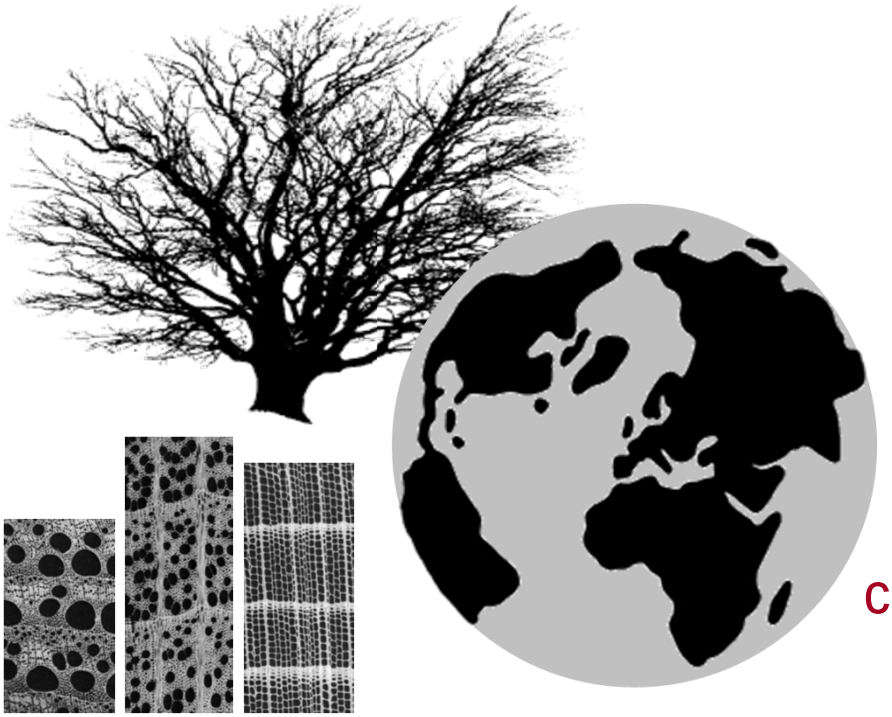
anthraco2015

6th International Anthracology Meeting

Freiburg • Germany • 30th August to 6th September 2015



Local to global significance of charcoal science

Congress-Guide Abstract-Volume

Program • Abstracts • Info

by Thomas Ludemann & Oliver Nelle

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University of Freiburg, Faculty of Biology, Dept. of Geobotany
Baden-Wuerttemberg State Office for Cultural Heritage, Tree-ring Lab

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Freiburg im Breisgau, Germany – August 2015 (ReproCenter Uni Freiburg)

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Congress guide

anthraco2015 - 6th International Anthracology Meeting

Local to Global Significance of Charcoal Science

University of Freiburg, Germany, 30th August to 6th September 2015

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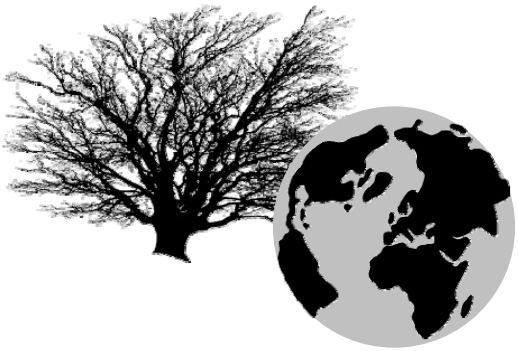

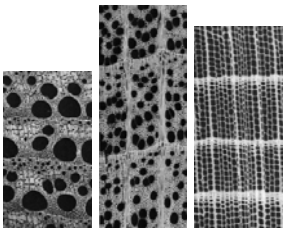

Local to Global Significance of Charcoal Science

anthraco2015 - 6th International Anthracology Meeting

Local to Global Significance of Charcoal Science

University of Freiburg, Germany, 30th August to 6th September 2015

Scientific committee

Eleni Asouti – University of Liverpool (UK)
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Koen Deforce – Flemish Heritage Institute (Belgium)
Emilie Dotte-Sarout - University of West Australia (Australia)
Barbara Eichhorn – University of Frankfurt (Germany)
Girolamo Fiorentino – University of Salento (Italy)
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Oliver Nelle – Baden-Wuerttemberg State Historic Preservation Office (Germany)
Jan Novak – University of South Bohemia (Czech Republic)
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Rita Scheel-Ybert – National Museum, University of Rio de Janeiro (Brasil)
Werner H. Schoch – Laboratory for Ancient Wood Research (Switzerland)

Organizing committee

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Introduction

Introduction to the 6th International Anthracology Meeting

Following the tradition of the past meetings – Montpellier 1991, Paris 2000, Lecce 2004, Bruessels 2008 and Valencia 2011 – four years after the last charcoal congress,

the 6th International Anthracology Meeting - anthraco2015

takes place at the University of Freiburg, SW-Germany, from 30th August to 6th September 2015.

Freiburg is a vibrant student city at the foot of the Black Forest in the heart of Western Central Europe in close vicinity to France and Switzerland, with rich cultural and academic life, and excellent recreational opportunities. Founded in 1457, the University of Freiburg is one of the oldest German universities and now is one of the nation's leading research and teaching institutions. The Faculty of Biology is renowned worldwide for its excellent research environment in multiple disciplines. Freiburg is the so-called "green city Freiburg", well-known for its broad initiatives to create high ecological standards in diverse aspects of life while balancing social and economic sustainability.

The 6th International Anthracology Meeting will be jointly organized by the Department of Geobotany, Faculty of Biology, University of Freiburg and the Tree-ring Lab of the Baden-Wuerttemberg State Office for Cultural Heritage.
Many new results have been worked out by anthracologists and charcoal scientists all over the world, with a broad range of scientific contexts and involved scientific disciplines. Consequently after four years of progress in charcoal science the 6th International Anthracology Meeting will focus on

(1) the present state of the art, innovative methods and new answers of (old) research questions,
(2) promoting charcoal science and experience transfer as well as new interdisciplinary cooperation and collaboration,
(3) identifying current and future research gaps and questions and initiating the corresponding studies in the close future.

It is intended to bring together scientists of the various fields and approaches dealing with charcoal and its analysis - archaeologists, botanists, (palaeo)ecologists, geologists, geographers, pedologists, historians, etc. ... from all over the world - **the world's charcoal science community** -, and to present their new anthracological and interdisciplinary results. The central scientific program will be presented from Monday, 31st August, to Friday, 4th September 2015 with six oral and poster sessions.

Moreover, within the congress week we want to offer some opportunities to get to know the rich cultural landscape and study objects of vegetation history and anthracology in the close surrounding of the congress city, especially of the famous Black Forest holiday landscape by several field activities (pre-, mid- and post-congress excursions).

Scientific sessions
Since the last international anthracology meeting many new anthracological results have been provided by archaeologists, botanists, palaeoecologists, geologists, geographers, pedologists, historians, etc. ... from all over the world and in a broad range of scientific contexts, in varies scientific fields and involved scientific disciplines. So the congress program has been structured and subdivided into six sections dealing with several topics of current interest. The corresponding sessions will take place from Monday, 31st August to Friday, 4th September 2015 with oral and poster presentations. During these five days, a great diversity of anthracological and palaeobotanical topics will be offered at the congress sessions. Each session will be opened by a **keynote**.

Session 1: New methods and challenges
This session is intended for contributions tackling primarily questions of (new) methodology like isotope research, as well as taphonomy and dating. New challenges might concern anthracology in hitherto "untouched" regions of the planet were wood anatomical ground work is still in its

beginnings. Other concerns may address field work (excavation, extraction, ...), representation of sampling quantities, determination of specific characters (e. g. wood anatomy), preservation of charcoal in different taphonomical contexts, the taphonomy of macro- and microcharcoals in lake sediments, stable isotope research, problems of dating charcoals in an archaeological context, etc.

Session 2: Geo- and Pedoanthracology
Charcoal is everywhere. Beyond the archaeological context, soils and sediments are ubiquitous archives storing information on fire frequency, species occurrence and stored carbon in the form of carbonised plant material. This session focuses on pre-quaternary charcoal in all kind of archives, as well as quaternary charcoal in soils, soil sediments (colluvisols), peats, lake and marine sediments (sedimentary anthracology). Soil charcoal analysis or pedoanthracology, allows the investigation of past occurrences of fire events and the identification of the correlated burnt woody vegetation, which is an important research field now, in the view of global climate change. The approach is based on the extraction of wood charcoal pieces from on-site-formed soils or soil sediments (e.g. colluvial soils), and their subsequent quantification (charcoal concentration per weight unit of sampled earth) and taxonomic identification, usually combined with radiocarbon dating. Pedoanthracology also contributes to the glacial refuge vs. early spread debate. Discussion will continue whether we keep talking of "pedoanthracology" for soil charcoal analysis which is usually done in a geoanthracological context. Regional contributions as well as syntheses or methodological issues are very welcome.

Session 3: Archaeo- and Ethnoanthracology
The first studies on archaeological charcoals date back to the 19th century. In the absence of wet preserved wood, analysis of wood charcoals from caves and settlements, camp fires and graves brings to light the human use of fuel and timber wood, thus addressing the wood economy. Beyond, environmental interpretations of archaeological charcoal assemblages are still controversially discussed in the light of the human filter effects. Contributions from any cultural period and any place of the world are welcome, as well as studies from experimental archaeology and ethnology.

Session 4: Charcoal production and Archaeometallurgy
Charcoal produced intentionally by humans is both resource and proxy. Research on former charcoal production becomes increasingly important. Kiln site anthracological work – the use of left-over charcoal from charcoal production sites to address questions of woodland composition reconstruction – dates back to the 1930s, while the last decade saw an augmented interest by archaeology, geography and landscape ecology. With modern techniques of airborne laser scanning, the historical importance in the wood economy becomes impressively clear, especially to produce charcoal for metal extraction and processing. Thus, contributions dealing with all aspects of charcoal production, as well as with the use of charcoal in metallurgy, are welcome. We especially encourage researchers dealing with social, economic or political aspects of charcoal production and metallurgy beyond or independent of charcoal analysis to join the session.

Session 5: Dendroanthracology
Dendroanthracology is the study of tree rings in charcoals. Besides dating charcoals if species and number of growth rings allows it, tree ring patterns reveal information on growing conditions of the charred wood, thus contributing to the interpretation of the size of the used wood (stems vs. branches vs. coppicing) and aspects of woodland management (e.g. coppicing, pollarding). Dendroanthracological information is on its way to become a standard asset in archaeoanthracological studies, however standardised methodologies (including subsampling, recording and analysis protocols) that are both applicable, economic as well as reliable and reproducible have yet to be established and agreed on.

Session 6: Multiproxy studies
This session addresses studies that seek to integrate anthracological datasets with other palaeoecological proxies in order to reconstruct past human impacts on the environment, ecosystem dynamics, and climate-people-landscape interactions. The integration of charcoal and pollen analysis is still not broadly enough practised, thus presentations bringing together these two sources of palaeoecological data are particularly welcome.

Thomas Ludemann & Oliver Nelle

Congress program

anthraco2015 - 6th International Anthracology Meeting

Local to Global Significance of Charcoal Science

University of Freiburg, Germany, 30th August to 6th September 2015

General program, oral presentations

Congress venue: Institute of Biology I, Hauptstraße 1, Freiburg-Herdern

Sunday, 30th August 2015

12.00-13.00	Registration and participant information (Inst.Bio. I, OG 1, R 1048)
13.00-19.00	Pre-congress excursion (Starting experimental charcoal kiln No.6 in the field etc.)
19.00-20.00	Registration and participant information (Inst.Bio. I, OG 1, R 1048)

Monday, 31st August 2015

8.00	Welcome desk opening, participant information and registration (Inst.Bio. I, R 1048)	
9.00-9.40	**Scherer-Lorenzen** M. (University Freiburg, Head of the Dept. of Geobotany), **Ludemann** T. & **Nelle** O.: Congress opening, welcome address, introduction	
Session 1: New methods and challenges		chair **NN**
9.40-10.20	**Fiorentino** G.	From charcoals to carbon: an outline on stable isotopes analysis in anthracology **- keynote**
10.20-10.40	**Carah** X. et al.	Assessing fuel wood selection strategies and matrix charcoal at Madjedbebe, northern Australia
10.40-11.20	coffee break	
11.20-11.40	**Jansen** D. et al.	A detailed data collection allows new paths of interpretation - the case of kiln site K653
11.40-12.00	**Arranz-Otaegui** A. et al.	Evaluating the impact of water processing on wood charcoal remains: Tell Qarassa North, a case study
12.00-12.20	**Vidal-Matutano** P.	GIS application on woody taxa distribution: A methodological approach from El Salt (Alcoi, eastern Iberia)
12.20-12.40	**Smidt** E. et al.	Aging of historical and prehistoric charcoals - characterization using Fourier Transform Infrared (FT-IR) spectroscopy and simultaneous thermal analysis (STA)
12.40-14.00	lunch	
Session 1: New methods and challenges *(cont.)*		chair B. **Eichhorn**
14.00-14.20	**Baton** F. et al.	Effects of oxygenated carbonization on the isotope signal in tree rings. Implication for ancient charcoals
14.20-14.40	**Dussol** L. & **Elliott** M.	Ancient Agroforestry in the Maya Rainforest. New Developments in Neotropical Anthracology at the site of Naachtun (Guatemala)
14.40-15.00	**Scheel-Ybert** R.	ANTHRAKOS: A new online database, charcoal identification, data management, and data charing system
15.00-15.20	**Höhn** A. & **Eichhorn** B.	Ecological interpretation of African rainforest charcoal - Is it feasible?
15.20-16.00	coffee break and **Poster session 1**	

Monday, 31st August 2015 *(cont.)*

Session 2: Geo- and Pedoanthracology		chair J. **Novak**
16.00-16.40	**de Lafontaine** G.	Biogeographic inferences using local-scale soil macrofossil charcoal analysis **- keynote**
16.40-17.00	**Morin-Rivat** J. et al.	Late-Holocene tropical moist-forests of southeastern Cameroon: some insight from soil charcoal analysis
17.00-17.20	**Benatti** A. et al.	The reconstruction of the natural and cultural landscape of the Cimone mountain (Northern Apennines, Italy) since the Neolithic from a pedoanthracological approach
17.20-17.40	**Moser** D. et al.	Soil charcoal analysis at Cecita Lake (Sila Massif, southern Italy): a useful tool to understand local environmental change
17.40-18.00	**García Álvarez** S. et al.	Pedoanthracology reveals the timescale and altitudinal boundaries of the Holocene Mediterranean mountain shrublands: the example of Sierra de Gredos (Iberian Central System, Spain)
18.00	welcome drink	

Tuesday, 1st September 2015

Session 2: Geo- and Pedoanthracology *(cont.)*		chair E. **Asouti**
9.00-9.20	**Bal** M. et al.	European open Landscapes: the comparison of the human land use strategies of three Mediterranean Mountains: the Mont Lozère (France), the Sierra de Gredos (Spain) and the Monte Cimone (Italy) since the Neolithic period. International AGRESPE network
9.20-9.40	**Bobek** P. et al.	Inter-regional comparison of the Holocene fire regimes in Bohemia (Czech Republic): spatio-temporal patterns and possible driving forces
9.40-10.00	**Marguerie** D. et al.	Charcoals identification as a complementary tool for the reconstruction of vegetation and fire activity during the late-glacial/early-Holocene transition around Blacktail Pond, USA
10.00-10.20	**Schulz** E. et al.	Wildfire versus slash-and-burn and flaming and the fate of charcoals
10.20-10.40	**Feiss** T. et al.	Soil charcoal analysis: a new methodological and statistical approach for a better use in ecology
10.40-11.20	coffee break and **Poster session 2**	
Session 3: Archaeo- and Ethnoanthracology		chair E. **Badal**
11.20-11.40	**Bachelet** C. & **Scheel-Ybert** R.	Fuel economy, environment and landscape of the Santa Elina rock shelter (Mato Grosso, Brazil) in the early Holocene
11.40-12.00	**Waisman** L. & **Scheel-Ybert** R.	Fuel economy and hearths technology of Proto-Jê groups at the southern brazilian highlands
12.00-12.20	**Austin** P.	Fuel-wood use in Late-Classic Maya salt processing - a study of charcoal macro-remains from Marco Gonzalez, Ambergris Caye, Belize: preliminary findings
12.20-12.40	**Elliott** M. & **Pereira** G.	Sacred Fires and Household Hearths: reconstructing Middle Postclassic Tarascan wood economy at Malpaís Prieto (13th - 15th centuries AD, Michoacán, Mexico)
12.40-14.00	lunch	

Tuesday, 1st September 2015 *(cont.)*

Session 3: Archaeo- and Ethnoanthracology *(cont.)*		chair I. **Figuerial**
14.00-14.20	**Whitau** R.	Home is where the hearth is: Anthracological analysis in Bunuba and Gooniyandi country, Western Australia
14.20-14.40	**Lennox** S.	Charcoal analysis from 58 and 49 000 year old hearths at Sibudu: implications for wood uses and the KwaZulu-Natal environment during the Middle Stone Age
14.40-15.00	**Dabrowski** V. et al.	Vegetation and importation of wood in the Oman peninsula at the end of the late pre-Islamic period: recent charcoal analyses from a burnt building at Mleiha (U.A.E, 2nd -3rd century AD)
15.00-15.20	**Ntinou** M.& **Tsartsidou** G.	Domestic and ritual use of plants and fuels in the neolithic cave of Alepotrypa, southern Peloponnese, Greece: the wood charcoal and phytolith evidence
15.20-16.00	coffee break and **Poster session 3**	
Session 3: Archaeo- and Ethnoanthracology *(cont.)*		chair G. **Fiorentino**
16.00-16.20	**Vaz** F. et al.	The Use of Wood as Fuel and Timber during the Iron Age and Roman Times in North-west Iberia: the Case of Sabor Valley (NE, Portugal)
16.20-16.40	**Martín-Seijo** M. et al.	Early-Middle Bronze Age Communities and Wood Resources Management in the Sabor valley (Northeast Portugal)
16.40-17.00	**Deforce** K.	Wood use in a growing medieval city. Evidence for the overexploitation of woody resources in Ghent (Belgium) between the 10th and 12th century
17.00-17.20	**Edlmair** S. & **Oeggl** K.	Conspicuous Charcoals in a Pit: Wood Remains of Fire Offerings as a Glimpse into the Past

Wednesday, 2nd September 2015

Session 3: Archaeo- and Ethnoanthracology *(cont.)*		chair A. **Höhn**
9.00-9.20	**Nocus** N. & **Dufraisse** A.	Woodlands evolution from the Neolithic to the early middle ages and human impact in Alsace (France). First dendro-anthracological analysis in the Kochersberg region
9.20-9.40	**Battentier** J. et al.	Vegetal landscape and its management in Provence at the end of the Neolithic (2880-2580 cal BC): the charcoal analysis of Limon-Raspail (Vaucluse, Southeastern France)
9.40-10.00	**Delhon** C. & **Moreau** C.	Selected fuel, rotten posts and glassy amorphous enigmatic residue: Charcoal analysis of a structured dwelling site from the middle Neolithic in Provence (Le Clos du Moulin, Vernègues, Bouche-du-Rhône, South of France)
10.00-10.20	**Figueiral** I. et al.	Gallo-Roman Nîmes (southern France): a case study on firewood supplies for urban and proto-urban centers (1st BC - 3rd AD)
10.20-10.40	**Picornell Gelabert** L. et al.	People, trees and landscapes in the Balearic Islands (Western Mediterranean): forests and prehistoric communities in Mallorca and Menorca through archaeological charcoal analysis
10.40-11.40	coffee break and **Poster session 3** *(cont.)*	
11.40-13.00	lunch	
13.00-19.00	Mid-congress excursion (from Hauptstraße 1)	

Thursday, 3rd September 2015

Session 4: Charcoal production and Archaeometallurgy		chair K. **Deforce**
9.00-9.40	**Groenewoudt** B.	Unexpected opportunities. On the landscape archaeological potential of charcoal kilns - **keynote**
9.40-10.00	**Eichhorn** B. & **Robion-Brunner**	Wood exploitation for a major pre-colonial West African iron production centre (Bassar,Togo)
10.00-10.20	**Py-Saragaglia** V. et al.	Late Holocene History of woodland dynamics and wood use in an ancient Mining area of the Pyrenees (Ariège, France)
10.20-10.40	**Hazell** Z. et al.	Archaeological investigation and wood charcoal analysis of charcoal burning platforms, Cumbria, NW England
10.40-11.20	coffee break and **Poster session 4**	
11.20-11.40	**Carrari** E. et al.	Former charcoal kiln sites in Mediterranean forests, a legacy still affecting vegetation diversity and ecology
11.40-12.00	**Dupin** A. et al.	Anthracology of charcoal kilns in the forest of Chailluz (France) as a tool to understand Franche-Comté forestry from the 15th to the early 20th centuries
12.00-12.20	**Rouaud** R. et al.	A ten-year study on the history of charcoal making in the west part of Massif central: a contribution to regional biogeography through the anthracology of charcoal kilns
12.20-13.20	lunch	
Session 5: Dendroanthracology		chair A. **Dufraisse**
13.20-14.00	**Girardclos** O.	Dendroanthracology, questioning past woodland management and first results to identify wood from sessile Oak *(Quercus petraea)* coppiced and seed-trees - **keynote**
14.00-14.20	**Cichocki** O. et al.	Charcoal and Treerings: To-the-year informations from Palaeolithic fireplaces
14.20-14.40	**Lorenz** I. et al.	Charcoals from the medieval settlement Haithabu (Northern Germany) - reconstruction of woodland usage
14.40-15.00	**Patzlaff** R.G. et al.	Dendro-anthracometry in tropical trees: first results on the use of fiber lines to obtain wood referentials for diameter measurements
15.00-15.40	coffee break and **Poster session 5**	
Session 5: Dendroanthracology *(cont.)*		chair D. **Marguerie**
15.40-16.00	**Kabukcu** C.	Identification of woodland management practices and tree growth conditions in archaeological fuel waste remains
16.00-16.20	**Coubray** S. et al.	Development of tyloses quantification method in oak: application to charcoal assemblages from two archaeological sites in northern France
16.20-16.40	**Liottier** L. et al.	Contribution of anthracological and dendro-anthracological analysis to the study of charred timber recovered from Lattara (Hérault, southern France) during the 5th century BC
16.40-17.00	**Cabanis** M. et al.	Wood resources in the Clermont-Ferrand Basin from the Neolithic to the Second Iron Age on the dendroanthracological analysis
17.00-17.20	**Dufraisse** A. et al.	The program DENDRAC - Development of dendrometric tools applied to anthracology: studies of human-resources-environmental relations
18.00-22.00	congress dinner (WaldHaus Freiburg, Wonnhaldestraße 6)	

Friday, 4th September 2015

Session 6: Multiproxy studies		chair F. **Damblon**
9.00-9.40	**Robin** V.	Charcoal as a key to multiproxy studies - **keynote**
9.40-10.00	**Kováčik** P.& **Cummings** L.C.	Reconstruction of woodland vegetation and firewood exploitation in Nine Mile Canyon, Utah, based on charcoal and pollen analysis
10.00-10.20	**Ponomarenko** E. et al.	Fire-induced mass transport in small catchment areas as a source of information on the past dynamics of human occupation
10.20-10.40	**Fantone** F.	Wood selection at Late Bronze Age Tell Sabi Abyad (Syria, ca 1230-1180 BC): results of the macro-charcoal analysis
10.40-11.20	coffee break and **Poster session 6**	
11.20-11.40	**Deckers** K. et al.	A multiproxy investigation to reconstruct vegetation and land use in Northeastern Syria from the 4th till 2nd millennium BC
11.40-12.00	**Wright** N. et al.	Wood resource use and change at Kaman-Kalehöyük, central Anatolia, Turkey: integrating wood charcoal, pollen data and stable isotopes to better understand climate-people-landscape interactions
12.00-12.20	**Asouti** E. & **Kabukcu** C.	Late Pleistocene and early Holocene woodland vegetation and ecology in the environs of Franchthi Cave, Peloponnese, Greece: integrating anthracological, dendroecological and archaeobotanical data
12.20-12.40	**Piqué** R. et al.	Landscape and firewood exploitation during the Holocene at La Garrotxa (Girona, NE Iberia)
12.40-14.00	lunch	
Session 6: Multiproxy studies *(cont.)*		chair R. **Scheel-Ybert**
14.00-14.20	**Grindean** R. et al.	The influence of climate, human impact and fire on the Holocene forest dynamics in the Apuseni Mountains, Romania
14.20-14.40	**Moskal-del Hoyo** M. et al.	Character of the Atlantic woodland of the Great Hungarian Plain
14.40-15.00	**Damblon** F. et al.	Charcoal, wood, mollusc, pollen and radiocarbon dates from Eurasian loess sites: an attempt of convergent multidisciplinary approach
15.00-15.20	**Tereso** J. et al.	Charcoal VS seeds? The combined interpretation of anthracological and carpological assemblages and their implications for understanding archaeological contexts
15.20-16.00	coffee break	
16.00-16.20	**Toriti** M. et al.	Gallo roman timber in maritime french alps (Col d'Adon, Les Mujouls, France): identification, uses and condition.
16.20-16.40	**Million** S. et al.	Utilisation of Abies around the Heuneburg during the Early Iron Age - local origin or timber import?
16.40-17.00	**Nelle** O. et al.	Woodland from Mesolithic to modern times: a combined approach of anthracology and palynology sheds new light on the vegetation history of Northern Germany
17.00-18.00	Discussion and conclusions – Closing the anthraco2015 presentation program	

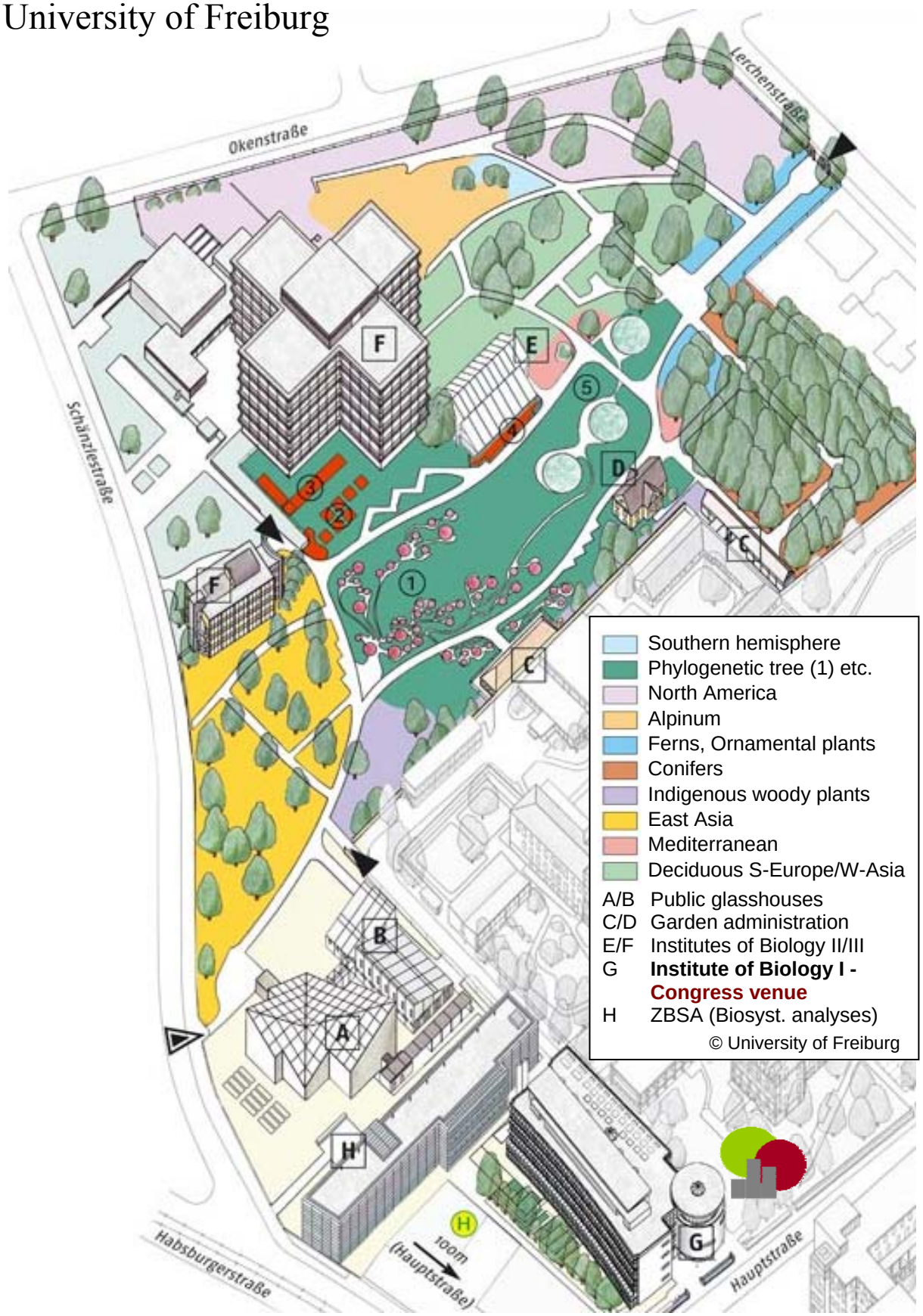
Saturday, 5th September 2015

8.30-19.00	Post-congress excursion (from Hauptstraße 1)

Sunday, 6th September 2015

8.30-13.00	Post-congress good-bye excursion (from Hauptstraße 1)

Botanical Garden and Biologicum
University of Freiburg



Congress program

anthraco2015 - 6th International Anthracology Meeting

Local to Global Significance of Charcoal Science

University of Freiburg, Germany, 30th August to 6th September 2015

Poster presentations

Congress venue: Institute of Biology I, Hauptstraße 1, Freiburg-Herdern

Monday, 31st August 2015 – 15.20-16.00

Poster session 1: New methods and challenges	
Dotte-Sarout E. & **Byrne** C.	Challenges and Opportunities for the application of anthracology in Oceania: comparison of recent studies in the Pacific and Australia
Martín-Seijo M. et al.	Limits and possibilities of charcoal analysis in Bronze Age sites: the case study of Pego (North-west Portugal)
Nocus N.& **Nourissier** A.	ACACIA, Automatical Creation of AnthraCologIcal dIagram
Robin V. & **Kelm** R.	Experimental analyze of the taphonomy of soil charcoal assemblages
Scheel-Ybert R.	INDEX ANTHRACORUM: Creation of a global directory for charcoal collections
Vanlandeghem M. et al.	Thule fuel management at Cape Espenberg (N-O Alaska): Experimental protocol and dataset from current driftwood deposits and archaeological charcoal remains

Tuesday, 1st September 2015 – 10.40-11.20

Poster session 2: Geo- and Pedoanthracology	
Fouquemberg C. et al.	Reconstruction of boreal forest dynamics of the Clay Belt region in Quebec by anthracological analysis of forest soils
Hubau W. et al.	Pedoanthracology reveals Holocene fire-vegetation-climate linkages in Central Africa
Ponomarenko E. & **Crossland** D.	Human visibility in the Maritime landscapes: anthropogenic ignition of windstorm debris
Quednau T. & **Ludemann** T.	First pedoanthracological study in the Black Forest, SW Germany
Robin V. et al.	Soil charcoal analysis of a Mediterranean old-growth: historical relict or anomaly?

