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Ancient Monuments Laboratory
Report 50/2000

ARCHAEOMAGNETIC DATING REPORT:
BEERWAY FARM, SHAPWICK, SOMERSET.

P Linford and L Martin.

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Summary

Two burnt clay surfaces from an excavation at Beerway Farm, Shapwick, Somerset, were sampled for archaeomagnetic dating. There were few artefacts found during excavation to date the site and it was hoped that magnetic dating would provide a timescale for the central features. Unfortunately the technique was of little use in this instance; post-depositional disturbance or low intensity remanent magnetism in the samples recovered are the most likely causes for the poor results.

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BEERWAY FARM, SHAPWICK, SOMERSET.

Archaeomagnetic dating report.

Introduction

An archaeological excavation was carried out at Beerway Farm, Shapwick, Somerset, following an earlier geophysical survey by the Ancient Monuments Laboratory (see AML Report 2/99). During the excavation two burnt clay surfaces were revealed inside a building of possible Saxon origin. As few artefacts were found with which to date the site it was hoped archaeomagnetic dating would provide a chronological framework for the surrounding features. The sampling (carried out on 13th of July 1999), subsequent measurement and evaluation of the samples was performed by the authors, both of the Ancient Monuments Laboratory.

Method

Samples were collected using the disc method (see appendix, section 1a) and orientated to true north using a gyro-theodolite. Twenty-six samples were recovered from the two features, varying from pink to orange-red to grey in colour:

SW1 01-03, 14-15; SW2 01-05: Orange
SW1 04-06: Pinkish
SW1 07-10: Red
SW1 11-13; SW2 08-11: Orange-red
SW2 06-07: Greyish

All the laboratory measurements were made using the equipment described in section 2 of the appendix.

Results

Measurements of the directions of Natural Remanent Magnetisation (NRM) of the samples are tabulated in Table 1 and 3; the corrections discussed in sections 3b and 3c of the appendix have been applied. A graphical representation of the distribution of these directions is depicted in Figures 1 and 2.

