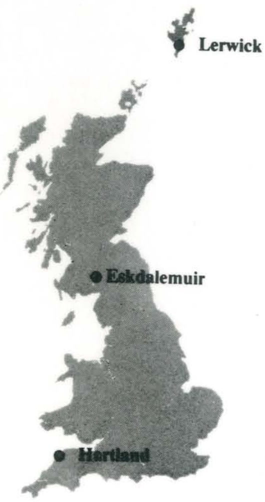
BRITISH GEOLOGICAL SURVEY

GEOMAGNETIC BULLETIN 25

Magnetic Results 1995

LERWICK, ESKDALEMUIR AND HARTLAND OBSERVATORIES



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1 INTRODUCTION

This bulletin is a report of the measurements made between 1 January and 31 December 1995 at the UK geomagnetic observatories operated by the British Geological Survey (BGS) at Lerwick, Eskdalemuir and Hartland.

The three observatory sites are described, with notes of any changes made during the year and a description is given of the Automatic Remote Geomagnetic Observatory System (ARGOS), operated at each observatory since 1 January 1987 (Riddick *et al.* 1990). The method of collecting the data from each observatory, the quality control procedures and the method of reducing the data to absolute values are also outlined.

The presentation of the data in this bulletin is principally in graphical form, with complete sets of daily magnetograms derived from one-minute values, and plots of hourly and daily mean values for each observatory. The data are available in digital form on request (details are given in Section 7).

2 DESCRIPTIONS OF THE OBSERVATORIES

The locations of the UK geomagnetic observatories are shown on the front cover of the bulletin. The history of the current UK geomagnetic observatories, and of other observatories that have operated in the British Isles, is described by Robinson (1982).

Lerwick (Shetland, Scotland)

Lerwick Observatory is situated on a ridge of high ground about 2.5 km to the SW of the port of Lerwick. The surrounding countryside is moorland comprising peat bog, heather and outcropping rock. The observatory is operated by the Meteorological Office as a meteorological station carrying out routine synoptic observations and upper-air measurements. Other work includes detection of thunderstorms, measurement of solar radiation, ozone and atmospheric pollution levels, and chemical sampling. BGS uses Lerwick as a seismological station, recording data from a local three-component seismometer set and, via radio link, from the Shetland seismic array. Lerwick was established as a meteorological site in 1919 and geomagnetic measurements began in 1922. Responsibility for the magnetic observations passed from the Meteorological Office to BGS in 1968. There are no members of BGS staff stationed at Lerwick.

Figure 1 is a site diagram of Lerwick Observatory. During 1995 no major changes were made at the site. Routine maintenance work was carried out on the observatory buildings.

The observatory coordinates are:

	Geographic	Geomagnetic
Latitude	60°08′N	62°02′N
Longitude	358°49′E	89°27′E
Height above *msl*	85 m	

Geomagnetic coordinates used in this report are relative to a geomagnetic pole position of 79°19′N, 71°26′W, computed from the 7th generation International Geomagnetic Reference Field (Barton, 1996) at epoch 1995.5.

Eskdalemuir (Dumfries & Galloway, Scotland)

Eskdalemuir Observatory is situated on a rising shoulder of open moorland in the upper part of the valley of the river White Esk in the Southern Uplands of Scotland. It is surrounded by moorland and young conifer forest with hills rising to nearly 700m to the NW. The observatory is 100km from Edinburgh and 25km from the towns of Langholm and Lockerbie.

Eskdalemuir is a synoptic meteorological station involved in measurement of solar radiation, levels of atmospheric pollution, and in chemical sampling. The observatory operates a US standard seismograph and an International Deployment Accelerometer Program long-period sensor. BGS has a three-component seismometer set installed at the observatory and records data from four remote sites transmitted to the observatory by radio link. The observatory opened in 1908. It was built because of disruption to geomagnetic measurements at Kew Observatory (London) following the advent of electric tramcars at the beginning of the 20th century. BGS took over responsibility for magnetic observations from the Meteorological Office in 1968. There are two members of BGS staff stationed at the observatory. Mr W E Scott and Mrs M Scott were responsible for the general maintenance of the observatory during 1995.

Figure 2 is a site diagram of Eskdalemuir observatory. No major changes were made at the observatory during 1995. Routine building maintenance was carried out on the observatory buildings.

The observatory coordinates are:

	Geographic	Geomagnetic
Latitude	55°19'N	57°54'N
Longitude	356°48'E	84°05'E
Height above *msl*	245 m	

Hartland (Devon, England)

Hartland Observatory is situated on the NW boundary of Hartland village. The site is the southern half of a large meadow which slopes steeply northward into a wooded valley. The sea (Bristol Channel) is about 3 km to both the north and west of Hartland. BGS operates a three-component seismometer set and a LF microphone at the observatory, and data from seismic outstations are transmitted to the observatory by radio link.

The observatory was purpose-built for magnetic work, and continuous operations began in 1957, the International Geophysical Year (IGY). Hartland is the successor to Abinger and Greenwich observatories. The moves from Greenwich to Abinger and then to Hartland were made necessary as electrification of the railways progressed, making accurate geomagnetic measurements impossible in SE England. BGS took over control of Hartland Observatory, from the Royal Greenwich Observatory, in 1968. The observatory also houses an archive of material consisting of records of geomagnetic measurements and observatory yearbooks from all over the world. The only member of BGS staff stationed at Hartland is the caretaker, Mr C R Pringle.

Figure 3 is a site diagram of Hartland observatory. Routine maintenance was carried out on all the observatory buildings during 1995.

The observatory coordinates are:

	Geographic	Geomagnetic
Latitude	51°00'N	54°01'
Longitude	355°31'E	80°24'
Height above *msl*	95 m	

3 INSTRUMENTATION

3.1 Absolute observations

At each observatory absolute measurements are made in a single absolute hut (see the site diagrams). Since 1 January 1990 absolute values of all geomagnetic elements are referred to a single standard pillar at each of the observatories. For continuity with previous records the differences between the new and old standards are quoted in the tables of annual mean values in the sense (new standard - old standard) for all elements of the geomagnetic field. Thus annual mean values prior to 1990.5 can be referred to the new standard by adding the site difference to the old standard values. A detailed account of the change in absolute measurement reference is given by Kerridge and Clark (1991).

The instruments used at each observatory are given below.

	Fluxgate-Theodolite (Inventory Number)	**Proton Vector Magnetometer (PVM)**
Lerwick	ELSEC 810 (LER32)	ELSEC 8801 Proton precession magnetometer mounted in ELSEC 5920 coils
Eskdalemuir	Bartington MAG 01H (ESK43)	ELSEC 8801 Proton precession magnetometer mounted in ELSEC 5920 coils
Hartland	ELSEC 810 (HAD16)	ELSEC 8801 Proton precession magnetometer mounted in ELSEC 5920 coils

3.2 ARGOS: Variometer Measurements

The essential components of the ARGOS systems are a three-component fluxgate magnetometer (EDA FM100C), two proton magnetometers (ELSEC 820M), and a Digital Equipment Corporation PDP 11/23 processor which controls the operation of the system. A block diagram of the ARGOS system is given in Figure 4a. The fluxgate sensors are orientated to measure the north (X), east (Y) and vertical (Z) components of the geomagnetic field. The fluxgate magnetometer is operated in 'full field' mode, providing an analogue output of 5 V in a field of 50,000 nT. The fluxgate sensors are located in a temperature-controlled variometer chamber, on a large single pier, with the individual sensors separated by about 1.5 m. Each sensor is mounted inside a calibration coil which can apply a bias field to the sensor when required. The current to the calibration coil is supplied by a Time Electronics 9818 programmable current supply. The temperature of the variometer chamber is monitored continuously. The proton magnetometers are sited in non-magnetic huts. Proton magnetometer P1 is used to make measurements of total field F every ten seconds which are filtered to produce one-minute values. Proton magnetometer P2 is mounted inside a set of two orthogonal Helmholtz coils which apply bias fields to measure changes in declination and inclination for the baseline reference measurements (see Section 3.3).

A Thaler Corporation VRE 105CA precision reference supply is used to generate a reference signal of 5 V to an accuracy of 0.4 mV. In routine operation the analogue outputs from the three channels of the fluxgate magnetometer, the temperature sensor and the voltage reference are switched in turn, by a Hewlett-Packard HP3488A scanner, to the input of a Datron 1061A digital voltmeter and the five signals are measured. At the same time the PDP 11/23 processor triggers one of the proton magnetometers (P1) which measures the total field strength (F). (The second proton magnetometer (P2) is routinely inhibited.) This measurement sequence is repeated every 10 seconds, with the timing reference provided by a CMOS digital clock connected to the PDP 11/23 through a parallel interface. Communications between the PDP 11/23 processor and the other instruments and peripherals are via an IEEE instrument bus and RS232 serial ports.

A 7-point cosine filter is applied to the 10-second samples to produce one-minute values, centred on the minute, (Green, 1985). At the end of each hour the 60 one-minute values of X, Y, Z and F are written to a DC100 data cartridge together with hourly mean values, one-hour and three-hour activity indices based on the range in the X-component, the temperature of the variometer chamber, the reference voltage, and items of `housekeeping' information. An hour's data is written, in ASCII, as two 512 byte blocks. The cartridge drive is a TU58 dual drive. The system program is loaded from tape on drive 0, and data are written to the tape mounted on drive 1. The tape capacity is sufficient to store up to ten days' data. At each observatory the data collected are displayed on a VDU, and updated every minute, to enable the status of ARGOS to be monitored locally. A printer, normally disabled, can be switched on to obtain hard-copy of the display.

A British Telecom Datel 4122 modem (operating at 1200 baud) allows remote communication with the ARGOS systems via the public switched telephone network (PSTN). ARGOS can be called up manually by an operator in Edinburgh using the Processing and Remote Interrogation System (PARIS), based on a PDP 11/23 computer. The operator in Edinburgh can examine the system status and control a number of other ARGOS functions which include resetting the system clock, repositioning the data tape, and restarting ARGOS in the event of a system failure.

A second modem connected to a Data Track Technology Tracker 2000 solid state memory transmits data to an IBM PS/2 in Edinburgh, which has been programmed to collect data automatically. Data can be retrieved every hour if necessary, but are normally collected every three hours.

Each ARGOS system is supported by a 500 VA Merlin-Gerin SX500 Uninterruptible Power Supply which has internal batteries capable of powering the full system for 30 minutes in the event of mains failure. Each observatory also has a stand-by diesel generator designed to start automatically within two minutes of loss of mains power. In the event of a sustained mains break and failure of the stand-by generators a further battery supply will maintain power to the fluxgates and the system clock for up to 7 days. This avoids deterioration in data quality due to drifts which are almost always severe when a fluxgate magnetometer is switched on after being powered down. The time from the system clock is essential to restart ARGOS automatically when power is restored.

3.3 ARGOS: Baseline Reference Measurements

A consequence of the automation of the observatories was the removal of observatory scientific staff, and therefore the loss of regular absolute observations made by experienced observers. Baseline reference measurements (BRMs) are designed to compensate for this change in observatory practice, enabling the standards achieved with manned operation to be maintained with an automated system.

The apparatus used to make BRMs is essentially a proton vector magnetometer (PVM), in which a proton precession magnetometer (PPM) sensor is mounted at the centre of a set of coils which are used to apply bias fields. Full PVM absolute observations require a sequence of measurements to be made with the coils rotated into positions which enable errors due to imperfect alignment of the magnetic axis to be eliminated. In a BRM the coils cannot be rotated, so the measurement is not error-free. If the mechanical stability of the coil system is good, and the pier on which it is mounted does not tilt, then the error is (practically) constant. Comparisons of BRM results with measurements made by the ARGOS fluxgates then show up short-term drifts in the fluxgate magnetometers which would not be detected by comparisons made with the less frequent absolute measurements. In effect, BRMs provide a means for interpolating between absolute observations.

The PVM system used for making BRMs at each of the UK observatories consists of a PPM sensor mounted at the centre of two orthogonal sets of Helmholtz coils in a "$\delta D/\delta I$" configuration. The coils are orientated initially so that one set provides a bias field approximately perpendicular to the geomagnetic field vector (F) in the magnetic meridian, and the other provides a bias field approximately perpendicular to F in the horizontal plane. If the resultant magnetic field is measured after applying the bias fields then vector algebra can be used to calculate the change in declination (δD) and the change in inclination (δI) relative to values of declination and inclination (D_0 and I_0) determined by the directions of the magnetic axes of the coils. The values of D_0 and I_0 can be determined by comparing the BRM measurements with absolute observations. This technique is described in full by Alldredge (1960).

In ARGOS, BRMs are made by the proton magnetometer P2 and are controlled by a microprocessor-based BRM controller driven by interrupts from the ARGOS PDP 11/23. Measurements are made every hour and are included in the data transmitted to Edinburgh.

3.4 Summary of Technical Specifications of the ARGOS Equipment

The specifications quoted here are those given by the manufacturers of the equipment.

a) FM100C fluxgate magnetometer

Sensitivity:	0.1 mV/nT
Dynamic range:	±100,000 nT
Temperature coefficient:	(in the range) 0.1 - 1 nT/°C

b) ELSEC 820M proton precession magnetometer

Resolution:	0.1 nT
Accuracy:	±1 nT
Measurement range:	14,000-90,000 nT

c) System clock

Accuracy:	1 second per week

d) Datron 1061A digital voltmeter (DVM)

Accuracy:	1 part in 10^7
Temperature coefficient:	0.2 μV/°C

e) Time Electronics 9818 programmable current supply

Maximum current:	1A
Accuracy:	1μA

f) Thaler Corporation VRE 105CA precision reference supply

Reference voltage:	5V
Accuracy:	±0.4 mV
Temperature coefficient:	0.6 ppm/°C

3.5 Back-up Systems

At each observatory an EDA FM 100B three-axis fluxgate magnetometer, completely independent of ARGOS, is maintained to provide back-up data in the event of a total ARGOS failure. The three fluxgate sensors are aligned with one along magnetic north to measure changes in the horizontal component (H), one along magnetic east to measure changes in declination (D) and one vertically to measure changes in the Z component. The analogue outputs of the magnetometer are input to a 12-bit A/D converter and sampled every 10 seconds. A 7-point cosine filter is used to convert the 10-second samples to one-minute values, which are then recorded on a 3.5" DOS diskette by a GCAT embedded PC. The disk is changed every 14 days and sent by post to BGS, Edinburgh, for archiving. The dynamic range of the magnetometers at Lerwick is ±2000 nT, at Eskdalemuir and Hartland it is ±1000 nT. A block diagram of the back-up system is shown in Figure 4b. A facility is also included in the back-up system to transmit data to Edinburgh via the METEOSAT geostationary satellite. This link can be used to retrieve back-up data quickly in the event of the loss of ARGOS data.

3.6 Calibration of geomagnetic measurements

The physical measurements made by ARGOS are of the analogue DC voltage output from the fluxgate sensors and the precession frequency radiated by the polarised sample in the PPM.

Provided drift in the voltage reference used by the DVM is less than that of the fluxgate magnetometer, long term changes in the measurement of the magnetic field are only due to drift in the magnetometer. The DVM is calibrated every three months by comparing it with a second DVM which is calibrated anually to comply with National Physical Laboratory (NPL) standards. Its accuracy is quoted as 1 part in 10^7. Checks are also made every three months using standard cells which are maintained at each observatory. A check of the fluxgate sensitivity is also carried out by applying a bias field to the sensor. This is done by passing a known current through Helmholtz coils with an accurately known coil constant. The current is supplied by a constant current power supply which is calibrated by measuring the voltage across a standard resistor using a DVM calibrated against NPL standards. The change in the applied magnetic field can then be related to the change in voltage output from the sensor.

The PPM measures the frequency of emitted radiation from a sample of proton rich fluid, which is related to the ambient magnetic field by the proton gyromagnetic ratio. The conversion from frequency to magnetic field value carried out by the PPM is checked by irradiating the sensor with a signal of known frequency from an oscillator. The frequency of this calibration signal is checked by comparing it with an accurate frequency standard transmitted from Rugby. This check on the PPM is carried out every three months at each observatory.

4 DATA PROCESSING

Data are retrieved to Edinburgh from the observatories by a dedicated IBM PS/2 which has been programmed to call the observatories automatically every three hours. The data are then transferred over a local area network to the BGS VAX 6410 mainframe for processing.

Data-processing is carried out automatically on the VAX each day shortly after midnight. The data files are first sorted into Universal Time (UT) day files. Subsequent data processing is carried out on these day files by a single FORTRAN program on the VAX which uses subroutines to generate various data products and derivatives. The data in each day file are first passed through a quality control routine which checks for a range of possible errors. The data products then generated each day are:

a A magnetogram;
b A formatted list of one-minute values of all the geomagnetic elements;
c Hourly mean values and range indices;
d A forecast of geomagnetic activity for the next 27 days;
e Hourly and daily ranges in each geomagnetic element;
f A comparison of F computed from X, Y and Z against F measured by P1;
g A list of missing data;
h K indices;
i An analysis of BRMs;
j An analysis of ARGOS reference voltage and variometer chamber temperature;
k A plot of absolute F measured by P1 at all three observatories.

The final check on the quality of the data is still the responsibility of the operator in Edinburgh who examines the magnetograms each day for erroneous values which may not have been detected by the automatic quality control procedures.

The prompt retrieval of data from the three UK observatories, made possible by ARGOS, immediately generated scientific and commercial demand for rapid access to the data. The VAX is connected to the UK Joint Academic Network (JANET) which enables transfer to academic users worldwide; commercial users can access the VAX using a British Telecom X25 gateway or dial-up modem. The Geomagnetism Information and Forecasting Service (GIFS) was created in 1988 to provide a "user-friendly" interface between enquirers and the data sets, (Kerridge and Harris, 1988). GIFS, originally set up for academic users, now has separate academic and commercial sections. The data sets on GIFS derived from UK observatory data are updated daily.

At the end of each month any gaps in the ARGOS data are filled using data from the back-up magnetometers. The resulting complete day files are archived on magnetic tape (two copies) on the VAX and also on optical disk. A monthly bulletin is issued for each observatory which includes magnetograms (with gaps filled), lists of K indices, the results of absolute observations, BRMs made during the month, tables of hourly mean values of H, D and Z, and a list of events associated with solar activity. The *aa* magnetic activity indices and a forecast of solar and geomagnetic activity are also given in the monthly bulletin. A diary giving details of any changes made during the month at the observatory is included at the end of the bulletin.

There were no periods in 1995 at any of the three UK observatories in which both the ARGOS and back-up variometers failed simultaneously. Consequently the time-series of one-minute values are complete throughout the year at all three observatories.

5 CORRECTION OF FLUXGATE VARIOMETER DATA TO ABSOLUTE VALUES

Where variometer records are made photographically a physical mark, a baseline, is made on the photographic paper. Absolute observations are used to allocate a value to the baseline using the sensitivity of the magnetometer (the scale value, usually expressed in nT/mm), to relate the offset of the trace at the time of an absolute observation (the ordinate) to the baseline. For a fluxgate magnetometer a baseline value may be taken to be the value of the geomagnetic field at an arbitrary output voltage of the magnetometer. An alternative view is that the fluxgate magnetometer sensitivity (usually expressed in mV/nT) is used to, in effect, deduce the magnetometer output in zero magnetic field. The absolute observations enable corrections to be made for any such zero-field offset, (which is likely to vary with time), and the site difference between the location of the fluxgate sensor and the appropriate absolute pier.

The zero-field offset corrections allocated for each observatory for 1995 are shown in Figures 5-7. (The results for each observatory are discussed in detail below.) The zero-field offset correction is derived by comparing the fluxgate measurements with absolute measurements taken simultaneously. In each of the figures the top two panels show the comparison between the absolute measurements and the fluxgate measurements for H (plotted in the sense absolute - fluxgate) and the BRMs and the fluxgate measurements for H (plotted as daily average BRM - fluxgate value). The next two panels show the same for D, in which East is represented by positive values, and the next two panels show the same for Z. The bottom panel shows the daily mean temperature in the fluxgate chamber. In the panels showing the absolute - fluxgate comparison, the symbols represent the observed values and the full line shows the adopted correction. The adopted correction is derived from piecewise polynomial fits to the observed values computed using the method of least squares. In deriving the polynomials the points immediately before the beginning and after the end of the year were used, but are not shown in the plots. This ensures that unrealistic discontinuities are not introduced at the year boundaries. The plots of the polynomial fits are stepped because the values computed from the polynomials have been rounded to the nearest nT or 0.1 min.

Lerwick (Figure 5)

Absolute measurements were made by BGS staff during service visits to the observatory in January, May, August and October. These show on the plots as clusters of measurements made within a few days. The measurements between service visits were made by Meteorological Office staff.

The ranges of the allocated zero-field offset corrections during the year were 3 nT for H, 1.6 minutes of arc for D and 15 nT for Z. The main deviation in the Z corrections appears to be an annual effect and is probably related to an increase in the temperature of the variometer chamber during the summer. The temperature variation in the variometer chamber was kept to within ±1 °C over the year.

The comparison of BRMs with fluxgate measurements shows a significant drift in the first four months of the year in the D BRMs. A period of drifting is also observed in the H BRMs during the summer months. It is likely that this drift is related to changes in the outside air temperature causing mechanical deformation of the coils. Despite these drifts, the BRMs are still useful at times for allowing greater confidence in interpolating zero-field offsets between absolute observations. This is important because there are relatively fewer absolute observations at Lerwick than at the other UK observatories.

The table below lists the root mean squared (*rms*) differences of the observed zero-field corrections from the allocated values. The *rms* differences for 1992-94 are also listed. The number of observations of each element in each year is given in brackets.

Year	H(nT)	D(min)	Z(nT)
1992	1.70 (26)	0.36 (27)	1.21 (26)
1993	1.69 (31)	0.36 (33)	0.93 (30)
1994	0.87 (21)	0.25 (21)	0.66 (21)
1995	0.97 (21)	0.35 (24)	0.85 (23)

Eskdalemuir (Figure 6)

Absolute measurements were made weekly by staff of the Meteorological Office at Eskdalemuir, supplemented by occasional measurements made by BGS staff.

The ranges in the allocated zero-field offset corrections over the year were 18 nT for H, 3.1 minutes of arc for D and 4 nT for Z. The rate of drift in the zero-field offset corrections appeared to increase towards the end of the year. The temperature variation in the variometer chamber was kept to within ±0.5 °C over the year.

The BRMs have been used to compute the zero-field offset corrections for the previous two years at Eskdalemuir, but in 1995 an irregular drift commenced in these measurements which meant they could not be used for this purpose.

The table below lists the *rms* differences of the observed zero-field corrections from the allocated values. The *rms* differences for 1992-94 are also listed. The number of observations of each element in each year is given in brackets.

Year	H(nT)	D(min)	Z(nT)
1992	1.43 (36)	0.55 (36)	0.83 (36)
1993	1.44 (40)	0.41 (42)	0.85 (41)
1994	1.56 (28)	0.45 (29)	0.92 (28)
1995	1.31 (44)	0.29 (42)	0.97 (45)

Hartland (Figure 7)

Absolute measurements were made weekly by the caretaker at Hartland Observatory and by Edinburgh staff during service visits.

The ranges of the zero-field offset corrections over the year were 6 nT for H, 0.1 minutes of arc for D and 10 nT for Z. The drift in the Z fluxgate, which appears to be similar to that observed at Lerwick, is probably related to the increase in temperature during the summer. The temperature variation in the variometer chamber was kept to within ±1.25 °C over the year.

The BRMs have exhibited large drifts in 1995 which seemed to be related to the increase in daily mean air temperature during the summer.

The table below lists the *rms* differences of the observed zero-field corrections from the allocated values. The *rms* differences for 1992-94 are also listed. The number of observations of each element in each year is given in brackets.

Year	H(nT)	D(min)	Z(nT)
1992	1.11 (48)	0.36 (49)	1.69 (49)
1993	1.16 (43)	0.28 (51)	1.36 (44)
1994	1.20 (56)	0.25 (56)	0.70 (56)
1995	1.05 (44)	0.21 (46)	1.24 (43)

6 PRESENTATION OF RESULTS

The data are organised by observatory in the order Lerwick, Eskdalemuir and Hartland. The results presented for each observatory are:

- a Daily magnetograms of H, D and Z;
- b Plots of hourly mean values of H, D and Z;
- c Plots of daily mean values of H, D and Z;
- d Plots of the daily maximum and minimum values of H, D and Z;
- e Tables of monthly and annual mean values of all geomagnetic elements;
- f Tables of K indices;
- g A list of rapid variations noted during the year;
- h Tables of annual mean values of geomagnetic elements;
- i Plots of annual mean values and secular variation for H, D, Z and F.

The daily magnetograms of H, D and Z are plotted 16 to a page, the data for days 1 to 16 of each month on one page, and the data for the remaining days of the month on the facing page. The D trace is plotted positive (east) upwards. The absolute level in each plot is indicated by the value shown to the left of the plots, in degrees for D and in nanoteslas for H and Z. The magnetogram scale values, shown to the right of the plots, are varied (by multiples of two) where necessary, and when changes are made this is indicated at the top of the magnetogram. This accounts for the occasional discontinuities in the traces at day boundaries.

The hourly mean data are plotted at a constant scale in 27-day batches, according to the Bartels rotation number. These plots show a number of features of geomagnetic field variations including diurnal variation, and seasonal changes in its magnitude, and periods of geomagnetic disturbance. By plotting the data in 27-day batches recurrent disturbances caused by active regions on the Sun which persist for more than one solar rotation are highlighted. Changes due to secular variation at the UK observatories over the course of a year are small compared to diurnal variations and disturbances. However, the gradual drift eastwards in D is discernible in the plots.

In the plots of daily mean values secular variation is quite clear in H, D and Z, as shorter period variations are attenuated by the averaging. The reference values shown on the left sides of the daily mean plots are the annual mean values. The black shading indicates when the daily mean was less than the annual mean, the white part indicates when the daily mean was greater. The plots of daily maximum and minimum values are also plotted relative to the annual means.

ARGOS data are corrected using BRMs and absolute observations to produce a series of absolute one-minute values of H, D and Z centred on the minute. Hourly mean values, centred on the UT half-hour, are computed from minute values, daily mean values from hourly means, and monthly mean values from daily means. (Hourly means are not computed if there are more than six one-minute values missing; daily means are not computed if there are more than two hourly means missing.) Annual mean values are calculated from the monthly mean values weighted according to the number of days in the month. At each stage of processing the mean values of the remaining geomagnetic elements are calculated from the corresponding mean values of H, D and Z. The monthly mean and annual mean values for all the geomagnetic elements are tabulated. Declination and inclination are expressed in degrees and decimal minutes of arc, the units of all the other elements are nanoteslas. The monthly and annual mean values are also calculated using only the five international quiet days and the five international disturbed days in each month.

The K index summarises geomagnetic activity at an observatory by assigning a code, an integer from 0 to 9, to each 3-hour UT interval. The index values are determined from the ranges in H and D (scaled into nT), with allowance made for the regular diurnal variation. The method for computing K indices is described by Clark (1992). The K index has a Local Time and seasonal dependence associated with the geographic and geomagnetic coordinates of the observatory. The complete set of K indices for each of the UK observatories are tabulated throughout the year. A summary of the occurrence of each K index in 1995 is given below, with the number of missing intervals under the column headed "Null".

	K Index										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Null**
LER	744	844	686	409	163	52	12	6	4	0	0
ESK	539	772	696	594	234	76	7	0	1	1	0
HAD	134	994	766	619	289	102	15	1	0	0	0

A number of 3-hour geomagnetic indices are computed by combining K indices from networks of observatories to characterise global activity levels and to eliminate Local Time and seasonal effects. K indices from each of the three UK observatories are used in deriving the planetary geomagnetic activity indices Kp, Kn and Km, sanctioned by the International Association of Geomagnetism and Aeronomy (IAGA). The K indices from Hartland and Canberra (approximately antipodal to Hartland) are used to produce the aa index, a further planetary activity index. (Definitive values of the indices recognised by IAGA are published by the International Service for Geomagnetic Indices, Paris.) Daily, monthly and annual mean values of the aa index are listed following the tables of K indices for Hartland. The derivation of the geomagnetic activity indices mentioned here is described in great detail by Mayaud (1980).

The scaling of rapid variations is performed according to the guidelines given in the Provisional Atlas of Rapid Variations (IAGA, 1961). Occurrences of Solar Flare Effects (SFE), Sudden Impulses (SI) and Storm Sudden Commencements (SSC) are given along with the time, amplitude and quality of the event.

The annual mean values at each observatory since operations began are tabulated. Declination and inclination are expressed in degrees and decimal minutes of arc, the units of all the other elements are nanoteslas. Plots of the annual mean values of H, D, Z and F, and of first differences of the annual means, representing secular variation at the observatories are presented. In the case of Hartland, annual mean values from Abinger observatory for 1925.5-56.5 have been included in the table. The plots for Hartland also include values from Abinger, taking into account the site differences between the two observatories determined during 1957 when both observatories operated simultaneously for a period of time.

7 DATA AVAILABILITY

One-minute mean values of geomagnetic elements at each of the UK observatories from 1983 onwards are available in digital form. Hourly mean values are available in digital form for Lerwick (1926-95), Eskdalemuir (1911-95), Abinger (1926-56) and Hartland (1957-95). K indices from the UK observatories are available in digital form from 1954 onwards. In its role as the World Data Centre C1 for Geomagnetism, the Geomagnetism Group also holds a selection of hourly mean values and annual mean values from observatories worldwide. Digital data can be transferred by electronic mail over JANET, or supplied on IBM compatible 3.5 inch diskettes. For more information contact:

Data Services
Geomagnetism Group
British Geological Survey
Murchison House
West Mains Road ☎: 0131 667 1000
Edinburgh EH9 3LA Fax: 0131 668 4368
Scotland UK Telex: 727343 SEISED G

8 GEOMAGNETISM GROUP STAFF LIST 1995

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PSec	Mrs M Milne
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	J C Riddick
SSO	Dr T D G Clark
HSO	S M Flower
	T J Harris
	Dr S Macmillan
	E M Reader
	Dr A W P Thomson
SO	J G Carrigan
	A Carruthers *(Contract finished Aug 1995)*
	Ms E Clarke
	M D Firth *(Contract finished Feb 1995)*
	C W Turbitt
ASO	J McDonald
Eskdalemuir	
Craftsman	W E Scott
Cleaner	Mrs M Scott
Hartland	
PGS E	C R Pringle

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Alldredge, L R. 1960. A proposed automatic standard magnetic observatory. *Journal of Geophysical Research*, **65**, 3777-3786.

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Kerridge, D J and Clark, T D G. 1991. The new standard for absolute observations at the UK geomagnetic observatories. *British Geological Survey Technical Report*, WM/91/17.

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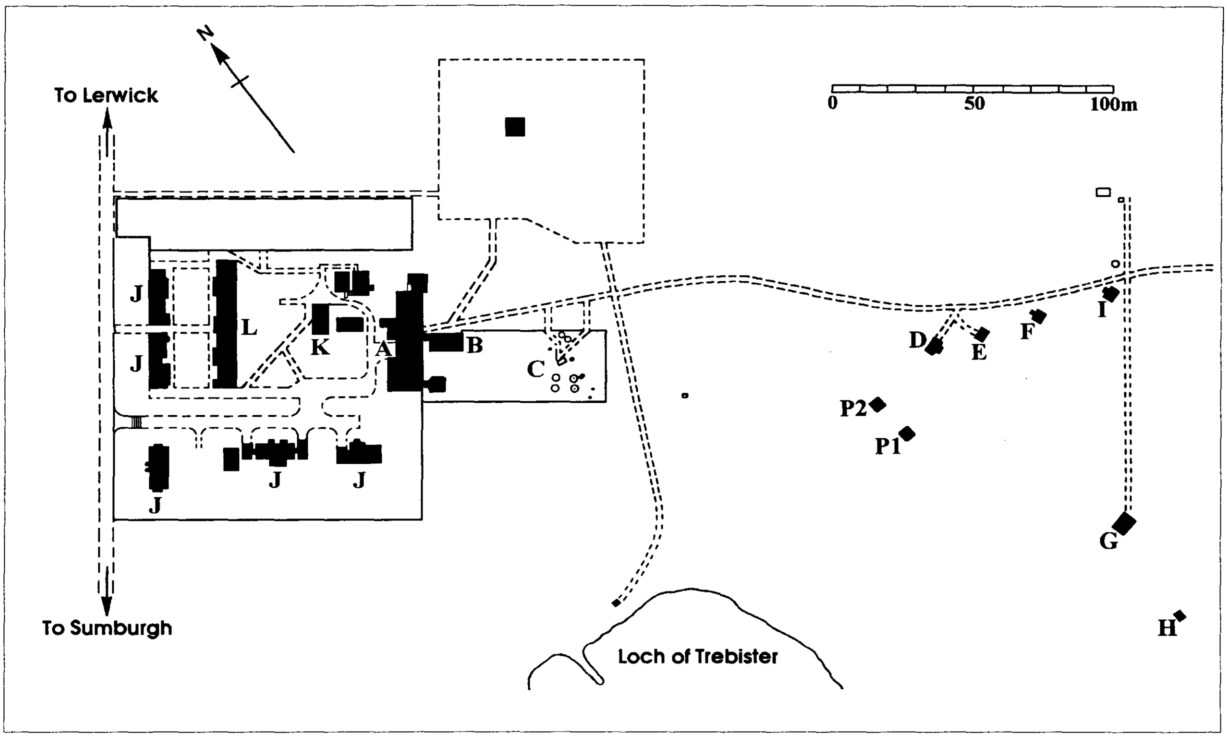
Mayaud, P N. 1980. Derivation, meaning, and use of geomagnetic indices, *American Geophysical Union, Geophysical Monograph 22*, Washington DC: American Geophysical Union, 154pp.

Riddick, J C, Greenwood, A C, and Stuart, W F. 1990. The automatic geomagnetic observatory system (ARGOS) operated in the UK by the British Geological Survey. *Physics of the Earth and Planetary Interiors*, **59**, 29-44.

Robinson, P R. 1982. Geomagnetic observatories in the British Isles. *Vistas in Astronomy*, **26**, 347-367.

Lerwick Observatory



Observatory Layout

A	Main observatory building
B	BGS office, seismic recorders
C	Meteorological instrument enclosure
D	Absolute Hut
E	Instrument Hut
F	Variometer House
G	West Hut
H	Azimuth mark
I	Back-up fluxgate data-logger
J	Staff houses
K	Standby generator
L	Staff hostel
P1	ARGOS Proton magnetometer 1
P2	ARGOS Proton magnetometer 2 & δ/D/δI coils

Instrument Deployment

Absolute Hut
PVM (used for H/Z/F measurements)
D/I Fluxgate Theodolite

The fixed mark (azimuth 8° 38' 02" E of S) is viewed through a sliding panel in the hut door.

Instrument Hut
PVM electronics
ARGOS electronics
ARGOS uninterruptible power supply (UPS)

Variometer House
ARGOS fluxgate sensors (X,Y,Z)
Back-up fluxgate sensors (H,D,Z)

The Variometer House is constructed from non-magnetic concrete and has internal dimensions of 4.9 by 3 metres. The roof is semi-circular in cross section. The temperature of the house is controlled to a diurnal range of ± 1°C. The meridian at the time of construction is defined on the north and south walls.

West Hut
Remote Fluxgate magnetometer transmitting via METEOSAT

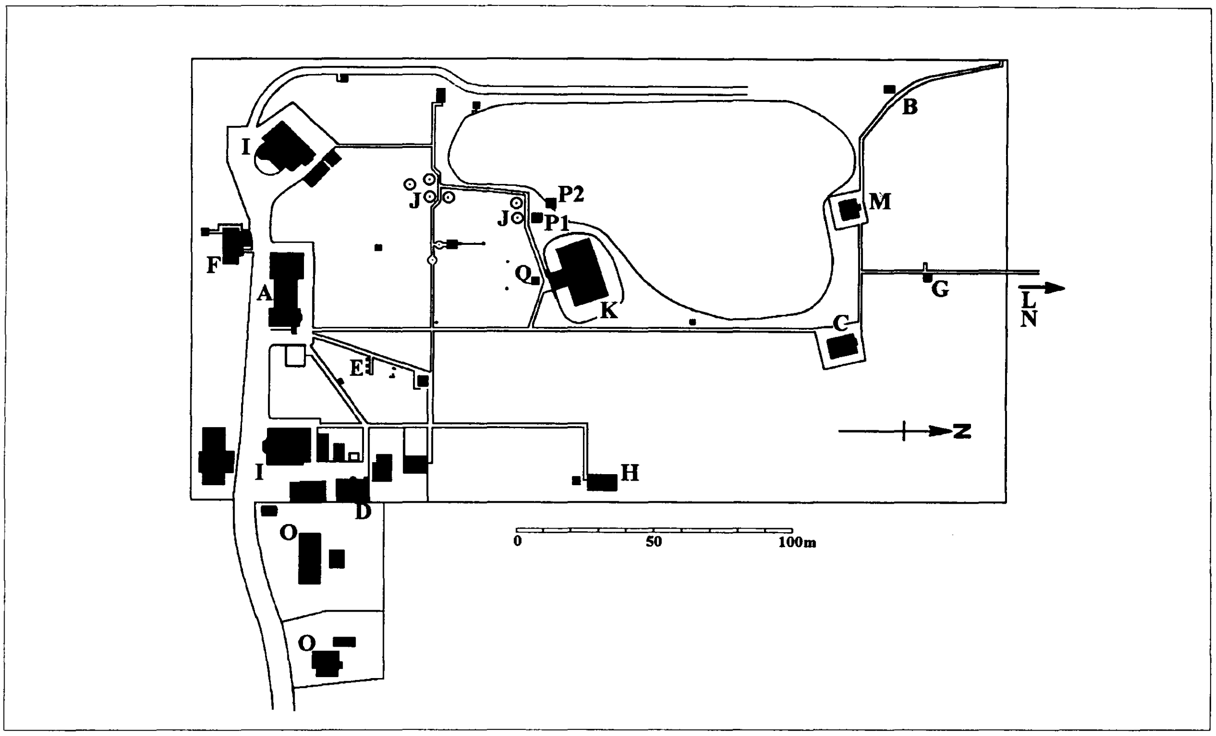
Previous descriptions

Harper, W.G. 1950 Lerwick Observatory. *Meteorological Magazine,* **79**, 309-314.

Tyldesley, J.B. 1971. Fifty years of Lerwick Observatory. *Meteorological Magazine,* **100**, 173-179.

Figure 1. Lerwick observatory site diagram

Eskdalemuir Observatory



Observatory Layout

A	Main observatory building
B	Atmospheric pollution sampling
C	East Absolute Hut
D	Garage and standby generator
E	Meteorological instruments
F	Seismic laboratory, seismic recorders, offices, electronics laboratory
G	Hut G
H	Non-magnetic laboratory
I	Staff accommodation
J	Rain gauges
K	Underground variometer chamber, instrument room containing data loggers
L	Seismic vault containing remote fluxgate (280 metres from boundary wall)
M	West Absolute Hut
N	Chemical sampling by Warren Spring Laboratory (75 metres from boundary wall)
O	Private houses - formerly staff housing
P1	Experimental δD/δI coils
P2	ARGOS Proton magnetometer 2 & δD/δI coils
Q	METEOSAT transmitter

Instrument Deployment
Hut G contains the PVM electronics, the digital clock and the printer used to record values during absolute observations.

East Absolute Hut
PVM (used for H/Z/F measurements)
D/I Fluxgate Theodolite
The fixed mark (azimuth 8° 12' 35" W of S) is viewed through a shutter on the south wall.

Underground Variometer Chamber
ARGOS fluxgate sensors (X,Y,Z)
Back-up sensors (H,D,Z) transmitting to METEOSAT

The variometer chamber comprises two separate rooms inside a domed chamber covered with a thick layer of earth to form a mound. The instruments and the greater part of the rooms are thus below the level of the surrounding ground. The temperature of the chamber is controlled to a diurnal range of ±0.5°C. The instrument room has been created by extending the former porch back into the stairwell and entrance, leaving a compartment under the floor for standby batteries. The entrance to the room is protected by an external porch.

West Absolute Hut
The hut contains three instrument piers. The fixed mark is viewed from the central pillar at a bearing of 4° 36' 08" W of S through a shutter in the south wall.

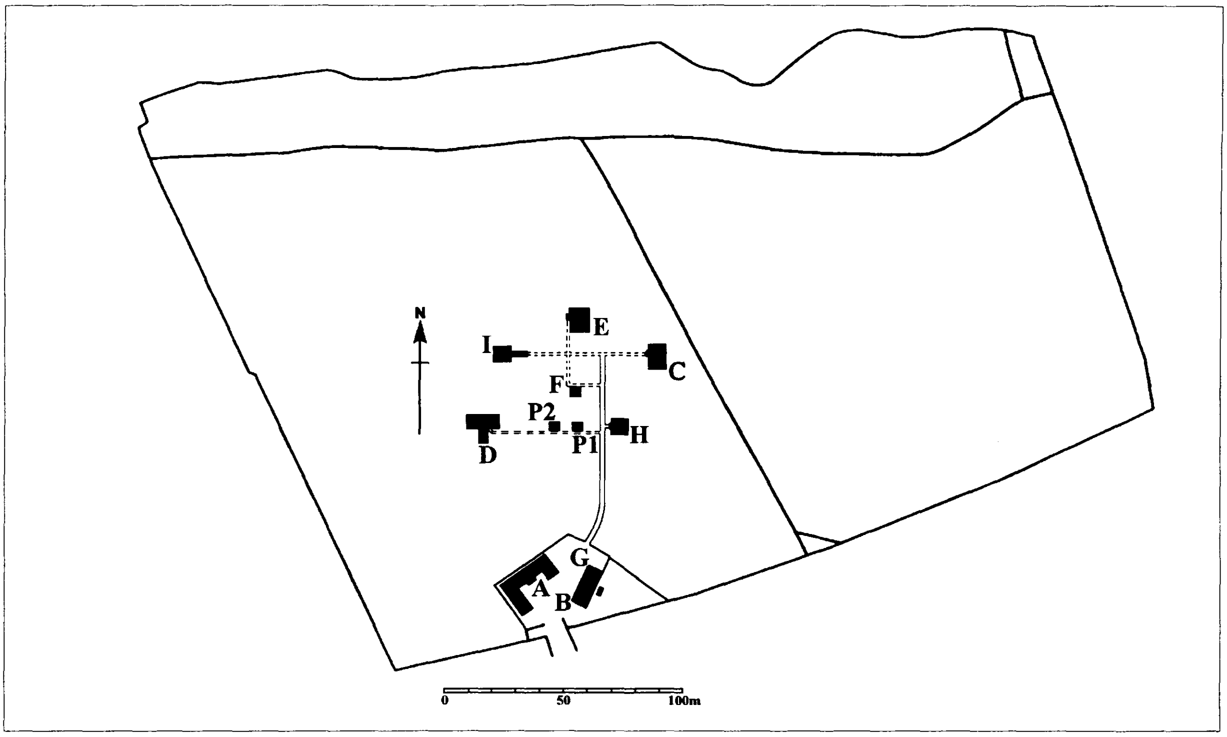
The Non-Magnetic Laboratory
The laboratory is used for instrument development and testing. It contains a sensor room with three piers and a larger instrument room with a single pier.

Previous descriptions

Blackwell, M.J. 1958. Eskdalemuir Observatory - the first 50 years. *Meteorological Magazine London* **87**, 129.Crichton, J. 1950. Eskdalemuir Observatory. *Meteorological Magazine London.* **79**, 337.

Figure 2. Eskdalemuir observatory site diagram

Hartland Observatory



Observatory Layout

A	Main observatory building
B	Caretakers house
C	Absolute Hut
D	Non-Magnetic laboratory, Back-up Fluxgate, METEOSAT transmitter
E	Variometer House
F	Instrument Hut
G	Garage
H	Test Hut 2
I	Test Hut 1
P1	ARGOS Proton magnetometer 1
P2	ARGOS Proton magnetometer 2 & δD/ δI coils

Instrument Deployment

Absolute Hut
PVM (used for H/Z/F measurements)
D/I Fluxgate Theodolite
The fixed mark (azimuth 11° 27' 54" E of N) is viewed through a window in the north wall.

Non-Magnetic Laboratory
The laboratory was built in 1972 to provide accommodation for a rubidium-vapour magnetometer digital recording system. It comprises an instrument room and a sensor room with five instrument piers where the backup system and sensors are located . This is connected to a data collection platform transmitting to the METEOSAT satellite. A second fluxgate system transmits data to the GOES satellite

Variometer House
ARGOS fluxgate sensors (X,Y,Z)

The Variometer House comprises an entrance porch and a main room, which contains two separate internal rooms, each divided into three compartments. The temperature of the house is controlled to a diurnal range of ±0.5°C. Two cable ducts connect the Variometer House to the Instrument Hut.

Instrument Hut
PVM electronics
ARGOS electronics
Standby batteries and ARGOS uninterruptible power supply (UPS)

Test Hut 1
The hut contains an orthogonal coil system and its power supplied. The inner coil, a vertical-axis square coil, was previously used for BMZ calibration. Two additional 2 metre square coils, for creating horizontal fields parallel and normal to the meridian, were added in 1983 to create a near zero field facility for investigating the magnetic signature of the AMPTE satellite.

Test Hut 2
Auxiliary measurement position. The fixed mark (azimuth 12° 52' 08" E of N) is viewed through a window in the north wall from the northeast theodolite position.

Previous descriptions

Finch, H.F. 1960 Geomagnetic measurement. *Journal of the Royal Naval Scientific Service.* **15**, No. 1, 26-31.

Figure 3. Hartland observatory site diagram

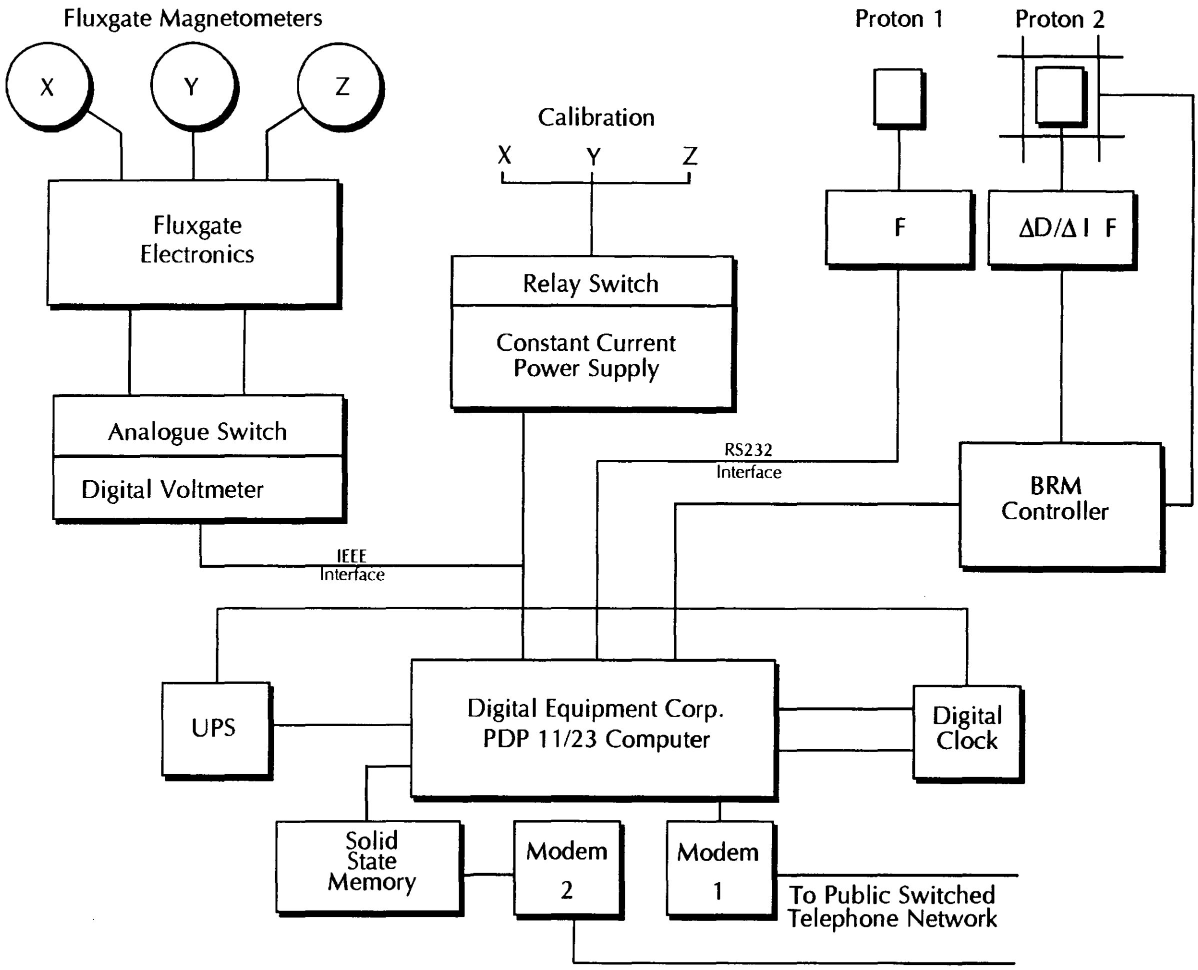


Figure 4a. Block diagram of ARGOS

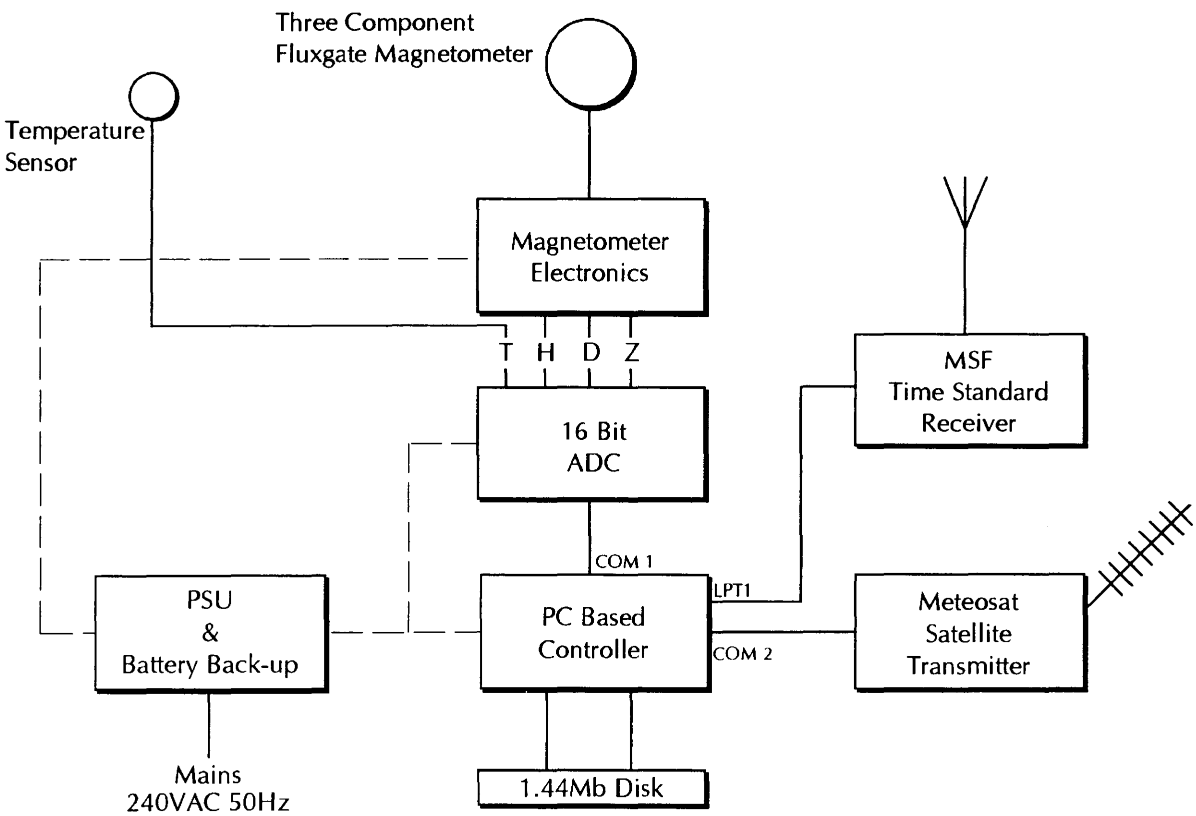


Figure 4b. Block diagram of back-up system

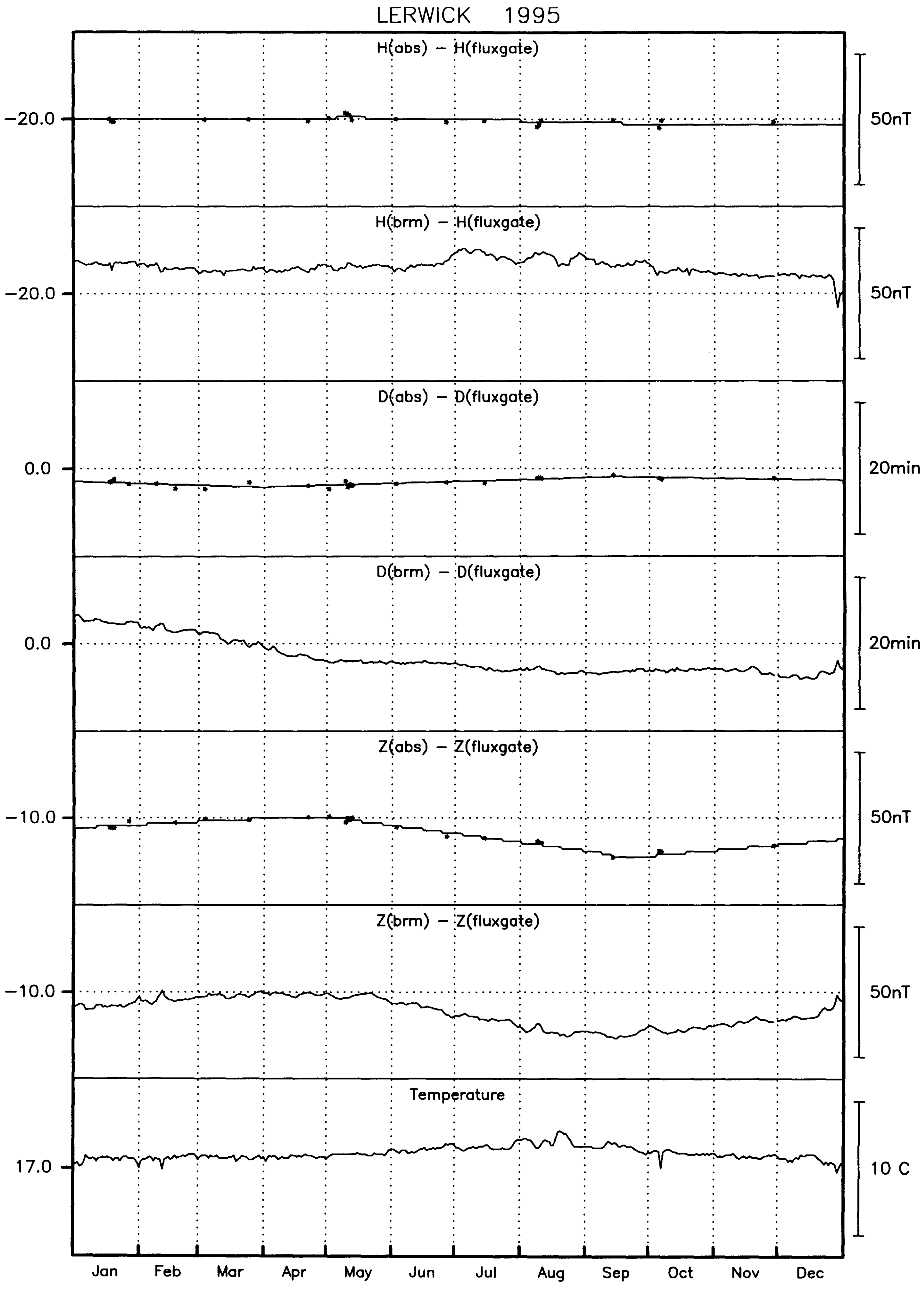


Figure 5. Zero-field offset corrections and BRMs, Lerwick

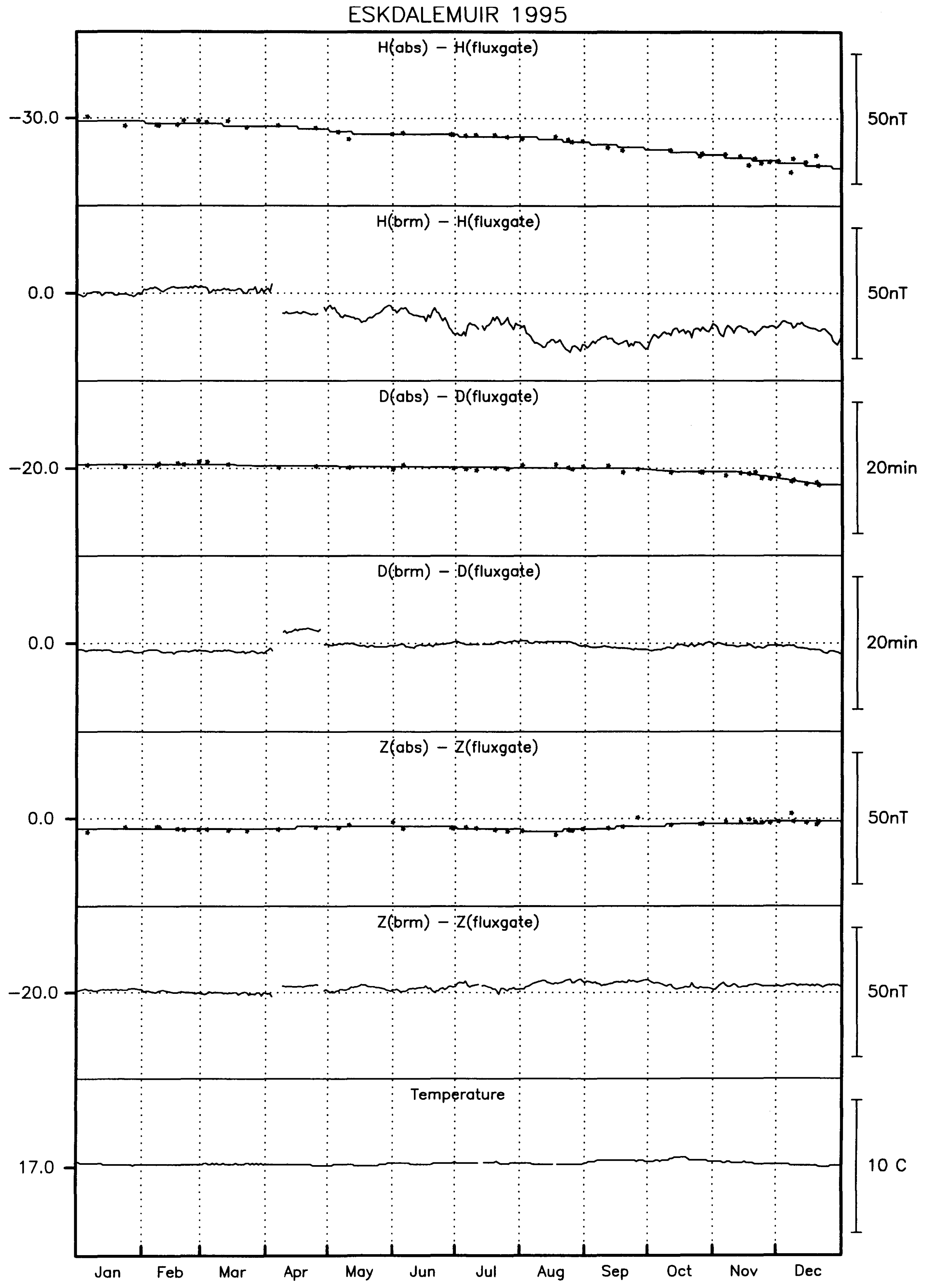


Figure 6. Zero-field offset corrections and BRMs, Eskdalemuir

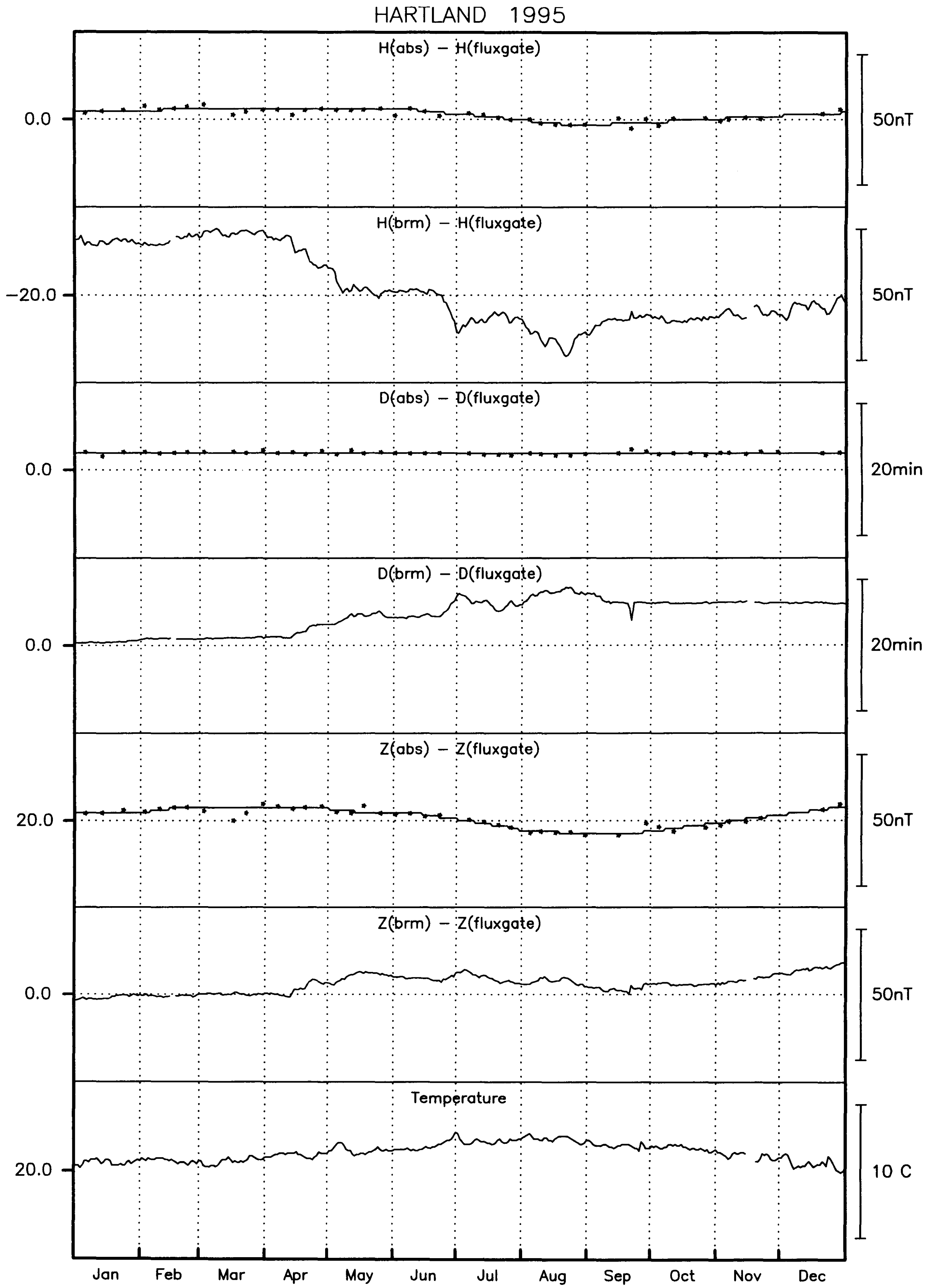
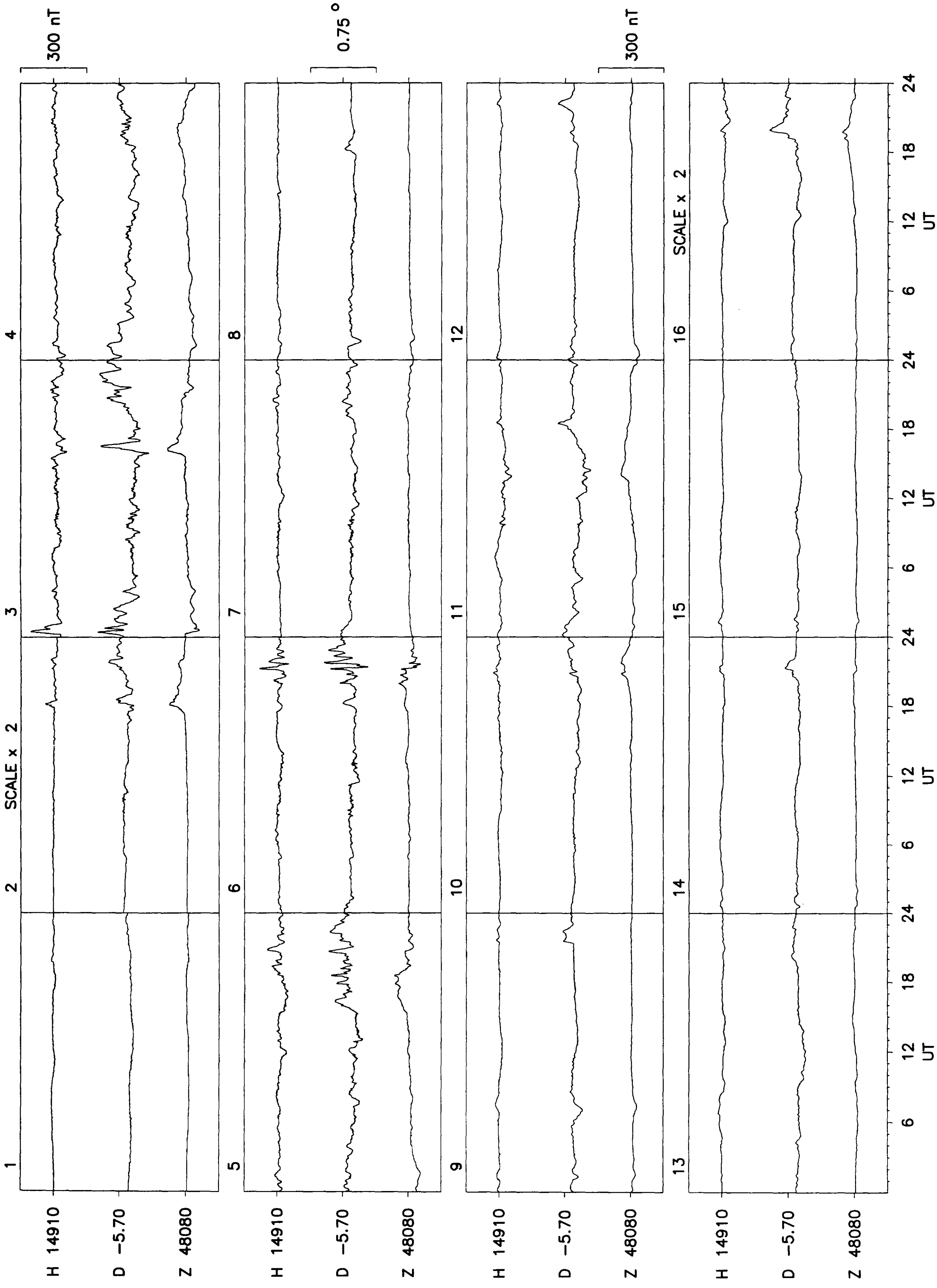


