Supplementary Information 1. Dendrochronology for EBEN0060

Dendro-sample: Ebensfeld Sample No. 60

a) **Sample identifier (Dendro-Lab Key-code):** EBEN0060
b) **Sample certainly derives from a single tree (Y/N):** Y
c) **Site:** Ebensfeld, River Main, S-Germany
d) Coordinates: 50° 4' 33" N 10° 57' 14" E
e) **Object type**: Subfossil wood sample
f) **Preservation**: Dry
g) **Sample type (e.g. core or slice):** slice
h) **Species:** Oak (*Quercus* sp.)
i) **No of rings**: 92
j) **Pith (Y/N):** Y
k) **Bark (Y/N):** N
l) **Waney edge:** N
m) **Sapwood (Y/N):** N
n) **Methodology used for dating:**

Dendrochronological crossdating of the time series with the Holocene German Oak Chronology (HOC, Friedrich et al. 2004) using *t*-values and Gleichläufigkeit indices (Baillie and Pilcher, 1973) in DosTSAP and visually verification using logarithmic scaling.

o) **Dated individually (Y/N):** Y

p) Cross-correlation statistics:

Series	Ref	Date (BC)	TB&P	Glk %	overlap	Public
Eben60	HOC (2004)	3691-3600	5,5	71	92	No

q) Raw ring width series:

HEADER:
Project=106
DateEnd=-3599
Length=92
Location=EBENSFELD MAIN
Species=QUSP
KeyCode=EBEN 60
TreeNo=60
DATA:Tree

364	408	555	465	556	469	594	449	572	404
477	435	564	496	410	547	395	522	528	501
304	458	403	447	268	258	299	284	346	391
333	495	362	277	332	284	218	185	170	203
196	266	299	254	153	212	266	222	201	240
258	177	274	206	250	189	228	143	208	214
271	331	200	207	301	253	160	123	162	172
244	229	209	229	229	267	238	160	233	210
163	121	183	174	159	187	113	174	147	157
120	157	0	0	0	0	0	0	0	0

r) Remainder of sample is stored in which archive?

Institute of Botany (210), Hohenheim University, D-70593 Stuttgart, Germany.

References:

Baillie MGL, Pilcher JR. 1973. A simple crossdating program from tree-ring research. Tree Ring Bulletin 33:7–14.

Friedrich M, Remmele S, Kromer B, Hofmann J, Spurk M, Felix Kaiser K, Orcel C, Küppers M. 2004. The 12,460-year Hohenheim oak and pine tree-ring chronology from Central Europe—A unique annual record for radiocarbon calibration and paleoenvironment reconstructions. Radiocarbon 46(3):1111–22.

Supplementary Information 2. ^{14}C measurements for EBEN0060

division	midpoint (ring)	block interval	calage cal BP	calspan	c14age	c14sig	c14addsig	$\delta^{13}C_{AMS}$	lab_id	sam_id	measurement
EBEN0060	1.5	EL	5639.5	2	4900	19	0.001	−25.3	46869	46869.1.1	C120807LW(1)
EBEN0060	1.5	EL	5639.5	2	4944	15	0.0012	−23.6	46869	46869.1.2	C160806LW1
EBEN0060	3.5	EL	5637.5	2	4901	18	0.001	−23.7	46870	46870.1.1	C120807LW(1)
EBEN0060	3.5	EL	5637.5	2	4919	15	0.0012	−24.1	46870	46870.1.2	C160806LW1
EBEN0060	5.5	EL	5635.5	2	4942	19	0.001	−29.3	46871	46871.1.1	C120807LW(1)
EBEN0060	5.5	EL	5635.5	2	4957	15	0.0012	−24.1	46871	46871.1.2	C160806LW1
EBEN0060	7.5	EL	5633.5	2	4935	19	0.001	−28.4	46872	46872.1.1	C120807LW(1)
EBEN0060	7.5	EL	5633.5	2	4927	15	0.0012	−24.8	46872	46872.1.2	C160806LW1
EBEN0060	9.5	EL	5631.5	2	4935	18	0.001	−20.7	46873	46873.1.1	C120807LW(1)
EBEN0060	9.5	EL	5631.5	2	4935	15	0.0012	−24.9	46873	46873.1.2	C160806LW1
EBEN0060	11.5	EL	5629.5	2	4944	19	0.001	−28.0	46874	46874.1.1	C120807LW(1)
EBEN0060	11.5	EL	5629.5	2	4943	15	0.0012	−25.7	46874	46874.1.2	C160806LW1
EBEN0060	13.5	EL	5627.5	2	4971	17	0.001	−25.0	46875	46875.1.1	C120809(LW2)
EBEN0060	13.5	EL	5627.5	2	4927	15	0.0012	−26.3	46875	46875.1.2	C160806LW1
EBEN0060	15.5	EL	5625.5	2	4929	17	0.001	−24.6	46876	46876.1.1	C120809(LW2)
EBEN0060	15.5	EL	5625.5	2	4927	15	0.0012	−25.1	46876	46876.1.2	C160806LW1
EBEN0060	17.5	EL	5623.5	2	4964	17	0.001	−25.9	46877	46877.1.1	C120809(LW2)
EBEN0060	17.5	EL	5623.5	2	4957	15	0.0012	−26.1	46877	46877.1.2	C160806LW1
EBEN0060	19.5	EL	5621.5	2	4940	17	0.001	−24.5	46878	46878.1.1	C120809(LW2)
EBEN0060	19.5	EL	5621.5	2	4942	15	0.0012	−26.2	46878	46878.1.2	C160806LW1
EBEN0060	21.5	EL	5619.5	2	4930	17	0.001	−25.9	46879	46879.1.1	C120809(LW2)
EBEN0060	21.5	EL	5619.5	2	4941	15	0.0012	−25.6	46879	46879.1.2	C160806LW1
EBEN0060	23.5	EL	5617.5	2	4992	17	0.001	−24.7	46880	46880.1.1	C120809(LW2)
EBEN0060	23.5	EL	5617.5	2	4971	15	0.0012	−24.6	46880	46880.1.2	C160806LW1
EBEN0060	25.5	EL	5615.5	2	4986	17	0.001	−24.0	46881	46881.1.1	C120809(LW2)

