

(SS31) Palynological evidence of past traditional farming systems and pastoralism

Date: August 28

Place: Room 5333 (oral), Room 6310 (poster)

Organizers: Jean Nicolas Haas & Didier Galop

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Purpose: Since the last two decades Non-Pollen-Palynomorphs (NPPs) get increased attention by Quaternary palynologists due to their ubiquity in all kind of habitats and their abundance in different sediment types, where they sometimes exceed the total number of pollen and spores. Algal cysts, fungal spores, trichomes, parasite eggs and/or zoological remains such as Neorhabdoceola eggs, among others, do therefore greatly add to our understanding on the evolution of former ecosystems worldwide. Together with classical palynological studies using pollen and cryptogam spores, NPP-microfossils such as spores from coprophilous fungi or nutrient indicators such as cyanobacteria and dinoflagellate cysts clearly add to our knowledge on past traditional farming systems and pastoralism, and may in turn – together with other palynological methods and proxies to be discussed and presented during this IPC session – help disentangling plant and animal diversity changes due to climatic change or human impact.

Oral Presentation

Aug. 28 [AM1] Room: 5333

Chair: Didier Galop

9:00-9:40 **[Keynote] The onset of alpine pastoral systems in the Eastern Alps** [SS31-O01 \(384\)](#)

Klaus Oegg, Daniela Festi

9:40-10:00 **Using palaeobotanical and geochemical investigations to disentangle complex relations between human and landscape: the lacustrine record from Lake Petit (2200 m)** [SS31-O02 \(49\)](#)

Elodie Brisset, Rosine Cartier, Frédéric Guiter, Cécile Miramont, Stéphane Guédron, Edward Anthony, Jacques-Louis De Beaulieu, Claire Delhon, Fabien Arnaud, Christine Paillès, Florence Sylvestre, Jérôme Poulenard, Jean-Dominique Meunier, Corine Sonzogni

10:00-10:20 **10,000 years of land and natural resources record – The example of high altitude pastoralism in the Silvretta Massif (Austria/Switzerland)** [SS31-O03 \(98\)](#)

Benjamin Dietre, Irina Anich, Karsten Lambers, Christoph Walser, Kurt Nicolussi, Andrea Thurner, Thomas Reitmaier, Jean Nicolas Haas

Aug. 28 [AM2] Room: 5333

Chair: Didier Galop

10:50-11:10 **Record of changing human activities around Lake Montcortès (southern Pyrenees) during the last millennium: contributions from non-pollen palynomorphs** [SS31-O04 \(345\)](#)

Encarni Montoya, Valentí Rull

11:10-11:30 **Development of an ombrotrophic peat bog and local vegetation under low human impact in NE Poland inferred from the biotic proxies** [SS31-O05 \(231\)](#)

Monika Karpińska-Kołaczek, Renata Stachowicz-Rybka, Andrzej Obidowicz, Piotr Kołaczek

- 11:30-11:50 **History of intentional fires and vegetation on the Soni Plateau, Central Japan, reconstructed from palynological records within mire sediment and cumulative soils** [SS31-O06 \(208\)](#)
Jun Inoue, Ryota Okunaka, Ryo Nishimura, Tatsuichiro Kawano, Hikaru Takahara
- 11:50-12:10 **Late Holocene landscape reconstruction of a highland river floodplain in Guatemala: Possible location of a Maya agricultural center** [SS31-O07 \(14\)](#) (Cancelled)
Carlos Avendaño, Sharon Cowling, Sarah Finkelstein, Juan Carlos Berrio
- Aug. 28 [PM2] Room: 5333
Chair: Jean Nicolas Haas
- 14:30-15:10 **[Keynote] Coprophilous fungi assemblages in grazed area: what are their relationships with catchment, vegetation and land use?** [SS31-O08 \(147\)](#)
Emilie Gauthier, Isabelle Jouffroy-Bapicot, Angélique Laine, Laurie Murgia, Benjamin Diètre, et Hervé Richard
- 15:10-15:30 **An assessment of the relationships between modern spores of dung-related Ascomycetes and summer grazing activities to reconstruct past pastoral activities in the western Pyrenees (Basque Mountains and Ossau Valley, France)** [SS31-O09 \(82\)](#)
Carole Cugny, Florence Mazier, Nicolas de Munnik, Damien Rius, Didier Galop
- 15:30-15:50 **Climate change, fire history and disturbance of upland forest in the UK: testing multiple hypotheses using NPPs and multi-proxy palaeoecology** [SS31-O10 \(36\)](#)
Jeff J Blackford, William Fletcher, Peter A. Ryan, John Carson, Alan Hogg, James B. Innes, Sarah E. Kneen, Jonathan Lageard, Charlotte O'Brien
- Aug. 28 [PM3] Room: 5333
Chair: Jean Nicolas Haas
- 16:20-16:40 **Diversity and indicator values of fungal spores from surface samples of the Nepal Himalaya** [SS31-O11 \(477\)](#)
Lyudmila S. Shumilovskikh, Frank Schlütz
- 16:40-17:00 **Landscape reconstruction at the Lachuá Region of the last ~2000 yrs: Maya environmental management implications in Salinas de los Nueve Cerros, Guatemala.** [SS31-O12 \(13\)](#) (Cancelled)
Carlos Avendaño, Sharon Cowling, Sarah Finkelstein, Juan Carlos Berrio
- 17:00-17:20 **Pollen and non-pollen palynomorphs from two Neolithic sites in Wallonia (SE Belgium)** [SS31-O13 \(80\)](#)
Mona Court-Picon, Hélène Collet, Dominique Bosquet
- 17:20-17:40 **A multi-proxy approach to the climate/vegetation/human relationships recorded in a piedmont bog in southern Poland** [SS31-O14 \(246\)](#)
Piotr Kołaczek, Barbara Fiałkiewicz-Kozieł, Monika Karpińska-Kołaczek, Mariusz Gałka, Mariusz Lamentowicz

Poster Presentation

Aug. 28 [PM1] Room: 6310

13:30-14:30 **Morphological features of minute charcoal particles in the soil of grassland of Japan**

[SS31-P01 \(385\)](#)

