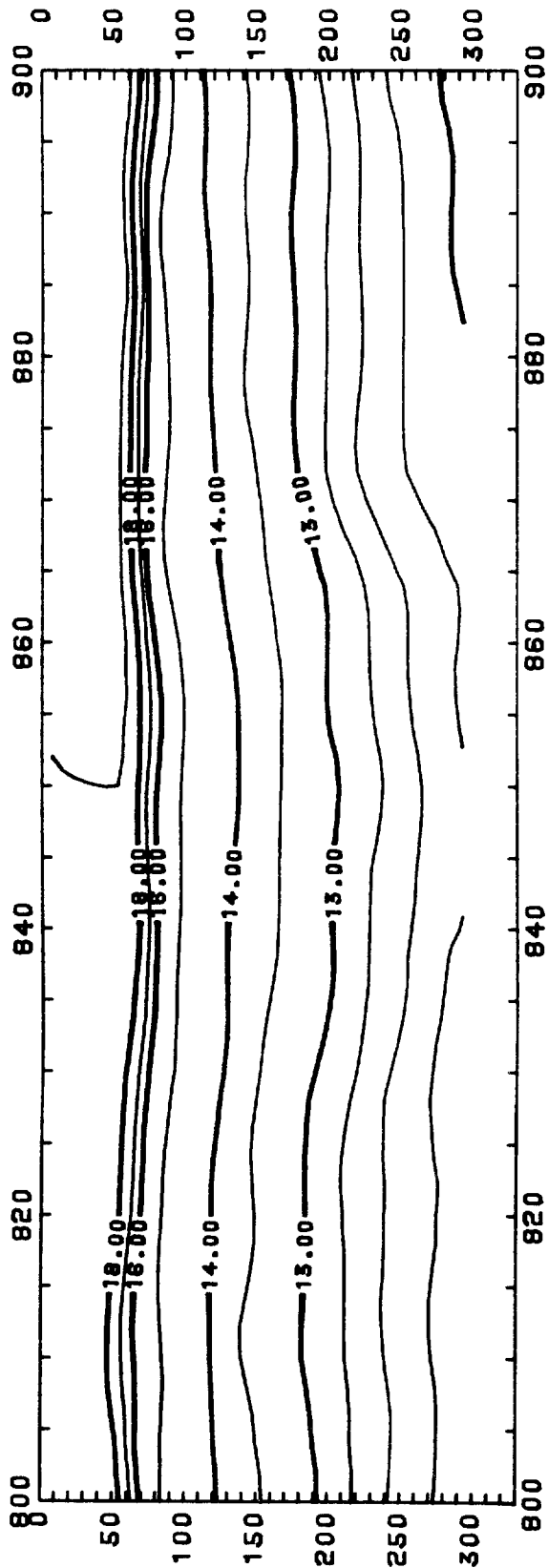
DISCOVERY 114 : OCT 1980 : 700-800 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE  
 41.9 41.8 41.7 41.6 41.5 41.4 41.3



DISCOVERY 114 : OCT 1980 : 700-800 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA\*100(CGS)

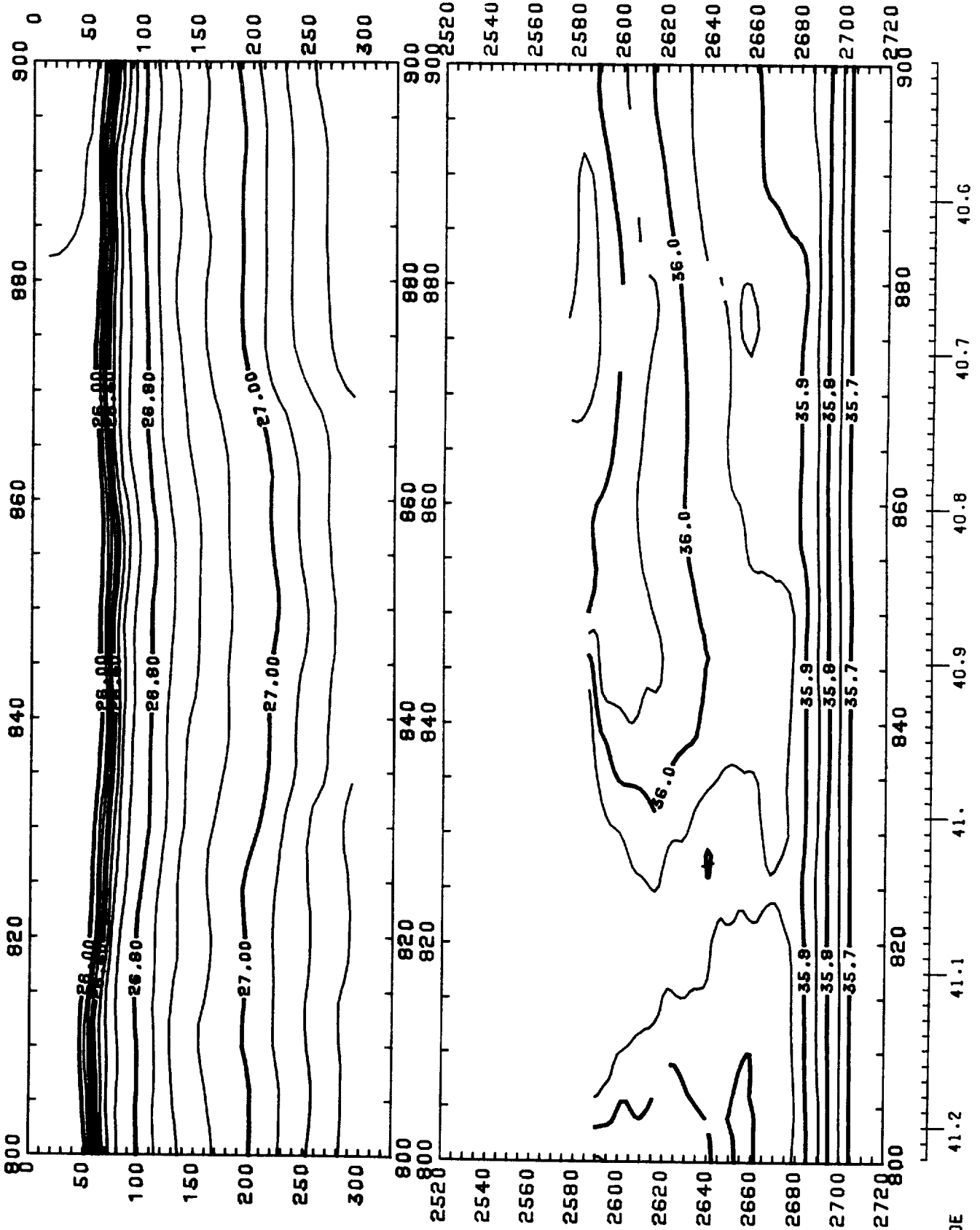
LATITUDE



DISCOVERY 114 : OCT 1980 : 800-900 KM  
===== === === =====  
CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

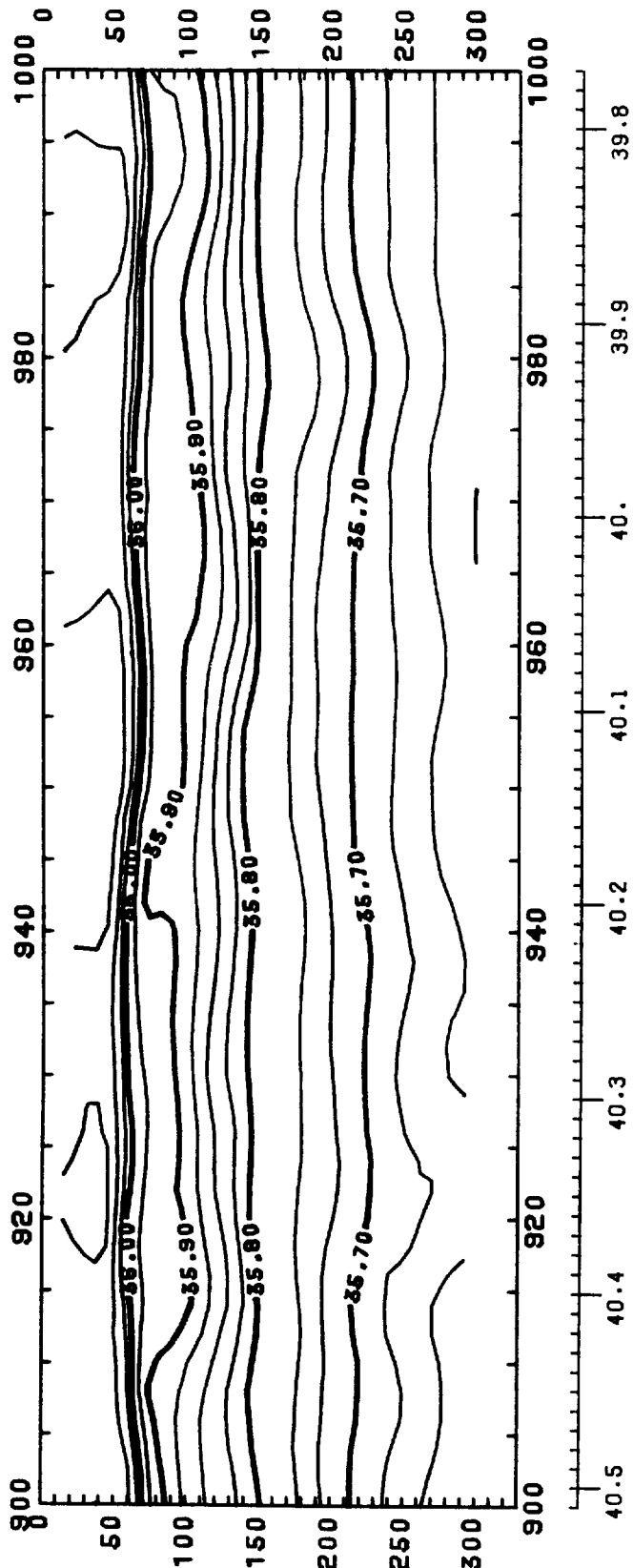
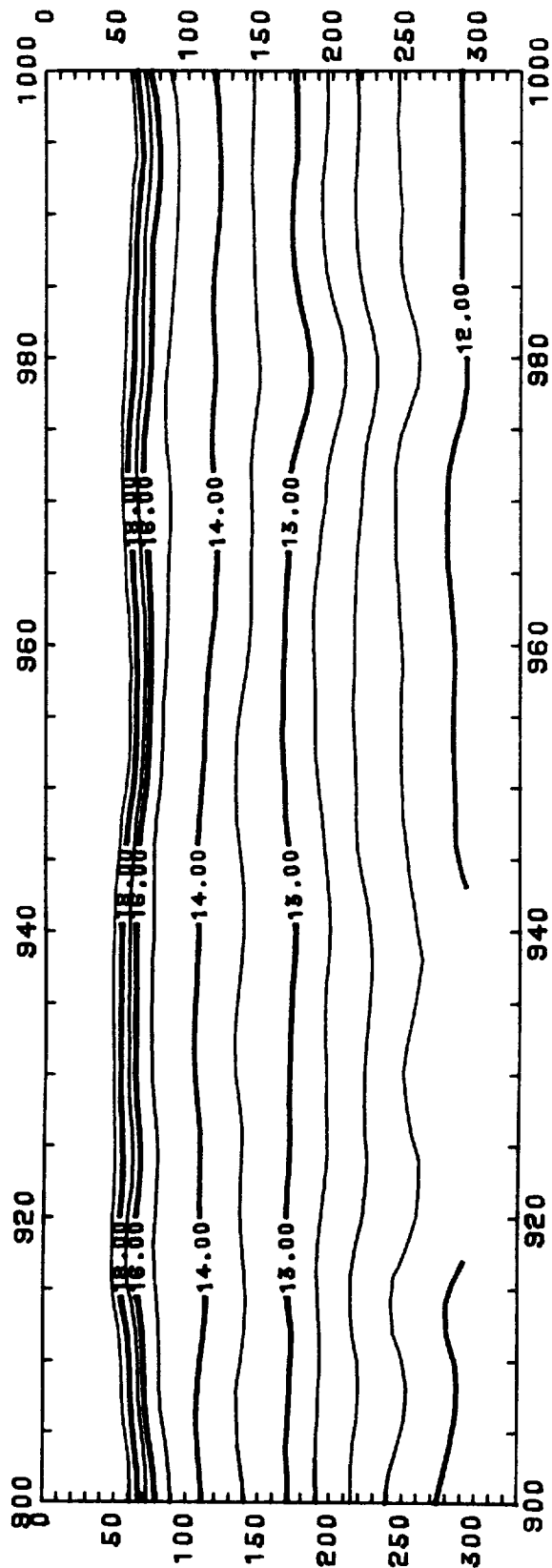
LATITUDE

41.2 41.1 40.9 40.8 40.7 40.6



DISCOVERY 114 : OCT 1980 : 800-900 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LATITUDE



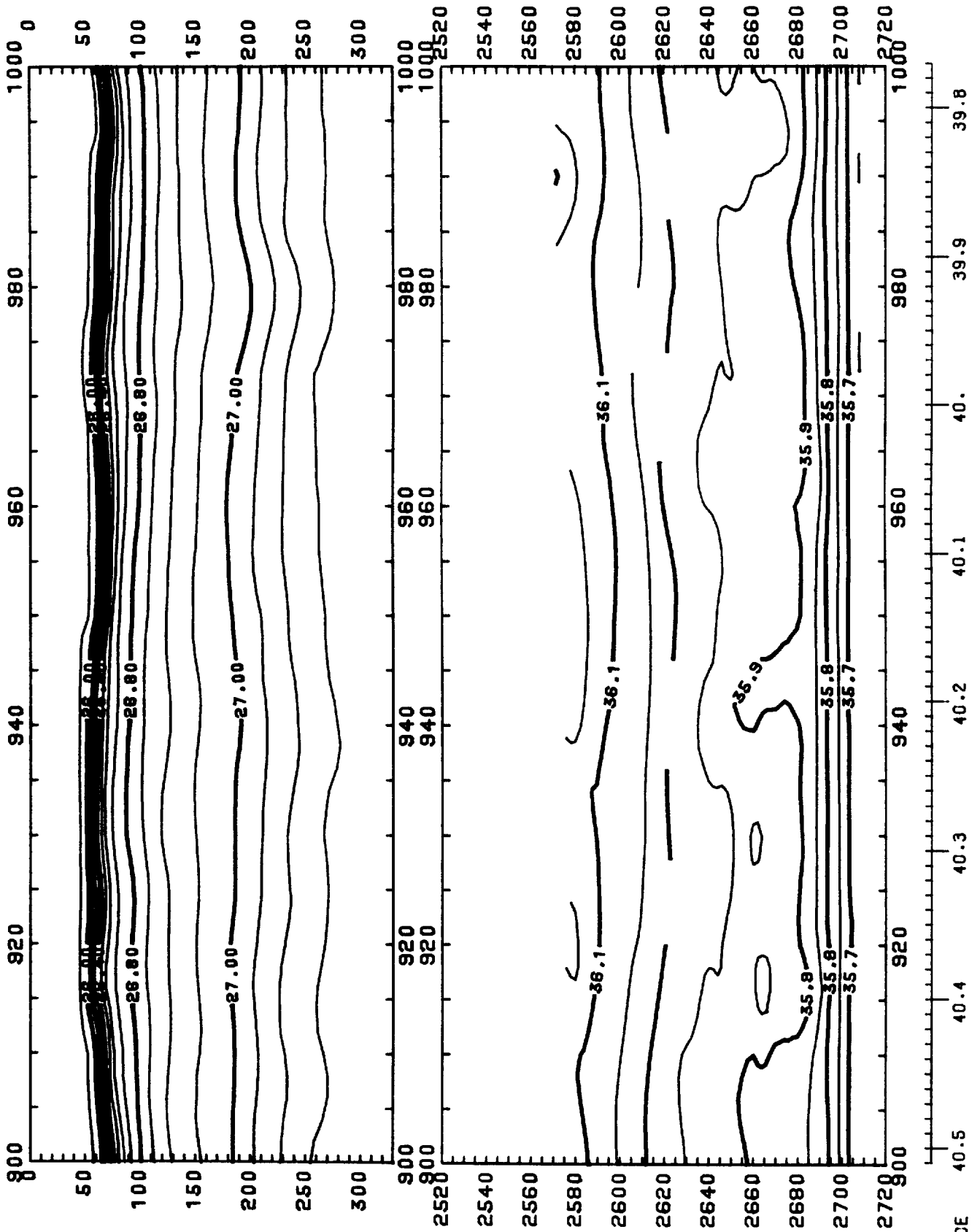
DISCOVERY 114 : OCT 1980 : 900-1000 KM

=====

CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)

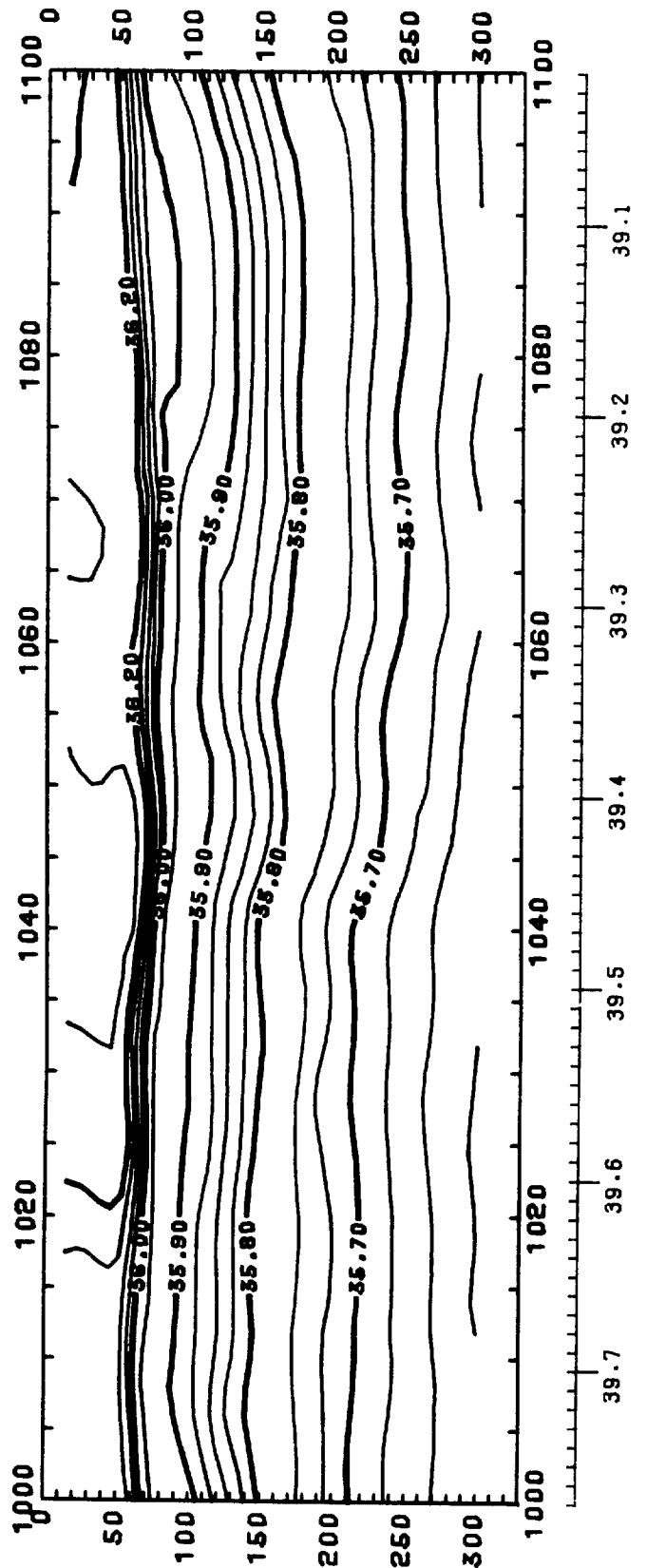
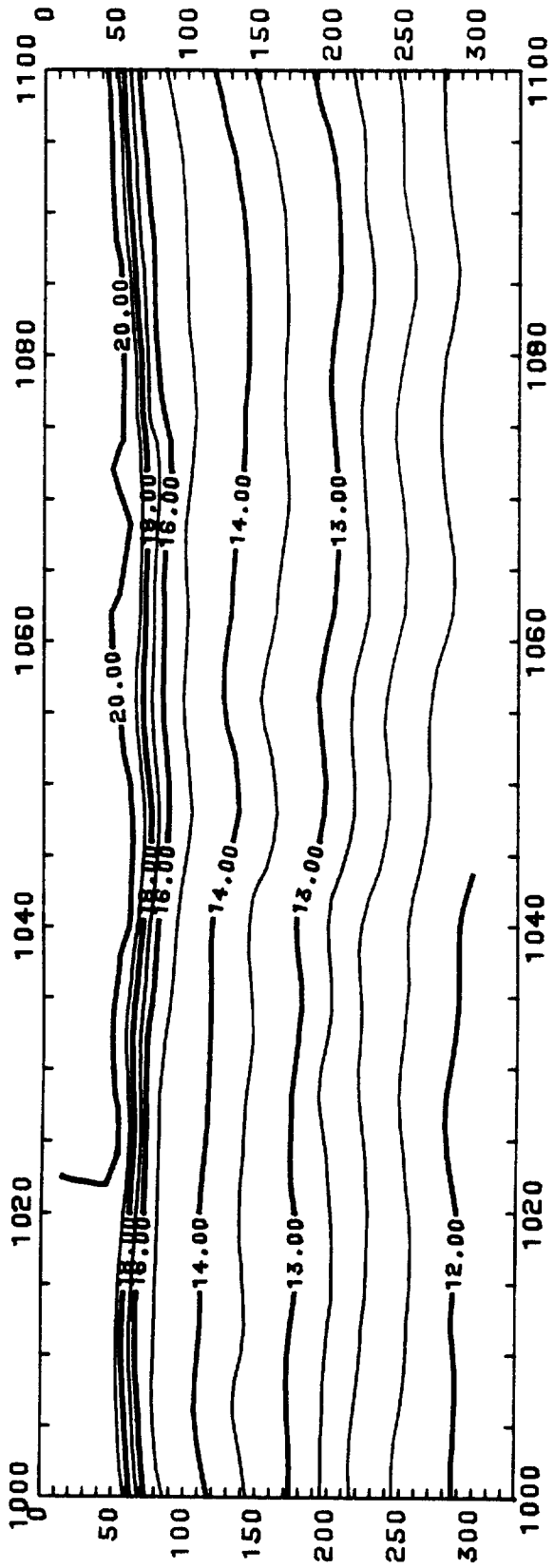
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE



DISCOVERY 114 : OCT 1980 : 900-1000 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

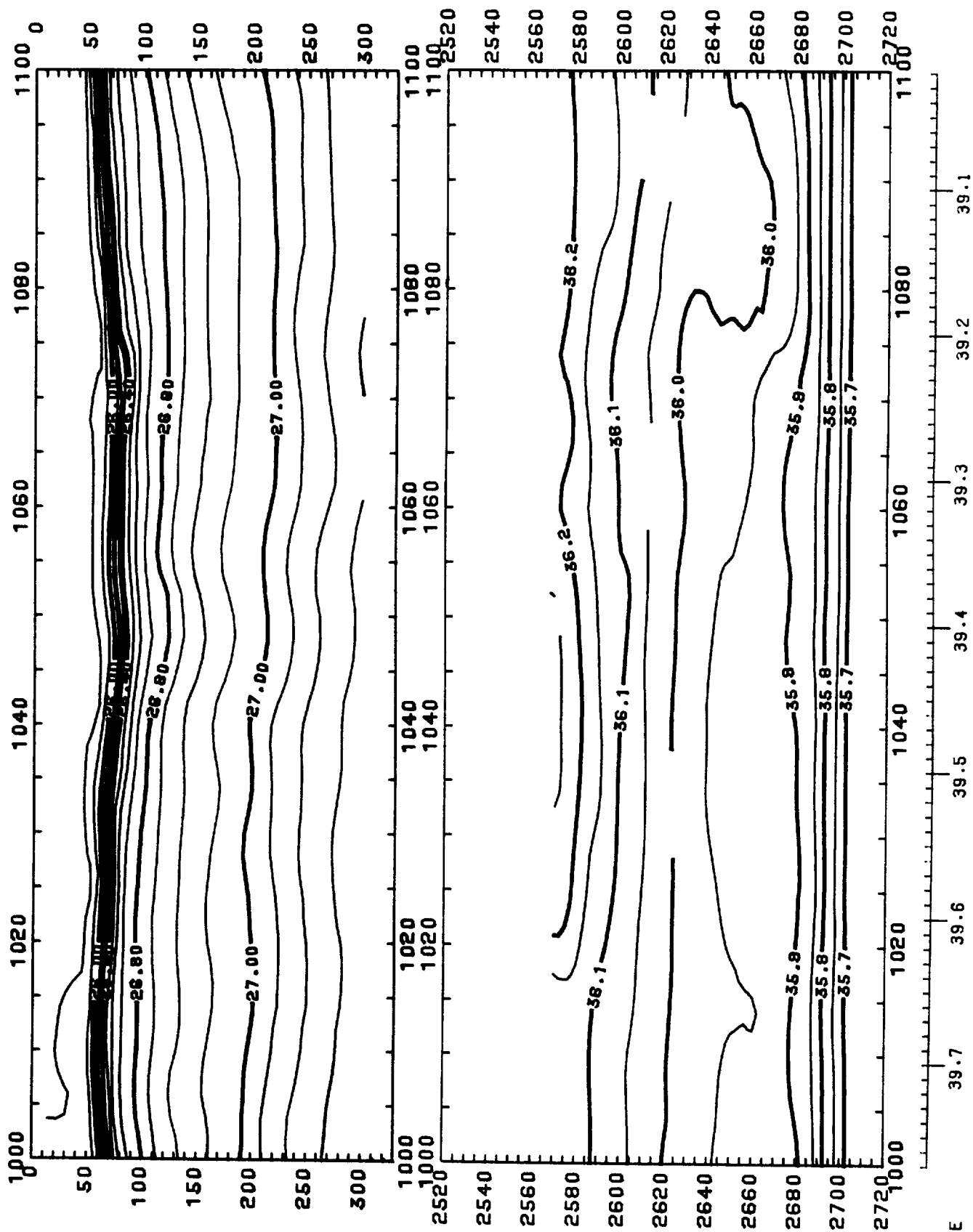
LATITUDE



DISCOVERY 114 : OCT 1980 : 1000-1100 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE

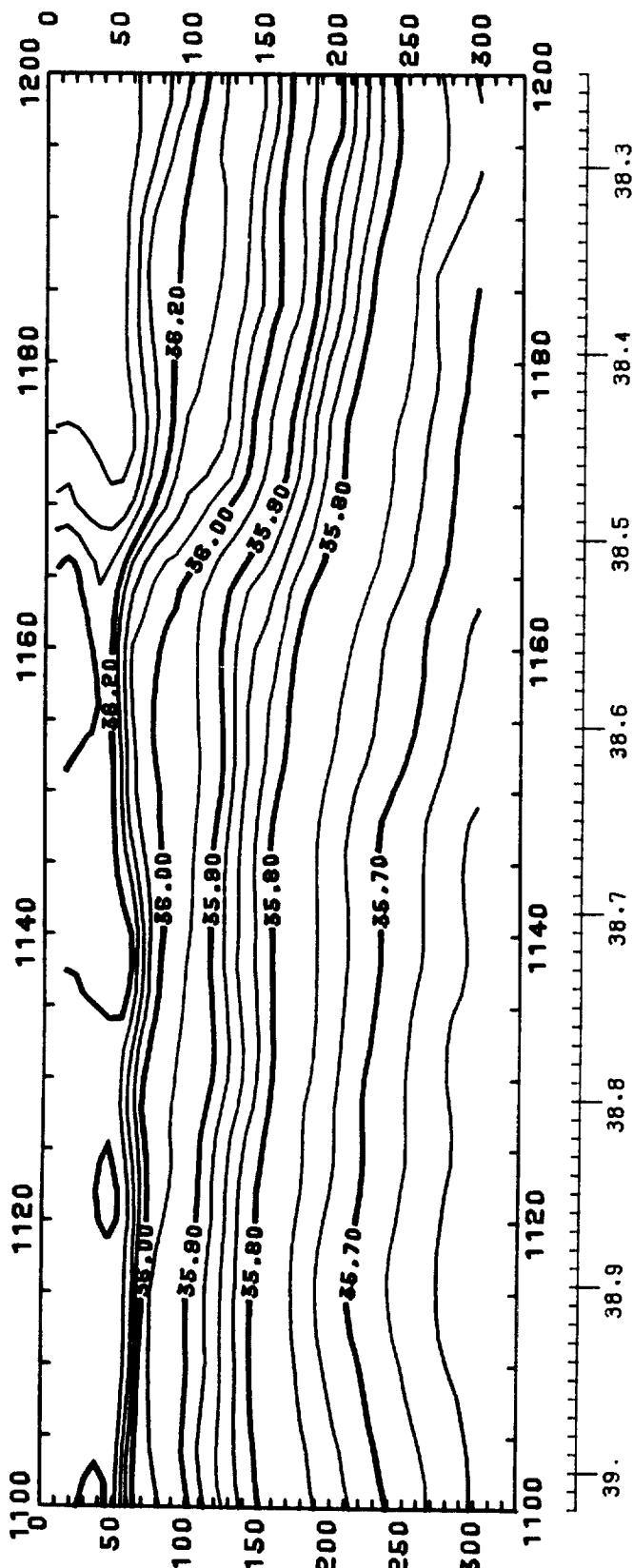
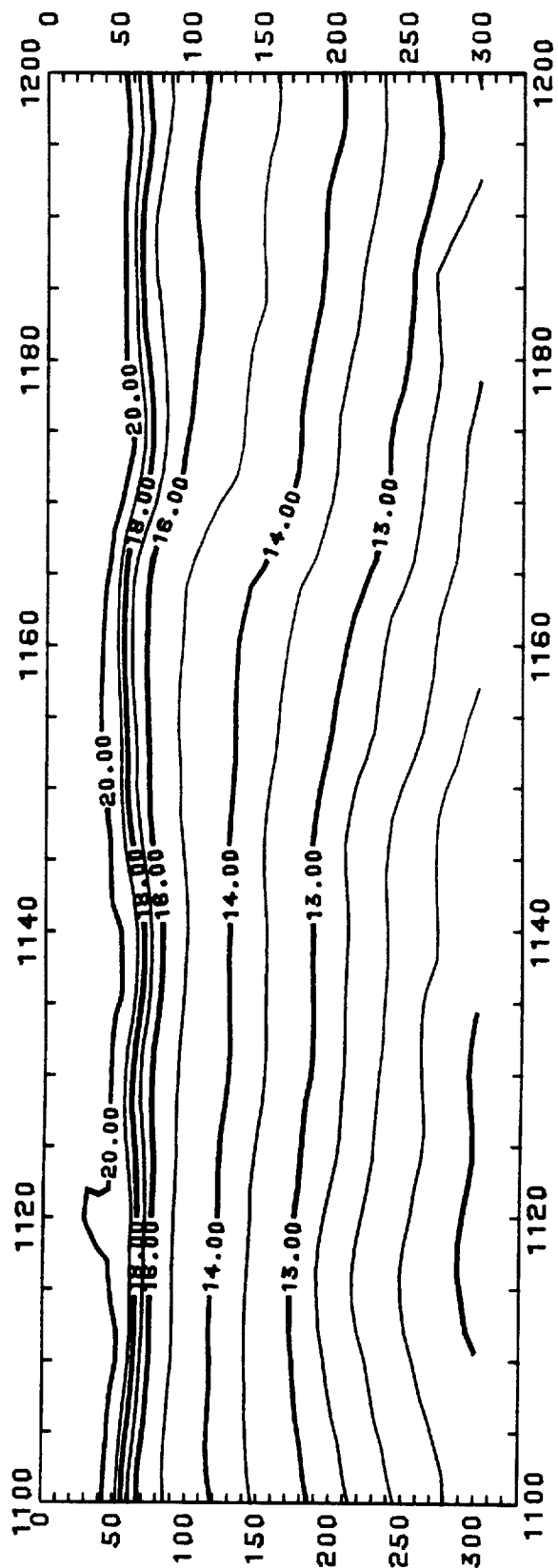




DISCOVERY 114 : OCT 1980 : 1000-1100 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LATITUDE

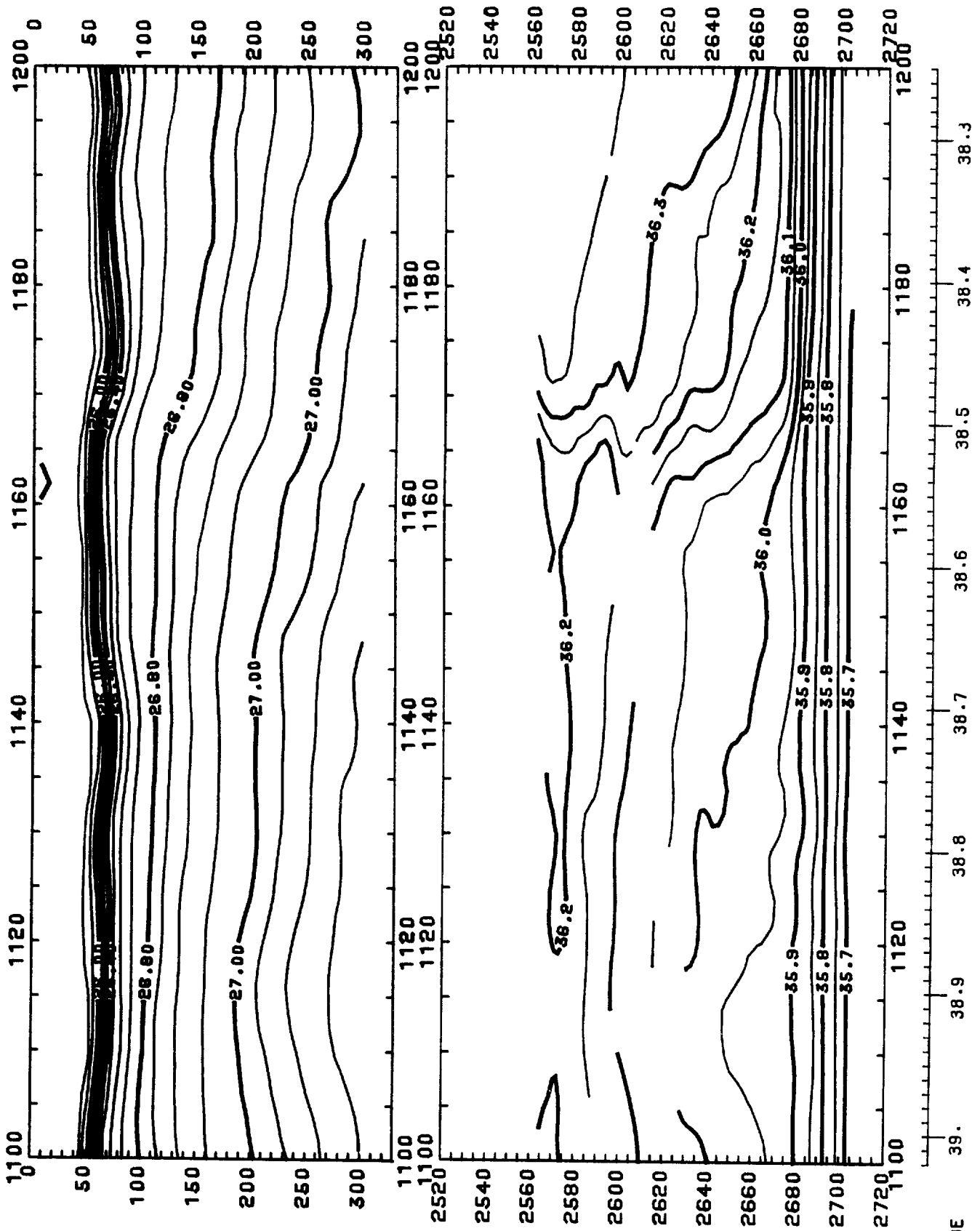
39.7 39.6 39.5 39.4 39.3 39.2 39.1



DISCOVERY 114 : OCT 1980 : 1100-1200 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

