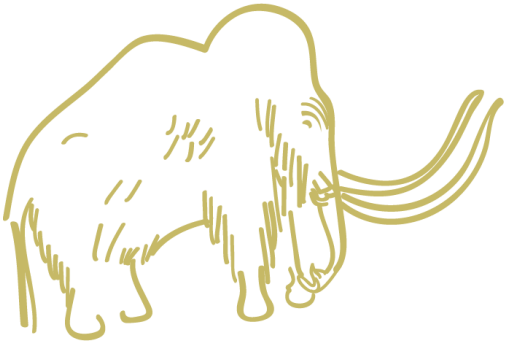

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II-1. Hunter-gatherers and farmers faced with climate change : adaptation and sustainability

Interlinked changes in the environment and crop production through the Neolithic in northern Germany

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The introduction of agriculture in the Neolithic marked the start of major alterations of the natural environment including deforestation and soil erosion. Human exploitation of natural resources and the effect on the environment during the Neolithic in northern Germany have been thoroughly investigated using high-resolution palaeoecological, archaeobotanical, geomorphological and archaeological data. Changes over time have been detected in the natural landscapes resulting from human activities, most prominently agriculture. The combined evidence suggests limited anthropogenic (e.g. farming) impact at the beginning of the regional Neolithic (Early Neolithic Ia), around 4100 cal BC, with some changes in woodland composition. A sharp rise in landscape openness in the Early Neolithic Ib (from c. 3800 cal BC) has been identified, coinciding with the emergence of the tradition of building megalithic graves. The degree of land use was lower at the start of the Middle Neolithic (around 3250 cal BC) perhaps due to climate deterioration, but was on the increase again across the region for about a century during this period. Towards the end of the Middle Neolithic, at around 3000 cal BC, a decline in human activity favoured woodland regeneration. This was followed by a series of alternating phases of landscape opening vs. forest regeneration through the Late Neolithic.
The major shifts in climate and vegetation likely coincided with changes in the agricultural practice. However, beyond the recognition of shifts through time in the vegetation composition and distribution, and the crop spectrum, little is known about the actual farming and land management strategies that drove and/or were affected by the changes. This paper addresses the questions of how and to what extent early farmers modified the natural surroundings in this region. It seeks to pinpoint specific agricultural and land use methods towards a better understanding of the ecological concomitants of prehistoric farming. The paper integrates the previous data on the Neolithic in northern Germany and presents new evidence derived from

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the ecological and stable isotopic analysis of plant macro-remains.
The results included in the paper derive from research funded by the *Deutsche Forschungsgemeinschaft* (DFG, German Research Foundation) and carried out within the Kiel University projects 'SPP1400: Early Monumentality' and 'SFB1266: Scales of Transformation'.

Keywords: Neolithic, environmental change, deforestation, crop cultivation, land management

PALEOENVIRONMENT, PLANT LANDSCAPE AND FUEL MANAGEMENT OF THE LAST HUNTER-GATHERERS AND FIRST FARMERS IN THE EBRO BASIN (NE IBERIA): CHANGES AND CONTINUITIES.

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This work is focused on a comprehensive approach to the interactions between prehistoric societies and woody vegetation in the Ebro Basin (NE Iberia). Wood charcoal analysis in archaeological contexts mediates this approach, both from a palaeoclimatic and a palaeoeconomic perspective.
The studied remains come from different archaeological sites registering human occupations between Magdalenian and Neolithic (14.5-6.5 kyr BP). These are concentrated in low and medium mountain areas of a biogeographic area characterized by its complex orography and the continentality of the climate. From 8.2 kyr BP a change in the regimen precipitation and the increase in winter temperatures favored the rise in altitude of vegetation belts, leading to the establishment of a well-developed Mediterranean forest in the lowlands. Concurrently, an increase in human activities and a subsequent modification of forest management occurred at the end of Mesolithic period. The diffusion of farming in Mediterranean areas (ca. 7.5 kyr BP) occurs in different forms and rhythms and implies significant changes concerning cultural behavior and settlement patterns.

Cultural and climatic transition between Lateglacial and the Middle Holocene is a topic of particular interest in regional archeology. Taxonomic and taphonomic studies have allowed us to approach to the plant landscape and forest management of the last hunter-gatherers and the first farmers. The best documented use of wood is its exploitation as a domestic fuel, although we have also documented other possible uses such as feeding livestock by tree fodder. Plant

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resources supply had a local character depending on the biogeographic location and the functionality of the settlements.
Palaeobotanical and archaeological data provided in this work (1) contributes to fill a relevant information gap in this area, (2) allows an approach to the evolution of the Atlantic- and Mediterranean-taxa related to climatic transitions and anthropic factors and particular interesting taxa distribution, and (3) provides new information about changes and continuities in forest management of the last hunter-gatherers and the first farmers and the beginnings of human impact in the landscape.

Keywords: Archaeobotany, wood charcoal analysis, firewood management, Mesolithic, Neolithic

Worldwide peopling during the last glacial maximum (LGM)

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The last glacial maximum was a terrible climate forcing for about 5,000 years (from 21 500 to 16 500 BP) societies of hunter-gatherers to abandon about half of the territories populated during the MIS3 and adapt to new living conditions in territories of refuge with better climates. Are studied the climate and environmental change (vegetation, sea levels, glaciers) for each continent, the abandonment of territories, the hunter-gatherer adaptations through their material culture, the changes in food resource management and raw material procurement, the mobility and the population decline.

Le peuplement mondial au dernier maximum glaciaire

Le dernier maximum glaciaire a été un événement climatique terrible, obligeant pendant environ 5 000 ans (de 21 500 à 16 500 BP) les sociétés de chasseurs-cueilleurs à abandonner environ la moitié des territoires peuplés pendant l'OIS3 et à s'adapter à de nouvelles conditions de vie dans des territoires refuges aux climats plus cléments. Sont étudiés les changements climatiques et environnementaux (végétation, niveau de la mer, glaciers) pour chaque continent, les abandons de territoires, les adaptations des chasseurs cueilleurs à travers leurs changements de culture matérielle, de gestion des ressources alimentaires et d'approvisionnement en matières premières, la mobilité et la baisse démographique.

Keywords: LGM, hunter gatherer, upper palaeolithic

*Speaker

Study of vertebrates from Lumentza site (Lekeitio, northern Iberian Peninsula)

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Lumentza site is located in the coastal town of Lekeitio (Bizkaia), at 114 m above sea level and on the south hillside of Lumentza or Calvario Mount. The principal access to the cave, which is oriented to south-west, leads through to spacious and rounded hall. This cavity has a high vault and dimensions of 17.8 m in the major axis and 8.5 m in the minor axis, with an area of approximately 220 m.
Three archaeological interventions have been carried out in Lumentza: the first one in 1926 and 1929, the second between 1963 and 1964 and the last one between 1984 and 1993. The samples studied in this work were provided by the last intervention, when the actual methodology of washing and sieving the sediment to recover microvertebrates was applied. During this third field season, three archaeological levels have been differentiated. Superficial levels (I and IIA) are a mix of modern and prehistoric remains. The second level is divided among other two sublevels: IIB and IIC. In sublevel IIB Bronze Age and Chalcolithic period occupations have been found, while the sublevel IIC can be attributed to an advanced phase of Neolithic. Finally, level III has a limited archaeological record, and there is not any diagnostic element to attribute it to a chronocultural specific period. The remains studied in this work come from sublevel IIB, sublevel IIC and level III.

In Lumentza, the amount of small vertebrate remains is scarce, whereas macrovertebrate remains are abundant. This is due to the fact that, normally, microvertebrates are accumulated by nocturnal predators, which are not present during the human occupation moments. For this reason, sites with long time human occupations are usually very poor in microfaunal remains.
Macrovertebrate remains are mainly compounded by domestic animals. The livestock use during Neolithic, Chalcolithic and Bronze Age is based on domestic bovine, ovicaprine and porcine with pastoral cabins. The taxon with the largest number of remains is the bovine, since it is the animal that provides highest meat mass. Remains produced by hunting practices are

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scarce already in the Neolithic, and practically disappear throughout subsequent occupations. The small vertebrate assemblage is dominated by *Apodemus sylvaticus-flavicollis* and *Anguis fragilis*. The abundance of those taxa in the Cantabrian region is indicative of relatively wet and warm periods, similar to nowadays. Apart of these, remains of *Microtus agrestis*, *Microtus (Terricola)* sp., *Arvicola* sp., *Glis glis*, *Talpa* sp. and *Sorex araneus-coronatus* have been found in minor proportion.

Keywords: 29/11/2017

Lateglacial pioneers in northern Germany – Is life really better at the lake?

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During the Weichselian Lateglacial, hunter-gatherer groups began to expand into Northern Europe. Some of these landscapes were only previously freed from the retreating Fenno-Scandinavian ice sheet and most areas were still influenced by deglaciation processes. The significant climatic changes of this period still shaped the landscape indirectly with e.g., soil creep due to melting permafrost, the deposition of coversands, and / or the development of the Baltic Sea.
The archaeological record of northern Germany indicates that humans have entered these unstable environments during this period but it remains uncertain how continuous their occupation of this region was. Stable territories do not become evident before the Early Mesolithic. Hence, the nature of the Hamburgian (classic and Havelte Group), Federmesser-Gruppen, Brommian, and Ahrensburgian occupation can be discussed regarding their pioneer character, the number of demic expansions, their adaptability as well as their sustainability.

In a four year DFG-funded project, we target those points of discussion by collecting and reviewing material evidence that is attributed to the Late Upper and Final Palaeolithic. We look for behavioural differences by comparing the archaeological record. These differences are then compared to the development of the Lateglacial landscape and environment. Therefore, we focus particularly on organic remains and sequences with organic matters to get a broader spectrum of behavioural expressions and the possibility of direct dating. Furthermore, microscopic and molecular analyses of these organic remains and sequences can help to further reconstruct the surrounding habitat and, thus, place the human behaviour directly in a specific environment.

The majority of this type of finds and sequences in northern Germany originates from former lake bodies and led to the impression that Lateglacial people preferred to settle alongside lakeshores. With source criticism in mind, we must ask how intensively this impression is biased by preservation conditions. And within this group of sites whether there were differences in the relation to the lakes? Resulting in the profound question how precise are actually the chronology and topography in these reconstructions of former lakes?
Only by approaching these questions first, we can develop reliable hypotheses of how people adapted to lake environments and how sustainable this settlement behaviour was during the

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Lateglacial. In this talk, we are going to present some preliminary results of this approach and show in how far they change our view of the better life at the lake.

Keywords: Pioneers, Northern Germany, lake environments, Late Upper Palaeolithic, Final Palaeolithic

The emergence and development of pottery technology by Jōmon hunter-gatherers during the Late Pleistocene and Early Holocene.

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With southern China and the Russian Far East, Japan is recognised as a centre for pottery innovation with the earliest vessels dated to around 16,500 cal BP during the late Pleistocene. Thanks to organic analysis of their contents we now know that the earliest pottery in Japan, the so-called Incipient Jomon, were largely used to process aquatic resources. During this period, pots were produced in only very small quantities and their estimated volumes were also relatively low. It suggested therefore that initially pottery may have been reserved for specialised subsistence activities or ritual use, particularly associated with the seasonal availability of migratory aquatic species, such as salmon. With climate amelioration, at the start of the Holocene, the scale of pottery production greatly increase and it has been assumed that this was in response to the expansion of broadleaf forest that offered access to abundant terrestrial resources (e.g. forest game, acorns and chestnuts). Also it has been suggested that pottery technology during the early Holocene, the Initial Jomon phase, became consolidated and embedded in everyday subsistence practices and therefore had a much greater range of uses. To investigate, here we determined the contents of over 652 potsherd and 172 food crusts from 47 sites across the Japanese archipelago dating across the Pleistocene/Holocene transition (date range) using lipid residue analysis. Pottery was obtained from hunter-gatherer sites over an ecological transect through Japan, which included inland and coastal localities. Against our expectations, we found a consistency in the use of pottery with a preference for aquatic resources despite the dramatic changes in climate and consequences for subsistence practices. However, we also noted a clear broadening in the range of aquatic species that were processed in pottery which may have included marine shellfish, marine mammals and freshwater species. This change in pottery use is hard to explain in terms of resource availability driven by the changing climate or by site location. It is perhaps best viewed as the development of cultural 'culinary' practice that endured for several thousand years.

*Speaker

Keywords: Hunter gatherer, Jomon, Japan, Prehistory, Organic residue analysis, Pottery

Integrative attempts to study cattle domestication: Biomechanical archaeology of first and second phalanges as a proxy for deciphering animal activity patterns in prehistoric time

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Wild animals expend considerable amount of energy in foraging to satisfy requirements such as food and water, social interactions and finding shelter. In captivity, they depend on human and expended energy and time is much reduced. Knowing the behavioral aspects of wild-domestic evolution is necessary to comprehend domestication process. We present in this communication the results obtained with the application of biomechanical concepts to the study of bovine domestication processes.

Considering the recent findings on the bone biomechanics, with the corporation of multibody dynamics and locomotion simulation, this work is oriented to stablish morphological indicators differentiating domestication at the transitional stage based on behavioral changes experienced by captive or tamed animals. A series of mathematical algorithms are proposed for accessing the information enfolded in bone tissue. Load estimation algorithm, which is based on bone histomorphology, provides an opportunity to quantitatively examine activity level of animals. With the aim to obtain new data about cattle domestication in the Near East, a total of 112 cattle first and second phalanx recovered in tell Halula site (7700 cal BC to 5500 cal BC, Euphrates valley, Syria) has been selected and scanned.

Scanned data were converted to .obj surface structure and surfaces then were optimized and 315 landmarks were selected and pinpointed on each specimen. Superimposed coordinates were analyzed by principal component analysis. The results show that it is possible to differentiate between free range

and captive types and to deduce animal activities and foraging behavior comparing expected and experienced loading. In this line, bone remodeling algorithms became a practical tool to understand and even simulate animal behavior in archaeological context.

Keywords: Neolithic, Domestication, Biomechanics, Morphometrics

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The times they are a changin'. A synthesis of the Middle and Lower Tagus Basin Mesolithic to Middle Neolithic records.

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he transition from the last hunter-gatherers to the first productive economies, its chronology and material culture(s), as well as aspects related to paleoenvironment and associated human dynamics have been widely debated in Western Iberia. The last decades saw a rise on available data, still generally unequally dispersed through the coast and valley areas in comparison to other inland regions.

Pluriannual projects comprising extensive field surveys have been (or are being) implemented allowing for a better understanding of the evidences dispersal. Still, sometimes data is not as precise as needed, due to its characteristics, namely the relevance of materials from field surveys. Nonetheless, both coastal and inland evidences indicate a low rise in the number of Mesolithic sites, but mainly in Early and Middle Neolithic sites throughout the region.

This presentation will be a synthesis of the available data for the 8th-6th millennium BP in the Lower and Middle Tagus Valley. We will focus our attention on aspects related to palaeoenvironmental records but taking into account inter-site archaeographic comparisons, rock art evidences, and questions of palaeoeconomy and mobility in an inter-regional comparison. Available information, together with new data from field surveys and excavations, radiometric dating and material culture studies will be presented and discussed regarding adaptation to climatic and environmental constraints, and geographical and chronological dispersal of evidences.

Keywords: Neolithisation process, Archaeography, Tagus Valley, Palaeoconomy, Palaeoenvironment

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Pleistocene climatic variability on the Armorican peninsula: what is the influence of palaeoenvironmental change on the palaeolithic settlements in Brittany?

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This paper proposes a general review of Palaeolithic sites on the Armorican peninsula with a focus on their palaeoenvironmental context. These early settlements of Western France occurred during Pleistocene climate changes; therefore they will be presented within their chronostratigraphical and environmental time frame. Indeed the pre-Neanderthal and Neanderthal populations that occupied the region were present in both interglacial contexts and the cooler interstadials of glacial phases. From the Lower Palaeolithic until the Last Glacial Maximum of the Upper Palaeolithic people came to settle at different times adapting themselves to the climatic constraints of their period. Consequently numerous occupations took place at the end of interglacial stages, during rather mild conditions. This is the case for several important sites, for example Menez-Dregan (Plouhinec, Finistère) and Piégu (Pléneuf-Val-André, Côtes-d'Armor). Contrastingly other occupations happened under periglacial contexts but during these cooler interstadials as seen at the settlements of Les Vallées-Nantois (Pléneuf-Val-André), Grainfollet and Les Gastines, and for the site of Le Mont-Dol (Ille-et-Vilaine). This work explores how these populations adapted to climatic constraints questioning whether their lithic industries contain technological adaptations to environmental change and what this can tell us in combination with the palaeogeographical data.

Keywords: Pleistocene, Armorican peninsula, Brittany, Palaeolithic, Palaeoenvironments

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Le peuplement de l'Europe aux Paléolithiques inférieur et moyen et l'adaptation aux changements climatiques.

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L'Europe, extrémité péninsulaire du vaste continent asiatique, a connu durant le Pléistocène des variations dans son peuplement humain dont les causes sont essentiellement liées aux conditions climatiques : les épisodes glaciaires et interglaciaires. Les épisodes froids occupent la majeure partie de la durée de l'occupation humaine dont les plus anciennes traces connues remontent à environ 1,5 Ma. Cependant, les variations internes aux épisodes glaciaires (interstades) ont permis, par endroits et selon les régions, des occupations humaines plus ou moins pérennes.
Parallèlement des phénomènes d'évolution technologiques ont pu favoriser l'implantation dans des environnements peu favorables.
Cette communication cherchera à synthétiser les données actuellement disponibles, essentiellement sur l'Europe occidentale et centrale.

Keywords: Paléolithique inférieur, Paléolithique moyen, climat

*Speaker

Neolithisation of South-East and Central Europe: cultural changes and adaptations to environment

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At the Pleistocene/Holocene transition and in the early Holocene the appearance of farming-stock breeding communities, that in western Eurasia replaced hunter-gatherers, was an extremely complex process. The agents in this process were, first of all, groups that migrated from the Near East and brought with them novel economy, but also local pre-Neolithic populations. The process of the diffusion of the new economy was both triggered or slowed down by local environmental conditions and adaptations to them, and also by global climatic cycles, notably by the last cool episode of the Pleistocene (Dryas III) as well as Holocene climatic variability documented by global events.
The presentation deals with the following aspects of the origin of farming-stock breeding economy in the territories from the Near East to Central Europe in relation to climatic fluctuations:

1. The role of the global climatic cooling at the Pleistocene/Holocene boundary (10 800-9 700 cal BC), at the transition of the Natufian to the Pre-Ceramic Neolithic A (9700-9 500 cal BC) in the Near East. It resulted in a greater settlement density, development of clay and stone architecture, a greater importance of plant foods, and dog domestication. Subsequently, groups of the Pre-Pottery Neolithic B population dispersed towards central and western Anatolia (8 600-7 000 cal BC). The onset of this expansion is associated with global IRD 7 episode. However this migration halted at the coasts of the Aegean and the Marmara Seas.

2. The role of marine contacts between the Near East, Cyprus and the Aegean Sea Basin that intensified in the period of climatic aridity in the Near East (7 000-6 500 cal BC). These contacts brought elements of the Neolithic "package" (settlement structures, architecture, a greater role of plant foods, pre-domestication of animals) to Aegean islands which were inhabited by forager-hunter-fisher communities. On Crete and in south-eastern Greece in that period the first groups arrived who commanded a full Neolithic "package" in the sphere of subsistence economy although they did not produce ceramics.

3. The role of continental routes of diffusion of Neolithic groups across the southern Balkans where they encountered relatively few Mesolithic groups with forager-hunter economy. The

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main routes were: across the Central Balkans (units with painted ceramics), and along the littoral zone of western Balkans (units with impresso ornamented ceramics). The former route was continued in the Carpathian basin, the letter along the coast of the western part of the Mediterranean basin. The climatic 8.2 ka BP event (IRD 5a) and regional environmental factors ("agro-ecological barriers") affected this diffusion.
4. The further Neolithic diffusion to Central Europe, mainly its eastern part, after mid-6th millennium cal BC. The formation of the Linear Band Pottery Culture (LBK), along the NW periphery of the complex with painted ceramics, and its spread in Central Europe (ca. 5500-5200 cal BC) took basically place without the involvement of the indigenous Mesolithic populations, as suggested i.a. by genetic data. It is difficult to assess whether these processes were conditioned by climatic factors. The pros and cons of such dependency will be discussed in the presentation. However, during this diffusion a careful selection of potential settlement regions took place, in terms of the ecological conditions most favourable for agriculture. Economic and socio-political disruptions in the LBK development, which can be recorded in the late 6th millennium BC, may be associated with deterioration of climatic conditions (aridization) of 5.1 ka event (IRD 5b?). In the long run, this deterioration contributed to the crystallization of new, post-Linear (Middle Neolithic) cultural patterns.

Keywords: early Holocene, environment, Neolithic expansion, Neolithic adaptations, late Mesolithic

Mongolian pastoralism and climate changes

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Mongolian pastoralism is the result of a multi-millennary process and it is still the current lifestyle of around the 30% of the population. It is difficult to say when and why it started, but apparently it begun after the Neolithic, during the Bronze Age. A climate change is supposed to be the reason of this crucial change.
Some of the patterns of Mongolian pastoralism have certainly remained constant over more than the last two millennia (i.e. the importance of horse breeding, the use of the felt tent and the fermented mare's milk). Therefore the ethnoarchaeological approach can be considered indispensable for a correct archaeology of nomadism of the steppe of Central Asia. In fact, it allows to understand the keywords of Central Asiatic pastoralism and to obtain interpretative models in an archaeological perspective.

To know when, how and why nomads move during the year is important as well to understand how they organize their life in their tent and in their camp. But it is crucial to observe and to understand how nomads face the climate change. Over the years the author has had the chance to document micro and macro changes in the life of Mongolian nomads. In fact the current climate change forces nomads to change their strategies to use the land. I.e. Mongolian nomads spend the winter in the mountains and the summer in the valleys but nowadays it is possible to observe them along the rivers even during the harsh cold season. If the roaming is important it is extremely interesting to observe the migration, to understand how nomads move and to calculate the time they need to move.
Another important keyword of Mongolian pastoralism is the use of dogs which are indispensable to survive. 100% of nomads say that the life is impossible without dogs. Their task is only to guard the camp against wolves and predators. They are not herder-dogs. In this perspective dogs can be considered a crucial element of the adaptation strategy of the nomads of Central Asian steppe.

Keywords: Cliomate change, roaming, Mongolian pastoralism, Central Asia, dogs

*Speaker

II-2. The impact of Upper Pleistocene climatic and environmental change on hominid occupations and landscape use (130-10 ka)

Cerro Benitez after the Ice: Pioneer human exploration South of the Patagonian Ice Cap

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The human exploration of Fuego-Patagonia is a complicated process that, at least near the Andean Cordillera, was dependent on environmental conditions. Cerro Benitez, Ultima Esperanza, Chile, is located immediately South of the Patagonian Ice Cap, and is the Western location where Late Pleistocene human occupations are recorded in Patagonia. The Late Pleistocene ice cover at Cerro Benitez began its retreat around 16,000 BP, while humans arrived around 11,000 BP. For a period of around 6000 years there were a number of environmental changes taking place in that region. These processes include karstogenesis, the cold period of the Antarctic Cold Reversal, continuous landscape revamping, biological colonization, human exploration and colonization, advance of the forest of *Nothofagus* and extinction of Pleistocene megafauna. Using a geoarchaeological and taphonomic approach, and on the basis of our recent results we will discuss the interaction between all these processes and will compare with the situation in other regions in Fuego-Patagonia.

