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Polarstern cruise ANT XIII/2
04 Dec 1995 - 24 Jan 1996
Underway data report comprising navigation, thermosalinograph, bathymetric and meteorological data

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ABSTRACT

During the FS *Polarstern* ANT XIII/2 cruise "underway" data comprising navigation, thermosalinograph, bathymetry and meteorological data were logged to the ship's computer system. This report describes their transfer to the Southampton Oceanography Centre PSTAR computing system and displays some of the results.

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Abstract

During the FS *Polarstern* ANTXIII/2 cruise "underway" data, comprising navigation, thermosalinograph, bathymetry and meteorological data were logged to the ship's computer system. This report describes their transfer to the Southampton Oceanography Centre PSTAR computing system and displays some of the results.

Data logging

Data from the shipboard navigation and scientific instruments were logged to the ship's VAX computer using the PODEV system. From there, data were available to other systems via the POLDAT (POLarstern DATa) interface, which generated user defined listings of variables in ascii format that could be transferred by ftp (file transfer protocol). Networked terminals throughout the ship were available to emulate the POLDAT interface (or display current data).

The first step in acquiring data was to create a configuration file (*.cgn). These files contained a list of the variables required together with the start and stop time of the period of data, the data interval, type and format. The configuration file was then submitted to the VAX computer to generate a batch job in which a log file (*.log) and a data file (*.miw) were created. The log file contained information about the job being run and the data file contained an ascii listing of all the variables at the interval specified, plus time.

Transfer via POLDAT

Configuration files were set up at the beginning of the cruise for the variables needed to process and analyse SeaSoar data and data were transferred approximately every 12 hours. Because jobs were submitted to the VAX batch queue the generation of ascii files was slow, for example, to create a 12 hour file containing 13 variables of navigation data at 1 second intervals took at least half an hour, usually longer and occasionally two or three hours, depending on what other jobs were queued.

Four different configuration files were set up; sococn, soctsg, socmet and socdpth. The nominal contents of each were respectively; position and related navigation variables, thermosalinograph, meteorology and bathymetry data. The variables transferred are listed in Table 1.

Transfer into PSTAR

When data were available in ascii they were transferred by ftp from the VAX to the (SOC) sun system. Conversion to PSTAR format was done using the fortran program poldat (appendix 1). In essence this program opened the ascii file for input and a binary PSTAR file for output, read in the integer format time variables for conversion to real seconds past the first time in the file, and read in the remaining data in free format for writing out in real*5. The two steps, ftp and poldat, were combined into a c-shell process "getPol" (appendix 2).

A few editing steps were necessary to ensure the data could be processed by PSTAR programs. First the absent data variable had to be added to the file (pabswp). The standard value was used, -999.0. Missing data in POLDAT were represented by the highest number available within the specified format of the data (see Table 1), eg. 9999.9 for pdop, or 99.99 for TSB salin. The program pedita, which selectively removes data outside specified ranges was used to convert POLDAT missing data values to PSTAR absent data values.

Data processing

ocn (navigation)

Three different sets of position variables were available on the POLDAT interface; gps, system and filter. It was decided to use the gps positions as these gave the most precise fix. System positions were provided to only two decimal places, thus limiting precision and accuracy. Filter positions had been averaged and appeared to contain more noise that the gps data.

Therefore, the gps positions were transferred to PSTAR. Ship's speed and heading were transferred for the electromagnetic and doppler logs and the ship's gyro compass. Various parameters (pitch, roll, attitude and pdop) were also transferred to provide information about the quality of each position fix. Further fields were available, eg gps mode used, ids of differential and normal gps satellites, number of satellites used and the id of the dgps reference station. But these fields were provided as text strings which are difficult to handle in PSTAR. For this reason only the "gps mode used" parameter was examined in any detail.

Differential gps (DGPS) data were available in real time referenced to the Cape Town station. As this provided the most accurate means of fixing the position of the ship this mode was used in preference when available. When DGPS was unavailable the track record was supplemented by normal gps fixes. As this is subject to selective availability the position calculated was less accurate (by metres). Examination of the gps mode used parameter showed that during the large scale SeaSoar survey (run 6) 89% of position fixes were obtained by DGPS (Fig. 1), however for the fine scale SeaSoar survey (run 8) only 76% of the data were DGPS (Fig. 2). GPS fixes were used for both spot fixes and for whole sections of track.

Selected sections of track record were examined in detail to investigate the quality of the data. For example, during the search for the first mooring (on day 343) the noise in the ship's track was of order 2 to 3 m (Fig. 3). This is within the accuracy of modern navigation methods (claimed accuracy for DGPS is 4 m).

For approximately 18 hours the ship was stationary within the fast sea ice. During this time cargo was unloaded and reloaded and crew and scientists left the ship to walk on the ice. There may have been some movement of the vessel with the ice due to local tides and currents but this should have been minimal and the ship can, for all practical purposes, be considered stationary. Position fixes collected during this period were centred within an approximate 10 m radius but showed extensive scatter in all directions of up to 50 m (Fig. 4). This is typical of the effect of selective availability on normal GPS (accuracy claimed for civilian code GPS is 50 m). Approximately 98% of these data were labelled DGPS but the baseline to the reference station at Cape Town was over 4000 km, well beyond the recommended distance. The corrections calculated and applied at Cape Town seem inappropriate at 70°S.

In PSTAR the 1 second navigation data were averaged to 30 second intervals and distance run along track (in kilometres) calculated (pdist) for use with the SeaSoar and ADCP data processing.

thermosalinograph

Thermosalinograph data were logged at approximately 2 second intervals. For creation of the plots shown here the data were averaged to 5 minute intervals. Salinity was calibrated as described below using the 2 second data.

meterological parameters

Meteorological data were logged at approximately 30 second intervals. Wind speed and direction were recorded following meteorological convention, ie the angle recorded gave the direction the wind was blowing from. For the figures in this report the data were changed (by adding 180° to direction) to oceanographic convention, thus the vectors show the direction the wind was blowing to. Data were averaged to 10 minute intervals.

bathymetry

Echosounder data were recorded approximately every 10 seconds, hydrosweep data were logged every second. Data shown here were averaged over 5 minutes. Echosounder data proved very noisy whereas the hydrosweep depth, recorded from the centre beam of the hydrosweep array, was remarkably clean. The hydrosweep data were therefore used in preference to the echosounder data.

Salinity calibration

Sample collection and analysis

Samples were drawn from the underway pumped seawater supply for analysis for salt content to calibrate the thermosalinograph and SeaSoar salinity data. The intake for the supply was located in the bow-thruster tube, at a depth of approximately 9 m, where the thermosalinograph (B) sensors were also located. During runs 2 and 3 and the first half of run 6, samples were drawn every half hour. Having established that the thermosalinograph was reasonably stable and maintaining the same calibration the sample rate was reduced to once per hour.

Some errors occurred in sampling due to the re-arrangement of the plumbing of the sampling outlet. Some samples (an unknown number) were drawn from a second pumped supply which had an intake depth of 12 m. The effects of this mistake are believed to be minimal as the salinity of the upper ocean in the survey area (transects 6 and 8) was vertically homogeneous down to about 50m and there was little variability in the horizontal distribution. The total range being less than 0.100 units vertically and less than 0.200 units horizontally.

Samples were analysed using a brand new Guildline 8400B autosal salinometer (S/N 59852) provided by AWI. Considerable problems were experienced at the beginning of the cruise with air bubbles in the intake tube, the cells would not fill and after about three or four crates (of 40 bottles) biological growth in the conductivity cell. The latter was resolved fairly quickly by soaking the cell in 5% Decon-90 solution overnight. Decon-90 is a wetting agent as well as a cleaning agent and helped reduce the number of bubbles in the tubing. After each crate of thermosalinograph samples the cell was left to soak in Decon-90 solution. The problem of the cell not filling was solved by cleaning the fine bore manifold tubes. As the cruise progressed the problems diminished and it was assumed that the tubing needed some use to improve its hygroscopy. All these problems were mechanical and throughout, the conductivity cell provided stable readings.

Some data were logged directly from the salinometer using the PC based SIS software "ATS". This provided salinity directly. Most data were logged manually as conductivity ratios and transferred to excel spreadsheets for conversion to salinity and transfer to the pstar data processing system. It was felt that the excel method provided better control over the corrections applied for the standardisation of the salinometer

Thermosalinograph calibration

In pstar the sample salinity values were merged with thermosalinograph B data (transferred from POLDAT - see preceding section). SeaSoar runs 2 and 3 combined provided the greatest range of salinity measured during the cruise. From these data a linear relationship was established between the thermosalinograph (tsg) salinity and sample salinity values to provide a correction to the thermosalinograph data (Fig. 5):

$$S_{corr} = 0.53473 + 0.98179 * S_{tsg} \qquad (r^2 = 0.99867)$$

Run 6 covered a much smaller range of salinity and although there was a slight change in the polynomial coefficients, no change was made to the correction applied. For run 6 the mean differences between sample and calibrated thermosalinograph values was 0.0008 ± 0.0038 (for 183 samples, two samples were discarded as being suspect and considerably outside this range).

The difference between calibrated thermosalinograph and salinity bottle values during SeaSoar run 8 showed an offset (Fig. 6), with a mean of 0.0091 ± 0.0040 (for 92 values). It was decided not to change the thermosalinograph calibration but to add on the extra 0.009.

Evidently an offset or drift of order 0.01 occurred between the end of run 6 and the beginning of run 8. Quantisation of the data obtained through poldat (thermosalinograph data were truncated to two decimal places) made it impossible to identify exactly when this occurred, and only limited calibration information was available between SeaSoar runs.

SeaSoar calibration

The object of calibrating the thermosalinograph salinity data was to provide a check on the SeaSoar salinity during SeaSoar deployments. The two SeaSoar conductivity cells were subject to constant fouling causing offsets and drifts in the data. By careful inspection the data were corrected relative to themselves, while CTD stations at beginning and end of each run provided a check on the calibration with depth.

SeaSoar data between 5 and 15 m were extracted from the 1 second, edited files. These data were merged with thermosalinograph data and the difference between thermosalingraph and SeaSoar salinity calculated. The range of the difference for each profile provided a measure of the vertical distribution of salinity and acted as a check on the potential error in the procedure. In the main survey area and south of the Subtropical Convergence the range (in the difference between salinities) was generally less than 0.020. This somewhat crude method was sufficient to show offsets and drifts in the SeaSoar data to better than 0.010. The SeaSoar data were then corrected according to the thermosalinograph salinity, whole profiles being offset. Such corrections were usually associated with fouling events that had not been quite perfectly corrected. Final checks were made by merging the salinity sample values with SeaSoar data between 8.5 and 9.5 m. The difference between sample and SeaSoar and sample and thermosalinograph differences was small, less than 0.005 and the overall calibration is believed to be better than 0.01, except in the vicinity of the Agulhas Current and Subtropical Convergence at the northern end of run 2. Here, the sharp gradients in both horizontal and vertical salinity gradients made it difficult to match samples with underway data, and the calibration is estimated to be no better than 0.05 (Figs. 7 - 10).

On SeaSoar run 8 the final corrections were slightly less rigorous than on the preceding runs. An offset occurred in the thermosalinograph salinity between runs 6 and 8 and an additional 0.009 had to be added to the data to bring it in line with the sample values. However, there was still evidence of small scale drift on the first half of the run. For this reason, SeaSoar data were compared to both sample and thermosalinograph values and no correction was applied unless indicated by the sample data. However, the sample data were more sparse than the thermosalinograph data so the latter were used to identify the correction.

Results

The data are presented here in a variety of forms.

Maps are presented for the entire cruise (Fig. 11), and SeaSoar transects 2 and 3 (Fig. 12), 6 (Fig. 13) and 8 (Fig. 14)

Thermosalinograph data are presented in map form for the two SeaSoar surveys, runs 6 and 8. Data were interpolated onto an even grid using uniras linear interpolation (pgridh, option 1). (Figs. 15-16).

Sections of depth from the hydrosweep centre beam are plotted for the transects south from Cape Town to Neumayer (SeaSoar runs 2 and 3) (Fig. 17) and from Neumayer to the Polar Front and back (Fig. 18). Data from SeaSoar run 6 are plotted as a series of offset sections from west to east. The first section shows the Shona Ridge at the north end while the last (most easterly) section shows the Shaka Ridge at the southern end (Fig. 19).

Vector maps of the wind speed and direction are given for the transect south from Cape Town to Neumayer, encompassing sections 1-4 (Fig. 20), for the SeaSoar coarse scale survey (run 6) (Fig.21), the first half of the CTD survey (run 7) (Fig. 22), the fine scale SeaSoar survey (run 8) (Fig. 23) and the second half of the CTD survey (run 9) (Fig. 24).

Meteorological parameters, air temperature and pressure, relative humidity, wind speed and direction, are shown in weekly plots together with the ship's speed and direction as measured by the electromagnetic log and gyro compass (Fig. 25-31). From top to bottom on each plot, the curves are relative humidity (light, jagged curve), air pressure (smooth), air temperature; wind speed, wind direction (light); ship speed (m/s) and heading. CTD station numbers are marked by arrows on the ship speed plot (zero speed). SeaSoar runs are marked on the ship heading plot (sections of constant direction).

Acknowledgements

All the data reported here were logged and processed by the ship's technical complement without whom we could not have obtained the data. We would like to thank Helmer Pabst and Udo Lembke for their help and hard work. Our participation was partially supported by the MOD under Joint Grant funding for FAME (Quantifying the structure of Fronts And Mesoscale Eddies).

Appendix 1: poldat

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
       PROGRAM POLDAT
C
C  Program to read in POLDAT CGN file, and extract variable names, positions
and
C  format.
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
      IMPLICIT REAL*8 (A-H,O-Z,a-h,o-z)
C
C  Include PSTAR parameters
C
#include "psio.h"
#include "datadf.h"
C
C  Data declarations.
C
C  Program name
       CHARACTER*8   PROG
C
C  Filename
       CHARACTER*80 FILENAME
       CHARACTER*8   FLDNAM(IFLDXX)
C
       INTEGER       INDISK
       REAL*8        BUF(IRECXX)
       INTEGER       PLEN
       LOGICAL       READ_ERROR
C
C Set header variables to blanks
C
      DATA INSTMT/'            '/
      DATA PLATYP/'        '/,PLTNUM/'          '/,PLTNAM/'              '/
      DATA FLDNAM/IFLDXX*'        '/,FLDUNT/IFLDXX*'        '/
      COMMON /IOFILS/FLNAMS
      NUMWRD=IRECXX
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C  DATA statements
C
      DATA PROG/'POLDAT01'/
      DATA INDISK/20/
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C  Initialise PSTAR parameters
C
      CALL PROGHD(PROG)
C
C  Request section name and station number from user.
C
 1000 WRITE(IOITT,*)' Enter filename suffix: '
      READ(INITT,'(A80)')FILENAME
```

```
      IF(fileName.EQ.'none')STOP 'No input file'
C
C  Open file.  Opens as sequential formatted file.
C  If there is a problem opening file, abort.
C
      ILEN=plen(FILENAME,80)
      WRITE(FILENAME(ILEN+1:ILEN+4),'(A4)')".cgn"
      CALL READCGN(INDISK,FILENAME,FLDNAM,FLDUNT,NVARS,
     &             IFDAY,IFSEC,IERR)
      IF(IERR.EQ.2)STOP 'No data'
      IF(IERR.EQ.1)STOP 'Problem with input file'
C
C Open input data file.
C
      WRITE(FILENAME(ILEN+1:ILEN+4),'(A4)')".miw"
      OPEN(UNIT=INDISK,
     &     FILE=FILENAME,
     &     ACCESS='SEQUENTIAL',
     &     FORM='FORMATTED',
     &     STATUS='OLD',
     &     IOSTAT=IERR,
     &     ERR=9000)
C
C Open pstar output file.
C
      CALL OPENOT(IODISK)
      IF(IODISK.EQ.-999) STOP 'No output file'
C
C Loop to read all data until end of file.
C
      NLEN=IRECXX/NVARS
      NOFLDS=NVARS-5
      NREAD=1000000
      NORECS=0
C
C Read first line of input data which are absent data values.
C Note: time variable is special; it's absent data value is
C       to -999 .  Variables 1 to 6 are ignored, since these
C       are reformatted to time later.
C
      READ(INDISK,*,END=5200) (BUF(I),I=1,NVARS)
      DO 4000 I=7,NVARS
          ABSENT(I-6)=REAL(BUF(I))
 4000 CONTINUE
      ABSENT(1)=-999.
C
      K0=1
      DO 5000 K=1,NREAD,NLEN
        IEND=0
        NL=MIN(NLEN,NREAD-K+1)
C
C Read line of data; NOFLDS is the number of variables in output file
C NVARS is the number of variables in input file.
C The first six variables from input file are:
C 'year'   BUF(N)
C 'month'  BUF(N+NL)
```

```
C 'day'     BUF(N+2*NL)
C 'hour'    BUF(N+3*NL)
C 'min'     BUF(N+4*NL)
C 'sec'     BUF(N+5*NL)
C These are combined to form 'time' (in seconds) for output file.  Hence,
C NOFLDS is five less than NVARS.
C Sixth variable (BUF(N+5*NL)) is overwritten.
C
        N0=0
        DO 5100 N=1,NL
          READ_ERROR=.TRUE.
          READ(INDISK,*,ERR=5150,END=5200) (BUF(N+(I-1)*NL),I=1,NVARS)
          READ_ERROR=.FALSE.
          N0=N0+1
          CALL GETTIME(INT(BUF(N)),       INT(BUF(N+NL)),
     &                 INT(BUF(N+2*NL)),INT(BUF(N+3*NL)),
     &                 INT(BUF(N+4*NL)),INT(BUF(N+5*NL)),
     &                 IDAY,ISEC)
          ID=IDAY-IFDAY
          IS=ISEC-IFSEC
          BUF(N0+5*NL)=ID*86400+IS
          DO 5110 I=7,NVARS
            BUF(N0+(I-1)*NL)=BUF(N+(I-1)*NL)
 5110     CONTINUE
 5150     IF(READ_ERROR) WRITE(IOITT,*)"error reading line ",NORECS+N
 5100   CONTINUE
        GO TO 5300
 5200   IEND=1
 5300   NORECS=NORECS+N0
C
C Write out data; ignore first five variables in BUF(), which are time info.
C Reformatted time starts at BUF(1+5*NL)
C
        DO 5400 I=6,NVARS
          CALL OTDATA(IODISK,I-5,K0,N0,BUF(1+(I-1)*NL),NOFLDS,NORECS)
 5400   CONTINUE
        IF(IEND.EQ.1) GO TO 6000
        K0=K0+N0
 5000 CONTINUE
C
 6000 CONTINUE
C
C Set absent data values.
C
      DO 7000 I=1,NOFLDS
         CALL UPRLWR(IODISK,I,1,NORECS,ALRLIM(I),UPRLIM(I),ABSENT(I),
     &                 NOFLDS,NORECS)
 7000 CONTINUE
C
C Reformat file start time for header.
C
      ICENT=1900
      CALL JULPRN(IFDAY,IYMD)
      CALL SECPRN(IFSEC,IHMS)
      CALL SETHEAD(MAGIC,DATNAM,NROWS,NPLANE,ALAT,ALONG,
     &               DEPTHI,DEPTHW,OPWRIT,RAWDAT,PIPEFL,
```

