BRITISH GEOLOGICAL SURVEY

GEOMAGNETIC BULLETIN 30

Magnetic Results 2000

LERWICK, ESKDALEMUIR AND HARTLAND OBSERVATORIES
AND UK REPEAT STATIONS

British
Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Magnetic Results 2000 : Lerwick, Eskdalemuir and Hartland Observatories and UK Repeat Stations

Compilers
E Clarke, C W Turbitt,
S Macmillan and J G Carrigan

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1. Introduction

This bulletin is a report of the measurements made between the 1st January and the 31st December 2000 at the UK geomagnetic observatories operated by the British Geological Survey (BGS) at Lerwick, Eskdalemuir and Hartland and at the repeat stations occupied during the year.

The three observatory sites are described, with notes of any changes made during the year. The Geomagnetic Automatic Unmanned Sampling System (GAUSS), which was developed by BGS staff (Turbitt *et al.*, 1999), was first installed in 1996 and became the definitive operating system for the three UK observatories from the 1st January 1997. A description of the GAUSS instruments is given and 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.

A brief description of the repeat station network is also given and the results of the observations made during 2000 are presented.

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).

A general introduction and guide to the operation of magnetic observatories is the International Association of Geomagnetism and Aeronomy (IAGA) guide by Jankowski and Sucksdorff (1996).

2. Descriptions of the Observatories

The locations of the UK geomagnetic observatories are shown on the map in Figure 1 and the co-ordinates of each are given in the table below.

Observatory		**Lerwick**	**Eskdalemuir**	**Hartland**
Geographic	**Latitude**	60° 08' N	55° 19' N	51° 00' N
	Longitude	358° 49' E	356° 48' E	355° 31' E
Geomagnetic	**Latitude**	62° 01' N	57° 52' N	53° 58' N
	Longitude	89° 08' E	83° 50' E	80° 13' E
Height above mean sea level		85 m	245 m	95 m

Geomagnetic co-ordinates given are relative to a geomagnetic pole position of 79° 33' N, 71° 34' W, computed from the tenth generation International Geomagnetic Reference Field (Macmillan and Maus, 2005) at epoch 2000.5.

The history of the current UK magnetic observatories, and of other observatories that have operated in the British Isles, is described by Robinson (1982).

2.1 LERWICK (SHETLAND ISLANDS, SCOTLAND)

Lerwick Observatory is situated on a ridge of high ground about 2.5 km to the south-west of the port of Lerwick. The surrounding countryside is moor land comprising peat bog, heather and rocky outcrops. 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 also 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. No members of BGS staff are stationed at Lerwick.

Figure 2 is a site diagram of Lerwick Observatory. During 2000, no major changes were made to the observatory instruments. There were intermittent communication problems. One reason was due to faults with the Terminal Adapter (TA) for the ISDN connection. This was replaced in December but further communication problems occurred. Other routine maintenance was carried out on the observatory buildings and grounds.

2.2 ESKDALEMUIR (DUMFRIES & GALLOWAY, SCOTLAND)

Eskdalemuir Observatory is situated in the Southern Uplands of Scotland. It is on a rising shoulder of open moor land in the upper part of the valley of the river White Esk. It is surrounded by young conifer forests with hills rising to nearly 700 m to the north-west. The observatory is 100 km from Edinburgh and 25 km 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 maintenance of the observatory buildings and grounds during 2000.

Figure 3 is a site diagram of Eskdalemuir Observatory. In January the GAUSS electronics were upgraded and in December the GAUSS PC was upgraded. There was a failure of the ADC in April, which was replaced. Other routine maintenance was carried out on the observatory buildings and grounds throughout the year.

2.3 HARTLAND (DEVON, ENGLAND)

Hartland Observatory is situated on the north-west 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 two 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 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 in 2000 was Mr C R Pringle.

Figure 4 is a site diagram of Hartland Observatory. During 2000, no major changes were made to the observatory instruments. In June the GPS clock failed and was replaced. It was replaced again along with the GPS receiver following another failure in December. Observatory maintenance included essential work on and testing of the mains electricity supply in November and the installation of an electrified fence in February to try to deter cattle in the adjacent field coming close to the huts. This was later removed again and the cattle were taken out of field instead. Other routine maintenance was carried out on the observatory buildings and grounds throughout the year.

2.4 UK REPEAT STATION NETWORK

Geomagnetic measurements are made at a network of 51 repeat stations throughout the UK. The locations of these are shown as circles on the map in Figure 1, which for the sites occupied during 2000 are filled in black. Absolute measurements of *D*, *I* and *F* are performed at each repeat station every 4 to 6 years so that temporal and spatial changes to the magnetic field in the UK can be evaluated. Data from the repeat station network are supplemented with data from Lerwick, Eskdalemuir and Hartland and magnetic observations made in Ireland and France, and are used to compute a model of the geomagnetic field for the region of Great Britain. This model represents the field arising from sources in the Earth's core and does not include the effects of near-surface crustal sources and the time-varying sources external to the Earth's surface.

3. Instrumentation

3.1 OBSERVATORY ABSOLUTE OBSERVATIONS

At each observatory absolute measurements are made in a single absolute hut (see the site diagrams). Since 1st 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 Magnetometer** (from GAUSS)
Lerwick	ELSEC 810 (LER32)	Overhauser Effect Proton precession magnetometer (GEOMAG, SM90R)
Eskdalemuir	Bartington MAG 01H (ESK43)	Overhauser Effect Proton precession magnetometer (GEOMAG, SM90R)
Hartland	ELSEC 810 (HAD16)	Overhauser Effect Proton precession magnetometer (GEOMAG, SM90R)

In an ideal fluxgate-theodolite, the magnetic axis of the sensor core would be parallel to the optical axis of the telescope. However, this situation is impossible to achieve and small alignment errors called collimation errors are the result. These are systematic errors associated with each individual instrument and should remain roughly constant. With the telescope horizontal, δ is the collimation error about the vertical axis and ε is the collimation error about the horizontal axis, both expressed as angles. A third error, measured in nT, is the zero-field offset. This represents the output if the instrument was placed in a zero field and is due to permanent magnetisation of the core or to features of the electronics. The collimation and zero-field offset values calculated throughout the year are plotted to check that they remain reasonably constant. Departures from a long-term mean value may be caused by mechanical or electronic changes to the fluxgate-theodolite or by errors in recording the measurements. A full description of the fluxgate-theodolite is given in Kerridge (1988).

3.2 PRIMARY OBSERVATORY OPERATING SYSTEM - GAUSS

The essential components of GAUSS are: a triaxial linear-core fluxgate magnetometer (Model FGE-89) manufactured by the Danish Meteorological Institute (DMI); an Overhauser Effect proton precession magnetometer (GEOMAG, SM90R), with its sensor mounted at the centre of a set of dual axis Helmholtz coils; and a Global Positioning Satellite (GPS) receiver (Garmin GPS36). These instruments all operate under the control of two IBM compatible Personal Computers (PC1 and PC2). A block diagram of the GAUSS system is given in Figure 5.

Each GAUSS system is supported by a 500 VA Merlin-Gerin SX500 Uninterruptible Power Supply (UPS); this equipment has internal batteries capable of powering the system for one hour in the event of a mains failure. Each observatory also has a stand-by diesel generator designed to start automatically, within one minute of loss of mains power. In normal operation the UPS is only required to maintain mains power to the GAUSS system until the generator takes over.

3.2.1 Fluxgate variometer measurements

The fluxgate sensors are orientated to measure the variations in the horizontal (*H*) and vertical (*Z*) components of the magnetic field. The third is orientated perpendicular to these and measures variations that are proportional to the changes in declination (*D*). The fluxgate magnetometers, operating as variometers, provide an analogue output of ±10 Volts, which corresponds to a magnetic field change of ±5000 nT. Mounted orthogonally to one another, the sensors are in a single 20 cm cube marble block, which is located on a pier in a temperature-controlled variometer chamber. At Eskdalemuir this marble block is supported in a gimballed mounting, which provides magnetometer tilt correction. This automatic compensation is not carried out at Lerwick or Hartland. The temperature in the variometer chamber is controlled by a separate temperature sensor, which activates heaters when required. A full description of the DMI fluxgate magnetometers is given in a DMI technical report (1997).

The rate at which the outputs from the three fluxgate sensors are sampled is one per second. These one-second values are then passed through a 61-point cosine filter to generate one-minute values of *H*, *D* and *Z* variations centred on the beginning of the minute.

3.2.2 PVM variometer measurements

The proton vector magnetometer (PVM) apparatus has been designed to measure absolute values of total intensity (*F*) as well as variations in *D* and Inclination (*I*). The apparatus used to make PVM measurements consists of a proton precession magnetometer (PPM) sensor mounted at the centre of two orthogonal sets of Helmholtz coils in a delta *D*/delta *I* (δ*D*/δ*I*) configuration. Currents are passed through the coils creating bias fields, the magnitude of which are measured in combination with the Earth's magnetic field. The coils are orientated initially so that one set provides a bias field approximately perpendicular to the geomagnetic field vector in the horizontal plane (δ*D*), and the other provides a bias field approximately perpendicular to the geomagnetic field vector in the magnetic meridian (δ*I*). If the resultant magnetic field is measured after applying the bias fields then vector algebra can be used to calculate the change in declination (δ*D*) and the change in inclination (δ*I*). These changes are relative to baseline 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 PVM measurements with absolute observations. This technique is described in full by Alldredge (1960).

The proton magnetometer and associated coils are sited in a non-magnetic hut, which is within 50 m of the GAUSS control electronics. A magnetic field measurement is made every eight seconds, following a sampling sequence of:

i. without a bias field (F_1);
ii. with a current flowing in the δ*I* coils to create a bias field positive in the direction of *I* (*I*+);
iii. with a current flowing in the opposite direction from that of *ii*. (*I*–);
iv. without a bias field (F_2);
v. with a current flowing in the δ*D* coils to create a bias field positive in the direction of *D* (*D*+);
vi. with a current flowing in the opposite direction from that of *v*. (*D*–); and
vii. without a bias field (F_3).

The complete cycle of measurements takes 56 seconds. Using the results from the vector measurements quasi-absolute one-minute values of *D* and *I* are derived as well as absolute one-minute mean values of *F*.

Full PVM absolute observations would require a sequence of measurements to be made with the coils rotated into positions enabling errors due to imperfect alignment of the magnetic axes to be eliminated. The Helmholtz coils used at the UK observatories 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 should be (practically) constant. Comparisons of PVM results with measurements made by the fluxgate magnetometers have shown that this is not the case. Drifting can be observed in the PVM values, which means that they have not been used as a means for interpolating between absolute observations as originally designed. Instead, these measurements have been useful as an extra quality control check for the individual absolute observations and, if used over short term periods only, as an extra back-up system for the one-minute variometer data.

3.2.3 Data collection, control and communications

In routine operations the analogue outputs from the three channels of the fluxgate magnetometer and the two temperature sensors are sampled every second by a 20-bit analogue to digital converter (ADC). The temperature sensors measure the temperature in the variometer chamber and the hut housing the PVM apparatus. The control of this operation along with switching bias currents to the Helmholtz coils and sampling of the proton magnetometer is done by the embedded PC2. This PC has its operating system and all control and data collection software stored in erasable programmable read only memory (EPROM). Its operation is dedicated to sampling the fluxgate and proton magnetometers and transferring these data through serial communications to PC1, which computes the one-minute values, handles the data storage and provides operating status codes.

In designing GAUSS one of the main constraints was that all data input and sensor control functions should be carried out through standard serial or parallel PC ports (COM1, COM2 or LPT1). No specialised interface cards have been used in its design. This feature will allow, in the event of a system failure, the replacement of either PC1 or PC2 with any IBM compatible PC fitted with the correct number of standard ports.

PC1 controls all data collection, filtering and error checking operations along with the transmission of data from the observatory back to Edinburgh for analysis, dissemination to users and archiving. All system timing operations are controlled by the PC1 software clock, which is synchronised to GPS time using the information received through the Garmin GPS receiver. Time information is received and decoded every second by the GPS receiver and relayed serially through the COM2 port on PC1 to update or correct the PC1 processor clock. This timing information is also relayed serially, from PC1 to PC2, and used to control all data collection operations. Using this method of time synchronisation the sample timing and time stamping of the recorded data is maintained to an accuracy of ±100 ms.

The data are stored in files on the disk drive on PC1. Each file contains one day of time-stamped one-minute values of *H*, *D* and *Z* variations from the fluxgate magnetometer, two sets of temperature measurements and five PVM measurements in the sequence *I*+, *I*-, *D*+, *D*- and *F*. These files are maintained for 40 days on PC1, after which they are overwritten.

Communication between Murchison House in Edinburgh and GAUSS at Lerwick and Hartland Observatories is provided by Integrated Services Digital Network (ISDN) connections on GAUSS and the data collection PC in Murchison House. The data from these two observatories are transferred every 4 minutes. A Local Area Network (LAN) is operational at Eskdalemuir, providing direct INTERNET access to the observatory from Murchison House . A Hitchhiker network device provides a link between GAUSS and the data collection PC in Murchison House and the data are transferred every 2 minutes. Normally, data retrieval is automatic, but facilities have been included to allow manual operator control of several functions. These permit the operator to extract any current data which have not been retrieved by an automatic call-up, retrieve historical data (up to 40 days old), replace GAUSS operating software or make adjustments to system configuration parameters (e.g. adjust fluxgate/ADC scaling factors).

3.2.4 Technical specifications summary

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

DMI fluxgate magnetometer	
Sensitivity	0.2 nT
Dynamic Range	±5000 nT (LER), ±4000 nT (ESK and HAD)
Temperature coefficient	< 0.25 nT/°C
GEOMAG SM90R Overhauser effect proton magnetometer	
Resolution	0.01 nT
Accuracy	±0.1 nT
Measurement Range	10,000 - 90,000 Nt
Garmin GPS receiver	
Output code	NMEA standard coded messages
Output data rate	4800 baud
Output update rate	Once/second
Analogue to digital converter	
Type	2 x Crystal CS5506
Resolution	20 bit (2^{20})
Number of channels	8
50Hz noise rejection	105 dB
Sampling rate	1 Hz (maximum 100/sec)
Scaling factor	approx. 52000 counts/volt (This depends on the calibration values of the fluxgate)
System clock	
PC1 Real Time Clock	without GPS corrections >1 second/day with GPS corrections applied every second within ±100 ms of GPS time.

3.3 BACK-UP OBSERVATORY OPERATING SYSTEMS – FLARE *PLUS*

The back-up systems provide completely independent back-up data in the event of a total GAUSS failure. They are the Fluxgate Logging Automatic Recording Equipment incorporating a proton magnetometer (FLARE *Plus*), which was developed by BGS. The FLARE *Plus* system is based on a PC, which controls the data logging and communications. The measurements are made using two types of magnetometers: a triaxial linear-core fluxgate magnetometer (model FGE-89) manufactured by the DMI; and an Overhauser PPM (GEOMAG, SM90R). Two of the fluxgate sensors are orientated to measure the variations in *H* and *Z* and the third is orientated perpendicular to these and measures variations that are proportional to the changes in *D*. Measurements are made every 5 seconds and are filtered using a 19-point Gaussian filter to produce one-minute values centred exactly on the minute. The PPM is used to make measurements of *F* every minute, also on the minute. As with GAUSS, accurate timing of the data is maintained using a GPS receiver. The one-minute values are stored both in memory (up to 2 days) and on 3½" floppy disk (up to 40 days). The FLARE *Plus* system is described in more detail by Turbitt *et al* (1997) and a block diagram of the system is shown in Figure 6.

FLARE *Plus* data are retrieved to the BGS office in Edinburgh using a Multitech modem operating at speeds of up to 9600 baud with the data relayed through the public switched telephone network (PSTN). This is normally carried out at four selected times by the automatic data collection processor in Edinburgh, but as with GAUSS, facilities have been included to allow manual operator control of several functions, including immediate data retrieval in the event of the loss of GAUSS data.

3.4 REPEAT STATION SURVEY INSTRUMENTS

A series of absolute observations are carried out at each site using the instrumentation summarised below. Calibration checks of all survey instruments are carried out before and after each field session.

Repeat Station Instrumentation		
Instrument	**Function**	**Accuracy**
Wild GAK-1 north seeking gyro attachment for theodolite.	To acquire a horizontal circle reading for **true north** for measurement of *D*.	10 arc-seconds
Elsec 810 fluxgate magnetometer sensor mounted on Zeiss non-magnetic theodolite.	Detection of magnetic meridian in the horizontal plane for measurement of *D* and detection of magnetic field vector in the magnetic meridian for measurement of *I*.	~6 arc seconds
GEM GSM-19 Overhauser effect proton precession magnetometer.	Measurement of *F*.	0.2 nT

Absolute values of *F* are measured using an Overhauser effect PPM. The instrument logs one-minute samples at a location a few metres from the repeat station for the duration of the occupation. An accurate site difference between the station and the PPM site is obtained initially by running two PPMs concurrently for 5 minutes. An azimuth reading for true north is obtained from a gyro-theodolite combination mounted on a tripod. This process is fully described by Kerridge (1984b). The instrument is set up at the station inside a non-magnetic shelter for protection from the weather. Successive absolute observations of *D* and *I* are then made at least once an hour for 4–6 hours. These measurements are made using a fluxgate-theodolite. The procedure is described in detail in Kerridge (1984a). Accurate times for each reading and position are obtained from a portable Garmin GPS receiver.

3.5 CALIBRATION OF OBSERVATORY INSTRUMENTS

The physical measurements made by GAUSS are of the analogue voltage output from the fluxgate sensors and the precession frequency radiated by the polarised sample in the proton precession magnetometer. For calibration purposes these measurements can be split into three separate processes: calibration of the fluxgate magnetometer; calibration of the ADC module; and calibration of the proton magnetometer.

At all three observatories the same calibration procedures are followed and all the sensors and digitising equipment listed above are calibrated four times per year. All test equipment used in these calibrations is checked annually against National Physical Laboratory (NPL) standards. A file containing the relevant certificates for all observatory test equipment is maintained at BGS, Edinburgh. The equipment used in these calibrations is a high resolution digital voltmeter (DVM), a precision 1000Ω manganin-wound resistor and a frequency source stabilised using the 198 kHz radio reference.

The calibrations were carried out routinely in 2000 during service visits to the observatories by Edinburgh based BGS staff. Lerwick instruments were serviced in February, May, August and December, Eskdalemuir instruments were serviced in January, June and November, and Hartland instruments were serviced in March and November.

3.5.1 Calibration of the fluxgate magnetometers

The scale values of the fluxgate sensors are calibrated by the manufacturer at the DMI. A regular check of the scale value of each sensor is carried out by measuring the current through the 1000 Ω resistor connected in series with the feedback coil of each sensor and then using the coil constant, provided by the manufacturer, to calculate the scale value. The object of the calibration is to check any drift, or change in the manufacturer's supplied scale values.

3.5.2 Calibration of the ADC

This unit is calibrated by disconnecting the fluxgate and applying a +5 Volt, zero Volt and a –5 Volt DC signal from a stabilised voltage source to each input of the ADC, respectively. This input voltage is measured using the calibrated DVM and the resultant digital counts are displayed on the PC1 monitor. The ADC conversion factor in Volts per count can then be calculated.

3.5.3 Calibration of the proton magnetometer

The proton magnetometer measures the frequency of emitted radiation from a sample of proton-enriched fluid. This is related to the ambient magnetic field by the proton gyromagnetic ratio. The conversion from frequency to magnetic field value carried out by the proton magnetometer is checked by irradiating the sensor with a signal of various frequencies derived from a stable frequency source. The stable source used to provide these frequencies is a 198 kHz signal transmitted from Droitwich. The long-term accuracy of this signal, quoted by NPL, is 1 part in 10^9; the short-term accuracy is 1 part in 10^{11}. All proton magnetometers operating at the UK magnetic observatories are calibrated using this method over a range of field values from 20,000 nT to 80,000 nT at three monthly intervals.

4. Observatory data processing

Data are retrieved to Edinburgh from the observatories by a dedicated IBM PS/2 PC. It can either be programmed to call the observatories automatically at predetermined times or it can be used to manually retrieve the data when required. The data are then transferred via a standard serial link to a Sun Workstation where they are stored in day files in raw binary format. The raw data are also stored on the data retrieval PC for 45 days, after which time they are overwritten.

Data processing is carried out automatically on the Sun workstation shortly after midnight. The binary data files are first converted into ASCII, with the data sorted by Universal Time (UT). Subsequent data processing is carried out on these day files by a single FORTRAN program, which uses subroutines to generate various data products and derivatives. Several quality control routines are also carried out to identify possible errors. The overall control of the automatic data processing jobs are carried out by UNIX C-Shell scripts, which are executed by the UNIX clock daemon command, *cron*.

The data products generated automatically each day are:

HDZ fluxgate magnetograms;
HDZ PVM magnetograms;
Plots comparing *F*, *D, H* and *Z* measurements made from the three systems;
Formatted lists of one-minute values;
Hourly mean values of each geomagnetic component;
Hourly standard deviations in *X* and *Y*;
Hourly and daily ranges in each geomagnetic component;
Daily mean values;
K indices; and,
Forecasts of geomagnetic activity for up to 27 days ahead.

The final check on the quality of the data is the responsibility of the operator in Edinburgh who examines the magnetograms and comparison plots each day. Any erroneous values, undetected by the automatic quality control procedures, will be identified at this stage. If required, data from the back-up system or the PVM measurements can be used to replace any erroneous values or fill any gaps in the GAUSS fluxgate data, after which the main data processing procedure is repeated.

At all three observatories there were no periods during 2000 when the GAUSS and back-up variometers and the GAUSS PVM measurements all failed simultaneously. Consequently, the time-series of one-minute values are complete throughout the year.

The scientific and commercial demand for rapid access to UK observatory data has steadily increased over recent years, prompting the continued development of the automatic data processing procedures and quality control standards. Data products are transferred to academic and commercial users worldwide by electronic mail. Established in 1987, the Geomagnetism Information and Forecast Service (GIFS), still provides free, "user-friendly" access to the data sets, and is available on the world-wide web (*www.geomag.bgs.ac.uk/gifs/on_line_gifs.html*). The data sets on GIFS derived from UK observatory data are updated daily.

At the end of each month, a monthly bulletin is issued for each observatory to present the magnetic results obtained during the month and record the quality control procedures undertaken to maintain the standard of these results. The magnetic results included in these bulletins are: magnetograms; hourly and daily mean plots; monthly mean values; lists of rapid variations; *K* and *aa* indices; and the forecasts of magnetic and solar activity. The quality control records included are: the results of absolute observations and the associated collimation errors; PVM–fluxgate comparisons; plots of the baselines applied to the variometer measurements; and a diary giving details of any changes made during the month at the observatory. The baseline values allocated to the variometer data are reviewed each month and definitive monthly mean values are published 4 to 6 months in arrears.

At the end of each year the baseline values are finalised to give absolute values, the details of which are given in Section 5. The results obtained from these definitive absolute values are described in Section 6 of this text and presented in the final results section.

5. Correction of data to absolute values

The GAUSS fluxgate magnetometers only monitor accurately variations in the components of the geomagnetic field, they do not measure the absolute magnitudes of the components. Absolute measurements of the field are made typically once a week. As described in Section 3.1, *D* and *I* are determined using a fluxgate sensor mounted on a theodolite and *F* is measured using a proton precession magnetometer. The absolute observations are used in conjunction with the GAUSS variometer measurements to derive baselines and produce a continuous record of the absolute values of the geomagnetic field elements as if they had been measured at the observatory reference pillar.

The baselines allocated for each observatory for 2000 are shown in Figures 7-9. (The results for each observatory are discussed in more detail below.) The baselines are derived by comparing the fluxgate measurements with absolute measurements taken simultaneously. In each of the figures, the top panel shows the comparison between the absolute measurements and the fluxgate measurements for *H* (plotted in the sense absolute − fluxgate). The second panel shows the same for *D*, in which East is represented by positive values, and the next panel shows the same for *Z*. In these absolute − fluxgate comparison panels, the symbols represent the observed values and the full line shows the adopted baselines. The adopted baselines are derived from piecewise polynomial fits to the observed values computed using the method of least squares. In deriving the baselines the observations made towards the end of the previous year and at the start of the following year were used, but are not shown in the plots. This ensures that unrealistic discontinuities are not introduced at the year boundaries. Daily mean differences between the measured absolute *F* and the *F* computed from the baseline corrected *H* and *Z* values are plotted in the third panel from the bottom (plotted in the sense measured − derived). The bottom two panels show the daily mean temperature in the fluxgate chamber and the daily mean temperature in the hut housing the PVM apparatus, which closely follows changes in the outside temperature.

5.1 LERWICK

Absolute measurements were made weekly by Meteorological Office staff based in Lerwick and were supplemented by measurements made by Edinburgh based BGS staff during service visits to the observatory. These are plotted in Figure 7 as the observed baselines, that is, with the variometer values subtracted. The clusters of measurements made within a few days indicate the dates of service visits.

The following baseline steps were observed during the year.

Original Date of Step	Reason for Step	Revised Date (day) (i.e. from 00:00 UT)	*H* (nT)	*D* (′)	*Z* (nT)
03-02-00	Routine service	04-02-00 (035)		-0.55	
17-05-00	Realignment of fluxgate sensors during service	18-05-00 (139)	-13.2 *	1.70 *	87.8 *

* Steps reduced to –4.0nT, 1.0′ and 4.0nT for *H*, *D* and *Z* respectively to fit on the plotting panel of the allocated baselines in Figure 7.

The ranges of the allocated baselines during the year, not including the realignment of the fluxgate sensors, were 3.4 nT for *H*, 2.02 minutes of arc for *D* and 3.0 nT for *Z*.

The table below lists the root mean squared (*rms*) differences of the observed baseline corrections from the allocated values. The *rms* differences for 1998-99 are also listed. The number of observations made for each component is given in brackets.

Year	*H*(nT)	*D*(min)	*Z*(nT)
1998	0.59 (73)	0.21 (70)	0.39 (74)
1999	0.90 (56)	0.17 (61)	0.46 (59)
2000	0.76 (48)	0.15 (45)	0.30 (47)

5.2 ESKDALEMUIR

Absolute observation measurements were made by the resident BGS staff at the observatory and by staff of the Meteorological Office at Eskdalemuir. These were supplemented by measurements made by Edinburgh based BGS staff during visits to the observatory. These are plotted in Figure 8 as the observed baselines, that is, with the variometer values subtracted.

The following baseline steps were observed during the year.

Original Date of Step	Reason for Step	Revised Date (day) (i.e. from 00:00 UT)	*H* (nT)	*D* (′)	*Z* (nT)
25-01-00	Installation of new electronics on GAUSS and realignment of sensors	25-01-00 (25)	-26.1 *	39.50 *	155.2 *
29-06-00	Routine service	30-06-00 (169)	0.8	0.10	1.3
03-11-00	Unknown	04-11-00 (309)			-0.8

* Steps reduced to –4.0nT, 1.0′ and 4.0nT for *H*, *D* and *Z* respectively to fit on the plotting panel of the allocated baselines in Figure 8.

The ranges of the allocated baselines during the year, not including the realignment of the fluxgate sensors, were 3.5 nT for *H*, 0.61 minutes of arc for *D* and 2.6 nT for *Z*.

The table below lists the root mean squared (*rms*) differences of the observed baseline corrections from the allocated values. The *rms* differences for 1998-99 are also listed. The number of observations made of each component in each year is given in brackets.

Year	*H*(nT)	*D*(min)	*Z*(nT)
1998	0.91 (58)	0.39 (65)	0.78 (60)
1999	1.05 (86)	0.22 (92)	0.44 (86)
2000	0.65 (68)	0.24 (67)	0.40 (76)

5.3 HARTLAND

Absolute observation measurements were made weekly by the resident BGS staff at Hartland Observatory. These are plotted in Figure 9 as the observed baselines, i.e. with the variometer values subtracted.

The following baseline steps were observed during the year.

Original Date of Step	**Reason for Step**	**Revised Date (day)** (i.e. from 00:00 UT)	***H* (nT)**	***D* (′)**	***Z* (nT)**
08-03-00	Realignment of fluxgate sensors during service	08-03-00 -check	15.4 *	64.22 *	-8.7 *

* Steps reduced to 4.0nT, 1.0′ and –4.0nT for *H*, *D* and *Z* respectively to fit on the plotting panel of the allocated baselines in Figure 9.

The ranges of the allocated baselines during the year, not including the realignment of the fluxgate sensors, were 2.9 nT for *H*, 0.78 minutes of arc for *D* and 2.2 nT for *Z*.

The table below lists the *rms* differences of the observed zero-field corrections from the allocated values. The *rms* differences for 1998-99 are also listed. The number of observations of each element in each year is given in brackets.

Year	H(nT)	D(min)	Z(nT)
1998	0.52 (65)	0.09 (67)	0.38 (66)
1999	0.45 (96)	0.09 (93)	0.30 (96)
2000	0.44 (89)	0.09 (90)	0.35 (89)

6. Presentation of observatory results

The data are organised by observatory in the order Lerwick, Eskdalemuir and Hartland. The following sub-sections summarise the results presented for each observatory.

6.1 ONE-MINUTE VALUES

The GAUSS one-minute values of *H*, *D* and *Z* are centred at the beginning of the minute. These are plotted in daily magnetograms of *H*, *D* and *Z*. They are organised as 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*, which have been set to equal the relevant monthly mean values. 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.

6.2 HOURLY MEAN VALUES

Hourly mean values, centred on the UT half-hour, are computed from the one-minute values. They are not computed if there are more than six one-minute values missing. 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 eastward in D is discernible in the plots.

6.3 DAILY MEAN, MINIMUM AND MAXIMUM VALUES

Daily mean values and the daily maximum and minimum values are calculated from the one-minute values. Daily means are not computed if there are more than 144 one-minute values (2 hours and 24 minutes) missing. In the plots of daily mean values, secular variation is quite clear in *H*, *D*, *Z* and *F* 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. These are shaded black and white relative to the daily means.

6.4 MONTHLY MEAN VALUES

Monthly mean values are calculated from the daily mean values. Monthly means are not computed if there are more than three missing daily values. 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*. Annual mean values are also calculated from the daily mean values. If there are more than 36 missing daily values they are not computed. 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. Monthly and annual mean values are also calculated for the five international quiet days and the five international disturbed days in each month.

6.5 INDICES

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 co-ordinates of the observatory. The complete sets of *K* indices for each of the UK observatories are tabulated throughout the year.

A summary of the occurrence of each *K* index in 2000 is given below (there were no intervals of missing *K* indices at any of the three UK observatories).

	K Index									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
LER	**502**	**834**	**791**	**460**	**203**	**76**	**26**	**22**	**7**	**7**
ESK	**373**	**684**	**774**	**672**	**300**	**89**	**21**	**7**	**4**	**4**
HAD	**204**	**735**	**789**	**688**	**365**	**116**	**21**	**5**	**4**	**1**

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 3-hourly *aa* and daily *Aa* index, a further planetary activity index. The *aa* indices have been computed in Edinburgh and the daily (*Aa*), monthly and annual mean values are listed following the tables of *K* indices for Hartland. (Definitive values of the indices recognised by IAGA are published by the International Service for Geomagnetic Indices, St. Maur, France.) The derivation of the geomagnetic activity indices mentioned here is described in detail by Mayaud (1980).

6.6 RAPID VARIATIONS

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 (SFEs), Sudden Impulses (SIs) and Storm Sudden Commencements (SSCs) are given along with the time, amplitude and quality of the event.

6.7 ANNUAL MEAN VALUES

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 the values from Abinger, taking into account the site differences between the two observatories determined during 1957 when both observatories operated simultaneously.

7. Repeat station network results

During 2000, observations were made at 13 repeat stations, the results for which are tabulated below. The values are reduced to a quiet level at the time of occupation using observatory data. The results of the modelling work for 2000 are shown in Figures 10 and 11. The data collection and processing are described in Carrigan (2001) and the modelling work is similar to that described in Macmillan and Carrigan (2000).

	Code	Date	Latitude	Longitude	Declination	Inclination	Total intensity
Godrevy Point	GOD	28/03/00	50° 14′ 15″ N	5° 23′ 35″ W	-5° 00′ 35″	65° 17′ 31″	47865.2
Stonebarrow Hill	GCA	29/03/00	50° 44′ 07″ N	2° 52′ 45″ W	-4° 06′ 26″	65° 45′ 19″	48039.2
Holyhead	HOL	16/05/00	53° 17′ 50″ N	4° 38′ 22″ W	-5° 22′ 22″	68° 02′ 48″	48760.8
Cregennan	CRE	17/05/00	52° 42′ 28″ N	3° 59′ 03″ W	-4° 57′ 33″	67° 16′ 23″	48666.2
Cardigan	CDG	18/05/00	52° 05′ 21″ N	4° 40′ 00″ W	-5° 02′ 31″	66° 59′ 01″	48446.0
Kenilworth	KEN	01/08/00	52° 21′ 14″ N	1° 36′ 49″ W	-3° 52′ 13″	67° 22′ 45″	48734.5
Grantham	GRA	02/08/00	52° 54′ 56″ N	0° 38′ 07″ W	-3° 32′ 52″	67° 34′ 51″	48683.2
Wheelock	WHE	03/08/00	53° 07′ 53″ N	2° 19′ 49″ W	-4° 06′ 35″	67° 44′ 05″	48704.2
Gainsborough	GAI	15/08/00	53° 23′ 05″ N	0° 44′ 49″ W	-3° 40′ 38″	67° 57′ 00″	48881.0
Derwent Estate	DER	16/08/00	53° 24′ 04″ N	1° 45′ 59″ W	-4° 05′ 41″	67° 58′ 48″	48862.7
Malham	MAL	17/08/00	54° 06′ 16″ N	2° 10′ 29″ W	-4° 20′ 19″	68° 29′ 42″	49027.3
Thirsk	THI	24/10/00	54° 14′ 08″ N	1° 21′ 16″ W	-4° 11′ 06″	68° 42′ 54″	49093.9
Robin Hood's Bay	RHB	15/11/00	54° 26′ 36″ N	0° 31′ 50″ W	-3° 48′ 11″	68° 45′ 23″	49118.6

8. Data availability

One-minute mean values of geomagnetic elements at each of the UK observatories are available in digital form from 1983 onwards. Hourly mean values are available in digital form for Lerwick (1926-present), Eskdalemuir (1911–present), Abinger (1926–57) and Hartland (1957–present). *K* indices from the current UK observatories are available in digital form from 1954 onwards. In its role as the World Data Centre C1 for Geomagnetism, the BGS also holds a selection of hourly mean values and annual mean values from observatories worldwide. Digital data can be transferred directly by electronic mail or *ftp* over the Internet. Up-to-date UK observatory hourly mean values, *K* indices, global geomagnetic indices and geomagnetic activity forecasts are also available on the BGS, Geomagnetism web site.

For more information contact:

Geomagnetism	☏:	+44 (0) 131 667 1000
British Geological Survey	Fax:	+44 (0) 131 650 0265
Murchison House	Email:	ecla@bgs.ac.uk
West Mains Road	Internet:	www.geomag.bgs.ac.uk
Edinburgh EH9 3LA,		
UK		

9. BGS staff working in geomagnetism during 2000

Edinburgh

Manager (Band 3)	Dr D J Kerridge
PA	Mrs M Milne
PRES	Dr D R Barraclough *
	Dr T D G Clark
	J C Riddick
SSO	S M Flower
	Dr S Macmillan
	Dr A W P Thomson
HSO	J G Carrigan
	E Clarke
	T J Harris
	C W Turbitt
ASO	P White

Eskdalemuir

Craftsman	W E Scott
Cleaner	Mrs M Scott

Hartland

PGS E	C R Pringle

* David Barraclough retired from BGS at the end of March 2000. He started his career in Geomagnetism with the Institute of Geological Sciences (forerunner to BGS) in January 1969, based at Herstmonceux Castle, Sussex, moving to Murchison House, Edinburgh in 1976.

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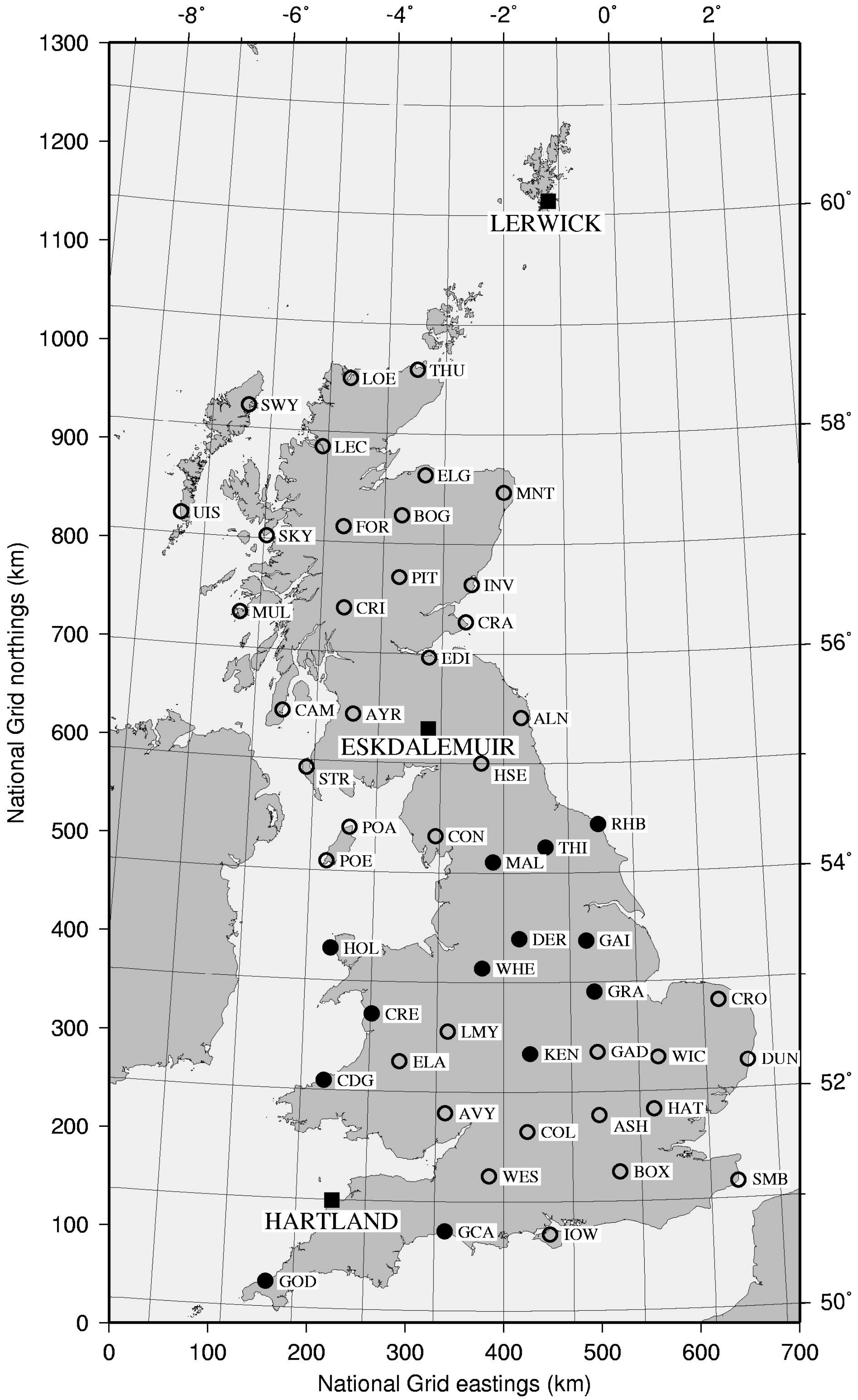
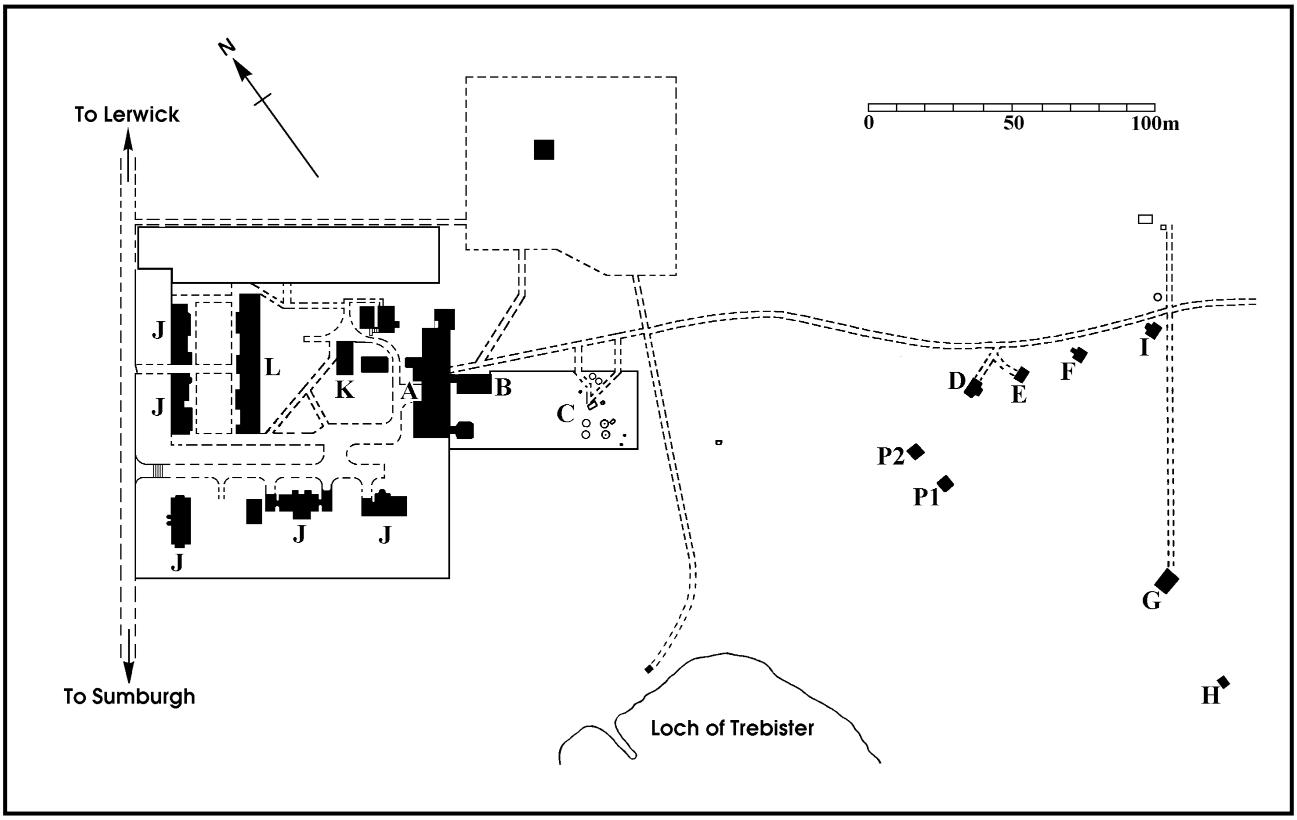


Figure 1 Locations of UK magnetic observatories (squares) and repeat stations (circles)

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 & MUTEST transmitter
J	Staff houses
K	Standby generator
L	Staff hostel
P1	Unused proton magnetometer
P2	GAUSS proton magnetometer & $\delta D/\delta I$ coils

Instrument Deployment

Absolute Hut
PVM (used as PPM for F measurements and QC)
D/I fluxgate theodolite

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

Instrument Hut
GAUSS logger
Uninterruptible power supply (UPS)

Variometer House
GAUSS fluxgate sensor (*HDZ*)
FLARE*plus* (backup) fluxgate sensors (*HDZ*)

The variometer house is constructed from non-magnetic concrete and has internal dimensions of 4.9 by 3 meters. The roof is semi-circular in cross section. The temperature of the house is controlled to a diurnal range of ±1ºC. 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
The observatory is described by Harper (1950) and Tyldesley (1971).

Figure 2. Lerwick Observatory site diagram

Eskdalemuir Observatory

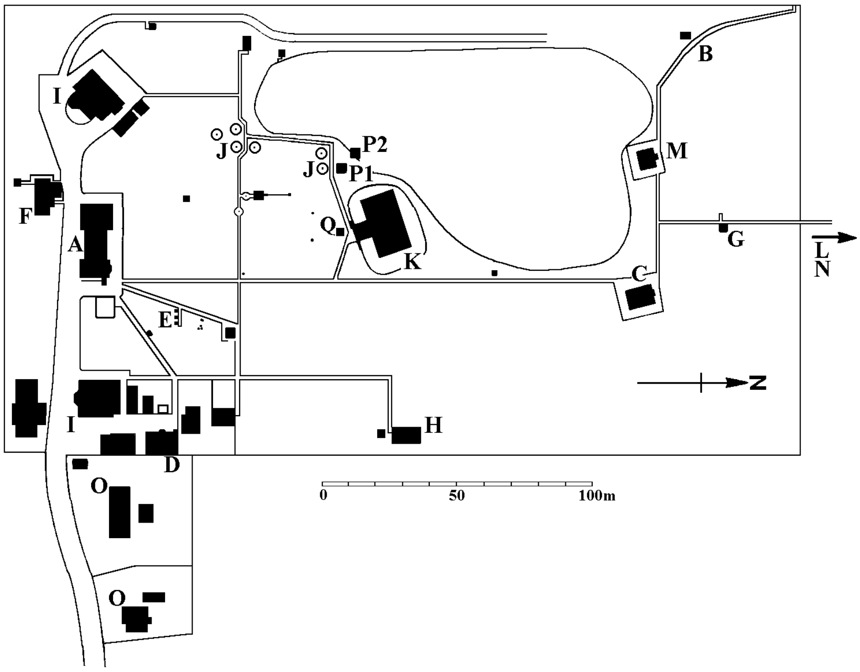


Figure 3. Eskdalemuir Observatory site diagram

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
L	Seismic vault containing remote fluxgate (280 metres from boundary wall)
M	West absolute hut
N	Chemical sampling (Warren Spring Laboratory) (75 metres from boundary wall)
O	Private houses – formerly staff housing
P1	GAUSS proton magnetometer & $\delta D/\delta I$ coils
P2	Unused proton magnetometer
Q	METEOSAT transmitter

Instrument Deployment

Underground Variometer Chamber
GAUSS fluxgate sensor (*HDZ*)
FLARE*plus* (backup) fluxgate sensors (*HDZ*) transmitting to METEOSAT

The variometer chamber comprises two separate rooms inside a domed chamber covered with a thick layer of earth. The instruments are situated below ground level. The inside temperature is controlled to a diurnal range of ±0.5ºC. The instrument room was created by extending the former porch back into the stairwell and entrance. Standby batteries are kept in a compartment under the floor. The entrance to the room is protected by an external porch.

Hut G
PVM electronics, digital clock and printer to record total field values during absolute observations.

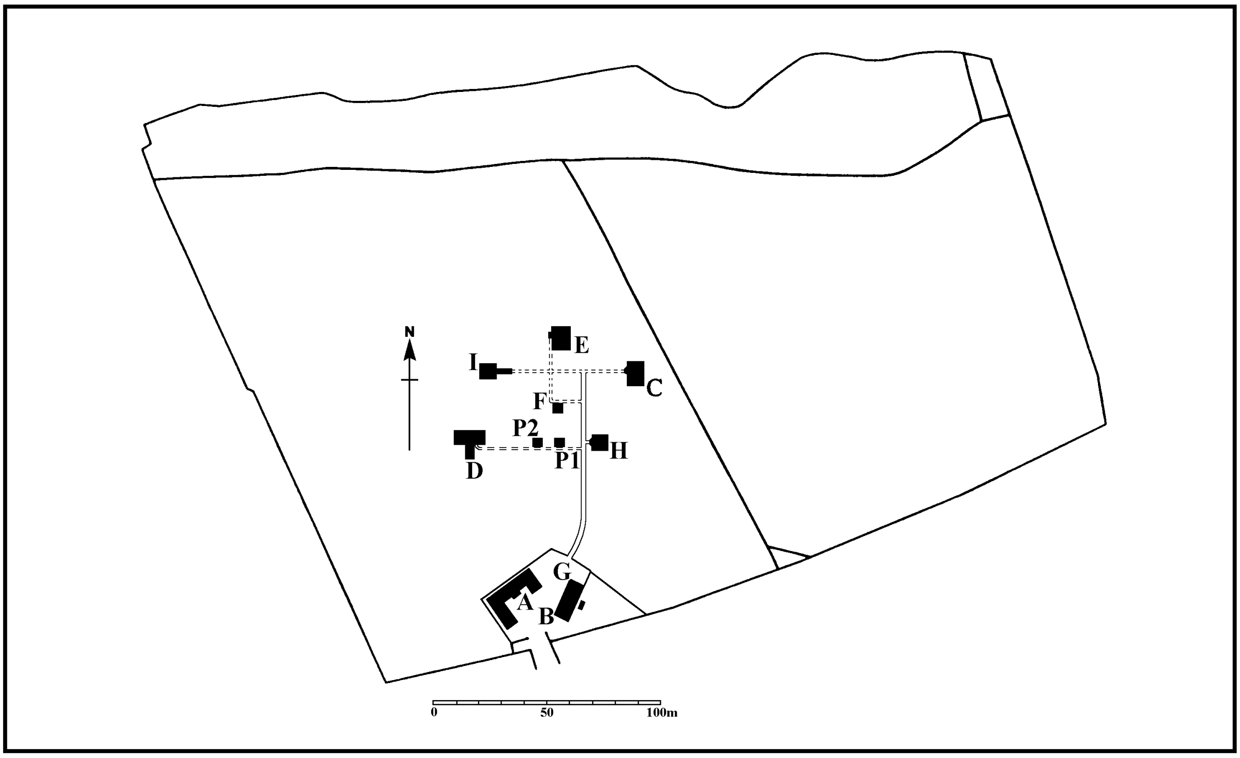
East Absolute Hut
PVM (used as PPM for F measurements and QC)
D/I fluxgate theodolite
The fixed mark (azimuth 8º 12' 35" W of S) is viewed through a shutter on the south wall.

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

West Absolute Hut
The hut contains three instrument piers. The fixed mark (azimuth 4º 36' 08" W of S) is viewed from the central pillar through a shutter on the south wall.

Previous descriptions
The observatory is described by Crichton (1950) and Blackwell (1958).

Hartland Observatory



Observatory Layout

A	Main observatory building
B	Caretakers house
C	Absolute hut
D	Non-magnetic laboratory
E	Variometer house
F	Instrument hut
G	Garage
H	Test hut 2
I	Test hut 1
P1	Unused proton magnetometer
P2	Unused proton magnetometer & $\delta D/\delta I$ coils

Instrument Deployment

Absolute Hut
PVM (used only as PPM for 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.

Variometer House
GAUSS fluxgate sensors (*HDZ*)
The variometer house comprises an entrance porch and a main room, which contains two separate internal rooms, each divided into three compartments. The temperature is controlled to a diurnal range of ±0.5°C. Two cable ducts connect the variometer house to the instrument hut.

The Non-Magnetic Laboratory
GAUSS proton magnetometer & $\delta D/\delta I$ coils (PVM)
FLARE*plus* (backup) fluxgate sensors (*HDZ*) transmitting to METEOSAT
Fluxgate system transmitting to the GOES satellite.

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.

Instrument Hut
GAUSS logger
Standby batteries
Uninterruptible power supply (UPS)

Test Hut 1
Low field facility (LFF) comprising an orthogonal coil system of dimension ~2m and its power supply. The system consists of a pair of vertical-axis square coils and two pairs of horizontal-axis square coils for creating fields parallel and normal to the meridian.

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 north-east theodolite position.

Previous descriptions
The observatory is discussed in Finch (1960) and Reader (1997).