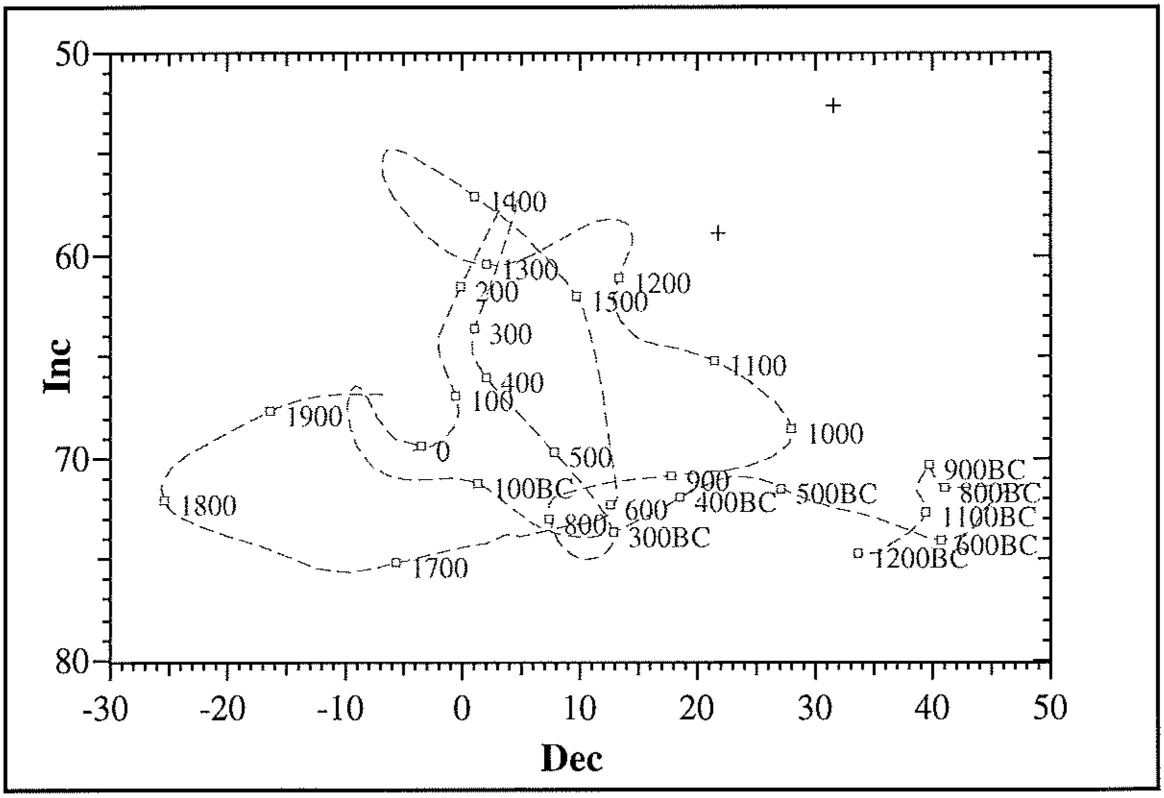

Figure 1; Distribution of remanent directions of samples from SW1 superimposed on the calibration curve.

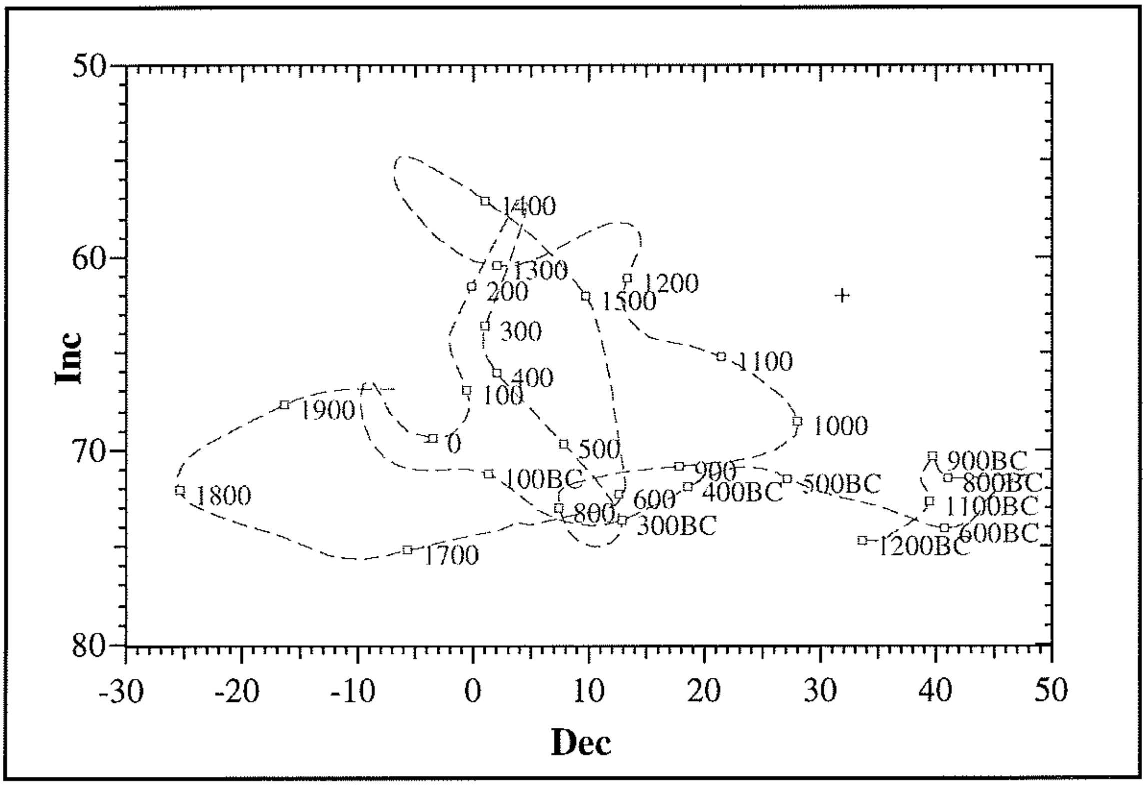

Figure 2; Distribution of remanent directions of samples from SW2 superimposed on the calibration curve.

It is clear from Tables 1 and 2 that the NRM directions of magnetisation in the samples are too widely scattered to be able to calculate reliable mean thermoremanent directions. Hence two pilot samples were partially demagnetised to a maximum field of 96mT to investigate the stability of the remanent magnetisation of the features. The results are listed in Tables 2 and 4 and depicted graphically in Figures 3 and 4. Of the following graphs, the one on the left shows the proportional decrease in intensity of magnetisation whilst the variation in the direction of remanence is plotted on a Bauer graph on the right.