Keywords: Pleistocene, Hunter, gatherers, karstogenesis, megafauna

*Speaker

Climate changes and coastal resource exploitation patterns from the Late Glacial Maximum to the Early Holocene in northern Iberia deduced from oxygen stable isotopes on marine shells

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The detailed study of the environmental variations from the Late Glacial Maximum to the Early Holocene increasingly shows the presence of abrupt climatic change events, of relatively short duration but very marked in terms of intensity, instead of slow processes of gradual change. Under this perspective, the study of their impact over human societies must move away of the models of smooth gradualistic adaptation and it is forced to enquire about the effect of abrupt change over human populations. In this direction, one must expect in those moments rapid changes in cultural responses, including the reorganization of group structures over more reduced territories, the reformulation of resource exploitation strategies and migratory movements. The problem of the detection of abrupt change in the past is its own characteristic, that render difficult the use of traditional climatic proxies, as changes in vegetation, faunas or even sediments. In the last few years, isotopic studies on marine shells have become a routine approach, not only to the study of climate changes, but also to the determination of seasonality patterns in shell collection. Molluscs form their shells by precipitating calcium carbonate in isotopic equilibrium with the surrounding environment, and so they become environmental archives. In the case of marine molluscs, stable oxygen isotopes (δ18O) are mainly dependent on seawater temperature (ST), and therefore, δ18O values can be accurately used for reconstruction of past ST. Besides, the possibility of direct dating of the shells and their association with other food or technological remains is a strong base to correlate climatic change with the behaviour of social groups and their spatial distribution. In this paper we aim to reconstruct the evolution of ST in northern Iberia (Spain), the seasonal patterns of shell collection, and the evolution of shell sizes from _˜25 to 10 ka cal BP using oxygen isotope ratios and biometrical data obtained from the limpet *Patella vulgata* (Linnaeus, 1758). Shell samples were selected from Solutrean, Magdalenian, Azilian and Mesolithic levels recorded at El Perro rockshelter and La Fragua cave, both located very close to each other in the lower Asón river basin (Cantabria, Spain). Changes in seawater temperatures will be compared to the seasonality of shell collection and biometrical data in order to determine whether climate changes influenced human behaviour related to coastal resource exploitation.

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Keywords: Climate change, Oxygen isotopes, Shell midden, Archaeomalacology, Cantabrian region, Upper Palaeolithic, Mesolithic.

Climate induced population breakdown and its consequences for hunter-gatherer social networks around the Last Glacial Maximum

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The late Gravettian (ca. 29,000-25,000 calBP) probably saw the severest demographic crises of *Homo sapiens sapiens* in Europe. Temperatures were at the lowest level of the entire Upper Paleolithic and continuously decreasing solar insolation presumably led to a steady decline in net primary production affecting also the available ungulate biomass. As a consequence, previously settled areas in Great Brittan, Belgium and Germany were abandoned. Demographic estimates indicate that population was shrinking everywhere in Europe. This speaks rather in favor of regional extinction events than for migration processes from northern areas to the south. It seems that the number of people drops roughly to the threshold value for minimal viable populations. The severe population decline apparently coincides with a decrease in typological variability in comparison to the early Gravettian and maybe also the loss of technological complexity. This situation changes during the Last Glacial Maximum (LGM, ca. 24,000-19,000 calBP). During this period, temperatures were rather stable at a level above the one of the late Gravettian and solar insolation started rising again. It is under these conditions that we see renewed demographic growth alongside with different adaptions in Western and Central Europe. Whereas hunter-gatherers in Western Europe preferred areas south of the permafrost line, the population in Central Europe had adapted to conditions north of the permafrost line, namely in the region of Lower Austria, Moravia and southern Poland. The adaption to cooler conditions coincided with larger site catchments as is indicated by raw material acquisition patterns and a very low number of people. The archaeological record indicates that this area might have been abandoned later after around 22,000 calBP. It seems that the pan-European communication network established during the Aurignacian and early Gravettian was severely disturbed during the late Gravettian resulting in increasing dissimilarity and accumulations of regional idiosyncrasies at the end of the late Gravettian and the beginning of the LGM, as is visible for instance in the Solutrean. However, re-occurring similarities in typological and technological concepts suggest that this situation was overcome rather quickly at around the onset of the LGM.

Keywords: Palaeodemography, adaption, climate change, communication networks, Last Glacial Maximum

*Speaker

Du site à l'environnement : approche géoarchéologique de deux sites du Pléistocène supérieur en Afrique de l'Ouest (vallée de la Falémé, Sénégal)

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Les recherches menées dans la vallée de la Falémé (Sénégal Oriental) ont déjà livré des données paléoenvironnementales couvrant le Pléistocène supérieur, permettant une première comparaison avec les données et résultats issus des recherches menées en zone sahélienne, dans la vallée du Yamé (Pays Dogon, Mali). La poursuite de ces recherches et la multiplication des proxys étudiés permettent de confirmer le potentiel des archives sédimentaires présentes dans la vallée de la Falémé, mais aussi d'affiner les premiers résultats et de mettre en place une approche géoarchéologique. La méthode adoptée combine des prospections géomorphologiques de terrain et des analyses haute résolution en laboratoire. L'étude sédimentologique, micromorphologique des dépôts et des phytolithes qu'ils contiennent permet de retracer l'histoire environnementale de la vallée au Quaternaire récent. Le poster présente les données et premiers résultats issus de l'étude de deux sites : Missira et Tomboura. Ces sites, localisés sur les rives de la Falémé ont fait l'objet au total de 15 coupes stratigraphiques, de huit sondages profonds réalisés dans les lobes de méandres et de deux transects géophysiques . En complémentarité de l'étude en laboratoire des sédiments, la réalisation de six datations OSL a permis de caler le cadre chronos-

*Speaker

tratigraphique de ces dépôts entre 47±4 BP et 21±2 BP. Elles témoignent donc d'environnements allant de la fin du Pléistocène moyen au Pléistocène récent. Les fouilles archéologiques ont par ailleurs révélés des niveaux de concentration en outillage lithique, la présence de pièces bifaciales attestant d'une industrie de type Middle Stone Age, jusque-là non représentée dans la vallée. Ces premiers résultats issus des recherches paléoenvironnementales révèlent un contexte de plaine alluviale plus énergique à la fin du Pléistocène moyen qu'au cours du Pléistocène supérieur. Les données phytolitiques vont également dans le sens d'une aridification de la plaine alluviale au Pléistocène supérieur. La bonne conservation des archives sédimentaires, et la présence de niveaux archéologiques bien dessinés mettent en lumière le potentiel d'une analyse géoarchéologique dans cette vallée soudanienne.

Keywords: Géoarchéologie, Afrique de l'Ouest, Paléohydrologie, Sédimentologie, Micromorphologie, Phytolites

Dynamics of Upper Pleistocene climate and hominin occupation during the Middle and Upper Paleolithic in the northwestern Caucasus

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Modern research of the Middle/Upper Paleolithic (MP/UP) in the northwestern Caucasus (NWC) is focused on the study of natural (climate and environment) and social (behavior and adaptations) factors that ruled settlement dynamics of Neanderthal and anatomically modern human (AMH) populations in the region. The most complete and palynologically best-characterized successions of Upper Pleistocene sediments known in NWC allow us to recognize several major climatic stages and significant dynamics of local palaenvironments, varied from tropical/subtropical deciduous woods to subalpic and even alpic conditions of high aridity and low temperatures characteristic for the maximum of full glaciation of the Caucasus mountains during OIS 4. The majority of MP sites in NWC shows development of a local variant of Eastern Micoquian through most of Upper Pleistocene (Golovanova, Doronichev 2003; Golovanova, 2016). In NWC the MP sites are widely spread from low foothills to middle mountains with elevations up to 1300–1500 m asl, and from almost the coast of the Sea of Azov through nearly the central part of Northern Caucasus. The final stage of Eastern Micoquian in NWC is notable in that the number of Neanderthal sites increases, and they show a higher variety and spread towards the eastern boundary of the region. Also, our research demonstrate a high level of Neanderthal adaptation to severe environments, moving of Neanderthal groups across wide territories and exploitation of a large spectrum of natural resources. The research provides new data indicating that ecology and subsistence of late Neanderthals were affected by a large volcanogenic catastrophic event, which caused Neanderthal extinction and divided a subsequent reoccupation of the region by UP/AMH groups. In NWC, the UP sites are found mostly in caves or rockshelters, and show two major periods of AMH occupation: (1) before the Last Glacial Maximum (LGM), from ¯39/38 to ¯20 ka; and (2) after LGM, between ¯18-12 ka. The early UP sites preceeding LGM are rare in the Northern Caucasus, while the Epipaleolithic sites postdating LGM are quite numerous. After LGM, favorable conditions of a long climatic optimum promoted increase of the number of sites and mobility of human groups. A high human mobility is confirmed by the facts that similar Epipaleolithic industries are found in the Southern and Northern Caucasus, and the same obsidian sources were exploited in both regions. Results of our research suggest that the most crucial factors for hominin settlement during the Upper Pleistocene in NWC were favorable climatic and environmental conditions.

*Speaker

Keywords: Upper Pleistocene climate and environment, hominin occupation, Middle and Upper Paleolithic, northwestern Caucasus

Evaluating the role of climate change on the 150,000-year long human occupation sequence at the Haua Fteah Cave (Cyrenaica, northeast Libya)

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The 1950s excavations by Charles McBurney in the great cave of Haua Fteah on the northern coast of Cyrenaica in eastern Libya yielded one of the most important sequences of Upper Pleistocene hominin occupations in North Africa. New excavations between 2007 and 2015 have established that the initial use of the cave was probably in late MIS 6 and probably by anatomically modern humans on the evidence of linkages between 'Pre-Aurignacian' material at the base of the sequence and material associated with two hominin mandibles that McBurney found in higher ('Levalloiso-Mousterian') levels. Occupation continued at different levels of intensity through MIS 6 to 1. The focus of the new work by a large interdisciplinary team has been on establishing the climate/environment framework within which this activity was located, and evaluating the extent to which the different scales and intensities – and absences – of human activity can be understood in relation to that framework. The paper assesses the extent to which the project has achieved that goal.

Keywords: Climate, Haua Fteah cave, MIS 5, 1, North Africa, Hominin adaptations

*Speaker

Exploring different scales of environmental impact on late Pleistocene hominins in western Eurasia

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Climatic and environmental changes operate, and have operated, at many different spatial and temporal scales. This presentation will evaluate how we should test the impacts of these different changes on late Pleistocene hominins. Major perturbations, such as Heinrich events and volcanic eruptions, will obviously vary in their scales and durations of impact from smaller-scale disturbances. Did hominins avoid areas at high risk from small-scale disturbances, and how might hominins have considered the risks of living in areas liable to major environmental disasters? How do we characterise the effects of major environmental disasters such as volcanic eruptions? Were decreasing temperatures always a disincentive to Palaeolithic occupation of environments? This presentation will use several case-studies to explore the effects of different scales of environmental and climatic change, and the potential for hominins of ameliorating any such fluctuations.

Keywords: Abrupt environmental transitions, Campanian Ignimbrite, Heinrich events, resource management, Neanderthals, modern humans, Eurasia

*Speaker

Exploring role of the maritime environment in the colonisation of Australasia, by 50,000 years ago

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The maritime environment plays a central role in the migration to Australasia by modern humans. This migration took place from Southeast Asia, and straits and seas had to be crossed to reach the continent. Recent advances in archaeological and genomic research have pushed the timing of the migration back to at least 50,000 years ago. Climatic changes around this time caused the global mean sea level to fall to around 75–80 m below the present level, exposing parts of the continental shelves of Southeast Asia and Australasia, and changing the environment encountered by migrating people.

It is clear that water crossings must have been made to reach Australasia. However, the archaeological record is fragmented, and there is no direct evidence of seafaring this far back in time. The seafaring capabilities and skills of the early colonisers are strongly debated, and the nature of the colonisation process is still poorly understood. To better understand this process, and explore questions on human behaviour during this important event in the peopling of world, it is crucial to better understand how the maritime environment, especially open ocean and tidal currents, affected movement over sea.

Here, dynamic effects of the maritime environment on seafaring are explored with high-resolution computer models of open ocean and coastal tidal circulation, forced with modern-day climate data. Lowered sea levels are simulated to provide a first examination of how changes in environmental conditions could have affected timescales and routes to Australasia. Initial results indicate a strong but variable influence of currents on movement, which should be considered in the debate on the nature of the colonisation of Australasia.

Keywords: maritime, migration, Australia, Upper Pleistocene

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Geoarchaeology and Late Pleistocene Paleoclimate at Lapa do Picareiro, Portugal

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Lapa do Picareiro is a mountaintop cave in Serra de Aire Natural Park, Portugal that contains rich faunal and lithic assemblages dating from the Middle Paleolithic through the Bronze Age. Geoarchaeological investigations at the site have revealed more than 10 m of stratified éboulis dated by more than 50 radiocarbon ages to roughly 9-75 ka. The sedimentation rate during this period varied between 10-30 cm per 1000 years, with the rate accelerating after 25 ka.
Most of the sedimentary fill is derived from spalling of small clasts, roof collapse, small-scale debris flows, and mud inflow through bedrock fractures. The presence of Middle Paleolithic (Mousterian) and Upper Paleolithic (Gravettian, Solutrean, and Magdalenian) components, abundant fauna, and a thick continuous sedimentary sequence make this one of the most complete terrestrial sequences for the Late Pleistocene in Iberia.

Rhythmic bedding in the central part of the cave, where clast-supported éboulis beds alternate with muddy éboulis beds, suggests a connection with late Pleistocene climate fluctuations. The most promising paleoclimate proxies are magnetic susceptibility and median clast size, which match Greenland ice core and deep sea sediment records closely back to at least 40 ka. Warm/humid interstadial phases are characterized by small clast size and magnetic susceptibility maxima, while cold/arid stadials are characterized by larger clasts and magnetic susceptibility minima. Coarse and relatively mud-free beds are associated with Heinrich events 1-6, which are overlain by very muddy beds with increased deposition of secondary carbonates.
Overall the sequence reflects a karst system subject to intense frost weathering and enlargement of conduits during cold stadials, followed by enhanced mud transport and speleothem growth during the subsequent warm interstadials. This interpretation of the sequence at Picareiro is supported by correlation with other regional proxies derived from speleothems, pollen studies, and nearby Middle/Upper Paleolithic archaeological sites.

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Keywords: Geoarchaeology, Paleoclimate, Iberia, Portugal, Middle Paleolithic, Upper Paleolithic

Human occupation and environment during the Last Glacial Maximum in the Middle Dniester region, Ukraine

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Human presence under cold and arid conditions of the Last Glacial Maximum is often argued to be limited to more favourable refugial areas. The East European Plain is a vast landscape characterized by more arid conditions than Western and Central Europe. Limiting factors of human presence on the East European Palin are not well understood. Here, we focus on the case study region of the Middle Dniester region in Ukraine, located in the western part of the East European Plain. We explore limitations of human occupation of the region by combining palaeoenvironmental record from loess-paleosol sequences using pedology and palynology, with the rich record of human behaviour archived in the archaeological sites of the region using faunal assemblages and lithic technology. Case study sites are Dorochivtsi, Korman 9, and Molodova V, for all of which we present new pollen and radiometric data along with new faunal and lithic data. Our results include evidence of human presence in the Middle Dniester region throughout the Last Glacial Maximum. Acknowledgements: Funded by Belgian Science Policy (Sc-04, Sc-09 and MO/36/021 research projects), INTAS projects 93-169, 93-169-Ext, 96-072, 2000-879, Leakey Foundation, European Commission (FP7 Marie Curie Career Integration Grant 'NEMO-ADAP', grant no. 322261), DM McDonald Grants and Awards Fund, Max-Planck-Society, British Academy, Isaac Newton Trust.

Keywords: Environment, climate, human occupation, palynology, Last Glacial Maximum, Dniester region

*Speaker

Late Glacial Rapid Climate Change and Human Response in the Western Mediterranean

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In the Western Mediterranean there is a long research history of Palaeolithic archaeology that is accompanied by a rich palaeoclimate record from the Atlantic and the Mediterranean Sea as well as terrestrial geo-archives. In addition, the Iberian Peninsula and Morocco are known for their high bioclimatic diversity ranging from hyperoceanic temperate bioclimates in the Cantabrian Mountains to the hyperdesertic tropical climate at the northern fringe of the Sahara. This combination of archaeological and paleoclimate data makes the Western Mediterranean an ideal test case for the study of hunter-gatherer behavior in relation to environmental changes.
In this paper, we evaluate available archaeological and geochronological data of more than 300 Solutrean and Magdalenian as well as Iberomaurusian occupations in order to characterize the extent and causes of occupation changes in the Western Mediterranean of Last Glacial hunter-gatherer groups. Three main geographical areas (Northern Iberia, Southern Iberia, and Morocco), where human populations reacted differently on palaeoenvironmental changes, could be differentiated.

We test different methods for a multi-proxy analysis as site numbers and site formation, 14C data and their summed calibrated date probability distribution (SCDPDs) as well as site distribution combined with Nearest Neighbour Analysis (NNA), Ripley's K analyses and Kernel Density Estimates (KDE).

For the LGM, displacement of populations in the Western Mediterranean due to environmental change is evident as well as strong regional differences. A significant increase of human presence in Southern Iberia during the Solutrean is recorded that might be interpreted as population boom. At the same time only a sparse repopulation is visible in Morocco after a gap of human occupation for several thousand years. After the LGM strong dry spells during Heinrich 1 Stadial probably cause a breakdown of human population in Southern Iberia that remains unstable

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after HS1 while in Morocco an increase of site numbers becomes apparent.
Population discontinuities played an important role in human presence and cultural change in the Western Mediterranean. Especially Southern Iberia and Morocco seem to have been high risk environments in special moments for hunter-gatherers. Our data suggest that groups of the Late Iberomaurusian found better answers to cope with climate stress than Magdalenian groups from Southern Iberia.

Keywords: Solutrean, Magdalenian, Iberomaurusian, Settlement pattern, Population turnover, Land use

Multidisciplinary study of man-environment interactions during the Upper Pleistocene in Central Spain: The Abrigo del Molino system

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Abrigo del Molino was discovered in 2012 and it is being excavated from 2013 to the present. It has been currently revealed as an important site to characterize late Mousterian occupations in the interior of the Iberian Peninsula. The rockshelter opens upstream of Eresma River (Segovia, Central Spain), in a monoclinal fold produced by the Alpine orogeny in the Cretaceous strata in which the cave was formed later. Fluvial sediments form the base of the stratigraphy, accumulated during palaeofloods of the Eresma River. This process was followed by a filling phase caused by the action of debris flow. From this moment, the rockshelter started to be occupied by Neanderthal groups.

During the 2014 campaign a small shelter, also totally filled by sediments was discovered in the immediately upper part of Abrigo del Molino, which was called "Abrigo del Molino superior". The human occupations registered in this shelter were smaller and slightly previous to the occupations at Abrigo del Molino. Everything indicates that the process of the embedding of the Eresma River, and the subsequent action of gravitational displacement of the debris flow on the slope, towards the river, caused the collapse and sealing of the "upper zone". Once the river incised and the slope stabilized, another rockshelter located at a lower level of the valley slope

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became accessible.
This process, which reflects the evolution of the "Abrigo del Molino" system, is a clear example of how the climatic factors that affect the geomorphological processes have conditioned human occupations in this inland area of the Iberian Peninsula. These processes caused the adaptation of the Neanderthal groups to this changing scenario.

Keywords: Mousterian, Neanderthals, Geoarchaeology

Neanderthal occupation patterns and landscape use during the Middle Paleolithic in Central Caucasus

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The research of changes in the natural environments and human subsistence during the Paleolithic has a high significance in modern studies. However, many regions remain "white spots". One of these areas is north-central Caucasus-region located between the highest European volcanic mountain peaks of Elbrus (5642m asl) and Kazbek (5034m asl). Although there are numerous evidences of contacts among Neanderthal populations inhabited neighboring regions and north-central Caucasus our knowledge of the Middle Paleolithic in this region is based only on a few surface collections of Mousterian artifacts, which age is difficult to evaluate, Weasel cave, and the recently discovered Saradj-Chuko Grotto (Doronicheva et al., 2017).
The north-central Caucasus is rich in different types of lithic raw materials and is notable as the region producing the only obsidian source (called Baksan or Zayukovo) known in the Northern Caucasus. Currently, studies show that artefacts from this obsidian are present in the Middle Paleolithic layers at Mezmaiskaya cave in north-western Caucasus (Doronicheva, Shackley, 2014); however, sites of this cultural tradition are not known in the obsidian source area. The Levallois and laminar characteristic, and absence of bifacial tools differ the Mousterian industry of Saradj-chuko grotto, and the entire north-central and north-eastern Caucasus (Terek river basin) and the Eastern Micoquian industry of the northwestern Caucasus (Kuban river basin), as well as suggest affinity with some Mousterian industries in the Southern Caucasus.
Based on multidisciplinary investigations at Saradj-chuko grotto, including the study of paleoclimate, local volcanism, absolute dating, palinology, geology and geomorphology, and research of local raw material sources, we report the synthesis of this interdisciplinary research, which comprises local chrono-stratigraphy reconstruction of paleolandscape and paleogeography of the region during the Upper Pleistocene. This comprehensive study enable us to reconstruct cultural-economic changes, migrations, and social relations in different periods of the Middle Paleolithic, determine influence of climatic cycles on changes of life support systems of the Neanderthal population during the Middle Paleolithic in Central Caucasus, and correlate stages of Neanderthal colonization of the Central Caucasus with the neighbouring areas of Western and Eastern Caucasus. Petroarchaeological and geochemical analyses of lithic raw materials (flint and obsidian) allow us to study Neanderthal migrations within the Central Caucasus region and interregional contacts. Especially important is the study of connections of the Central Caucasus with the western and eastern parts of the Caucasus, settlement dynamics in different regions of the Caucasus, origins and evolution of culture in the Middle Paleolithic. The research was funded by the Russian Scientific Foundation grant for the research project 17-78-20082, "Human-nature interaction in the Past in the Central Caucasus: dynamics of environmental change and technological innovations, and subsistence strategies".

*Speaker

Keywords: occupation patterns, paleoclimate, volcanism, adaptations, raw material strategies, Middle Paleolithic, Central Caucasus

Neanderthals and Climate Change from a Belgian, Late Pleistocene, Loessic Perspective

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The most characteristic feature of the Quaternary deposits, which were studied at the *Vandersanden* quarries at Veldwezelt-*Hezerwater* and at Kesselt-*Op-de-Schans* (Belgium), is the recurrent alternation of sedimentation, weathering and denudation processes, which were called forth by climatic fluctuations. Loess, loess-derived sediments and soils are usually very susceptible to these climatic fluctuations. In favourable conditions, as is the case at Veldwezelt-*Hezerwater* and Kesselt-*Op-de-Schans*, they provide possibilities for several cycles to be studied in direct superposition. At these sites, Middle Pleistocene and Late Pleistocene loess-soil sequences provided detailed chronostratigraphic, palaeoclimatic and palaeoenvironmental information. These loess-soil records are now generally considered as the continental equivalent of the deep-sea oxygen isotope records.
The Late Pleistocene loess-soil climosequence at Veldwezelt-*Hezerwater*, overlies the fluvial *Maas* terrace and layers of *Hezerwater* gravel, sands and silts. Then follow several loam and loess layers, within which several paleosoils were attested. The Last Interglacial Soilcomplex at Veldwezelt-*Hezerwater*, is overlain by relatively thick and differentiated Last Glacial loess/loam layers, which were further characterised by periods of interstadial pedogenesis. Indeed, this Last Glacial loam and loess accumulation phase has been interrupted repeatedly by periods of soil formation. At the beginning of the Last Glacial cycle, the formation of soils exceeds the sedimentation of loess or loam, whereas to the end of the Last Glacial cycle, the deposition of pure loess prevailed. The loess-soil climosequence provides proof of environmental and palaeoclimatic changes, which affected this part of Northwest Europe during the Middle and Late Pleistocene. It seems that Middle Palaeolithic core and tool reduction strategies constituted a whole range of technological options, which were invoked differently according to context. The 'cyclic' appearance or reappearance of prismatic or Levallois core reduction strategies, the presence or absence of unifacial, bifacial, notched, denticulated, Quina or 'small' tools in the different lithic assemblages excavated at these open-air sites should not be seen as extraordinary events, but simply as the natural outcome of the dynamics of flint knapping. Not the cyclic 'reinvention' of some sort of core or tool reduction strategy, but the recognition of it, as being more useful for certain kinds of activities in specific climo-environmental contexts, was the crucial element in this fluctuating technological system. Technological 'equifinality' and 'formal convergence' (*e.g.*, mechanical & physical restraints) almost certainly overrode in most cases any hypothetical 'cultural' component.