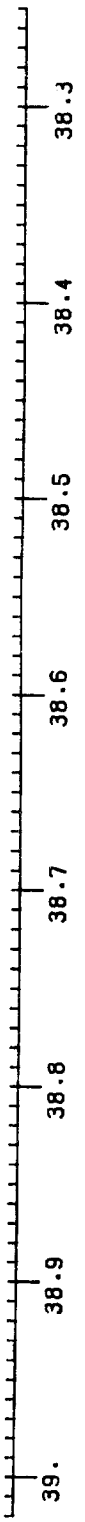
LATITUDE

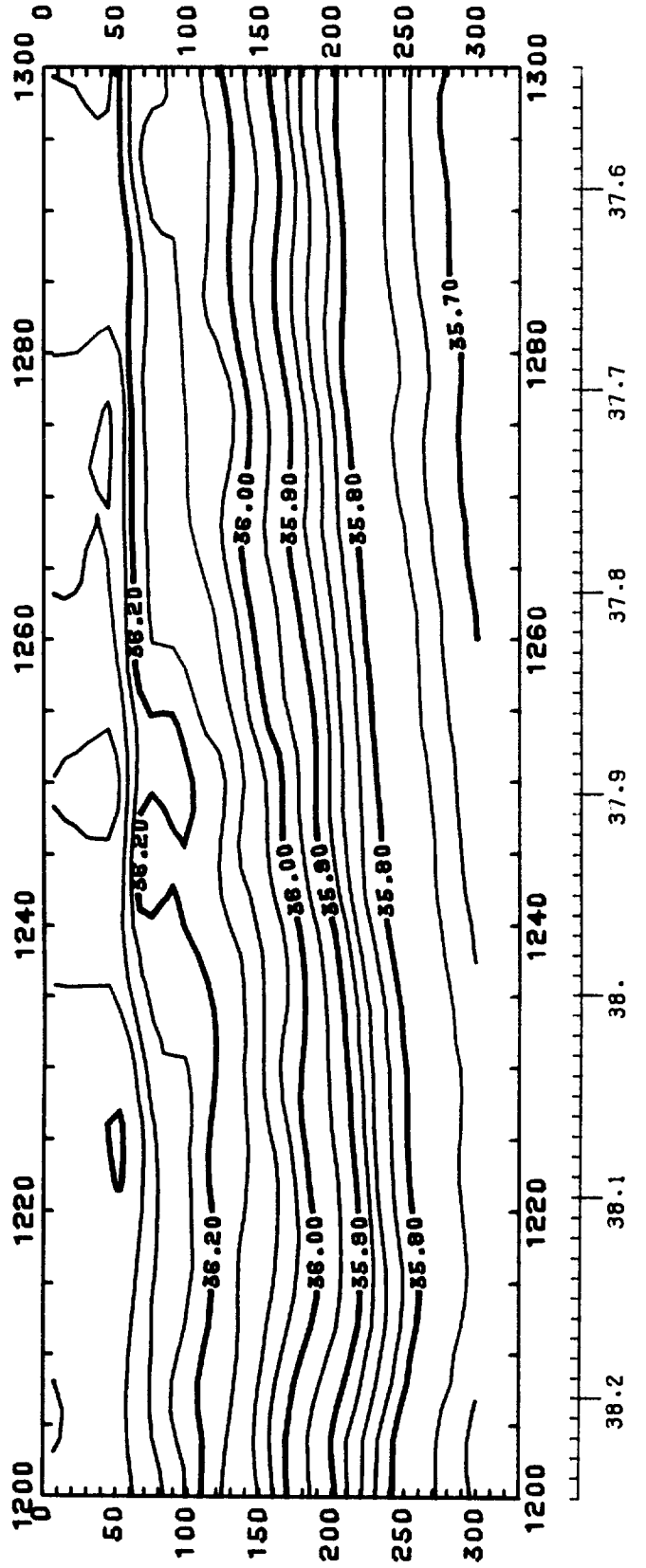
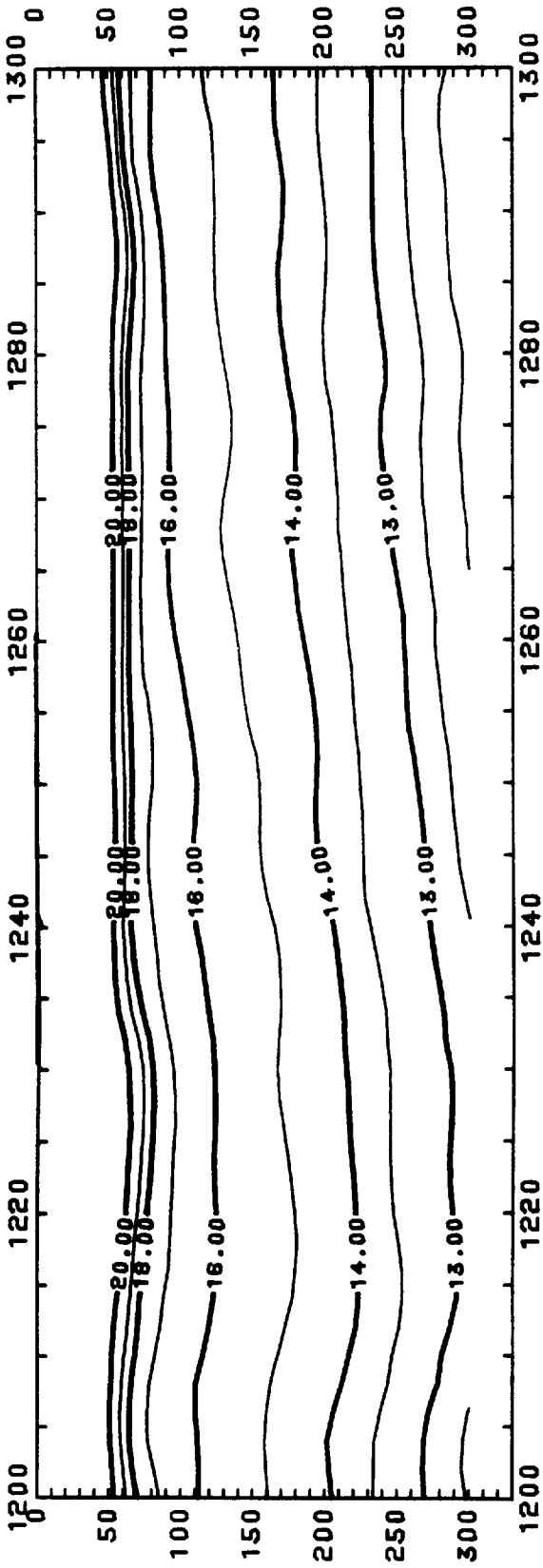
39.0 38.9 38.8 38.7 38.6 38.5 38.4 38.3



DISCOVERY 114 : OCT 1980 : 1100-1200 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

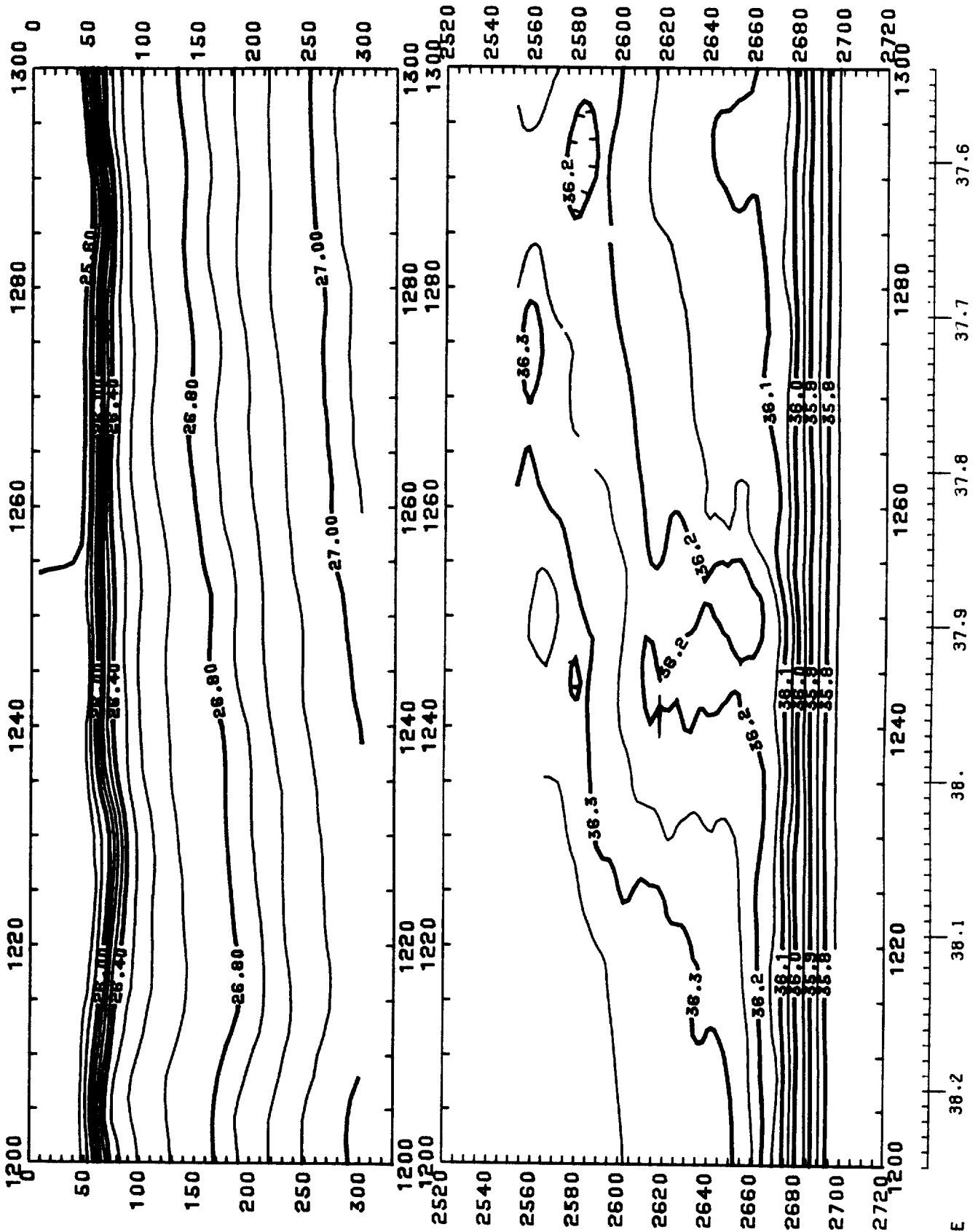
LATITUDE





DISCOVERY 114 : OCT 1980 : 1200-1300 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

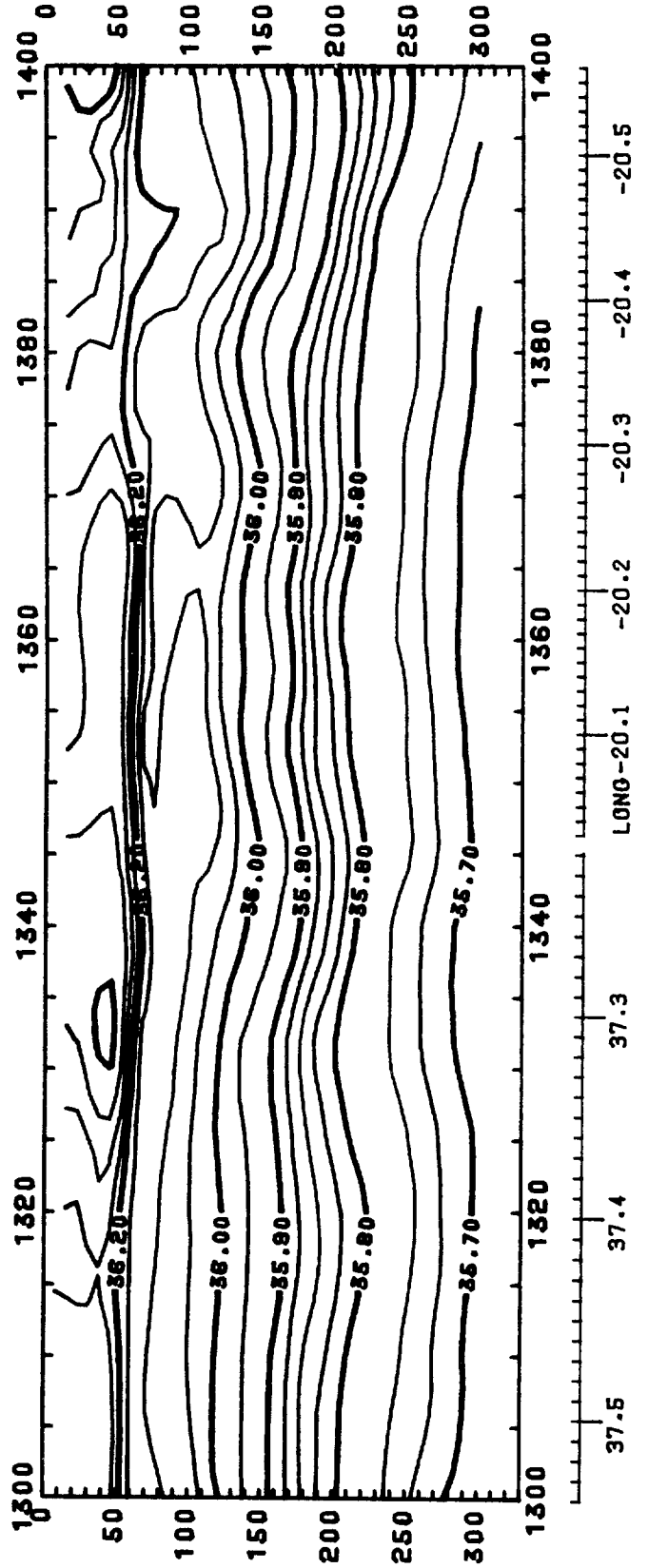
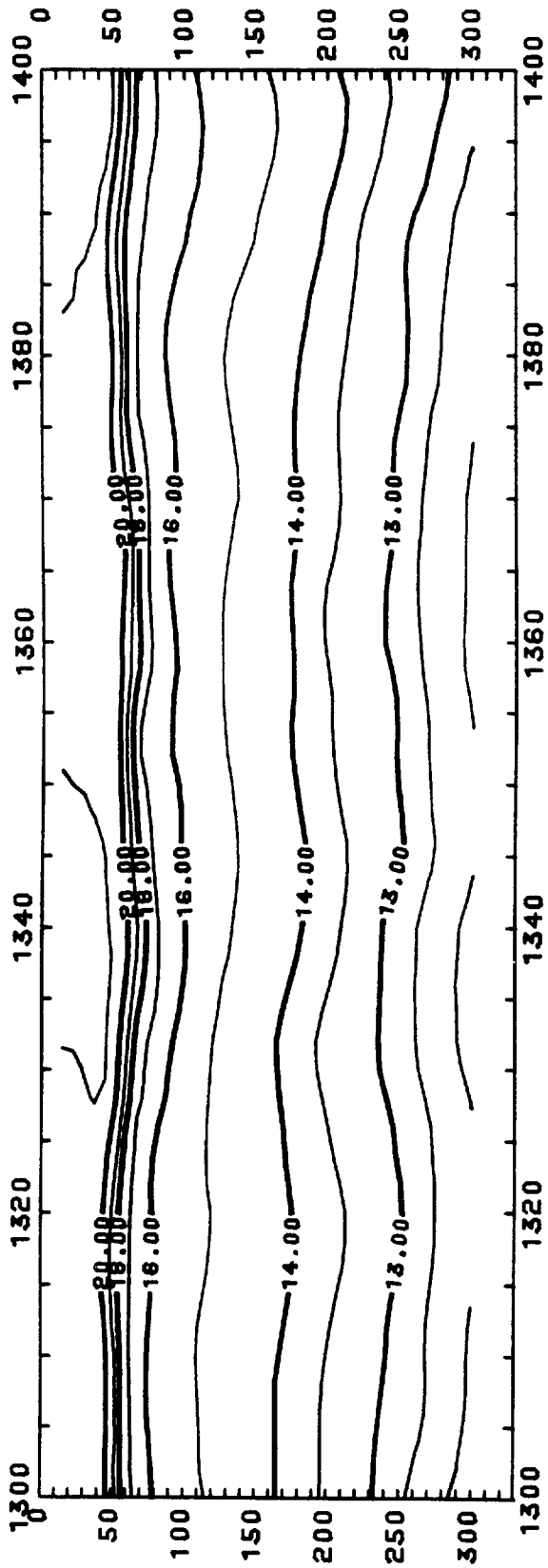
LATITUDE



DISCOVERY 114 : OCT 1980 : 1200-1300 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LATITUDE

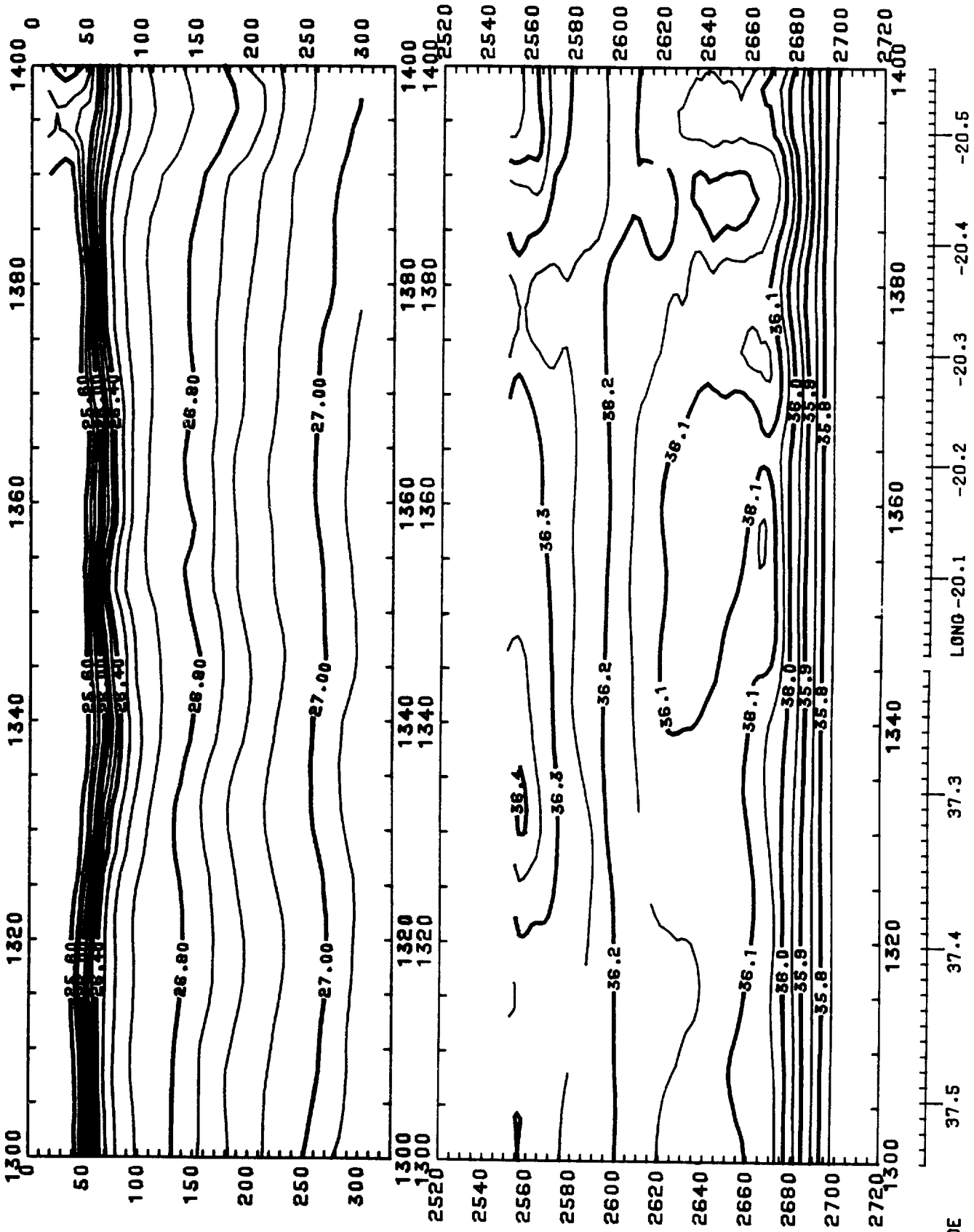
38.2 38.1 38. 37.9 37.8 37.7 37.6



DISCOVERY 114 : OCT 1980 : 1300-1400 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

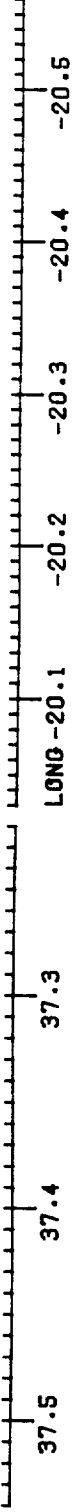
LATITUDE

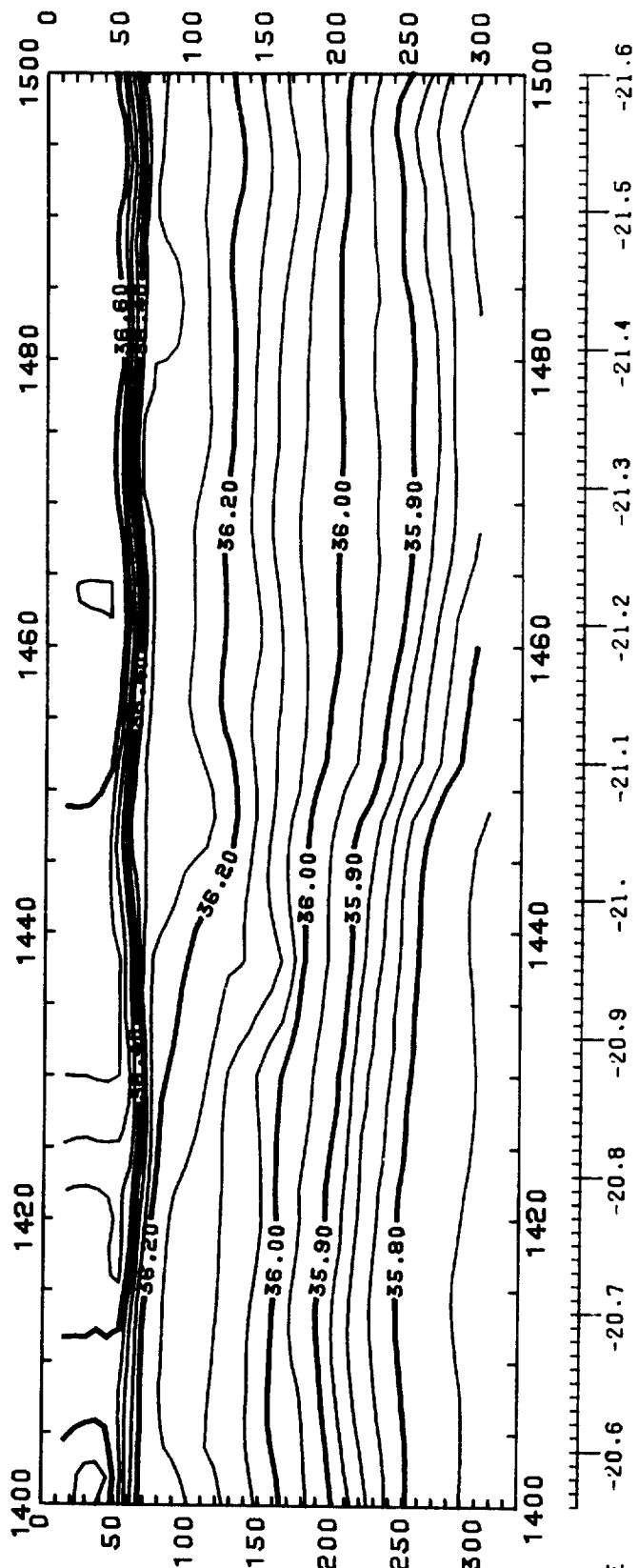
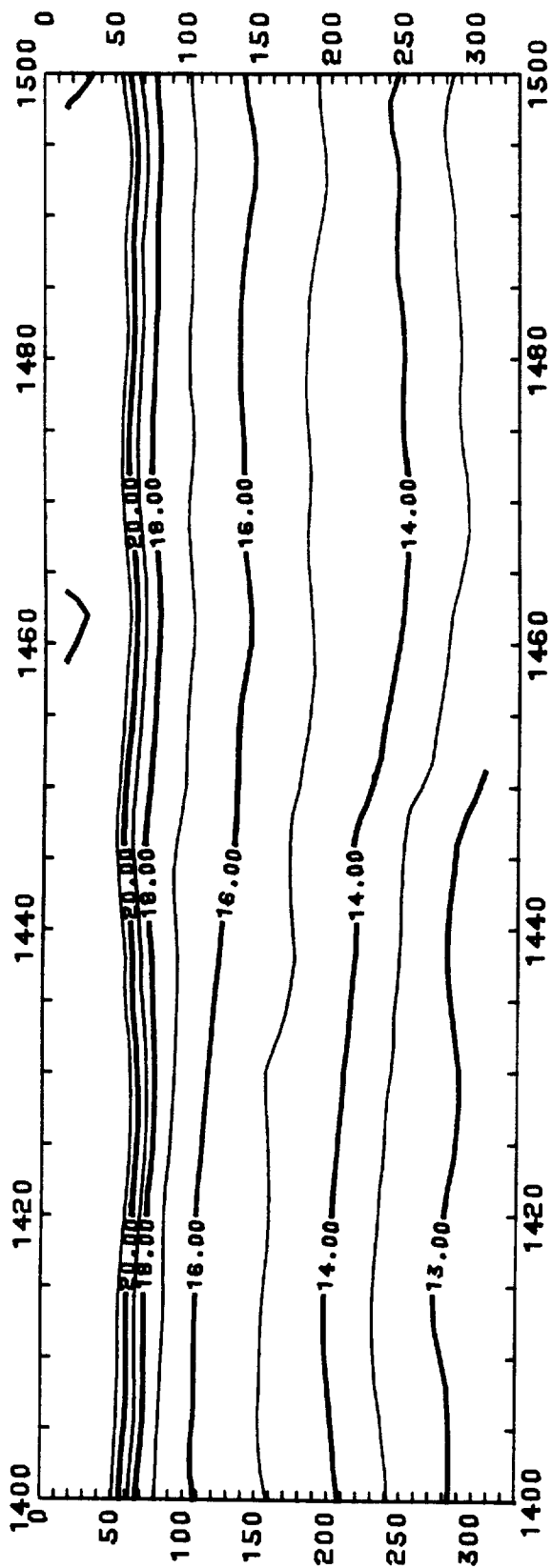
37.5 37.4 37.3 37.2 37.1 37.0 36.9 36.8 36.7 36.6 36.5 36.4 36.3 36.2 36.1 36.0 35.9 35.8 35.7 35.6 35.5 35.4 35.3 35.2 35.1 35.0 34.9 34.8 34.7 34.6 34.5 34.4 34.3 34.2 34.1 34.0 33.9 33.8 33.7 33.6 33.5 33.4 33.3 33.2 33.1 33.0 32.9 32.8 32.7 32.6 32.5 32.4 32.3 32.2 32.1 32.0 31.9 31.8 31.7 31.6 31.5 31.4 31.3 31.2 31.1 31.0 30.9 30.8 30.7 30.6 30.5 30.4 30.3 30.2 30.1 30.0 29.9 29.8 29.7 29.6 29.5 29.4 29.3 29.2 29.1 29.0 28.9 28.8 28.7 28.6 28.5 28.4 28.3 28.2 28.1 28.0 27.9 27.8 27.7 27.6 27.5 27.4 27.3 27.2 27.1 27.0 26.9 26.8 26.7 26.6 26.5 26.4 26.3 26.2 26.1 26.0 25.9 25.8 25.7 25.6 25.5 25.4 25.3 25.2 25.1 25.0 24.9 24.8 24.7 24.6 24.5 24.4 24.3 24.2 24.1 24.0 23.9 23.8 23.7 23.6 23.5 23.4 23.3 23.2 23.1 23.0 22.9 22.8 22.7 22.6 22.5 22.4 22.3 22.2 22.1 22.0 21.9 21.8 21.7 21.6 21.5 21.4 21.3 21.2 21.1 21.0 20.9 20.8 20.7 20.6 20.5 20.4 20.3 20.2 20.1 20.0 19.9 19.8 19.7 19.6 19.5 19.4 19.3 19.2 19.1 19.0 18.9 18.8 18.7 18.6 18.5 18.4 18.3 18.2 18.1 18.0 17.9 17.8 17.7 17.6 17.5 17.4 17.3 17.2 17.1 17.0 16.9 16.8 16.7 16.6 16.5 16.4 16.3 16.2 16.1 16.0 15.9 15.8 15.7 15.6 15.5 15.4 15.3 15.2 15.1 15.0 14.9 14.8 14.7 14.6 14.5 14.4 14.3 14.2 14.1 14.0 13.9 13.8 13.7 13.6 13.5 13.4 13.3 13.2 13.1 13.0 12.9 12.8 12.7 12.6 12.5 12.4 12.3 12.2 12.1 12.0 11.9 11.8 11.7 11.6 11.5 11.4 11.3 11.2 11.1 11.0 10.9 10.8 10.7 10.6 10.5 10.4 10.3 10.2 10.1 10.0 9.9 9.8 9.7 9.6 9.5 9.4 9.3 9.2 9.1 9.0 8.9 8.8 8.7 8.6 8.5 8.4 8.3 8.2 8.1 8.0 7.9 7.8 7.7 7.6 7.5 7.4 7.3 7.2 7.1 7.0 6.9 6.8 6.7 6.6 6.5 6.4 6.3 6.2 6.1 6.0 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1 3.0 2.9 2.8 2.7 2.6 2.5 2.4 2.3 2.2 2.1 2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0



DISCOVERY 114 : OCT 1980 : 1300-1400 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA\*100(CGS)

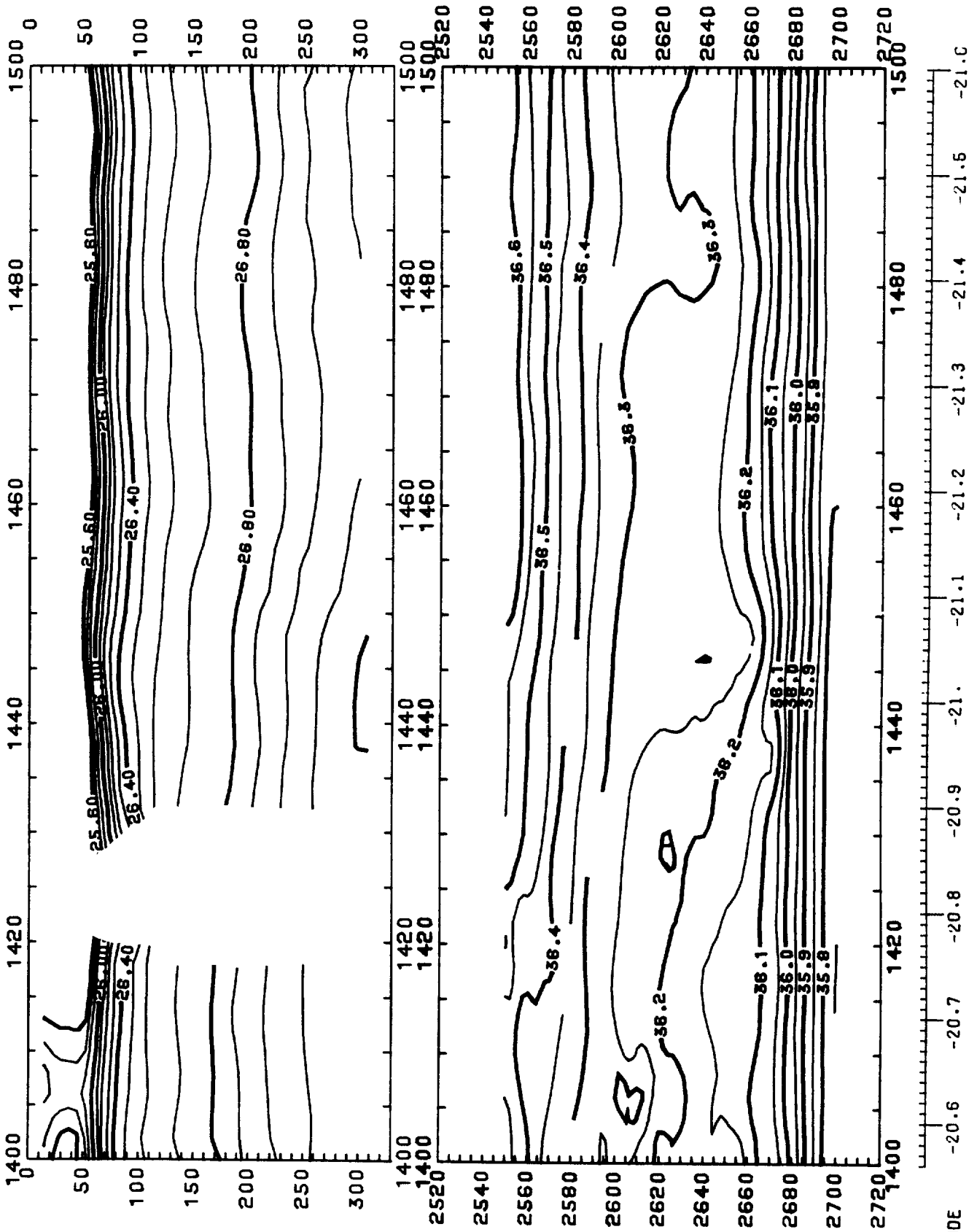
LATITUDE





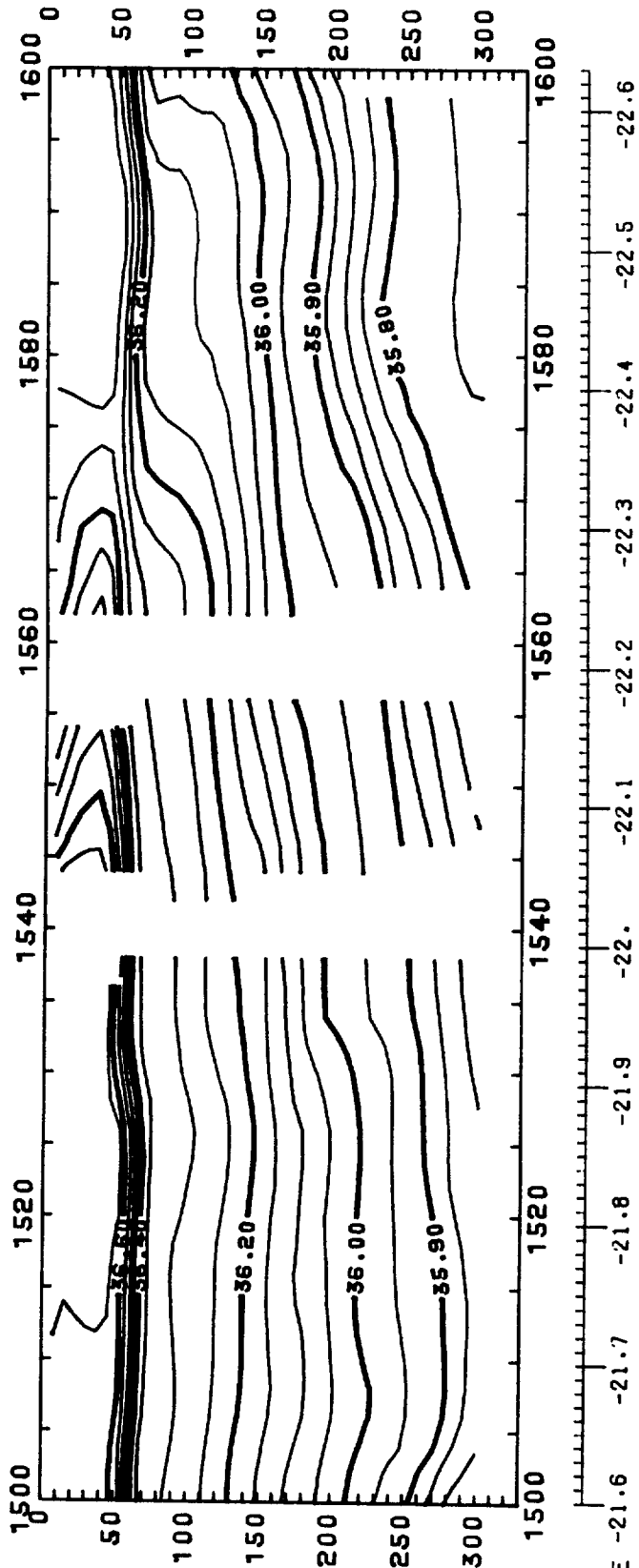
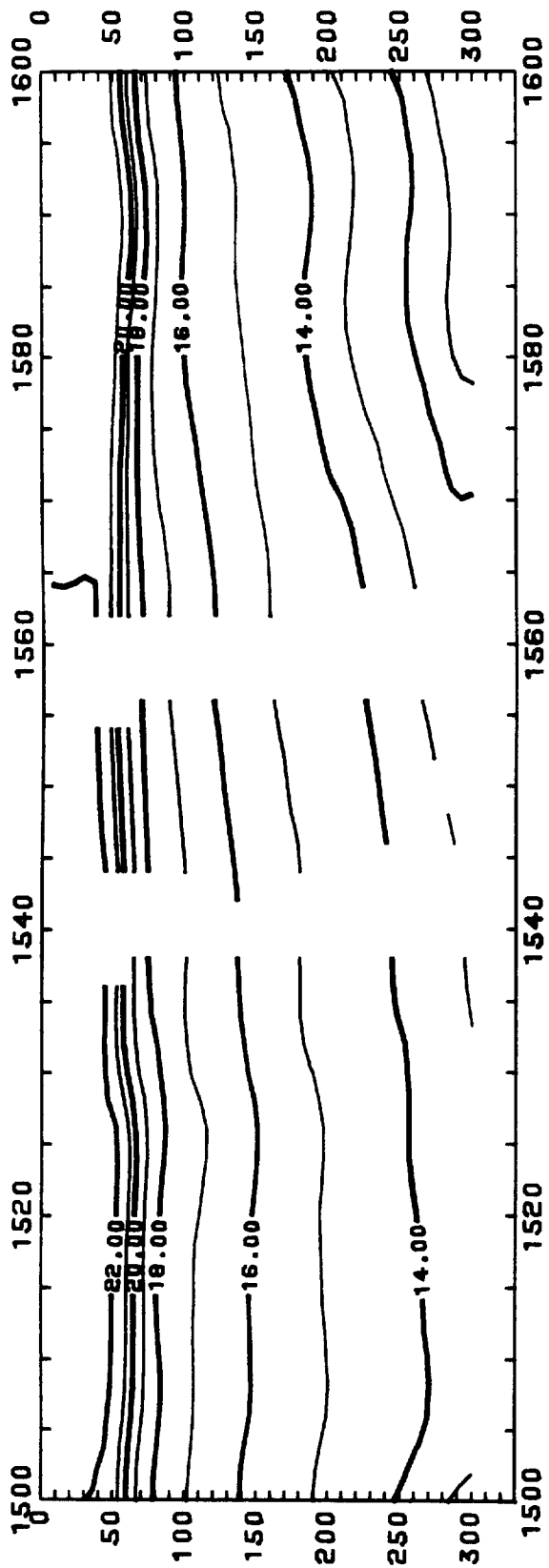
DISCOVERY 114 : OCT 1980 : 1400-1500 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(OB)





