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GEOLOGICAL SURVEY OF BELGIUM PROFESSIONAL PAPERS
N. 303 - 2008/1

4th INTERNATIONAL MEETING OF ANTHRACOLOGY

BRUSSELS, 8 - 13 SEPTEMBER 2008



CHARCOAL AND MICROCHARCOAL

CONTINENTAL AND MARINE RECORDS

PROGRAMME AND ABSTRACTS

by Freddy DAMBLON
& Mona COURT-PICON

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of Belgium

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4th International Meeting of Anthracology, Brussels,

Royal Belgian Institute of Natural Sciences, 8-13 September 2008

CHARCOAL AND MICROCHARCOAL : CONTINENTAL AND MARINE RECORDS

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4th International Meeting of Anthracology, Brussels,

Royal Belgian Institute of Natural Sciences, 8-13 September 2008

CHARCOAL AND MICROCHARCOAL : CONTINENTAL AND MARINE RECORDS

Organization committee

Dr Freddy DAMBLON - Royal Belgian Institute of Natural Sciences (Belgium)
Dr Mona COURT-PICON - Royal Belgian Institute of Natural Sciences (Belgium)
Mr Adriano VANDERSYPEN - Royal Belgian Institute of Natural Sciences (Belgium)
Ms Aurélie SALAVERT - University of Paris I & Royal Belgian Institute of Natural Sciences (Belgium)
Prof. Cecile BAETEMAN - Royal Belgian Institute of Natural Sciences, Geological Survey (Belgium)
Dr Hans BEECKMAN - Royal Museum of Central Africa (Belgium)
Prof. Philippe GERRIENNE - University of Liège (Belgium)
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Scientific committee

Prof Ernestina BADAL GARCIA	University of Valencia, Spain
Prof Christopher CARCAILLET	University of Montpellier, France
Prof Barbara EICHHORN	University of Frankfurt, Germany
Prof Isabel FIGUEIRAL	University of Montpellier, France
Prof Girolamo FIORENTINO	University of Lecce, Italy
Prof Dominique MARGUERIE	University of Rennes, France
Prof Oliver NELLE	University of Kiel, Germany
Prof Mitchell POWER	University of Salt Lake City, USA
Prof Andrew C SCOTT	Royal Holloway Univ., London, U.K.
Prof Stéphanie THIÉBAULT	University of Paris I, Nanterre, France
Prof. Jean-Louis VERNET	University of Montpellier, France
Dr Hans BEECKMAN	Royal Museum of Central Africa, Belgium
Dr Freddy DAMBLON	Royal Belgian Institute of Natural Sciences, Brussels, Belgium
Prof Philippe GERRIENNE	University of Liège, Belgium
Prof Marcel OTTE	University of Liège, Belgium
Prof Jacques VERNIERS	University of Gent, Belgium

INTRODUCTION TO THE PROGRAMME OF THE MEETING

Since the last 3d International Meeting of Anthracology, many researchers and students have published good results in a large array of archaeology and palaeoenvironment journals. Other researchers have focused on various aspects of charcoal production and preservation from the Palaeozoic up to present times. Such a situation has led to subdivide the meeting in five sections dealing with the main topics of current interest.

The scientific sections of the meeting

Section 1. Methods, taphonomy, dating

Anthracology (the study of charcoal) begins with field work. How to unravel stratigraphy? How to excavate and organize a sampling strategy? How to take samples, to record them for a database? How to extract charcoal fragments from sediment and remove any clay matrix from charcoal pieces, to clean them for microscopic examination, to count fragments, present and discuss the results? All these simple questions seem evident but may have important implications in the quality of the results and discussion. Who has not been faced to the question of sub-sampling a big charcoal concentration, for example in a Roman site? How to count microcharcoal from a lake sequence? What do micro-charcoal counts mean?

What is the influence of the taphonomic processes on the preservation state of charred wood or other plant tissues and on their anatomy? What is the meaning of melted or vitrinised wood structures in some charcoal assemblages: the answer could vary according to the local conditions and the period considered, or on the definition or their interpretation. What was the role of bacterial activity on wood in anoxic conditions? How can we interpret an assemblage of charcoalified plants preserved in alluvial systems? Is it possible to understand the sequence of gesture and handling by man to make fire or to estimate the burning temperature of the wood structures preserved in an archaeological site? Many of these questions will be addressed in the section 1

Concerning radiocarbon dating on charcoal, we are often dealing with hundreds dates of unequal accuracy and precision from which a critical evaluation may lead to discounting more than the half of them. How many specialists are still simply working with a mean value between a set of dates from an archaeological layer: a dangerous operation when a part of the material is suspected to have been reworked, transported, redeposited, mixed with younger material and collected by man along a river. How many are presently applying a direct inappropriate software calibration of their dates?

This picture may appear a little too depressing and exaggerated but it summarizes a set of questions that seems worth debating within the framework of this first section.

In Section 1, one keynote by P. Haesaerts on stratigraphy and chronology, eleven oral communications and nine posters are devoted to various fundamental questions dealing with reference collection, field work, experiment on combustion, reworking and preservation, interpretation of charcoal rings and problems of dating charcoal. Notice that the keynote by I. Théry-Parisot on taphonomy in archaeological context is directly linked to Section 1.

Moreover, the workshop led by A.C. Scott will also be focused on taphonomic processes leading to fossil or recent charcoal assemblages. Therefore, it is of general interest for every specialist in charcoal research.

Section 2. Pre-Quaternary charcoal

Charcoal in archaeological context actually represent only an infinitesimal part of charcoalified plant remains in sediments but most charcoal constitutes remnants of wild fire since the origin of plant life on dry land. Some of them are still in place as local or larger fire testimony; others were reworked, transported by rivers or by sea streams and often form mixtures of different origins. An example of this will be discussed during the excursion on the Wealden site (Cretaceous) of Hautrage (see the excursion booklet). A range of plant organs are routinely found as charcoal, not only wood but also charred leaves, seeds and even flowers. Might we be missing these by our sampling strategy? What might they tell us about fire-prone communities or the role of fire in the evolution of particular plant groups?

What can tree rings and other wood structures tell us about climates and other environmental conditions in the past geological periods? What is the importance of burnt wood and other charred plant remains in Devonian or Carboniferous fossil assemblages and what do they say about plant evolution? How to do the link between burnt wood structures and charred fruit or leaf remains in a given geological layer? New results from the last decades give new light on theses questions that will be discussed in Section 2.

The Pre-Quaternary Section 2 comprises five oral communications and one poster. The keynote by A.C. Scott also deals with Pre-Quaternary charcoal.

Section 3. Pedo-anthracology

Charcoal is preserved in soils and palaeosols. Here too, a lot of questions arise. What is the meaning of charcoal assemblages in such conditions? Are we able to reconstruct an evolution of the environment from a soil or have we a mixture and might it have been fragmented by the action of worms and micromammals in the A & B-horizons?

Several studies have shown that the facts are in between, notably in mountainous areas where the deforestation stages can be reconstructed and the upper treeline evolution, due to the impact of human activities or climate variation,

evaluated thanks to multi-proxy data including charcoal and pollen records. For the Holocene, pedo-anthracology remains the only discipline that allows control the local occurrence of some forest taxa whose pollen grains are subject either to long distance transport (Pinaceae) or low production (Rosaceae, Malaceae).
However, charcoal in soils constitute a good testimony of ancient agropastoral or industrial practices as accidental fire in forest land, use of fire for forest management and widening pasture lands, using hearth for heating and cooking, making charcoal fuel for metallurgy, etc.
In Section 3, six oral and eight poster communications will be presented. Notice that the oral communication n° 7 by M. Thinon, in Section 1, could have been included in Section 3 too.

Section 4. Archaeo-ethno-anthracology

Since the middle of the 20th century, a long tradition of anthracological research deals with archaeology, notably due to the fact that the majority of charcoal concentrations were found in human settlement sites from the Palaeolithic to the Middle Ages. Methodologies for anthracology were first developed in archaeological context and have led to major results on the use of wood resources for fuel, building, making tools, and on various domestic and religious practices, briefly what we call wood economy.
Another goal is to give information on past environments from the association of taxa in charcoal assemblages. However, such a process cannot be used without a minimum of caution, simply because charcoal represents essentially the ligneous component of the vegetation, while burnt herbaceous charred plant debris remain rather rare in archaeological sites (if we except fruits and seeds). Why should this be when in charcoal assemblage from recent wildfire sites we see a broad range of herbaceous charcoals and even charred mosses? Other underlying problems that need addressing are the determination of the evolution of vegetation as recorded at an archaeological site. Problems include the accuracy of charcoal identification, the taphonomic processes and the approach of the stratigraphy, fundamental factors too often neglected in vegetation dynamics reconstructions.
Nowadays, the work is using multi-proxy studies to allow the integration of charcoal data in a wider palaeobotanical context and to relate it with diverse geological and geophysical data. This approach recently allowed to gain accurate information on the flora in Eurasia during the Pleistocene, including refuge areas, to collect charcoal material for confident radiocarbon dating, to draw up ways of migration of taxa across continents during the climatic warming periods and to compare charcoal data with pollen records in reconstructing past vegetation. Such problems will also be discussed during the excursion to the Scladina cave at Sclayn (see excursion guide book).
Section 4 is clearly the richest one in number of communications for the reasons already outlined but numerous conjunctions do inevitably arise between anthracology from archaeological sites and methodological or taphonomical problems. Twenty eight oral communications and forty one posters are presented while a keynote synthesis will be presented by S. Thiébault.

Section 5. Climato-anthracology

In archaeological sites, charcoal most often forms biased assemblages by human selection or handling. Even when it is safely identified, a set of charcoal fragments represents only a part of the local or regional woody flora. When diversified, a charcoal assemblage in natural contexts may be considered as illustrative of a type of climate (arctic, boreal, temperate, etc), but maybe not if the range of taxa is too low. However, when dealing with long sequences, it is possible to record some changes in charcoal assemblages that come from variations in vegetation and climatic conditions, as in Southern France, Spain, Italy and even in Belgium where shifts from interglacial to glacial and to interstadial episodes can be observed. An example of this will be also given during the excursion to Scladina cave (see field trip guide book).
The problem becomes more complicated concerning pleniglacial periods that show rapid climatic oscillations, which are too short for inducing significant qualitative modifications in the woody flora and vegetation. Therefore, multi-proxies are needed to generate evidence for such short events as they are sealed, for example, in loess. In this case, and combined with pedostratigraphy, anthracology becomes a very efficient tool providing good quality material for ^{14}C dating and provides useful information on past flora, vegetation and climate.
Charcoal and charred remains are also preserved in wet conditions, including peat and lake deposits. In peat bogs, they may be the result of running fire that had charred organs like stems, leaves, flowers, fruits or seeds. Micro-fragments are present too but they often cannot be identified, except in some cases. Their amount with regard to the sediment mass can be used for estimating the intensity and frequency of fires, but this is a controversial character and needs discussion. Microcharcoal can also be put in evidence in cave records and provide information of climate variations.
Microanthracology is also applied in marine records by comparing the amount of micro-charcoal in each layer of a sequence. But quantification and interpretation of the data lead to controversies, notably due to possible reworking and difficulties in the identification of the potential charcoal sources on the continent.
In Section 5, seven oral communications and three posters present various approaches of climate reconstruction and the impact of fire on vegetation, the challenge for the Holocene being to make the difference between the action of man and the role of climate conditions in the evolution of the landscape. The keynote by Mitchell Power on wildfire during the late Quaternary is also to be placed in Section 5.

Conclusion

Finally, a common interest of anthracologists and charcoal researchers lies in taphonomy both in natural as well as archaeological conditions, each with an important experimental element. During the present meeting this topic appears as a major key point not only in specific talks and posters but also as an element in various communications of diverse sections like Pre-Quaternary charcoal, pedo-anthracology, palaeoclimatology and ethno-archaeology. Clearly such an approach of charcoal research should provide efficient tools for the interpretation of past charcoal assemblages in terms of reconstruction of flora, vegetation, climate and human activities.

However, the diversity of the themes of research and the complexity of the problems to solve in order to gain accurate interpretations lead to a high number of papers in a wide range of journals. This matter of fact contributes to increasing the difficulty to overview the published data when the need for syntheses appears necessary for example in the question of interaction between climate and man. Therefore setting up accurate databases becomes urgent with an attempt of making compatible a maximum amount of data from both natural and archaeological origin.

Such a processes implies a good collaboration between each charcoal researcher aiming at building a worldwide network to progress towards a better understanding natural and anthropic evolution of the plant cover of our planet.

In this perspective, as suggested in Paris in 1996, it would be useful for young scientists and experienced searchers to set up an international association of charcoal researchers with the aim at making the dissemination of information easier. This association could:
- centralise and redistribute a maximum of publications dealing with charcoal;
- disseminate all kinds of information about various meetings related to our speciality;
- announce Ph.D. theses;
- facilitate the organisation of training for students and young researchers;
- present reviews of important textbooks;
- allow exchange of information on wood and charcoal identification;
- favor collaboration on some topics;
- promote the creation of a general database on charcoal in connexion with the existing ones in relation to fire regimes or archaeology.

The interested persons are invited to consult the document IACR at the end of the present volume as a basis for discussion during the workshop 3.

Freddy Damblon
Andrew Scott

4th International Meeting of Anthracology, Brussels,

Royal Belgian Institute of Natural Sciences, 8-13 September 2008

CHARCOAL AND MICROCHARCOAL : CONTINENTAL AND MARINE RECORDS

PROGRAMME OF THE MEETING

ORAL COMMUNICATIONS

Monday 8th a.m.

8.30 - 10	**Welcome desk**			**Registration check, documents, badges, information**

Plenary session

10 - 10.15	Auditorium	**General Director**	**Camille PISANI**	**Welcome address**
10.15 - 10.20			**Freddy DAMBLON**	**Introduction**
		Chair:	**Michel THINON**	
10.20 - 11		**Keynote**	**Paul HAESAERTS**	**Long loess sequences with charcoal in Eurasia: their implication in the chronology of the Upper Pleistocene climate sequences**
11 - 11.40	Room mezzanine	Coffee break	and	**POSTER SESSION 1**

Section 1: Methods, taphonomy, dating

11.40 - 12	Auditorium	1	Carla LANCELOTTI & Marco MADELLA	Building a reference collection: experimental production and analysis of fresh wood and charcoal of selected South Asian species
12 - 12.20		2	Victoria A. HUDSPITH, Andrew C. SCOTT, Margaret E. COLLINSON & Colin J.N. WILSON	Charcoals in pyroclastic deposits of Montserrat and New Zealand: temperature proxies
12.20 - 12.40		3	Isabelle THÉRY-PARISOT & Lucie CHABAL	From wood to charcoal, experimental study of a taphonomic agent: the combustion
12.40 - 14		Lunch		

Monday 8th p.m.

Plenary session

Section 1: Methods, taphonomy, dating

		Chair:	**Andrew C. SCOTT**	
14 - 14.20	Auditorium	4	Laura C. Mc PARLAND, Margaret E. COLLINSON, Andrew C. SCOTT & Gill CAMPBELL	Experimental re-charring of charcoal: implications for recognising use of charcoal as a fuel
14.20 - 14.40		5	Julia CHRZAVZEZ	The taphonomic processes and their consequences for the preservation of wood charcoals in archaeological context: an experimental approach
14.40 - 15		6	Elena PONOMARENKO, Darwin ANDERSON & Alex JOKIC	Signature of forest fires in prairie soils
15 - 15.20		7	Michel THINON	Reconsideration of pedoanthracology and its methods
15.20 - 16	Room mezzanine	Coffee break	and	**POSTER SESSION 2**
		Chair:	**Dominique MARGUERIE**	
16 - 16.20	Auditorium	8	Sandrine PARADIS & Alexa DUFRAISSE	Wood radius curvature measurement and wood diameter: comparison of different image analysis techniques
16.20 - 16.40		9	Elena MARINOVA	How to get representative information on the woodland use in an early Byzantine town: anthracological analysis of Sagalassos, SW Anatolia
16.40 - 17		10	Johan YANS, Jean DEJAX, Thomas GERARDS, Philippe GERRIENNE, Paul SPAGNA & Eddy KEPPENS	Carbon isotopes on wood material: a tool for chemostratigraphy? Evidence from the Wealden facies sediments (Mons basin, Belgium).
17 - 17.20		11	Freddy DAMBLON & Paul HAESAERTS	Dating charcoal from Quaternary loess sequences: questions and suggestions
18.30	Brussels International Center	**Welcome Drink**		

Tuesday 9th a.m.

Plenary session

Section 2: Pre-Quaternary

		Chair:	**Hans BEECKMAN**	
9 - 9.40	Auditorium	**Keynote**	**Andrew C. SCOTT**	**Charcoal in deep time and the role of fire in earth system processes**
9.40 - 10		12	Cyrille PRESTIANNI, Damien FOKAN & Philippe GERRIENNE	The Famennian (Devonian) charcoals of Belgium
10 - 10.20		13	Andrew C. SCOTT, Fabien KENIG, Roy E. PLOTNICK, William G. CHALONER & Ian J. GLASSPOOL	Pennsylvanian extra-basinal fires: evidence from combustion products preserved in a Pennsylvanian cave fill.
10.20 - 11.10	Room mezzanine	Coffee break	and	**POSTER SESSION 3**
		Chair:	**Elena PONOMARENKO**	
11.10 - 11.30	Auditorium	14	Claire M. BELCHER & Jennifer C. McELWAIN	The burning question: new limits for combustion in low O_2 redefine palaeoatmospheric predictions for the Mesozoic
11.30 - 11.50		15	Luciana WITOVISK, Rita SCHEEL-YBERT, Marcelo de ARAUJO CARVALHO & Renato R. CABRAL RAMOS	Analysis of Cretaceous charcoalified wood from James Ross Island, Antarctic peninsula: preliminary results
11.50 - 12.10		16	Rita SCHEEL-YBERT, Luis H. P. BARROS, Marcelo de ARAUJO CARVALHO & Renato R. CABRAL RAMOS	Charcoalified wood remains from the Eocene of São José de Itaboraí basin, Southeastern Brazil
12.10 - 14		Lunch		

Tuesday 9th p.m.

Plenary session

Section 3: Pedoanthracology

		Chair:	**Barbara EICHHORN**	
14 - 14.20	Auditorium	17	Philippe TOUFLAN, Loïc BOTTA, Vincent ROBIN & Brigitte TALON	Soil charcoal analysis: a reliable tool for spatially precise studies of past forest dynamics
14.20 - 14.40		18	Vincent ROBIN, Loic BOTTA, Maryse ALVITRE & Brigitte TALON	Pedoanthracological contribution to natural forest assessment: illustrated by the case of ancient forest history study in the French South Alps (Queyras)
14.40 - 15		19	Claire DELHON, Sébastien GUILLON & Jean-François BERGER	Sea, fire, people: the history of Holocene vegetation on the eastern French Mediterranean coast
15.00 - 15.50	Room mezzanine	Coffee break	and	**POSTER SESSION 4**
		Chair:	**Isabelle THÉRY-PARISOT**	
15.50 - 16.10	Auditorium	20	Brigitte TALON, Frédéric HENRY & Thierry DUTOIT	On the contrasted origins of herbaceous plant communities in Europe: a view from the South
16.10 - 16.30		21	Oliver NELLE & Stefan DREIBRODT	Combining palaeo-archives: the contribution of anthracology to landscape history scenarios
16.30 - 16.50		22	Stefania IMPAGLIAZZO & Gaetano DI PASQUALE	High spatial resolution approach in upper forest line dynamic reconstruction during the late Holocene (northern Andes)
17.30: Departure of the bus to	**Africa Museum Tervuren**	**Visit of the Xylarium**	Hans BEECKMAN	Exhibition: **"Knock the wood"**

Wednesday 10th a.m.

9 - 12.30	**Room Wifi**	**Workshop**	**Andrew C. SCOTT**	**Charcoal Recognition / Taphonomy**

Plenary session

Section 4: Archaeo-ethno-anthracology

		Chair:	**David GOLDSTEIN**	
9 - 9.40	Auditorium	**Keynote**	**Stéphanie THIÉBAULT**	**Archaeological charcoal records: experience and perspectives**
9.40 - 10		23	Barbara EICHHORN, Caroline ROBION-BRUNNER, Sébastien PERRET & Vincent SERNEELS	Iron metallurgy in the Dogon country (Mali, West Africa) – "deforestation" or sustainable use?
10 - 10.20		24	Alexa HÖHN	The Nok charcoal remains - first results
10.20 - 11.10	Room mezzanine	Coffee break	and	**POSTER SESSION 5**
		Chair:	**Jean-Louis VERNET**	
11.10 - 11.30	Auditorium	25	Emilie DOTTE-SAROUT	The development of anthracology in pre-colonial Kanak archaeology of New Caledonia (1000-1854 ad): first results
11.30 - 11.50		26	David John GOLDSTEIN & Izumi SHIMADA	An experimental and ecological approach to modelling ancient fuel use in South America
11.50 - 12.10		27	Fanny MOUTARDE	Stakes and perspectives of anthracology in Peru
12.10 - 12.30		28	Auréade HENRY, Claire ALIX, Isabelle THÉRY-PARISOT & Evgenya VORONKOVA	Ethno-archaeology as a mean of testing archaeo-anthracological models: examples from the boreal forest and tundra environments (Eastern Siberia and Alaska)
12.30 - 14		Lunch		

Wednesday 10th p.m.

Plenary session

Section 4: Archaeo-ethno-anthracology

		Chair:	**Ingelise STUIJTS**	
14 - 14.20	Auditorium	29	Paloma UZQUIANO	The "Altamira territory" revisited : landscape and woodfire management from anthracological studies of the El Linar, Cualventi and Las Aguas caves (Alfoz de Loredo, Cantabria, Northern Spain)
14.20 - 14.40		30	María MARTÍN SEIJO & Raquel PIQUÉ	New data about wood use in the northwest of the Iberian Peninsula
14.40 - 15		31	Yolanda CARRION, Dominique MARGUERIE & Nancy MARCOUX	The southern littoral forest of Brittany (France) under the impact of the Mesolithic and Neolithic groups from the archaeological charcoal analysis
15.00 - 15.50	Room mezzanine	Coffee break	and	**POSTER SESSION 6**
		Chair:	**Laura C. Mc PARLAND**	
15.50 - 16.10	Auditorium	32	Ingelise STUIJTS	Woodland resources around a late-Mesolithic site in Lough Kinale, Ireland
16.10 - 16.30		33	Welmoed A. OUT	Selective use of firewood at Dutch late Mesolithic and Neolithic wetland sites?
16.30 - 16.50		34	Yolanda CARRION, Maria NTINOU & Ernestina BADAL	Neolithic woodland in the North Mediterranean basin: the case of *Olea europaea*
17	Parking Iguanodon	Picture group		
18: departure of the bus to	**Botanical Garden, Meise**	**Visit of the Plant Palace**		

Thursday 11th a.m.

9 - 12.30	**Small auditorium**	**Workshop**	**Mitchell POWER**	**The importance of databases in Anthracology and possible connection with other databases in Palaeobotany**

Plenary session

Section 4: Archaeo-ethno-anthracology

		Chair:	**Brigitte TALON**	
9 - 9.40	Auditorium	**Keynote**	**Isabelle THERY-PARISOT & Lucie CHABAL**	**Anthracology and taphonomy, from wood gathering to charcoal analysis. A review of the taphonomical processes modifying anthracological assemblages**
9.40 - 10		35	Alexa DUFRAISSE	Firewood gathering in Neolithic lakeshore settlements of the northern alpine area: social functioning and environment
10 - 10.20		36	Isabel FIGUEIRAL, Lucie CHABAL & Laurent FABRE	The answer is deep down in the well: charcoal and waterlogged wood from archaeological wells in Southern France
10.20 - 11.10	Room mezzanine	Coffee break	and	**POSTER SESSION 7**
		Chair:	**Thomas LUDEMANN**	
11.10 - 11.30	Auditorium	37	Jaromír BENES, Petr KVETINA & Jan ROLECEK	Charcoal in the Neolithic Bylany, Czech Republic
11.30 - 11.50		38	Aurélie SALAVERT	Anthracology of Linearbandkeramik sites in Middle-Belgium: new data
11.50 - 12.10		39	Christophe VASCHALDE, Aline DURAND, Isabel FIGUEIRAL, Robert GADAY & Jacques THIRIOT	Charcoal analysis of lime kiln remains in southern France : an original process of mediaeval and modern traditional lime burning
12.10 - 13.40		Lunch		

Thursday 11th p.m.

17 - 18	**Auditorium**	**Workshop**	**Freddy DAMBLON**	**International Association of Charcoal Research**

Plenary session

Section 5: Climato-anthracology

		Chair:	**Marie-José GAILLARD**	
13.40 - 14	Auditorium	40	Katleen DECKERS & Hugues PESSIN	Vegetation development in relation to human occupation and climatic change in the Middle Euphrates and upper Jazirah (Syria/Turkey) during the Bronze Age
14 - 14.20		41	Maria NTINOU & Nina KYPARRISI-APOSTOLIKA	The Pleistocene-Holocene charcoal record from Theopetra cave, Thessaly, Greece: implications for vegetation, climate and human use
14.20 - 14.40		42	Jean-Louis VERNET	The setting of the French Mediterranean primary forest and its change during the Holocene: qualitative and quantitative charcoal analyses
14.40 - 15		43	Francesca TESCARI & Stefano CARNICELLI	Anthracological study in the Ziway-shala lakes basin, main Ethiopian rift (Ethiopia)
15 – 15.50	Room mezzanine	Coffee break	and	**POSTER SESSION 8**
		Chair:	**Isabel FIGUEIRAL**	
15.50 - 16.10		44	Grant HALL, Lyn WADLEY & Stephan WOODBORNE	Evidence of past climatic change from stable carbon isotope analysis of archaeological charcoal from Sibudu cave, Kwazulu-Natal, South Africa
16.10 - 16.30		45	Marie-José GAILLARD, Annica GREISMAN, Geoffrey LEMDAHL & Fredrik OLSSON	The role of climate variability and fire in early and mid-Holocene forest dynamics of Southern Sweden
16.30 - 16.50		46	Gabriel MAGNAN, Martin LAVOIE & Serge PAYETTE	Impact of fire on the long term dynamics of three ombrotrophic peatlands in Northwestern Québec
17 - 18.15		**Workshop**	**Freddy DAMBLON**	**International Association of Charcoal Research**
18.15 - 19	Visit Iguanodons			
19.30	Room columns	**Conference Dinner**		

Friday 12th a.m.

Plenary session

Section 4: Archaeo-ethno-anthracology

		Chair:	**Werner SCHOCH**	
9 - 9.40	Auditorium	**Keynote:**	**Mitchell POWER, Jennifer MARLON, Patrick BARTLEIN, Sandy HARRISON & members of the GLOBAL PALAEOFIRE WORKING GROUP**	**Climate driven changes in fire regimes during the late Quaternary**
9.40 – 10		47	Valentina CARACUTA & Girolamo FIORENTINO	The anthracological analysis at the Bronze Age Ebla site (NW Syria): results and perspectives
10 - 10.20		48	María Soledad GARCÍA MARTÍNEZ, Elena GRAU ALMERO & Maria Milagrosa ROS SALA	Woody plants in semi-arid Southeastern Iberia during the Bronze Age: charcoal analysis from Punta de Los Gavilanes (Mazarrón, Murcia, Spain)
10.20 - 11.10	Room mezzanine	Coffee break	and	**POSTER SESSION 9**
		Chair:	**Girolamo FIORENTINO**	
11.10 - 11.30	Auditorium	49	Anton Stefan SCHWARZ, Rüdiger KRAUSE & Klaus OEGGL	Anthracological analysis from a mining site in the Eastern Alps to evaluate woodland uses during the Bronze Age
11.30 - 11.50		50	Werner H. SCHOCH	Charcoals from possibly the world's oldest gold mine in Sakdrissi / Georgia
11.50 - 12.10		51	Romain ROUAUD	Anthracology and charcoal makers' knowledge, used like two tools for the history of a charcoal producing forest in the upper Dordogne valley (France, Auvergne - Limousin)
12.10 - 14		Lunch		

Friday 12th p.m.

