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ARCHAEOMAGNETIC DATING OF THE FEATURES FROM EXCAVATIONS AT QUOYGREW, WESTRAY, ORKNEY

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Abstract
The report describes the archaeomagnetic investigations of two hearth deposits from within Structure 1, Area F on the site of Quoygrew, Westray. 18 samples were collected from the upper hearth (F958), with 30 samples being collected from the lower hearth (F881). The material from both features was soft and friable, requiring the samples to be collected within tubes. The stepwise demagnetisation of the samples indicated that they both recorded stable and consistent signals that on calibration produced the following age ranges: the most archaeologically probable range for F958 was 1460-1510AD, while for F881 a range of 1430-1530AD was produced, although the latter should be treated with some caution. Despite the features producing stable magnetic signatures, the calibrated ranges were inconsistent with those produced from the 2002 field season by Batt (2003). The discrepancy between the dates has been interpreted as a problem with the calibration curve within the period covered by the site.

An introduction to archaeomagnetic dating and an explanation of the technical terms used in this report can be found in Appendix 1. A sample inventory is provided within Appendix 2, while the detailed measurements and statistical analyses can be found in Appendix 3 and 4, which has also been provided on disc.

1. Introduction

Oriented archaeomagnetic samples were taken from two stratigraphically related features within Structure 1 in area F. The objectives were to:

- Investigate the suitability of burnt material of this nature and from this period for archaeomagnetic dating
- Provide a date of last use of each feature

The sampling and measurement programme was carried out by Zoe Outram.

2. Archaeological Context

Quoygrew (Lat. 59.33° Long. 2.98°W) is a well-preserved Viking Age, medieval and post-medieval rural settlement in Westray, Orkney. Excavations have been conducted between 1997-2004 as part of the Viking Age Transitions Project. The features under investigation here were revealed by excavation of a stone-built longhouse of Late-Norse design in Area F. (Barrett, 2003). Associated with the use of the structure were a number of areas of apparent heating. A series of five features were sampled during the 2002 excavation season, three of which produced stable magnetisation, and were used as a comparable dataset. In addition to the archaeomagnetic dates, a number of radiocarbon dates have been produced for the site ranging from 9th or 10th century AD to the 17th century AD

(Barrett 2003). These dates will aid the discussion associated with the features sampled for this report.

The upper hearth sampled, F958, was composed of a layer of soft, pale orange ash sealed by hearthstones F831 (Figure 1). This ash in turn sealed a lower hearth represented by flags F828 with associated ash, F881 (Figure 2). The ash layer F881 was sampled for dating purposes, being described as heat affected glacial till (Barrett *pers.comm*). Context F881 also contained several small pebbles which complicated the sample collection procedure as they limited where and how deeply tubes could be inserted.

3. Sample Collection

Samples were taken from cleaned horizontal surfaces within this hearth deposits using the tube method described in Appendix 1, as the material was soft and friable. The details of the exact sampling locations are given in the field notebooks and in the photographic record (figures 1 and 2). Samples were oriented using a magnetic compass as there appeared to be no local disturbances to the geomagnetic field caused by the feature or other factors, and it was not possible to use a sun compass. In the laboratory, the exposed surface of the samples was cleaned and the Munsell reference code recorded. A full listing for each sample has been recorded in Appendix 2. They were then sealed and stored in a cool environment.

4. Measurements

The direction of the remanent magnetisation was measured using a Molspin fluxgate spinner magnetometer as listed in Appendix 1. The stability of the magnetisation was investigated by the stepwise demagnetisation of pilot samples in fields of 2.5, 5, 7.5, 10, 12.5, 15, 20, 30, 40, 50, 60, 80, and 100mT (peak applied field), with the remanence being measured after each step (Appendices 3 and 4). A total of 3 samples were submitted for pilot analysis for F958, while 4 samples were selected from F881. From a study of the pilot sample behaviour, an alternating field was chosen to provide the optimum removal of the less stable component, leaving the magnetisation of archaeological interest. After partial demagnetisation in this field, sample remanences were re-measured (Appendices 3 and 4). The pilot demagnetisation data was also used to provide an indication of the magnetic stability of the measurements and therefore the validity of the results produced; this was assessed using methods defined by Tarling and Symons (1967).

5. Results

The results for each feature will be discussed individually in this section in terms of their magnetisation (sections 5.1 and 5.2) and the process of calibration (section 5.3). The results of both features sampled are summarised below in table 1, all measurements are presented in degrees:

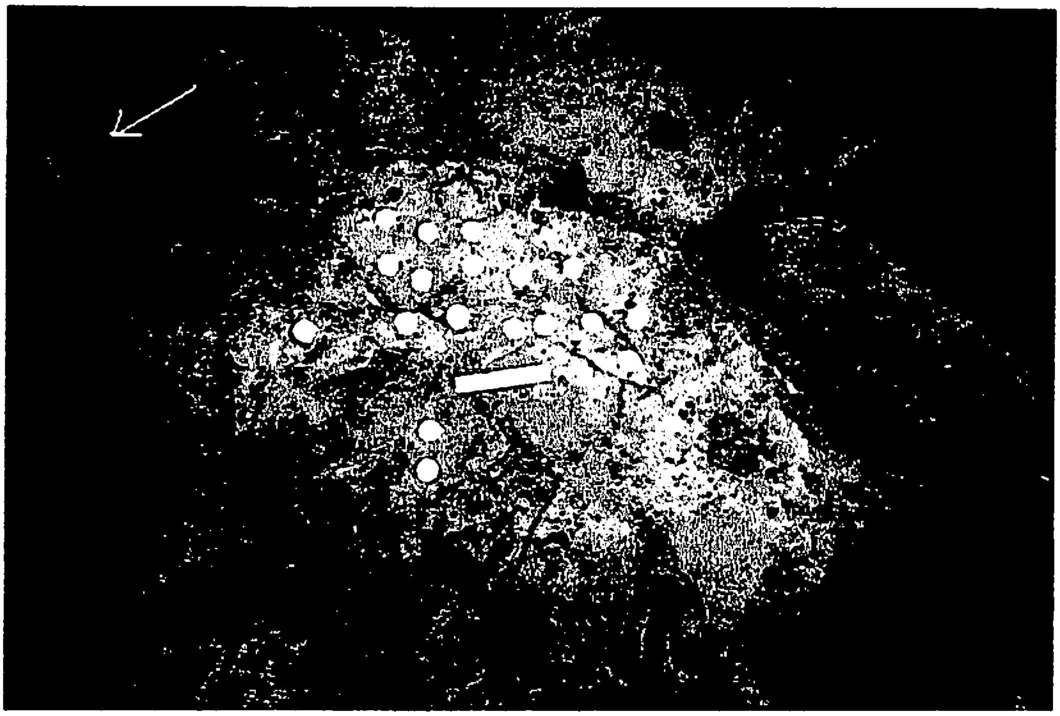

Figure 1: Feature F958 showing sample positions

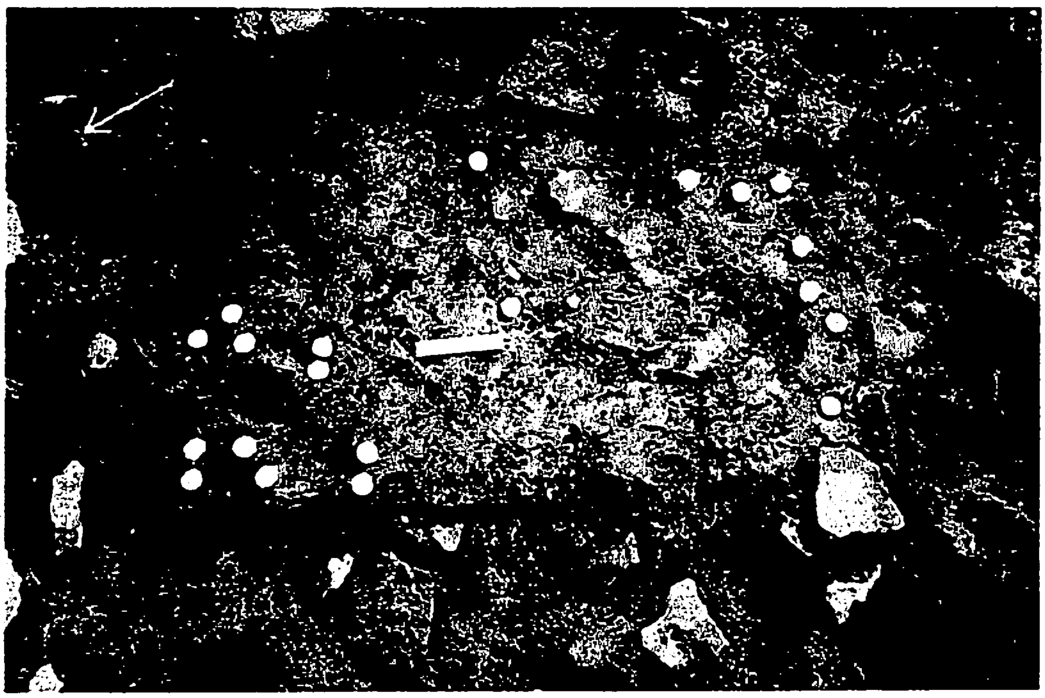

Figure 2: Feature F881 showing sample positions

	NRM			Partial demagnetisation			Calibrated age range
Sample	*Dec*	*Inc*	α_{95}	*Dec*	*Inc*	α_{95}	
F958	6.2	65.5	1.6	6.7	65.8	1.8	1460-1510AD; 490-440AD
F881	-1.6	65.4	3.5	0.1	64.9	3.3	1430-1530AD; 270-510AD; 55-210AD

Table 1: Summary of the results for the sampled features before and after partial demagnetisation. Results are corrected to Meriden and errors are at 95% confidence.

5.1 FEATURE F958 (Q3)

Of the 18 samples collected for this feature, three did not survive the transport back to Bradford: samples Q3/3, Q3/8 and Q3/14. The remaining 15 samples were processed to determine the NRM. The samples directions were well grouped indicating that the samples all recorded the same magnetic field. This was reflected in the very small alpha-95 value produced for the NRM measurements of 1.6°, which was well within the recommended values used in dating defined by Clark *et al.* (1988: 606). The intensity of the samples ranged from 19-66 $mA.m^{-1}$ indicating that there may have been some difference in the level of heat received by the sampled context but this did not have an extreme effect on the samples. The excellent agreement between the samples was demonstrated further as none of the samples could be statistically classed as outliers, based on the tests discussed in Appendix 1.

Three samples were subjected to stepwise pilot demagnetisation: Q3/1, Q3/10 and Q3/12. The MDF values produced ranged from 9.5-12.5mT and suggested that the magnetism was dominated by soft minerals such as magnetite. This was supported by the percentage magnetism remaining following demagnetisation at 100mT, as low values were produced ranging from 2.6-8.8%. Assessment of the Zijderveld diagrams demonstrated that the samples were composed of two magnetic components, one component of lower stability, with the exception of sample Q3/10 which appeared to be composed of a minimum of three magnetic components. The magnetic signal was classified as stable after removal of the lower stability component at 2.5mT for all of the samples, and was the field selected for the bulk demagnetisation of the remaining twelve samples. After partial demagnetisation, the direction vectors were still very well-grouped, with an alpha-95 value of 1.8°. As with the NRM values, no samples could be statistically classed as an outlier, and so the full set of samples were used to determine the final vector. A summary of the results can be found in table 1.

5.2 FEATURE F881 (Q1)

It was noted during the collection of the samples in the field that context F881 was difficult to sample due to the thin nature of the context as well as the presence of a large number of small stones within the matrix. This resulted in a number of the tubes being partly empty. This can be a problem during the time the samples are transported back to Bradford as the samples may shrink as they dry within the tubes which will then allow then to move. Movement was clearly identified within samples Q3/3, 8 and 14, as shown in Appendix 2, and so they were not included within the assessment of the feature. However, for some of the other samples collected from the feature this could not be confidently determined. The samples were all consolidated as soon as they arrived in Bradford to ensure that they remained stable until the measurements were carried out.

During the determination of the NRM value for F881 it was noted that there was a large scatter in the data: the declination values ranged from 334-110° while the inclination values ranged from 39-85°. This resulted in a larger alpha-95 value than recorded for F958, of 5.95° and is above the recommended value used for dating (Clark *et al.* 1988: 606). The stereograph shown in Appendix 4 clearly identifies the anomalous samples, which was supported by the statistical analysis: samples Q1/7, Q1/13, Q1/17, Q1/28 and Q1/30. These samples were all located towards the edge of the feature and may therefore have suffered from some level of disturbance, in addition to the difficulties identified during the collection of the samples due to the pebbly nature of the context. It was has been noted in Appendix 2 that tubes of Q1/28 and Q1/30 were not completely full which may suggested that the material had moved slightly during transport back to Bradford. On removal of these samples the alpha-95 value of the NRM data was reduced to 3.52°, which is a more acceptable value.

The initial assessment of the samples revealed a range in intensity values from 3 to 53mA.m^{-1}, exceeding a 10-fold increase. The location of the higher values were restricted to two main areas of the sampled feature, both of which lying towards the northern end of the hearth. This may suggest that the samples were more efficiently heated within this area which may in turn relate to the thickness or friability of the hearth stones located above it. In general, the majority of the samples produced intensity values around 8-12 mA.m^{-1}, suggesting that either the context was not well heated or that there was a low concentration of magnetic minerals. This was investigated further using the demagnetisation of the pilot samples.

Four pilot samples were selected; Q3/18 and 19 were chosen to represent the modal group of the samples, while Q3/13 and 17 represented the outliers. The graphs of the intensity changes over the different applied fields showed that all of the magnetic signals were dominated by soft magnetic minerals, such as magnetite. This was supported by the MDF values ranging from 8-12mT, as well as the values for the percentage of magnetism remaining after demagnetisation at 100mT ranging from 2.8-6.1%. Both of these results suggest that the magnetic minerals present lost their magnetism quickly and therefore had a low coercivity, characteristic of the softer minerals such as magnetite. The similarity between the values obtained from from this sample compared to F958 suggests that a similar source of material was used to construct the hearth bases.

The Zijderveld plots produced for F881 suggested that the magnetic signal was composed of between 2 and 3 magnetic components, which produced a stable signal at 2.5mT after the component of lower stability was removed. Only Q3/17 was classed as unstable using the calculations defined by Tarling and Symons (1967), and may reflect why this sample was classified as an outlier. In summary, the pilot assessment of the samples indicated that magnetic minerals were dominated by soft materials. The majority of the samples produced stable signals, which indicates that the feature was sufficiently fired and that the low intensity values may be due to a low concentration of the magnetic minerals within the clay. After the remaining samples were partially demagnetised at 2.5mT there was a general improvement in the overall scatter of the samples, as shown in table 1. There were still some obvious outliers, which were removed from the final assessment of the directional vector:

5.3 CALIBRATION

Following the production of the magnetic vectors the results were calibrated by comparison to the Clark curve (1988) in the conventional manner (see Appendix 1). The results have been summarised in table 1 and shown in figures 3 and 4. In archaeomagnetic dating it is often necessary to quote multiple age ranges as the earth's magnetic field has had the same directions at different times in the past. The earlier dates within the 5th century AD have been excluded on the basis of the archaeological evidence as well as radiocarbon dates produced for the site. It is important to note that the age ranges of the two features are consistent within themselves, maintaining the stratigraphic relationships of the calibrated results.

6. DISCUSSION

It can be seen from tables 1 and 2 that the age ranges produced for F958 and F881 are consistent with each other. This in itself provides confidence in the ranges produced. However, the results were then compared to the sequence of dates collected from the same structure during the 2002 excavation season (Batt 2003) which unfortunately demonstrated a lack of agreement, as summarised in table 3 which are listed in stratigraphic order from the top to the bottom of the sequence:

Sample	**Magnetic vector following partial demagnetisation**			**Calibrated age range**
	Declination	*Inclination*	*Alpha-95*	
F384	-12.4	58.8	5.4	1310-1360AD*
F071	-13.8	58.0	6.9	1300-1420AD
F412	-1.8	60.3	3.2	1280-1340AD; 1390-1450AD
F958	6.7	65.8	1.8	1460-1510AD
F881	0.1	64.9	3.3	1450-1475*

*Table 2: Summary of the archaeomagnetic results from the 2002 and 2004 excavation season. * denotes the results should be treated with caution due to problems with the location of the magnetic vectors relative to the calibration curve (after Batt 2003: Table 1)*

This is demonstrated further when the results are displayed within stratigraphic order using the OxCal program (Figure 5). It should be noted that the OxCal program does not display the archaeomagnetic dates correctly, plotting them as normally distributed bell-shaped curves: the distribution should be represented as a rectangle as any part of the calibrated age range is equally as likely to be the 'real' age of the feature. Despite this, the program does aid the direct comparison of the features sampled, indicating if their stratigraphic integrity of the samples has been maintained (Bronk Ramsey 2005):

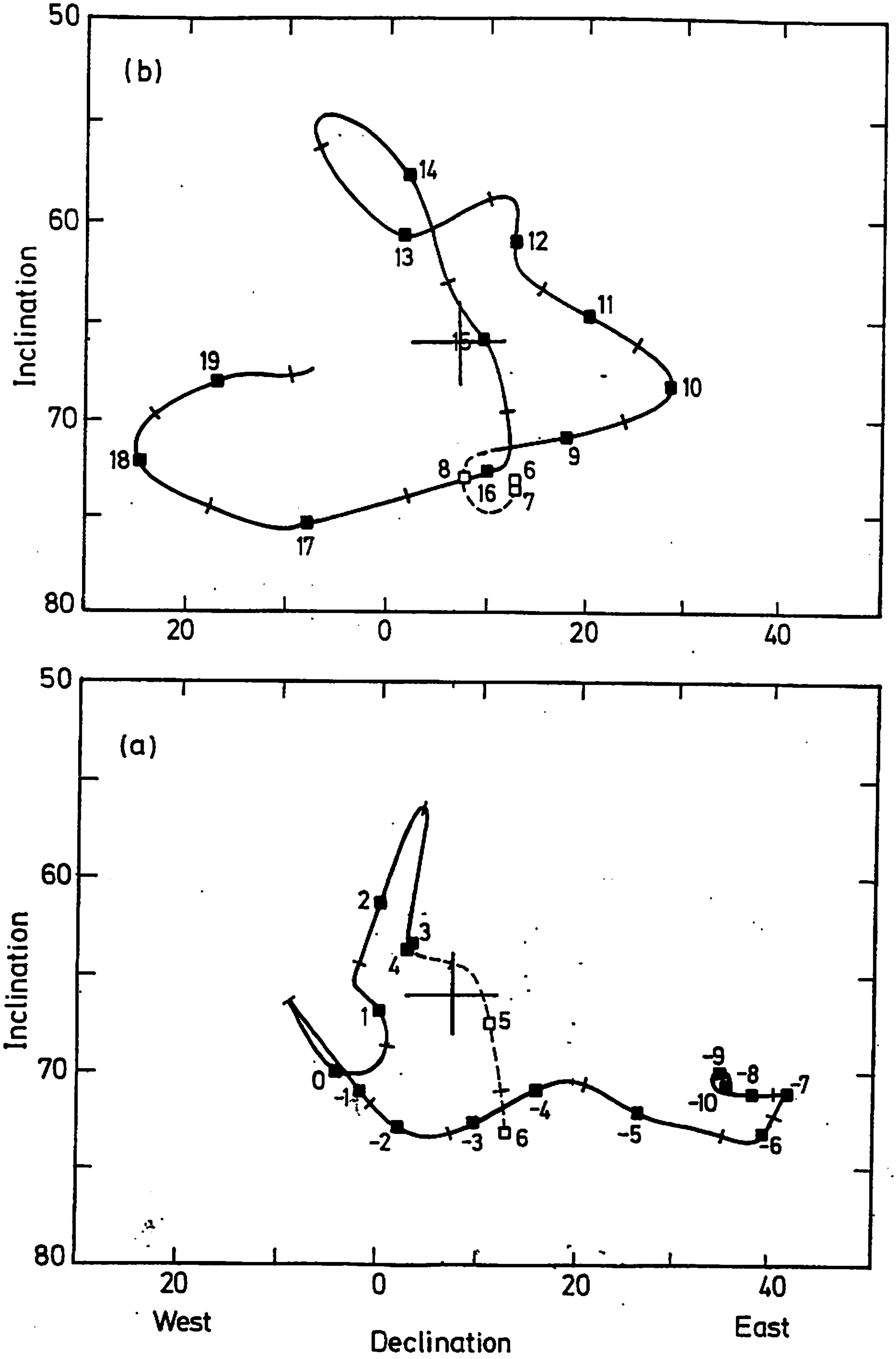

Figure 3: Corrected remanence vectors for F958 with 95% confidence level errors, superimposed on the British archaeomagnetic calibration curve (Clark et al. 1988), normalised to Meriden