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Keywords: Veldwezelt, Hezerwater, Late Pleistocene, Neanderthals, Middle Palaeolithic, Loess, Paleosoils

Peopling the Arctic Siberia in the Late Pleistocene

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Successive large-scale complex restructuring of the environment in Arctic Siberia within the last 60,000 years certainly contributed to human dispersal within the area and affected the cultural development of the region's human population. The earliest known evidence for human habitation in the Arctic Siberia dates to almost 50 ka. At around this time, tundra-steppe landscapes form in northern Eurasia.
The open habitat challenged a number of revolutionary Upper Paleolithic technological innovations necessary to exist in a treeless, basically flat topography. Thus, unlimited use of bone and ivory tools became the greatest innovation of the Upper Paleolithic coeval to the time of the MIS 3 mammoth steppe formation. As soon as humans were armed with this technology, which allowed subsistence in open landscapes, they became capable of quickly colonizing the tundra-steppe across northern Eurasia including the Arctic regions.

The early occupants of Arctic Siberia were sparsely distributed, but their descendants presumably maintained successful survival throughout the middle MIS 3. By the end of MIS 3, they settled in the Arctic Eastern Siberia in Yana river. They were not completely preoccupied with mammoth hunting, as indicated by a lack of mammoth mass kill sites. Their subsistence was based mainly on bison, horse, and reindeer while mammoth procurement was aimed largely at getting the tusks, an important raw material.

Upper Paleolithic inhabitants continued living in Arctic Siberia throughout the LGM. Even then, the mammoth steppe biome remained supportive enough for large grazers providing sufficient forage resources for them. Thus decline in mammoth population in Arctic Siberia during the LGM was compensated by growing bison population numbers. Despite certain changes in biodiversity and in animal population numbers, the steppe-tundra habitat remained comfortable for humans whose sites are known in Yana-Indighirka interfluve. This undermines the human depopulation hypothesis.

Decline of the West Beringian mammoth population during and after the LGM probably led to important cultural changes. Dispersion of the Beringian Microblade tradition follows the area populated by mammoth in a northerly direction as mammoth habitat shrinks. Notably, the oldest known microblades in Arctic Siberia date to _˜12,500 years BP. Then mammoth extinction serves as a trigger for archaeologically visible technological changes. Thus from the very beginning, human habitation in Arctic Siberia was constantly driven by environmental changes whose

*Speaker

effect on the human spatial distribution pattern, culture, and behavior are well-pronounced in the archaeological record.
This work is supported by Russian Science Foundation project No. 16-18-10265-RNF.

Keywords: Upper Paleolithic, Arctic, Beringia, human dispersal, subsistence strategy, climate change, environment change

Population dynamics during the early Upper Palaeolithic in Europe

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Recent debates have again questioned simple, linear models linking demographic, cultural, and environmental changes in Palaeolithic research. While the human-environmental interaction has received considerable attention during the last decades, studies repeatedly suffer from low chronological resolution of the records. Simultaneously, the awareness towards social factors influencing hominin dispersal and survival has increased in model building theory. The lack of consistently derived demographic estimates for Palaeolithic societies – which consider different spatial and temporal scales as well as effects of dispersal and contractions – has been an obstacle in any discussion of population dynamics. Drawing from results of an ongoing research program, Project E1 of the CRC 806 "Our Way to Europe", funded by the German Research Foundation since 2009, the present study provides such estimates for the early Upper Palaeolithic and focuses on population dynamics across the western and central European subcontinent. We use a geo-statistical up-scaling approach to model areas of long-term and intensive occupation, for which demographic estimates can subsequently be derived. In an interdisciplinary endeavour, socio-economic and cultural data on site distribution patterns, mobility (raw material transport) and interconnectedness (personal ornaments) are brought together with data on the palaeoenvironmental and geophysical setting. We propose a scenario for the observed population dynamics during the Aurignacian and subsequent early Gravettian period that is based on an understanding of demographic processes as a response to social network structures within hunter-gatherer societies.

Keywords: Population dynamics, Demography, early Upper Palaeolithic, Aurignacian

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Should the Solutrean culture be considered as an "impact" of Upper Pleniglacial climatic and environmental change? Searching for the true changes in economy and mobility of Solutrean groups in Southwestern France.

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How did Palaeolithic human groups live in changing environments? And can we consider some characteristics (invention, borrowing, development, abandonment, modification) related to technology, habitat, settlement patterns, economy, as well as emergence and decline of a society, to be answers to major environmental changes? The case of Western Europe hunter-gatherer societies who lived between 26,000 and 22,000 cal. BP illustrates this question. In the coldest and driest environment of the Upper Palaeolithic, whereas Northern Europe was devoid of human occupation, some human groups lived in Southern/Western France and in the Iberian Peninsula. They created a new lithic technology and produced particular lithic tools and components of hunting weapons, as well as specific ornaments. So should we consider that the extreme climatic conditions led to the Solutrean culture and how? More generally, how could lithic production and technology, animal resources economy and mobility be linked to a new environment people would have adapted to? However we must identify specific features within the Solutrean economic system, before wondering if they are linked to a possible environmental change. This paper addresses this issue through the investigation of animal resources exploitation, curiously seldom considered in current research. We focused on Solutrean faunal resources, Reindeer hunting strategies, antler exploitation patterns, seasonal hunting-collecting patterns, mobility strategies and annual cycle of nomadism. Then we compared these features with Gravettian and Magdalenian ones to demonstrate how they were different and linked to the changing environment.

Keywords: Solutrean culture, Environmental changes, Economic system, Mobility stategies

*Speaker

Spatial and temporal trends in late Pleistocene hunting behaviour in Northern Vietnam: evidence from the Tràng An World Heritage Area

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This paper will consider ongoing research by the SUNDASIA project (AHRC, UK) in the limestone karst forests of the Tràng An World Heritage property, Ninh Binh province, Northern Vietnam. Archaeological excavation of cave sites within Tràng An has yielded records dating from the late Pleistocene to the present. The paper will focus on the late Pleistocene zooarchaeological record, which currently dates from c. 24,000 years before present to the Pleistocene/Holocene transition. It will consider taxonomic and taphonomic trends in the exploitation of vertebrates and how these varied as a function of space and time in the World Heritage Area.

The zooarchaeological record currently suggests that - over the course of c. 12,000 years - hunting behaviours varied more as a function of space, rather than time. The evidence suggests a consistent, long-term pattern in the exploitation of several mammalian taxa while inter-site variability is suggestive of local-scale variation in the targeting of prey animals, most parsimoniously explained as a function of differing local environmental conditions and habitats. Taphonomic analyses suggest that preservation of animal bones varied more as a function of site formation processes rather than denoting differences in carcass processing. Despite the likely abundance and diversity of mammalian prey, however, exploitation of individual carcasses of a range of taxa appears to have been intense and suggests expedient utilisation of prey animals throughout the late Pleistocene.

These findings will be compared with regional records to consider the wider applications of the evidence from Tràng An in modelling hunting behaviour in response to environmental change in late Pleistocene Southeast Asia.

Keywords: Zooarchaeology, late Pleistocene, Vietnam

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The Neanderthals and AMHs Odyssey in the hellenic peninsula

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Finds in eastern Europe, the Balkans, the Anatolia and the Levant based on archaeological and anthropological studies have shown that AMH's after their exodus from Africa occupied the Levant between 130 and 80 ka BP. In the Levant they met with the Neanderthals, who resident the Levant between 75 and 45 ka BP after migrating from central Europe during MIS 4 and MIS 3 to avoid the cold. The AMHs finally started spreading from the Levant to Europe around 50 and 47 ka BP through the Bosporus land-bridge. Since then AMHs and Neanderthals did coexist in many parts of Europe.
In this paper recent archaeological and palaeo-geographical studies from the Hellenic peninsula are presented, for addressing the following questions: (i) did Neanderthals and AMHs coexisted in the Hellenic peninsula and (ii) did Neanderthals and AMHs in their movement from the Levant and Anatolia to Europe and vice versa were crossing the Aegean sea using the islands during MIS 4 and MIS 3 (74 to 23 ka BP).

For answering the aforementioned a chrono-cultural framework is established for the Hellenic Peninsula and the Aegean Sea for the MIS-4 and MIS-3 and compared to those from the Levant, Anatolia and eastern Europe. Furthermore, the palaeo-shoreline configuration of the Aegean Sea is established over the same time span, to examine the insularity of the Aegean islands

The analysis of the above data shows that: (i) the Hellenic peninsula was occupied by the Neanderthals during MIS 4 and MIS 3, (ii) Neanderthals and AMHs co-existed in the Hellenic peninsula at around 40 cal ka BP, (iii) the max. time-span of the Neanderthals and AMHs co-existence in the Hellenic peninsula may extend from 44 to 33 cal ka BP, (iv) Neanderthals and AMHs were seafaring in the Aegean Sea, the former from around 60 to 35 ka BP and probably from 120 to 35 ka BP, the latter from 35 ka BP and onward, (v) Neanderthal and AMHs in their movement from the Hellenic peninsula to the Anatolia and vice-versa had established a coastal route via the Aegean Archipelago, "the Aegean route", which might have been used as an alternative route to the Bosporus land-bridge.

Keywords: Neanderthals, AMHs, Hellinique Peninsula, seafearing, human migration, Aegean route

*Speaker

The effects of paleoenvironment changes in the North-Eastern Europe and the Urals in the Upper Pleistocene on the Initial Inhabitation of the region during Upper Palaeolithic

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The report examines data on the environment of Early Upper Paleolithic sites (38-28 kyr) and late Paleolithic sites (18-9.5 kyr) situated in North-Eastern Europe (Pechora and Upper Kama rivers basins) and the Urals. It has been shown that during MIS3 there was the most favorable conditions for the settlement of the region by Upper Palaeolithic men. At the beginning of the MIS2, the region experienced a significant deterioration of the natural and climatic conditions, which in the first half of the MIS2 (27-19 kyr) were extremely unfavourable for the Paleolithic people. The abrupt change in the paleoenvironments led to the intermittent settlement of the north-east of the Eastern European plain and the Urals in the second half of the Late Pleistocene. Two episodes of settlement of the region in the second half of Late Pleistocene are currently being recorded. Major characteristic of colonization of the Northern Urals during Early Upper Palaeolithic (38 – 33 ka) is almost simultaneous populating of the South (the Kama river) and the North (the Pechora river) of the region. Types of sites are represented by temporary hunting camps in the Upper Kama basin (Zaozer'e, Garchi I) and sites on mammoth burial grounds (Mamontova Kur'a, Byzovaya) on the Pechora river. The central regions of the East European Plain served as the original area of settlement, with migrations spreading from South-West. We can assume that during this period people started exploring the region.
During the last stage of the Early Upper Paleolithic (29 – 28 ka), probably, change in character of colonization of the region takes place resulting in shift from exploration to populating. However, this process did not logically end in the formation of regional culture. In the first half of the Late Valdai due to various reasons, one of which was, probably, sharp deterioration of regional natural and climatic conditions, at least in the Northern Urals, depopulation begins.

The next colonization wave begins in the second half of the Late Valdai, after the LGM.

First stage of the Late Paleolithic colonization in terms of character of populating is practically analogous to the previous wave. Early sites of this migration cycle are also located far enough (over 2000 km) from culturally close sites. Migrations spread from South-East. Migration type, as in the previous period, complied with TEM model.

*Speaker

Formation of local Late Paleolithic Ural culture became the major event in the Paleolithic history in the region. Evolution of the Ural culture was to a great extent autochthonous. At the first period of its existence, the characteristics of the culture are very similar to parent Siberian small blades industries. During the second period similarity with Siberian industries becomes less pronounced but does not disappear completely; cultural interconnections between various groups of people within the Ural region are established; cultural consolidation begins and cultic sites emerge. During the third, Final Paleolithic stage, for the first time constant intraregional cultural interconnections are traced, primarily with people of the East European Plain which dominate on the western boundary of the culture areal. At the same time, traits of cultural differentiation process in the region appear. Forms of cultural interconnections indicate existence of constant population in the region during the Late and Final Paleolithic. Directions and forms of ethnocultural interconnections between people of the Ural region in the Upper and Late Paleolithic were determined by specific historic situation, being formed in surrounding the region territories in the Middle and Late Valdai.

The Ural region was colonized by prehistoric communities whose life sustaining system was based on hunting large herbivores. This adaptive type was characterized by high mobility of population (local cultures based on eco-adaptation, according to A. V. Golovnev (*Golovnev,* 2009:18–23). In the beginning of the Early Paleolithic it was common for the whole Eurasia (*Anikovich* et al., 2008:76–78; *Goebel*, 2004: 162–195). In the Late Paleolithic it remains and develops in Siberia (*Abramova*, 1993: 85–99; *Vasil'ev*, 2000: 173–196), while on the East European Plain another adaptive type – type of semi-settled mammoth hunters of Eastern Gravettian and Epigravettian cultures (*Anikovich* et al., 2008: 232–233; *Abramova*, 1993: 93–94; *Anikovich*, 1998: 63) – is formed. Distant migration was uncommon for people living in the center of the East European Plain, they moved within the already explored area.Absence of significant natural barriers between the Urals, the East European Plain and Siberia, dense river network serving as natural ways for colonization and furthering people migration were the major natural and geographic factors that determined early populating of the Urals region.

Keywords: Northeastern Europe, Urals, Upper Palaeolithic, initial inhabitation, palaeoenvironment, landscape use

The impact of habitat suitability on cultural transmission during the Last Glacial Maximum in Western Europe.

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Climate instability during the Last Glacial period affected habitat suitability and thus, human mobility. During the glacial maximum the population of Western Europe appears to have contracted its range as the climate became both less hospitable and more unpredictable. Archaeological data, climate simulations and agent-based modelling are combined in this research to explore the impact of habitat suitability on human populations. We use a model of habitat suitability derived from archaeological site distributions, paleo-climate simulation data and environmental predictors to derive a GIS landscape (Burke et al. 2017). An agent-based model is then used to explore the impact of this landscape structure on patterns of cultural transmission within Western Europe. Some of the parameters tested here include different human mobility strategies and inter-regional exchange. Our results allow us to better understand how environmental change affected the cultural landscape of human beings as well as their geographic distribution

Keywords: climate variability, habitat suitability, cultural transmission, Last Glacial Maximum, land use, Western Europe

*Speaker

The role of environmental change in the expansion of early modern humans in the Levant – what we can learn from mollusc shells

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Humans respond to changes in their local environment on daily to seasonal timescales. Therefore, a robust assessment of the impact of environmental change on human behaviour requires an understanding of local environmental change at seasonal to sub-seasonal resolution. Stable isotope records from mollusc shells provide one of the few sub-seasonally resolved palaeoenvironmental proxies in the Mediterranean. Obtaining these records from molluscs that were consumed by people enables the reconstruction of a more detailed picture of how humans responded to changing climatic regimes in the past and ensures that the resulting palaeoenvironmental records are directly linked with human activity. Here we present sub-monthly resolved environmental reconstructions from stable isotope analyses of mollusc shells from the Upper Palaeolithic assemblages of the archaeological sites of Ksăr Akil in Lebanon and Manot Cave in Israel. These highly resolved environmental records, coupled with well-dated archaeological sequences provide a framework for assessing the complex interplay between early modern humans and their local environments. We found evidence for fluctuating temperature, rainfall and seasonality regimes throughout marine isotope stages (MIS) 4 to 2, some of which appear to be linked to northern hemisphere millennial-scale climate oscillations. The archaeological records show human occupation of these sites occurred during both warmer and cooler phases and during both high and low seasonality regimes, indicating that modern human populations were somewhat resilient to the resource uncertainty that would have accompanied these changing temperature and seasonality regimes. These paired cultural-environmental records have enabled an examination of hominin-environment interactions during critical periods of the late Pleistocene in a region with comparatively few high-resolution climate records.

*Speaker

Keywords: stable isotopes, mollusc shells, seasonality, early modern humans, sea surface temperature, palaeoclimete, human, environment interaction, early modern humans, Levant, Mediterranean

UPPER PLEISTOCENE CHRONOSTRATIGRAPHY AND PALAEO-HUMAN-OECOLOGY OF THE B́UKK MTS, HUNGARY

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Due to the regular cave excavations started in 1906, Northeast Hungary and the B́ukk Mts. within this region became the birthplace of the Hungarian prehistory studies, and additionally of the litho-, bio- and archaeostratigraphy based on cave sediments as well. The first (in the sense of that time) complex chronostratigraphic summary was published in the monography describing the Suba-lyuk Cave from the South B́ukk, and it can be considered as modern up to the turn of the 1960's and 70's years.
László Vértes published in 1959 a paper titled "Untersuchungen an H́ohlensedimenten in Ungarn", distinguishing 15 stratigraphic and climatologic periods in the Late Pleistocene of the B́ukk Mts.

Based on the vertebrate palaeontological studies of Dénes Jánossy (1979), in 1991 László Kordos and Árpád Ringer started to evaluate a modern Upper Pleistocene chronostratigraphy of the mountains.

The correlation of the cave and subaerial sediments was carried on with nearly 25 years of cave and open field excavations made in the B́ukk Mts. region, also revising earlier records mainly from cave explorations. The key site was the Diósgýor-tapolca Cave in Miskolc with the infill of the cave and the surrounding surface, where subaerial palaeosoils and loess beds were laterally connected with the cave soil beds (H́ohlenb́oden) and the sediments of cooling periods with a loess matrix.

Our presentation introduces a generalized column of the Upper Pleistocene cave and subaerial sedimentary succession of the B́ukk Mts, the characteristics of the palaeosoils and sediments of the 22 warming and cooling climatic periods, fauna and flora of these periods and the coexisting archaeological cultures and their landscape use.

The chronostratigraphy is supported by recently measured radiocarbon-14 dating in collaboration of Marcel Otte, Brian Adams, William Davis and J́urgen Richter.

*Speaker

Keywords: B′ukk Mts., Upper Pleistocene, chronostratigraphy, environment, prehistoric economy

Understanding human adaptive responses to abrupt climate change in western Iberia during MIS 3 and 2 using multi-scale archaeological, paleoenvironmental, and paleoclimate records

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During the Upper Pleistocene (MIS 5-2), human populations adapted to abrupt climate changes that created highly variable paleoenvironments across the Iberian Peninsula. Our understanding of human responses to environmental change derives from multi-scale spatio-temporal archaeological, paleoenvironmental, and paleoclimatic records. Artifact assemblages from archaeological palimpsests and high-resolution sites reflect human-environment interactions during this period. Polar ice cores record global scale temperature and sea-level changes on annual time scales for the entire Upper Pleistocene. Deep-sea sediment cores off Iberia record regional and continental scale climate and environmental changes at centennial and millennial time scales. Terrestrial sediment traps, including lakes, bogs, and caves, record local and regional scale records at similar temporal scales. For western Iberia, Lapa do Picareiro, a cave site in central Portugal, provides a diachronic record for MIS 3 and 2 human occupation and environmental change. The cave contains a continuous, 10.5 m stratified sequence of minimally-disturbed sediments spanning 60,000 years of the Upper Pleistocene, making it an ideal locale to track long-term changes in paleoenvironments and human ecodynamics. The sedimentary sequence of Picareiro contains Middle and Upper Paleolithic occupations, extremely rich faunal assemblages, and subtle variations in particle size and geochemistry that record changes in the climate, hydrology, and morphology of the cave environment. Age control is provided by over 50 radiocarbon dates. Stratified lithic artifact assemblages fit regional and local patterns of technological change during the Middle and Upper Paleolithic. Taphonomic analyses of the faunal remains inform on local paleoenvironments and human diet choice during MIS 3 and 2. Sedimentological analyses including magnetic susceptibility link the cave deposits with global scale records of Upper Pleistocene climate from the Greenland ice cores and regional-scale ones from deep-sea cores off Portugal. We use these data to synchronize abrupt climate changes and human ecodynamics during the Upper Pleistocene.

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Keywords: Middle Paleolithic, Upper Paleolithic, Iberia, Portugal, cave

Were the Gravettian cultural innovations triggered by climatic change? Insights into the lithic assemblages from Hohle Fels, SW Germany.

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During the Gravettian several innovations in lithic technology and typology appear. Blank production focusses on long, straight and narrow blades and bladelets. The preparation and maintenance of cores is frequent, and core exploitation is efficient. Often bladelets and smaller blades are transformed into backed elements, among them the well-known Gravette and Micro-gravette points. Backed elements in general were mostly hafted; many were parts of a modular projectile technology, but some served other uses such as cutting or perforating. These artefacts are part of a highly mobile toolkit, and their modular nature makes them especially convenient in terms of transport and maintenance. Here we look at the lithic assemblages from the Gravettian of Hohle Fels Cave (Germany) and discuss the possible impact that climate change might have had on Palaeolithic hunter-gatherer societies during the end of Marine Isotope Stage 3. We examine the degree to which environmental development may have triggered some of the innovations that came with the Gravettian.

Keywords: Gravettian, Swabian Jura, MIS 3, Lithic Technology

*Speaker

II-3. Agropastoral and climate change. Crossed analysis of archaeological and palaeoenvironnemental data

.... et ceux qui creusent. Toi, tu creuses. (.... and those who dig. You dig.) Le fossé, le climat, la société.

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Un travail conduit, depuis une vingtaine d'années, sur le rythme et la nature des occupations protohistoriques post-néolithiques (entre le IIIe millénaire et le début de notre ère commune), a mis en évidence des cycles dans les formes de l'habitat, les structures agraires et plus spécifiquement les planimétries agraires. Cette lecture a été confrontée à un examen multiscalaire et multiproxy, multipliant les échelles d'études (dans l'Ouest de la France et le sud de l'Angleterre) et les indicateurs (paléoenvironnement, flux sédimentaires, climat), dans le cadre d'une modélisation résolument orientée sur l'observation de trois principales variables : le fossé (le Bon), le climat (la Brute) et la société (le Truand). Dans le cadre de cette communication nous livrons les premiers résultats de ce travail vu sous l'angle d'une restitution du comportement historiques des hommes sur 2500 ans.

Keywords: Ouest France, Sud Grande, Bretagne, archéologie, climat, Société

*Speaker

AN EVOLUTIONARY COMPARISON BETWEEN ANCIENT AND MODERN AGRICULTURAL COMMUNITIES

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For the interpretation of the dynamics going on in ancient agricultural communities it is very helpful to know more about those dynamics in modern communities. But rather than compare past and present as analogues to one another, an evolutionary approach in which the trajectory between the ancient past and the present is taken into account seems to have more to contribute to our understanding of both past and present. Archaeology's long-term perspective is eminently suited to outline major changes that have occurred in the past, while the study of the present is better suited to understand the detailed dynamics between these major changes. In this paper I will try and contribute to such an approach by combining both approaches in a couple of examples

Keywords: agropastoral system, modern, ancient

*Speaker

Climate change and site formation processes in a Neolithic lakeside settlement. Integration of geoarchaeological and palaeo-environmental data at La Draga (Girona, NE Iberian peninsula).

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This paper is focused on the stratigraphic correlation between sectors with different sedimentary processes within the same archaeological site. The stratigraphy recorded from the excavated sectors at the Neolithic lakeside settlement of La Draga, Banyoles (Girona, Spain), reflects different formation processes, which may result from both social use of space and changes in the lake water level and/or sedimentary subsidence. Samples of two different sectors, one emerged (Sector A) and another (Sector D) partially covered by the phreatic level, have been analyzed. The analysis of the stratigraphic record includes palaeoenvironmental studies (pollen and NPP analyses), geomorphological and geochemical analyses and 3D correlation of stratigraphic columns. Palaeoenvironmental and geoarchaeological data enabled a detailed characterization of both different layers and phases as well as the reconstruction of local palaeoenvironmental evolution associated with climate change. In sector D, the oldest phase layers, show a humid environment and sedimentation in waterlogged conditions, while soil erosion episodes are recorded during the more recent phase in the context of deforestation processes. During excavation of sector A, those phases couldn't be clearly identified, so soil micromorphology is applied in thin sections, in order to detect probable different episodes of sedimentation. The integration of geoarchaeological and palaeoenvironmental data allowed assessing how climate oscillations affected landscape evolution and sedimentary processes involved in the formation of La Draga. While lake level regression in the context of a dry episode enabled the occupation of a newly exposed lacustrine beach, soil erosion episodes and sedimentary subsidence would have conditioned the use of space during the more recent phase of occupation, through the construction of a travertine stone pavement.

