
# UK Archaeological Sciences Conference

## April 3rd – 5th, 2024

**ABSTRACT BOOKLET**

# CONTENTS

# WELCOME

**Welcome to the 2024 UK Archaeological Sciences Conference at the University of York!** The organising committee would like to extend a warm welcome to all participants, both physically and virtually. Over the next three days, we have an exciting lineup of talks, poster presentations, and social events planned for you to enjoy. We extend sincere thanks to our presenters, and participants for their invaluable contributions.

**The UKAS 2024 organising committee:**

**Elizabeth Marshall** | Conference administrator
**Michelle Alexander** | Professor of Bioarchaeology
**Sophy Charlton** | Lecturer in Bioarchaeology
**Oliver Craig** | Professor of Archaeological Science
**Lara Gonzalez Carretero** | Lecturer in Bioarchaeology
**Jessica Hendy** | Senior Lecturer in Palaeoproteomics
**Mik Lisowski** | Technical Specialist in Zooarchaeology
**David Orton** | Senior Lecturer in Zooarchaeology
**Nathan Wales** | Lecturer in Archaeological Science

# SPONSORS

**This event would not be possible without the kind contributions of our sponsors**

**The UKAS 2024 welcome reception is kindly sponsored by Sercon:**

Sercon Limited consistently demonstrates a commitment to advancing scientific research across various disciplines including the field of Archaeology. With a specialised focus on research collaborations, their cutting-edge technologies (including Isotope Ratio Mass Spectrometers, Carbon and Nitrogen Analysers, and Gas Chromatography-Mass Spectrometry systems), Sercon empowers researchers world- wide to delve deeper into the mysteries of our past. Sercon Limited's support reflects their ongoing dedication to fostering innovation and collaboration within the archaeological community.

sercon
innovators in isotopes

---

**Prizes for PhD and Early Career Research oral presentations and posters are kindly sponsored by:**

ANTIQUITY

The Society for Archaeological Sciences
Since 1977

York Archaeology
Pioneering new ways for people to discover, explore and experience archaeology for over 50 years.

---

**The Royal Archaeological Institute are kindly sponsoring a prize for the best oral presentation by a PhD student or early career researcher on a climate-related theme.**

ROYAL ARCHAEOLOGICAL INSTITUTE

# CODE OF CONDUCT

We are committed to providing a safe, harassment-free environment for all attendees and conference staff. We ask that all attendees of the UKAS 2024 conference treat others with respect and communicate thoughtfully, particularly when expressing a different perspective or opinion.

Harassment in any form will not be tolerated at the conference. Harassment includes, but is not restricted to, offensive comments or behaviour, deliberate intimidation, stalking, following, harassing photography or recording, sustained disruption of talks or other events, whether related to sex, gender identity and expression, age, sexual orientation, disability, physical appearance, race, ethnicity, career stage, religion (or lack thereof), or other factors. Persons asked to stop any harassing behaviour are expected to comply immediately. Venue security may be contacted in the event of harassing behaviour. Individuals who feel subject to harassment are asked to report to one of the UKAS organising committee members on site, if they are able, or to contact: `ukas2024@york.ac.uk`.

A poster or talk should not be recorded or photographed without the permission of the presenter. Attendees are asked to respect a presenter's wishes if they do not wish their work to be discussed on social media.

We have drawn on the **Society for Post Medieval Archaeology** and **International Society for Biomolecular Archaeology** in drawing up this Code of Conduct.

# USEFUL INFORMATION

## Pre-conference gathering

For those who arrive in York on Tuesday 2nd April, we will be meeting at **The Market Cat** in the centre of York from 6pm onwards.

## Conference dinner

The UKAS 2024 conference dinner will be one to remember! It will be held on Thursday evening from 6:30-11:00pm at the **Merchant Adventurers' Hall**, a medieval guildhall in the centre of York. Prepare your appetite and your dancing shoes for delicious food and drink, a roaring fire, and a lively ceilidh band!

## Venue

The conference will be held in the **Spring Lane Building**. You can find the Spring Lane Building on **Google Maps** as well as on the Campus map. The main lecture theatre (SLB/118) is fully accessible and has excellent AV equipment.

## Getting to the venue

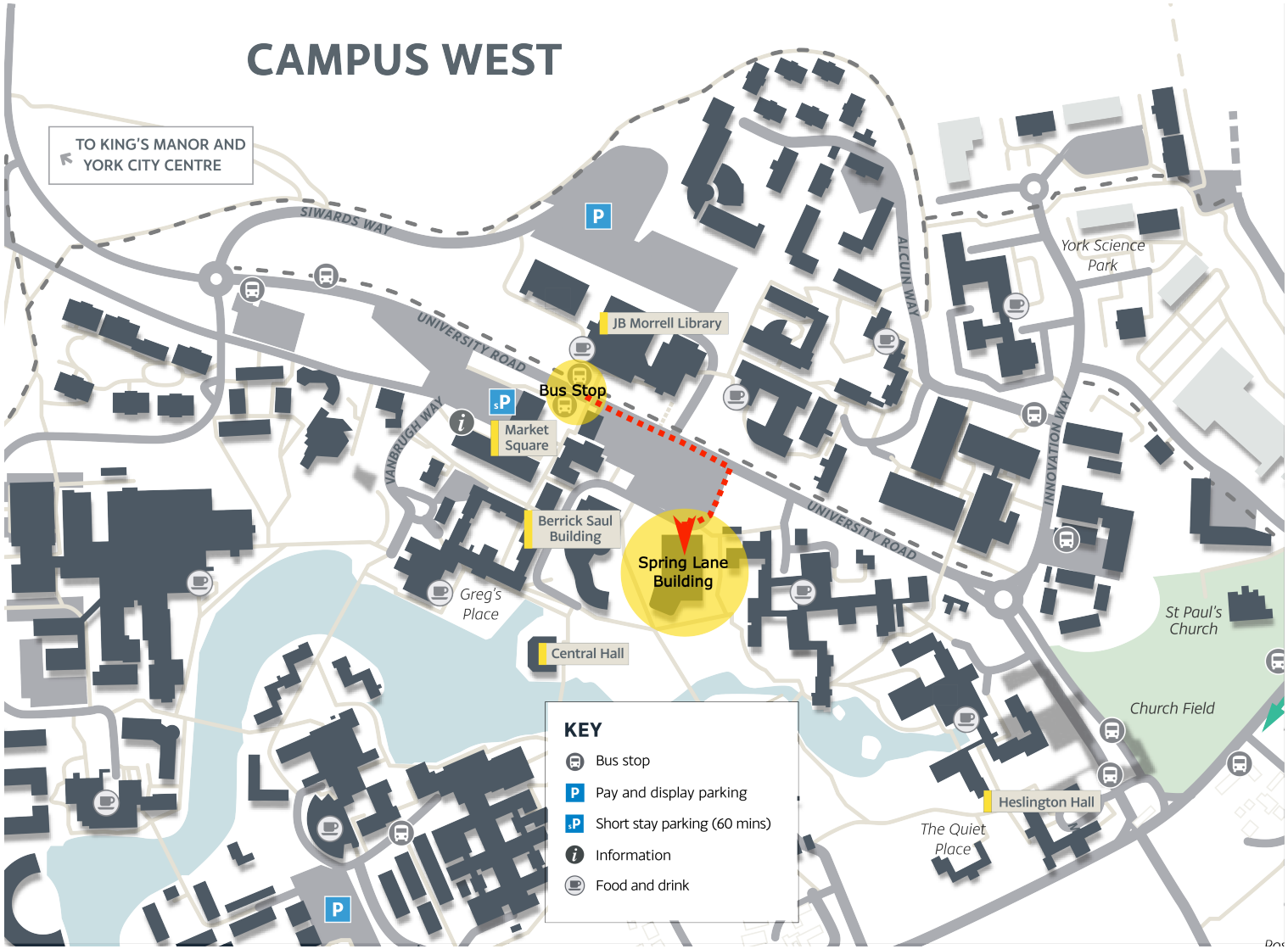
**Walking.** It is approximately 30 minutes to the city centre by foot.

**Cycling.** York is relatively flat and well suited for cycling.

**Bus.** Bus routes 66 and 67 travel between York Station and campus. It is a 2 minute walk (shown on the Campus Map) from the 'University Library' Bus stop to the Spring Lane Building.

Taxis and ride-hailing services are available and relatively inexpensive.

# CAMPUS MAP


CAMPUS WEST
TO KING'S MANOR AND YORK CITY CENTRE
SIWARDS WAY
UNIVERSITY ROAD
VANBRUGH WAY
ALCUIN WAY
INNOVATION WAY
York Science Park
JB Morrell Library
Bus Stop
Market Square
Berrick Saul Building
Spring Lane Building
Greg's Place
Central Hall
St Paul's Church
Church Field
Heslington Hall
The Quiet Place
KEY
Bus stop
Pay and display parking
Short stay parking (60 mins)
Information
Food and drink

# CONFERENCE OUTLINE

## Wednesday

**9:00** **Opening Remarks**
SLB/118

**9:15** **Oral Presentations: People and Lifeways**
SLB/118

**10:30** **Coffee Break**
Spring Lane Building Foyer

**11:00** **Oral Presentations: People and Lifeways**
SLB/118

**11.30** **Oral Presentations: Advances in chronology and dating**
SLB/118

**12:30** **Lunch**
Spring Lane Building Foyer

**1:30** **Oral Presentations: Human plant and animal interactions**
SLB/118

**15:00** **Coffee Break**
Spring Lane Building Foyer

**15:30** **Oral Presentations: Human plant and animal interactions**
SLB/118

**17:00** **Break**

**17:15** **Reception & Poster Session 1**
Seminar Rooms

## Thursday

**9:15** **Oral Presentations: Food diet and cuisine 1**
SLB/118

**10:30** **Coffee Break**
Spring Lane Building Foyer

**11:00** **Oral Presentations: Scientific approaches to materials**
SLB/118

**12:30** **Lunch & Poster Session 2**
Seminar Rooms

**14:15** **Oral Presentations: Methodological advances**
SLB/118

**15:15** **Coffee Break**
Spring Lane Building Foyer

**15:45** **Oral Presentations: Methodological advances**
SLB/118

**18:30** **Conference Dinner**
Merchant Adventurers' Hall, Fossgate, York, YO1 9XD

## Friday

**9:15** **Oral Presentations: Food diet and cuisine 2**
SLB/118

**10:30** **Coffee Break**
Spring Lane Building Foyer

**11:00** **Oral Presentations: Food diet and cuisine 2**
SLB/118

**12:30** **Lunch**
Spring Lane Building Foyer

**13:30** **Oral Presentations: Environments climate and landscapes**
SLB/118

**15:00** **Coffee Break**
Spring Lane Building Foyer

**15:30** **Oral Presentations: Environments climate and landscapes**
SLB/118

**16:45** **Closing Remarks**
SLB/118

# DETAILED OUTLINE | ORAL PRESENTATIONS

**Note:** Presenters eligible for the Early Career Researcher oral presentation prize are marked with a '⋆', and those eligible for the PhD oral presentation prize are marked with a '†'

| WED | **People and Lifeways** | **Chair: Jessie Hendy** |
|---|---|---|
| **9:15** | Archaeometabolomic identification of tobacco use and its relationship to disease in Early Modern Britain | Sarah Inskip⋆ |
| **9:30** | Combining new genome-wide analysis with legacy isotope data: gender and kinship in the first Neolithic societies in central Europe | Penny Bickle |
| **9:45** | Investigating *Yersinia pestis* in Late Neolithic Human and Canine Remains | Magdalena Haller-Caskie† |
| **10:00** | Paget´s Disease of Bone: Insights from the study of Medieval Skeletons in the UK | Silvia Gonzalez |
| **10:15** | Learning lessons from lesions: a ONE palaeopathological approach to understanding entheseal change in elite horses from post-medieval England | Richard Thomas |
| **11:00** | A Bioarchaeological Study of Infant Feeding Practices in Newfoundland, Canada, ca. 1750-1850 CE | Alison Harris⋆ |
| **11:15** | Reconstructing early medieval life histories through multi-isotope and ancient DNA analyses at Lochhead Quarry (Angus, Scotland) | Lucy Koster† |

| WED | **Advances in chronology and dating** | **Chair: Marc Dickinson** |
|---|---|---|
| **11:30** | Old fossils, new information: testing the chronology of Zambian cave site sequences using enamel amino acid geochronology | Chloe Baldreki† |

| | | |
|---|---|---|
| **11:45** | Challenges and lessons from a large-scale application of CSRA on absorbed lipid residues | Isabel Wiltshire |
| **12:00** | Amino acid specific approaches to radiocarbon freshwater reservoir corrections | Corrie Hyland† |
| **12:15** | Dating dung: Radiocarbon dating ovicaprid fecal pellets | Daniel Fuks⋆ |

WED **Human, plant and animal interactions** **Chair: Ele Green**

| | | |
|---|---|---|
| **13:30** | Ancient genomics to explore cattle and human interactions on the Western Atlantic Edge | Victoria E Mullin |
| **13:45** | All about those cattle: Multi-proxy analysis of cattle mobility and management in Middle Neolithic Cova de les Pixarelles (NE Iberia) | Roger Alcàntara Fors |
| **14:00** | Isotopic Perspectives on Cattle Management During the Early and Mid-Neolithic of Mongolia | Moses Akogun |
| **14:15** | Feeding the Roman Army in Britain: new insights from a multi-isotope approach | Leia Mion⋆ |
| **14:30** | Birds, people and “multi-species” networks | Beatrice Demarchi |

**Chair: Nathan Wales**

| | | |
|---|---|---|
| **15:30** | Identification of Asian rice varieties combining traditional morphometrics and geometric morphometrics | Mizanur Rahman† |
| **15:45** | Continuity in Cetamura: Insights into grapevine cultivation and the history of wine | Oya Inanli† |
| **16:00** | Investigating insular pastoralism using foetal and neonatal bone collagen Carbon, Nitrogen and Sulphur stable isotope analysis of Hebridean herbivores | Jennifer Rose Jones |

| | | |
|---|---|---|
| **16:15** | Lipid biomarker evidence for Terminal Pleistocene sheep and goat penning at Abu Hureyra, Syria, from 12,800 calBP | Karen Milek |
| **16:30** | New insights about camelid herding in the Atacama Desert: A diet characterisation using stable isotope analysis | Emilio Andrade† |

## THURS Food, diet and cuisine 1 — Chair: Alejandro Serna

| | | |
|---|---|---|
| **9:15** | An isotopic perspective on the last 10,000 years of European dietary and farming practices | Carlo Cocozza⋆ |
| **9:30** | Trendy isotopes: estimating past rates of change in big datasets | Rowan McLaughlin |
| **9:45** | Stronti-YUM: Exploring diet using radiogenic and stable strontium isotope ratios and concentrations | Hannah F. James⋆ |
| **10:00** | Interpreting ancient cereal practices through the compound-specific stable isotope analyses of absorbed lipid residues | Mengyao Zhang† |
| **10:15** | Parallel worlds, mixed economies: multi-proxy biomolecular analysis for decoding the complexities of early farming in the NE Baltic | Ester Oras |

## THURS Scientific approaches to materials — Chair: Clare Burke

| | | |
|---|---|---|
| **11:00** | Biomolecular perspectives on the uses of birch bark tar in prehistoric Europe | Anna White† |
| **11:15** | Multi-Analytical Assessment of Archaeological Wood Preservation: A Case Study from La Draga, Spain | Deborah Roversi† |
| **11:30** | Production of arsenical bronze using speiss on the Elephantine Island (Aswan, Egypt) during the Middle Kingdom (Middle Bronze Age) | Jiří Kmošek† |

| | | |
|---|---|---|
| **11:45** | Carving methods of Roman-era magical intaglios | Jordan Poole† |
| **12:00** | LIBS and LA-ICP-MS analysis of coloured slips and decorations on Hellenistic tableware | Maja Mise |
| **12:15** | Provenancing Islamic plant-ash glass from the eastern Silk Roads: an isotopic approach | Qin-Qin Lü⋆ |

THURS **Methodological advances** **Chair: Maddy Bleasdale**

| | | |
|---|---|---|
| **14:15** | Quantifying Timescales of Dietary Change using Isotopic Measurements on Bones with Different Turnover Rates | Alistair Pike |
| **14:30** | Developing temporally relevant and spatially robust sulfur ($\delta^{34}$S) isotope baselines for archaeological studies of residence and mobility | Derek Hamilton |
| **14:45** | Coal and Iron in Northern Roman Britain | Elizabeth La Duc† |
| **15:00** | Pyrolysis-GC-MS as a Rapid Means of Distinguishing Coprolites | Helen Whelton⋆ |

**Chair: Lara Gonzalez Carretero**

| | | |
|---|---|---|
| **15:45** | Cortisol in the cusps: investigating dental cortisol methods for assessing stress in living and archaeological populations | Leslie Quade⋆ |
| **16:00** | Mummy nose best: VOCs as a rapid means of assessing the source of Egyptian embalming materials | Wanyue Zhao⋆ |
| **16:15** | Improving taxonomic identification of lipids in archaeological ceramics using high resolution mass spectrometry | Jasmine Lundy⋆ |
| **16:30** | $\delta^{13}$C and $\delta^{15}$N values of modern plants as baselines for palaeodietary and palaeoecological studies | Doris Vidas† |

| | | |
|---|---|---|
| **16:45** | Stable isotope analysis of archaeobotanical remains: a perspective | Amy Styring |

FRI **Food, diet and cuisine 2** **Chair: Sophy Charlton**

| | | |
|---|---|---|
| **9:15** | Neanderthal cannibalism and subsistence at Abri Moula (France): integrating palaeoproteomics, zooarchaeology and taphonomy | Pauline Raymond† |
| **9:30** | Integrating biomolecular methods to understand the ecology, subsistence and diet of early Homo sapiens at Ilsenhöhle in Ranis, Germany | Geoff Smith |
| **9:45** | Optimised seasonal shellfish exploitation strategies by Neanderthals during the Middle Palaeolithic in southern Europe from $\delta^{18}$O ratios of Phorcus turbinatus | Asier García-Escárzaga |
| **10:00** | Lighting up the blindspots: SEM, lipid and protein analysis of Mesolithic-Neolithic foodcrusts | Joannes Dekker† |
| **10:15** | Foodways to Complexity: Isotopes and the metabolism of society in Late Bronze Age Greece | Efrossini Vika |

**Chair: Jasmine Lundy**

| | | |
|---|---|---|
| **11:00** | Feasting at the Ness of Brodgar? Tracing subsistence patterns during the Late Neolithic, Britain using organic residue analysis | Julia Becher† |
| **11:15** | Lifting the Lid on the Hebridean Neolithic: Using Organic Residue Analysis to Reconstruct Foodways in the Hebridean Landscape | Daniel Brown† |
| **11:30** | Pottery spilled the beans: patterns in the processing of foodstuffs in Central Germany from the Neolithic to the Bronze Age | Adrià Breu⋆ |

| | | |
|---|---|---|
| **11:45** | Eating on the Edge of the Empire: Proteomic evidence for ingredients and cuisine in Roman Britain | Miranda Evans† |
| **12:00** | The effect of a change in food availability during the 14th century | Rachèl Spros† |
| **12:15** | Catching up with the Past: Applying Zooarchaeology to Understand Pre-Contact Indigenous Fisheries | Kristin Oliver† |

FRI **Environments, climate and landscapes** **Chair: David Orton**

| | | |
|---|---|---|
| **13:30** | Unveiling the diversity of cetacean exploitation through ZooMS on prehistoric archaeological bone assemblages in southeastern coastal Brazil | Krista McGrath† |
| **13:45** | Fuelling the northern frontier? New research on Roman activity and landscape impacts in the Hadrian's Wall region | Lisa-Marie Shillito |
| **14:00** | Seasonality in the Scottish Islands: Birds as windows of time | Julia Best |
| **14:15** | Multidisciplinary perspectives on the marine historical ecology of fishes in the eastern Mediterranean | Rachel Winter⋆ |
| **14:30** | Four thousand years of marine subsistence, food web dynamics and mercury concentrations in the Aleutian Islands, Alaska | Marjolein Admiraal⋆ |

**Chair: Alice Rose**

| | | |
|---|---|---|
| **15:30** | Exploring early agro-pastoral strategies in the Carpathian Basin through stable isotope data and multiproxy land-use models | Margaux L. C. Depaermentier⋆ |
| **15:45** | Investigating temporal and geographical variation in the dietary behaviour of wolves with dental microwear texture analysis | Amanda Burtt |

| | | |
|---|---|---|
| **16:00** | Detecting climate-mediated site occupation patterns at Palaeolithic sites – a multiproxy stable isotope and lipid biomarker approach | Sarah Pederzani |
| **16:15** | A long-term and seasonally resolved climatic record of Franchthi's stone age | Danai Theodoraki† |
| **16:30** | Reindeer distribution in Late Palaeolithic to Early Mesolithic Sweden: Climatic shifts, human interaction, and environmental dynamics | Markus Fjellström⋆ |

# DETAILED OUTLINE | POSTER SESSIONS

## WED Poster Session 1

| | | |
|---|---|---|
| **P1** | Accessing mini-metabarcodes in shotgun aDNA libraries | Amy Allan-Jones |
| **P3** | Pits and people: Biomolecular, osteological and funerary approaches to the human remains from Danebury Iron Age Hillfort | Madeleine Bleasdale |
| **P5** | The Grain Romans: A Paleopathological Study and Establishment of Demography using Osteological Analysis | Amy Brooks-Cole |
| **P7** | Steppe by Steppe: New Biomolecular Insights into Ancient Mongolian Statecraft | Christina M. Carolus |
| **P9** | Crafting the Past: ZooMS Identification of Chinese Bronze Age Fauna Materials from Huanbei Shang City | Pengpeng Chen |
| **P11** | Tracing Dietary Histories: Human Bone Stable Isotope Analysis in the Republic of Korea | Jisun Choi |
| **P13** | A potential on-site test for the quick detection of sedimentary ancient DNA | Nihan Dilsad Dagtas |
| **P15** | Remodelling variability in human femoral cortical bone and its implications for dietary biographical investigations of stable carbon and nitrogen isotopes | Yasmine de Gruchy |
| **P17** | Taphonomic & diagenetic alteration of tooth enamel, and its potential impact on biomolecular preservation | Marc Dickinson |
| **P19** | Increasing the sensitivity of cereal detection in pottery using UPLC-Q-Orbitrap MS | Jonica Ella Doliente |
| **P21** | A Scientific Study of a Han Ancient Adhesive: First Discovery of The Use of Bovine Bone Powder in Pottery Bonding | Ruochen Ge |

| | | |
|---|---|---|
| **P69** | Biomolecular assessment of human teeth recovered from Monte Abatone Etruscan necropolis: strategies to analyse highly degraded samples | Lilly Vieting |
| **P71** | Sulfur isotopes in archaeological grains and collagen as indicators of past local environments: interim results from controlled growth experiments | Sarah K. Wexler |
| **P73** | What was the impact of the Roman-Early Medieval transition on the health of British populations? | Aster Wood |
| **P75** | Citrullination: A potential proteomic biomarker for rheumatoid arthritis? | Fiona McLeish |

## THURS **Poster Session 2**

| | | |
|---|---|---|
| **P2** | Rapid Enamel-Based Palaeoproteomic Sexing: Developing Mass Spectrometric Methods for Sex Estimation Using Enamel Protein Amelogenin | Charllotte Blacka |
| **P4** | A Bioarchaeological Understanding of the Lifecycle Identity and Lived Experiences of Children During the Anglo-Saxon Period in Southeast England | Alexandra Bowers |
| **P6** | Testing the limits of tiny tooth enamel $\delta^{18}$O and $\delta^{13}$C analyses | Stacy Carolin |
| **P8** | Fastening Roman Britain: a metallurgical characterisation of nails from Fishbourne Roman Palace | Michael Charlton |
| **P10** | Go Your Own Way: Bronze Age Mobility in the Seine Valley with the input of strontium isotope variability mapping | Solène Chevallier |
| **P12** | Reconstructing our evolutionary past using sediment DNA: Best practices and Applications | Pnina Cohen |
| **P14** | Organic residue analysis of Neanderthal stone tools: an example from El Salt (SE Spain) | Javier Davara |

# WEDNESDAY | ORAL PRESENTATIONS | ABSTRACTS

## People and Lifeways

### 9:15

### Archaeometabolomic identification of tobacco use and its relationship to disease in Early Modern Britain

[1]***Sarah Inskip***, [1]*Diego Badillo Sanchez*, [1]*Anna Davis Barrett*, [1]*Maria Serrano Ruber*, [2,3]*Don Jones*

[1]School of Archaeology and Ancient History, University of Leicester [2]Leicester Cancer Research Centre, University of Leicester [3]The Leicester van Geest MultiOmics Facility, University of Leicester

**Abstract:** The arrival of tobacco in post-medieval North Western Europe resulted in one of the biggest global health threats of the modern era. While the impacts of modern tobacco smoking on health are well known, little is known about the situation in the past due to an inability to identify tobacco use, and to link it to disease in historic populations. The Tobacco, Health and History project aims to fill this gap through the development of a metabolomic approach to identify those exposed to tobacco, and to assess how this relates to patterns of disease. We analysed femoral cortical bones samples from 450 pre and post-tobacco skeletons of adults from Barton upon Humber and Industrial London using LC-HRMS. From this we were able to create a metabolomic model that could accurately predict tobacco exposure in archaeological individuals. Our research shows that approximately half the sample was using tobacco, and rates were far higher in women than expected. In addition, the effects of tobacco use on respiratory and oral health were clearer in the population from Barton, a semi-rural community, than they were in highly Industrial London where people would have been exposed to a multitude of pollutants. The results demonstrate that tobacco was likely to be a cause of ill health in past populations, although its impact may have been variable by community due to pre-existing health risks. In addition, it demonstrates the potential of metabolomics to reveal new information about phenotypes that cannot be obtained from other means.

**Keywords: Metabolomics, Tobacco, Health, Biomarkers**

**9:30**

## Combining new genome-wide analysis with legacy isotope data: gender and kinship in the first Neolithic societies in central Europe

[1]***Penny Bickle***, [2]*Pere Gelebert*, [3]*Daniela Hofmann*, [2,4]*Maria Teschler-Nicola*, [5]*Alexandra Anders*

[1]University of York [2]University of Vienna [3]University of Bergen [4]Natural History Museum of Vienna [5]Eotvos Lorand University, Budapest [6]Harvard Medical School

**Abstract:** The early Neolithic in central Europe was almost certainly spread by migration, which has often been characterised as the expansion of pioneering patrilocal lineages. Biomolecular data over the large scale supports these models, with greater mobility for females interpreted as arising in marriage patterns and a very small contribution to the population from the indigenous communities seen in aDNA data. These "big picture" studies have worked to provide rather static conceptions of Neolithic kin-groups through time and across different geographies, with gender often overlooked or only characterised as following modern assumptions about its binary nature. In this paper, we use new genome-wide aDNA sequencing of burials from the Linearbandkeramik (LBK, c.5600-5000 cal BC), comparing results from a cemetery (58 individuals), a settlement (48 individuals), and a massacre site (74 individuals). We assess the aDNA results in light of existing stable isotope data, osteological analysis, and grave good assemblages, to explore how funerary rites may have contributed to alternative senses of belonging in a community which was dynamic and mobile through time. Through examining correlations between isotopes and biological relationships at the three sites, we consider how different forms of biomolecular data can be combined to not only reveal life histories, but also to investigate shared community- and kin-based practices. Using these results, we then reflect on the extent to which broader models of patrilocal and patrilineal practices, and the implicit assumptions made about gender, stand up to the new results.

**Keywords: Genome-wide aDNA, Neolithic, Gender, Isotope analysis**

**9:45**

## Investigating Yersinia pestis in Late Neolithic Human and Canine Remains

***Magdalena Haller-Caskie***, *Julian Susat*, *Joanna H. Bonczarowska*, *Almut Nebel*, *Ben Krause-Kyora*

Institute of Clinical Molecular Biology, Kiel University

**Abstract:** *Yersinia pestis* has been infecting humans since the Neolithic. Whether those early infections were isolated zoonoses or initiators of a Eurasia-wide pandemic remains unclear. Here, we analyze two new *Y. pestis* genomes isolated from Late Neolithic human remains from the site of Warburg (Germany, 5300-4900 cal BP) and find that the two genomes belong to distinct strains associated with independent infection events. Furthermore, all Late Neolithic *Y. pestis* genomes known today are on a basal position in the phylogeny and represent separate lineages that probably originated in different animal hosts. In addition, we investigated whether *Y. pestis* transmission from infected rodents or birds to humans may have been facilitated by dogs as vectors. Thereby, we confirm the presence of *Y. pestis* in a Late Neolithic dog from Sweden, supporting the scenario of isolated zoonoses mediated through early canines.

**Keywords: Ancient DNA, *Yersinia pestis*, Dog, Neolithic**

**10:00**

## Paget´s Disease of Bone: Insights from the study of Medieval Skeletons in the UK

[1]***Silvia Gonzalez***, [2]*Paola Ponce*, [3]*Sam Rennie*, [3]*Carla Burrell et al.*

[1]Liverpool John Moores University [2]York Osteoarcheology and Paleohub, University of York [3]Bournemouth University [5]Frances Crick Institute, London [6]University of Nottingham

**Abstract:** Paget´s Disease of Bone (PDB) disrupts the normal cycle of bone renewal, causing bones to become weakened and susceptible to fractures. Despite remaining the second most common metabolic bone disorder in the modern UK, the origin of PDB remains an enigma. In the past few decades in the UK, remarkable reductions in incidence, age at onset and severity have occured, that can only be explained by rapid changes in environmental triggers. In the archaeological record, evidence of bone changes in human skeletal remains that resemble modern PDB, but with very different features, (e.g. young age-at-onset, extensive disease), have been reported. Using proteomics, we have confirmed that a cluster of Medieval skeletons (11th to 16th Centuries) from the UK´s most excavated monastic site at Norton Priory, Runcorn, were indeed afected by an unusual form of atypical Paget´s. We have stablished that from 128 skeletons up to 54.6% of the population show radiographic evidence of PDB. We have extended the research now to the NE of England to include medieval skeletons from the Lincoln Bypass, Lincolnshire (7th to 9th Centuries) that show strong evidence of PDB. A multidisciplinary approach is used to characterise the medieval skeletons, including: osteoarcheology, stable isotopes analysis (C, N, Sr and O), paleoproteomics, ancient DNA and heavy metal analysis. Our results show a detailed snapshot of Medieval lives for people affected by PDB, together with astonishing high values of lead and arsenic in the skeletons suggesting a strong environmental component as a trigger for PDB.