Plenary session

Section 4: Archaeo-ethno-anthracology

		Chair:	**Rita SCHEEL-YBERT**	
14 - 14.20		52	Andreas G. HEISS	Thus spoke Pausanias? Fuel wood selection in alpine burnt-offering places
14.20 - 14.40	Auditorium	53	Emilia ALLEVATO, Elda RUSSO ERMOLLI, Rocco MITRO, Carmine LUBRITTO & Gaetano DI PASQUALE	First evidences of chestnut (*Castanea sativa* mill.) cultivation for timber production in Campania (Southern Italy): a high spatio-temporal definition through pollen and charcoal data
14.40 - 15		54	Robyn VEAL	The wood fuel supply to Pompeii 4th century BC to AD79: economic, cultural and taphonomic considerations
15 - 15.50	Room mezzanine	Coffee break	and	**POSTER SESSION 10**
		Chair:	**Katleen DECKERS**	
15.50 - 16.10		55	Philippe ALLEE & Sandrine PARADIS	The medieval charcoal-producing forest of Mont Lozère, a guide to the interpretation of proto-industrial territory
16.10 - 16.30	Auditorium	56	Arne PAYSEN	Forest-economy during the late Middle Ages in Northern Germany, an anthracological investigation on early industry sites
16.30 - 16.50		57	Thomas LUDEMANN	Kiln site anthracology and fuel wood ecology in Central Europe
17 - 18	Auditorium			**DISCUSSION AND CONCLUSION CLOSING THE CONFERENCE**

4th International Meeting of Anthracology, Brussels,

Royal Belgian Institute of Natural Sciences, 8-13 September 2008

CHARCOAL AND MICROCHARCOAL : CONTINENTAL AND MARINE RECORDS

PROGRAMME OF THE MEETING

POSTERS

Monday 8: Sections 1, 2 & 3

Poster session 1	n°	Authors	Section	Title
11 - 11.40	1	Miklos KAZMER	1	Anthracotheca – fossil and recent charcoal collection for the Carpathian-Pannonian region
	2	Stefania IMPAGLIAZZO, Ugo NAVARRETE & Gaetano DI PASQUALE	1	A computer system for charcoal identification of tropical Andean species
	3	Ingelise STUIJTS	1	Wodan: database for archaeological wood and charcoal
	4	Andrew C. SCOTT, Jean GALTIER, Neil J. GOSTLING, Selena Y.SMITH, Marco STAMPANONI, Frederica MARONE, Margaret E. COLLINSON, Phillip C. J. DONOGHUE & Stefan BENGTSON	1	The use of synchrotron radiation x-ray tomographic microscopy (srxtm) in the study of fossil charcoalified Pteridosperm fertile organs
Poster session 2				
15.20 - 16	5	Auréade HENRY	1	Biological degradation of wood: experimental approach and anthracological implications: first results on coniferous wood (*Pinus sylvestris* L., *Larix cajanderi* Mayr.)
	6	Koen DEFORCE & Kristof HANECA	1	Tree ring analysis of archaeological charcoal: a tool to identify past woodland management?
	7	Cosimo D'ORONZO, Giampiero COLAIANNI, Anna Maria GRASSO, Daniela MARTELLA, Angela STELLATI & Girolamo FIORENTINO	1	Decoding wood exploitation in archaeological site by taphonomical analysis

Tuesday 9: Sections 1, 2 & 3

Poster session 3	n°	Authors	Section	Title
10.20 - 11.10	8	Laurent MARQUER, Elise Van CAMPO, David KANIEWSKI, X. SUN, Jackie DESPRIÉE, Thierry OTTO, Grégory BAYLE & Josette RENAULT-MISKOVSKY	1	Fire signals from the centre of France along Middle and Upper Pleistocene
	9	Elena PONOMARENKO, Donna CROSSLAND & Judy LOO	1	Reconstructing tree species composition at the time of land clearance: two approaches compared
	10	Luke MANDER, Claire M. BELCHER & Jennifer C. McELWAIN	2	Ecosystem instability and the role of wildfire across the Triassic - Jurassic boundary in East Greenland
	11	Jean-François GILLET, Hans BEECKMAN & Jean-Louis DOUCET	3	The origin of the forests in the north of the Congo Republic: an anthraco-pedological contribution
	12	Michel THINON & Ama-Edi KOUYA	3	First pedoanthracological studies in the Guineo-Congolian forest (Togo, West Africa)
	13	Fatiha ABDOUN & Samira AMRANI	3	The contribution of anthracology and palynology to the knowledge of the Saharian biogeography
Poster session 4				
15.00 - 15.50	14	Magali CHACORNAC-RAULT	3	Study of fire detection in three Holocene cores of Gunung Sewu (Java, Indonesia)
	15	Vincent ROBIN & Oliver NELLE	3	Disturbances and vegetation dynamics in Northern Germany as documented by anthracological and dendro-ecological approaches
	16	Loïc BOTTA, Philippe TOUFLAN, Vincent ROBIN & Brigitte TALON	3	Multi-sampling strategy in pedoanthracological analysis (Southern French Alps)
	17	Brigitte TALON, Marie BERGAGLIO & Pascal CAMPAGNE	3	Holocene forest composition and dynamics from soil charcoal of a siliceous French Provence area (Massif des Maures)
	18	Raquel CUNILL, Marie-Claude BAL, Albert PELACHS & Joan Manuel SORIANO	3	Treeline evolution in the southern basin of Pyrenees. Pedoanthracology as a tool for studying the history of the supraforest area practices

Wednesday 10 : Section 4

Poster session 5	n°	Authors	Section	Title
10.20 - 11.10	19	Alexa HÖHN	4	Charcoal from african rain forest sites: first steps in identification and interpretation
	20	Caroline F. CAROMANO, Leandro M. CASCON, Alisson RANGEL, Levemilson M.da SILVA, Rita SCHEEL-YBERT & Eduardo Góes NEVES	4	Anthracology in Central Amazon, Brazil: preliminary results
	21	Rita SCHEEL-YBERT, Mariana BEAUCLAIR & Angela BUARQUE	4	Palaeoenvironmental reconstruction during the late Holocene in the Araruama region (Southeastern Brazil) based on archaeological charcoal
	22	Gina Faraco BIANCHINI & Rita SCHEEL-YBERT	4	Palaeoenvironmental and palaeoethnobotanical inferences in a shellmound site from Southern Brazil
	23	Mariana BEAUCLAIR, Rita SCHEEL-YBERT & Angela BUARQUE	4	Bark hearths in South-American Tupiguarani funerary ritual
	24	Laura CARUSO	4	Forest resources exploitation and management by Selknam hunter-gatherer societies: results of the archaeobotanical analysis of Ewan site (Tierra del Fuego, Argentina)
Poster session 6				
15.00 - 15.50	25	Isabelle THÉRY-PARISOT, Maria NTINOU & Eric BOËDA	4	Umm el Tlel: environment and firewood use by hunter-gatherers during the Middle Palaeolithic.
	26	Laura SADORI, Alessia MASI & Francesca SUSANNA	4	Timber use in the public and private structures of the Late Chalcolithic 5 (3300-3000 B.C.) at Arslantepe, Malatya (Turkey)
	27	Carla LANCELOTTI, Margareta TENGBERG & Stépahnie THIEBAULT	4	Woodland vegetation and wood exploitation at Harappa, a Bronze Age metropolis in Pakistan: a preliminary study of wood charcoal.
	28	Valentina BELLAVIA, Gaetano DI PASQUALE, Mario MARZIANO & Emilia ALLEVATO	4	First anthracological data from the Roman vicus of Thamusida – (Sidi Ali ben Ahmed, North-West Morocco)
	29	Ethel ALLUÉ	4	Anthracology from Paleolithic archaeological sites at the north east of the Iberian Peninsula: implications on hunter-gatherers landscapes and forest resource management
	30	Ernestina BADAL & Violeta ATIENZA	4	Microscopic analyses of herbivores coprolites found in Cova de les Cendres (Alicante, Spain)
	31	Llorenç PICORNELL & Gabriel SERVERA	4	Archaeobotanical research in the prehistoric Balearic islands: anthracology and archaeopalynology
	32	Tzvetana POPOVA	4	The impact of man on the vegetation in Bulgaria from Neolithic and Chalcolithic period

Thursday 11: Sections 4 & 5

Poster session 7	n°	Authors	Section	Title
10.20 - 11.10	33	Jan NOVÁK, Kateřina NOVÁKOVÁ, Libor PETR & Alexandra BERNARDOVÁ	4	Early Iron Age forest communities in north part of the Oderská Brána (NE Czech Republic)
	34	Romana KOCAROVA, Petr KOCAR & Libor PETR	4	Woodland management and history in the surroundings of the high mediaeval villages in the Czech Republic, comparison of anthracological, palynological and written sources
	35	Magdalena MOSKAL-DEL HOYO	4	Anthracological analysis from a Bronze Age necropolis at Kokotów (Poland)
	36	Katarzyna CYWA & Lubomira TYSZLER	4	The use of wood by the population of the Przeworsk and Lusatian cultures based on charcoal analysis from Konopnica (Central Poland)
	37	Francesco SOLINAS & Girolamo FIORENTINO	4	Anthracological analysis from Hierapolis (Turkey): charcoals in the rituals of Sanctuary of Apollo
	38	Ethel ALLUÉ, Ferran ANTOLÍN, Marie-Claude BAL, Laura CARUSO, Mireia CELMA, Carme CUBERO, Raquel CUNILL, Itxaso EUBA, María MARTÍN, Carmen MENSUA, Albert PÈLACHS, Llorenç PICORNELL, Raquel PIQUÉ, Àlex SOLÉ & Jaume ZAMORA	4	Charcoal analysis in the northeast of the Iberian Peninsula: history, current research and perspectives
Poster session 8				
15.20 - 16	39	Ferran ANTOLÍN, Carmen MENSUA & Raquel PIQUÉ	4	The perception of the environment during the Mesolithic and the Neolithic in Can Sadurní (Begues, Barcelona). A view from the archaeobotanical data
	40	Raquel PIQUÉ, Ferran ANTOLIN, Laura CARUSSO, María MARTÍN SEIJO & Carmen MENSUA	4	Variability in firewood consumption during Neolithic in north-east of the Iberian Peninsula
	41	Maria Oliva RODRÍGUEZ-ARIZA	4	The use of wood in Argaric settlements of the South-Eastern Iberian Peninsula

42	Paloma UZQUIANO, Blanca RUIZ-ZAPATA, Maria José GIL, Manuela PEREZ & José RAMOS	4	The archaeobotanical record from SW Spain : Holocene environmental changes and firewood use at the Palmones (Algeciras, Cádiz) and Retamar (Puerto Real, Cádiz) archaeological sites
43	Albert PÈLACHS, Ramon PÉREZ-OBIOL, Raquel PIQUÉ, Marie-Claude BAL, Raquel CUNILL & Joan Manuel SORIANO	4	Vegetation changes in the Pyrenees forest caused by human impact: 2000-yr of metallurgy history
44	Carmen MENSUA	4	The use of firewood in the incineration ritual during the Iron Age in N.E. of the Iberian Peninsula
45	Itxaso EUBA & Josep Maria PALET	4	Reconstruction of the vegetation and the use of wood: taxonomical analysis and the study of charcoal artifacts from Roman and Modern sites from the Madriu valley and the Cadí mountain range (sub-alpine stage from the East Pyrenees)

Friday 12: Sections 4 & 5

Poster session 9	n°	Authors	Section	Title
10.20 - 11.10	46	Mónica RUIZ-ALONSO, Lydia ZAPATA & Alvaro ARRIZABALAGA	4	Charcoal analysis of the archaeological site of Irikaitz (Zestoa, Basque Country, Spain)
	47	Kahina MAAMES	4	Archaeobotanical analysis of waterlogged woods archaeological data from a Gallo-Roman site in Northern France (Châteaubleau, Île-de-France)
	48	Donatella NOVELLIS & Girolamo FIORENTINO	4	A regional review of anthracological data in Calabria (Southern Italy): new data from Neolithic to Medieval period
	49	Doris JANSEN, Michael OVERBECK & Oliver NELLE	4	Charcoals from iron smelting furnaces – fuel supply and environment of a Medieval iron smelting site near Peppange / Luxemburg
Poster session 10				
15 - 15.50	50	Sylvie COUBRAY	4	The necropolis of Porta Nocera (Pompei) – anthracological study of the funerary enclosure
	51	Anna Maria GRASSO, Chiara MARATINI, Giovanni Pietro MARINO, Andrea STARACE & Girolamo FIORENTINO	4	New anthracological data from Pompei: charcoal analysis from Insula 7 and Temple of Venus
	52	Alessia MASI, Laura SADORI, Francesca CARBONI & Maria Antonietta TOMEI	4	Charcoals from a I century A.D. fire level at the base of the Domus Tiberiana, Via Nova, Rome
	53	Valentina CARACUTA	4	The Faragola midden: new perspective in the study of a Late Antique (III - VI century A.D.) dump in the Tavoliere plain, (SE Italy)
15.20 - 16	54	Daniele COLOMBAROLI & Dan GAVIN	5	2000 years of fire regime in the Siskiyou Mountains: a high resolution charcoal record from Little Squaw Lake (SW Oregon, USA)
	55	Marie-Claude BAL, Albert PELACHS, Ramon PEREZ & Joan Manuel SORIANO	5	Long-time record of fire during the last 3000 years: the case of the Estany de Burg (Pyrenees, Spain)
	56	Milena PRIMAVERA, Massimo CALDARA & Girolamo FIORENTINO	5	Charcoals, ^{13}C and macrophytes proxies for tracking paleoenviromental and climate changes in the Ariscianne marsh (Apulia - Italy)
	57	Mona COURT-PICON, Stéphane PIRSON, Paul HAESAERTS & Freddy DAMBLON	5	New palaeobotanical data (charcoal and pollen) from the Walou cave (Vesdre basin, Belgium)

Exhibition timetable of the posters

Date	Sessions / Hours		Section 1		Section 2		Section 3		Section 4		Section 5	
			exhib.	pres.	exhib.	pres.	exhib.	pres.	exhib.	pres.	exhib.	pres.
Monday 8th	**1**	11 - 11.40	1 - 9	1 - 4	10	10	11 - 18	11 - 18	-	-	-	-
	2	15.20 - 16	1 - 9	5 - 7	10	10	11 - 18	11 - 18	-	-	-	-
Tuesday 9th	**3**	10.20 - 11.10	1 - 9	8 - 9	10	10	11 - 18	11 - 13	-	-	-	-
	4	15 - 15.50	-	-	-	-	-	14 - 18	-	-	-	-
Wednesday 10th	**5**	10.20 - 11.10	-	-	-	-	-	-	19 - 38	19 - 24	-	-
	6	15 - 15.50	-	-	-	-	-	-	19 - 38	25 - 32	-	-
Thursday 11th	**7**	10.20 - 11.10	-	-	-	-	-	-	19 - 38	33 - 38	-	-
	8	15.20 - 16	-	-	-	-	-	-	39 - 53	39 - 45	54 – 57	-
Friday 12th	**9**	10.20 - 11.10	-	-	-	-	-	-	39 – 53	46 - 50	54 – 57	-
	10	15 - 15.50	-	-	-	-	-	-	39 - 53	51 - 53	54 - 57	54 - 57

The cells give the days and numbers of the posters to be exhibited (**exhib.**).
The bordered cells give the session and numbers of the posters to be presented (**pres.**).

On Thursday 11th, due to the limited number of panels, the posters of Section 4 will be presented in two steps: n° 19-38 in the morning and n° 29-54 in the afternoon. Therefore, the authors will be invited to make the change of posters in the mid time of the day.

The authors cited in a particular session are invited to be present by their poster for explanation and discussion during their session time of poster. They are also invited to be free during the whole exhibition time of their poster.

4th International Meeting of Anthracology, Brussels,

Royal Belgian Institute of Natural Sciences, 8-13 September 2008

CHARCOAL AND MICROCHARCOAL : CONTINENTAL AND MARINE RECORDS

ABSTRACTS OF THE

ORAL AND POSTER COMMUNICATIONS

THE CONTRIBUTION OF ANTHRACOLOGY AND PALYNOLOGY TO THE KNOWLEDGE OF THE SAHARAN BIOGEOGRAPHY [1]

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In the Sahara, sites providing conservation of micro-plant remains like pollen are extremely rare. The palaeobotanical data relating to this area are nevertheless mainly the result of pollen analysis. The application of anthracology helps to identify the past distribution of woody species and to test the palaeo-phytogeographical interpretations proposed.

We are interested here in the cases of some remarkable woody species of the Central Saharan flora which are subject to conservation measures and biodiversity value targets. Understanding the Holocene dynamics of this flora allows for a better orientation towards strategies enhancing protection of biodiversity and natural heritage.

Key-words: Pedoanthracology, Palynology, Phytogeography, Holocene, Central Sahara

[1] Section 3, poster

THE MEDIEVAL CHARCOAL-PRODUCING FOREST OF MONT LOZÈRE, A GUIDE TO THE INTERPRETATION OF PROTO-INDUSTRIAL TERRITORY [1]

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Since 1999, the ongoing inventory and taphonomic study of metallurgic sites in the Mont Lozère area (Massif Central, France) have brought to light nearly 80 lead-ore smelters and more than 180 charcoal-burning sites. All of these sites were found in a zone measuring 10 by 4 kilometres, at an altitude of between 1300 and 1500 metres, and they all date from the central Middle Ages (11^{th}-14^{th} centuries).

A multidisciplinary approach, combining spatial archaeology, palaeometallurgy, isotopic analyses and anthracology, provides better knowledge of the functioning of this protoindustrial territory (Ploquin et al, 2003).
The galena was extracted from old mines surrounding the Mont Lozère; these mines were situated about 10 kilometres south of the smelting sites (fig 1). So the ore had to be taken to the metallurgical workshops via a transhumance route called "the Draille".

However, the metallurgical workshops and the charcoal-burning sites were associated, the wood charcoal (the fuel for the smelting activity) being produced near the smelting kilns. The wood supply is likely to explain the installation at altitude of travelling workshops, as near as possible to the charcoal-producing forest.
The archaeobotanic remains of charcoal-burning sites are very useful for the reconstruction of the medieval forest (expanse of the forest, nature of the wood, and management methods) (fig 1). This forest used to grow on the steep slopes below the pasture grazed by migrant sheep flocks at the summit. The first anthracological results indicate a secondary beech forest managed as coppice.

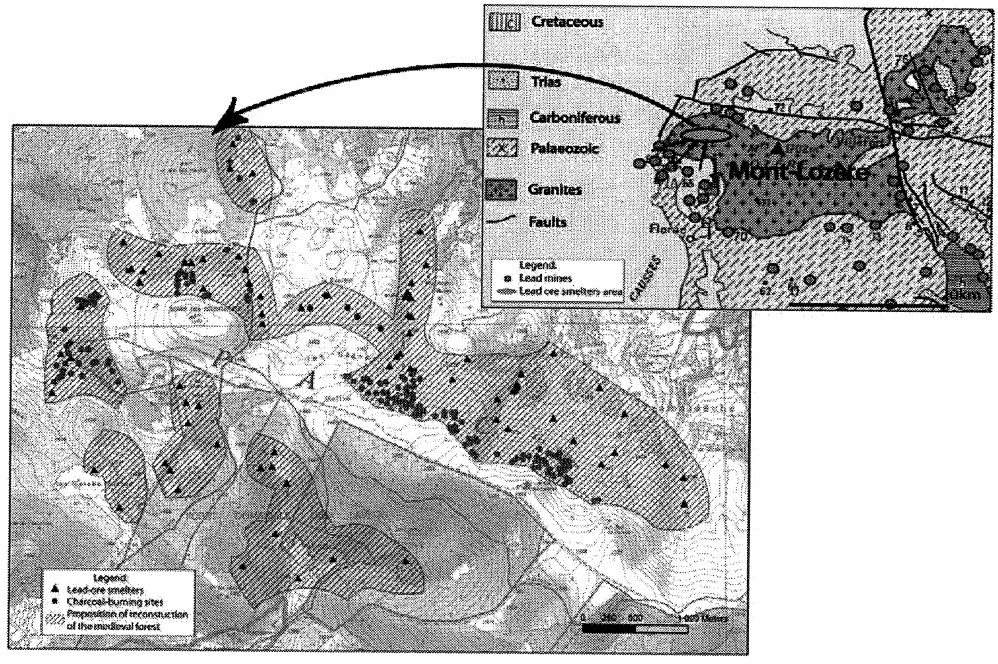


Fig 1: Left - lead mines used for the ancient metallurgical activities (Map modified from Routhier, 1963).
Right - zoom on the study area (proposition of reconstruction of the medieval forest).

PLOQUIN A., ALLEE P., BAILLY-MAITRE M.C., BARON S., BEAULIEU de J.-L., CARIGNAN J., LAURENT S., LAVOIE M., MAHE-LE CARLIER C., PEYTAVIN J. & PULIDO M., 2003. Medieval lead smelting on the Mont-Lozère, Southern France. *International Conference in Archaeometallurgy in Europe*, 1: 635-644.

Key-words: Charcoal-burning, Palaeometallurgy, Wood diameter, Forest history, Massif Central

[1] Section 4, Oral

FIRST EVIDENCES OF CHESTNUT (*CASTANEA SATIVA* MILL.) CULTIVATION FOR TIMBER PRODUCTION IN CAMPANIA (SOUTHERN ITALY): A HIGH SPATIO-TEMPORAL DEFINITION THROUGH POLLEN AND CHARCOAL DATA [1]

Emilia ALLEVATO [1], Elda RUSSO ERMOLLI [1], Rocco MITRO [1], Carmine LUBRITTO [2] & Gaetano DI PASQUALE [1]

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The history of *Castanea sativa* (sweet chestnut) diffusion is yet far from being clearly defined as it is strongly related to human activities. Pollen data are not able to give a precise picture of the geographical and temporal distribution of chestnut cultivation and it seems that, apart from the Insubrian Region and the north of the Italian peninsula, no other centre of chestnut cultivation existed in Europe during the Roman period.

Comparison between palynological and anthracological data allowed a high spatial and temporal definition of chestnut cultivation to be obtained along the northern slope of Vesuvius between the I and the V century AD.

Three archaeological sites close to each other (less than 20 km far away) were investigated in the study area.

- Pollen analysis was carried out on the deposits of the ancient harbour of Naples (site "A") where the anaerobic conditions and sediment nature allowed preservation of organic matter. Palynological data show a high temporal resolution as the entire sedimentary succession, about 6 metres thick, is well chronologically constrained between the end of IV century BC and the start of V century AD.
- Charcoal and macroremain analyses were carried out on two Roman sites on the Vesuvius northern slope (Site "B" and "C"), less than 5 km far from each other. Both sites were inhabited until the 472 A.D., when a Vesuvius eruption buried them.

Chestnut pollen in *Neapolis* harbour sediments are scarce and intermittent along the entire profile, ranging between its maximum value in 1st century AD with 3.6% of arboreal pollen and its minimum value with 1.4% at the end of the 2nd century AD. These data could suggest no chestnut cultivation in the area but, the wooden structures of the building in the closeby site "B" were made exclusively of chestnut, and chestnut wood was found in fireplaces too. A small amount of chestnut charcoals was found in the near site "C" too. Our palynological record from the *Neapolis* harbour is in agreement with the previous palynological studies in central and southern Italy, detecting small amounts of chestnut pollen. On the contrary, anthracological data attest a sure presence of *C. sativa* cultivation in two neighbouring sites.

Anthracological data allowed a chestnut cultivation for timber production to be detected on the northern slope of Vesuvius. Comparison with the *Neapolis* pollen data suggests a small size of the cultivation stand, not detectable by pollen analysis. This approach based on pollen and charcoal comparison revealed that chestnut cultivation centres in southern Italy were probably more widespread than what was suggested by pollen records and this finds a major agreement with the classical literature which indicate an increasing importance of chestnut starting from the 1st century A.D. Ongoing ^{14}C dating of the Chestnut charcoal will allow a better determination of the age of the wooden structures of the site "B".

Key-words: Chestnut, Roman period, Anthracology, Palynology, Italy

[1] Section 4, Oral

ANTHRACOLOGY FROM PALEOLITHIC ARCHAEOLOGICAL SITES AT THE NORTH EAST OF THE IBERIAN PENINSULA: IMPLICATIONS ON HUNTER-GATHERERS LANDSCAPES AND FOREST RESOURCE MANAGEMENT [1]

Ethel ALLUÉ

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Charcoal remains from Palaeolithic sequences are a source for the study of past environments and human behaviour. The taxonomic identification and the taphonomy approach permit to achieve certain records on local vegetation, climatic records and the relation between humans and their environment. Concerning landscapes, charcoal sequences offer a more precise record of local taxa and arboreal formations, which are not perceived through other disciplines. Forest resources management is approached as a tool for understanding the selection making on wood among different human groups.

In this study we are presenting different anthracological assemblages from the NE of the Iberian Peninsula which contributes to the knowledge of Pleistocene landscapes and hunter-gatherers behaviour in relation to fuelwood management. Due to preservation problems there are two main periods that provide data on the area for this study: the first one corresponds to a chronology between 60 and 40 kyrs. BP.; and the second correspond to a chronology between 13 to 9 kyrs. BP. Both of them are relatively small excavations with short deposits characteristics of this period.

In all sequences should be remarked the importance of *Pinus sylvestris* type. Other species such as *Juniperus*, *Prunus*, *Rhamnus cathartica/saxatilis* and *Acer* appear commonly at the most recent periods showing a transformation of landscape and changes on the resources management. These forests formations were well established at the North East of the Iberian Peninsula. Concerning wood choices and preferences there is dependence on the environment, but other considerations such as availability of species or type and duration of occupations are made to interpret wood management for each site.

Key-words: Palaeolithic, Landscape, Hunter-gatherer, Palaeoeconomy, NE Iberian Peninsula

[1] Section 4, Poster

CHARCOAL ANALYSIS IN THE NORTHEAST OF THE IBERIAN PENINSULA: HISTORY, CURRENT RESEARCH AND PERSPECTIVES [1]

Ethel ALLUÉ [1], Ferran ANTOLÍN [3], Marie-Claude BAL [4], Laura CARUSO [3], Mireia CELMA [3], Carme CUBERO [5], Raquel CUNILL [4], Itxaso EUBA [2], María MARTÍN [3], Carmen MENSUA [3], Albert PÈLACHS [4], Llorenç PICORNELL [6], Raquel PIQUÉ [3], Àlex SOLÉ [1] & Jaume ZAMORA [1]

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5. Fundació Privada l'Esquerda, Bac de Roda, 6 08510 Roda de Ter, SPAIN.
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Charcoal analysis is a technique that has been developed and applied in a generalized way in Catalonia since the 80s. It has been focused mainly in the determination of woody species used as fuel in Prehistory from archaeological sites. The amount and quality of the obtained data has allowed interpreting them in palaeoecological terms and therefore characterizing the main components of the landscape and its transformation from the upper Pleistocene to the Holocene.

Since charcoal remains are accumulated in the sites as a result of human activities, they are also indicators of the main strategies of forest management. Current landscapes are the consequence of this forest management. For this reason, it is not possible to understand the current landscapes without the historical referent.

The data obtained in Catalonia can be correlated to main historical processes: the adoption of agriculture and the necessity to obtain fields and grasslands, and the generalization of urbanism and metallurgy.

Recently, the studies in historical contexts, specifically charcoal kilns, offer a new view to understand the historical management of the forests and landscapes dynamics. And finally, pedoanthracology has become an important tool for the understanding of vegetation landscape in relation with agropastoral practises in the Pyrenees.

We will show in this poster the main results of this research on the basis of GIS and its graphical representations. These maps show the pressure evolution on the landscape in relation to the historical processes. The analysis of these data will be the goal of collaboration between all the researchers working in charcoal analysis in Catalonia. Besides, this work will be in the frame of a net of research involving Catalonia, Midi Pyrenees and Aquitaine.

Key-words: Charcoal, Catalonia, Forest management, Palaeolandscapes

[1] Section 4, Poster

THE PERCEPTION OF THE ENVIRONMENT DURING THE MESOLITHIC AND THE NEOLITHIC IN CAN SADURNÍ (BEGUES, BARCELONA). A VIEW FROM THE ARCHAEOBOTANICAL DATA [1]

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There is no doubt that one of the biggest changes between Mesolithic and Neolithic societies is their relation with the environment. Mesolithic societies managed their surrounding sources so that their environment could allow the regeneration of their own production and reproduction systems, whereas Neolithic societies, besides managing these sources, deliberately changed their environments so as to produce specific desired goods. Since the relation with the environment is such an important subject in the study of subsistence economies, we strongly believe archaeobotany has to make a new effort to understand the relationship between human beings and their environment further than what species were consumed.

In this poster we present a first approach on this sense, presenting a preliminary study of archaeobotanical data coming from the Mesolithic and Neolithic site of Can Sadurní (Begues, Barcelona). Clear differences can be observed between the last hunters and gatherers and the first agriculturalists even though they related with a similar environment. On the other hand, consequences on this environment as a result of these different interactions are also observable in a long term view.

Key-words: Neolithic, Mesolithic, Perception, Environment, Archaeobotany

[1] Section 4, Poster

MICROSCOPIC ANALYSES OF HERBIVORES COPROLITES FOUND IN COVA DE LES CENDRES (ALICANTE, SPAIN) [1]

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It is easy to find animal faeces at archaeological levels. However few analyses have been done in this material because most prehistoric remains studied have been animal bones. The first who investigated animal faeces in cave sediments from animal pen level were Beeching & Moulin (1983) in France, followed by AKERET *ET AL.* (1999), AKERET & JACOMET (1997), BROCHIER (1996), RASMUSSEN (1993), in France and Switzerland. More recent works documented animal-consumed plants by charcoal analyses to characterise their impact on surroundings in Spain and France. Interpretation of anthracological data from cave sites interpreted as animal enclosures, have put forward the possible use of lignified plants as animal fodder (*Fraxinus*, *Olea*, etc). The analysis of the plant remain content of coprolites and the comparison of the data with anthracological information from related archaeological layers appear to be the only reliable way to prove or refute this hypothesis (BADAL, 1999; CARRIÓN, 2005; THIÉBAULT, 2005).

In this study, analyses data of sheep and/or goat coprolites from the Neolithic period in la Cova de les Cendres (Alicante, Spain) using both metallographic microscope and S.E.M. techniques are presented. Our objective is to characterise the coprolites of domestic animals to know the pastures, the animals' diseases and the organic material decomposition processes at archaeological sites. We will attempt to relate cattle feed with the flora identified in coprolites with charcoal analyses at la Cova de les Cendres. Our results indicate that it is possible to distinguish coprolites from adults and neonate animals. No plant material was found inside the coprolites from young animals and, finally, the adult animals' coprolites contained plant, fungal, microbial and mineral remains. We will present photographic evidence of our findings.