Figure 4. Hartland Observatory site diagram

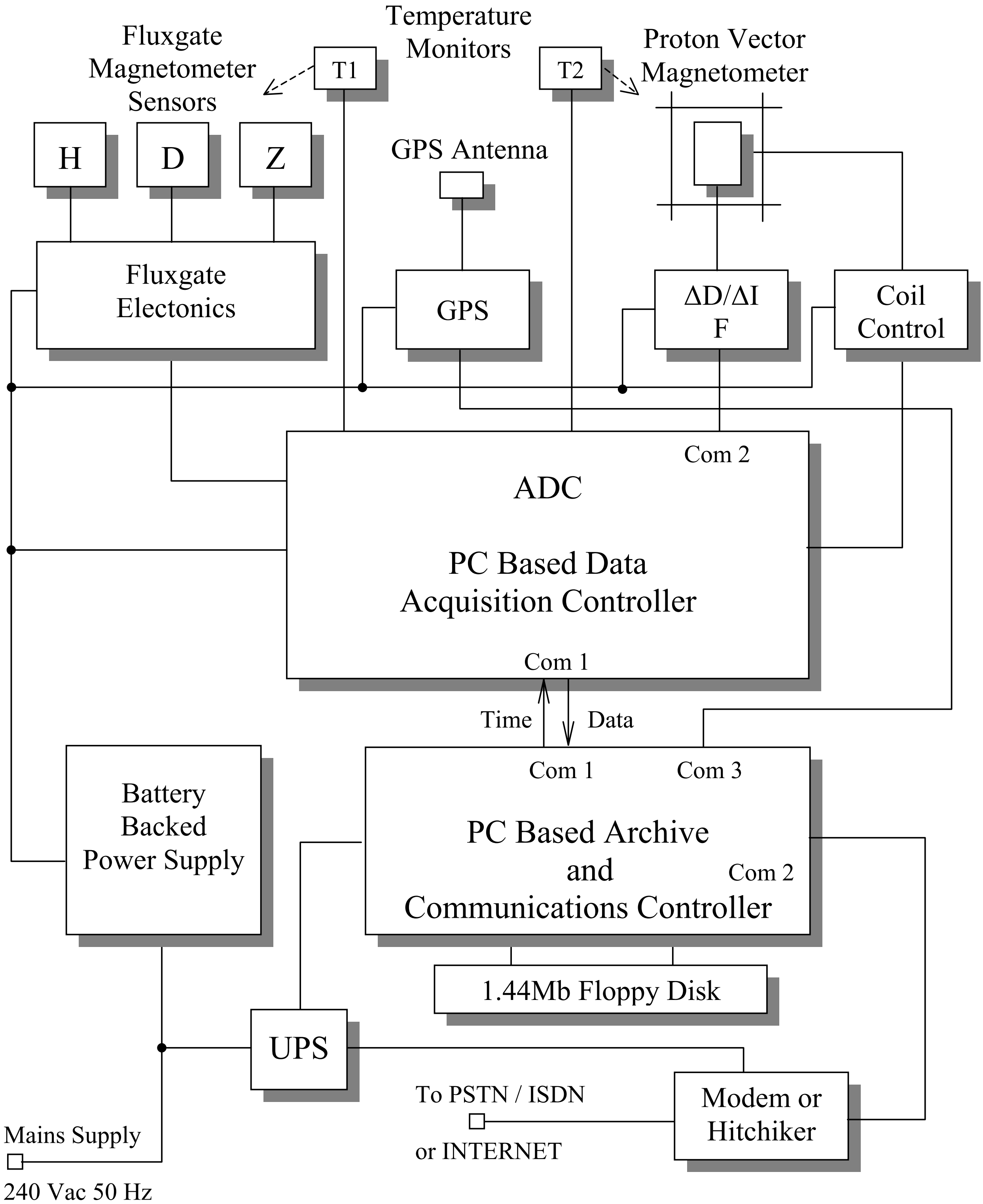


Figure 5. Block diagram of GAUSS

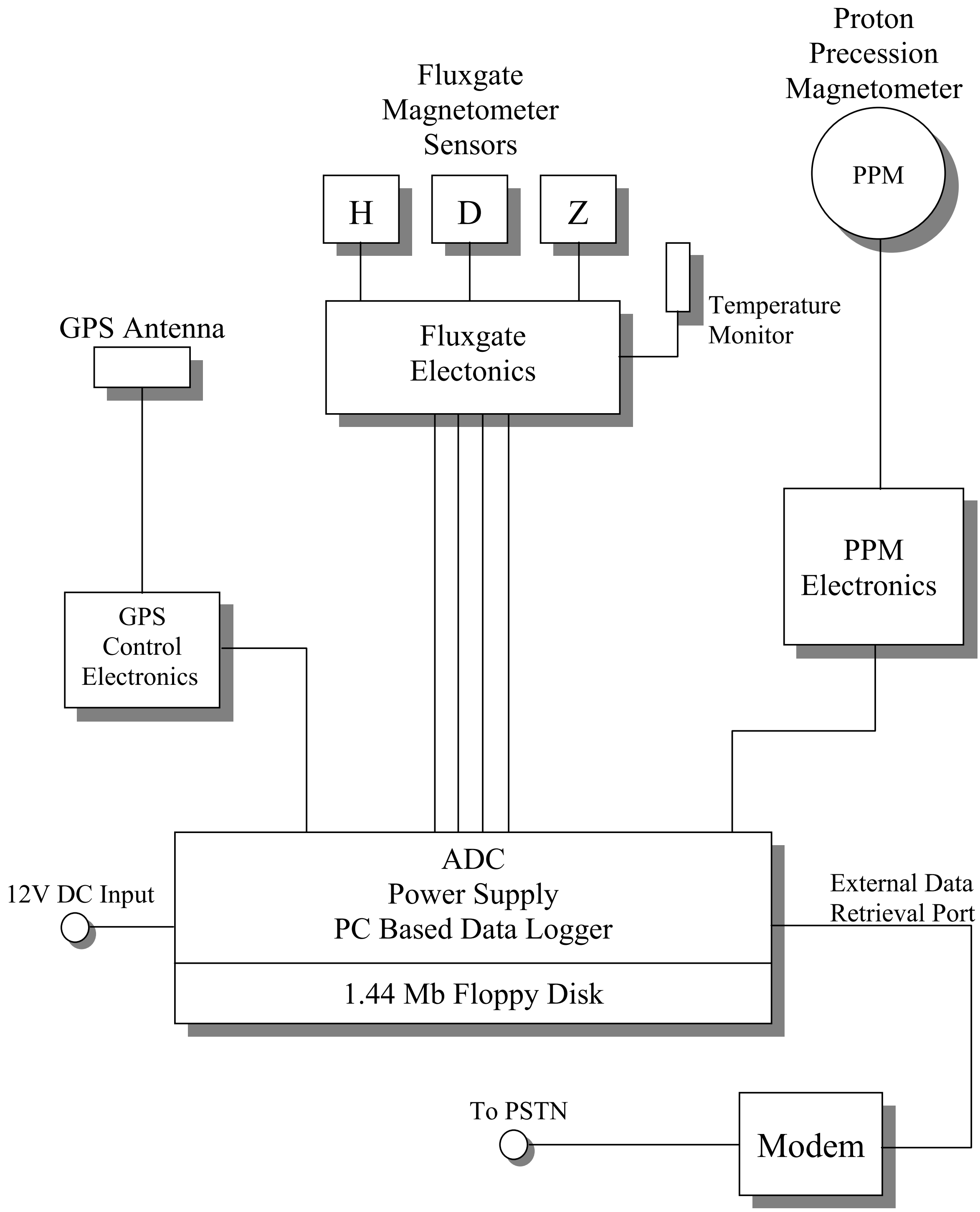


Figure 6. **Block diagram of the FLARE *plus* backup system**

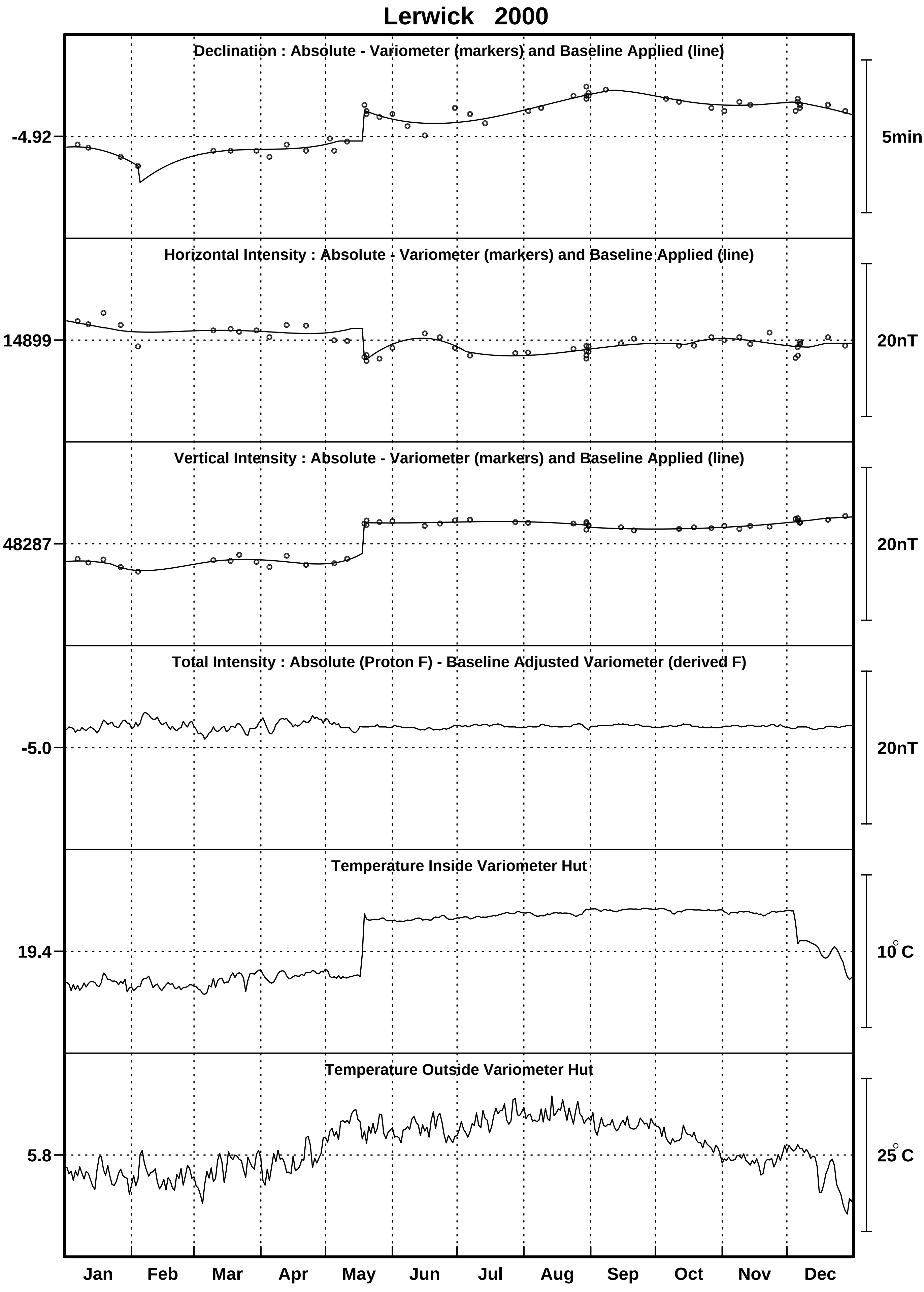


Figure 7: Observed and allocated baselines at Lerwick

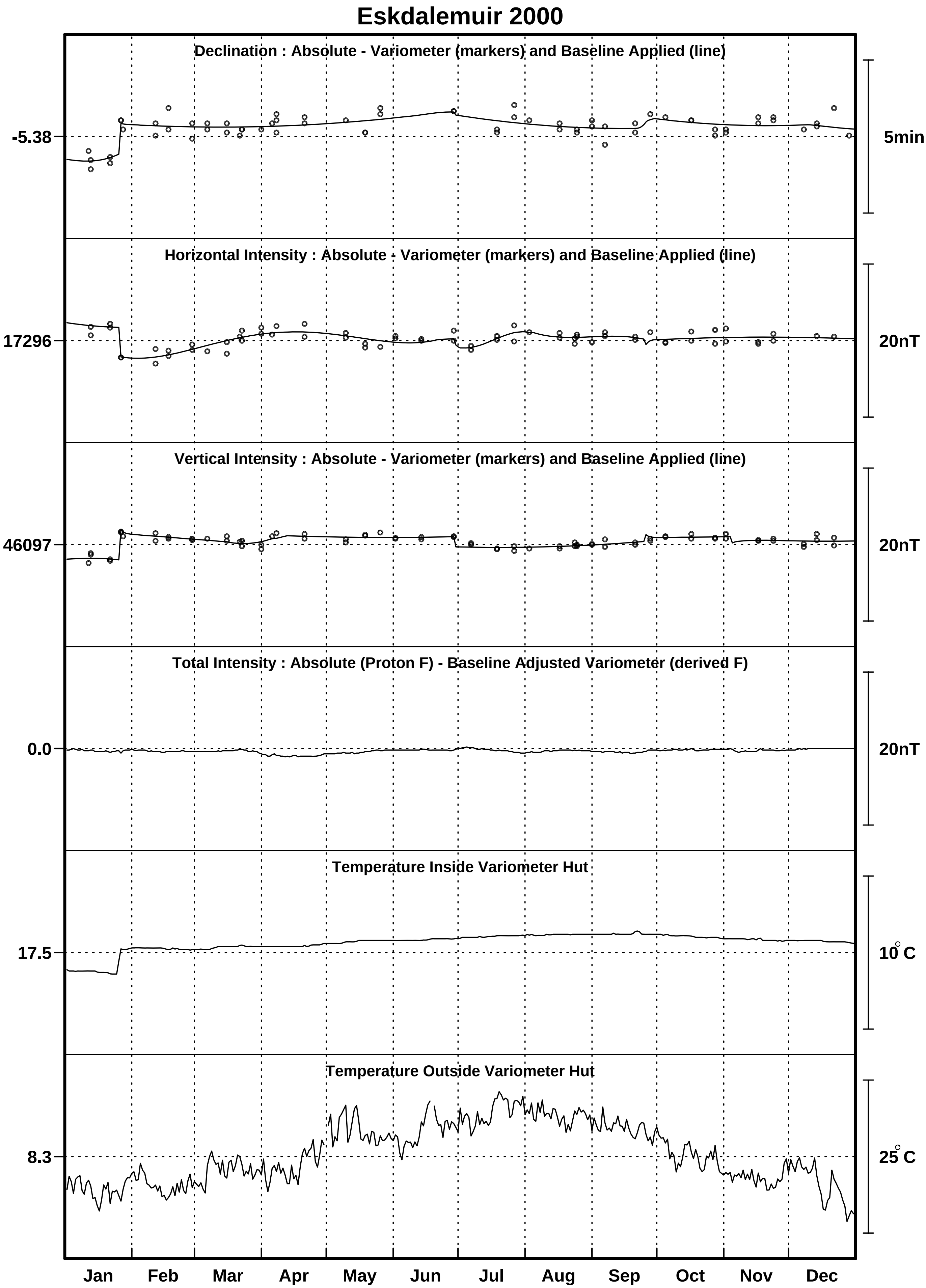


Figure 8: Observed and allocated baselines at Eskdalemuir

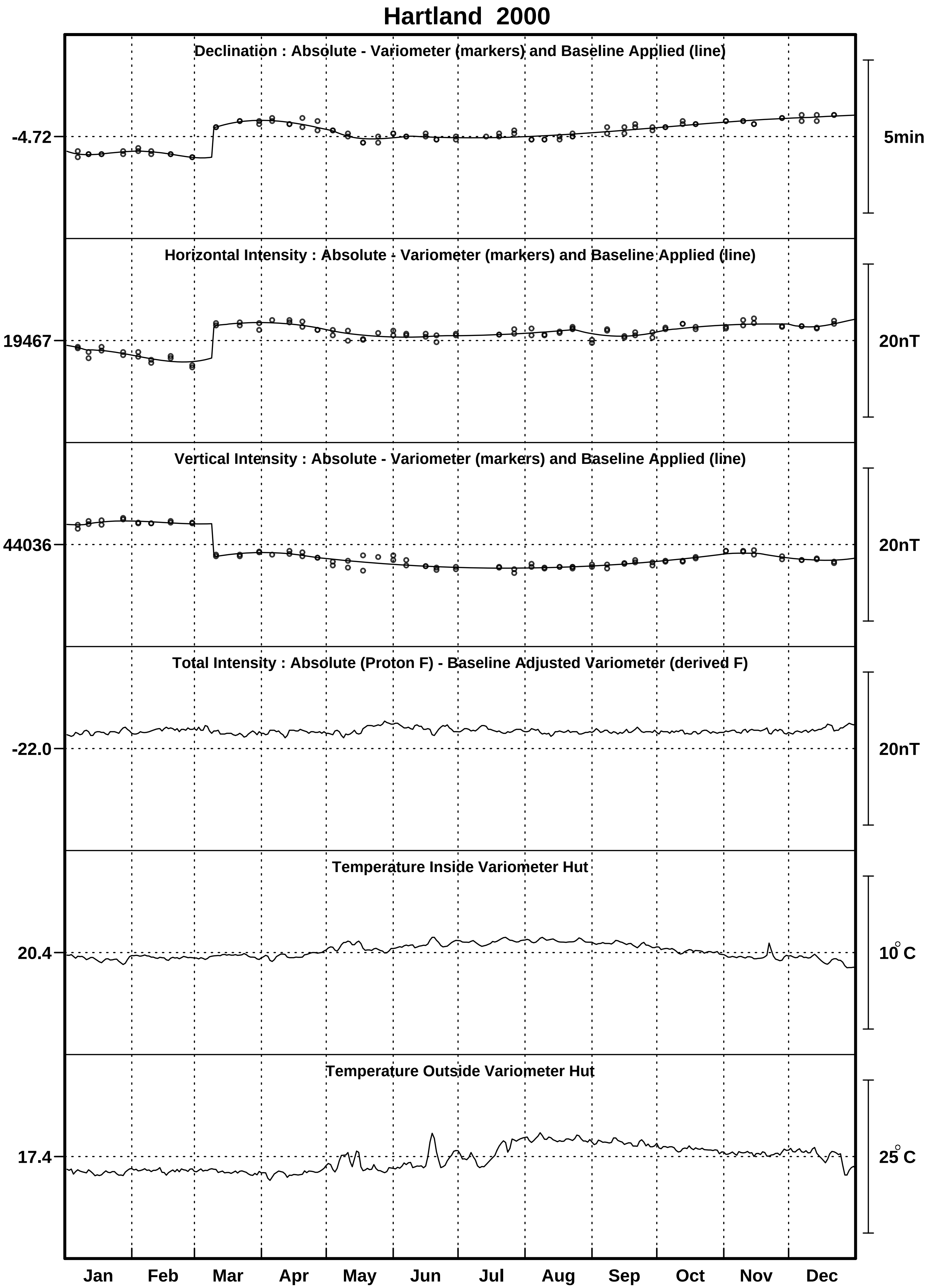


Figure 9: Observed and allocated baselines at Hartland

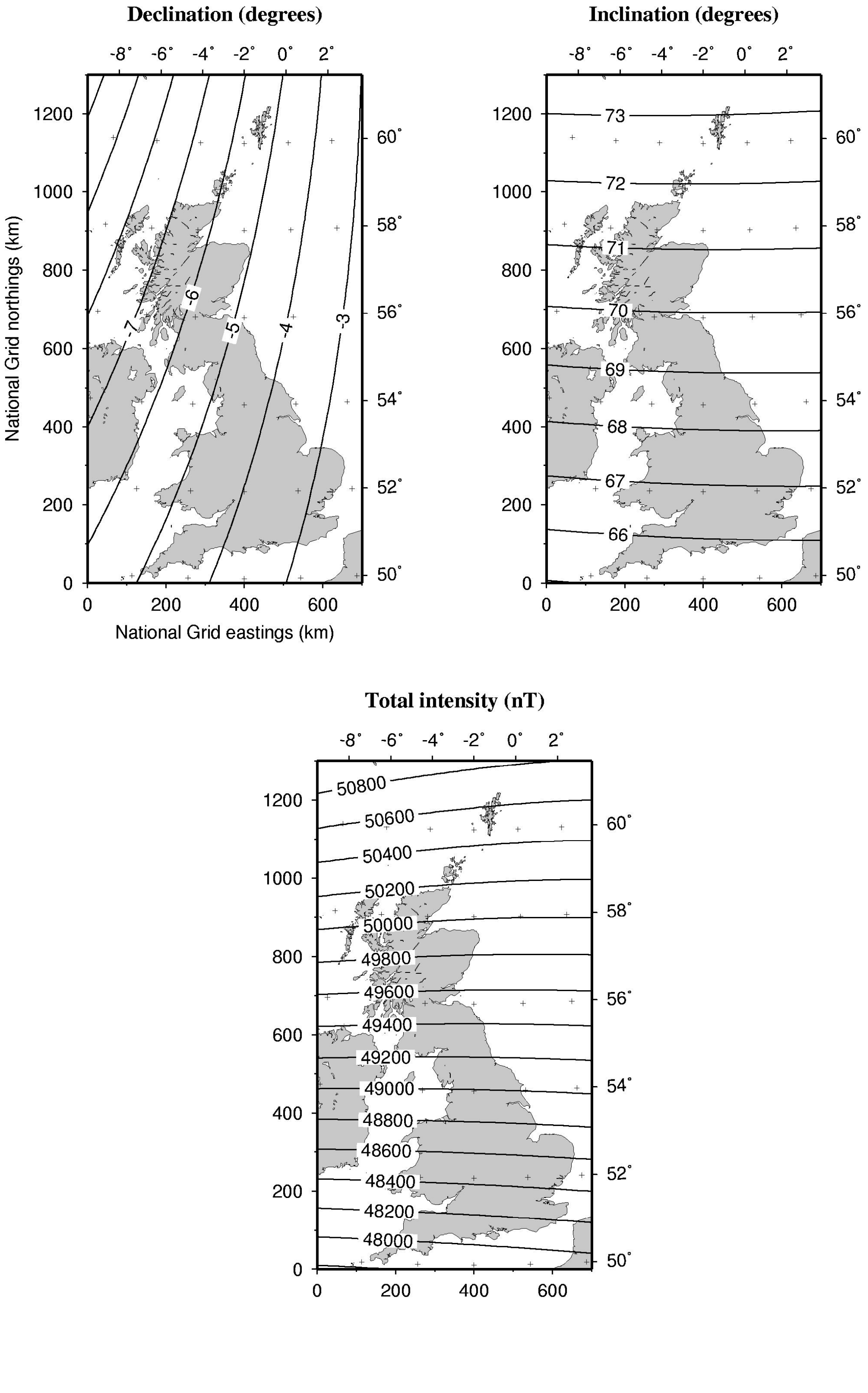


Figure 10 Declination, inclination and total intensity at 2000.5

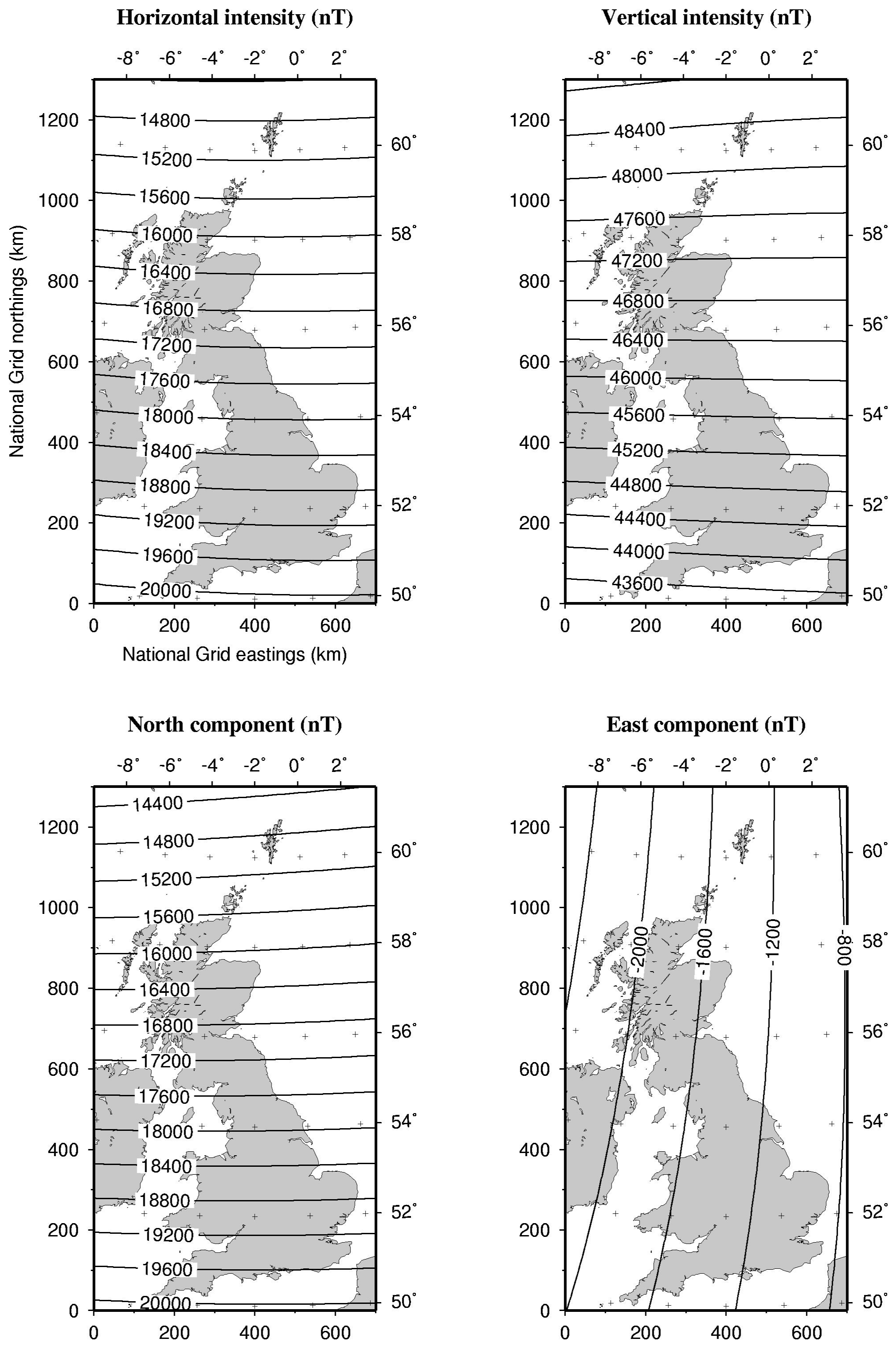
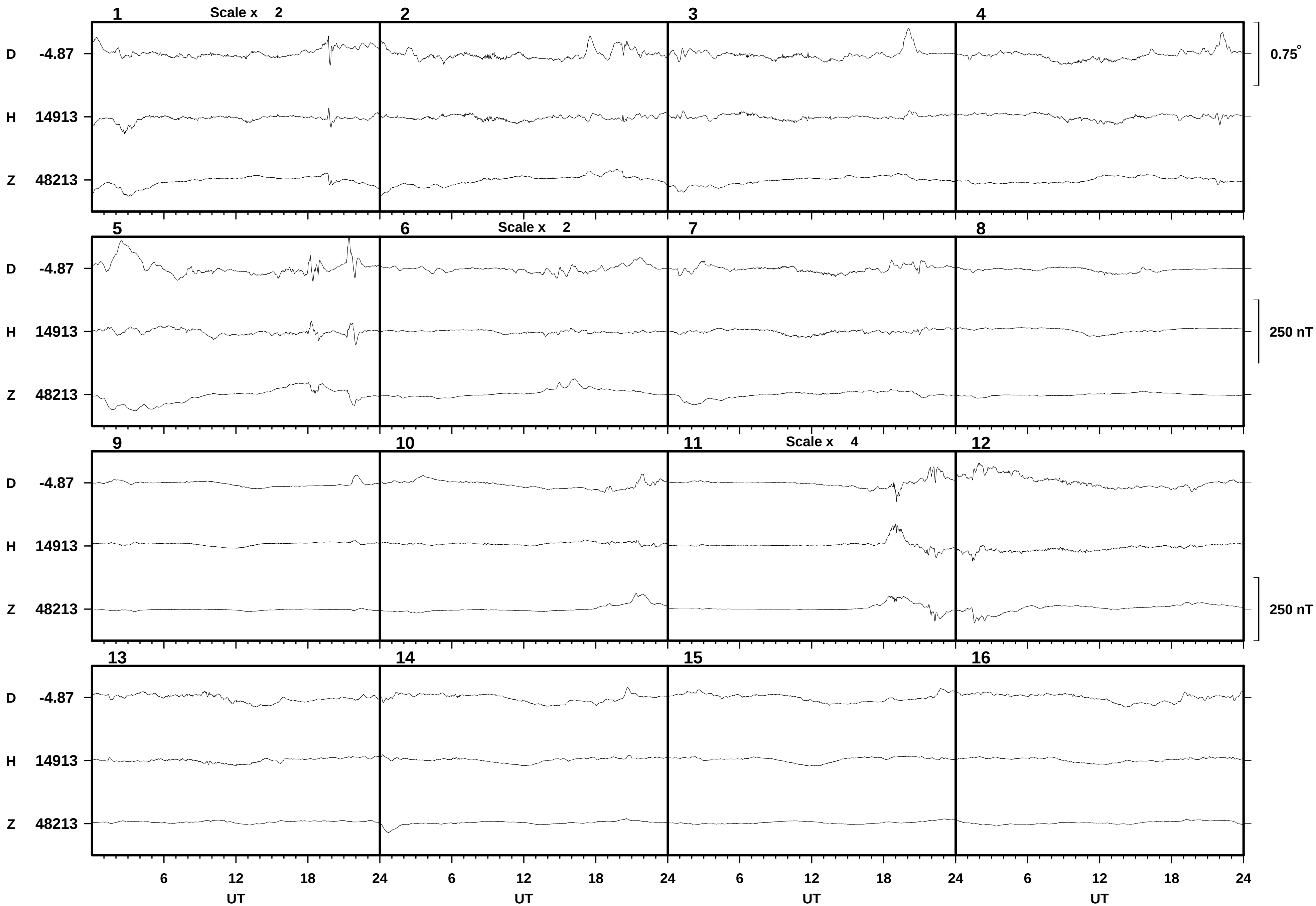


Figure 11 Horizontal, vertical, northerly and easterly intensities at 2000.5

Lerwick Observatory Results 2000

Lerwick January 2000



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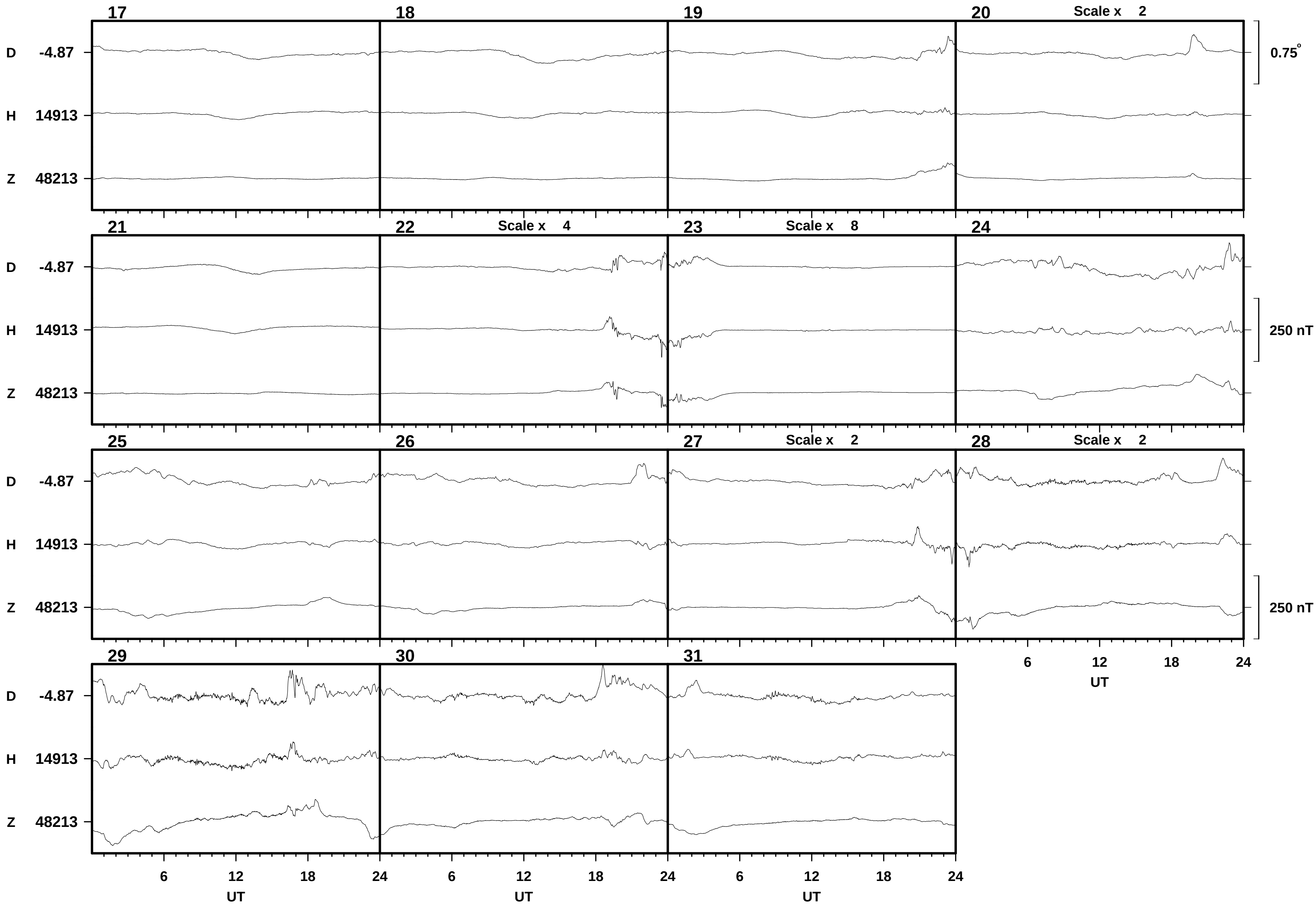
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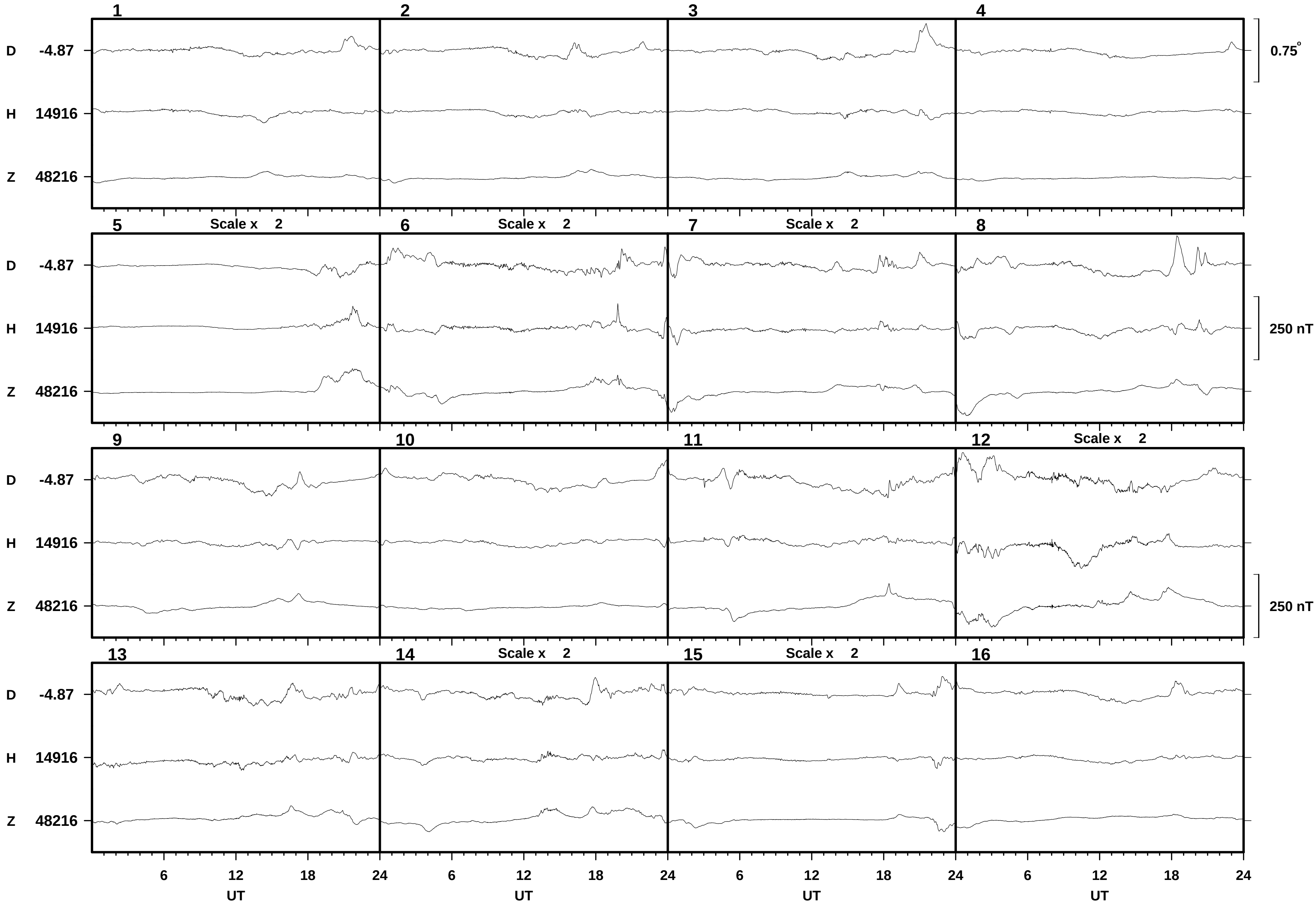
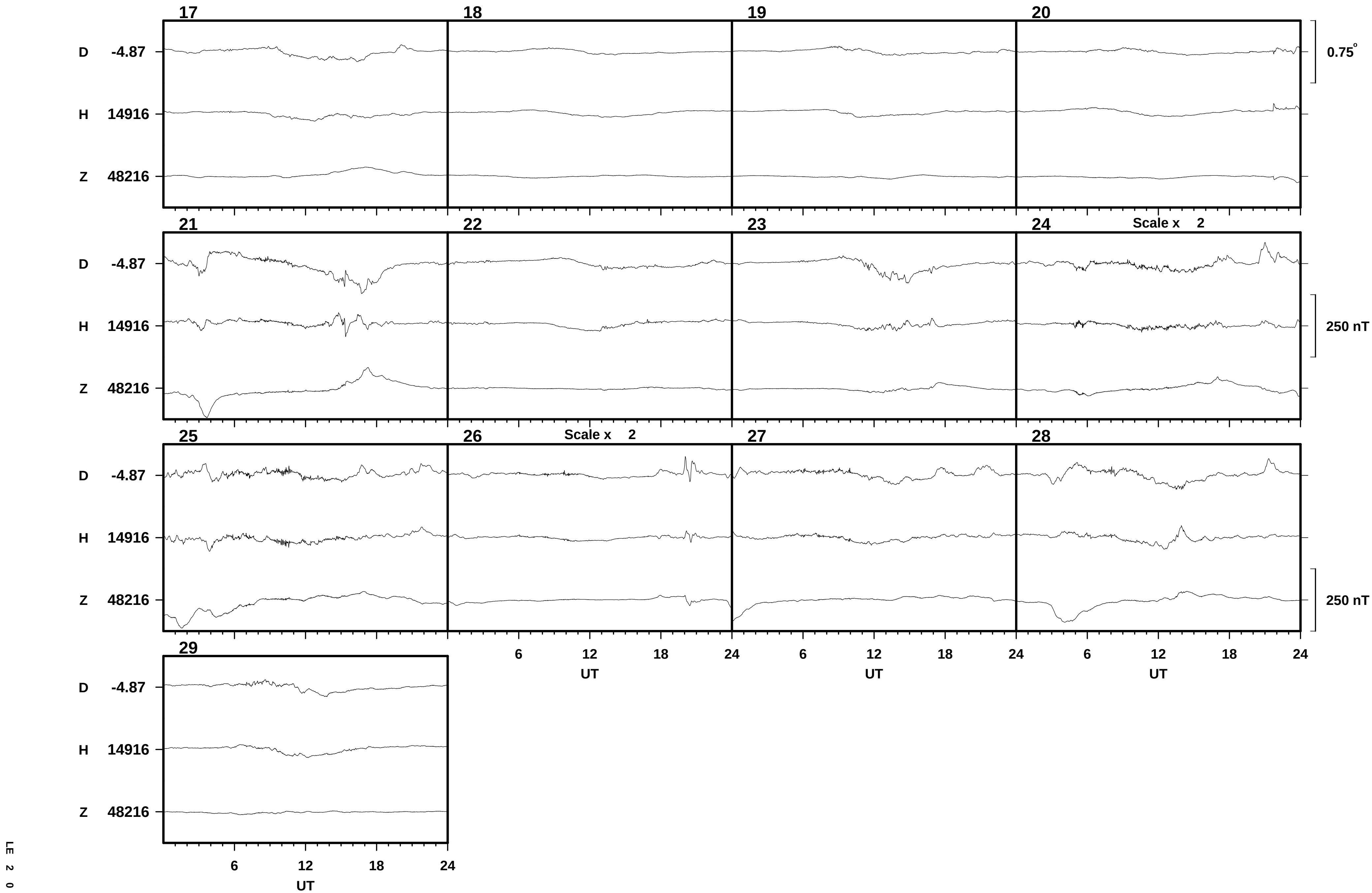
Lerwick February 2000



LE 2 0



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D -4.87
H 14916
Z 48216
0.75°
250 nT
250 nT
6
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18
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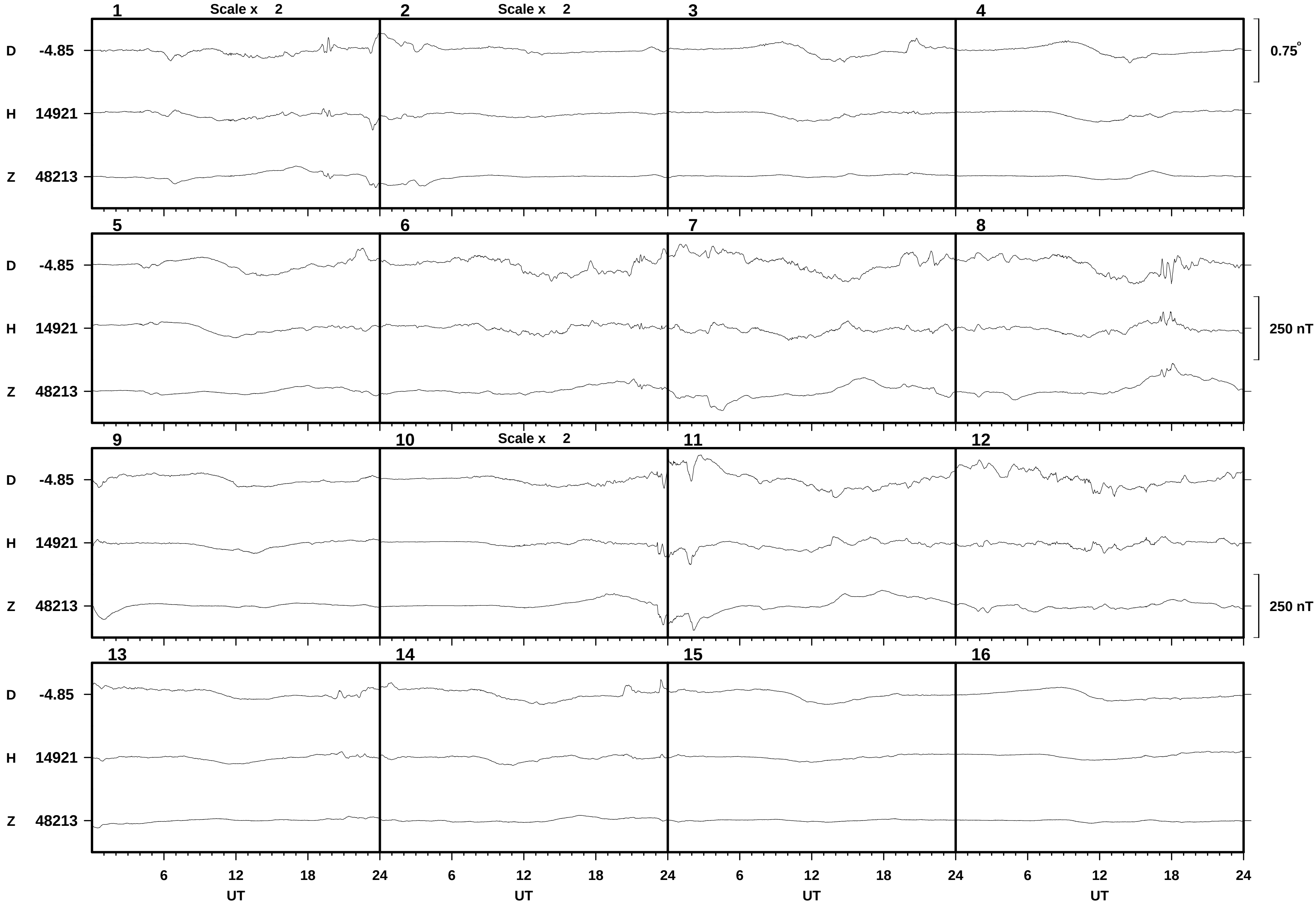
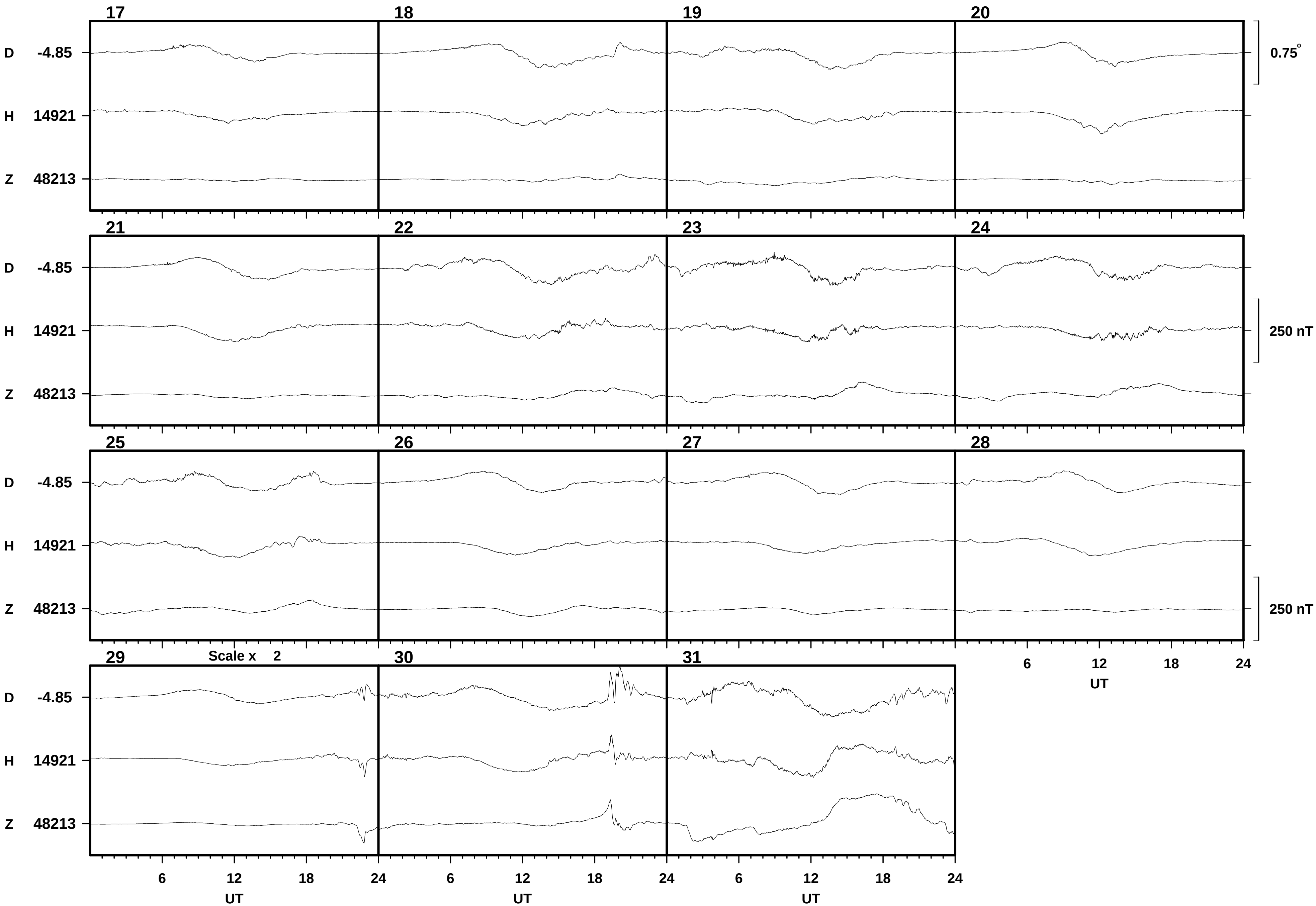
UT
LE 2 0

Lerwick March 2000



LE 3 0



17
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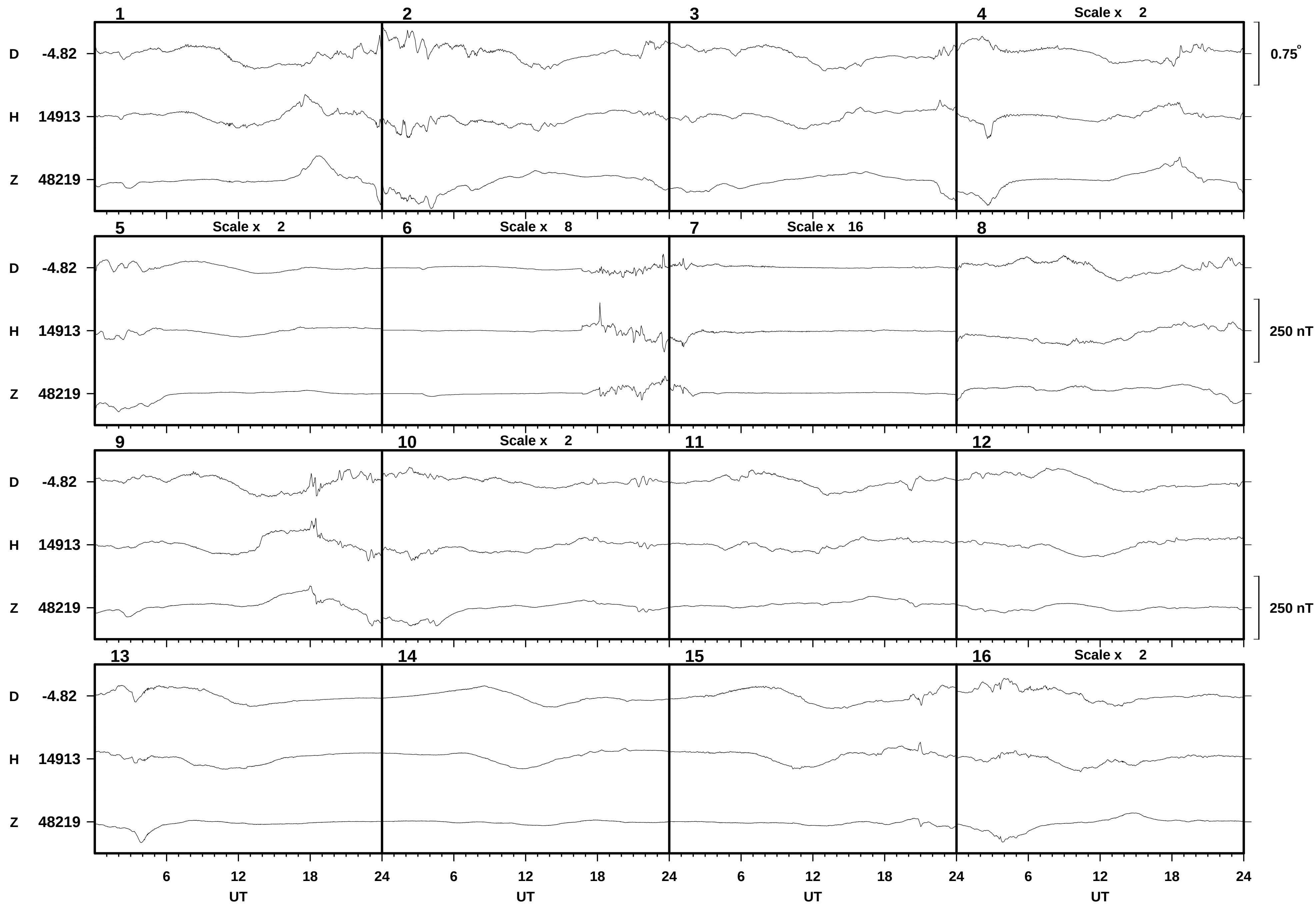
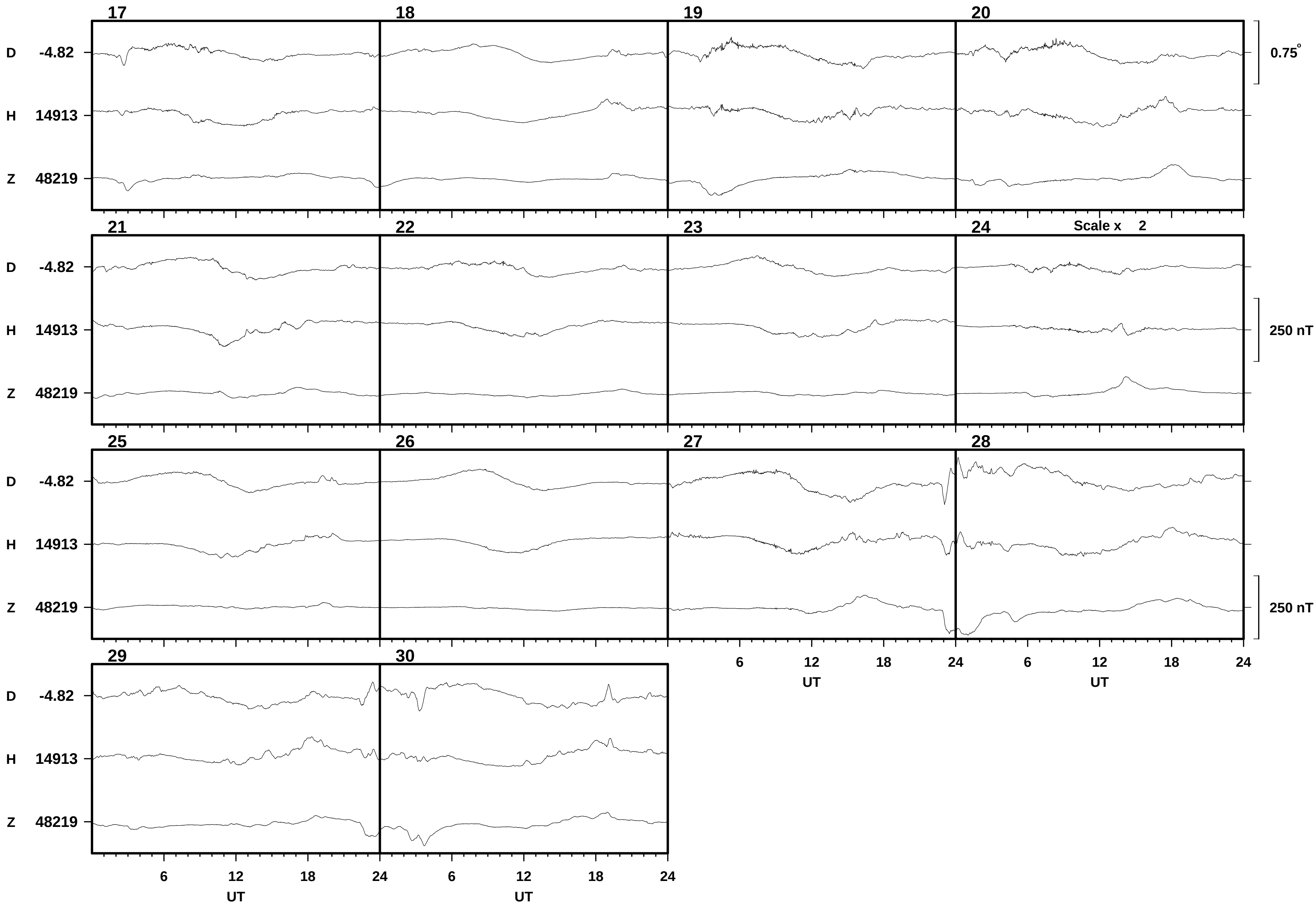
22
23
24
25
26
27
28
29
30
31
D -4.85
H 14921
Z 48213
0.75°
250 nT
250 nT
Scale x 2
6
12
18
24
UT

LE 3 0

Lerwick April 2000

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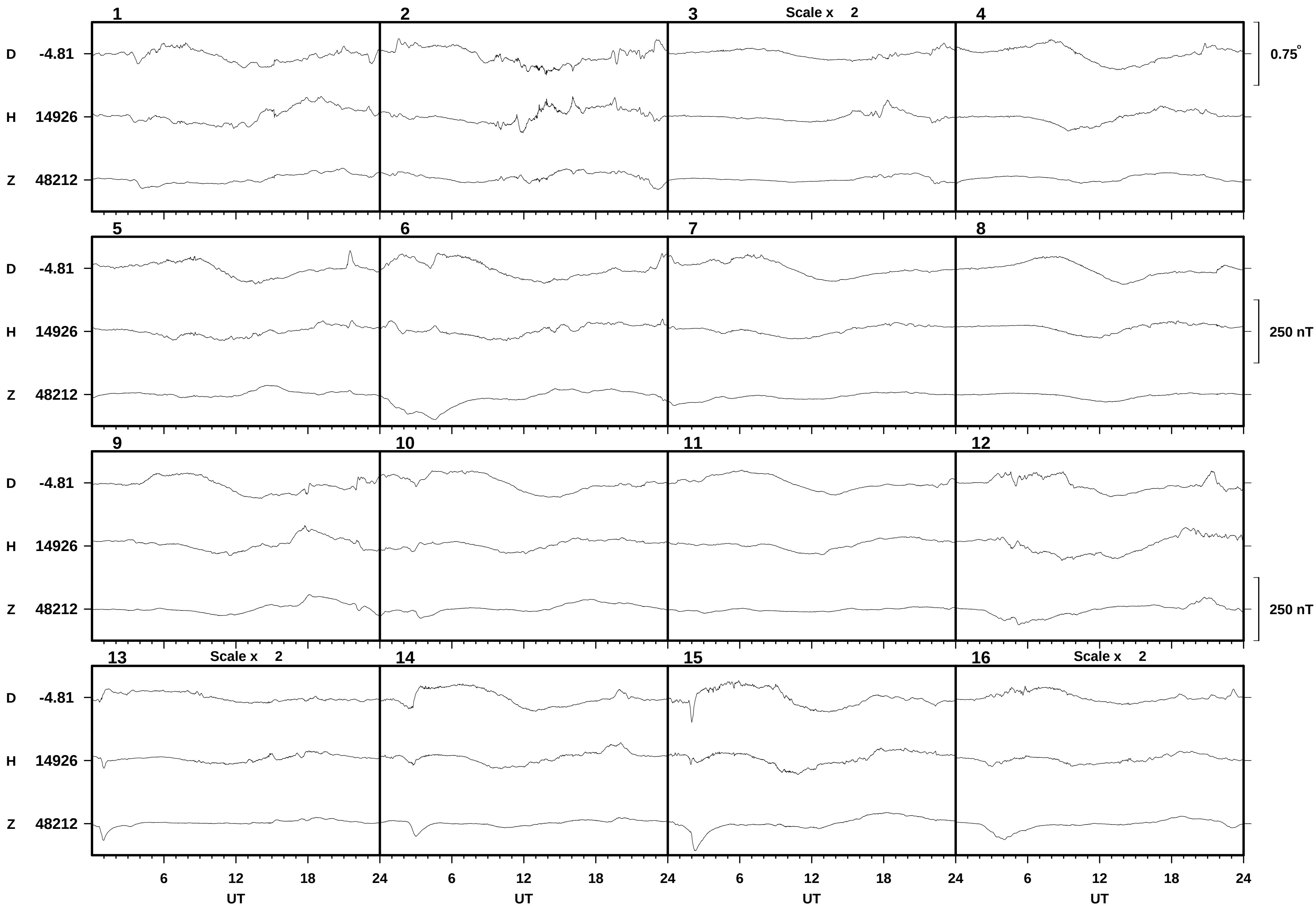
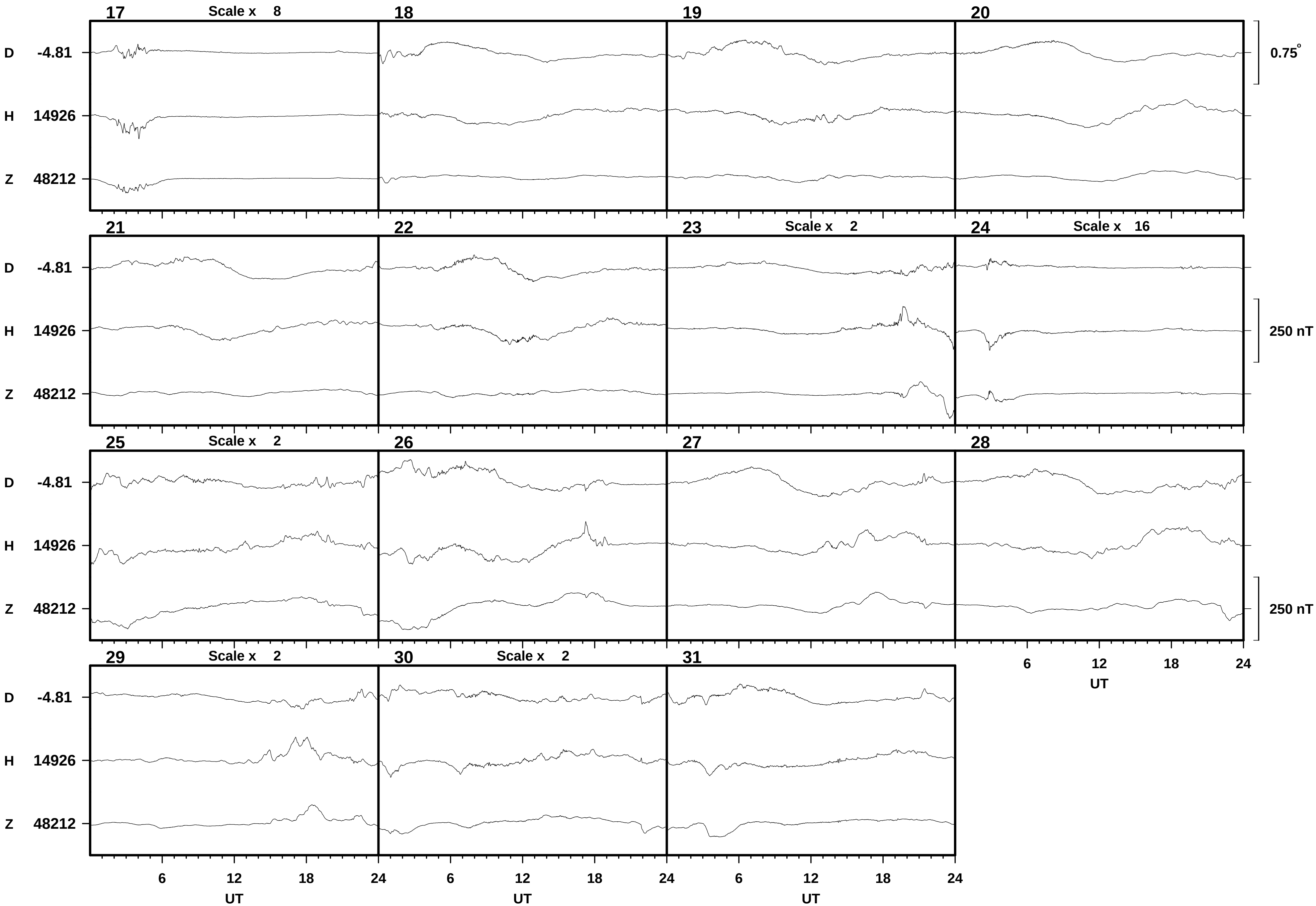
24
25
26
27
28
29
30
D -4.82
H 14913
Z 48219
0.75°
Scale x 2
250 nT
250 nT
6
12
18
24
UT

LE 4 0

Lerwick May 2000



LE 5 0


17
Scale x 8
18
19
20
D -4.81
H 14926
Z 48212
0.75°
21
22
23
Scale x 2
24
Scale x 16
250 nT
25
Scale x 2
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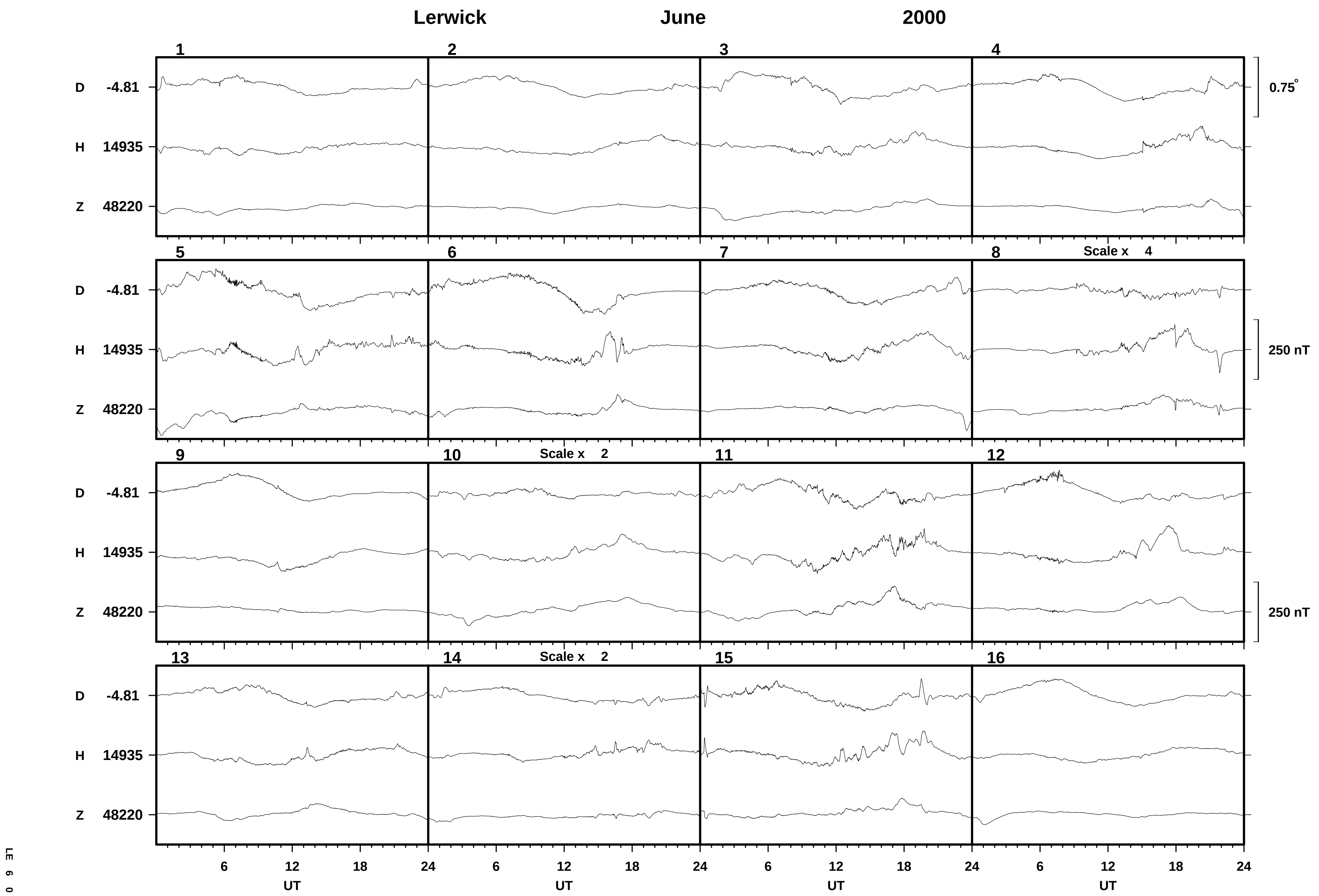
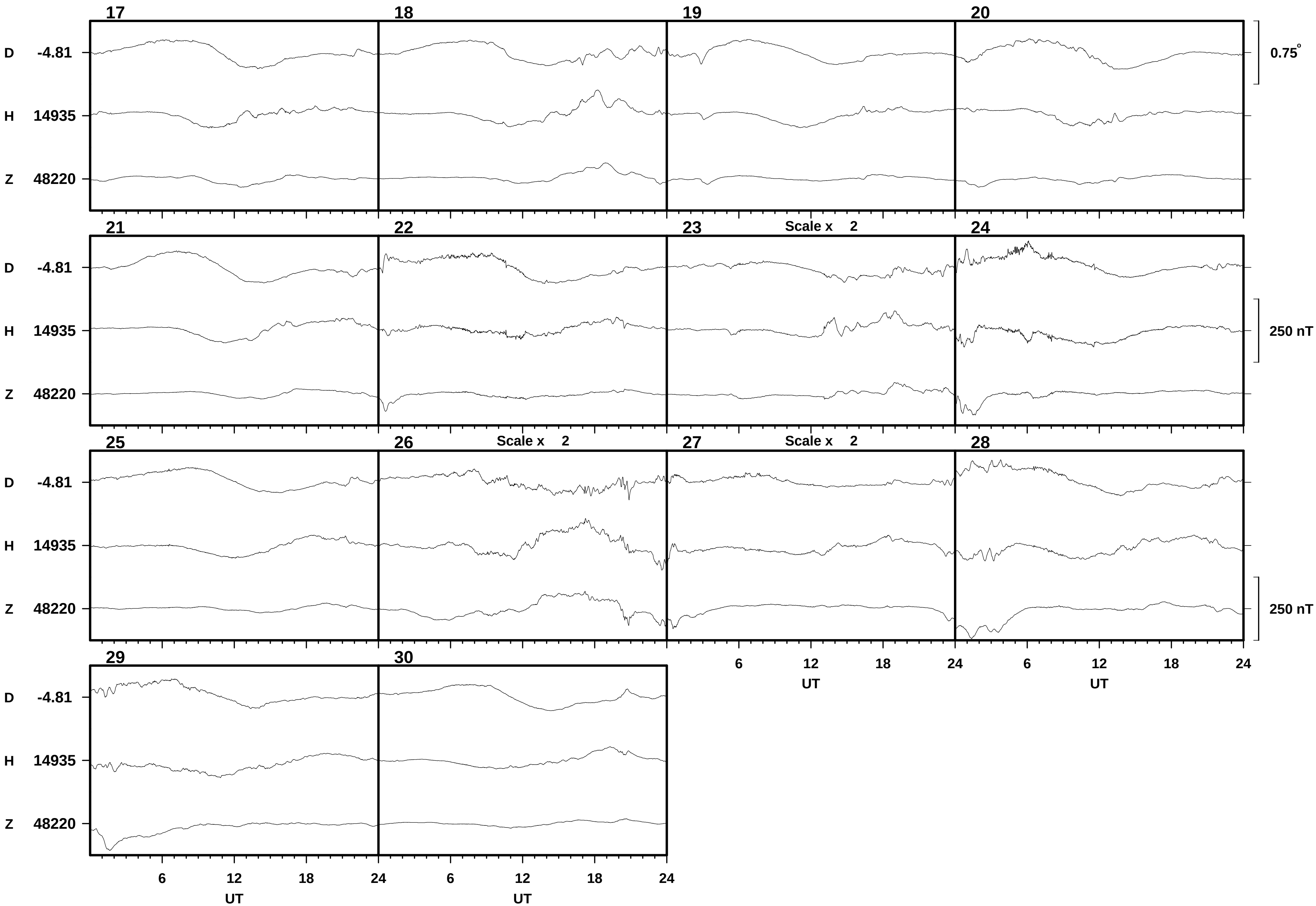
27
28
250 nT
29
Scale x 2
30
Scale x 2
31
6
12
18
24
UT