Figure 7. Zero-field offset corrections and BRMs, Hartland

Lerwick 1995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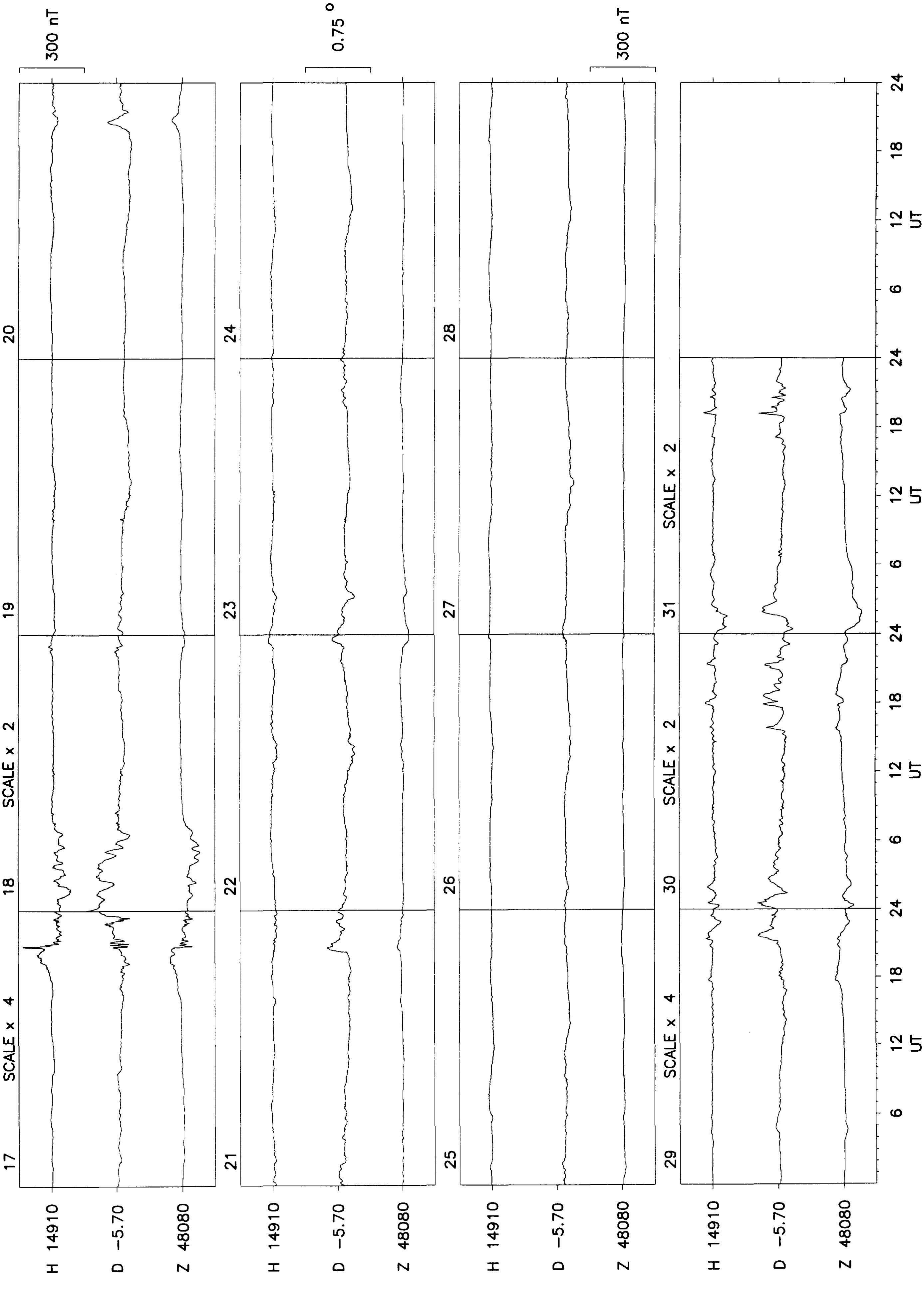
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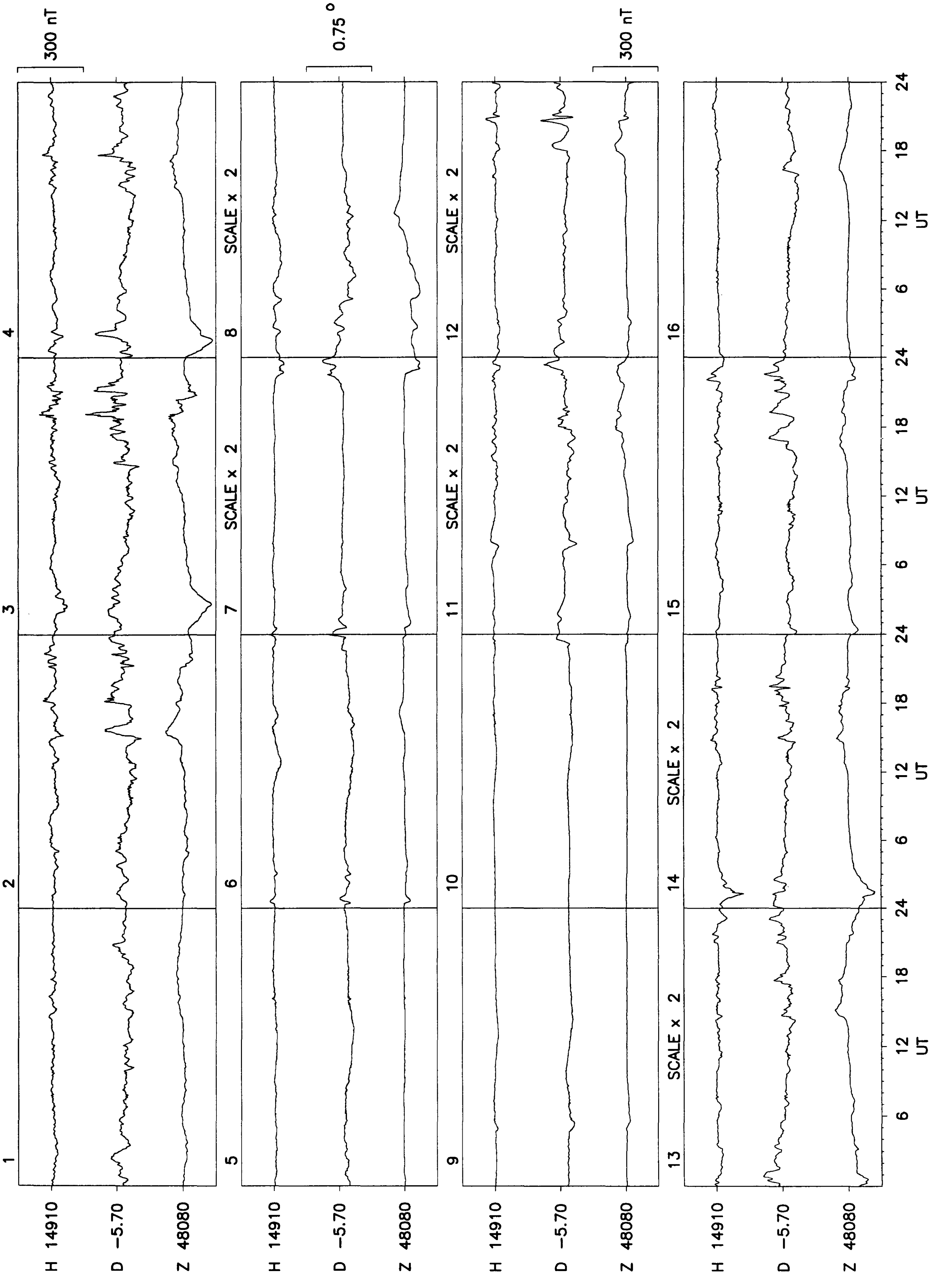
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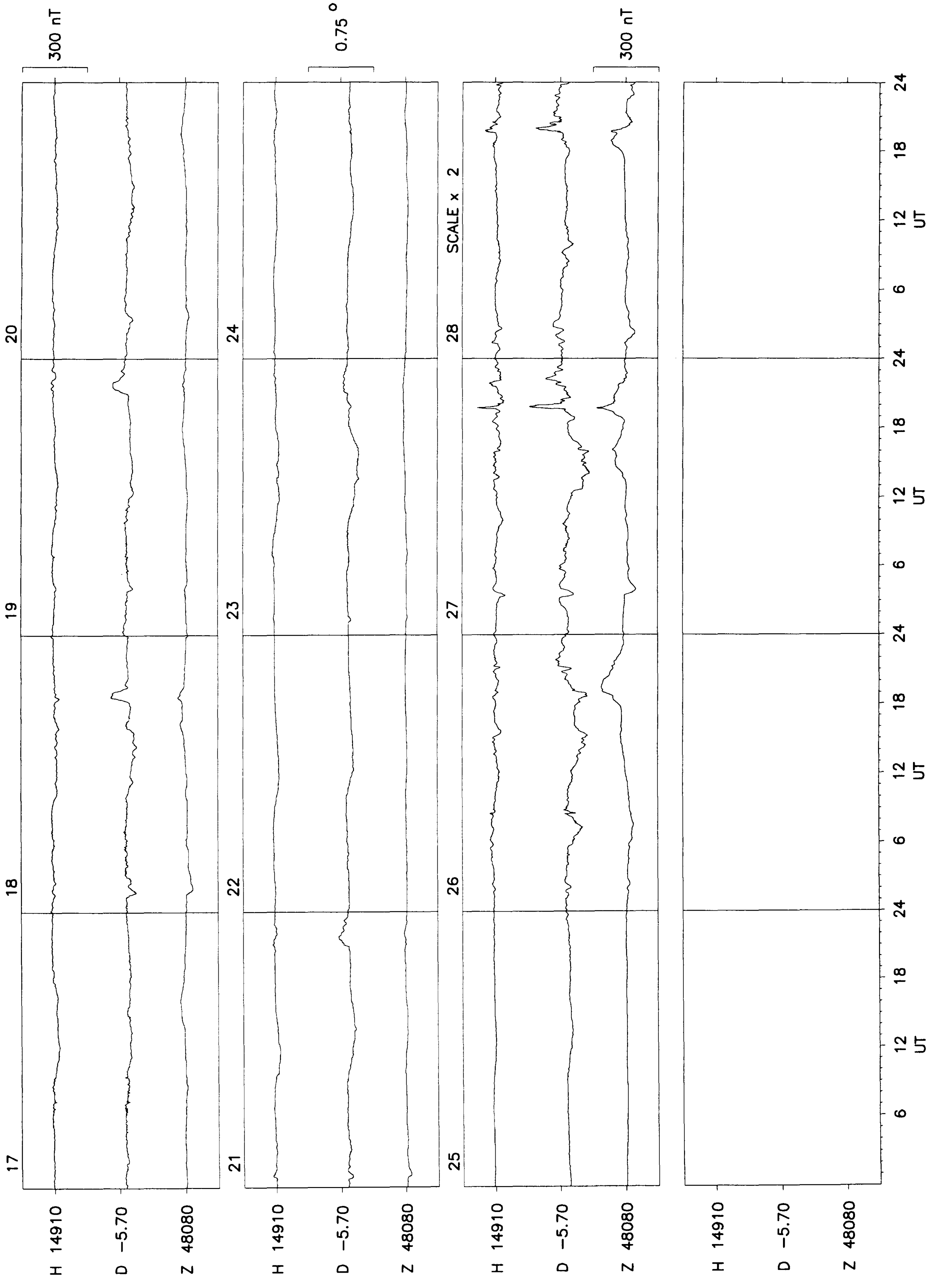
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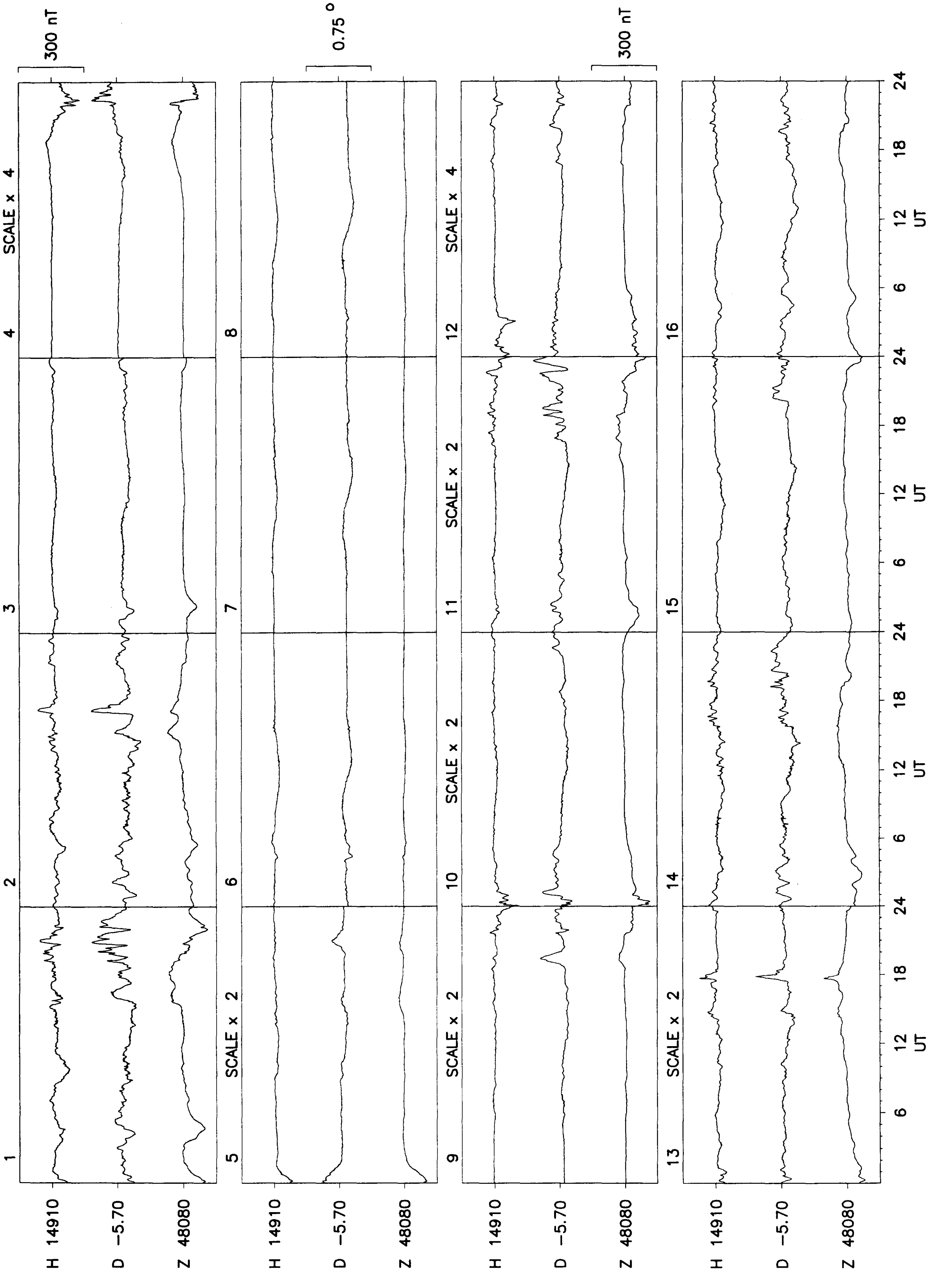
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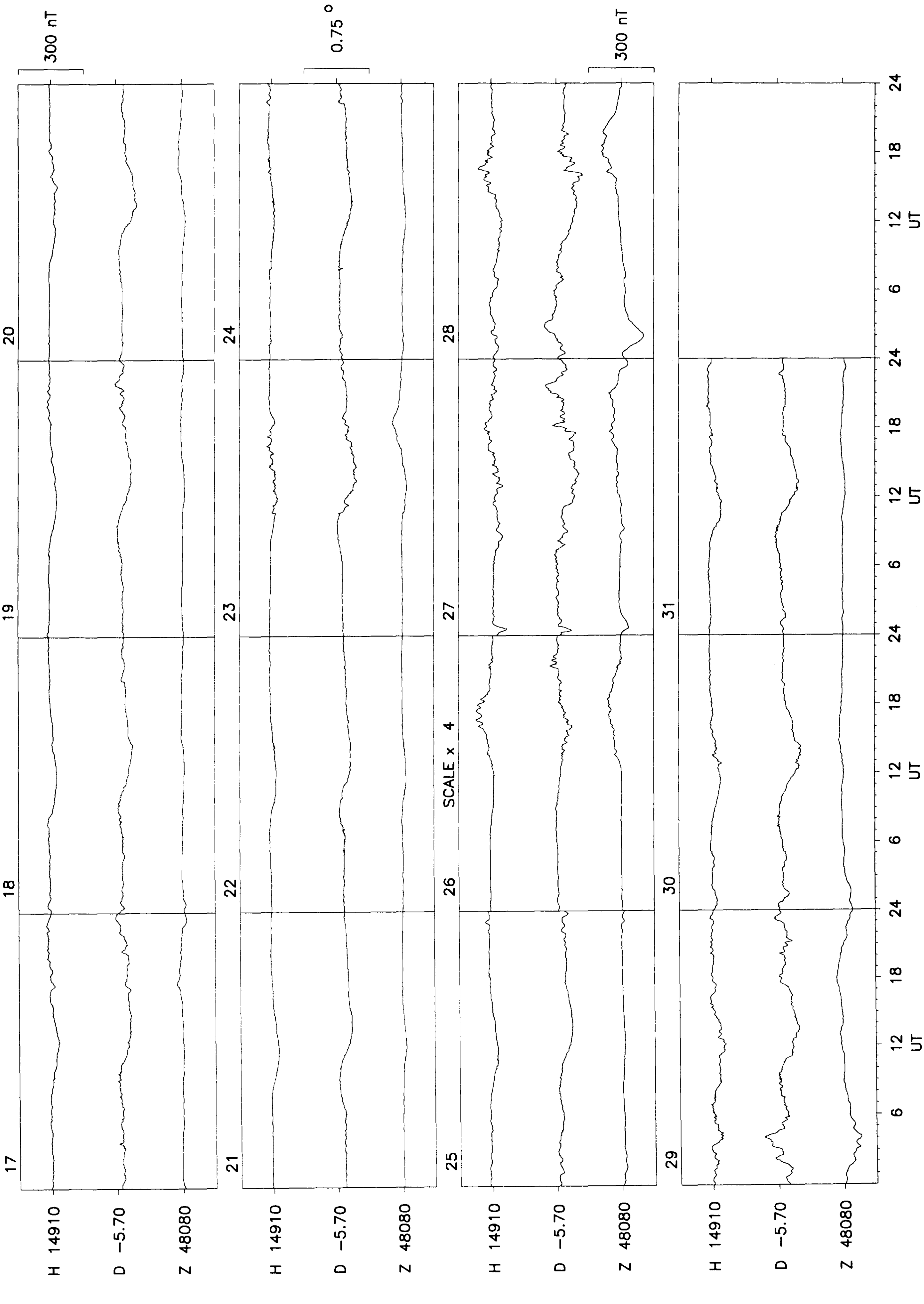

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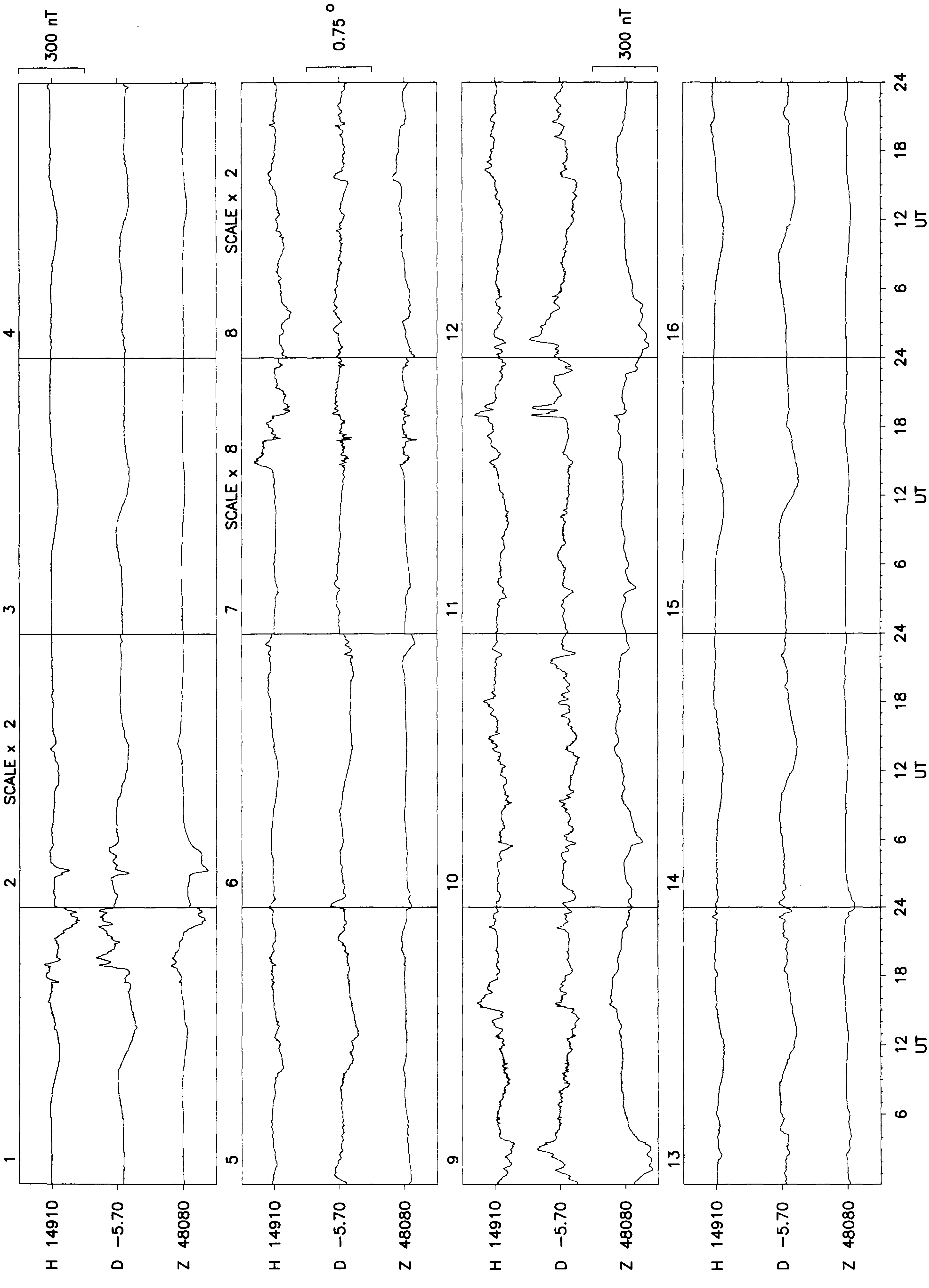
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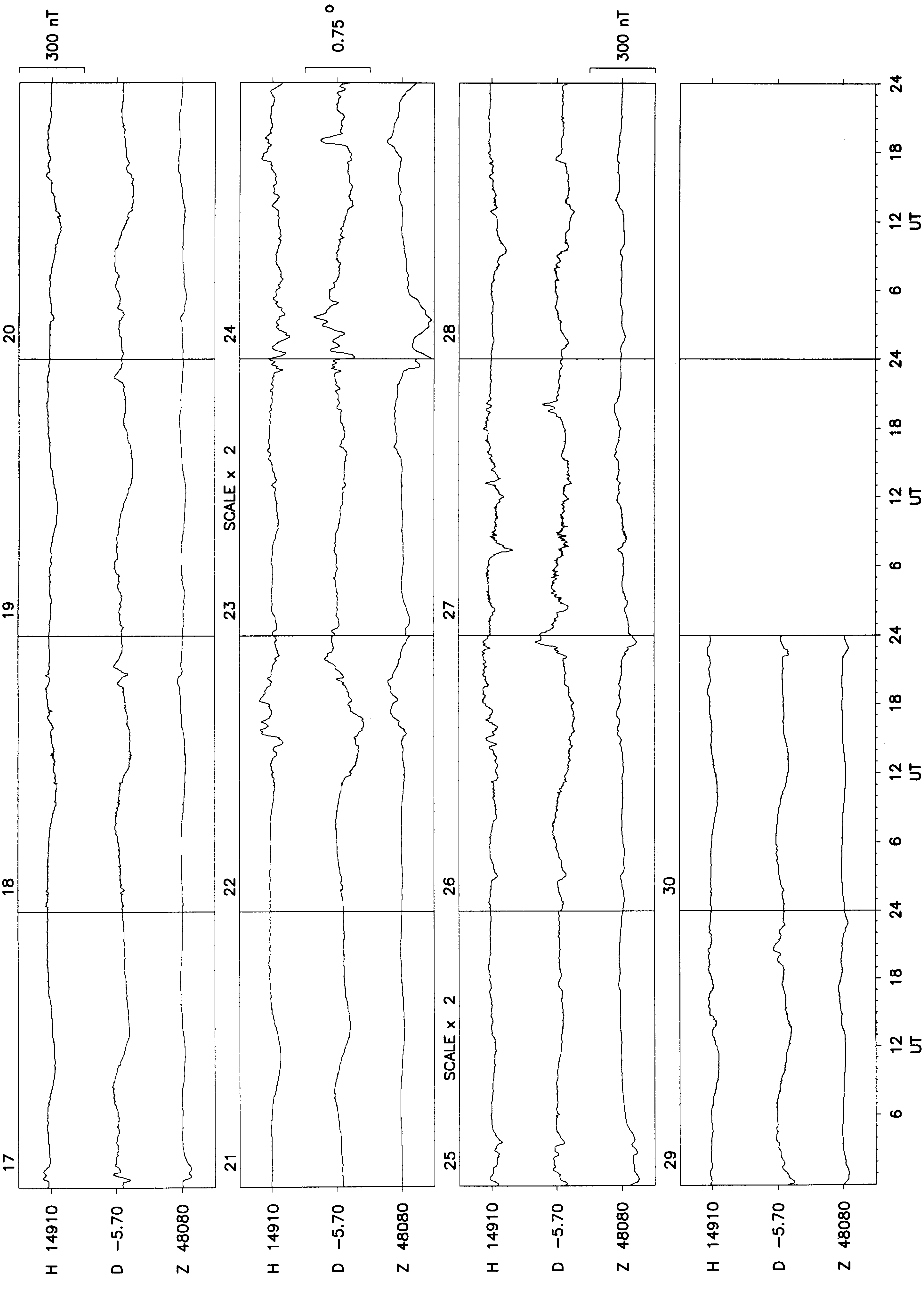
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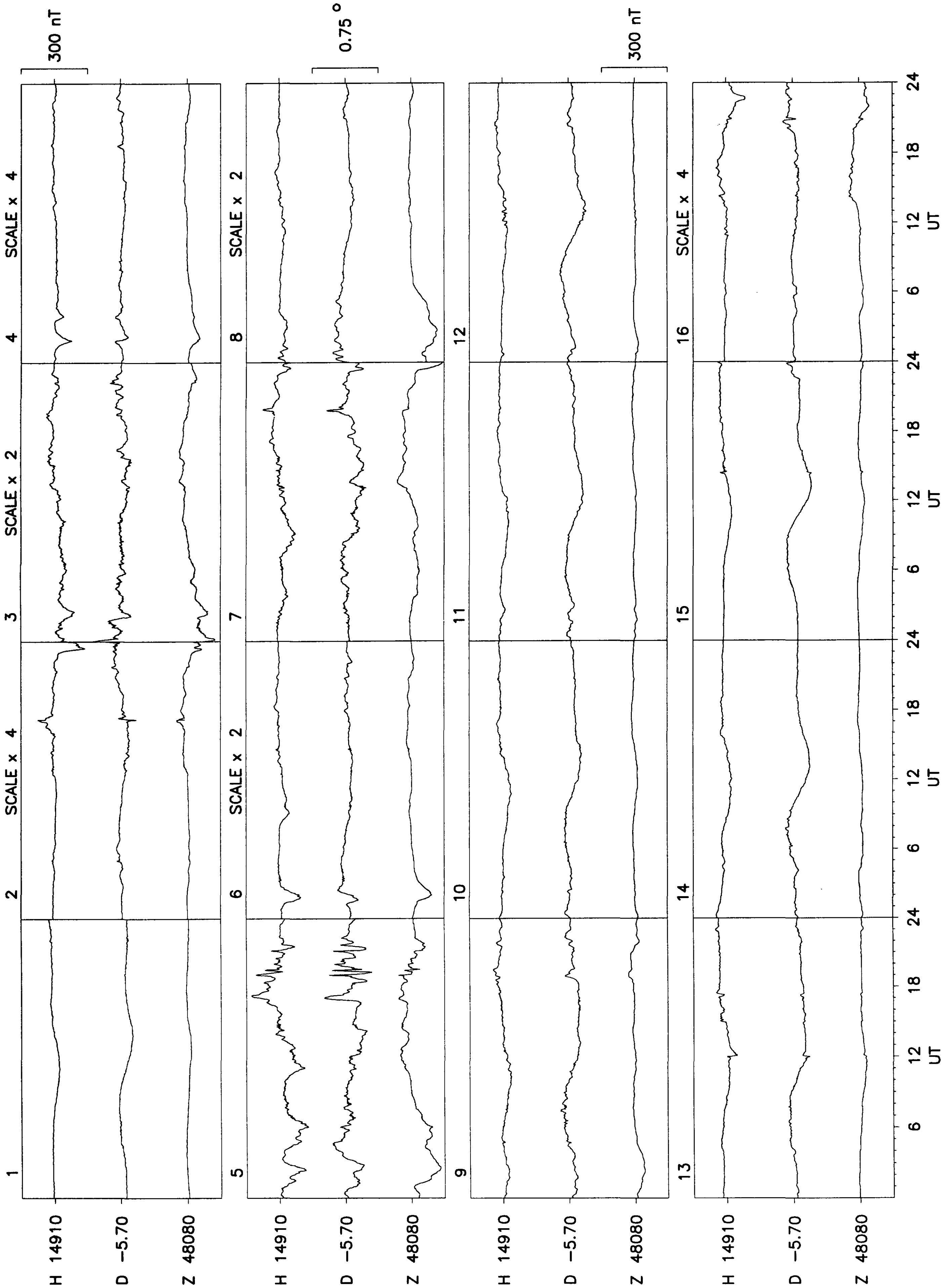
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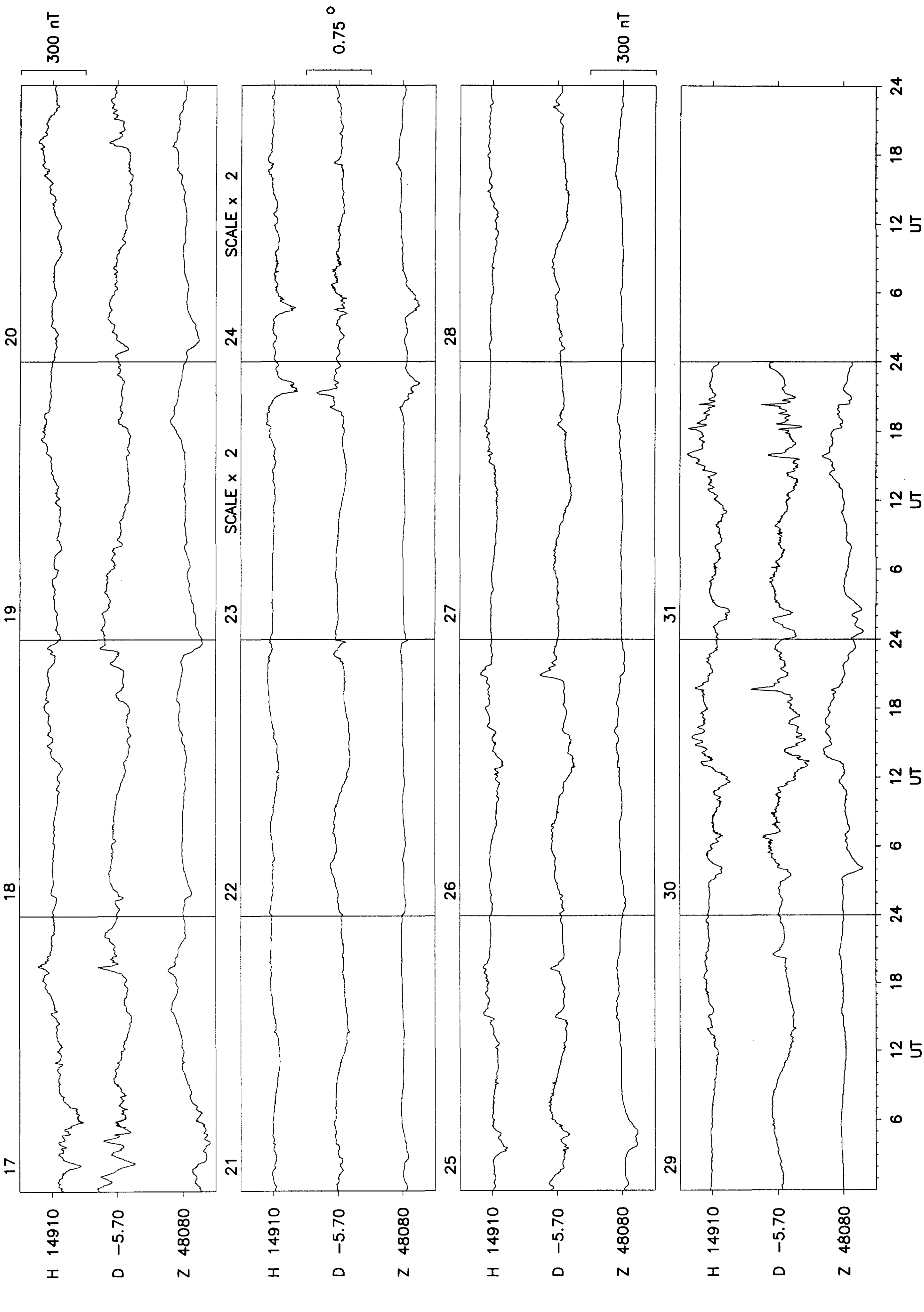

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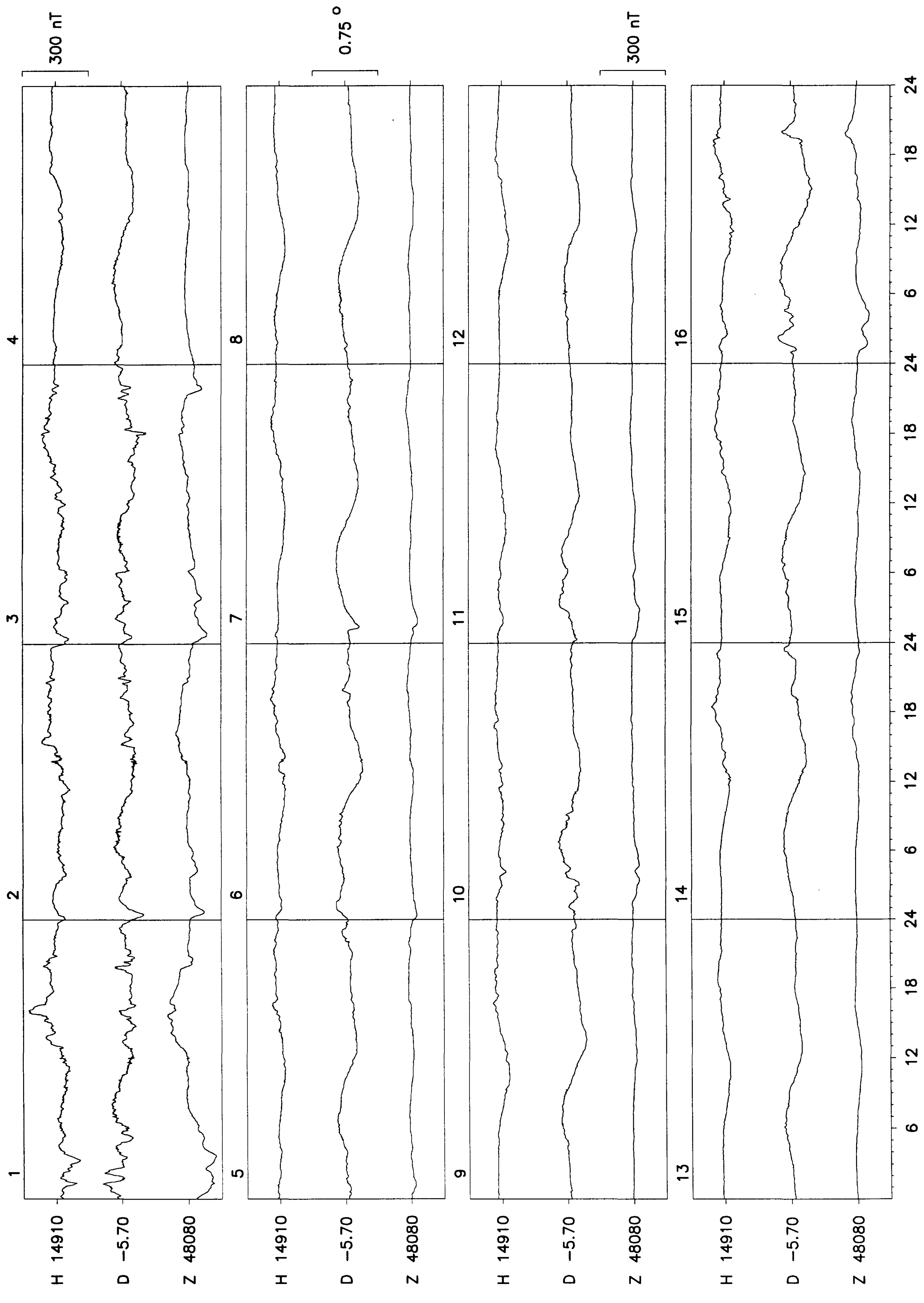
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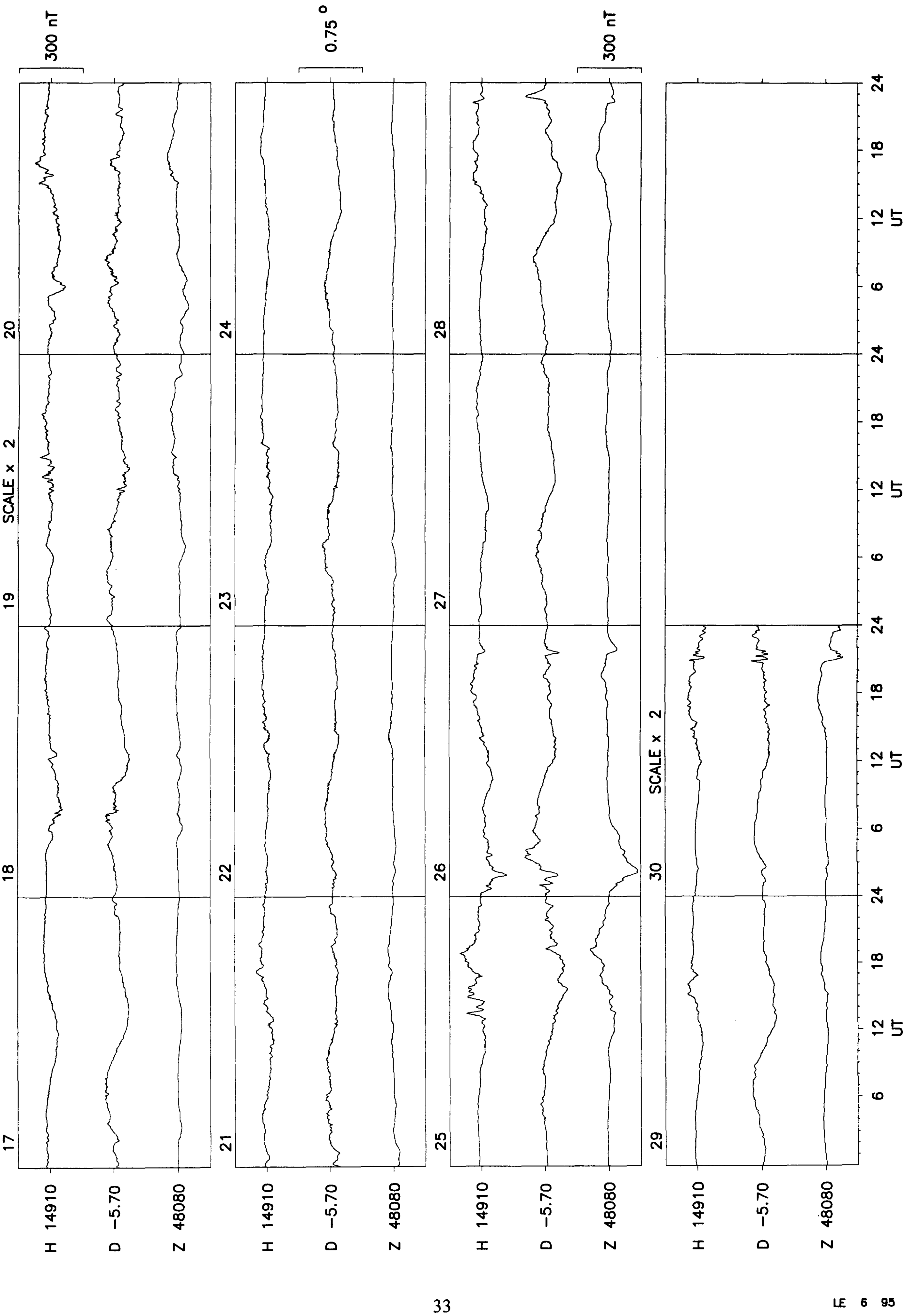
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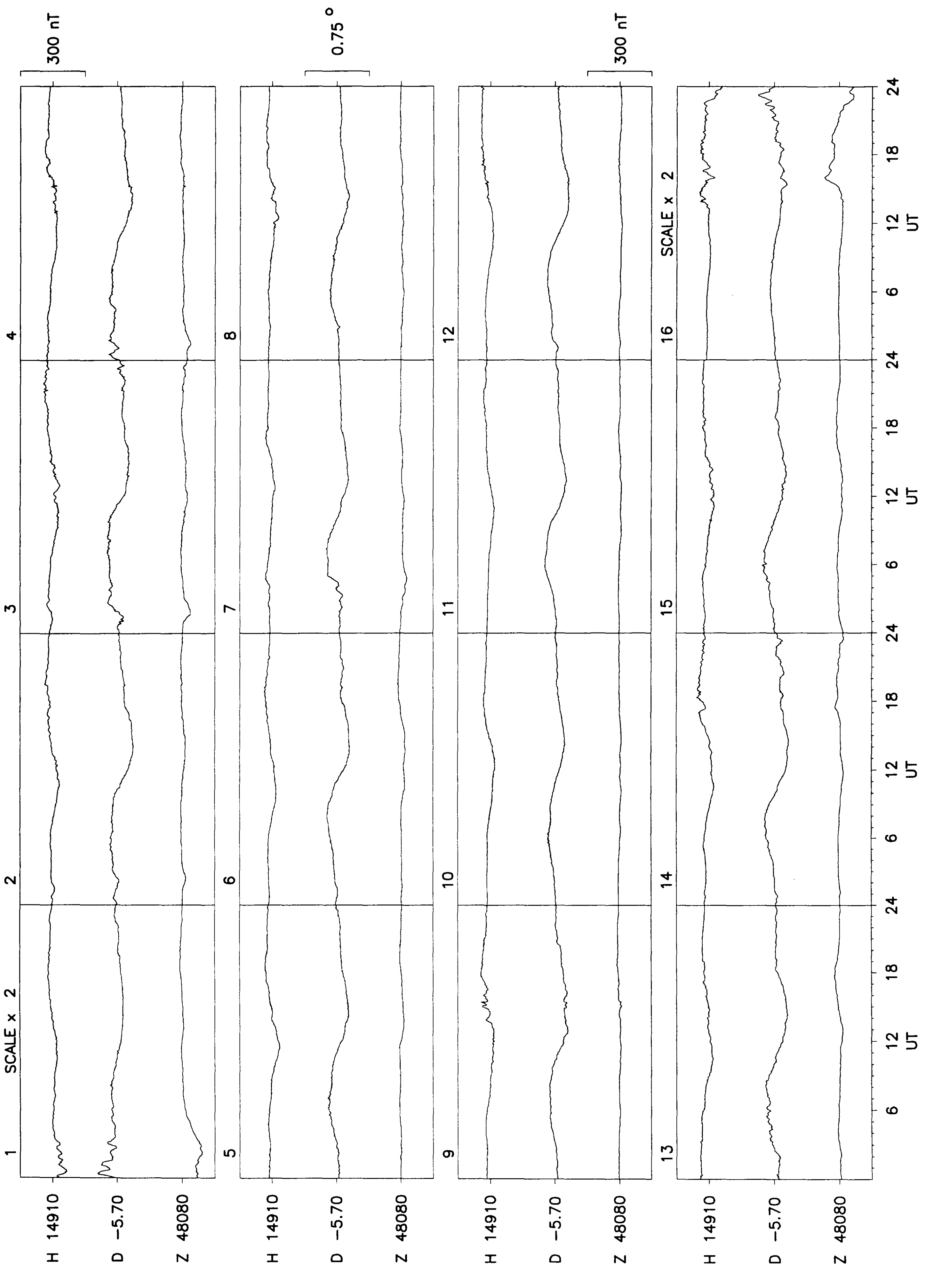
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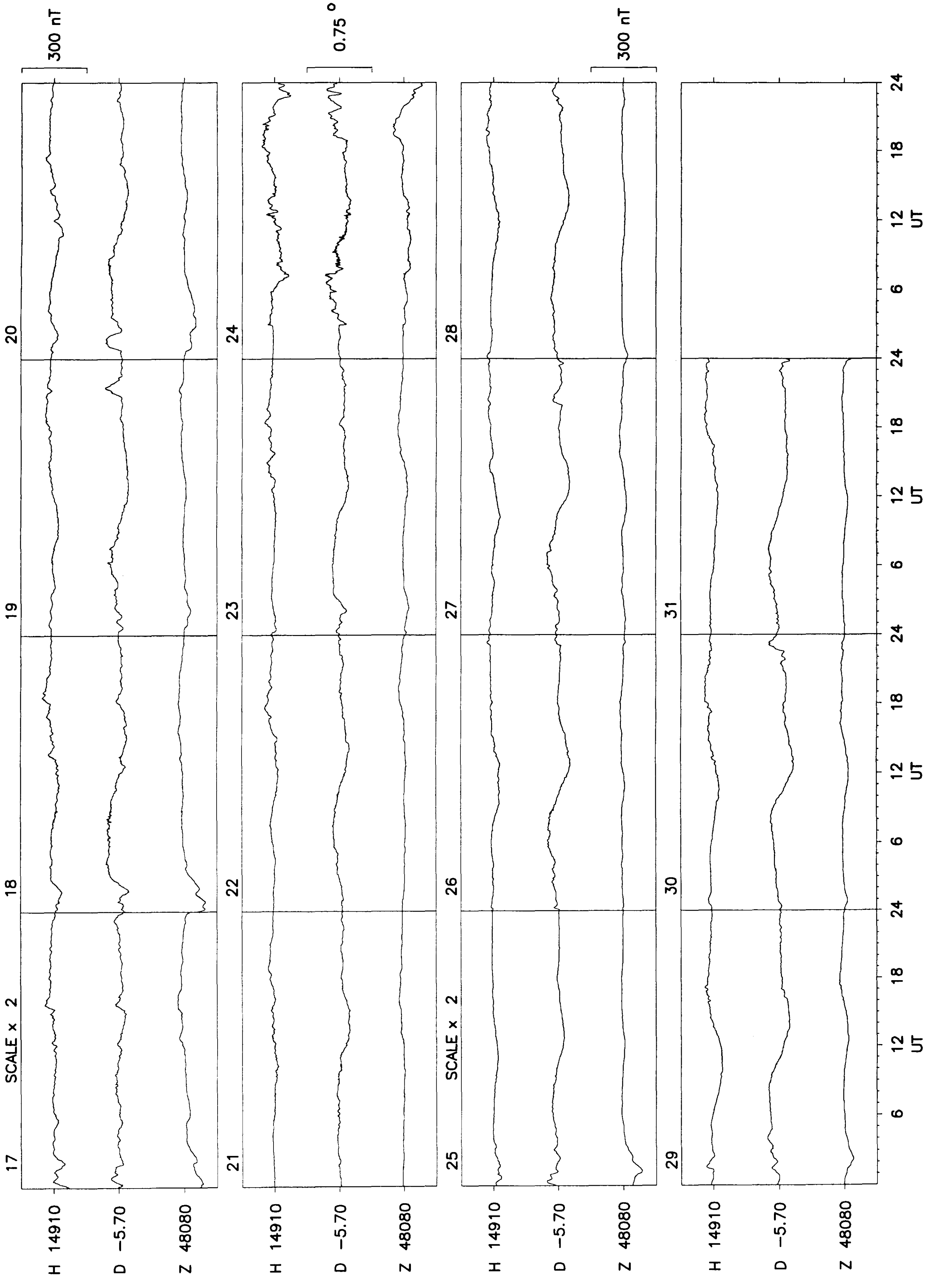
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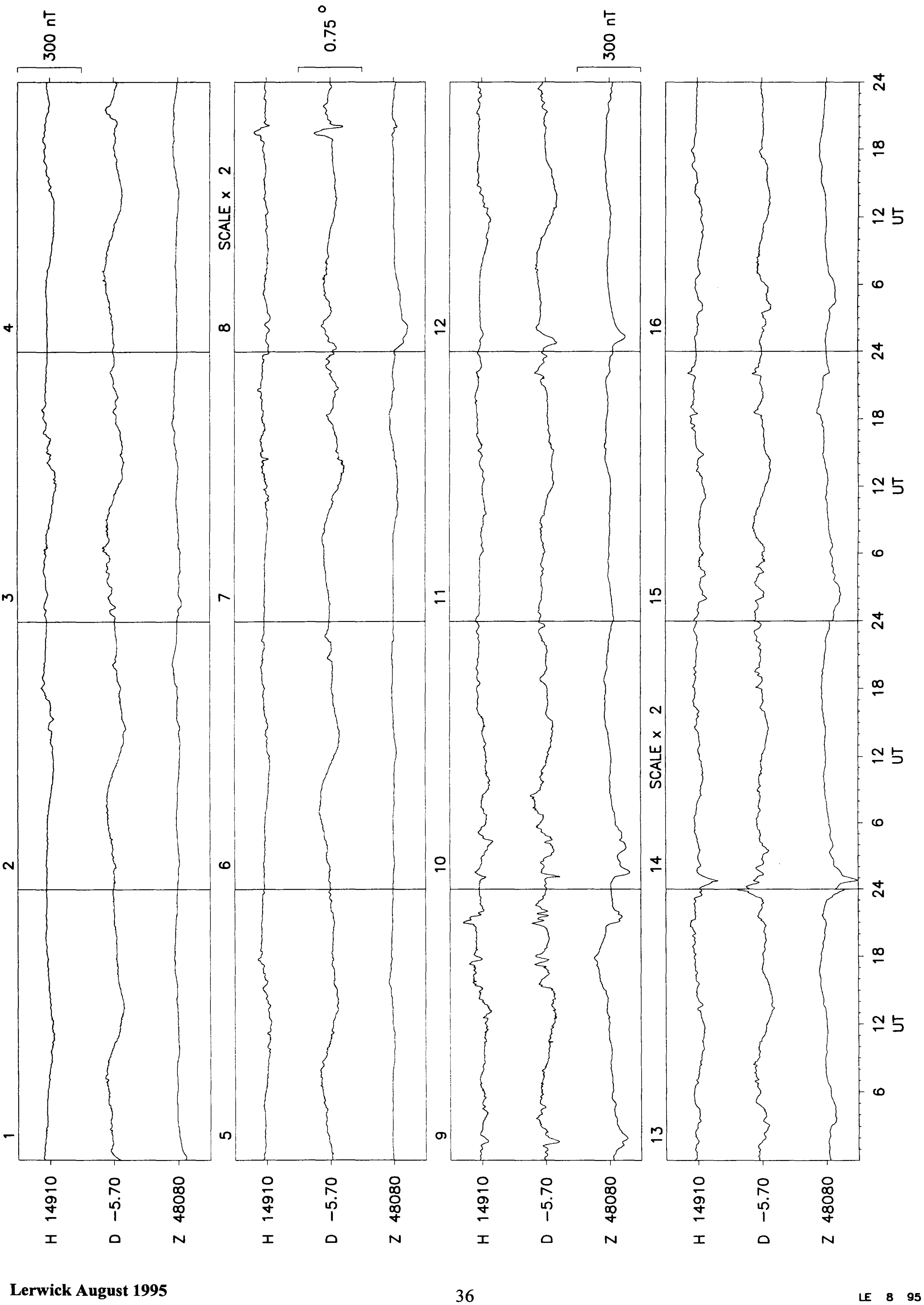
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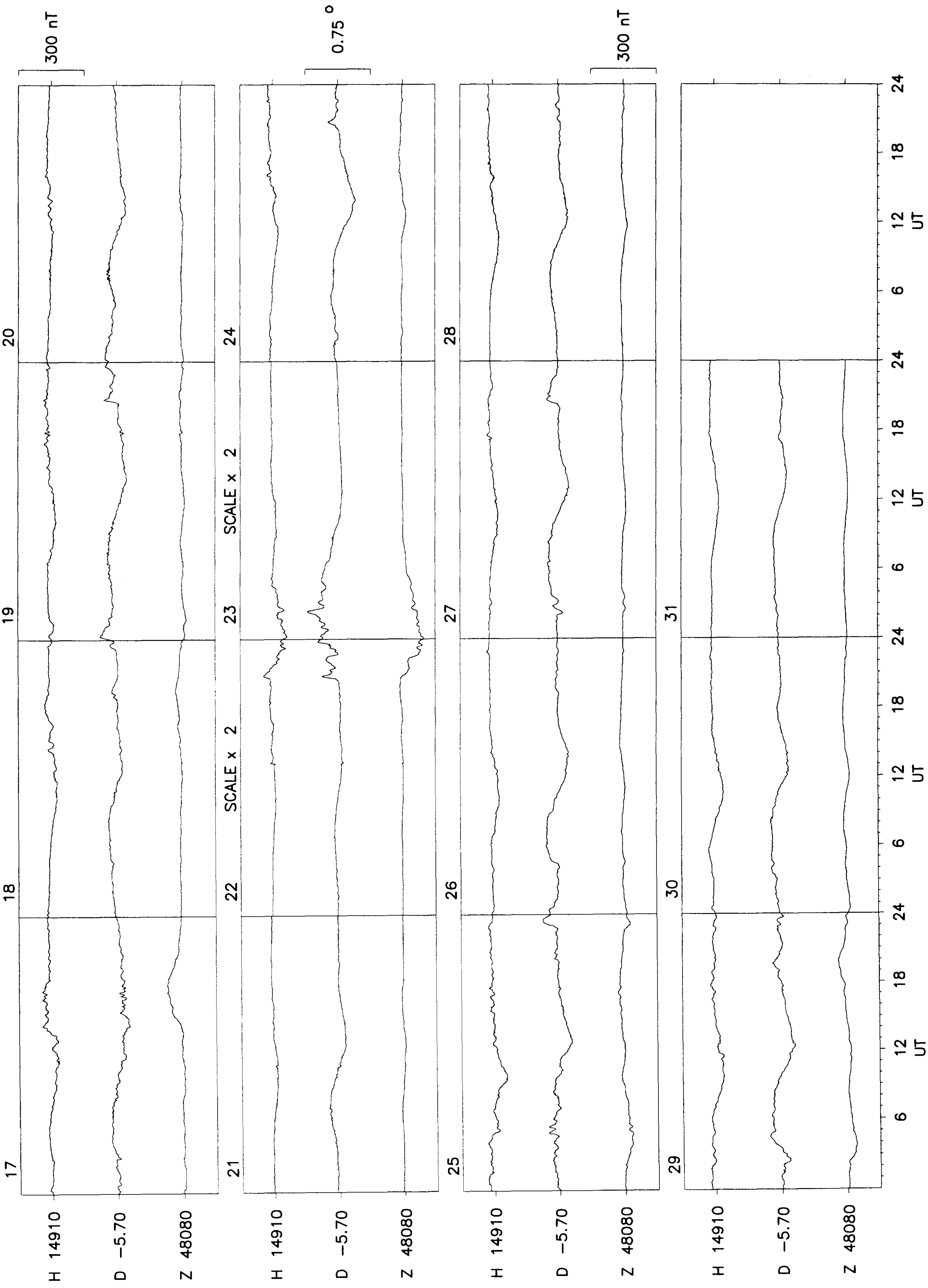
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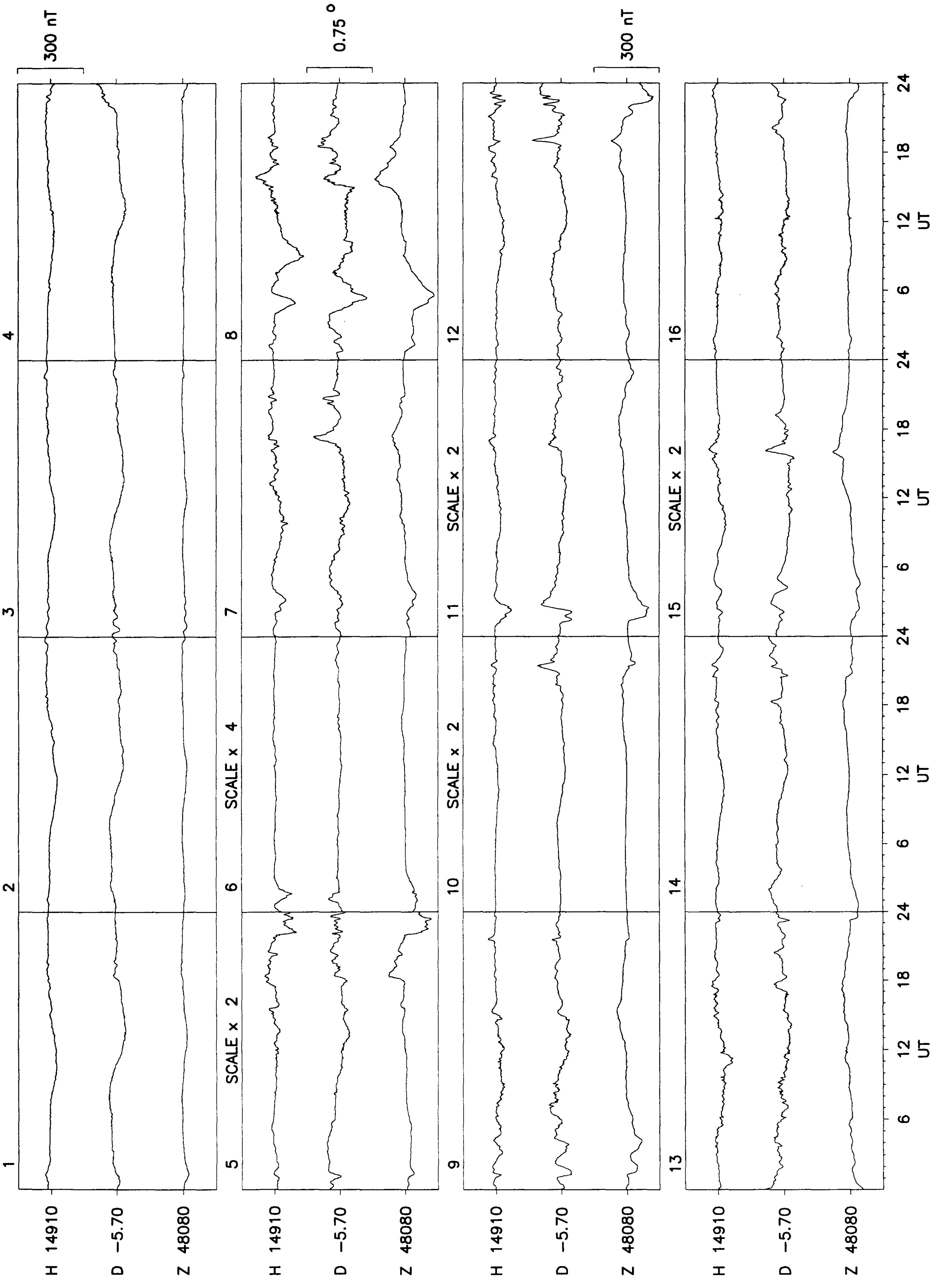
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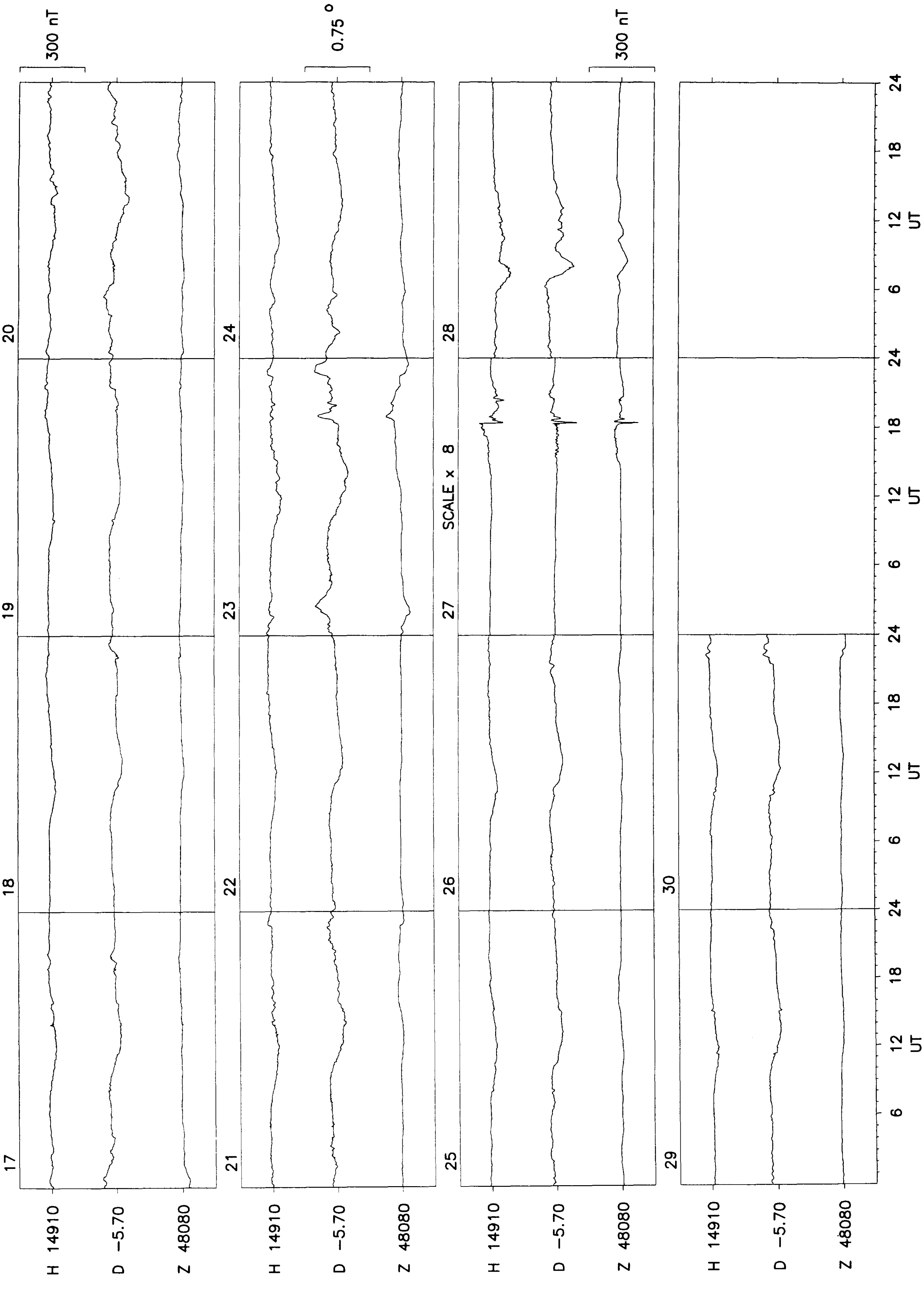