Key-words: Coprolites, Vegetal content analyses, Charcoal, Fungi, Neolithic, Pastures, Livestock

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[1] Section 4, Poster

LONG-TIME RECORD OF FIRE DURING THE LAST 3000 YEARS: THE CASE OF THE *ESTANY DE BURG* (PYRENEES, SPAIN) [1]

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Study of microscopic charcoal from peat bog has led to a better understanding of climate, vegetation and fire history and human impact. To determine the long-term role of fire during the last 3000 cal. BP. in southern slope of central Pyrenees, we have studied the first two meters of an exceptionally deep sedimentary sequence of fourteen meters at the *Estany de Burg* (42°30'18" N lat, 1°18'22" E long, 1821 m elev.). The charcoal was estimated by a sieving-method (150 micrometers). This research is fitted into an interdisciplinary approach (sediment characteristics, microcharcoals, macrocharcoals, pollen and macro-remains) which permits to obtain high-resolution data about palaeoenvironmental and archaeological reconstruction of mountain areas. In this communication we present new results about pattern of fire frequency during the last 3000 years. The history of fire will be correlated with pollen results. The Scots pinewood (*Pinus sylvetris*), between 2800 years Cal BP and the present time has been an indicator that allowed to contrast the importance of the climate in relation to human activity. Specialization towards different economic activities has been a strong conditioner of the presence of the pine. In this way, livestock (during Middle Ages) and the metallurgical activity (18th and 19th) are the main activities modelling present day forest appearance. These data allow understanding fire regimes might be controlled by climatic, human and vegetation change.

Key-words: Sedimentary charcoal, Fire history, Peat bog, Pyrenees

[1] Section 5, Poster

BARK HEARTHS IN SOUTH-AMERICAN TUPIGUARANI FUNERARY RITUAL [1]

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Archaeological charcoal samples may provide palaeoenvironmental as well as palaeoethnobotanical information. The engagement of pre-historical people in transporting wood to the dwelling site does not invalidate past vegetation reconstructions. Likewise, anthracological studies aiming at palaeoenvironmental reconstructions shall not obfuscate palaeoethnobotanical data that might be enclosed, sometimes in the same samples. The finding of high proportions of bark in several charcoal samples from Morro Grande archaeological site (Southeastern Brazil. 22°47'07"S, 42°21'49"W) illustrate this principle. This site, which earliest occupation is dated between 2920±70 BP (3220-2840 cal BP) and 2600±160 BP (3000-2150 cal BP), is associated to the Tupiguarani Tradition, attributed to supposed ancestors of Tupinambá native populations, who occupied the major part of the Brazilian coast in the XVI century. A large sampling of dispersed and concentrated charcoal was performed. The analysis of dispersed charcoal demonstrated the permanence of the Atlantic Forest in the region during all the occupation period. Concentrated charcoal samples from the site's earliest occupation level allowed important interpretations. The analysis concerned 1636 charcoal pieces recovered from hearths in domestic and funerary contexts: 10 hearths and a sample of dispersed charcoal in funerary context from Locus 2, and two more hearths from Loci 1 and 4. From these, 535 wood fragments were determined, 97 charred pieces could not be identified (knots, small branches, poorly-preserved fragments), and 1006 pieces corresponded to dicotyledonous bark. Thirty-one taxa were recognized. Prevailing taxa were frequently Leguminosae genera: *Bauhinia* sp, *Copaifera* sp, *Myroxylon* sp, *Poecilanthe* sp, and *Inga* sp. Other important taxa were *Tabebuia* sp, Myrtaceae, and Lauraceae. Most hearths presented very low taxonomic diversity, agreeing with usual descriptions of concentrated charcoal in burning features, which commonly originate from short duration fires, reflecting only the species used in the last (or single) burning episode. They may also be associated to specialized or ceremonial activities. All identified taxa are common in the Brazilian Atlantic Forest, and there was no evidence of wood selection. However, the composition of funerary hearths is clearly distinct from that of domestic ones, especially regarding bark content. A number of hearths from Locus 2 were associated with the mortuary ritual, for they were found encircling the funerary urn and associated with ceramic fragments painted with elaborated patterns in black, white, and red. From these, six provided charcoal for anthracological analysis. Other hearths, spatially isolated from the funerary area, were associated to fragments of utilitarian non-painted ceramics and were therefore attributed to domestic contexts; four domestic hearths could be analyzed. Five of the funerary hearths presented more than 70% of bark pieces; another hearth and a sample of dispersed charcoal in the same context presented not less than 25% of bark each. Conversely, few or no bark fragments were identified in the domestic hearths, and the same was true for the dispersed charcoal samples. The high proportion of bark found in the funerary hearths attests that this material was intentionally selected as fuel. But why did such a selection take place? The interpretation of this issue was based on ethnographic and ethnologic analogy. Modern ceramists consider bark as one of the best fuels to fire ceramics, because of its high and instantaneous heat. Bark hearths used by Tupinambá women to fire ceramics were reported by H. Staden in 1557. However, the studied hearths were undoubtedly in a ceremonial context and were certainly not utilitarian. Many chroniclers from the XVI and XVII centuries report the importance of fire and the omnipresence of hearths in Tupinambá funerary rituals, even if there is no reference to these hearths' specific composition. Historical texts and ethnographic accounts make clear that fire is one of the cornerstones of Tupiguarani funerary rituals, playing an essential role in the transition of the soul from the world of the living to the world of the dead. But why bark? We propose that this material was selected because of its calorific power. Firing ceramics was probably the quotidian activity demanding the greater hearth potencies these people knew – bark hearths were able to reach temperatures that could make clay glow and become ceramics. They had the *power of transformation*. And the perilous journey the dead must overcome stands for a period of transformation. It is conceivable that the power of transformation of ceramics hearths was transferred to a spiritual level: the transformation of the body soul in the revered soul – an Ancestor.

Key-words: Bark, Hearth, Charcoal, Palaeoethnobotany, Brazil

[1] Section 4, Poster

THE BURNING QUESTION: NEW LIMITS FOR COMBUSTION IN LOW O_2 REDEFINE PALAEO-ATMOSPHERIC PREDICTIONS FOR THE MESOZOIC [1]

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Atmospheric oxygen has played a key role in the development of life on Earth, with the rise of oxygen in the Precambrian (>542 Ma) being closely linked to biological evolution. Evidence for variations in the concentration of atmospheric O_2 throughout geological time comes mainly from models based on geochemical cycling and rock abundance. Such models predict atmospheric O_2 concentrations as low as 10% in the Early Triassic (245 Ma). Few proxies have been developed for testing the modelled past atmospheric O_2 concentrations, particularly the low O_2 predicted in the Triassic and Jurassic. Charcoal in the geological record offers a means to assess palaeoatmospheric oxygen levels and numerous studies have sought to test the limits of combustion under varying concentrations of oxygen, however, none have been able to fully assess these limits within a fully controlled and realistic atmospheric environment. A unique state-of-the-art experimental atmospheres and climate facility (UCD PÉAC) that has full atmospheric, temperature and humidity control has been constructed where experimental burns were performed for a variety of materials (including natural plant material) at 20°C and O_2 concentrations ranging from 9 to 21% and at ambient and high (2000ppm) CO_2. Here we present a unique dataset which reveals that the lower limit of the "fire window" (the range of O_2 under which natural wildfires will occur) should be readjusted from 12% to 15% O_2. The record of palaeowildfires known to have occurred throughout the Mesozoic, based on the occurrence of fossil charcoal, inertinites and geochemical proxies (e.g. polycyclic aromatic hydrocarbons), is documented and compared to the predicted atmospheric oxygen curve in light of this newly adjusted "fire window". We show that wildfires are prevalent throughout the Mesozoic and that the record of wildfires in the Triassic and Jurassic is incompatible with any of the extremely low (10-14%) atmospheric oxygen levels predicted for this time.

Key-words: Mesozoic, Atmospheric oxygen, Palaeowildfire, Charcoal, Combustion

[1] Section 2, Oral

FIRST ANTHRACOLOGICAL DATA FROM THE ROMAN *VICUS* OF *THAMUSIDA* (SIDI ALI BEN AHMED, NORTH-WEST MOROCCO) [1]

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Archaeological surveys carried out between 1999 and 2006 in *Thamusida* site (north-western Atlantic coast) brought to light the Pre-Roman to Islamic layers dating to between the 5th century BC and the 3rd century AD. The excavation concerned a Roman *Vicus.*

Anthracological analysis shows the presence of several evergreen taxa such as *Cistus*, *Olea* and evergreen oak. In particular the presence and the use of *Quercus suber* are well documented from charcoal and charred cork remains. Cork oak is today prevailing in the forest vegetation in the surrounding of the site (Maamora forest). From a biogeographical point of view, the presence of *Tetraclinis articulata* (Pre-Roman layers), deciduous *Quercus* (1st – 2nd century AD) and *Castanea sativa* (2nd – 3rd century AD) is noteworthy.

Further analysis will allow to better define the significance of these taxa and vegetation dynamics from the 5th century BC to the 3rd century AD.

Key-words: Morocco, Pre-Roman, Islamic, Charcoals analysis

[1] Section 4, Poster

CHARCOAL IN THE NEOLITHIC BYLANY, CZECH REPUBLIC [1]

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Recent knowledge about lowland forests in Neolithic Bohemia is based mainly on pollen analyses. Their results suggest that between the Boreal and Atlantic periods, important changes in the natural forest composition took place and Bohemia became almost completely forested in the Atlantic period. At all altitudinal zones, previous pine and/or birch-dominated woodlands were replaced by a new set of forest trees. In the lowlands, mixed oak woodlands developed, characterised by the dominance of broad-leaved trees. This model is in agreement with another, indirect model of tree species distribution, derived from geobotanical reconstructions that are based on the knowledge of tree species ecology and prevailing site conditions.

An important source of direct evidence on the "Neolithic forest" in Bohemia is charcoal from Bylany, Central Bohemia, analyzed by J. Slavíková 20 years ago. It reflects woodland composition around typical Neolithic (LBK) settlement area. This unique anthracological assemblage was analyzed and the results published only preliminarily, without contextual analysis. The dominant wood is unambiguously oak (*Quercus*), present in 79 % of all studied charcoals. The second most common species is elm (*Ulmus*) with 2.45 %. This remarkable species was more common in the Atlantic period, during which, however, its decline began, that is usually ascribed to human activity, the use of land for grazing, slash and burning, and variety of other purposes. Such events might be recorded in the quantitative trends of occurrence of particular tree species, especially when contextual analysis is performed.

Key-words: Neolithic, LBK, Charcoal, Data structure, Palaeoecological trends

[1] Section 4, Oral

PALAEOENVIRONMENTAL AND PALAEOETHNOBOTANICAL INFERENCES IN A SHELLMOUND SITE FROM SOUTHERN BRAZIL [1]

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Anthracological analysis in Brazilian shellmounds is being carried out since the late 1990s. Important results have already been obtained in the Southeastern Rio de Janeiro coast, where data on the palaeovegetation, firewood economy, and diet revealed essential aspects of the moundbuilders way of life. Although some anthracological research had already been achieved in Santa Catarina State, Southern Brazil, the available results were as yet preliminary and concerned merely the palaeovegetation. The study area is situated on the Jaguaruna region, Santa Catarina State, at ca. 1 km from the southwestern margins of the Garopaba do Sul Lagoon and at ca. 6 km from the sea (699489/6835694 UTM). Climate in this region is temperate sub-hot, with winter mean temperatures over 15 °C and no dry season. Mean annual temperature is 20 °C and mean precipitation is 1400 mm/yr. Although the natural vegetation is almost absent from this region nowadays, the site is situated in the phytosociological domain of the *restinga* ecosystem, typical of the Brazilian coast. *Restinga* forests probably dominated the palaeodunes. The Atlantic Forest is situated inland, as well as the subtropical forest, typical of the high plateaus of more than 800 m altitude.

The Sambaqui Jabuticabeira II, dated between 2880 and 1800 years BP, attains 400 m x 150 m, with up to 8 m in height. The site is formed by numerous alternated layers of funerary levels and construction material. The later are characterized by small mounds of shells and sand sediments virtually devoid of cultural archaeological remains, disposed above the funerary structures. Funerary layers are extremely rich in hearth features, charcoal remains, artifacts, and faunal remains. The burials are usually surrounded by a great number of post-holes, indicating the existence of funerary constructed structures. Charcoal samples collected from a 4 m profile in Locus 1 were recovered by flotation in the field. The greater part of this profile is composed by constructive layers, while lie above a funerary layer about 20 cm-thick. Charcoal pieces were manually broken exposing the fundamental wood anatomical sections and examined under a reflected light brightfield/darkfield microscope. Systematic determination was achieved using Atlas Brasil software, a reference collection, and the specialized literature. All charcoal fragments over 4 mm were analyzed, attaining more than 3700 analyzed pieces. Smaller fragments are normally impossible to identify in the tropics, for in general they do not present enough discriminant characters. The site was clearly situated in the *restinga* environment, corroborating previous studies that indicated that these moundbuilders used to establish themselves in this vegetation domain. "Open *restinga*" vegetation, typical of the sand beach ridges nearer to the sea, is quite common during all the period of site occupation, as well as the "restinga forest", an evergreen low forest usually occurring in the inner beach ridges. However, the high proportion of Atlantic Forest *taxa* suggests that this dense ombrophilous forest of high biodiversity actually occurred nearer to the coast than is case in the present climatic conditions. Anthracological analysis disclosed a clear opposition between the "constructive" and the "funerary" layers. Palaeoenvironmental indicators are similar all along the charcoal diagram, suggesting that no significant environmental change took place during the occupation period. The quantity of charcoal remains is, relatively, significantly higher in funerary layers, as well as the taxonomic diversity, reflecting the high importance of fire and hearths in the mortuary rituals. Indeed, the number of analyzed charcoal samples, as well as of identified *taxa* from the 3,80 m of constructive material is roughly the same found in just 0,20 m of funerary structures. Moreover, food remains are completely absent from the constructive layers, while they are particularly abundant in the funerary samples, attaining in some cases more than 30% of the analyzed remains. Most food remains are as yet indeterminated, but Arecaceae, Annonaceae, and Cucurbitaceae fruits or seeds were already identified. The abundance of edible fruits in the mortuary layers corroborate a hypothesis based on zooarchaeological studies, suggesting the practice of food offerings, and/or ritualistic or feasting ceremonies. Palaeoenvironmental and palaeoethnobotanical results obtained so far indicate that Jabuticabeira-II moundbuilders have inhabited the *restinga* environment for a very long time, exploiting their surroundings for domestic, utilitarian, and ritualistic wood and food. Although presenting a relative stability, this landscape was probably deeply used and managed by these people.

Financial support: CNPq.

Key-words: Anthracology, Archaeobotany, Charcoal, Food remains, Brazil

[1] Section 4, Poster

MULTI-SAMPLING STRATEGY IN PEDOANTHRACOLOGICAL ANALYSIS (SOUTHERN FRENCH ALPS) [1]

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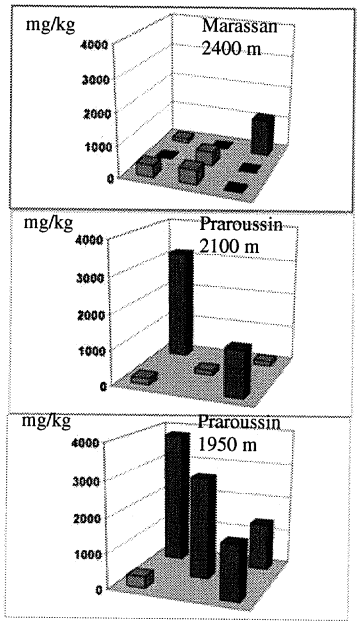
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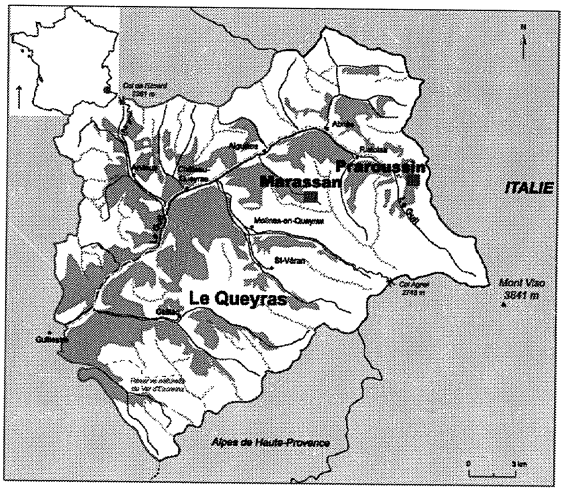
The investigation of small-scale sites (0.5 to 1 ha) allowed us to re-evaluate previous hypotheses regarding anthracomass distributions.

The first results of this multi-sampling charcoal analysis carried out on three small areas (0.5 to 1 ha) within the subalpine forest reveals discontinuity in the distribution of charcoal in the soils of a forest stand and demonstrate important variations in both quantities of charcoal and species diversity at a small-scale. This relates to the distribution of dead wood on the soil surface prior to its burning. Moreover, the relative quantities of *Larix/Picea* and *Pinus cembra* soil charcoal vary significantly from one pit to another, and also between the three sites.

Restricted sampling from one single pit, rather than several, would have resulted in a partial assessment of the history of the forest stand in our case study area. The high variability of soil charcoal demonstrated in this study highlights the very high spatial resolution of this palaeoecological tool.

Key-words: Charcoal analysis, High-resolution, Multi-sampling, Methodology





[1] Section 3, Poster

THE ANTHRACOLOGICAL ANALYSIS AT THE BRONZE AGE EBLA SITE (NW SYRIA): RESULTS AND PERSPECTIVES [1]

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Starting from 2003, several archaeobotanical campaigns have been carried out on the Ebla site, NW Syria, in order to shed light on the use of plants between the Early Bronze Age IIIa and Middle-Late Bronze Age.

The results of the anthracological analysis, here presented for the first time following a continuous chronological pattern, have revealed changes in plants exploitation according to cultural aspects, functions of use and climate. Several contexts were investigated and the anthracological framework inferred from showed changes in the use of wood between the Early and Middle-Late Bronze Age.

Wood taxa found in the EBA Royal palace G were, for the major part, beams and poles of *Cedrus* and *Abies* employed as carpentry. In the same layers luxury artefacts of Pomoideae and *Olea* wood were found. More articulate is the framework emerging from the study of material coming from M/LBA phases due to the variety of contexts investigated. Public buildings, private houses, tanners, dumps and cultural wells gave back a diversified pattern of wood exploitation and led to evaluate the Ebla catchment in relation to the natural resources and the cultural habits.

Key-words: Catchment analysis, Ebla, Bronze Age, Syria

[1] Section 4, Oral

THE FARAGOLA MIDDEN: NEW PERSPECTIVE IN THE STUDY OF A LATE ANTIQUE (3RD - 6TH CENTURY A.D.) DUMP IN THE TAVOLIERE PLAIN, (SE ITALY) [1]

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The discovery of a midden in the Late Antique site of Faragola (3rd-6th century), in the Tavoliere Plain (SE Italy), offered the possibility to investigate how this secondary deposit of burned material was formed. Quite usual in the archaeological sites of the region, this kind of formation has never been subject to archaeobotanical investigation. Labelled as dump, discarded deposit, midden, or refuse pit, the deposits are full of charred material (especially charcoal) mixed with pottery and other debris. The archaeological assemblage found in the deposits can derive from the discarding of domestic debris or from the cleaning of work places. In the case of the Faragola midden the type of assemblage seems to have been originated both from the de-functionalization of private/public contexts and the cleaning of metal forges and kilns. The analysis of the charred material, found inside, led to 1) the definition of the *in-site* catchment of the midden, 2) the determination of the species used in the pyrotechnical activities, 3) the characterization of the tree cover of the Faragola landscape.

Key-words: Midden, Late Antique, Faragola, Tavoliere Plain

[1] Section 4, Poster

ANTHRACOLOGY IN CENTRAL AMAZON, BRAZIL: PRELIMINARY RESULTS [1]

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The Amazonian palaeoclimatic and palaeovegetational history since the Late Pleistocene is still under debate. A critical point of discussion regards the Holocene: was it a period of stability or of major environmental changes? Human occupation in Amazonia begun at least by 11,000 years B.P. Long periods of occupation in diverse environments were interrupted by hiatuses or discontinuities, frequently attributed to broader palaeoecological and palaeoclimatic processes. Several pollen and phytolith studies in Amazonia, including in the Central Amazon region, identified significant changes in forest structure and composition throughout the Holocene, interpreted as an alternation of humid and dry periods. Although anthracology has now been introduced in Brazil for a decade, archaeobotanical studies are still rare, especially in the Amazon. Nevertheless, the abundance of charcoal in Amazonian archaeological sites deserves attention, for their identification may provide valuable environmental as well as cultural information. Anthracological analyses, associated with data acquired during many years of archaeological research, may reveal important aspects of the way of life and cosmogony of the first inhabitants of the Amazon. The study of archaeological charcoal from Amazonian sites is being carried out thanks to a partnership between the Central Amazon Project (PAC) of the University of São Paulo (USP) and the Plant Palaeoecology Laboratory (LAPAV) of the National Museum of Rio de Janeiro (MN/UFRJ). The research conducted by the PAC allowed great advances in the understanding of the chronology in Central Amazon, as well as in settlement patterns, function, and processes of change in ancient societies from this region. Archaeological sites are characterized, for the most part, by mound structures formed by deep layers of juxtaposing dark earth ("*terra preta*") and ceramic fragments. Hearths, generally presenting high concentrations of charcoal, are extremely frequent in most of the hitherto studied sites, as well as dispersed charcoal in the sediments. Refinement in the acquisition of palaeoenvironmental and palaeoethnobotanical information is presently one of the main objectives of this project. The anthracological research under development might supply data to palliate the absence of empirical information on human influence for the formation of the Amazonian environment and on the palaeoecological reconstruction of the region, portraying the vegetation around the site during the occupation period and, consequently, the climate. An appropriated procedure for charcoal sampling is being followed in all excavations performed by the PAC since the beginning of the researches in 1995. Sediment samples for dispersed charcoal, as well as concentrated charcoal in features, are systematically collected in all soil levels and floated in the laboratory. The resulting material is then sorted, setting apart wood charcoal and carbonized seeds from faunistic remains. The interpretation of this material must rely upon comparison with existent ecosystems. Constitution of comparative collections and databases is an invaluable tool to these studies, especially in tropical regions, where the high biodiversity engenders as yet a poor knowledge of the wood anatomy of native species. For this reason, a reference collection of existent carbonized wood is being assembled through institutional donations, such as from the National Research Institute of the Amazon (INPA) wood collection. Around 160 species, from more than 45 families, have already been obtained. Carbonization and anatomical descriptions are in course. These samples will increment the anthracological reference collection already available in the LAPAV, which was, up to this moment, still quite poor in Amazonian species. The first archaeological charcoal analysis already performed followed the standard techniques: charcoal pieces were hand broken along the three fundamental wood sections and examined under a reflected light brightfield/darkfield microscope. Taxonomic determination was obtained by referring to the comparative collection and to the literature, as well as by employing the "Atlas Brazil" software. The analysis of a feature from Maria de Jesus site, located in the district of Anamã, on the margins of the Solimões River, in the state of Amazonas (Brazil) disclosed a number of taxa typical to the Amazonian Forest. The pursuit of the analysis shall reveal important information for palaeoenvironmental and palaeoethnobotanical reconstructions.

Financial Support: CNPq, FAPESP.

Key-words: Anthracology, Palaeoethnobotany, Holocene, Central Amazon, Archaeology

[1] Section 4, Poster

NEOLITHIC WOODLAND IN THE NORTH MEDITERRANEAN BASIN: THE CASE OF *OLEA EUROPAEA* [1]

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The available information concerning the presence of *Olea europaea* L. in prehistoric contexts of the northern Mediterranean basin seems to indicate that the Holocene history of the olive shows significant differences between the east and the west.

The anthracological data from the sites of Youra, Knossos, Petras and Drakaina in Greece shows that the olive is absent or infrequent in the studied areas during the earliest part of the Holocene appearing only later by the end of the Neolithic. This is in agreement with the pollen record for southern Greece and Crete and the general picture that emerges is that of the olive progressively proliferating and establishing around 4700 BC, in chrono-cultural relation to the Late Neolithic. Therefore, charcoal and pollen data raise the question whether the olive (and /or its cultivation) was native in the area or a later arrival forming part of the Neolithic package.

In southern Italy, *Olea* appears already during the Early Neolithic in lowland sites (up to 200m asl) but is absent from ones of a higher altitude. In Liguria the olive has been identified in the Middle Neolithic levels of Caucade and Giribaldi (Thiébault, 2001), both located near the sea and under the influence of thermomediterranean conditions.

In the Iberian Peninsula, the presence of olive charcoal and stones in Upper Palaeolithic contexts has been shown to be the result of post-depositional and taphonomical processes. However, *Olea europaea* L. macroremains have been recovered from the Epipalaeolithic levels at Cueva de Nerja, la Falaguera, Castelejo and other sites located at the thermomediterranean bioclimatic stage. From the 7th millennium BC onwards, *Olea* becomes the most abundant taxon in anthracological assemblages, probably indicating the existence of olive-dominated climax plant formations in the thermomediterranean stage. Olive macroremains recovered in sites located at the mesomediterranean stage are always of a later date and in contexts where there is evidence for the domestication of the plant.

With this presentation we attempt to make a synthesis of available published data, new anthracological analyses and AMS dates of olive charcoal aiming at the reconnaissance of the biochronological, ecological and taphonomical status of *Olea europaea* L. in southern Europe.

Key-words: *Olea europaea,* Charcoal, Holocene, Mediterranean, Neolithic

S. Thiébault. 2001. "Anthracoanalyse des établissements néolithiques de la région liguro-provençale". *Bul. Sc. Préhistorique Française* 90 (1) : 399-409.

[1] Section 4, Oral

THE SOUTHERN LITTORAL FOREST OF BRITTANY (FRANCE) UNDER THE IMPACT OF THE MESOLITHIC AND NEOLITHIC GROUPS FROM THE ARCHAEOLOGICAL CHARCOAL ANALYSIS [1]

Yolanda CARRION, Dominique MARGUERIE, Nancy MARCOUX

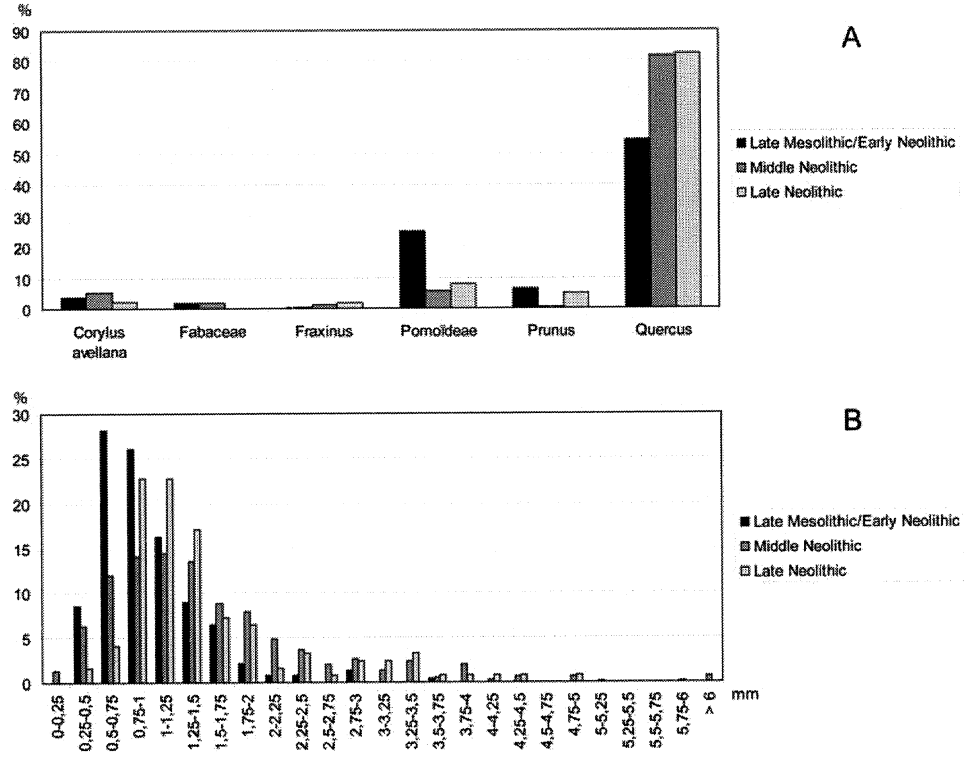
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The coast of southern Brittany constitutes a very interesting area to approach the complex relations of the last communities of hunters-gatherers and farmers with their vegetal environment.

For the Mesolithic and the Neolithic periods, the analysis of archaeological charcoal from twelve archaeological sites evidences the existence of dense forest formations with oaks and other mesophilous taxa throughout the coasts, including the islands.

The systematic measurement of the tree-ring width of archaeological charcoal shows a progressive opening of the forest during the Neolithic, consequence of the adoption of production economy and a change in the strategies of wood collecting. Indeed, during the middle Neolithic, charcoal spectra describe an anthropogenic, locally deforested landscape, with heliophilous taxa, such as hazel trees and alders. Some particular sites, such as megalithic monuments or hearths with burned stones, cannot be included in this pattern, maybe due to special strategies of wood exploitation.