```
     &                ARCHIV,PREFIL,POSTFL,PLATYP,PLTNUM,
     &                RECINT,PLTNAM,INSTMT,COMENT)
C
      CALL PFINIS(IODISK,PROG,
     & MAGIC,NOFLDS,NORECS,NROWS,NPLANE,ICENT,IYMD,IHMS,
     & FLDNAM,FLDUNT,ALRLIM,UPRLIM,ABSENT,
     & ALAT,ALONG,DEPTHI,DEPTHW,OPWRIT,RAWDAT,PIPEFL,ARCHIV,VERS,
     & DATNAM,PREFIL,POSTFL,PLATYP,PLTNUM,RECINT,PLTNAM,INSTMT,COMENT)
C
      STOP
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C  Error processing
C
 9000 CONTINUE
      WRITE(IOITT,*)' Open error',FILENAME,IERR
      STOP
C
      END
```

Appendix 2: getPol

```
#!/bin/csh
#
#     Script to get poldat data (ASCII) from selpoldat and convert into pstar
format.
#
#     Get name of file to read; e.g. if file is socnav.miw enter nav.
#
  echo    "Enter type of file (for example, if file is  "
  echo -n "socnav.miw, enter nav ): "
  set name = $<
#
#     Using ftp, copy both the .cgn (header) file and the .miw (data) file.
After,
#     check both files exist; if not, exit with error status.
#
  ftp 134.1.100.1 >& /dev/null << !
selpoldat
get soc$name.cgn
get soc$name.miw
quit
!
  if (! -e soc$name.cgn || ! -e soc$name.miw) then
    echo " Problem with ftp - file(s) not transferred."
    exit(1)
  endif
#
#     Get file number for these data and from that derive the filename and
dataname.
#
#     Filename (and dataname) will be of the form $name$CRUISE$num, where:
#     $name   3 character string (e.g. gps)
#     $CRUISE 3 character string (e.g. ANT)
#     $num    2 digit number     (e.g. 01)
#
  echo -n "Enter file number: "
  set num = $<
  set filename = $name$CRUISE$num
  echo $filename

  poldat << !
soc$name
$filename
$name$CRUISE
!
#
#     Check status.
#
  if ( $status != 0 )then
     echo "Problem converting POLDAT to PSTAR"
     exit(1)
  endif

