



Book of abstracts

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**IV-1. Old Stones, New Eyes?
Charting future directions in lithic
analysis.**

Found Objects and Readymade in the Lower Palaeolithic: Selection and Collection of Fully Patinated Flaked Items for Shaping Scrapers at Qesem Cave, Israel

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Found objects (*objet trouvés*) and *readymade* are two definitions known from the world of modern art. It describes art created from fully formed, but often modified, objects that are not normally considered materials from which art is made; often because they already have a non-art function (i.e. a mass produced object, a utilitarian item, a natural object). Readymade as a mode of art embraces the idea that the ‘inner self’ as an expressive self is no longer the only truth. Thus, the artist is no longer seen only as a ‘creator’, but also as a ‘synthesizer’ and ‘manipulator’ of extant signs and objects. Thus, readymade as a mode of art has possibly more than a technical role only.

In that sense, readymade as an object is an agent between humans, aesthetics, technology and technique. Prehistoric humans were also aware of objects and things in their surroundings. Thus, it is only reasonable that they were also aware of older objects made by man. Although both *found objects* and *readymade* are considered twentieth-century modes of art bearing more of a modern political connotations, there are much earlier known artifacts in the world that may be considered as representing similar concepts.

Here we present the case of flint side-scrapers, made on fully patinated flaked items, from the Acheulo-Yabrudian 420-200 kyr ago site of Qesem Cave, Israel. Flaked Flint items bearing patina are available and dominant in all lithic assemblages at the site, throughout the 200,000 years of its occupation (n=4,552). Side scrapers made on fully patinated flaked items, are items that were collected and modified again, but only slightly, in order to give the object its new function. The only new modification is the retouch of the scrapers’ active edge. This manner of modification almost fully preserves the morphology of the original patinated flaked item, leaving the varying colors, textures and patterns of the patina, as well as the previous modifications made by past humans, visible and dominant.

It will be claimed that the Paleolithic case presented here may be considered a very early example of a concept similar to the one of *readymade*. The selection of the fully patinated flaked item, its collection and slight modification for the making of side-scrapers was clearly aimed at achieving a functional tool, yet being an ‘old’ item may have had cosmological significance too.

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The selection and recycling of the patinated flaked items in that manner may represent appreciation and enchantment towards man-made object's biographies and memories as a creation of previous humans. As such, side-scrapers made in that manner are agents mediating human action the functional sphere, and cosmological meanings in similar concepts to *readymade* and *found objects* pieces of modern art. This subject will be discussed based on *readymade* art theories, and sociological-anthropological theories about objects as active agents.

Keywords: Palaeolithic, Patina, Scrapers, Readymade, Found objects, Technology, Theory, Affordances, Agency, Biographies, Technology of enchantment

Lithic technology as part of the ‘human landscape’: an alternative view

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The people in the past who made, used, and abandoned stone artefacts rarely undertook all these activities in one place and rarely at one time. Therefore, what is present archaeologically are artefacts deposited at one place, at the endpoint of their use life histories, where most of the activity connected with the artefacts occurred at multiple locations within a landscape. Given this, artefacts made and used together were probably only rarely deposited together. This poses challenges for archaeologists who are intent on interpreting the patterns groups of artefacts found together form. Much of the pattern seen may not be interpretable as a result of short time scale behaviours but may instead emerge due to the long term outcome of activities conducted at multiple times and places. The issues this poses for lithic analysis are illustrated using examples from Australia and Egypt.

Keywords: lithic analysis, landscape archaeology, Australia, Egypt

*Speaker

Moving on from here: the evolving role of mobility in studies of Paleolithic technology.

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Beginning with a series of seminal works in the late 1970s' archaeologists began to think about hunter-gatherer technologies through the lens of mobility. It was recognized that the ways foragers moved about their landscapes as individuals and groups produced somewhat predictable responses in the designs and life histories of artifacts. Reversing the logic, this meant that characteristics of lithic assemblages could provide us with information about foraging, labor organization and territoriality in the remote past. At this point mobility-thinking has permeated studies of lithic technology in the Americas and to a lesser extent in Europe. In the meantime research agendas in the field have shifted and expanded, encompassing new models and new goals. Mobility is still central to many of the novel cognitive, behavioral and evolutionary phenomena that now preoccupy the field. But new goals will force us to think about mobility in different ways. There are productive ways to relate human movement to cultural transmission and evolution, to the formation of archaeological landscapes, and to evolving socio-economic systems in the Pleistocene. Archaeological landscapes are essentially products of human movement, but they force us to envisage mobility at a fine, granular scale rather than as a series of voyages between "sites". Among hunter-gatherers, social relations are constituted by movement with and between groups. Phenomena such as division of labor by age, gender and social role, are expressed in different ways of moving about the landscape. Addressing differentiation in roles requires a focus on intra-assemblage variation in artifact life histories. In the absence of telecommunications, social networks, the ground of social learning and cultural evolution, are created by the movement of people and maintained by the circulation of material tokens such as gifts and "trade goods". Here the challenge is distinguishing movement of things across social networks from movement of things in people's pockets.

Keywords: lithic technology, mobility, Paleolithic

*Speaker

The settlement system of Mount Carmel (Israel) at the threshold of agriculture as reflected in Late Natufian flint assemblages

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The Late Natufian culture played a pivotal role in the transition from hunting-gathering to agricultural economies and sedentary settlements in the Levant. Among the rich material remains, the flint assemblages are commonly used to define Natufian phases, as well as to reconstruct daily activities at the sites and to a certain extent landscape use and settlement patterns. El-Wad Terrace (a habitation site) and Raqefet Cave (a burial site) are two Natufian sites located on Mount Carmel, Israel, at the heart of the Natufian 'core area'. Although the two sites are located on the same mountain range they are situated in different ecological niches. It has been frequently held that all contemporaneous Natufian sites in Mount Carmel belong to one social framework.

The purpose of the current study is to examine the Late Natufian settlement system in Mount Carmel as expressed by similarities and differences between the el-Wad Terrace and Raqefet Cave flint assemblages (two case studies). The analysis focuses on selected techno-typological characteristics, raw material classification and sourcing, and indices of breakage and trampling.

Preliminary results show a general resemblance between the two assemblages, with both encompassing all the *chaîne opératoire* stages and the same tool types. However, apparent differences between the assemblages are observed. First, although the same raw materials are used at both sites, the frequencies of each vary considerably. Second, there are apparent differences in the reduction sequences used at each site. Third, the amount of secondary processing and frequencies of the final products (tool types) also show marked differences. Fourth, breakage frequencies and trampling also reflect profound differences.

Although the contemporaneous habitation site (el-Wad Terrace) and burial cave (Raqefet Cave) are rather close geographically, the clear differences in their flint assemblages are discussed not only in terms of site function, but also in the wider context of whether they were part of the same social network and sharing the same territory.

Keywords: Natufian culture, Mount Carmel, flint assemblages, Settlement system

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What lithic technology (really) wants. An alternative "life-theoretical" perspective on technological evolution in the deep past

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Even though humanity of the 21st century has to grapple with increasingly artificial and cybernetic worlds, the nature and significance of human dependency on early technologies, including knapped stone technology, has hitherto rarely been investigated in a long-term and/or evolutionary perspective (but see Bo'eda 2013; Shea 2017). This is both surprising and unfortunate since the evolutionary importance of the dialectics between the human freedom to create and the ability of the created to enchain have long been recognised (e.g. Hodder 2012). The emerging issue of dependency brings into focus two additional vectors of co-evolving human-technology systems: (a) dissimilar temporalities of transformation, e.g. the role of "technical furnishing" as a historical *a priori*, and (b) the relative autonomy of technological evolution. These two aspects, the historicity and path-dependency of evolving technical systems, is now more and more taken into account by other disciplines as well (Beyer 2006; Arthur 2009). Within this climate of re-conceptualising the nature of long-term technological developments, Kevin Kelly (2010) recently concluded: "[t]echnology is a living force that can expand our individual potential – *if we listen to what it wants*" (italics added). This portrays technological evolution not as merely man-endowed or as predictable and mechanistic, but as process dependent, "organic" and always evolving. If we look for complexity in technological evolution, this is where we find it. Departing from his general outlook, this paper draws together latent perspectives that emerge at the intersection of cybernetic thought, complexity theory, philosophy of technology and technological anthropology to develop a new vision of how lithic technology evolves and why. I argue that much is to be gained if we approach knapped stone technology through the lens of life itself: as a quasi-living organism that "breathes", "jiggles" and is often difficult to tame. I present and discuss a number of palaeo-archaeological examples to illustrate how this alternative perspective might affect the analysis and interpretation of lithic artefacts on the ground.

Keywords: technological evolution, organicism, creative matter, path dependency, directedness, irreversibility, complexity, nonequilibrium systems, dissipative systems, dynamical régime, selfassembly, technological autonomy, human dependency on technology

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Exploring knowledge-transfer systems during the Still Bay at 80-70 thousand years ago in southern Africa

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The Middle Stone Age of southern Africa dates roughly to between 300 000 and 30 000 ago, and is renowned for genetic, fossil and archaeological evidence that attests to the biological and cultural evolution of early modern humans in the region. The Still Bay technocomplex and its associated behaviours, dating to between roughly 80-70 thousand years ago, play a major part in this discussion. Here we present directly comparable morphometric data and our interpretation of point-production strategies for the Still Bay point assemblages from Hollow Rock Shelter (Western Cape, South Africa), Umhlatuzana and Sibudu (KwaZulu-Natal, South Africa), and Apollo 11 (Namibia). We demonstrate that while there are no statistically significant differences in the morphometric data sets between the sites, there are subtle similarities and differences in point-production strategies and the use of raw materials for knapping. We suggest that these similarities and variations represent aspects of how knowledge-transfer systems and knapping conventions were followed on both intra- and inter-regional scales.

Keywords: Middle Stone Age, southern Africa, Still Bay, lithic technology

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Technological Choices along the Early Natufian Sequence of el-Wad Terrace, Mount Carmel, Israel

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The long sequence of the Early Natufian at el Wad enables us to see whether there are any temporal changes in the technological choices made by the inhabitant's knapping activities. Since many of the influential factors are similar – the provenance of raw material, the type and nature of the raw material, similar subsistence resources it is possible to see more clearly whether there is a change from the earlier to the later occupations of the Early Natufian at the site. The methodology used here is based primarily on attribute analysis of the lithics since refitting is not possible in such a site. In addition, a more in-depth analysis of the cores and core trimming elements was done. The study is still underway but preliminary results show that in all levels the dominant raw material type is a local one, found within the immediate vicinity of the site. This trend, of higher exploitation of the immediate area, is also visible in the stages of production. Large flake cores are absent; most of the blanks are probably the byproducts of the main sequence that was primarily aimed at producing bladelets. The endscrapers might have been brought as finished tools, and perhaps also constitute evidence of another reduction sequence, that was aimed at producing blanks specifically for endscrapers. Besides diachronic changes our study also regards spatial analysis of the various features at the site. Together they will provide a comprehensive picture of the technological choices made during the Early Natufian of this site.

Keywords: natufian, lithic technology, long term occupation

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Trying the old and the new: Combining approaches to lithic analysis

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Despite being the most abundant type of remains found in the archaeological record, as well as the earliest example of material culture produced by our species, macroscopic approaches to lithic analysis have remained largely the same over the past few decades except for a few pushes for innovation (Grosman 2016; Herzlinger et al. 2017; Lycett 2016; Riddle & Chazan 2014). The classical approach for lithic tool classification relies on qualitative and quantitative observations. Quantitative approaches have largely focused only in a few primary measurements such as maximal length, width and thickness of an item (Andrefsky 2005), which is barely adequate to describe more complex shapes (such as a polyhedral core) while qualitative observations (e.g. a "teardrop shape" used to describe a biface; Wang et al. 2014) may be of limited use when comparing or classifying tools and can be too constraining on the face of something new or slightly different.

That isn't to say that qualitative analysis should be eschewed from the archaeologist's repertoire. Understanding the *chaîne opératoire(s)* underlying an assemblage is crucial in the comprehension of the cognitive processes involved in knapping and provide valuable insights into the behaviour of hominids. However, for the task of comparing shape or symmetry of tools as well as measuring their characteristics and typological classification, the classical typological methods could be exhausting their full potential, leading to archaeologists looking for new methods in the natural sciences (Chacon et al. 2016). The inherent subjective character of some of the methods used in lithic analysis for comparison represents an obstacle when classifying and comparing artefacts with different ages or geographical distribution (e.g. the Acheulian tradition) and can lead to controversies on regards to artefact typology, such as when a lithic tradition is associated with a specific hominid species (McNabb et al. 2018) or the presence or absence of a specific tradition in a specific geographical location (such as the Movius line controversy) (Yang et al. 2016; Yang et al. 2014).

Borrowing from the natural sciences, geometric morphometrics have seen an ever increase application in archaeological analysis (Chacon et al. 2016; Lycett & Von Cramon-Taubadel 2013; Iovita & McPherron 2011; Buchanan & Collard 2010) and can help revitalize old techniques. Differently from the natural sciences (Fruciano 2016; Cardini et al. 2015; Cardini 2014), however, there's a rare or non-existent concern with more rigorous error measurement or even with

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the validity of applying two-dimensional analysis to three-dimensional structures.

We believe that a better combination of qualitative and quantitative methods, specifically geometric morphometrics, allied with more rigorous control over error measurement and widespread access to databases of scanned material for peer-reviewing can provide a better framework for understanding lithic assemblages and traditions in a global scale. With access to more digitized material and less subjective data we will be able to solve pending questions over the nature of assemblages such as the Acheulian and the interconnectivity of their presence or absence tied to the dispersal of early humans out of Africa.

Keywords: Lithics, Geometric Morphometrics, Error measuring

Early tool-making and the biological evolution of memory systems in brains of early Homo.

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For IV-1 Old stones, New eyes?

Abstract: Evolution of procedural and prospective memory played a fundamental biological part in early Palaeolithic technology of later Early and Middle Pleistocene *Homo* (Manrique and Walker, 2017), a *habitual* but not an *obligatory* tool-user (Shea, 2017). Procedural long-term memory sustains unspoken habitual physical activities, including manual (haptic) stone-knapping, and prospective memory allows imagining mishaps and opportunities. Holding things in mind, whilst diverting attention to others, characterizes human attention and planning. Choosing between imagined possibilities implies mental capacity to conceive alternatives, thereby enabling modification of behaviour engrained in procedural memory. Haptic evidence of choice appears in Africa (~1.7-1.3 Ma) with alternative bifacial-flaking techniques required for fashioning hand-axes and reducing discoidal cores for hierarchical flake-removal. Their coexistence ≥ 0.8 Ma in Spain (Walker et al., 2013, 2016) implies *logico-mathematical* awareness of conceivable *alternative* shapes and correspondingly separate self-constraining, self-determining haptic knapping procedures, recognisability of reversible/irreversible procedures, and achievement of Piagetian *concrete operational* thinking (vis-à-vis *preoperational* cognition). Self-generated composition/decomposition of overlapping similar/dissimilar concepts interacted with imitative observational (non-verbal) learning from conspecifics of shared behavioural chains of haptic activity, thereby strengthening the basis, at the biophysical neuronal level, for appropriate implicit (non-declarative) procedural memory. Haptic memory (Fuster, 1999) involves enhanced intracellular biophysical responses evoked by touch in some cerebral sensory neurones, with ensuing network effects mediated by prefrontal cortical neurones in functional systems of active working short-term memory by preparing motor neurones to respond instantaneously (and attuning other kinds of sensory neurones), and even to anticipate appropriate responses (implying recourse to acquired memory). This haptic active working short-term memory (=working attention) is "a mechanism of temporal integration essentially based on the concurrent and recurrent activation

*Speaker

of cell-assemblies in long-term memory networks of frontal and posterior cortex” (Fuster, 2001), requiring flexible parallel-processing of programs capable of integrating neocortical ”motor engrams” for ”motor habits... of the nature of machine programs” (Fuster 1999). Understanding tool-use involves our left inferior parietal lobule (Peeters et al., 2009) and, plausibly, frontal and parietal mirror and canonical neurones (Rizzolatti and Sinigaglia, 2008). Temporal cortex hippocampal neurogenesis continues throughout life. Hippocampal neurones are active in prospective memory. Their well-known role in episodic explicit (declarative) long-term memory is complemented by engram-encoding (Tonegawa et al., 2015); ”an engram is not yet a memory but provides the necessary physical conditions for a memory to emerge” (Josselyn et al., 2015). Transcriptome analysis illuminates epigenetic characterization of post-transcriptional modification of DNA (hundreds of non-coding RNA regulators of gene expression exist). Central nervous-system epigenetic effects occur and exert transgenerational effects on memory. In early *Homo*, evolutionary consequences of epigenetic effects (cf. Somel et al., 2013) caused irregularities in rates of biological change, hitherto considered invariant from the standpoint of the classical Neo-Darwinian Synthesis. That possibility puts in a new light an apparent Pleistocene record of *non-linear co-evolution* of habitually tool-using *Homo* palaeospecies with archaeological Palaeolithic trajectories and lack of spatiotemporal parallelism between those - reasons for which are discussed. (References: Fuster, 2001, *Neuron* 30, 319-333; 1999, *Memory in the cerebral cortex*, MIT Press; 2015, *The prefrontal cortex*, Elsevier-Academic Press; Josselyn et al., 2015, *Nature Reviews Neuroscience* 16, 521-534; Manrique & Walker, 2017, *Early evolution of human memory*, Palgrave-Macmillan; Peeters et al., 2009, *J. Neuroscience* 29, 11523-11539; Rizzolatti & Sinigaglia, 2006, *So quel che fai: Il cervello che agisce e i neuroni specchio*, Raffaello Cortina, Milan; Shea, 2017, *Evolutionary Anthropology* 26, 200-217; Somel et al., 2013, *Nature Reviews Neuroscience* 14, 112-127; Tonegawa et al., 2015, *Neuron* 87, 918-931; Walker, 2017, *Palaeolithic pioneers*, Archaeopress; Walker et al., 2013, *Quaternary International* 294, 135-159; 2016, *Human Evolution* 31, 1-67.)

Keywords: Tools, memory, Pleistocene, evolution, cerebral neurones

New methodology for studying old lithics to answer new questions: about the laterality in human evolution.

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Stone tools are the most represented archaeological remains in Pleistocene sites. Firstly, for the better preservation of the lithic remains, and secondly, because they are direct evidences of human activity. However, the traditional technological studies are currently in non-use, and new research addressed to cognitive evolution, socialization and knowledge transmission of our ancestors are emerging. In this framework, we have been developing for the last years a research project aimed to obtain more information about the hominin hand laterality through lithic production.

Hand laterality in human evolution has been studied from different disciplines. Essential questions about when, how and why appears the manual dominance need for further research. Previous studies have shown that the difference in manual preferences between humans and chimpanzees' is not so big. In order to search for this feature in the archaeological record, we have designed an experimental program on lithic knapping with modern humans. The aim of this experimental program was to identify 1) technical characteristics on the lithic pieces signalling the hand laterality of the knapper, and 2) laterality patterns from the scatters of lithic pieces at knapping. To do this, we have developed a new methodology, which has been finally applied to two sites: the pre-Neanderthal unit of TD10 in Gran Dolina (Atapuerca, Burgos), and the Neanderthal site of Abric Romaní (Capellades), both in Spain.

In addition, this new methodology allows us obtaining more information about the brain hemispherical laterality of the early hominins at sites with or without human remains, and increasing our knowledge about the cognitive complexity of the hominin brain.

Keywords: Lithics Technology, Hand laterality, Gran Dolina, Abric Romani, New methodology

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Approaches and limits of core classification systems and new perspectives

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At the beginning of the 1980s and the associated specification of research on stone artifacts, the focus was increasingly on cores and their reduction. The Levallois concept highlighted by E. Bo´eda was the cornerstone of this new approach. Building on this and supplementing, numerous concepts have been discussed over the years on how core reduction can take place. In addition to Levallois, discoidal, blade production, the various reduction at edges (burins) or blanks (Kombewa, Kostenki) are to be mentioned. On the basis of well-known core classification systems, this talk will focus on the differences and common features of numerous reduction concepts, as well as add further variants. Here we discuss the dichotomy of volumetric and planimetric reduction variants, as well as the hierarchical structuring and ramification of reduction concepts. The question of whether several reduction concepts can occur in a lithic volume in succession or in parallel is also discussed. The physical parameters of reduction, independent of the producing species, are addressed in order to investigate the extent to which a technological approach barrier exists in the investigation of different epochs (Lower, Middle and Upper Paleolithic). Furthermore, new approaches and its combination for the recognition and analysis of reduction systems are presented and discussed, including Working Stage Analysis, Harris matrices, volume and negative completion, refitting, as well as the possibilities of three-dimensional reconstruction. We endeavor to give an overview of the spectrum of methods available for analyzing lithic reduction strategies and what their significance is.

Keywords: lithic core classification, Levallois, Discoidal, Blank production, Blade, Bladelets, dichotomy of volumetric and planimetric reduction, reduction concepts, reduction strategies

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On the application of 3D analysis to the definition of lithic technological tradition

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The manufacture of lithic tools, as all technological skills, is influenced by a knapper's cultural and social environment. The knapper adopts a series of motor behaviors depending on their learning environment. This micro-technological 'fingerprint' will likely be found in features of the final products and by-products of the stone tool manufacturing process and can be used to track the cultural affinity between different knapping groups, geographically or chronologically separated.

Specifically, this work investigates the technological affinity between human groups of the Early and Middle Epipalaeolithic (21,000 - 15,000 cal BP ca.) of the southern Levant. Cultural entities of these periods are traditionally defined based on typological changes in microliths shape. While this qualitative definition allows sorting between the different cultural entities, it lacks the possibility of quantifying the technological variability between them. A quantitative description of the degree of technological affinity between human groups that settled in a limited geographical area in different phases of the Epipalaeolithic will provide an insight into whether the changes observed in the typological composition of the lithic assemblages can be related to movement of populations in the area or to the development/adoption of new stylistic solutions by the indigenous population.

A novel methodology for quantifying micro-technological features of different lithic assemblages is presented. It combines traditional technological analysis with the use of 3D digital analysis. 3D analysis allows precise measurements of 'traditional' metric attributes (length, width, thickness) based on an automatic positioning of the artifact, together with the quantitative description of a series of other features related with manufacturing. Preliminary results will be presented on the variability of the mean cutting edge angle and a series of features extracted based on the automatic segmentation of scars on the lithic artifacts and between the different lithic assemblages. These attributes reflect technological choices of the knapper and can be used to define the technological fingerprint particular to the learning environment of their community. A quantitative approach to the technological affinity between lithic assemblages can be applied to provide a novel insight into the population dynamics beyond traditionally defined prehistoric cultural entities.

Keywords: Levant, Epipalaeolithic, Lithic technology, Computerized Archaeology, 3D models

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The strength of lithic tool typology in the Upper Pleniglacial hunter-gatherer archaeology in eastern central Europe

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Hunter-gatherer archaeological remains of Pleistocene age are overwhelmingly knapped stone artifacts. Therefore, it is natural to the Palaeolithic archaeology that the analytical methods to extract the most information from stone tools are various. The first analytical technique working on stone artifacts was the lithic tool typology, which ruled the Palaeolithic research up to the 1980s. Lithic typology then was challenged by another approach, the technological reading of stone artifact assemblages, often called lithic technology. The differences in the achievements between these two have been severally showed, and lithic technology became a prominent method to reveal the technical behavior and the technological organization of Pleistocene humans. In spite of all the benefits of lithic technology, in this paper, we intend to show from an extensive research of Upper Pleniglacial archaeological record in eastern central Europe that lithic tool typology in our methodology is a powerful tool to understand Pleistocene hunter-gatherer societies.

Keywords: typology, central Europe, lithic analysis

*Speaker

What technical objects can say about human nature? Technological studies of Middle Palaeolithic techno-complexes from Oscurusciuto rock shelter (Southern Italy)

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For their non-perishable nature, lithic artefacts are the most ancient evidence of human crafting; they are spread all over the Earth and have accompanied human kind since their dawn. Due to the strict link between the technical instrument and their creator, it is impossible to investigate the human behaviour without considering the study of stone tools.

A lithic object is a palimpsest of information expressed in the variability of forms and functions that it solved during time. Lithic tools fulfil requirements given by humans in a determined cultural and natural landscape. Actually, the interaction between natural landscape (type, kind, and availability of raw material...) and human needs (nutritional needs, perception and management of the landscape, gesture and technical know-how, social, cultural and religious aspects...) sinergically combined determined the variability of lithic techno-complexes.