LE 5 0


Lerwick June 2000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Scale x 4
Scale x 2
Scale x 2
D -4.81
H 14935
Z 48220
0.75°
250 nT
250 nT
6 12 18 24
UT
LE 6 0


17
18
19
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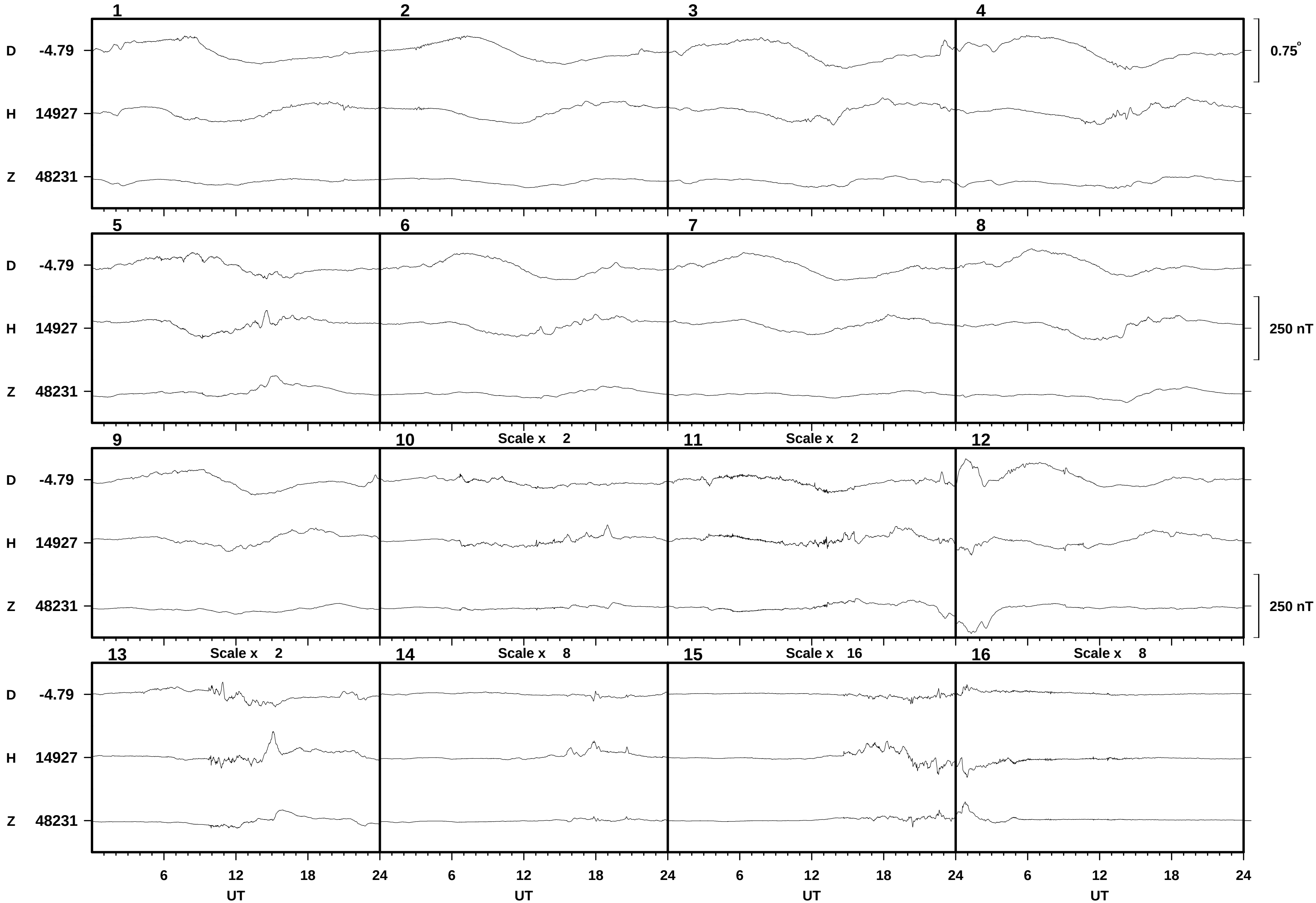
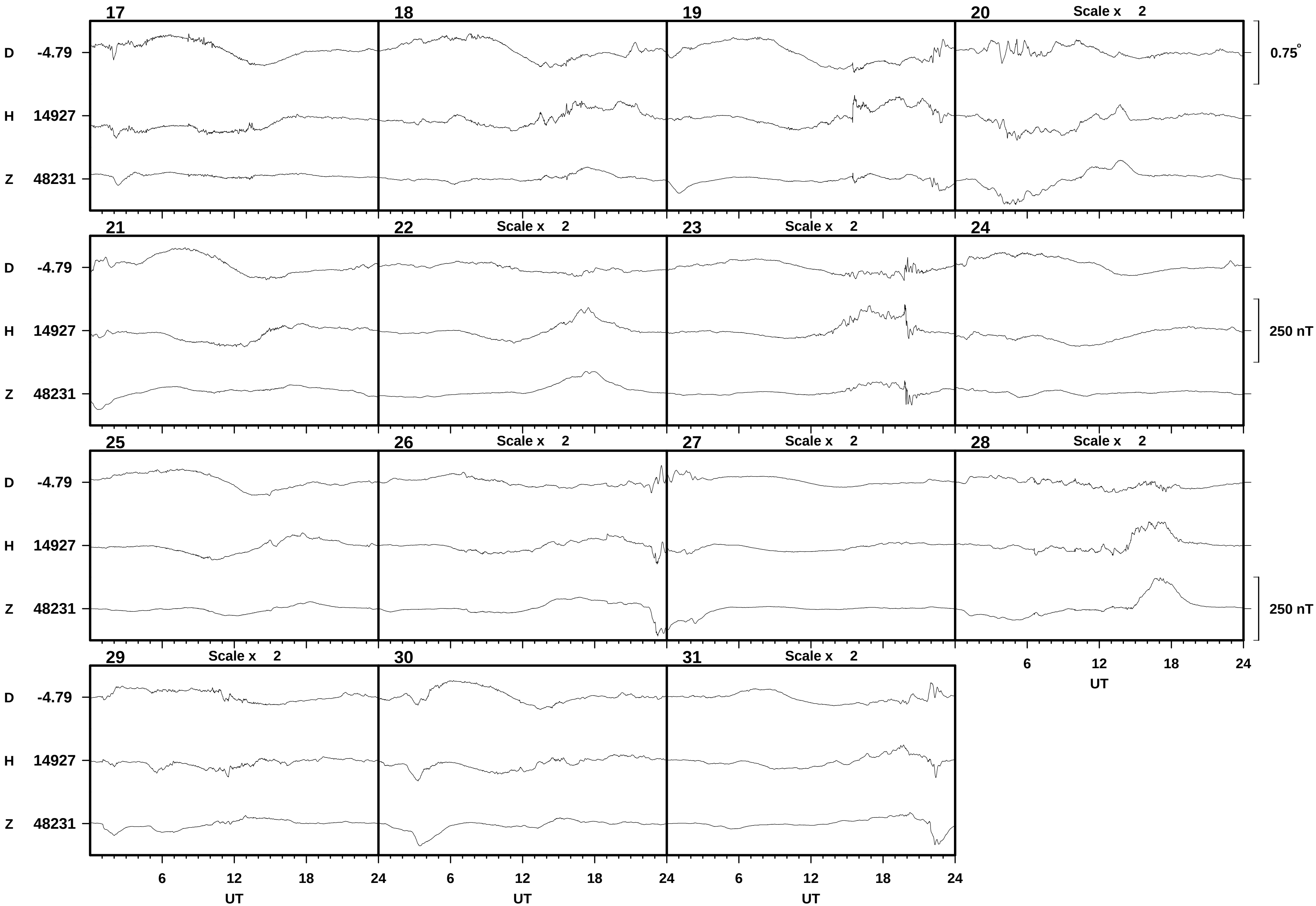
21
22
23
24
25
26
27
28
29
30
D -4.81
H 14935
Z 48220
0.75°
250 nT
250 nT
Scale x 2
Scale x 2
Scale x 2
6
12
18
24
UT

LE 6 0

Lerwick July 2000



LE 7 0


17
18
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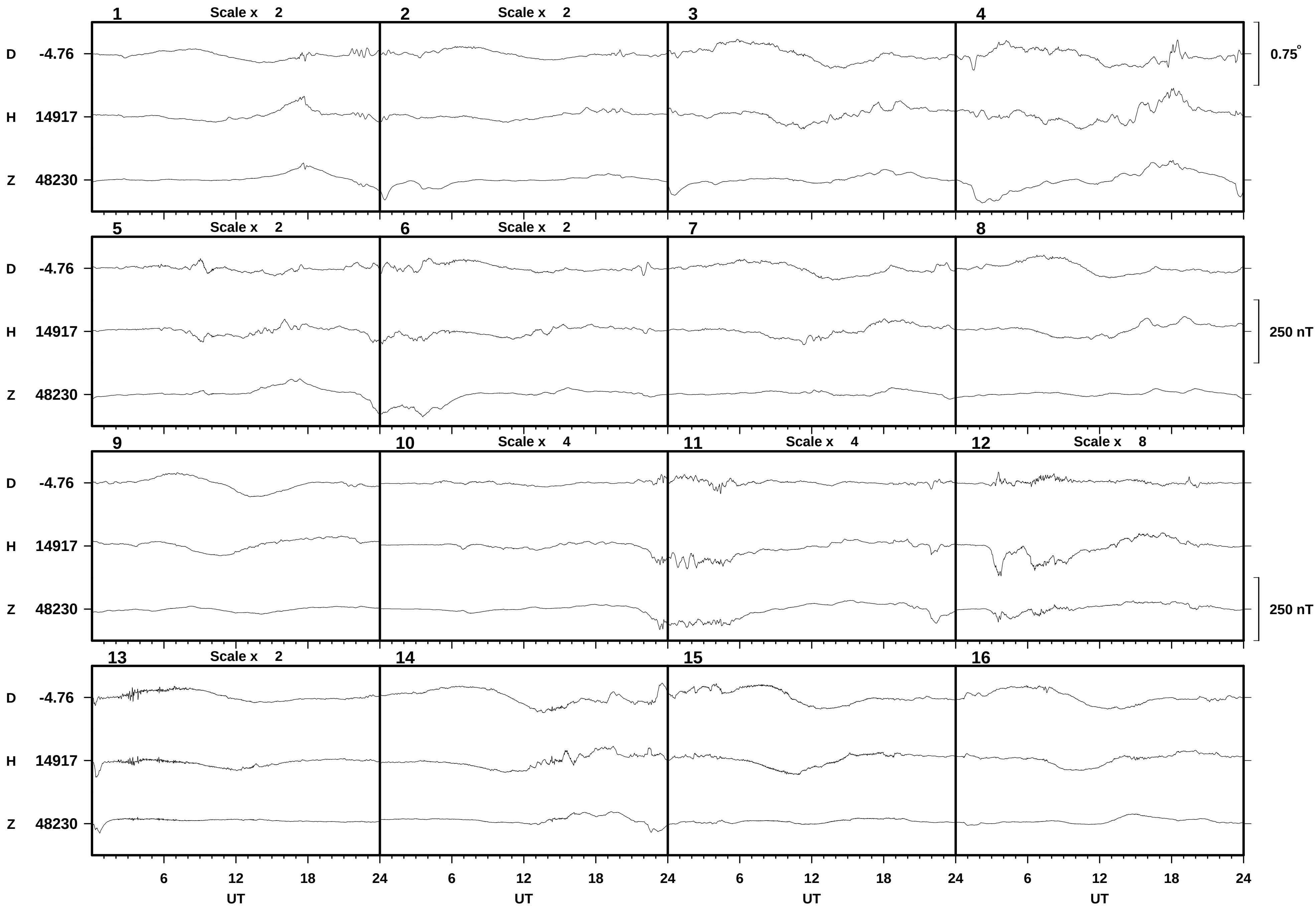
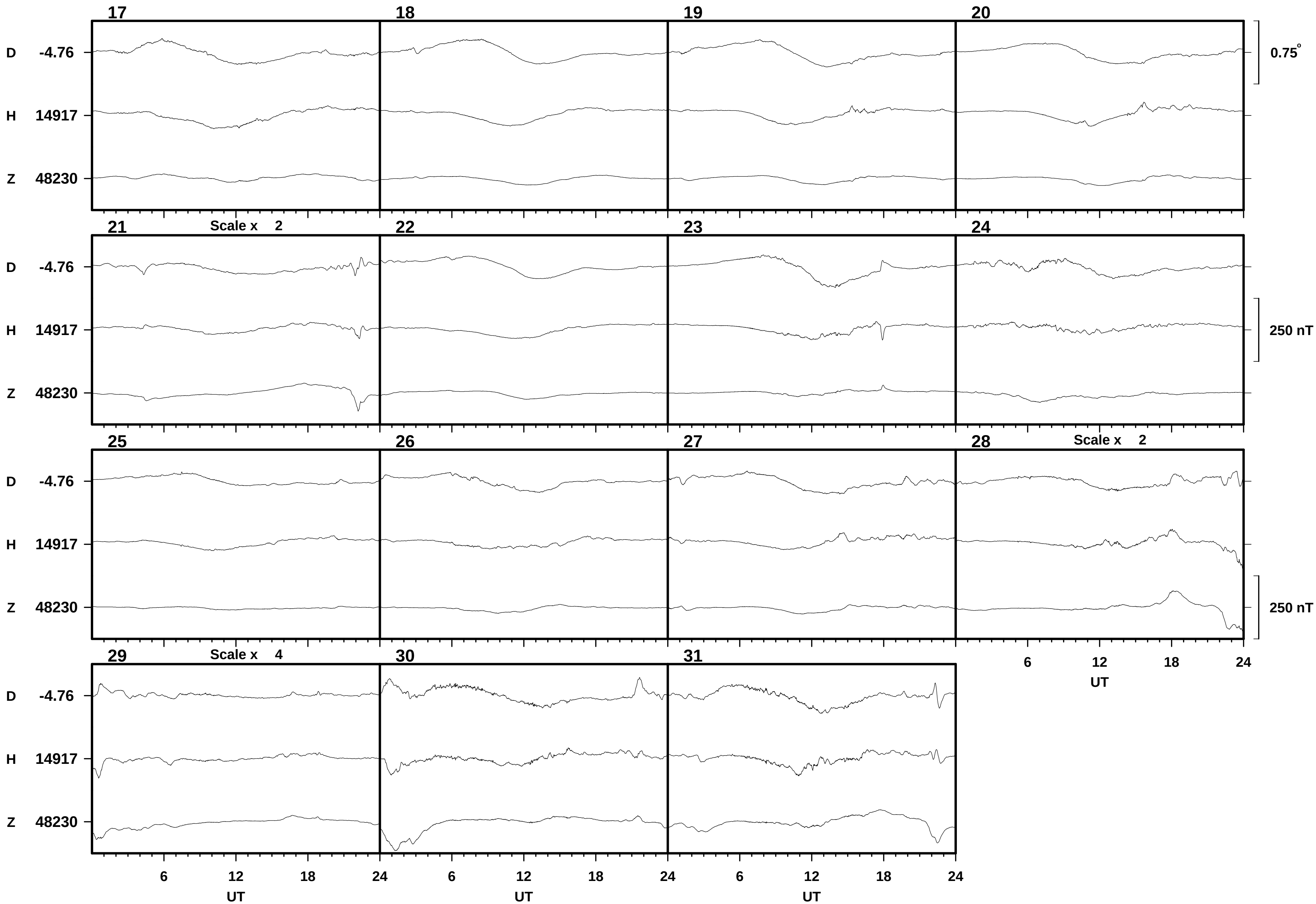
22
23
24
25
26
27
28
29
30
31
Scale x 2
D -4.79
H 14927
Z 48231
0.75°
250 nT
6
12
18
24
UT

Lerwick August 2000



LE 8 0


17
18
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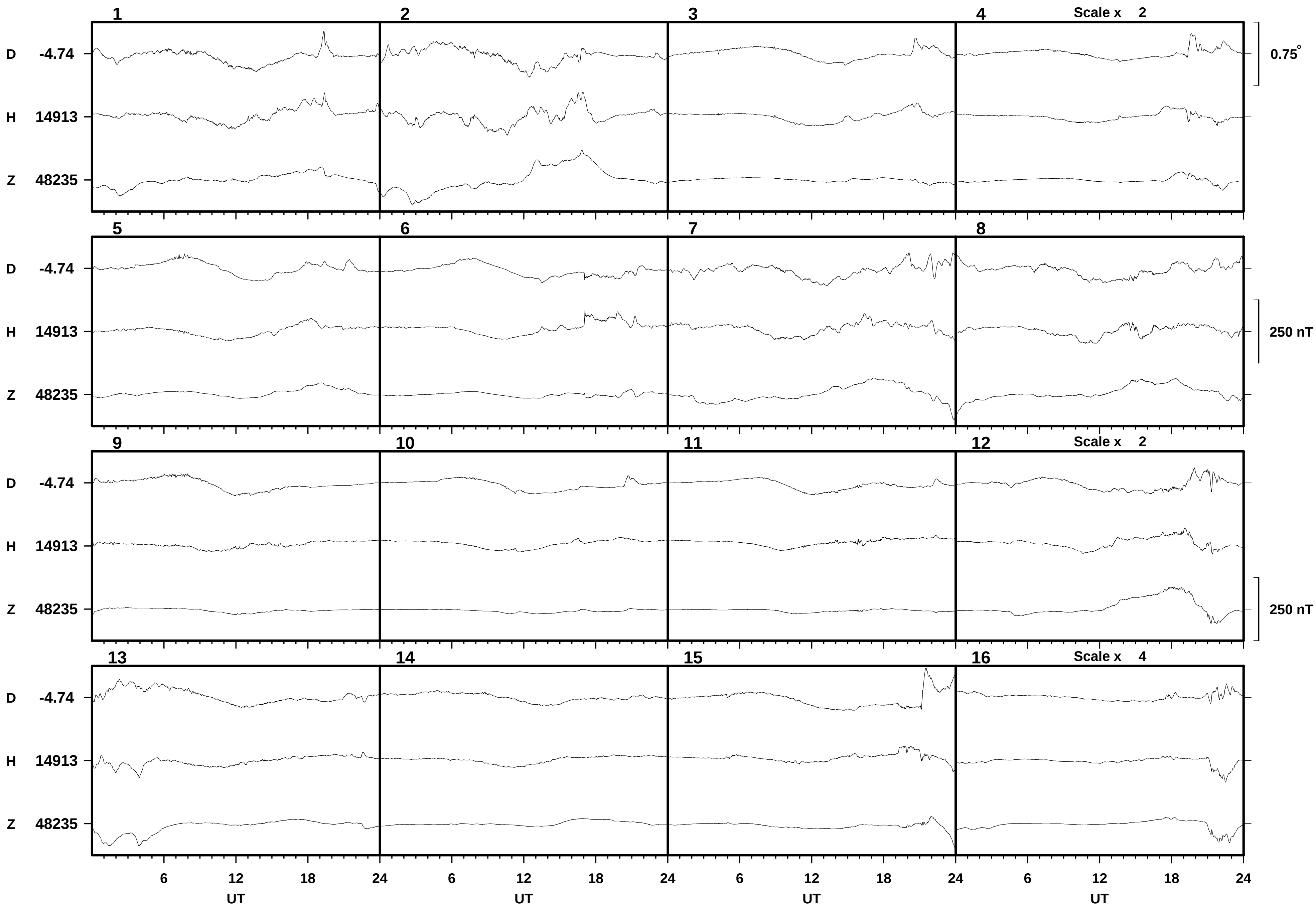
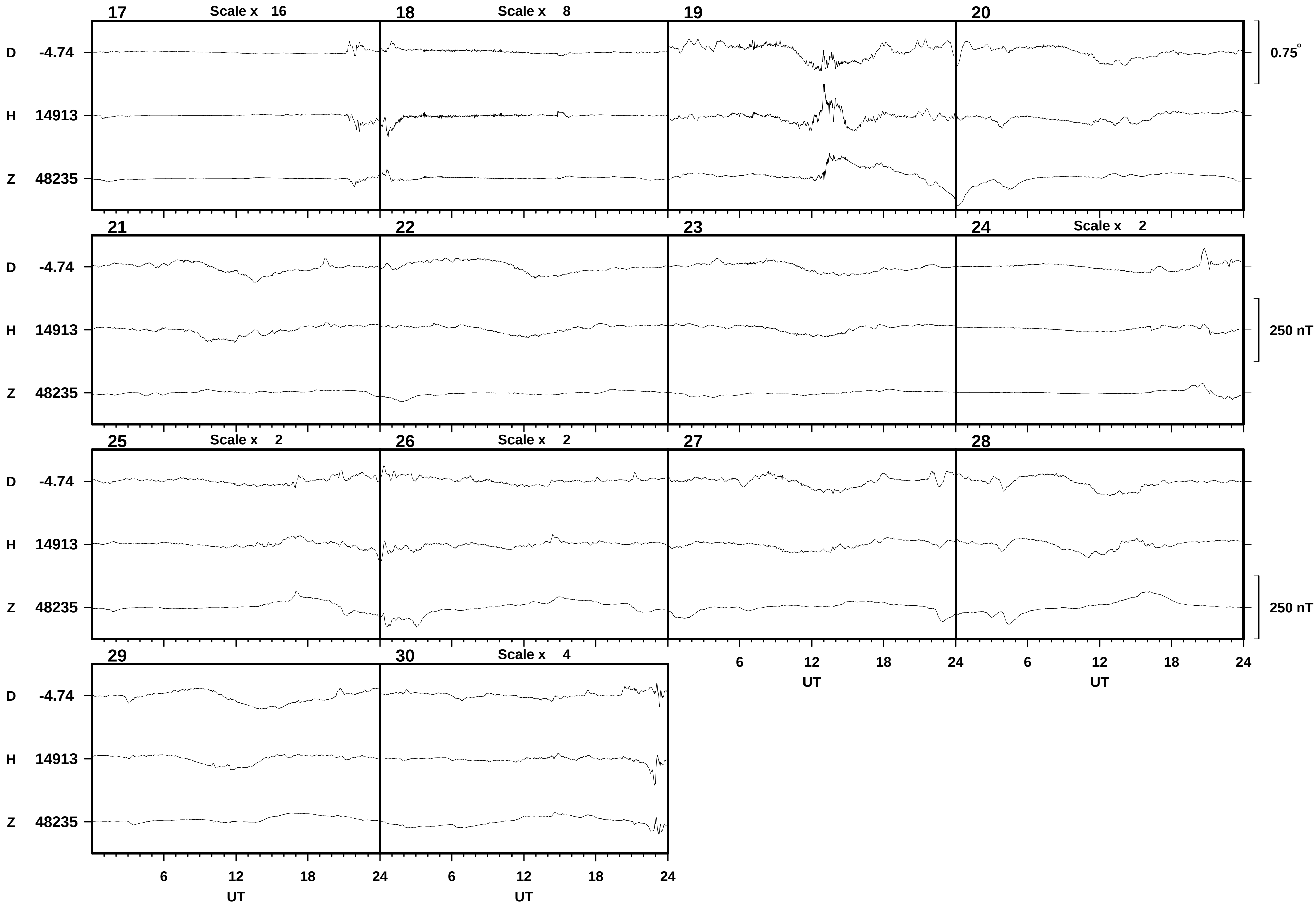
25
26
27
28
29
30
31
D -4.76
H 14917
Z 48230
0.75°
250 nT
250 nT
Scale x 2
Scale x 2
Scale x 4
6
12
18
24
UT

Lerwick September 2000

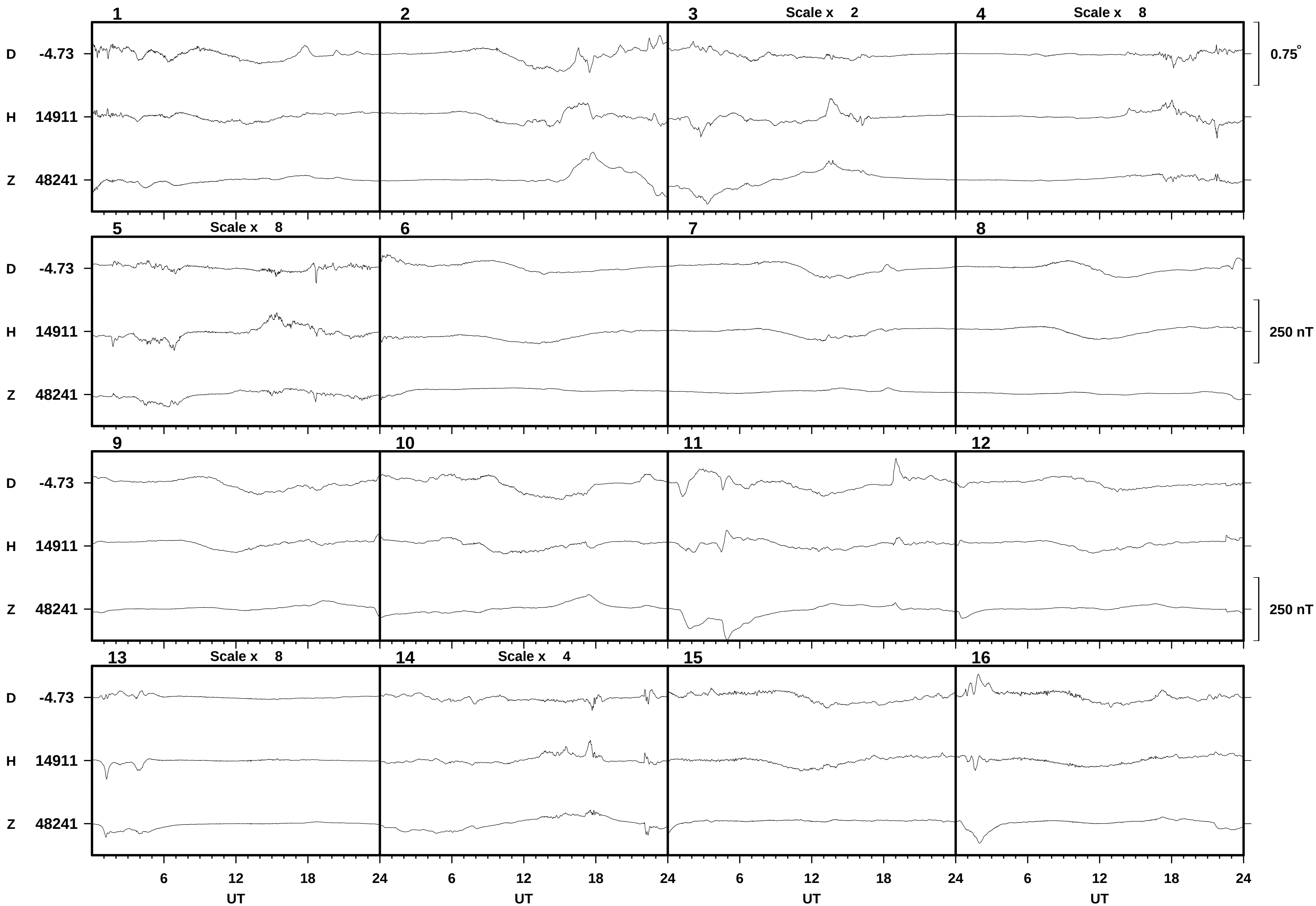




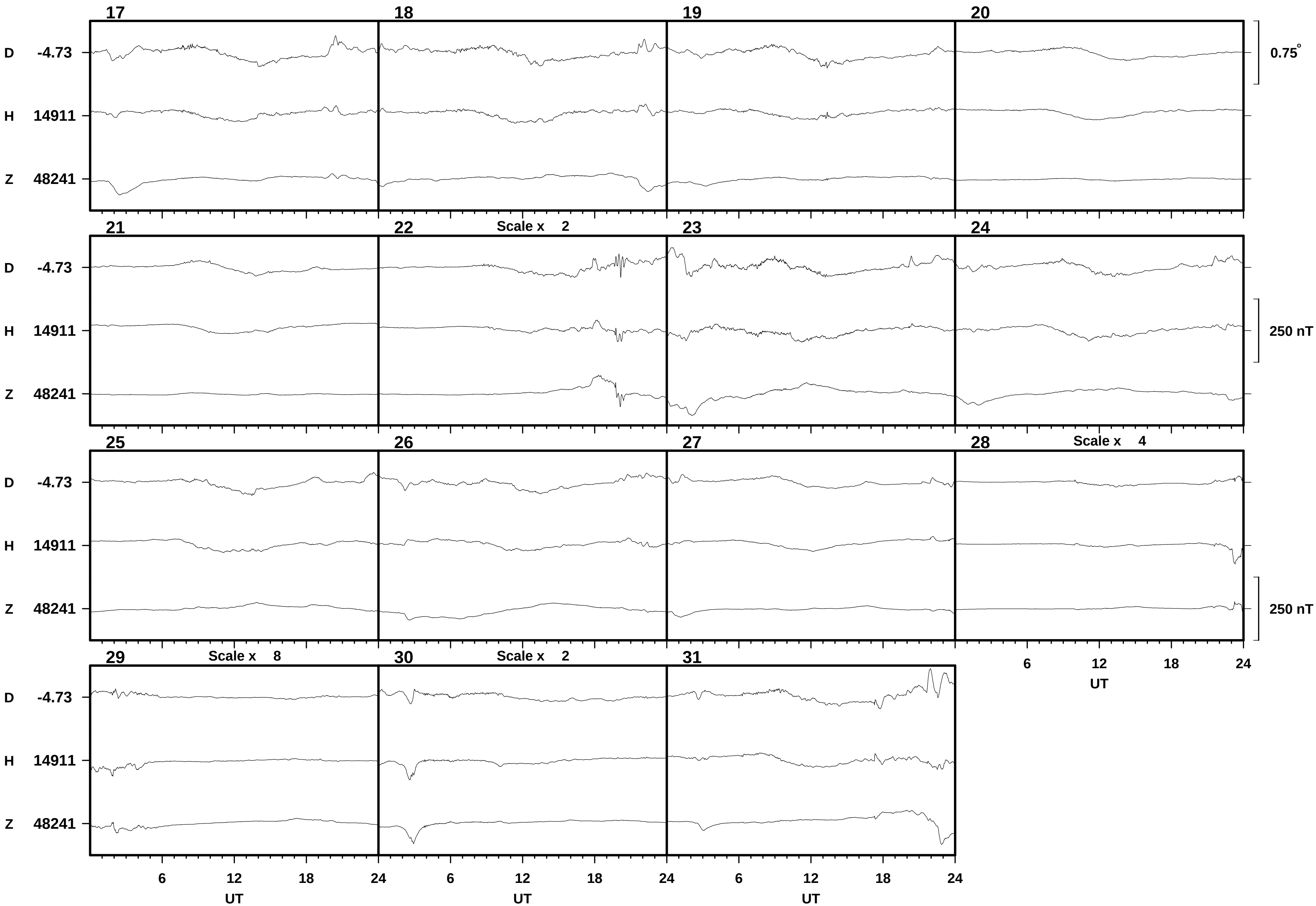
17
Scale x 16
18
Scale x 8
19
20
D -4.74
H 14913
Z 48235
0.75°
21
22
23
24
Scale x 2
250 nT
25
Scale x 2
26
Scale x 2
27
28
29
30
Scale x 4
6
12
18
24
UT

LE 9 0

Lerwick October 2000

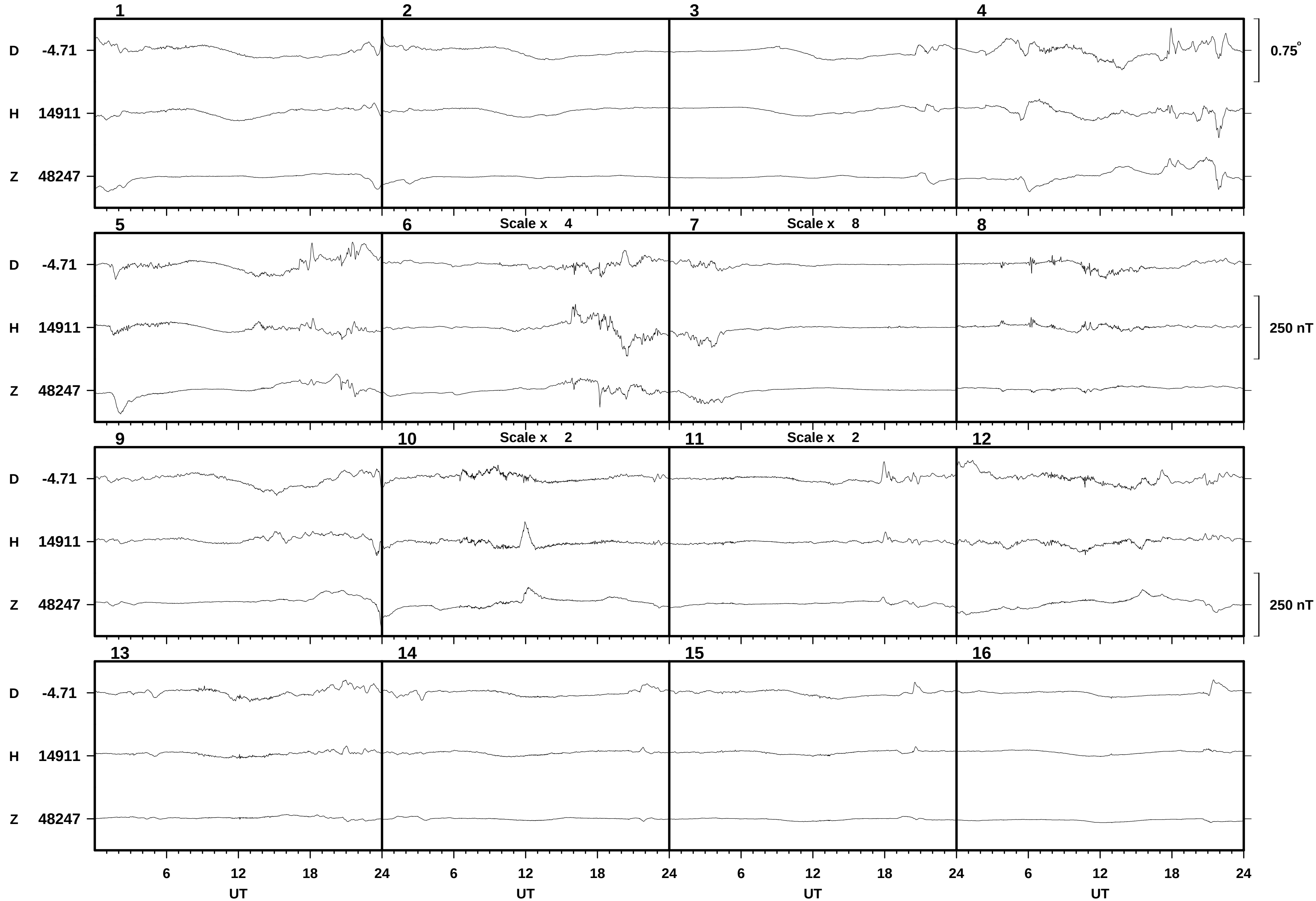


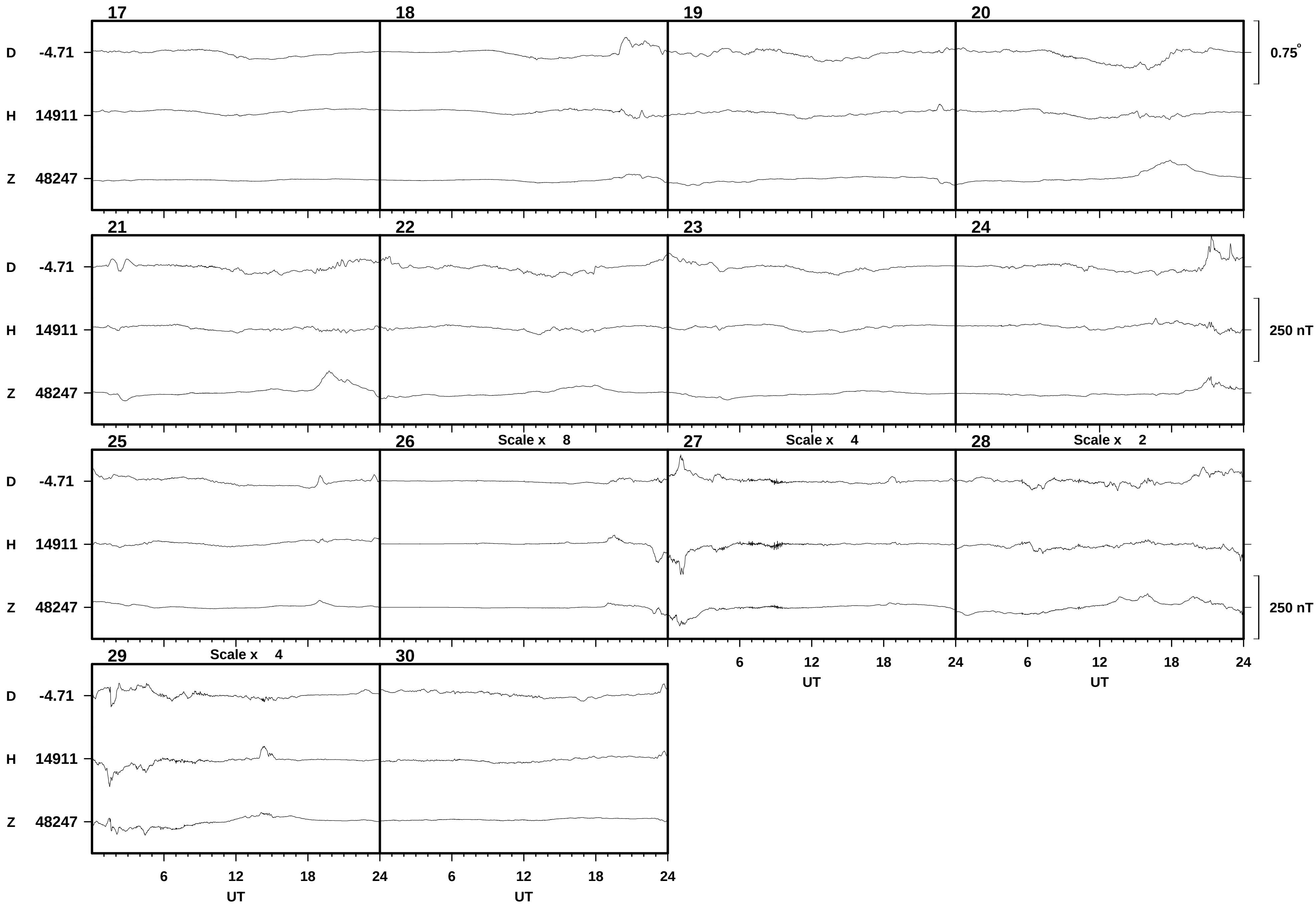
LE 10 0


17
18
19
20
21
22
Scale x 2
23
24
25
26
27
28
Scale x 4
29
Scale x 8
30
Scale x 2
31
D -4.73
H 14911
Z 48241
0.75°
250 nT
250 nT
6
12
18
24
UT

LE 10 0

Lerwick November 2000




17
18
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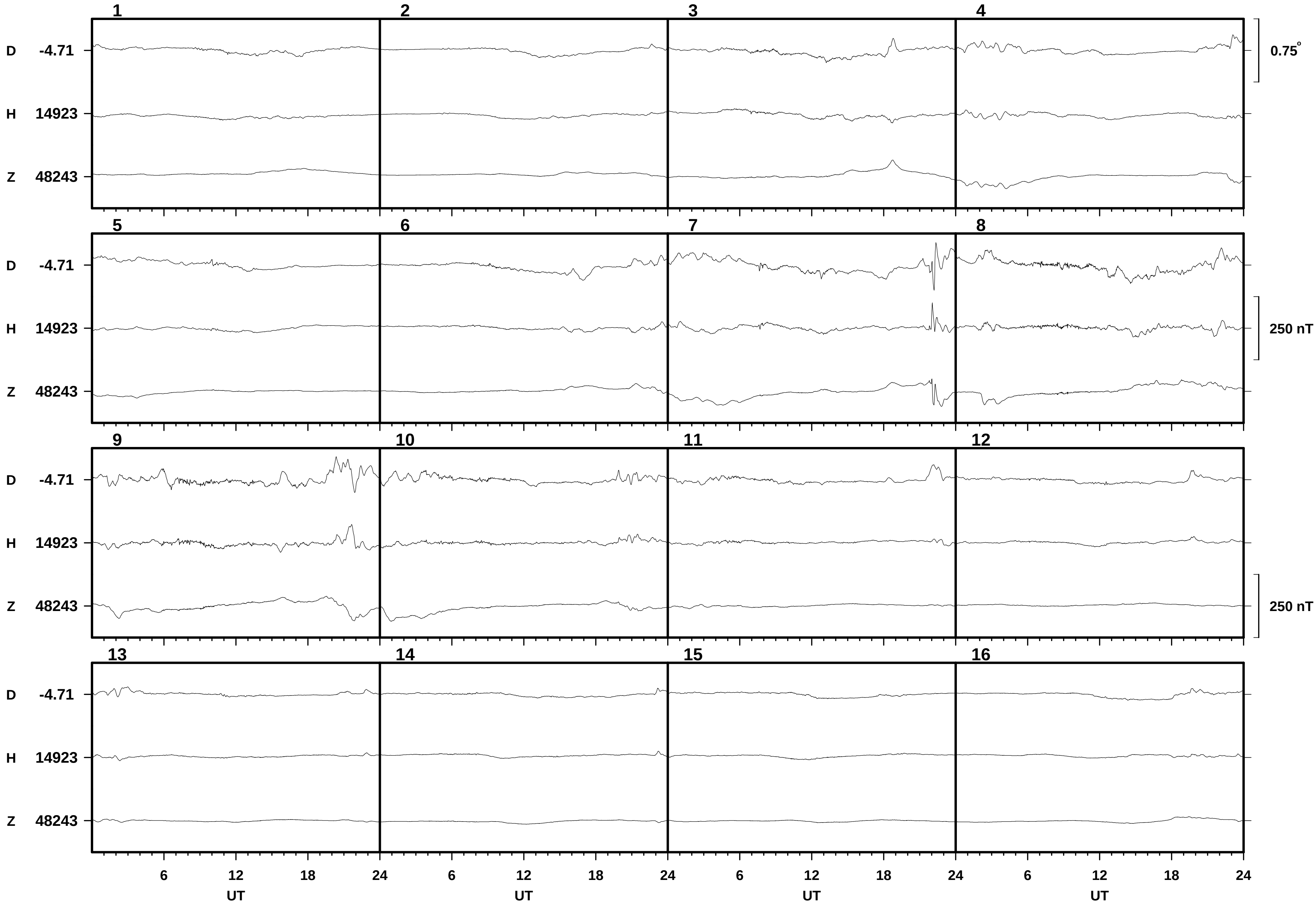
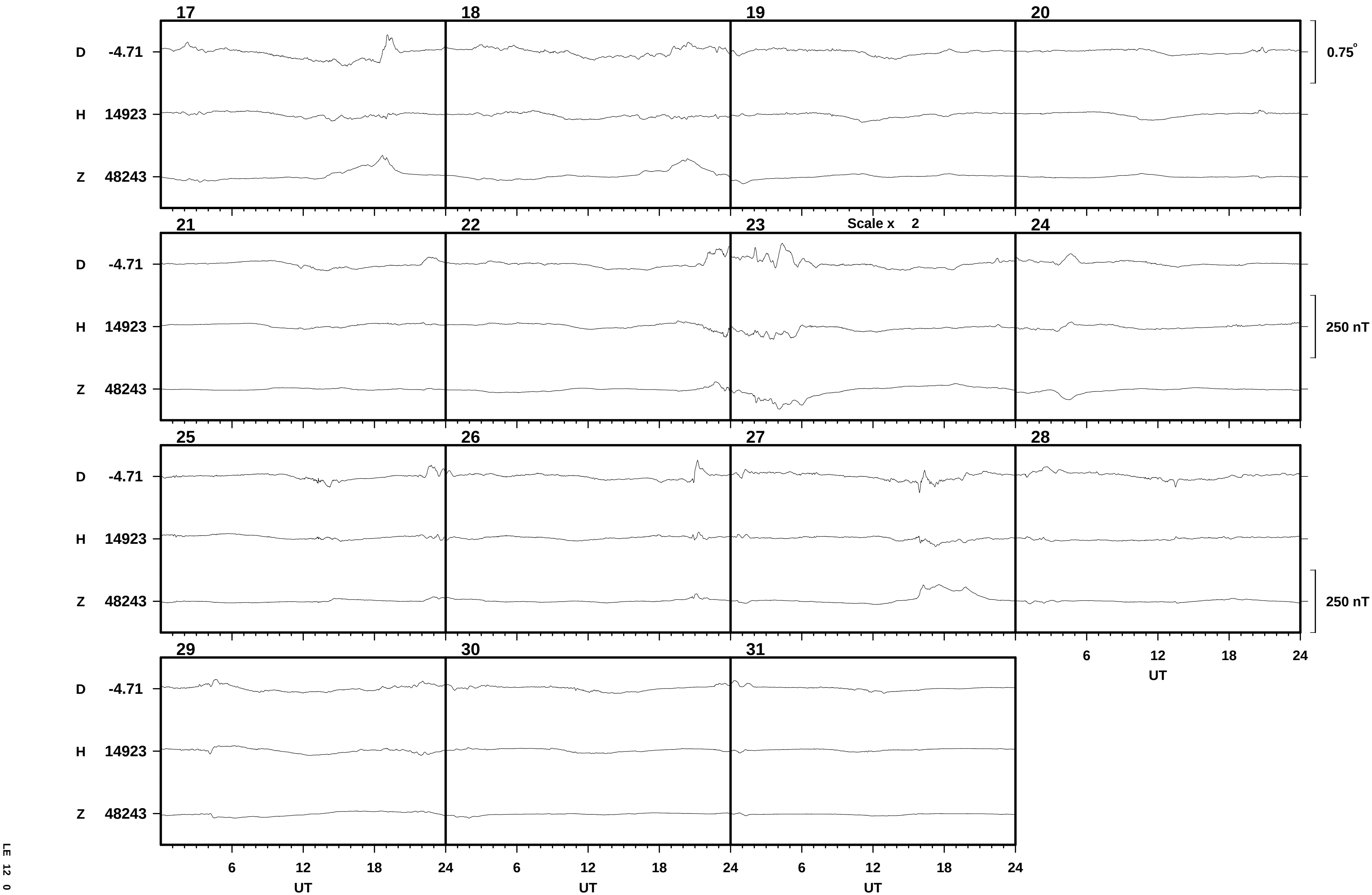
22
23
24
25
26
27
28
29
30
D -4.71
H 14911
Z 48247
0.75°
250 nT
250 nT
Scale x 8
Scale x 4
Scale x 2
Scale x 4
6
12
18
24
UT

LE 11 0

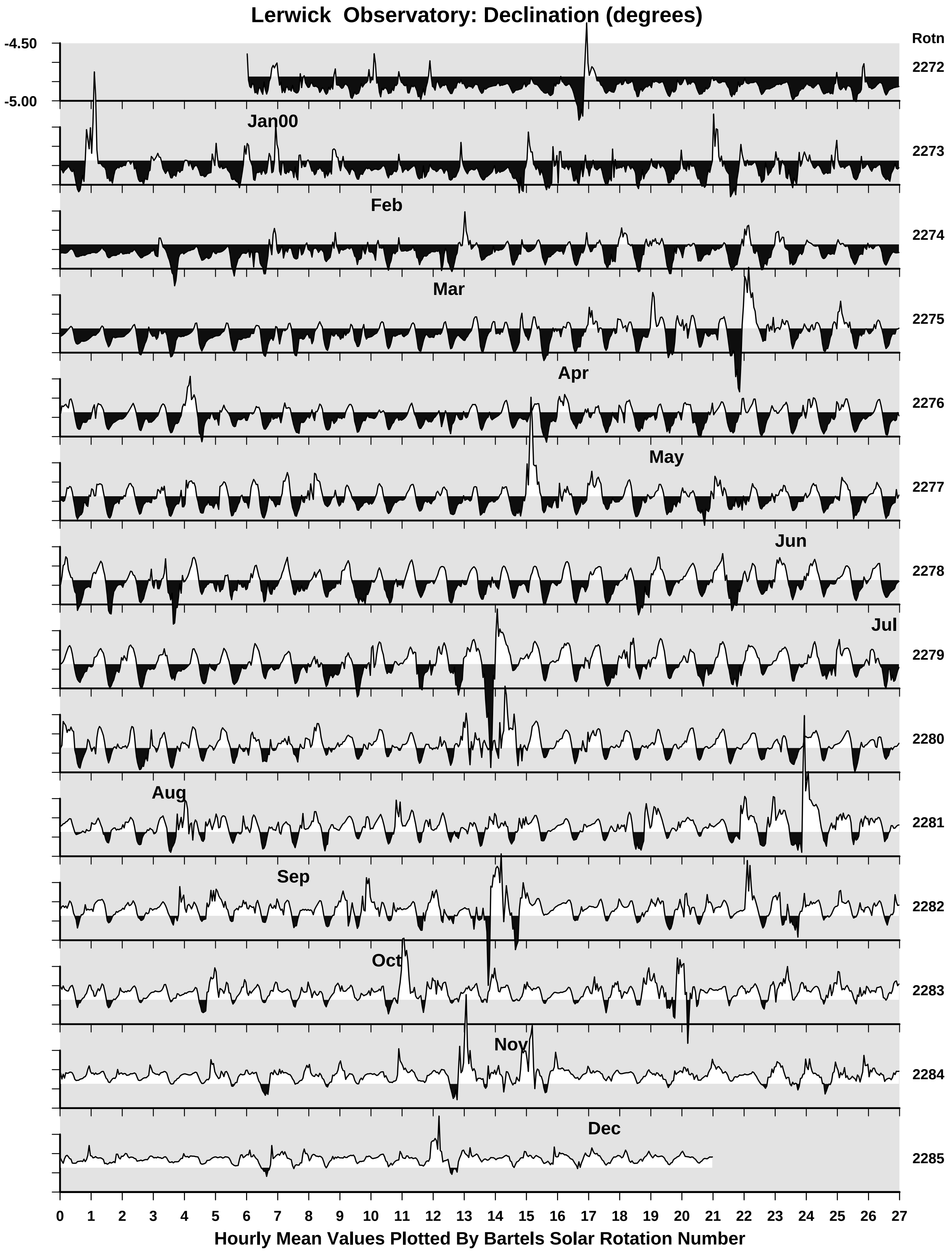
Lerwick December 2000



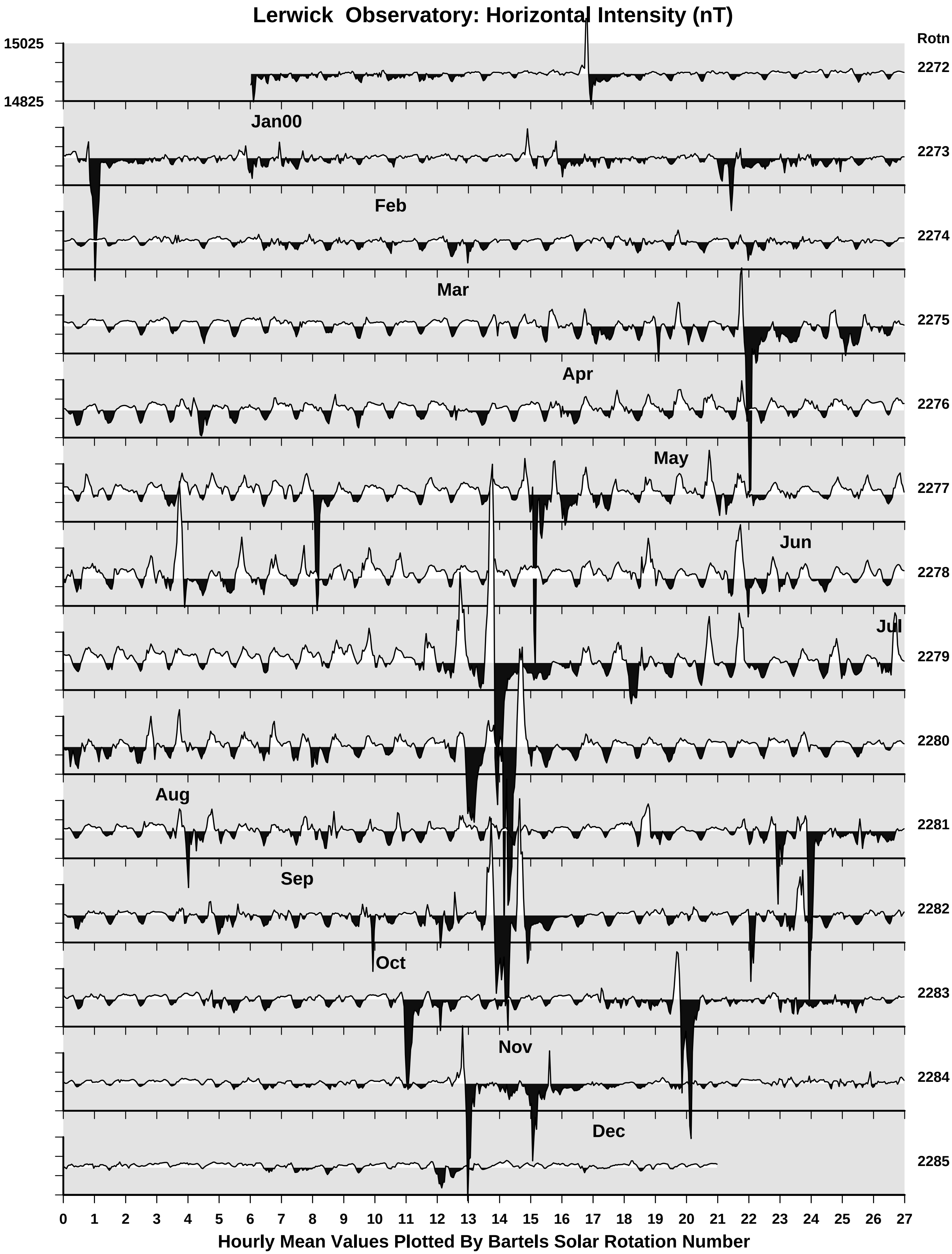
LE 12 0



17 18 19 20
21 22 23 24
25 26 27 28
29 30 31
D -4.71
H 14923
Z 48243
0.75°
Scale x 2
250 nT
250 nT
6 12 18 24
UT
LE 12 0

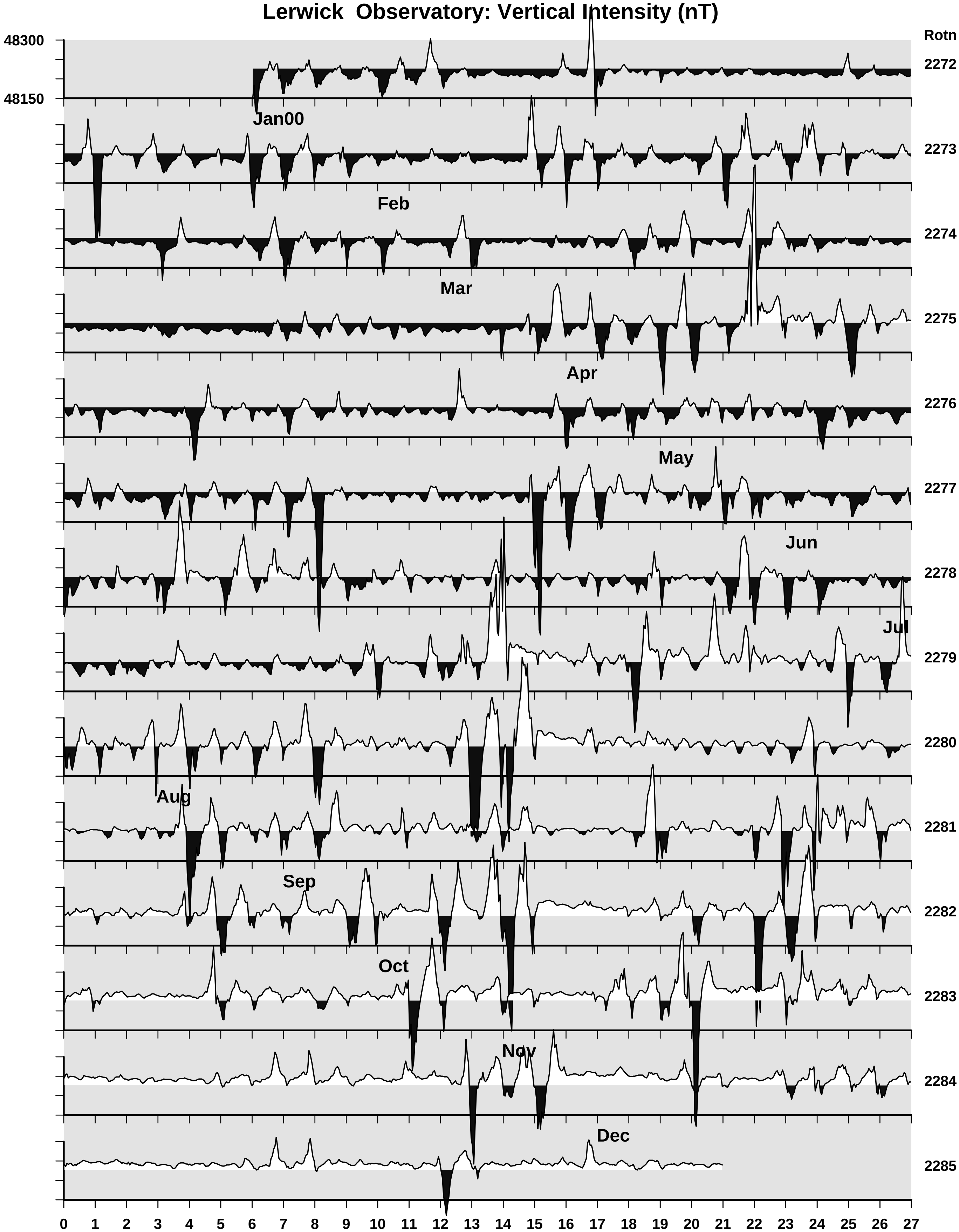


Lerwick Observatory: Declination (degrees)
-4.50
-5.00
Rotn
2272
2273
2274
2275
2276
2277
2278
2279
2280
2281
2282
2283
2284
2285
Jan00
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted By Bartels Solar Rotation Number