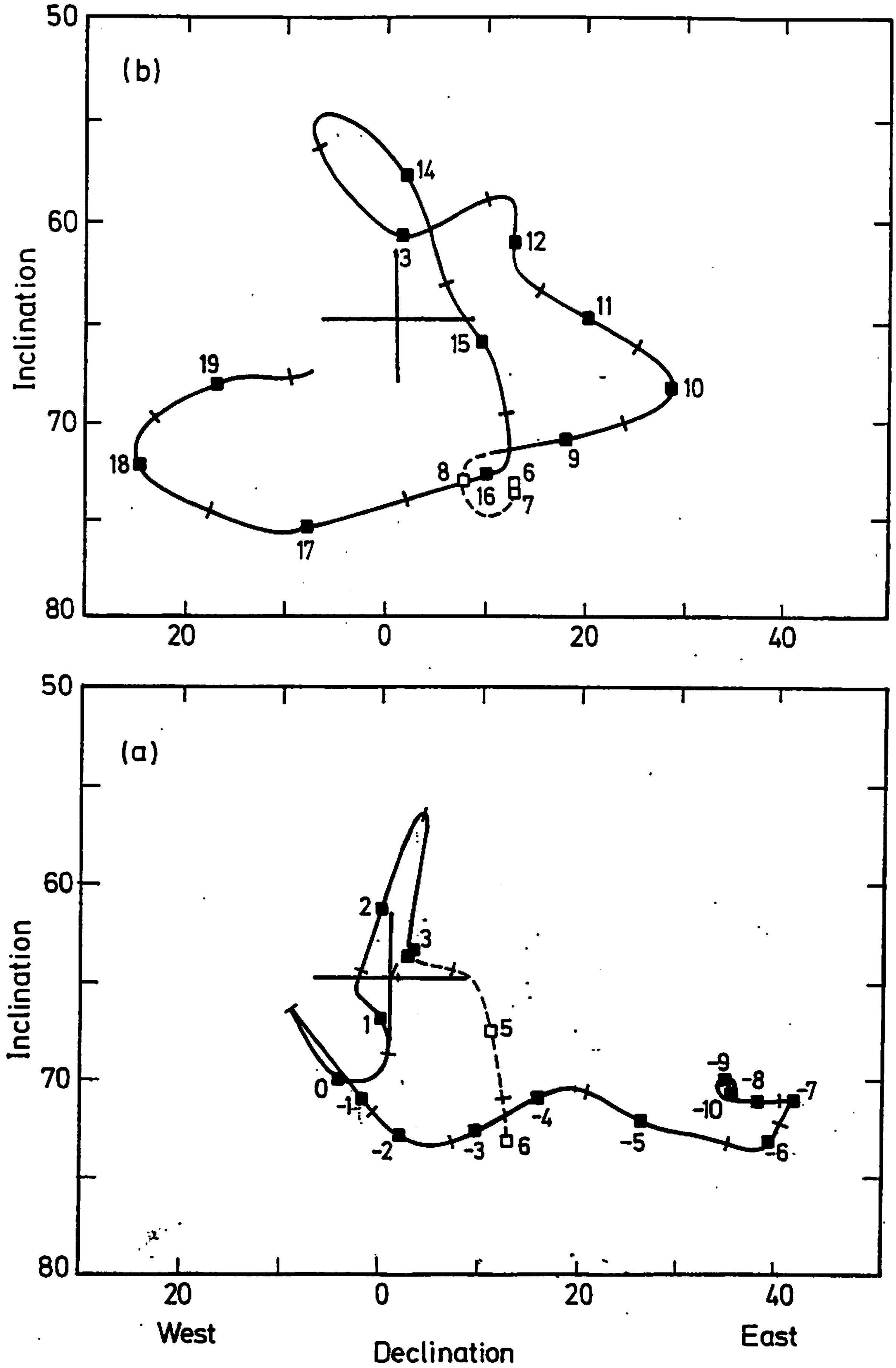

Figure 4: Corrected remanence vectors for F881 with 95% confidence level errors, superimposed on the British archaeomagnetic calibration curve (Clark et al. 1988), normalised to Meriden

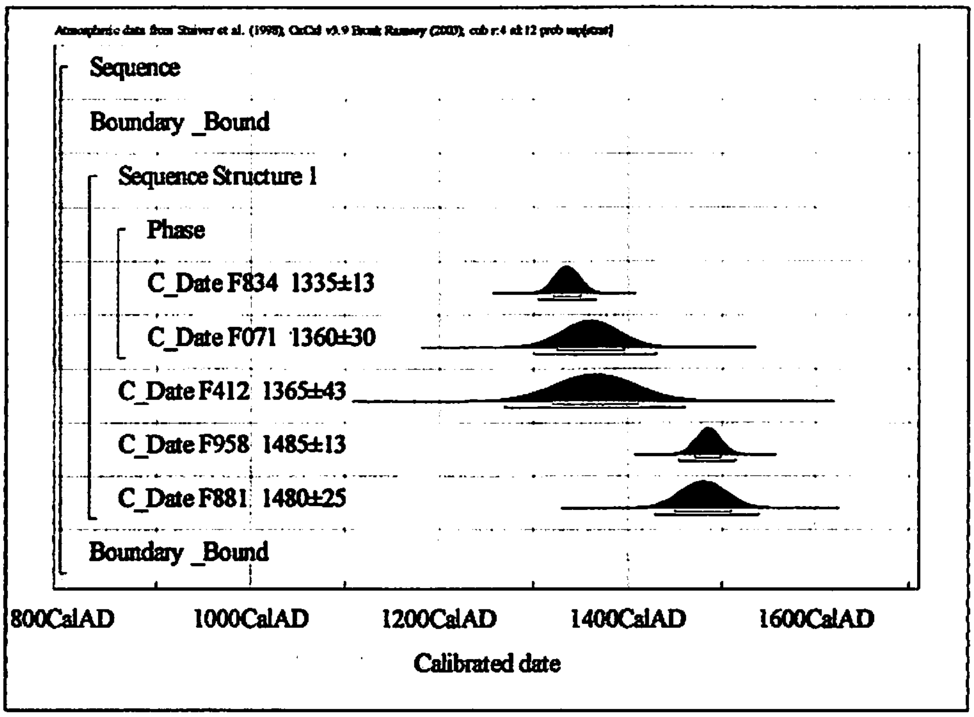

Figure 5: Summary of the archaeomagnetic results from the 2002 and 2004 excavation season displayed as probability distribution in stratigraphic order.

Figure 5 clearly shows that the results do not conform to their stratigraphic order. It has been discussed in sections 5.1 and 5.2, as well as in Batt (2002), that all of the featured samples were classed as magnetically stable suggesting that alternative explanations are required to understand the discrepancy.

In addition to figure 5, the feature vectors were plotted together on the same calibration curve to determine if they respected the shape and therefore the changes in the geomagnetic field over time (Figure 6). It can be seen from Figure 6 that there was a general trend towards increasing inclination and declination values throughout the samples as they were compared in stratigraphic order. Therefore the magnetic vectors are changing broadly as would be expected between 13th and 15th centuries AD but there are inconsistencies in the fine detail comparisons.

One possible explanation for this difference may relate to the position of the two features sampled in 2004 at the base of the stratigraphic sequence. The weight of the archaeological material on top may have caused the material associated with the hearths to be differentially compacted, therefore distorting the inclination values recorded. This explanation is plausible as a decrease in the inclination values would make the two calibrated dates younger and therefore more in line with the samples from the 2002 season. However, the inclination values would need to be decreased by approximately 10° which should have been visible when the samples were collected. Also, the excellent alpha-95 values associated with sample F958 suggests that this feature was not disturbed as it is difficult to imagine how the feature could have been disturbed in such a uniform manner.

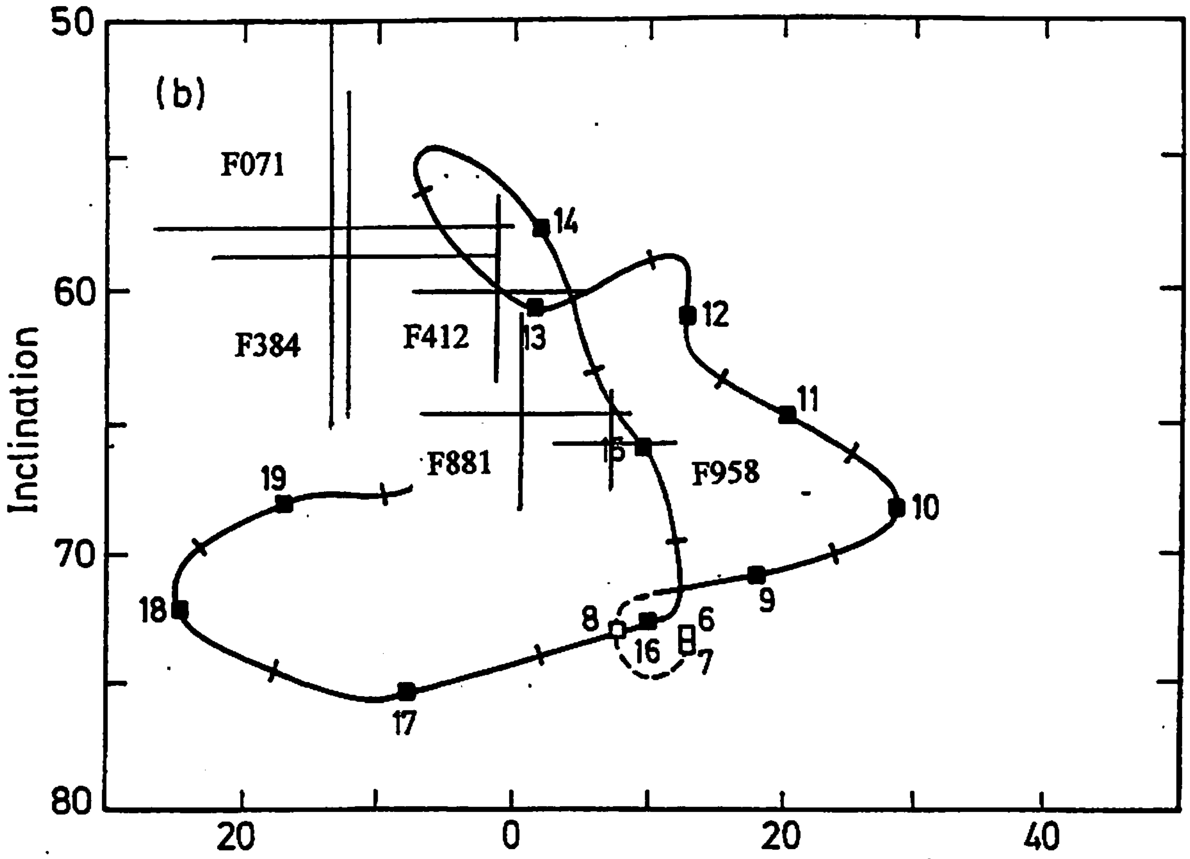

Figure 6: Corrected remanence vectors for all features sampled within 2002 and 2004, with 95% confidence level errors, superimposed on the British archaeomagnetic calibration curve (Clark et al. 1988), normalised to Meriden

Alternatively the results obtained may be a reflection of the calibration process. There have been a number of recent papers in the past that have highlighted the limitations of the Clark curve used within this report (Batt 1997; Batt 1998; Tarling & Dobson 1995). An archaeomagnetic date produced can only be as accurate as the calibration curve used to calibrate the data. The current British calibration curve is based on approximately 200 direct observations from AD1576 and over 200 measurements as well as lake sediment data and material from approximately 92 archaeological sites (Mallin & Bullard 1981, 357; Batt 1998, 991; Clark *et al.* 1988). The Clark *et al.* (1988) calibration curve was hand-drawn and traces the movement of the geomagnetic field from over the measurements, giving weight to features "deemed more reliable" based on magnetic stability and the scatter in the data, effectively drawing a 'line of best fit' (Batt 1997: 155). Many feel that this is a subjective procedure and adds a bias into the calibration procedure, which is compounded by the lack of error representations within the curve (Batt 1998: 992; Batt 1997: 157).

These limitations have been addressed recently by first incorporating the archaeological features measured since the publication of the Clark curve as well as using different statistical models. Despite the fact that this work is still very preliminary, it is clear that the shape of the current calibration curve within the 13th-16th centuries may change slightly following reassessment, although until a full calibration curve is made available this cannot be clarified (Zananiri *et al.* 2005). What it does show is that to give precise dates a finer detail is required within the calibration curve over the period covered at Quoygrew than is currently available. This has affected the results by exaggerating the discrepancies between the calibrated ranges. There are clearly uncertainties in the dates produced for this report which limits their use within production of the chronological sequence for the site at present. However, the fact that the dated features can be stratigraphically related and display a systematic change in direction over time is invaluable for the re-evaluation of the British calibration curve, providing a glimpse into how the geomagnetic field changed over a short time period. This in turn will allow the information within this report to be reassessed in the future and it is anticipated that the discrepancies noted can be resolved by ongoing research.

APPENDIX 1: AN INTRODUCTION TO ARCHAEOMAGNETIC DATING

PRINCIPLES

Archaeomagnetic dating is based on a comparison of the ancient geomagnetic field, as recorded by archaeological materials, with a dated record of changes in the Earth's field over time in a particular geographical area. The geomagnetic field changes both in direction (declination and inclination) and in strength (intensity) and archaeomagnetic dating can be based on either changes in direction or intensity or a combination of the two. Dating by direction requires that the exact position of the archaeological material in relation to the present geomagnetic field to be recorded, and so material must be undisturbed and *in situ*. Dating by intensity does not require *in situ* samples but is less precise and experimentally more difficult. The laboratory at Bradford uses archaeomagnetic dating by direction.

SUITABLE MATERIALS FOR DATING

For an archaeological material to be suitable for dating using magnetic direction, it must contain sufficient magnetised particles and an event must have caused these particles to record the Earth's magnetic field. Many geologically derived materials e.g. soils, sediments, clays, contain sufficient magnetic minerals. There are primarily two types of archaeological event which may result in the Earth's magnetic field at a particular moment being recorded by archaeological materials: heating and deposition in air or water.

If materials have been heated to a sufficiently high temperature (>600°C) they may retain a thermoremanent magnetisation (TRM), which reflects the earth's magnetic field at time of last cooling. Suitable archaeological features would include hearths, kilns, and other fired structures.

Sediments may acquire a datable detrital remanent magnetisation (DRM) from the alignment of their magnetic grains by the ambient field during deposition. Such an effect allows the deposits in wells, streams, and ditches to be dated. However, this aspect of archaeomagnetic dating is still under development, as factors such as bioturbation and diagenesis, can cause post-depositional disturbances of the magnetism.

Archaeomagnetic dating can be applied to features expected to date from 1000BC to the present day, as this is period covered by the calibration curve. However, as discussed below the precision of the date obtained will vary according to the period being dated.

SAMPLING

Samples of robust fired materials are taken by attaching a 25mm diameter flanged plastic reference button to a cleaned, stable area of the feature using a fast setting epoxy resin (Clark *at al*, 1988). The button is levelled, using a spirit level, and held in place with a small bead of plastecine while the resin sets. The direction of north is then marked on using a magnetic compass, sun compasses, or gyrotheolodite and the button removed with a small part of the feature attached to it. Samples are trimmed and consolidated in the laboratory with a solution of 10% polyvinylacetate in acetone. Sediments and friable fired materials are sampled by insertion of a 2cm diameter plastic cylinder, onto which the direction of north in marked. Magnetometers used are sufficiently sensitive for only small samples (c.1cm^3) to be required; approximately 12 samples are needed from each feature and it may be possible to select sampling location to minimise the visual impact, if the feature is to be preserved.

Laboratory Measurements

In the laboratory a spinner magnetometer is used to measure the remanent magnetisation of each sample (Molyneux, 1971). The measurement indicates the relative strength and direction of the magnetic field of the sample. The stability of this magnetisation is then examined by placing the sample in alternating magnetic fields of increasing strength and removing the magnetisation step-by-step. The demagnetisation measurements allow removal of any less stable magnetisation acquired after the firing or deposition event, leaving the magnetisation of archaeological interest. It can also be used to indicate the magnetic mineralogy of the samples using information relating to the field require to reduce the intensity to half its original value, known as the median destructive field (MDF): Higher values are indicative of harder magnetic minerals, such as haematite (Sternberg *et al.* 1999, 422). The results of measurements of the direction of a group of samples are represented on a stenographic plot, which shows declination as an angle measured clockwise from north and inclination as a distance from the perimeter.

Statistical Analysis

The magnetic directions from a number of samples expected to have the same date are combined to give a mean direction, the precision of which is defined using Fisherian statistics (Fisher, 1953). The alpha-95 (α_{95}) represents a 95% probability that the true direction lies within that cone of confidence around the observed mean direction, and would be expected to be less than 5° for dating purposes. A value larger than this indicates that the magnetic direction of the samples are scattered and therefore do not all record the same magnetic field.

Samples thought to be very different from the mean directional value were assessed using statistical tests defined by Beck (1983) and McElhinny and McFadden (2000: 92). The Beck '2-delta' test defines the samples that were located 2 angular standard deviations from the mean value. These samples were then tested using McElhinny and McFadden equations of $\text{Cos}\theta_{95}$, if the values failed this test they could statistically be classified as lying significantly form the mean and therefore could be removed from the analysis.

The stability of magnetisation of an individual sample on a demagnetisation is quantified using the Stability Index (Tarling & Symons, 1967). For a stable magnetisation this value would be expected to be greater than 2.5, a value less than this would indicate that the recorded magnetisation was not reliable for dating purposes.

Calibration of dates

Once a stable, mean magnetic direction has been obtained this is dated by comparing it with a calibration curve showing changes in the Earth's field over time. The calibration curve is compiled from direct measurements of the field, which extended back to AD1576 in Britain, and from archaeomagnetic measurements from features dated by other methods. Because the geomagnetic field changes spatially, data for the calibration curve must be corrected mathematically to a central location (Noel & Batt, 1990). There is a single calibration curve for England, Scotland and Wales and directions are corrected to Meriden (52.43°N, 1.62°W). Conventionally British archaeomagnetic dates are calibrated by visual comparison to the calibration curve produced by Clark *et al.* (1988). However, this method takes no account of the errors in the calibration curve itself and an alternative method is also used (Batt, 1997). The latter method gives a larger error margin on the date but is a better reflection of the actual error.

The dating of the cores is usually carried out using radiocarbon or optically stimulated luminescence (OSL) dating but problems associated with this technique which may affect the reliability of this information includes:

- Post-deposition rotation of the sediment particles
- Changes in the rates of sedimentation
- Erosion of sediments and therefore a particular time period.
- The possibility of chemical change of the samples, which produces chemical remanent magnetisation
- Errors in orientation of the samples due to the actual coring process
- Bioturbation which will affect the directional information recorded and also the dating of the sediments through the introduction of older/younger materials into the sample (Tarling 1983, 174).

These problems require any information used from lake cores needs to be treated with caution, but the "geomagnetic importance" of this information is invaluable (Tarling 1983, 174).

PRECISION OF DATES

There are a number of factors that will influence the error margins of the dates obtained:

- Differential recording of the field by different parts of the feature
- Disturbance of the material after firing / deposition
- Uncertainties in sampling and laboratory measurements
- Error margins in the calibration curve itself
- Uncertainties in the comparison of the magnetic direction with the calibration curve
- Spatial variation of the geomagnetic field

The precision of the calibration curve varies according to the archaeological period and so the precision of the date obtained will depend on the archaeological date. As the geomagnetic field has occasionally had the same direction at two different times, it is also possible to have two or more alternative dates for a single feature. In most cases the archaeological evidence can be used to select the most likely of these.

Given the number of different factors it is not possible to give a general figure for the precision of archaeomagnetic dates but there will be an error margin of at least ±25 years. It is important to note that, since the method relies on the reliability of previously dated sites, the calibration curve can be improved as more measurements become available.

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Appendix 2: Sample Inventory

Feature 1: [F881], Q1/1-30

Lab Code	Munsell Reference	Colour	% Missing from tubes	Comment
Q1/1	5YR 4/4	Reddish brown	10	
Q1/2	5YR 4/6	Yellowish red	0	
Q1/3	7.5YR 6/4	Light brown	70	Moved – not *in situ?*
Q1/4	7.5YR 4/6	Strong brown	0	
Q1/5	7.5YR 4/6	Strong brown	0	
Q1/6	7.5YR 4/6	Strong brown	5	
Q1/7	7.5YR 4/6	Strong brown	2	
Q1/8	7.5YR 4/6	Strong brown	0	
Q1/9	7.5YR 4/6	Strong brown	0	
Q1/10	7.5YR 4/6	Strong brown	0	
Q1/11	7.5YR 4/6	Strong brown	0	
Q1/12	7.5YR 4/6	Strong brown	0	
Q1/13	5YR 4/6	Yellowish red	5	
Q1/14	7.5YR 4/6	Strong brown	0	
Q1/15	7.5YR 4/6	Strong brown	2	Broke during transport
Q1/16	7.5YR 4/4	Brown	0	
Q1/17	5YR 4/6	Yellowish red	0	
Q1/18	2.5YR 4/6	Red	0	Mottles of 5YR 2.5/1 (black)
Q1/19	7.5YR 4/6	Strong brown	0	
Q1/20	5YR 4/4	Reddish brown	50	
Q1/21	5YR 4/4	Reddish brown	0	
Q1/22	7.5YR 4/6	Brown	20	
Q1/23	7.5YR 5/4	Brown	2	
Q1/24	-	-	-	Broke in the field
Q1/25	5YR 4/6	Yellowish red	10	Broke during the transport
Q1/26	5YR 4/4	Reddish brown	5	
Q1/27	-	-	-	Broke in the field
Q1/28	5YR 4/6	Reddish brown	80	
Q1/29	5YR 4/4	Reddish brown	?	Surface seems fine but moves underneath
Q1/30	7.5YR 4/6	Strong brown	10	Contains a stone – distort magnetic signal?