Tuesday, 1st September 2015 – 15.20-16.00 & Wednesday, 2nd September 2015 – 10.40-11.40

Poster session 3: Archaeo- and Ethnoanthracology	
Alcolea M. et al.	Fuel and acorns: Early Neolithic plant use from Chaves cave (Huesca, Spain)
Alcolea M. et al.	Landscape and firewood at Espantalobos Mesolithic site (Huesca, Spain)
Allué E. et al.	Palaeoenvironmental reconstruction and anthropogenic activity from the Upper Pleistocene to the Holocene based on the anthracological record of the Garraf-Ordal Massif (Barcelona, NE of Iberian Peninsula)
Badal E. et al.	Neanderthals and Mediterranean woodlands: firewood collection in a changing landscape
Buonincontri M. et al.	Charred wood remains from a foundation ritual of a Medieval church in southern Tuscany (10th-11th century AD)
Galarce N. et al.	Anthracology Research in the Southern Brazil
Gruat P. et al.	The oppidum of Puech de Mus (Saint-Eulalie-de-Cernon, Aveyron, France): a defensive protohistoric habitat from the Causse du Larzac. Archeo-anthracological approach
Kocár P. et al.	The middle and upper holocene woodland history (5500 BC - 550 AD) of Czech Republic based on the anthracological data from archaeological sites
Lorenz I. et al.	Wood usage and woodland composition at an Iron Age ring wall in Northern Germany
Matias R. et al.	There is no smoke without fire: charcoal analyses from Animal 1, Cabeço da Amoreira, Muge shellmidden (Portugal)
Mavromati A.	Landscape and fuel wood in Akrotiri (Thera, Greece) during the Bronze Age
Monteiro P. & **Bicho** N.	Charcoal analyses from Muge shellmiddens: comparative analyses from CCabeço da Arruda and Cabeço da Amoreira
Moser D. et al.	Timber for building in the Vesuvius area during the 1st century AD: wooden and charcoal remains from Oplontis and Herculaneum (Naples, Southern Italy)
Moskal-del Hoyo M. et al.	Landscape changes in the Miechów Upland (South Poland) from the Early Neolithic to the Early Middle Ages
Moskal-del Hoyo M. et al.	The different uses of wood in cemetery and settlement areas of archaeological sites in Ulów (Tomaszów Lubelski district, East Poland)
Paradis-Grenouillet S. et al.	The Chestnut tree in Limousin, an indigenous or imported species? New anthracological data on a rural housing in the first iron age (Mézières sur Issoire, Haute Vienne, France)
Riquelme-Toro I. et al.	Fuel management strategies at the extreme and changing environments: the case of El Chueco 1 site (11500-2500 yr. cal. B.P.) at central western Patagonia
Salavert A. et al.	Early Neolithisation process in eastern Europe: first charcoal analysis from two sites in south-western Ukraine
Santeramo R.	Medieval rural landscape and economy in northern Spain: preliminary archaeobotanical studies of deserted villages
Uzquiano P.	Vegetation and human interactions in Cantabrian Spain related to Holocene climate dynamics: A synthesis based on chacoal studies

Thursday, 3rd September 2015 – 10.40-11.20

Poster session 4: Charcoal production and Archaeometallurgy	
Ludemann T. et al.	Local scale pattern of past fuel wood use and ecological growth condition of the exploited forests - examples from the Western Black Forest (SW Germany)
Nelle O. et al.	A kiln site turned upside down: archaeological and anthracological study of a charcoal burning platform (K653) in the Black Forest, Southwestern Germany
Nölken W. & **Ludemann** T.	Regional pattern of past fuel wood use by charcoal burning in the Southern Vosges, France
Poggiali F. et al.	Charcoal analysis in a prehistoric cinnabar mine (Uccellina Mts., Central Italy)
Rassat G. et al.	Wood charcoal production and iron metallurgy in Charente lowland's forests (France): an ancient history revealed by the use of new tools

Thursday, 3rd September 2015 – 15.00-15.40

Poster session 5: Dendroanthracology	
Blondel F.& **Cabanis** M.	Dendrochronology dating experimentation on oak coals deciduous collected from archaeological contexts sites: Molle (Allier), Laroquebrou (Cantal) and Saint-Paulien (Haute-Loire)
Brochard S. et al.	Circulus database
Dufraisse A. et al.	Geometric morphometrics: a promising tool for anthracology. Application to stem disc
Dufraisse A. et al.	A morphometrical approach to past pollarding practices: perspectives in anthracology
Paradis-Grenouillet S. & **Dufraisse** A.	A comparative study on wood shrinkage during carbonizing between oak and chestnut. An application to the study of wood diameters in a charcoal burning process
Rodríguez-Ariza M.O.	Dendroanthracological study of Castellón Alto (Galera, Granada, Spain)

Friday, 4th September 2015 – 10.40-11.20

Poster session 6: Multiproxy studies	
Badal E. & **Martínez** C.M.	Different parts of the same plants. Charcoals and seeds from Cova de les Cendres (Alicante, Spain)
Caruso Fermé L. et al.	Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina)
Novák J.& **Houfková** P.	Vegetation history of the Doubrava forest (NE Czech Republic): a comparison of anthracological, pedoanthracological and pollen results
Pescini V. et al.	Anthracological evidence in historical ecology: landscape and land use at the Punta Mesco Cape in the Cinque Terre National Park - NW-Italy (XVII - XX century)
Robin V. et al.	Multi-proxy assessment of past fire regime and ecosystems response in northern central Europe
Uzquiano P. et al.	New insights on the palaeobiogeography of Quercus ilex woods in the Cantabrian region (N Spain) based on integrated charcoal and pollen studies

Excursions: General information and instructions

Good hiking boots and standard **outdoor equipment**, especially against rain, are strongly recommended for all excursions! The Black Forest could have rather cold and humid conditions (maximum annual average precipitation in the upper montane belt about 2000 mm; maximum annual average temperature about 3 to 4 °C!). Despite this the Black Forest is a very nice holiday landscape!
Registration needed for the excursions.

Pre-congress welcome excursion
A pre-congress welcome excursion is planned for Sunday afternoon, 30th August 2015. A bus will start with the participants in front of the Institute of Biology I, Hauptstr. 1, at 1.00 pm and bring them back to the same place around 7.00 pm. With this trip, we would like to offer the opportunity to get some deeper insights in our kiln site anthracological and mining archaeological research field and field work at the western edge of the Black Forest. We will visit the experimental charcoal kiln No.6 and the start of the charcoal burning process. Depending on the weather and on the progress of the charcoal burning process, and if there is enough time available we may also visit the highest tree of Germany or a pilot area of historical mining. The program will differ from the program the following Sunday. A guide book of the excursion will be provided to the participants.

Mid-congress excursion
A mid-congress excursion is planned for Wednesday afternoon, 2nd September 2015. A bus will start with the participants in front of the Institute of Biology I, Hauptstr. 1, at 1.00 pm and bring them back to the same place around 7.00 pm. This trip gives the opportunity to get some deeper insights in the historical cultural landscape and traditional land-use practices of the Southern Black Forest. Depending on the weather we will climb up (mainly by cablecar) on the mountain top of the city of Freiburg, one of the highest mountains of the Black Forest, visit some typical well-prepared sites of historical charcoal burning, cross the heart of a valuable nature conservation area of high (European; FFH/Natura2000) significance and enter an old traditional farm and especially the well-conserved farmhouse. Moreover, the area visited has also a long tradition of historical mining with a large mine. A guide book of the excursion will be provided to the participants.

Post-congress excursion
An all-day post-congress excursion is planned for Saturday, 5th September 2015. A bus will start with the participants in front of the Institute of Biology I, Hauptstr. 1, at 8.30 am and bring them back to the same place around 7.00 pm. We would like to offer the opportunity to get some deeper insights in the settlement, land-use and vegetation history of a very remote area of the Central Black Forest. The participants will visit a late-settled steep, rocky and stony area of the Central Black Forest, which was agriculturally used only for a few centuries after the middle ages and is mainly abandoned since decades, having the status of a nature conservation area and a strictly protected forest area today and since nearly half a century – representing the highest degree of conservation in the state of Baden-Wuerttemberg as well as a (relatively) low degree of anthropogenic influence in Western Central Europe (conservation of natural processes). It is an area of well-known land-use history, vegetation and cultural landscape elements. A guide book of the excursion will be provided to the participants. At the end of the excursion we will try to schedule a stop at a Black Forest farm inn.

Post-congress good-bye excursion
A post-congress good-bye excursion is planned for morning at Sunday, 6th September 2015. A bus will start with the participants again in front of the Institute of Biology I, Hauptstr. 1, at 8.30 am and bring them back to the same place around 1.00 pm. With this trip, we would like to offer (again) the opportunity to get some deeper insights in our kiln site anthracological and mining archaeological research field and field work at the western edge of the Black Forest. We will visit the running traditional charcoal kiln (experimental kiln No.6) again – 7 days later, after starting the charcoal burning process –, as well as a pilot area of historical mining and/or the highest tree of Germany. The program will differ from the program on Sunday a week before. A guide book of the excursion will be provided to the participants.

Abstracts

anthraco2015 - 6th International Anthracology Meeting

Local to Global Significance of Charcoal Science

University of Freiburg, Germany, 30th August to 6th September 2015

Abstracts of oral and poster presentations

Contents of abstract volume (oral presentations and posters)

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Fuel and acorns: Early Neolithic plant use from Chaves cave (Huesca, Spain)

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Wood charcoal and seed analysis was carried out at Chaves cave (Bastarás, Huesca). The site is located in the southern slope of Guara range in the central Pre-Pyrenees. Present-day vegetation is dominated by Mediterranean formations of Quercetum rotundifoliae. This settlement presents a complete sequence from Upper Palaeolithic to Bronze Age. Our research focuses on the analysis of charred macro-remains from two Neolithic levels dated from 5500 to 5079 cal BC. Chaves is a particular important site for the Early Neolithic of the northeast Iberian Peninsula. According pollen information human activity in the environment is well-documented since Neolithic times that reveal the presence of several plant herbs (Plantago, Rumex, Chenopodiaceae, etc) (López García, 1992). Wood charcoal analysis reveals the exploitation of fuelwood resources in different environments. The results show a predominance of conifers wood in the assemblage. Junipers, mediterranean (Pinus halepensis) and montane pines (Pinus type sylvestris/nigra) are documented. Also, both evergreen and deciduous Quercus are also well-represented. Xerophytic and thermophilous trees and shrubs (Leguminosae, Rosmarinus officinalis, Rhamnus/Phillyrea) are accompanied by mesophylous taxa and other elements indicating a humid environment during VI millennia cal BC. The location of the archaeological site in a mid-mountain environment (663 m.a.s.l.) favors a mixed exploitation of resources in lowlands and mountainous areas. Therefore, we have documented a great variety of woody taxa and formations. Among charred wood we have also documented an abundant presence of acorns (Quercus sp. seed) (Zapata et al., 2008) whose economic significance is revaluated.

López, P., (1992): Análisis polínicos de cuatro yacimientos arqueológicos arqueológicos situados en el Bajo Aragón. In P. Utrilla (coord.): Aragón/Litoral mediterráneo: intercambios culturales durante la Prehistoria. En Homenaje a juan Maluquer de Motes. Institución Fernando el Católico. Zaragoza, pp. 235-242.

Zapata, L., Baldellou, V., Utrilla, P. (2008): Bellotas de cronología neolítica para consumo humano en la cueva de Chaves (Bastarás, Huesca). IV Congreso del Neolítico Peninsular: 27-30 de noviembre de 2006. M. S. Hernández Pérez, Soler Díaz, J.A., López Padilla, J.A. (coords.), Vol. 1, pp. 402-410.

Wood charcoal analysis, Early Neolithic, Acorns, Pre-Pyrenees, Environmental Archaeology

Landscape and firewood at Espantalobos Mesolithic site (Huesca, Spain)

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The paper presents new anthracological results from Mesolithic site of Espantalobos (Quicena, Huesca). This settlement is located in the lowlands south of the Pre-Pyrenaean foothills and dated from 8980 to 8160 cal BP. Present-day vegetation is dominated by thermophylous holm oak woodland (Quercus ilex spp. rotundifolia) and natural cover has been heavily modified by human activity. Here we present the results of the analysis of 1150 charcoal fragments from two archaeological layers and different hearths. According the wood charcoal analysis, the collection of firewood was carried out in an environment characterized by open vegetation. The IX millennium cal BP, in the framework of Atlantic period (Climatic optimum), is characterized by hot and wet climate. A high taxonomic diversity is observed in the assemblage. Xerophytic and thermophilous trees and shrubs are abundantly documented (Pinus halepensis, evergreen Quercus, Pistacia sp., Leguminosae, Rosmarinus officinalis, Rhamnus/Phillyrea). However, mesophilous and deciduous taxa, mainly maples (Acer sp.), are also well represented. Pinus halepensis has played a fundamental role in this environment. It is also identified in other anthracological sequences of the middle Ebro valley in Mesolithic times such as Los Baños (Badal, 2004) and Cabezo de la Cruz (Badal, 2013) and would form part of climax vegetation of the Atlantic period in this territory. According pollen information we are at a stage of climatic improvement previous to the expansion of Quercus genera (Valero Garcés et al., 2014).

Badal, E., 2004. Análisis antracológico de los restos del fuego doméstico del abrigo de Los Baños (Ariño, Teruel). In: Utrilla, P., Rodanés, J.M. (Eds.): Un asentamiento epipaleolítico en el valle del río Martín. El Abrigo de Los Baños (Ariño, Teruel). Monografías Arqueológicas. Prehistoria, 39. Prensas Universitarias Universidad de Zaragoza, Zaragoza, pp. 63-74.

Badal, E., 2013. El uso de los vegetales leñosos en el Cabezo de la Cruz (La Muela, Zaragoza) durante la ocupación mesolítica. In: Rodanés, J.M., Picazo, J.V. (Eds.) El campamento mesolítico del Cabezo de la Cruz (La Muela, Zaragoza). Monografías Arqueológicas. Prehistoria, 45. Prensas Universitarias Universidad de Zaragoza, Zaragoza, pp. 83-99.

Valero-Garcés, B.L., González-Sampériz, P., Moreno, A., 2014. Paisajes y climas del último ciclo glacial en el NE de la Península Ibérica: una visión desde la evolución de los glaciares, lagos y espeleotemas. In: Vadillo, J.A., González-Sampériz, P., Martínez, T.L., Valero-Garcés, B.L. (Eds.) Geoecología, cambio ambiental y paisaje: homenaje al profesor José María García Ruiz, pp. 19-45.

Wood charcoal analysis, Mesolithic, Middle Ebro valley, Environmental Archaeology

Palaeoenvironmental reconstruction and anthropogenic activity from the Upper Pleistocene to the Holocene based on the anthracological record of the Garraf-Ordal Massif (Barcelona, NE of Iberian Peninsula)

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The Garraf Massif is located near the city of Barcelona, (~20 km) and is part of the Catalan Coastal Range. Since 2002 a research project carried out in this area (Daura et al., 2008; 2013 2015) revealed several archaeological sites spanning from Middle Pleistocene to Holocene, i.e. from Middle Palaeolithic to Early Neolithic and Bronze Age. The present study focuses on archaeological charcoal taxonomic identification with the aim of palaeoenvironmental reconstruction and to discern the origin of charred macroremains in these sites. MIS 5 is represented by Cova del Rinoceront site (ca. 74-175 ka), which has yield very scarce anthracological record, mainly composed by angiosperms. MIS 4 and MIS 3 is represented by Cova del Gegant (ca. 67-47 ka) and Cova del Coll Verdaguer (ca. 33.4-55 ka) respectively and Heinrich Event 4 (HE4) by Terrasses de la Riera dels Canyars (39.6 ka cal BP) showing recurrent presence of Pinus sylvestris type. Holocene record is represented by Cova Bonica (ca. 7200-4600 cal BP), showing a dominance of Quercus evergreen and Quercus deciduous with high variability of shrubby composition, while Cal Maurici (ca. 6100-3700 cal BP) constitutes a shallow marshes site located at the massif foothills and composed of charcoals washed down along the river. These assemblages provides an opportunity to evaluate the evolution and transformation of the forested landscapes according to the climatic variations occurred along the Upper Pleistocene and Holocene and to evaluate changes on woody plant according to cultural transformation. Furthermore, these contexts will be discussed in the topic of natural vs. anthropogenic anthracological records and data will be contextualized and discussed within other assemblages from the NE of the Iberian Peninsula.

Daura, J., Sanz, M., Vaquero, M., Allué, E., Rodríguez, R., Subirà, M., Fullola, J., Fornós, J., Torres, T., Ortiz, J., 2007. Noves dades sobre el poblament paleolític al massís del Garraf-Ordal. Tribuna d'Arqueologia 2008, 127-146.

Daura, J., Sanz, M., García, N., Allué, E., Vaquero, M., Fierro, E., Carrión, J.S., López-García, J.M., Blain, H.A., Sánchez-Marco, A., Valls, C., Albert, R.M., Fornós, J.J., Julià, R., Fullola, J.M., Zilhão, J., 2013. Terrasses de la Riera dels Canyars (Gavà, Barcelona): the landscape of Heinrich Stadial 4 north of the "Ebro frontier" and implications for modern human dispersal into Iberia. Quaternary Science Reviews 60, 26-48.

Daura, J., Sanz, M., Julià, R., García-Fernández, D., Fornós, J., Vaquero, M., Allué, E., López-García, J., Blain, H., Ortiz, J., 2015. Cova del Rinoceront (Castelldefels, Barcelona): a terrestrial record for the Last Interglacial period (MIS 5) in the Mediterranean coast of the Iberian Peninsula. Quaternary Science Reviews 114, 203-227.

Pleistocene, Holocene, vegetation changes, wood uses, NE Iberian Peninsula

Evaluating the impact of water processing on wood charcoal remains: Tell Qarassa North, a case study

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Despite the flotation method allows for the systematic recovery of plant macroremains by processing large amounts of sediment, it is known that water processing can affect plant macroremains leading to their hyper fragmentation or complete destruction as soon as coming into contact with water. In this work a comparison of the results obtained from water processing and hand-picking of wood charcoal remains at the Neolithic site of Tell Qarassa North (south Syria) is presented. The material comes from a burnt roof structure, where a total of 50 hand-picked wood samples and four flotation samples (120.5 l) were recovered. The aim of the work is to evaluate if water processing affects similarly all of taxa or instead, differences exists in the preservation of certain types of remains. To evaluate this, taxonomic and taphonomic analyses were carried out, including the recording of alterations such as vitrification and those related to decay. The results showed large differences in the taxonomic and taphonomic composition of wood remains retrieved in situ and through flotation. While Amygdalus had same proportions in both assemblages, in those derived by flotation, there were greater proportions of Pistacia and lower proportions of Salicaceae. Interestingly, taphonomic analyses showed that the presence of vitrification in samples processed through flotation was twice as high as those handpicked and affected only Pistacia and Amygdalus remains. We need to bear in mind that vitrification is the fusion of different anatomic elements of the wood, which binds the cells and may increase resistance to mechanical damage during processes as flotation. This may explain why vitrification was better represented in the roof samples processed by flotation, since water might have destroyed weaker wood charcoal remains as those not vitrified (i.e. Salicaceae) and therefore, the proportion of vitrified wood charcoal samples would be larger than originally. These results suggest that recovery methods may be introducing biases, particularly in assemblages where features such as vitrification are unevenly distributed among the taxa present at the site. The results presented here warn against straightforward interpretations of wood charcoal frequencies in terms of original composition of past vegetation, and suggest that it would be advisable to use more than one recovery technique, along with recording of different types of alterations, in controlling for over or under-representation of certain taxa.

Taphonomy, anthracology, vitrification, vegetation

Late Pleistocene and early Holocene woodland vegetation and ecology in the environs of Franchthi Cave, Peloponnese, Greece: integrating anthracological, dendroecological and archaeobotanical data

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This paper presents the first results of anthracological analyses undertaken on botanical samples obtained from a complete stratified sequence from the prehistoric site of Franchthi Cave in Greece. Franchthi Cave, originally excavated in the 1970s, is exceptional in that (to date) it represents the only site in the southern Aegean dating from the late Pleistocene-early Holocene transition that has been comprehensively sampled for archaeobiological remains. The present paper adds to the long list of already published materials from the site with the presentation of anthracological results, including assemblage composition and qualitative and quantitative dendroecological analyses of wood charcoal macrofossils. Anthracological results are integrated through multivariate techniques with seed archaeobotanical data, previously published from the same contexts, in order to evaluate long-term vegetation changes in the vicinity of the site, and the contribution of human and other palaeoecological agents in landscape change and assemblage formation.

Anthracology, fuel use, woodland management, Greek Mesolithic, Franchthi Cave

AUSTIN – oral session 3

Fuel-wood use in Late-Classic Maya salt processing - a study of charcoal macro-remains from Marco Gonzalez, Ambergris Caye, Belize: preliminary findings

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Anthracological research is an increasingly enlightened discipline that is well established in temperate and arid regions of the world. However, it is less established in tropical and neotropical regions where recovery and analysis of archaeological wood charcoal is uncommon and rarely comprehensive. For much of Central America the exploitation of woody plants by the ancient Maya, possible effects of human activities on the environment, and taphonomic factors, all remain improperly understood. Wood charcoal recently recovered from stratified deposits on 'Marco Gonzalez', a Maya site on the southernmost tip of Ambergris Caye, Belize, provides an opportunity to investigate wood use over several centuries and recover information relating to the contemporary vegetation. Occupation of 'Marco Gonzalez' was more or less continuous from the Late Pre-Classic (ca.300BC) into the Late Post-Classic (1500s AD). Of particular interest is a period spanning approximately 200 years (ca.600-800AD), during the Late Classic, when it is believed that salt processing was a major activity on the site. To date, the greatest quantity of wood charcoal has been recovered from this phase and most likely represents the remains of wood used as fuel in the salt extraction process. Prolonged occupation and periods of intense activity at 'Marco Gonzalez' has had a profound and lasting effect on local soils and vegetation. Today the site is visually conspicuous because of a marked contrast in the character and composition of the vegetation that grows on the fertile anthrosol enveloping the structural remains and that of the mangrove swamp encircling the site. Juxtaposition of distinctive vegetation types is a phenomenon seen elsewhere in the Maya zone and can help with locating ancient Maya sites. The aims of the current research include identifying the woods used as fuel; assessing if, and to what extent, taxon selection/avoidance was practised; determining if wood was sourced locally or imported; and recognising taphonomic factors associated with neotropical environments and their influence on taxon representation. In this paper the preliminary findings of the wood charcoal analysis are presented and discussed in relation to these aims.

Charcoal; fuel-wood; neotropical; Maya; salt; mangrove; anthrosol

Fuel economy, environment and landscape of the Santa Elina rock shelter (Mato Grosso, Brazil) in the early Holocene

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Human presence in central Brazil (Goiás, Mato Grosso do Sul and Mato Grosso states) is attested since the late Pleistocene in several archaeological sites. In Mato Grosso state, multidisciplinary researches coordinated by Agueda Vilhena Vialou (1984-2014) revealed a long and important occupation of the region by hunter-gatherers and ceramists groups. The oldest traces of occupation come from the Santa Elina rock shelter. Stratigraphy, faunal remains, stone tools and different dating methods attest to the antiquity of this archaeological site. Besides its ancientness, the great importance of this site stands for its long lasting occupation. Between 10.000-2.000 years BP, several human groups have succeeded, leaving many traces of their passage, including well-preserved plant remains (fruits, seeds, braided fibers, sandals, wooden stakes, etc.), carbonized or not, and many hearths. The presence of this plant remains indicate that natural resources have played a significant role in the daily lives of these populations. In this work, we present the anthracological analyses of carbonized remains collected in hearths dating from 9000-10.000 years BP. The taxonomic identification of charcoal aims to highlight hunter-gatherers' practices related to the collection and use of wood (firewood, species selection, catchment areas, etc.) and the environment in which they have dwelled from the early Holocene. The first results indicate that human groups practiced a diversified and opportunistic collection, mainly focused on dry wood available in the vegetation around the site. Until now, all taxa identified are markers of deciduous and semi-deciduous forests characteristic of the study area. These results corroborate those obtained by the many archeobotanical analyzes from plant vestiges, micro- and macro-remains already performed on the more recent occupation levels, and provide important information for the understanding of past human behaviors.

Anthracology, Archaeobotany, Landscape, Prehistory, Brazil, Holocene

Neanderthals and mediterranean woodlands: firewood collection in a changing landscape

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Neanderthals used woodland resources for various needs such as fuel, food, medicine, raw material, etc. The preservation of plant resources due to their nature is difficult and some of the above-mentioned uses are not easily documented in the archaeological record. The most abundant remains are usually those deriving from firewood and the increasing application of accurate sampling methods allows obtaining high resolution results concerning past vegetation. Assuming that an opportunistic collection of firewood was carried out, these remains represent a random sampling of local forests, which are still quite unknown for the early periods of Prehistory. Indeed, although an overall picture of the vegetation of Europe is obtained from pollen studies, these offer a rather general idea of the woody vegetation distribution while the detailed configuration of local woodland still remains largely unknown. In this presentation, we address the configuration of plant landscapes between MIS 5 and MIS 3 in the eastern and western Mediterranean, based on the wood charcoal results from several archaeological sites, where comprehensive sampling methods have been implemented in recent excavations: Gruta da Oliveira, Figueira Brava, Cueva Antón, Abric del Pastor, El Salt and Abrigo de la Quebrada in the Iberian Peninsula, Klissoura Cave and Theopetra Cave in Greece, and Taforalt in northern Morocco. We point out differences and similarities between the eastern and western Mediterranean flora and assess regional particularities in terms of latitude and altitude of the sites. Moreover, little is known about past vegetation in northern Africa, and first results from the MSA levels of Taforalt are crucial to understand the landscape evolution in the southern Mediterranean. Overall, during MIS 5 the results for the western Mediterranean show typical warm Mediterranean vegetation with certain taxonomical diversity including the presence of some thermophilous markers, such as Pinus halepensis, Pistacia and Quercus. During MIS 4 and 3, this picture changes and the most widespread flora corresponds to arid and cold conditions, where Juniperus or the mountain pines are dominant, depending on the region, while other xerophytic taxa such as Artemisia, Ephedra, Compositae or Fabaceae play an important role, thus providing an image of open, grassy landscapes. The picture of the vegetation for the eastern Mediterranean is less detailed since there is anthracological data from only two sites. Nevertheless, the available data covers the period from MIS 5 to MIS 3. During MIS 5e deciduous woodland with Quercus, Fraxinus and Carpinus would have expanded in the northern areas, while open parkland vegetation with Prunus and Juniperus would have prevailed during MIS 4 and 3. Interstadial conditions are documented in the course of MIS 3 in the southern locations. The presence of temperate species throughout the Upper Pleistocene suggests that tree refugia existed in the eastern Mediterranean area. Neanderthals exploited local plant resources that changed as the climate did and depending on the latitude and altitude of the sites. All available woody resources, trees, small shrubs and herbs, were likely to be collected, since the flora identified at each site is very consistent with the corresponding biogeographic location.

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Neanderthals, firewood, Upper Pleistocene, Mediterranean flora

Different parts of the same plants. Charcoals and seeds from Cova de les Cendres (Alicante, Spain)

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In the archaeological sediments wood and seeds can be preserved when charred. The analysis of these remains improves our knowledge about the species used by human groups during Prehistory, especially when jont anthracological and carpological studies are carried out. Complementary results may provide accurate botanical identifications to the species level, thus allowing detailed knowledge of the palaeoenvironmental conditions and the reconstruction of the landscapes in the past. However, in the Iberian Peninsula there are few Upper Palaeolithic sites that combine charcoal and seeds analyses. For this reason our communication is going to be focused in the Upper Palaeolithic sequence of Cova de les Cendres (Alicante, Spain), where we have combined the anthracological and carpological results in order to characterize the landscape of the eastern part of the Iberian Peninsula during MIS 2. In the Gravettian levels of Cova de les Cendres dense woodlands of Pinus nigra and/or P. sylvestris existed. During the Last Glacial Maximum, which corresponds to the Solutrean period, Juniperus dominated cold, dry and open vegetation formations and woody Fabaceae developed. Finally, cryophilous pines and Fagaceae characterized the Magdalenian period. Quercus sp. evergreen is present along the sequence while deciduous Quercus sp. is only documented in the Magdalenian levels, indicating the increase of precipitations at the end of the Late Glacial (Badal and Carrión 2001; Villaverde et al. 2010). In the east of the Iberian Peninsula, during the cold and dry stadial periods, the formations dominated by Juniperus were really prominent. Although it is not possible to identify Juniperus species on the basis of the anatomy of their wood, by contrast, this can be achieved through the botanical identification of their seeds. Thus, in the Middle Magdalenian level of Cova de les Cendres seeds of Juniperus sabina, J. communis and J. oxycedrus have been identified. These, along with other species identified among the carpological and anthracological remains, allow a high-resolution paleoclimatic reconstruction. All the 14C dates from Cova de les Cendres have been obtained on charcoals and seeds previously identified botanically, making possible to pursue accurately the distribution of cryophilous taxa such as Pinus nigra and/or P. sylvestris and Juniperus sabina. Moreover, the AMS radiocarbon dates of thermophilous species, like Quercus sp. evergreen, Rosmarinus officinalis, Ephedra sp., etc., show that in the Last Glacial Maximum the coastline of Alicante was a refuge area.

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Charcoal, Seed, Upper Paleolithic, Alicante, Spain

BAL ET AL. – oral session 2

European open Landscapes: the comparison of the human land use strategies of three Mediterranean Mountains: the Mont Lozère (France), the Sierra de Gredos (Spain) and the Monte Cimone (Italy) since the Neolithic period. International AGRESPE network

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The presentation aims to compare the origin of the open landscapes of pastoral mountain systems located in the Mediterranean Basin (France: Mont Lozère, Spain: Sierra de Gredos, Italy: Tosco-Emiliano Apennines) since the Neolithic period. Even if the three mountains selected show several differences linked to the climate, vegetation types, altitude, they are characterized by the change from an intense agro-pastoral and industrial exploitation to a gradual abandonment which leads to an open landscape part of the heritage identity. Until 2011, date of the construction of the network AGRESPE (Gestion de Ressources Environnementales passéeS et Patrimonialisation paysagèrE, dir. Bal et Allée) these three mountain systems were studied with a strong difference in the scientific interest. For example, the Mont Lozère was considered very early as an anthroposylvosystem. Therefore, the palaeoecological and archaeological studies were developed with the same importance. Unlike the Sierra de Gredos (Spain) and the Monte Cimone (Italy) for which there is a lot of pastoral structures but the archaeological study was inexistent. The objective of the Agrespe network is to apply the same geographical approach and the same scientific methodology in all of these European mountains. Pedoanthracology is a potent method allows study of the composition of past plant woody communities and to highlight the history of the ligneous landscape at a high spatial scale (the scale of the slope). In order to increase the knowledge of these open landscapes and to obtain new data at a high spatial scale, the pedoanthracology was applied according to an altitudinal transect and compared with preliminary data (pollen, subfossil wood, historical sources, pastoral archaeology) concerning each area. Even if these mountains shared some similarities in the use of the environmental resources, the construction and the management of the open spaces reveal some dissimilarities. At the Mont Lozère, the soil charcoal data extracted from the Nardus stricta grassland located at above 1400 m altitude, permit to identify this open area like a mountain belt recovered by an ancient open beech forest that has been used and transformed by societies since the Neolithic period. At the Sierra de Gredos (Spain), the pedoanthracological data reveal an ancient Pinus timberline located at around 1700 m a.s.l., and above 1700 m a.s.l. a natural open space dominated by Fabaceae since the last 9000 year BP. At the northern Apennines, the preliminary pedoanthracological results demonstrate that the ancient timberline was probably located at higher altitude (around 1800 m asl.) than the actual (1550 m asl.). The increase of the knowledge of these landscapes help us to propose future management of these open spaces in collaboration with parks and heritage associations at the scale of each country and at the scale of Europe.

Soil charcoal, cultural landscape, European mountain, open space

Effects of oxygenated carbonization on the isotope signal in tree rings. Implication for ancient charcoals

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Stable isotope composition of plants is known to be influenced by environmental conditions[1]. When applied to tree rings, isotope studies in combination with wood anatomy allow detailed reconstructions of fine climatic variations[2]. Therefore isotope study of ancient charcoals at the ring scale, combined with growth ring anatomy, potentially represents a powerful tool to document past climates. However, the effects of carbonization on wood isotope composition are poorly documented. Previous studies have mainly monitored isotope signal during experimental carbonization in conditions that are not representative of domestic fires: often without O_2 and/or in muffle furnace. Additionally, the isotope composition of charcoals was never investigated at the ring scale. The aim of the present study was thus to investigate, at the ring scale, the effects of carbonization in oxygenated conditions on the $\delta^{13}C$ signal in wood, in order to better constrain the use of isotope signal in ancient charcoals. This approach focuses on deciduous oak (Quercus f.c) as representative of European temperate forests and anthrocological spectra. A fully monitored open fire was designed to carbonize wood in reproducible conditions. Identified wood sections were burnt in mesh bags so as to recover small fragments after carbonization. Individual growth rings were sampled before and after carbonization thanks to a diamond abrasive drill bit, and analyzed for their $\delta^{13}C$. Preliminary results show highly variable effect of oxygenated carbonization on ring $\delta^{13}C$ ranging from 3.5‰ to +1.3‰. To test whether the potentially high effects of carbonization preclude the use of isotope composition of ancient charcoals to reconstruct past environments, we have investigated archeological charcoals coming from well documented and contrasted environments. The sampled charcoals come from the Neolithic deposits of Lake Chalain (Jura Mountain, France) and correspond to fire residues of domestic activities. The deposits are characterized by transgressive-regressive cycles. Multidisciplinary studies (palynology, lake level data and tree-limit variation[3]) have showed that the transgressive layers were associated with a relatively cold and wet climate while the regressive layers corresponded to a warmer and drier climate. Ring series of numerous charcoal fragments from each layer were characterized with a double approach: dendro-anthracology and isotope geochemistry. Preliminary results suggest that environmental variations can be recorded by combined ring anatomy and ring $\delta^{13}C$ values of archeological charcoals in temperate climate.

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Isotope, carbonization, climate, ring anatomy, Quercus

BATTENTIER ET AL. – oral session 3

Vegetal landscape and its management in Provence at the end of the Neolithic (2880-2580 cal BC): the charcoal analysis of Limon-Raspail (Vaucluse, Southeastern France)

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The Late Neolithic is generally characterised in the South of France landscape by the shift from the primary deciduous oak forests to the shrublands (Vernet & Thiébault, 1987) as it has been shown at Font Juvenal (Heinz & Thiébault, 1998) and Pendimoun (Battentier et al., in press). During this period, cultural evolutions are intense, indicating growing interactions between groups (Cauliez, 2011). The agro-pastoral productions increase suggesting a specialised land management (Blaise, 2009). The architectural remains become numerous and diversified alluding to a stronger anchorage to the ground (Beeching, 2003). This hypothesis is supported by the seasonality of the domestic caprines slaughtering in open-air sites which sometimes reveals long term or yearly settlements (Blaise, 2009). However, Provence presents only few sites which precisely document the management of the environment of these Late Neolithic communities and they all show very contrasted response to agro-pastoralism development. Indeed, the Late Neolithic occupations of Ponteau (Martigues) and Pendimoun (Castellar) show the primacy of shrubland while at Le Clos de Roque (Saint-Maximin-La-Sainte-Baume) the deciduous oak forest dominates (Battentier, 2011; 2012). The open-air settlement of Limon-Raspail (Bédoin), located between the lower Rhone alluvial plain and the alpine foothills at 350 m a.s.l and 80 km from the Mediterranean Sea, displays detailed and very well preserved deposits dated from 2880 to 2580 cal BC. Twenty two pits provided numerous and varied remains resulting from a broad range of activities and occupations at all seasons (Cauliez et al., 2011). The communication presents the first anthracological results. We analysed the 16 pits sampled. Nineteen taxa are represented among the 1682 charcoal fragments. They give a new insight on the ligneous vegetation management and on the firewood gathering practices during a period of cultural and environmental transition. They also provide additional information on the anthropization process in this contrasted region where it proved to have very heterogenic consequences on the vegetal cover.