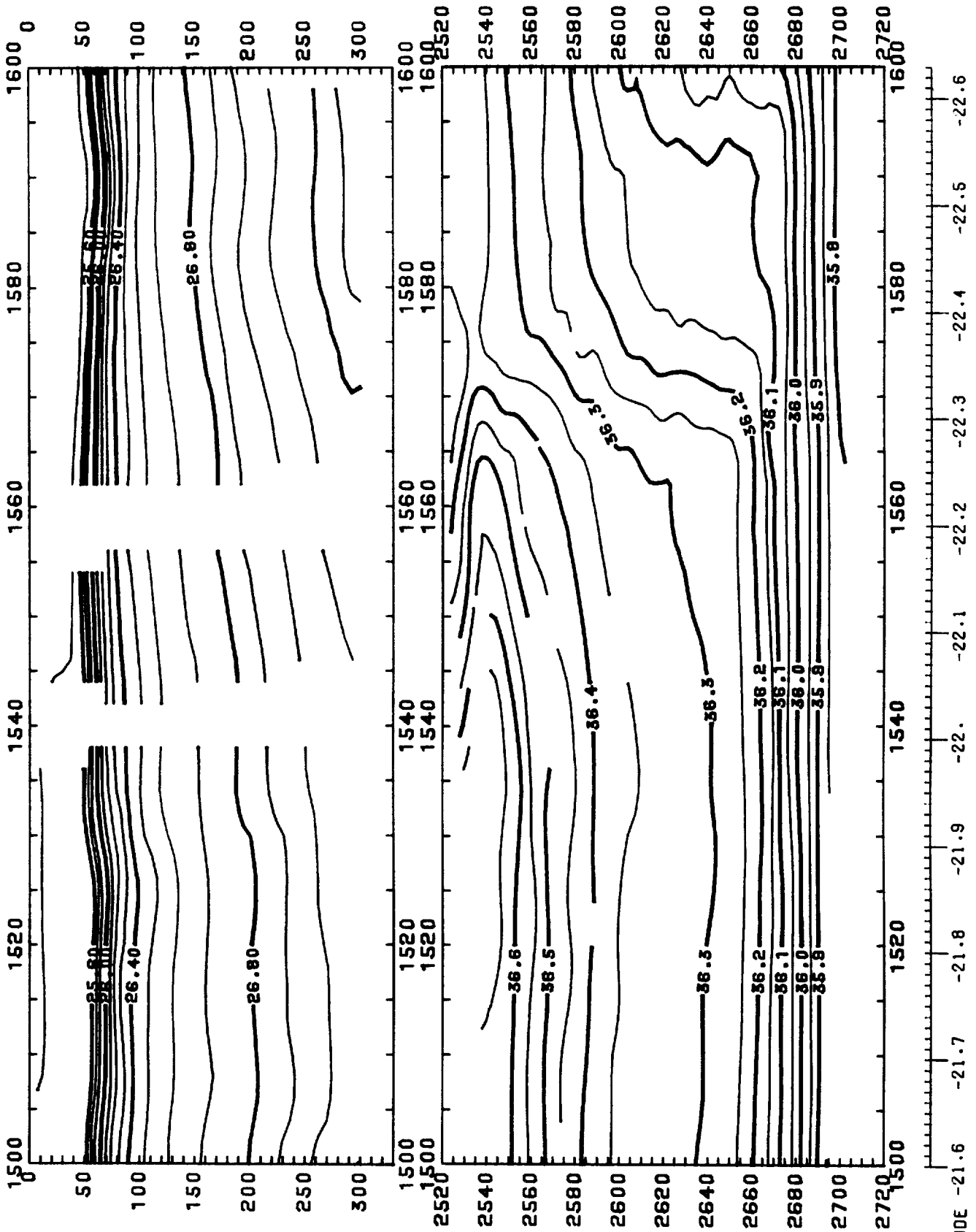
DISCOVERY 114 : OCT 1980 : 1400-1500 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LONGITUDE -20.6 -20.7 -20.8 -20.9 -21.0 -21.1 -21.2 -21.3 -21.4 -21.5 -21.0



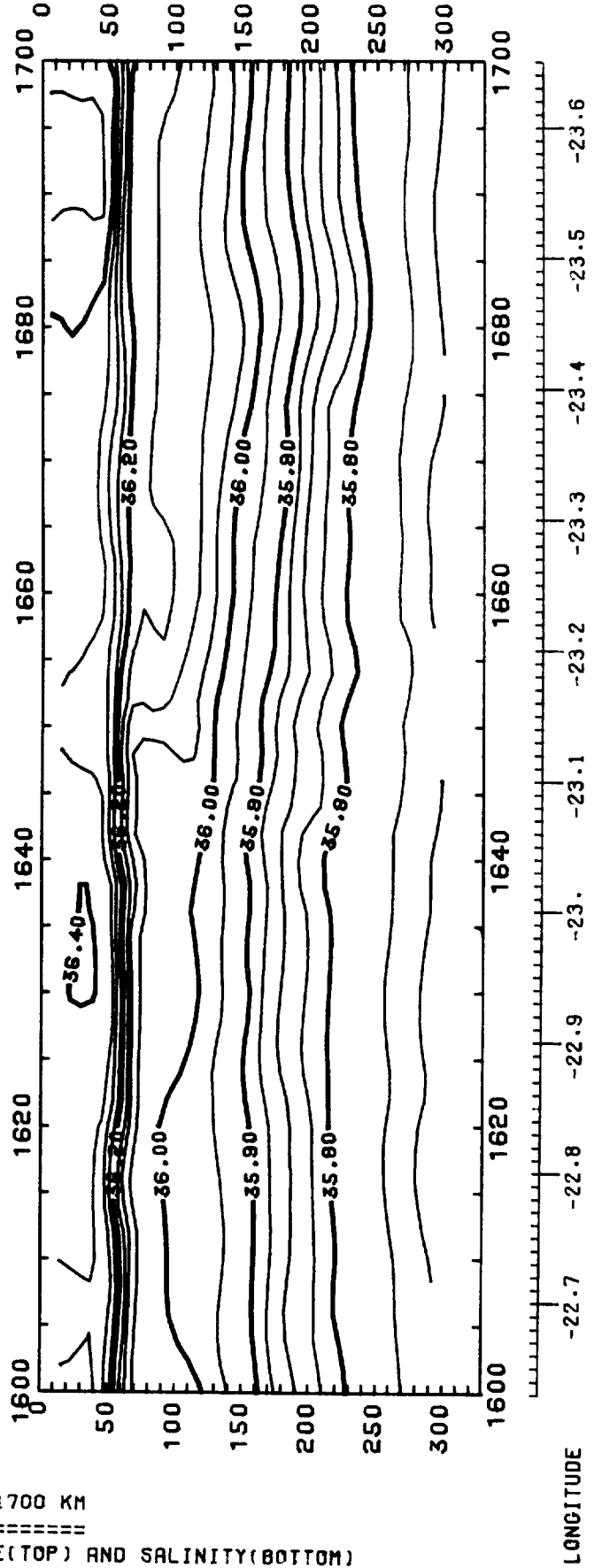
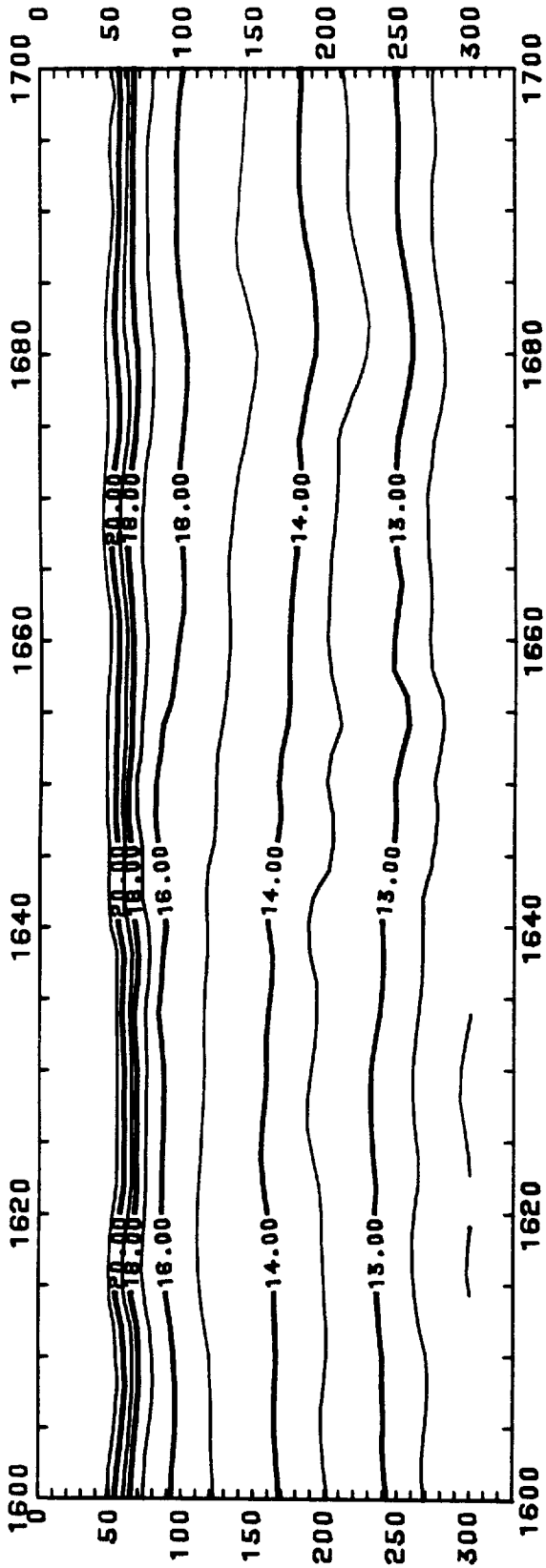
DISCOVERY 114 : OCT 1980 : 1500-1600 KM  
===== ||| ||| ||| ||| ||| =====  
CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE -21.6 -21.7 -21.8 -21.9 -22.0 -22.1 -22.2 -22.3 -22.4 -22.5 -22.6

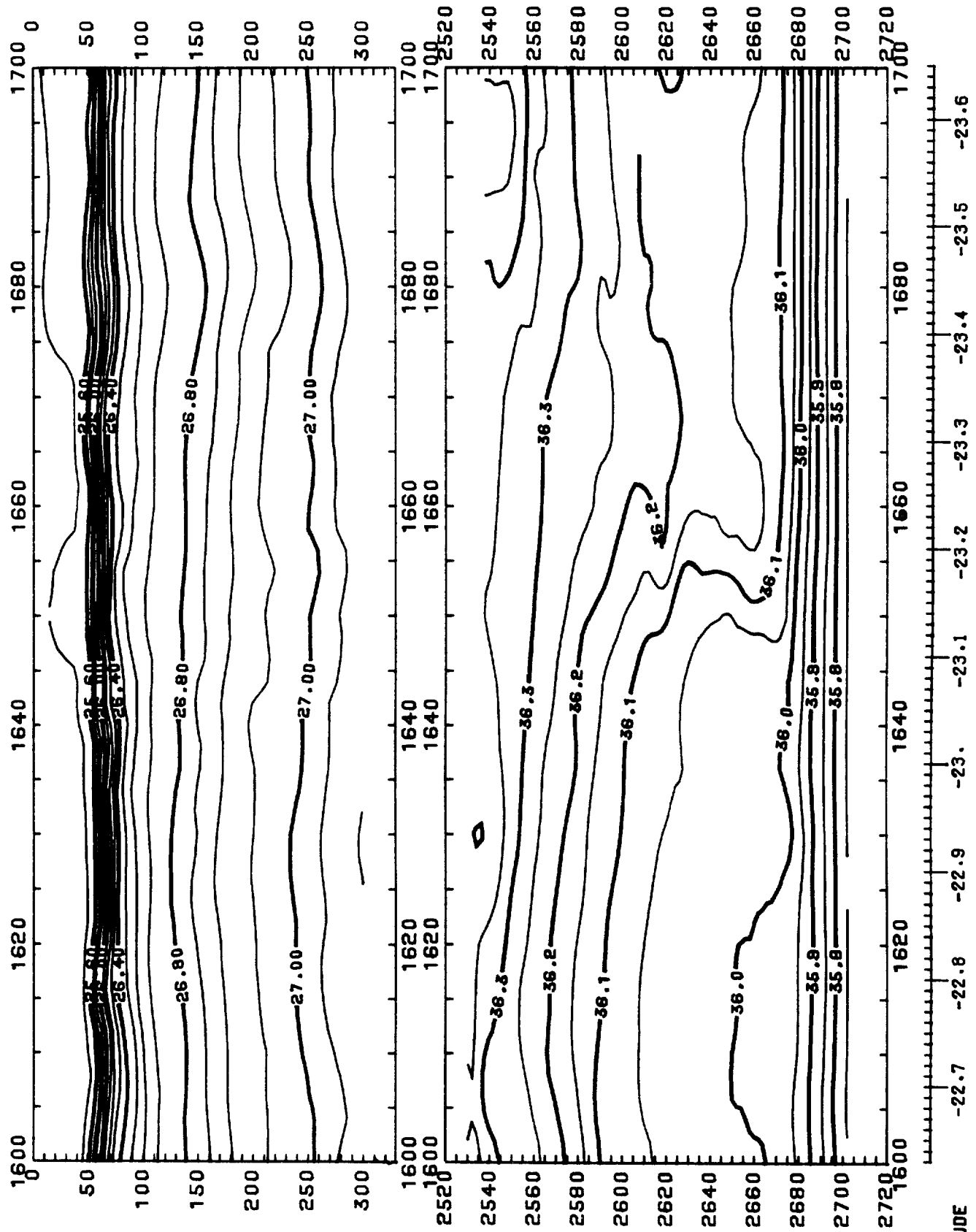


DISCOVERY 114 : OCT 1980 : 1500-1600 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X-DISTANCE RUN(KM) : Y-PRESSURE(DB) OR SIGMA THETA=100(CGS)

LONGITUDE -21.6 -21.7 -21.8 -21.9 -22.0 -22.1 -22.2 -22.3 -22.4 -22.5 -22.6



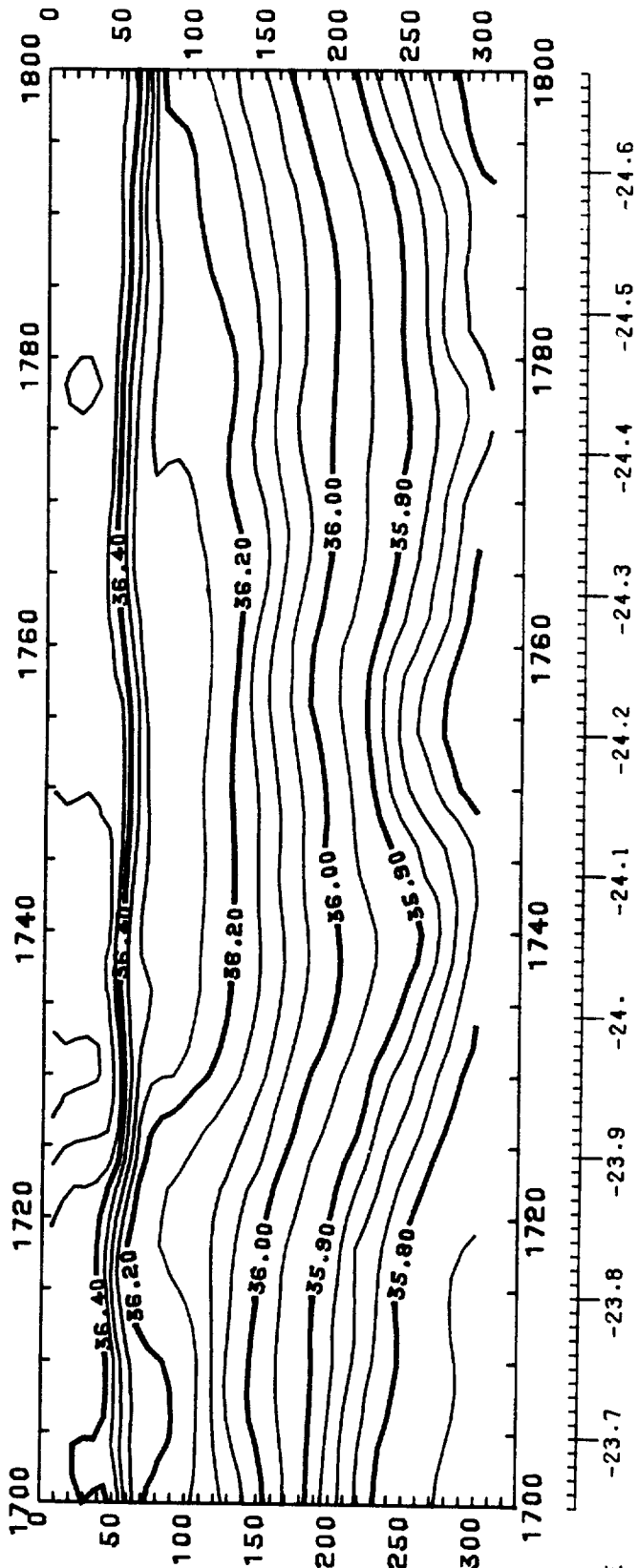
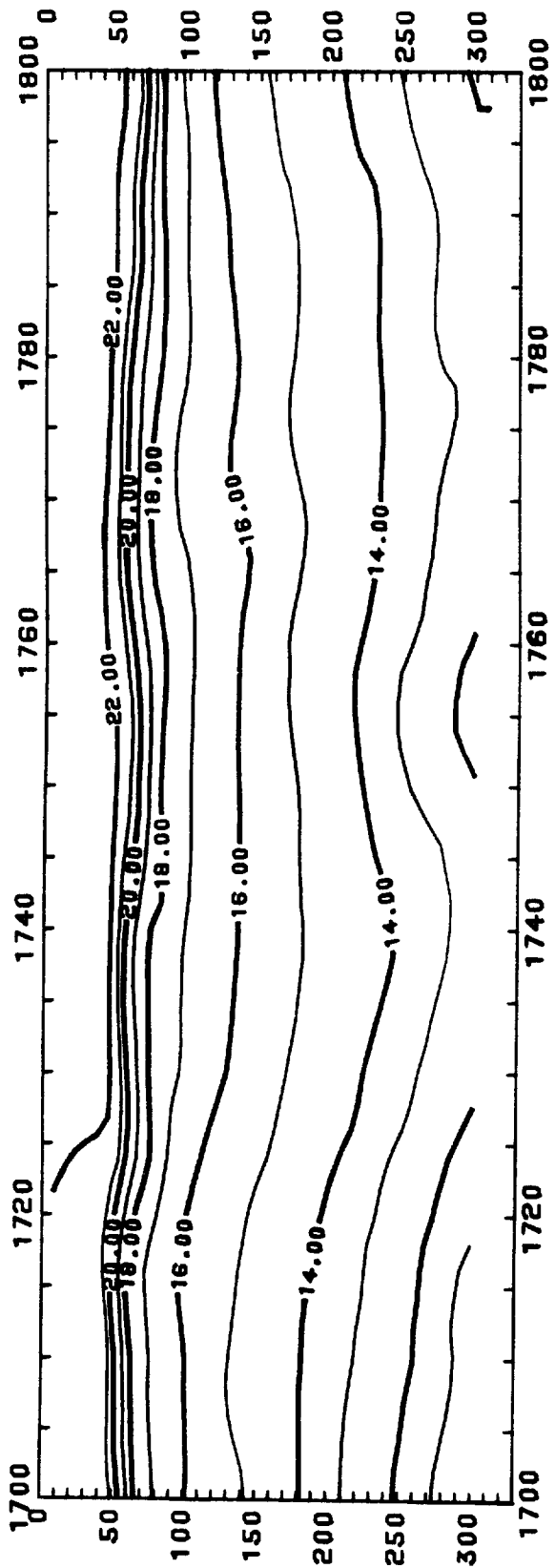
DISCOVERY 114 : OCT 1980 : 1600-1700 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)



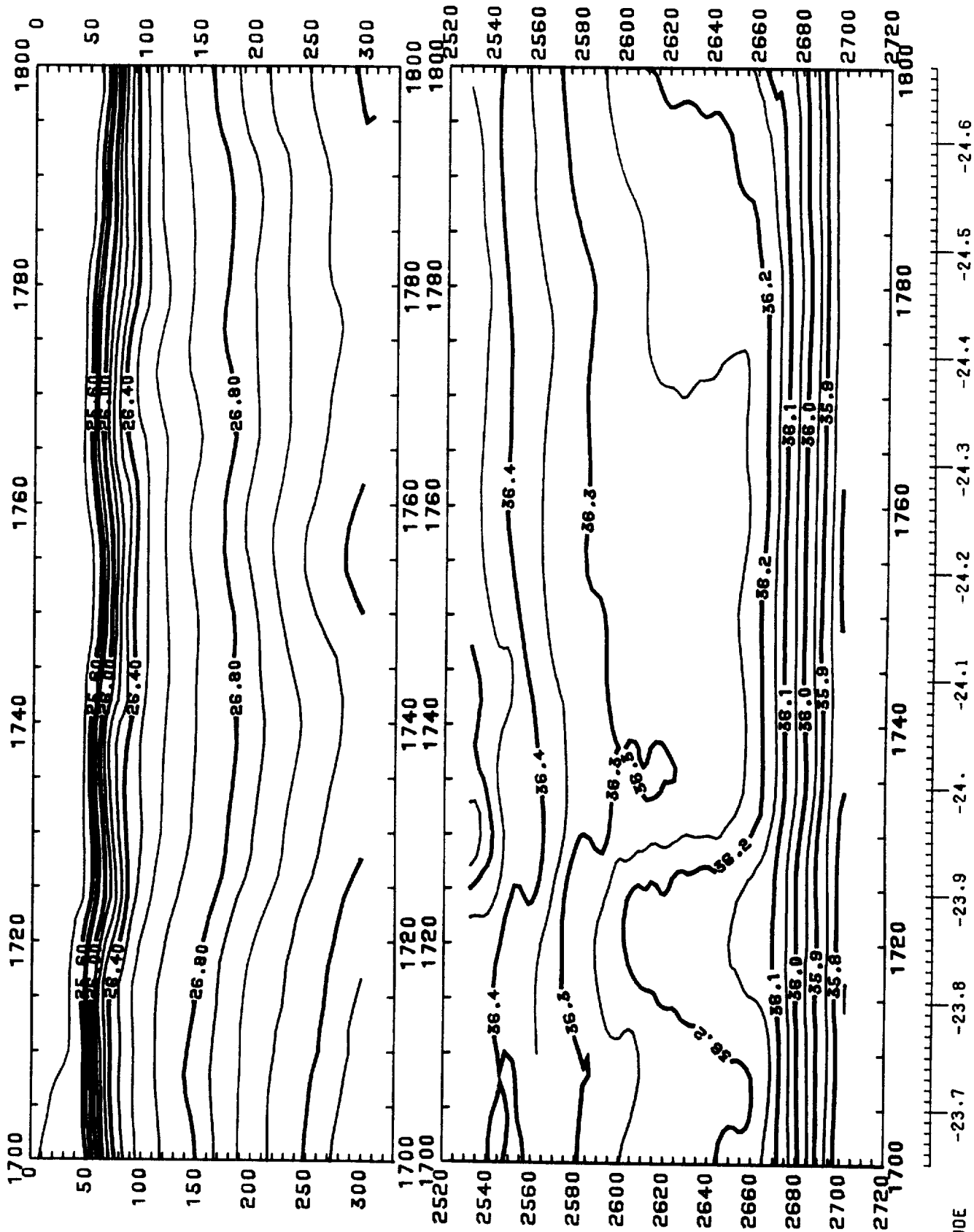
DISCOVERY 114 : OCT 1980 : 1600-1700 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LONGITUDE

-22.7 -22.8 -22.9 -23. -23.1 -23.2 -23.3 -23.4 -23.5 -23.6



DISCOVERY 114 : OCT 1980 : 1700-1800 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

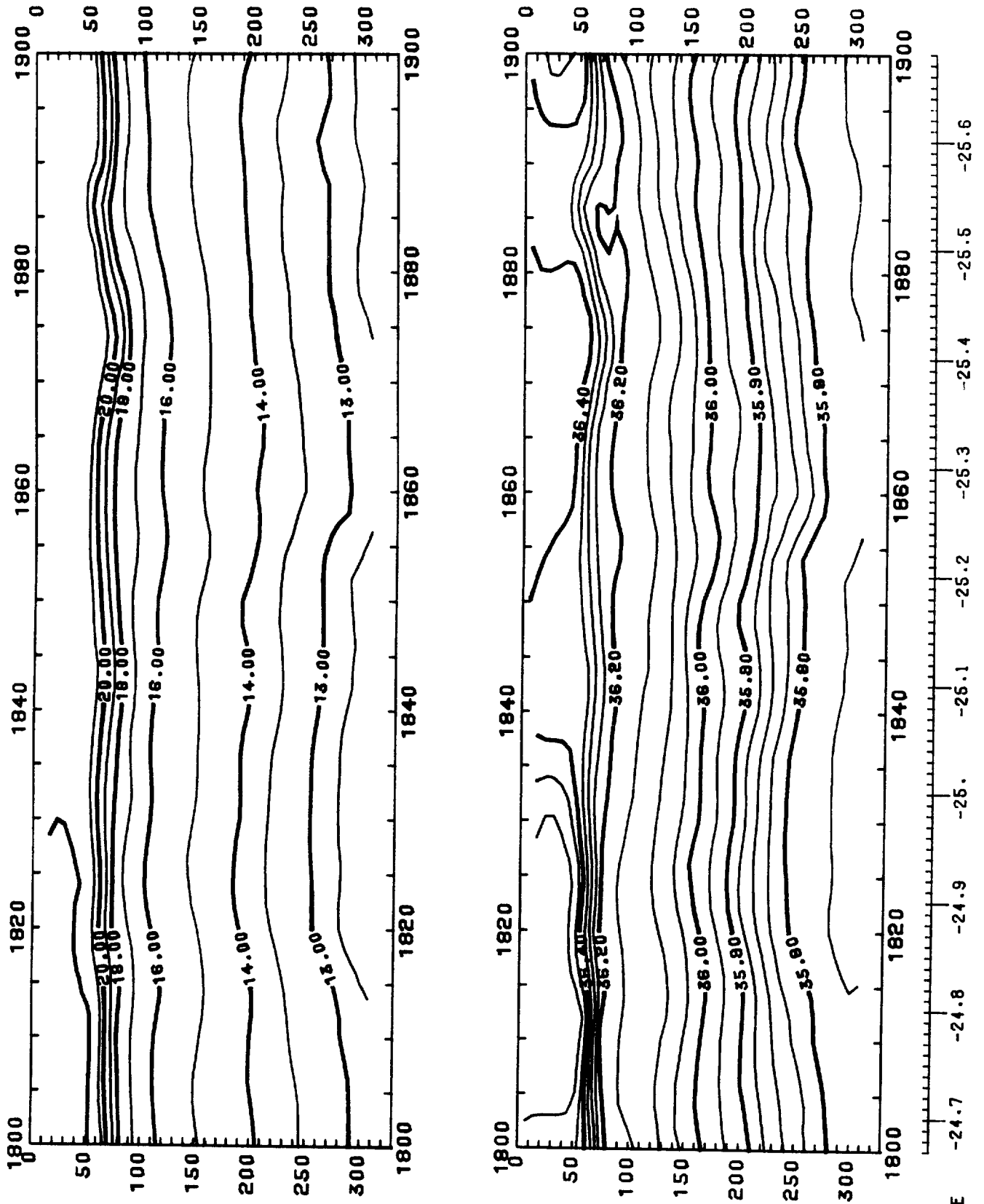


DISCOVERY 114 : OCT 1980 : 1700-1800 KM

CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)

X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LONGITUDE

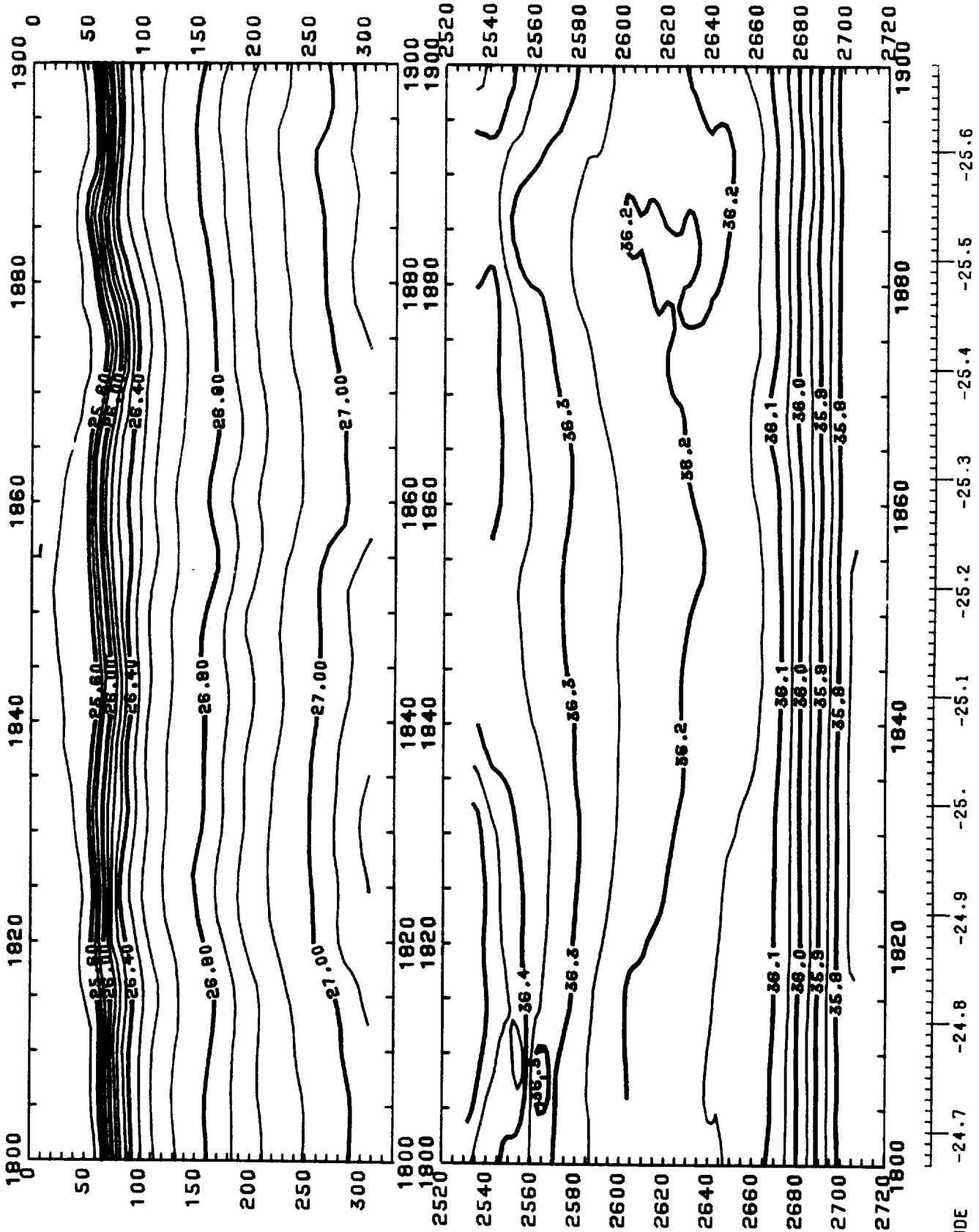


DISCOVERY 114 : OCT 1980 : 1800-1900 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE

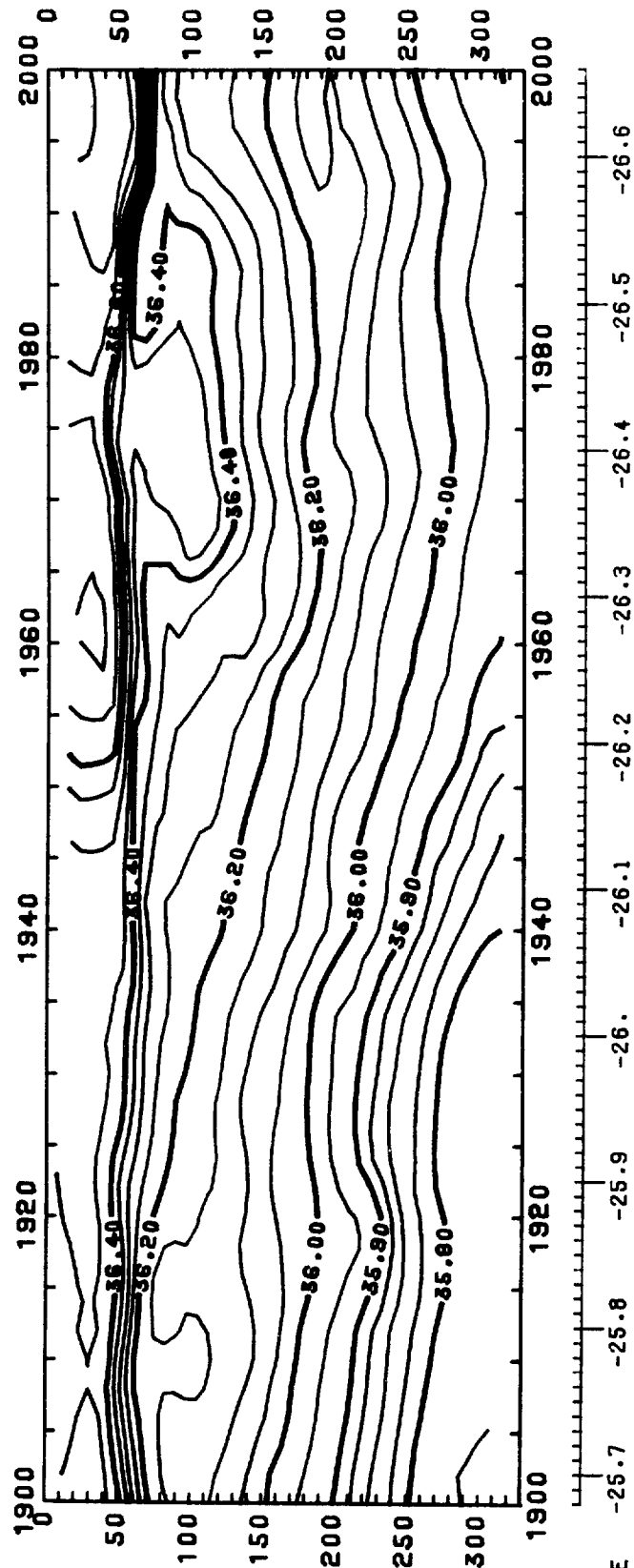
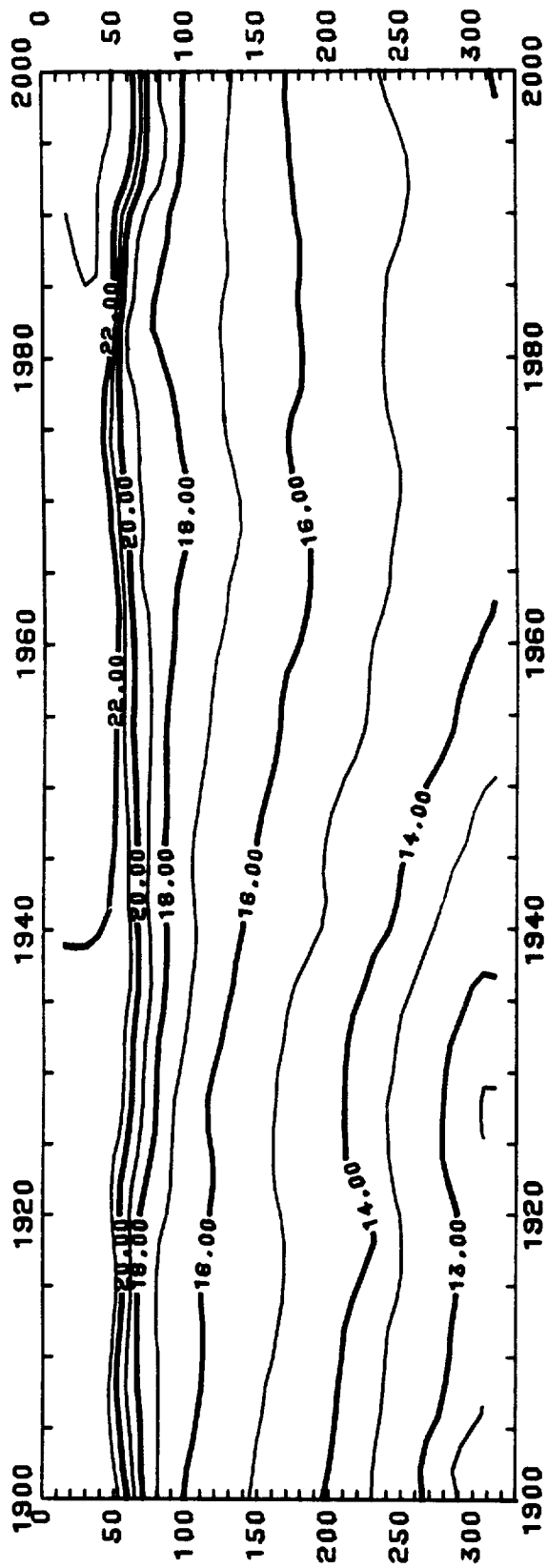
-24.7 -24.8 -24.9 -25.0 -25.1 -25.2 -25.3 -25.4 -25.5 -25.6





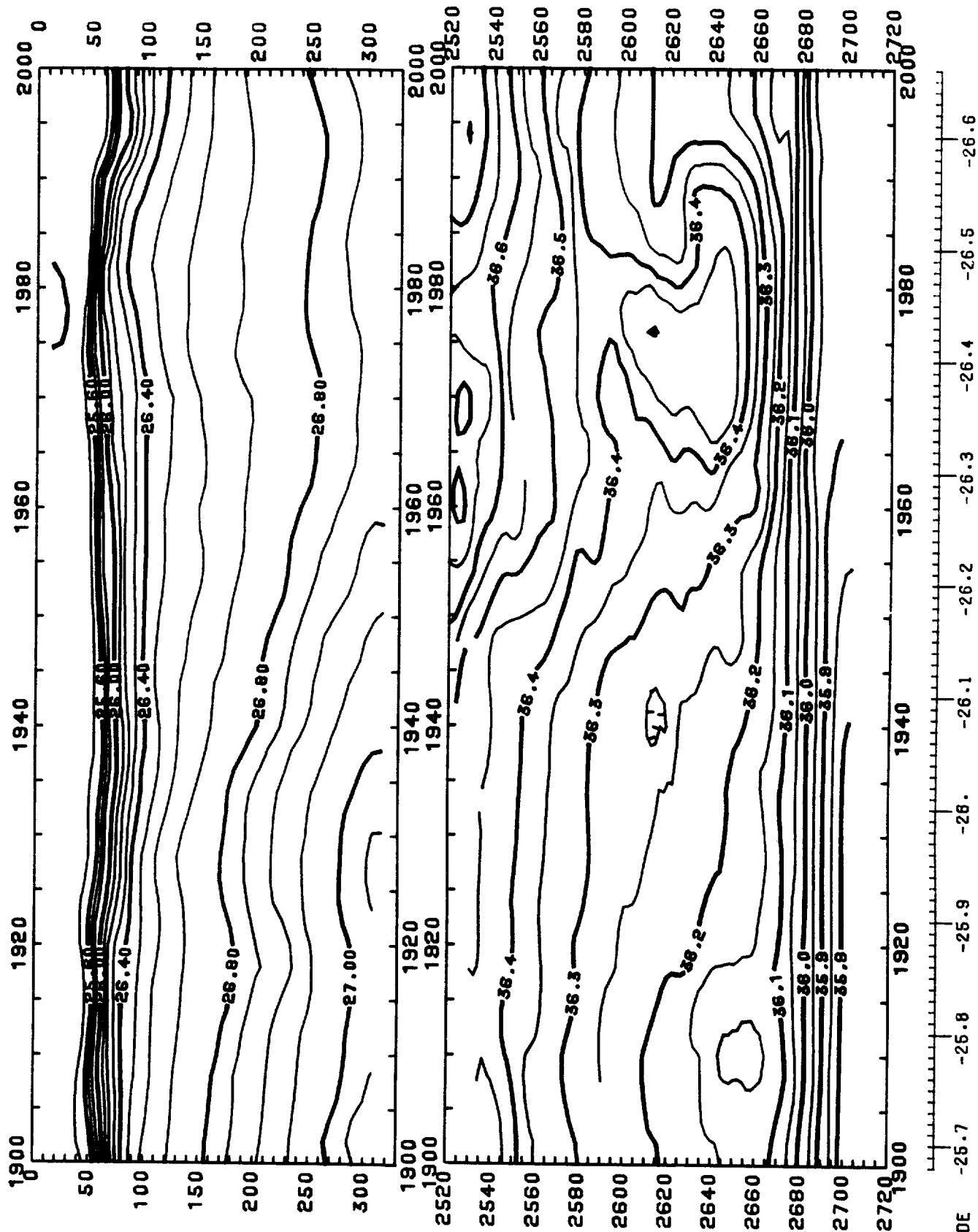
DISCOVERY 114 : OCT 1980 : 1800-1900 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X-DISTANCE RUN(KM) : Y-PRESSURE(DB) OR SIGMA THETA=100(CGS)