division	midpoint (ring)	block interval	calage cal BP	calspan	c14age	c14sig	c14addsig	$\delta^{13}C_{AMS}$	lab_id	sam_id	measurement
EBEN0060	25.5	EL	5615.5	2	5003	15	0.001	−25.5	46881	46881.1.2	C160806LW1
EBEN0060	27.5	EL	5613.5	2	4987	17	0.001	−25.9	46882	46882.1.1	C120809(LW2)
EBEN0060	27.5	EL	5613.5	2	4965	15	0.001	−24.7	46882	46882.1.2	C160806LW1
EBEN0060	29.5	EL	5611.5	2	4964	21	0.001	−25.9	46328	46328.1.1	C120601CS
EBEN0060	29.5	EL	5611.5	2	4989	15	0.001	−25.7	46328	46328.1.2	C160806LW1
EBEN0060	31.5	EL	5609.5	2	4955	21	0.001	−23.8	46329	46329.1.1	C120601CS
EBEN0060	31.5	EL	5609.5	2	4963	15	0.001	−24.9	46329	46329.1.2	C160806LW1
EBEN0060	33.5	EL	5607.5	2	4966	21	0.001	−23.7	46330	46330.1.1	C120601CS
EBEN0060	33.5	EL	5607.5	2	4956	15	0.001	−25.6	46330	46330.1.2	C160806LW1
EBEN0060	35.5	EL	5605.5	2	4934	20	0.001	−22.5	46331	46331.1.1	C120601CS
EBEN0060	35.5	EL	5605.5	2	4943	15	0.001	−24.1	46331	46331.1.2	C160806LW1
EBEN0060	37.5	EL	5603.5	2	4937	21	0.001	−23.2	46332	46332.1.1	C120601CS
EBEN0060	37.5	EL	5603.5	2	4930	15	0.001	−27.3	46332	46332.1.2	C160806LW1
EBEN0060	39.5	EL	5601.5	2	4939	21	0.001	−23.4	46333	46333.1.1	C120601CS
EBEN0060	39.5	EL	5601.5	2	4972	15	0.001	−23.7	46333	46333.1.2	C160806LW1
EBEN0060	41.5	EL	5599.5	2	4920	22	0.001	−22.6	46334	46334.1.1	C120601CS
EBEN0060	41.5	EL	5599.5	2	4903	15	0.001	−25.0	46334	46334.1.2	C160806LW1
EBEN0060	43.5	EL	5597.5	2	4906	21	0.001	−24.2	46335	46335.1.1	C120601CS
EBEN0060	43.5	EL	5597.5	2	4891	15	0.001	−26.5	46335	46335.1.2	C160806LW1
EBEN0060	45.5	EL	5595.5	2	4897	21	0.001	−25.6	46336	46336.1.1	C120601CS
EBEN0060	45.5	EL	5595.5	2	4889	15	0.001	−24.9	46336	46336.1.2	C160806LW1
EBEN0060	47.5	EL	5593.5	2	4885	21	0.001	−23.8	46337	46337.1.1	C120601CS
EBEN0060	47.5	EL	5593.5	2	4887	15	0.001	−25.9	46337	46337.1.2	C160806LW1
EBEN0060	49.5	EL	5591.5	2	4858	21	0.001	−22.6	46338	46338.1.1	C120601CS
EBEN0060	49.5	EL	5591.5	2	4894	15	0.001	−24.8	46338	46338.1.2	C160806LW1
EBEN0060	51.5	EL	5589.5	2	4874	20	0.001	−24.5	46339	46339.1.1	C120609CS
EBEN0060	51.5	EL	5589.5	2	4830	15	0.001	−25.2	46339	46339.1.2	C160806LW1

