**From Roman Table to Anglo-Saxon Grave: An Archaeological Biography of the Scremby Cup**

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Supplementary Material

**Supplementary Material 1**

**Niton XL3T X-Ray Fluorescence analyzer accuracy statement**

Analysis was conducted using a Thermo Scientific Niton XL3T-980 GOLDD X-Ray Fluorescence XRF Analyzer. The device was used in handheld mode set to ‘General Metals’, with a total sample cycle time of 45 seconds; 30 seconds of sample time on the main filter and 15 seconds on the low filter.

Accuracy was determined across a range of compositions using Bureau of Analysed Samples Ltd Certified Reference Materials (CRMs hereafter). Specifically, BAS 344, a brass, and BAS 207/2, a gunmetal, were used. These CRMs were chosen for their relation to heritage manufactured copper and copper alloys, as the main elements deemed useful for categorising alloys are Cu, Zn, Sn, Ni, As, and Pb. Arsenic was determined through an uncertified in-house prepared material that is measured at 7 wt% As. All replicates of the arsenic sample are within 10% CV (coefficient of variation).

Accuracy is expressed as %error and is dependent on element concentrations. For the certified reference materials, achieved accuracy as %error is shown in Table S1. Error associated with lead (Pb) is 23.18% when measured as a trace element, though Niton pXRF measurements are within 0.2% difference to the CRM.

***Table S1.*** *The reference materials showing certified and measured results using a Niton XL3T portable XRF device.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Cu (%) | Sn (%) | Zn (%) | Pb (%) | Ni  (%) | Fe  (%) |
| BAS 344 70/30 Brass | Certified | 68.98 | 0 | 30.98 | 0 | 0 | 0 |
| Measured | 69.25 | ND | 30.69 | ND | ND | 0.04 |
| Accuracy (%error) | 0.39 | 0 | 0.93 | 0 | 0 | 200 |
| BAS 207/2 Gunmetal | Certified | 87.35 | 9.74 | 1.6 | 0.7 | 0.28 | 0.029 |
| Measured | 85.25 | 10.4 | 1.71 | 0.88 | 0.29 | 0.09 |
| Accuracy (%error) | 2.43 | 6.55 | 6.99 | 23.18 | 4.59 | 108.7 |

**Supplementary Material 2**

**Organic residue analysis methods**

The acidified methanol extraction (AE) method is now the most commonly used method in extracting lipids from archaeological samples that favours both high extraction yield and direct methylation for stable carbon isotopes measurements [(Correa-Ascencio & Evershed, 2014)](https://paperpile.com/c/akZiqo/C0Ji). In brief, methanol and concentrated (96%) sulfuric acid were added to ~ 300mg of the residue sample and a soil control before heating at 70°C for 4 hours. After centrifuging, the supernatant was extracted and transferred to a clean labelled hatch tube. The lipid extract was separated from the acid in hexane and passed through a filter pipette with potassium carbonate. The extracts were transferred to a hydrolysis vial and dried under a gentle stream of nitrogen. The extracts were then resuspended in hexane and transferred to an auto-sampling vial for analysis. Prior to extraction 10µg of internal standard (alkane C34:0) was added to the sample and, before analysis by gas chromatography techniques, 10µg of a second standard (alkane C36:0) was added.

**Gas Chromatography analysis**

Both acidified methanol extracts (residue sample and soil control) were screened by gas chromatography fitted with a flame ionisation detector (GC-FID) for quantification and general screening of preservation. An Agilent 7890A Series gas chromatograph was fitted with a DB1-High temperature (HT) column (15 m × 0.32 mm × 0.1 μm). 1 µl of sample was injected via a splitless injector maintained at a temperature of 300°C. The temperature of the column was kept at 100°C for 2 minutes and then increased by 20°C every minute until a final temperature of 325°C was reached. 325°C was then held for 2 minutes. Helium was used as the carrier gas at constant flow. The detector was kept at 300°C with hydrogen flow of 30 ml min−1. This was a short temperature programme for 20 minutes.