Studying a technical object, means considering each tool as a single entity, as part of a determinate society, as a part of a net of objects and relations, as an object with a certain scheme of functioning, as a vehicle of a synthesis of a previous net of objects. It is a palimpsest of unities, relations and significances. Understanding a technical object means considering the object as the depositary of human realities. Witness of deeper knowledge such as social dynamics, behavioural decisions, and cognitive meanings. Above all, a lithic tool is a technical object and technicity is not a marginal aspect of humans. Technicity is actually fundamental to understand the relation between humans and the World. That is the main reason that led us to study lithic tools.

*Speaker

Depending on the question that we pose regarding tools, the approach to apply is different; our aim in this presentation is to underline the great advantage, which the techno-logic approach could give in the understanding of technique thus behavior.

As a case study, we propose the studies of techno complexes from the Oscurusciuto rock shelter (Ginosa, Puglia) which is a Middle Palaeolithic site characterized by a long sequence of Levallois plus less represented additional debitage. The raw material are small pebbles of chert, jasper, cherty limestone and quartz sandstone locally available. Thanks to an intense study of the collections and especially cores of Oscurusciuto it was possible to identify divergences and similarities through time.

Keywords: Technology, Techno logic, Cores, Levallois, Middle Palaeolithic.

The development of micro-blade technology during the Upper Paleolithic and problems of interpretation (on materials of northwestern Caucasus).

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Caucasus is one of the regions where micro-blade (bladelet) knapping technology appears in the beginning of Upper Paleolithic (40-42 ka) and develops throughout the entire duration of this period (until about 12 ka). Unfortunately, most of the Upper Paleolithic sites in the region were excavated in the last century using old excavation methods. In the Northern Caucasus, only a few Upper Paleolithic sites including Mezmaiskaya cave were excavated and multidisciplinary studied at the modern level (Golovanova, Doronichev, 2012; Golovanova et al., 2014).

Our research of knapping technology indicates important changes from the early Upper Paleolithic (layer 1C) to Epipaleolithic (layer 1-3) industries in Mezmaiskaya cave. Analysis of metric parameters of micro-blades (bladelets) shows statistically significant differences indicating that the changes in sizes and proportions of micro-blades obey a certain regularity - the average width increased, while a relative thickness decreased from the earlier to later layers. Variability of micro-blade dimensions also decreases from the lower layers towards layer 1-3. These differences have been determined on the basis of large samples and therefore cannot be taken as a statistical error.

It would be logical to interpret the tendencies revealed by our study using the data of experimental archaeology. However, when the author referred to relevant publications, he has faced with considerable difficulties. The theoretical basis of experimental works on micro-blade technology often lacks methodical orientation and statistic data are not reported, which hinders the application of experimental results for interpretation of archaeological data. The criteria for distinguishing different knapping methods that experimenters offer (for example, Pelegrin, 2012; Tardy et al., 2016) are quite vague and overlapping. Therefore, when trying to interpret the tendencies revealed in changes of metric characteristics among micro-blades in Mezmaiskaya cave, the author has to rely only on several qualitative and quantitative criteria that most of experimenters define as specific for a particular knapping technique.

A comparison with experimental data allowed us to assume that the revealed tendencies may be associated with the change in the knapping technique. The early Upper Palaeolithic industries show the predominance of bladelets, which metric characteristics more conform to the direct percussion technique. The analysis allows us to draw a preliminary conclusion that metric characteristics of bladelets from the upper horizons of layer 1-3 are most similar to experimental bladelets that were struck using a hand pressure technique.

*Speaker

Keywords: micro, blade technology, knapping technique, Upper Paleolithic, Epipalaeolithic, Caucasus

The assemblage as a sequence of events

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Assemblages, particularly lithic assemblages, constitute one principal class of synthetic units of archaeological reasoning. Moreover, selected reference assemblages are conventionally used to include or to exclude newly discovered occurrences to specific cultural groupings. My contribution will try to systematically elucidate the internal structure of what we call assemblages by interpreting them as remnants of sequential activities. To this end, I will engage examples and experiences from the Middle Paleolithic from the Crimea and from Southern Germany.

Keywords: Theory, lithic analysis, behavior, variability

*Speaker

Experimental study for quantifying core reduction in Palaeolithic flake-production strategies.

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The artifacts recovered in the archaeological sites are end products, final morphologies, so the technological variability in the archaeological assemblages largely depends on the time when the objects were discarded. Understanding flintknapping as a process of volumetric reduction –that is, a continuous loss of mass and variation of morphology-, it is necessary to approach and quantify the intensity of such reduction process. In this sense, most of the works have focused on the study of the reduction intensity of retouched and/or large shaped tools, in order to approach to its use-life.

However, cores are key elements, since they are present in all technologies, they are quite frequent in the archaeological sites, and they preserve information about their reduction process. Therefore, they are essential in the study of the raw materials selection and management as well as a complementary element to analyses the retouched tools, in order to infer, for example, the mobility patterns and the duration and type of occupations. For these reasons, in the last years several quantitative analyses applying mathematical indexes have been developed to estimate the intensity of core's reduction.

These analyses have the potential to allow direct comparison between different lithic assemblages. However, in our view the original size of the blanks can influence the results obtained by these indexes. Cores with different sizes but similar degrees of exploitation can result in different reduction ratios. For this reason, we have carried out a pilot experiment applying two different flake-production strategies (unipolar longitudinal and centripetal) on a specific raw material (quartzite), with different sizes of blanks (small cobbles [64-160mm], large cobbles [160-256mm], and boulders [> 256 mm]). The aim of this experiment is to evaluate the correlation between the proportion of extracted mass and different parameters present in the cores, such as the number of flake-scars and the proportion of remaining cortex. In addition, we intend to contrast the effectiveness of various indexes of reduction (Clarkson, 2013, Li *et al.*, 2015) and its capability to infer the intensity of core reduction depending on the original size of the blank and the type of production performed. To do this, we have analyzed the reduction process sequentially quantifying different exploitation moments in every single core.

*Speaker

In this paper, we present the results of this experiment and discuss the different research lines concerning the study of the reduction intensity of cores, according to their initial sizes/volumes and knapping production systems.

Keywords: Lithic reduction, Reduction intensity, Cores, Volumes, 3D scanning.

Identification of gestural sequences in Early and Middle Pleistocene lithic industries

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The study of the technological complexity throughout the Pleistocene is one of the main issues in the current scientific debate. The analysis of the *chaînes opératoires*, that is, the process by which lithic tools are manufactured, is fundamental to face technological complexity. Each knapping sequence is composed of an organized chain of actions, and in turn, each action is formed by a specific set of manual gestures. To identify these gestural criteria among different types of technologies, we have developed a new methodology based on a behavioral catalogue of lithic technology, that allow us to determine the gestural sequences involved in the manufacture of tools. In a first phase of this work, we have established that the sequencing of manual gestures is an useful instrument to address the basis of diachronic technological changes.

However, these manual gestures are not directly reflected in the archaeological record. Therefore, we have designed an experimental program in order to recognize the manual gestures that may have "fossilized" in the lithic assemblages.

Employing this methodology, we analyzed three knapping sequences, one for chopper, one for a chopping-tool and one for a handaxe. The three knapping sequences have been carried out by an expert knapper. Subsequently, we have designed and carried out a test of presences and absences of gestural criteria. The aim of this test is to document the loss of information occurring since the beginning of the knapping sequence. We have structured this test in three phases:

- 1) A comparison of the full-length sequences -documented by video recording- with the refitted experimental material.
- 2) A comparison between the refitted and unrefitted experimental material.
- 3) A comparison of the unrefitted experimental material with a sample of archaeological material.

Our results point to a fragmented recognition of the gestural sequences, which will allow, through statistical procedures, to reconstruct the complete gestural process.

*Speaker

Keywords: Manual gesture, behavioral catalogue, lithic industry, technological complexity, Pleistocene.

Gearing the chaîne opératoire approach toward reconstructing the nature of the interactions between fossil hominins

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DNA and morphological analysis have shown that diverse fossil hominin groups exchanged genes and in turn must have interacted. However, how frequent were these interactions, where exactly interactions happened and what else than genes people exchanged – in other words how much *socially* intimate people belonging to different groups were - can't be reconstructed using biological techniques. Here I will explore how a chaîne opératoires analysis used in conjunction with a tailored taskcape visibility theoretical framework and applied to diverse set of material culture can powerfully contribute reconstructing the nature of interactions between fossil hominins. Such a discussion will be built upon the middle-range theory developed by G. Tostevin (2011) and will use the Middle to Upper Palaeolithic site of Quinçay, France, as researched by Roussel et al (2016) as a test-case.

Keywords: Chaîne opératoire, interaction

*Speaker

Reflective Mirror-like Objects Made of Obsidian from Anatolia and the Near East

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The so-called ‘obsidian mirrors’ found in Anatolia and the Near East are some of the most remarkable objects produced by prehistoric peoples. However, we know surprisingly little about them. This is partly because interest in these objects has been as a category rather than as meaningful objects.

Our project involves a holistic approach. Our first step was to build a comprehensive database that covers different aspects of the mirrors. This provides a firm foundation on which to base more detailed studies of specific aspects of these objects particularly in terms of their morphologies, technologies, contexts and raw material. In the database we record attributes relating to their dimensions, the nature and treatment of the support and surface treatment including any evidence of shaping, striations from grinding, any macroscopically visible use-wear and so on and, where known, the provenance of the obsidian. We are also developing tribological and functional methodologies to determine the degree of reflectiveness of the ground and polished surfaces; ultimately we hope to compare the finish on the ‘mirrors’ with other ground-and-polished objects. We also aim, where possible, to test our hypotheses by producing and using similar objects.

Some initial studies of the consistency of the level of grinding and polishing of the surface using confocal microscopy and interferometry and determine their SPA and Porosity has already been undertaken and we intend to develop this using, for example the refractive indexes (RI) and surface topographies of different types of ground-and-polished obsidian objects. RI can be determined using the ‘optical natural glass property test’ by the oil immersion method or by Glass Refractive Index Measurement (GRIM); glass density measurement will also be considered using a variable density fluid method.

Experimental studies (e.g. Vedder 2005) have already demonstrated that polishing required the use of progressively finer grinding media and imply considerable investment in time as well as in design and technological knowledge which suggest that they were not everyday items.

In parallel to the material studies outlined above we are researching the use of ‘mirrors’ in other cultures of all types to investigate practical and symbolic uses in different cultures and contexts.

*Speaker

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In our paper we hope to demonstrate how holistic studies can develop and recontextualise our understanding of ‘mirrors’ and other objects.

Keywords: Tribology, Confocal microscopy and interferometry, Refractive indexes, provenance studies, experimental archaeology

Functional Analysis of Acheulian Tools: in Indian Context

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Typological study of the lithic assemblages in India has been opted by several Pre-historians since Robert Bruce Foote's pioneer work (Foote, 1914; 1916).). The contributions of the eminent scholars like Paterson (De Terra and Paterson, 1939), Sankalia (Sankalia, 1964), Jayaswal (Jayaswal, 1978, 1979, 1982) made a strong foundation for Stone Age techno-typological studies in India. These previous studies suggest the classification and nomenclature of stone tools on the basis of their shapes, on the medium these made and sometimes on the basis of the techniques these prepared. The question is whether we should continue following the previously give nomenclatures and categorizations or go for function based analysis of the tools? As the stone tools depict the daily activities and behaviour of the primitive man and in Archaeological studies the ultimate aim is to search for Human behaviour and life. Therefore it seems to be necessary to focus and analyse the tools according to their functions which could be ultimately interpreted in terms of the behaviour of primitive man. Keeping the aforementioned problem in mind in the present work the major tools (Handaxe, Cleaver, Chopper & Chopping Tool, and Scraper) of the Acheulian phase have been tried to classify on the basis of their functions. In view of that, the working parts of these tools i.e. tip and butt for Handaxe; edge and butt for Cleaver, Chopper & Chopping tool and cutting edge for Scraper have been considered as the basis of the classifications. For this work tools of twelve Indian Acheulian sites named: Didwana, Paisra, Sihawal-II, Nakjharkhurd, Adamgarh, Bhimbetka, Durkadi Nala, Chirki, Hunsgi, Anagawadi, Site-128 (Nagarjunakonda), Site-SXIII (Nagarjunakonda), have been measured and analysed. Eventually, an overall function based classification of these five major Acheulian tools has been prepared.

Keywords: Function, Classification, Acheulian, Handaxe, Cleaver, Chopper, Chopping Tool, Scraper

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Controlled experiments in flake production – what have we learned?

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The study of lithic artifacts has changed considerably over the past several decades, from a primary focus on variability in formal characteristics (for example, size, shape, and placement of retouch) to an emphasis on identifying the processes that underlie such variation. Replicative knapping experiments have played an early, and crucial, role in reconstructing methods and techniques of stone tool production that may have been used in the past, contributing greatly to our understanding of how particular variables can be manipulated to achieve particular results. The identification of these relationships has also provided a better understanding of the knapping choices of prehistoric people, their skills, learning processes, and cultural transmission. More recently, the design of lithic experiments has been broadened to investigate these relationships in a more objective and quantitative fashion. Such controlled experiments, which utilize a robotic device to produce a flake, make it possible to isolate the effects of a single variable on a resulting flake's formal characteristics and, from there, to examine more complex interplays of several different variables in combination. In this paper, we will present some of the main results on the formation of lithic artifacts that emerged from these experiments and discuss the contributions that this experimental approach makes to our understanding of the fundamentals of the knapping process. Principally, these are related to how platform depth and shape, exterior platform angle, core surface morphology, hammer type, and raw materials affect blank size and shape. While these results have confirmed some conclusions drawn from replicative experiments, they have also demonstrated the importance of certain variables relative to others. Above all, both controlled and replicative experiments can be considered as being complementary to each other, with the former better able to explore the formation of individual flakes while the latter is more suited to reconstructing core reduction sequences.

*Speaker

Keywords: lithic technology, experimental archaeology, flake formation, controlled experiments

Lithics as a proxy for population dynamics: food for thought

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For the past decades, advances in physical anthropology, genetic and archaeometry have changed the way archaeologists understand Pleistocene population dynamics. Peopling events, contacts or replacements of species are no longer recognized solely through changes in the archaeological record and there are now other methods that bring more direct answers to questions about the population history of human groups. Challenges for the pre-existing models of human dispersals, acculturation or local transitions came along with a growing skepticism regarding the use of lithic studies to address historico-cultural issues. It is also notable that major changes in material culture are consistent with the genetic history of the Pleistocene and Holocene Europe. What can lithic assemblages tell us about ‘the big picture’ after all? With a cross-look between the available genetic and archeological data, it is possible to identify what features in stone tool assemblages are the most useful (or on the contrary misleading) to predict the major changes observed at the population level in Europe. Such observations are proposed here to offer perspectives on interpretative models used by (some) lithic specialists. After looking through the record, I highlight here a few examples of derived features likely to be reliable proxies to define techno-complexes. I also discuss the difficulty to recognize continuity between assemblages (and ‘archaeological culture’) and more specifically, the role of lithic object/reduction sequences that re-occur in unrelated environmental, geographical and chronological contexts. Some of those techno-typological traits are inherent to all forms of stone flaking (and thereby prone to independent re-inventions) and are not strong arguments to support phylogenetic links between lithic ‘traditions’ or to suggest population continuity over several millennia. Overall, under certain conditions (e.g. large sample size, complex set of derive features) similarities and differences in technology or typology between lithic assemblages can prove to be surprisingly accurate in predicting large-scale events in terms of population dynamic. When conditions are not met (e.g. ubiquity of expedient technology, small sample size, logistical mobility), the lithic data *does not support nor invalidate* population-related hypotheses and other proxies should prevail.

Keywords: lithic, population

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**IV-2. Becoming Specialists. From
Imitation to Professionalism: A
Palaeolithic to Neolithic Perspective.**

Learning to Knap by the fire-place: Identifying knowledge transmission mechanisms through techno-spatial analyses at middle Pleistocene Qesem Cave

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Among prehistoric societies as well as contemporary hunter-gatherers, the hearth is a focal point in a camp site. Economic, social and cultural activities take place next to the hearth, food is being processed, cooked and shared, tools are being manufactured, conversations are being held, and knowledge is being transmitted among group members. Archaeological intra-site spatial studies aimed at exploring issues of space organization in Paleolithic sites usually focus on the hearth as a central activity area in a base camp. We would like to present and discuss the results of a techno-spatial study focusing on lithic findings originating from the central hearth area of Middle Pleistocene Qesem Cave, Israel (late Lower Paleolithic, Acheulo-Yabrudian Cultural Complex, 420-200kyr). We will suggest that learning processes related to flint-knapping were conducted in this area, including the sharing of both stone and knowledge between experienced knappers and inexperienced ones living in the cave.

The analysis combines a techno-typological classification of flint cores with the spatial distribution maps and density data comparing the hearth area (number of cores=81, 3.2% out of debitage) with the area adjacent to it to the south (n= 74, 3.4% out of debitage). These areas are of similar stratigraphic position and roughly contemporary. They cover an area of some 15 m², excavated to a maximum depth of 60 cm.

Being a base camp, Qesem cave was used repeatedly for various time spans during a time range of over 200kyr. The habitual use of fire is apparent throughout the stratigraphic column, and the central hearth has been dated to 300kyr. A study examining the densities and spatial distribution of lithic assemblages at the cave (Gopher et al., 2016) supported by a reconstruction of hearth centered activities (Blasco et al., 2016) indicates a consistent spatial association of lithics with carcass processing and bone discard related to the use (cooking, roasting) of fire. The lithic assemblage of this area (débitage items= 3280) has been assigned to the Amudian industry characterized by systematic blade production.

Several knowledge transmission mechanisms related to knapping practiced at the site were recently characterized through the analysis of cores. Some of these mechanisms possibly reflect trial and error and self-experiencing with the basics of knapping which is suggested by the presence of cores showing repeated knapping mistakes, and by the selection of low quality materials

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for knapping. Another mechanism involves sharing of stone and knowledge between knappers, as indicated by the notable presence of specific cores reflecting two "generations" of blank removals: a successful stage followed by an unsuccessful one – which we termed "shared cores". A comparative analysis indicates that 'shared cores' have some distinguishable techno-typological features compared to 'non-shared cores'. These cores, in their second "less successful" production phase, show twice as many knapping mistakes. Probably, as a result, they were abandoned at an earlier stage. Their presence might indicate that experienced knappers at Qesem allocated previously shaped but not fully exploited cores for inexperienced knappers. These were then used, so it seems, for accumulating experience in knapping, while benefiting from a good "starting point" which contributed to a better understanding of specific technological tradition practiced at the site, and of the most suitable raw materials. Although 'shared cores' appear throughout the cave, these are especially frequent in the central hearth area, consisting up to 25% of the cores. For comparison, in the area south to the hearth they only constitute 9% of the cores. The increased presence of "shared cores" might indicate that learning activities were practiced regularly around the fire-camp.

In order to spatially characterize learning activities relevant to knapping in the central hearth area and the area to the south of it, we prepared three spatial distribution maps based on the density of flint items (as a whole and by techno-typological categories). The maps exhibit some distinguishable differences between the two areas:

1. While the density of 'shared cores' in the hearth area is very high, it is very low in the area south of it.
2. Within the hearth area itself, 'shared cores' are found in two major and very small concentrations, one covering a single square meter and the second only half a square meter.
3. These spatial patterns appear repetitively throughout the two chronological phases identified in the hearth area.

These results point to a repeated behavioral pattern of sharing knowledge and resources by the fire-place at Qesem Cave. The study links at least two important elements in human evolution: the habitual use of fire, sharing (see also Stiner et al. 2009) and the application of knowledge transmission mechanisms, and emphasizes the central role of fire in the social process as early as the Lower Paleolithic period.

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Keywords: Learning Processes, Flint Knapping, Middle Pleistocene, Fire Place, Techno Spatial analyses

PREKARN project to track the prehistoric novel knapping

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The skill spectrum for stone tool knappers is very wide. Concepts such as *connaissance*, *savoir-faire*, know-how, knowledge cognition, and motor ability are more difficult to track in human evolution. However, it is possible to identify if we search for the prehistoric individual, and analyse his/her lithic production.

In this paper, we present the first results of the PREKARN project. This project studies and identifies the role developed by learning stone knapping in cultural evolution. To carry out this goal we have designed: first, an experimental program to identify and interpret technological traits associated with novice flint-knappers. Second, the application of these results to the archaeological record to understand the knappers' process in acquiring technical knowledge. This research expands our knowledge of lithic stone knapping, from the processes of learning to an inter-disciplinary study.

The experimental program aims to define and identify the varying technological characteristics involved in the process of knapping learning. We have designed a statistically robust methodology to identify the technological traits associated with novice modern flint-knappers. By applying this methodology to archaeological refit assemblages we aim to identify the prehistoric individual, lithic refits are primarily the product of a single knapping event and are therefore, likely to be associated to a single individual. By combining these two methodologies, we can analyse the *know-how* of a prehistoric individual, and therefore, identify novice knappers in prehistory.

Keywords: knapping learning, individual, experimental archaeology, lithic refits, cognitive archaeology

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Skill learning and social connectivity: obsidian blade knapping of the Late Upper Paleolithic in Hokkaido, northern Japan

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Recently, several researchers have attempted to discuss the manner of direct or indirect connections occurring between masters and novices through the analysis of the lithic production technology, and its implications for the skill transmission processes within the prehistoric hunter-gatherer groups. The identification of different skill levels based on the analysis of lithic refits and their spatial patterning within a site provides an important insight into a variety of skill transmission processes, such as observation, imitation, exercise, demonstration, and instruction, which are essential traits for understanding socioeconomic organization within prehistoric groups. Considering the distributional patterns of such traits and the technological similarities of lithic assemblages in a vast region allows us to understand how social connectivity involving technological transmission occurred between groups. To date, abundant lithic refitted artifacts involving blade and bifacial productions have been recognized from several Middle and Late Upper Paleolithic sites in Hokkaido, northern Japan. In this paper, I would like to present the analysis of abundant obsidian refitted artifacts from the Late Upper Paleolithic assemblages at the Shirataki sites in eastern Hokkaido to investigate what skill learning behaviors occurred. Furthermore, I will show inter-site comparison with regard to the distributional patterns of the skill learning behaviors across eastern Hokkaido to understand social connectivity.

Keywords: skill learning, refitting

*Speaker

Key Trends and Transitions in the Evolution of Lithic Technology from the Lower Palaeolithic to the Neolithic: Technological and Cognitive Approaches to Skill

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Over the 3.3 million years of their existence stone tools have undergone much morphological and technological change. Debates continue surrounding the mechanisms for these changes, whether they be environmental, biological, functional, cultural, or a combination thereof. A key component of identifying mechanisms of technological change is an ability to compare the relative skill levels and behavioural complexity required for different technologies, and their efficiency. Without an understanding of the efficiency, skill, and behavioural complexity required for a technology's manufacture, we are unable to reliably explain technological change at major archaeological transitions.

We present here a summary of previous experiments relating to efficiency and behavioural complexity, and present new results that compare the level of skill required for manufacturing particular technologies. These experiments were all designed to compare a range of technologies spanning the Lower Palaeolithic to the Neolithic, including discoidal, biface, Levallois, and blade knapping. Complete experimental reduction sequences of these technologies were analysed, providing detailed technology-specific data.

The path to becoming a specialist or skilled practitioner of knapping involves both manual and cognitive developments. Dexterity is required for manually manipulating cores and billets, while procedural memory is required to cognitively codify repetitive actions to streamline the knapping process. We report on the relative amounts of manual and cognitive skill acquisition required for the manufacture of different lithic technologies. Our results suggest that blade making involves nil or negligible added efficiency and behavioural complexity compared to technologies like biface and Levallois knapping. But, blade knapping did involve somewhat higher levels of manual and cognitive skill.