**Keywords: Osteoarchaeology, paleopathology, heavy metals, Pagets Disease of Bone**

**10:15**

## Learning lessons from lesions: a ONE palaeopathological approach to understanding entheseal change in elite horses from post-medieval England

[1]***Richard Thomas***, [2]*Holly Miller*, [3]*Ludovic Orlando*, [4]*Gareth Cambridge*, [1]*Rachel Small*

[1]University of Leicester [2]University of Nottingham [3]CNRS [4]University of Cambridge [5]University of Newcastle

**Abstract:** When seeking to understand observed palaeopathological phenomena in zooarchaeology, there is an instinctive preference to interpret causal links between lesions and human behaviours. This instinct reflects the centrality of the human that is inherent within archaeology and reflective of post-enlightenment thinking more broadly. Perhaps inevitably, a "human cause first" framework has lead to errors of interpretation – errors that have only been corrected when animals have been considered on their own terms. This experience, stresses the value of a posthuman perspective, which questions the human-oriented hierarchy and encourages new ways of thinking within a flattened ontology. The latter approach is inherent within ONE Palaeopathology, which demands consideration of the complex interaction between biological, environmental and socio-cultural phenomena and necessitates practitioners to take an interdisciplinary approach. In this paper, we emphasise the benefits of this approach, by bringing together multiple specialists and multiple lines of evidence – documentary sources, archaeology, palaeopathology, anatomy, ethology, ancient DNA, dietary stable isotopes – to interrogate and contextualise a recurring entheseal lesion on the radii within a dump of horse bones recovered from outside the stables of an elite post-medieval household. These horses were treated ignominiously in death - knackered and utilised as building materials – but the ONE Palaeopathology approach, contributes to a much richer understanding of their lived experience: as manifestations of a social milieu that granted them a significant status, which included drinking wine.

**Keywords: Palaeopathology, Zooarchaeology, Horse, Post-Medieval**

**10:30-11:00 - COFFEE BREAK**

**11:00**

## A Bioarchaeological Study of Infant Feeding Practices in Newfoundland, Canada, ca. 1750-1850 CE

[1,2]***Alison Harris***, [1]*Carlo Cocozza*, [3]*Geert van Biesen*, [4]*Lindsey Paskulin*, [4]*Jenna Loupret*

[1]Department of Anthropology, Max Planck Institute of Geoanthropology [2]Department of Archaeology, Memorial University of Newfoundland and Labrador [3]Core Research Equipment & Instrument Training (CREAIT) Network, Stable Isotope Laboratory, Memorial University of Newfoundland and Labrador [4]Department of Anthropology,University of British Columbia [5]Department of Earth Sciences, Memorial University of Newfoundland and Labrador

**Abstract:** Family life among European settlers during the development of the Newfoundland cod fishery is understudied from an archaeological perspective. In this presentation, we examine the influence of the unique economic, social, and physical environments of Newfoundland on infant feeding practices during the 18th and 19th centuries. Stable carbon and nitrogen isotope analysis of tooth dentine and bone collagen from 17 human skeletons recovered from two sites in Newfoundland was conducted to estimate dietary histories. This allowed us to estimate a temporal credibility interval during which weaning may have been completed and revealed inter-site differences concerning infant feeding practices. Additionally, we noted that during the weaning process, infants consumed foods that were isotopically dissimilar from those eaten by older children and adults. Compound specific carbon isotope analysis of dentine increment samples from three adult individuals was performed to investigate this further. Peptide sequencing of enamel from the same teeth was also conducted to estimate biological sex. All of the data are considered in relation to the roles that family support systems, the local environment, and historical context play in shaping infant feeding practices.

**Keywords: Amino acids, Weaning, Isotopes, Newfoundland**

**11:15**

## Reconstructing early medieval life histories through multi-isotope and ancient DNA analyses at Lochhead Quarry (Angus, Scotland)

[1]***Lucy Koster***, [1]*Kate Britton*, [2]*Neil Curtis*, [3]*Pontus Skoglund*, [1,4]*Linus Girdland Flink et.al.*

[1]School of Geosciences, University of Aberdeen [2]Museums and Special Collections, University of Aberdeen [3]Ancient Genomics Laboratory, The Francis Crick Institute [4]School of Biological and Environmental Sciences, Liverpool John Moores University

**Abstract:** This study combines multi-isotope and ancient DNA (aDNA) analyses to reconstruct mobility, diet, and biological relatedness at Lochhead Quarry, an early medieval long cist cemetery in Angus, Scotland. Eighteen skeletons dating from the 5th to 7th century cal. CE were recovered from the cemetery during a rescue excavation in 2004 by AOC Archaeology. Analysis of carbon ($\delta^{13}$C), nitrogen ($\delta^{15}$N), and sulphur ( $\delta$34S) isotopes indicates a low protein intake compared to other Pictish sites. These findings and suggest both local residence in later life, and potentially a community composed of relatively lower social status individuals. Our findings of evidence for lifetime mobility ($\delta^{18}$O and 87Sr/86Sr) in combination with little indication of genetic relatedness, is not consistent with previous views that this may have been the cemetery of a 'local' community organised around (biological) kin groupings. This study demonstrates the benefits of utilising multiple biomolecular approaches, alongside other archaeological and osteological methods, to reconstruct individual lifeways.

**Keywords: Ancient DNA, Multi-isotope analysis, Life history, Early medieval**

# Advances in chronology and dating

**11:30**

## Old fossils, new information: testing the chronology of Zambian cave site sequences using enamel amino acid geochronology

[1]***Chloe Baldreki***, [2]*Tom S. White*, [3]*Lawrence Barham*, [1]*Kirsty Penkman*

[1]Department of Chemistry, University of York [2]Department of Life Sciences, Natural History Museum, London [3]Department of Archaeology, Classics and Egyptology, University of Liverpool

**Abstract:** In Zambia, fossil preservation at cave sites such as Twin Rivers and Mumbwa Caves provide rare opportunities to study the region's archaeology and changing palaeoenvironments over the Pleistocene. Dating is crucial to understanding these sites individually, and especially when relating them to the wider mammalian (including hominin) evolutionary patterns; however the chronology of the region is not well understood. Cave depositional histories are notoriously complex and can provide an especially challenging environment to date. Here we propose the use of amino acid geochronology, using the relative dating information from intra-crystalline protein degradation (IcPD) in fossils, as a tool for testing the chronology of cave site stratigraphies. IcPD exploits the time-dependent breakdown of proteins (racemisation, hydrolysis and degradation of amino acids) contained within biominerals (e.g. mollusc shell and teeth). Targeting the intra-crystalline fraction of protein minimises the effects of contamination, leaching and other impacts of the depositional environment, and provides direct dates on relevant fauna, on Pleistocene timescales. Here we discuss the IcPD analysis of mammalian tooth enamel from two cave sites in Zambia, with more general implications for the reliability of interpreting archaeological and palaeoenvironmental material within cave site stratigraphies.

**Keywords: Africa, Cave sites, Dating, Intra-crystalline protein degradation (IcPD)**

**11:45**

## Challenges and lessons from a large-scale application of CSRA on absorbed lipid residues

[1]***Isabel Wiltshire***, [1,2]*Timothy Knowles*, [3]*Joshua Pollard*, [1]*Lucy Cramp*

[1]Organic Geochemistry Unit, School of Chemistry, University of Bristol [2]Bristol Radiocarbon Accelerator Mass Spectrometry Facility, University of Bristol [3]Department of Archaeology, University of Southampton

**Abstract:** The compound-specific radiocarbon dating of individual fatty acids, the most common surviving residues from foodstuffs prepared in vessels, was finally enabled through methodological advances from Casanova and colleagues. Preparative gas chromatography and a novel trapping technique allow for specific compounds extracted from archaeological pottery (generally C16:0 and C18:0 fatty acids) to be separated and radiocarbon dated. This has previously been used to provide dates for the use of vessels and to investigate questions of typochronology and the appearance of certain commodities. One advantage of this method is that dates are determined for two compounds are radiocarbon dated for each vessel, which are usually only considered valid if both measurements are statistically consistent at the 95% confidence level. This provides an internal quality control and in cases where the two measurements are not statistically consistent, the dates are typically rejected and an absolute date for the vessel cannot benot established. In one of the first wide-scale applications of this method, 40 new compound-specific radiocarbon measurements on absorbed lipid residues were obtained to investigate the appearance and spread of the Neolithic in Britain. Whilst this was mostly a successsuccessful overall, some difficulties arosewere encountered, the most common of which was obtaining statistically inconsistent measurements on two fatty acids from the same vessel. Here, I will discuss these inconsistent measurements and the steps taken to resolve them and obtain archaeologically useful information.

**Keywords: Lipid residue analysis, Radiocarbon dating, Neolithic**

**12:00**

## Amino acid specific approaches to radiocarbon freshwater reservoir corrections

[1]***Corrie Hyland***, [1]*Amy Styring*, [1]*Rick Schulting*, [2,3,4]*Andrzej Weber*

[1]School of Archaeology, University of Oxford [2]Anthropology Department, University of Alberta [3]Research Centre "Baikal Region", Irkutsk State University [4]Laboratoire Méditerranéen de Préhistoire Europe Afrique (LAMPEA), Aix-Marseille Université

**Abstract:** Amino acid specific stable isotope and radiocarbon dating techniques are increasingly used to distinguish aquatic and terrestrial foods in past human diets in regions where bulk stable isotope analysis produces overlapping values. These amino acid specific techniques have been applied to address the freshwater reservoir effects among prehistoric hunter-fisher-gatherers within the broad Cis-Baikal region, East Siberia. Current radiocarbon correction equations rely on bulk stable isotope analysis and produce associated uncertainty ranges that have hampered efforts to develop site chronologies at a generational resolution. This has impeded a wide range of archaeological questions regarding kinship, cultural change, and resource use from being explored in greater detail. Our research has applied stable carbon and nitrogen stable isotope analysis on amino acids and radiocarbon dating of the amino acid hydroxyproline to a dataset of archaeological human skeletal remains with known reservoir offset ages, their associated terrestrial fauna, Baikal seals (nerpa) of archaeological age, and modern fish from the Upper Lena River. While amino acid stable carbon isotope analysis was unsuccessful in distinguishing the terrestrial resources from those of the nerpa and Upper Lena River fish, amino acid stable nitrogen isotope analysis distinguished all three food sources through trophic level differences better than bulk collagen $\delta^{15}$N values, and matched well the known offset ages for the human radiocarbon dates from the Little Sea microregion. The results of the hydroxyproline dating will also be compared to the bulk radiocarbon dates with consideration to the hydroxyproline stable carbon and nitrogen isotope values.

**Keywords: Amino acid specific stable carbon and nitrogen isotope analysis, Hydroxyproline radiocarbon dating, Freshwater reservoir effect correction, Hunter-gather-fisher**

**12:15**

## Dating dung: Radiocarbon dating ovicaprid fecal pellets

***Daniel Fuks***

University of Cambridge

**Abstract:** Ancient dung is a scarce but important archaeological resource, encapsulating information on past economies and ecologies. In a recently published study, we found that sheep/goat dung pellets from the Negev desert, Israel, could be radiocarbon dated following acid-alkali-acid pretreatments. Moreover, shavings of the outer surface of the pellets were shown to provide equivalent dates to the inner part of four dung pellets. This is significant for multi-proxy coprolite analysis since the outer surface is a source of biomolecular and microbotanical contamination and is often avoided or discarded in coprolite analysis. Building on these results, we conducted a series of follow-up experiments designed to attempts to confirm or qualify the efficacy of the pellet exterior for reliable radiocarbon dating. These involve tests for consistency, homogeneity, pretreatment effects, and reliability of radiocarbon dates obtained from dung pellet exteriors. This paper presents the latest findings and highlights additional directions for improving the dating of ancient dung. The apparent utility of fecal pellet exteriors for radiocarbon dating will facilitate the application of multiple destructive analyses to a single coprolite, particularly for species with medium-small fecal pellets, such as sheep/goat.

**Keywords: Coprolite, Multi-proxy analysis, Pretreatment, Radiocarbon**

**12:30-13:30 - LUNCH**

# Human, plant and animal interactions

**13:30**

## Ancient genomics to explore cattle and human interactions on the Western Atlantic Edge

*Victoria E. Mullin*
Trinity College Dublin

**Abstract:** The domestication of Bos taurus ∼10.5kya in Southwest Asia was a significant period in human prehistory. The initial migration of cattle across Western Europe concluded with the movement of animals to the Western Atlantic Edge, the islands of Ireland and Britain. For millennia cattle have been an integral source of meat, milk, hide and traction for human societies and subsequently both species have been shaped by one another. One route to explore the cattle:human relationship, and further understand the impact of the domestication process, is the sequencing of ancient cattle nuclear genomes. Utilising a spatio-temporal dataset of >120 ancient cattle genomes, with a specific focus on the Western Atlantic Edge, we explore cattle populations over time and space to identify migration events, genetic replacement and admixture with wild aurochs. This time series dataset further facilitates exploration of the intertwined histories of cattle and humans, highlighting possible animal management strategies including bull choice and timing the selection of present day cattle production traits.

**Keywords: Domestication, Ancient DNA, Cattle, Genomes**

**13:45**

## All about those cattle: Multi-proxy analysis of cattle mobility and management in Middle Neolithic Cova de les Pixarelles (NE Iberia)

[1,2]***Roger Alcàntara Fors*** [1]*Richard Madgwick*, [3]*Laura C. Viñas Caron*, [2]*Kaveh Yousef Pouran*, [2]*Maria Saña Seguí*

[1]School of History Archaeology and Religion, Cardiff University [2]Departament de Prehistòria, Universitat Autònoma de Barcelona [3]University of Copenhagen

**Abstract:** Despite their longstanding importance to pastoralists, how cattle were integrated into early pastoral communities remains relatively poorly understood. This work focuses on the Middle Neolithic site of Cova de les Pixarelles (3942–3632 cal. BCE), located in the northeast of the Iberian Peninsula. The site provides one of the few Iberian contexts of this chronology with a representative assemblage of faunal remains. In addition, it stands out because of its high percentage of cattle remains. This study brings together the results obtained from a comprehensive archaeozoological analysis combined with a paleopathological study, biomechanics, bulk bone collagen carbon ($\delta^{13}$Ccoll) and nitrogen ($\delta^{15}$N) isotopes, sequential analysis of enamel bioapatite oxygen ($\delta^{18}$O) and carbon ($\delta^{13}$Ccarb) isotopes, and strontium ($^{87}$Sr/$^{86}$Sr). This pioneering integrated approach for the Mediterranean provides a high level of biographical detail, further enhancing our understanding of animal management practices during the Middle Neolithic, and providing new insights into the diet, mobility and reproduction rhythms of cattle. Results indicate that the Neolithic communities that used Cova de les Pixarelles mainly exploited these animals for their meat, and were let to roam freely in the available pastures. In addition, evidence of healed trauma suggests that these animals were taken great care of. Optimal pastures were ensured by moving a part of the herd seasonally from lowland areas to higher mountain plateaus, ultimately modifying their reproductive cycles, likely contributing to widening milk availability.

**Keywords: Middle Neolithic, Cattle management, Mobility, Birth seasonality**

**14:00**

## Isotopic Perspectives on Cattle Management During the Early and Mid-Neolithic of Mongolia

[1]***Moses Akogun***, [1]*Lisa Janz*, [2]*Paul Szpak*, [3]*Davaakhuu Odsuren*

[1]Department of Anthropology, University of Toronto [2]Department of Anthropology, Trent University

[3]Mongolian National University of Education

**Abstract:** Recent excavations at Tamsagbulag (8400-7400 cal BP), an Early Neolithic site in Northeastern Mongolia, present evidence of extensive exploitation of large herds, particularly aurochs and equids, among sedentary hunter-gatherers. Results from these excavations, coupled with genomics studies from other sites in East Asia, have raised speculation about the possible management of indigenous East Asian aurochs before and during the adoption of domesticated taurine cattle from the West 5,000 years ago. Here, we use stable isotope analysis to investigate the population structure and diet of selected aurochs and ancient taurine cattle from Mongolia to assess whether these species were managed. Our analysis includes 25 genetically identified bovines drawn from five sites dating from the Early Upper Palaeolithic to the Turkic period ( 35,000-1500 years ago). This isotope analysis includes the oldest DNA-sequenced (low coverage) East Asian auroch. Our data provides insight into changes in cattle diets over the past 35,000 years and offers a new set of data that shed light on cattle-human interactions on the Mongolian plateau.

**Keywords: Isotope Analysis, Cattle Management, Neolithic, Mongolia**

**14:15**

## Feeding the Roman Army in Britain: new insights from a multi-isotopes approach

[1]***Hongjiao Ma***, [1]*Leia Mion*, [2]*Angela Lamb*, [3]*Peter Guest*, [1]*Richard Madgwick*

[1]School of History, Archaeology and Religion, Cardiff University [2]National Environmental Isotope Facility, British Geological Survey [3]Vianova Archaeology & Heritage Services

**Abstract** Provisioning large concentrations of professional soldiers in Britain after the invasion in AD 43 was a major challenge for the Roman imperial administration. In a distant frontier province such as Britannia, it is generally believed that locally produced agricultural resources must have been vital in feeding and maintaining the occupying army, but what happened during the earliest phase of Roman's occupation before local supply system may have been established? This paper focus on the multi-isotope ($\delta^{13}$C, $\delta^{15}$N, $\delta^{34}$S, $^{87}$Sr/$^{86}$Sr) results from the 'Feeding the Roman Army in Britain' project, funded by the Leverhulme Trust, with a particular focus on strontium isotopes $^{87}$Sr/$^{86}$Sr and animal supply networks. A total of 469 fauna specimens (Bos p. taurus, Caprinae, Sus s. scrofa) dating to the earliest phase of Roman's occupation (I-II c. AD) and 46 modern plants from 16 sites of South Wales, Hadrian's Wall and the Antonine Wall regions have been sampled to explore the networks of supply and husbandry strategies that supported the Roman army. This represents one of the largest faunal multi-isotope studies ever undertaken in archaeology. FRAB's faunal strontium isotope dataset from the three frontiers demonstrated diverse networks, with some sites drawing on distant supply lines and others being overwhelmingly reliant on locally-raised fauna. These findings demonstrate that flexible, adaptable strategies were employed in provisioning the army on the frontiers of Britannia.

**Keywords: Multi-isotopes, Zooarchaeology, Roman Archaeology**

**14:30**

## Birds, people and “multi-species” networks

[1]***Beatrice Demarchi***, [1]*Maria C. Codlin*, [2]*Josefin Stiller*, [3]*Camilla Mazzucato*, [3]*Lisa Yeomans*

[1]ArchaeoBiomics, Department of Life Sciences and Systems Biology, University of Torino [2]Centre for Biodiversity Genomics, University of Copenhagen [3]Department of Cross-Cultural and Regional Studies, University of Copenhagen

**Abstract:** Multi-species approaches in archaeological theory shift the attention from people to the network of relationships existing between all living and non-living beings. Most zooarchaeologists have embraced these nuanced interpretations, seeking to trace processes of world co-construction carried out by human and non-human agents. However, this requires reconstructing the full array of biological diversity in the past - a difficult task for groups such as birds, which are species-rich and often poorly represented in the archaeological record. Here we discuss multi-species interactions at Shubayqa in Eastern Jordan, an Early Natufian to Pre-Pottery Neolithic (PPN) A/PPNB site with a long sequence of occupation showing evidence for the management of wetlands as well as for early agriculture. Focussing on the human-bird interface, we assessed the diversity of aquatic avifauna based on osteoarchaeology and palaeoproteomics. Leveraging novel genomic data from the B10K (Birds 10,000 genomes) project, we were able to develop protein-based markers for the taxonomic determination of the eggshell of Anatidae (swans, geese and ducks). Based on the ecological requirements of the species identified, we hypothesise that a stable wetland was present at Shubayqa throughout the Pleistocene-Holocene transition, including the short arid spell of the Younger Dryas, and highlight the importance of tracing “mutual ecologies” in the past. In the future, we will further improve the methods available for the study of avian-human interactions, optimising protein-based techniques but also developing Deep Learning algorithms as an aide to expert zooarchaeologists. The fine-grained information we will obtain will be a strong foundation for multi-species interpretations.

**Keywords: Avian zooarchaeology, Proteomics, Multi-species theory**

**14:45-15:30 - COFFEE BREAK**

**15:30**

## Identification of Asian rice varieties combining traditional morphometrics and geometric morphometrics

[1,2]***Mizanur Rahman***, [1]*Amy Boggard*, [1]*Michael Charles*

[1]School of Archaeology, University of Oxford [2]Department of Archaeology, Jahangirnagar University

**Abstract:** Rice is one of the world's major staple crops, providing nutrition to around one-third of the global population. Recent molecular studies of modern rice have revealed that at least three different rice varieties, japonica, aus, and indica, originated and spread in the geographical region stretching from China to Bangladesh and India between 7000 and 3000 BP. The ability to distinguish rice varieties in archaeobotanical assemblages is fundamental to understanding the evolutionary origin of rice and its routes of dissemination across Asia. This study aims to develop a method to identify the three rice varieties by combining traditional morphometrics and geometric morphometrics (GMM). Distinguishing the varieties of rice based on charred rice grains is challenging. Traditional morphometrics is useful for distinguishing japonica and indica, while the inclusion of aus increases overlap problems in grain forms. GMM is now an established method in archaeobotany for refining the identification of crops and fruits. Building on charring experiments to establish optimal preservation conditions, this study will present preliminary results combining morphometrics and GMM to distinguish modern charred rice grains of japonica, aus and indica. The method is demonstrated through application to early rice assemblages in Bangladesh.

**Keywords: Rice, Identification, Morphometrics, Bangladesh**

**15:45**

## Continuity in Cetamura: Insights into grapevine cultivation and the history of wine

[1,2]***Oya Inanli***, [2]*Jazmin Ramos-Madrigal*, [3]*Nancy De Grummond*, [2]*Hannes Schroeder*, [1]*Nathan Wales*

[1]BioArch, Department of Archaeology, University of York [2]Globe Institute, Faculty of Health and Medical Sciences, University of Copenhagen [3]Department of Classics, Florida State University

**Abstract:** Given its long cultural significance and its link to the development of ancient civilisations, the grapevine (*Vitis vinifera*) is one of the most celebrated domesticated plant species. Despite the academic and wider intrigue, major questions remain about the origins and spread of the vine. At the site of Cetamura del Chianti (Siena, Tuscany), well-preserved grape seeds left by Etruscans and Romans provide an exciting opportunity to understand ancient viniculture better. In this project, we have characterised ancient DNA from these seeds to understand the long-term cultivation of varieties and the types of grapes used in antiquity. We extracted DNA from over 60 grape seeds collected from different locations of the site, dating from 480 BCE to 375 CE. Half of the seeds were particularly well preserved, allowing for genome-wide analysis. The amount of DNA damage confirmed that recovered DNA is indeed ancient and not the result of recent contamination. Our data reveal the use of predominantly domesticated grapevines but some gathering of wild grapes. We observed genetic clones through the sequence, pointing to the long-term propagation of a local variety in antiquity. In addition, kinship analysis of ancient seeds gave the closest match in a database of modern-day varieties. In this ongoing project, we investigate the colour of the grapevine and its contribution to ancient wine to connect genetic information with cultural practices of winemaking. Our analyses highlight that ancient DNA analysis is informative in understanding extinct diversity and expanding our knowledge of past viniculture practices.

**Keywords: aDNA, Cetamura del Chianti, Viticulture, Grapevine**

**16:00**

## Investigating insular pastoralism using foetal and neonatal bone collagen Carbon, Nitrogen and Sulphur stable isotope analysis of Hebridean herbivores

[1] ***Jennifer Rose Jones***, [2] *Jacqui Mulville*

[1]Centre for Field Archaeology and Forensic Taphonomy, University of Central Lancashire [2]School of History, Archaeology and Religion, Cardiff University

**Abstract:** Farming in insular locations can provide extensive challenges due to factors such as fragile soil systems, seasonal coastal flooding and hostile weather conditions. For past populations providing fodder for animals over the winter to ensure survival of animals, and particularly pregnant animals was a challenge. In the Western Isles of Scotland high mortality rates of neonatal cattle and sheep are noted in prehistory and the Norse period. Whether this relates to poor management strategies, or represents a deliberate strategy (e.g. culling of infants linked to milking economies) is hotly debated. In total 91 foetal and neonatal sheep and cattle specimens from Bronze Age, Iron Age and Norse contexts from the sites of Cladh Hallan and Bornais in the Outer Hebrides have been studied using bone collagen $\delta^{13}$C, $\delta^{15}$N and $\delta^{34}$S analysis to inform on the management of pregnant and nursing animals during prehistoric and historic periods. Results show that seaweed was being consumed by ewes in all periods, with high inter-individual variability indicative of ad hoc management rather than specialist strategies. Cattle results through time suggest that they were provided with terrestrial fodder, and could support the hypothesis that they were being carefully managed for milking. Clear differences in $\delta^{15}$N between adults, nursing animals, and foetal animals informs on fractionation between parents and offspring of domestic herbivores. The analysis of juvenile and neonatal animals helps to provide an holistic understanding of pastoral strategies in the past.

**Keywords: Neonatal, Foetal, stable isotopes, Zooarchaeology**

**16:15**

## Lipid biomarker evidence for Terminal Pleistocene sheep and goat penning at Abu Hureyra, Syria, from 12,800 calBP

[3]***Karen Milek***, [1,2,3]*Loïc Harrault*, [3]*Peter Rowley-Conwy*, [4]*Alexia Smith*, [5]*Andrew Moore*

[1]Univ Brest, CNRS, IRD, Ifremer, LEMAR, Plouzané [2]CNRS, EPHE, PSL, UMR METIS, Sorbonne Université [3]Department of Archaeology, Durham University [4]Department of Anthropology, University of Connecticut [5]Department of Sociology and Anthropology, Rochester Institute of Technology

**Abstract:** Ungulates were first domesticated in Southwest Asia, but the precise locations, dates, and social processes involved in this important transformation in human-animal relations remain poorly understood. This study contributes to the debate by presenting the first application of faecal lipid biomarkers (stanols) to the identification of the wild animal species held at an Epipalaeolithic site by hunter-gatherers. Lipids were extracted from sediment samples and from the amorphous organic matter recovered in flotation residues dating to c. 12,800-8,000 calBP from Abu Hureyra 1, in Syria, which had been archived for 50 years and recently analysed for calcareous faecal spherulites (Smith *et al.* 2022). The results demonstrated that faecal stanol concentrations in indoor and outdoor occupation surfaces and fire features were closely related to faecal spherulite concentrations. Multivariate analysis (HCPC) of the six stanols recovered from the archaeological samples allowed stanol signatures to be identified to species level based on their degree of similarity with modern faecal reference samples. Results clearly indicate that the faecal material on the site was derived from sheep and goats, not gazelle. Their dung was put to use as a fuel from the earliest phase of holding these animals and was burnt alongside wood from at least 12,800 calBP. The novel methods employed in this study, particularly the first recovery of lipids from the amorphous organic 'dust' in flotation residues, open a powerful new approach for investigating past human-animal relations, including the very earliest steps towards domestication.

**Keywords: Lipid biomarkers, Faecal stanols, Dung spherulites, Animal domestication**

**16:30**

## New insights about camelid herding in the Atacama Desert: A diet characterisation using stable isotope analysis

[1]***Emilio Andrade***, [1]*Catalina Campos*, [2]*Ariel Sperling*, [1]*Francisca Santana-Sagredo*, [3]*Petrus le Roux et.al.*

[1]Escuela de Antropología. Pontificia Universidad Católica de Chile [2]Independent Researcher [3]Department of Geological Sciences, University of Cape Town [4]Departamento de Antropología. Universidad de Chile [5]Instituto de Ciencias Naturales Alexander von Humboldt. Universidad de Antofagasta

**Abstract:** Dating to the Late Intermediate Period (LIP) (AD 900-1450), Pica 8 is a cemetery located in the Atacama Desert, northern Chile. Agro-pastoralist practices were common in this period, including camelid management. This is evidenced by the presence of complete mummified individuals, bones, fibres and textiles. However, questions remain whether these camelids were herded in the Pica Oasis itself, or at higher altitudes in the Andes. Therefore, the aim of this work is to characterise the diet of camelids from Pica 8 to evaluate their possible provenance during the LIP. A total of 41 samples were analysed for diet characterisation including textiles (n=29), bones (n=11) and fibres (n=1). Stable carbon and nitrogen analyses were carried out in all the samples. Results show $\delta^{13}$C and $\delta^{15}$N -17.9 ± 3.4‰ and 10.5 ± 3.7‰ for textiles, -10.6 ± 4.1‰ and 15.6 ± 6.6‰ for bones, and -10.3‰ and 21.7‰ for the fibre sample, respectively. Results from textiles indicate that camelids consumed non-fertilised C3 plants. However, bones and fibre suggest a diet based on the consumption of seabird-fertilised C4 plants. Following this, it is suggested that the wool used for textile production came from camelids feeding largely on C3 plants, probably in the surroundings of Pica. Conversely, camelids with higher values of $\delta^{13}$C and $\delta^{15}$N likely lived in the oasis and were probably fed by humans. This could indicate that such animals were raised for consumption and/or as companion animals.

**Keywords: Camelids, Management, Diet, Stable Isotopes**

# THURSDAY | ORAL PRESENTATIONS | ABSTRACTS

## Food, diet and cuisine 1

**9:15**

### An isotopic perspective on the last 10,000 years of European dietary and farming practices

[1,2]***Carlo Cocozza***, [3]*Silvia Soncin*, [3]*Giulia Formichella*, [3]*Martina Farese*, [1,4,5,6]*Ricardo Fernandes*

[1]Department of Archaeology, Max Planck Institute of Geoanthropology [2]MAReA Centre, Università della Campania "Luigi Vanvitelli" [3]Dipartimento di Biologia Ambientale, Sapienza University of Rome [4]Faculty of Arts, Masaryk University [5]Climate Change and History Research Initiative, Princeton University [6]Department of Bioarchaeology, University of Warsaw

**Abstract:** Isotopic analysis has emerged as a critical tool in archaeological research, enabling the establishment of chronologies, reconstruction of paleoenvironments and -climates, and the exploration of ancient human diets and mobility, among other applications. The prolific production of isotopic measurements has led to their aggregation into structured repositories to explore new research avenues across spatiotemporal scales. This presentation illustrates the potential of continental scale isotopic meta-analyses to delve into the development of past human societies and their response and resilience to a spectrum of anthropogenic and environmental pressures. To do so, we employ data from the IsoMemo collaborative network (https://isomemo.shh.mpg.de/about/) and Bayesian modelling developed within this initiative. As a case-study, here we focus on Europe. Preliminary results reveal links between isotopic shifts and large-scale historical events, mapping out patterns of human adaptations to political upheavals, socio-economic transformations, cultural and religious clashes, pandemics, and climate change. This presentation will delineate the main findings relatively to European dietary and farming practices and discuss their implications for our understanding of historical human resilience and adaptability.

**Keywords: Stable Isotope Analysis, Big Data, Bayesian Modelling, Human Lifeways**

**9:30**

## Trendy isotopes: estimating past rates of change in big datasets

***Rowan McLaughlin***

Maynooth University

**Abstract:** Decades of work have resulted in thousands of published stable isotope measurements of archaeological material from around the world. Many new studies are seeking to obtain ever larger sets of new measurements to address questions of economic change and mobility. Finding patterns in these data is made complicated by chronological uncertainty (e.g. radiocarbon calibration), with most studies relying on time-slicing to estimate diachronic change. This paper introduces new Bayesian modelling approaches and software tools for developing dynamic time series for isotopic (and other) data. These allow the rate of change to be dynamically modelled, resulting in a statistic that is directly interpretable in terms of human behaviour. These tools are made available via a new-user friendly 'R' package. In a case study from Ireland, the application of these methods has revealed subtle but significant spatial and temporal patterns in stable carbon and nitrogen isotope data from human bone, which can now be interpreted in terms of the changing relationships between human cultural practices, settlement density and ecology. We also explore how simulation experiments using these techniques are useful in study design.