Feature 3: [F958], Q3/1-18

Lab Code	Munsell Reference	Colour	% Missing from tubes	Comment
Q3/1	5YR 4/6	Yellowish red	5	Portion 7.5YR 4/4 (brown) – cut through deposit?
Q3/2	2.5YR 4/6	Red	10	
Q3/3	-	-	-	Broke in the field
Q3/4	5YR 4/6	Yellowish red	0	
Q3/5	5YR 4/6	Yellowish red	0	
Q3/6	5YR 4/6	Yellowish red	0	
Q3/7	2.5YR 4/6	Red	0	
Q3/8	10YR 4/3	Brown	2	Broke during transport to Bradford
Q3/9	7.5YR 4/4	Brown	0	
Q3/10	10YR 5/4	Yellowish brown	40	Not *in situ*?
Q3/11	7.5YR 4/3	Brown	70	Not *in situ*?
Q3/12	5YR 4/6	Yellowish red	5	Patch of 10YR 3/2 (very dark greyish brown)
Q3/13	10YR 4/3	Brown	0	
Q3/14	-	-	-	Broke during transport to Bradford
Q3/15	10YR 4/4	Dark yellowish brown	0	
Q3/16	10YR 4/4	Dark yellowish brown	0	
Q3/17	10YR 4/3	Brown	0	
Q3/18	7.5YR 4/4	Brown	0	

Appendix 3: Detailed measurements and statistical analysis for F958

Incorporates:

- Site information
- Magnetic measurements
- Statistics for NRM
- Statistics for partial demagnetisation
- Statistics for corrections, final result and errors
- Scatter plots and stereoplots for the NRM and demagnetised samples
- Pilot demagnetisation measurements and plots

SITE INFORMATION

Site Name	Quoygrew
Area	F, Structure 1
Context No	F958
Description	Pale orange ash sealed by hearth stones F831
Latitude (+ve N)	59.328079
Longitude (+ve E)	-2.994636
Magnetic Var	-5.302
Date Sampled	Aug-04

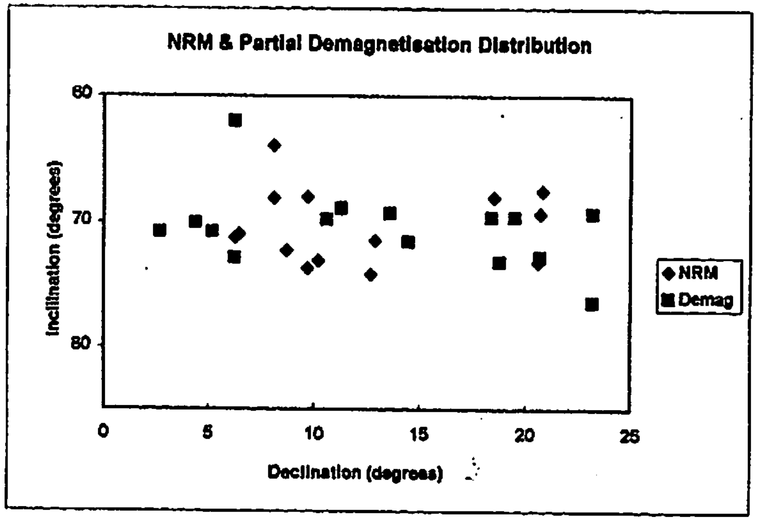
MAGNETIC MEASUREMENTS

Sample no.	NRM			Field	After partial demag			Pilot?
	D	I	Int		D	I	Int	
	degs.	*degs.*	*arb*	*mT*	*degs.*	*degs.*	*arb*	*Y/N*
Q3/1	10.2	73.1	28.7384	2.5	20.7	72.8	28.43	y
Q3/2	8.7	72.3	26.2657	2.5	6.3	72.9	26.5235	
Q3/4	11.3	68.9	28.0854	2.5	11.3	68.9	28.09	
Q3/5	6.5	71	89.1414	2.5	13.6	69.3	90.4134	
Q3/6	18.5	68	55.7446	2.5	18.4	69.6	56.6431	
Q3/7	20.8	67.5	66.7455	2.5	23.2	69.3	66.7983	
Q3/9	9.7	68	49.0397	2.5	10.6	69.8	49.9098	
Q3/10	12.9	71.5	27.5424	2.5	2.7	70.8	27.9681	y
Q3/11	9.7	73.7	19.4192	2.5	14.5	71.6	19.9508	
Q3/12	8.1	63.9	35.8508	2.5	6.3	62	33.3125	y
Q3/13	6.3	71.3	47.5038	2.5	5.2	70.8	48.8008	
Q3/15	20.6	73.2	43.1184	2.5	23.2	76.4	45.8846	
Q3/16	20.7	69.3	36.4439	2.5	19.5	69.6	37.4085	
Q3/17	12.7	74.2	49.9672	2.5	18.8	73.2	51.0637	
Q3/18	8.1	68.1	56.0571	2.5	4.4	70.1	57.0853	

NRM DISTRIBUTION

PARTIAL DEMAG DISTRIBUTION

Sample no.	NRM				Demag			
	D	I	D	I	D	I	D	I
	degs.	degs.	degs	degs.	degs.	degs.	degs	degs.
Q3/1	10.2	73.1	10.2	73.1	20.7	72.8	20.7	72.8
Q3/2	8.7	72.3	8.7	72.3	6.3	72.9	6.3	72.9
Q3/4	11.3	68.9	11.3	68.9	11.3	68.9	11.3	68.9
Q3/5	6.5	71	6.5	71	13.6	69.3	13.6	69.3
Q3/6	18.5	68	18.5	68	18.4	69.6	18.4	69.6
Q3/7	20.8	67.5	20.8	67.5	23.2	69.3	23.2	69.3
Q3/9	9.7	68	9.7	68	10.6	69.8	10.6	69.8
Q3/10	12.9	71.5	12.9	71.5	2.7	70.8	2.7	70.8
Q3/11	9.7	73.7	9.7	73.7	14.5	71.6	14.5	71.6
Q3/12	8.1	63.9	8.1	63.9	6.3	62	6.3	62
Q3/13	6.3	71.3	6.3	71.3	5.2	70.8	5.2	70.8
Q3/15	20.6	73.2	20.6	73.2	23.2	76.4	23.2	76.4
Q3/16	20.7	69.3	20.7	69.3	19.5	69.6	19.5	69.6
Q3/17	12.7	74.2	12.7	74.2	18.8	73.2	18.8	73.2
Q3/18	8.1	68.1	8.1	68.1	4.4	70.1	4.4	70.1



STATISTICS FOR NRM DATA

Sample no.	Dec	Inc	x	y	z
Q3/1	10.2	73.1	0.2861078	0.051479	0.956814
Q3/2	8.7	72.3	0.3005348	0.045988	0.952661
Q3/4	11.3	68.9	0.3530181	0.07054	0.932954
Q3/5	6.5	71	0.3234754	0.036855	0.945519
Q3/6	18.5	68	0.3552483	0.118864	0.927184
Q3/7	20.8	67.5	0.3577423	0.135894	0.92388
Q3/9	9.7	68	0.369251	0.063117	0.927184
Q3/10	12.9	71.5	0.3092963	0.070838	0.948324
Q3/11	9.7	73.7	0.2766541	0.047289	0.959805
Q3/12	8.1	63.9	0.4356502	0.061988	0.898028
Q3/13	6.3	71.3	0.3186768	0.035182	0.94721
Q3/15	20.6	73.2	0.270551	0.101693	0.957319
Q3/16	20.7	69.3	0.3306559	0.124944	0.935444
Q3/17	12.7	74.2	0.2656188	0.05986	0.962218
Q3/18	8.1	68.1	0.3692667	0.052554	0.927836

Number = 15
Sum x = 4.9216
Sum y = 1.0771
Sum z = 14.1024
R = 14.9753
x bar = 0.3287
y bar = 0.0719
z bar = 0.9417

Mean Dec = 12.3444
Mean Inc = 70.3405
Alpha95 = 1.6072

CORRECTIONS

Mean Dec = 12.34
Mean Inc = 70.34

Correction for magnetic variation
Mean Dec = 7.04
Mean Inc = 70.34054073

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	x	y	z
Q3/1	20.7	72.8	0.276618	0.104525	0.955278
Q3/2	6.3	72.9	0.292265	0.032266	0.955793
Q3/4	11.3	68.9	0.353018	0.07054	0.932954
Q3/5	13.6	69.3	0.343564	0.083117	0.935444
Q3/6	18.4	69.6	0.330752	0.110026	0.937282
Q3/7	23.2	69.3	0.324891	0.139249	0.935444
Q3/9	10.6	69.8	0.339406	0.063518	0.938493
Q3/10	2.7	70.8	0.328502	0.015492	0.944376
Q3/11	14.5	71.6	0.305595	0.079032	0.948876
Q3/12	6.3	62	0.466636	0.051517	0.882948
Q3/13	5.2	70.8	0.327513	0.029806	0.944376
Q3/15	23.2	76.4	0.216127	0.092632	0.971961
Q3/16	19.5	69.6	0.328578	0.116356	0.937282
Q3/17	18.8	73.2	0.273612	0.093145	0.957319
Q3/18	4.4	70.1	0.339376	0.026114	0.940288

Number = 15
Sum x = 4.8465
Sum y = 1.1073
Sum z = 14.1181
R = 14.9678
x bar = 0.3238
y bar = 0.0740
z bar = 0.9432

Mean Dec = 12.8702
Mean Inc = 70.6015
Alpha95 = 1.8354

CORRECTIONS

Mean Dec = 12.87
Mean Inc = 70.60

Correction for magnetic variation
Mean Dec = 7.57
Mean Inc = 70.60153

Correction to Meriden (CVP)

Uncorrected Dec =	7.042390378
Uncorrected Inc =	70.34054073
Latitude =	59.328079
Longitude =	-2.994636
Kal =	35.54609195
Latitude of pole=	83.79754999
Beta1 =	41.2779522
Longitude of pole =	135.7274118
Geomag colat =	42.30955302
Corrected Inc=	65.52889198
Beta 2 =	42.6525882
Corrected Dec=	6.243296646

FINAL RESULT

Corrected Dec=	6.243296646
Corrected Inc =	65.52889196
Alpha95 =	1.61

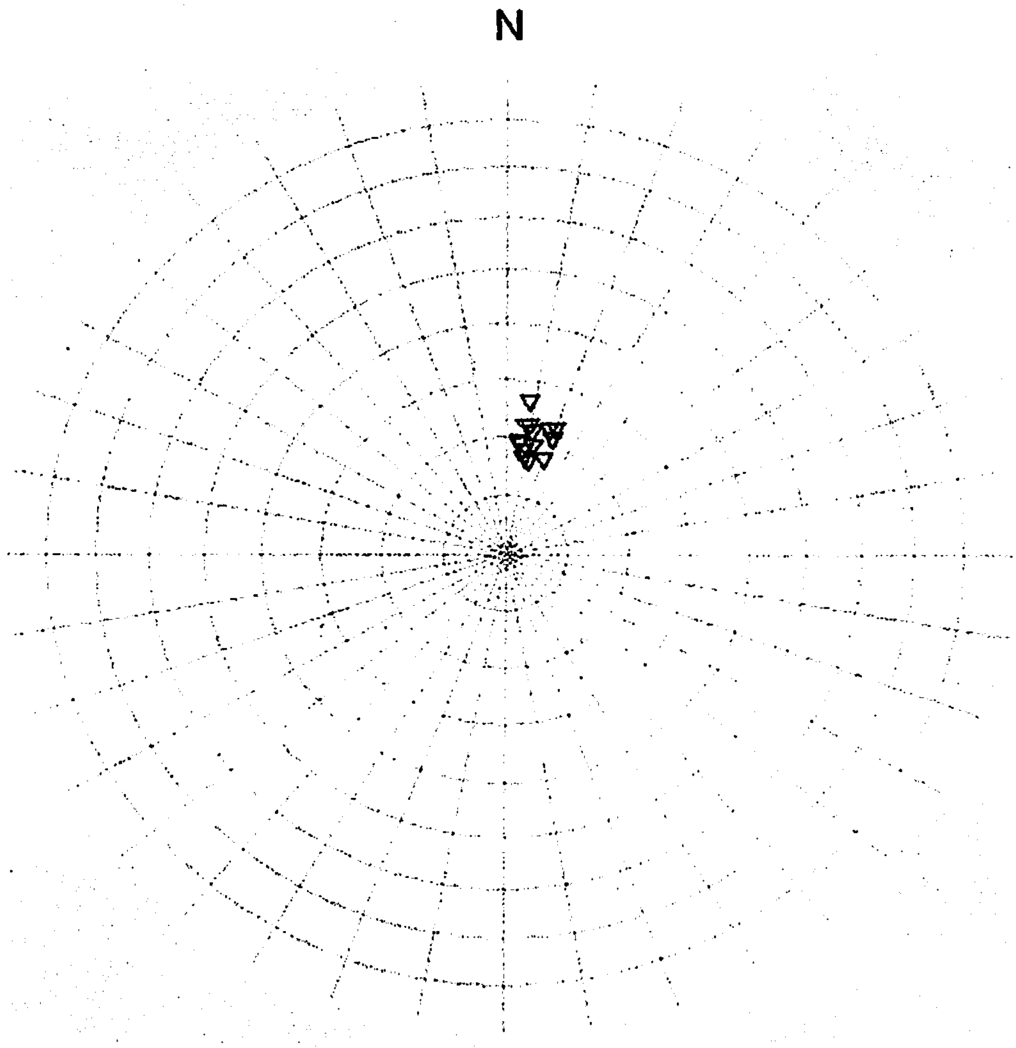
Correction to Meriden (CVP)

Uncorrected Dec =	7.568221
Uncorrected Inc =	70.60153
Latitude =	59.32808
Longitude =	-2.99464
Kal =	35.15516
Latitude of pole=	83.92355
Beta1 =	45.75875
Longitude of pole =	131.2466
Geomag colat =	41.9055
Corrected Inc=	65.8337
Beta 2 =	47.13339
Corrected Dec=	6.670696

FINAL RESULT

Corrected Dec=	6.670696
Corrected Inc =	65.8337
Alpha95 =	1.84

NRM distribution: F958



STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	x	y	z
Q3/1	10.2	73.1	0.286108	0.051479	0.956814
Q3/2	8.7	72.3	0.300535	0.045988	0.952661
Q3/4	11.3	68.9	0.353018	0.07054	0.932954
Q3/5	6.5	71	0.323475	0.036855	0.945519
Q3/6	18.5	68	0.355248	0.118864	0.927184
Q3/7	20.8	67.5	0.357742	0.135894	0.92388
Q3/9	9.7	68	0.369251	0.063117	0.927184
Q3/10	12.9	71.5	0.309296	0.070838	0.948324
Q3/11	9.7	73.7	0.276654	0.047289	0.959805
Q3/12	8.1	63.9	0.43555	0.061988	0.898028
Q3/13	6.3	71.3	0.318677	0.035182	0.94721
Q3/15	20.6	73.2	0.270551	0.101693	0.957319
Q3/16	20.7	69.3	0.330656	0.124944	0.935444
Q3/17	12.7	74.2	0.265619	0.05986	0.962218
Q3/18	8.1	68.1	0.369267	0.052554	0.927836

Number = 15
Sum x = 4.921648
Sum y = 1.077088
Sum z = 14.10238
R = 14.97531
x bar = 0.328651
y bar = 0.071924
z bar = 0.941709

Mean Dec = 12.34439
Mean Inc = 70.34054
Alpha95 = 1.60725

BECK 2-DELTA TEST
2-delta 6.803557

MCFADDEN 1982 DISCORDANCY TEST

STATISTICS FOR DEMAG DATA

			(N-1)		
Sample no.	Dec	Inc	x	y	z
Q3/1	10.2	73.1	0.286108	0.051479	0.956814
Q3/2	8.7	72.3	0.300535	0.045988	0.952661
Q3/4	11.3	68.9	0.353018	0.07054	0.932954
Q3/5	6.5	71	0.323475	0.036855	0.945519
Q3/6	18.5	68	0.355248	0.118864	0.927184
Q3/7	20.8	67.5	0.357742	0.135894	0.92388
Q3/9	9.7	68	0.369251	0.063117	0.927184
Q3/10	12.9	71.5	0.309296	0.070838	0.948324
Q3/11	9.7	73.7	0.276654	0.047289	0.959805
Q3/13	6.3	71.3	0.318677	0.035182	0.94721
Q3/15	20.6	73.2	0.270551	0.101693	0.957319
Q3/16	20.7	69.3	0.330656	0.124944	0.935444
Q3/17	12.7	74.2	0.265619	0.05986	0.962218
Q3/18	8.1	68.1	0.369267	0.052554	0.927836

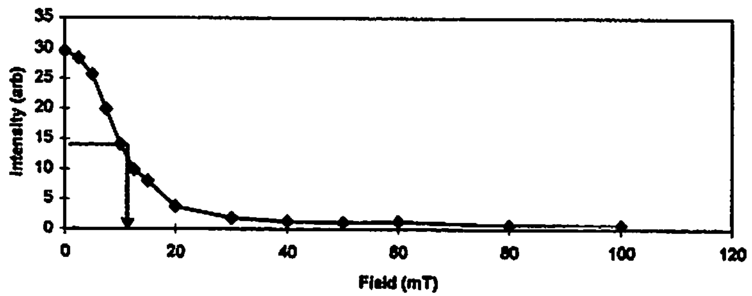
Number =	14
Sum x =	4.486097
Sum y =	1.0151
Sum z =	13.20435
R =	13.9825
x bar =	0.320837
y bar =	0.072598
z bar =	0.944348
Mean Dec =	12.74999
Mean Inc =	70.79509
Alpha95 =	1.459207
COS gamma(1-P)	6.088703

PILOT DEMAGNETISATION

Sample Number Q3/1 (central)

Demag Step	RM					
	D	I	Int	x	y	z
mT	*degs.*	*degs.*	*arb*			
0	16	72.8	29.5817	8.4112	2.4139	28.2577
2.5	20.7	72.3	28.4337	8.0984	3.0679	27.0829
5	15.8	71.4	25.7315	7.9016	2.2388	24.3858
7.5	11.3	71.5	19.8821	6.1916	1.2412	18.8527
10	16.3	71.9	14.1464	4.224	1.2328	13.4447
12.5	14.8	69.4	9.857	3.3548	0.8858	9.2261
15	7.6	69	8.0617	2.8602	0.3837	7.5275
20	359.4	74.8	3.7932	0.9959	-0.0108	3.6601
30	353.5	71.3	1.9322	0.6147	-0.0701	1.8305
40	332	62.6	1.4458	0.5881	-0.3128	1.2833
50	265	54.7	1.2666	-0.0634	-0.729	1.0339
60	293.7	51.2	1.3871	0.3495	-0.7957	1.081
80	293.8	75.9	0.8361	0.0826	-0.1868	0.8108
100	330.2	70	0.7651	0.2269	-0.1301	0.719

Normalised data (% Heamatite) = 2.586396

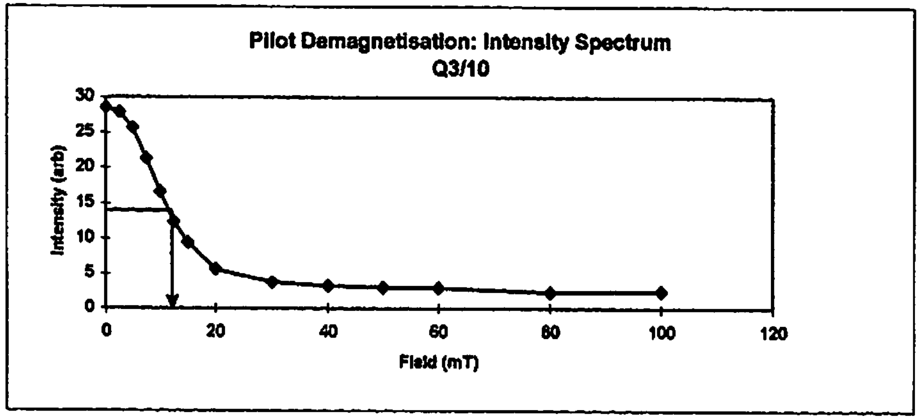


→ MDF value 9.5mT

PILOT DEMAGNETISATION
Sample Number Q3/10 Central

Demag Step	RM					
	D	I	Int	x	y	z
mT	*degs.*	*degs.*	*arb*			
0	4.7	72.4	28.5327	8.5786	0.6993	27.2036
2.5	2.7	70.8	27.9581	9.1711	0.427	26.4077
5	4.9	71.6	25.7274	8.0903	0.6925	24.4124
7.5	11.2	70.4	21.3114	7.0178	1.3952	20.0744
10	9.9	67.8	16.642	6.1984	1.0842	15.4065
12.5	3.8	67.6	12.3902	4.7108	0.311	11.4555
15	358.4	64.7	9.4785	4.051	-0.1109	8.5685
20	10.8	64.5	5.6923	2.4104	0.4614	5.1361
30	16.7	61.7	3.7533	1.7036	0.511	3.3051
40	10.6	57.1	3.2465	1.733	0.3244	2.726
50	12.6	54.4	3.0142	1.712	0.3824	2.4512
60	358.4	50.2	2.9382	1.8809	-0.0538	2.2566
80	37.7	53	2.3784	1.1321	0.8741	1.9003
100	22	47.6	2.514	1.5717	0.6362	1.8562

Normalised data (% Heamatite) = 8.810943

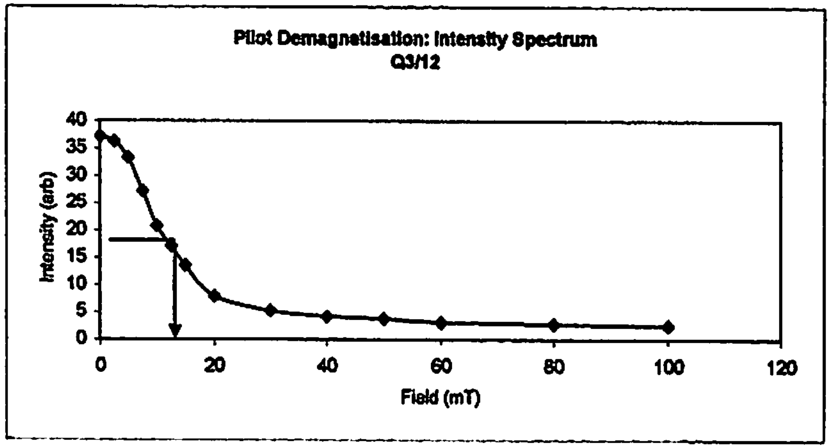


→ MDF value 10.25mT

PILOT DEMAGNETISATION
Sample Number Q3/12 outlier (?)