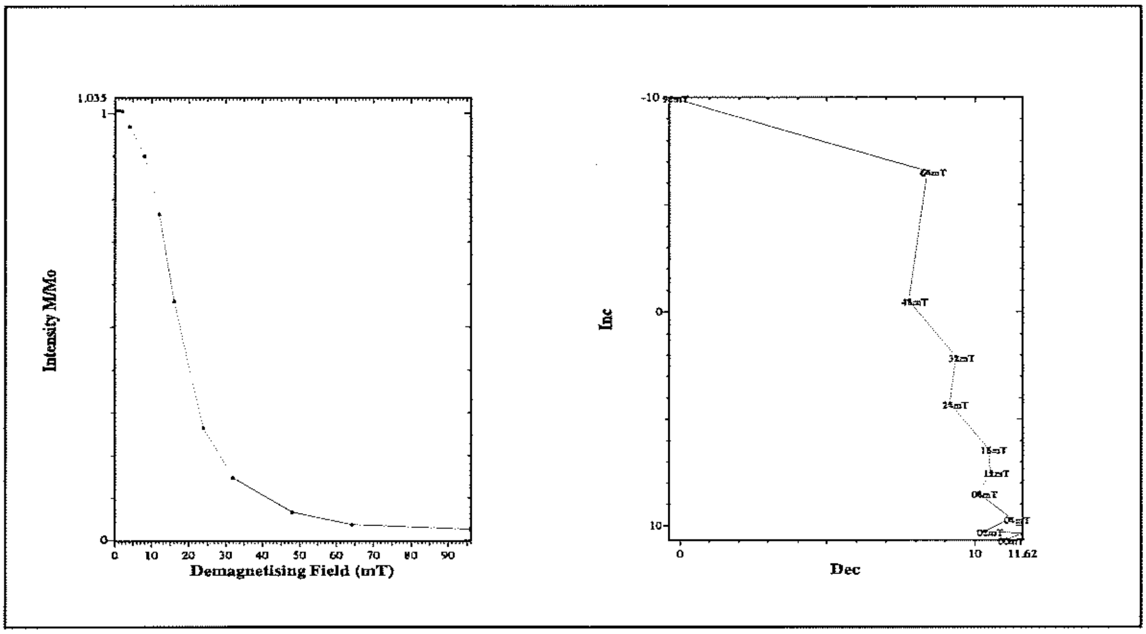

Figure 3; Variation of isothermal remanent magnetisation with increasing AF demagnetisation for sample SW1-05.