  exit(0)
```

Table 1. Variables transferred to PSTAR

PSTAR fieldname	POLDAT name	POLDAT format
ocn (nav)		
gps_lat	GPS position latitude	1.4
gps_lon	GPS position longitude	1.4
gps_hdg	GPS heading	3.1
gps_ptch	GPS pitch	3.1
gps_roll	GPS roll	3.1
attitude	attitude	4.0
pdop	PDOP	4.1
emlog_sp	EM log speed (electromagnetic log)	3.1
gyr_hdg	gyro heading	4.1
dolog_fa	DOLOG speed water-track ahead (doppler log)	3.1
dolog_ps	DOLOG speed water-track across (doppler log)	3.1
tsg		
temp2	TSB temperature 2	3.2
cond	TSB conductivity	2.2
salin	TSB salinity	2.2
met		
air_temp	air temperature luv	3.1
rel_humi	relative humidity	4.0
air_press	air pressure	4.1
rel_sp	relative wind velocity luv	4.1
rel_dirn	relative wind direction luv	4.0
tru_dirn	true wind direction	4.0
tru_sp	true wind velocity	4.1
hswp		
echodpth	echosounder	5.1
hswpdpth	hydrosweep	5.1

Figures

Fig. 1	GPS mode used during SeaSoar run 6. Differential GPS is represented by 1, normal GPS is represented by 2. Sections are offset from east to west (ie. legs 2 to 7) by 2 units (up).
Fig.2	GPS mode used during SeaSoar run 8. Differential GPS is represented by 1, normal GPS is represented by 2. Sections are offset from west to east (ie. legs 1 to 11) by 2 units (up).
Fig. 3	Ship's track at the first mooring showing the small scale noise (of order a few metres).
Fig. 4	Ship's position in the fast sea ice in Atka Bay showing the effect of selective availability on GPS.
Fig. 5	Thermosalinograph salinity and conductivity plotted against bottle salinity samples from SeaSoar runs 2 and 3 showing the linear relationship of $S_{corr}=0.53473+0.98179S_{tsg}$