Jun-ichi Ogura

Climate-pastoral activity interactions in the Champsaur Valley (French Alps) and their effect on the evolution of biodiversity during the last 3400 years [SS31-P02 \(81\)](#)

Mona Court-Picon, Elena Ortu, Alexander Correa-Metrio, Joel Guiot, Jacques-Louis de Beaulieu

Coprophilous fungal spores and selected non-pollen palynomorphs (NPPs) in lake and peat deposits from Greenland [SS31-P03 \(114\)](#)

Kevin J. Edwards, Emilie Gauthier, Paul Ledger, J. Edward Schofield

Impact of pastoral activities on the vegetation during the Holocene – the case of the Aubrac highlands (South-western Massif Central, France) [SS31-P04 \(122\)](#)
(Cancelled)

E. Faure, D. Galop, F. Mazier

Neolithic and Bronze Age landnam of the former dense woodlands of the calcareous Alpine Plateau Silberer (Muotathal, Canton Schwyz, Switzerland) [SS31-P05 \(229\)](#)

Thilo Kappelmeyer, Notburga Wahlmüller, Urs Leuzinger, Walter Imhof, Jean Nicolas Haas

Holocene sedimentary and pollen evidence on sea-level change and primary agriculture history in Fuzhou basin [SS31-P06 \(611\)](#)

Zhuo Zheng, Barry Rollete, Yuanfu Yue, Kangyou Huang

A palaeoenvironmental study of the Shiniusi archaeological sites in the Wujiang Drainage Area, upper Yangtze River, Chongqing region, China [SS31-P07 \(300\)](#)

Chuanxiu Luo, Zhuo Zheng, Houxi Zou, Jiujiang Bai, Dongshan Yuan, Hong Wang, Anding Pan, Chunhai Li, Jie Li, Linglong Cao

SS31-O01 (384)

The onset of alpine pastoral systems in the Eastern Alps

Klaus Oegg, Daniela Festi

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Since the discovery of the Neolithic glacier mummy “Ötzi” in the nival belt of the main Alpine ridge, the onset of alpine pasture is matter of a highly controversial debate both in archaeology and in palaeo-ecology of the Eastern Alps. The implication is that his sojourn in the high-altitudes of the Alps is considered to be connected with pastoral nomadism. Furthermore it is suggested, that such herders familiar with the peculiarities of the high-altitudinal regions gave valuable information to

prehistoric ore prospectors for the exploitation of these mineral resources, and thus contributed to the expansion of metallurgy in the Alps. Regrettably any archaeological evidence for the existence of such Neolithic alpine pastoral systems is missing up to now and the assumption is based on palynological data only. However, also the palynological record is ambiguous, because pasture indicators in the alpine regions react positive on grazing as well as on fertilization induced by a higher runoff of precipitation. Thus alpine pasture indicators reflect both grazing pressure and climatic change. Anyhow, alpine pastoral systems are a common practice in Alpine animal husbandry, but from an economic point of view such a seasonal vertical transhumance is costly. There are three main reasons for its practice: i) climatic, ii) economic (mainly in connection with population pressure or mining activities), and iii) cultural ideology. In this study we tested the above mentioned reasons in an interdisciplinary study on the beginning of pastoral activities in high altitudes in the central part of the Eastern Alps. This is conducted by palynological analyses of peat deposits situated in the vicinity of the timberline (1600 – 2400 m a.s.l.) combined with archaeological surveys. The investigated sites are located in traditional Alpine transhumance regions and aligned on a transect through the central part of the Eastern Alps beginning in the Northern Limestone Alps, crossing the Ötztal Mountains and ending in the Ortles Mountains in the south. The studies reveal that grazing pressure is reflected since the Bronze Age, which is corroborated by archaeological findings in the vicinity of the investigated sites. However, in some of sites of the alpine belt (above 2400m) early occurrences of pollen-types, which are integrated in pasture indicators, are recorded. The possible reasons for their early occurrence are discussed.

Keywords: palynology, transhumance, prehistory, Neolithic glacier mummy, archaeology.

SS31-O02 (49)

Using palaeobotanical and geochemical investigations to disentangle complex relations between human and landscape: the lacustrine record from Lake Petit (2200 m)

Elodie Brisset^{1,2,3}, Rosine Cartier², Frédéric Guiter^{1,3}, Cécile Miramont^{1,3}, Stéphane Guédron⁴, Edward Anthony², Jacques-Louis De Beaulieu¹, Claire Delhon⁵, Fabien Arnaud⁶, Christine Paillès^{2,3}, Florence Sylvestre^{2,3}, Jérôme Poulénard⁶, Jean-Dominique Meunier², Corine Sonzogni^{2,3}

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Archaeological studies carried out in the European Alps have documented ancient human occupation of mountains, characterized by hunting, pastoral activities and mining. High resolution multi-proxy analyses, including sedimentological, palynological and geochemical investigations, were carried out on a 144 cm-long sediment core from the Lac Petit (2200m, Mediterranean French Alps) in order to reconstruct past interactions between humans, the environment and the climate over the last 5000 years. Three main phases were identified, evidencing a progressive destabilization of the local environment. The first phase (ca. 4800 to 4300 cal. BP) is characterized by a relatively stable environmental conditions, as attested by a high lake productivity with the deposition of pure diatomite, the local presence of trees (conifer stomata, macro-remains), and well developed soils on slopes. The second phase (ca. 4300 to 1500 cal. BP) corresponds to a drastic decrease in arboreal pollen abundance, interpreted as the result of deforestation. In the same time, the lake geochemical record highlights an abrupt switch in sediment source marked by an input of terrestrial organic and mineral matters. Regular occurrences of anthropogenic pollen assemblages suggest early pastoral

activity in the lake vicinity, while wetter conditions may have triggered hillslopes destabilization. The most recent phase (since ca. 1500 cal. BP) is marked by a degradation of the environment: the lake productivity dramatically decreased contemporaneously with the fall of the proportion of arboreal pollen. The highest values of anthropogenic pollen taxa and the highest concentrations of lead and mercury are recorded. Abundant terrigenous inputs also suggest that high-intensity rainfall events might have occurred, while agro-pastoralism and local mining activities continuously weakened the slopes. Even if the climate could have triggered such drastic changes, a discreet but continuous human impact since 1550 cal. BP might be the main factor of slopes degradation and ecosystem destabilization in the catchment.

