# Online Supplementary Information 3

## Bayesian modelling of wood-age offsets in cremated bone

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## Archaeobotanical results

Archaeobotanical analyses of material from 11 urn graves from Aarre urnfield cemetery (Museum no. VAM 1600) were carried out by Henrike Effenberger from Effenberger Archäobotanik. Some graves have multiple numbers from the same context (pit/urn), but this is simply an effect of the excavation procedure. The following results are extracted from three archaeobotanical reports (Effenberger 2017a; Effenberger 2017b; Effenberger 2019). Suitable material for radiocarbon dating was recommended in the reports and we have here provided a list of actual dated samples for each grave.

### Grave A86, x339 (urn)

One charcoal sample was sampled for radiocarbon dating:

AMS no. KIA-53941 *Acer* sp. trunk wood charcoal (0.03 g, Ø >10 cm)

Contents:

* No plant macrofossils
* Several pieces of charcoal, some bigger pieces
* All pieces of charcoal either from oak (*Quercus* sp., trunk, >10 cm in diameter) or maple (*Acer* sp., trunk, >10 cm in diameter)
* no short-lived pieces like twigs, no fragments with visible bark pieces or sapwood.

### Grave A95

Two charcoal samples were sampled for radiocarbon dating (Table 1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Context | AMS no. | Description | Weight | Diameter category of growth ring |
| A95, x368 (large bag) | KIA-53984 | *Quercus* sp. twig | 0.022 g | < 0.3 cm |
|  | KIA-53985 | *Acer* sp. twig | 0.129 g | < 0.5 cm |

Table 1: Charcoal pieces sampled for radiocarbon dating from grave A95.

#### A95 x100 (pit)

Contents:

* Small quantity of plant macrofossils, too small for radiocarbon dating; contains sclerotia of *Cenococcum geophilum*
* Small quantity of charcoal, very small pieces; no short-lived pieces like twigs (Table 2).

|  |  |  |
| --- | --- | --- |
| Taxa | *Quercus* sp. | *Acer* sp. |
| Ø 2-3 cm | - | - |
| Ø 3-5 cm | - | - |
| Ø 5-8 cm | - | - |
| Ø 8-10 cm | - | - |
| Ø >10 cm | 18 | 2 |

Table 2: Diameter of determined charcoal pieces from grave A95, x100.

#### A95, x368 (large bag, pit)

Contents:

* Cremated bone remains
* Various small plant macrofossils, many small fragments of weed stems (perhaps remains of tinder material?); plant macrofossils too small for radiocarbon dating; contains sclerotia of *Cenococcum geophilum*
* Many charcoal pieces, several twigs (Table 3).

|  |  |  |
| --- | --- | --- |
| Taxa | *Quercus* sp. | *Acer* sp. |
| Ø < 0.5 cm | 6 | 5 |
| Ø 2-3 cm | - | - |
| Ø 3-5 cm | 2 | - |
| Ø 5-8 cm | 4 | - |
| Ø 8-10 cm | 9 | - |
| Ø >10 cm | 14 | - |

Table 3: Diameter of determined charcoal pieces from grave A95, x368 (large bag).

#### A95, x368 (small bag, pit)

Contents:

* No plant macrofossils for radiocarbon dating; contains sclerotia of *Cenococcum geophilum*
* Small quantity of charcoal, very small pieces; no short-lived pieces like twigs.

### Grave A99

Four charcoal pieces were sampled for radiocarbon dating (Table 4).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Context | AMS no. | Description | Weight | Diameter category of growth ring |
| A99, x65 | RICH-25067 | *Quercus* sp. trunk | 0.005 g | < 10 cm |
| A99, x65 | RICH-25071 | *Alnus* sp. trunk | 0.006 g | 8-10 cm |
| A99, x346 | RICH-25069 | *Alnus* sp. twig | 0.011 g | < 0.3 cm |
| A99, x346 | RICH-25066 | *Alnus* sp. trunk | 0.031 g | > 10 cm |

Table 4: Charcoal pieces sampled for radiocarbon dating from grave A99.

#### A99, x65 (pit)

Contents:

* No plant macrofossils; contains sclerotia of *Cenococcum geophilum*
* Small quantity of charcoal, very small pieces; no short-lived pieces like twigs (table 5).

|  |  |  |  |
| --- | --- | --- | --- |
| Taxa | *Quercus* sp. | *Alnus* sp. | *Acer* sp. |
| Ø 2-3 cm | - | - | - |
| Ø 3-5 cm | - | - | - |
| Ø 5-8 cm | 2 | - | - |
| Ø 8-10 cm | - | 3 | - |
| Ø >10 cm | 3 | 5 | 3 |

Table 5: Diameter of determined charcoal pieces from grave A99, x65.

#### A99, x346 (urn)

Contents:

* Cremated bones
* A few plant macrofossils, too small for dating; contains sclerotia of *Cenococcum geophilum*
* Many pieces of charcoal; 4 twig fragments from different trees (Table 6).

|  |  |  |
| --- | --- | --- |
| Taxa | *Quercus* sp. | *Alnus* sp. |
| Ø < 0.3 cm | 1 | 3 |
| Ø 2-3 cm | - | - |
| Ø 3-5 cm | - | - |
| Ø 5-8 cm | - | 1 |
| Ø 8-10 cm | - | - |
| Ø >10 cm | 4 | 31 |

Table 6: Diameter of determined charcoal pieces from grave A99, x346.