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Mediterranean hinterland, Late Neolithic, open-air site, palaeoenvironment, fuel

The reconstruction of the natural and cultural landscape of the Cimone mountain (Northern Apennines, Italy) since the Neolithic from a pedoanthracological approach

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Mont Cimone is the highest mountain of the Northern Apennines mountain system, feature that allowed him to be in the past until today an important place of cultural identity for indigenous populations. Mont Cimone is located in the "Parco regionale dell'Alto Appennino Modenese" and is an important spot of biodiversity that is protected in the Natura 2000 network. This territory has a rich and diversified floral heritage due to his geographical position between two great phytogeographic regions: Euro-Siberian and Mediterranean region. In the north-western slope of Mt. Cimone, the summital part between 1600m and 2100m a.s.l. is characterized by the presence of heathland dominated by Vaccinium myrtillus and Vaccinium gaultherioides and above 1600 m asl. there is a coppice beech forest. At the scale of the northern Apennines, the palaeoecological records (pollen, wood, organic matter, sedimentary) obtained from peat bogs located in the Apennines Ligure (from 800 to 1500 m a.s.l.) (Branch, 2004; Cruise, 1990a, 1990b; Cruise et al., 2009) and Tosco-Emiliano, (from 700 to 1800 m a.s.l.) (Bertolani Marchetti et al., 1994; Bertoldi et al., 2007; Lowe et al., 1994a, 1994b; Watson, 1996) have reconstructed the history of the vegetal landscape linked to climatic changes since the Tardiglacial. In Italy, few studies concerning the relationship between societies and environment are developed in mountain systems. The archaeological data concern essentially the plain where the archaeological remains are very frequent. The first survey on the Mont Cimone, has revealed the numerous archaeological remains like charcoal platforms located within the beech coppice and pastoral huts situated at the upper part between 1700m a.s.l. and 2000 m a.s.l. This fieldwork demonstrates that the Cimone landscape is an anthroposylvosystem transformed by societies since a long time. The aim of this PhD research is to develop an interdisciplinary approach based on geography, archaeology, history and palaeoecology methods. Convince by the role of societies in the construction of the landscape of the Cimone without discarding the role of the climate change, pedoanthracological transect was applied for the first time on this mountain in order to obtain at a more precise spatial scale, the reconstruction of the ligneous palaeolandscape and the history of fire events since a long time. In this context nine soil profiles were sampled at the north-west slope of Mt. Cimone across an altitudinal transect from 1650 m a.s.l. to 2078 m a.s.l. 8 pits are located in the current grassland and one pit is situated at the limit of the actual limit of the beech forest at around 1650 m a.s.l. The presence of charcoals in all the pits suggest the importance of fire events in the history of the Cimone landscape's. The charcoal assemblages show a strong dominance of Ericaceae (1077 - 1153 cal AD) at higher altitudes (above 1700m a.s.l.) as occurs in the present. The occurrence of forest species charcoals as Fagus and Abies in the current grassland between 1650 m and 1800 m a.s.l., shows that in the past these trees were well above the present treeline. The radiocarbon dating will provide useful data for the interpretation of temporal vegetational dynamics at the scale of the slope. These new information will be useful for a multiproxy interpretation to refine the knowledge of the vegetation and fire history of this area.

Pedoanthracology, Cultural landscape, Vegetation history, Northern Apennines

Dendrochronology dating experimentation on oak coals deciduous collected from archaeological contexts sites: Molle (Allier), Laroquebrou (Cantal) and Saint-Paulien (Haute-Loire)

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Dating by dendrochronology on oak deciduous charcoals is not a usual method. It is still in the exploratory phase. The laboratory Archéosciences (CReAAH, UMR 6566) and Rennes Dendrotech Company tried to set up the foundations of this new approach (Marguerie et al. 2010). A first method was developed from charcoals with 20-30 rings minimum. The first step is to gather the fragments of the same charcoal often disintegrated during the sampling. Then, before synchronization of the ring width, the essential step is to position the charcoals in the block from the curvature of the rings even the estimation of the pith. Therefore, the growth of an individual is restored fragment by fragment, ring after ring, from the pith to bark in the best case. Then growth series synchronization occurs most often visually for this type of sample. Good agreement of the series provides an incomplete sequence but comprising more widely than originally rings. It is thus possible to obtain the growth curves of at least from 50 to 60 rings, minimum threshold to obtain a dating dendrochronology. The state of charcoal remains the constraint for this method of dating. Indeed, in addition to the small number of preserved rings, fragmentation of charred wood, shrinkage cracks and deformations due to wood carbonization complicate analysis of samples. To overcome these difficulties, we must analyze the most of charcoals and increase measures of ring widths two to three times a charcoal and measurement path. The results obtained in this experiment have to be compared with a radiocarbon dating and / or relative chronology (artefacts) to be validated. Few tests, sometimes successful, were conducted on charred wood oak charcoals of elements from several of Auvergne sites: Molles 'La Couronne' (Allier), Saint-Paulien (Haute-Loire) and Laroquebrou (Cantal). This presentation summarizes the first results, the process and limits of this experimental method.

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Charcoal, dating, dendrochronology, experimentation, Auvergne

Inter-regional comparison of the Holocene fire regimes in Bohemia (Czech Republic): spatio-temporal patterns and possible driving forces

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Fire disturbances within temperate forests in Central Europe trigger successional processes which are responsible for short-term changes in community assembly. Single fire-induced change, however, does not persist for longer time period as it is gradually replaced by vegetation types of late-successional stages. Thus, only repeated fire events are relevant for inducing long-lasting shifts in species composition. Recently, wide range of fire regimes were described using soil and sedimentary charcoal (Adámek et al., 2015) indicating variable impact on vegetation during specific time periods of the Holocene. We aimed to describe fire frequencies within three contrasting regions in Bohemia (Czech Republic) to assess possible corresponding effects on vegetation development. We have collected dataset consisted of macro-charcoal (>125 µm) content in peat sediments, pollen records, radiocarbon dating and taxonomic identification of soil charcoal fragments. We observed substantial intra-site similarities in fire synchronicity indicating that local-scale drivers prevailed during the Late Holocene. We presume that such pattern could be attributed to management practices related to pasture. Concurrently, inter-regional comparison revealed an evidence of increased fire occurrence before spruce or broad-leaved forests has been established in period of the Early Holocene. We acknowledge the grant project of Czech Academy of Sciences GA GR 14-22658S for supporting our research.

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Fire disturbance, fire regime, charcoal, pollen

Circulus database

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Circulus is the information system for the Dendrac's program (database and web interface) that aims to develop new frameworks used for all future archaeobotany research themes (Laurens, 2013). The structure of Circulus database, built under the database management system MySQL, is based on four areas: the user, the sampling site, the sample and the measurements. This articulation induces a flexibility that allows the addition of future protocols without significant modification of the database scheme. Several references have been put in place including a current dendro-anthracological repository in order to facilitate interoperability of the database. This database is used to group numerous thematic studies or "workshops" as quantitative anatomy, geometric morphometric, dendroecology and isotopy. These studies often realized separately are centralized. This provides a better overview of a sample from its original site and analyzes. The web interface of Circulus was integrated into the website of the NRA Dendrac with secure authentication system. It is possible to perform multi-criteria searches by combining various workshops. The web interface has two ways to insert data: through forms or by automatic integration of spreadsheet files to insert a large volume of data.

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Circulus, database, information system, flexibility, references

Charred wood remains from a foundation ritual of a Medieval church in southern Tuscany (10th-11th century AD)

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The Rectory of San Niccolò is located on the plateau of the hill of Montieri in the Metalliferous Hills (southern Tuscany). The site has been the focus of archaeological surveys carried out by the University of Siena and consisted of several buildings, including a church with six apses, covering a period between the 11th and 12th centuries AD (Bianchi et al., 2013). During the excavation of the church, a jewel was recovered in the pit of a foundation ritual, associated with a concentration of charred wood. Charcoals were sampled for the anthracological analysis and radiocarbon dated between the 10th and the first half of the 11th centuries AD (AD 893-AD 1053). Overall, 131 charcoal fragments (>4 mm) were analysed allowing 17 taxa. Deciduous trees are the most representative taxa with Ostrya/Carpinus and Quercus cerris; Fagus sylvatica, Corylus avellana, Acer and Q. pubescens are also present. Among evergreen sclerophyllous taxa, Q. ilex dominates followed by Erica. Some fruit taxa are present, including Castanea sativa, Olea europaea and Vitis vinifera. Pinus halepensis/pinea are even recorded. Data show high eterogeneity compared with the restricted and concentrated archaeological context of the votive pit, connected to a single action of fire. Q. cerris, F. sylvatica, C. avellana and C. betulus are typical of the mixed deciduous forest, characterizing the high altitude hill of Montieri (between 800 and 900 m a.s.l.); thus, they could be immediately present near the Rectory. In contrast, the evergreen sclerophyllous taxa, such as Q. ilex, characterize the lower areas with a drier mediterranean climate; in particular, the area of P. halepensis/pinea is the Tyrrhenian coast at ca. 70 km. The presence of three fruit taxa, chestnut (C. sativa), olive (O. europaea) and grape vine (V. vinifera), is very interesting. Currently, chestnut woods are widely present on the hills near the Rectory. Recently, archaeobotanical data highlighted that the spread of chestnut cultivation and orchards for fruit production in southern Tuscany were closely connected to the economic system of the Carolingian manors in the 9th century AD (Buonincontri et al. accepted); in the Metalliferous Hills several archaeological settlements recorded the gradual expansion of chestnut wood in the 10th and 11th centuries AD (Di Pasquale et al. 2014). As regards grape vine and olive tree, scant trees could be cultivated for the Christian rituals of the Rectory. It is interesting to note that the matching of pollen and charcoal data in this period suggested the beginning of olive tree growing in the Metalliferous Hills to satisfy a rising demand for food and luxury products (Di Pasquale et al., 2014). In conclusion, the great variety of taxa in the anthracological record suggest a clear will in the choice of the charred wood. Not only trees of the local deciduous forest, easily available, but also species of far lower areas (Q. ilex) or even alloctonous (P. halepensis/pinea), without excluding the choice of species with economic (chestnut) or cultual (grape vine and olive tree) roles.

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Archaeological charcoal analysis; concentrated charcoal; heterogeneity; votive pit

Wood resources in the Clermont-Ferrand Basin from the Neolithic to the Second Iron Age on the dendro-anthracological analysis

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Dendro-anthracological analyses were performed on 18 archaeological sites located in the Limagne plain and dated from the 5th millennium BC to the 1st century BC. Analyses concerned different archaeological contexts such as fireplaces, post-holes and settlement sites. The data shows a change in wood supply through the time, among others the replacement of oak by beech between the 1st and the 2nd Iron Age. On the light of pollen records, this change does not seem to be related to a contemporary change in local wood availability: for instance, beech forests were already present in the area from the Bronze Age. In addition, the higher diversity of heliophilous taxa, the increasing trend of the deciduous oak average tree-ring width and the proliferation of sites reporting more than 10 % of small charcoals – i.e. branches, twigs – reveal a heterogeneous vegetation context which included a low undergrowth cover like as hedges and thickets. Such environmental diversification reported from the early Iron Age, which is further stressed from the second Iron Age, corroborates the land use pattern documented in the Basse Auvergne from this age before the roman period. This shows a progressively denser settlement with a land plot network and oppida. Anthracological analyses presented in this presentation are a series of particular local case-studies which interpreted all together, enable to define the timber resource management history of the Basse Auvergne from the Neolithic to the second Iron Age.

Charcoal, dendrology, wood resource, Holocene, Massif central, France

Assessing fuel wood selection strategies and matrix charcoal at Madjedbebe, northern Australia

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The site of Madjedbebe (formerly Malakunanja II), the oldest known archaeological site in Australia, is an ideal location to examine key issues in Australian anthracology. Less than twenty anthracological studies have been undertaken in Australia to date with few critiquing how methods are applied and the interpretive currency of their data. Australia remains an 'untouched' region for anthracology. It is, however undergoing a renaissance with this research the first PhD conducted on the subject (Dotte-Sarout et al. 2015). The anatomical ground work for Australian wood is still in its infancy. However, there is a dedicated group of anthracological researchers in Australia focused on developing reference collections. This research has examined fuel wood selection strategies as well as critiquing the use of matrix charcoals in archaeological interpretations. It is clear from the taxonomic identification of charcoal from eleven domestic hearths that the fuel wood selection strategy operating a Madjedbebe has change diachronically. This change has been influenced by changes to the local vegetation, responding to climatic fluctuations, however it also demonstrates selective behaviour separate from climatic factors. The second major contribution of this research is its investigation of the use of matrix charcoals for palaeoenvironmental reconstructions in Australian archaeological sites. Many previous Australian studies have used matrix charcoals to reconstruct the palaeoenvironment without examining the provenance of these charcoals. This paper will present an exploratory approach for determining the provenance of matrix charcoals in Australian rock shelter sites and define their interpretative power. The provenance of matrix charcoal will be defined through a comparison of hearth (defined context), matrix (non-contextual), and environmental charcoals. This method demonstrates that compositionally matrix charcoal is far more similar to hearth charcoal than charcoal from the local environment. This finding has implications for future Australian researchers who may consider matrix charcoal as an independent palaeoenvironmental dataset when in fact it is influenced by anthropogenic selection pressures. This is especially pertinent when considering the selective behaviours conditioning the hearth charcoals at the site.

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Australia, Pleistocene, hearths, fuel wood selection, Madjedbebe

Former charcoal kiln sites in Mediterranean forests, a legacy still affecting vegetation diversity and ecology

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Production of woody charcoal is one of the oldest forms of forest use, that existed for millennia and only vanished in the last century in the Mediterranean countries (Nocentini & Coll 2013). The legacy of such widespread activity are thousands of abandoned charcoal kiln sites in present-day forests, still recognizable as small, flat areas with more or less circular shape and thick, blackish soil (Blondel 2006). However, information on the density and spatial distribution of these sites in different areas and types of forest communities is still scanty. A first aim of this work was therefore to fill this gap based on field inventories of nine 1-ha sample areas in three major forest types in Tuscany (central Italy). For this purpose, the applicability of the LIDAR technique is also under investigation. In addition, we tested the hypothesis that former charcoal sites may represent small ecological "islands" in the forest landscape with peculiar abiotic conditions and vegetation traits. The accumulation of thick layers of charred residuals in the soil (Deforce 2013) is in fact likely to have persistent effects on factors that are important for plant growth, such as pH and nutrient availability. Indeed, vegetation on these areas was apparently different from the surrounding environment, though no studies addressing this question was available. Accordingly, we analyzed soil and light conditions and vegetation in 61 representative sites in three major forest types dominated by evergreen sclerophylls (mainly Quercus ilex), deciduous oaks (Q. cerris, Q. petraea) and beech (Fagus sylvatica). We found that the soil of kiln sites is characterized by higher content of Carbon and C/N ratio, but not lower pH or Nitrogen content. Light resulted also higher on kilns sites. Such factors are possibly associated with the largely positive effects found on the understorey vegetation (<1.3 m) in terms of species diversity and biomass production. On the contrary, we observed negative effects on tree regeneration which may explain the substantial lack of forest recolonization in these sites. A common garden experiment is on the way to understand the effects of charcoal soil on growth and vigour of tree seedlings. Given these ecological effects and their density in the examined areas (ca. 5/ha, 2-3% surface) our findings suggest that kiln sites form extensive networks of neglected ecological "islands" that increase the fine-scale habitat heterogeneity and plant diversity of Mediterranean forests. Accordingly, conservation measures are advocated to preserve against various external threats.

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Charcoal, diversity, forest, light, understorey, regeneration, soil

Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina)

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The study of micro and macrobotanical remains allow to infer about vegetation type and to know the role of vegetable resources in the economy of a society. However, despite presence of plant remains from archaeological contexts represents a great potential for paleoenvironmental reconstructions and assessing past human behavior, its study as a whole is still rare in Patagonian hunter-gatherer archaeological research. The objectives of this work are the integral study of micro and macrobotanical remains, the assessing of taxonomic resolution levels and the contribution offered by each type of proxies. For this purpose, micro and macrobotanical remains (pollen and small plant remains) of human and camelids coprolites, and macrobotanical remains of sediments (wood and charcoal) coming from three stratigraphic levels dated by 14C and resulting in ages of 9,640 ± 190 years BP, 8,380± 120 years BP and 6,150 ± 105 years BP, of the site Cerro Casa de Piedra 7 were analysed. The results of this study show different taxonomic resolutions. Coprolite pollen analysis allowed the identification of Nothofagus sp., whereas macroremains analysis evidenced the presence of N. pumilio and N. antarctica species. Furthermore, Poaceae pollen was determined whereas microhistological analysis allowed the identification of several species of Poaceae. Also Apiaceae pollen was identified and Azorella monantha were determined by microhistological analysis. The analyses performed in this study enriched the floristic list for each stratigraphic level. These results show the value of multiproxy studies for the integral study of archaeological sites.

Charcoal, wood, plant remains, pollen, hunter-gatherers, Patagonia

CICHOCKI ET AL. – oral session 5

Charcoal and Treerings: To-the-year informations from Palaeolithic fireplaces

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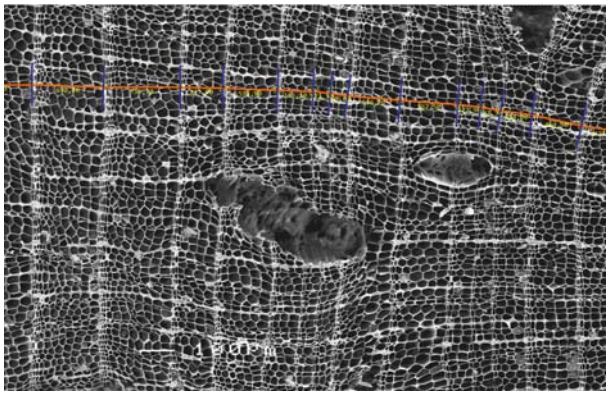
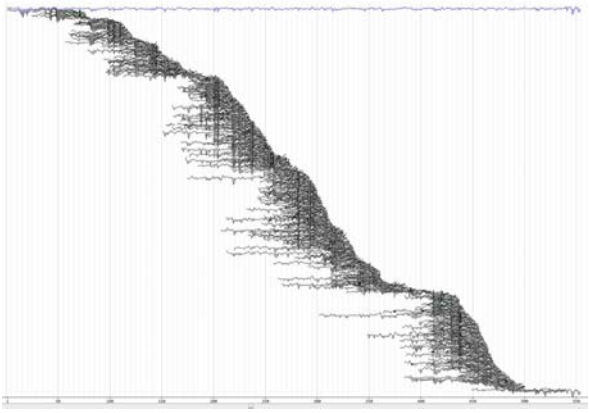
From several Palaeolithic sites north of river Danube in Lower Austria and Southern Moravia in Loess sediments occupation layers with aggregations of charcoal have been found, many of them associated with stone tools and bones, mostly scattered around fireplaces. C14 analysis provided dates between 41000 and 26000 BP, which is right before the maximum of the Wuerm glaciation. Due to the short distance of to the northern fringe of the Alpine ice shield local trees usually grew very narrow rings. The species spectrum was limited to frugal and enduring species like Pinus (and sometimes Alnus). Charcoal samples were photographed under the electron microscope and on the merged sequences of pictures of each single radius widths of the tree rings were measured. These data were synchronized to floating dendrochronological standards of up to 550 years for now. Our main site was Krems-Wachtberg (new excavations, 28000 - 26000 BP), but we also made first investigations on charcoals from Krems-Wachtberg (old excavations), Krems/Hundssteig, Willendorf, Gösing and from the Moravian sites of Dolni Vestonice II and Pavlov. The aim of this research is to investigate details of single sites (tree species, source of wood, age of trees, usage of felled or already dead trees - branches or stems, details of visiting cycles - temporal distance of visits, horizontal and/or vertical dislocation of associated samples), to compare neighbouring sites (relative temporal comparison, comparison of tree species, contemporary/alternating visits) and to reconstruct climatic details (variability and cycles in ring patterns, number, temporal distance and distribution of extreme events, reconstruction of climatic parameters) on the basis of the single-year signals documented in tree rings. This research is a cooperation between the University of Vienna and the Austrian Academy of Sciences.





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Charcoal, Palaeolithic, Austria, dendrochronology, dendroclimatology, relative dating

Development of tyloses quantification method in oak: application to charcoal assemblages from two archaeological sites in northern France

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A major challenge of the DENDRAC project is to develop standardized measuring tools useful in investigations dealing with archaeological wood charcoal. As reflected by color change commonly unnoticed on charred wood and by the formation of tyloses in the vessels easily detectable following anatomical analysis, in oak tree (Quercus petraea) the process of heartwood formation is set up, on average, around the age of 20 years. In anthracological analyses, tyloses are most often rated in terms of presence/absence. However, forestry shows that while tyloses are common in the heartwood, less frequently they can be also found in the sapwood (Bakour, 2003). The analysis of 905 tree-rings series retrieved from 9 oak trees sampled in 3 forestry stations (two aged coppices converting in high forest and one young coppice) allowed the quantification of plugged vessels by tyloses and resulted in (i) the assessment of sapwood/heartwood discrimination thresholds; (ii) the evaluation of age-related tyloses density; (iii) the quantification of tyloses density depending on the tree vigour (i.e., the Vigour Woodland Index), the quantification of tyloses density depending on the trunk/branch portion (Dufraisse et al., 2015). In a second phase, this method has been applied to oak charcoals retrieved in anthracological assemblages from two French archaeological sites excavated in the context of rescue archaeology: Fort Saint-Sébastien, a training camp for the Louis XIV's troops located in Saint-Germain-en-Laye, Seine Valley, occupied between 1669 and 1670, and an extended Late Hallstatt occupation near Dijon dated to 5th century BC. Their choice is based on a well-stratified and chronologically unambiguous context and a clear distinction in the record between fire wood and timber. A dendro-anthracological analysis (diameter restitution, growth pattern) supplemented by tylose quantification was conducted on two batches of 100 oak charcoals. This research project provides first valuable information on the wood supply of these archaeological sites and proposes hypotheses on woodland exploitation and management.

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Dendro-anthracology, tyloses, quantification, oak charcoal, woodland structure

Vegetation and importation of wood in the Oman peninsula at the end of the late pre-Islamic period: recent charcoal analyses from a burnt building at Mleiha (U.A.E, 2nd -3rd century AD)

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Few archaeological sites in the Oman peninsula (eastern Arabia) have so far been studied from an anthracological point of view and this is particularly true for the historical periods (Tengberg 1999, 2002). The recent excavations of a burnt building at the late pre-Islamic site of Mleiha in the Emirate of Sharjah (United Arab Emirates) allow us to gain unique knowledge on the wood economy of the inhabitants of the site in the 2nd and 3rd century AD. Carbonised construction elements as well as pieces of a large diversity of wooden objects were retrieved from the excavations and also charcoal possibly resulting from the use of wood as fuel. Consequently, the understanding of construction methods and the choice of wood for these purposes are issues that can be approached by this material. Moreover, these remains help us to reconstruct part of the vegetation cover around the site whether of natural or anthropogenic origin. In this context, the possible cultivation of fruit trees like jujube (Ziziphus spina-christi) and probably pomegranate (Punica granatum) in local date palm gardens will be discussed. Finally, at this site, where the archaeological finds point to the involvement in long-distance trade, in particular with Iran, Mesopotamia and India, the question of the importation of wood is of particular interest and we will consider the possible origin of non-indigenous temperate taxa such as Plane (Platanus sp.), Cypress (Cupressus sp.), Ash (Fraxinus sp.) and Pine (Pinus sp.).

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Timber, objects, Middle east, Antiquity, environment, trade

Charcoal, wood, mollusc, pollen and radiocarbon dates from Eurasian loess sites: an attempt of convergent multidisciplinary approach

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The fossil material content of loess deposits varies greatly depending on various local conditions of geology, geomorphology, macro- and microclimate, soil evolution, biological activity, and possible reworking, all of them determining the taphonomy of the plant or animal material. Most of loess sites appear to be poor in fossil material due to decay under the action of oxidization, bacterial activity, mechanical erosion, action of water or frost or desiccation. In diverse circumstances, reworking or intrusion may lead to mixing different fossil assemblages and thus induce inadequate interpretations. Moreover, in archaeological sites, human activities may also have produced more or less intense disturbances in the fossil assemblages. Therefore, a challenge is to select loess sites that were formed and preserved in the most undisturbed conditions as possible. Nevertheless well preserved long loess sequences were found and excavated in Belgium, France, Germany, Austria, Czechia, Romania, Moldavia, Ukraine and Russia up to Siberia that contained informative fossil material on vegetation, fauna and climate both in natural and archaeological context. In each site, the accuracy of the data has been tested with regard to the stratigraphy, chronology and sedimentary dynamics in order to produce a coherent evolution scheme of the past environment at the local and regional scales. Careful selection of well identified charcoal remains also provided multiple radiocarbon dates in sequences allowing to set up safe chronologies that can be put in parallel with the Greenland ice chronologies. Here we will present illustrative examples from Belgium (Remicourt, Harmignies, Walou), Austria (Willendorf), Ukraine (Molodova, Mezhyrich, Mira) and Siberia (Kurtak) where new multiple data (charcoal or wood remains, pollen or mollusc depending on the site) were gained and compared allowing a better understanding of the past environment of Neandertal and Modern Humans in a firm chronological and chronostratigraphical framework. The comparison of long loess sequences rich in charcoal material may lead to draw an overview of the plant environment and the climate that conditioned the life of men in Europe during the Upper Palaeolithic.

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Charcoal, wood, pollen, mollusc, radiocarbon, loess, Eurasia, Upper Pleistocene

A multiproxy investigation to reconstruct vegetation and land use in Northeastern Syria from the 4th till 2nd millennium BC

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Charcoals from 4th till 2nd millennium BC archaeological sites in Syria have been investigated with a multi-tiered approach to gain insight into the density and composition of the vegetation, insight into human impact on the vegetation and into the climate-people-landscape interactions. Besides charcoal taxon identifications, diameter and radial growth measurements on charcoal fragments were undertaken and the wood structure was studied into greater detail. Seed and fruit data from several archaeological sites have been investigated to gain additional information on the vegetation. From the seed and fruit data and our knowledge about their growth properties land cover maps for the different periods have been made within a GIS. These reconstructions help interpreting the anthracological results. Additionally, the seed and fruit remains of these sites also have been investigated for their anti-pastoral species. This line of evidence supports the interpretation of the anthracological results.

Charcoal identification, detection of anti-pastoral taxa, diameter measurements, fruit and seed analysis, land use mapping, radial growth measurements, regional synthesis

Wood use in a growing medieval city. Evidence for the overexploitation of woody resources in Ghent (Belgium) between the 10th and 12th century

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Both charcoal and waterlogged wood from a refuse layer that accumulated between the 10th and 12th century in the city of Ghent (N-Belgium) has been analysed. Most of the identified wood fragments are chips, representing the remains of timber production and woodworking activities. The analysed charcoal is believed to represent the remains of domestic fires. The results show that in the 10th century, the best suited woody taxa were used for both woodworking and firewood. Quercus sp., Carpinus betulus and Betula sp. dominate the charcoal assemblages and Quercus sp. and Fraxinus excelsior are the most important taxa in the assemblages of the waterlogged wood in the levels corresponding to this period. Through time, Alnus sp. gradually becomes more important in the assemblages of charcoal and waterlogged wood, and by the 12th century, it is the dominant wood species in both categories. This tree provides a lower quality of wood however, both for timber as for fuel. This shift in wood use is thus most likely the consequence of the decline of better suited taxa like Betula sp., Carpinus betulus and Quercus sp. for fuel wood and Quercus sp. and Fraxinus excelsior for timber, in the vegetation surrounding the city of Ghent. During the period covered by the analysed waste deposit, Ghent evolved from a rather small commercial centre to a large city. By the end of the 12th century, it had become the second highest populated city north of the Alps. The expansion of this medieval city caused an increasing demand for woody resources, resulting in the overexploitation of specific taxa. By the end of the 12th century, the lower quality Alnus sp. wood, which was still plentiful available from the alluvial areas surrounding the city of Ghent, replaced the better suited taxa for both timber and fuel wood.

Charcoal, medieval city, overexploitation, wood, woody resources

DELHON & MOREAU – oral session 3

Selected fuel, rotten posts and glassy amorphous enigmatic residue: Charcoal analysis of a structured dwelling site from the middle Neolithic in Provence (Le Clos du Moulin, Vernègues, Bouche-du-Rhône, South of France)

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Le clos du Moulin is on open-air middle Neolithic site excavated by Archeodunum© in 2014 in the South of France, 40 km north-west from Marseille and the Mediterranean sea, in the village of Vernègues. The excavation brought to light numerous postholes which allow reconstructing for the first time in the area a dozen of domestic buildings dated from the middle Neolithic (late Chassey, 4100-3800 BC), arranged around an area occupied by heated stones combustion features. Living floors are not preserved: the archaeological remains were only found in the hollow structures. Artefacts and ecofacts were in particular preserved in wells surrounding the buildings. Charcoal analysis was carried on samples from the postholes, the heated stones hearths and a well. Charcoal in postholes could most of the time be the remains of the post. They show rotting features suggesting the posts may have begun to decay before being charred, which is in accordance with the rhythms of occupation of the site suggested by the archaeological findings and the micromorphological observation of the holes sedimentary infillings. The anthracological results show a selection of natural resources depending on the use of the wood: timber or fuel. The size required for the posts can restrict the scope of the species suitable for timber. On the contrary, the choice of fuel wood seems to be less constrained by technical limitations. Nevertheless, a clear selection of one particular species, Arbutus unedo, is obvious for fuel supply. Finally, peculiar amorphous glassy remains were found among the charcoal in the well: they are still being analysed, but they could be evidences of the exploitation of an alternative source of carbon, either for pyrotechnical or technological purpose. Overall, charcoal analysis at Le Clos du Moulin shows that wood harvesting - as recorded by hollow structures - is selective. The selection is probably targeted to fit technical requirements that we can only partly identify, but also cultural prescriptions which remain unreachable to our understanding. Moreover, the choices are probably guided by the system of land and vegetal resources management in order to permit the coexistence of various wood-consuming activities in a single territory.

Fuel, Timber, wood selection, Néolithic, South of France

Challenges and Opportunities for the application of anthracology in Oceania: comparison of recent studies in the Pacific and Australia

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While anthracology has grown to become an important part of archaeological research in Europe and around the Mediterranean in the past 10-20 years, the discipline has remained an underdeveloped field of research in Oceania. This trend is starting to change though, as there has been a small but meaningful multiplication of projects implementing anthracology in the region over the last 5 years. The specific conditions of archaeological practice in Oceania induce a set of challenges – but also exciting prospects – for applying and pioneering anthracology. In this talk, we wish to present three projects recently led in Australia and the Pacific, comparing and discussing methodological and theoretical implications. After a rapid overview of the development of wood charcoal studies in Oceania, the three case-studies will be summarized, and the challenges and prospects identified will be detailed (eg.: issues with the assemblages size or stratigraphic relations; pertinence of the PLE and use of ethnobotanical data for the interpretation of the results).

Oceania, Arid Australia, Tropical Pacific Islands, Methods, Theory

The program DENDRAC - Development of dendrometric tools applied to anthracology: studies of human-resources-environmental relations

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Since five years the DENDRAC project, funded by the French National Research Agency (ANR), has allowed the development of dendrometric tools to be applied to the study of archaeological charcoal fragments. The project aims at increasing the informative potential of this type of remains in terms of past wood selection, forest management and the human and climatic impact on woodlands. The first aim is to establish several tools that can be used by all anthracologists. As the usually small size of archaeological charcoal is not adequate for the application of traditional dendro-ecological methods new approaches have been developed including image analysis, specialised computer tools and modern wood referentials. Dendrometrical tools have been developed to complete the measurements of tree-ring width. The first of these is the "pith location tool" that allows us to approach the missing radius on charcoal fragments. Seven temperate taxa have been tested and provided similar error ranges that allow the establishment of correction factors. The method is also applicable to tropical taxa (developed by Patzlaff et al.). The second tool uses a geometric morphometric approach and combines numerous tree-ring parameters. Specimens were characterised by the rather original application of sliding-landmarks to two consecutive rings and two multiseriate rays. Based on more than 1300 samples obtained from branches and trunks of three trees growing in the same locality, the results indicate that different categories of age and diameter can clearly be separated by statistical means. Further, the different samples showed distinctive characters – "a tree signal" - that allowed them to be attributed to a particular tree developed by Dufraisse et al.). This approach thus helps in improving the evaluation of the representativeness of heterogeneous deposits. Dendroecological references are also developed on the basis of the study of modern forest stands. We propose a quantitative approach of vessels with tyloses in oak in order to discriminate heartwood from sapwood, estimate the minimum age of exploited wood and establish a "Vigour Woodland index". A first archaeological application is in progress (developed by Coubray et al.). Based on wood anatomy of four taxa, a referential for pollarded trees is also in progress. The first analysis will allow us to recognise specific signals of leaf removing and to propose perspectives to apply them to charcoal assemblages (developed by Dufraisse et al.). To complete this line of research, we developed a reference based on oak wood anatomy to discriminate wood from seed and coppice shoots (Quercus) (developed by Hamdidi et al.): the association of radius of curvature, tree-ring width and the ratio earlywood/latewood appears efficient. More complex dendro-ecological developments combining several parameters of wood anatomy are thus promising for examining modes of selection of wood and for studying population parameters. Moreover, the combination of dendro-anthracology and geochemical measurements (stable carbon isotope - δ13C) at the tree-ring scale suggests that climate parameters can be recorded in archaeological charcoals in temperate climate conditions (developed by Baton et al.). Additionally, the effects of the carbonisation on wood parameters have to be evaluated. A first comparative study of shrinkage between oak and chestnut according to the wood morphology (slice, log, size) is in progress (developed by Paradis and Dufraisse). Finally, the development of the above-mentioned tools will constitute a decisive methodological progress for charcoal analysis, and such studies must be extended to other taxa. These reference data will be diffused and completed (centralization, storage, durability and accessibility of data). A free access database "Circulus" has been created for this purpose (developed by Brochard et al.).