Key-words: Mesolithic, Neolithic, Charcoal, Dendrology, Palaeovegetation, Firewood economy



A - Synthetic percentage charcoal diagram for twelve sites of southern littoral of Brittany (France)
B - Bar chart of the ring-widths of oak charcoals from twelve sites of southern littoral of Brittany (France)

[1] Section 4, Poster

FOREST RESOURCES EXPLOITATION AND MANAGEMENT BY SELKNAM HUNTER-GATHERER SOCIETIES: RESULTS OF THE ARCHAEOBOTANICAL ANALYSIS OF EWAN SITE (TIERRA DEL FUEGO, ARGENTINA) [1]

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Throughout the history, the forest has been exploited by human societies in order to satisfy the needs related to subsistence and social reproduction (habitat, food, manufacture of goods and means of production). In the case of archaeological sites, archaeobotanical studies allow to obtain data about the strategies of provisioning, use and consumption of vegetal resources. The exploitation of the forest plays a central role in production and reproduction systems of hunter-gatherer societies concerning its employment as essential raw materials.

Up to this moment the archaeological studies carried out in Selknam´s archaeological sites have been focused on the role played by hunting in their economy, in contrast the role of vegetal resources has been poorly understood. Therefore I concentrate on the analysis of plant macroremains recovered in Ewan I and Ewan II located in the central part of Tierra del Fuego (Argentina). This poster constitutes a first approach of the use of forest by Selknam hunter-gatherers. The information obtained revealed the exploited species as well as the mode and the characteristics of its usage as fuel by these hunter-gatherer group.

Key-words: Hunter-gatherers, Forest exploitation, Archaeobotanical studies, Tierra del Fuego, Argentina

[1] Section 4, Poster

STUDY OF FIRE DETECTION IN THREE HOLOCENE CORES OF GUNUNG SEWU (JAVA, INDONESIA) [1]

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The study of fire detection in three Holocene marshes in the region of the Gunung Sewu (Java) was undertaken in addition to pollen and phytolith analysis.

This study was conducted using the method of microcharcoal analysis in palynological slides, as described in Clark (1982). It revealed a change in the fire mode from the beginning of cultivation of graminaceous species onwards. It also demonstrates a slash-and-burn technique and various phases of fires which are attributed to human activities or to climate (marked dry season or El Niño event), or a combination of these two factors.

In addition, the comparison between microcharcoal curves obtained for these three Java sites with the curve of the regional fire history of South-East Asia and the West Pacific (Haberle S. G. *et al.*, 2004) indicates that the fires of the Gunung Sewu area follow the overall trend observed in South-East Asian fires and helps to isolate local events which are due to climate and settlement history of this region.

Key-words: Microcharcoal, Pollen, Phytolith, Human activities, Java

CLARK R. L., 1982. Point count estimation of charcoal in pollen preparations and thin sections of sediments, *Pollen et Spores*, vol. XXIV (3-4): 523-535.

HABERLE S. G., ROWE C., RULE S., BLUMBACH P. B., HEIJNIS H. & FORBES Z., 2004. Fire Histories from the Wet Tropics. *In*: *Polen, Contribution to the XI International Palynological Congress*, July 4-9, 2004, Granada, Spain, Departamento de Biologia Vegetal, Universidad de Cordoba, p. 540.

[1] Section 3, Poster

THE TAPHONOMIC PROCESSES AND THEIR CONSEQUENCES FOR THE PRESERVATION OF WOOD CHARCOALS IN ARCHAEOLOGICAL CONTEXT: AN EXPERIMENTAL APPROACH [1]

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Like most archaeological remains, post-depositional processes have an impact on wood charcoal leading to their horizontal and vertical migration due to faunal activity, root system, runoff, etc.. The mechanical constraints resulting from freezing-thawing cycles or sediment shrinking and swelling, as well as diagenetic processes can break down wood charcoal fragments and even lead to their total destruction. Therefore, these processes can alter the initial assemblage in both qualitative and quantitative terms and modify the paleoecological and paleoeconomic interpretations drawn up by anthracology.

Data on the consequences of taphonomic processes on wood charcoal are still scarce. We will focus here on the methodological approach adopted within an experiments cycle intended to estimate the effects of these various processes on charcoal. We present the results of some of the experiments carried out in natural periglacial and archaeological environment (Gavarnie and Estaubé, Pyrenees, France; Castanet Cave, Dordogne, France) in the order to evaluate the possible differential preservation of species.

Key-words: Taphonomy, Charcoal fragments, Experimentation, Mechanical properties, Inter-species variability

[1] Section 1, Oral

2000 YEARS OF FIRE REGIME IN THE SISKIYOU MOUNTAINS: A HIGH RESOLUTION CHARCOAL RECORD FROM LITTLE SQUAW LAKE (SW OREGON, USA) [1]

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The Siskiyou Mountains in the Pacific Northwest host one of the most floristically diverse National Forest in the US and fire represents a natural factor of disturbance in these ecosystems. During the last several decades, extensive logging and certain forest management policies such as fire suppression altered the natural forest regeneration process and led to an initial increase, and then decrease, of fire episodes. Thus, this area represents an interesting opportunity to check how human driven factors altered the natural fire regime over time and at what extent modern fire has diverged from its natural range of variability.

Palaeoecological methods such as charcoal analyses can provide unique long-term data for reconstructing disturbance regimes over time. We combine series of pollen, macroscopic charcoal and sedimentological data to reconstruct the history of fire during the last 2000 years at Little Squaw Lake (SW Oregon, USA). In contrast to more frequently studied high altitude locations, low elevation areas such as our site are characterized by more frequent and less severe fire. The high sedimentation rate at Little Squaw Lake (2-5 yr/cm) allows us to assess how our charcoal signal is able to represent smaller fire events at annual to decadal scales. We compared our charcoal series to historical record of fire events of different size and distance from the lake, to assess how recent fires were incorporated into our record. Our results show that major fires are represented by major charcoal pulses in the sediment record. The entire 1800-year record reveals that during the Medieval optimum forests were quite dense (with abundant *Taxus*, Cupressaceae and understorey taxa such as *Corylus* and *Rubus*) compared to today's highly disturbed ecosystems with *Pinus ponderosa* and *Pseudotsuga menziesii*. Magnetic susceptibility reveals minor but distinct erosion episodes following individual fires, suggesting that fire events were severe enough to affect soil stability. However, this effect increased significantly after 1950, when logging commenced in the watershed, probably due to more road construction on steep slopes and fire disturbances.

Our data show that high severity fires are not a recent phenomenon in this region, but that dense forests existed over long periods of time, experiencing both low and high intense fire. This study also provides a better insight into natural processes that occurred prior to the impacts of extensive forest management, in a region that is regarded for its high values of biodiversity.

Key-words: Fire regime, Forest management, Macroscopic charcoal, Siskiyou Mountains, Oregon

[1] Section 5, Poster

THE NECROPOLIS OF PORTA NOCERA (POMPEI). ANTHRACOLOGICAL STUDY OF A FUNERARY ENCLOSURE [1]

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The charcoal record from a Roman necropolis such as Porta Nocera, near Pompei, concerns a variety of aspects, including the reconstruction of the funerary rituals affecting the burial itself and its nearby space. In this perspective, the present study focuses on the funerary-related activities and rituals as they can be indirectly assessed by means of the analysis of the anthracological remains collected from the cremation pots and the nearby ground surfaces within the funerary enclosure.

In order to reconstruct the soil formation processes and the dynamics related to the archaeological materials lying within and outside the cremations, since the first field season we performed the individual 3D record of each ecofact. The interpretation of the anthracological record from a funerary enclosure which was active for over a century (from 40 BC to 79 AD), testifies some time-related differences in fuel use and technological fire control likely related to changing funerary practices.

Key-words: Anthracology, Roman cremation pyre, wood fuel, Pompei

[1] Section 4, Poster

NEW PALAEOBOTANICAL DATA (CHARCOAL AND POLLEN) FROM THE WALOU CAVE (VESDRE BASIN, BELGIUM) [1]

Mona COURT PICON [1], Stéphane PIRSON [1], Paul HAESAERTS [1] & Freddy DAMBLON [1]

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On continent, palaeoenvironmental reconstructions for the Pleistocene are supported by diverse paleontological records from lacustrine, peat, loam and cave sequences. Most often the latter are considered as dubious due to high risks of contamination and corrosion of the fossil material including charcoal, pollen and bone.

The advantage of the Walou cave lies in the cave entrance where the Pleistocene sequence is recorded. In such a particular situation the stratigraphic sequence includes several pedogeneses in a loessic sediment and favours the conservation of charcoal and pollen assemblages.

However, some intrusion of pollen grains did occur due to bioturbation but, at Walou, they could be detected by a clear difference in the preservation state of the pollen grains: corroded pollen from Pleistocene and fresh fashion pollen from Holocene. The former group was made of boreo-arctic taxa while the latter is essentially represented by mesophilous arboreal taxa corresponding to the present day surrounding vegetation.

Taking this fact into account, the comparison between pedostratigraphy and associated pollen assemblages clearly shows a very good agreement between both types of records for palaeoclimatic interpretation. So, inside the loessic layers of periglacial character, pollen spectra are largely dominated by steppic herbs. On the other hand, the humiferous layers and palaeosols, and also derived colluvial layers, include a significant part of boreal or ubiquitous tree taxa like pine and birch. Their role in the pollen spectra seems linked to the intensity of the pedogenesis.

By another way, the lowest part of the sequence, which was attributed to the early Glacial by stratigraphy, contained charcoal remains allowing to control the local origin of the tree taxa. Even more, the occurrence in a wildfire horizon from this period, of mesophilous tree taxa such as Quercus, Fraxinus and Carpinus, reinforces the temperate character of the environment reconstructed from these deposits. Therefore, we can conclude to the good agreement between stratigraphy, charcoal and pollen data in the sequence of Walou.

Considered globally, the palaeobotanical record in the cave entrance of Walou represents a decisive contribution to the palaeoenvironmental and palaeoclimatic interpretation of the site and the region during the Upper Pleistocene. In this way, it provides safe information on the life environment of man during the Upper Pleistocene in a limestone region of northwest Europe.

Key-words: charcoal, pollen, cave, Pleistocene, stratigraphy

[1] Section 5, Poster

TREELINE EVOLUTION IN THE SOUTHERN BASIN OF PYRENEES. PEDOANTHRACOLOGY AS A TOOL FOR STUDYING THE HISTORY OF THE SUPRAFOREST AREA PRACTICES [1]

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In the southern basin of Pyrenees different palaeoenvironmental studies (pollen analysis, charcoal kiln, etc.) have brought long term knowledge about vegetation dynamics and a first introduction to the treeline evolution.

Pedoanthracology study gives the opportunity to improve the knowledge about the evolution of this ecotone area during Holocene period trough a more precise spatial delimitation. In this poster we present the first pedoanthracologic study in this region. This study is included into an interdisciplinary approach with the aim to explain the mountain landscape evolution trough the palaeoenvironmental and archaeological studies. We focus our attention on the vegetation dynamics and the mountain anthropization in Plaus de Boldís (1° 17' 12" E, 42° 37' 49" N) which are located in the Central Pyrenees between 1,500m and 2,600m above see level. Two species were dated in the first part of the study: *Pinus uncinata/sylvestris* (1,070 cal BP) and *Genista balansae* (5,290 cal BP).

The pollen analysis carried out in Coma de Burg in the nearby valley of Vallferrera shows these two last periods like key moments for the landscape history for this area. It is known that *Genista balansae* is a burned pine area colonizer. Historical sources demonstrate that traditional livestock area system used to use the fire with aim to keep free of shrubs and improve the grasslands. We focus our study on vegetation dynamics about the *Pinus uncinata/sylvestris* and *Genista balansae* vegetation and how pedoanthracolgy can contribute to explain anthropic practices of this area.

Key-words: Pedoanthracolgy, Treeline, Southern Pyrenees

[1] Section 3, Poster

THE USE OF WOOD BY THE POPULATION OF THE PRZEWORSK AND LUSATIAN CULTURES BASED ON CHARCOAL ANALYSIS FROM KONOPNICA (CENTRAL POLAND) [1]

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On the area of the multi-culture archaeological site in Konopnica (No. 6), located on the left-bank terrace of the Warta river valley, the zone of numerous storage pits of the Lusatian culture (Bronze and Early Iron Age) and the settlement of the Przeworsk culture (Roman period, 2nd – 3rd cent. AD) were discovered. Among features representing the Przeworsk culture over a dozen buildings, metallurgic stoves, a lime-kiln, and numerous hearths (with constructions) were found. From the chosen features (storage pits, buildings, hearths) charcoal pieces were collected for anthracological analysis. In total 52 samples from 39 features were analyzed.

In the samples from features of the Lusatian culture (mainly storage pits) wood of *Quercus* sp., *Pinus sylvestris* L., *Carpinus betulus* L., *Populus* sp. and *Betula* sp. was identified.

Among the charcoal pieces, taken from the features of the Przeworsk culture, the following taxa of trees and shrubs were determined: *Quercus* sp., *Pinus sylvestris* L., *Betula* sp., *Carpinus betulus* L., *Alnus* sp., *Populus* sp., *Fraxinus excelsior* L., *Corylus avellana* L., *Abies alba* Mill. and *Picea/Larix*. In samples consisting of the elements of charred wooden construction mainly *Quercus* sp. was registered and in two cases also *Pinus sylvestris* L.

The results of charcoal analysis suggest, that the population of the Lusatian culture used almost exclusively wood of oak and pine, but it must be kept in mind that all collected samples originated only from storage pits. In the Przeworsk culture still oak wood was used commonly, and in a smaller degree pine wood, but at the same time the use of many other trees and shrubs became more frequent. The wide spectrum of wood genera present in the younger period probably results from functional differentiation of features, from which the samples were collected (buildings, hearths, and other objects).

Key-words: Anthracology, Lusatian culture, Przeworsk culture, Central Poland

[1] Section 4, Poster

DATING CHARCOAL FROM QUATERNARY LOESS SEQUENCES: QUESTIONS AND SUGGESTIONS [1]

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The history of climate, vegetation and man is founded on investigations of both continental and marine sequences. This implies an accurate chronological frame allowing to setting each natural or anthropogenic event in time, a goal uneasy to reach due to difficulties to gain good material for safe and precise radiometric dating.

The high potential of charcoal for radiocarbon dating is well known because it is made of inert carbon even if some degradation may occur with time in certain conditions. However, despite this advantage, some ^{14}C dating results published in the literature remain debatable for various reasons linked notably to the strategy of sampling and the lack of laboratory treatment.

In the course of research programs in the loess belt from Belgium to Siberia, the authors have obtained more than 500 new radiocarbon dates from about 20 Upper Palaeolithic sites and compared them with previous ones from the same sites.

The main problem is to establish from a same layer a clear relationship between the event – natural or anthropogenic – to be dated and the charcoal assemblage submitted to dating by taking the geological and taphonomic processes into account, as for example reworking of lower geological layers or inclusion of drift wood in a charcoal assemblage of human origin. The taxonomic identification of the material can give indication on the integrity of a charcoal assemblage and the possible intrusion of younger paradoxical material.

Only long multilayered loess sequences combining stratigraphic markers with radiocarbon dates on strongly selected charcoal may provide a safe tool to control the accuracy of the chronology of the events recorded in these sequences. The coherence of that chronology is drawn up in the logic succession of the dates, including ones on other kind of material, from the oldest layers to the youngest ones. In this way, anomalies can be suspected or detected and eventual bad dates put aside.

More and more the experience shows the absolute necessity to control each step of field investigation, sampling and treatment before dating, especially the geological history of the site and the collection of charcoal samples on clean sections, the careful treatment in the laboratory, the taxonomic identification, the cleaning and the selection of the adequate charcoal fragments to date, and even the labelling that must be achieved by a same team.

The present contribution aims at discussing the role of the anthracologist in such a problematic as a basis for further setting up an accurate chronology of the climatic events and human occupations before any effort of modelisation processes.

Key-words: Charcoal, Radiocarbon, Loess, Eurasia, Upper Pleistocene, Palaeolithic

[1] Section 1, Oral

VEGETATION DEVELOPMENT IN RELATION TO HUMAN OCCUPATION AND CLIMATIC CHANGE IN THE MIDDLE EUPHRATES AND UPPER JAZIRAH (SYRIA/TURKEY) DURING THE BRONZE AGE [1]

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The analysis of about 50000 identifiable fragments of charcoal from in total 12 archaeological sites along the Middle Euphrates and Upper Jazirah allows gaining an overview of vegetation development from the Early to Late Bronze Age for Northern Syria/Southern Turkey, an area where pollen preservation is generally poor and little was known about the vegetation development.

Overall, while the *Pistacia*-almond woodland steppe was seriously reduced towards the end of the 3rd millennium BC compared to the Neolithic period, the distribution of the deciduous oak during the Early Bronze and Middle Bronze Age was probably still similar to that of the potential reconstructions by Hillman under present day climatic conditions, thus within northern Syria, further south than its present distribution. While woodlands, e.g. the *Pistacia*-almond woodland, in some areas may have been cleared to meet the demands of growing population, other lands probably saw the expansion of planted groves of trees for fruit or timber. Besides human impact, the period under consideration is also marked by climatic change that could have had impact on the vegetation, with relatively moist conditions during the Early Bronze Age; a dry peak at the end of the Early Bronze Age and overall a long-term average tendency to climatic drying afterwards. Within this paper, we will explore possible causes for the observed vegetation changes.

Key-words: Vegetation development, Syria, Turkey, Climatic impact, Human impact

[1] Section 4, Oral

TREE RING ANALYSIS OF ARCHAEOLOGICAL CHARCOAL: A TOOL TO IDENTIFY PAST WOODLAND MANAGEMENT ? [1]

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In 2005, a large number of charcoal fragments has been recovered from the remains of a late medieval castle situated in Oudenaarde (Belgium). The size of the fragments and the way they are charred suggest that they are the result of charcoal production rather than the remains of a domestic fire or a fire hazard within the castle.

As most of the charcoal fragments consist of almost entire pieces of round wood, their entire growth ring pattern can be measured. The growth rings close to the pith are conspicuously wide, but decrease dramatically after between 4 and 8 years. This specific growth ring pattern is probably a consequence of intensive coppice woodland management. To verify this hypothesis, cross sections and increment cores from modern coppice stands of *Quercus spp.*, *Corylus avellana*, *Fraxinus excelsior* and *Carpinus betulus* have been collected and measured to compare their growth ring pattern with the charcoal fragments. The preliminary results suggest that it is possible to demonstrate past woodland management techniques by studying the growth ring pattern of charcoal fragments from archaeological sites.

Key-words: Woodland management, Coppice, Anthracology, Dendro-ecology, Belgium

[1] Section 1, Poster

SEA, FIRE, PEOPLE: THE HISTORY OF HOLOCENE VEGETATION ON THE EASTERN FRENCH MEDITERRANEAN COAST [1]

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Deep coring was realised along the railway connecting Cannes to Nice, on the eastern French Mediterranean coast, in several rias of the « French riviera » (44°N). Wood charcoal is abundant all along the recovered profiles and thus provides a valuable record of palaeofires and palaeovegetation.

« La Digue » is a small coastal river draining a 3.5 km long basin that reaches its higher point at 130m asl. A 20m-deep core was obtained next to its mouth. Although located in a calcareous area, the basin is mainly made of siliceous volcanic substratum that determines the presence of calcifuge vegetation. Nowadays, this vegetation is deeply anthropised since the area is highly urbanised.

Pollen and charcoal analyses of the sequence reveal a 9-millennia-old fire succession and its impact on the coastal Mediterranean ecosystems. Eleven radiocarbon dates support a solid chronostratigraphical frame. The presence of numerous charcoal layers (about 50), in particular along the deepest part of the core which corresponds to the early Holocene, reveals the great recurrence of natural fires in that bioclimatic area (lower mesomediterranean stage). During more recent times, fire rhythm is altered by human practices with lower fuel accumulation.

Taxonomic identification of charred wood and pollen shows that the Holocene vegetation dynamics differs for various aspects from the pattern available for calcareous Provence and Languedoc. In particular, all the sequence, including pre-Neolithic levels, is characterised by the permanence of « macchia » associations including sclerophyllous oak in which Ericaceae (*Arbutus* and several heaths) play a major part.

We assume that the presence of this plant community should be related on one hand to the siliceous and volcanic nature of the substratum and on the other hand, to the recurrence of fire in the area all along the 9 studied millennia. Its settlement before the Neolithic period, to the detriment of mesophilous, ombrophilous and deciduous mixed oak-lime forest, suggests natural cyclic perturbation.

Key-words: Mediterranean vegetation, Holocene, Fire, Disturbance, 8200 BP

[1] Section 3, Oral

DECODING WOOD EXPLOITATION IN ARCHAEOLOGICAL SITE BY TAPHONOMIC ANALYSIS [1]

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The purpose of this work is to investigate some anatomical traces in wood tissue due to biotic and abiotic factors in order to decode wood exploitation. Taphonomic analysis was carried out on wood material observing the interaction between wood tissue and biotic factors like fungi, insects and marine borers, and alteration products by chemical and physical agents. The samples are collected from different archaeological contexts like wrecks, wells, human burials and hearth structures. The material is preserved in different ways.

Waterlogged wood: these samples were recovered from sea bed and wells. In the first case, we analyzed some fragments of a ship (Wreck B, Torre Chianca-Le) showing attacks by shipworms and shellfishes, like *Teredo navalis* and *Balanus*; in the second case, we are studied some wood artefacts and pruning branches from a medieval well (Supersano-Lecce). Wood replaced by metal corrosion products: we examined some traces of wood tissue found on metal objects, like swords (carried out in a classical necropolis) and nails (carried out in a medieval burial). Others samples were recovered from a rubbish pit in Carlo V castle (Lecce). Charcoal remains: we consider wood fragments from hearth structures. The samples were collected from archaeological sites dated from Middle Palaeolithic up to Late Middle Ages, characterized by hyphae traces in the vessels. In this case a series of controlled combustions in laboratory were performed in order to evaluate the survival of deterioration traces in charred material.

The macroscopic and microscopic analyses of charred remains, waterlogged wood and wood replaced by metal corrosion products shed new light on depositional and post-depositional processes that led to anatomical wood changes.

Key-words: Taphonomy, Wood degradation, Post-deposition, Experimental design

[1] Section 1, Poster

THE DEVELOPMENT OF ANTHRACOLOGY IN PRE-COLONIAL KANAK ARCHAEOLOGY OF NEW CALEDONIA (1000-1854 AD): FIRST RESULTS [1]

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This paper will propose a presentation of the first results acquired from a PhD program associating ethnobotanical, archaeological and anthracological data, to precise the ecological dynamics in the northern Grande Terre of New Caledonia during kanak precolonial times (i.e. from around 1000 to 1853 AD). It is focused on the particular study of forest types changes compared with the kanak settlement patterns and landscape organization, in order to understand the human management of forest lands and use of woody species. The study is based mainly on an anthracological approach but also on the examination of general archaeological and socio-cultural data relating to settlement patterns as well as horticultural practices – based on tubers and tree crops.

This project tries to apply anthracology in New Caledonia for the first time and hence to test its potential for South West Pacific Islands palaeoecological and archaeological research. A reference collection of woody species linked with an anatomy atlas for identification have had to be created during the first year of the PhD research. Given the extreme diversity and specificity of the New Caledonia vegetation (more than 3700 species and 67,5% of endemicity), ethnobotanical, ecological and botanical data have been used to identify priority taxa for the constitution of an efficient preliminary reference collection. We will present the different phases of the work and the database created. Its efficiency will be evaluated by looking at the first results of the anthracological analysis of charcoal fragments that have been sampled during archaeological excavations of kanak precolonial settlement sites, led as part of the PhD program in association with the New Caledonia Department of Archaeology.

Key-words: New Caledonia, Ethnobotany, Archaeo-anthracology, Reference collection, Wood anatomy

[1] Section 4, Oral

FIREWOOD GATHERING IN NEOLITHIC LAKESHORE SETTLEMENTS OF THE NORTHERN ALPINE AREA: SOCIAL FUNCTIONING AND ENVIRONMENT [1]

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Intra-site studies of archaeological charcoals are usually aimed today at reconstructing the forest environment around a site, since charcoal provide good evidence for the areas exploited and their vegetation. Charcoal is the remain of firewood gathered and transported by man for specific uses, such as heating, lighting and cooking. Furthermore, firewood management is governed by the techno-economic and socio-cultural characteristics of societies. This is well illustrated by analyses of charcoal from ten finely dated Neolithic settlements on lakes Chalain and Clairvaux in France, Zürich and Constance in Switzerland, as well as the Federsee marsh in Germany. The analyses are based on species identification, measurement of tree-rings and estimation of size from curvature. Environmental characteristics mostly determine the modalities of firewood collection, although the natural constraints offer a variety of options. The examples presented here in detail show the choices made by communities and the technical, social, cultural or economic criteria involved, as well as the specific effects on the forest environment. Since the exploitation of firewood forms an integral part of the technical system, these charcoal analyses shed new light on how Neolithic communities functioned, by describing sets of choices and constraints.

Key-words: Neolithic, Lakeshore settlements, Tree-rings, Diameter, Fuel management

[1] Section 4, Oral

IRON METALLURGY IN THE DOGON COUNTRY (MALI, WEST AFRICA): "DEFORESTATION" OR SUSTAINABLE USE ? [1]

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West African iron metallurgy has since long been suspected to have triggered massive ecological deterioration, caused by an over-exploitation of woody resources for fuel used in the iron smelting process. The decline or extinction of single preferred tree species has been discussed, as well as deforestation or even desertification of whole landscapes, especially in areas and for periods of supposed large scale iron production.

This point of view corresponds to the opinion expressed by many European archaeologists and ecologists who suggested for Middle Europe and Great Britain a vast opening of landscapes and forest destruction already during the early Iron Age. Wood exploitation for iron production and agricultural intensification connected to the now easier cultivation of land with iron tools have been considered to be important causes.

Several studies integrating for example fine scale pollen and/or charcoal analysis, however, indicate that vegetation changes were sometimes out of phase with the cultural innovations. Furthermore, reasonable calculations of wood demand for iron smelting, regarding the regenerative nature of wood as well, showed that pre-industrial iron production in middle Europe would not have caused a severe degradation of woody resources and woodlands. Furthermore, simple management strategies like coppicing systems would allow for a long term regeneration of fuel. The clear environmental impact of intensive iron production from the Middle Ages onwards, however, remains generally undoubted. A more differentiated view on the ecological consequences of iron production in West Africa seems thus appropriate too, integrating methods of different disciplines (anthracology, archaeology, archaeometallurgy, archaeometry).

At least since the beginning of the second millennium AD, iron production has played an important role in the Dogon country (Mali, West Africa), as witnessed by numerous, partly enormous slag heaps and other archaeological remains like furnace remnants. Since 2001, systematic prospecting and archaeological excavations of these remains has been conducted within the framework of the multidisciplinary project "Human population and palaeoclimatic evolution in West Africa", meanwhile allowing to establish a synthesis of the importance and variability of iron metallurgy on the Bandiagara plateau and its escarpment. Anthracological analyses of charcoal originating from the slag heaps point to selection of high burning quality wood with an elevated basic density rather than to an over-all selectivity for certain species. At two site complexes with a long chronology and a probable surplus production of iron, there are changes in the anthracological assemblages over time, which we interpret as clear indications of vegetation change. This might be directly correlated with an over-exploitation of wood for the bloomery process, but several other factors have to be considered for the period in question which sees the emergence and decline of great West African empires like agricultural intensification and diversification, increasing influence of livestock, but also increasing aridity and climatic variability. In order to test the hypothesis of an over-use of woody resources, we aim on quantifying iron production and thus wood consumption establishing mass balance ratios and a clear chronological frame. On the credit side, we try to consider quantitatively the regenerative capacity of savannas, agroforestry systems and gallery forest.

Key-words: Iron metallurgy, Species selection, Ecological consequences, Quantification, West Africa

[1] Section 4, Oral

RECONSTRUCTION OF THE VEGETATION AND THE USE OF WOOD: TAXONOMIC ANALYSIS AND THE STUDY OF CHARCOAL ARTIFACTS FROM ROMAN AND MODERN SITES FROM THE MADRIU VALLEY AND THE CADÍ MOUNTAIN RANGE (SUB-ALPINE STAGE FROM THE EAST PYRENEES) [1]

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We present the results of the charcoal analyses of different structures of Roman and Modern periods, located in the sub-alpine stage, which has allowed us carrying out the reconstruction of the vegetation of the Madriu valley and the Vansa valley, Mountain range of the Cadi. In spite of the little taxonomic variability that the results show us, we have been able to observe several vegetal formations: essentially, forests of mountain pine, monospecific or accompanied by other species. Due to the post-depositional fragmentation that takes place during the combustion processes and during the recovery of the vegetal macro-rest, the charcoal from an archaeological deposit rarely conserve their original morphology (Figure 1 and 2). In several deposits located in the Madriu valley and in the Cadí Mountain range, several rests of structures, objects and activities related to the wood work have been recovered: wood with axe cuts, handle of utensil, part of enclosures and cover, shavings and corks of containers. These fragments that conserve this type of morphologies come from different structures with different chronologies and functionalities: charcoal kilns, furnaces and pastoral structures. This has allowed us, along with the taxonomic identification of the rest of fragments of these structures, to know the use of the wood of the societies that lived in the high mountain during summer time from Neolithic to Modern Time. Results inform us that the presence in high mountains, in spite of the hard climatic and orographic conditions, is due to the resources that offer these, like minerals, grass of quality and abundant forest zones. The tree wood is used to carry out industrial activities, but also for domestic activities like the domestic fire and the elaboration of utensils or structures. Nevertheless, although the wood available in the surroundings was mainly used, one does not discard that another type of considered wood of greater quality was transported.