Fig. 6	Thermosalinograph temperature, conductivity and uncalibrated salinity plotted with bottle salinity (+) for SeaSoar run 8 showing the 0.009 offset between bottle and thermosalinograph salinity values (x).
Fig. 7	Salinity calibration of SeaSoar run 2. SeaSoar data from 5 to 15 m is shown together with thermosalinograph salinity. Thermosalinograph - SeaSoar salinity difference is shown before and after final corrections were made. The final version is offset up by 0.05 and overlaid with the bottle - SeaSoar salinity differences.
Fig. 8	Salinity calibration of SeaSoar run 3, as for Fig. 7.
Fig. 9	a & b) Salinity calibration of SeaSoar run 6, as for Fig. 7.
Fig. 10	Salinity calibration of SeaSoar run 8, as for Fig. 7.
Fig. 11	Ship's track during Polarstern Ant XIII/2, 4 December 1995 - 24 January 1996. Depth contours plotted at 200, 2000 and 4000 m intervals.
Fig. 12	Ship's track during SeaSoar runs 2 and 3.
Fig. 13	Ship's track during SeaSoar run 6, individual legs are labelled 1 to 7.
Fig. 14	Ship's track during SeaSoar run 8, individual legs are labelled 1 to 11.
Fig. 15	Surface temperature and salinity data from the thermosalinograph (B) for run 6 (approx. 9 m depth).
Fig. 16	Surface temperature and salinity data from the thermosalinograph (B) for run 8 (approx. 9 m depth).
Fig. 17	Ocean depth on the transect from Cape Town to Neumayer.
Fig. 18	Ocean depth on the transects between the Polar Front survey area and Neumayer. Sections are offset (up) by 2000 m from the preceding profile. Transects are offset in the order 3 and 4 (worked to the south), 5 and 6.1 (north), 10 (south) and 11 (north).