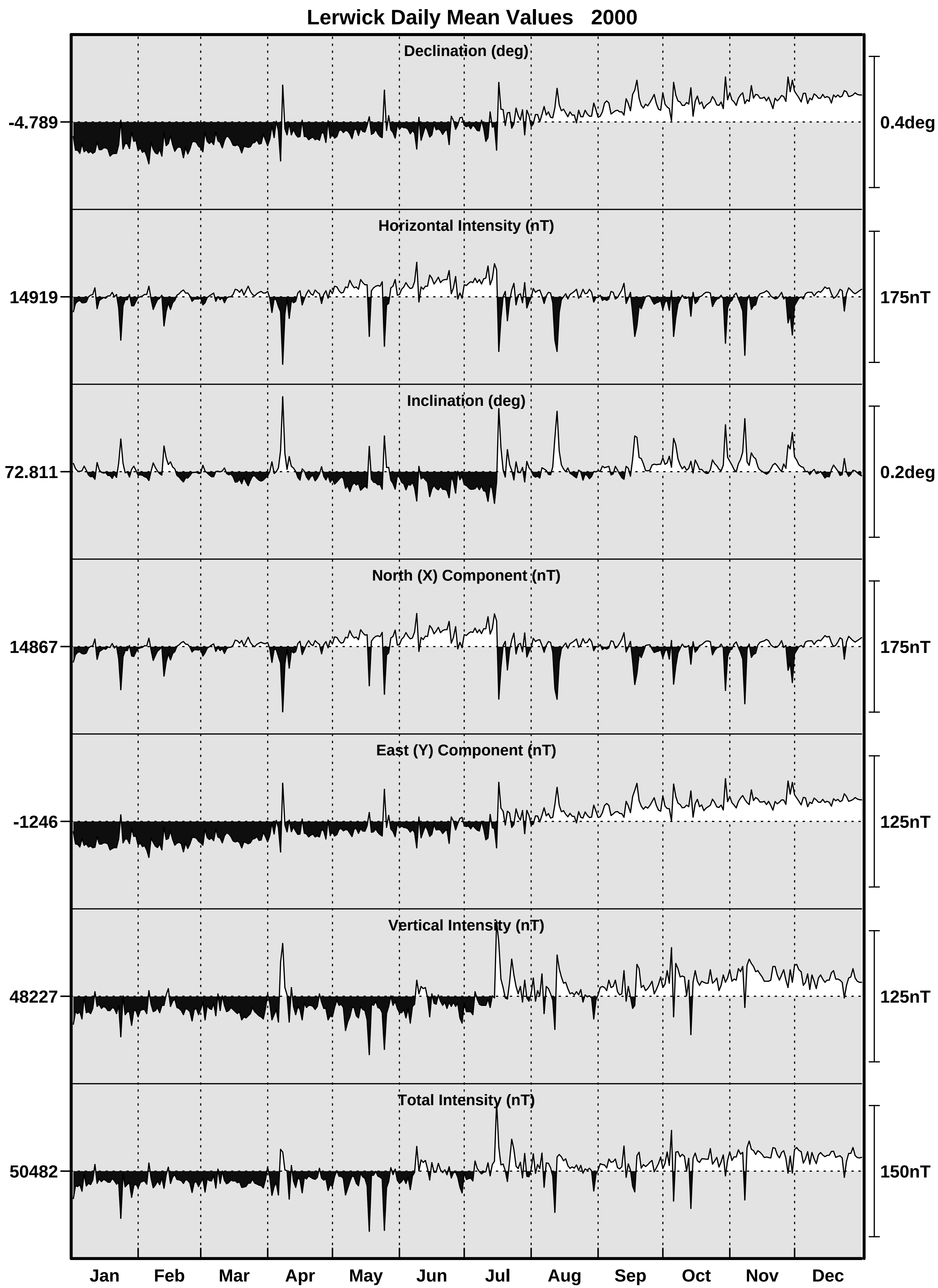


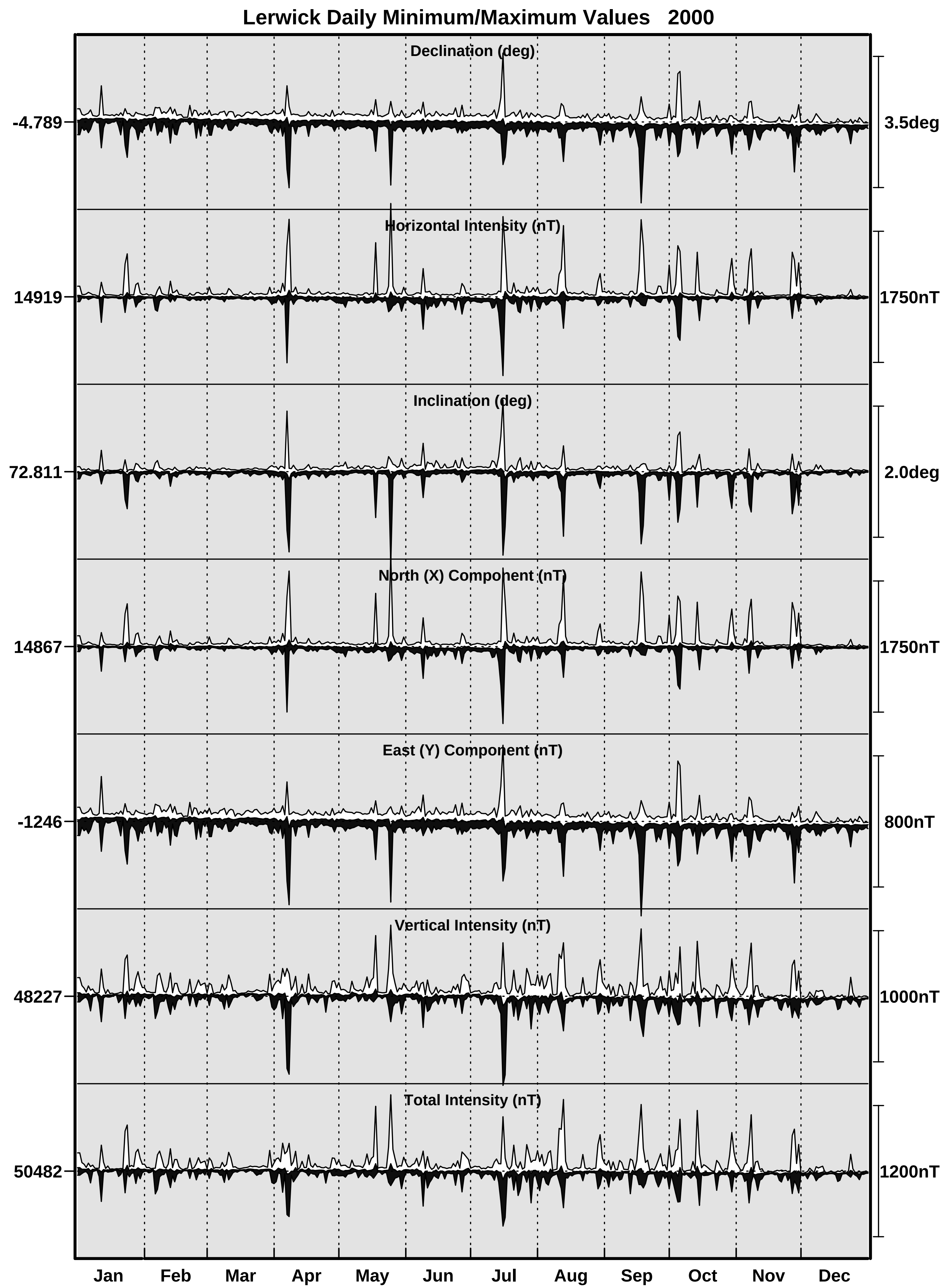
Lerwick Observatory: Horizontal Intensity (nT)
15025
14825
Rotn
2272
2273
2274
2275
2276
2277
2278
2279
2280
2281
2282
2283
2284
2285
Jan00
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted By Bartels Solar Rotation Number

Lerwick Observatory: Vertical Intensity (nT)



Hourly Mean Values Plotted By Bartels Solar Rotation Number


Lerwick Daily Mean Values 2000
Declination (deg)
-4.789
0.4deg
Horizontal Intensity (nT)
14919
175nT
Inclination (deg)
72.811
0.2deg
North (X) Component (nT)
14867
175nT
East (Y) Component (nT)
-1246
125nT
Vertical Intensity (nT)
48227
125nT
Total Intensity (nT)
50482
150nT
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Lerwick Daily Minimum/Maximum Values 2000
Declination (deg)
-4.789
3.5deg
Horizontal Intensity (nT)
14919
1750nT
Inclination (deg)
72.811
2.0deg
North (X) Component (nT)
14867
1750nT
East (Y) Component (nT)
-1246
800nT
Vertical Intensity (nT)
48227
1000nT
Total Intensity (nT)
50482
1200nT
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Monthly Mean Values for Lerwick 2000

Month	D	H	I	X	Y	Z	F

Based on All Days

Month	D	H	I	X	Y	Z	F
January	-4° 52.0′	14913 nT	72° 48.7′	14859 nT	-1265 nT	48213 nT	50466 nT
February	-4° 52.1′	14916 nT	72° 48.6′	14862 nT	-1266 nT	48216 nT	50470 nT
March	-4° 51.2′	14921 nT	72° 48.2′	14868 nT	-1262 nT	48213 nT	50470 nT
April	-4° 49.3′	14913 nT	72° 48.9′	14860 nT	-1254 nT	48219 nT	50472 nT
May	-4° 48.8′	14926 nT	72° 47.9′	14873 nT	-1252 nT	48212 nT	50469 nT
June	-4° 48.7′	14935 nT	72° 47.4′	14883 nT	-1253 nT	48220 nT	50480 nT
July	-4° 47.4′	14927 nT	72° 48.2′	14875 nT	-1246 nT	48231 nT	50488 nT
August	-4° 45.7′	14917 nT	72° 48.9′	14865 nT	-1238 nT	48230 nT	50484 nT
September	-4° 44.1′	14913 nT	72° 49.2′	14862 nT	-1231 nT	48235 nT	50488 nT
October	-4° 43.6′	14911 nT	72° 49.4′	14861 nT	-1229 nT	48241 nT	50493 nT
November	-4° 42.8′	14911 nT	72° 49.6′	14860 nT	-1225 nT	48247 nT	50499 nT
December	-4° 42.7′	14923 nT	72° 48.7′	14873 nT	-1226 nT	48243 nT	50499 nT
Annual	**-4° 47.3′**	**14919 nT**	**72° 48.6′**	**14867 nT**	**-1246 nT**	**48227 nT**	**50481 nT**

International quiet day means

Month	D	H	I	X	Y	Z	F
January	-4° 53.0′	14920 nT	72° 48.2′	14866 nT	-1270 nT	48212 nT	50468 nT
February	-4° 52.5′	14921 nT	72° 48.3′	14867 nT	-1268 nT	48216 nT	50472 nT
March	-4° 51.3′	14924 nT	72° 48.0′	14870 nT	-1263 nT	48212 nT	50469 nT
April	-4° 49.9′	14922 nT	72° 48.3′	14869 nT	-1257 nT	48217 nT	50473 nT
May	-4° 49.1′	14934 nT	72° 47.3′	14881 nT	-1254 nT	48211 nT	50471 nT
June	-4° 47.6′	14931 nT	72° 47.8′	14879 nT	-1248 nT	48222 nT	50481 nT
July	-4° 47.4′	14929 nT	72° 47.9′	14877 nT	-1246 nT	48224 nT	50482 nT
August	-4° 45.6′	14922 nT	72° 48.5′	14871 nT	-1238 nT	48228 nT	50484 nT
September	-4° 44.9′	14921 nT	72° 48.6′	14870 nT	-1235 nT	48231 nT	50486 nT
October	-4° 43.8′	14915 nT	72° 49.2′	14865 nT	-1230 nT	48245 nT	50498 nT
November	-4° 43.5′	14924 nT	72° 48.6′	14873 nT	-1229 nT	48243 nT	50498 nT
December	-4° 42.4′	14928 nT	72° 48.3′	14878 nT	-1225 nT	48241 nT	50498 nT
Annual	**-4° 47.6′**	**14924 nT**	**72° 48.2′**	**14872 nT**	**-1247 nT**	**48225 nT**	**50482 nT**

International disturbed day means

Month	D	H	I	X	Y	Z	F
January	-4° 50.0′	14902 nT	72° 49.4′	14848 nT	-1255 nT	48206 nT	50457 nT
February	-4° 51.3′	14906 nT	72° 49.3′	14853 nT	-1261 nT	48219 nT	50471 nT
March	-4° 50.9′	14917 nT	72° 48.6′	14863 nT	-1261 nT	48220 nT	50474 nT
April	-4° 48.0′	14895 nT	72° 50.4′	14843 nT	-1246 nT	48237 nT	50484 nT
May	-4° 47.4′	14902 nT	72° 49.2′	14850 nT	-1245 nT	48198 nT	50449 nT
June	-4° 50.4′	14949 nT	72° 46.5′	14895 nT	-1261 nT	48218 nT	50482 nT
July	-4° 47.3′	14922 nT	72° 48.9′	14870 nT	-1246 nT	48250 nT	50505 nT
August	-4° 44.4′	14893 nT	72° 50.4′	14842 nT	-1231 nT	48228 nT	50475 nT
September	-4° 41.7′	14890 nT	72° 50.7′	14841 nT	-1219 nT	48235 nT	50481 nT
October	-4° 42.7′	14894 nT	72° 50.4′	14843 nT	-1223 nT	48230 nT	50478 nT
November	-4° 41.1′	14879 nT	72° 51.5′	14829 nT	-1215 nT	48241 nT	50483 nT
December	-4° 42.4′	14919 nT	72° 48.8′	14868 nT	-1225 nT	48236 nT	50490 nT
Annual	**-4° 46.5′**	**14905 nT**	**72° 49.5′**	**14854 nT**	**-1241 nT**	**48226 nT**	**50477 nT**

Lerwick Observatory K Indices 2000

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4432 3253	1010 2123	1232 2244	3112 2433	1322 3433	3221 2102	2120 1122	2212 2433	3122 3343	3221 2321	3110 1103	1101 1201
2	2222 2332	1101 2312	4311 2102	3322 2123	3123 4333	1110 1122	1110 1211	3311 1332	3333 3422	0001 2323	2000 0000	0000 1002
3	3212 1141	1011 2234	0001 1132	2211 2223	1111 2443	3222 2231	2111 3223	2212 2321	0111 2233	5442 5411	0000 1122	1111 2231
4	2112 2223	1110 1002	0001 1100	5421 3453	1011 1222	0120 1332	2201 3221	3322 3442	1111 2454	1233 6687	2322 3434	3211 1013
5	4332 2244	1000 1245	0100 1123	3310 1220	1121 2123	3232 4333	1122 3210	1244 4424	1111 1333	6674 7775	3210 3343	1111 1100
6	2322 3333	4423 3355	1122 2323	1311 3698	3301 2213	2122 3411	0100 2220	4411 3224	1010 2433	2000 1010	3333 4686	0001 0222
7	3201 1132	5222 3444	3322 3333	9553 3434	2110 1110	1112 3233	2100 1121	0112 2222	2221 3334	0000 2220	7734 3231	3221 2225
8	1001 1100	3211 3242	2212 2342	2222 2122	0000 1112	3335 5776	1211 3220	1111 2221	3122 3323	0001 1102	0233 3212	3222 3323
9	1100 1002	1221 2311	2001 1011	2221 4243	1201 2422	1112 1112	0111 1222	1100 0112	2111 1100	1000 1122	2111 2324	2332 2344
10	1100 1113	2221 2223	0011 1324	4432 3333	3310 1111	3323 4432	1233 3442	0243 4336	0001 1222	2221 1222	3335 5223	3211 1132
11	2111 2365	3321 2232	3221 3222	1221 2232	1010 1112	2323 3431	2323 4444	6542 4345	0001 1212	4421 1142	2201 2442	2211 1013
12	3211 1121	5545 4433	2323 3222	2220 1211	1322 2133	2230 4442	4312 1221	6877 7564	1222 4354	2001 1102	2322 2322	1000 1121
13	1212 2201	2112 2323	1000 0022	2311 0000	4122 3321	1222 3213	1224 6524	4421 3112	3410 1112	7622 4322	1212 1123	2100 0001
14	2110 1231	3333 4543	2001 1122	0000 1110	3201 1131	3131 4443	3333 5764	0100 2333	0010 1111	3443 5645	2200 0002	0000 0002
15	2110 1112	3211 2144	1000 0000	0001 2223	4222 2212	4222 3442	3343 7899	2211 1210	0101 1224	2211 2112	0100 0021	0000 0000
16	1010 1122	3101 1231	0000 0100	3443 3221	3422 2333	2011 1101	7544 4321	2020 2111	3212 2436	3111 1212	0000 0013	0000 0021
17	1000 1000	1012 2221	1011 1000	2221 1211	7832 2133	1001 2222	3222 3211	2211 2111	5322 4349	2211 2133	1000 0000	2100 2241
18	0000 1100	0000 0000	0001 2231	1110 0031	2211 1111	1001 2432	1221 3323	1100 0010	8545 5523	2111 2113	0000 1133	1111 1222
19	0000 1113	0001 0101	2211 2210	2311 2311	2112 2211	3200 0211	2011 2434	1000 1211	3224 5333	2111 2112	1211 1112	1101 1110
20	2111 2141	0000 0012	0012 2000	2321 2332	1100 1221	2112 2100	4545 4333	0002 0221	3312 2211	0000 0010	1111 1322	0000 0010
21	1000 1000	3322 3431	0011 1210	2102 3311	1211 1112	1100 2212	3111 3211	2301 1234	1112 2121	0001 1010	2211 1122	0001 1102
22	1111 2266	1100 1101	1221 2333	1111 2110	1222 2121	3212 2231	2212 2441	0100 0100	2111 1110	1012 3453	2111 2212	0100 0013
23	7522 3201	1012 3301	2223 3211	0011 1211	1211 2255	2322 5443	1201 4562	0001 2331	1211 1111	4222 1122	2201 1100	4531 1222
24	1122 1224	2323 3445	3212 2311	1233 4222	9955 4555	4332 1101	2210 1102	1222 1110	0100 1353	2112 2122	0101 1223	1200 0000
25	1211 1122	3323 2323	1121 2330	2002 2220	4433 3443	1000 1112	0101 2211	0000 1110	2222 2435	1011 2022	2100 0122	1000 2002
26	1211 1113	2222 1353	0011 1111	0010 1010	3322 3420	2344 5455	2222 4235	1111 1210	5332 4323	3111 1112	1131 3367	1100 0123
27	3211 2255	2112 2222	1011 1010	2112 2324	1111 3322	5221 4334	3200 1112	2000 2121	2131 2223	2011 1102	7544 3242	2100 1321
28	5332 3335	2322 4213	1111 1100	3221 2222	1112 2322	3311 2212	3333 5442	2112 3445	2312 3210	0013 3126	3343 3344	2100 2000
29	4322 3432	0022 2100	0001 1135	2212 3433	1212 4553	2221 2101	4434 3323	6343 3342	2202 2221	6632 2343	7543 5423	1210 0112
30	2221 2243		2110 2243	3410 2231	4243 3333	0001 1221	3301 2221	3211 2223	3343 4447	5422 1221	1111 0102	1000 0000
31	3122 2212		2322 4333		2321 1113		1221 3445	2213 3223		2111 1324		1000 0000

SIs and SSCs

Day	Month	UT		Type	Quality	H(nT)	D(min)	Z(nT)
11	1	14	26	SSC*	C	14.1	-3.10	5.1
27	1	14	53	SSC*	C	11.2	0.40	-3.7
3	2	12	21	SSC*	C	6.2	-2.65	1.5
5	2	15	43	SSC*	A	11.4	-1.20	3.4
11	2	02	58	SSC*	A	16.0	-6.05	-3.7
14	2	07	32	SSC*	B	-17.7	2.31	4.3
20	2	21	39	SSC*	A	30.7	-2.29	-12.5
21	2	07	41	SSC*	C	6.1	-1.18	-2.6
21	2	15	17	SI	B	-69.0	10.11	16.5
1	3	03	57	SSC*	C	7.8	1.64	-
29	3	14	05	SSC*	C	-5.1	0.47	2.6
29	3	19	24	SSC	C	14.5	-1.88	-5.7
06	4	16	39	SSC*	A	137.3	-11.26	-37.0
1	5	15	08	SSC	A	-32.1	3.70	11.6
23	5	17	03	SSC*	A	25.2	-2.22	-9.2
4	6	15	01	SSC*	A	49.4	-2.90	-15.8
8	6	09	10	SSC*	A	-68.4/+73.7	16.78	-18.0/+26.3
11	6	08	01	SSC*	B	-14.2	2.58	-2.0/+2.5
23	6	13	02	SSC*	B	47.0	-1.77/+1.36	-21.5
10	7	06	37	SSC*	B	-11.1	4.96	-6.4
11	7	13	11	SI*	C	-96.2	-5.34	-22.7/+30.0
13	7	09	42	SSC*	B	-11.7	4.53	-5.2
14	7	15	32	SSC*	B	104.5	-5.97	-28.8
15	7	14	37	SSC*	A	276.3	-13.67	-100.0
17	7	08	07	SSC*	B	12.2	5.80	-10.3
19	7	15	26	SSC*	A	77.1	-4.81	-26.3
28	7	06	33	SSC*	B	-40.9	-5.92	-10.7/+12.7
10	8	05	00	SSC*	B	-8.5	-4.90	-1.2
11	8	18	45	SSC	C	25.5	-3.76	+4.0/-4.8
6	9	17	01	SSC*	A	61.8	-5.20	-20.1
17	9	17	24	SSC*	B	64.3	-4.89	-23.9
18	9	14	44	SSC*	B	171.7	-11.77	-44.9
12	10	22	27	SSC*	A	24.1	-1.69	-10.6
31	10	17	14	SSC*	A	29.3	3.95	-12.1
6	11	09	47	SSC*	B	14.6	6.68	-4.7
7	11	18	16	SSC*	C	49.9	3.65	-20.6/-19.3
10	11	06	28	SSC*	B	-26.8	-8.51	17.6
26	11	11	58	SSC*	C	-10.1	3.55	-5.3
28	11	05	30	SSC*	B	-23.5	-5.84	-14.8
21	12	11	33	SSC*	C	3.9	-1.13	-1.3
22	12	19	26	SSC	C	6.7	+0.34/-0.34	-3.2
24	12	17	46	SSC	C	4.8	0.32	-1.3

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)
28	10	09	54	10	04	10	20	23.7	-9.15	-13.4

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

Annual Values of Geomagnetic Elements

Lerwick

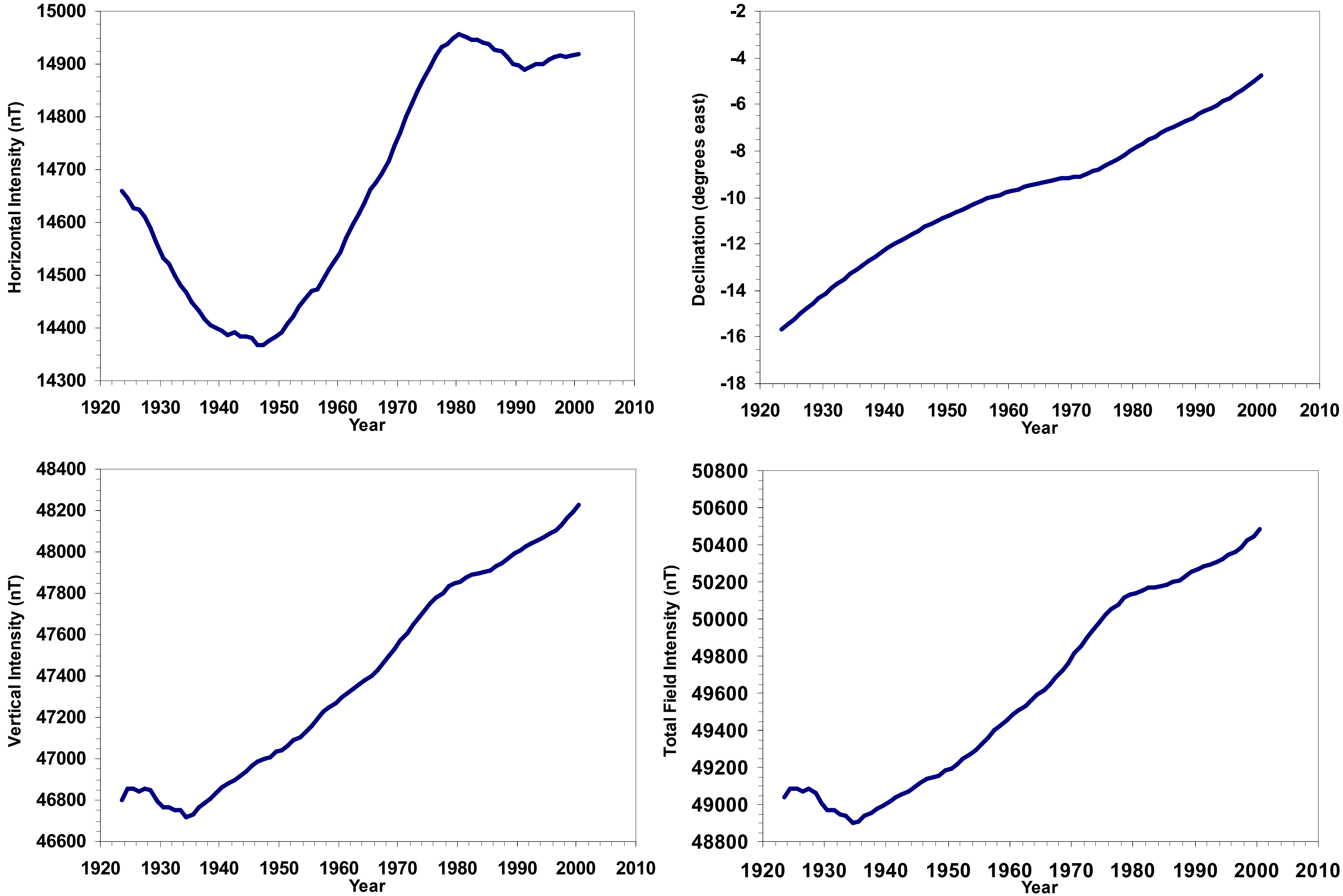
Year	D		H	I		X	Y	Z	F
1923.5	-15	40.3	14655	72	33.7	14111	-3959	46655	48902
1924.5	-15	26.5	14642	72	35.7	14113	-3899	46708	48950
1925.5	-15	13.5	14621	72	37.2	14108	-3840	46713	48948
1926.5	-14	58.6	14618	72	37.1	14121	-3778	46699	48933
1927.5	-14	45.7	14607	72	38.1	14125	-3722	46713	48944
1928.5	-14	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
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

Year	D		H	I		X	Y	Z	F
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
Note 3	0	0.0	0	0	0.5	0	0	8	6
1996.5	-5	32.6	14914	72	46.5	14844	-1441	48103	50362
1997.5	-5	21.6	14919	72	46.7	14854	-1393	48130	50389
1998.5	-5	9.6	14913	72	47.7	14853	-1341	48164	50420
1999.5	-4	58.5	14917	72	48.1	14860	-1293	48190	50446
2000.5	-4	47.3	14919	72	48.6	14867	-1246	48227	50481

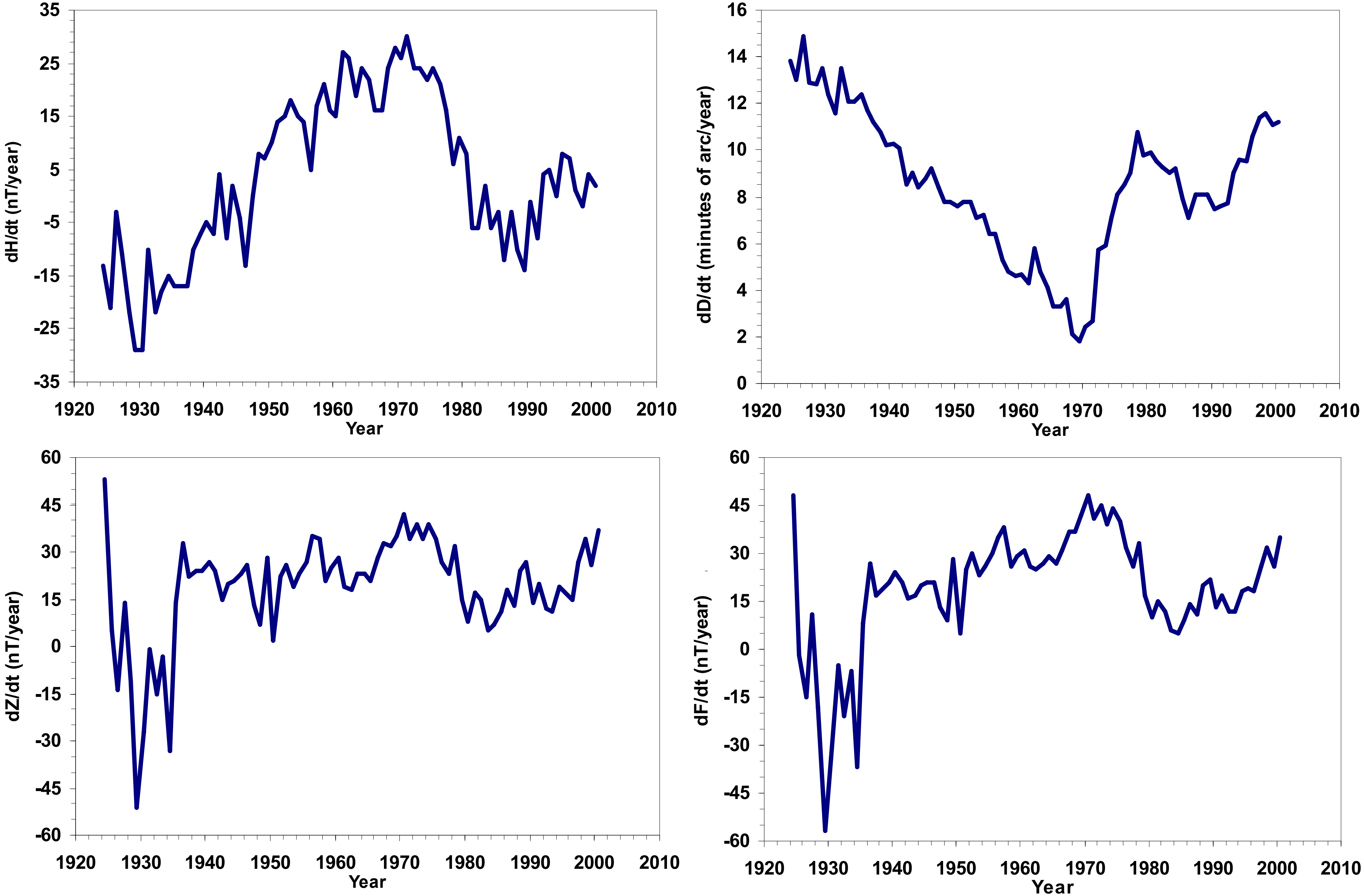
1 Site differences 1 Jan 1934 (new value - old value)
2 Site differences 1 Jan 1990 (new value - old value)
3 Site differences 1 Jan 1996 (new value - old value)

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

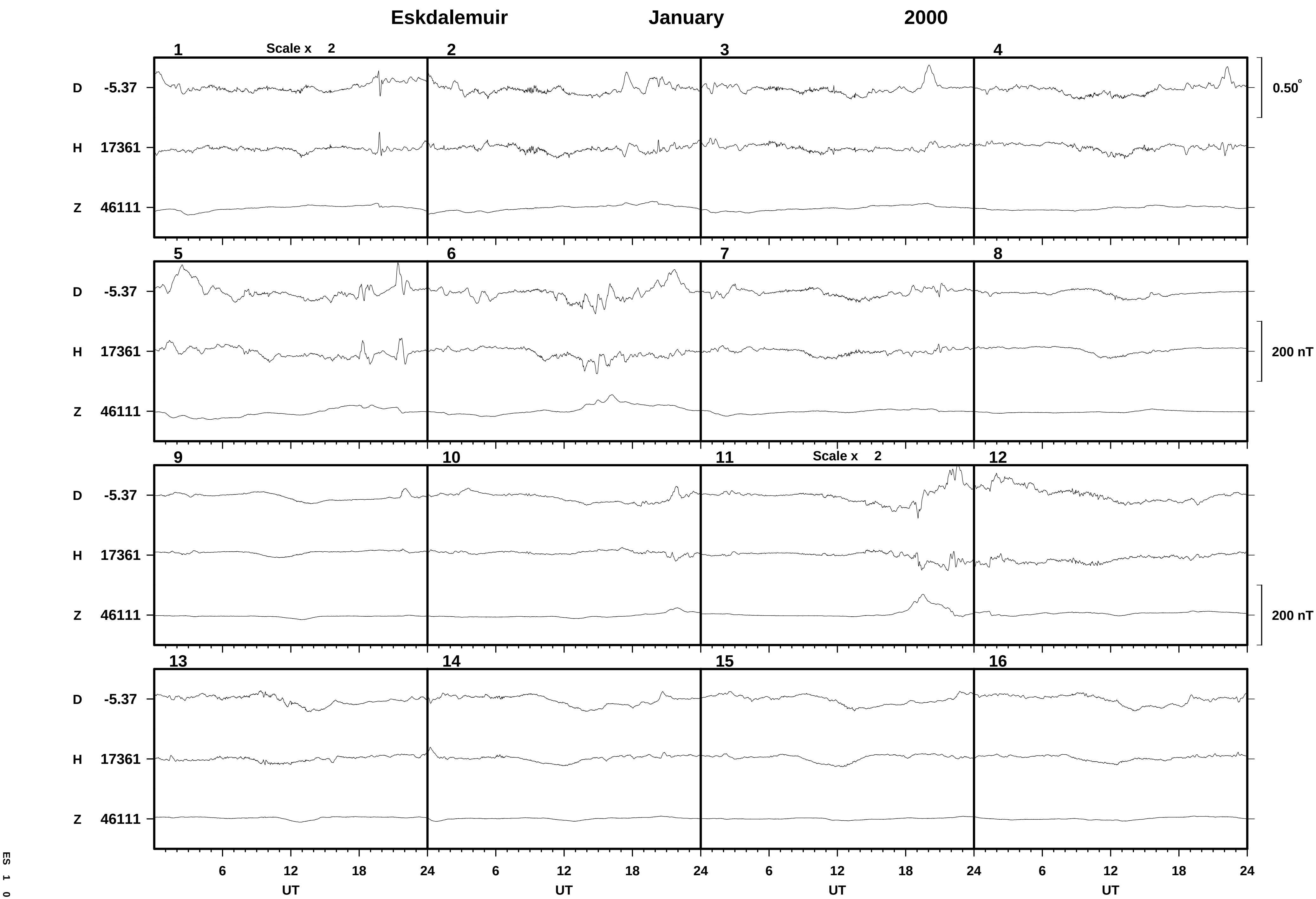
Annual Mean Values at Lerwick



Rate of Change of Annual Mean Values at Lerwick



Eskdalemuir Observatory Results 2000


Eskdalemuir
January
2000
1
Scale x 2
2
3
4
5
6
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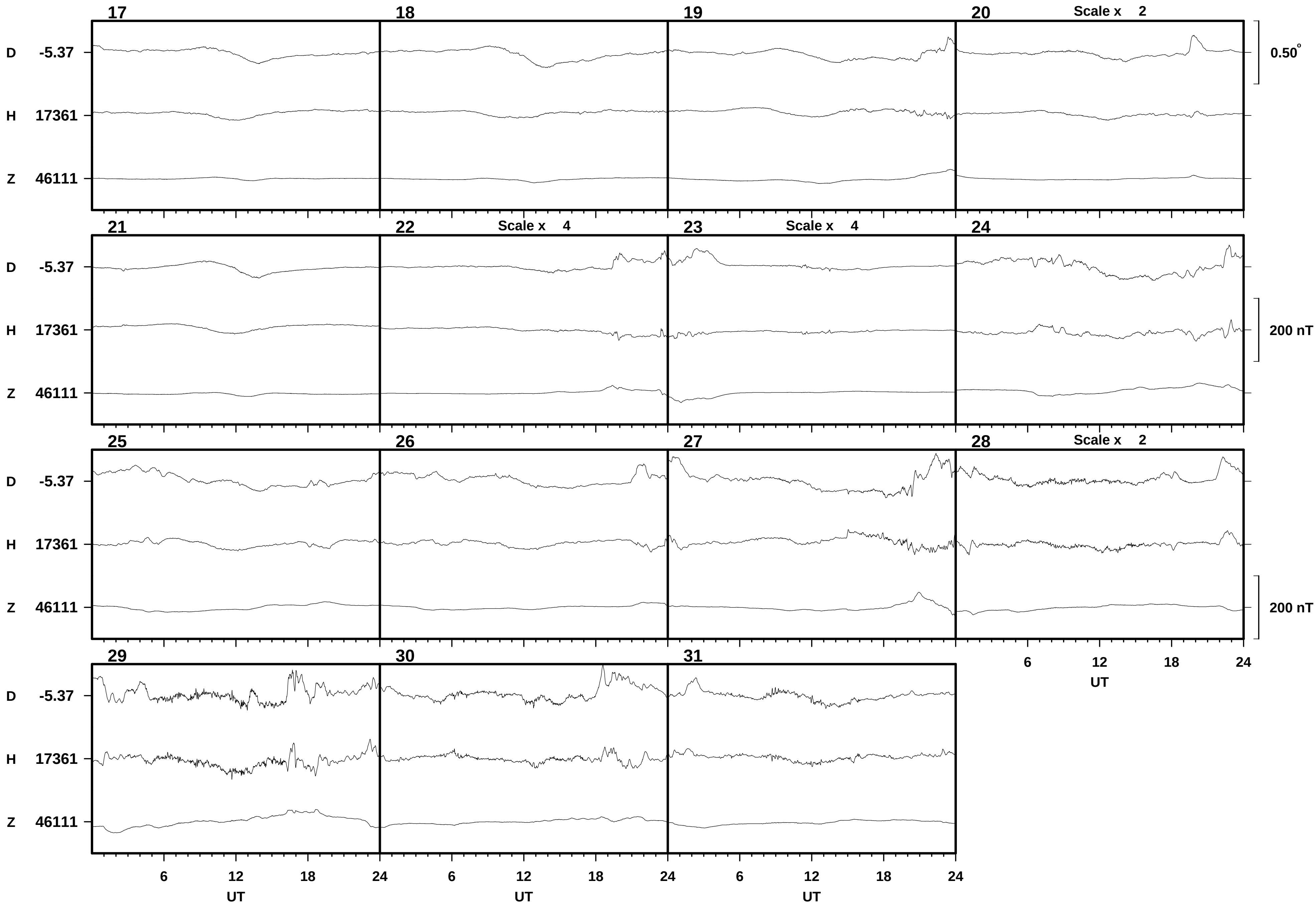
8
9
10
11
Scale x 2
12
13
14
15
16
D -5.37
H 17361
Z 46111
0.50°
200 nT
200 nT
6
12
18
24
UT
ES 1 0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18
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Scale x 2
21
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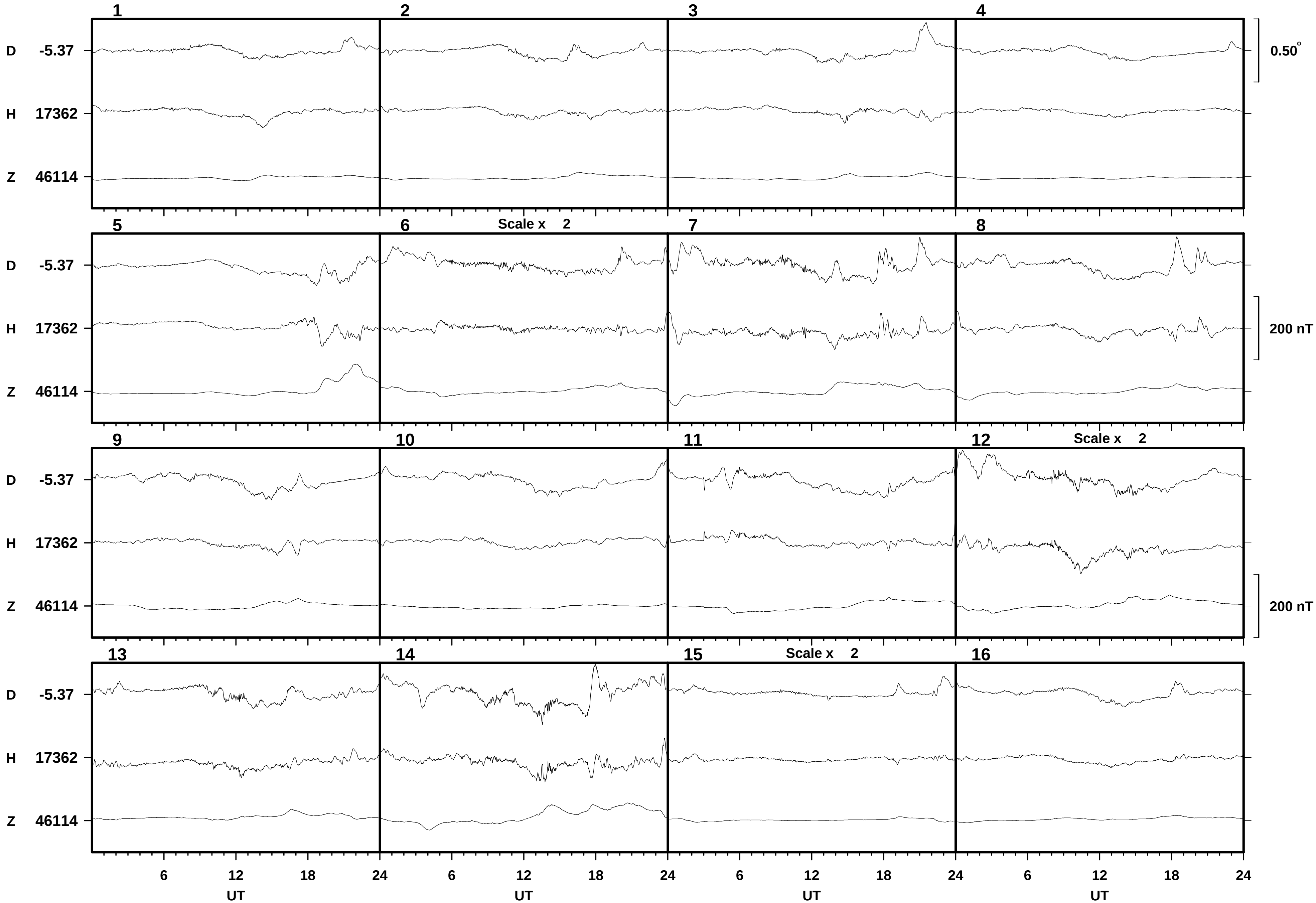
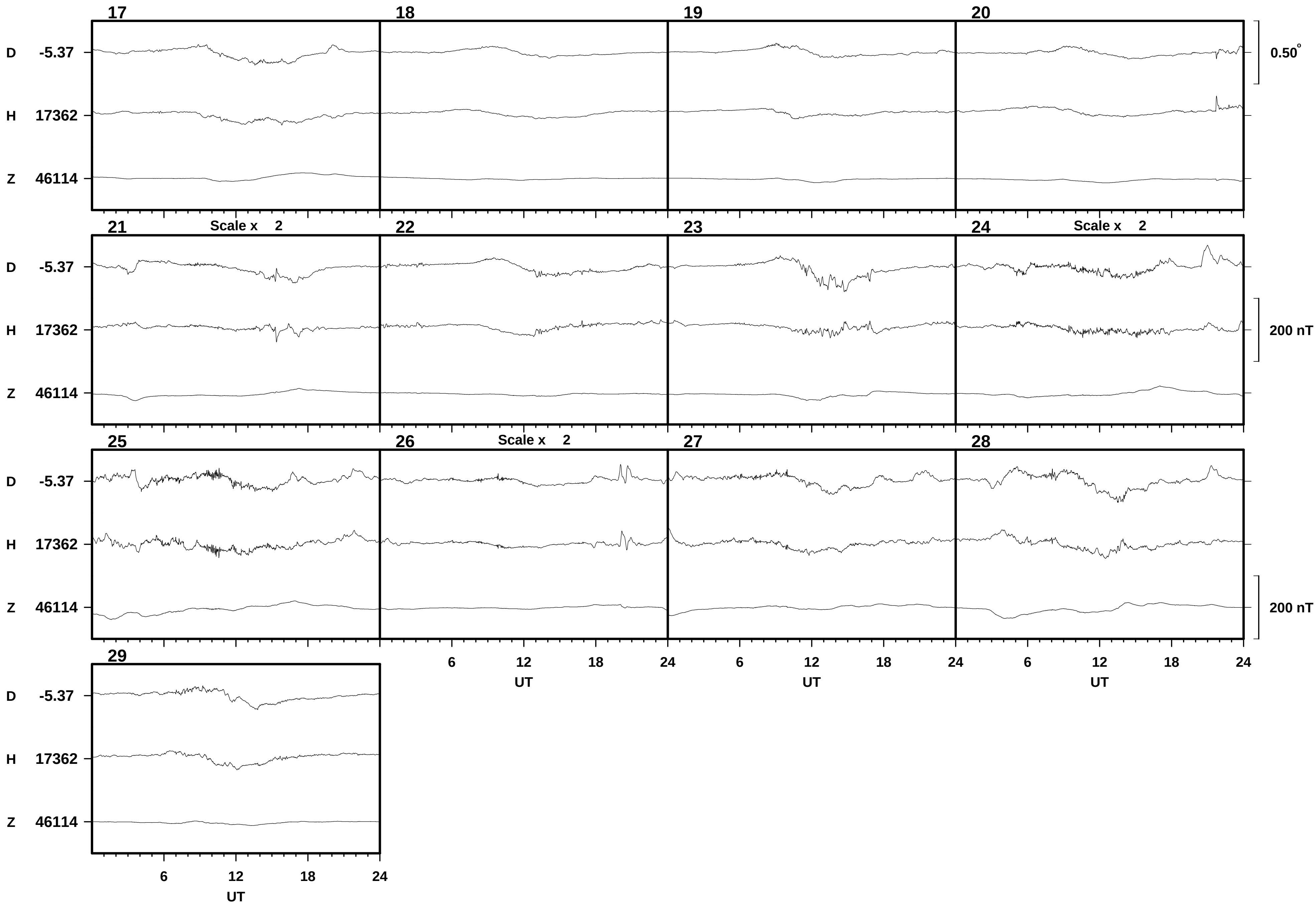
Scale x 4
23
Scale x 4
24
25
26
27
28
Scale x 2
29
30
31
D -5.37
H 17361
Z 46111
0.50°
200 nT
200 nT
6
12
18
24
UT

ES 1 0

Eskdalemuir February 2000



ES 2 0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Scale x 2
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Scale x 2
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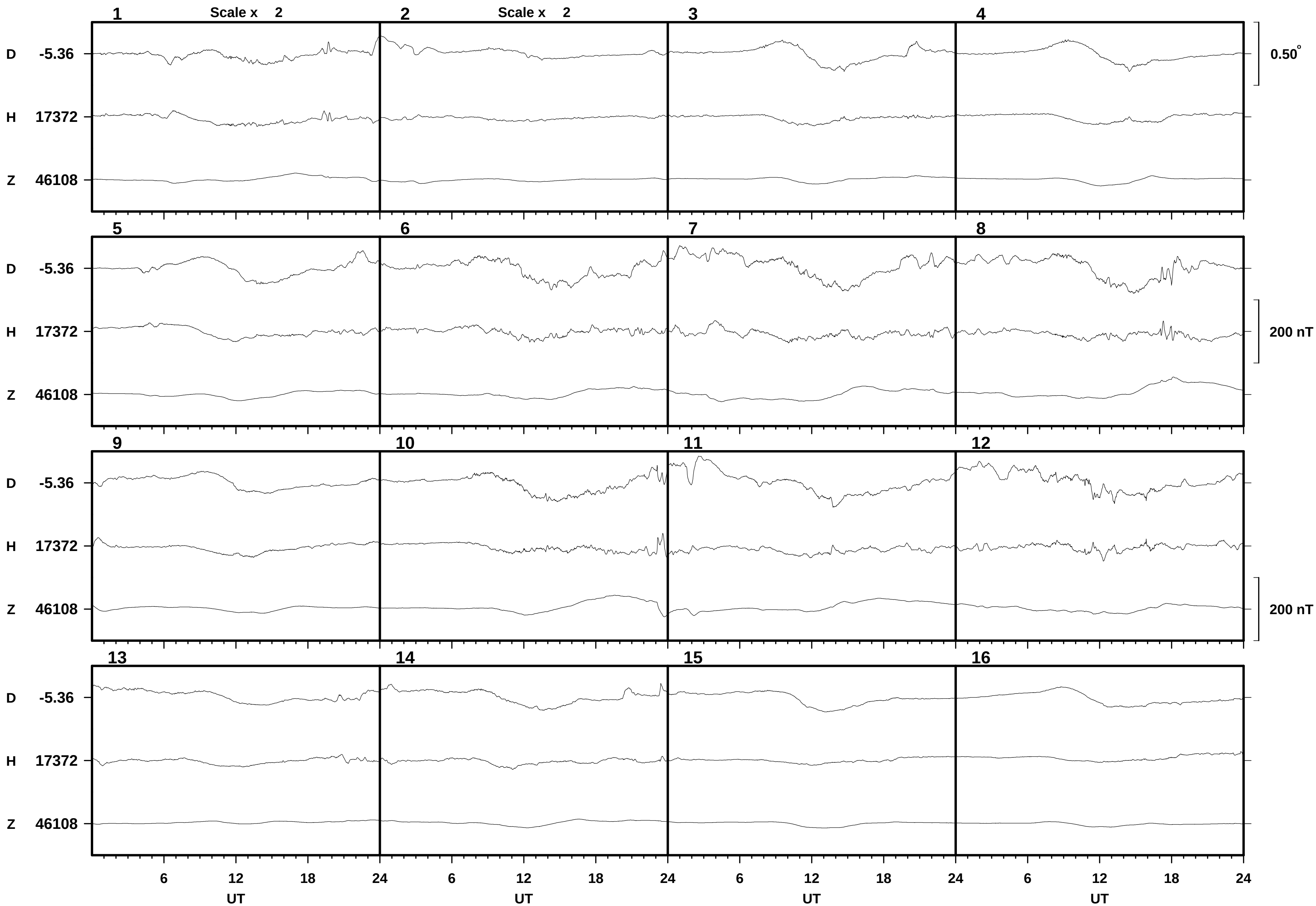
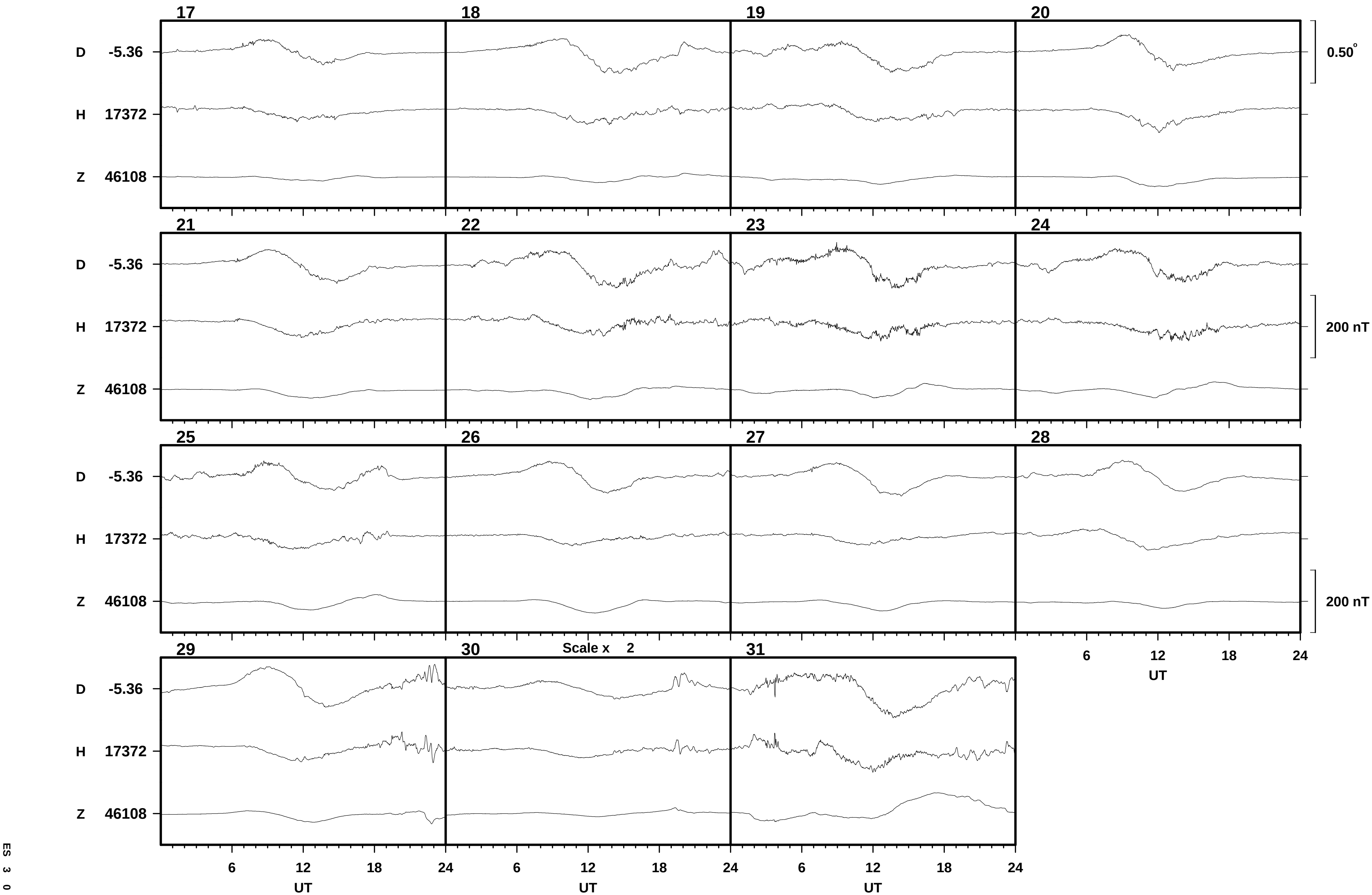
26
Scale x 2
27
28
29
D -5.37
H 17362
Z 46114
0.50°
200 nT
200 nT
6
12
18
24
UT

ES 2 0

Eskdalemuir March 2000



ES 3 0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18
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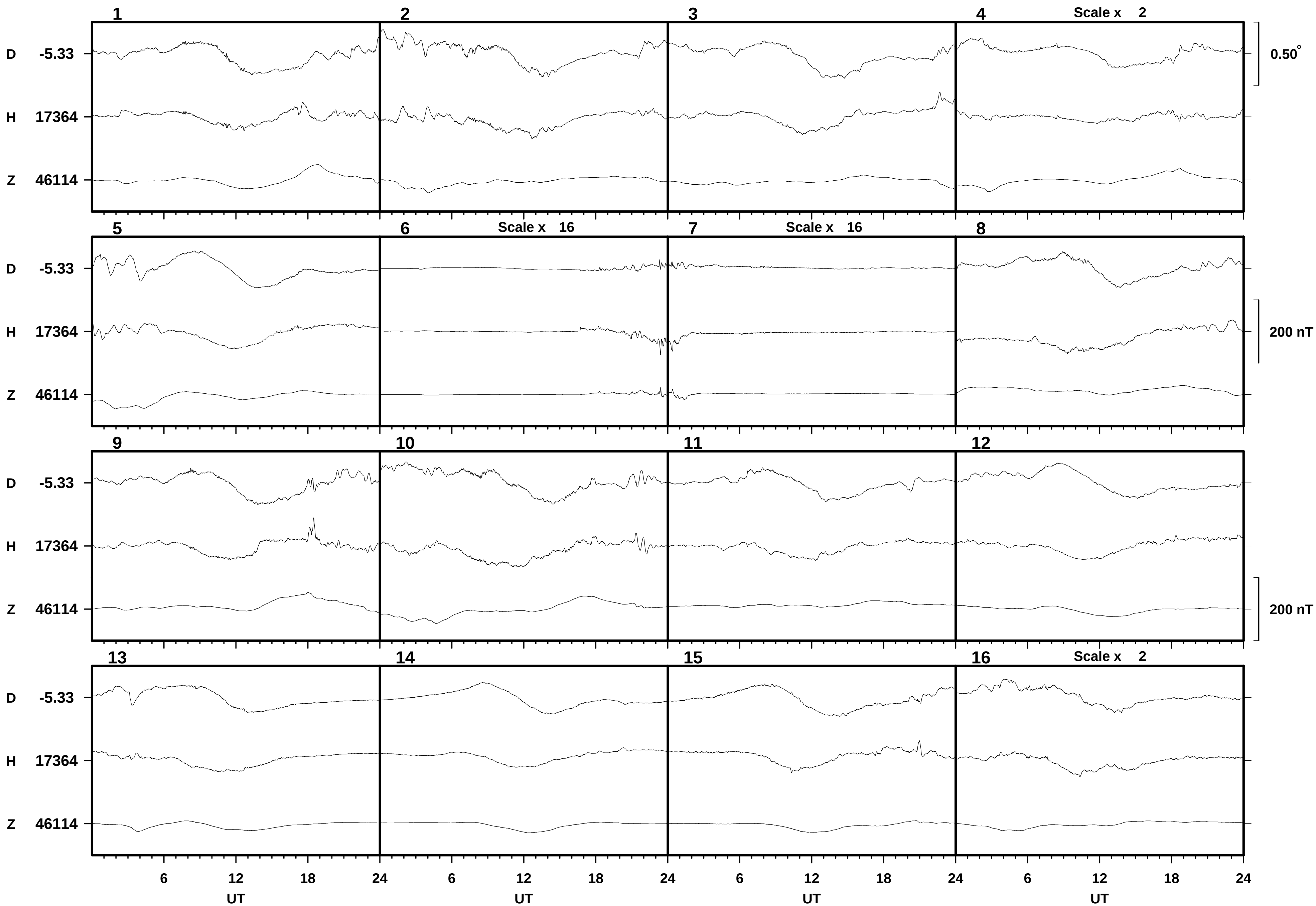
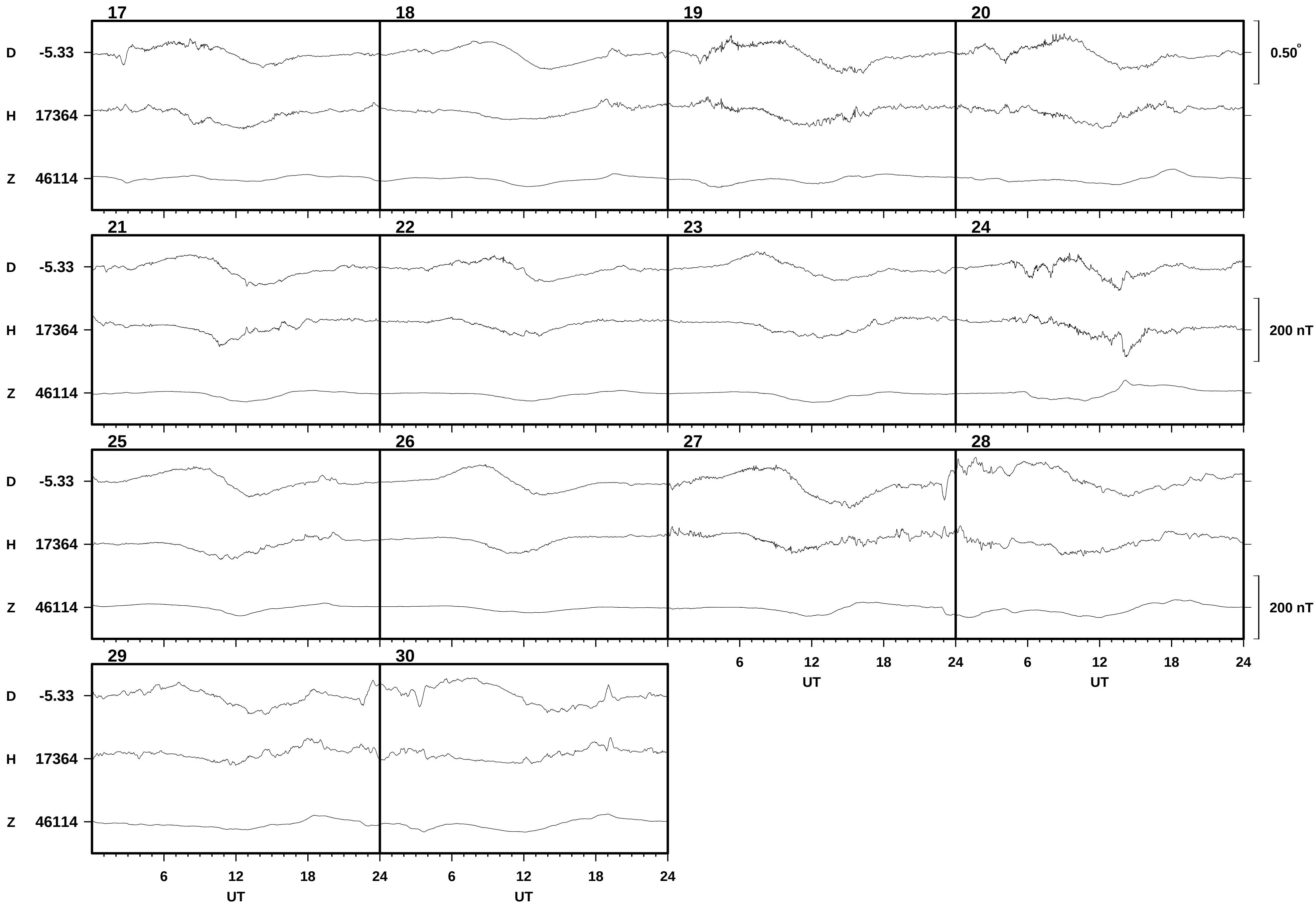
22
23
24
25
26
27
28
29
30
31
D -5.36
H 17372
Z 46108
0.50°
200 nT
200 nT
Scale x 2
6
12
18
24
UT
ES 3 0