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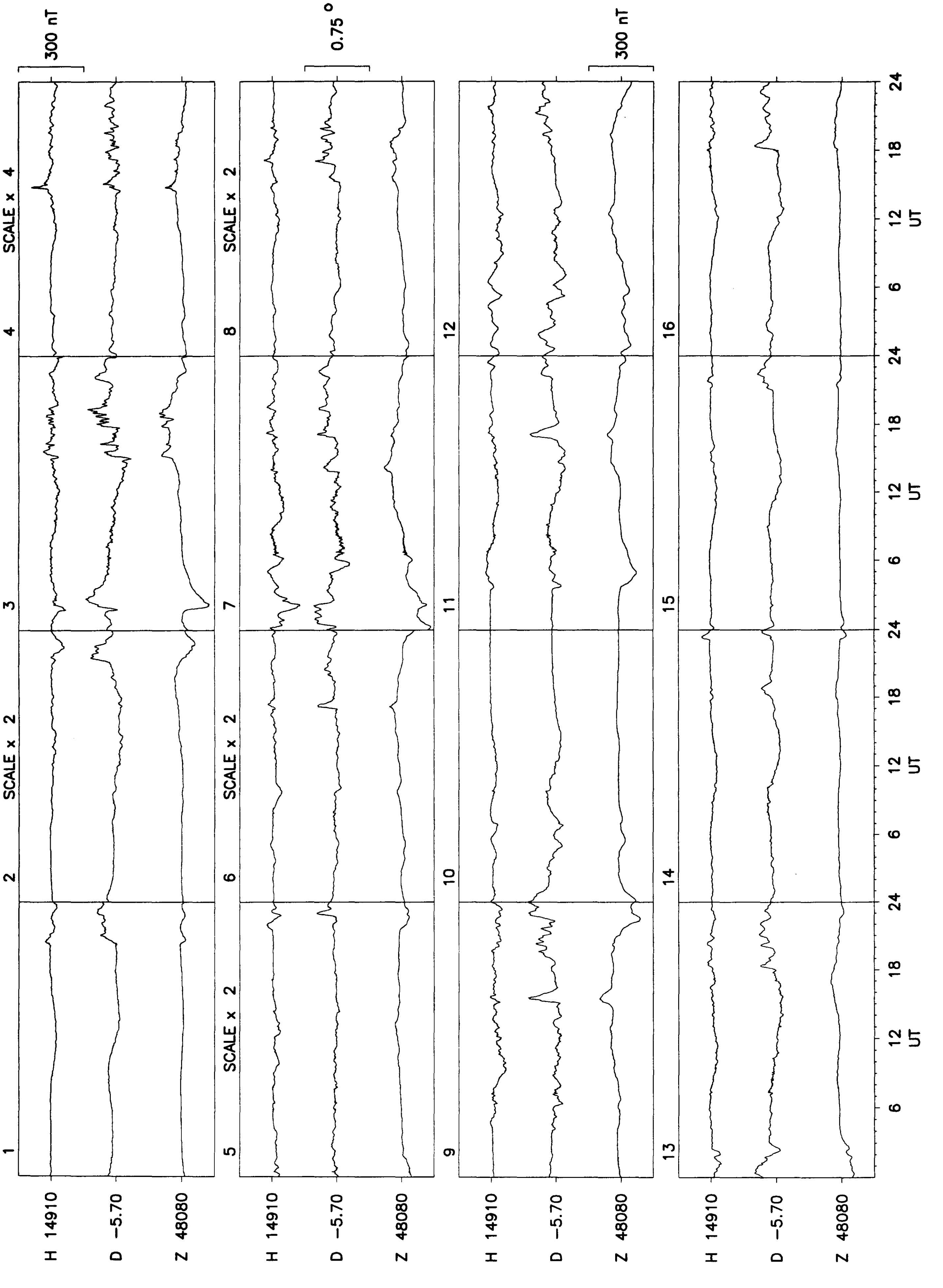
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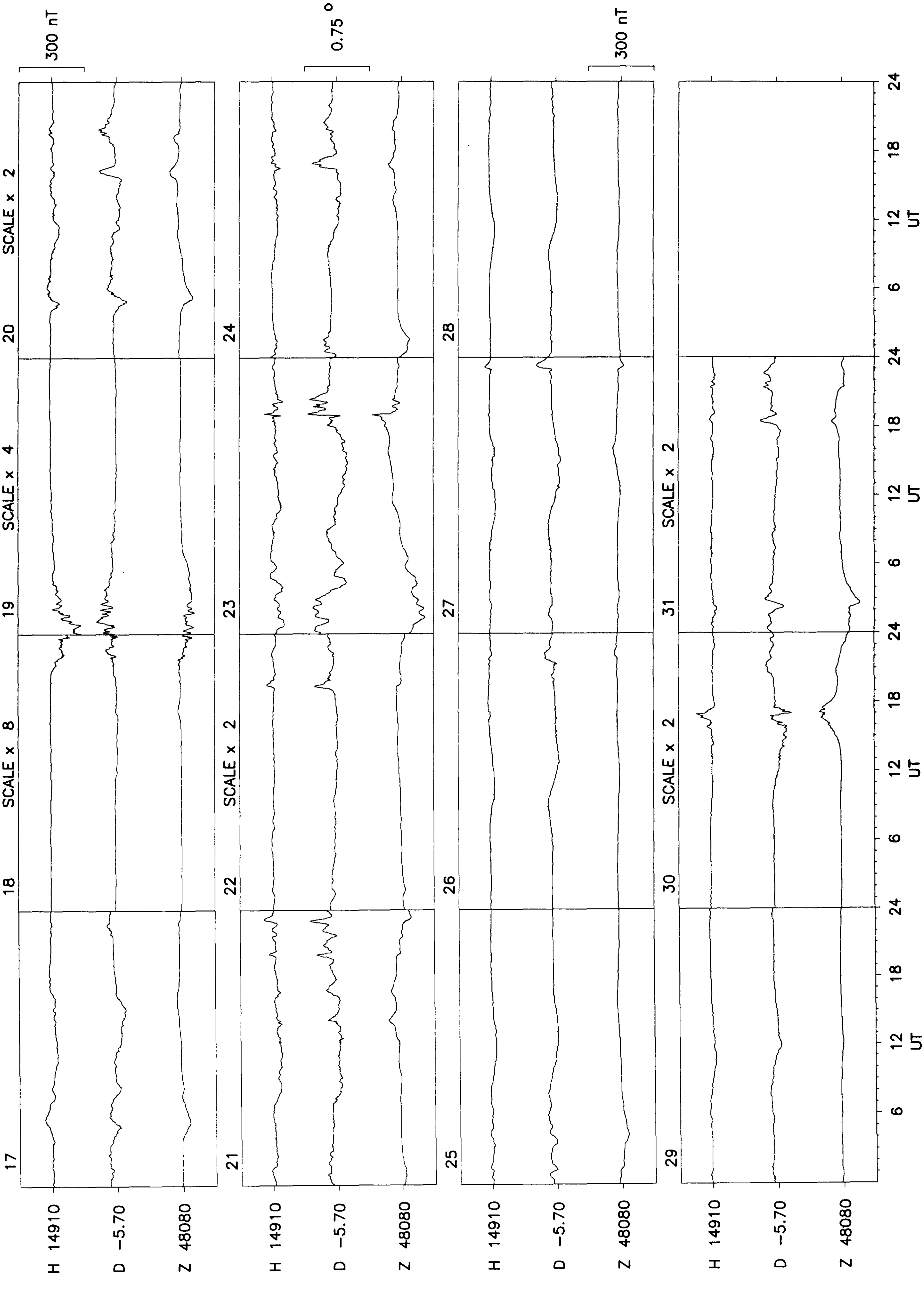
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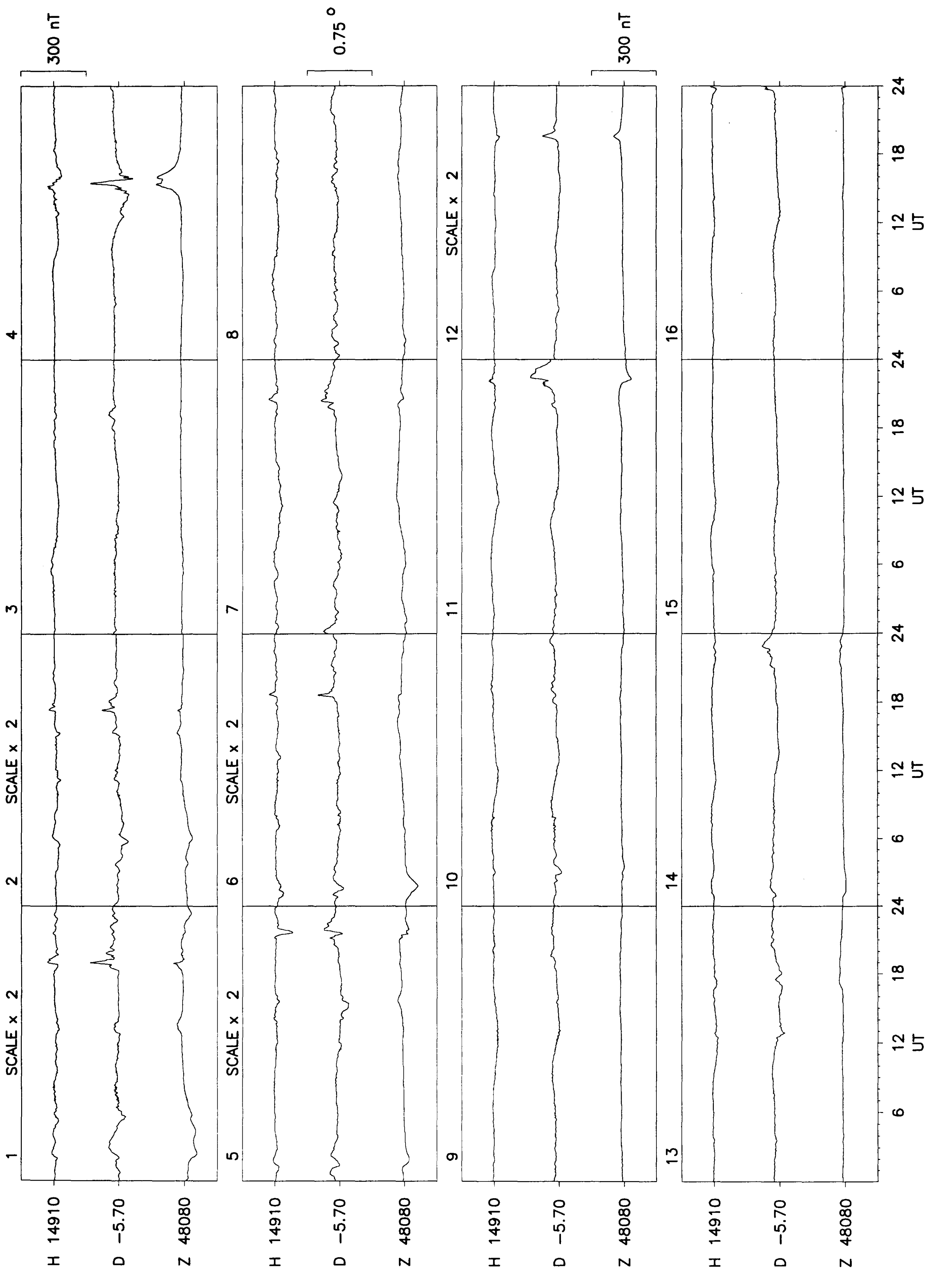
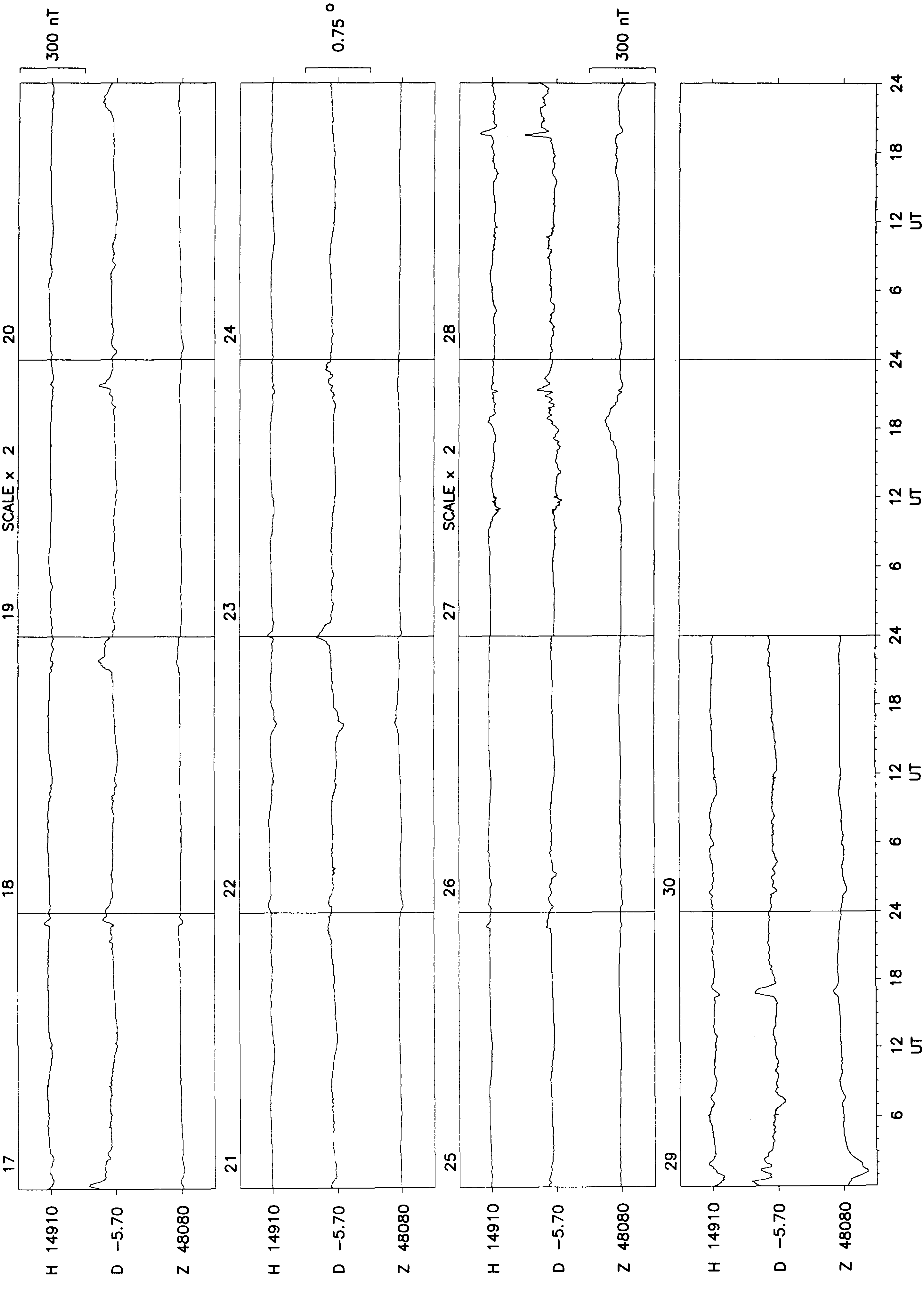
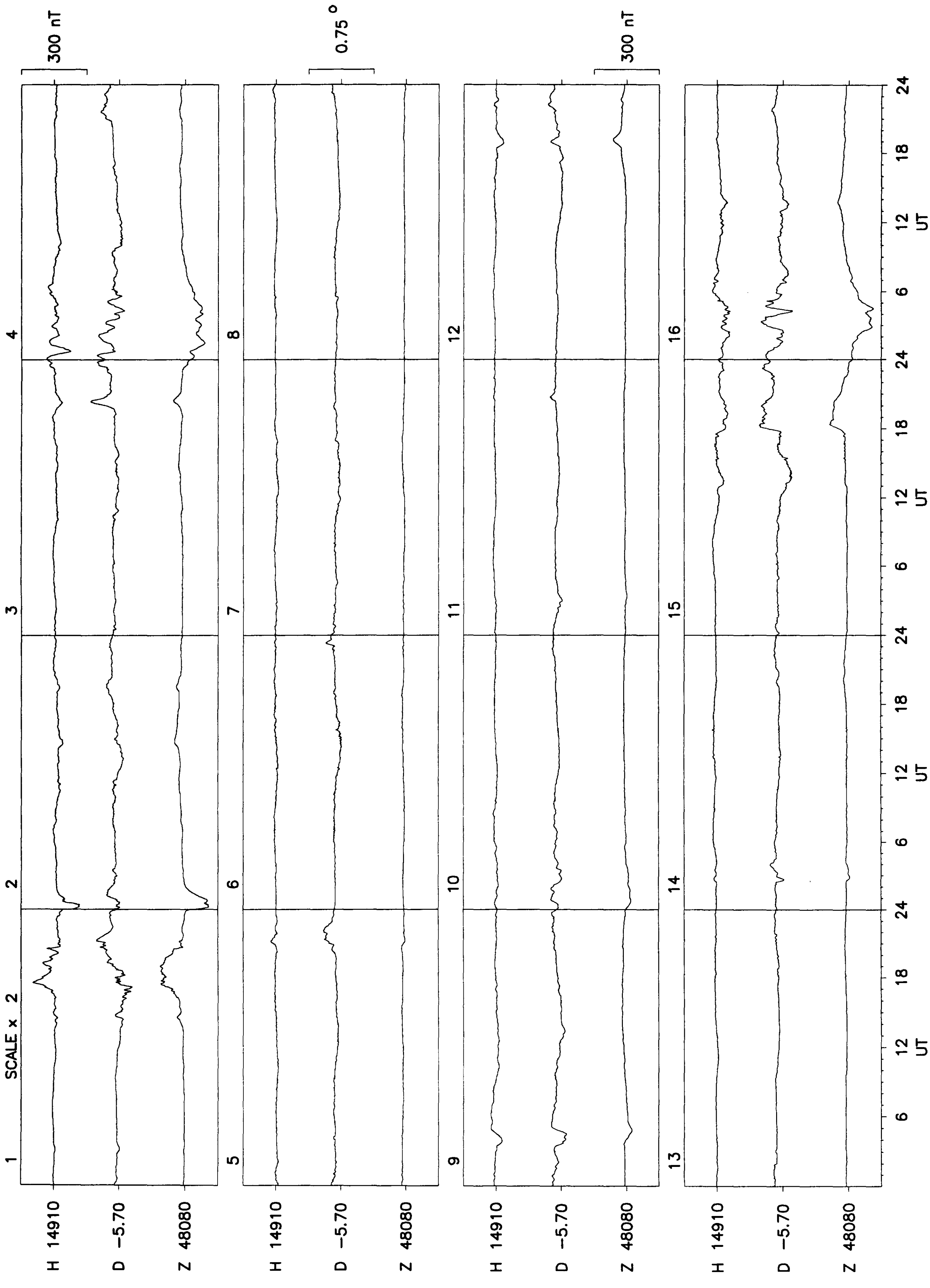
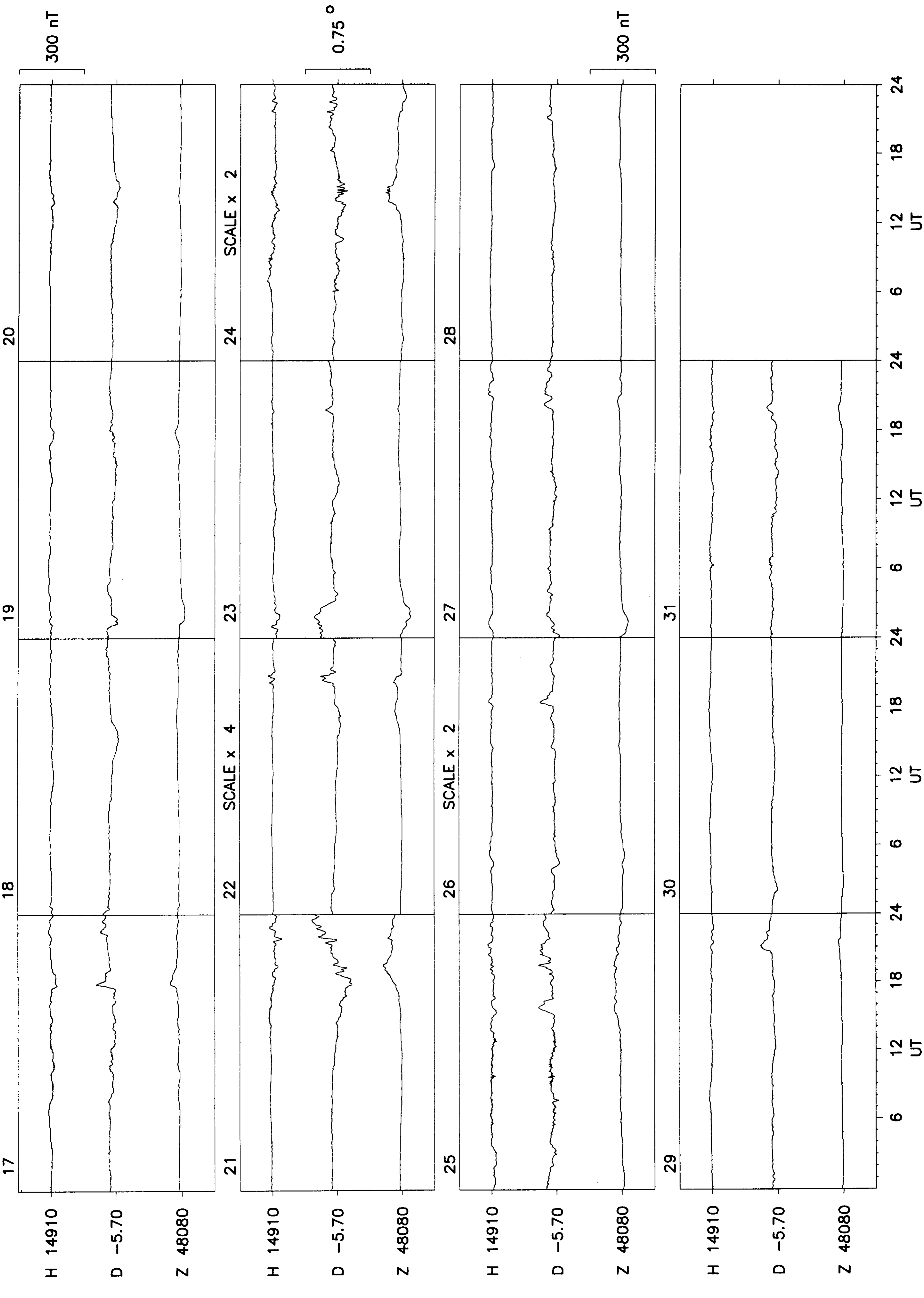
30
31
H 14910
D −5.70
Z 48080
UT
6
12
18
24


300 nT
0.75 °
300 nT
SCALE x 2
H 14910
D −5.70
Z 48080
UT
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16



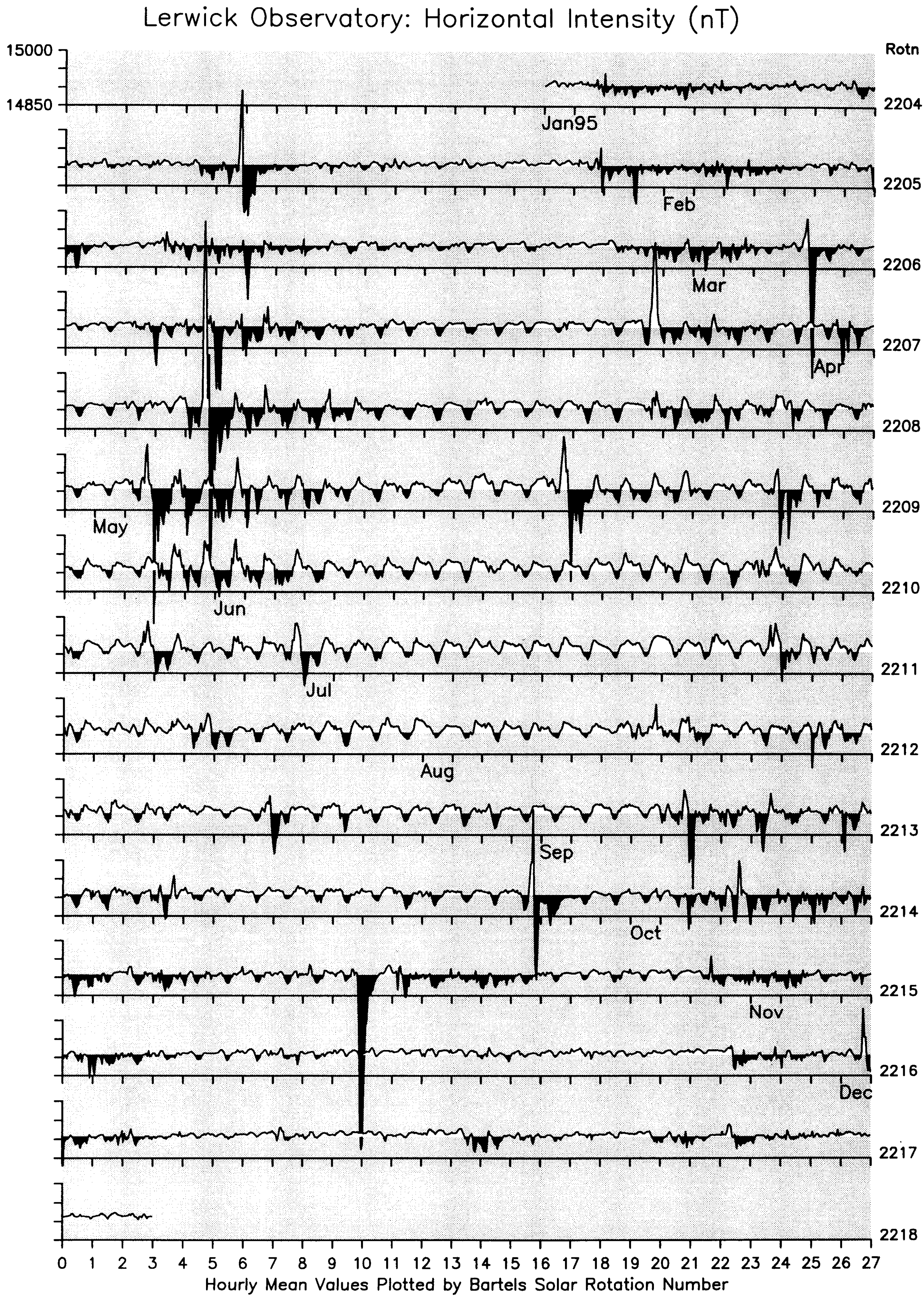
300 nT
0.75 °
300 nT
SCALE x 2
SCALE x 2
17
18
19
20
21
22
23
24
25
26
27
28
29
30
H 14910
D −5.70
Z 48080
6
12
18
24
UT


SCALE x 2
300 nT
0.75 °
300 nT
H 14910
D −5.70
Z 48080
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
6
12
18
24
UT

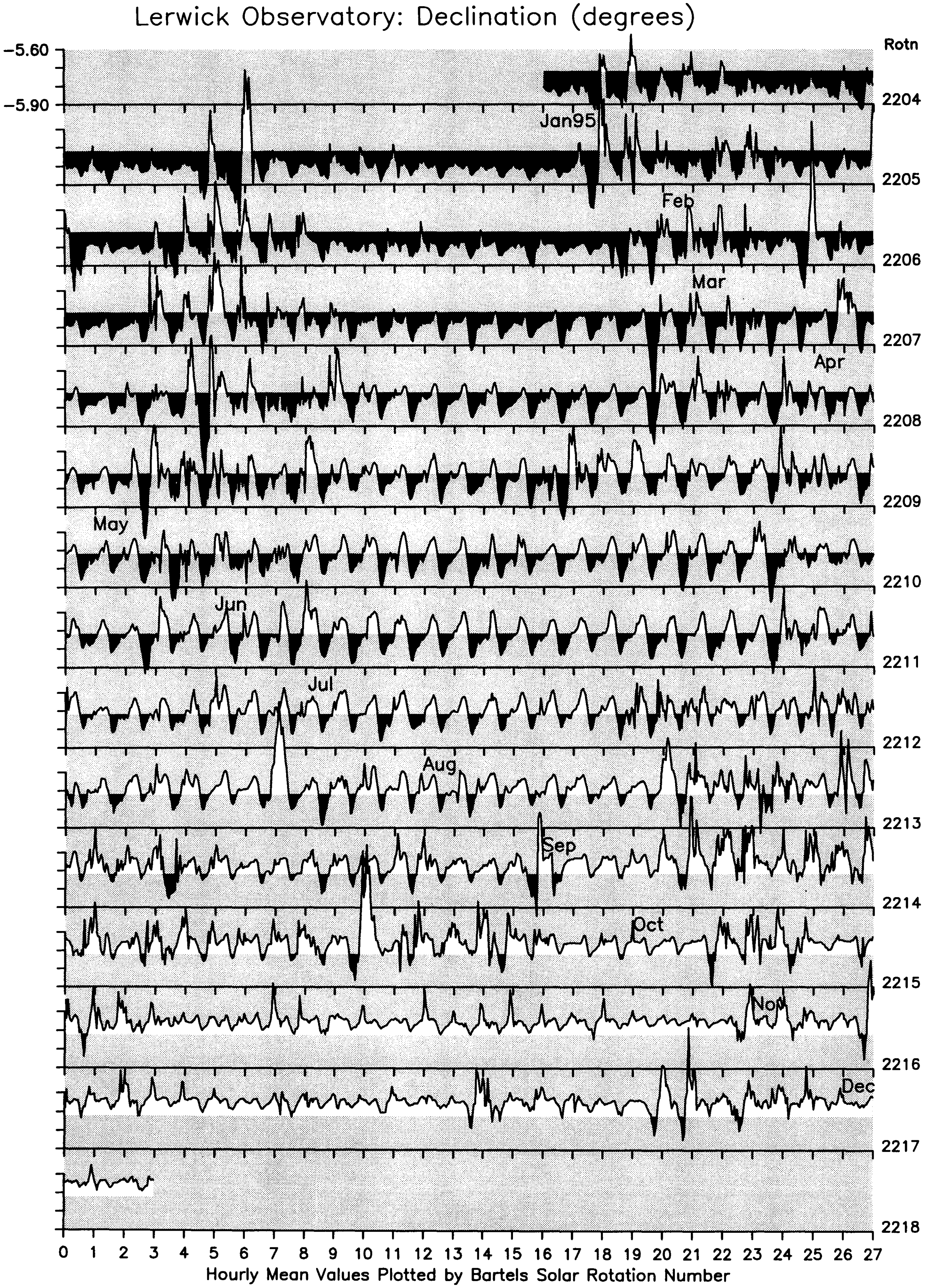


300 nT
0.75 °
300 nT
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
SCALE x 4
SCALE x 2
SCALE x 2
H 14910
D −5.70
Z 48080
H 14910
D −5.70
Z 48080
H 14910
D −5.70
Z 48080
H 14910
D −5.70
Z 48080
6
12
18
24
UT

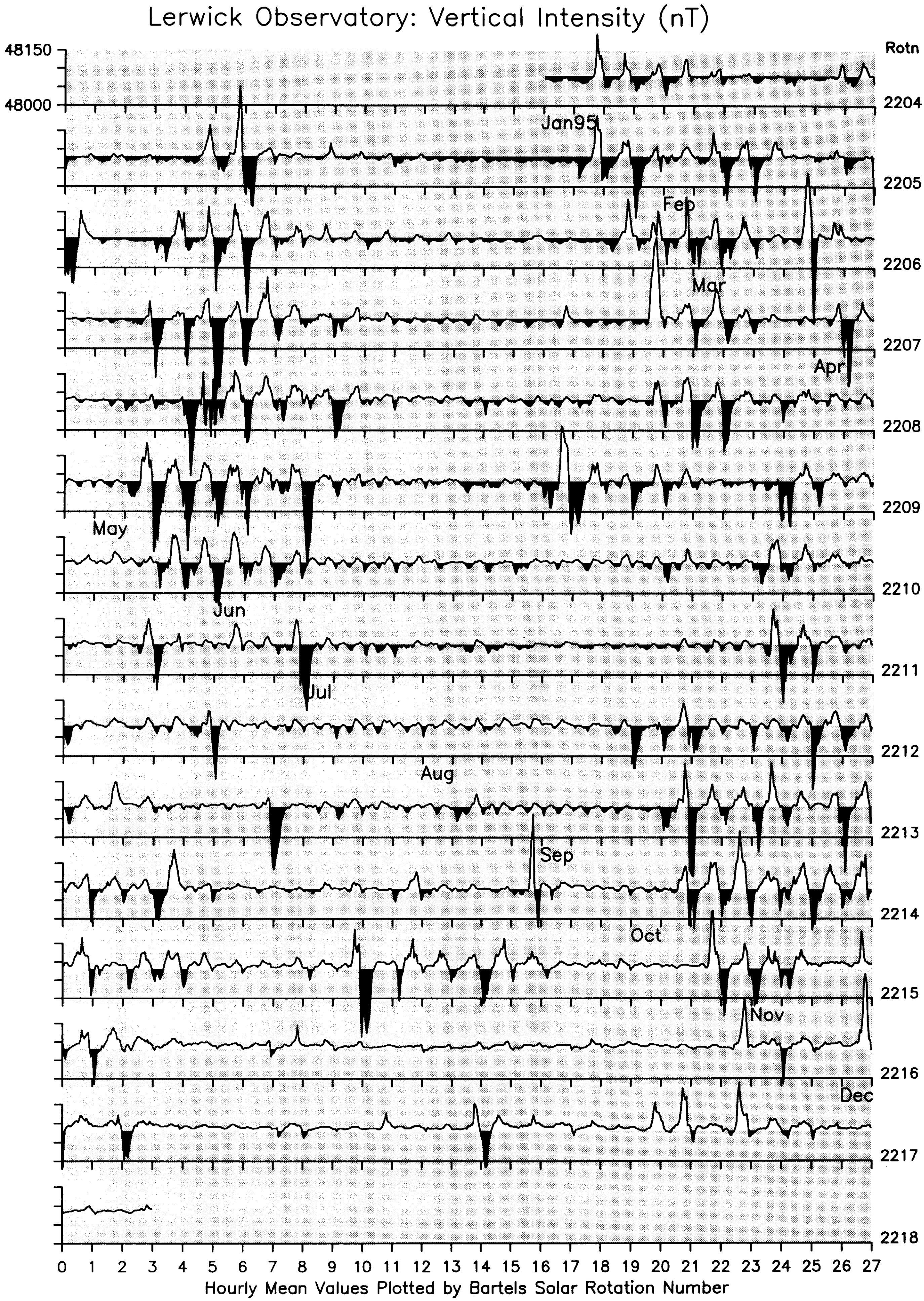
LE 12 95



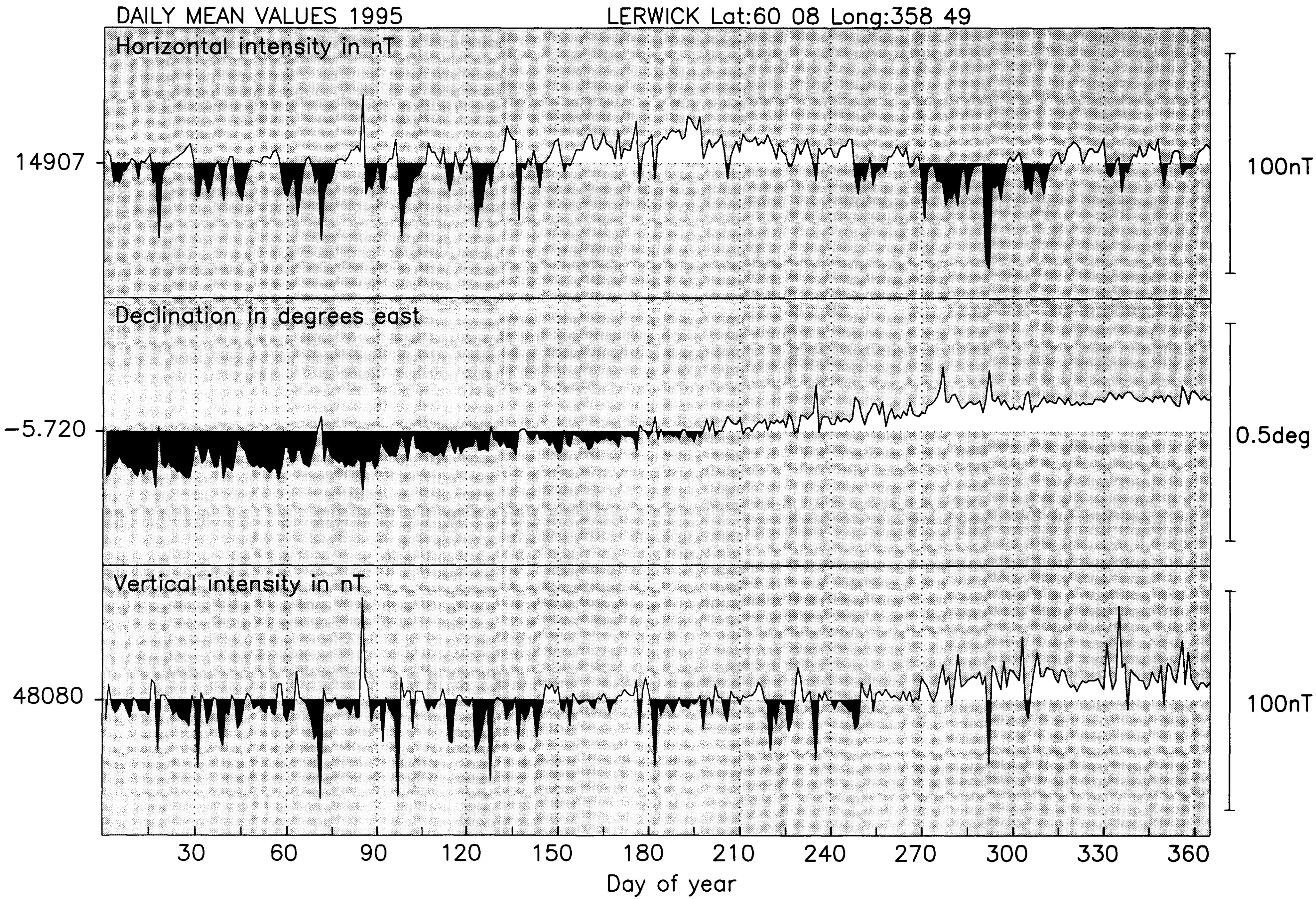
Lerwick Observatory: Horizontal Intensity (nT)
15000
14850
Rotn
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
Jan95
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted by Bartels Solar Rotation Number



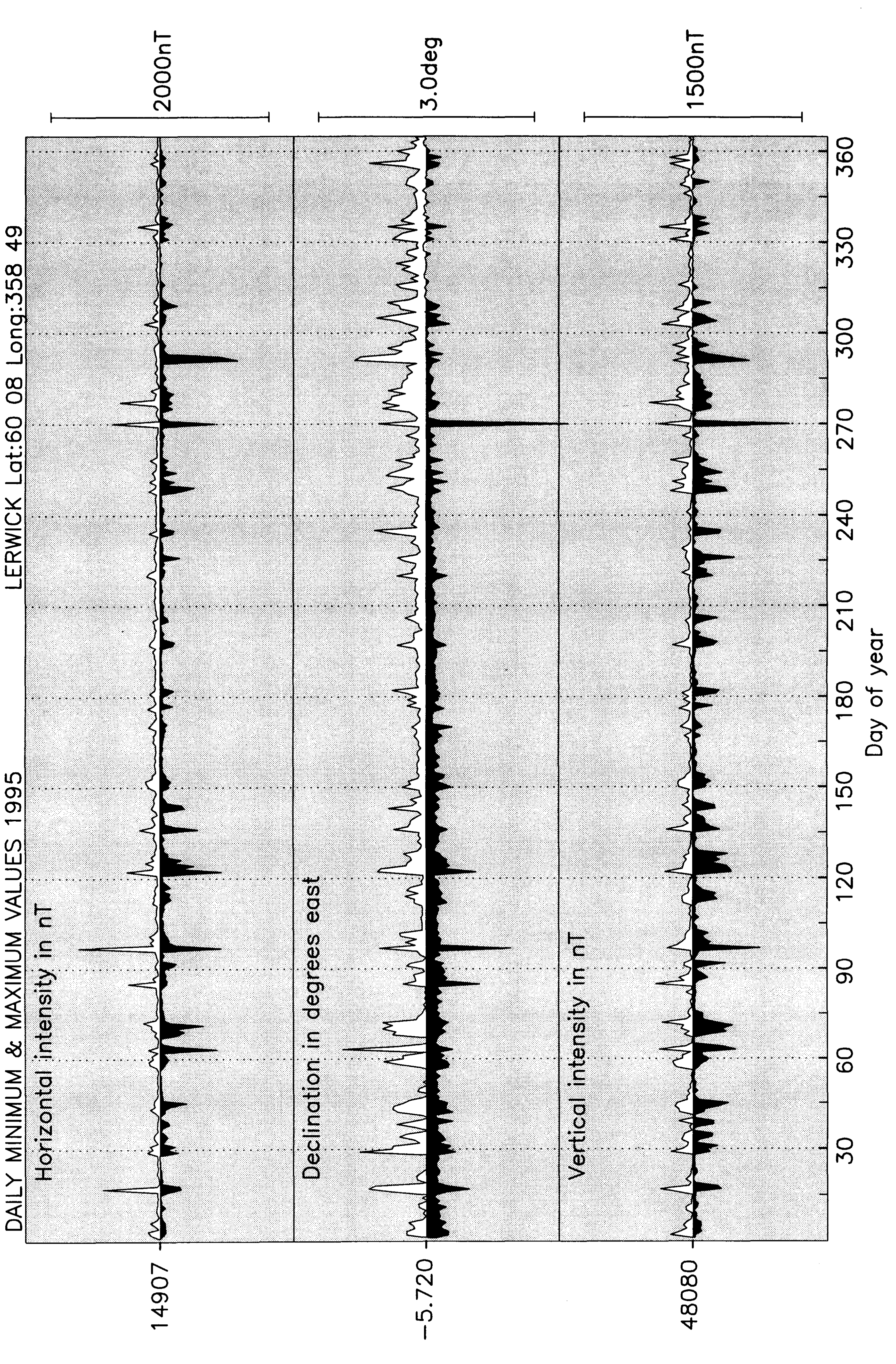
Lerwick Observatory: Declination (degrees)
-5.60
-5.90
Rotn
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
Jan95
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted by Bartels Solar Rotation Number



Lerwick Observatory: Vertical Intensity (nT)
48150
48000
Rotn
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
Jan95
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted by Bartels Solar Rotation Number



DAILY MEAN VALUES 1995
LERWICK Lat:60 08 Long:358 49
Horizontal intensity in nT
14907
100nT
Declination in degrees east
−5.720
0.5deg
Vertical intensity in nT
48080
100nT
30
60
90
120
150
180
210
240
270
300
330
360
Day of year



DAILY MINIMUM & MAXIMUM VALUES 1995
LERWICK Lat:60 08 Long:358 49
Horizontal intensity in nT
2000nT
14907
Declination in degrees east
3.0deg
-5.720
Vertical intensity in nT
1500nT
48080
30
60
90
120
150
180
210
240
270
300
330
360
Day of year

Monthly Mean Values for Lerwick 1995

Month	D ° '	H nT	I ° '	X nT	Y nT	Z nT	F nT
Based on all days							
Jan	-5 48.0	14904	72 46.5	14828	-1506	48075	50332
Feb	-5 47.4	14903	72 46.6	14827	-1503	48076	50333
Mar	-5 46.9	14903	72 46.7	14827	-1501	48077	50334
Apr	-5 45.6	14903	72 46.6	14828	-1496	48076	50333
May	-5 44.7	14906	72 46.4	14831	-1492	48074	50332
Jun	-5 44.2	14914	72 46.0	14839	-1491	48080	50340
Jul	-5 43.0	14917	72 45.7	14843	-1486	48077	50338
Aug	-5 41.7	14913	72 46.0	14839	-1480	48078	50338
Sep	-5 40.6	14906	72 46.5	14833	-1474	48081	50339
Oct	-5 38.8	14898	72 47.2	14826	-1466	48089	50344
Nov	-5 39.0	14908	72 46.6	14836	-1468	48090	50348
Dec	-5 38.5	14909	72 46.6	14837	-1466	48092	50350
Annual	**-5 43.2**	**14907**	**72 46.5**	**14833**	**-1486**	**48080**	**50338**
International quiet day means							
Jan	-5 49.2	14913	72 45.9	14836	-1512	48072	50332
Feb	-5 48.2	14910	72 46.1	14834	-1508	48074	50333
Mar	-5 47.7	14910	72 46.2	14834	-1505	48076	50335
Apr	-5 46.1	14907	72 46.5	14832	-1498	48080	50338
May	-5 44.9	14911	72 46.2	14836	-1493	48079	50338
Jun	-5 44.6	14917	72 45.8	14842	-1493	48081	50342
Jul	-5 43.4	14921	72 45.5	14847	-1488	48077	50339
Aug	-5 41.6	14914	72 46.0	14840	-1480	48081	50341
Sep	-5 41.0	14912	72 46.1	14839	-1477	48081	50340
Oct	-5 39.7	14909	72 46.5	14836	-1471	48088	50346
Nov	-5 39.1	14913	72 46.2	14841	-1469	48089	50348
Dec	-5 38.6	14913	72 46.3	14841	-1466	48090	50349
Annual	**-5 43.7**	**14913**	**72 46.1**	**14839**	**-1488**	**48081**	**50341**
International disturbed day means							
Jan	-5 46.6	14894	72 47.2	14818	-1499	48076	50330
Feb	-5 46.0	14897	72 47.0	14822	-1497	48074	50329
Mar	-5 45.6	14899	72 46.9	14824	-1495	48077	50333
Apr	-5 45.2	14893	72 47.3	14818	-1493	48075	50329
May	-5 45.5	14901	72 46.7	14826	-1495	48074	50330
Jun	-5 44.0	14912	72 46.0	14837	-1490	48076	50336
Jul	-5 42.4	14913	72 45.9	14839	-1483	48071	50331
Aug	-5 41.5	14911	72 46.0	14837	-1479	48070	50330
Sep	-5 39.9	14898	72 47.0	14825	-1471	48077	50332
Oct	-5 37.6	14889	72 47.8	14817	-1460	48090	50342
Nov	-5 38.8	14897	72 47.3	14825	-1466	48089	50344
Dec	-5 38.2	14903	72 47.1	14831	-1464	48097	50353
Annual	**-5 42.6**	**14901**	**72 46.8**	**14827**	**-1483**	**48079**	**50335**

Lerwick Observatory K Indices 1995

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0000 0110	3212 2232	3333 2344	0000 1344	0000 0001	3432 4432	4321 2111	2011 1000	1000 1110	1000 0032	3432 3153	2101 3554
2	0112 1244	2322 3433	3332 3423	4522 3111	3332 4647	3322 3323	2001 1120	1000 1220	1000 1111	2012 2224	2323 2430	4111 2121
3	5322 2444	3322 3344	3001 1012	0000 0000	5334 4433	3332 3333	2111 2112	2121 2221	2000 1111	4321 3433	0110 0020	1001 1132
4	3322 2232	4221 3433	1112 2367	1000 1101	6532 4334	1111 2211	2200 2210	1010 1122	0010 1113	4424 7554	0001 2410	4322 1112
5	2222 3333	1010 0100	5212 2243	2112 2122	4444 4444	1100 1212	1010 1111	0101 2211	3222 3445	3223 3214	3212 3325	1000 0012
6	2112 2234	2101 2203	0200 0100	3100 1012	5233 3232	2111 2121	0000 1010	0000 1111	6222 3323	2323 2433	3232 3142	0000 0112
7	2112 2222	3220 0124	0000 0100	4543 8886	2233 3343	3000 1111	1200 1100	0002 2232	3322 3431	4332 3333	2211 1023	1000 1100
8	3100 1120	3443 3210	0110 0010	4433 3433	4312 3322	1100 0100	1100 2210	4322 2253	3454 2431	2322 3543	2111 1111	0000 0001
9	2120 1102	0200 0000	0121 2255	4432 3423	2111 1122	0001 1211	0001 2211	3221 3334	3322 2212	0222 2434	0000 1011	1311 1001
10	0000 1122	0000 0102	5311 2223	2323 3333	1101 1210	3212 1200	0000 1000	3322 2222	1011 2224	3221 1100	2210 0111	2200 0000
11	3212 3332	2242 2335	3221 2345	1321 2343	2101 1111	2210 1100	1100 0011	1111 1213	5421 2332	0221 2412	1001 0013	2100 0010
12	2000 0123	3312 2353	6632 3455	4211 2322	2111 2221	0011 0200	1000 1211	3001 2212	1112 2243	3332 2123	1121 1141	0000 0122
13	0111 1111	4333 4434	4323 4543	2201 1212	1101 3211	0000 1010	2111 1110	2211 2124	3223 2322	3111 1233	0000 2221	0000 0001
14	1100 0012	5222 4443	3322 3333	2001 1111	1111 1110	0000 2232	0001 1222	5332 2333	2100 1133	1111 1123	1010 0002	2200 1110
15	2000 0000	2212 1433	1111 2033	0000 1110	0000 2112	1111 2211	1111 2111	3221 2222	3423 3531	2001 1213	0100 0000	1000 2332
16	1102 3253	1111 1312	2221 2232	0000 1011	2333 5456	3211 3231	1111 4435	1220 2210	2122 3122	2101 1132	0000 0002	3421 2101
17	3223 2376	1021 1101	1101 2212	3110 0000	4442 2343	2111 1111	5322 3423	2111 3221	2100 2110	1321 1201	3111 1002	0111 1322
18	5542 2123	2111 1230	2011 1010	1001 1222	2111 3223	1232 3112	3111 2221	0101 2221	0001 0012	1113 2347	1001 0012	1000 1100
19	1001 1000	1111 1102	1000 0112	1110 0012	2222 2222	3333 5332	1221 1123	2011 1232	1001 0111	7522 1112	1210 1024	2100 1210
20	0000 1132	1201 1110	0001 2210	1211 2210	3222 2233	2432 2422	3213 2211	1111 2100	2211 2212	1433 3441	2010 0002	0000 2100
21	2110 0133	2101 0002	0000 0000	0000 0000	2100 1000	2212 2221	0001 1211	0001 0000	1100 2212	2121 3333	1000 0101	0000 1333
22	2000 2112	0000 0000	0010 0000	0001 3433	1110 1102	1101 2211	0100 2221	0000 3245	1000 1111	2121 1143	1100 1202	2110 2353
23	2200 0011	1010 1111	0002 2220	3222 3324	2101 2345	1222 1210	3100 2221	4311 1110	3211 2233	3432 2242	3000 0011	3201 1020
24	1000 0000	0000 0011	1010 1101	4322 2343	3533 3322	1110 1110	2332 3234	1101 2221	2211 0110	2001 2421	0000 0000	1133 4323
25	1110 0000	0000 0000	1110 0112	4421 2221	3311 2221	0111 4342	3211 0110	2322 2213	0011 0110	2210 0000	0000 0002	2222 2332
26	1000 0001	2131 2233	2122 4564	2322 3324	1112 3233	4312 2123	1111 2111	2210 1011	0001 1111	0000 1102	1200 0000	2321 2242
27	0000 1000	2322 3343	3122 3333	4243 4231	1100 1220	1111 0011	1111 1121	2111 1222	2112 4685	1000 1103	0124 3334	2111 1122
28	0000 1000	4333 2254	3221 3321	2123 2211	1111 2112	1011 3323	1101 1112	0000 1211	1242 2100	1000 0000	1112 1242	0000 0111
29	1322 3436		3322 3223	2100 2222	1001 2221	1010 2311	2100 1200	2212 2222	0001 0100	1001 1000	3221 1310	0010 0022
30	5322 2445		2111 2200	1000 0012	1333 5343	2213 4444	1000 1213	1101 1111	0001 1012	0001 3523	2221 0001	1000 0000
31	5221 3353		1111 1211		3223 3443		1100 0212	0000 0110		4321 1243		1121 1120

SIs and SSCs

Day	Month	UT		Type	Quality	H(nT)	D(min)	Z(nT)
1	1	19	40	SI*	B	10	-0.6	-5
29	1	01	02	SSC*	C	7	-1.3	-4
12	2	15	35	SSC*	C	29	-1.8	-10
26	2	08	27	SI*	B	17	-7.8	3
14	3	07	45	SI*	B	21	3.3	8
23	3	10	36	SSC*	A	15	-3.0	-4
24	3	07	47	SSC*	B	-8	-3.3	3
1	4	17	20	SSC	C	-36	3.5	13
18	4	11	09	SSC*	B	13	1.2	4
2	5	05	00	SSC*	C	23	6.8	5
2	5	12	56	SSC*	C	-35	3.2	15
2	5	17	12	SI*	B	-121	-16.0	-135
13	5	14	54	SSC*	B	15	-0.8	-5
3	7	21	13	SSC*	C	-18	2.0	7
4	7	13	03	SI	C	14	-1.6	-3
4	7	15	09	SI*	B	-26	2.6	11
16	7	08	30	SSC*	C	-3	2.3	-2
24	7	02	54	SSC	A	22	-4.9	-8
9	8	10	22	SI*	C	-11	3.6	
9	8	12	28	SSC*	B	24	-1.7	-7
17	8	02	56	SSC*	B	8	-3.1	-2
22	8	13	07	SSC*	A	48	-3.6	-15
18	10	11	22	SSC*	A	31	4.4	6
30	10	10	10	SSC*	B	-7	1.2	-2
10	11	07	52	SI	C	10	2.7	-2
27	11	08	27	SSC*	B	-11	-1.9	
12	12	15	41	SSC*	C	5	0.6	2
15	12	15	16	SSC*	B	-15	-1.4	7
24	12	06	00	SSC*	A	10	-7.8	-2
24	12	08	48	SI*	B	-43	-1.4	-13

Notes

A * indicates that the principal impulse was preceded by a smaller reversed impulse.
The quality of the event is classified as follows :

A = very distinct
B = fair, ordinary, but unmistakable
C = doubtful

The amplitudes given are for the first chief movement of the event.

