I.O.S.

SEASOAR PROFILES
IN THE ICELAND-SCOTLAND AREA, MAY 1987

BY

W.J. GOULD, J.F. READ & J. SMITHERS

REPORT NO. 253

1987

INSTITUTE OF
OCEANOGRAPHIC SCIENCES
DEACON LABORATORY

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

DEACON LABORATORY

Wormley, Godalming,
Surrey, GU8 5UB, U.K.

Telephone: 0428 79 4141
Telex: 858833 OCEANS G
Telefax: 0428 79 3066

Director: Sir Anthony Laughton, Ph.D., F.R.S.

Natural Environment Research Council

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SeaSoar profiles in the Iceland-Scotland area, May 1987

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ABSTRACT

Sections of temperature, salinity and derived parameters including sound speed are presented. They were obtained using the SeaSoar towed CTD system on board RRS *Challenger* Cruise 15/87 in May 1987.

The data provide detailed information obtained in the Iceland-Faroes area and include several crossings of the Iceland-Faroes Front. The data cover approximately 1250km of ship track and give information between the surface and 300m depth.

ISSUING ORGANISATION

Institute of Oceanographic Sciences
Deacon Laboratory
Wormley, Godalming
Surrey GU8 5UB. UK.

Director: Dr A S Laughton FRS

TELEPHONE 0428 79 4141

TELEX 858833 OCEANS G

TELEFAX 0428 79 3066

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ICELAND-FAROES FRONT

CONTRACT

PROJECT PH 27

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CONTENTS

INTRODUCTION

SeaSoar is a towed, undulating CTD vehicle capable of profiling the upper 300m of the water column at tow speeds of order 9 kts. SeaSoar was used during RRS Challenger Cruise 15/87 (GOULD et al, 1987) to obtain temperature and salinity data between Scotland and Iceland. In particular the work focussed on traverses across the subarctic (Iceland-Faroes) front which marks the boundary between warm Atlantic water and the colder water masses of the Norwegian Sea basin.

The work of the cruise is described in GOULD et al (loc cit) and the associated lowered CTD profiles will be presented in a data report by SAUNDERS (in prep).

The surface expression of the front across which the SeaSoar tracks were made is clearly visible on an AVHRR image from shortly after the survey was completed. This image is shown in Figure 1 overprinted with the ship tracks during the survey. Unfortunately the Challenger was unable to receive the satellite images at sea and in consequence the survey pattern was based solely on historical evidence for the frontal position and on information collected on board.

SEASOAR INSTRUMENT

The SeaSoar vehicle contains an NBIS CTD probe housed in a towed body fitted with wings (Pollard, 1986). The wing attitude is controlled by signals passed down the conducting tow cable and causes the vehicle to climb or dive. Maximum and minimum operating depths can be preset on the shipboard deck unit, the maximum depth achievable being dependent on tow speed and cable length. On this particular cruise 300m was attained using a 600m faired cable and tow speeds of between 8 and 9 kts. The vehicle was towed over a wide throated block suspended from the stern "A" frame.

The data, in this case for pressure, temperature and conductivity, are passed back up the cable and processed on a PDP 11/34 computer. A back-up digital tape record of the data is also made in order to safeguard against

data loss in case of computer failure. Details of the computer software are given in other IOS data reports by POLLARD et al. Here we will outline briefly the processes which were carried out on the data on board the ship.

DATA PROCESSING AT SEA

Data were processed initially in 2-hour segments. The processing concentrated on the elimination of data spikes and jumps and on the correction of gross shifts in computed salinity. At the end of each two hour period the data were plotted as profiles of temperature vs pressure, salinity vs pressure, salinity vs temperature and in the form of time series of pressure, temperature and salinity. Colour coding of up and down profiles and the offsetting of groups of four successive profiles from one another enables problems with any particular profile to be identified. In general temperature and pressure data were "clean" and suffered only from very occasional spikes or data dropout. Computed salinities however were affected by errors in conductivity data caused by calibration changes or by fouling of the conductivity sensor.

Such jumps were identified by deviations from the rather stable T-S relationship at the deepest levels and were corrected by applying offsets to the salinity data in order to bring the values back to the stable T-S line. In cases where salinity jumps occurred in an irregular fashion data were deleted. In general jumps persisted for only part of each up or down profile since the fouling cleared when the vehicle reached the sea surface.

The "clean" data were then archived to tape at the end of each two hourly editing session. Twice daily the data were merged with navigation information, gridded to a grid of 4km x 10m and plotted in computer contoured sections similar to those presented in this report. Derived quantities such as sound speed, density and geostrophic velocity normal to the ship's track were also computed and plotted.

NAVIGATION

It had been planned to use LORAN C navigation data throughout the cruise but although strong signals were received from the Master Station the slaves showed small signal to noise ratios (one tenth of the values that should have been obtained). The problem could not be identified nor rectified and therefore navigation was based on Transit satellite navigation fixes with intermediate positions interpolated using the ship's two component electromagnetic log. The navigation data were then merged with the gridded SeaSoar data. A plot of the ship's track is shown in Fig. 2. The relationship between turning points and distance run is given in Table 1.

SALINITY CALIBRATIONS

The final determination of the SeaSoar salinity calibrations was carried out as follows.

A thermosalinograph was run from the ship's non-toxic seawater supply throughout the cruise and logged on the computer. Its calibration was determined from samples taken at regular intervals from the seawater supply whose salinities were determined on a Guildline Autosal Salinometer. A correction of +0.15 was applied to the thermosalinograph data based on the calibration data.

At the end of the cruise, plots were made of the differences between the gridded sea surface salinities derived from SeaSoar and the logged, corrected thermosalinograph data. Apart from the few data spikes, particularly where fronts had been crossed, the data were seen to show slowly varying offsets of up to 0.03. A linear fit to these data were then used to correct the SeaSoar salinities which were then seen to have a residual noise level of ±0.02. This then is the assumed accuracy of the SeaSoar salinity determinations.

A further calibration of the SeaSoar CTD unit when lowered vertically and compared both with a previous lowering on the same position using a deep CTD unit which had been used and calibrated throughout the cruise and with salinities collected using a multisampler confirmed the calibration derived from the thermosalinograph.

DATA PRESENTATION

The data are presented here in the form of contoured plots derived from the gridded (4km x 10m) calibrated data. The panels are of typically 100km sections corresponding to linear parts of the survey. The location of the segments in relation to the entire survey can be seen from the small insert of track chart with each set of data.

Data are presented on pairs of opposing pages and show (reading downwards and from left to right) and with the noted contour intervals

(1) Potential temperature (**1.0**, 0.25) °C
(2) Salinity (**0.1**, 0.02)
(3) Density (**0.1**, 0.02) sigma θ
(4) Sound speed (**5.0**, 1.0) $m.sec^{-1}$
(5) Salinity on density surfaces (**0.1**, 0.020)
(6) Geostrophic shear (**10.0**, 5.0) cm s^{-1}

In addition to these contour plots we present groups of θ-S curves from 20km segments of the gridded data. These serve to illustrate the extreme variability of θ-S relationship in the frontal area in particular.

Each group of plots is offset by 0.20 in salinity from the previous group, e.g. the last group displayed on p.44 is for 2200-2220 km and is offset by 1.8 in salinity.

ACKNOWLEDGEMENTS

The willing and able assistance of the Master, Officers and crew of RRS Challenger is gratefully acknowledged. The cruise was blessed with remarkably fine weather which as well as enabling us to obtain excellent AVHRR images, made the cruise a very pleasant and productive one.

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The NOAA 9 AVHRR image is reproduced by courtesy of the University of Dundee.

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GOULD, W J et al. 1987 RRS Challenger 15/87, 9 May - 5 June 1987. Oceanographic variability and the Faroe Islands. Institute of Oceanographic Sciences Deacon Laboratory, Cruise Report, No. 197, 40pp.

POLLARD, R T 1986 Frontal surveys with a towed profiling conductivity/temperature/depth measurement package (SeaSoar). Nature, 323, 433-435.

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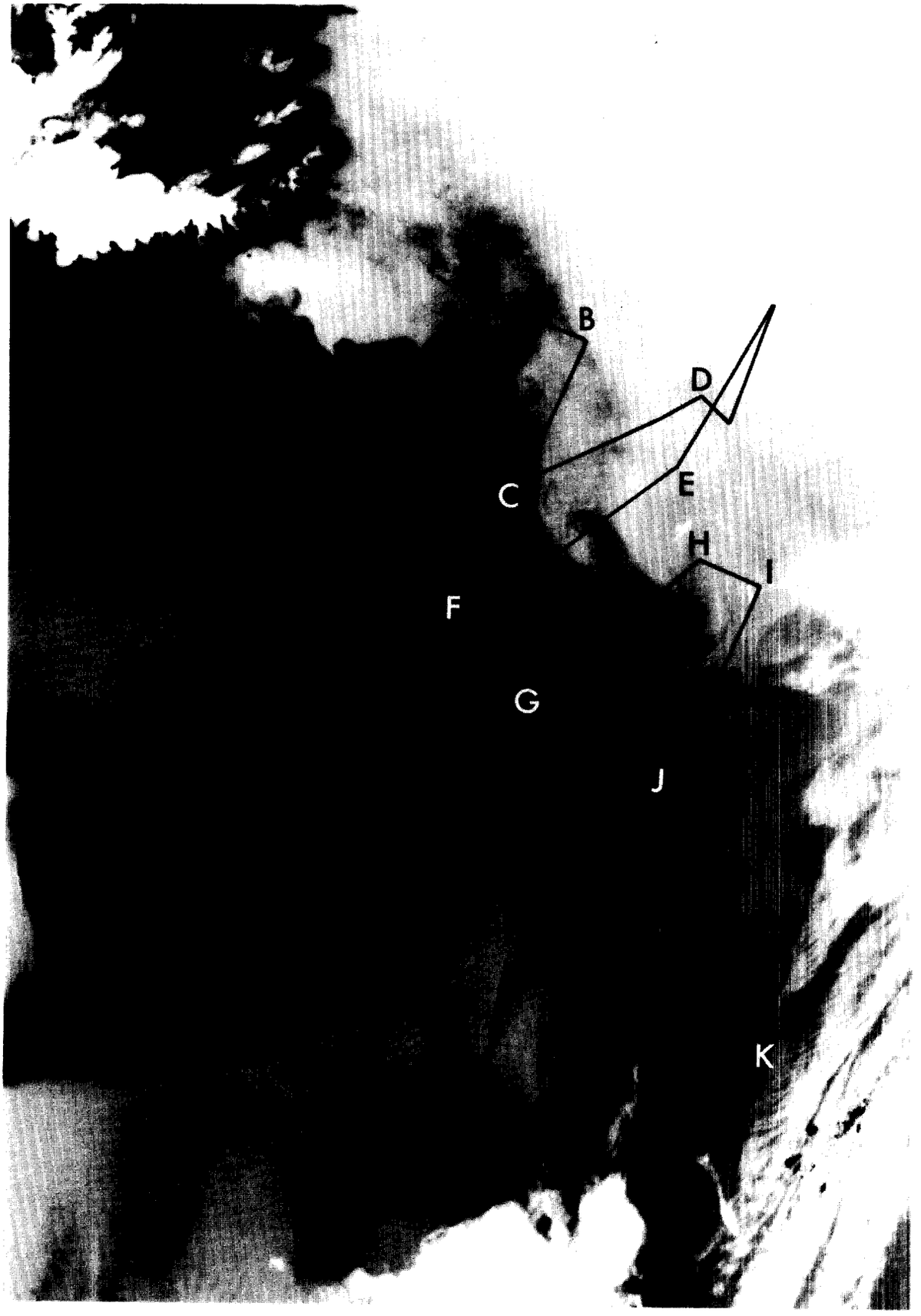

Figure 1. AVHRR image of Iceland-Faroes area overprinted with SeaSoar track chart

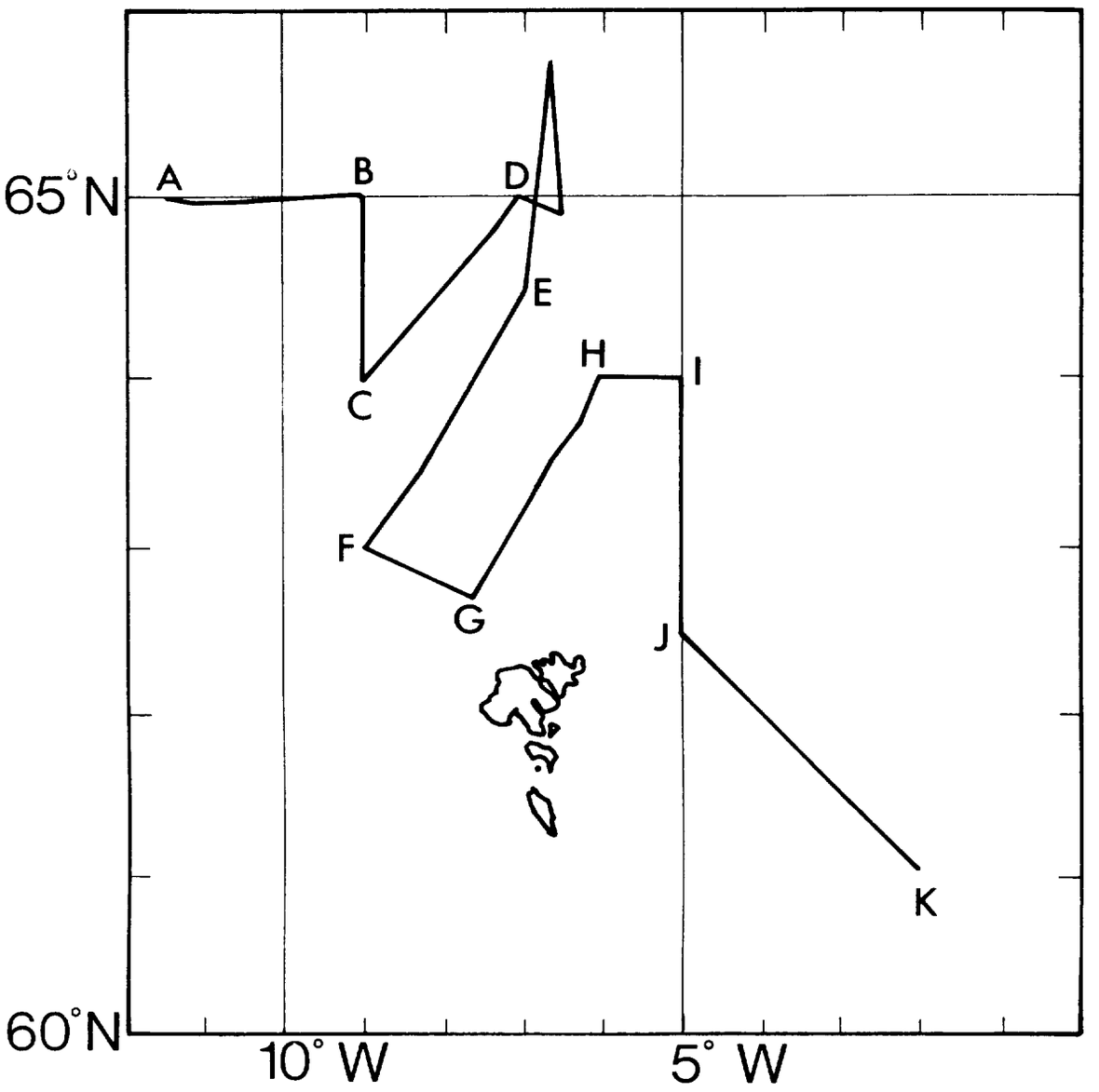

Figure 2. Positions of reference points from Table 1

TABLE 1

Position and timing of course alterations

Run	Leg	Dist run km	Lat N.	Long. W	Day	Time(z)	Comments
1	A	2021	64 59.1	11 23.1	136	1606	Start Co 090°
	B	2133	65 00.2	09 00.3	137	0024	A/C to 180°
	B	2136	64 59.3	08 59.6	137	0033	On Co 180°
	C	2246	63 59.5	09 00.0	137	0828	A/C to 035°
	C	2250	63 59.2	08 56.8	137	0844	On Co 035°
	D	2396	65 00.7	07 01.8	137	1900	Start recovery
Interruption of SeaSoar survey to work calibration station with HNMS Tydeman.							
2	E	2674	64 28.6	07 00.1	138	1600	Start Co 045°
	F	2865	62 58.8	08 59.5	139	0540	A/C 120°
	F	2869	62 57.9	08 57.1	139	0558	On Co 120°
	G	2942	62 41.8	07 39.5	139	1112	A/C 030°
	G	2943	62 42.3	07 38.0	139	1119	On Co 030°
	H	3108	64 00.0	06 02.8	139	2238	A/C 090°
	H	3110	64 00.2	06 00.9	139	2245	On Co 090°
	I	3158	64 00.3	05 01.0	140	0212	A/C 180°
	I	3160	63 59.6	04 59.7	140	0220	On Co 180°
	J	3326	62 30.1	05 00.0	140	1409	A/C 135°
	J	3327	62 29.5	04 59.8	140	1415	On Co 135°
	K	3550	61 02.8	02 01.9	141	0615	Start recovery

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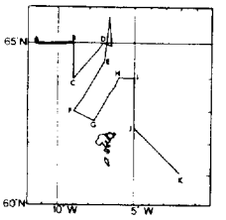
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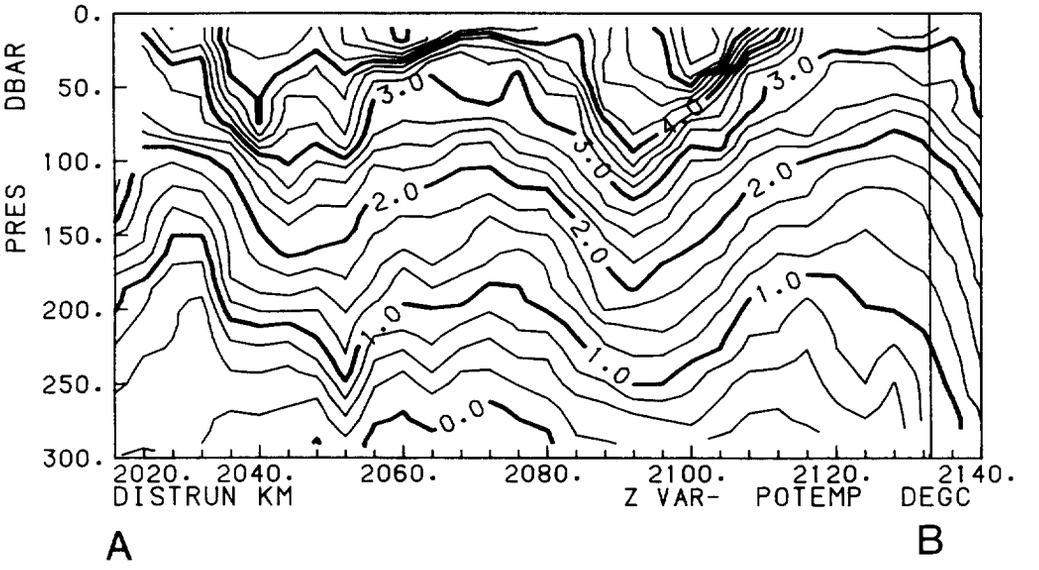
5°W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1.0
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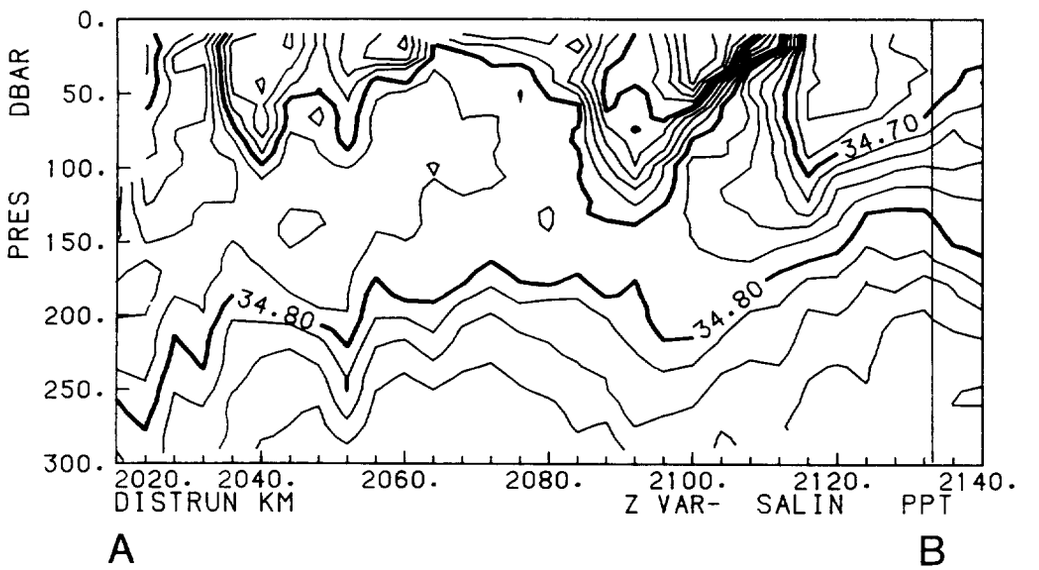
Z VAR- POTEMP DEGC
A
B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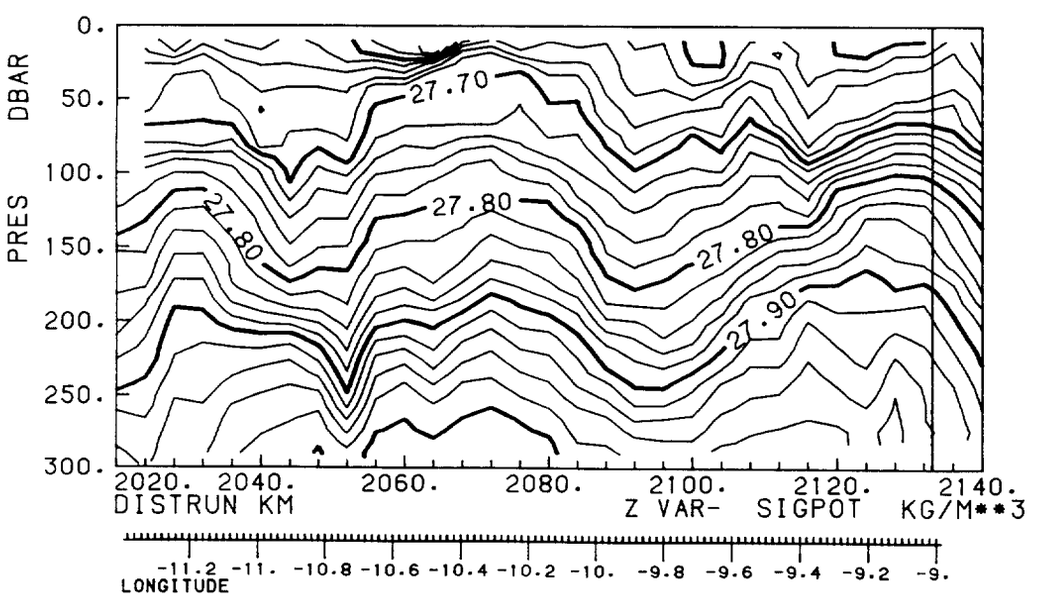
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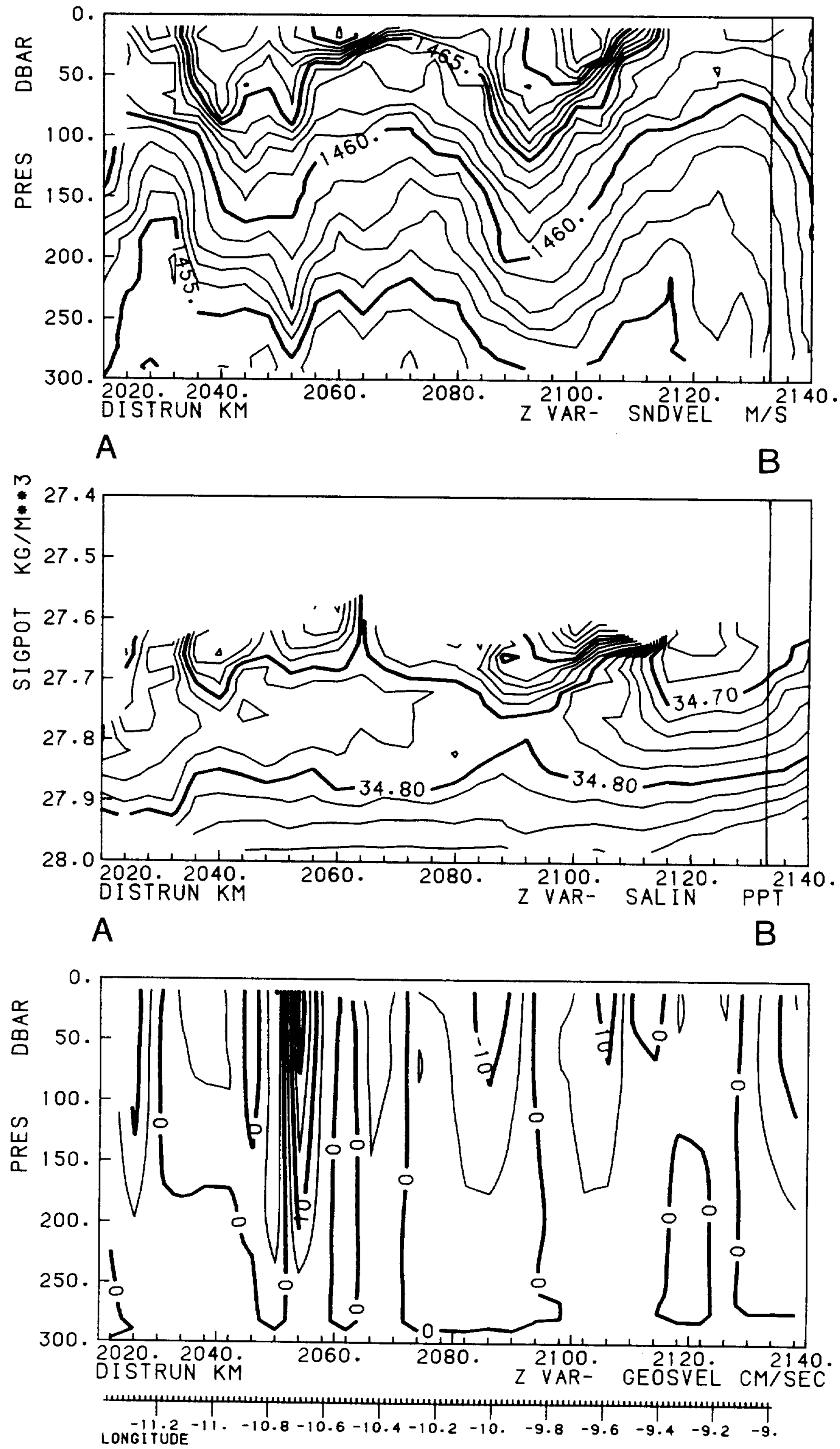
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A
B
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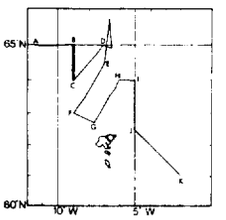
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10° W
5° W