### Grave A117

Two charcoal pieces were sampled for radiocarbon dating (Table 7).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Context | AMS no. | Description | Weight | Diameter category of growth ring |
| A117, x769 | KIA-53943 | *Quercus* sp. trunk, 1 annual ring | 0.053 g | > 10 cm |
| A117, x774 | KIA-53944 | *Quercus* sp. trunk | 0.097 g | > 10 cm |

Table 7: Charcoal pieces sampled for radiocarbon dating from grave A117.

#### A117, x769 (urn)

Contents:

* No plant macrofossils
* Several pieces of charcoal, some bigger pieces
* All pieces of charcoal from oak (*Quercus* sp., trunk, >10 cm in diameter)
* no short-lived pieces like twigs, no fragments with visible bark pieces or sapwood.

#### A117, x774 (urn)

Contents:

* No plant macrofossils
* Several pieces of charcoal, some bigger pieces
* All pieces of charcoal from oak (*Quercus* sp., trunk, >10 cm in diameter), mostly small annual rings (around 5-10 rings per piece)
* no short-lived pieces like twigs, no fragments with visible bark pieces or sapwood

### Grave A130

Two plant macrofossils were sampled for radiocarbon dating (Table 8).

|  |  |  |  |
| --- | --- | --- | --- |
| Context | AMS no. | Description | Weight |
| A130, x82 no.1 | KIA-53945 | Charred grass stem | 0.007 g |
| A130, x82 no.2 | KIA-53946 | Cereal grain, *Triticum* cf. *aestivum* | 0.018 g |

Table 8: Plant macrofossils sampled for radiocarbon dating from grave A130.

#### A130, x82 (urn)

Contents:

* several plant macrofossils in bad condition
* some seeds, stem fragments of grass, several buds, one caryopsis of millet (*Panicum miliaceum*), one caryopsis of cf. naked wheat (*Triticum* cf. *aestivum*)
* small quantity of charcoal from oak (*Quercus* sp., trunk, >10 cm in diameter), no short-lived pieces like twigs, no visible sapwood

### Grave A155

Two plant macrofossils were sampled for radiocarbon dating (Table 9).

|  |  |  |  |
| --- | --- | --- | --- |
| Context | AMS no. | Description | Weight |
| A155, x127 no.1 | KIA-53948 | Cereal grain cf. *Triticum* sp. | 0.010 g |
| A155, x127 no.2 | KIA-53949 | Grass bulb of *Arrhenatherum elatius* ssp. *bulbosum* | 0.018 g |

Table 9: Plant macrofossils sampled for radiocarbon dating from grave A155.

#### A155, x127 (urn)

Contents:

* several plant macrofossils
* some stem fragments of grass; one bulb of bulbous oat grass (*Arrhenatherum elatius* ssp. *bulbosum*); two cereal caryopses: one indeterminate, one probably of wheat (cf. *Triticum* sp.)
* several pieces of charcoal from oak (*Quercus* sp., trunk, >10 cm in diameter), no short-lived pieces like twigs, no visible sapwood

### Grave A198

One charcoal sample was sampled for radiocarbon dating:

AMS no. KIA-53951 *Alnus* sp. trunk wood charcoal (0.051 g, Ø >10 cm)

#### A198, x338 (urn)

Contents:

* Small quantity of plant macrofossils: stem fragments (grass), too small for dating
* Several pieces of charcoal, some bigger pieces
* All pieces of charcoal either from oak (*Quercus* sp., trunk, >10 cm in diameter) or alder (*Alnus* sp., trunk, >10 cm in diameter)
* no short-lived pieces like twigs, no fragments with visible bark pieces or sapwood

### Grave A278

Two plant macrofossils were sampled for radiocarbon dating (Table 10).

|  |  |  |  |
| --- | --- | --- | --- |
| Context | AMS no. | Description | Weight |
| A278, x782 no.1 | KIA-53953 | Charred grass stem | 0.009 g |
| A278, x782 no.1 | KIA-53954 | Charred grass, stem and root fragment | 0.009 g |

Table 10: Plant macrofossils sampled for radiocarbon dating from grave A278.

#### A278, x782 (urn)

Contents:

* Small quantity of plant macrofossils
* several stem and root fragments of grass, one bud, 1 weed seed (too small for dating)
* several pieces of charcoal from maple (*Acer* sp., trunk, >10 cm in diameter), no short-lived pieces like twigs, no visible sapwood

### Grave A393

Four samples of plant macrofossils and one charcoal sample were sampled for radiocarbon dating (Table 11).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Context | AMS no. | Description | Weight | Diameter category of growth ring |
| A393, x561 no.1 | KIA-52411 | Charred cereal, *Hordeum vulgare nudum* | 0.018 g | - |
| A393, x561 no.3 | KIA-52412 | Charred cereal, *Hordeum vulgare nudum* | 0.021 g | - |
| A393, x561 | KIA-52413 | *Quercus* sp. trunk wood charcoal | 0.010 g | > 10cm |
| A393, x568 no.1 | RICH-25068 | Charred cereal, *Triticum dicoccum* | 0.015 g | - |
| A393, x568 no.2 | RICH-25070 | Charred cereal, *Hordeum vulgare nudum* | 0.010 g | - |

Table 11: Plant macrofossils and charcoal sampled for radiocarbon dating from grave A393.