Key-words: East Pyrenees, Sub-alpine stage, Charcoal kilns, Pastoral structures, Furnaces



Figure 1. Handle of utensil recovered in a Roman furnace



Figure 2. Cover of container reclaimed in a an antic cabana

[1] Section 4, Poster

THE ANSWER IS DEEP DOWN IN THE WELL: CHARCOAL AND WATERLOGGED WOOD FROM ARCHAEOLOGICAL WELLS IN SOUTHERN FRANCE [1]

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In Southern France, increasing attention has been given recently to the contents of archaeological wells, especially those dating back to the Roman period, but also from Proto and Prehistory. Rescue and/or programmed excavation of these structures is expensive, but the wealth of information usually obtained seems to justify such investments.

These deposits are characterised by the preservation of organic material, both charred and waterlogged, in anaerobic conditions. It also appears that most of the material falling into wells is well preserved. It is also possible that some wells were periodically cleared of debris, but no common effect seems to be observed, such as that experienced in other archaeological contexts resulting from cleaning, modification and trampling. If a synthesis effect exists in wells, this precedes deposition in this type of structure.

Material recovered from wells includes abundant charcoal fragments, objects made out of wood (tools, furniture, timber, etc.) some resulting from fire events, wood working chips, pruning waste, fragments of stakes, fruits, seeds, fauna (sometimes entire skeletons), basketry remains, sparterie, fabrics, leather, human remains along with other archaeological artefacts. Some of these may have been lost accidentally, or have fallen naturally (seeds...). But most of the material has been voluntarily disposed of while the well was still in use and later during its filling. It is clear that wells were used as dumping areas, at least by the end of their use. In time, this filling made them unusable as water sources.

The exploitation of wells as a rubbish pit is easy to recognize. It is more difficult to understand how the organic remains were transported, where they came from, their function or use and their archaeological meaning. Our study aims to understand the provenance of discarded woody elements, and the information they can provide in terms of the environment and function at the site. Data presented here are based on the analysis of charcoal and waterlogged wood from 15 wells excavated in southern France (Hérault and Gard). Results presented comprise taxonomic spectra and frequencies of small charcoal fragments, dimension and shape of larger wood specimens, and wood function when possible. The diversity of results obtained is remarkable. The function and provenance of wood remains (charred and waterlogged) vary between wells and in the same well. Different examples are presented, leading to the suggestion of hypotheses concerning: the environment of the site (close or distant provenance), craft, domestic or agricultural activities, and events such as fires. It is clear that each well containing organic material, is a case apart, providing specific information, which needs to be analysed, deciphered and explained.

Key-words: Archaeology, Charcoal, Waterlogged wood, Well, Southern France

[1] Section 4, Oral

THE ROLE OF CLIMATE VARIABILITY AND FIRE IN EARLY AND MID-HOLOCENE FOREST DYNAMICS OF SOUTHERN SWEDEN [1]

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The objective of this study was to investigate the possible links between regional climate, fire, and vegetation at the small spatial scale during early and mid-Holocene in southern Sweden using pollen, plant macrofossil, and charcoal records from a small bog. High fire activity is related to dry and warm climate around 8550, 7600, 5500-5100, and 4500 cal. yrs BC. Low fire activity *ca.* 6500-6000 and 4750 BC may correspond to the wide-spread "8200 BP cool event" (*ca.* 6200 BC) recorded across the North Atlantic region, and a later, brief period of increased precipitation, respectively. A long mid-Holocene period with low fire activity (*ca.* 4350 – 1000 BC) agrees with the pattern emerging for Europe from the global charcoal database, and may correspond to generally wetter and cooler conditions. High fire activity *ca.* 8550 BC probably triggered the local establishment of *Corylus*. Warmer and drier conditions (and high fire activity) *ca.* 7600 BC might have favoured the establishment of *Alnus*, *Quercus* and *Tilia*. The decrease in broadleaved trees culminating *ca.* 6500 to 6000 BC correlates with the "8200 BP cooling event". The fire-adapted *Pinus* maintained important populations throughout the early and mid-Holocene.

Key-words: Fire history, Vegetation history, Climate-fire relationships, Early and mid-Holocene, Southern Sweden

[1] Section 5, Oral

WOODY PLANTS IN SEMI-ARID SOUTHEASTERN IBERIA DURING THE BRONZE AGE: CHARCOAL ANALYSIS FROM PUNTA DE LOS GAVILANES (MAZARRÓN, MURCIA, SPAIN) [1]

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This paper presents the results of the charcoal analysis from the Prehistoric phase of Punta de los Gavilanes (Gavilanes IV), an archaeological site located on South-Eastern Spanish coast.

According to multidisciplinary studies and several radiocarbon calibrated dates, the first occupation of this settlement begins at the 3rd millennium cal. BC until the middle of the 2nd millennium cal. BC. During this period (belonging to Argaric Bronze Culture) the site is inhabited by a small permanent group devotes to exploiting resources from the marine environment and the lagoon near this promontory. Its population was probably dependent on other principal settlement placed on inland area.

Anthracological study from Gavilanes IV has permitted to know the patterns about vegetation dynamics on Mazarron coast during this period and estimate the anthropogenic activity on the surrounding arid environment.

The results show the development of characteristic species of saline soils as well as some Mediterranean and North African taxa, which degradation was lesser than the present one. The fuelwood supply was mainly provided from areas near the promontory, though other farther areas could also give wood to the population of Punta de Los Gavilanes.

An intense selection proceeding from *Pinus halepensis* and *Pinus pinea/pinaster* is documented to make domestic and marine resources treatment buildings. The wood used in these constructions is very degraded by fungi and wood-eating insects.

Key-words: Charcoal, Bronze Age, Palaeoecology, Fuelwood, Southeastern Iberia

[1] Section 4, Oral

THE ORIGIN OF THE FORESTS IN THE NORTH OF THE CONGO REPUBLIC: AN ANTHRACO-PEDOLOGICAL CONTRIBUTION [1]

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The vegetation of the Sangha region in the North of the Congo Republic is composed of a mosaic of forest formations including semi-deciduous humid dense forests characterized by Ulmaceae and Sterculiaceae, evergreen forests with *Gilbertiodendron dewevrei* and woodland with Marantaceae. Palynological analyses proved that this region witnessed an arid phase 2500 years ago. This was associated with an important reduction of the forest cover and an equal extension of savannahs that could have facilitated the migrations of the Bantou people and the propagation of the shifting cultivation agriculture in the whole region which is, still at the moment, sparsely populated.

In order to verify climatic and anthropological influences on the present composition of the forest vegetation, a pedological investigation has been set up in the region of Pokola (1.5° N; 16.5 °E) comprising 43 drillings and 12 pits along a gradient covering the different forest types.

Charcoal has been found in 84% of the cores in all the forest formations especially between 30 cm and 60 cm depth. Charred oil palm seeds (*Elaeis guineensis*), often a culture accompanying species, have been found in 60% of the pits. C^{14} analysis revealed dates between 600 and 2200 years BP.

Pedological analyses showed the association between semi-deciduous humid dense forest and red ferralsols, between Marantaceae woodlands and ochre ferralsols (poorer than the former) and between *Gilbertiodendron dewevrei* stands and pseudogleys and gleysols.

The identification of the botanical taxon of charcoal fragments from tropical regions deals with important limitations due to scarce reference collections that are far from being complete. Therefore it is crucial to combine a thorough knowledge of the different vegetation types and their character species with a wood anatomical study.

Given the hypothesised strong influence of man induced perturbations and past climatic changes, these results emphasize the importance of edaphic factors in differentiating the forest stands in the North of the Congo Republic. They also permit a better understanding of a potential evolution of the forests in this region driven by the actual climatic changes.

Key-words: Charcoal analysis, Tropical forest soils, Vegetation reconstruction, Central Africa

[1] Section 3, Poster

AN EXPERIMENTAL AND ECOLOGICAL APPROACH TO MODELING ANCIENT FUEL USE IN SOUTH AMERICA [1]

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A considerable focus of the past thirty years of the Sicán Archaeological Project in the La Leche Valley of Northern Peru was the reconstruction of craft production and political economy in the region. In 1999 and 2001 the excavation of an artefact workshop, dedicated to producing ceramic and metalwork and associated with three domestic buildings, permits unique insight into domestic economy and the organization of craft production during the tenth and eleventh centuries. Additional experimental work recreating the pyrotechnologies used in production, a survey of the local forests of the area, and the detailed examination and determination of fuel remains from the site all aided in the reconstruction of primary material allocation across the site. Here, we present our 'holistic' approach to analysis of the site. It highlights the important coordination between a variety of anthropological and other scientific methods of inquiry to interpret adequately the carbonized production remains. While the wood charcoal is essential to the interpretation of the ecological variables critical to production, it is the inclusion of feature-to-feature comparisons and determination of seed and fruit remains that are critical to the reconstruction of site-wide activities. Our analyses permit the description and assessment of recycling and fuel supplements, solutions seen in ethnographic examples of fuel use that typified this pre-industrial model of resource allocation. We demonstrate that with data derived from systematic experimentation and excavation, together with ecological survey, assessments of sustainability and resource use can be described for past societies. These integrated analyses generate baseline data for ecological studies to understand human-environment interactions over the long term and assess sustainable resource use in the past and present.

Key-words: Experimental archaeology, Forest ecology, Wood anatomy, Craft production, South America

[1] Section 4, Oral

NEW ANTHRACOLOGICAL DATA FROM POMPEI: CHARCOAL ANALYSIS FROM INSULA 7 AND TEMPLE OF VENUS [1]

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Since 2005 the Archaeobotanical Laboratory of Lecce has begun a research project on two different contexts of Pompeii in collaboration with the Archaeological Mission in Pompeii of Ca' Foscari Venice University and Scuola di Specializzazione of Matera.

The first investigation concerns the anthracological analysis of a residential district (Insula VI, 7, 26) characterized by a very complex deposit dated from the beginning of 2nd century BC to 79 AD.

The second context of study regards several deposits, situated in the western and in the eastern area of the Venus Temple, connected to the ritual practices of the sanctuary and covering a chronological range between the 3rd century B.C. and 79 A.D.

Here we present the results of the anthracological analysis made on both contexts comparing the assemblage produced by residential and the cultual activities.

Key-words: Pompeii, Venus Temple, Insula 7, Charcoal

[1] Section 4, Poster

LONG LOESS SEQUENCES WITH CHARCOAL IN EURASIA: THEIR IMPLICATION IN THE CHRONOLOGY OF THE UPPER PLEISTOCENE CLIMATE SEQUENCE [1]

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During the last decade, investigations devoted to complementary long lœss records from Central Europe with pluristratified Palaeolithic settlements rich in charcoal, allow a new insight on the palaeoenvironmental background and chronology of the middle and late pleniglacial. It concerns respectively the key-sections of Willendorf, Stranska Skala and Dolni Vestonice in the Central Danube Basin, Molodova, Mitoc-Malu Galben and Cossautsi in the East Carpathian Area and Kostienki in the Russian Plain. The climatic approach of the selected sections lies essentially on a qualitative evaluation of the palaeoenvironmental background of the pedosedimentary events completed case by case by palynological and malacological data, the chronological frame of the system back to ± 53 ka uncal BP being based on a semi-continuous series of over 400 radiocarbon dates mainly achieved in the Groningen and Oxford laboratories on good quality identified charcoal.

The conjunction of these complementary sequences provides for the first time a high resolution palaeoclimatic record for the period between ca. 53 ka to 10 ka BP, encompassing about twenty-six short interstadial events with a degree of resolution close to several centuries. The middle pleniglacial succession was further improved with the loess sequence of Kurtak (Central Siberia), which provided a remarkable climatic signature well dated from 26 ka to 42,5 ka BP on wood remains and charcoal.

This approach confirms the predominance of highly unstable environmental conditions during OIS 3 and OIS 2 on the scale of the Eurasian Continent and leads to a better understanding, in a global perspective, of the distribution of the loess sedimentation with regard to the maximum extension of the northern ice cap. In this way, the integrated palaeoclimatic loess sequence could be compared by proxy-correlation with the climatic signal recognized in the fluctuations of ^{18}O in the Greenland ice cores, taking into account the distribution of the aeolian components in both records. This correlation also allows the atmospheric radiocarbon ages of the lœss sequence to be compared with the Greenland calendar chronology and gives further access to the corrected chronology based on paired ^{14}C and U/Th dates, correlated with the Greenland record via the climatic signal of the marine sequence preserved along the Iberian margin.

Key-words: Middle and late pleniglacial, high resolution climatic record, Radiocarbon chronology, Palaeolithic

[1] Section 5, Oral

EVIDENCE OF PAST CLIMATIC CHANGE FROM STABLE CARBON ISOTOPE ANALYSIS OF ARCHAEOLOGICAL CHARCOAL FROM SIBUDU CAVE, KWAZULU-NATAL, SOUTH AFRICA [1]

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Palaeoenvironmental reconstructions based on archaeological material require interpretative proxy data which reflect little or no anthropogenic bias. Woody species represented in archaeological charcoal assemblages are biased as a result of the preferential selection of suitable species for fuel and may only provide a limited representation of past plant communities. The anthropogenic bias may be overcome through isotopic analyses of wood and archaeological charcoals as the ^{13}C values of some tree species reflect subtle responses to changing environments. This study presents the potential of stable carbon isotopes of archaeological charcoal as a means of reconstructing past environmental conditions. We first demonstrate that an environmental signal is preserved in modern charcoal ^{13}C records through a series of combustion experiments. Second, stable carbon isotope data from archaeological charcoal representing two genera (*Podocarpus* and *Celtis*) from the Middle Stone Age site of Sibudu Cave, KwaZulu-Natal, South Africa show interesting trends through the period ~65 ka to ~48 ka. These trends reflect an isotopic response to changing environmental conditions, rather than changes due to the charcoal formation process. The isotopic data indicate that there is an overall warming trend throughout the sequence. Conditions were colder than present with high available moisture levels before 60ka, becoming colder and arid at ~58 ka. At ~48 ka, moisture levels and temperatures begin to rise. This interpretation is supported by the botanical, faunal and sedimentological proxy data from the site.

Key-words: Middle Stone Age, Stable carbon isotopes, Charcoal, Environmental proxies

[1] Section 5, Oral

THUS SPOKE PAUSANIAS ? FUEL WOOD SELECTION IN ALPINE BURNT-OFFERING PLACES [1]

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Alpine burnt-offering places (*Brandopferplätze*) were for the first time defined as a separate group of finds in the 1960s. As generally accepted, these sites are defined by the following common traits: (1) their spatial distribution (Alps), (2) their temporal range (mainly Middle Bronze Age until Late Iron Age), the often massive occurrence of (3) calcinated animal bones and (4) intentionally destroyed artefacts (either pottery or metal objects). Since the beginnings of research on Alpine *Brandopferplätze*, parallels have been drawn between them and the burnt sacrifices in Greek antiquity, especially referring to the Olympic ash altar of Zeus as reported by Pausanias. Research during the last decades revealed that although the Alpine burnt-offering places were a ritual phenomenon clearly independent from the ancient Greek rites, both obviously shared some characteristics (as the deliberate selection of animal body parts, with heads and lower extremities dominating). Plant remains, however, never played a major role in these considerations of commonness or delimitation between the Alpine and the Greek rites, as only scarce information on plant-based offerings or on the fuel wood was available until recently. The written sources *e.g.* mention the exclusive use of (white) poplar wood.

In order to clarify the role of plants in the Alpine sacrificial rites, archaeobotanical analyses were carried out for nine burnt-offering places across the Alps (from west to east):

- Wartau, Ochsenberg (Switzerland, St. Gallen)
- Feldkirch, Altenstadt (Austria, Vorarlberg)
- Fließ, Pillerhöhe (Austria, Tyrol)
- Ganglegg, Hahnehütterbödele (Italy, Bozen-Südtirol/Bolzano-Alto Adige)
- Maneidtal/Val Maneda, Grubensee/Lago Gruben (Italy, Bozen-Südtirol/Bolzano-Alto Adige)
- Ulten/Ultimo, St. Walburg/S. Valburga (Italy, Bozen-Südtirol/Bolzano-Alto Adige)
- Schlern/Sciliar, Burgstall (Italy, Bozen-Südtirol/Bolzano-Alto Adige)
- St. Nikolai, Sölkpass (Austria, Styria)

In order to cover both the offerings and the used fuel wood, carbonised carpological remains and charcoal were identified. Fragments of amorphous food residues were analysed via SEM and chemical decomposition. For the identified charcoal, also dendrological and taphonomic parameters were collected such as growth ring width and radius, presence of wood-decaying fungi, damages resulting from carbonisation (radial cracks, vitrifcation features) and presence of compression wood in Gymnosperms. These data were used to gain information on the used wood qualities (thin branches/twigs *vs.* thick branches/trunks, deadwood *vs.* freshly hewn/dry-stored wood). All results were compared to published data on burnt offerings from eleven further cult sites in Austria and Northern Italy, in order to set the new data within a greater context.

The charcoal record resulted in a total of 27 woody plant taxa, corresponding to a minimum of 20 species. Reconstructed vegetation data from the respective locations, based on palynological analyses and actual/potential vegetation maps, were compared to the charcoal record of the nine Alpine sites. Surprisingly, the choice of woods used as fuel for the sacrificial pyres obviously was mainly guided by their immediate availability at the majority of investigated sites. Hints on taxon selection (*e.g.* for cultic reasons) were found in a comparatively small number of sites. Within the range of the Alps, only the site at Pfaffenhofen, Trappeleacker, and the cult building at Ganglegg, Hahnehütterbödele, give clear evidence on specific selection. In both cases the charcoal spectra clearly deviate from the reconstructed local vegetation. The used wood diameters were also much higher than usually found in burnt-offering sites. At least for the material from the area of the cult building at the Ganglegg site, this can be seen as a hint on burnt construction timber.

[1] Section 4, Oral

The wood qualities used are also rather consistent between most of the treated sites: of all 20 presented cult sites, data on wood quality is available for 17. Twelve of these show a clear dominance of partly decayed (gathered/dead) wood. At only three sites (Schwarzsee/Lago Nero, Trappeleacker, and the cult building at Hahnehütterbödele) the results point to deliberately stored or freshly hewn wood. Together with the data on cultivated plants, the charcoal results show that carbonised plant remains can contribute substantially to the comprehension of ritual activities in the Pre-Roman Alps, which obviously deviated in more than one way from the ancient written source.

Key-words: Alps, Bronze Age, Iron Age, Plant-based offerings, Fuel wood

BIOLOGICAL DEGRADATION OF WOOD. EXPERIMENTAL APPROACH AND ANTHRACOLOGICAL IMPLICATIONS: FIRST RESULTS ON CONIFEROUS WOOD (*PINUS SYLVESTRIS* L., *LARIX CAJANDERI* MAYR.) [1]

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The degradation of wood components by bacteriological agents as fungi leads to strength, weight and density losses, which progressive stages are microscopically identifiable through different types of cell wall alterations, still visible after charring. Previous experimental data tend to show that the thickness of the cell walls is not a reliable criterion for the recognition of bacteriological attacks on anthracological assemblages since the process of carbonization masks the original cell wall information. Nevertheless, carbonized wood which had been previously inoculated with white and brown-rot under laboratory conditions could be discriminated from healthy wood according to cell wall decay features such as deformation, compaction, gaps in wood structure and refractive aspect. The recognition of the action of pathogenic agents *ante* combustion on archaeological charcoal, therefore interpreted as use of "rotten" wood, has led to the formulation of hypotheses concerning specialized hearth functions. Bacteriological attacks on wood have also been identified frequently on our anthracological samples, and led to undertake supplementary experiments with wood which had been naturally colonized by degradation agents. Those were conducted mainly in order to test if a precise evaluation of microscopic degradation features could lead to the formulation of hypotheses regarding the selection strategies (e.g. dead wood on the ground/still on the tree, etc.), the underlying idea being to identify a correlation between macroscopic and microscopic features of wood degradation, in order to acquire a more accurate conception of what can be considered microscopically as "rotten", "healthy", etc.

A first experiment consisted in the selection (according to well-defined criteria), the charring (under controlled conditions) and the anthracological survey of four samples of *Pinus sylvestris* presenting different phonological states. In addition, charcoal of two specialized hearths containing *Larix cajanderi* were sampled during an ethno-archaeological survey which took place among a native group of South-Eastern Siberia. Those were also examined microscopically and compared to the merely experimental charcoal. This paper describes the experimentation and its methodological issues. The first results indicate a strong correlation between macroscopic and microscopic degradation when a statistically satisfactory number of charcoal is studied, discussed in terms of applicability to the archaeo-anthracological material.

Key-words: Anthracology, Experimentation, Degradation of wood, Taphonomy

[1] Section 1, Poster

ETHNO-ARCHAEOLOGY AS A MEAN OF TESTING ARCHAEO-ANTHRACOLOGICAL MODELS: EXAMPLES FROM THE BOREAL FOREST AND TUNDRA ENVIRONMENTS (EASTERN SIBERIA AND ALASKA) [1]

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Ethno-archaeology as an "aid to archaeological interpretation" (Hodder, 1982) is a well-known discipline, and often an active part of prehistoric research. However, less common is the conduct of ethno-archaeology in an anthracological perspective. Indeed, anthracology has long been a more strictly palaeo-environmental discipline, therefore not perceived as a mean of studying social behaviour in terms of firewood economy.

Our systemic approach, influenced by archaeological techno-economic studies, defines firewood economy as "the expression of the relationship between the energetic needs of the human groups and their capacity to satisfy them inside a defined gathering territory » (Théry-Parisot, 2001) and has led to the formulation of hypotheses regarding fuel management of Palaeolithic hunter-gatherers.

In this context, recording ethnographical data among peoples living in Boreal and Arctic environments seemed beneficial not only to enrich our reference datasets but also to engage in a reflection about the diversity of practices and traditional uses of firewood in cold and highly contrasted climates.

This paper presents the results of surveys we conducted among present day native populations in Alaska and South-Eastern Siberia while keeping in mind specific issues in anthracology such as environmental representativity of charcoal assemblages resulting from short term occupations and patterns of wood selection in relation to hearth types and functions, and/or cultural choices. Analysis of this information provides evidence that even though the management of firewood is quite variable, strong convergences exist between peoples living at similar latitudes.

Key-words: Anthraco-ethno-archaeology, Firewood management, Boreal forest, Tundra, Alaska, Siberia

[1] Section 4, Oral

THE NOK CHARCOAL REMAINS - FIRST RESULTS [1]

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The Nok-culture in Central-Nigeria is famous for its impressive terracottas. The first sites were discovered in the 1960s but until recently not much was known about Nok: the sites date between 500 BC and 200 AD and besides the terracottas, slag and furnaces were found, putting the Nok-people among the earliest societies that mastered iron-production in West Africa. However, the socio-economic background of the terracotta-creators remained obscure.

Since 2005 Nok-culture is being researched in Frankfurt, the main aim being to unveil the society behind the art.

Several excavations revealed terracottas, pots and stone layers, often buried in a layer containing charcoal fragments. However, the amounts of identifiable charcoal fragments are very variable.

Key-questions of the ongoing analysis are:

- Can we establish the source of the charcoal layers in the sites?
- Can we trace iron smelting and/or baking of ceramics in the charcoal assemblages?
- In what kind of environment did the Nok-culture develop?
- And what kind of influence did it exert on the woody vegetation?

Key-words: Nok-culture, Iron-smelting, Environment, Human impact

[1] Section 4, Oral

CHARCOAL FROM AFRICAN RAIN FOREST SITES: FIRST STEPS IN IDENTIFICATION AND INTERPRETATION [1]

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This poster demonstrates the current state of our anthracological research into sites of pottery-producing people in the Cameroonian rain forest. Charcoal is well preserved and present in sufficient amounts in most sites. Fragments of Sapotaceae, Euphorbiaceae and Leguminosae are often present. The analysis poses difficulties at different levels of identification. Some fragments can be assigned to a certain genus (e.g. *Uapaca*, *Pterocarpus*), while with others the assertion of genus or species is hindered by the large amount of possible species with similar wood structure within one or even more families. Some fragments belong to one wood type, but so far the identity remains unknown.

Wood structures of established types as well as of unknowns are displayed and very preliminary diagrams depict the major differences between the charcoal assemblages from the different sites.

Key-words: Cameroon, Rain-forest, Charcoal identification, Environment

[1] Section 4, Poster

CHARCOALS IN PYROCLASTIC DEPOSITS OF MONTSERRAT AND NEW ZEALAND: TEMPERATURE PROXIES

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The eruption of the Soufriere Hills Volcano in Montserrat, British West Indies provides an opportunity to study the process of incorporation and preservation of plants into hot block and ash deposits from pyroclastic density currents (Scott & Glasspool, 2005). The eruption produced large lava domes that collapsed and generated pyroclastic density currents. In addition, explosive eruptions generated widespread air fall ash as well as hot pyroclastic density currents from column collapse. Plants were charred by hot pyroclastic surges from the density currents. Temperatures ranged from 300 to 800°C and the plants were exposed to these temperatures for a few minutes. Herbaceous vegetation, plant litter and the soil surface were also heated and the plants preserved as charcoal (Scott *et al.*, 2008). Plants were also entombed by hot ash and block flows from the pyroclastic density currents that may have remained hot, over 300°C, for several months. Charcoalified upright trunks and logs were also often preserved.

Experimental charcoalification studies of woods, at varying temperatures and times, have shown rising charcoal reflectance (in polished blocks under oil) with both temperature and time (Scott & Glasspool, 2005). However, petrologic reflectance stabilizes after around 4 hours so that reflectance may be used as a temperature proxy for pyroclastic deposits (Scott & Glasspool, 2005). Data from measured temperatures of block and ash deposits confirmed the validity of charcoal reflectance as an indicator of the temperature of a hot pyroclastic flow (Scott & Glasspool, 2005).

Many of the world's largest and most violent volcanic eruptions have resulted not only in major devastation but also in the deposition of vast quantities of volcanic ash, including from pyroclastic density currents, over a wide area. The most violent eruption in historic times was of Taupo in New Zealand 1800 years ago. The Taupo Ignimbrite is a widespread, well preserved pyroclastic deposit that has entombed and preserved plant material as charcoal. The total eruptive volume is about 70km^3 covering an almost circular area across the North Island of New Zealand (Wilson, 1985), with an average thickness of 1.5m. The Taupo Ignimbrite consists of two layers that were both deposited from a single density current (Wilson, 1985). Where known, the pre-eruptive vegetation consisted mainly of coniferous podocarp forest (Clarkson *et al.*, 1988). A total of 43 wood samples (12 angiosperm, 31 gymnosperm), spanning both layers and 13 localities at varying distances from the vent, were studied by reflectance microscopy, in order to determine temperature variation across the pyroclastic flow profile. When the charring time may be short, maximum reflectance values yield a minimum emplacement temperature of the flow. Mean reflectance values are normally used when the length of heating is likely to be over 4 hours. Both maximum and mean reflectance values from charcoals at Taupo show identical patterns. Interpreted charring temperatures were generally low across the flow profile and ranged from 220°C to 415°C with both layers showing a zone of low reflectance, therefore low temperature (<300°C), up to 60km from the vent. This zonation can be attributed to a combination of factors, including the interaction with water from Lake Taupo cooling the flow and the size of the sample and degree of transport. Temperature proxies can also be obtained from palaeomagnetic data from remnant magnetism of lithic clasts to give equilibrium temperatures (emplacement temperatures of the flow) (McClelland *et al.*, 2004). Both sets of results indicate a significant impact of the interaction of water from Lake Taupo on the temperature of the pyroclastic density current.

Key-words: Volcanism, Preservation, Pyroclastic flows, Eruption, Microscopy

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A COMPUTER SYSTEM FOR CHARCOAL IDENTIFICATION OF TROPICAL ANDEAN SPECIES [1]

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Wood and charcoal identification in the Northern Andes (Ecuador) is not feasible because of the absence of anatomical wood descriptions of the woody species present in the area. In this framework, according to the IAWA list reference, we described and coded the anatomical features of 60 wood species belonging to two high tropical ecosystems (cloud forest and paramo) of the Guandera Biological Station, a protected mountainous area situated in the Northern inter-Andean valley of Ecuador. This station conserves a small portion of the last sizable highland Inter-Andean valley forest left in Northern Ecuador. Less than 4% of this forest type remains. This tropical wet mountain forest at 3100-3600 meters and the paramo above it possess a surprisingly diverse flora and fauna for such a high altitude site. Our work concerned the realization of both a data-base of the observed anatomical features and a computerised system of wood identification. These coded data and a brief anatomical description are the starting point to realise also an anatomical atlas. The results of this research were applied successfully to pedoanthracological analysis carried out in this area.

Key-words: Wood anatomy, Cloud forest, Tropical alpine vegetation, Database, Computer system, Pedoanthracology

[1] Section 1, Poster

HIGH SPATIAL RESOLUTION APPROACH IN UPPER FOREST LINE DYNAMIC RECONSTRUCTION DURING THE LATE HOLOCENE (NORTHERN ANDES) [1]

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The dynamics of the upper forest line (UFL) in the tropical mountainous area in the Northern Andes has been investigated especially by pollen analysis. These studies have shown that after 5000 yrs BP the UFL varied in responses to both climate change and increased human impact. Because of the long distance transport of the pollen, the interpretations of the vegetation signal have sometimes been equivocal. In order to obtain a higher spatial resolution of the UFL dynamics, we used pedoanthracological analysis. Our investigated area was the Guandera Biological station (0°35'N, 77°42'W) in the Northern Andes (Ecuador) that protects one of the last remains of the primary cloud forest; here an abrupt UFL is located at *ca.* 3600 m. We identified and dated by ^{14}C AMS, macroscopic charcoal (size >400 m) found in six rich soils sampled along an altitudinal transect from 3400 to 4000 m a.s.l. This transect includes a cloud forest, with interspaced "paramo islands" of unclear origin and an upper belt of grassland vegetation (paramo).