Keywords: Stratigraphy correlation, formation processes, climate change, wetlands, pollen

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Climate, agriculture, and changing landscapes in the Malpaso Valley, Zactecas: an interdisciplinary approach to untangling the roots and consequences of Classic period settlement on Mesoamerica's northern frontier (AD 200-900)

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, Ben Nelson[†] , Paula Turkon[‡] , Sturt Manning

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The 3rd to 10th centuries AD represented a phase of unprecedented territorial and cultural expansion along Mesoamerica's northern fringe. The swell of Mesoamerican farmers into semi-arid deserts traditionally occupied by hunter-gatherer groups seems to have followed the collapse of the influential Teotihuacan state in Central Mexico, resulting in the creation of a frontier zone that encompassed roughly 100,000 km^2 and increased the northern limits of Mesoamerican settlement by up to 250 km. This region also was a crossroads for new social and economic interactions between the traditional Mesoamerican core of Central Mexico and more distant, "foreign" regions. Nomadic groups (*Chichimecs,* or "barbarians") came to coexist or meld with the more newly arrived Mesoamerican famers. Marine shell crossed the western Sierra Madre Mountains, while copper and turquoise, originating in what is today the Southwest of the United States and West Mexico, travelled more than 2000 km northward and southward via trade networks that are not yet fully understood.
Nevertheless, settlement within the northern frontier did not persist beyond the end of the Classic period (AD 900/100). Instead, the region abruptly underwent a series of site abandonments and severe demographic declines. Permanent agricultural settlements ceased to be occupied, and nomadic or semi-nomadic groups based strongly on wild resources once again dominated the landscape. The simultaneous appearance of regional abandonment, shifts to mobile foraging strategies, ruptures of Classic period trading networks, and observations of what is today an ecologically fragile desert landscape led several researcher to suggest regional-scale climate change drove the rise and fall of Mesoamerican settlement in these northern regions. Nevertheless, very little empirical data have been available to test and explore this environmental hypothesis.

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In this paper, we present a synthesis of work we have carried out in the Malpaso Valley of Zacatecas, a settlement system of over 200 contemporaneous Classic period sites located in an alluvial valley on the extreme northern edge of the frontier zone. Combining archaeological survey, excavation, plant macrofossil analysis, multi-proxy sedimentary study, and dendrochronology, we propose an integrated vision of the social and environmental interactions that accompanied the founding of this Mesoamerican polity as well as its subsequent decline and abandonment. We also address the difficulties inherent in the confrontation and reconciliation of a wide range of datasets, derived from a number of different disciplines that are often highly divergent in the temporal and spatial scales represented.

Keywords: climate, agriculture, drought, frontier, Mesoamerica, desertification, phytoliths, dendrochronology

Confrontation du témoignage des textes et de l'archéologie et des courbes sur l'évolution du climat de l'âge du Fer en France ; Confrontation of the textual archaeological datawith the curves on the climate change of the age of iron in France

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Les auteurs grecs et latins ne sont pas très diserts sur le climat des pays "barbares ", et rares sont les événements climatiques qu'ils mettent en corrélation avec les faits historiques. Les analyses statistiques des données archéologiques montrent des fluctuations dans l'occupation du sol qui ont pu être influencées par les migrations (les Celtes en Italie, les raids des Cimbre et des Teutons, la romanisation), par les progrès techniques (développement de la faux, des moulins rotatifs, des pratiques agricoles etc.) et par l'évolution du climat. On se bornera pour le moment à juxtaposer des courbes.

Greek and Latin authors are not very talkative on the climate of the "barbarians" countries, and there are few climate events that they correlated with the historical facts. Statistical analysis of archaeological data show fluctuations in the occupation of the soil which could be influenced by migration (the Celts in Italy, the raids of Cimbri and Teutones, the romanization), by technological advances (development of the scythe, rotary mills, agricultural practices etc.) and by the changing climate. It will restrict itself for the moment to juxtapose curves.

BUCHSENSCHUTZ O. - Note sur la perception du climat de l'Europe nord-alpine par les Celtes et par les auteurs grecs et latins, in BAGLEY J.-M., EGGL CH., NEUMANN D., SCHEFZIG M. (dir.), *Alpen, Kult und Eisenzeit*, Festschrift f́ur Amei Lang zum 65. Geburtstag, Leidorf 2009, p. 317-322.
L'Europe celtique à l'âge du Fer (VIIIe - Ier siècles), Olivier Buchsenschutz, Marie-Bernadette Chardenoux, Katherine Gruel, Pierre-Yves Lambert, Thierry Lejars,

Keywords: climat, texte, Archéologie, Age du Fer, migrations, technique

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Evolution d'un secteur de marge aride du Paléolithique à l'âge du Fer : occupation du territoire et variations climatiques à Adam, Sultanat d'Oman

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Dans les milieux de marges arides, l'histoire des populations et de leurs territoires est étroitement liée à l'eau, à sa disponibilité et à son contrôle. Au Sultanat d'Oman, les fluctuations climatiques pléistocènes et holocènes sont caractérisées par une forte variabilité pluviométrique, notamment contrôlée par la remontée vers le nord de la zone de convergence intertropicale et des pluies de mousson. Durant les périodes préhistoriques, les phases humides étendent le territoire des groupes d'hommes et rendent accessibles des secteurs aujourd'hui complètement dévégétalisés appartenant au " quart vide ". Inversement les périodes arides sont des phases de replis vers des zones refuges, principalement littorales. La structuration de ces zones refuges à la fin Néolithique s'accompagne du développement du pastoralisme et d'une emprise territoriale croissante, notamment autour des zones naturellement plus " humides ". Ces territoires restreints se renforcent à l'âge du Bronze, période à laquelle s'amorcent progressivement les conditions arides actuelles. Ils sont aménagés par des sociétés de plus en plus sédentaires et agricoles, à l'origine des premières oasis, qui achèveront leur formation à l'âge du Fer avec le développement du *falaj*. La région archéologique d'Adam, située au sud des Montagnes Hajar et aux portes du désert du Rub al Khali, présente des vestiges archéologiques allant du Paléolithique Inférieur à l'âge du Fer. L'étude de la distribution des sites archéologiques et de leur contenu, associée à des reconstitutions hydro-climatiques et à des analyses de potentiels agronomiques à l'échelle de la région ont permis de reconstituer les modes d'occupation de ce secteur sur le temps long et d'appréhender les réponses et les stratégies adoptées par les groupes d'hommes face aux variations climatiques et à la réduction des écoulements de surface.

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Keywords: Oman, Holocène, Variations hydro, climatiques, Occupation du territoire, Oasis

Influence climatique sur les populations Néolithique du Sahara Central d'après l'art rupestre

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Les variations du climat à la surface de la terre est un phénomène reconnu depuis le début du siècle par les géologues en se fondant sur de multipIes indications fournies par les dépôts anciens.

Au Sahara centra pendant le néolithique, l'homme échappe de plus en plus aux contraintes

de l'environnement, les peuples sont chasseurs-pêcheurs-pasteurs, a la période dite du Bubale, d'après les gravures rupestres, succède, au Veme et au VI eme millénaire AV.JC la période des pasteurs bovidiens qui couvre l'essentiel du néolithique puis vient la période du cheval vers la fin du II eme millénaire, enfin celle du chameau aux environs de l'ère chrétienne. La

grande faune a commencé à régresser dès la période des pasteurs et les occupants du Sahara néolithique de plus en plus ont émigré en direction du sud.
Depuis l'humide néolithique, le Sahara n'a connu que des fluctuations climatiques mineures et de plus l'irrégularité des pluies caractérise ces régions subdésertiques. Si plusieurs années sèches consécutives ou années humides peuvent modifier le paysage végétal ce qu'on constate dans les dépôts des sites préhistoriques du Sahara à l'heure actuelle la surpopulation et le surpâturage apparaissent comme les causes les plus graves de la désertification dans ces régions.

Keywords: Sahara, art rupestre, paléoclimat, pale environnement.

*Speaker

La production des céréales dans le Bassin parisien entre 400BC et 600 AD estimées d'après les données dendroclimatiques. Premières confrontations avec les données archéologiques.

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L'influence du climat sur les productions agricoles est complexe mais a déjà fait l'objet d'analyse pour la période moderne (Le Roy Ladurie, 1960). Dans l'Europe océanique et tempérée c'est la récurrence des années humides (hiver pluvieux, printemps froid et mouillé, " été pourri ") qui représente le principal danger pour les récoltes.
En Europe, les données dendroclimatiques ont permis d'estimer les températures et les taux de pluviométries annuels depuis 400 avant J.-C (B'untgen *et al.* 2011). En nous basant sur ces données, nous proposons une estimation qualitative de la production céréalière avec une résolution annuelle en fonction des reconstructions climatiques. Il ressort que durant la période de 400 BC à 600 AD, on peut distinguer des périodes favorables (-400 à -365 ; -315 à -56, 33 à 325, 434 à 535) entrecoupées de périodes défavorables (-364 à -316, -55 à 32, 326 à 434, 535 à 600).

Pour discuter de l'impact de ces risques climatiques pour les récoltes, nous examinerons un corpus d'une centaine d'établissements ruraux fouillés dans le Bassin parisien selon différents critères(durée d'occupation, superficie, structures de stockage, données archéobotaniques et archéozoologiques, etc). Il s'agira de confronter aux données dendroclimatiques lesévolutions décelées dans les rythmes de peuplement et les systèmes agro-pastoraux, perçus à travers l'étude des données archéobotaniques et archéozoologiques.

Il apparaît que le nombre de sites laténiensatteint son maximum vers 200 BC, avant de chuter

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fortement durant la période augustéenne. Ce n'est qu'au Haut-Empire, alors que le climat est plus favorable, que l'on observe une phase majeure de création de sites ruraux qui atteint un maximum vers 200 ap. J.-C. On observera que ces deux maxima (200 BC et 200 AD) correspondent à des périodes favorables à la production céréalière. En revanche, les profondes transformations sociétaleset la restructuration territoriale (abandon de certains oppida au dépend des villes nouvellement crées) qui font suite à la Guerre des Gaule au cours du 1er siècle av. J.-C. dans le Nord de la Gaule, se déroulent dans un contexte de risque frumentaire élevé. C'est durant cette période que l'on peut noter la succession de plus de sept années de probables très faibles récoltes (entre -46 et -41). Pour finir, durant la période postérieure à 326, les crises frumentaires ont dû accentuer les crises économiques et politiques de l'antiquité tardive.

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Keywords: Climat, production agro, pastorale, Gaule, la Tène, gallo, romain, dendrochronologie

Late Holocene Oases of South-East Arabia: emergence and agricultural management of the mountainous palm grove of Masafi (UAE)

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Oases are precious agro-ecosystems, fragilized today by decreasing resources and changing human activities. Due to their rich heritage, their preservation and revitalization is currently implemented in the United Arab Emirates. However, this management strategy lacks a better understanding of the link between climate change, resource availability/management, and human occupation. It seems therefore necessary to provide new data on the long-term socio-environmental dynamics of these spaces.
The oasis of Masafi (Emirate of Fujairah) has been excavated by the French Archaeological Mission in the United Arab Emirates since 2007. Still cultivated for its dates and exploited for its mineral water, this terraced landscape has been occupied, exploited, cultivated and irrigated since the beginning of the Iron Age (I st mil. BCE). To allow for more direct correlations between climatic data (indicating continuous aridification for the last 4 millennia in Arabia) and socio-economic dynamics (indicating regional cycles of land development *vs* abandonment), a project structured around the reconstruction of the hydro- and agrosystems, considered as the main structural elements of an oasis, as well as their dynamics and interactions has been developed in Masafi since 2014 in the framework of a MAEDI and ANR project (ANR OASIWAT).

A systematic geoarchaeological, chronological and paleoecological study, combined with a geophysical and geomatical survey, have revealed the preservation of circa five meters of sediments in some areas, dated from the last 4 millennia onwards. The results highlight phases of massive landscape artificialization associated with major hydro-agricultural development, such as during the 1st mil. BCE (Iron Age) (soil burning, runoff water harvesting, use and drainage of high groundwater levels) and after the 14th century CE (Middle-Late Islamic Period) (underground water channelling, well). On the other hand, the results also suggest different land use, settlement pattern or resource availability between 300 BCE to 1000 CE (Late Pre-Islamic, Sassanian and Early Islamic periods). These events, which will be related to changing climatic conditions and phases of land anthropisation, allow for an illustration of systemic answers to ecological and social issues.

*Speaker

Keywords: oasis, irrigation, agriculture, palaeoenvironment, geoarchaeology, Southeast Arabia, United Arab Emirates, Masafi

Mid-mountains and human being: resources and co-evolution. Shaping the landscape in Toledo Mountains (Central Spain) since Early Neolithic

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Since the very beggining, human being has used woodlands for supplies, building materials and firewood but also for hunting or apiculture, among other resources. This exploitation, along with climatic events over the environment through centuries has drawn a high valuable cultural landscape. Many studies have highlighted the main role that high-mountain spaces have played in the human necessities. Nevertheless, mid-mountains are still not well known as a survival space. These landscapes, not usually described as a single unit but comparing them with valleys or high-mountain spaces, show great resource diversity, heterogenic relief and a climatic mildness very useful for human interests, allowing management strategies such as terracing the slopes and a huge crop variety. Hence, they hosted broad human activities and represent a great scene for palaeoenvironmental research because the traces left by the co-evolution side to side of different cultures and the landscape through time are very present in mid-mountain areas even today. Thus, it is possible to point out the importance of fire as the most effective management tool, becoming essential on human history. It generates open areas used for human habitat, agriculture or grazing, which has deep consequences over the forest coverage, being deforestation or soil erosion the most relevant. This long-term interaction is present in Toledo Mountains. In the very heart of Iberian Peninsula, separating Tagus and Guadiana basins, this mid-mountain complex show an evident human management. El Perro peat bog is the southernmost sequence studied until today. The core, whose bottom is dated in 5500 *cal.* BC, shows an anthropic intervened environment but also the importance of climatic trends and their consequences over human communities and the landscape itself. Thus, this is a very interesting study site because shows the Toledo city influence and the role played by the population spread throughout this land crossed by main cattle roads and commercial routes. It is also possible to complete the study with the northern cores analysed and compare the results in order to find regional tendencies and different exploitation trends.

Keywords: Paleoenvironment, anthropogenic dynamics, fire, Toledo Mountains, Late Holocene

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Neolithic woodland management practices at Gueldaman Cave 1 (Algeria). Plant evidence for fuel and fodder.

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Gueldaman Cave 1 (Algeria) presents a wide sequence from Iberomaurusian to Late Neolithic (Kherbouchet *et al.*, 2014), including moments of major changes in landscapes. Analyses of plant remains (wood and seeds/fruits) show a shift in vegetation from last hunter-gatherers to first farmers' levels: a Late Glacial phase of plant colonization with Cupressaceae formations, which are gradually integrating some elements of sclerophyllous vegetation, such as several species of *Pistacia*; then, Neolithic levels showing *Olea europaea* formations dominating the spectra. These changes must be reassessed as climatic response of vegetation to the final deglaciation process, and to a particular woodland management, including fodder provisioning, as the cave was used as animal penning. The hypothesis of massive use of *Olea europaea* for animal feeding has been contrasted by a microscopic study of the ovicaprine coprolites. Identification of Monocotyledon species and *Olea* leaves in these coprolites shows the species mainly used as fodder. The presence of different parts of *Olea* (wood and olive stones) points to the input of the entire branches to the cave, then using them for fire. The presence of others sclerophyllous species is also investigated.

Keywords: Gueldaman, Algeria, Neolithic, animal penning, woodland management, fodder

*Speaker

Tales from the Inequality Possibility Frontier: Equality, Production, Population and Climate in the Northern Pueblo (US) Southwest

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We profit from the fact that for the central Mesa Verde region of the US Southwest we have relatively firm temporally anchored estimates of population size, climatically conditioned estimates of potential maize production, and estimates of "wealth" inequality (Gini coefficients) derived from distributions of house sizes through time. Our use of house size as a measure of wealth reflects our broad conceptualization of wealth as incorporating what have been called its embodied, relational, and material aspects. Using these ingredients we are able to estimate how closely the elites approach absorbing all the available productive surplus (beyond minimal subsistence needs) of their societies, and how that changes through time in these societies. This maximum feasible degree of inequality has been called the Inequality Possibility Frontier by Branko Milanovic. Now we can assess the ratio between the actual inequality and the maximum feasible inequality; this ratio is called the Inequality Extraction Ratio. Examining inequality in this way allows us to compare Pueblo societies (traditionally consdered as relatively egalitarian) with other societies that have been analyzed in this way, which includes contemporary countries as well as historical entities including the Roman Empire, Byzantium, and medieval England and Wales. Measuring inequality in this way moves us toward the goal of reconstructing human experience, since it shows how exploitive the elites were in Pueblo societies through time relative to what they could have been. These are the first such estimates for any society known primarily through archaeology.

Keywords: Neolithic, Pueblo, Inequality, Wealth

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The role of human activities and fire dynamics in the Gredos range (Spanish Central System, Spain) during the Late Holocene: the Manaderos record.

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In order to reconstruct long-term landscape shaping and socioeconomic history in Central Spain, we carried out a palaeoenvironmental study in Manaderos mire and proximities, supported by 8 AMS radiocarbon measurements. Manaderos is located at medium-high altitude (1292m asl) in the Central-Eastern part of the Gredos range, belonging to one of the main mountains of the Iberian Peninsula. In the vicinity of the mire there are a few ancient *Pinus nigra* trees, this fact could indicate the past presence of a forest of this species in the region. According to historical sources, this forest was largely managed and deforested in the Middle Ages to obtain wood. In this work, we present the high-resolution pollen and charcoal record of this peat sequence. Data were analyzed using statistical methods and compared with other similar mountainous records of Central Iberia. To describe the local vegetation and relate it to current close forests, modern pollen rain samples have taken and PCA/DCA has been performed. In order to define fire history, charcoal and crosscorrelation analysis were carried out. Results show that the mean vegetation was a *Quercus pyrenaica-Pinus pinaster* mountainous forest, being the Pyrenean oak the dominant taxon, while in the valleys cereals, olive and chestnut trees were cultivated. In that period fire episodes were frequent but these two species seem to be low sensitive to moderate fire activity. During the XVIII century there are not local fires and the mountainous landscape started to change: *Pinus pinaster* begun to be the dominant species, replacing the Pyrenean oak. These results are in agreement with other records that relate this occurrence to anthropic reforestations because of the economic interest of this species. The constant presence of anthropogenic indicators and marked charcoal influx point to remarkable human impact, that could affect the state and evolution of the potential relict *Pinus nigra* forest and the rising development of *Pinus pinaster* forest.

Keywords: Vegetation history, fire history, human impact, socioeconomic activities, relict forest

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Épistémologie de la relation société-climat : comment integrer des données historiques, archéologiques et paléoclimatiques ?

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L'objectif de cette communication sera d'analyser dans une perspective épistémologique l'étude de l'impact des changements climatiques sur les sociétés du passé, dans la recherche française et anglo-saxonne. A côté des scénario-catastrophes attribuant le déclin d'une civilisation à une grande catastrophe naturelle (tsunami, météorites, éruptions volcaniques, etc.), ou de la responsabilité de " dégradations " climatiques dans la migration des peuples anciens, de nouveaux questionnements et raisonnements ont émergé durant ces dernières décennies autour de thèmes comme la gestion du risque fluvial (Arnaud-Fassetta 2004). L'introduction récente du concept de résilience[1] en archéologie environnementale tend aussi à inverser d'anciennes perspectives en mettant moins l'accent sur la vulnérabilité des sociétés face aux changements que sur leur capacité à les gérer. Nous chercherons d'autre part à mieux cerner l'usage que les historiens, les archéologues et les paléoclimatologues font des données paléoclimatiques et sociétales. Nous nous interrogerons également sur la manière dont les différents spécialistes comprennent, critiquent et utilisent les données des autres disciplines dans le cadre d'une analyse intégrée, seul cadre possible pour étudier la relation société-climat. Afin d'illustrer le rôle des variations climatiques dans l'évolution des sociétés et notre façon d'aborder cette question, nous exposerons deux exemples de sociétés holocènes sédentaires (maya et gallo-romaine), en intégrant les difficultés inhérentes aux données archéologiques et en insistant sur la représentativité et la résolution chronologique des données.

http://www.resilience.org/

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Keywords: Epistémologie, climat, sociétés, histoire, archéologie, paléoclimat, maya, gallo, romain

II-4. Late Holocene Social and Climate Change in Arid and Semiarid Environments

An oasis in the middle of the Patagonian desert: the Valley of Genoa at the Holocene

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Arid and semiarid environments, which constitute a big part of Earth environments, share similar characteristics around the world. Since there is a limited scope of biological answers to deal with their abiotic selective pressures, mainly determined by moisture scarcity (Brown et al., 1979) it is reasonable to expect biotic convergence on them. Although humans had a vaster array of answers, given by cultural behaviors, past climatic fluctuations, even of minor magnitude, should have a stronger impact in these environments.
In Patagonia (southern South America), two principal climate drivers are highly significant: latitude (related to solar insulation and mean annual temperature), and the presence of the Andes Mountains, with its influence on the precipitation régime and winds. The frequent winds coming from the Pacific Ocean ascend when reaching the Andes, while cooling adiabatically and generating high precipitation on the western slopes. They contribute to a rain shadow in the eastern side of the Andes, which generates true desert conditions (Montes et al. 2017). Hence, in few kilometers human populations has the chance to have a quick access to Andean forest resources to the West or to the lava mesa and plateaus (highlands) to the East.

In this paper we will characterize the late Holocene of the Central-West Chubut area and specifically we will refer to the Genoa Valley which conforms one of the biggest wetlands or mallín in Patagonia (Horne, 2010). Being located between the Cordillera de los Andes and the Precordillera hills it is surrounded by highlands. The presence of minor wetlands and peatlands at the alluvial plain and adjacent tributary streams, springs and water bodies warrant the presence of guanaco herds looking for high quality pastures. This area was archaeologically unknown until our team began a research project in 2012.
We will explore as a first approach to this subject if archaeological distributions in the steppe and the forest could be correlated with the known Holocene climatic fluctuations, as recent work allow to consider, and how the occupation of this area was developed.

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Keywords: Arid environments, Patagonia, Hunter, gatherers

Conquering the desert. Environment and Human Occupations in Pampa del Tamarugal, Atacama Desert.

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The archaeological site of Ramaditas has a meaning that goes beyond its historic-social and environmental value. Settled in the world driest and perhaps oldest desert, the Atacama Desert, the site is challenge to current understanding of what water means as a resource for human sustainability anywhere in the world. Under these conditions, it is difficult to explain how prehispanic society was able to settle and prosper in such hard environment. Previous research, especially in Guatacondo and Tarapaca regions, demonstrates that these societies have been extremely productive in past times. The fact that these groups were able to develop themselves in such hard environments maintaining higher demographic levels than today's demand an explanation.The archaeological area of Ramaditas contains important architectonic compounds grouped in two main villages, extended relicts of agricultural fields including artesian wells, reservoirs, and complex networks of canal irrigation. The area is important both from a climatologically view point as well as archaeologically because the assemblage indicates people were practicing full agriculture 2500 ago. In this paper I provide new data in relation to paleoenviroment of the area steaming from dendrochronology research that favors a macrophysics' paleoclimatic model based on precipitation data from the surrounding highlands and its subsequent water runoff towards Pampa Tamarugal.