Methodology; dendro-anthracology; measurement tools; quantification; referential; woodland; climate

Geometric morphometrics: a promising tool for anthracology. Application to stem disc

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The program DENDRAC, funded by the French National Research Agency (ANR) for five years, aims to reconstruct the dendrometric characteristics of the tree and/or forest stand exploited, through the study of the anthracological assemblage. To achieve this goal, we are developing analytic protocols to highlight the discriminating anatomical criteria necessary for the identification of the organ of the tree, its age, and its physiognomy. These protocols are intended for archaeological wood charcoal through the study of modern forested stands.The application of geometric morphometrics to uncarbonized wood samples and to charcoal residues should lead to a correlation between the shape of a sample and external parameters, such as paleoenvironmental factors. With the use of this method, we hope to determine individual parameters such as population and climate. The study samples are issued from an oak-coppice forest (Quercus petraea) (dating back approximately 60 years, located near Châtellerault (France). Three trees were catalogued and downed with the trunks sawn in 1 meter sections. A stem disc sample was taken from each extremity of the trunk. Taking into account the technical and anatomical constraints unique to the oak taxon, the study sample was determined using two consecutive rings and two multiseriate rays, and described rather originally using anatomical landmarks and sliding semi landmarks. The sample composed of 2 « cells », is defined by the positioning of 50 reference points (Landmarks). For 7 stem discs from branches and trunk, there are currently 1369 specimens in the reference dataset. The mapping of each disc was realized in such a manner as to establish benchmarks allowing for the repositioning of each data sample in the whole. A disc is defined by N objects that have been associated with age and diameter classes. For the purpose of this study, they were aligned as much as possible with traditional dendrometrical standard age classes. For the 7 stem disc samples, diameter and age show statistically different shape (Manova's $p<0.05$). A discriminant analysis allows for the quantification and visualization of the shape related to these two parameters. For the discriminant analysis on age, axis 1 contrasts the long, thin cells to the proportionally larger cells while working axis 2 contrasts cells in which the curvature is more pronounced to cells in which the curvature is less pronounced. Concerning the discriminant analysis on diameter, the working axis describes formation patterns relatively similar to the precedent discriminant analysis. The test phase of this analytical tool provided highly encouraging results, as by means of this protocol it is possible to be back to the diameter- and age-classes with a high percentage of re-assignment.Furthermore, a marked “tree marker” occurs and allows a reattribution of each specimen to each tree. Then it would become possible to improve the evaluation of the representativeness of heterogeneous deposits. The next steps will be to establish the correlations between shape and environmental influences (pluviometry, temperature, exposition).

Methodology; morphometric geometrics; tree marker

A morphometrical approach to past pollarding practices: perspectives in anthracology

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The research program DENDRAC - "Development of dendrometric tools applied to anthracology : studies of human-resources-environmental relations" - funded by the French National Research Agency (ANR) since 2011 has allowed the development of standardised measuring tools that can be applied to archaeological charcoal. These tools can be used to address a variety of research issues, for example the practice of pollarding of trees for leaf-fodder. The practice of cutting green branches for feeding livestock during the dry summer or the cold winter is still current with numerous examples from different geographical contexts. Until recently, that is the first half of the 20th century, leaf-fodder played a major role in agro-pastoral economies in many European countries. In a recent article P. Halstead (Halstead et al. 1998) shows the importance of storing dry leaves for the survival of the livestock during winter. He, as well as I. Austad in Norway (1988), further underline that besides providing an important source of fodder, regular pollarding of trees also had an influence on the form, structure and composition of landscapes. In archaeology the importance of pollarding for fodder has been shown by the work of P. Rasmussen at the Neolithic site of Egolzwil 3 in Switzerland where the preservation of botanical remains is particularly good (Rasmussen 1993). A research direction that merits development is that of showing how the wood structure reacts to pollarding practices. The regular cutting of ash in the Swiss Valais region could indeed be demonstrated through wood anatomical analysis (Haas and Schweingruber, 1993). It now remains to investigate, by eco-anatomical analysis, if similar signatures can be found within other broad-leaved species and, in particular, if such evidence can be detected on archaeological charcoal. We have thus initiated a project aiming at associating the wood anatomical study with precise knowledge of pollarding practices. From two regions in central Sweden (Småland and Östergötland) where pollarding for fodder has been conducted at a large scale until the mid 19th century and now is resumed for landscape conservation purposes, we have sampled different taxa that were submitted to regular cutting. Five different stations have provided wood samples from pollarded trees of ash, elm, hazelnut and lime. At every station, ten trees of different ages were chosen together with a non pollarded "standard" tree. The sampling of wood was associated with dendrometric and floristic inventories in order to characterise each population. Preliminary results of the analysis of the samples suggest the occurrence of specific signatures in different parts of the tree linked to the cutting of leaves. The promising perspectives for applying the results from this still ongoing study to archaeological charcoal assemblages will be discussed.

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Methodology; wood anatomy; pollarding; fodder; firewood

Anthracology of charcoal kilns in the forest of Chailluz (France) as a tool to understand Franche-Comté forestry from the 15th to the early 20th centuries

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Franche-Comté (region of north-eastern France) was – at least since the 15th century – one of the French regions that produced the most charcoal. Demand was indeed high due to, inter alia, the consumption by the Saline of Salins, and, at a wider scale, by the metallurgy industry. In 1789, Franche-Comté even ranked second among French regions for the production of cast-iron and iron (Lassus, 1968). To assess the archaeological potential of the forests of Besançon (provincial capital of Franche-Comté since 1674), a LIDAR survey was carried out in the Chailluz Forest (north of Besançon) during the thesis of C. Fruchart. The surveys revealed about one thousand charcoal kilns distributed across 1700 ha. This high concentration of colliery platforms raised several questions. Did they work intensively over a short period, or during a longer period? Another major question concerns the presence of charcoal kilns in the 'quart de reserve', active from 1750 to 1969 (Dianin, 1995). Indeed, 25 charcoal kilns were radiocarbon-dated and revealed the first utilization of the platforms since the mid-17th century to the early 20th century (Fruchart, 2014). Furthermore, the early 18th century was characterized by a scarcity of wood due to the increase of the population of Besançon by 100% in 70 years (Fohlen, 1965). Moreover, there was heavy demand for wood from forges, blast furnaces and the army. To alleviate this shortage, several large-scale felling of forested in the 'quart de réserve' was performed during the 18th century. Were charcoal kilns in Chailluz Forest used for this purpose, knowing that it had been forbidden to produce charcoal in this forest since 1763 (Dianin, 1995)? To further counteract this shortage, blast furnaces were prohibited in the area of Besançon, and Baume provided the firewood by flotation (Vion-Delphin, 1991). In light of this, what was the purpose of one thousand charcoal kilns? To answer these questions and understand the impact of charcoal production on the Chailluz Forest, we carried out an anthracological survey on nine charcoal kilns. A multidisciplinary approach (magnetic susceptibility, AMS dating, micromorphology) was applied to two platforms (CH29 and CH30) to establish a protocol for the study of the other charcoal kilns. We thus sampled the charcoal kilns by successive sections a few centimeters thick over a depth of 30 cm (thickness of the burnt soil) (Davasse, 2000; Py and Ancel, 2006 in particular). The charcoal concentrations (Paradis-Grenouillet, 2012) suggest that CH29 was used at least twice in 20 years. Also, we chose to study at least one platform by major type of forest stations (source: Organisation Nationale des Forêts). Preliminary results attest to the similarity between the anthracological spectra (hornbeam in majority, beech, linden, few oak) and the current forest stations. However, the presence of heliophilous species in the spectra (e.g. pome fruits, serviceberry, laburnum) suggests a more open landscape than nowadays. We identified 14 species in the anthracological spectra. By contrast, most other surveys identified only half a dozen of species (Rouaud, 2013, in particular). These results from the Chailluz Forest emphasize the diversity of the site. Finally, the absence in the spectra of some species currently present (such as Holly, English ash, elm) points to the presence of competitive forest products, other than charcoal.

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Charcoal kilns, archaeology, anthracology, Chailluz forest, forests of Franche-Comté, forestry

DUSSOL & ELLIOTT – oral session 1

Ancient Agroforestry in the Maya Rainforest. New Developments in Neotropical Anthracology at the site of Naachtun (Guatemala)

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One of the primary objectives of the Naachtun Archaeological Project (University of Paris 1/UMR 8096 Archaeology of the Americas) is to conduct a systematic anthracological study of the wood resources used by the site's ancient Maya inhabitants, as well as the evolution of this economy through time (from about AD 150 to 950). Our research is innovative because charcoal analysis is rarely carried out in the tropical rainforest of the Maya Lowlands, despite the fact that researchers have long considered that the relations between ancient Maya societies and their forested landscapes significantly affected social and environmental developments throughout the region. Specifically, no attempts have been made to reconstruct systematically the global wood economies of ancient Maya cities or their impacts on the surrounding landscape. Instead, the few studies that have been realized are limited to highly specific themes, such the woods selected for ritual fires (Morehart 2011) or local trade of select woody species (Lentz et al. 2005). In our presentation, we discuss some of the challenges to our reconstruction of the wood economies at Naachtun. Foremost among these is the extremely high biodiversity that characterizes the modern tropical rainforest environment, as well as the great inter-specific anatomical proximity that exists among certain botanical families (e.g. Sapotaceae, Rubiaceae or Leguminosae), which can make precise taxonomic identifications difficult. We address these issues through the construction of the first systematically collected and vouchered anatomical reference collection for the region around Naachtun, a long-term collaborative project that links research institutions in France, Guatemala and Mexico. We also face a number of challenges related to the interpretation of the archaeological contexts from which the charcoal assemblages are recovered. In particular, we consider interpretive issues related to the differential preservation of charred wood remains. Various taxa are over- or under-represented in the anthracological records of Maya sites when compared with their proportions in the surrounding modern forests. While wood selection and forest management strategies, as well as ecological heterogeneity across the landscape, may be at the root of these phenomena, it is also essential to test the possibility that differential taphonomic biases impact the proportions of taxa recovered. We present an ongoing program of experimental combustion that aims to determine to what degree differential preservation at Naachtun may be a function of physical properties of wood and fire, and to what degree it reflects cultural practices.

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Maya Lowlands, wood economy, reference collection, taphonomy, experimentation

Conspicuous Charcoals in a Pit: Wood Remains of Fire Offerings as a Glimpse into the Past

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Charcoal analysis has been known in Archeology since the middle of the 20th century and has been employed to study former ecosystems, changes in vegetation, effects of human activities on the environment and timberline fluctuations due to climatic and anthropogenic causes [1]. These are also the areas of interest concerning research on anthraco-archeological remains from bronze-aged, sacrificial sites in the Finailtal [2] in an altitude of 2460 meters (46°45'22.12"N, 10°49'8.35"E), situated in the Schnalstal in the upper Etschtal (Autonome Provinz Bozen-Südtirol, Italy). With the site of discovery of the Neolithic glacier mummy "Ötzi" nearby, these anthracological analyses gain additional importance in a regional historical and archeological context. A main goal of the study is the identification of the charred wood remains to derive the composition of the burned species and compare these results to the climatic situation more than 3000 years ago. Furthermore xylotomical analyses were performed to determine the growth conditions of the formerly living tree [3], as the sacrificial site is assumed to have been situated at about the height of the subboreal timberline. This knowledge will enable a better estimation of timberline fluctuations and forest composition not only for epochs long ago but also for times of warming due to climatic change, to come. The authors present the results of the undertaken anthracological analyses with regard to climatic and palaeoethobotanical questions.

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Archeo-anthracology, timberline, Südtirol, Ötzi

EICHHORN & ROBION-BRUNNER – oral session 4

Wood exploitation for a major pre-colonial West African iron production centre (Bassar,Togo)

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Local iron production played a major role in pre-colonial West African economy and early voyagers report the industrial magnitude of certain metallurgical centres. One of them is the Bassar Region in central Togo where iron production operated on a high level until the early 20th century and ceased completely only in the 1950s. Its onset is considered to date back before Christ, but only from the 14th century onwards, the area experienced production intensification within four distinct periods. Bassar iron metallurgy has early been in the focus of scientific research and was often accused to have caused massive deforestation and vegetation degradation mainly due to wood exploitation for charcoal production for the iron smelting furnaces. In the local population, there is still a lively and detailed memory of the metallurgical chaîne opératoire, the related charcoal production and involved local specialisation of skills. A number of trees and shrubs are considered suitable for iron smelting, among them several species with a strong ability to re-sprout after coppicing. In periods of strong demand, iron smelters could buy pre-fabricated wood charcoal from specialised charcoal producing villages at least in the last two production periods. In turn, processing of the raw iron – demanding additional fuel – was the task of further villages. We argue that the development of local crafts specialisation in combination with the use of regenerating species and the Sudano-Guinean area's high biomass reproduction capacity is inconsistent with the idea of massive vegetation degradation due to iron metallurgy in the Bassar Region. The taxa composition of charcoal assemblages from the enormous metallurgical waste heaps of site complexes throughout the region is coherent with the oral traditions and is regularly dominated by trees and shrubs able to re-sprout. Distinct changes during the four production periods are not yet visible but a focus on few site complexes will help us to establish local long-term charcoal sequences in order to better separate spatial from temporal differences.

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West Africa, Bassar, Sudano-Guinean area, crafts specialization, biomass regeneration

Sacred Fires and Household Hearths: reconstructing Middle Postclassic Tarascan wood economy at Malpaís Prieto (13th – 15th centuries AD, Michoacán, Mexico)

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According to the Relación de Michoacán and other ethnohistoric sources, fire played a central role in the ritual practices of the Postclassic Tarascan society that inhabited West Central Mexico from the 13th century of our era to the time of Spanish contact in the 16th century (Caso 1943). Sacred hearths were kept perpetually burning outside temples, and the cazonci (king) was personally reasonable for obtaining the impressive quantities of wood necessary for this feat. Fuel acquisition for these ritual fires was often embedded in other ceremonial activities, such as hunts carried out by the Tarascan nobility. Nevertheless, the sacred aspects of fire were not restricted to elite and public contexts. In addition to obtaining wood for their daily domestic needs, commoners were also expected to supply the majority of the fuel for the temple hearths. Furthermore, rituals associated with domestic hearth represented a significant part of the day-to-day affairs of households of all social ranks (Faugère 1998). However, despite the central role of fire and fuelwood among the Tarascans, little archaeological or anthracological study of these practices and their associated material culture has been undertaken. This paper presents a new and ongoing study of charcoal remains and combustion structures in a variety of contexts at the Middle Postclassic site of Malpais Prieto, in the Zacapu Basin of northern Michoacán, to elucidate how the use of fire varied among social strata, in public vs. private contexts, and how wood resources were obtained and managed.

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Mesoamerica, ritual, wood procurement, social organization

FANTONE – oral session 6

Wood selection at Late Bronze Age Tell Sabi Abyad (Syria, ca 1230-1180 BC): results of the macro-charcoal analysis

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Tell Sabi Abyad is located in the middle of the Balikh valley of Northern Syria, between Raqqa on the Euphrates and Harran beyond the Syro-Turkish border. In this sector, with ca. 250 mm rainfall per annum, the Balikh runs across a steppic landscape whose vegetation composition mostly depends on climatic and edaphic conditions. After an occupation during the Late Neolithic, the site saw the establishment in a previously abandoned region of a Middle Assyrian fortified estate with agricultural functions during the Late Bronze Age (ca.1230-1180 BC). This involved a substantial building project and the carrying out of productive activities probably in connection with the needs of the Assyrian army. From this perspective the availability of local resources of, for example, timber and fuel must have played a crucial role. This paper summarizes the recent results of the macro-charcoal analysis at Late Bronze Age Tell Sabi Abyad. These indicate how in the Late Bronze Age a rich riverine forest existed in the Balikh valley with Populus and Salix being dominant and mostly used for building purposes along with Fraxinus and Ulmus. The evidence of deciduous Oak contributes to the issue of the limit of its south distribution in the region. The comparison with the charcoal from Neolithic Sabi Abyad shows that no significant changes happened or a recovery of the riverine vegetation might have occurred from the Late Neolithic to the Late Bronze Age.

Late Bronze Age, Northern Syria, man-landscape interaction, wood use, spatial analysis

Soil charcoal analysis: a new methodological and statistical approach for a better use in ecology

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The historical ecology of forests aims at reconstructing former land uses in forest and their influence on community composition, dynamics, and functioning. As a discipline, pedo-anthracology provides important information on the woody component of forests, which structures ecosystems, and also on the soils. However, it is still unclear how far archaeo-environmental reconstructions that are based on charcoals retrieved from the different edaphic horizons are representative from tree and shrub communities of the past. The objective of this study was to determine, first, the charcoal spatial autocorrelation and, secondly, the minimal sampling effort to obtain a pedo-anthracological picture which is representative of specific richness and composition in forests. The vertical and horizontal distribution of charcoals was considered. We sampled three soil types (cambisol, luvisol, podzol) in two ancient forests from North France (Compiègne and Saint-Gobain). For each site, to investigate the charcoal spatial distribution we sampled vertically on the soil pit (20 samples of 1L/horizon) and a plot of 1000 m² surrounding the soil pit to collect 30 topsoil samples using an auger of 20 cm depth. At the lab, soil samples were dried, weighed and sieved at 4, 2 and 0.8mm under wet conditions. The total number of charcoal fragments extracted per litter was weighed. The specific anthracomass per liter (AS) and per taxon (AST) was then calculated as the ratio between the charcoal mass and the total mass of soil. The charcoals were identified with an incident light microscope, using the key of determination (Schweingruber 1978, 1990a, 1990b) and a reference collection obtained by carbonized wood in the laboratory. We used the AS or AST x sample matrices to calculate the spatial autocorrelation with Moran's I index. Otherwise, we employed the species x sample matrices of abundance to construct rarefaction curves, subsequently followed by additive partitioning of diversity. The parameters of the curves (slope and intercept) were then compared to determine the minimal sampling effort. Diversity values were used to compare this minimal sampling effort among soil types. We will present the results of spatial autocorrelation of the anthacomass among soil types in Compiègne and Saint Gobain forests. The sampling effort will be treated with Compiègne forest results. We discuss and conclude on the need to take into account the density of the charcoals and their vertical and horizontal spatial distribution to determine the minimum sampling effort needed to provide unbiased interpretations in historical ecology, paleo-geoecology and pedological dynamics.

Rarefaction curve, minimal sampling effort, spatial autocorrelation, forest historical ecology, additive partitioning of diversity

Gallo-Roman Nîmes (southern France): a case study on firewood supplies for urban and proto-urban centers (1st BC - 3rd AD)

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The town of Nimes (Gard) located in the Languedoc region still shows off the most visible and well preserved remains of its flourishing Gallo-Roman past. More hidden "treasures" are sporadically excavated by preventive archaeology prior to major urban works. This is the case of the excavation carried out in 2007, in the town centre (Avenue Jean Jaurès), over a 400m long - 15m wide strip, before the construction of an underground parking. Evidence uncovered provided information on the origins of Nîmes, especially concerning the process which transformed the indigenous village into a roman town. The southern limit of the town first devoted to agriculture (2nd cent. BC) was later transformed into an artisanal quarter (blacksmiths) which in turn was changed into a residential area (from the time of Augustus). These (proto-) urban communities relied mostly on their hinterland for timber and firewood; information concerning this aspect of everyday life was provided by the study of abundant charcoal remains recovered from different contexts. Qualitative and quantitative data from the structures incorporated in the artisanal quarter separate the structures into three different groups: the first concerns contexts dominated by Erica, the second assembles contexts dominated by Fraxinus, while the evergreen Quercus characterises the third group. These differences are also clearly discriminated by Correspondance analysis. Results obtained so far suggest some form of woodland management taking into account the specific needs of metallurgy. For the moment, it is impossible to recognize whether wood was burned as such or first transformed into charcoal as iron smelting is supposed to require the use of charcoal. The question remains as to why small branches of Erica were used for this activity, especially when diverse tree species were clearly available. Erica and Quercus (evergreen), in association with Quercus (deciduous) were also repeatedly used as fuel in the cremations uncovered. The diversity of species used in the cremations (21) suggests that fuel supplies derived from the exploitation of all sorts of surroundings, a fact already observed elsewhere (Figueiral et al. 2010). This plant diversity is significantly greater than that used for metallurgy (14). Together they provide a coherent picture of local firewood availability and habitat diversity during this time period. This picture is enriched even further by the identification of charcoal from a well in the more recent residential area, where the occurrence of Celtis australis is particularly worth mentioning, as this supposedly native species seems conspicuously absent from charcoal diagrams.

Figueiral I., Fabre L., Bel V. 2010. Considerations on the nature and origin of wood-fuel from Gallo-Roman cremations, in the Languedoc region (southern France). Quaternaire, 21 (3): 325-331

Firewood, (proto)urban, metallurgy, incinerations, habitat diversity

From charcoals to carbon: an outline on stable isotopes analysis in anthracology

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In recent decades the analysis of stable isotopes (carbon, nitrogen, strontium) in plants has become a useful method to infer natural and anthropogenic effects on the growing conditions of plants. Despite a long tradition of studies on the analysis of the isotopes in the wood, the applications on the charred remains in archaeological contexts focused mainly on the remains of cereals, while applications are still limited on charcoal remains. For example, stable carbon isotope analysis of archaeological charcoals has been used to identify ancient environmental conditions for plant growth in the Mediterranean region and the Near East. We will provide an overview of the historical background to this research, from the pioneering studies of Vernet et al. (1996), followed by relevant theoretical and methodological considerations in recent times. We will then concentrate on the main applications, namely inferring past climate and human-environmental interactions.

Reconstruction of boreal forest dynamics of the Clay Belt region in Quebec by anthracological analysis of forest soils

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In the boreal forest of eastern Canada, late-successional stands dominated by balsam fir (Abies balsamea) and black spruce (Picea mariana) alternate in the landscape mosaic on the same surface deposit (clay) and climatic conditions. Hence, these two stand types seem to be alternative stable states governed by different ecological processes, corresponding to two basins of attraction for mesic stands on clay soils, characterized by dominance by either balsam fir or black spruce in late-successional stages. Previous studies have suggested that the relative abundance of the two basins of attraction in the landscape could be explained by historical factors including postglacial forest dynamics and the emptying of proglacial lakes, and by natural disturbances (e.g., wildfire). It is important to understand when, why and how the spatial distribution of the two basins of attraction developed, in order to anticipate the effects of climate change and human activities (e.g., logging) on future forest composition. Therefore, the aim of this study is to better understand climate-fire-vegetation interactions on clay soils of the boreal zone of eastern Canada to characterize ecosystem resilience. As a first step to achieve this goal, we developed methods to improve the characterization of stand history using soil charcoal. Trembling aspen (Populus tremuloides), a poor charcoal producer, is a common species in in early-successional stands of the study area later to be dominated by balsam fir. Charcoal from companion species (trees and shrubs) could be useful to differentiate the assemblages typical of the different stand types characterizing the two basins of attraction. We sampled soil charcoal from four different stands in a recently burned area where pre-fire species compositions was known. All stands were on clay and typical of early- to mid-successional stages of the two basins of attraction (2 stands each). Charcoal fragments with diameter ≥ 2 mm were retrieved from 27 samples per stand for taxonomical identification. Discriminant function analysis will allow us to differentiate indicator species for each basin of attraction. These indicator species will be useful to reconstruct stand history and gain a better understanding of when, why and how the spatial distribution of the two basins of attraction came into place on clay deposits of the boreal zone of eastern Canada.

Pedoanthracology, boreal forest, Populus tremuloides, Abies balsamea, Picea mariana

Anthracology Research in the Southern Brazil

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In this work we present the results of the exploratory study of the macroremains for archaeobotanical recovered in archaeological contexts of the sites RS-T-123 and RS-T-114 (Taquari Valley, Rio Grande do Sul, Brazil). The sites are dated from 1300 to 1660 AD; 1460-1800 AD 1515-1625 AD and it correspond to the residential sites associated to the Guarani and Meridional Jê occupation. The objective of the research is to understand the resource management environmental. For the site RS-T-123, we analyzed samples carbonized vegetable material of 25 fragments coming from the structure of the combustion collected on 30 cm of profundity. For the site RS-T-114 we choose 112 samples collected on the site. In this case, the charcoals was associated with ceramic fragments, lithics and archaeological animals remains. The average depth collected was 35 cm. To determine the charcoal we use articles about 67 species of wood of Southern Brazil. We did microscopical observations of the anatomy of the charcoals and compared with the reference collection. However, it has found difficulties to determine the species because the collection of reference is only a partial sampling of the area of diversity. So far, we identified 16 morphotypes, one of them is a monocotyledon. The others are: Myrsine umbellata; Maclura tinctoria; Myrocarpus frondosus; Ilex paraguariensis; Erythrina crista-galli; Ficus citrifolia; Luehea divaricata; Alchornea triplinervia; Ruprechtia laxiflora and Cinnamodendron dinisii. But, there are five different morphotypes without identification. The results has been interpreted from them botanical, ethnobotanical and etnohistorical studies of Jê/Kaingang and Guarani groups. According to the results it is possible to identify ecological dynamics of the study area during the prehistorical occupation.

Archaeology, Charcoal, Anthracology, Guaraní Archaeology, Meridonal Jê. Brazil

Pedoanthracology reveals the timescale and altitudinal boundaries of the Holocene Mediterranean mountain shrublands: the example of Sierra de Gredos (Iberian Central System, Spain)

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The highest landscapes of many Mediterranean mountains are dominated by shrub communities often rich in entomophilous taxa which could be subestimated in pollen records, such as Leguminosae. Indeed, the most common palaeobotany indicators (pollen, woods) are usually only found in particular sites (peat-bogs, lakes, streams) of these regions, providing a relatively poor choice of sampling. In contrast, natural and human fires use to leave abundant charcoal signal in their soils. The identification and dating of soil charcoal allow to reconstruct with accuracy the local presence of woody plants, providing key data to improve the knowledge of these mountain landscapes, often linked to cultural uses. The Middle-Late Holocene vegetation history of Sierra de Gredos (Iberian Central System, Spain) has been mainly described in previous works as a process of decline of an ancient pine forest probably enhanced by human activity. Altogether, historical sources, dendrochronology, pollen analyses and macrofossil data prove the widespread presence of this Pinus forest between 6000-1500 yr cal BP and its subsequent reduction. Subfossil remains reported the local presence of Pinus sylvestris L. and Pinus nigra J.F. Arnold between 1100-1800 m.a.s.l. Nevertheless, the local information available over 1800 m.a.s.l. is almost completely absent. In this context, an altitudinal pedoanthracological transect has been studied in the Northern slope of the heart of Sierra de Gredos (Macizo Central). Six points of sampling have been placed from 2200 to 1700 m.a.s.l. all of them in the current open landscape dominated by Leguminosae taxa as Echinospartum barnadesii (Graells) Rothm., Genista cinerascens Lange and, above all, Cytisus oromediterraneus Rivas Mart. & al. The high concentration of soil charcoal (anthracomass) was dominated by Leguminosae in all the profiles except the lowest and the only presence of Pinus was found at 1700 m.a.s.l. The strong abundance of Pinus charcoal and the moderate presence of other tree remains (deciduous Quercus and Betula) at this profile characterize a charcoal assemblage very different from the higher ones. This change in the relative abundance of tree and shrub taxa between 1700 m.a.s.l. and 1800 m.a.s.l. suggests that an ancient timberline was probably located in this altitude interval. Punctual presence of Betula has also been registered between 1900-2100 m.a.s.l. AMS 14C radiocarbon dating was applied to 23 charcoals coming from the six fosses (14Chrono Centre, Queens University, Belfast), providing results between 10000 yr cal BP and 1000 yr cal BP. Fire events have been therefore occurring during the whole Holocene in the studied highland. Leguminosae is present and dominant at least since the last seven-eight millennia at 2100-2200 m.a.s.l. They were probably also dominant during the Early and Middle Holocene at lower altitudes (1800-2000 m.a.s.l.), but sharing these spaces with some trees (mainly Betula). Finally, Leguminosae is the only taxon registered in our dating assemblage for the last three millennia, with a slight grouping trend around 2000 yr cal BP coincident with the beginning of the intensification of human activities in the region.

Treeline, Cultural landscape, Leguminosae, Pinus, Betula

Dendroanthracology, questioning past woodland management and first results to identify wood from sessile Oak (Quercus petraea) coppiced and seed-trees

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The analysis and interpretation of charcoals macrofossils found in archaeological contexts give different reconstructions of woodland vegetation depend of the kind of site structure and analytical process implemented. It is now well replicated and accepted that archaeological sediment contain a "long-term" deposit of domestic fuel remains allow meaningful analysis of the past vegetation composition and diversity. See for example L. Chabal, E. Asouti and P. Austin work almost based on anatomical identification and the interpretation of "charcoal assemblage". Anatomical feature like reaction wood, pith or bark presence are near always notified when observed. The dendroanthracology approach is based on these supplementary qualitative and/or quantitative variables acquired after identification. Marguerie et al. preconize in "Dendroanthracologie dans La dendroécologie, principes méthodes et applications" to systematically estimate -when remain have a significate area- a mean radial increment and a wood diameter in three ordinal classes. Software are now available to obtain continuous estimate. All anthracological studies have in background that firewood gathering is not only based on the diversity of the vegetation but the aims of dendroanthracology are more focus on forest structure: in a first attempt diameters exploited and mean productivity observed for species suspected to furnish the main volume. Woodland management practices in relation with wood supply seem more drive by this wood diameter and diversity appears like consequence of practices. Dendrochronology is also well replicated as a dating tool and has been successfully perform on large charcoals (see contribution of F. Blondel, M. Cabanis). Beyond dating, aims of dendro-typology which means "classifying timber using dendrochronological and technomorphological criteria (A. Billamboz)" in order to define the structure of crop in relation with stand dynamics show convergences with dendroanthracology. The study material of the two disciplines is almost the wood stem dedicated to construction and a smaller diameter which could be exploited in branches or small trees for fire-wood. Archaeological sites where these two forest products could be analyzed jointly will steel exceptions, but we propose to bring together approaches and results matches can be expected. For example, at small regional scale near the city of Besançon, we compare differences of stem growth productivity and industrial firewood production as represented by charcoal kiln studies (see A. Dupin). This convergence is a key task of the program DENDRAC managed by A. Dufraisse, in which it is attempt to develop dendrometric tools intended for charcoal fragments. This keynote contributes and presents collective results steel in process from this program. We studied the distribution and dimensions of vessel area in early-wood of sessile Oaks with image analysis tools. The samples come from a living stand near Charleville-Mézières (Ardennes) where all other conditions are identical for coppiced and seed-trees. Difference is observed in vessel diameter classes frequencies for analyzed rings. Vessels are more numerous and smallest in coppiced shoot than in seed trees (B. Hamdidi). But the significance of this difference has to be relativized by the circumference and height in the tree where the rings are observed. This example illustrate dendroanthracology of archeological remains can be based on the biological hypothesis that wood anatomy traits of one taxa respond to environmental variability (see for example J.F. Terral work). With the general principle of actualism this hypothesis can be used in archaeological periods but one difficulty is to evaluate the accuracy of the observed variation in front of other variability sources like positions in the tree, individuals and/or sites conditions.

MARGUERIE et al. 2010 : Marguerie (D.), Bernard (V.), Begin(Y.) et Terral (J.-F.) Dendroanthracologie In S. Payette & L. Filion (dir.), La dendroécologie : principes, méthodes et applications. Presses de l'Université Laval, Québec, 311-350.

