Section 31Archaeomagnetic dating

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Cross-references to Digital Supplement in red
Cross-references to Printed Synthesis in brown

Method statement

This report was completed in October 1989. The author died in 1997.

All samples were obtained by the disc method and oriented by gyro theodolite, except in the case of SS23, for which a magnetic compass was used. In this method, a number of small levelled plastic discs are glued to the feature, marked with an orientation line related to true north, and then removed with a small piece of the material attached. Measurements were made in a Molspin spinner magnetometer. Stability of magnetisation was tested by stepwise partial demagnetisation in an alternating magnetic field (AF), and any viscous magnetic components removed at a field level identified by this process. Alternatively, these components were removed by prolonged storage in zero field.

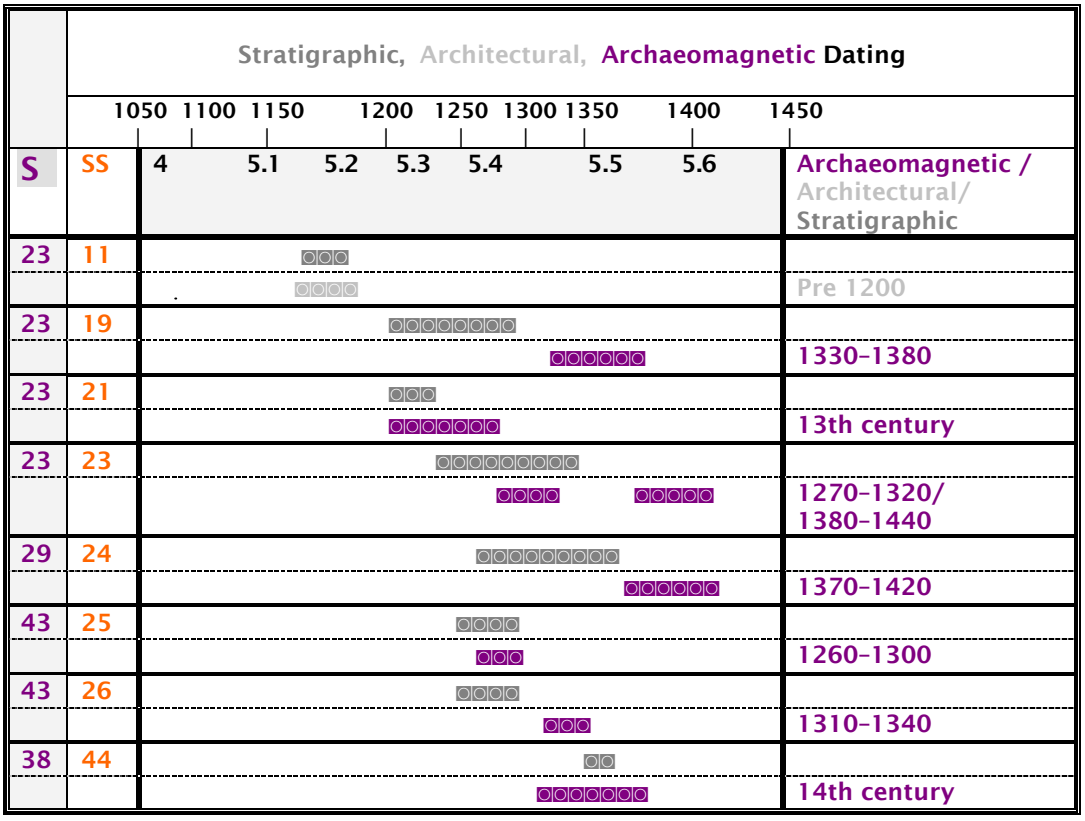
Dec refers to the declination, or bearing relative to true north, of the mean remanent magnetic field of the samples. Inc is the angle of inclination or dip of this field. Alpha-95 is a measure of the precision of the determination: the smaller its value the better.

Dates are given here at approximately the 68% confidence level, making allowance for the quality of the measurement and the estimated reliability of the calibration curve, as at present known, for the period in question. Due to the crossover in the curve (see below), alternative date spans requiring resolution on archaeological grounds may be given.