Both extracts were analysed using Gas Chromatography Mass Spectrometry (GC-MS). The GC component was an Agilent 7890A series chromatography attached to an MS Agilent 5975 Inert XL mass selective detector with a quadrupole mass analyser (Agilent technologies, Cheadle Cheshire, UK). A DB-5MS (5%-phenyl)-methylpolysiloxane column (30 m × 0.250 mm × 0.25 µm; J&W Scientific, Folsom, CA, USA) was used. The GC column was inserted directly into the ion source of the mass spectrometer. 1 µl of sample was injected via a splitless injector maintained at a temperature of 300 °C. Helium at constant flow was used as the carrier gas. The ionisation energy of the spectrometer was 70eV and spectra were obtained by scanning between *m/z* 50 and 800. The temperature of the column was kept at 50°C for 2 minutes and then increased by 10 °C every minute until a final temperature of 325°C was reached.

With the primary aim to screen for *ω*-(*o*-alkylphenyl) alkanoic acids (APAAs) which are formed through thermal transformation of mono- and polyunsaturated fatty acids present in plant, terrestrial and aquatic oils [(Cramp & Evershed, 2014; Bondetti et al,*.* 2021)](https://paperpile.com/c/akZiqo/ivKD+j3sc). Acidified methanol extracts were analysed on the GC-MS using a DB-23 (50%-cyanopropyl)-methylpolysiloxane (60 m × 0.25 mm × 0.25 μm; J&W Scientific, Folsom, CA, USA) column. The temperature of the column was kept at 50 degrees for 2 minutes and then increased by 10 degrees every minute until 100 degrees. The temperature increased then until 140 degrees by 4 degrees every minute, then until 160 degrees by 0.5 degrees every minute and finally until 250 degrees by 20 degrees every minute. A selected ion monitoring (SIM) method was used to target ions *m/z* 74, 105, 262, 290, 318, 346 for the detection APAAs with carbon lengths C16 to C22 (APAA16-22).

The residue extract was further analysed by Gas Chromatography-Combustion-Isotope Ratio Mass Spectrometry (GC-C IRMS) to determine the stable carbon isotope value of the major fatty acids (C16:0 and C18:0). This approach has been shown to be helpful in distinguishing ruminant adipose (i.e. carcass fats), non-ruminant adipose ruminant dairy fats (Dudd & Evershed, 1998; Copley et al., 2003), as well as marine and freshwater resources based on their δ13C values compared to modern reference values (Craig et al., 2013). An Isoprime 100 (Isoprime, Cheadle, UK) with a Hewlett Packard 7890B series GC (Agilent Technologies, Santa Clara, CA, USA) and an Isoprime GC5 interface (Isoprime Cheadle, UK) was used. A DB-5MS Ultra inert fused silica column (US, 60 m × 0.25 mm × 0.25 µm) was fitted. 1 µl of sample was injected via a splitless injector at a temperature of 300°C. Helium at a constant flow was used as the carrier gas. An Agilent 5975C mass spectrometer detector was attached to the column and half of the gas eluting from the column was directed to and ionized in the mass spectrometer. The other half of the gas eluting from the column was directed to the reactor tube to oxidize carbon species in CO2. The ionization energy of the mass spectrometer was 70 eV and ion intensities of *m/z* 44, 45 and 46 were recorded. IonOS software was used to compute the 13C/12C ratio of the peaks in the extracts (details can be found in previously published works (Craig et al., 2013)).

**Heating markers**

The absence of heating markers in the lipid profiles of the residue, such as ketones (Evershed et al., 1995) or ω-(o-alkylphenyl) alkanoic acids (APAAs) (Bondetti et al., 2020), does not allow us to confirm whether these fats had been heated before entering the copper-alloy vessel, were in the copper-alloy vessel itself, or if they were not processed at all. Ketones are only formed through the heating of fats at high temperatures (>350 °C) or after multiple heating events (Evershed et al., 1995; Evershed, 2008). APAAs, on the other hand, have been shown to form more readily at lower temperatures (<270 °C); here, they were not identified despite the use of sensitive techniques for their detection (Cramp & Evershed, 2014). Note, however, that APAAs can only form in the presence of a clay matrix containing metal ions and would not form if heated directly in the metal vessel (Evershed et al*.,* 1995; Raven et al., 1997; Bondetti et al., 2020).

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