ENGLISH HERITAGE

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Dear Ian,

NANTWICH BOREHOLES 2012 SERIES– RADIOCARBON DATING

Please find enclosed the radiocarbon results from the six samples of waterlogged plant macrofossils that you submitted for radiocarbon dating from the Nantwich boreholes earlier this year.

The samples were dated by Accelerator Mass Spectrometry (AMS) at the Scottish Universities Environmental Research Centre in East Kilbride (SUERC-) and the Oxford Radiocarbon Laboratory (OxA-) respectively. The samples dated at SUERC were pre-treated using methods outlined in Stenhouse and Baxter (1983), combusted following Vandeputte *et al* (1996), graphitized as described by Slota *et al* (1987), and measured by AMS (Xu *et al* 2004). The samples processed at ORAU were pre-treated using a standard acid/base/acid method followed by an additional bleaching step (Brock *et al* 2010), combusted, converted to graphite, and dated as described by Bronk Ramsey *et al* (2004). Internal quality assurance procedures and international inter-comparisons (Scott 2003; Scott *et al* 2010) indicate no laboratory offsets and validate the measurement precision quoted.

The results reported are conventional radiocarbon ages (Stuiver and Polach 1977). The calibrated date ranges have been calculated by the maximum intercept method (Stuiver and Reimer 1986), using the program OxCal v4.1 (Bronk Ramsey 1995; 1998; 2001; 2009) and the IntCal09 data set (Reimer *et al* 2009). They quoted in the form recommended by Mook (1986), rounded outwards to 5 years. The probability distributions of the calibrated dates, shown below, have been calculated using the probability method (Stuiver and Reimer 1993), and the same data.

Each of the pairs of duplicate radiocarbon measurements from the specific heights in the different boreholes are statistically consistent at 95% confidence:

Nantwich borehole AE6/T 340-400 (T'=0.8; (T'(5%)=3.8; ν =1; Ward and Wilson 1978);
Nantwich borehole AF19/T 248-300 (T'=0.3; (T'(5%)=3.8; ν =1; Ward and Wilson 1978);
Nantwich borehole AF17/T 200-227 (T'=2.3; (T'(5%)=3.8; ν =1; Ward and Wilson 1978).

The dated duplicate samples from each bore hole could therefore represent material of the same actual age.

Copies of the final dating certificates for the project archive are enclosed, as are radiocarbon comment forms. Could you please complete these so that your comments on the archaeological significance of the dates can be included in the EH datelist series in due course?

Do, please get back to me if you have any queries.

Best wishes,

Alex Bayliss
Head of Scientific Dating

cc: Sue Stallibrass

References cited:

Brock, F, Higham, T, Ditchfield, P, and Bronk Ramsey, C, 2010 Current pretreatment methods for AMS radiocarbon dating at the Oxford Radiocarbon Accelerator Unit (ORAU), *Radiocarbon*, **52**, 103–12

Bronk Ramsey, C, 1995 Radiocarbon calibration and analysis of stratigraphy, *Radiocarbon*, **36**, 425–30

Bronk Ramsey, C, 1998 Probability and dating, *Radiocarbon*, **40**, 461–74

Bronk Ramsey, C, 2001 Development of the radiocarbon calibration program, *Radiocarbon*, **43**, 355–63

Bronk Ramsey, C, 2009 Bayesian analysis of radiocarbon dates, *Radiocarbon*, **51**: 337–60

Bronk Ramsey, C, Higham, T, and Leach, P, 2004 Towards high precision AMS: progress and limitations, *Radiocarbon* **46**, 17–24

Mook, W G, 1986 Business meeting: Recommendations/Resolutions adopted by the Twelfth International Radiocarbon Conference, *Radiocarbon*, **28**, 799