All archaeomagnetic dating evidence has been incorporated into the relevant sections, along with the artefactual and stratigraphic evidence. The archaeological phasing date ranges have been incorporated into the archaeomagnetic descriptions. These are presented in structure order, then sub-structure within them [31.01, 31.02, 31.03].

S	SS	Type	Archaeomagnetic date	Stratigraphic date
23	19	malting kiln	1330–1380	Phase 5.3–5.4
23	21	rake-out pit	Probably C13th	Phase 5.3
23	23	pair of ovens	1270–1320 or 1380–1440	Phase 5.3 or Phase 5.4–5.5
29	24	hearth	1370–1420 tentative	Phase 5.4–5.5
38	44	kiln	Probably C14th	Phase 5.5–[6.2]
41	30	hearth		Phase 5.4–5.6
41	40	oven		Phase 5.5–5.6
43	22	oven		Phase? 5.3–5.5
43	25	hearth	1260–1300	Phase 5.4
43	26	hearth	1310–1340	Phase 5.4
55	n/a	footing	*in situ*	Phase 5.4–5.6

31.01 Table showing subsidiary structures ordered by Structure with function, archaeomagnetic date, and stratigraphic date (Baker)



31.03 Correlation of archaeomagnetic, stratigraphic, and architectural dates for subsidiary structures (Baker)

Sub-structures 16, 21, 22, 23, 24, 25, 26, 30, 40, 44

A number of sub-structures were sampled for archaeomagnetic dating to produce independent dating evidence. The method measures the direction of the thermoremanent field induced by the Earth's field in clay and other iron-bearing materials in the course of firing. Unfortunately, the technique was not available in the first years of excavation, and some important features, particularly from T13 in the northern court, were not sampled. Most apparently-undisturbed hearths and ovens excavated from 1982 onward were submitted for sampling.

Of the ten hearths and ovens sampled, four produced dates with spans of 50 years (ie approximately plus or minus 25 years) at the 68% confidence level, although one (SS23) was affected by the notorious crossover in the calibration curve at AD1280/1420, giving an alternative 60 year span requiring resolution on archaeological grounds. Two other features could only be dated approximately within a century, and one set of measurements was made to ascertain whether components of the structure were *in situ*. Three sets of measurements were too scattered to give meaningful results. This success rate is fairly typical of archaeomagnetic measurements, the failures reflecting magnetic distortions and physical movements that can take place with time, often leaving a feature deceptively undisturbed in appearance. However, the successful results are generally more precise than can be achieved with standard radiocarbon dates, as well as being unaffected by residuality problems. Archaeomagnetism is reset each time a feature is fired, and thus represents the date when it was last heated.

Structure 23, Sub-structure 19

Type malting kiln
Location Area 10 Context T23/136
[4.26=21.05, 4.27, 10.08, 10.10, 29.01, 29.02, 29.03, 29.05, 30.01, 30.02]
Measurement ref AJC-28
Dec 5.2^{0}W; Inc = 49.5^0; alpha-95 = 3.6^0
Date 1330–1380 at the 68% confidence level
Stratigraphic phasing phase 5.3 early to mid-13th century, to phase 5.4 mid- to late 13th to mid-14th centuries

Structure 23, Sub-structure 21

Type Rake-out pit, reuse SS11
Location Area 10 Context T23/124
[4.26=21.05, 29.01, 29.02, 29.03, 29.05, 30.01]
Measurement ref AJC-27
Dec 12.9^0; Inc = 50.5^0; alpha-95 = 7.1^0
Date probably 13th century
Stratigraphic phasing phase 5.3 early to mid-13th century

Structure 23, Sub-structure 23

Type Pair of clunch ovens
Location Area 10 T23/89
[4.64=21.07, 29.01, 29.02, 29.03, 29.05, 30.01, 30.03, 30.04]
Measurement ref AJC-29
Dec = 2.7^0; Inc = 46.4^0; alpha-95 = 4.4^0
Date 1270–1320 or 1380–1440 at the 68% confidence level
Stratigraphic phasing phase 5.3/4 mid- to late 13th century, to ?early phase 5.5, mid-14th century

One of three experimental tests made on various burnt materials at an early stage. Tests 1 and 2 were not successful. This experiment, based on ten samples from a clunch hearth floor, produced results that were rather scattered, but possibly of some value. The result given is based on all samples magnetically cleaned to 12.5 microtesla, but a 'tighter' result based on the original (NRM) values of six selected samples, indicated a similar date span.
This result was difficult to interpret because of a crossover in the calibration, exacerbated by much scatter in inclination due to magnetic refraction caused by the exceptionally high intensity of magnetism of the carstone. Thus it is necessary to give two alternative date spans.