GRINDEAN ET AL. – oral session 6

The influence of climate, human impact and fire on the Holocene forest dynamics in the Apuseni Mountains, Romania

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Forest dynamics are determined by a complex interplay between environmental resources (climate, soils), disturbances (fire, human impact) and competition between species. Here, results spanning the last 11,800 years from pollen, plant macrofossils, micro- and macrocharcoal, magnetic susceptibility, and loss on ignition performed on four sedimentary sequences from the Apuseni Mountains are used to document the impact of climate, human activities and biomass burning on the vegetation succession in this region. Generally, dry and warm conditions were associated with increased fire activity, whilst cool and moist conditions with decline in fire activity. Burning activity also appears to be coincident with significant changes in tree species composition. Our results demonstrate the importance of species composition, particularly if species with high flammability are also associated with favorable climate conditions for fire. Thus the development of high flammable coniferous forest during the early Holocene, increase fire activity, whereas deciduous forest at the time when climate was still warmer and drier resulted in reduced charcoal activity. Additionally, changes in fire activity at centennial time scales in these mountains also coincide with changes in human activities. Pollen and charcoal evidence points to human induced landscape change as early as 6300 cal BP (in the lowlands) and during the last 2000 - 1000 years (in the mountain environments).

Pollen, climate, fire, human activities, Holocene, Romania

GROENEWOUDT – keynote session 4

Unexpected opportunities. On the landscape archaeological potential of charcoal kilns

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Charcoal offers unexpected opportunities to reconstruct past landscapes and human behaviour. Provided that they are systematically recorded and subjected to meticulous dating, remains of charcoal production in particular can be a valuable source of information for studying the interaction between people and their environment from a long term perspective. They can, potentially. But not if they are studied by charcoal specialists (only). If charcoal data are to contribute to answering major, over-arching research questions they need to be contextualized: They must be linked to other relevant data. And combined datasets should be subjected to interdisciplinary study. In my talk this will illustrated by (mostly recent) research on woodland history and settlement dynamics. I will also reflect on the potential of linking charcoal kiln data to the natural presence of iron ore and archaeometallurgical data. What I will present is not university research. Most data come from 'simple' development-driven excavations.

The oppidum of Puech de Mus (Saint-Eulalie-de-Cernon, Aveyron, France): a defensive protohistoric habitat from the Causse du Larzac. Archeo-anthracological approach.

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Puech de Mus, discovered in the 1960's by A. Soutou, is a walled site located in the western border of the Causse du Larzac, in the proximity of a major economic route linking the Mediterranean with the Massif Central. The site, implanted at an altitude of c. 842m dominates the valley of the Cernon a tributary of the Tarn river. The earliest settlements dating back to the Middle Neolithic were succeeded by a more intensive occupation during the Chalcolithic followed by and more intermittent occupation up to the Middle Ages. Field work on the protohistoric enclosure (c. 1ha) was carried out between 1995 and 2007. The remains of the palisaded enclosure testify to the Final Bronze Age (IIIb) - First Iron Age (IX-VIth B.C.) occupation. Thorough excavation work over more than 3000m2 uncovered a large area occupied by successive fortifications, built during the Vth and IVth centuries B.C. , with two series of buildings constructed over stakes, some of them used as metallurgy workshops. The complex defensive system developed during a period of c. 200 years was destroyed by fire, which lead to the accumulation of charcoal fragments associated with warfare implements. The anthracological study concerns these fire residues, including timbers used in the defensive walls, palisades, fortifications and other buildings as well as firewood for metal working. Charcoal fragments were recovered manually and registered according to their spatial location / stratigraphic units / artificial layers. Twenty five taxa were recognized. Deciduous Quercus and Fagus sylvatica represent 75% of the total number of fragments. The other twenty three taxa appear sporadically but clearly indicate that most, if not all, of the ecological habitats were exploited. The presence of both mesophilous and thermophilous species indicate that the area exploited covered both the lower valleys and the highlands of the Causse du Larzac. The taxonomic diversity identified also testifies to the long lasting occupation of the site.Results obtained are presented according to their chronology, phase by phase and discussed. Timbers used must have been obtained from mature forests, such as that of the supra Mediterranean woodland (Quercus – Fagus) of Guiral or the mesophilous–oak forest on clay - siliceous soils at La Cavalerie. This forest, long vanished, would also provide a good hunting ground, as well as arable land (after clearing of the vegetation). Firewood must also have been collected from the Quercus-Buxus woodlands. The near disappearance of these forests apparently coincided with the abandonment of the site (- 320). The peak of deforestation was reached later on, during the exploitation of the pottery kilns at La Graufesenque.

Gruat (Ph.), Marty (G.), Marchand (G.) in collaboration with Abraham (Ph.), Francqueville (B.), Le Fillatre (V.), Poujol (J.) - Systèmes de fortification de l'habitat de hauteur du Puech de Mus à Sainte-Eulalie-de-Cernon (Aveyron) au Ve s. av. J.-C. Documents d'Archéologie Méridionale, 26, 2003, p. 63-157.

Protohistory, archeo-anthracology, timber wood, firewood

Archaeological investigation and wood charcoal analysis of charcoal burning platforms, Cumbria, NW England

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Historic England's *National Archaeological Identification Survey:* Upland Pilot project in north-west England was carried out between 2013-2015. The first phase of work (mapping historic environment features from aerial survey sources – photographs and LiDAR) recorded two groups of features at Barbon Park (Barbondale, Cumbria) as charcoal burning platforms (CBPs); a larger group of more well-defined features to the east of Barbon Wood on open, grazed slopes (NRHE (National Record of the Historic Environment) ref. 1574919) and another, smaller group, of more-subtle features in open parkland to the west of the wood (NRHE 1575141). In October 2013 a series of rapid, focussed, small-scale archaeological interventions (test-pits and sediment cores) was carried out on a selection of the CBPs in order to test the results of the aerial mapping and investigate these features further. A key objective was to recover samples for wood charcoal analysis and radiocarbon dating in order to: i) identify the taxa selected for charcoal production at the site and see if there were indications of past woodland management techniques (eg coppicing), ii) determine what period/s of use the features represent and iii) establish whether this information could inform on a likely use of the charcoal (eg for gunpowder or, in particular, whether it was used to fuel a medieval iron bloomery reportedly located in Barbon). Excavations were focussed on the eastern group, where three CBPs underwent test-pitting and sampling. Here, concentrated charcoal deposits (including complete round-wood fragments) were recovered from: a) within one of the platforms, and b) the downward slope front 'apron' of the other two platforms (thought to have been deposited there as the platforms were cleaned out between burns). In all three cases, the charcoal deposits were shallow; often immediately underlying the topsoil. Charcoal samples (hand-picked fragments and bulk samples for flotation) were taken from the excavated platforms, and fragments were recovered from the eroding surface sediments of a fourth platform for dating. Results of the Assessment stage have identified the prevalence of Fraxinus, together with Betulaceae type/s (including Corylus), Hedera, Ilex, Maloideae, and some Populus/Salix and Quercus. This is being resolved in more detail with the Analysis stage. At the two CBPs in the western group investigated through sediment coring, small charcoal fragments (too small for charcoal analysis and dating) were observed. Radiocarbon dates from the four platforms in the eastern group were determined to be 'Post-medieval' in age. Given that the previously suggested uses for the charcoal now seem unlikely (based on the taxa present and the radiocarbon ages), it is hoped that documentary sources from the estate's archives will help clarify the ultimate use of the charcoal. The archaeological investigations have confirmed these features' function as CBPs and successfully demonstrated that rapid, well-targeted, small-scale excavations, can recover material suitable for analyses and scientific dating.

Charcoal analysis; Charcoal burning platforms; Post medieval

Ecological interpretation of African rainforest charcoal - Is it feasible?

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Anthracological research in the Central African rain forest has recently begun to be regularly implemented, especially on material from Cameroon and the Democratic Republic of the Congo (e.g. Höhn et al., 2008; Hubau et al., 2013; Morin-Rivat, 2012). Additionally, charcoal from Iron Age pits in the DRC is currently under investigation by B. Eichhorn. On this base it is now time to review the progress that has been made, to highlight the possibilities and limits of the method in the Central African rainforest and to discuss how to establish sound protocols of identification and interpretation. Identification of charcoal from such species-rich woody environments is difficult. Obstacles to be encountered in identification are the sheer number of woody species in the region and wood anatomical similarities in different taxa. Identifications are limited by interspecific similarity and intraspecific variability. Furthermore, the wood of many species has not been described yet. With the aforementioned investigations some types have emerged as quite reliably identifiable and comprising only one genus or – in rare cases – one species (e.g. Sacoglottis gabonensis), while for many other charcoal types a group of genera or sometimes even family level is (so far) the end of identification process. Obviously, this poses problems concerning the ecological interpretation of charcoal assemblages. Which balance can we achieve between what is possible concerning identification and what is necessary for ecological interpretation? Especially for larger groups like the legumes, where only a few types can be successfully established, this problem is evident. Moreover, several at first sight significant taxa occur and co-occur in quite different plant communities. For example, swamp forest taxa in the Central African rainforest are often the same as pioneer or young secondary forest taxa (e.g. Anthocleista, Alchornea, palms) rendering the identification of human impact difficult. Nevertheless, there are possible approaches to enhance the ecological significance of rainforest anthracology. Even identifications on high levels (family, sub-family, genus) can be useful if we pursue an approach based on the composition of the assemblage, rather than on the requirements of the individual taxa (possibly) represented by the charcoal types. The comparison of assemblages from different ecological units may help us to discern characteristic taxa compositions even if we have to operate with high level ids. Such an approach is successfully applied in pollen analysis where species level identifications are also seldom realized. Furthermore, combining anthracology with the analysis of other proxies such as phytoliths from the same sites also improves its ecological validity.

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Rain forest, Central Africa, identification, ecological interpretation, assemblage

Pedoanthracology reveals Holocene fire-vegetation-climate linkages in Central Africa

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Pedoanthracology can be used to reconstruct fire and vegetation dynamics which in turn explain or illustrate paleoclimatic and anthropogenic shifts (Di Pasquale et al. 2008; Tovar et al. 2014). Although charcoal analysis has proven worthwhile for vegetation reconstructions in temperate and arid ecosystems, it has only sporadically been applied in tropical contexts due to the lack of straightforward identification techniques coping with species-rich environments. Therefore, we recently developed a transparent charcoal identification procedure for Central Africa using large databases and well defined characters (Hubau et al. 2012). Moreover, we illustrated how combining imaging techniques can provide optimal visualization of charcoal anatomy, enabling evaluation of specific difficulties encountered during charcoal examination. This eventually leads to high level identification of charcoal taxa (Hubau et al. 2013). Here we present how these techniques resulted in charcoal records demonstrating a direct temporal link between Holocene droughts, palaeofire and vegetation change in the Democratic Republic of Congo (Hubau et al. 2015). We find three distinct periods of local palaeofire occurrence: 7.8 - 6.8 ka BP, 2.3 - 1.5 ka BP, 0.8 ka BP - present. These periods are linked to well-known Holocene drought anomalies: the 8.2 ka BP event, the 3rd millennium BP rainforest crisis and the Medieval Climate Anomaly. During and after these Holocene droughts the Central African rainforest landscape was characterised by a fragmented pattern with fire-prone open patches, especially near the forest boundary. Furthermore, the dominance of pioneer and woodland savanna taxa in younger charcoal assemblages indicates that rainforest regeneration was hampered by increasingly severe drought conditions after 0.8 ka BP. Finally, first results from the Central Congo basin indicate that disturbance through fire after 0.5 ka BP could be at the origin of present-day patchy distribution patterns of long-lived secondary forest stands. An example is a forest type dominated by the famous flagship species Pericopsis elata (wood known as afrormosia). These results support the notion of a dynamic forest ecosystem at multi-century time scales across the Central African rainforest.

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Central Africa, charcoal identification, fire history, palaeoclimate

A detailed data collection allows new paths of interpretation – the case of kiln site K653

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Kiln site K653 is located in the Southern Black Forest (Germany) close to Freiburg and was subjected to an archaeological excavation in 2012 (compare Nelle et al abstract, Nelle et al 2014). Sediment samples were taken, these were floated to extract botanical remains and three fragment classes of charcoal were separated (>1 mm, >2 mm, >4 mm). From the resulting 23 samples, 1482 fragments were analysed. In total nine taxa were found, the spectra is dominated by fir (Abies alba, 49 %) and beech (Fagus sylvatica, 33 %). The data collection was following a piecewise scheme with documentation of fragment number, taxon, weight, number of growth rings, radial width of fragment, presence of the last growth ring and diameter size class (classes 1-5, according to Ludemann 1996, Ludemann & Nelle 2002, Nelle 2002). The mean growth ring width is calculated by dividing the radial width by the number of growth rings (according to Marguerie & Hunot 2007). Thus, the compilation of accumulation / development curves – for example for taxa, mean diameter – and comparison of fragment weights becomes possible. Furthermore, a multidimensional evaluation of mean growth rings and a combination of additional traits – for example diameter class and presence of last growth ring – becomes possible. Here we focus on the following questions, considering the central aim of our study: (1) How many charcoal samples and how many charcoal pieces per sample should be analysed? (2) Can the effect of fragmentation on the charcoal assemblages be quantified and can the quantification be used for the interpretation of older charcoal samples?

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Accumulation curves, fragmentation, kiln site, sediment samples, statistics

KABUKCU – oral session 5

Identification of woodland management practices and tree growth conditions in archaeological fuel waste remains

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This paper presents the results of dendroecological analyses conducted on the wood charcoal assemblage retrieved from the Neolithic and Chalcolithic occupation phases at Çatalhöyük (central Anatolia, Turkey). The main research aim was to reconstruct the composition and ecology of prehistoric woodlands in central Anatolia, and document vegetation change dynamics under climatic and anthropogenic impacts. In addition to botanical identification, a range of qualitative features including the presence of deadwood, traumatic growth, tyloses and discontinuous growth rings were recorded. Qualitative assessment of growth ring curvature (following Marguerie and Hunot 2007) was supplemented by quantitative estimation of minimum wood diameter (following Paradis et al. 2013) alongside ring width measurements. The range of methodological applications on this well-preserved assemblage from the multi-period site of Çatalhöyük enabled the assessment of the systematic applicability of qualitative and quantitative dendroecological techniques on archaeological fuel waste remains. Alongside botanical identification, the recording of dendroecological features and quantitative measurements, and their analysis through multivariate statistical techniques permitted the assessment of the taphonomic history of the charcoal assemblages, and the relative importance of wood size, type and species in prehistoric fuel selection, thus obtaining a detailed view of woodland use and availability in the landscape. The signatures of anthropogenic and climatic impacts on the growth conditions of woodland taxa as reflected in the anatomy of wood charcoal specimens at Çatalhöyük indicate that woodland management practices in the semi-arid woodlands of central Anatolia date as early as the Neolithic period.

Marguerie, D. and Hunot, J.-Y. (2007) Charcoal analysis and dendrology: data from archaeological sites in northwestern France. Journal of Archaeological Science 34: 1417-1433.

Paradis, S., Dufraisse, A. and Allée, P. (2013) Radius of curvature measurements and wood diameter: a comparison of different image analysis techniques. In Damblon, F. (ed) Proceedings of the 4th International meeting of Anthracology. Brussels, 8-13 September 2008. Royal Belgian Institute of Natural Sciences. Pp. 173-182. BAR International Series 2486.

Dendroecology, fuelwood, woodland management, Neolithic, Southwest Asia

poster session 3 – KOČÁR ET AL.

The middle and upper holocene woodland history (5500 BC - 550 AD) of Czech Republic based on the anthracological data from archaeological sites

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The goal of our study is to investigate the potential of the anthracological analysis for the reconstruction of the woodland history during an agriculture prehistory (5500 BC - 550 AD) using charcoal data from archaeological sites. We have created a charcoal dataset which contains our unpublished charcoal data and already published older data from Czech Republic. Our study has included 471 archeological sites. Study sites are situated in the lowland, hilly regions and rarely extends to lower highland (up to 800m a.s.l.). The charcoal dataset containes 174 211 of charcoal records and revealed a 37 charcoal taxa. The study is focused on the comparison of anthracological records with selected environmental conditions (archaeological period, geology, altitude, slope) and regional variation.

Anthracological analysis, archaeological sites, Czech Republic, middle and upper holocene

oral session 6 – KOVÁČIK & CUMMINGS

Reconstruction of woodland vegetation and firewood exploitation in Nine Mile Canyon, Utah, based on charcoal and pollen analysis

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Charcoal and pollen analysis conducted on samples from multiple sites in Nine Mile Canyon, Utah, were used to reconstruct the woodlands of this region and interpret firewood exploitation during the Fremont occupation. The pollen record identifies the paleoenvironmental potential of this region, reflecting species that grew in the vicinity of the site and in the broader area. Wood charcoal reflects various trees and shrubs that were used as fuel or for construction by the Fremont occupants settled in Nine Mile Canyon. Wood charcoal is one of the most common remains recovered from archaeological sites, but its interpretative value often has been limited to AMS radiocarbon analysis. Results show that the spectrum of wood taxa varies in different parts of the canyon, mostly reflecting local availability of these taxa. In addition to local wood, some species that grow at higher altitudes also were recovered, indicating their value to the Fremont occupants. SEM imagery was used to document anatomical characteristics of different species recovered in the charcoal record.

Charcoal, Pollen, Fremont, Utah, Woodland, Firewood, SEM

DE LAFONTAINE – keynote session 2

Biogeographic inferences using local-scale soil macrofossil charcoal analysis

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While soil charcoal recovered from archaeological sites has been used to reconstruct past vegetation, climate, or fire for more than half a century, palaeoenvironmental inferences based on charred macrofossils sampled in natural ecosystems are still quite recent. Soil macrofossil charcoal analysis (SMCA) is an emerging palaeoecological approach relying on the botanical identification and accelerator mass spectrometry (AMS) radiocarbon dating of fossilized wood preserved as macroscopic charcoal in mineral soil. Here I review some of the promises, challenges, and caveats of the SMCA approach with respect to inferring the Late Quaternary vegetation and wildfire history, as well as ecological dynamics of forest stands. The discussion primarily builds upon the knowledge acquired from two recent case studies using stand-scale SMCA to address biogeographical questions, namely the origin and dynamics of subalpine white spruce (Picea glauca) and balsam fir (Abies balsamea) stands in the boreal forest of eastern North America (de Lafontaine and Payette 2011, 2012) as well as the discovery of cryptic Pleistocene European beech (Fagus sylvatica) microrefugia within a Periglacial desert in southwestern France (de Lafontaine et al., 2014). These two examples specifically highlight the relevance of the approach as a robust palaeoecological tool because SMCA was successfully used to uncover stand-scale palaeovegetation and fire history of sites where other paleoecological records were lacking. Furthermore, in these two case studies, insights from SMCA was corroborated with other, independent lines of evidence including phylogeography and dendroecology. Hence, the approach appears quite useful in interdisciplinary efforts addressing major biogeographical questions using joint inference.

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de Lafontaine G, Amasifuen Guerra CA, Ducousso A, Petit RJ. 2014. Cryptic no more: soil macrofossils uncover Pleistocene forest microrefugia within a periglacial desert. New Phytologist, 204, 715–729.

Biogeography, forest, macrofossil, palaeoecology, soil charcoal, vegetation history, wildfire history

Charcoal analysis from 58 and 49 000 year old hearths at Sibudu: implications for wood uses and the KwaZulu-Natal environment during the Middle Stone Age

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Sibudu cave, occupied by hunter gatherer groups of modern humans during the Middle Stone Age, between 77 and 38 000 (38 ka) years ago, is in the summer rainfall region on the eastern South African coast. The site includes technological industries such as Still Bay and Howiesons Poort that are distinguished by specific stone tool types. Woody taxa identified from charcoal in this site, indicated changes in vegetation and wood use. Archaeological charcoal specimens, from hearths on three putative occupation floors, were analysed for behavioural information about wood selection and use at given "moments in time". Two of the stratigraphic layers, BYA2 (i) and SPCA, are approximately 58 ka old and MOD layer is approximately 49 ka old, from the post-Howiesons Poort industry. Comparative identifications of woody taxa were made by means of an indigenous charcoal reference collection and the InsideWood database. Charcoal was studied under a binocular microscope using reflected light. Taxa identified, such as Podocarpus spp., confirmed that the coldest, driest phase of occupation was at approximately 58 ka. Bushveld woods, including five Acacia Types, have been identified in charcoal from MOD layer. The vegetation mosaic was different from today's coastal forest and savanna near Sibudu. The availability of natural wood around Sibudu, visible in the type of wood burnt in hearths, has changed since 58 ka and 49 ka for either climatic or anthropogenic reasons. In all three layers, the wood bundles included tinder, fuel, and a selection of woody plants that today are known to have medicinal bark, leaves and wood. People may have selected wood for burning properties (for example, temperature, light and coal production) and for medicine. Woods suitable for making firesticks for starting fires by means of friction are present. Wood from Spirostachys africana (tambotie) occurs in one hearth in each of the three layers. Since S. africana is normally avoided in cooking fires as it is poisonous, this suggests that the wood was selected deliberately and burnt for insecticidal smoke or other medicinal purposes. Tarchonanthus camphoratus (wild camphor) charcoal occurred in layer SPCA. This adds to the knowledge, through earlier discoveries, of sedge bedding topped with aromatic, insecticidal Cryptocarya woodii (river-quince) leaves (Wadley et al. 2011. Science 334 (6061): 1388-1391). Wood use is different between hearths and surrounding sediments and between occupations dating 58 ka and 49 ka.

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Middle Stone Age, Phytomedicine, Sibudu, Spirostachys africana

Contribution of anthracological and dendro-anthracological analysis to the study of charred timber recovered from Lattara (Hérault, southern France) during the 5th century BC

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The ancient port city of Lattara, founded at the beginning of the 5th century BC by different populations (indigenous, Etruscans and probably Greeks), is an original site characterised by different Mediterranean influences. The excavations which started in the 80', have finally reached the earliest levels of the occupation, i. e. those linked with the origins of the agglomeration. Recent field work carried out on islet 1 (zone 1) uncovered the remains of two structures (a house and a covered courtyard) destroyed by fire during the latter half of the 5th century BC. These fire events allowed the preservation of timber used in the constructions. Indeed, several long wood pieces resembling beams as well as also pegs were recovered. This material has been analysed and the data from both field observations and laboratory work (morpho-technical observations, anthracology, dendro-typology and dendrochronology) are assembled here. We already know that the mechanical properties, the shape, the durability and the diameters of wood seem important factors when choosing construction wood. Thanks to new methods and protocols for the measurement of growth rings on charcoals, it is now possible to put forward working hypothesis in two main domains:

- Dendroecology, with inferences concerning wood collection, wood-timber resources and their exploitation around Lattara. These are further interpreted in terms of the architectural evolution of the dwellings.
- Dendrochronology, specifying the sequence of occupations sealed by two successive fires in the same islet, based on crossdating.

These new data shed light on the availability of these building materials, probably in the immediate surroundings, and provide evidence on forest physiognomy and composition.

Dendroanthracology, dendroecology, dendrochronology, construction, timber, Iron Age, Lattara

Charcoals from the medieval settlement Haithabu (Northern Germany) – reconstruction of woodland usage

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The Viking trading settlement Haithabu existed from the second half of the 8th till the 11th century and exhibits a well-preserved wooden legacy. In former investigations about 4000 oak timbers from the settlement and harbour were dendrochronologically dated and more than 13000 wet wood remains, including artefacts, were analysed by their taxa. In this paper the results from a newly performed anthracological research are presented. This research is part of a current German Research Foundation-project (Medieval woodland and its use in the Schleswig isthmus) which addresses the analysis of tree ring patterns for questions of woodland structure and change, as well as management issues. Now, with more than 3000 charcoals analysed from pit houses and graves, a more complete picture of wood usage for different purposes emerges. The results are used to disentangle which taxa were used for construction and fuel, therefore the diameter of each piece was analysed. The artefacts are mostly made of light demanding trees such as Corylus (hazel) and Sorbus. Another aspect is the measurement of the tree rings from the largest charcoals and the attempt of a dendrochronological dating. Anthracological data in combination with dendrochronology and dendrotypology is now used at this important archaeological site to develop a more profound understanding of the woodland change and the resource usage during medieval times.

Charcoal, dendrochronology, medieval, Viking, Haithabu

Wood usage and woodland composition at an Iron Age ring wall in Northern Germany

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The first Iron Age ring fort in the northern German state of Schleswig-Holstein was recently discovered. This site is located in the Riesewohld forest, Dithmarschen. Archaeological excavation revealed a ditch, a palisade and an occupation layer. The function of the wall and ditch system remains unknown but there are several possibilities: It could have been used for protection, as a type of symbolic separation or to demarcate a cult site. The enclosure was constructed around the year zero during occupation of the area by the Chaucii tribe. A similar enclosed site is known from the early phase of the 'Heideschanze von Sievern' (Cuxhavendistrict, Niedersachsen), which was built during the same period – perhaps some years earlier – and is similar in size and structure. Anthracological analysis has demonstrated that Quercus (oak) was the main type of wood used in the construction of this bastion. Thirteen additional wood taxa were identified, of which the next best represented is Corylus (hazel) and surprisingly much Ilex (holly). Interestingly enough the samples did not contain Fagus (beech) or Carpinus (hornbeam), which are both common in the area today. Combined with data from pollen cores, the data show that during the time of the enclosure, Fagus had begun to establish itself in the local woodland, but did not gain importance until the Iron Age was over.The study has also shown that even small scale archaeological excavations can yield important new localized data on wood utilization, which can be used to guide the reconstruction of local woodland composition.

Charcoal, ring wall, Iron Age, Northern Germany

Local scale pattern of past fuel wood use and ecological growth condition of the exploited forests – examples from the Western Black Forest (SW Germany)

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Sample sites of historical charcoal production belong to the most common remnants of past wood use in mountainous regions of western Central Europe. Thousands of historical wood charcoal kiln sites are known within the Black Forest solely. Kiln site distribution and density indicate the great importance of wood charcoal production in the past. Moreover, it underlines the outstanding scientific potential of kiln site anthracological studies. The large number, wide distribution and high densities of such sites provide unique opportunities to gain exact information on the ancient forests and the changes therein with fine spatial resolution on a landscape level. Furthermore local relations and dependencies of past wood use on the natural diversity of growth conditions, tree species composition and wood supply could be identified. In our study we have analysed charcoal samples of traditional wood charcoal burning on a local spatial scale. Our main topic centered on analyses of archaeological macrocharcoals from groups of neighbouring kiln sites laying close together in the landscape (kiln site anthracology) and how these can provide answers to questions of local vegetation history and forest ecology. Examples of local scale results and of the fine spatial resolution of kiln site anthracology already have been given of altitudinal gradients from the upper montane to the subalpine belts (e.g. Ludemann 1994, 2002a; Ludemann and Britsch 1997, Ludemann and Nelle 2002). Moreover, an example has been given of a landscape profile crossing a boggy depression within a natural coniferous forest area of the eastern part of the Black Forest (Ludemann 2002b, Ludemann et al. 2004). In addition, new kiln site anthracological results from three local scale profiles in the mixed deciduous-coniferous-forest area of the western part of the Black Forest are given by the study presented here. The sites analysed from these profiles range over landscape profiles of a few kilometres only, but covering divers ecological conditions in its surrounding. The individual sample sites analysed show considerable differences in composition and frequency of the tree taxa exploited, of which regular spatial patterns of the past tree species distribution have been deduced on a local scale. These patterns can be explained quite well by local differences in the ecological growth conditions, i.e. the different edaphical site conditions of the soils of the exploited forests in the closest vicinity of each charcoal burning site. Again a pronounced dependency of past fuel wood use on the local natural wood supply and tree species distribution is discernible.

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Black Forest, charcoal production, forest ecology, forest exploitation, fuel wood, kiln site anthracology, local scale resolution

Charcoals identification as a complementary tool for the reconstruction of vegetation and fire activity during the late-glacial/early-Holocene transition around Blacktail Pond, Yellowstone National Park, USA

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Analysis of charcoal particles preserved in lake sediments has been frequently used to reconstruct fire, vegetation and climate history. Larger macroscopic particles (>100 µm) are attributed to local burning whereas microscopic charcoals (<100 µm), observed on pollen slides, are a regional signal of fire. Taxonomic identification of the charred particles can augment the fire-history reconstruction by providing information about the fuel composition and characteristics. For example, identification of charcoal from conifers, hardwoods, shrubs, and herbs and, in some cases, attribution to genus or species can unravel one of the longstanding questions regarding past fire regimes, namely what was burning. Analysis of macroscopic charcoal (180-500 µm) particle morphology (size and shape) has been explored by a few researchers. Among them, Umbanhowar et al. (1998) examined external charcoal morphology (area, length, length/width) as an indicator of burned vegetation type. When available plant cell fragments are present and by chance correspond to one of the anatomical plans of wood, the identification of Monocotyledons, Dicotyledons, Gymnosperms is possible on fragments > 180 µm (Marquer et al., 2012). This project involved identification of charcoal particles preserved in the sediment of a small closed-basin lake in Yellowstone National Park. Blacktail Pond (44.954°N, 110.604°W; 2012 m elev) is located in an open parkland of steppe and subalpine conifer forests. A multi-proxy study of sediment cores revealed a series of environmental changes following ice recession through the early Holocene, a period of rapid environmental change (Krause and Whitlock, 2013; Huerta et al., 2009). Prior to 11,500 cal yr BP, cool conditions dominated and fire activity was low. A step-like climate change to warm summer conditions then occurred and fire activity increased. From 11,500 to 8280 cal yr BP, warm summers and abundant moisture supported closed Pinus contorta forests. Forty sediments samples were taken at 0.5 cm intervals spanning the period from 11,500 to 9900 cal yr BP. The sediments were sieved and residues examined under the stereomicroscope. Twenty-eight of them contained charred particles (> 180 µm); all of which were studied under SEM. At the same time, anatomical reference materials were collected from living trees (3 conifers) and shrubs (4) in Yellowstone. The term "charcoal" was assigned to all burnt plant remains (particles opaque, black, angular, planar, easily breakable into smaller angular fragments) (Whitlock and Larsen, 2002), not only woody fragments. Among them, we were able to recognize conifers (e.g. Pinus, Picea), shrubs (e.g. Artemisia) and monocotyledon occurrences using SEM. These results are consistent with the interpretation based on the other proxies at Blacktail Pond. Climate change was the primary control of postglacial vegetation change in Yellowstone, and increased fire activity facilitated the transition from Picea parkland to Pinus contorta forest over the course of several centuries.

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Charcoals, identification, fire, late-glacial/early-Holocene transition, lake, Yellowstone, USA

Early-Middle Bronze Age Communities and Wood Resources Management in the Sabor valley (Northeast Portugal)

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The archaeological work developed in the Trás-os-Montes region and focused in the Sabor valley led recently to the identification, register and excavation of several Bronze Age sites. Early and Middle Bronze Age occupations were identified in Terraço das Laranjeiras and Quinta de Crestelos, both sites were occupied recurrently since Chalcolithic. In the third place considered, Foz do Medal, two different Middle Bronze Age occupations where identified, the first one was linked to burial practices and the second with grain storage. The location of these sites at the valley bottom or on the hillside conditioned the kind of archaeological features preserved. These three sites are highly affected by erosive processes remaining only pits and post-holes, while huts and fireplaces were preserved occasionally. Charcoal was recovered mainly from secondary contexts –pits- and only in few cases charred wood was collected from primary contexts such as fireplaces. Charcoal analysis of these assemblages provides data about wood resources procurement and management in relation to day-to-day activities of Early and Middle Bronze communities. In the three sites a diversified exploitation of forest resources was identified. Firewood was gathered from evergreen forest, riverine woodland and scrubland formations. The recurrence of scrubland species such as Erica sp., Cistus sp. and Fabaceae could be related with the degradation of the forest cover. Finally it is important to note the presence of Pinus pinaster and Olea europaea. These assemblages of the Sabor valley provide valuable information about wood resources management by Early and Middle Bronze Age communities in Northeast Portugal where only two sites with these chronologies were previously studied: Castelo Velho de Freixo de Numão (Figueiral 1999, Figueiral and Jorge 2008) and Fumo (Queiroz and Van Leeuwaarden 2003).

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Bronze Age, Charcoal analysis, Wood resources, Firewood

Limits and possibilities of charcoal analysis in Bronze Age sites: the case study of Pego (Northwest Portugal)

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The archaeological site of Pego (Braga, NW of Portugal) highlights the limits and possibilities of charcoal analysis in Bronze Age sites with long and recurrent occupations (Sampaio et al. 2008, Sampaio and Bettencourt 2011, 2014; Sampaio 2014). The site was occupied since the end of the Early to Late Bronze Age. Its earliest features of this site are located in Sector II, a plain grave's necropolis dating to the end of the Early to Middle Bronze Age was found. Probably with intentional depositional purposes, during Middle-Late Bronze Age this area was used for digging few pits covered with weathered granite. Near it, in sector V (on the top of the hill), there was identified a fireplace and at least four pits (pits 1, 3, 18 and 19) linked to an occupation of this area also dating back to the Middle Bronze Age. In the same area, several other pits and post-holes, small ditches and a perimetral ditch (comprising a palisade) were also identified. In many cases some of these structures date back to Late Bronze Age. The assemblages considered were mostly recovered from secondary contexts, something usual in these Bronze Age sites. This fact connected with the recurrent occupation of the sample's place during long periods of time complicates the interpretation of charcoal analysis outcomes. In these cases we consider that it is essential to go beyond taxonomic identification considering also taphonomical and dendrological attributes. At the same time this methodology can help identifying different site's moments of occupation.