SFEs

Day	Month	Universal Time Start		Maximum		End		H(nT)	D(min)	Z(nT)
21	5	13	37	13	42	13	52	10	-1.4	-3

Notes

The amplitudes given are for the first chief movement of the event.

Annual Values of Geomagnetic Elements

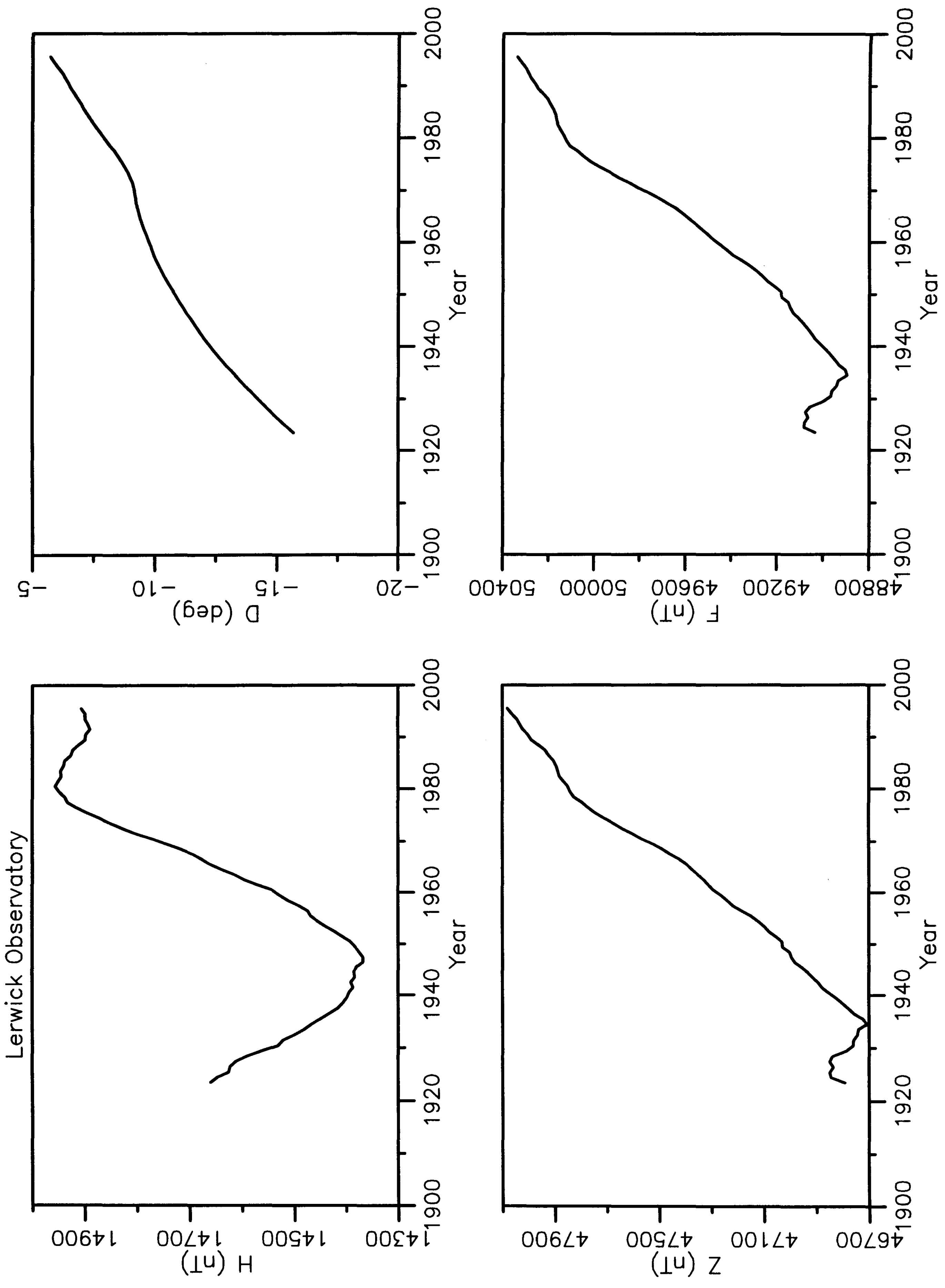
Lerwick

	Year	D		H	I		X	Y	Z	F
	1923.5	-15	40.3	14655	72	33.7	14111	-3959	46655	48902
	1924.5	-15	26.5	14642	72	35.7	14113	-3899	46708	48950
	1925.5	-15	13.5	14621	72	37.2	14108	-3840	46713	48948
	1926.5	-14	58.6	14618	72	37.1	14121	-3778	46699	48933
	1927.5	-14	45.7	14607	72	38.1	14125	-3722	46713	48944
	1928.5	-14	32.9	14585	72	39.4	14117	-3664	46702	48926
	1929.5	-14	19.4	14556	72	40.3	14104	-3601	46651	48869
	1930.5	-14	7.0	14527	72	41.6	14088	-3543	46624	48835
	1931.5	-13	55.4	14517	72	42.3	14090	-3493	46623	48830
	1932.5	-13	41.9	14495	72	43.5	14083	-3433	46608	48809
	1933.5	-13	29.8	14477	72	44.6	14077	-3379	46605	48802
Note 1		0	0.0	0	0	3.0	0	0	144	138
	1934.5	-13	17.7	14462	72	48.0	14074	-3326	46716	48903
	1935.5	-13	5.3	14445	72	49.4	14070	-3271	46730	48911
	1936.5	-12	53.6	14428	72	51.2	14064	-3220	46763	48938
	1937.5	-12	42.4	14411	72	52.8	14058	-3170	46785	48955
	1938.5	-12	31.6	14401	72	54.0	14058	-3123	46809	48974
	1939.5	-12	21.4	14394	72	54.9	14061	-3080	46833	48995
	1940.5	-12	11.1	14389	72	55.8	14065	-3037	46860	49019
	1941.5	-12	1.0	14382	72	56.8	14067	-2994	46884	49040
	1942.5	-11	52.5	14386	72	56.8	14078	-2960	46899	49056
	1943.5	-11	43.5	14378	72	57.8	14078	-2922	46919	49073
	1944.5	-11	35.1	14380	72	58.1	14087	-2888	46940	49093
	1945.5	-11	26.3	14376	72	58.8	14090	-2851	46963	49114
	1946.5	-11	17.1	14363	73	0.2	14085	-2811	46989	49135
	1947.5	-11	8.7	14363	73	0.5	14092	-2776	47002	49148
	1948.5	-11	0.9	14371	73	0.1	14106	-2746	47009	49157
	1949.5	-10	53.1	14378	73	0.2	14119	-2715	47037	49185
	1950.5	-10	45.5	14388	72	59.5	14135	-2686	47039	49190
	1951.5	-10	37.7	14402	72	59.1	14155	-2656	47061	49215
	1952.5	-10	29.9	14417	72	58.6	14176	-2627	47087	49245
	1953.5	-10	22.8	14435	72	57.8	14199	-2601	47106	49268
	1954.5	-10	15.6	14450	72	57.3	14219	-2574	47129	49294
	1955.5	-10	9.2	14464	72	56.9	14237	-2550	47156	49324
	1956.5	-10	2.8	14469	72	57.3	14247	-2524	47191	49359
	1957.5	-9	57.5	14486	72	56.8	14268	-2505	47225	49397
	1958.5	-9	52.7	14507	72	55.8	14292	-2489	47246	49423
	1959.5	-9	48.1	14523	72	55.3	14311	-2472	47271	49452
	1960.5	-9	43.4	14538	72	54.9	14329	-2455	47299	49483
	1961.5	-9	39.1	14565	72	53.5	14359	-2442	47318	49509
	1962.5	-9	33.3	14591	72	52.1	14389	-2422	47336	49534
	1963.5	-9	28.5	14610	72	51.3	14411	-2405	47359	49561
	1964.5	-9	24.4	14634	72	50.2	14437	-2392	47382	49590
	1965.5	-9	21.1	14656	72	49.2	14461	-2382	47403	49617
	1966.5	-9	17.8	14672	72	48.7	14479	-2370	47431	49648
	1967.5	-9	14.2	14688	72	48.3	14498	-2358	47464	49685
	1968.5	-9	12.1	14712	72	47.4	14523	-2353	47496	49722
	1969.5	-9	10.3	14740	72	46.2	14552	-2349	47531	49764
	1970.5	-9	7.9	14766	72	45.4	14579	-2343	47573	49812
	1971.5	-9	5.2	14796	72	44.1	14610	-2337	47607	49853
	1972.5	-8	59.5	14820	72	43.3	14638	-2316	47646	49898
	1973.5	-8	53.6	14844	72	42.4	14666	-2295	47680	49937
	1974.5	-8	46.5	14866	72	41.8	14692	-2268	47719	49981
	1975.5	-8	38.4	14890	72	40.9	14721	-2237	47753	50021
	1976.5	-8	29.9	14911	72	40.1	14747	-2204	47780	50053
	1977.5	-8	20.9	14927	72	39.5	14769	-2167	47803	50079
	1978.5	-8	10.1	14933	72	39.8	14782	-2122	47835	50112
	1979.5	-8	0.3	14944	72	39.3	14798	-2081	47850	50129
	1980.5	-7	50.4	14952	72	39.0	14812	-2039	47858	50139
	1981.5	-7	40.9	14946	72	39.7	14812	-1998	47875	50154
	1982.5	-7	31.6	14940	72	40.4	14812	-1957	47890	50166
	1983.5	-7	22.6	14942	72	40.4	14818	-1918	47895	50172

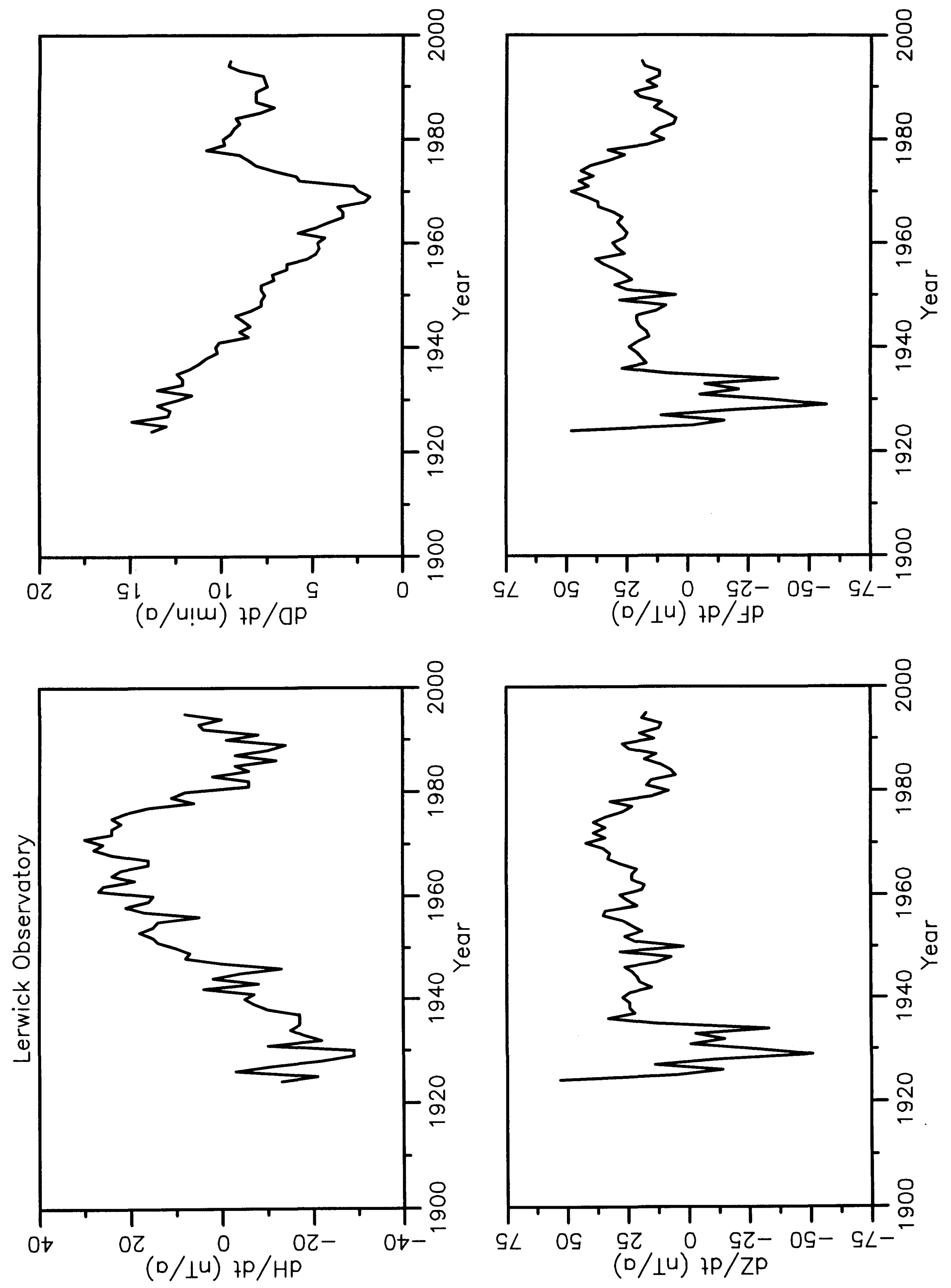
	Year	D		H	I		X	Y	Z	F
	1984.5	-7	13.4	14936	72	40.9	14818	-1878	47902	50177
	1985.5	-7	5.5	14933	72	41.3	14819	-1844	47913	50186
	1986.5	-6	58.4	14921	72	42.5	14811	-1811	47931	50200
	1987.5	-6	50.3	14918	72	43.0	14812	-1776	47944	50211
	1988.5	-6	42.2	14908	72	44.1	14806	-1740	47968	50231
	1989.5	-6	34.1	14894	72	45.6	14796	-1704	47995	50253
Note 2		0	0.0	5	0	-0.5	5	-1	-8	-6
	1990.5	-6	26.6	14898	72	45.4	14804	-1672	48001	50260
	1991.5	-6	19.0	14890	72	46.4	14800	-1638	48021	50277
	1992.5	-6	11.3	14894	72	46.3	14807	-1606	48033	50289
	1993.5	-6	2.3	14899	72	46.2	14816	-1567	48044	50301
	1994.5	-5	52.7	14899	72	46.6	14821	-1526	48063	50319
	1995.5	-5	43.2	14907	72	46.5	14833	-1486	48080	50338

1 Site differences 1 Jan 1934 (new value - old value)
2 Site differences 1 Jan 1990 (new value - old value)

D and I are given in degrees and decimal minutes
All other elements are in nanoteslas

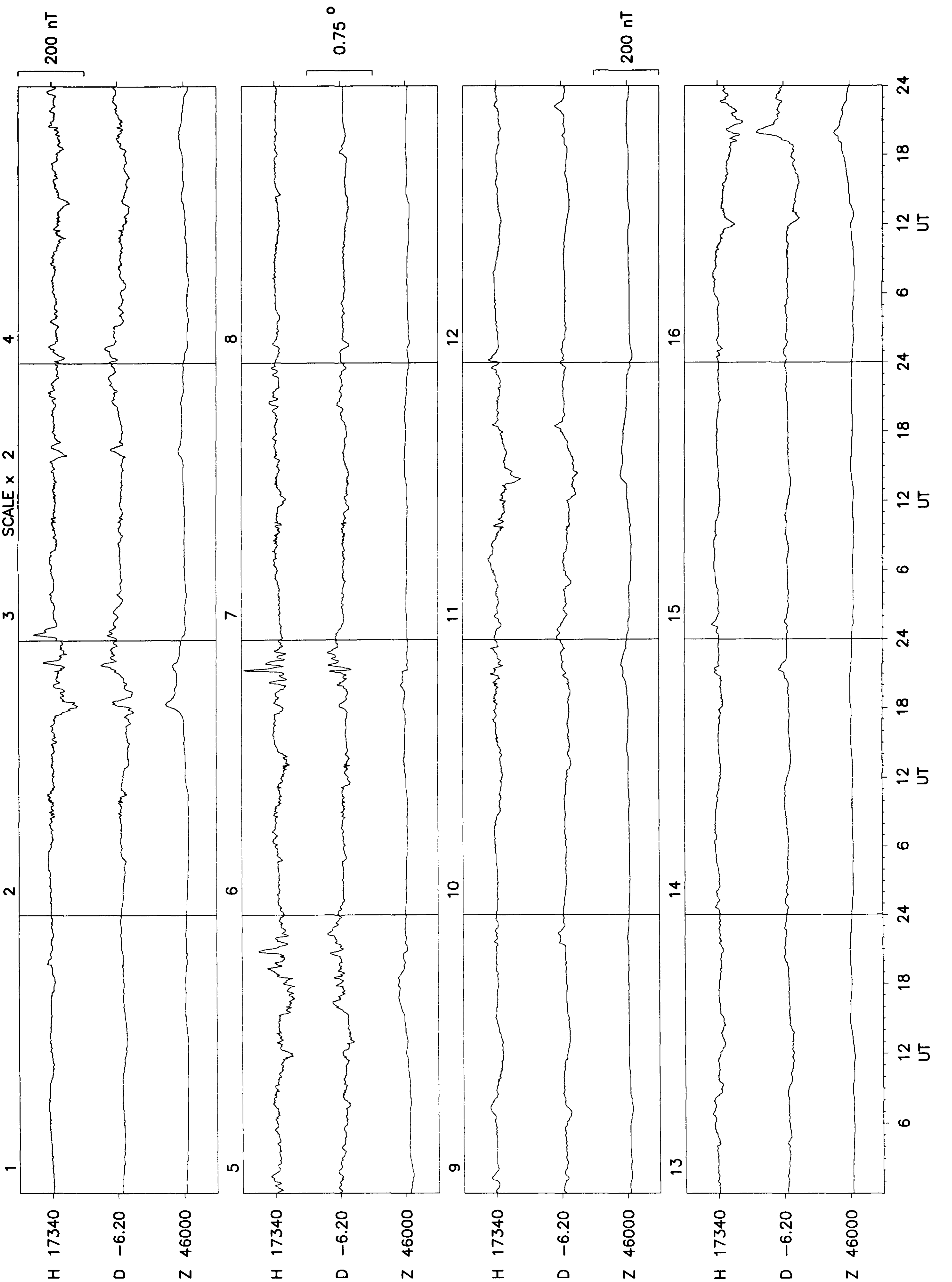


Annual mean values of H, D, Z &F at Lerwick



Rate of change of annual mean values of H, D, Z &F at Lerwick

Eskdalemuir 1995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0.75 °
200 nT
SCALE x 2
H 17340
D −6.20
Z 46000
UT
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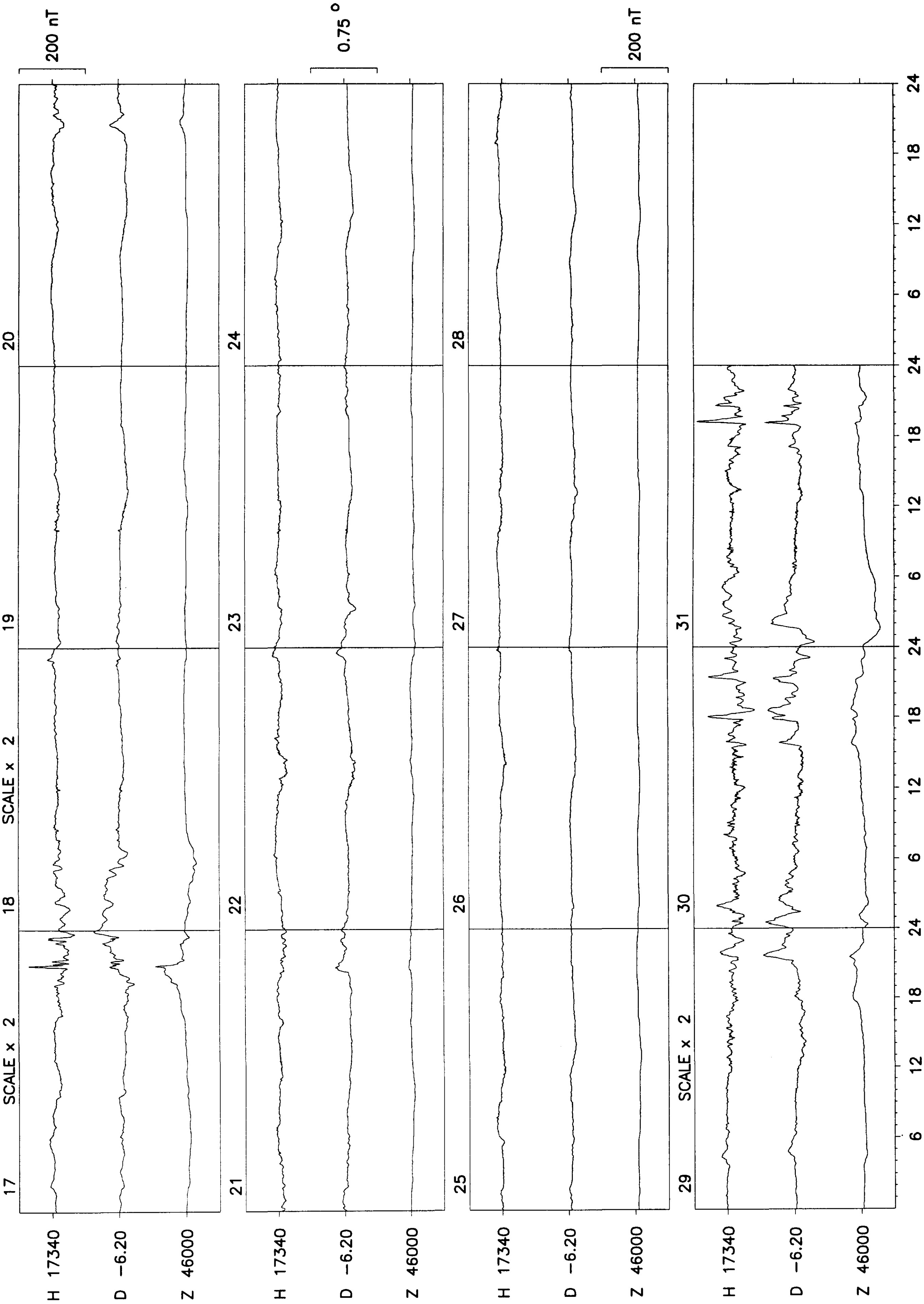
200 nT
0.75 °
200 nT
17
SCALE x 2
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SCALE x 2
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28
29
SCALE x 2
30
31
H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
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UT
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24
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UT
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UT
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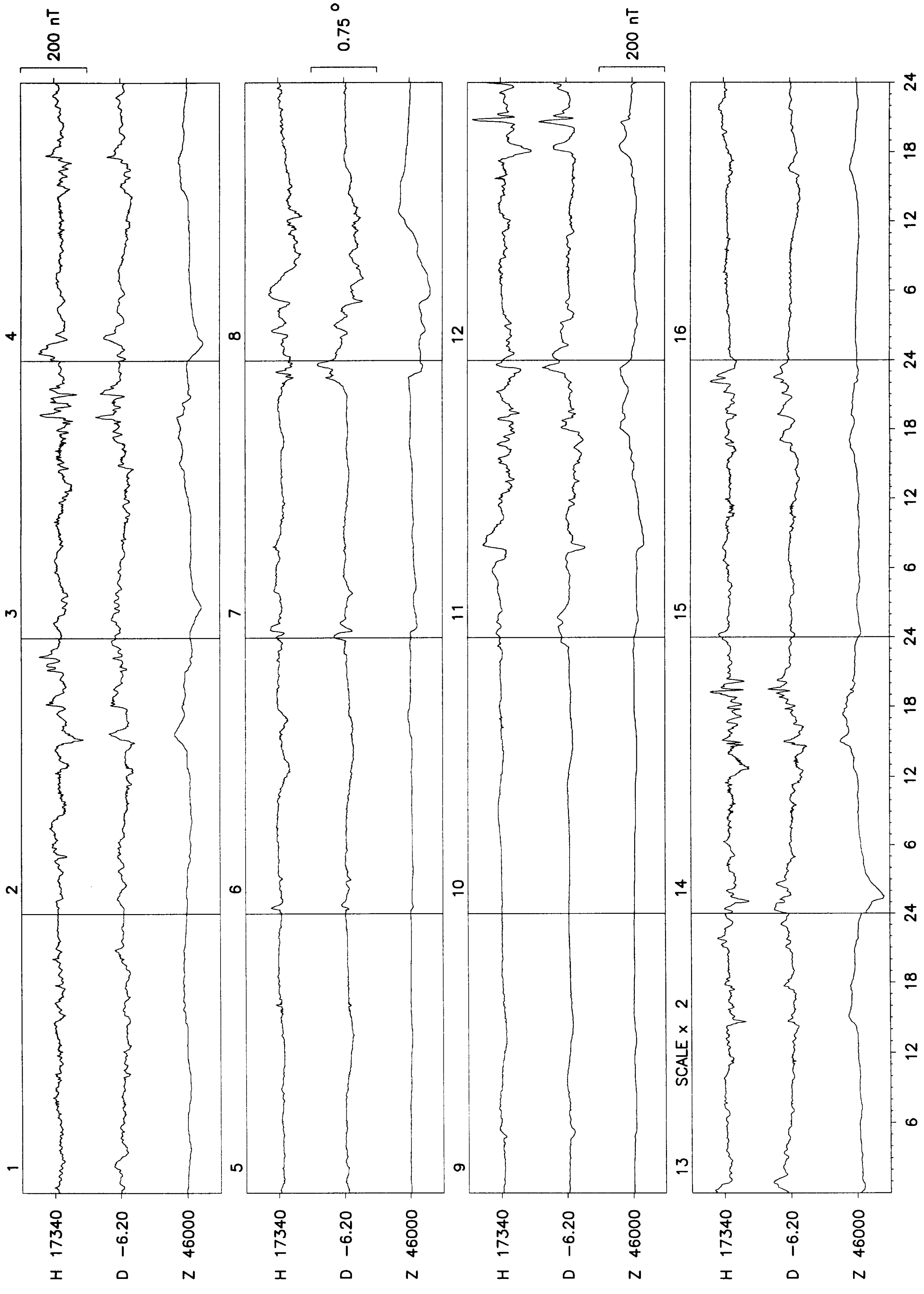

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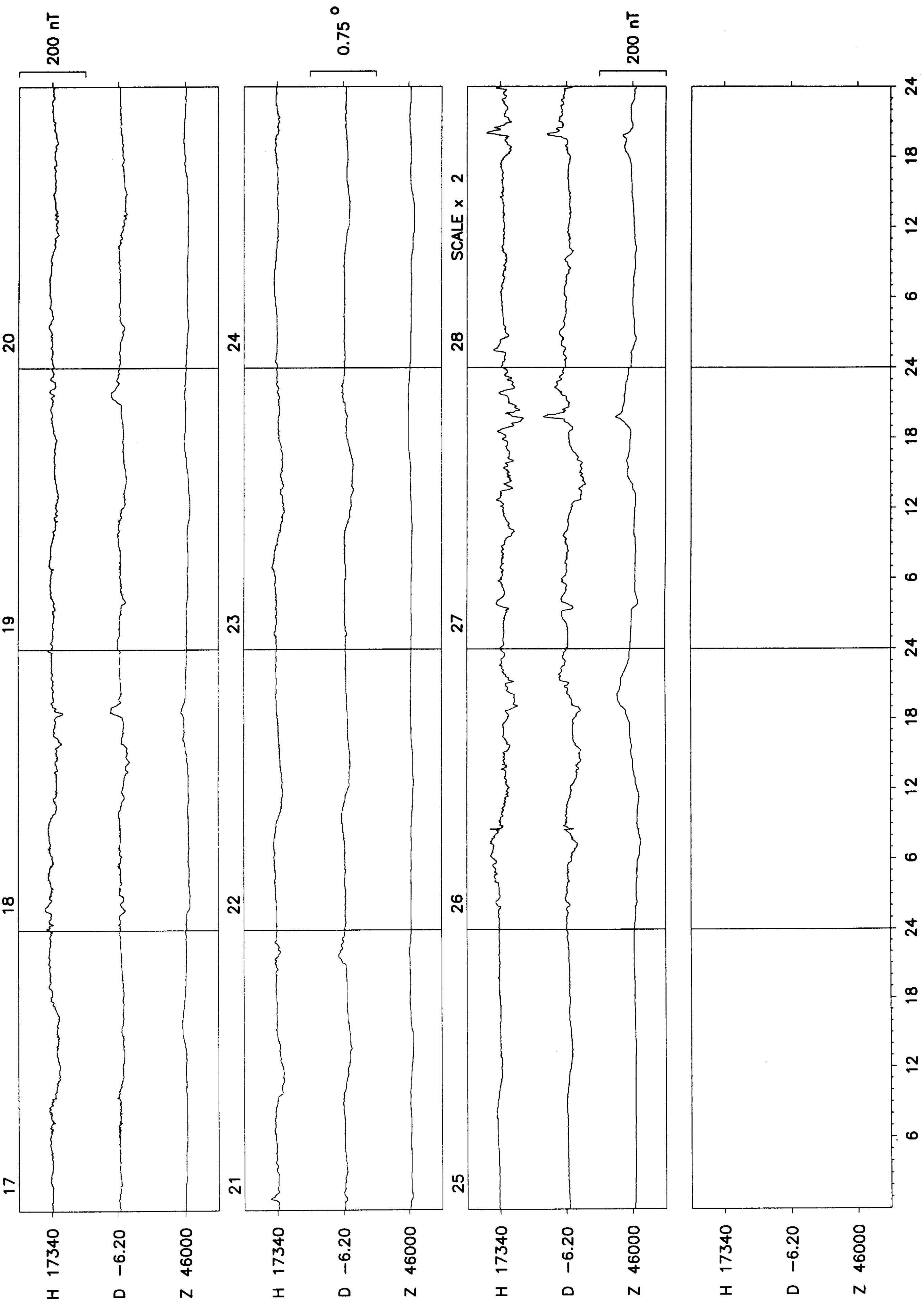
200 nT
H 17340
D −6.20
Z 46000
SCALE x 2
UT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0.75 °
200 nT
SCALE x 2
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H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
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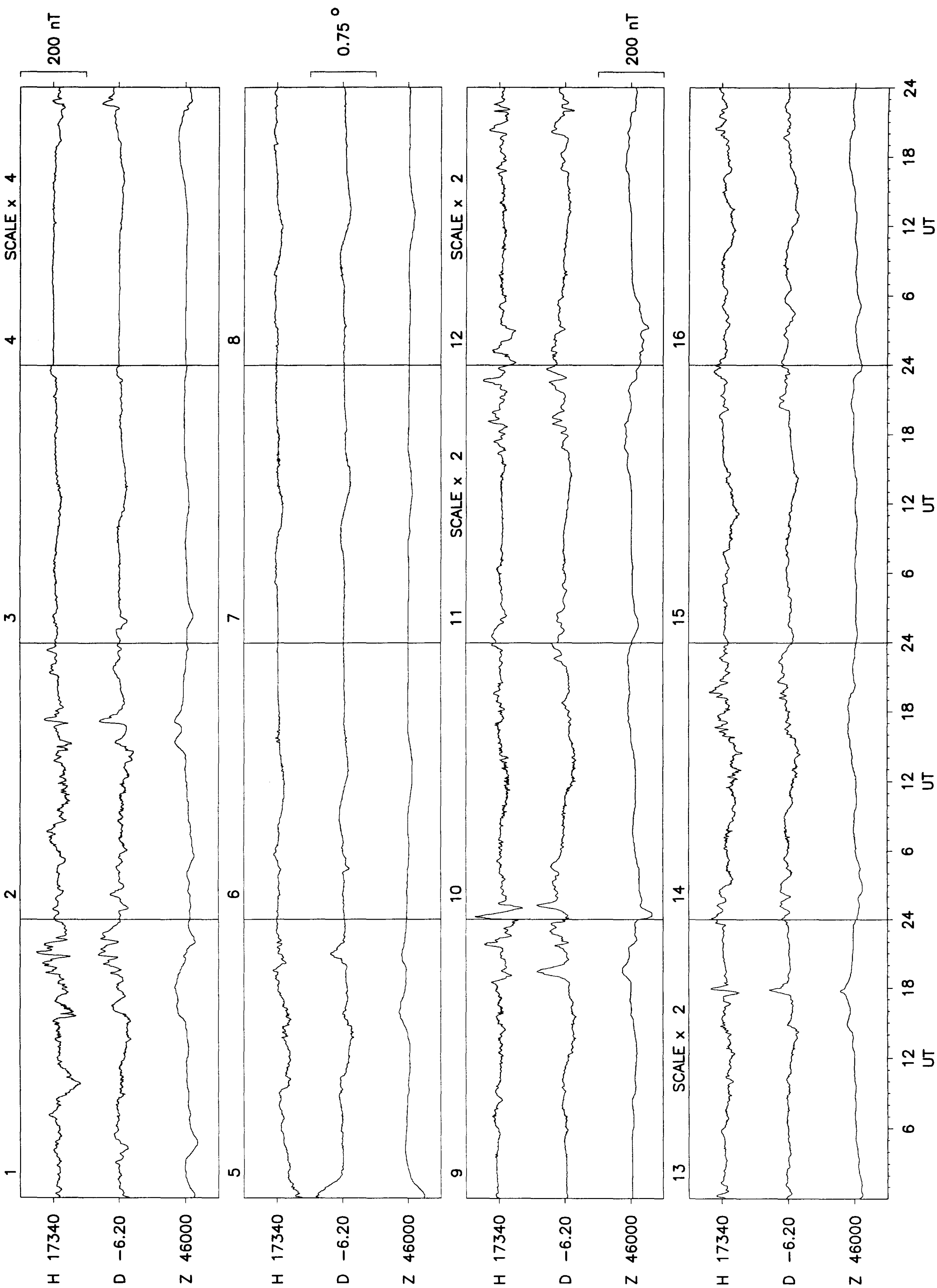
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200 nT
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SCALE x 2
SCALE x 2
SCALE x 2
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H 17340
D -6.20
Z 46000
UT
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18
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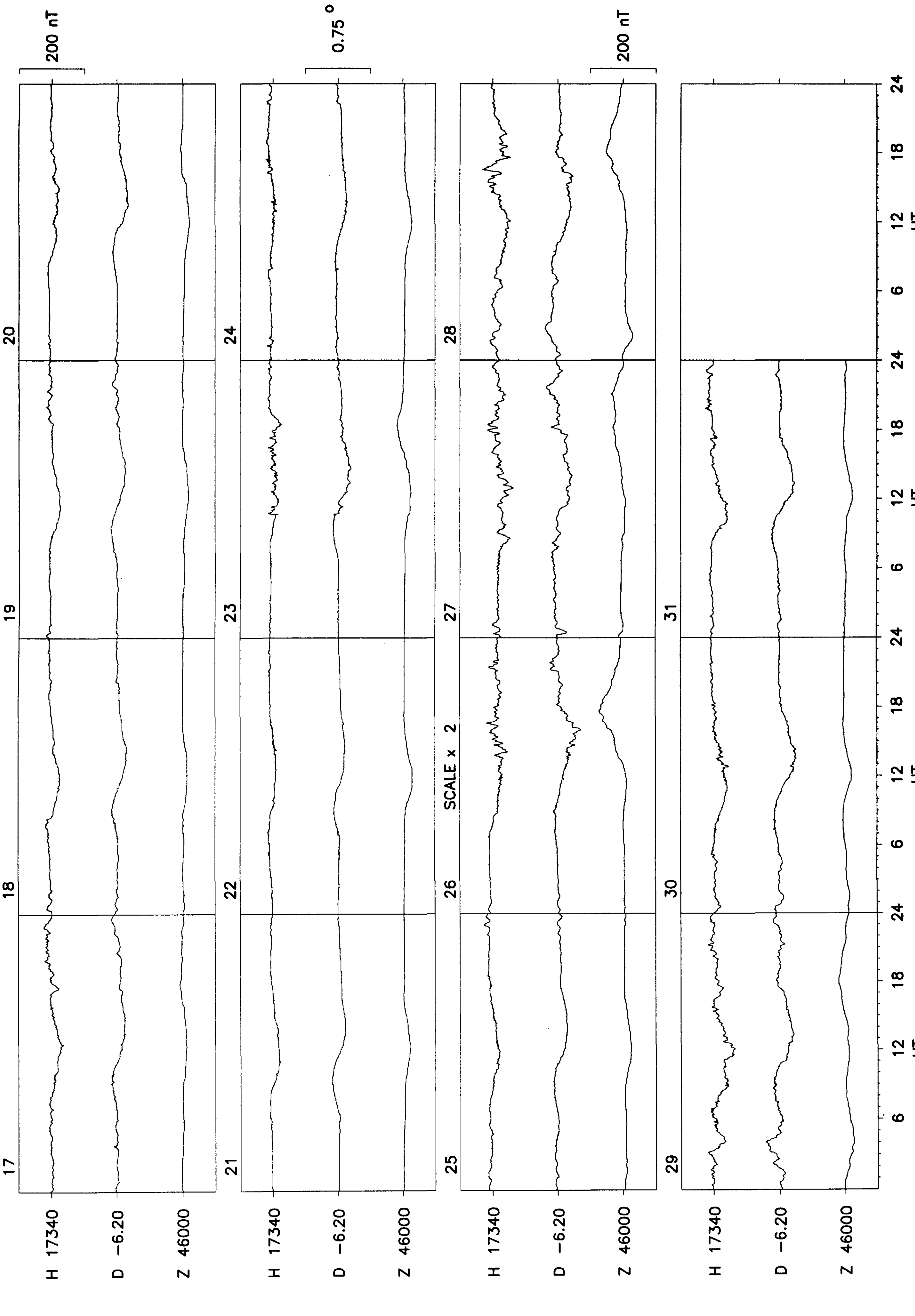
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0.75 °
200 nT
SCALE x 2
H 17340
D −6.20
Z 46000
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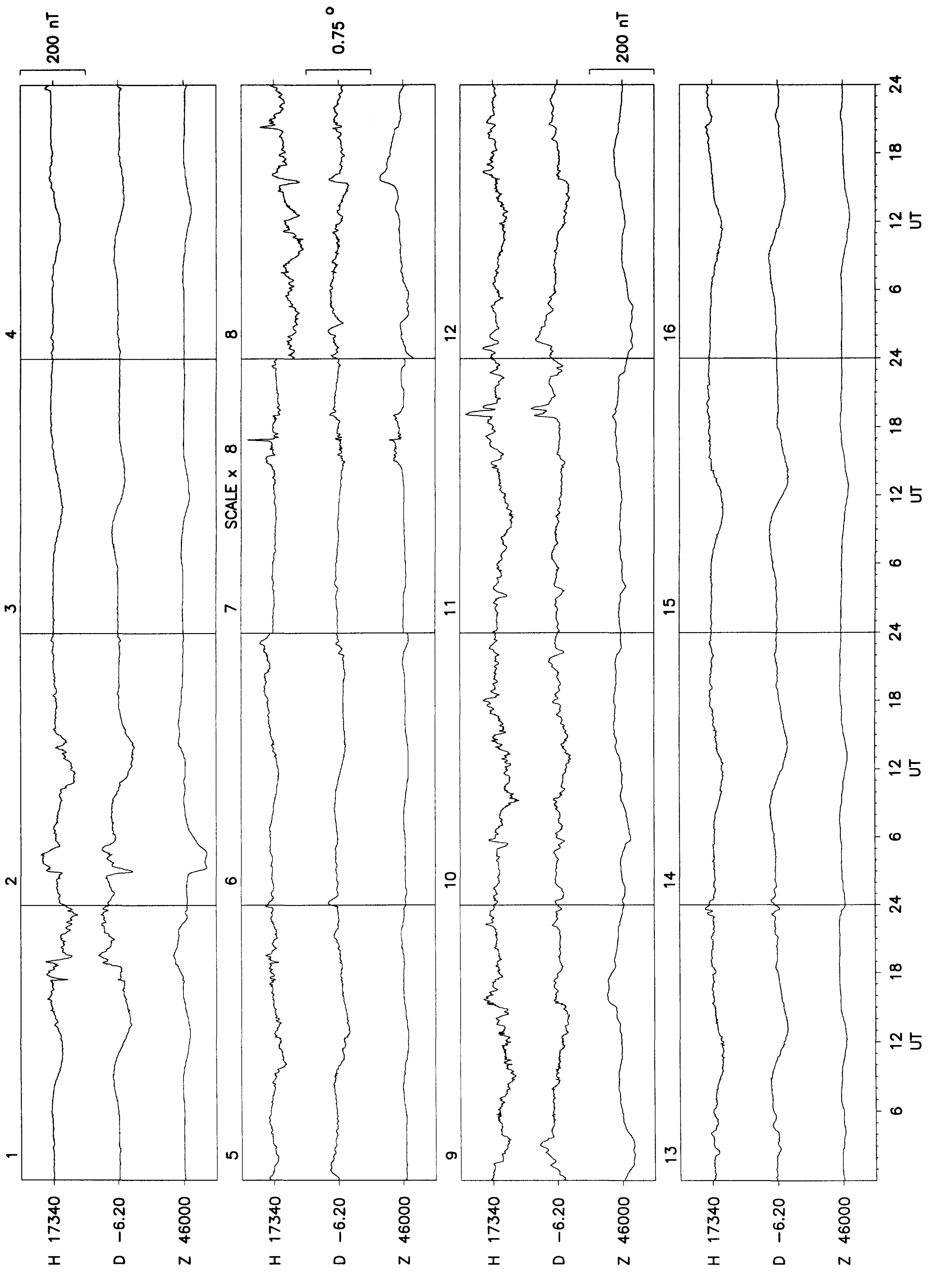
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0.75 °
200 nT
SCALE x 8
H 17340
D −6.20
Z 46000
UT
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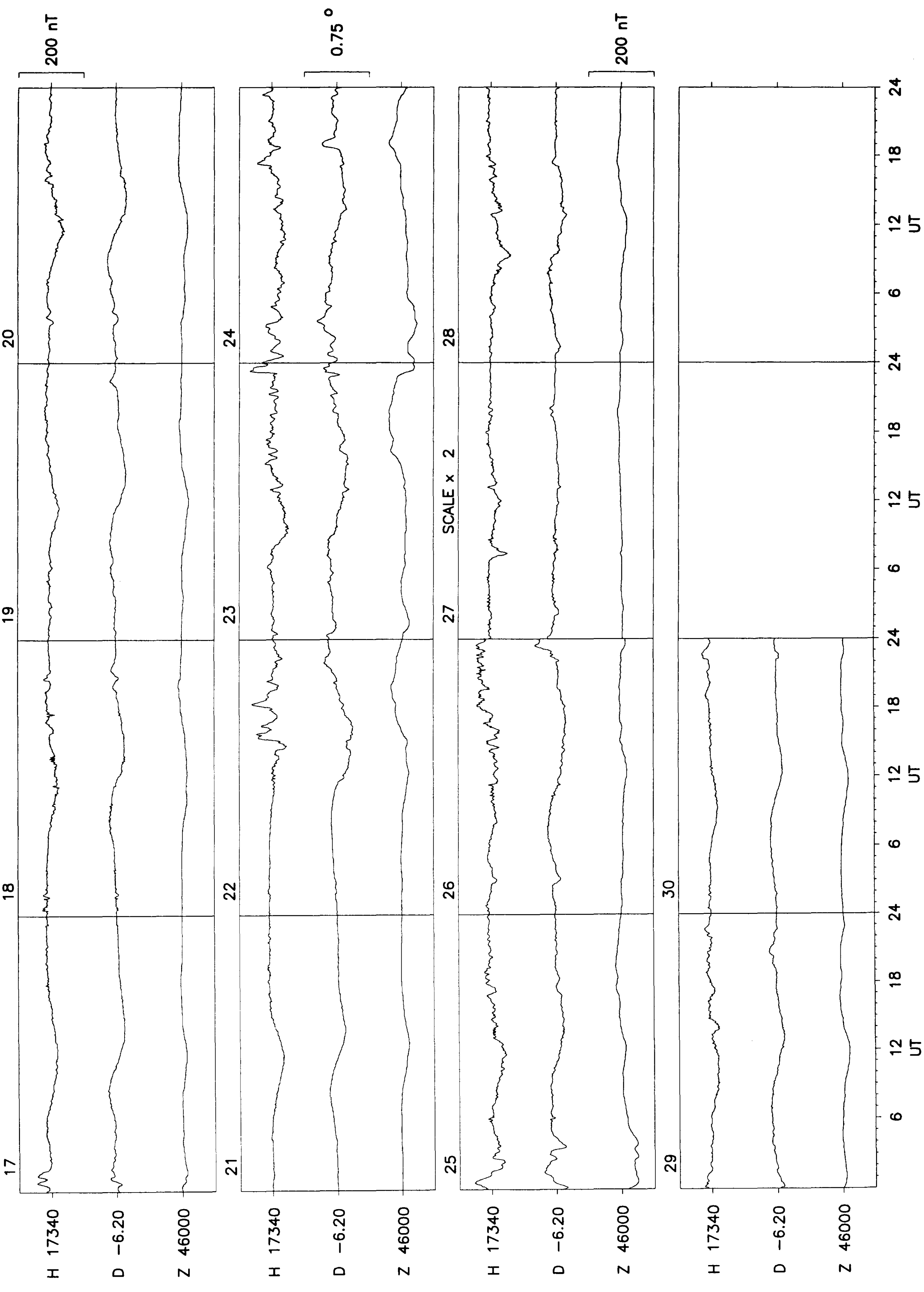