Keywords: Atacama Desert, Dendrochronology, Paleoenvironment, Ramaditas.

*Speaker

Environmental influence on human occupation changes in subtropical inland Chile, Combarbalá

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Archaeological research in the subtropical band between 31◦ and 32◦ S west of the Andes has been biased in favor of coastal settlements which appear to have been redundantly occupied since the onset of the Holocene. Conversely, the occupation of the inland region has received little attention in terms of surveys, excavations, radiocarbon dating, assemblage characterization, paleoenvironmental records and papers published. In the coast, diminishing human signatures have been recognized between 8000-6200 cal BP and 2300-1800 cal BP and, at least during the first interval, the trough appears to be climate driven since these period is associated to enhanced aridity according to local paleoenvironmental reconstructions. However, ages in these time ranges have been recorded in the inland area of Combarbalá, where we have conducted investigations since 2003. Contexts under rock shelters, of very little representation in the coast -where occupations are observed in the form of shell middens-, are remarkably common in a conglomerate volcanic unit in Combarbalá, and have yielded evidence useful for discussing differences in the use of space of mobile communities for the region. We present new data on the excavation and dating of La Coipa 1, Techo Negro, Los Bullines, Los Zorros, Lucero and La Olla sites which provide a complementary perspective on the archaeological information gathered in the broader region. These sites show primarily the use of local resources such as local stone tool selection and inland prey choices. Preliminary stable isotope information is consistent with inland diets. Although the distribution of the archaeological information of this region remains uneven, data gathered on inland locations over the last decades as well as the one presented here allow for more accurate understanding of human regional trends.

Keywords: environmental change, Andes, inland occupation, use of space

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Society and environment. Southern Jordan in the Neolithic and early Bronze Age

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The state of research on the issue of the Neolithic and Early Bronze Age in the lands of the Levant is not uniform. So far, most information has been collected from the area located on the east of the Jordan river, less from Syria, while the least from the lands of Transjordan. There is also a lot of very important data concerning this period yielded by the research conducted in Egypt (particularly in the Nile Delta). The situation partially results from the fact that the main burden of settlement and trade routes rested apparently on the lands of western Levant. It seems, however, that also the territory of present-day south Jordan (understood as the historic land of Edom, geographical area between Wadi Al-Hasa and the Gulf of Aqaba) ought to be more seriously considered within general studies. The role of this territory is underestimated which is a result of both, the state of research and very limited related publications, especially concerning the environmental issues. The present state of knowledge induces us to state that many hypotheses functioning in the scientific world are either poorly confirmed by discoveries, or they simply require contemporary verifying. Within the presentation we will try to describe the main research problems and gaps in our knowledge, as well as direct the discussion to the questions of: **i)** the settlement continuity (including the explanation of hypothetical hiatuses) and its structure in the region, **ii)** connections with neighbouring territories, and **iii)** directions and mechanisms of exchange of goods. All this issues definitely have to be presented in relation to the then environmental situation in the area (taking into account the level of its description), which will allow for creating a more complete image of communities functioning here during the Neolithic-Early Bronze Age period. The problems of linking the archaeological image of this region with the environmental and climatic data, seems to be actually one of the most significant. An important reference point for these remarks will be also related with the new research project initiated by the authors in the south of Jordan in 2017, as part of which excavations on two so far sites have been started. The mentioned sites – al-Munqata'a and Faysaliyya – can be the perfect exemplification of problems appearing in research on this area.

Keywords: Neolithic, Bronze Age, Jordan, social changes, environment impact, Transjordan, Levant

*Speaker

The concept of extensification in Southern Patagonia

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concept of *extensification* in an archaeological perspective is not very usual. Furthermore, its definition is not very clear; more related with its opposition, the concept of *intensification*; a term well defined and used in Archaeology.
In this presentation, the main purpose is to clarify this concept in terms of its use in an archaeological example of Southern Patagonia. Also, the example takes into account a case of European precontact, previous to the introduction of horses in the Tehuelche society. The use of Binford's frame of references, like environmental information and Effective Temperatures (ET), were an useful tool to identify cases of the process of extensification in the study area.

The area corresponds to the southern extreme of the American continent in Santa Cruz Province, Argentina, and is characterized as a herbaceous and shrub steppe, with annual rainfall ranging between 100-400 millimeters

The extensification concept could be applied under an ecological perspective, more than a technological one. In the present case, it was very useful and important to calculate ET from different environments and altitude above sea level. Then, the different areas considered are viewed complementarily, where the guanaco mobility (*Lama guanicoe*) - the main resource for hunters - and its social behavior can be totally integrated with human mobility.

During the Late Holocene, when climatic conditions dramatically changed, in the highlands seasonal activities and logistical strategies undertook place in order to deal with the heterogeneously distribution of the primary and secondary productivity. This new strategy was related with an extensification process.

Keywords: Climate change, Patagonia, Extensification

*Speaker

II-5. Climatic variability and societal responses during the Metal Ages in Europe and the Mediterranean (3000-300 BC)

Adaptive Collapse, Habitat-Tracking and Nomadization at 4.2 ka BP

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The abrupt global megadrought and cooling at ca. 4.2-3.9 ka BP (2200-1900 BC) is documented globally in lake and marine sediments, glacial and speleothem cores, and tree-rings. The highest resolution records for the 4.2 ka BP megadrought include, prominently, the estimated 30-50% reduction in precipitation delivered by the Mediterranean westerlies in the eastern hemisphere, where they provide for dry-farming and irrigation agriculture across the Mediterraneanand West Asia, and Indian Summer Monsoon disruption that reduced Indus precipitation and Nile River flow.
The proxy records for the interruption of the Mediterranean westerlies and the Indian Summer Monsoon are located where regional archaeological records are most numerous and highly resolved: the Mediterranean, the Levant, Egypt, Turkey, and Mesopotamia. Here, widely distributed and organizationally different, cereal-agriculture-based societies collapsed synchronously and coincident with the megadrought. The archaeological record for these societal collapses includes (1) intensive regional settlement surveys (2) high-resolution radiocarbon dating for abrupt abandonments in dry-farming domains across the scales of settlement, from villages to cities, and (3) epigraphic and radiocarbon data for the collapses of the region-wide, expanding Mesopotamian Akkadian Empire and the Egyptian Old Kingdom.

In the regions dependent upon rain-fed agriculture, the adaptive societal response linked with abandonment was habitat-tracking to riparian, paludal and karstic refugia. Region-wide settlement surveys suggest that the populations abandoning the rain-fed plains of southwestern Turkey, western Syria and northern Mesopotamia became the habitat-tracking populations that settled along the banks of the Euphrates River and the karst-spring fed Orontes River. Similar habitat tracking occurred synchronously in the southern Levant and in the western Mediterranean.

The Amorites, a large tribal confederation of pastoral nomad "campers", also exploited the Mesopotamian and Levantine landscapes, traversing the middle Euphrates River valley seasonally to steppe lands and dry-farming plains for sheep-flock forage. The abrupt desiccation disrupted this ancient seasonal pattern, forcing the tribal groups to seek refugia along and down the Euphrates River. This infiltration of southern Mesopotamian urban kingdoms prompted their dynasts to construct the "Repeller-of-the-Amorites" wall recorded in contemporary records. The wall proved porous, however, and within a few generations the former pastoralists' descendants became the Amorite rulers of Babylon.
An explanation for the resettlement of Mesopotamian dry-farming domains, and the opportunistic sedentarization of formerly pastoralist Amorites at the abrupt ca. 1900 BC return of

*Speaker

pre-aridification precipitation, now comprises a major anthropological and archaeological challenge. The Amorite resettlement swiftly generated the famous warring kingdoms and massive military struggles for rain-fed land and imperial power across west Asia. Resettlement is apparently not self-evident: for instance, the post-megadrought abandonment of the central Maya lowlands in the 9th century AD continued.

Keywords: 4.2 ka BP, megadrought, collapse, habitat, tracking, West Asia, Mesopotamia, Levant, Egypt, Mediterranean

Agricultural strategies and climate change in later prehistoric northern Europe

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Agriculture in northern Europe during the Bronze Age is often considered to have provided a strong basis for economic growth and emerging social power. In Ireland, for example, there is extensive archaeological evidence for farming during the Late Bronze Age (1200–800/700 BC). Significant changes relating to environments and the organisation of societies then occur, affecting what and how people were farming. Evidence for farming is rather difficult to detect during the Early Iron Age (800/700–400 BC), coinciding with a time of climate change. This may reflect dramatic collapses in societal organisation and crises in food-management strategies, or more simply reorganisation of food systems. By the time of the Developed Iron Age (400 BC–AD 1), evidence for farming is more easily recognisable in the archaeological record, coinciding with the beginning of so-called Celtic migrations. Detailed research has been undertaken in recent years on the timing and nature of environmental change during these centuries, particularly in relation to climate. A detailed understanding of farming practices is, however, less well developed. Extensive scientific data from excavations – particularly archaeobotanical and zooarchaeological evidence – have become available over the past two decades. Despite this availability of data and the recognised importance of changing farming practices during the Late Bronze Age and Iron Age, detailed analysis of what was being farmed, and how farming was undertaken, is often absent from archaeology narratives. To address this issue, an INSTAR-funded research project was established, "Settlement and Landscape in Later Prehistoric Ireland – Seeing beyond the site", which aims to contextualise the archaeology of Late Bronze Age and Iron Age Ireland within its contemporary prehistoric landscape, focusing on farming strategies and broader landscape interactions. This paper will reveal results from collation and analysis of archaeobotanical and zooarchaeological data, focusing on south-east Ireland during the Late Bronze Age and Iron Age. The paper will explore farming practices in the context of changing climates and environments, and within the broader context of northern Europe.

Keywords: Bronze Age, Iron Age, Ireland, Europe, Archaeobotany, Zooarchaeology

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Climate change and societal responses in Atlantic Europe around the Bronze Age / Iron Age transition

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A climatic downturn between the 9th and 8th centuries BC has generally been held responsible for many of the distinct economic and societal changes observed in the archaeological record throughout much of Atlantic Europe around the time of the Bronze Age / Iron Age transition, including an alleged abandonment of upland settlements, disruption of long-distance exchange networks, and large-scale population movements. In this paper we will be comparing palaeoenvironmental and archaeological data from different regions on Europe's Atlantic façade, to try and address the spatial complexity of the effects environmental changes at this time may have had on human societies. We will also discuss issues of chronological resolution in different proxy records, to determine the reliability of proposed synchroneities between events and the possible impact of suck-in or smear effects on different explanatory models formulated by past research.

Keywords: climate change, environment, society, Atlantic Europe, Bronze Age, Iron Age

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Climatic variations and social conflict. Evidence of conflict and the phenomenon of hoardings in differents moments of Metal Ages in western Europe

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Can climatic variations influence some periods of social conflict and insecurity? Western Europe know, during Metals Ages a change from Late Atlantic (4000- 2500 BC) to sub-Boreal (2500- 800 BC) and to sub-Atlantic (800- until today). Sub- Boreal is characterized by a colder and rainy climate, which begins to change around 1300 BC with a slight increase in temperature, until having a greater drought in Mediterranean between end II millennium and the start of I millennium BC. In that work will be analyze the evidences of social conflict (fortifications, evidence of fight in human skeletons in graves, frequency of the weapons) and evidences of instability, like the frequence of hoarding metal, considering those deposits that are evidently the fruit of hiding a wealth and not a votive offering. For each of the two periods, first the passage between Chalcolithic to Early Bronze Age (Calcolítico/Bronze Inicial to the Iberian Peninsula- Chalcolithique/Bronze Ancien I to central/eastern France - Neolithic/Bronzezeit A1 to central Europe) and after the passage bewteen Late Bronze Age to Final Bronze Age (Bronce Final to the Iberian Peninsula- Bronze Final I/Bronze Final IIIb to central/eastern France- Bronzezeit D- Hallstatterzeit B2/B3 to central Europe) the appropriate quantitative differences in metal production will be taken into account to the analysis.

Keywords: Climatic variations, Conflictuality, Metal Ages, Western Europe

*Speaker

Economic responses to climate and landscape change in Malta, 2500 to 1000 BC

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In this paper we explore the evidence for economic and environmental change during the Bronze Age transition in Malta. The Late Neolithic / Copper Age in Malta was a time of intense cultural development and land-use – a sustained phase of elaborate behaviour including megalithic architecture, rich burial traditions, developed artistic and stylistic idioms, and a highly productive farming system that enabled all other aspects of human life. This was despite the small size of the islands and their relative isolation in the Central Mediterranean. Around 2350 BC there were sudden cultural shifts – settlement on a reduced scale, abandonment of ritual centres, and changes to farming. We discuss the palaeoecological and geoarchaeological evidence that this event had two likely main causes – a long-term trend towards aridification, which society could manage to some degree, and short-term instability, which perhaps pushed society too far. As the Bronze Age progressed, society in Malta nonetheless adapted, eventually growing to considerable size. We discuss how agriculture evolved throughout this time, and how natural forces such as soil erosion were managed in response to a changing environment and an increasingly networked human world. This work was funded by the European Research Council ("Fragsus").

Keywords: Malta, Copper Age, Bronze Age, erosion, geoarchaeology, palaeoecology, archaeobotany, collapse

*Speaker

Human-Environment interactions in Northern Greece since the Early Bronze Age: Rapid Climate Changes and social dynamics consequences onto Mediterranean landscapes. A palaeoenvironmental and multiscalar approach.

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The research conducted in the southern part of lower Strymon Valley in Northern Greece show up to 15 m of fluvio-lacustrine deposits for the last 5 millennia. Two terrestrial cores, located into a favorable and regional context to palaeoenvironmental records, between the Tenaghi-Philippon former marsh, 50 km to the east, the Ohrid or Prespa Lake, 250 km to the west, and the Dojran Lake, 100 km to the northeast, were carried out. Precisely, the two cores spaced from 2 km each other, are situated on the riverbank of two contemporary large river systems (Strymon and Angitis) into the former Achinos Lake. These cores drilling also take place close to marine cores, 100 km from the M2 and 130 km from the SL152, which constituted key references for the Eastern Mediterranean Basin.
These sedimentary archives describing the interval between 3000 to 400 cal BC (Early Bronze Age-Antiquity in this region) and the regional archaeological knowledge offer a significant potential for high-resolution palaeoenvironmental studies. The reconstruction of environmental changes is based on cores with respectively 17 and 10 consistent AMS. Multi-proxy sedimentological (size particle analysis, LOI, Carbonate content, electrical resistivity tomography and magnetic susceptibility) as pollen and non-pollen palynomorphs analyses have been conducted. Palaeobotanical proxy gives an overview of climate variability in the Eastern Mediterranean and Balkans regions and particularly for some Rapid Climate Change episodes (around 2200 cal BC, 1600 cal BC and 800 cal BC) and thereafter a comprehensive view of anthropogenic responses and impacts on the vegetation cover.

*Speaker

This case study highlights the interest to (1) combine geomorphological data with palynological evidence and multiscalar approach to develop discussion on the Climate/environment/Society interactions particularly around the aforementioned climatic events and their extent impacts to compare with other regional records. (2) It points out the necessity to assess the effects of specific farming and herding practices as of the Climate Change on the dynamics of mosaic landscapes in Mediterranean areas. This long term analysis about landscape dynamics provides (3) new data in order to discuss the timing of the anthropogenic impact and (4) food for thought to fill the archaeological shortcoming for this period, guiding the future investigations.

Keywords: Palynology, geomorphology, sedimentary archives, mediterranean lanscape, rapid climatic changes, social dynamics, multiscalar approach

Introducing the unknown? A study of the use of "inferior" legumes in the Bronze Age Carpathian Basin (Hungary)

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Agricultural innovations and the incorporation of new dietary attitudes and habits, can often be related to transformations that occur within societies. Archaeobotanical results suggest that the use of legumes in the Hungarian Carpathian Basin became widespread during the Bronze Age, more so than in the preceding periods. For instance, the presence of bitter vetch (Vicia ervilia) is first attested for this period, and grass pea (Lathyrus sativus) as well is more frequently encountered for the Bronze Age archaeobotanical record.

Legumes (Fabaceae) have been important staple crops in most regions characterised by grain agriculture. (Wild) legumes contain different types of toxic compounds that protect them from predation. In domesticated legumes, these compounds have either been reduced or completely removed. Still, most species of legumes require soaking, cooking and/or fermentation before they are safe for human consumption.

At least since the Roman period, both bitter vetch and grass pea have generally been viewed as inferior for human consumption. Historical and ethnographic records indicate that the two legumes were primarily utilised as animal fodder, and were only consumed by the very poor or during times of famine. They have, thus, been considered as "inferior" human food. Ethnographic studies also show that legumes in general have been part of traditional food culture in many communities.

The use of these "inferior" legumes in pre- and protohistoric societies is not yet fully understood. Exploring their status in Bronze Age plant economy in Hungary may shed light on the reasons for their appearance (bitter vetch) or increased presence (grass pea) in this period, and thus add to the current knowledge on the variety of ways in which legumes could have been exploited within prehistoric societies. Does the appearance of such legumes indicate famine? Is there a relationship between their introduction and adaptations to changing environmental conditions? Or do the archaeobotanical data suggest intensified cultural exchange with neighbouring regions? The aim of this paper is to use legumes as a proxy to identify changes in the Bronze Age crop assemblage in the Hungarian Carpathian Basin, and thereby relate these changes to furhter socio-environmental transformations.

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Keywords: Legumes, Bronze Age, subsistence economy, traditional food culture, adaptation to environment, cultural exchange

Les dégradations climatiques en Europe tempérée, de la fin de l'âge du Bronze au Ier siècle avant notre ère

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Les dégradations climatiques reconnues au cours du Néolithique et en particulier durant la fin de l'âge du Bronze (en croisant les résultats de différentes disciplines scientifiques) et leurs effets sur les modalités de l'occupation humaine, sont envisagées plus particulièrement sous l'angle de l'adaptation des communautés agricoles au milieu humide, soit les célèbres villages "lacustres" des lacs et marais subalpins, de la France de l'Est, du Plateau suisse et du sud de l'Allemagne. Sans tomber dans le déterminisme, on observe qu'à ces dégradations (comme celle de L'obben vers 1500/1400 av. J.-C.) correspondent des transgressions lacustres et l'abandon des villages riverains. L'absence de telles occupations palafittiques entre -1500 et -1200 sur le Plateau suisse est patente. L'augmentation de l'activité solaire, dès -1100, entraîne une hausse des températures moyennes et un abaissement des niveaux des lacs qui co'incident avec plus de 2 siècles d'intenses occupations riveraines. A nouveau, une dégradation subite (la crise climatique du Subatlantique) dans la seconde moitié du IXe s. av. J.-C., signifie la fin de plus de 3 millénaires et demi de palafittes, entrecoupés d'interruptions, parfois de plusieurs siècles. *Le rôle du volcanisme est pris en compte. Le rôle du volcanisme est mis en exergue.*
L'influence du climat marque à l'évidence l'économie des sociétés, participe des changements culturels, démographiques, notamment au début de l'âge du Fer au VIIIe s. av. J.-C. Elle peut se traduire par une déstabilisation et des déplacements de populations, comme les célèbres migrations celtiques de la fin du Ve et du début du IVe s. av. J.-C. suivies de l'installation de peuples connus par l'Histoire en Italie du Nord. Inversément, la dendrochronologie et les Commentaires sur la Guerre des Gaules par Jules César nous renseignent indirectement sur le climat du milieu du Ier s. av. J.-C.

Keywords: âge du Bronze, âge du Fer, climat, Plateau suisse, volcanisme

*Speaker

Macro-scale European population trends and the impact of regional climate dynamics towards the Bronze Age-Iron Age transition.

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Increasing and decreasing population trends represent a common denominator in prehistoric research. Traditionally, the 2nd millennium and the beginning of the 1st millennium BC in prehistoric Europe are characterized by several phases of crisis regarding settlement strategies, exchange networks and, at regional scale, demographic density. Nowadays, archaeologists interested in quantifying long-term human population changes have used the frequency of radiocarbon dates in order to detect changes in the demographic intensity. The most used technique is the construction of SCPD (Summed Calibrated Probability Distribution) of sequences of 14C dates. In this paper, we test the capabilities of such method between 1800 and 800 BC using the updated EUBAR database including more than 1700 radiocarbon dates from archaeological contexts from the Ebro to the Danube River (namely, north-east Iberian Peninsula, Southern France, Northern Italy, Switzerland, Austria and Southern Germany). Our results suggest a slow process of demographic growth on the macro scale with evidences of phenomena of discontinuity detectable locally. Additionally, we compared these smaller-scale trends with regional pollen-based climatic reconstructions, identifying variable degrees of correlation between population trends and temperature/precipitation dynamics.

Keywords: Bronze Age, Paleoclimate modeling, Paleodemographic reconstruction, South, Western Europe, Radiocarbon dates, Palynological records

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Palaeoenvironmental dynamics and social complexity in the late prehistory (2500-1800 cal BC) of central Sicily

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The Erei uplands is a hilly area located in the innermost part of Sicily, recently the focus of intense archaeological research, producing a large amount of new data concerning the settlement patterns, the material culture, and the social structures of the communities which occupied the area from the Neolithic to the Iron Age. The geographical space of the Erei is marked by the constant interplay of rolling clay hills, with sudden and sharp limestone ridges, rising northward, towards the increasingly steep slopes of the Nebrodi Mountains. The Erei landscape is also crossed by a dense hydrographic web, formed by long and slow-flowing rivers, heading eastwards towards the Ionian coast. In the central part of the region, close to Enna, is the Lago di Pergusa, an endorheic basin of tectonic origin, one of the few natural lakes still existing in Sicily. Palaeoenvironmental analyses carried out on the lake sediments allow a detailed reconstruction of past vegetation and climatic history for this part of central Sicily, covering the entire Holocene. The pollen and micro-charcoals analyses, in facy, indicate how, since the 5th millennium BC, there has been an increasingly arid climatic regime. However, this has been interrupted by short periods of improved climatic conditions. One of the most important is dated to the 3rd millennium BC, with a rapid expansion of evergreen forest and higher rainfall level, but also with the first evidence of cultivated cereals. This phase finish at the end of the same millennium, when a new dramatic arid phase start. The improved climatic conditions of 3rd millennium BC correspond, in central Sicily, to a phase of sudden demographic explosion, mainly interesting the Late Copper Age and the beginning of Early Bronze Age (2600-1900 cal BC). Together with a growing number of sites, located in different environmental niches, unoccupied in the previous periods, there are now also clear evidence of substantial domestic and funerary architectures, complex structures involved in craft activities and in the transformation of agricultural products, and new exchange networks connecting inner Sicily with central and western Mediterranean, well represented by the Beaker complex. The worsening of climatic conditions, clearly evidenced in the Pergusa pollen sequence, dating between the end of 3rd and the beginning of 2nd millennium BC, could be part of the explanation for the end of this complex social formation and the passage to the Middle and Late Bronze Ages.

Keywords: Sicily, palaeoenvironment, Copper Age, Bronze Age, settlement pattern, material culture, social complexity

*Speaker

Reconciling temporal and spatial relationships between palaeoclimate and archaeological records during the northwest European Bronze and Iron Ages

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Climate change is increasingly regarded as an agent in past social transformation and collapse during the prehistoric period, support for which is frequently based upon the close timing of changes in climate proxies and the archaeological record, although synchronicity is not in itself evidence of causality. Within the palaeoclimate reconstructions, however, there is often a high degree of chronological uncertainty which impedes the precise establishment of a temporal linkage with archaeological data whose own chronological resolution varies from annual to centennial. Furthermore, macro-scale climate variance is rarely well-constrained, leading to the use of climate proxy data from wider or other localities as evidence for climatically-forced societal responses. This paper reviews the range of palaeoclimate data spanning the Bronze Age to Iron Age in northwestern Europe, including for the widely reported 4.2 kyr and 2.8 kyr events, as well as the precisely resolved growth anomalies in European tree-ring records. In particular, the spatial and temporal representation of the proposed events is examined, with a critical evaluation of the inferred societal effects these events are deemed to have had. The paper draws attention to the pitfalls of using palaeoclimate data in archaeological interpretations without due consideration of their limitations, and endorses the use of integrated palynological and palaeoclimate records as a means of exploring more meaningfully the impact of climate variability on past societies.