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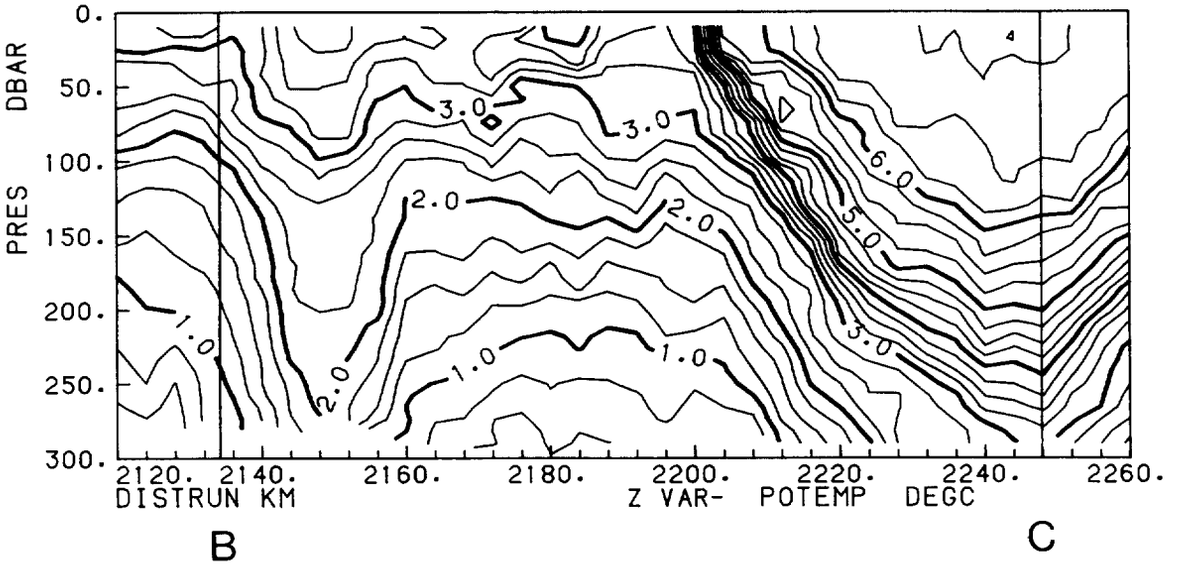
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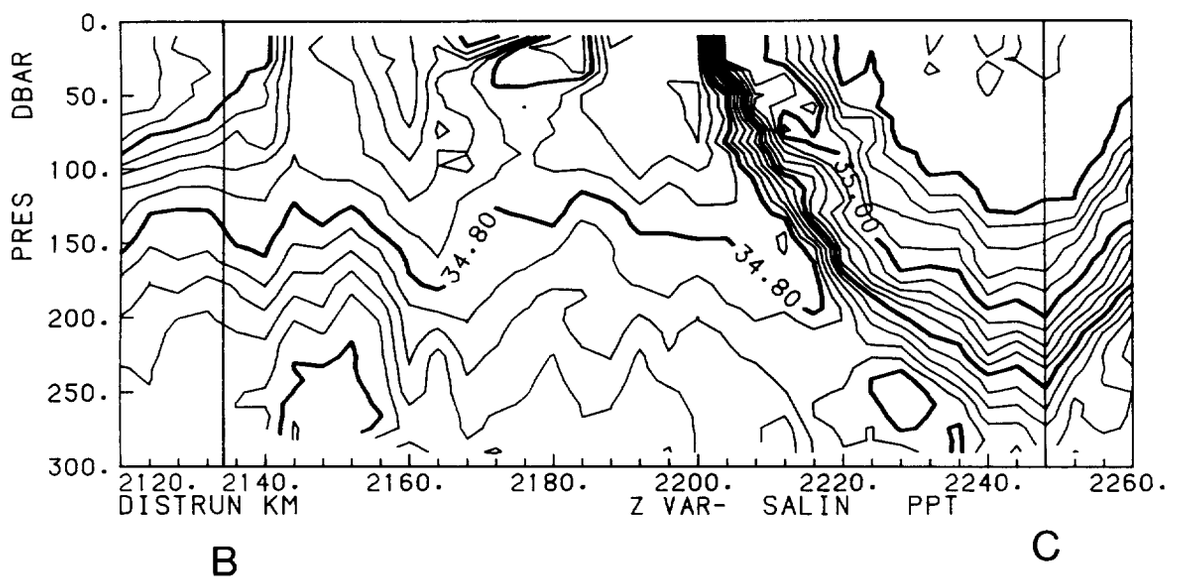
B
C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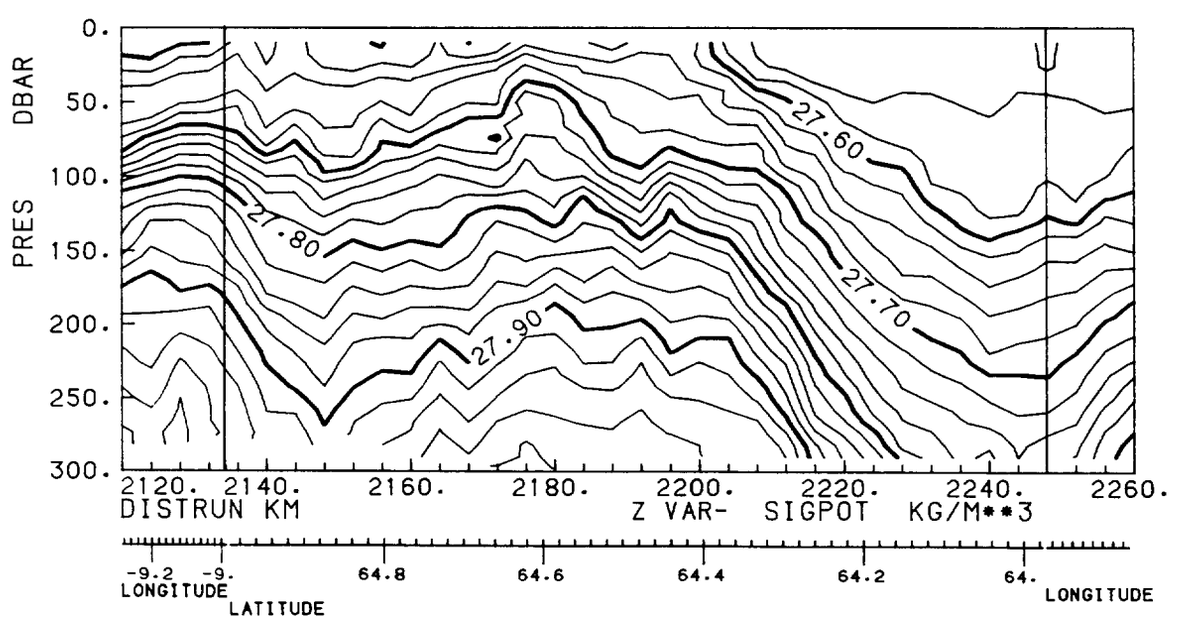
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LATITUDE
LONGITUDE

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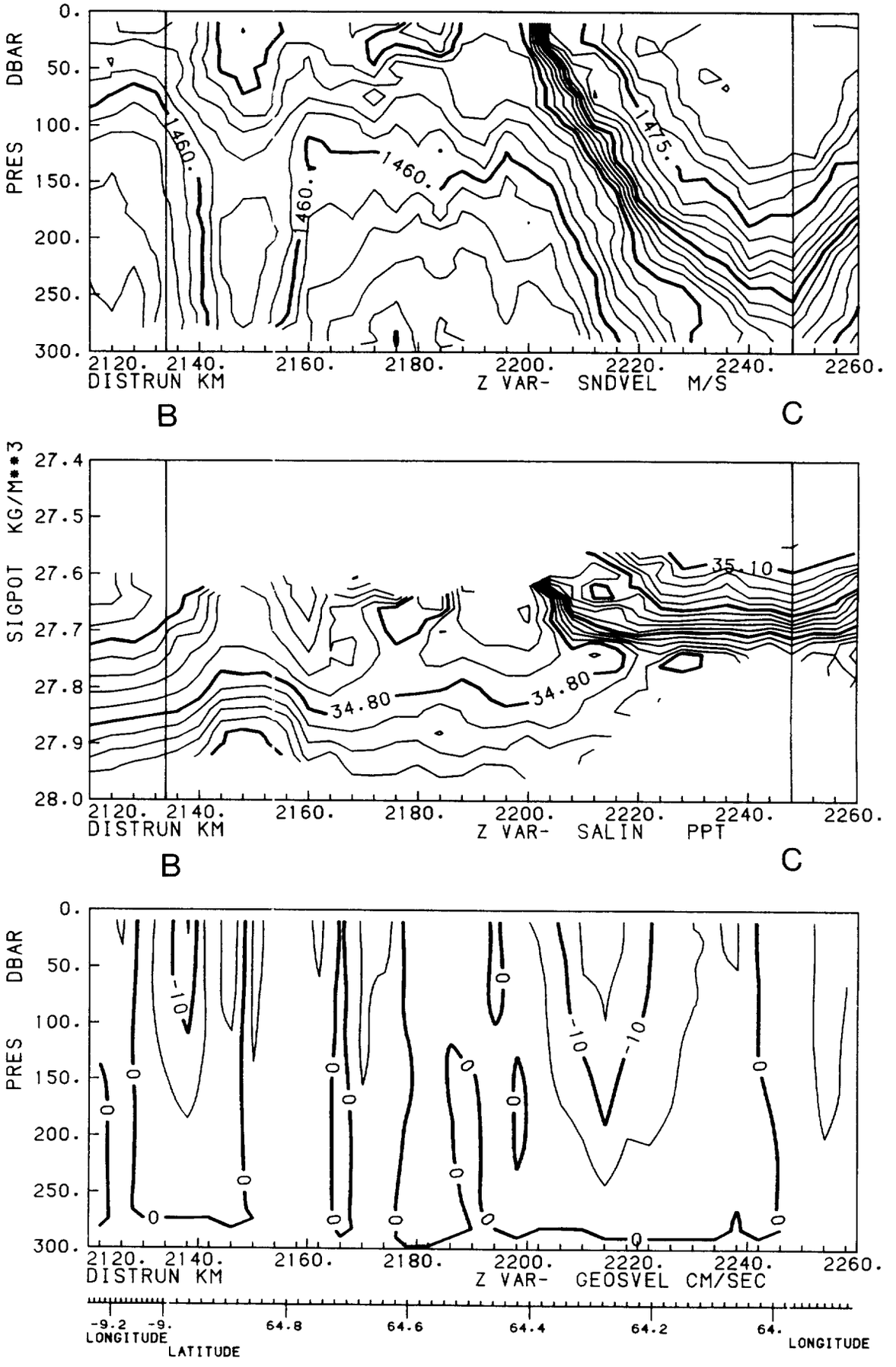
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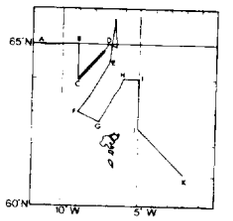

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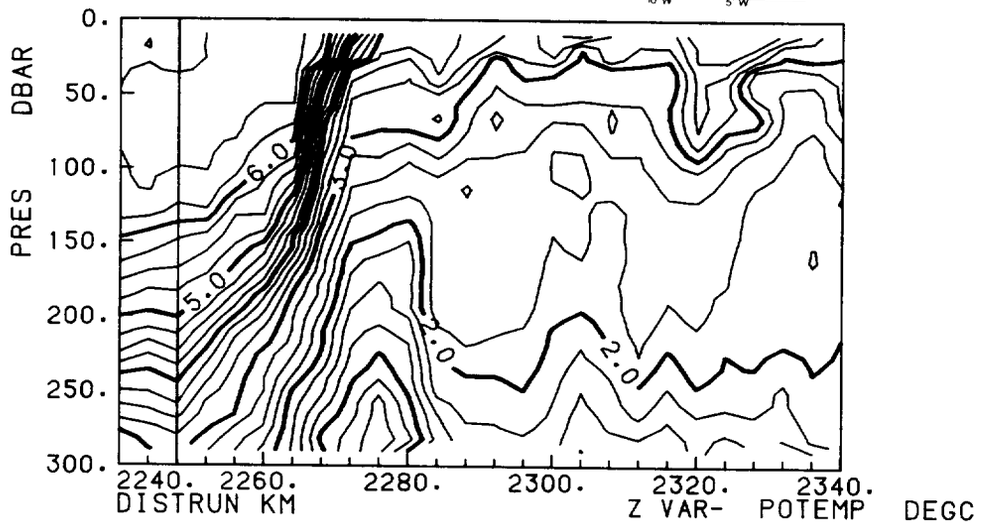

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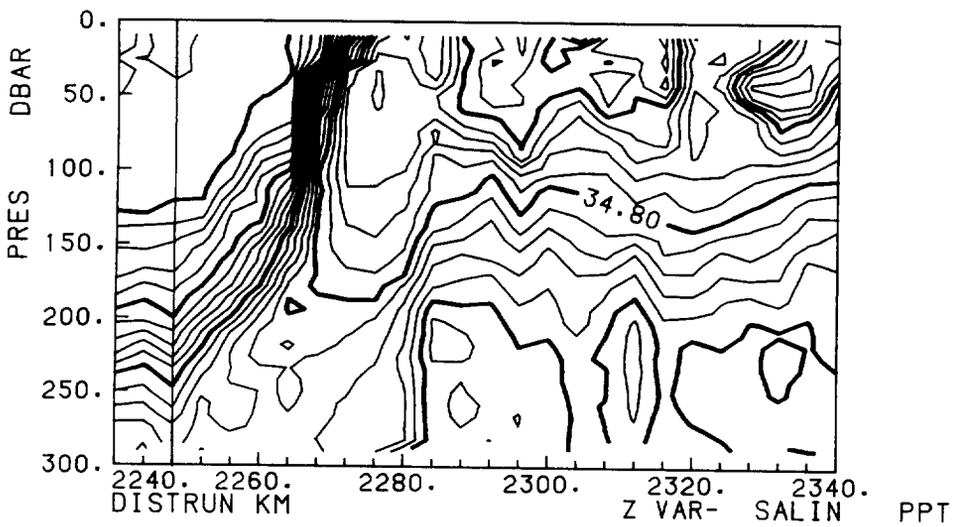

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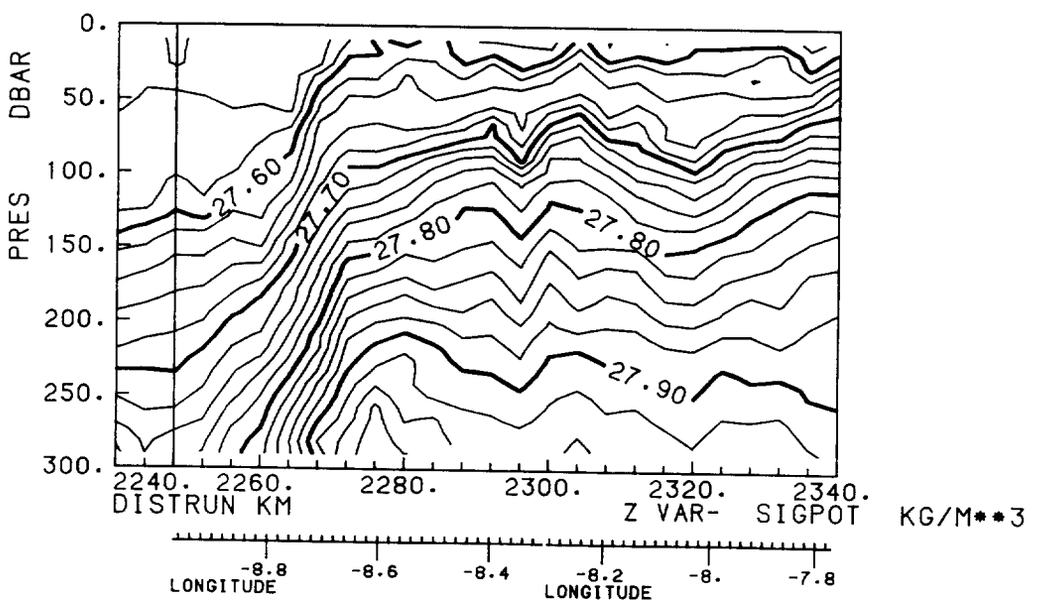

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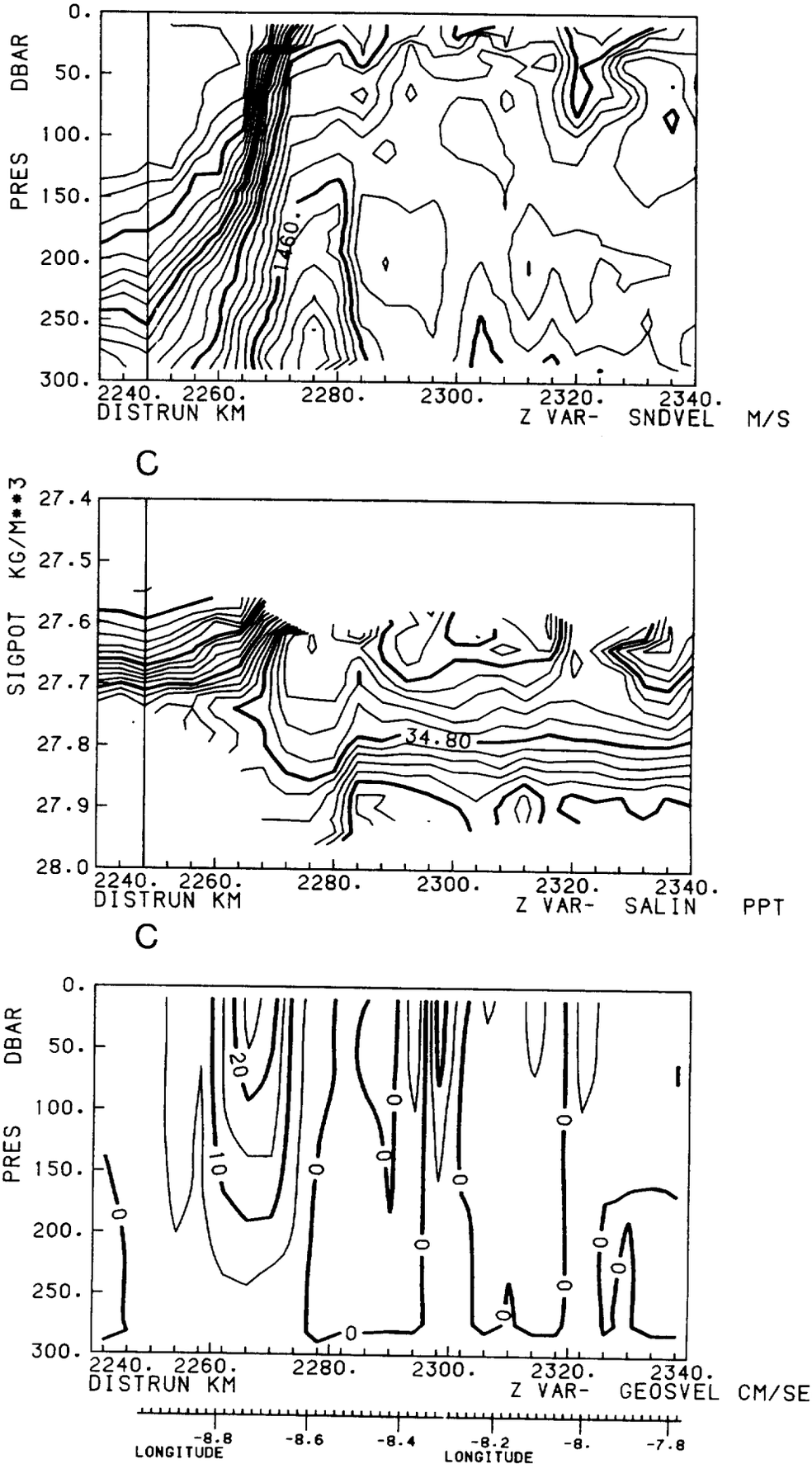
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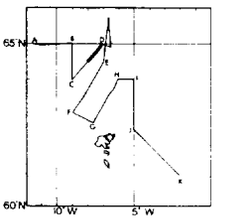