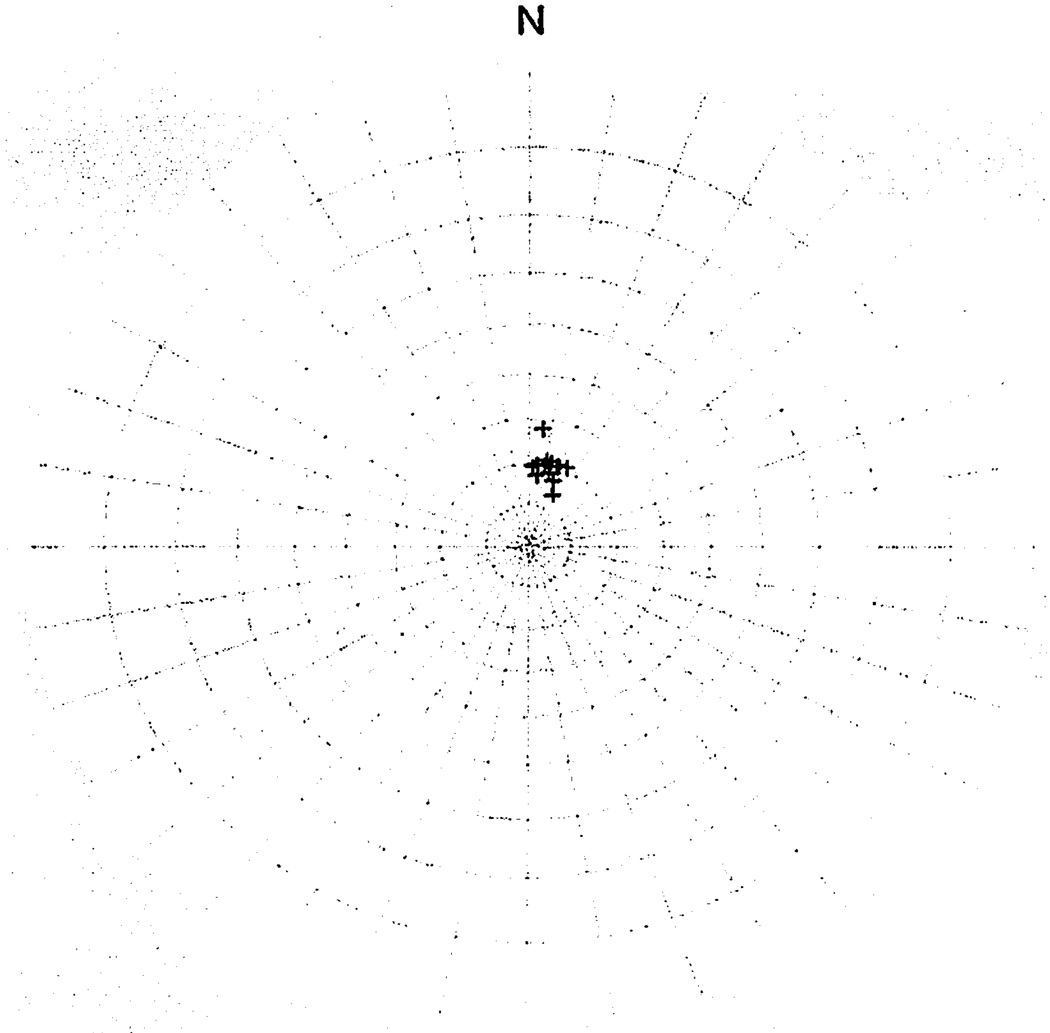
Demag Step	RM					
	D	I	Int	x	y	z
mT	*degs.*	*degs.*	*arb*			
0	8.8	64.5	37.1175	15.7641	2.4532	33.514
2.5	6.3	62	36.3125	15.5644	2.2504	29.4032
5	8.6	64.8	33.2931	14.0386	2.1192	30.114
7.5	9.4	63.3	27.2087	12.0805	2.0075	24.297
10	8.2	63.2	20.7513	9.274	1.3344	18.5157
12.5	9	61.7	17.1427	8.0243	1.2765	15.0948
15	8.2	58.6	13.671	7.055	1.0155	11.6659
20	8.8	55.7	8.0053	4.4574	0.6874	6.6139
30	10.8	51.9	5.2607	3.1909	0.6076	4.138
40	3.1	52	4.1969	2.5774	0.1393	3.3093
50	10	49.3	3.795	2.4373	0.4297	2.877
60	2.3	62.7	3.103	1.4243	0.0579	2.7562
80	4.3	59.6	2.8405	1.4335	0.1074	2.4498
100	8.6	64.9	2.515	1.055	0.1603	2.2774

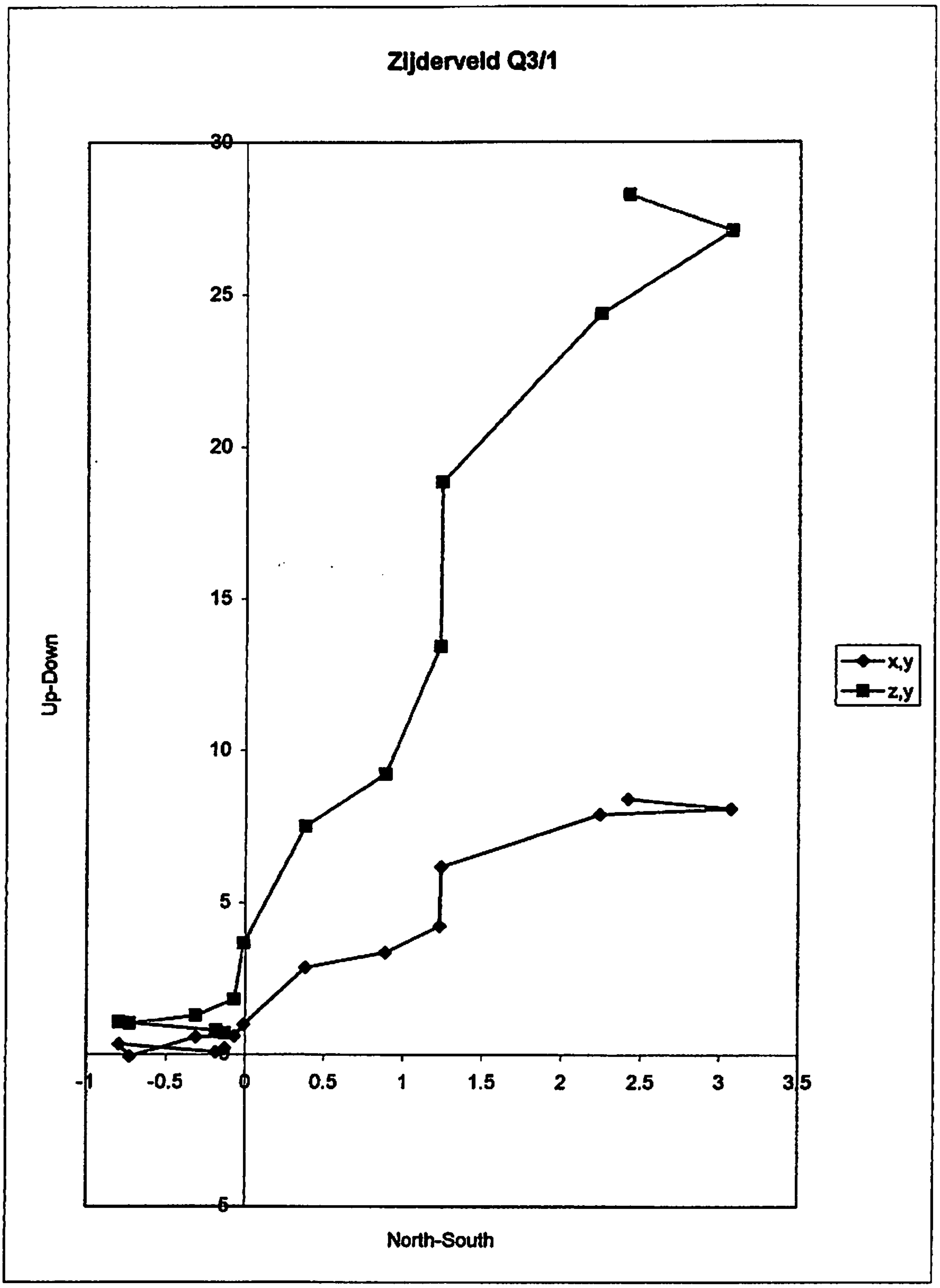
Normalised data (% Heamatite) = 6.77578



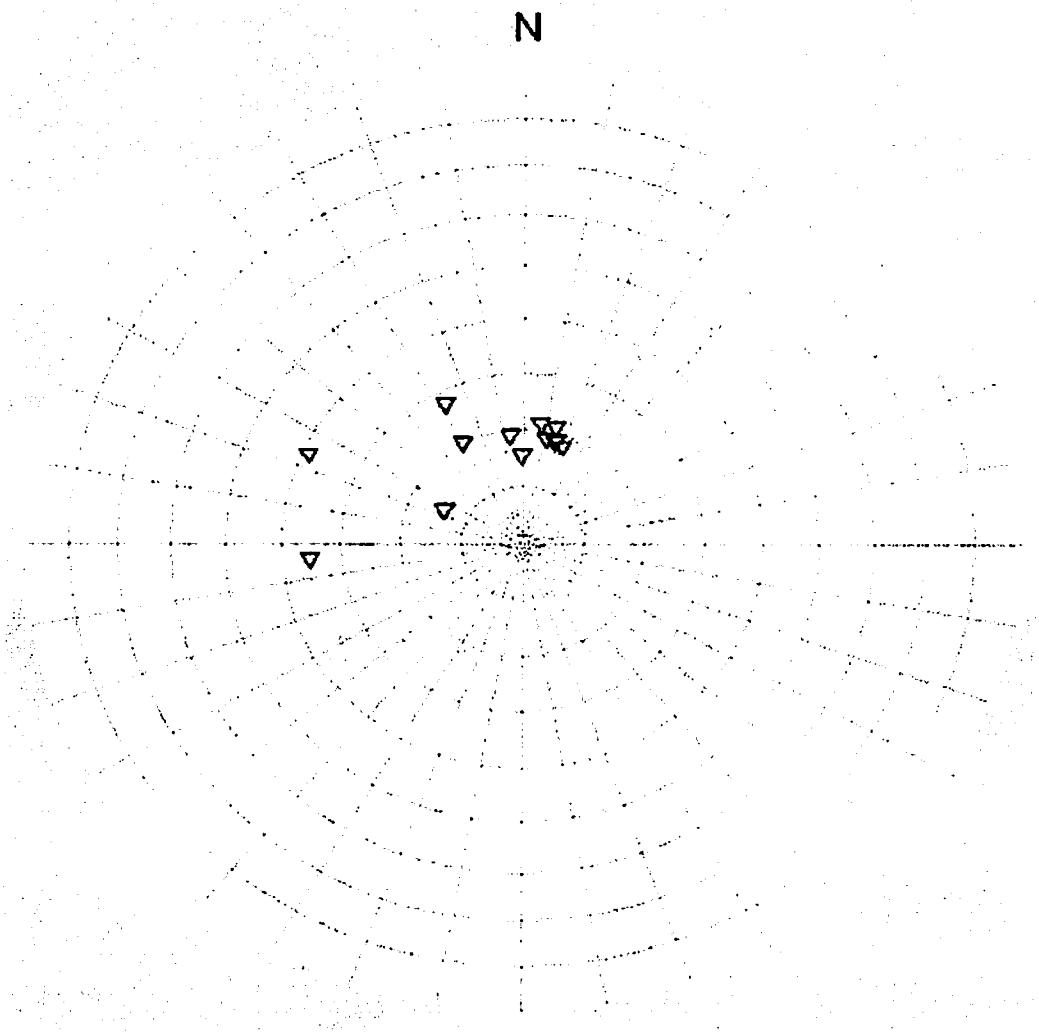
→ MDF value 12.5mT

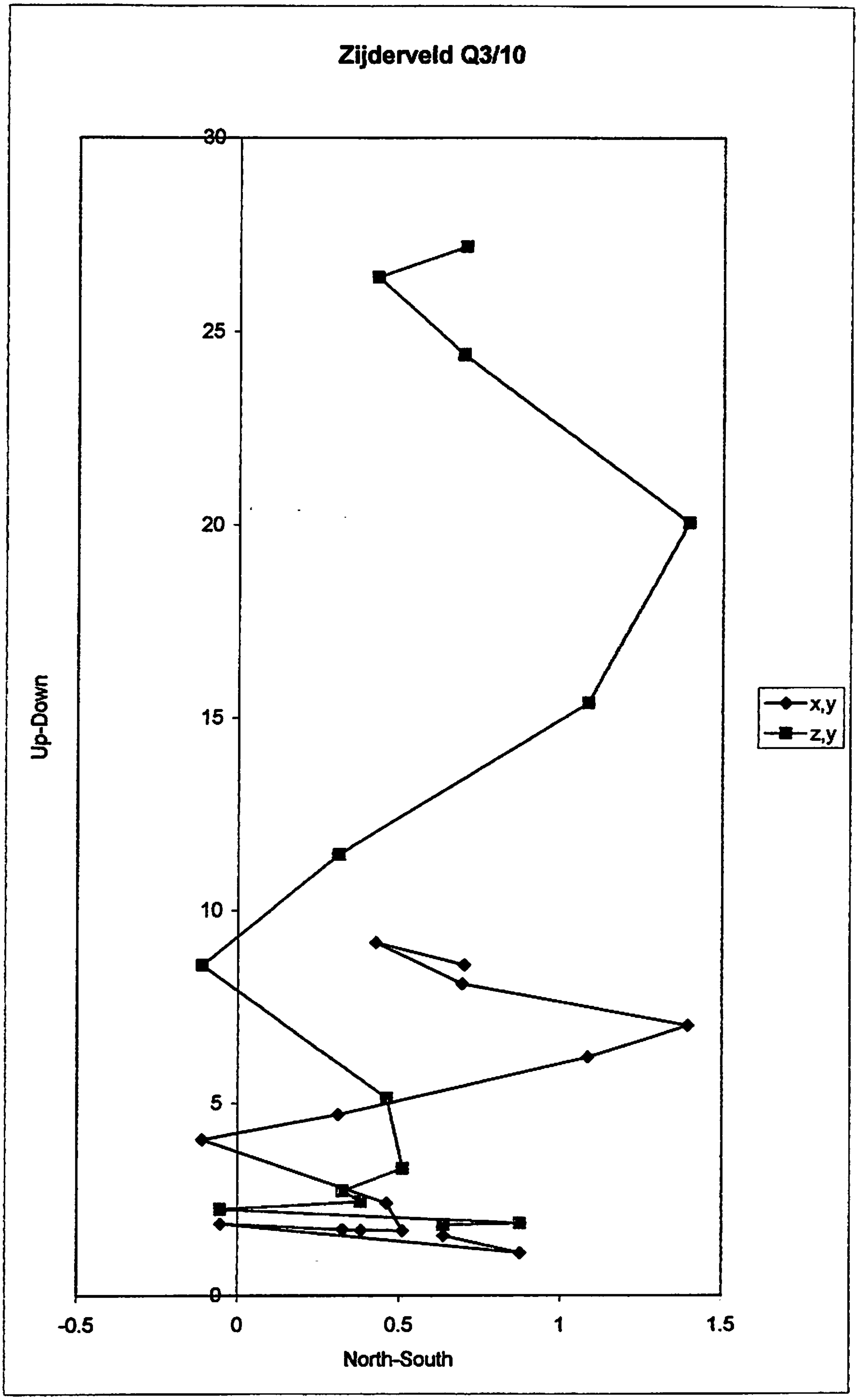
Distribution folowing partial demagnetisation at 2.5mT




Zijderveld Q3/1
30
25
20
15
10
5
0
-5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
Up-Down
North-South
x,y
z,y

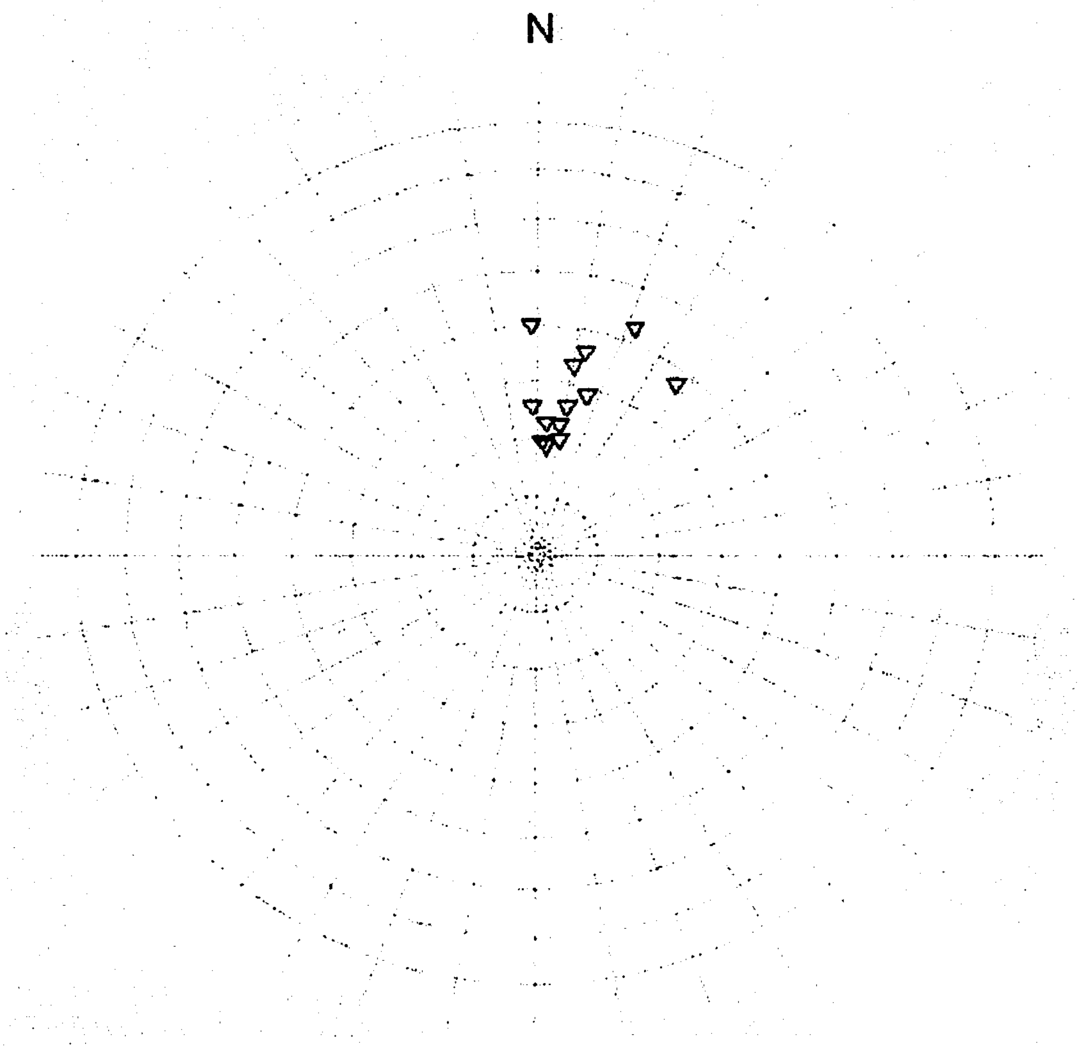
Pilot demagnetisation Q3/1(0-100mT)