LONGITUDE -24.7 -24.8 -24.9 -25. -25.1 -25.2 -25.3 -25.4 -25.5 -25.6



DISCOVERY 114 : OCT 1980 : 1900-2000 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE -25.7 -25.8 -25.9 -26. -26.1 -26.2 -26.3 -26.4 -26.5 -26.6

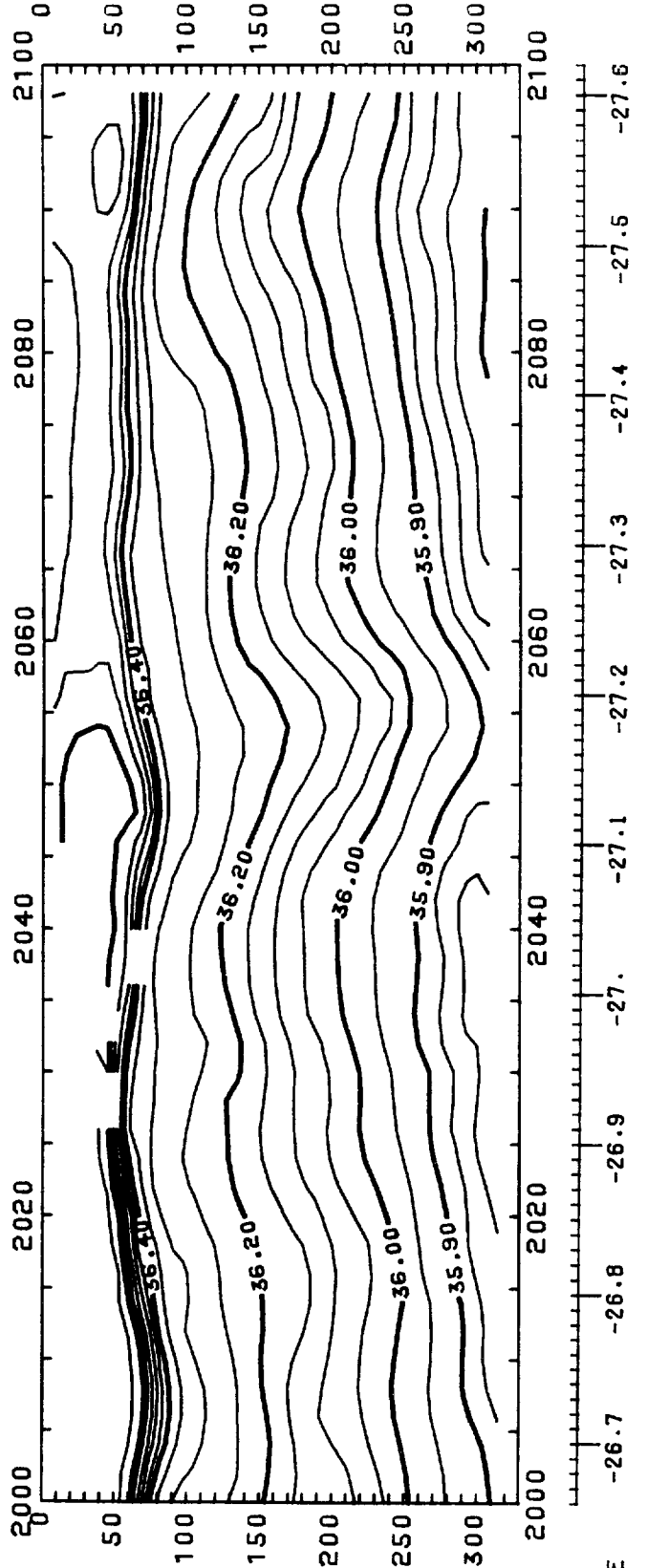
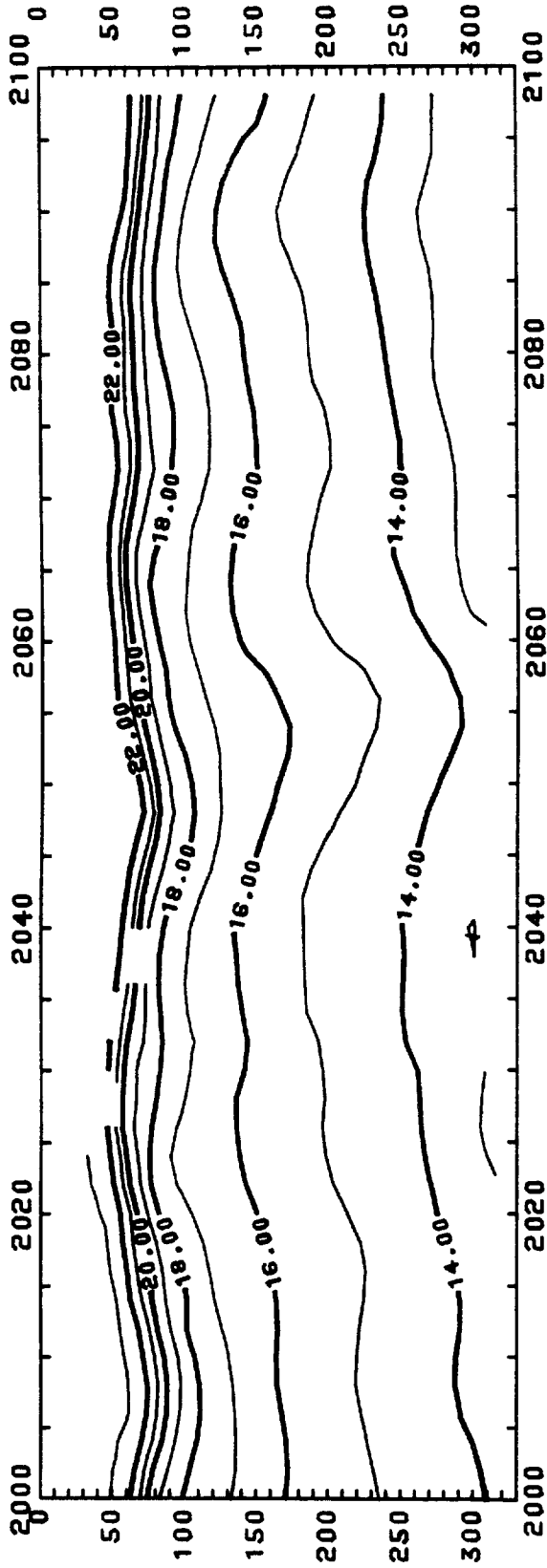


DISCOVERY 114 : OCT 1980 : 1900-2000 KM

CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)

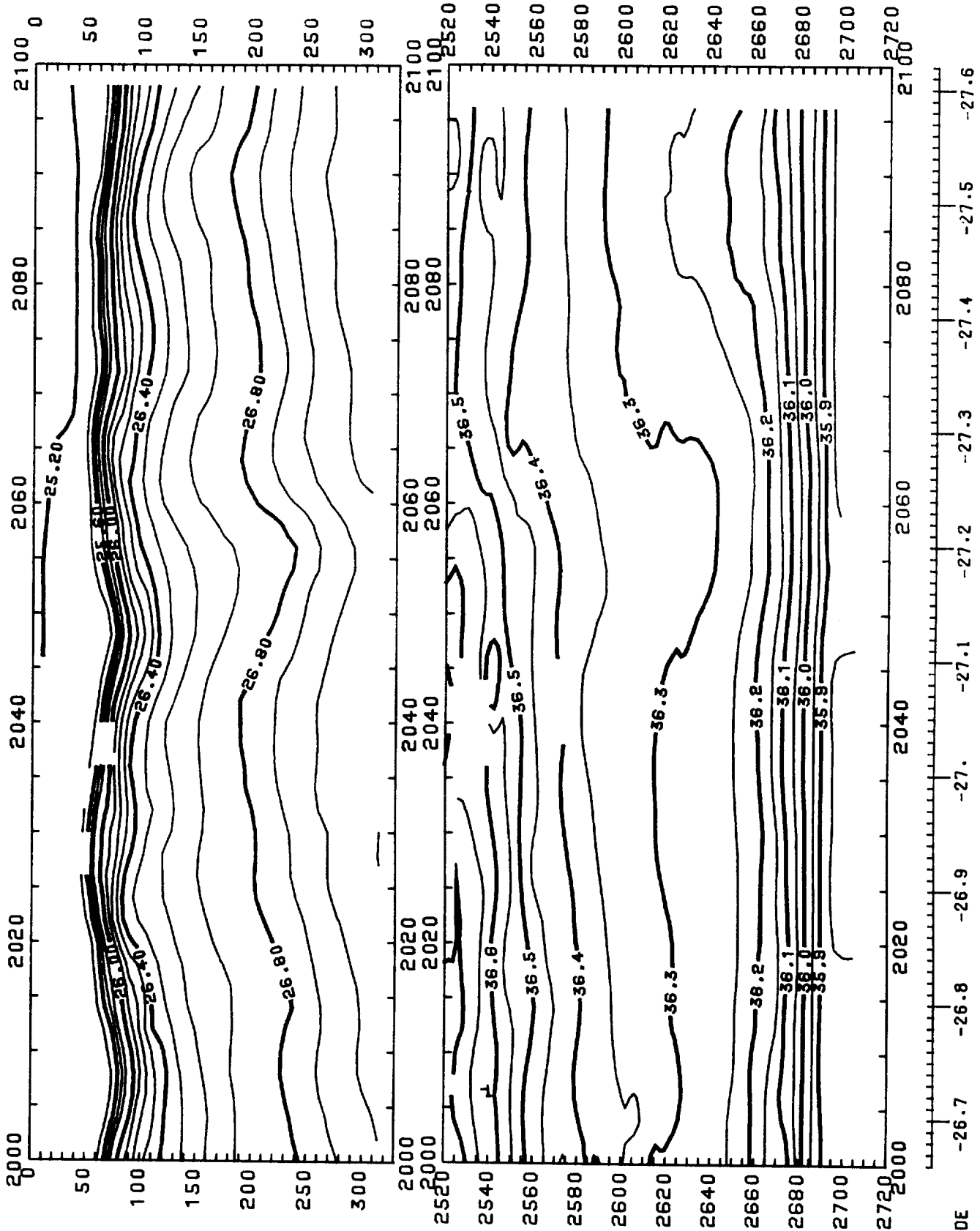
X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA\*100(CGS)

LONGITUDE -25.7 -25.8 -25.9 -26.0 -26.1 -26.2 -26.3 -26.4 -26.5 -26.6



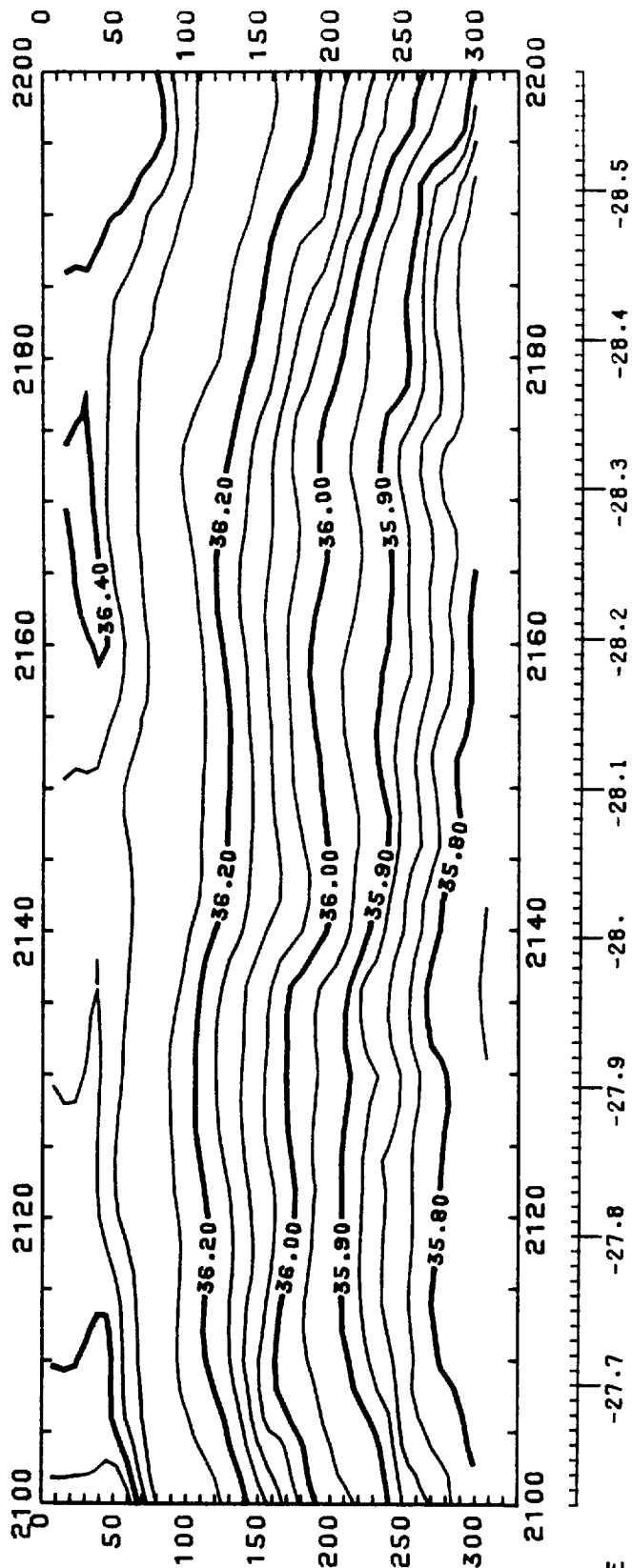
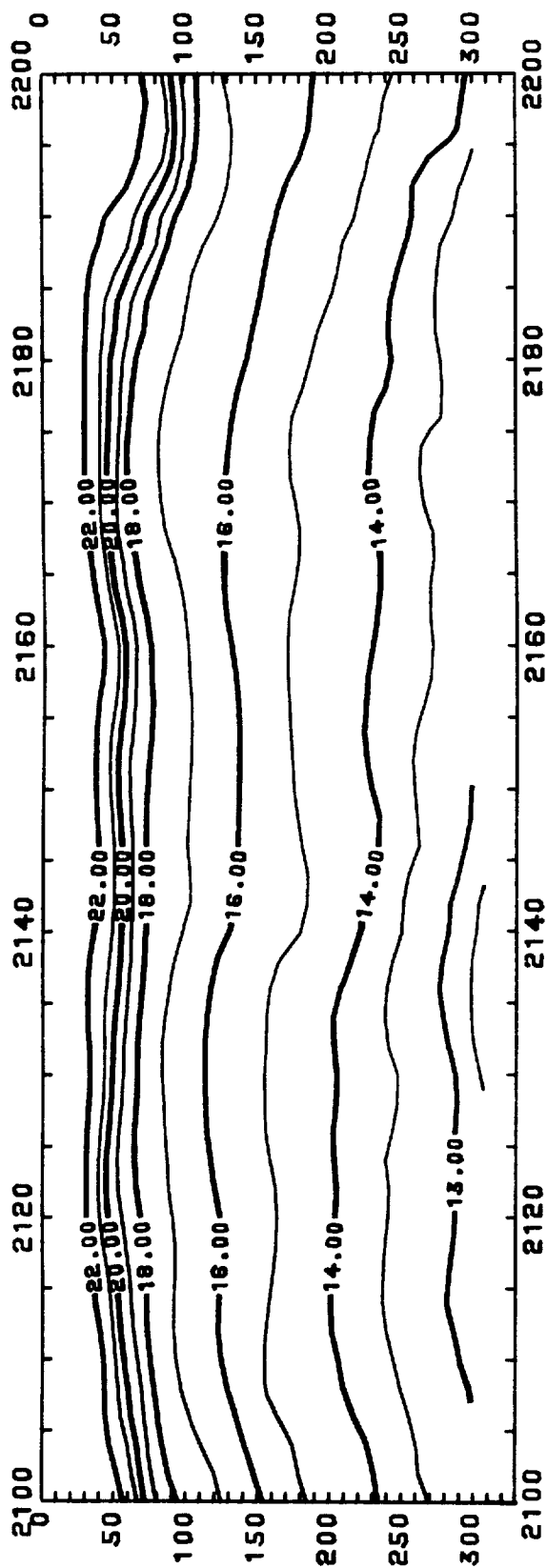
DISCOVERY 114 : OCT 1980 : 2000-2100 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE



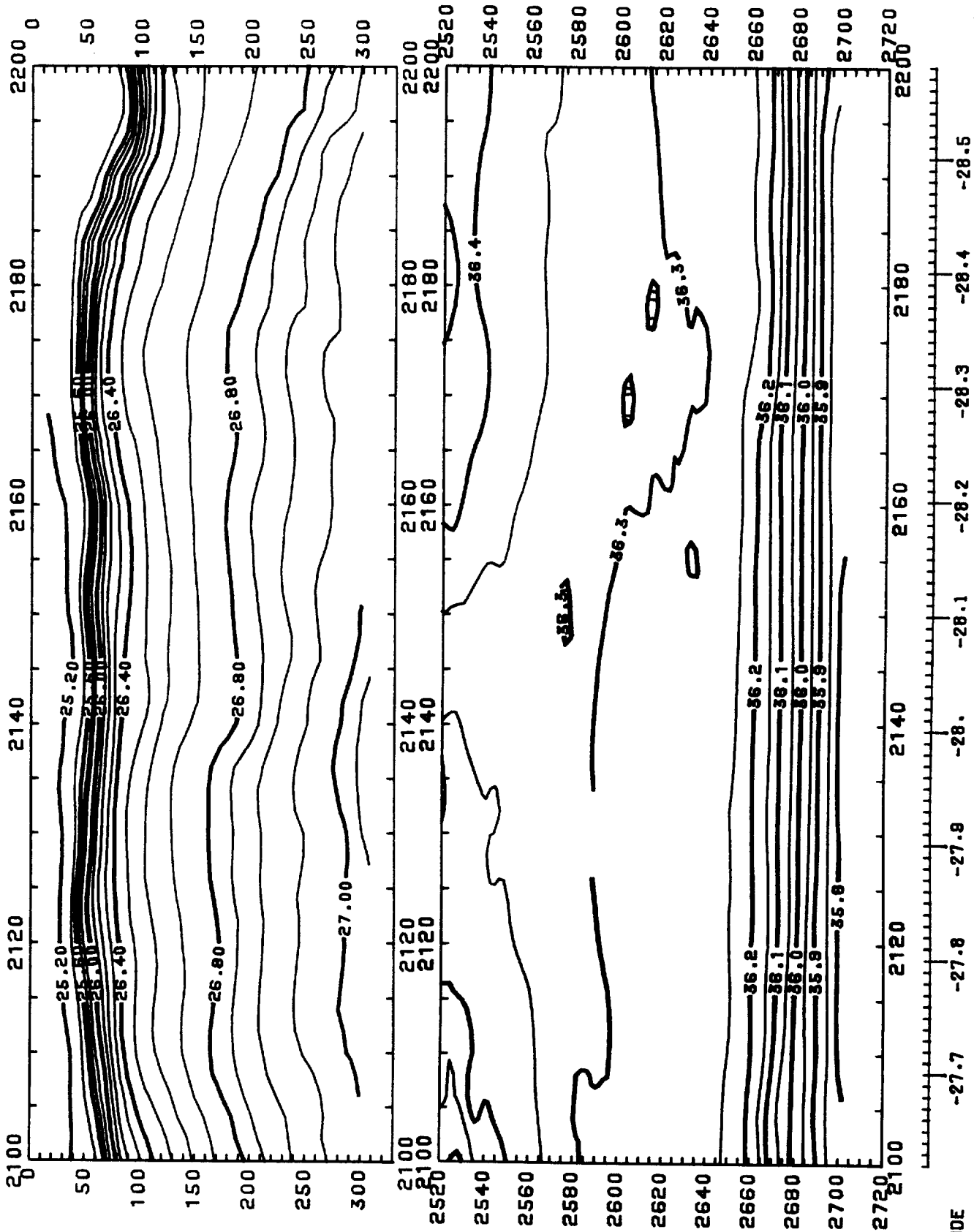
DISCOVERY 114 : OCT 1980 : 2000-2100 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LONGITUDE -26.7 -26.8 -26.9 -27.0 -27.1 -27.2 -27.3 -27.4 -27.5 -27.6



DISCOVERY 114 : OCT 1980 : 2100-2200 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE

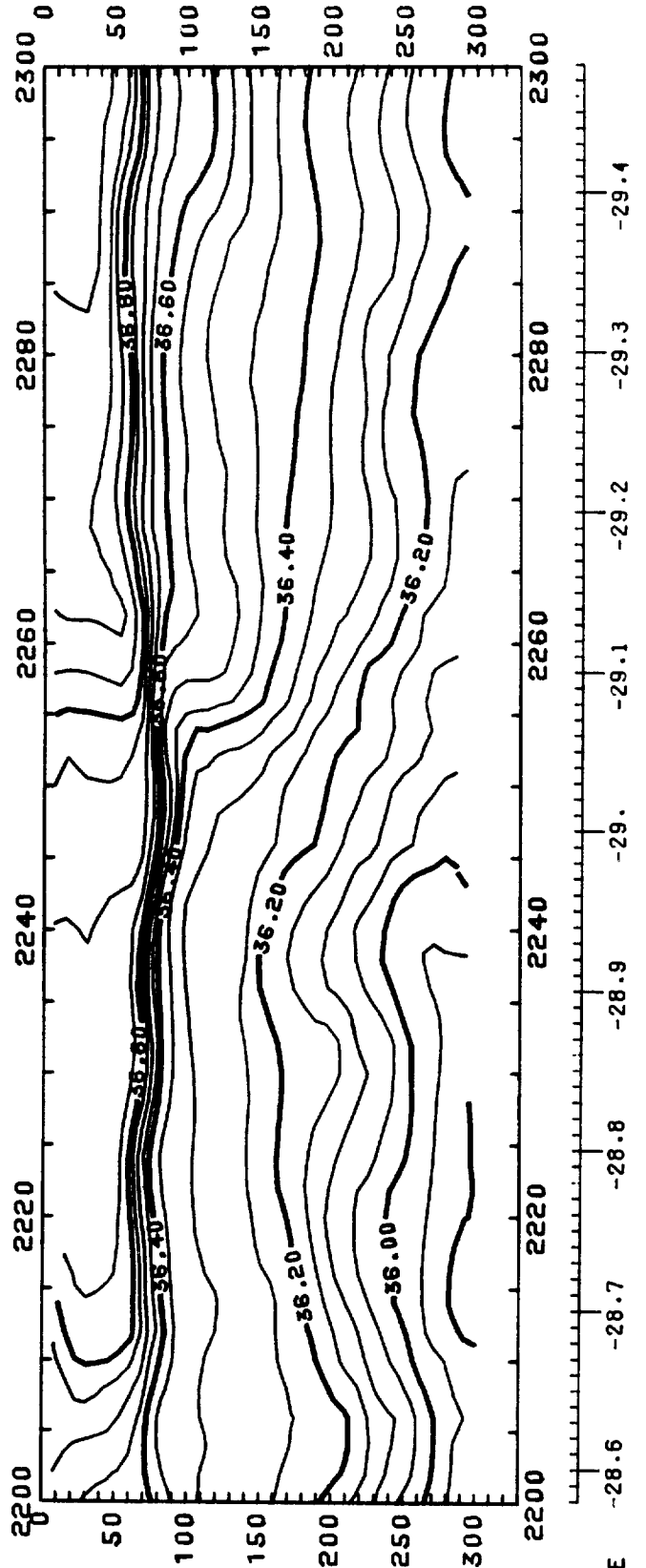
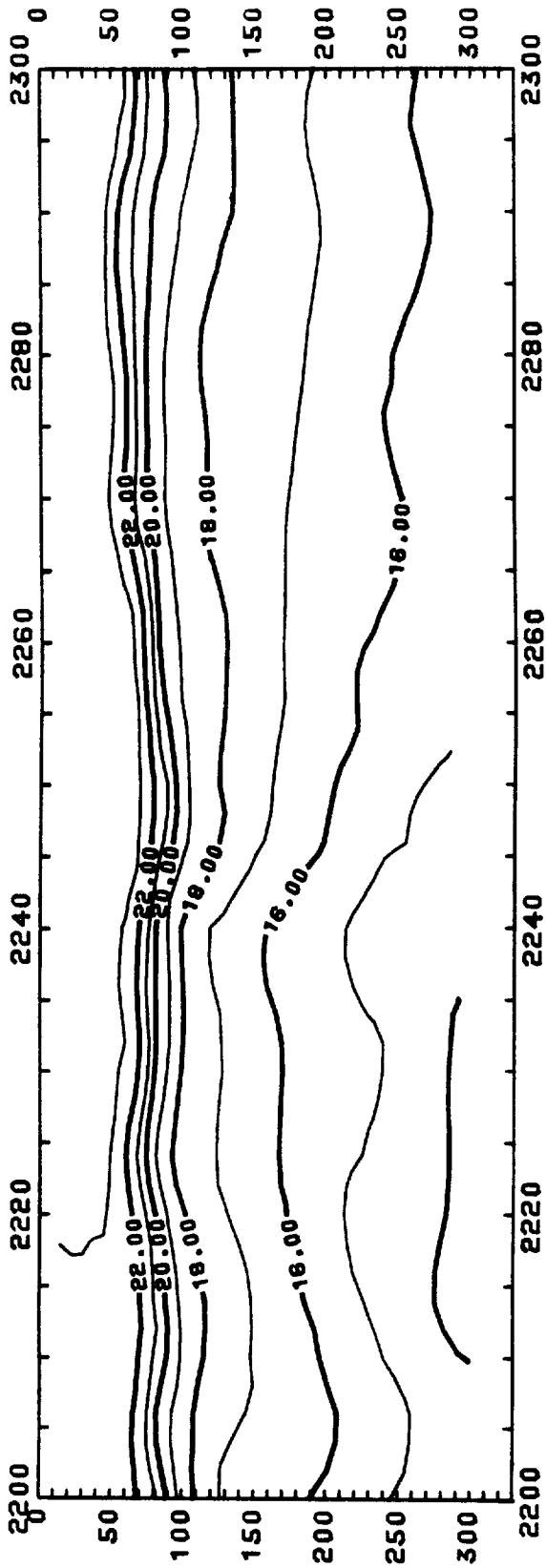


DISCOVERY 114 : OCT 1980 : 2100-2200 KM

CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)

X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CG)

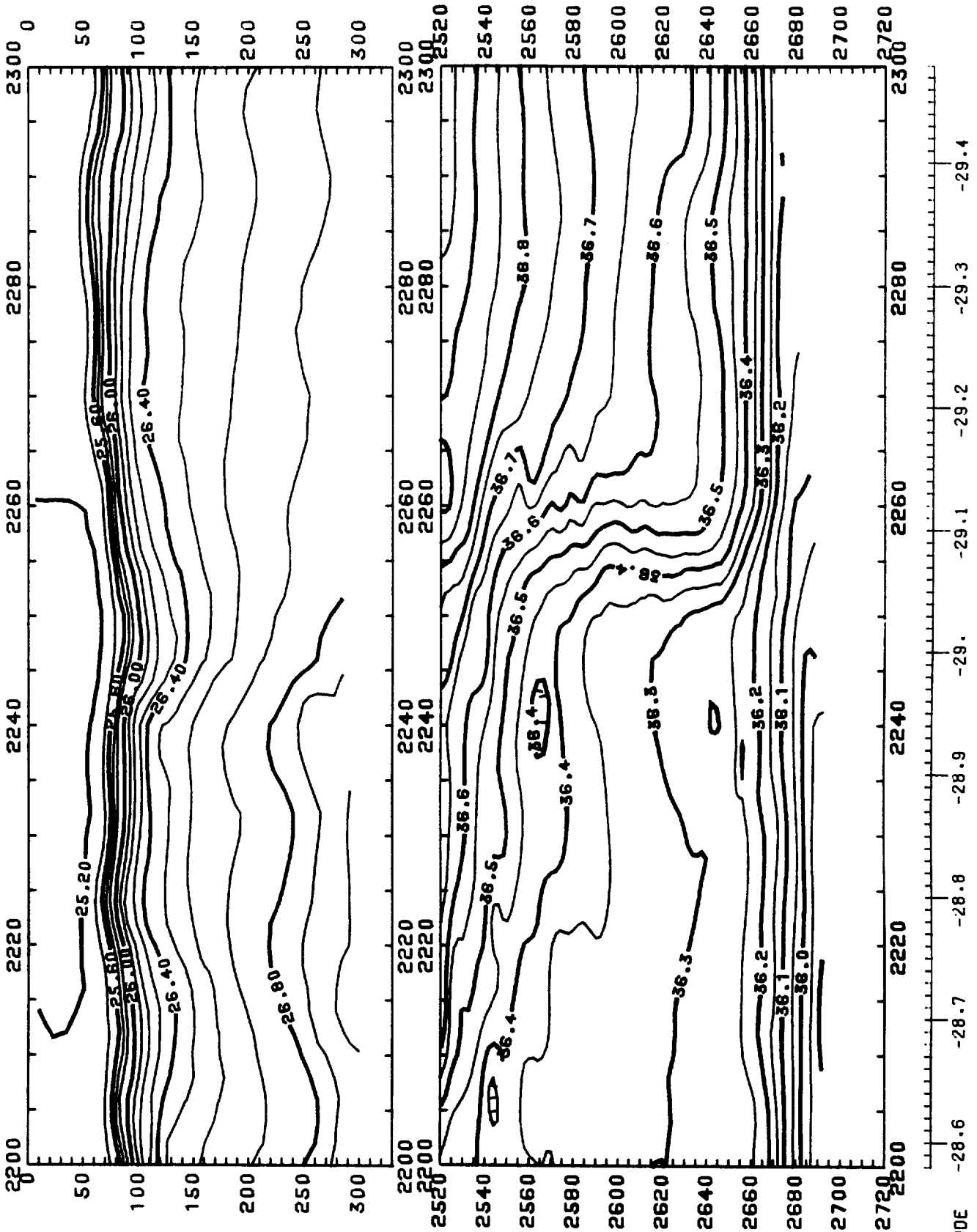
LONGITUDE



DISCOVERY 114 : OCT 1980 : 2200-2300 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

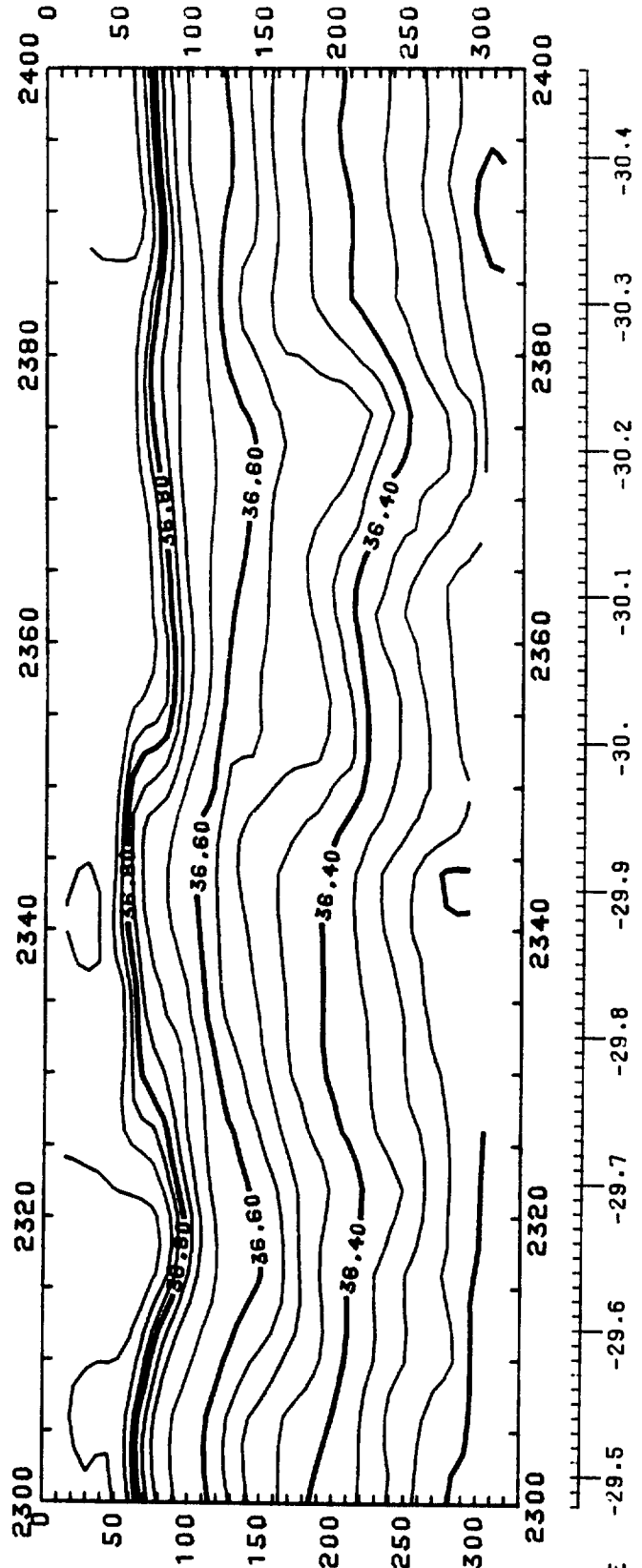
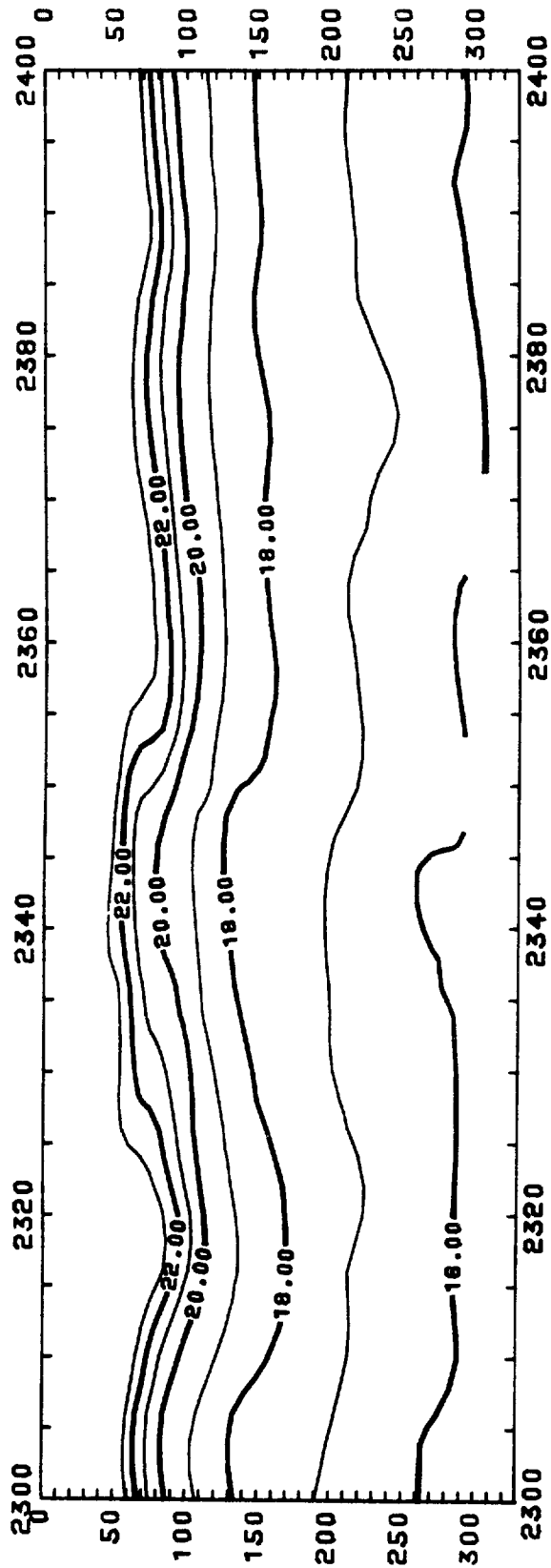
LONGITUDE