**Keywords: Isotopes, Dating, Statistics, Bayesian**

**9:45**

## Stronti-YUM: Exploring diet using radiogenic and stable strontium isotope ratios and concentrations

***Hannah F. James***, *Carina T. Gerritzen*, *Anneminne Frère*, *Yasmine Cornelissen*, *Christophe Snoeck*

Archaeology, Environmental changes & Geo-Chemistry research group, Vrije Universiteit Brussel

**Abstract:** Diet is a fundamental aspect of human society, and one that can provide crucial information about past populations. Commonly, carbon and nitrogen isotopes are employed to identify diet. In the case of cremated remains, where the process of cremation has irrevocably altered carbon and nitrogen isotope ratios, recent developments in stable strontium ($\delta^{88}$Sr) might provide us with the chance to view diet. This presentation will showcase simultaneous triple strontium ($^{87}$Sr/$^{86}$Sr, $\delta^{88}$Sr, and [$^{Sr}$]) data from modern food products, and archaeological animal and human remains, and highlight the potential for diet to be visible using just strontium measurements. Firstly, modern food experiments and archaeological animal samples show the difference in $\delta^{88}$Sr between marine and terrestrial resources as well as differences between terrestrial animals with different digestive tracts. Secondly, through applying these triple strontium proxies to archaeological remains, socio-cultural features of diet appear to emerge. Data from cremated remains in Belgium show potential signals of breastfeeding and salt consumption, and when compared to archaeological evidence from sites (such as grave good topology), social stratification in diet is seen. Lastly, this presentation will highlight the future potential in the application of these triple strontium proxies in archaeology and beyond.

**Keywords: Strontium isotopes, Diet, Stable strontium**

**10:00**

## Interpreting ancient cereal practices through the compound-specific stable isotope analyses of absorbed lipid residues

[1]***Mengyao Zhang***, [1]*Melanie Roffet-Salque*, [2]*Lucy Cramp*, [1]*Richard Evershed*

[1]Organic Geochemistry Unit, School of Chemistry, University of Bristol [2]Department of Anthropology and Archaeology, University of Bristol

**Abstract:** While animal fats are by far the most widespread class of lipid residue preserved in archaeological potsherds, the possibility of mixing foodstuffs in vessels is evident from the detection of plant and beeswax lipid residues in some sherds. Such 'mixed' extracts are usually excluded from isotopic analyses aimed at determining the origins of the animal fat components. Further complications arise when cooking foodstuffs comprise mixtures of C3 and C4 origins. This particularly relevant in regions where broomcorn millet (*Panicum miliaceum*) was introduced by pioneer farmers alongside domesticated animals. Broomcorn millet processing has been identified in lipid extracts of archaeological potsherds based on miliacin biomarker at a number of sites in Central Asia accompanied by abundant animal fats. We have conducted degradation experiments to explain the unusually high abundances of miliacin seen in potsherds lipid extracts. We now explore the effects of processing varying proportions of millet grains with animal products on the $\delta^{13}$C values of C16:0 and C18:0 fatty acids used to assign the origins of animal fats. A combination of theoretical mixing calculations and cooking experiments were used to test different scenarios of mixing animal products and millet grains. In all instances the millet fatty acids were found to be 'invisible' when processed with meat or dairy products due to 'over-printing' by the abundant animal acyl lipids. Thus, the $\delta^{13}$C values of C16:0 and C18:0 fatty acids can be used confidentially to determine the origins of animal fats even when millet processing is detectable through the milaicin biomarker.

**Keywords: Compound-specific $\delta^{13}$C values, Lipid residues, Broomcorn millet, Animal origins**

**10:15**

## Parallel worlds, mixed economies: multi-proxy biomolecular analysis for decoding the complexities of early farming in the NE Baltic

[1,2,3]***Ester Oras***, [1,2]*Mari Tõrv*, [2]*Kristiina Johanson*, [2]*Eve Rannamäe*, [4]*Alexandre Lucquin*

[1]Institute of Chemistry, University of Tartu [2]Institute of History and Archaeology, University of Tartu [3]Swedish Collegium for Advanced Study (SCAS), Linneanum [4]BioArCh, Department of Archaeology, University of York

**Abstract:** The transition from foraging to farming was a key turning point in ancient socio-economies, but the complexities and regional variations of this transformation are still poorly understood. Here we present an extensive multi-proxy dietary overview combining zooarchaeological, archaeobotanical, dietary stable isotopes and pottery lipid residue analysis. These combined methods help to reveal the nature and extent of early farming in the 3rd millennium cal BCE in the NE Baltic; a region characterised by stable and affluent forager communities in northern latitudes. Our results show that farming was introduced by genetically different incoming Corded Ware groups. Intriguingly, however, certain dietary segregation existed within these communities, with some having more access to domesticates, others incorporating more wild resources into their diet. The Corded Ware groups co-existed in parallel with local hunter-fisher-gatherers, who remained true to their wild resources without any indication of the adoption of domesticates. There was no transition from foraging to farming in the 3rd millennium cal BCE in the NE Baltic. Instead, we see a complex system of parallel worlds with local foragers continuing their wild lifeways, and incoming farmers practicing mixed economies, with the continuation of these subsistence strategies for at least a millennium after the first encounter with domesticated animals.

**Keywords: Early agriculture, Ancient diet, Biomolecular archaeology, NE Baltic**

**10:30-11:00 - COFFEE BREAK**

# Scientific approaches to materials

**11:00**

## Biomolecular perspectives on the uses of birch bark tar in prehistoric Europe

[1,2]***Anna White***, [2,3]*Tabea Koch*, [3]*Martine Regert*, [1]*Hannes Schroeder*

[1]Globe Institute, Faculty of Health and Medical Sciences, University of Copenhagen [2]Department of Archaeology, University of York [3]Université Côte d'Azur, CEPAM, CNRS, Nice

**Abstract** Birch bark tar has been widely used since the Middle Pleistocene in Europe for hafting stone tools or, later, for repairing ceramics. Pieces of birch tar are often found with tooth imprints indicating that they were chewed. However, the exact uses of birch tar and why it was chewed remain debated. Ancient DNA analyses provide a new way of analysing ancient birch tar that can provide new insights into its uses in the past. Here we combined GC-MS analyses with shotgun DNA sequencing to characterise the composition of archaeological birch bark tar from Neolithic contexts in Europe and to explore its uses. The GC-MS analysis enables the identification of natural compounds including betulin and lupeol and their degradation markers that are characteristic of birch bark and are thought to have antibacterial properties, while the DNA analyses enable us to determine whether or not the pieces were chewed and to identify potential additives, which can shed light on how it was used or why it was chewed. In addition, the human DNA from the tar enables us to determine the genetic sex of the individuals who chewed the tar, giving fascinating insights into gendered practices of tool use and manufacture in the past. Our results highlight how combining GC-MS analysis with ancient genomics can provide new insights into the uses of birch bark tar artefacts and the technological choices of prehistoric communities.

**Keywords: Birch bark tar, aDNA, Ancient metagenomics, GC-MS**

**11:15**

## Multi-Analytical Assessment of Archaeological Wood Preservation: A Case Study from La Draga, Spain

[1,2]***Deborah Roversi***, [1]*Kirsty Penkaman*, [1]*Kirsty High*, [2]*Isabelle Théry-Parisot*

[1]Department of Chemistry, University of York [2]CEPAM (UMR7264) Cultures, Environnements : Préhistoire, Antiquité, Moyen-Age, Université Côte d'Azur - CNRS

**Abstract** The presence of well-preserved wood in archaeological sites is a rare occurrence, with wood materials being vulnerable to chemical and biological degradation during both burial and post-excavation phases. Despite its fragile nature, archaeological wood provides valuable insights into past societies, including environmental management and technological skills in crafting wooden artefacts. A thorough understanding of the preservation state is crucial to plan conservation and display conditions for such artefacts. Given the complexity of wood materials, a multi-analytical approach is vital in obtaining a clear picture of the present state of decay of wooden materials. Wood morphology is examined through optical and scanning electron microscopy (SEM), offering insights into biological attacks and structural integrity. The integration of SEM with energy-dispersive X-ray spectroscopy (EDS) enables targeted analysis of inorganic content on sample surfaces. Chemical degradation is assessed through molecular techniques such as attenuated total reflectance infrared spectroscopy (ATR-FTIR), pyrolysis gas chromatography/mass spectrometry (Py-GC/MS), and evolved gas analysis/mass spectrometry (EGA-MS). These techniques provide molecular-level information on wood components, aiding in understanding decay causes and establishing preventive conservation measures. This multi-method approach was applied to archaeological wood samples from La Draga (Banyoles, Spain), a lake dwelling dating from 5300–4900 cal BC, which shows exceptional wood preservation. This case study provides insights into the preservation of different taxa and their potential variations across diverse site areas characterised by distinct soil conditions. This emphasises the approach's applicability to assess the preservation of archaeological wood and other lignocellulose-derived materials.

**Keywords: Archaeological wood, Preservation study, Analytical approach**

**11:30**

## Production of arsenical bronze using speiss on the Elephantine Island (Aswan, Egypt) during the Middle Kingdom (Middle Bronze Age)

[1,2] ***Jiří Kmošek***, [3] *Martin Odler*, [4] *Peter Kopp*, [4] *Johanna Sigl*

[1]Nuclear Physics Institute, Academy of Sciences of the Czech Republic [2]Institute of Science and Technology in Art, Academy of Fine Arts Vienna [3]Newcastle University [4]German Archaeological Institute, Cairo branch

**Abstract** We would like to present in this paper the first direct evidence of the copper alloying by arsenic in Ancient Egypt, i.e. the evidence of the production of arsenical bronze. The material in question comes from a well-stratified and well-dated context of the Middle Kingdom settlement on the Elephantine Island, within Aswan city. The main deposits are datable from the Eleventh to Thirteenth Dynasty. Almost 500 stratified metallurgical remains (slags, fragments of crucibles, casting prills), minerals and finished produced artefacts were documented and analysed using the pXRF in the site magazines. Selected 48 metallurgical by-products were studied more in detail using metallographic methods (at the laboratory of the Institut français d'archéologie orientale du Caire, pôle Archéométrie) and the SEM/EDX (Desert Research Center), with the research supported overall by the Ministry of Tourism and Antiquities. Secondary metallurgical operations including melting, casting, alloying and possible recycling, processing unalloyed copper, mostly arsenical copper and also ternary alloy of copper, arsenic and tin were recorded within this extensive analytical research. Evidence of the copper alloying by arsenic and intentional production of arsenical bronze at the site is supported by the finding of speiss fragment, coming from the remains of House 175, datable to the advanced Twelfth Dynasty (18th Century BC). This newly studied material makes the corpus from the Elephantine Island a crucial contribution to the understanding of the processes of Middle Kingdom copper metallurgy in Egypt.
**Keywords: Arsenical bronze production, Middle Kingdom, Elephantine Island, Speiss**

**11:45**

## Carving methods of Roman-era magical intaglios

***Jordan Poole***

University of Liverpool

**Abstract** The work of Sax and Meeks (et al.), building on the foundational studies of Gorelick and Gwinnett, demonstrated the application of latex casts and SEM imaging for identifying the lapidary tools used to carve ancient seals and intaglios. Beyond the tools used for carving, we know almost nothing about how ancient skilled artisans were able to carve intricate designs onto miniscule gemstone surfaces. This paper outlines the results of modern digital microscopy 2D and 3D image analysis of 'Anguiped-style' gems, and presents the benefits of this non-destructive and flexible approach over a SEM. 3D depth analysis of individual carving grooves can not only identify the tool used for carving, but their size and shape. The depth and positioning of individual marks illustrates the order of the carving, which when analysed with compositional observations, as well as the identification of carving mistakes, indicates the extent to which the complex designs were planned and actioned. Vector maps of the carving strokes are created and analysed for directionality data, which can indicate the use of rigs or a workflow that would have optimised the carving process. Commonalities and differences in results for iconography and inscriptions address the literacy competencies of the carvers, or the involvement of multiple hands. In addition, the extent to which the category of Anguiped-style gems is consistent will be assessed and the variance of quality and approach to carving acknowledged.

**Keywords: Microscopy, Intaglios, Production, 3D analysis**

**12:00**

## LIBS and LA-ICP-MS analysis of coloured slips and decorations on Hellenistic tableware

***Maja Mise***, Michael Charlton

UCL, Institute of Archaeology

**Abstract:** Greek and Hellenistic painted vases have captivated scholars primarily owing to their artistic significance and depictions of ancient daily life. As advancements in scientific methods for analysing ancient ceramics have unfolded, researchers have increasingly directed their focus towards the technological aspects of these vases. Analytical methods offer insights into various facets, including the application of coloured slips and decorations, as well as the firing temperatures of the vases. However, delving into the study of slip composition and the vase body poses challenges due to the thin layers of slips applied to the surface. Distinct analytical techniques are employed for the chemical characterization of slips (commonly using SEM) and the bulk composition of the vase body by XRF, ICP-MS, and INAA. The complexity of techniques involved can make it challenging to compare the overall compositions of the clay used for slips and the vase body. Additionally, museum curators are often hesitant to provide samples for analysis because these chemical characterization methods can be intrusive. To address the inquiry into slip coating technology on vases, we undertook simultaneous compositional analysis of slips and bodies of fine Hellenistic ware using LIBS (Laser-Induced Breakdown Spectroscopy) and LA-ICP-MS (Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry). Our study centres on the coloured slipped Hellenistic tableware from the Greek town of Issa (island of Vis) in Croatia. The application of these analytical methods yielded valuable results, unveiling significant compositional differences between the slips on the surface and the body of the vases in certain types of wares.

**Keywords: Hellenistic ware, Coloured slips, Chemical composition, LA-ICP-MS**

**12:15**

## Provenancing Islamic plant-ash glass from the eastern Silk Roads: an isotopic approach

[1]***Qin-Qin Lü***, [2]*Julian Henderson*, [3]*Germain Bayon*, [4]*Hassan Basafa*, [1]*Marcos Martinón-Torres*

[1]University of Cambridge [2] University of Nottingham [3]Institut Français de Recherche pour l'Exploitation de la Mer [4]University of Neyshabur

**Abstract** Compared to plant-ash glass from the Near East, the production and trade of plant-ash glass from the eastern Silk Road regions, including Iran, Central Asia, and Xinjiang (China), are not well understood. Here, we present research on plant-ash glass provenance in these regions through the application of Sr and Nd isotopes. Sr and Nd isotopes are respectively used to trace the major glassmaking materials – plant ash and silica. The glass isotopic signatures can be compared to those of bioavailable Sr and detrital Nd isotopes for demarcated zones in the Tigris-Euphrates River Basin, Iran, and Central Asia, serving as the geochemical benchmark for raw material provenancing. We provide a pilot study on an 11th–12th century assemblage excavated in Shadyakh, Nishapur, Iran. We found different origins for these artefacts and suggest that the decentralised glass industry in Islamic-period West and Central Asia likely thrived by exploiting and sharing diverse, regionally characteristic raw material sources. Our research demonstrates the utility of Sr-Nd isotopes in characterising diverse plant-ash glasses from the eastern Silk Road regions.

**Keywords: Islamic plant-ash glass, Sr-Nd isotopes, Silk Roads, Provenance**

## 12:30-14:15 - LUNCH & Poster Session 2

# Methodological advances

## 14:15 Quantifying Timescales of Dietary Change using Isotopic Measurements on Bones with Different Turnover Rates

[1]***Alistair Pike***, [1,2]*Miriam Andrews*

[1]Department of Archaeology, University of Southampton [2]Institute of Sustainable Heritage, University College London

**Abstract:** Carbon and Nitrogen isotope ratios ($\delta^{13}$C and $\delta^{15}$N) of bone collagen are commonly used in archaeology to reconstruct past diets. A number of studies have shown the potential of sampling skeletal elements that form at different times, or have different turnover rates, to identify dietary changes over time and reconstruct 'life histories' of past individuals. There are many possible reasons for dietary change, but when several individuals show the same change, this may be an indication of the centralised provision of food (e.g., in hospitals, military units etc.). Here we present a model to quantify timescales of dietary change using $\delta^{13}$C and $\delta^{15}$N measurements on bones with different turnover rates (e.g. ribs and longbones) for individuals who have shared the same diet. Application of the model to published $\delta^{13}$C and $\delta^{15}$N data from the Viking-age mass grave on Ridgeway Hill, Dorset, UK, shows two groups that may have shared the same diet, and may be consistent with the sharing of food in households, or military units. The model, when applied to new $\delta^{13}$C and $\delta^{15}$N measurements from St Mary Magdalen Leper Hospital, Winchester, UK, shows the average residence time of those with leprous lesions to be less than 3 years. This is much shorter than the average longevity of lesioned individuals estimated from a published mortality hazard model based on a Medieval Danish cemetery, and may suggest St Mary Magdalen was offering end of life care to extreme cases of leprosy rather than serving to isolate leprosy victims from wider society.

**Keywords: Bone turnover, Dietary Change, Stable Isotopes, Leprosy**

## 14:30 Developing temporally relevant and spatially robust sulfur ($\delta^{34}$S) isotope baselines for archaeological studies of residence and mobility

[1]***Derek Hamilton***, [1]*Kerry Sayle*, [2]*Katharine Steinke*

[1]Scottish Universities Environmental Research Centre, University of Glasgow [2]University of Edinburgh

**Abstract** Many of the central questions of archaeology engage directly with themes relating to movement, mobility, and migration. The two most common isotope systems that have been exploited for this purpose are strontium (87Sr/86Sr) and oxygen ($\delta$16O), with sulfur isotopes ($\delta$34S) being a much most recent addition to the isotopic arsenal for investigating residence and mobility. Because the application of sulfur is not limited solely to tooth enamel, by targeting skeletal tissues that represent different periods in an individual's lifetime, it has the possibility of directly tracing residence, isotopically, an individual throughout a lifetime. The paper presented here demonstrates that in the rush to apply this isotope system to past remains our overall appreciation of the natural variability of $\delta$34S in the environment has not been well characterised, which may be leading researchers to developing archaeological narratives and broad models of $\delta$34S variations across regions that are 'importantly wrong'. Furthermore, it presents methods for developing more robust baseline data for interpreting archaeological$\delta$34S values and thusly moving the state-of-the-art forward for interpreting both human and faunal data.

**Keywords: Bioarchaeology, Sulfur, Mobility**

## 14:45 Coal and Iron in Northern Roman Britain

[1]***Elizabeth La Duc***, [1]*Martin Millett*, [1]*Marcos Martinon-Torres*

[1]University of Cambridge

**Abstract:** The occurrence of coal on Romano-British archaeological sites has been recognized for many years, but the evidence for how coal was actually employed was mostly circumstantial, based on the association of coal finds with artefacts. Here, the use of coal for iron smithing in Roman Britain is definitely proven based on the analysis of iron production debris from a 2nd century CE blacksmithing workshop in Aldborough (Isurium Brigantum), Yorkshire, with confirmation from other Romano-British sites in Yorkshire, Lancashire, and Northumberland, including from Hadrian's Wall. This study, using SEM-EDS and optical microscopy, shows that fuel choice – whether coal or wood-derived charcoal – can be identified through several microstructural and chemical features, including the presence of fuel inclusions and a difference in bulk chemistry, reflecting the contribution of fuel ash. Ongoing research seeks to answer the question of which factors – environmental, economic, or technological – led to the innovation of using coal. The ambiguous and sometimes contradictory environmental evidence for woodland management and/or deforestation in northern Roman Britain will be discussed. Finally, this study highlights the importance of fuel in the chaîne opératoire of metallurgy and the need for further research combining materials analysis with the study of human-environment interactions.

**Keywords: Archaeometallurgy, Human-environment interactions, Roman, Yorkshire**

## 15:00 Pyrolysis-GC-MS as a Rapid Means of Distinguishing Coprolites

***Helen Whelton***, *Natalie Brooks*, *Ian Bull*
Organic Geochemistry Unit, School of Chemistry, University of Bristol

**Abstract:** Coprolites comprise complex mixtures of lipids derived from diet and biochemical processes of the producer. Analyses of lipids preserved within the coprolite matrix are well established as faecal biomarkers and are used as a means of identification and an indication of dietary inputs. Faecal lipid biomarker analysis requires extraction and separation of organic compounds before analysis via Gas Chromatography-Mass Spectrometry (GC-MS). One of the main drawbacks of this technique is large sample size required and the length of laboratory and analytical time required to separate lipid fractions for analysis and identification. Alternative techniques have been proposed as a means of fast screening coprolites. Fourier-Transform Infrared (FT-IR) has been shown to distinguish coprolites from other non-faecal material based on phosphate content. More recently, volatile organic compounds (VOCs) have been utilised as a means of characterising coprolites using Solid Phase Micro Extraction (SPME). Another technique which can potentially be employed as a fast-screening analytical method is Pyrolysis GC-MS (Py-GC-MS). Py-GC-MS involves thermal decomposition of compounds at high temperatures in an inert atmosphere and is advantageous due to the very small sample size and minimal sample preparation required prior to analysis. Py-GC-MS has been applied to a range of faecal material to differentiate between faecal material of different species. Initial results show Py-GC-MS is effective for the identification of a range of faecal biomarkers. The Py-GC-MS data were successfully used with an existing ratio proxy to differentiate ruminant and omnivore faeces based on lipid content.

**15:15-15:45 - COFFEE BREAK**

**15:45**

## Cortisol in the cusps: investigating dental cortisol methods for assessing stress in living and archaeological populations

[1] [2]*Leslie Quade*

[1]Austrian Archaeological Institute, Austrian Academy of Sciences [2]Department of Anthropology, Faculty of Sciences, Masaryk University

**Abstract:** Cortisol is a glucocorticoid hormone that plays important roles within normal metabolic functioning and the biological stress response. However, excess cortisol stemming from psychosocial or physiological stressors can negatively impact health and wellbeing. As such, studies of modern human and non-human populations regularly assess cortisol concentrations in bodily fluids and hair as a measure of stress experience. Recent research has detected cortisol from within human permanent and deciduous tooth tissues from both modern and archaeological contexts. These findings have important implications for studies of chronic stress when only skeletal materials are available.

Cortisol concentrations are most commonly assessed through enzyme-linked immunosorbent assays (ELISA). However, mass spectrometry combined with separation techniques may offer several advantages, including increased precision in analyte detection. In this pilot study, tooth enamel and dentine samples from 27 primary and permanent teeth were assessed for cortisol concentrations via both ELISA and liquid chromatography combined with a triple quadrupole mass spectrometer. Sampled teeth came from archaeological contexts and donations from living individuals.

Within this study, LC-MS/MS successfully detected cortisol in more samples than ELISA methods. However, as with previous research on dental cortisol, not all samples produced results that could be detected via LC-MS/MS or ELISA. These results continue the advancement of the dental cortisol methodology, providing new opportunities for analysis and comparisons of dental cortisol data.

**16:00**

## Mummy nose best: VOCs as a rapid means of assessing the source of Egyptian embalming materials

***Wanyue Zhao***, *Katherine Clark*, *Richard Evershed*, *Ian Bull*
University of Bristol

**Abstract:** Volatile organic compounds (VOCs) have been used to characterise the biomolecular profile of ancient Egyptian mummies and to distinguish between mummy samples that are derived from distinct historical periods (dated from ca. 2000 BC to 295 AD) and are composed of various embalming materials. The results suggest that headspace solid phase micro extraction gas chromatography-mass spectrometry (HS-SPME-GC/MS), as a non-destructive analytical procedure, can provide valuable information to characterise the volatile components of ancient Egyptian mummies. The VOC profiles obtained from archaeological embalming materials reveal VOCs representative of each, for example: aromatic derivatives and short-chain fatty acids from fat/oil; mono-carboxylic fatty acids and cinnamic derivatives from beeswax; aromatic derivatives and sesquiterpenoids from resins, and naphthalene derivatives from bitumen. The discrimination observed between different embalming material compositions correlated well with previous lipid identification results and supports the overall hypothesis that VOCs can be used as a fast and sensitive screening tool to differentiate between sources of ancient Egyptian embalming materials.
**Keywords: Mummification, Embalming, Chemistry, Biomarker**

**16:15**

## Improving taxonomic identification of lipids in archaeological ceramics using high resolution mass spectrometry

[1] ***Jasmine Lundy***, [1,2,3] *Léa Drieu*

[1]University of York Department of Archaeology [2]University of York Department of Chemistry [3]CNRS Delegation Regionale Cote d'Azur

**Abstract:** Organic residue analysis (ORA) of archaeological ceramics is an invaluable tool for understanding past culinary habits, but conventional methods are sometimes limited in the taxonomic identification of animal and plant products. This can be further hindered by mixed signals of different organic products within the same vessel. Here, we propose the use of high-resolution mass spectrometry (MALDI-MS and MALDI-MS/MS) to target and identify the structure of triacylglycerols (TAGs) to distinguish between animal carcass and dairy fats as well as providing greater taxonomic resolution of plant oils. In this presentation, we will show how MALDI-MS/MS methods have provided advanced insight into the use of medieval Sicilian ceramics by distinguishing between goat, sheep, and cow dairy products, animal carcass fats (pig and cow) and identified plant oils in amphorae. We will also propose how these methods can be applied in contexts outside of the medieval Mediterranean to better characterise culinary practices in the past.

**Keywords: Lipids, Triacylglycerols, MALDI**

**16:30**

## $\delta^{13}$C and $\delta^{15}$N values of modern plants as baselines for palaeodietary and palaeoecological studies

[1]***Doris Vidas***, [1]*Amy Styring*, [1]*Michael Charles*, [1]*Valasia Isaakidou*, [2]*Paul Halstead*

[1]University of Oxford [2]University of Sheffield

**Abstract** The development of carbon ($\delta^{13}$C) and nitrogen ($\delta^{15}$N) isotopic baselines is fundamental for understanding isotopic variability in palaeodietary and palaeoecological studies in relation to local environmental and microclimatic conditions. Dispilio is a Neolithic site (mid-6th – mid-5th mill. BC) on the shore of Lake Orestias, western Greek Macedonia, where ongoing studies are exploring the nature and scale of livestock management and its implications for understanding how early farming communities adapted to wetland and mountainous ecosystems. In order to better interpret the stable isotope values of faunal bone collagen from the site in terms of diet, habitat use and feeding strategies, this study examines the $\delta^{13}$C and $\delta^{15}$N composition of 130 wild plants from thirteen localities within the Dispilio catchment area. The plants were collected across different habitat types, including marshes, hedges, shrublands, rocky ridges, deciduous woodlands and traditional pasture. The plant species belong to three different functional groups, namely trees, shrubs, and herbaceous plants, the latter being the most common. At least one leguminous plant was collected at each locality. The taxa and plant parts targeted were predominantly those which would be consumed by domestic livestock. The influence of temperature, precipitation and altitude are also considered. This study demonstrates the importance of determining the variability of carbon and nitrogen values in the local environment for the interpretation of animal management practices in the past.

**Keywords: Isotopes, Modern Vegetation, Pasture, Animals**

**16:45**

## Stable isotope analysis of archaeobotanical remains: a perspective

*Amy Styring*
University of Oxford

**Abstract** Stable isotope analysis of plant remains recovered from archaeological sites is becoming increasingly routine. There remains a lack of consensus, however, on how to select archaeological plant remains for isotopic analysis, how to account for differences in preservation and the effect of potential contamination, and how to interpret the measured isotope values in terms of the conditions in which the plants grew. Here, I outline the main issues that should be considered when planning and conducting an isotopic study of archaeobotanical remains. These include: setting out the research question(s) to be addressed in such a study, consideration of the archaeological context from which plant remains derive, determining appropriate sample size given the inherent variability in isotope values of plants growing in the same cultivation plots, establishing the conditions in which plant remains have been preserved and the effect on their isotope values, and accounting for potential contamination during deposition. With these issues in mind, I propose some guidelines for researchers to follow when planning and conducting an isotopic study of archaeobotanical remains.

**Keywords: Carbon, Nitrogen, Methodology, Agriculture**

# FRIDAY | ORAL PRESENTATIONS | ABSTRACTS

## Food, diet and cuisine 2

**9:15**

### Neanderthal cannibalism and subsistence at Abri Moula (France): integrating palaeoproteomics, zooarchaeology and taphonomy.

[1]***Pauline Raymond***, [1]*Karen Ruebens*, [2]*Geoff M. Smith*, [1]*Jean-Jacques Hublin*

[1]Paleoanthropology Chair, Collège de France [2]School of Anthropology and Conservation, University of Kent

**Abstract:** Cannibalism remains a debated topic in discussions about ancient human subsistence, despite several Paleolithic sites providing evidence for this behavior among Neanderthal groups. Abri Moula (Ardèche, France) is famous for its layer XV (97 ± 10 ka -119 ± 13 ka (MIS 5) in which 108 Neanderthal bones were recovered, corresponding to a minimum of six individuals, with the majority showing anthropic modifications interpreted as cannibalism. Employing advanced methods from archaeological science, like palaeoproteomics and virtual histology, alongside more traditional zooarchaeological and taphonomic analyses, this study reevaluates Neanderthal cannibalism using morphologically unidentifiable bone material from Abri Moula layer XV. We sampled 800 bone fragments for collagen fingerprinting (ZooMS) and identified 86.7% of the samples, revealing new taxa, including birds, alongside additional human remains (n = 23). Faunal proportions in the ZooMS assemblage are slightly different, with more Cervinae, and fewer human remains, compared to the morphological identifications. Detailed taphonomic and zooarchaeological analyses, focusing on anthropic modifications like marrow fractures and cut marks were conducted. Unexpectedly compared to the morphological assemblage, anthropic modifications on human remains were significantly lower (8.7%) than on other ungulates (e.g. Cervinae 20.7%, Equidae 35.7%), indicating a different treatment of the carcasses. Studies of glutamine deamidation values, alongside virtual histology using micro-CT scanning also allow to further assess patterns of differential diagenesis between human and ungulate bone fragments. Overall, this study shows that by integrating paleoproteomics, zooarchaeology, and taphonomy, we can gain additional insights into Neanderthal cannibalism, challenging assumptions to unravel the intricacies of past human behavior.

**Keywords: ZooMS, Taphonomy, Cannibalism, Subsistence**

## 9:30 Integrating biomolecular methods to understand the ecology, subsistence and diet of early Homo sapiens at Ilsenhöhle in Ranis, Germany.

***Geoff Smith***, *et al.*
School of Anthropology and Conservation, University of Kent

**Abstract:**The dispersal of Homo sapiens into Europe and their role in the disappearance of Neanderthals remains highly debated. Recently, directly-dated Homo sapiens fossils indicate their earlier arrival in Europe, prior to 40ka, during an extremely cold phase. However, the period between 45-40ka is marked by a mosaic of technocomplexes, such as the Lincombian-Ranisian-Jerzmanowician (LRJ), for which the makers remain unknown or highly debated. Recent excavations at Ilsenhöhle in Ranis (Germany) provide evidence for an early incursion of Homo sapiens into central Europe 45,000 years ago, associated with the LRJ. These new excavations have produced a wealth of archaeological and biomolecular datasets. Here, we integrate results from zooarchaeology, palaeoproteomics, sediment DNA and stable isotopes to characterise the ecology, subsistence and diet of these early Homo sapiens. Dominant taxa include reindeer, cave bear, woolly rhinoceros and horse, indicating cold climatic conditions. Numerous carnivore modifications, alongside sparse cut-marked and burnt bones, illustrate a predominant use of the site by hibernating cave bears and denning hyaenas, coupled with a fluctuating human presence. Faunal diversity and high carnivore input were further supported by ancient mammalian sediment DNA. Bulk collagen stable isotope data confirm a cold steppe/tundra setting, and indicate a high trophic position for Homo sapiens. The values are similar to Neandertals but lower than later Upper Palaeolithic groups suggesting a similar diet to local Neanderthals. Overall, this study demonstrates the potential of combining archaeological and biomolecular datasets to provide a more in depth understanding of human site use, subsistence and diet.