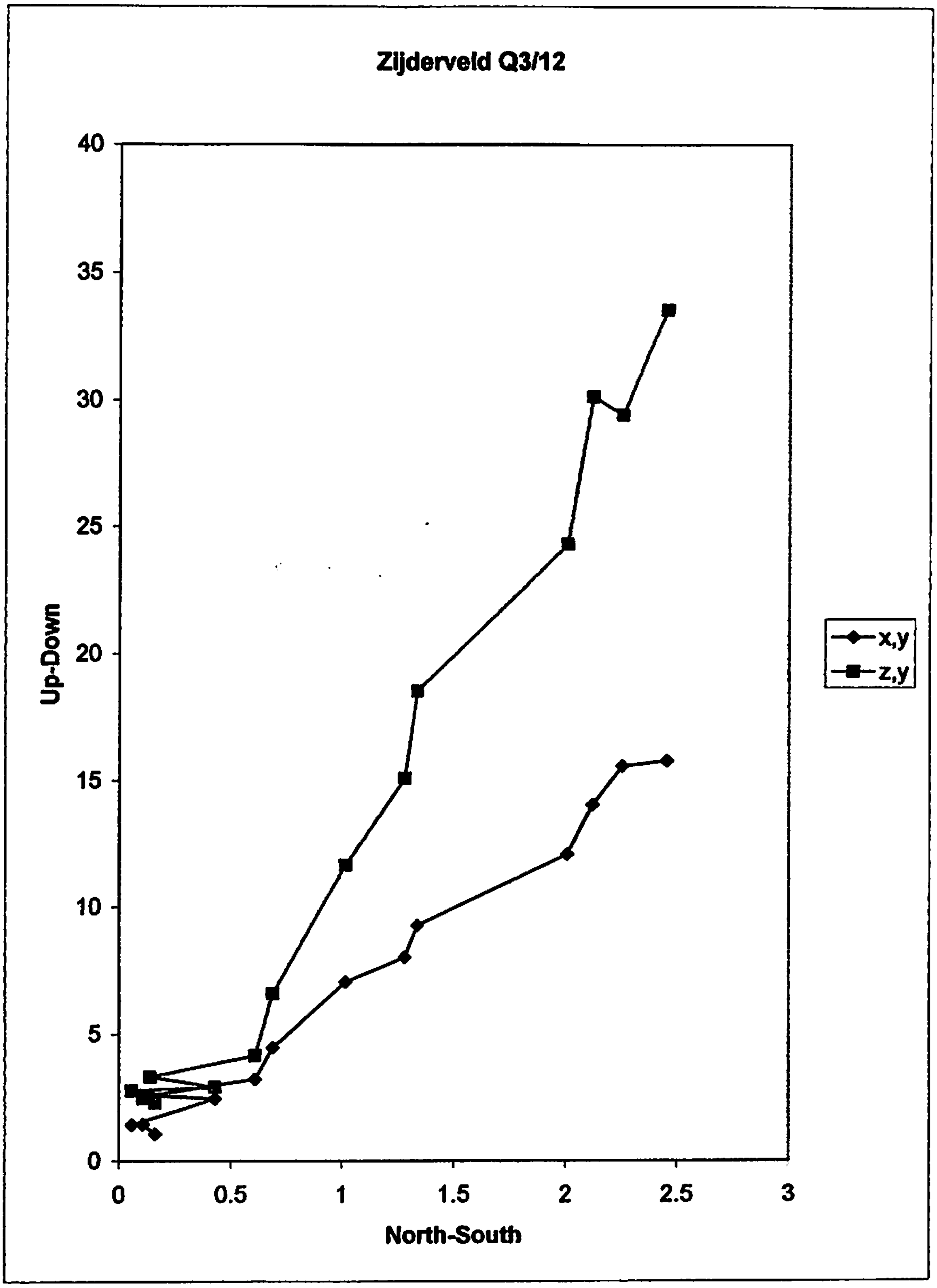




Zijderveld Q3/10
30
25
20
15
10
5
0
-0.5
0
0.5
1
1.5
Up-Down
North-South
x,y
z,y

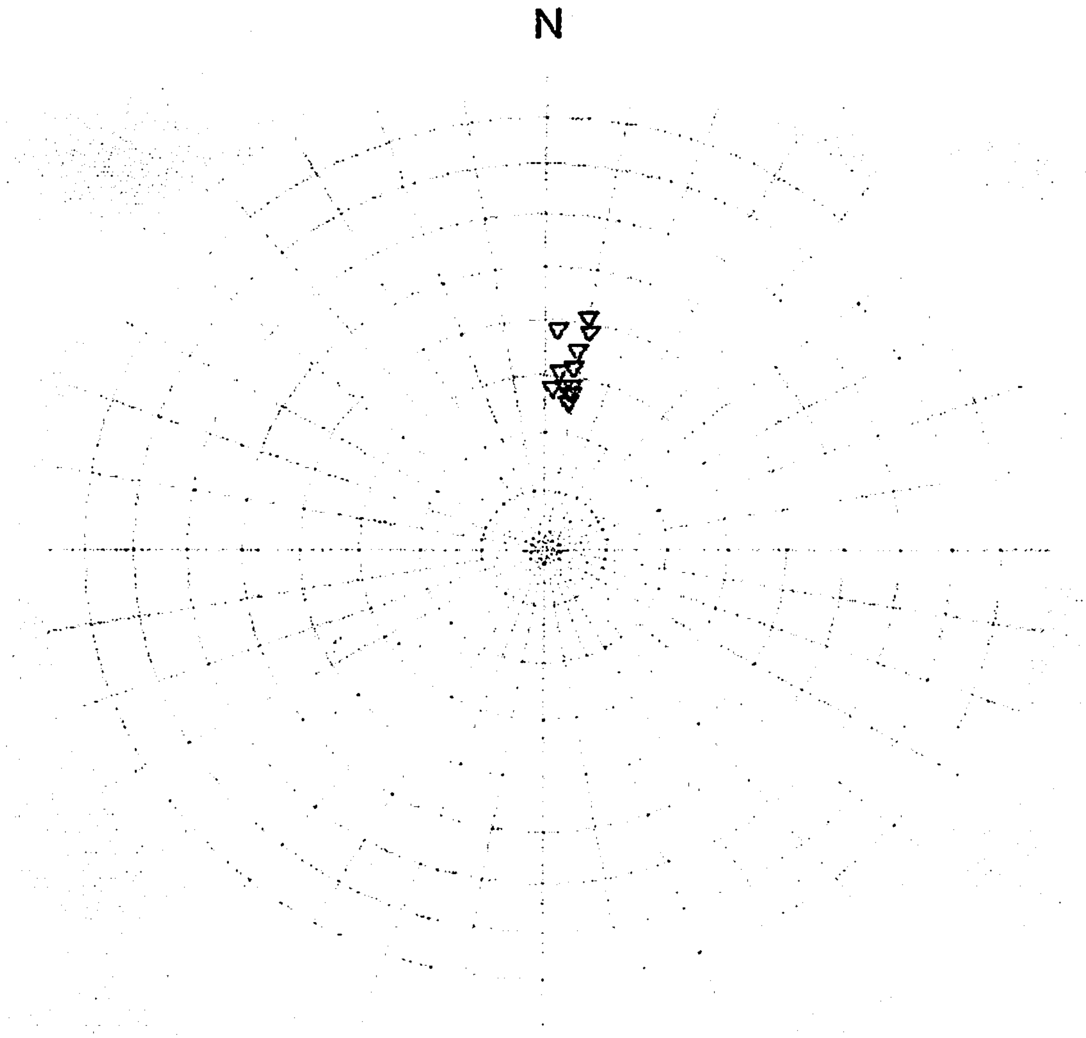
Pilot demagnetisation Q3/10 (0-100mT)





Zijderveld Q3/12
Up-Down
North-South
0
5
10
15
20
25
30
35
40
0
0.5
1
1.5
2
2.5
3
x,y
z,y

Pilot demagnetisation Q3/12 (0-100mT)



STATISTICS FOR DEMAGNETISATION DATA

Sample no.	Dec	Inc	x	y	z
Q3/1	20.7	72.8	0.276618	0.104525	0.955278
Q3/2	6.3	72.9	0.292265	0.032266	0.955793
Q3/4	11.3	68.9	0.353018	0.07054	0.932954
Q3/5	13.6	69.3	0.343564	0.083117	0.935444
Q3/6	18.4	69.6	0.330752	0.110026	0.937282
Q3/7	23.2	69.3	0.324891	0.139249	0.935444
Q3/9	10.6	69.8	0.339406	0.063518	0.938493
Q3/10	2.7	70.8	0.328502	0.015492	0.944376
Q3/11	14.5	71.6	0.305595	0.079032	0.948876
Q3/12	6.3	62	0.466636	0.051517	0.882948
Q3/13	5.2	70.8	0.327513	0.029806	0.944376
Q3/15	23.2	76.4	0.216127	0.092632	0.971961
Q3/16	19.5	69.6	0.328578	0.116356	0.937282
Q3/17	18.8	73.2	0.273612	0.093145	0.957319
Q3/18	4.4	70.1	0.339376	0.026114	0.940288

Number =	15
Sum x =	4.846454
Sum y =	1.107335
Sum z =	14.11811
R =	14.96781
x bar =	0.323792
y bar =	0.073981
z bar =	0.943232
Mean Dec =	12.87022
Mean Inc =	70.60153
Alpha95 =	1.835443

BECK 2-DELTA TEST

2-delta	7.767489

MCFADDEN 1982 DISCORDANCY TEST

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	(N-1) x	y	z
Q3/1	20.7	72.8	0.276618	0.104525	0.955278
Q3/2	6.3	72.9	0.292265	0.032266	0.955793
Q3/4	11.3	68.9	0.353018	0.07054	0.932954
Q3/5	13.6	69.3	0.343564	0.083117	0.935444
Q3/6	18.4	69.6	0.330752	0.110026	0.937282
Q3/7	23.2	69.3	0.324891	0.139249	0.935444
Q3/9	10.6	69.8	0.339406	0.063518	0.938493
Q3/10	2.7	70.8	0.328502	0.015492	0.944376
Q3/11	14.5	71.6	0.305595	0.079032	0.948876
Q3/13	5.2	70.8	0.327513	0.029806	0.944376
Q3/15	23.2	76.4	0.216127	0.092632	0.971961
Q3/16	19.5	69.6	0.328578	0.116356	0.937282
Q3/17	18.8	73.2	0.273612	0.093145	0.957319
Q3/18	4.4	70.1	0.339376	0.026114	0.940288

Number =	14
Sum x =	4.379817
Sum y =	1.055818
Sum z =	13.23517
R =	13.98096
x bar =	0.31327
y bar =	0.075518
z bar =	0.946657
Mean Dec =	13.55339
Mean Inc =	71.20131
Alpha95 =	1.522336
COS gamma(1-P)	6.352655

FINAL STATS

Sample no.	Dec	Inc	x	y	z
Q3/1	20.7	72.8	0.276618	0.104525	0.955278
Q3/2	6.3	72.9	0.292265	0.032266	0.955793
Q3/4	11.3	68.9	0.353018	0.07054	0.932954
Q3/5	13.6	69.3	0.343564	0.083117	0.935444
Q3/6	18.4	69.6	0.330752	0.110026	0.937282
Q3/7	23.2	69.3	0.324891	0.139249	0.935444
Q3/9	10.6	69.8	0.339406	0.063518	0.938493
Q3/10	2.7	70.8	0.328502	0.015492	0.944376
Q3/11	14.5	71.6	0.305595	0.079032	0.948876
Q3/12	6.3	62	0.466636	0.051517	0.882948
Q3/13	5.2	70.8	0.327513	0.029806	0.944376
Q3/15	23.2	76.4	0.216127	0.092632	0.971961
Q3/16	19.5	69.6	0.328578	0.116356	0.937282
Q3/17	18.8	73.2	0.273612	0.093145	0.957319
Q3/18	4.4	70.1	0.339376	0.026114	0.940288

Number = 15
Sum x = 4.846454
Sum y = 1.107335
Sum z = 14.11811
R = 14.96781
x bar = 0.323792
y bar = 0.073981
z bar = 0.943232

Mean Dec = 12.87022
Mean Inc = 70.60153
Alpha95 = 1.835443 Alpha 68 1.094137

CORRECTIONS

Mean Dec = 12.87022
Mean Inc = 70.60153

Correction for magnetic variation
Mean Dec = 7.568221
Mean Inc = 70.60153

Correction to Meriden (CVP)

Uncorrected Dec = 7.568221
Uncorrected Inc = 70.60153
Latitude = 59.32808
Longitude = -2.994636

Kai = 35.15516
Latitude of pole= 83.92355
Beta1 = 45.75875
Longitude of pole = 131.2466
Geomag colat = 41.9055
Corrected Inc= 65.8337
Beta 2 = 47.13339
Corrected Dec= 6.670696

FINAL RESULT
Corrected Dec= 6.670696
Corrected Inc = 65.8337
Alpha95 = 1.835443 Alpha 68 1.094137

SITE INFORMATION

Site Name	Quoygrew
Area	F, Structure 1
Context No	F881
Description	Orangey-red glacial till, sealed by hearth stones F828
Latitude (+ve N)	59.326079
Longitude (+ve E)	-2.994636
Magnetic Var	-5.302
Date Sampled	Aug-04

MAGNETIC MEASUREMENTS

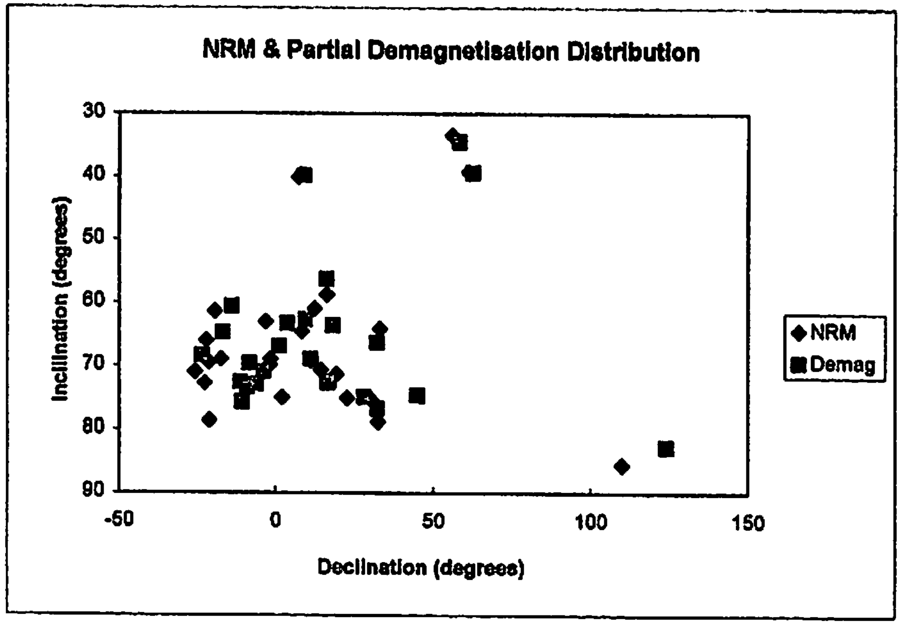
Sample no.	NRM			Field	After partial demag			Pilot?
	D	I	Int		D	I	Int	
	degs.	*degs.*	*arb*	*mT*	*degs.*	*degs.*	*arb*	*Y/N*
Q1/1	342.5	68.9	8.5119	2.5	351.7	69.6	8.6878	
Q1/2	14.4	70.6	10.6456	2.5	16.9	72.5	11.0581	
Q1/3	358.2	68.9	8.336	2.5	1.1	66.9	8.4726	
Q1/4	19.4	71.3	12.5539	2.5	16.6	72.7	12.893	
Q1/5	356.8	63	7.982	2.5	3.7	63.3	8.5159	
Q1/6	8.3	64.5	9.0494	2.5	9.5	62.7	9.5467	
Q1/7	61.2	39.2	7.9719	2.5	62.5	39.4	8.9258	
Q1/8	33.1	64.1	11.4266	2.5	32.3	66.3	12.7439	
Q1/9	22.8	75.1	14.7664	2.5	32.4	76.8	15.3737	
Q1/10	12.3	61	16.2216	2.5	18.1	63.6	17.1273	
Q1/11	334.1	71	19.5626	2.5	348.8	72.6	20.8994	
Q1/12	338.7	78.7	28.134	2.5	349.2	75.8	29.799	
Q1/13	55.8	33.4	53.6617	2.5	58.3	34.5	53.02	y
Q1/14	11.2	69.2	42.1789	2.5	11.2	68.9	44.4945	
Q1/16	337.2	72.7	72.0681	2.5	353.9	72.9	73.4092	
Q1/17	7.2	40.1	38.7328	2.5	9.1	39.8	39.61	y
Q1/18	2	75	32.2532	2.5	351	73.5	32.38	y
Q1/19	358.1	69.9	47.4571	2.5	356.2	71	46.05	y
Q1/20	338.6	69.4	19.9418	2.5	336.4	68.3	19.6098	

Q1/21	340.5	61.4	23.3991	2.5	346	60.6	24.1935	
Q1/22	30.4	75.4	5.531	2.5	28.1	74.9	5.6523	
Q1/23	32.5	78.8	3.0227	2.5	45	74.7	3.0277	
Q1/26	16.3	58.8	14.4657	2.5	16.3	56.3	14.7689	
Q1/28	337.7	66	7.1102	2.5	343	64.7	7.1251	
Q1/30	110.1	85.5	10.3809	2.5	124	82.7	10.4302	

NRM DISTRIBUTION **PARTIAL DEMAG DISTRIBUTION**

Sample no.	NRM				Demag			
	D	I	D	I	D	I	D	I
	degs.	*degs.*	*degs*	*degs.*	*degs.*	*degs.*	*degs*	*degs.*
Q1/1	342.5	68.9	-17.5	68.9	351.7	69.6	-8.3	69.6
Q1/2	14.4	70.6	14.4	70.6	16.9	72.5	16.9	72.5
Q1/3	358.2	68.9	-1.8	68.9	1.1	66.9	1.1	66.9
Q1/4	19.4	71.3	19.4	71.3	16.6	72.7	16.6	72.7
Q1/5	356.8	63	-3.2	63	3.7	63.3	3.7	63.3
Q1/6	8.3	64.5	8.3	64.5	9.5	62.7	9.5	62.7
Q1/7	61.2	39.2	61.2	39.2	62.5	39.4	62.5	39.4
Q1/8	33.1	64.1	33.1	64.1	32.3	66.3	32.3	66.3
Q1/9	22.8	75.1	22.8	75.1	32.4	76.8	32.4	76.8
Q1/10	12.3	61	12.3	61	18.1	63.6	18.1	63.6
Q1/11	334.1	71	-25.9	71	348.8	72.6	-11.2	72.6
Q1/12	338.7	78.7	-21.3	78.7	349.2	75.8	-10.8	75.8
Q1/13	55.8	33.4	55.8	33.4	58.3	34.5	58.3	34.5
Q1/14	11.2	69.2	11.2	69.2	11.2	68.9	11.2	68.9
Q1/16	337.2	72.7	-22.8	72.7	353.9	72.9	-6.1	72.9
Q1/17	7.2	40.1	7.2	40.1	9.1	39.8	9.1	39.8
Q1/18	2	75	2	75	351	73.5	-9	73.5
Q1/19	358.1	69.9	-1.9	69.9	356.2	71	-3.8	71
Q1/20	338.6	69.4	-21.4	69.4	336.4	68.3	-23.6	68.3
Q1/21	340.5	61.4	-19.5	61.4	346	60.6	-14	60.6
Q1/22	30.4	75.4	30.4	75.4	28.1	74.9	28.1	74.9
Q1/23	32.5	78.8	32.5	78.8	45	74.7	45	74.7

Q1/26	16.3	58.8	16.3	58.8	16.3	56.3	16.3	56.3
Q1/28	337.7	66	-22.3	66	343	64.7	-17	64.7
Q1/30	110.1	85.5	110.1	85.5	124	82.7	124	82.7



STATISTICS FOR NRM DATA

Sample no.	Dec	Inc	x	y	z
Q1/1	342.5	68.9	0.3433351	-0.108253	0.932954
Q1/2	14.4	70.6	0.3217257	0.082605	0.943223
Q1/3	358.2	68.9	0.3598192	-0.011308	0.932954
Q1/4	19.4	71.3	0.3024094	0.106495	0.94721
Q1/5	356.8	63	0.4532826	-0.025342	0.891007
Q1/6	8.3	64.5	0.4260018	0.062147	0.902585
Q1/7	61.2	39.2	0.3733324	0.679089	0.632029

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	x	y	z
Q1/1	351.7	69.6	0.344921	-0.05032	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/7	62.5	39.4	0.356809	0.685423	0.634731