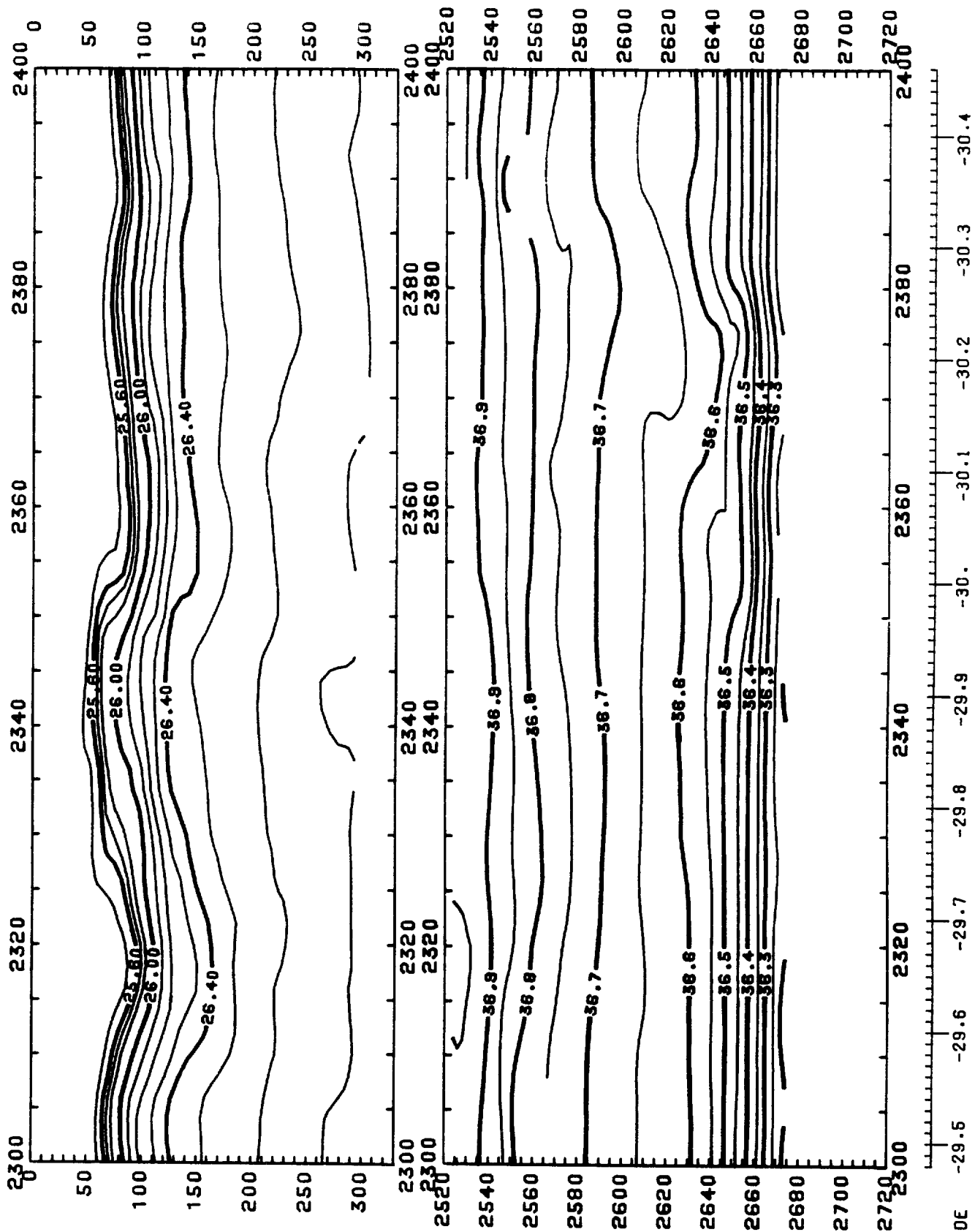
DISCOVERY 114 : OCT 1980 : 2200-2300 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA\*100(CGS)

LONGITUDE



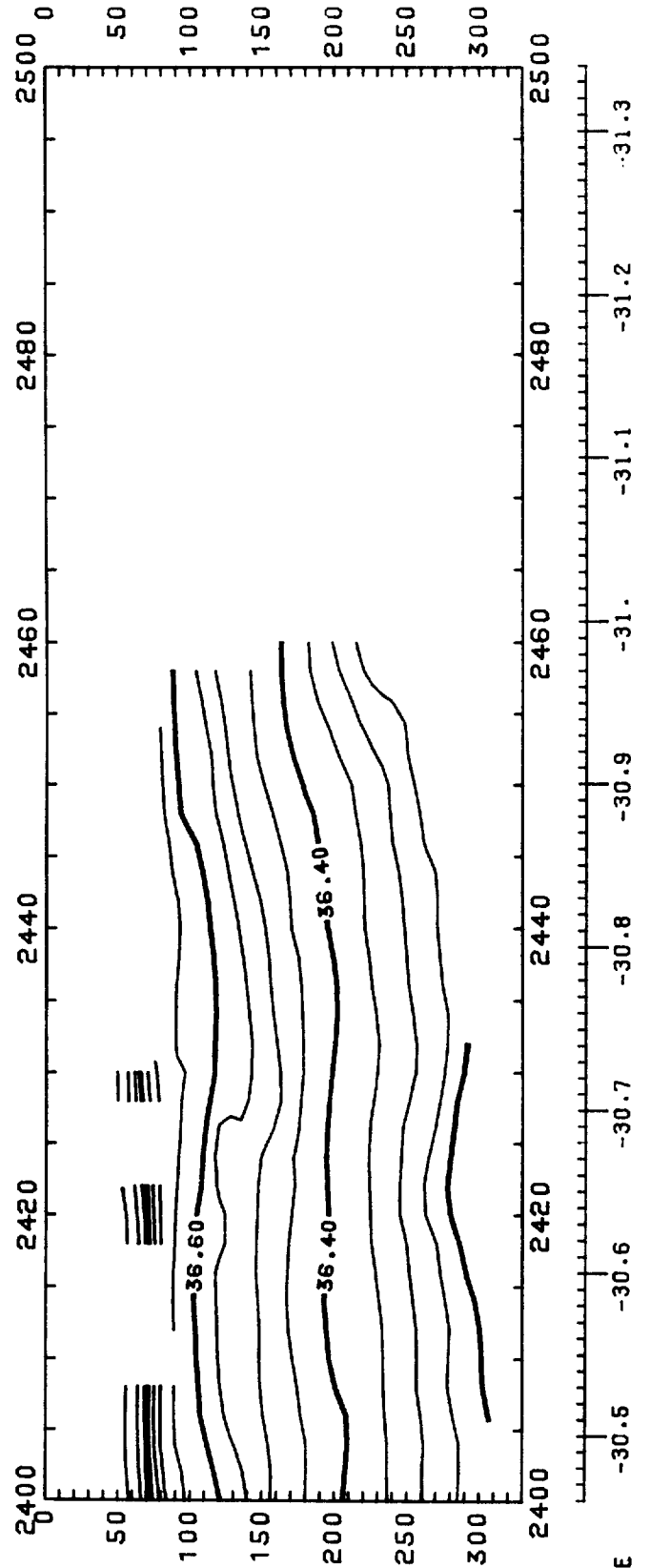
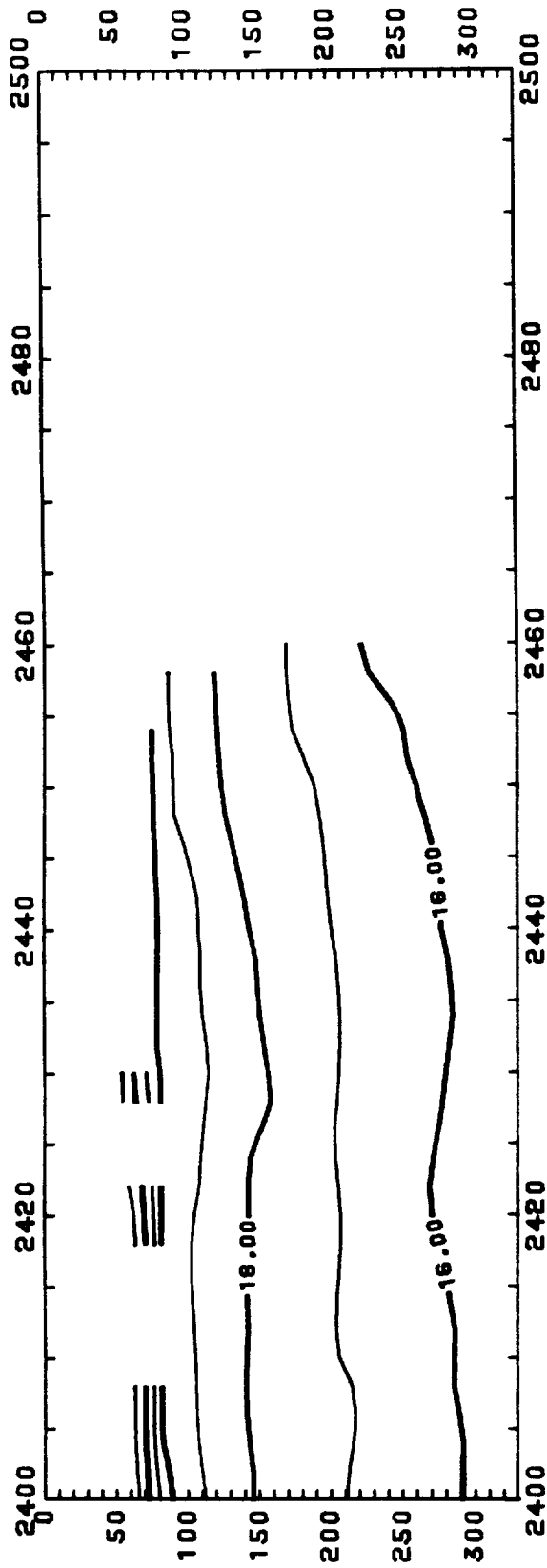
DISCOVERY 114 : OCT 1980 : 2300-2400 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE -29.5 -29.6 -29.7 -29.8 -29.9 -30.0 -30.1 -30.2 -30.3 -30.4



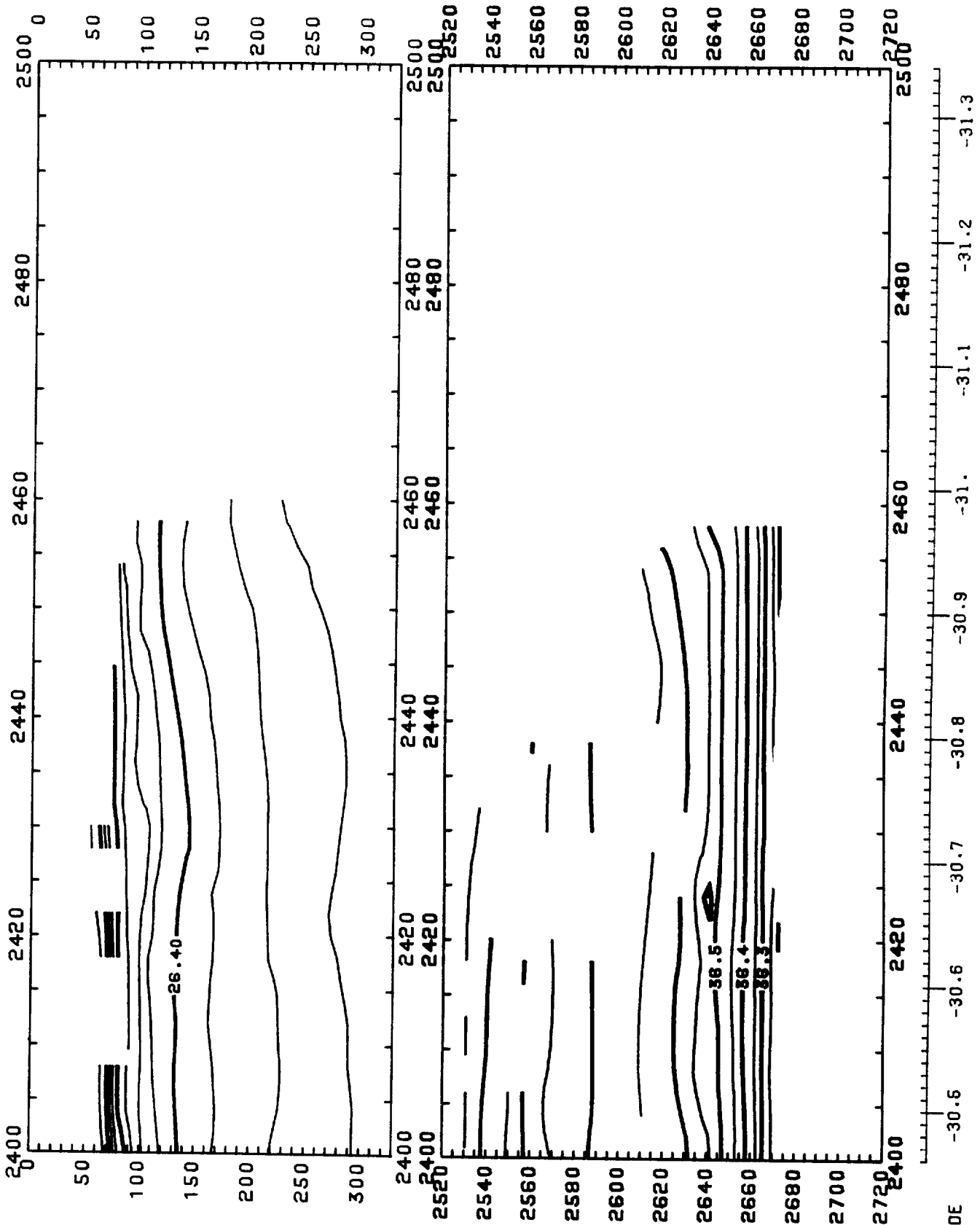
DISCOVERY 114 : OCT 1980 : 2300-2400 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

LONGITUDE -29.5 -29.6 -29.7 -29.8 -29.9 -30.0 -30.1 -30.2 -30.3 -30.4



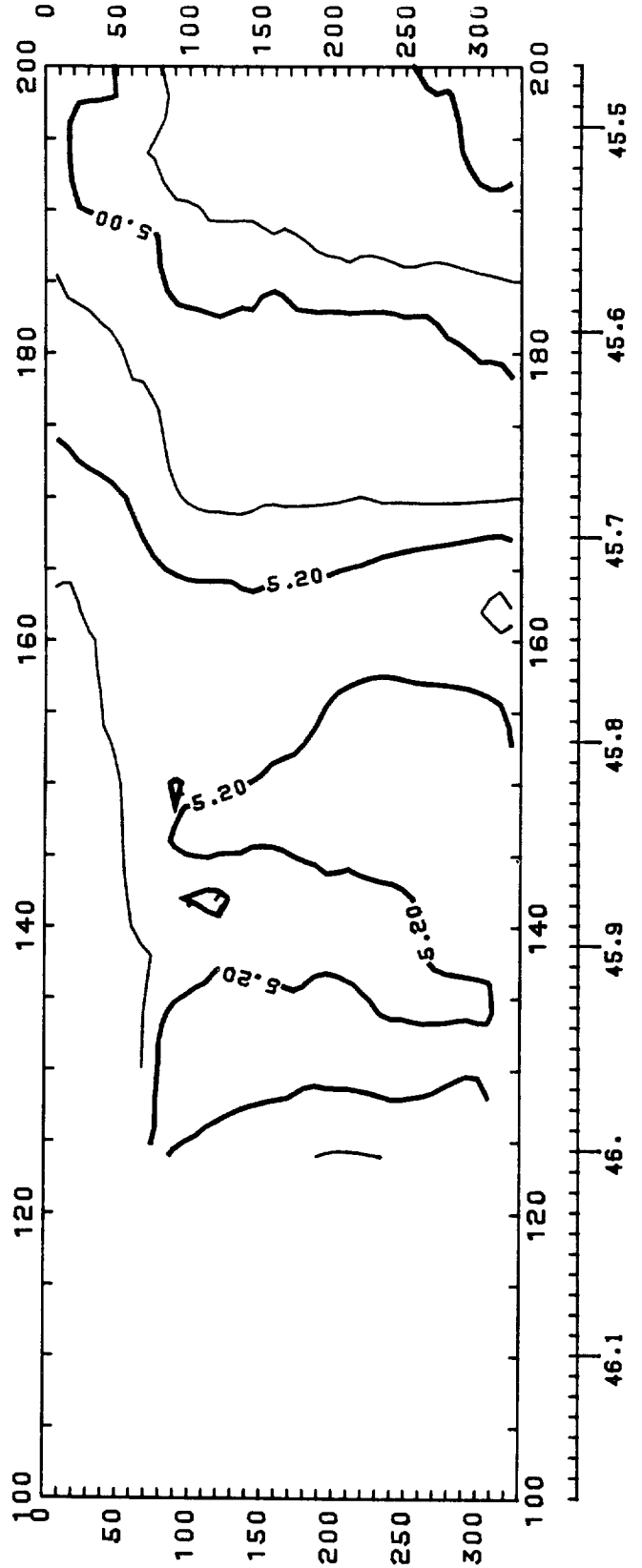
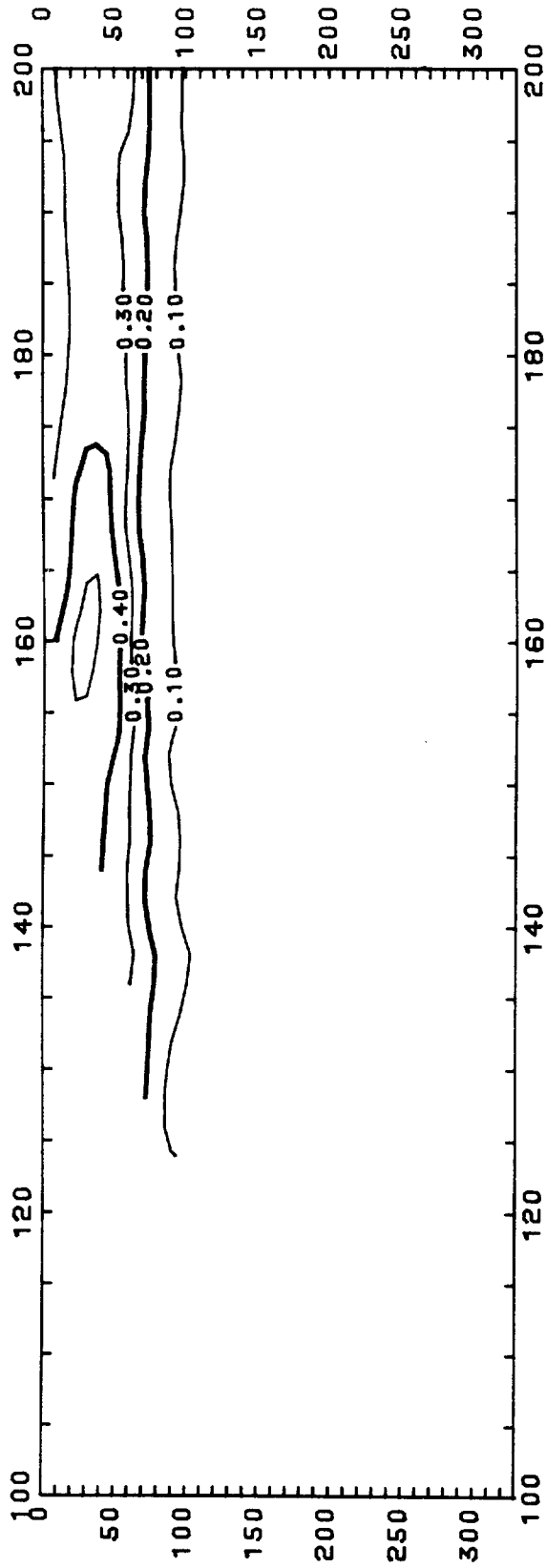
DISCOVERY 114 : OCT 1980 : 2400-2500 KM  
 =====  
 CONTOURS OF POTENTIAL TEMPERATURE(TOP) AND SALINITY(BOTTOM)  
 X-DISTANCE RUN(KM) : Y-PRESSURE(DB)

LONGITUDE



DISCOVERY 114 : OCT 1980 : 2400-2500 KM  
 =====  
 CONTOURS OF SIGMA THETA(TOP) AND SALINITY(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB) OR SIGMA THETA=100(CGS)

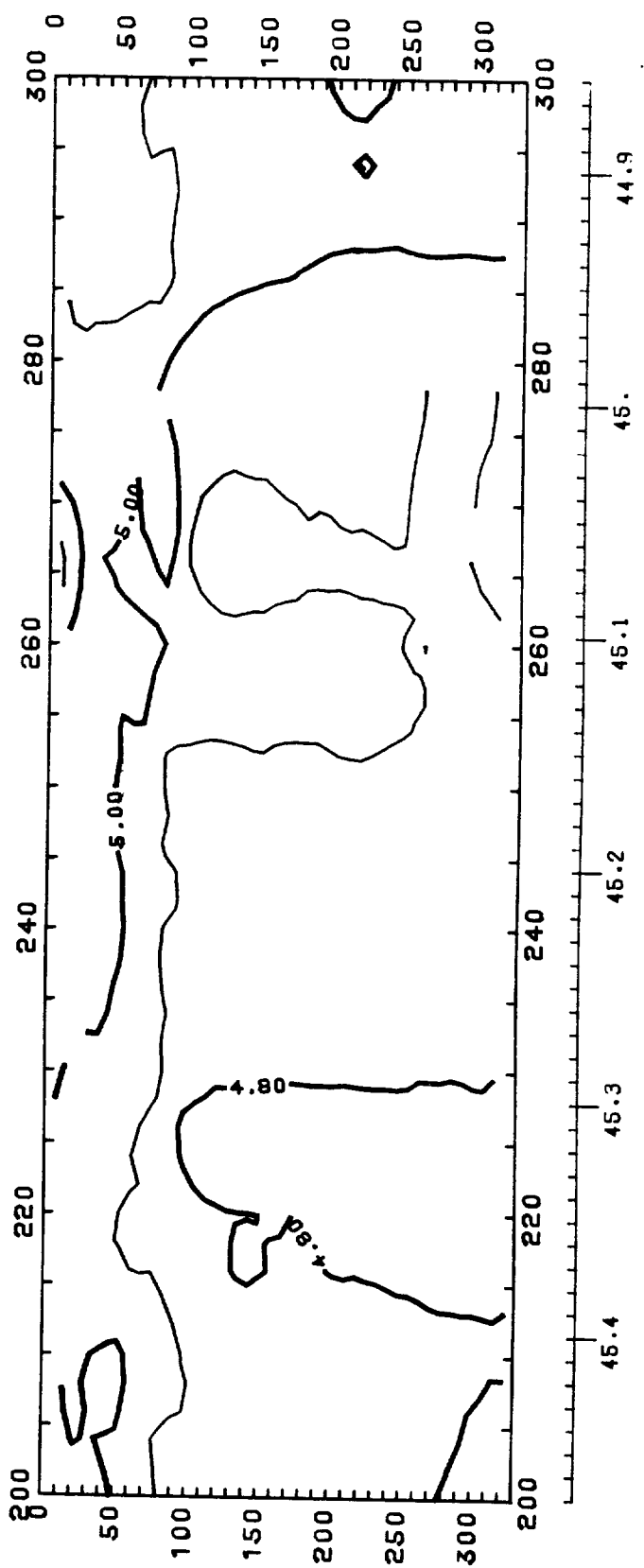
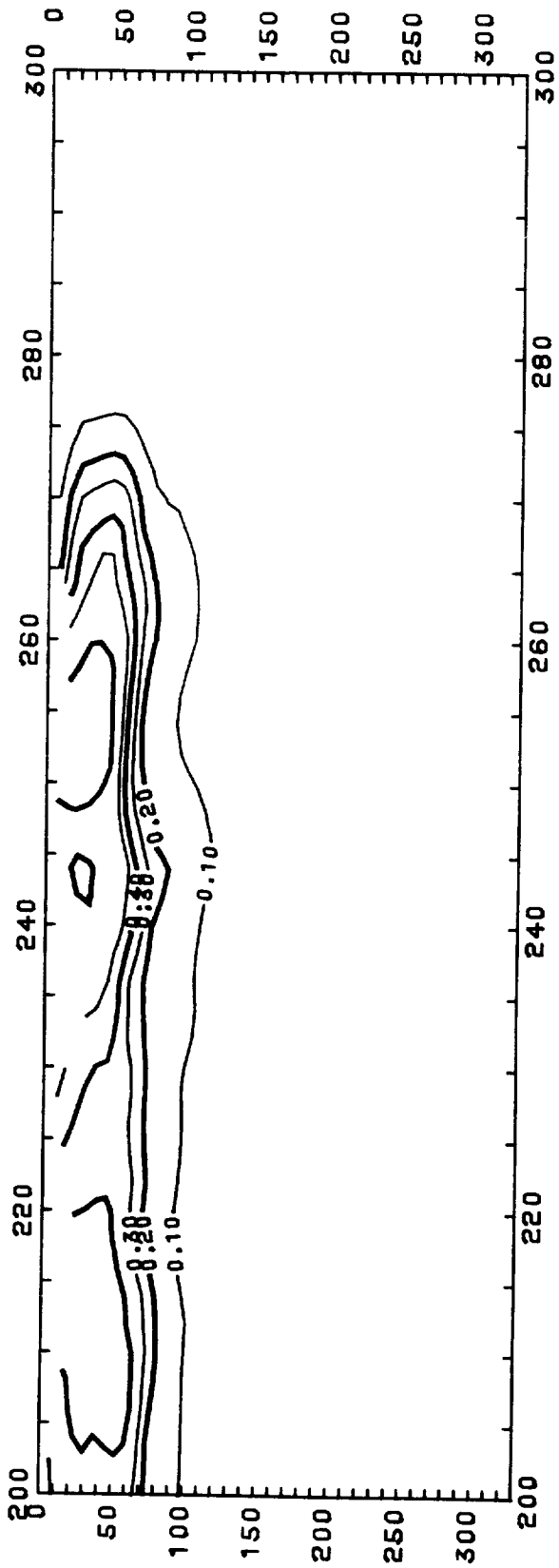
LONGITUDE



DISCOVERY 114 : OCT 1980 : 100-200 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) ; Y=PRESSURE(DB)

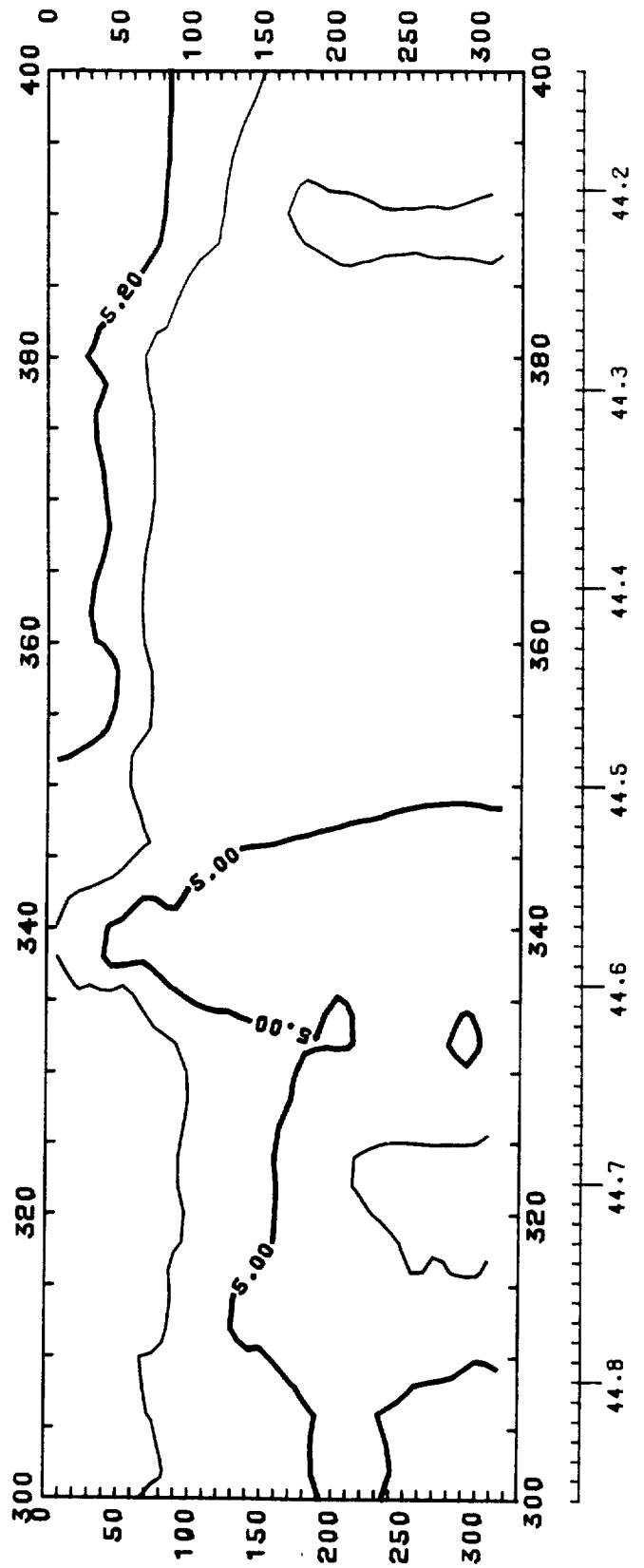
LATITUDE

46.1 46. 45.9 45.8 45.7 45.6 45.5



DISCOVERY 114 : OCT 1980 : 200-300 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

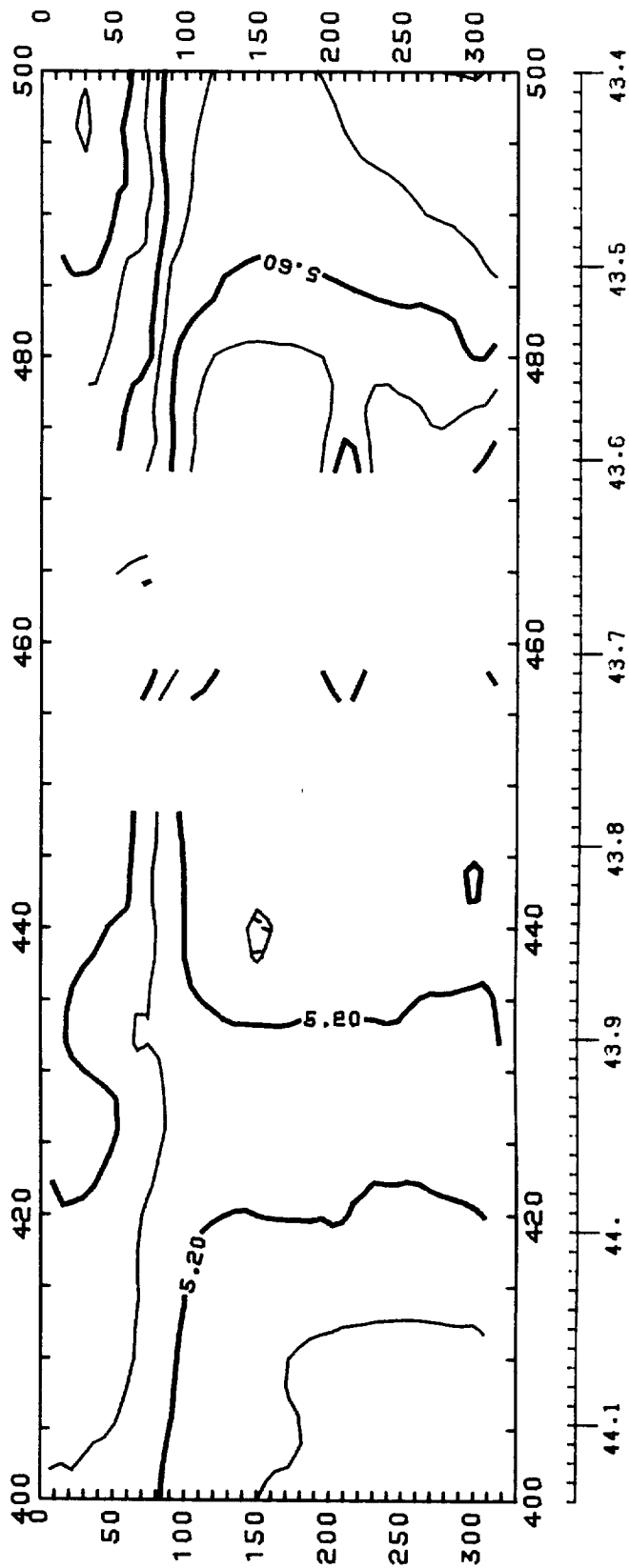
LATITUDE



DISCOVERY 114 : OCT 1980 : 300-400 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=LATITUDE

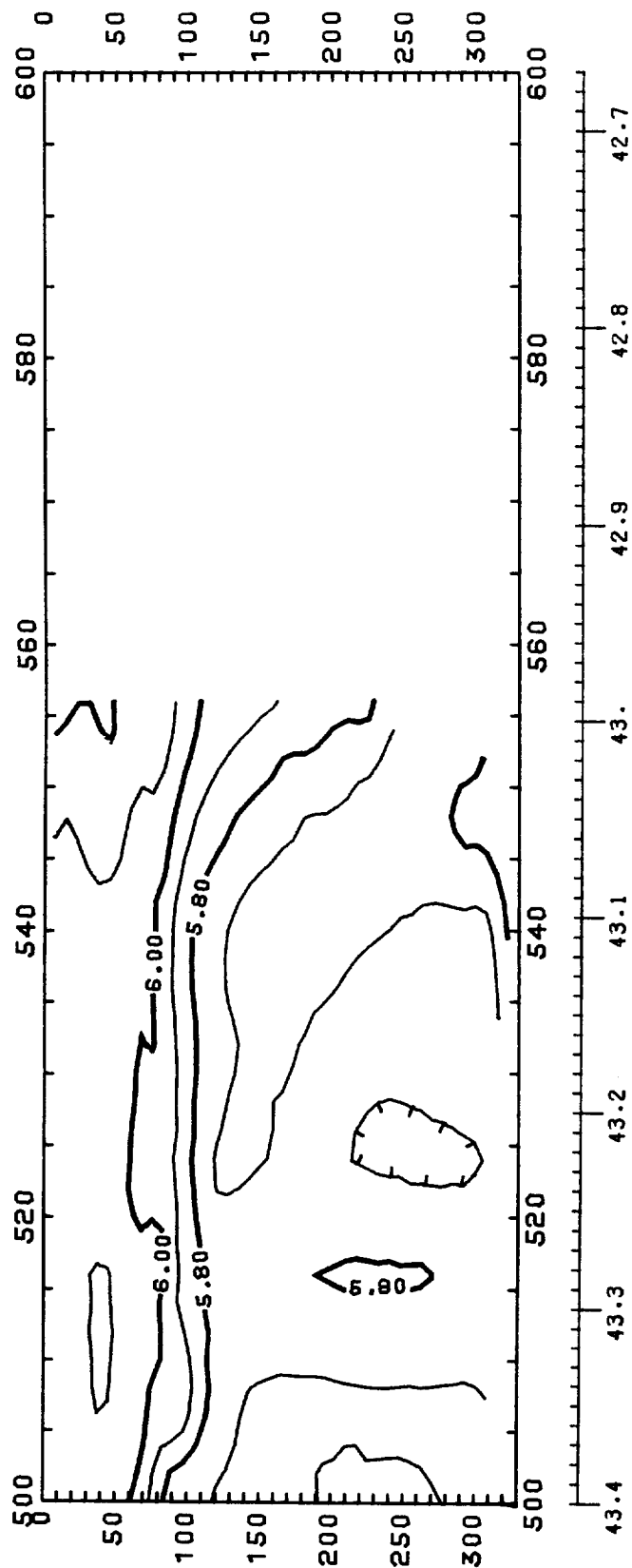
LATITUDE





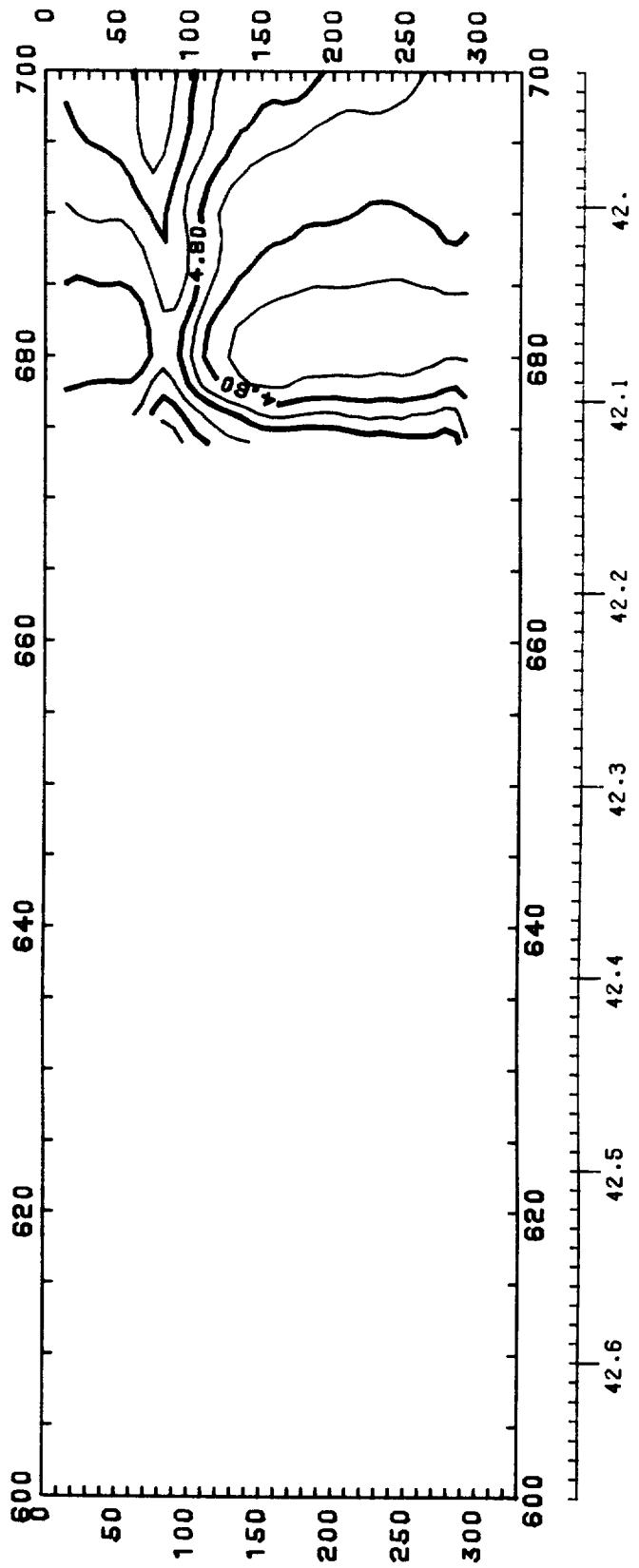
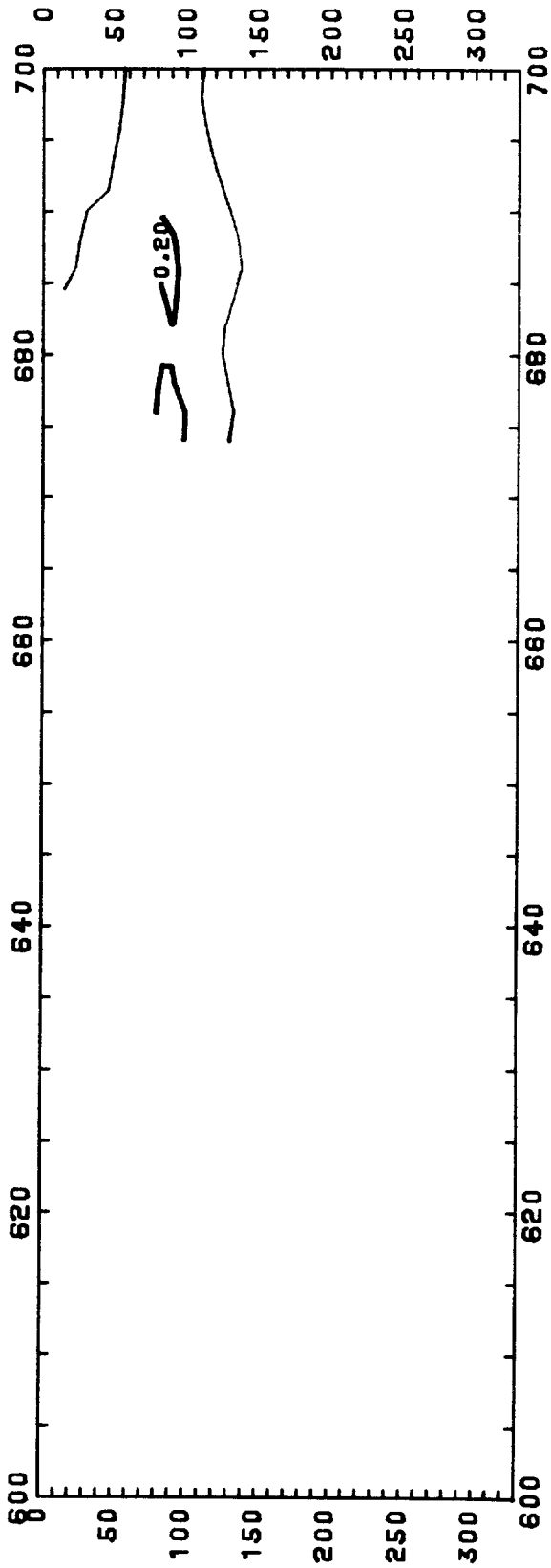
DISCOVERY 114 : OCT 1980 : 400-500 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE