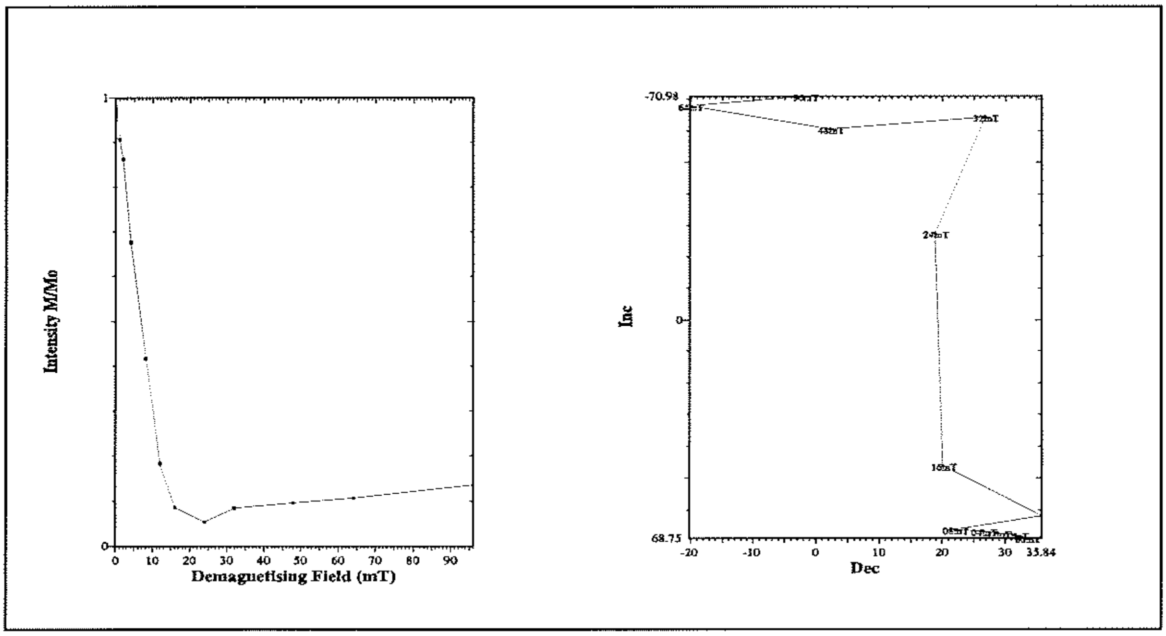

Figure 4; Variation of isothermal remanent magnetisation with increasing AF demagnetisation for sample SW2-02.

The demagnetisation results for sample SW1-05 suggests that magnetisation was indeed stable and there is nothing to indicate that low-coercivity magnetic domains within the material have been affected by viscous remanent magnetisations acquired since it was last fired. This sample had a high magnetisation and it is thus likely that its anomalous direction (and that of the other strongly magnetised samples) is due to it having moved since it was last fired.

By contrast sample SW2-02 is weakly magnetised and an analysis of the variation of intensity of magnetisation as a function of coercivity suggests that the magnetisation is unstable. The fact that the intensity of remanent magnetisation rises with increasing partial demagnetisation above 30mT may suggest that the last burning event experienced by the sample was not hot enough to completely realign domains that had been aligned by some previous event. It was concluded that partial demagnetisation of the weakly magnetised samples was unlikely to improve their NRM scatter.

Conclusion

Unfortunately the scatter of NRM directions exhibited by the samples was so wide that it was not possible to produce a reliable mean thermoremanent direction from which a date could be derived. Analysis suggests two reasons for this:

i) Some of the material appears well fired but not in the same position as when it was last fired – perhaps due to a collapse from a superstructure.

ii) Other material appears not to be well fired, perhaps because the floor of the feature was formed of natural clayey soil which quickly became insulated by a layer of ash during firing, preventing it from experiencing very high temperatures.

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Sample Number	NRM Measurements		
	Dec°	Inc°	M (Am^2x10^{-5})
SW1-01	60.02	-77.37	4.65
SW1-02	-74.78	-41.94	163.23
SW1-03	-57.74	-79.90	6.55
SW1-04	78.93	-57.25	7.16
SW1-05	10.52	11.04	518.71
SW1-06	-4.74	-2.62	3.96
SW1-07	33.99	36.04	5.45
SW1-08	21.80	58.85	45.57
SW1-09	34.81	41.34	8.51
SW1-10	15.19	47.73	8.91
SW1-11	-7.61	-61.94	5.49
SW1-12	3.239	38.51	8.44
SW1-13	-21.14	46.64	9.44
SW1-14	31.53	52.60	33.16
SW1-15	50.74	30.00	14.40

Table 1; Thermoremanent magnetisations of samples from SW1, Beerway Farm (Dec=Declination, Inc=Inclination, M=Total intensity of remanent magnetisation).

Sample Number	NRM Measurements		
	Dec°	Inc°	M (Am^2x10^{-5})
SW2-01	40.99	-18.02	11.13
SW2-02	31.84	61.96	33.82
SW2-03	6.98	24.12	42.93
SW2-04	42.44	13.02	22.62
SW2-05	58.46	40.14	34.76
SW2-06	72.41	-33.70	21.03
SW2-07	-5.22	14.82	10.09
SW2-08	71.30	74.21	49.67
SW2-09	19.62	-0.40	6.18
SW2-10	-81.40	73.27	72.58
SW2-11	-28.40	31.25	16.71

Table 2; Thermoremanent magnetisations of samples from SW2, Beerway Farm (Dec=Declination, Inc=Inclination, M=Total intensity of remanent magnetisation).