Keywords: Skill, Cognition, Discoidal, Biface, Levallois, Blade, Knapping Experiments

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Palaeolithic Tool Standardisation Indicates Theory of Mind and Language

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Stone tools, being products of learning, offer us a continuous record of cultural transmission throughout human evolution. Reflected in this behaviour are the human perceptual abilities needed to transmit and acquire those skills. I hypothesised one way we would see cultural transmission in the lithic record is through the range of morphometric variability of a tool assemblage. Standardisation would reflect faithful replication and complex social learning abilities amongst a population; this does not mean that high variation reflects complex social learning abilities are not at play, as there are many sources that introduce variation in tools. Complex social learning is therefore necessary but not sufficient to produce a highly standardised stone tool assemblage. I tested this through a knapping experiment where novices replicated model handaxes on standardised porcelain blanks in simulated social learning environments. Results showed that higher fidelity social learning environments resulted in assemblages that were more standardised. The Implications are that standardisation in the archaeological record can be read as indicating complex social learning abilities. Imitation and teaching necessitate theory of mind abilities, as an individual needs to process the intent and desire of another in order to map that behaviour to the production of a tool. Theory of mind is intimately correlated to language ability, and from child developmental studies we can draw what linguistic information would be present to scaffold and develop theory of mind abilities that in turn allow for complex social learning to take place. Standardisation, then, offers us an indication of complex social behaviour in ancient hominins, but also complex linguistic behaviour.

Keywords: Lithics, cultural transmission, theory of mind, language

*Speaker

What the Elders say, counts! Social learning in Late Middle Palaeolithic Neanderthals

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Certain types of lithic artefacts represent valuable archaeological archives in tracing early hominin learning behaviours. Bifacial backed knives (*Keilmesser*) and some asymmetric types of scrapers ('Pradnick scrapers') characteristic of many Late Middle Palaeolithic assemblages in Central and Eastern Europe, display a single cutting edge only. Their overall tool asymmetry means left-lateral and right-lateral tools can be distinguished. Their lateralization can arguably be interpreted as a proxy for handedness.

Data compiled in a comparative study of two of the richest *Keilmesser*-assemblages from the cave of Balver Höhle and the Buhlen rock-shelter, both in Germany, contributed to an improved understanding of learning strategies among Late Middle Palaeolithic Central European Neanderthals. At each of the sites, the frequencies of asymmetric tool forms show strong divergences from the expected ratios between left- and right-lateral artefacts, when following the assumption that they serve as proxies for handedness. The well-studied *châînes opératoires* of the *Keilmesser* and the high degree of standardization with elaborate re-sharpening strategies provide an interpretation highlighting different (individual) manufacturers and/or users.

Qualitative as well as quantitative criteria are forwarded to distinguish tools of short-term use that 'mimic' or imitate more elaborate tools that may display long-term histories, including repeated re-sharpening sequences. It is argued that the first type of tools, represented by the 'Pradnick scrapers', are expedient tools, regularly made on recycled or waste material by less experienced manufactures or tools users, while the production and long-term usage of the latter tools, especially the *Keilmesser*, requires higher skill levels, knowledge and experience. The overall picture is interpreted in that the first group of tools is likely made by children who 'mimic' grown-up tool-making behaviour, while the latter were made by more skilled and experienced, likely elder individuals. Differences in the laterality of the objects imply a certain transfer of knowledge between generations and suggest noticeable influence of the older, more skilled individuals on the younger ones through teaching.

A combination of Late Neanderthal longevity and modes of social learning that imply teaching of the younger individuals from a certain age onwards, may have led to the formation of regionally and temporally defined sets of rules, transferred from one generation to another. Consequently, the data presented may explain the origin of regional tool making traditions as a result of newly established inter-generational strategies for the transferral of knowledge, underlying Late Neanderthal cultural evolution.

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Keywords: Lateralization of asymmetric tools, handedness, learning strategies, imitation, teaching levels of skill/experience, origin of traditions

L'activité de taille : niveaux techniques et apprentissage à Pincevent

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C'est dans un contexte d'actives réflexions autour de la technologie animés par les ethnologues et en relation avec eux que les préhistoriens ont développé une approche dynamique de la taille du silex. Si pour l'école J. Tixier c'est à travers l'expérimentation, du côté de A. Leroi-Gourhan c'est à travers l'analyse des remontages. La jonction des travaux conduits par l'équipe Tixier et par celle de Leroi-Gourhan pour exploiter un site fouillé avec précision dans une optique d'ethnographie fut particulièrement féconde sur le développement d'une approche de l'individu

Au sein de l'équipe Tixier S. Ploux aborde la question d'une reconnaissance de l'individu en analysant la production de tailleurs expérimentaux. Elle met au point une grille de lecture des manières de-faire propre à chacun. L'étape suivante fut une réflexion sur l'adaptation de cette grille élaborée avec des tailleurs contemporains taillant pour la science dans leur laboratoire à des tailleurs magdaléniens taillant pour vivre au sein de leur société. C'est sur un ensemble bien circonscrit à une unité d'habitation qu'elle développe sa méthode. Puis son travail est inscrit dans l'analyse des données de fouille faisant évoluer dans leur espace de vie les tailleurs reconnus.

Trois groupes apparaissent: les tailleurs expérimentés, compétents, malhabiles. Sont en jeu les objectifs de chacun, sa maîtrise de la matière première, ses choix stratégiques, son savoir-faire. Dans le groupe des malhabiles dont l'objectif est l'acquisition d'un savoir la stabilité des connaissances est moindre. Si l'apprentissage est fondé sur l'observation des activités quotidiennes se déroulant dans l'habitation, sur des jeux d'imitation parfois sous l'œil d'un adulte (exercices en marge de postes de taille), il nécessite aussi la démonstration de notions abstraites impliquées dans la taille. Au sein de chaque groupe, habitation par habitation, il devient possible de suggérer une identification d'individus reconnaissables à leurs performances. Cette analyse est étendue à l'ensemble des unités, habitations ou ateliers, avec l'aide de P. Bodu.

Il devient alors possible de comptabiliser les tailleurs et donc de proposer une approximative quantification de l'importance du groupe. La réflexion sur la place de la taille pendant l'occupation et celle des tailleurs à différents niveaux de cette petite société associe l'analyse du matériel à une approche ethnographique : savoir partagé par l'ensemble du groupe mais savoir-faire propre à certains membres en relation avec les activités qu'ils sont amenés à accomplir, compétences associées à une place dans la cellule sociale mais aussi dans le groupe.

*Speaker

Keywords: Magdalénien, Remontage, Débitage, Individus, Compétences, Apprentissage, Organisation sociale

The hidden skills: Mousterian lithic technology, social learning and mastership

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Middle Palaeolithic flaking systems introduce a great variety in the technological requirements of the tool production. In this context, is frequent to find abundant places with extensive concentrations of lithic knapping residues in quarries areas and secondary deposits. The richness of this places, conform this areas as the better places for the study of the possible existence of asymmetries in the technical and technological levels of the authors as well as the eventual presence of training and learning activities. Although in this context, diachronic occupations generate complex palimpsest that deserve a careful analysis, in our case, the study of the Cañaveral archaeological sites(Madrid-Spain), the spatial distribution of remains, its refits and in particular the technological reading and the experimental comparisons, provide qualified data for the recognition of expertise and unskilled productions. In our sites, the variability in skills and the abundance of asymmetries can only be explain as a result of the repetitive existence of catchment activities simultaneously with knapping learning and training.

Keywords: learning, mastership, lithic technology, middle paleolithic

*Speaker

Flintknappers of Late Palaeolithic. The case study from Hamburgian sites in western Poland.

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The study of skill in lithic technology allow to improve our understanding of past social life. This analytical path is particularly important in Lowland Late Palaeolithic research, where the data are frequently limited only to concentration of lithics, which effects in highly elaborate technological analysis but often also in reduced social context of technological actions. The insight into social life of past hunter-gatherer groups through individuals and their activities change the perspectives to the bottom-up approach. The questions addressed in presentation are: how can we measure the skill level and which features should we consider in analysis of different types of technologies? Moreover, the necessities of using refitting method in skill studies should be highlighted.

Therefore, the aim of the paper is to examine the usefulness of flintknapping skill analysis. The paper present the possibilities and limitation of such analysis through application on particular example. The case study from Late Palaeolithic sites of Hamburgian Culture from western Poland will be considered where the refitting method was apply to analysis of lithic inventories. The various attributes implemented in stone tool production skill research previously were used to distinguished two groups of knappers.

The postulate of more holistic approach is presented, where besides technological analysis, the spatial one can reinforce the identification of different knappers and shows social division of space. However, the main advantage of skill study in palaeolithic can be seen not in the identification of particular knappers or group of knappers with different skills but rather in different perspectives on technology, understood as an social phenomenon.

Keywords: skill, refitting method, late palaeolithic, hamburgian

*Speaker

Specialization and access to technical knowledge: knapping learning at Casa Montero (Spain) and Jablines (France) Neolithic mines

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The aim of this work is to compare of the learning processes between two different lithic productions: Ancient Neolithic blade production at Casa Montero (Spain) and axe production at the Middle and Late Neolithic flint mines of Jablines and Flins-sur-Seine (France). Although both productions took place in the context of flint extraction, they represent two substantially different historical frameworks.

Our hypothesis is that the increase in production specialization is associated with limited access to technical knowledge and that those limitations would be reflected in mining contexts. From a methodological point of view, the criteria for recognizing skills are not universal and they have been adapted to both productions, taking into account the need for comparability. Besides the selection and execution mistakes due to lack of skill that are present in both mines, the main difficulty that novice knappers had to confront at Casa Montero was the premature abandonment of the core reduction. However, in axe production from Jablines and Flins-sur-Seine, the challenge was to deal with three dimension symmetry and size.

This work also considers aspects of knapping learning such as the age of initiation and whether it is possible to recognize different social positions between knappers and the rest of the group. In comparison with Casa Montero, a more ancient mine, with a moderately specialized blade production, a less complex communitarian social context and a more generalized access to technical knowledge, the analyzed French mines allow consideration about which factors were responsible for restrictions in the access to knowledge.

Keywords: Neolithic, knapping learning, flint mines, blade production, stone axes

*Speaker

Becoming Specialist – Losing Knowledge: lithic artefact manufacture during the 4th and 3rd mil. BC in the Rhineland (Western Germany)

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For many Central European Neolithic contexts we would assume, that lithic artefact manufacture was a routine task aiming at producing an almost standardized set of artefacts (sometimes described as "Neolithic tool kit"). However, a closer look reveals regional and diachronic differences that might be explained by differences in the knowledge of lithic artefact manufacture. A striking example is the development of lithic artefact production during the 4th mil. BC in Western Germany (and beyond). While lithic assemblages of the earlier Neolithic periods (Linearbandkeramik, Grossgartach, Roessen, Michelsberg 5500-3500 BC) are characterized by the production of regular blades that were modified further, the later Neolithic tool production (from 3500 BC onwards) is marked by flakes with retouches that hardly conform to our notion of lithic artefacts in the narrower sense. Analysis of lithic assemblages creates an impression of "loss of knowledge" for these later Neolithic periods. At the same time, exceptional artefacts like Grand Pressigny blades or remarkably long blades made from Rijckholt flint appear in the archaeological record, reflecting a growing division of labor in the context of raw material acquisition and related to this in the manufacture of certain types of artefacts. However, the existence of full-time specialists is highly debated, even for the later Neolithic periods. If we want to understand these developments we have to have a closer look on raw material acquisition, subsistence strategies, social organization and settlement structures of these societies i.e. a contextual approach is needed.

Keywords: lithic artefact manufacture, loss of knowledge, Neolithic, Western Germany

*Speaker

Itinerant knappers at Neolithic villages in northern Mesopotamia?

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The Neolithic lithic industries of northern Mesopotamia (northeast Syria and north Iraq), characterized by the pressure debitage for blade/bladelet blank production, display strong techno-typological contrasts to the Levant, where blade production using opposed-platform cores by percussion was prevalent. In this paper, the specialist nature of pressure blade production in northern Mesopotamia is discussed. The study data are the pre-pottery Neolithic lithic assemblages from Tell Seker al-Aheimar (ca. 9300–8800 cal. BC). An analysis reveals the following features for pressure debitage: the use of exotic raw material, namely obsidian and high-quality flint; the import of prepared cores; a remarkably high skill level and success rate; high standardization resulting in production of blade blanks with the consistent shape and ridge pattern; and the disposal of a limited amount of knapping debris in certain spots within the settlement. These features, which were observed repeatedly in different occupation levels, indicate that pressure blade/bladelet production was practiced by skilled knappers within the settlement, but on a small-scale and an episodic manner. Given that local flint was almost exclusively used for flake production, and that there is not sufficient evidence of the existence of apprentices of pressure debitage, a question concerning the socioeconomic contexts of the pressure knappers of this settlement, such as their origins, social roles, and how they acquired adequate skills and knowledge, is raised. Referring to other data sets from non-lithic evidence, this paper argues the possibility that they were itinerant knappers.

Keywords: Neolithic, specialization of stone tool production, pressure debitage, trade, Mesopotamia

*Speaker

**IV-3. Contribution of the ceramic
technological approaches to the
anthropology and archaeology of pre
and protohistoric societies**

Ceramic technical traditions in the second part of the IVth millenium. The settlement of Twann "Bahnhof" (Bern Canton, Switzerland).

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The neolithic settlement of Twann "Bahnhof" has been excavated during the 1970's. It presents successive sets covering nearly all the second part of the IVth millenium. The ceramic set has been published (*Die neolitischen Ufersiedlungen von Twann*, 20 volumes, between 1977 and 1981). This dwelling is a reference for the lacustrine research. However, far too little attention has been paid to the technological aspects of ceramics.

This communication suggests to reexamine many potteries of the site from late Cortaillod to recent western Horgen, in order to study pottery manufacturing and to reconstitute the "chaînes opératoires". This case study will allow us to abord methodological questions about the constitution of technical groups, production groups and technical traditions. Moreover, the technological study of a selection of characteristic potteries from each layer makes possible the opening of a new talk about the transitional process between middle and Late Neolithic in the Three Lakes region.

Indeed, the flatterring of bottoms and the reduction of the "esthetic" aspect of potteries are evocated since a long time in litteratur as morphological markers to identifie changes in ceramic production (for example: Hafner and Suter, 2006). So, what about the technological aspects? What is the evolution of technical traditions on one site, during the second part of the IVth millennium? Are they following closely the morphological variations or, on the contrary, can we see different changes between technical and stylistic aspects? Conditions will be reunited to evocate new interpretative propositions about contacts between populations in the Three Lake region during the second part of the IVth millenium.

Keywords: neolithic, ceramic, technical traditions, Horgen, Cortaillod

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Sharing meals from the past. An innovative method to understand pottery function : case study from the late Neolithic of the south of France

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In a time period where written sources are absent, functional studies unveil important social information. However, functional studies remain scarce, contrariwise to typological and technological studies of potteries.

This analysis aims to understand daily life activities through consumption practices, namely cooking, storing and drinking by studying the use-wear of potteries.

Extensive experimental studies have been conducted in order to create a referential of traces. Some contents such as salt, fermented goods, acidic liquids, burnt food etc., put ceramics under such stress that they leave important marks in the pottery walls. Each trace bares a distinctive signature that is used for identification. Organic chemistry and pre-existing ethnological data have also been used to enrich and test the referential of traces.

These experimental results have been compared to over a thousand pots from the late Neolithic of the south of France (3500 - 2300 B.C.).

Recurring use-wear show a distinctive link between form and function. Some innovative results, regarding drinking practices, show that small polished cups appear to have been used in numerous occurrences to consume acidic and fermented liquids.

Functional analysis can also be used to better understand the function of sites. For example, distinctive traces in potteries show that some sites in the plateaus had the sole function of collecting, drying and storing massive quantities of seasonal goods (such as berries in *Clos d'Aubarne, Gard* and berries and acorn in *Boussargues, Hérault*). These sites are to be put in link with big villages from the plain where, in a contrastive way, a diversity of activities can be identified in the use wear of pots.

This innovative method of use-wear analysis allow us to better understand food habits and daily life activities in time periods that lack written or iconographical sources.

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This communication aims to share and discuss the methodology and the results of use wear studies and functional approaches.

Keywords: functional studies, use wear, pottery, neolithic, cooking, storing, drinking

Technological Choices and Social Inferences in the Copper Age Pottery Production of the Rome Area

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Recent archaeological investigation in the Rome area revealed a long occupation during the prehistoric period. The archaeological evidences unearthed so far indicate the presence of human groups settled between the Tiber river, the Aniene river and the Colli Albani Volcano, between the 4th and the end of the 3rd millennium B.C. The integrity and the richness of the archaeological evidences, as domestic and relative burial contexts, represent a testimony of the sharing of a limited area where prehistoric human groups exploited the available resources and came in contact favoring the exchange of information within different traditions. To this matter, the study of domestic and funerary ceramic assemblages lead to define and highlight patterns of continuity or discontinuity in choices of production, providing data and insights useful to investigate and better understand the occupation dynamics of the area. Through the application of a multidisciplinary approach, which includes compositional analysis of the clay pastes, traces analyses and experimental archaeology, it was possible to reconstruct choices concerning raw materials exploitations and manufacturing processes (including modelling sequences, surface treatments and decoration techniques) adopted by the prehistoric groups. Such a study based on an empirical set of archaeological and experimental data lead to focus on social inferences in prehistoric communities and transmission of a technical knowledge, largely documented in ethnoarchaeological studies, and its related archaeological patterns. In this scenario, it has been possible to develop preliminary observations regarding the identity of copper age potters and their social role in a period, like the copper age, during which the social complexity is incipient rather than developed as suggested by the funerary context discovered in the Rome area.

Keywords: Pottery, Technology, Copper Age, Craft

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‘To Each His Own’. The Pottery Production of the Bronze Age site of Mursia (Pantelleria, Sicily). Some Technological and Functional assessments.

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This poster aims to show the preliminary results of a techno-functional analysis of the pottery assemblages identified in the Bronze Age settlement of Mursia (island of Pantelleria, Sicily) (1750-1450 B.C.).

The material culture of the settlement is mostly represented by handmade and unpainted ceramic artifacts. In this work, among the large amount of vessels, with different sizes and shapes, only three pottery categories have been selected as representative case-studies: *cups*, *handled goblets and ladle cups* (drinking vessels), *pedestal bowls* (table vessels) and *jars* (storage or cooking ware).

To overcome the traditional typological classification based on the shape of the vessels, specific technological and morphometrics parameters have been considered in order to highlight the variability and the possible function of the vessels.

The technological aspect has been focused on the description of fabrics, modes of manufacturing, surface treatment and cooking conditions; whereas the morphometric parameters concern the ratio between diameter and height of the vessel (Index of Depth), the presence, type and position of the handles, the profile of the rim, the configuration of the bottom, etc. The analysis took into consideration only the vessels preserved in a way to define the entire shape, in order to evaluate their dimensional and measurable attributes and their capacities. The construction of different capacity classes allowed the identification of different groups of vessels that share similar features and thus are suitable for similar purposes.

This new approach will allow to enhance the *multi-functionality* of wares (one single vessel can be used for different purposes), and their *interchangeability* (the single action can be realized using different vessels).

Pottery assemblages and their location in the domestic spaces are important evidence that allow the identification of different activities, the reconstruction of daily life and deeper insight into the cultural identity of the inhabitants of Pantelleria in the Bronze Age.

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Keywords: Bronze Age, Pottery Production, Functional Analysis, Technological Analysis, Vessels, Mursia, Island of Pantelleria, Cultural Identity

Évolutions typo-technologiques des productions céramiques de la nécropole de Wanar (Sénégal) : démarche archéologique et implications anthropologiques.

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Depuis plusieurs décennies, les recherches archéologiques menées sur les sites mégalithiques du Sénégal et de Gambie mettent en évidence un abondant mobilier céramique. Outre des poteries entières, parfois volontairement déposées en façade orientale des monuments funéraires, ces vestiges rassemblent un important mobilier fragmenté. Les contextes stratifiés soigneusement renseignés sur la nécropole mégalithique de Wanar (Sénégal) (dir. L. Laporte et H. Bocoum) permettent de situer ce mobilier par rapport aux séquences architecturales et funéraires propres à chaque monument. Une opposition apparaît alors entre poteries à carènes très marquées d'une part, et à carène discrète d'autre part qui correspond à la fois à une logique chronologique et fonctionnelle. Les exemplaires à carène marquée renvoient en effet à une phase plus ancienne que celle des poteries à carène peu développée. Les premières sont également contemporaines de grands récipients décorés à la roulette de fibres plates pliées et dont les bords, larges et épaissis, sont compatibles avec la dépression concave aménagée en arrière du col des poteries à carène marquée. Elles semblent avoir été utilisées, ou conçues, comme des couvercles. Dans les niveaux plus récents, le passage aux vases carénés non adaptables en couvercle, plus petits, s'accompagne également de modifications sur les grandes jarres. Leurs bords sont plus fins et les motifs d'impressions couvrantes sont ici obtenus à partir de roulette de cordelette torsadée double. Enfin, un lien est établi entre, d'une part, la nature et la quantité de poteries déposées et, d'autre part, le type architectural de ces monuments. Les monuments aux monolithes courts et trapus (type B) rassemblent ainsi l'essentiel des dépôts de poteries, dont un nombre important de vases à carène non marquée. Les dépôts liés aux architectures à monolithes fins et allongés (type A) semblent au contraire moins nombreux mais comprennent des céramiques à carène très marquée. Si, dans ce schéma, la fonction de couvercle des poteries à épaulement caréné marqué s'estompe parmi les petits vases de dépôts des phases récentes, une pratique en garderait toutefois la mémoire : leur disposition l'ouverture contre le sol, en position retournée. Plus largement, cette évolution des productions céramiques et des pratiques rituelles amène à questionner les transferts techniques et culturels à leur origine.

*Speaker

Keywords: Céramique, typo, technologie, mégalithisme sénégalais, pratiques rituelles, transferts techniques, transferts culturels, identité.

Chaînes opératoires et contacts techniques : l'analyse tracéologique du mobilier céramique du Chalcolithique de Sardaigne

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La transition Néolithique/Chalcolithique est marquée en Sardaigne par une série de transformations graduelles mais importantes par rapport à l'organisation de la production et plus particulièrement dans le domaine de la céramique : on remarque la survivance de quelques aspects de la tradition néolithique, mais en même temps une très évidente perte d'intérêt pour le décor et l'introduction de nouvelles formes vasculaires, parmi lesquelles le " tegame ", un plat pour la cuisson, qui fait l'objet de notre étude. Il s'agit d'une catégorie formelle bien attestée dans le cadre des productions céramiques du Chalcolithique ancien de la Sardaigne, notamment dans un des villages les plus importants, Su Coddu/Canelles (Selargius), qui a été objet de plusieurs fouilles extensives et qui a délivré une série de datations radiométriques. La recherche, qui s'est développée dans le cadre d'une collaboration entre les universités de Sassari et des Iles Baléares, a permis de reconstruire environ 50 unités vasculaires relatives à " tegami ", la plupart avec profil complet. Elles ont été comparées à d'autres récipients retrouvés dans les villages contemporains du Cronicario (Sant'Antioco) et Terramaini (Cagliari).

Le façonnage est généralement une des étapes les plus stables du processus de fabrication de la poterie, contrairement aux décorations et aux traitements des surfaces. Par rapport aux " tegami ", en analysant les différentes chaînes opératoires, on a pu déterminer une ou diverses stratégies de fabrication. L'identification des traces observées et sa vérification expérimentale ont permis d'établir l'existence du même savoir-faire dans les différents contextes, avec quelques variations dans les stratégies techniques auxiliaires. Ces variations sont présentes au sein d'un même village, tandis qu'on ne remarque pas d'évidentes différences régionales.

Les résultats de la recherche suggèrent l'existence de savoir-faire technologiques partagés au-delà du village avec des groupes appartenant à des habitats proches (Terramaini) ou éloignés (Cronicario). Cet aspect confirme l'existence d'une mobilité régionale attestée par la circulation des matières premières.

Keywords: Chalcolithique, Sardaigne, Tracéologie, Céramique, Chaîne opératoire

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Provenance and technology of pottery from the Mesolithic-Neolithic transition period in Belgium

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The main objective of this research is to understand the mobility of objects/people and the possible contact/exchange between farmer and forager populations during the Mesolithic-Neolithic transition period and to contribute to our knowledge of how early agriculture spread along the North Sea basin.

In the sandy lowlands of northern Belgium, sites with final Mesolithic hunter-gatherer pottery occur on a few locations in the Scheldt valley. At Doel "Deurganckdok" three sites (B, J and M) yielded hunter-gatherer (Swifterbant) pottery, along with one site (C) with middle Neolithic (Michelsberg) pottery. At two other sites on the left bank of the Scheldt river, Bazel "Sluis" and Melsele "Hof ten Damme", possible hunter-gatherer pottery was found together with early and middle Neolithic pottery within a stratigraphically complex 'palimpsest' situation. These sites represent the most southern find locations of hunter-gatherer (Swifterbant) pottery and the most north(west)ern find locations of Limburg, LPC and (Epi)R'ossen/Bisschheim pottery in the Rhine-Meuse-Scheldt area. Hence these sites are important for studying the possible relations between the northern forager and the southern farmer populations, in a period during which the knowledge of pottery production and agriculture became widespread.