Keywords: palaeobotany, forest clearance, soil erosion, airborne pollution, Mediterranean mountain.

SS31-O03 (98)

10,000 years of land and natural resources record – The example of high altitude pastoralism in the Silvretta Massif (Austria/Switzerland)

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In a highly sensitive European mountain region such as the Silvretta Alps (between Austria and Switzerland), pastoral activities and the use of natural resources may have huge impact on Alpine vegetation. The Silvretta Massif provides a diversified range of archaeological sites from the Mesolithic to the Medieval Times, witness of past human presence and subsequently of their land-use and subsistence strategies at and above today's timberline. Our research area therefore offers the possibility to reconstruct past vegetation evolution for all of the Holocene thanks to several peat bog records. Here we present a diachronic study performed on the Las Gondas bog (2360 m a.s.l.) on the Northern side and the Plan da Mattun bog (2300 m a.s.l.) on the Southern side of the Silvretta Massif. Palynological evidence of former pastoral activities in the Massif was thereby achieved by the analysis of pollen typical for anthropogenic and livestock activities, as well as by the detailed determination of non-pollen palynomorphs (as spores from coprophilous fungi). Dozens of new non-pollen palynomorph types were described, most of them probably specific for subalpine-alpine environments, as well as for prehistorical pastoral activities. Palynological studies comprising non-pollen palynomorph analyses allow therefore extensive insight into the vast flora, vegetation and biodiversity changes of Alpine ecosystems during the Holocene.

SS31-O04 (345)

Record of changing human activities around Lake Montcortès (southern Pyrenees) during the last millennium: contributions from non-pollen palynomorphs

Encarni Montoya, Valentí Rull

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Human activities have contributed to the shaping of almost all present-day landscapes, especially during the last millennium. A key issue in paleoecology is the need to disentangle the influence of natural climatic variations from human impact on the observed ecological changes. The southern Pyrenees have been under the pressure of several climatic shifts and human disturbances that have promoted different vegetation responses, but the recognition and differentiation of the forcing factors and their consequences is not an easy task due to the interaction between environmental drivers. This work reports the inferred changes in past human practices in Lake Montcortès catchment (1027 m, southern pre-Pyrenean flank) during the last millennium, and their effects on the vegetation. This record has an average resolution around 30 years, being an excellent target for high-resolution studies. Previous studies of this lake based on sedimentology, pollen, diatoms and historical documentation reported the occurrence of several climatic shifts (including the MWP and the LIA), as well as forest clearance by fire, agriculture and presence of pastures as the main human impacts. Here, the study of non-pollen palynomorphs (NPP) on the same sequence has been focused on the reconstruction of the different human activities. Independent proxies for fire and forest clearance were found, supporting former studies. Moreover, the NPP record shows several events of high abundance of coprophilous fungi: 1) At the base of the sequence (AD 770 - 850); 2) since AD 1050 to AD 1250, 3) since AD 1600 to AD 1800; and 4) At the top of the sequence, since AD 1830 to AD 1920. The first three events seem to have happened during periods of increased cattle raising reported in historical documents. The fourth event occurred in a period of land abandonment and has been interpreted as a forest recovery, also in agreement with the pollen record. The combination of pollen, historical documents, and NPP has allowed reconstruction of shifts in land use along the last millennium that have been mostly related to population density, and historical political and cultural changes. This study highlights the importance of the multi-proxy approach, and emphasizes the utility of NPP and the need to include them in routine pollen analyses, in order to improve the accuracy of the paleoecological reconstructions.

Keywords: cattle raising, forest clearance, fires, multi-proxy, vegetation changes.

SS31-O05 (231)

Development of an ombrotrophic peat bog and local vegetation under low human impact in NE Poland inferred from the biotic proxies

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A profile from a peat bog adjacent to Lake Czarne (NE Poland) was palynologically examined, regarding a complete analysis of non-pollen palynomorphs (NPPs), which makes it unique in the scale of Poland. The radiocarbon dates confirmed the beginning of sedimentation in the Late Glacial (probably at the Allerød/Younger Dryas boundary) and its continuity up to present times. The combined results of palynological and palaeobotanical analyses enabled the reconstruction of the vegetation changes mostly in the close vicinity of the lake, but also on a more regional scale. During the Younger Dryas period, a mosaic of steppe and tundra communities prevailed in the area, while stands of *Juniperus* existed on the morainic slopes around the lake. The beginning of the Holocene brought climate change that enabled the spread of pioneer woodlands with *Betula* and an admixture of *Pinus sylvestris* as well as the development of first riparian forests with *Ulmus* in this area. The presence of *Taxus baccata* at the site signalize its faster than assumed expansion in the area of

Poland. In the Boreal chronozone *Corylus avellana* started to spread rapidly in the understorey and *Tilia cordata* with *Quercus* appeared in the expanding woodlands. At the same time alder (*Alnus*) carrs and riparian forests with *Fraxinus* and *Ulmus* became more important components in the landscape. An optimum of mixed deciduous forests fell on the Atlantic chronozone. However, the transition to the Subboreal chronozone failed to reflect the *Ulmus* fall, recognized in several sites in Europe. The final fall in *Ulmus* was recorded about 3850 cal. BP and from that period the profile reflects a more frequent (but irregular) presence of human indicators up to modern times. At the beginning of sedimentation, the dystrophic/eutrophic water body existed at the site and was the habitat for several species of *Potamogeton* and algae mostly from *Pediastrum* and *Botryococcus* genera. On the lake margins marsh communities and rich fen developed. However, the advancing terrestrialization changed the water taxa composition during the Boreal chronozone and led to the disappearance of *Pediastrum* sp. and the spread of members of Nymphaeaceae. Subsequently, about 6100 cal. BP, the NPPs composition abruptly changed and bog taxa became dominant. Among them mutually excluding optima of Type 10 and *Amphitrema flavum* seems to correspond with dry and wet phases on the bog. A probable fall in the water level, during the last millennium, led to the withdrawal of many bog taxa.

