Contribution ID: **84** Contribution code: **AAC-6** Type: **Oral Presentation**

Compound-specific radiocarbon dating of lipids in pottery via SFE-pcGC

Tuesday, 22 October 2024 11:20 (20 minutes)

Radiocarbon dating plays a pivotal role in establishing reliable chronologies in both archaeological and paleoenvironmental studies, spanning over 55,000 years. Pottery, pervasive throughout the Holocene archaeological record, offers a crucial avenue for dating human activity, employing a combination of relative methods such as typology and seriation, alongside absolute techniques. Traditional radiocarbon dating of pottery often relies on carbon fractions from various origins, such as temper or associated organic materials like bone and charcoal. However, inaccuracies can arise from relative dating as a result of stratigraphic uncertainties and poor preservation, whilst the direct dating of different carbon fractions may not accurately reflect the timing of vessel use. Over the past decades, researchers have pursued an alternative avenue; leveraging lipid residues, particularly fatty acids absorbed into pottery walls during the processing and storage of plant and animal-derived foods, for radiocarbon dating [1, 2]. This approach holds promise for delivering highly accurate measurements directly correlating to the use of vessels. At the Oxford Radiocarbon Accelerator Unit, efforts have been made to refine this methodology through compound-specific radiocarbon dating of pottery, employing advanced techniques such as supercritical fluid extraction (SFE) coupled with preparative capillary gas chromatography (pcGC). The adoption of SFE may represent a substantial leap forward, since it has been demonstrated to yield 95% more lipid residue than traditional solvent extraction [3]. This presentation will compare SFE yields to the acidic methanol extraction method. Here, we delineate the developed methodology and present preliminary findings, including analyses conducted on pottery samples sourced from archaeological sites with well-established chronologies.

1. E. Casanova, et al., Accurate compound-specific 14C dating of archaeological pottery vessels. Nature 580, 506–510 (2020).
2. A. W. Stott, et al., Radiocarbon Dating of Single Compounds Isolated from Pottery Cooking Vessel Residues. Radiocarbon 43, 191–197 (2001).
3. T. Devièse, et al., Supercritical Fluids for Higher Extraction Yields of Lipids from Archeological Ceramics. Analytical Chemistry 90, 2420–2424 (2018).

Student Submission

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Session Classification: Applications in Archaeology

Track Classification: Applications in Archaeology