division	midpoint (ring)	block interval	calage cal BP	calspan	c14age	c14sig	c14addsig	$\delta^{13}C_{AMS}$	lab_id	sam_id	measurement
EBEN0060	53.5	EL	5587.5	2	4853	20	0.001	−24.8	46340	46340.1.1	C120609CS
EBEN0060	53.5	EL	5587.5	2	4854	15	0.001	−24.1	46340	46340.1.2	C160806LW1
EBEN0060	55.5	EL	5585.5	2	4851	20	0.001	−24.7	46341	46341.1.1	C120609CS
EBEN0060	55.5	EL	5585.5	2	4834	15	0.001	−25.4	46341	46341.1.2	C160806LW1
EBEN0060	57.5	EL	5583.5	2	4813	20	0.001	−26.1	46342	46342.1.1	C120609CS
EBEN0060	57.5	EL	5583.5	2	4818	13	0.001	−26.4	46342	46342.1.2	C160806LW1
EBEN0060	59.5	EL	5581.5	2	4828	21	0.001	−25.8	46343	46343.1.1	C120609CS
EBEN0060	61.5	EL	5579.5	2	4793	20	0.001	−24.7	46344	46344.1.1	C120609CS
EBEN0060	61.5	EL	5579.5	2	4814	16	0.001	−24.9	46344	46344.1.2	C160812LW1
EBEN0060	63.5	EL	5577.5	2	4800	20	0.001	−24.8	46345	46345.1.1	C120609CS
EBEN0060	63.5	EL	5577.5	2	4799	16	0.001	−24.3	46345	46345.1.2	C160812LW1
EBEN0060	65.5	EL	5575.5	2	4773	20	0.001	−25.6	46346	46346.1.1	C120609CS
EBEN0060	65.5	EL	5575.5	2	4780	16	0.001	−22.5	46346	46346.1.2	C160812LW1
EBEN0060	67.5	EL	5573.5	2	4776	20	0.001	−24.3	46347	46347.1.1	C120609CS
EBEN0060	67.5	EL	5573.5	2	4800	16	0.001	−23.4	46347	46347.1.2	C160812LW1
EBEN0060	71.5	EL	5569.5	2	4770	20	0.001	−26.2	46349	46349.1.1	C120609CS
EBEN0060	71.5	EL	5569.5	2	4776	16	0.001	−24.8	46349	46349.1.2	C160812LW1
EBEN0060	73.5	EL	5567.5	2	4742	20	0.001	−24.5	46350	46350.1.1	C120612CS
EBEN0060	73.5	EL	5567.5	2	4770	16	0.001	−24.9	46350	46350.1.2	C160812LW1
EBEN0060	75.5	EL	5565.5	2	4742	20	0.001	−27.7	46351	46351.1.1	C120612CS
EBEN0060	75.5	EL	5565.5	2	4756	16	0.001	−25.5	46351	46351.1.2	C160812LW1
EBEN0060	77.5	EL	5563.5	2	4767	20	0.001	−26.1	46352	46352.1.1	C120612CS
EBEN0060	77.5	EL	5563.5	2	4766	16	0.001	−24.4	46352	46352.1.2	C160812LW1
EBEN0060	79.5	EL	5561.5	2	4800	20	0.001	−27.9	46353	46353.1.1	C120612CS
EBEN0060	79.5	EL	5561.5	2	4764	16	0.001	−25.4	46353	46353.1.2	C160812LW1
EBEN0060	81.5	EL	5559.5	2	4762	20	0.001	−25.3	46354	46354.1.1	C120612CS
EBEN0060	81.5	EL	5559.5	2	4786	16	0.001	−24.0	46354	46354.1.2	C160812LW1

division	midpoint (ring)	block interval	calage cal BP	calspan	c14age	c14sig	c14addsig	$\delta^{13}C_{AMS}$	lab_id	sam_id	measurement
EBEN0060	83.5	EL	5557.5	2	4770	20	0.001	−25.0	46355	46355.1.1	C120612CS
EBEN0060	83.5	EL	5557.5	2	4769	16	0.001	−25.1	46355	46355.1.2	C160812LW1
EBEN0060	85.5	EL	5555.5	2	4748	21	0.001	−28.5	46356	46356.1.1	C120612CS
EBEN0060	85.5	EL	5555.5	2	4794	16	0.001	−24.6	46356	46356.1.2	C160812LW1