Keywords: palynology, non-pollen palynomorphs, *Taxus baccata*, Holocene, Central Europe.

SS31-O06 (208)

History of intentional fires and vegetation on the Soni Plateau, Central Japan, reconstructed from palynological records within mire sediment and cumulative soils

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Under conditions of high precipitation and a temperate climate, forest has come to cover most of the Japanese Islands. However, small areas within Japan contain grassland that is intentionally burnt to enhance its survival. The history of fires and the expansion of grassland in the area in response to fires remain poorly understood. Pollen, phytoliths, and charcoal particle in sediments (e.g. lake, bog, and swamp sediments) and in soils provide important information that enables the reconstruction of past environmental change with intentional fire. In this study, we examined charcoal fragments, pollen and phytolith in mire sediment and cumulative soils on the Soni Plateau, Central Japan where Japanese pampas grassland has been stood for at least 100 yr. High charcoal abundance were recognized both in sediments and soils deposited from ~1500 cal BP to the present, and high percentage of Gramineae pollen and Bilobate short-cell phytoliths are also recognized in the sediments and the soils, respectively. Prior to ~1500 cal BP, low charcoal abundance, high percentages of *Abies*, *Quercus* and *Fagus* pollen and high percentages of Bambusoid short cell were recognized. These results indicate prior to ~1500 cal BP forest stood with dwarf bamboo flourished on the forest floor under fire free condition whereas since ~1500 cal BP grassland dominated by Japanese pampas grass has been sustained by periodic intentional burning that has continued until the present day.

Keywords: fire history, grassland, charcoal fragments, pollen, phytolith.

SS31-O07 (14)

Late Holocene landscape reconstruction of a highland river floodplain in Guatemala: Possible location of a Maya agricultural center

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Despite of the critical importance of highland Maya cities in Mesoamerican history, paleoecological research has been developed majorly in the lowland Classic Maya cities. Here we present the first paleoecological study of the headwaters of the Cahabon River floodplain, located in the Las Verapaces highlands of Guatemala, comprising 2390 yrs of history before the present (BP). The appearance of cultigen pollen *Zea* and other disturbance related taxa (e.g. Amaranthaceae-Chenopodiaceae, Asteraceae) suggest possibly the establishment of an agricultural center in the floodplain since the Late Preclassic (~2150 yrs BP). A many-fold drop in sedimentation rate took place ca. 340 yrs after the first appearance of pollen, suggesting a possible trial-and-error time for the Maya to successfully develop soil conservation practices in the floodplain (e.g. terraces). Disappearance of *Zea* pollen at the Terminal Classic and its re-appearance at the early Postclassic suggest a temporary abandonment of agriculture at the floodplain, associated probably to the “Maya collapse”. Active agricultural phases match relative low values of Cyperaceae pollen possibly due to an increase in water-levels as a result of flooding practices (e.g. chinampa), since this taxon in general is known to prefer shore-line environments. Though more exploration is needed, increase of Poaceae and Cyperaceae pollen during the Classic-Postclassic transition could possibly mean a drier environment (e.g. drought). Postclassic agriculture re-establishment in the floodplain is halted at the time of the European conquest and colonization, when the most dramatic change is observed in the sedimentary record. Concomitantly, a many-fold increase in sedimentation rate and Cyperaceae pollen values, likely indicate a radical land use change with higher erosion rates and drained floodplain conditions, respectively. *Pinus* pollen dramatic increase at this time represents most likely the tree pioneer’s character in secondary succession. Recovery of *Hedyosmum* pollen, a non-commercial tree, suggests a possible recovery of lower montane and montane forests, while selective forestry management is reflected in a drop of *Quercus* pollen values. There is possibly a regional signal of the Little Ice Age, since ca. 300 yrs BP pollen from *Abies* appears for the first time in the record. *Quercus* pollen increase in the present, suggest probably the impact of regional conservation measures. The paleoecology of the the Cahabon floodplain agricultural center indicates high resiliency over 1300 yrs of history, but that was not able to withstand the drastic impact of the European Conquest, a similar case found elsewhere in the Americas.

Keywords: Mesoamerica, *Zea* pollen, Cyperaceae pollen, sedimentation rate, European Conquest.

SS31-O08 (147)

Coprophilous fungi assemblages in grazed area: what are their relationships with catchment, vegetation and land use?

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Coprophilous fungi are of the uttermost importance to understanding and assessing past grazing pressure related to domestic or wild herbivores in various environments. Local dung indicators are though well known: *Sporormiella*, *Cercophora*, *Sordaria*, *Tripterospora*, *Chaetomium*, *Podospora*... However, distributions these fungal spores not always follow group or assemblage expectations. In the light of recent researches, *Sporormiella* seems to be the most accurate taxa for assessing grazing pressure. This taxon occurs frequently in open grazed areas; it is related to livestock during the medieval and modern periods and to megafauna during the Late Glacial period. However, during the earliest periods (Neolithic, Bonze and Iron Age), *Sporormiella* often becomes of less importance than others coprophytic types (such as *Sordaria* or *Cercophora*...). Thus, the presence and/or association of coprophilous remains may change with land use, local vegetation, substrate and catchment. Our palaeoecological investigations lead in different context, from low altitude areas (Burgundy) to mountainous (Jura and Morvan mountains), steppe and subarctic zones (Mongolia and south Greenland) try to evidence the different types of coprophilous assemblages and their relationship with their environment. Modern analogues as well as high resolution analyses performed on mid- and late Holocene sequences from peat deposits and lakes, are used to understand fungal spores assemblages, deposition and distribution.

Keywords: coprophilous fungi, palynology, grazed area, wild and domestic herbivores, past land use.