#### A393, x561 (urn)

Contents:

* Several cereal caryopsis
* Small quantity of charcoal, very small pieces; no short-lived pieces like twigs.

#### A393, x568 (pit)

Contents:

* Several different cereal grains and other plant macrofossils, some weed stems (tinder material?); contains sclerotia of *Cenococcum geophilum*
* Several smaller pieces of charcoal; no short-lived pieces like twigs charcoal from trunk; pieces of four different taxa; no heartwood (Table 12).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Taxa | *Quercus* sp. | *Acer* sp. | *Ulmus* sp. | *Pinus* sp. |
| Ø 2-3 cm | - | - | - | - |
| Ø 3-5 cm | - | - | - | - |
| Ø 5-8 cm | 2 | - | - | - |
| Ø 8-10 cm | - | - | - | - |
| Ø >10 cm | 21 | 9 | 6 | 2 |

Table 12: Diameter of determined charcoal pieces from grave A393, x568.

### Grave A394

Four samples of charcoal and one plant macrofossil were sampled for radiocarbon dating (Table 13).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Context | AMS no. | Description | Weight | Diameter category of growth ring |
| A394, x556 no.1 | KIA-52414 | *Alnus* sp. charcoal from branch sapwood, youngest ring sampled | 0.077 g | 3-5 cm |
| A394, x781 no.9 | KIA-53983 | *Acer* sp. trunk wood charcoal | 0.038 g | > 10 cm |
| A394, x785 no.1 | KIA-52415 | Charred cereal, *Triticum aestivum* | 0.006 g | - |
| A394, x785 no.4 | RICH-25068 | *Alnus* sp. heartwood charcoal | 0.079 g | 2-3 cm |
| A394, x786 no.1 | KIA-52417  | *Quercus* sp. trunk wood charcoal | 0.173 g | >10 cm |

Table 13: Plant macrofossils and charcoal sampled for radiocarbon dating from grave A394.

#### A394, x556 (urn)

Contents:

* No plant macrofossils
* One piece of charcoal, branch of *Alnus* sp.; Ø 3-5cm; 7 annual rings.

#### A394, x567 (pit)

Contents:

* Small quantity of plant macrofossils, not suited for radiocarbon dating
* Big quantity of charcoal, mostly smaller pieces; no short-lived pieces like twigs (Table 14).

|  |  |  |
| --- | --- | --- |
| Taxa | *Quercus* sp. | *Alnus* sp. |
| Ø 2-3 cm | - | 1 |
| Ø 3-5 cm | - | - |
| Ø 5-8 cm | - | 1 |
| Ø 8-10 cm | 2 | 16 |
| Ø >10 cm | 19 | 10 |

Table 14: Diameter of determined charcoal pieces from grave A394, x567.

#### A394, x781 (urn)

Contents:

* Small quantity of plant macrofossils, too small for radiocarbon dating
* Several pieces of charcoal; no short-lived pieces like twigs (Table 15).

|  |  |  |  |
| --- | --- | --- | --- |
| Taxa | *Quercus* sp. | *Acer* sp. | *Alnus* sp. |
| Ø 2-3 cm | - | - | - |
| Ø 3-5 cm | - | - | - |
| Ø 5-8 cm | - | - | - |
| Ø 8-10 cm | - | - | - |
| Ø >10 cm | 12 | 1 | 3 |

Table 15: Diameter of determined charcoal pieces from grave A394, x781.

#### A394, x785 (urn)

Contents:

* One cereal caryopsis
* Several pieces of charcoal; no short-lived pieces like twig; one piece of *Alnus* sp. heartwood (Table 16).

|  |  |  |
| --- | --- | --- |
| Taxa | *Quercus* sp. | *Alnus* sp. |
| Ø 2-3 cm | - | 1 |
| Ø 3-5 cm | - | - |
| Ø 5-8 cm | - | - |
| Ø 8-10 cm | 1 | 4 |
| Ø >10 cm | 4 | 2 |

Table 16: Diameter of determined charcoal pieces from grave A394, x785.

#### A394, x786 (urn)

Contents:

* No plant macrofossils
* One charcoal piece, *Quercus* sp., trunk.

### Grave A484

No samples were radiocarbon dated from this grave.

#### A484, x281 (urn)

Contents:

* No plant macrofossils
* Very small quantity of charcoal, very small pieces; no piece big enough for radiocarbon dating.

## References

Effenberger H. 2017a. Report about the results of the charcoal analysis and selection of datable material for the sites HOM and VAM1600. Effenberger Archäobotanik.

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