Q1/8	33.1	64.1	0.365917	0.238538	0.899558
Q1/9	22.8	75.1	0.2370412	0.099643	0.966376
Q1/10	12.3	61	0.4736811	0.103279	0.87462
Q1/11	334.1	71	0.2928674	-0.142209	0.945519
Q1/12	338.7	78.7	0.1825613	-0.071178	0.980615
Q1/13	55.8	33.4	0.4692541	0.690486	0.550481
Q1/14	11.2	69.2	0.348344	0.068974	0.934826
Q1/16	337.2	72.7	0.2741389	-0.115237	0.954761
Q1/17	7.2	40.1	0.7588898	0.09587	0.644124
Q1/18	2	75	0.2586614	0.009033	0.965926
Q1/19	358.1	69.9	0.3434708	-0.011394	0.939094
Q1/20	338.6	69.4	0.3275842	-0.128379	0.93606
Q1/21	340.5	61.4	0.4512348	-0.159791	0.877983
Q1/22	30.4	75.4	0.2174133	0.127556	0.967709
Q1/23	32.5	78.8	0.1638156	0.104362	0.980955
Q1/26	16.3	58.8	0.4972051	0.145393	0.855364
Q1/28	337.7	66	0.3763167	-0.154339	0.913545
Q1/30	110.1	85.5	-0.0269632	0.07368	0.996917

Number = 25
Sum x = 8.5913
Sum y = 1.7597
Sum z = 22.3664
R = 24.0242
x bar = 0.3576
y bar = 0.0732
z bar = 0.9310

Mean Dec = 11.5755
Mean Inc = 68.5902
Alpha95 = 5.9569

CORRECTIONS

Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.05808	0.95424
Q1/12	349.2	75.8	0.240962	-0.04597	0.969445
Q1/13	58.3	34.5	0.433055	0.701176	0.566406
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.03125	0.955793
Q1/17	9.1	39.8	0.758614	0.12151	0.64011
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.02158	0.945519
Q1/20	336.4	68.3	0.338822	-0.14803	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954
Q1/28	343	64.7	0.408684	-0.12495	0.904083
Q1/30	124	82.7	-0.07105	0.105341	0.991894

Number = 25
Sum x = 8.6012
Sum y = 2.2649
Sum z = 22.3488
R = 24.0537
x bar = 0.3576
y bar = 0.0942
z bar = 0.9291

Mean Dec = 14.7525
Mean Inc = 68.2984
Alpha95 = 5.8625

CORRECTIONS

Mean Dec =	11.58
Mean Inc =	68.59

Correction for magnetic variation

Mean Dec =	6.27
Mean Inc =	68.59020304

Correction to Meriden (CVP)

Uncorrected Dec =	6.273505791
Uncorrected Inc =	68.59020304
Latitude =	59.328079
Longitude =	-2.994636
Kai =	38.1030441
Latitude of pole=	81.77583811
Beta1 =	28.12472803
Longitude of pole =	148.880636
Geomag colat =	44.88332792
Corrected Inc=	63.52817263
Beta 2 =	29.49936403
Corrected Dec=	5.728680565

FINAL RESULT

Corrected Dec=	5.728680565
Corrected Inc =	63.52817263
Alpha95 =	5.96

Mean Dec =	14.75
Mean Inc =	68.30

Correction for magnetic variation

Mean Dec =	9.45
Mean Inc =	68.29843

Correction to Meriden (CVP)

Uncorrected Dec =	9.450503
Uncorrected Inc =	68.29843
Latitude =	59.32808
Longitude =	-2.99464
Kai =	38.51839
Latitude of pole=	80.51395
Beta1 =	38.34924
Longitude of pole =	138.6561
Geomag colat =	45.21229
Corrected Inc=	63.26473
Beta 2 =	39.72388
Corrected Dec=	8.534527

FINAL RESULT

Corrected Dec=	8.534527
Corrected Inc =	63.26473
Alpha95 =	5.86

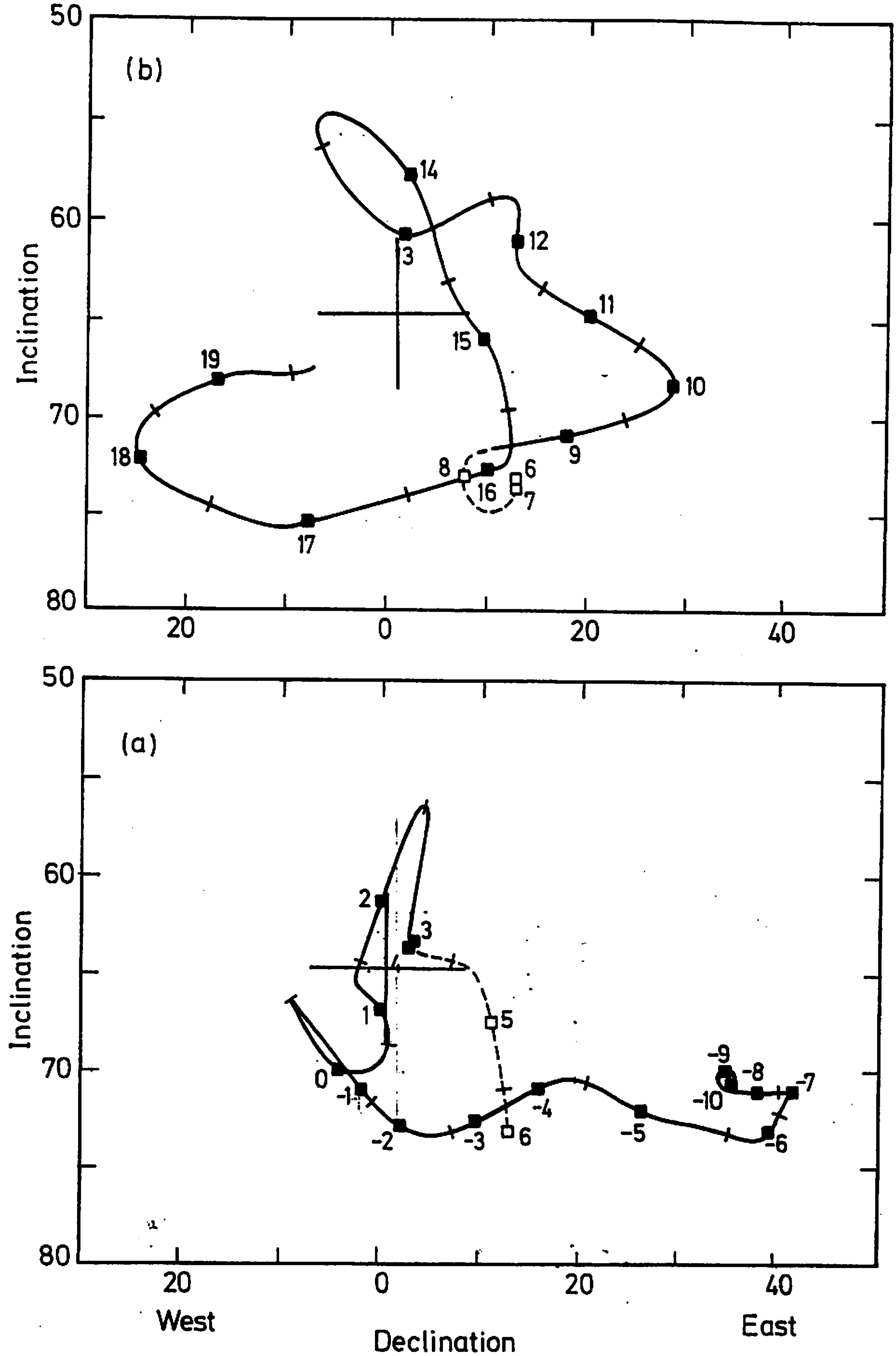
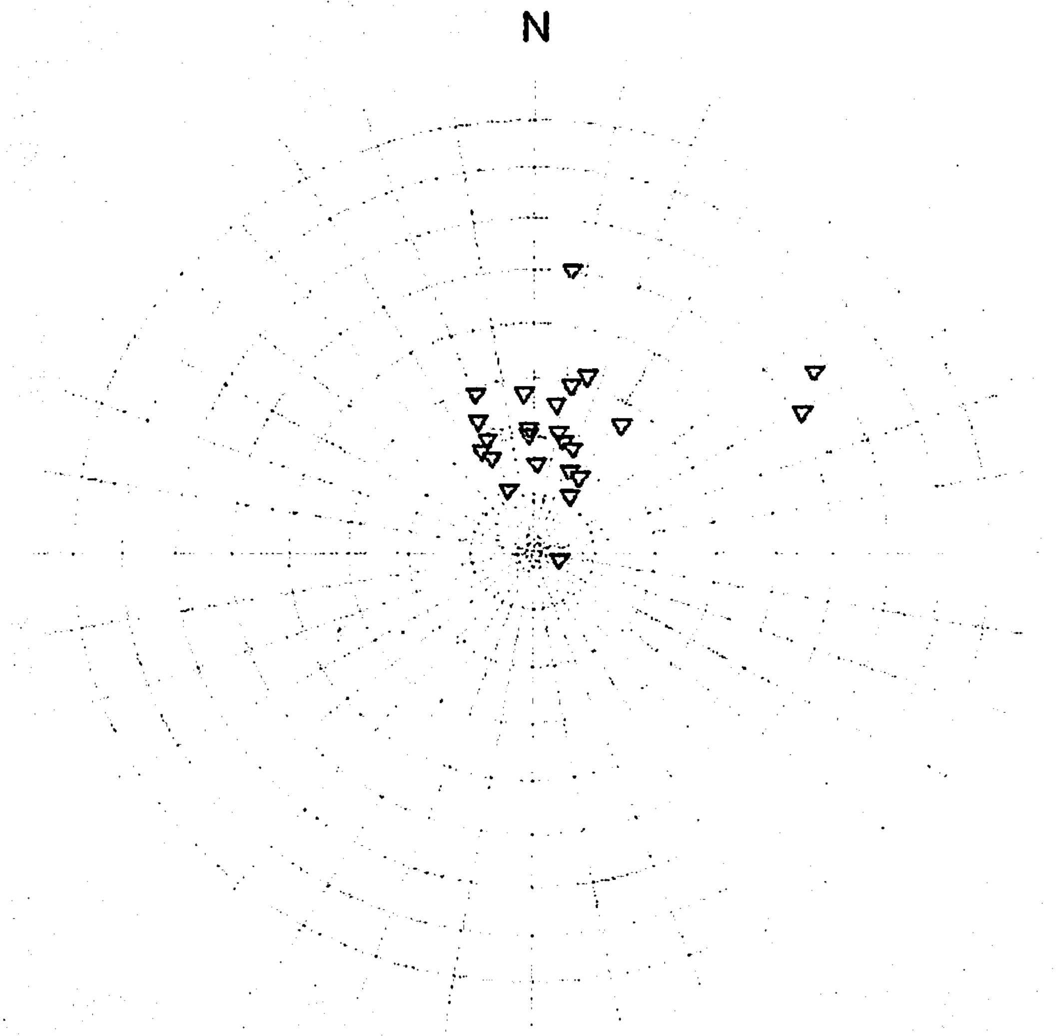


Fig. 9.10 Reference curves for Britain, normalized to 52.4 °N, 1.6 °W (redrawn from Clark *et al.* 1988): (a) 1000 BC–AD 600, (b) AD 600–1975. Figures on the curves indicate date in hundreds of years (negative for BC); transverse ticks are half-century points. Data used are from dated archaeological features, from lake sediments and from direct recording after 1576.

NRM distribution: F881



STATISTICS FOR NRM DATA

Sample no.	Dec	Inc	x	y	z
Q1/1	342.5	68.9	0.343335	-0.108253	0.932954
Q1/2	14.4	70.6	0.321726	0.082605	0.943223
Q1/3	358.2	68.9	0.359819	-0.011308	0.932954
Q1/4	19.4	71.3	0.302409	0.106495	0.94721
Q1/5	356.8	63	0.453283	-0.025342	0.891007
Q1/6	8.3	64.5	0.426002	0.062147	0.902585
Q1/7	61.2	39.2	0.373332	0.679089	0.632029
Q1/8	33.1	64.1	0.365917	0.238538	0.899558
Q1/9	22.8	75.1	0.237041	0.099643	0.966376
Q1/10	12.3	61	0.473681	0.103279	0.87462
Q1/11	334.1	71	0.292867	-0.142209	0.945519
Q1/12	338.7	78.7	0.182561	-0.071178	0.980615
Q1/13	55.8	33.4	0.469254	0.690486	0.550481
Q1/14	11.2	69.2	0.348344	0.068974	0.934826
Q1/16	337.2	72.7	0.274139	-0.115237	0.954761
Q1/17	7.2	40.1	0.75889	0.09587	0.644124
Q1/18	2	75	0.258661	0.009033	0.965926
Q1/19	358.1	69.9	0.343471	-0.011394	0.939094
Q1/20	338.6	69.4	0.327584	-0.128379	0.93606
Q1/21	340.5	61.4	0.451235	-0.159791	0.877983
Q1/22	30.4	75.4	0.217413	0.127556	0.967709
Q1/23	32.5	78.8	0.163816	0.104362	0.980955
Q1/26	16.3	58.8	0.497205	0.145393	0.855364
Q1/28	337.7	66	0.376317	-0.154339	0.913545
Q1/30	110.1	85.5	-0.026963	0.07368	0.996917

Number =	25
Sum x =	8.59134
Sum y =	1.759721
Sum z =	22.36639
R =	24.02422
x bar =	0.357612
y bar =	0.073248
z bar =	0.930993

Mean Dec =	11.57551
Mean Inc =	68.5902
Alpha95 =	5.95694

BECK 2-DELTA TEST

2-delta	32.66516

MCFADDEN 1982 DISCORDANCY TEST

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	(N-1) x	y	z
Q1/1	342.5	68.9	0.343335	-0.108253	0.932954
Q1/2	14.4	70.6	0.321726	0.082605	0.943223
Q1/3	358.2	68.9	0.359819	-0.011308	0.932954
Q1/4	19.4	71.3	0.302409	0.106495	0.94721
Q1/5	356.8	63	0.453283	-0.025342	0.891007
Q1/6	8.3	64.5	0.426002	0.062147	0.902585
Q1/7	61.2	39.2	0.373332	0.679089	0.632029
Q1/8	33.1	64.1	0.365917	0.238538	0.899558
Q1/9	22.8	75.1	0.237041	0.099643	0.966376
Q1/10	12.3	61	0.473681	0.103279	0.87462
Q1/11	334.1	71	0.292867	-0.142209	0.945519
Q1/12	338.7	78.7	0.182561	-0.071178	0.980615
Q1/13	55.8	33.4	0.469254	0.690486	0.550481
Q1/14	11.2	69.2	0.348344	0.068974	0.934826
Q1/16	337.2	72.7	0.274139	-0.115237	0.954761
Q1/17	7.2	40.1	0.75889	0.09587	0.644124
Q1/18	2	75	0.258661	0.009033	0.965926
Q1/19	358.1	69.9	0.343471	-0.011394	0.939094
Q1/20	338.6	69.4	0.327584	-0.128379	0.93606
Q1/21	340.5	61.4	0.451235	-0.159791	0.877983
Q1/22	30.4	75.4	0.217413	0.127556	0.967709
Q1/23	32.5	78.8	0.163816	0.104362	0.980955
Q1/26	16.3	58.8	0.497205	0.145393	0.855364
Q1/28	337.7	66	0.376317	-0.154339	0.913545

Number =	24
Sum x =	8.618303
Sum y =	1.686041
Sum z =	21.36948
R =	23.10351
x bar =	0.37303
y bar =	0.072978
z bar =	0.924945
Mean Dec =	11.06925
Mean Inc =	67.66003
Alpha95 =	5.955917
COS gamma(1-P)	26.64898

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	(N-2) x	y	z
Q1/1	342.5	68.9	0.343335	-0.108253	0.932954
Q1/2	14.4	70.6	0.321726	0.082605	0.943223
Q1/3	358.2	68.9	0.359819	-0.011308	0.932954
Q1/4	19.4	71.3	0.302409	0.106495	0.94721
Q1/5	356.8	63	0.453283	-0.025342	0.891007
Q1/6	8.3	64.5	0.426002	0.062147	0.902585
Q1/8	33.1	64.1	0.365917	0.238538	0.899558
Q1/9	22.8	75.1	0.237041	0.099643	0.966376
Q1/10	12.3	61	0.473681	0.103279	0.87462
Q1/11	334.1	71	0.292867	-0.142209	0.945519
Q1/12	338.7	78.7	0.182561	-0.071178	0.980615
Q1/13	55.8	33.4	0.469254	0.690486	0.550481
Q1/14	11.2	69.2	0.348344	0.068974	0.934826
Q1/16	337.2	72.7	0.274139	-0.115237	0.954761
Q1/17	7.2	40.1	0.75889	0.09587	0.644124
Q1/18	2	75	0.258661	0.009033	0.965926
Q1/19	358.1	69.9	0.343471	-0.011394	0.939094
Q1/20	338.6	69.4	0.327584	-0.128379	0.93606
Q1/21	340.5	61.4	0.451235	-0.159791	0.877983
Q1/22	30.4	75.4	0.217413	0.127556	0.967709
Q1/23	32.5	78.8	0.163816	0.104362	0.980955
Q1/26	16.3	58.8	0.497205	0.145393	0.855364
Q1/28	337.7	66	0.376317	-0.154339	0.913545

Number =	23
Sum x =	8.24497
Sum y =	1.006952
Sum z =	20.73745
R =	22.33909
x bar =	0.369083
y bar =	0.045076
z bar =	0.928303
Mean Dec =	6.963008
Mean Inc =	68.17179
Alpha95 =	5.325042
COS gamma(1-P)	23.20953

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	(N-3) x	y	z
Q1/1	342.5	68.9	0.343335	-0.108253	0.932954
Q1/2	14.4	70.6	0.321726	0.082605	0.943223
Q1/3	358.2	68.9	0.359819	-0.011308	0.932954
Q1/4	19.4	71.3	0.302409	0.106495	0.94721
Q1/5	356.8	63	0.453283	-0.025342	0.891007
Q1/6	8.3	64.5	0.426002	0.062147	0.902585
Q1/8	33.1	64.1	0.365917	0.238538	0.899558
Q1/9	22.8	75.1	0.237041	0.099643	0.966376
Q1/10	12.3	61	0.473681	0.103279	0.87462
Q1/11	334.1	71	0.292867	-0.142209	0.945519
Q1/12	338.7	78.7	0.182561	-0.071178	0.980615
Q1/14	11.2	69.2	0.348344	0.068974	0.934826
Q1/16	337.2	72.7	0.274139	-0.115237	0.954761
Q1/17	7.2	40.1	0.75889	0.09587	0.644124
Q1/18	2	75	0.258661	0.009033	0.965926
Q1/19	358.1	69.9	0.343471	-0.011394	0.939094
Q1/20	338.6	69.4	0.327584	-0.128379	0.93606
Q1/21	340.5	61.4	0.451235	-0.159791	0.877983
Q1/22	30.4	75.4	0.217413	0.127556	0.967709
Q1/23	32.5	78.8	0.163816	0.104362	0.980955
Q1/26	16.3	58.8	0.497205	0.145393	0.855364
Q1/28	337.7	66	0.376317	-0.154339	0.913545

Number =	22
Sum x =	7.775716
Sum y =	0.316466
Sum z =	20.18697
R =	21.63505
x bar =	0.359404
y bar =	0.014627
z bar =	0.933068
Mean Dec =	2.330607
Mean Inc =	68.91815
Alpha95 =	4.121754
COS gamma(1-P)	17.48789

STATISTICS FOR DEMAG DATA

			(N-4)		
Sample no.	**Dec**	**Inc**	**x**	**y**	**z**
Q1/1	342.5	68.9	0.343335	-0.108253	0.932954
Q1/2	14.4	70.6	0.321726	0.082605	0.943223
Q1/3	358.2	68.9	0.359819	-0.011308	0.932954
Q1/4	19.4	71.3	0.302409	0.106495	0.94721
Q1/5	356.8	63	0.453283	-0.025342	0.891007
Q1/6	8.3	64.5	0.426002	0.062147	0.902585
Q1/8	33.1	64.1	0.365917	0.238538	0.899558
Q1/9	22.8	75.1	0.237041	0.099643	0.966376
Q1/10	12.3	61	0.473681	0.103279	0.87462
Q1/11	334.1	71	0.292867	-0.142209	0.945519
Q1/12	338.7	78.7	0.182561	-0.071178	0.980615
Q1/14	11.2	69.2	0.348344	0.068974	0.934826
Q1/16	337.2	72.7	0.274139	-0.115237	0.954761
Q1/18	2	75	0.258661	0.009033	0.965926
Q1/19	358.1	69.9	0.343471	-0.011394	0.939094
Q1/20	338.6	69.4	0.327584	-0.128379	0.93606
Q1/21	340.5	61.4	0.451235	-0.159791	0.877983
Q1/22	30.4	75.4	0.217413	0.127556	0.967709
Q1/23	32.5	78.8	0.163816	0.104362	0.980955
Q1/26	16.3	58.8	0.497205	0.145393	0.855364
Q1/28	337.7	66	0.376317	-0.154339	0.913545

Number =	21
Sum x =	7.016827
Sum y =	0.220595
Sum z =	19.54284
R =	20.76553
x bar =	0.337907
y bar =	0.010623
z bar =	0.941119
Mean Dec =	1.800675
Mean Inc =	70.2404
Alpha95 =	3.46162
COS gamma(1-P)	14.53176