Our data show that about 1000 yrs ago the UFL rose to 3400 m a.s.l. and only subsequently reached for the first time its current elevation (3600 m). In agreement with this finding, the charcoal identifications reveal that the "paramo islands" have not yet and never been closed completely by forest vegetation. At the same time, the lack of fire evidence after 800 yrs BP could be attributed to the Spanish arrival, which could have caused a change of land use and favoured forest formation at a high elevation.

In conclusion we hypothesize that the UFL have risen of 200 m to its current position in the last few hundred years and that fires which occurred at a high elevation have never burnt the forest.

Key-words: **Cloud tropical forest, Paramo, Human impact, Pedoanthracology**

[1] Section 3, Oral

CHARCOALS FROM IRON SMELTING FURNACES – FUEL SUPPLY AND ENVIRONMENT OF A MEDIEVAL IRON SMELTING SITE NEAR PEPPANGE (LUXEMBOURG) [1]

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Since 2003 the Pre- and Protohistory Department, Westfälische Wilhelms-University Münster (Michael Overbeck M.A., Prof. Dr. A. Jockenhövel), in cooperation with the "Musée National du Luxembourg" and the "Musée Rural de Peppange", investigates medieval iron smelting furnaces near Peppange, Luxembourg. The sampled charcoal were analysed by the Historical Geobotany working group of the Ecology Centre (Christian-Albrechts-University, Kiel).

In addition to the determination of the charcoal, measurements of the diameters and calculations of the average growth rates were made. For the diameter measurements, the bendings of the annual growth rings were fitted into a circular template which is divided into five diameter-classes. Mainly charcoal of beech and hornbeam was used. In addition, charcoal of oak, hazel, willow, poplar, maple and mountain ash was used. "We assume that forest stands, dominated by beech and hornbeam, in the vicinity of the smelting furnaces were used for charcoal production, though the actual production sites are not known yet. The results of the diameter measurements show the use of small dimensioned wood implying coppice-wood-use. An alternative hypothesis could be that the trunks were used as timber and only the branches and twigs were charcoaled. However, the growth ring analysis supports the hypothesis of the use of coppiced woodland for fuel supply of the medieval iron smelting site.

Key-words: Diameter measurements, Growth ring analysis, Dendroanthracology, Coppiced woodland

[1] Section 4, Poster

ANTHRACOTHECA – FOSSIL AND RECENT CHARCOAL COLLECTION FOR THE CARPATHIAN - PANNONIAN REGION [1]

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A systematic charcoal collection is being established within the Tree-ring Laboratory, Department of Palaeontology, Eötvös University (Budapest, Hungary). Trunk, branch, and twig samples of recent arboreal and shrub vegetation are being gathered throughout the Pannonian Basin, and from the surrounding Alpine, Carpathian, and Dinaric mountain ranges. Wood of trees known from past geological ages in the region is gradually collected from their present-day occurrences from all around the world. Wood affected by fungal and bacterial degradation is included.

Specimens are individually enveloped in an aluminium foil and heated to ~ 400 °C. Fractured surfaces are produced in transversal, longitudinal radial and longitudinal tangential directions. Photos by reflected light and by scanning electron microscope are taken and printouts are arranged in ring folders by genera and species.

Our purpose is to establish a collection suitable for comparative determination of archaeological and geological charcoal, and non-carbonized wood material from a range of depositional settings (settlements, fluvial, lacustrine, paludal, and aeolian environments).

Key-words: Charcoal collection, Fossil, Recent, Miocene, Quaternary

[1] Section 1, Poster

WOODLAND MANAGEMENT AND HISTORY IN THE SURROUNDINGS OF HIGH MEDIEVAL VILLAGES IN THE CZECH REPUBLIC: COMPARISON OF ANTHRACOLOGICAL, PALYNOLOGICAL AND WRITTEN SOURCES [1]

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Most recent research of deserted High Medieval villages in Bohemia (13th – 15th Centuries), situated in woodland areas, produced an extensive archaeobotanical dataset. Three types of evidence were combined in this study:

a) anthracological analysis of excavated deposits within villages,
b) test pits and small scale excavations of ponds providing pollen profiles as well as archaeological artefacts (including organic material), and
c) documentary evidence (the 14th – 15th Century written records).

These data enable us to reconstruct the High Medieval environment, vegetation changes, agricultural and other human activities (especially forest crafts, *e.g.* charcoal and tar production) and their long-term impacts on the environment. Comparison of the archaeobotanical evidence from various types of landscape shows great differences that can be interpreted as divergent economic models and subsistence strategies.

Key-words: High Medieval, Deserted villages, Bohemia, Anthracological analysis, Palynological analysis

[1] Section 4, Poster

BUILDING A REFERENCE COLLECTION: EXPERIMENTAL PRODUCTION AND ANALYSIS OF FRESH WOOD AND CHARCOAL OF SELECTED SOUTH ASIAN SPECIES

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The importance of a reference collection for the study of archaeological wood charcoal is a well established concept. However, our knowledge on the physical variations induced by pyrolysis on fresh wood, is still not homogeneous. Although much work has been done regarding European woods, little is known about tropical and subtropical species.

This paper presents the initial stage of creating a reference collection for South Asian species, taking into account not only charred wood, but also fresh wood and phytoliths from wood and leaves. Particularly, the comparison between fresh and charred wood is taken into consideration and the results of charring experiments are presented.

Three different species of trees and shrubs, with different densities, commonly found and used as fuel in Gujarat (North-West India) are part of this study. Two pieces of wood for each species have been charred at three different heating regimes (200-280-400°C); these temperatures have been decided on the basis of the thermal stages of the combustion processes (Beall, 1972). The weight, volume, density and L:W ratios of each piece have been measured prior to charring and then compared with the same values for the charred wood. Subsequently the charcoal has been examined under an optical microscope and a SEM and the difference in fresh and charred wood as well as optical and SEM vision has been analysed. The last experiment regarded the breakage properties of the different species and their reaction to the application of a known pressure. This paper presents the results af these analysis.

Key-words: Reference collection, Fresh wood, Charred wood, Breakage, South Asia

BEALL F. C., 1972. Introduction to thermal analysis in the combustion of wood. *Wood Science* 5: 102-108.

WOODLAND VEGETATION AND WOOD EXPLOITATION AT HARAPPA, A BRONZE AGE METROPOLIS IN PAKISTAN: A PRELIMINARY STUDY OF WOOD CHARCOAL [1]

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The preliminary results of charcoal studies form the Bronze Age site of Harappa (Pakistan) are presented. The site is at present one of the major known centres of the Harappan Civilization which, at its apogee around 2600 BC, included nearly a thousand settlements throughout North Western India and Pakistan. It was a complex over-regional system based upon some big urban sites and a number of smaller farming villages which shared the same cultural, economical and technological traits (Kenoyer, 1994, 1998).

The Harappan Civilization extended over a vast territory comprising several different ecological areas, with an average rainfall varying from less than 50 to about 600 mm per year. However, the entire area can be described as arid to semi-arid with spots of semi-humid climate along some of the rivers (Agrawal & Pande, 1977; Allchin & Allchin, 1997).

In the past, there have been some studies on the palaeoenvironment of the area on a bigger scale. Nevertheless little is known about woodland utilisation at a smaller scale. This paper presents the preliminary results of charcoal analysis conducted on material from Harappa.

Key-words: Palaeovegetation, Wood use, Harappan Civilization, Harappa

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[1] Section 4, Poster

KILN SITE ANTHRACOLOGY AND FUEL WOOD ECOLOGY IN CENTRAL EUROPE [1]

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Results and perspectives of anthracological studies in Central Europe were highlighted, with special regard to sites of historical mining, archaeo-metallurgical processes and charcoal burning. The main topic was how analyses of archaeological macrocharcoal from kiln sites (kiln site anthracology) can provide answers to the questions of vegetation history and vegetation ecology at the landscape level (fuel wood ecology). Primarily the spatial differentiation was demonstrated at different spatial scales (regional to local). In Central Europe scientifically analysable charcoal remnants of historical mining and charcoal burning are widespread. They are the most frequent charcoal remnants in the landscape. Thousands of historical kiln sites are known. Their systematic anthracological analysis offers us unique possibilities to gain results with fine spatial resolution in the field of vegetation history and vegetation ecology. They provide new and unexpected results for vegetation science.

An overview was given of a synthesis for a large, diversified pilot area in the heart of Central Europe, with special regard to the natural diversity of growth conditions, forest vegetation and tree species composition. It includes results of 876 historical sites in the Black Forest, the Vosges and neighbouring regions. The material analysed spreads over a time scale of 7000 years from the Neolithic period to Modern Times. Most samples have been selected from post-medieval charcoal burning in the Black Forest and the Vosges as well as from medieval mining in the western part of the Black Forest. In addition, methodological studies of recent and experimental charcoal burning have been carried out. With these studies the methods used and the interpretations of the anthracological results were verified.

Generally, no selection of distinct wood species for fuel wood use was made. All of the tree species to be expected for the natural conditions were exploited in the past and the frequencies of the wood species exploited reflect a natural situation: The tree species of the climax vegetation were mainly used and all other species were quantitatively unimportant. The individual sample sites show considerable differences in tree taxa composition and frequency, from which regular spatial patterns of the past tree species distribution have been deduced on a local and regional scale. Linking the anthracological results with those of recent site ecology and vegetation science, these patterns can be explained by regional and local differences in the ecological site conditions of the exploited forests in the vicinity of the sites studied. A pronounced dependency of the fuel wood use on the natural site specific distribution of the tree species is discernible. Moreover, species composition and diameter of the used wood often indicate the exploitation of close-to-nature non-degraded forest stands in the past. The local natural offering of wood and the restricted possibilities of wood transport were important criteria for past fuel wood exploitation. The observed relations of past fuel wood exploitations and the ecological conditions of the exploited forests have been delineated by landscape sections of different spatial scales (fuel wood ecology).

Key-words: Charcoal burning, Forest history, Fuel wood economy, Historical mining, Natural climax vegetation

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ARCHAEOBOTANICAL ANALYSIS OF WATERLOGGED WOODS: ARCHAEOLOGICAL DATA FROM A GALLO-ROMAN SITE IN NORTHERN FRANCE (CHÂTEAUBLEAU, ILE-DE-FRANCE)

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The xylologic analyses of waterlogged woods coming from wells excavations help us to know about the environment of Châteaubleau, at the Gallo-roman period. The remains consist of branches and scraps, found in the humid well layers, dated from the 3rd century AD.

The branches have been taken nearby the human habitations, or from the wooded areas around the site. They reveal an important diversity: 26 taxa were identified. *Salix* is predominant. It is followed by the Rosaceae group (Pomoideae, Prunoideae) and the hornbeam tree (*Carpinus*). These taxa restore an open landscape, with heliophilic taxa related to dispersed communities, edges, pioneers (*Salix, Populus, Betula, Pomoideae, Prunoideae, Rosa, Corylus, Fraxinus*). Willow and poplar, hydrophilic species, indicate a humid substratum, which might be related to many water points surrounding the site.

Moreover, there are bushes (*Ligustrum, Buxus, Viburnum, Cornus, Euonymus, Prunus spinosa*) and liana (*Lonicera, Hedera helix, Clematis*). These plants are usually kept in hedgerows and gardens. In some contexts, bevelled branches are found among the archaeological material, attesting that the trees were trimmed. Tools which have probably been used in this cutting activity are found in the excavation of a well and a pit, at "La Justice", the north district of the site.

Those "garden plants" might be cultivated in pots, as suggested by Latin agronomists who describe reproduction methods using seedlings and cuttings, made in these containers. Horticultural vases have been found in "La Justice" district. Sometimes, the containers correspond to kitchen utensils that are reused for cultivation. These findings confirm the hypothesis of keeping plants in pots.

In those garden areas, different fruit species are represented: *Corylus*, *Juglans*, Prunoideae. For the last ones, the carpological remains enable us to specify which fruits have been eaten: cherries, plums and peaches.

The age groups of the branches help us to know about the frequency of trimming. When the last tree ring (the cambium) is preserved, it is possible to specify the season of cut. The results point out the elimination of young branches. Thus, the growth of the trees and bushes is controlled thanks to regular trimmings. As the willow branches are predominant, there was probably an osier plantation nearby, exploited for basketwork activity. Other strong bushes such as *Ligustrum, Prunus spinosa, Clematis, Cornus*, turn into invading plants if they are not regularly cut.

Most of the branches were cut out of the vegetation period, as it was recommended by antique authors in their description of the agricultural calendar. Indeed, when the trees are trimmed during budding or flowering, their stumps wear because of the sap that flows out. In the other hand, the surplus of sap at spring makes the fungus proliferate. As a result, the wound caused by the cuts does not heal in the good way.

Concerning the worked woods, 18 taxa were identified. *Quercus* was predominant with 70% of the scraps. Other taxa were represented in little proportions (*Carpinus, Fagus, Ulmus, Fraxinus, Populus, Alnus, Betula, Acer*). Two conifers were present: fir (*Abies*) and spruce (*Picea*). These mountainous tree taxa were not recorded among the branches, and did not belong to the spontaneous flora of the region. Those conifers or their wood material have probably been imported. Most of the worked woods are cut following the radial plane. This technical reduces the risks of distortion after seasoning.

Key_words: Gallo-roman period, Wells, Waterlogged woods, Xylology, Northern France

IMPACT OF FIRE ON THE LONG TERM DYNAMICS OF THREE OMBROTROPHIC PEATLANDS IN NORTHWESTERN QUÉBEC [1]

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In the lichen woodland of northwestern Quebec, forest fire frequency has been estimated for the past centuries using dendrochronological methods. However, fire frequency in ombrotrophic peatlands is still unknown. While peatlands are often considered as barriers inhibiting the spread of forest fires, the presence of surficial and stratigraphic charcoal layers within these ecosystems indicate that they are recurrently affected by fire. The first objective of this study is to reconstruct the fire history for three ombrotrophic peatlands located in north-western Québec (53°N; 77°W). A high stratigraphic resolution (1 cm-interval) macroscopic charcoal (>500 m) analysis was conducted to establish a chronology of fires for the past 7000 years. The age of each fire event was obtained using AMS radiocarbon dating conducted on charcoal particles and charred plants. The second objective is to reconstruct the post-fire vegetation successions using plant-macrofossil analysis. Pollen analysis was also conducted for one core, providing additional information about the vegetation dynamics at local and extra-local scales. Our results show that one of the peatland was frequently burned (minimum of 9 fires) during the past 6200 years, resulting in a proliferation of mosses (*Dicranum* spp., *Polytrichum strictum*, *Pohlia nutans*) and herbaceous plants (*Carex* spp.), as well as a decline of *Sphagnum* mosses. These changes in the local vegetation cover have sometimes persisted many decades. Long-term peat accumulation rates were also affected by fire events. This study illustrates the impact of fire on the long term development of ombrotrophic peatlands.

Key-words: Paleoecology, Fires, Ombrotrophic peatlands, Macrofossils, Pollen

[1] Section 5, Oral

ECOSYSTEM INSTABILITY AND THE ROLE OF WILDFIRE ACROSS THE TRIASSIC - JURASSIC BOUNDARY IN EAST GREENLAND [1]

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The Triassic – Jurassic boundary (TJB; 200 Ma) is marked by the third greatest ecological catastrophe in the history of life, with the loss of 23% of marine families and 22% of terrestcrial families. This mass extinction event coincided with major environmental upheaval, highlighted by a perturbation of the global carbon cycle. Analyses of stomatal indices suggest a fourfold increase in palaeoatmospheric CO_2 levels across the TJB, and results of modelling studies imply a maximum 16°C regional climatic warming. Recent studies of the plant macrofossil record in the Jameson Land region of East Greenland have provided evidence of localised ecosystem instability millions of years prior to, and following, peak extinction at the TJB, demonstrating that terrestrial vegetation was profoundly disrupted at this time. However, it is presently unclear exactly how these local patterns scale-up to the wider Jameson Land region. Fire has played the role of cause, consequence and catalyst to the development of terrestrial life on Earth, yet remains largely unexplored as a potential mechanism of palaeoecological change across the TJB. To investigate these issues, we have undertaken a palynological analysis of the Triassic – Jurassic transition in East Greenland. Our study is based on samples collected from the fluvial – lacustrine Kap Stewart Group at Astartekløft. The vegetation history of the Jameson Land region, as recorded by fossil pollen, has been compared with palaeoecological studies based on macrofossil leaves to build a more comprehensive picture of regional versus local vegetation change. The fire history of the region, as recorded by fossil charcoal, has been set against the patterns of floral change, to assess the contribution of ancient wildfire to vegetation dynamics at the Triassic – Jurassic transition.

Key-words: Triassic, Jurassic, Charcoal, Palaeowildfire, Vegetation, Pollen

[1] Section 2, Poster

HOW TO GET REPRESENTATIVE INFORMATION ON THE WOODLAND USE IN AN EARLY BYZANTINE TOWN: ANTHRACOLOGICAL ANALYSIS OF SAGALASSOS, SW ANATOLIA [1]

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The Roman and early Byzantine occupation of Sagalassos, between the 1st and 7th centuries AD, had an influence on the shaping of the landscape and, in particular, on the surrounding woodlands around the site during this period. Thanks to the long term environmental archaeology studies at Sagalassos, excavated under the directorship of Prof. Marc Waelkens (K.U.Leuven), a large number of anthracological samples from different contexts are available. These numerous wood charcoal retrieved from the cultural layers of the site give us the possibility to follow directly, which kind of wood was used at the site and to establish how this use both reflects and has affected the surrounding of the town of Sagalassos. The current study presents the wood charcoal analyses of over 40 samples (total volume ca. 760 l and more than 5000 charcoal fragments) from the period between the 5th to 7th centuries. The studied material originates from 6 areas of the town – connected with official (Odeion (OD), Lower Agora (LA), domestic (Domestic Area (DA)), craft (Potters' Quarter (PQ)), and other (Roman Baths (RB) and Macellum (MAC)) activities.

The vast surface of the town and the variation in the use of space raises the question of how to obtain representative information on the woodland use when a wide variety of contexts is available connected with official, domestic, craft or other purposes. To answer this question, optimal sample size estimations and statistical techniques were considered as well as the composition of contemporary samples from the different areas and contexts. Most of the studied samples were obtained through flotation. Samples taken from construction wood were threatened separately. The general tendency of prevailing cedar wood in the town's late occupation was confirmed in all of the studied contexts. This probably shows the use of the wood resources from the higher mountain, since the species grows in the coniferous belt of the mountain at an elevation between 1400 and 2000 m a.s.l. Finally, the data from the anthracological analyses were compared to those of the pollen analysis for the surroundings of Sagalassos.

Key-words: Anthracology, Taphonomy, Archaeobotany, Roman Age, Turkey

[1] Section 1, Oral

FIRE SIGNALS FROM THE CENTRE OF FRANCE ALONG MIDDLE AND UPPER PLEISTOCENE [1]

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The loessic deposits of Bonneval in the Centre of France (Eure-et-Loir) show that the regional fire signal history during the last 450,000 years follows the climate change along Glacial/Interglacial periods. Eight dates obtained between 95,000 and 450,000 years by Optically Stimulated Luminescence method from aeolian quartz permitted to indicate that the core extends along Middle and Upper Pleistocene. An age model was calculated and permitted to compare the microcharcoal proxy of Bonneval to the large climatic trends of theses periods.

Key-words: Fire signals, Microcharcoal, Climate, Middle and Upper Pleistocene, France

[1] Section 1, Poster

NEW DATA ABOUT WOOD USES IN NORTHWEST OF IBERIAN PENINSULA [1]

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This paper presents new data about wood use in archaeological contexts in the Northwest of the Iberian Peninsula. Charcoal and wood samples from different sites, most of them being settlements with a chronology ranging from Prehistoric to Historical times, were analysed. The sites analysed and presented in this paper are: Montenegro (Neolithic), Os Remedios (Chalcolithic), Castro de Montealegre, Castro de Punta do Muiño, Castro de Navás, Castrolandín, Castro de O Neixón Pequeno, Castro de Zoñán, Corona del Cerco de Borrenes, El Castrelín de San Juan de Paluezas, Pedreiras del Lago, Castro Orellán, Cerro Pendón, Valencia de Don Juan, Los Cuestos de la Estación (Iron Age-Roman Period), Mourela (Medieval-Postmedieval Period).

The results were registered in a specific archaeobotany database, which was used in combination with a GIS program to analyse the different spatial contexts of the samples on both a microscale and intrasite level, and in a broader geographical context. The results show the different uses of wood within the settlements, and the differences and continuities between geographical areas and chronological periods.

Key words: Wood use. Charcoal Analysis. Iron Age. Northwest of the Iberian Peninsula.

[1] Section 4, Oral

CHARCOAL FROM A 1ST CENTURY AD FIRE LEVEL AT THE BASE OF THE DOMUS TIBERIANA, *VIA NOVA*, ROME [1]

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The *Domus Tiberiana* rises in the NW corner of the Palatine hill, being the first of the imperial palaces conceived in an organic and monumental style. The northern front, the most imposing, constitutes a scene-wing of the Roman *Forum* with its high arcade preserved for a height of ca. 20 m. The large rooms facing on the *Forum* and on the underlying *Via Nova*, were built by the emperor Hadrian, which prolonged until the *Forum* the previous Flavius front of the Palace of Tiberius.

The lowest part of the *Domus Tiberiana* facade is formed by a series of rooms, interpreted as *tabernae* (stores) opening on *Via Nova*. They are rather well preserved and show many restoration phases of imperial age. In some of them, paintings, benches, basins, and floors mosaics are still visible. An upper floor, reachable through stairs, can be reconstructed.

The soil samples investigated in the present study are from an excavation carried out in 2006, during a restoration and consolidation intervention of the architectonical complex built in the Hadrian age. The urgent excavation was carried out by the *Soprintendenza Archeologica di Roma*, on the southern front of *Domus Tiberiana*, opening on *Via Nova* and facing the *Forum*. The archaeological investigation went down to the tuff geologic bank of the Palatine hill, in order to establish if structural damage had involved the foundation of the imperial palace.

Eighty cm below the deepest floor of the *tabernae*, a stratum, slightly less than 1 m thick, formed by superimposed strata of soil mixed up with charred material, containing charcoals and ashes, alternated with clayey lenses. The study of the pottery fragments surely belonging to the 1st century AD is still in progress. Its development will allow to ascribe precisely this context either to Nero's fire (64 AD) or to a less famous one, happened in 80 AD, under Titus.

The charred wood fragments, always very small in size, were sampled by the archaeobotanists during the emergency excavation, keeping them in their original soil. They were extracted in the laboratory from the soil that contained pottery fragments, mosaic tesseras and animal bones.

For detailed wood identification of so small fragments (generally less than 1 cm^3) a phase contrast microscope with differential interference contrast (DIC), also called a Nomarski microscope, was employed.

Six arboreal taxa have been recognized, summing up to 72% of the total charcoals (*ca.* 15 g in all), often too small to be identified. Evergreen *Quercus* (29%), *Carpinus* (28%), and *Castanea* (10%) charred woods constitute the main find. *Rhamnus,* deciduous *Quercus*, *Pinus* (not of *sylvestris/montana* type, *sensu* Greguss, 1955), and a pine cone fragment have also been found.

This study adds new data on a historical fire dated at the second half of 1st century AD and is of help in defining the timber used by Romans for building structures and in reconstructing the natural landscape of the imperial age. For this a period, archaeobotanical research concerning the zone of Rome and its surroundings is rather scanty. The historical and literary sources, taken in the right concern, suggest the presence of many woods, sometimes preserved because considered sacred, and their integration with archaeobotanical data resulted very important (Giardini *et al.*, 2006; Sadori *et al.*, submitted).

Key-words: Imperial Rome, Nero's fire, Charcoal, Domus Tiberiana, Via Nova

[1] Section 4, Poster

GIARDINI M., CALDERONI G., JOLIVET V., MARI Z., SADORI L., SUSANNA F. & TRESSERRAS J.J., 2006. Indagini archeobotaniche su alcuni materiali degli horti Luculliani (Roma) e di Villa Adriana (Tivoli). *In:* Morel J-P., Tresserras Juan J., Matamala J.C. (eds), *The archaeology of crop fields and garden*, Edipuglia, Bari, 129-144.

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EXPERIMENTAL RE-CHARRING OF CHARCOAL: IMPLICATIONS FOR RECOGNISING USE OF CHARCOAL AS A FUEL [1]

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Wood charcoal is and was utilised as fuel due to its ability to provide sustained high temperature heat, essential for many industrial processes of the past such as metallurgy. The inert nature of charcoal allows it to be easily preserved in the archaeological record making it a vital resource for archaeologists. Cell wall reflectance values of charcoal in polished blocks under oil provide a proxy for temperature of formation (Mc Parland *et al.*, 2007; Scott, 2000; Scott & Glasspool, 2007). Re-charring experiments were undertaken to discover whether it would be recognisable if charcoal (in this case of *Quercus*) had been used as a fuel in a high temperature industrial process (≥800 °C). Results indicated that re-charring at higher temperatures did not destroy anatomical structure and so should not prevent the botanical identification of charcoals. Charcoals became increasingly brittle with increasing temperature of formation. High temperature charcoals are therefore more likely to break-up and so small fragments should not be ignored. Re-charred charcoals take on the reflectance value of the highest temperatures experienced; reflectance values were not constrained by the original temperature of formation. Where very high temperatures (≥1100 °C) are indicated by reflectance values this almost certainly indicates intentional generation of high temperature burns by humans. High temperatures are most easily achievable by the burning of charcoal fuel, and hence high reflectance charcoals are likely to represent re-charred charcoal. Reflectance data from assemblages representing burning of charcoal is likely to indicate temperatures between that of the charcoal production (~500 °C) and the maximum temperature reached in the subsequent process (≥1100 °C). In contrast, assemblages representing burning of wood will include fragments showing lower reflectance (<500°C) and will lack high temperature charcoals (>800 °C). Therefore this quantitative reflectance method can be used in archaeology to determine the minimum temperature of formation of charcoals in anthropological processes that involve fire and can indicate the likelihood of use of charcoal or wood as fuel.

Key-words: Archaeology, Metallurgy, Wood, Reflectance, Petrography

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[1] Section 1, Oral

THE USE OF FIREWOOD IN THE INCINERATION RITUAL DURING THE IRON AGE IN N.E. OF THE IBERIAN PENINSULA [1]

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The ritual is an expression of the system of beliefs of a society. It has for goal the social cohesion, the transmission of the social order, the identification of the belonging to the group of the individuals who practice it and at the same time the differentiation between them in the sinus of the group. The ritual is recognized for the recurrence of the same actions and for the use of the same objects, items or artefacts with a symbolic value. For this reason we can consider that the use of firewood is also regulated by the ritual. The study of the vegetal fuel remains associated to the funerary structures indicates one of the components of the ritual: the species selected for this purpose. The comparison between the pattern of firewood consumption in domestic and ritual areas for the same chronologies and locations allows a better understanding of the rule of firewood in the ritual. In this poster we show the results of the study of firewood consumption in the necropolis of Can Piteu (Sabadell) and Pi de la Lliura (Vidreres), both in the North-East of the Iberian Peninsula. The differences between domestic and ritual firewood uses are discussed. The data obtained shows more specialization in the use of firewood in funeral contexts. On the other hand, we discuss the meaning of the differences observed between structures in such contexts.

Key-words: Firewood, Incineration, Ritual, Northeastern Iberian Peninsula

[1] Section 4, Poster

ANTHRACOLOGICAL ANALYSIS FROM A BRONZE AGE NECROPOLIS AT KOKOTÓW (POLAND) [1]

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The Kokotów cemetery (Kraków, Poland) is located on sandy soils, in the vicinity of the Vistula River. This necropolis is dated to the last phases of the Bronze Age culture of Urn Field (*ca.* 700-600 BC). This work presents anthracological analysis based on charcoal remains found in graves, which represent both urn and pit structures. The study has two main aspects: first, to determine if the wood used in cremation ceremonies corresponds to a special taxonomic selection that will provide mostly palaeoethnographic information; and second, if the gathered wood has palaeoecological significance.

The charcoal fragments come from the flotation of the pits' sediments as well as from the contents of the urns. Within almost 4000 charcoal fragments 14 taxa were found, in which four taxa appeared more frequently and were ubiquitous: oak (*Quercus* sp. deciduous), common pine (*Pinus sylvestris*), birch (*Betula* sp.) and heather (*Calluna vulgaris*). Besides, it is observed that the taxonomic richness in the necropolis is related to the number of graves and fragments analyzed. Even if no quantitative interpretation of the vegetation can be performed, qualitative analysis can reveal the woody plants that appeared in the proximity of the site. Furthermore, three different vegetation communities can be observed as catchment's area: pine forest developed on sandy soils, broadleaf or mixed deciduous forest dominated by oaks and riverside forest.

Key-words: Charcoal analysis, Wood exploitation, Palaeoenvironment, Bronze Age necropolis, Poland

[1] Section 4, Poster

STAKES AND PERSPECTIVES OF ANTHRACOLOGY IN PERU [1]

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Anthracology has only developed in Latin America recently and in a rather sporadic way. In Peru, three investigations examining archaeological wood charcoal were carried out in the 1980's; subsequently in 2002, anthracological studies reappeared, followed by the production of methodological tools such as an anthracological atlas which was non-existent prior to this. However, Peru is an extraordinarily rich area for answering archaeological and palaeoenvironmental questions thanks to anthracology. Peru has a very rich ecological diversity with the vegetation covering 5000 m of altitude. The climatic archives available in Peru are numerous: marine sediments off the coast; Andean glaciers; speleothems in karstic caves of the eastern Andean slopes; lacustrine sediments in the high lakes and lastly historical documents from the recent periods. Archaeological sites are abundant in the landscape and rich in wood charcoal notably on the coast where they are well-preserved in the arid climatic conditions. Furthermore, anthracological studies can be complemented by investigating modern rural population who largely follow a traditional way of life. Such ethnographic studies provide important information on agro-forestry practices or the management of woody vegetation.