Structure 29, Sub-structure 24

Type pitched clay tile hearth
Location Area 11 Context T3/1077
[4.37=21.17, 29.01, 29.02, 29.03, 29.05, 29.13, 30.05, 30.07]
Date 1370–1420; tentative dating
Stratigraphic phasing phase 5.4 mid- to late 13th to mid-14th centuries, to phase 5.5 late 14th century

This pitched tile hearth had been subjected to prolonged reheating, including a reversal of the tiles to utilise the unburnt tile edges.

Structure 38, Sub-structure 44

Type kiln
Location Area 6 Context T30/266
[22.18, 29.01, 29.02, 29.03, 29.05, 30.08, 30.09]
Measurement ref AJC-32
Dec 3.0^{0}W; Inc = 56.5^0; alpha-95 = 6.6^0
Date probably 14th century
Stratigraphic phasing phase 5.5 mid- to late14th centuries, to phase 6.2 late 16th century onwards

The material had been subject to varying degrees of thermoremanent magnetisation, presumably due to variations in burning intensity, and was also affected by physical instability. As a result, only a rather broad indication of date could be obtained.

Structure 43, Sub-structure 22

Type oven floor
Location Area 9 Context T30/127
[4.42=23.06, 23.02, 23.03, 29.01, 29.02, 29.03, 29.05, 30.11, 30.13, 30.14]
Date none
Stratigraphic phasing ?phase 5.3, to early phase 5.5 mid-14th century

Too weak and scattered in magnetisation to produce a meaningful result.

Structure 43, Sub-structure 25

Type pitched clay tile hearth
Location Area 9 Context T30/148
[4.42=23.06, 29.01, 29.02, 29.03, 29.05, 30.11, 30.12, 30.13]
Measurement ref AJC-31
Dec 6.0^{0}E; Inc = 55.8^0; alpha-95 = 2.3^0
Date AD 1260–1300 at the 68% confidence level
Stratigraphic phasing phase 5.4 mid- to late 13th century to mid-14th centuries

Structure 43, Sub-structure 26

Type clunch oven floor
Location Area 9 Context T30/147
[4.42=23.06, 29.01, 29.02, 29.03, 29.05, 30.11, 30.12]
Measurement Ref AJC-30
Dec 2.5^{0}W; Inc = 59.2^0; alpha-95 = 2.4^0
Date 1310–1340 at the 68% confidence level
Stratigraphic phasing phase 5.4 mid- to late 13th to mid-14th centuries

A single sample was taken from each of four central square blocks in this hearth. Such a small number of samples would normally be inadequate, but the results were very consistent in spite of weak magnetisation. The stability of the structure was clearly high, but the consistency is probably also due to the purity of the magnetic component in the clunch, compared with those encountered in the more heterogeneous clays normally measured.

Structure 55

Type footing
Location Area Context T30/741
[24.07]
Measurement ref AJC-33
Dec ; Inc = 50.8^0, 45.9^0 and 59.3^0; alpha
Date N/A
Stratigraphic phasing phase 6.1 mid- to late 15th to mid- to late 16th centuries.

These carstone blocks formed part of a footing which showed signs of burning, masonry forming a probable external staircase to the building. Magnetic samples were made on samples taken from them to test whether they were *in situ.*

They proved to be very weak and unstably magnetised, which indicated that they had probably been very lightly burned. However, the inclination values were sufficiently reasonable and consistent to show that they had probably remained horizontal since being heated. The declinations were too unstable to confirm that they had not been rotated in the horizontal plane, although it is unlikely that this could have happened without upsetting the inclinations, unless the stones were very flat, and the surface on which they lay both flat and horizontal.

Thus the magnetic evidence is in favour of the stones having remained *in situ* since they were heated.