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Bronze Age, charcoal analysis, wood resources, taphonomy

There is no smoke without fire: charcoal analyses from Animal 1, Cabeço da Amoreira, Muge shellmidden (Portugal)

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Muge shellmiddens archaeological complex, located 60 km northeast from Lisbon, were discovered in 1863 and are an important Mesolithic settlement in Europe. The richness and available resources in the area allowed the establishment of these Mesolithic populations nearby Muge river valley, for seasonality occupation. The archaeological settlements are characterized by the formation of shellmiddens resulting from the exploitation of marine and terrestrial resources. The context here presented was identified in Cabeço da Amoreira shellmidden. It is a specific context from layer 4 found during 2014 fieldwork campaign lead by Dr. Nuno Bicho. The context is composed by a deposition of faunal remains (Cervus elafus) partially in anatomic connection, lithics and charcoal. Still under investigation, the functionality of these remains is uncertain, but the intentional deposition is evident. The goal of this poster is to present the anthracological data from this context (Animal1) and compare with charcoal results from other areas of Cabeço da Amoreira and other palaeoenvironmental data, for understanding the fuelwood use in this particular context. Charcoal has been recovered by flotation, sieving and hand-picked. Taxonomic and taphonomic analyses have been made with microscope observation (x100, x200)(Martin Seijo, 2012; Chabal,). Three main sections (transversal, longitudinal tangential, longitudinal radial) were observed for identification. The preliminary results allowed the identification of the following taxa: Pinus pinea/pinaster, Pinus tp. sylvestris, Pinus sp., Quercus sp., indeterminate angiosperms and gymnosperms. These first analyses show that the identified taxa are the most frequent in the shellmidden. This corroborates with other charcoal analyses made in other contexts of Cabeço da Amoreira, suggesting the preference for gathering these species for fuel.

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Mesolithic, charcoal, Pinus, Quercus, Muge shellmiddens, Cabeço da Amoreira

MAVROMATI – poster session 3

Landscape and fuel wood in Akrotiri (Thera, Greece) during the Bronze Age

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The aim of this study is to present the results of the analysis of wood charcoal macroremains retrieved from the deep shaft of Pillar 35, excavated during the construction of the new shelter of the archaeological site of Akrotiri, Thera Greece. Pillar 35 is situated on the Square of the Double Horns. The stratified layers from which the wood charcoal fragments have been sampled are dated from the Early Cycladic II (2800-2300 BC) to the Late Cycladic I (1550-1500BC) period (Καριώτης 2003). At the deeper layers of the shaft, there have been unearthed two chambers dug into the natural rock. The middle strata are occupied with three superimposed rooms (1 to 3), while the upper layers comprise the two phases of the Square of the Double Horns (Καριώτης 2003). The advance of this study is the identification of a few taxa to species level i.e. Pinus type brutia/halepensis and Prunus amygdalus that help characterize specific vegetation types and/or anthropogenic activities. Thus, the 1203 charcoal fragments studied from 22 samples taken from stratified layers of the shaft show that, during the Early Cycladic period thermo-mediterranean vegetation existed on the island with Pinus type brutia/halepensis prevailing. Juniperus sp. and Olea europaea were also present in significant quantities, while other species indicative of this vegetation, such as members of the Fabaceae family, Prunus sp. and Ficus carica, occurred in lower percentages. The early Middle Cycladic period is characterized by the decrease of the fragment numbers of Pinus type brutia/halepensis and other wild flora and the predomination of Olea europaea, which retains its high values through the Late Cycladic period. During these periods, other cultivable species, like Punica granatum and Prunus amygdalus appeared in significant quantities. The obtained results suggest that during the early stages of the site, an Aleppo pine forest was present on the island and that the inhabitants were using pine as their main source of fuel wood. However, in the Middle and Late Cycladic period a reduction of pine trees in favor to the fruit bearing Olea europaea and secondarily Punica granatum and Prunus amygdalus is observed. Thus, the increase of cultivated species use is possible to be correlated to an expansion of agricultural land on the island. All the above, come in accordance with the results of Asouti (2003) who suggested the presence of a pine forest on the island (Asouti 2003, 480) and the use of olive and pine wood as the primary sources of fuel wood, as well as the early exploitation of olive and pomegranate fruits from the inhabitants of Akrotiri.

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Wood charcoal, Akrotiri, Aegean, Bronze Age, Greece

Utilisation of Abies around the Heuneburg during the Early Iron Age – local origin or timber import?

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The Heuneburg is an important settlement center of the Early Iron Age, located on the left side of the river Danube, south of the Swabian Alb in Southwestern Germany. Several excavations of the site revealed also preserved wood, of which – besides the dominance of oak (Quercus sp.) – fir (Abies alba) was found in relevant quantities. The Bettelbühl necropolis is located 2.2 km south of the hill fort Heuneburg, in the floodplain of the Danube. The excavation of burial mound No 4 started in 2010 and is still ongoing. The archaeologists uncovered a grave chamber with preserved oak and fir timber. The dendrochronological dating successfully unveiled a felling date with waney edge (bark) to the year 583 BC. Today, fir can be found only scarcely in the vicinity of the sites, and appears to have been planted on sites with a sufficient water supply. Thus, according to vegetation science, these archaeological sites lie off or at the boarder of the area of fir in the region, potentially due to low precipitation during summer and thus, consequent unsuitable moisture conditions for fir growth. The question of the fir origin in burial mound No 4 arose already in the early stages of the dendrochronological analysis. The issue was whether fir was growing close to the sites, and later disappeared from the region, or whether fir timber was imported, possibly by rafting on the Danube or its tributaries from fir dominant stands e.g. the Black Forest. New charcoal data from an Early Iron Age grave mound 2.3 km west of the Heuneburg and 3.6 km northwest of the Bettelbühl grave chamber brought additional evidence of fir usage in the burial context. Notably small wood diameter, probably from branches of fir, is pointing to a local origin. Strontium isotope analysis ($^{86}Sr/^{87}Sr$) was performed on archaeological samples, as well as on modern fir stem material together with soil samples, and indicates a local origin. Summarizing, we postulate that during the Early Iron Age, fir was available in the area, but was considerably diminished due to intensive timber use and landscape opening, with the consequence of a today`s gap in the distribution map. Furthermore, in the ditches of Heuneburg is pollen evidence for the nearby presence of fir. The fact of the occurrence of fir outside its present area had also been observed in other parts of Central Europe, where the nowadays growth conditions are too dry and too warm compared to former time periods.

Dendrochronology, $^{86}Sr/^{87}Sr$ analysis, pollen analysis, Bettelbühl necropolis

Charcoal analyses from Muge shellmiddens: comparative analyses from Cabeço da Arruda and Cabeço da Amoreira

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Muge shellmiddens complex in Central Portugal are one of the main references for the Mesolithic Europe. Muge shellmiddens are composed by several shellmidden settlements located in both sides of Muge River. The climatic alterations from the transition to Holocene transformed the Muge valley into an estuarine basin rich in biomass that favoured the human settlement and exploitation of both marine and woodland resources (Bicho et al, 2010, 2012). Cabeço da Amoreira and Cabeço da Arruda are sites from both margins of the river and the considered the most important along with Moita do Sebastião, due to their dimensions, burials and assemblages (Bicho et al, 2011). These sites have been studied and excavated since their discovery in XIX century. A recent project researching about the subsistence, economy and social complexity began in 2008 opened a new excavation area in Cabeço da Amoreira and sampled several profiles in both settlements for datation and flotation. Charcoal has been recovered from layers and profiles in Cabeço da Amoreira and Cabeço da Arruda and taxonomic and taphonomic analyses were carried out on over 4500 charcoal fragments. So far the following taxa have been identified: Pinus pinaster, Pinus pinea/pinaster, Pinus tp. sylvestris, Pinus sp., Quercus ilex/Q. coccifera, Quercus subg. Quercus, Quercus sp., Arbutus unedo, Pistacia lentiscus, cf. Salix, Monocotylodones, indeterminate angiosperms and gymnosperms. This poster will present the results from charcoal analyses from Cabeço da Amoreira and Cabeço da Arruda, comparing with the fuelwood uses between sites and other palaeoenvironmental and archaeological data. As preliminary conclusions Cabeço da Amoreira shows a diversity of taxa that is not verified in Cabeço da Arruda, although the variety of contexts and sample size might be biasing the results. The results show an abundance of Pinus both in Cabeço da Amoreira and Cabeço da Arruda indicating a clear preference for pine for fuelwood in both sites, an available species in Muge woodlands (Wollstonecroft et al, 2006; Schriek et al, 2008; Monteiro et al, 2012).

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Charcoal analyses, Mesolithic, Muge shellmiddens, Cabeço da Amoreira, Cabeço da Arruda, Pinus

Late-Holocene tropical moist-forests of southeastern Cameroon: some insight from soil charcoal analysis

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Tropical forests of Central Africa constitute the second most important block of moist forest of the world. Little is known, however, about past vegetation in this region that remains underexplored (Vleminckx et al. 2014; Morin-Rivat et al. 2014). Determining the past specific composition of these forests could allow bringing insights into their evolution over time and providing data about their resilience capacity facing global change. We performed a pedoanthracological analysis in the semi-deciduous forests of southeastern Cameroon. We excavated 53 test pits of 53 50 × 50 × 60 cm in plots of botanical inventory along a NS 80-km long mega-transect that followed a vegetation gradient. We sorted and quantified charred macrobotanical remains by layers of 10 cm, then identified species from wood charcoals. We used the InsideWood database, implemented with 163 new anatomical descriptions of woods present in the study area by using the reference collection of African woods of the Royal Museum for Central Africa (Belgium). Finally, we obtained 25 radiocarbon dates on charcoals and oil palm endocarps. Results showed that repeated fire events occurred across the study area during the last 2500 years, soon after the well-documented "rainforest crisis" (e.g. Lézine et al. 2013). The analyzed charcoals are likely human-induced regarding evidence of associated human settlements (e.g. potsherds). Aged were distributed into two time periods: the Early Iron Age (2300-1300 BP) and the Late Iron Age (700-100 BP) with an intermediate hiatus in human occupation (see e.g. Wotzka 2006; Morin-Rivat et al. 2014). Specific composition during both periods did not strongly differ from current composition, which is now dominated by light-demanding canopy trees belonging to old-growth semi-deciduous Celtis forests (Gond et al. 2013; Fayolle et al. 2014). This argues in favor of the maintenance of light-demanding tree species by anthropogenic activities, such as slash-and-burn shifting cultivation. We conclude that moist forests have a good resilience capacity regarding moderate and scattered disturbances. These forests can nonetheless be deeply impacted by land-use intensification (e.g. degraded forests along roads and close to cities; Gond et al. 2013).

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Tropical Africa, Holocene, pedoanthracology, taxonomic identification

Soil charcoal analysis at Cecita Lake (Sila Massif, southern Italy): a useful tool to understand local environmental change

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The area around the Cecita Lake on the Sila Massif (southern Italy) is nowadays occupied partly by grassland and pasture and partly by forests dominated by Pinus laricio, resulting from a reforestation program started in the '50. Previous anthracological investigations carried out at two archaeological sites excavated around the lake and dated to the Neolithic and to the Roman Age have shown a strong shift in the vegetation cover. While in the Neolithic a mixed broadleaves forest characterized the surrounding landscape, a pine forest is attested during the Roman time (Pelle et al. 2013). In order to better understand the dynamics of the vegetation change, soil charcoal analysis was carried out on five soil profiles excavated in different locations both nearby the lake and at a longer distance. 33 AMS radiocarbon dates were implemented to better define the chronology and to obtain a more precise date for the vegetation change. The high number of radiocarbon dates permitted to display a very large chronological frame, spanning from the Late Glacial to the modern times, and to underline the presence of reworking phenomena due to colluviation and alluviation in some of the soil profiles. Despite this, the soil charcoal data clearly indicate the persistence of a mixed broadleaves forest dominated by deciduous Quercus and with the presence of Abies and Juniperus until around 3000 BP. This is in agree with the pedological analysis carried out on many soil profiles in the area (Scarciglia et al. 2008), showing the persistence of warm and wet condition during the Neolithic and until the 3000 BP, when a climate with less marked seasonal contrast in the temperature rate and at least temporary lower rainfall is attested with evident erosional events in almost all the investigated profiles. Though the pedological data shows deterioration in the climatic conditions after the late Prehistoric period, the main forcing leading to the shift in the vegetation seems to be the human overexploitation of forest resources, being the human impact documented by numerous archaeological settlements dated to the Neolithic, Eneolithic, Greek and Roman Age around the lake. To better disentangle the question and try to clarify if the environmental change was mainly climate or human inducted, the published pollen records from the region (e.g. Joannin et al. 2012) were collected together with the available works aimed to past climate reconstruction (e.g. Frisia et al. 2006, Giraudi et al. 2011). They were then compared with the available archaeological data to gain information about settlement density and settlement distribution over the considered chronological frame to evaluate the human impact on the Sila massif.

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Sila massif, vegetation change, Late Holocene, Quercus, Pinus

Timber for building in the Vesuvius area during the 1st century AD: wooden and charcoal remains from Oplontis and Herculaneum (Naples, Southern Italy)

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The Vesuvius area in Campania (southern Italy) is one of the richest places in archaeological sites all over the world. In particular, the volcanic eruption of Mount Somma-Vesuvius in the year 79 AD, covering with a thick deposit of volcanic material the Roman cities of Pompeii, Herculaneum and Stabiae and numerous villas located on the Sarno plain and along the Bay of Naples, allowed their preservation in an excellent state. In Herculaneum and at the Poppaea's Villa in Oplonis (Torre Annunziata), the anaerobic conditions created by the volcanic flows and the high temperature of the volcanic surges permitted the conservation of a huge amount of organic material, among which also timber used for building. In both sites, the timber is preserved fresh and carbonized and, in Herculaneum, also in waterlogged conditions. The status of conservation is extraordinary: in both sites entire elements used for ceiling, roofing and framing are still preserved in situ or stored in different rooms on the sites. Despite this richness of findings, still few are the studies devoted to wood/charcoal analysis and they are often restricted to a very low number of samples (e.g. Caramiello et al. 1992). In this paper, we present the results of the charcoal and wood analysis carried out on timber used for building in Herculaneum and in Oplontis (Moser et al. 2013). At both sites, the study concerned the analysis of beams, joists, poles, planks and window and door frames. In Herculaneum, the ceiling and roofing of the marble hall of the Casa del Rilievo di Telefo was also investigated. The analysis permitted not only to understand which were the preferred taxa used for building by the Romans in this area, but also to advance hypothesis on the different use of timber in relation to its technical properties and on the circulation and trade of timber during the Roman Age. Through the comparison with the available pollen records of the region, then, a jigsaw piece was added to the reconstruction of the past landscape of the area. Coniferous timber is the preferred material for building, in particular Abies and Cupressus constitute the main source of timber in the Vesuvius area. Silver fir is widely used in all the kind of building elements, testifying its large presence in the surrounding forests during the 1st century AD. Very interesting is the selective use of cypress for the production of poles, highlighting a practice that is nowadays abandoned in Italy. Picea abies and Picea/Larix are also employed for making beams and planks: pollen analysis indicates that Norway spruce and European larch never grew in southern Italy during the Holocene (Ravazzi 2002). We have, indeed, to hypothesize the import of timber from the northern Apennines (for spruce) or from the Alps (for larch and spruce). Among the broadleaves, all present in the nearby vegetation, the most used is Castanea sativa, this fact confirming the preferential use of this taxon for timber purposes instead of for fruit production during the Roman Age (Di Pasquale et al. 2010). Deciduous Quercus, Juglans regia, Ulmus and Fagus are also present in the record, reflecting the woodland composition in the area.

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Vesuvius area, building timber, Abies, Cupressus, Picea/Larix

Character of the Atlantic woodland of the Great Hungarian Plain

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The aim of this research is to compare the forest structure derived from the wood charcoal analysis of the Neolithic period in the Great Hungarian Plain with the pollen-based vegetation reconstructions in order to infer the character of forest communities developed between 8500 and 6000 cal. yr BP. The study focuses on the north-eastern region of Hungary, where several archaeological (e.g. including unpublished data from Polgár-Bosnyak-domb and Polgár-Csőszhalom) and natural (e.g. Sarló-hát, Báb-tava) sites have provided anthracological and palynological records. An interesting issue is the structure and aerial coverage of the woodlands in the Early-Mid Holocene, particularly during the Holocene Thermal Optimum, when summer mean temperatures were higher than those recorded today. Pollen studies of materials from this period have revealed a dominance of hazel (Corylus avellana) and oak (Quercus sp.) with significant naturally open, steppe covered habitats (Magyari et al. 2010, 2012). On the other hand, the wood charcoal records indicate a relatively lower presence of hazel along with a higher content of oak admixed with several other woody taxa (Moskal-del Hoyo 2013). These taxa include Cornus sp. and Rosaceae shrubs that remain either invisible or poorly represented in the pollen diagrams. The two methods are complementary and the results help to enhance the knowledge about this important time period, when Neolithic agriculture made a massive spread in the GHP (Whittle 1996; Anders, Siklós 2012; Raczky et al. 2012). The possible presence of Cornelian cherry (Cornus sp. cf. C. mas) is discussed, as it is a member of the Sub-Mediterranean wooded steppe associations in lowland Bulgaria and NW Turkey, where today warmer summer conditions predominate relative to those experienced in the GHP. The abundance of Cornelian cherry in the Atlantic wood charcoal assemblages suggests that the environment of the GHP was more similar to the Balkan Sub-Mediterranean wooded steppe environments during the Atlantic phase.

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Wooded steppe environments, anthracology, palynology, Neolithic, Atlantic period, Hungary

Landscape changes in the Miechów Upland (South Poland) from the Early Neolithic to the Early Middle Ages

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This research aims to contribute to a better understanding of the history of natural vegetation in the loessic upplands of southern Poland, especially of the Miechów Upland. This region has been identified as "a white spot" in the map of paleoecological studies in Poland due to the lack of suitable sites for palynological investigations (Ralska-Jasiewiczowa 1989, p. 43). Apart from a few anthracological studies (Wasylikowa et al. 1992; Burchard, Lityńska-Zając 2002), there is still little knowledge about the development of the palaeovegetation in the region. The excavations carried out at site number 3 in Miechów have included the gathering of archaeobotanical samples, which have provided a great opportunity to investigate the dynamics of local vegetation and to understand the people-environment interactions. Due to its fertile soils, this part of the loessic plateau was settled by the first farming groups that appeared in Poland (e.g. Kruk, Milisauskas 1999; Nowak 2009). In Miechów, the Neolithic occupation began at the end of the VIth millennium BC with the appearance of the Linear Pottery Culture (LBK) and continued with several occupation phases representing different cultures, including the Lengyel-Polgar Complex, the Funnel Beaker, and the Baden cultures. Archaeobotanical material was also found within the archaeological features dated to the Bronze Age (Lusatian culture), the Iron Age (Przeworsk culture) and the Early Medieval Period. Therefore, these anthracological assemblages are a valuable source of information for palaeoenvironmental analysis as they indicate changes in local woodlands that occurred during the decline of the Atlantic period, in the Subboreal and Subatlantic periods. The study of other plant remains may enrich the inferences about the local landscape and may permit assesing the plant resources used by people of different cultures and to characterize the human influence on ecosystems that developed near the settlements. A special emphasis was placed on Neolithic plant remains. The main research tasks included the characterization of primeval forests, the determination of the openness of the landscape, and confirming the existence of a xerothermic steppe-like vegetation.

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Oak-woods, steppe-like vegetation, archaeobotany, anthracology, Neolithic, Atlantic phase, Poland

The different uses of wood in cemetery and settlement areas of archaeological sites in Ulów (Tomaszów Lubelski district, East Poland)

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Several archaeological sites have been recently discovered in a forest near the village of Ulów (commune Tomasz Lubelski) in Central Roztocze (Niezabitowska-Wiśniewska 2009). The anthracological analysis of the material found in the settlement (site 9) and the cemetery (site 3) has allowed assessing the different uses of wood and, on the other hand, characterizing the local woody vegetation. A type of wood utilized in funerary rites is of special interest (Moskal-del Hoyo 2012). The archaeological sites are dated to the Late Roman Period (Wielbark culture associated with the Goths) and to the Migration Period (late Germanic tribes - possibly the Heruls). In the settlement, the charcoals mainly came from archaeological pits, but also appeared in daub pieces that were part of ancient constructions. In the cemetery, the charcoals were found in different features such as funerary pyres of the cremation graves and in features forming 3 rectangular structures (4.0 x 3.5 m, 4.4 x 3.8 m and 1.8 x 1.7-1.8 m), which were oriented to the four cardinal points and probably represented overground platforms supported by wooden posts. Charcoals that appeared in features interpreted as hearths were also studied. Some of them contained burned beams made of oak (Quercus sp.), which were subjected to dendrochronological investigations compared with radiocarbon dating of branchwood. These features, in contrast to the graves that were rich in artefacts, mostly made of glass and metal did not contain any archaeological material. Moreover, during the archaeological excavation campaigns, models of wooden overground platforms and funeral pyres were reconstructed on the premises of the Primary School in Ulów. This provided a better understanding of palaeoethnohraphic habits and played an important role in the spread of archaeological investigations of the Ulów micro-region among local people.

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Cemetery-settlement complex, funerary rites, anthracology, Ulów, Late Roman and the Migration Periods, Poland

Woodland from Mesolithic to modern times: a combined approach of anthracology and palynology sheds new light on the vegetation history of Northern Germany

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This paper summarises archaeo- and geoanthracological as well as palynological research performed in the last ten years in Northern Germany, notably the southern part of the Cimbrian (or Jutland) peninsula (state of Schleswig-Holstein). The region has a long tradition of palynological research. The approach combines soil and soil sediment profile sampling, samples from archaeological sites, as well as peat cores for pollen and micro-/macrocharcoal analysis. Several palaeoarchive types were used: an inland dune complex, soils and soil sediments (small and large profiles), lake sediment and peat from mires, and archaeological sites, including settlements, grave mounds, and charcoal production sites. With the combination of charcoal giving a more local evidence of species occurrence, and pollen data, we were able to narrow down questions of woodland composition in time and space, which were hitherto reconstructed in a more general way with pollen analysis alone. For example, megacharcoal (charcoal > 1mm) evidence was found for a pioneer presence of Fagus around 4000 BP, though the spread of Fagus did not occur until much later, according to both local as well as regional pollen diagrams. In the western part of the southern Cimbrian peninsula, Fagus seems to have established considerably later than in the east. Human usage of wood is reflecting local availability of species. With the combination of soil and sediment/peat charcoal analysis, fire evidences were found more or less throughout the last 12 000 years, but with a mid-Holocene gap. Thus fire activity seems to have been naturally triggered in the early Holocene, and mostly anthropogenic in the late Holocene. Data from late medieval and modern times charcoal kiln sites allow to locate woodland management practices, like coppiced stands or standards-with-coppice plots.

Anthracology; Northern Germany; Palynology; vegetation history; Northern Germany

A kiln site turned upside down: archaeological and anthracological study of a charcoal burning platform (K653) in the Black Forest, Southwestern Germany

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In the southern part of the Black Forest, about 8 km south of Freiburg, a charcoal production site was excavated archaeologically and detailed charcoal sampling and analysis was performed on several profiles and layers. The site is part of an ensemble of about a dozen charcoal burning platforms (kiln sites) at this slope (west-facing, submontane altitude) where todays potential natural vegetation is a beech-fir-forest. A former study established that indeed mainly Fagus and Abies was used by the charcoal burners at these sites (Ludemann & Nelle 2002). Four 14C-AMS dates place the site in the period 15th-17th c. AD, and support the stratigraphically deduced assumption of at least two main usage phases of the site. This hypothesis was thereafter tested by a detailed anthracological approach. With more than 2000 single charcoal taxonomic identifications, as well as minimum diameter analysis, from several samples at several positions of the platform along two long profiles (see also presentation by Jansen et al.), and in different depths of the charcoal rich layer, it became clear that in an earlier exploitation phase, Fagus was predominantly used, but which considerable proportions of Populus and Betula, as well as some Corylus, Carpinus, and Fraxinus. This points to an early modern times forest vegetation which was considerably opened by human wood exploitation in an area where the next settlement is only one km distant. Later, the predominantly charred wood came from Abies trees. Moreover, anthracological diameter analyses give evidence that large trunks of this coniferous species well suitable for construction timber have been converted to charcoal.

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Anthracology; charcoal production; archaeological excavation; stratigraphy; multi-phase exploitation

ACACIA, Automatical Creation of AnthraCologIcal dIagram

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Anthracological data representation handles with clear standards (Chabal 1997). Nevertheless, diagram creation often takes times and requires softwares which are not always available to everyone. A macro has been created on Excel with the financial support of UMR 7209 (CNRS/MNHN), PAIR (Pôle Archéologique Interdépartemental Rhénan) and ANR DENDRAC. Easy of utilization, ACACIA allows creating diagram from a classic data table. With simple commands, it computes automatically percentages, confidence interval and then, creates the charcoal diagram. The final diagram is available on BMP files. Several options are proposed to allow each user to create his own diagram (colours, size of boxes, etc.) in function of his needs. ACACIA will soon be diffuse to the anthracologists community with an instruction manual on a web site.

Anthracological Diagram, Semi-automatic, Excel

Woodlands evolution from the Neolithic to the early middle ages and human impact in Alsace (France). First dendro-anthracological analysis in the Kochersberg region

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Rescue excavations on a high-speed railway line between Baudrecourt and Strasbourg have allowed the discovery of many sites in the Kochersberg region (Bas-Rhin, Alsace, France) conduct by PAIR (Pôle Archéologique Interdépartemental Rhénan) and INRAP (Institut National de Recherches Archéologiques Préventives) institutions. There are dated from the Neolithic to the early Middle Ages. In addition to the archaeological research, further environmental analyses were carried out. While past forests research was very scarce in Alsace with the exception of the Vosges, the numerous archaeological sites have allowed new research on the field of charcoal studies. This presentation deals with the analysis of 11 archaeological sites separated only by 10 kilometres and studied in the context of a PhD (Nocus 2014). 8 504 charcoal fragments have been identified on 13 levels from middle Neolithic to early Middle Ages. Beside the identification of 26 taxa, radius curvature and tree-ring width have been measured. These dendro-anthracological results allow a first synthesis of the vegetation dynamic in the Rhine plain. The Neolithic period is mainly characterized of mixed oak forests with ash, maple and Maloideae. Beech develops during the Bronze Age then decrease while hornbeam appears at the beginning of Iron Age. This taxon develops after, during the Middle Ages. Light-demanding species increase during time as well as the diversity indices and the tree-rings growth, showing the opening of the wooded landscape. The numerous sites and charcoals studied for the Iron Age period enable to detail woodland managements and human impact which appears stronger from the Hallstatt D period. While oaks are important in the anthracological diagram during La Tène A period, this result allows to question whether or not the oaks percentages are the reflect of the environment or if it could be link with specific practices such as coppice.

Nocus N. 2014: Forêts et Sociétés aux étages plantitiaires et collinéens de l'Alsace du Néolithique au haut Moyen Âge : approche dendro-anthracologique. PhD MNHN. 380 pp.

Dendro-anthracology, Radius curvature, Tree-ring width, Eastern France

Regional pattern of past fuel wood use by charcoal burning in the Southern Vosges, France

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Anthracological studies of sites of historical charcoal production (kiln sites, charcoal burning platforms) can yield detailed information on the ancient forests, e.g. on their tree species composition and the changes therein on different spatial scales of the landscape level. Therefore such investigations are a main key to regional and local forest and land use history. Here we have analysed charcoal samples of traditional wood charcoal burning in the Southern Vosges, NW France, on a regional spatial scale including the divers growth conditions of this mountainous study area, in particular characterized by its distinct altitudinal gradient. However, to establish these studies and results first the exact field position of a large number of such chacoal sample sites is required. It should enable us to create a sample design that covers broadly the diversity of the ecological conditions of the Southern Vosges. Therefore time-consuming field surveys had to be undertaken to localize those charcoal burning platforms in the landscape. Based on this knowledge 155 sample sites were selected between 420 and 1230 m a.s.l. for the anthracological analyses. The tree taxa composition and the wood diameter size classes distribution of the fuel wood used by local charcoal production was given of each kiln site sampled. Differences between the charcoal assemblages of the single sites have been tested by statistical methods. Taxa composition and structural features of the exploited forest stands have been deduced and discussed with special regard to the ecological conditions of the surrounding of each site. Like in the Black Forest (Ludemann 2002, 2003, 2010; Ludemann et al. 2004) the tree species of the climax vegetation (regional natural forest vegetation) beech (Fagus sylvatica, 75 %), silver fir (Abies alba, 16 %) and great maple (Acer pseudoplatanus, 5 %) were mainly used. All other tree taxa established (14 taxa) are quantitatively unimportant (together 4 %). The individual kiln sites show several differences in composition and frequency of the exploited taxa. These differences can be explained by regional and local differences in the ecological growth conditions in the close vicinity of the sites, especially in their altitude above sea level, as the major ecological factor. An often suspected fuel wood selection of distinct tree taxa by the charcoal burners on the one hand and indications of forest degradation on the other was not supported by the present study. Again the local natural availability of wood seems to be one of the most important criteria for past wood use and forest exploitation.

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Charcoal burning platform, forest ecology, forest history, fuel wood, kiln site, Vosges

Vegetation history of the Doubrava forest (NE Czech Republic): a comparison of anthracological, pedoanthracological and pollen results

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The purpose of this study is to investigate a woodland history of the lowland forests during the holocene history in the Doubrava forest (NE Czech Republic). The goal of our study is an interpretation of the anthracological data from the archaeological sites, pedoanthracological profiles and pollen data from two profiles (Kačení louka; Králová jezírko) for reconstruction of the woodland history. The middle holocene changes of lowlands provides an idea of the dynamic succession of a forest vegetation. However the anthracological result from archaeological sites has showed the continuale presence of the broadleaved forest with a dominance of Quercus sp. and very common presence of Fraxinus excelsior and Ulmus sp. The significant change was recorded during the Bronze Age, when the presence of Fraxinus excelsior decreased and Carpinus betulus reversed. The anthracological data document the stability of species composition in the vicinity of archaeological sites in the lowland during middle and upper holocene history. The result from nearby pedoanthracological profiles reveal a higher diversity of arboreal dominants during a woodland history. The woodland composition from pedoanthracological profiles documents a close connection with local environmental conditions. The pollen profiles are situated in the extralocal alder wetlands and pollen analysis records the less distinguishable mixture of local and regional pollen rain. The cross-correlation of charcoal data from archaeological sites, pedoanthracological profiles and pollen data provided more comprehensive reconstruction and interpretation of the vegetation history.

Pedoanthracology; pollen analysis; charcoals from archaeological sites, woodland history; cross-correlation

Domestic and ritual use of plants and fuels in the neolithic cave of Alepotrypa, southern Peloponnese, Greece: the wood charcoal and phytolith evidence

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The study presents the combined results of wood charcoal and phytolith analysis at Alepotrypa Cave, southern Peloponnese, Greece. The cave preserves rich cultural remains (hearth and floor constructions, pits and platforms, human bone scatters, massive quantities of fine pottery, lithic artefacts and ornaments) spanning the late Early Neolithic to the Final Neolithic. The studied macro and micro-remains come from two distinct areas of the cave, the anterior chamber (close to the entrance of the cave) and the interior chambers (including a small fresh water lake), which, as has been suggested by several lines of evidence (analyses of cultural remains, bones and micromorphology), were used for domestic and ritualistic purposes respectively. The aim of this study is two-fold: a) to investigate the local vegetation, and woodland management, b) to understand the use of plants and use of space along the habitation history of the cave in the domestic setting of the anterior chamber and the ritualistic setting of the interior . Wood charcoal and phytolith analyses support the two modes of usage; different fuel types in the hearths of the interior and anterior chambers of the cave along with different activities are documented. For domestic firewood needs, along the entire habitation sequence, the neolithic inhabitants of the cave made frequent use of the open vegetation that expanded on the surrounding rocky slopes and included various scrub plants (Fabaceae, Labiatae, Cistus) and scattered drought-resistant trees (Prunus amygdalus, P. spinosa, Maloideae, Juniperus). Through time and probably as a response to increased demand due to more frequent and longer-lasting use of the cave, they expanded their fuel-procurement activities to nearby evergreen woodland (Quercus evergreen, Phillyrea/Rhamnus alaternus, Arbutus, Acer, Pistacia) and deciduous oak thickets (Quercus deciduous, Fraxinus) that would have spread on deeper soils. Leafy branches of those trees were used for feeding the hearths and grasses were used for kindling according to phytolith assemblages. These hearths in which strong fire was burning as well as platforms that preserve small remains of cereal processing or consuming served the domestic purposes of the front chamber. By contrast the ritualistic activities suggested for the interior, involved the use of selected types of fuel, i.e. dung in parallel to preference for firewood from scrub vegetation and small diameter wood of Fabaceae, Cistus and Phillyrea. The excellent burning qualities of most probably mature sheep dung, the ease of transportation of such material as well as of the small size firewood to serve for kindling would explain their preferential use in the interior chambers where access was exceptionally difficult. On the symbolic side, the slow-burning glow and smell of dung and the light of Pinus nigra resinous wood used for torches may have enhanced the powerfully evocative atmosphere of the interior chambers.