SS31-O09 (82)

An assessment of the relationships between modern spores of dung-related Ascomycetes and summer grazing activities to reconstruct past pastoral activities in the western Pyrenees (Basque Mountains and Ossau Valley, France)

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In this poster, modern non-pollen palynomorphs (NPPs) assemblages from summer pastures in the western Pyrenees Mountains (Ossau valley, France) are studied in order to provide spatial and ecological indicative values of NPPs for reconstructing past pastoral activities using three peat cores from the Ossau Valley and the Basque Mountains. Forty surface samples (from small wetlands and peatbogs and from bordering terrestrial sites) are selected to cover the major gradients of grazing pressure and of openness. At each site, moss samples and 47 local environmental and pastoral variables are collected. In addition, four variables describe the proximity of the sites to the closest individual trees and forests and the degree of enclosing of the sites by trees and forests. Out of 266 modern NPP Types, 51 spore-types belong to dung-related Ascomycetes taxa among Pleosporales (Sporormiaceae, Phaeotricaceae, Delitschiaceae), Sordariales (Sordariaceae, Lasiosphaeriaceae, Coniochaetaceae), Melanosporales (Cerastomataceae) and Xylariales. Direct ordinations (redundancy and canonical correspondence analyses) are used to relate these spore-types to environmental and pastoral variables. Several spore-types of Xylariaceae, Coniochaetaceae and other Sordariales present clear optimums for burnt sites rich in surface charred particles; they can therefore be considered as local fungal indicators of burning. 22 spore-types, related to the grazing pressure in general, show different responses to specific grazing variables such as the total amount of dung. The spore-types richness also provides an accurate indicator of dung amount and grazing pressure. Those results are applied to the interpretation of the three fossil NPP records. Fossil records of dung-related Ascomycetes are compared to pollen and charcoal data. The results emphasize different trends of evolution of grazing activities over the last 2000 years between the Ossau and the Basque Mountains

as well as within the Ossau valley.

Keywords: non-pollen palynomorphs, coprophilous fungi, modern datasets, pastoralism, Pyrenees mountains.

SS31-O10 (36)

Climate change, fire history and disturbance of upland forest in the UK: testing multiple hypotheses using NPPs and multi-proxy palaeoecology

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The openness of upland areas of the British Isles, and the dominance of heath vegetation, was originally believed to be due to the poor climate and soils currently found there. Pioneering pollen studies in the 1960s and 1970s overturned this view, and attributed these landscapes to an anthropogenic cause, beginning with fire-related forest disturbances during the Mesolithic period, continuing with the first farmers and intensifying in later prehistory. Aspects of the 'natural' paradigm, however, have not been refuted, but have just faded from view. The possible contributions of climatic deterioration, natural fires and wild animals in contributing to woodland disturbance still need to be fully assessed. The aim of this paper is to report the findings of multi-proxy palaeoecological studies from multiple sites in the British uplands, with a focus on the record from West Bilsdale Moor, North Yorkshire. Data from the analysis of preserved wood, tree rings, NPPs including fungal spores, peat humification and beetles are added to the more commonly-used proxies of pollen and charcoal. These data sets suggest a complex and variable interaction of factors, with disturbance phases of different types and duration. The paper will critically examine evidence for 'forest farming' and pre-Neolithic 'pastoralism'- fungal spore evidence for increased animal numbers in the later Mesolithic. There is also a link between palaeoecologically-inferred local drier phases and charcoal peaks, perhaps suggesting that (at West Bilsdale Moor) fires occurred mostly in climatically-constrained periods. While multiple microlith find sites in the areas around the study sites show human presence, no direct evidence for anthropogenic woodland disturbance has been found. A multiple working hypothesis approach currently fails to eliminate natural processes as factors in pre-agricultural woodland recession.

Keywords: Mesolithic, NPPs, palaeoclimate, charcoal, fungi.

SS31-O11 (477)

Diversity and indicator values of fungal spores from surface samples of the Nepal Himalaya

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Several groups of fungi, important components of ecosystems, form spores quite resistant against natural decay and laboratory treatment. Their presences in sediments allow paleoenvironmental reconstructions of such crucial biological interactions as parasitism and symbioses. As well they can indicate erosion processes and the occurrence of decaying wood and dung. Studies on recent material are required for a better understanding and the evaluation of indicator values of fungal spores. For this purpose 40 surface samples, collected in Nepal in altitudes from 250 to 5500 m a.s.l., were studied in detail. The sampling design presents environmental gradients from the tropical, subtropical through temperate, subalpine and alpine belts along two transects. Special attention was paid to include samples from settlements, fields and meadows. We documented and described ~200 types of fungal spores counting to a minimum of at least 150 spores in each sample with additional consideration of further non-pollen palynomorphs, fern spores and pollen. The results demonstrate a clear coincidence of a number of characteristic fungal spore types to specific ecological conditions as well as the occurrence of spore types that seem to be indifferent to environmental gradients. In this talk we will provide further details of the study and discuss fungal spores as important paleoenvironmental indicators in mountain ecosystems.

Keywords: non-pollen palynomorphs, biodiversity, mountain, environmental gradients, human influence.

SS31-O12 (13)

Landscape reconstruction at the Lachuá Region of the last ~2000 yrs: Maya environmental management implications in Salinas de los Nueve Cerros, Guatemala.

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Paleoecology in Guatemala has been done mostly in the Petén Northern Lowlands where the largest established Maya cities were abandoned during the Terminal Classic Collapse (760-1000 AD). We present the first paleoecological reconstruction spanning ~2000 yrs. BP of the Lachuá Region, located south of Petén at the foothills of the North Central mountain ranges. The sediment core was collected from a wetland located in the tropical rain forest of Lake Lachuá National Park (LLNP). Our study covers the periphery of the ancient Maya city of Salinas de los Nueve Cerros (SNC), which flourished due to its salt production up to the Terminal Classic when the city was abandoned due to the collapse of major neighbor Maya cities. According to the pollen spectra along the sedimentary record during the late Preclassic and Classic, the outskirts of SNC were forestry lands and not agricultural, possibly under the management regime known as Maya Forest Gardens (MFG). The presence of arboreal pollen taxa indicate the establishment of useful species for the Maya (e.g. Myrtaceae, Sapotaceae, *Sapium*, *Spondias*), which in combination with disturbance related pollen taxa such as Solanaceae, suggest that possibly during the Classic the MFG were kept under secondary succession stages with sufficient forest cover (high arboreal pollen values ca. 80%), where erosion was controlled (e.g. LOI 500°C ca.80%). Evidence of the city abandonment is pointed by the successional change from Solanaceae to Combretaceae-Melastomataceae pollen taxa, which indicates the onset of later successional stages probably related to the halt in management of MFG during the Terminal Classic (e.g. 900-1000 AD). At the resolution level of our study, we did not find

evidence of droughts which are believed to be associated to the Maya Collapse at the Classic-Postclassic transition. There is a temporary drop in LOI during this transition, which may be related to disturbances during the city abandonment and Postclassic period development. Following for ca. 800-900 yrs, Combretaceae-Melastomataceae pollen dominates the record with the remaining presence of useful trees associated with MFG, which informs of the age and structure genesis of the forest protected currently in the LLNP. Ordination analysis of pollen composition along depth-time, indicates that recent disturbance during the late 20th century is directing vegetation succession to secondary vegetation dominance and late succession vegetation decrease, physiognomically similar to the Classic management regime, with the critical difference that most likely the landscape management during the Classic followed different forestry principles.