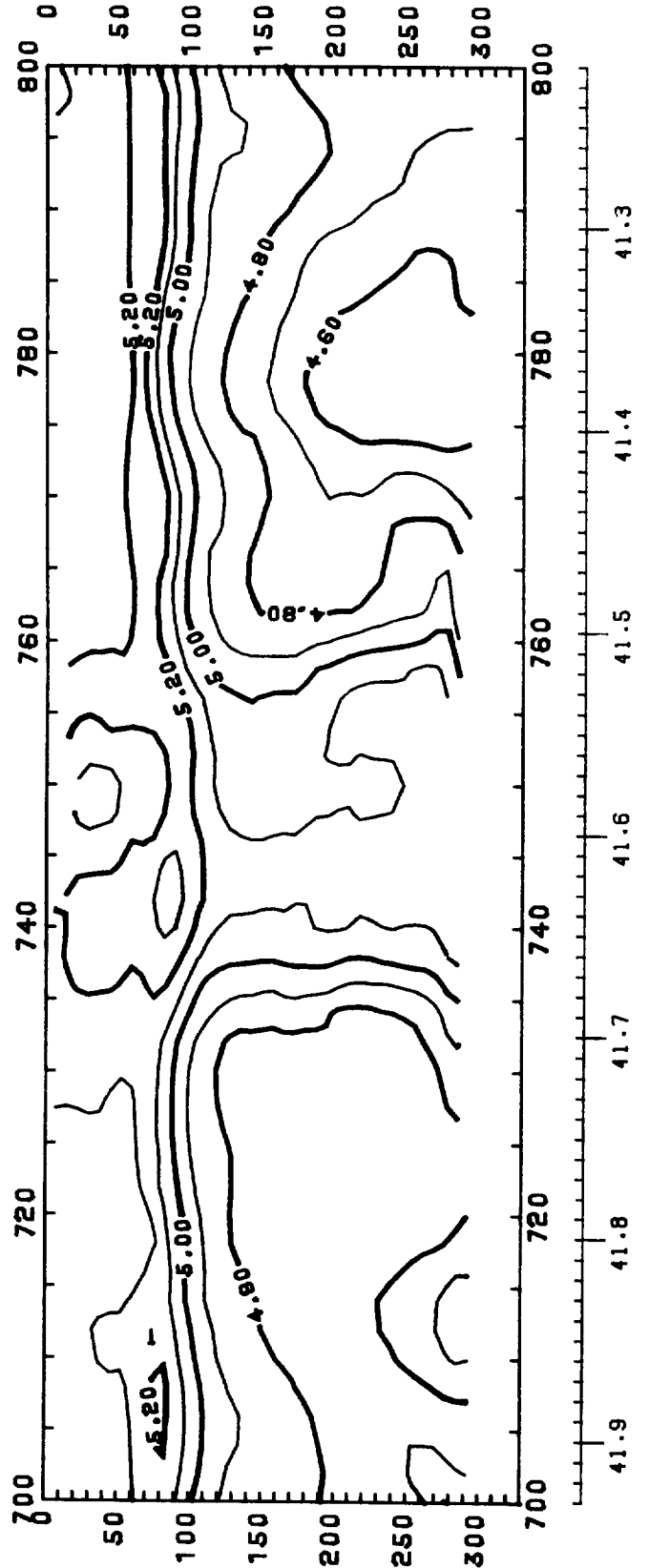
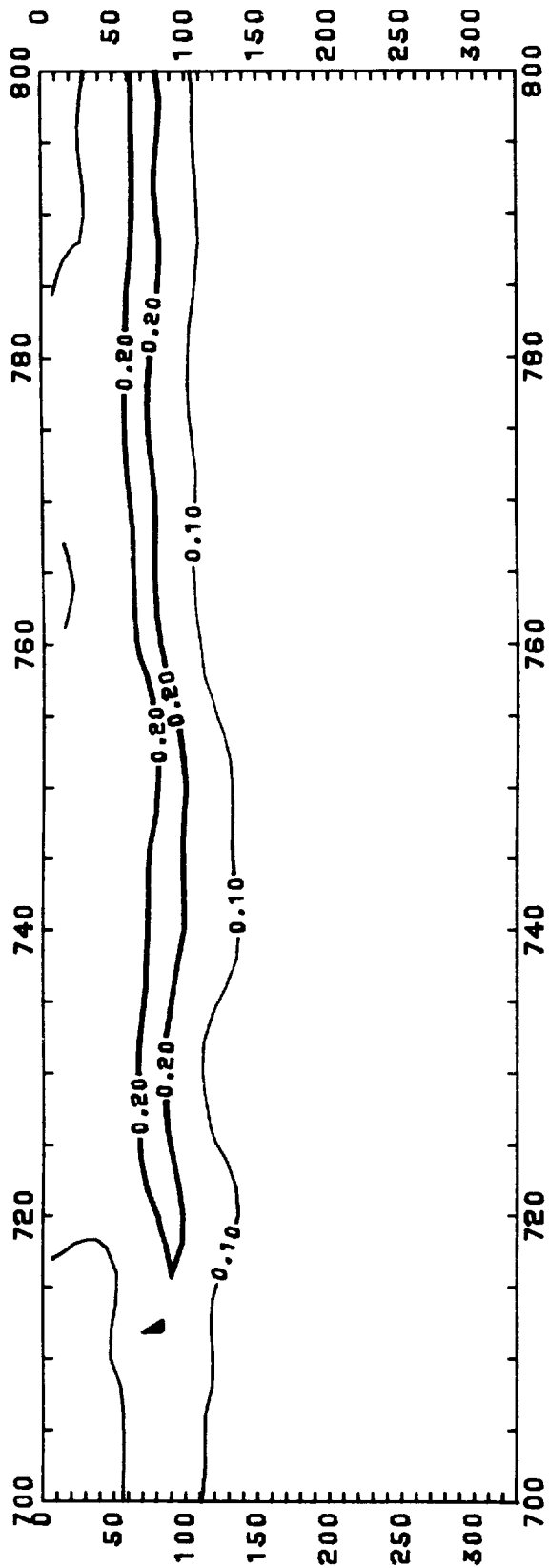
DISCOVERY 114 : OCT 1980 : 500-600 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE



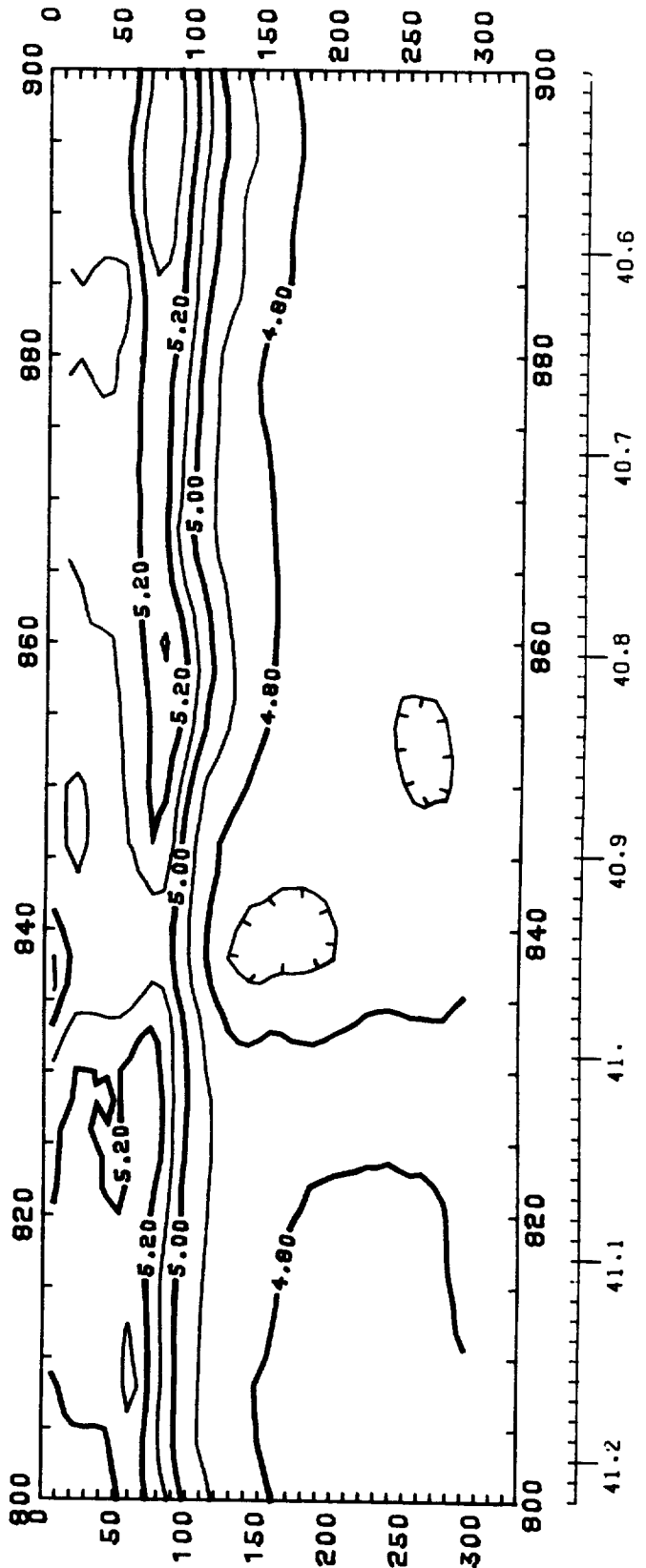
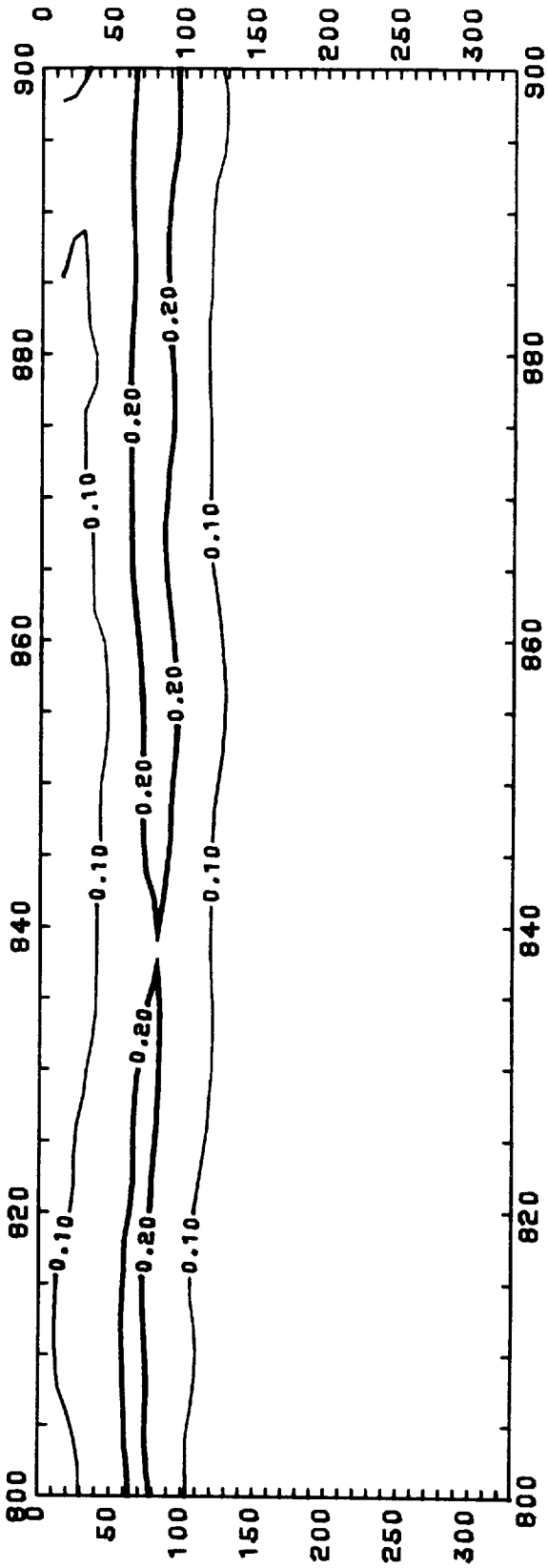
LATITUDE  
 42.6  
 42.5  
 42.4  
 42.3  
 42.2  
 42.1  
 42.

DISCOVERY 114 : OCT 1980 : 600-700 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)



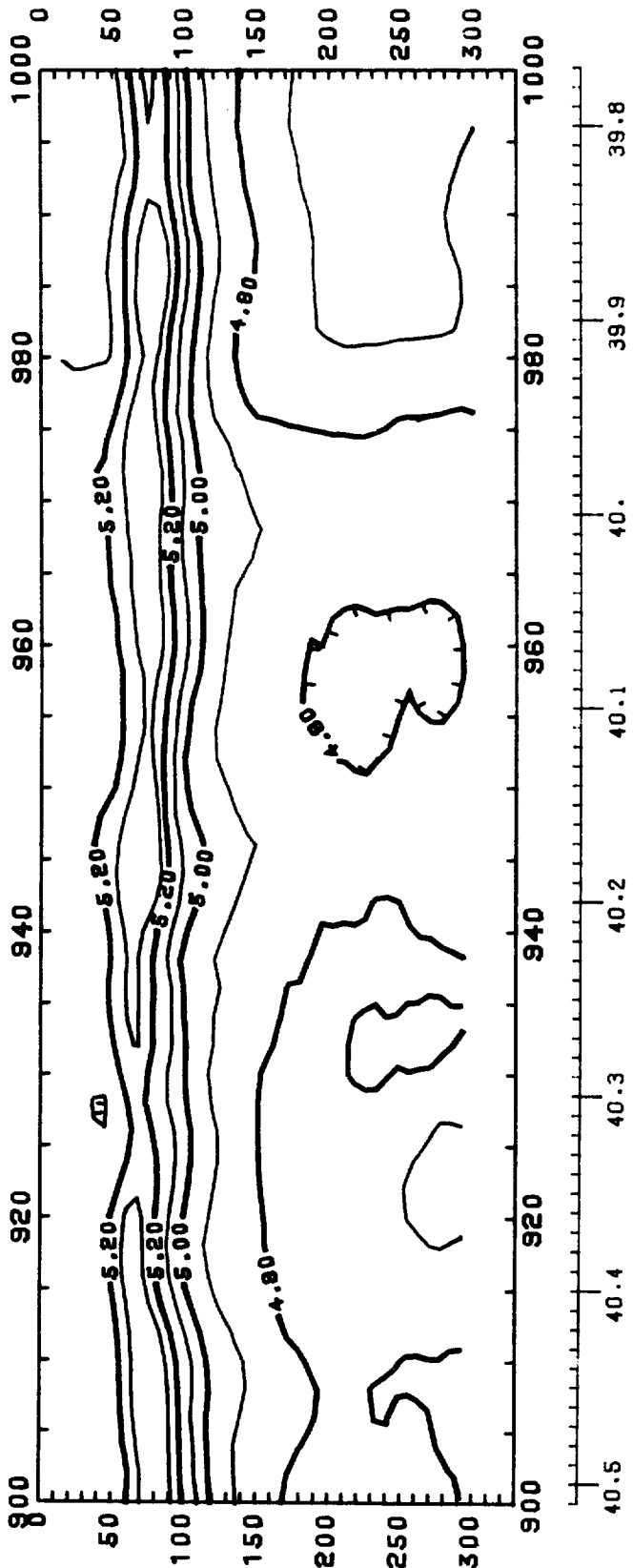
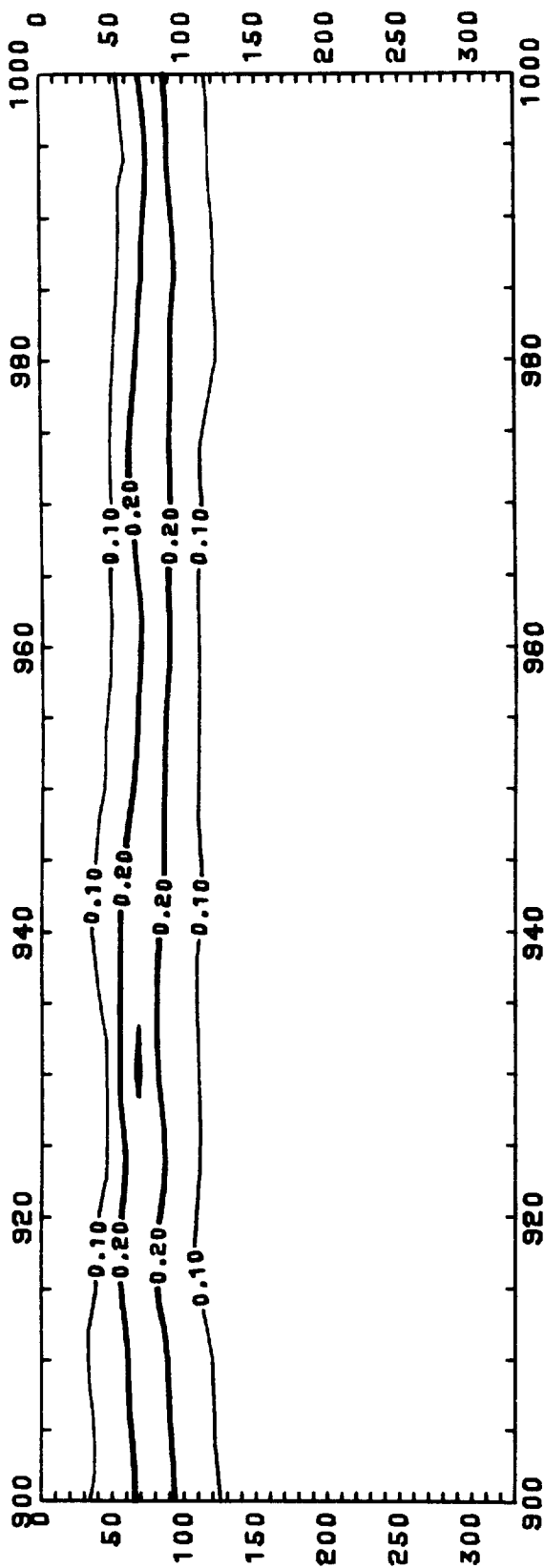
DISCOVERY 114 : OCT 1980 : 700-800 KM  
===== ||||| ||||| ||||| ||||| ||||| =====  
CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE



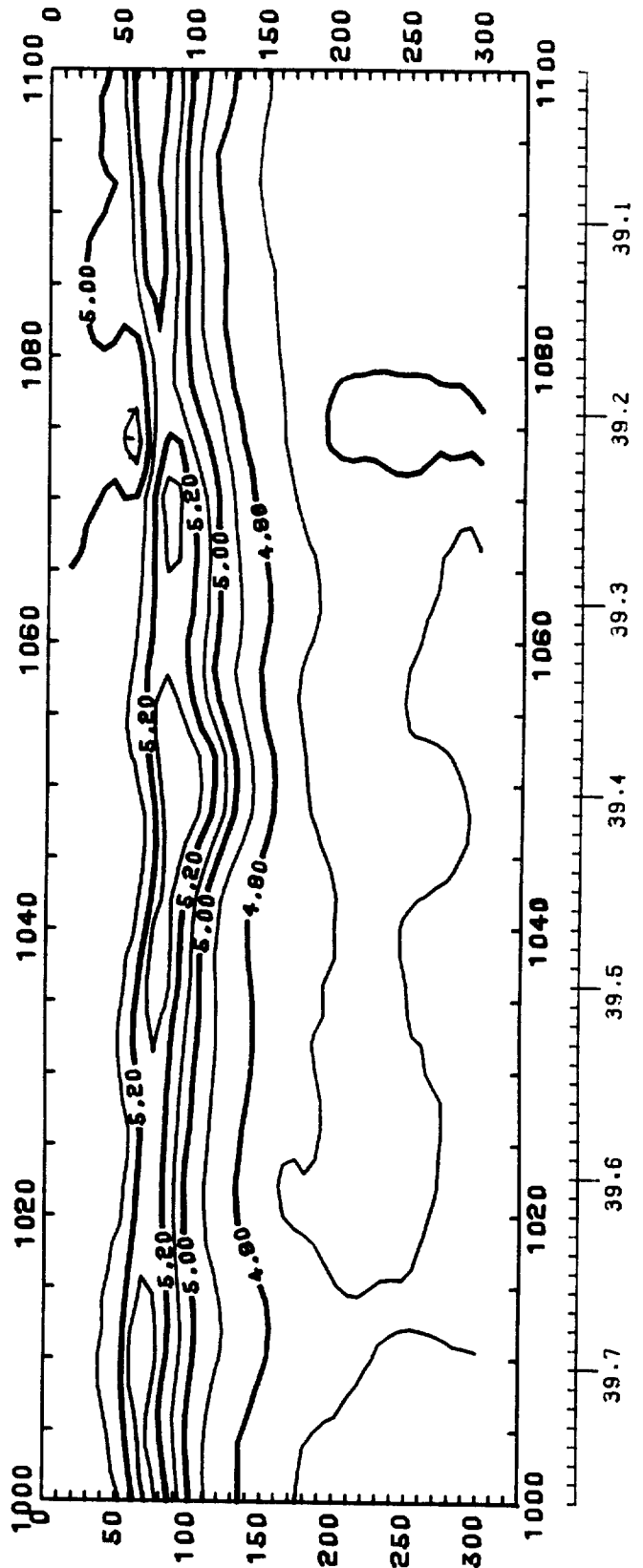
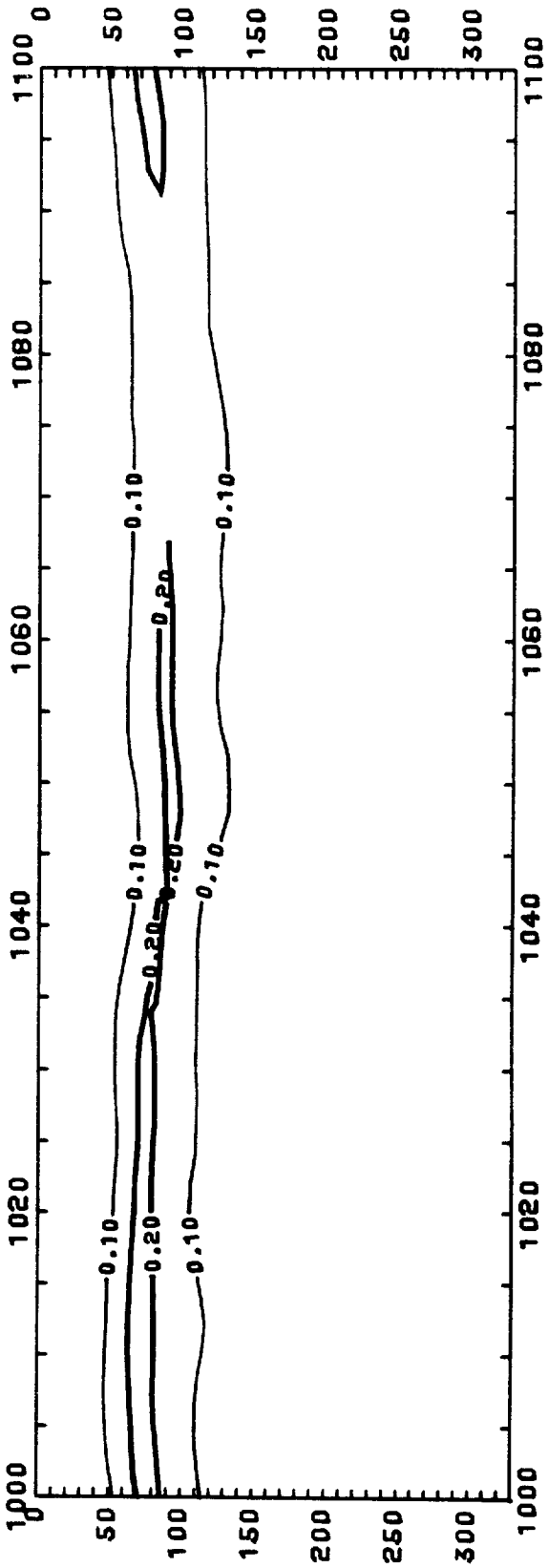
DISCOVERY 114 : OCT 1980 : 800-900 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE



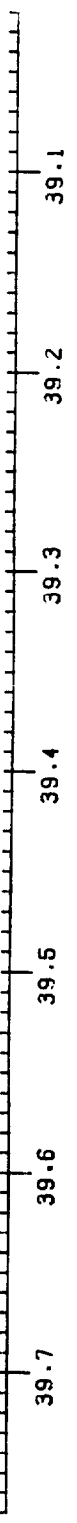
DISCOVERY 114 : OCT 1980 : 900-1000 KM  
=====      ==      =====  
CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

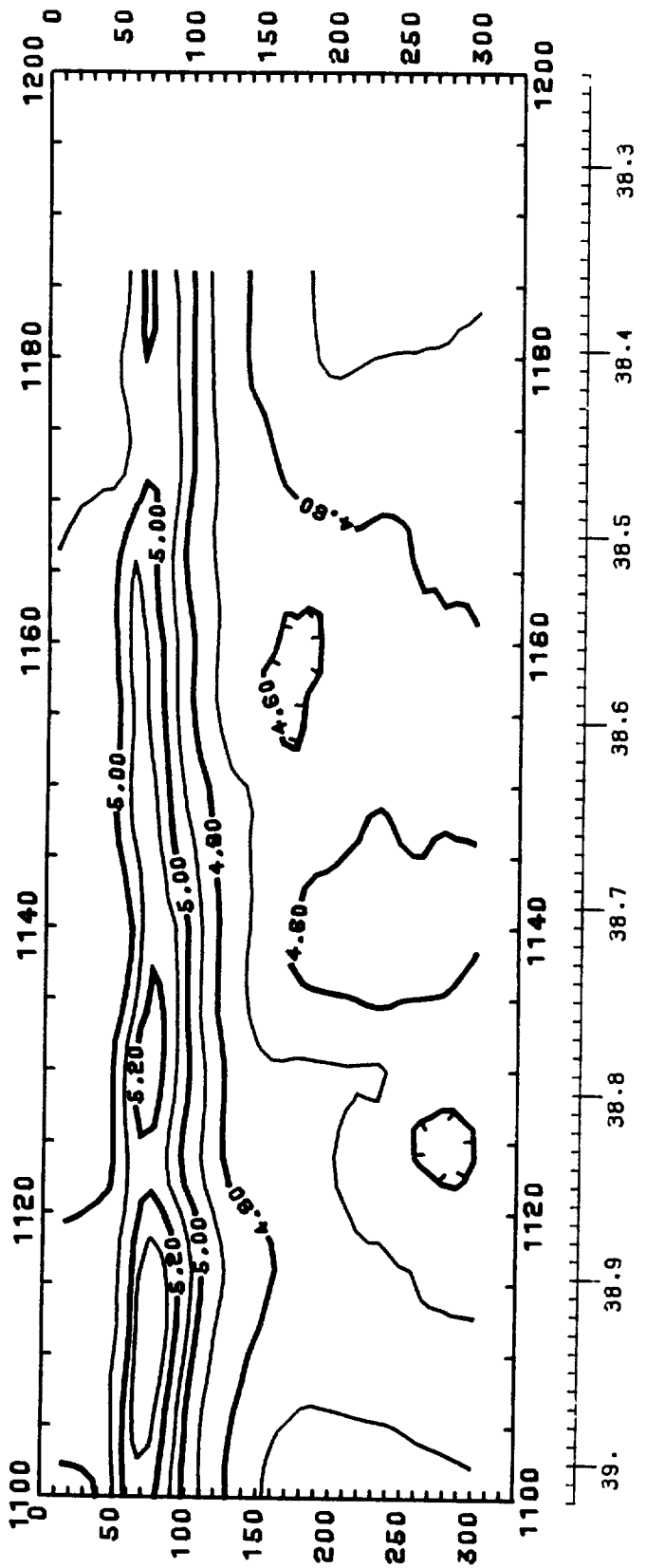
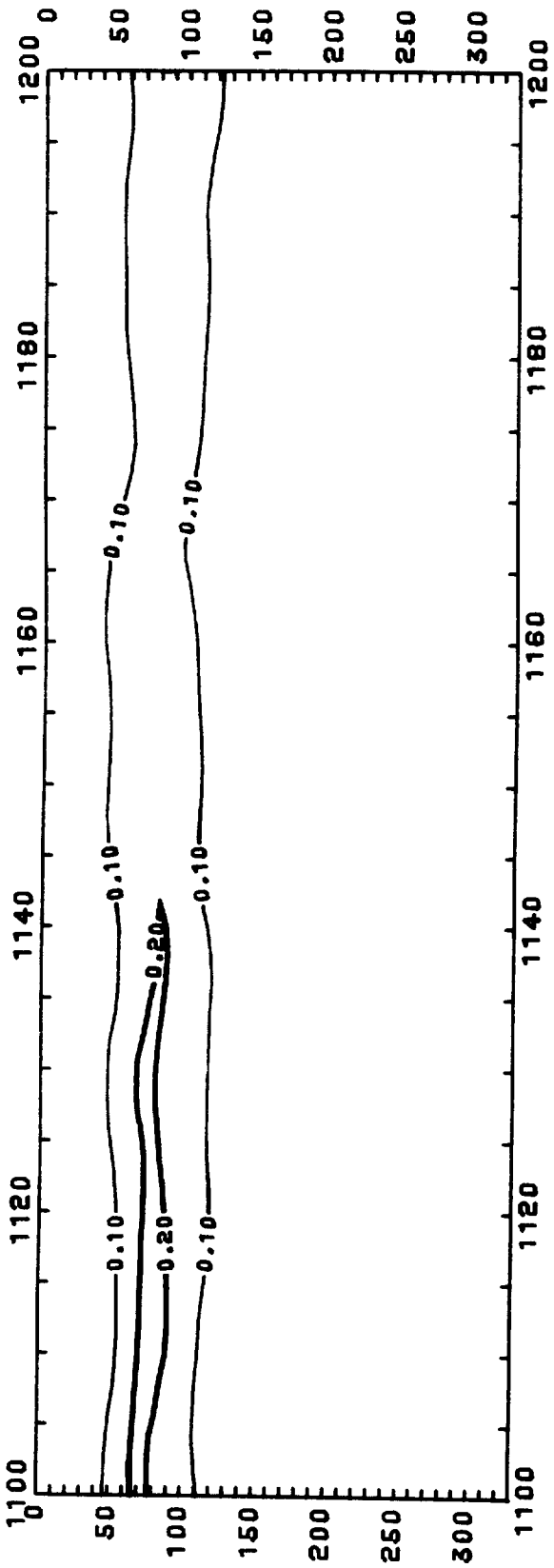
LATITUDE



DISCOVERY 114 : OCT 1980 : 1000-1100 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LATITUDE

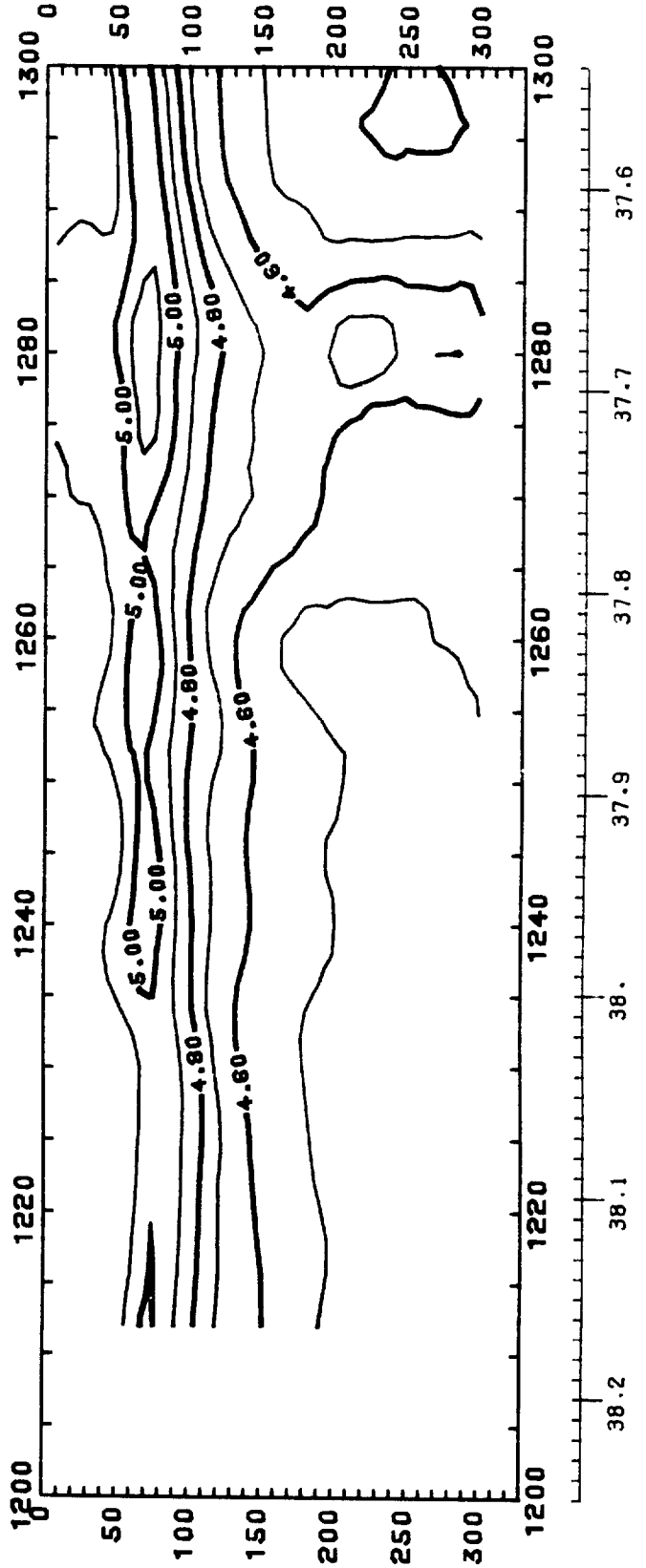
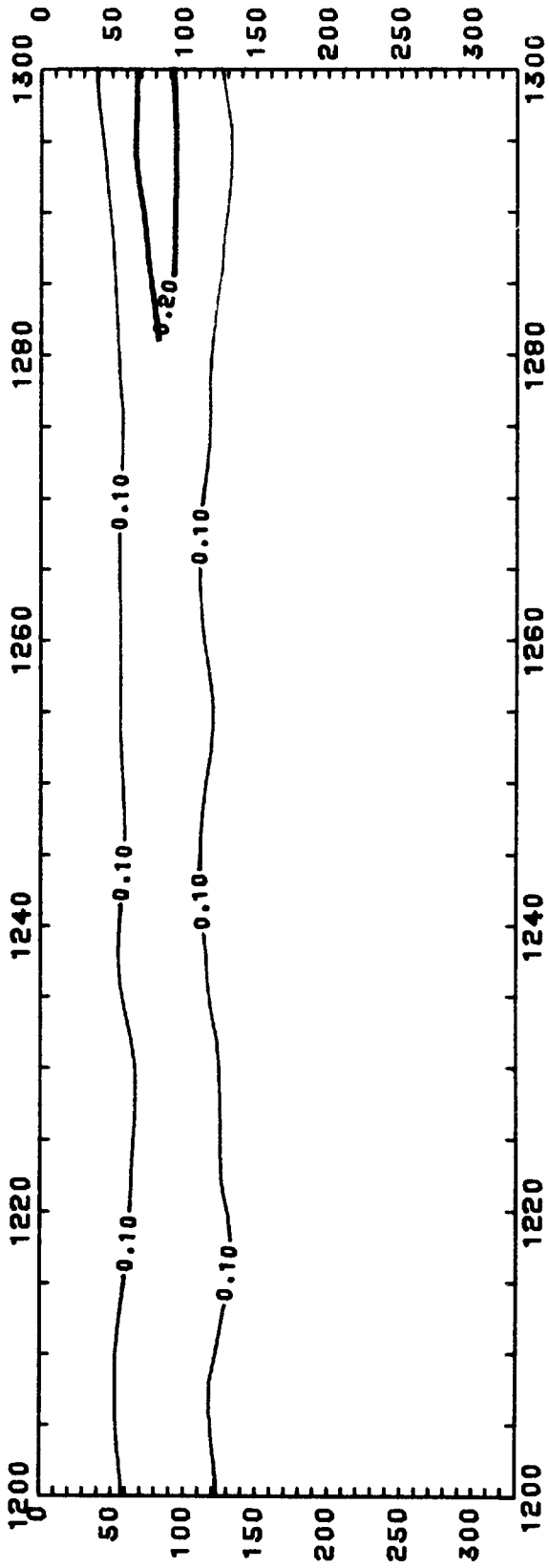