Eskdalemuir April 2000



ES 4 0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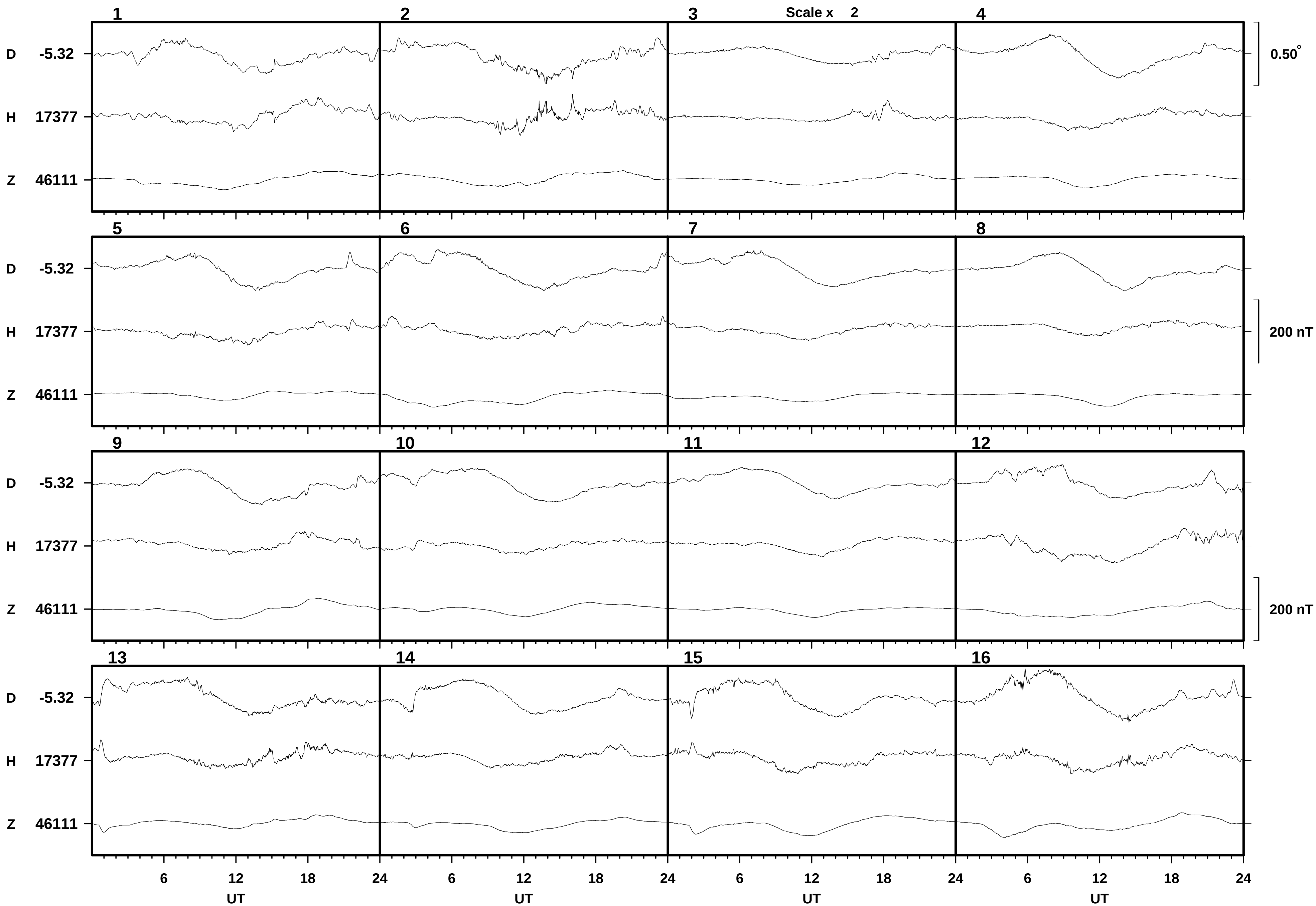
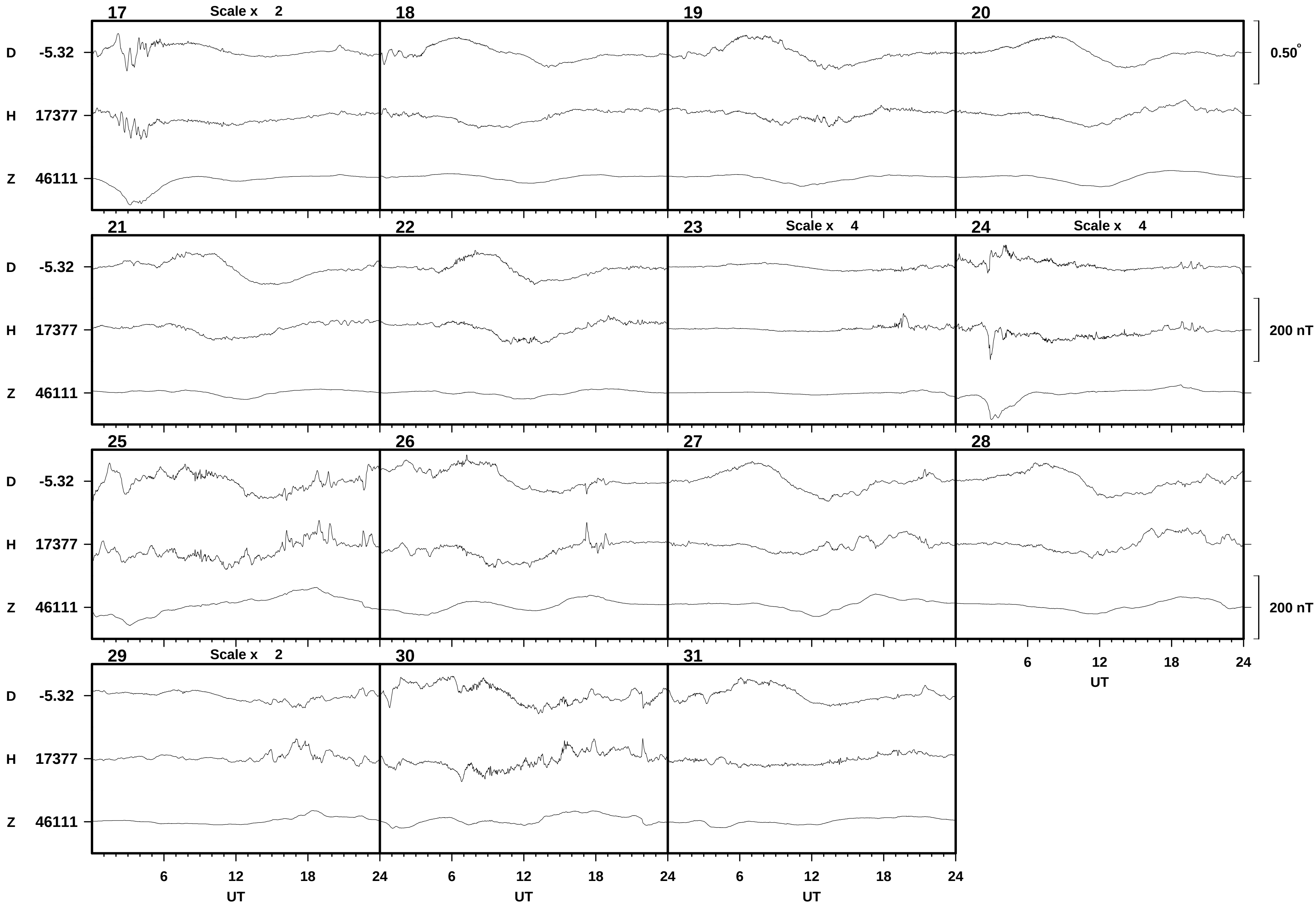
25
26
27
28
29
30
D -5.33
H 17364
Z 46114
0.50°
200 nT
200 nT
6
12
18
24
UT

ES 4 0

Eskdalemuir May 2000



ES 5 0



17
Scale x 2
18
19
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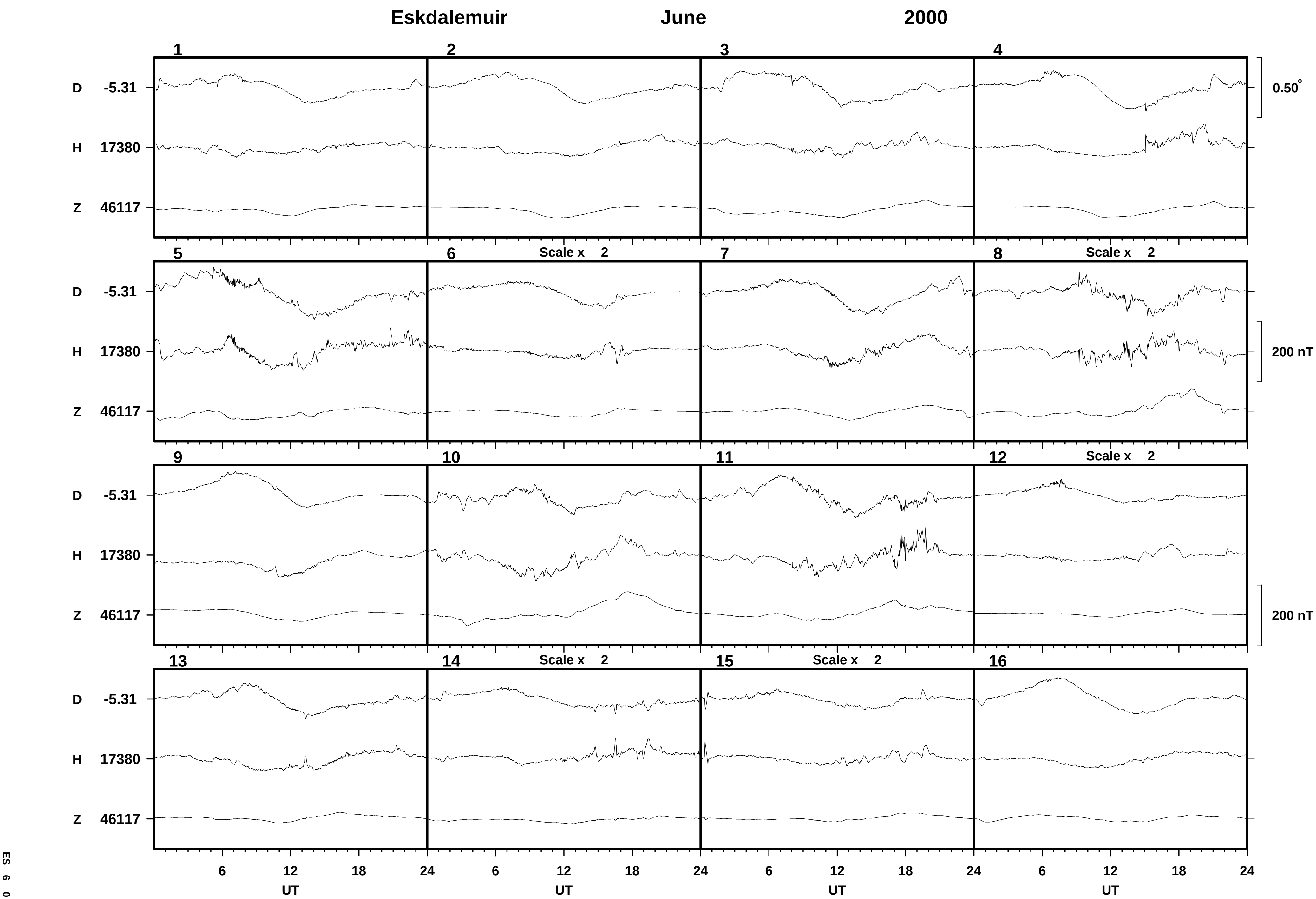
23
Scale x 4
24
Scale x 4
25
26
27
28
29
Scale x 2
30
31
D -5.32
H 17377
Z 46111
0.50°
200 nT
200 nT
6
12
18
24
UT


Eskdalemuir June 2000
1
2
3
4
5
6
7
8
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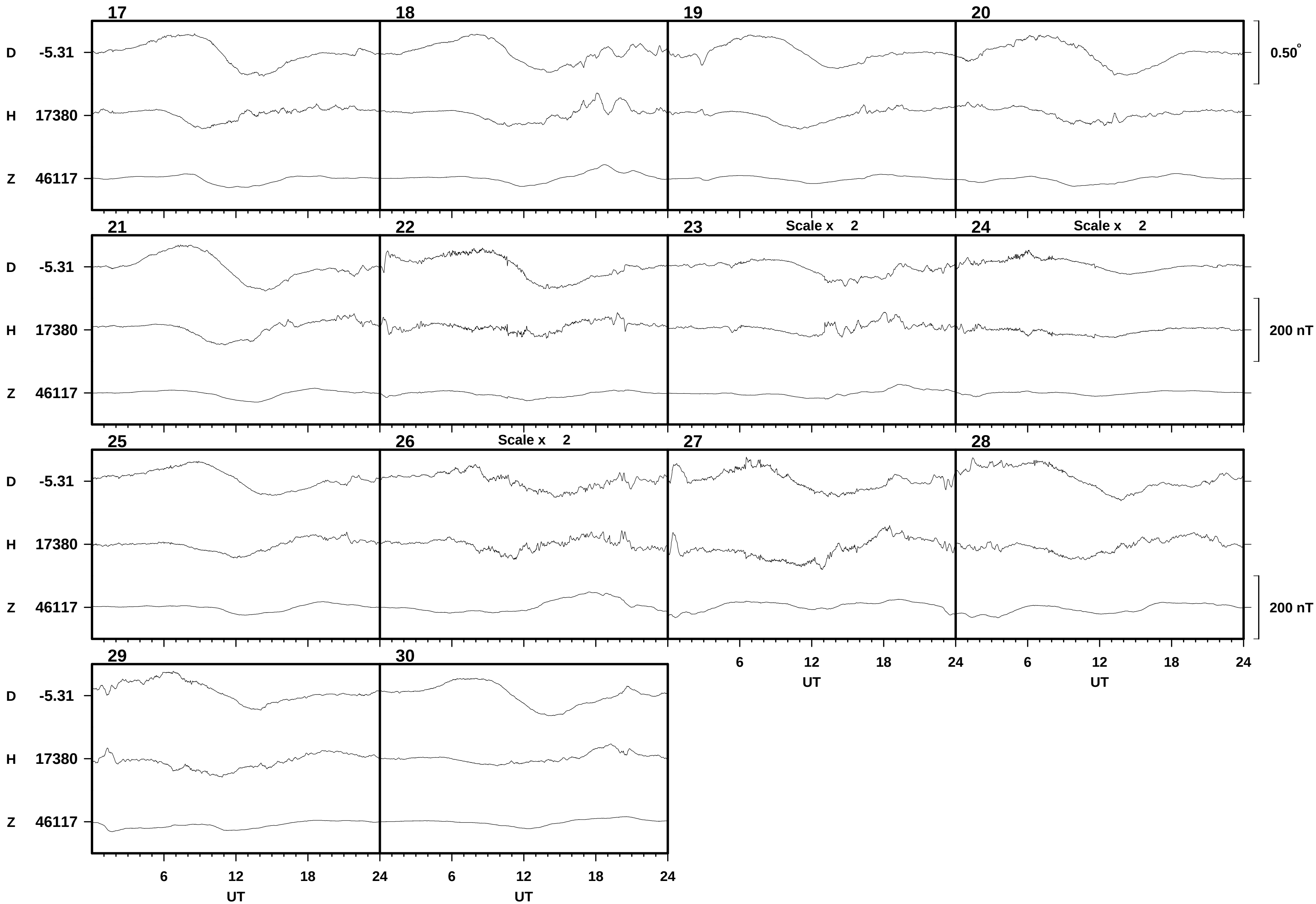
10
11
12
13
14
15
16
D -5.31
H 17380
Z 46117
0.50°
200 nT
200 nT
Scale x 2
6
12
18
24
UT
ES 6 0


17
18
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25
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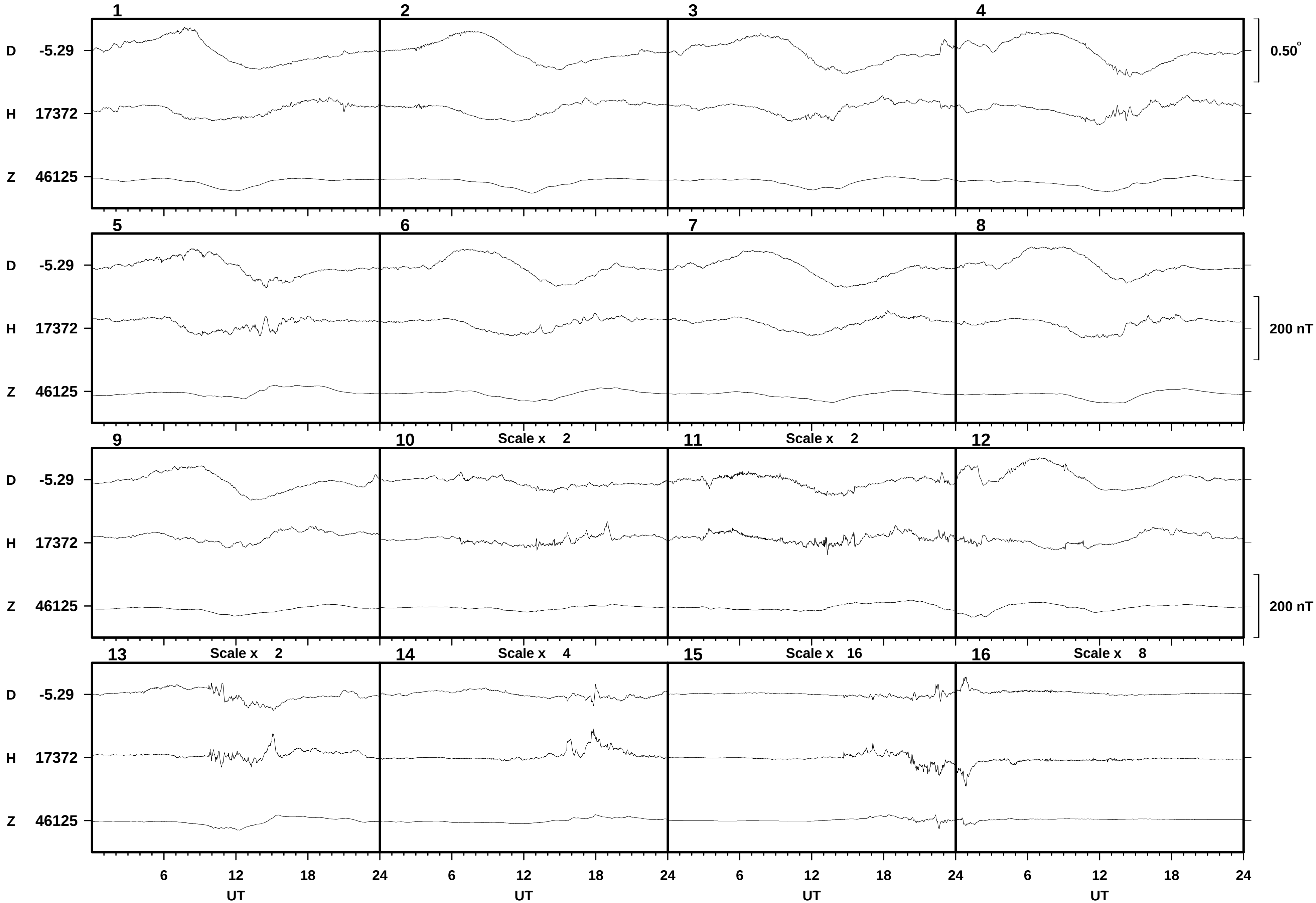
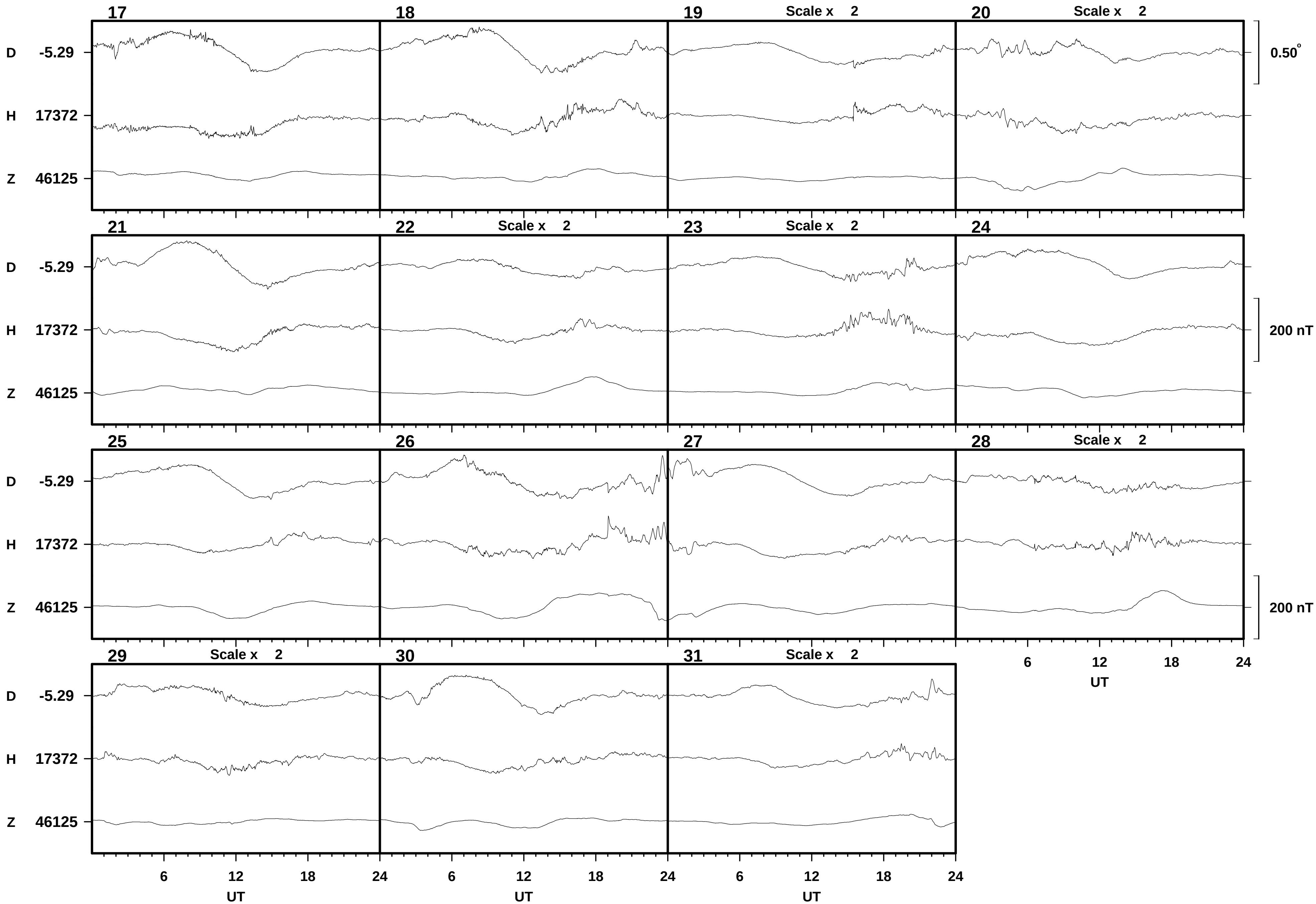
27
28
29
30
D -5.31
H 17380
Z 46117
Scale x 2
0.50°
200 nT
6
12
18
24
UT

Eskdalemuir July 2000



ES 7 0



17
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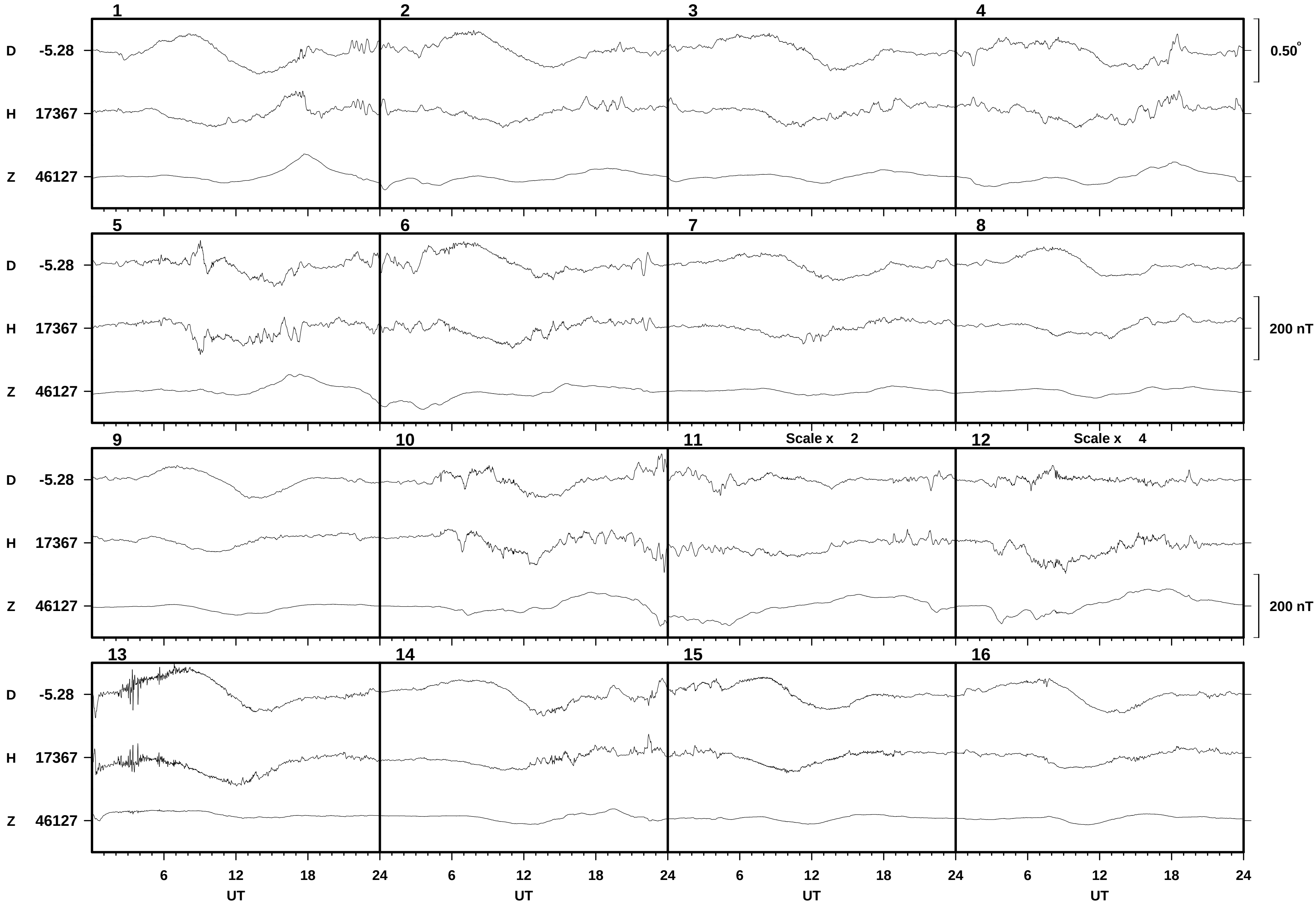
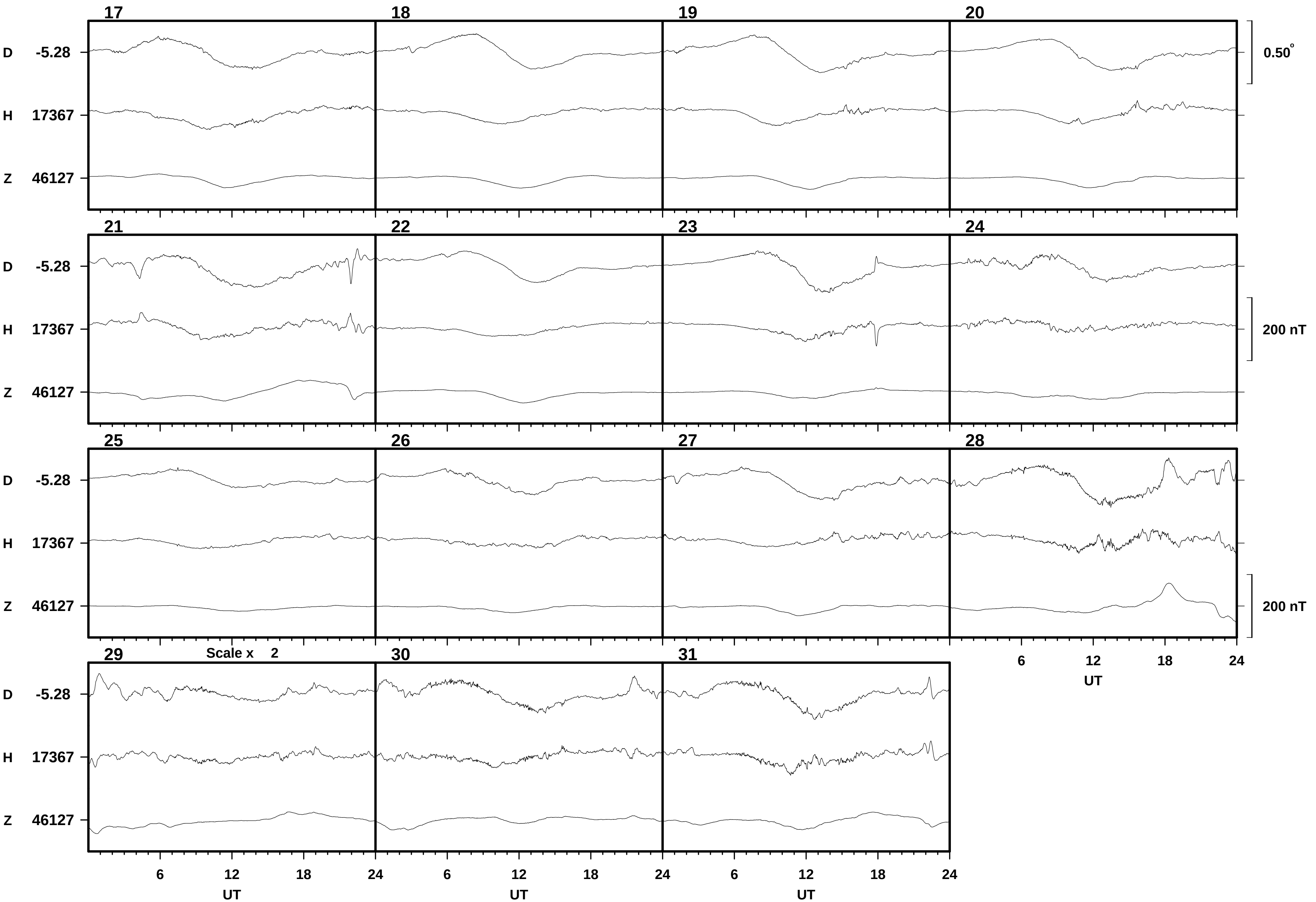
27
28
29
30
31
Scale x 2
D -5.29
H 17372
Z 46125
0.50°
200 nT
200 nT
6
12
18
24
UT

Eskdalemuir August 2000

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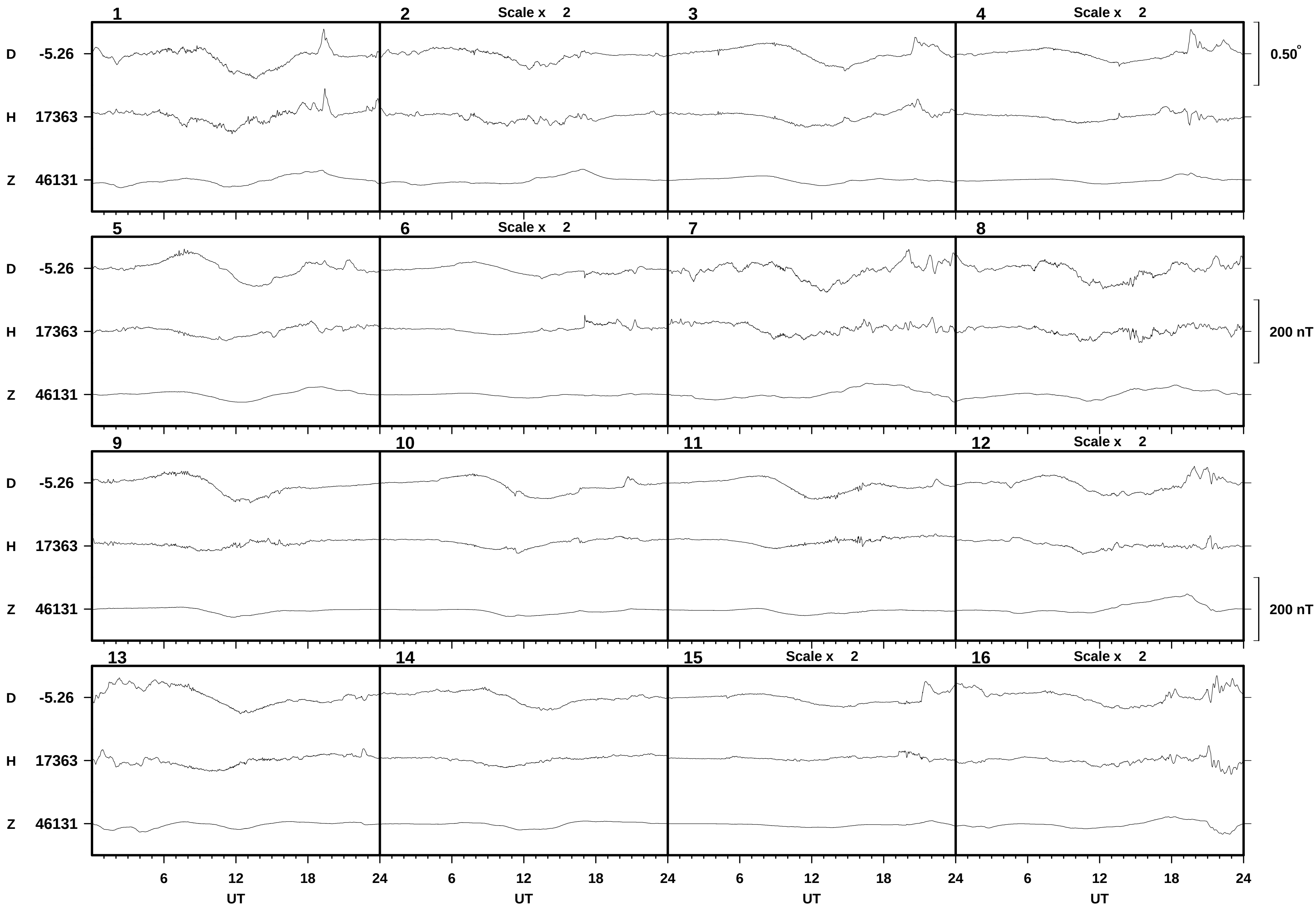
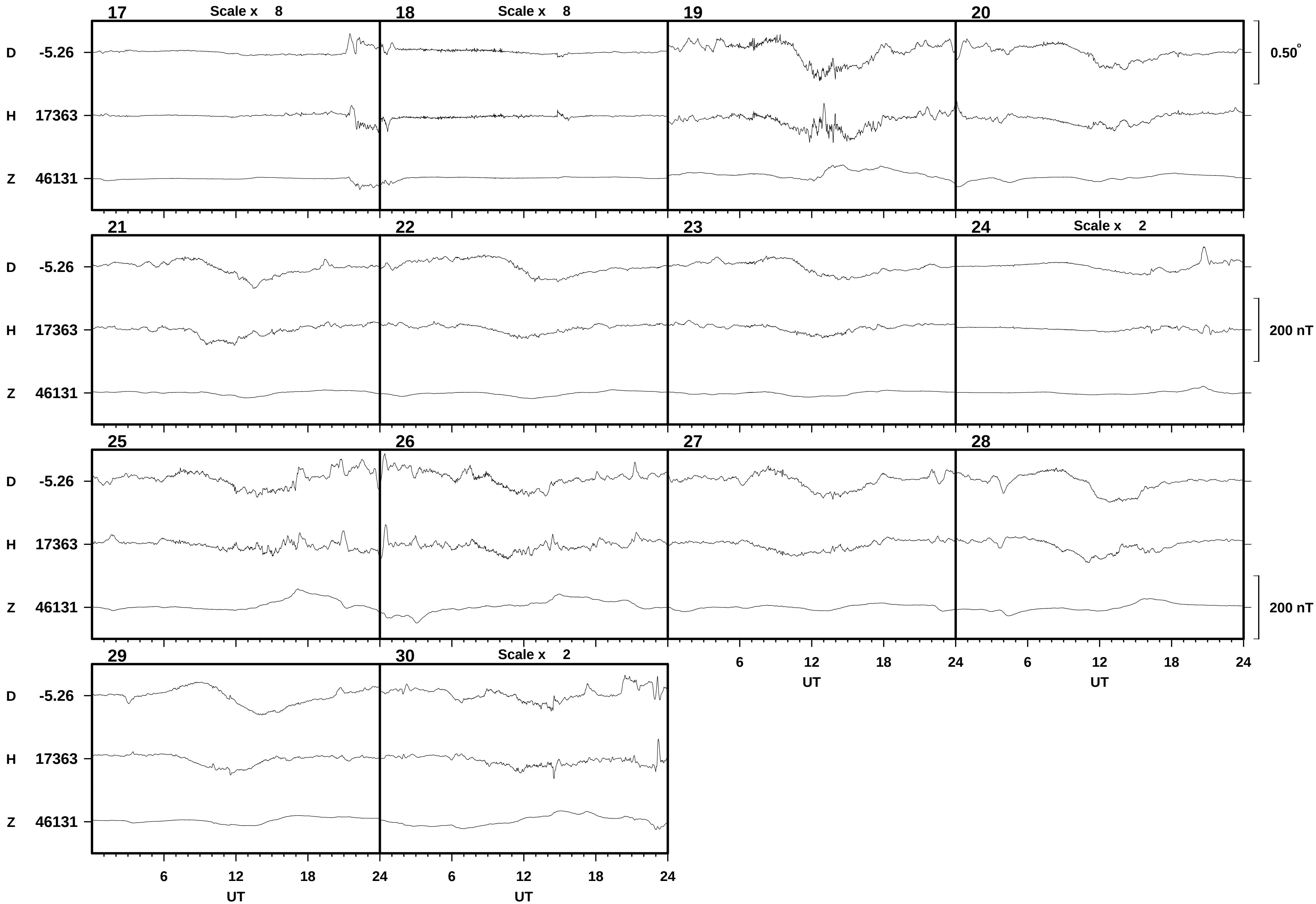
23
24
25
26
27
28
29
30
31
Scale x 2
D -5.28
H 17367
Z 46127
0.50°
200 nT
200 nT
6
12
18
24
UT

Eskdalemuir September 2000

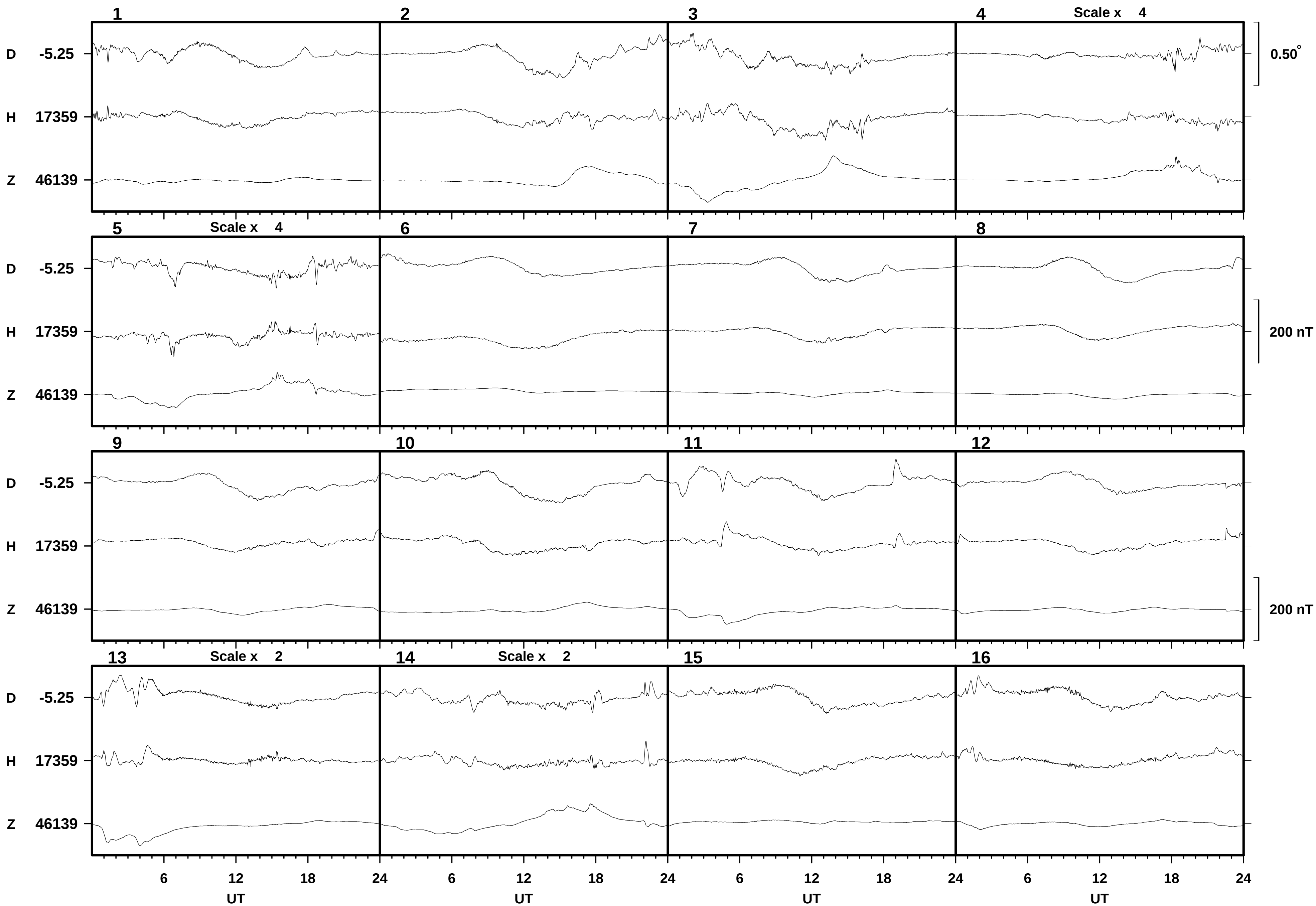


ES 9 0

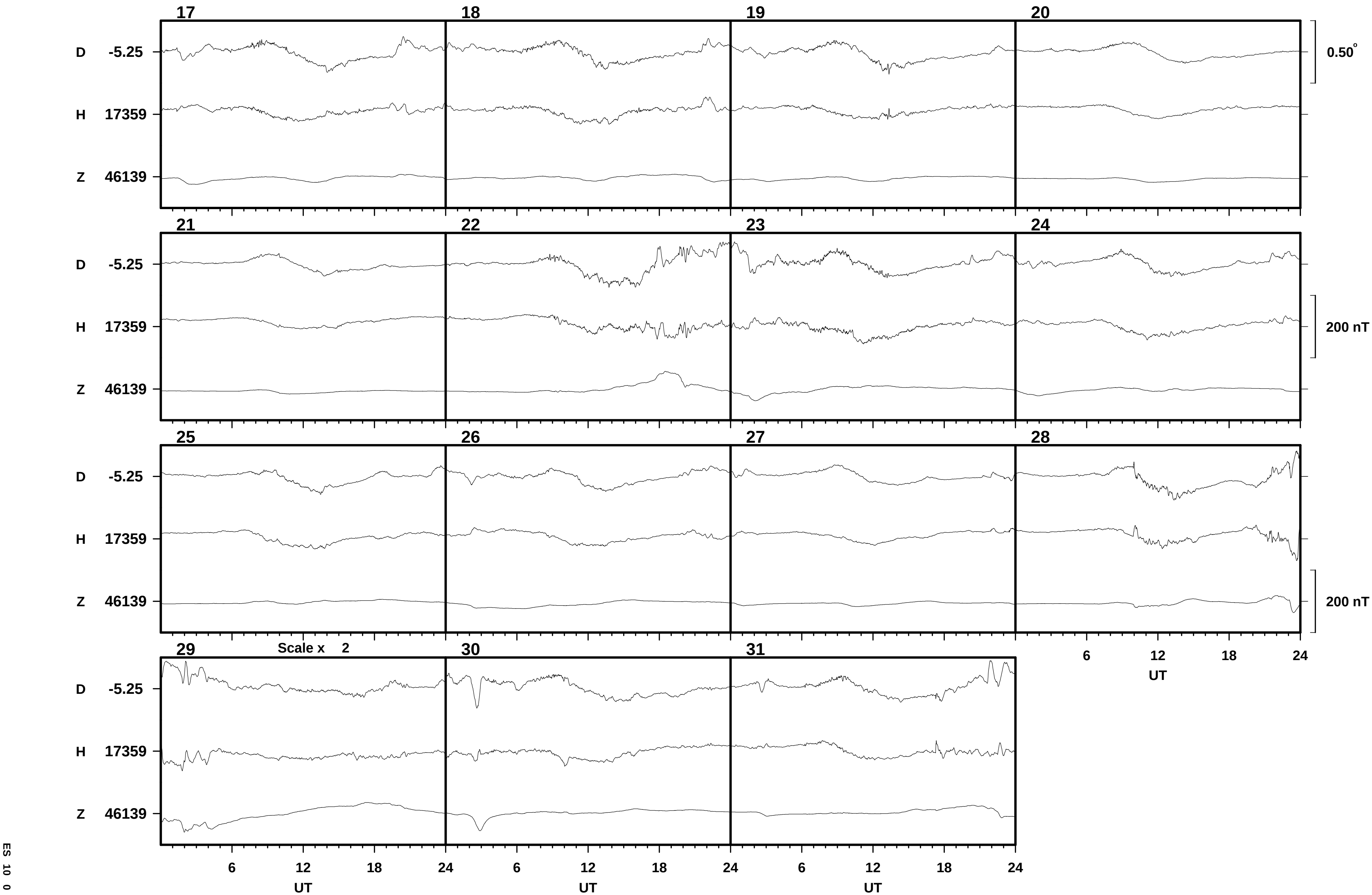

17
Scale x 8
18
Scale x 8
19
20
21
22
23
24
Scale x 2
25
26
27
28
29
30
Scale x 2
D -5.26
H 17363
Z 46131
0.50°
200 nT
200 nT
6 12 18 24
UT

ES 9 0

Eskdalemuir October 2000



ES 10 0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27
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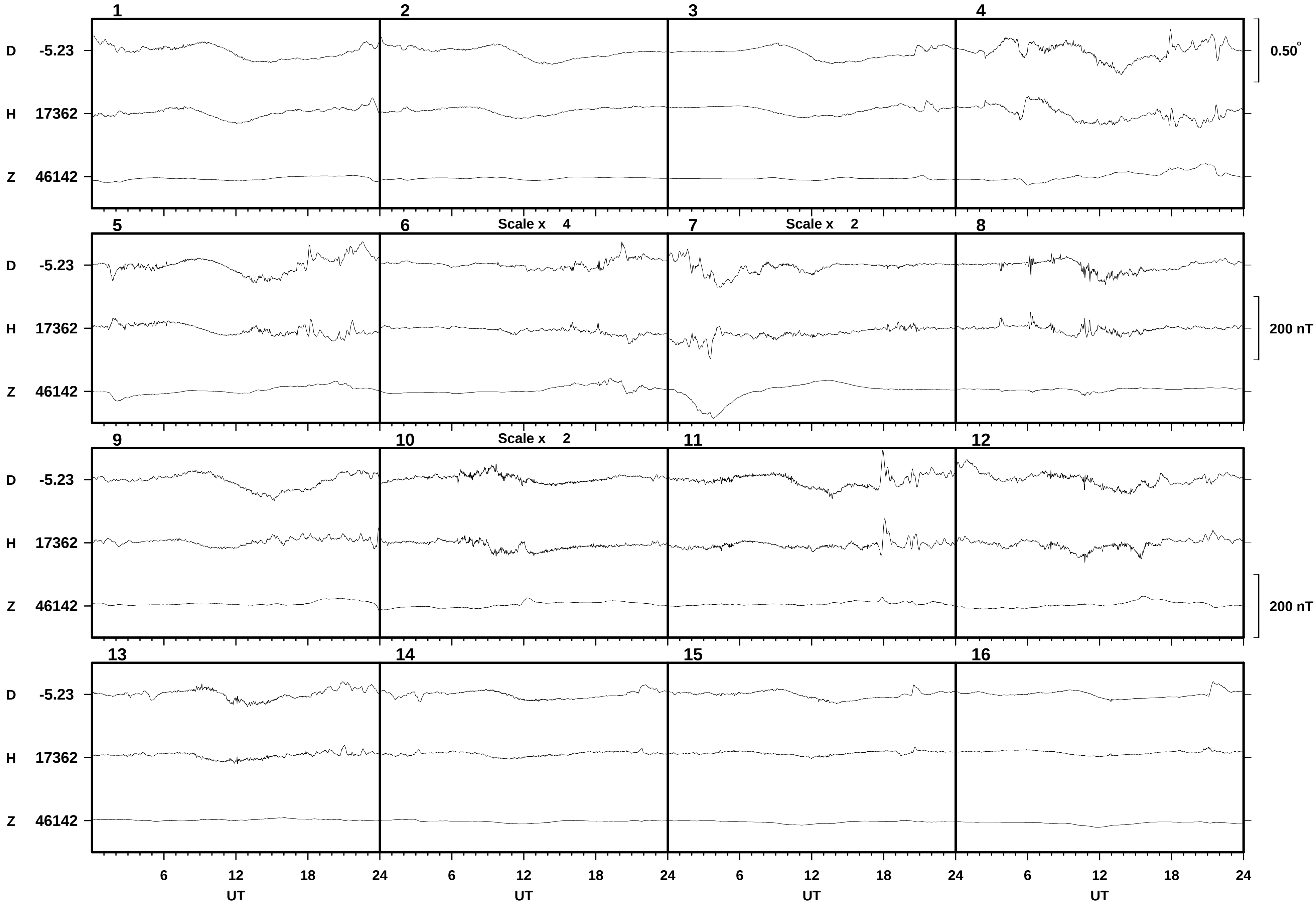
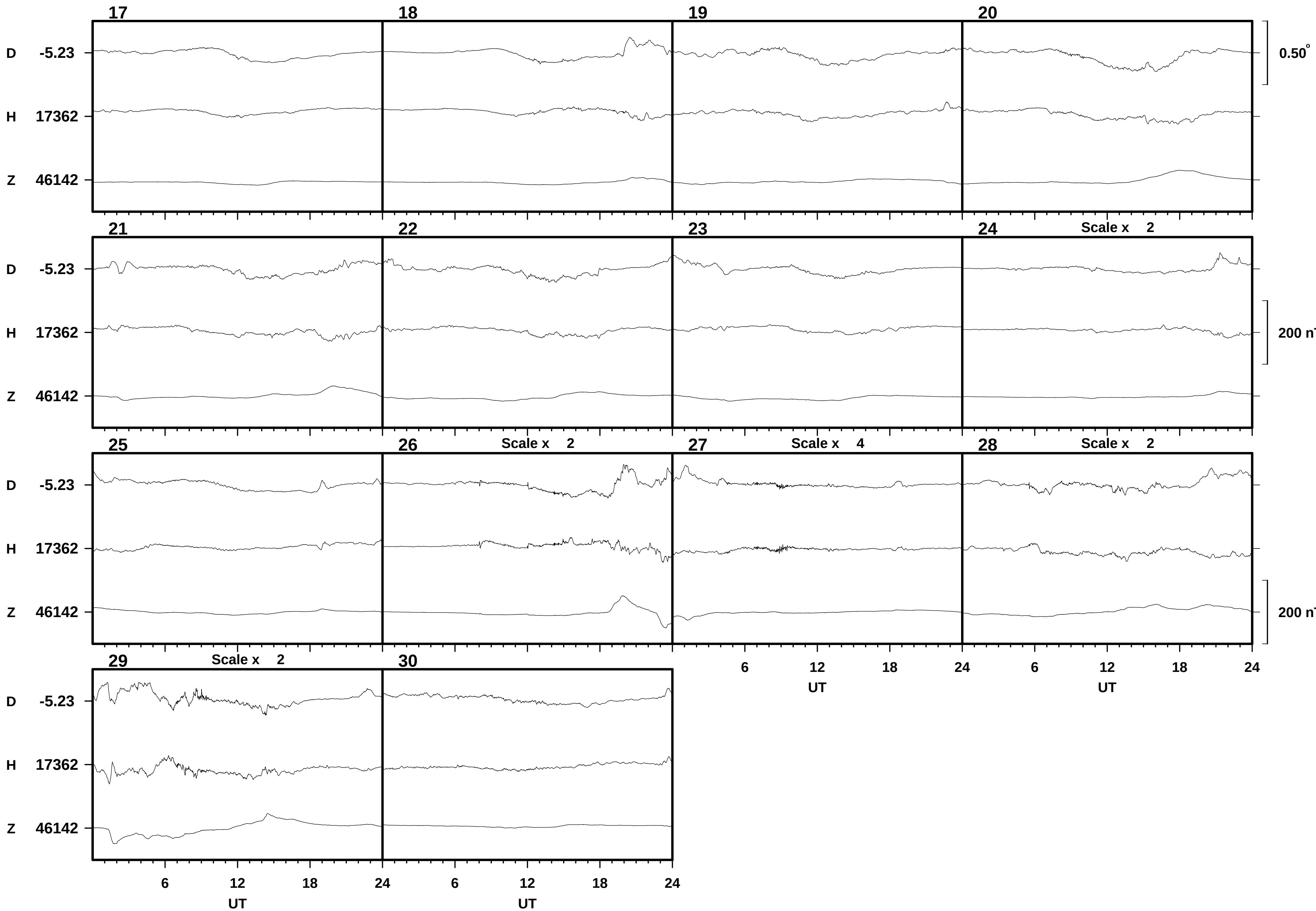
29
30
31
Scale x 2
D -5.25
H 17359
Z 46139
0.50°
200 nT
200 nT
6
12
18
24
UT
ES 10 0

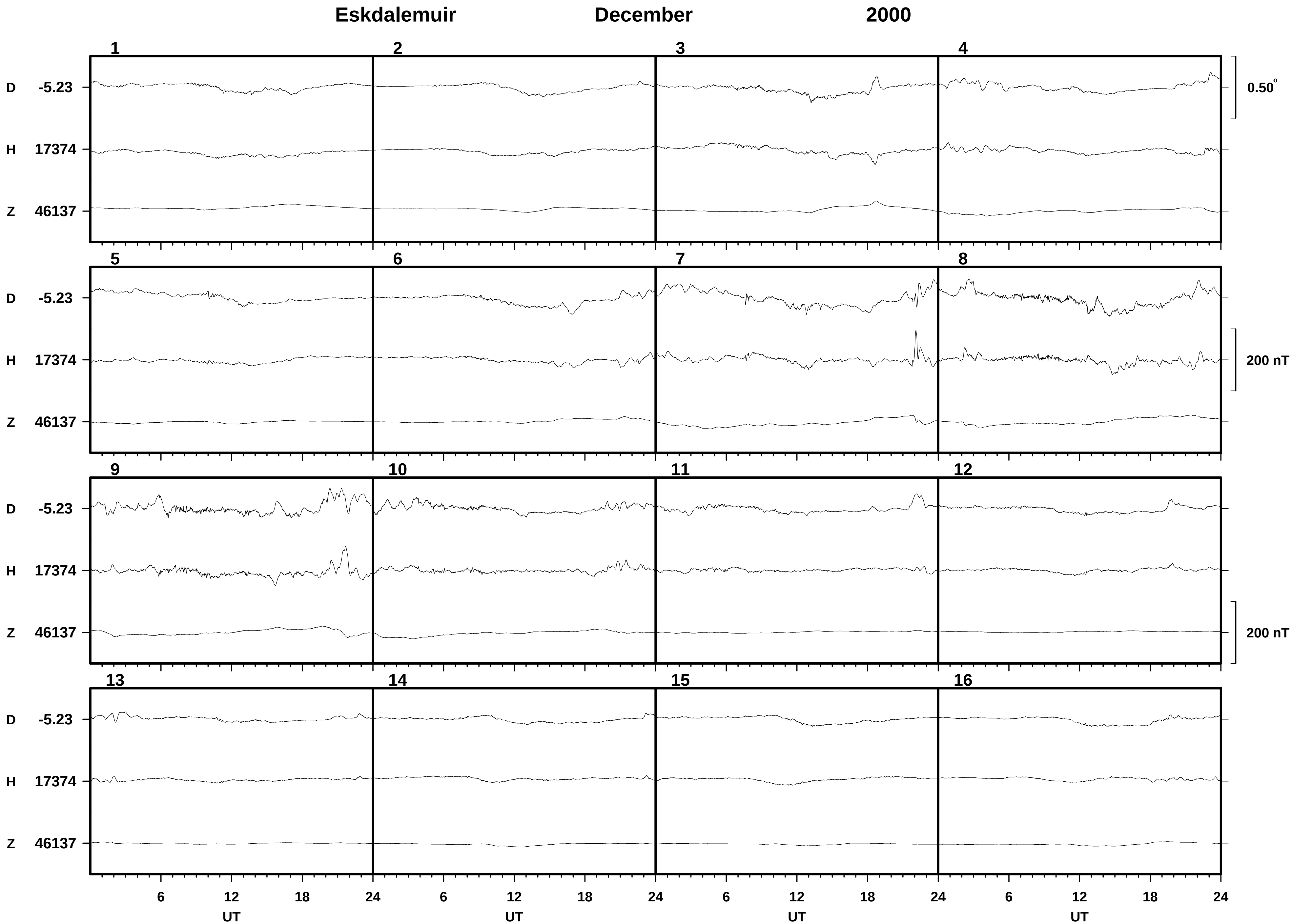
Eskdalemuir November 2000



ES 11 0

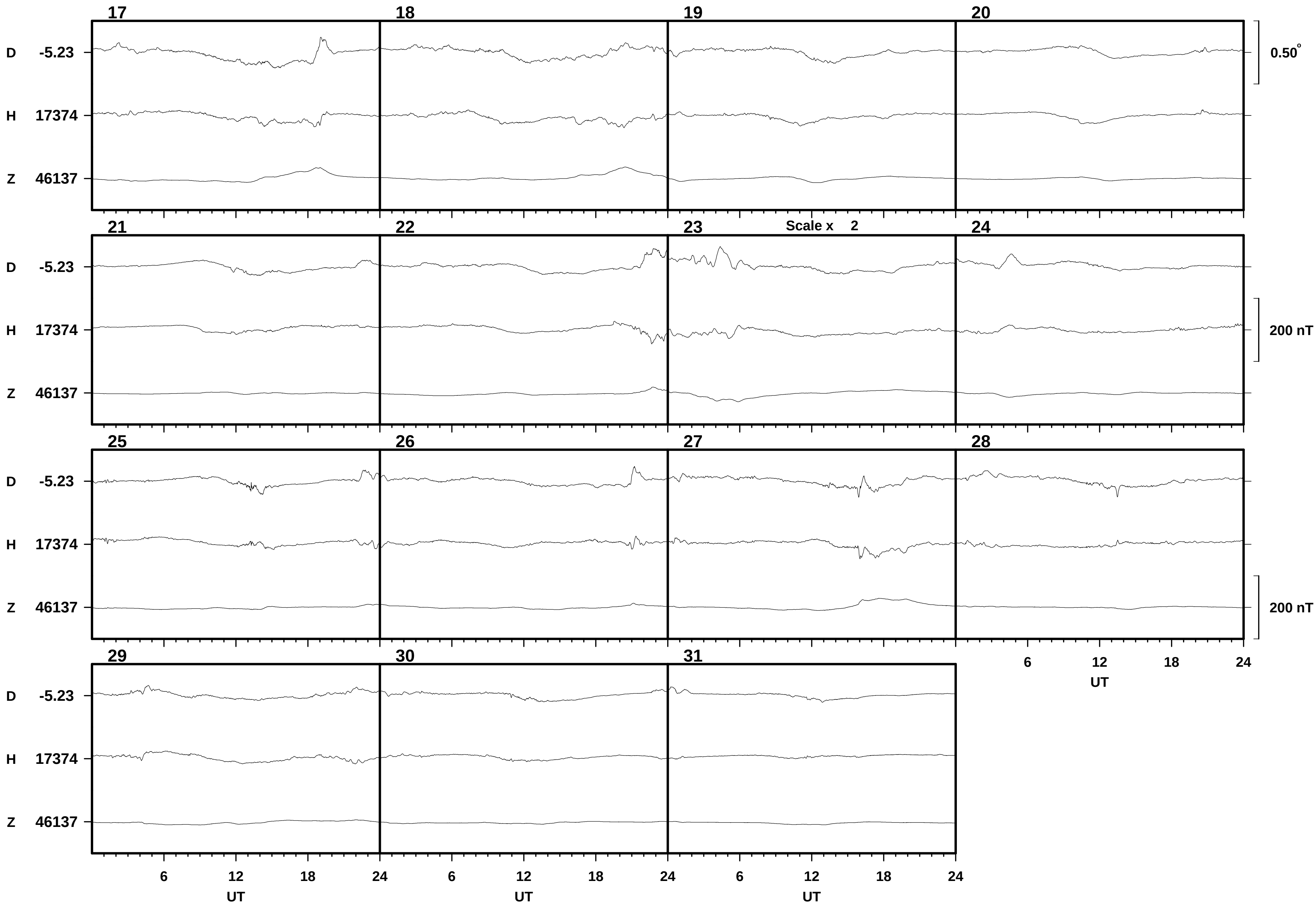

17
18
19
20
21
22
23
24
25
26
27
28
29
30
D -5.23
H 17362
Z 46142
0.50°
200 nT
200 nT
Scale x 2
Scale x 2
Scale x 4
Scale x 2
Scale x 2
6
12
18
24
UT