The pottery from these sites is now being fully analysed to establish (1) which fabric or pottery groups are present, (2) which cultural groups this pottery belongs to and (3) which pottery is produced locally or originates from outside the Scheldt valley. This research combines the typological and technological (reconstruction of the operating chains) ceramic analyses with the petrographic (Polarizing Microscope and SEM+EDS), mineralogical (XRD) and geochemical (LA-ICP-MS) characterisation of the pottery clays and tempers and raw material sourcing.

Keywords: Mesolithic, Neolithic, neolithisation process, pottery, technological analysis, provenance analysis

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Approches technologiques des productions céramiques en contexte gréco-indigène en Italie méridionale aux 8e et 7e siècles av. J.-C.

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Dans le cadre d'une reprise marquée des circulations méditerranéennes dès le 8e siècle av. J.-C., dans le cadre d'une phase qui peut être qualifiée de " protocoloniale ", les côtes de l'Italie méridionale voient l'arrivée de communautés en provenance de Grèce, constituées notamment d'artisans. Certaines de ces communautés artisanales sont accueillies dans des établissements indigènes importants de l'âge du Fer sud-italien, où elles réalisent leurs propres productions céramiques, à côté – et de manière contemporaine – des productions indigènes, et vraisemblablement à l'invitation ou sur commande des autorités locales.

Cette cohabitation artisanale se traduit par des " contaminations " réciproques sur les plans formel et stylistique ; on observe dans le même temps une continuité et une autonomie dans chacune des traditions artisanales céramiques, dans presque toutes les étapes de la chaîne opératoire de la fabrication des vases, mis à part quelques exemples insolites – voire anecdotiques – qu'il convient toutefois d'intégrer au sein d'explications satisfaisantes en termes d'organisation sociale de ces communautés mixtes. Nous verrons également que la question de la consommation des céramiques provenant de ces contextes productifs particuliers ne doit pas non plus être écartée des problématiques de la production et de la technologie.

Prenant comme point de départ de notre analyse le mobilier inédit du site de l'Incoronata, l'enquête céramologique se poursuivra sur plusieurs sites de l'Italie méridionale actifs entre les 8e et 7e siècles av. J.-C., des sites dont les données à disposition permettent d'étendre et d'enrichir les observations technologiques sur les productions céramiques et les espaces artisanaux qui en sont à l'origine.

Keywords: Protohistoire, Italie du Sud, production céramique, technologie céramique, âge du Fer, interactions grecs indigènes

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Identifying pottery forming techniques and ‘ways of doing’ from a diachronic perspective: the example of pottery production of La Dou (Catalonia, Spain) during the Ancient Neolithic and Late Bronze Age

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The reconstruction of forming methods in pottery production constitutes one of the manners to understand pottery traditions, the ways of making pots as well as the social and economic organization of pottery production. Despite its interpretative potential, pottery forming techniques have been practically unconsidered on the researches carried out for the Iberian Peninsula, since the introduction of first pottery products to the appearance of potter’s wheel.

The main objective of the present study is to provide a first approach of these techniques from a diachronic perspective through the analysis of pottery productions from La Dou (Catalonia, Spain) on its occupation phases. During the Ancient Neolithic (4800-4300 cal BC) the site had reiterative occupations with different fire structures linked to pottery sherds concentrations. Afterwards, the site was dwelled by a Late Bronze Age settlement (1200-900 cal BC) represented by a large pit with a burnt level compounded for log charcoals and vessels broken inside.

The paper presents the study of pottery forming techniques identified in both periods following the methodologies applied on last researches carried out in Europe (e.g. Livingstone 2007, Garcia and Calvo 2013, Gomart 2014). Through the analysis of manufacture macrotraces, it was observed that coiling methods and internal moulds were employed for building vessels during the Ancient Neolithic. Whereas, for the Late Bronze Age the variety of forming techniques was increased considerably by different methods of coils, slabs, moulds and work processes of pinching the clay.

First results obtained show there were similarities and changes in pottery forming techniques and in the ways those communities produced vessels. Even though the temporal distance between each period treated, could it be considered some preservations in the ways of producing ceramics? Otherwise, was there a diversification of pottery production in Late Bronze Age due

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to the variety of forming methods? These, and other, questions will be discussed during the proposed communication.

Keywords: Ceramic manufacture, Pottery shaping, Macrotrace analysis, Diachronic research, Pre-history, NE Iberian Peninsula

Sea, ceramics and islands in western France, a diachronic perspective

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The aim of this paper is to present research on the ceramic production and exchange between the mainland and islands of Brittany (western France) from the middle Neolithic (4600 B.C.) to the end of the Iron Age period (52 B.C.). By archaeometric analysis of pottery, we questioned the impact of sea and insularity on communications and exchanges networks, between the island and mainland communities. Did these islands produce their own pottery or were they dependent on mainland production? Did exist particular traditions on the island in the production of ceramics? By determining the origin of the raw material used to shape the pottery, it is possible to identify the changing degrees of connection with, or isolation from, wider networks. In this paper, we will present research on the ceramic production and exchange between the mainland and islands of Brittany in western France from the middle Neolithic (4600 B.C.) to the end of the Late Iron Age (52 B.C.).

Several multi-scalar approaches have been used to study ceramics from 25 different occupations from the island and mainland. The macroscopic observations, as well as microscopic examination of ceramic thin sections for the identification of the mineralogical composition of the clay, and to determine its geological and geographic origins. These techniques have been complemented by global chemical analyses: SEM-EDS, XR-D and P-XRF and a new approach by punctual analyses by LA-ICP-MS of non-plastic inclusions.

This diachronic work allows us to document the evolution of characteristics, changing locations of raw material supply and pottery production. We observed through time the increase of the ceramic importations on the island, and the decrease of exchange between the islands. Furthermore, we highlighted significant changes in the size of non-plastic inclusions, during the Bronze Age, and Late Iron Age linked to the adoption of new technologies by potters. Moreover, this research enabled us to develop a new concept in the exchanges of ceramics: the fact that pottery can be considered as prestige good due to the utilisation of certain types of raw materials, with particular physical and mechanical proprieties. Finally, the results of this research provide new evidence about the prehistoric occupation of the islands of Brittany by petrographic and chemical analyses of ceramics.

Keywords: Ceramic, petrography, production, economy, island, sea, Neolithic, Bronze Age, Iron Age

*Speaker

Exploring pottery use in the Southwestern Atlantic Europe: an approach from the organic residue analysis

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The origin and spread of pottery vessels marked an important change in culinary practices of prehistoric societies. Its introduction across Europe followed different geographic patterns and processes. In this context, the introduction and adoption of pottery technology in the western extreme of the continent occurred later than in other parts of South Europe.

This presentation is focused on the earliest evidence of pottery use along the Southwestern Atlantic coast of Europe. In this way, representative pottery assemblages from Portugal, Spain

*Speaker

and France are used to investigate the role of this technology in relation to the arrival of the first domesticates to the region. By applying organic residue analysis on extracted lipids (i. e. gas chromatography, gas chromatography-mass spectrometry and gas-chromatography-combustion-isotope ratio mass spectrometry), this presentation assesses the function of pottery during this unprecedented cultural transition, which supposed the end of the hunter-gatherers communities in the region. Our results reveal considerable geographic variability in early pottery use related to the processing of different animal products. The results have significant implications for discussing regional patterns in Neolithic diffusion and the nature of early agropastoral economies in western Europe.

Keywords: organic residue analysis, lipids, isotopes, Southwestern Europe, Neolithic

Indigenous and foreigner practices: a technological study of ceramic artifacts from a Late Bronze Age site in central Sicily

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Sant'Angelo Muxaro is located at the top of a hill in Central Sicily, in the northern side of the Agrigento province. This site is well known among archaeologists because of its rock-cut tombs spanning the Late Bronze Age and the Early Iron Age of Sicily (13th - 8th century BC). The most recent excavation (2006-2007) allowed archaeologists, with the help of the local community, to recover and record more than 100 burials along the southern slope of the hill, including human remains and grave goods (ceramic and metal artifacts) spanning several generations of the local prehistoric inhabitants. Although current approaches have focused their attention towards the definition of relative chronologies in regards to local cultural developments, a more comprehensive study in regards to pottery-making practices, the habits, and the technological choices involved in the creation of ceramic products is still lacking. Here, we show the results of an archaeometric analysis of pottery remains coming from the most representative burial contexts, ranging from the 13th to the 10th century BC. The opportunity to explore main ceramic technological trends over time in relation to raw material procurement, the steps involved in the *chaîne opératoire*, and the intensity and the scale of local cultural receptiveness or resistance, can potentially lead to a definition of the most common practices adopted by indigenous potters during a crucial time period in the central Mediterranean. Particularly, these tombs were used continuously through time for five centuries, thus triggering the opportunity to look at techniques and choices made by potters, and, then, tracing technological trends over time in regards to ceramic production. Therefore, through a combination of chemical and petrographic analyses of the grave goods, it is possible to identify evidence of the long lasting relationships between Sicily and the Aegean, at the time of the highest peak of eastern Mediterranean influences over indigenous people, who, in response, started to build up new forms of representation in order to express their identities.

Keywords: Technology, Ceramics, Archaeometry, Bronze Age, Iron Age, Sicily, Mediterranean

*Speaker

The most ancient ceramic traditions as a reflection of the interaction between the Neolithic cultures of the Volga-Kama region

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By the beginning of the 21st century researchers have identified several archaeological Neolithic cultures. However, it was not always possible to track the temporal and spatial interaction between their bearers at the typological level. Since 2007 a technological analyses has been carried out on a large number of the vessels belonging to these cultures. The typical characteristics for the cultures of each region were identified. Moreover, a large series of radiocarbon dates was obtained for a large number of monuments of these cultures, including the dates on the organic matter in the ceramics.

During the entire Neolithic in the Northern Caspian region, the Kairshak and Tenteksor ceramic traditions are represented by molding masses from lake silt. Judging by radiocarbon dates, this tradition exists between 6500 and 5500 BC. At the same time, the ceramic tradition of Rakushechny Yar culture develops in the Low Don. However, its technological characteristics do not allow to assume the interaction of these culture-bearers at early stages.

During 6500-5500 BC Orlovskaya Neolithic culture is developing in the north of the Caspian Sea, in the Lower Volga region. Its early stage is characterized by features similar to the Caspian ones. That might suggest the influence of the Caspian population on the formation of the ceramic tradition of the Low Volga region. Later on this territory the process of evolutionary development of the molding masses is under way: from silt to muddy clays at the developed stage, and at a later stage to clays. The system of ornamentation is also changing.

Within the period of 6500 - 5500 the Elshanskaya ceramic tradition, based on clay molding masses, is developing to the north, in the forest-steppe Volga region. The vessels of the syncretic type were found in the Lower Volga region, which testify to the interaction of the bearers of Orlovskaya and Elshanskaya cultures.

In 5700 BC a ceramic tradition appears in the forest zone of Volga-Kama, similar to the Elshanskaya one. This allows us to assume a significant role of the Elshanka inhabitants in its appearance.

A special ceramic tradition is emerging around 5500 in the forest lands, on clay with an admixture of chamotte. At the same time, there are syncretic vessels demonstrating the interaction between the forest-steppe and forest cultures.

*Speaker

Thus, new methods allowed to obtain new qualitative information on the interaction between the bearers of different Neolithic cultures in Volga-Kama.
*Project 33.1907.2017/PCh

Keywords: Low Volga region, ceramic tradition, radiocarbon dates

Analysis of organic residues and artefacts in archaeological findings by mass spectrometry

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Chemical analysis of organic residues and artefacts is a key part of current research in archaeology. Extensive rescue archaeological survey commonly precedes larger infrastructure constructions. During this work a lot of archaeological objects are obtained that must be inspected in short time to evaluate the relevance of findings and decide on the need for further (more detailed) research in a given locality. Appropriate analytical techniques providing reliable information on the chemical composition of archaeological findings in a timely manner are highly appreciated in this process. The modern analytical instrumentation, i.e. mass spectrometry especially in combination with multivariate statistical methods appeared to be powerful tool for that purpose.

In this communication, capability of high resolution mass spectrometry with (matrix assisted) laser desorption ionization ((MA)LDI-MS), Atmospheric Solids Analysis Probe (ASAP-MS) and gas chromatography/mass spectrometry (GC/MS) for the characterization of organic materials present in various archaeological findings in wide time range will be discussed.

GC/MS study of differences among particular soil layers in excavated vessels from the end of Eneolithic period revealed the presence of triterpenoid milliacin that occurs in broomcorn millet. Subsequent ASAP-MS experiment provided high resolution tandem mass spectra unambiguously confirming the identity of this compound (being the first utilization of ASAP-MS in archaeology). This finding of milliacin can be considered as the earliest evidence of broomcorn millet usage in Central Europe. MALDI-MS combined with Multivariate statistical approaches revealed the presence of fatty residues in some of the excavated vessels. Signals belonging to di- and triacylglycerols were found in ceramic beakers belonging to Corded Ware culture. Those results were confirmed by ELISA assay that proved the presence of cow milk or a dairy product.

Besides, LDI-MS was used for analysis of unknown fibre pieces captured in eyelet of S-shaped-

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end ring jewels found in proximity of female skulls in tombs. Signals of sodium adducts of oligosaccharide chains suggest the presence of plant material (presumably linen, hemp or nettle) used for fixation of the jewels.

Finally, LDI-MS in combination with multivariate statistics allowed estimation of the geographical origin of amber artefacts found.

Keywords: mass spectrometry, organic residues, analytical chemistry, laser desorption/ionization, gas chromatography

Earliest pottery of hunter-gatherers communities of Eastern Europe (7–6 mill BC): pottery making technology and cultural milieu

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Earliest pottery appeared in Eurasia and Northern Africa in hunter-gatherers communities in the 15–9 mill BC, in Eastern Europe – in the first half of the 7th mill BC. These dates are much older than the time of appearance of Neolithic communities in other European parts. Pan-European understanding of Neolithic led to a definite isolation of Eastern Europe and division of Europe into two worlds – the world of farmers with a particular ceramic assemblages, including painted pottery and impressed ware and the world of hunter-gatherer societies with predominance, as it is always assumed, of conical bottom wares. Appearance of conical bottom pottery is attempted to be explained as a stadial feature, basing on the investigation of modern hunter-gatherers communities; as one common world, that connected Middle Volga River basin and Scandinavia (Elshanskaya and Ertebolle pottery); as a world of semi-mythical Hyperboreans, who penetrated into Scandinavia from somewhere far from the East. However all these ideas cannot explain different ceramic wares which suddenly appeared in Eastern Europe, the reasons of this event, particularities of their origin, differences and similarities in pottery making technology, their further existence and even disappearance. In what particular conditions the most ancient pottery in Eastern Europe appeared, why the Hyperboreans appeared to be just a myth? In order to understand this, it is important to analyze archaeological materials of a number of archaeological cultures existed in Eastern Europe during the 7–6th mill BC. This report will focus on analysis of different regional ceramic traditions, particularities of pottery making technology, description of the sites, chronology of appearance and further distribution of different ceramic traditions in Eastern Europe.

Keywords: pottery making technology, hunter, gatherers, chaînes opératoires, Eastern Europe

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‘Ocs’od-Kováshalom and the Neolithic Ceramic Technological Tradition in Hungary

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‘Ocs’od-Kováshalom is a well known archaeological site of the Tisza culture on the Great Hungarian Plain, which was excavated in several successive campaigns between 1980 and 1987. A complex analysis of the Late Neolithic tell-like settlement is carried out within the frames of a new research project that has begun in 2016. The most abundant category of finds recovered from the settlement features at ‘Ocs’od is pottery of various forms and ornamentation. In this new, ongoing project we have started to study the formal-stylistic characteristics of pottery assemblages as well as the physical properties of the ceramic material. Macroscopically observable technological markers provided us the possibility to detect such several forming methods in the case of the vessel types from ‘Ocs’od as they were identified earlier in Middle Neolithic Alföld Linear Pottery assemblages by Louise Gomart. Our preliminary results consist of 13% of the total pottery material, cca. 10.000 sherds. We have just started the microscopic investigations by preparing thin sections for petrography. The analysis of 100 samples is in progress at the Interdisciplinary Laboratory of the Institute of Archaeological Sciences (Budapest) Beside the intensive Late Neolithic occupation, sporadic traces of Early Neolithic (K’or’os Culture) and Middle Neolithic (ALPC) settlements were found at ‘Ocs’od-Kováshalom. Despite of that fact the continuous existence of Neolithic population could not be proved on the spot, moreover, temporal gaps between settlement phases seem very plausible. Nevertheless, the three mentioned Neolithic assemblages suggest a long-term local ceramic tradition. The complex technological analysis and our comprehensive study of these assemblages offer a one-thousand-year perspective about the development and change of local pottery traditions from 6000 cal BC to 5200 cal BC.

Keywords: Neolithic ceramic, Forming methods

*Speaker

Ceramic technology of the Urnfield culture (Late Bronze and Early Iron Age) in the middle Ebro Valley (Spain) through an archaeometric approach

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This research addresses the ceramic technology of two archaeological sites of the Urnfield culture located in the middle Ebro Valley. El Sequero (La Rioja, Spain) is formed by two Late Bronze Age pit-houses dated from 900 to 805 cal BC and El Morredon (Aragon, Spain) is a large settlement occupied during the Late Bronze and Early Iron Age and dated from 1150 to 600 cal BC. The hand-made ceramic assemblage of both sites has similarities in typological and decorative aspects.

The ceramic technology has been analyzed through the following archaeometric methods: petrology, scanning electron microscope (SEM) and inductively coupled plasma atomic emission spectroscopy (ICP-AES). The results of the archaeological ceramic analysis have been compared with the raw material available in the region of both sites.

As a result, different compositional groups have been identified in each site. The addition of grog as a temper is the most important characteristic in the pottery of El Morredon. On the other hand, the pottery of El Sequero highlights the absence of grog and the addition of crushed calcite as a temper. Therefore, the results show different ways of doing in each site at least in the raw material procurement strategies and paste recipes, despite the fact that both have similar typology and decorative patterns at the same period.

Consequently, we suggest the ceramic technology of Urnfield culture in the middle Ebro Valley has particularities in the pottery production in each site conceivably related to the socio-cultural framework of each community. Future studies will complete our knowledge about the ceramic technology in the former and subsequent periods in this region and allow us to ascertain the evolution of hand-made ceramic technology over time.

This research completes a lack of knowledge about the ceramic technology in the Late Bronze and Early Iron Age in the middle Ebro Valley and enriches the state of the art of well-known areas in the northeast of Iberian Peninsula, such as the Basque Country or Catalonia.

*Speaker

Keywords: ceramic technology, Urnfield Culture, Late Bronze Age, Early Iron Age, middle Ebro Valley, ceramic petrology, SEM, ICPAES

The wheel-made pottery from the Wielbark Culture cemeteries in Ulów (SE Poland) - import or local production?

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In the vicinity of Ulów (Middle Roztocze, SE Poland) the complex of multicultural archaeological sites was found. Among them two bi-ritual cemeteries (site 3 and 7) originating from the Roman Period and the early Migration Period were discovered. On the map of archaeological cultures, Ulów is located in the settlement zone F of the Wielbark Culture. Therefore, the features typical of this culture dominate over the cemeteries discovered in Ulów. However, no fewer is the number of features of funeral rite, location of the site, as well as grave goods possessing parallels in other cultural units from the European *Barbaricum* (e.g. Maslomecz Group, Chernyakhov Culture). It is known that the Wielbark Culture has a small number of wheel-made pottery. Moreover, it has not yet been proved that the population of this culture produced such a ware (apart from one "episode" from Weklice). According to many archaeologists, wheel-made pottery from the Wielbark Culture sites are in most cases imported from the Chernyakhov or Sântana de Mureş Cultures. In the light of this fact, surprising is the extraordinary number of wheel-made pottery and its fragments discovered in Ulów. In site no. 7, they comprise more than a half of ceramic ware from the Roman and Migration Periods. In this case, it can not be ruled out the local production of at least part of the wheel-made pottery, connecting the ornamentation of the hand-made Wielbark Culture pottery with the technology and morphology of the wheel-made pottery characteristic for the Chernyakhov or Sântana de Mureş Cultures. In the light of the series of radiocarbon dates obtained from some of the graves containing the wheel-made pottery, the influence of the Dacians culture can not also be excluded.

Keywords: wheel, made pottery, Wielbark Culture, Ulów, SE Poland

*Speaker

Fonction des sites, organisation de la production et dynamiques géoculturelles : l'apport des approches croisées entre technologie et typologie. Exemples de sites néolithiques du sud de la France

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Si l'approche technologique est désormais incontournable pour caractériser les céramiques néolithiques, celle-ci gagne à être confrontée aux approches typologiques plus classiques pour finalement tenter une caractérisation systémique de ces productions. Plusieurs sites du sud de la France, datés du Néolithique ancien au Néolithique final, ont fait l'objet ces dernières années d'études détaillées de leurs assemblages céramiques : le Mas de Vignoles (Nîmes, Gard), Camprafaud (Saint-Pons-de-Thomières, Hérault), le Ta'í (Remoulins, Gard) et la grotte de la Chauve-Souris (Donzère, Drôme). Un travail principalement fondé sur la gestion des matières premières (nature et origine), sur le traitement des terres argileuses (ajout de dégraissants notamment) et sur les caractères morpho-stylistiques des assemblages permet d'aborder la fonction des sites (habitat pérenne, site-étape, lieu de production,...), leur statut (simple habitat, site d'agrégation, lieu de rassemblement), l'organisation de la production (production domestique, spécialisée et valeur de la production,...) et la structure sociale des groupes consommateurs et/ou producteurs de cet artisanat.

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Keywords: Céramique, Néolithique, Technologie, typologie, statut des sites

Technical behaviours of the first farmers in the north-western Mediterranean: an integrated approach to ceramic production and consumption from Arene Candide Cave

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The paper presents the results of an integrated approach to the pottery manufacturing sequences and uses at the Arene Candide Cave (Liguria, northwestern Italy) during the sixth millennium BCE.

Between 1997 and 2012, new archaeological investigations detected a detailed stratigraphic sequence of Impresso and Cardial aspects of the site, of major relevance for the knowledge of the northern Mediterranean early Neolithic.

The pottery assemblage includes the remains of over 200 vessels and is the subject of an ongoing interdisciplinary research aiming at the reconstruction of choices in raw materials sources, techniques of preparation, forming, surface treatments, decoration, as well as vessel function. This approach includes:

(i) the characterization of fabrics by integrating data from stereomicroscopic observation of the whole assemblage and optical microscope analysis of selected thin-sections;

(ii) the identification of manufacturing traces, sequences of gestures and stages of the manufacturing process, using macro-analysis;

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(iii) chemical analyses in order to identify post-firing treatments on and uses;

(iv) ^{14}C radiocarbon dating of samples from short-lived taxa embedded in vessels showing techno-typological diagnostic features.

The use of specific tools in ceramic production is also considered in the light of microscopic use-wear analysis on the associated macro-lithic and flint industry.

Such aspects of the ceramic technical sub-system, along with high-resolution stratigraphic data, offer a broad perspective on ceramic production and consumption at the local scale, as well as insights on the interaction networks at the regional scale.

The results provide an original contribution to the reconstruction of Neolithic technical behaviours of the first farmers in the northwestern Mediterranean, offering new insights into the site function and economic organization.

Keywords: Arene Candide Cave, NW Mediterranean, Ceramic production and consumption, Early Neolithic

Variability amongst the Bell Beaker ceramics in northwestern part of France

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The aim of this poster is to discuss the broad difference seen between the ceramics attributed to the Bell Beaker phenomenon, especially the beakers themselves. The Bell Beaker phenomenon take place in the second half of the third millenium in the northwestern part of France. In order to understand the spread of this phenomenon on the atlantic shore, we used a technological analysis about the process of crafting the ceramics. This approach allowed us to see the different *chaines opératoires* used by the potters of the second half of the third millenium to produce a very specific shape : the bell beaker. If theses ceramics fall in the same category in a typological point of view, they're in fact made in different way. Consequently, our next approach is to determine the minimal number of ceramic's tradition for the second half of the third millenium. Our target will be to trace the origin of theses different tradition prior to the Beaker phenomenon.