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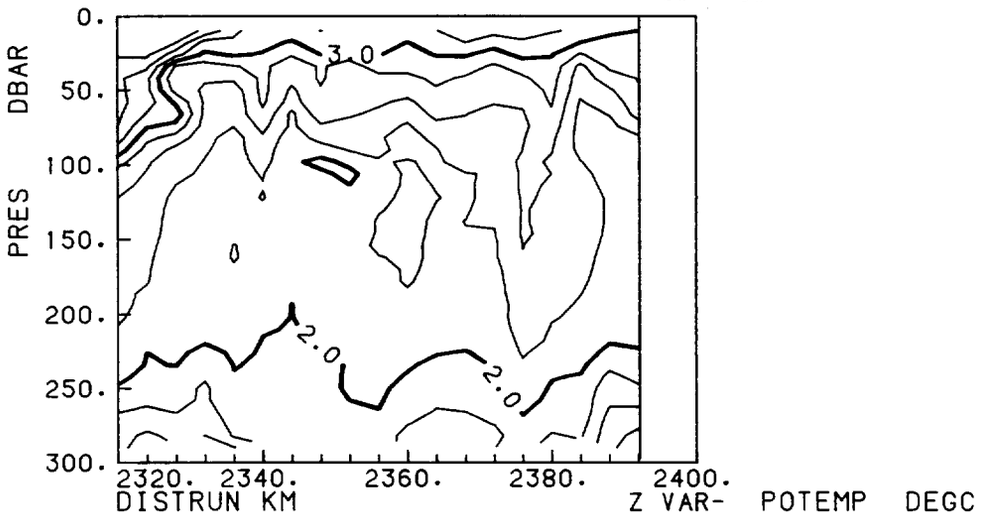

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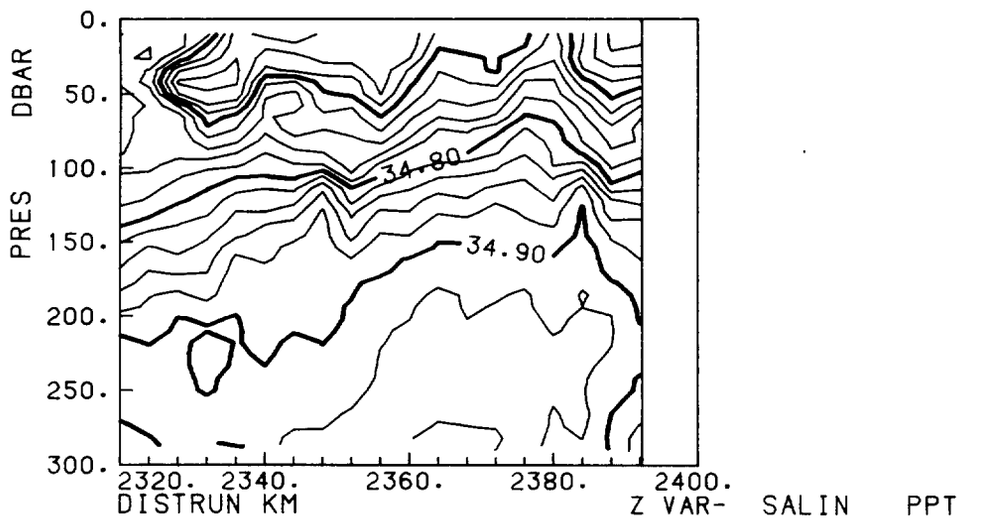

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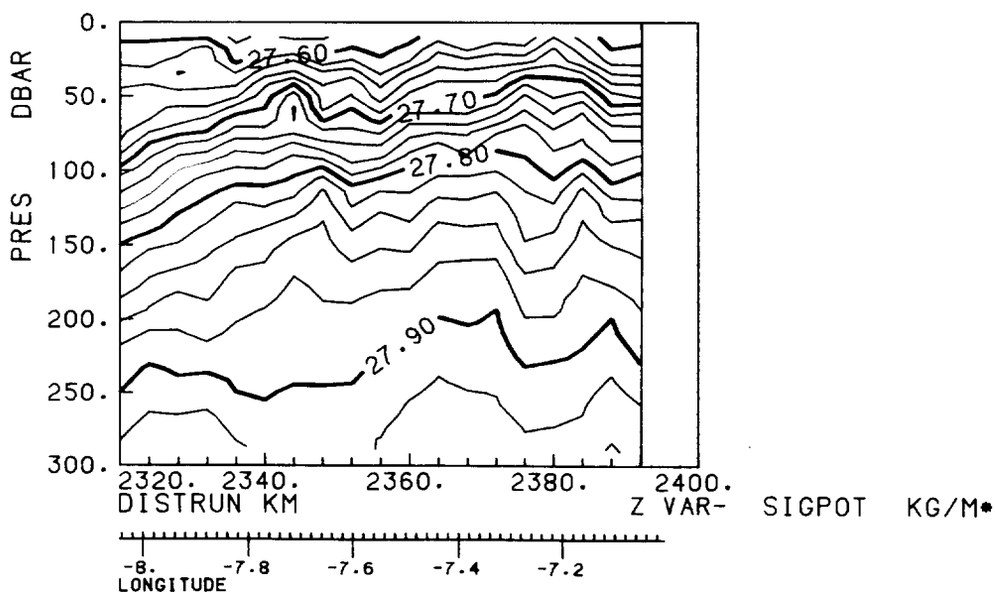

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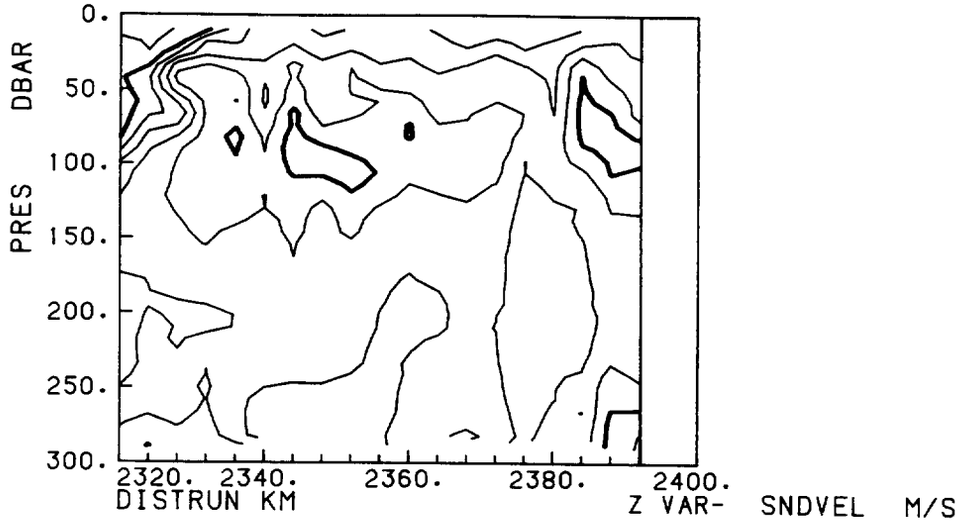

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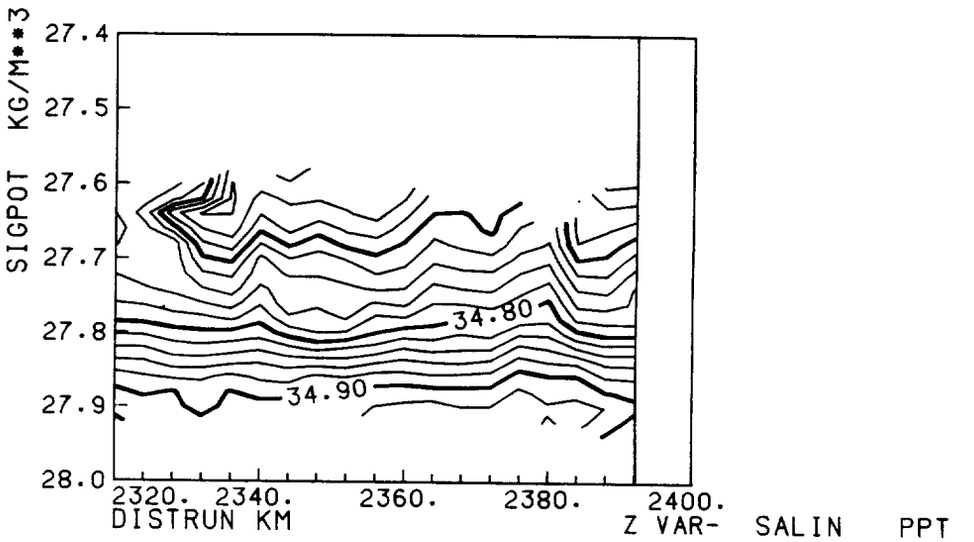

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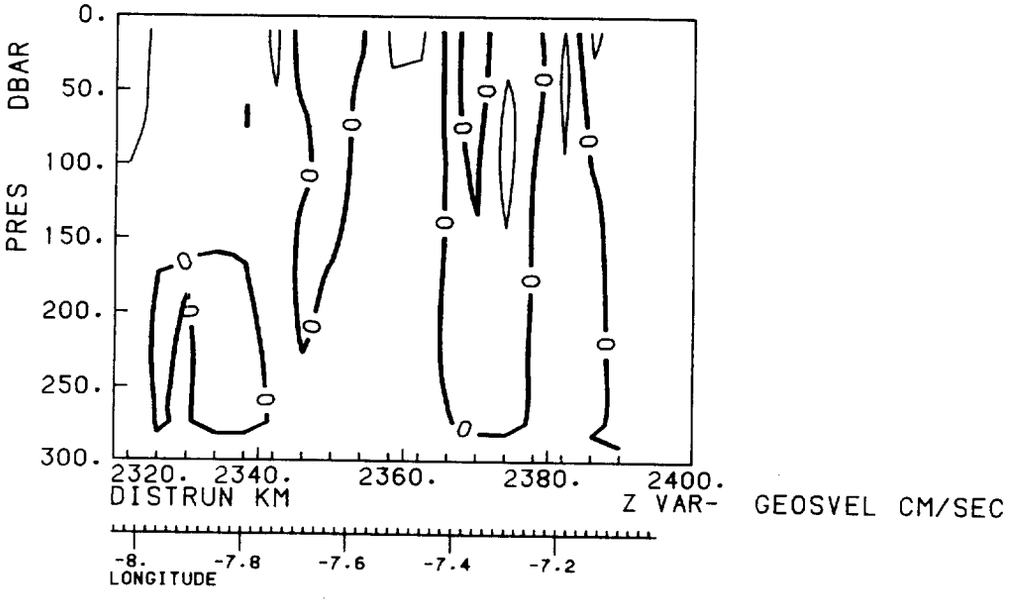

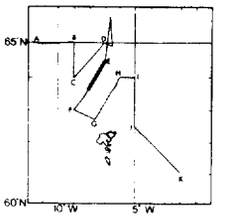

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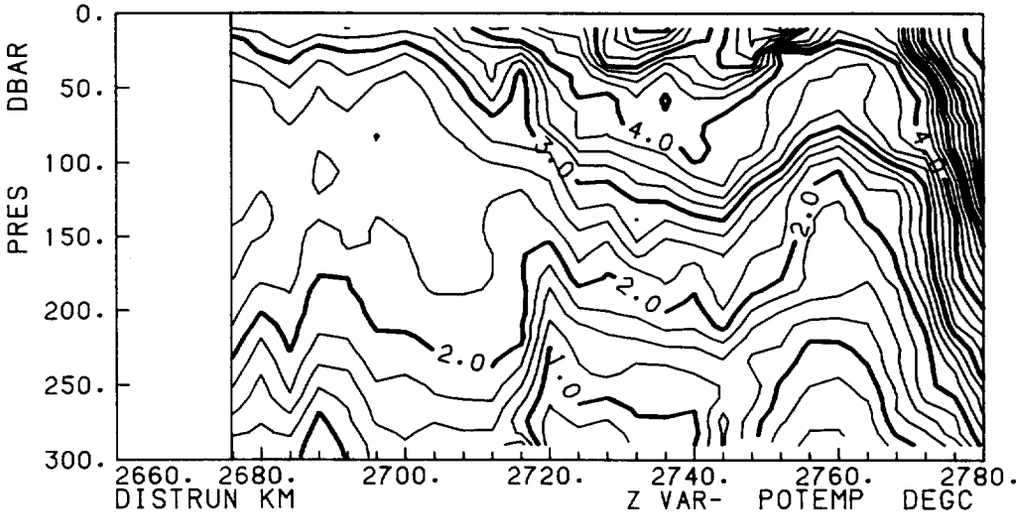

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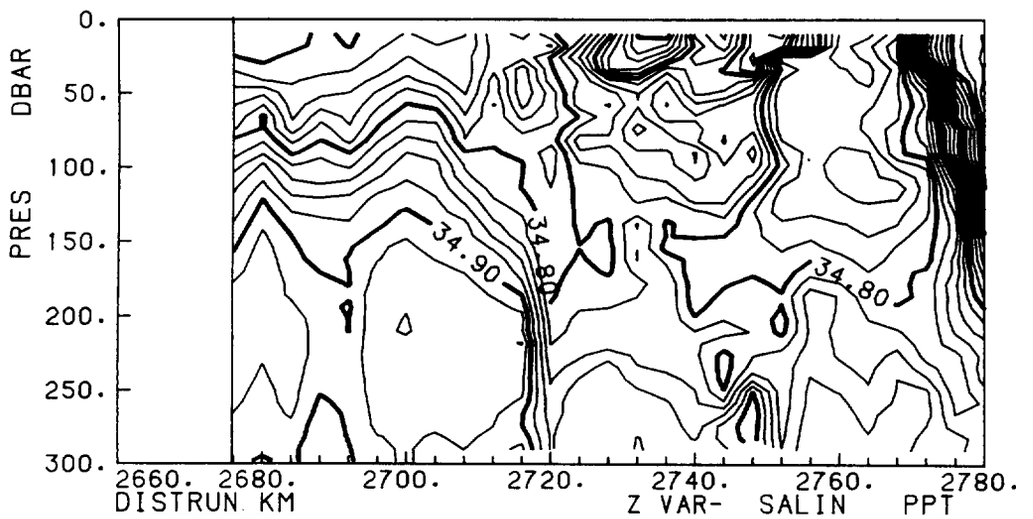
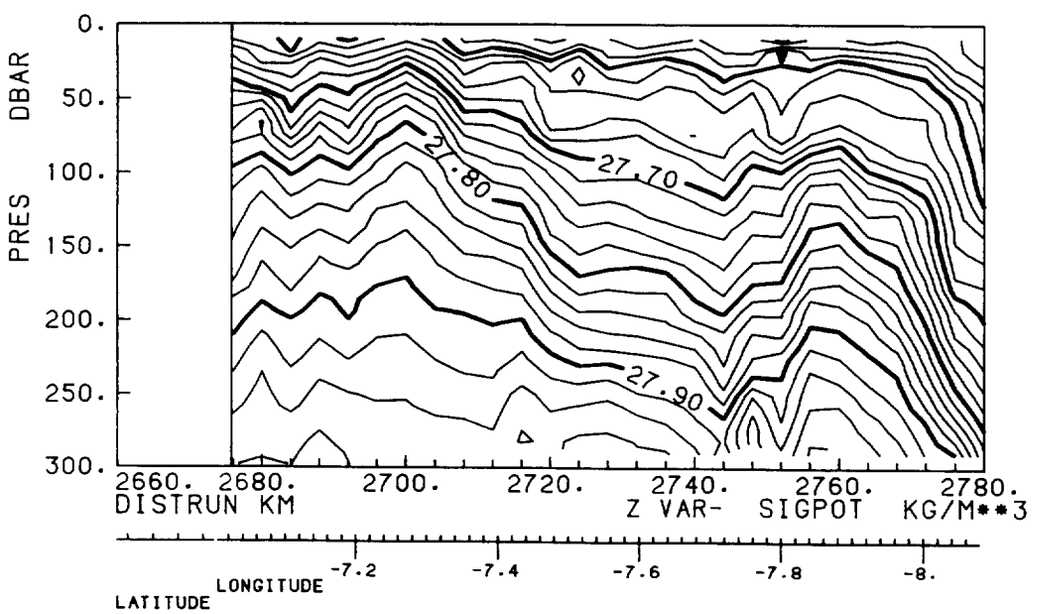


E



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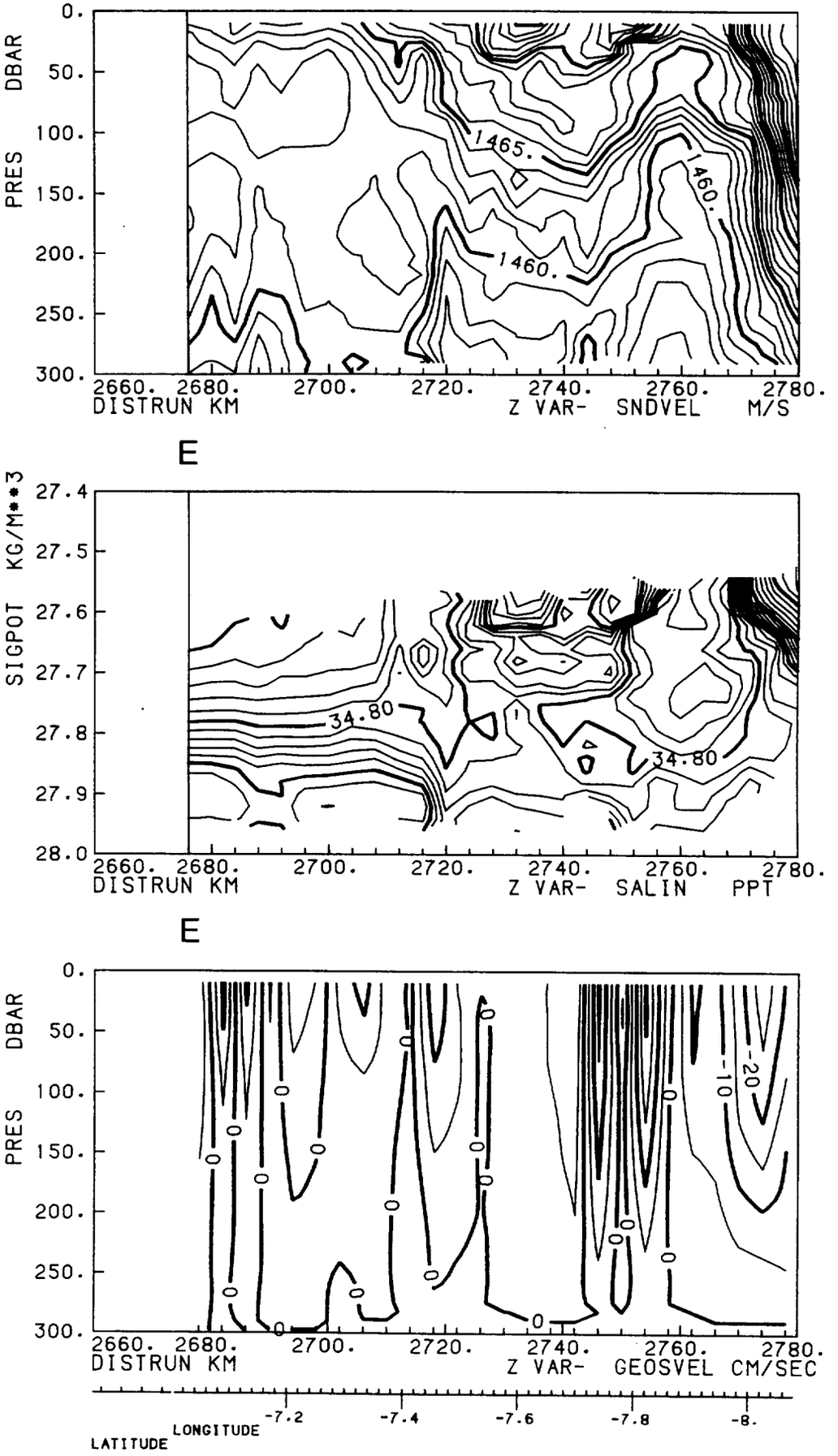
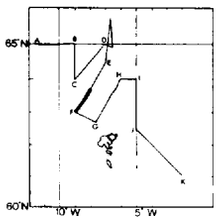

PRES DBAR
0.
50.
100.
150.
200.
250.
300.
1465.
1460.
1460.
2660. 2680. 2700. 2720. 2740. 2760. 2780.
DISTRUN KM
Z VAR- SNDVEL M/S
E
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
34.80
34.80
2660. 2680. 2700. 2720. 2740. 2760. 2780.
DISTRUN KM
Z VAR- SALIN PPT
E
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
0
-10
-20
2660. 2680. 2700. 2720. 2740. 2760. 2780.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-7.2
-7.4
-7.6
-7.8
-8.
LONGITUDE
LATITUDE



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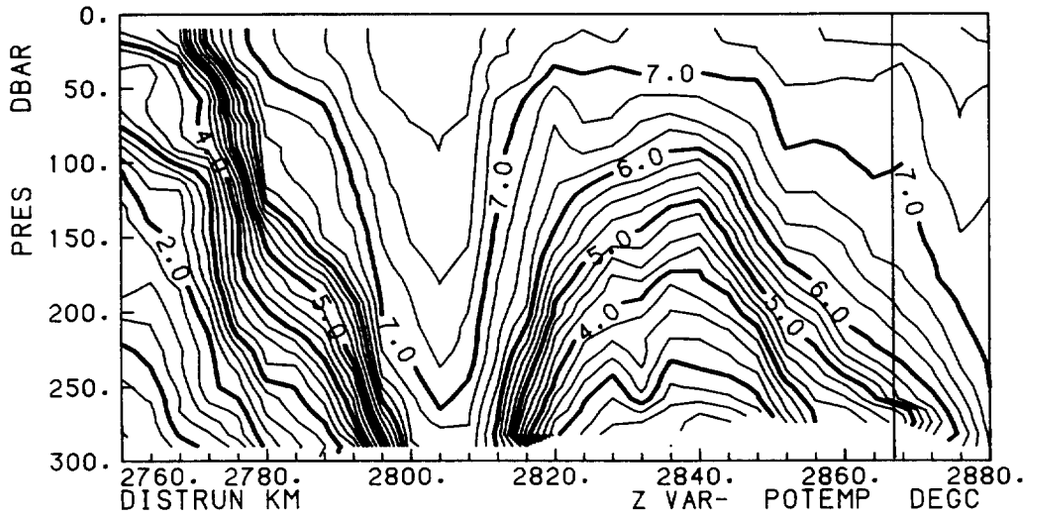