ES 11 0

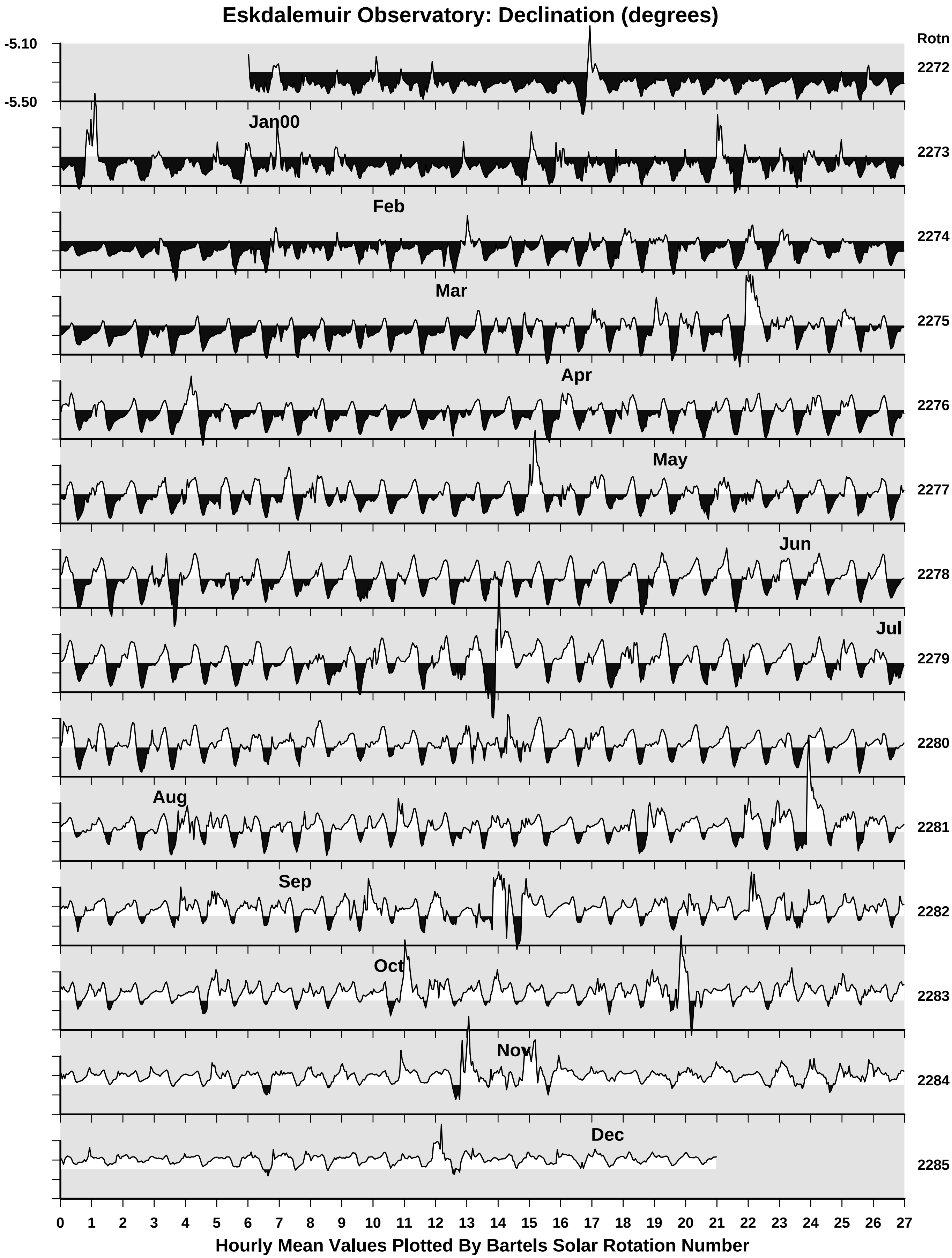


Eskdalemuir
December
2000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
D -5.23
H 17374
Z 46137
0.50°
200 nT
200 nT
6
12
18
24
UT

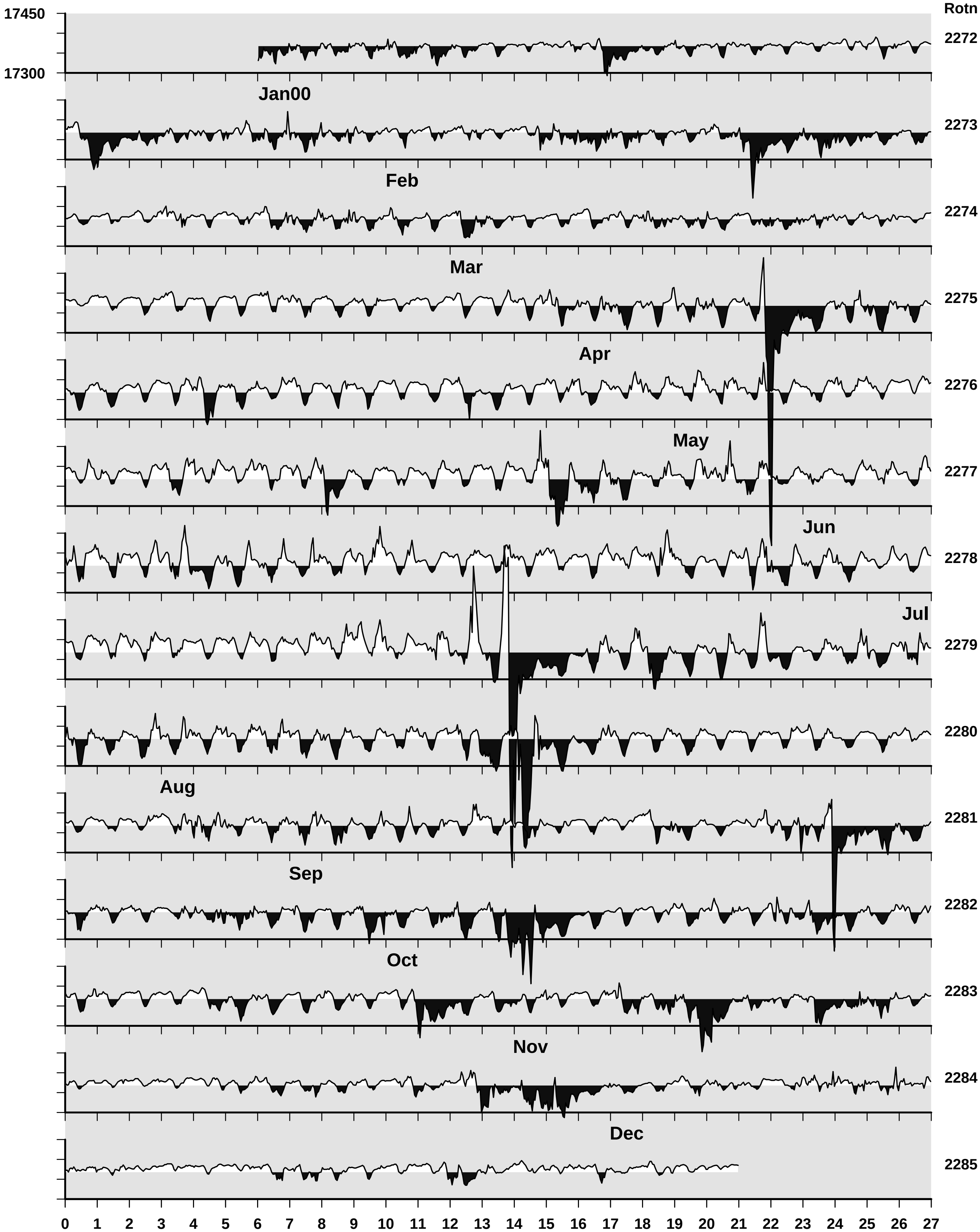
ES 12 0


17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
D -5.23
H 17374
Z 46137
0.50°
200 nT
200 nT
Scale x 2
6
12
18
24
UT

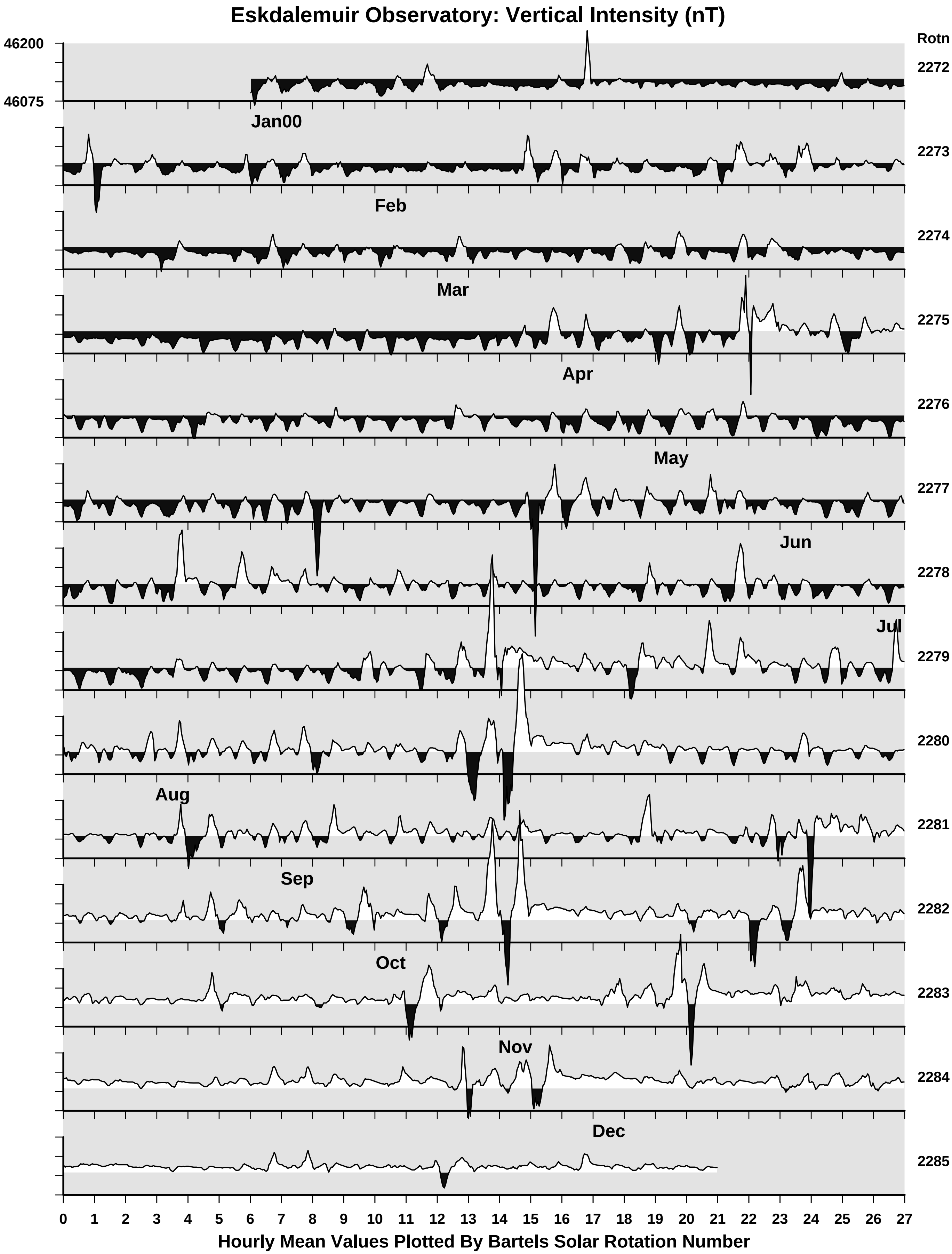
ES 12 0

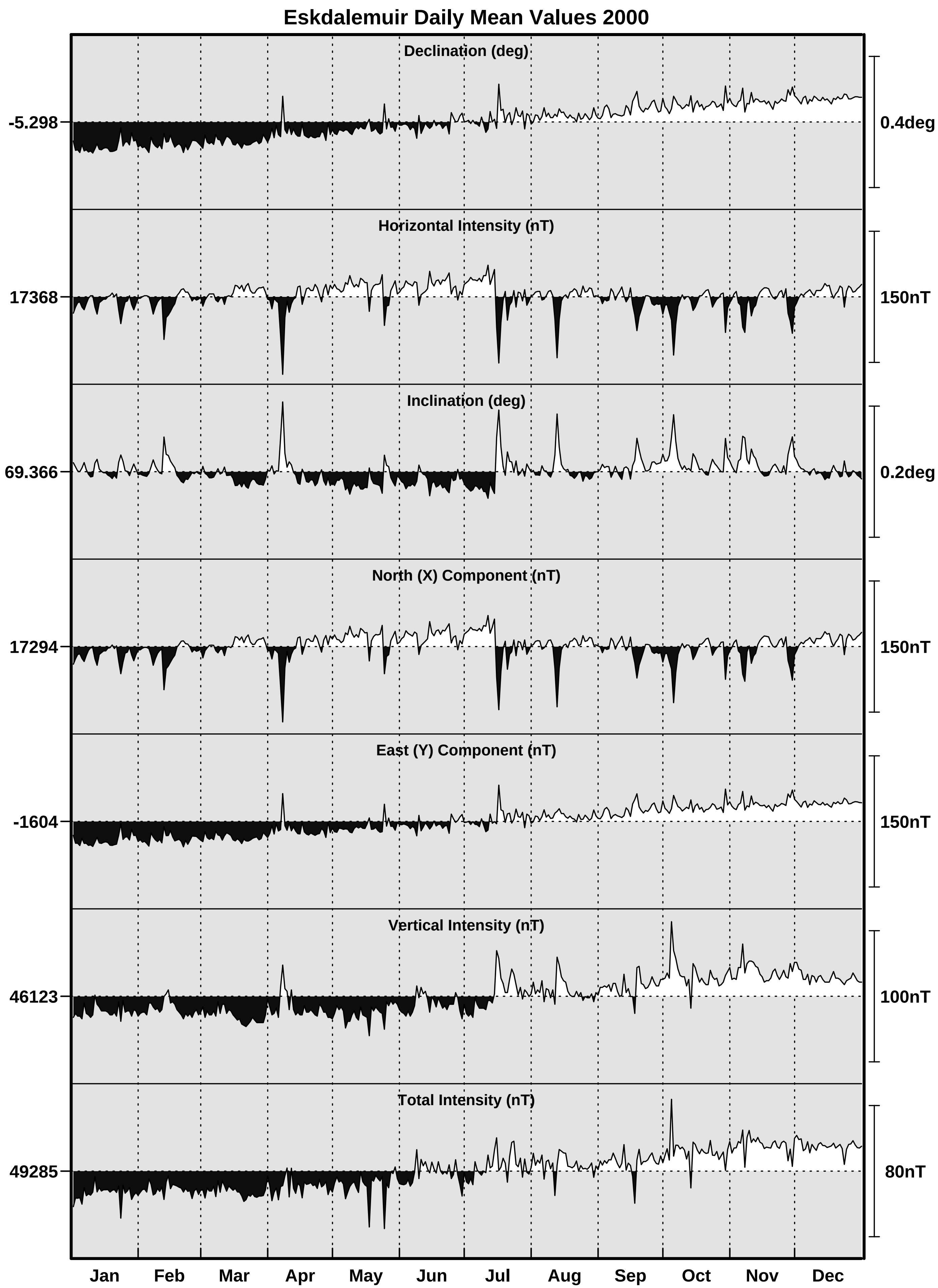

Eskdalemuir Observatory: Declination (degrees)
-5.10
-5.50
Rotn
2272
2273
2274
2275
2276
2277
2278
2279
2280
2281
2282
2283
2284
2285
Jan00
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted By Bartels Solar Rotation Number

Eskdalemuir Observatory: Horizontal Intensity (nT)

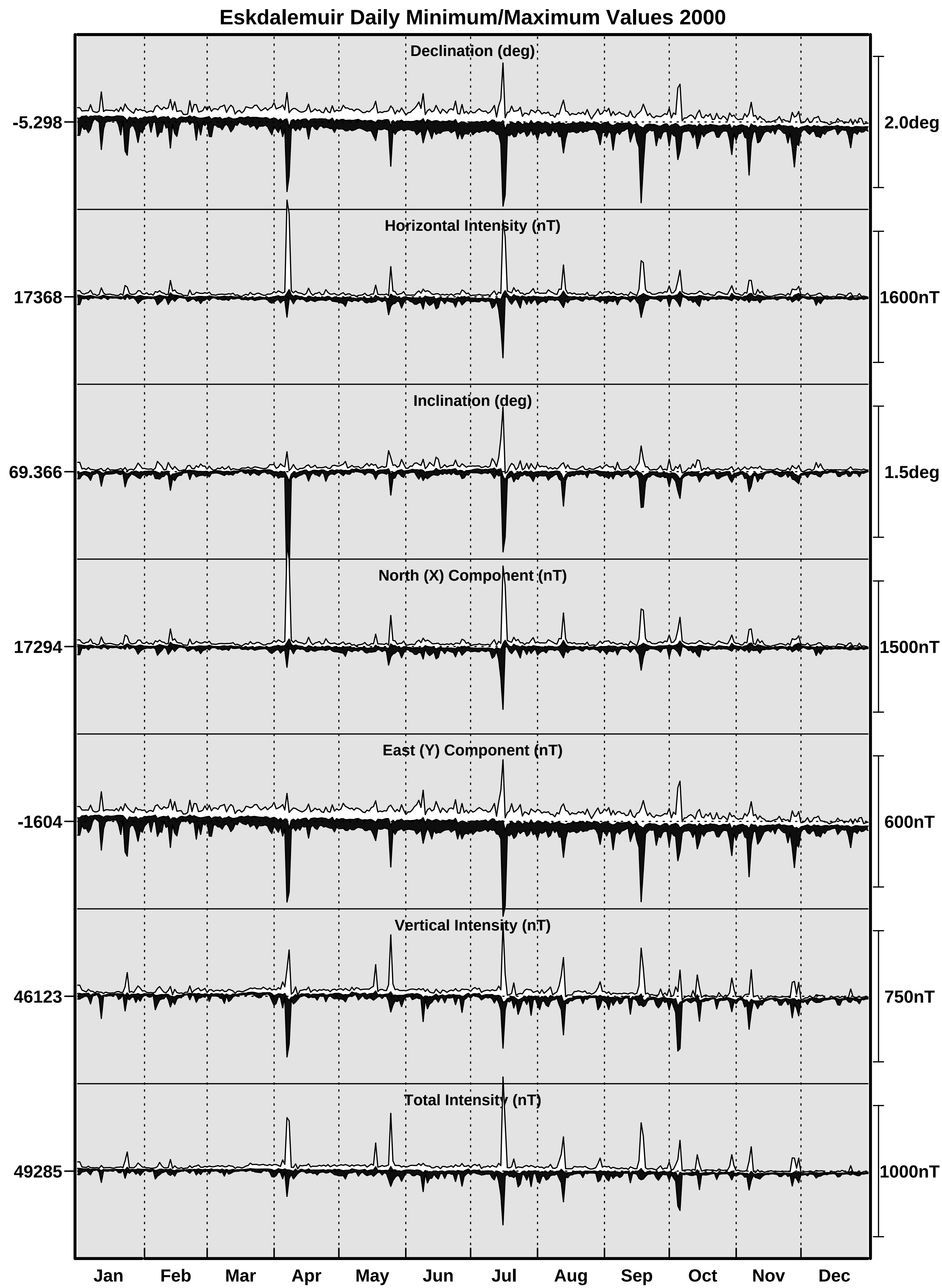


Hourly Mean Values Plotted By Bartels Solar Rotation Number


Eskdalemuir Observatory: Vertical Intensity (nT)
46200
46075
Rotn
2272
2273
2274
2275
2276
2277
2278
2279
2280
2281
2282
2283
2284
2285
Jan00
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



Eskdalemuir Daily Mean Values 2000
Declination (deg)
-5.298
0.4deg
Horizontal Intensity (nT)
17368
150nT
Inclination (deg)
69.366
0.2deg
North (X) Component (nT)
17294
150nT
East (Y) Component (nT)
-1604
150nT
Vertical Intensity (nT)
46123
100nT
Total Intensity (nT)
49285
80nT
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec



Eskdalemuir Daily Minimum/Maximum Values 2000
Declination (deg)
-5.298
2.0deg
Horizontal Intensity (nT)
17368
1600nT
Inclination (deg)
69.366
1.5deg
North (X) Component (nT)
17294
1500nT
East (Y) Component (nT)
-1604
600nT
Vertical Intensity (nT)
46123
750nT
Total Intensity (nT)
49285
1000nT
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Monthly Mean Values for Eskdalemuir 2000

Month	D	H	I	X	Y	Z	F

Based on All Days

Month	D	H	I	X	Y	Z	F
January	-5° 22.4′	17361 nT	69° 22.1′	17284 nT	-1626 nT	46111 nT	49271 nT
February	-5° 22.0′	17362 nT	69° 22.1′	17286 nT	-1624 nT	46114 nT	49274 nT
March	-5° 21.5′	17372 nT	69° 21.3′	17296 nT	-1622 nT	46108 nT	49272 nT
April	-5° 19.8′	17364 nT	69° 22.0′	17289 nT	-1613 nT	46114 nT	49275 nT
May	-5° 19.0′	17377 nT	69° 21.0′	17302 nT	-1610 nT	46111 nT	49276 nT
June	-5° 18.4′	17380 nT	69° 21.0′	17305 nT	-1607 nT	46117 nT	49284 nT
July	-5° 17.3′	17372 nT	69° 21.8′	17298 nT	-1601 nT	46125 nT	49288 nT
August	-5° 16.8′	17367 nT	69° 22.1′	17293 nT	-1598 nT	46127 nT	49289 nT
September	-5° 15.5′	17363 nT	69° 22.5′	17289 nT	-1591 nT	46131 nT	49290 nT
October	-5° 14.7′	17359 nT	69° 22.9′	17286 nT	-1587 nT	46139 nT	49297 nT
November	-5° 14.0′	17362 nT	69° 22.8′	17289 nT	-1584 nT	46142 nT	49300 nT
December	-5° 13.7′	17374 nT	69° 21.9′	17302 nT	-1583 nT	46137 nT	49300 nT
Annual	**-5° 17.9′**	**17368 nT**	**69° 22.0′**	**17294 nT**	**-1604 nT**	**46123 nT**	**49285 nT**

International quiet day means

Month	D	H	I	X	Y	Z	F
January	-5° 23.1′	17369 nT	69° 21.6′	17292 nT	-1630 nT	46109 nT	49272 nT
February	-5° 22.3′	17369 nT	69° 21.6′	17293 nT	-1626 nT	46112 nT	49275 nT
March	-5° 21.8′	17376 nT	69° 21.0′	17299 nT	-1624 nT	46106 nT	49272 nT
April	-5° 20.3′	17375 nT	69° 21.2′	17300 nT	-1617 nT	46111 nT	49276 nT
May	-5° 19.3′	17384 nT	69° 20.5′	17309 nT	-1613 nT	46109 nT	49277 nT
June	-5° 17.6′	17377 nT	69° 21.3′	17303 nT	-1603 nT	46118 nT	49283 nT
July	-5° 17.3′	17378 nT	69° 21.2′	17304 nT	-1602 nT	46119 nT	49284 nT
August	-5° 16.7′	17373 nT	69° 21.6′	17299 nT	-1598 nT	46123 nT	49286 nT
September	-5° 16.2′	17372 nT	69° 21.8′	17298 nT	-1595 nT	46126 nT	49289 nT
October	-5° 14.9′	17364 nT	69° 22.6′	17291 nT	-1588 nT	46139 nT	49298 nT
November	-5° 14.6′	17375 nT	69° 21.8′	17303 nT	-1588 nT	46136 nT	49299 nT
December	-5° 13.6′	17380 nT	69° 21.5′	17307 nT	-1583 nT	46135 nT	49300 nT
Annual	**-5° 18.1′**	**17374 nT**	**69° 21.5′**	**17300 nT**	**-1606 nT**	**46120 nT**	**49284 nT**

International disturbed day means

Month	D	H	I	X	Y	Z	F
January	-5° 20.9′	17351 nT	69° 22.8′	17275 nT	-1617 nT	46111 nT	49268 nT
February	-5° 21.2′	17349 nT	69° 23.1′	17273 nT	-1619 nT	46119 nT	49274 nT
March	-5° 21.2′	17363 nT	69° 22.1′	17287 nT	-1620 nT	46115 nT	49275 nT
April	-5° 18.2′	17339 nT	69° 23.9′	17265 nT	-1603 nT	46124 nT	49275 nT
May	-5° 18.1′	17364 nT	69° 21.8′	17290 nT	-1605 nT	46108 nT	49269 nT
June	-5° 19.5′	17387 nT	69° 20.6′	17312 nT	-1613 nT	46119 nT	49288 nT
July	-5° 16.7′	17354 nT	69° 23.2′	17280 nT	-1596 nT	46136 nT	49292 nT
August	-5° 16.5′	17350 nT	69° 23.3′	17276 nT	-1595 nT	46130 nT	49285 nT
September	-5° 13.6′	17345 nT	69° 23.6′	17273 nT	-1580 nT	46132 nT	49285 nT
October	-5° 13.8′	17337 nT	69° 24.6′	17264 nT	-1580 nT	46148 nT	49297 nT
November	-5° 12.7′	17336 nT	69° 24.6′	17264 nT	-1575 nT	46147 nT	49296 nT
December	-5° 13.5′	17370 nT	69° 22.1′	17297 nT	-1582 nT	46135 nT	49297 nT
Annual	**-5° 17.2′**	**17354 nT**	**69° 23.0′**	**17280 nT**	**-1599 nT**	**46127 nT**	**49283 nT**

Eskdalemuir Observatory K Indices 2000

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	5332 4354	2111 3223	2343 3344	2212 2433	1423 3433	3221 2212	2120 1132	3212 2433	3233 3343	3332 2321	3211 1113	1101 2200
2	3332 3433	2111 2322	4311 2102	3332 3123	3123 4433	1120 1222	1210 2221	3321 1332	3343 4433	0001 2423	2100 1000	0000 1112
3	3322 2241	0121 3234	0001 2131	2211 2224	2121 2453	3233 3231	2112 3223	3212 2332	0111 2133	3343 4412	0000 1123	1121 2231
4	2122 3233	1110 1102	0001 2200	4221 3344	1111 2222	1120 1443	3302 4322	3333 3443	1111 3354	1343 5575	2433 3444	3221 1012
5	4333 2244	1001 1343	0100 2223	4410 1221	1132 3123	4344 4343	1222 4321	2354 3433	1121 2333	5565 7665	3220 3344	1212 2110
6	2313 4433	4434 4355	1123 2333	1412 3689	3311 2323	3222 4521	1101 3221	3422 4323	1110 2444	2000 1011	3334 3565	0111 1323
7	3311 2232	5233 4444	3332 3333	9454 4433	2210 1121	2123 4324	2101 1121	1113 3222	3232 3333	0000 2220	5644 3242	3232 3225
8	1001 1200	4312 3343	2213 3443	2222 2123	0000 1222	3345 5644	2311 3320	1111 3222	3122 3333	0000 1112	1344 3212	3222 4334
9	1100 0002	1221 3311	3101 2011	2221 4343	1211 2333	1113 1113	1112 2233	2211 1112	2111 2200	0000 1123	2111 2324	3332 2345
10	1100 1113	2222 2223	0012 2224	3322 3334	3310 2211	3334 3433	2233 4453	1243 4335	0002 1222	3221 1212	3345 4323	3221 2133
11	2212 3355	3322 2235	4321 3222	1221 2231	1110 1102	2334 3542	3434 5444	4443 4244	0001 2312	4421 2141	2212 3443	2221 1113
12	3222 1121	5545 4433	2334 3323	2220 1222	2332 2233	3330 4433	3312 1222	4666 6663	1323 3244	2001 1113	3333 3423	1100 2121
13	2213 2212	3123 3323	2100 0022	2310 1100	4122 4432	1322 3323	1225 6533	4532 3213	4321 2113	5532 4432	1213 2233	2201 1001
14	3110 1221	3333 4544	2111 1122	0000 1110	3211 2231	3242 4554	3334 4764	0101 3434	0110 1111	3444 3445	2200 0012	0000 1002
15	2211 3212	4312 2244	1000 0110	0012 1233	4322 2322	5233 4442	3353 7899	3311 1221	0201 1234	2222 2122	1100 1021	1000 1000
16	1111 2222	2111 2232	0000 0111	3343 3322	3433 3333	2111 2111	8544 5431	2120 2222	4223 3446	3222 2323	0000 1013	0000 1121
17	1000 1000	1112 2221	2112 2100	3232 2212	6522 2133	2111 2222	3222 3211	2211 2111	4323 4448	3221 2233	1000 1000	2200 3241
18	0000 1110	0000 0000	0002 2231	1110 0132	3211 1111	1001 2443	1222 3333	1100 1110	7445 6533	3112 2223	0000 1133	1211 1232
19	0000 1123	0001 1100	2211 2221	3411 3322	3222 3311	3310 0321	2111 2534	1000 1311	3334 5434	2221 3112	1211 1112	2111 1110
20	2111 3242	0011 0013	0012 3100	2332 3322	1110 1232	2222 3111	4544 3333	0002 1321	4312 3222	1100 0010	1121 1321	0001 1020
21	0000 1000	3422 4532	0011 2210	3103 3321	1211 1122	1000 2323	3201 3222	2312 2234	1222 3221	0001 2110	3211 2233	0001 1112
22	1112 3355	2200 2211	2222 3333	0112 2111	1222 2232	3223 3341	2222 2432	1100 1001	2211 2120	1023 3433	2112 2222	0100 1123
23	5513 3211	2013 3312	3333 3311	0021 2222	1221 3464	2322 4553	2202 4553	0011 3431	2211 2211	4233 2122	1201 1110	3531 2222
24	1132 2233	3434 3454	3213 3311	1333 4322	7755 5554	4432 2112	2210 0112	2332 2210	0100 2353	2122 2122	0112 2333	1300 0011
25	1210 2122	3333 3323	2221 1330	1002 2220	4434 3444	1001 1123	0111 2312	0110 0121	3223 3444	0012 2022	2200 0022	2100 2103
26	1211 1113	3223 2353	0001 1111	0000 1010	3332 3440	2344 4454	2332 3444	1111 1211	5333 4233	3111 1122	0133 4355	2100 1123
27	3211 3344	4223 2323	1111 1110	3222 3334	2111 2323	4232 4433	3200 1222	2111 3222	2233 2323	2001 1102	5444 3242	2101 2321
28	4333 4435	3333 4223	1111 1100	4322 2222	1122 2333	3321 2323	3334 5431	2123 3444	2312 3311	0024 3235	2343 4343	2110 3110
29	4334 3444	0123 2100	0001 1134	2212 3434	2322 4554	3231 2211	4344 4433	5443 3443	2202 2222	6533 3333	5554 4323	1210 0112
30	2232 3243		3210 3343	3411 2332	4343 3434	0001 1232	2401 3221	3322 2213	3344 5446	4333 2221	1111 1112	1001 1000
31	3122 2222		3433 3333		3421 2223		1231 3454	3223 3224		2211 2324		1000 1000

SIs and SSCs

Day	Month	UT		Type	Quality	H(nT)	D(min)	Z(nT)
11	1	14	26	SSC*	C	13.5	-3.29	-2.0
27	1	14	53	SSC*	C	12.8	0.55	-1.8
3	2	12	21	SSC*	C	9.6	-2.39	0.8
5	2	15	43	SSC*	A	13.9	-1.25	0.9
11	2	02	58	SSC*	A	28.9	-6.16	-3.3
14	2	07	32	SSC*	B	-19.8	1.96	2.3
20	2	21	39	SSC*	A	49.2	-3.35	-5.2
21	2	07	41	SSC*	C	6.6	0.89	0.4
21	2	15	17	SI	B	-94.1	12.15	6.0
1	3	03	57	SSC*	C	6.5	1.22	-
29	3	14	05	SSC	C	-6.5	0.67	-
29	3	19	23	SSC*	C	24.5	-2.30	-2.5
06	4	16	39	SSC	A	181.4	-12.86	-10.6
1	5	15	08	SSC	A	-37.5	4.85	3.1
23	5	17	03	SSC*	A	36.4	-2.78	-2.4
4	6	15	01	SSC*	A	68.6	-4.33	-3.6
8	6	09	10	SSC*	A	-99.3/+102.0	14.70	+4.6/-7.8
11	6	08	01	SSC*	B	-17.3	2.49	1.0
23	6	13	02	SSC	B	58.3	-3.83	-6.3
10	7	06	37	SSC*	B	-28.6	3.92	1.3
11	7	13	10	SI*	C	-109.5	3.96	9.2
13	7	09	42	SSC*	B	27.4	3.48	-6.1
14	7	15	32	SSC	B	103.5	-7.37	-6.0
15	7	14	37	SSC*	A	331.2	-18.69	-22.6
17	7	08	07	SSC*	C	9.3	4.49	-2.2
19	7	15	26	SSC*	A	99.1	-6.55	-4.6
28	7	06	33	SSC*	B	-28.2	-4.98	-2.3/+2.5
10	8	05	00	SSC*	B	13.4	-4.33	-2.2
11	8	18	45	SSC	C	39.8	-3.89	-1.8
6	9	17	01	SSC*	A	73.4	-6.23	-5.1
17	9	17	24	SSC*	B	99.1	-6.23	-7.5
18	9	14	44	SSC*	B	181.0	-16.79	-14.0
12	10	22	27	SSC*	A	37.9	-2.38	-5.2
31	10	17	14	SSC*	A	39.4	-1.97	-3.1
6	11	09	47	SSC*	B	-18.9	5.90	1.4
7	11	18	16	SSC	C	36.3	-3.65/+3.20	-2.7
10	11	06	28	SSC*	B	-36.6	-7.62	-4.5/+5.6
26	11	11	58	SSC*	C	-15.0	3.65	-1.8
28	11	05	30	SSC*	B	-12.4	-5.89	-2.2
21	12	11	33	SSC*	C	6.1	-1.19	-
22	12	19	26	SSC	C	9.3	0.42	-1.3
24	12	17	46	SSC	C	5.8	0.44	0.5

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						H(nT)	D(min)	Z(nT)
		Start		Maximum		End				
28	10	09	54	10	04	10	21	34.3	-8.17	-10.6

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

Annual Values of Geomagnetic Elements

Eskdalemuir

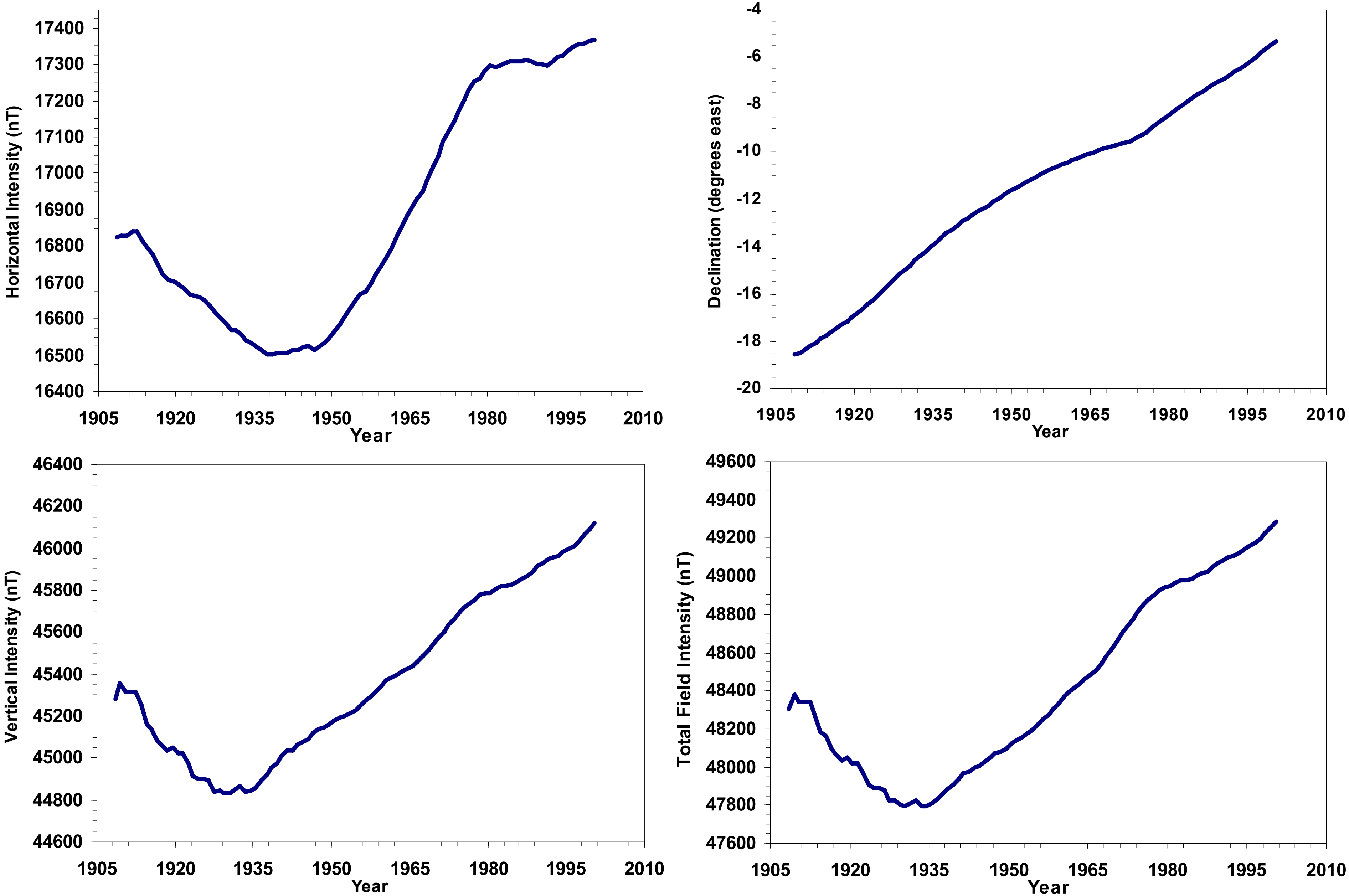
Year	D		H	I		X	Y	Z	F
1908.5	-18	33.3	16821	69	37.3	15947	-5353	45283	48306
1909.5	-18	30.1	16826	69	38.9	15956	-5339	45360	48380
1910.5	-18	23.3	16826	69	37.8	15967	-5308	45317	48340
1911.5	-18	12.4	16836	69	37.1	15993	-5260	45317	48343
1912.5	-18	3.9	16836	69	37.2	16006	-5221	45318	48344
1913.5	-17	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
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

Year	D		H	I		X	Y	Z	F
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
1996.5	-6	0.1	17349	69	20.5	17254	-1814	46012	49174
1997.5	-5	49.4	17356	69	20.5	17266	-1761	46034	49197
1998.5	-5	38.5	17357	69	21.2	17273	-1707	46064	49226
1999.5	-5	28.2	17364	69	21.4	17285	-1655	46090	49253
2000.5	-5	17.9	17368	69	22.0	17294	-1604	46123	49285

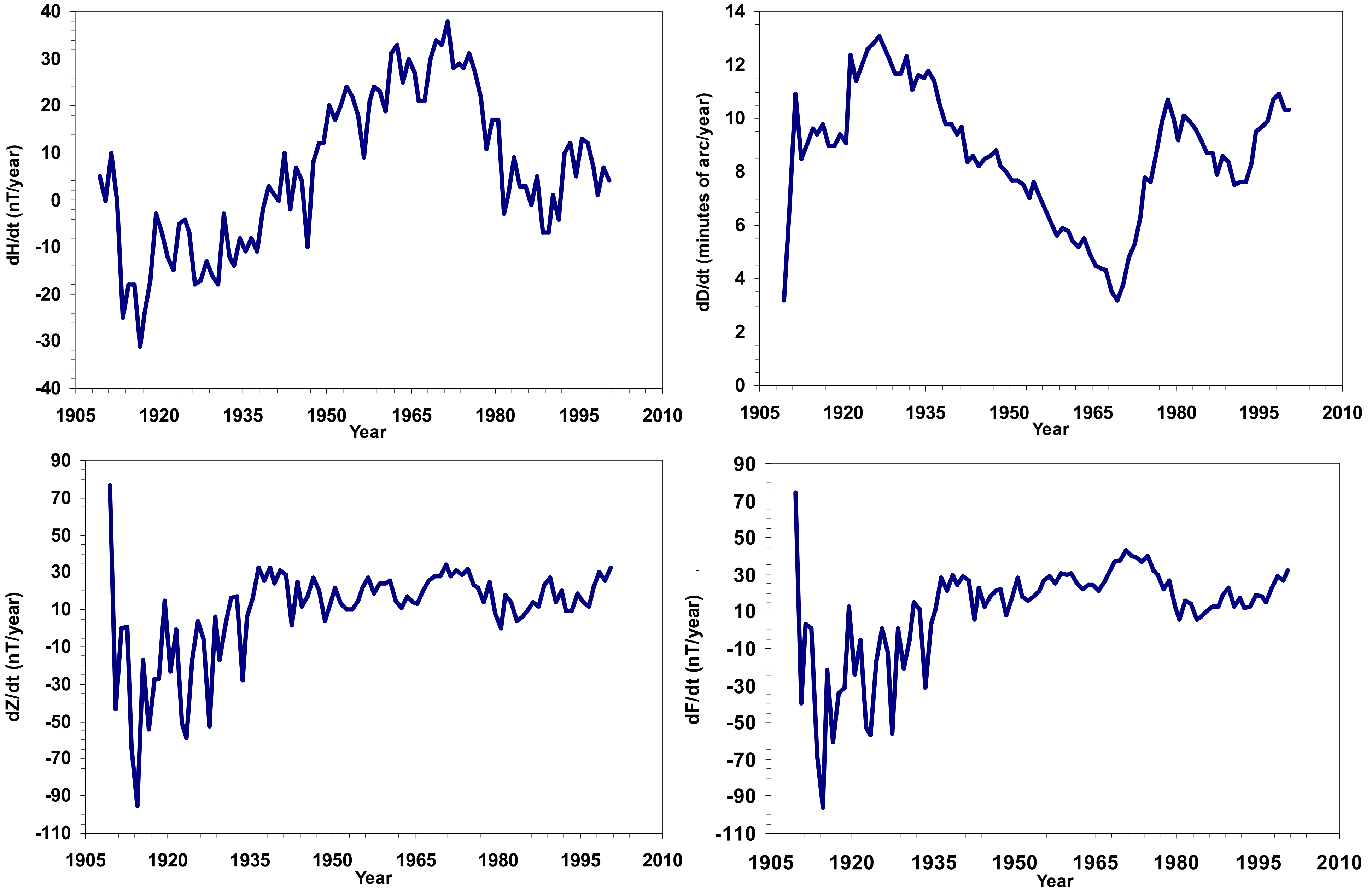
1 Site differences 1 Jan 1990 (new value - old value)
2 Site differences 1 Jan 1994 (new value - old value)

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

Annual Mean Values at Eskdalemuir

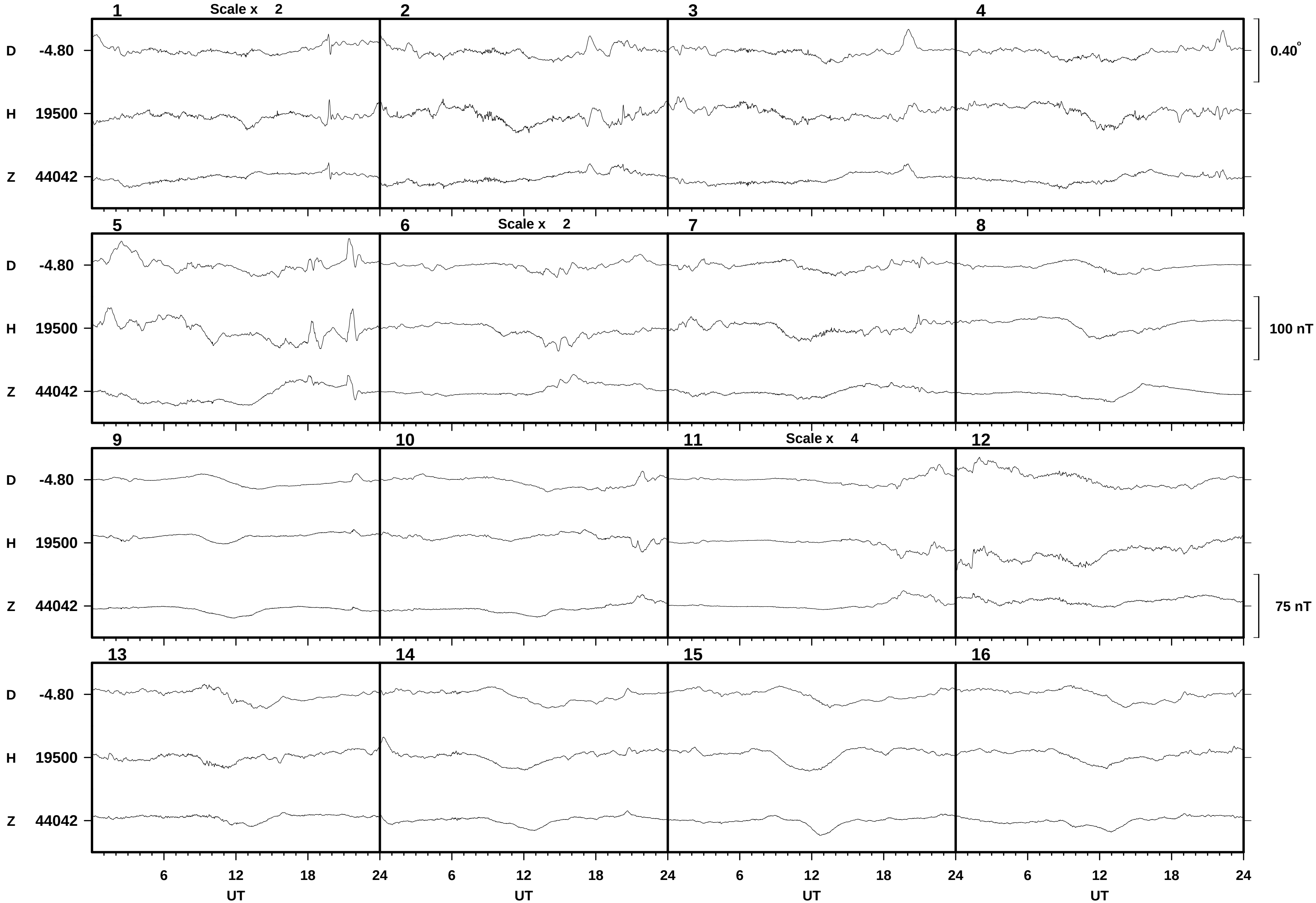


Rate of Change of Annual Mean Values at Eskdalemuir

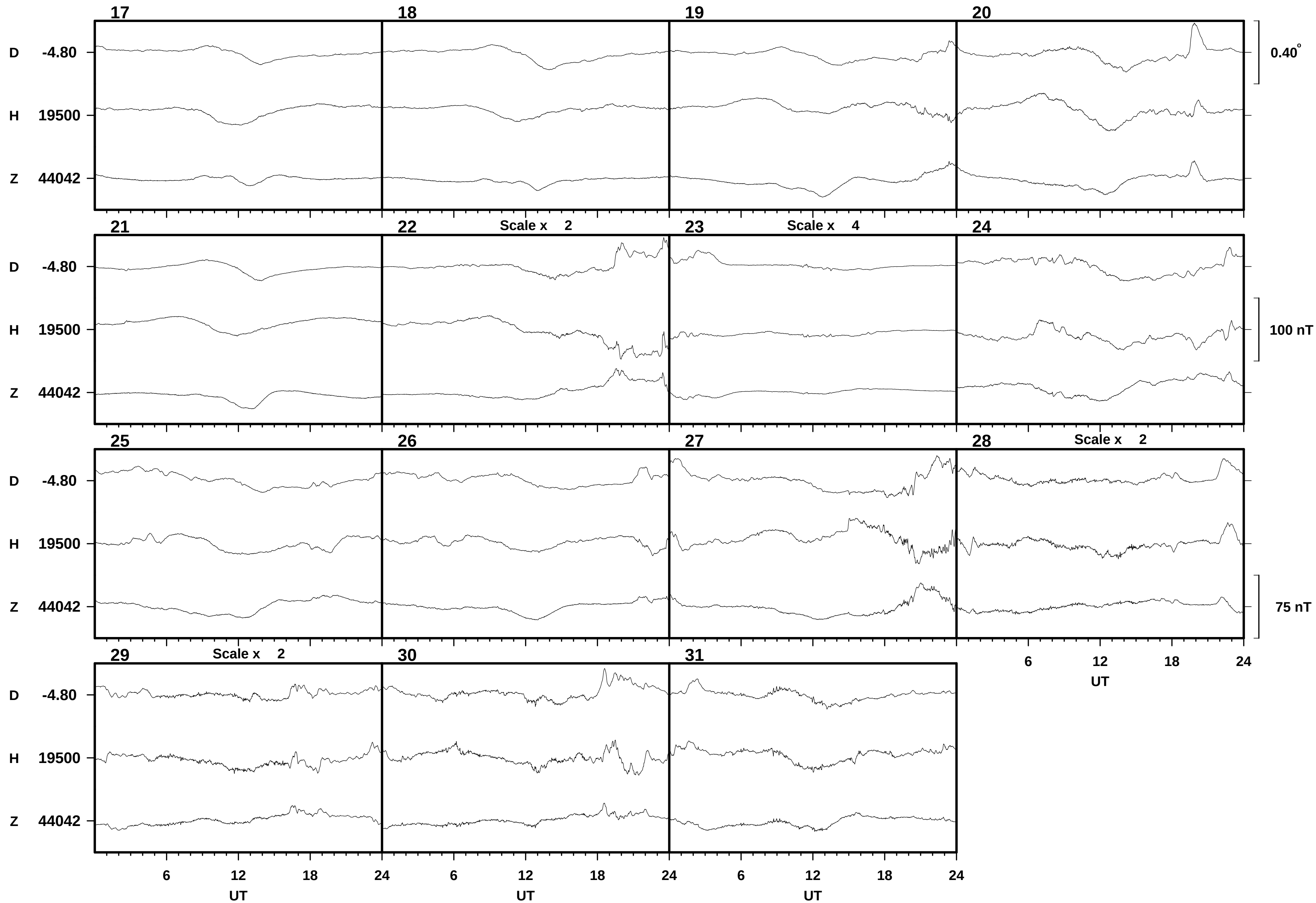


Hartland Observatory Results 2000

Hartland January 2000



HA 1 0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Scale x 2
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Scale x 4
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Scale x 2
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Scale x 2
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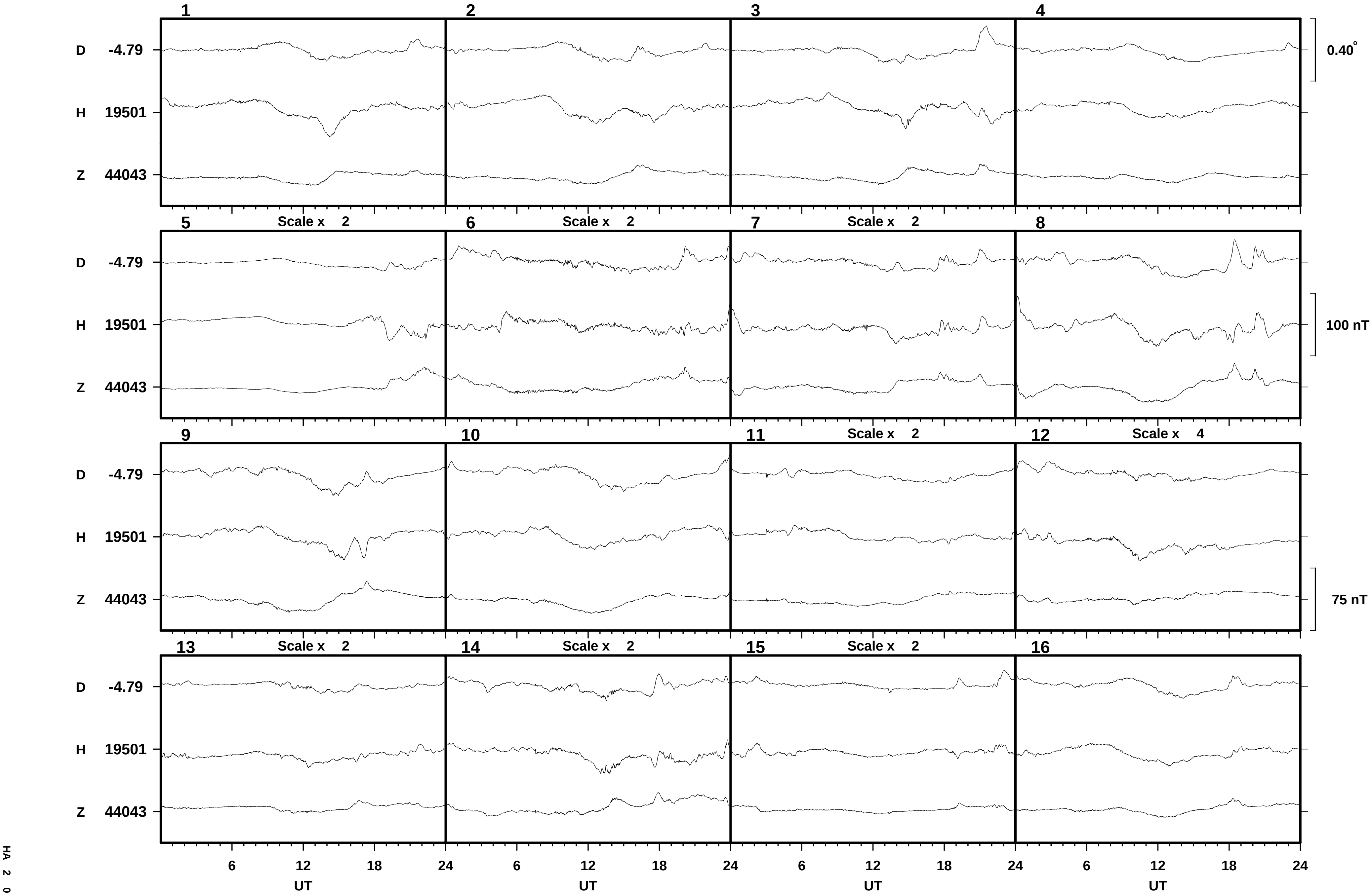
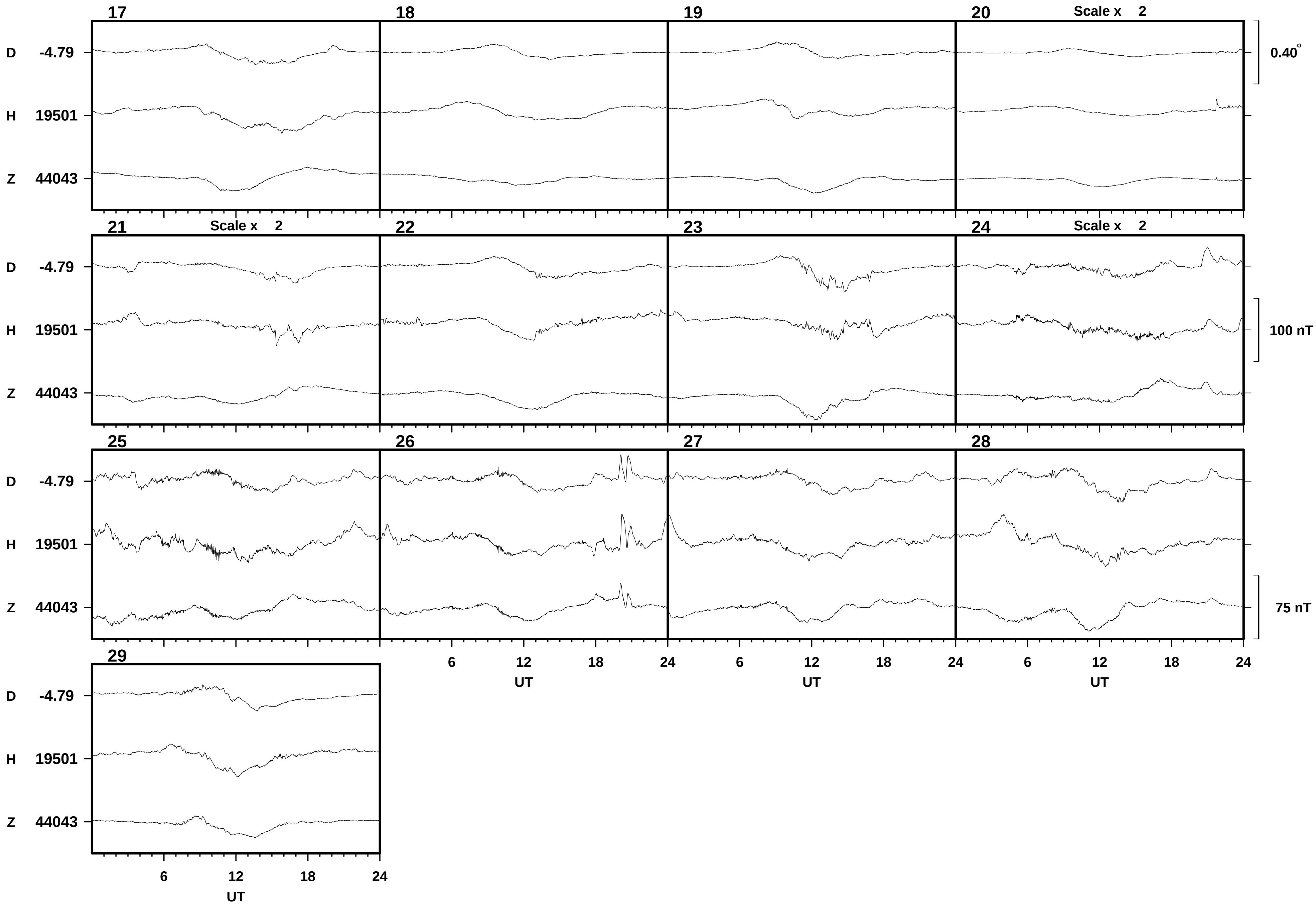
D -4.80
H 19500
Z 44042
0.40°
100 nT
75 nT
6
12
18
24
UT