Fig. 19	Bathymetry of the coarse scale SeaSoar survey (run 6) measured by the hydrosweep. Each section is offset up from by 1000 m the initial profile, and from west to east.
Fig. 20	Wind vectors along the transect from Cape Town to Neumayer.
Fig. 21	Wind vectors during SeaSoar run 6.
Fig. 22	Wind vectors during the first half of the CTD survey, run 7.

Fig. 23 Wind vectors during SeaSoar run 8.
Fig. 24 Wind vectors during the second half of the CTD survey, run 9.
Fig. 25 Meteorological parameters. 4 - 11 December 1995. CTD stations are numbered.
Fig. 26 Meteorological parameters. 11 - 18 December 1995. CTD stations are numbered.
Fig. 27 Meteorological parameters. 18 - 25 December 1995. CTD stations are numbered.
Fig. 28 Meteorological parameters. 25 December 1995 - 1 January 1996. CTD stations are numbered.
Fig. 29 Meteorological parameters. 1 - 8 January 1996. CTD stations are numbered.
Fig. 30 Meteorological parameters. 8 - 15 January 1996
Fig. 31 Meteorological parameters. 15 - 22 January 1996. CTD stations are numbered.

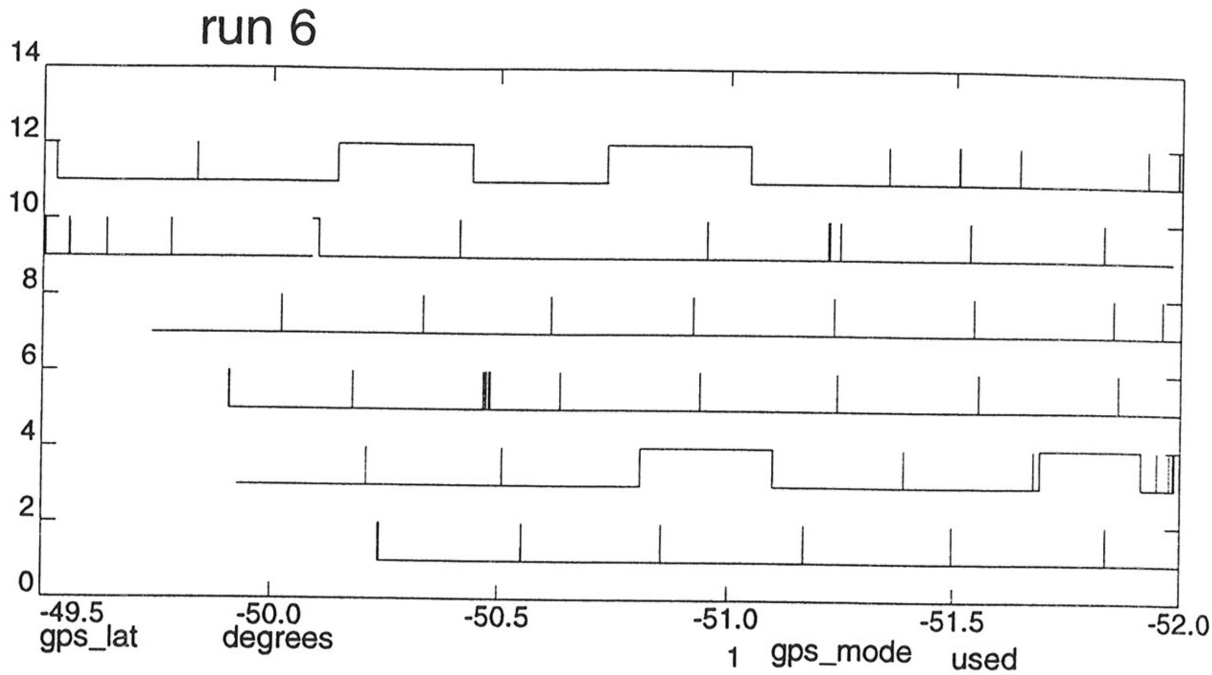


Fig. 1 GPS mode used during SeaSoar run 6. Differential GPS is represented by 1, normal GPS is represented by 2. Sections are offset from east to west (ie. legs 2 to 7) by 2 units (up).

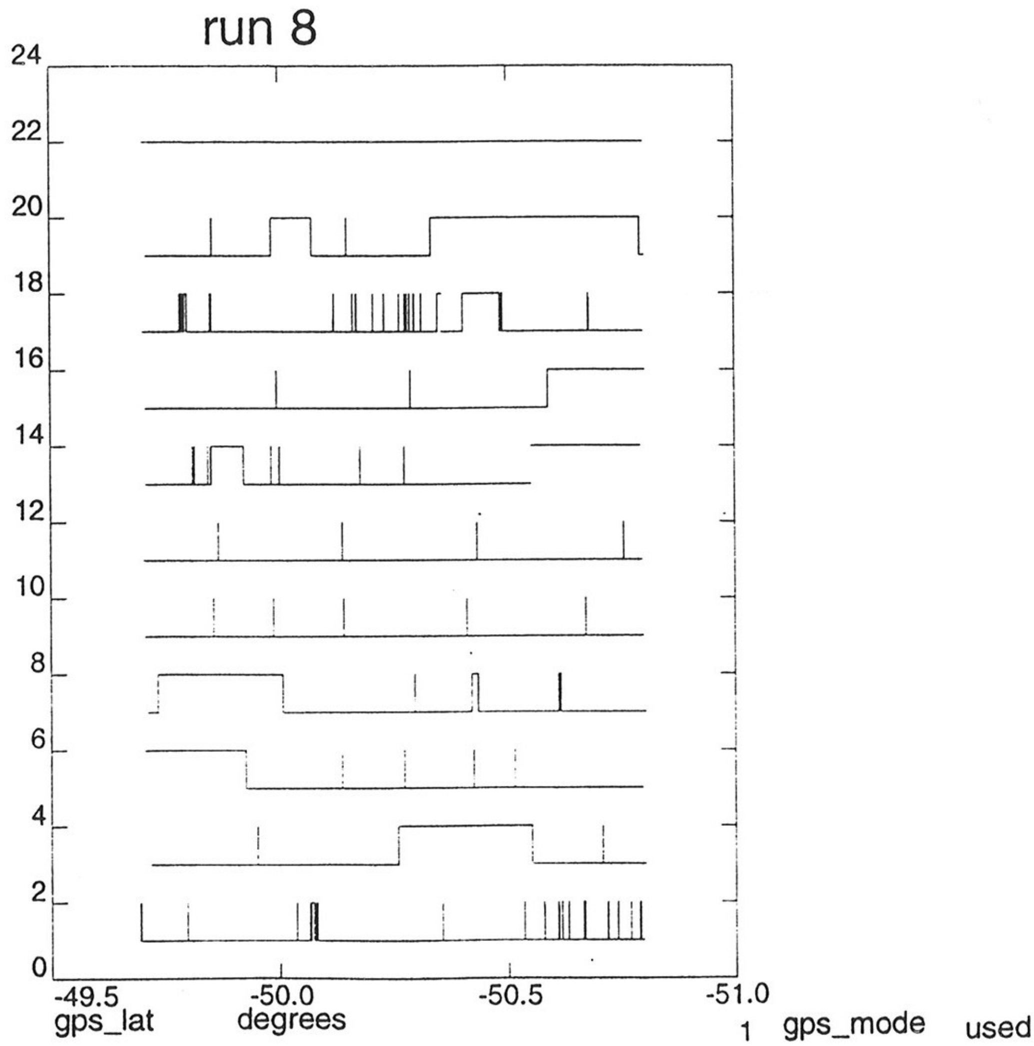


Fig.2 GPS mode used during SeaSoar run 8. Differential GPS is represented by 1, normal GPS is represented by 2. Sections are offset from west to east (ie. legs 1 to 11) by 2 units (up).