Neolithic, domestic, ritual, wood-charcoal, phytoliths, vegetation, fuel

A comparative study on wood shrinkage during carbonizing between oak and chestnut. An application to the study of wood diameters in a charcoal burning process

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The work undertaken for a few years by the ANR DENDRAC has established the stages necessary to the restitution of wood diameters through the analysis of charcoal found on archaeological sites. Following the measurement of the radius curvature on a great number of charcoal pieces it has been demonstrated that it was necessary to correct these data in order to take in consideration at least the shrinkage of wood due to carbonization process. If this correction seems to be crucial to conduct subsequently the statistic processing allowing the restitution of the diameter of the woods used, the assessment of the corrective factor due to shrinkage seems more complex to assess. Indeed some studies tend to emphasize a wood shrinkage differential varying with the wood types (Garcia and Dufraisse 2011, Paradis-Grenouillet 2012). An experiment carried out on three experimental kilns containing logs of oak and chestnut shows that the application of a 25 % corrective factor provides results that are more distant from the original data for the chestnut, which is not the case for oak (Paradis-Grenouillet 2012). Through this observation we may suppose that these two taxa do not react in the same way to the carbonization process. This is why a new workshop has been created in the ANR DENDRAC to compare wood shrinkage in these two taxa in conditions as close as possible to those collected during the experiment on charcoal kilns (a carbonization taking place in an environment with a poor level of oxygen), with different temperatures (400, 500, 600° C), the state of wood (green wood, oven-dry wood, carbonized wood). The study has been carried out in a muffle furnace on different shapes of wood (slice of logs and logs of different sizes). Benchmarks have been marked in order to estimate the heterogeneity of the shrinkage. This approach enables us nowadays to better understand the shrinkage process and to suggest corrective factors adapted to these two taxa.

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Paradis-Grenouillet Sandrine (2012), Etudier les forêts métallurgiques: Analyses dendro-anthracologiques et approches géohistoriques. Exemples des forêts du mont Lozère et du Périgord Limousin. Thèse, Université de Limoges

Shrinkage, wood diameter study, corrective factor, chestnut, oak

The Chestnut tree in Limousin, an indigenous or imported species? New anthracological data on a rural housing in the first iron age (Mézières sur Issoire, Haute Vienne, France)

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In the memory of the Limousin region, the chestnut tree, an emblematic tree in this area, presents several aspects. It is first of all associated to orchards, declining by the end of the eighteenth century, but also to single species coppices of chestnut trees dedicated to the production of wood battens at the end of the nineteenth century. Finally recent studies have emphasized the importance of charcoal making in the establishment of these coppices, especially to provide the fuel necessary to the development of proto industries in the eighteenth and nineteenth centuries. (Paradis-Grenouillet, 2012, Rouaud, 2013). The history of the chestnut tree in Limousin is very complex, and the origin of its development in the landscape of this area has been the subject to vast debates. Through numerous archeobotanic studies led since the eighties (Belligaud et Fredon, 1985 ; Poirier, 1999 ; Allée et al., 1997 ; Miras, 2013), it is now admitted that the species would have been introduced in Antiquity. The recent discovery of charcoals dating from the first iron age on the site of Mézières sur Issoire north west of the region (excavations of preventive archaeology, EVEHA) brings a new element to discuss on the origin of the chestnut tree in Limousin. Indeed these archaeo-anthracological data confirm previous pollen data, dating from the first iron age, collected at the bottom of a valley in the western part of the region. (Allée et al., 1997). Based on these new data we propose to revisit the issue of the origin of the chestnut tree in Limousin, by examining, among other points, the hypothesis of its being indigenous and the possible existence of micro-shelters during the latest ice age, as was proved in Périgord. (Krebs et al., 2004)

Chestnut history, limousin, anthracology

Dendro-anthracometry in tropical trees: first results on the use of fiber lines to obtain wood referentials for diameter measurements

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Understanding management strategies of forest resources by studying the exploited wood is essential to rebuild the physiognomy of ancient forests. Estimations of wood diameters are valuable because selecting wood sizes was probably as important as species selection. Besides, they help to rebuild the structure of forest communities surrounding archaeological sites. Dendro-anthracometry is still incipient in Brazil. Models and analytical protocols developed in Europe since the 1990's to estimate the diameter of different species used in human activities greatly rely on anatomical standards of temperate species, using annual growth rings and wood rays in wood cross sections as reference. Their application is hampered in tropical areas, where most of the trees lack growth rings. This work analyzed the possibility of using concentric fibers lines from the secondary xylem, instead of growth rings, to develop wood referentials of tropical trees. Fibers are the only cell type present in all Angiosperm woods, being produced in a concentric arrangement by the cambium of most species. We followed in this study the model proposed by Dufraisse and collaborators for estimating wood diameter, developed by ANR DENDRAC program. It is based on the trigonometry of the isosceles triangle; the angle and the distance between two wood rays are used to calculate the distance to the pith – the radius (Dufraisse & Garcia-Martínez, 2011; Paradis et al, 2013). Measures are obtained on photographs of charcoals and fresh wood taken in a macroscope, which are analyzed using an image analysis software. The study was performed in fresh woods of four species belonging to three tropical families, typical from the Atlantic Forest (Annonaceae, Anacardiaceae, and Euphorbiaceae) collected by our team in Rio de Janeiro state, Brazil. Lines of fibers were identified in slices of fresh wood under a macroscope and highlighted with a thin graphite. Measurements of distance, angle, and radius were performed using these lines. The samples' real diameters were measured with a caliper rule and the real distance between fiber lines and pith, used as reference, was measured with a ruler. In woods presenting parenchyma lines, measurements were also performed in regard to these lines, in order to compare with the fibers measurements. The differences between the estimated and the reference measures were quantified and classified into three classes of error percentages, as established in Dufraisse's model: measurements with a percentage error between 0-20% were considered "reliable", those between 20-45% as "moderately reliable" and those above 45% as "unreliable"; the latter were rejected. Only 13,5% of the measures obtained for all four species analyzed are inside the last class, and therefore unreliable, attesting that it is possible to use the fiber lines instead of growth rings in this model. These first results suggest that diameter estimations can be achieved with a reasonable degree of accuracy in woods up to 10cm. All species confounded, the average error for estimations of 0-5cm-diameter varied between 0,5-8%; those of 5-10cm between 7,5-23%. Application of this model in tropical environments presents therefore a great potential. These preliminary results are a key step to a better understanding of the structure and diversity of forest fragments under anthropogenic influence in tropical regions, still poorly studied. New specimens will be added to the samples in order to improve these findings and new experiments will be performed with the same wood samples charred.

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Archaeobotany; dendro-anthracometry; charcoal; diameter; forest management.

Anthracological evidence in historical ecology: landscape and land use at the Punta Mesco Cape in the Cinque Terre National Park, NW-Italy (XVII – XX century)

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This paper presents the results of the anthracological analyses from Punta Mesco, a promontory in the Cinque Terre National Park (NW- Italy), which are part of a number of micro-historical studies applied for the restoration of historical heritage. Since 2009, a project was developed in this area by FAI (Fondo Ambiente Italiano, an association for the preservation of artistic and environmental heritage) with the aim of studying and restoring a peculiar site of terraced farming, set in a Mediterranean vegetation. In addition to other initiatives (e.g. restoration of the buildings and recovery of historical crops) and as a reference for these activities, the study of historical and environmental features of the site was planned by LASA since 2014. The methodological approach for this research is historical ecology, including anthracological analyses from different contexts such as soils, fire places, remains of charcoal kilns. The results from anthracological studies have been integrated with other historical sources, including documentary and field surveys, but also pollen analysis, in order to reconstruct the local past agro-ecosystem and its changes over time, from the 17th century up to modern time.

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Anthracology; Historical Ecology; Environmental Archaeology; Cultural Landscape; Post-medieval age; NW-Italy

People, trees and landscapes in the Balearic Islands (Western Mediterranean): forests and prehistoric communities in Mallorca and Menorca through archaeological charcoal analysis

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In the recent years, anthracological analysis carried out in the Balearic archipelago has been significantly increased, offering the possibility to address a diversity of research goals through the study of archaeological charcoal assemblages, specially in Menorca and Mallorca between c. 4.000 and 2.000 BP (Picornell 2012). This research has been driven by a set of theoretical and methodological assumptions that permits a general goal: the study of the interactions between society and woody plants in the Prehistory and Protohistory of the Balearic Islands within the frame of the socio-environmental relations of these groups. To do so, a holistic and contextual approach to charcoal assemblages, considered as the material result of past interactions between people and plants, has been developed in the frame of the archaeological study of the relations between humans and the environment. We have, thus, focused on both the reconstruction of the vegetation dynamics and the study of the relations of humans with it, considering a diversity of theoretical and methodological aspects: the relation between the social perception of the environment and the plants with the cultural use of these; the study of the firewood within the context of everyday domestic practices and in no way isolated from these; the analysis of the technological factors related to the fire chaîne opératoire and of the use of timber as raw material; and the holistic consideration of the social practices connected to the use of wood in various social contexts (the everyday and the ritualised). In this sense, the anthracological results are not considered as independent datasets, but integrated with others in order to be contextualized. The research strategy has resolutely considered in an integrate perspective different kind of charcoal assemblages (e.g. domestic fuel, ritual fuel, timber, wooden objects). It has been also significant the construction of a dialog between anthracological and other paleoecological data (mainly off-site pollen diagrams) of the Balearic Islands, as this exercise has resulted in the identification and definition of both paleoecological and social trends that become observable by the combination of archaeological, bioarchaeological and paleoecological datasets. Some unexpected trends of the Mediterranean vegetation have been evidenced in this research, as the evergreen oak forests expected to be dominant in the Balearic landscape during all the Holocene are almost invisible in the anthracological record. On the contrary, open sclerophyllous formations, with a marked shrubby character and with a sclerophyllous shrublands dominated by Olea europaea, characterize the vegetation of the islands of Mallorca and Menorca. It deals with phytogeographic associations completely defined and stable in relation to the biogeographic conditions of the archipelago. The notion that they are the result of the degradation of other forest formations (e.g. oak forests) due to the activity of the human groups is discarded. The changes appreciated in the charcoal assemblages are due to the changes in the management of the forest resources, activity which does not suppose a substantial modification of the vegetable landscape, upon not appreciating substitutions of vegetable formations nor significant transformations of the taxonomic composition during the studied period. This forest resources management changes throughout time in relation to the transformations in landscape perception, spatial rationality and relations with forests among the prehistoric communities.

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Anthracology/charcoal analysis, prehistory, Balearic Islands, Mediterranean landscape, people – plants interactions, paleobotany

Landscape and firewood exploitation during the Holocene at La Garrotxa (Girona, NE Iberia)

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The aim of this work is to assess the landscape and management of firewood resources during the Holocene at La Garrotxa (Girona, NE Iberia), a middle mountain region (400-1600 m asl.) located within a volcanic area in the Pre-pyrenees. Anthracological and palynological data from archaeological sites and lacustrine and peat deposits from this area have been considered in order to carry out an approach to the landscape and the use of resources. Archaeobotanical data discussed here come from two main valleys, Vall d'en Bas and Vall del Llierca, where several archaeological sites were excavated covering the whole Holocene, from Mesolithic to Middle Ages. In addition to the diachronic objective, a comparison between the two valleys and among synchronic settlements in different historical periods has been done in order to evidence differences between areas both in environmental availability of raw material and in social management of natural resources. Palynological data allowed us to evaluate vegetation history in the area through the Holocene, which has been subject to climate fluctuations and to anthropic disturbance. In the Early Holocene, the landscape was characterised by the progressive expansion of forests started after the end of the Late Glacial, mainly dominated by conifers (pine and juniper) and deciduous trees (oak and hazel). The Holocene Climatic Optimum lead the culmination of forests expansion, with the dominance of dense oak forests, the landscape that first farming societies found in their arrival to this area. During Middle Holocene, the expansion of evergreen sclerophyllous trees and the regression of broadleaf deciduous trees are recorded, regarding to both climatic and anthropic causes. In the Late Holocene, the process of vegetal succession from broadleaf deciduous forests (oak) to Mediterranean evergreen forests (pine and evergreen oak) is consolidated. Charcoal data from 29 archaeological levels show the main resources used as firewood. Quercus sp. deciduous and Buxus sempervirens were the most important taxa during all the periods and areas. However some other taxa had certain importance in some periods and sites. The variability observed between sites is discussed regarding the availability of resources and landscape transformations recorded in the palynological data. This could explain the appearance of Quercus sp. evergreen and other Mediterranean taxa in the anthracological record at the Middle-Late Holocene. But also the archaeological features of the sites and the socio-historical processes are considered in order to understand the use of firewood. The characteristics of the occupations, functionality and duration, could determine how was organized the management of resources.

Landscape, Firewood, Holocene, NE-Iberia

Charcoal analysis in a prehistoric cinnabar mine (Uccellina Mts., Central Italy)

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This work presents the preliminary anthracological data from Buca di Spaccasasso mining site. The Spaccasasso hill is a calcareous hill in Maremma Regional Natural Park in Uccellina Mountain (Southern Tuscany, Grosseto, Italy). On the north-west side of the hill there is an important prehistoric funerary and mining site. The archaeological evidence is known as Buca di Spaccasasso Cave. The cave and the calcareous rock face is characterised by thermal action, which deposits mercury sulphide in the limestone rock and results in cinnabar veins. Cinnabar minerals were mined in different phases of the site's occupation, and the site shows evidence of occupation over a long period of time, from Late Neolithic to the Copper Age, the Early and Middle Bronze Age, and Late Antiquity (V-VI cen. B.C.). During the Copper Age the site was used as a funerary area, characterised by secondary deposition rituals. Under the funerary evidence layers mining evidence was found. The mining activity findings are connected with the fire place mining technique which is evidenced by a large fireplace and some ateliers. This paper presents the preliminary charcoal analysis in the context of the fireplace used to heat the rock face. The archaeological investigation is still in progress.

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Charcoal analysis, Late Neolithic, Copper Age, Mining, Cinnabar

Fire-induced mass transport in small catchment areas as a source of information on the past dynamics of human occupation

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The territory of the Volga River bend (Samara's Luka) is an area of forested hills within the flat steppe region: it has excellent resources of wood, water, and surficial iron ore deposits. In the last 2 millennia, this territory was characterized by the frequent population change: the sites belonging to various archaeological cultures persisted here for time periods that varied from several centuries to several decades. Such short-term occupation does not allow for the temporal ordination of neighboring sites by means of radiocarbon dating. It is not clear whether some of the sites co-existed, or there were breaks in occupation between them, and what land use pattern was associated with each occupation. To answer these questions by analyzing the archaeological sites themselves is not plausible. We've hypothesized that such disturbances as forest clearing, burning, ploughing, grazing, and trampling on small watersheds in the forest-steppe transition zone can lead to a rapid and substantial increase in the surface run-off, mass transfer, and accumulation of colluvium in closed depressions and gullies within the catchment areas. Depopulation of the catchment area would, in contrary, cause the surface stabilization and either grassland or forest soil formation. In this context, the climatic dynamics would impact the size and amount of transported materials rather than the number of the depositional events. The combination of pedological, ichnological, and anthracological studies was utilized to reconstruct the history of human occupation of a small watershed adjacent to the Zhiguli medieval site and burial ground (VII-IX cent.AD, Khazars) and the catchment area downstream from the site. Seven cycles of erosion and accumulation occurred here during the Holocene. Each cycle began with fires, leading to the increase in runoff and ravine incision, and ended with the stabilization of the surface as grassland or forest was reestablished. The cycles were correlated with the periods of human occupation of the catchment area known from the archaeological surveys and radiocarbon dated using the soil charcoal. Differences between the charcoal assemblages associated with the forest fires, swidden cultivation, and repeated burning of pastures were described. Only two of the multiple fire occurrences were attributed to the forest fires, the others were associated with the land clearance. The length of the periods with a similar land use pattern varied from a few decades in the agricultural cycles of the early Middle Ages, up to several hundred years in the nomadic-pastoral cycles of the Chalcolithic, Bronze Age, Iron Age and the late Middle Ages. The analysis of species composition recorded in the soil charcoal assemblages showed that the vegetation cover changed within every cycle. The human utilization of the watershed resulted in the elimination of the understory, reduction of tree-species richness, and increase in the proportion of conifers. Regardless of the extensive utilization of oak as a wood fuel, oak remained a dominant species of the forest canopy, whereas the proportion of linden, birch and maple varied. A combination of fire and grazing has triggered a wide deforestation of this potentially forested area during the warm climatic phase of the middle Holocene (IV millennium BC, the Chalcolithic). A new period of progressive deforestation began in X-XI cent. AD (during the Medieval Warming). The first traces of the typical steppe inhabitants, the burrowing rodents, are found in the soils of this age. Discontinuities in human occupation of the area lasting a few hundred years occurred in the middle Holocene. Shorter breaks (less than a century) occurred between the Scythian-Gorodets period and the Imenkovo-Khazar period, later between the Khazar period and the Bulgarian period, and in the period preceding the Russian colonization of the area in the sixteenth century.

Fire history, pedoanthracology, paleoecology, geoarchaeology, swidden, tracefossils

Human visibility in the Maritime landscapes: anthropogenic ignition of windstorm debris

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Our research aimed to reconstruct pre-historic fire regimes in three coastal areas of Canadian Maritimes: Kouchibouguac National Park (New Brunswick), Prince Edward Island National Park (PEI), and Kejimkujik National Park (Nova Scotia). The three study areas have a similar forest cover (species-rich, mixed Acadian forest), but differ drastically in the general geomorphology and soil texture, which could entail differences in the fire frequencies. Reconstruction of past fire regimes was based on radiocarbon dating of the soil charcoal incorporated in uprooting structures. According to our findings, the tree uprooting caused by hurricane-speed winds creates in the soil a specific signature that enables a site-specific reconstruction of past windstorms. Trace fossil analysis of soils in three Maritime national revealed presence of several generations of hurricane-caused tree uprooting structures in each of our 105 study sites. As the hurricanes created an immense amount of woody debris, the debris could be ignited: many paleo-hurricanes were followed by fires. Timing of the past hurricane events was determined by the radiocarbon dating of charcoal associated with coupled hurricane-fire events. In each of our study areas, traces of 13 to 14 coupled hurricane-fire events were recorded for the time period from 300 to 10000 years ago, with the average frequency of the events peaking in the last millennium. Some of the events occurred simultaneously in all three areas, whereas the others occurred simultaneously in two of the three areas. Simultaneous events occurred in the New Brunswick and PEI lowlands approximately 5000 BC and 2300 BC, in eastern PEI and south-eastern Nova Scotia ~AD 920 and AD 1350. Finally, all three areas were affected by large-scale fires in approximately 2000 BC, AD 1100, AD 1550, and late 1700-s. The windstorms were not always followed by fires: prolonged breaks in fires were documented in Kejimkujik and PEI NP areas (e.g., between 2000BC and BC300, and 300BC and AD500), whereas in Kouchibouguac the fire occurrence was more regular. In contrast to the peak fire frequencies, the breaks were mainly asynchronous for the three areas which could be attributed to the absence of camp sites/open hearths during the breaks. The synchronous ignition of the debris in the areas distanced for hundreds of kilometers most likely reflected the colonization/exploration of the area by newcomers: the migration waves of Early, Middle, and Late Woodland cultures and, later, the Europeans. After AD900-1000, the fires frequencies increased drastically, reaching an average of 200yrs for the area in general. In depressional areas of relief, traces of even more frequent fires (every 40-60yrs), not associated with uprooting structures were recorded. The period of Medieval Warming was characterized by the spread of swidden agriculture in more southern areas: in Canadian Maritimes, the cultivation of corn was described by the early travelers, but not confirmed archaeologically. The unprecedented synchronous occurrence of fires in all study areas in AD 900-1000, drastic increase in the fire frequencies after AD1000, and new finds of specific charcoal-cored concretions (indicators of deforestation) in deposits accumulated during this period can be interpreted as a new evidence for the swidden cultivation in Canadian Maritimes from AD900-1000 onwards.

Fire history, paleohurricanes, human migrations, tracefossils, swidden

Late Holocene history of woodland dynamics and wood use in an ancient mining area of the Pyrenees (Ariège, France)

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This paper is a part of an interdisciplinary study, which is focused on woodland changes and ancient land use in a small mining area called “Les Argentières-Lacore”. It is located in the upper Garbet valley (in the province of Couserans) that marks the end of the polymetallic Pyrenees and beyond this natural border, iron deposits are dominant, particularly in the Vicdessos valley. The study area has two argentiferous galena deposits that were already exploited by the end of the Iron age-Antiquity by means of firesetting, then again in the 18th and the 19th centuries. Moreover, it is crossed by the road, which connected both valleys via the “Port de Saleix” for centuries. This road was used since the 14th century for the iron/charcoal exchange that was sealed between the Vicdessos – a major steel valley – and the Couserans, a forest valley with the "mouline" technology, at the end of the middle ages. The rich mining history of this area and its margins raises the question about the impact of mining and ore processing activities on the dynamics and trajectories of woodland cover. In particular, we want to characterise their potential ties with (1) the near elimination of Abies alba in favour of Fagus sylvatica, and with (2) the late-holocene upper timberline variation. In addition, we want to measure the environmental consequences of the implementation of the exchange treaty iron/charcoal. Here, we present anthracological records from (1) 31 charcoal kilns staggered between 1400 and 1700 m asl on the Lacore side, (2) 1 pedo-archaeological pit opened on the Argentière heap waste, and (3), 2 pedological pits opened on the Lacore side. Particularly, the initial diameter of charcoals from charcoal kilns was evaluated from the observation of the curvature of growth rings. The anthracological data is compared with palynological data from a core sampled in a peaty area located near the Argentière mine. The data analysis, which is based on several radiocarbon dates, permits a detailed reconstruction of the woodland cover changes between 1400-1700 m asl and reveals that the mining and ore processing activities form part of a complex process of anthropisation that increases at the end of the Iron Age. The intensification of charcoal production during the Renaissance and the Modern Era fell within a managed forest (beech coppice with a short rotation).

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Mine, charcoal kilns, anthracology, pedoanthracology, woodland dynamics, Late Holocene, Pyrenees

QUEDNAU & LUDEMANN – poster session 2

First pedoanthracological study in the Black Forest, SW Germany

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For the first time a pedoanthracological study was undertaken in the Black Forest, SW Germany, considering past tree species composition of the forests. For this purpose a total of ten soil profiles were sampled in highlands of the Southern Black Forest namely each two profiles at the highest locations of five mountaintops. The pedoanthracological approach includes extraction, taxonomical analysis and radiocarbon dating of soil charcoal fragments from the soil material (Thinon 1992; Carcaillet & Thinon 1996) ; however,no charcoal pieces were dated during this study. The main challenges of our investigation were (1) the verification of significant residues from historical wildfires and the documentation of their concentration distribution within each soil profile and among different soil profiles, as well as (2) the taxonomical analysis of single charcoal pieces, which can give indications of the woody vegetation of the past. Almost 40 g charcoal were extracted from the collected soil material. 2240 pieces of charcoal were taxonomical analyzed and six wood types were distinguished. Most pieces of charcoal were attributed to maple (Acer), followed by fir (Abies) and spruce (Picea). Only 31 charcoal pieces of beech (Fagus) were found which represent about 1.8 % of total extracted charcoal. The four tree taxa mentioned are also currently the most common one in the study areas, albeit with greatly differing proportions. Spruce is dominating in the upper montane belt of the Southern Black forest by far, followed by beech, while fir is rarely abundant. Currently sycamore maple is frequently found in the upper montane belt, but usually with less percentage. The pedoanthracological results of the five study sites indicate a general increase in Picea-share geographically from west to east. Concentrations of this magnitude of extracted pieces of charcoal suggest that for the most part it is the result of natural forest fires, like described in other pedoanthracological publications (Schwarz et al. 2005; Robin et al. 2012 a; Robin et al. 2012 b; Robin et al. 2012 c).

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Black Forest, forest fire history, forest history, Picea abies, soil charcoal analysis

Wood charcoal production and iron metallurgy in Charente lowland's forests (France): an ancient history revealed by the use of new tools

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Charentaise lowland's forests, like other forests in France and Europe, still home to many archaeological remains. Constituting evidence of an occupation and a past exploitation, these sites allow to understand the complex dynamics and the long history of forest land. By choosing to study metallurgical sites within an ancient activity - prior to the fifteenth century - it seemed essential to determine a possible relationship between this and the many charcoal platforms located in the near environment. These places of charcoal production could indeed be those supplying metal workshops. It is based on a specific approach, both interdisciplinary and multi-scalar, and the use of tools such as LiDAR, photogrammetry, and radiocarbon dating, the methodology developed in the part of a doctoral thesis (Rassat, ongoing) tried to answer.

Rassat G. (ongoing) – L'artisanat du fer en Charente et Dordogne avant le haut-fourneau : approche paléométallurgique et environnementale, sous la dir. de Philippe Allée, Nadine Dieudonné-Glad et Marie-Claude Bal-Serin, PhD thesis, Université de Limoges.

Wood charcoal production, iron metallurgy, archaeology in forest, LiDAR, photogrammetry, forest

Fuel management strategies at the extreme and changing environments: the case of El Chueco 1 site (11500-2500 yr. cal. BP) at central western Patagonia

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The relations between the human groups and their environment are of utmost importance when studying regional archaeologies that focus on the assessment of the knowledge and exploitation of the resources by past hunter gatherer societies. The anthracological theories and methods are aplyed to the study of the archaeological site of « El Chueco 1 », located at the Cisnes river valley (Central Western Patagonian steppe ~44ºS). This site is a very interesting case for the study of fuel management strategies, owing to the very dynamic environmental characteristics which ocurred during the Final Pleistocene, the Pleistocene-Holocene transition and the Holocene at the Central-Western Patagonia. The anthracology, contributes to this research area, through defining « chaines opératoires », where both the procurement of raw materials, and the knowledge of the environment and their natural resources, are major components of the human decisions, until now an unexplored fields in this area. This paper presents the first approach of fuel management study at Central Western Patagonia during the Final Peistocene and Holocene.The Patagonian territory, presents extreme and constrasting environmental characteristics, which offer diverse resources for past human societies. Central Western Patagonia is particular in that it shows biomes ranging from evergreen forests in the west to semiarid steppes in the east, thereby providing a good case for assessing differential procurement of resources. The Cisney valley, is located on an ideal area for studying such a problem since they connect this ecological diversity and yield human occupations starting at the onset of the Holocene. This archaeological site is located at high altitudes in the steppe of the Cisnes river course (950 masl). « El Chueco 1 » is a key site for understanding differences in resource selection considering the evidences that suggest a connectivity networks with the others sites of this river course, and the changing climatic and landscape. In this paper we explore the anthracological assemblages of « El Chueco 1 », to analyse resource procurement strategies under the assumption that their must have been different and adaptive to changing environment.

Anthracology, fuel management, human – environment relation, Central Western Patagonia, extreme environments, Holocene

Charcoal as a key to multiproxy studies

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Multiproxy study is a key approach to deal with the complex history of the environment. Indeed, the mechanisms of the environmental dynamics are multi-scale and multi-factorial. Therefore, our understanding of the past environmental dynamics can greatly vary according to the spatial level of perception and the temporal resolution of the analysis. For instance, in many cases local signals of Holocene fire frequency do not fit together from site to site, or to regional trend. Also, the determinism of environmental changes are often multiple with combined processes, at various scales, as for instance the climate-people-landscape interactions. Moreover, the taphonomic processes often increase the complexity of the interpretation of the paleo-signals. Secondary deposit, transformation of indicator, etc., may blur the significance of a proxy, and its interpretation. Therefore, to get a solid and relevant picture of the past environments it is necessary to use multiproxy approaches, to be able to interpret together indicators completing (and correcting) each other's. In such research design, charcoal proxy appears especially interesting because it permits to develop various relevant useful connections with other data. Hereby it is aimed to illustrate through various study cases the relevance of the charcoal data into multiproxy approaches. First, it is shown that charcoal data can constitute a multiproxy database by itself. Indeed, charcoal assemblages can be in multiple forms (mainly according to the size of the pieces) and extracted from various type of archive (natural or archaeological context, moist as well as dry archives), and thus provide a multiproxy picture of some aspects of the history of the environment. Then, it is shown that charcoal data are relevant in complementary with other type of proxy, possibly extracted from the same archives (e.g. pollen), or from totally divers origin (e.g. dendrochronology). In the end it is shown that charcoal data use in multiproxy approach provide a more complete picture of the past environmental dynamics at various scales, permitting to get closer to the spatiotemporal continuity of environmental changes.

Experimental analyze of the taphonomy of soil charcoal assemblages

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During the last decades soil charcoal analyses was a more and more used paleoecological approach, for a large range of paleoenvironmental issues and in various biomes in the world, with contributions which permitted significant advances. However, the interpretation of the charcoal assemblages embedded in soils or soil sediments remains limited by their complex taphonomy. Indeed, although the taphonomy of charcoal assemblages from archaeological context and from chronostratified archives (i.e. lake sediment), have been well investigated, and are therefore relatively well understand, the archiving processes of charcoal pieces in natural soils or soil sediments context remain poorly documented. The formation and preservation of charcoal assemblages in soil / sediment matrix is a complex multifactorial process which is a challenge for the interpretation in terms of spatial resolution, chronological stratigraphy, representativeness through time, quantification. These latter points are key issues for the interpretation of paleo-records and therefore it is needed to improve their understanding. To do this we have developed an experimental approach to observe the taphonomy of macroscopic charcoal in natural soil, focusing on the processes of 1) burying and 2) fragmentation. The experimental design is to analyze these previous processes in a comparative way, for charcoal of four wood anatomical types (Acer, Fagus, Quercus, Picea; produced in controlled conditions), at three various time steps (1, 5 and 10 years). In 2010, a quantified charcoal input of each wood anatomical type was done at the surface of raked natural soil on experimental squares of 1m², with three replicas per anatomical type. Also, it was included experimental controls in the experimental design, corresponding to experimental squares without charcoal input. Here we present first results of comparative observation in number of pieces and weight to assess the fragmentation and anthracomass loss, for various depth steps.

Experimentation, Pedoanthracology, Taphonomy, Natural soil, soil sediment

Soil charcoal analysis of a Mediterranean old-growth forest: historical relict or anomaly?

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In the Mediterranean basin, old-growth forests are "anomalies" subsisting in the degraded landscapes. Indeed, the co-determinism of old and intense human activities with the constraint of the Mediterranean climate have induced the widespread presence of semi-open to open ecological systems (matorral vegetation). Forests systems reestablished after secondary successions are most of the time highly sensible to perturbations (e.g. fire) and therefore do not stays long enough to develop mature stages of forest dynamic. However, it has been also pointed out in the Mediterranean basin the presence of old-growth forests presenting features of mature forest stage. But the history of these forests remains poorly documented so far. Indeed, most of these forests are on small in size and therefore needed to be investigated at local scale. This is a challenge in the Mediterranean context where archives suitable for the recording and the preservation of most of the paleo-indicators are rare. Thus, key issues about the Mediterranean old-growth forests remain unclear: 1) the spatiotemporal dynamics of these old-growth forests, and 2) the determinisms of their subsistence in the degraded landscapes of the Mediterranean basin. Aiming to clarify these pervious issues, with suitable paleo-signals we have done soil charcoal analysis in an old-growth forest in the southeast of France, the Sainte Baume Forest. This forest is a remarkable forest presenting nowadays many temperate species, such as Fagus sylvatica and Taxus baccata. We have done soil charcoal analyses, combined with geomorphological assessment, in- and nearby- the current forest area to assess the local history of the forest and its surroundings. It have been open and sampled 17 soil profiles in the forest and 5 nearby the forest (2 on its north, and 3 on its south). Macroscopic charcoal assemblages have been extracted. Their taxonomical spectrums show a clear distinction between the samples from the forest and from the soundings. The charcoal assemblages from the forest are clearly dominated by temperate tree species such as Fagus and deciduous Quercus, while those from the surroundings are dominated by evergreen vegetation, with only few deciduous Quercus. Radiocarbon dating from selected charcoal pieces proves the ancient presence of the temperate forest, as an island in a semi-open landscape. Also, the presence of the forest is proved to be before the forest became a holly place and the establishment of a monastery during the Middle-Age. Thus it is postulate that this forest is a the subsistence of a former larger forest, which was degraded in some places, and remains at the Sainte Baume place due to specific physical condition and thanks to its holly statute.

Mediterranean old-growth forest, Local Forest dynamic, Temperate versus degraded forests

Multi-proxy assessment of past fire regime and ecosystems response in northern central Europe

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Fire is a major disturbance of ecosystems dynamics. This is well stated concerning easy flammable ecosystems under dry climate conditions. In such ecosystems the high frequency of wildfire and / or man-made fire is a key structuring and functional component. Thus a large part of the paleoenvironmental changes may be related to fire history, and the dynamic of the ecosystems maybe assessed according to the reconstructed past fire regime. In central Europe climate and vegetation features limit strongly the occurrence of wildfire, and thus fire appear to have a weaker role into the dynamics of ecosystems. Nevertheless, man-made fire may occur and have significant consequences on the state of the ecosystems. However, the temporal heterogeneity of human development, the spatial heterogeneity of land-use, and the various way to use fire, blur the past fire-signal and thus the reconstruction of the past fire regime. Therefore, the past fire regime of fire disturbance, whether on local or regional levels, remains poorly documented today. Here we present a study aiming to complete our knowledge about past fire regime in northern central Europe, and its consequences for the dynamics of the ecosystems. To overcome the limitation due to the predominance of man-made fire it is used an innovative approach based on the comparative analysis of various and complementary type of charcoal assemblages, and from various archives. Also this innovative approach permits to assess directly various component of the past fire regime such as type of fuel, fire magnitude, frequency, etc. Moreover, the ecosystems response to the past fire regime is documented by the analysis of several pollen records. It is presented the first results of a paleoenvironmental investigation done is northern Germany (Schleswig-Holstein), in the domain of temperate broadleaf forests, under oceanic climate. Micro- and macro-charcoal signals have been extracted, as well as pollen records, from peat and lake sediment archives, with large and small catchment areas. Mega-charcoals assemblages were extracted from soils samples taken from the surroundings of the cored mires and lakes. The various charcoal assemblages have been quantified, related to their chronological frames. The mega-charcoal assemblages have been matter of taxonomical analysis. The response of the ecosystems to the fire disturbance occurrences was identified through pollen and geomorphological analysis. It as has been identified a clear and strong influence of human into the past fire regime, but with spatial heterogeneity in high resolution, at least for some time windows. Ecosystems changes according to the past occurrence of fire, but the high spatial heterogeneity of the fire events seems to permit the redevelopment of the pre-fire vegetation from nearby unburnt areas. Finally, it is highlighted the relevance of our innovative approach to reconstruct past fire regime, especially in a context of heterogeneous environmental history.