Supplementary Information 3. Southern British Long Barrows – CQL2 code files

The original analysis of Ascott-under-Wychwood, Fussell's Lodge, Hazleton, West Kennet and Wayland's Smithy (Bayliss and Whittle 2007) was undertaken using OxCal v.3.10 (Bronk Ramsey 1995) with the models defined using Chronological Query Language (CQL: Bronk Ramsey 1998) an extension of the model definitions found in OxCal. The preferred models from these sites have been reprogrammed for this study using Chronological Query Language 2 (CQL2, Bronk Ramsey 2009) and Table SI3.1 provides concordance between Chronological Query Language elements that have changed between the original analysis (CQL; OxCal v.3.10) and this study (CQL2, Bronk Ramsey 2009).

The code for Wayland's Smithy corrects a couple of issues with the published model (Whittle et al. 2007, fig 4), firstly the laboratory code OxA-14471 appears twice for ws9 and ws16 (Whittle et al. 2007, fig 3); the correct laboratory code for the measurement on ws9 is OxA-14771 (Whittle et al. 2007, table 1). Secondly, the two dates (OxA-13175 and OxA-13170) that are cross-referenced (`Xreference`[1]; see Table SI3.1) within the same overall `Phase` (Phase human burials; Whittle et al. 2007, fig 4) have been moved to outside the modelled phase while retaining their constraints. In the original model the cross-referencing within the same overall `Phase` resulted in the same prior being applied twice for these events, ie the model assumed that there were two more independent variables than there actually are. Thus instead of a uniform prior (see Bayliss et al. 2007a) for the span of burial activity the prior was 1/s^2 (Bronk Ramsey pers comm; Bronk Ramsey 2009, 351–2). The amended model provides an estimate for burial within Wayland's Smithy I of between *1–125 years* (*95% probability*; distribution not shown) probably for *1–75 years* (*68% probability*) as opposed to between *1–65 years* (*95% probability; use Wayland's Smithy I*, Whittle et al. 2007, fig 5) probably *1–15 years* (*68% probability*).

References

Bayliss A, Bronk Ramsey C, van der Plicht J, Whittle A. 2007a. Bradshaw and Bayes: Towards a timetable for the Neolithic. Cambridge Archaeological Journal 17(S1):1–28.

Bayliss A, Benson D, Galer D, Humphrey L. 2007b. One thing after another: the date of the Ascott-under-Wychwood Long Barrow. Cambridge Archaeological Journal 17(1 suppl.):29–44.

Bayliss A, Whittle A, Wysocki M. 2007c. Talking about my generation: the date of the West Kennet Long Barrow. Cambridge Archaeological Journal 17(1 suppl.):85–101.

Bronk Ramsey C. 1995. Radiocarbon calibration and analysis of stratigraphy: the OxCal program. Radiocarbon 37(2):425–30.

Bronk Ramsey C. 1998. Probability and dating. Radiocarbon 40(1):461–74.

Bronk Ramsey C. 2009. Bayesian analysis of radiocarbon dates. Radiocarbon 51(1):337–60.

Meadows J, Barclay A, Bayliss A. 2007. A short passage of time: the dating of the Hazleton Long Cairn revisited. Cambridge Archaeological Journal 17(1 suppl.):45–64.

Whittle A, Bayliss A, Wysocki M. 2007. Once in a lifetime: the date of the Wayland's Smithy Long Barrow. Cambridge Archaeological Journal 17(1 suppl.):103–21.

Wysocki M, Bayliss A, Whittle A. 2007. Serious mortality: the date of the Fussell's Lodge long barrow. Cambridge Archaeological Journal 17(1 suppl.):65–84.

[1] OxCal CQL2 keywords are given in `Courier font`

Table SI3.1: Concordance of CQL (OxCal v.3.10) and CQL2 (OxCal v4.3) elements that differ from the models described in Bayliss et al. (2007b, figs 3, 5–7; Ascott-under-Wychwood); Wysocki et al. (2007, figs 10–11; Fussell's Lodge); Meadows et al. (2007, figs 6–9; Hazleton), Bayliss et al. (2007c, fig 6; West Kennet) and Whittle et al. (2007, fig 4; Wayland's Smithy) and the code shown below.