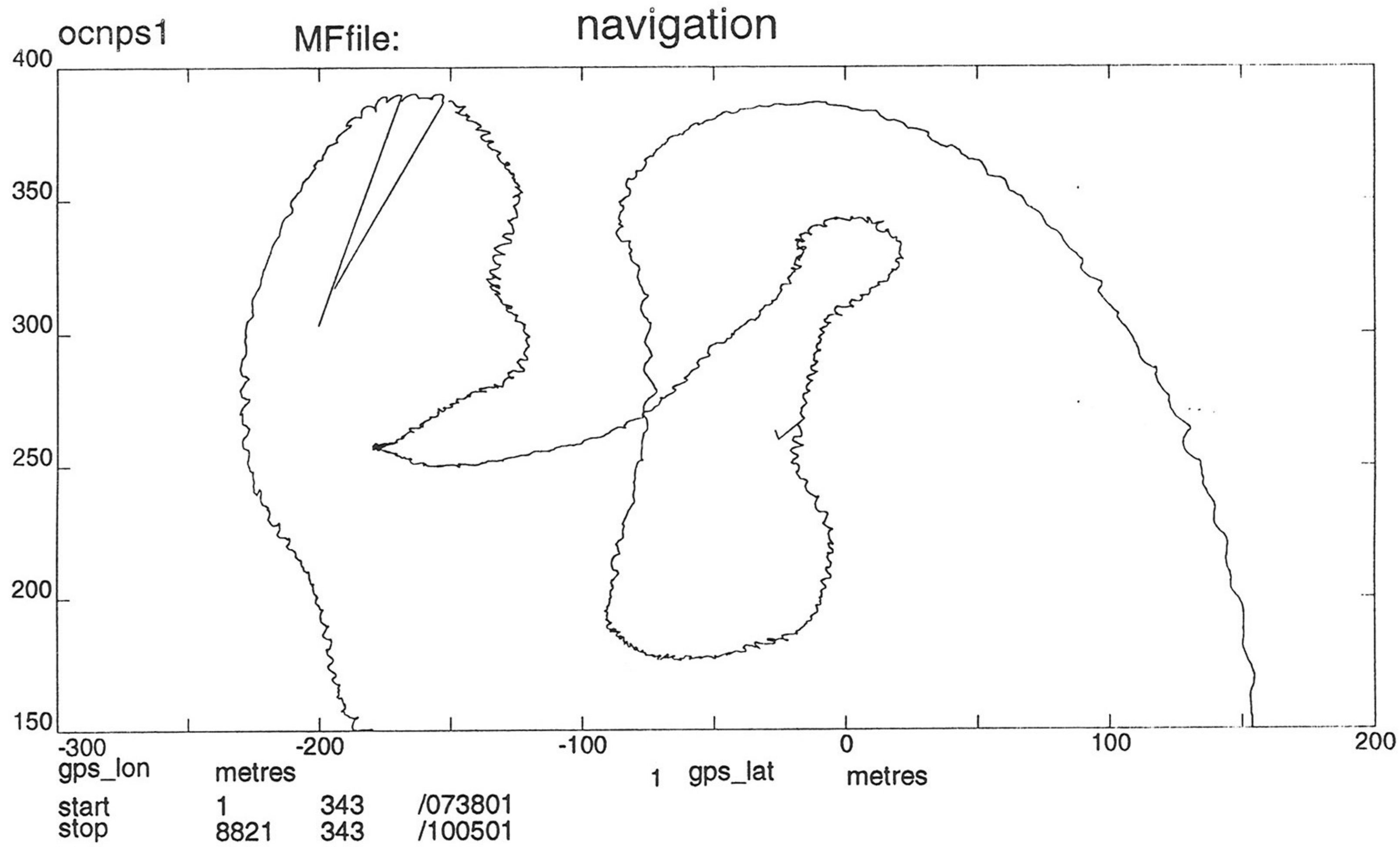


Fig. 3 Ship's track at the first mooring showing the small scale noise (of order a few metres).

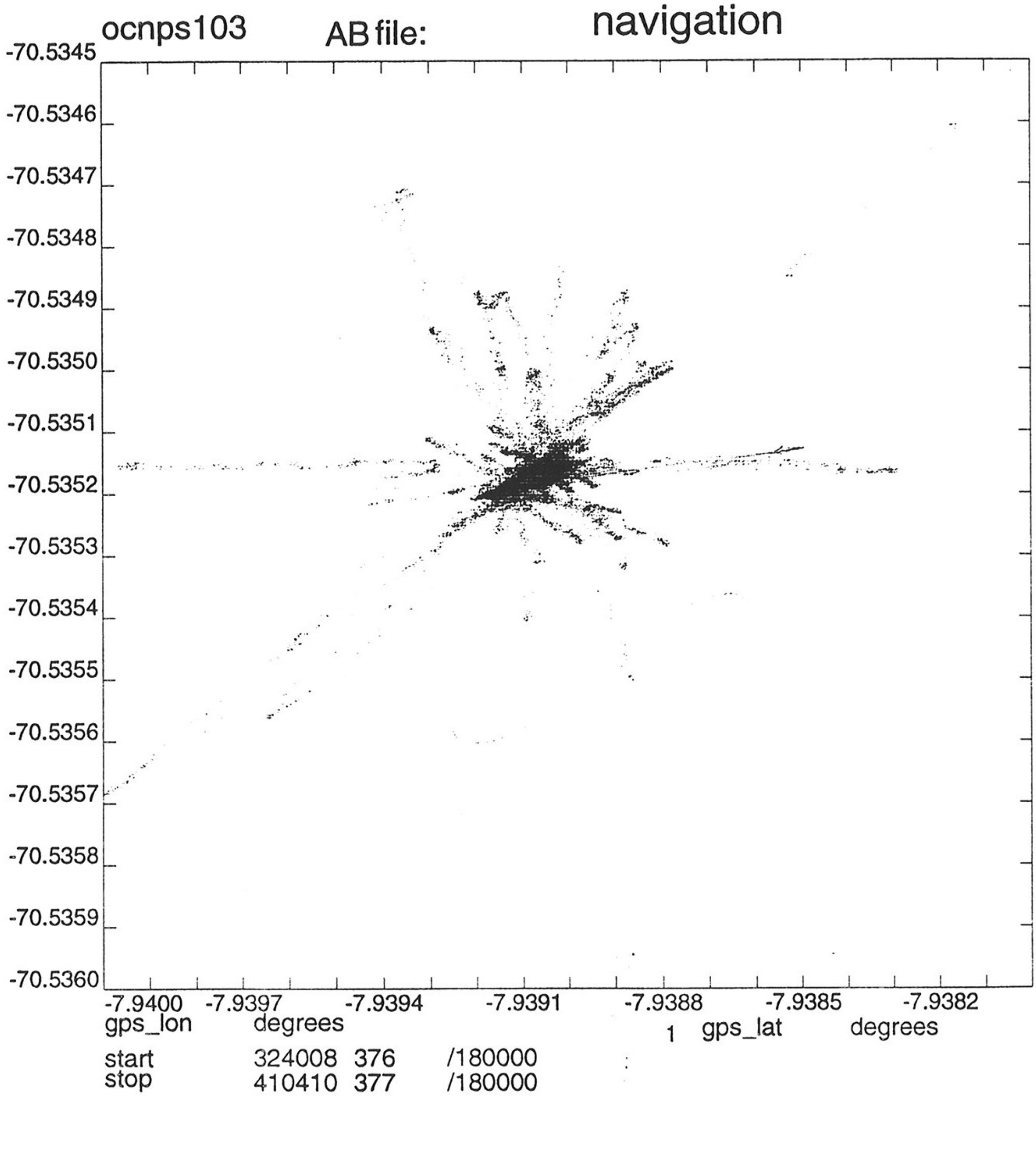


Fig. 4 Ship's position in the fast sea ice in Atka Bay showing the effect of selective availability on GPS.

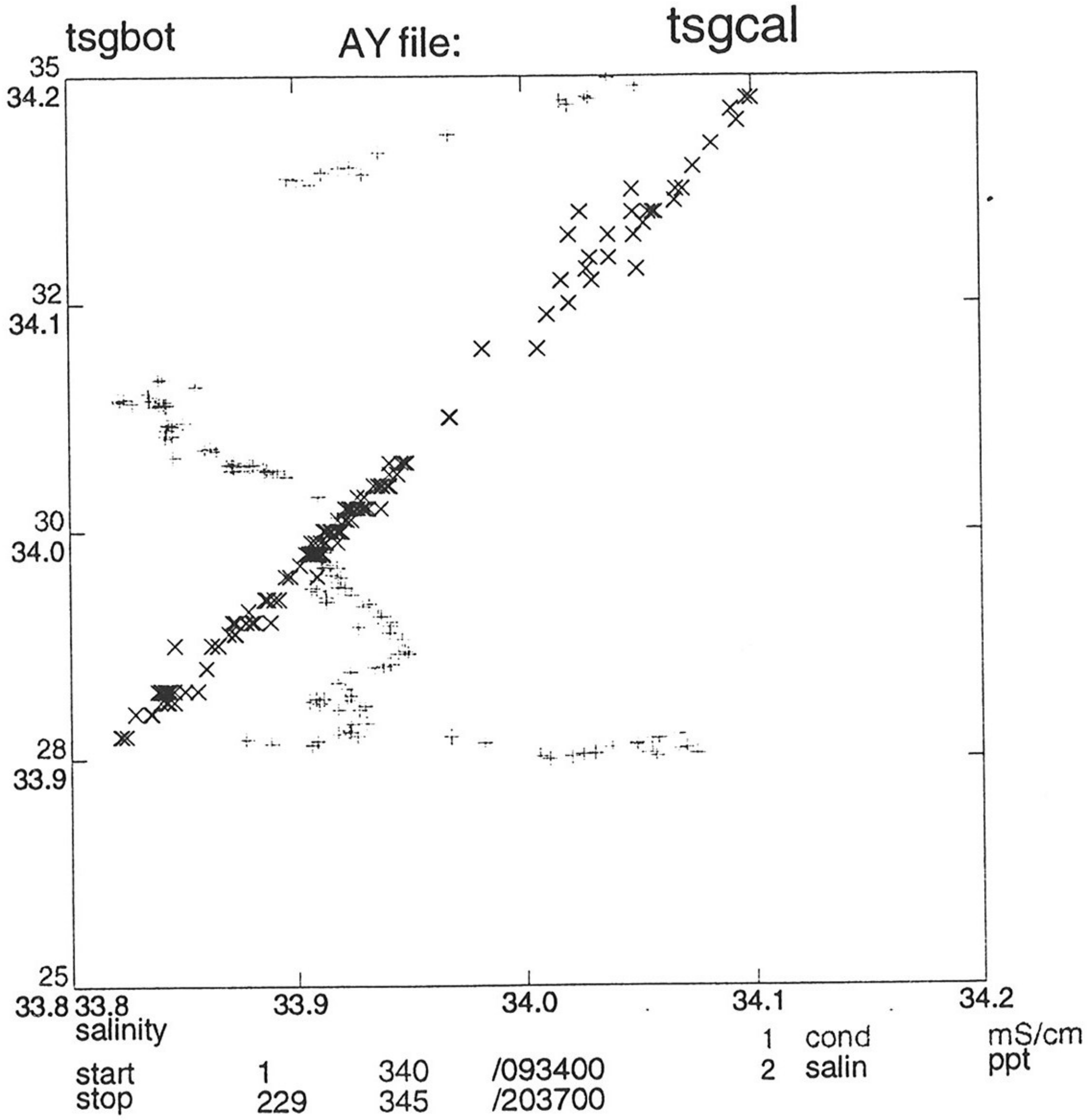


Fig. 5 Thermosalinograph salinity and conductivity plotted against bottle salinity samples from SeaSoar runs 2 and 3 showing the linear relationship of $S_{corr}=0.53473+0.98179S_{tsg}$

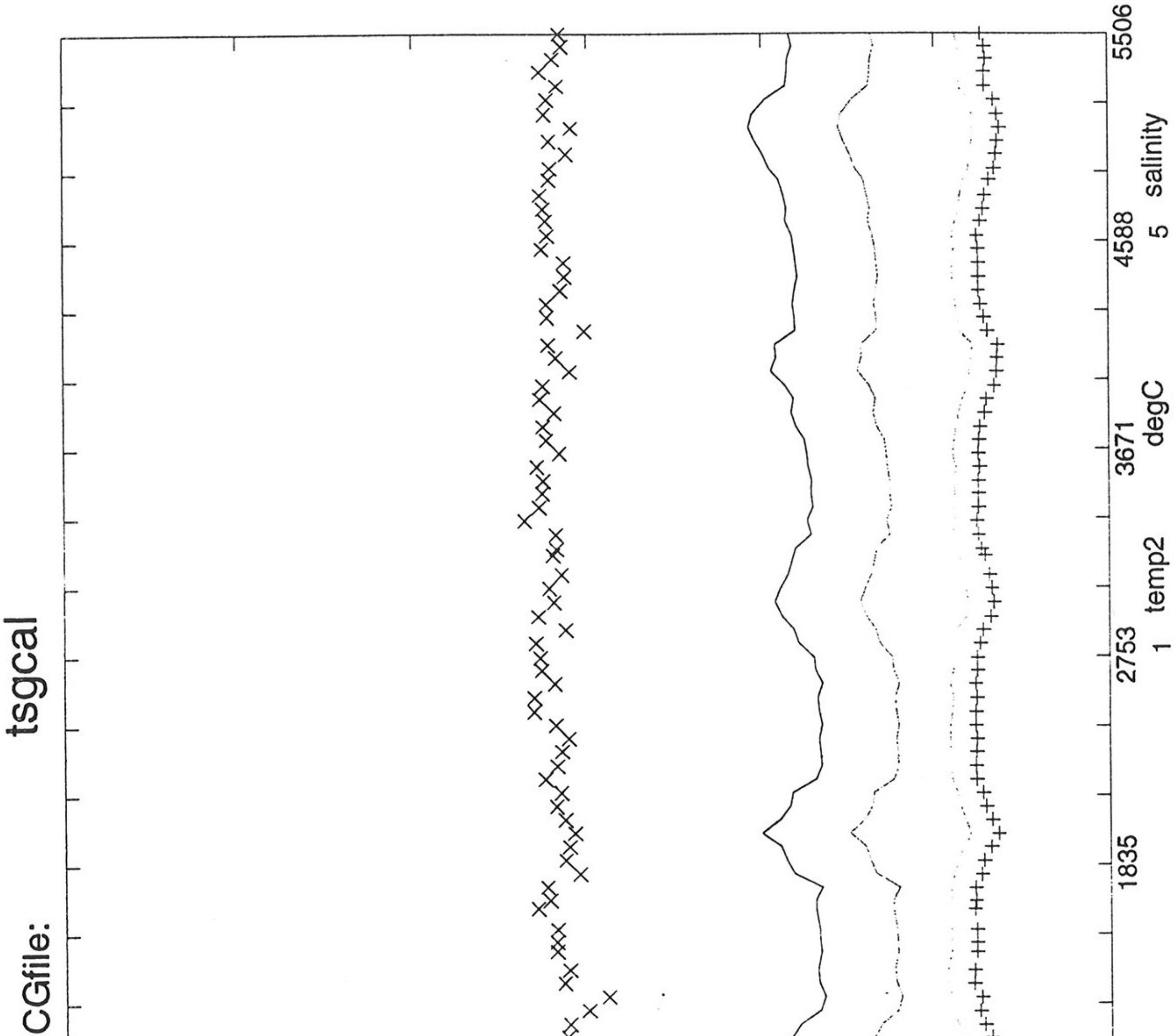


Fig. 6 Thermosalinograph temperature, conductivity and uncalibrated salinity plotted with bottle salinity (+) for SeaSoar run 8 showing the 0.009 offset between bottle and thermosalinograph salinity values (x).

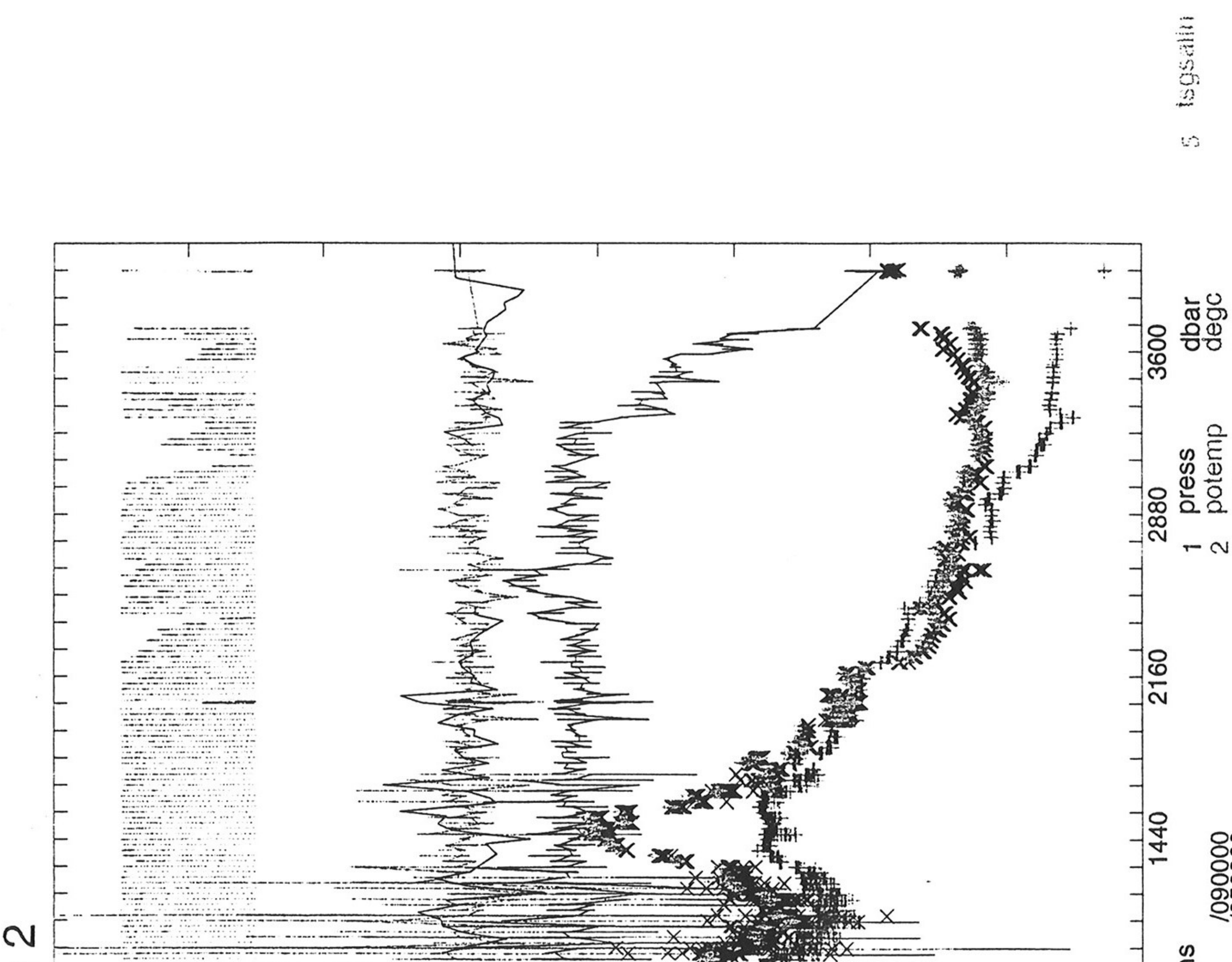


Fig. 7 Salinity calibration of SeaSoar run 2. SeaSoar data from 5 to 15 m is shown together with thermosalinograph salinity. Thermosalinograph - SeaSoar salinity difference is shown before and after final corrections were made. The final version is offset up by 0.05 and overlaid with the bottle - SeaSoar salinity differences.

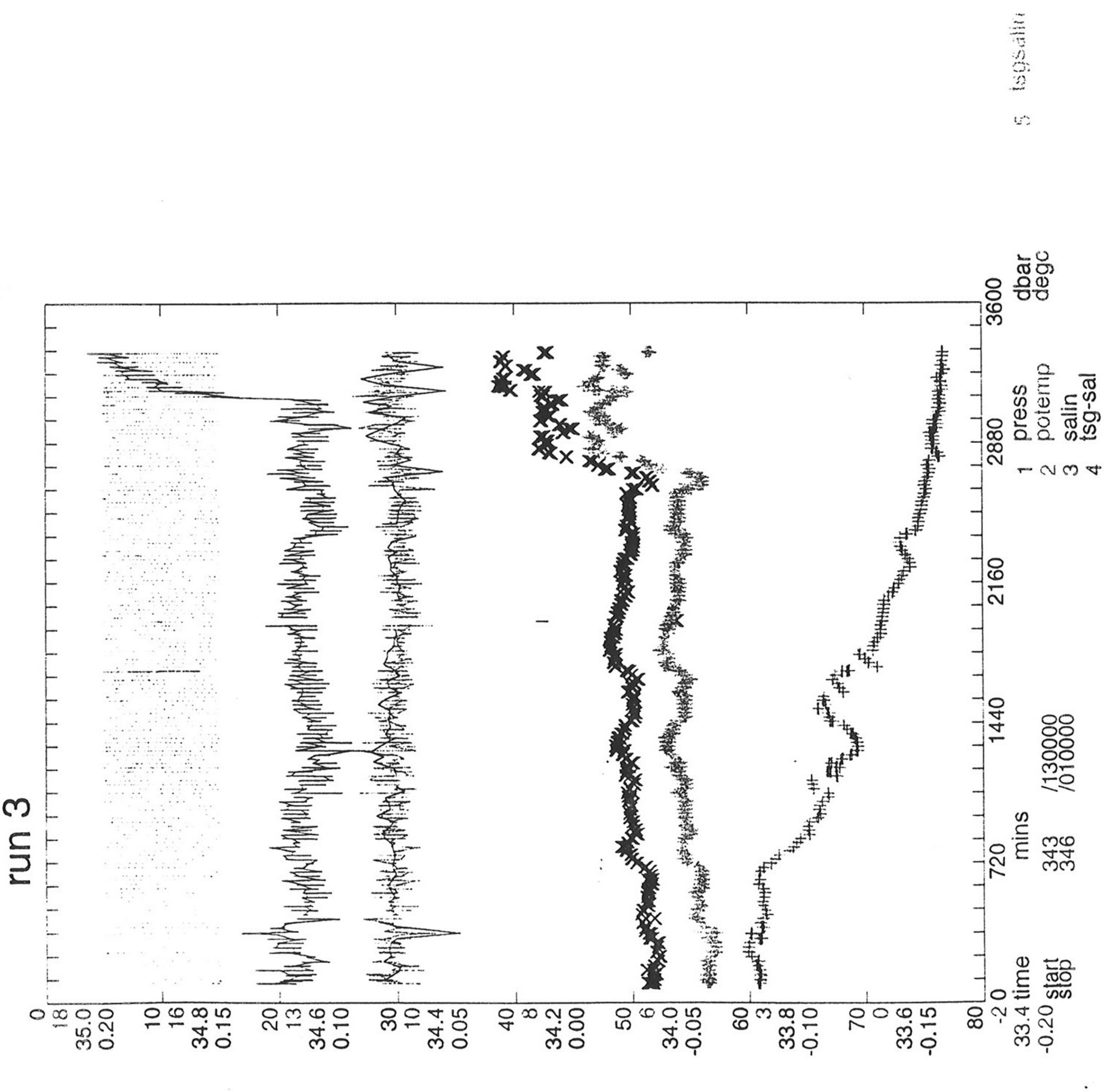


Fig. 8 Salinity calibration of SeaSoar run 3, as for Fig. 7.

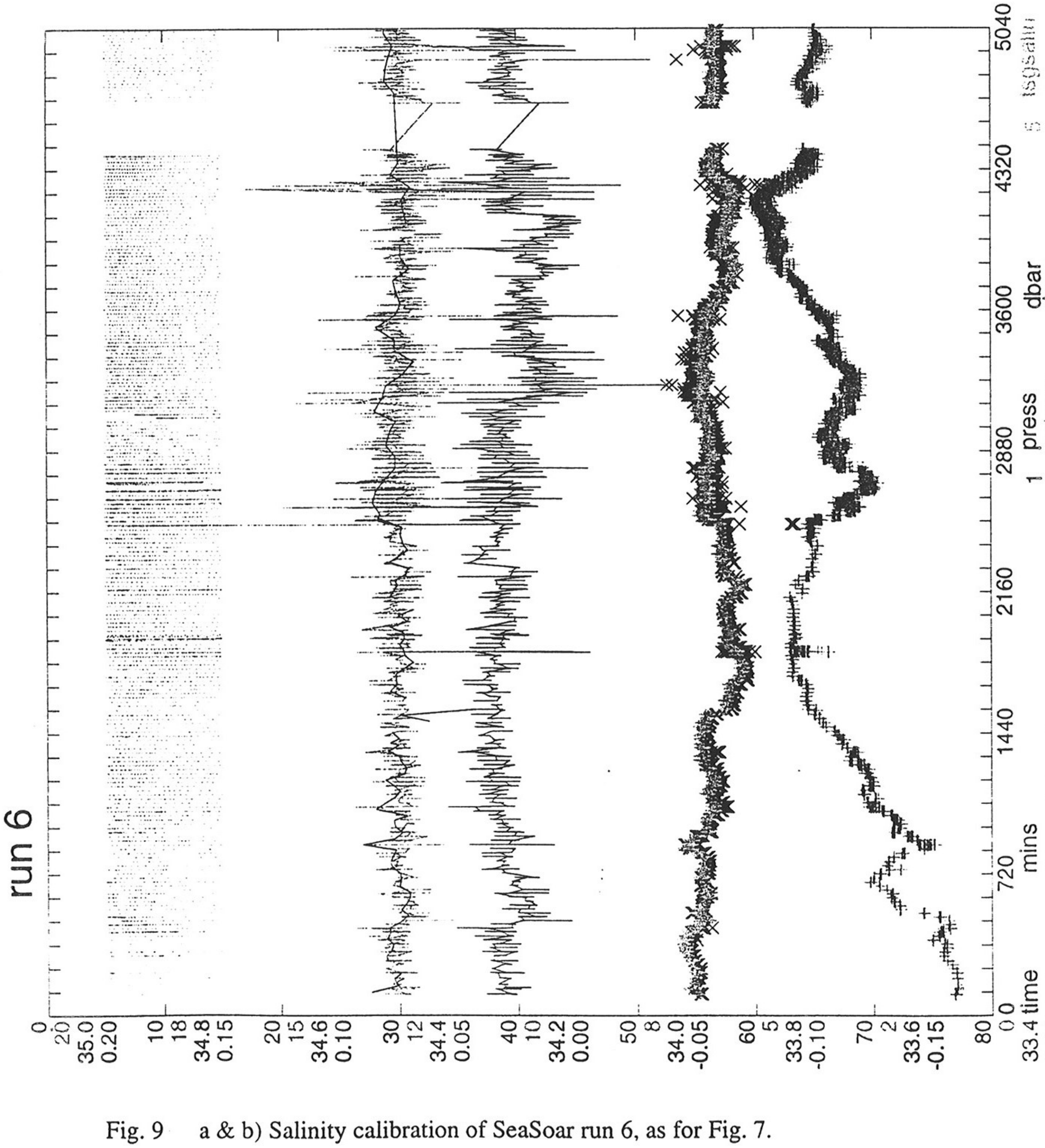
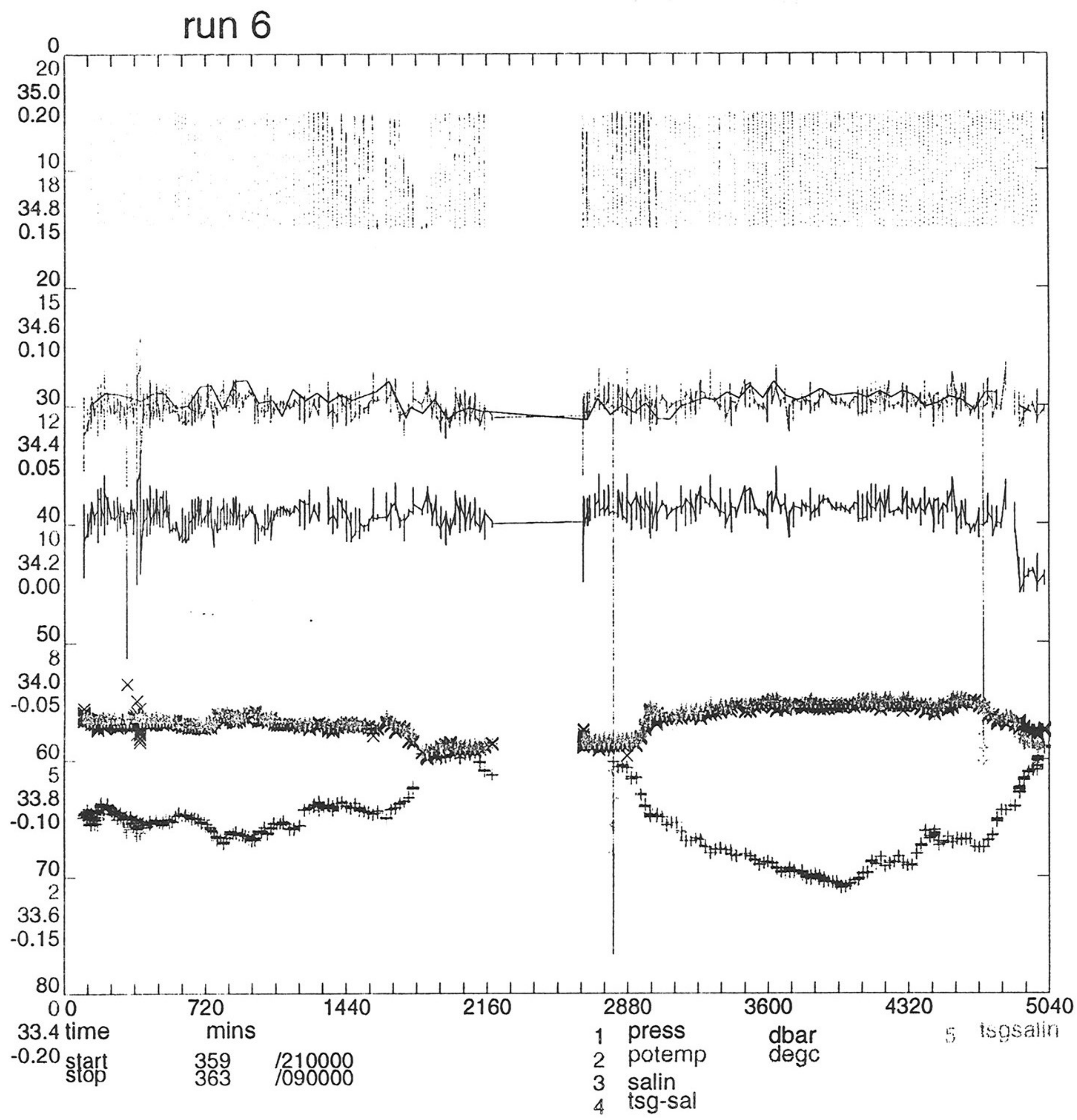


Fig. 9 a & b) Salinity calibration of SeaSoar run 6, as for Fig. 7.


run 6
0
20
35.0
0.20
10
18
34.8
0.15
20
15
34.6
0.10
30
12
34.4
0.05
40
10
34.2
0.00
50
8
34.0
-0.05
60
5
33.8
-0.10
70
2
33.6
-0.15
80
0 0
33.4
-0.20
0
720
1440