Keywords: Ceramic technology, Bell Beaker phenomenon, Chaine opératoire, Late Neolithic

*Speaker

IV-4. Fire as an artifact: Advances in the study of Paleolithic combustion features

Where There's Fire, There's Smoke: Reconsidering Air Circulation and Hearth Location at Paleolithic Cave Sites

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The human use of fire in the Paleolithic period has been widely researched in recent decades due to its major implications for the understanding of human adaptation and evolution. In the Levant, it appears that by the end of the Lower Paleolithic period, ca. 400-300 kya, humans were already using fire on a regular basis, and most probably even controlled fire to some extent. Hearths produce an intense heat that breaks up the wood polymers into smaller molecules. The smoke emitted from the combustion contains a number of oxygen-based compounds. When wood burning is inefficient, the particles contain inorganic compounds such as ash and soot, as well as compressed inorganic components. Smoke from the burning wood contains around 200 different chemical materials, mostly of a size that can be inhaled and some that are noxious and carcinogenic. These chemicals, which are transported via smoke, influence human health. Although the use of fire also has many direct advantages, we may assume that the continuous use of a hearth in caves and rock shelters required contending with its disadvantages by carefully selecting its location and its possible influence on human health. In this study we offer a new explanation for the choice of hearth location in caves and rock shelters, based on an air-circulation model due to irritations of smoke to human. The air-circulation model is influenced by the temperature difference between the cave's interior and the external environment, based on thermodynamics laws. The model takes into account the cave structure, hearth characteristics, and seasonal temperature fluctuations. We then apply the model to a number of caves and rock shelters in order to demonstrate its validity.

Keywords: fire, hearth, air, circulation, cave

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Fuelling the fire: firewood and mobility in the Pleistocene

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By Upper Palaeolithic times, and especially in European mid-upper latitudes, it is clear that fire was fundamental to a diverse range of activities and capabilities relevant for life. The widespread occurrence of charcoal found in association with hearths indicates that wood was a primary fuel component, almost certainly due to its availability and superior raw material properties compared to other possible fuels. Wood gathering will therefore have been an important part of everyday life during the Palaeolithic, requiring more transportation labour per capita due to its bulk than most other supplies such as lithic raw materials, or animal carcasses that provided several resources in one package. Modelling firewood collection strategies thus offers another potential window through which Palaeolithic occupation strategies and resource utilisation across a landscape may be reconstructed and understood. Key to this is availability and distribution of wood fuel.

This presentation draws attention to firewood as a natural resource that was gathered, processed and consumed on a daily basis by Palaeolithic groups. Using Gravettian occupation of the Pavlovské Hills as a case study (dated to around 30,000 years BP), we have investigated firewood availability using archaeological, palaeoenvironmental and ecological data, including making inferences from charcoal in Pavlovian hearths (Pryor et al. 2016). The collated evidence suggests that while dead wood was likely readily available in woodland areas where humans had not recently foraged, longer term occupations – or repeated occupation of the same area by different groups – would have quickly exhausted naturally occurring supplies. Once depleted, the deadwood pool may have taken several generations (c.40–120 years) to recover enough to provide fuel for another base camp occupation. Such exhaustion of deadwood supplies is well attested ethnographically for hunter-gatherers living in a wide range of environments. Thus, we argue that Pavlovian groups likely managed firewood supplies using methods similar to those used by recent hunter-gatherers: through *planned geographic mobility* and by *deliberately killing trees years in advance of when wood was required*, so leaving time for the wood to dry out. Such management of fuel resources was, we argue, critical to human expansion into these cold, hitherto marginal, ecologies of the Upper Palaeolithic.

Pryor, A. J. E., Pullen, A., Beresford-Jones, D. G., Svoboda, J. A. and Gamble, C. S. (2016). "Reflections on Gravettian firewood procurement near the Pavlov Hills, Czech Republic." *Journal of Anthropological Archaeology* **43**: 1-12.

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Keywords: Gravettian, fire, firewood, mobility, duration of occupation, Pavlovian, charcoal

WHERE'S THE FIRE? : Spatial analysis of the distribution of burnt lithics from the Aurignacian in Šalitrena cave, Serbia

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Fire was developed very early in human history, it is multifunctional and important for various aspects of human life. Because of this, it is important to study combustion features at an archaeological site, just as much as any other cultural remains that we may find. However, detecting in-situ combustion features can be difficult. Postdepositional processes and the geology of a site may contribute to the destruction of these features, thus making them invisible to archaeologists. Excavation techniques can also reduce the visibility of combustion features at an archaeological site.

However, fire is a destructive artefact, everything that was touched by this artefact is changed forever and is thus recognizable in the archaeological material. The study proved that analyzing spatial distribution of the burnt artifacts can detect invisible ghost” hearths. It has also been proven that it is a good way of determining combustion feature spread area, as it is sometimes missed during excavation or not defined precisely enough.

Analyzing the lithics from Aurignacian layer in Šalitrena cave (western Serbia), this paper has two goals. First of them is to detect combustion features on the site and areas occupied around them through spatial distribution of technological categories, with special attention on burnt artefacts. The results of this analysis are compared with the situation recorded during excavation where the lines of the combustion features are detected. The second one is to reconstruct technological behavior, and what kind of behavior/s Aurignacian communities practiced around combustion features. The results are discussed in the light of the methodology used on excavations.

Keywords: combustion features, spatial analysis, technology, behavior, Aurignacien

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Fires and noises of Late Paleolithic camps: The issues in spatial analysis of hearths

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This paper deals with the methodological issues in identification of hearths at Late Paleolithic sites of the North European Plain through the intra-site spatial analysis. Dominating in this area acidic sandy environment usually does not preserve not only organic debris such as burnt bones or charcoal, but often even not heat-altered sediments or ash which may easily indicate places of potential fireplaces. Moreover, in many cases low amount of iron in sand does not allow to change the color of the soil into red one. Other factors, which might have influence the weak preservation of fireplaces are their short utilization, cultural behavior, (i.e. sleaning) natural leaching of charcoals and other post-depositional processes. The utility of methods recently applied to archaeological data, including the kernel-density analysis, quadrant count method in its different modifications, sector and ring method, cluster analysis and point pattern analysis is discussed both from the perspective of their mathematical structure and specifics of sites in the macro-region. The analysis is accompanied by the case study on identification of hearths at the Federmesser and Swiderian camp-sites in Lubrza 10, Western Poland. Special attention in our research is given to the noisy effects in model outcomes, which are caused by natural fire events, human behavior behind the specific deposition of artefacts, vertical and horizontal re-deposition of materials, as well as the issue of patterns of ‘noisy’ shapes. Methodological insights into identification of hearths enable the discussion of camp structure and its duration in the Late Paleolithic of North European Plain.

Keywords: Late Paleolithic, hearths, intra site spatial analysis, campsite, preservation

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Fire Use and Site Maintenance by Neandertals at Lakonis Cave I, Southern Greece

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Archaeologists have long recognized the myriad important social and practical uses of fire in the Paleolithic: warmth, cooking, keeping away carnivores, and extending the day, among others. Through advancements in understanding site formation processes and improved methods for identifying and interpreting combustion features (mostly using micromorphology), archaeologists have been able to turn to more targeted questions regarding the use of fire, such as the issue of bone burning for fuel and site maintenance through the burning of organic waste. In this paper, we examine the use of fire in the late Middle Paleolithic (ca. 44,000-39,000 BP) at Lakonis I in the Mani Peninsula of southern Greece. During excavation, researchers noticed two distinct parts of the site, a hearth area with a high concentration of *in situ* and raked out combustion features that included a large number of burned bones and lithics, and a bone breccia that seemed to reflect a dump and possible carcass processing area. High concentrations of burned bones in the hearth area led to the question of whether or not bones were burned for fuel. We test this by examining the fragmentation rates of different types of bone (i.e., flat, compact, and cancellous) combined with the degree of burning on cancellous bone, and by comparing our results with other archaeological test cases and experimental studies conducted by Costamagno and colleagues. Based on our results, we conclude that bones were intentionally burned at Lakonis I, but not primarily for fuel. Rather, the rates of overall burning, low levels of high-temperature burning, and low proportions of highly burned cancellous bones, indicate that hominins at Lakonis I burned bones as part of a site maintenance strategy. This behavior, along with the scooping out of hearth features and discard of deposits in a different part of the site, provides evidence for two different kinds of site maintenance by Neandertals. We therefore consider Lakonis I to be among the growing number of sites that preserve evidence for site maintenance and the differential use of space by Neandertals. This points to a level of domestic complexity that we are better able to interpret through our understanding of the use of fire.

Keywords: site maintenance, Middle Paleolithic, southern Greece, burned bone

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Driftwood, seal oil and caribou bones: interdisciplinary insight into fuel management and fire-related activities in Arctic contexts

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Within the Cape Espenberg sites, layers of carbonized and cemented remains are found associated with Birnirk and Thule semi-subterranean houses (11th-18th century AD). These burned areas raise a number of questions about fire related outside activities, the use of multiple fuels, and the long-term processes that led to their formation. In this wood-poor arctic environment, ethnographic observations report that driftwood can be used as a fuel, often coupled with animal resources to meet fire energy needs.

In this paper, we present combustion areas excavated from the Rising Whale site at Cape Espenberg. We analyzed each hearth feature by sorting and identifying wood and animal fuels. We discuss the representation of firewood taxa with a statistical analysis of their frequency and fragmentation. In previous analysis, we showed that the combustion process can be altered by animal fuels. The intentional addition of seal oil in an experimental fire results in the production of a higher mass of charcoals and contributes to the preferential preservation of spruce (*Picea* sp.) charcoal. Hence, it is important to record the ratio of spruce to test whether it is systematically overrepresented in archaeological hearths in which animal fat was added. Do the results of charcoal identification express the availability of driftwood species or the impact of animal fuel on the wood combustion? Alternatively, they could be the results of wood selected for specific hearth functions.

Different combustion can be related to different hearth functions, from flame production to flameless charring, or from domestic to specialized combustion (ceramic firing). We conducted

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sixty-four experimental fires to help understand combustions types, fuel types properties and potential hearth functions. Thirty fires were under controlled conditions in a laboratory (using either wood or mixed wood-pork fat), and thirty-four at Cape Espenberg (fueled with driftwood, seal oil and/or caribou bones) to test their differential combustions and record their effects on the firewood spectrum. Our results show that animal fuels influence the duration of fire at flame phase and pyrolysis. The addition of seal oil maximizes fire durations but also increases temperatures by 100°C. Consequently, seal oil seems an ideal fuel for activities requiring high heat or a long charring phase. Animal grease and bones can be deliberately combined in a driftwood fire for activities requiring a quick heat, intense flame phase, or moderate charring. These fuels qualities are beneficial for meeting a wide range of needs.

Keywords: Hearth, Fire, Experimentation, Fuel management, Driftwood, Charcoal, Alaska, Birnirk, Thule

Animal Fats and Ancient Pyro-Technologies: Reading the Residues in Archaeological Hearth Deposits

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Processing and combustion of animal products including bone, fat, and oil for food and fuel can provide a crucial source of calories, heat, and light in cold, fuel-poor environments. Previous studies have shown that remnant lipids from the combustion and processing of animal products preserve exceptionally well in many Arctic sites, and various terrestrial and aquatic lipid sources can be identified through combined molecular and isotopic analyses. Similar analyses could be applied to fire-related sediments from some Middle and Upper Paleolithic sites. However, there are added challenges to the detection and identification of lipid sources in very old deposits and those located in warmer environmental settings. Lipid concentrations in Middle and Upper Paleolithic combustion structures are expected to be much lower than those encountered in more recent Arctic sites. Furthermore, difficulties distinguishing certain more recent lipids from ancient lipids could introduce interpretive errors. Given these concerns, biomarker selection in this study has focused on compounds with greater long-term preservation potential than those typically relied upon in arctic settings. Our research is also focused on specific molecules that can be linked to combustion events. This talk will present data on the molecular and isotopic analysis of black layers from experimental fires as well as data from laboratory heating experiments. Experimental fires were constructed with various combinations of ruminant long-bones, seal oil, and wood. Laboratory heating experiments sought to produce the same biomolecules under more controlled conditions using a variety of animal tissues, temperature programs, and artificial sediments. Analysis of black layers from experimental fires and laboratory heating experiments have identified a suite of biomarkers formed through pyrolysis of animal fats, which are otherwise rare in the environment. Applications to Middle and Paleolithic fire-related sediments may provide a unique line of evidence on resource processing and technological behaviors related to heating, lighting, and food preparation.

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Keywords: Combustion Feature, Hearth, Animal Fat, Bone Burning, Food Processing, Fuel, Biomarkers, CSIA, GC/MS, Paleolithic

Pyrotechnology, Specialized Knowledge, and Feature Architecture at the Upper Paleolithic site of Vale de Óbidos, Portugal

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This presentation demonstrates the profound significance of pyrotechnology to anthropological interpretations at the well-preserved, open-air Upper Paleolithic site of Vale de Óbidos. Hearths, roasting pits, fire-cracked-rock stone-boiling features, and ochre manufacturing activity areas are among the types of thermal features documented during excavation within a "high-resolution" research design. Sedimentology and statistical cluster analysis of associated tools reinforce explanations for the significant variation manifest in thermal technology between activity areas. At the analytical level, distinct thermal features were primary nodes in structured activity area space. Vale de Óbidos yields evidence for sophisticated pyrotechnical techniques during the Upper Paleolithic, probably indicating specialized knowledge or skills possessed by certain group members. For example, goethite-rich sandstone and conglomerate cobbles from deflated pavements of the Sesmarias hillslope were carefully heated in a controlled, oxidizing environment to between 275 and 300 degrees centigrade. This process dehydrated yellow-brown goethite to red hematite, a mineral that microscopic residue analysis of tools from the site assemblage demonstrates was used in the scraping and preparation of hides. Replication experiments provide the foundation for identifying the quartzite and quartz artifacts resulting from rapid thermal shock during stone boiling. The archaeological record at Vale de Óbidos validates thermal feature architecture and fire use as robust sources of information for evaluating anthropological questions of cultural transmission, chaînes opératoire, and the emergence of labor division during the Late Pleistocene.

Keywords: pyrotechnology, specialized knowledge, hearth, fire, cracked, rock, stone boiling, ochre

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Fuliginochronology: a new way of studying fire events chronicles, examples of speleothem deposits as archives.

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The micromorphological study of fireplaces becomes more and more common, but biases exist in the recording of fire events in hearth structures. In this presentation, we will introduce another method for studying fire as an artefact: the *Fuliginochronology*, from Latin *fuliginosus*, *fuligo*: soot, fuliginous, and from Greek *khronologia*: chronology, which consists of studying the succession of soot deposits trapped in a matrix. Here we will only develop the cases of soot trapped in carbonate deposits and more specifically in speleothems. In the particular case of an archaeological site like a rock shelter or a cave, these fuliginous calcite deposits (i.e. stalagmite, parietal crust, flowstones) are a record of past human occupations, which can be enumerated (Vandeveldé et al. 2017a, b; Vandeveldé et Dupuis 2017).

This pioneer method is based on high-resolution observation of soot layers trapped in calcite deposits and of the speleothems themselves, coupled with complementary analyses (characterisation: SEM, Raman, FTIR, μ LIBS). It will be presented through three different temporal context: first, the method will be defined on a long archaeological sequence of Palaeolithic context at Grotte Mandrin site (middle Rhône Valley, France); then it will be validated on modern

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cases (Han-sur-Lesse, Belgium; Arcy-sur-Cure, France; Villars, France; Postojna, Slovenia), and finally, the use of experimental approach at Grotte Mandrin site will help us to address a number of questions about formation of fuliginous speleothems and preservation of soot through the study of present day data. This last part will also allow us to try to overcome limitations of the method in some contexts.

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Keywords: Fuliginochronology, soot, carbonates, speleothems, human occupation

Silcrete heat treatment in South Africa and Australia, a first attempt at comparing two a priori unrelated contexts

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Heat treatment of silcrete, a coarse-grained silica rock, is one of the oldest transformative technologies used to alter the properties of materials. It's first use dates back to the southern African Middle Stone Age (MSA) and several examples are known from Australia. The research questions associated with this finding are related to the purpose of heat treatment for tool manufacture, the investment in time and resources needed for it or the social and cognitive capacities it requires. Intensive research on these questions has been conducted on the African MSA for almost ten years now. Experimentation, in combination with new archaeometric methods, has for the first time allowed to obtain precise data on the techniques and gestures used for heat treatment. Only very recently, the same methods and techniques have been applied to Australian Prehistory. In this presentation I will summarise the Some of the findings resulting from the studies on both continents. These data have important implications for orienting future research on the subject in Australia, providing the possibility for an inter-continental comparison.

Keywords: Heat treatment, Early pyrotechnology, Fire use

*Speaker

Early Mesolithic hearth pits in SE Iberia: a multiscale interdisciplinary approach to clarify formation processes.

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Behaviours and ecology of the last prehistoric hunter-gatherers in Europe have been traditionally addressed through the investigation of archaeological lithic and faunal assemblages. Fire features, a source of potentially key data for the reconstruction of human activities, occupation modes and management of natural resources, have only been explored partially, especially in Early Holocene dune systems of the Iberian Peninsula. In such contexts, hearth pits documented have been described, providing account of morphometrics and contents (e.g. rock fragments, artefacts, charcoal, shells). However, detailed graphic recording, sampling and subsequent laboratory analysis of the sediments and materials that make the bulk of the burnt remnants have received limited attention. The lack of a comprehensive methodological approach together with the scarcity of investigations addressing the sedimentary evidence at a multiscale level of fire features have resulted in a consistent loss of information vital for the characterisation of use of the space, the assessment of the integrity of the archaeological record and the reconstruction of site formation processes.

This communication introduces the preliminary results of the investigations on Early Holocene combustion structures currently conducted within the frame of the project PALEODEM-*Late Glacial and Postglacial Population History and Cultural Transmission in Iberia* (ERC-CoG 2015-ref 683018). Data from a selection of hearth pits documented in El Arenal de la Virgen, an Early Mesolithic (9.3 – 8.6 Kyr) camp site located in continental dunes at the margins of a paleolake in SE Iberia, are presented.

An integrative methodology has been developed for the analysis of the hearth pits and their sedimentary setting based on contextual geoarchaeology, archaeobotany, lithic analysis and 3D photogrammetry.

Results available to date allow us to provide a suite of multiscale interdisciplinary param-

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ters for the understanding of the processes involved in the formation and taphonomy of the early Mesolithic hearth pits investigated and distinguishing them from apparently similar features that are the product of natural dynamics.

Keywords: Hearth pits, Early Mesolithic, Geoarchaeology, Micromorphology, Archaeobotany, 3D photogrammetry, Iberia

A Micro-Contextual Approach to Neandertal use of fire at the site of Pech de l'Azé IV (Dordogne, France)

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Long assumed to be a fundamental technological achievement essential for human adaptation, pyrotechnology is increasingly the subject of Paleolithic research, both in documenting the evidence for fire in sites [e.g. 1] and in developing new methods for analyzing fire residues [2, 3]. Recent studies have shown that the use of fire varied considerably during the Middle Paleolithic (~250–40 ka) of southwest France, with significantly less evidence of fire during colder periods even though it was regularly used during warmer periods [4-9]. These findings suggest that fire did not immediately assume the importance it now has, highlighting the questions of how Neandertals used fire and its role in their overall adaptation. Here we present a new project to re-excavate numerous combustion features contained in Layer 8 (MIS 5c) at Pech de l'Azé IV [10, 11]. Our goal is to understand variability in fire signatures by characterizing combustion zones in terms of their surficial features, and their subsurface attributes, which reflect alterations of sediment and objects within the three-dimensional volume affected by the heat. Employing a micro-contextual approach, the excavations will be performed at a much finer scale than typically done for archaeological deposits of this age and will benefit from the application of several recently developed techniques for analyzing prehistoric fire residues. Our methodology will be based on the removal of individual blocks of sediment (~10 cm thick), with further work carried out under laboratory conditions. Some of these blocks will be resin impregnated and used for micromorphology sampling, while others will be excavated. In addition to proveniencing artifacts, all sediments will be provenienced and collected directly into 5 cl vials, permitting multiple samples to be taken from any particular micro-context. Further analyses will provide data on fire attributes, including temperatures achieved, depth of heat penetration, presence/absence of organic residues, and the type of fuel used. This permits study the sediment itself at the same level of detail as is normally given to artifacts, and will provide a means of more accurately reconstructing the deposit and its components in their original associations.

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Keywords: Fire, Neandertals, Pech de l'Azé IV, Micro, contextual approach

Artifact or advantageous accident? The problem of combustion at the late Early Pleistocene site of Cueva Negra del Estrecho del Río Quípar (Caravaca de la Cruz, Murcia, Spain).

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For: IV-4 Fire as an artefact Abstract: As a physiologist and medical doctor and also a prehistoric archaeologist and palaeoanthropologist I am torn between the "cooking hypothesis" (Wrangham, 2009, 2017) - physiologically attractive from theoretical considerations of human biological evolution, and the lack of enough empirical findings in the Palaeolithic record for its corroboration. On the one hand, "To deny Early to Middle Pleistocene hominins the habitual use of fire... is to ignore the archaeological record of their evolution, behavior, and culture" (Alperson-Afil, 2017), with Geshen Benot Ya'akov from 0.78 Ma in mind here. On the other, uncertainty exists about whether, much later on, even Neanderthals were still only habitual users of fire rather than that their survival depended on it (Dibble et al., 2017; Henry, 2017). Presence of combustion features in late Early Pleistocene sediments at Wonderwerk Cave in South Africa (~1.07-0.99 Ma, containing bifacially-flaked hand-axes: Berna et al., 2012) and Cueva Negra del Estrecho del Río Quípar (between < 0.99 - > 0.78 Ma, containing a bifacially-flaked hand-axe: Walker et al., 2016) imply an ability to tend fire in places affording protection from extinction by wind or rain while protecting a living space from predators. Whilst that need imply no more than opportunistic introduction of glowing brands or embers left outside by a passing bush fire, the high temperature reached of at least 400-600° C (possibly 700-900°) implies presence of fuel (wood, bone) inside Cueva Negra, and hence likely forethought given to habitual preparation for sporadic advantage to be taken of natural events (Walker et al., 2016), even were the site to have been periodically abandoned and used by other creatures (Rhodes et al., 2016). "Domestication" of fire (Alperson-Afil, 2017) at late Early Pleistocene sites neither implies an ability to generate or ignite fire, nor the control of heat required for

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effective cooking, much less obligatory dependence on fire for daily survival. Taken together with even earlier indications in Africa of combustion at Early Pleistocene Palaeolithic sites, its presence at Wonderwerk, Cueva Negra and Gesher Benot Ya'aqov may demonstrate that late Early Pleistocene human behaviour included habitual opportunistic appreciation of fire (cf. Chazan, 2017). (References: Alperson-Afil, 2017, Spatial analysis of fire: archaeological approach to recognizing early fire, *Curr.Anthrop.* 58 Suppl.16, S258-266; Berna et al., 2012, Microstratigraphic evidence of in situ fire in the Acheulean strata of Wonderwerk Cave, Northern Cape province, South Africa, *Proc.Natl.Acad.Sci.USA* 109, 7593–7594; Chazan, 2017, Toward a long prehistory of fire, *Curr.Anthrop.* 58 Suppl. 16, S351-359; Dibble et al., 2017, How did hominins adapt to ice age Europe without fire? *Curr.Anthrop.* 58 Suppl. 16, S278-287; Henry, 2017, Neanderthal cooking and the costs of fire, *Curr.Anthrop.* 58 Suppl.16, S329-336; Rhodes et al., 2016, Fire in the Early Palaeolithic: Evidence of small mammal burning at Cueva Negra del Estrecho del Río Quípar, Murcia, Spain, *J.Archaeol.Sci. Rep.* 9, 427-436; Walker et al., 2016, Combustion at the late Early Pleistocene site of Cueva Negra del Estrecho del Río Quípar [Murcia, Spain], *Antiquity* 90, 571-589; Wrangham, 2009, *Catching fire: how cooking made us human*, Profile Books; Wrangham, 2017, Control of fire in the Paleolithic: evaluating the Cooking Hypothesis, *Curr.Anthrop.*58 Suppl. 16, S303-313).

Keywords: Combustion, Early Pleistocene, opportunistic advantage

Technical innovations and socio-economic behaviours in Upper Solutrean. New data on heat treatment in southwestern France

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The heat treatment of siliceous rocks is an intentional process that alters the mechanical properties of the material. It is now recognized that this process improves at least the knapping ability of siliceous rocks and the sharpness of artefacts. The use of this process during the Solutrean techno-complex is attested from the 1960-70s with the discovery of fragments of heat-treated laurel leaves in the collections of Laugerie Haute and Placard (Bordes 1969, Collins 1974, Inizan et al. 1976). Evidences of intentional heat treatment were later detected in the Solutrean of Iberian facies (Tiffagom 1998,2006).