CQL statement (OxCal v3.10)	**Explanation**	**Example**	**CQL statement (OxCal v4.3)**	**Explanation**	**Example**

`TPQ`	*(Terminus post quem)* Used within a sequence to force all items later in the sequence to follow the items in the TPQ group; all items earlier in the sequence are not directly affected	`TPQ` "unidentified charcoal"
		{
		`R_Date` "BM-835" 5198 225;
		};
			`After`	Group function that returns a probability density function (PDF) for being after all of the grouped elements; in MCMC analysis defines *terminus post quem* (TPQ) events	`After`("unidentified charcoal")
					{
					`R_Date`("BM-835", 5198, 225);
					};

`TAQ`	*(Terminus ante quem)* Used within a sequence to force all items earlier in the sequence to precede the items in the TPQ group; all items later in the sequence are not directly affected	{
		`TAQ` "hearths F50"
		{
		`R_Date` "BM-492" 4735 70;
		};
			`Before`	Group function that returns a PDF for being before all of the grouped elements; in MCMC analysis defines *terminus ante quem* (TAQ) event	{
					`Before`("hearths F50")
					{
					`R_Date`("BM-492", 4735, 70);
					};

`Question (?)`	Used to question the position of an event for example in a sequence	`R_Date` "OxA-13318" 5222 31?	`Outlier`	Removes an item from consideration in a model	`R_Date`("OxA-13318", 5222, 31)
					{
					`Outlier`();
					};

`XReference`	Used to refer to an event already defined somewhere else in the stratigraphic sequence.	`XReference` "OxA-12680";	`n/a`	There is no longer a specific cross reference term since cross referencing can be used much more generally.	`Date`("=OxA-12680");
`Event`	Used to determine the distribution of an event which is constrained in some way by the model but which has no direct dating information. A model consisting almost	`Event` "construction finished";	`Date`	Type conversion function that returns a date or PDF for a date from an expression	`Date`("construction finished");

CQL statement (OxCal v3.10)	Explanation	Example	CQL statement (OxCal v4.3)	Explanation	Example
	entirely of events can be constructed to check the effective prior distributions for the model.				

CQL2 code defining chronological model for Ascott-under-Wychwood

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Phase("Ascott under Wychwood")
  {
   Phase("Mesolithic activity")
   {
    Phase("structure 1 (F16)")
    {
     R_Date("OxA-12677", 5353, 32);
     R_Date("OxA-12678", 5246, 32);
    };
    Phase("roe deer bones in pre-barrow midden")
    {
     R_Date("GrA-27098", 6180, 45);
     R_Date("GrA-27099", 6000, 45);
    };
   };
   Page( );
   Sequence("Neolithic activity")
   {
    Sequence("pre-mound occupation")
    {
     Boundary("start_occupation");
     Phase("pre-mound occupation")
     {
      Before("hearths F50")
      {
       R_Date("BM-492", 4735, 70);
       R_Date("GrA-23927", 4970, 45);
       R_Date("OxA-12679", 4930, 31);
       R_Date("OxA-12680", 4989, 31);
      };
      Sequence("F7 and Neolithic midden")
      {
       Phase("pit F7")
       {
        R_Date("GrA-23933", 5105, 45);
        After("mature elm")
        {
         R_Date("BM-491b", 4893, 70);
        };
       };
       Phase( "pre-barrow midden")
       {
        R_Date("GrA-27102", 5130, 45);
        R_Date("OxA-13135", 4950, 100);
        R_Date("GrA-27094", 5095, 45);
        R_Date("GrA-27093", 5100, 45);
        R_Date("GrA-27096", 5095, 45);
        R_Date("GrA-27100", 5010, 45);
       };
      };
     };
     Boundary("end_occupation");
```

```
};
Sequence("long barrow")
{
 Boundary("start_barrow");
 Phase( )
 {
  Sequence("long barrow")
  {
   Phase("construction materials")
   {
    Phase("primary mound")
    {
     R_Date("GrA-23828", 4940, 50);
     R_Date("BM-832", 4942, 74);
     R_Date("BM-833", 5020, 92);
     R_Date("OxA-13315", 4962, 30);
     R_Date("GrA-25295", 4940, 45);
    };
    Sequence("quarry ditches")
    {
     R_Date("GrA-23829", 5050, 50);
     After("unidentified charcoal")
     {
      R_Date("BM-835", 5198, 225);
     };
     After("oak")
     {
      R_Date("BM-836", 4445, 61)
      {
       Outlier();
      };
      R_Date("BM-837", 4714, 166)
      {
       Outlier();
      };
     };
    };
   };
   Date("primary construction");
   Phase("use")
   {
    Phase("burials")
    {
     First("first_body");
     Phase("northern")
     {
      Phase("northern passage")
      {
       R_Combine("individual E")
       {
        R_Date("OxA-13400", 4876, 33);
        R_Date("BM-1974R", 4680, 160);
       };
      };
      Phase("northern inner cist")
      {
       Sequence("individuals D3/4 and D1")
       {
        R_Date("OxA-13404", 4945, 32);
        R_Date("GrA-25294", 4840, 40);
        Last("last_d");
```