**Keywords: Zooarchaeology, ZooMS, Isotopes, sedaDNA**

## 9:45 Optimised seasonal shellfish exploitation strategies by Neanderthals during the Middle Palaeolithic in southern Europe from $\delta^{18}$O ratios of Phorcus turbinatus

**[1]Asier García-Escárzaga**, [2]Igor Gutiérrez-Zugasti, [3]Adolfo Moreno-Márquez, [4]João Zilhão, [1]André C. Colonese

*[1] Department of Prehistory and Institute of Environmental Science and Technology (ICTA-UAB), Universitat Autònoma de Barcelona [2] Instituto Internacional de Investigaciones Prehistóricas de Cantabria, Universidad de Cantabria, Banco Santander, Gobierno de Cantabria) [3] Abdera Research Gorup, Department of Geography, History and Humanities, University of Almería. [4] UNIARQ – Centro de Arqueologia da Universidade de Lisboa, Faculdade de Letras de Lisboa, Universidade de Lisboa*

**Abstract:** The southern coasts of Europe have been at the centre of archaeological debates contrasting the social and cognitive capabilities of Neanderthals and Anatomically Modern Humans (AMH). Early evidence of marine exploitation by Neanderthals in this region has challenged the theoretical proposition that coastal adaptation was a distinctive trait of AMH's cognition and behaviour. Yet, while it is now accepted that Neanderthals exploited marine resources to secure protein-rich foods, in which period of the year they exploited marine resources remains debatable. Determining the season when marine resources were collected has the potential to enhance our understanding of the role played by coastal habitats in the resilience of the last European Neanderthals and how these strategies compare to subsequent AMH in the region. To achieve this objective, we analysed the stable oxygen isotope composition of dozens of shells from the topshell Phorcus turbinatus (Born, 1778) collected by Neanderthals in northwestern Mediterranean basin. Shell stable oxygen isotope ratios are a reliable proxy for seasonal seawater temperature and can accurately establish the period of the year when molluscs were collected. The results reveal that Neanderthals exploited P. turbinatus throughout the year, with a prevalence during colder months, when this taxon seems more profitable (higher meat yield). These findings support the emerging consensus that Neanderthals in Southern Europe maintained a robust interaction with coastal environments, sharing fundamental ecological knowledge about intertidal resources.

**Keywords: Stable Oxygen Isotopes, Human Evolution, S. Europe, Subsistence Strategies**

## 10:00 Lighting up the blindspots: SEM, lipid and protein analysis of Mesolithic-Neolithic foodcrusts

[1]Joannes Dekker, [1]Alexandre Lucquin, [1]Lara Gonzalez Carretero, [6]Matthew Collins, [1]Jessica Hendy

[1] BioArCh, Department of Archaeology, University of York [2] Section for GeoBiology, Globe Institute, University of Copenhagen, [3]The Nice Institute of Chemistry, Université Côte d'Azur [4] NTNU University Museum, Norwegian University of Science and Technology [5] Museum Lolland-Falster [6] McDonald Institute for Archaeological Research, University of Cambridge

**Abstract:** Charred organic residues on pottery, foodcrusts, have proven a valuable source of data on ancient culinary practices and diet in general. Past studies have frequently applied SEM or lipid analysis on foodcrusts and in recent years there has been a small number of studies attempting to analyse these using palaeoproteomics. Each of these approaches is by themselves able to provide valuable insights on past diets. However, each also has significant disadvantages in terms of particular resources that might be overrepresented and others that are rarely recovered. To highlight the blindspots of each method and how they complement each other, we combine SEM, lipid and protein analysis on foodcrusts from the Mesolithic and Neolithic assemblages of Sylthom II (MLF00906-I/II Denmark). We show that this combined approach greatly increases the diversity of resources identified in each specimen. Additionally, the combined approach provides more precise taxonomic information regarding the cooked foodstuffs. The value of this approach is further demonstrated by the finding of evidence for dairy alongside wild plants and marine resources in the Danish Mesolithic as well as combinations of dairy and cereals in early Neolithic ceramic vessels. These results indicate, where possible, the necessity of a combined approach for obtaining data representative of all the cooked contents of the vessel.

**Keywords: Palaeoproteomics, Organic residue analysis, SEM, Ancient diet**

### 10:15 Foodways to Complexity: Isotopes and the metabolism of society in Late Bronze Age Greece

[1]**Efrossini Vika**, [2]Helen Talbot, [2]Matthew von Tersch, [3]Grigoris Grigorakakis, [2]Michelle Alexander

[1] The Wiener Lab, American School of Classical Studies at Athens [2] BioArCh, Department of Archaeology, University of York [3] Ephorate of Antiquities in Kefalonia and Ithaca, Kefalonia, Greece

**Abstract:** Food producing activities by default cause environmental change. Biomolecular applications in the study of domesticated landscapes revolutionized the way we think about social structure in the past, however the flux of resources and the associated territorial and urban planning in Greek prehistory is not fully understood and requires a more rigorous approach. Here, we present a novel, two-directional approach to the reconstruction of foodways: first, we employ carbon, nitrogen, and sulphur isotope analysis to horizontally reconstruct availability and provenance of food sources within the landscape, and then we employ compound-specific nitrogen analysis to vertically quantify these food sources within society members. The discursive tools of the theory of metabolism, a concept that studies how social structures are related to raw materials (here, food sources) and the decision-making processes behind socio-environmental action, are used to contextualise the results. The focus on specific Late Bronze Age polities that had a different survival trajectory will demonstrate the link between foodways, sustainability, and societal success in the past. This research has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Marie Sklodowska-Curie grant agreement no 836119 and The Odysseus Unbound Foundation.

**Keywords: Isotopes, Bronze Age, Social metabolism**

## 10:30-11:00 - COFFEE BREAK

## 11:00 Feasting at the Ness of Brodgar? Tracing subsistence patterns during the Late Neolithic, Britain using organic residue analysis

[1,2,3]Julia Becher, [2]Martine Regert, [1]Mark Edmonds, [1]Oliver E. Craig, [4,5]Nick Card, et al.

[1]University of York, BioArCh [2]Université Côte d'Azur, CNRS, CEPAM [3]Eberhard Karls University Tübingen, Archaeometry Working Group [4]University of the Highlands and Islands [5]Ness of Brodgar Trust

**Abstract:** Late Neolithic Britain (ca. 3200 and 2200 cal. BC) is known for its remarkable ceremonial complexes often linked to large-scale feasting events. Distinctive Grooved Ware vessels were deposited across several site's structures and spaces, including houses, middens and pits. Recent excavations at the Ness of Brodgar, Orkney, revealed the largest pottery assemblages of its kind in Britain in addition to one of the largest bone collections in Neolithic Scotland allowing exceptional conditions for in-depth analysis to reconstruct the past. Previous organic residue analysis (ORA) studies on Grooved Ware pottery assemblages revealed clear indications for animal fat processing, however, small sample sets were used (n=<40) for inter-site comparisons without a clear understanding of intra-site functions. Through ORA, we investigated 340 pottery samples from the Ness of Brodgar using various methodological approaches. These included a combined lipid biomarker and compound specific isotope approach (GC-MS, GC-C-IRMS) using solvent and acid/methanol extractions, proteomics and examining the technological aspects of the pottery manufacture. This represents one of the largest datasets collected from a single archaeological site based on organic residues and allows the investigation of various activity zones within the Ness of Brodgar on a spatial and chronological scale. The dataset has been integrated into previously conducted ORA studies allowing more comprehensive inter-site comparison. Our analyses demonstrate excellent lipid preservation, with results showing the evidence of plant, ruminant adipose and dairy processing within the ceramic vessels as well as possibly distinct vessel uses, demonstrating the life history of a vessel.

**Keywords: Late Neolithic, Organic residue analysis, Grooved Ware, Depositional contexts**

## 11:15 Lifting the Lid on the Hebridean Neolithic: Using Organic Residue Analysis to Reconstruct Foodways in the Hebridean Landscape

[1]Daniel Brown, [1]Lucy J. Cramp, [2]Duncan Garrow

[1]Department of Anthropology and Archaeology, University of Bristol [2]Department of Archaeology, University of Reading

**Abstract:** This contribution will present preliminary results from the analysis of dietary practices of the early farming communities of the Early-Middle Neolithic of the Outer Hebrides, c. 3700-3200 BCE . This project utilises cutting-edge organic residue analysis of pottery lipids from both water-logged islet-related contexts and dryland domestic settlements. My project utilises both GCMS analysis to scan for specific trace biomarkers and stable isotope analysis to determine the origins of animal fats. This analysis allows a greater understanding of the activities taking place at these different sites in this region at the northwestern edge of the European Neolithic. Hebridean crannogs are artificial islets set within lochs. Underwater surveys have recovered archaeological material from the loch-beds surrounding some of these islets and the waterlogged conditions have enabled the recovery of elusive lipid biomarkers for cereals. It has been proposed that these sites were important centres for the formation of community identity via feasting activities. Therefore, by re-constructing the dietary patterns of these sites, the functions and activities taking place at these centres can be explored. My work extends previous analyses of pottery residues from four Hebridean islets, bringing in additional crannog sites for comparison and increasing the representation of key forms of pottery to test hypothesised differences in use. I am comparing these results with pottery from dry-land domestic settlement sites such as the sites of An Doirlinn and Screvan Quarry. By reconstructing and comparing the dietary patterns at these sites, a more detailed interpretation can be constructed of their social role.

**Keywords: Neolithic, Lipids, Crannogs, Ceramics**

## 11:30 Pottery spilled the beans: patterns in the processing of foodstuffs in Central Germany from the Neolithic to the Bronze Age

[1,2]Adrià Breu, [1]Roberto Risch, [3]Susanne Friederich, [3]Harald Meller, [3]Franziska Knoll, et al.

[1]Department of Prehistory, Autonomous University of Barcelona [2]Department of Social Sciences and Humanities, Koç University [3]State Office for Heritage Management and Archaeology Saxony-Anhalt, Halle (Saale), Germany

**Abstract:** The dynamic tapestry of Central European prehistory during the Neolithic and Bronze Age (ca 5500-1750 BCE) unfolds through a mosaic of diverse archaeological groups and pottery styles. Expressing themselves through an array of shapes and types—from the Early Neolithic Linearbandkeramik to the Corded Ware and Bell Beaker pottery, and the Bronze Age Únětice—distinct vessels reveal themselves as artifacts of highly dynamic societies. The organic residues of 124 exceptionally well-preserved ceramic vessels from 17 domestic and funerary sites in Central Germany have been analysed since 2018, revealing valuable insights into the region's culinary practices. Our results, intertwined with zooarchaeological assemblages, collagen isotopic values, and the contextual deposition of vessels, illuminate the multifaceted usage of pottery throughout Later Prehistory. Key findings include a marked surge in dairy product consumption correlated with innovations in pottery types in the 4th millennium BCE. Patterns emerge in the contents of vessels used as grave goods by the Corded Ware and Bell Beaker populations, underscoring their distinct practices. Furthermore, we explore the advent of the standardized yet surprisingly versatile Únětice pottery assemblage. Through the meticulous examination of lipid residues in a high-quality sampling set from a specific region in Central Europe, this long-term study initiates the detection of complex relationships prehistoric populations established between food resources and the primary means of their preparation, storage, and consumption.

**Keywords: Organic residue analysis, Pottery typology, Neolithic and Early Bronze Age, Central Germany**

## 11:45 Eating on the Edge of the Empire: Proteomic evidence for ingredients and cuisine in Roman Britain

[1,2]**Miranda Evans**, [3,4,5]Francesca Mazzilli, [3]Katie Anderson, [3]Oscar Aldred, [3]Christopher Evans

[1]Department of Archaeology, University of Cambridge [2]BioArCh, Department of Archaeology, University of York [3]Cambridge Archaeological Unit [4]Institute for Classical and Christian Archeology, University of Münster [5]Department of Classics at Royal Holloway University of London [6]Classics Faculty, University of Cambridge [7]The GLOBE Institute, Faculty of Health and Medical Sciences, University of Copenhagen

**Abstract:** Food is integral to our daily lives yet detecting distinct 'cuisines' in the archaeological record is challenging. Proteomics is a valuable tool for investigating ancient foodways in calcified residues, often offering tissue and taxonomically-specific ingredient detection and glimpses into food preparation. Ceramics are robust, and ubiquitous in many contexts, providing evidence for function and chronology. However, limited sample sizes have hampered chronological comparisons. Roman culinary discourse is often elite and urban-centric, lacking insight into ordinary rural diets. Large-scale proteomic evidence can complement the existing lipid analyses which address use and consumption of foodstuffs in Roman Britain. This study explores the dietary habits of rural inhabitants, and their evolution over time. Here, we analyse 128 samples from 99 ceramic vessels to investigate cuisine throughout the occupation of Northstowe, a rural hinterland settlement in Cambridgeshire, where extensive excavations revealed a substantial ceramic assemblage. We scrutinise vessel-ingredient relationships and biases impacting proteomic detection of particular foods in calcified residues. The results reveal the use of dairy products from sheep, cows, and goats; Bovidae meat, and barley. A shift from multi-species dairying to a reliance on cows around 150 CE was observed. Dietary protein results were higher in vessel forms likely used in cooking; however, they were also detected in serving wares. The relative absence of plants and abundance of dairy results may relate to methodological biases, or the physicochemical properties of proteins and peptides. Ongoing research involves complementary application of lipid analysis, and experimental simulations to understand proteome entrapment in calcified residues.

**Keywords: Palaeoproteomics, Cuisine, Roman Britain, Pottery**

## 12:00 The effect of a change in food availability during the 14th century

[1,2]**Rachèl Spros**, [2]Bart Lambert, [1]Barbara Veselka, [2,3]Veronica Jackson, [1]Christophe Snoeck

[1]AMGC-Vrije Universiteit Brussel [2]SHOC-Vrije Universiteit Brussel [3]ARCS-Vrije Universiteit Brussel

**Abstract:** Crop failures, a large scale bovine pestilence, and international conflicts significantly affected food availability during the 14th century in north-western Europe. As a result, cities that were dependent on external food sources were forced to change their food import strategies and the citizens needed to adapt their diets. The inhabitants of Ypres, present-day Belgium, were no exception. During the 11th to 13th centuries, the city expanded into one of the largest in north-western Europe, but experienced a population decline during the 14th century. As only fragmentary historical sources are available for this site and region, multi-isotope analyses on human remains can provide information on how the 14th century events affected the diet of the people of Ypres. Over 700 multi-isotope datapoints obtained from 88 individuals from medieval Ypres (12th – 16th century) are chronologically compared. Their 87Sr/86Sr reflect changes in food provenances over time, while their $\delta^{15}$N values suggest the intake of protein remained similar throughout the medieval period. Only their $\delta^{13}$Ccol values give some indication of a change in dietary composition. The implications of these findings are not only relevant for the medieval population of Ypres, but also for studies focussing on the impact of the 14th century, and studies on the medieval period in general.

**Keywords: Isotopes, Diet, Medieval, Chronology**

### 12:15 Catching up with the Past: Applying Zooarchaeology to Understand Pre-Contact Indigenous Fisheries

[1]Kristin Oliver, [2]Jennifer Zhu, [2]Camilla Speller
[1]Simon Fraser University [2]University of British Columbia

**Abstract:** Climates are changing, oceans are warming, and irreversible environmental disaster is on our proverbial doorstep, set to impact every biosphere, ecosystem, and population. Cultural and ecological keystone species like Pacific salmon (*Oncorhynchus* spp.) are integral to the success of complicated food webs and cultural systems at local and global scales. Current estimates indicate 29% of Pacific salmon have been lost since European contact and more than one-third of remaining populations are threatened or endangered. Despite their importance, there is limited historical ecological information on individual salmon species, largely due to the absence of interspecific skeletal morphological variation. This project examines archaeological salmon remains from deep, well-stratified shell midden deposits at the Pentlatch Site, a K'ómoks ancestral village (ca. 1450-1670 cal BP) on British Columbia's Vancouver Island. Using Zooarchaeology by Mass Spectrometry (ZooMS), fine-grained taxonomic identifications have offered insight into pre-contact Indigenous fisheries. These data are crucial for modern conservation management strategies and provide direction for stakeholders on where efforts for species-based habitat restoration, spawning programs, and other endeavors should be focused.

**Keywords: Pacific salmon, ZooMS, Pacific Northwest America**

## 12:30-13:30 - LUNCH

## Environments, climate and landscapes

### 13:30 Unveiling the diversity of cetacean exploitation through ZooMS on prehistoric archaeological bone assemblages in southeastern coastal Brazil

[1]Krista McGrath, [2]Tatiane Andaluzia, [3]Dione da Rocha Bandeira, [4]Fernanda Mara Borba, [1]André Carlo Colonese

[1]Institute of Environmental Science and Technology (ICTA-UAB) and Dept. of Prehistory, Universitat Autònoma de Barcelona [2]Universidade Federal do Paraná [3]Universidade da Região de Joinville (Univille) [4]Museu Arqueológico de Sambaqui de Joinville, Joinville, Brazil

**Abstract:** Species identification of archaeological faunal remains not only plays a key role in many aspects of understanding past human populations, from dietary patterns and hunting practices to species selection for tool manufacture, but it can also hold great significance for understanding past local species diversity, and thus important implications for current conservation agendas. It is rare, however, to find sites in which most of the faunal assemblage has been taxonomically identified, and often the proportion of faunal remains that are identifiable using traditional zooarchaeological methods is quite low due to fragmentation and/or modification. Zooarchaeology by Mass Spectrometry (ZooMS), method of collagen peptide mass fingerprinting, has emerged as a fast and cost-effective technique for taxonomic identification of bone remains. ZooMS is particularly useful with remains that are highly fragmented or lacking diagnostic features, however its application in South America has been relatively limited thus far. Here, in the context of the ERC project TRADITION, we present the combined application zooarchaeolgoical anlaysis and ZooMS to cetacean remains, both artefacts and ecofacts, from prehistoric sambaqui (shellmound) sites along the southeastern coast of Brazil. The implications for both archaeological interpretations and conservation biology faunal baseline development are discussed.

**Keywords: ZooMS, Cetacean exploitation, Sambaquis, Southeastern Brazil**

## 13:45 Fuelling the northern frontier? New research on Roman activity and landscape impacts in the Hadrian's Wall region

[1]Lisa-Marie Shillito, [1]Eline van Asperen, [1]Damian Rudge, [1]Rob Collins, [2]Simon Chenery

[1]Newcastle University [2]British Geological Survey

**Abstract:** This paper presents current research on and around Hadrian's Wall, investigating the nature of landscape change from the Late Iron Age through Roman periods. We present pollen and geochemical analysis of two peat cores from Alston Moor near Epiacum, new lead isotope data on artefacts from Redhouse bathhouse, Chesters and Corbridge, along with botanical and geoarchaeological evidence from current excavations at Birdoswald. Together these data are beginning to paint a picture of the scale of resource extraction for the interlinked activities of fuel and fabrication, and how these activities may have been organised. The long-term perspective of pollen analysis indicates the complexities of landscape change, which begins locally in the Bronze Age. A more significant clearance event started in the Early Iron Age and peaked around cal AD 250-295/311-409, roughly contemporary with the establishment of Epiacum Fort AD 213-2016. Simultaneously, the lead content of the peat also increased, reaching a peak during the Roman period. Isotope data indicates exploitation of both the north Pennines and Mendips lead orefields and suggests larger items such as pipes were produced locally, whilst portable items are more variable, and may have been made from recycled lead. The rich assemblage at Birdoswald indicates exploitation of a wide range of tree species, as well as coal and reeds. Human activities can significantly change landscapes. By combining evidence from artefacts, historical sources, pollen and trace metals we can better understand the timing and character of the impact of human activities on this iconic landscape.

**Keywords: Lead isotopes, Micromorphology, Phytoliths, Geochemistry**

## 14:00 Seasonality in the Scottish Islands: Birds as windows of time

**Julia Best**
Cardiff University

**Abstract:** The Scottish Islands today hold some of the most diverse and important avian populations in Britain. In the past these formed a valued resource for meat, eggs, feathers, and oil. This paper will explore the role of birds in time marking and seasonal experience in the Scottish islands. Birds are (generally) very mobile creatures, with certain species travelling great distances during migration and others covering large areas to feed. From daily feeding and roosting to long distance migrations, the avian fauna in the islands are a marker of time and season, altering a landscape with their presence and absence. By combining zooarchaeology, historical documentation, and eggshell analysis birds can act as a proxy for season and as markers of change through time. This facilitates a deep-time perspective on resource availability, landscape use, breeding/feeding ranges, avian population make-up, exploitation, and how human populations perceived and experienced the passage of time. In these settings, large colonies of gregariously breeding seabirds would have provided a concentrated resource base in summer that could be targeted intensely or sporadically. The arrival of wintering birds would have both heralded a different change of season, and provided a new set of resources for exploitation at what could have been a challenging time. By exploring the temporality of birds, we can more fully understand life in these islands from their first settlement to the present day. This enhances our understanding of human-animal interactions in these locations in the past, and is also essential for understanding avian populations today.

**Keywords: Zooarchaeology, Seabirds, Seasonality, Scottish islands**

## 14:15 Multidisciplinary perspectives on the marine historical ecology of fishes in the eastern Mediterranean

[1,2]**Rachel Winter**, [2]Elena Desiderà, [2]Paolo Guidetti, [4]Michelle Alexander, [5]Alberto Taurozzi

[1]CNRS- Laboratoire écologie fonctionnelle et environnement, Universite Toulouse Paul Sabatier III [2]Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn–National Institute of Marine Biology, Ecology and Biotechnology—Genoa Marine Centre, Genoa, Italy [4]BioArCh, Department of Archaeology, University of York [5]The Globe Institute, Faculty of Health and Medical Science, University of Copenhagen

**Abstract:** Millennia of anthropogenic actions have had profound impacts on terrestrial and aquatic ecosystems. The long history of marine resource exploitation and ongoing consequences of opening of the Suez Canal in 1869 poses the Mediterranean region as an excellent case study in marine historical ecology of applying multidisciplinary approaches to zooarchaeological assemblages. An emphasis will be placed on groupers (Epinephelidae) due to their high ubiquity in coastal Mediterranean archaeological contexts and due to their ecological and economic importance today. Archaeological material studied comes from three coastal Levantine archaeological sites; Kinet Höyük in Turkey and Tell Fadous-Kfarabida and Tell el-Burak in Lebanon. Osteometrics were used to reconstruct catch sizes in the past, assess for fluctuations in the size structure of past grouper populations, and revise current conservation targets. Stable isotope analysis ($\delta^{13}$C, and $\delta^{15}$N) of archaeological fish bones (13 families) was undertaken to reconstruct the foraging ecology of ancient marine ichthyofauna in the eastern Mediterranean to assess the ongoing impacts of bioinvasions. Lastly, proteomic analysis of four grouper species in the Mediterranean was carried out for reconstruction of collagen sequences, revision of grouper phylogeny, and historical insight regarding past species abundance. This piece of work establishes ecological baselines for Mediterranean fisheries and showcases the importance of long term perspectives and multidisciplinary approaches in historical ecology.

**Keywords: Historical ecology, Isotopes, Proteomics, Zooarchaeology**

## 14:30 Four thousand years of marine subsistence, food web dynamics and mercury concentrations in the Aleutian Islands, Alaska

**Marjolein Admiraal**, [2]Nicole Misarti, [2]Benjamin Barst, [2]Julie Avery, [2]Lorrie Rae
University of Alaska Fairbanks, Water and Environmental Research Center, Stable Isotope Facility

**Abstract:** Northern coastal communities depend heavily on local marine ecosystems for their sociocultural, economic and subsistence resources. In the Aleutian Islands marine exploitation by humans dates back almost 9.000 years. These ancestral Unangax groups were known for their highly-skilled maritime hunting techniques often targeting high trophic level species such as Stellar sea lions and Northern fur seals. These long-lived apex predators have undergone sharp declines in more recent times, with the Western stock of Stellar sea lions now listed as an endangered species. One reason for the decline may be the increase of mercury concentrations in high latitudes since the industrial revolution. Little is known about natural mercury toxicology in the past and its impact on ecosystems and the humans that subsisted on them. Other important drivers may include cultural and climate change. As part of the NSF-funded Aleutian Mercury Dynamics project we analysed stable carbon and nitrogen isotopes of single amino acids, as well as mercury concentrations from archaeological bone of Stellar sea lions and Northern fur seals from the past 4.000 years in the Aleutian Islands to better understand temporal and spatial change. Here we present our preliminary results. We assess isotopic baselines and trophic levels through time, while considering natural mercury concentrations as well as cultural and environmental change in the Aleutian Islands, Alaska.

**Keywords: Single isotope analysis of amino acids, Mercury, Marine exploitation, North Pacific food web**

## 14:45-15:30 - COFFEE BREAK

## 15:30 Exploring early agro-pastoral strategies in the Carpathian Basin through stable isotope data and multiproxy land-use models

[1]**Margaux L. C. Depaermentier**, [2]Michael Kempf

[1]Vilnius University, Faculty of History, Department of Archaeology [2]University of Basel, Department of Environmental Sciences, Quaternary Geology

**Abstract:** The Neolithic and Chalcolithic periods in the Carpathian Basin witnessed the emergence and development of the first agro-pastoralist societies between around 6000 and 3800/3000 BC. According to the archaeological context, animal husbandry and crop production, hunting and gathering, and settlement complexity evolved differently over time, depending on regional environmental settings and cultural background. Among the broad variety of methods used to explore these aspects of past civilizations, stable carbon and nitrogen isotope analyses proved effective in tracking subsistence strategies. To gain new insights into the evolution of agricultural and dietary practices in the Carpathian Basin, we have analysed the carbon and nitrogen stable isotope compositions of 173 animal and 464 human bone collagen samples. Published data increase the dataset to 675 human and 366 animal samples. In addition to hypotheses testing of socio-cultural transformations, we consider the influence of environmental factors in local to supra-regional isotope variability. For this purpose, we use computational modelling techniques and paleoclimate proxy analyses to create high-resolution spatio-chronological land-use models for each site catchment. This approach enables to balance the interpretation of complex isotope data by including both socio-cultural and environmental aspects at various spatial and temporal scales.

**Keywords:Stable carbon and nitrogen isotopes, Paleoclimate proxies, Environmental analysis, Neolithic and Chalcolithic subsistence strategies**

## 15:45 Investigating temporal and geographical variation in the dietary behaviour of wolves with dental microwear texture analysis

[1]**Amanda Burtt**, [2,3]Neil Adams, [1]Fabienne Pigiere, [1]Danielle Schreve

[1]Department of Geography, Royal Holloway University of London [2]Natural History Museum, London [3]Centre for Palaeobiology and Biosphere Evolution, School of Geography, Geology and the Environment, University of Leicester

**Abstract:** In this paper, the dietary behaviour of grey wolves (*Canis lupus L.*, 1758) is explored with dental microwear texture analysis. We examine variation in modern and past wolf diets, to assess the impact of forcing factors such as changes in climate, environment, prey community and carnivore competition on feeding behaviour and the rates of change at which these occur. Diet is broadly considered the most influential factor for understanding behavioral and ecological variation in animals. Dental microwear texture analysis is a well-established method for reconstructing the dietary behaviour of extinct and extant animals. This method uses the quantification of dental textures in three dimensions by combining confocal microscopy with scale-sensitive fractal analysis and 3D surface texture analysis. These techniques have proven successful for distinguishing between canid species and niche position within species. Dental textures can be examined to demonstrate the extent to which carcasses are utilized and thus evaluate durophagous behaviour among carnivores. We use these measures to investigate dietary behaviour of wolves from glacial and interglacial periods over the last 200 000 years. The conservation status of grey wolves varies from Endangered to Least Concern across their ranges in the Northern Hemisphere. Incorporating information from the fossil record of wolves informs our understanding of their ecological resilience to changing climatic and environmental conditions over a longer period of time than can be obtained through modern observations alone.

**Keywords: Dental microwear, *Canis lupus*, Palaeoecology, Dietary reconstruction**

## 16:00 Detecting climate-mediated site occupation patterns at Palaeolithic sites – a multiproxy stable isotope and lipid biomarker approach

[1,2,3]Sarah Pederzani, [4]Vera Aldeias, [1]Antonio V. Herrera-Herrera, [1]Javier Davara, [5]Kate Britton

[1]Archaeological Micromorphology and Biomarkers Laboratory (AMBI Lab), Instituto Universitario de Bio-Orgánica "Antonio González", University of La Laguna [2]Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany [3]Department of Geology & Geophysics, University of Utah [4]Interdisciplinary Center for Archaeology and Evolution of Human Behaviour (ICArEHB), University of Algarve [5]Department of Archaeology, University of Aberdeen

**Abstract:** Understanding human responses to climatic shifts is crucial for unravelling key events in our evolutionary history, including Homo sapiens dispersals and the Neanderthal disappearance around 45,000 years ago. The Late Pleistocene archaeological record of both hominins reveals significant variability, attributed to changing climates. However, establishing clear links between climatic shifts and archaeological changes has proven challenging due to a lack of directly correlated climatic data at archaeological sites. To address this gap, we leverage diverse sample types from La Ferrassie, France, linked to the Late Pleistocene hominin occupations (MIS 5 – 3). We employ stable isotope analysis on lipid biomarkers from sediment samples and faunal skeletal remains, offering distinct climatic insights with different time resolutions. In a prior study, we observed a divergence between warm-climate faunal stable isotope signatures and sedimentary freeze-thaw markers within a single layer of La Ferrassie. Expanding on this, we present new data on hydroclimate and vegetation structure from lipid biomarkers in sediment samples, particularly n-alkane ('plant wax') $\delta^{13}$C and $\delta^{2}$H measurements. These data shed light on climatic conditions during sedimentary formation, yielding information from a naturally accumulated archive. We compare this with $\delta^{18}$O, $\delta^{13}$C, and $\delta^{15}$N data from faunal remains linked to hominin hunting activity. This anthropogenically accumulated archive offers a direct connection with hominin occupations. We explore if this approach can reveal climate-mediated site-occupation patterns, characterize conditions during occupation hiatus, and reveal potential climatic preferences of Pleistocene humans.

**Keywords: Palaeoclimate, Palaeolithic, Neanderthal, Pleistocene**

## 16:15 A long-term and seasonally resolved climatic record of Franchthi's stone age

[1,2]Danai Theodoraki, [2]Niklas Hausmann

[1]Leibniz-Zentrum für Archäologie, Mainz, Germany [2]Johannes Gutenberg-Universität Mainz

**Abstract:** Here we present high-resolution paleoclimatic data retrieved from the archaeological shell record of the prehistoric site of Franchthi in southern continental Greece. Our novel method combines sclerochronology with laser spectroscopy and oxygen isotope analysis in order to extract high-resolution sea-surface-temperature data. This cost-effective workflow expands our sample size to over 180 high-resolution (30 µm) records. Mollusc shells can significantly contribute to archaeological research regarding several aspects of human behaviour as well as of past environmental change. In this work, we analyse limpet shells (*Patella spp.*) which have been proven to be reliable sclerochronological and sclerochemical archives that are able to provide high-resolution insights into past human subsistence strategies alongside a paleoenvironmental context for other archaeological remains from the same stratigraphic layers. To draw more holistic conclusions on past human activities and the influence of the climate, we further integrate other archaeological archives with our shell-derived data, in order to better understand the influence of local and short-term expressions of the climate, which would have been perceived by the prehistoric occupants of Franchthi.