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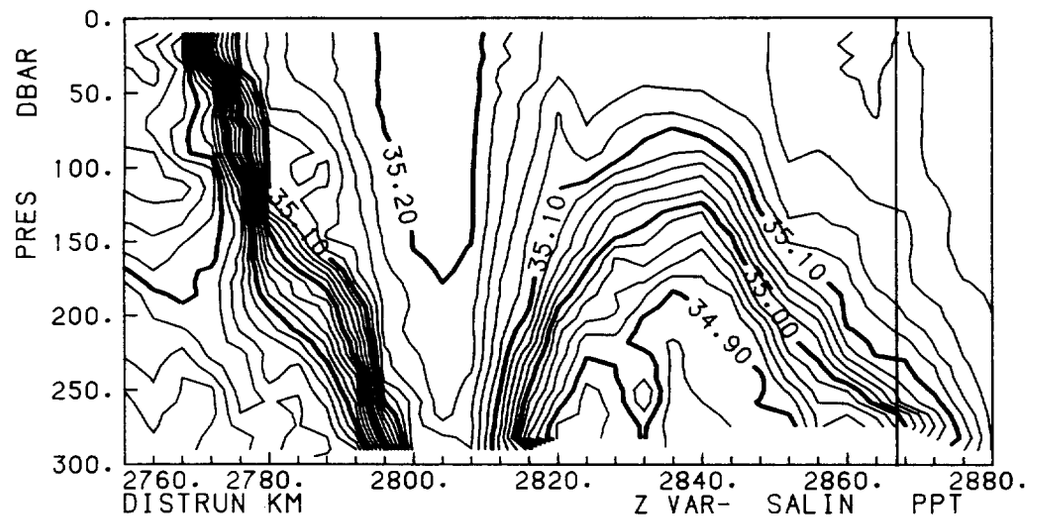

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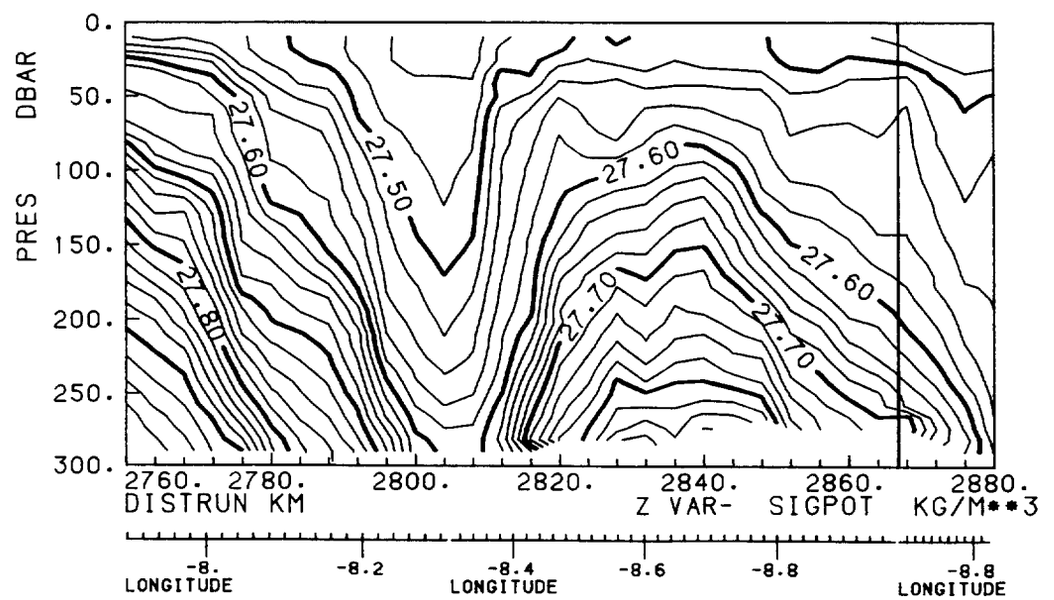

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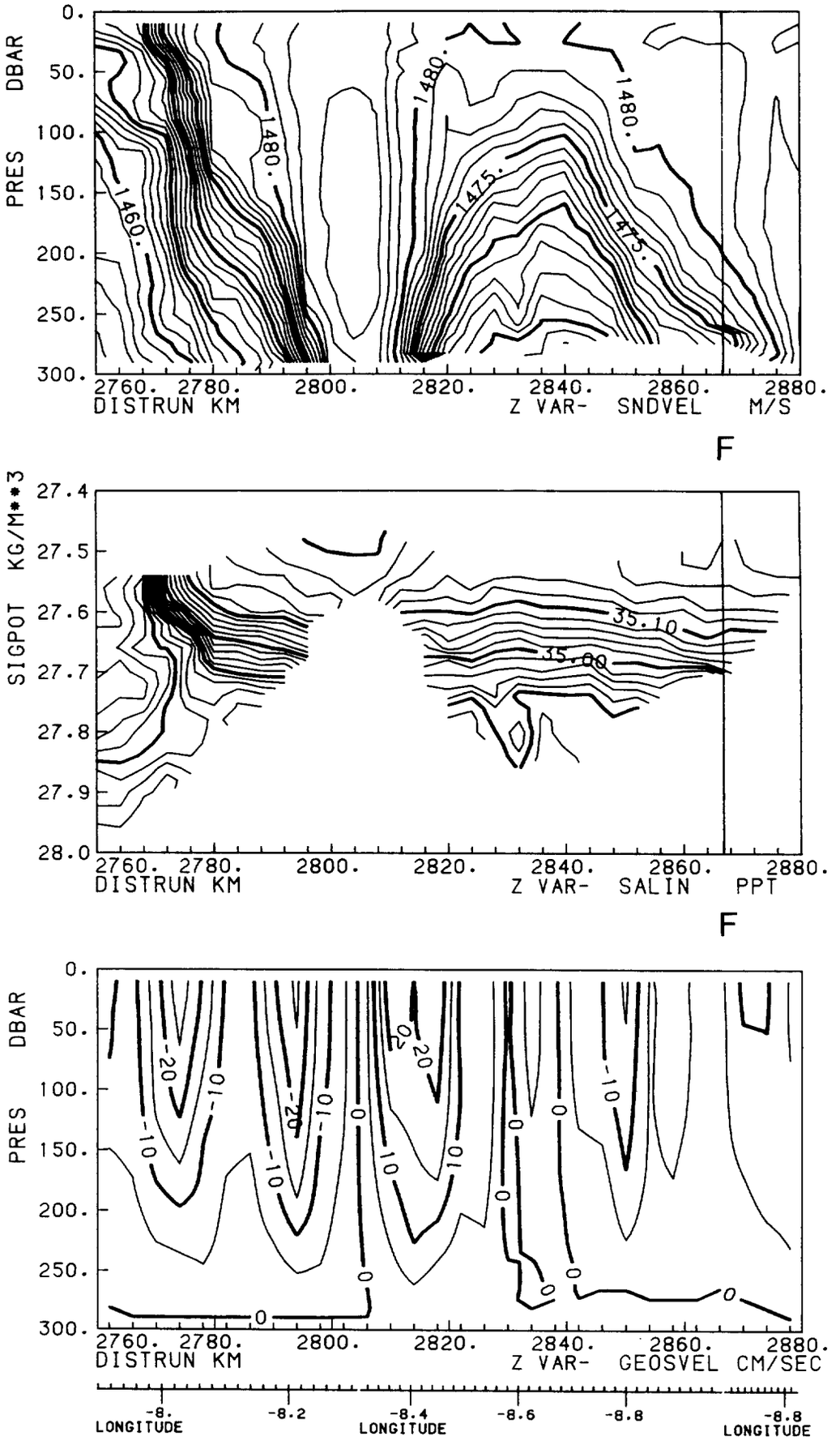
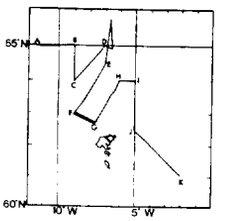

PRES DBAR
0.
50.
100.
150.
200.
250.
300.
1480.
1475.
1460.
2760. 2780. 2800. 2820. 2840. 2860. 2880.
DISTRUN KM
Z VAR- SNDVEL M/S
F
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
35.10
35.00
DISTRUN KM
Z VAR- SALIN PPT
F
PRES DBAR
-20
-10
0
10
20
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-8. -8.2 -8.4 -8.6 -8.8 -8.8
LONGITUDE
LONGITUDE
LONGITUDE



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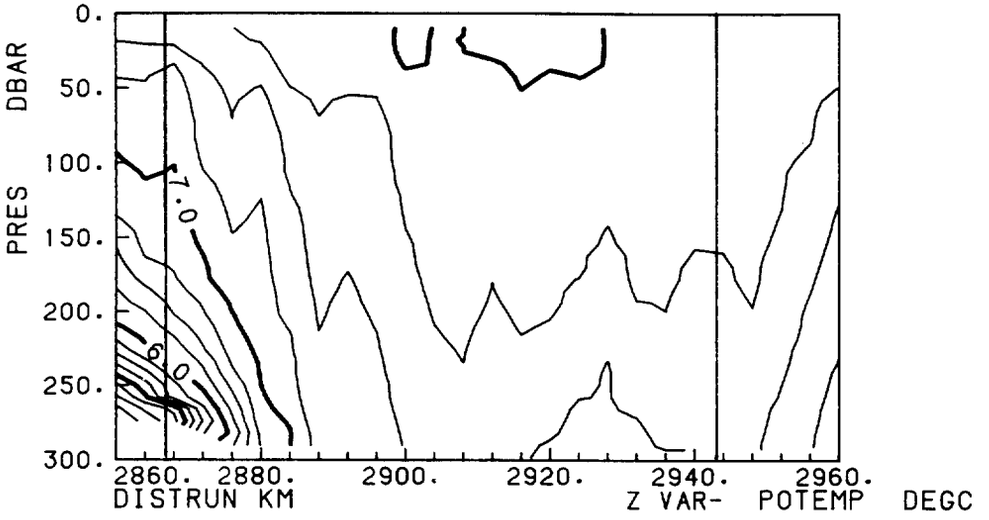
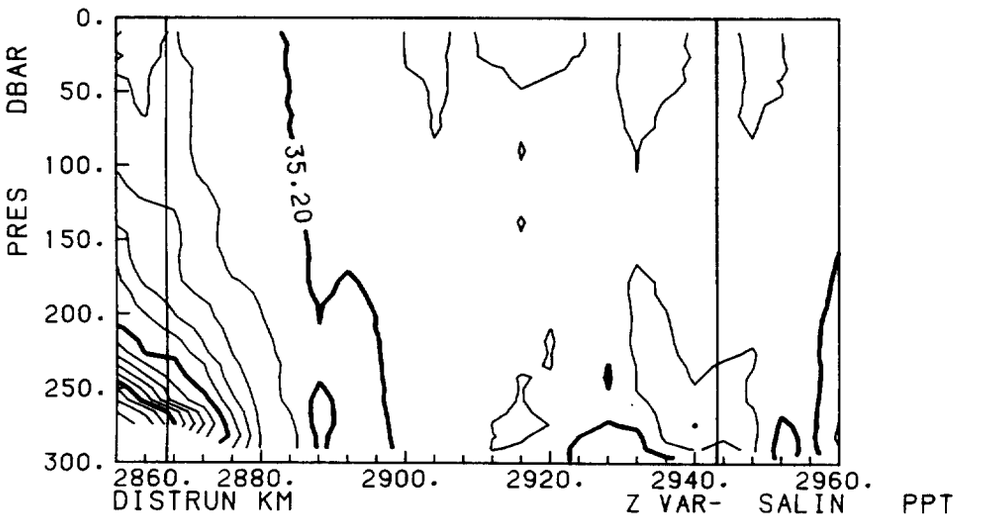
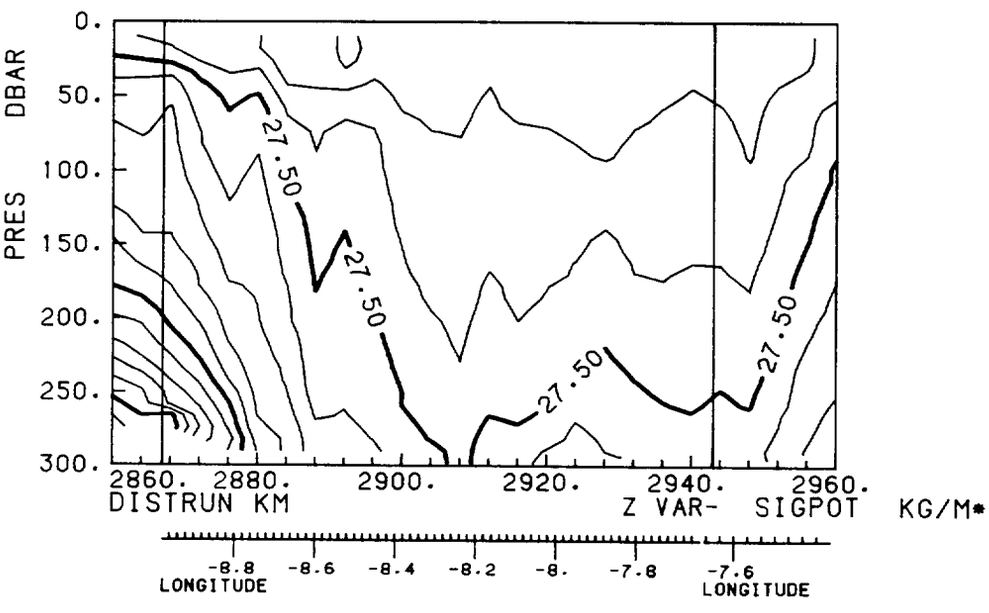
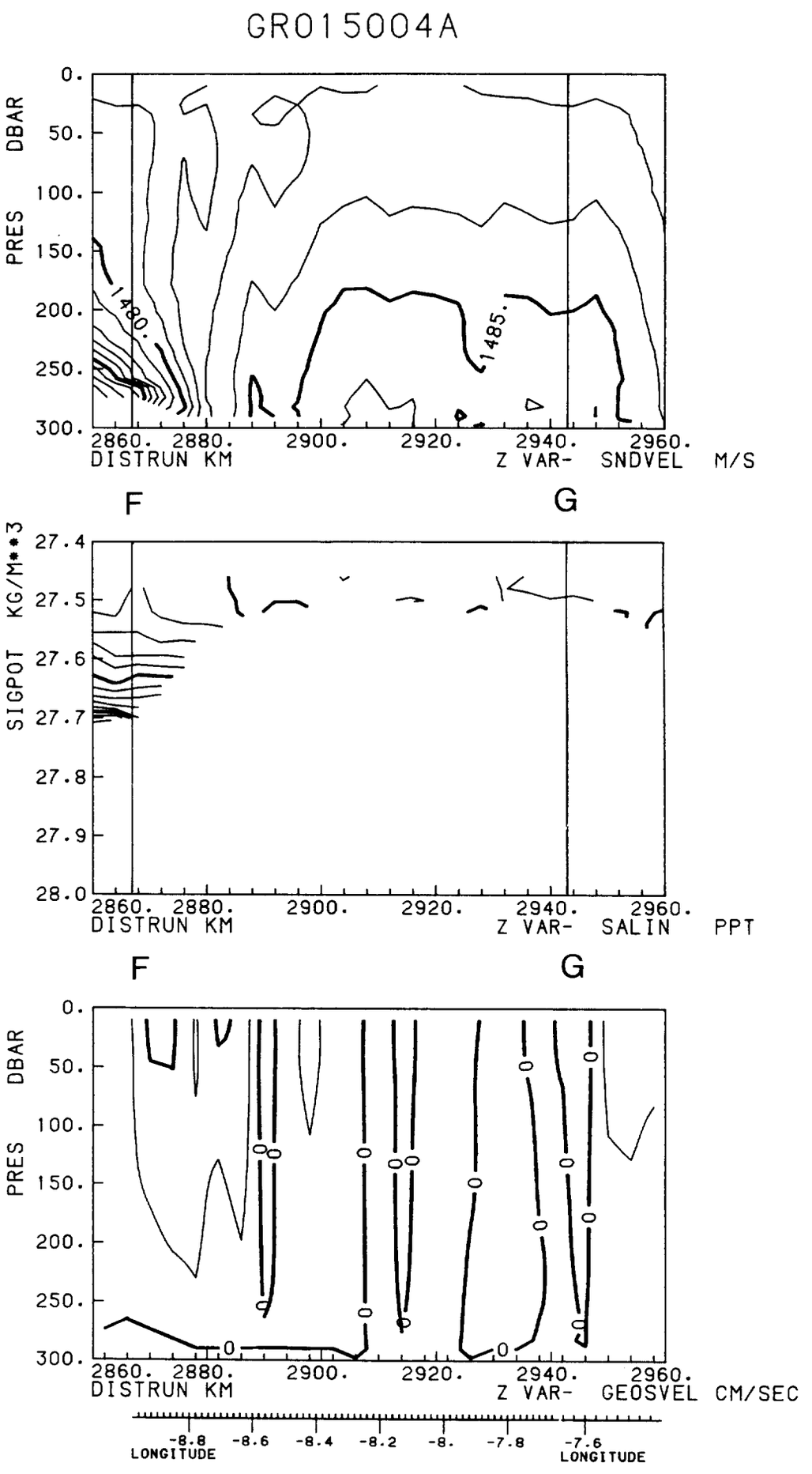


F G

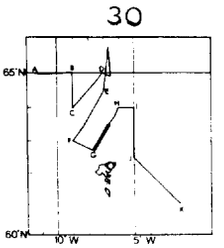


F G




GR015004A
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
1480.
1485.
2860. 2880. 2900. 2920. 2940. 2960.
DISTRUN KM
Z VAR- SNDVEL M/S
F
G
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
2860. 2880. 2900. 2920. 2940. 2960.
DISTRUN KM
Z VAR- SALIN PPT
F
G
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
0
2860. 2880. 2900. 2920. 2940. 2960.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-8.8 -8.6 -8.4 -8.2 -8. -7.8 -7.6
LONGITUDE
LONGITUDE

30



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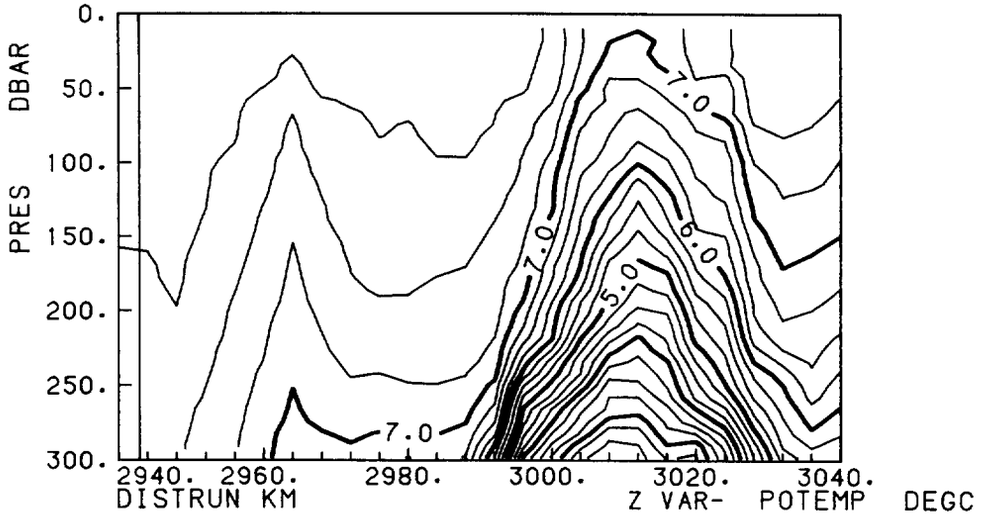

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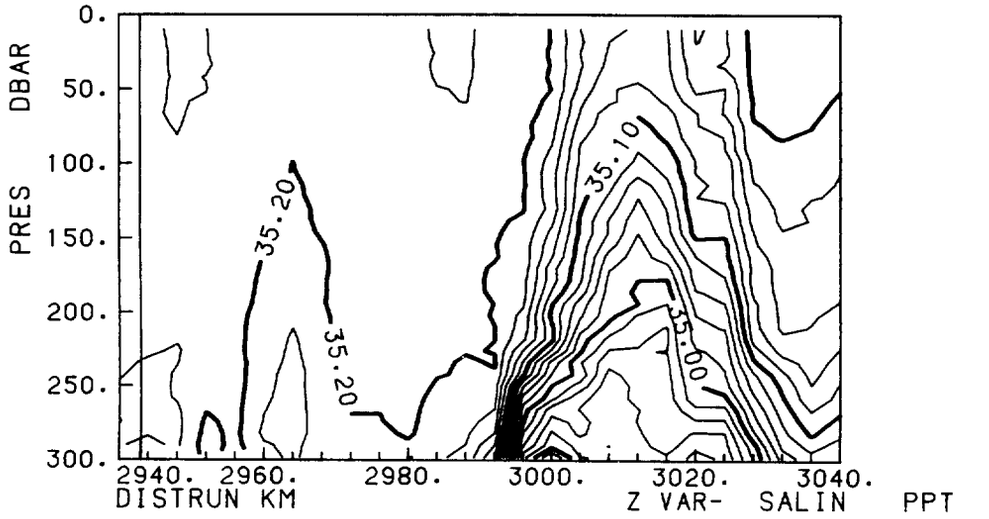

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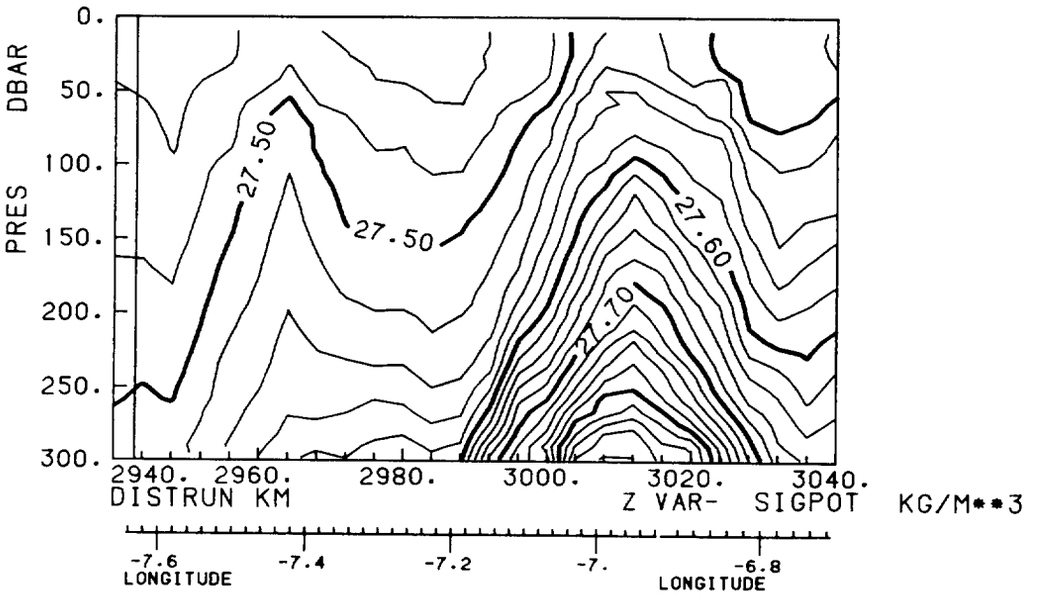