Keywords: Palaeoclimate, climate proxies, Bronze Age, Iron Age

*Speaker

Regional climatic and social transformations during the 4.2 ka BP event at the Southern Iberian Peninsula. First results of a paleoclimatic-archaeological project

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Within the F1 project of the CRC 1266 'Scales of Transformation' we are investigating the 4.2 ka BP event in the western Mediterranean and its influence on the transformation of societies at the major cultural transition from a Neolithic/Chalcolithic configuration towards the Bronze Age.
We aim at investigating the local timing and magnitude of the climatic oscillation during the event and the intensity and character of the societal change by quantification of the archaeological record. The intent is to correlate both proxies and to test if and to what extent the climate may have triggered and influenced developments in the human sphere.

One possible, and maybe most prominent, aspect of the societal change could be represented by shifts in population. Demographic studies are currently again an emerging field in archaeology. Among the reasons for this development are the resurrected debate about ethnicity and migration resulting from the advances in aDNA methodology, and the broad application of summed 14C dates as an activity and demographic proxy.

Geochemical analyses of long chained n-alkanes and alkenones from a marine sedimentary archive (ODP-161-976A) from the Alboran Sea are taken out in order to investigate changes in precipitation, vegetation dynamics and sea surface temperatures.

In this presentation we would like to explore the trajectories of societies in the Southern Iberian Peninsula under the influence of the 4.2 ka BP event. Our recent results indicate two prominent arid periods centred around 4.0 ka BP and 4.25 ka BP interrupted by more humid conditions. Furthermore, we found a correlation between the development of precipitation and demographic proxies. It is also evident that the settlement structures changed in the course of the climatic shift.
Still a finer chronological resolution is desirable for both climatological and archaeological proxies. Nevertheless, it is already possible to examine the hypothesis of early statehood on the Iberian Peninsula in a more differentiated way than before by taking into account the changed

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environmental conditions and a detailed and quantitative description of large transformations in the social sphere.

Keywords: Iberian Peninsula, Chalcolithic, Bronze Age, 4.2 ka event, paleoclimatology, social transformation

II-6. Climato-geographical archeologies of the Americas

ARCHAEOLOGICAL OCCUPATIONS IN THE ARAGUAIA-PEIXE INTERFLUVE, GOIÁS, CENTRAL BRAZIL

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Recent researches carried out in the Brazilian Central Plateau indicate that the human settlement of the region began with the establishment of hunter-gatherer groups in late Pleistocene and early Holocene, between 12,000 and 10,000 years BP. Data from December 2014 indicate that in the State of Goiás there are more than 1,246 Archaeological sites registered in the Cerrado biome, which has a high diversity of fauna and flora and isthought to be the second largest Brazilian biome in diversity. This research is located in the center of the country in the State of Goiás, with an extension of 340,257 km^2, called the Brazilian Central Plateau in which the Araguaia river basin is located. The archaeological sites are located in the interfluve of the Araguaia and Peixe rivers, in the socalled Brazilian Mesopotamia. The Araguaia River is one of the main rivers of South America with 2,115km of extension. In the 1940s more than twenty indigenous villages were listed along the river. Researches carried out in the 1970s indicate that these indigenous villages varied between 8 and 115 thousand square meters in circular, semicircular and linear forms. In view of this, it became fundamental to understand how these groups occupied the banks of the rivers of the region. This research deals with the contextual study of archaeological occupations in the Araguaia and Peixe rivers, their locations and chronology. Eight sites and six archaeological occurrences have been identified, all close to rivers and lakes. The general aim of this research is to test hypotheses about pre-colonial occupation, space occupation, formation of archaeological sites and settlement systems in river interfluve, with emphasis on formation (depositional) and modifiers (post-depositional) of the archaeological record. In order to achieve this, it was necessary to use theoretical approaches, methods and techniques of geochemistry, geology, geomorphology, geography and archaeology. The focus is on the contexts of human occupations and their surrounding environment, taking not only material culture as a means of analysis, but all the variables to be thought for the construction of these dwellings. In this way, we used micromorphological analysis, chemical analysis of sediments, X-ray fluorescence analysis (pXRF), apparent electrical conductivity (EC) and magnetic susceptibility (K). The purpose of this article is to present the preliminary results obtained and how these results contribute to the cultural contextualization of the human groups that occupied the area.

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Keywords: Cerrado biome, Brazilian Central Plateau, Araguaia River

Archaeological Perspective of the Bananal Island, Brazil

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The archaeology of the Brazilian Central Plateau presents little information regarding the occupation of the area in the late Pleistocene and early Holocene. We highlight the research carried out in Santa Elina, Abrigo-do-Sol and Serranópolis. Some areas present great potential for archaeological research in this period based on geology, geomorphology and the presence of archaeological sites, among them the Quaternary Fluvial Basin of the Bananal (QFBB), the intracratonic basin that forms part of the Araguaia river basin (medium Araguaia) , resulting from denudational processes and covering an area of approximately 106,000km2. In the north of the basin is the Bananal Island, which occupies an area of 20,000 km2 (approximately twice the area of the Republic of Cyprus) encompassing the Araguaia National Park and the Araguaia Indigenous Area. In the BFQB, there are depositional units inserted in the Middle Pleistocene (240,000 +/- 29,000 and 159,600 +/- 18,542 years BP), in the Upper Pleistocene (121,000 +/- 15,000 and 17,200 +/- 2,300 years BP) and in the Holocene (9,800 +/- 1,100 years BP). These units present records of paleohydrological and paleoclimatic changes. Also significant for archaeology are the dates obtained in sediments of the Araguaia Formation that indicate that the QFBB has undergone changes in the fluvial pattern in recent times, more precisely during the average Pleniglacial (56,600 +/- 5,900 and 34,000 +/- 4,600 years BP) and in the Upper Pleniglacial (26,400 +/- 3,100 and 17,200 +/- 2,300 years BP). A survey conducted in the 1970s showed a thickness of 47.9 meters for the Araguaia Formation. The information concerning the QFBB presents a scientific significance for the archaeology of the region, when mainly analyzing aspects such as the spatial distribution, the thickness of the depositional package, the chronology and the 10 archaeological sites of farmers and ceramists groups identified in the Bananal Island. In this sense, the expansion of archaeological research on Bananal Island, with emphasis on the late Pleistocene and early Holocene sites, may provide important information regarding the precolonial and paleoenvironmental occupation of the region.

Keywords: geoarchaeology, brazilian archaeology

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Arroyo del Vizcaíno: strengths and weaknesses of a very old site in southern South America

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Found during a severe drought in the summer of 1997 in the bottom of a stream, the site of Arroyo del Vizcaíno (AdV), near the town of Sauce, Uruguay, has yielded over 1600 fossil remains (mostly belonging to the giant sloth *Lestodon armatus* but also from other Pleistocene megamammals). About 60 of them show marks with features compatible with human agency. This is congruent with other lines of evidence, such as other modifications of the bones, the mortality profile and the anatomical regions represented, among others. Since the dates obtained from radiocarbon and luminiscent analyses cluster about ca. 30 kybp, the possibility of human presence at such an old age and so far south as 34° S latitude challenges currently most accepted models of human dispersal in the Americas, although joins other proposed pre-LGM sites (Monteverde in Southern Chile, Toca do Boqueirão da Pedra Furada and Toca do Sítio do Meio in Brazil, etc.), including the very unexpectedly old site of Cerruti Mastodon in the USA. Here the AdV site is presented, the difficulties for its excavation posed by its geographical circumstances are explained, its strengths and weaknesses as an archaeological site are discussed and its importance as a local and national cultural phenomenon is stated.

Keywords: Arroyo del Vizcaíno, pleistocene, southern South America

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Cacao 1.A: New Data and questions about first south-americans at Antofagasta de la Sierra, Argentina

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Cacao 1 is a shelter with rock art is situated at the confluence of the Cacao and Curuto bogs, at 25○54'46" S. and 67○20'27.1"W. and at 3755 m.asl, in the Antofagasta de la Sierra Department, Catamarca. We here present the stratigraphic record and archaeological evidences, artifacts and ecofacts, of a component stratified in a layer of megafauna dung. This level is characterized by a matrix mainly composed of vegetal remains and a smaller proportion of fine sand, originated from the disaggregation and trampling of extinct fauna feces (megatherium, mylodon, horse). At the time of writing this abstract there are five AMS dates between 39,000 to 37000 yr BP. The evidences includes an lithic artifact assemblage-7 artifacts- composed of flaked tools, used flakes and, also, some debitage. All the artifacts and ecofacts were found in a flat, horizontal position in the above mentioned component (level 5). Lithic artifacts include obsidian from Ona or Salar de Hombre Muerto sources (60 km), quartzite and vulcanite from sources close to Antofagasta de la Sierra (20km) and a local vulcanite. These indicate a provisioning range of 80Km which is larger when considering also vegetal remains. The contwext also includes cordage from chichillidae fibers, pendants of copper mineral, human hair and camelids fibers.
With the Brazilians sites of Pedra Furada and new nearest sites excavated by Eric Bo´eda and by Tom Dillehay at Monte Verde, Chile, Cacao 1.A invites to review the chronological data proposed up to date for South America peopling and to a reflection on the hiatus we have between those AMS and the 14000/12000 accepted dates in the archaeological forum.

Keywords: Pleistocene Peopling of the Americas, Highland of South, Central Andes, Hunter, Gatherers

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Early Hominin Dispersal into North America During Late MIS 6/Early MIS 5e: Climatic and Ecological Explanations of Hominin and Faunal Movements

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Recent publication of the Cerruti Mastodon Site, a ˜130,000-year-old archaeological site in southern California, USA indicates an early movement of hominins into North America. This discovery offers the opportunity to develop climatic and ecological hypotheses concerning how early hominins could have arrived in North America this early. Rapid climate warming and attendant floral and faunal changes during late MIS 6 and early MIS 5e caused faunal migrations far to the north of their pervious ranges in North America. This included the migration of mastodons and sloths from the midwestern United States far to the north above the Arctic Circle in the Yukon and Alaska. It seems only logical that humans would have rapidly increased their range far to the north in Asia in a similar response to climate change. Rapid sea level rises inundated Beringia early in MIS 5e cutting off this land route, indicating that if hominins arrived in North America via the Beringian Land Bridge, they entered more than ˜ 130,000 ka. At the same time, a major faunal migration of bison took place with bison first appearing in the Yukon at ˜ 130,000 ka having crossed the Bering Land Bridge from Siberia. Hominin groups adapted to bison hunting may have expanded their range along with this prey animal. A coastal route of entry for early hominins by watercraft is also a possibility. Early hominins developed watercraft capable of crossing short distances of open ocean by ˜130,000 ka as evidenced by the presence of early humans on Crete in the Mediterranean Sea and on the island of Sulawesi in Indonesia. Both islands are separated from continental land by many kilometers of open water and have been islands throughout the later Pleistocene. During rapid climate warming at the onset of late MIS 6/MIS 5e, early hominins using watercraft could have followed the east coast of Asia far to the north to the southern coast of Beringia and then followed the west coast of North America to the south without having to cross large stretches of open water, if they arrived before Beringia was inundated. There could have been both a land crossing and a coastal watercraft adaptation because these are not competing hypotheses.

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Keywords: Early Hominin, North America, Late MIS 6/Early MIS 5e:

Environmental, ecological, climatic and cultural aspects in the tropical lowlands of the cerrado biome during the late Quaternary

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Studies developed on tropical lowlands in areas presently covered by Cerrado biome, show during the late Pleistocene and Holocene, environmental, climatic and cultural changes in the groups that occupied the region, mainly from the Holocene. Palaeoecological interpretations were based on palynological, mineralogical and sedimentological analyses of lake sediment samples and lime peat lens on river terraces. Radiocarbon dating obtained from several areas allowed to establish the age of different phases, when occurred variation in the composition and distribution of different vegetation types and change in the processes of weathering and formation of clay minerals, during the Late Pleistocene and Holocene, which were probably caused by climatic changes from 40,000 years AP. The environmental evolution of the tropical lowlands is marked by two different phases of vegetational composition and distribution, separate by a phase during which semi-arid conditions were present. Although there were fluctuations in the two identified phases, the lower sequence, located in the Upper Pleniglacial, is represented by a set of predominantly arboreal and swamp elements, indicative of a more humid and cold climate than at present, becoming extremely cold and dry during the Last Glacial Maximum in the tropical lowlands but in diachronic way. The second phase beginning at the Holocene are marked by a gradual increase of humidity and temperature, and predominance of cerrado botanic elements. During the Holocene, different areas with palynological records show oscillations in temperature and humidity of lesser amplitude than those recorded in the Pleistocene and without evident synchronism. The changes occurred during the late Pleistocene, can be correlate with changes recorded in other areas of tropical lowlands and are associated to the last glacial period W´urm/Wisconsin in Northern Hemisphere. In the Holocene the climatic changes present variations related also to the physical characteristics of each area. The human occupations initiated in the Late Pleistocene and Early Holocene with hunter and gatherer groups with well-defined lithic industry, present in the sites like rock shelter show an occupational hiatus from 6,500 years AP, which is repeated in the cerrado areas and which may be correlated to Holocene climate change. This multi-disciplinary approach involving aspects of palynological, mineralogical and sedimentological analysis of sediments associated to material culture has been efficient used in palaeoecological studies and is very efficient to understand the dynamics of vegetation and climatic changes in tropical lowlands, besides the settlement patterns.

*Speaker

Keywords: Archaeology, Palaeoecology, Occupational hiatus

IZTACCIHUATL, TOLUCA, TLALOC: AN ANTHROPOLOGICAL AND COMPARATIVE LOOK AT THE VOLCANIC GEOGRAPHY OF MEXICO AND ITS ARCHAEOLOGY

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The cult of mountains in volcanic geographies has been a fundamental part of the social history of Latin America. During the fifteenth century, the highest summits of South American volcanoes were the scene of offerings and sacrifices performed during the consolidation of the Inca domination in the Andes. The volcanoes in the Valley of Mexico were also used for ritual purposes during the Postclassic Period. High altitude archeologists in the Mexican mountains (Sergio Iwaniszewski, Arturo Montero García, Victor Arribalzaga, Lourdes López and collaborators) have explored the heights of Popocatepetl (5,465 m), Iztaccihuatl (5,230 m) and Toluca (4690 m), where evidence of ancient rituals of bleeding and offerings have been discovered. According to historical sources, the Aztec priests also used to make sacrifices of children in a temple located on the summit of Mount Tlaloc (4.125 m), a volcano named after the deity of rain. The modern cult of Mexican volcanoes and its relationship with climate has been studied, among others by Julio Glockner, Beatriz Albores and Johanna Broda, who have addressed the role that these mountains fulfill in the Nahua religion, particularly in the ritual praxis of the "graniceros" who are believed to conjure hail and storms.
Having explored dozens of Southamerican volcanoes in the context of my research on Andean high altitude archeology, I have personally ascended to the tops of the three Mexican volcanoes that are the subject of this work, collaborating in field trips with local colleagues. I have also made observations in ethnographic contexts which have allowed me to delve into the religious and onirical bond established by ritual experts, for the prevention of the catastrophic effects of volcanic eruptions and earthquakes in the highlands of Mexico and Costa Rica. This presentation analyses Mesoamerican and Andean volcanic geography from a comparative perspective, to deepen an understanding of rites and beliefs that have evolved from antiquity to modern times.

Keywords: HIGH ALTITUDE ARCHAEOLOGY, SACRED MOUNTAINS, VOLCANOES, MEXICO, ANDES

*Speaker

Landscapes & Archaeology: settlement patterns in the south-central coast of Santa Catarina (Brazil) in front of palaeoenvironmental changes.

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Bioclimatic conditions during the Holocene have been significantly unstable, promoting sea-level fluctuations and changes in the vegetation. Other factors, as regional and locals agents have played an important role in the landscape configuration of the south-central Coastal Plain of Santa Catarina State (Brazil). Systematic sea-level investigations have shown evidence of a transgression maximum *ca.* 5100 cal yr BP that reached approximately 2,5 m in the southern State of Santa Catarina. (Angulo et al., 2006).These changes, resulting in the formation of sand barriers (barrier IV), the relocation of fluvial channels and the development of interconnected lagoons, were also recorded in different continental cores drilled along the Coastal Plain. These cores provided new information about the palaeovegetation history, among other data, allowing the interpretation of palaeoenvironmental evolution.
This changing landscape was the scenario for prehistoric groups to settle, more specifically the shell mounds builders (*sambaquis*), Meridional Jê and Guaraní groups, establishing a direct relation between them and their environment.
What we present is a synthesis of the existing data for the south-central Santa Catarina Coastal Plain about palynological studies, relative sea level fluctuations and the timing of the human occupation in the region. Palaeoenvironmental evolution is graphically represented considering

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different factors such as the marine influence, the Atlantic Rain Forest development, and the diverse prehistoric groups.

Keywords: Southern Brazil, Palaeoenvironmental Evolution, Holocene, Prehistoric Settlements, Landscape

Les modalités de peuplement depuis le pléistocène au Nord/Est du Brésil au regard des changements climatiques. The settlement modalities since the Pleistocene in Northeast of Brazil in the light of climate changes.

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La mission franco-brésilienne a depuis 2011 mis en évidence une occupation du sud du Piaui (Brésil) qui a commencé il y a 40 000 ans au moins. Ces données reposent sur la mise au jour de 6 séquences archéologiques provenant d'environnements sédimentaires différents, ayant livré plus d'une trentaine de niveaux archéologiques, composés, selon le type d'environnement, des artefacts lithiques ainsi que des restes osseux en interaction avec ceux-ci. L'analyse de la technologie des assemblages lithiques montre une succession de traditions techniques qui peuvent être soit similaires soit pas d'un site à l'autre quel qu'en soit le type d'environnement, ou inversement différents d'une couche à l'autre au sein d'un même site. Ces différences, du fait de la disparité des éléments de la culture matérielle recueillis, nous empêchent de déterminer la fonction exacte de chaque site. Néanmoins, les données issues de l'analyse des micro-traces d'utilisation sur les artefacts lithiques et les données de l'archéozoologie semblent indiquer des fonctions différentes.

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Les très nombreuses dates (plus d'une centaine) issues de méthodes différentes nous permet de caler dans le temps, et de façon assez précise, l'ensemble de ces occupations et ainsi de les corréler avec les fluctuations climatiques connues de cette zone. Le croisement de l'ensemble de ces données, sur une échelle de temps allant jusqu'à l'holocène moyen, montre qu'à certaines périodes, il y a une certaine corrélation entre la fréquence d'occupation et des tendances climatiques particulières, mais qu'à d'autres moments ces corrélations n'ont plus de valeur. Ce non déterminisme montre que si les changements climatiques ont pu avoir des répercussions sur l'environnement végétal et animal, l'occupation du territoire a été quasiment pérenne. Cette pérennité renvoie aux modalités d'occupation. S'agit-il des mêmes groupes ayant su apporter des réponses techniques satisfaisantes pour se confronter aux changements?, ou au contraire s'agit-il de groupes différents, dont seraient témoins les différentes traditions techniques ? The Franco-Brazilian mission has since 2011 highlighted an occupation of southern Piaui (Brazil) that began at least 40,000 years ago. These data are based on the discovery of 6 archaeological sequences from different sedimentary environments, having delivered more than thirty archaeological levels composed, depending on the type of environment, of lithic artefacts, as well as bone remains interacting with them. The technological analysis of the lithic assemblages shows a succession of technical traditions that may or may not be similar from one site to another, regardless of the type of environment, or even different from one layer to another in the same site. These differences, because of the disparity of the elements of the material culture collected, prevent us from determining the exact function of each site. Nevertheless, data from the analysis of micro-traces of use on lithic artefacts and data from archaeozoology seem to indicate different functions. The many dates (more than a hundred) from different methods allows us to call in time, quite accurately all these occupations and thus correlate with the known climatic fluctuations of this area. Crossing all these data, on a time scale up to the Middle Holocene, shows that at certain times there is some correlation between the frequency of occupation and particular climatic trends, but that at other times these correlations have no value. This non-determinism shows that although climate change may have had repercussions on the plant and animal environment, the occupation of the territory has been almost permanent. This durability refers to the modes of occupation. Are these the same groups capable of providing satisfactory technical responses to change, or are they other groups that will witness different technical traditions?

Keywords: Brésil, pléistocène, peuplement, climat

PALEOPAYSAGES, PREMIERS PEUPLEMENTS ET GEOCATASTROPHISME AU NORTH-OUEST DE L'AMERIQUE DU SUD /PALEOLANDSCAPE DYNAMICS, EARLY PEOPLING AND GEOCATASTROPHIC EVENTS IN NORWESTERN SOUTHAMERICA

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Les caractéristiques volcaniques de la Cordillère des Andes et les dynamiques des principaux fleuves en Colombie comme le Magdalena et Cauca, montrent la complexité des donnés qui préservent ou effacent les vestiges des premières périodes culturelles. Au nord, la néotectonique, les changements du niveau de la mer et les changements climatiques ont transformé différents paysages, y compris les impacts possibles de l'inondation d'une méga-paléo-lac. Au centre et au sud du territoire colombien dans l'intérieur du continent, le volcanisme actif de la Cordillère Andine Centrale a joué un rôle important, avec pour conséquences une large distribution de cendres volcaniques et une sédimentation spécifique dans les terres basses des bassins inter-Andines du Magdalena et du Cauca.
Les recherches géo-archéologiques en cours ajoutent des données importantes pour comprendre les transformations majeures des paléo-paysages. La présence ou l'absence d'artéfacts et de sites archéologiques de différentes périodes sont fortement conditionnées à l'emplacement, la hauteur, l'existence ou non de dépôts volcaniques, les processus d'érosion, et les variables de décisions socio-culturel. Aussi les aspects et les données négatives doivent être considérés. Nous signalons l'importance de la récurrence et la puissance des différentes éruptions du système volcanique Cerro Bravo-Cerro-Machin et ses conséquences sur les deux côtés de la Cordillère Centrale. Il est essentiel de renforcer la connaissance des méthodes de modification de compréhension en géomorphologie, la formation des sols, les complexités stratigraphiques, les effets de la bioturbation, les conditions de conservation et les différents aspects paléo-environnementaux, qui affectent les modes de distribution et de séquences chronologiques des sites à partir du Pléistocène tardif.

A la vallée centrale du Magdalena, entre 10.400 A.P., jusqu'à ca. 3.600 A.P. il y a des ensembles

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d'outils de chasse spécialisée, liée aux activités côtières de la pêche. Dans les montagnes du bassin du Cauca, à la même temporalité, il y a des outils que démontre l'appropriation millénaire des plantes. Les dynamiques environnementales sont très complexes et des événements significatifs récents ont effacé les sédiments formés à la fin Pléistocène et au début de l'Holocène. Les autres sédiments sont profondément enfouis. L'enregistrement conservé ne reflète pas avec exactitude les caractéristiques des paléo-paysages, ni l'univers des outils produits à différents temporalités. C'est plutôt un miroir de la conservation géologique, où certains contextes ont été préservés, par exemple, ceux sur le sommet de terrasses ou de collines (paysages fossilisés).

Colombian contexts and particularly Magdalena fluvial dynamic is a good case to think about erased evidences for early cultural periods. Magdalena archaeological sites show mostly late ceramic evidences, most of the previous record has been erased by environmental dynamics. At the North, the neo-tectonism, the changes of the sea level and the climatic changes had important significance in the landscape configuration, including the possible impacts of the flooding of an ancient mega-paleolake. At the center and south of Colombian territory, active volcanism of the Central Cordillera has played an important role in the middle section of the Magdalena and Cauca watersheds in the continental interior.