STATISTICS FOR DEMAG DATA

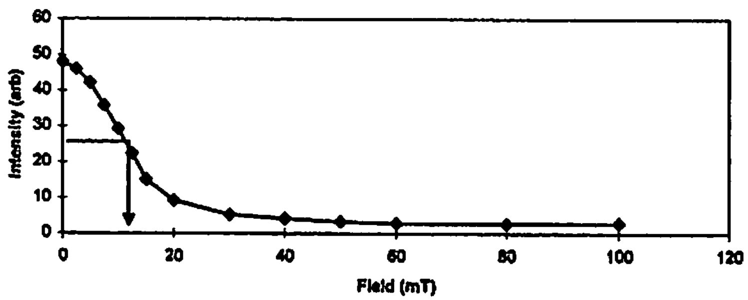
Sample no.	Dec	Inc	x (N-5)	y	z
Q1/1	342.5	68.9	0.343335	-0.108253	0.932954
Q1/2	14.4	70.6	0.321726	0.082605	0.943223
Q1/3	358.2	68.9	0.359819	-0.011308	0.932954
Q1/4	19.4	71.3	0.302409	0.106495	0.94721
Q1/5	356.8	63	0.453283	-0.025342	0.891007
Q1/6	8.3	64.5	0.426002	0.062147	0.902585
Q1/8	33.1	64.1	0.365917	0.238538	0.899558
Q1/9	22.8	75.1	0.237041	0.099643	0.966376
Q1/10	12.3	61	0.473681	0.103279	0.87462
Q1/11	334.1	71	0.292867	-0.142209	0.945519
Q1/12	338.7	78.7	0.182561	-0.071178	0.980615
Q1/14	11.2	69.2	0.348344	0.068974	0.934826
Q1/16	337.2	72.7	0.274139	-0.115237	0.954761
Q1/18	2	75	0.258661	0.009033	0.965926
Q1/19	358.1	69.9	0.343471	-0.011394	0.939094
Q1/20	338.6	69.4	0.327584	-0.128379	0.93606
Q1/21	340.5	61.4	0.451235	-0.159791	0.877983
Q1/22	30.4	75.4	0.217413	0.127556	0.967709
Q1/23	32.5	78.8	0.163816	0.104362	0.980955
Q1/26	16.3	58.8	0.497205	0.145393	0.855364

Number =	20
Sum x =	6.64051
Sum y =	0.374934
Sum z =	18.6293
R =	19.78099
x bar =	0.335702
y bar =	0.018954
z bar =	0.941778
Mean Dec =	3.231583
Mean Inc =	70.35227
Alpha95 =	3.523959
COS gamma(1-P)	14.77055

PILOT DEMAGNETISATION
Sample Number Q1/19

Demag Step	RM					
	D	I	Int	x	y	z
mT	*degs.*	*degs.*	*arb*			
0	357.1	69.8	48.1552	8.4112	2.4139	28.2577
2.5	356.2	71	46.0513	8.0984	3.0679	27.0829
5	357.4	70.9	42.1779	7.9016	2.2388	24.3858
7.5	2	71.4	35.8506	6.1916	1.2412	18.8527
10	355.8	70.5	29.3149	4.224	1.2328	13.4447
12.5	1.6	70.7	22.3754	3.3548	0.8858	9.2261
15	358.2	70.1	15.1149	2.8602	0.3837	7.5275
20	0.6	70.4	9.2582	0.9959	-0.0108	3.6601
30	349.5	66.4	5.3285	0.6147	-0.0701	1.8305
40	325.1	63.2	4.3493	0.5881	-0.3128	1.2833
50	1.7	67.4	3.4021	-0.0634	-0.729	1.0339
60	268.3	77.6	2.9466	0.3495	-0.7957	1.081
80	356.4	64.3	2.8087	0.0826	-0.1868	0.8108
100	300	59.1	2.958	0.2269	-0.1301	0.719

Normalised data (% Heamatite) = 6.142639

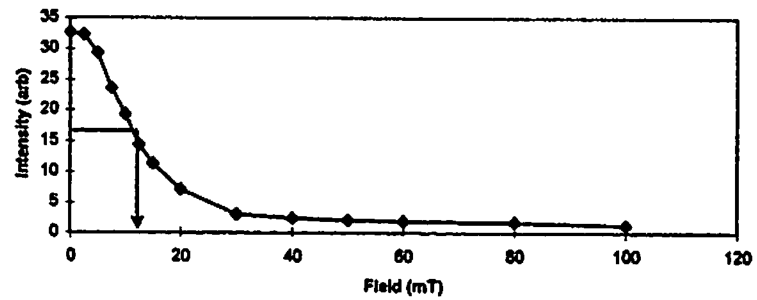


→ MDF value 12mT

PILOT DEMAGNETISATION
Sample Number Q1/18

Demag Step	RM					
	D	I	Int	x	y	z
mT	degs.	degs.	arb			
0	1.3	76.7	32.7203	8.5786	0.6993	27.2036
2.5	351.9	73.5	32.3777	9.1711	0.427	26.4077
5	352.1	74	29.4268	8.0903	0.6925	24.4124
7.5	355.4	73.8	23.5744	7.0178	1.3952	20.0744
10	348.6	75.5	19.3539	6.1984	1.0842	15.4065
12.5	353.7	73.6	14.4457	4.7108	0.311	11.4555
15	348.3	71.8	11.4152	4.051	-0.1109	8.5685
20	2.1	74.8	7.1106	2.4104	0.4614	5.1361
30	354.2	71.5	3.1512	1.7036	0.511	3.3051
40	0.3	72.6	2.4919	1.733	0.3244	2.726
50	346.6	70.6	2.2041	1.712	0.3824	2.4512
60	343.6	71.5	1.9881	1.8809	-0.0538	2.2566
80	11.6	58.1	1.7858	1.1321	0.8741	1.9003
100	32.2	75.3	1.3495	1.5717	0.6362	1.8562

Normalised data (% Heamatite) = 4.124351

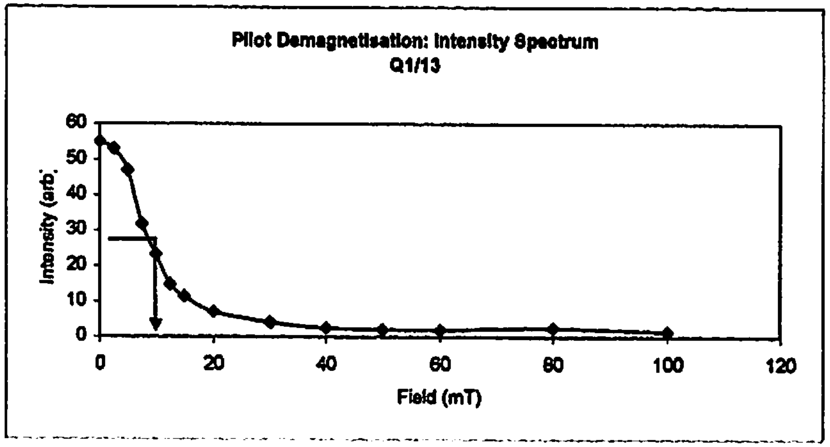


MDF value 12mT

PILOT DEMAGNETISATION
Sample Number Q1/13

Demag Step	RM					
	D	I	Int	x	y	z
mT	*degs.*	*degs.*	*arb*			
0	59.6	32.7	54.9769	15.7641	2.4532	33.514
2.5	58.3	34.5	53.0201	15.5644	2.2504	29.4032
5	58.9	30.5	47.0286	14.0386	2.1192	30.114
7.5	60.2	26.8	31.7521	12.0805	2.0075	24.297
10	59.3	28.4	23.3075	9.274	1.3344	18.5157
12.5	57.2	32.3	14.8491	8.0243	1.2765	15.0948
15	57.1	33.1	11.3773	7.055	1.0155	11.6859
20	61	38.2	7.0426	4.4574	0.6874	6.6139
30	52.8	34.6	4.0873	3.1909	0.6076	4.138
40	49.8	43.8	2.5854	2.5774	0.1393	3.3093
50	38.4	46.3	2.108	2.4373	0.4297	2.877
60	37.9	45.3	1.9992	1.4243	0.0579	2.7562
80	64.9	33.6	2.5449	1.4335	0.1074	2.4498
100	36.8	45.9	1.5629	1.055	0.1603	2.2774

Normalised data (% Heamatite) = 2.84283

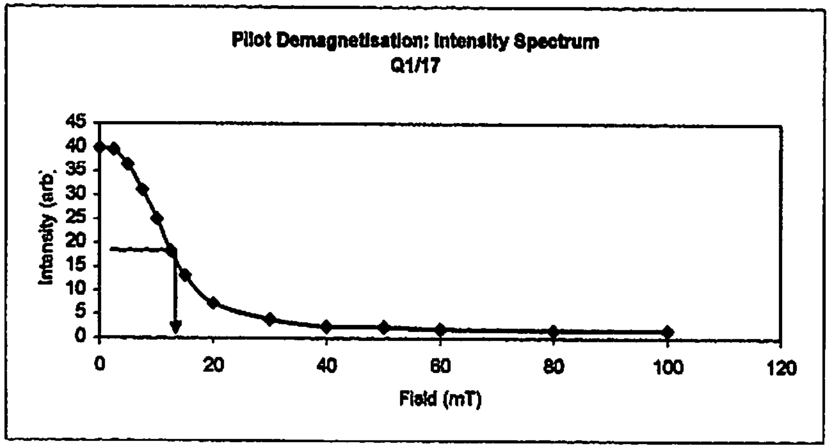


MDF value 8mT

PILOT DEMAGNETISATION
Sample Number Q1/17

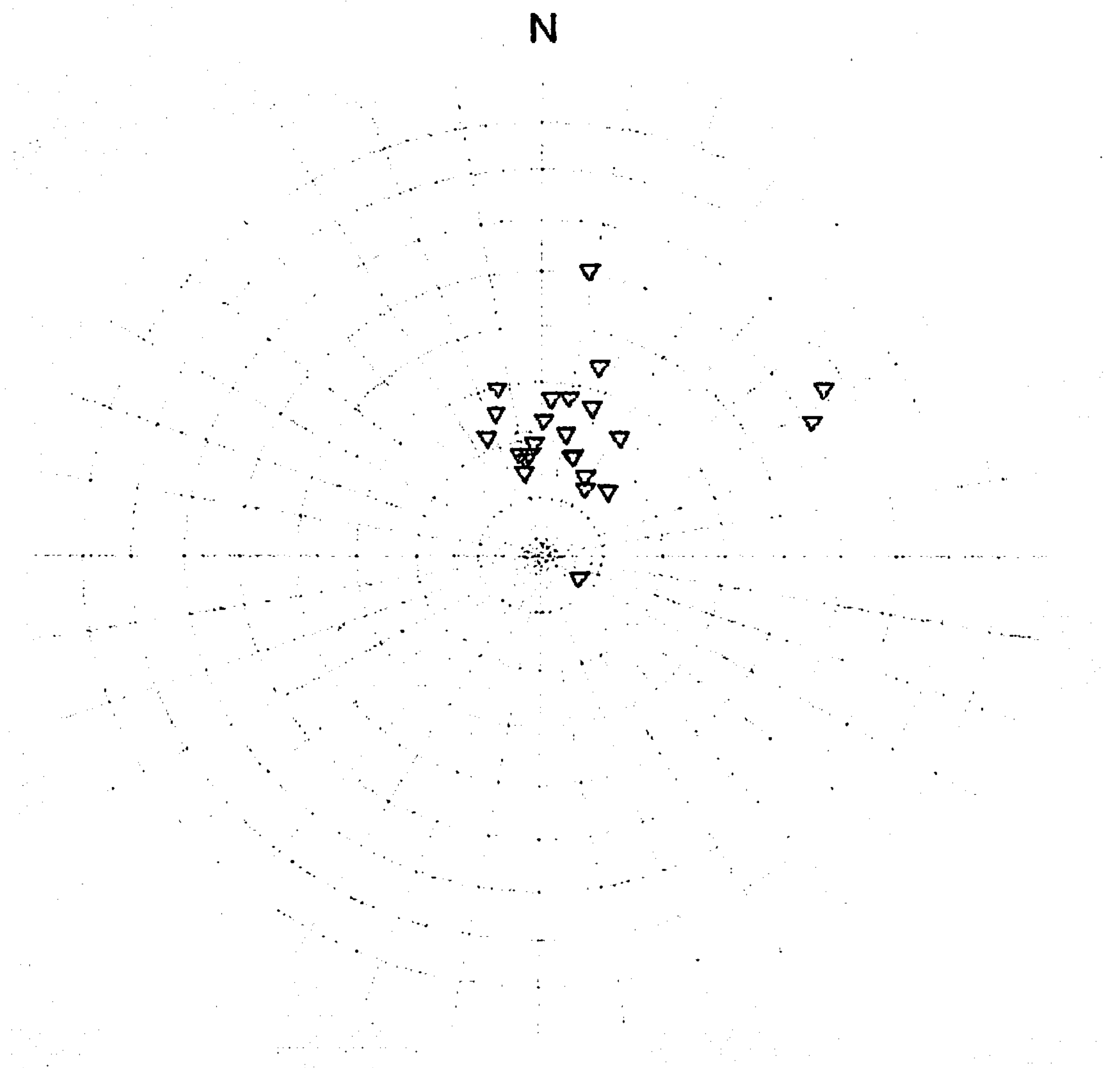
Demag Step	RM					
	D	I	Int	x	y	z
mT	*degs.*	*degs.*	*arb*			
0	7.7	40.1	39.9895	15.7641	2.4532	33.514
2.5	9.1	39.8	39.6099	15.5844	2.2504	29.4032
5	8.5	37	36.5072	14.0386	2.1192	30.114
7.5	9.1	33.1	31.1588	12.0805	2.0075	24.297
10	11.6	29.9	25.0299	9.274	1.3344	18.5157
12.5	9.3	33.9	18.404	8.0243	1.2765	15.0948
15	7.9	42.1	13.2222	7.055	1.0155	11.6659
20	3.6	53.9	7.3205	4.4574	0.6874	6.6139
30	352.2	65	3.9469	3.1909	0.6076	4.138
40	350.8	60.4	2.4965	2.5774	0.1393	3.3093
50	351.2	41.1	2.3389	2.4373	0.4297	2.877
60	293.1	52.5	1.9435	1.4243	0.0579	2.7562
80	339.7	57.2	1.7153	1.4335	0.1074	2.4498
100	346.3	52.7	1.6707	1.055	0.1603	2.2774

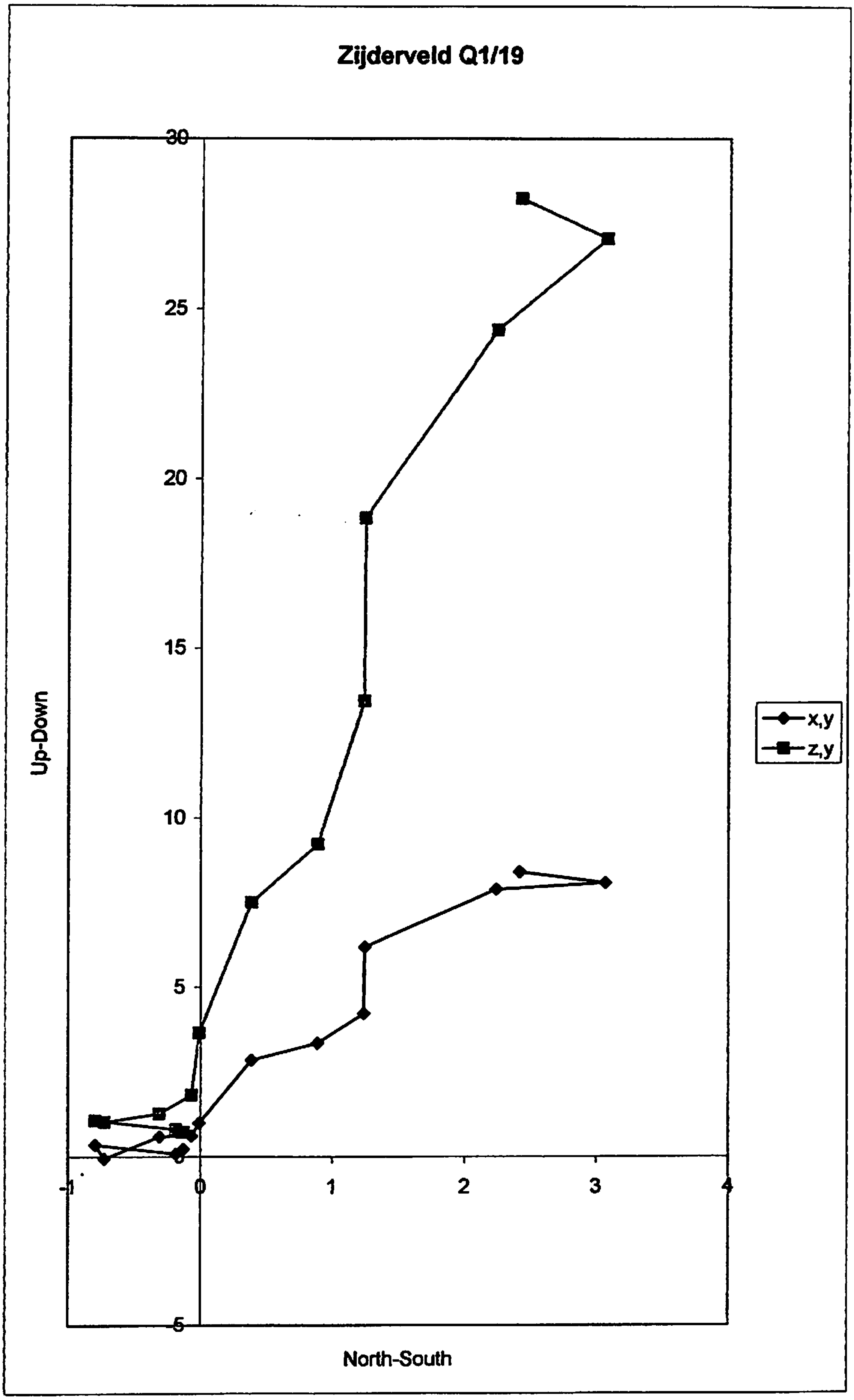
Normalised data (% Heamatite) = 4.179937



→ MDF value 12mT

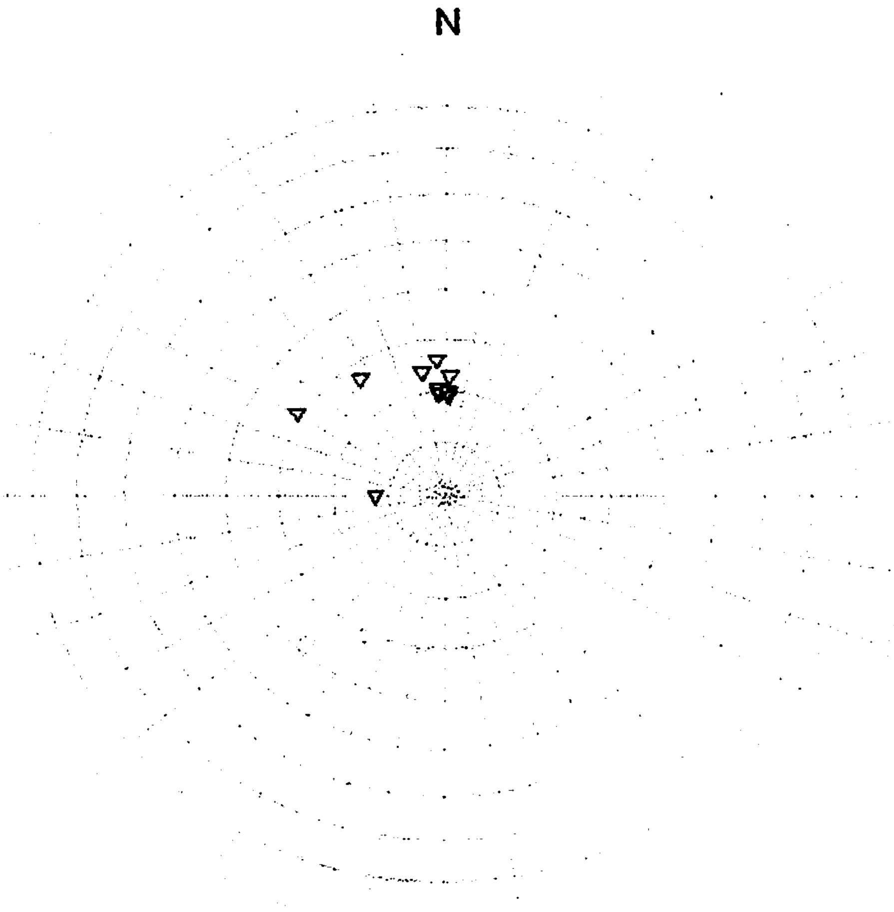
Distribution folowing partial demagnetisation at 2.5mT