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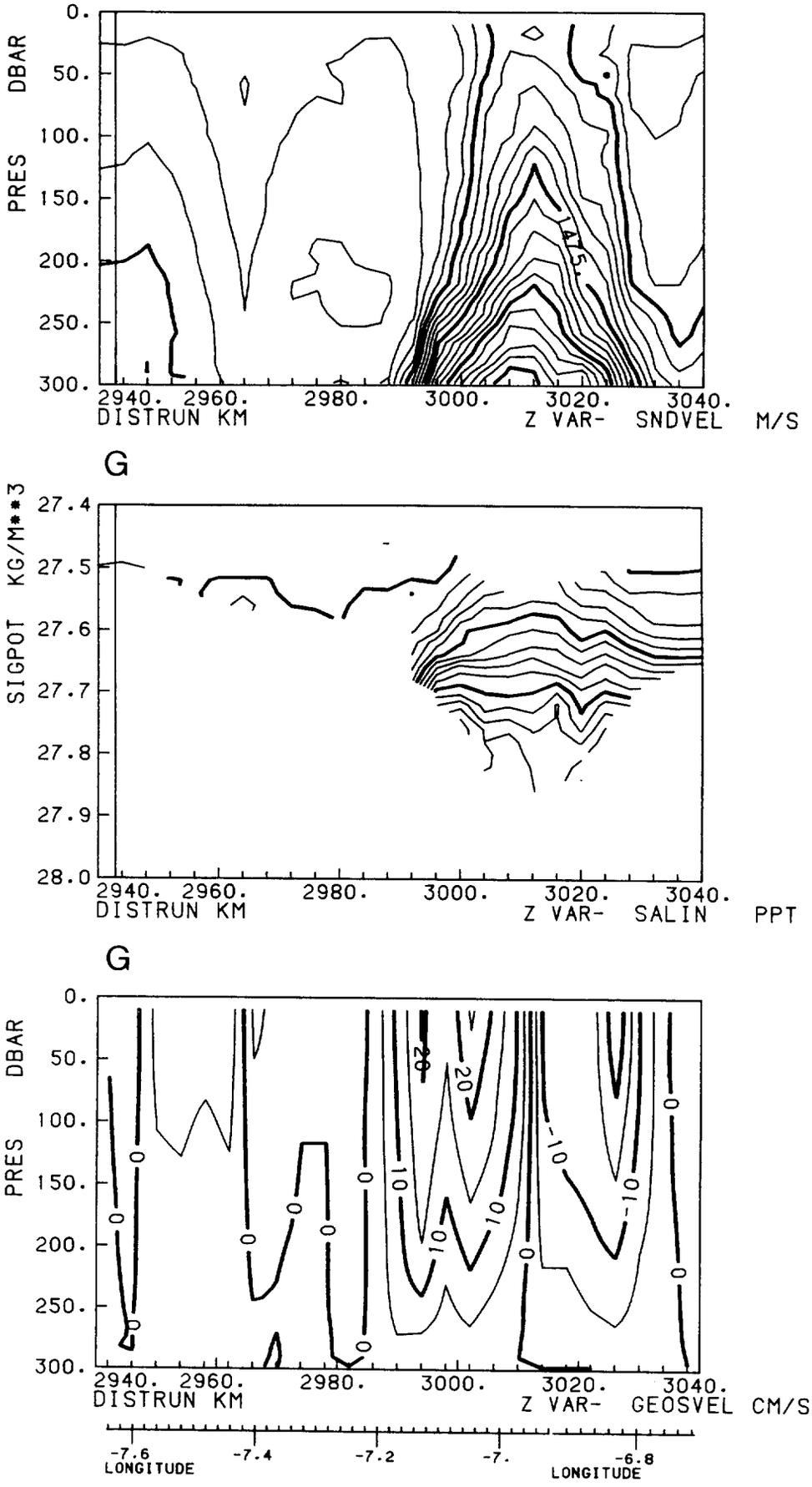
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50.
100.
150.
200.
250.
300.
14.5
1
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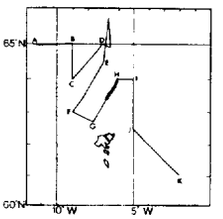
DISTRUN KM
Z VAR- SNDVEL M/S
G
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
2940. 2960. 2980. 3000. 3020. 3040.
DISTRUN KM
Z VAR- SALIN PPT
G
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
20
10
0
-10
2940. 2960. 2980. 3000. 3020. 3040.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-7.6 -7.4 -7.2 -7. -6.8
LONGITUDE
LONGITUDE



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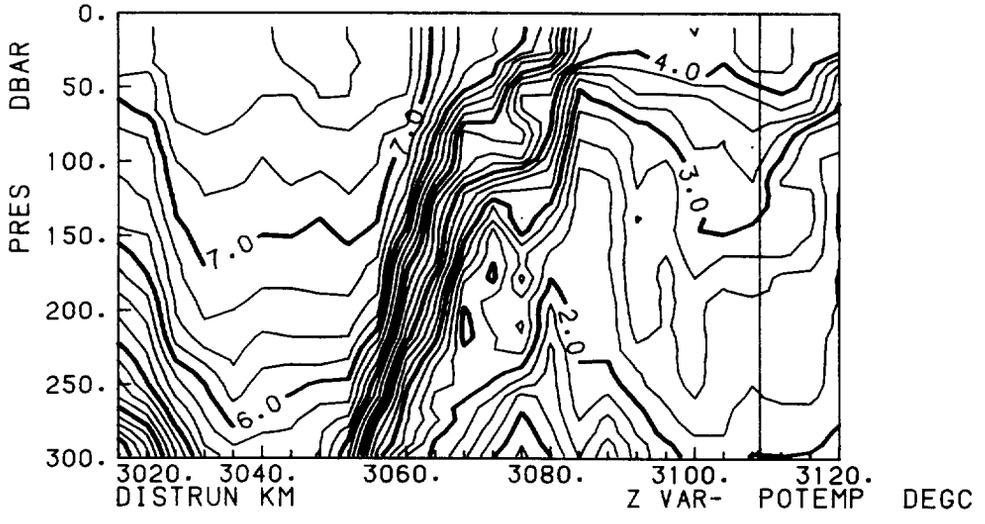

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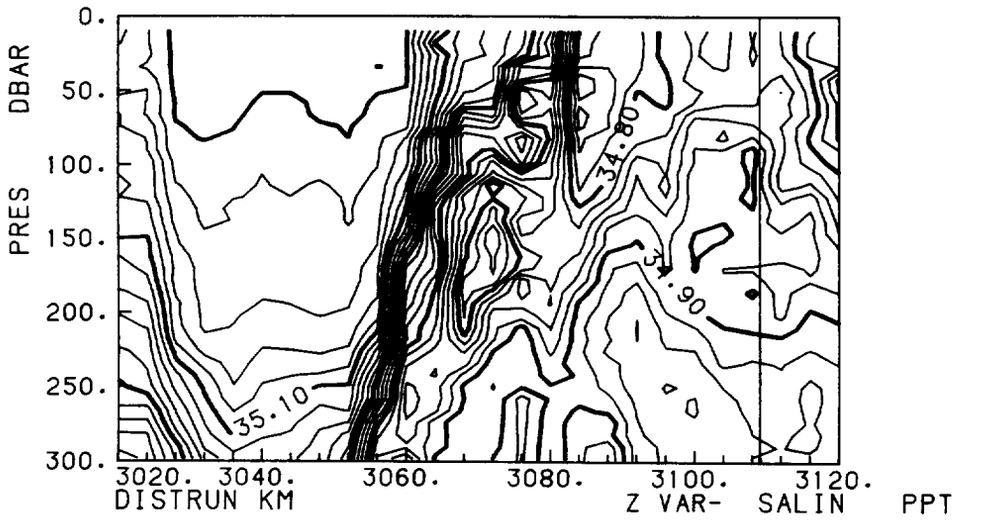

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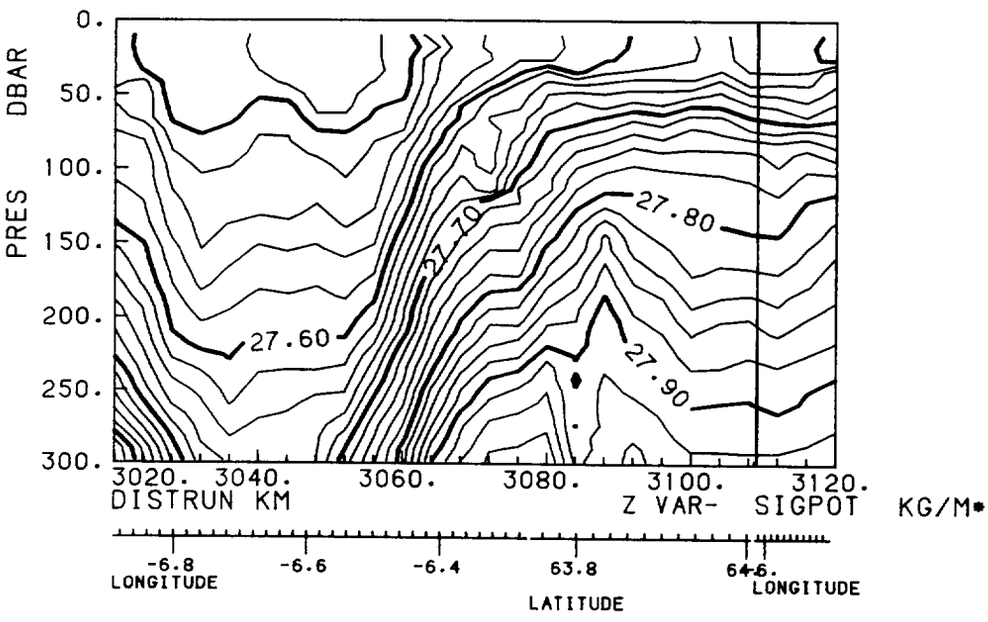

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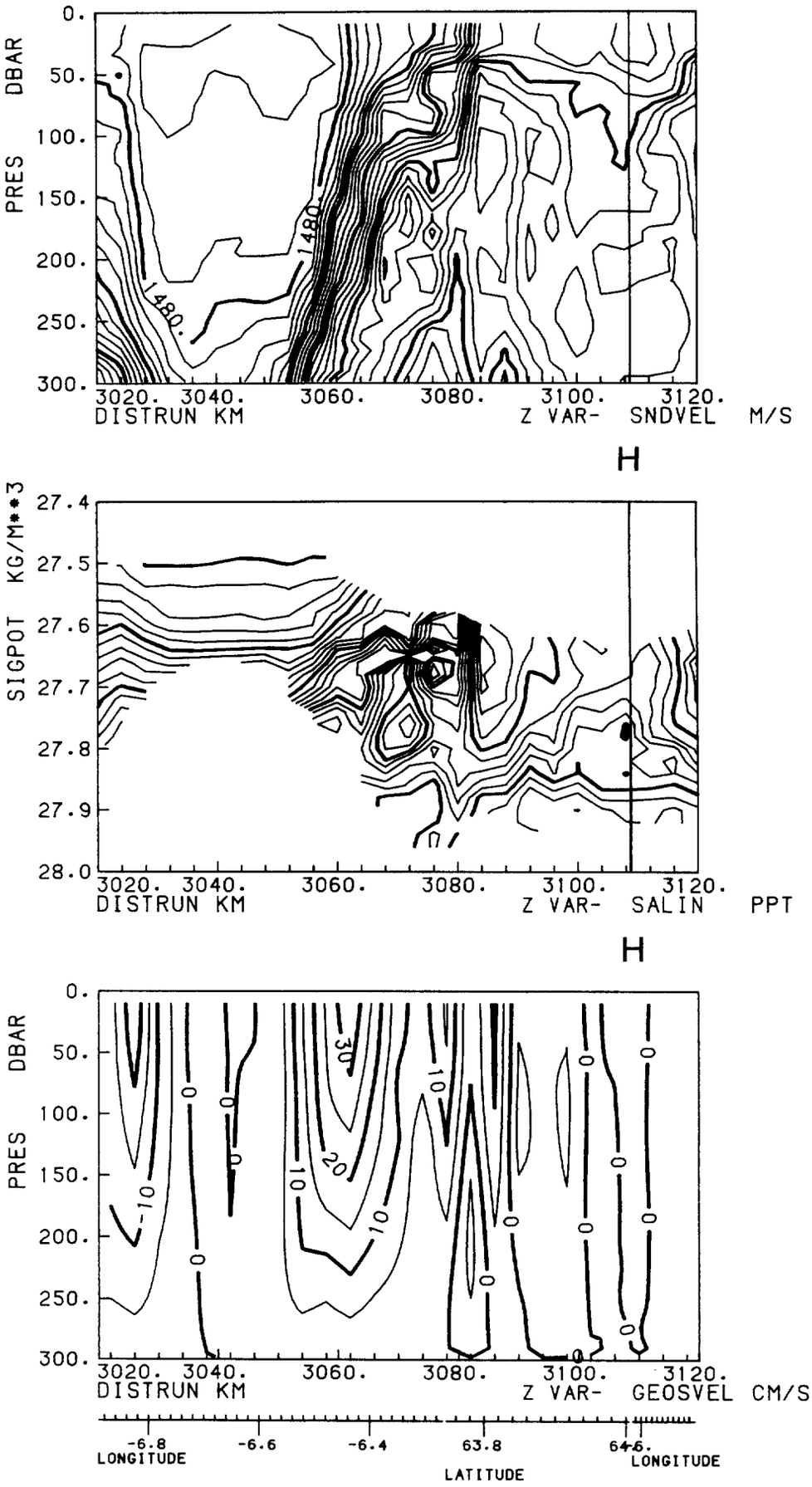
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0.
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100.
150.
200.
250.
300.
1480.
1480.
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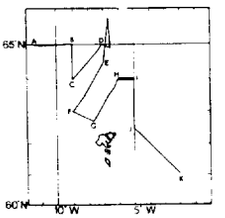
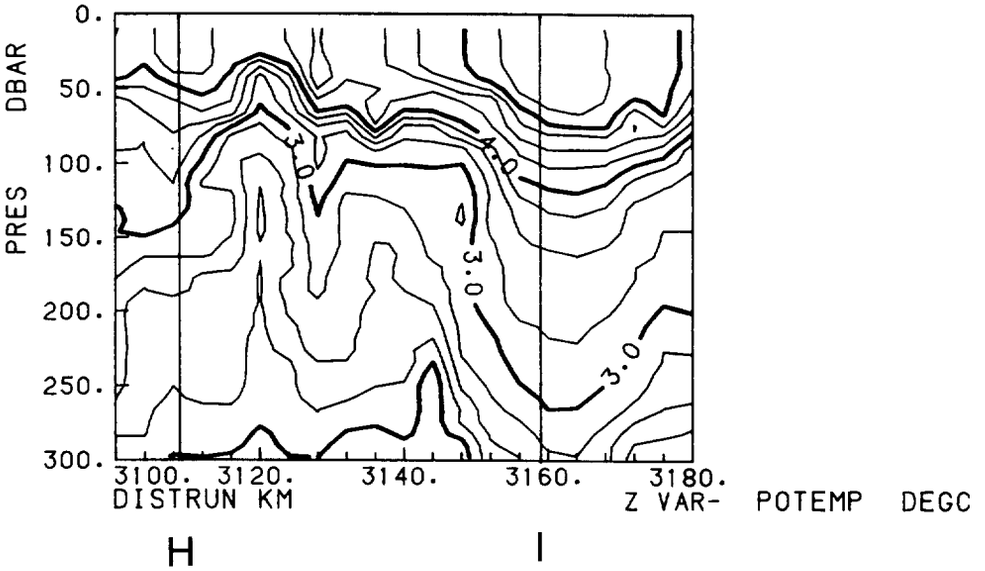
DISTRUN KM
Z VAR- SNDVEL M/S
H
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
3020. 3040. 3060. 3080. 3100. 3120.
DISTRUN KM
Z VAR- SALIN PPT
H
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
-10
0
0
0
30
10
20
10
10
0
0
0
0
0
0
0
3020. 3040. 3060. 3080. 3100. 3120.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-6.8
LONGITUDE
-6.6
-6.4
63.8
LATITUDE
64.6.
LONGITUDE


65°N
60°N
10°W
5°W

GR015005B


PRES DBAR
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100.
150.
200.
250.
300.
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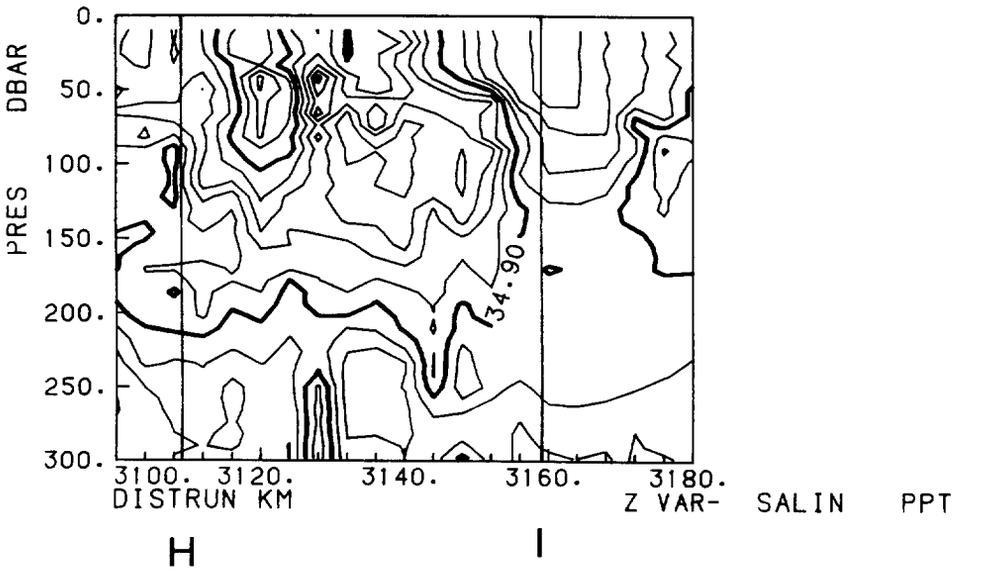
4.0
3.0
3.0
3100. 3120. 3140. 3160. 3180.
DISTRUN KM
Z VAR- POTEMP DEGC
H
I


PRES DBAR
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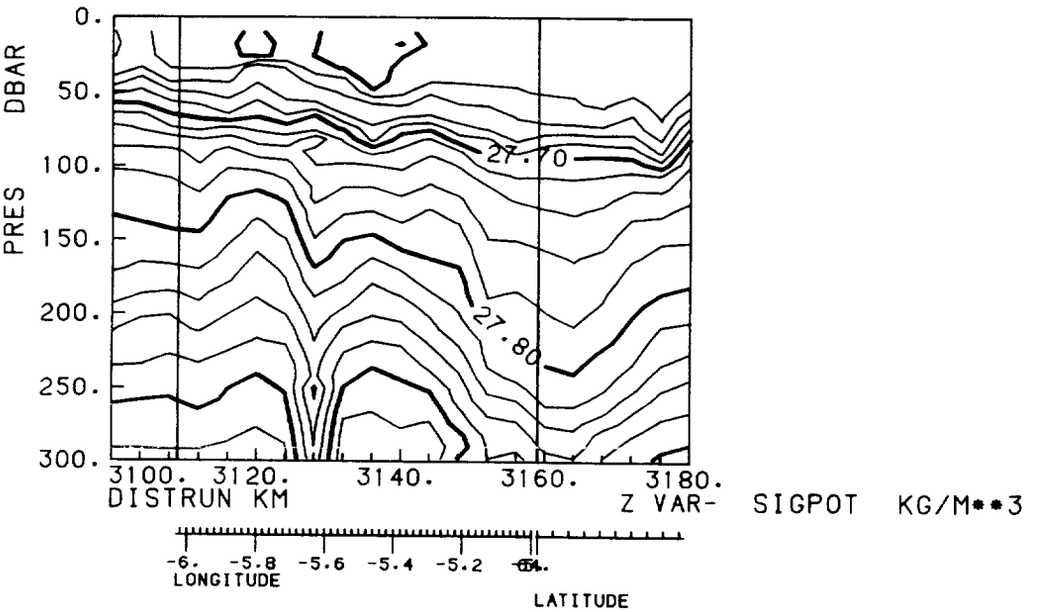
50.
100.
150.
200.
250.
300.
34.90
3100. 3120. 3140. 3160. 3180.
DISTRUN KM
Z VAR- SALIN PPT
H
I


PRES DBAR
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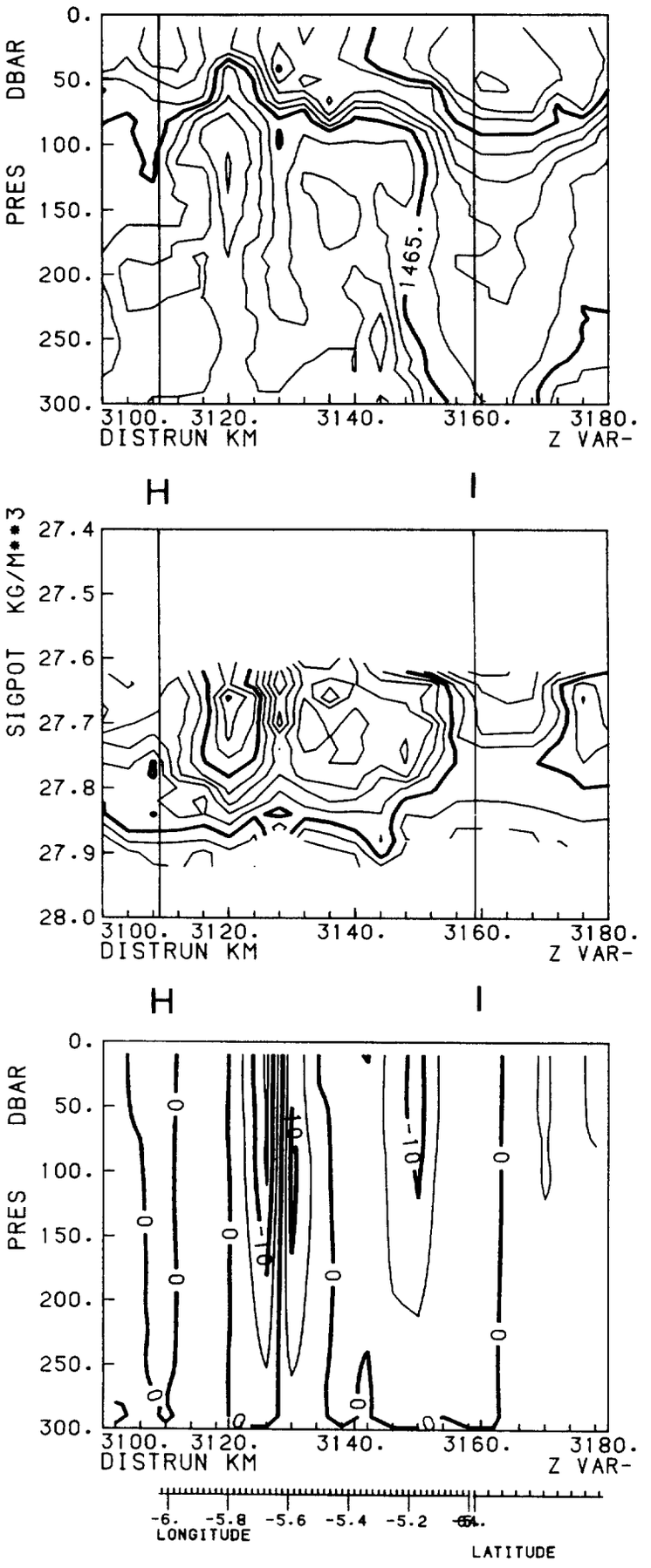
100.
150.
200.
250.
300.
27.70
27.80
3100. 3120. 3140. 3160. 3180.
DISTRUN KM
Z VAR- SIGPOT KG/M**3
-6. -5.8 -5.6 -5.4 -5.2 -64.
LONGITUDE
LATITUDE