```
    };
    Last("last_north");
   };
  };
  Phase("southern")
  {
   Phase("southern passage area")
   {
    First("first_c");
    R_Date("GrA-25305", 4820, 40);
    R_Date("GrA-25306", 4805, 40);
    R_Date("OxA-13403", 4816, 31);
    R_Date("BM-1975R", 3870, 100)
    {
     Outlier();
    };
    Last("last_c");
   };
   Phase("southern outer cist")
   {
    Phase("disarticulated")
    {
     R_Date("OxA-13402", 4964, 32);
    };
    Sequence("individuals B1 and B2")
    {
     R_Date("GrA-25304", 4890, 40);
     R_Date("OxA-13401", 4765, 31);
    };
    Last("last_b");
   };
   Phase("southern inner cist")
   {
    R_Combine( "individual A2")
    {
     R_Date("GrA-25292", 4880, 40);
     R_Date("BM-1976R", 4930, 100);
    };
    Sequence("individuals A1 and A3")
    {
     R_Date("OxA-13319", 4984, 29);
     R_Date("OxA-13320", 4974, 29);
    };
    Last("last_a");
   };
   Last("last_south");
  };
  Last("last_body");
  Span("use_bodies");
 };
 Sequence("secondary barrow")
 {
  After("hearths F50")
  {
   Date("=OxA-12680");
   Date("=OxA-12679");
   Date("=GrA-23927");
  };
  Date("secondary construction");
  Phase("secondary mound")
  {
```

```
          R_Date("OxA-12675", 5050, 33)
          {
           Outlier();
          };
          R_Date("OxA-12676", 4992, 33);
          R_Date("GrA-25296", 4965, 40);
          R_Date("OxA-13318", 5222, 31)
          {
           Outlier();
          };
         };
        };
       };
      };
     };
     Boundary( "end_barrow");
    };
   };
  };
 };
```

CQL2 code defining chronological model for Fussell's Lodge

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Phase( )
 {
  Sequence("Fussell's Lodge")
  {
   Boundary("build_box");
   Sequence( )
   {
    Phase("Bone Groups A & B")
    {
     Phase("Group B")
     {
      Phase("green bone")
      {
       R_Date("OxA-13329", 4894, 39);
       R_Date("OxA-13187", 4932, 34);
      };
      R_Date("OxA-12279", 4857, 31);
      R_Date("GrA-28174", 4940, 45);
      R_Date("OxA-12280", 4991, 32);
      R_Date("GrA-28175", 4850, 45);
      R_Date( "GrA-28207", 4760, 50)
      {
       Outlier();
      };
      R_Date("GrA-28208", 4940, 50);
     };
     Phase("Group A")
     {
      After("Group A1 (ancestors?)")
      {
       R_Date("OxA-12277", 4971, 31);
       R_Date("OxA-13174", 5075, 40);
       R_Date("OxA-12278", 5021, 31);
      };
      Phase("Bone Group A2")
      {
       R_Combine("FS 8.2")
       {
        R_Date("GrA-23195", 4955, 45);
        R_Date("OxA-13185", 4955, 42);
       };
       R_Date("OxA-14480", 4865, 39);
       After("Group A2 (ancestor?)")
       {
        R_Date("GrA-28129", 5050, 50);
       };
      };
```

```
     };
    };
    Date("extend_box");
    Phase("Bone Groups C & D")
    {
     After("oak branch")
     {
      R_Date("BM-134", 5180, 150);
     };
     R_Date("OxA-13206", 4877, 37);
     Phase("Group D")
     {
      R_Combine("FS 26")
      {
       R_Date("OxA-12281", 4850, 31);
       R_Date("GrA-23183", 4950, 50);
      };
     };
     Phase("Group C")
     {
      R_Combine("individual 1")
      {
       R_Date("GrA-28209", 4860, 50);
       R_Date("OxA-13186", 4824, 39);
      };
      R_Date("OxA-14458", 4859, 35);
     };
    };
    Phase("hides & barrow")
    {
     R_Date("OxA-13173", 4728, 49);
     R_Combine("FSA1")
     {
      R_Date("GrA-28199", 4880, 50);
      R_Date("GrA-28218", 4880, 50);
      R_Date("OxA-13205", 4851, 37);
     };
    };
   };
   Boundary("build_barrow");
   R_Date("OxA-13326", 4757, 39);
  };
  Phase("calculations")
  {
   Difference("second_box", "build_barrow", "extend_box");
   Difference("first_box", "extend_box", "build_box");
  };
 };
```