HA 1 0

Hartland February 2000

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Scale x 2
0.40°
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Scale x 2
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Scale x 2
100 nT
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75 nT
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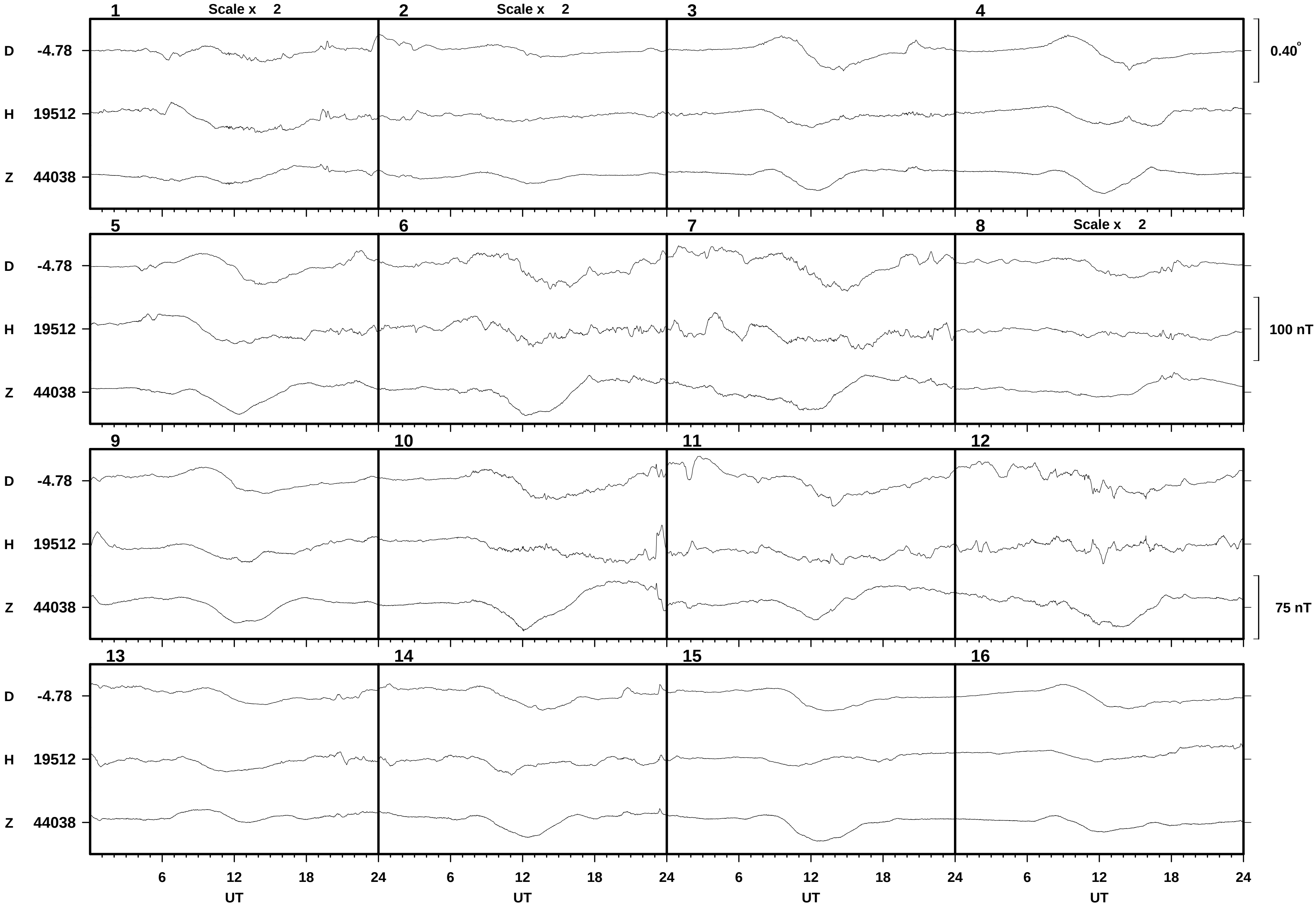
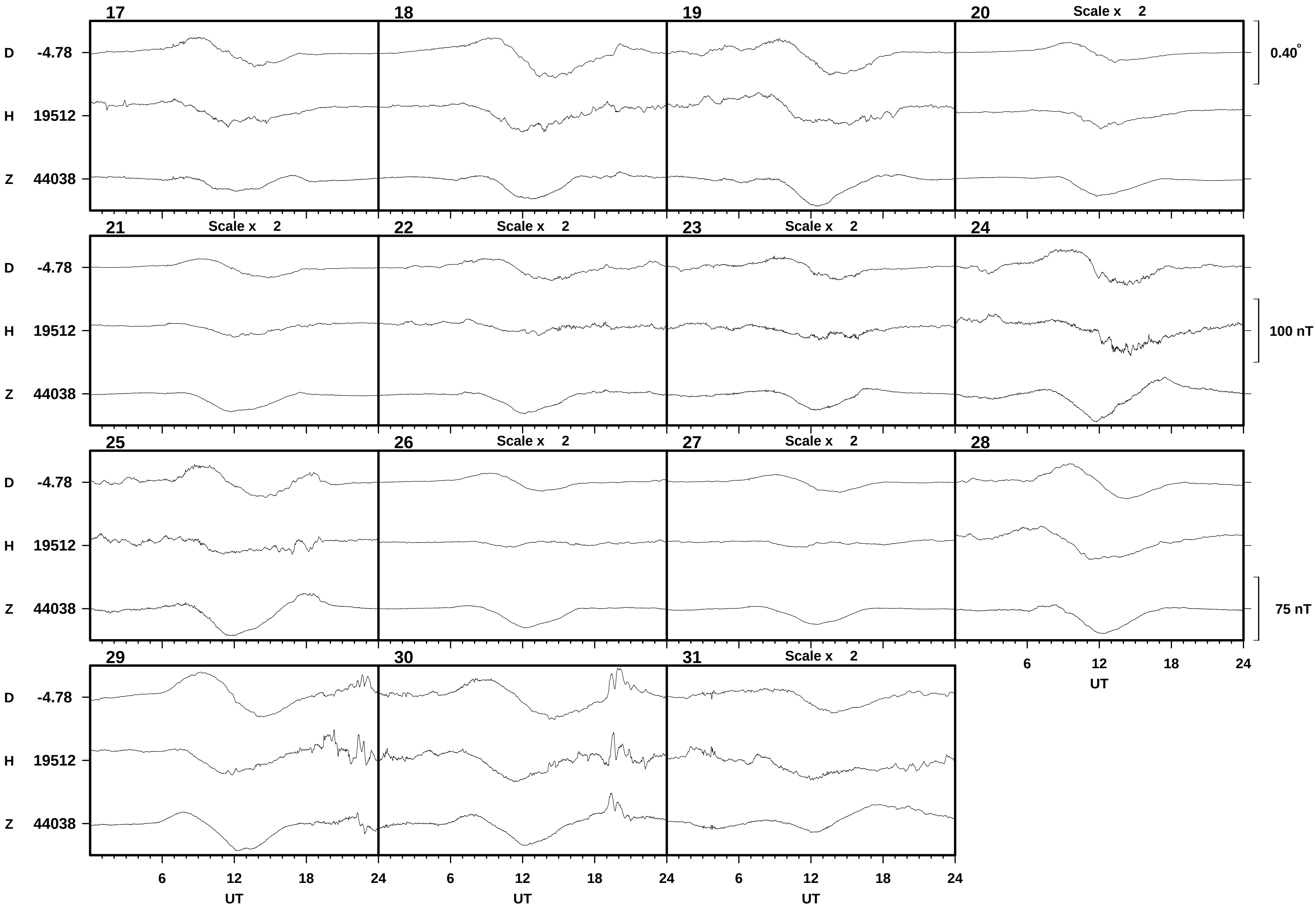
D -4.79
H 19501
Z 44043
6
12
18
24
UT

HA 2 0

Hartland March 2000



HA 3 0



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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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Scale x 2
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Scale x 2
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Scale x 2
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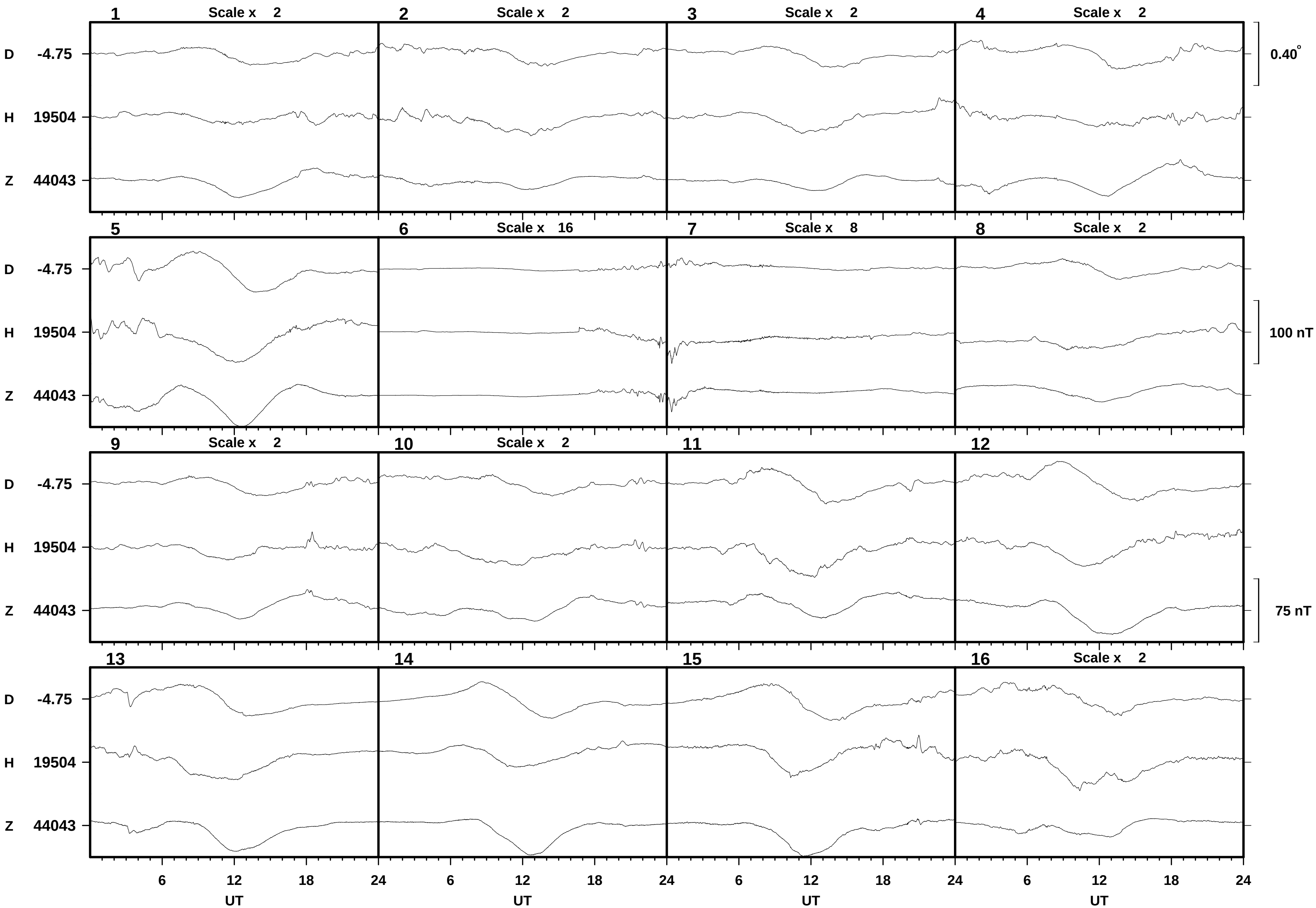
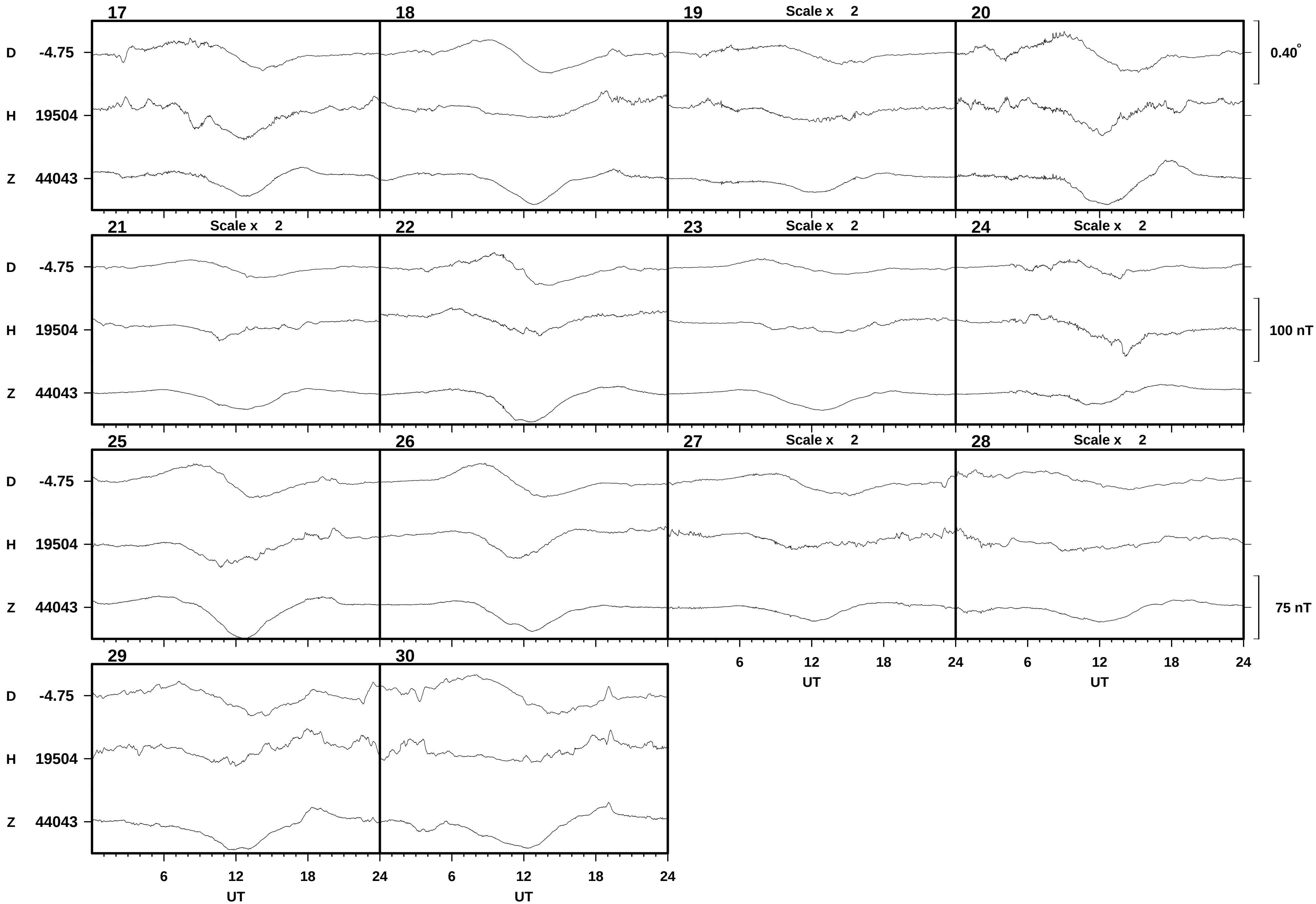
29
30
31
Scale x 2
D -4.78
H 19512
Z 44038
0.40°
100 nT
75 nT
6
12
18
24
UT

HA 3 0

Hartland April 2000

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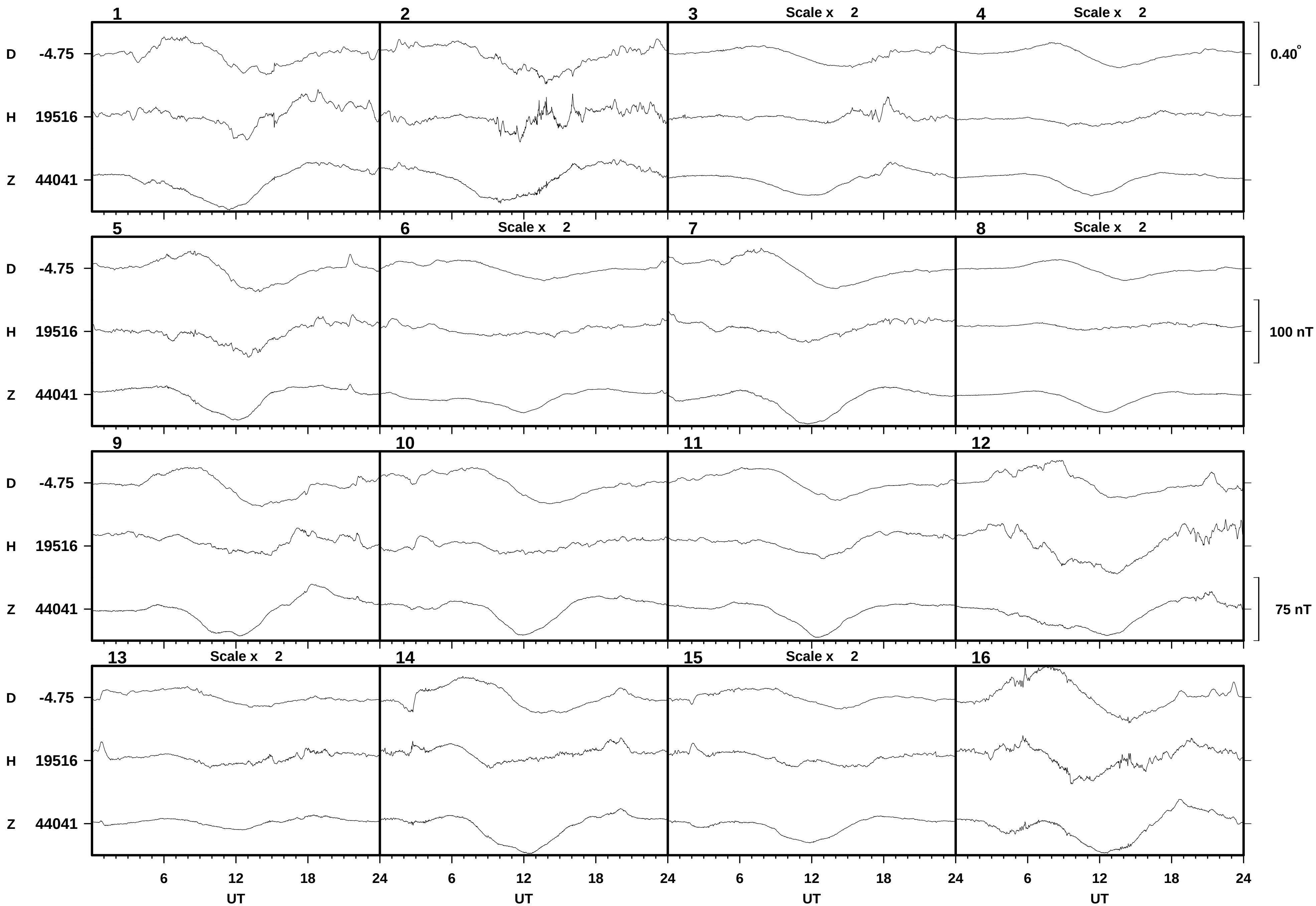
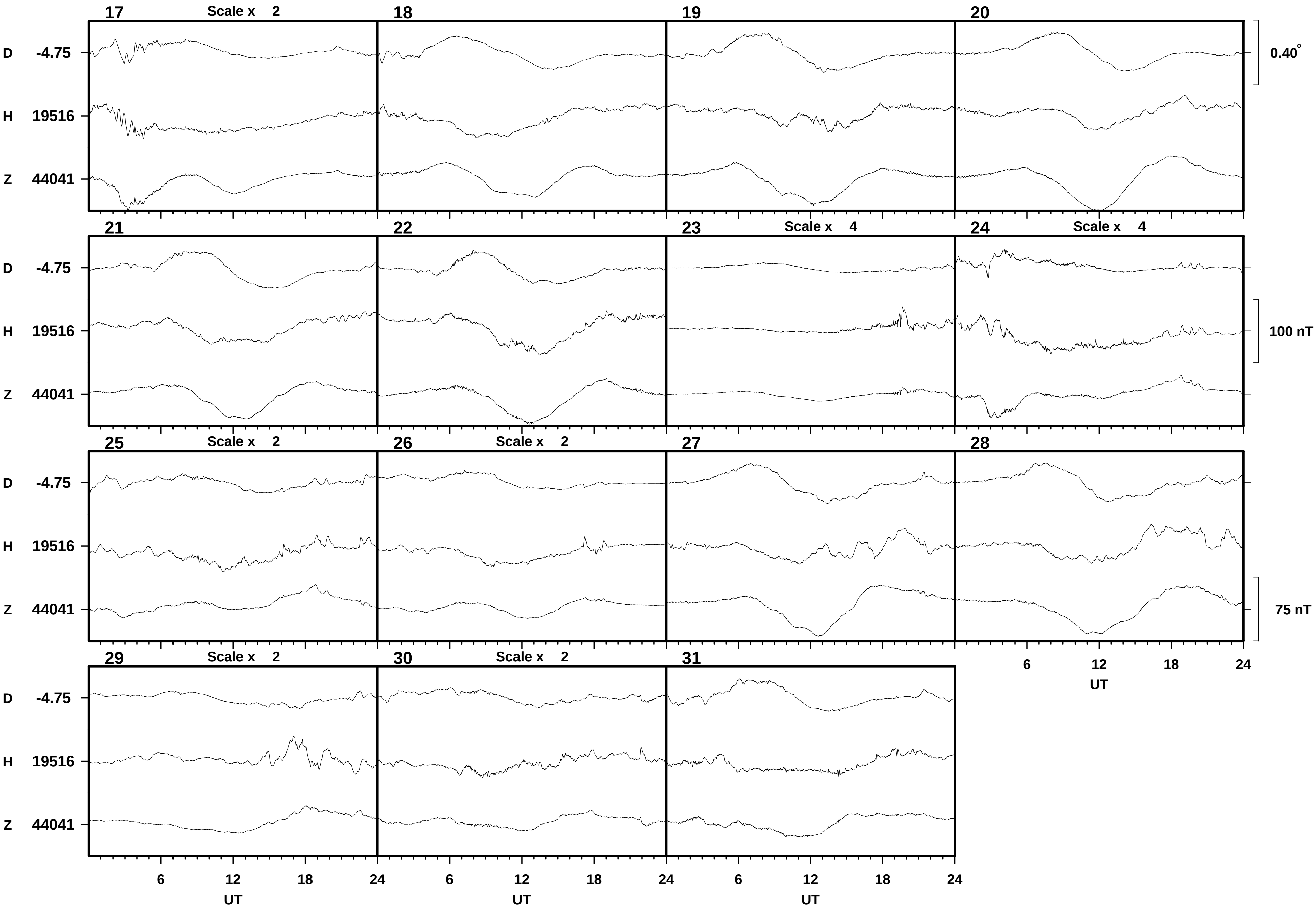
18
19
Scale x 2
20
0.40°
D -4.75
H 19504
Z 44043
21
Scale x 2
22
23
Scale x 2
24
Scale x 2
100 nT
25
26
27
Scale x 2
28
Scale x 2
75 nT
29
30
6 12 18 24
UT
HA 4 0

Hartland May 2000



HA 5 0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Scale x 2
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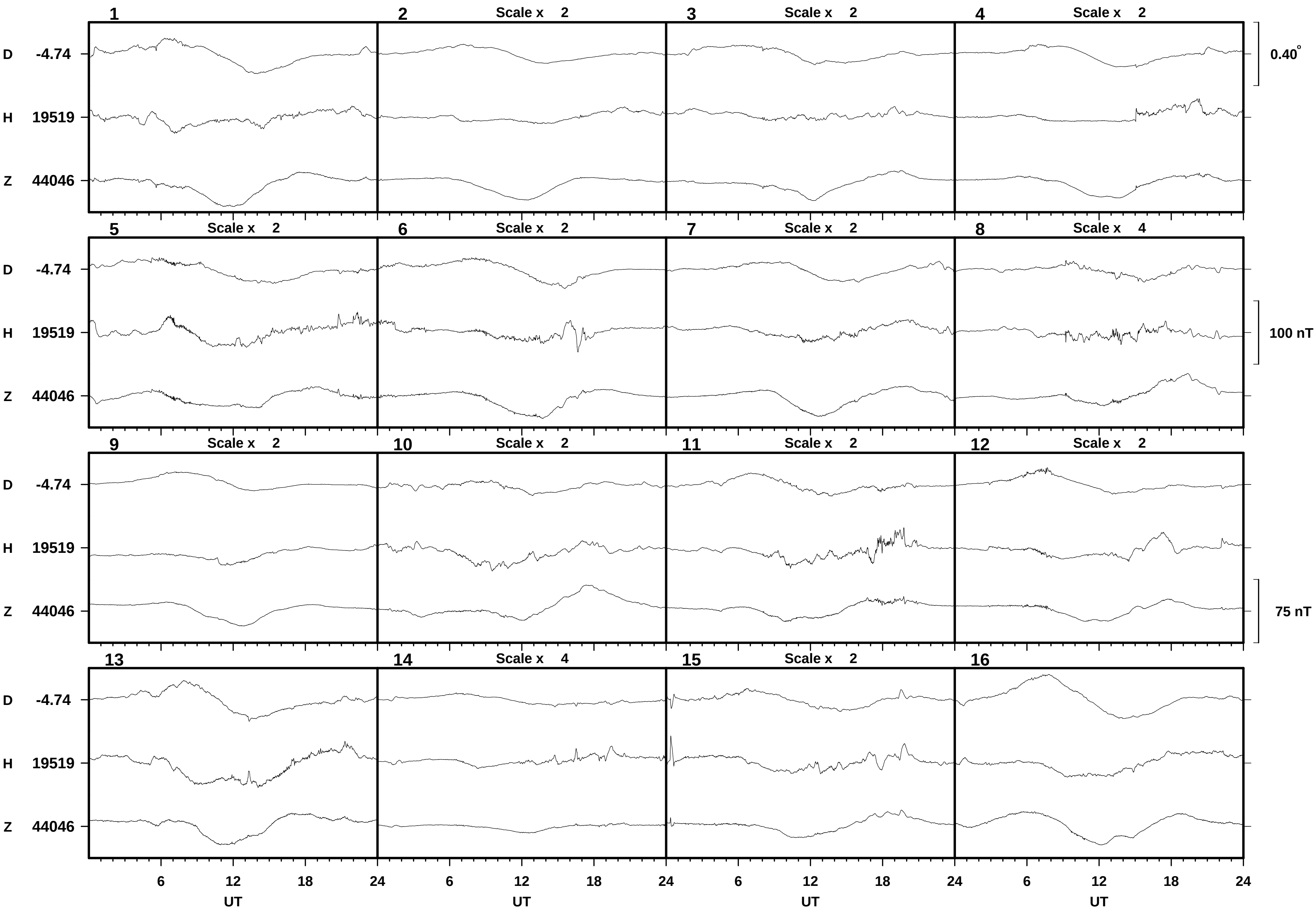
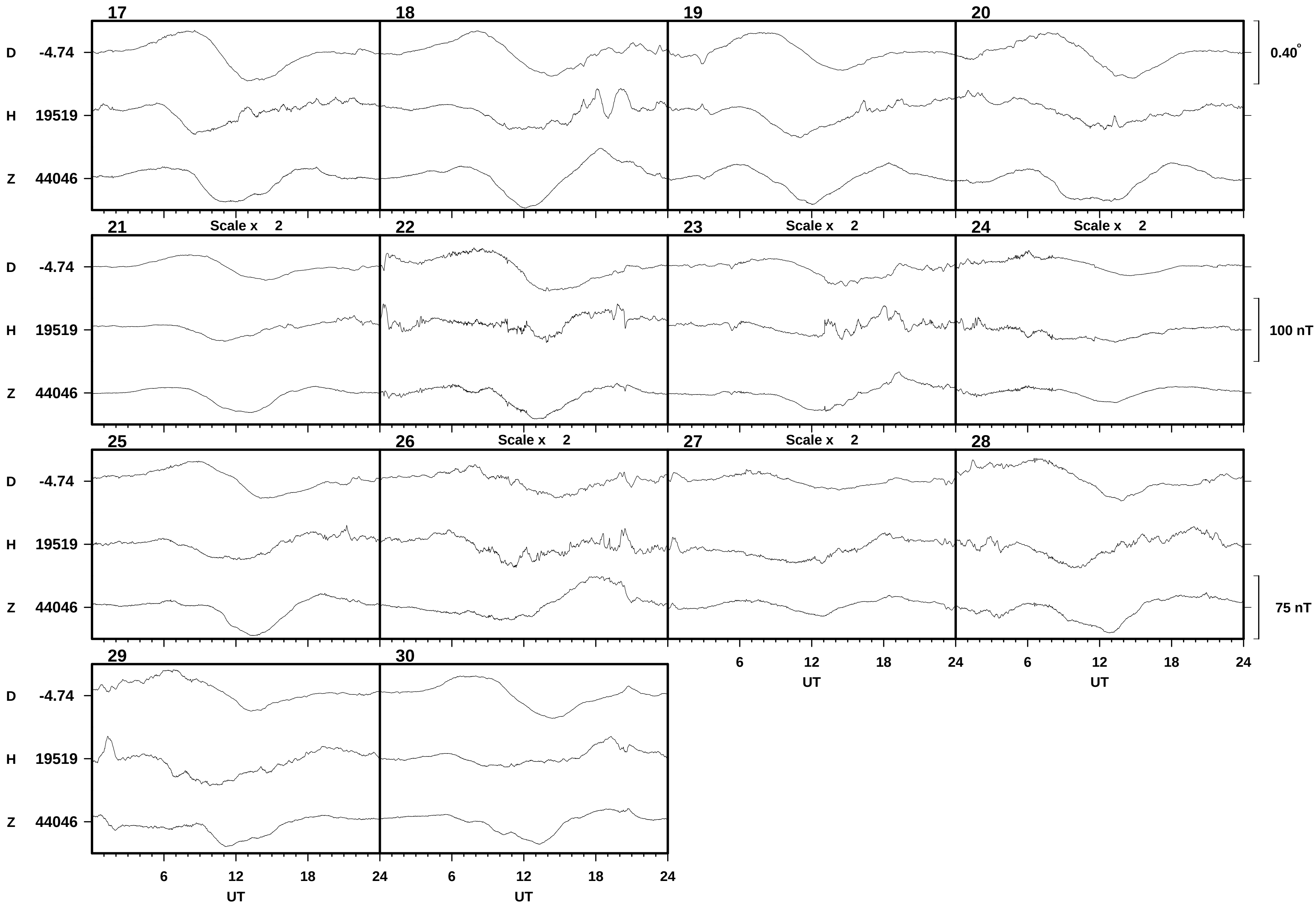
D -4.75
H 19516
Z 44041
0.40°
21
22
23
Scale x 4
24
Scale x 4
100 nT
25
Scale x 2
26
Scale x 2
27
28
75 nT
29
Scale x 2
30
Scale x 2
31
6
12
18
24
UT

HA 5 0

Hartland June 2000



HA 6 0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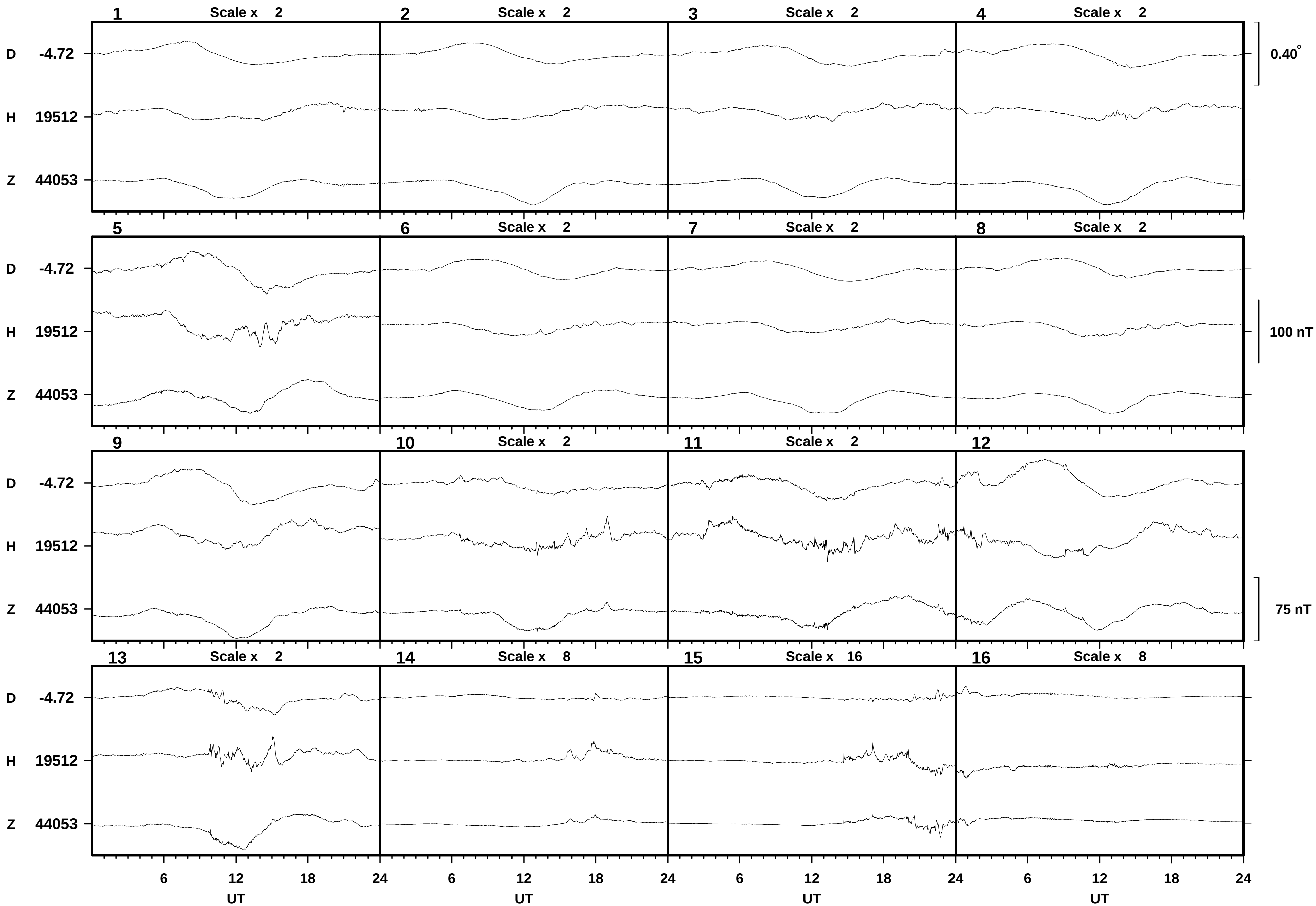
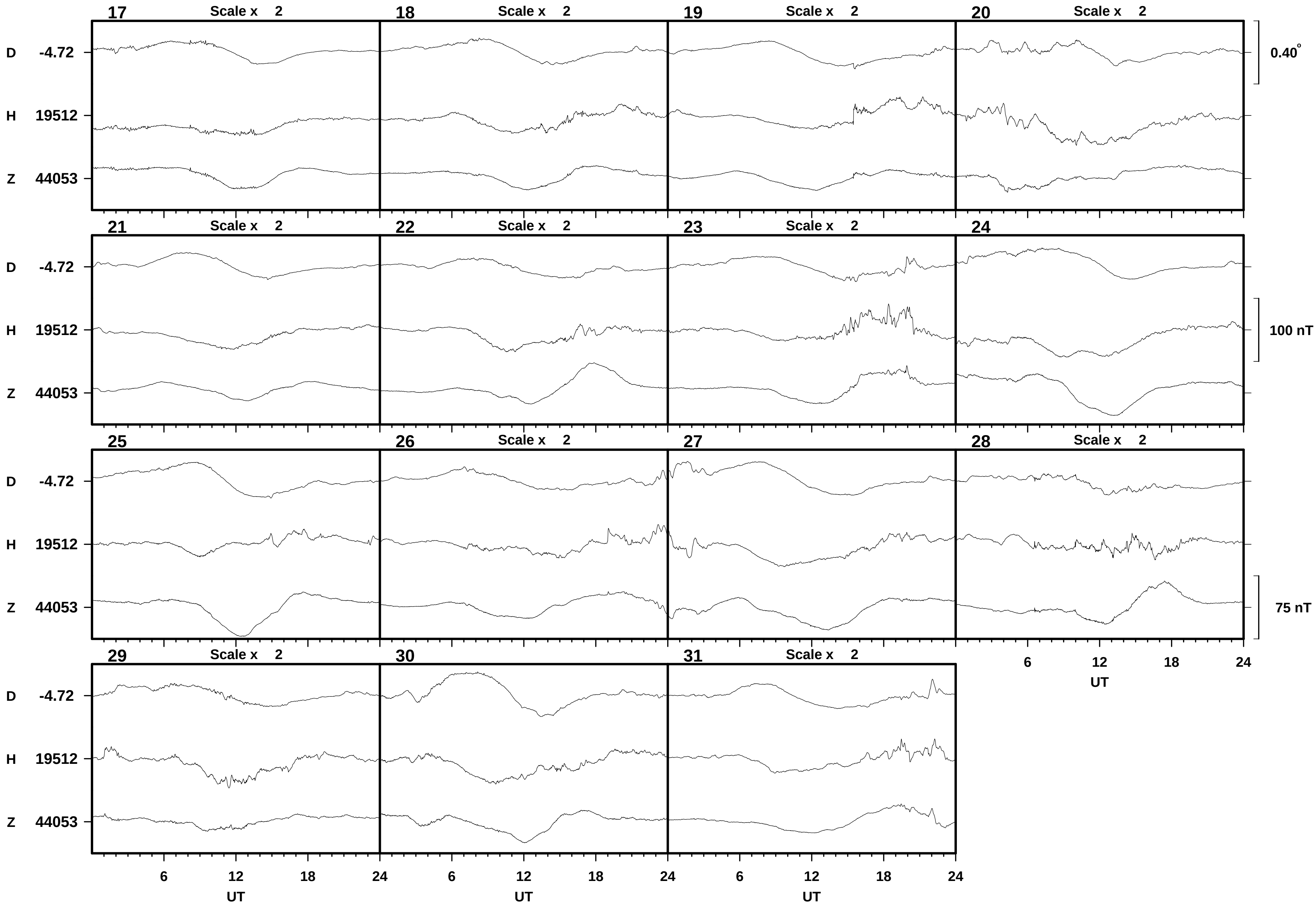
30
D -4.74
H 19519
Z 44046
Scale x 2
0.40°
100 nT
75 nT
6
12
18
24
UT
HA 6 0

Hartland July 2000



HA 7 0



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23 Scale x 2
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25
26 Scale x 2
27
28 Scale x 2
29 Scale x 2
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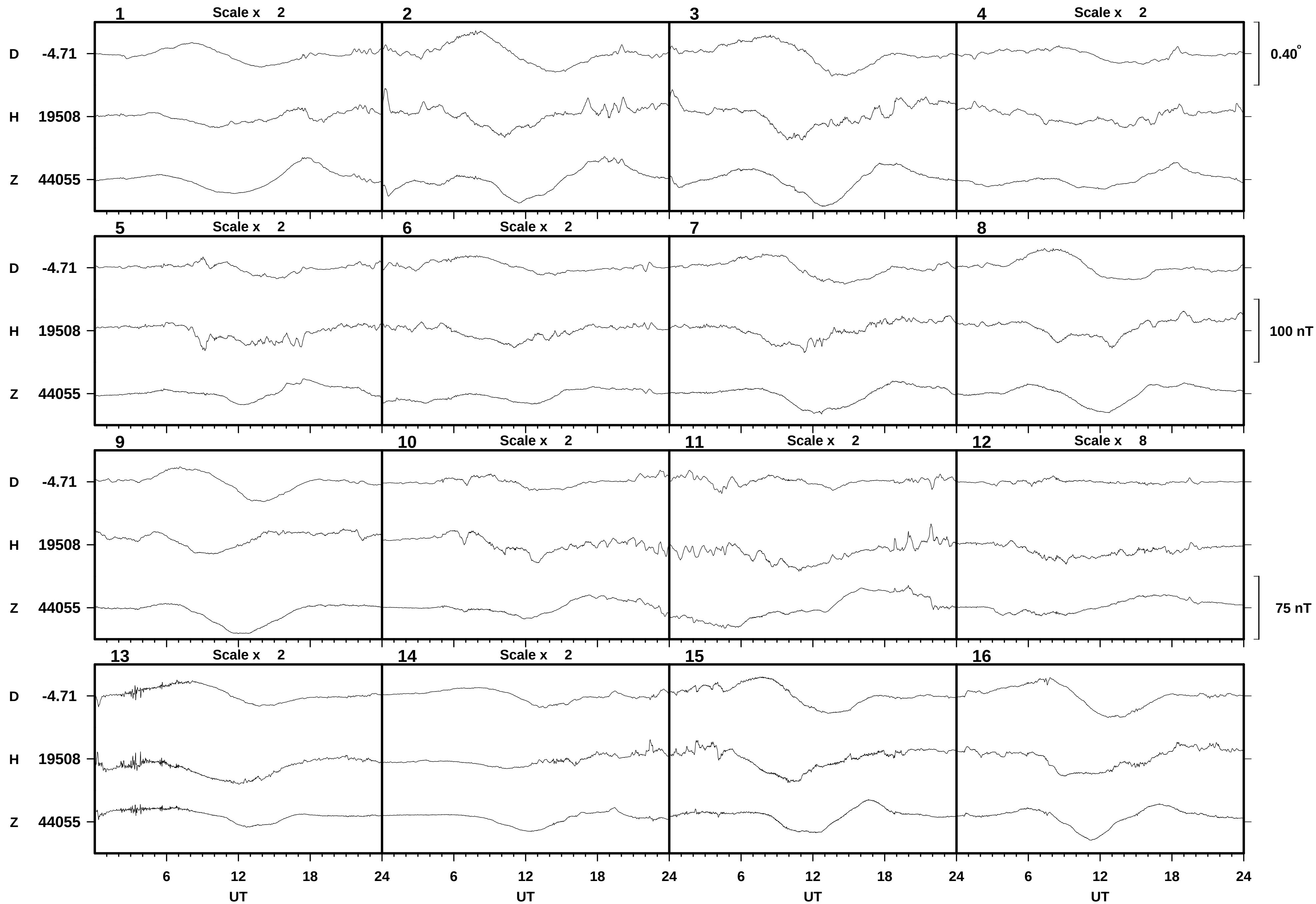
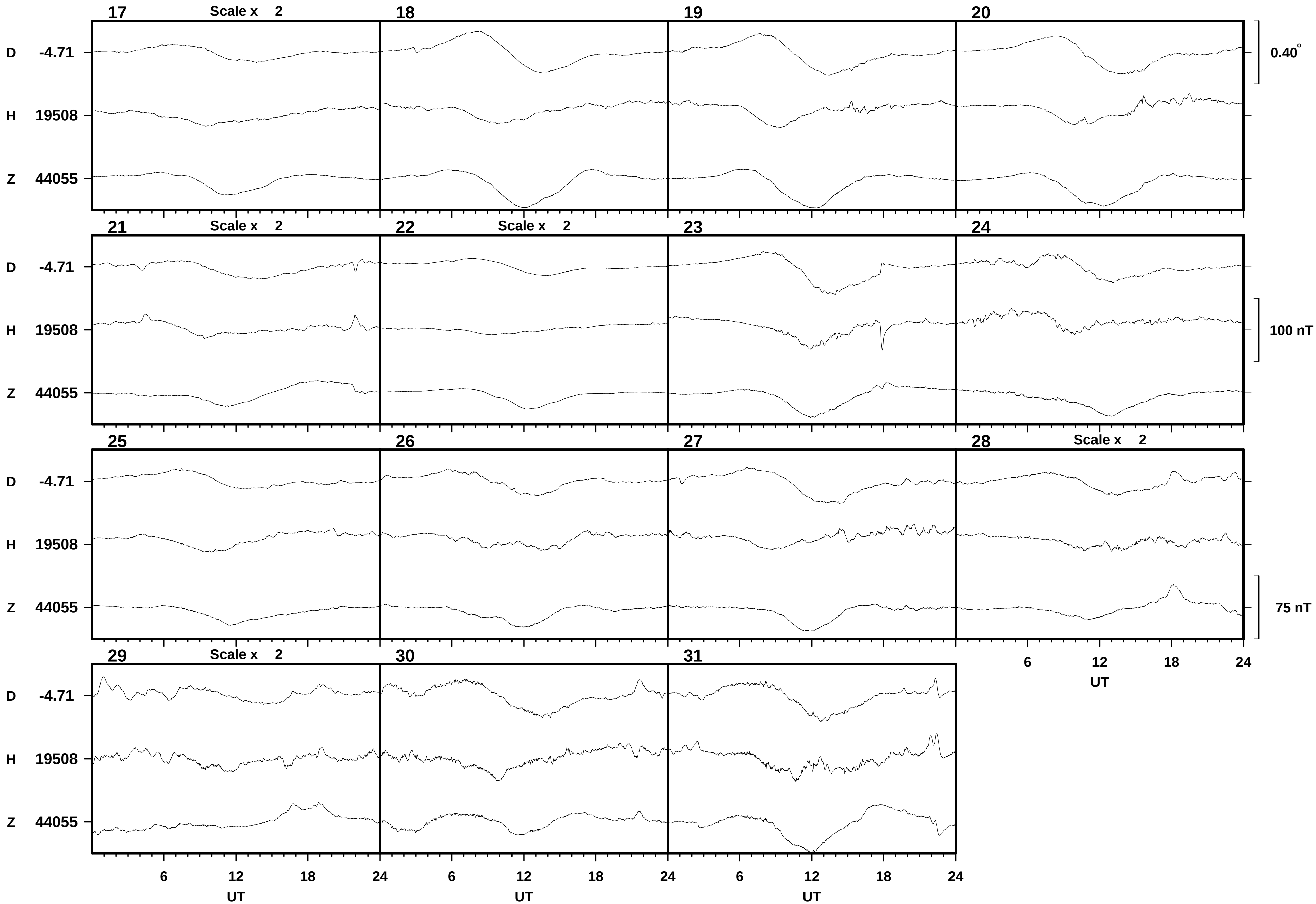
31 Scale x 2
D -4.72
H 19512
Z 44053
0.40°
100 nT
75 nT
6 12 18 24
UT

HA 7 0

Hartland August 2000



HA 8 0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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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28
Scale x 2
29
Scale x 2
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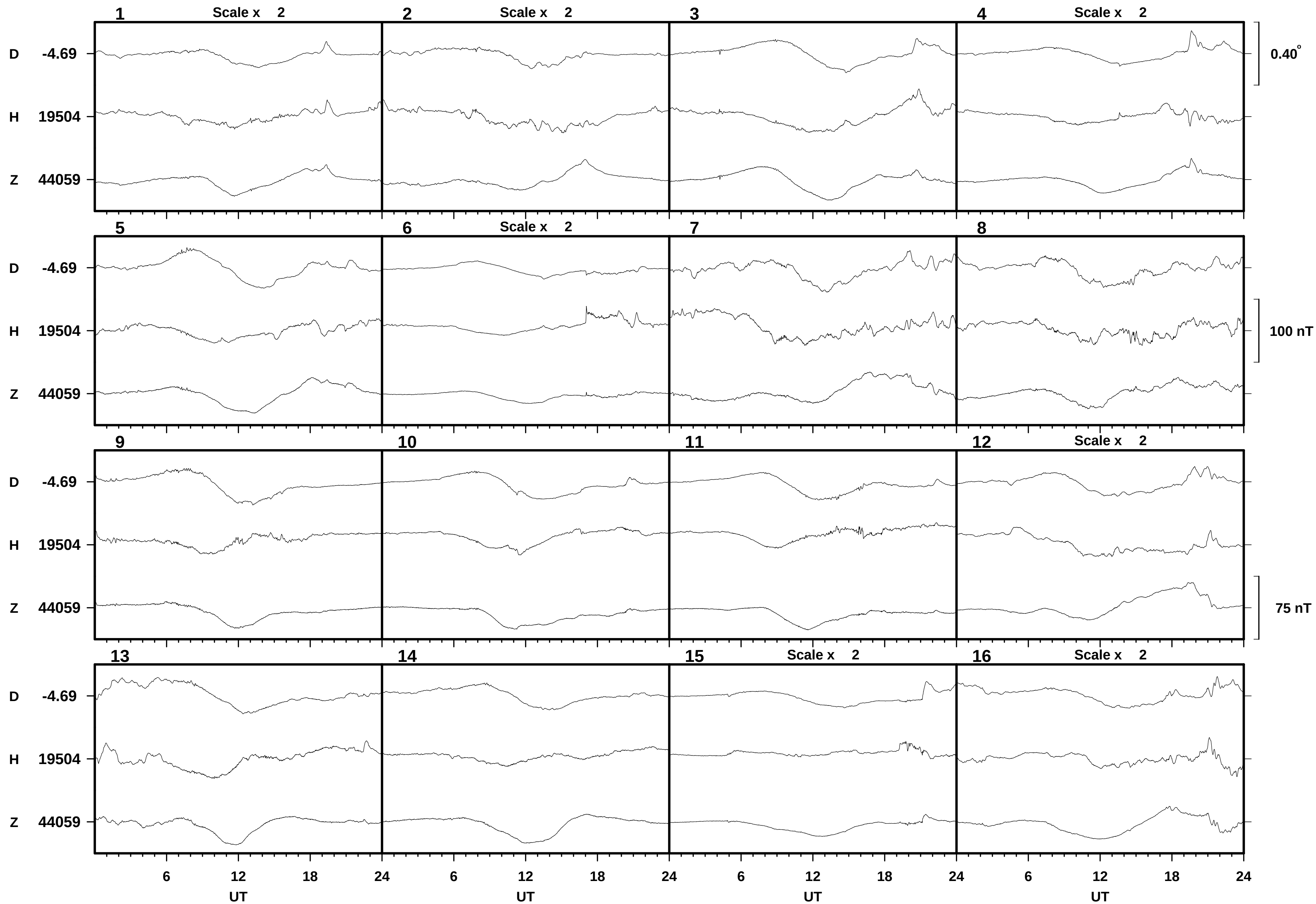
31
D -4.71
H 19508
Z 44055
0.40°
100 nT
75 nT
6 12 18 24
UT

HA 8 0

Hartland September 2000



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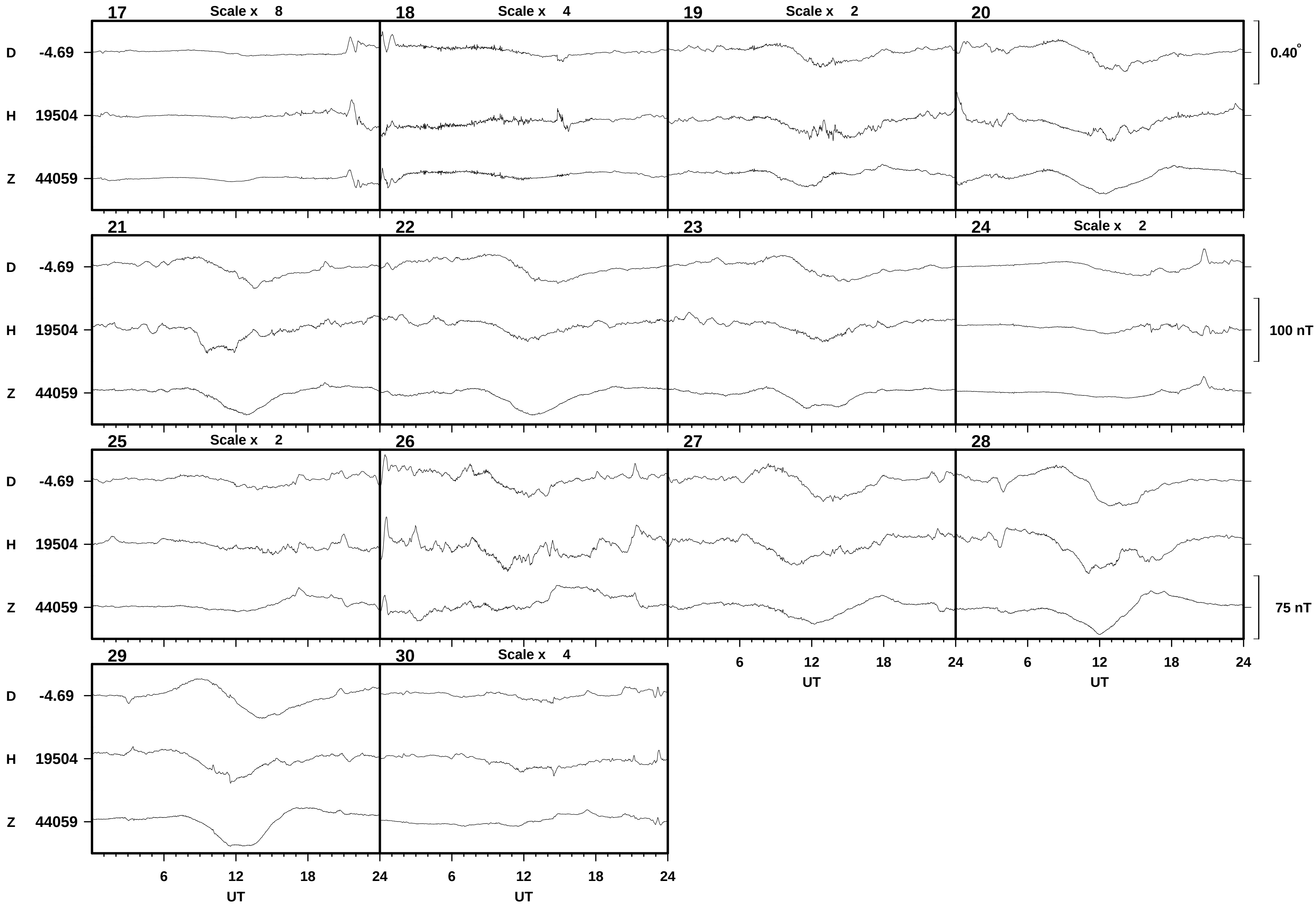

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Scale x 8
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Scale x 4
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Scale x 2
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Scale x 2
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Scale x 2
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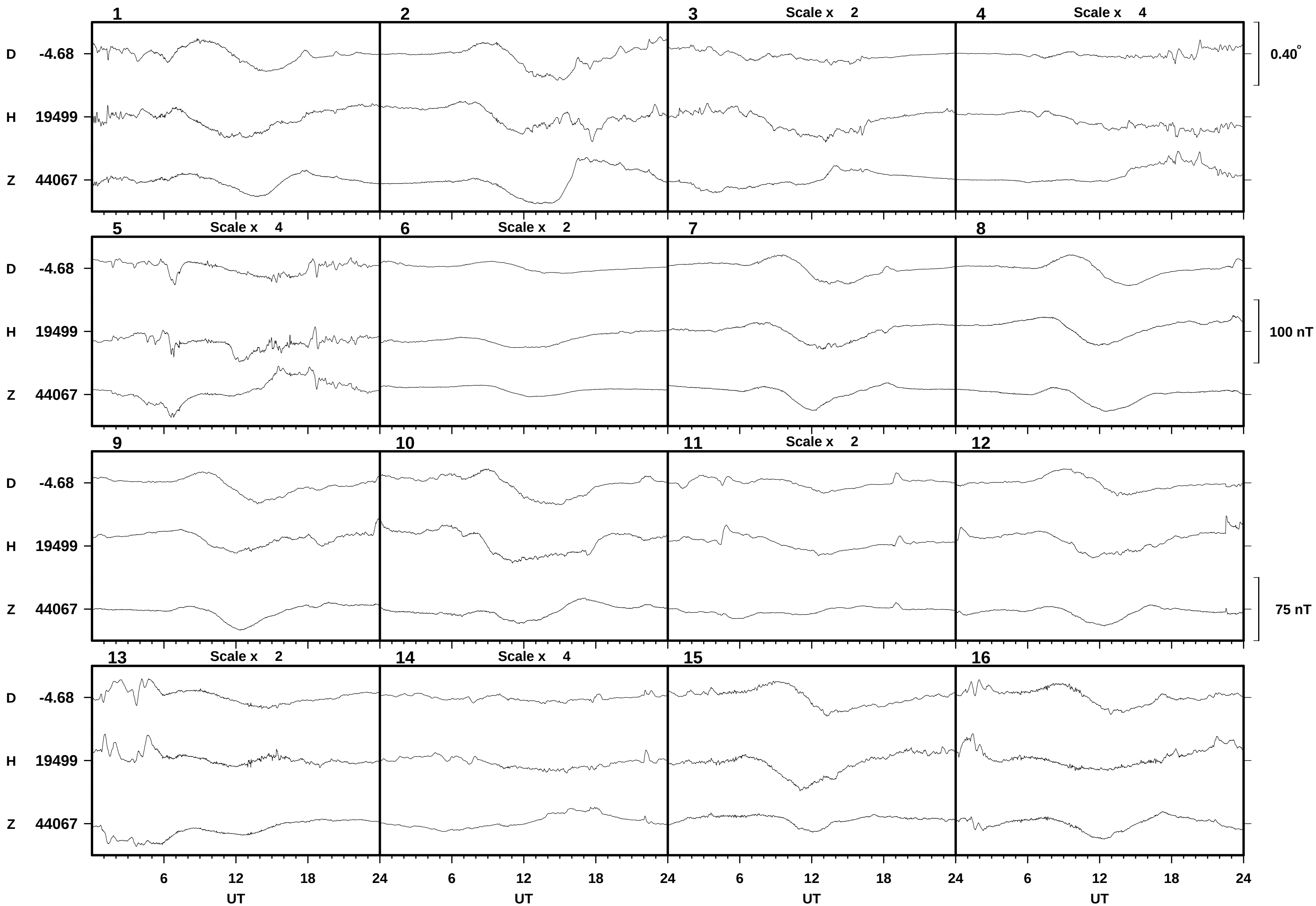
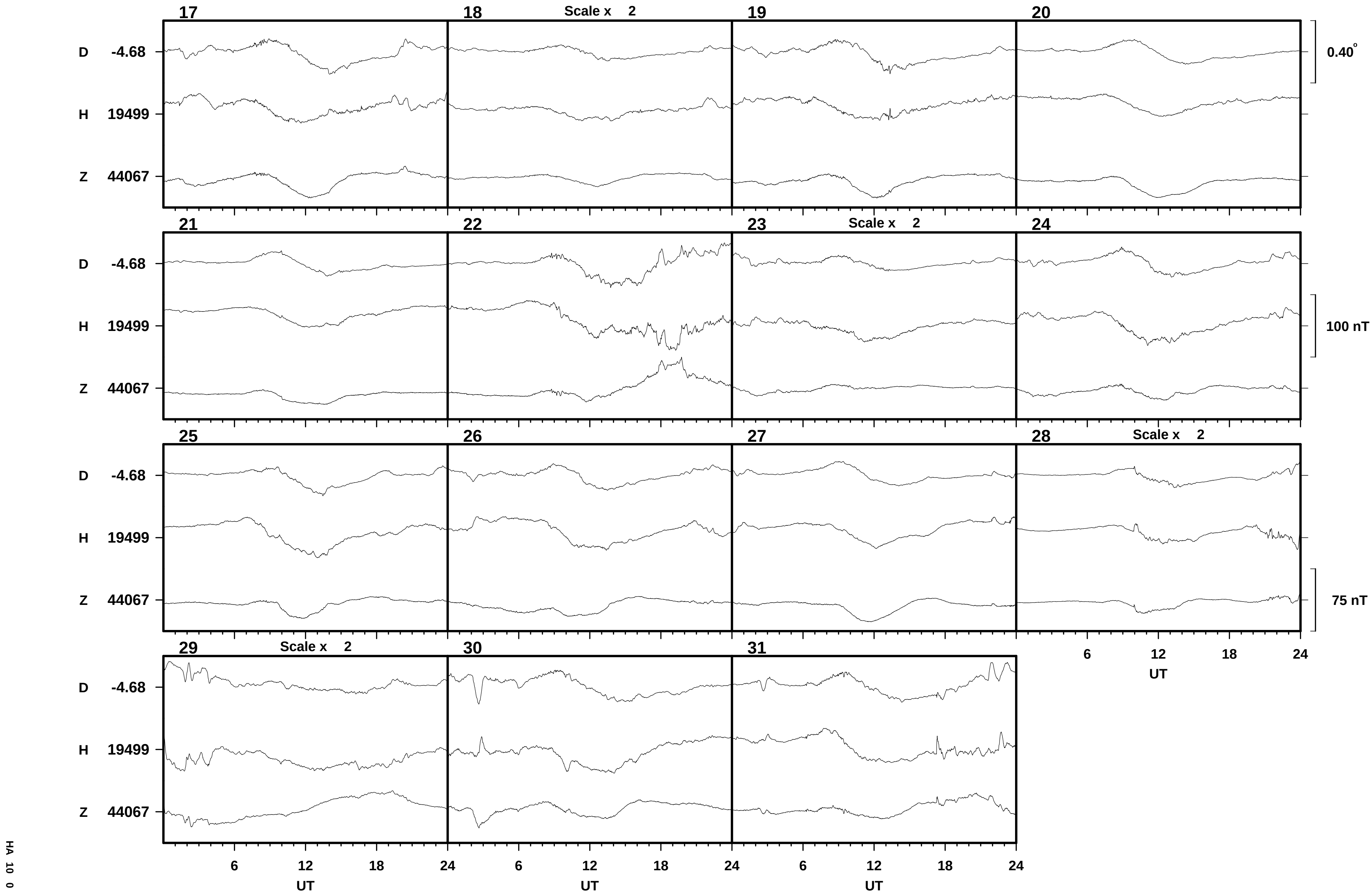
29
30
Scale x 4
D -4.69
H 19504
Z 44059
0.40°
100 nT
75 nT
6
12
18
24
UT