2160
2880
3600
4320
5040
time mins
start 359 /210000
stop 363 /090000
1 press dbar
2 potemp degc
3 salin
4 tsg-sal
5 tsgsalin

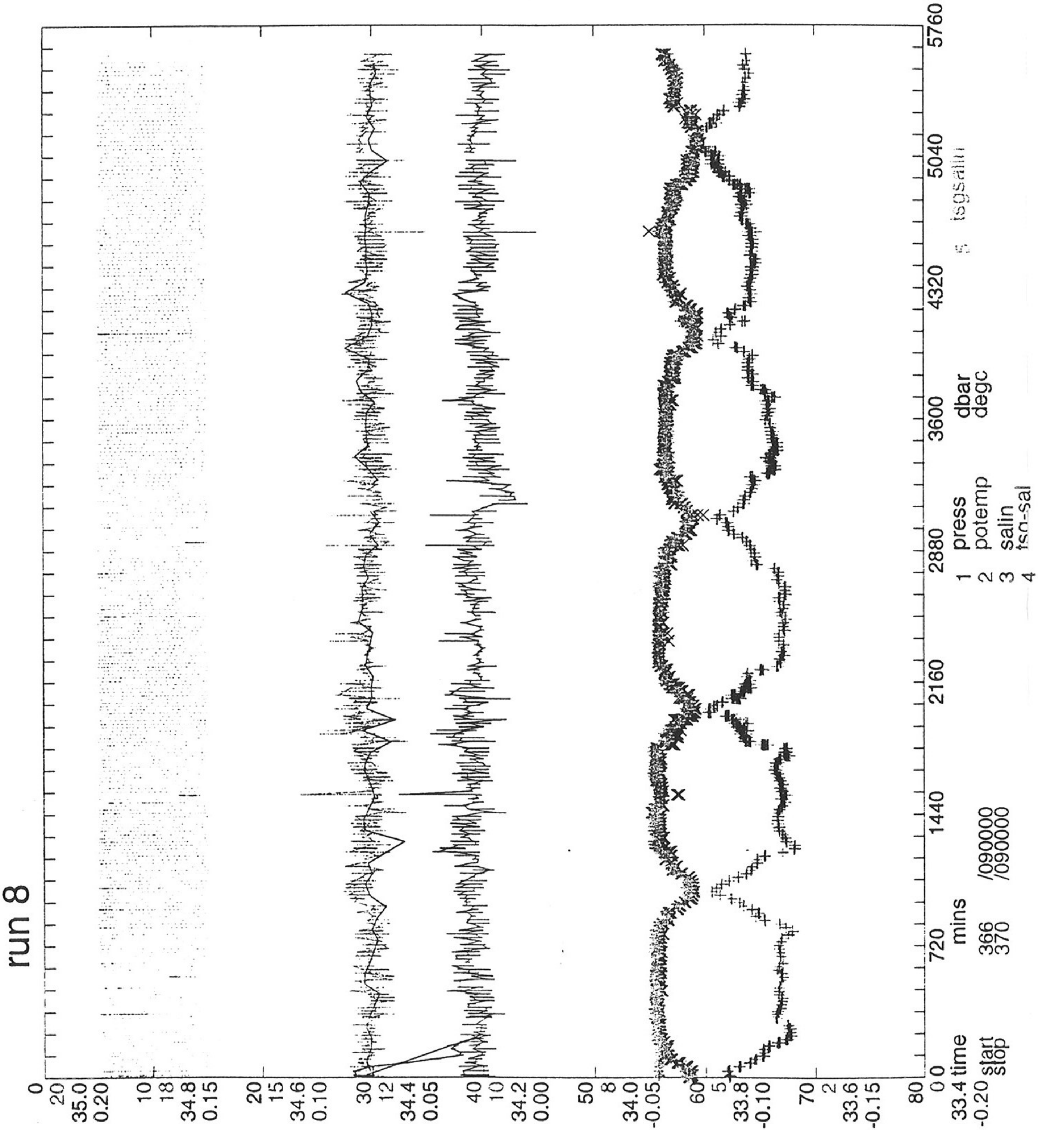


Fig. 10 Salinity calibration of SeaSoar run 8, as for Fig. 7.

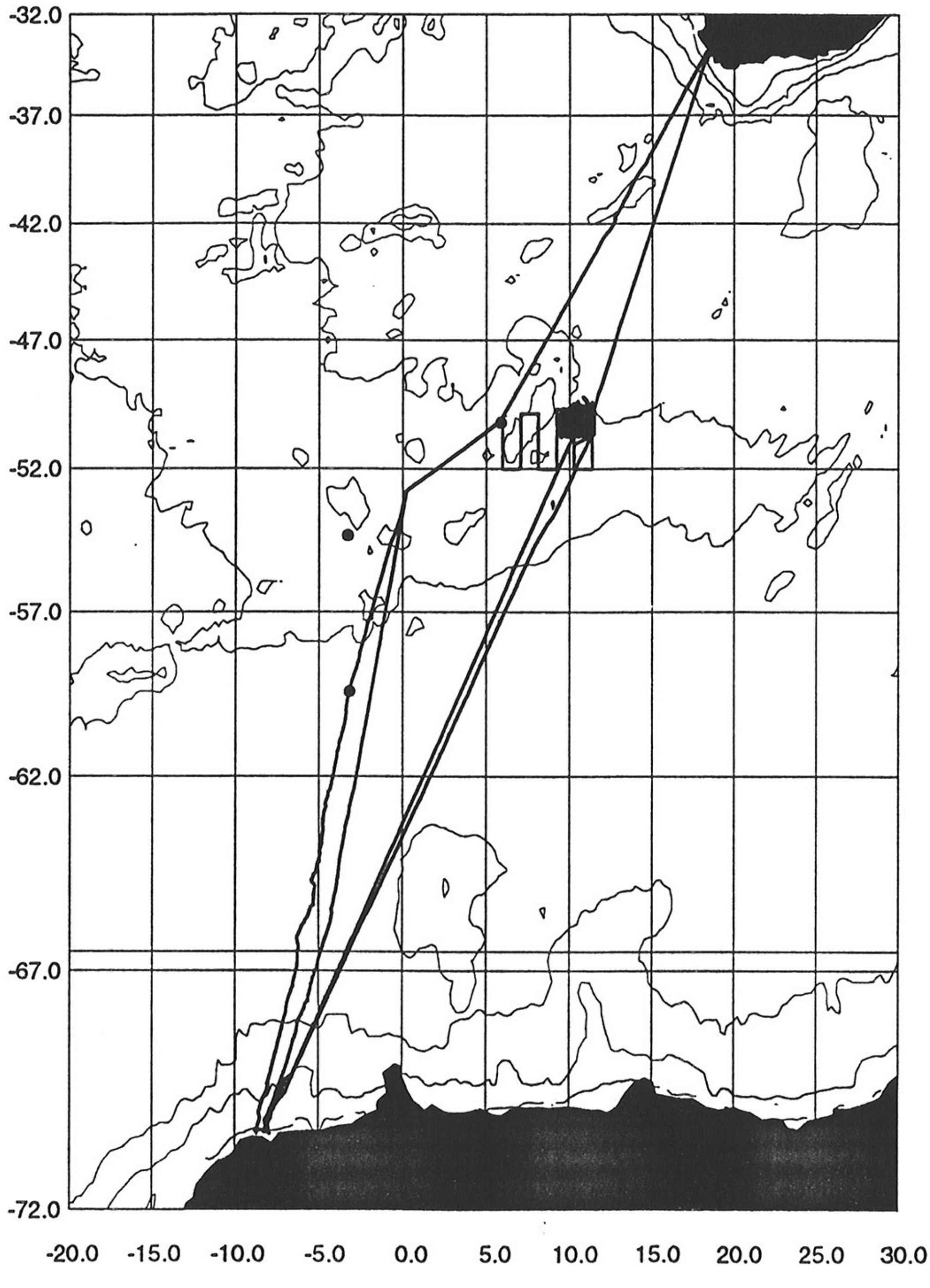


Fig. 11 Ship's track during Polarstern Ant XIII/2, 4 December 1995 - 24 January 1996. Depth contours plotted at 200, 2000 and 4000 m intervals.

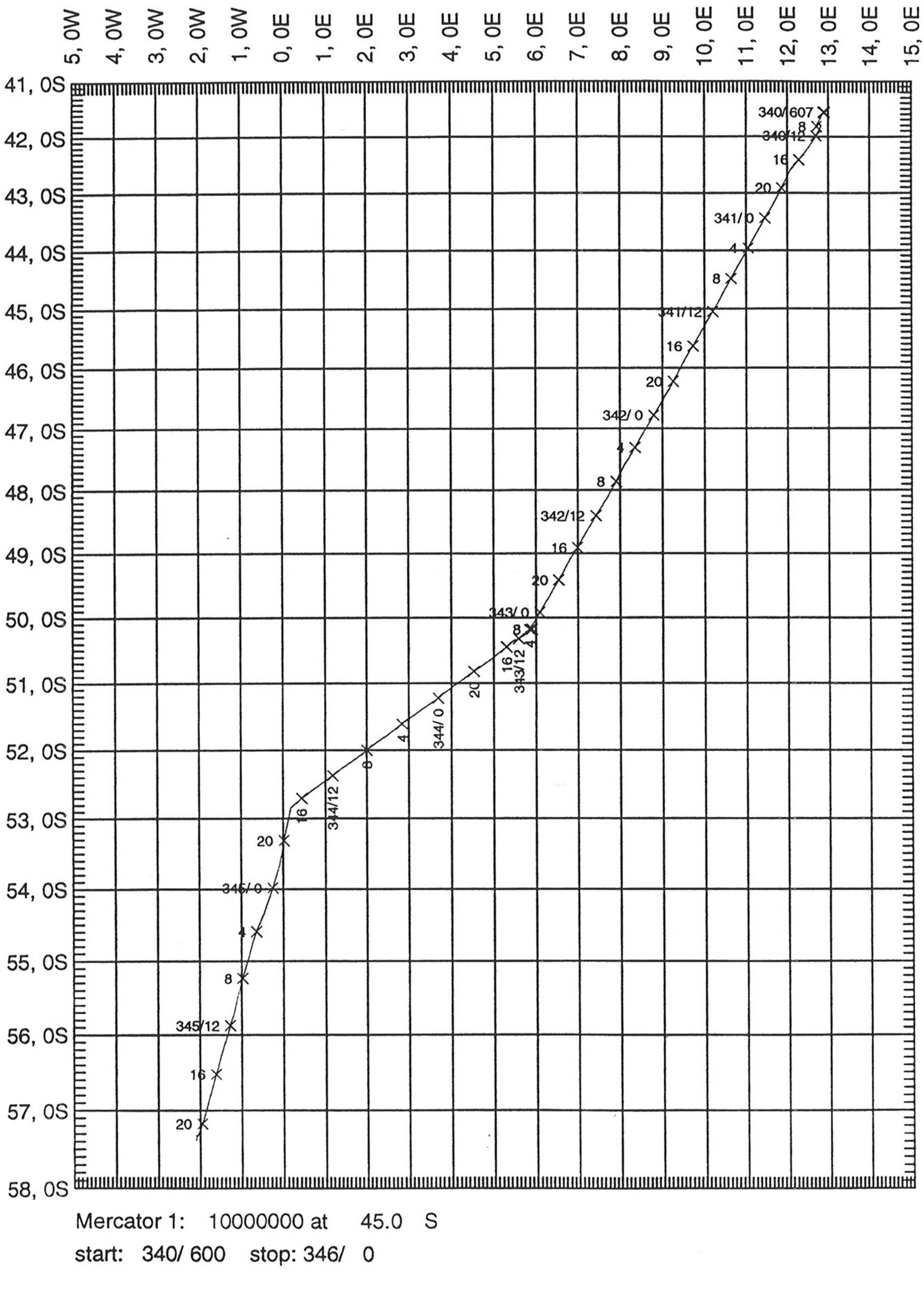


Fig. 12 Ship's track during SeaSoar runs 2 and 3.

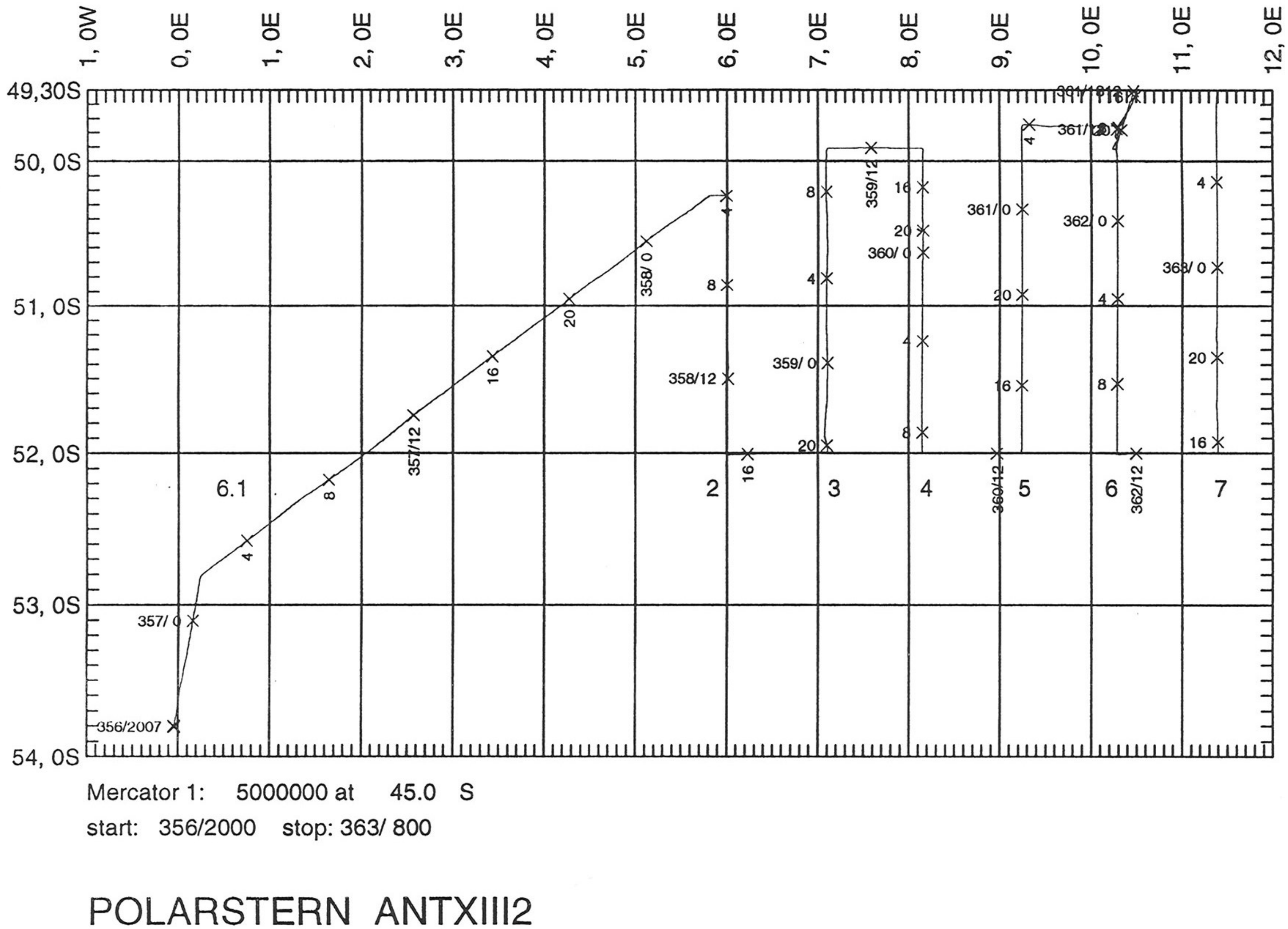


Fig. 13 Ship's track during SeaSoar run 6, individual legs are labelled 1 to 7.

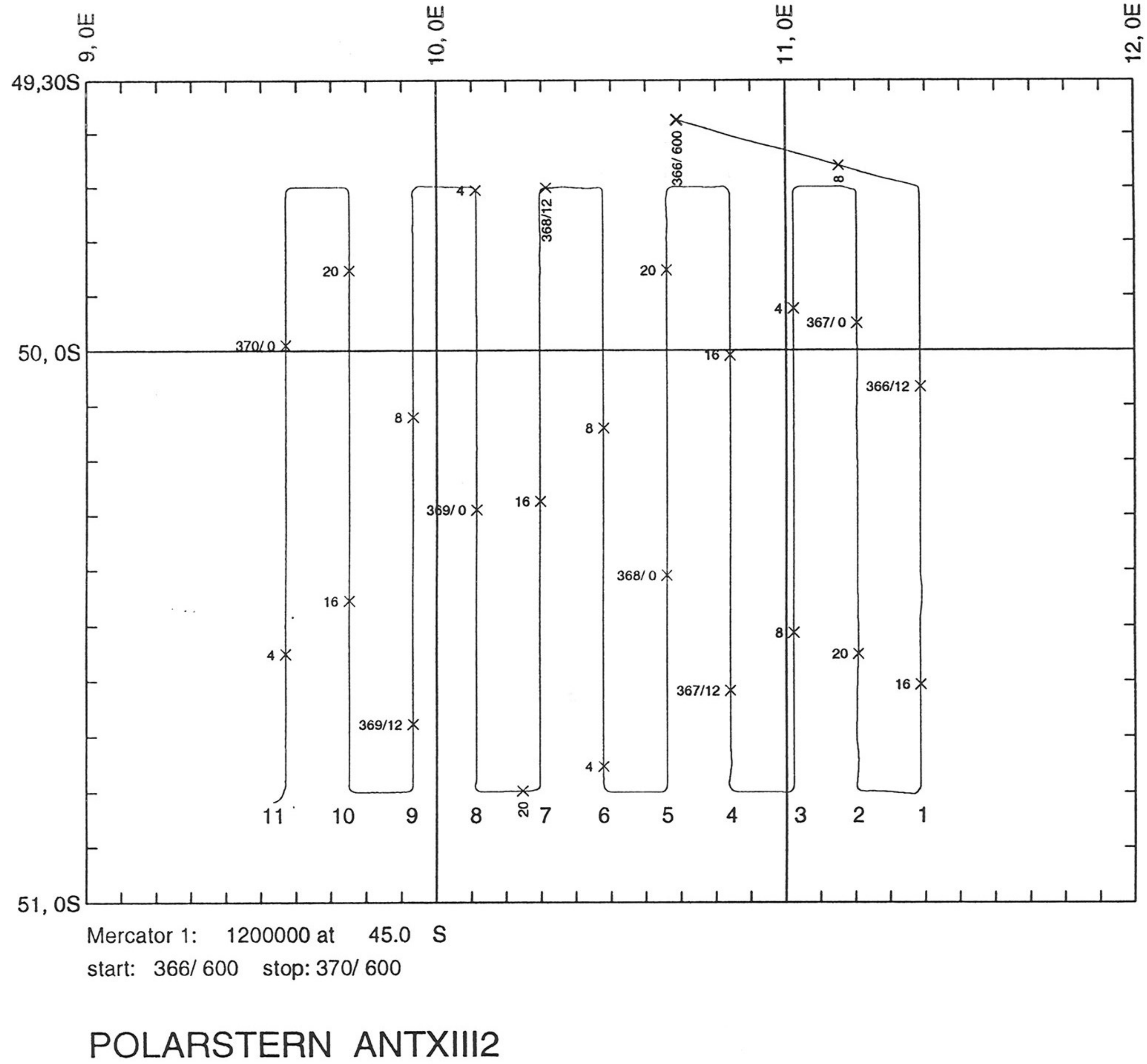


Fig. 14 Ship's track during SeaSoar run 8, individual legs are labelled 1 to 11

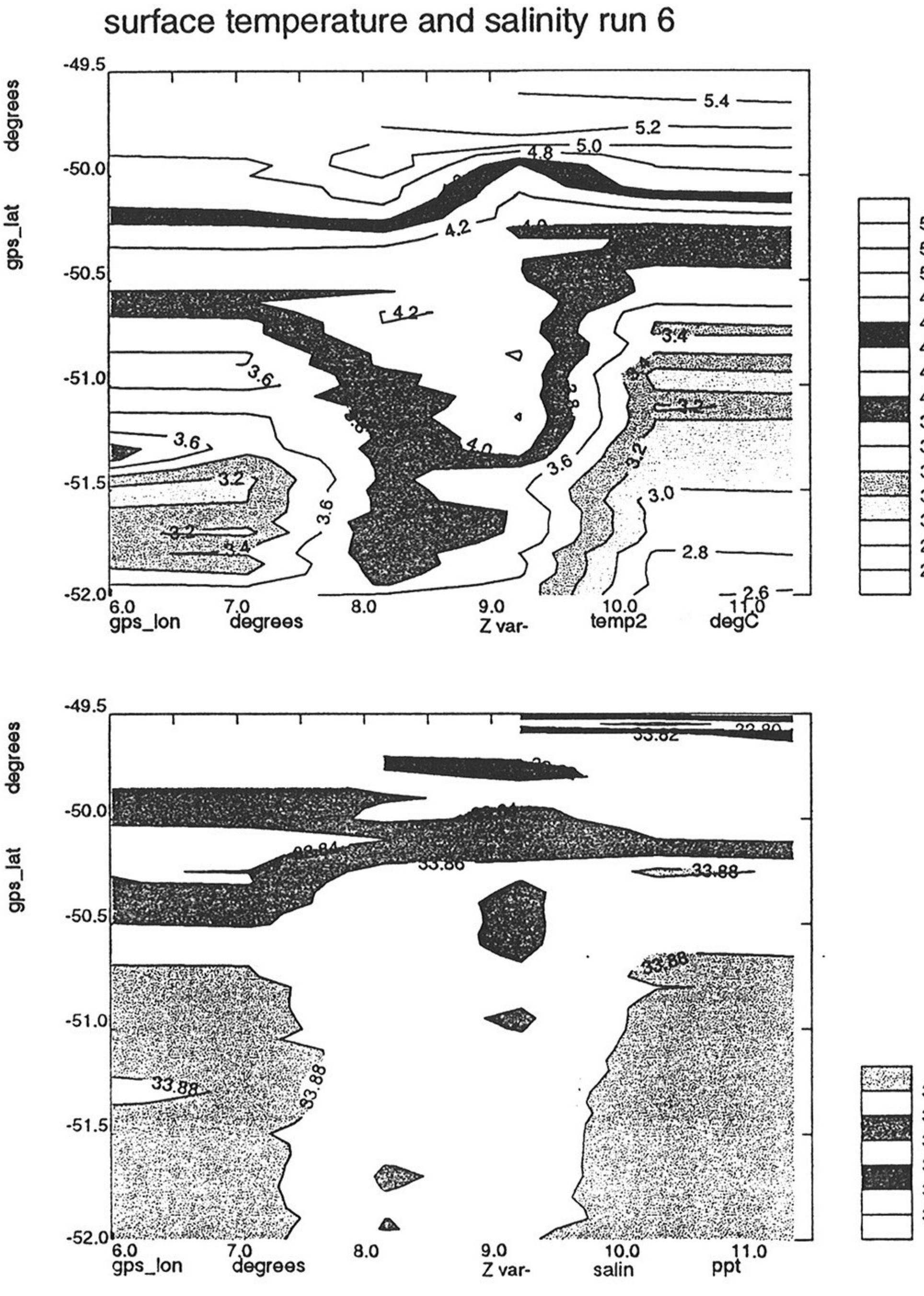


Fig. 15 Surface temperature and salinity data from the thermosalinograph (B) for run 6 (at a depth of approximately 9 m).

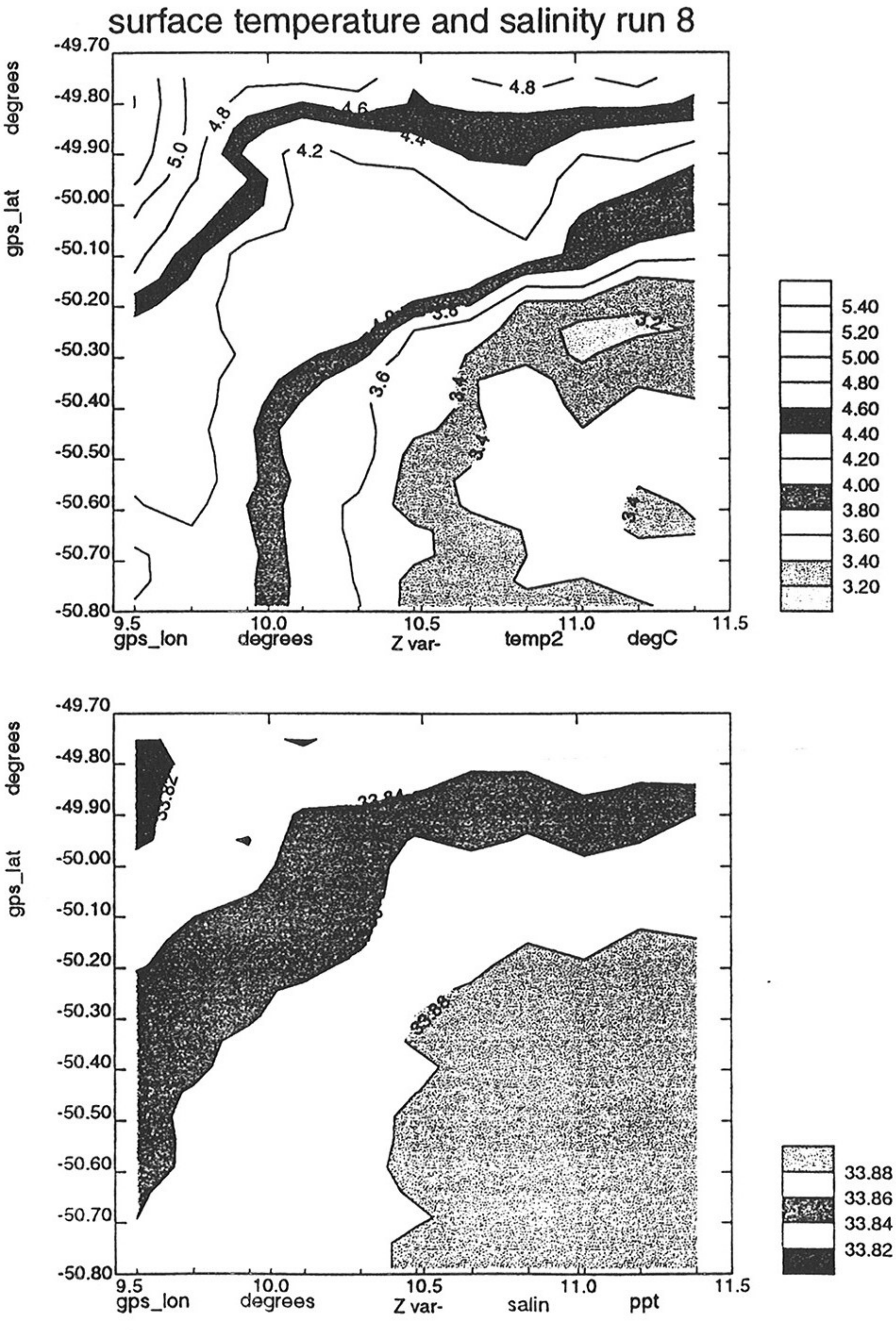


Fig. 16 Surface temperature and salinity data from the thermosalinograph (B) for run 8 (at a depth of approximately 9 m).

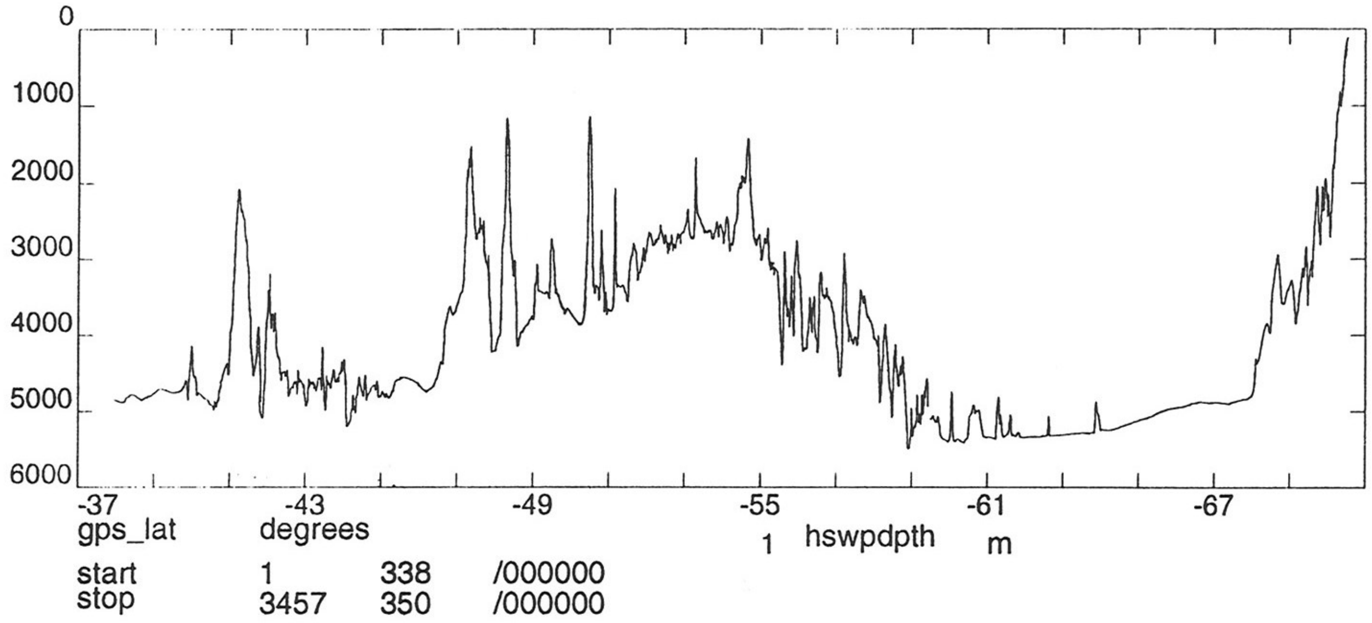


Fig. 17 Ocean depth on the transect from Cape Town to Neumayer as measured by the hydrosweep centre beam

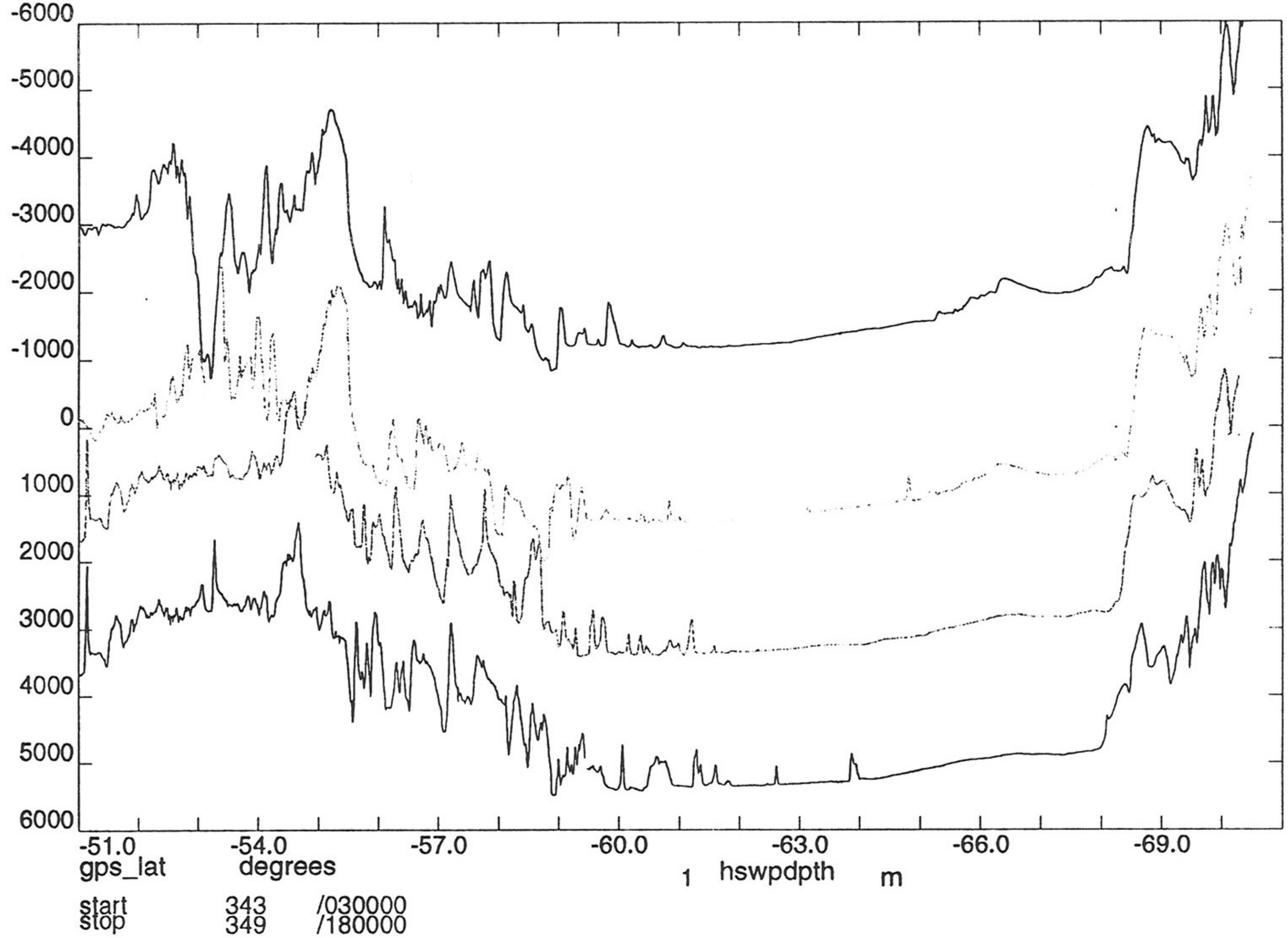


Fig. 18 Ocean depth on the transects between the Polar Front survey area and Neumayer. Sections are offset (up) by 2000 m from the preceding profile. Transects are offset in the order 3 and 4 (worked to the south), 5 and 6.1 (north), 10 (south) and 11 (north).

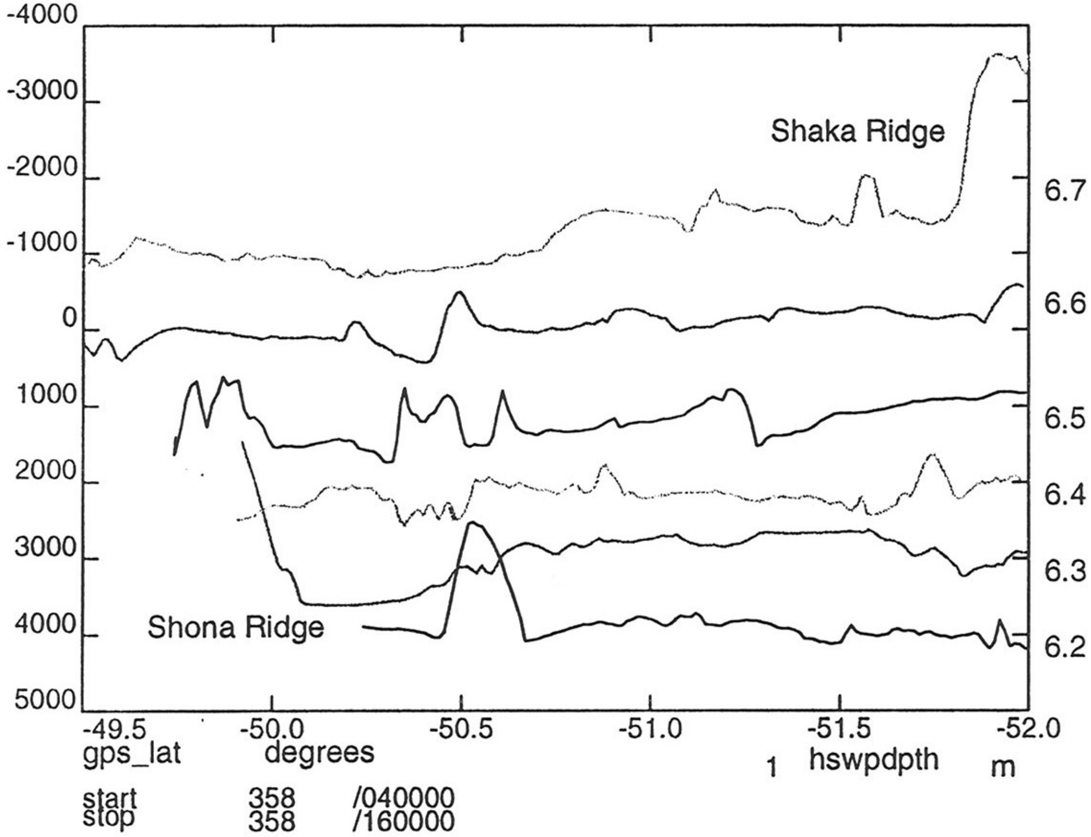