The Upper Solutrean (23.5-23 ky cal BP) is also characterized by the systematization of another technical process: the pressure retouch technique. These two technological innovations appeared in parallel with the development of a very specific hunting implements. In this context, a heat treatment phase is a significant process. It takes place in otherwise complex operating procedures which are already heavily invested economically and technically, and introduces an additional degree of risk. The management of heat treatment thus oscillates between a benefit of the mechanical properties of the material and a high risk of failure in case of poor process control.

At this time our knowledge of heat treatment remains scattered concerning the heating environment and its place in the solutrean technical system. We want to restart the research work on this issue in order to improve our understanding of the socio-economic organisation upper solutrean groups. It's also necessary to question the sociocultural conditions that allowed the adoption and generalization of these innovations. The abandonment of these technologies in Badegoulian is associated with a probable economic and social restructuring of the nomadic groups.

My previous work has produced initial results and food for thought on lithics systems and heat treatment, as well as on the organisation and social composition of Solutrean groups. My thesis combines techno-economic analyses of lithic industries, macroscopic observations of heat treatment, experiments and physico-chemical analyses. One of the objectives is therefore to carry out a more global work on the heat treatment of siliceous rocks in south-western France at the

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dawn of the Last Glacial Maximum. We intend to present some of the data and results collected so far.

Keywords: Upper Solutrean, Heat Treatment, Silica rocks, Upper Paleolithic – Southwestern Europe, Lithic points, Technical innovations

Heated bone and the importance of fundamental research in the study of Palaeolithic fire use

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Palaeolithic combustion features are usually characterised by the presence of organic and inorganic heat altered materials, such as charred plant material, heated bone, ash, and heated sediment and lithics. As fire is a chemical process, we need to have an understanding of the effect it has on the specific physical and chemical properties of the various residues it leaves behind. When combined with ideas on the related hominin behaviour, e.g. drawing from ethnographic sources, this type of data will provide a powerful tool to reconstruct the use of combustion features in the deep past.

Here I present the results of controlled laboratory-simulated heating of bovine bone, under both reducing and oxidising conditions, covering a broad temperature range (20-900°C). Analyses with a variety of different analytical techniques indicate that ‘charred’ and ‘combusted’ bone follow distinctly different thermal alteration trajectories. This has implications for the way these residues are affected by post-depositional processes, as well as for the suitability of the different analytical techniques. This research takes the first step towards devising a robust toolkit for the reconstruction of past heating conditions, suitable for the analysis of heated bones from various ages and contexts. Additionally, this study illustrates how the field of Palaeolithic fire use can benefit from fundamental research.

Keywords: Palaeolithic, Fire, Heated bone, Charring, Combustion, Experimental archaeology

*Speaker

Fire and Hearth. To what extent can they light Paleolithic ways of life? A synthesis of twenty years experimental research on fuel properties and use.

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Due to its bad conservation, there is still limited understanding of how the wood was used by palaeolithic societies. Unlike wood, charcoal is usually well preserved in prehistoric occupations. As witnesses of the activity of human communities exploiting woody taxa from nearby catchments, charcoal is useful for studying the local environment. But even if it is less documented, charcoal remains would also be relevant to address the way past societies managed the fire and surrounded activities. As part of several "systèmes techniques", the management of vegetal resources as fuel provide unreachable information on cultural traits. However, most of the time, we fail in understanding the function of Paleolithic hearths because of the bad conservation of the structures themselves, the scarcity of fuel residue remains, but also due to too actualistic and restrictive knowledge of wood properties. In this paper, we present unpublished results on fuel properties based on experimental studies. In the light of these results, also supported by some archeological examples (e.g. La Combette, Les Canalettes, Chauvet-Pont d’Arc cave, Ormesson, Regismont), we discuss the way hunter-gatherer’s societies have managed the firewood, the criteria that could have guided the fuel selection, and the way to objectify the function of hearths in Paleolithic context.

Keywords: Paleolithic, experimentation, fuel, fire

*Speaker

Function and duration of 11 fireplaces in two ethno-archaeological sites of Tierra de Fuego (Argentina): Integrating chemical and intra-site analysis in Hunter-Fisher-Gatherer contexts

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We present the results of an ethnoarchaeological experimentation approach regarding to the chemical analysis of eleven fireplaces of two ethno-archaeological sites located in the northern coast of the Beagle Channel (Isla Grande of Tierra del Fuego, Argentina) and dating back to the 18-19th centuries. Both sites were excavated between 1989 and 2005 in the framework of several Spanish-Argentine projects with the main objective of testing archaeological methodology. Archaeological work allowed to identify in both cases a ring-shaped shell midden resulting of the daily accumulation of food remains around a central hut.

In the central area of Túnel VII, one of the sites, a sequence of overlapping fireplaces made directly on the ground and separated by fine layers of sediment, corresponding to abandonment periods, allowed to identify even ten discrete re-occupations in different seasons of the year. During these occupations different activities have been carried out and the resources have been exploited with different emphases. The other site, Lanashuaia, is located 60 km east of Túnel VII and both have similar characteristics. However, in Lanashuaia only one or two different occupation periods of probably longer duration have been registered, and the intensive exploitation of a whale is documented.

The ethnographic information and excellent preservation of the remains in both sites have provided an opportunity to carry out a meaningful reconstruction of the history of each fireplace –i.e. mode of functioning, function, duration of use–, based on the study of their formation processes, the examination of preserved organic content and their association with the spatial distribution of burnt remains resulting from the exploitation of animal and vegetal resources, and from cleaning activities. Thus we can see the divergences between the two different types of record and discuss the practical problems that arise in the interpretation of the chemical analyses of sediments of archaeological combustion features in Hunter-Fisher-Gatherer contexts.

Keywords: Archaeochemistry, Ethnoarchaeology, Hunter Gatherers, Fireplaces, Tierra del Fuego

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Fire Use during the Early Upper Paleolithic: Complex Behaviors Highlighted by Fuels Management and Layout Variability.

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Most studies regarding the Paleolithic use of fire in France have focused on its earliest traces, its mastery by Neanderthals, and its structures in Late Pleistocene open-air sites. Pyrotechnology nevertheless has apparently been fully integrated into human technical baggage at least since the beginning of the Upper Paleolithic, making it all the more striking that for earlier phases of this period this subject remains relatively unexplored. It would be fair to say all the same that the archaeological evidence for fire in this context is scarce, with many instances having been excavated early following nowadays questionable methodologies, ultimately inhibiting their comparison with recent studies beyond simple morphological descriptions.

Using examples from two recently excavated open-air sites, we provide insights on several elaborate fire-features. The first set of data comes from the Aurignacian campsite of Régismont-le-Haut (Poilhes, Southern France) and consists of a sample of its 30 recognized fire-related structures. Les Bossats (Ormesson, Paris region) comprises several layers, from the Middle Paleolithic to post-LGM phases of the Upper Paleolithic, yet here we will focus on the the Gravettian locus. By means of a multiscale approach involving field observations, laboratory analysis (micromorphology and organic geochemistry) and comparisons with an experimental dataset, we will address fuel management, structures morphology and layout, and functional questions. In particular, the use of bone as fuel is shown to be a regular practice, used in addition to wood, and these two combustion elements are managed in differential yet complimentary ways. Several examples from domestic spaces within both sites shed light on complex structures formed by the merging of several fireplaces and their related maintenance features.

The discussion of these results in regard to other cases, such as Abri Pataud, advocates for a thorough re-examination of the pyrotechnology during the Early Upper Paleolithic. The question here is not whether *Homo sapiens* had mastered fire, but rather the economic and functional underpinnings of human behavior in regards to fire, and what this can tell us about prehistoric cultural systems.

Keywords: Early Upper Paleolithic, Fireplaces, Micromorphology, Organic Geochemistry, Open air Site

*Speaker

Redefining Hearths

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Archaeologists are often required to define artifacts or features recovered from archaeological contexts. Hearths, however, are features of all contemporary hunter-gatherer societies, and when found in such contexts they exhibit high variability of construction methods, size, morphology, intensity, and functions. The lack of a clear archaeological definition of a hearth appears to result from their universal contemporary occurrence, as well as from their apparent variability. Ethnographic data emphasize the notion that a hearth is not necessarily a built (e.g. stone-lined) feature, and underline their high degree of variability.

In his "Dictionnaire de la Préhistoire" Leroi-Gourhan (1988) suggested that a hearth should exhibit discoloration (dark sediments) and charcoal will be preserved. Other definitions in the archaeological literature similarly depends on the state of preservation and suggest discoloration of sediments, presence of charcoal, and a round or oval-shape.

The available definitions however, appear to suit the definition of a "well-preserved hearth" better than that of a "hearth". Ethnoarchaeological studies demonstrated that the preservation of combustion features, particularly in open-air sites, depends on a variety of factors (e.g. fuel used, soil moisture, rates of sedimentation, chemical variations in sediments) and requires favorable depositional and post-depositional conditions in order to be preserved in the archaeological record. In summary, it is evident that hearths vary in terms of sedimentological setting, intensity, size, fuel used, structure, and function. These variables will eventually dictate the archaeological appearance of these features, i.e., whether hearths will exhibit a stone lining, whether ash and/or charcoal will be preserved, or whether discoloration of the sediments will occur. Consequently, as in the ethnographic record, the archaeological occurrences of hearths are extremely variable and uneven, and hearths are independently defined for each site. It seems that the only common feature of all hearths is the simple fact that people intentionally burn fuel in order to produce a fire.

As the archaeological appearance of hearths is variable in color, size, contour, depth, and the use of stones for construction, it is difficult to generate an archaeological definition that suits these features. However, since hearths serve as focal points for activities, they display areas of refuse accumulation, specifically small refuse. Accordingly, an archaeological definition of a hearth will specify that a hearth is a combustion area, variable in structure, size, and depth, which preserves the remains of burned materials. Such hearths are frequently preserved as *phantom hearths* that lack observable traits or features (e.g. structuring, discoloration of sediments, ash, charcoal), but can and should be discernible through observable patterns of artifacts' spatial distributions.

*Speaker

Keywords: hearth, archaeology

Introducing "fiReproxies": Computer simulation-based tool for gaining a better understanding of archaeological fire proxy evidence

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The presence of fire proxy data within an archaeological layer, usually in the form of heated lithic debris or charred or combusted bone fragments, is often cited as evidence for on-site burning in the past. In instances where these data are tallied, the determined quantities are often used by archaeologists to infer the relative amount of fire used, generally boiling down to higher percentages indicating fire was used often and lower percentages suggesting fire was used only rarely. Despite the logical nature of this conclusion, how much can we truly say about the prevalence of fire use on a site based on these values? The number of variables that factor into the production and preservation of fire residues and proxies is extensive. These include (among others) site occupation frequency, fire size and intensity, lithic production rate, sedimentation rate and site surface area, to name a few. In isolation, the effects that some of these parameters will have on the generation of fire proxies may appear largely intuitive. However, the cumulative effects of these variables on the final percentage of heated lithics within a layer is more difficult to grasp, as is the relative effect of any one variable within the system as a whole. We address this problem by simulating the effects of some of these variables using our R-based model entitled "fiReproxies". Our model adds quantitative values to these effects, thereby producing tangible results that can be compared with extant archaeological fire proxy data. If palaeoenvironmental, depositional or behavioural conditions can be surmised from excavated materials, these can serve as guides for users to estimate the values set for the various parameters currently incorporated into our model in their simulations. If the simulated results align well with known fire proxy quantities, then our interpretations of these conditions could be considered sound. Conversely, if the simulated percentages of fire proxies differ greatly from those calculated from the archaeological material, then researchers can ponder why this disparity exists and begin to parse out what unaccounted for variables could justify this discrepancy. Using the Middle Palaeolithic of western Europe as a backdrop, we demonstrate the utility of our model by applying it to a hypothetical Neandertal cave site. We also briefly discuss a few archaeological instances where our model could be helpful in gaining a deeper understanding of the processes influencing fire proxy signals at Palaeolithic sites. It is our hope that the fiReproxies model could be used in tangent with other analytical methods to gain a better understanding of how prevalent fire use was in the past and under what conditions it was used.

*Speaker

Keywords: fire, fire proxies, computer simulation, heated lithics, hearths, Palaeolithic archaeology, Middle Palaeolithic, Neanderthals, thermal buffering, site formation processes

Foyer, aire de rejet ou accumulation taphonomique ? Analyse d'une possible structure de combustion du Paléolithique moyen de Mutzig " Rain " (Alsace, France)

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Fouillé depuis 2009, l'abri sous roche de Mutzig " Rain " a livré au moins 7 niveaux archéologiques du Paléolithique moyen datés du Stade Isotopique Marin 5, ce qui en fait un site exceptionnel pour la région alsacienne (Koehler et al., 2016). Le gisement est également remarquable par les nombreux témoins de combustion découverts : charbons, os et pierres brûlés, sédiments thermo-altérés. Ces vestiges de combustion se retrouvent de façon plus ou moins diffuse dans différents niveaux. Dans la couche 7C1, une zone ovale bien délimitée d'environ 4 m² comprend une forte concentration d'ossements brûlés. Par comparaison à d'autres secteurs, la zone n'a en revanche pas livré une quantité importante de charbons. L'objectif de l'étude est d'investiguer la nature de cette zone : s'agit-il d'un foyer (combustion sur place), d'une aire de rejet (dépôt secondaire anthropique de restes de combustion) ou d'une accumulation naturelle de vestiges brûlés provoquée par des phénomènes post-dépositionnels ? La démarche s'appuie sur l'analyse des restes fauniques thermo-altérés (degrés et types d'altérations colorimétriques, altérations morphologiques, taux de fragmentation, histologie) ainsi que sur l'étude des vestiges lithiques brûlés qui y sont associés. Les sédiments sous-jacents sont également analysés afin de tenter de déterminer si la combustion a eu lieu *in situ*. Le recoupement des indices fournis par l'analyse de ces différentes catégories de vestiges permet d'évaluer les différentes hypothèses et de proposer une interprétation.

Keywords: Paléolithique moyen, structure de combustion, os brûlés

*Speaker

Fire on the Steppe: Behavioral Insights from Ephemeral Combustion Features

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The Ikh-Tulberiin-Gol has yielded a cluster of Upper Paleolithic sites investigated by international teams for the last two decades. Although archeological combustion features have been frequently reported, only a few have been analyzed in detail. Preliminary results of geoarcheological investigations led to the following observations. First, natural fire is a common phenomenon in the region during the Pleistocene especially under arid conditions. Second, combustion features are mostly associated with archeological assemblages. Third, burned bones and charcoal are extremely rare probably due to a preservation bias in the loess sediment matrix. So far, numerous questions remain regarding the nature of the fire, the type of fuel in use and the intensity of the combustion. In 2017, the newly excavated site from Tolbor-17 has yielded a significant amount of burnt material associated with an Upper Paleolithic assemblage. This exceptional situation provides a first opportunity for the study of fire use and maintenance at this open air locality. Here we present the results of an analysis of the spatial distribution and the Fourier-transform infra-red spectroscopy (FTIR) of large (> 2cm) and small (< 2cm) fraction of burned bones. Then we discuss behavioral implications and the potential of the method for analyzing fire ‘ghost features’ in open-air contexts.

Keywords: Fire, Bones, Combustion Feature, FTIR, Upper Paleolithic

*Speaker

NEW INVESTIGATIONS OF FIRE RELATED INTERGLACIAL SEDIMENTS (MIS11) AT BEECHES PIT

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We present details of a new project investigating burnt sediments at Beeches Pit in conjunction with new palaeoenvironmental and geoarchaeological analyses of related depositional environments, using a range of geological and geophysical proxies. Along with four other blocks, all of which appear to contain evidence of burning, a one ton mega-sample was extracted from the site in 1994 and transported back to the University of Liverpool, contextualising the largest combustion feature. Pilot work has so far been conducted on this largest block using sedimentary facies analysis and a suite of geomagnetic parameters and interparametric ratios including magnetic susceptibility and anhysteretic remanent magnetisation. The sequence shows an evolution from a small water body depositing clays to sandy sediments indicating a connection to more widespread river drainages. The fire-affected sediments are related to a hiatus within the sandy unit. The magnetic susceptibility results along with the ratios of χ_{ARM}/χ_{FD} and χ_{ARM}/χ_{LF} can be used to show unequivocal evidence of fire at Beeches Pit and accord with previous interpretations at this site of multiple hearths. The magnetic results are further supported by the identification of micro-charcoal within the < 125 μm fraction from one of the burned samples. Work will continue on all the hearths and surrounding sediments to provide a fuller picture of the burned areas and their depositional settings at Beeches Pit.

Keywords: fire, palaeolithic, environmental magnetism, Beeches Pit

*Speaker

The thermal alterations of Bruniquel Cave's speleofacts: experimental and archaeometric approach

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In archaeological context, heating marks on materials around the fireplace, like wall, supports and cladding still generate many questions. Here, a study on calcite and limestone response to heating, and more specifically on speleothems' calcite, is applied to the understanding of the heated or combustion areas of the Bruniquel Cave's structures. It is based on hearths experimentations and laboratory test in furnace. These experimentations allowed to reproduce the thermal alterations visible on Bruniquel's speleofacts and to propose an estimation of the corresponding temperatures. Moreover, the ability of some fuels (wood and bone) to induce these thermal alterations has been tested. It allows to discuss the minimal fuel quantity required for their reproduction. Finally, many observations on the thermal impacts visible on the experimental hearths' ground, as well as the black deposit presence, identified as a char different than soot, allowed to build relations with the type of fuel used. These results could be used to argue about the question of the heated areas' function in the Bruniquel Cave.

Keywords: Experimentation, hearths, fuels, speleothems, thermal alterations, Neandertal, Bruniquel Cave.

*Speaker

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The Zooarchaeology of Fire: Contextual Taphonomy in Levantine Epipaleolithic Camps

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Two of the most notable types of remains in the Paleolithic record are combustion features and faunal remains. The link between them is usually investigated by vertebrate taphonomy methods, which include identifying thermal alteration on the bones and investigating the processes that caused these alterations. This can be done by checking the differential patterns of bone burning across taxa or body parts, or within skeletal elements. Archaeofaunal remains in the context of a Paleolithic camp may exhibit burning because of nutritional activities, e.g., cooking and roasting, because of other intentional actions such as camp maintenance, use as fuel or bone tool manufacture, and finally bone burning may be due to accidental charring. I argue that contextual taphonomy, i.e., the integration of the taphonomic attributes of the faunal assemblage with the contextual and stratigraphic data, has the potential to improve our understanding of identifying these processes. This is demonstrated by case studies from the Epipaleolithic Period of Mount Carmel (Israel), where faunal-based insights from contextual taphonomy offer an additional line of evidence for human use of fire. A series of inter- and intra-site comparisons between domestic and mortuary contexts and between different camp areas showed that these terminal Pleistocene hunter-gatherers used fire for roasting but also accidentally burned pre-existing refuse; they haphazardly maintained their hearths, which were located immediately at the probable living areas. It appears that bone burning in the Levantine Epipaleolithic (and earlier) is primarily a product of non-intentional burning of preexisting refuse and as such, it constitutes an important marker for site-occupation intensity.

Keywords: Zooarchaeology, Contextual Taphonomy, Fire, Epipaleolithic, Levant

*Speaker

Fire use in the operational chain of prehistoric wooden tools

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As is known, artifacts made from wood are very rarely encountered in Prehistoric deposits due to the low durability of this material. Emergency excavations in the spring of 2012, at Poggetti Vecchi, central Italy, brought to light an open-air, stratified Paleolithic site which was around 160 m² wide in total. The finds are radiometrically dated to the late middle Pleistocene. Hence, the site is particularly attractive, not only because it offers snapshots of the local environment at a time when early Neanderthals occupied the area but also for the recovering of wooden tools. Poggetti Vecchi's Unit 2 is to date the only late middle Pleistocene (MIS 7/6 transition) site in Europe that yielded remains of seven individuals of *Paleoloxodon antiquus* not accumulated by natural agents, associated with stone and boxwood implements.

The presence of a burnt film on some of the artifacts has led us to conjecture that, in addition to stone tools, fire was also used in the manufacture of the sticks, as documented in ethnography and hypothesized for prehistoric digging sticks. The experimental study was carried out to reconstruct the operational chain of this kind of tool. This study demonstrate that the use of fire was functional to the process of manufacture of the sticks featuring this morphology. The working of a very hard wood like *Buxus* is painstaking and requires a complicate operational chain, from the selection of the particular wood to its working employing stone tools and fire, with an important investment of time and effort.

Keywords: late middle Pleistocene, wooden stick

*Speaker

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IV-5. Earthen construction technology

A micromorphological approach for the study of earthen mound construction in southwestern Amazonia

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Here we present the first geoarchaeological study of one of the largest geoglyph sites in the southwest of the Brazilian Amazon: the Sol de Campinas do Acre site (SCA), located near the border with Bolivia. Considered by the National Register of Archaeological Sites as a circular geoglyph, it is currently made of 15 mounds with an average height of 3 meters. The mounds are arranged elliptically around a central plaza covering approximately 15.000 m². Radiocarbon datings showed that SCA was built after most geoglyph sites in the region. Specifically Mound 11, studied in this work, revealed a succession of occupation events between the 11th and 17th centuries.

Geoglyph is a general and popular denomination for the series of archaeological structures identified in the Amazonian southwest. Recently the term is being used for sites made of ditches or embankments, differing from earthen mound type constructions. This is due to the perception that, even when relating spatially, there are substantial differences between earthen mounds and other types of earthworks, such as chronologies, sizes and construction techniques.

Earthen mounds complexes have been widely known in the Amazon since ancient times because of their conspicuousness in the landscape (often interpreted as evidence of monumentality). Despite the quantity, extent, and diversity of forms that earthen mounds can adopt, little is known about their use in the communities responsible for their construction. Recent research in the southwest Amazon conceives earth engineering as a dynamic, enduring cultural practice that transformed the landscape and established regional communication networks. Although widely known, there are still few geoarchaeological studies on the Amazonian earthen mounds seeking to understand the formation processes of the structures from the study of its main component: sediments.

This work presents the preliminary results of the micromorphological study of Mound 11 at SCA. Analyses have indicated a clear intentionality in the choice for construction material. The lower layers of Mound 11 were engineered using the A horizon of the surrounding soil adding allochthonous material, such as nodules of iron oxide and / or manganese, possibly to offer more resistance to the structure. Micromorphology has the potential to reveal hidden aspects in the formation of earthworks and to offer complementary data for the interpretation of site use and function.

*Speaker

Keywords: micromorphology, earthen mounds, Amazon

Bronze Age earthen architecture in Crete: a case for craft specialisation?

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Mudbricks represent one of the most widespread building materials in the world and as both artefacts and ecofacts are a rich source of information for archaeological investigation. In Bronze Age Crete mudbricks have not been investigated until recently due to taphonomic bias, thus recent geoarchaeological analysis has opened a new research direction to better understand the relationship between human and natural environment.

This paper presents a multidisciplinary methodology combining architectural analysis, geoarchaeology and ethnoarchaeology to assess forms of raw source material procurement, technological development, and craft specialisation in relation to Minoan earthen architecture. The combination of multidisciplinary datasets introduces new types of records to determine processes of standardisation, specialisation and labour organisation in earthen architecture. The geoarchaeological analysis focuses on raw source procurements and temper performance in earthen architecture, while ethnoarchaeological and architectural records investigate the *chaîne opératoire* behind Minoan mudbrick production and construction, analysing diachronic and synchronic changes.

This research determines that modification in earthen architectural practices over time, both within a single site and across the island, are indication of wider transformation patterns in manufacturing practices and are largely determined by skill transfer and ongoing specialisation in the architecture of Bronze Age Crete. The results focus on multiple case studies from Bronze Age Crete and offer fresh insight into a new methodological approach to investigate earthen architecture.