DISCOVERY 114 : OCT 1980 : 1100-1200 KM  
===== === === =====  
CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM.)  
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

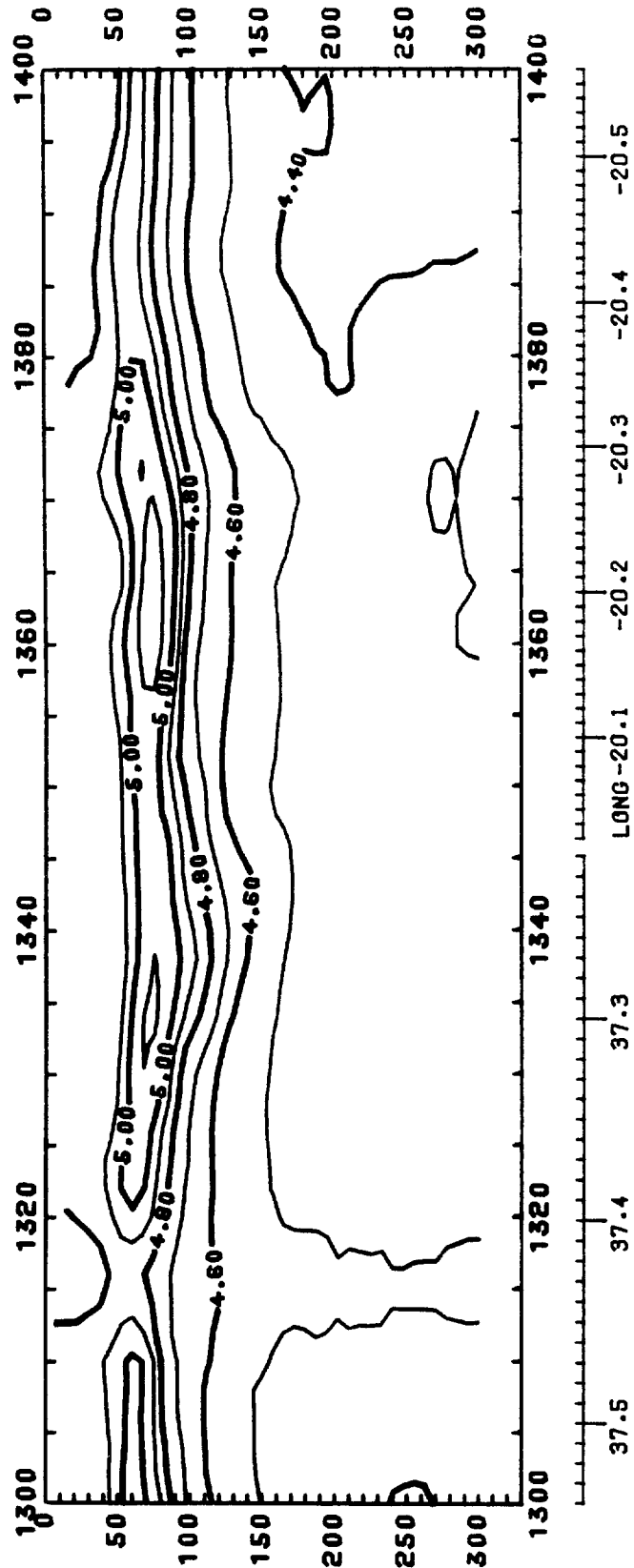
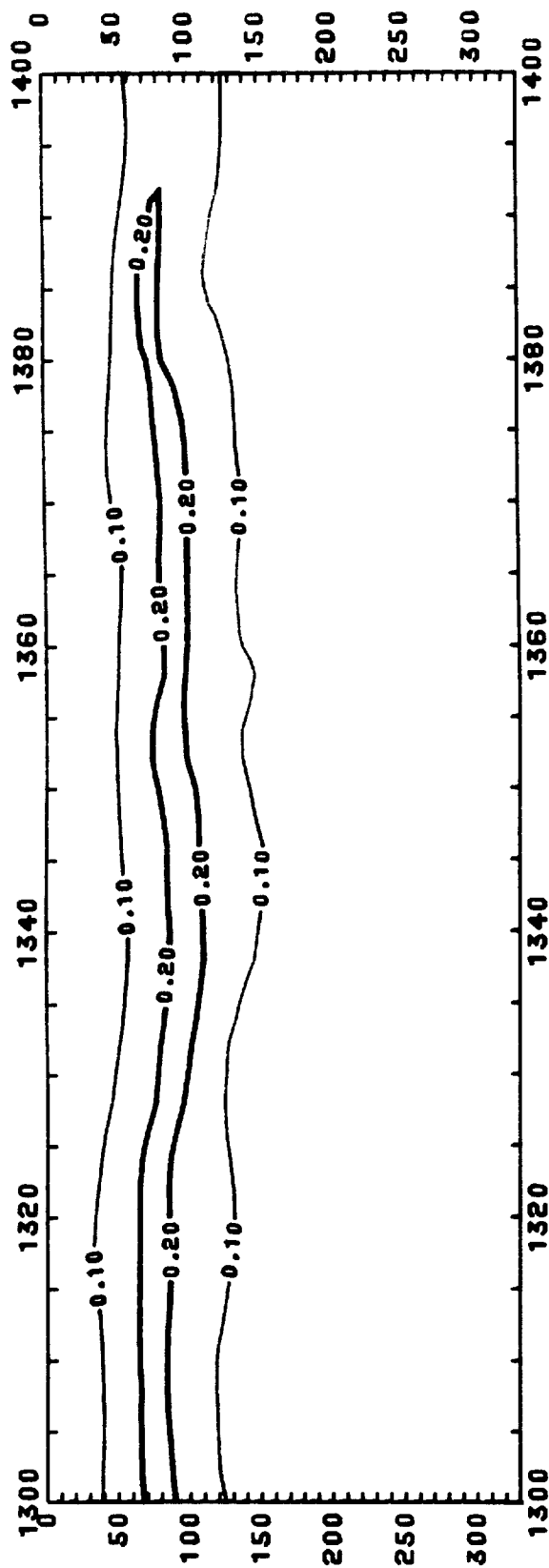
LATITUDE





DISCOVERY 114 : OCT 1980 : 1200-1300 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

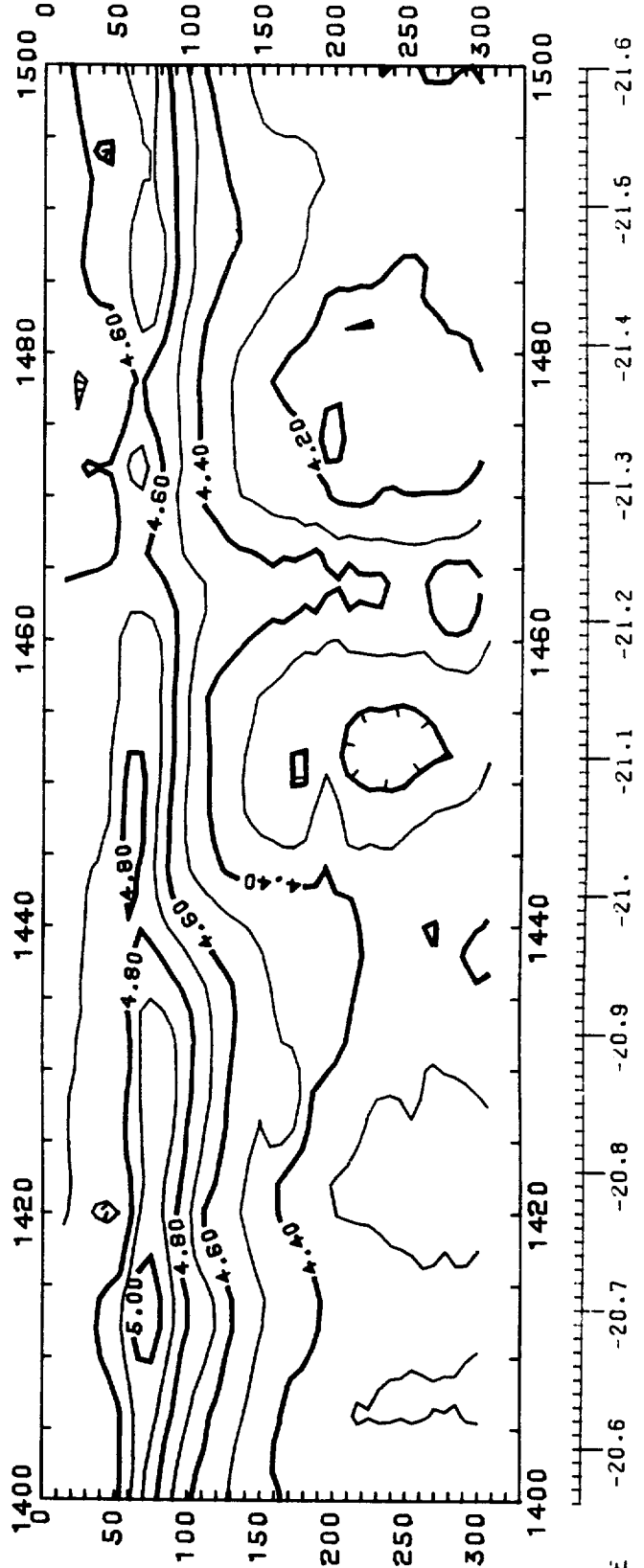
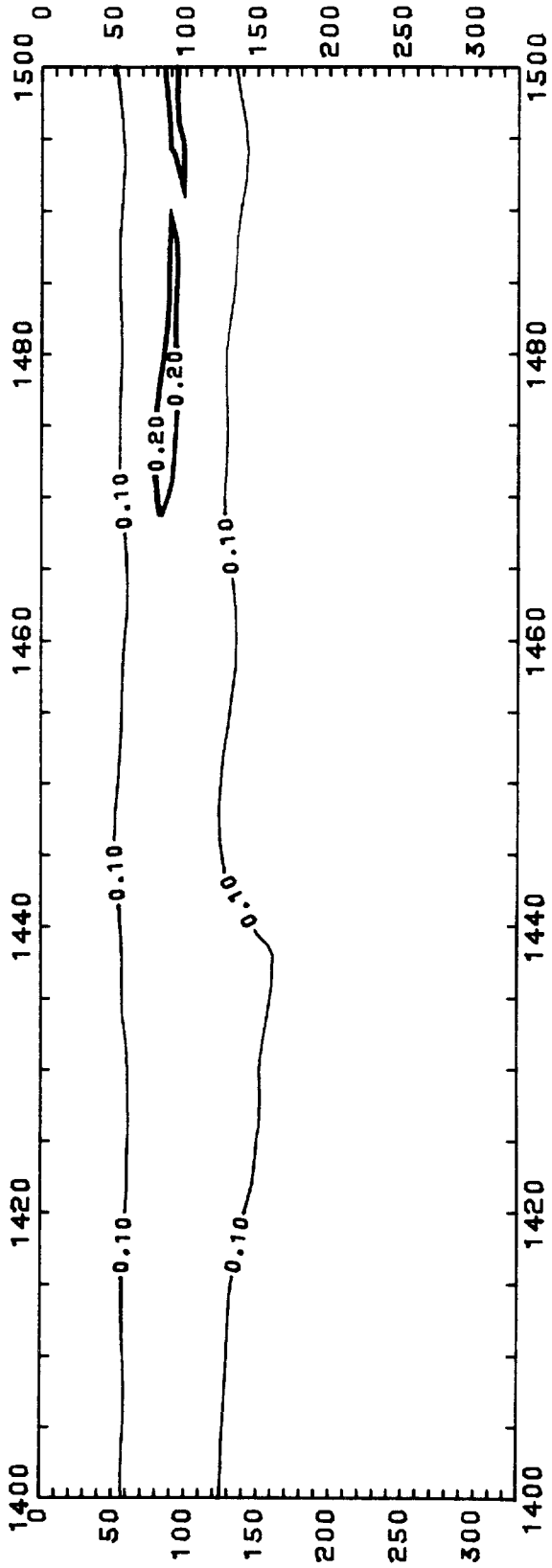
LATITUDE



DISCOVERY 114 : OCT 1980 : 1300-1400 KM  
===== ||| ||| ||| ||| ||| =====  
CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

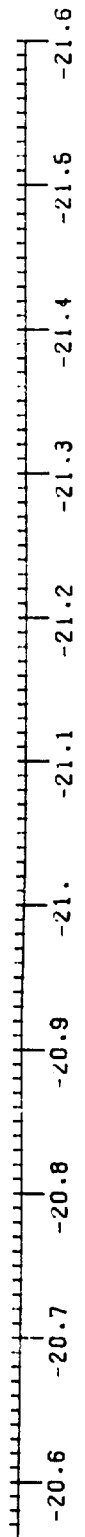
LATITUDE

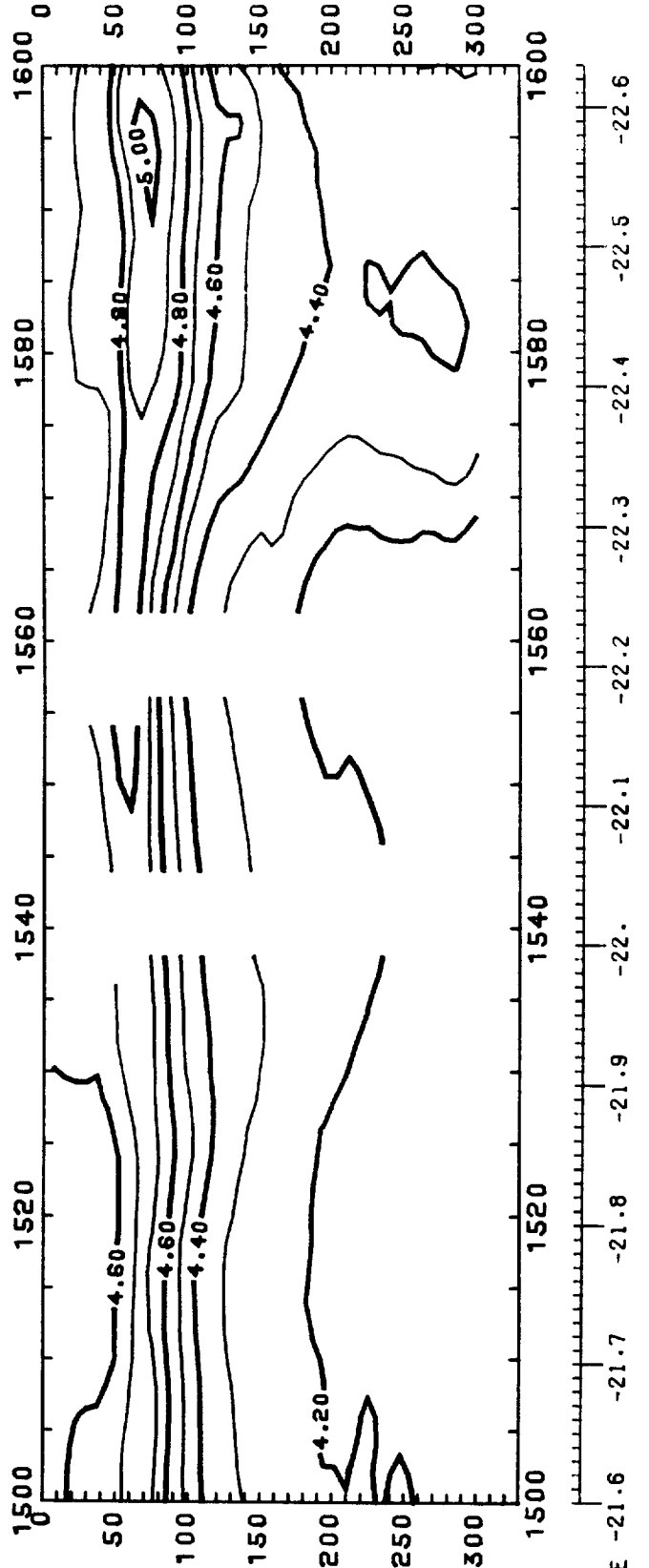
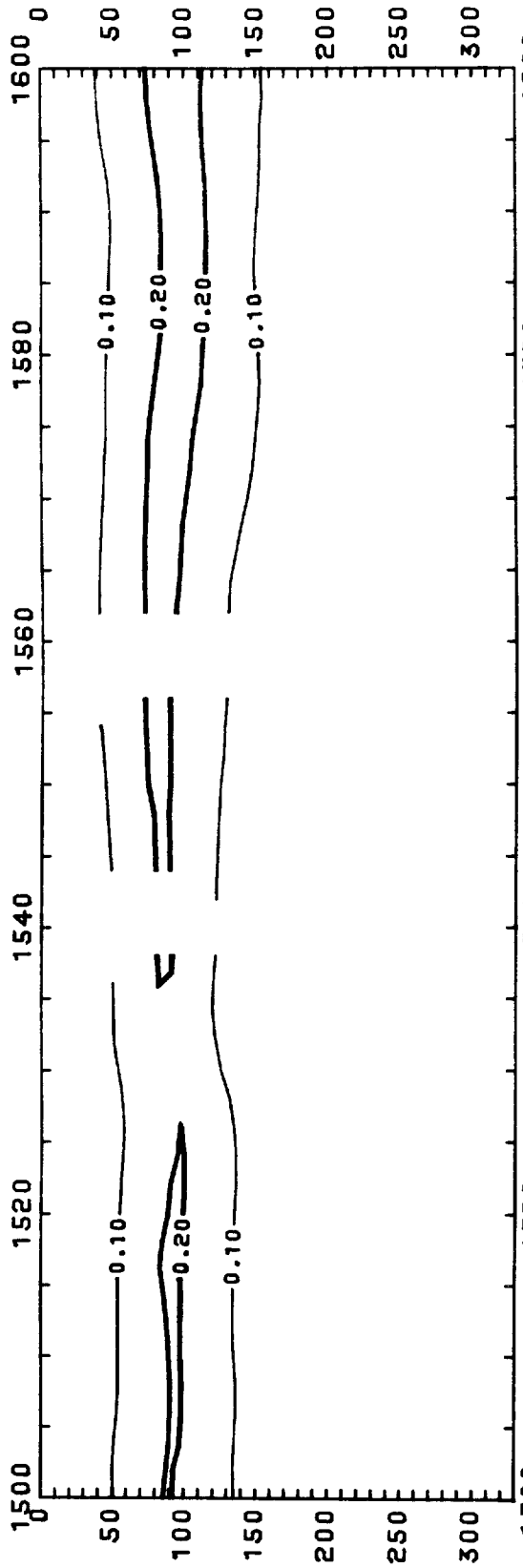
37.5 37.4 37.3 37.2 37.1 37.0 36.9 36.8 36.7 36.6 36.5 36.4 36.3 36.2 36.1 36.0 35.9 35.8 35.7 35.6 35.5 35.4 35.3 35.2 35.1 35.0 34.9 34.8 34.7 34.6 34.5 34.4 34.3 34.2 34.1 34.0 33.9 33.8 33.7 33.6 33.5 33.4 33.3 33.2 33.1 33.0 32.9 32.8 32.7 32.6 32.5 32.4 32.3 32.2 32.1 32.0 31.9 31.8 31.7 31.6 31.5 31.4 31.3 31.2 31.1 31.0 30.9 30.8 30.7 30.6 30.5 30.4 30.3 30.2 30.1 30.0 29.9 29.8 29.7 29.6 29.5 29.4 29.3 29.2 29.1 29.0 28.9 28.8 28.7 28.6 28.5 28.4 28.3 28.2 28.1 28.0 27.9 27.8 27.7 27.6 27.5 27.4 27.3 27.2 27.1 27.0 26.9 26.8 26.7 26.6 26.5 26.4 26.3 26.2 26.1 26.0 25.9 25.8 25.7 25.6 25.5 25.4 25.3 25.2 25.1 25.0 24.9 24.8 24.7 24.6 24.5 24.4 24.3 24.2 24.1 24.0 23.9 23.8 23.7 23.6 23.5 23.4 23.3 23.2 23.1 23.0 22.9 22.8 22.7 22.6 22.5 22.4 22.3 22.2 22.1 22.0 21.9 21.8 21.7 21.6 21.5 21.4 21.3 21.2 21.1 21.0 20.9 20.8 20.7 20.6 20.5 20.4 20.3 20.2 20.1 20.0 19.9 19.8 19.7 19.6 19.5 19.4 19.3 19.2 19.1 19.0 18.9 18.8 18.7 18.6 18.5 18.4 18.3 18.2 18.1 18.0 17.9 17.8 17.7 17.6 17.5 17.4 17.3 17.2 17.1 17.0 16.9 16.8 16.7 16.6 16.5 16.4 16.3 16.2 16.1 16.0 15.9 15.8 15.7 15.6 15.5 15.4 15.3 15.2 15.1 15.0 14.9 14.8 14.7 14.6 14.5 14.4 14.3 14.2 14.1 14.0 13.9 13.8 13.7 13.6 13.5 13.4 13.3 13.2 13.1 13.0 12.9 12.8 12.7 12.6 12.5 12.4 12.3 12.2 12.1 12.0 11.9 11.8 11.7 11.6 11.5 11.4 11.3 11.2 11.1 11.0 10.9 10.8 10.7 10.6 10.5 10.4 10.3 10.2 10.1 10.0 9.9 9.8 9.7 9.6 9.5 9.4 9.3 9.2 9.1 9.0 8.9 8.8 8.7 8.6 8.5 8.4 8.3 8.2 8.1 8.0 7.9 7.8 7.7 7.6 7.5 7.4 7.3 7.2 7.1 7.0 6.9 6.8 6.7 6.6 6.5 6.4 6.3 6.2 6.1 6.0 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1 3.0 2.9 2.8 2.7 2.6 2.5 2.4 2.3 2.2 2.1 2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0



DISCOVERY 114 : OCT 1980 : 1400-1500 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

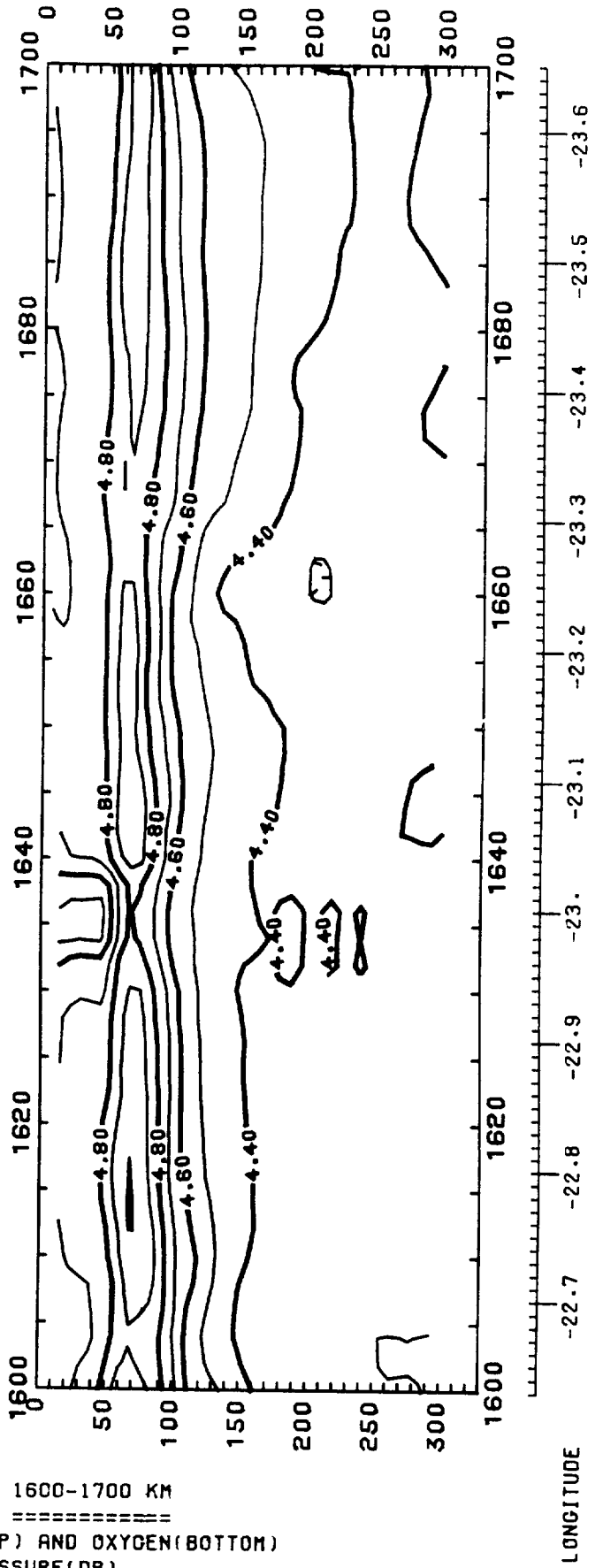
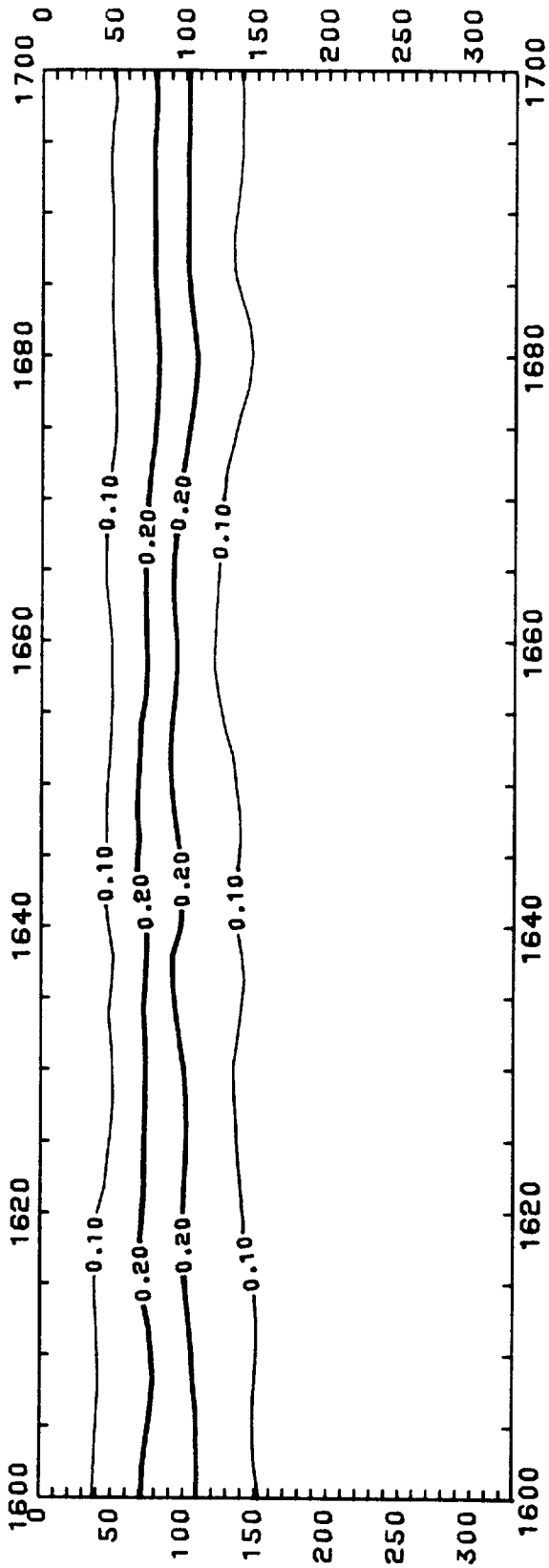
LONGITUDE





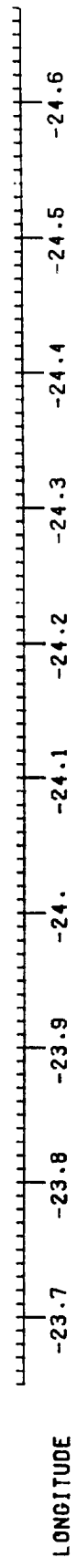
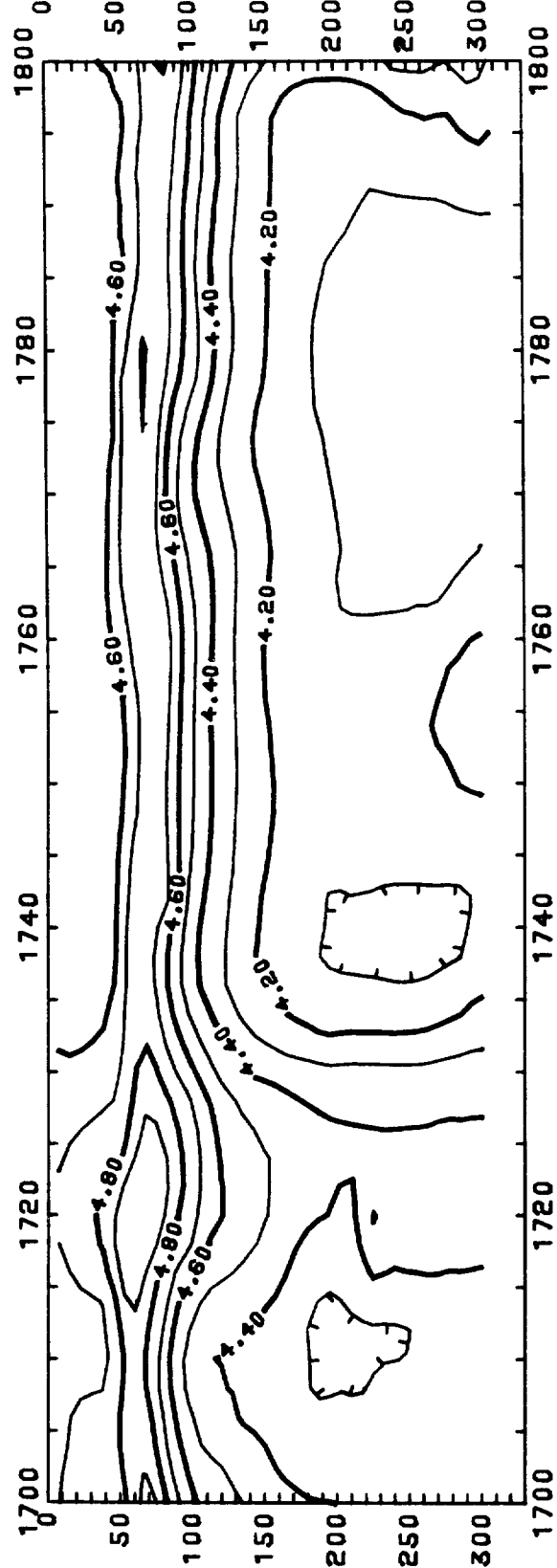
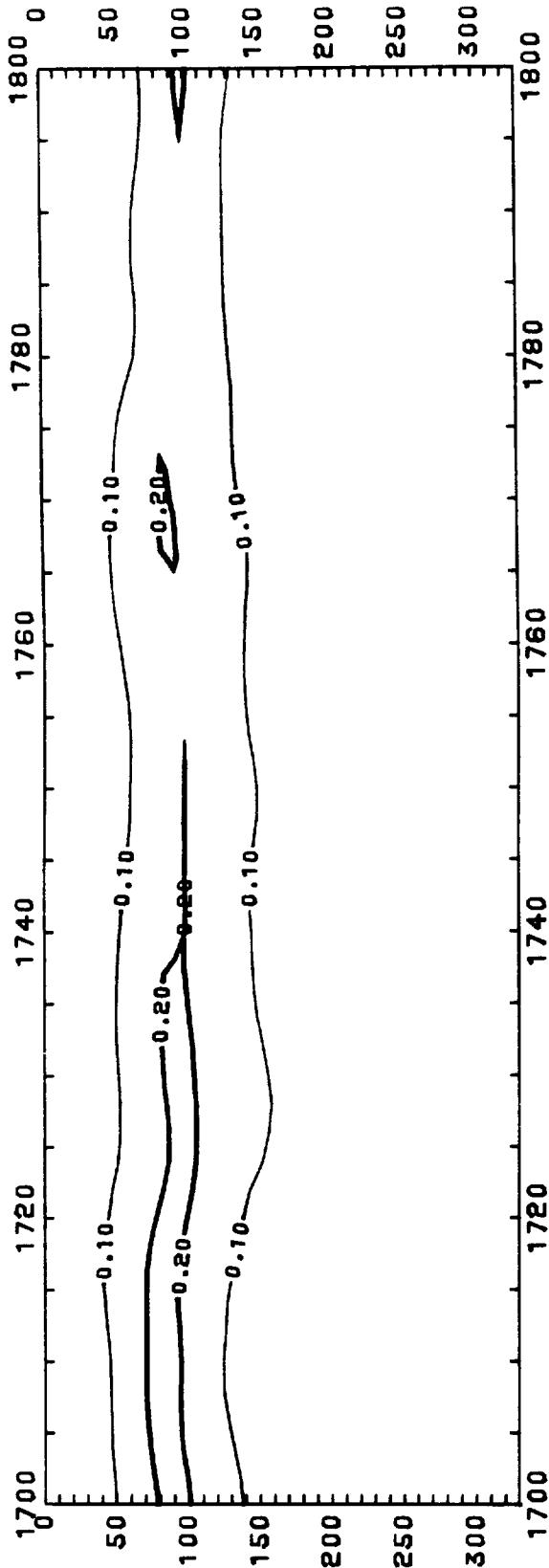
DISCOVERY 114 : OCT 1980 : 1500-1600 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE -21.6 -21.7 -21.8 -21.9 -22.0 -22.1 -22.2 -22.3 -22.4 -22.5 -22.6



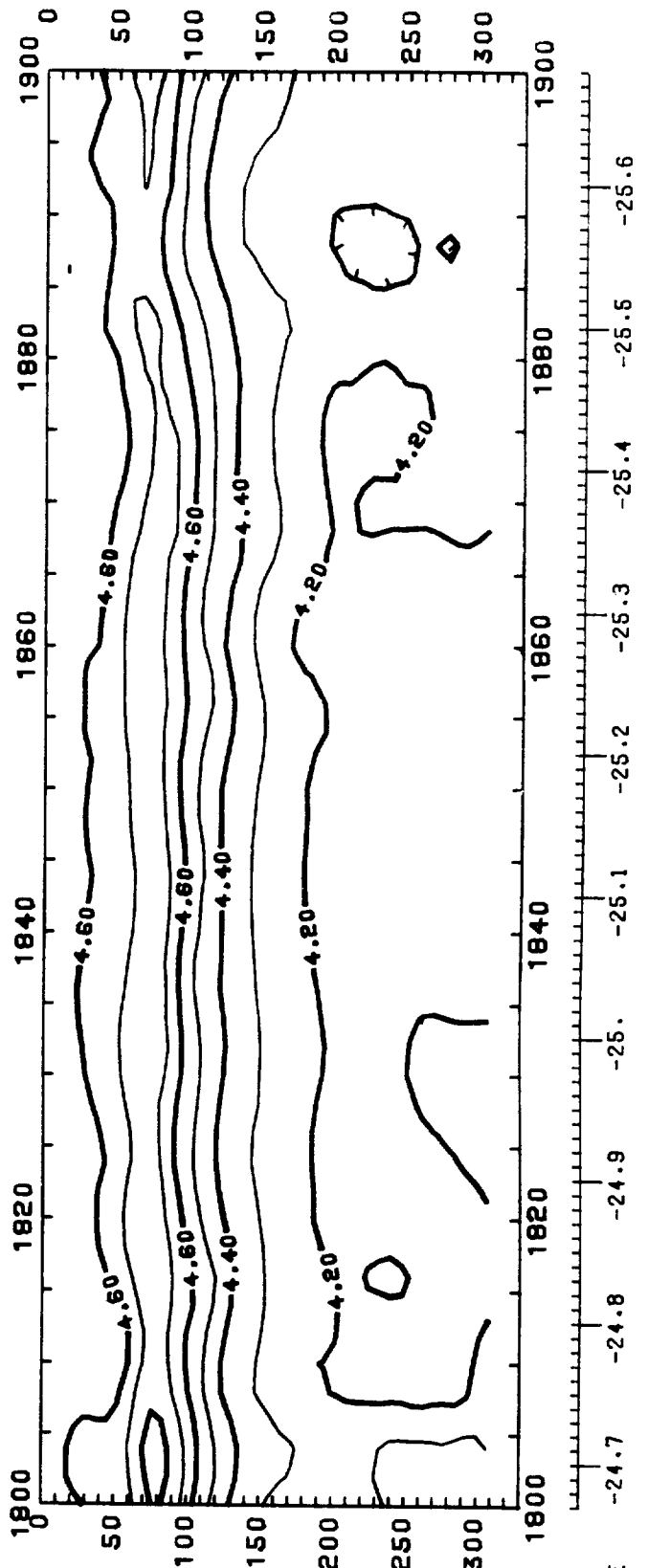
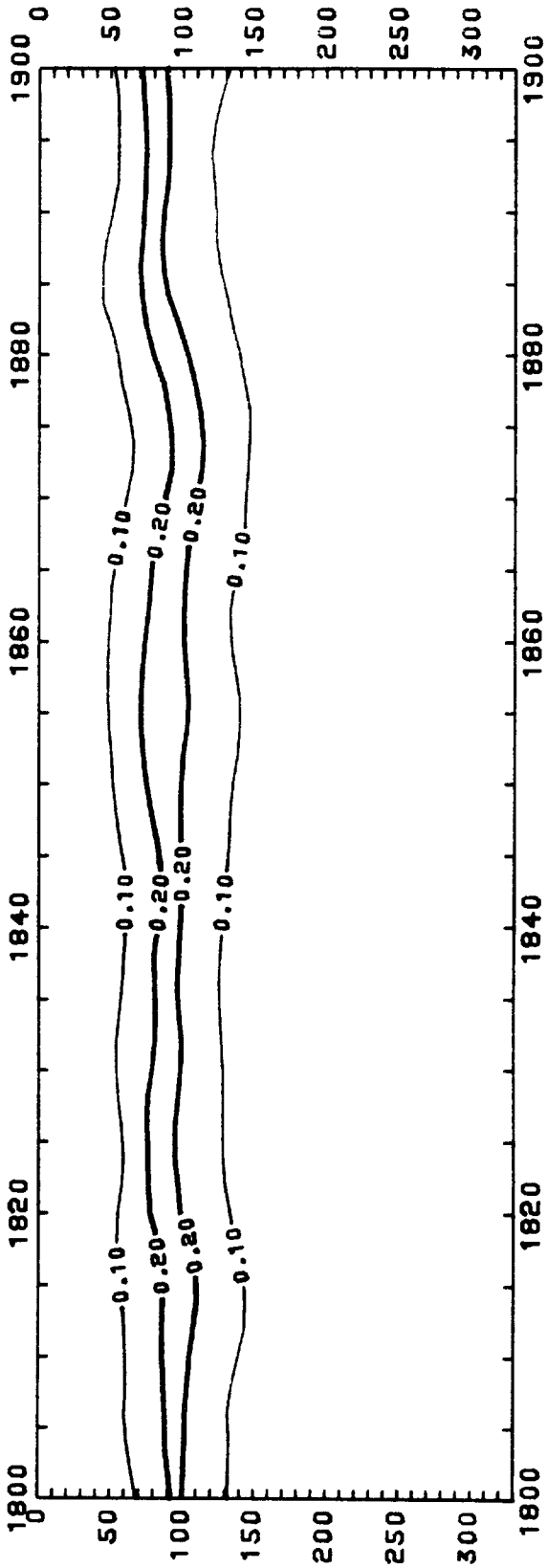
DISCOVERY 114 : OCT 1980 : 1600-1700 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE



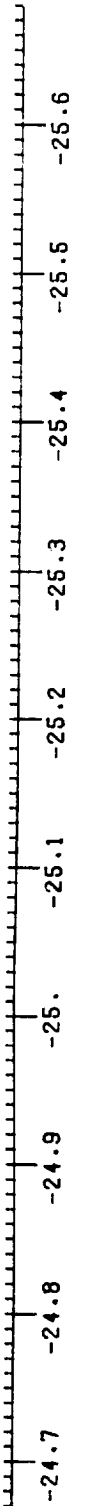
DISCOVERY 114 : OCT 1980 : 1700-1800 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

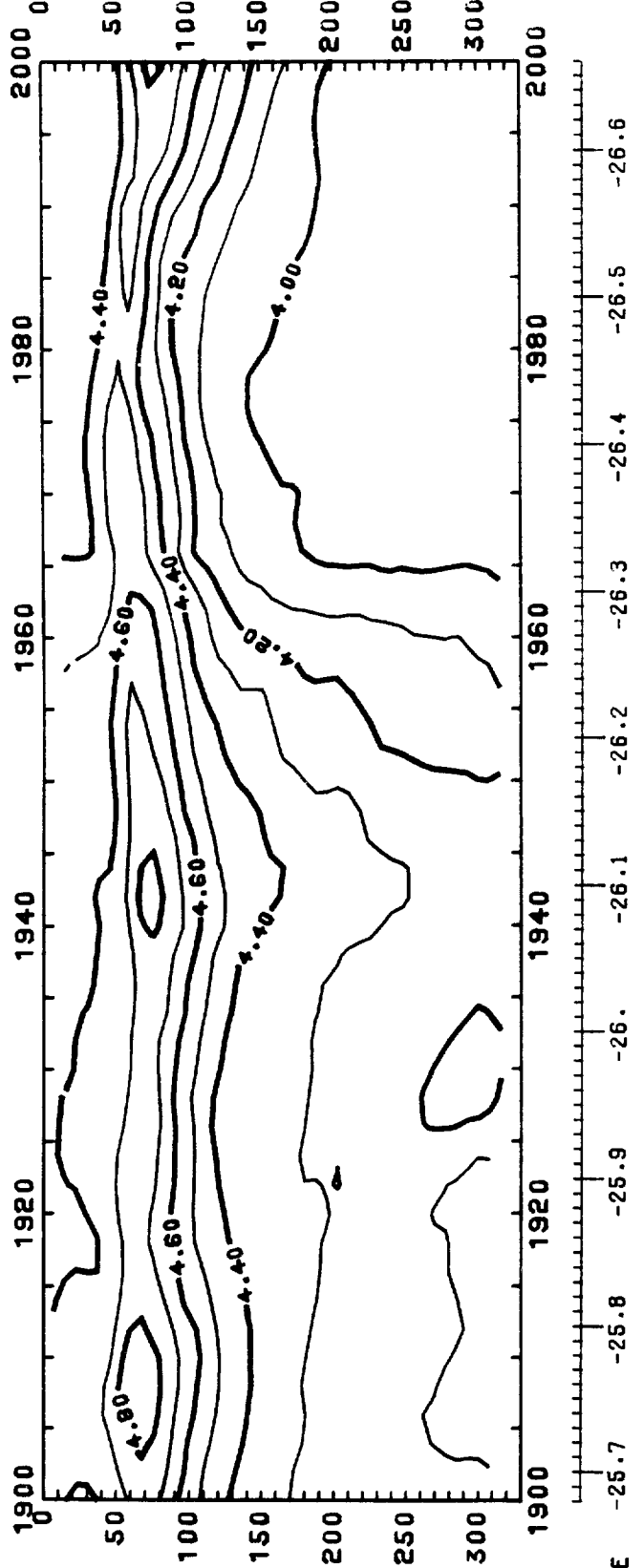
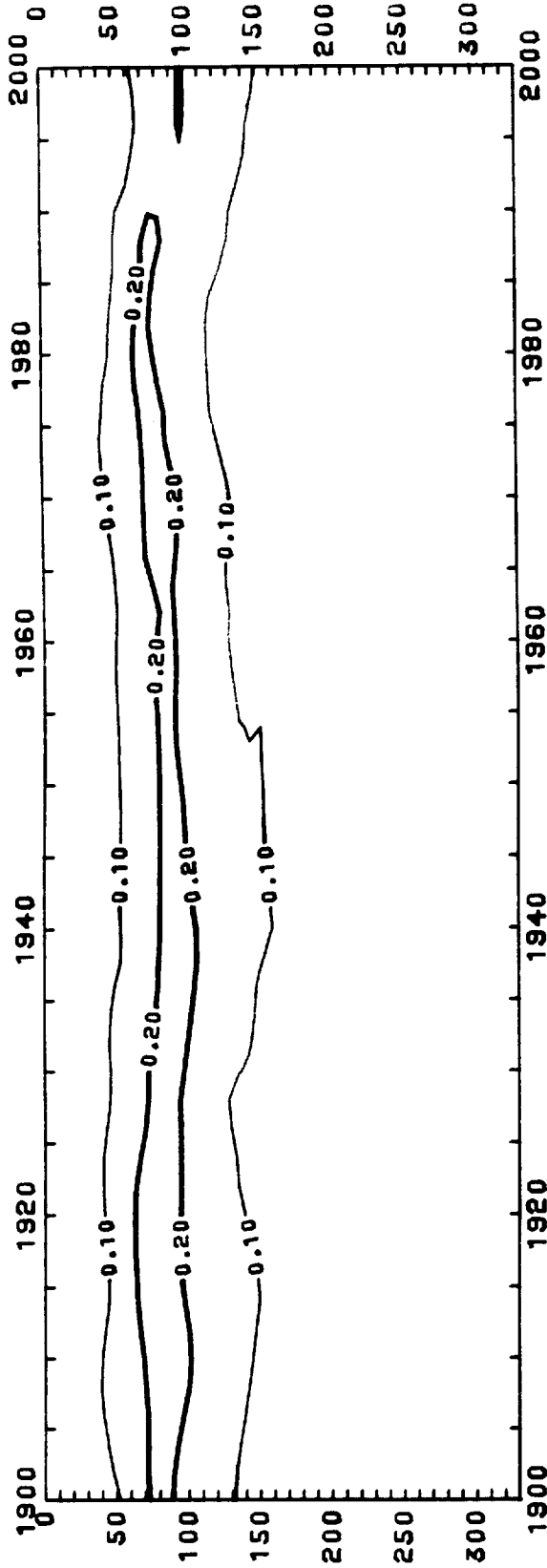
LONGITUDE



DISCOVERY 114 : OCT 1980 : 1800-1900 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE

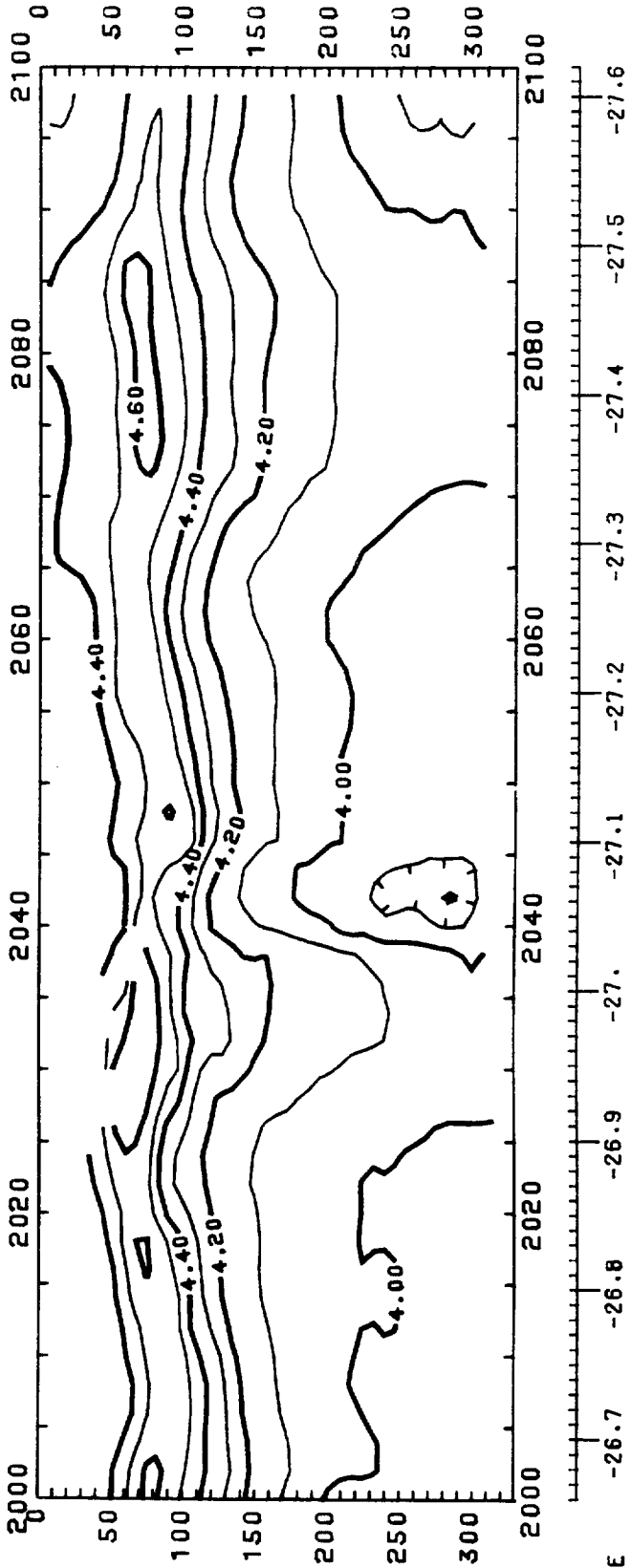
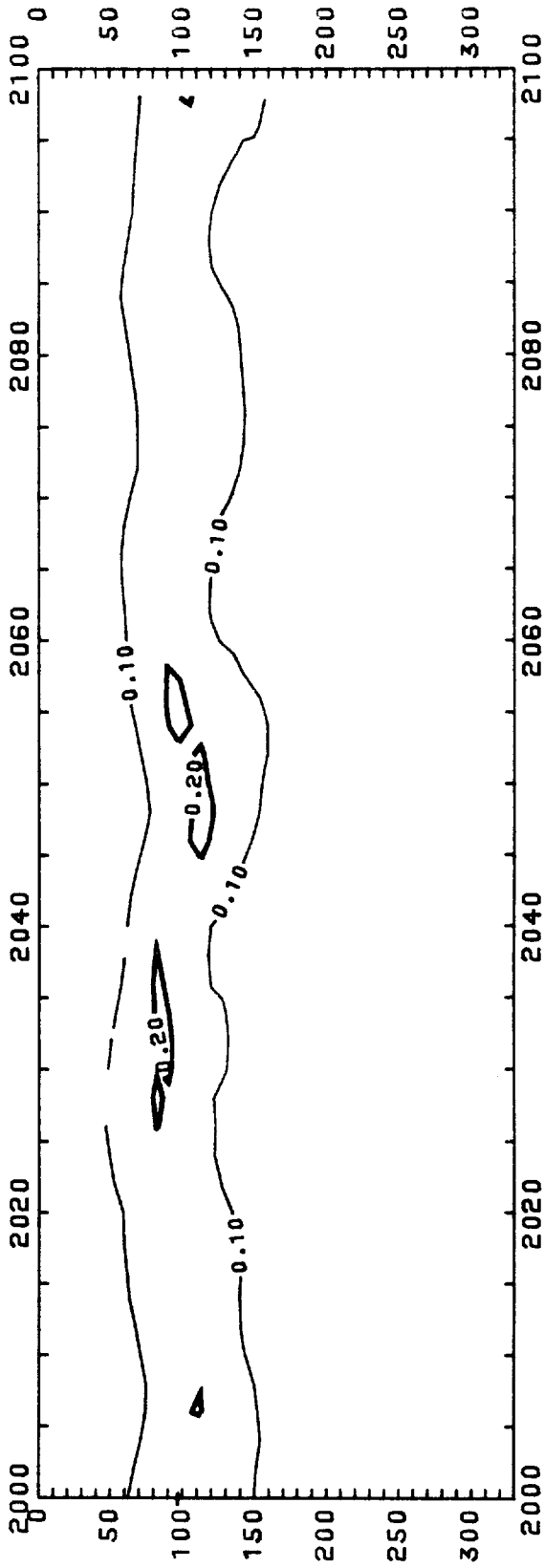




DISCOVERY 114 : OCT 1980 : 1900-2000 KM  
===== === === =====  
CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE -25.7 -25.8 -25.9 -26. -26.1 -26.2 -26.3 -26.4 -26.5 -26.6

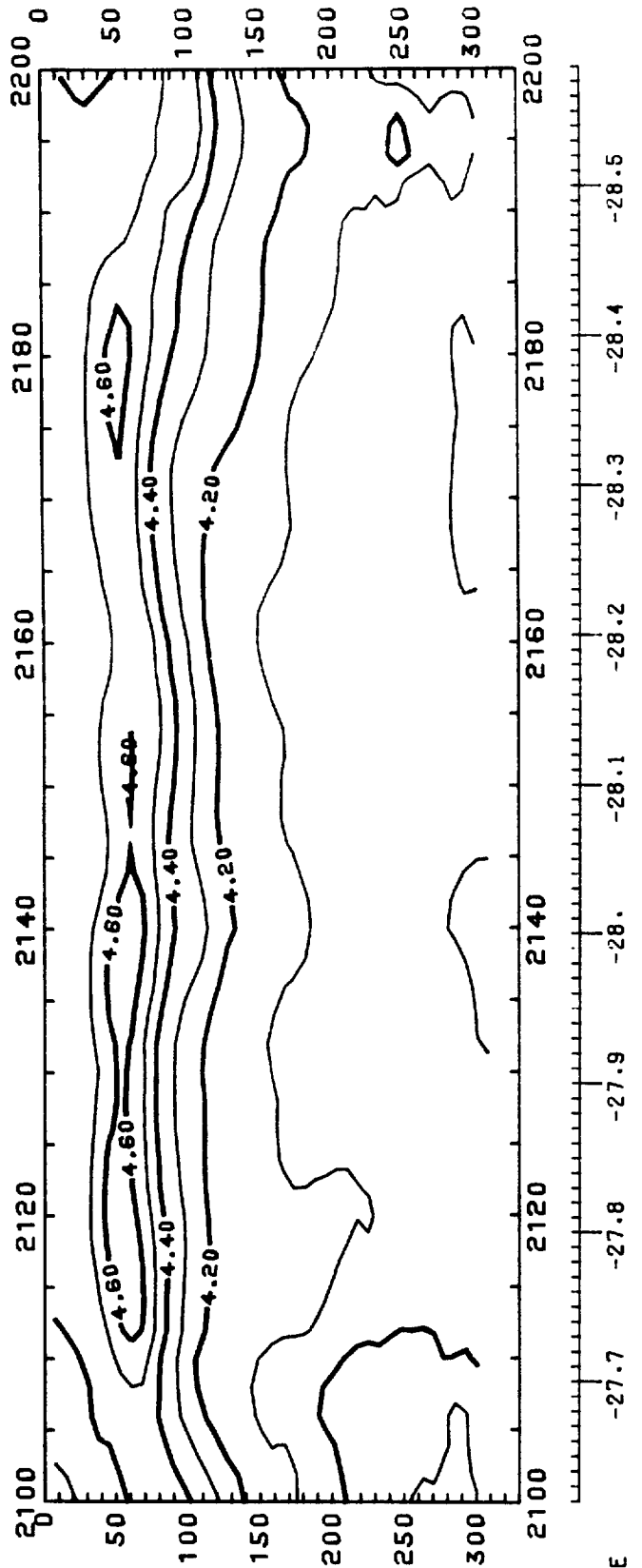
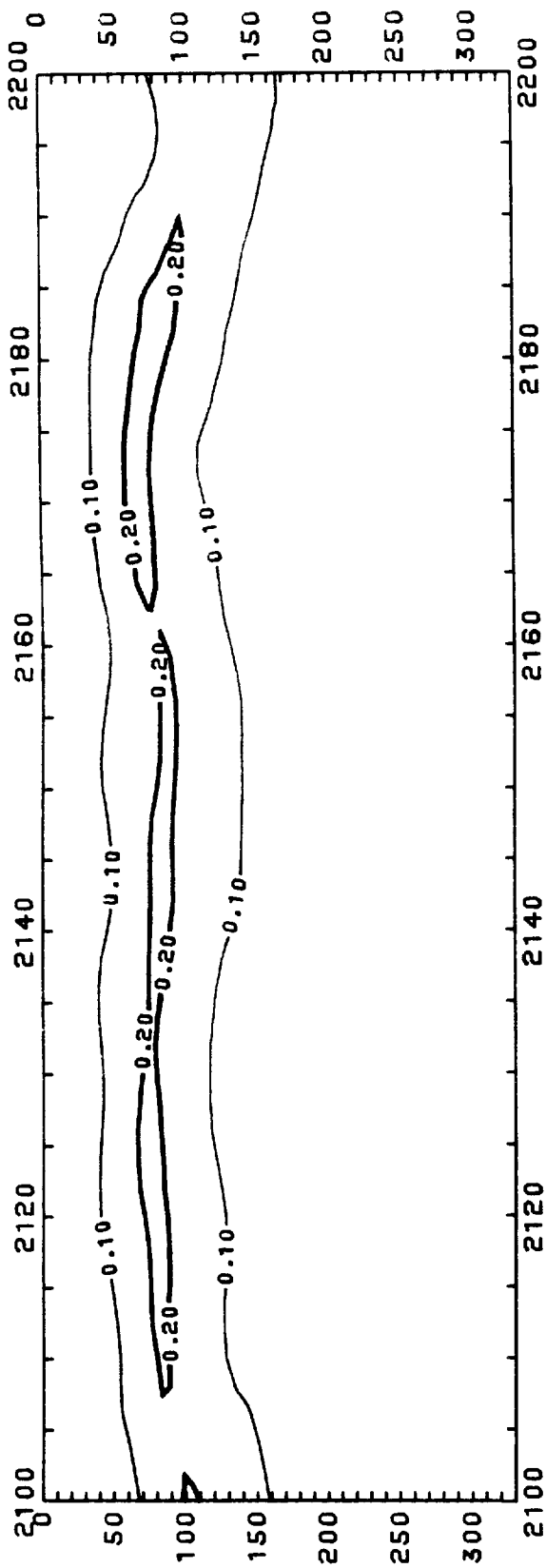




DISCOVERY 114 : OCT 1980 : 2000-2100 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

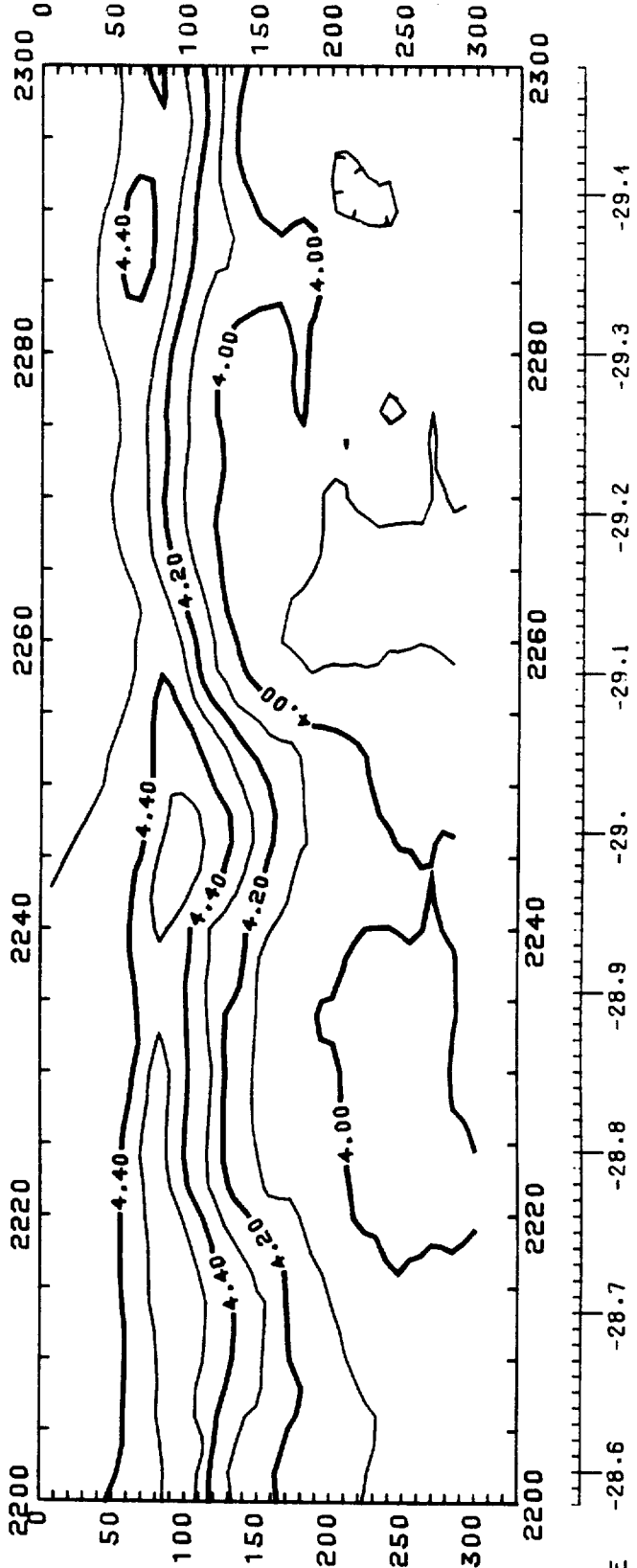
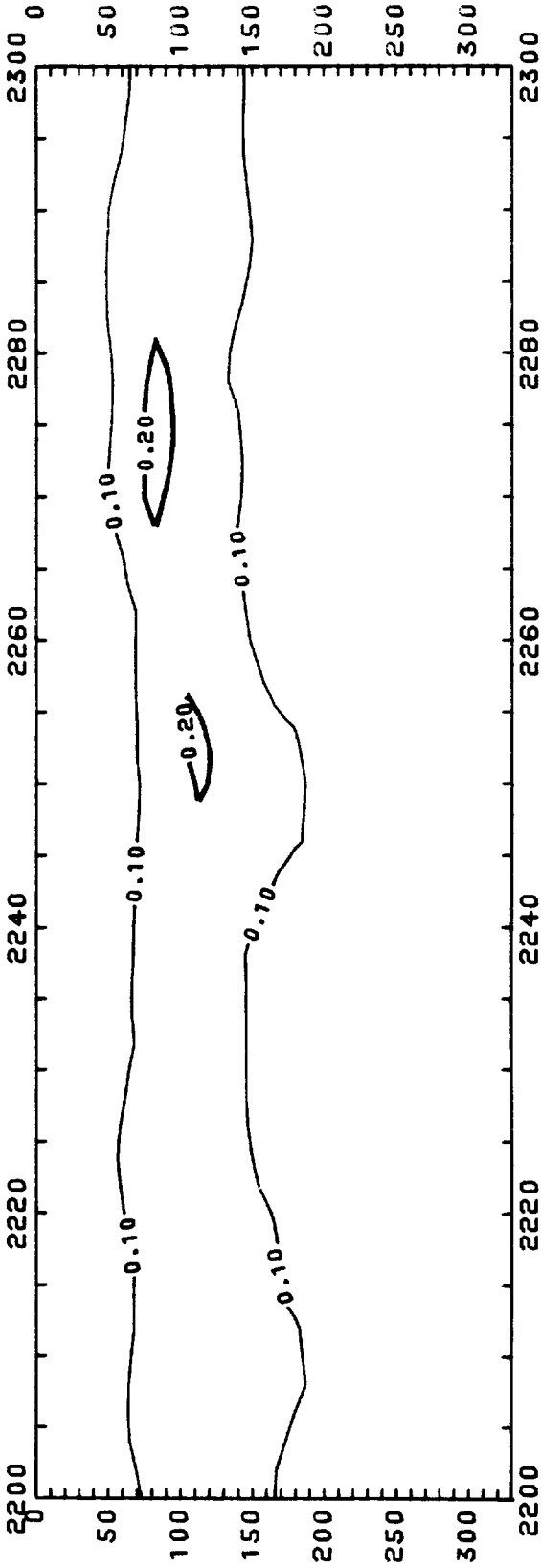
LONGITUDE





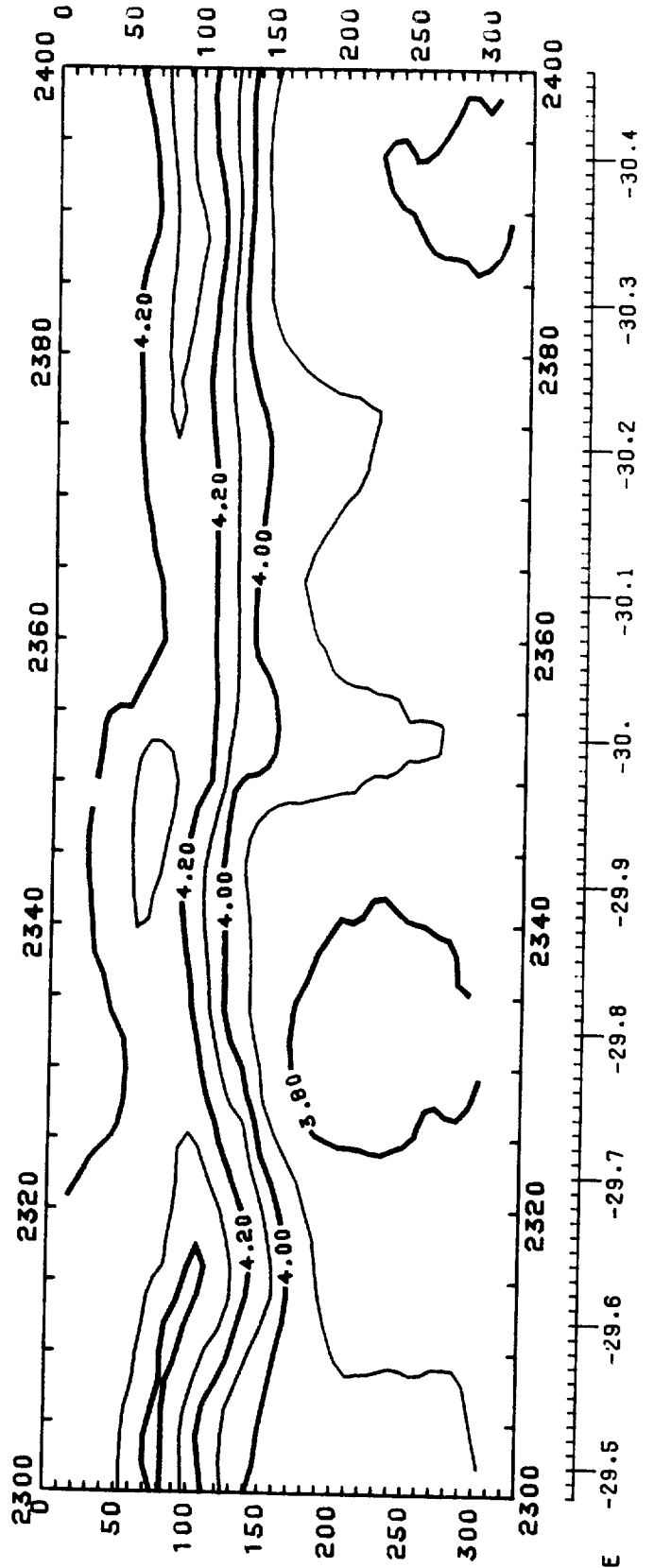
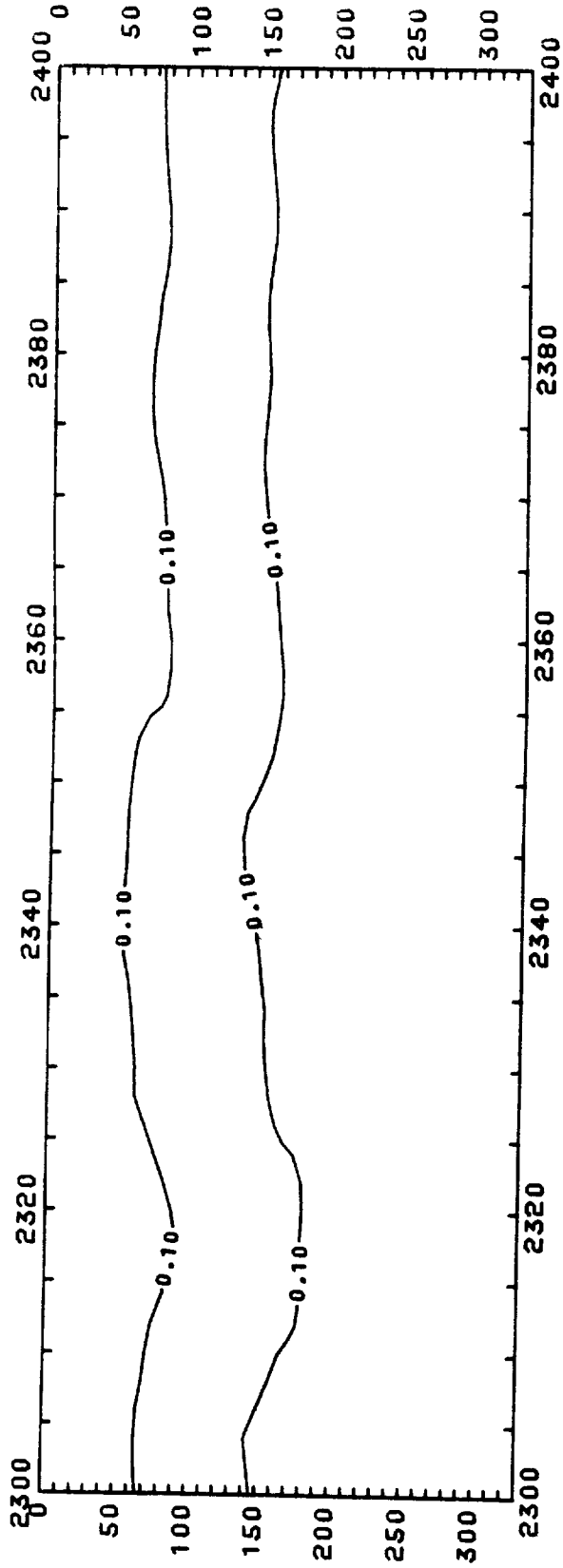
DISCOVERY 114 : OCT 1980 : 2100-2200 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE



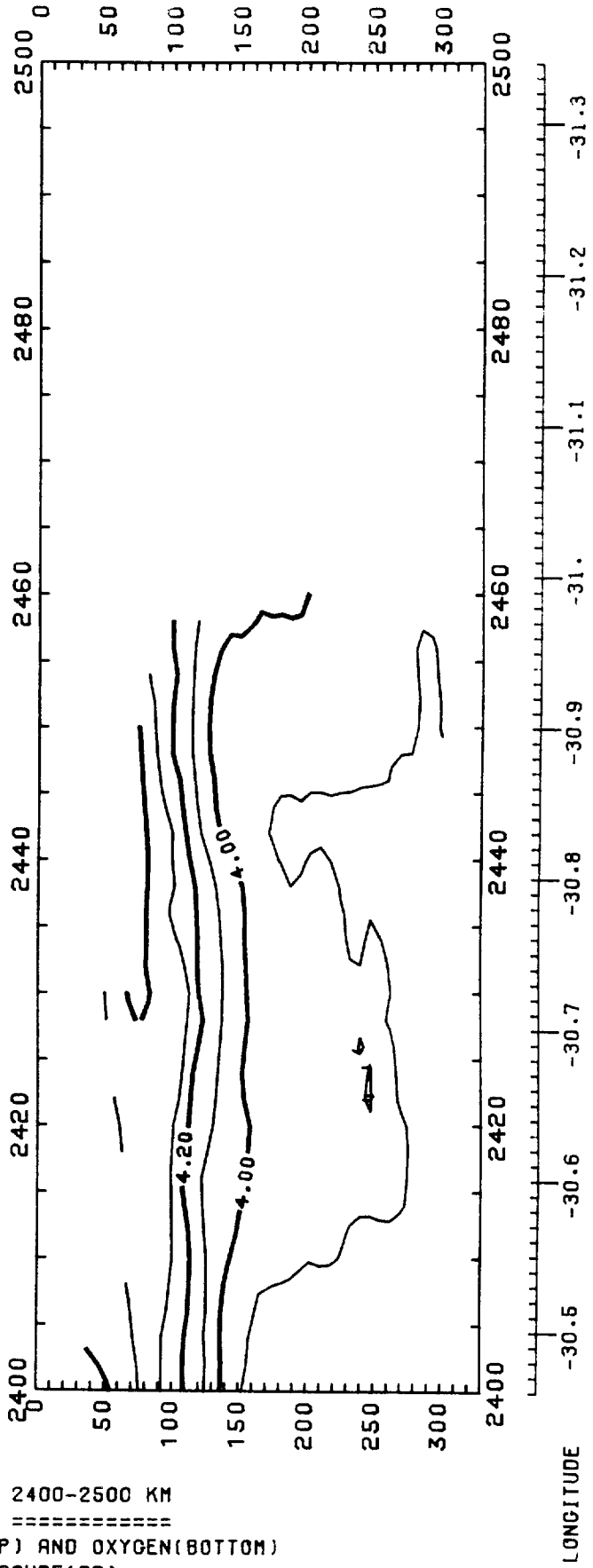
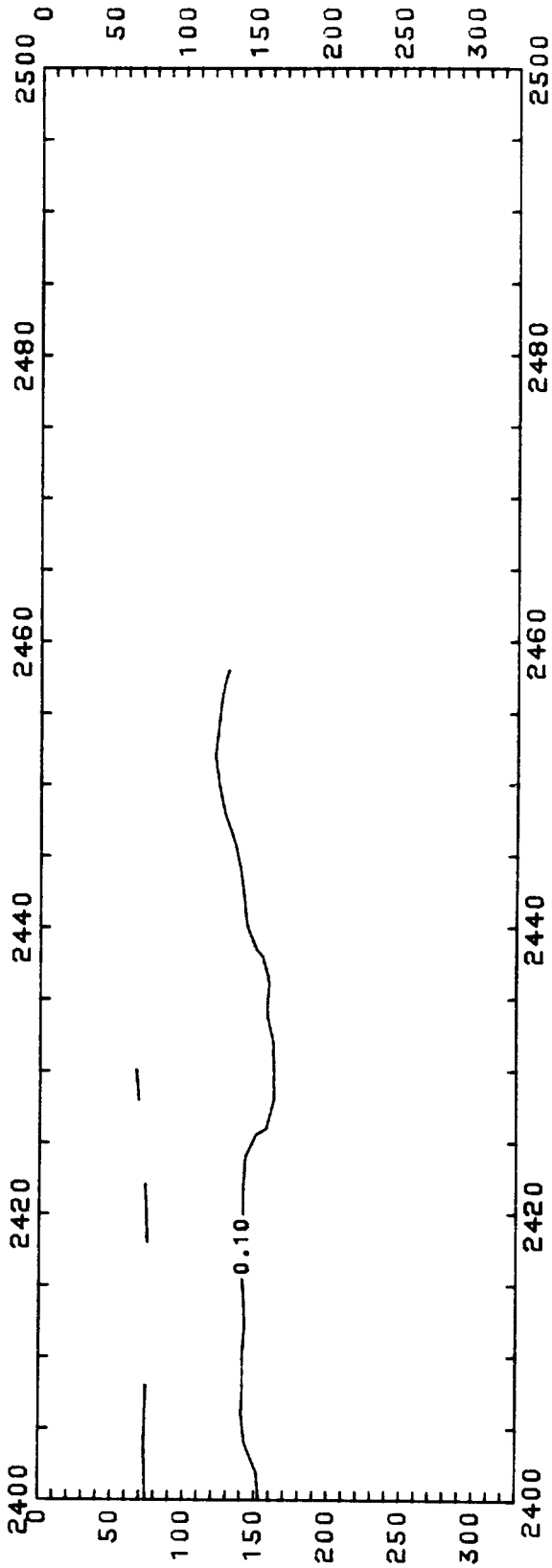
DISCOVERY 114 : OCT 1980 : 2200-2300 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE -28.6 -28.7 -28.8 -28.9 -29.0 -29.1 -29.2 -29.3 -29.4



DISCOVERY 114 : OCT 1980 : 2300-2400 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)

LONGITUDE -29.5 -29.6 -29.7 -29.8 -29.9 -30.0 -30.1 -30.2 -30.3 -30.4



DISCOVERY 114 : OCT 1980 : 2400-2500 KM  
 =====  
 CONTOURS OF CHLOROPHYLL(TOP) AND OXYGEN(BOTTOM)  
 X=DISTANCE RUN(KM) : Y=PRESSURE(DB)