Geoarcheological research in progress add important data to understand major landscape transformations. Magdalena and Cauca watershed archaeological data point to consider that there were an important occupation during the *Estadial el Abra equivalent to the Younger Dryas* in a dry period, between 11.000 to 10.000 BP during a dryer and colder period, after the warm precedent period.
Colombian environmental dynamics are very complex and recent significant events have erased sediments formed during the final Pleistocene and early Holocene. Other sediments are deeply buried. The preserved early record in Colombia does not reflect with complete accuracy past landscapes, nor does it reflect the universe of ancient occupations at different points in time. It is rather a mirror of geologic preservation, where some components preserve, e.g., those on the summit of terraces or hills (fossilized landscapes) but many are lost.

Keywords: COLOMBIE, PALEOPAYSAGES, PREMIERS PEUPLEMENTS ET GEOCATASTROPHISME

Pleistocene-Holocene sequences in the Serra da Capivara National Park, Brazil: a regional chronological framework for the study of human occupations

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In the long and contentious debate surrounding the Late Pleistocene occupation of South America, our French-Brazilian research team has investigated since 2008 several sites in and around the Serra da Capivara Regional Park in Piaui, Brazil. Seven sequences have been studied or are currently under study. For six of the seven sequences, a chronological framework has been established thanks to luminescence dating methods and/or radiocarbon (see for example Lahaye *et al.*, 2015; Bo´eda *et al.*, 2016). With this available data, we now propose to establish a chronocultural framework of these late-Pleistocene and Holocene occupations at a micro-regional scale. The model is based on Bayesian statistical modeling with the BayLum package (Combès et Philippe, 2017; Philippe *et al.*, submitted), taking into account both results from numerical dating methods (luminescence and radiocarbon, in this case) and stratigraphic constraints, regional geological settings and cultural similarities among archaeological levels.

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Keywords: chronology, luminescence, America, Bayesian modeling

Reconstitution de l'environnement aquatique de la capitale olmèque de San Lorenzo (Etat de Veracruz, Mexique) à l'aide des données Lidar.

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Le niveau de résolution hypsométrique des données lidar ouvre de nouvelles perspectives notamment dans l'étude des changements morphologiques que peuvent entrainer les variations climatiques sur l'environnement des sociétés préhistoriques et protohistoriques. Le cas de la ville de San Lorenzo, première capitale olmèque, qui correspond à la première civilisation de Mésoamérique, permet d'illustrer ce propos. Cet établissement humain fut construit sur une légère éminence de la plaine fluviale du fleuve Coatzacoalcos. Les premières reconnaissances ont mis à jour les fameuses têtes colossales olmèques, sculptures monolithiques ayant environ 2900 ans, et on estimait alors que la subsistance de cette culture devait être principalement basée sur l'agriculture du ma'is. En fait, suite à des enquêtes de terrain menées pendant ces dernières vingt années, l'hypothèse de la présence d'un vaste plan d'eau situé au nord de l'emplacement de la capitale olmèque s'est imposée, ce qui implique une diversification de l'alimentation provenant, entre autres, de ressources halieutiques. L'existence d'un tel plan d'eau d'une profondeur moyenne d'environ deux mètres peut être mis en évidence en réalisant des simulations appliquées à un ensemble de données Lidar. Des simulations de subsidence qui se basent sur une interpolation de type multidirectionnel, montrent qu'en fait la diminution actuelle du volume d'eau présent dans l'étendue d'eau saisonnière qui se situe au nord de San Lorenzo est due à l'accumulation au cours des siècles, de sédiments provenant du cours du rio Coatzacoalcos, accumulation qui a réduit le volume aquatique, partant les ressources halieutiques. Les résultats obtenus à l'aide de ces simulations sont corroborés par les sondages effectués sur d'antiques monticules d'origine olmèque, sondages qui montrent à quelle profondeur se situait en fait le fond du bassin à cette époque.

Keywords: Reconstruction du paysage, simulation, interpolation multidirectionnelle, culture Olmèque,

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données lidar

Sequence stratigraphy of the northeastern pampas valleys and climate-demographic OIS 3 expansion stages. Buenos Aires, Argentina.

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Geoarchaeology and cultural content of the northeastern Pampean valleys pre-LGM secondary sites, first described in the 19th century, are reassessed. Artifact assemblages, embedded in late Pleistocene channel and alluvial plain settings, consist of abundant modified megafaunal bones and scarce lithics. Based on facies and sequence stratigraphy analysis and isotopic dating, we conclude that the outcropping Pleistocene valley fluvial fill spans from OIS 5 to OIS 2, with sequence boundaries reflecting regional glacioeustatic downcutting events. This dating allowed assignment of an Upper Pleistocene age to most of the levels described by Florentino Ameghino in 1882 as containing cultural evidence. These deposits are sealed by a rich layer of organic matter or "black mat," indicating an abrupt climatic change with an increase of humidity, triggering extinctions, starting sometime between 12,5 and 13 kys BP. After recent data provided by Eurasian sites, genetic analysis, and the understanding of global climatic-eustatic events, it is here hypothesized that occupation of the Americas, excluding possible pre-OIS 4 incursions, was shaped by expansion-diffusion stages modulated fundamentally by two factors: First, global climatic cycles inducing changes in the productivity and distribution of biomes; and in turn, human demographic changes. Secondly, once a minimum critical mass of population density and social networking was reached for each biome, cultural complexity arose. For the Chaco-Pampean area, we hypothesize that the peopling was shaped by the following succession of events:
- An exploration-colonization event had occurred between 50 and 30 kys BP (Expansion I). The climate improvement of the OIS 3 interstadial triggered this process of demographic expansion.

- The marked climatic deterioration during the OIS 2 cooling phase produced a significant ecological redistribution, with human decolonization of certain areas.

- The post-LGM climate improvement induced the re-colonization (Expansion II), uninterrupted exploration, occupation, and displacement of new groups, under strongly improving environmental conditions.

- Between 12 and 13 kys BP, radical climatic changes occurred, associated with megafauna mass extinctions. Significant demographic and /or adaptive changes are inferred.

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- Benign Holocene climate conditions triggered population redistributions, occupation of all ecological niches, with a flowering of diverse adaptations and complex networking.
These main climatic-demographic stages modulated the diffusion of different biological-cultural components. The pre-LGM expansion would be characterized by generalized technological elements with roots in the middle terminal Paleolithic; and the post-LGM expansion by an increasing participation of later components, all of them carrying upper terminal Paleolithic technologies. Analysis of museum collections, prospection trenches, and taphonomic analysis confirm the presence of artifacts in the "lujanian" deposits; leading to consideration of a Pampean peopling from, at least, 35,000-45,000 BP.

Keywords: OIS3, pampas, Lujan, demographic expansions, fluvial sequences, pre, LGM peopling

The Record at Cerro El Sombrero Abrigo 1, stratigraphic and lithic information.

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Several sites in the Tandilia Range in the Argentine Pampas were occupied during the Late Pleistocene/ Early Holocene. Among them is Abrigo 1, a small orthoquartzite rockshelter in Cerro El Sombrero locality at 398 m a.sl. AMS C-14 ages place the first occupation of the site in the range of 10,200- 10,800 yrs BP. Its sedimentary filling is composed of two stratigraphic units. The lower unit (Unit 1) includes the archaeological material of the early occupation. It is _˜ 20 cm thick and exhibits a faint horizontal lamination. It is composed of a clayey silty sand deposit with coarse sand and very fine gravel resulting from rock disaggregation; micaceous quartzite slabs from the rock shelter wall are common as well as some others coming from roof-fall episodes; clay patinas cover the upper surfaces of the slabs. Regional paleoclimatic reconstructions suggest rather cold environmental conditions favoring likely the physical weathering of the orthoquartzites during the interval of human occupation. The upper unit (Unit 2) is mainly composed of eolian sediments and some roof-fall slabs with scarce findings of archaeological material. The cultural assemblage associated with the dates is comprised of lithic artifacts and ochre fragments. Tools are mostly on regional high quality orthoquartzite and on immediately available quartz. They include Fishtail or Fell's Cave Stemmed points, scrapers and other tools, cores and debitage. According to lithic functional analysis, this rockshelter is considered a specific activity site. All the sites in the microregion under study are easy to access, yet early domestic sites tend to be placed at lower altitudes and special purpose or ephemeral sites are higher. We propose that climate can in part account for the way in which different places were used as higher microenvironments were more exposed to the rigorous conditions.

Keywords: Pampa, Fishtail points, stratigraphy

*Speaker

II-7. The role of climate in the transition from foraging to farming systems

Adaptation and sustainability of humans and natural environment. From the last hunter-gatherers to the first farmers and shepherds in the south of Catalonia.

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Through this article we intend to present the results of the investigation of a set of records that correspond to the period of time between the late Pleistocene and early Holocene in the territorial framework which coincides with the actual regions of southern Catalonia with coastal facade: Baix Camp, Baix Ebre and Montsià, in addition to the Priorat and Ribera d'Ebre, in order to draw conclusions that allow us to detect the strategies that used the last communities of hunter-gatherers, to continue the sociocultural progress that entails the passage to the Neolithic in these places. Considering that the study of prehistory is not limited to the tools of these societies, which have been preserved to this day, but also involves the reconstruction of the paleoenvironment in which all their activities are developed. We gather all evidence: archaeological, geological, faunal and pertaining to the landscape which -according to our criterion- is more significant for formulating an interpretative hypothesis, allowing us to sketch a picture of the environment. It comes to the development of a synthesis which constitutes a first approximation to pursue further research. The interest of the subject lies in being in a geographical area that presents a varied landscape rich in natural resources, exploited since the early stages of prehistory with a coastal front between the courses of the rivers Francolí and Sènia; the existence of wetlands, passing through the network of the Ebro (with its tributaries the rivers Siurana and Montsant), with a changing delta formation, which develops in fertile land, raw materials and basic foodstuffs; mountain areas of strong relief with rich and varied georesources in easy reach, as well as cavities of some length, suitable as living spaces. Therefore, it is no wonder the long list of researchers who have preceded us that already studied several sites in the area which have become today a scientific reference for its stratigraphic record, like the cave of La Mallada (Perelló) as well as the shelter of St. Gregory in Falset and the whole complex of deposits of the banks of the river Montsant in el Priorat, amongst countless other sites, such as the more than a hundred sites with surface stone tools, as well as an unknown number of archaeological sites, the result of emptying inventories Archaeological Heritage of Catalonia (IPAC), in addition to the most the most important rock art sites known in the northeast of the peninsula, where the Levantine and Schematic art coexist. In addition we have the recent discoveries of rock art in the Montsant and the Ports which make us consider the existence of a richness of quaternary

*Speaker

settlements in this territory. The analysis of these artistic manifestations gives us valuable information on the behaviour of these human groups as well as an approach to their beliefs and religion.

Keywords: Ebro basin, Siurana, Epipaleolithic, Rock Art, lithic industry

Assessing the impact of the 10.2 cal. ky BP abrupt climatic event in the emergence of agricultural economies in the northern Levant

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This paper is aimed at demonstrating the interconnectedness of the first agricultural economies in the Levant and the ecosystems they inhabited, emphasizing the complex nature of human responses to environmental change during the Neolithic period in the region. An analysis of archaeological radiocarbon dates and diagnostic material culture records from a series of key sites in the Euphrates valley revealed a major cultural discontinuity taking place around 10,200 cal BP. This observed transition in archaeological material cultures occurred in synchrony with climatic anomalies present in multiple proxies at _˜10.2 cal ky BP, showing that the hitherto apparent long-term continuity interpreted as the origins and consolidation of agricultural systems was not linear and uninterrupted. In order to advance our understanding of the potential correlation between human population dynamics and climate-driven changes in terrestrial ecosystem variability in the region, we have expanded our study to cover the whole northern Levant between _˜11–8 cal ky BP. This allows us to explore human responses to climate variability among Neolithic communities occupying different ecosystems during the proposed 10.2 ky BP event. From the methodological standpoint, efforts have been made to manage the sources of uncertainty associated with radiocarbon dating, as well as intersecting 14C-data with other lines of evidence in order to better characterize how the first agricultural communities responded to an abrupt climate anomaly in the northern Levant.

Keywords: Neolithic, Near East, Human Environment Interaction, Early Holocene RRCs, Population Dynamics

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Climate change and agro-pastoralism spread in the Lower Tagus Valley (Portugal)

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The transition from hunter-gatherers to farming systems in the Western Iberian Peninsula and the development of this new economic system continues to be the subject of interdisciplinary research. Palaeobotany is one of the scientific areas that contributes to a better understanding of the Holocene environmental dynamics and its relationship with human behaviour.
Palaeobotanical data obtained for the Lower Tagus Valley, in two sedimentological cores from Vale de Cavalos (Chamusca) and Golegã (Central Portugal) allows to verify that the vegetation dynamics reflect the influence of several dry and moist climatic oscillations manifested by forests expansion and decline. An initial relation between human behavioral changes and woodland decline was not verified. The various phases of diminishing or relative expansion of forest areas coincides with climatic variations and cycles described for the Holocene.
Environmental data does allow to suggest a pre-Neolithic forest degradation. Although the indicators of agriculture and pastoral practices are observable since the Mesolithic/Early Neolithic, the vegetation records only indicate an anthropic impact in the landscape after circa 5.000 cal BP. This might have its relation is aspects related to the archaeographic record, which suggests that the first productive economies in the area (ie., Early and Middle Neolithic) were mainly of small groups, very mobile and with a mixed economy where hunting (and gathering) would still be important, as suggested by archaeographic records.

Keywords: Palaeobotany, Vegetation evolution, Climate change, Human impact

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Climatic impacts during the origins of agriculture

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Climatic fluctuations in mid-latitudes may have variable impacts on humans depending on the economic basis of their affected society and its social organization. Prehistoric and historic research demonstrated that until recently (the last 300 years) humans' activities did not affect the annual, decadal or even centennial climatic conditions. On the contrary, climatic changes were shown by more than one project to have positive or negative impacts on particular societies. Economic benefits were when food plants, either cultivated as wild or fully domesticated, were favored by rain by sufficient amount in the right season. Similarly, when animals, either hunted or herded had the adequate amount of grass growth, shrubs, and trees to satisfy their vegetarian diet, then people would view it as the required condition to secure their biological survival. But all the conditions that could be seen as positively supporting a foraging society could be regarded as limiting factors among fast-growing agricultural populations. The line that separates between lush conditions to famine could be very thin. Foragers may save themselves by increasing mobility if no one limits their movements. Successful farmers may have a degree of resilience in front droughts or floods unless the worsening conditions become disastrous and result in site abandonment. A series of examples from Eurasia will illustrate how climatic fluctuations in the evolutionary course from mobile hunter-gatherers to established farmers societies faced good times and bad times. They took the benefits of their social organization to secure their physical survival, while others failed and disappeared. Several Paleolithic and Neolithic examples from the Levant and China will be discussed.

Keywords: Paleoclimate, farmers, resilience, Levant, China

*Speaker

Environmental conditions during the Early Holocene in northern Iberia derived from stable oxygen isotopes on marine mollusc shells

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The relatively homogeneous climate of the Holocene is punctuated by a number of short climatic events, which had significant impacts on past societies. The most prominent of these is the 8.2ka event, a short period characterised by relatively cold conditions. How this event affected hunter-fisher-gatherer societies in southern Europe is still unclear. The Mesolithic in northern Iberia (ca. 10.8 - 6.8 ka cal BP) is characterised by the formation of shell middens in coastal locations. Archaeological shells found in these middens provide information not only on human subsistence strategies, but also on environmental conditions. Molluscs form their shells by precipitating calcium carbonate in isotopic equilibrium with the surrounding environment, and so they become environmental archives. In the case of marine molluscs, stable oxygen isotope (δ18O) are mainly dependent on seawater temperature (ST), and δ18O values can be accurately used to establish ST. This paper aims to improve our knowledge of climate variability in northern Iberia during the Early Holocene. To achieve this, δ18O values were obtained from subfossil shells of *Phorcus lineatus* (da Costa, 1778) recovered from five stratigraphic units at the Mesolithic shell midden site of El Mazo cave (Asturias, northern Iberia). Results showed cooler winter temperatures at the start of the archaeological sequence (ca. 8.9 ka). Temperatures increased between 8.5 and 7.5 ka, suggesting the existence of warmer conditions than today, mainly in winter. However, shells from units dated to around 8.2 ka (stratigraphic units 105 and 112) recorded slightly cooler summers and smaller ranges of annual temperatures than the rest of the sequence.

Keywords: Molluscs, Environment, Oxygen, isotopes, Mesolithic, Early Holocene, 8.2 ka event

*Speaker

Herpetofaunal remains in the Natufian sequence of el-Wad Terrace (Mount Carmel, Israel): Paleo-environmental reconstruction and its possible connection to cultural change

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The Natufian culture in the Levant has great importance as a transitional phase between the Paleolithic cultures with their mobile hunter-gatherer way of life to the beginning of sedentary life and the transition to farming economy. Previous studies have linked the emergence of the Natufian culture and the transition from the Early to the Late Natufian to climatic–environmental changes. However, recent studies have questioned the temporal correlation between climatic changes and the emergence of both the Natufian culture and the transition between the Early and the Late Natufian. Here we reconstruct the environment of the key Natufian sequence of el-Wad Terrace, Mount Carmel, Israel, using herpetofaunal remains. This Natufian sequence is one of the longest and most complete in the Levant and is therefore most relevant to our research.

The study of archaeological herpetofauna (amphibians and reptiles) provides a tool for reconstructing the Natufian environment, as they are ectothermic vertebrates that depend on specific environment and climatic conditions for thermal regulation (reptiles) or the presence of water for respiration and reproduction (amphibians). The distribution and abundance of amphibians and reptiles is determined by the temperature and precipitation in their immediate environment. Thus, herpetofaunal analysis is an accurate tool for paleo-environmental reconstructions of the site's surroundings and can accurately detect climatic and environmental changes through time. Taphonomic characterization of herpetofanal accumulation patterns in the Natufian layers will allow reconstruction of the paleo-environments of the Early and Late Natufian in the site of el-Wad Terrace. This research will test the assumed correlation between the emergence of the Early Natufian and the cultural changes in the Late Natufian and environmental-climate change, in order to examine the environmental and cultural attributes that predated the transition to agriculture.

Keywords: Natufian, herpetofauna, paleo, environmental reconstruction, climate change

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Reconstructing Environmental Impacts on Late Pleistocene and Early Holocene Societies in the Marginal Zone of the southern Levant: A Case Study from Shubayqa

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The Younger Dryas event has for a long time been described as a key climatic trigger event that disrupted the stability of the early Natufian, and led to a re-adjustment of late Natufian and early Neolithic settlement and economy in the Levant. To test what impact the Younger Dryas had on Late Natufian economy, settlement and society in the southern Levant we initiated the Shubayqa Archaeological Project in 2012, targeting a series of late Pleistocene and early Holocene sites in the semi-arid to arid zone of northeast Jordan. One of the underlying ideas of this project has been that the environmental degradation that has been suggested to have occurred as part of the Younger Dryas could be expected to have been particularly severe in the so-called 'marginal' steppe and desert zone of the southern Levant. Consequently. the effect of the Younger Dryas on late Natufian groups in the area could also be expected to have been severe. In this paper, we present some of the results of our ongoing palaeoenvironmental and archaeological fieldwork in the Qa' Shubayqa area. Drawing on archaeobotanical, zooarchaeological, archaeological, chronological and geomorphological data we examine palaeoenvironmental and cultural change during the late Pleistocene and early Holocene of northeast Jordan, we show that although there is some evidence for increasing aridity in the area that the overall impact on late Natufian economy and settlement pattern was negligible.

Keywords: Late Epipalaeolithic, Pre, Pottery Neolithic, Natufian, Jordan, Levant

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The transition from foraging to farming systems in southern Levant - the contribution of carbon isotopes analyses and archaeobontany to understand the role of climate.

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The end of Pleistocene was a critical period in the history of humankind, with a system of subsistence that shifted from hunting and gathering wild resources to farming and herding domesticated stocks, but it was also a period of significant climatic changes. With the end of the Last Glacial period, around 23,000-20,000 years BP, the vegetal cover started to change to adapt to the new environmental conditions and, even though the changes affected different areas in different ways, there were variations in the type of plants and animals available to the primitive hunter-gatherers. In some areas, such as Southern Levant, the natural adjustments were associated to cultural and social mutations that reshaped the traditional ways of subsistence into new forms, paving the way to farming and adoption of a sedentary lifestyle.
Evidence of such epic transformation is visible in many Epipalaeolithic sites in the area of the Mt. Carmel and around it, where archaeological excavations reveal some of the earliest evidence of these processes. Investigating the subsistence of the Natufian communities through the study of the plant assemblage found in the earlier dwellers site of el-Wad has offered a unique opportunity to understand the processes that led to the onset of agriculture.

The combined study of seeds, charcoals and stable Carbon isotopes and radiocarbon dating applied to material coming from el-Wad allowed us to shed new light on ecological conditions that favored the spread of forms of pre-agriculture among the Early Natufian communities.

Keywords: Southern Levant, Palaeoclimate, Natufian, Archaeobotany, Carbon Stable Isotopes, Radiocarbon

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II-8. Different times? Archaeological and environmental data from intra-site and off-site sequences

Anthropogenic impact and environmental changes from middle Mesolithic to late Neolithic in Normandy at Cairon (Western France).

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The site of Cairon is located in the Vey valley, at about 250 meters from the Middle Neolithic settlement of " la Pierre Tourneresse ". Archaeological excavations have allowed to distinguish three occupation phases between the Middle Neolithic I and II. The two first phases correspond to the remains of a religious area, and then of a domestic settlement. According to the archaeobotanical and archaeozoological data, at the beginning of the Middle Neolithic II the forest is already interspersed by clearing. It attests too that agropastoral activities exist around the settlement. The last phase corresponds to the building and the use of a cairn. Previous pollen analysis on an off-site core (Cairon) supplies limited information about agropastoral practices during this period. Results don't allow to correlate intra-site and off-site records.
New high-resolution multi-proxy analyses (pollen, non-pollen palynomorphs, macroscopic charcoals, magnetic susceptibility and C/N ratio) have been carried out on a new core (Cairon 2016). Chronology of Cairon 2016 is based on a stratigraphic correlation between Cairon 2016 and the former cores, and 6 radiocarbon dates. According to the age depth model, this sequence covers the Mid-Holocene approximately between 7300 - 7000 and 3500 - 3300 cal. BC. Thus it covers the whole of the Middle Neolithic.
The aim of this communication is to present new data: 1) to show environmental consequences of the rapid climate changes that occurred during the Mid-Holocene; 2) to characterize agricultural practices during the Middle Neolithic period; 3) and to study agrarian landscape structure. Until the Middle Neolithic I (c. 4400 cal. BC), environmental changes are mainly due to the water table variations. The first anthropogenic indicators and the increase in macro charcoal particles coincide with the first occupation phase. But presence of cereals cultivation is only attested during the domestic settlement phase (c. 4200 – 4000 cal. BC). Following the building

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of the cairn, anthropogenic indicators become more irregular. From this period our data may reflect the integration of the Cairon valley bottom in a wider agrarian system.