Partial Demagnetisation (mT)	Declination	Inclination	Remaining Fraction of Initial Magnetisation (M/M_0)
0	11.02	10.65	1.000
1	11.62	10.37	1.005
2	10.32	10.25	1.004
4	11.22	9.67	0.967
8	10.13	8.46	0.899
12	10.53	7.48	0.763
16	10.45	6.38	0.560
24	9.15	4.27	0.262
32	9.36	2.08	0.145
48	7.77	-0.56	0.064
64	8.40	-6.58	0.035
96	-0.36	-10.02	0.025

Table 3; Variation of magnetisation vector for sample SW1-05 with increasing partial demagnetisation.

Partial Demagnetisation (mT)	Declination	Inclination	Remaining Fraction of Initial Magnetisation (M/M_0)
0	33.51	68.75	1.000
1	31.54	67.68	0.906
2	28.76	67.10	0.862
4	26.50	66.51	0.676
8	21.97	66.02	0.416
12	35.84	61.66	0.183
16	20.08	45.93	0.086
24	18.79	-27.39	0.053
32	26.71	-64.36	0.084
48	2.01	-60.49	0.096
64	-20.24	-67.84	0.106
96	-1.89	-70.98	0.136

Table 4; Variation of magnetisation vector for sample SW2-02 with increasing partial demagnetisation.

Appendix: Standard procedures for Sampling and Measurement

1) Sampling

One of three techniques is employed depending on the consistency of the material (Clark, Tarling and Noel 1988):

a) Consolidated materials: Rock and fired clay samples are collected by the disc method. Several small levelled plastic discs are glued to the feature, marked with an orientation line related to True North, then removed with a small piece of the material attached.

b) Unconsolidated materials: sediments are collected by the tube method. Small pillars of the material are carved out from a prepared platform, then encapsulated in levelled plastic tubes using plaster of Paris. The orientation line is then marked on top of the plaster.

c) Plastic materials: Waterlogged clays and muds are sampled in similar manner to method 1b) above; however, the levelled plastic tubes are pressed directly into the material to be sampled.

2) Physical Analysis

a) Magnetic remanences are measured using a slow speed spinner fluxgate magnetometer (Molyneux et al. 1972; see also Tarling 1983, p84; Thompson and Oldfield 1986, p52).

b) Partial demagnetisation is achieved using the alternating magnetic field method (As 1967; Creer 1959; see also Tarling 1983, p91; Thompson and Oldfield 1986, p59), to remove viscous magnetic components if necessary. Demagnetising fields are measured in milli-Tesla (mT), figures quoted being for the peak value of the field.

3) Remanent Field Direction

a) The remanent field direction of a sample is expressed as two angles, declination (Dec) and inclination (Inc), both quoted in degrees. Declination represents the bearing of the field relative to true north, angles to the east being positive; inclination represents the angle of dip of this field.

b) Aitken and Hawley (1971) have shown that the angle of inclination in measured samples is likely to be distorted owing to magnetic refraction. The phenomenon is not well understood but is known to depend on the position the samples occupied within the structure. The corrections recommended by Aitken and Hawley are routinely applied to measured inclinations, in keeping with the practise of Clark, Tarling and Noel (1988).

c) Remanent field directions are adjusted to the values they would have had if the feature had been located at Meriden, a standard reference point. The adjustment is done using the method suggested by Noel (Tarling 1983, p116), and allows the remanent directions to be compared with standardised calibration data.

d) Individual remanent field directions are combined to produce the mean remanent field direction using the statistical method developed by R. A. Fisher (1953). The quantity "alpha-95" is quoted with mean field directions and is a measure of the precision of the determination (see Aitken 1990, p247). It is analogous to the standard error statistic for scalar quantities; hence the smaller its value, the better the precision of the date.

4) Calibration

a) Material less than 3000 years old is dated using the archaeomagnetic calibration curve compiled by Clark, Tarling and Noel (1988).

b) Older material is dated using the lake sediment data compiled be Turner and Thompson (1982).

c) Dates are normally given at the 68% confidence level. However, the quality of the measurement and the estimated reliability of the calibration curve for the period are not taken into account, so this figure is only approximate. Owing to crossovers and contiguities in the curve, alternative dates are sometimes given. It may be possible to select the correct alternative using independent dating evidence.

d) As the thermoremanent effect is rest at each heating, all dates for fired material refer to the final heating.

e) Dates are prefixed by "cal", for consistency with the new convention for calibrated radiocarbon dates (Mook 1986)

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