Keywords: earthen architecture, geoarchaeology, Bronze Age, mudbricks, Minoan

*Speaker

Comparing floor constructions from the epicenter and the periphery of Teotihuacan: A microcontextual investigation

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This poster presents microcontextual analysis of floor constructions from Teotihuacan, Mexico. Our research investigates craftsmanship, domestic and political life and the relation of these to processes of urbanization, administration, and governance. To this aim our geoarchaeological study focusses on the reconstruction of building techniques of floors, their use and maintenance as well as variation in different contexts. We employ micromorphology coupled with Fourier-transform infrared spectroscopy on the constructed floors. Our materials come from excavations of the *Proyecto Arqueológico Tlajinga, Teotihuacan* in 2013 and 2014 as well as from excavations of the *Proyecto Plaza de las Columnas* in 2017. These excavations uncovered domestic households and an obsidian workshop at *Tlajinga*, located in the periphery of Teotihuacan, as well as palatial structures and elite residential units at the *Plaza de las Columnas*, in the epicenter of the city. Our preliminary analyses show variations between these two broad contexts, the epicenter and the periphery, as well as within each of these contexts. Floors at *Tlajinga* are mainly simple stamped earth floors and more rarely crushed *tepetate* floors. Little microscopic remains could be observed on the surface of the floors; they appear to have been regularly swept. At *Plaza de las Columnas* building techniques are more elaborate. We observed a predominance of crushed *tepetate* floors, of variable thickness and sorting, in outdoor areas. Plastering of floors also occurred. Indoor floor constructions in elite residential and administrative buildings are typically composed of a subfloor of crushed *tepetate* followed by a concrete layer, topped with a lime plaster layer, which is often colored with red pigment. We also observed replastering in one instance. These preliminary analysis illustrate the great potential of microcontextual analysis of construction materials to reconstruct domestic life and status variability at Teotihuacan.

Keywords: Teotihuacan, Floor constructions, Micromorphology, FTIR

*Speaker

Conditions climatiques et choix techniques dans la construction en terre : l'exemple du site de Dikili Tash au Néolithique récent I et II (Macédoine orientale, Grèce du Nord)

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Les fouilles des sites néolithiques en Grèce du Nord et au Sud des Balkans ont montré depuis longtemps l'utilisation de la terre comme matériau privilégié pour la construction et l'aménagement des maisons. L'étude des vestiges architecturaux menée depuis une vingtaine d'années sur deux secteurs du tell de Dikili Tash en Macédoine orientale grecque met en évidence les choix techniques des Hommes préhistoriques durant le Néolithique récent I et II, selon la terminologie égéenne dominante (ca. 5000-4250 av. J.-C.). L'influence des conditions climatiques dans ces choix techniques apparaît dès la conception de la maison, et se retrouve ensuite dans sa réalisation et son entretien.

En effet, le climat conditionne les ressources naturelles ou cultivées à la disposition des habitants. Ainsi, sur le site de Dikili Tash, la présence de dégraissants végétaux dans la " terre à bâtir " met en évidence l'intégration des techniques de construction dans la gestion des récoltes de céréales. De même, l'utilisation privilégiée de la technique du torchis sur armature en poteaux jointifs pour la construction des murs, suppose des ressources en matière première arbustive abondantes à proximité du site, ce que les études paléoenvironnementales ont confirmé. Les conditions climatiques et environnementales dont dépendent la nature et l'abondance des ressources forestières et végétales influent donc probablement sur les choix des matières premières et des techniques des constructeurs.

L'architecture en terre requiert un entretien régulier qui est toutefois différent en fonction des conditions climatiques auxquelles elle est exposée. À Dikili Tash, les variations d'humidité et l'action de l'eau provoquent l'érosion, voire la destruction partielle, des constructions en terre. Les stigmates et les techniques de réparation visibles sur le matériel en sont des indicateurs. En outre, l'étude des vestiges architecturaux a montré que certaines techniques ont aussi été choisies pour isoler (fondation de structures de combustion, par exemple) et protéger les parties les plus fragiles de la construction (revêtements d'enduit des murs).

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Keywords: architecture en terre, architecture en bois, Néolithique, Grèce, Dikili Tash

Conservation and restoration of mud brick structures at the temple of Millions of Years of Thutmosis III in Luxor

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Since 2008 a multidisciplinary Spanish-Egyptian project has been carried out in the temple of Millions of Years of Thutmosis III, in Luxor-Egypt

A large part of the architectural structures of the temple were made with mud bricks, among which stand out: the Pylon, the enclosure wall, floors of the courtyards, the storage areas, the houses of the priests and the foundations. This circumstance gives a prominent role to the restoration processes of the above-mentioned areas.

In order to conserve and exhibit this type of structures, we created a protective layer with the same recycled materials from the excavation itself, using the same construction techniques as the ancient Egyptians.

Many mud bricks with interesting marks are allowing a study on various construction stages, techniques and organization of the builders of this temple. Some of these elements will be presented at this congress.

Keywords: mud brick structures, temple of Millions of Years, conservation

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Early Bronze Age domestic architecture at Arslantepe (Malatya, Turkey): technological procedures and social requirements.

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In recent years, the important role played by the principles and practice of construction in Protohistoric societies has gained increasing attention. Considering the built landscape as the way humans have been organizing and shaping the space, an ongoing interdisciplinary research on earthen domestic architecture at Arslantepe-Malatya (Turkey) is pointing out changes and continuity in building materials and construction techniques as a mirror for changes and continuity in social organisation.

The extensive excavation conducted in Arslantepe without interruption since 1961 made it possible to examine the evolution over time of entire settlements through their construction-evolution-abandonment-destruction cycle. Hence, the rich database that the archaeologists have at their disposal acts as a pivot in the interpretation of each single building. The interdisciplinary method in recovering data is based upon different points of view and theoretical approaches, using also disciplines other than archaeology, like architecture, ethnoarchaeology and archaeometry.

The main goal of this research work is to better understand the economic and social structure of the Early Bronze Age communities living in Arslantepe at the turn of the second quarter of the third millennium, when some abrupt transitions occurred in the development of the society as well as in the site external relations. This paper presents the preliminary results of a) the characterization of mudbricks physical and mineralogical properties; b) the functional analysis of the organization and use of space; c) the investigation on technological procedures and architectural know-how, and d) the definition of the settlement planning and layout. By making the building material talk, the technological analysis of archaeological data is providing more and more valuable information on the practice of construction of ancient societies.

Keywords: earthen architecture, technology, building material, construction technique.

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Earthen Architectural Diversity at an Early Village in the U.S. Southwest

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Early Pueblo villagers in the Southwestern United States used a variety of earthen construction techniques. These techniques incorporated stone, wood, and other plant material in various ways to modify and strengthen the adobe matrix. The specific construction technology varies with structure function, with different techniques used for surface habitations, storage rooms, residential pit houses, and large, communal pit structures. But techniques vary within structure types as well, and this variation likely reflects the fact that early villages formed through the aggregation of numerous small social groups with diverse origins and local traditions. We explore the variation in earthen architecture at one early Pueblo village, Alkali Ridge Site 13, which dates to the late A.D. 700s and is one of the largest and most extensively excavated Pueblo I villages in the Southwestern United States. Excavations in the 1930s uncovered 118 storage rooms, 11 pit houses, and 25 surface habitation rooms that display a wide range of architectural diversity. Additional excavations in 2012 and 2013 have helped clarify construction characteristics and recover architectural material not collected in previous excavations. In this paper we present detailed analysis of the recently recovered materials, including adobe fragments that retain evidence of construction techniques, posts and roof beams, and field observation of construction sequences and structure design. This allows us to document the technology used to create the earthen architecture at Site 13 and how construction techniques vary across the site. We then place our findings within the social framework of multi-group community architecture.

Keywords: Earthen Architecture, U.S. Southwest

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Earthen Mounds and Political Centers: The Rise and Fall of the Izapa Kingdom, Chiapas, Mexico

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Mesoamerica is one of the cradles of civilization where the early kingdoms and states emerged during the latter part of the first millennium BCE. Recently collected lidar (light detection and ranging) and archaeological survey data document for the first time the entire kingdom of Izapa, on Mexico's southern Pacific coast. Settlement work shows the movement of population to the piedmont around the Izapa capital (from the coastal plain) occurred as the kingdom coalesced at 700 BCE. Recent research further documents forty previously unknown urban centers that comprise the kingdom. Each of these newly discovered sites was formed by numerous monumental earthen mounds creating plaza groups at each site's center that were surrounded by smaller residential mounds. All centers were built according to the same design principles and together formed a four-tiered administrative hierarchy that established internal cohesion within the kingdom until it collapsed after 100 BCE. Large secondary centers defined the kingdom's perimeter and maintained external sovereignty from neighboring kingdoms. This study exemplifies the transformative capability of lidar technology for documenting earthen mound in tropical environments. The largest of a network of early kingdoms on the Pacific coast of southern Mesoamerica, the Izapa polity provides insight to the origins of urban life and hierarchical political relations.

Keywords: Mesoamerica, lidar, Mexico, political organization, earthen mounds

*Speaker

Earthen large-scale buildings in Teotihuacan, Mexico

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Large ancient urban settlements offer a research framework to understand human-environmental interactions that can be explored through architecture. The Mesoamerican city of Teotihuacan, c. A.D. 0-650, is characterized by a designed grid plan dominated by long-term projects as the Moon Pyramid and the Sun Pyramid. In that sense, monumental platforms of Teotihuacan's civic-ceremonial centre can be an effective way to approach to sustainability.

During the Early Tlamimilolpa phase (A.D. 200-250), the two mentioned pyramids arose in to their monumental form. Despite a large portion of Teotihuacan architectural corpus was made from stone, Building 4 of the Moon Pyramid and the Sun Pyramid were built with fills of earthen mixes and covered with stone and stucco facades. Construction technology of earthen large-scale buildings have had little interest, just few data and observations have been published. As well, the analysis carried out to earth as a raw material are scarce and mainly link to paleoenvironment due to the presence of the Black San Pablo Paleosoil and some botanical remains in the fills' matrix.

In this context, the paper will review published data of technological aspects of the Moon Pyramid and the Sun Pyramid, and of the paleoenvironment studies in order to make visible earthen monumental buildings. Moreover, it will discuss similarities and differences in construction process and implications connected with the selection of this raw material. The purpose of that paper is debate about how earthen large-scale constructions can reveal data of Teotihuacan's sustainability, of impact to the local environment and inner landscape, and of interactions with the regional area.

Keywords: architecture, Mesoamerica, sustainability

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L'architecture de terre sur les sites archéologiques. Principes de durabilité vs circonstances et processus de dégradation.

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La présence de ” terre à bâtir ” : terre employée comme matériau de construction, tel que l’a défini Olivier Aurenche dans le dictionnaire illustré multilingue de l’architecture du Proche-Orient ancien (Aurenche 1977 : 167-168 ; Aurenche et al. 2011 : 13-34), est attestée sur les sites archéologiques depuis au moins onze millénaires. Depuis leur émergence jusqu’aux périodes contemporaines, les cultures constructives associées au matériau terre, n’ont cessé de s’enrichir et de se diffuser dans le monde. Les quatre principaux modes de mise en œuvre que sont le torchis, la bauge, la brique et le pisé se sont déclinées en de multiples variantes dont une classification nous est proposée par le laboratoire CRAterre (Houben et Guillaud 1989 ; Fontaine et Anger 2011).

Avec une telle continuité chronologique et une diffusion des techniques sur tous les continents, les sites archéologiques présentant de la terre à bâtir comme matériau de construction des murs, des sols ou des toitures, sont innombrables. Certains sites pré / protohistoriques, encore remarquablement conservés, apportent la démonstration que la construction en terre peut être parfaitement durable dans certaines conditions. Mais dans de nombreux cas, avec le départ des occupants qui en assuraient la maintenance, des processus de dégradation se sont enclenchés qui ont progressivement entraîné leur ruine et parfois même leur disparition quasi-totale (Joffroy 1999).

À travers plusieurs exemples de sites monumentaux orientaux construits en briques crue et désormais inscrits sur la Liste du patrimoine mondial de l’UNESCO, cette communication vise à mettre en évidence des principes de durabilité et d’adaptabilité aux changements climatiques des architectures de terre en contexte archéologique, tout en soulignant les circonstances et processus de dégradation qui les menacent. Nous aborderons également la question des enjeux liés à la conservation et la mise en valeur de ces sites au regard des attentes actuelles en termes de patrimonialisation des sites archéologiques en terre et de valorisation de ce matériau pour la construction contemporaine.

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Keywords: architecture de terre, culture constructive, patrimoine mondial, archéologie, conservation

Les Modèles Numériques de Terrain pour l'identifier des sites archéologiques et détecter des effets environnementaux : Le cas d'El Marquesillo, Veracruz, Mexique.

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La plupart des sites archéologiques du Centre Sud et sud de Veracruz, México, ont été construits en terre tassée ce qui les rend plus fragiles aux effets du climat de mousson tropical, en comparaison avec ceux construits en pierre. Malgré un grand nombre de bâtiments monumentaux de sites archéologiques qui sont conservés jusqu'à aujourd'hui, beaucoup d'autres ont été endommagés ou ont disparu à cause de l'action humaine et des conditions environnementales.

Dans le cas du site d'El Marquesillo, fondé sur la berge de la rivière San Juan, plusieurs bâtiments monumentaux en terre qui datent du Préclassique (1200-400 av. J.C.) et Classique récent (600-900 ap. J.C.), ont été détruits par les crues. Cependant, à partir des Modèles Numériques de Terrain (MNT), il est possible de reconnaître les modifications provoquées par les inondations et de déterminer le degré de destruction des constructions.

Pour avoir les meilleurs résultats, il est nécessaire de développer le Modèle à partir de cartes topographiques de haute résolution, des données archéologiques de surface du site, et des informations historiques qui documentent les modifications du terrain par l'activité humaine et les intempéries.

Keywords: Archéologie, Modèles Numériques de Terrain, architecture de la terre tassée

*Speaker

New perspectives on the impact of climate change in the Huastec cultural development.

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The region known as Huasteca, is in Northeast Mexico, occupies an area larger than 25,000 square kilometers, and its more accepted limits are: to the North, the Guayalejo - Tamesí river, the Tuxpan river to the South, to the East defined by the Gulf of Mexico and, to the West by the Sierra Madre Oriental.

Recent archaeological studies, show that not a single cultural tradition existed through time, by contrast, we found that there were different cultural manifestations that cannot be assign, as it was believed, to a single ethnic group which progressed throughout the pre-Hispanic development of this region.

In this presentation, we limit ourselves to discuss the events that occurred between the 9th and the 13th centuries, probably due to a climatic variation, and mainly the data obtained in the Tamuín area, in the State of San Luis Potosi, where we found a sudden transformation in the methods of building, as in other archaeological artifacts. We can see these changes in the type of mound construction as in the planning of the settlements, since certain spaces were created in large bases with the same techniques and patterns employed - hundreds of kilometers to the Northeast – by the Mississippian cultures.

For this reason, we conclude that the Huasteca, during these centuries, relates to other cultures, some coming from the Mayan Area and some that evolved in the "Southeast" of the United States; in addition, throughout its history - as we already mentioned - it was populated by diverse cultures. Therefore, we consider essential to study the Huasteca from this point of view, contrary to the traditional canons of its development, which only created confusion.

Keywords: Huastec, mounds, earthen, constructions, Mesoamerica, Mississippi

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Origin of the Mesoamerican earthen architecture traditions

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In contrast with South and North America, earthen architecture in Mesoamerica is rarely studied, eclipsed by the magnificence of Central Mexican and Maya stone constructions. Yet the oldest public buildings, including palatial residences, ball-courts, altars, and pyramids, are made of earth and found distributed along the humid tropical lowlands of Central America and Mexico (Isthmus and Gulf coast), in adverse climatic conditions for such architecture. They arise relatively late, in the second millennium BC, but in a context of rapidly increasing social complexity, driven by intense regional networking and probably long-distance cultural contacts. The material evidence includes, besides public buildings, the co-occurrence of sumptuary burials, jadeite trade, ceramic vessels and figurines, cacao and maize beverage consumption, and rubber ball game, all traits that will come to define the "Mesoamerican way of life". Thus it is relevant to understand earthen architecture. Due to the little attention given to it up to now, only in few sites have the building techniques been correctly identified and registered, making synchronic and diachronic comparisons a work in progress. Apparently, from the start, techniques in platform building include structured fills of stamped earth (not rammed), cob (puddled mud), and adobes (first conical, then rectangular). Regional variations seem to correlate with environmental conditions and with the later development of distinct architectural traditions.

Keywords: construction technology, archaeology, adobe, stamped earth, cob

*Speaker

Spread and Independent technical Invention of the earthen material in Southern Caucasus and Northern Mesopotamia during the sixth millennium

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Relationships between Southern Caucasus and Northern Mesopotamian communities were established mainly during the 1960's, especially with the discovery of Mesopotamian ceramics at the site of K'ultepe, in Nakhichevan, but the nature of the relationships was not clearly defined. Since the 1990's, research in Southern Caucasus has intensified. International archaeological teams have focused in this region in order to understand the " neolithisation process " on the fringe of the Near East.

Despite a lengthy history of architectural researches in Near Eastern studies, works related to earthen material are recent. Following the further work begun in 1980's and 1990's by O. Aurenche and M. Sauvage in the Near East and thanks to methodological work performed in the South of France by C. Cammas, J.-C. Roux and C.-A. de Chazelles over the past thirty years, an outdated terminology can be revised to define architectural techniques. A precise evolution of earthen material in Southern Caucasus and Northern Mesopotamia during the sixth millennium can be proposed by a re-examination of stratigraphic contexts, bibliographical data and archive records and also by new discoveries in these regions.

We will focus on the evolution of the cob and the mud brick techniques. The spread of the cob could be assumed across Northern Mesopotamia (Hassuna and Halaf cultures) since the second half of the seventh millennium, and then towards Eastern Anatolia (Hajji Firuz culture) and the South Caucasus (Aratashen and Shulaveri-Shomu cultures) during the sixth millennium. Simultaneously appeared the moulded plano-convex mud brick in the Shulaveri-Shomu culture (Aruchlo, Mentesh Tepe) at the beginning of the sixth millennium. This special technique seems to appear as a local and independent innovation in the Kura Valley, according to other architectural characteristics in the region (subterranean and circular buildings...).

Data submitted are the results of a PhD work on know-how architectural exchanges between Southern Caucasus and Mesopotamia during the sixth and fifth millennium.

Keywords: Shulaveri, Shomu, Halaf, Samarra, Caucasus, Mesopotamia, earthen architecture, mud bricks, cob

*Speaker

THE CONSTRUCTION TECHNIQUES IN THE MIDDLE BASIN OF THE DOURO BETWEEN THE 3RD AND 2ND MILLENNIUM BC

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The domestic architecture from the earliest metallurgic societies in the Northern Spanish plateau falls outside the interest of researchers. That was due to the lack of remains in primary position such as post holes, foundations or even accumulated rubble. This absence was understood as a consequence of the constant ploughing the land suffered from long time ago, especially since the introduction of agricultural machinery in the second half of the 20th century. The main evidence of these huts is the large accumulations of clay plaster remains found inside some pits. These remains were often discarded by the archaeologists arguing that no information could be achieved from them. The objective of this paper is to refute that statement. The clay plaster remains from El Casetón de la Era (Villalba de los Alcores, Valladolid, Spain) and from other areas of the Douro Basin were studied through a combination of a macroscopic study with some laboratory techniques (XRD, FTIR, DTA-TG, thin section). The results gave a large amount of data concerning the construction technique applied in the edification of those huts and some ideas about their end. This analysis allowed determining not only the construction technique used on the walls (wattle and daub in most of the cases) but also some specific elements such as hearths or benches. Furthermore, the destruction of the dwellings seemed to be presumably caused by an intentional fire as part of the process to dismantle the huts. That process ended with the deposition of the remains inside the pits, leaving no residues of the dwellings in the landscape.

Keywords: Domestic Architecture, wattle and daub, Chalcolithic, Bronze Age, Archaeometry.

*Speaker

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The building process of earthen mounds (Cerritos de Indios) of southern Brazil. A new perspective on non-linear building

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The building process of earthen mounds (Cerritos de Indios) of Pampa Biome is a researching line in the Archaeology since the 1990's. At least, four building models were thought, since the Classic Model of 1970's that saw the Cerritos as non-intentional arisen earthen mounds, to the recent models that understand the Cerritos as funerary or domestic facilities. The difference in this two recent models lies in the sequence of the dynamic of construction. In this work, we propose the Cerritos as the result of a dynamic that involves a not linear process of soil management, which is carried and replaced from inside and outside the earthen mound. In this process, the daily activities were not necessarily sequential in time, what is clear by the stratigraphic inversions in the archaeological sites and the arrangement of materials in the archaeological record. In this way, besides the soil management, we propose that the earthen mounds must be understood considering the adjacent topographical transformation, as well as the burial, domestic, cropping, and by-product activities. The focus of our work lies in the Pontal da Barra, near the Patos Lagoon, Southern Brazil, where we have been mapping and digging a complex of 18 cerritos, dated between 2500 and 1000 years BP. These earthen mounds comprehend part of the history of indigenous groups of Pampa biome in the South American lowlands.

Keywords: Archaeology, Earthen Mounds, Cerritos de Indios, Constructive Model, Indigenous History, South American Lowlands

*Speaker

The construction system in the archaeological site of Xochitécatl-Cacaxtla, Tlaxcala.

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The architecture and construction systems have been very useful archaeological indicators to infer the concept of space and time of those societies that we investigate. The emergence of the first Ceremonial Centers during the Formative indicates the use of different materials and natural resources to build them. In this work we analyze the site of Xochitécatl-Cacaxtla as an example of architecture, which, from the Formative to the Epiclassic period, was built using mainly earth materials, such as volcanic tuffs and mud finishes.

The archaeological site of Xochitécatl-Cacaxtla has two moments of occupation. In its origin during the formative period (800 a.C. - 200 d.C.) is built on the top of an extinct volcano. The site is abandoned by the eruption of the Popocatepetl volcano and is again occupied during the Epiclassic period (700-1200 AD). The design of the Ceremonial Center reproduces the volcanic landscape of the Puebla-Tlaxcala Valley. Three buildings are built, the Pyramid of Flowers that imitates the Malinche volcano, the Serpent Building to the Iztaccíhuatl volcano and the Spiral Building is the reproduction of the Popocatepetl volcano. The archaeological evidences indicate that the buildings of the ceremonial center were reconstructed in the second period of occupation to the Pyramid of the Flowers they are added new bodies and a ladder of "tepetates" and covered with flattened mud.

The construction systems in Xochitécatl-Cacaxtla, during their two occupations, use as tepetate and earth construction materials, in the filling of buildings and in the construction of facades, stairs and foundations. The housing units are built with tepetate also used as floor, foundations and in some cases to build "formaciones troncocónicas" for storage. This work describes the construction systems and techniques used to explore, consolidate and restore the buildings and leave them outdoors for their visit. In the case of housing units, excavation and restoration and consolidation techniques are explained for the floors and foundations that were covered to avoid deterioration.

Keywords: Tepetate, architecture on land, consolidation of adobe

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The role of minerals in the cohesion and endurance of pre-Hispanic adobes. The case of the Great Pyramid of Cholula, Mexico

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The Great Pyramid and the surrounding buildings in the archaeological site of Cholula in Puebla, central Mexico, were built with the adobe constructive system. This type of construction is part of the past and present of the Mexican culture since the soil material used has proven to have the properties and mechanical resistance for construction. Since the adobes are built from natural soil, an abundant and therefore sustainable material, the analysis and study of the ancient constructive system increases our current comprehension of the structure and properties that our ancestors dominated in Mesoamerica.

In this work we present the mineralogical characterization of the Cholula adobes that were fabricated with volcanic soils that has semicrystalline and amorphous materials naturally occurring in this type of soil. We identify their role and importance on the cohesion and endurance of the adobes by relating it with the mechanical properties of the adobe and also of the constructive system designed by the Cholulteca people.

The results obtained denote the complex and profound knowledge required for earth construction and how technological studies of the past can help us improve the present constructive systems in the local region.