**Keywords: Sclerochronology, Laser-Induced Breakdown Spectroscopy (LIBS), Isotope analysis, Prehistory**

## 16:30 Reindeer distribution in Late Palaeolithic to Early Mesolithic Sweden: Climatic shifts, human interaction, and environmental dynamics

[1]**Markus Fjellström**, [2]Peter Jordan, [4]Anders Angerbjörn, [2]Kerstin Lidén

[1]Department of Archaeology and Ancient History, Lund Univeristy [2]Archaeological Research Laboratory, Stockholm Univeristy [3]Silvermuseet/INSARC, Arjeplog, Sweden [4]Department of Zoology, Stockholm Univeristy

**Abstract:** The deglaciation of northern Europe and the following recession of the Fennoscandian Ice Sheet initiated dynamic environmental changes, prompting the immigration of various species, among them the reindeer. In this study, we focus on reindeer immigration into southern and western Sweden from continental Europe dating from the Late Palaeolithic to the early Mesolithic, exploring their origins, migration routes, chronology, and potential anthropogenic impacts. We also address the uncertainty regarding the disappearance of reindeer from southern Sweden, exploring potential causes such as rapid climatic changes and anthropogenic factors. We have applied radiocarbon and stable isotope analysis, in order to understand their adaptation to rapid climatic and environmental changes in southern and western Sweden. Results from 14C, $\delta^{13}$C and $\delta^{15}$N analyses demonstrate that there were different reindeer immigration events, but also that there are shorter periods with no reindeer present in Sweden, possibly linked to the disappearance of the ice bridges. We see a decline of reindeer during the middle Early Mesolithic with the youngest reindeer dating to the 9.3 cooling event. The $\delta^{13}$C values varies substantially suggesting different grazing patterns and suggests presence of different reindeer populations during the studied period.

**Keywords: Reindeer, Carbon and nitrogen stable isotopes, Radiocarbon, Late Palaeolithic**

# POSTER PRESENTATIONS | ABSTRACTS

## P1 Accessing mini-metabarcodes in shotgun aDNA libraries

[1]***Amy Allan-Jones***, [1,2]*Linus Girdland Flink*

[1]Department of Archaeology, School of Geosciences, University of Aberdeen [2]School of Biological and Environmental Sciences, Liverpool John Moores University

**Abstract:** We investigate the effectiveness of combining specific metabarcode primers with general shotgun library primers to amplify metabarcodes of arbitrary lengths while retaining damage patterns in the 5' end of the molecule. To achieve this, we combined a 12S metabarcode primer designed for mammals (containing an Illumina-compatible overhang) with a TruSeq-compatible index primer. These were applied to libraries produced using the Meyer & Kircher (2010) method on ancient DNA extracts from archaeological pig and cattle bones. We determine the specificity and taxonomic profile of deep-sequenced amplicon data and analyse damage patterns. Our results indicate that the method is efficient at retrieving 12S metabarcodes of varying length but that the system will also amplify non-mammalian DNA. We also observe patterns consistent with elevated rates of C>T transitions at the ends of amplified molecules, but inconsistently across the analysed samples. We conclude by identifying potential future directions for further developing this approach.

## P2 Rapid Enamel-Based Palaeoproteomic Sexing: Developing Mass Spectrometric Methods for Sex Estimation Using Enamel Protein Amelogenin

[1,2]***Charllotte Blacka***, [1]*Jessica Hendy*, [2]*Kirsty Penkman*, [2]*Jackie Mosely*

[1]Department of Archaeology, University of York [2]Department of Chemistry, University of York

**Abstract:** Enamel is an extremely robust biomineral, and its proteins are thought to be protected by the biomineral structure, meaning they can survive vast time periods and diverse contexts. Amelogenin is an enamel-specific protein that is encoded on the sex chromosomes of many mammals; consequently, the X- and Y-isoforms of the protein differ in many species. These differences can be exploited by mass spectrometry (MS) to provide palaeoproteomic sex estimation for humans and animals. This approach presents some advantages over aDNA sex determination (which is hindered by the relative instability of aDNA and therefore preservation limitations), and osteology (limited by skeletal variability between the sexes, and its inapplicability to subadult remains).

To fully understand population-wide demographics (whether for human or zooarchaeological studies), the ability to sex large numbers of samples is essential; this calls for the development of a cheap, high-throughput amelogenin analytical method. Current widely used methods are hindered by long MS analyses and high costs. Here, a new timsTOF method has been developed for amelogenin palaeoproteomic analysis, allowing for MS run times to be decreased to as little as 2.9 minutes. The use of this short timsTOF method, in conjunction with an enamel acid etch protocol which has been optimised for timsTOF analysis, enables rapid sample preparation and analysis, with an overall analytical time of less than 25 minutes per sample (including sample preparation, MS acquisition and data processing). This development is a major step towards wider applicability of sex determination methods to diverse archaeological and palaeontological contexts.

## P3 Pits and people: Biomolecular, osteological and funerary approaches to the human remains from Danebury Iron Age Hillfort

[1] ***Madeleine Bleasdale***, [2,1] *Claire-Elise Fischer*, [1] *Sebastian Metz*, [1] *Laura Castells Navarro*, [1,3] *Lindsey Büster*, *et al.*

[1]Department of Archaeology, University of York [2]UiT - Norges Arktiske Universitet; Tromsø Museum - Universitetsmuseet [3]Canterbury Christ Church University

**Abstract:** Danebury Hillfort (c. 550 - 100 BC) is one of the best known Iron Age sites in Britain and has served as a focal point for discussions surrounding social organisation at this time. Excavations led by Barry Cunliffe (1969-1988) unearthed approximately 300 deposits of human remains (e.g. pit 'burials', partially articulated remains, isolated bones). Despite the significance of Danebury within its regional context and its vital contribution to our wider understanding of Iron Age society, questions remain about the interconnectedness, residential origins and social structure of the buried community. Here we present new multiproxy results (DNA, isotopes, osteology) to tackle these important questions.

Previous isotope results of animals from Danebury show significant levels of mobility (Hamilton et al. 2019). These data have been used as a proxy for human mobility to challenge concepts of Iron Age communities as predominantly sedentary. To further explore this, we generated genetic data (n = 90) and applied a multi-isotope (Sr-Pb-O-C) approach to over forty (n = 41) individuals. We confirm the presence of non-locals who spent their childhood elsewhere but came to be buried at the hillfort as adults. We also identified a core local group who likely lived and died at Danebury. This multidisciplinary approach has offered fresh insights into the lives of the Danebury community and through comparisons with neighbouring sites (e.g. Suddern Farm) will be woven into broader narratives of mobility and connectivity during the British Iron Age.

## P4 A Bioarchaeological Understanding of the Lifecycle Identity and Lived Experiences of Children During the Early Medieval Period in Southeast England

***Alexandra Bowers***, *Allison Stewart*, *Jennifer R Jones*

University of Central Lancashire

**Abstract:** There is a distinct lack of bioarcheological studies of children from the British early Anglo-Saxon period, despite it being a dynamic period of cultural transition, migration and change. Previous research found that periods of transition greatly affect childhood health, as children are valuable conduits through which stresses in the population based on changing environmental conditions and resources, may be observed. Studying health and stress indicators in subadult remains from early Anglo-Saxon cemeteries addresses a key archaeological question of how this transitional phase might have affected the living, breathing people who were experiencing it. Only around 21% of subadult remains are recovered from early Anglo-Saxon sites, meaning sites with higher-than-usual numbers are important foci for delving deeper into understanding childhood during this period. This research employs a multidisciplinary approach including stable isotope analysis, osteological assessment and burial evaluation on 65 subadults (0-18years) from 5-6th century Anglo-Saxon Oakington, southeast England. Initial findings show that of those with observable skeletal elements, 100% expressed stress indicators. Isotopic analysis contributes to understanding subadult diet, weaning patterns and periods of stress. Elevations in $\delta^{15}$N may correlate with osteological evidence of stress during phases of high mortality risks like the weaning period and other important lifecycle events. Biological or social transitions associated with different lifecycle stages linked to periods of stress may be reflected in death and burial treatment. By taking this multi-methodological approach, it is possible to reconstruct the lived experiences and identities of these children rather than just understanding their circumstances of death.

## P5 The Grain Romans: A Paleopathological Study and Establishment of Demography using Osteological Analysis

***Amy Brooks-Cole***

*Department of Archaeology and Anthropology & School of Law and Policing, University of Central Lancashire*

**Abstract:** This poster will present an interesting case study of a Roman skeletal assemblage and its importance in understanding pathology, migration, and the lived experience of people from this time period. The location of this discovery on the Isle of Grain is significant to understanding Roman migration as it sits at the confluence of two major rivers: The Medway and The Thames. As such, it likely formed an important site for the migration of people and the movement of goods between Britain and the continent. Identified during the excavation three individuals present interesting cases of decapitation, this poster will investigate the Roman context and the significance of this practice. Using osteoarchaeological analysis to determine the timing and mechanism of the trauma may suggest the circumstances in which these events occurred. Despite the interesting location, the human remains exhumed from this site have not undergone any osteological analysis in over 40 years. Therefore, the rare opportunity has arisen for newer methodological and biomolecular approaches to be applied to the human remains which will aid in furthering the discussion on who used the site, who was buried there, and what was their lived experience. Using this information to comment on how the Isle of Grain compares to contemporaneous sites within Britain and the Roman Empire.

## P6 Testing the limits of tiny tooth enamel $\delta^{18}$O and $\delta^{13}$C analyses

[1]***Stacy Carolin***, [2]*Scott Blumenthal*, [3]*Christopher Day*, [4]*Emmanuelle Stoetzel*, [1]*Amy Styring*, *et al.*

[1]School of Archaeology, University of Oxford, Oxford, UK [2]Department of Anthropology, University of Oregon, Eugene, OR, USA [3]Department of Earth Sciences, University of Oxford, Oxford, UK [4]Histoire Naturelle de l'Homme Préhistorique, CNRS/MNHN/UPVD, Musée de l'Homme, Paris, France [5]Institut National des Sciences de l'Archéologie et du Patrimoine, Rabat, Morocco

**Abstract:** Rodent teeth are found in abundance at many archaeological sites and have the potential to provide complementary environmental insights alongside other geochemical, paleontological, and sedimentological proxies. Rodent teeth are difficult to analyse for stable isotope composition using conventional pre-treatment and analytical techniques that typically require 1-2 mg of enamel, owing to their very small size and thin enamel. Here we present a comparative study used to test the capabilities and relative accuracy of refined methods designed for analysis of small enamel samples. We consider the impact of secondary carbonate contaminants specific to each method.

An exceptional concentration of microvertebrate remains are found in a deep stratigraphic sequence at El Harhoura 2 cave (near Rabat, Morocco). We target three layers in the El Harhoura 2 stratigraphy which contain large numbers of small rodent fossil teeth (>70 kyr age), which may be isotopically distinct due to environmental factors having shifted rodent enamel isotopes in the past. A priori knowledge of past environmental change stems from taphonomic and palaeoecological studies of the micromammals of El Harhoura 2 and palaeoclimate model simulations. Knowledge of the relationship between Moroccan rodent enamel isotopes and the environment stems from a modern calibration study. We use the samples to examine variations in tooth enamel isotopes across sediment layers when measured using four different techniques: laser ablation of total enamel, (i) untreated and (ii) pre-treated to remove surface secondary carbonates; and acid digestion of structural carbonates in enamel powders, (iii) untreated and (iv) pre-treated to remove secondary carbonates.

## P7 Steppe by Steppe: New Biomolecular Insights into Ancient Mongolian Statecraft

[1,2]***Christina M. Carolus***, [1]*Asa Cameron*, [1]*Bukhchuluun Dashzeveg*, [2]*Andrew Kenney*

[1]Yale University [2]University of York

**Abstract:** From the appearance of monumental traditions in the Late Bronze Age (c.1500-1000 BC) through the emergence of the Xiongnu culture as founders of Asia's first nomadic empire (c.250 BC-150 AD), populations of the Gobi-steppe of Mongolia underwent a series of dramatic transitions. These changing social and climatic dynamics altered how populations interacted and moved within the landscape, transformed subsistence and habitation practices, and spurred the development of inter- and intra-regional political complexity. Investigation of shifting foodways and mobility patterns provides concomitant throughlines for these transitions, linking local and regional changes in community-level organization to better understand the position of Gobi-steppe populations within this unique historical setting. The following paper integrates several lines of novel biomolecular evidence (stable and radiogenic isotopes, lipid residue analysis, proteomics) from the Gobi-steppe of southeastern Mongolia to chart diachronic changes in subsistence and human and livestock movement during the Late Bronze Age, the Early Iron Age (c.1000-400 BC), and the Xiongnu Period. These data are put into dialogue with conventional narratives regarding the development of cultural and political complexity in Mongolia, with a specific focus on what regional changes in mobility and foodways can reveal about the formation and structure of the broader Xiongnu empire.

## P8 Fastening Roman Britain: a metallurgical characterisation of nails from Fishbourne Roman Palace

[1]***Michael Charlton***, [2]*Rob Symmons*, [3]*Ethan Greenwood*

[1]UCL Institute of Archaeology [2]Fishbourne Roman Palace [3]University of Exeter

**Abstract:** Iron nails were the essential fastener for Roman builders and found in high frequency at every Roman site. Though not celebrated finds, these simple machines did more than bind architectural elements (and other stuff) together; their production histories and distributions left traces of past supply chain structures and logistics that helped bind the fabric of society. Those traces of extinct exchange networks find themselves trapped within the trace element chemistry of the metal and its slag inclusions.

Fishbourne Roman Palace in Sussex, England is emblematic of the Roman Empire's expansion to Britain, and is home to several thousand excavated nails. We explore the production history and provenance of a sample of these nails through a combination of metallographic and chemical characterisation using standard nital etching, x-ray microanalysis (SEM-EDS), and Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS). Materials diversity is explored with qualitative and multivariate statistics and the Weald evaluated as a possible source of iron. This is the first known application of LA-ICP-MS to iron provenance in Britain and a logical next step in understanding the role of iron in Romano-British socioeconomy.

## P9 Crafting the Past: ZooMS Identification of Chinese Bronze Age Fauna Materials from Huanbei Shang City

[1,3]***Pengpeng Chen***, [2]*Yuling He*, [1]*Zhichun Jing*, [1]*Jay Hilsden*, [1]*Camilla Speller*

[1]Department of Anthropology, the University of British Columbia [2]Institute of Archaeology, Chinese Academy of Social Science [3]University of Oxford

**Abstract:** Located in the present-day city Anyang, Huanbei served as the capital of the middle Shang Dynasty (3200 BP) during Bronze Age China, featuring a bone tool workshop that reflected the thriving craft industry of the Shang dynasty and the high demand for animal bone products. Excavations within the workshop uncovered a tomb, exposing layers of fill containing fragmented animal bones (n=764) and bone artifacts (n=19). Osteological analysis affirmed the prevalence of cattle bones, alongside sheep, dogs, pigs, and deer within the fill. However, most of the bones are either too fragmented or modified to be identified, presenting challenges in examining raw material selection in tool production. In this investigation, we explore the diversity of animals utilized at different stages of tool production, shedding light on broader patterns of animal husbandry and hunting practices at the site. We selected 79 samples, including raw (unprocessed) material, semi-finished, and finished bone/antler products for minimally-invasive and destructive Zooarchaeology by Mass Spectrometry (ZooMS). Our findings reveal that the majority of semi- and finished products were crafted from cattle bone, complemented by lesser quantities of large deer species and exotic materials such as tortoise shells. In contrast, unprocessed materials exhibited a wider range of domestic and wild animals, including sheep, pigs, small deer, and dogs. This investigation highlights the applicability and significance of employing the ZooMS and the minimally-invasive sampling strategy on Chinese samples, providing novel insights into craft production during the Shang Dynasty in China.

## P10 Go Your Own Way: Bronze Age Mobility in the Seine Valley with the input of strontium isotope variability mapping

[1,2,3]***Solène Chevallier***, [3]*Hannah F. James*, [3]*Christophe Snoeck*, [4,5]*Rebecca Peake*, [2]*Estelle Herrscher*

[1]Inrap Siège, Paris, France [2]LAMPEA, UMR 7269, CNRS, Aix Marseille Université, Ministère de la Culture, Aix en Provence, France [3]Archaeology, Environmental changes & Geo-Chemistry, Vrije Universiteit [4]Inrap Centre-Île-de-France, Pantin, France [5]Artehis, UMR 6298, Université de Bourgogne Franche-Comté , CNRS, Ministère de la Culture, Dijon, France

**Abstract:** The Bronze Age in France is marked by the interplay of various cultural influences, especially during the transition from the Middle to the Late Bronze Age which is characterised by a shift in population dynamics and the emergence of new cultural influences. Population mobility could explain this pattern and studies of archaeological artifacts support this hypothesis. In this study, strontium isotopes (87Sr/86Sr) analyses are used to reconstruct past mobility, based directly on human cremated bones. 103 human samples were analysed from 8 Bronze Age sites located in the Upper Seine valley (north-eastern France), with a maximum distance of 25 kilometres between them. The results show a general isotopic homogeneity within each site. Despite the geographical proximity between the sites, two clusters are identified based on Sr values. This observation would suggest a distinct management of the land and resources, with the consumption of food from different areas of the local landscape, depending on the geographical location across the valley. Therefore, to establish a robust local baseline of the bioavailable strontium, we collected 97 plants from 33 locations, covering an area of 1600km

## P11 Tracing Dietary Histories: Human Bone Stable Isotope Analysis in the Republic of Korea

[1,]***Jisun Choi***, [1]*Soyeong Kang*

[1]National Research Institute of Cultural Heritage, Republic of Korea

**Abstract:** In the Republic of Korea, palaeodiet research has historically focused on analyzing agricultural tools and plant remains excavated from archaeological sites. Since 1994, stable carbon and nitrogen isotope analyses have been played a crucial role in establishing a scientific framework for dietary studies. This study specifically involved analyzing carbon and nitrogen stable isotopes extracted from 367 human bones discovered at 31 Korean archaeological sites. These sites span a timeline from the Neolithic period (4800 BC) to the Joseon Dynasty (17th century).

The analysis unveiled temporal patterns in stable carbon isotopes, revealing a shift in values from $\delta^{13}$C = –13.1‰ to –19.6‰. This shift indicated a transition from a C4 plant-based diet (millet, sorghum, etc.) to a C3 plant-based diet (rice, barley, etc.). These results are consistent with the historical shift from the cultivating of millet during the Neolithic period to the cultivating of rice during the Joseon Dynasty.

Furthermore, stable nitrogen isotope results highlighted a shift in animal protein consumption, indicating a transition from marine-based sources to terrestrial herbivores, with values ranging from $\delta^{15}$N = 18.1‰ to 10.5‰. However, this observation could be influenced by the prevalence of pre-Three Kingdoms period sites located along the coast. This aligns with historical evidence suggesting a diet rich in animal proteins obtained through hunting and animal husbandry after the Three Kingdoms period. Continued research efforts aim to offer a more comprehensive understanding of the overall palaeodiet in Korea.

**Acknowledgements:** This research was supported by the National Research Institute of Cultural Heritage, Korea.

## P12 Reconstructing our evolutionary past using sediment DNA: Best practices and Applications

[1,2]***Pnina Cohen***, [3]*Sarah Johnson*, [3]*Elena Zavala*, [3]*Priya Moorjani*, [1,2,4]*Viviane Slon*

[1]Department of Anatomy and Anthropology and Department of Human Molecular Genetics and Biochemistry, Faculty of Medicine, Tel Aviv University [2]The Dan David Center for Human Evolution and Biohistory Research, Tel Aviv University [3]Department of Molecular and Cell Biology, Center for Computational Biology, University of California, Berkeley [4]Edmond J. Safra Center for Bioinformatics, Tel Aviv University

**Abstract:** Ancient DNA (aDNA) analyses— the study of genetic material from individuals that died hundreds or thousands of years ago— have revolutionized the research in human evolutionary genetics. At most archaeological sites dated to the Middle or Late Pleistocene (780,000-12,000 years ago), no human remains have been found. However, recent studies have shown that aDNA can be recovered from archaeological sediments, even in the absence of any skeletal remains, providing an exciting new avenue to learn about our evolutionary past. Despite that, so far only a limited number of studies have successfully recovered, identified and authenticated ancient human DNA from prehistoric sediments. This is due to the complexity of ancient sedimentary DNA datasets, which tend to be composed of small quantities of short and degraded fragments, often representing multiple species and multiple individuals, within an overwhelming background of environmental DNA. We focus on advancing and developing analytical frameworks to support the study of ancient human DNA from sediments. Here, we evaluate current methods for imputation, phasing and kinship analyses of genetic variants such as Glimpse, Beagle and LinkImpute - testing them for accuracy on both empirical data and on simulated datasets mimicking the characteristics of ancient sedimentary DNA, including very low genetic coverage, restricted relevant reference panels, mixture of individuals within a single sample, and the presence of non-human ancient DNA. Based on this, we propose appropriate filters and parameters for the tested software, when applied to the study of ancient human DNA from sedimentary samples.

## P13 A potential on-site test for the quick detection of sedimentary ancient DNA

[1,2,3]***Nihan Dilsad Dagtas***, [1,2,3]*Viviane Slon*

[1]Department of Anatomy and Anthropology, Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel [2]Department of Human Molecular Genetics and Biochemistry, Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel [3]The Dan David Center for Human Evolution and Biohistory Research, Tel Aviv University, Tel Aviv, Israel

**Abstract:** Ancient DNA retrieved from sediment samples has been shown to be a promising tool to study the genetics of past populations. However, it is not a common practice to sample sediments for genetic analyses; and this approach has been applied to relatively few archaeological sites so far. While the exact source of the ancient DNA fragments in sediments and the factors that lead to their long-term preservation are still being investigated, sampling strategies tend to rely on 'gut-feeling' as to where to collect the samples. After sampling it usually takes several months until the results of the initial screening are available, as the procedure to generate sequencing data from such samples is lengthy. However, by then, the archaeological site in question may not be available for further sampling. Therefore, implementing the best sampling strategy in the field is crucial for the smooth flow of any project. Here, to develop a method that allows for the rapid, on-site detection of preserved sedimentary ancient DNA, we tested the performance of several rapid DNA extraction protocols. We compared a protocol commonly used in the laboratory for sediment samples to rapid protocols developed for specimens of non-sediment origin. We evaluated the protocols in terms of time and handling required, and the success of amplification using species-specific oligos. The results will discuss how to quickly extract DNA from sediment samples in the field using minimal equipment, as well as how to detect preserved ancient DNA by utilizing custom-made oligos in a real-time PCR assay.

## P14 Organic residue analysis of Neanderthal stone tools: an example from El Salt (SE Spain)

[1,2]***Javier Davara***, [1]*Cristo M. Hernández*, [2]*Antonio V. Herrera-Herrera*, [3]*Eneko Iriarte*, [1,2,4]*Carolina Mallol*

[1]Departamento de Geografía e Historia, Facultad de Humanidades, Universidad de La Laguna, San Cristóbal de La Laguna, Tenerife, Spain [2]Archaeological Micromorphology and Biomarker Research Laboratory (AMBI Lab), Instituto Universitario de Bio-Orgánica Antonio González, Universidad de La Laguna, San Cristóbal de La Laguna, Tenerife, Spain [3]Laboratorio de Evolución Humana-IsoTOPIK Lab, Departamento de Historia, Geografía y Comunicación, Facultad de Humanidades y Comunicación, Universidad de Burgos, Spain [4]ICArEHB - Interdisciplinary Center for Archaeology and the Evolution of Human Behaviour, Universidade do Algarve, Faro, Portugal

**Abstract:** The molecular investigation of lipid residues preserved in archaeological materials has provided valuable insights into past human populations. However, despite their ubiquity at prehistoric sites, lithics have not been extensively examined using this analytical approach. Crucial aspects, such as the types and quantities of lipids that can be preserved in archaeological stone tools, remain largely unexplored. In this study, we extracted organic biomarkers from a set of flint flakes and limestone pebbles from El Salt Middle Palaeolithic Site (Alcoy, SE Spain) and analysed them using gas chromatography-mass spectrometry (GC-MS) and with compound-specific carbon isotope analysis (GC-C-IRMS). Preliminary results suggest that Middle Palaeolithic stone tools preserve a wide range of lipid biomarkers, sometimes distinct from those found in the surrounding sediment. These findings open up the possibility of utilizing lipids retrieved from lithics as proxies in Middle Palaeolithic functional and palaeoclimate investigations. Our study highlights the remarkable preservation potential of biomolecular remains within the Palaeolithic record and underscores the importance of exploring them in different contexts, both in sediments and in other kinds of materials.

## P15 Remodelling variability in human femoral cortical bone and its implications for dietary biographical investigations of stable carbon and nitrogen isotopes

[1]***Yasmine de Gruchy***, [1]*Richard Madgwick*, [2]*Katrien Van de Vijver*, [3]*Eline Schotsmans*, [1]*Alexandra Nederbragt*

[1] Cardiff University [2] Royal Belgian Institute of Natural Sciences, Brussels [3] Centre for Archaeological Science, Wollongong, New South Wales [4] Amgueddfa Cymru - Museum Wales

**Abstract:** This project seeks to uncover the potential to develop a new collagen extraction method for isotope analysis when reconstructing dietary biographies of human individuals. Current practices require several different skeletal elements to understand the diet and locality of an individual during different periods of their life, due to varied remodelling rates and subsequent temporal signals. This study investigates the possibility of reducing the number of elements to just one by comparing osteon population density with stable carbon and nitrogen isotope data across successive samples of femoral diaphyseal cortical bone, along the growth axis, for temporal variation. The results confirmed differences in isotope values between cross-sectional segments of up to 1.3‰ for carbon and 1.8‰ for nitrogen. Remodelling agent frequency also varied across bone sections, occurring predominantly within the endosteal portion, followed by the midcortical and periosteal. With this, we concluded that the endosteal portion reflects a shorter period of life, closer to time of death. By contrast, the periosteal provides a longer average, though there were exceptions, which were accounted to possibly being age-related trends. A weak negative correlation between osteon population density and either isotope proxy was revealed, implying that remodelling has little effect on subsequent isotope values. Thus, intra-bone remodelling variation shows potential for single bone use when reconstructing in-life dietary change.

## P16 The Genetic Signature of Moza Through the lens of aDNA: Investigating Kinship, Migrations and Genetic continuity of Levantine early farmers

[1,2,3]***Giulia Di Crosta***, [3]*Marie Anton*, [4]*Jacob Vardi*, [4]*Hamoudi Khalaily*, [1,2,3]*Viviane Slon*

[1] Department of Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv University [2] Department of Human Molecular Genetics and Biochemistry, Sackler Faculty of Medicine, Tel Aviv University [3] The Dan David Center for Human Evolution and Biohistory Research, Tel Aviv University [4] The Israel Antiquities Authority [5] Department of Orthodontics, Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University

**Abstract:** The Neolithic Revolution was a crucial period in human history. In particular, The Pre-Pottery Neolithic (PPN) period in the Levant (ca. 11,800-7,800 BCE) witnessed the transition from a nomadic hunter-gatherer lifestyle to a sedentary agricultural way of life. This shifting in subsistence strategies has been coupled with migration waves that originated a mosaic of genetic interactions, leading to demographic fluctuations and active population growth.

Ancient DNA (aDNA) analyses have proven to be a powerful tool to investigate prehistory. However, due to the challenges concerning aDNA degradation in warm climates in the Levant, little is still known about the genetic makeup of Levantine Neolithic populations.

Moza is located in the central region of Israel. Occupied from the PPN to the Middle Iron Age (8600-500 BCE), excavations at the site uncovered a wealth of evidence, unearthing skeletal remains of at least 200 individuals. The well-preserved deposits make it an ideal case study for investigating the genetic makeup of early agricultural communities in the region.

Here, we report our aDNA analysis of Moza people. DNA was extracted from 30 selected individuals and converted into double-indexed, single-stranded DNA libraries. Shallow shotgun sequencing and targeted enrichment for human mtDNA were used to evaluate ancient endogenous DNA in each library. All libraries containing aDNA were analyzed to infer about their biological sex and their genetic affinities to each other and to ancient individuals from the region. Overall, genetic data from Moza have the potential to shed new light onto the PPN society of the southern Levant.

## P17 Taphonomic & diagenetic alteration of tooth enamel, and its potential impact on biomolecular preservation

[1]***Marc Dickinson***, [2]*Laila Patinglag*, [2]*Kirsty Shaw*, [3]*Michaela Ecker*, [1]*Kirsty Penkman*

[1]Department of Chemistry, University of York, Heslington, York, YO10 5DD, UK [2]Manchester Metropolitan University, All Saints Building, Manchester, M15 6BH, UK [3]Christiana-Albrech University of Kiel, Schleswig-Holstein, Germany

**Abstract:** The long term preservation of endogenous material in the fossil record provides a valuable repository that can be used to help reconstruct past environments and climates, behaviours and movements of species, as well as enable us to estimate evolutionary rates and phylogenetic relationships. Understanding the mechanisms for this preservation and the factors impacting these repositories (both organic and inorganic) is key for assessing endogeneity, and thus the robustness of the interpretations. Proteins and amino acids are one such repository that have been shown to persist into deep time, providing a variety of different types of information. For example, chiral amino acid analysis has been used for age estimation, while proteomic sequences have been used to determine phylogenetic relationships and the biological sex of an individual. To better understand the processes of amino acid & protein preservation in tooth enamel, we have investigated the taphonomic/diagenetic alteration of enamel through a combination of chiral amino acid analysis and an array of techniques (including high resolution imaging through SEM and EDX) to examine the interface between the inorganic and organic structures. This has provided essential insights into the impacts of different types of mineral diagenesis, with implications for other biomolecular studies such as palaeoproteomics and isotope analysis. We are also exploiting advances in microfluidic technology to develop a "lab-on-a-chip" approach for preparation of samples, with an aim to reduce sample masses and potentially enable IcPD dating to be undertaken outside specialist labs.

## P18 Revealing the Evolutionary History of Domestic Ferrets

***Alice Dobinson***, *Greger Larson*, *Joel Alves*

Palaeogenomics and Bio-Archaeology Research Network (PalaeoBARN), School of Archaeology, University of Oxford

**Abstract:** The evolutionary history of ferrets is widely uncertain, hindered by a scarcity of archaeological evidence, ambiguities within the historic record, and non-specific/unreliable zooarchaeological species identification. Yet, the story of ferret domestication appears unique in the history of human-animal relationships due to their apparently intrinsic connection with another domesticate, the rabbit. During the Medieval period, rabbits expand rapidly across Europe, coinciding with the earliest depictions of harnessed albino ferrets driving rabbits from their burrows. This raises the possibility that growing demand for rabbit hunting and management triggered ferret domestication. If correct, ferrets may be unique in having entered the human niche for the direct purpose of hunting and managing another specific species. The evolutionary history of ferrets and rabbits therefore has implications not only for our limited understanding of their domestication but also the dynamic history of the process more generally. Here, we test the degree of connection by weaving together the historic, archaeological, and genomic record to create a high-definition, tandem history of the two species through time. Ancient genomes of ferrets/polecats across Europe will be generated and analysed in combination with modern genome sequencing data. We intend to identify which wild population(s) of polecats first gave rise to ferrets and reconstruct the spread of lineages through time and space. These results will be analysed in parallel with a concurrent investigation into the origin of rabbit domestication and expansion across Europe. I will present the background, aims, latest results, and the future of the project as an ongoing study.