Reimer, P J, Baillie, M G L, Bard, E, Bayliss, A, Beck, J W, Blackwell, P G, Bronk Ramsey, C, Buck, C E, Burr, G S, Edwards, R L, Friedrich, M, Grootes, P M, Guilderson, T P, Hajdas, I, Heaton, T J, Hogg, A G, Hughen, K A, Kaiser, K F, Kromer, B, McCormac, G, Manning, S, Reimer, R W, Remmele, S, Richards, D A, Southon, J R, Talamo, S, Taylor, F W, Turney, C S M, van der Plicht, J, and Weyhenmeyer, C E, 2009, INTCAL09 and MARINE09 radiocarbon age calibration curves, 0–50,000 years cal BP, *Radiocarbon*, **51**(4), 1111–50

Scott, E M, 2003 The third international radiocarbon intercomparison (TIRI) and the fourth international radiocarbon intercomparison (FIRI) 1990–2002: results, analyses, and conclusions, *Radiocarbon*, **45**, 135–408

Scott, E M, Cook G and Naysmith, P, 2010, The fifth international radiocarbon intercomparision (VIRI): an assessment of laboratory performance in stage 3. Radiocarbon **53** (2–3), 859–65

Slota Jr, P J, Jull, A J T, Linick, T W, and Toolin, L J, 1987 Preparation of small samples for ^{14}C accelerator targets by catalytic reduction of CO, *Radiocarbon*, **29**, 303–6

Stenhouse, M J, and Baxter, M S, 1983 ^{14}C dating reproducibility: evidence from routine dating of archaeological samples, *PACT*, **8**, 147–61

Stuiver, M, and Polach, H A, 1977 Reporting of ^{14}C data, *Radiocarbon*, **19**, 355–63

Stuiver, M, and Reimer, P J, 1986 A computer program for radiocarbon age calculation, *Radiocarbon*, **28**, 1022–30

Stuiver, M, and Reimer, P J, 1993 Extended ^{14}C data base and revised CALIB 3.0 ^{14}C age calibration program, *Radiocarbon*, **35**, 215–30

Vandeputte, K, Moens, L, and Dams, R, 1996 Improved sealed-tube combustion of organic samples to CO_2 for stable isotope analysis, radiocarbon dating and percent carbon determinations, *Analytical Letters*, **29**(15), 2761–73

Ward, G K and Wilson, S R, 1978 Procedures for comparing and combining radiocarbon age determinations: a critique, *Archaeometry,* **20**, 19–31

Xu, S, Anderson, R, Bryant, C, Cook, G T, Dougans, A, Freeman, S, Naysmith, P, Schnabel, C, and Scott, E M, 2004 Capabilities of the new SUERC 5MV AMS facility for ^{14}C dating, *Radiocarbon*, **46**, 59–64

Table 1: Radiocarbon Dates and stable isotope measurements from the second set of samples from the Nantwich boreholes

Laboratory number	**Sample**	**Radiocarbon age (BP)**	**^{13}C (‰)**	**Calibrated date (68% confidence)**	**Calibrated date (95% confidence)**
Nantwich borehole AE6/T					
OxA-26170	Hazel nutshell, 340-400	1532±29	-22.97	cal AD 470570	cal AD 430605
SUERC-39418	Hazel nutshell, 340-400	1495±30	-26.9	cal AD 545605	cal AD 535640
Nantwich borehole AF19/T					
OxA-26171	Hazel nutshell, 248-300	897±27	-23.35	cal AD10501180	cal AD 1035-1215
SUERC-39423	Hazel nutchell 248-300	875±30	-28.0	cal AD 1155-1215	cal AD 1045-1225
Nantwich borehole AF17/T					
OxA-26232	Wood twig 200-227	826±30	-27.21	cal AD 1190-1260	cal AD 1160-1270
SUERC-39419	Wood twig 200-227	890±30	-28.8	cal AD 1050-1210	cal AD 1035-1220

Figure 1: calibration of radiocarbon results from the Nantwich boleholes 2012 series by the probability method (Stuiver and Reimer 1993)