200 nT
0.75 °
200 nT
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SCALE x 2
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D −6.20
Z 46000
H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
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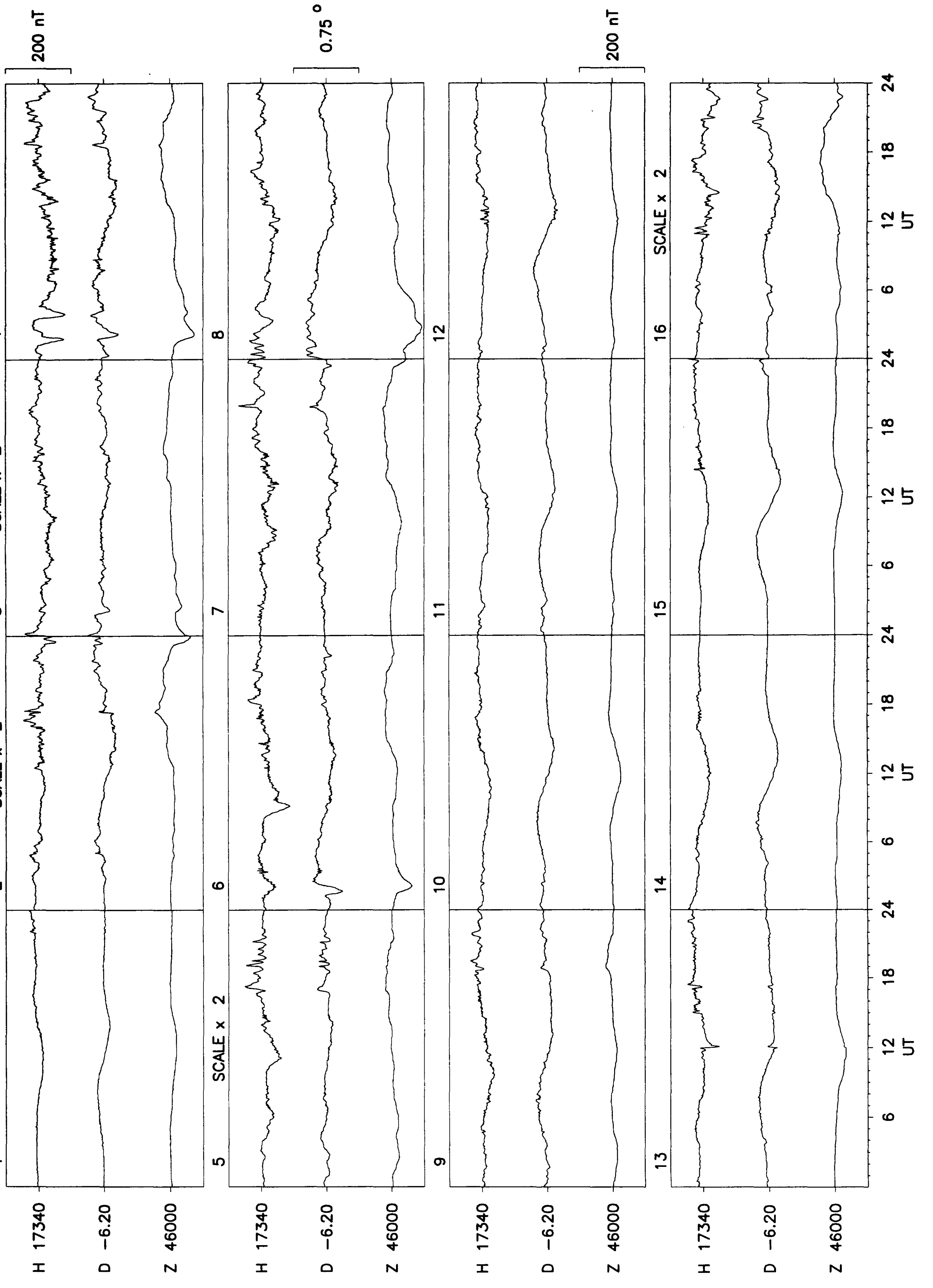
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D −6.20
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200 nT
0.75 °
SCALE x 2
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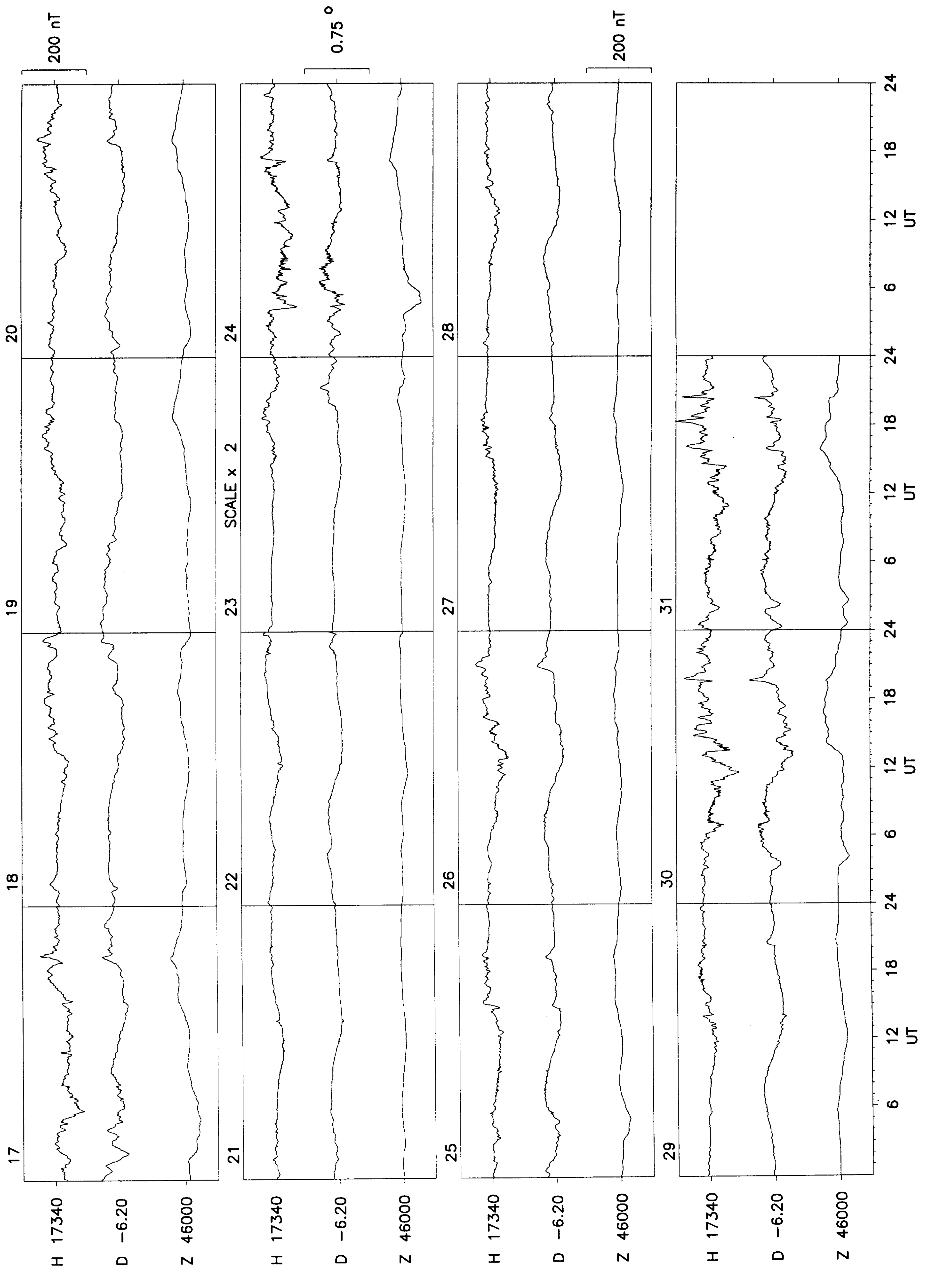
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200 nT
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SCALE x 2
H 17340
D −6.20
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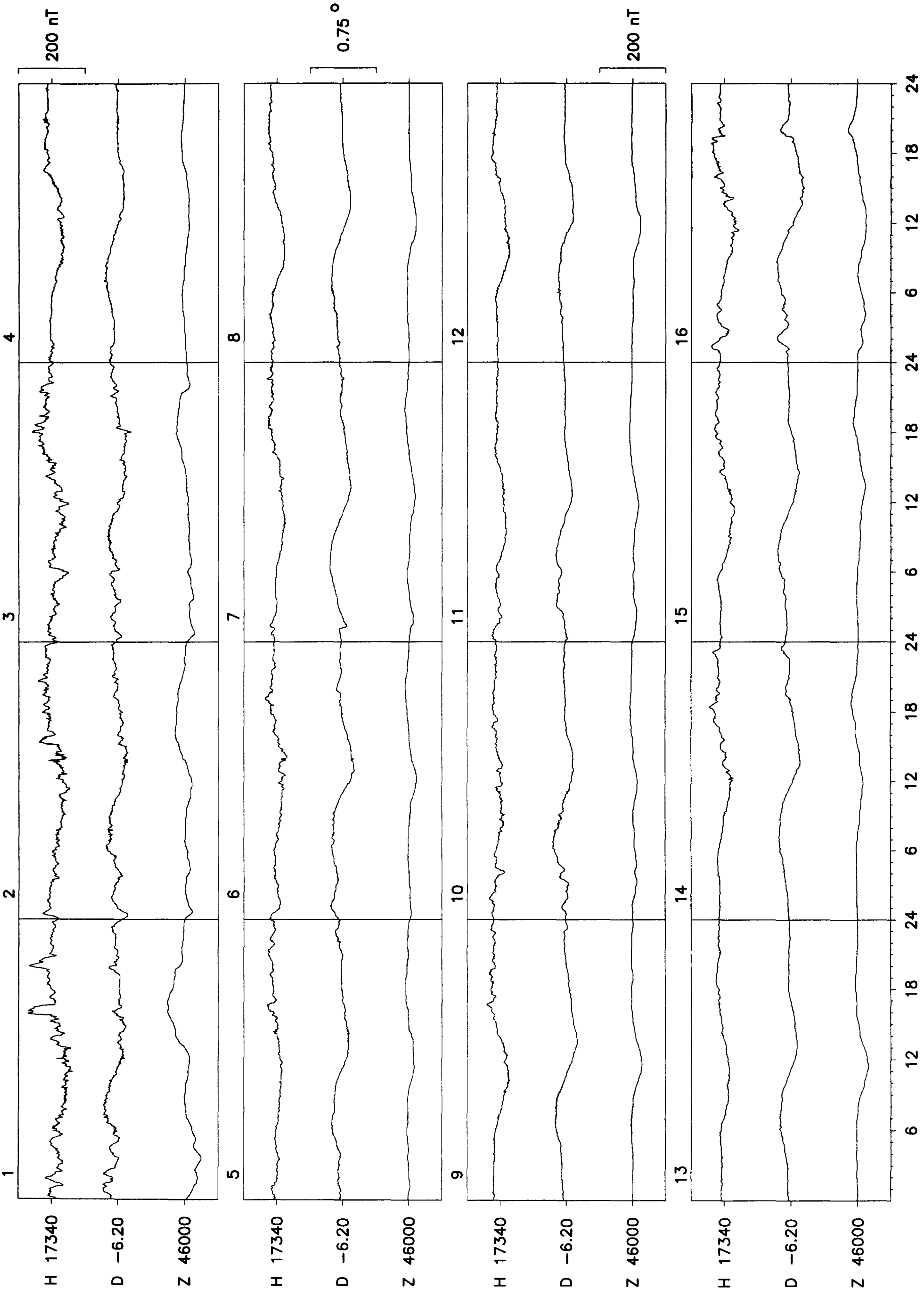
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200 nT
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D −6.20
Z 46000
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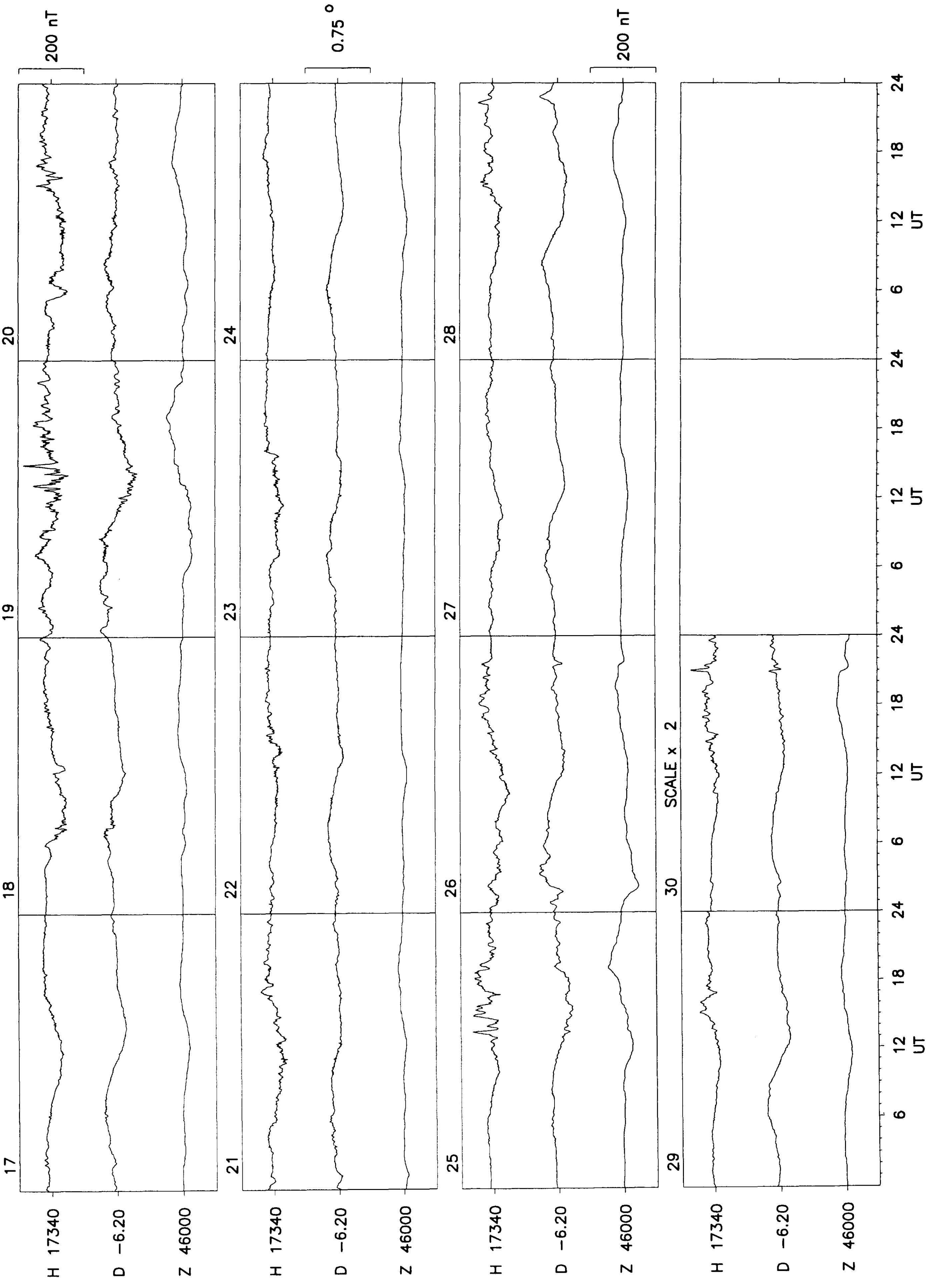
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SCALE x 2
H 17340
D -6.20
Z 46000
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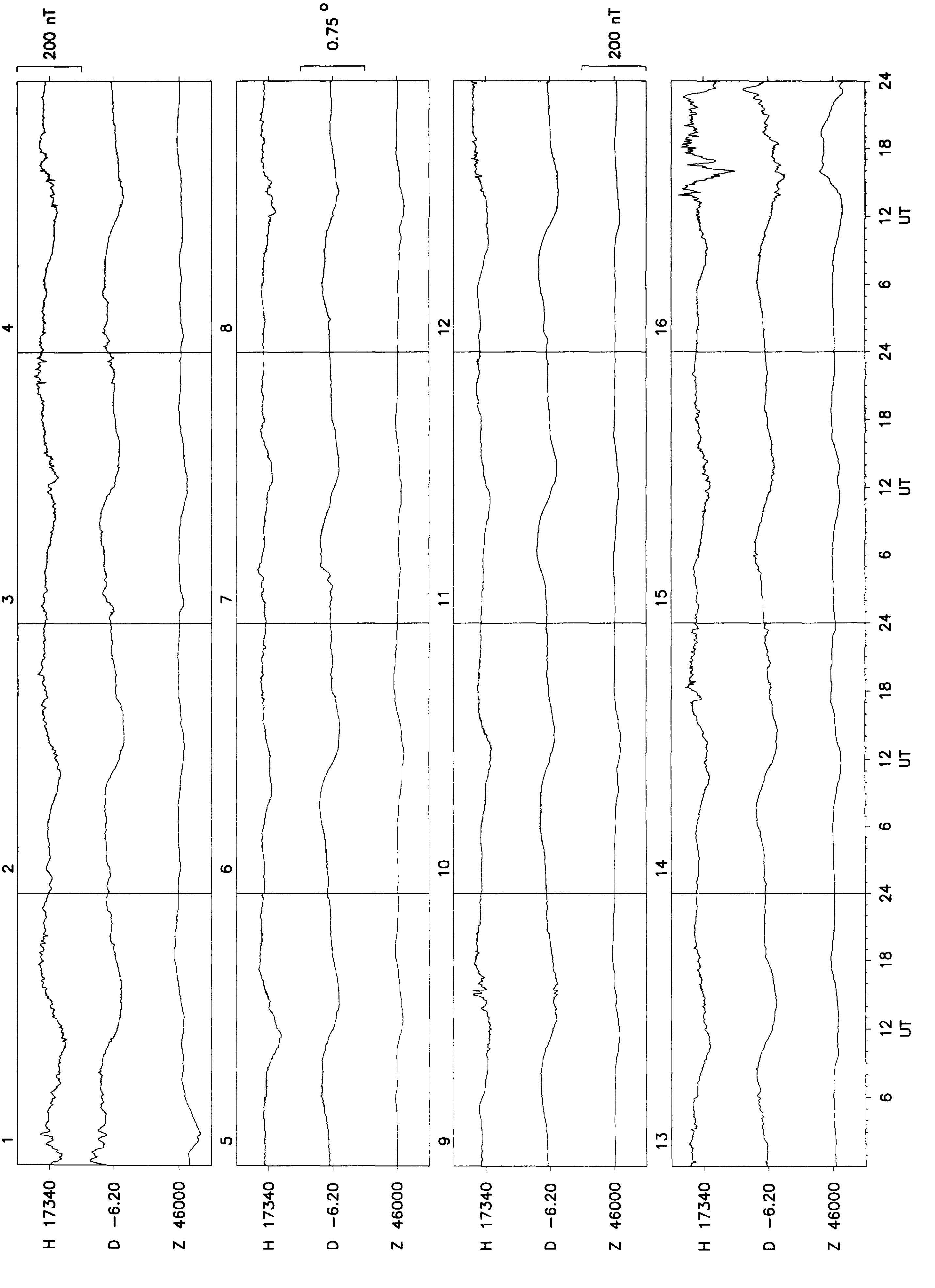
ES 6 95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0.75 °
200 nT
H 17340
D −6.20
Z 46000
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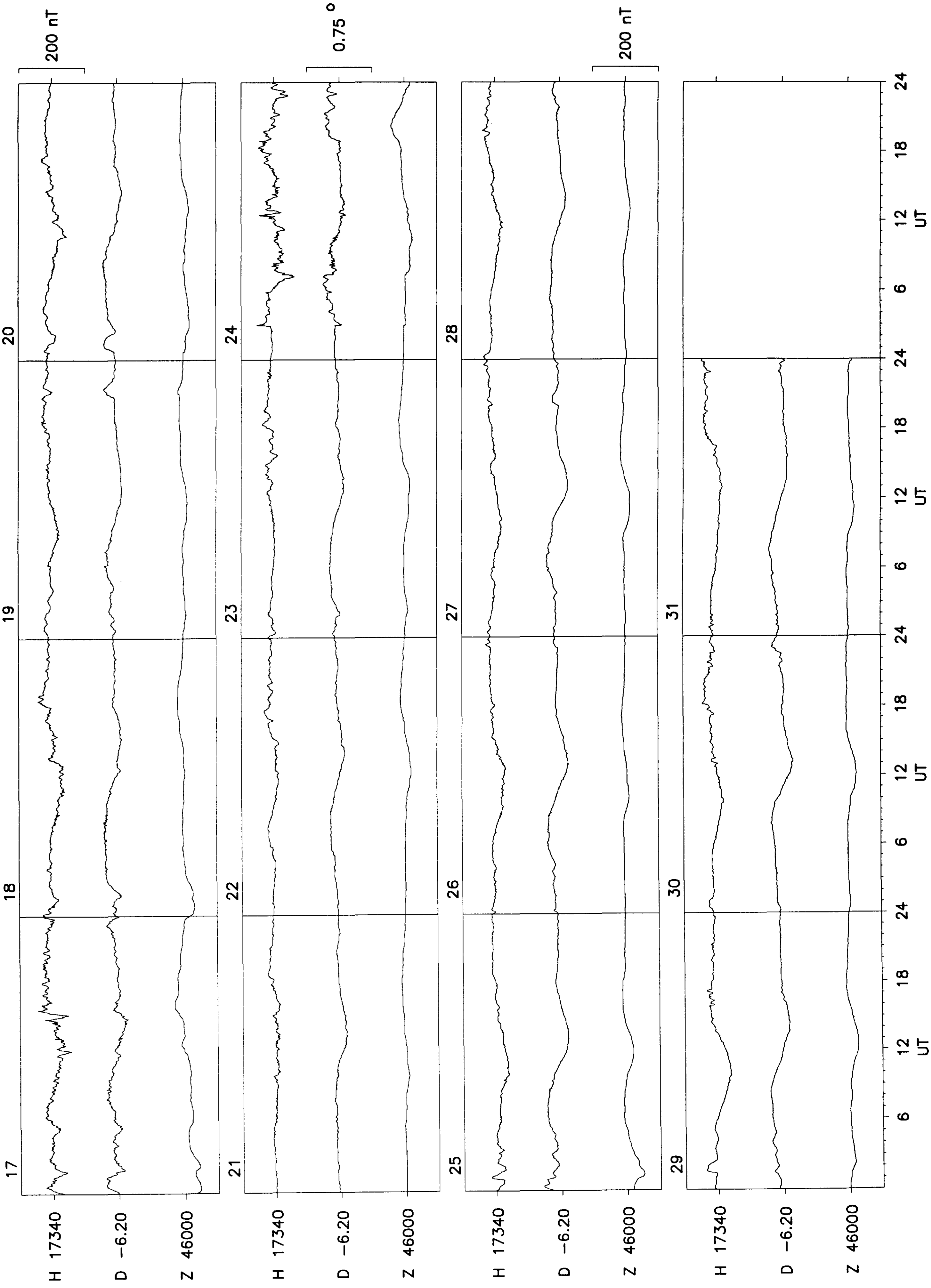
UT



200 nT
0.75 °
200 nT
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H 17340
D −6.20
Z 46000
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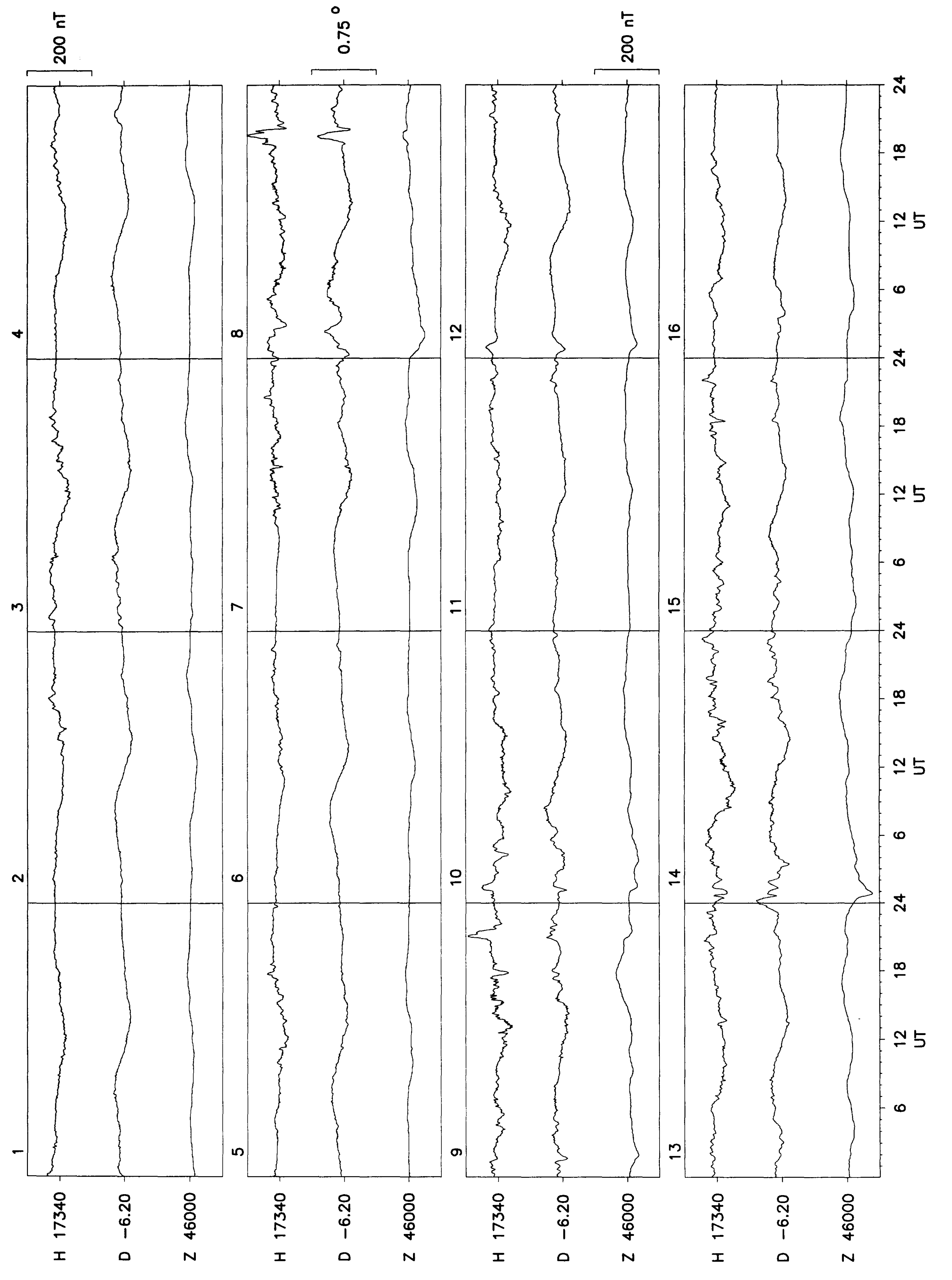
UT



200 nT
0.75 °
200 nT
H 17340
D −6.20
Z 46000
H 17340
D −6.20
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H 17340
D −6.20
Z 46000
H 17340
D −6.20
Z 46000
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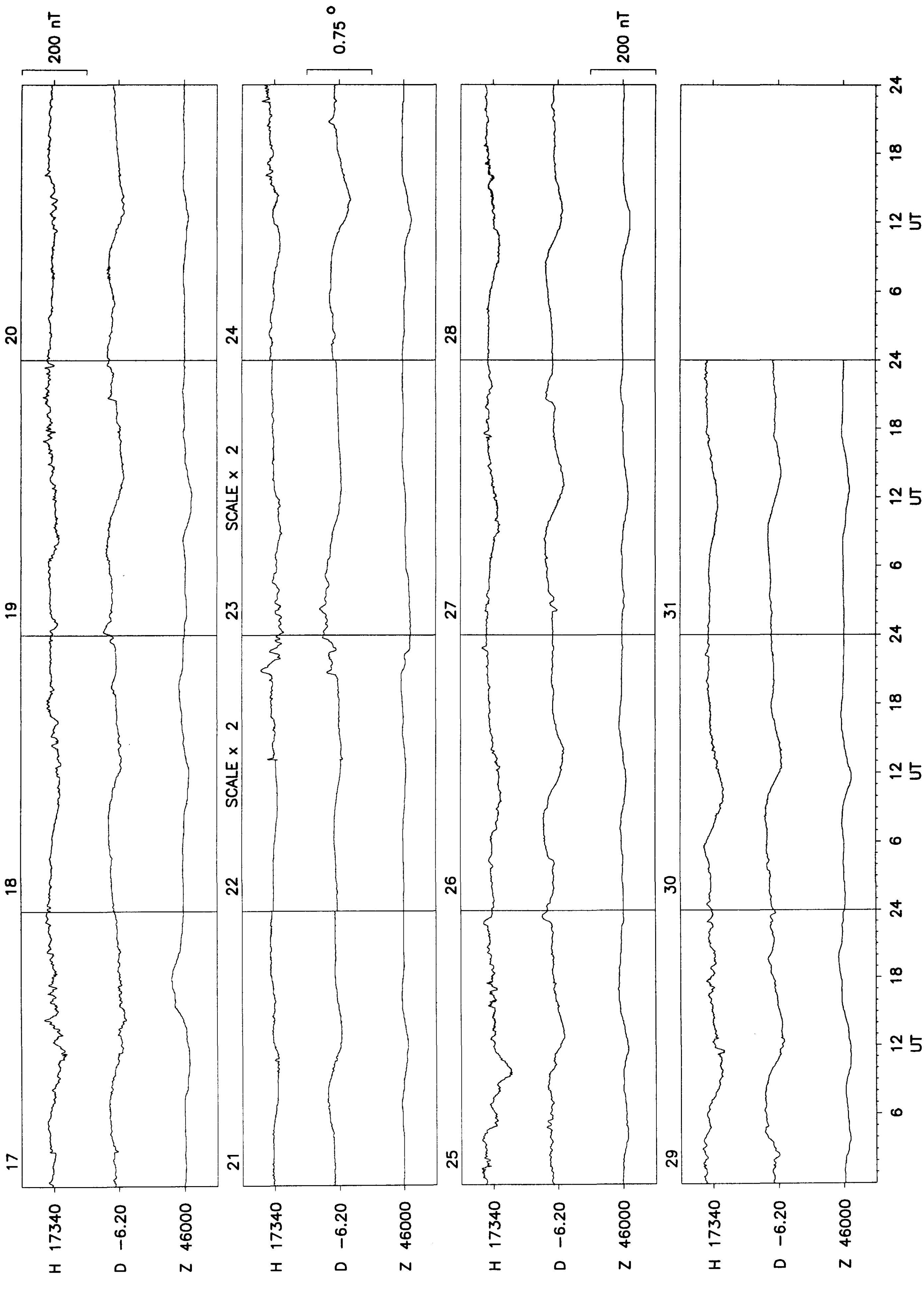
UT


200 nT
0.75 °
200 nT
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SCALE x 2
SCALE x 2
H 17340
D −6.20
Z 46000
6
12
18
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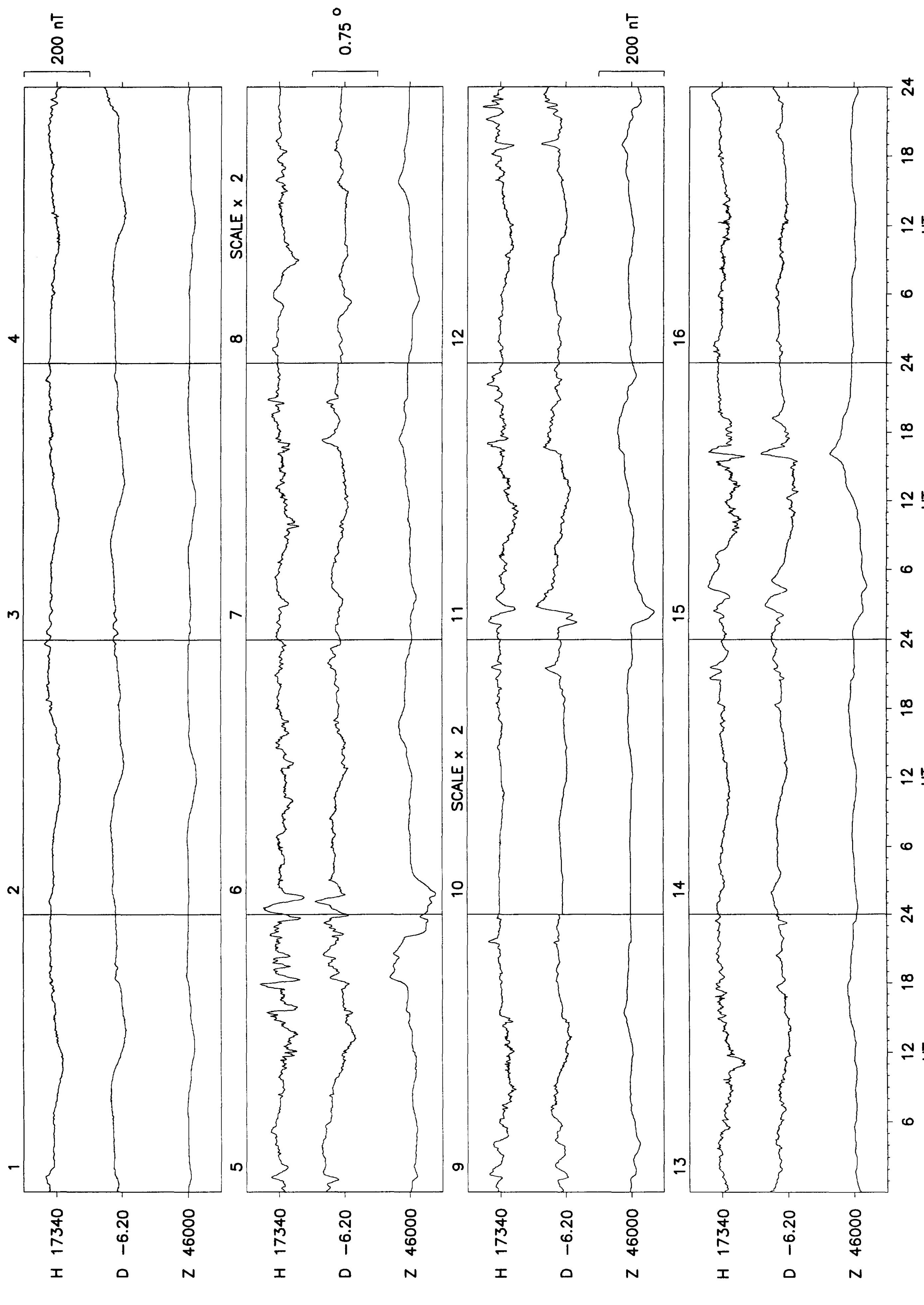
UT



H 17340
D −6.20
Z 46000
200 nT
0.75 °
SCALE x 2
UT
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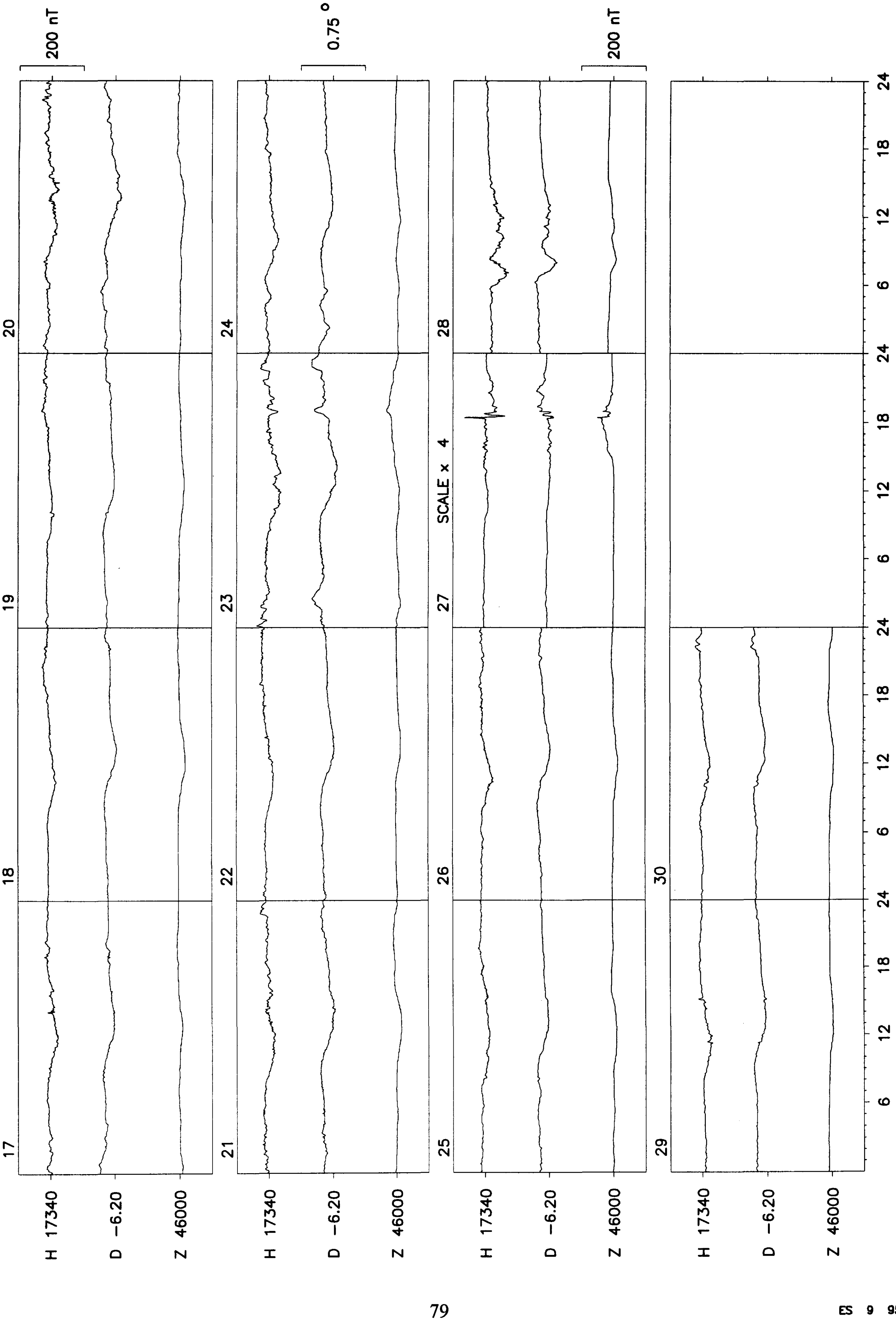
200 nT
0.75 °
200 nT
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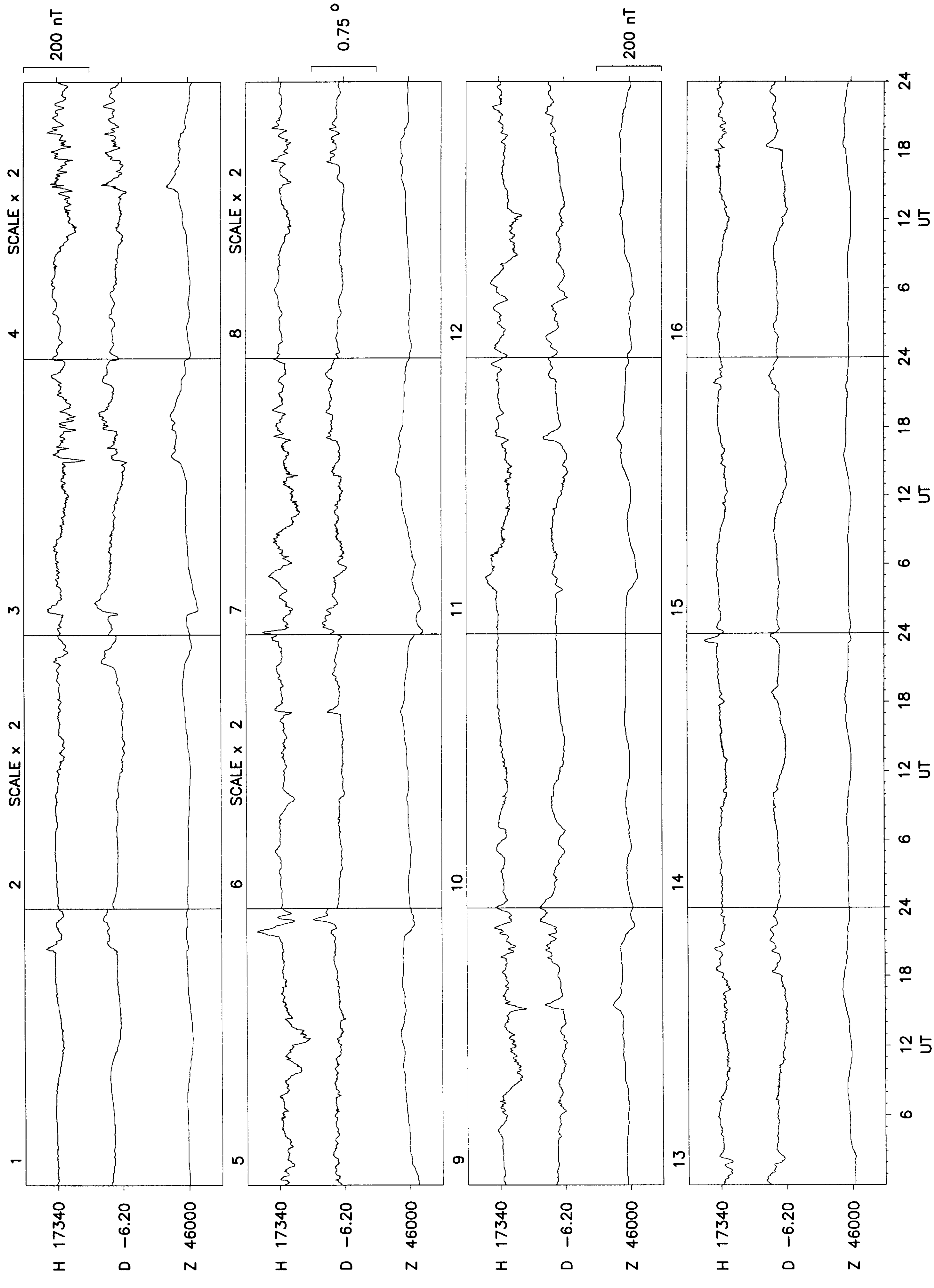
SCALE x 4
H 17340
D −6.20
Z 46000
6
12
18
24
UT


200 nT
0.75 °
200 nT
SCALE x 2
SCALE x 2
SCALE x 2
SCALE x 2
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H 17340
D −6.20
Z 46000
UT
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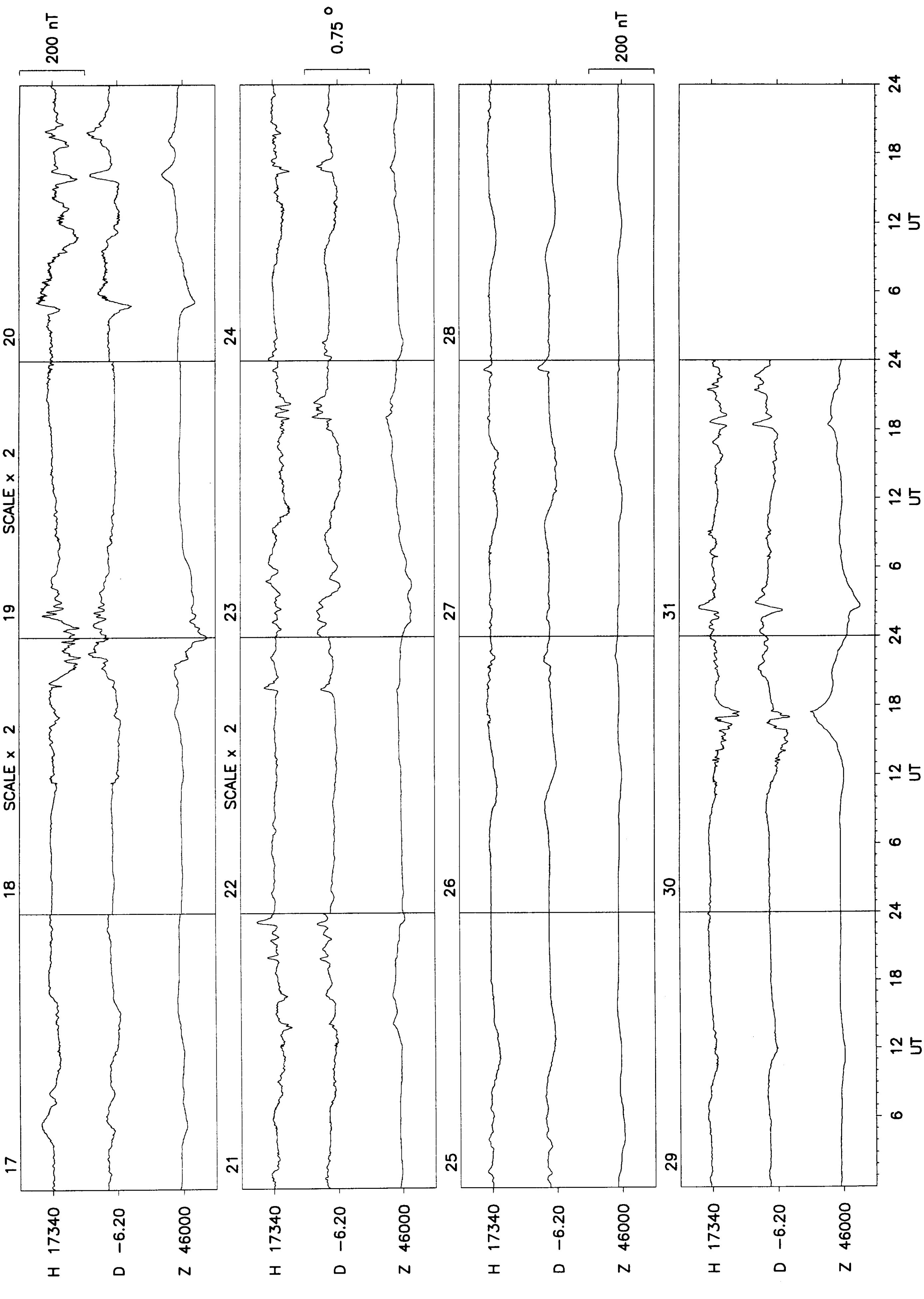
200 nT
0.75 °
200 nT
17
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SCALE x 2
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SCALE x 2
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SCALE x 2
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H 17340
D −6.20
Z 46000
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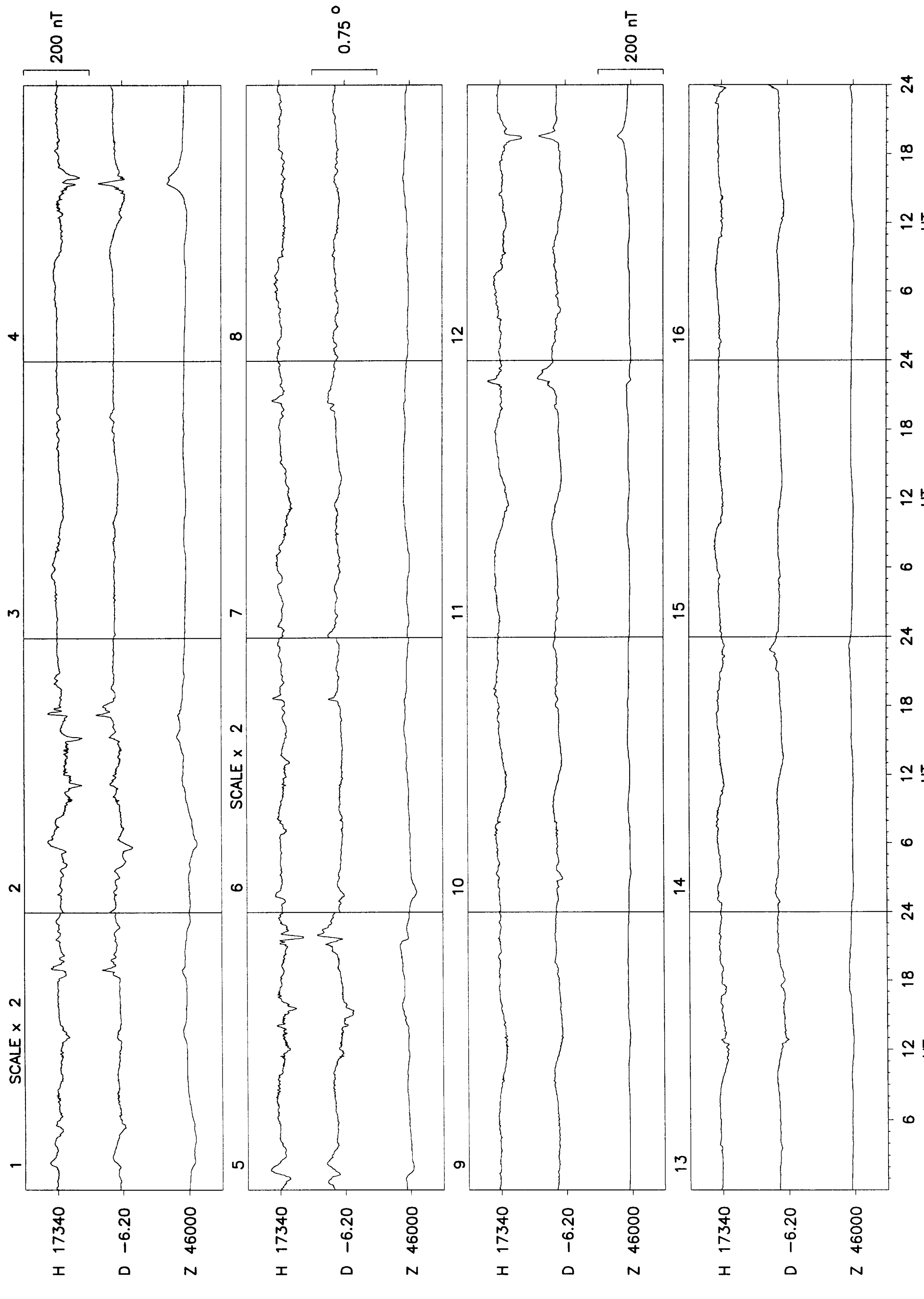
UT



200 nT
0.75 °
200 nT
SCALE x 2
SCALE x 2
H 17340
D −6.20
Z 46000
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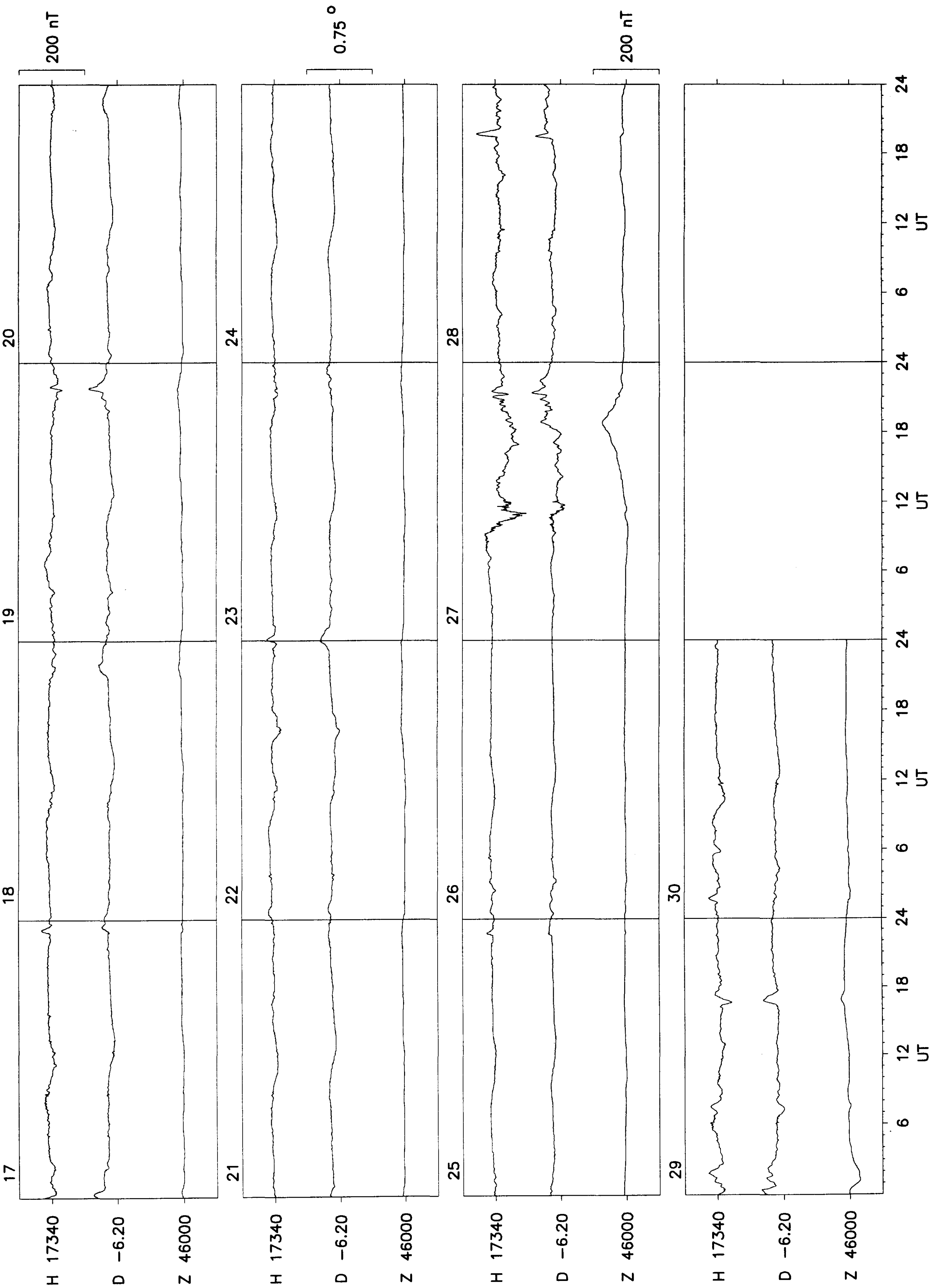
UT


200 nT
0.75 °
200 nT
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H 17340
D −6.20
Z 46000
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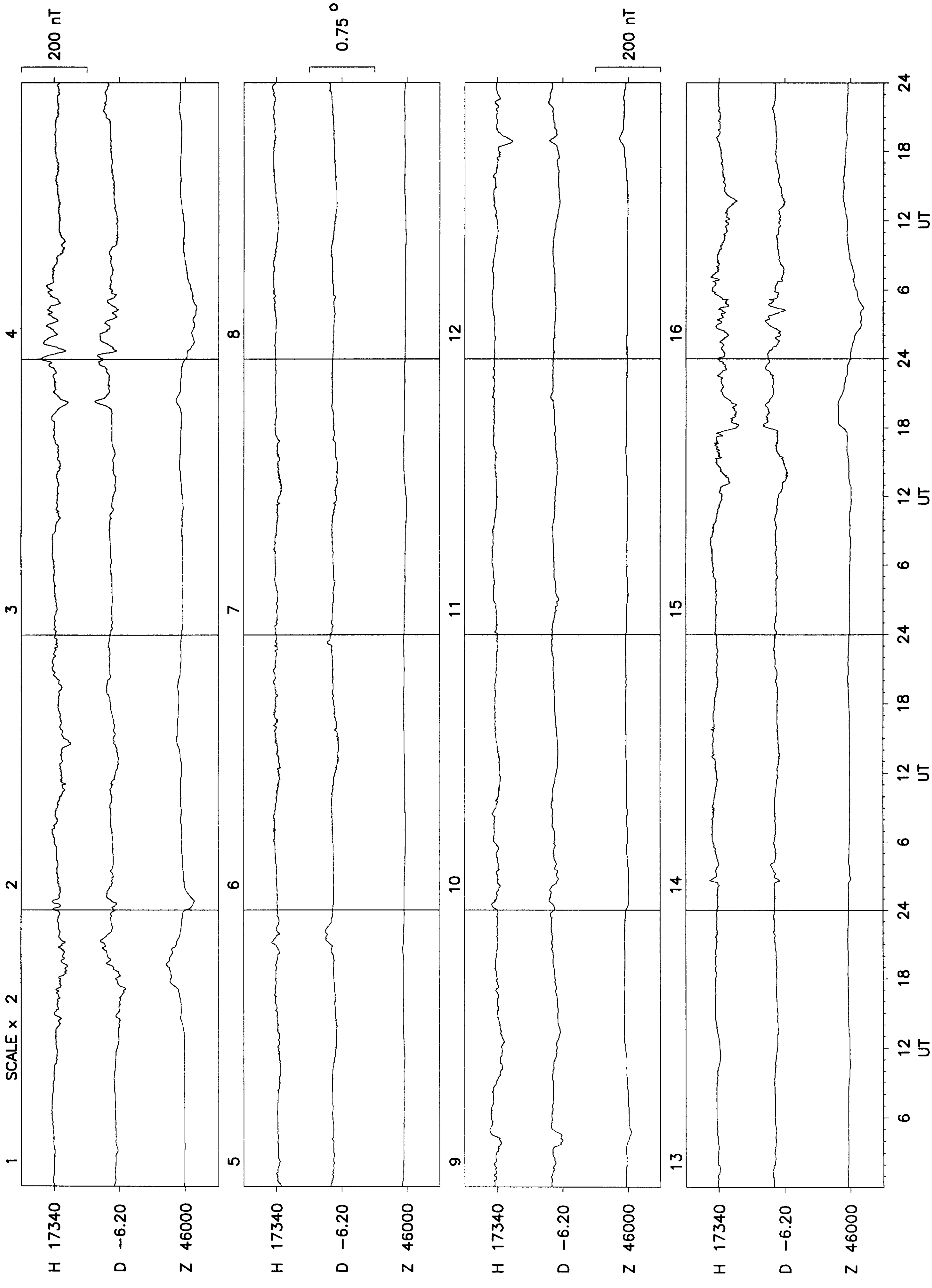
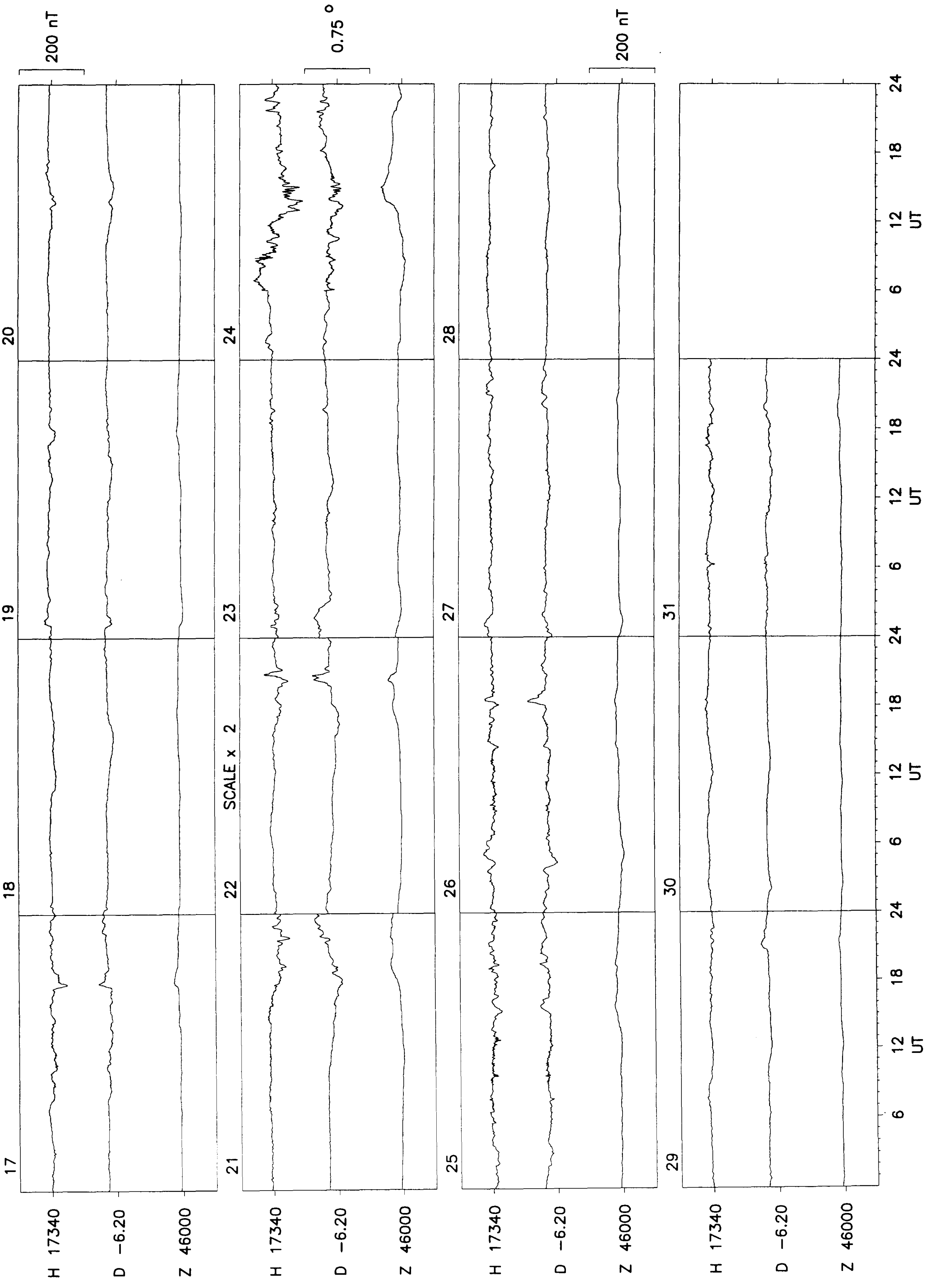
UT



SCALE x 2
200 nT
0.75 °
200 nT
H 17340
D −6.20
Z 46000
UT


200 nT
0.75 °
200 nT
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SCALE x 2
H 17340
D −6.20
Z 46000
6
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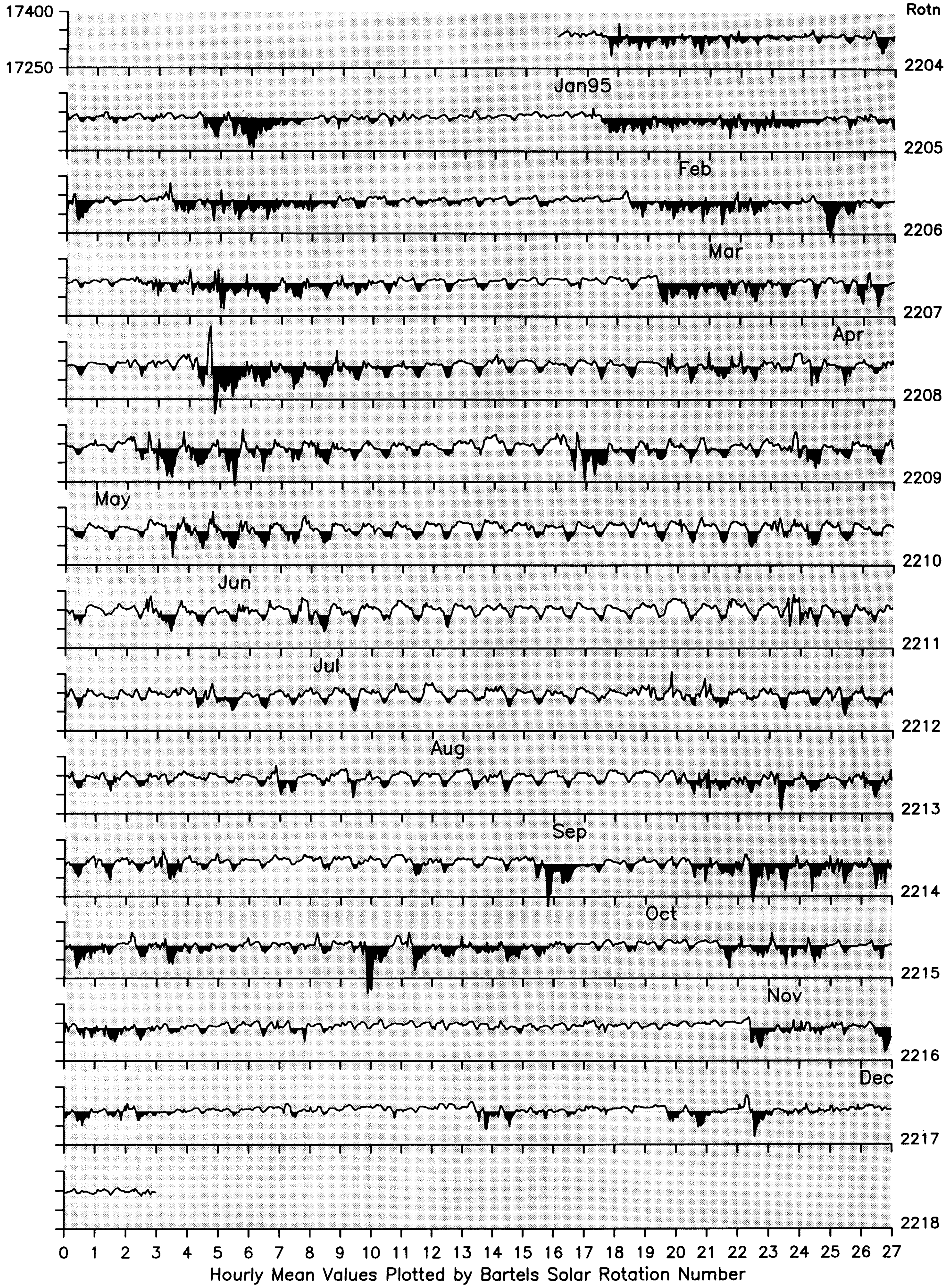
UT

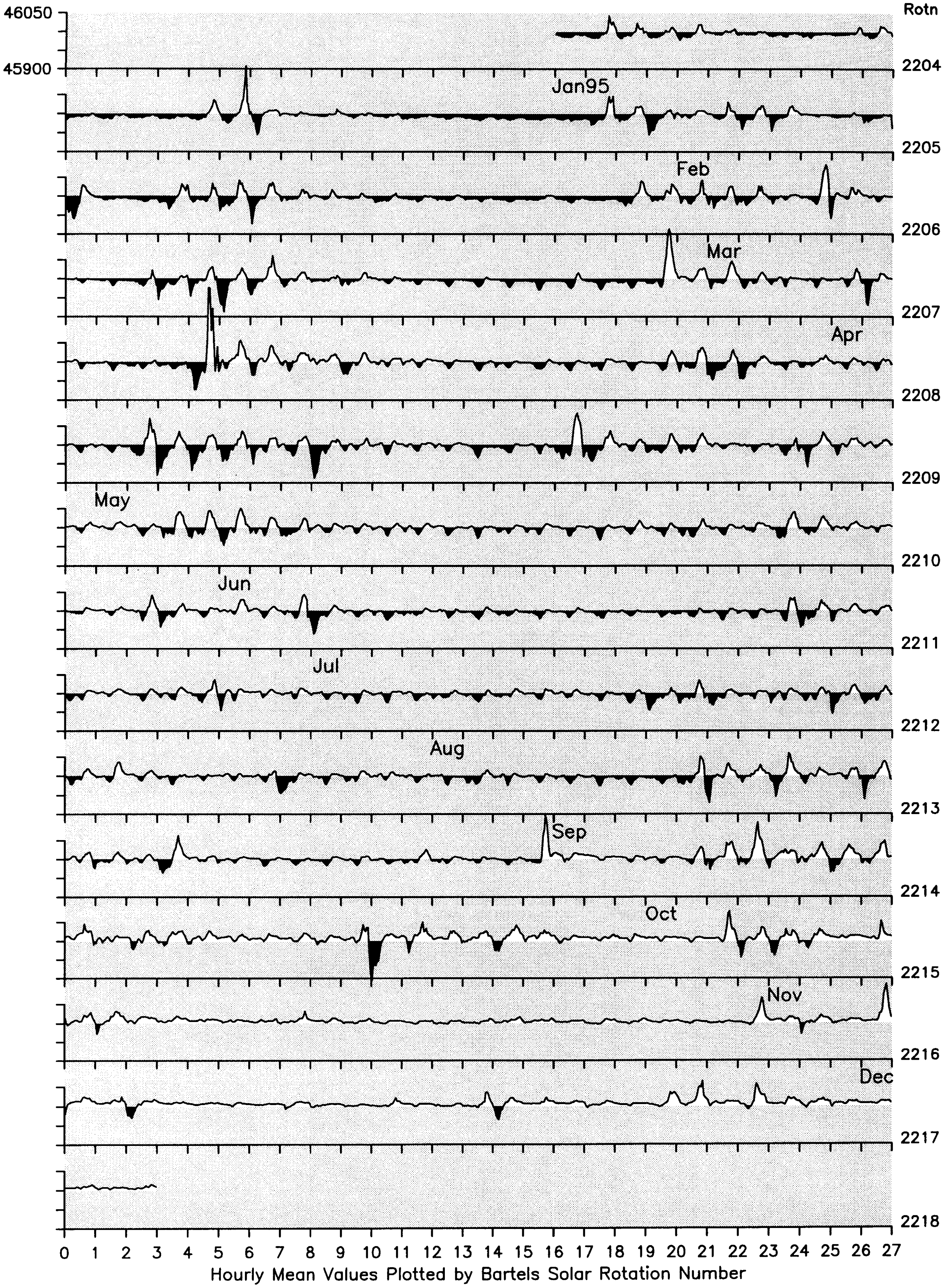
Eskdalemuir Observatory: Horizontal Intensity (nT)