## P19 Increasing the sensitivity of cereal detection in pottery using UPLC-Q-Orbitrap MS

[1,2,3]***Jonica Ella Doliente***, [4]*Swen Langer*, [2]*Marc Dickinson*, [5]*Miriam Cubas*, [3]*André Colonese*, et al.

[1] Department of Archaeology, BioArCh, University of York [2] Department of Chemistry, University of York [3] Department of Prehistory, Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona, [4] Department of Biology, University of York [5] Department of of History and Philosophy, University of Alcalá

**Abstract:** Alkylresorcinols (ARs) are cereal-specific biomarkers, and they have recently been recovered from potsherds dating from the Neolithic and Early Bronze Age, demonstrating their potential for investigating prehistoric pottery use. Their detection in archaeological contexts is valuable as it can help determine the spread of cereal exploitation by prehistoric communities. Due to ARs' inherently low concentration in cereals, their detection is difficult, so we are exploring different approaches to the current gas chromatography-mass spectrometry (GC-MS)-based methods for AR analysis. Liquid chromatography (LC)-MS-based methods have the potential to offer superior resolving capabilities, high sensitivity and selectivity, less sample preparation (no sample derivatisation required), and faster scan speeds, although they come at higher cost. Here we report the testing, development, validation, and application of a LC-MS method for the detection and identification of low-concentration ARs in modern cereal grains and archaeological pottery. The method comprises a purification step and uses an ultra-performance liquid chromatography (UPLC) separation system connected to an orbitrap mass analyser. The achieved LOD was found to be 250- and 10-times lower than the values obtained from GC-MS and GC-Q-TOF-MS. The developed UPLC-Q-Orbitrap MS method was then applied to a Late Bronze Age material from Must Farm, UK. Analysis of the purified Must Farm total lipid extracts (TLEs) indicated that emmer grain was the main source of ARs extracted from the pots. Overall, the described method offers a highly sensitive alternative approach to GC-MS (particularly for low-concentration samples) for the detection and identification of AR homologues in archaeological pottery.

## P20 Characterizing the Last Glacial Maximum and human adaptability in the Iberian Peninsula: A multidisciplinary approach based on small mammal assemblages

[1,2]***Mónica Fernández-García***, [3,4]*Joaquim Soler Subils*, [4,5]*Isaac Rufí*, [1]*Valentín Villaverde*, [1]*Yolanda Carrión*

[1] Departament de Prehistòria, Arqueologia i Història Antiga, Universitat de València, Av. Blasco Ibañez 28, 46010 Valencia, Spain [2] Institut Català de Paleoecologia Humana i Evolució Social (IPHES-CERCA), zona Educacional 4 Edifici W3, Campus Sescelades URV, 43007 Tarragona, Spain [3] Institut Català de Recerca en Patrimoni Cultural (ICRPC-CERCA), plaça de la Catedral, 8, 17004, Girona, Spain [4] Institut de Recerca Històrica - Universitat de Girona, plaça Sant Domènec, 1, 17004, Girona, Spain [5] Departament d'Història i Arqueologia, Universitat de Barcelona, Montalegre 6-8, 08001 Barcelona

**Abstract:** The Last Glacial Maximum (LGM) is a crucial period for understanding human population dynamics and the adaptive capacities of our species. In Eurasia, the Gravettian expansion coincided with progressive environmental cooling and aridification, potentially causing human groups to contract towards refuge areas in the southern peninsulas, such as the Iberian Peninsula, which intensified during the Solutrean period. A precise characterization of local and regional climatic dynamics is essential for comprehending human resilience during this critical period. In Iberia, the exact timing of deteriorating climatic conditions is not well-documented. Small mammals, abundant in archaeopaleontological sites, serve as reliable environmental indicators. Additionally, stable isotope analyses on faunal remains offer a precise means to detect climatic changes and quantify their magnitude. Applying these analyses to small mammal assemblages presents both opportunities and challenges for Pleistocene climatic reconstructions. This proposal discusses the potential and limitations of these analyses within a research project focused on reconstructing the LGM in the Iberian Peninsula. The project centers on Gravettian and Solutrean levels from the Mediterranean area, including the sites of Mollet III and Arbreda (Serinyà, Girona) in the northeast; and Cova de les Cendres (Teulada-Moraira, Alacant) and Cova de les Malladetes (Barx, València) in the Levant. Antecedents in the study of this underrepresented period in the Mediterranean area of Iberia are presented, along with project objectives. This multidisciplinary approach aims to shed light on the climatic and adaptive aspects of human populations during LGM and enhance stable isotope studies on small vertebrate remains.

## P21 A Scientific Study of a Han Ancient Adhesive: First Discovery of The Use of Bovine Bone Powder in Pottery Bonding

[1]***Ruochen Ge***, [2]*Linlin Zhou*, [1]*Yuxuan Zhang*, [1]*Jingjie Liu*, [1]*Lu Yang*

[1]School of Cultural Heritage, Northwest University, Xi'an 710000, China [2]Qingzhou Museum, Qingzhou 262500, China

**Abstract:** The ancient adhesives are closely related to Chinese pottery's assembly and repair processes, demonstrating the technical levels at that time. In this study, an ancient adhesive of a pottery horse excavated from a Han Dynasty tomb in Xiangshan, Qingzhou, Shandong Province was examined by multiple technologies, including optical microscopic observation, scanning electron microscope–energy spectrometer (SEM–EDS), X–ray diffractometer (XRD), infrared spectrometer (FTIR), and liquid chromatography/mass spectrometry (LC/MS–MS). The findings indicate the presence of burned bone powder and clay in samples; meanwhile, the bovine Collagen α–1(I) and Collagen α–2(I) are both detected in bones and clay matrix by palaeoproteomic studies; based on three groups of replicated experiments, we believe that burnt bone powder is produced by being fired at 250℃ after being ground. The craft of this adhesive is closely related to the fabrication of the horse because it is used to bond different parts of the horse. It is noteworthy that, according to previous studies, these pottery horses were moulded and bonded by parts, but the original adhesive for bonding was not mentioned. A common phenomenon is that the majority of the pottery horses in this tomb are broken at the junctions of parts, such as the horse's head and leg breaking at the joint with the trunk. The adhesive in this study, in our opinion, is used to assemble pottery horses. The marks are found on the bonding surface for proper assembly or to increase the roughness of the surface.

## P22 Developing a triple strontium approach to refine provenance in human and animal remains

[1]***Carina T. Gerritzen***, [1]*Steven Goderis*, [1]*Hannah F. James*, [2]*Matija Črešnar*, [1]*Christophe Snoeck*

[1]Archaeology, Environmental Changes and Geochemistry Research Unit, Vrije Universiteit Brussel, Pleinlaan 2, Brussels [2]Centre for interdisciplinary Research in Archaeology, Department of Archaeology, Faculty of Arts, University of Ljubljana, Aš ker?eva 2, Ljubljana, Slovenia [3]Department of Environmental Sciences, Jožef Stefan Institute, Slovenia

**Abstract:** Strontium (Sr) isotope mapping plays a crucial role in determining the geographical origin of archaeological human or animal remains, contributing valuable insights to studies on migration, trade, and cultural interactions. Traditionally, Sr mapping relies on variations in the radiogenic Sr isotope ratio (87Sr/86Sr) of different rock types. This ratio is assimilated by soil, water, and plants in the surrounding area. The agency of humans and animals adds a layer of difficulty to provenance studies. Activities such as trade can lead to the consumption of food transported from non-local regions with distinct isotopic signatures. Furthermore, certain regions exhibit diverse landscapes, leading to significant variations in strontium isotopes in close proximity. The purpose of this study is to use strontium concentrations ([Sr]), and $\delta^{88}$Sr to refine potential sources of food. A region with generally lower [Sr] would contribute less to the overall Sr signature compared to regions with high [Sr]. Ours is a first approach to create a baseline for $\delta^{88}$Sr. The $\delta^{88}$Sr varies along the food chain, which makes a mapping approach difficult. However, geographical variations can be found in $\delta^{88}$Sr data and are therefore important to consider in any dietary reconstructions.

## P23 BEaR-capture (Base Excision ancient Repair capture): A novel method for enriching dsDNA libraries for uracil-containing molecules

***Linus Girdland Flink***, *Niamh Shelley*

Department of Archaeology, School of Geosciences, University of Aberdeen

**Abstract:** We present a novel uracil selection method that targets U:G mismatches in dsDNA. Our approach involves incorporating biotin-labelled cytosines into the USER-mediated base excision repair (BER) pathway, followed by pull-down on streptavidin-coated magnetic beads. The protocol integrates with any library preparation method that generates dsDNA with U:G mismatches and can be applied at the end of any such protocol, prior to PCR amplification. Moreover, it is backward compatible with pre-existing libraries, especially those potentially contaminated with modern, non-uracil DNA. Sequence data produced from BEaR-captured libraries retains uracil-derived damage patterns in single strand overhangs and can be authenticated using established best-practice workflow.

## P24 How did prehistoric societies deal – culturally and economically – with environmental change?

[1]***Aikaterini Glykou***, [2]*Markus Fjellström*, [3]*Kerstin Lidén*

[1]Archaeological Research Laboratory, Department of Archaeology and Classical Studies, Stockholm University

**Abstract:** How did prehistoric societies deal – culturally and economically – with environmental change? This project explores how humans used culture as a means to handle sudden environmental change, and detect different patterns of human behaviour in prehistoric coastal societies in the Baltic Sea area. The project focus on three major global environmental events, with different longevity and impact: the 8200 cal BP cold event in the Mesolithic, the 4200 cal BP aridification event in the Neolithic and the 536 AD dust-veil event in the Migration Period. These have been associated with cultural shifts worldwide, but not previously in the Baltic Sea Region. By integrating studies on archaeology, bioarchaeology, marine mammal ecology and environment, we aim to explore how the prehistoric environment entangled with both human culture and marine mammal ecology, affecting each other both ways. To address these, we will study dietary shifts, mobility and changes in material culture and technology in coastal and inland populations to infer how they dealt with different environmental/climatic change, as well as study demography in seals. To detect detailed temperature fluctuations caused by such events we will analyse skeletal remains of both humans and seals. We present the preliminary results from stable isotope analyses (carbon, nitrogen, oxygen) from Middle Mesolithic sites (Tågerup, Segebro, Bredasten, Norje Sunnansund, Stora Förvar, Dagsmosse, Kanaljorden and Strandvägen) which chronologically cluster around the 8.2 event, are typically assigned to the hunter-fisher-gatherer Kongemose Culture (c. 8500-7400 cal BP) in southern Sweden, and corresponding archaeological cultures in east central Sweden.

## P25 Watching the Pennies: Decontamination strategies for cost-effective DNA sequencing of ancient micromammals

[1]***Eleanor Green***, [1]*Michelle Feider*, [1]*Samantha Presslee*, [1]*David Orton*, [1]*Nathan Wales*
BioArCh, University of York

**Abstract:** Due to their vast numbers and short generations, the population information preserved in the ancient DNA of microfauna offers great potential. However, the type of aDNA analyses which can be conducted on samples is dependent on the amount of target DNA preserved within and extracted from a sample. Typically DNA extractions yield <5% endogenous DNA; the remainder includes environmental and handling contamination. Practically, this means that >95% of sequencing costs are spent generating data to discard. Decontaminating bones in the laboratory and targeting elements less exposed to external contamination, notably the petrous, have improved DNA yields from large mammals, but petrous bones of micromammals are rarely recovered due to their size and tendency to detach from crania.
RATTUS is a zooarchaeological project applying multiple morphological and molecular methods to micromammal remains. This means that bones are exposed to human DNA during recording without gloves (standard zooarchaeological practice) shortly before biomolecular sampling. So, an experiment was designed to remove recent contamination from microfauna remains and assess the impact of these approaches. After handling, fourteen ancient rat bones were powdered, homogenised and randomly split into four subsamples. Each set was treated with a different decontamination approach before DNA was extracted and double-stranded libraries were prepared and sequenced. The proportion of endogenous DNA, actual number of target reads, library complexity and damage profiles were compared across the methods. This is an important benchmarking experiment for assessing the effectiveness of laboratory decontamination approaches for micromammals, ultimately reducing the amount of discarded sequencing data.

## P26 Rebuilding Late Neolithic/Chalcolithic lifeways using multi-isotope analyses of human enamel, dentine, and bone from the Legaire Sur passage tomb, Spain.

[1]***Jacob I. Griffith***, [1]*Hannah F. James*, [1,2]*Christina Cheung*, [3,4]*Teresa Fernández-Crespo*, [1]*Christophe Snoeck*

[1] Archaeology, Environmental Changes, and Geo-chemistry Research Group (AMGC), Vrije Universiteit Brussel, Brussels [2] Department of Anthropology, Chinese University of Hong Kong, Shatin, Hong Kong [3] Departamento de Prehistoria, Arqueología, Antropología Social y Ciencias y Técnicas Historiográficas, Universidad de Valladolid, Spain [4] Research Laboratory for Archaeology and the History of Art, School of Archaeology, University of Oxford, United Kingdom [5] Department of Archaeology and New Technologies, Arkikus, Spain

**Abstract:** The transition between the Late Neolithic and the Chalcolithic in northern Spain was a period of profound social and economic change, defined by the consolidation of the farming economy and a substantial increase in population and inequality. To comprehend how such socioeconomic shifts affected past populations, the application of multi-tissue, multi-isotope, and incremental sampling approaches can help to recreate these lifeways in great detail.

This study combines multi-tissue sampling (bone collagen, tooth enamel, and dentine) with incremental sampling, to track age-related lifeway changes in 18 individuals from Legaire Sur, Álava (ca. 3400–2300 BC). $\delta^{18}$O and 87Sr/86Sr variations from the enamel of serially forming molars (M1, M2, & M3) reveal that the majority of the population, when compared to the local baseline, has a childhood local to the monument ( 30km away from the site). One individual (ID:405), presents elevated 87Sr/86Sr and $\delta^{18}$O values across all three teeth, indicating a childhood away from the rest of the burial location. Incremental $\delta^{13}$C and $\delta^{13}$C taken from the dentine of the successional molars also indicate homogeneity in childhood diet and weaning practices. However, again ID:405 presents a different childhood; a far longer breastfeeding signal combined with a relatively depleted $\delta^{13}$C profile. The adult diet profiles are all close clustering, indicative of terrestrial protein sources exploited within a similar landscape, with ID:405 adult profile now aligning closely with the rest of the population. The results provide a valuable insight into individual experiences with mobility, weaning, and diet in Late Neolithic/Chalcolithic northern Spain.

## P27 Growing Up Medieval: Using Puberty Assessments to Investigate the Health and Development of Adolescents Buried at Hereford Cathedral

[1]***Isobel Grimley***, *Hannah Koon*, [1]Shirley Curtis-Summers

University of Bradford

**Abstract:** The importance of studying adolescence in the past has recently been brought to the fore after often being overlooked in earlier archaeological research. Puberty consists of physical and psychological changes associated with achieving sexual maturity and is often combined with a social transition into adulthood. Healthy pubertal development is integral for overall population health, and it is well established that a variety of factors can determine the timing and tempo of this important life stage. This can include adverse environmental and social conditions (e.g. malnutrition or intense physical activity) experienced during early life and/or during puberty itself, with clinical research showing early and delayed pubertal development heavily influencing later adulthood morbidity and mortality risk. This project analysed the pubertal stages of 72 individuals aged 8-25 years-at-death from Late Saxon to Medieval Hereford Cathedral to understand how puberty may have affected the health of these young people. Results show these individuals experienced puberty between the ages of 11-22 years, with males appearing to move through some of the stages more slowly than their female counterparts. Furthermore, 14 individuals were identified as potentially delayed in their pubertal development. This poster will compare these results to existing data on pubertal timing during the medieval period and consider the social and physical implications of having delayed development. Additionally, potential associations with palaeopathological lesions and dietary stable isotope analyses will be explored, alongside the limitations of applying puberty methods to fragmentary osteological collections.

## P28 Genomic Analysis of Ancient Sheep in Europe and Western Asia

***Áine Halpin***

*Trinity College Dublin*

**Abstract:** Genomic analysis of ancient domestic animals can reveal important information about prehistoric societies, culture and even human behaviour. Possible research themes to be explored include the timing of domestication events, human-driven migrations of livestock, selection of traits, and the subsequent development of breeds. This research focuses on extending a spatiotemporal dataset of ancient sheep genomes, aiming to assess the impact of human migrations and selection pressures on the sheep genome. In particular, this research focuses on Neolithic and Bronze Age sheep populations in eastern Europe and Southwest Asia, exploring whether the prehistoric migrations of humans, especially the third millennium BC human migrations from the Steppe to northern and central Europe, mirror those of domestic sheep. Many researchers have contributed to this work and will be fully acknowledged.

## P29 An incremental carbon and nitrogen isotope study of four Neolithic individuals from Monkton-up-Wimborne, Dorset

[1]***Eleanor Harrison***, [1]*Chris Fowler*, [2]*Darren Gröcke*, [1]*Lisa-Marie Shillito*, [3]*Janet Montgomery*

[1] School of History, Classics and Archaeology, Newcastle University [2] Department of Earth Sciences, Durham University [3] Department of Archaeology, Durham University

**Abstract:** A Neolithic burial of four individuals at Monkton Up Wimborne, Dorset, dating to 3514–3101 cal BC, was excavated by Martin Green in 1997. Since then, it has attracted a great deal of interest, as an unusual example of intact inhumation of a small group of individuals which has been researched using a range of scientific methods. The group was comprised of an adult female and three juveniles (one aged around five, another eight to nine, and another nine to ten) There is no osteological indication of their cause of death. Previous work has confirmed the sex of the children through peptide analysis (Montgomery et al. in prep) and strontium and lead isotope analysis has indicated that the group were mobile throughout their lives (Montgomery et al. 2000).

This new study on the Monkton Up Wimborne individuals reports incremental dentine carbon ($\delta^{13}$C) and nitrogen ($\delta^{13}$C) isotope profiles that are used to generate new insights into their health and diet. The data confirm previous interpretations that the individuals were mobile and adds further evidence to suggest they may have been traveling as a group due to similarities in their carbon and nitrogen profiles. The results do not indicate any health issues or malnutrition, while their diets also appear broadly similar to other Neolithic people buried in different ways at the time. This evidence provides further context for interpretations of inhumation burial in this period, suggesting that unusual burials may result from, for example, manner of death rather than an unusual biography.

## P30 Seasonal Culinary Patterns in Ancient Ampurias: A Study of Kitchen Remains

[1]***Niklas Hausmann***, [2]Henning Kuhnert, [3]Père Castanyer Masoliver,[3] Marta Santos Retolaza, [4]Dirce Marzoli, Ramon Julià, [5]Helmut Brückner

[1]*Leibniz Zentrum für Archäologie (LEIZA)* [2]*MARUM* [3]Museu d'Arqueologia de Catalunya-Empúries [4]Instituto Arqueológico Alemán de Madrid [5]University of Cologne

**Abstract:** This study examines the dietary habits in the ancient Greek colony of Ampurias, focusing on a kitchen context related to a local holy place. By analyzing sequential oxygen isotope profiles of Cerastoderma glaucum (cockle) shells from five distinct layers dating to 540–500 BCE, we observed varied seasonal consumption patterns. While 3 out of 5 layers revealed a year-round consumption of cockles, 2 indicated a specific winter collection and preparation. The first layer, a single accumulation, showed a uniform season of death, suggesting simultaneous collection for a singular event. The second layer, directly below the hearth, shows gradually shifting time of death from winter towards spring. These findings provide insight into the seasonal culinary practices related to holy places and religious activities in ancient Ampurias.

## P31 Crop husbandry strategies in North-East England inferred from nitrogen, carbon and sulphur stable isotopes on archaeobotanical assemblages from corn-drying kilns.

[1]***Joanna Iosifidi***, [2]*Darren Gröcke*, [3]*Charlotte O'Brien*, [3]*Lorne Elliott*, [1]*Mike Church*

[1] Department of Archaeology, Durham University [2] Department of Earth Sciences, Durham University

[3] Archaeological Services Durham University

**Abstract:** We present the results of stable isotope analysis on archaeobotanical assemblages associated with corn-drying kilns from five sites in the North-East of England, selected from the archaeobotanical archive of Archaeological Services Durham University. We use nitrogen, carbon, and sulfur stable isotopes to understand crop growing conditions and soil amendment strategies employed in crop cultivation (cereals and pulses) from Romano-British to Late Medieval contexts. Our findings highlight the potential of analyzing legacy material from developer-funded excavations, using a combined archaeobotanical and stable isotope approach. By focusing on corn-drying kilns, we demonstrate that these structures are a valuable source of well-preserved archaeobotanical assemblages that are ideal for stable isotope research and enhance our understanding of crop cultivation in the past. The data presented in this study also contributes to a more comprehensive understanding of agricultural investment and socio-economic status of past communities in the North-East of England, as well as providing insight into the long-term trajectories of soil health and management in Britain.

## P32 Strength in Numbers: DNA Preservation and Sex Ratios in ∼1,000 Ancient Canids

[1]***Sarah Johnston***, [1,2]*Jessica Peto*, [1,3]*Anders Bergström*, [1]*Pontus Skoglund*

[1] The Francis Crick Institute [2] HumAnE Lab, University of Exeter [3] School of Biological Sciences, University of East Anglia

**Abstract:** Our laboratory is currently undertaking a large-scale ancient DNA project to piece together the unique relationship between humans, wolves, and dogs in the past. We will examine this from several different perspectives: exploring the genetic history of Ice Age wolves; tracing domestication from wolves into dogs; and reconstructing how dogs adapted to changing human environments. The project is based on close collaborations and data sharing with zooarchaeological researchers, where initial results are made immediately available for inclusion in external studies and reports. We have used the initial aDNA results from over 1,000 individual canid specimens across a broad spatial and temporal range to investigate trends in skeletal element preservation. This confirmed superior preservation in ossicles and petrous bones, and produced new evidence for improved DNA yield in cementum over dentine samples. We have also used these initial results to develop a new genetic sex identification pipeline for canids, which revealed an overall bias in male remains in the archaeological record. This mirrors previous sex bias studies in mammalian fossils (Gower et al. 2019), as well as certain modern wolf population dynamics (Packard & Mech 1980). Overall, this presentation outlines some of our newest contributions to understanding human-canid relationships, and how we plan to keep addressing this question in future studies.

## P33 Meals for the Dead? A Multidisciplinary approach to Romano-British foodways and funerary practices

***Medi Jones-Williams***

*University of Bristol*

**Abstract:** My research project is exploring the multifaceted aspects of ancient foodways and funerary practices in Roman Britain by conducting the first large-scale study, employing organic residue analysis (ORA) on accessory vessels found in distinct funerary contexts at Brougham, York, and Colchester. Research on archaeological biomarkers has revolutionized our understanding of ancient foodways. The case studies offer unique insights into the contrasting characters of Romano-British sites, from remote military cemeteries to cosmopolitan urban centers. The chosen methodology, based on ceramic variability at each site, ensures a nuanced exploration of vessel function across settlement hierarchies and regions. This poster will introduce the research aims, case study sites, and material being investigated for this project. Methodologically, my project combines material culture analysis with new organic residue data and existing archaeobotanical and zooarchaeological evidence, providing a comprehensive understanding of foodways, and the particular role of funerary vessels. Utilizing gas chromatography (GC), gas chromatography-mass spectrometry (GC-MS), and GC-combustion-isotope ratio MS (GC-C-IRMS), I will identify biomarkers that characterize the nature of substances, both food and non-food, stored or prepared within the vessels prior to deposition. Using a novel multidisciplinary approach, my research will enrich our understanding of Roman Britain, a culturally complex society undergoing social, economic, and environmental changes. The findings will contribute to the reconstruction of diet, patterns of trade and exchange, and diversity in burial traditions in Britain during the Roman period.

## P34 Understanding the Dietary Patterns of Joseon Dynasty: A Socio-Economic Perspective

*Soyeong Kang*

[1]National Research Institute of Cultural Heritage, Korea

**Abstract:** Our study focuses on analyzing biological remains recovered from archaeological sites, with the aim of unveiling the lifestyles of ancient civilizations through biological and chemical exploration of ancient biomolecules. Specifically, the use of stable isotope analysis, particularly in the investigation of dietary practices, serves as a crucial method in understanding the lifestyles of prehistoric individuals. This study investigates the socio-economic attributes prevalent during the Joseon Dynasty by conducting carbon and nitrogen stable isotope analysis on skeletal remains. Employing an enhanced Longin method, we extracted bone collagen from an individual's excavated tomb, followed by EA-IRMS examination to derive carbon and nitrogen stable isotope values. Results indicated an average carbon stable isotope value of $\delta^{13}$C = –19.3±0.6‰ (n=161), ranging between –20.9 and -16.9‰, and an average nitrogen stable isotope value of $\delta^{15}$N = 10.0±1.3‰ (n=161), distributed between 6.9 and 15.2‰. These values suggest a diet rich in C3 plants and terrestrial animal protein consumption. Analysis across regions, burial styles, and age groups revealed no significant differences. However, gender-based comparison among individuals buried together exhibited relatively higher stable nitrogen isotope values in males, potentially indicating gender-specific disparities in animal protein intake during the Joseon Dynasty.

## P35 Understanding the role of adhesives for ornamentation in Iron Age metalwork

[1]***Tabea Koch***, [2]*Sophia Adams*, [3]*Francesco Palmas*, [4]*Aimée Little*, [5]*Martine Regert*

[1]Université Côte d'Azur, CEPAM, CRNS, Nice, France. [2]YEAR Centre/PalaeoHub, Department of Archaeology, University of York, York, UK. [3]Department of Britain, Europe and Prehistory, British Museum, London, UK [4]Department of Scientific Research, British Museum, London, UK.

**Abstract:** Adhesives were produced and employed from the Middle Palaeolithic up to the Medieval Era. In earlier periods adhesives were employed predominantly for hafting tools and weapons, but their functionality evolved with the advent of ceramic technologies, now finding use in pottery repair and ornamentation. Limited attention has been directed towards their application in metalwork. It remains unclear whether this scarcity of adhesive findings on metal is due to preservation, such as corrosion-related issues, or a research focus on other materials present like associated metal portions, coral, and glass. To address this issue, we conducted chemical analyses including gas chromatography – mass spectrometry on 21 adhesive residues sampled off 16 objects from Iron Age France and England. These artefacts include ornamented brooches and harness fittings, the Basse-Yutz Flagons, and the Battersea Shield. Our findings suggest that plant and animal-derived adhesives were employed in assembling the ornamentation on these objects. These include birch tar and conifer resins, but also beeswax. However, the application waxes in conservation practices introduces notable challenges that can potentially constrain the interpretation of molecular analyses. Our findings have implications for the understanding of adhesive technologies, and illustrate the potential of identifying adhesives in metal ornamentation.

## P36 Examining the effects of pollution on the sulfur isotope biosphere

[1]***Angela Lamb***, [1]*Jane Evans*, [2]*Richard Madgwick*, [1]*Carolyn Chenery*, [3]*Andy Macdonald*

[1] British Geological Survey [2] Cardiff University [3] Rothamsted Research

**Abstract:** The inclusion of sulfur isotopes in multi-proxy studies has lagged behind other isotope systems for various reasons. Partly this is due to the low S concentration in organic material and the technical challenges this poses. The other issue is a belief that anthropogenic impacts on the contemporary sulfur biosphere are widespread and significant, leading to a widely held assumption that the use of modern biosphere mapping as an analogy for past environments is not appropriate to pre-industrialized landscapes and that this is the reason that prehistoric and modern biosphere values diverge. Here we examine recent changes in anthropogenic sulfur input using a historical plant archive in the Southeast of England. Historic samples demonstrate a functional relationship between UK SO2 emissions and both herbage S% and $\delta^{34}$S from Rothamsted Research Station between 1863 and 1995 (Zhao et al. 1998). Following UK legislation in the 1950/60's SO2 emissions have declined rapidly, accompanied by an increase in $\delta^{34}$S values towards pre-industrial values. This project extends the analyses a further 24 years to 2019. We demonstrate that herbage $\delta^{34}$S values continue to increase in-line with decreasing coal-derived SO2 emissions, but this is complicated by increasing SO2 emissions from other sources. We will further explore the implications of this finding for sulfur isotope studies.

## P37 Metrical Variation Between Populations Of Discus Rotundatus As A Palaeoecological Proxy: A 2d Geometric Morphometric Approach And Its Archaeological Implications

***Matt Law***

*Bath Spa University*

**Abstract:** A number of species of terrestrial mollusks vary in their shell dimensions in response to environmental factors. Discus rotundatus is one of these, although the factors causing the variation are not unambiguously clear. Studies in mainland Europe have suggested that there may be greater homogeneity in shell shape among D. rotundatus in older woodland habitats, but also that under ideal laboratory conditions shells will grow larger with taller spires.

This research project aims to investigate variances in shell size and shape across different habitats in southern Britain to attempt to identify patterns in variation in relation to precipitation and bedrock geology. It applies two different approaches: traditional shell measurements and two-dimensional geometric morphometrics. The archaeological implications of metrical variation within the species are considered.

## P38 Population Continuity between Roman and Early Medieval Northumbria? Scorton, North Yorkshire as seen through Dental Anthropology

***Matthew Lee***, *Rebecca Gowland*, *Janet Montgomery*, *Sarah Semple*

Durham University

**Abstract:** Much debate exists around how the transition between Roman and Early Medieval Britain occurred. Theories derived from historical, archaeological, and biomolecular evidence suggest a range of possibilities, between mass migration to the migration of only Elite society members, and/or cultural ideas. Analyses of the Early Medieval period often exclude the complex frontier zone of the north of England, instead focusing primarily on the South and East of the country. This poster presents preliminary results from the analysis of the late Roman (c. 4th Century AD) and Anglian (c. 5th to 8th Century AD) cemeteries found at Hollow Banks Quarry, Scorton, North Yorks. Dental morphological and metric data was collected from 44 individuals, 11 Roman and 33 Anglian. This data was examined using the recently published biodistance analysis statistical method FLEXDIST to explore the possibility of population continuity between the two cemeteries. Ten individuals from the Roman cemetery had previously been analysed isotopically for both dietary and migration information. This analysis found that Roman Scorton contained a mixture of individuals who could be local to the site, elsewhere in Britain, or to Continental Europe. These interpretations are incorporated into the FLEXDIST results to explore how isotopic and biodistance analysis can work together to examine questions about past population movement and continuity. What emerges is a more complex image highlighting distinct biological groups alongside the mixing of individuals who could be considered to be local to the site as well as those from further afield in Europe.