GR015005B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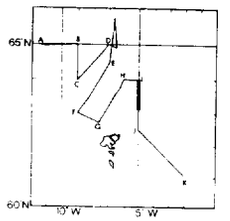
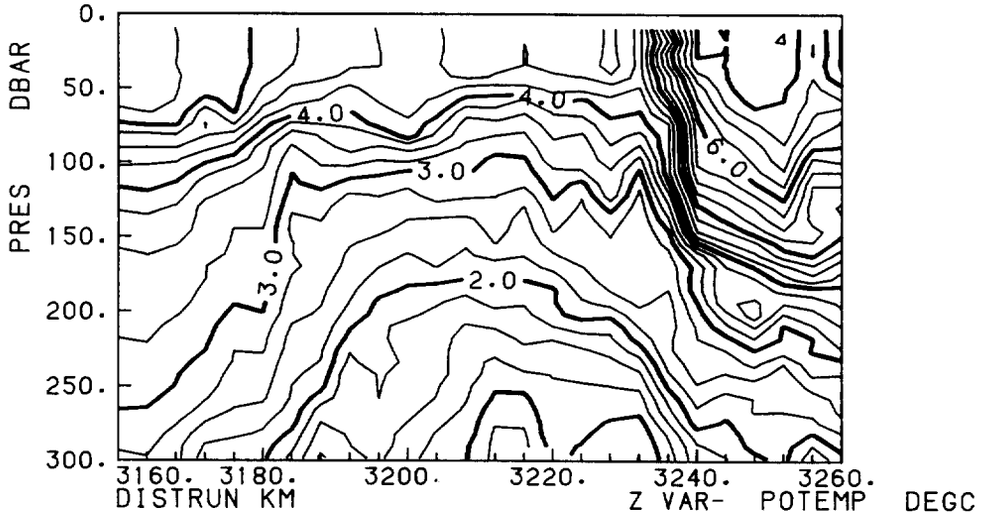
100.
150.
200.
250.
300.
1465.
3100. 3120. 3140. 3160. 3180.
DISTRUN KM
Z VAR- SNDVEL M/S
H
I
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
3100. 3120. 3140. 3160. 3180.
DISTRUN KM
Z VAR- SALIN PPT
H
I
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
3100. 3120. 3140. 3160. 3180.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-6. -5.8 -5.6 -5.4 -5.2 -5.
LONGITUDE
LATITUDE


65 N
60 N
15 W
5 W

GR015006A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50.
100.
150.
200.
250.
300.
4.0
4.0
3.0
6.0
3.0
2.0
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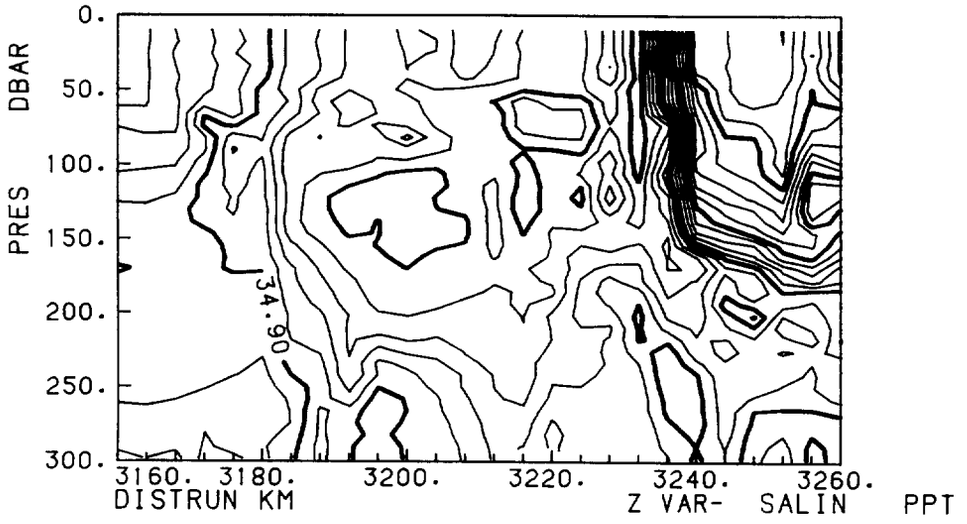
DISTRUN KM
Z VAR- POTEMP DEGC


PRES DBAR
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50.
100.
150.
200.
250.
300.
34.90
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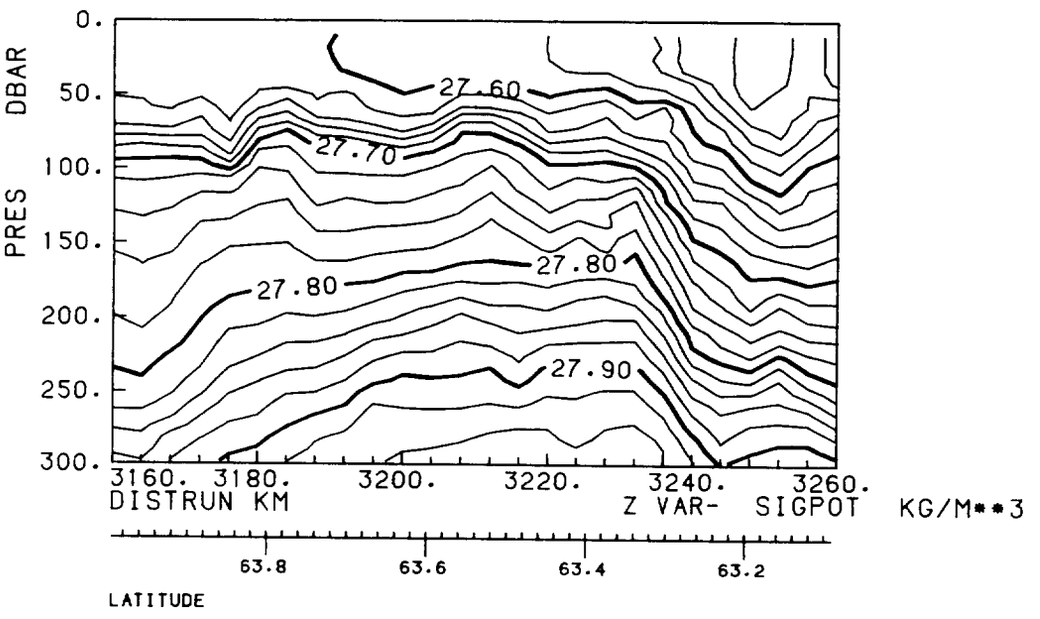
DISTRUN KM
Z VAR- SALIN PPT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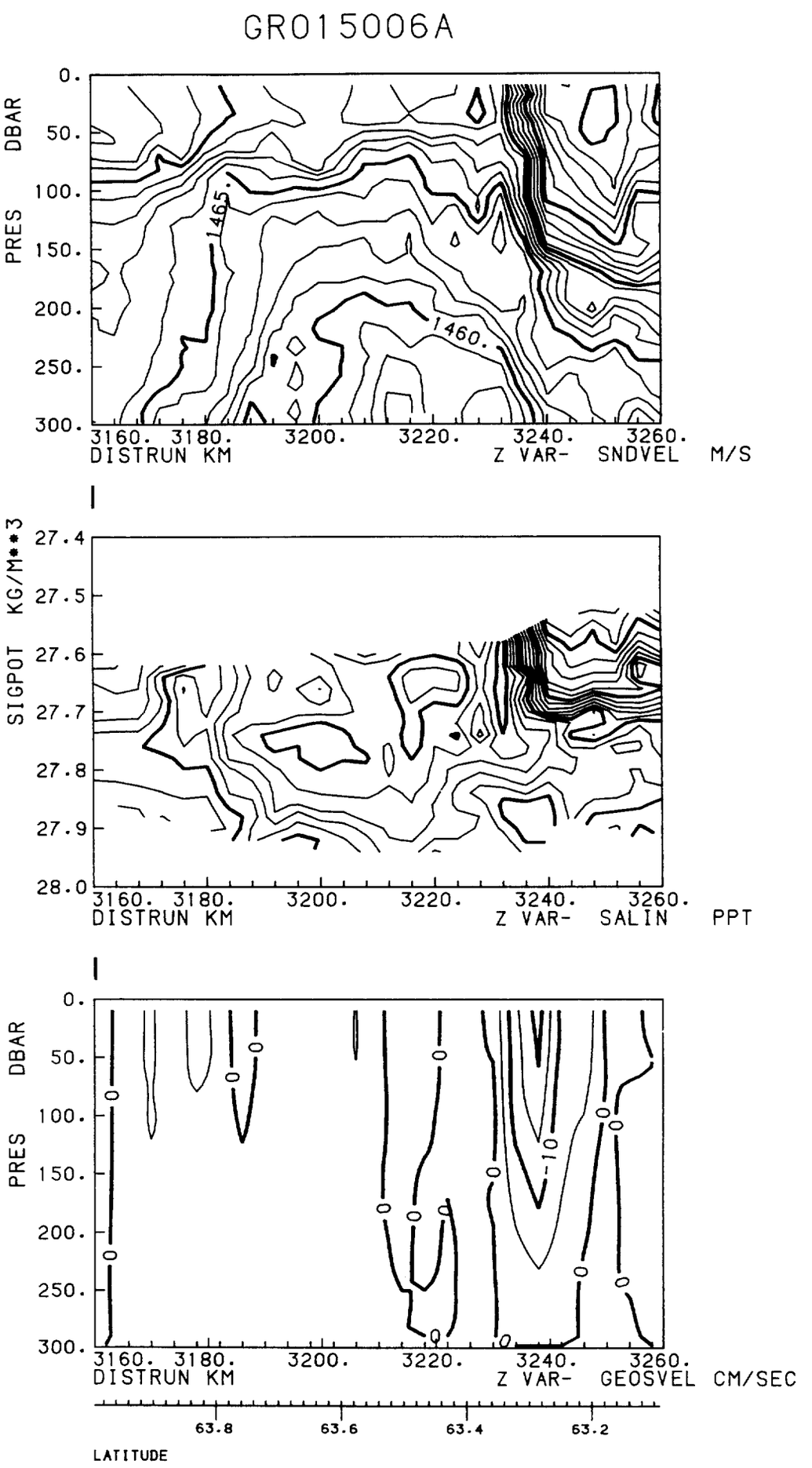
50.
100.
150.
200.
250.
300.
27.60
27.70
27.80
27.80
27.90
3160. 3180. 3200. 3220. 3240. 3260.
DISTRUN KM
Z VAR- SIGPOT KG/M**3
63.8
63.6
63.4
63.2
LATITUDE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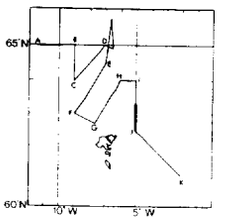
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
1465.
1460.
3160. 3180. 3200. 3220. 3240. 3260.
DISTRUN KM
Z VAR- SNDVEL M/S
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
3160. 3180. 3200. 3220. 3240. 3260.
DISTRUN KM
Z VAR- SALIN PPT
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
0
-10
3160. 3180. 3200. 3220. 3240. 3260.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
63.8
63.6
63.4
63.2
LATITUDE



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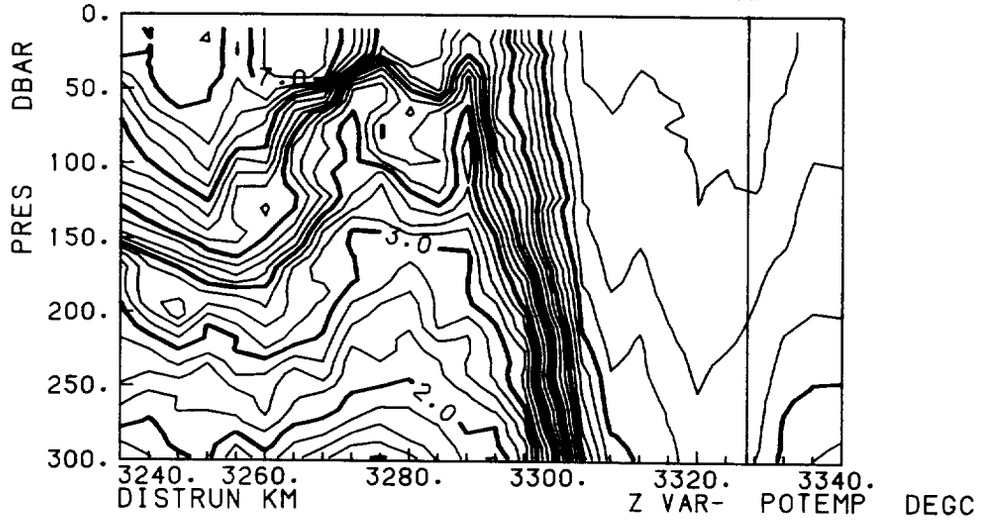

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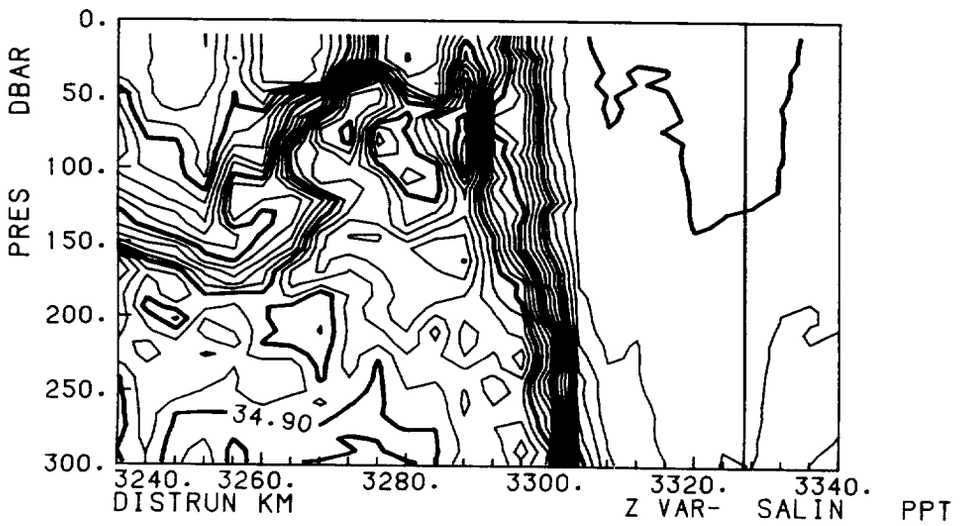

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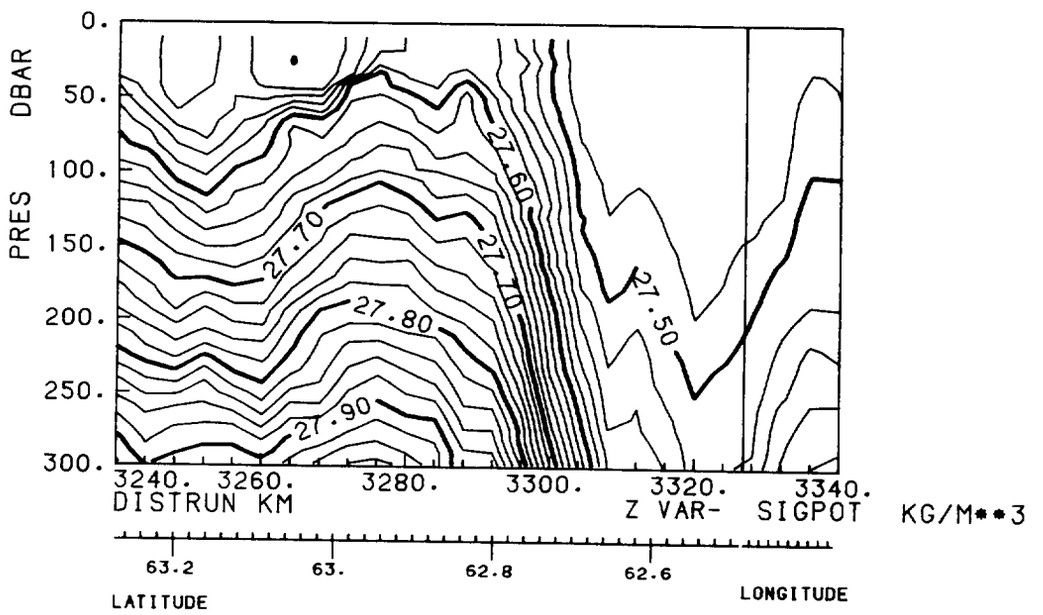

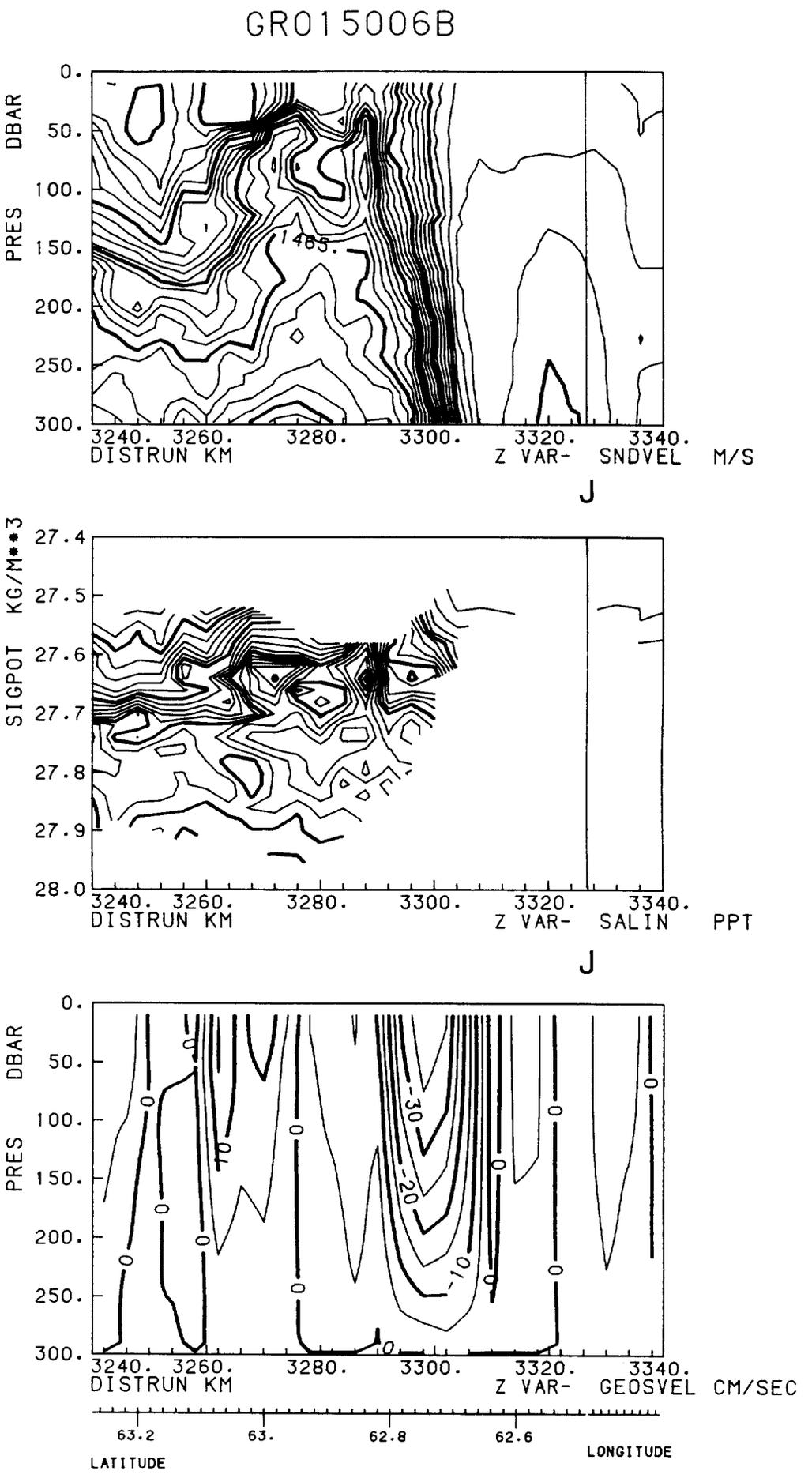
GR015006B
PRES DBAR
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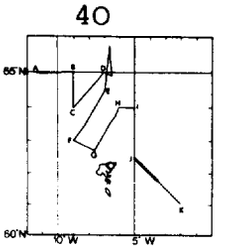
50.
100.
150.
200.
250.
300.
1485.
3240. 3260. 3280. 3300. 3320. 3340.
DISTRUN KM
Z VAR- SNDVEL M/S
J
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
3240. 3260. 3280. 3300. 3320. 3340.
DISTRUN KM
Z VAR- SALIN PPT
J
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
0
10
-10
-20
-30
3240. 3260. 3280. 3300. 3320. 3340.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
63.2 63. 62.8 62.6
LATITUDE
LONGITUDE



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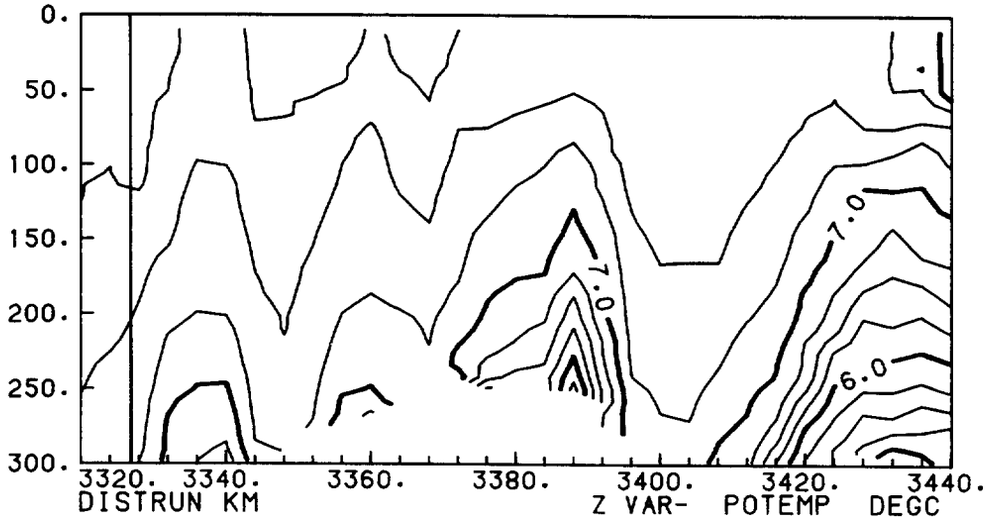
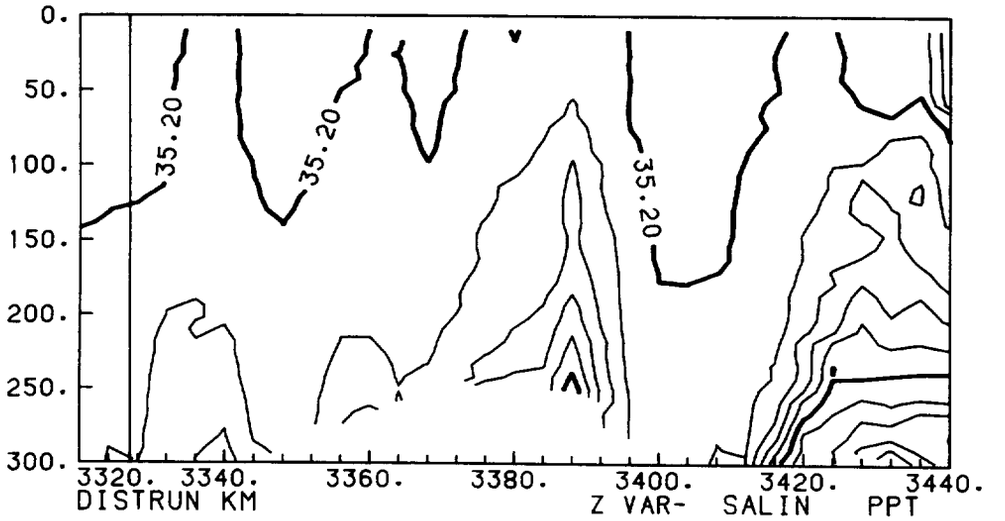
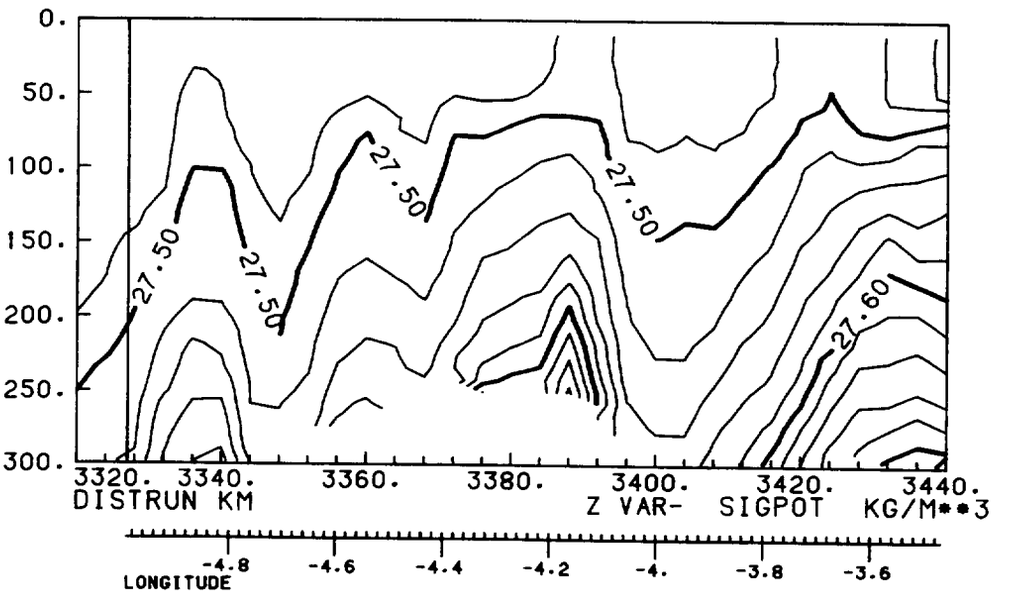