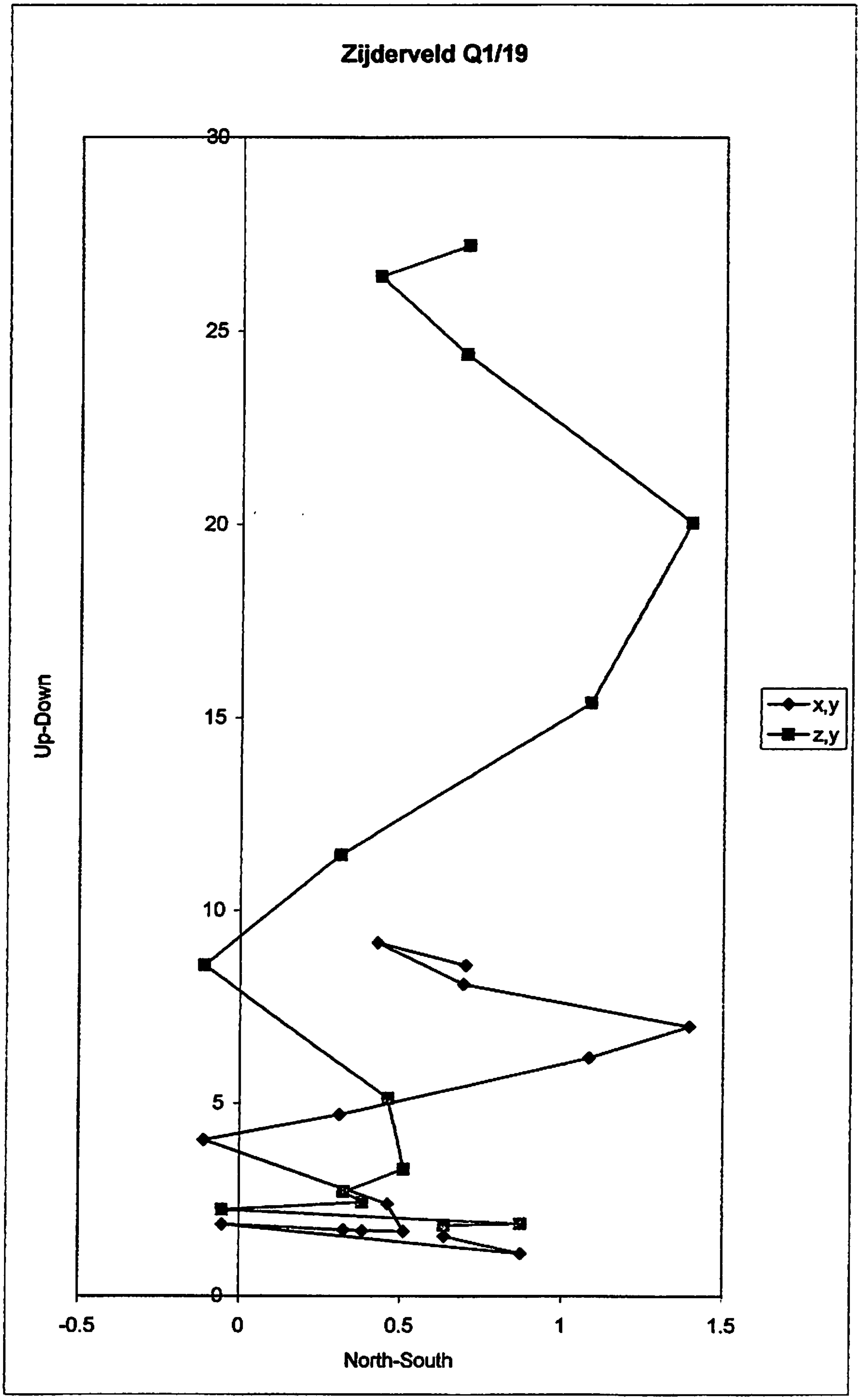




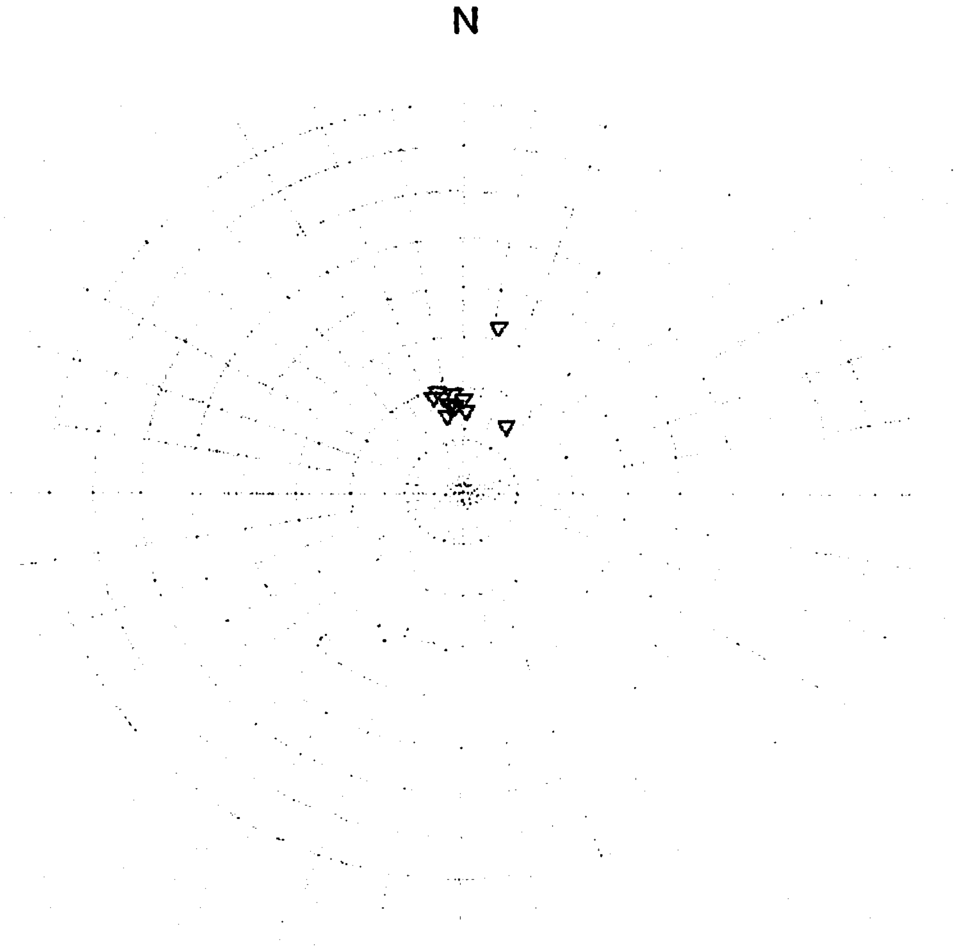
Zijderveld Q1/19
30
25
20
15
10
5
-5
-1
0
1
2
3
4
Up-Down
North-South
x,y
z,y

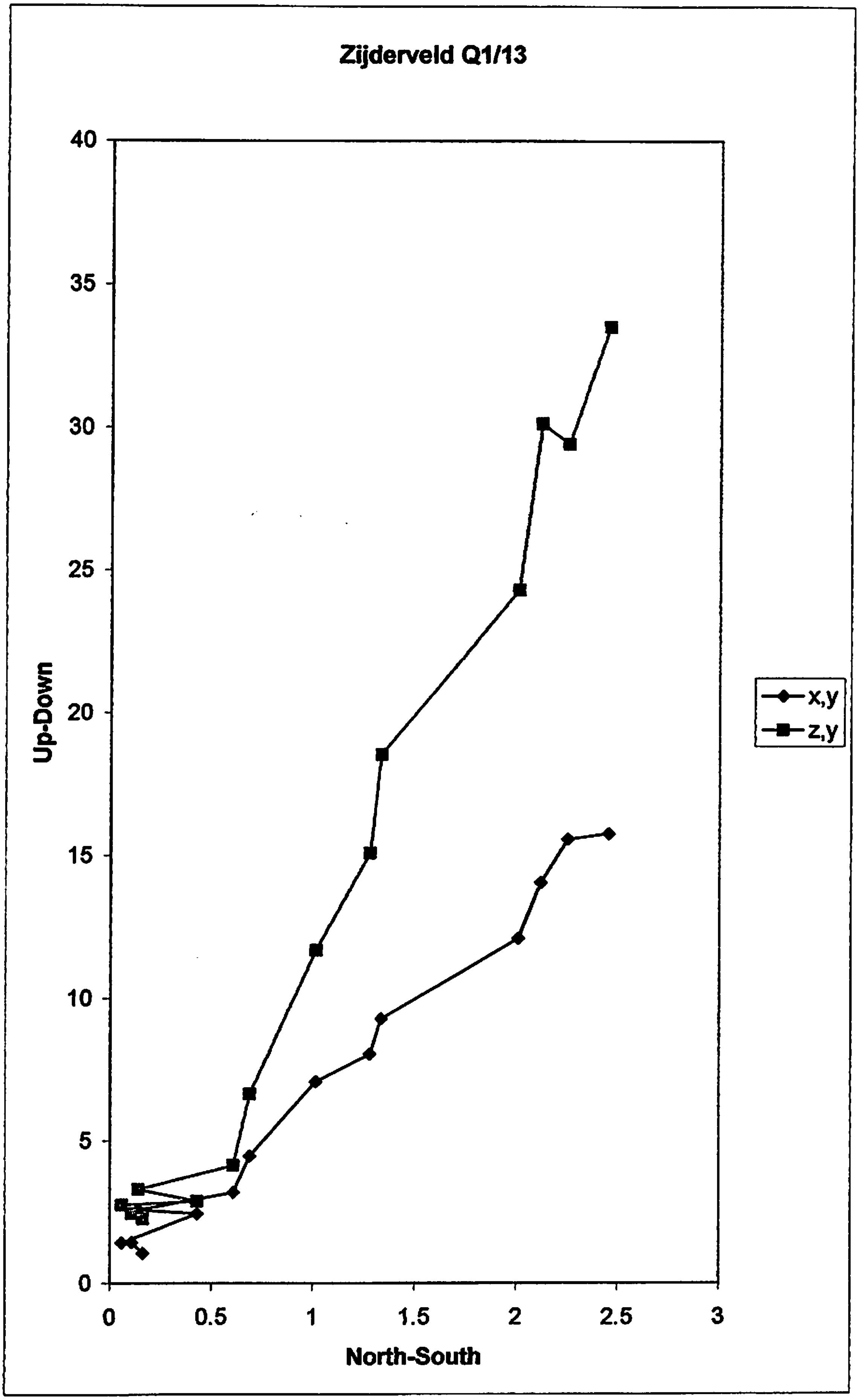
Pilot demagnetisation Q1/19: change in direction following the application of fields between 0-100mT




Zijderveld Q1/19
30
25
20
15
10
5
0
-0.5
0
0.5
1
1.5
North-South
Up-Down
x,y
z,y

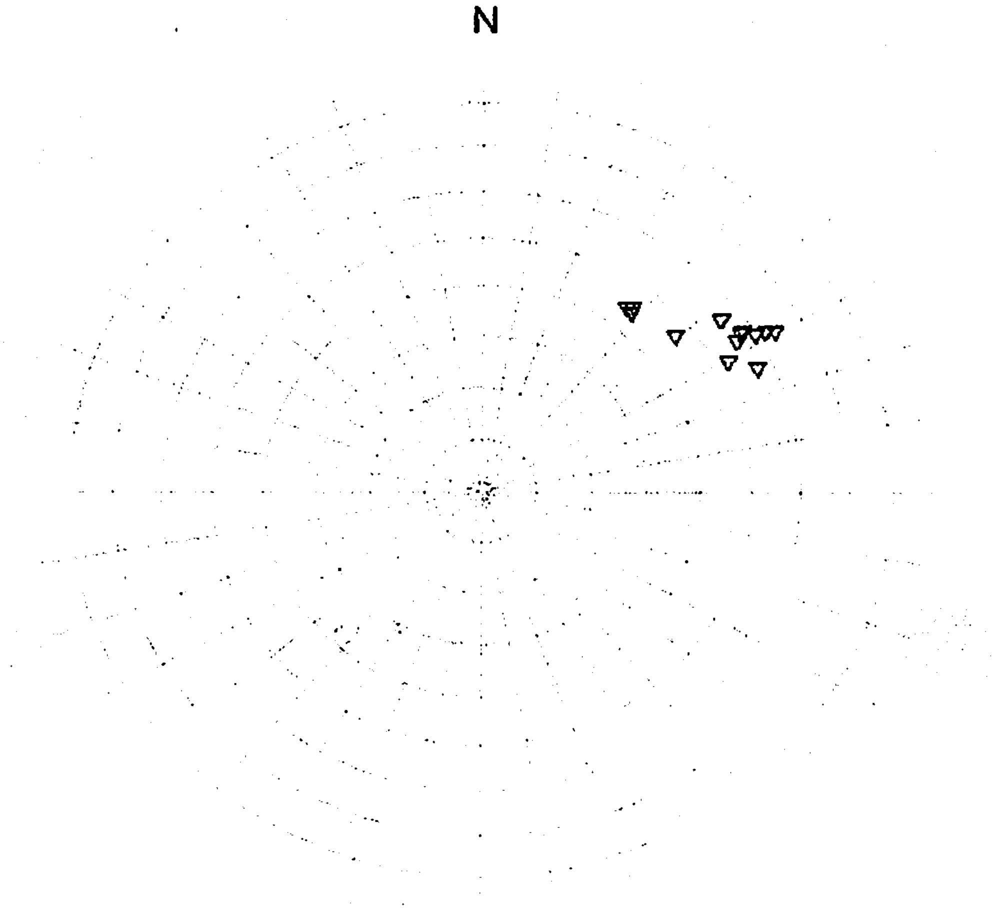
Pilot demagnetisation Q1/18: change in direction following the application of fields between 0-100mT





Zijderveld Q1/13
Up-Down
North-South
x,y
z,y
0
5
10
15
20
25
30
35
40
0
0.5
1
1.5
2
2.5
3

Pilot demagnetisation Q1/13: change in direction following the application of fields between 0-100mT



STATISTICS FOR DEMAGNETISATION DATA

Sample no.	Dec	Inc	x	y	z
Q1/1	351.7	69.6	0.344921	-0.050319	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/7	62.5	39.4	0.356809	0.685423	0.634731
Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.058084	0.95424
Q1/12	349.2	75.8	0.240962	-0.045966	0.969445
Q1/13	58.3	34.5	0.433055	0.701176	0.566406
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.031246	0.955793
Q1/17	9.1	39.8	0.758614	0.12151	0.64011
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.021577	0.945519
Q1/20	336.4	68.3	0.338822	-0.148028	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954
Q1/28	343	64.7	0.408684	-0.124947	0.904083
Q1/30	124	82.7	-0.071054	0.105341	0.991894

Number =	25
Sum x =	8.601189
Sum y =	2.264906
Sum z =	22.34885
R =	24.05372
x bar =	0.357583
y bar =	0.09416
z bar =	0.929122
Mean Dec =	14.7525
Mean Inc =	68.29843
Alpha95 =	5.862543

BECK 2-DELTA TEST

2-delta	32.16771

MCFADDEN 1982 DISCORDANCY TEST

STATISTICS FOR DEMAG DATA

			(N-1)		
Sample no.	Dec	Inc	x	y	z
Q1/1	351.7	69.6	0.344921	-0.050319	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/7	62.5	39.4	0.356809	0.685423	0.634731
Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.058084	0.95424
Q1/12	349.2	75.8	0.240962	-0.045966	0.969445
Q1/13	58.3	34.5	0.433055	0.701176	0.566406
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.031246	0.955793
Q1/17	9.1	39.8	0.758614	0.12151	0.64011
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.021577	0.945519
Q1/20	336.4	68.3	0.338822	-0.148028	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954
Q1/28	343	64.7	0.408684	-0.124947	0.904083

Number =	24
Sum x =	8.672243
Sum y =	2.159565
Sum z =	21.35695
R =	23.15148
x bar =	0.374587
y bar =	0.09328
z bar =	0.922488
Mean Dec =	13.9834
Mean Inc =	67.29251
Alpha95 =	5.788246
COS gamma(1-P)	25.75848

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	(N-2) x	y	z
Q1/1	351.7	69.6	0.344921	-0.050319	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.058084	0.95424
Q1/12	349.2	75.8	0.240962	-0.045966	0.969445
Q1/13	58.3	34.5	0.433055	0.701176	0.566406
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.031246	0.955793
Q1/17	9.1	39.8	0.758614	0.12151	0.64011
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.021577	0.945519
Q1/20	336.4	68.3	0.338822	-0.148028	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954
Q1/28	343	64.7	0.408684	-0.124947	0.904083

Number =	23
Sum x =	8.315434
Sum y =	1.474142
Sum z =	20.72222
R =	22.377
x bar =	0.371606
y bar =	0.065878
z bar =	0.92605
Mean Dec =	10.05282
Mean Inc =	67.82725
Alpha95 =	5.1656
COS gamma(1-P)	22.43359

STATISTICS FOR DEMAG DATA

Sample no.	Dec	Inc	x	y	z
			(N-3)		
Q1/1	351.7	69.6	0.344921	-0.050319	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.058084	0.95424
Q1/12	349.2	75.8	0.240962	-0.045966	0.969445
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.031246	0.955793
Q1/17	9.1	39.8	0.758614	0.12151	0.64011
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.021577	0.945519
Q1/20	336.4	68.3	0.338822	-0.148028	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954
Q1/28	343	64.7	0.408684	-0.124947	0.904083

Number =	22
Sum x =	7.882379
Sum y =	0.772966
Sum z =	20.15582
R =	21.65609
x bar =	0.36398
y bar =	0.035693
z bar =	0.930723
Mean Dec =	5.600661
Mean Inc =	68.54775
Alpha95 =	3.999184
COS gamma(1-P)	16.9398

STATISTICS FOR DEMAG DATA (N-4)

Sample no.	Dec	Inc	x	y	z
Q1/1	351.7	69.6	0.344921	-0.050319	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.058084	0.95424
Q1/12	349.2	75.8	0.240962	-0.045966	0.969445
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.031246	0.955793
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.021577	0.945519
Q1/20	336.4	68.3	0.338822	-0.148028	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954
Q1/28	343	64.7	0.408684	-0.124947	0.904083

Number =	21
Sum x =	7.123766
Sum y =	0.651456
Sum z =	19.51571
R =	20.78546
x bar =	0.342728
y bar =	0.031342
z bar =	0.938912
Mean Dec =	5.225064
Mean Inc =	69.86957
Alpha95 =	3.309614
COS gamma(1-P)	13.87369

STATISTICS FOR DEMAG DATA			(N-5)		
Sample no.	Dec	Inc	x	y	z
Q1/1	351.7	69.6	0.344921	-0.050319	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.058084	0.95424
Q1/12	349.2	75.8	0.240962	-0.045966	0.969445
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.031246	0.955793
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.021577	0.945519
Q1/20	336.4	68.3	0.338822	-0.148028	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954

Number =	20
Sum x =	6.715081
Sum y =	0.776403
Sum z =	18.61162
R =	19.8012
x bar =	0.339125
y bar =	0.03921
z bar =	0.939924
Mean Dec =	6.595298
Mean Inc =	70.03878
Alpha95 =	3.355647
COS gamma(1-P)	14.04503

FINAL STATS

Sample no.	Dec	Inc	x	y	z
Q1/1	351.7	69.6	0.344921	-0.05032	0.937282
Q1/2	16.9	72.5	0.287719	0.087416	0.953717
Q1/3	1.1	66.9	0.392265	0.007532	0.919821
Q1/4	16.6	72.7	0.284981	0.084957	0.954761
Q1/5	3.7	63.3	0.448382	0.028996	0.893371
Q1/6	9.5	62.7	0.452359	0.075699	0.888617
Q1/8	32.3	66.3	0.339751	0.214782	0.915663
Q1/9	32.4	76.8	0.192803	0.122357	0.973579
Q1/10	18.1	63.6	0.422633	0.138138	0.895712
Q1/11	348.8	72.6	0.293346	-0.05808	0.95424
Q1/12	349.2	75.8	0.240962	-0.04597	0.969445
Q1/14	11.2	68.9	0.353141	0.069924	0.932954
Q1/16	353.9	72.9	0.292375	-0.03125	0.955793
Q1/18	351	73.5	0.280519	-0.04443	0.95882
Q1/19	356.2	71	0.324852	-0.02158	0.945519
Q1/20	336.4	68.3	0.338822	-0.14803	0.929133
Q1/21	346	60.6	0.476322	-0.11876	0.871214
Q1/22	28.1	74.9	0.229798	0.122701	0.965473
Q1/23	45	74.7	0.186586	0.186586	0.964557
Q1/26	16.3	56.3	0.532543	0.155726	0.831954
Q1/28	343	64.7	0.408684	-0.12495	0.904083

Number = 21
Sum x = 7.123766
Sum y = 0.651456
Sum z = 19.51571
R = 20.78546
x bar = 0.342728
y bar = 0.031342
z bar = 0.938912

Mean Dec = 5.225064
Mean Inc = 69.86957
Alpha95 = 3.309614 Alpha 68 1.993339

CORRECTIONS

Mean Dec = 5.225064
Mean Inc = 69.86957

Correction for magnetic variation
Mean Dec = -0.07694
Mean Inc = 69.86957

Correction to Meriden (CVP)

Uncorrected Dec = -0.07694
Uncorrected Inc = 69.86957
Latitude = 59.32808
Longitude = -2.99464

Kai = 36.24518
Latitude of pole= 84.42659
Beta1 = -0.46837
Longitude of pole = 177.4737
Geomag colat = 43.14279
Corrected Inc= 64.89256
Beta 2 = 0.906267
Corrected Dec= 0.12871

FINAL RESULT
Corrected Dec= 0.12871
Corrected Inc = 64.89256
Alpha95 = 3.309614 Alpha 68 1.993339