Hartland October 2000



HA 10 0



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Scale x 2
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Scale x 2
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Scale x 2
29
Scale x 2
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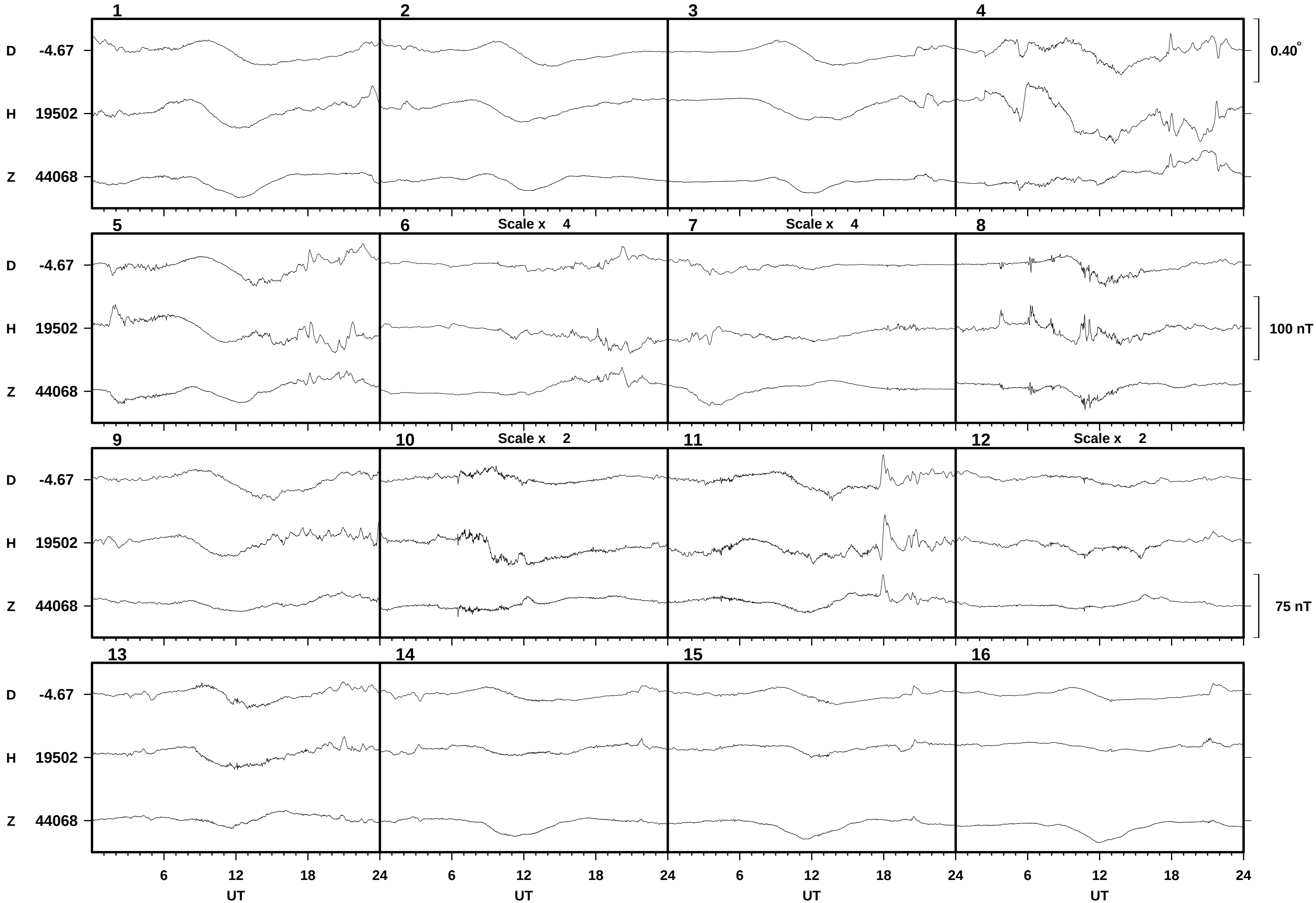
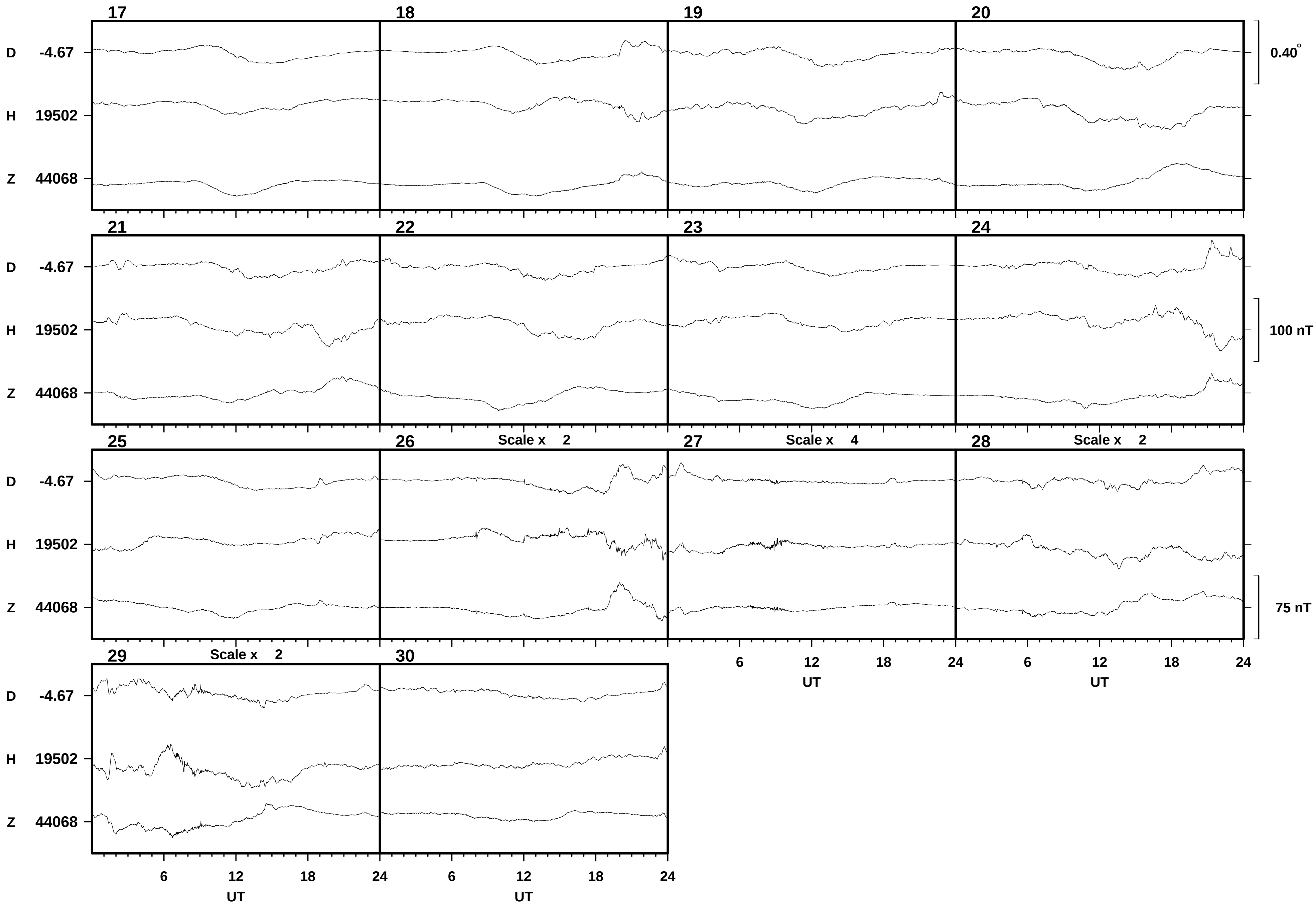
31
D -4.68
H 19499
Z 44067
0.40°
100 nT
75 nT
6 12 18 24
UT
HA 10 0

Hartland November 2000



HA 11 0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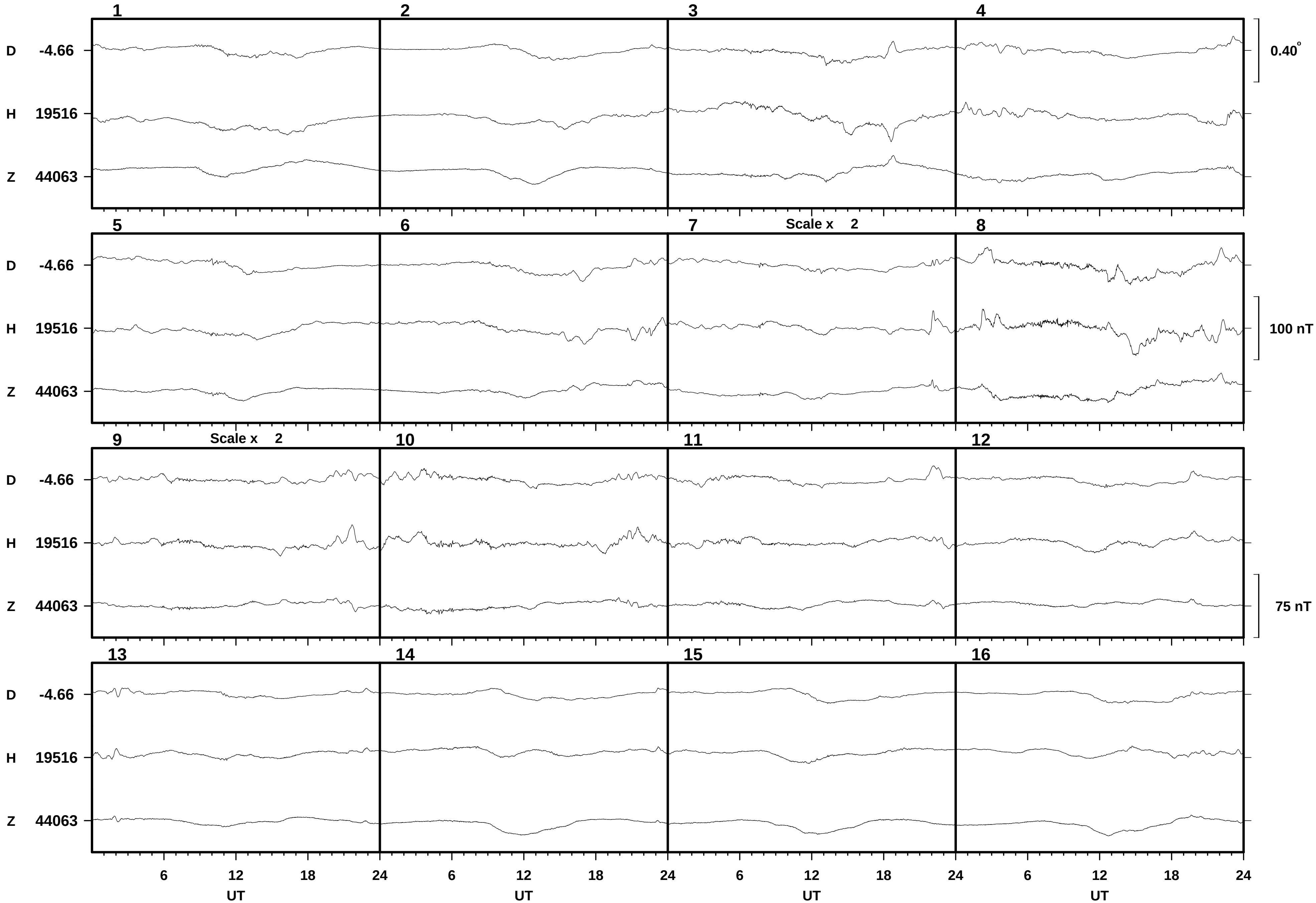
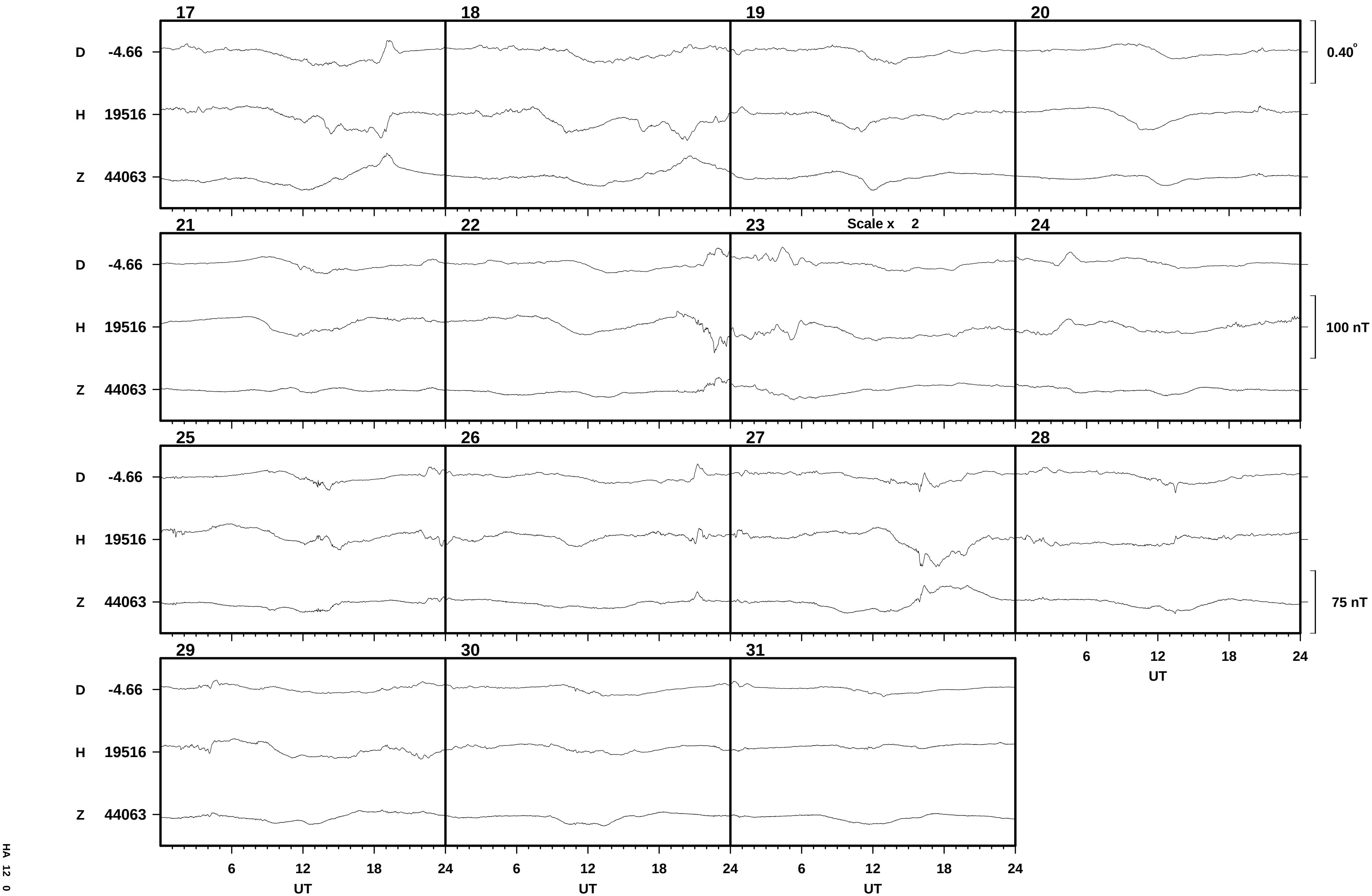
26
Scale x 2
27
Scale x 4
28
Scale x 2
29
Scale x 2
30
D -4.67
H 19502
Z 44068
0.40°
100 nT
75 nT
6
12
18
24
UT

HA 11 0

Hartland December 2000



HA 12 0



17
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23
Scale x 2
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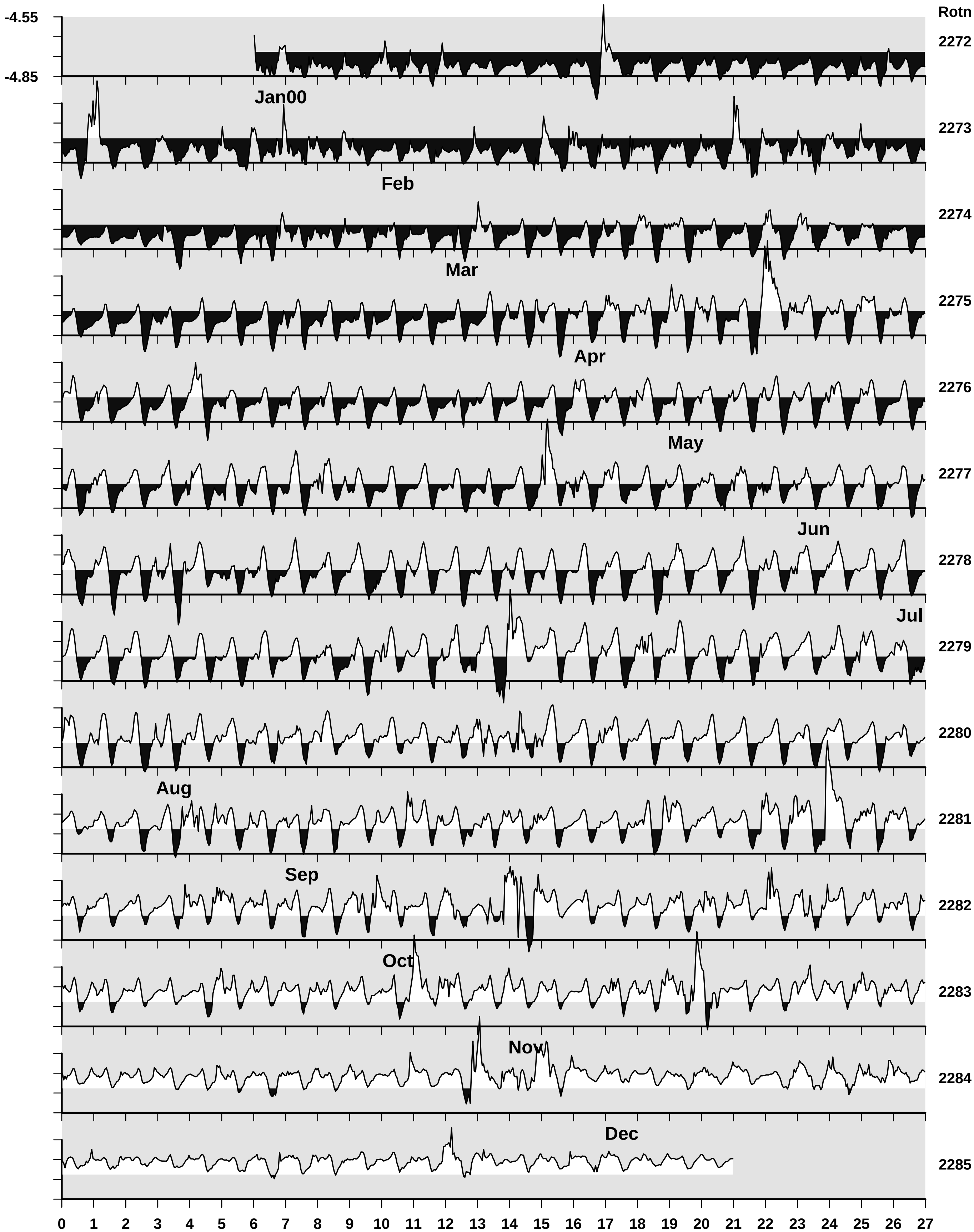
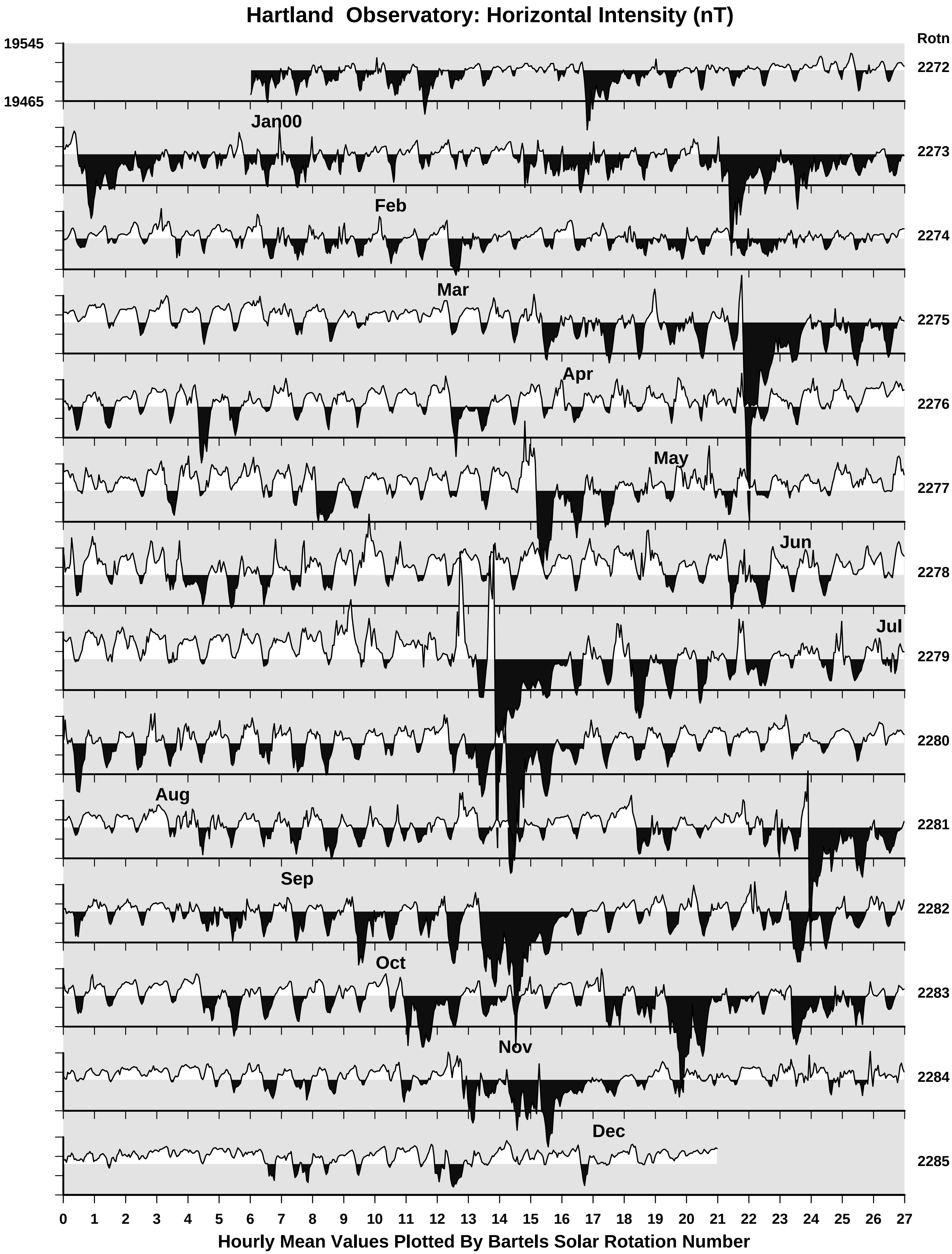
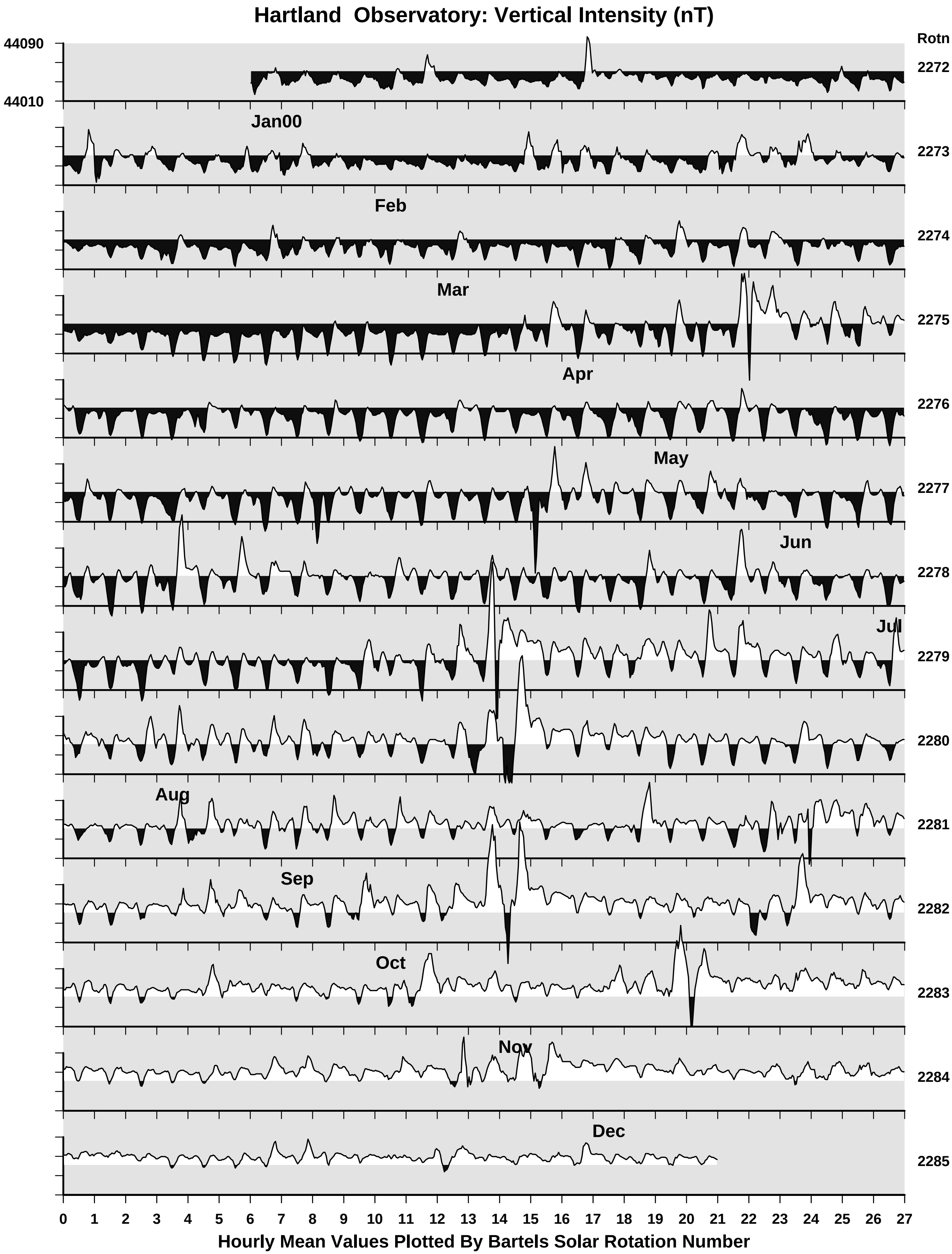
25
26
27
28
29
30
31
D -4.66
H 19516
Z 44063
0.40°
100 nT
75 nT
6
12
18
24
UT
HA 12 0

Hartland Observatory: Declination (degrees)

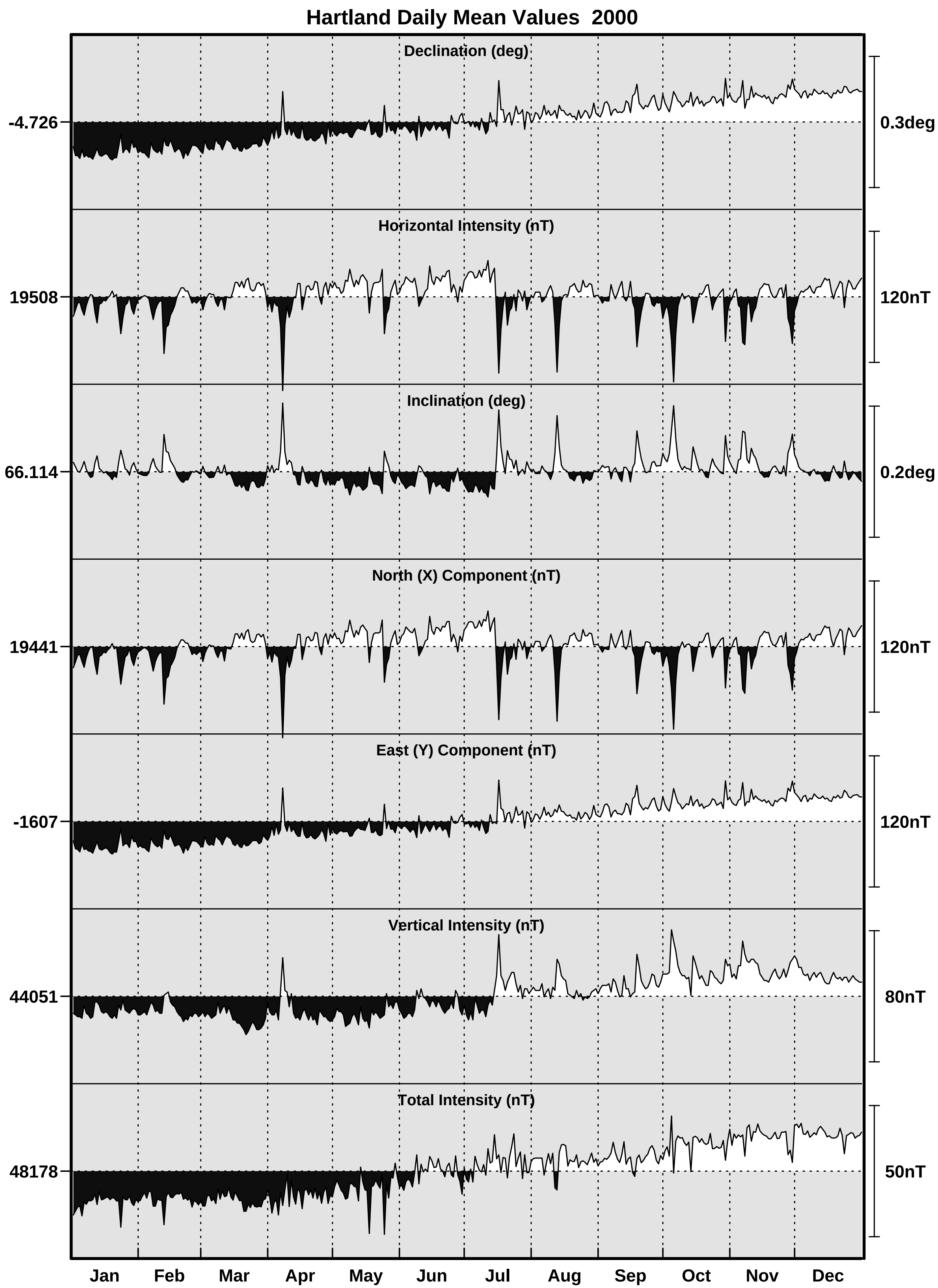


Hourly Mean Values Plotted By Bartels Solar Rotation Number


Hartland Observatory: Horizontal Intensity (nT)
19545
19465
Rotn
2272
2273
2274
2275
2276
2277
2278
2279
2280
2281
2282
2283
2284
2285
Jan00
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

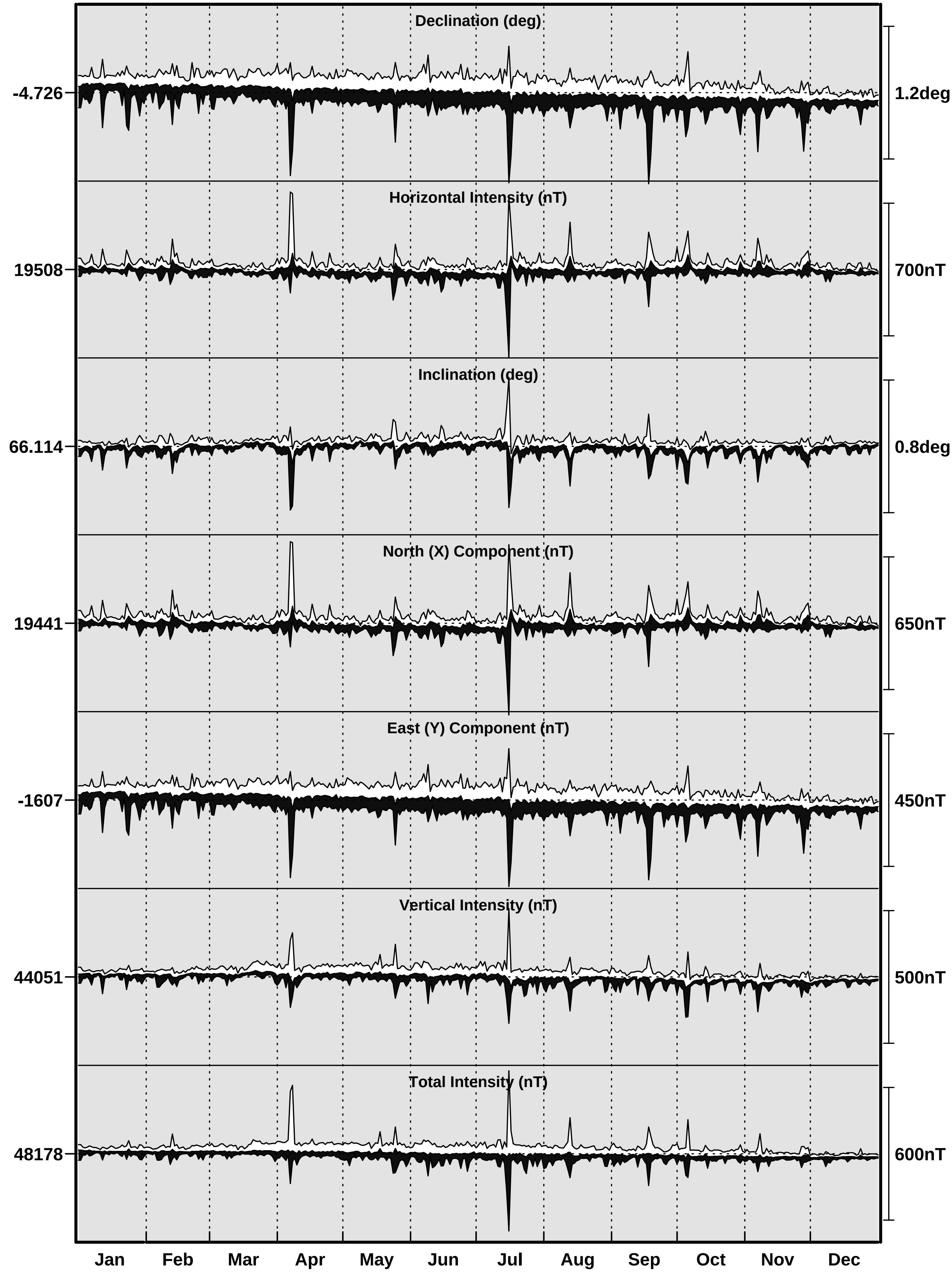


Hartland Observatory: Vertical Intensity (nT)
44090
44010
Rotn
2272
Jan00
2273
Feb
2274
Mar
2275
Apr
2276
May
2277
Jun
2278
Jul
2279
2280
Aug
2281
Sep
2282
Oct
2283
Nov
2284
Dec
2285
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Hourly Mean Values Plotted By Bartels Solar Rotation Number



Hartland Daily Mean Values 2000
Declination (deg)
-4.726
0.3deg
Horizontal Intensity (nT)
19508
120nT
Inclination (deg)
66.114
0.2deg
North (X) Component (nT)
19441
120nT
East (Y) Component (nT)
-1607
120nT
Vertical Intensity (nT)
44051
80nT
Total Intensity (nT)
48178
50nT
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Hartland Daily Minimum/Maximum Values 2000



Monthly Mean Values for Hartland 2000

Month	D	H	I	X	Y	Z	F
Based on all days							
January	-4° 47.8′	19500 nT	66° 7.1′	19432 nT	-1631 nT	44042 nT	48166 nT
February	-4° 47.4′	19501 nT	66° 7.0′	19433 nT	-1628 nT	44043 nT	48167 nT
March	-4° 46.8′	19512 nT	66° 6.2′	19444 nT	-1626 nT	44038 nT	48167 nT
April	-4° 45.1′	19504 nT	66° 6.8′	19437 nT	-1616 nT	44043 nT	48168 nT
May	-4° 44.7′	19516 nT	66° 6.0′	19449 nT	-1615 nT	44041 nT	48171 nT
June	-4° 44.3′	19519 nT	66° 5.9′	19453 nT	-1612 nT	44046 nT	48177 nT
July	-4° 43.1′	19512 nT	66° 6.6′	19446 nT	-1605 nT	44053 nT	48181 nT
August	-4° 42.4′	19508 nT	66° 6.9′	19442 nT	-1601 nT	44055 nT	48181 nT
September	-4° 41.3′	19504 nT	66° 7.3′	19439 nT	-1594 nT	44059 nT	48183 nT
October	-4° 40.7′	19499 nT	66° 7.9′	19434 nT	-1590 nT	44067 nT	48188 nT
November	-4° 40.0′	19502 nT	66° 7.7′	19437 nT	-1586 nT	44068 nT	48191 nT
December	-4° 39.5′	19516 nT	66° 6.7′	19451 nT	-1585 nT	44063 nT	48192 nT
Annual	**-4° 43.6′**	**19508 nT**	**66° 6.9′**	**19441 nT**	**-1607 nT**	**44051 nT**	**48178 nT**
International quiet day means							
January	-4° 48.4′	19509 nT	66° 6.4′	19440 nT	-1635 nT	44039 nT	48167 nT
February	-4° 47.6′	19509 nT	66° 6.5′	19441 nT	-1630 nT	44041 nT	48169 nT
March	-4° 47.1′	19517 nT	66° 5.8′	19449 nT	-1628 nT	44035 nT	48166 nT
April	-4° 45.7′	19515 nT	66° 6.0′	19448 nT	-1620 nT	44039 nT	48170 nT
May	-4° 45.1′	19524 nT	66° 5.4′	19457 nT	-1617 nT	44038 nT	48172 nT
June	-4° 43.7′	19517 nT	66° 6.1′	19451 nT	-1609 nT	44047 nT	48177 nT
July	-4° 43.2′	19519 nT	66° 6.0′	19453 nT	-1606 nT	44047 nT	48179 nT
August	-4° 42.3′	19516 nT	66° 6.3′	19450 nT	-1601 nT	44051 nT	48181 nT
September	-4° 41.8′	19514 nT	66° 6.5′	19448 nT	-1598 nT	44054 nT	48183 nT
October	-4° 40.8′	19506 nT	66° 7.4′	19441 nT	-1592 nT	44065 nT	48189 nT
November	-4° 40.5′	19517 nT	66° 6.6′	19452 nT	-1590 nT	44062 nT	48191 nT
December	-4° 39.5′	19522 nT	66° 6.2′	19458 nT	-1585 nT	44060 nT	48192 nT
Annual	**-4° 43.8′**	**19515 nT**	**66° 6.3′**	**19449 nT**	**-1609 nT**	**44048 nT**	**48178 nT**
International disturbed day means							
January	-4° 46.7′	19489 nT	66° 7.8′	19422 nT	-1623 nT	44044 nT	48163 nT
February	-4° 46.8′	19486 nT	66° 8.2′	19418 nT	-1624 nT	44048 nT	48166 nT
March	-4° 46.6′	19501 nT	66° 7.1′	19433 nT	-1624 nT	44044 nT	48168 nT
April	-4° 43.7′	19481 nT	66° 8.6′	19415 nT	-1606 nT	44051 nT	48167 nT
May	-4° 44.0′	19503 nT	66° 6.9′	19436 nT	-1609 nT	44042 nT	48167 nT
June	-4° 45.1′	19524 nT	66° 5.7′	19457 nT	-1617 nT	44048 nT	48181 nT
July	-4° 42.6′	19497 nT	66° 7.9′	19431 nT	-1601 nT	44063 nT	48183 nT
August	-4° 42.2′	19490 nT	66° 8.2′	19425 nT	-1598 nT	44059 nT	48178 nT
September	-4° 39.8′	19486 nT	66° 8.6′	19422 nT	-1584 nT	44064 nT	48180 nT
October	-4° 39.8′	19471 nT	66° 10.0′	19407 nT	-1583 nT	44076 nT	48185 nT
November	-4° 38.9′	19474 nT	66° 9.8′	19410 nT	-1578 nT	44076 nT	48186 nT
December	-4° 39.4′	19511 nT	66° 7.0′	19447 nT	-1584 nT	44063 nT	48190 nT
Annual	**-4° 43.0′**	**19493 nT**	**66° 8.0′**	**19427 nT**	**-1603 nT**	**44057 nT**	**48176 nT**

Hartland Observatory K Indices 2000

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	5333 4354	2111 3223	2343 3345	2222 2334	2423 3433	3321 2212	2121 1132	3222 2433	3233 3343	4341 2421	3211 1113	1102 2201
2	3333 3433	2122 3323	4321 2202	4333 3223	3224 4433	1220 1122	1210 2221	4221 1332	4343 3433	0011 2433	2111 1111	0011 2212
3	3322 2241	1121 3344	1012 2132	2212 2224	2121 3453	3232 3232	2212 3223	3222 2332	1211 2243	3343 4412	0011 1133	1121 3331
4	2223 3334	2111 2112	0011 2201	4221 4254	1112 1222	1220 1443	3302 3322	3333 3433	2111 3354	2344 4474	3444 3444	3221 1123
5	4433 2344	1011 1354	1211 2223	4410 1231	2132 2123	4343 3344	1232 3421	2354 3433	1121 1333	5566 6565	3221 3344	1212 2110
6	2323 4434	4434 4355	1223 3434	1422 3678	3311 3223	4222 3521	1211 2221	3422 3324	1120 3444	2000 1011	3434 4565	0111 1323
7	3312 2233	5334 4444	3332 2333	7553 4443	3220 1121	1223 3424	2101 1131	1113 3222	3233 3343	0011 2220	5544 4342	3232 3235
8	2011 1200	4333 3343	2223 2443	2232 2123	1001 1222	3345 5654	2211 2320	2121 3222	3133 3333	0011 1112	2344 3222	3322 4433
9	1100 1002	1332 3412	3101 2111	2331 2443	1211 2333	0113 1111	0111 2223	2210 1112	2122 2200	1001 1133	2111 2334	3332 2345
10	1211 1123	3221 2224	0022 2224	3333 2433	3311 1211	3344 3333	2344 4453	1344 4334	0012 0122	3232 1212	3345 3323	3322 2133
11	3222 4455	3423 2345	4322 4222	1231 2231	1110 1112	2334 4542	3435 5444	4544 4245	0001 2212	4421 2141	3223 3543	3221 2123
12	3332 1221	5545 5433	3334 4323	1330 1222	2343 2134	3341 4433	3312 1222	4666 5563	2333 3354	3111 2113	3334 3423	1111 1231
13	2213 2212	3123 3323	3110 0122	2421 1000	4232 3432	1221 3223	1225 5533	4531 2222	4321 1112	5532 4431	1223 2233	3201 1112
14	3111 1231	3434 4545	2111 1233	0010 0120	3211 1232	3242 4555	3344 4764	0110 3434	1111 1111	3444 3445	2211 1112	0011 1002
15	2211 2222	4322 3245	1001 0110	0112 1233	4322 2322	5333 3452	3454 7988	3311 1221	1211 1235	2322 2122	1111 1031	1000 1110
16	1111 2132	2211 2232	0000 1111	3444 4322	3433 3333	2111 2211	6544 4421	2221 2222	4223 3446	4222 2323	1010 1023	0000 1121
17	1011 2110	1112 2221	2112 2100	3243 1212	5522 2133	2121 3222	3322 3221	2211 2111	4334 4558	3322 2243	1111 1100	2211 3241
18	0011 2110	0001 1000	0012 2232	1210 0132	3311 1111	1011 2443	2321 3433	1110 0111	6445 5533	3222 3113	0001 2133	1222 1333
19	0111 1124	0012 1111	2311 2221	3421 2312	3222 3311	3410 1321	2111 2444	1010 1311	3335 4434	3222 3112	1221 2112	2112 2120
20	3111 3252	1011 1113	0023 3110	3332 3322	1111 1232	2221 3111	4554 4333	0002 1321	4313 3222	1101 0111	1121 1332	0001 1121
21	1000 2000	4422 4432	0011 2320	3113 2321	1321 1122	1101 1223	3211 2212	2311 1224	2222 3222	0011 2111	3212 2233	0011 2112
22	2123 3465	2211 3212	2323 3333	0222 2011	1332 2232	4223 3331	2223 3432	1110 0101	2211 2121	1123 3543	2112 2222	1100 1124
23	5523 3211	2113 4312	3343 4321	1121 2222	2221 2465	2321 4553	2212 4553	0011 2431	2221 2221	4334 2123	1311 1110	3532 2232
24	1232 2234	3434 4455	3224 3321	1343 4322	6655 5554	4442 1212	2210 1112	2332 1210	0101 2353	2123 2122	1112 2344	2311 1111
25	2221 2132	4333 3323	2232 1330	1012 2221	5434 3444	1110 1123	1111 2322	0110 1121	3223 3444	1022 3122	3210 1132	2111 3203
26	1211 1113	3224 2344	0011 1111	0110 1011	3333 2440	3344 4454	2332 3444	1121 1211	4433 3233	3222 2123	1133 4365	2111 1123
27	4211 3344	4223 3323	1111 2111	3222 2334	2111 3333	4232 4433	4210 1222	2111 3222	2243 2333	2011 1112	6444 3242	2111 2432
28	4433 4445	3433 3323	1111 1100	4332 2322	1222 2433	3321 2322	3334 5542	3123 3544	2323 3311	0024 3235	3443 4453	2111 3110
29	4434 4544	1123 3211	0111 1244	3222 3334	2332 4554	4321 2111	4334 4433	5443 2443	2212 1222	5533 3343	5554 4423	1211 1122
30	3232 3343		3221 2253	3411 2332	4333 3434	0001 1232	3411 2221	3322 2214	3344 4555	4333 2221	2211 1212	1011 1101
31	3233 3222		4433 3334		3421 2223		1231 3455	3223 3224		3322 2424		2000 1000

DAILY Aa INDICES 2000

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	47	15	36	29	28	18	12	22	33	27	15	14
2	33	17	15	23	35	16	8	18	40	22	8	10
3	22	24	11	20	28	25	16	19	18	40	9	24
4	28	10	7	38	13	25	15	30	28	75	47	19
5	38	29	13	15	18	37	23	40	16	134	30	11
6	36	60	25	118	22	25	10	25	24	8	72	21
7	20	48	23	85	10	20	9	15	29	11	54	32
8	9	32	23	19	9	68	11	15	28	6	46	37
9	5	25	8	28	18	9	11	10	10	11	24	33
10	14	20	18	30	12	32	37	38	9	15	60	21
11	48	40	20	15	8	43	55	58	9	27	37	16
12	18	91	33	13	28	31	13	138	45	16	35	11
13	16	27	9	9	26	15	45	30	18	46	20	10
14	13	56	14	5	14	43	66	22	10	60	9	7
15	13	33	4	11	22	37	207	20	28	18	9	5
16	14	15	5	39	29	8	50	15	49	21	9	10
17	6	12	10	20	29	11	15	12	96	21	7	19
18	7	4	11	10	12	21	20	5	84	21	11	19
19	13	8	14	21	14	14	20	7	43	18	11	10
20	21	12	14	24	9	10	51	8	21	7	15	6
21	4	39	9	15	10	10	11	18	19	7	17	10
22	42	15	24	10	17	22	21	5	12	37	15	19
23	37	24	31	12	41	37	32	13	13	29	9	30
24	24	59	23	32	103	25	7	15	21	19	24	14
25	15	35	16	10	44	9	11	6	36	15	12	20
26	13	30	7	6	35	59	34	9	37	17	51	13
27	37	26	6	25	21	29	13	14	27	8	68	18
28	52	31	6	28	22	19	47	33	21	43	61	14
29	55	13	17	24	36	16	43	50	15	44	70	13
30	29		32	21	42	10	17	21	70	24	12	9
31	21		44		18		33	24		28		5
Monthly Mean Values	**24.2**	**29.4**	**17.1**	**25.2**	**25.0**	**24.8**	**31.1**	**24.3**	**30.2**	**28.1**	**29.0**	**16.1**

Yearly Mean Value for 2000 = 25.3

SIs and SSCs

Day	Month	UT		Type	Quality	H(nT)	D(min)	Z(nT)
11	1	14	26	SSC*	C	8.3	-2.35	-4.6
27	1	14	53	SSC*	C	11.6	-	1.6
3	2	12	21	SSC*	C	4.3	-1.51	-2.4
5	2	15	43	SSC*	A	9.6	0.95	-1.2
11	2	02	58	SSC*	A	15.2	-4.00	-8.3
14	2	07	32	SSC*	B	-14.8	-1.19	-6.8
20	2	21	39	SSC*	A	35.1	-1.57	7.1
21	2	07	41	SSC*	C	4.9	-0.51	1.6
21	2	15	17	SI	B	-32.6	6.83	3.7
29	3	14	04	SSC*	C	-4.2	0.35	-
29	3	19	23	SSC*	C	17.0	-1.19	-3.3
06	4	16	39	SSC	A	116.0	-6.56	23.6
1	5	15	08	SSC	A	-23.1	3.01	-
23	5	17	03	SSC	A	25.1	-1.21	-
4	6	15	01	SSC*	A	41.9	-2.31	9.6
8	6	09	10	SSC*	A	-69.2/+66.7	7.99	-14.1/+12.5
11	6	08	01	SSC*	B	-6.8	1.46	3.0
23	6	13	02	SSC	B	43.7	-2.13	+7.6/-9.8
10	7	06	37	SSC*	C	-12.5	2.34	3.9
11	7	13	11	SI*	C	-70.3	1.99	-15.4
13	7	09	42	SSC*	B	5.5	1.76	2.5
14	7	15	32	SSC*	B	61.0	-3.66	13.2
15	7	14	37	SSC*	A	246.0	-7.85	63.2
17	7	08	07	SSC*	C	11.7	3.32	8.1
19	7	15	26	SSC*	A	45.9	-3.46	12.0
28	7	06	33	SSC*	B	+13.9/-16.9	-3.1	-10.3
10	8	05	00	SSC*	B	8.8	-2.57	-4.7
11	8	18	45	SSC	C	26.1	-1.68	5.7
6	9	17	01	SSC	A	48.3	-3.16	8.8
17	9	17	24	SSC*	B	65.8	-2.59	+15.6/-13.2
18	9	14	44	SSC*	B	78.0	-8.87	9.4
12	10	22	27	SSC*	A	28.3	-1.60	4.1
31	10	17	14	SSC*	A	29.1	1.96	6.4
6	11	09	47	SSC*	B	-7.4	3.41	3.9
7	11	18	16	SSC*	C	30.0	-2.24/+2.50	10.9
10	11	06	28	SSC*	B	-35.9	-5.78	-19.7/+13.9
26	11	11	58	SSC*	C	-5.8	2.05	-3.9
28	11	05	30	SSC*	B	-13.8	-3.84	-12.1
21	12	11	33	SSC*	C	3.8	0.75	-
22	12	19	26	SSC	C	7.0	-	1.5
24	12	17	46	SSC	C	4.0	-	-

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						H(nT)	D(min)	Z(nT)
		Start		Maximum		End				
28	10	09	54	10	04	10	22	24.8	-6.50	-19.5

Notes
The amplitudes given are for the 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

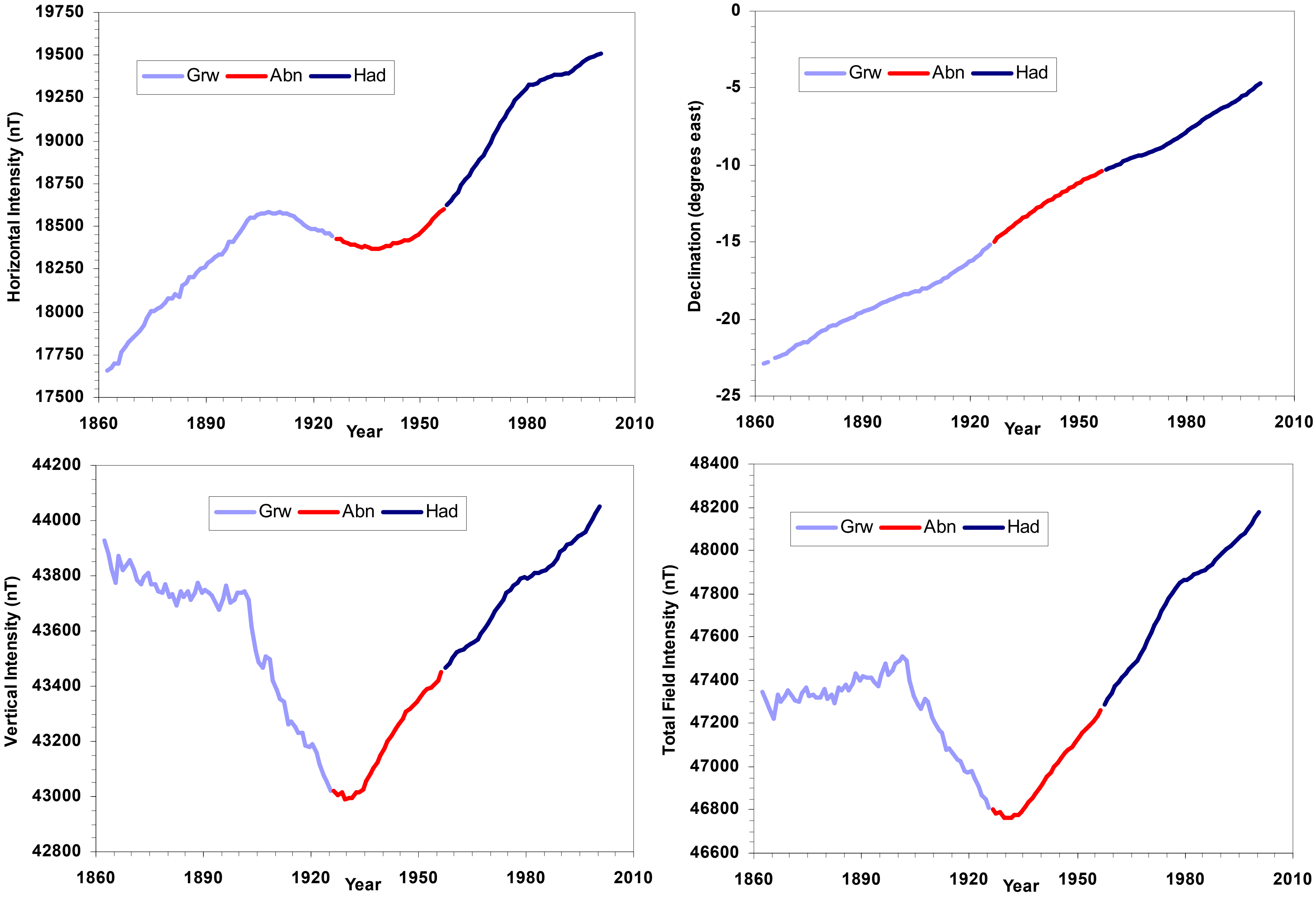
Year	D		H	I		X	Y	Z	F
Note 1	-1	-46.6	-146	0	11.4	-247	-542	56	-6
1957.5	-10	17.2	18627	66	47.7	18328	-3326	43451	47275
1958.5	-10	11.0	18655	66	46.3	18361	-3298	43465	47299
1959.5	-10	5.0	18681	66	45.1	18392	-3271	43484	47327
1960.5	-9	58.8	18707	66	43.9	18424	-3242	43504	47356
1961.5	-9	53.0	18744	66	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
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

Year	D		H	I		X	Y	Z	F
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
1996.5	-5	23.4	19475	66	6.4	19389	-1829	43960	48081
1997.5	-5	13.4	19485	66	6.2	19404	-1774	43979	48102
1998.5	-5	3.0	19490	66	6.7	19414	-1715	44004	48127
1999.5	-4	53.3	19500	66	6.6	19429	-1661	44024	48149
2000.5	-4	43.6	19508	66	6.9	19441	-1607	44051	48178

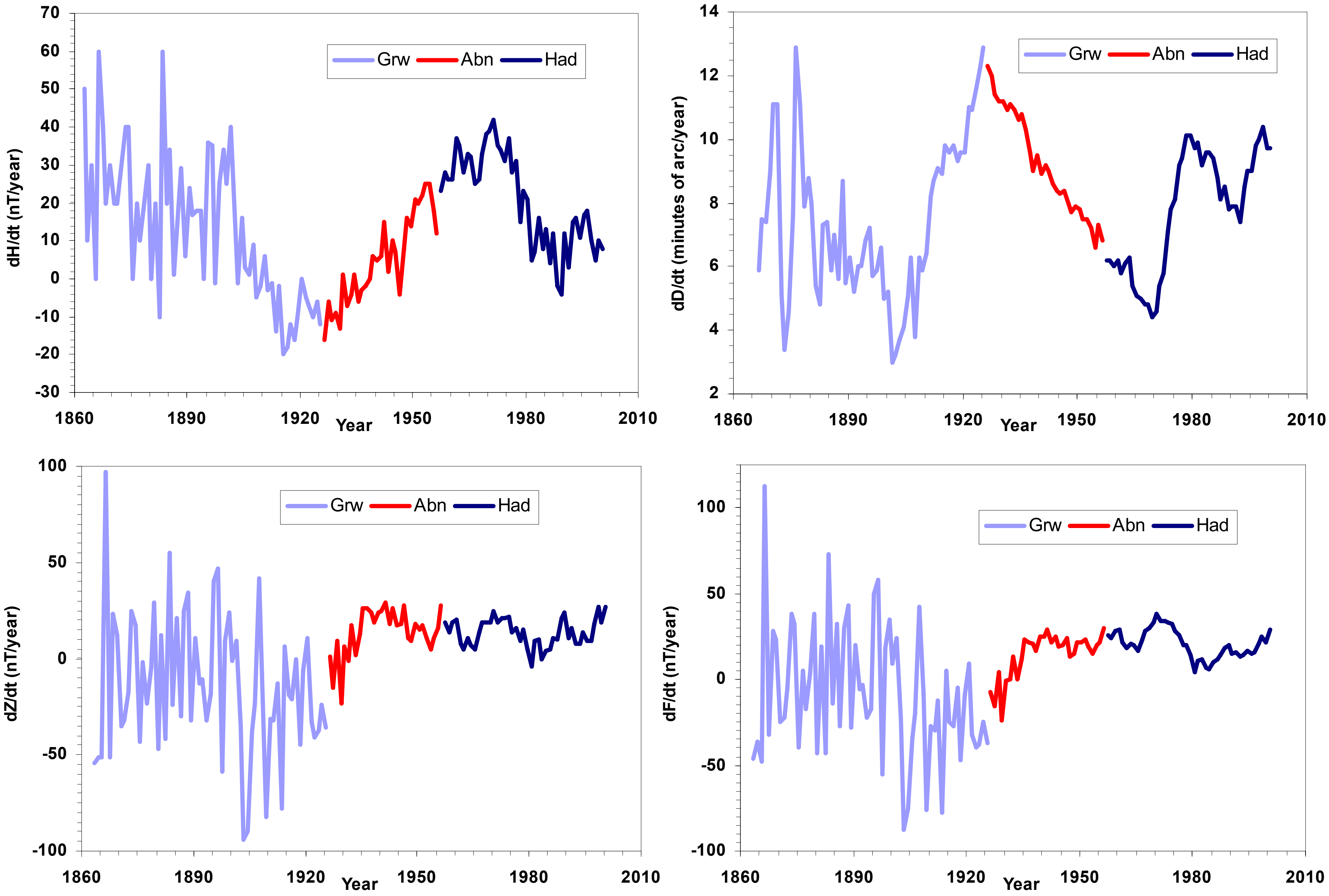
1 Site differences 1 Jan 1957 (Hartland value - Abinger value)
2 Site differences 1 Jan 1980 (new value - old value)
3 Site differences 1 Jan 1990 (new value - old value)

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

Annual Mean Values at Hartland



Rate of Change of Annual Mean Values at Hartland



BRITISH GEOLOGICAL SURVEY

Murchison House, West Mains Road,
Edinburgh EH9 3LA
☎ 0131-667 1000
Fax 0131-668 2683
e-mail: scotsales@bgs.ac.uk

Keyworth, Nottingham NG12 5GG
☎ 0115-936 3241
Fax 0115-936 3488
e-mail: sales@bgs.ac.uk
www.bgs.ac.uk

London Information Office at the Natural History Museum (Earth Galleries), Exhibition Road, South Kensington, London SW7 2DE
☎ 020-7589 4090
Fax 020-7584 8270
☎ 020-7942 5344/45
email: bgslondon@bgs.ac.uk

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The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as its basic research projects. It also undertakes programmes of British technical aid in geology in developing countries as arranged by the Department for International Development and other agencies.

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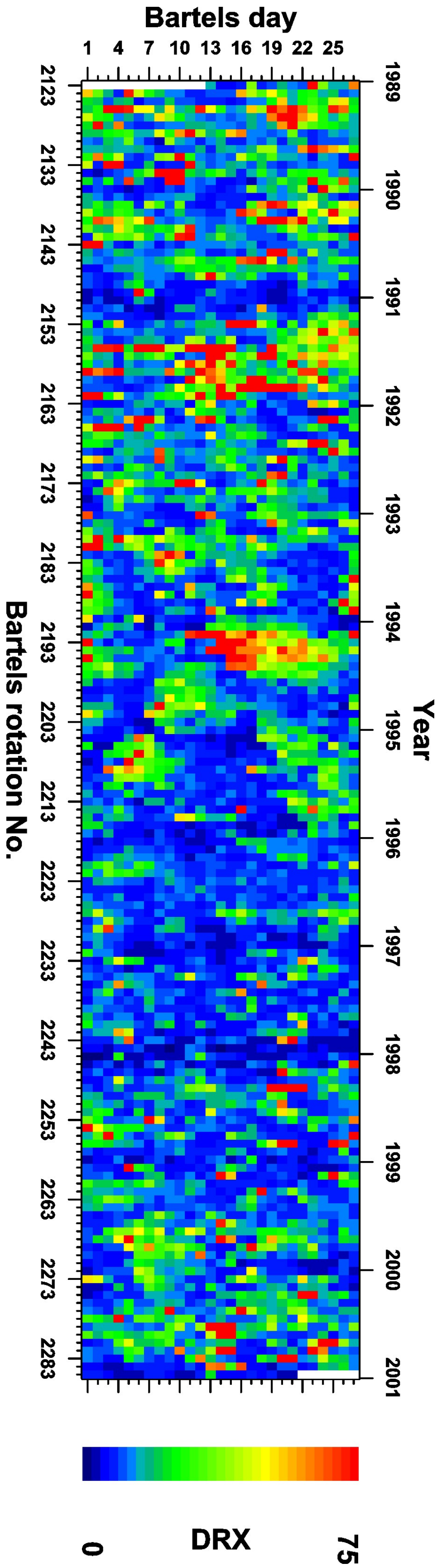
Front cover photograph
Aerial View of Eskdalemuir Observatory

Back cover image
The daily geomagnetic index DRX from Lerwick Observatory plotted by Bartels rotation for the years 1989-2000 (inclusive)



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
9. Magnetic results 1973-77 Eskdalemuir, Hartland and Lerwick observatories
10. Annual mean values of the geomagnetic elements
11. Magnetic results 1978-79 Eskdalemuir, Hartland and Lerwick observatories
12. A bibliographic guide to the production of local and regional magnetic charts
13. Magnetic results 1980 Eskdalemuir, Hartland and Lerwick observatories
14. Magnetic results 1981 Eskdalemuir, Hartland and Lerwick observatories
15. Magnetic results 1982 Eskdalemuir, Hartland and Lerwick observatories
16. Magnetic results 1983, 1984 Eskdalemuir, Hartland and Lerwick observatories
17. Magnetic results 1985 Eskdalemuir, Hartland and Lerwick observatories
18. Magnetic results 1986 Eskdalemuir, Hartland and Lerwick observatories
19. Magnetic results 1987-89 Lerwick, Eskdalemuir and Hartland observatories
20. Magnetic results 1990 Lerwick, Eskdalemuir and Hartland observatories
21. Magnetic results 1991 Lerwick, Eskdalemuir and Hartland observatories
22. Magnetic results 1992 Lerwick, Eskdalemuir and Hartland observatories
23. Magnetic results 1993 Lerwick, Eskdalemuir and Hartland observatories
24. Magnetic results 1994 Lerwick, Eskdalemuir and Hartland observatories
25. Magnetic results 1995 Lerwick, Eskdalemuir and Hartland observatories
26. Magnetic results 1996 Lerwick, Eskdalemuir and Hartland observatories
27. Magnetic results 1997 Lerwick, Eskdalemuir and Hartland observatories
28. Magnetic results 1998 Lerwick, Eskdalemuir and Hartland observatories
29. Magnetic results 1999: Lerwick, Eskdalemuir and Hartland observatories and UK repeat stations