J



J



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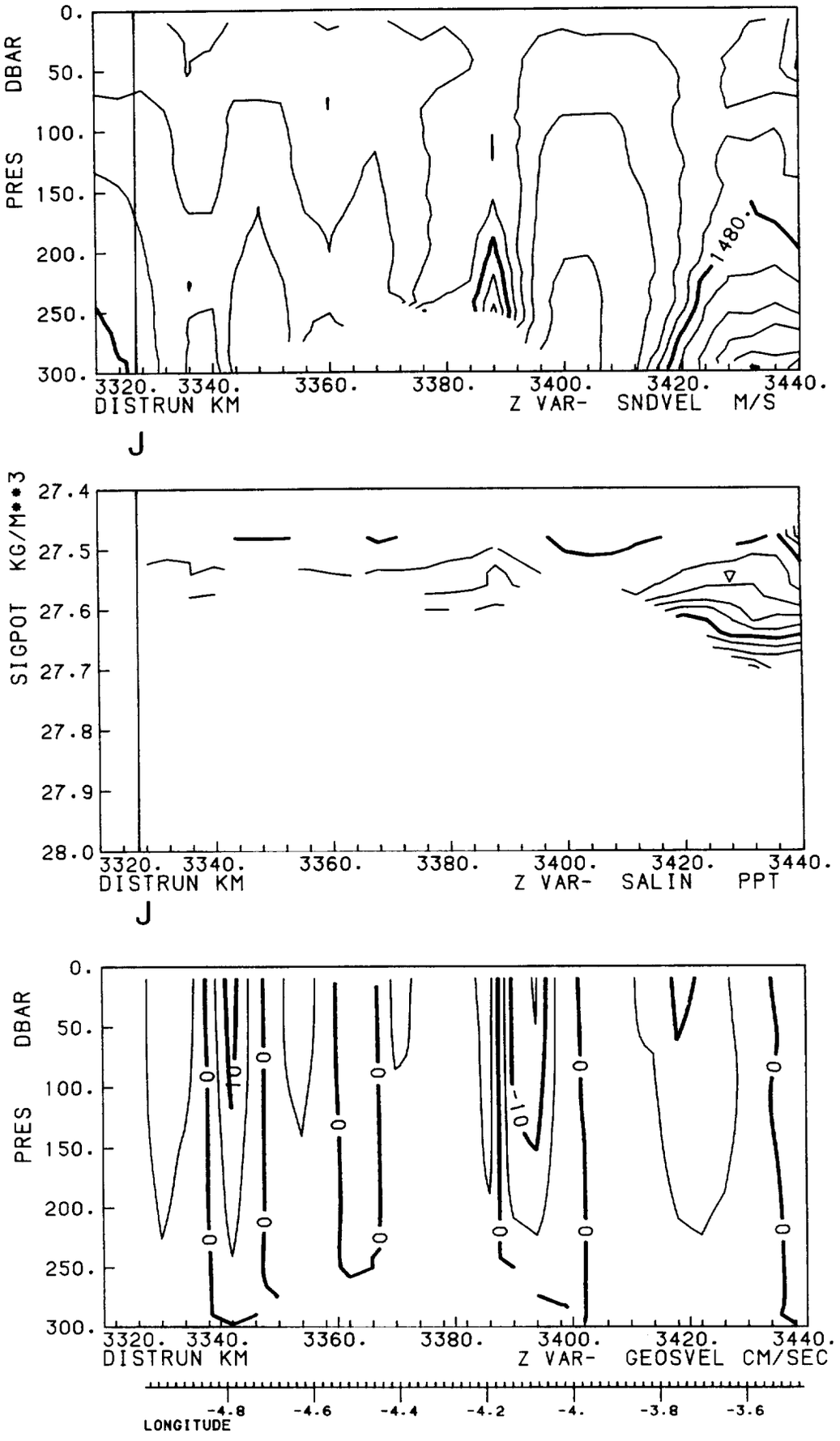
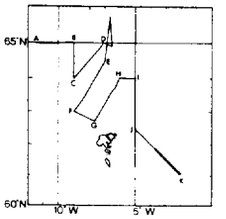

PRES DBAR
0.
50.
100.
150.
200.
250.
300.
1480.
3320. 3340. 3360. 3380. 3400. 3420. 3440.
DISTRUN KM
Z VAR- SNDVEL M/S
J
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
3320. 3340. 3360. 3380. 3400. 3420. 3440.
DISTRUN KM
Z VAR- SALIN PPT
J
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
10
0
-10
3320. 3340. 3360. 3380. 3400. 3420. 3440.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-4.8 -4.6 -4.4 -4.2 -4. -3.8 -3.6
LONGITUDE



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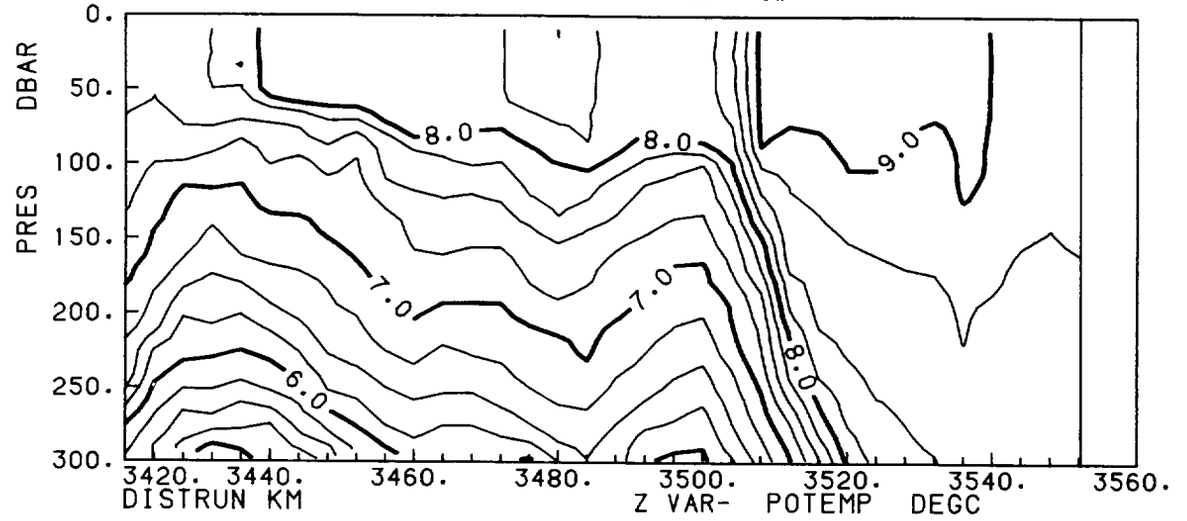
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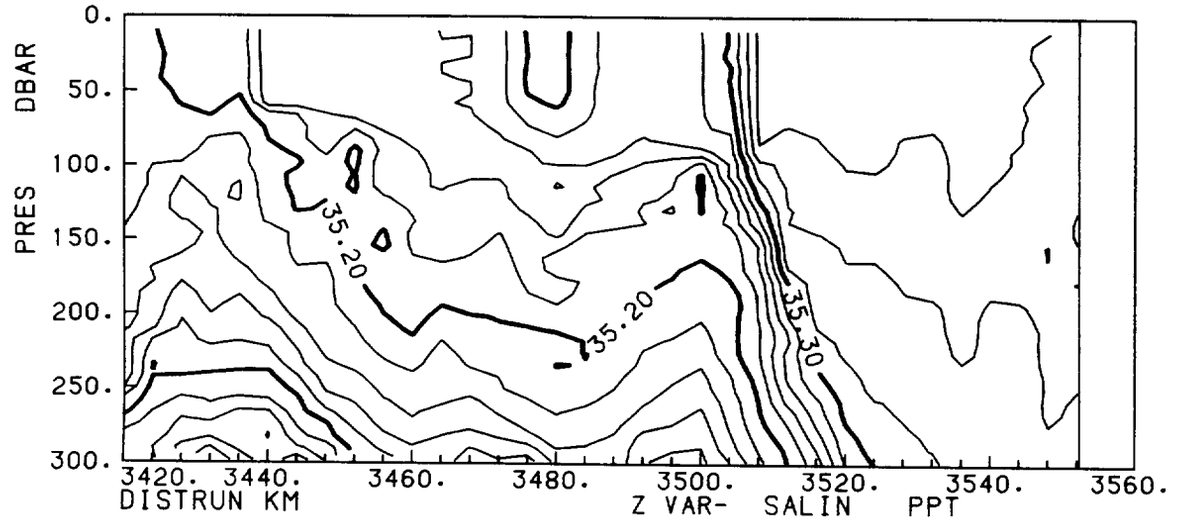
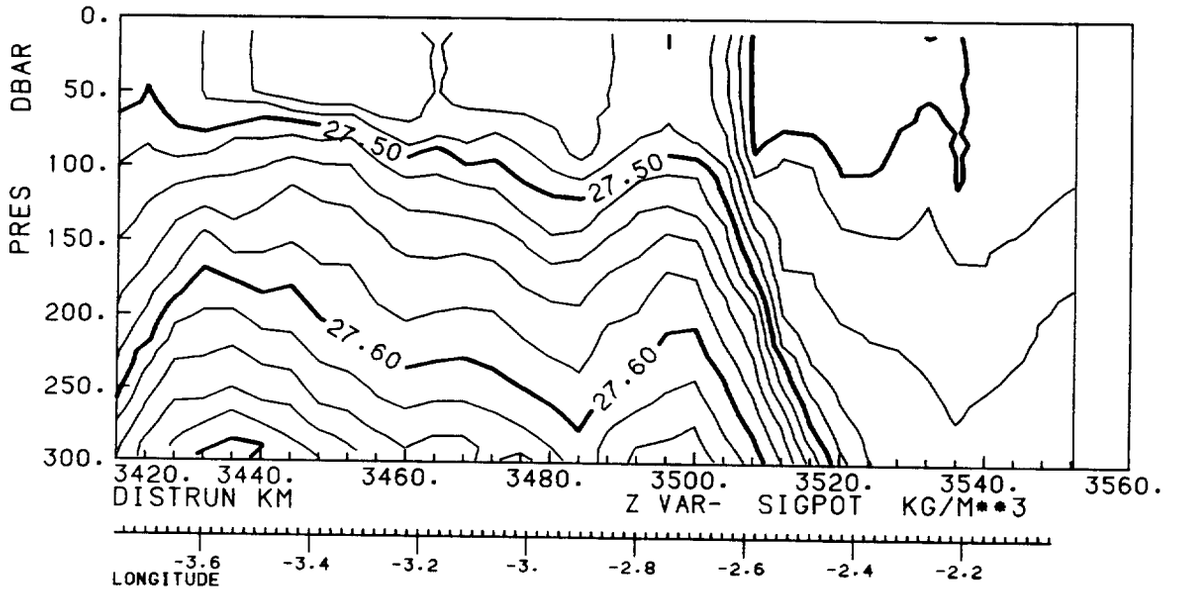
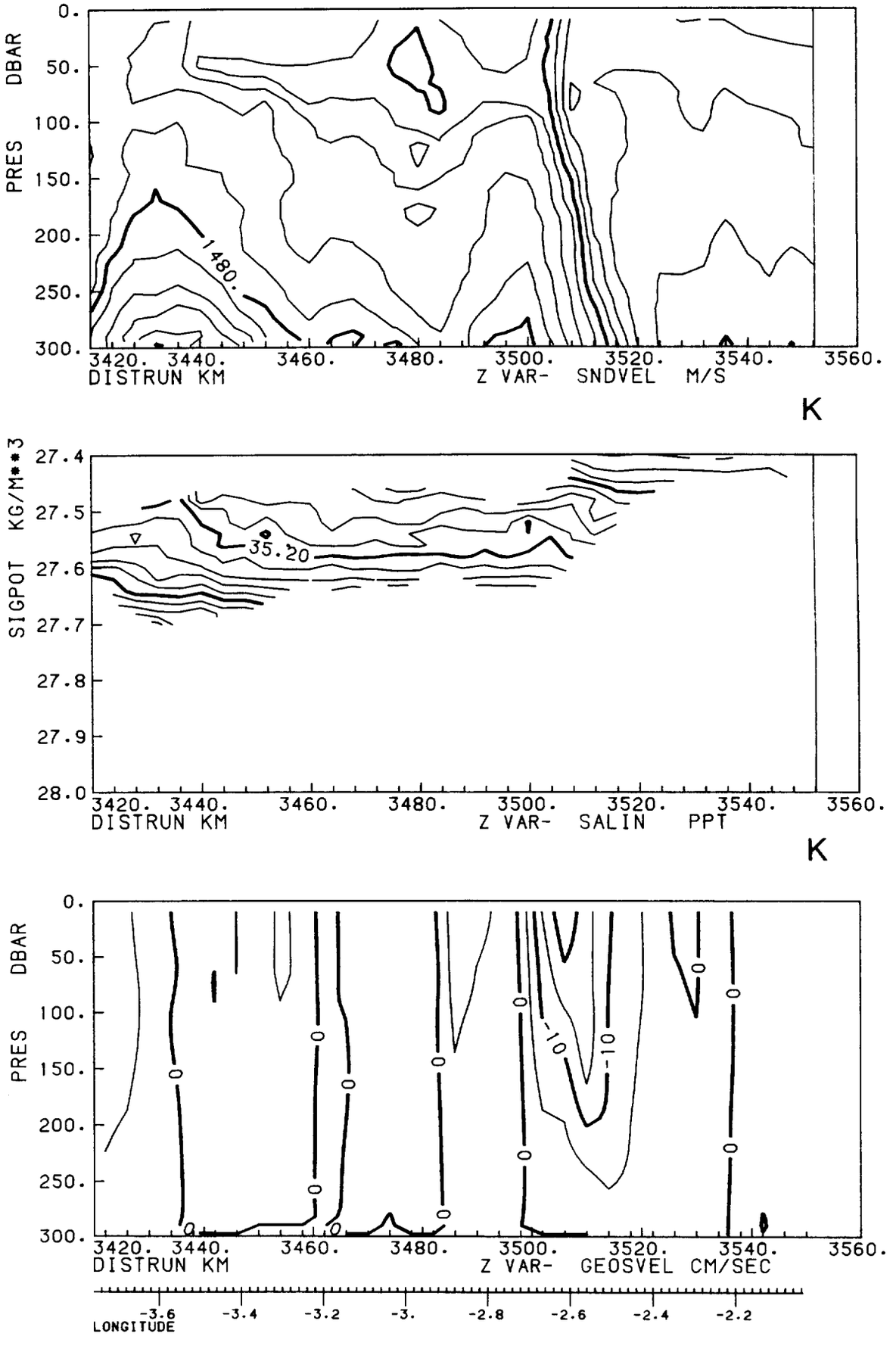
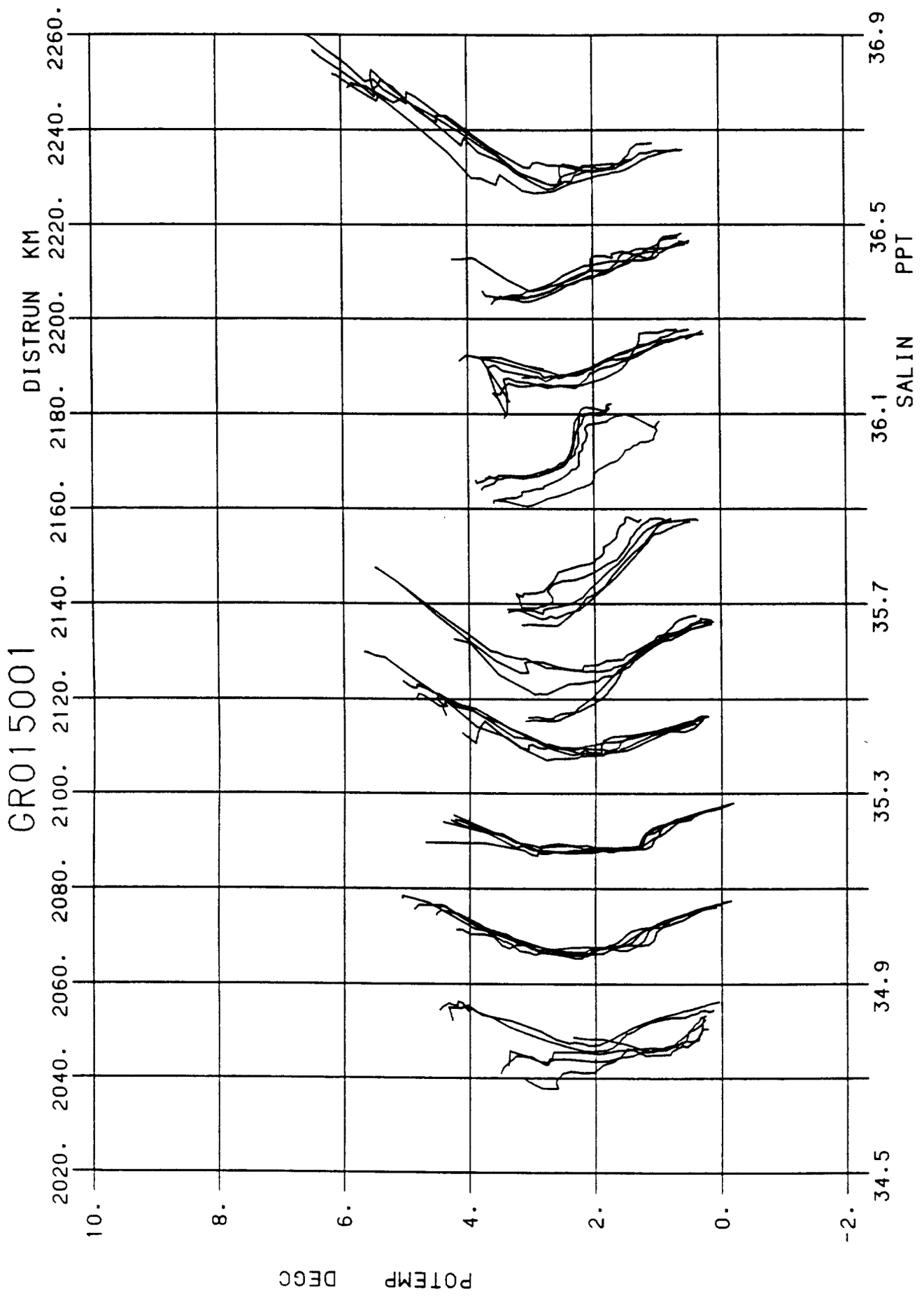
0.
50.
100.
150.
200.
250.
300.
8.0
8.0
9.0
7.0
7.0
8.0
6.0
3420. 3440. 3460. 3480. 3500. 3520. 3540. 3560.
DISTRUN KM
Z VAR- POTEMP DEGC
K

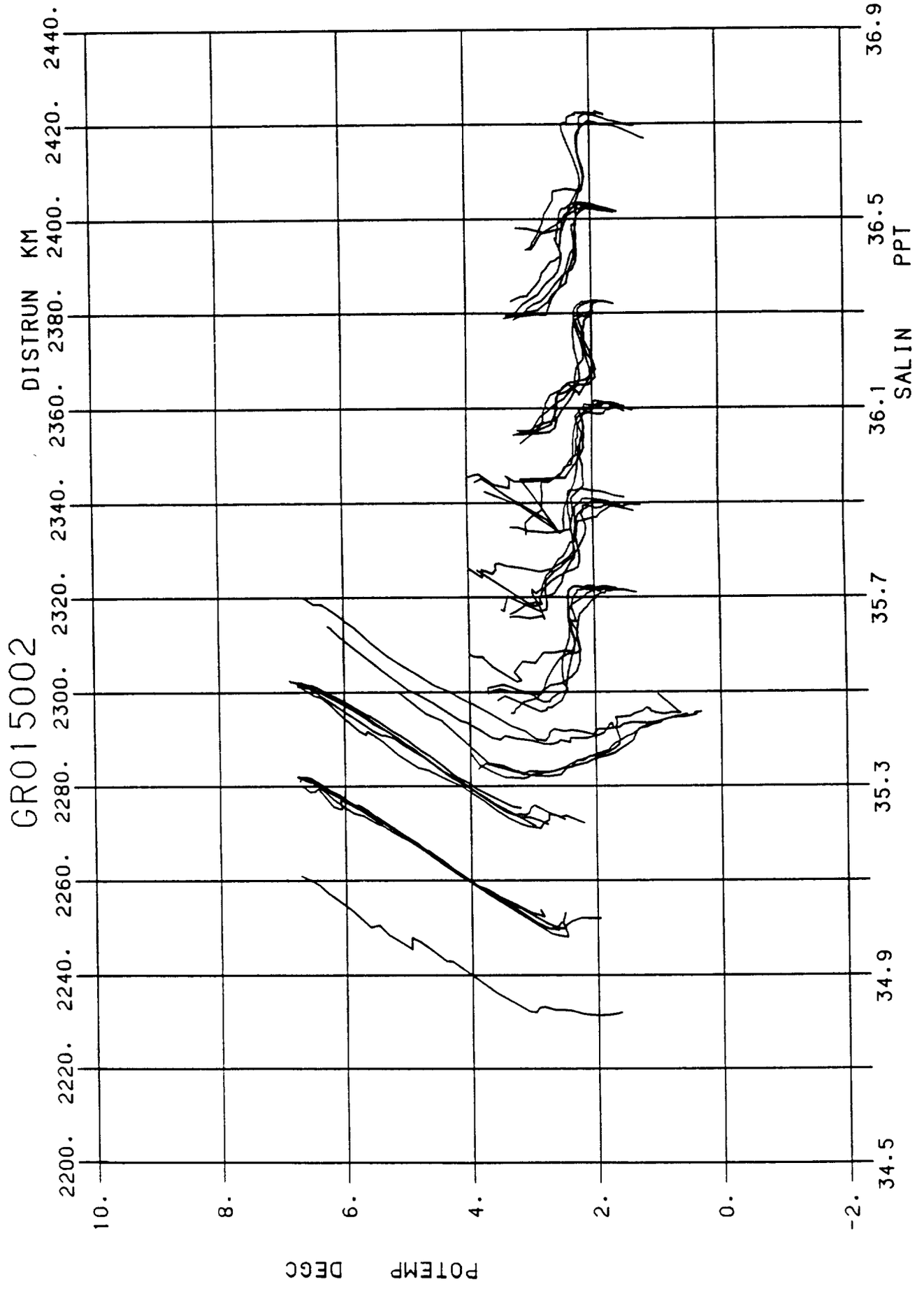

PRES DBAR
0.
50.
100.
150.
200.
250.
300.
35.20
35.20
35.30
3420. 3440. 3460. 3480. 3500. 3520. 3540. 3560.
DISTRUN KM
Z VAR- SALIN PPT
K