Keywords: volcanic soils, amorphous materials, mechanical properties, adobes

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IV-7. La percussion lancée au Paléolithique : identification de son usage, types d'outils associés et étendue chronologique

De l'utilisation en percussion lancée d'éclats bruts massifs dans les activités bouchères et du travail du bois : le niveau moustérien de la Doline de Cantalouette II (Dordogne-France)

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Le niveau Moustérien de la Doline de Cantalouette II, d'âge moyen de 60.000 ans, remarquable par sa richesse, sa composition et sa structuration récurrente des activités dans l'espace (Bourguignon et al. 2008) livre une gamme d'instruments lithiques utilisés en percussion lancée. Outre une panoplie importante des percuteurs de taille (sur galets de quartz, éclats ou nucléus en silex), des éclats massifs en silex ont également été utilisés selon cette gestuelle pour des opérations de traitement de matériaux périssables tels les carcasses animales ou les végétaux. C'est exclusivement sur ces dernières utilisations que nous orienterons notre communication. Les activités de production de ce Moustérien récent participent essentiellement d'un débitage algorithmique mettant en œuvre des séries unipolaires récurrentes obtenues selon des plans de fracturation sub-parallèles aux dépens d'une ou de plusieurs surfaces. Des éclats épais, présentant souvent une asymétrie latérale sont obtenus à partir d'un ou plusieurs plans de frappe circonscrits (opposés ou perpendiculaires) et très rarement aménagés. Plus rarement un débitage Levallois à éclat préférentiel, orienté vers une exportation des produits est également mis en œuvre. La production principale est quasi exclusivement réalisée pour une utilisation immédiate des éclats, distante du poste de taille, avec ou sans, aménagement des parties actives et préhensées par la retouche (Bourguignon et al. 2008). C'est parmi cette production qu'une sélection d'éclats massifs aisément préhensibles à mains nues, souvent issus des premières étapes de la chaîne opératoire (corticaux), s'opère pour leur utilisation en percussion lancée. Sur la base d'une sélection macroscopique de tranchants (souvent bruts) présentant des stigmates d'écrasement, d'arrachement ou d'esquille, une lecture fonctionnelle a été réalisée selon la méthodologie analytique développée par S.A. Semenov (1964). Parallèlement, s'agissant d'objets de grandes dimensions des répliques sur papier acétate ont été réalisés. Deux registres d'activité en percussion lancée ont été déterminés, l'un orienté vers des travaux de boucherie, l'autre vers le travail du bois. Pour ce qui est des activités bouchères ces gros éclats massifs ont été utilisés comme des

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fendoirs, couperets ou feuilles de boucher. Sur les fils des ces instruments sont documentés de grands enlèvements résultant du choc sur les ossements durant la désarticulation ou le dépeçage des animaux. Les matières végétales dures, demi-durs et ligneuses quant à elles ont également été travaillées en percussion lancée essentiellement dans l'objectif de les amincir ? (desbartar). Certaines pièces de très grandes dimensions suggèrent une prise à deux mains et, dans ce cas, un seul fil de tranchant est utilisé. Sur les autres pièces de moins grandes dimensions, pouvant être tenues avec une seule main, le nombre de parties actives est plus important (au moins deux). Ces parties actives sont souvent denticulées (plus ou moins grandes encoches retouchées ou non) au sein desquelles se concentrent les polis d'usage. Ces denticulations sont, dans certains cas, initialement aménagées mais peuvent être aussi la conséquence du choc sur le matériau lors de la percussion.

Ces deux registres d'activités seront donc ici présentées en détaillant et illustrant les stigmates et polis d'usage relatifs à chacun d'eux.

Keywords: percussion lancée, moustérien, macro outil, boucherie, travail du bois

Functional analysis of stone balls (spheroids/polyhedron) from Middle Pleistocene Qesem Cave (Israel)

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Macrolithic tools have been found at the Middle Pleistocene site of Qesem cave (420-200,000 ka, Acheulo-Yabrudian Cultural Complex). The presence of these artefacts, classified as stone balls - Spheroids / Polyhedrons - marks the latest appearance of this type of artefacts in the Palaeolithic period of the Levant, and represents the end of a long Palaeolithic tradition of producing and using such items. The functional interpretation of Palaeolithic stone balls is far from being resolved. We present here new results of a functional analysis of these items, and suggest that at Qesem, they were used in thrusting percussion activities of crushing fresh bones. The repertoire of stone ball that has been analysed includes 30 limestone items, which were found mostly concentrated in particular locations within Amudian (blade dominated) contexts in the south-western part of the cave.

We studied them through trace analysis using low and high power approaches - by stereomicroscope and a metallographic microscope - in association with macroscopic residues analysis. The presence of functional traces on some macrolithics, related to thrusting percussion on organic material, led to the formulation of a specific experimental protocol.

The experimentation focused on the collection of raw materials similar to these characterizing the archaeological sample from the area surrounding the cave. We then photographed the samples before and after the experiments. The experiments included crushing bone for marrow extraction and treating tuber (*Asphodelus*). The choice of experimental activities was based on the presence of a rich assemblage of animal bone at the site and the presence of traces of plant foods in dental calculus, as shown by recent studies.

The functional analysis of the experimental samples, compared to the archaeological remains from Qesem cave, made it possible to establish that four of the stone balls exhibit traces related to the crushing of fresh bones through thrusting percussion activity. Especially the micro-traces and the polishes observed by the metallographic microscope are very characteristic and well preserved.

The faunal remains of Qesem show cut-marks, burning damage and damage caused during bone

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breakage on a significant number of the bones, indicating that butchering, roasting and marrow extraction activities were conducted at the site. The skeletal pattern of Qesem indicates a tendency to highly utilise body parts of high nutritional value implying that marrow was of importance in Qesem hominin transport decisions (Blasco et al. 2014, 2016). The significantly high proportions of burnt and fractured bones, which indicates a continuous fat-oriented use of prey at the site supports this too. The results of the functional analysis presented here emphasize that the stone balls may have played an important role in activities of marrow extraction.

Keywords: Qesem Cave, use, wear, macrolithics, thrusting percussion, Paleolithic, experimentation

L'outillage façonné utilisé en percussion lancée du site paléolithique moyen du " Bois de l'Hôpital " (Saint-Sulpice, Tarn)

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Le site du " Bois de l'Hôpital " a été fouillé dans le cadre d'une opération d'archéologie préventive réalisée entre novembre 2015 et avril 2016. Il s'insère dans une épaisse formation limoneuse colluviale qui couvre la basse terrasse du Tarn (Fy1) dont le sommet correspond à la superposition de deux horizons argiliques luvisoliques de rang interglaciaire (BT1 et BT2) au sein duquel plusieurs niveaux paléolithiques ont été identifiés. Le plus ancien, situé à la base de l'horizon BT2, se compose d'une série lithique quantitativement peu importante avec une composante bifaciale marquée et se rattache à l'acheuléen pyrénéo-garonnais de la fin du Pléistocène moyen. Plusieurs niveaux sus-jacents sont attribués au Paléolithique moyen dont le niveau principal se situe au sein d'une matrice à graviers épais d'une quinzaine de centimètres,

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à l'interface entre les horizons BT1 et BT2.

L'analyse présentée ici repose sur les niveaux archéologiques du Paléolithique moyen. Ces derniers présentent une forte composante d'outillages lourds, essentiellement produite aux dépens de galets de quartz, pour lesquels la variabilité pétrographique et la zone de collecte sont documentées. Les galets à enlèvements unifaciaux sont les plus fréquents, mais leurs volumes, leurs techniques de productions et leurs structurations fonctionnelles sont variables. Ils sont associés à de rares galets à enlèvement bifaciaux et à quelques bifaces (108 outils au total). Ces différences de nature techno-morpho-fonctionnelles ont permis de caractériser différents groupes d'outils sur la base d'un potentiel fonctionnel commun. Par ailleurs, plusieurs outils (15.7%), présentent sur leurs tranchants des macro-traces, témoins de leur utilisation en percussion lancée directe. Des expérimentations spécifiques, pratiquées avec les mêmes types d'outils et les mêmes matières premières, permettent de valider cette interprétation concernant le geste utilisé pour la mise en action de l'outil.

Ainsi, il a été possible de relier certains groupes d'outils à un geste pratiqué. La structuration fonctionnelle de l'outil permet, au-delà de macro-traces de même nature, de percevoir deux modes d'emploi au sein des gestes de percussion lancée directe, une percussion droite et une tangentielle. Les galets aménagés sont le plus souvent considérés comme des outils employés en percussion lancée, sans que cela ne repose sur une démarche analytique concrète. Ici, la combinaison des analyses techno-morpho-fonctionnelle et tracéologique (faible grossissement), permet d'attester cet usage. Par ailleurs, ces résultats rappellent la forte part remplie par le macro-outillage dans les activités des hominins, y compris au sein d'un techno-complexe du Paléolithique moyen.

Keywords: Macro, outillage, Percussion lancée, Techno, morpho, fonction, Macro, traces, Pléistocène supérieur.

La percussion lancée dans le niveau de l'Aurignacien ancien de Barbas III (Dordogne, France).

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L'Aurignacien ancien de Barbas III (Dordogne France) présente à la fois des caractéristiques classiques de cette période avec une production de lames (de moyennes et petites dimensions), lamelles (torses) et un outillage retouché typique (lames étranglées, lames retouchées, grattoirs etc) mais aussi des spécificités. Ainsi, sont également représentés dans l'industrie une production de lamelles droites normalement typique de l'Aurignacien archaïque, un débitage orienté vers de très grandes lames (27 x 6 x 2,2 cm en moyenne) considéré comme l'œuvre de spécialiste (Ortega 2001, 2005 ; Rios *et al.* 2002) et un débitage d'un bloc orienté spécifiquement à la production de très gros éclats (plus de 25 cm de large).

L'analyse fonctionnelle d'un échantillon important de pièces couplée à une analyse de l'organisation de l'espace avait également mis en évidence des spécificités de cette occupation avec une orientation des activités vers le travail de bois animal et/ou végétal bien délimitées dans l'espace occupé (Rios *et al.* 2002).

Notre communication s'orientera spécifiquement sur les artefacts minéraux (blocs, galets, nucléus, éclats et lames) utilisés en percussion lancée. Les zones actives de percussion de cet outillage souvent lourd sont diversifiées : tranchantes (bord coupant d'un gros éclat ou d'une grande lame) ou non (méplats, parties convexes ou arêtes) et seront décrites tous comme les zones réceptives de ces percussions (planes ou concaves). Une analyse macroscopique de ces zones actives a tout d'abord permis de différencier différents stigmates (piquetage, écrasement, esquillements, arrachements) sous entendant diverses catégories d'outils (enclume en grès, des percuteurs et machette) utilisées pour des usages diversifiés de percussion lancée. L'analyse des micro-traces a, quant à elle, permis pour certains cas d'aborder la matière travaillée. Lorsque ce registre n'a pas été documenté par la conservation ou le développement des poliss, la gestuelle d'utilisation a cependant été déduite.

Nous aborderons également la place de cet outillage lourd et léger utilisé en percussion lancée dans les activités menées durant l'occupation.

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Keywords: percussion lancée, Aurignacien, outillage lourd

Launched percussion with heavy-duty tools in the Early Acheulian level (US4) of the Bois-de-Riquet site (Lézignan-la-Cèbe, Hérault, France).

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The rich industry from level US4 of the Bois-de-Riquet archeological site (Lézignan-la-Cèbe, France), dated around 800 Ka, was made from blocks and cobbles of basalt, quartz and aplite collected from the local environment. The assemblage contains, alongside products made by different stone reduction concepts, a range of heavy-duty tools manufactured specifically in basalt. This heavy toolkit results from various production chains representing either the selection and shaping of blocks with specific morphologies, or, the production of *Large Flakes* that were also shaped according to varying degrees of technical investment.

These tools have been the subject of a techno-morpho-functional analysis dividing them into five groups, based on the identification of sharp edges and flat surfaces with different orientations. The ergonomics and the mass of these tools suggest that they were employed for launched percussion activities using different gestures. In addition, several parts of the tools (active or prehensile) present removal negatives- often bifacial and alternate -which seem to result from uses according to this modality.

Specific experiments were set up to reproduce basalt tools using the same knapping methods and to use them for percussive activities in accordance to their different functional groups: bone

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fracturing and chopping fresh wood. Each activity was reproduced with 10 tools, while varying usage rates were counted in terms of number of blows carried. The resulting macro-traces were analyzed (*i.e.* position, repartition, distribution, initiation, terminaison and overlapping) using a stereoscopic microscope and results were interpreted in terms of the gestures employed, cutting edge type, material type and tool mass and results were compared with the archeological materials and other experimental references.

However, not all the stigmas observed on the archeological material were obtained in the experiments. Even though certain types of removal negatives observed on the archeological material were reproduced experimentally, thus supporting the hypothesis of the use of these tools for percussive activities, other kinds of negatives located on contact zones considered as prehensile, were not obtained during this first experiment. The use of these pieces as ‘sharp-edged anvils’ or as part of an indirect launched percussion gesture is the main hypothesis to be developed in future experiments. The identification of tools linked to activities carried out with a launched percussion gesture in the context of the Early Acheulean, informs us about a mode of action on the material that is often underestimated. Also, our contribution underlines the importance of this type of gesture in the activities practiced by hominins at the beginning of the Middle Pleistocene.

Keywords: Middle Pleistocene, Basalt, Experimentation, Percussive activities

Les ossements utilisés pour la percussion lancée au Paléolithique ancien

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La percussion est une caractéristique majeure des industries acheuléennes et son impact sur l'ensemble du matériel archéologique découvert sur des niveaux d'occupation est primordiale. Les industries lithiques, riches en percuteurs de toutes natures, en particulier les galets, les pierres et autres blocs de matière premières font de cette activité, la plus évidente sur les sites.

Les ossements sont les premiers témoins de la percussion lancée car la fracturation intentionnelle des crânes, os longs et même os courts, est systématique et utilisée certes pour ouvrir les os mais aussi pour désarticuler et d'autres objectifs difficiles à comprendre.

Plusieurs types d'ossements sont également utilisés dans le cadre de ce type de percussion, le meilleur exemple est celui des différents modèles de retouchoirs, des fragments de séries dentaires ou des grands outils en os de proboscidiens.

L'analyse des stigmates, aux différentes échelles d'observation, permet de proposer différentes catégories d'outils de percussion : les retouchoirs à fines stries parallèles ne sont pas associés à une percussion lancée contrairement aux retouchoirs sur esquille de grand mammifères à profondes encoches localisées, aux mandibules de grands mammifères avec des enlèvements latéraux sur les dents ayant servi de percuteurs, les grands éclats d'os ou d'ivoire de mammoth ou éléphants aux pointes émoussées et cassées.

Ces différentes observations sont issues de plusieurs sites du Paléolithique ancien d'Europe et d'Asie et illustrent le caractère essentiel de la percussion lancée pour les activités de ces hommes.

Keywords: percussion, ossements, paléolithique, retouchoirs, stigmates

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Outillage osseux éphémère utilisé dans des activités de percussion lancée dans le Moustérien de type Quina : l'exemple des Pradelles (Marillac Le Franc, France)

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Le site Moustérien de type Quina des Pradelles interprété comme une halte de chasse dédiée à la boucherie de rennes abattus collectivement lors leur migration contient un nombre de retouchoirs en os très important. Cet effectif reporté au nombre d'outils retouchés présents dans les industries, suggère une exportation d'une large partie de l'outillage lithique confectionnée sur place (Costamagno *et al.* 2017).

Sur la base de la profondeur et de l'orientation des stigmates, du développement de la plage impactée et de sa localisation sur la diaphyse, les retouchoirs ont été classés en 11 catégories. Certains de ces types dont les caractéristiques ne sont pas compatibles avec de la retouche de type Quina semblent très éphémères dans leur utilisation. Pour autant, pour certains leur rôle dans les activités de mise en fonction de l'outillage (tel qu'une retouche d'ajustement) semble important représentant jusqu'à 26.7 % de l'ensemble des retouchoirs.

Dans le cadre de cette communication, nous souhaitons préciser la fonction de ces pièces dans les activités de taille qui se sont déroulées sur le site. Cinq types (F, G, H, I et P) d'outils percutants ou percutés en os seront décrits depuis leur sélection parmi les fragments à disposition (dont certains présentent des spécificités peu habituelles tels les bords de gouttière des métatarsiens ou la branche horizontale des mandibules) jusqu'à leur abandon.

Les plages impactées, zones actives de percussion ou zones passives percutées, présentant des stigmates très superficiels, des coups dispersés voire isolés, d'orientations diversifiées (transversales, obliques ou longitudinales) et de profondeurs distinctes (peu profonds ou au contraire très profonds) feront ici l'objet d'une discussion sur la base d'un référentiel expérimental ciblé. Ce protocole expérimental mis en place dans l'objectif de reproduire les stigmates observés comprend différents modes de maintien du retouchoir relativement à une orientation et une an-

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gulation particulières du tranchant en silex au moment des impacts et des activités percussives où l'élément osseux est passif.

Référence :

Costamagno S., Bourguignon L., Soulier M.-C., Beauval C., Meignen L., Rendu W., Maureille B. (2017) : Bone retouchers and site function in the Quina Mousterian : the case of Les Pradelles (Marillac-le-Franc, France). In *The Origins of Bone Tool Technologies actes du Workshop Retouching the Palaeolithic: Becoming Human and the Origins of Bone Tool Technology* The Retouching the Palaeolithic, Hannover 21-23 October 2015. p. 1-31.

Keywords: Moustérien de type Quina, Retouchoir en os, éphémère, outillage lithique

Outils de percussion au Paléolithique supérieur ancien : l'exemple de sites aurignaciens et gravettiens en Vallée de la Vézère (Dordogne, France)

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Souvent passé sous silence, voire non collecté lors des fouilles anciennes, le matériel de percussion en matières minérales est pourtant en général assez abondant sur les sites du Paléolithique supérieur. À l'occasion de plusieurs projets de fouille en vallée de la Vézère, nous nous sommes intéressés à ce matériel minéral, provenant selon les cas de collections existantes (mais inédit), de collectes dans les déblais des fouilles anciennes ou de nos propres fouilles. Ce travail a été réalisé sur les niveaux de Gravettien final de trois sites (abri Pataud, Laugerie-Haute Est et Les Peyrugues) et sur trois sites aurignaciens (les abris Castanet, Blanchard et Cellier). Parmi le matériel étudié, une analyse macroscopique a révélé la présence de différentes catégories d'outils de percussion, correspondant à des usages diversifiés.

Les objets les plus communs correspondent aux percuteurs utilisés pour la taille de l'outillage en silex. Souvent en quartz, il s'agit généralement de galets de taille moyenne à faible.

D'autres galets, généralement plus gros et plus lourds, quasi-exclusivement en quartz, présentant des traces de percussions beaucoup plus importantes sont interprétés comme des percuteurs de concassage, destinés à fragmenter des matériaux tels que les ossements. Certains galets de quartz taillés, correspondant technologiquement à des choppers, de poids et dimensions similaires présentent des traces de percussions identiques, ainsi que des arêtes totalement percutees. Ils ont probablement été également utilisés comme percuteurs de concassage.

Deux pièces en calcaire sont interprétées comme des percuteurs de pierre tendre.

Des petits galets de roches magmatiques ou métamorphiques dures, de forme généralement allongée, fortement sélectionnés, présentent de multiples traces d'utilisation, parmi lesquelles des plages de traces de percussions sur leurs flancs ou leurs faces. Ces objets peuvent être considérés comme des retouchoirs lorsque les traces sont sur les flancs et comme des maillets lorsqu'elles sont sur les faces (De Beaune, 2000).

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Certains objets en silex présentent également des traces de percussions. Dans tous les cas il s'agit d'une réutilisation d'objets ayant initialement eu un autre usage. Dans la plupart des cas ce sont des nucléus, le plus souvent de petites dimensions, qui peuvent dans des cas extrêmes devenir de petits objets quasiment sphériques, totalement percutés. Il peut également s'agir de grattoirs carénés. Deux hypothèses sont proposées pour l'usage de ces objets : soit des percuteurs pour la taille du silex soit des bouchardes pour le travail de la pierre.

Enfin, quelques pièces de silex, assez volumineuses, présentant des traces de percussion sur deux extrémités opposées sont interprétées comme des pièces intermédiaires entre le percuteur et le matériau à travailler. Dans la plupart des cas il est possible de reconnaître le côté percuté du côté en contact avec le matériau.

L'analyse macroscopique de l'ensemble des matériaux lithiques hors silex utilisés sur ces quelques sites du Paléolithique supérieur ancien a donc montré que parmi les pièces retrouvées, de nombreux outils sont présents, et en particulier une grande quantité d'outils liés à la percussion. D'autre part, nous avons également pu montrer que, parmi ces objets, diverses catégories pouvaient être identifiées, correspondant à des usages très diversifiés de la percussion.

Keywords: paléolithique supérieur ancien, Aurignacien, Gravettien, percuteur, galet

Techno-functional and macro-wear analysis of Nalai site, Bose Basin, Guangxi, Southern China. A new insight into hominin behaviors and technical evolution in Eastern Asia.

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The Bose Basin, Guangxi, Southern China, has yielded many Middle Pleistocene sites known for a very long time. The technology is based on pebble shaping, usually unifaces and sometimes on both sides. Although the technology has been carefully studied in several sites, the tools themselves were analyzed so far only from a typological point of view.

Two major results came out from the previous analyses of Bose Basin archaeological sites. First, the technology seems to remain stable from 800 ka to 20 ka, which is an important singularity in the worldwide Pleistocene archaeological record. Second, the tool-kit is dominated by heavy-duty tools shaped on pebbles, with a high proportion of picks and transversal cutting edges.

The discovery of Nalai site, rich of more than 2 000 pieces into 7 stratigraphic layers from the Lower Pleistocene to the Neolithic provides an opportunity for studying the assemblage from a techno-functional approach, in order to identify precisely techno-functional groups and their functional potentials. Furthermore, macro-wear traces were preserved on some of the pieces. This combination allows this study to focus on the diversity of the tool-kit and its use by hominins through the Middle Pleistocene in Southern China.

Focusing on the Pleistocene stratigraphy also leads to address the issue of technical stability or continuity into the hominin technologies through time. The chronological succession will provide brand new data to understand the technical evolution in the Bose Basin through the Middle Pleistocene to the Holocene.

The results of this work show a good correlation between the techno-functional categories hypothesized and the macro-wears identified. It brings the research to a next step of understanding

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in terms of technical activities and hominin behaviors in Southern China during the Lower Pleistocene.

Keywords: Southern China, Techno, functional analysis, Bose Basin, thrusting percussion, macro, wear analysis

The Specific Patterns of Selection and Use of Hammerstones at the Middle Palaeolithic of the Iberian Peninsula.

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The hammerstones have been only roughly studied until the present times in scientific literature, probably because their unmodified nature and generally variate raw materials makes difficult a classification of the selection or use patterns. In the present work, we propose an approach to the analysis of these items in terms of technical attributes as volumetric modules, weight, indexes of compression or direction of use during the Middle Palaeolithic in the Iberian Peninsula. After our proposal of classification, we show that in this framework there is a specificity in the patterns of selection and use of hammerstones with a clear adaptation of these patterns to the knapping goals of each Technical System.

Keywords: Hammerstones, Middle Palaeolithic, Iberian Peninsula, selection patterns, use patterns

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Thrusting and Resting Percussion in Oldowan contexts: state of the art

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In Oldowan contexts the use of the thrusting and resting percussion is testified by the presence of cores, hammerstones and stone flakes. From many decades scholars have also applied the analysis of the bone marks, as breakages or cut marks, for the study of the involvement of thrusting and resting percussion in the processing of animal carcasses. Quite recently the interest has shifted to the objects showing the direct evidences of percussion, the percussive lithic tools. Different approaches have been applied: morphometric analysis (Caruana et al. 2014), experimental approach (La Torre et al. 2013), use-wear (Diez-Martín 2009; Lemorini 2014). This paper is aimed at discussing the state of the art of the study of percussive tools in Oldowan contexts in terms of methodologies and results. In particular, the paper will focus on the behavioural significance of the preferential use versus the integrated use of these two percussive techniques.

Keywords: Thrusting percussion, resting percussion, Lithic, Oldowan

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Traceology of the manufacturing techniques of Olmec axes

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The Olmec culture, one of the earliest complex societies of Mesoamerica, reputed for its high quality stone work in monumental sculptures like the famous colossal head and in its portable sculpture like mask and figurines. Also famous for its massive offerings of different artifacts, mostly, votive axes some made of jade and serpentine found in sites like La Venta, Arroyo Pesquero, el Manatí among others. Associated to rituals of deities of water and fertility. We had access to some axes, discovered in context of archeological project in the sites of San Lorenzo, La Venta and Arroyo Pesquero, to be able to cast polymer mold samples of the surface with a replicating tapes softened with acetone, that technique allows to observe the manufacturing techniques in the SEM (Scanning Electron Microscope) and was already been successfully implemented in other pre-Hispanic objects from other Mesoamerican region comparing with an extensive reference in experimental techniques of burnishing, polishing and incisions. The results of these analyzes presented in this dissertation, allow us to recognize similarities and differences in the manufacture of these axes between the early formative 1500-900 a.C. and the formative medium 900-400 a.C. in the Gulf coast, where we could observe continuities and changes in manufacturing technique.

Keywords: Olmec, Traceology, Technology

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