Fig. 19 Bathymetry of the coarse scale SeaSoar survey (run 6) measured by the hydrosweep. Each section is offset (up) by 1000 m from the initial profile, and from west to east.

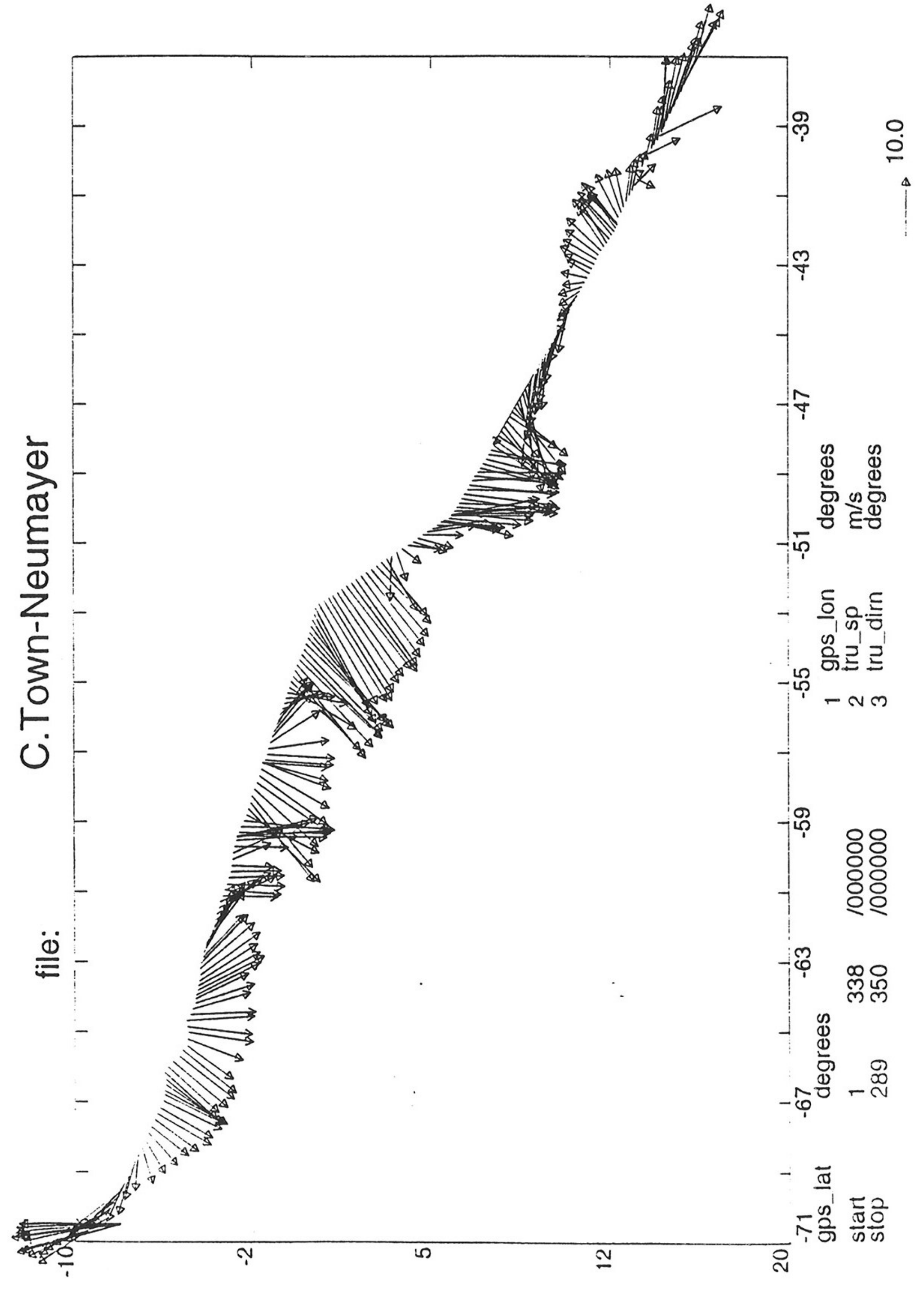


Fig. 20 Wind vectors along the transect from Cape Town to Neumayer.

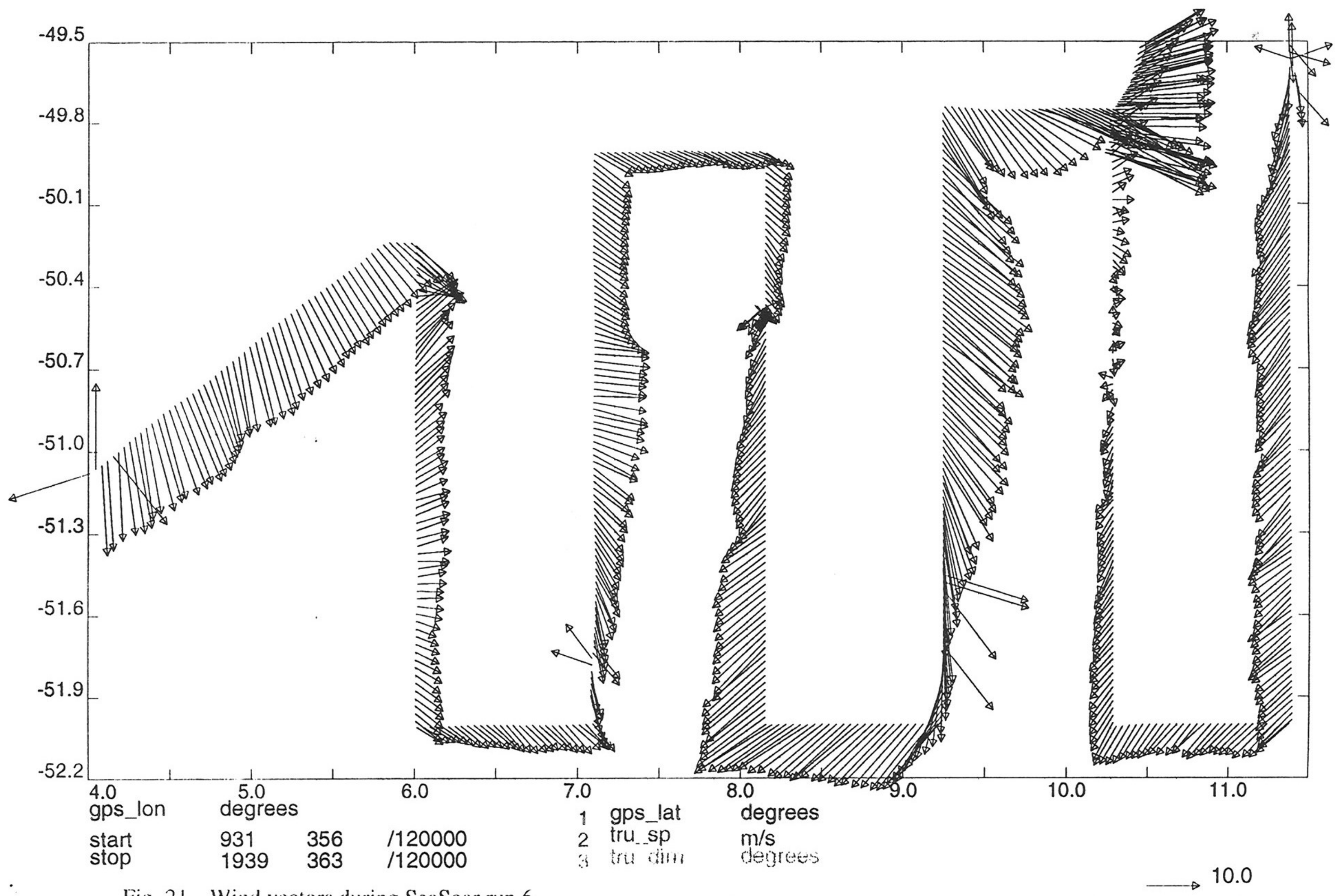


Fig. 21 Wind vectors during SeaSoar run 6.

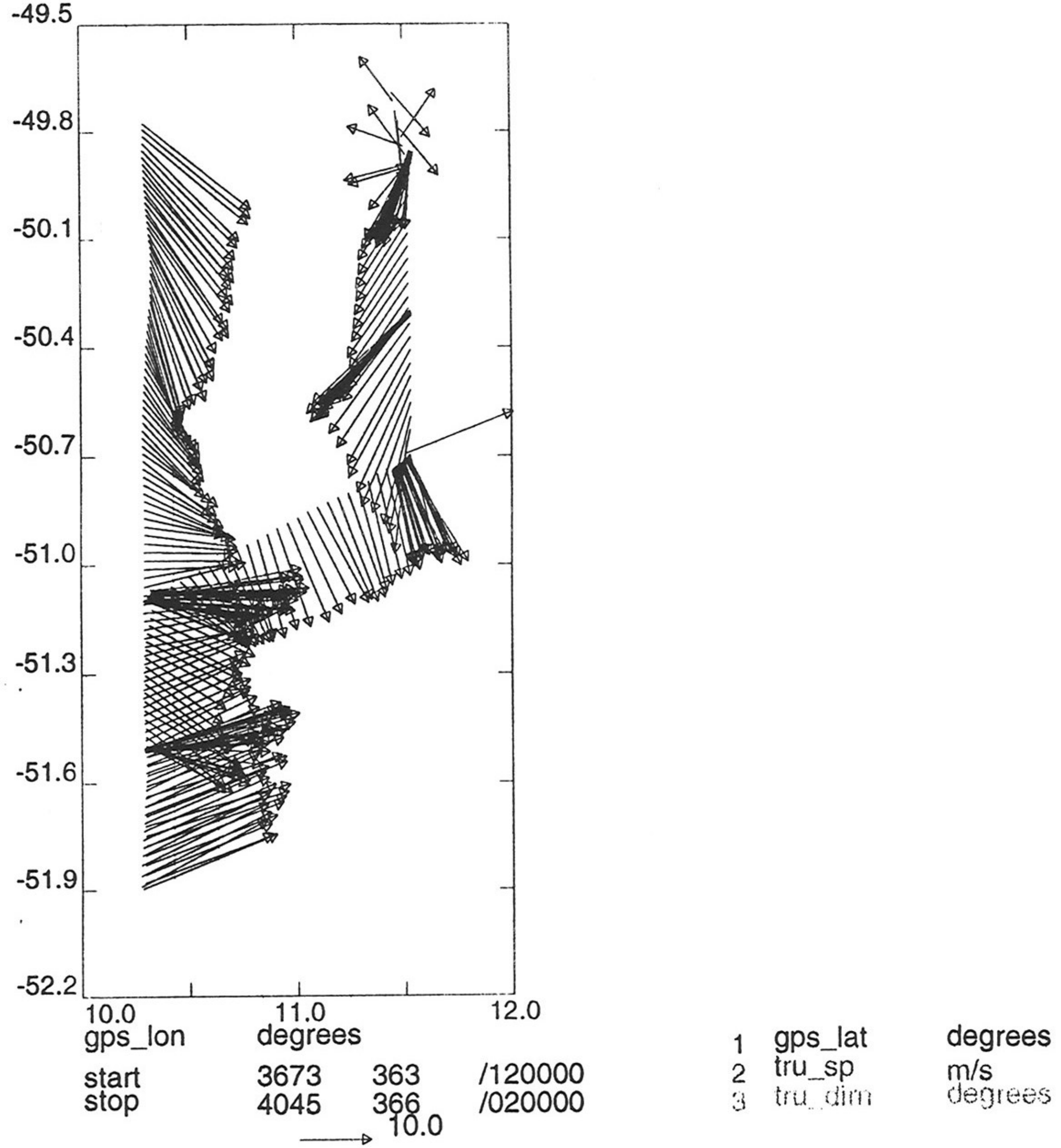


Fig. 22 Wind vectors during the first half of the CTD survey, run 7.

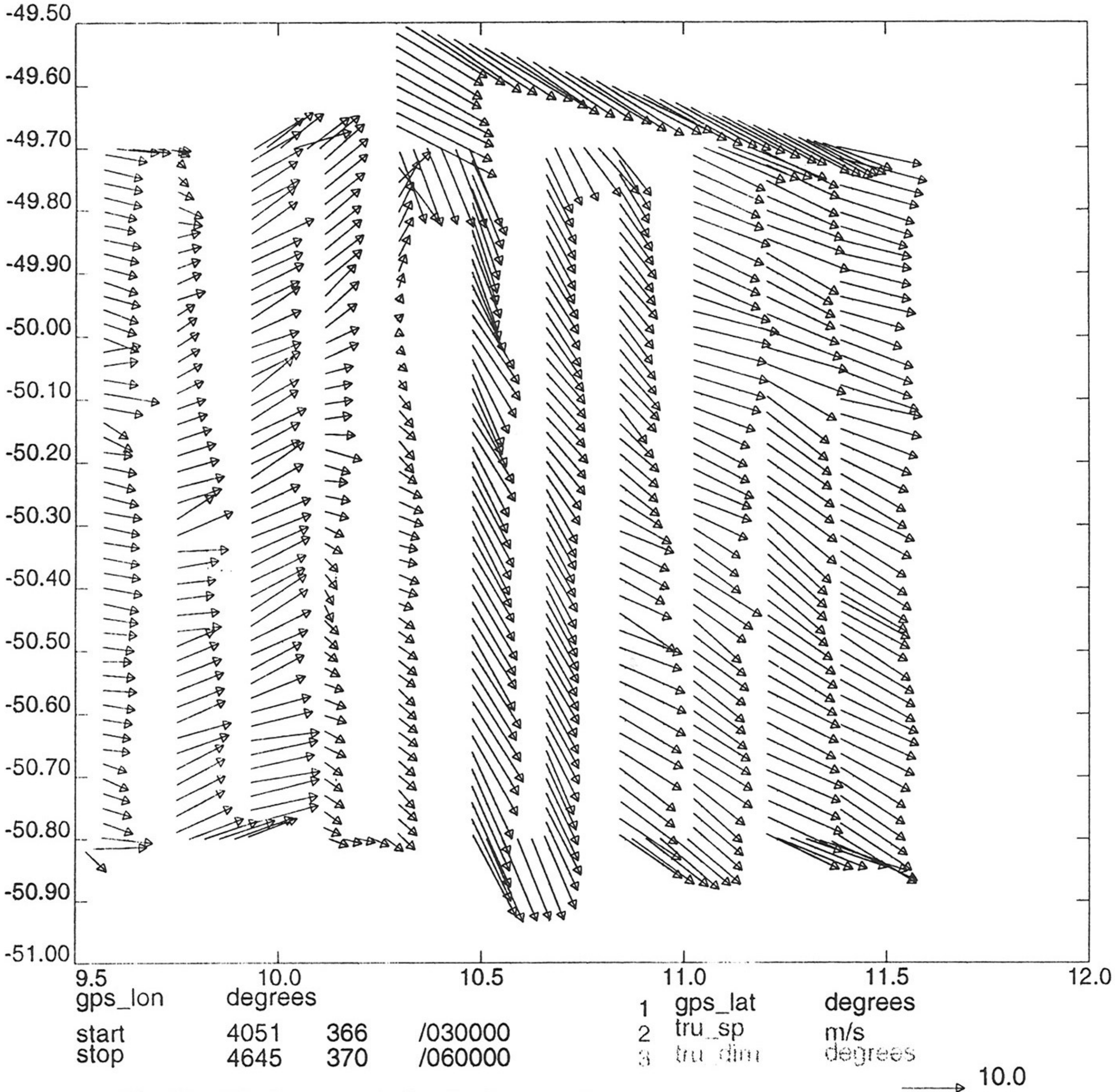


Fig. 23 Wind vectors during SeaSoar run 8

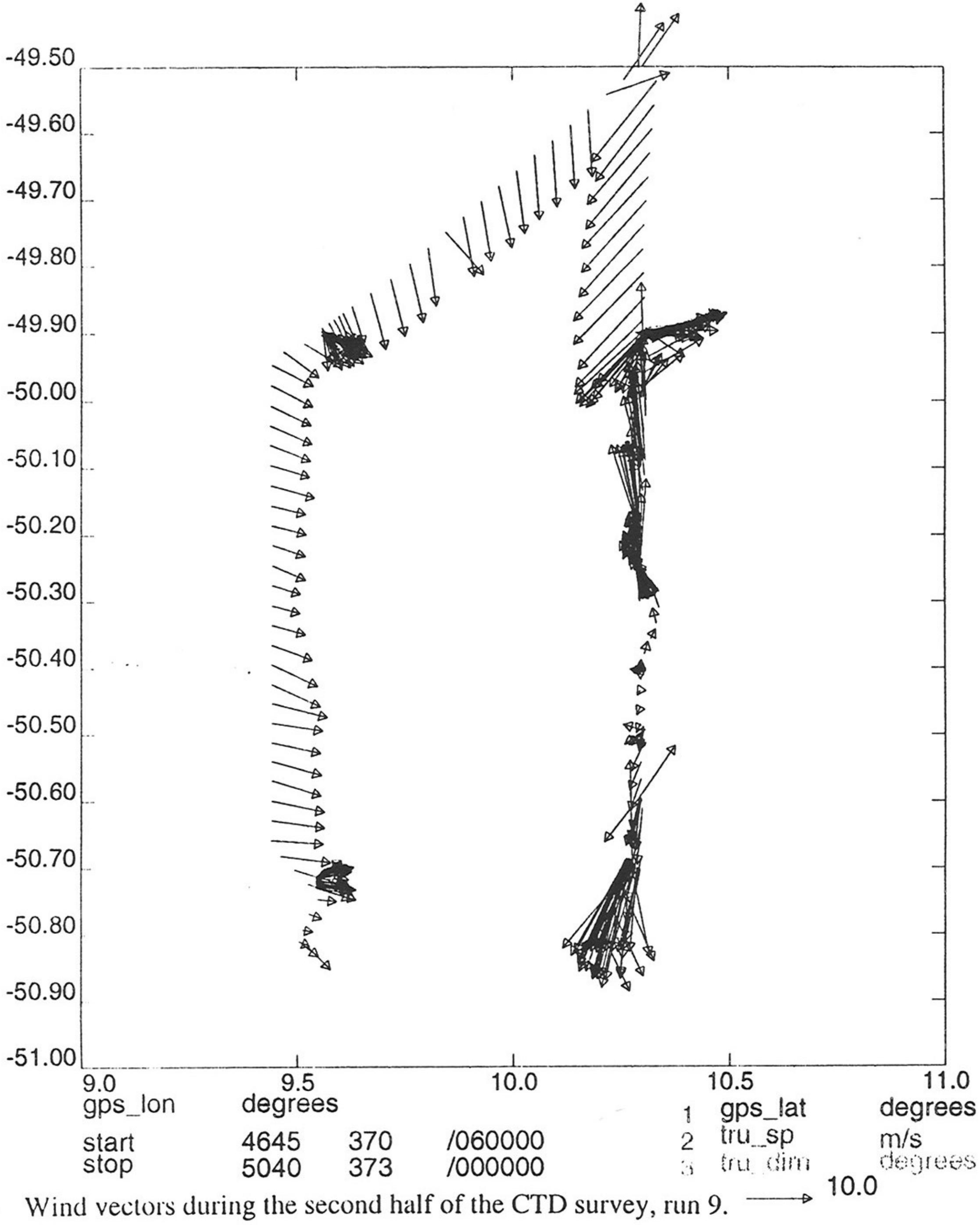


Fig. 24 Wind vectors during the second half of the CTD survey, run 9.

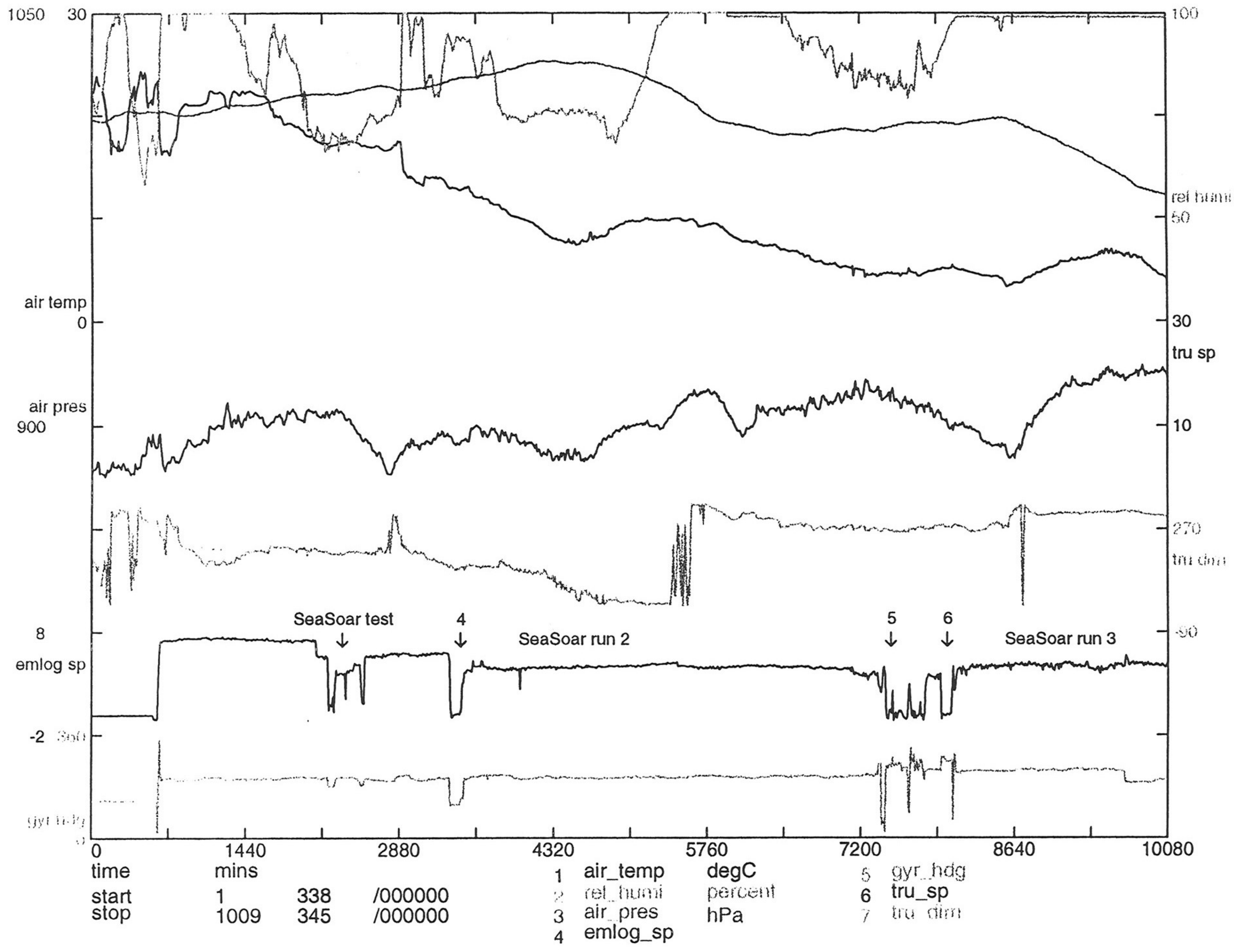


Fig. 25 Meteorological parameters. 4 - 11 December 1995. CTD stations are numbered.

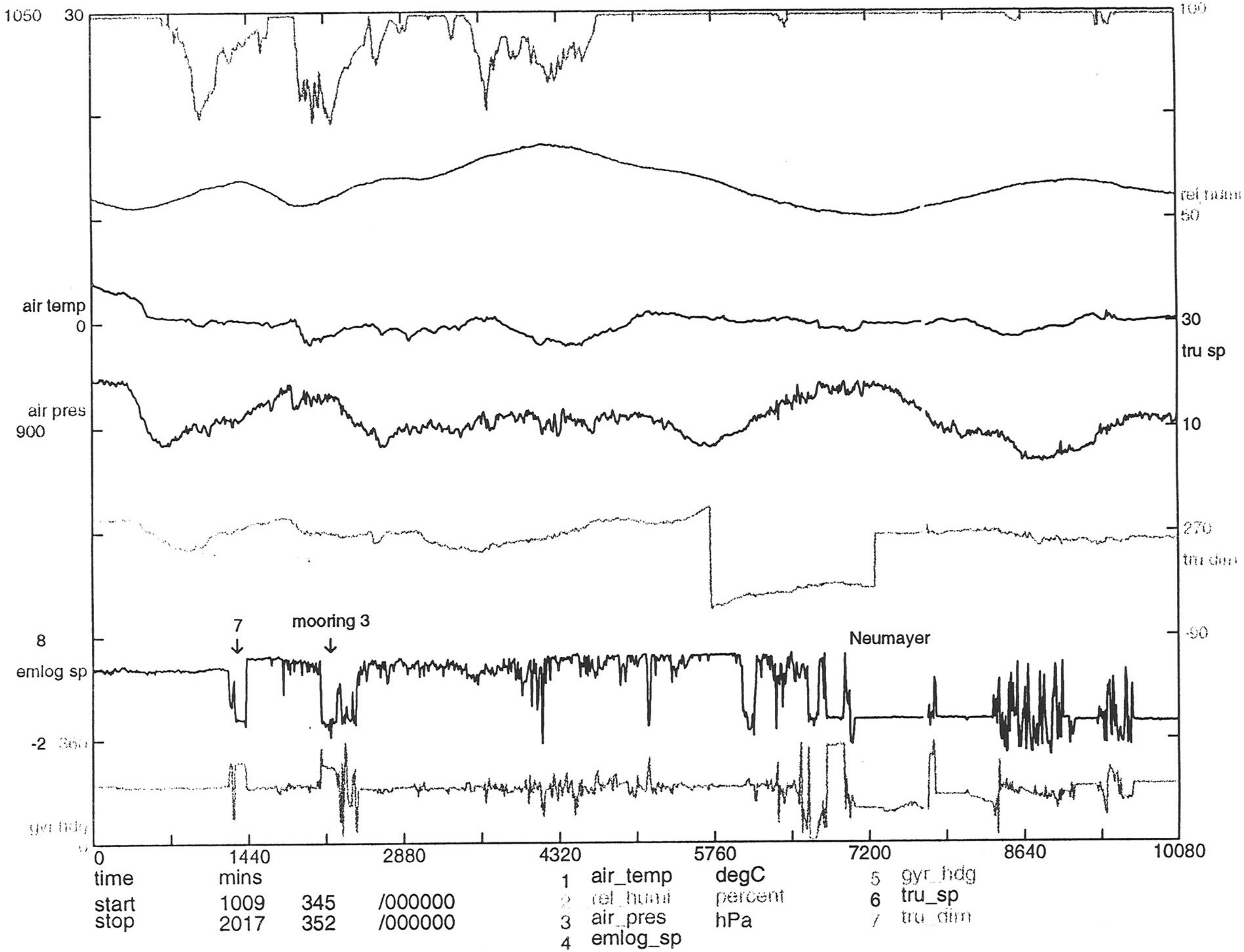


Fig. 26 Meteorological parameters. 11 - 18 December 1995. CTD stations are numbered.

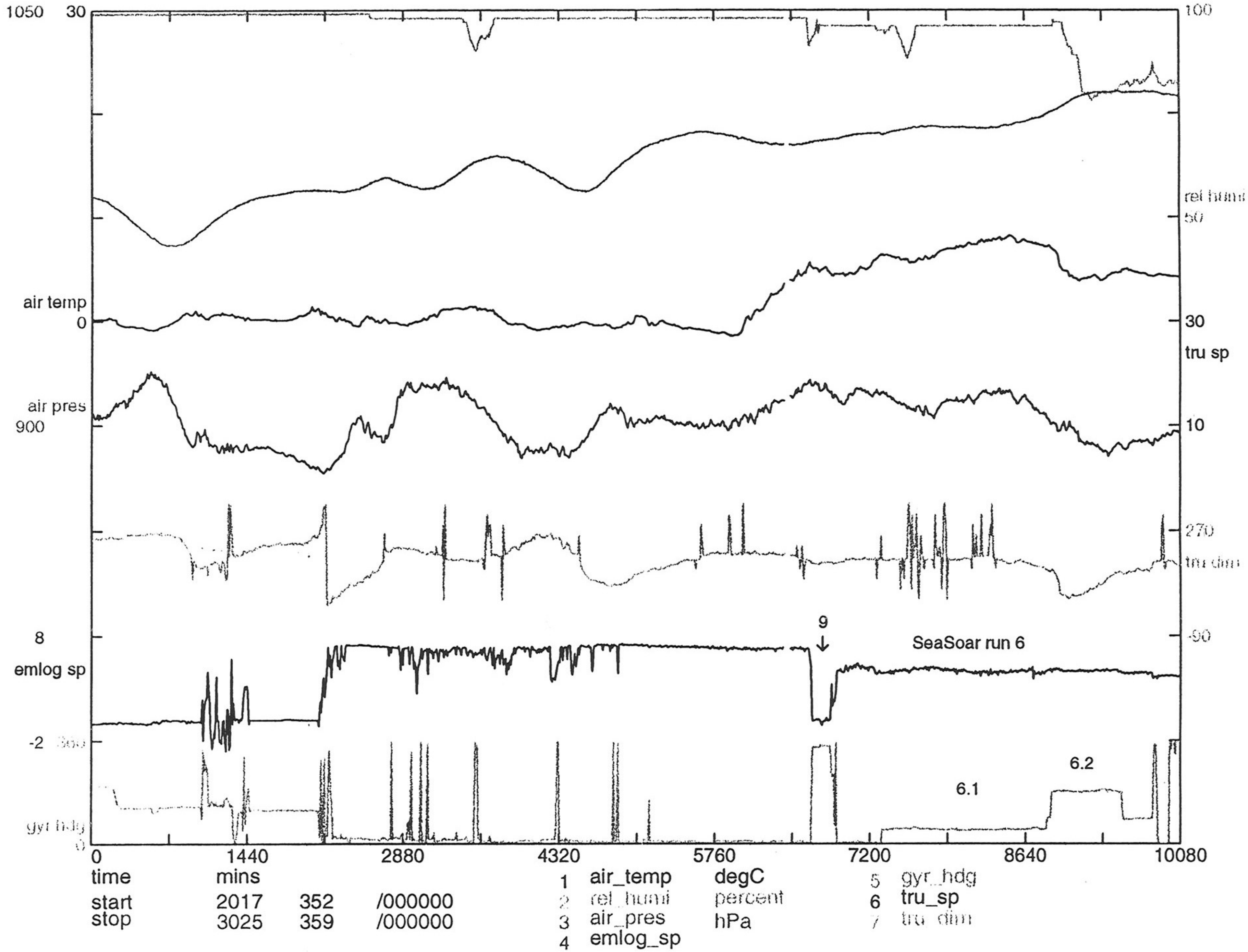


Fig. 27 Meteorological parameters. 18 - 25 December 1995. CTD stations are numbered.

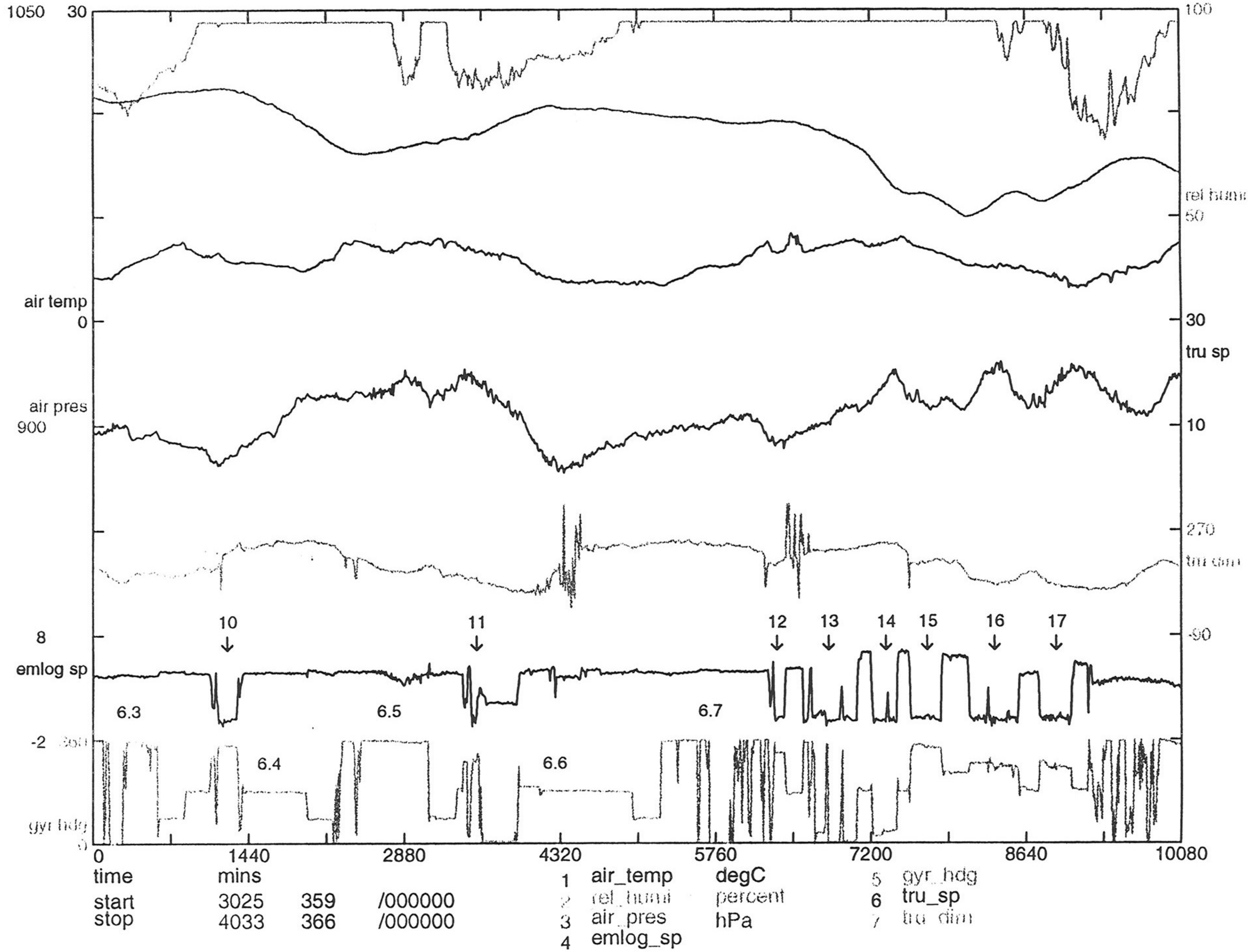


Fig. 28 Meteorological parameters. 25 December 1995 - 1 January 1996. CTD stations are numbered.

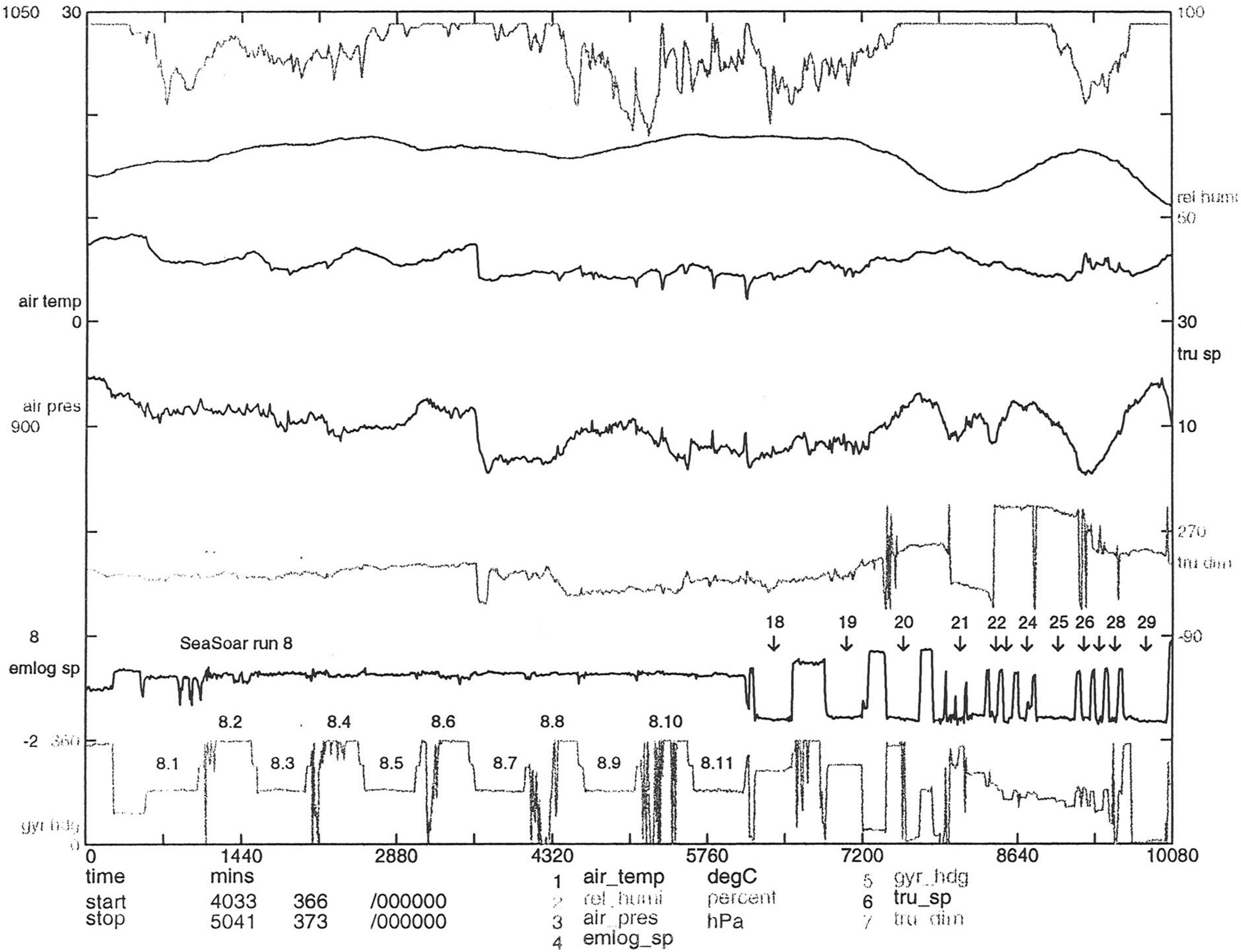


Fig. 29 Meteorological parameters. 1 - 8 January 1996. CTD stations are numbered.

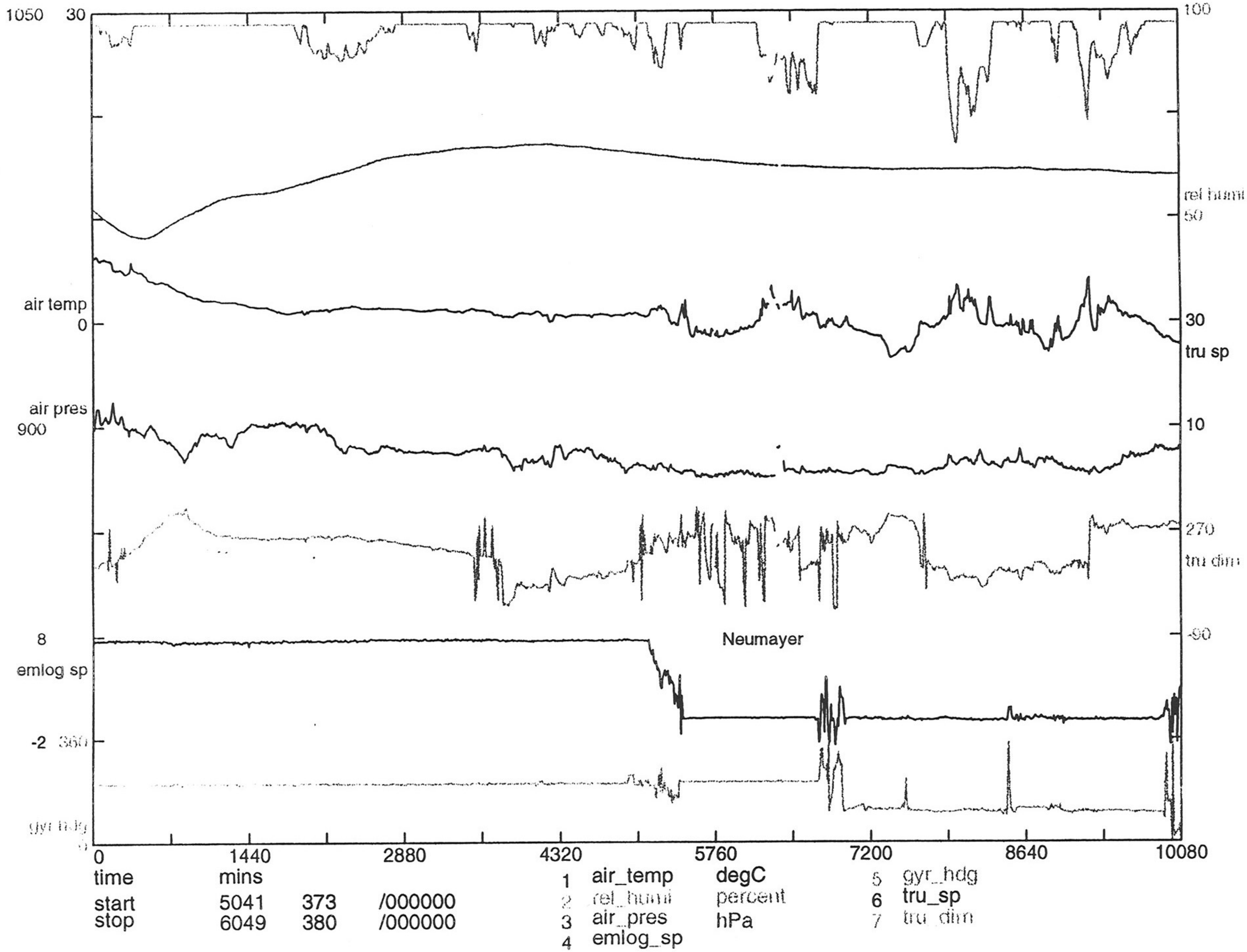


Fig. 30 Meteorological parameters. 8 - 15 January 1996

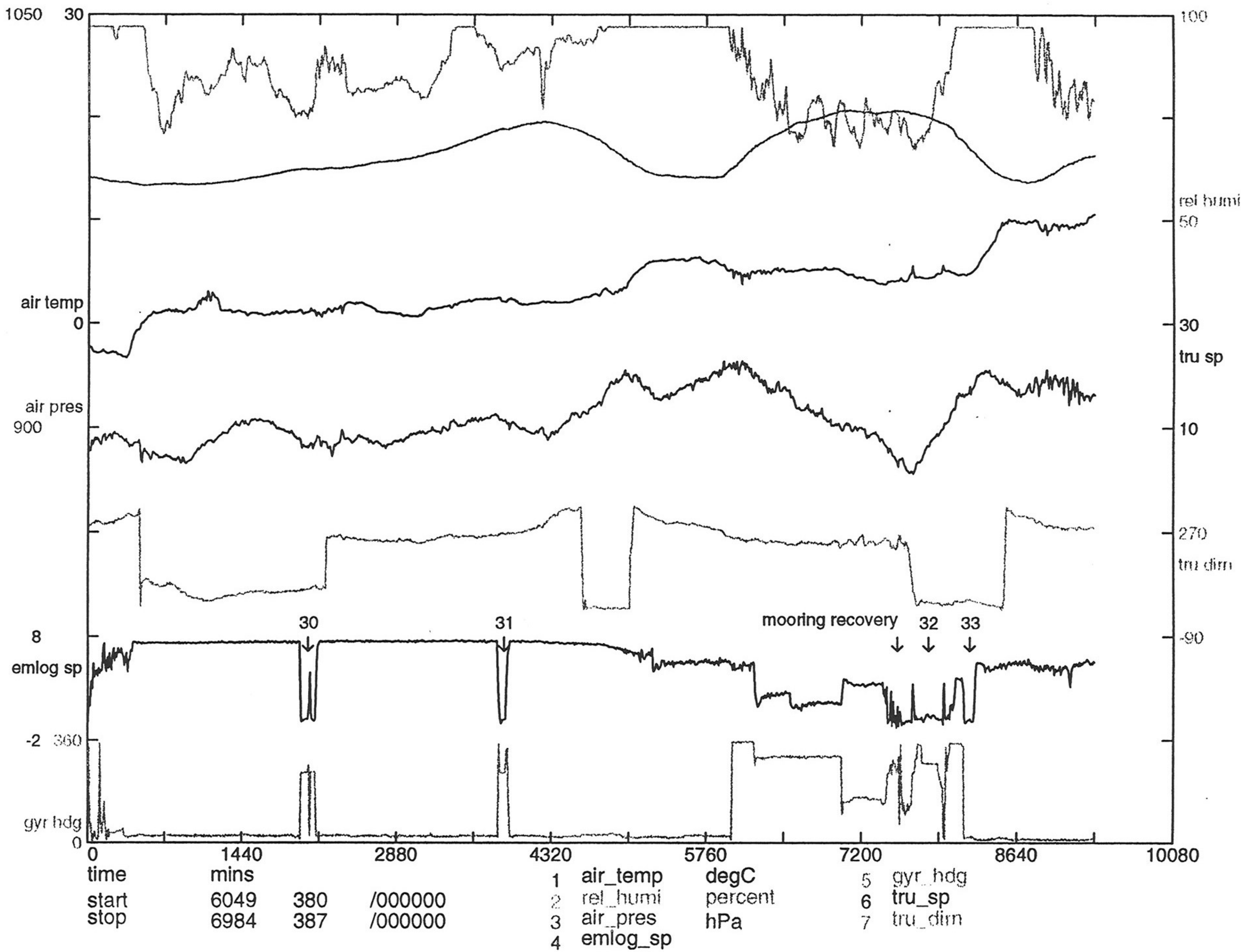


Fig. 31 Meteorological parameters. 15 - 22 January 1996. CTD stations are numbered.