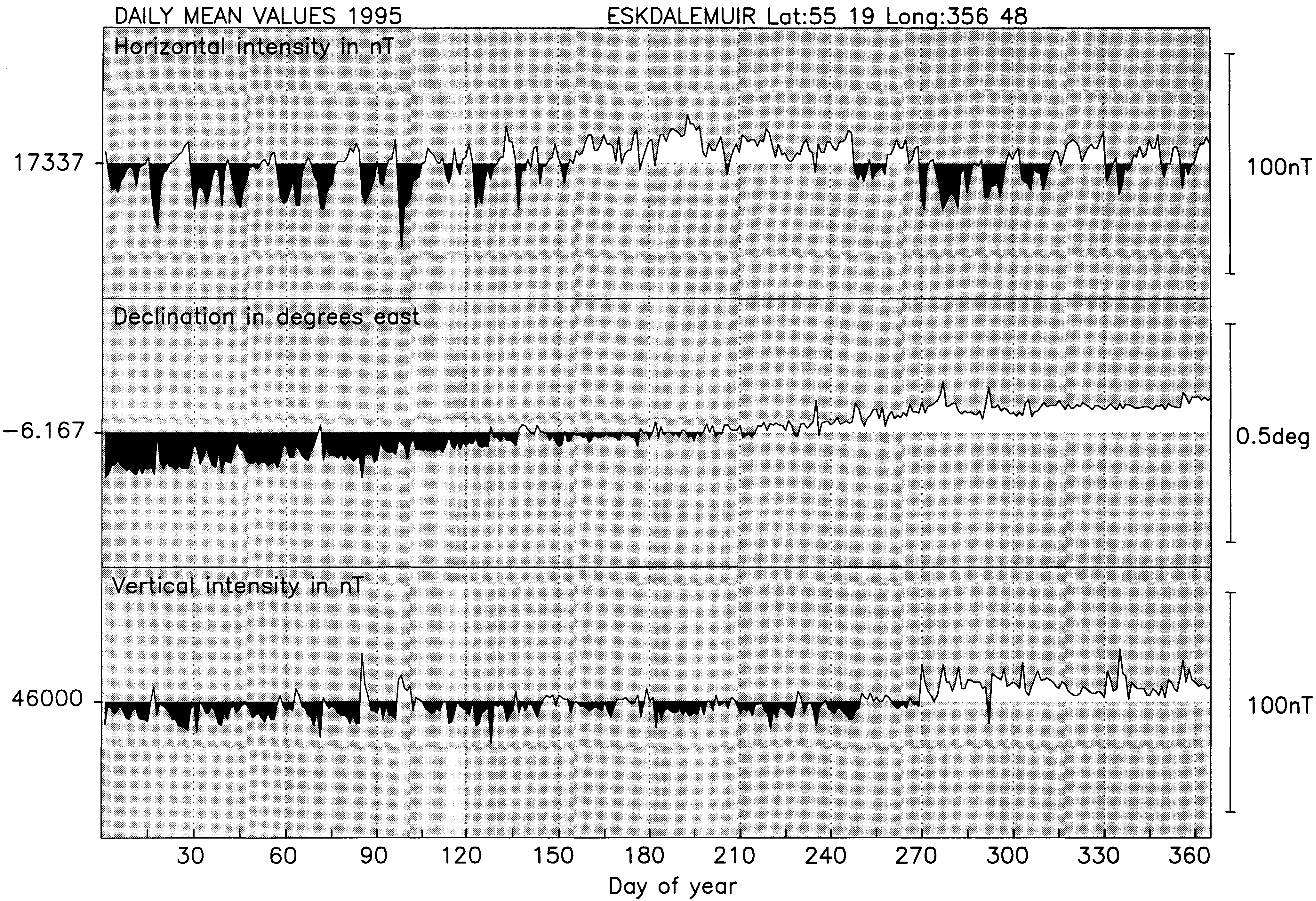


Eskdalemuir Observatory: Declination (degrees)

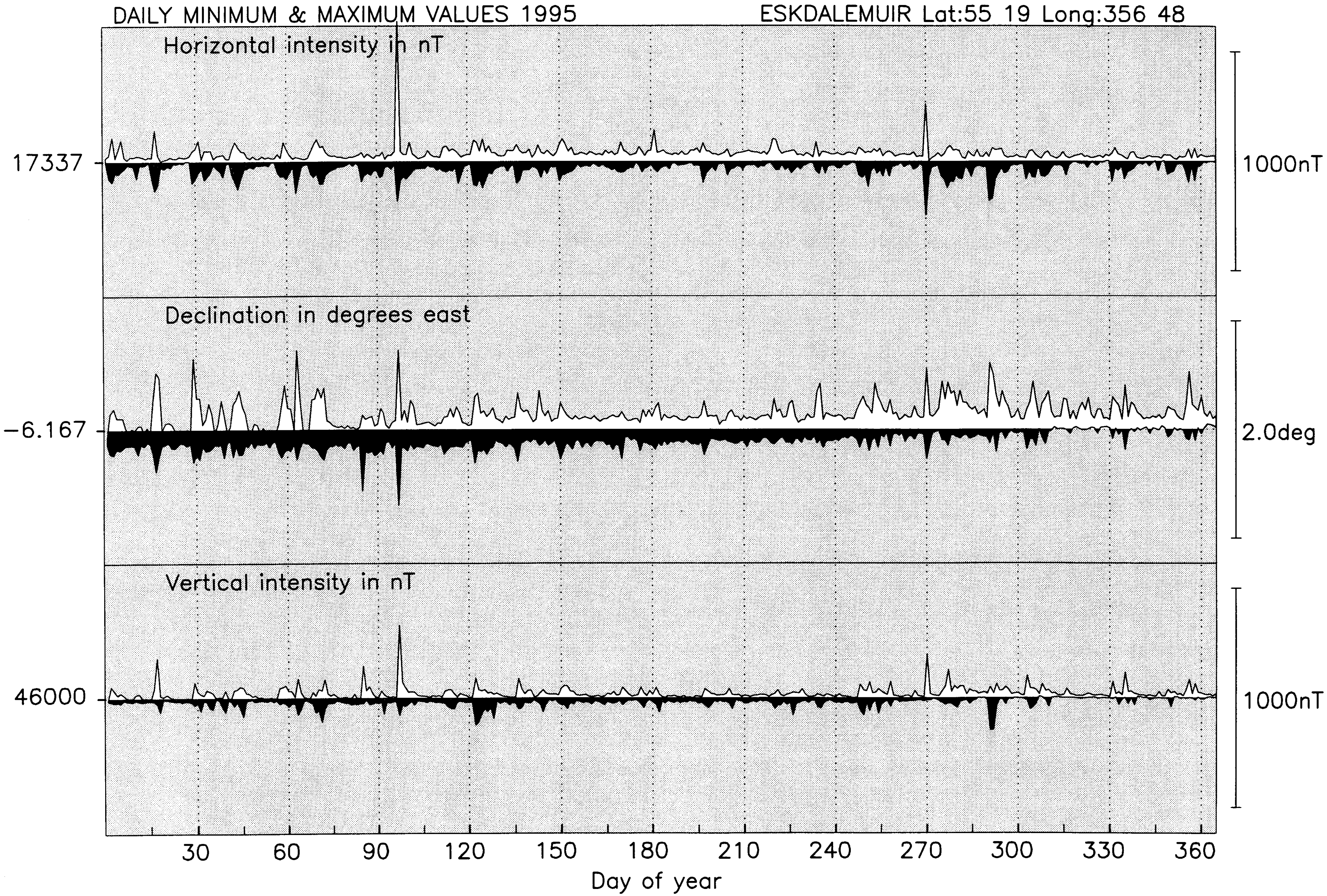
Hourly Mean Values Plotted by Bartels Solar Rotation Number

Eskdalemuir Observatory: Vertical Intensity (nT)





DAILY MEAN VALUES 1995
ESKDALEMUIR Lat:55 19 Long:356 48
Horizontal intensity in nT
17337
100nT
Declination in degrees east
-6.167
0.5deg
Vertical intensity in nT
46000
100nT
30
60
90
120
150
180
210
240
270
300
330
360
Day of year



DAILY MINIMUM & MAXIMUM VALUES 1995
ESKDALEMUIR Lat:55 19 Long:356 48
Horizontal intensity in nT
Declination in degrees east
Vertical intensity in nT
17337
-6.167
46000
1000nT
2.0deg
1000nT
30
60
90
120
150
180
210
240
270
300
330
360
Day of year

Monthly Mean Values for Eskdalemuir 1995

Month	D	H	I	X	Y	Z	F
	° '	nT	° '	nT	nT	nT	nT
Based on all days							
Jan	-6 14.5	17332	69 21.1	17229	-1884	45994	49151
Feb	-6 13.7	17330	69 21.3	17228	-1880	45996	49152
Mar	-6 13.0	17331	69 21.3	17229	-1877	45997	49154
Apr	-6 12.1	17333	69 21.2	17232	-1872	45998	49155
May	-6 10.7	17336	69 20.9	17235	-1866	45997	49155
Jun	-6 10.5	17343	69 20.5	17242	-1866	45999	49160
Jul	-6 9.9	17347	69 20.2	17247	-1863	45997	49159
Aug	-6 9.0	17344	69 20.4	17244	-1858	45997	49158
Sep	-6 7.5	17338	69 20.9	17239	-1850	46000	49159
Oct	-6 6.5	17330	69 21.6	17232	-1844	46008	49164
Nov	-6 6.4	17339	69 21.0	17241	-1845	46007	49166
Dec	-6 6.0	17339	69 21.0	17241	-1843	46008	49167
Annual	**-6 10.0**	**17337**	**69 20.9**	**17237**	**-1862**	**46000**	**49159**
International quiet day means							
Jan	-6 15.0	17343	69 20.3	17240	-1888	45989	49150
Feb	-6 14.0	17339	69 20.6	17236	-1883	45992	49152
Mar	-6 13.3	17340	69 20.6	17238	-1879	45994	49154
Apr	-6 12.4	17337	69 20.9	17235	-1874	45997	49156
May	-6 10.9	17341	69 20.6	17240	-1867	45998	49158
Jun	-6 10.7	17347	69 20.2	17246	-1867	45997	49159
Jul	-6 10.0	17351	69 19.9	17251	-1864	45995	49159
Aug	-6 8.8	17345	69 20.3	17245	-1857	45997	49159
Sep	-6 7.8	17344	69 20.4	17245	-1852	45998	49159
Oct	-6 7.0	17341	69 20.8	17242	-1848	46006	49166
Nov	-6 6.4	17344	69 20.6	17246	-1845	46005	49166
Dec	-6 5.9	17344	69 20.7	17246	-1843	46007	49168
Annual	**-6 10.2**	**17343**	**69 20.5**	**17243**	**-1864**	**45998**	**49159**
International disturbed day means							
Jan	-6 13.1	17318	69 22.2	17216	-1876	45999	49151
Feb	-6 12.4	17323	69 21.8	17221	-1873	45997	49151
Mar	-6 12.2	17321	69 22.0	17220	-1872	46000	49153
Apr	-6 11.8	17319	69 22.3	17218	-1869	46007	49159
May	-6 11.6	17331	69 21.3	17230	-1870	45998	49155
Jun	-6 10.4	17340	69 20.7	17239	-1865	46000	49160
Jul	-6 9.3	17343	69 20.4	17243	-1859	45996	49157
Aug	-6 8.6	17343	69 20.4	17243	-1856	45994	49155
Sep	-6 6.9	17329	69 21.5	17230	-1846	46002	49158
Oct	-6 5.5	17322	69 22.2	17224	-1838	46010	49163
Nov	-6 6.4	17328	69 21.8	17230	-1843	46009	49164
Dec	-6 5.9	17329	69 21.8	17231	-1841	46012	49167
Annual	**-6 9.5**	**17329**	**69 21.5**	**17229**	**-1859**	**46002**	**49158**

Eskdalemuir Observatory K Indices 1995

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0000 0121	3222 2332	3344 2444	0000 2443	0000 1112	3333 4443	4222 2222	2111 1100	2000 1110	0000 0032	4432 4153	2201 3455
2	1222 2344	3332 3444	4333 3423	4513 3211	3432 3545	3323 3433	2001 1231	1000 2330	1000 1122	2022 3234	2433 3430	3112 3122
3	5333 3544	3322 3344	3101 1012	0000 0000	5434 4443	3343 4343	3112 3123	2121 3321	2000 1112	4321 3433	0211 0120	1011 1243
4	3323 3232	4222 3433	2112 3446	1000 0102	4433 4334	2011 2321	2210 2321	1110 1123	0111 2113	4335 5555	0011 3421	4322 1112
5	3223 3444	1010 1200	4122 2333	3113 2233	3434 4554	2110 2222	0110 1100	1112 2311	3223 4544	3333 4215	4212 3324	2000 0023
6	2223 3335	3201 2313	1200 1200	3100 1023	4344 3332	3111 3221	0000 1111	1100 2122	5222 3323	1334 3534	4233 3242	0011 1122
7	2122 3222	4321 0125	0100 1110	3543 6965	2233 3343	3000 2222	1200 2210	0002 3333	3323 3432	4333 3333	3211 1133	1101 1100
8	3111 2120	4443 3212	1110 1011	3334 4443	4322 4333	1110 1110	1111 3210	4432 3253	3454 3442	3323 3553	2111 1211	0100 0001
9	2121 1112	0210 0000	1231 2254	4333 3323	2222 2133	0101 1221	0101 3321	3222 4345	3332 3213	0233 3434	0000 1011	2311 2111
10	0001 2123	0000 0112	5322 2234	3333 3433	2111 2221	3322 2211	0000 1100	3332 3322	0111 2235	3331 1100	2210 1111	3211 0000
11	3213 4332	2243 3345	4331 2455	2322 2353	2211 2121	3310 1110	0100 0011	2112 2223	5432 3433	1331 2423	1001 0024	2100 0110
12	3000 1113	3322 3554	5433 3455	4322 2332	2111 2221	0111 1210	1000 1212	3112 2212	2112 2244	3343 3123	1221 2141	0000 1232
13	0221 1111	5334 5434	4333 4544	2211 1222	1112 4312	0010 1111	2211 1110	3221 2134	3334 2323	4112 2233	0000 2221	1000 0000
14	2000 0023	4323 4443	3322 3443	2000 1111	1221 1210	0000 2232	1101 2332	4443 3333	2201 1233	1112 1223	2010 1102	2200 1110
15	2001 1011	3223 2434	2222 2133	0000 1110	0000 3223	1211 2221	1212 2221	3322 3233	4433 3531	2011 2103	0101 0000	1101 3433
16	2113 3254	2111 1322	3321 3332	0001 0022	2344 4454	3212 3331	1111 4544	1331 2210	2222 3223	2101 3232	1001 1003	3431 3111
17	3333 2366	1022 1211	1211 2222	3110 0101	4443 2443	2111 1211	4322 4433	2222 3321	2101 2220	2331 1211	3111 1103	1112 1322
18	5543 2123	2211 2231	2010 1010	2112 2222	3012 3233	1242 3213	3222 3231	1101 2322	0000 1012	1113 3455	1001 0112	1000 1100
19	1102 1010	1221 1112	1000 0122	1211 1112	2232 2232	3333 5343	2221 1223	2121 2322	1001 1121	6432 2123	2221 1124	2110 1210
20	0000 1132	1201 1111	1001 1210	1211 2220	3222 2333	2432 4432	3213 2211	1111 2211	2221 3222	2534 3542	2011 0002	0000 2100
21	2111 0232	2101 1102	0000 0000	0000 1111	2100 2010	2212 3322	0012 2221	0001 1000	1101 2222	2122 3334	1000 0101	0000 1333
22	2111 2212	0000 0000	0000 1000	0002 3443	1201 2102	2111 3211	0110 2321	1000 4245	1100 1121	2221 2143	1101 1202	2111 2354
23	2311 1011	1011 1111	0002 2231	3232 3334	2111 3445	1222 2311	3101 2321	4332 2210	3302 2233	3433 2242	3010 0012	3202 1020
24	1100 1000	1000 0011	2011 2211	4332 3443	3433 3423	1110 1210	3343 4333	1101 3222	3311 1211	3011 2422	0000 0000	2233 4423
25	1110 1110	0000 0000	1101 1112	4321 3331	3312 3231	0111 4443	3211 1110	2333 2323	1111 0110	2210 0000	1000 0002	2222 2332
26	1000 1001	2231 3233	2123 4534	3313 3334	1112 3343	4332 2333	1211 2212	2211 2012	0111 1111	0000 1112	2200 0000	2322 3243
27	0000 1100	2323 3353	3132 3333	4353 4331	0111 1220	2111 1122	1211 1122	2211 1232	2122 3485	1010 2213	0135 3344	3111 2122
28	0000 1011	4334 2254	3321 3431	2223 3211	2111 3212	1112 4333	2101 1222	0001 2221	1243 2000	1000 0001	1212 1242	0110 0211
29	1323 3446		3433 3333	2111 3222	1101 3232	1110 3321	3200 1211	3212 2222	0002 1200	1001 1001	3332 2311	0010 0122
30	5333 3555		3211 3211	1000 1122	2434 5353	3213 4455	2001 2223	2211 1111	0001 1002	0001 3423	3222 1001	1000 0010
31	5331 3354		1112 1222		4233 4453		1100 1222	0000 0101		4332 1343		1131 2221

SIs and SSCs

Day	Month	UT		Type	Quality	H(nT)	D(min)	Z(nT)
1	1	19	40	SI*	B	14	-0.5	
29	1	01	02	SSC*	C	11	-1.2	
12	2	15	35	SSC*	C	30	-1.6	
26	2	08	28	SI*	B	30	-6.7	-4
14	3	07	46	SI*	C	18	2.1	
23	3	10	36	SSC*	A	25	-3.4	-5
24	3	07	47	SSC*	C	4	-2.4	2
1	4	17	20	SSC	C	-53	4.4	5
18	4	11	09	SSC*	B	18	-1.7	-2
1	5	21	57	SSC*	C	11	-0.3	
2	5	05	00	SSC*	C	20	-6.5	4
2	5	12	56	SSC*	C	-36	2.4	3
13	5	14	53	SSC*	B	18	-1.3	
3	7	21	14	SSC*	C	-29	2.4	3
4	7	13	02	SI	C	18	-1.7	
4	7	15	08	SI*	C	-25	2.0	2
16	7	08	31	SSC*	C	-6	1.9	
24	7	02	53	SSC*	A	42	-4.8	-6
9	8	10	22	SI*	C	-13	3.1	
9	8	12	29	SSC*	B	29	-2.2	-2
17	8	02	57	SSC	B	17	-2.9	-2
22	8	13	07	SSC*	A	62	-4.2	-4
18	10	11	22	SSC*	A	30	3.0	-3
30	10	10	09	SSC*	B	-7	0.8	
10	11	07	51	SI*	C	9	2.2	
27	11	08	27	SSC*	B	-9	-1.0	
15	12	15	16	SSC*	B	-20	-1.2	3
24	12	06	00	SSC*	A	19	-7.3	-3
24	12	08	48	SI*	B	-54	-0.8	3

Notes
A * indicates that the principal impulse was preceded by a smaller reversed impulse.
The quality of the event is classified as follows :

A = very distinct
B = fair, ordinary, but unmistakable
C = doubtful

The amplitudes given are for the first chief movement of the event.

SFEs

Day	Month	Universal Time Start		Maximum		End		H(nT)	D(min)	Z(nT)
21	5	13	37	13	42	13	52	10	-1.4	

Notes
The amplitudes given are for the first chief movement of the event.

Annual Values of Geomagnetic Elements

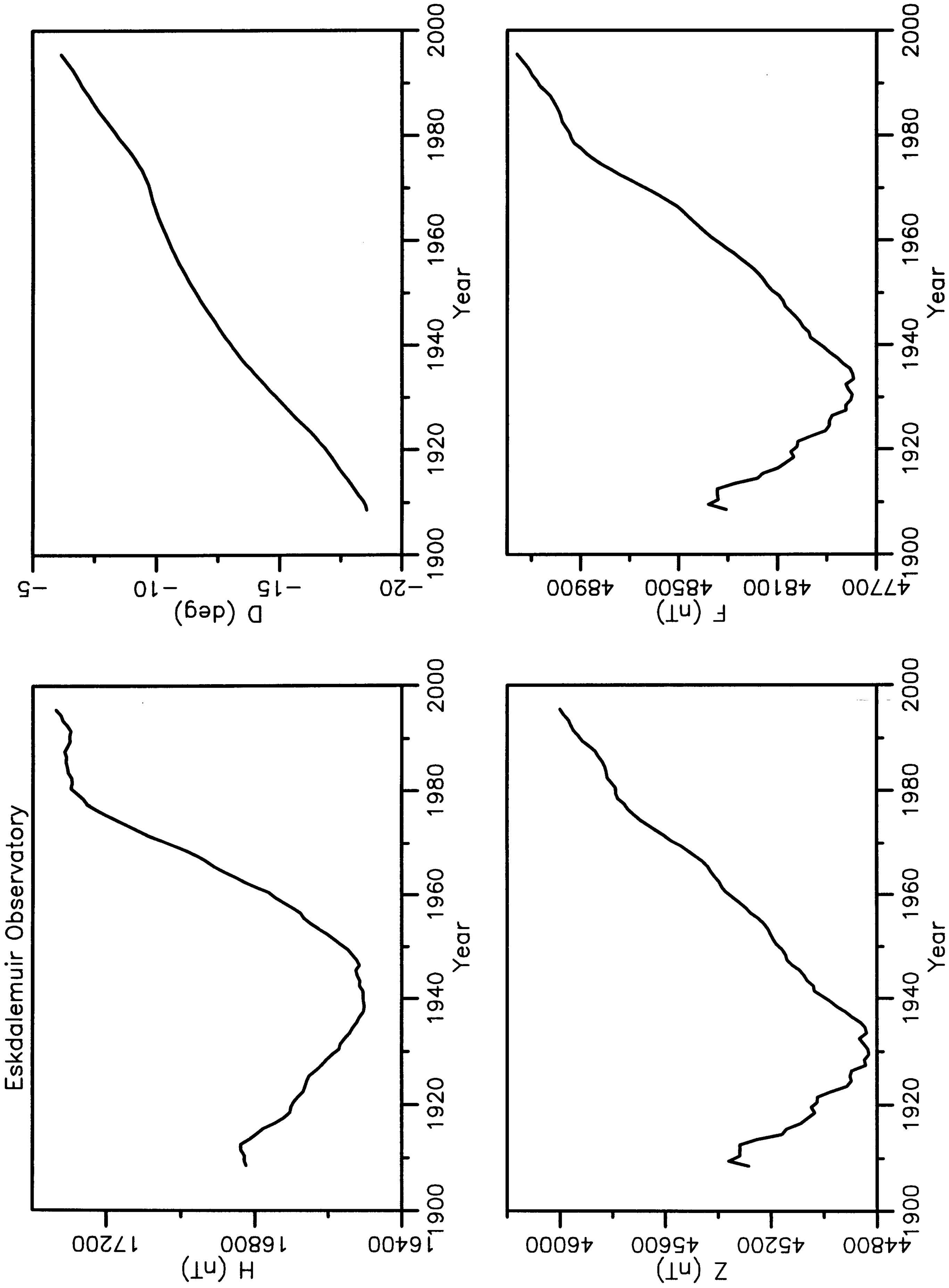
Eskdalemuir

Year	D	H	I	X	Y	Z	F
1908.5	-18 33.3	16821	69 37.3	15947	-5353	45283	48306
1909.5	-18 30.1	16826	69 38.9	15956	-5339	45360	48380
1910.5	-18 23.3	16826	69 37.8	15967	-5308	45317	48340
1911.5	-18 12.4	16836	69 37.1	15993	-5260	45317	48343
1912.5	-18 3.9	16836	69 37.2	16006	-5221	45318	48344
1913.5	-17 54.9	16811	69 37.3	15996	-5171	45254	48276
1914.5	-17 45.3	16793	69 36.1	15993	-5121	45159	48180
1915.5	-17 35.9	16775	69 36.9	15990	-5072	45142	48158
1916.5	-17 26.1	16744	69 37.6	15975	-5017	45088	48097
1917.5	-17 17.1	16720	69 38.6	15965	-4968	45061	48063
1918.5	-17 8.1	16703	69 39.0	15962	-4921	45034	48032
1919.5	-16 58.7	16700	69 39.6	15972	-4877	45049	48045
1920.5	-16 49.6	16693	69 39.5	15978	-4832	45026	48021
1921.5	-16 37.2	16681	69 40.3	15984	-4771	45025	48016
1922.5	-16 25.8	16666	69 40.0	15985	-4714	44974	47963
1923.5	-16 13.8	16661	69 38.8	15997	-4657	44915	47906
1924.5	-16 1.2	16657	69 38.7	16010	-4597	44898	47889
1925.5	-15 48.4	16650	69 39.3	16020	-4535	44902	47890
1926.5	-15 35.3	16632	69 40.3	16020	-4469	44896	47878
1927.5	-15 22.7	16615	69 40.2	16020	-4406	44843	47822
1928.5	-15 10.5	16602	69 41.2	16024	-4346	44849	47823
1929.5	-14 58.8	16586	69 41.9	16022	-4287	44832	47802
1930.5	-14 47.1	16568	69 43.2	16019	-4228	44834	47797
1931.5	-14 34.8	16565	69 43.7	16032	-4170	44850	47812
1932.5	-14 23.7	16553	69 45.0	16033	-4115	44867	47823
1933.5	-14 12.1	16539	69 45.2	16033	-4058	44839	47792
1934.5	-14 0.6	16531	69 45.9	16039	-4002	44845	47795
1935.5	-13 48.8	16520	69 47.0	16042	-3944	44861	47806
1936.5	-13 37.4	16512	69 48.4	16047	-3889	44894	47834
1937.5	-13 26.9	16501	69 49.8	16049	-3837	44920	47855
1938.5	-13 17.1	16499	69 50.7	16057	-3791	44953	47885
1939.5	-13 7.3	16502	69 51.1	16071	-3746	44977	47909
1940.5	-12 57.9	16503	69 51.8	16082	-3703	45008	47938
1941.5	-12 48.2	16503	69 52.5	16093	-3657	45037	47965
1942.5	-12 39.8	16513	69 51.9	16111	-3620	45039	47971
1943.5	-12 31.2	16511	69 52.7	16118	-3579	45064	47994
1944.5	-12 23.0	16518	69 52.5	16134	-3542	45076	48007
1945.5	-12 14.5	16522	69 52.6	16146	-3503	45093	48025
1946.5	-12 5.9	16512	69 54.0	16145	-3461	45120	48046
1947.5	-11 57.1	16520	69 53.9	16162	-3421	45140	48068
1948.5	-11 48.9	16532	69 53.2	16182	-3385	45144	48076
1949.5	-11 40.9	16544	69 52.8	16201	-3350	45158	48093
1950.5	-11 33.2	16564	69 52.0	16228	-3317	45180	48121
1951.5	-11 25.5	16581	69 51.1	16252	-3284	45193	48139
1952.5	-11 18.0	16601	69 50.0	16279	-3253	45203	48155
1953.5	-11 11.0	16625	69 48.7	16309	-3224	45213	48173
1954.5	-11 3.4	16647	69 47.6	16338	-3193	45228	48194
1955.5	-10 56.3	16665	69 46.9	16362	-3162	45250	48221
1956.5	-10 49.7	16674	69 47.0	16377	-3132	45277	48250
1957.5	-10 43.6	16695	69 46.0	16403	-3107	45296	48275
1958.5	-10 38.0	16719	69 45.0	16432	-3085	45320	48306
1959.5	-10 32.1	16742	69 44.1	16460	-3061	45344	48336
1960.5	-10 26.3	16761	69 43.5	16484	-3037	45370	48367
1961.5	-10 20.9	16792	69 41.8	16519	-3016	45385	48392
1962.5	-10 15.7	16825	69 39.8	16556	-2997	45396	48414
1963.5	-10 10.2	16850	69 38.6	16585	-2975	45413	48438
1964.5	-10 5.3	16880	69 36.9	16619	-2957	45427	48462
1965.5	-10 0.8	16907	69 35.5	16649	-2940	45440	48483
1966.5	-9 56.4	16928	69 34.6	16674	-2922	45460	48509
1967.5	-9 52.1	16949	69 33.8	16698	-2905	45486	48541
1968.5	-9 48.6	16979	69 32.5	16731	-2893	45514	48578
1969.5	-9 45.4	17013	69 31.0	16767	-2883	45542	48616

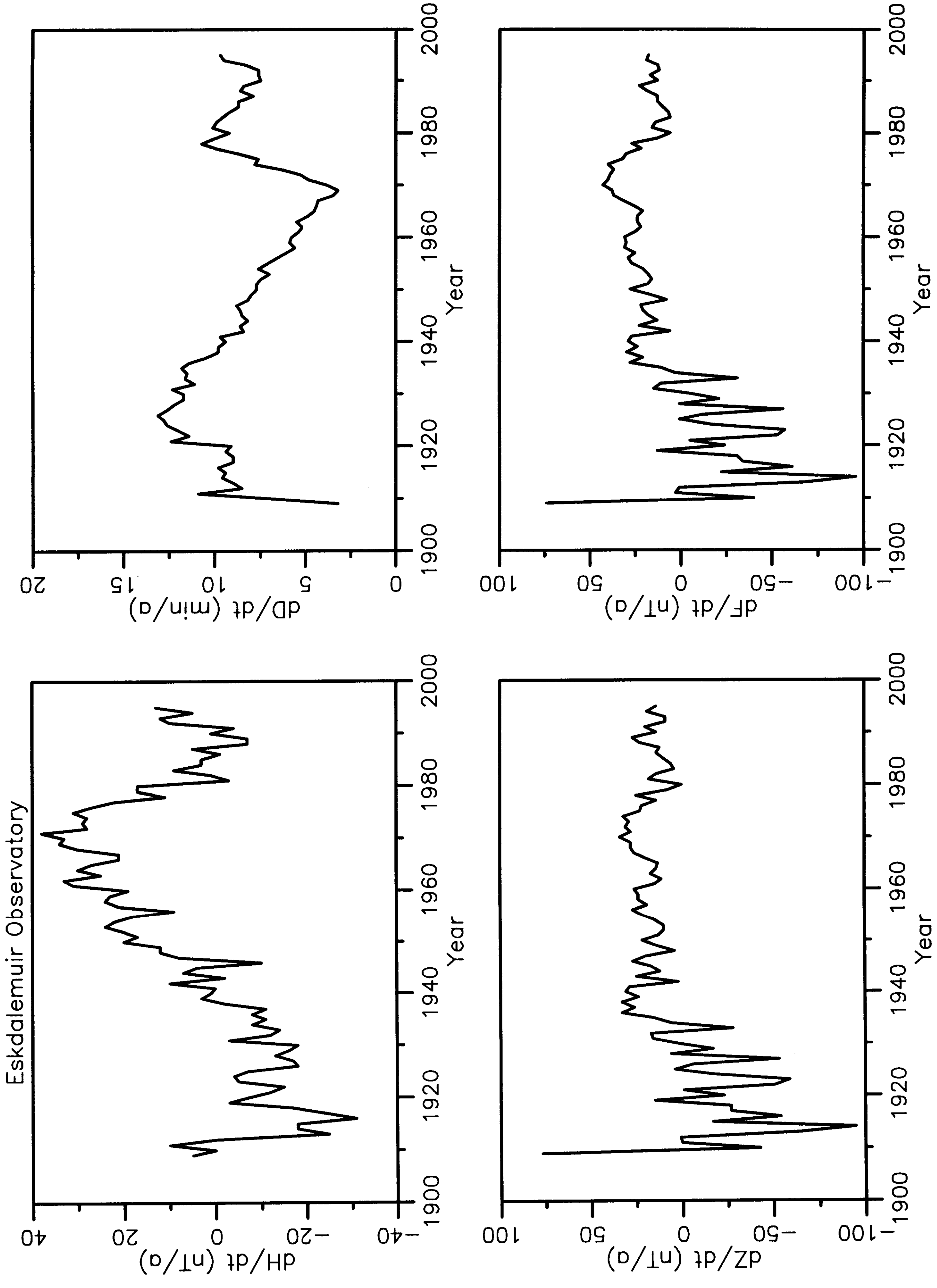
	Year	D		H	I		X	Y	Z	F
	1970.5	-9	41.6	17046	69	29.6	16803	-2870	45576	48659
	1971.5	-9	36.8	17084	69	27.8	16844	-2853	45604	48699
	1972.5	-9	31.5	17112	69	26.7	16876	-2832	45635	48738
	1973.5	-9	25.2	17141	69	25.5	16910	-2805	45664	48775
	1974.5	-9	17.4	17169	69	24.5	16944	-2772	45696	48815
	1975.5	-9	9.8	17200	69	23.0	16981	-2739	45719	48847
	1976.5	-9	1.1	17227	69	21.8	17014	-2700	45741	48877
	1977.5	-8	51.2	17249	69	20.6	17044	-2655	45755	48899
	1978.5	-8	40.5	17260	69	20.5	17063	-2603	45780	48926
	1979.5	-8	30.5	17277	69	19.6	17087	-2556	45788	48939
	1980.5	-8	21.3	17294	69	18.5	17110	-2513	45788	48945
	1981.5	-8	11.2	17291	69	19.2	17114	-2462	45806	48961
	1982.5	-8	1.3	17292	69	19.4	17123	-2413	45820	48975
	1983.5	-7	51.7	17301	69	18.9	17138	-2366	45824	48981
	1984.5	-7	42.5	17304	69	18.9	17147	-2321	45830	48988
	1985.5	-7	33.8	17307	69	18.9	17156	-2278	45840	48998
	1986.5	-7	25.1	17306	69	19.4	17161	-2234	45854	49011
	1987.5	-7	17.2	17311	69	19.3	17171	-2196	45866	49024
	1988.5	-7	8.6	17304	69	20.4	17170	-2152	45889	49043
	1989.5	-7	0.2	17297	69	21.5	17168	-2109	45916	49066
Note 1		0	0.0	11	0	-0.2	11	-1	22	25
	1990.5	-6	52.7	17309	69	21.6	17184	-2073	45952	49104
	1991.5	-6	45.1	17305	69	22.3	17185	-2034	45972	49121
	1992.5	-6	37.5	17315	69	21.9	17199	-1998	45981	49133
	1993.5	-6	29.2	17327	69	21.3	17216	-1957	45990	49146
Note 2		0	0.0	-8	0	0.0	-8	1	-23	-24
	1994.5	-6	19.7	17324	69	21.4	17218	-1910	45986	49141
	1995.5	-6	10.0	17337	69	20.9	17237	-1862	46000	49159

1 Site differences 1 Jan 1990 (new value - old value)
2 Site differences 1 Jan 1994 (new value - old value)

D and I are given in degrees and decimal minutes
All other elements are in nanoteslas

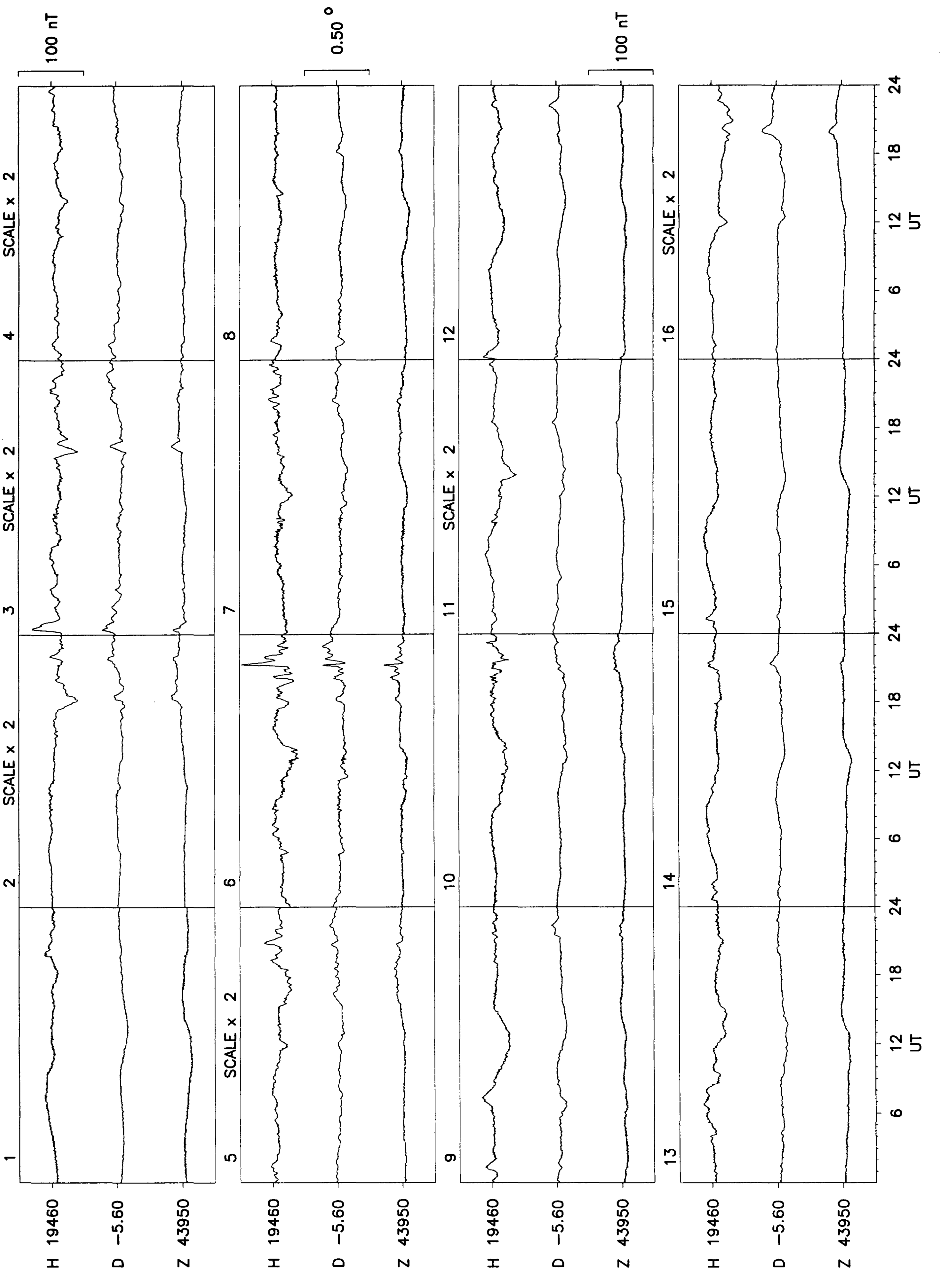


Annual mean values of H, D, Z, & F at Eskdalemuir



Rate of change of annual mean values of H, D, Z, & F at Eskdalemuir

Hartland 1995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D −5.60
Z 43950
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7
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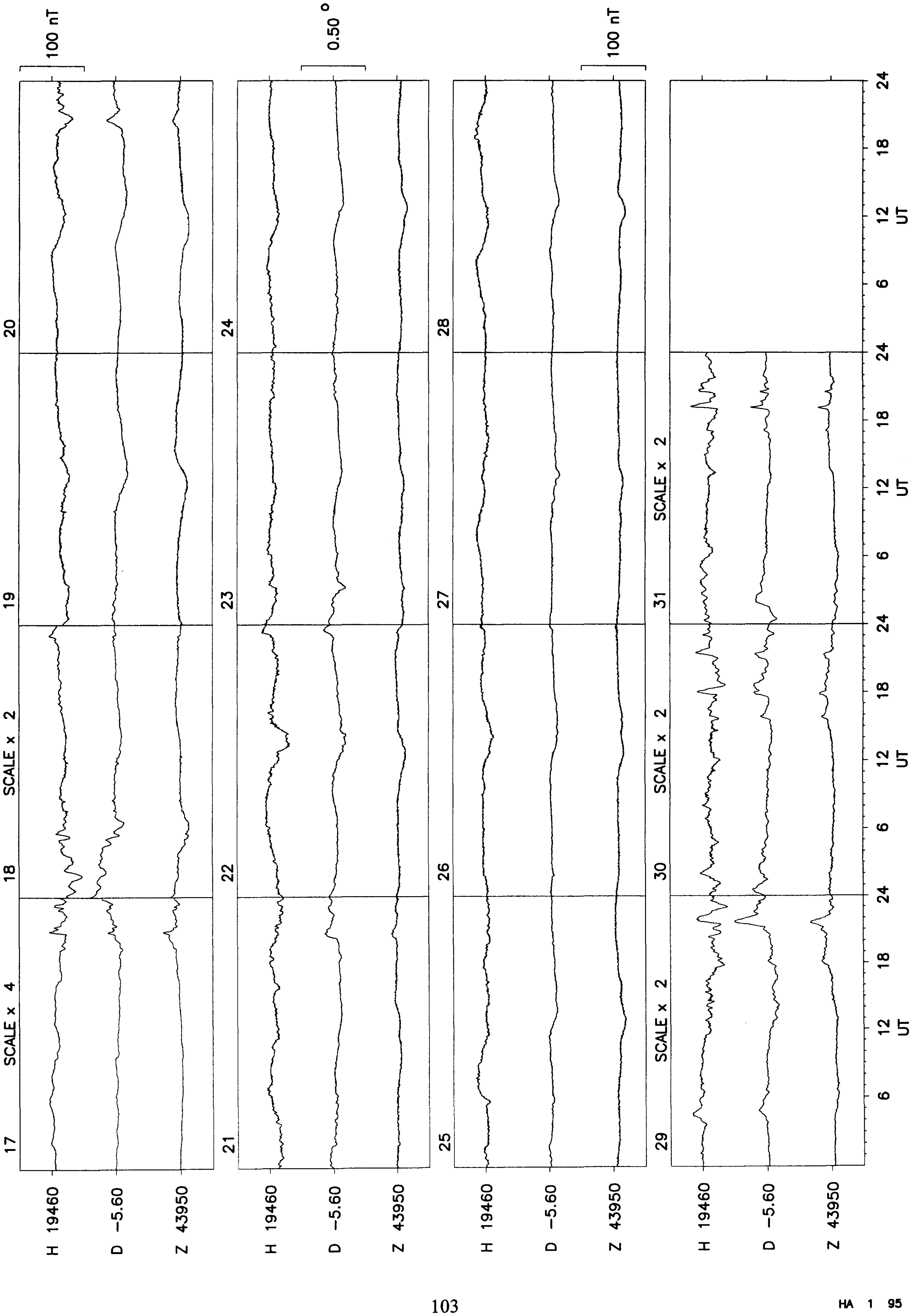
16



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100 nT
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SCALE x 2
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20
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22
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24
25
26
27
28
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SCALE x 2
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SCALE x 2
31
SCALE x 2
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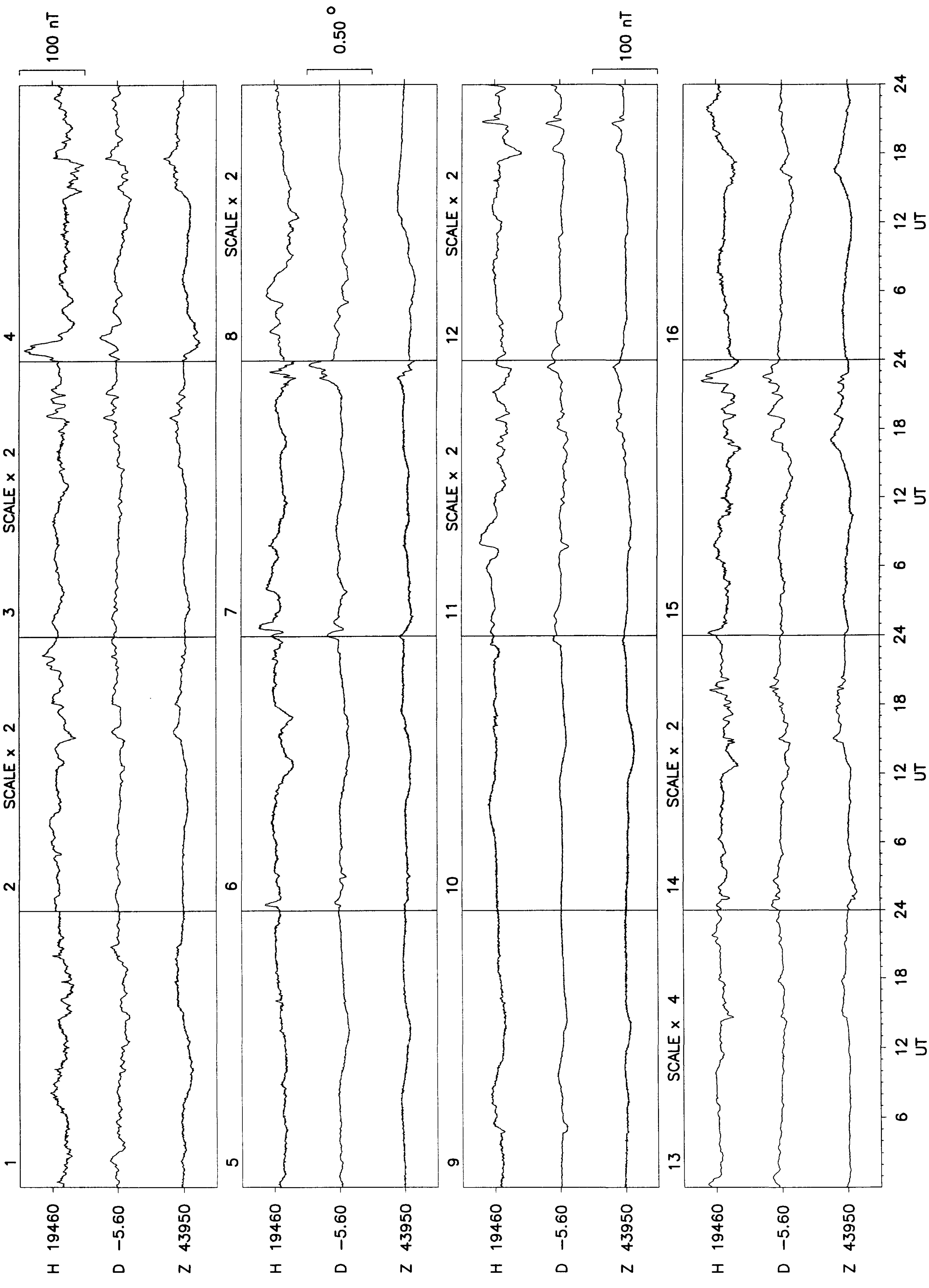
D −5.60
Z 43950
6
12
18
24
UT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SCALE x 2
SCALE x 4
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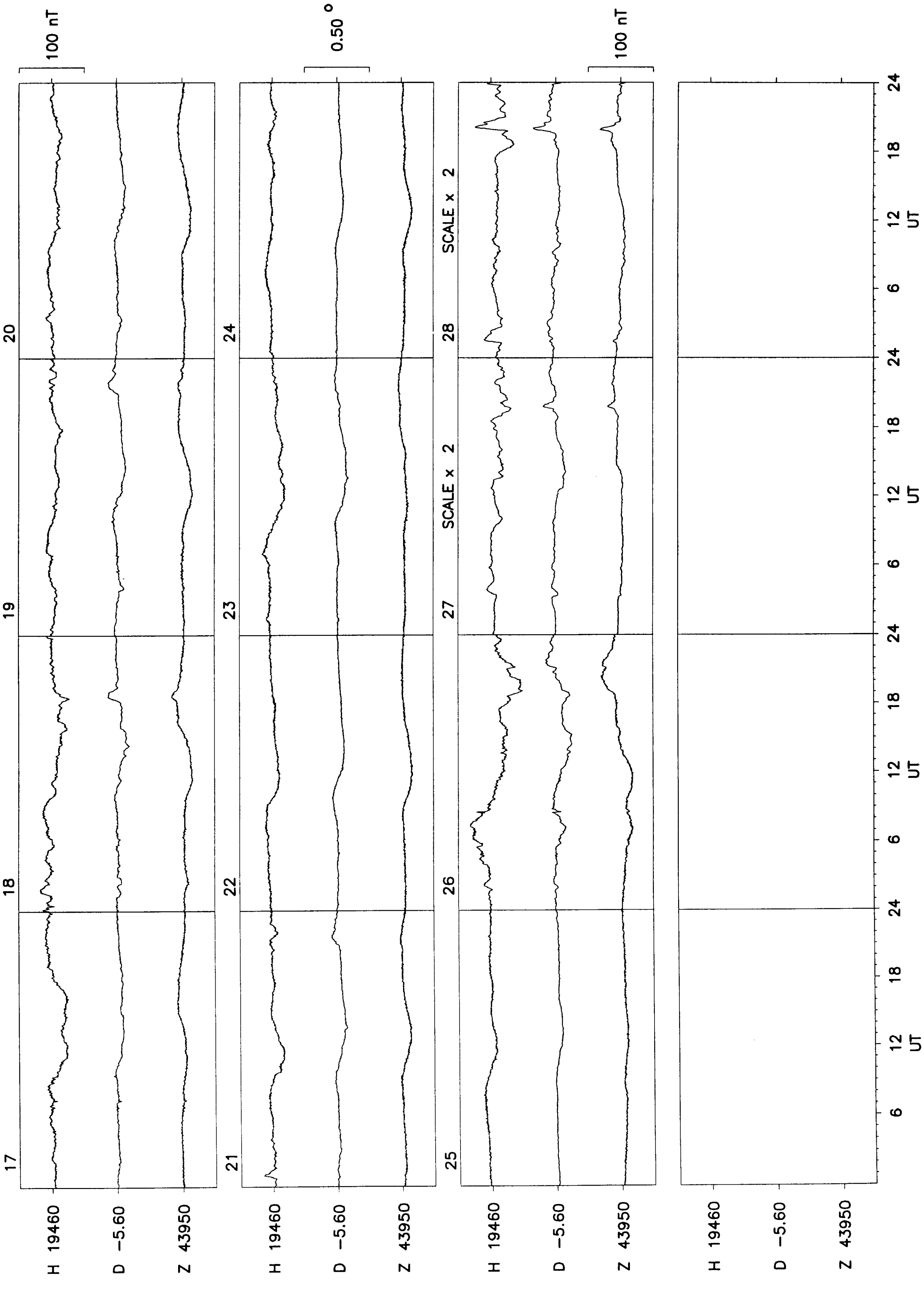
D −5.60
Z 43950
6
12
18
24
UT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SCALE x 2
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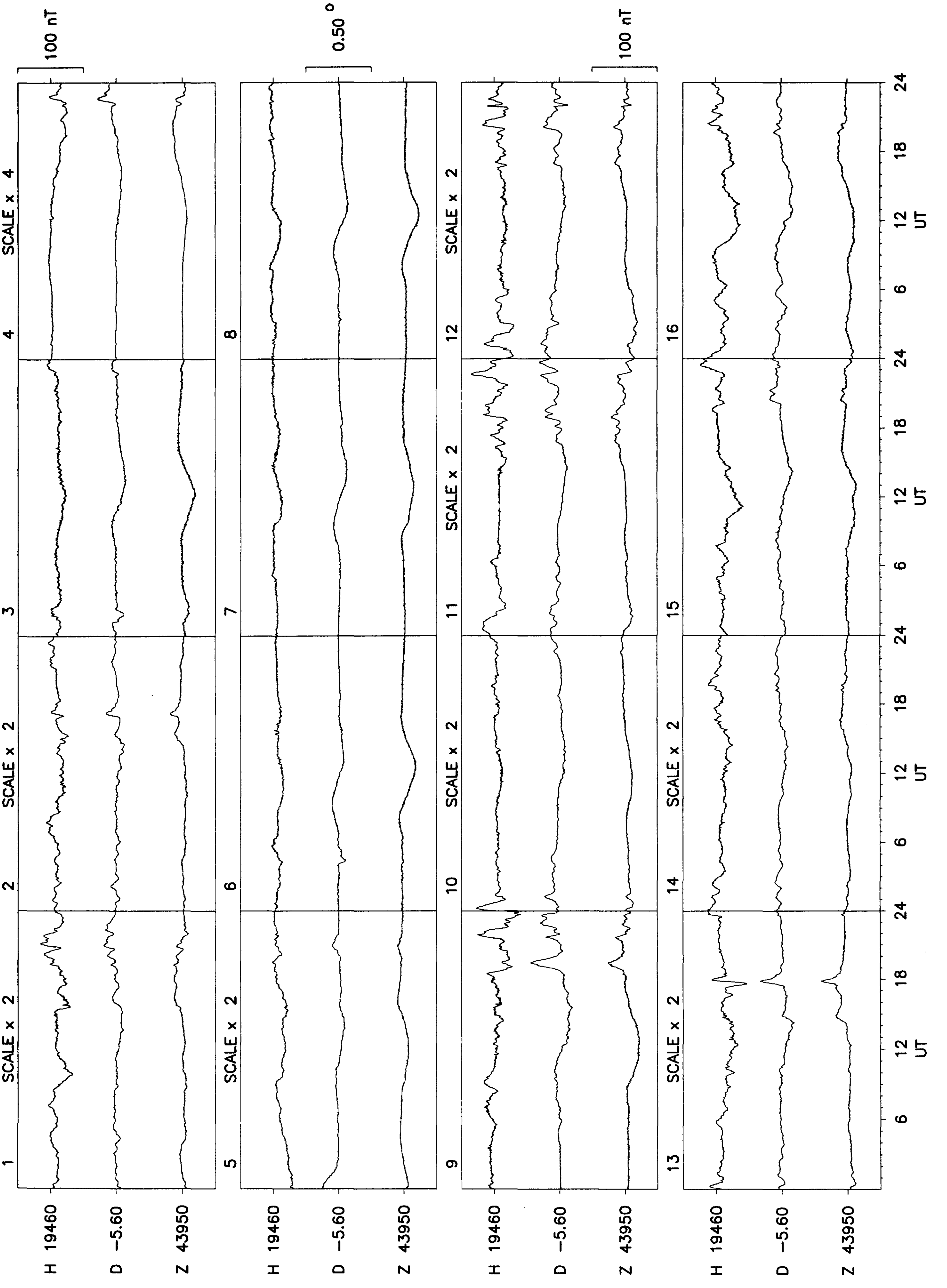
D −5.60
Z 43950
UT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H 19460
D −5.60
Z 43950
UT
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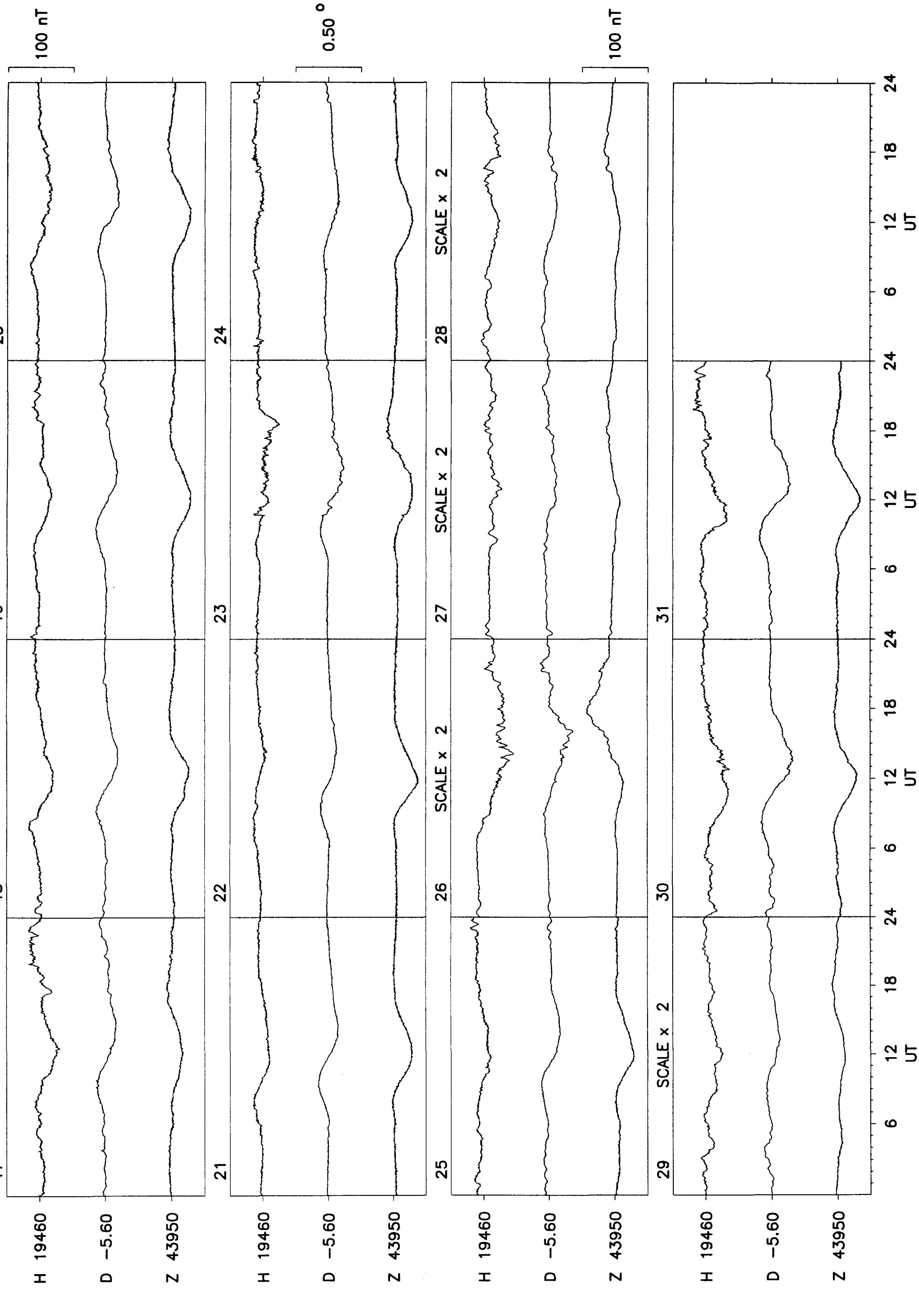
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D −5.60
Z 43950
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0.50 °
SCALE x 2
UT
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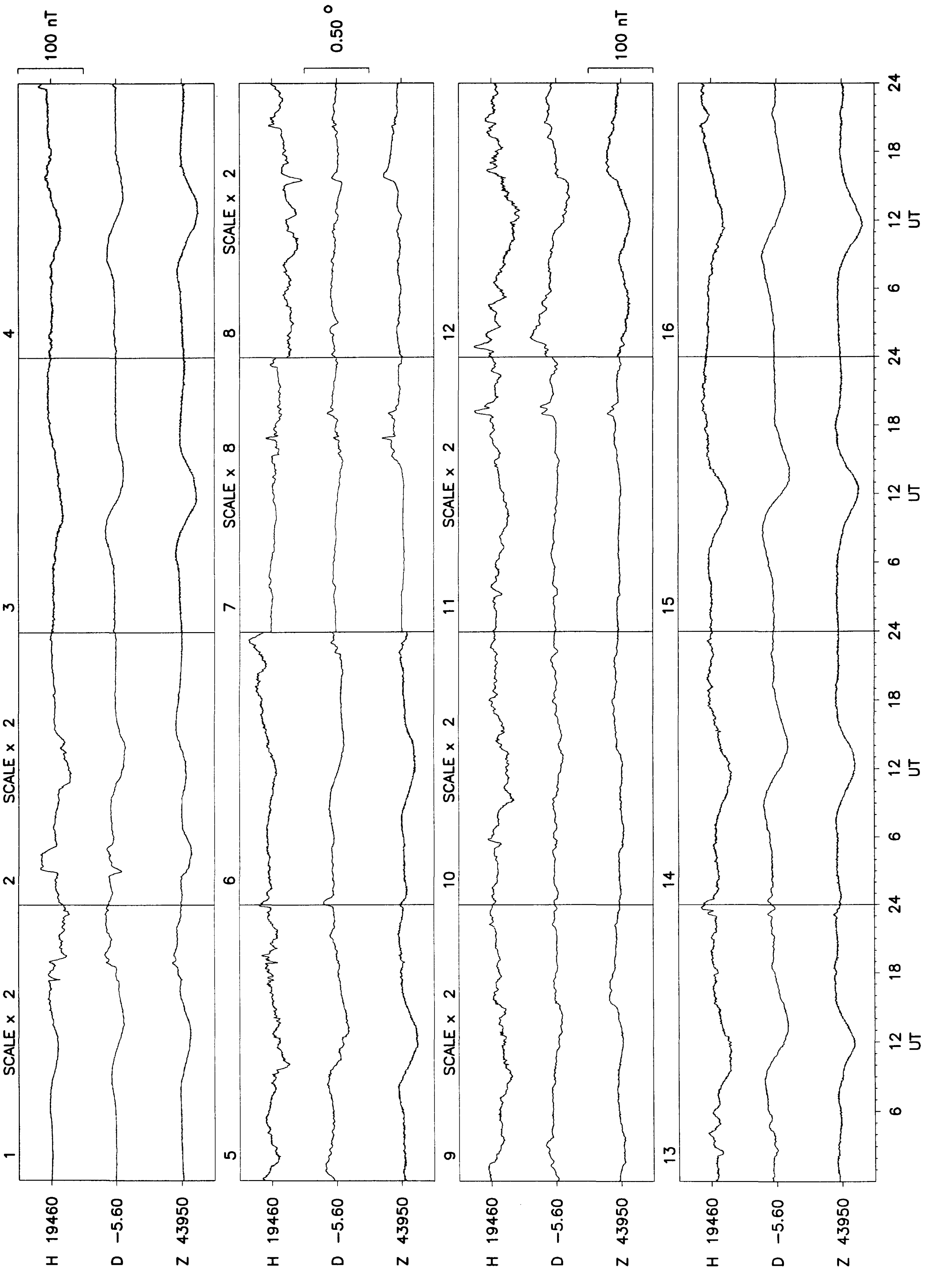
31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100 nT
SCALE x 2
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D −5.60
Z 43950
UT
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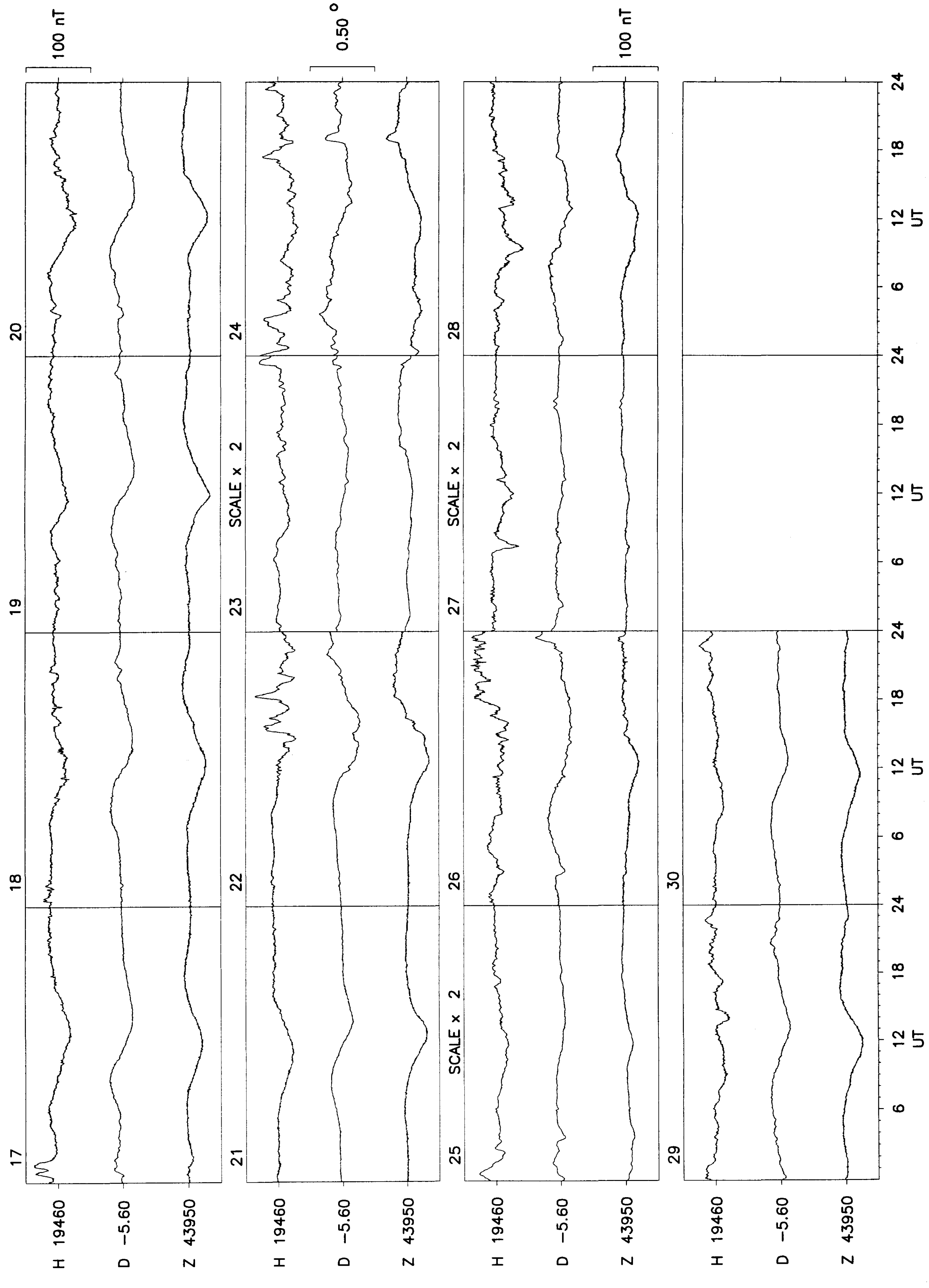
SCALE x 8