Keywords: Mesoamerica, Maya Forest Garden, Terminal Classic Collapse, pollen spectra, Lake Lachuá National Park.

SS31-O13 (80)

Pollen and non-pollen palynomorphs from two Neolithic sites in Wallonia (SE Belgium)

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The study presented in this contribution is part of a new multidisciplinary research program undertaken by the "Service Public de Wallonie" since 2011 on archaeological sites uncovered in the Walloon region (SE Belgium). Indeed, very few archaeoenvironmental studies have been done in this area, especially in archaeobotany, and none of them was employed in combination. Up to now, most of the studies have been concentrated on the Neolithic period which is thus the best documented so far. In this context, we analysed pollen and NPPs from two Neolithic sites of primary importance for the understanding of the first sedentary occupations and/or their specific activities. Our data represent the first NPPs records in Wallonia. The first site (Fehxe-le-Haut-Cloch e) is an Early Neolithic village (Belgian LBK) situated on the Belgian High Speed Train path Brussels-Liege. It is characterized by outlying houses which are older than the rest of the village's houses located within an enclosure. Pottery style, techno-functional aspects of flint-tools and AMS C14 dating attest that these isolated houses may be considered as pioneer installations. Pollen and NPPs analyses are based on 35 samples coming from 18 pits and ditches linked to 8 houses belonging to both pioneer and secondary phases. The second site (Spiennes), located in the outskirts of Mons, is well known for its Middle-Late Neolithic flint mines which are listed on the UNESCO World heritage Sites since 2000. The men who started to dig mines in Spiennes had just discovered a profuse deposit of quality, which was to be exploited for more than 1800 years. In total, around one hundred hectares were to be exploited and thousands of shafts were to be bored. Pollen and NPPs samples (48) have been retrieved from exploited flint layers, extraction shafts infillings and flint knapping workshops of 12 structures scattered on 3 different parcels of the exploitation. The purposes of this study are (i) to reconstruct the vegetation around each site and its evolution between the different occupation phases by means of pollen and NPPs analyses, (ii) to try to characterize local settlement dynamics, nature and function of different structure types, and specialized activities such as animal husbandry, cultures, waste management or mining, and (iii) to compare the pollen and NPPs results with those of the other palaeoenvironmental analyses undertaken (charcoal, seeds and fruit, phytoliths, archaeozoology). Questions relating to the economy and organisation of Neolithic society are also considered.

Keywords: Belgian Neolithic, settlement dynamics, prehistoric farming systems, mining activities, vegetal economy.

SS31-O14 (246)

A multi-proxy approach to the climate/vegetation/human relationships recorded in a piedmont bog in southern Poland

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Two millennia of the interplay between climate, vegetation and human in the Orawa-Nowy Targ Depression recorded in the profile from Puścizna Mała bog were investigated regarding pollen, non-pollen palynomorphs (NPPs) and plant macrofossils. The research revealed 8 distinct phases of such relationships. In the phase I (AD 300–475) humans of the Przeworska Culture (Roman Period) occupied the area. The simultaneous occurrence of *Sphagnum* sec. *Sphagnum* and *Eriophorum vaginatum* (both taxa have mutually excluding maxima) indicates unstable hydrological conditions then. Phase II (AD 475–520) reflects greater content of decomposed organic matter and hydrological conditions similar to the previous phase. At that time *Pinus sylvestris* probably occurred on the bog surface and traces of agricultural activity diminished. In the phase III (AD 520–570) *Sphagnum* sec. *Cuspidata* and testate amoeba *Archerella flavum* indicate an increase in the water table that possibly led to the retreat of *Pinus* from the bog. Simultaneously, a revival of human activity was recorded. Phase IV (AD 570–1125) reflects relatively stable hydrological conditions, which enabled the spread of *Sphagnum* sec. *Sphagnum* and supported the occurrence of *Archerella flavum*. At that time agricultural activity of first Slavs and subsequent early medieval time (still uncovered by archeological research) was identified in pollen spectra. During the phase V (AD 1125–1330) *Sphagnum* sec. *Acutifolia* appeared. At that time Cistercians arrived to the region (13th century) and their economy triggered deforestations. Phase VI (AD 1330–1375) reveals a very dry shift demonstrated by strong peat decomposition and the disappearance of *Archerella flavum*, which led to the spread of *Calluna vulgaris* and HdV-10 – an NPP type indicating dry conditions. Simultaneously *Abies*, *Fagus* and *Picea* forests were strongly degraded. The ¹⁴C chronology of the phase VI is contrary to the historical facts which show a low possibility of such drastic deforestations at that time, therefore it is highly uncertain. Even though, a drop in the decomposed organic matter content may show the improvement of water conditions during the phase VII (AD 1330–1900), the expansion of *Sphagnum* sec. *Acutifolia* and *Polytrichum strictum* still indicates relatively dry conditions. Pollen spectra reveal that there is a probable depositional gap in the greater part of this section (perhaps peat exploitation). The layer recording the 20th century (phase VIII) reflects the bog regeneration but the composition of mosses, similar to the phase VII, still points to relatively dry conditions.

Keywords: human impact, climate change, pollen, non-pollen palynomorphs (NPPs), plant macrofossils.