CQL2 code defining chronological model for Hazleton

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Sequence("Hazleton North main model")
  {
   Sequence("pre-cairn activity")
   {
    Boundary("start of pre-cairn phase");
    Phase("pre-cairn phase")
    {
     R_Date("OxA-12969", 5125, 34);
     R_Date("OxA-13374", 5110, 90);
     R_Date("OxA-13375", 4980, 100);
     R_Date("OxA-646", 4875, 80);
     R_Date("OxA-738", 4970, 80);
     R_Date("OxA-739", 4915, 80);
     Span("duration of pre-cairn phase");
    };
    Boundary("end of pre-cairn phase");
   };
   Interval("cultivation");
   Sequence("cairn activity")
   {
    Boundary( "start of cairn phase");
    Phase( "cairn phase")
    {
     Sequence("construction/burial")
     {
      Phase("antlers")
      {
       R_Date("HAR-8349", 4830, 60);
       R_Date("HAR-8350", 4950, 60);
       R_Date("GrA-24638", 4790, 50);
       R_Date("GrA-24513", 4830, 50);
      };
      Date("construction finished");
      Phase("burial activity")
      {
       Sequence("north chambered area")
       {
        Phase("north chamber")
        {
         R_Date("OxA-644", 4840, 80);
         R_Date("OxA-905", 4950, 70);
         R_Date("GrA-24506", 4940, 50);
         R_Date("GrA-24510", 4810, 50);
         R_Date("OxA-12875", 4883, 31);
         R_Date("OxA-12876", 4870, 33);
```

```
    };
    Date("passage collapse");
    Phase("north entrance")
    {
     Sequence("articulated skeletons")
     {
      R_Combine("6672.16")
      {
       R_Date("OxA-903", 4840, 60);
       R_Date("GrA-24508", 4850, 50);
      };
      R_Date("OxA-904", 4860, 70);
      R_Combine("5037.32")
      {
       R_Date("GrA-24504", 4800, 50);
       R_Date("OxA-902", 4820, 70);
       R_Date("OxA-643", 4600, 120);
      };
     };
    };
   };
   Phase("south chambered area")
   {
    R_Date("OxA-12871", 4758, 31);
    R_Date("OxA-12873", 4763, 32);
    R_Combine("7835")
    {
     R_Date("OxA-12872", 4747, 31);
     R_Date("GrA-24509", 4750, 50);
    };
    R_Combine("11035")
    {
     R_Date("GrA-24564", 4945, 45);
     R_Date("OxA-912", 5200, 150);
    };
    R_Date("GrA-24512", 4860, 50);
    R_Date("OxA-645", 4780, 80);
    R_Date("OxA-906", 4880, 70);
    R_Date("OxA-907", 4970, 60);
    R_Date("OxA-908", 4830, 60);
    R_Date("OxA-910", 5000, 70);
    R_Date("OxA-911", 4830, 80);
   };
   Span("burial activity duration");
  };
 };
 Phase( "feasting")
 {
  R_Date("OxA-913", 4960, 70);
  R_Date("OxA-914", 4970, 70);
  R_Date("OxA-915", 4840, 70);
  R_Date("OxA-916", 4810, 70);
 };
```