Climatic fluctuations are at the heart of nearly all archaeological questions in the Andean archaeology; nevertheless, the co-evolution between societies and the environment has not been the subject of specific investigations until recently. One of the Andean anthropological models is the vertical archipelago developed by J. Murra for the Late Periods (900-1532 AD). According to the model, the societies during this time interval were set up to maximize access to the resources, scattered across different ecological levels or ecosystems, by using colonies or co-exploitating systems. Ecological levels may have fluctuated in altitude due to past climatic changes, but no study has been carried out until now on the basis of environmental *proxies*. In this region, climatic variations have a particularly strong impact as they influence the lower and upper cultivation limits of major crops such as potato or maize, as well as plants with a high ritual value, including coca. Climate fluctuations and therefore vegetation distribution play a crucial role on the territorial organization of societies and their political and social structure. Hence, it is of the utmost importance to understand the extent to which climate and the environment were factors influencing pre-Columbian settlement choices or pushing migration, as well as potentially explaining the development and decline of prehispanic and colonial societies. The study of anthracological assemblages, carried out in conjunction with the analysis of others environmental *proxies* is the best approach for reconstructing past vegetation dynamics, particularly on the coast where pollen is often poorly-preserved.

On a modern level, Peru is confronted by numerous environmental and social problems. In the Andean Cordillera, the steep slopes experience strong soil erosion accentuated by over-grazing. Unfortunately, the tree that has largely been chosen to reforest the slopes is the eucalyptus, imported in the 19th, which impoverishes the vegetation and acidifies the soil. In addition, the Peruvian Pacific coast will experiment a lack of fresh water with global warming. It will become increasingly difficult to supply water to the inhabitants of the coast, especially with the constant rural emigration which brings each year more people into the Lima region. Unfortunately, these newcomers also often lack an income. We consider that anthracology has a role in the resolution of some of these problems, on a local scale, proposing for example that endemic species are more appropriate for reforestation or in revealing agro-forestry practices which have disappeared since the Spanish conquest. These suggestions may find an empowerment for rural populations by consolidating their collective past and a greater recognition and appreciation of their traditional knowledge. We have tested this approach working on the *lomas*. *Lomas* are special plant communities growing on the hills that overhang the Peruvian coastal plain, which exist by trapping atmospheric humidity. Nowadays, they are highly damaged by overgrazing, indiscriminate cutting of shrubs and trees, urbanization and exploitation of opencast mining. Using anthracological studies, bibliographical investigations and field surveys, we discovered that during the pre-Columbian period, the *lomas* were wooded and occupied by sedentary or semi-sedentary populations who managed them. The trees were at the heart of this ecosystem, capturing humidity and allowing the cultivation of maize or peanuts. Today, to preserve the *lomas* and rehabilitate them, simple measures need to be taken. By restricting cattle access or by replanting endemic woody species, the restored *lomas* could answer many environmental and economic problems. Thanks to reforestation, the humidity capitation system would be reactivated and provide water to irrigate

[1] Section 4, Oral

crops, which could be sold and provide incomes for the families. Some communities have already started reforestation programmes, but they are not always using the appropriate species. Anthracological investigations enabled the identification of the *lomas* endemic species and this information could then be passed onto the communities for planting the appropriate species.

Key-words: Anthracology, Peru, Palaeoenvironment, Lomas, Sustainable development

COMBINING PALAEOARCHIVES: THE CONTRIBUTION OF ANTHRACOLOGY TO LANDSCAPE HISTORY SCENARIOS [1]

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The genesis of landscapes until today is the base for its current state - *e.g.* today's biodiversity. A number of indicators (botanical remains, pedological laboratory data, historical data) should be investigated and the results should be interpreted in a holistic systems approach to attain a thorough understanding of a landscape's history. In this context we present the potential of integrated analysis on charcoal, soils, colluvial layers and lake sediments. The occurrence and type of soil sediments provide insight into timing, extend and consequences of agricultural land use and accompanied soil development on different temporal (long term development to events) and spatial (landscapes to ecosystems to sites/habitats/biotops) scales. Charcoal fragments embedded within buried soils or colluvial layers provide information about local vegetation and land use when careful interpretation in a palaeobotanical as well as archaeological context is assured. Thus charcoal analysis complements palynological information where the pollen source area is uncertain. The natural pattern of soils (which was one of larger, more uniform patches) changed into one with smaller, more diverse patches, more or less influenced by erosion, sedimentation, changes in water level or nutrient state. Results of current integrated analysis of bio- and geo-archives in two landscapes in Northern Germany provide a more detailed understanding of Holocene landscape genesis and show future potentials of the use of these archives for anthracological research.

Key-words: Pedoanthracology, Integrated palaeoecosystem research, Northern Germany, Landscape history

[1] Section 3, Oral

EARLY IRON AGE FOREST COMMUNITIES IN NORTH PART OF THE ODERSKÁ BRÁNA (NE CZECH REPUBLIC) [1]

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Forest communities and their possible exploitation are studied based on charcoal, pollen and macro remain analyses from three archaeological sites and profiles nearby in the Oderská brána region (NE Czech Republic).

The results of all palaeoenvironmental analyses have shown very similar course of the vegetation history. Fir (*Abies alba*) and beech (*Fagus sylvatica*) are dominants, birch (*Betula*), hazel (*Corylus avellana*), hornbeam (*Carpinus betulus*) and lime tree (*Tilia* sp.) are abundant in the set. Local low presence of oak (*Quercus*) and pine (*Pinus*) are quite unusual for Central European lowlands. Vegetation was probable influenced by the climatic conditions and region position, which is situated near the Silesia lowland and the Carpathians. The rich species composition indicates only low settlement with enclave character in Early Iron Age.

Key-words: Charcoal, Early Iron Age, Pollen and macro remain analyses, Oderská brána region (NE Czech Republic).

[1] Section 4, Poster

A REGIONAL REVIEW OF ANTHRACOLOGICAL DATA IN CALABRIA (SOUTHERN ITALY): NEW DATA FROM NEOLITHIC TO MEDIEVAL PERIOD [1]

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Calabria, in the far south of Italy, has an extraordinary variation of landscape, climate and vegetation deriving from its geomorphological conformation and its geographical location. The vegetal cover change rapidly from the coast to mountain area in a limited space. Thanks to charcoal analysis in the archaeological sites of different periods we propose a diachronically reconstruction of vegetation characteristics.

So far there are a few archaeological sites where anthracological analyses have been done (*Locri*, *Favella, Torre del Mordillo*, *Grotta S. Sebastiano, Jure Vetere*).

The amount of data that we have for every chronologic time is very heterogeneous. In the complex have been studied only coastal areas. The medieval monastery of *Jure Vetere* (S. Giovanni in Fiore – CS) is the only mountainous area. The wide part of Calabrian territory and any chronological phases haven't yet been studied with archaeobotanical methods.

The latest anthracological analyses have been done on hilly sites of the Ionic Sea Coast (*Castiglione di Paludi*) and of the Tirrenum Sea Coast (*Cozzo Piano Grande di Serra d'Aiello*, *Oppido Mamertina*) and they covered chronologically a really long period from the Prehistory to the Middle Age.

These analyses lead us to come to really interesting results, adding more other information about it, clarifying some issues and are full of many researches cues.

Key-words: Anthracology, Charcoal, Palaeovegetation, Archaeology, Southern Italy

[1] Section 4, Poster

THE PLEISTOCENE-HOLOCENE CHARCOAL RECORD FROM THEOPETRA CAVE, THESSALY, GREECE: IMPLICATIONS FOR VEGETATION, CLIMATE AND HUMAN USE [1]

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The cultural sequence and chrono-stratigraphy of Theopetra cave covers the period from the Middle Palaeolithic to the Neolithic and constitutes a valuable source of information on patterns of human presence in the cave and on palaeoenvironmental conditions. Charcoal analysis applied to depositional Units II and IV of the sequence attempts to reconstruct the Pleistocene-Early Holocene vegetation around the site for the period from 129,000 BP to 9000 BP according to the latest TL and ^{14}C dates. During this period the charcoal sequence from the cave shows successive changes in the composition and density of the vegetation; gallery forests to wooded environments to open parkland and again to woodland expansion is evidenced in distinct anthracological zones that can be seen in association to the MISs and the global climatic events of the Late Pleistocene and the Early Holocene.

In the lowermost Units II1 and II2 few charcoal remains attributed to *Salix-Populus* and *Sambucus* sp. were recovered, probably indicating that arboreal vegetation was mainly restricted along watercourses. A change in the vegetation can be seen in the following Units II3 to II4 when pioneer species like *Prunus* sp. proliferate, pointing to the existence of open vegetation where, however, temperate taxa (*Carpinus/Ostrya*) make their appearance. The repercussion of better climatic conditions creating favourable habitats is also attested in thick anthropogenic burnt layers in the cave. Units II5 to II9 present greater diversity of tree taxa and a more consistent temperate component reflected in taxa that are considered the markers of interglacial vegetation, namely *Carpinus/Ostrya*, *Fraxinus* sp. and *Quercus* sp. type deciduous. The above-mentioned charcoal results indicate a transition from harsher to milder climatic and environmental conditions reflected in stages of vegetation succession. Moreover, these characteristics together with the presence of temperate taxa and in particular that of *Carpinus/Ostrya* could situate that part of the cave's sequence to the MIS5, a conclusion supported by the TL ages for Units II2 and II4, 124±16 and 129±13 ka BP respectively.

Changes in plant cover and composition occur in Units II10 and Unit II11. Open environments and concentration of tree taxa in gallery-forests are evidenced in the abundance of *Prunus* sp., *Juniperus* sp. and *Salix-Populus* and in the absence of temperate taxa. The characteristics of the vegetation in those units point towards the existence of harsher climatic conditions when compared to the lower part of the sequence. We postulate that here are reflected the environmental conditions of the MIS3 taking into account as well the cryogenic features observed at the base of Unit II10 (that could be associated to the even colder MIS4) and the TL age of Unit II11, 57±6 ka BP.

Features of freeze-thaw activity and absence of charcoal remains from Unit II12 might indicate the unfavourable climatic conditions of the MIS 2 and of the Last Glacial Maximum. A hearth in the upper boundary of Unit II12, where *Salix-Populus* and *Juniperus* wood was burnt, was dated to around 19,800 cal BP and is the only evidence for human presence at the cave before the Lateglacial.

The charcoal remains from the upper part of the cave's sequence, namely Unit IV, show the characteristics of vegetation succession from open formations with pioneer species and gallery forests to open woodland with temperate and thermophilous taxa, in particular *Pistacia terebinthus*. A Late Glacial, Late Glacial-Holocene transition and Early Holocene sequence is postulated from the charcoal results from Unit IV and is supported by the available radiocarbon dates (15,000 - 9000 cal BP).

Key-words: Vegetation succession, Middle Palaeolithic, Mesolithic, MISs

[1] Section 5, Oral

SELECTIVE USE OF FIREWOOD AT DUTCH LATE MESOLITHIC AND NEOLITHIC WETLAND SITES ? [1]

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This study presents a comparative analysis of charcoal of Dutch wetland sites belonging to the Late Mesolithic, the Early and Middle Neolithic Swifterbant culture and the Middle Neolithic Hazendonk group (5500-3400 cal BC). Many charcoal analyses from these cultural groups have been published in the past years, but an overview is lacking until now. The aim of the study is to investigate whether selective use of firewood occurred at the sites studied. Therefore, charcoal data are compared with data of unworked waterlogged wood, assuming that the latter are representative of the natural vegetation. The results indicate that firewood collection was based on a combination of random collection, selection and avoidance.

Key-words: Firewood collection, Swifterbant culture, Hazendonk group, Charcoal, Unworked wood

[1] Section 4, Oral

WOOD RADIUS CURVATURE MEASUREMENT AND WOOD DIAMETER: COMPARISON OF DIFFERENT IMAGE ANALYSIS TECHNIQUES [1]

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The dendrological study of wood charcoal is very important for the understanding of wood supply. This type of approach, which was launched in the 1990s (Marguerie, 1992) has evolved considerably since then. New protocols have been created for a better estimate of exploited wood diameter. Some protocols are practiced under binocular lens, with a qualitative estimate of the tree ring curvature (Marguerie, 1992, 2006). Other protocols use a diameter stencil (a test card) to measure the radius of curvature (Nelle, 2002, Ludeman, 2006 Dufraisse, 2002, 2006). However, this method is not sufficiently precise and great care is therefore required when interpreting data. Very large diameter classes must be used so as to implement the burnt wood diameter reconstruction model (BWDR) (Dufraisse; 2002, 2006).

The development of new equipment (camera on binocular lens and image analysis software) has greatly improved measurement techniques.

In addition to the circle tool technique (fig 1, A), based on tree-ring curvature, three new techniques based on wood radius are presented here. These three techniques use image analysis software and geometric formulas (fig 1, B, C and D), such as trigonometry.

One of the aims of this work was to compare different measurement methods of the radius curvature on a perfectly graduated target, to set the reliability and limits of each method. This comparative study used three parameters: angle between radii, distance between radii, and theoretical diameter of the graduated target. So, with this analysis, it was possible to define the charcoal minimal size (distance between radii), and the minimal angle between radii that can be measured with each technique.

The second objective of this work was to establish diameter classes adapted to each of the methods, to find the best fit for the burnt wood diameter reconstruction model. Thus, it was possible to propose minimal diameter classes for each measurement technique, including margins of error revealed in the comparative analysis and which it can use in the BWDR model.

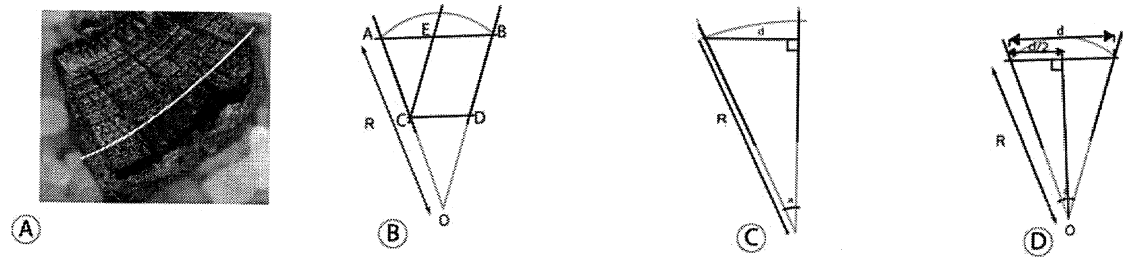


Figure 1: Technique using image analysis software. A: circle tool technique. B, C and D techniques using geometric formulas (B: Thales, C: Trigonometry in a right triangle, and D: trigonometry in a isosceles triangle)

Key-words: Wood charcoal, Wood diameter, Image analysis software, Radius curvature

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FOREST-ECONOMY DURING THE LATE MIDDLE AGES IN NORTHERN GERMANY: AN ANTHRACOLOGICAL INVESTIGATION ON EARLY INDUSTRY SITES [1]

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Before coal and oil where used for industrial processes, only wood and charcoal gave the energy for running iron smelting-places, glassworks and brickworks. There are hardly written sources about the wood-consumption and the forest-economy at early industry areas, consequently only archaeological and anthracological investigations can give an idea of the usage of medieval woodlands.

At all medieval craft-sites it is possible to find charcoal, remaining from the burning-processes. The most important industry-remains are charcoal-kilns, because nearly every craft-site needed charcoal to heat material. Other important objects of research are the remaining mass and size of charcoal in these sites, which are able to give a lot of detailed information about the surrounding woodland.

The anthracological investigation on charcoal-kilns in Schleswig-Holstein (Northern Germany) included the identification of the wood species, the minimum diameter and the year ring-structure. The results were compared with several results of experimental burned charcoal-kilns, where the same parameters where ascertained, and the wood charge was known. The combination of archaeological, anthracological and experimental research enable us to distinguish the ancient use of branches, coppice-woods and trunks in early industrial craft-sites. Combined with the distribution of wood-species the charcoal-analysis gave detailed indications of the wood-conditions during the Middle Ages.

The results are very differing: Near Bargstedt in the middle of Schleswig-Holstein was a large charcoal and iron industry during the 16th century, producing more than 2400 tons of charcoal every year. The charcoal-analysis showed that the consumption of the wood was managed very well, so that no deforestation took place. Until the 1580th old oaks, white-beeches and beeches dominated the surrounding woodland. In contrast to Bargstedt there was a similar iron-producing area near Flensburg from the 13th century, but this forest was in a very bad condition: only slow growing small willows, few beeches, nearly no tree more than 10 cm in diameter. These facts suggest that the human impact was very massive in former times.

In different areas in Eastern Holstein the charcoal analysis showed a working system of white-beech coppice-woods. Cut down every 20 or 30 years, the charcoal-burners had no lack of wood, because coppice trees grow up to three times faster than usual trees. The human impact in these areas seems to be part of a lasting system. Another interesting fact is that charcoal made from white-beech has the best quality. It is much heavier and burning warmer and slower than other charcoal. Therefore the white beech was probably chosen for burning charcoal.

The charcoal of glassworks from the late 16th century showed, that only very old and slow growing beeches were used to vitrify the glass. Several written sources underline the fact that Schleswig-Holstein had a lot of woodland and forests during the late Middle Ages, but later, between 1650 and 1750, nearly all old woodland was cleared owing to the increasing number of glassworks.

Key-words: Early industry, Charcoal-kilns, Forest-management

[1] Section 4, Oral

VEGETATION CHANGES IN THE PYRENEES FOREST CAUSED BY HUMAN IMPACT: 2000-YR OF METALLURGY HISTORY [1]

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In this work we present a synoptic overview of a multidisciplinary research undertaken in Vallferrera valley, located in the southern slope of Central Pyrenees, where long-term metallurgy exploitation has been documented. In this Pyrenean region we applied a methodology based on different techniques: plant remains (palynology, anthracology and dendrochronology) and documental sources (written, graphics and oral). The work carried out in the Virós forest is used as indicator to measure the intensity of different disturbances and the degree of affectation throughout the all history. The results obtained from the study of 900 kiln sites, mines and slag concentration put in evidence how the forest vegetation has been conditioned for the last 2000 years by metallurgy history, with a high intensity during the 18th and 19th centuries. The results show the interaction between society and environment throughout that time and its influence in the present distribution of the main species forest (*Abies alba*, *Fagus sylvatica*, *Pinus sylvestris* and *Pinus uncinata*).

Key-words: Pyrenees, Metallurgy, Charcoal kiln, Forest history

[1] Section 4, Poster

ARCHAEOBOTANICAL RESEARCH IN THE PREHISTORIC BALEARIC ISLANDS: ANTHRACOLOGY AND ARCHAEOPALYNOLOGY [1]

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This poster shows the archaeobotanical research carried out in prehistoric sites of the Balearic Islands, based on the interdisciplinary studies on archaeobotany and the integrated interpretations of results. This research combines anthracological and archaeopalynological data to improve our knowledge on past vegetation dynamics and human-environment interactions in insular ecosystems.

Pollen records from natural deposits show that Balearic vegetation experienced a deep change between 6000 and 5000 yrs BP (Pérez-Obiol *et al.*, 2000), coinciding with the first evidences of human presence in the islands. Before this date, the landscape was dominated by deciduous species such as deciduous *Quercus, Corylus, Acer, Sorbus* and *Fagus* with wide presence of *Buxus* and *Juniperus* (*ibidem*). Since 6000-5000 yrs BP these taxa decreased, replaced by more xeric plant communities dominated by *Olea*. *Corylus* disappeared in the islands whereas *Buxus* and *Juniperus* survived in Mallorca as relicts in mountains. The anthracological record has shown that *Buxus* and *Juniperus* persisted at the Mallorca island low altitudes from 5000 to 2750 yrs BP, and they were used as fuel wood and, probably, as fodder (Picornell *et al.*, i.p.). In theses sectors, both taxa were present together with more thermophilous taxa such as *Olea, Pistacia* and *Rhamnus-Phillyrea*. No evidence of *Corylus* has been recognized in the charcoal record, but two deciduous taxa (*Quercus* and *Acer)* have been documented at the Iron Age site of Son Ferrer (Mallorca), suggesting that these species survived as relicts of the past vegetation (Picornell & Allué i.p.). Anthracological data record a new change in Mallorca's landscape at *ca.* 2500 yrs BP (Piqué & Noguera, 2002). Before this date, the almost exclusive plant used as fuel wood was *Olea*, but after 2500 yrs BP, *Pinus* increased and shrubby stratum such as *Pistacia, Erica, Rhamnus/Phillyrea, Cistus*, diversified. This change has been recorded in Iron Age sites of Mallorca island (Piqué & Noguera, 2002; Picornell & Allué, i.p.; Picornell & Noguera, 2007).

Anthracological analyses from Balearic prehistory sites allowed us to establish the nature of landscape change as well as the *responsibility* of humans in this process. An additional aim of our research is to make sense of the human perception of vegetation in order to elucidate if changes in the anthracological record were caused by vegetation changes due to climatic changes and/or wood resources by human management. We propose that changes in the relationships between Societies and Nature could be also triggered off by new cultural perceptions of the Environment. With this aim, we tried to identify patterns of landscape perception and cultural uses of plants in prehistoric Balearic Islands applying archaeobotanical techniques. In this effort it is essential to combine palynological and anthracological data from different sites and contexts. Previous studies allowed us to identify ritual/symbolic uses of plants in funerary caves and monuments of the Late Bronze Age and the Iron Age (Cova des Pas, in Minorca, and Son Ferrer funerary mound, in Mallorca), such as floral votive offerings or sacred fires based on aromatic plants (Servera & Riera i.p.; Picornell *et al.*, 2008).

Key-words: Archaeobotany, Anthracology, Archaeopalynology, Vegetation history, Palaeoethnobotany

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VARIABILITY IN FIREWOOD CONSUMPTION DURING NEOLITHIC IN NORTH-EAST OF THE IBERIAN PENINSULA [1]

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The goal of this work is to discuss the causes of the variability in charcoal analysis data from the Neolithic sites in North East of the Iberian Peninsula. Charcoal analysis from open air settlements, caves, burials and sites with special activities, like livestock farming or processing of lithic raw materials, offers an overview about the firewood uses and forest management between these societies. The particularities of local vegetations and transformations in the landscape are, without doubt, one of the factors to consider in the explanation of the taxa variability. But this one is also the result of the firewood management strategies. The size, the permanence of the activities made in the settlements, as well as the nature of site, are the main factors to explain this variability.

Key-words: Firewood, Forest management, Neolithic, North-Eastern Iberian Peninsula

[1] Section 4, Poster

SIGNATURE OF FOREST FIRES IN PRAIRIE SOILS [1]

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Millimetre-sized, reddish brown to black, sub-round to ovoid bodies, so-called iron-manganese concretions, were described in prairie soils over 60 years ago. They were a popular object of studies from the 1960s to 1970s, and became a part of standard soil descriptions as an indicator of alternating conditions of reduction and oxidation in sites with impeded drainage. Re-examining concretions collected at various depths in closed depression areas within temperate grasslands of Canada and Russia using modern methods of SEM and microprobe analysis showed that these concretions have a potential of becoming a new palaeoenvironmental and palaeoclimatic indicator. That is based on our finding that prairie concretions are built around a charcoal core. The concretions have a complex structure that consists of a "core" enriched in manganese, with fragments of charred wood preserved within the core, and mineral coating enriched in iron oxides. The coating usually contains clusters of phytoliths typical for the insoluble fraction of ash. Fragments with a well-preserved plant anatomy often appear as "half-moons" of a higher diameter than groundmass lustre immediately beneath the coating, *i.e.* at the surface of the initial charcoal particle. In some concretions, however, the plant anatomical structure is preserved as domains in the former interior of charcoal fragments. In both cases, preservation of charcoal was associated with its impregnation by silica. Cross-sectioning a large number of concretions showed that their ovoid, pebble-like shape is a result of superposing some mineral coating over an initially asymmetric charcoal fragment. That suggests lateral transport of charcoal fragments in a slurry of mud and perhaps ash for considerable distances: for our indices (length: width ratio) as far as a few hundred meters. Such long-distance transport is possible only if the soil surface is bare of vegetation along the migration path. It is postulated that the deposition of clay-coated charcoal fragments was the result of large-scale, high-intensity fire events, followed by transport of charred material laterally and down slope and its deposition in closed depression areas. Widespread impregnation of charcoal fragments by silica was associated with desiccation of ash-enriched, alkaline sloughs. Deposition of iron and manganese oxides was secondary events under wet and reduced conditions. Although the foregoing could result in the build up of char particles in any concave area, the actual formation of concretions would be favoured in those seasonally wet depressions with alternating conditions of reduction and oxidation.

Personal observations of one of the authors during soil surveys in Saskatchewan grasslands indicated that the concretions have a sporadic distribution, appearing only in some wetland depressions and lacking in the others even if their hydrological regimes are very similar. Finding that formation of concretions is associated with fires affecting arboreal vegetation links the spatial distribution of the concretions with the presence of arboreal vegetation. Re-analyzing the distribution of concretions recorded in the Saskatchewan soil data base allowed us to map previously-forested areas within modern grasslands.

Finding radiocarbon datable objects in prairie soils is always a challenge. Our discovery allows for radiocarbon dating the concretion-encasing deposits and, moreover, for mapping palaeo-dynamics of forested areas within the grasslands. The fist radiocarbon dates obtained for concretions from the lowest of concretion-bearing layers in Canadian grasslands marked a transition from forest to grassland vegetation approximately 10 thousand years ago in the southernmost part of the grasslands and approximately 3 thousand years ago at the northernmost part of the grasslands/southern border of parklands.

Key-words: Charcoal-cored concretions, Forest-steppe transition, Holocene

[1] Section 1, Oral

RECONSTRUCTING TREE SPECIES COMPOSITION AT THE TIME OF LAND CLEARANCE: TWO APPROACHES COMPARED [1]

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Land clearance for agricultural purposes always involves burning. It can be burning of logging slash piles in the sites cleared to establish a permanent field or in situ burning of litter and shrubs in swiddens. In the former case, land clearance begins with logging of trees, utilizing their trunks and large branches and burning the rest. Even if initially localized, products of combustion become spread throughout the field by the lateral mass movement during ploughing. Through ploughing, the immense amount of charcoal produced during land clearing becomes incorporated into the plough layer and possibly mixed with older charcoal which presumably comprises a small proportion of such mixture. Therefore, it should be possible to estimate the species composition of cleared tree stands by analyzing a sufficient sample of charcoal fragments from plough horizons. Many European farmlands have been cleared for ploughing from many centuries to thousands years ago. Charcoal produced during the land clearance could have been affected by weathering and disintegrated into sand and silt fractions. Important factors affecting charcoal preservation within plough layers are the number of cultivations that affected a site after its clearing and the activity of earthworms. In the Canadian Maritimes first forests were cleared for fields only in 18th century, with the clearance booming in 19th century. The number of cultivation events was therefore not very high here; moreover, the Maritimes were lacking native earthworms until recently: European earthworms were introduced through farming. Finally, once cleared the fields remained farmlands until their recent abandonment, not going through the cycles of shifting cultivations.

We used botanical identification of macroscopic charcoal from former plough horizons in abandoned farmlands to reconstruct pre-agricultural species composition of Acadian forest within the Kouchibouguac National Park (Canadian Maritime Lowlands). About forty sites were examined to create a map of pre-agricultural species composition. Field was used as a sampling unit, with ~50 charcoal fragments identified to either genus or species level for each unit. These fragments were subsampled from charcoal assemblages based on the size of fragments. In each assemblage, length and width of charcoal fragments were measured for a further analysis of selective preservation of identified species. Commonly, larger fragments (an upper quartile of length distribution) originated from such species as birch and maple, and slightly burned fragments of cedar. Better preservation of these species may have led to their overrepresentation in charcoal assemblages in comparison to other species logged and burned along with them. In the same time, charcoal of *Picea* and *Tsuga* rarely appear in this size group (presumably due to faster comminuting), which may lead to their under-representation in charcoal assemblages. Botanical identification of charcoal was complemented by the trace fossil analysis: traces of root systems of the last pre-agricultural tree generation preserved in situ below the plough layer provided some idea of tree species at the time of land clearance (*e.g.* tap roots vs. branched roots), as well as of the density and spatial distribution of pre-agricultural tree generation. Sources of charcoal in plough layers were confirmed by excavating logging slash piles and comparing the charcoal composition in the logging slash burns with that in other areas within the same field. Age of charcoal fragments was consistent with the historical descriptions of agricultural colonization (approximately 130 to 250 years ago) according to the results of radiocarbon dating. Finally, results of the reconstruction were compared to archival descriptions of the Acadian forest. In the early 1800s, Deputy Surveyors divided New Brunswick landscape into various-sized parcels, marking trees on the bounds of each plot. Location and species of such "witness trees" were recorded on surveyor plan drawings. A total of 1100 survey plan drawings were found for the study area, resulting in ~2500 witness trees used for the subsequent analysis and its comparison with results of the charcoal analysis.