100 nT
0.50 °
100 nT
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27
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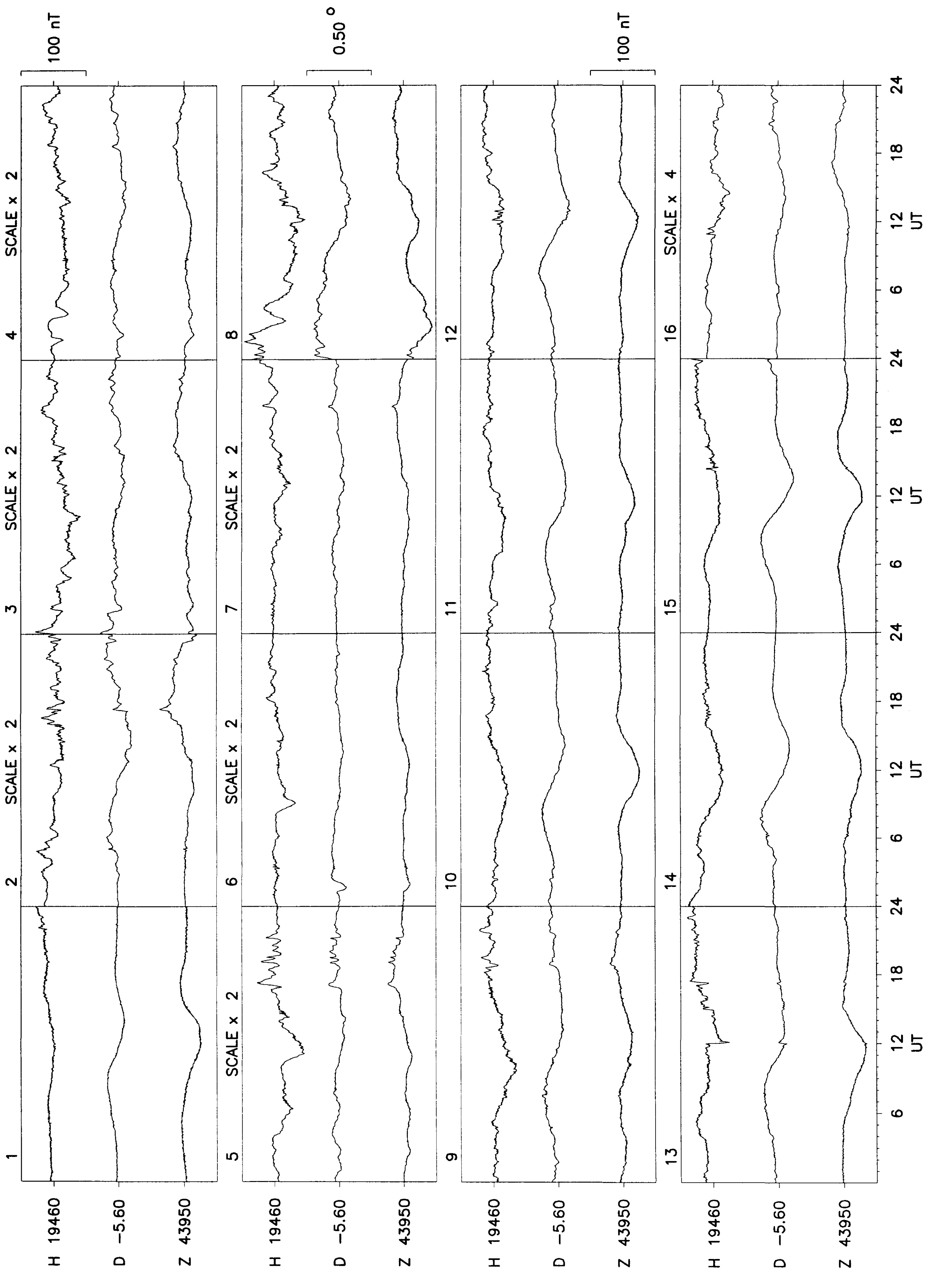
29
30
SCALE x 2
SCALE x 2
SCALE x 2
H 19460
D −5.60
Z 43950
6
12
18
24
UT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0.50 °
100 nT
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SCALE x 4
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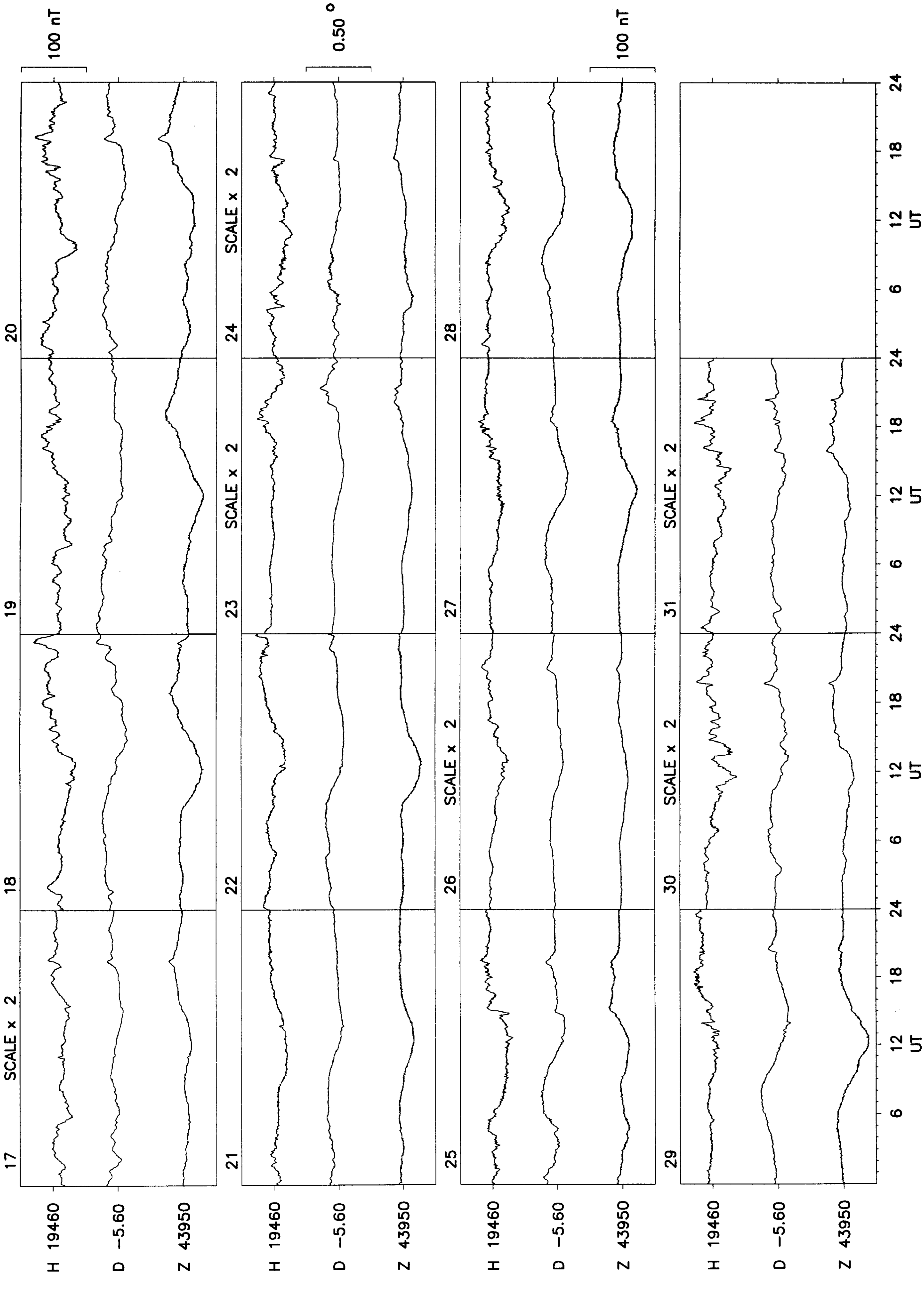
H 19460
D −5.60
Z 43950
6
12
18
24
UT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0.50 °
100 nT
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D -5.60
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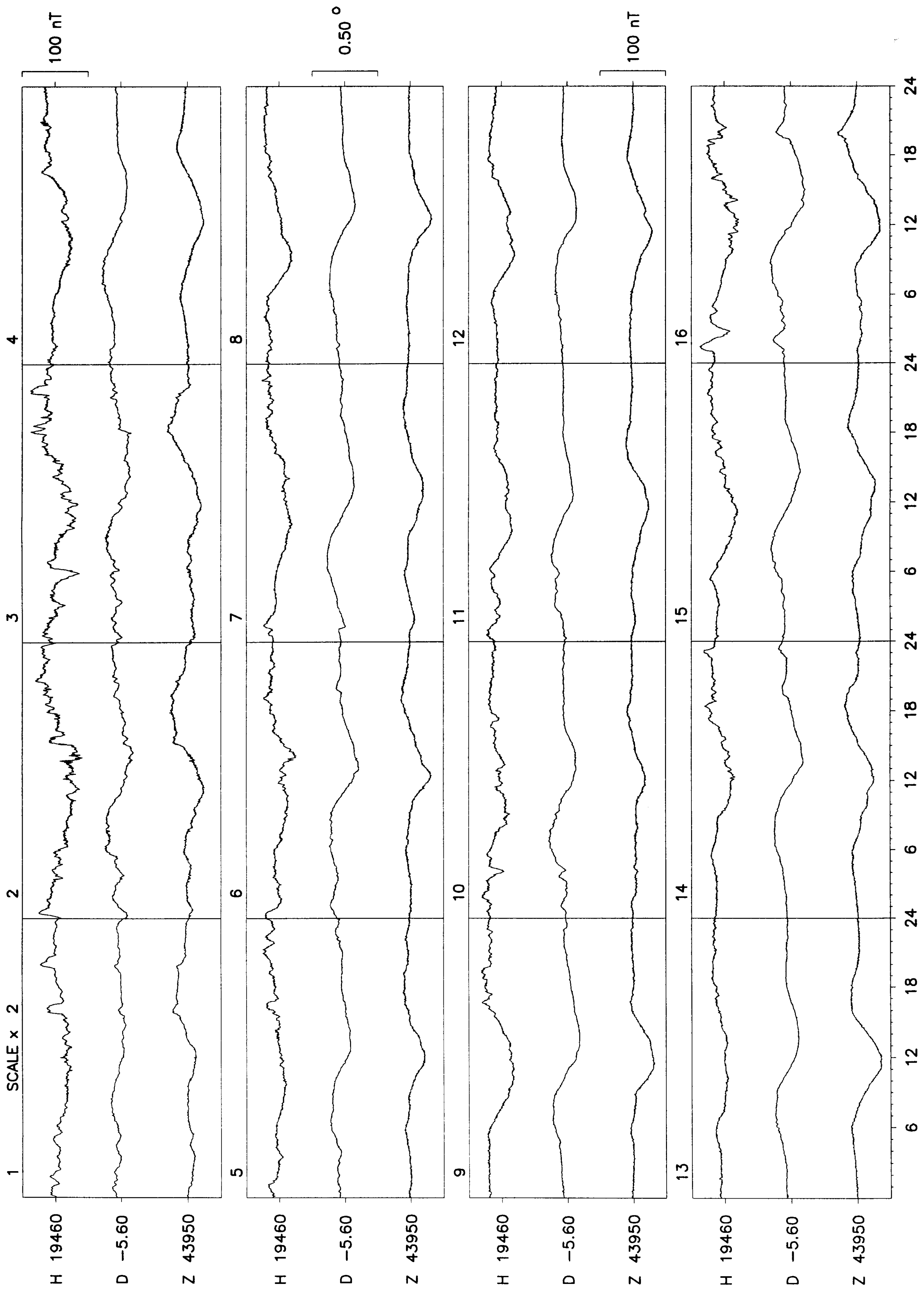
UT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0.50 °
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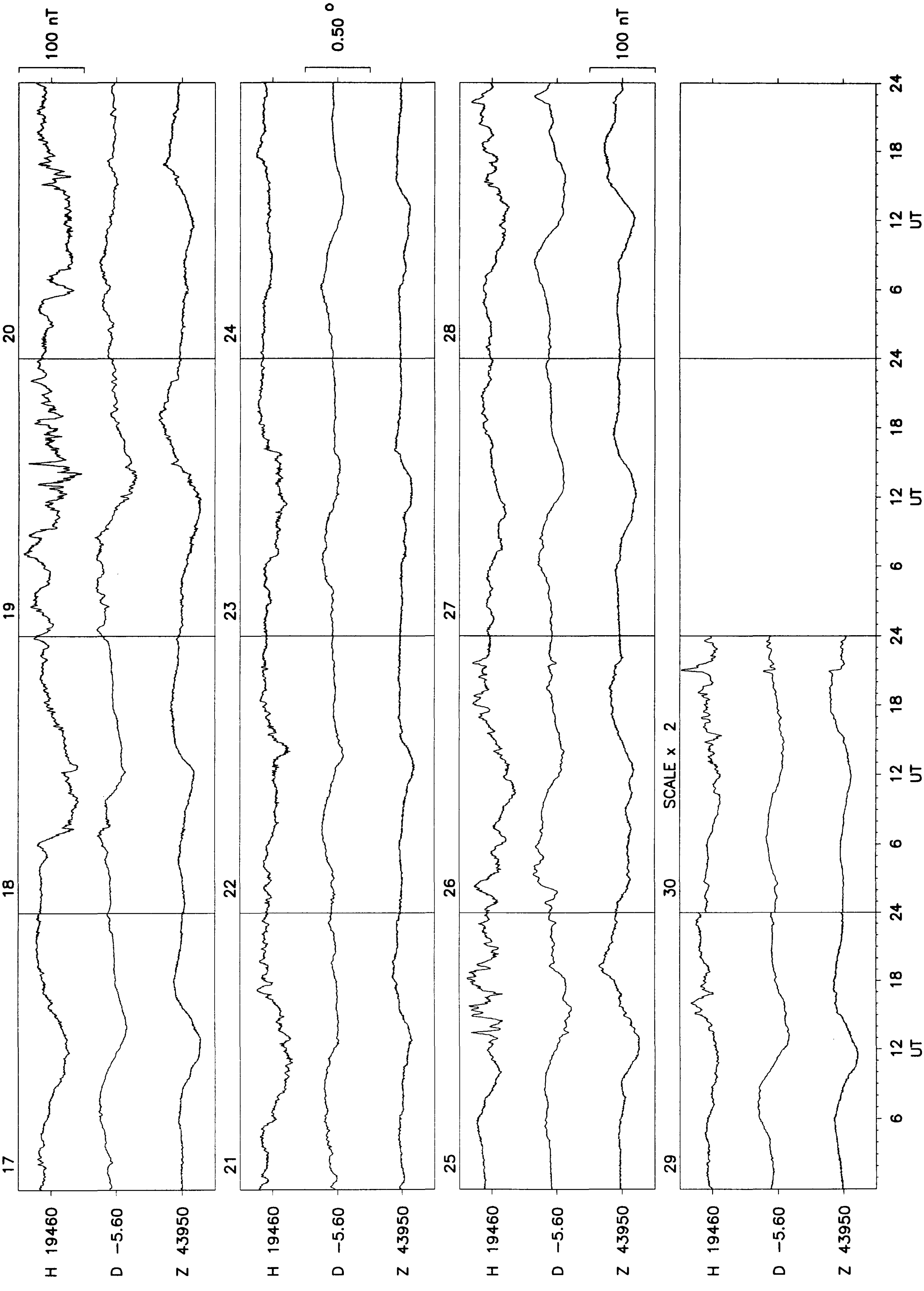
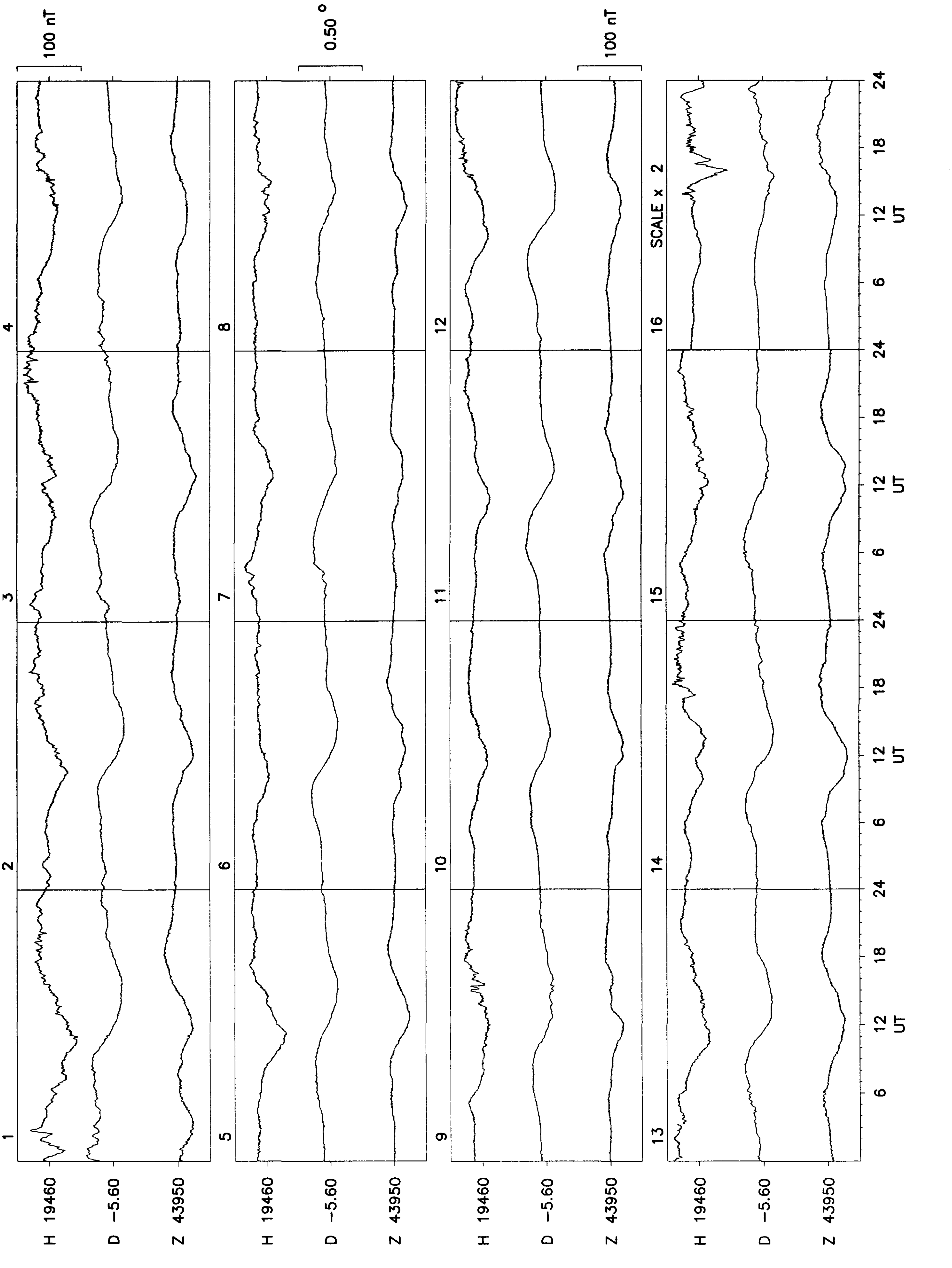
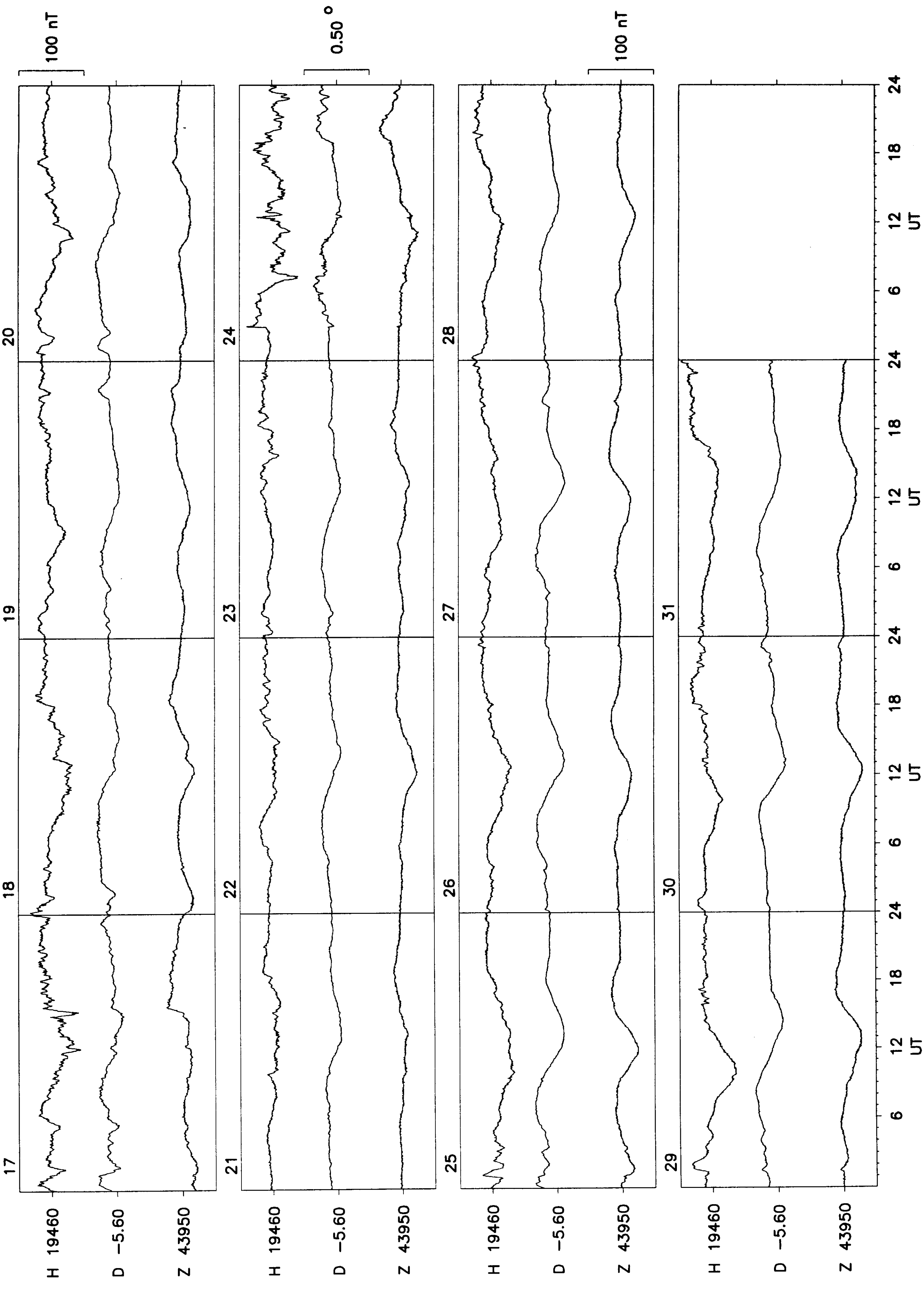
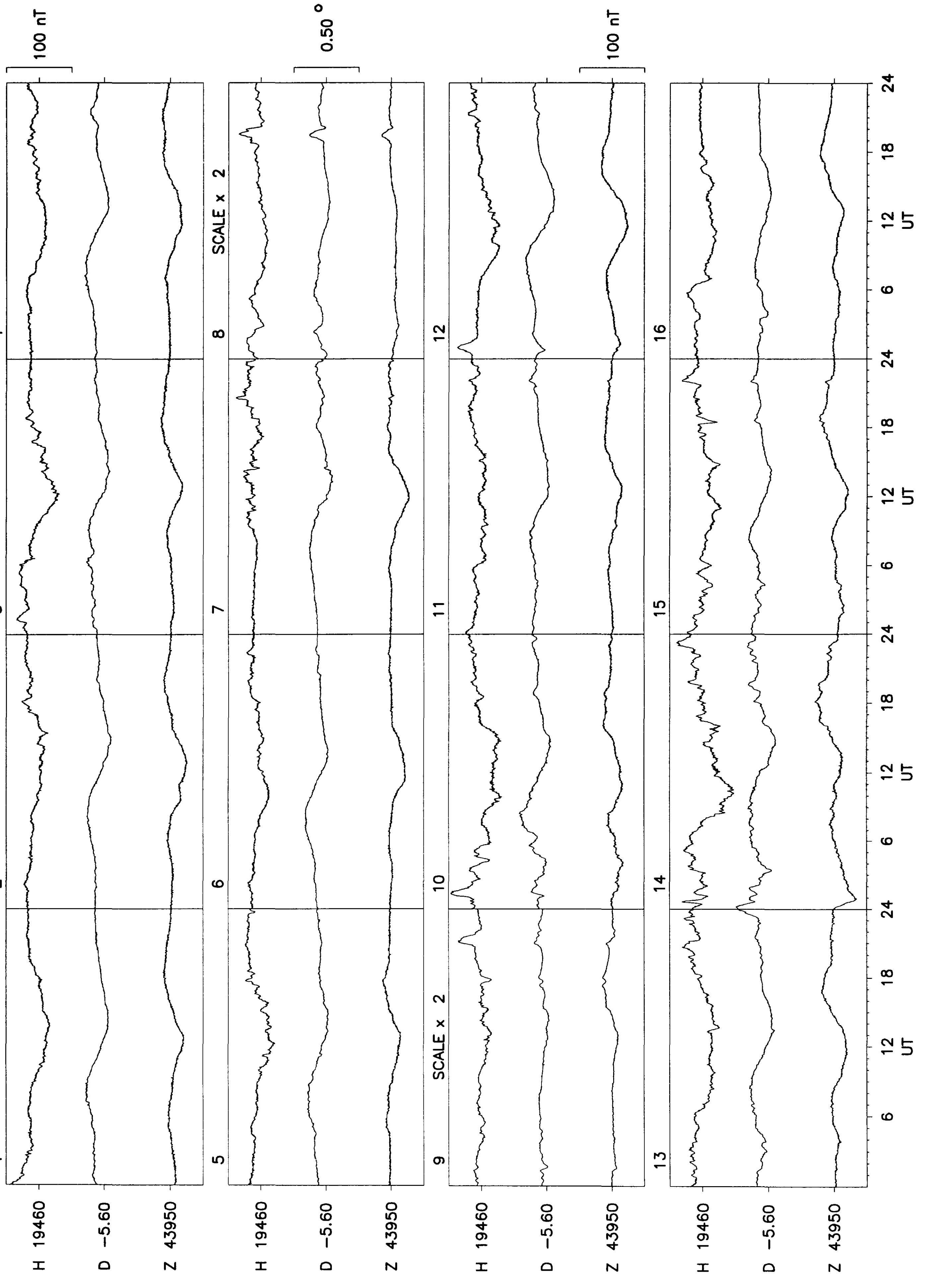
5
6
7
8
9
10
11
12
13
14
15
16
H 19460
D −5.60
Z 43950
6
12
18
24
UT

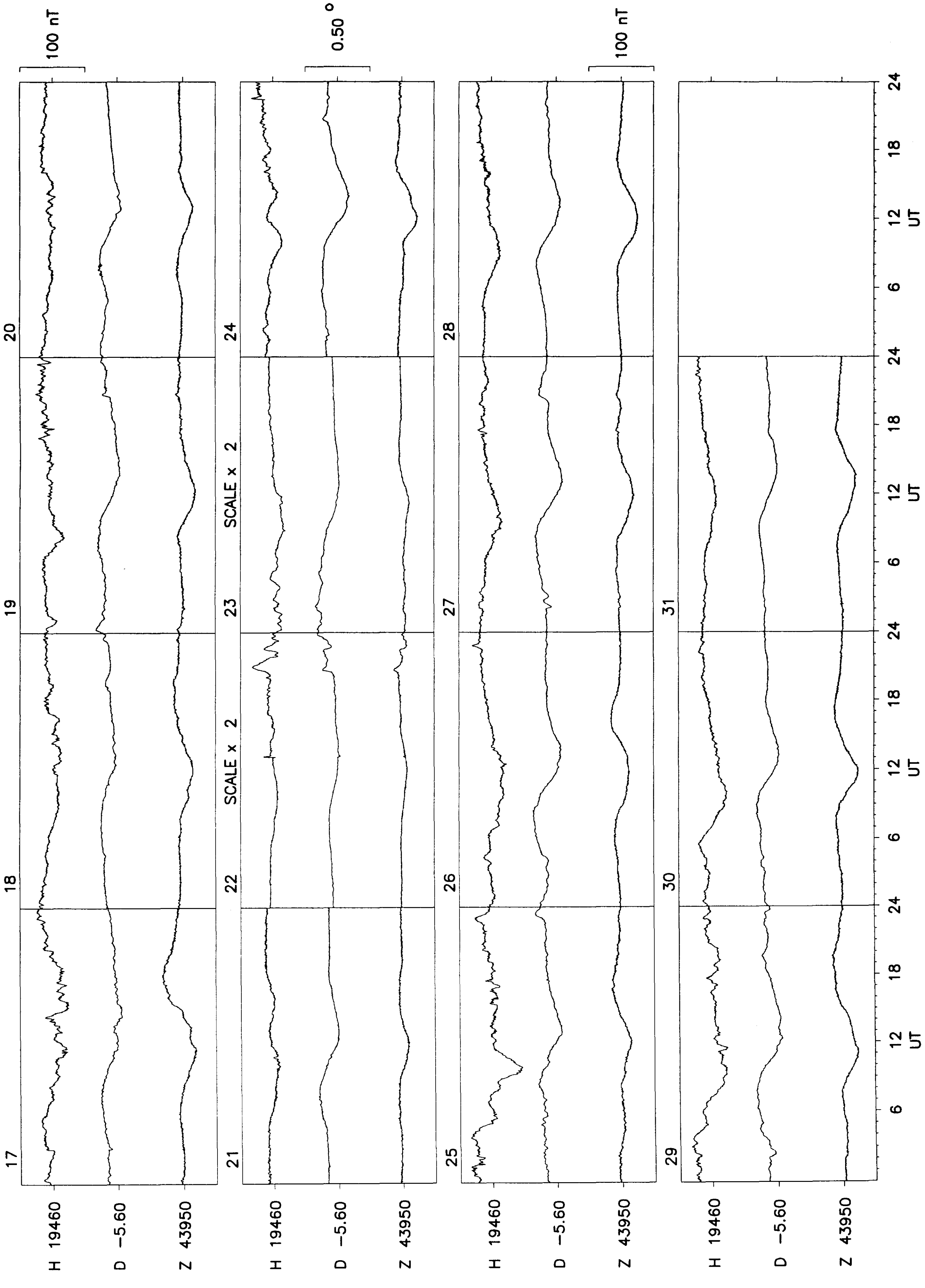

100 nT
0.50 °
100 nT
17
18
19
20
21
22
23
24
25
26
27
28
29
30
SCALE x 2
H 19460
D −5.60
Z 43950
6
12
18
24
UT

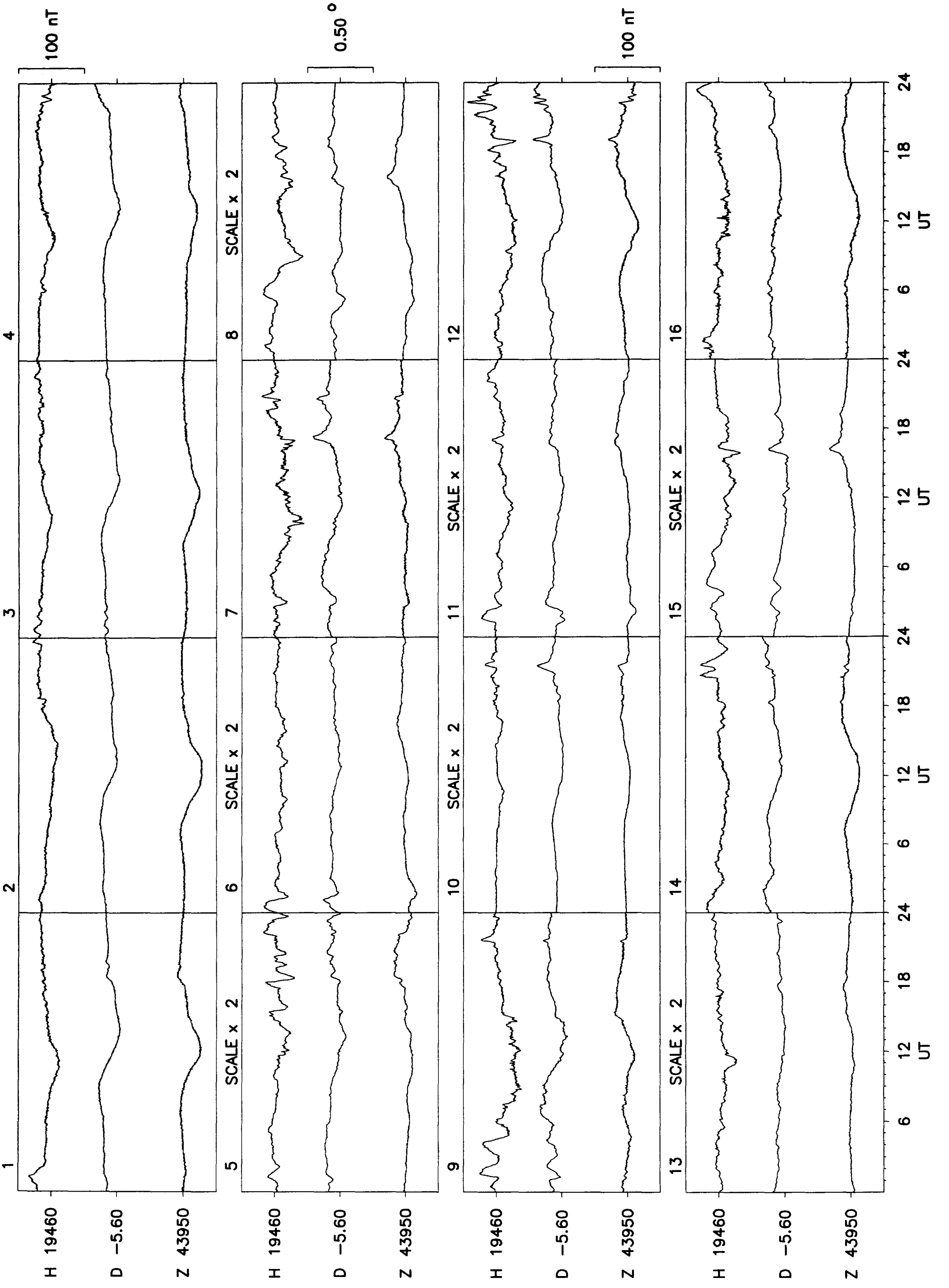

100 nT
0.50 °
100 nT
SCALE x 2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
H 19460
D −5.60
Z 43950
6
12
18
24
UT

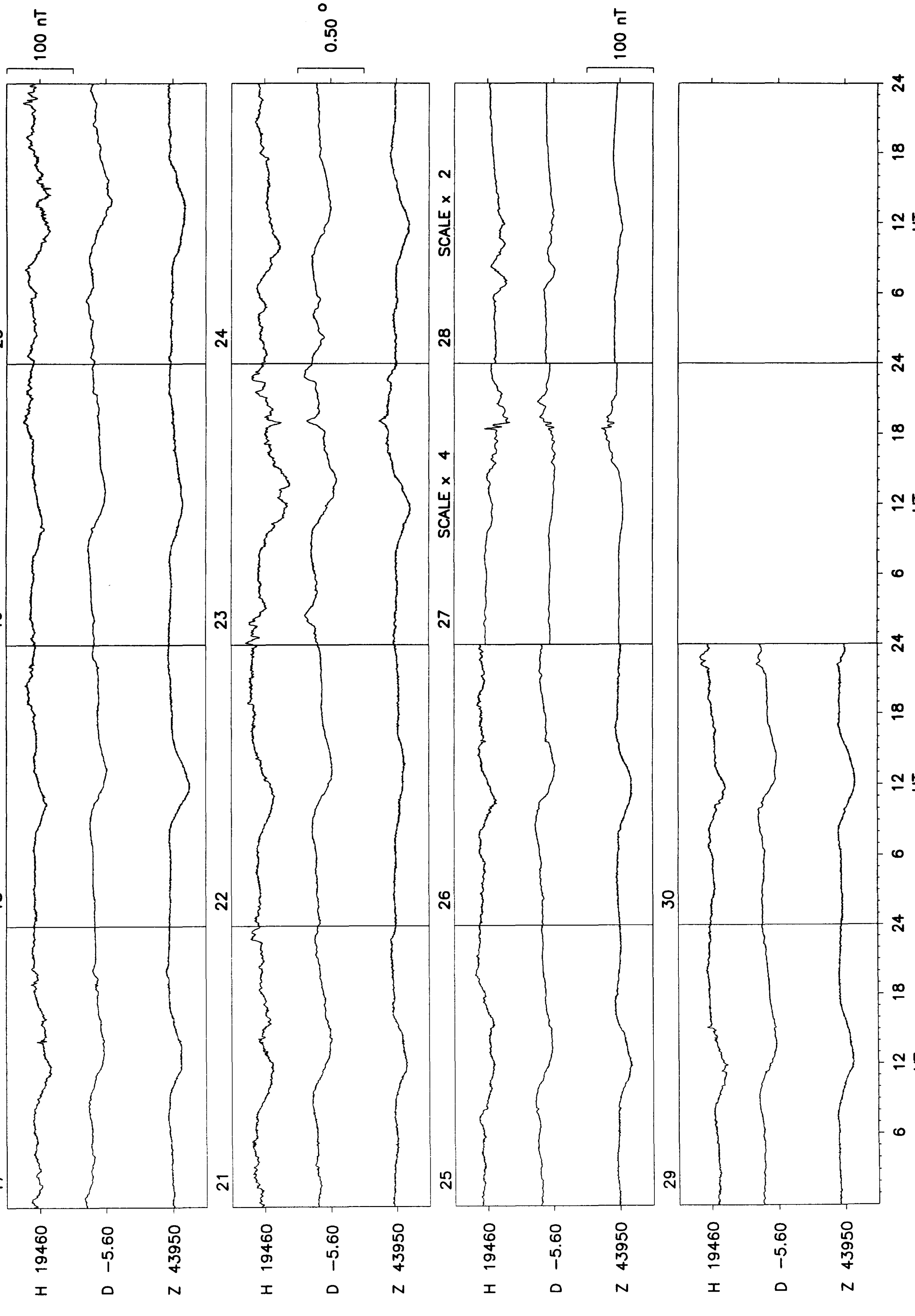


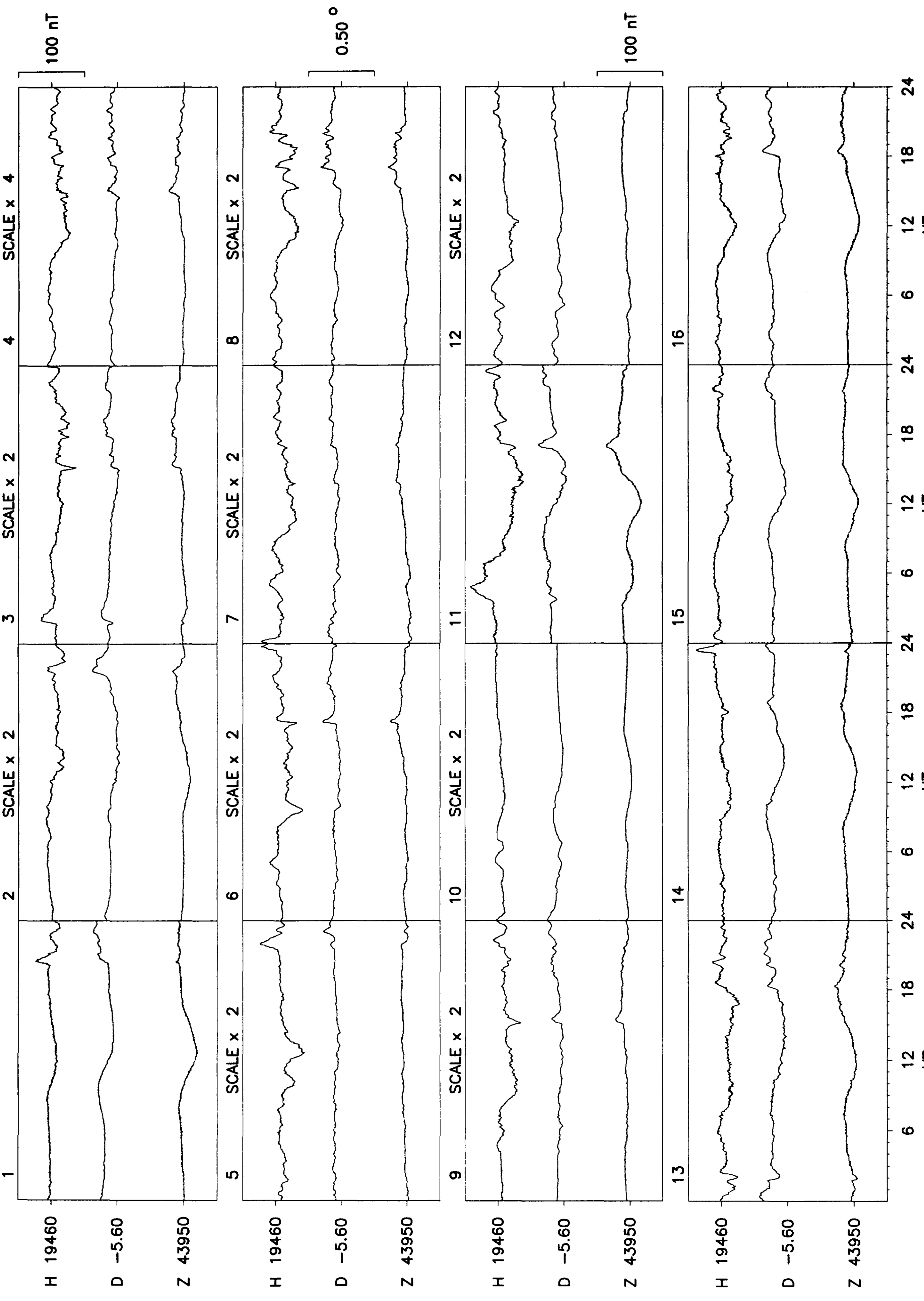
100 nT
0.50 °
100 nT
H 19460
D −5.60
Z 43950
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
6
12
18
24
UT


100 nT
0.50 °
100 nT
SCALE x 2
SCALE x 2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
H 19460
D -5.60
Z 43950
6
12
18
24
UT

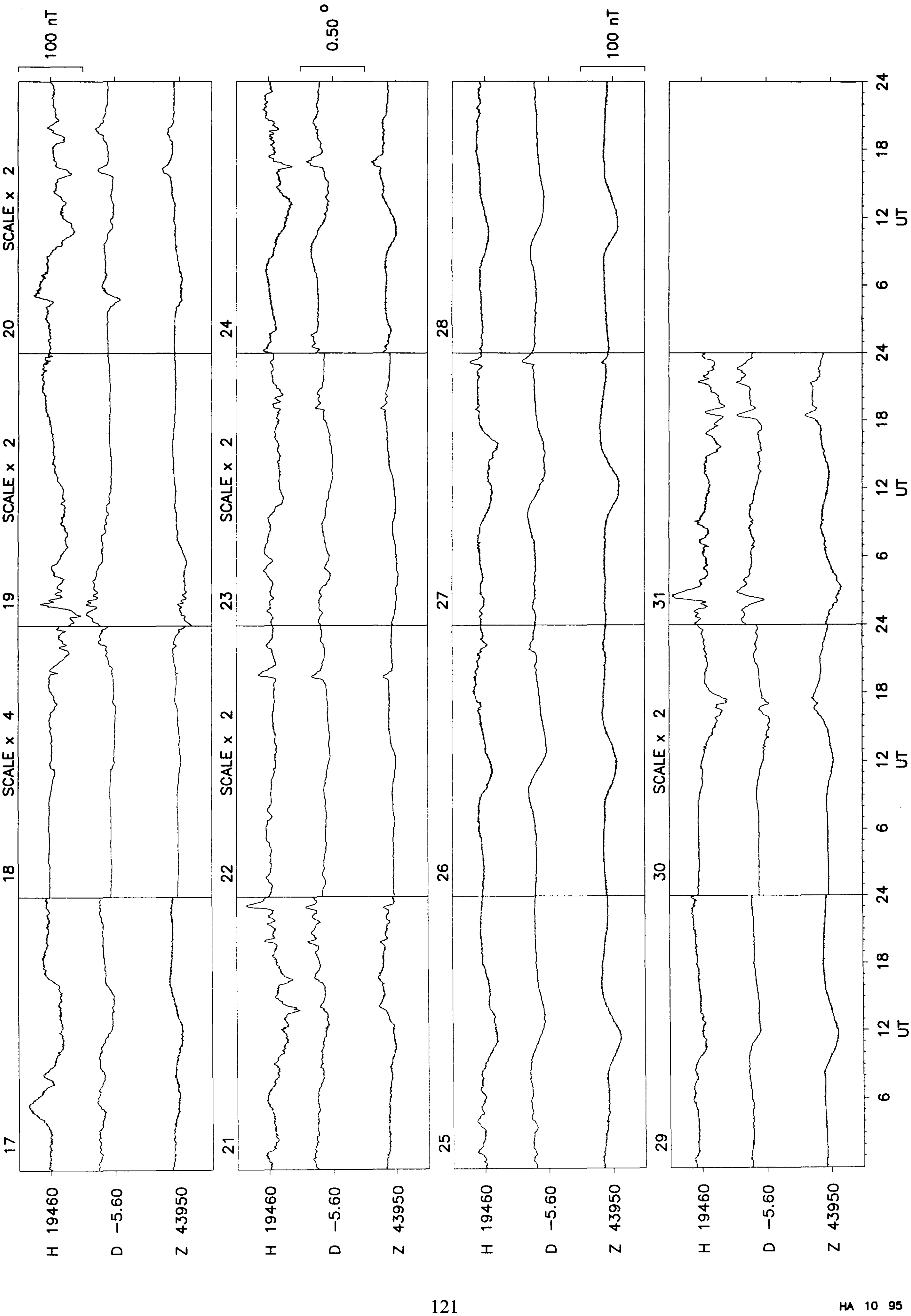

100 nT
0.50 °
100 nT
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
SCALE x 2
SCALE x 2
H 19460
D −5.60
Z 43950
6
12
18
24
UT


100 nT
0.50 °
100 nT
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
SCALE x 2
H 19460
D −5.60
Z 43950
UT
6
12
18
24

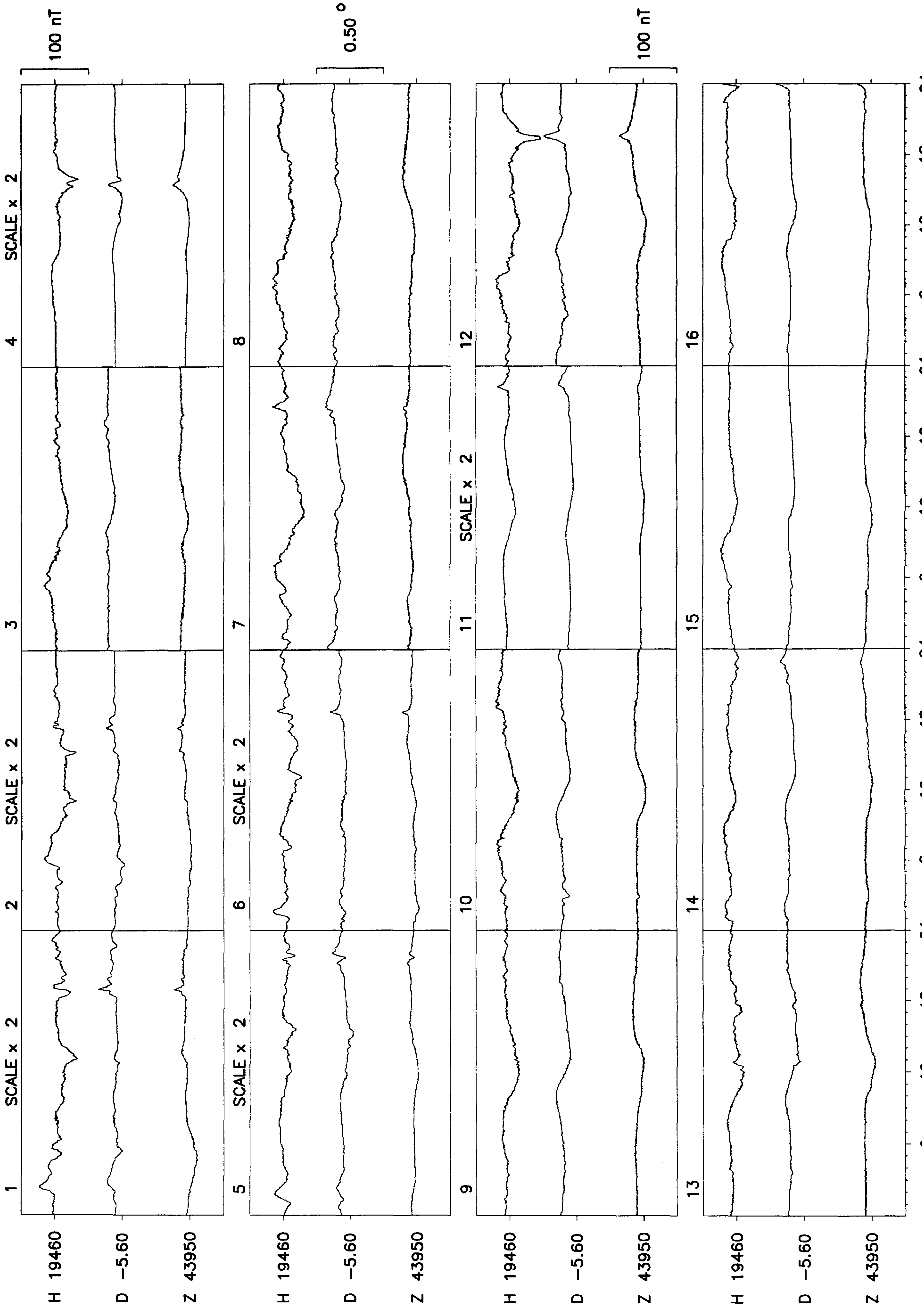

100 nT
0.50 °
100 nT
17
18
19
20
21
22
23
24
25
26
27
28
29
30
SCALE x 4
SCALE x 2
H 19460
D −5.60
Z 43950
6
12
18
24
UT



100 nT
0.50 °
100 nT
SCALE x 2
SCALE x 4
UT
H 19460
D −5.60
Z 43950



H 19460
D −5.60
Z 43950
100 nT
0.50 °
100 nT
SCALE x 4
SCALE x 2
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
UT