```
    Span("main cairn phase duration");
   };
   Boundary("end of cairn phase");
  };
  Interval("hiatus");
  Phase("later burials")
  {
   R_Date("OxA-12874", 4606, 32);
   R_Combine("human rib 3705")
   {
    R_Date("OxA-383", 4450, 90);
    R_Date("OxA-1177", 4640, 80);
   };
  };
 };
};
```

CQL2 code defining chronological model for West Kennet

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Sequence("West Kennet")
  {
   Sequence("(primary)")
   {
    Boundary("start West Kennet primary");
    Phase("(primary)")
    {
     Phase("SE")
     {
      Phase("children")
      {
       R_Combine("WK2")
       {
        R_Date("GrA-23178", 4835, 45);
        R_Date("OxA-13179", 4778, 38);
       };
       R_Combine("WK4")
       {
        R_Date("OxA-13180", 4787, 41);
        R_Date("GrA-23179", 4855, 45);
       };
       R_Date("OxA-13241", 4806, 36);
      };
      Phase("adults")
      {
       R_Date("OxA-13200", 4872, 38);
       R_Date("OxA-13199", 4880, 38);
      };
      Phase("disarticulated")

       R_Date("OxA-13331", 4747, 37);
      };
     };
     Phase("NW")
     {
      R_Combine("WK16")
      {
       R_Date("OxA-12653", 4803, 32);
       R_Date("GrA-23181", 4950, 50);
      };
      Phase("disarticulated")
      {
       R_Date("OxA-12283", 4835, 33);
       R_Date("OxA-13188", 4767, 38);
       R_Date("OxA-449", 4825, 90);
       R_Date("OxA-563", 4780, 90);
      };
     };
     Phase("SW")
     {
      Phase("disarticulated")
      {
       R_Date("OxA-12284", 4797, 31);
```

```
      R_Date("OxA-13190", 4680, 39);
      R_Date("OxA-13332", 4791, 37);
     };
     R_Date("OxA-13201", 4827, 38);
     R_Date("OxA-451", 4780, 90);
    };
    Phase("NE")
    {
     R_Date("OxA-13198", 4838, 37);
     Sequence( )
     {
      R_Combine("WK12")
      {
       R_Date("OxA-12652", 4856, 31);
       R_Date("GrA-23180", 4790, 50);
      };
      R_Combine("WK20")
      {
       R_Date("OxA-12282", 4819, 30);
       R_Date("OxA-450", 4700, 80);
      };
     };
    };
   };
   Boundary("end West Kennet primary");
   Span("West Kennet primary use");
  };
  Interval("West Kennet abandonment");
  Sequence("(secondary)")
  {
   Boundary("start West Kennet infill");
   Phase( )
   {
    Phase("NE (secondary)")
    {
     R_Date("OxA-13243", 4583, 45);
    };
    Phase( "NW (secondary)")
    {
     R_Date("OxA-13202", 3934, 36);
    };
    Sequence("SE (secondary)")
    {
     R_Date("OxA-13182", 4454, 34);
     Phase( )
     {
      R_Date("OxA-13183", 4103, 38);
      R_Date("OxA-13184", 4478, 37);
      R_Date("OxA-13242", 4506, 37);
     };
     R_Date("OxA-13181", 4105, 35);
    };
   };
   Boundary("end West Kennet infill");
   Span("West Kennet infill");
  };
 };
};
```

CQL2 code defining chronological model for Wayland's Smithy

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot(Waylands Smithy)
 {
  Sequence("WS I & II")
  {
   Sequence("Wayland's Smithy I")
   {
    Boundary("start");
    Phase("human burials WSI")
    {
     Sequence()
     {
      Phase()
      {
       R_Date("KIA-27625", 4713, 37);
      };
      R_Date("OxA-14772", 4787, 34);
      R_Date("OxA-14769", 4812, 35);
     };
     R_Date("OxA-13176", 4809, 44);
     Sequence()
     {
      Phase()
      {
       R_Date("OxA-14471", 4808, 38);
       R_Date("OxA-13175", 4717, 45);
      };
      Phase()
      {
       R_Date("OxA-13170", 4791, 40);
       R_Date("OxA-14771", 4749, 34);
      };
      R_Date("OxA-14770", 4802, 35);
      R_Date("KIA-27626", 4714, 36);
     };
     R_Date("KIA-27623", 4750, 32);
     R_Date("OxA-13330", 4817, 39);
     R_Date("KIA-27624", 4779, 40);
     R_Date("OxA-13203", 4749, 38);
    };
    Boundary("end");
    Span("Wayland's Smithy I");
   };
   R_Date("OxA-13169", 4634, 45);
   R_Date("I-2328", 4770, 130);
   Sequence("Wayland's Smithy II")
   {
    Boundary("start WS II");
    Phase("Wayland's Smithy II")
    {
     Sequence("primary construction")
     {
      Phase("ditch II")
      {
       R_Date("OxA-13167", 4649, 41);
       R_Date("OxA-13244", 4683, 39);
```

```
      };
      Phase("transepted chambers")
      {
       R_Date("OxA-13245", 4770, 38);
       R_Date("OxA-13171", 4761, 41);
       R_Date("OxA-13325", 4707, 40);
       R_Date("OxA-13246", 4603, 35);
      };
     };
     Phase("mound II secondary")
     {
      R_Date("OxA-13168", 4547, 54);
     };
    };
    Boundary("end WS II");
   };
   Span("WS I & II");
  };
  // additional constraints
  Sequence()
  {
   Date("=OxA-13175");
   Date("=OxA-14772");
  };
  Sequence()
  {
   Date("=OxA-13170");
   Date("=OxA-13176");
  };
 };
```