## P39 Geolocation of fish in the Baltic Sea: the potential as a tool of isotope analysis of pike bone and enameloid

***Veronica Lee***

University of York

**Abstract:** The northern pike (*Esox lucius*) was a primary food fish in medieval Europe, particularly in the Baltic Sea region, where it inhabits fresh- and brackish waters. Historical and archaeological data point to a large-scale interregional trade in pike across and beyond the Baltic, but neither the trade nor the wider economic significance of pike has been studied systematically on a regional scale. Despite the prominence of pike in the archaeological record, few studies analyse archaeological evidence for its trade from individual sites and none attempt molecular provenancing. This poster presents the preliminary isotopic results from a project investigating pike exploitation and trade in the Baltic Sea region, and explores the potential of isotopes for geolocation. The handful of biomolecular studies determining the living environment of archaeological fish have concentrated on relatively broad distinctions between marine and freshwater environments, and between large bodies of water, from carbon-, nitrogen- and, more recently, sulphur isotope analysis of bone collagen. This pilot project explores the analysis of $\delta^{13}$C, $\delta^{13}$C and $\delta^{34}$S from pike bone, and, more experimentally, $\delta^{18}$O from tooth enameloid as a potential new tool for greater resolution in the geolocation of fish in the Baltic Sea. The project will determine the analytical potential of the carbonate fraction – more easily extractable than the phosphate – of archaeological enameloid, and test its response to pre-treatments. By developing methods for detecting imports and refining catch locations of archaeological remains, the project aims to expand the toolkit for identifying traded pike, and fish more widely.

## P40 Reading tea leaves: Assessing the impact of tea consumption on strontium isotopes and concentrations

[1]***Emma Legrand***, [1]*Hannah F. James*, [1]*Carina T. Gerritzen*, [1]*Christophe Snoeck*

[1] Archaeology, Environmental changes & Geo-Chemistry (AMGC) research group, Vrije Universiteit Brussels

**Abstract:** Strontium (Sr) is ubiquitous in our ecosystem, and its presence at the very basis of the food chain in plants and water ensures its integration into the human body. Dietary Sr dominates the Sr input of skeletal tissues, mainly through the consumption of plants. Consumption of specific foodstuffs on a regular basis, such as imported foods, can influence 87Sr/86Sr or [Sr] in the body towards exogenous values, as has been demonstrated with marine products and salt. In these instances, the consumption of such products, if not properly accounted for, can affect the archaeological interpretations of results in mobility and dietary analyses. Tea is a popular drink whose consumption has been dated back to the Warring States Period (475-221 BC) in China. Gradually spreading across all continents, it is today the second most consumed drink after water in the world. The cultivation of the *Camellia sinensis L.* shrub can only be achieved in tropical and subtropical areas, resulting in the importation of tea. As a beverage made from the brewing of these imported leaves and consumed on a regular basis, tea may affect Sr isotopic and concentration values of consuming populations. This pilot study presents 87Sr/86Sr, [Sr], and $\delta^{87}$Sr data for various types of tea and herbal teas, and how the brewing process influences the Sr values in the final consumed beverage. This is the first step in exploring the potential impact of tea consumption on the interpretation of Sr data.

## P41 What's the smell of the past? Developing a methodology to approach the study of archaeological aroma

*Judith Margarita López Aceves*
University of Leicester

**Abstract:** In this poster, I will explore the fascinating question of how to investigate the aroma of the past through the innovative technique of Solid Phase Microextraction coupled to Gas Chromatography Mass Spectrometry (SPME-GC-MS). This presentation will reveal the ability and issues of this methodology to capture and analyse volatile compounds that have endured over time, offering a unique window into the olfactory history of archaeological materials. Tobacco and archaeological pipes (Bradgate House, Bradgate Park, Leicestershire, (17th century) were analysed to develop a non-destructive methodology to identify scents of the past, and to understand their cultural and social relevance in historical contexts.

## P42 Multi-method geoarchaeological approaches untangle complex site formation processes and soil biographies at early Neolithic Peiligang, middle Yellow River Valley, China

[1]***Zhe Ma***, [2]*Karen Milek*, [3]*Yongqiang Li*

[1]Department of Archaeology, Durham University [2]Institute of Archaeology, Chinese Academy of Social Science

**Abstract:** This geoarchaeological study examines the impact of environmental and cultural processes on Peiligang, an early Neolithic site in the loess plains of the middle Yellow River Valley, China. Continuous occupation since the Neolithic and complex post-depositional processes caused irregular interlacing of darker and yellower soils, which posed major challenges for the excavation, sampling, and interpretation of the site. The geoarchaeological programme carefully sampled the darker and yellower soils separately in order to identify their formation processes. Quantitative analyses of geochemical properties, including pH, electrical conductivity, magnetic susceptibility, and organic matter content, were compared to micromorphological analyses of both soil types. This multi-method approach revealed that the darker soils, with higher magnetic susceptibility, organic matter content, and artefact densities, were the original Neolithic A horizons amended with cultural material from the Peiligang settlement, which had been subjected to long-term post-depositional pedogenic processes. The yellow soils, on the other hand, were vertebrate and invertebrate burrows infilled with 'clean' loess dragged in from overlying and underlying aeolian layers. The resulting long-term biography of the Peiligang soils, spanning 7000 years, has made it possible to strip back the later phases of soil development and to extract the soil characteristics relevant to the early Neolithic phase of occupation. This has major implications for our understanding of Peiligang and will have significant impacts on how other early prehistoric sites on China's loess plateau are investigated.

## P43 Towards the Co-Extraction of Proteins and Lipids from Dental Calculus for Maximising Dietary Information

[1]***Meaghan Mackie***, [2]*Cynthianne Spiteri*, [3]*Federica Dal Bello*, [4]*Beatrice Demarchi*, [5]*Robert C. Power*

[1]School of Archaeology, University College Dublin, Ireland [2]Archaeobiomics, Department of Life Sciences and Systems Biology, University of Turin, Italy [3]Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, Eberhard Karls Universität Tübingen, Germany [4]Department of Comparative Biomedicine and Food Science, University of Padua, Italy [5]Department of Molecular Biotechnology and Health Sciences, University of Turin, Italy

**Abstract:** In the last decade, the examination of ancient dental calculus using proteomics has become an important source of direct dietary information of past people, especially for animal products. More recently, lipid residues and metabolites have also been extracted from calculus to gain further insight into past foodstuffs, especially those from plants. The two sources of information are therefore complementary and necessary to get a more holistic idea of ancient diets. However, current protocols usually involve these extractions done on separate samples of calculus. A more sustainable and comparable approach to examine this limited resource would be co-extraction of proteins and lipids from the same sample of calculus. This would allow for a more detailed understanding of individual diets in the past with fewer samples destroyed, leaving the door open for future analyses. We have examined different protocols for the sequential extraction of lipids and proteins from the same sample of calculus to determine the extent of the dietary information that could be attained. Both gas and liquid chromatography methods were explored for the analysis of the lipidic fraction. Modern and mediaeval calculus were used to determine the effectiveness of the different lipid extraction and mass spectrometry methods, and any modifications to the protein yield and composition caused by preceding lipid extraction. In addition, the use of the leftover pellet from the extractions for microscopic analysis and therefore the maximising of dietary information from a single sample is discussed.

## P44 You cannot dine with the Langobards! Stable isotope analysis of the individuals from Corte Romana (Cividale, NE Italy)

[1]***Valentina Martinoia***, [2]*Paola Saccheri*, [3]*Angela Borzacconi*, [2]*Luciana Travan*, [1]*Michael Richards*

[1] Department of Archaeology, Simon Fraser University, Burnaby (BC), Canada [2] Department of Medicine, University of Udine, Udine, Italy [3] National Archaeological Museum of Cividale, Cividale del Friuli, Italy

**Abstract:** The arrival of the Langobards (Lombards) in Friuli-Venezia Giulia (NE Italy) significantly impacted the region's territorial and socio-political dynamics during the Early Middle Ages. Between the 6th and 7th century AD, Cividale del Friuli (NE Italy) saw the coexistence of the local population and the ruling Langobard community. Archaeological evidence highlighted differences in burial practices between these two groups. At the end of the 6th century AD, the local population was buried within the city walls in scattered funerary areas, while the Langobards were buried in organized necropolises outside the city. The local population buried at Corte Romana (a residential area of Cividale) includes adult individuals (n=16) and an unusual number of stillborn (n=12) and subadults (<18 years; n=24). We undertook bulk collagen stable $\delta^{13}$C, $\delta^{13}$C, and $\delta^{34}$S isotope analysis to investigate the diet and mobility of the individuals from Corte Romana. Our results showed the consistent consumption of C4 plants and a remarkable disparity in the consumption of protein-rich foods between the local adult and subadult individuals despite their being all local to the area. Specifically, subadults aged 5 to 18 show restricted access to specific animal-derived proteins compared to the adults. Additionally, when compared to previously published data for Langobard subadults of corresponding age categories from nearby sites, this dietary disparity becomes more evident – a clear indication of sociocultural differences in terms of access to resources between the existing local population and the new Langobard invaders.

## P45 Untangling Fragments: An interdisciplinary study of a commingled deposit at Ibida, Romania

[1]***Mackenzie Masters***, [3]*Andrei D. Soficaru*, [1]*James Cox*, [1,2]*Malin Holst*, [1]*Michelle Alexander*

[1]University of York [2]York Osteoarchaeology [3]Fransic I. Rainer Institute of Anthropology

**Abstract:** In this study, a multi-isotopic approach is used in tandem with osteological analysis and archaeothanatology to enhance the understanding of a deposit of disarticulated commingled human remains at the site of Ibida, Romania. Skeletal remains dating to the 4th- 6th century CE have been excavated from three burial contexts, a high-status chamber tomb (MNI=39), a necropolis (MNI=163), and a commingled deposit (M141) (MNI=28). Remains from M141 comprise adult and non-adult remains of both sexes; there are indications of perimortem cranial trauma and postmortem damage to long bones. We present the results of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) (n=105 humans, 21 animals) isotopes analysis from bone collagen and bulk dentine (n=19), to understand the diet of individuals across the burial contexts. Preliminary $\delta^{13}C$ results indicate distinctly different dietary behaviours in the individuals from the mass grave, with a significant contribution of C4 food sources. In contrast, individuals from the high-status family vault consumed a C3 dominant diet, while those from the necropolis present a range of C3 and C4 dietary inputs. Sulphur ($\delta^{34}S$) (n=36 humans, 8 animals) isotope analysis from bone collagen was undertaken to explore the possibility of a non-local origin for individuals from M141. Results demonstrate a surprising distinction between M141 and other populations at Ibida, suggesting some of these individuals may be non-locals. This multi-disciplinary approach has enhanced our understanding of deposit M141 and allowed for a better understanding of the dietary behaviours of individuals at Ibida that would otherwise have been overlooked.

## P46 Dietary Dynamics on the Northern Fringes of the Roman Empire: an Isotopic Study of York

[1]***Elisha Meadows***, [1]*Michelle Alexander*, [1,2]*Malin Holst*, [3]*Christine McDonnell*

[1] University of York [2] York Osteoarchaeology Ltd. [3] York Archaeology

**Abstract:** York has a diverse Roman-period funerary landscape, which can provide valuable insight into life on the northernmost fringe of the Empire. Previous osteological and biomolecular investigations in York have begun to demonstrate York's complex relationship with the wider Roman world through isotopic and DNA analysis, which has raised questions surrounding personhood, migration and burial in York during this period.

Building on previous work, this project takes a 'whole town' approach, utilising large scale, multi-isotopic analysis from a variety of cemetery populations in order to understand how diet and mobility varied at an intra- and inter-individual, and population scale. Results from new isotopic analysis aim to capture the diversity of the population through a broader exploration of individuals, including a focus on non-adults. By expanding on previous work, it is possible to facilitate new conversations regarding social groups who have traditionally received less attention in modern scholarship. This study will also draw upon thematic frameworks present in archaeology, social anthropology and bioarchaeology to explore questions relating to personhood, migration and social behaviours in York as a way of understanding the lived experience of people living in a single town within the Roman Empire.

In this poster, preliminary results of carbon ($\delta^{13}$C) and nitrogen ($\delta^{13}$C) isotope analysis are presented from Roman-period cemeteries across York. This data will be used to explore diet, health and cultural behaviour from different demographic or social backgrounds, and results are compared to pre-existing data to give a rare insight into population and dietary dynamics within the city.

## P47 Original amino acids from tooth enamel: extending the potential for dating and palaeoproteomics

[1]***Fazeelah Munir***, [1]*Marc Dickinson*, [2]*Ryan Sinclair Paterson*, [2,3]*Palesa P. Madupe*, [4,5]*Weronika Karolina Cieszynska*

[1]Department of Chemistry, University of York, UK [2]Geogenetics Section, Globe Institute, University of Copenhagen, Denmark [3]Human Evolution Research Institute (HERI), University of Cape Town, South Africa [4]Department of Earth Sciences, University of Florence, Italy [5]Department of Earth Sciences, University of Pisa, Italy

**Abstract:** The excellent preservation of proteins in tooth enamel makes it an invaluable repository of biomolecular information into deep time. By using mass spectrometry (MS) to analyse the protein sequences (palaeoproteomics) from tooth enamel, we are able to better understand phylogenetic relationships (Cappellini et al., 2019) and in some cases determine biological sex (e.g., Madupe et al., 2023) from Pleistocene vertebrate teeth. Chiral amino acid analysis of tooth enamel by reverse phase high performance liquid chromatography (RP-HPLC) is a reliable tool for building geochronologies (Dickinson, 2018) and has also been used to help demonstrate the presence of endogenous proteins through their patterns of decomposition (e.g., Cappellini et al., 2019). Bringing together these two complementary techniques (RP-HPLC & MS), we are able to better understand the biomolecular information generated, and thus have greater confidence in the conclusions drawn.

Here we present amino acid data from mammalian tooth enamel ranging from the Pleistocene to the Miocene to screen the palaeoproteomic potential of samples. Using the predictable patterns of intra-crystalline amino acid decomposition, we are able to identify samples which contain amino acids that exhibit closed system behaviour. Based on this information, we can test the likely endogeneity of peptides determined from these samples using LC-MS. This demonstrates the potential of amino acid analysis in authenticating the biomolecular information in ancient samples, and the power of combining the two approaches to more fully understand protein preservation.

## P48 Introducing benzene polycarboxylic acid analysis: archaeological potential of a molecular marker for charring

[1,2]***Ivy Notterpek***, [1]*Isabelle Théry*, [2]*Oliver Craig*, [2]*Alexandre Lucquin*, [3]*Samuel Abiven*

[1]Université Côte d'Azur, France [2]University of York, UK [3]École normale supérieure, France

**Abstract:** Since its development in 1998, benzene polycarboxylic acid analysis has become a powerful and frequently employed tool in environmental science research for its ability to elucidate the molecular characteristics of charred material on the entire combustion continuum from charcoal to condensates and soot. Applications of the method to ancient soils and sediments are presently limited, yet the method holds great potential in archaeological research as a molecular marker for charred biomass, including cases where no or few macroscopic charcoal fragments remain. The interpretations drawn from BPCA results—namely related to the aromaticity, aromatic condensation, and combustion temperature of the charred material—are here demonstrated through the statistical analysis of a BPCA database created for lab-produced chars. The analytic potential of BPCA research in archaeological deposits is demonstrated through a case study from an apparent MIS 5 wildfire directly overlaying Levallois lithic remains in the Middle Palaeolithic deposits of Ormesson (Seine-et-Marne, France).

## P49 Axes of power, axes of toil: the production and use wear of the ancient Egyptian and Nubian copper alloy axes

[1]***Martin Odler***, [2,3]*Jiří Kmošek*

[1]Newcastle University [2]Institute of Science and Technology in Art, Academy of Fine Arts Vienna [3]Nuclear Physics Institute, Academy of Sciences of the Czech Republic, Řež

**Abstract:** In 1987, Vivian Davies published a catalogue of the ancient Egyptian and Nubian axes within the collection of the British Museum, London. Their standard typological research was aided by a broad archaeometallurgical dataset, encompassing all discussed specimens. Not only that, a corpus list of all known Chalcolithic and Bronze Age axes known from Egypt and Nubia, provenanced and unprovenanced, was included. With the addition of material published after this date, it totals altogether more than 1,900 known specimens of full-size and model axe blades from the entire periods and regions mentioned. The present paper is focused on the macro- and micro-evaluation of this dataset, as the recent upsurge in online publication of museum collections enables to gather more information on the artefacts than ever before. This is aided by the meticulous study of the production and use wear of the tens of artefacts, which were available for direct inspection, and compared with rich Egyptian iconographic and textual sources. And by the addition of the elemental composition data, from the literature, but also newly gathered by the portable XRF and more precise techniques, such as e.g. NAA and metallography. The dataset enables us to address anew the questions of the distinction between the battle axes and artisan ones (used for woodwork and stonework), as well as identifying the unclear category in between both of these. The paper is an interim report on a post-doctoral project EgypToolWear – Metalwork Wear Analysis of Ancient Egyptian Tools, supervised by Prof. Andrea Dolfini.

## P50 Violent lives and violent deaths. Ante-mortem and peri-mortem trauma in a 13th to 14th century mass grave in Karakorum (Mongolia)

[1] ***Júlia Olive Busom***, [2] *Susanne Reichert*, [2] *Jan Bemmann*, [1] *Alice Toso*

[1]Bonn Center for ArchaeoSciences (BoCAS) Institut für Archäologie und Kulturanthropologie Rheinische Friedrich-Wilhelms-Universität Bonn [2]Institut für Archäologie und Kulturanthropologie, Rheinische Friedrich-Wilhelms-Universität Bonn

**Abstract:** During a survey excavation carried out in Karakorum, the former capital of the Mongol Empire, a mass grave with 13 skeletons was recovered. The radiocarbon dating of six individuals reveals that their deaths took place between the 13th and the 14th centuries. Their anthropological and palaeopathological analysis indicates that males are exclusively found, and evidence of ante-mortem and peri-mortem trauma is detected in five individuals. Written accounts of confrontations between Ming Chinese and Mongol armies during the second half of the 14th century throughout the Mongolian Plateau exist, however no definitive archaeological evidence of destruction, indicating an attack on Karakorum, has been found so far. Taking into account the archaeological context in which the remains were found and the obtained radiocarbon dates, which are all very similar, we propose that the individuals represented in this mass grave were deposited synchronously. Moreover, this context and the presence of peri-mortem trauma not only strongly hints at the possibility of a violence-related death but, when combined with the presence of co-occurring ante-mortem trauma, suggests the individuals' involvement in interpersonal conflicts. Although it is still unclear if this mass grave could be related to the Ming Chinese and Mongol conflicts, this assemblage raises questions and sheds light on the reality of interpersonal violence during the Pax Mongolica.

## P51 Additional evidence for Neolithic marine resource consumption at the Holm of Papa Westray North, Orkney

[1]***Brett Ostrum***, [2]*Chris Fowler*, [3]*Darren Gröcke*, [4]*Vicki Cummings*, [1]*Janet Montgomery*

[1] Department of Archaeology, Durham University [2] School of History, Classics and Archaeology, Newcastle University [3] Department of Earth Sciences, Durham University [4] School of History, Archaeology and Religion, Cardiff University

**Abstract:** A major contribution of isotopic research to archaeological studies in Britain has been the revelation of the declining role of marine resources in subsistence strategies from the Mesolithic to the Neolithic period (c. 4000 BC), with Neolithic communities predominantly relying on terrestrial food resources. An exception to this trend is recorded at the Sumburgh cist in Shetland, where stable isotope analysis of incremental dentine identified occasional, short-term periods of marine food consumption for a number of individuals. Previous isotopic research on bulk bone collagen from the Holm of Papa Westray North chambered cairn in Orkney also suggests that some individuals at this site may have consumed marine foods—or perhaps meat and/or dairy products from terrestrial animals that had in turn fed on marine resources. Here, we present new stable carbon ($\delta^{13}$C), nitrogen ($\delta^{13}$C), and sulphur ($\delta^{34}$S) isotope results from incremental dentine for four individuals from Holm of Papa Westray North to develop a greater understanding of possible marine food consumption at this site. The data indicate that two individuals had predominantly terrestrial diets, while two others have data that indicate some of their dietary protein was derived from marine sources. Incremental $\delta^{34}$S analyses are used to further disentangle marine and terrestrial food consumption. Although only two of the four individuals sampled at Holm of Papa Westray North demonstrate consumption of marine foods, the results provide additional evidence for the occasional continuing, and perhaps regional, role of marine resources in Neolithic subsistence strategies.

## P52 Paleoproteomic Analysis of Dog Coprolites from SGang Gwaay Llnagaay, Haida Gwaii

[1]***Lindsey Paskulin***, [1]*Jay Hilsden*, [1]*Jenna Loupret*, [1]*Camilla Speller, et al.*

[1] Ancient DNA and Proteins (AD$\alpha$PT) facility, Department of Anthropology, University of British Columbia, Vancouver, Canada [2] Archaeology and History Branch, Indigenous Affairs and Cultural Heritage Directorate, Parks Canada, [3] Council of the Haida Nation, Haida Gwaii, BC, Canada [4] Haida Gwaii Museum, Skidegate, BC, Canada [5] Archipelago Management Board, Gwaii Haanas National Park Reserve [6] National Marine Conservation Area Reserve, and Haida Heritage Site, Queen Charlotte, BC, Canada

**Abstract:** Excavations conducted by Parks Canada, the Haida Nation and the Haida Gwaii Museum in 2021 uncovered the presence of preserved coprolites at the ancient Haida village at SGang Gwaay Llnagaay, Haida Gwaii. This work is part of the 'Living Landscapes of SGang Gwaay' 6 year project with funding from the Government of Canada's Conservation and Restoration Program, and approved by the Archipelago Management Board, and the Haida Hereditary Chiefs Council. Proteins were extracted from two coprolites and analyzed via liquid-chromatography tandem mass-spectrometry. The two samples displayed very good biomolecular preservation, identifying over 100 proteins matching both bacteria and eukarya. The bacterial proteins, primarily matching to Bacteroidetes, Firmicutes and Proteobacteria, were consistent with those phyla found within the mammalian gastrointestinal tract as well in soil. The eukaryotic proteins were generally highly conserved and primarily matched to the class Mammalia, although one Canis specific protein was identified. We identified mammalian proteins expressed within the gastro-intestinal tract, pancreas, intestines, colon, and colonic epithelium, and associated with specific biological functions such as digestion, vitamin B12 metabolism, protein and fat digestion and absorption, and pancreas secretion pathways. Some proteins could be matched to putative food sources, including matches to muscle proteins of bivalves (Mytilus sp.), and bony fishes (Teleostei). Using ZooMS, three small bone fragments within the coprolite were identified as halibut (Hippoglossus sp.). Together, this proteomic evidence is consistent with a gastro-intestinal proteome, confirming the identification of these materials as dog paleofeces, and providing insight to human-animal interactions and diet at SGang Gwaay Llnagaay.

## P53 The Development of Yorkshire's Arable Weed Flora (4000 BCE – 1100 CE)

*Neal Payne*
Faculty of Classics, University of Cambridge

**Abstract:** My poster presents a new analysis of Yorkshire's arable weed flora spanning the Neolithic through Early Medieval periods (4000 BCE – 1100 CE). Arable weeds are typically herbaceous plants that thrive in disturbed soil conditions, particularly those created during the management (including plowing) of arable fields. These weeds, both native and introduced, compete with deliberately cultivated crop plants to exploit these anthropogenic landscapes. This research explores the continual evolution of Yorkshire's weed flora through a synthesis of all currently available published and unpublished archaeobotanical reports, collating and standardizing the archaeobotanical evidence from 6500 sampled contexts originating from over 500 archaeological sites. Extra-local arable weed introductions to Yorkshire are explored, revealing the acceleration of regional introductions from the (Middle) Iron Age through the Roman periods and the decline of new introduction during the Late Roman and Early Medieval period. The periodized analysis of the weed flora's ecological traits (flowering time, lifecycle, and their affinity for particular soil conditions) demonstrates progressively declining soil fertility alongside increasing indicators of soil-disturbance. This analysis establishes 5000 years of evolving weed flora diversity and ecological modification in Yorkshire's arable fields.

## P54 Nature of the beast? Identifying drivers of prey choice, competition and resilience in wolves: isotopic analysis approach.

[1]***Fabienne Pigiere***, [2]*Angela Lamb*, [1]*Amanda Burtt*, [1]*Danielle Schreve*

[1]Department of Geography, Royal Holloway University of London, Egham, Surrey TW20 0EX, UK [2]National Environmental Isotope Facility, British Geological Survey, Nicker Hill, Keyworth, Nottinghamshire, NG12 5GG, UK

**Abstract:** The wolf was a keystone predator throughout the Pleistocene in Europe and its ability to adapt ecologically has ensured its longevity to the present day. While this great dietary plasticity remains today, the conditions and timing of this flexibility is poorly understood. The 'Nature of the beast' NERC project aims to reconstruct wolf diet from the late Middle Pleistocene throughout the Holocene using a multi-proxy approach that combines dental micro-wear, isotopic analysis, cranio-dental morphology, and analysis of scats in order to investigate the adaptation of wolves to forcing factors, including changing climate, environment and competition from other predators. A pilot study has provided isotopic evidence for changing patterns of wolf prey choice through the Pleistocene. While both small and large prey (hare, horse) were taken by wolves in the MIS 7c-a interglacial, only large prey (reindeer, bison) were targeted during MIS 5a and a broader range of large prey items (horse, woolly rhinoceros, bison) during MIS 3. This paper will further examine contrasting prey choices and dietary niches between wolves and other competitors, including carnivores and humans, during the MIS 3 and MIS 2 using a combination of published and new isotopic data. The lack of synchronicity previously observed in wolf palaeodietary reconstructions between isotopic analysis and the evolution of cranio-dental morphology for MIS 3 will be studied in greater detail on the basis of new data from Kents Cavern and we will explore new insights from Pin Hole and Cattedown cave fauna.

## P55 Identification of treatment for syphilis in post-medieval individuals by a mercury speciation methodological approach

[1]***Paola Ponce***, [1,2]*Gianni Gallello*,[3]*María Luisa Cervera Sanz*,[2]*Angel Morales-Rubio*, [1]*Adrienne Morris*

[1] University of York [2] Department of Prehistory, Archaeology and Ancient History, University of Valencia, Spain [3] Department of Analytical Chemistry, University of Valencia, Spain [4] Environmental Change Research Centre, University College London, UK

**Abstract:** The treatment of syphilis with mercury during the pre-antibiotic era is well-documented. From the late 15th century into the early 20th century, the metal was administered orally, by injection, topically with a mixture of grease, or through fumigation. As mercury accumulates in both trabecular and compact bone it is possible to estimate the concentration in a given sample. This work aims to develop a method to determine the level of biogenic mercury present in seven post-medieval skeletons recovered from the Queens' Chapel of the Savoy, London, five of them showing pathognomonic signs of syphilis. To control the post-depositional processes affecting the biogenic elemental bone profile, sampling consisted of separating the outer and inner parts of ribs and long bones together with soil in contact with the bones and soil collected from the churchyard. Furthermore, to differentiate the possible post-mortem mercury contamination from the biogenic one, an analytical approach was developed for the identification of mercury species in bone samples with the use of a mercury analyser. For this, dilutions of different mercury species ($Hg^0$, $HgSO_4$, yellow HgO, red HgO, HgS, $Hg(NO_3)_2$, $Hg(CH_3COO)_2$, $HgI_2$, $HgCl_2$, and $Hg_2Cl_2$) were prepared employing experimental bone and soil samples to make the matrices similar to those of the studied samples. The concentration of each mercury species released at different temperatures was measured. The obtained results showed the presence of mercury (II) chloride in individuals with syphilis.

## P56 Molecular proxies for investigating Indigenous land use on Curaçao, Leeward Antilles (circa cal. AD 1227 – present)

[1]***Sophie Rabinow***, [2]*S. Yoshi Maezumi*, [3]*Claudia Kraan*, [4]*Ainara Sistiaga*, [5]*Christina Giovas*

[1]Department of Archaeology, University of Cambridge, Cambridge, UK [2]Department of Archaeology, Max Plank Institute of Geoanthropology, Jena, Germany [3]National Archaeological-Anthropological Memory Management, Curaçao [4]The Globe Institute, University of Copenhagen, Copenhagen, Denmark [5]Department of Archaeology, Simon Fraser University, Burnaby, Canada

**Abstract:** The Caribbean is a globally significant biological hotspot whose terrestrial fauna and flora were shaped through land use and species introductions, starting with the earliest phase of human arrivals, around 4000 BC. On the island of Curaçao, located in the Leeward Antilles, archaeological investigations support an increase in the number of settlements and settlement persistence around AD 800, as well as the possible introduction of several continental mammals at this time. In AD 1499, Spanish colonizers arrived in Curaçao and developed ranching and logging activities; they were followed in AD 1634 by Dutch groups who exploited the land for agriculture, grazing, and salt production. Molecular proxies specific to certain organisms or processes (sometimes described as biomarkers in archaeology) can characterize human arrivals, change in plant species composition, and anthropogenic fire use. In this paper, I present the preliminary results for molecular proxies from a sediment core collected from Saliña Sint Marie (basal date circa cal. AD 1227), a lagoon on Curaçao's western shore in proximity to pre- and post-Contact archaeological sites. Results advance understanding of the timing and evolution of land use strategies on Curaçao, which is crucial considering the challenging preservation conditions which characterize Caribbean archaeological sites. In addition to its cultural implications, this study contributes towards framing the impacts of Indigenous arrivals and activities on local ecosystems and therefore is valuable for establishing a longitudinal perspective for ecological research.

## P57 Benchmarking the identification of a single degraded protein to explore optimal search strategies for ancient proteins

[1]***Ismael Rodríguez Palomo***, [1,2]*Bharath Nair*, [2,3]*Yun Chiang*, [2,4]*Joannes Dekker*, [1,2]*Matthew Collins*

[1]McDonald Institute for Archaeological Research, University of Cambridge, United Kingdom [2]Globe Institute, University of Copenhagen, Denmark [3]The Nice Institute of Chemistry, Université Côte d'Azur, Nice, France [4]Department of Archaeology, University of York, United Kingdom

**Abstract:** Palaeoproteomics is a rapidly evolving discipline, and practitioners are constantly developing novel strategies for the analyses and interpretations of complex, degraded protein mixtures. The community has also established standards of good practice to interrogate our data. However, there is a lack of a systematic exploration of how these affect the identification of peptides, post-translational modifications (PTMs) and protein and their significance (through the False Discovery Rate) and correctness. We systematically investigated the performance of a wide range of sequencing tools and search engines in a controlled system: the experimental degradation of the single purified bovine β-lactoglobulin (BLG), heated at 95 ºC and pH 7 for 0, 4 and 128 days. We target BLG since it is one of the most robust and ubiquitous proteins in the archaeological record. We tested different reference database choices, a targeted dairy protein one, and whole bovine proteome and three digestion options (tryptic-, semi-tryptic- and non-specific searches), in order to evaluate the effects of search space and the identification of peptides. We also explored alternative strategies, including open search that allows for the global identification of PTMs based upon wide precursor mass tolerance and de novo sequencing to boost sequence coverage. We analysed the samples using Mascot, MaxQuant, Metamorpheus, pFind, Fragpipe and DeNovoGUI (pepNovo, DirecTag, Novor), and we benchmarked these tools and discussed the optimal strategy for the characterisation of ancient proteins.