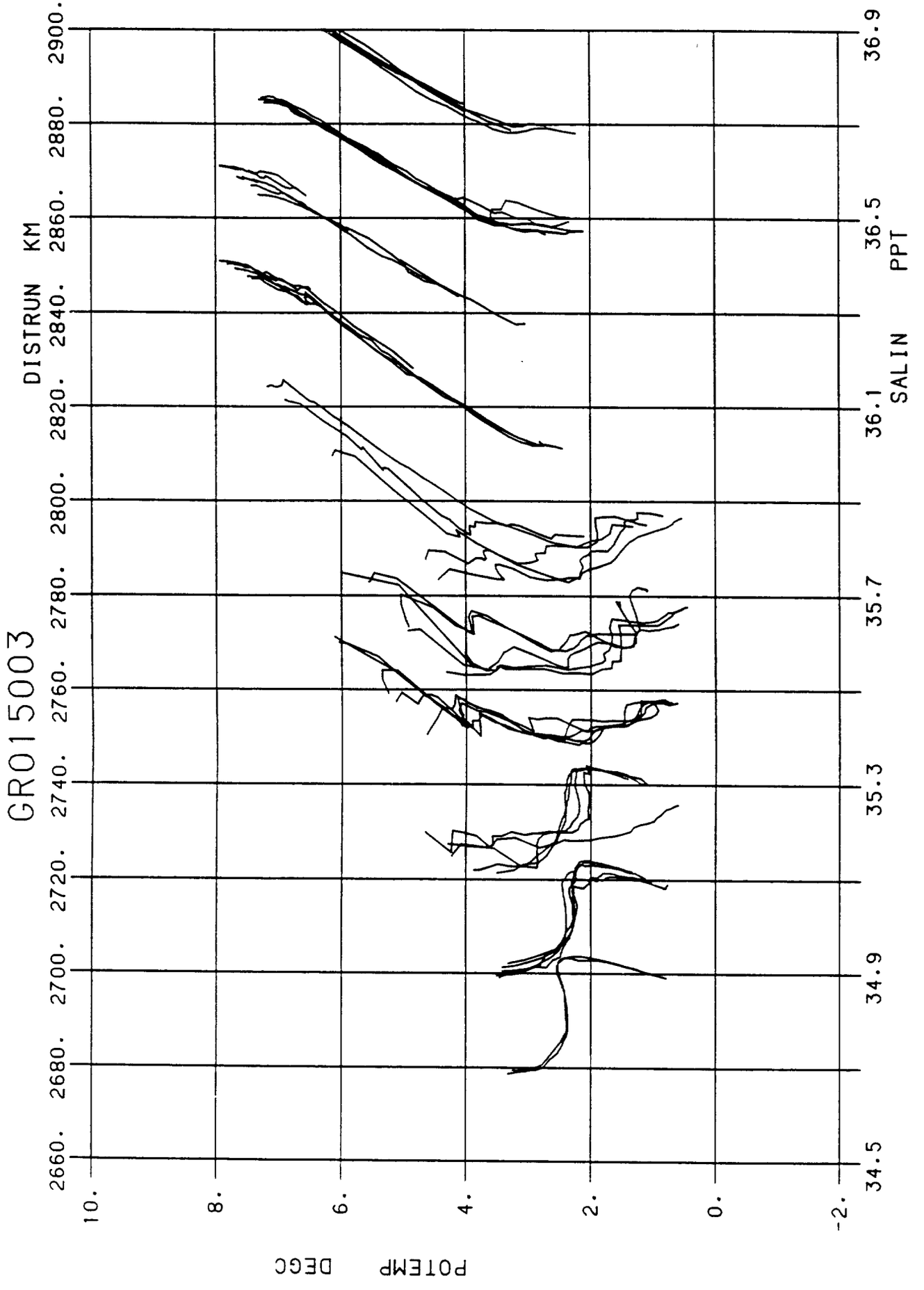

PRES DBAR
0.
50.
100.
150.
200.
250.
300.
27.50
27.50
27.60
27.60
3420. 3440. 3460. 3480. 3500. 3520. 3540. 3560.
DISTRUN KM
Z VAR- SIGPOT KG/M**3
-3.6 -3.4 -3.2 -3. -2.8 -2.6 -2.4 -2.2
LONGITUDE

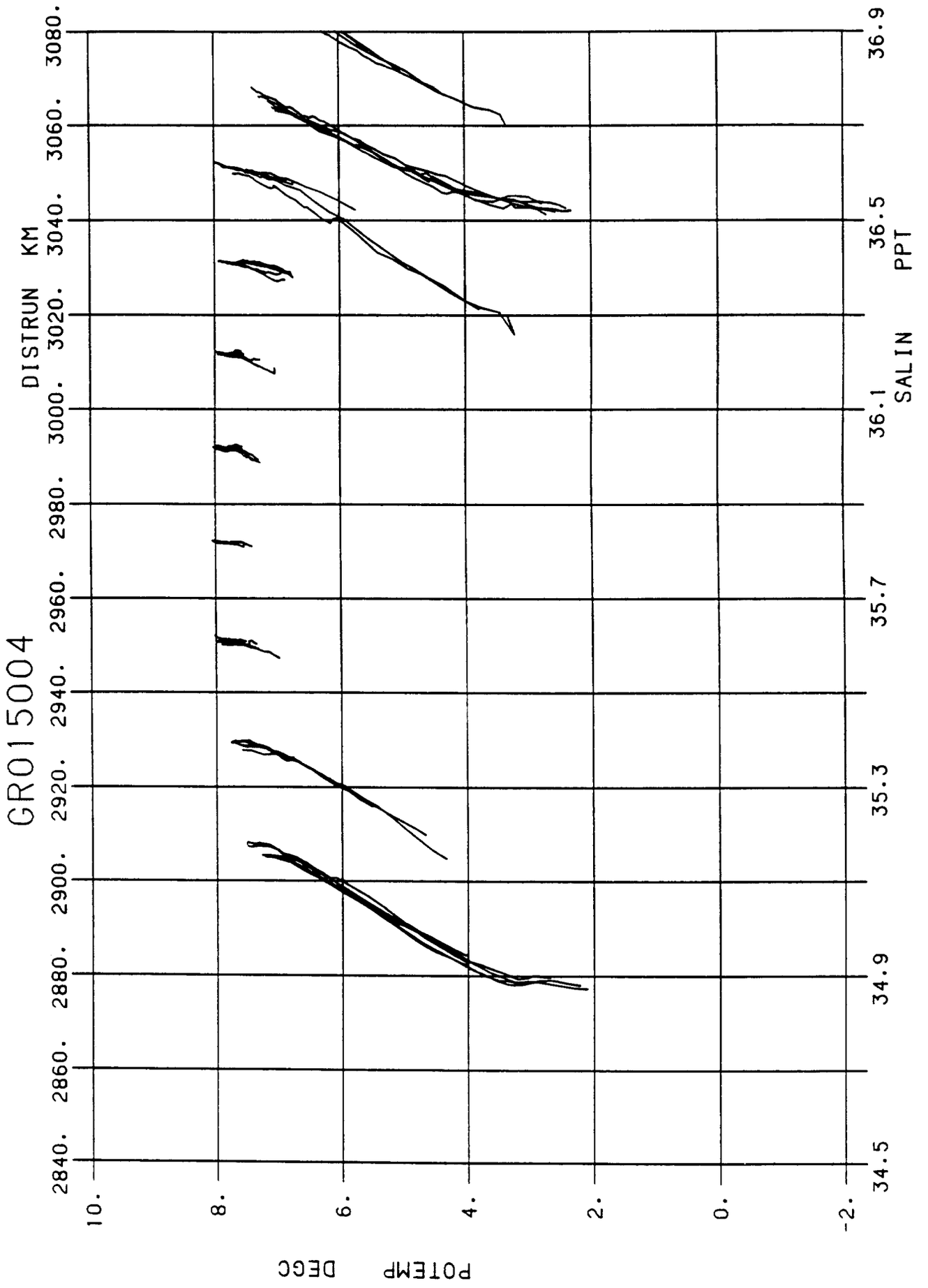
GR015007B

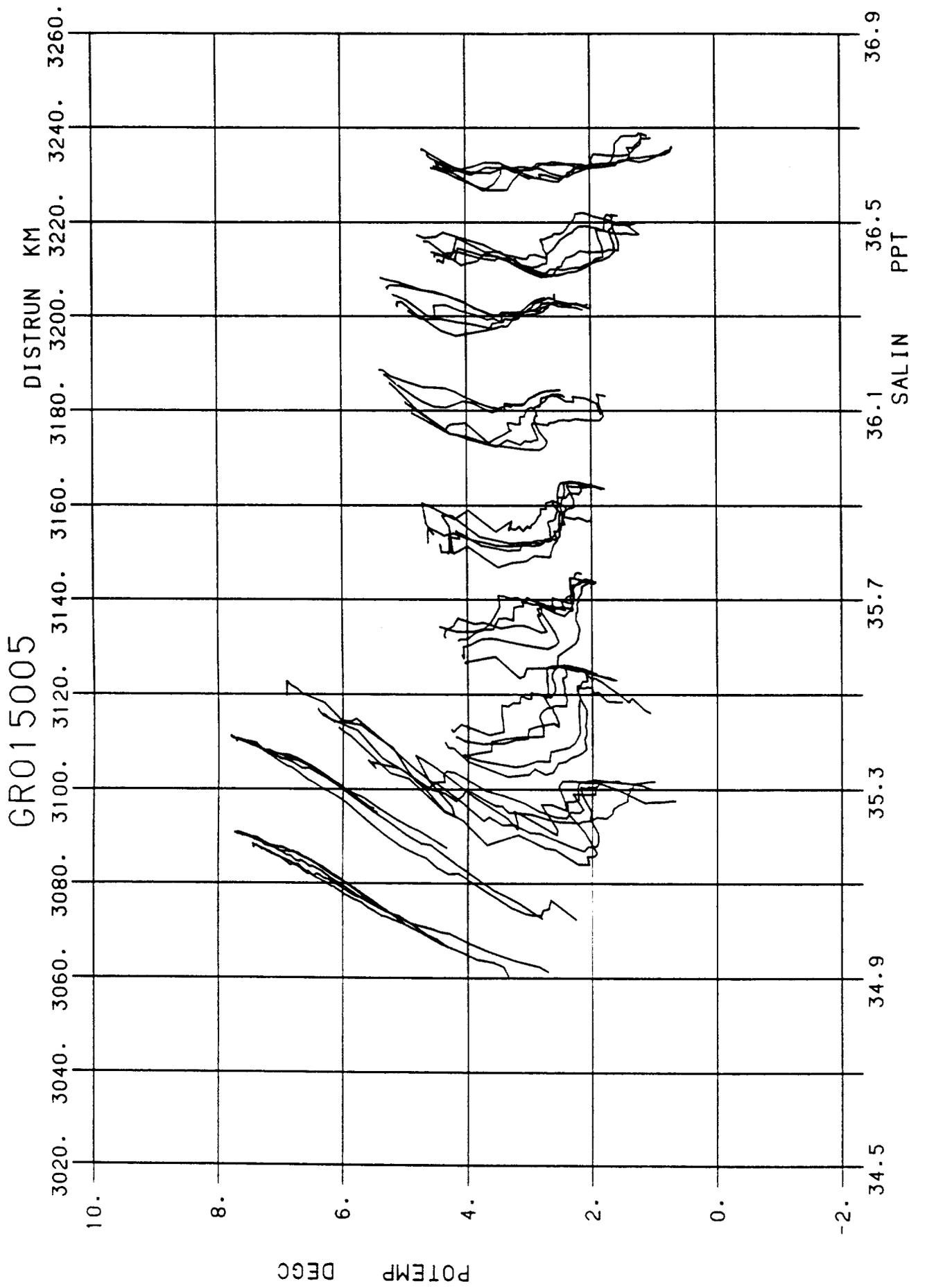

PRES DBAR
0.
50.
100.
150.
200.
250.
300.
1480.
3420. 3440. 3460. 3480. 3500. 3520. 3540. 3560.
DISTRUN KM
Z VAR- SNDVEL M/S
K
SIGPOT KG/M**3
27.4
27.5
27.6
27.7
27.8
27.9
28.0
35.20
3420. 3440. 3460. 3480. 3500. 3520. 3540. 3560.
DISTRUN KM
Z VAR- SALIN PPT
K
PRES DBAR
0.
50.
100.
150.
200.
250.
300.
0
-10
3420. 3440. 3460. 3480. 3500. 3520. 3540. 3560.
DISTRUN KM
Z VAR- GEOSVEL CM/SEC
-3.6 -3.4 -3.2 -3. -2.8 -2.6 -2.4 -2.2
LONGITUDE

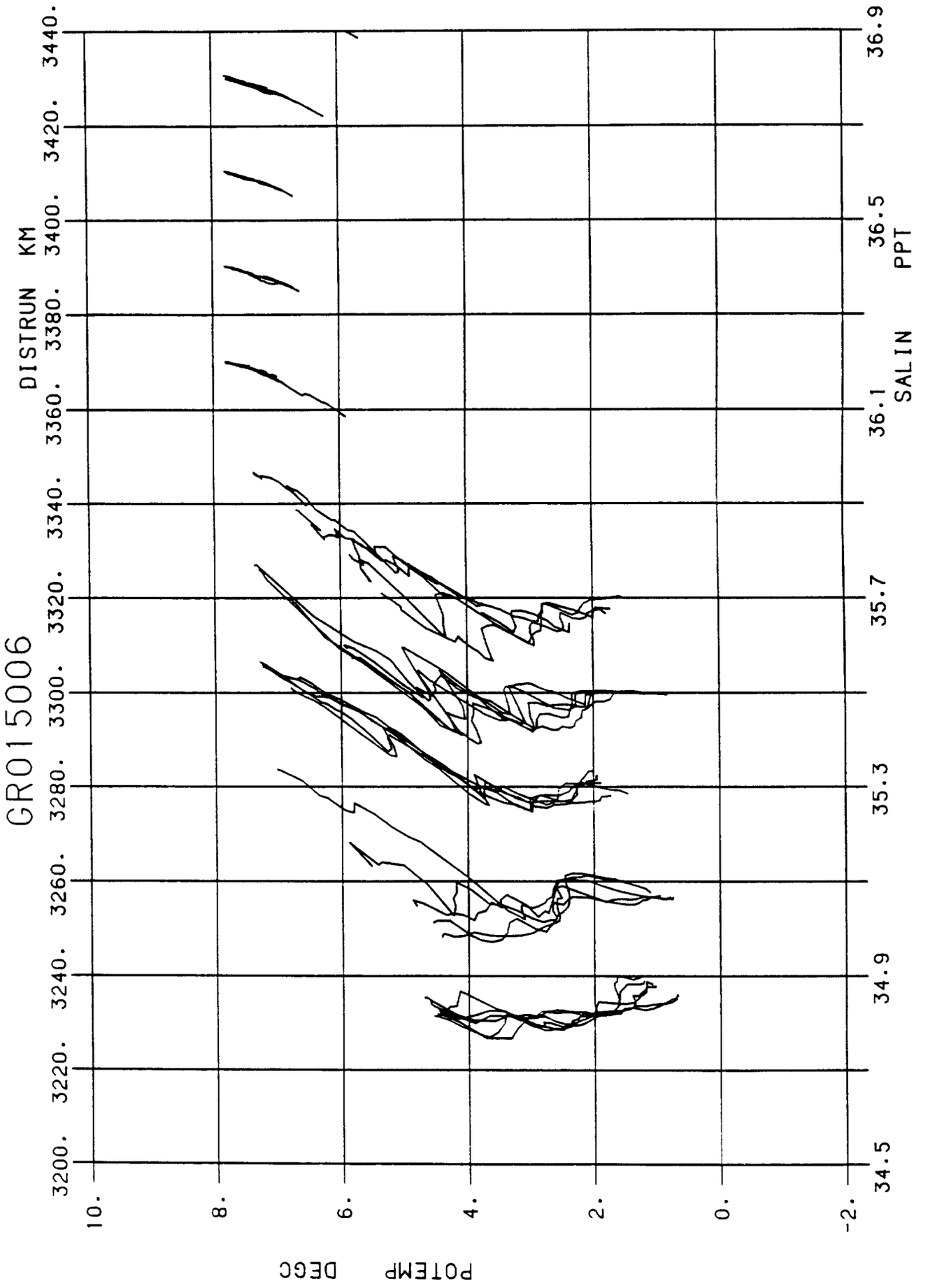

GR015001
DISTRUN KM
2020. 2040. 2060. 2080. 2100. 2120. 2140. 2160. 2180. 2200. 2220. 2240. 2260.
SALIN PPT
34.5 34.9 35.3 35.7 36.1 36.5 36.9
POTEMP DEGC
10. 8. 6. 4. 2. 0. -2.

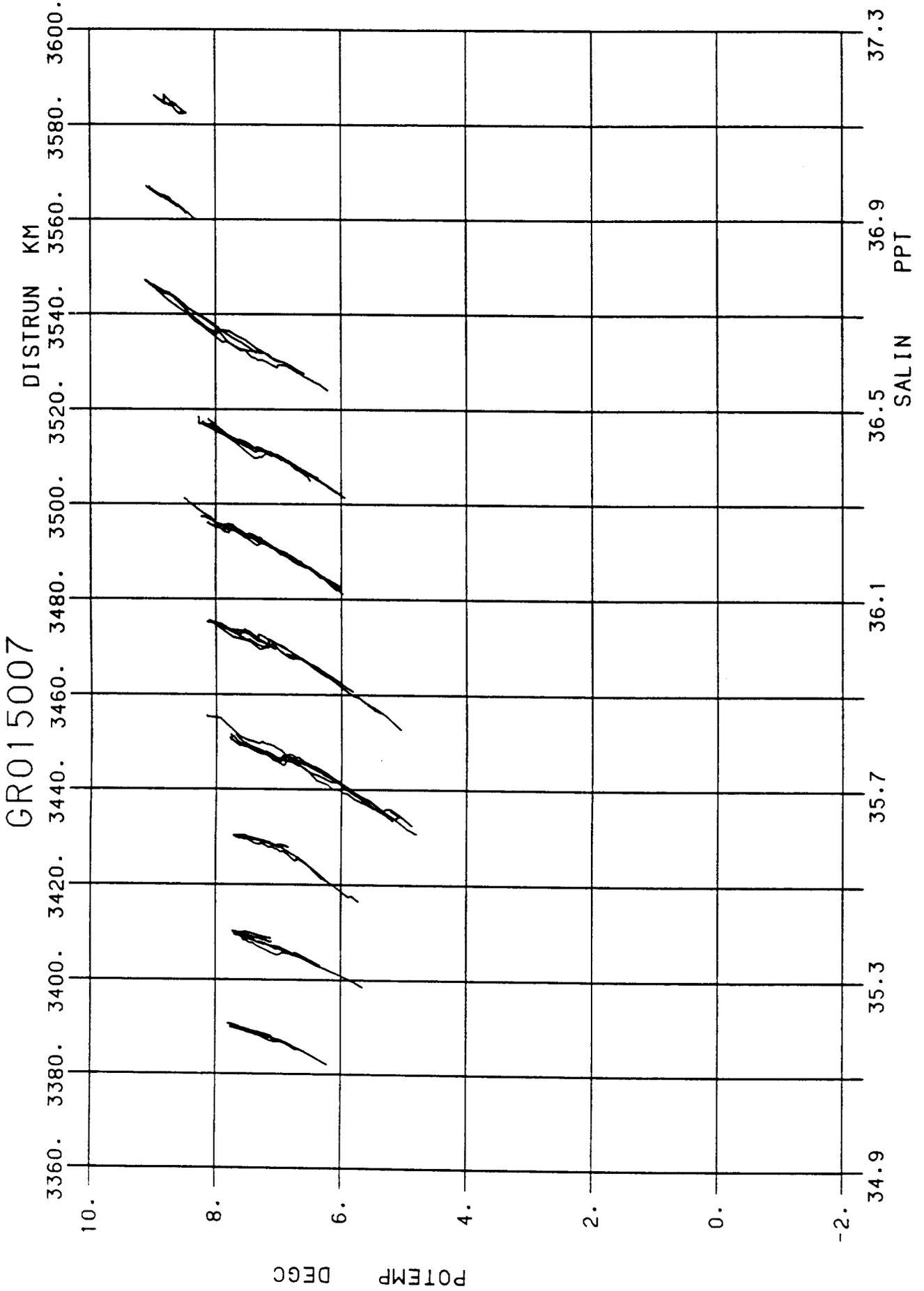

GR015002
DISTRUN KM
2200. 2220. 2240. 2260. 2280. 2300. 2320. 2340. 2360. 2380. 2400. 2420. 2440.
SALIN PPT
34.5 34.9 35.3 35.7 36.1 36.5 36.9
POTEMP DEGC
10. 8. 6. 4. 2. 0. -2.


GR015003
DISTRUN KM
2660. 2680. 2700. 2720. 2740. 2760. 2780. 2800. 2820. 2840. 2860. 2880. 2900.
SALIN PPT
34.5 34.9 35.3 35.7 36.1 36.5 36.9
POTEMP DEGC
10. 8. 6. 4. 2. 0. -2.


GR015004
DISTRUN KM
2840. 2860. 2880. 2900. 2920. 2940. 2960. 2980. 3000. 3020. 3040. 3060. 3080.
SALIN PPT
34.5 34.9 35.3 35.7 36.1 36.5 36.9
POTEMP DEGC
10. 8. 6. 4. 2. 0. -2.


GR015005
DISTRUN KM
3020. 3040. 3060. 3080. 3100. 3120. 3140. 3160. 3180. 3200. 3220. 3240. 3260.
POTEMP DEGC
10. 8. 6. 4. 2. 0. -2.
SALIN PPT
34.5 34.9 35.3 35.7 36.1 36.5 36.9


GR015006
DISTRUN KM
3200. 3220. 3240. 3260. 3280. 3300. 3320. 3340. 3360. 3380. 3400. 3420. 3440.
SALIN PPT
34.5 34.9 35.3 35.7 36.1 36.5 36.9
POTEMP DEGC
10. 8. 6. 4. 2. 0. -2.


GR015007
DISTRUN KM
3360. 3380. 3400. 3420. 3440. 3460. 3480. 3500. 3520. 3540. 3560. 3580. 3600.
SALIN PPT
34.9 35.3 35.7 36.1 36.5 36.9 37.3
POTEMP DEGC
10. 8. 6. 4. 2. 0. -2.