SS31-P01 (385)

Morphological features of minute charcoal particles in the soil of grassland of Japan

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Minute charcoal particles in soil or peat are important clues to know the past vegetation and fire history. However the basic studies of minute charcoal particles to know the origins of particular species or vegetation types are not enough yet. Here the morphological studies about the minute charcoal particles from the soil of grassland region were done. Topsoil samples from 20 spots were collected in Aso region, Kyushu, Japan where grasslands have been widely seen for a long time. Minute charcoal particles were extracted from the samples by some chemical and physical processes. Those charcoal particles sieved through 250 μ m mesh screen and trapped by the 125 μ m mesh screen were observed using a microscope of 400 magnifications under the vertical down light. 100 photographs of charcoal particles from each sample were randomly taken by a digital camera with zoom of double magnifications. Those photographs were classified into some types according to the morphological features of the charcoal particles. As a result, those types of charcoal particles seen a lot vary from spot to spot. It seems to be due to the species which dominates a spot of grassland and geographic conditions which affect the wind velocity, the humidity and so on.

Keywords: vegetation, fire history, Aso region, microscope, geographic conditions.

SS31-P02 (81)

Climate-pastoral activity interactions in the Champsaur Valley (French Alps) and their effect on the evolution of biodiversity during the last 3400 years

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This work reconstructs the history of local landscape at two sites located in the Champsaur Valley (French Alps), namely Lac de Faudon (1577 m asl) and Laus des Combettes (1175 m asl), during the last 3400 years. Here we propose a multidisciplinary approach to explain complex human/climate relationships and their effects on the evolution of biodiversity over time scales that go beyond human life span. Modern pollen data and vegetation surveys from 49 sites, selected within different environmental and land-use contexts in the Champsaur Valley, were used to create a pollen-based transfer-function to quantify pasture pressure. Its application to the two well-dated pollen sequences, covering the last 3400 and 2000 years respectively, allowed reconstructing the evolution of pasture-pressure through time. The pollen-based reconstructions were compared with changes in percentages of palynological and NPP pastoral indicators like spores of coprophilous Fungi, showing a good correlation but differences in the inferred intensity of the pastoral pressure. Palaeoecological data, in consistence with archaeological and historical evidences, underline a continuous human presence surrounding the two sites since the Antiquity. Pollen diversity reaches its highest value during the Medieval Warm Period (850-550 cal BP), when demography increase and stability of human presence are reported. An unprecedented fall of diversity is recorded at the beginning of the climate deterioration of the Little Ice Age (650 and 380 cal BP), coinciding with invasions from neighbouring human groups and wars and with a reduced pastoral activity at both sites. Data suggest that the interaction between human activities and climate changes produced important

transformations in the composition of the local flora, resulting in a weakened ecosystem highly dependent on Human cares and more sensitive to climate variability.

Keywords: palynology, late Holocene vegetation history, human/environment relationships, pasture pressure modeling, diversity indexes.

SS31-P03 (114)

Coprophilous fungal spores and selected non-pollen palynomorphs (NPPs) in lake and peat deposits from Greenland

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Fungal spores are commonly found preserved alongside other palynomorphs in a wide variety of depositional contexts (lakes, mires, ponds, soils, etc.). For many years these microfossils were largely neglected by palaeoecologists, but their potential as powerful proxy indicators for past environmental and land-use change is becoming widely recognized. There are relatively few examples of the application of fungal spore analyses in northern, and especially sub-Arctic, localities. Here we present records for coprophilous fungal spores and other selected non-pollen palynomorphs (NPPs) from a network of sites across southern Greenland. These focus upon changes around the time of the Norse settlement or *landnám* – commencing *ca* AD 985 – when natural (pristine) environments were replaced by cultural landscapes shaped predominantly by animal husbandry. The end of Norse settlement as reflected in individual site records lasted, variously, up to and including the 15th century AD. In order to evaluate the usefulness of these microfossils as a signature for grazing activity and land-use dynamics in this environment, changes in the frequencies of coprophilous fungal spores (e.g. *Sporormiella*-type, *Sordaria*-type) in mires and archaeological/cultural deposits (e.g. middens, plaggens) are considered in relation to the patterns of settlement, occupation and abandonment. These are compared to longer term (Holocene) records from lakes which provide a natural baseline against which later (anthropogenic) changes to the fossil spore record can be evaluated.

Keywords: palynology, coprophilous fungi, grazing impact, Norse settlement, South Greenland.

SS31-P04 (122)

Impact of pastoral activities on the vegetation during the Holocene – the case of the Aubrac highlands (South-western Massif Central, France)

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The "Plateau de l'Aubrac", a well known upland area in the south-western part of the Massif central,

remains one of the most important grazed areas currently used in this Massif. Since the 80's several palynological studies were performed in this area rich in peat and lakes deposits with the objective to reconstruct vegetation history. However the human impact on the landscape dynamics is still poorly documented. In this communication we present the results of a recent interdisciplinary approach that combines pollen data with complementary historical and archaeological data to provide a better understanding of the socio-ecological dynamics of this ancient grazed area. Four long-term records from the Aubrac highlands (southern Massif Central) have been studied in order to reconstruct the role of human-induced disturbances, such as grazing and/or agricultural activities, on the dynamic of the vegetation. The pollen data comparisons show differences in past land-use since the first clearing of the forest revealing local small-scale events. In the patchy landscape of the Aubrac highlands, opportunities for pastoral and agricultural activities are fragmented and can be restricted to specific areas. The earliest signs of human impact in this mountainous area appeared during the early Neolithic period, however evidences of human activities are strongly attested by pollen data since the late Neolithic. The Iron Age and Antiquity periods are both characterized by a major phase of expansion in human activities recorded synchronously in all pollen records. During the Late Middle Ages the upland areas have undergone an important shift in land-use management from extensive to intensive grazing activities, as suggested by a decrease in arboreal pollen and an increase in pastoral pollen indicators. During this period, archaeological and historical data mention the presence of monastic settlements in this area (located c.a 5-15 km to our sites) which would explain the land-use change.