100 nT
0.50 °
100 nT
SCALE x 2
SCALE x 2
SCALE x 2
SCALE x 2
SCALE x 2
SCALE x 2
H 19460
D −5.60
Z 43950
UT
1
2
3
4
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6
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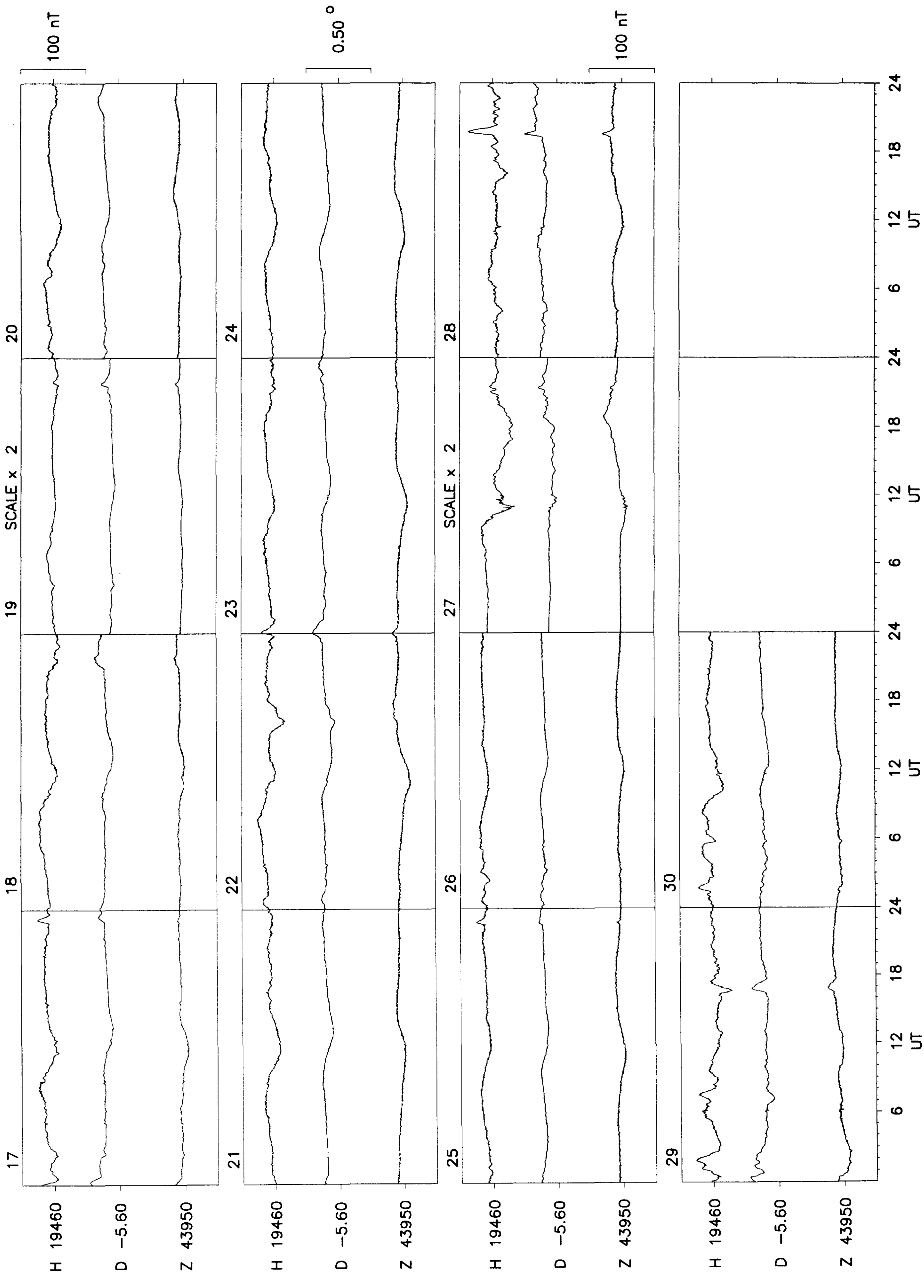
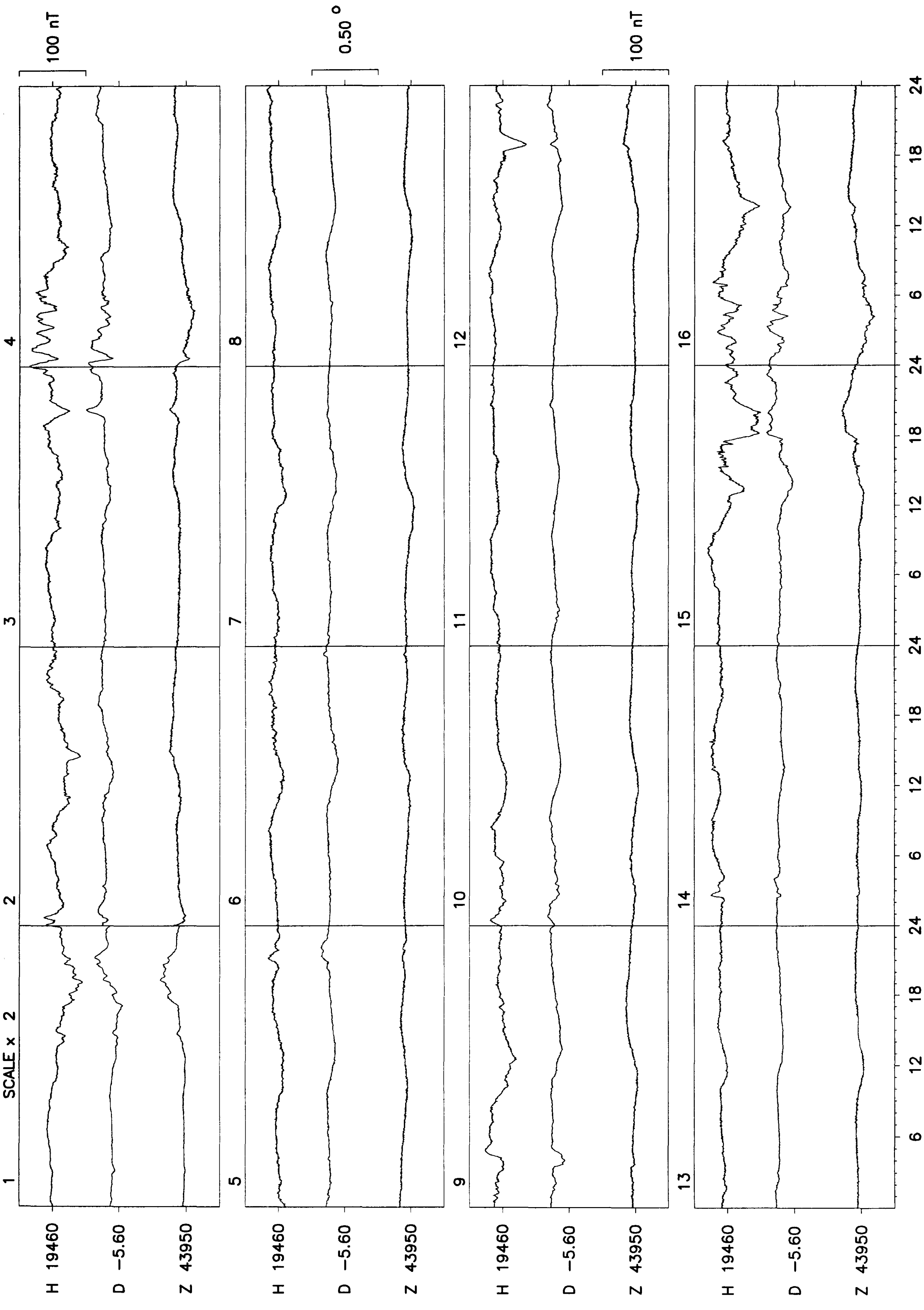
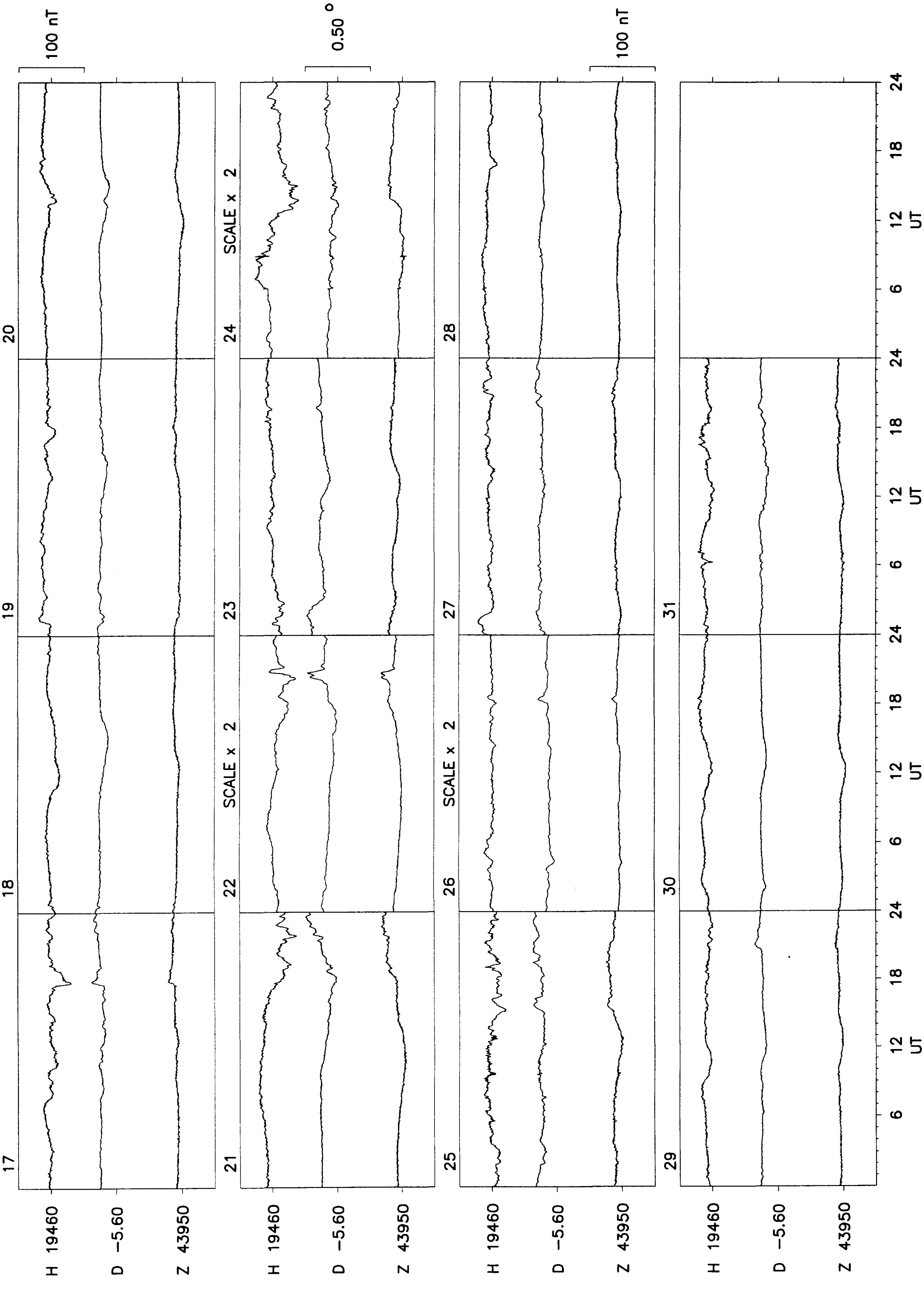
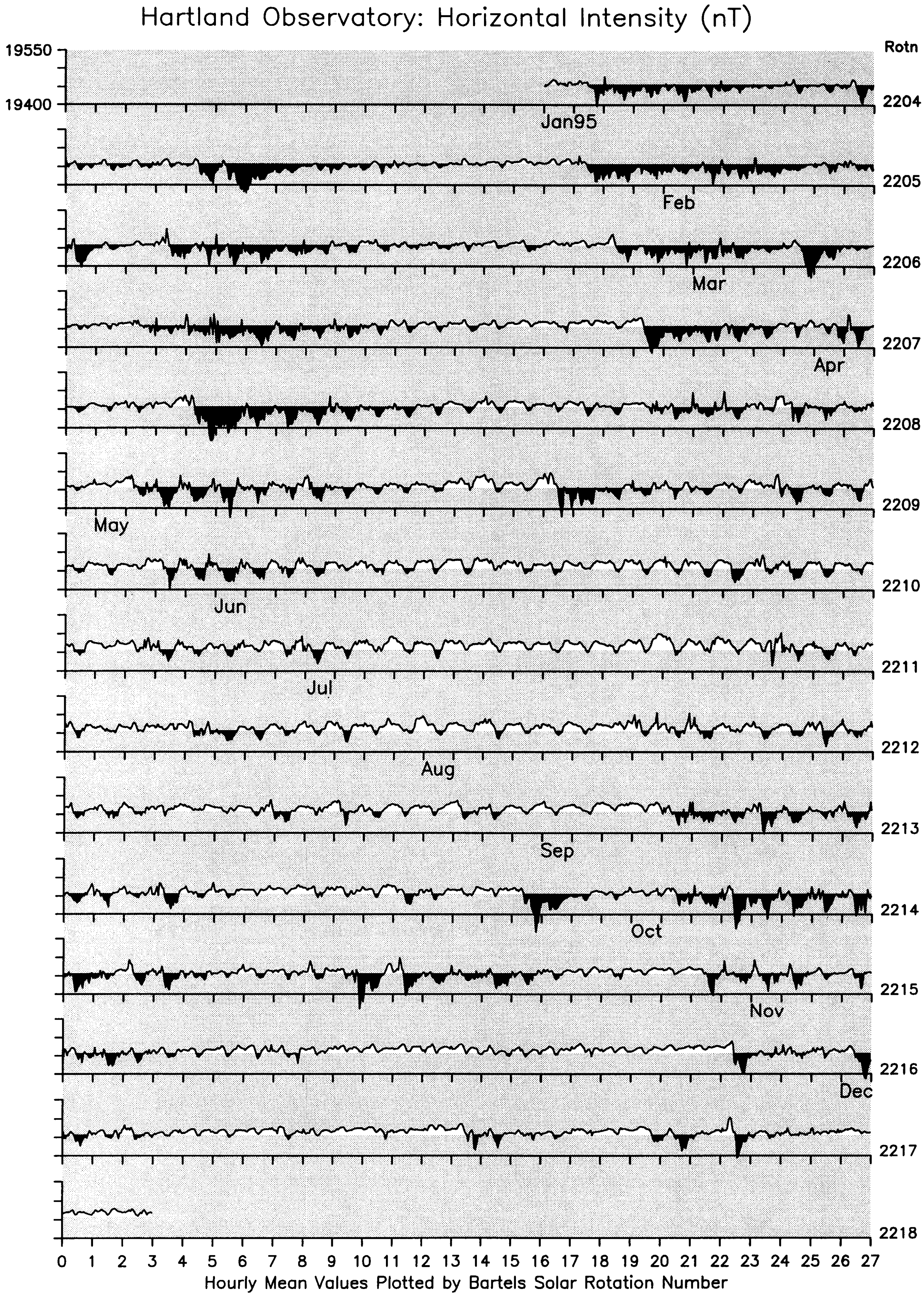
8
9
10
11
12
13
14
15
16

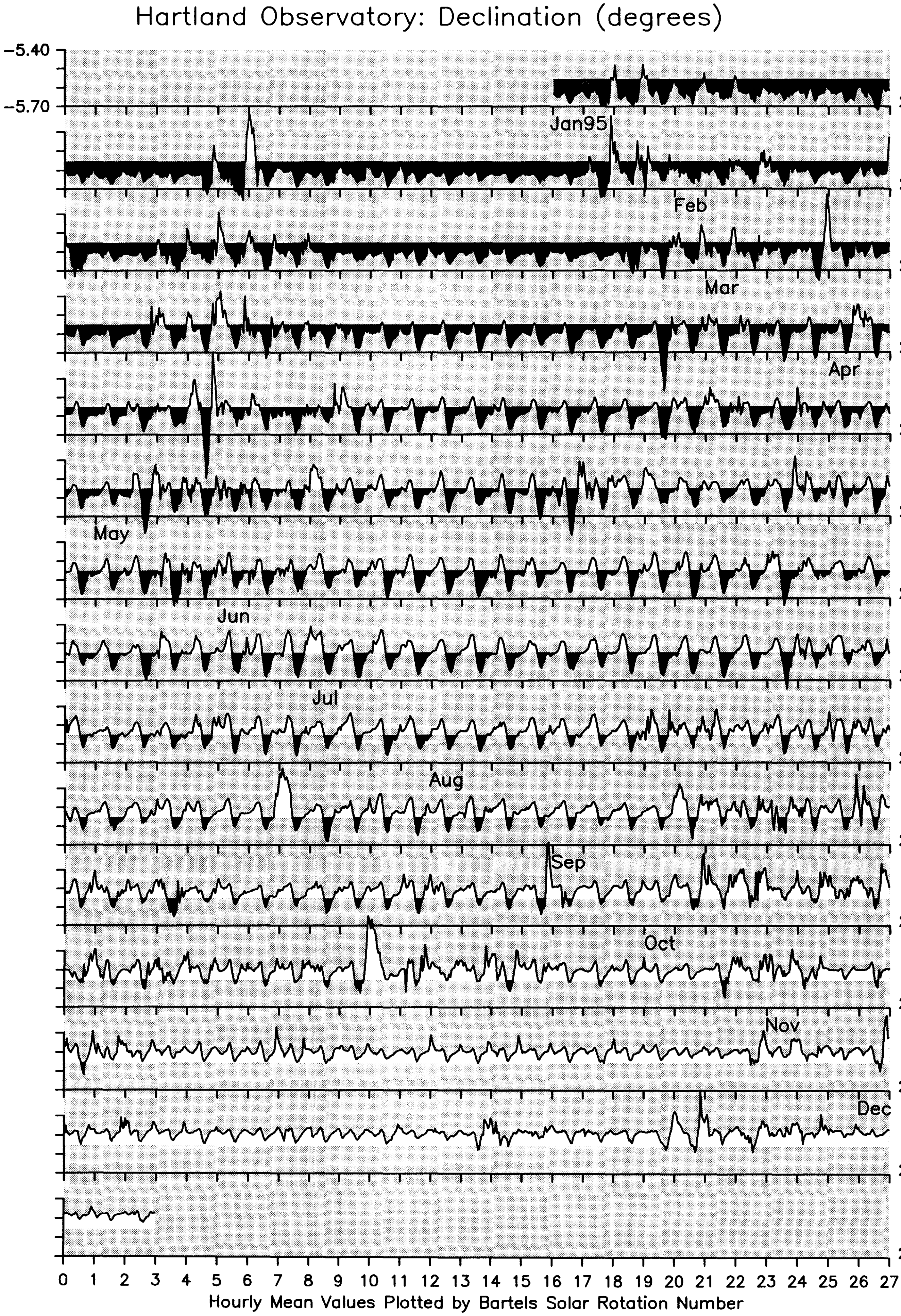

100 nT
0.50 °
100 nT
SCALE x 2
SCALE x 2
17
18
19
20
21
22
23
24
25
26
27
28
29
30
H 19460
D −5.60
Z 43950
UT
6
12
18
24


SCALE x 2
100 nT
0.50 °
100 nT
H 19460
D −5.60
Z 43950
UT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16


100 nT
0.50 °
100 nT
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
SCALE x 2
SCALE x 2
SCALE x 2
H 19460
D −5.60
Z 43950
6
12
18
24
UT

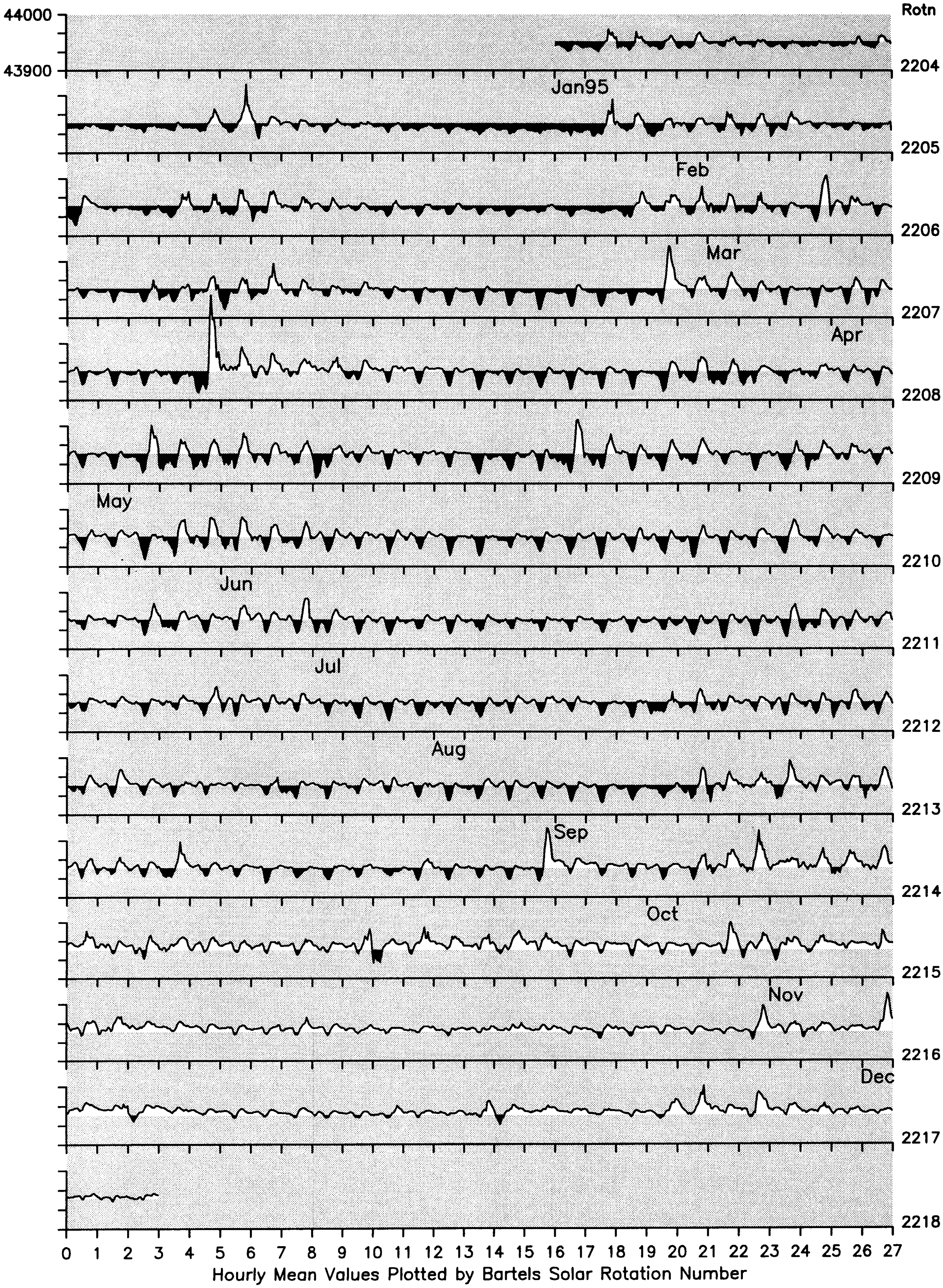


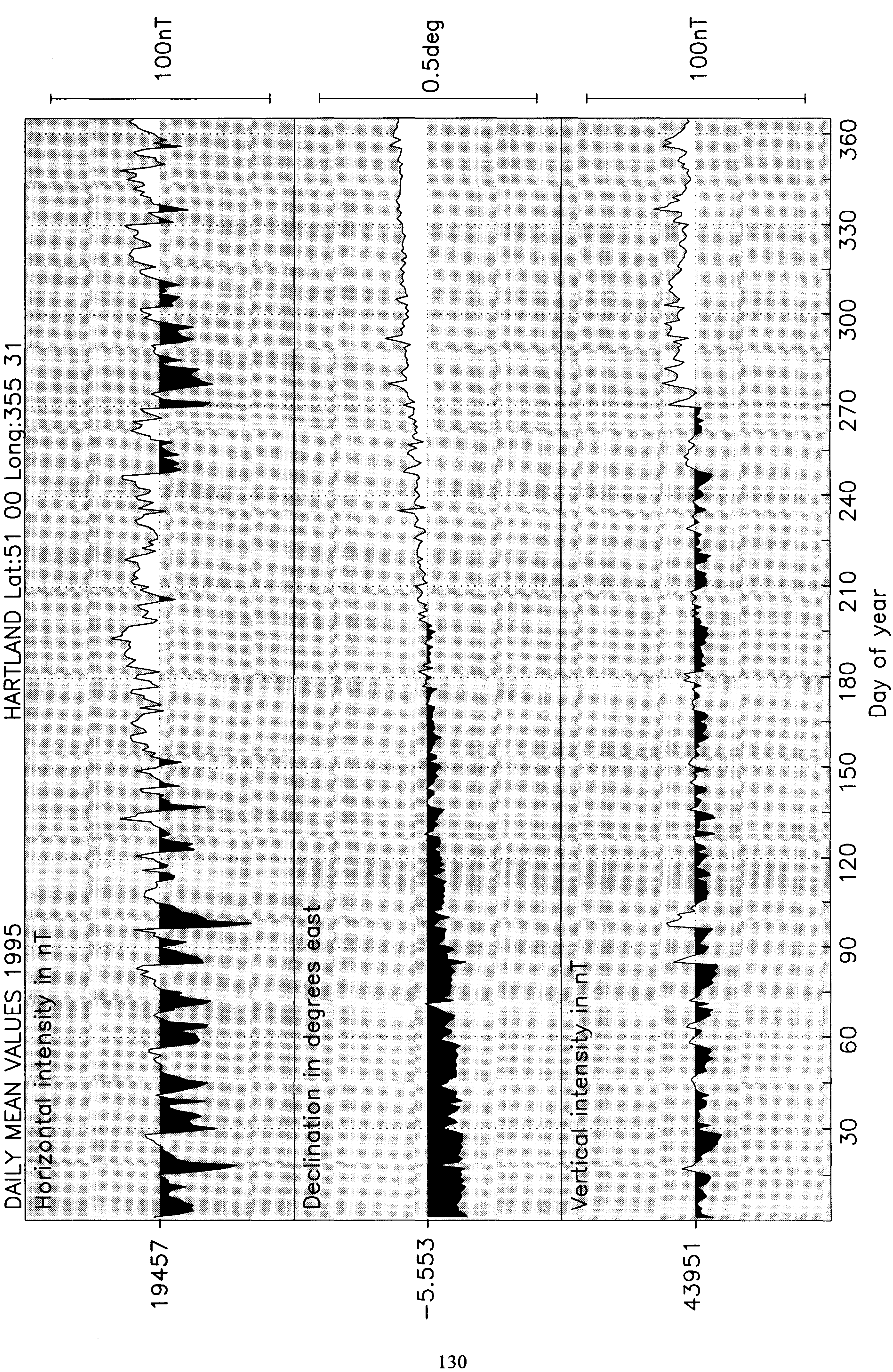
Hartland Observatory: Horizontal Intensity (nT)
19550
19400
Rotn
2204
Jan95
2205
Feb
2206
Mar
2207
Apr
2208
2209
May
2210
Jun
2211
Jul
2212
Aug
2213
Sep
2214
Oct
2215
Nov
2216
Dec
2217
2218
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted by Bartels Solar Rotation Number

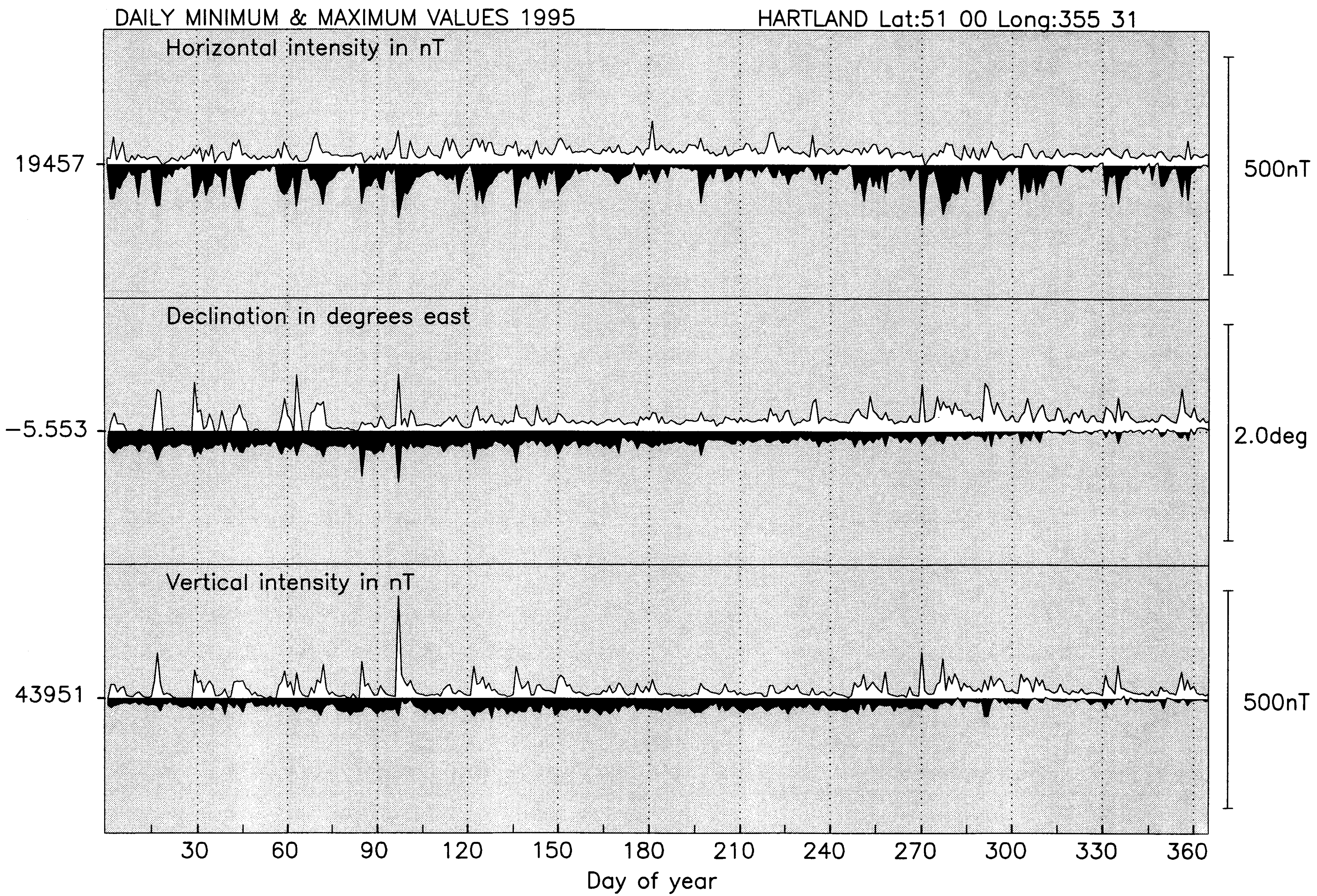


Hartland Observatory: Declination (degrees)
-5.40
-5.70
Rotn
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
Jan95
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted by Bartels Solar Rotation Number

Hartland Observatory: Vertical Intensity (nT)




DAILY MEAN VALUES 1995
HARTLAND Lat:51 00 Long:355 31
Horizontal intensity in nT
Declination in degrees east
Vertical intensity in nT
19457
-5.553
43951
100nT
0.5deg
100nT
30
60
90
120
150
180
210
240
270
300
330
360
Day of year


DAILY MINIMUM & MAXIMUM VALUES 1995
HARTLAND Lat:51 00 Long:355 31
Horizontal intensity in nT
Declination in degrees east
Vertical intensity in nT
19457
-5.553
43951
500nT
2.0deg
500nT
30
60
90
120
150
180
210
240
270
300
330
360
Day of year

Monthly Mean Values for Hartland 1995

Month	D °	D '	H nT	I °	I '	X nT	Y nT	Z nT	F nT
Based on all days									
Jan	-5	37.5	19449	66	7.7	19355	-1906	43947	48058
Feb	-5	36.8	19449	66	7.7	19356	-1902	43949	48060
Mar	-5	36.1	19451	66	7.6	19358	-1899	43948	48060
Apr	-5	35.1	19452	66	7.6	19360	-1893	43950	48062
May	-5	34.3	19457	66	7.2	19365	-1889	43949	48063
Jun	-5	33.8	19463	66	6.8	19371	-1887	43950	48067
Jul	-5	33.0	19467	66	6.5	19376	-1883	43948	48067
Aug	-5	32.0	19464	66	6.8	19373	-1877	43949	48066
Sep	-5	31.3	19458	66	7.2	19368	-1872	43951	48066
Oct	-5	29.9	19451	66	7.9	19362	-1864	43960	48071
Nov	-5	29.8	19462	66	7.1	19373	-1864	43958	48074
Dec	-5	29.2	19463	66	7.1	19374	-1861	43958	48074
Annual	**-5**	**33.2**	**19457**	**66**	**7.3**	**19366**	**-1883**	**43951**	**48065**
International quiet day means									
Jan	-5	37.9	19460	66	6.8	19366	-1910	43942	48058
Feb	-5	37.1	19459	66	7.0	19366	-1905	43945	48061
Mar	-5	36.6	19461	66	6.8	19368	-1902	43944	48060
Apr	-5	35.4	19458	66	7.1	19365	-1895	43947	48062
May	-5	34.6	19461	66	6.9	19369	-1891	43948	48064
Jun	-5	34.3	19468	66	6.4	19376	-1890	43947	48066
Jul	-5	33.4	19472	66	6.2	19380	-1885	43947	48068
Aug	-5	31.9	19465	66	6.7	19374	-1876	43949	48067
Sep	-5	31.6	19465	66	6.7	19375	-1875	43948	48066
Oct	-5	30.3	19463	66	7.0	19373	-1867	43956	48072
Nov	-5	29.9	19467	66	6.8	19377	-1865	43957	48075
Dec	-5	29.2	19467	66	6.8	19378	-1861	43956	48074
Annual	**-5**	**33.5**	**19464**	**66**	**6.8**	**19372**	**-1885**	**43949**	**48066**
International disturbed day means									
Jan	-5	36.4	19434	66	8.8	19341	-1899	43951	48056
Feb	-5	35.8	19442	66	8.3	19349	-1896	43951	48059
Mar	-5	35.5	19440	66	8.4	19347	-1894	43952	48059
Apr	-5	34.9	19434	66	9.0	19342	-1890	43959	48063
May	-5	34.9	19451	66	7.7	19359	-1892	43951	48063
Jun	-5	33.6	19459	66	7.2	19367	-1885	43952	48067
Jul	-5	32.6	19461	66	6.9	19370	-1880	43949	48065
Aug	-5	31.7	19462	66	6.9	19371	-1875	43949	48065
Sep	-5	30.6	19447	66	8.0	19357	-1867	43955	48065
Oct	-5	29.2	19443	66	8.5	19354	-1859	43962	48070
Nov	-5	29.7	19450	66	8.0	19361	-1863	43961	48072
Dec	-5	29.0	19452	66	7.9	19363	-1859	43963	48074
Annual	**-5**	**32.8**	**19448**	**66**	**8.0**	**19357**	**-1880**	**43955**	**48065**

Hartland Observatory K Indices 1995

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0011 1121	3332 3342	4334 2445	1010 2343	1101 1112	3333 3443	4222 2222	2111 1211	3111 1120	1001 0032	4432 4153	2211 3455
2	1223 2444	3333 3434	4343 3533	4534 3211	3433 4554	4422 3433	2111 2232	1111 2331	1110 1122	2122 4345	2444 3430	3222 3223
3	5333 2544	3323 3354	3111 1112	0110 0100	5434 3444	3443 3343	3212 3223	2231 2221	2111 1112	4322 3444	1221 1120	1112 2243
4	3333 3232	5332 3433	2222 3456	1010 1112	4432 4344	2111 2321	3210 2321	1111 1123	0121 2113	4336 5555	0121 3421	4323 1222
5	3234 3454	2111 1201	5223 2343	3123 2233	3435 5544	2211 1322	1111 1111	1212 2322	3223 4455	3334 4325	4213 4435	2101 1123
6	2223 3335	3211 2313	1310 1100	3110 1123	5344 3333	3121 3222	1010 1111	1111 1122	5233 3323	2334 3544	4333 4343	0011 1222
7	3222 3232	4321 1225	0111 1111	4544 6676	2333 4344	3101 2222	1311 1211	1102 3233	3323 3442	5433 3333	3222 1133	1111 2211
8	3211 2221	4553 3212	1110 1011	3433 4443	4322 4333	1111 1111	1111 2211	5432 2253	3554 4442	3333 3552	2222 1222	1111 1011
9	2131 2213	1211 1110	1231 2254	4443 3323	3222 2133	1111 1222	0111 2321	4222 3455	3433 3223	1343 3444	1111 1111	2312 2112
10	1111 2223	0000 0112	5322 2234	3444 4433	2111 1231	3422 2211	0110 1111	4442 2332	1112 2345	3341 1101	2211 1121	3221 1101
11	3323 4333	3343 3445	5331 3455	2332 2354	2111 2221	2321 1111	0111 0011	2222 1223	5432 3433	1332 2433	1111 1124	2201 1111
12	3110 1123	4323 3564	5432 2455	4322 3332	2111 3221	1111 1100	2101 1222	3112 2222	2212 2344	3443 4123	2221 2142	1110 1242
13	1232 2122	5434 5434	4333 4644	2211 1223	1212 3322	1110 1111	2221 1221	3322 2134	3334 2333	4112 2233	1111 2221	1101 0111
14	2111 1123	4323 4443	3323 3443	3111 1222	1221 1221	0111 2222	1111 1332	4443 3333	3211 1234	2122 1233	2111 1113	3211 1111
15	2111 1111	3222 2444	2233 2133	1101 1111	0110 2222	1211 2221	2211 2222	2322 3233	4433 3541	2111 2113	1111 0000	1111 3433
16	2214 3254	2111 1323	3332 3333	1111 1022	3444 5554	4312 3342	1111 4645	1331 2211	3223 3223	2111 2232	1001 1103	3431 3121
17	3333 2466	1122 2212	2211 2333	3211 1111	5443 3443	2111 1211	4332 4423	3222 3332	2211 2221	2331 1211	3121 1112	1122 2332
18	5543 3223	3222 2231	2111 1111	2112 2222	3212 3234	1243 3223	3222 3231	1111 2222	0011 1122	2214 3455	1111 1113	2101 1211
19	2101 2110	1222 1223	2110 1122	2121 1122	2232 2232	3334 5343	2221 1123	3131 2333	1111 1122	6432 2123	2221 1124	3211 2221
20	1011 1142	2211 1111	1011 1211	2221 2222	3323 2343	2432 3422	3213 2311	2121 2211	2221 3223	2535 3542	2021 1002	0101 2211
21	2111 1243	2111 1113	1110 0011	1101 1111	2111 1111	3222 2322	1112 1221	1111 1110	2211 2222	2222 3334	2101 1111	1011 1344
22	2111 3223	1111 1110	0111 1111	1112 3443	1211 2113	2211 3222	1211 2321	1111 3345	1111 1121	3221 2253	2211 1313	2221 3464
23	3311 1112	1021 1111	1013 2331	3232 3335	2111 2455	1222 2311	3111 2322	3332 1111	3312 3243	3433 2242	3111 1112	3212 2121
24	1111 1110	1011 1121	2121 1211	4432 2443	3434 3423	1111 1221	3443 4343	2111 2223	3312 1211	3111 3432	1010 1110	3244 5434
25	1221 1111	0011 0101	2101 1112	5422 2331	3321 3331	0211 4443	3311 1111	3433 2323	1111 1211	2210 1100	1101 1112	3222 2333
26	1101 1101	2242 2343	2124 4534	3322 2435	2222 4343	4332 2333	2221 1222	2221 2112	1111 1221	0001 1113	2211 1100	2432 3243
27	1011 2110	2323 4353	3233 3334	4354 4431	1212 1221	2221 1222	1321 1232	3221 1233	2223 3465	2111 2313	1135 3344	3211 2222
28	0111 1111	4434 2365	4331 3432	2223 3311	2112 2212	1112 3334	3111 1122	0111 1221	1243 2111	1100 1011	2222 1343	1111 1211
29	2422 4446		3433 3333	2211 3222	1111 3332	1111 2321	3211 1211	3312 2222	1102 1211	1111 1001	3332 2421	1011 1123
30	5334 3555		3211 2211	1111 1123	3435 5353	3223 4455	2111 1223	2211 1111	1112 1113	1011 3433	3333 2111	2111 1111
31	5332 3354		2123 2222		4333 4453		2211 1223	1100 1111		5322 2344		1131 2221

DAILY aa INDICES

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	10	27	51	18	6	40	20	8	8	6	42	41
2	34	39	42	29	62	34	12	11	7	36	33	23
3	53	39	10	5	63	39	16	13	8	43	12	19
4	29	43	39	6	51	11	14	8	11	75	22	26
5	42	8	30	18	75	12	7	12	48	44	36	10
6	29	19	8	10	51	14	6	6	34	42	38	11
7	21	23	5	110	45	12	9	13	34	43	20	9
8	13	35	6	48	33	7	8	32	54	43	15	6
9	14	7	27	37	19	8	10	37	26	39	8	17
10	15	5	25	50	12	18	6	28	27	15	10	11
11	33	39	41	36	11	9	4	14	45	25	15	8
12	11	49	48	28	12	5	7	13	23	34	20	14
13	16	55	53	12	17	6	10	20	32	20	9	5
14	10	35	31	10	11	11	11	39	18	14	10	11
15	9	30	22	5	8	11	12	23	41	11	7	26
16	30	13	23	7	68	25	50	18	22	15	11	33
17	56	14	17	9	49	8	36	25	12	16	15	21
18	39	18	8	13	22	26	23	12	8	51	12	9
19	9	13	9	11	21	50	18	19	8	41	15	14
20	15	9	10	14	28	32	15	12	20	55	9	11
21	16	9	4	5	8	21	9	7	13	27	7	20
22	16	6	5	22	12	15	12	25	8	25	15	37
23	13	10	15	35	34	15	14	18	27	29	8	15
24	8	7	12	41	44	9	44	14	15	20	6	54
25	10	5	9	29	26	27	12	27	10	7	7	24
26	9	26	49	30	27	26	11	13	10	9	6	29
27	7	43	40	42	12	12	14	15	56	13	46	13
28	7	62	35	23	12	19	10	8	21	5	23	10
29	54		32	14	15	11	13	22	7	8	24	10
30	57		14	8	58	40	12	8	12	25	16	9
31	44		15		47		13	5		32		15
Monthly Mean Value	23.4	24.4	23.8	24.2	30.9	19.0	14.9	17.0	22.2	27.9	17.1	18.1

Annual mean value for 1995 = 21.9

SIs and SSCs

Day	Month	UT		Type	Quality	H(nT)	D(min)	Z(nT)
1	1	19	39	SI*	B	11	-0.5	3
29	1	01	02	SSC*	C	8		
12	2	15	35	SSC*	C	15	-0.5	6
26	2	08	27	SI*	B	12	-4.1	-5
14	3	07	45	SI*	C	11	1.4	6
23	3	10	36	SSC*	B	16	-1.7	-7
1	4	17	20	SSC	C	-34	2.0	-6
18	4	11	09	SSC*	B	13	-1.2	4
1	5	21	57	SSC*	B	8	-0.2	3
2	5	05	00	SSC	C	8	3.0	9
2	5	12	56	SSC*	C	-21	-1.1	-8
13	5	14	55	SSC	C	10	-0.7	
3	7	21	15	SSC	C	-21	1.3	6
4	7	15	09	SI	C	-13	-0.7	-4
16	7	08	33	SSC	C	-5	0.8	-3
24	7	02	54	SSC	A	30	-2.6	-6
9	8	10	23	SI*	C	-8	2.0	
9	8	12	30	SSC	B	18	-1.2	
17	8	02	55	SSC*	B	11	-1.9	-4
22	8	13	07	SSC*	A	36	-1.3	+7/-7
18	10	11	22	SSC*	B	20	1.8	-3
30	10	10	09	SSC*	C	-3	0.7	
10	11	07	51	SI*	C	5	1.5	4
27	11	08	27	SSC	C	6	-0.5	-3
15	12	15	15	SSC*	B	-13	-0.8	-5
24	12	06	00	SSC*	A	15	-4.9	-10
24	12	08	48	SI*	B	-44	-2.2	-20

Notes

A * indicates that the principal impulse was preceded by a smaller reversed impulse.
The quality of the event is classified as follows :

A = very distinct
B = fair, ordinary, but unmistakable
C = doubtful

The amplitudes given are for the first chief movement of the event.

SFEs

Day	Month	Universal Time Start		Maximum		End		H(nT)	D(min)	Z(nT)
21	5	13	36	13	42	13	52	6	-1.2	

Notes

The amplitudes given are for the first chief movement of the event.

Annual Values of Geomagnetic Elements

Abinger

Year	D	H	I	X	Y	Z	F
1925.5	-13 22.7	18597	66 35.2	18092	-4303	42946	46800
1926.5	-13 10.4	18581	66 36.3	18092	-4234	42947	46794
1927.5	-12 58.4	18575	66 36.2	18101	-4170	42932	46778
1928.5	-12 47.0	18564	66 37.2	18104	-4108	42941	46782
1929.5	-12 35.8	18555	66 37.2	18108	-4047	42918	46758
1930.5	-12 24.6	18542	66 38.2	18109	-3985	42924	46757
1931.5	-12 13.7	18543	66 38.1	18122	-3928	42923	46757
1932.5	-12 2.6	18536	66 39.1	18128	-3868	42940	46770
1933.5	-11 51.7	18532	66 39.4	18136	-3809	42942	46770
1934.5	-11 41.1	18533	66 39.7	18149	-3754	42955	46782
1935.5	-11 30.3	18527	66 40.9	18155	-3695	42981	46805
1936.5	-11 20.0	18524	66 41.8	18163	-3640	43007	46827
1937.5	-11 10.4	18522	66 42.7	18171	-3589	43031	46848
1938.5	-11 1.4	18522	66 43.2	18180	-3542	43050	46865
1939.5	-10 51.9	18528	66 43.5	18196	-3492	43074	46890
1940.5	-10 43.0	18533	66 43.9	18210	-3446	43099	46915
1941.5	-10 33.8	18539	66 44.3	18225	-3399	43128	46944
1942.5	-10 24.8	18554	66 43.9	18248	-3354	43146	46966
1943.5	-10 16.2	18556	66 44.5	18259	-3308	43172	46991
1944.5	-10 7.8	18566	66 44.3	18277	-3265	43189	47010
1945.5	-9 59.5	18573	66 44.3	18291	-3223	43207	47030
1946.5	-9 51.1	18569	66 45.4	18295	-3177	43235	47054
1947.5	-9 43.1	18577	66 45.2	18310	-3136	43246	47067
1948.5	-9 35.4	18593	66 44.4	18333	-3098	43255	47082
1949.5	-9 27.5	18607	66 44.0	18354	-3058	43273	47104
1950.5	-9 19.7	18628	66 43.0	18382	-3019	43288	47126
1951.5	-9 12.2	18648	66 42.1	18408	-2983	43305	47149
1952.5	-9 4.7	18670	66 41.0	18436	-2946	43316	47168
1953.5	-8 57.5	18695	66 39.5	18467	-2911	43321	47183
1954.5	-8 50.9	18720	66 38.1	18497	-2879	43332	47203
1955.5	-8 43.6	18738	66 37.4	18521	-2843	43348	47225
1956.5	-8 36.8	18750	66 37.4	18539	-2808	43376	47255
1957.1	-8 32.9	18755	66 37.6	18547	-2788	43394	47274

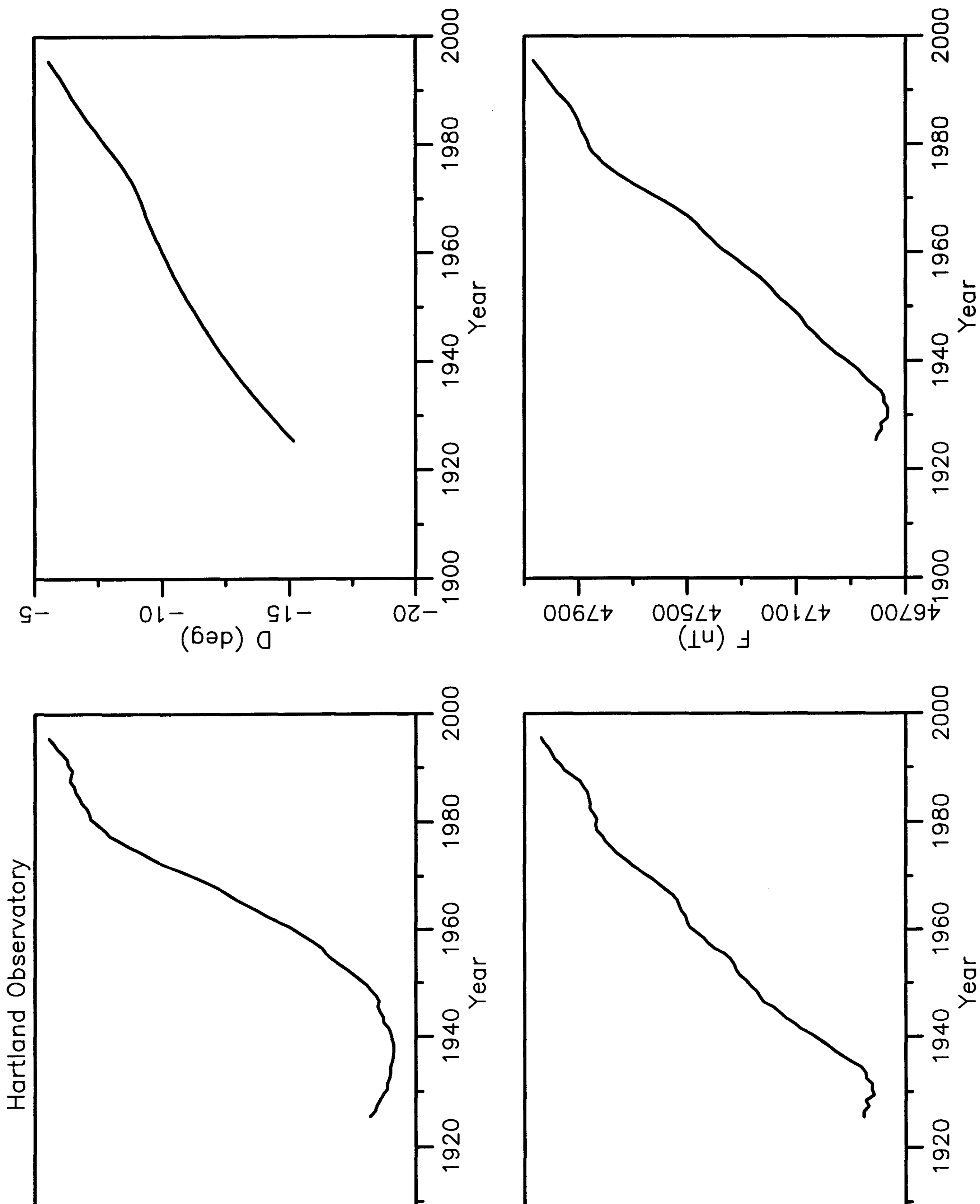
Hartland

Note 1		-1 -46.6	-146	0 11.4	-247	-542	56	-6
	1957.5	-10 17.2	18627	66 47.7	18328	-3326	43451	47275
	1958.5	-10 11.0	18655	66 46.3	18361	-3298	43465	47299
	1959.5	-10 5.0	18681	66 45.1	18392	-3271	43484	47327
	1960.5	-9 58.8	18707	66 43.9	18424	-3242	43504	47356
	1961.5	-9 53.0	18744	66 41.7	18466	-3217	43512	47378
	1962.5	-9 46.9	18779	66 39.5	18506	-3190	43517	47396
	1963.5	-9 40.6	18807	66 37.9	18539	-3161	43528	47417
	1964.5	-9 35.2	18840	66 36.0	18577	-3138	43535	47437
	1965.5	-9 30.1	18872	66 34.0	18613	-3115	43540	47454
	1966.5	-9 25.1	18897	66 32.7	18642	-3092	43554	47477
	1967.5	-9 20.3	18923	66 31.5	18672	-3071	43573	47505
	1968.5	-9 15.5	18956	66 29.9	18709	-3050	43592	47535
	1969.5	-9 11.1	18994	66 27.9	18750	-3032	43611	47568
	1970.5	-9 6.5	19033	66 26.1	18793	-3013	43636	47606
	1971.5	-9 1.1	19075	66 23.8	18839	-2990	43655	47640
	1972.5	-8 55.3	19110	66 22.1	18879	-2964	43676	47674
	1973.5	-8 48.2	19144	66 20.5	18918	-2930	43697	47707
	1974.5	-8 40.4	19175	66 19.1	18956	-2892	43719	47739
	1975.5	-8 32.3	19212	66 17.0	18999	-2852	43733	47767
	1976.5	-8 23.1	19240	66 15.7	19034	-2806	43749	47793
	1977.5	-8 13.7	19271	66 13.9	19073	-2758	43758	47813
	1978.5	-8 03.6	19286	66 13.3	19095	-2704	43773	47833
	1979.5	-7 53.5	19309	66 12.0	19127	-2651	43778	47847
Note 2		0 0.0	0	0 -0.2	0	0	-6	-5
	1980.5	-7 43.8	19330	66 10.3	19154	-2600	43768	47846

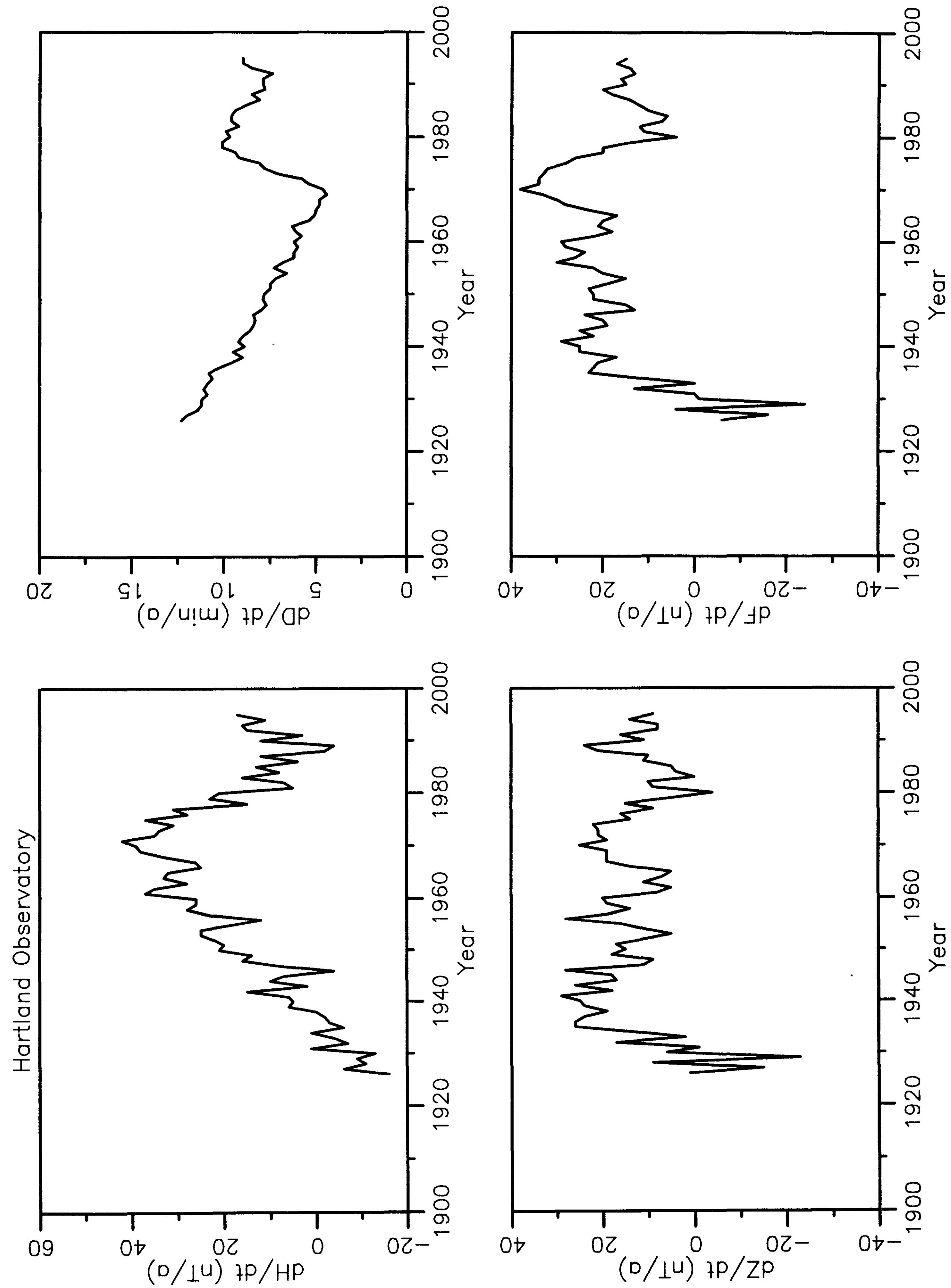
	Year	D		H	I		X	Y	Z	F
	1981.5	-7	33.9	19335	66	10.2	19167	-2546	43777	47857
	1982.5	-7	24.7	19342	66	10.1	19180	-2495	43787	47869
	1983.5	-7	15.1	19358	66	9.0	19203	-2443	43787	47876
	1984.5	-7	5.5	19366	66	8.6	19218	-2391	43791	47882
	1985.5	-6	56.1	19379	66	7.9	19237	-2340	43796	47892
	1986.5	-6	47.3	19383	66	8.0	19247	-2291	43807	47904
	1987.5	-6	39.2	19395	66	7.4	19264	-2247	43817	47918
	1988.5	-6	30.7	19393	66	8.2	19267	-2199	43838	47936
	1989.5	-6	22.9	19389	66	9.1	19269	-2155	43862	47956
Note 3		0	0.0	-6	0	1.1	-6	1	23	19
	1990.5	-6	15.0	19395	66	9.7	19280	-2111	43896	47990
	1991.5	-6	7.1	19398	66	10.0	19288	-2067	43912	48006
	1992.5	-5	59.7	19413	66	9.3	19307	-2028	43920	48019
	1993.5	-5	51.2	19429	66	8.4	19328	-1981	43928	48033
	1994.5	-5	42.2	19440	66	8.1	19344	-1932	43942	48050
	1995.5	-5	33.2	19457	66	7.3	19366	-1883	43951	48065

1 Site differences 1 Jan 1957 (Hartland value - Abinger value)
2 Site differences 1 Jan 1980 (new value - old value)
3 Site differences 1 Jan 1990 (new value - old value)

D and I are given in degrees and decimal minutes
All other elements are in nanoteslas



Annual mean values of H, D, Z, & F at Hartland



Rate of change of annual mean values of H, D, Z, & F at Hartland

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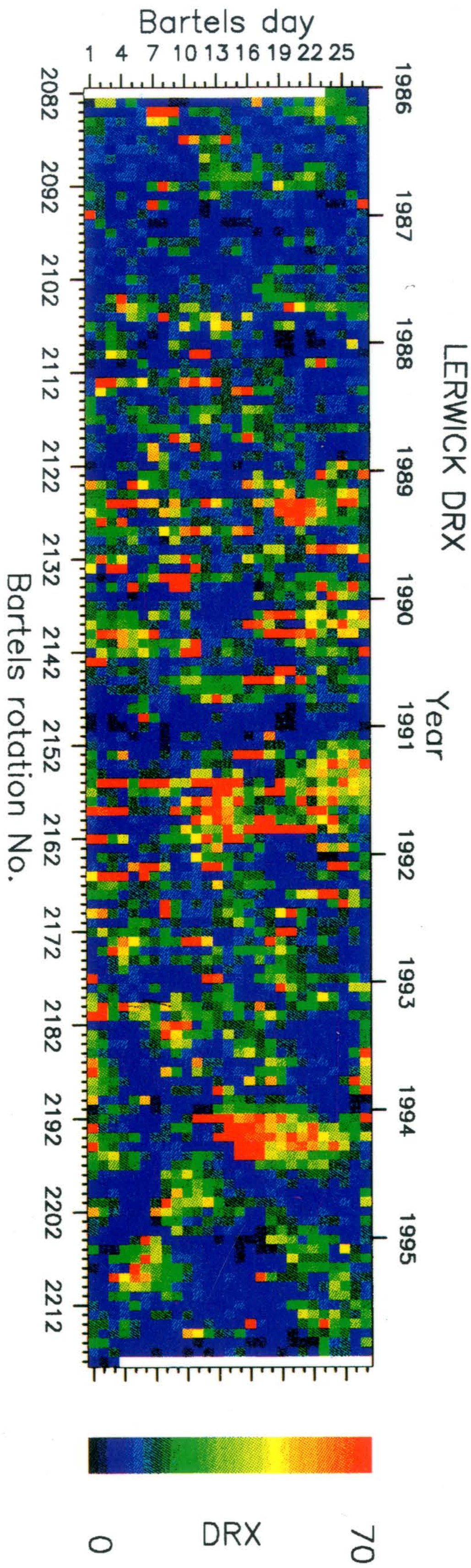
Cover photos

Front
The coast at Hartland Point

Back
The daily geomagnetic index DRX from Lerwick Observatory plotted by Bartels rotation for the years 1986–95



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GEOMAGNETIC BULLETINS

1 Hartland Observatory magnetic results 1965, 1966 and 1967

2 Magnetic results 1968 Eskdalemuir, Hartland and Lerwick observatories

3 Magnetic results 1969 Eskdalemuir, Hartland and Lerwick observatories

4 Magnetic results 1970 Eskdalemuir, Hartland and Lerwick observatories

5 Magnetic results 1971 Eskdalemuir, Hartland and Lerwick observatories

6 Annual mean values of the geomagnetic elements since 1941

7 Magnetic results 1972 Eskdalemuir, Hartland and Lerwick observatories

8 Spherical harmonic models of the geomagnetic field

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10 Annual mean values of the geomagnetic elements

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25 Magnetic results 1995 Lerwick Eskdalemuir and Hartland observatories

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