## P58 Effects of cheese-making on the molecular and fatty acid carbon isotope compositions of dairy lipids

***Melanie Roffet-Salque***, *Charlie A. Maule*, *Laura E. Everett*, *Julie Dunne*, *Richard P. Evershed*

[1]Organic Geochemistry Unit, School of Chemistry, University of Bristol

**Abstract:** The transformation of milk into cheese involves essential stages, starting with the coagulation of milk, separation of curds from the whey and pressing of curds into shape. The origins of cheese-making are tightly linked to those of milk exploitation, the latter having been extensively investigated in the last 30 years using iconography, faunal remains and typological and lipid residue analyses of pottery vessels. The characterisation of degraded milk-derived fats in archaeological pottery relies heavily on compound-specific carbon isotope analyses of animal fats (C16:0 and C18:0 fatty acids). Characteristic $\delta^{13}$C values observed in milk fats arises from their unique biochemical origin, although some modern diets alter this isotopic signal. While few studies have attempted to investigate the effect of cheese-making on the $\delta^{13}$C values of milk fatty acids, extensive analyses of a full modern-day cheese-making process has never been carried out. Here we investigate the effects of modern cheese-making on the dairy molecular and carbon isotope compositions using milk, curd and cheese samples collected from the Cheddar Gorge Cheese Company Ltd. Few changes in the molecular composition of dairy fats was observed during the cheese-making process, while fatty acid $\delta^{13}$C values were unchanged during the cheese-making process. This strongly suggests that archaeological lipids arising from milk and cheese have comparable $\delta^{13}$C values. Therefore, the investigation of cheese-making using lipid residue analyses can only be achieved by making connections to vessels whose typologies are indicative of an association with cheese-making, e.g. cheese-strainers.

## P59 Laser Ablation Analysis of Low Strontium Bioapatites: Warnings and Opportunities

[1]***Bryony Rogers***, [2]*Matt Horstwood*, [2]*Vanessa Pashley*, [1]*Geoff Nowell*

[1]Durham University [2]NEIF, British Geological Survey

**Abstract:** Using strontium isotope(87Sr/86Sr) analysis in low strontium concentration bioapatite samples (i.e. human and animal tooth enamel) to assess mobility and provenance is becoming increasingly common in the literature. The use of laser ablation MC-ICP-MS can reduce the complexity of sample preparation, cost of analysis and increase the speed of data acquisition and therefore sample throughput. However, this in-situ analytical approach is usually accompanied by a sacrifice in the precision, accuracy, and reproducibility, and can increase the bias of the acquired data. In regions of high biosphere strontium isotope variability this enhanced uncertainty and level of accuracy of LA-MC-ICP-MS Sr isotope data can often be tolerated whilst still enabling useful interpretations. However, in regions with low biosphere strontium isotope variability the tolerance for imprecision is much lower. Here we address the question: 'how low can we go?' with current instrumentation. Additionally, we look forward to the potential opportunities for laser ablation strontium isotope analysis of low concentration tooth enamel using newer instruments with mass filters and/or collision cells which are becoming more widely available.

## P60 Integrating ZooMS and zooarchaeology to assess the Châtelperronian and carnivore occupations at Cassenade (Dordogne, France)

[3]***Geoffrey M. Smith***, [2]*Emmanuel Discamps*, [1]*Karen Ruebens*, [1]*Jean-Jacques Hublin*

[1] Chaire de Paléoanthropologie, CIRB (UMR 7241 – U1050), Collège de France. [2] CNRS UMR5608 TRACES, University of Toulouse Jean Jaures, Toulouse, France [3] School of Anthropology and Conservation, University of Kent, Canterbury, UK

**Abstract:** Across the Palaeolithic, humans and carnivores repeatedly occupied the same caves and rock shelters. Identifying bone fragments from these dual occupation contexts through Zooarchaeology by Mass Spectrometry (ZooMS) can provide additional insights into both carnivore and human behaviour.

Here, we apply ZooMS to all morphologically unidentifiable bone fragments larger than 2 cm (n = 817) recovered from the 2012-2013 excavated Châtelperronian layer at Cassenade (Dordogne, France). Collagen was extracted using the ammonium-bicarbonate (AmBic) extraction method and over 99% of the sampled bone fragments could be taxonomically identified. While the proportion of Equidae is similar in the ZooMS and zooarchaeological collections, Bos/Bison is represented at a threefold increase in the ZooMS fraction (50.8 vs 16.7%). Conversely, Ursidae, the dominant taxa in the morphologically identifiable remains (36.6%), only formed 7.3% of the ZooMS fragments. While large proportions of the Rhinocerotidae (63.79%), Elephantidae (52%), Equidae (48%) and Bos/Bison (45%) remains have been digested by carnivores, this is only the case for 1.7% of the Ursidae ZooMS fragments. Three-dimensional data is available for all the ZooMS-identified fragments and confirm the near-exclusive presence of cave bear in the lower part of the sequence. Further, the ZooMS spatial data identified a restricted presence of mammoth in the middle part of the sequence and a diverging presence of reindeer and Cervid/saiga remains at the bottom and top.

Overall, this study illustrates the added value of integrating zooarchaeological and ZooMS datasets to obtain additional insights into past ecologies, changing site use, carnivore diet and human subsistence practices.

## P61 The dietary impact of the Yamnaya horizon on Early Bronze Age agriculturalist populations in the Pontic-Caspian steppe

[2]***Volker Heyd***, [1]*Lucy Cramp*, [1]*Elena Sandoval*

[1] University of Bristol [2] University of Helsinki

**Abstract:** The migration of Yamnaya people in the Early Bronze Age, ca. 3,300 BCE–2,800 BCE, into the Pontic-Caspian steppe changed the genetic fabric of Europe. However, how much of the existing societal fabric, if any, was influenced by this migration and subsequent genetic mixing has not been thoroughly explored. Determining the extent of the Yamnaya influence on prehistoric Europe requires an interdisciplinary approach that combines multiple lines of evidence.

This study presents how potential cultural flow is being investigated through the lens of diet, via stable isotopic analysis. Based on the lack of settlement evidence, a pastoralist subsistence pattern is generally assumed for the Yamnaya populations, but dietary patterns are difficult to reconstruct due to the lack of associated cultural and environmental evidence. In this study, dietary practices within the Yamnaya are reconstructed from the human remains themselves, using bulk stable isotopic analysis. Samples of 110 skeletal remains were chosen to reflect this angle of inquiry creating a sample group that is comprised of Eneolithic, Early Bronze Age, and Middle Bronze Age skeletal remains from across modern-day Bulgaria, Romania, and Hungary, creating an in-depth study to enable comparison of both spatial and temporal dietary trends.

Here, I will present the findings from the analysis of multiple skeletal elements from 60 Yamnaya individuals and 50 non-Yamnaya individuals. This study provides the first detailed picture of the subsistence patterns and change throughout the Yamnaya migration and subsequent contact with Early Bronze Age societies through a statistical modeling framework.

## P62 Not only caravans: Mobility patterns of camelids in the Atacama Desert, an approach using incremental $^{87}Sr/^{86}Sr$

[1]***Francisca Santana-Sagredo***, [2]*Petrus le Roux*, [3]*Josefina González*, [4]*Mauricio Uribe*, [5]*Chris Harrod*

[1]Escuela de Antropología. Pontificia Universidad Católica de Chile [2]Department of Geological Sciences. University of Cape Town [3]Independent Researcher [4]Departamento de Antropología. Universidad de Chile. [5]Instituto de Ciencias Naturales Alexander von Humboldt. Universidad de Antofagasta.

**Abstract:** South American camelids have been crucial for Andean societies. They have provided humans, both during present and ancient times, with meat, wool, raw materials and manure. It has been proposed that camelids also played a key role as beasts of burden, carrying goods for exchange between different geographical areas, leading to the establishment of llama caravans. These caravans would have had their origin exclusively in the highlands. However, these hypotheses were built almost exclusively on the presence of non-local items in lowland sites such as textiles, pottery and exotic animals. Notably, there is no direct evidence for the movement of camelids during pre-Hispanic times. This work aims is to characterise the mobility patterns of camelids in the Atacama Desert of during the Late Intermediate Period, specifically at the Pica 8 cemetery located in the Pica Oasis-Tarapacá region (Chile), by means of incremental $^{87}Sr/^{86}Sr$ compositions of tooth enamel. A total of nine tooth samples were considered including molars (n=8) and incisors (n=1). Incremental $^{87}Sr/^{86}Sr$ analyses were carried out using LA-MC-ICP-MS. Results show a high diversity in strontium isotope composition per individual with a mean of 0.70828 ± 0.00079. Some of the individuals did not show evidence of movements, and were probably local to the Pica Oasis. However, other individuals displayed drastic changes in their strontium composition suggesting high mobility amid the lowlands and highlands, or between inland and coastal areas.This suggests that camelid mobility had different types of organisation or reasons behind their travels.

## P63 Conquest and Cuisine: Exploring Communities' Experiences of 1066 in the Adur Valley through Dietary Signatures

*Siddhant Sarkar*

Department of Anthropology and Archaeology, University of Bristol

**Abstract:** The Norman Conquest of 1066 is widely recognised for having instigated a series of changes immediately after William's coronation, many of which continue to have an influence today. Various investigations have enhanced our understanding of the Norman Conquest and its impact, such as landscape modifications, ecclesiastical developments, political events, and sumptuary law, to name a few. However, until recently, most of this work remained biased and succeeded in only representing the elites or aristocracy while ignoring others. Despite knowing that food corresponds with socio-cultural identity, the medieval diet remains understudied. Therefore, this project aims to investigate the dietary practices of people living in the Adur Valley, Sussex, to address wider questions of continuity or change. Cooking pots from the sites of Bramber Castle, Steyning (a market town) and Botolph (a rural site), ranging within 950–1250 CE, will be investigated using GC, GC-MS and GC-C-IRMS to gain insights into the culinary practices of that time period. Thus, enabling the first comprehensive inter-site investigation of this era while also facilitating the examination of the Conquest's effects on other aspects of society. This study will also help determine the rate at which new rulers and their legislation were adopted, whether it occurred uniformly across society and if they encountered any resistance. Ultimately, it will provide a clearer image of how the conquest affected the lives of those residing on the frontier and, in doing so, lay a strong foundation for further research.

## P64 Tracing Ostrogothic Impact: Bioarchaeological research of germanic influences in Northern Italy

[1,5]***Dominika Schmidtova***, [2]*Julie Kocergina*, [2]*Bohuslava Čejková*, [4]*Joan Pinar Gil*, [1,5,6]*Ricardo Fernandes*

[1] Department of Archaeology and Museology, Masaryk University, Arna Nováka, Czech Republic [2] Czech Geological Survey, Geologicka 6, Prague, Czech Republic [4] Department of Archaeology, University of Hradec Králové, Czech Republic [5] Max Planck Institute of the Geoanthropology, Jena, Germany [6] Climate Change and History Research Initiative, Princeton University, USA

**Abstract:** The influence of the Ostrogoths in Northern Italy is most readily discerned through remnants in the region's material culture, with particularly significant traces found in the north. Our research centred on examining the archaeological site of Villa Clelia in Imola, Bologna, located in Emilia Romagna. Villa Clelia, which dates to the 5th and 6th centuries AD, offers archaeological and historical evidence of Ostrogothic presence. The goal of our project is to piece together the patterns of spatial movement among groups at the site and to explore both intra- and inter-population disparities by employing strontium and oxygen isotopes for our analyses. Situated roughly 50 kilometres from the historical centre of Ravenna, Villa Clelia has yielded nearly 300 burials dating from the 5th to the 8th centuries. Notably, one grave stands out due to its opulent contents, suggesting the resting place of someone of high status given the rarity and richness of the accompanying artefacts. Our ongoing study draws from a multidisciplinary approach, harnessing the fields of archaeology, anthropology, stable and radiogenic isotope analysis, and genetics to concentrate on selected individuals, thereby generating pioneering pilot data. Preliminary isotopic data offers insights into the complexities of late antique urban settlements at Villa Clelia (Imola, Bologna) while also casting light on the movements of Gothic tribes across Northern Italy, unraveling the nature of their interactions with and assimilation into the local communities.

## P65 Exploring the juvenile health and infant care in India during the Mature Harappan period

***Sayan Sinha***, *Katie A. Hemer*, *Rhiannon E. Stevens*

Institute of Archaeology, University College London

**Abstract:** The Harappan culture (3300-1300 BC approx.) flourished in present-day regions of north-western India, Pakistan and parts of Afghanistan, with three distinct periods – Early, Mature and Late. Mature period (2600-1900 BC approx.) saw zenith of urbanization, trade, craft specialization, complex societal systems etc ending in sudden decline during Late period. Climate change and ecological imbalance, often considered key factors, influenced cropping and settlement pattern, consequently the Harappan social life. The present study seeks to explore childhood experience during Mature period which preceded this decline. Previous studies on human remains from Harappa (Pakistan) focusing on skeletal stress markers, have argued that certain social and sex-based discrimination were prevalent during Mature period; which influenced the nature of conflict and violence in Late Harappan society. Individuals from such economic and societal strata were also exposed to resource discrimination, disease and infections during the Late period. In present study, a large dataset of human skeletons (Mature period) from multiple Harappan sites in north-western India would be analysed. This would abet in assessing consistency of arguments from previous studies regarding risk groups, across other Harappan regional centres. Use of dental histology and stable isotopes and published osteological datasets, is aimed at understanding spatial variation in Harappan mother-infant nexus, childhood experience, transition to adolescence, and consequent adulthood. In essence, this carries an exciting prospect to delve for alternative interpretation of social status, hierarchy and power; taking into account that social realities may not be unpretentious, but complex amalgamation of collective and individual aspirations, conflict and manipulation.

## P66 Variability in the use of Woodland pottery from Northeastern North America revealed through lipid residue analysis

[1]***Karine Taché***, [2]*Alexandre Lucquin*, [3]*Roland Tremblay*, [4]*Christian Gates St-Pierre*, [5]*Marjolein Admiraal*

[1] Université Laval [2] University of York [3] Ethnoscop Inc. [4] Université de Montréal [5] University of Alaska Fairbanks [6] New York State Museum

**Abstract:** Previous studies have shown that Early Woodland (ca. 3000-2400 years ago) pottery from Northeastern North America was a hunter-fisher-gatherer innovation selectively used for the processing of aquatic resources. Little is known, however, about how pottery uses changed in subsequent time periods, for example ca. 1000 years ago when some groups inhabiting this region began to establish increasingly larger settlements and integrate domesticated plants such as maize, squash and beans to their diet. Here we explore variability in pottery uses during the Middle (ca. 2400-1000 years ago) and Late Woodland (ca. 1000-500 years ago) periods based on results obtained from two sites in the High Laurentian region and two sites from the Saint-Lawrence valley, in Canada. Over one hundred pottery samples were analyzed using gas chromatography-mass spectrometry (GC-MS), bulk carbon and nitrogen isotope analysis (EA-IRMS) and compound-specific isotope analysis of palmitic and stearic fatty acids by GC-combustion-isotope ratio-MS (GC-c-IRMS). Through well-established molecular and isotopic criteria, we discern the types of commodities (e.g., aquatic, ruminant, non-ruminant, and plant) that might have been processed using ceramic containers. Our results demonstrate a specialized use of pottery for processing ruminant animals among Middle Woodland groups of the High Laurentian region, and site-specific patterns in pottery use among agriculturalists inhabiting the St-Lawrence valley in Late Woodland times. Further analysis is currently ongoing to better characterize and understand these trends.

## P67 Developing a modern sulphur isotope map (isoscape) for British Columbia, Canada, for archaeological and forensic studies

***Damon Tarrant***, *Michael Richards*

Simon Fraser University, Department of Archaeology, Burnaby, Canada.

**Abstract:** In archaeological and forensic studies, sulphur isotope ratios in human bone collagen and hair are increasingly used as dietary and mobility indicators. For these mobility studies, sulphur isotopes are often used similarly to strontium isotopes, where if the human results are determined to be consistent with the regional values they are considered 'local' and if not, 'non-local. However, the use of strontium isotopes for migration studies regularly relies on baseline strontium isotope maps, often estimated from the underlying bedrock or based on Sr measurements of modern plants. Until recently, it was generally believed that producing a modern baseline sulphur isotope map using modern plants was impossible due to sulphur contamination from fossil fuels. However, the research team from NIGL (BGS) led by Jane Evans has recently successfully produced a modern sulphur isotope map for the UK using modern plant samples that clearly shows patterning across different regions of the UK (https://www.bgs.ac.uk/news/updated-biosphere-map-for-the-uk-released). This poster presents the first results of our similar efforts to produce a sulphur baseline map for British Columbia, Canada, using modern plant samples. Plants were collected across the southern part of the province in 2023 over approximately 800km (west to east). We have observed clear changes in the sulphur values related to geographical location and conclude that the main variation is likely due to precipitation related to the two main mountain ranges in the province. This map will be expanded in future studies and combined with strontium isotope studies for a comprehensive isotope map for British Columbia.

## P68 Diagenetic Stability of Cremated Bone: A Geochemical Examination of Elemental Mobility

[1]***Emese Vegh***, [2]*Pim Kaskes*, [1]*Tom Boonants*, [1]*Steven Goderis*, [1]*Christophe Snoeck*

[1]Archaeology, Environmental Changes, and Geo-Chemistry (AMGC), Vrije Universiteit Brussel, Pleinlaan 2, 1050, Brussels, BE. [2]Laboratoire G-Time, Université Libre de Bruxelles, Av. F.D. Roosevelt 50, 1050 Brussel, BE.

**Abstract:** The crystal structure of cremated bones recovered from archaeological sites is thought to be chemically stable after burial. Yet, understanding the constancy of elemental composition post-cremation and burial remains incomplete, potentially involving exchanges with the environment and leaching of endogenous trace elements. A *Bos taurus* femur was sectioned and burnt at controlled temperatures (250-700°C) and subsequently subjected to a simulated burial solution (comprising K, Mg, Al, Sr, Ba, Zn, Cl, Na at 10 ppm and Fe, Zr, Si, Ce, S, Mn at 1 ppm). The aim of this study was to mirror potential elemental introduction processes post-burning. Major and trace element concentrations pre- and post-burning and pre- and post-doping were determined using micro-X-ray fluorescence ($\mu$XRF) high-resolution element mapping and linescans (25 or 200 µm resolution from the inner trabecular surface towards the outer bone cortex), as well as bulk inductively coupled plasma mass spectrometry (ICP-MS). These measurements were repeated following standard pre-treatments procedures typically applied in preparation of the analysis of cremated bones for $^{14}$C dating and isotopic studies. Elemental mobility was simulated with a diffusion-advection model. Preliminary results indicate stability in major elements (Ca and P) in bone. Bone burnt up to 600°C displays uptake in Al, Mn, Zn, Sr, and Ba, not observed at 700°C. Conversely, Mg and Cl show an inverted pattern, while K and S demonstrate a tendency to leach out of bone. Thus, cremated bones not reaching calcination lack chemical stability, showing uptake and leaching of specific elements.

## P69 Biomolecular assessment of human teeth recovered from Monte Abatone Etruscan necropolis: strategies to analyse highly degraded samples.

***Lilly Vieting***, *Alice Toso*, *Martin Bentz*

University of Bonn

**Abstract:** This study delves into innovative methodologies employed when faced with the challenge of scant and poorly preserved human remains at archaeological sites. The samples used for this study are taken from the Monte Abatone necropolis in Cervereti, Italy. During two excavations in 2019 and 2022, badly preserved human teeth were recovered from the site. Owing to the absence of roots and the overall fragmented state, standard analytical procedures were rendered impractical. The unique burial conditions, characterised by acidic tuff stone, presented a significant obstacle to traditional archaeological analyses. The scarcity of human remains within the Etruscan tumuli demanded a carefully devised strategy for extracting valuable information. Consequently, a multi-proxy approach was adopted to glean insights into the geographical origins, demographics, and dietary habits of the individuals interred in the tumuli. Strontium analysis was used as a pivotal tool in determining whether the buried individuals were local residents or migrants. Proteomic analysis of human enamel through quantification of amelogenin, applied for sex determination, provided reliable results despite the compromised state of the dental specimens. Additionally, attempts were made to extract collagen from the teeth to reconstruct the dietary practices of the individuals. A number of biomolecules were successfully recovered and showed two sets of male and female individuals in each tomb, prompting a reassessment of the grave goods that didn't show different sexes in the tumuli. Overall, this study shows the potential of biomolecular techniques applied to highly degraded samples, while providing novel data on the Etruscan population from Cerveteri.

## P70 Invisible Plants: Challenges in the Recovery of Plant Signatures from Experimentally Produced Lipid Residues

[1]***Rachel Vykukal***, [1]*Anastasia Gabiger*, [2]*Helen Whelton*, [3]*Martin Pitts*, [4]*Lucy Cramp*, *et al.*

[1] Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg [2] Organic Geochemistry Unit, University of Bristol [3] Classics and Ancient History, University of Exeter [4] Department of Anthropology and Archaeology, University of Bristol

**Abstract:** Lipids absorbed into archaeological pottery can reveal food resources consumed by ancient societies, but often reveal mostly animal-derived resources. Commodities that naturally have lower lipid content, such as legumes and fruits, consistently prove problematic in residue analysis and with few exceptions, no robust biomarkers have been established. As a result, many plants are underreported or completely undetectable in archaeological pottery residues, even though other evidence points to some level of consumption. The goal of our research is to address these gaps in knowledge by improving the detection of plants in archaeological lipid residues. We conducted a multi-commodity cooking experiment to locate potential biomarkers of foodstuffs thought to have been imported into Britain by the Romans or the consumption of which increased during the Roman period, as a part of the Roman Melting Pots project. Repeated cooking episodes with eight plant and plant-derived commodities, including dates, carrots, and fava beans, were conducted to produce residues in replica Roman cookware. Extracted experimental residues were analyzed with liquid chromatography and gas chromatography coupled with high-resolution mass spectrometry [LC-HRMS, GC-HRMS] and compared to the lipid signatures of the raw food products. This experimental research demonstrates the complex relationship between lipid absorption and cooking practice and the difficulties of identifying plant remains even in highly controlled laboratory conditions, such as incomplete and variable lipid recovery and masking by other compound classes. These and other challenges will be discussed, as well as the significant implications they have for archaeological lipid residue research.

## P71 Sulfur isotopes in archaeological grains and collagen as indicators of past local environments: interim results from controlled growth experiments

[1]***Sarah K. Wexler***, [1]*Rhiannon E. Stevens*, [2]*Daniel S. Read*, [3]*Simon Bottrell*, [2]*Denise W. Pallett*

[1]Institute of Archaeology UCL [2]UK Centre for Ecology and Hydrology [3]School of Earth Sciences, University of Leeds

**Abstract:** We present interim results from ongoing controlled growth experiments investigating the effect of transient waterlogging on the sulfur isotopic composition of plants. These experiments are designed to improve our understanding of sulfur isotopes in ancient grains and herbivore collagen. We are testing whether short-term biogeochemical processes harnessed by seasonal waterlogging in soil can bring about isotopic fractionation that results in a light sulfur isotopic composition in plants. Some early crop cultivation is thought to have taken place on floodplains. Floodplain soils may have aided cultivation by providing natural irrigation and nutrients, while rich floodplain grassland, once drained, would have provided high quality grazing and foddering. These environments may have influenced the gradual development from hunter gatherer behaviour to the establishment of settlements practising crop cultivation and animal management. We want to know whether floodplain environments can leave a distinctive biogeochemical fingerprint in the sulfur isotopic composition of crop and fodder plants, and how environmental parameters affect this. If we find that an isotopic signal from short-term waterlogging occurs, and is transferred to plants, this will enhance our interpretation of sulfur isotopes in archaeobotanical grains and herbivore collagen, enabling us to identify origins from floodplains and waterlogged environments. We will present interim results from plants, soil and soil water.

## P72 Invisible death rites in the early Neolithic: results of archaeothanatological analysis of Linearbandkeramik funerary practices from settlements

[1]***Iseabail Wilks***, [1]*Penny Bickle*, [4]*Krisztián Oross*, [2]*Martin Furholt*, [3]*Zuzana Hukelova*

[1] University of York [2] Kiel University [3] Slovak Academy of Sciences [4] Hungarian Academy of Sciences

**Abstract:** This poster presents the results of an archaeothanatological study of early Neolithic burials belonging to the Linearbandkeramik (LBK) culture (c.5600-5000 cal BC). The dataset comprised 56 burials, from the settlements of Balatonszárszó, Hungary, and Vráble, Slovakia. Using high quality photographs from excavations, archaeothanatology was used to identify and categorise mortuary practice. The focus of this project was to identify evidence for diversity and intimacy in the treatment of the body after death.

The results highlight high levels of diversity in LBK mortuary practice, which are arguably minimised by simpler categorisations currently used. This includes evidence for complex and protracted treatment of the body, including disarticulation, and tightly crouched positions, likely achieved through binding. This may indicate an interest in preserving or mummifying the dead, as has been suggested by the presence of similar body positions in archaeothanatological studies of other datasets.

The application of archaeothanatology has also suggested new patterns in treatment in relation to age and sex. Male-sexed burials hold lower overall levels of diversity in practice, but were more likely to be involved in controlled disarticulation. The treatment of female-sexed individuals was more diverse, and more frequently involved tight binding indicative of mummification. This practice type also showed a significant correlation with age, more frequently being used to prepare the bodies of juveniles and mature adults. These results are significant to our understanding of sex and age in the early Neolithic, as well as their role within the mortuary sphere.

## P73 What was the impact of the Roman-Early Medieval transition on the health of British populations?

*Aster Wood*

University of York

**Abstract:** The withdrawal of Roman control in Britain in 410 AD caused massive societal upheaval such that the daily life of an individual was unrecognisable within a generation. Society looked different on every level, from the loss of central government, to housing style, the collapse of towns and a return to subsistence farming. A downturn in climate also occurred, with colder, wetter weather impacting food production and disease transmission. Despite these sudden and encompassing changes, the effect on the population's health is unknown. This PhD research examines populations from Roman (n=5) and Early Medieval (n=7) cemeteries, and others that span the transition (n=6) from northern England, analysing skeletal indicators of stress. It aggregates existing data from previous analyses of age and sex, stature, cribra orbitalia, dental enamel hypoplasia and rickets for comparison between the two time periods. In addition to the creation of this large dataset from small excavations around northern England, some populations are reanalysed to collect vertebral neural canal measurements. This novel technique uncovers growth stunting that may have been masked in stature by adolescent catch-up growth, and so will enhance the picture of the health status of these populations. The ongoing analysis of the dataset is revealing a picture of encompassing poor health in the Roman period, with the early medieval populations comparatively better off. Stature reveals growth stunting in the Roman populations which is not reflected in the vertebral neural canal measurements. The factors impacting these results are explored in this ongoing PhD project.

## P74 Funeral or ritual? What the cremated human bones of Baekje tell us.

[1]***Jia Yu***, [1]*Serin Park*, [1]*Jiyoung Shin*

[1]National Research Institute of Cultural Heritage, Korea

**Abstract:** The Seokchon-dong tombs are one of the most important burial sites in the early years of the Baekje Kingdom (18BC - 475AD). There are large and small stone mound tombs, ritual sites, and wooden coffin tombs within an area of about 100 meters, which are interconnected. Thousands of burnt roof tiles and nearly four kilograms of cremated human bones were found in the three ritual areas adjacent to the main burial area. The cremated bones were initially thought to be animal bones but were later identified as human bones and the remains of multiple individuals. We aimed to estimate the combustion atmosphere during the cremation process because there is limited information on the cremation culture of the Baekje period. Fourier transform infrared spectroscopy and X-ray diffraction analyses revealed similar thermal alteration of phosphate, carbonate, and hydroxyapatite, but distinct differences in the presence of cyanamide, water, and protein. Due to the lack of oxygen in the combustion environment, it was assumed that there was water and protein present. The cremated bones found in the ritual sites of the Seokchon-dong tombs provide a valuable insight into the funerary culture of the Baekje. Despite questions regarding whether these bones had been part of a ritual ceremony or discarded following a funeral, understanding the cremation culture can contribute to our archaeological comprehension of the Seokchon-dong tombs.

**Acknowledgments and Funding:** This research was supported by the National Research Institute of Cultural Heritage, Korea and we are grateful for the cooperation of the Seoul Baekje Museum.

## P75 Citrullination: A potential proteomic biomarker for rheumatoid arthritis?

[1]**Fiona McLeish**, [2]Norma Schmill, [1,3]Malin Holst, [5]Camilla Speller, [1]Jessica Hendy, et al.

[1]Department of Archaeology, University of York, York, United Kingdom [2]Independent Researcher, Calgary, Canada [3]York Osteoarchaeology Ltd. [5]Department of Anthropology, University of British Columbia, Vancouver, Canada

**Abstract:** Despite its significance as a major autoimmune condition, rheumatoid arthritis (RA) is challenging to detect in archaeological populations. Most of the known archaeological RA cases are based on a paleopathological differential diagnosis, and the literature primarily focuses on attempting to determine the disease's origin. In clinical cases, RA is known to cause the presence of citrullinated peptides within patients; therefore, using palaeoproteomics, this study investigates if citrullination is detectable in archaeological human bone samples. This study applied quantitative mass spectrometry methods to eight bones from six individuals - two from post-Medieval United Kingdom, two from Classic Mexico, and two from post-Classic Mexico, including individuals with morphological indicators of RA and unaffected controls. While we detected citrullinated peptides within the archaeological samples, there was no significant correlation between the presence of citrullinated peptides and the RA-positive individuals. Nevertheless, the ability to detect citrullination is a positive outcome that warrants future research as a potential biomarker for RA archaeologically.

## P76 The early Patagonian hunter-gatherer pottery (Argentina) and its function through organic residue analysis

[1,2]**Alejandro Serna**, [1]Alexandre Lucquin, [1]Javier A. Montalvo-Cabrera, [2,3]Luciano Prates, [1]Oliver E. Craig, *et al.*

[1]BioArCh, Department of Archaeology, University of York, York, United Kingdom [2]División Arqueología, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina [3]CONICET – Consejo Nacional de Investigaciones Científicas y Técnicas – Argentina

**Abstract:** Archaeological research in the Northern Hemisphere suggests that pottery was a hunter-gatherer innovation aimed at the processing of aquatic resources, however, the adoption of pottery in other regions remains poorly understood. In Patagonia, the southernmost limit of pottery dispersal in the Americas, pottery was scarcely used by hunter-gatherers over a diverse landscape for ca. 2000 years. Regardless of the environmental variability, could this technology be related to the stability of the aquatic resources? Did it suppose a change in respect to pre-ceramic times? In this work, we explore the function of Late Holocene Patagonian hunter-gatherer pottery through organic residue analysis. One-hundred pottery samples from sites across Patagonia were analyzed using gas chromatography-mass spectrometry (GC-MS) and compound specific isotope analysis of individual lipids by GC-combustion-isotope ratio-MS (GC-c-IRMS) (C 16:0 , C 18:0 ). Through well-established molecular and isotopic criteria, we discern the types of commodities (e.g., marine, freshwater, ruminant, non-ruminant and plant) that might have been processed using ceramic containers. Contrary to some expectations from early contexts worldwide that show that aquatic resources predominate, our results point that ruminants and plants are the most likely processed commodities; playing a pivotal role in the use and spread of pottery in southernmost region of the Americas.