Disturbance regime, Fire history, Human impact, Pollen, Sedimentary charcoal, Soil charcoal

Dendroanthracological study of Castellón Alto (Galera, Granada, Spain)

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The archaeological site of Castellón Alto, belonging deposit to the Culture of Argar (Middle Bronze Age) has provided an enormous quantity of charcoal. The existence of two widespread fires did that all the wood, proceeding from the construction of the huts and from the domestic utensils, they will go on to the archaeological record as charcoal. This is allowing us to produce a floating dendrochronological curve of the site. In addition, the existence of a large number of branches of different species such as Salix, Populus, Atriplex, from the roofs of the huts, allows us through the dendrological study know different aspects: time of cutting, the choice of sizes and management of the different species used.

Bronze Middle Age, Dendroanthracology, Iberian Peninsula

ROUAUD ET AL. – oral session 4

A ten-year study on the history of charcoal making in the west part of Massif central: a contribution to regional biogeography through the anthracology of charcoal kilns

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Before the widespread use of fossil fuels in the 20th century the production of charcoal has played a strategic and considerable role in providing fuel for cities and metal industries (Bourquin-Simonin, 1969; Buridant, 2000). The needs were so massive that charcoal making concerned all forest areas and constituted a real socio-economic phenomenon. (Acovitsoti-Hameau, 2000, Merlin et al., 2005). An exhaustive exploitation of the forest contributes to the selection of some taxa ; over a long period it modifies the repartition of some tree species at the expense of others, thus deeply shaping forest landscapes (Houzard 1985). We have been working for ten years now on this impact of forest exploitation for charcoal, especially through the anthracology of charcoal platforms. This enables us to estimate the impact of charcoal making activity on present forest areas since they provide a very accurate archeaobotanic information over a surface of thousands of square meters. (Jalut et Métailié, 1991 ; Fabre et Gervet, 1992). We are able to illustrate the contributions of this approach through three examples: the forests in the gorges in upper Dordogne, the chestnut woods in Limousin, and the Braconne forest in Charente. By integrating historical data, this compared approach enables to show the importance of regional political and socio economic backgrounds which influence and even go beyond the biogeographical frame of forest ecosystems.

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Charcoal production, massif central, anthracology

Early Neolithisation process in eastern Europe: first charcoal analysis from two sites in south-western Ukraine

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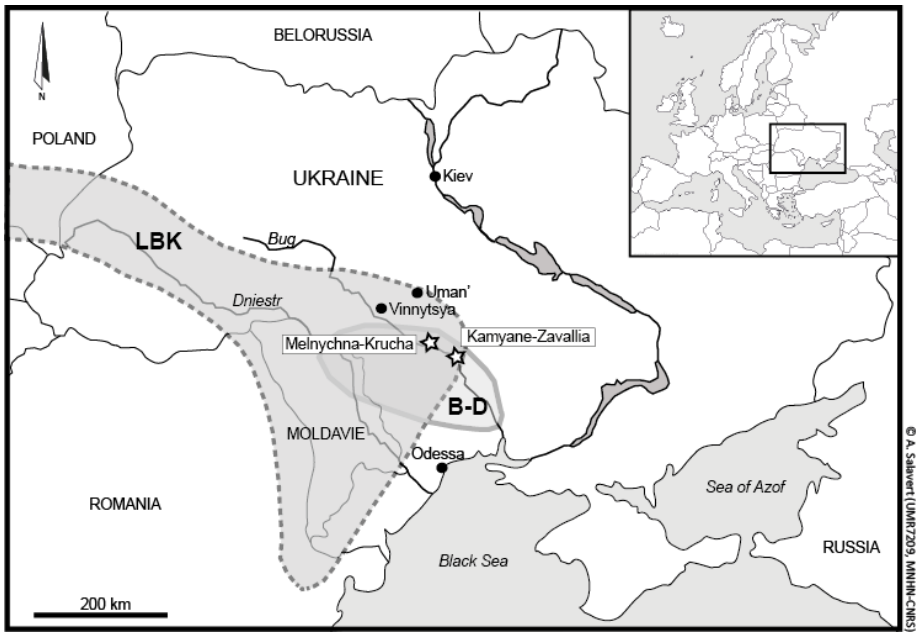
The Neolithisation process in south-western Ukraine, and on a broader level in Eastern Europe, is still not well understood. In that sense, the woody environment exploited by the first Neolithic groups has never been studied so far. Here are given the preliminary results of charcoal analyses undertaken on two early Neolithic sites located in the Bug valley: Melnychna-Krucha, reported to the Bug-Dniester culture (6000-5300 BC), and Kamyane-Zavallia, which is the easternmost ever-excavated site of the Linearbandkeramik (LBK) culture (5300-4900 BC) (Kiosak 2014a, 2014b). Macroremains have been sampled in August 2014 in the frame of a French-Ukrainian cooperation program . Furthermore, phytoliths, seeds and fruits analyses are also carried-out to assess the vegetal economies on both Neolithic sites. Although the dataset is still quite narrow (due to the limited extension of the 2014 excavations), the charcoal-based results represent a valuable first approach to provide information on firewood managements by first Neolithic groups, in a region where the environment is currently steppic. The archaeobotanical analyses might be extended in a near future in this key area of the northern Black Sea.



Location of the Neolithic sites, with simplified geographical extension of the Bug-Dniester (BD) and Linearbandkeramik (LBK) cultures.

The project “Interactions et dynamiques des sociétés et des environnements à la transition Mésolithique-Néolithique dans les steppes du sud-ouest de l’Ukraine”, coordinated by A. Salavert, was supported by the program Action Transversale du Muséum "Les dynamiques socio-écosystémiques".

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Ukraine, Neolithic, Bug-Dniester, Linearbandkeramik, firewood, landscapes

SANTERAMO – poster session 3

Medieval rural landscape and economy in northern Spain: preliminary archaeobotanical studies of deserted villages

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In this paper we illustrate the first results of the anthracological studies carried out in some medieval deserted villages located in the Alava Plain, in the Basque Country, north of Spain. In the last few year very extensive archaeological projects conducted in the sites such as Zaballa (6th-15th centuries) and Zornoztegi (5th-13th centuries) had provided a large collection of archaeobotanical remains. Given their long period occupation, the charcoal evidence allows analysing the palaeoenviromental and palaeoeconomical dynamic of the site, paying attention to the study of building techniques and craft activities. The interpretation of these records will be done in relationship with other bioarchaeological and archaeobotanical studies carried out in these sites. The main topics discussed are the formation of medieval villages, their transformation during the feudal age and the desertion process.

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Archaeology; Anthracology; Middle Ages; Rural economy; Landscape

ANTHRAKOS: A new online database, charcoal identification, data management, and data charing system

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Anthracological analysis is based on charcoal identification through wood anatomical features. It depends on a good knowledge of wood anatomy characters, on the use of descriptions and/or photographs from the literature, and on reference collections and databases. This is not such a great problem in temperate and Mediterranean regions, where wood anatomy is rather well known, and several atlases exist that can help identification. In tropical regions, however, charcoal identification is much harder, due to their enormous biodiversity. The anatomy of tropical wood is as yet incompletely known, and therefore the development of comparative collections and of databases is a critical issue. From several computer-aided wood identification systems already developed, the most important are those based on DELTA-INTKEY language (Richter & Trockenbrodt, 1996) and InsideWood (InsideWood. 2004; Wheeler, 2011), but none of these is specifically designed for charcoal identification, and none presents any possibility of sharing information while protecting unpublished data either. The "Anthrakos" system, specifically conceived with his purpose, is an improved, internet-accessible version of the former "Atlas Brasil" program (Scheel-Ybert et al., 2000), which was very efficient, but suffers of irreparable malfunctions due to outdated software. The Anthrakos database is designed to the management of anatomical data from both reference collections of charred wood (or wood slides) and ancient specimens (archaeological, paleoecological, or fossil), but can also be used for conventional wood anatomy and literature data. The features taken into account were standardized from the International Association of Wood Anatomists criteria (IAWA Committee, 1989), including some specific adaptations for anthracology. Besides wood anatomical data, images may be associated to taxon description, as well as general information on each species. The system allows recording description forms, performing searches, and generating text files with anatomical descriptions. It is currently available in Portuguese, English, and French; translations to Spanish and German are also foreseen. Users are organized in research groups that share access to a set of data, each composed of an administrator and his collaborators. The whole system was designed to protect unpublished data, so only administrators are able to decide which data will be publicly available without restriction. Users of different groups do not share information, with the exception of public data. The development of this system is an attempt to integrate data from different research teams on a common platform, maximizing efforts in the establishment of reference collections and description of different species worldwide. It has been largely tested and has already proved to be an important tool for taxonomic identification, data management, and data sharing. It can largely contribute for the development of anthracological research, and may be useful to researchers of different specialties.

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Anthracology, charcoal, identification, database, internet, wood anatomy

SCHEEL-YBERT – poster session 1

INDEX ANTHRACORUM: Creation of a global directory for charcoal collections

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Anthracology, as a field of knowledge, will soon be completing five decades of history. The proliferation of studies has demonstrated that, in most instances, the lab work is largely based on the consultation of charcoal reference collections. A first inventory on charcoal collections maintained by scientific institutions or personally owned by individual researchers around the world was gathered through consultation of researchers, laboratories, and international mailing lists. This survey revealed as yet 53 charcoal collections in five continents. The first known charcoal collection has been initiated in the late 1960s, but it was not until the 1980s that they began to proliferate, and 65% of them were created after 2000. About 40% of these charcoal collections (20) are dedicated to European species, followed by c. 20% (10) dedicated to South American taxa. European/Mediterranean and South American taxa are also the best represented in number of specimens. Five collections specialize in Australia and the Pacific; although assembled quite recently, these collections account for a large number of specimens. Five collections target African species. Only three collections are specialized in North American species, all of them from Canada. Three small charcoal collections focus on Central America, all of them located in European institutions. Finally, there are seven diversified collections containing specimens from different parts of the world. No charcoal collection was identified in Asia, although anthracological research seems to be currently prolific there. Yet, specimens from Asia are included in several general collections. When it comes to institutional location, almost 60% of the charcoal collections are held in Europe, against 17% in South America; the others are distributed in North America, Australia, and Africa, with up to 10% in each. The high concentration of collections and specimens in Europe reflects a better established and longer tradition of charcoal identification in temperate and mediterranean regions. However, research seems to be firmly advancing in other parts of the world, especially in the tropics, where important collections are being established – mostly in Brazil, the tropical Pacific and Australia. The great increase observed in the number of existing charcoal collections and their geographical spread in the last years attest of the vigor and advancement of the discipline in its different approaches. The improvement and expansion of charcoal collections, as well as a better knowledge of their contents, and an optimization in their use are essential to the further development of the discipline and to encourage its new applications. We propose therefore the creation of a complete international catalogue, comparable to the already existing Index Herbariorum (Thiers, 2015/ongoing) and to IAWA's Index Xylariorum (Stern, 1988; Lynch & Gasson, 2015/ongoing). This global directory of existing charcoal collections might bring together information on the physical location; contents; responsibles/curators; regions, countries, or taxa in which the charcoal collection specializes; existence of herbarium vouchers and/or dry wood samples associated; and other. The establishing of such "Index Anthracorum" might be an important tool for anthracological research, improving scientific exchanges and cooperation among research teams.

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Anthracology, charcoal, identification, collection, wood anatomy

Wildfire versus slash-and-burn and flaming and the fate of charcoals

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A wildfire site at Leghia in western Transylvania/Romania provides the opportunity to compare the regeneration types of vegetation and soil after fire with the slash- and-burn-experiment at Forchtenberg/ SW-Germany. This is done by botanical, pedological and micromorphological investigations. Both sites are situated in deciduous forests of maple, beech and oak. The climatic is comparable too, however, much more contrasted at Leghia. Here the forest is on slope with a shallow rendzina on lime- and sandstone whereas the Forchtenberg site is on a loess-covered plateau showing cambisols and luvisols. Flaming and field burning provides information on the behaviour of grass coal. At Leghia about 5 ha were afforested with pine-trees 60 years ago. In august 2011 the pine area accidently took fire for about two days. Thus, there were ground and crown fire and much more charcoals on the ground as on the slash and burn plot. Looking to the 3-years period after fire there are several differences in the early successions. Submediterranean shrubs dominated at Leghia. A dense Rubus-cover, typical for the Forchtenberg site, did not develope. Soil surfaces were covered be thick Ol/Of/Oh –layers at Leghia, which are rare at Forchtenberg. Concerning the fate of charcoals on both sites it became evident that soil animals represent the most important factor for their mobility or preservation near the surface. It concerns three main groups: Earthworms, enchytrees, mites and collembols and finally ants. From the droppings and transformation of the soil material it got evident, that earthworms diminish charcoals stepwise and distribute them vertically very effectively. In contrast to them enchytrees, mites and collemboles are keen to alterate charcoals on or near the soil surface. The Leghia site, however, shows that under a contrasted seasonal climate swelling and shrinking of clay or silt material provokes a mulching process with an alteration and even distribution of charcoals, which is also supported by enchtyrees depositing small charcoal assemblages by their droppings. This counteracts the conservation process of charcoals in the moder-layers beneath Pinus stands, in which earthworms are very rare. However, they appear under deciduous trees. Concerning ants, they are able to transform the whole topsoil to a loose and homogenous structure destroying any previous structure. Charcoals are exploited as building material for the subaerial constructions but avoided for their subterranean nests. A burned wheat field near Kitzingen/N-Bavaria as well as a flamed meadow and wheat field near Lehghia evidenced two main differences to slash-and-burn or wild fire. Charred material consisted only of grasses. The soil surface was burned in a mosaic-like manner. Charcoal was very fine and distributed on the surface with half a cm´s thickness. Enchytrees and swelling /shrinking processes were responsible for the vertical transport to about 5cm depth. As any flaming in Germany is strictly forbidden the microcharcoals were very rare in the topsoil. In contrast to them microcharcoals were evenly present in the topsoil of the two Transylvanian sites even flaming is forbidden since many years too as in the western part of Central Europe.

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Wildfire, intended fire, charcoal weathering, soil animals, SW-Germany, Transylvania.

Aging of historical and prehistoric charcoals - characterization using Fourier Transform Infrared (FT-IR) spectroscopy and simultaneous thermal analysis (STA)

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Based on the infrared spectral and thermal fingerprint and multivariate data analysis chemical changes due to aging of prehistoric (Bronze Age) and historical (Medieval Period and Modern Period) charcoals were identified. The series of samples originated from a region in Styria called Eisenerzer Ramsau (Austria), where charcoal was used for metallurgical processes. While the Bronze Age samples were residues from the copper production, the historical samples were produced in charcoal kilns. Spectral and thermal characteristics of recent charcoals that were produced according to the historical charcoal burning technology in a rectangular charcoal kiln represented the starting material. The chemical changes of charcoals with time are reflected by specific infrared bands assigned to organic functional groups. Due to this development charcoals become more hydrophilic which is additionally stressed by the absorption band of water in the spectrum and the corresponding mass loss in the thermal profile. The continuing aging process is paralleled by an increase of these properties and causes different periods to form a separate group in the Principal Component Analysis. Spectral and thermal fingerprints reflect the degree of charcoal carbonization and therefore provide information on its history. Carbonized wood originating from combustion residues of fire disasters or hearths can be clearly separated from charcoal that had been produced for energy supply. Spectral and thermal profiles of combustion residues still reveal wood characteristics that are lost during a charcoal production process. Both discriminant analysis and classification based on infrared spectral characteristics unambiguously segregated two sample sets assigned to the Medieval Period, charcoals from Styria (Eisenerzer Ramsau) and carbonized wood of combustion residues from the medieval site in Tulln (Lower Austria). FT-IR spectroscopy and STA provide a comprehensive characterization of charcoals. By means of multivariate methods much information can be extracted regarding the degree of carbonization, the progress of aging and the origin. The latter is mainly reflected by the mineral components of the environment where historical charcoals came from. The evolution of classification models for a region enables to assign samples very fast to a defined category.

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Prehistoric and historical charcoals, FT-IR spectroscopy, STA, multivariate data analysis

Charcoal VS seeds? The combined interpretation of anthracological and carpological assemblages and their implications for understanding archaeological contexts

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Charcoals are frequently found together with other plant remains, such as pollen, fruits and seeds, among others. Still, these are often interpreted separately. The advantages in gathering charcoal and pollen information in palaeoecological interpretations have been pointed out by several investigators (e.g. Nelle et al. 2010) and other studies demonstrate how useful the combined study of charcoal and fruits/seeds can be for understanding specific contexts and the gestures related to them (Caracuta and Fiorentino 2014). Still, the interpretation of anthracological and carpological assemblages is frequently done separately despite being usually recovered in the same archaeological contexts. This happens because their study is sometimes carried out by different investigators, with different timings or even within different projects. We argue that this can lead to misinterpretation of both charcoal and carpological assemblages. This is valid for archaeological charcoal and pedoanthracological studies. The combined interpretation of charcoal and seeds/fruits assemblages presents a wide set of advantages, although three can be emphasised: a) It gives a wider perspective of plant resources used in specific contexts. E.g., carpological assemblages can provide information regarding herbaceous species and non-wood plant parts used as fuel; b) The presence of different plant parts can add taxonomic detail on charcoal assemblages; c) The presence/absence and the frequency of carpological remains among charcoal assemblages may change the interpretation of the latter. The opposite is also true. Examples will be given for each of these cases, mostly focusing published and unpublished data from prehistoric and historic sites in western Iberia. With these we will question the interpretation of structures such as pits and demonstrate that fruits and seeds can had relevant information regarding the fuel used in some hearths and ovens.

Caracuta, V., Fiorentino, G., 2014. Garbage Disposal in the Middle Bronze Age in Tell Mardikh-Ebla (NW Syria): Using Plant Remains to Investigate Midden Formation Processes. In Francesca Baffi, Roberto Fiorentino, Luca Peyrone (eds.), Tell Tuqan Excavations and Regional Perspectives. Cultural Developments in Inner Syria from the Early Bronze Age to the Persian/Hellenistic Period. Proceedings of the International Conference May 15th-17th 2013, Lecce. Congedo Editore.

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Charcoal analysis, carpology, combines interpretation

Gallo roman timber in maritime french alps (Col d'Adon, Les Mujouls, France): identification, uses and condition

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The archaeological and anthracological analysis of material from the settlement of Col d'Adon (1000 m altitude), in the Southern French Alps, emphasizes how timber is chosen and used in a rural Gallo-Roman construction, from the first to the third centuries AD, according to various structures : beams , floor, door and lintel collapsed and charred. While excavating, different sampling protocols were applied based on archaeological contexts characterization and on type of surveys out of the grip of the site but including levels of contemporary occupations. The first paleoenvironmental data provide an overview of floristic diversity during the site occupation and lead to compare with data from layers and settlements contexts. It provides the opportunity to identify whether or not there is a species timber's selection. The charred wooden structures discovered during the annual archaeological excavations have been investigated by multidisciplinary approaches: archaeology, anthracology and entomology. The aim is to document how timber is used in rural construction, which technical process can be recognized and is timber protected against wood-borer pests ? The entomology's contribution to anthracological analysis is original. The archaeological context and taphonomy preserve traces of wood pests : tunnels, charred woodworms, remains of elytra and wood deformations. Their observations reveal which insect colonized timber before burning. Each species lives in its own bio-ecological environment and presents its own characteristics. A better understanding of wood's conditions (treated, debarked, sick, young, etc.) is available. Specific examples will be developed including: The example of floor, US 3090. Mainly in Scots pine type, the floor is stuffed with insect tunnels and small worm holes beetles. The presence of common furniture beetle (Anobium punctatum) is attested. Spatialization and measures of colonizing population proportions offer a dynamic vision of pest infestation.

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Lepesme P. 1944 – Les coléoptères, des denrées alimentaires et des produits industriels entreposés. Paris, éd. Paul Lechevalier, 124 p.

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Moskal-del Hoyo et al. 2010 - MOSKAL-DEL HOYO (M.),WACHOWIAK (M.), BLANCHETTE (R.A.) - Preservation of fungi in archaeological charcoal. Journal of Achaeological Science, 37, 2010, pp. 2106-2116.

Archaeology, Anthracology, Entomology, Southern French Alps, Gallo-Roman

New insights on the palaeobiogeography of Quercus ilex woods in the Cantabrian region (N Spain) based on integrated charcoal and pollen studies

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A synthesis about the presence and evolution of the evergreen oak plant formations throughout the Cantabrian region is presented on the basis of charcoal analysis and complemented with palynological data. The charcoal information comes from 14 archaeological sites distributed along the littoral and pre-littoral territories of Country Basque, Cantabria and Asturias. The period of time covered spans from 40 to <3.5 Kyr BP (uncalibrated dates) which culturally ranges from Mousterian to the Iron Age. Pollen information mainly comes from peatbogs and lakes distributed throughout the same area of study including the uppermost slopes of the Cantabrian Cordillera and the northern Iberian mountain range and covering the same period of time. Evergreen oak already appears ca 42-40 Ka (>44 in the pollen record) although its presence is sporadic and discontinuous in an environment dominated by Pinus sylvestris during Mousterian and Aurignacian periods (40-30 Kyrs BP) according to charcoal record. This taxon is hardly present on the charcoal and pollen records between 25 and 13 Kyrs BP, which is characterized by high amounts of Fabaceae in the charcoal record. From the Late Magdalenian onwards Quercus ilex and karstic shrubs appear again remaining continuous throughout the Holocene although low regarding the dominant amounts recorded by deciduous oak both in pollen and charcoal records of the Cantabrian region submit to prevailing oceanic climate influences. On the contrary the relationships between deciduous and evergreen Quercus are more favourable to the later in the north of the Iberian mountain range (pollen) where oceanic influences are attenuated by those of Mediterranean type.

Quercus ilex, pollen, charcoal, Cantabrian region, Pleistocene, Holocene

UZQUIANO – poster session 3

Vegetation and human interactions in Cantabrian Spain related to Holocene climate dynamics: A synthesis based on chacoal studies

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This study reports a series of anthracological data obtained in archaeological sites from the Cantabrian region (N Spain) in order to reconstruct the interactions between climate dynamics, vegetal landscape and economic management developed by humans in its respective cultural stages occurred throughout the Holocene. The transition to the Holocene was a period of important changes. The increase in temperature and moisture precluded the expansion of deciduous Quercus over the previous pioneer taxa Pinus or Betula depending on the coastal or innermost location of sites, and coinciding with the Azilian-Mesolithic cultural transition. The development of deciduous oak forest (Quercus, Corylus, Fraxinus, Ulmus) occurred during the Holocene climatic optimum and became the main vegetation formation exploited by the Cantabrian Mesolithic groups living in lower altitudes. The different geographical position of the sites (shoreline, pre-littoral elevations/inner Atlantic valleys and uppermost intra-mountain valleys), their topographic characteristics, substrate type and altitude explain the main floristic variations observed in the anthracological assemblages (Pinus, Betula, Quercus). Furthermore, the management of woodfire during this period showed a strong correlation with the Mesolithic economic system mainly based on the hunting of Cervus herds following their altitudinal movements in an upland-lowland direction along the valleys, complemented with the collection of molluscs in littoral areas. In this regard the emergence of some peculiar taxa observed in the charcoal spectra (Fagus, Castanea, Taxus) would be related both to the geographic characteristic of the area and the economic practises aforementioned. The arrival of the Neolithic occurred in some of these sites (Cares Valley) represents in terms of vegetation rather an intensification in the exploitation of the same plant ecosystems already started in the previous Mesolithic period, and whose effects can be felt on later periods (Bronze age).

N Spain, Anthracology, Holocene, Economy, Wood resource exploitation

Thule fuel management at Cape Espenberg (N-O Alaska): Experimental protocol and dataset from current driftwood deposits and archaeological charcoal remains

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This anthracological study addresses the issue of the availability of wood fuel to the inhabitants of the archaeological sites of Cape Espenberg in north-western Alaska during the second millennium AD. We focus specifically on the mechanisms for firewood collection and management in a tundra environment that is poor in wood resources. In this region, driftwood deposited on the shorelines served as the main source of wood for past Thule populations (Alix, forthcoming). Archaeological and ethnographic data indicate that driftwood and other non-timber products (such as animal products) were sometimes mixed to improve the calorific conditions of fires (Burch, 2006). In this study, we first establish an experimental protocol to evaluate 1) the over / under-representation of driftwood species in charcoal assemblages after burning, and 2) how the addition of a non-timber product (animal fat) to the wood fuel may affect the preservation of different species. The results of this experiment highlight the influence of animal fat on driftwood fires and their resulting charcoal assemblages. Next, we present the results of the analysis of excavated anthracological charcoal in Thule houses at Cape Espenberg. Finally, we apply the results of our experimental fires to the interpretation of the archaeological charcoal to determine whether animal fat was combined with wood fuel by Thule people.

ALIX C. (forthcoming) - A critical resource: wood use and technology in the North American Arctic, in M. T. Friesen et O. K. Mason dir, Oxford Handbook of Arctic Archaeology.

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Arctic archaeology, Alaska, Thule culture, Driftwood, Wood economy, Experimentation.

The Use of Wood as Fuel and Timber during the Iron Age and Roman Times in North-west Iberia: the Case of Sabor Valley (NE, Portugal)

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From 2010 to 2014, more than two hundred archaeological sites along the Sabor River valley (North-east of Portugal) were excavated within the framework of the construction of a hydroelectric dam. The archaeobotanical sampling undertaken throughout this vast project provided the most extensive set of archaeological plant remains ever put together in Portugal. For this presentation, we will focus on the analysis of the charcoal assemblages from nine specific sites, ranging from the Late Iron Age to the Late Roman Period. Over 2500 samples were recovered and analysed in a wide array of combustion structures (kilns, fireplaces, etc.) as well as in construction contexts such as perishable components of horrea storage structures, among others. Comparative analysis regarding species, dendrological features and other charcoal characteristics will be made in a paleoetnobotanical point of view. Special emphasis will be made regarding the differential use of species according to the typology and purpose of the structure. Given the number of analyzed sites, their long and continuous occupations, position in the valley and number of samples recovered, this dataset provided invaluable information regarding trends of use of wooden resources throughout this valley covering the transition between Iron Age to Roman Period.

North-west Iberia, Iron Age, Roman Period, Fuel, Timber

GIS application on woody taxa distribution: A methodological approach from El Salt (Alcoi, eastern Iberia)

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Spatial analyses applied on lithic and faunal remains from Paleolithic sites are abundant and they constitute a key to our understanding of hunter-gatherer societies behavior. GIS application in archaeobotany is more recent and, therefore, we have fewer studies from a spatial perspective (Balme and Beck, 2002). However, published research such as the one carried out at Ohalo II site (Snir et al. 2015) shows the relevance acquired by the use of these techniques in the plant record. In this work we present anthracological data from El Salt, Stratigraphic Unit X, a Middle Paleolithic rockshelter from MIS 3 located in eastern Iberia at 700 m a.s.l. This unit is characterized by a high presence of combustion features of variable dimensions (0,20 – 1,00 m in diameter). These hearths, which are associated with rich anthracological assemblages, define several activity areas near the travertine wall. The application of several sampling techniques in Unit X (handpicking, wet sieving using 5 mm and 2 mm meshes sizes and wet sieving with 1 mm and 0,5 mm meshes sizes) has enabled a quantitative and qualitative comparison of the obtained results. As a methodological approach, GIS application allows us the spatial observation of the taxonomic distribution from combustion features, and the distinction between frequent and infrequent taxa according to the sampling technique used. In addition to the spatial projection of the recovered woody taxa, GIS are crucially important to address some taphonomic features such as the representation of the fragmentation degree of the charcoal remains in accordance with the sampling type used or even the spatial location of some taxa a priori inconsistent with the analysed flora in order to detect possible percolations from upper units. The results presented here point out that the handpicking method provides a partial picture of the local flora with an overrepresentation of the dominant taxon (Pinus sylvestris and/or Pinus nigra). With the wet sieving method using different meshes sizes, the fragmentation degree is higher but the anthracological spectrum is more heterogeneous, where Pinus sylvestris and/or Pinus nigra is the dominant taxon but it appears accompanied by a consistent woody taxa assemblage according to the bioclimatic belt. This recovery method offers the possibility of refining the ecological conditions and the firewood gathering criteria by hunter-gatherer societies.

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Anthracology, GIS, Neanderthals, El Salt, Palaeoenvironment

Fuel economy and hearths technology of Proto-Jê groups at the southern brazilian highlands

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Analysis of hearthsand dispersed charcoal at four Proto-Jê archaeological sites in southern Brazilian highlands allowed understanding issues related to fire technology and fuel economy of this society. The hearths were examined from a qualitative perspective, considering structural and contextual characteristics. Structural characteristics, like concave base, shape, stones and, sometimes, it sposition at the site define the potential use of each structure, and indicate technological choices and control of the burning process. Fuels were examined within an anthracological approach. The anthracological analysis demonstrated evidences of specific use of palm, bamboo and some Fabaceae taxa that suggest fuels selection. Firewood gathering was probably performed in an Araucaria forest with secondary vegetation, through the gathering of fallen dead wood in the forest and logging. The methodology applied allowed figuring out some traditional practices of Proto-Jê people, related to the acquisition and use of fire, use and selection of fuels, resources gathering, transformation of vegetation,and landscape. The research suggests that hearths were at the center of the social life, imbued with a key role both in domestic and in ceremonial activities. They were set in place and managed following a range of traditional knowledge of Proto-Jê people. These results are an important contribution to a better understanding of the Southern Proto-Jê occupation and to the comprehension of the relationships of these groups with their plant environment in the Southern Brazilian Higlands.

Hearths, Anthracology, Fuels Economy, Southern Brazilian Highlands

Home is where the hearth is: Anthracological analysis in Bunuba and Gooniyandi country, Western Australia

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Preservation of organic proxies in monsoonal Australia is characteristically poor, and the stability of the ancient landscape limits the creation of depositional archives for analysis. With the exception of archaeobotanical investigations conducted at the archaeological site Carpenter's Gap 1 rock shelter, palaeoenvironmental reconstruction of the Kimberley region in Western Australia has relied largely upon sedimentological analyses, in conjunction with the extrapolation of palynological data from wider Australia. Such studies tend to be of a scale, both temporally and spatially, that defy any direct interpretation with the archaeological record. This research, which is part of the ARC Linkage Project: Lifeways of the First Australians, applies anthracological analysis to three sites in the Kimberley region of Western Australia: Riwi, Carpenter's Gap 1, and Mount Behn rockshelter. This presentation will focus on the anthracological analysis of Riwi, a limestone cave on the edge of the Great Sandy Desert, where excavations have revealed evidence for over 47,000 years of human occupation. Anthracological analyses of excavated charcoals from matrix and hearth contexts have enabled both a local-scale vegetation reconstruction that is more complex than regional palaeoclimate archives, and a more informed understanding of mobility and wood-gathering practices.

Anthracology, Wood charcoal, Pleistocene Australia, palaeovegetation

Wood resource use and change at Kaman-Kalehöyük, central Anatolia, Turkey: integrating wood charcoal, pollen data and stable isotopes to better understand climate-people-landscape interactions

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The driving factors for ancient woodland modification and resource use can be especially difficult to understand given that many archaeological sites have few context types to analyse and there is a relative lack of integration between multiple proxies when analysing substantive archaeological questions. However, reconstructing the factors that influence woodland modification may be key in furthering our understanding of the way in which ancient peoples utilised wood resources. This paper expands on previously published pit fill data from Kaman-Kalehöyük in central Anatolia, Turkey which indicates dramatic changes in both the number and type of taxa that compose the pit assemblages. Most obvious is a sudden and dramatic increase in pine use from the Early Iron Age onwards. This shift in pine follows a decline in taxon richness from the Middle Bronze Age to the Late Bronze Age. In order to test the driving factors influencing these changes this paper presents a diachronic wood charcoal assemblage for the Middle Bronze Age to Late Iron Age from Kaman-Kalehöyük and explores the compositional differences between general multi-use pits and more specific contexts such as hearths and room fills. Similarly to the pit assemblages, results from domestic hearth assemblages show a significant decline in taxa richness from the Middle Bronze Age to the Late Bronze Age, particularly during the Hittite Empire period, followed by a dramatic increase in pine in the Iron Age. However, the room fill composition does not match the same pattern indicating that pit fills at Kaman-Kalehöyük primarily follow patterns driven by fuel wood selection as indicated by hearth fills. Additionally, the data is then compared to pollen and climate data for the region as well as carbon stable isotope data from the site to further understand to what extent the local and regional proxies vary. This comparison allows us to begin to disentangle the complex relationship between climate, people and landscape during the Bronze and Iron Age occupation of the site.

Kaman-Kalehöyük, stable isotopes, management, signature, pollen