SS31-P05 (229)

Neolithic and Bronze Age landnam of the former dense woodlands of the calcareous Alpine Plateau Silberer (Muotathal, Canton Schwyz, Switzerland)

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Palaeoecological research including pollen and spores, non-pollen palynomorphs and macrofossils was performed on sediments from a small peat bog in the remote Alpine valley of Muotathal, Canton Schwyz (Switzerland), where such studies were lacking up to now. Our "Silberer" research area is located in a calcareous geological setting famous for its huge and impressive karstic caves. Although this geological underground is responsible for a huge scarcity of Holocene peat and lake deposits in the 20 X 10 km large mountain area at 1800-2300 m altitude, a complete Holocene peat stratigraphy was extracted in 2009 from the small Schattgaden-Bog (1890 m a.s.l) covering the last 11'000 year within 130 cm of peat. Early Holocene flora and vegetation was dominated by dense woodlands of pine (*Pinus spec.*), hazel (*Corylus avellana*) and elm (*Ulmus spec.*), noteworthy in an altitude which is bare of all woodland today. Several bones of wild forest animals found in the near-by caves support this high forest density. First human impact and forest opening is evidenced for Neolithic Times with abundant anthropogenic indicators (herb pollen) culminating at 3000-2200 BC, which fits the known and dated fire place from the Corded Ware Culture excavated archaeologically in an adjacent valley. Complete local forest clearance (by fire as evidenced by macrofossil charcoal and subsequent extensive minerogenic sand input due to erosion) occurred during the Bronze Age (2200-1000 BC) due to heavy pastoral use of the Silberer area. This is well paralleled with five contemporary cave shelters in the immediate vicinity ("Abriss", excavated by archaeologists between 2006 and 2008), and which were used by Bronze Age people and their livestock. Numerous finds of

animal bones within these abris from animals living in open space landscape corroborate the treeless pastoral land since the Bronze Age and leading to the today's vegetation openness. Interestingly, a major shift in herb diversity of pastoral plant indicators occurred around 1000 AD (e.g. massive rise in Cichoriaceae and *Botrychium*) and was probably related to an intensification of local pastoralism with livestock. This fits well the age of the oldest ruins of Alpine settlements (huts and stables) still visible today in the Silberer area and some of the later written sources. This major change at 1000 AD is also represented by massive floristic changes within the peat vegetation composition as shown by the invasion and dominance of the mire and aquatic plant *Sparganium angustifolium* (Branched bur-reed) reflecting its ecological needs of high nutrients provided by historically known high livestock numbers.

Keywords: palynology, non-pollen palynomorphs, macrofossils, Holocene, prehistorical pastoralism.

SS31-P06 (611)

Holocene sedimentary and pollen evidence on sea-level change and primary agriculture history in Fuzhou basin

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The present study concerns the timing of the Holocene sea-level rise and afterward retreat based on a series of cores located in Fujian coastal region and Fuzhou basin. Result shows that Holocene marine transgression reached Fujian coastline at calibrated age of about ~10500 cal BP and subsequently advanced into Fuzhou basin (lower reach of Min River) at ~9200 cal BP. The marine transgression was at high stand of regional relative sea-level at the time range between ca.7500-3500 cal BP which was testified by the marine sediment phase of inland core in Minhou. The Neolithic first human installation in the region, found in Pingtan Island, was dated about 7300 cal BP (~6500 14C age). This result confirms the simultaneous occurrence of sea-level high stand and Neolithic culture appearance. The famous Tanshishan Neolithic culture appeared in the lower reach of Min River, more than 60 km inlands, in ~6300 cal BP (~5500 14C age), suggesting the fishery and hunting economy and human community developed rapidly after the sea-level high stand. Furthermore, the high-resolution of a core from Fuzhou basin (FZ4) displays regular tidal lamination intercalated with many thick coarse layers related to big surge event. This implies that a great amount of catastrophic events took place during the period of high sea level. Sedimentary and pollen records of the most cores show that marine retreat began at ~ 3500 cal BP and totally retreated from Fuzhou basin was dated ~1900 cal BP. The rapid pollen percentage increase of Poaceae and *Dicranopteris* indicates the occurrence of rice agriculture and subsequently disturbance on the forest ecosystem. The present results clarify that the environment plays a considerable role in the outcomes and collapse of the Neolithic culture (Grant No. 41072128).

Keywords: Holocene, sea level change, pollen analysis, sedimentology, pre-history of agriculture.

SS31-P07 (300)

A palaeoenvironmental study of the Shiniusi archaeological sites in the Wujiang Drainage Area, upper Yangtze River, Chongqing region, China

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Environmental archaeology helps researchers understand the correlation between environmental changes and their impacts on human civilization. One such study is taking place along the Wujiang river in Chongqing, China, at and near the Shiniusi site. Moss samples were obtained under natural mountain vegetation, along with soil samples from the QST4 unit at the Shiniusi site and surface soil sites from nearby archeological sites. By combining comprehensive palynology, charcoal, and isotopic chronology analyses with cultural artifacts, and comparing the results with those from adjacent sites, historical insights were obtained. The modern pollen assemblage of the Wujiang comprises mostly monolet spores and tree pollen, with no pollen from the Brassicaceae or rice (*Oryza sativa*), indicating a lack of human activity. The modern pollen and spore assemblage at nearby sites contains more trilete spores than monolet spores, and increased pollen from the Brassicaceae and Poaceae, indicating increased human activity. From the Shang Dynasty to the Song Dynasty, the pollen and spore assemblage of the QST4 unit was mainly monolet spores and the pollen of trees and herbaceous vegetation, with little pollen of rice and none of the Brassicaceae. Since the Ming Dynasty (1368 to 1644 AD), the pollen and spore assemblage has approached the modern assemblage near the archeological site, with more trilete spores than monolet spores, and increased pollen from the Brassicaceae and Poaceae, indicating greater human activity correlated with cultivation of rice and brassicaceous vegetables. The dominant pollen was from the Brassicaceae, the Poaceae, and the Fabaceae in the CJ unit at the Chenjiazui archeological site from the Zhou Dynasty (1100 to 256 BC) until modern times. High contents of micro-charcoal grains <125 µm from the Shang and Zhou Dynasties to the Han Dynasty are probably correlated with natural forest fires and climate change, and show reduced human impacts. The increase in micro-charcoal grains >125 µm since the Tang Dynasty is probably correlated with local grassland burning to fertilize crops.

Keywords: Wujiang river, Chongqing, environmental archaeology, human environmental impacts, Holocene.