Keywords: Anthropization, Pollen analysis, Valley bottom, Middle Neolithic, Western France

Archaeological and paleo-environmental reconstructions in the tropical Maya area: the Case Of Naachtun (Guatemala)

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The city of Naachtun (Guatemala) is an important Maya regional capital located between the two superpowers, Tikal and Calakmul that subdued alternatively most of the main cities of the classic Maya lowlands. Naachtun, as every big city, seems to have dominated a vast territory occupied by a dense population, as shown by the first LiDAR images of its hinterland. This city is located near a large and deep wetland called *bajo* (a karst polje). The regional climate is a tropical wet and dry one, and the end of the dry season is a critical period for water availability. This study zone -covered by a sub-perennial tropical forest- is a sensitive environment area to climate change and anthropogenic impacts.
Since 2013 a joined team of archaeologists and paleoenvironmentalists (geomorphology, geoarchaeology, archaeobotany, zooarchaeology) has been conducting a pluridisciplinary program on this site, in order to reconstruct the city history and to understand local resources evolution and management by the Mayas (mainly water, soils, fauna and woods). In parallel, intensive archaeological excavations conducted since 2010, and environmental works both in the site epicenter and in its surroundings areas, allowed us to draw a sequence of intra-site occupation during roughly a millennium (150 AD – 950 AD). The comparison between the archaeological and environmental reconstructions differs greatly as the latter cover the last four millennia. The sedimentary archives studied are spatially continuous and characterized by lateral and vertical gradients of anthropisation (between settlements, reservoirs, marsh and fields).
In this contribution, we aim to present the focal points and the divergences between the two

*Speaker

sequences in progress (archaeological and environmental), one mainly based on chrono-ceramic sequence and radiocarbon dating of refuse middens and abandonment deposits, and the other on absolute dating of charcoal and organic matter in soils within prehispanic agrarian fields or within flooded and colluviated sedimentary environments (anthropogenic reservoirs and wetlands) both in intra-site and in off-site. On the one hand, the interdisciplinary dialogue allows us to identify and date the main societal changes (during emergence, growth and decline of the city) and environmental changes (fluctuations in local water supplies, episodes of soil erosion, forest dynamics and farming practices). On the other hand, it allows us to characterize the nature and timescales of environment-societies interactions or to identify discrepancies between the two sequences (deforestation, hydraulic works and agrarian practices attested during the Preclassic period vs absence of clear archaeological evidence of a simultaneous occupation).

Keywords: ecosystem, sociosystem, maya agrarian practices, archaeological/environmental sequence

Can Stable carbon isotope ratios (δ13C) from archaeological charcoal be used as regional palaeoenvironmental indicators? : Potential of the method for "les gorges de l'Ardèche" archaeological complex during Upper Paleolithic.

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Since Prehistory, the evolution of societies is embedded in a context of deep environmental and climatic changes modifying human/environment interactions, resources and territories accessibilities. Understanding the way ancient societies faced environmental conditions and their changes are critical issues for prehistorians. However, establishing correlations between cultural and environmental changes is fraught with complexity as long as the latter are documented mainly by extra-regional data (e.g. far ice cores). Most of the models are supported by proxies that show no direct connection with archaeological records (e.g. pollen, 18O), providing information on the prevailing environmental conditions at wider (e.g. extra-regional) levels. Conversely, charcoal which is usually well preserved in prehistoric occupations and provides records covering long term spans is a witness of local environment. Studies focusing on plants δ13C isotopic signal have become a reliable method to reconstruct past climatic and environmental conditions. Wood remains are notably absent from the very ancient archaeological record, due to degradability of plant tissue. For archaeological studies, the analysis of isotopic signals from charcoal of Pinus species, which is more reliably preserved over time, and continuously represented among archaeological remains yielded more robust findings. Methodological assessment of this approach has been developed in a previous study, confirming the possibility to use it for archaeological implementation. Indeed, a primary reference set was established in the context of climatic and environmental parameters for archaeological analyses of charcoal remains. We present here the first study of the stable carbon isotope ratios (δ13C) applied to charcoal from the Pinus genus of

*Speaker

a complex of Paleolithic sites from the same region: "Les gorges de l'Ardèche": "la Grotte aux Points", "Les Deux Ouvertures", La Baume d'Oulen" et "La Grotte de Chauvet Pont d'Arc". We then discuss the potential and the limit of the method as a regional climatic proxy at a scale which **really documents the climatic conditions experienced by the human groups.**

Keywords: Stable isotopes, Charcoal, Paleolithic, Paleoclimatology, Palaeoenvironment, Pleistocene

Comparing anthracological and archaeological sequences to reconstruct socio-environmental dynamics at Naachtun, Guatemala.

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The rise and development of ancient Maya societies in the tropical forests of the Maya Lowlands question how these societies exploited the forest, impacted landscapes and adapted to changing environments over three millennia. Wood was indeed an indispensable resource for the Maya, and is therefore a key economic and ecological indicator for understanding socio-environmental interactions over time. In this presentation, we propose to analyze relations between human activities and woodland changes at a Maya site, by conducting a systematic and diachronic anthracological study, mostly in domestic contexts. Naachtun, a Classic period city located in northern Petén, Guatemala, developed over eight centuries (AD 150-950/1000) with non-linear population dynamics, and proved its resilience during the Terminal Classic crisis. This makes the site a relevant candidate for studying the interactions between the ancient Maya and the forest on a long-term scale. The comparison between the sequence of firewood use and the socio-political and economic history of the city reveals important discrepancies. In particular, the remarkable stability of wood use during the first six centuries of the city's history, completely contrasts with the continuous population growth. On the contrary, the sudden shift in firewood collection strategies that occurs by the middle of the Late Classic (AD 600-830) is consistent with the highest population pressure on the landscape. These lines of evidence question the relations of causality between societal changes and the evolution of woodlands around the site, and thus allow for a better reconstruction of socio-environmental dynamics and human behaviors in the Maya Lowlands.

Keywords: Anthracology, diachrony, firewood economy, Maya Lowlands

*Speaker

Correlation between palaeoenvironmental interpretations and MIS curve: the Caune de l'Arago case

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Caune de l'Arago is a karstic cave located between the Mediterranean Sea and the Pyrenees, close to diverse landscapes and numerous biotopes. Two thirds of its infilling have been excavated up to now, in which 55 Middle Pleistocene occupation layers have been individualized through the study and distribution of hundreds of thousands of faunal and lithic remains. The correlation to the LR05 Marine Isotopic Stage (MIS) curve, based on palaeoenvironmental, radiometric and biochronological data, attributes the excavated layers to MIS 15 to 5.
However, this correlation induces a huge difference in the sedimentation rate between the Middle and the Upper Stratigraphic Complexes, *i.e.* before and after MIS 12, which has to be interpreted. Moreover, the distinction between interglacial and interstadial may be delicate through the palaeoenvironmental interpretations deduced from faunal and pollen proxies. Last but not least, more local MIS curves (*i.e.* Mediterranean ones) may be preferred to the LR05 stack curve in order to correlate the data more accurately.

Tightly linked is the question of what time do the geoarchaeologist read while studying these sediments? Ultrashort deposition episodes during paroxysmal events, or continuous accumulation through very slow sedimentation, or a mix of the two, or both, depending on the climate? Are granulometrical or micromorphological approaches sufficient to decipher?
Here we propose to discuss different correlation schemes through the recently published radiometric dates, detailed interpretation of the climatic changes from small vertebrate assemblages, and induced sedimentation rates.

Keywords: Middle Pleistocene, MIS, Geoarchaeology, Palaeoenvironment, Microvertebrates, Caune de l'Arago

*Speaker

Evolution de l'environnement végétal et des activités humaines entre 5100 et 4600 cal. BC dans le bassin aval de la Marne : apport de la palynologie hors-site à la dynamique de peuplement du Néolithique ancien

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Entre 5100 et 4600 cal. BC, le bassin aval de la Marne a connu une forte colonisation du Néolithique ancien, d'abord Rubané Final du bassin de la Seine (RFBS) puis Blicquy-Villeneuve-Saint-Germain (BVSG). Pour cette étape, de loin la mieux représentée, les données archéologiques plaident pour une intensification des implantations durant la phase médiane puis un étiolement final. S'appuyant sur les nombreuses analyses polliniques, effectuées hors-sites en fonds de vallée mais autour des occupations du Néolithique ancien, la question s'est posée de savoir si la palynologie pouvait relater, sur un laps de temps aussi court, une évolution 1) de l'environnement végétal et 2) des activités de ces groupes humains (RFBS et BVSG) ainsi que de leur impact sur le milieu végétal. Outre la haute résolution et les modèles d'âge des différentes séquences polliniques, l'exercice repose sur l'utilisation d'un système de gestion de base de données relationnel (SGBDR) et une modélisation quantitative des données polliniques (modèle REVEALS) qui vise une meilleure reconstruction du couvert végétal en intégrant les biais inhérents à la discipline. D'après les comptages polliniques et leur modélisation, les premiers néolithiques (RFBS) semblent arriver dans un environnement constitué de boisements assez clairs où se mêlent composants de la chênaie-tillaie, essences de lumière et tapis herbacé. Une densification des tillaies se marque ensuite durant le BVSG alors que les zones de prairies augmentent. Certes dépendantes de la fiabilité des modèles d'âge et influencées par la proximité plus ou moins marquée des séquences polliniques avec les occupations, les données polliniques permettent de discerner des rythmes d'appropriation du milieu par les groupes du Néolithique ancien. Jusqu'à environ 4900 cal. BC, l'empreinte humaine reste très ténue. Ce n'est qu'aux alentours de 4800 cal. BC que la pression sur les boisements et les activités agricoles sont vraiment perceptibles. Ensuite, vers 4700-4600 cal. BC l'enregistrement d'activités agro-pastorales est moins

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systématique, traduisant un impact moins marqué sur le milieu et une reprise forestière après l'abandon des terres. Cette évolution perçue au travers des séquences polliniques implantées hors-sites fait donc un parfait écho aux données pluridisciplinaires acquises intra-sites.

Keywords: palynologie, Néolithique ancien, vallée de la Marne, hors sites, modèles âge/profondeur

Hills on the Plain: The Evolution of Neolithic Tells in the K'or'os Region of the Great Hungarian Plain

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In this paper, we bring together environmental, geological, and archaeological information to investigate the evolution of two tells located in the K'or'os region of the Great Hungarian Plain – Szeghalom-Kovácshalom and Vészt'o-Mágor. By analyzing data collected via regional geological sediment cores, on-site micromorphological samples, geophysical surveys, intensive surface collections, and targeted excavations, we discuss the evolution of these two tells within their microregional settings in the broader landscape of the K'or'os region. The research discussed in the presentation was collected by the K'or'os Regional Archaeological Project from 2010-2015 and reveals two strikingly different trajectories of tell formation despite the close proximity of the two contemporaneous sites.

Keywords: Neolithic, Hungary, Tells, Carpathian Basin, Great Hungarian Plain

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Kersulec (Plonéour-Lanvern, Finistère) : un site au fond d'une ria?

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Une fouille d'archéologie préventive réalisée en 2015 sur le site de Kersulec sur la commune de Plonéour-Lanvern (Finistère) a permis de mettre à jour une occupation domestique associée à un atelier de métallurgie datant de l'âge du Bronze ancien. L'étude du mobilier archéologique a soulevé plusieurs questions sur les possibles échanges culturels et commerciaux par les voies maritimes entre ce secteur de la Bretagne et différentes régions de la façade atlantique. Or, le site de Kersulec se trouve actuellement au bord d'une vallée côtière, située à plus de 5 km du rivage. De plus, cette partie du littoral ne présente pas aujourd'hui des havres naturels permettant une navigation et un accostage facile. En s'arrêtant donc sur une étude du site, il n'est pas aisé de tirer des conclusions sur son statut et sa situation géographique. Afin de pallier ces difficultés, une étude géomorphologique, basée sur la réalisation de carottages et de profils de résistivité électrique, a été menée indépendamment de la fouille dans le fond de cette vallée. Les premiers résultats mettent en évidence de profonds changements géomorphologiques et paysagers au cours des derniers millénaires. La compréhension de ces évolutions nous permet de reconsidérer la situation géographique du site de Kersulec et de le replacer dans son contexte culturel et environnemental.

Keywords: l'âge du Bronze, géomorphologie littorale, voies maritimes

*Speaker

Nature and intensity of the anthropogenic impact in Holocene malacological series from northern France: time and scale

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Mollusc shells are some of the most common fossil remains in Quaternary sediments and particularly in calcareous silty sequences of fluvial environments. These faunas are sensitive to minor variation of their habitat because of their minute size, their slow locomotion and their short lifecycle. As a result of this great sensitivity, changes in the composition of malacological associations enable the reconstruction of small-scale environmental changes both in a spatial and temporal sense. In addition to this local value, the development of malacofaunas has also a regional significance. From the synthesis of the malacological data collected over fifteen sites in the Seine basin large floodplains, three main environmental stages have been reconstructed in these lowlands. During the first half of the Holocene, forest environments are prevalent (Seine 1). As early as c.4.6 cal. BC, the first evidence of woodland clearance is observed at some sites (Seine 2) and, from c. 1.5 cal. BC, the lowlands have been largely cleared of trees and are dominated by grassland (Seine 3). Our results pinpoint anthropogenic disturbance as the key factor in the openness of the Holocene landscape. This long-term environmental impact of human societies on the structure of landscapes highlights a continuous use of these lowlands even though the archaeological remains are often tenuous there. The malacological analysis recently led at Passel "Le Vivier", in the same region, challenges this regional model. Actually, the malacological analysis carried out on a sequence located in the direct vicinity of a Neolithic monumental enclosure, highlights the subsistence of deep forest habitats during and after the Neolithic occupation. The construction of the enclosure and its occupation seem to have had a very limited impact on the nearby environment. The very short duration of the archaeological settlement that is considered by archaeologists could explain the light environmental impact of human settlements at Passel. All these results obtained in the Paris Basin question the matter of scale in our perception of anthropogenic impact, its nature and intensity.

*Speaker

Keywords: molluscs, palaeoenvironment, Holocene, France

Off-Site Environmental Sequences Around Aşikli H'oy'uk Ppn Site (Central Anatolia, Turkey): A Contribution to 14C Chronology of the Site Occupation on the Temporal and Spatial Scales

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Aşikli H'oy'uk is a Neolithic site in central Anatolia. It is positioned on the valley floor of the Melendiz river in western Cappadocia (Turkey) (Kuzucuoğlu, 2013). The site has been almost continuously occupied from ca 8400 (start of Level 5) to ca 7350 cal BC (last but eroded building remains of Level 1) ('Ozbaşaran, 2011; 'Ozbaşaran et al., 2012). The archaeological accumulation below the eroded summit of the mound ("h'oy'uk") is ca 14 m thick. Level 5, equivalent to the PPNA way of living of the Levant and dated ca 8400-8300 cal BC, is rooted in Epipalaeolithic culture. Levels 4 to 2 are PPNB in Levantine terms and are dated between ca 8300 to ca 7400 cal BC. Contacts between Levels present discontinuities which are mostly archaeological (mound slopes, irregular topographies, remodeled surfaces, digs, pits) but may be natural (erosion) such as over the truncated top of the mound. Continuity in the way of life is however significant.
The latest Aşikli material culture has been also excavated at Musular, a satellite site specialized in butchery and processing of hunted animals ('Ozbaşaran et al., 2012). Dated ca. 7500-7300/7100 cal BC), this site is located on the other side of the river, on top of a rocky terrace out of reach of the river dynamics constrained lower in the valley. Ca 7100 cal BC, the Musular site is abandoned, while the Aşikli site had been abandoned earlier. In this context, we performed a series of:

- 4 off-site cores: in 2010 (1 exploratory core), 2011 (1 core) and 2014 (2 cores) in the area between the h'oy'uk and the rock slope bordering the valley to the East;

- 2 off-site sections (1 dug pit and 1 slope section) opened in 2012 in the same area;

- 1 in-site dug pit (2015) below the earliest human structures (earliest subterranean houses and open-air activity areas).

On the basis of our results, we propose to discuss environmental (ie non-archaeological) causes

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for some difficulties in confronting 14C and cultural chronologies at the site. The presentation will focus on two subjects:

1) In the lowest archaeological layers at the mound, two 14C dates from charcoals give ages of ca 8970 ± 220 and 9010 ± 200 cal BC. Such ages are clearly older than the emergence of sedentism at Aşikli (Stiner et al., 2014). Results from the core studies will propose an answer to the question: what kind of environmental matters may have caused the discrepancy between the ca 9000 cal ± 220 BC dates obtained and the expected 8400 cal BC age (eg. for an Epi-palaeolithic occupation)?
2) During the 2nd half of the 8th mill. BC, there were relationships between the crowded Aşikli mound in the eastern side of the river and the satellite site on the terrace on the western side of the valley. There is indeed a cultural continuity between the two sites, one ending (Aşikli), the other one overlapping for ca two centuries with Aşikli and continuing for two more centuries after the end layer of Aşikli. Thanks to their space distribution around the site, our cores give a new light on these relationships. These new data may modify former interpretations, such as abandonment of Aşikli ca 7350 ka cal BC and relocation of the site and population elsewhere in the valley. We think that they even transform our vision of the success of Aşikli just before the abandonment of the area by the Neolithic population.

Keywords: 14C chronology, central Anatolia, Pre Pottery Neolithic, Asikli, Environment

Reconstructing the palaeoenvironment in southern Cyprus and its interaction with the Neolithic humans: the case of Klimonas (PPNA)

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The site of Klimonas, in the district of Limassol, Cyprus constitutes the most ancient human settlement on the island. Klimonas was settled around 8800 cal BC (PPNA). Beyond the study of the site itself, Klimonas and its surroundings can provide important information on the palaeoenvironment and palaeotopography of the region. Its position, on a slope formed by colluvium deposits and next to the small coastal stream Athiaki, offers good conditions for a geomorphological study. The extra-site study on Klimonas was conducted on two scales: the first concerns the left slope on which the site was settled and the second the Athiaki valley itself. The study of a section directly related to the site provides information on the palaeotopography of the site when it was settled and the colluvium's dynamic. The Athiaki valley is formed by three 15 meters height alluvial terraces. They were liable to have recorded the environmental changes since the Late Pleistocene, and we undertook their study in the hope to reconstruct the evolution of the climatic conditions and of the river dynamic during their formation since that times, including the time of occupation of Klimonas. The radiocarbon dating of the palaeosols of the two main sections under study revealed that they have been accumulated between the Last Glacial Maximum and the beginning of the Holocene; a part of them is actually contemporary to the occupation of Klimonas. Through geoarchaeological approaches and different kinds of analyses such as magnetic susceptibility, sedimentology, soil micromorphology and XRF, this study aimed to reconstruct the palaeo-environmental and fluvial conditions before and during the Neolithic occupation of Klimonas. Additional study of phytolithes conducted in the palaeosoils related to the site and in the earth used for the construction of the buildings, allowed us to understand the interaction of the Neolithic society with its environment.

*Speaker

Keywords: PPNA, Cyprus, palaeoenvironment, Klimonas, neolithic

The Huaca Grande archaeological sequence: a thousand years of human occupation history in the Sechura desert (Peru)

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The Huaca Grande is a large mound extending over 176 m long and 73 m wide by 7-8 m high, located in the Sechura Desert (north of Peru), about 300 m from the Pacific Ocean. Excavated in the 1970s (Cardenas et al., 1991), then between 2015 and 2017 by the Sechura Desert Archaeological Project, the site provided a thick stratigraphic succession of approximately 2.8 m, consisting of alternating hearths, layers of shells and remains of fish interstratified with sterile sandy levels. In addition, a clay wall, possibly a remnant of a structure, and several post holes were discovered at a depth of 2.2 m. Eight absolute dates were run along the sequence, which covers more than a thousand years of local history, between cal. AD 399 and 1447.
Given its richness and variety, the sequence has been the subject of a high-resolution multidisciplinary study (micromorphology, sedimentology, malacology, marine mammals, ichthyology, anthracology and plant macrorests). The results of sedimentological and micromorphological analyses allowed us to determine the composition and nature of the various stratigraphic units that make up the sequence, and to identify the natural processes and anthropogenic actions and activities that led to their deposition. We were thus able to reconstruct the history of the site and its evolution over time, firstly stating that it is not a continuous occupation and that some abandonment phases have been recorded. Biomarker studies have enriched this reconstruction by providing detailed information not only on the use of natural resources by the inhabitants of the site but also, indirectly, on the environmental contexts contemporaneous with the pre-Hispanic human occupation.

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This multidisciplinary approach, carried out on a diachronic scale that is still unexplored in the region, coupled with the study of structures and archaeological remains, has provided an insight into the modalities of human occupation of the Sechura Desert between the AD 5th and 15th centuries.

Keywords: Sechura Desert, pre, Hispanic occupation, geoarchaeology, micromorphology, palaeoenvironment

Times of historical developments and environmental changes in the Minoan town of Malia, Crete: an intra and off-site geoarcheological approach

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The site of Malia, on the northwest coast of Crete, is a good case study for geoarchaeology. A Minoan palatial town developed during the Middle and Late Bronze Ages in an area that was occupied for a long occupied, and has been the subject of archaeological excavations for a century. A small marsh located near the sea and close to the archaeological site offers rich natural archives and new record. They can now be combined with archaeological data and allow to address some important issues: the questions of chronology and causes of apparent changes are especially important and tricky in the Minoan world where the absolute chronology is still under debate. How can we link the temporal frames of extra and intra-site, for events/breaks but also for more durable situation?

Improvements in defining local archaeological sequence, based on artefacts typologies and stratigraphical evidence from recent excavated areas, lead to a better understanding of relative chronology and historical developments of the settlement, especially during the palatial period: researches in the Area Pi show that the Middle Minoan III phase was not a "gap" after the great fire destruction of the first palace and town of Middle Minoan II, but an extensive occupational phase marked by one or two important earthquakes; a last massive destruction affected the area during LM IA, possibly in relation with the Santorini eruption. Duration of these phenomena, factors and rates of change are difficult to precise and call for a dialogue with specialists of natural sciences.

The investigations conducted off-site offer the opportunity to assess the long-term changes of the environment due to climatic, tectonic or sea level changes or to land use changes related

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to the change of the human activities. 11 new core-drillings have been added in 2015 to the first investigations of the 1990's. The 40 radiocarbon dates obtained show that all the cores cover the Minoan period. The first geomorphologic, sedimentologic and palynologic results offer the opportunity to reconstruct the landscape at the bottom of the Minoan site from the Late Neolithic to the historic periods and to discuss the causes of the environmental changes. In particular, the question of the direct and indirect impact of the Santorini eruption on the landscape and the town and the effect of the agropastoral practices on the wetland is raised. More generally, based on the results obtained, the methodology of comparison of in-site and off-site and of archaeological and environmental data is discussed.

Keywords: Geoarchaeology, on, site, off, site, Aegean World, Minoan period, wetland, santorini eruption

Vegetation changes and land use in Calabria (Italy) during Prehistory

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In Calabria (southern Italy), the mild climate, the availability of rich and diverse resources, the presence of shielded environments and landing coastal stretches have favored settlement continuity over the last millennia. In order to shed light on the impact that prehistoric communities exerted on this territory, pollen analysis was undertaken on a sediment core drilled on the Poro highplain, located at the top of the Tropea Promontory, an area rich in archeological evidence dated from the Late Neolihic up to the Iron Age. The coring intercepted a peat deposit whose base (2,40 m) and the top (1,20 m) were 14C dated to the second half of the 5th and the late 2nd millennium cal BC respectively. During the Late Neolithic and Eneolithic (Calcolithic) periods, high amounts of micro-charcoals, recorded in concomitance to decreasing arboreal percentages, attest to the use of anthropogenic fires to open the landscape for agricultural practices (cereals) and animal husbandry, which is also testified by the high percentages of fungal spores, indicative of pasturage.
In the Early and Middle Bronze Ages, a decrease in the fire setting practice and sheep farming is coupled with the recovery of the forest cover and an increase in the marsh plants. These vegetation changes could indicate an abandonment of the area even if some cereal crops were still present. In the EBA, a peak of *Trifolium* cfr *patens* opens up interesting hypothesis on the occurrence of forage crops. Between the Middle and Recent Bronze Age, pollen data seem to indicate a re-colonization of the area, whereas between the Final Bronze Age and the Iron Age a clear abandonment of the area is indicated by the rapid recovery of the Alder forest on the wet soils surrounding the marsh. The last Iron Age level shows a possible re-colonization.

The reconstructed history of vegetation changes and their connection to land use by prehistoric communities on the Tropea Promontory shows some coherence but also some discrepancies with the archaeological evidence. Improving the chronological framework of the pollen record with new 14C dating is necessary to evaluate the consistency of such divergences.

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The archaeological data from the same area confirm an intense presence of settlements during the Late Neolithic and Eneolithic periods, and also in the Early and Recent Bronze Age, and a phase of abandonment in the Middle Bronze Age. Final Bronze Age and Early Iron Age settlements are present on the Poro highplain, but at a distance of some kilometers from the site of the core.

Keywords: palinology, microcharcoals, deforestation, human impact, late Holocene