Information derived from both methods characterizes the Acadian forest *ca* 1800, just prior to heavy anthropogenic modification. Both methods detected a high diversity of species including the species that are currently not common in the landscape (*e.g. Ulmus* and *Ostrya*). Generally, the same set of species was reconstructed by both

[1] Section 1, Poster

methods, indicating that historic forests in the area were mixed and comprised of mid- to late successional species (*Picea* sp., *Tsuga canadensis, Betula* sp., *Acer* sp., *Fagus, Abies balsamea* and *Pinus strobus*) in 70-80% of sites. Early succession and shade-intolerant species, such as *Populus, Pinus resinosa, Larix laricina and Quercus rubra* were present at marginal levels according to both methods (1-3% of sites). According to both methods, *Pinus banksiana*, fire-dependant species common and widespread in the modern landscape, was absent at the time of land clearance. Frequency of species calculated on the basis of their presence/absence in each of the sites examined was generally similar, differing in much higher frequencies of *Betula* and *Thuja* and the much-reduced percentages of *Tsuga canadensis* in charcoal assemblages in relation to the witness trees results. Several explanations of such discrepancies were considered. Despite some discrepancies, comparison of the two methods confirmed applicability of the analysis of charcoal assemblages from plough layers for the site-oriented reconstruction of tree species composition at the time of land clearance. That opens an opportunity of applying the same procedure to the agricultural areas that are lacking historical descriptions.

Key-words: Land clearance, Farmlands, Species reconstruction

THE IMPACT OF MAN ON THE VEGETATION IN BULGARIA AT THE NEOLITHIC AND CHALCOLITHIC PERIODS [1]

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The Southern region of Bulgaria is one of the less studied with respect to the palaeobotanic regions of Bulgaria compared with some other parts of the country. In the last years the archaeological excavations in this area have increased in number. Most of the studied sites (Human settlements) are located alongside the main stream and the feeders of the rivers.

The studied settlements comprise the period from the Early Neolithic to the Late Chalcolithic. In the recent study an attempt has been made to summarize the results of the several studied sites (settlements), as well as to compare the data with that of some other scholars who have studied sites in the region.

The results of the studied settlements are generalized and compared with other archaeobotanical materials of the same period and of adjoining regions.

The presence of wood in the archaeological sites is usually connected with its usage in different activities: construction, production of instruments, fire, etc. It has almost always been collected in the vicinity; therefore, the wood analysis provides precise information about the woody flora in the studied region. Such studies are extremely important in the low-lying lands of our country, in particular the valleys of the Struma, Mesta and Maritza rivers, lacking in preserved sediments suitable for pollen analysis.

The Neolithic settlements in Southern Bulgaria are rich in anthracological material. The wood present in the settlement layers shows the oak forests prevalence and of the use of diverse ecological niches by man in the near proximity. In the riverside valleys, the woods collected are elm-trees (*Ulmus*), alder-trees (*Alnus glutinosa/incana*), ash-trees (*Fraxinus*) and plums (*Prunus*). The use of black pine-trees (*Pinus*) shows that it has been even more widely spread in the past than nowadays.

Key-words: Charcoal, Wood, Chalcolithic, Neolithic, Bulgaria

[1] Section 4, Poster

CLIMATE DRIVEN CHANGES IN FIRE REGIMES DURING THE LATE QUATERNARY [1]

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A global charcoal database, with over 400 records documenting changing fire regimes over the Late Quaternary has been created by the IGBP Global Palaeofire Working Group. The database provides a long-term observational record with reasonable geographic, climate- and biome-space coverage during the past 21,000 years. The data show a general increase in biomass burning between the Last Glacial Maximum (~21,000 years ago) and present, and a shift from low to high spatial heterogeneity in fire activity at ~12000 years ago. Regional changes in fire during the last 2000 years track climate except for the significant reduction in fire activity over the past 100 years, possibly reflecting increased human suppression of naturally-ignited fires. This database provides an important source of information about fire regimes and prime targets for model benchmarking.

Key-words: Fire, Climate, Charcoal, Database, Late Quaternary

[1] Keynote

THE FAMENNIAN (DEVONIAN) CHARCOAL OF BELGIUM [1]

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The Belgian Upper Devonian flora has been extensively studied. Most of it is preserved as compressions, mainly from the siliciclastic Evieux formation localities. The Evieux flora is highly diversified and is represented by up to 23 taxa. However, no coaly layers had been reported to date. We have recently identified two organic-rich beds from two localities (Val-Dieu quarry and Arbre quarry). In the latter, charcoal are preserved in a thick grained matrix of light (nearly white) sandstone. Plant remains are mainly crushed and disarticulated, but some wood pieces have been collected. The organic-rich layers from Val-Dieu are equally very light, but they are very fine grained. They presumably represent the B-horizon of a parautochtonous palaeosol. Plants are exquisitely preserved as charcoal and consist of abundant leaf fragments, sporangia, and wood fragments. They correspond to two different wood types. In radial sections, the first type shows groups of 20 to 40 multiseriate bordered pits in radially aligned rows, corresponding to *Callixylon* wood. The second is made up of many rods strands (?) of scalariform tracheids with numerous narrow pits. The results of this work will be discussed and compared with other Upper Devonian charcoal localities as well as with the Evieux compression flora.

Key-words: Famennian, Charcoal, *Callixylon*, Val-Dieu, Arbre

[1] Section 2, Oral

CHARCOAL, $\delta^{13}C$ AND MACROPHYTE PROXIES FOR TRACKING PALAEOENVIROMENTAL AND CLIMATE CHANGES IN THE ARISCIANNE MARSH (APULIA, ITALY) [1]

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The Ariscianne-Belvedere wet area is located between Trani and Barletta (Apulia, South-Eastern Italy) near the Camaggi stream mouth at the foot of Murge Plateau. This area was inhabited during the Neolithic age and some evidences were identified by archaeological surveys on hills surrounding the wetland and along the coastline. A multidisciplinary research project was carried out in 2002-2003 with a core drilling program aimed at reconstructing the evolution of this coastal area and the human interaction. Results show that, starting from the Neolithic, the area was probably the inner part of a coastal basin characterised by fresh water ponds.

In order to track the palaeoenvironmental and climate changes in the Ariscianne marsh, macrophyte seeds/fruits from ARI24 core have been analysed together with charred wood remains, also considering the $\delta^{13}C$ values inferred from IRMS technique on charcoal. Analysis indicates that during the mid-Holocene phase (5190-2610 BC) the area was characterised by the presence of fens fed by freshwater springs. An erosion surface separates these levels from recent alluvial sediments.

The analysis has allowed us to distinguish, at least, three periods with increases in the marsh water level occurring between 4930-4390 BC, around 3240 BC and before 2610 BC. For the period 4930-4390 BC the fen-alkaline water body is characterised by a typical "great fen-sedge" and temporary presence of submerged vegetation. Between 4390-3240 BC the plant remains suggests a reduction in springs water budget. A return to a greater freshwater availability has been recognised around 3240 BC and shortly before 2610 BC.

Here we discuss about the variation in springs water budget of Ariscianne marsh in relation to charred wood remains identification and their $\delta^{13}C$ values (by IRMS techniques) in order to track possible micro-climatic variations (humid *vs* arid phases) in South-Eastern Italy during mid-Holocene period.

Key-words: Ariscianne marsh, Plant remains, Carbon isotopes, Palaeoclimate

[1] Section 4, Poster

PEDOANTHRACOLOGICAL CONTRIBUTION TO NATURAL FOREST ASSESSMENT ILLUSTRATED BY THE CASE OF ANCIENT FOREST HISTORY STUDY IN THE FRENCH SOUTH ALPS (QUEYRAS) [1]

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In the current topics of biodiversity loss and with current vegetation change, the notion of level of natural forest is very important. This notion allows us to determine the degree of proximity between the current state of vegetation and the reference ecological system. With that, we can determine the consequences of local disturbances on the global evolution of the ecological system which is in question since the last glaciation. In this frame, the definition of the reference ecological system is crucial. To determine this, many tools are usually used, like dendroecology, volume and state of deadwood or palynological data. Important data can be provided by the pedoanthracological approach. Pedoanthracology allows to combine long time scale with century time scale, and to combine global space scale with local space scale, and thus allows us to ameliorate the definition of the reference ecological system. Today, we know that human activities have often a very important role in vegetation change. Human activities are one of the main disturbances on vegetation. So, to study the evolution of the local forest dynamics, specifically in terms of species composition and space distributions, it is very interesting and relevant to work with one scientific tool, like pedoanthracology, which is directly the result of the disturbance occurrence (fire). Moreover, we know that human used fire to manage landscapes.

Thus, we make one pedoanthracological study for help to the natural forest assessment of two sites of subalpine ancient forests in the French South Internal Alps. On each area (Lourette and Marassan) we tried to determine to what extent this approach can provide information usable for levels of natural versus managed or disturbed forest. After charcoal extraction from our 10 profiles (5 per site) and with information obtained in terms of species composition (five species in all: *Larix decidua*, *Picea abies*, *Pinus* type *sylvestris*, *Pinus cembra*, *Ericaceae*), space distribution and past vegetation dynamics (based on 9 AMS radiocarbon datations) proved that pedoanthracology is a very useful and reliable tool for proportion of natural forest analysis. Particularly, it gives specific palaeoecological indications on the Holocene time scale and the ligneous vegetal community space scale. Concretely, we have shown locally the early role of *Pinus uncinata* and *Larix decidua* (with oldest datation for this two species in the French South Alps), the Holocene dynamic of *Pinus cembra*, the late installation of *Picea abies*, and we raise questions about local Holocene dynamic of *Abies alba*.

Additionally, the pedoanthracological approach allows an interesting opening in terms of interdisciplinary and multidisciplinary studies, which is an indispensable approach for the level of natural forest assessment.

Key-words: Wood charcoal, Naturalness, Holocene, Vegetal community, Space and time scale

[1] Section 3, Oral

DISTURBANCES AND VEGETATION DYNAMICS IN NORTHERN GERMANY AS DOCUMENTED BY ANTHRACOLOGICAL AND DENDROECOLOGICAL APPROACHES [1]

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One Forest, or one landscape, is not one isolated and fixed entity, but a complex, dynamic, and global system. So, their current state is the result of ecological mutual interactions processes at different levels of ecological systems and along different timescales. One of the main dynamic drivers of the ecological systems is disturbances. This process allows a perpetual space and time resumption of vegetation dynamics, based on their occurring regime. Today, we know this process well and we know that human activities are one of the main disturbances on ecological systems. But of course, locally many important questions remain. For example: what are the consequences of human activities on forest tree species space distribution and composition?

For this reason, multidisciplinary and interdisciplinary approaches are the best scientific approaches to study ecological systems. That is the aim of the graduate school "Integrated Studies of Human Development in Landscapes" at Christian-Albrechts-Universität of Kiel which includes different disciplines of arts and humanities and natural sciences.

Our study takes place in this conceptual frame. We study disturbances and vegetation dynamics in northern Germany during the Holocene and compare this with the current state of vegetation and landscape to gain information for forest management and conservation. For that we use three different scientific tools: 1) micro-charcoal analysis, 2) pedo-anthracological analysis, and 3) dendroecological analysis. These tools give data that are different, but complementary, in terms of time and space resolution. Moreover, the three scientific tools are directly based on the disturbance notion. Indeed, they are based on the occurrence of disturbance events because their data recordings are the result of disturbances. For example charcoals in the soil and charred particles in sediments (anthracological data) are the result of fires. This connects tightly with the human role on Holocene vegetation dynamics (human use fire since the Neolithic to maintain the landscape open, *e.g.* for pasture).

Thus, with all this information we obtain a data matrix with precise information for time, space and source of disturbances, which is the result of the multidisciplinary approach. Then, we can compare the results with the current state of vegetation and its management, and offer information for local forest management. So, for todays work on biodiversity conservation there should be a multidisciplinary approach that takes care of ecological dynamic process in time and space.

Key-words: Disturbances, Holocene, Multidisciplinary approach, Anthracology

[1] Section 3, Oral

THE USE OF WOOD IN ARGARIC SETTLEMENTS OF THE SOUTH - EASTERN IBERIAN PENINSULA [1]

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The settlements of the Argaric culture that developed in the South-Eastern Iberian Peninsula during the Middle Bronze Age had in most cases 1 or 2 levels of generalized fire. These fires destroyed the habitat, and in some cases the village was reshaped and in some cases abandoned. The largest of these fires, whether provoked or chance, surprised the inhabitants of the village, who were forced to hurry away from their houses. This fact has major implications for the knowledge of the plant environment and of its utilisation by man. Some of the utensils and materials went directly from a systemic context of use to an archaeological context without other depositional processes intervening, as in the case of wastes and abandonment. Therefore the use inferences are direct and the economic conclusions are important, although the carbonization of all the vegetal materials causes difficulties in identifying their origin. However, the differences in sizes and features of the carbons according to whether they correspond to hearths, beams, posts, tools, etc. can help define their provenance.

In these settlements, we have determined the plant species used for diverse uses:

- Combustible items for domestic hearths and foundry ovens.
- Construction materials in the form of posts, beams, walls, and roofs.
- Utensils and tools for daily use.
- Objects or materials used in funerary rituals.
- Baskets and containers.

This study reveals part of the technological process of wood working, confirming the development of carpentry in these settlements. Thus, the study of the remains of basketry, primarily esparto, shows a varied range of techniques and items, such as rope, baskets, and containers.

All this variety of trees, shrubs and herbaceous species used for the different activities of daily life and that the environment offered expresses an intimate knowledge of and relationship with the plant environment. The species most used in everyday work came from the immediate surroundings, while the radius of collecting the plant materials covered a larger territory for more special elements.

Key-words: Anthracology, Argar Culture, Bronze Age, South-Eastern Iberian Peninsula

[1] Section 4, Poster

ANTHRACOLOGY AND CHARCOAL MAKERS' KNOWLEDGE USED AS TWO TOOLS FOR THE HISTORY OF A CHARCOAL PRODUCING FOREST IN THE UPPER DORDOGNE VALLEY (FRANCE, AUVERGNE - LIMOUSIN) [1]

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The study of the charcoal producing forest of the upper Dordogne valley, is associated with a Collective Project of research called "geohistory and geoarchaeology of the Limousin foresters country" led by Geolab, a geography laboratory, and supervised by Mr Philippe Allée.

The upper Dordogne valley is a unique massif of 100,000 hectares of sloping forests situated in the French countries of Auvergne and Limousin. This wide natural territory offers a very interesting environment for the bio-geographical approach but has a badly-known historical context.

Indeed, this forest was exploited during the Modern Times for its charcoal which was forwarded via the Dordogne River to the Bordeaux's economical basin.

Everywhere in these sloping forests the vestiges of this activity are present. Thousands of charcoal boards form our archaeobotanical corpus.

With the first anthracological results made on remains of this charcoal burning activity, we can interpret a continuance in the arboreal composition of the forested landscape during the past three or four centuries. In this case, anthracology allows to thrash out the history of the tree population dynamics, as this woodland composition could have been generated by the managing for charcoal.

Besides that archaeobotanical approach, collecting authentic accounts from the last "charcoal burners" of our surveyed land backs up in our interpretation of the natural remains: the charcoal kilns.

Key-words: Woodland, Anthracology, Charcoal kilns, Charcoal burners, Dordogne Valley



[1] Section 4, Oral

CHARCOAL ANALYSIS OF THE ARCHAEOLOGICAL SITE OF IRIKAITZ (ZESTOA, BASQUE COUNTRY, SPAIN) [1]

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We present the results of the charcoal analysis of the archaeological site of Irikaitz (Zestoa, Basque Country, Spain). This is an open air site with an interesting archaeological sequence which includes Lower Palaeolithic, Upper Palaeolithic and post-Palaeolithic, the only site so far with Lower Palaeolithic occupations in primary position in the Basque region. Besides, archaeobotanical studies of early chronologies in the Iberian Peninsula are particularly scarce.

Irikaitz adopted from the beginning of the excavation a systematic sampling strategy and recovery methodology through flotation in order to retrieve all types of plant macro-remains. Some samples have also been hand-picked in situ.

Macro-remains recovered at the site present a very good preservation. 2878 charcoal fragments have been analysed. The most important taxon in all samples is *Quercus* subgenus *Quercus* (deciduous oak). Some species possibly linked to wet soils along streams are also very important, such as *Corylus avellana* (hazel), *Salix* (willow), *Fraxinus excelsior* (ash), etc. Taxa linked to shrub and open communities have also been identified (*Ericaceae*, *Leguminosae*). The general results suggest species living under mild climatic conditions.

Key-words: Charcoal analysis, Carpology, Macro-remains, Lower Palaeolithic

[1] Section 4, Poster

TIMBER USE IN THE PUBLIC AND PRIVATE STRUCTURES OF THE LATE CHALCOLITHIC 5 (3300-3000 B.C.) AT ARSLANTEPE, MALATYA (TURKEY) [1]

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Arslantepe is an archaeological site located close to the Euphrates River, in the plain of Malatya, in Turkey. The site is an anthropogenic hill, a mound (*tepe* in Turkish), 30 m high and 4 hectares wide. The long and complex stratigraphic record of the mound was formed by superimposed towns and villages built during millennia. It was almost uninterruptedly occupied from the Chalcolithic (4250 BC) to Roman and Byzantine ages (4-6th century AD). Many populations followed each other on the *tepe*.

In the final centuries of the fourth millennium (3300-3000 BC) a huge monumental public complex composed by two temples, representative rooms, areas for discarding administrative materials and distributive storerooms, a courtyard, all flanking a long corridor, was built at Arslantepe, constituting the first known example of a palatial complex in the Near East. Only few seeds of legumes, few tens of badly preserved and fragmented wheat caryopses and some grape pips, either of wild or cultivated type, have been found sieving huge quantities of sediment. Hundreds of hulled, many-rowed barley caryopses were recovered from waste places or corridors and from an open area just outside the palace gate. This absence cannot be fortuitous; there must have been some storage bins that haven't yet been discovered.

Two temples were excavated; in temple B, large amounts of big charred wooden beams, some posts and other wooden structures or objects were found *in situ*. Charcoal from the rooms devoted to the administration and management of public and consumer goods have been studied as well.

Besides the palace structures, few élite houses belonging to the same period, have so far been excavated, two of which containing plant charred macro-remains. Charcoal data are presented by taking into consideration the single functions of the public (religious or secular rooms) and private (élite houses) structures.

More than two hundred samples of charcoal have been recovered in temple B (Sadori *et al.*, 2008) for a total weight exceeding 30 kg. They were, in order of decreasing amount, *Alnus, Pinus sylvestris/montana* gr., *Juniperus, Populus, Ulmus, Fraxinus, Rosaceae maloideae,* deciduous *Quercus*. Also some monocotyledonous structures of reeds ascribable to *Arundo*, which were probably used for the roof construction, were found. It is clear that the choice of timber is due to the architectural features and use destinations of the single rooms of the temple structure.

The excavation of secular rooms provided a good amount of charred woods (more than 2 kg) and small amounts of seeds, the only exception being some hundreds caryopses of barley. The same taxa of the temple have been found, excepting rosaceans and monocots. In this functional sector charcoals of *Populus* and deciduous *Quercus* are the most abundant.

In the two élite houses with charred wood remains (slightly exceeding 2 kg), only *Alnus*, *Populus*, *Pinus sylvestris/montana* gr., and *Fraxinus* have been found. Among the four taxa, only the two first mentioned have been found in high quantities, the other ones being less than 1%.

Considering the technological properties of the single taxa, neither *Alnus*, probably preferred for its high trunks, nor *Populus*, probably locally abundant, are generally considered as a good timber for construction; considering the archaeological phase in its complexity, they are the most abundant and both riparian trees. *Pinus* probably presents the best characteristics, amongst the wood found, for construction purposes, but it was probably less available than the other trees in the area around the site (nowadays being mountain pines restricted to the Taurus mountains), as it is used for few beams in the temple and only sporadically present in other areas; *Juniperus* is likely to be the most precious, as it is a slow growing plant, mainly used in a lateral room of the temple. The other exception is deciduous *Quercus* wood, which was used only in the rooms of the palace with administrative function.

[1] Section 4, Poster

The comparison of charcoal from previous and following levels of the *tepe* will help to understand if the use of different timbers was intentional and determined by both constructive and prestigious needs, or by the availability in the area at that time.

Key-words: Arslantepe, Late Chalcolithic 5, Charcoal, Palace, Houses

SADORI L., SUSANNA F. & BALOSSI RESTELLI F., 2008. Collapsed beams and wooden remains from a 3200 BC temple and palace at Arslantepe (Malatya, Turkey). *In:* FIORENTINO G. & MAGRI D. (eds), *Charcoal from the past, Cultural and Palaeoenvironmental Implications*, BAR International Series, Oxford: 103-116.

ANTHRACOLOGY OF LINEARBANDKERAMIK SITES IN MIDDLE-BELGIUM: NEW DATA [1]

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This presentation aims at reviewing the knowledge of the environment of the first farmers occupying the loess belt of Middle-Belgium at the very end of 6th millennium BC. Until recently, few anthracological analyses have been carried out in this region.

In the late 1990s, construction of the TGV line between Brussels and Liège led to the excavation of several Linearbandkeramik (LBK) sites in Hesbaye. Anthracological analyses of these sites are currently being undertaken for a PhD thesis (University of Paris 1, RBINS). This paper will concentrate in particular on the data from Fexhe-le-Haut-Clocher "Podri l'Cortri". Preliminary results indicate that the charcoal assemblage is quite poor in taxa (only 10) and is mostly composed of *Fraxinus* (ash) and *Quercus* (oak), followed by *Corylus* (hazelnut) and Pomoideae.

Furthermore, this LBK settlement has a distinctive organisation, with occupations both outside and inside a ditched enclosure. The occupation outside is earlier and the occupation inside is later. These two areas produced different charcoal assemblages, enabling comparison through time. It can be recalled here that the LBK in Hesbaye lasted about 200 ^{14}C years.

What do we know about the environment settled by LBK people? To what extent did their activities have an impact on their surroundings? How did this population exploit forest resources? This small cluster of sites provides new data to address these questions.

Key-words: Middle-Belgium, Hesbaye, Linearbandkeramik, Palaeoenvironnement, Forest management

[1] Section 4, Oral

PALAEOENVIRONMENTAL RECONSTRUCTION DURING THE LATE HOLOCENE IN THE ARARUAMA REGION (SOUTHEASTERN BRAZIL) BASED ON ARCHAEOLOGICAL CHARCOAL [1]

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The "Atlantic Forest", the second largest Neotropical rainforest, just after the Amazonia, is considered as a biodiversity hotspot. Different facies of this forest once extended almost continuously along the Brazilian coast, occupying the crystalline coastal plains and the foothills and Atlantic slopes of the Brazilian coastal mountain ranges up to 2000 m. Endemism in trees is particularly high, reaching more than half of the species. In spite of its great ecological importance, very few floristic and phytosociological studies have already been done, and palaeoenvironmental records are virtually inexistent. Morro Grande site, situated in the Araruama region, southeastern coast of Rio de Janeiro State (22°47'07"S, 42°21'49"W), is in the Atlantic Forest phytosociological domain. It is attributed to proto-Tupinambá agriculturalist and ceramist populations, recognized by producing typical polychromic ceramics beautifully decorated on red, black and white colours. The site covers an area of about 90,000 m^2. Archaeological excavations, made along several stages of field work since 1993, identified five stratigraphic layers in different loci. The occupation level attains 0,60 m of thickness, within a sandy substratum. Charcoal from hearths was systematically collected during the excavation seasons, and kept for anthracological analysis and radiocarbon dating. A large charcoal sampling of dispersed and concentrated material was performed, aiming at anthracological studies. For that, all the sediments removed from locus 2 excavation area were dry- or water-sieved and charcoal pieces were collected with supple tongs. Three periods of occupation were identified at this site: 1) a first period dated between 2920±70 BP (3220-2840 cal BP) and 2600±160 BP (3000-2150 cal BP); 2) a second period dated at 1740±90 BP (1820-1390 cal BP); and 3) a third moment dated as 315±50 (TL) and 510±160 BP (750-0 cal BP). Only samples from the two earlier periods were available for anthracological analysis. Charcoal pieces were manually broken exposing the fundamental wood anatomical sections; sections were examined under a reflected light brightfield/darkfield microscope. Systematic determination was achieved using Atlas Brasil software, a reference collection (*cf.* Scheel-Ybert *et al.*, 2006), and the specialized literature (*e.g.* Metcalfe & Chalk, 1950; Détienne & Jacquet, 1983). More than 3000 charcoal fragments were analysed. Seventy-one taxa from several botanic families were determinated, *e.g.* Anacardiaceae, Annonaceae, Apocynaceae, Araliaceae, Bignoniaceae, Chrysobalanaceae, Combretaceae, Compositae, Euphorbiaceae, Flacourtiaceae, Lauraceae, Lecythidaceae, Leguminosae, Malpighiaceae, Melastomataceae, Myrtaceae, Ochnaceae, Rhamnaceae, Rubiaceae, Sapindaceae, Sapotaceae, Verbenaceae and Vochysiaceae. All identified taxa are common in the Brazilian Atlantic Forest, except for *Laguncularia racemosa*, typical of the mangrove. Leguminosae species are clearly dominant in the anthracological record. This family is still, at the present, frequently dominant in the Atlantic Forest, either in number of species as of individuals (Vaz, 1992). The analysis of dispersed charcoal demonstrated the permanence of the Atlantic Forest in the region between 3220 and 1390 cal years BP. In addition, analysis of concentrated charcoal allowed the identification of ritual funerary hearths, as well as of a probable specialised feature for cooking ceramics.

Financial support: CNPq, FAPERJ.

Key-words: Palaeoenvironment, Rainforest, Neotropics, Archaeobotany, Charcoal

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[1] Section 4, Poster

CHARCOALIFIED WOOD REMAINS FROM THE EOCENE OF SÃO JOSÉ DE ITABORAÍ BASIN, SOUTHEASTERN BRAZIL [1]

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Despite being one of the smallest Brazilian sedimentary basins, the São José de Itaboraí basin (Rio de Janeiro State, Southeastern Brazil, 22°50'26.46"S, 42°52'43.89"W) is internationally recognized by its rich fossiliferous contents, which include the most ancient record of Cenozoic continental fauna in Brazil. Palaeobotanical studies, however, are still extremely rare. A palynological study revealed several taxa related to coal deposits dated to the Early Eocene; a fossil wood from the same stratum was identified as Bombacaceae (*Quararibeoxylon*) (Mussa *et al.*, 1987). In addition, Myrtaceae leaves attributed to *Psidium* and Ulmaceae fruits identified as *Celtis* were recorded in travertines from the Upper Eocene. Research activities in this region were significantly lowered since the late 1980s, because of the flooding of the basin, which precluded the access to most outcrops. However, several samples are deposited in the Palaeobotany Collection at the National Museum, Federal University of Rio de Janeiro (Brazil), comprising either petrified or charcoalified material. The occurrence of coal deposits in this basin is mentioned by several authors (*e.g.* Mussa *et al.*, 1987). An ankaramitic lava flow at the northern border of the basin was dated as Early Eocene (52.6G2.4 Ma, K/Ar age) (Sant'Anna *et al.*, 2004). Charcoalified wood material was found immediately underlying these deposits, their origin being probably associated to the volcanic activities. The analysis of one of these samples, consisting in numerous wood pieces measuring between 0.5 and 2.5 cm, disclosed a very well preserved wood anatomy. Anatomical description and morphometry were performed under a reflected light brightfield/darkfield microscope according to international criteria (IAWA Committee, 1989). The three fundamental wood sections were examined, after manually fracturing the fragments. All pieces belong to the same taxon. The wood is diffuse-porous, with growth rings absent or indistinct; vessels in random arrangement, mostly solitary (64%), but also in multiples of 2 (29%) and 3 (7%); vessels tangential diameter 100 (70-120) μm; 8,2 (6-10) vessels per square mm; tyloses absent; perforation plates simple; vestured alternate intervessel pits, measuring 4 (2,5-6,5) μm in tangential diameter; vessel-ray pits similar to intervessel pits; paratracheal parenchyma lozenge-aliform; homogeneous rays 1-2-seriate, non-storied; very thin fiber walls. Wood characters allow attributing this wood to the Leguminosae Mimosoideae, having strong affinities with species from the genus *Inga*, which is presently characteristic of forest formations. Leguminosae is the plant family with the greater and more diversified fossil record (Wheeler & Manchester, 2002). However, a preliminary bibliographic research suggests this could be the most ancient known record for an *Inga* species. Identification of a single sample does not allow a reliable palaeoenvironmental reconstruction, but the occurrence of this taxon, along with its anatomical characters, point to a tropical climate and a forested environment in the studied area during the Early Eocene. The analysis of other samples shall contribute to a better characterization of the past environmental conditions in this region, as well as provide important information on the evolution of tropical plant taxa.

Financial support: FAPERJ.

Key-words: Pre-Quaternary charcoal, Eocene, Leguminosae, Palaeoenvironment, Palaeobotany

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[1] Section 2, Oral

CHARCOALS FROM POSSIBLY THE WORLD'S OLDEST GOLD MINE IN SAKDRISSI (GEORGIA) [1]

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In 2004, German and Georgian archaeologists discovered what may be the world's oldest gold mine, located at Sakdrissi, about 50 kilometres southwest of Tbilisi in the Republic of Georgia.

Thomas Stöllner and Andreas Hauptmann of Ruhr University in Bochum, Germany, and Irina Gambashidze, an archaeologist from the Centre of Archaeological Studies in Tbilisi, dated the mine to the third millennium BC. Archaeometrists have tracked the gold in museum artefacts to the gold from this mine.

Stratigraphically determined charcoal pieces were collected from a total of eight mine pits, which were exploited on the surface, and mine shafts that were up to 20 meters deep.

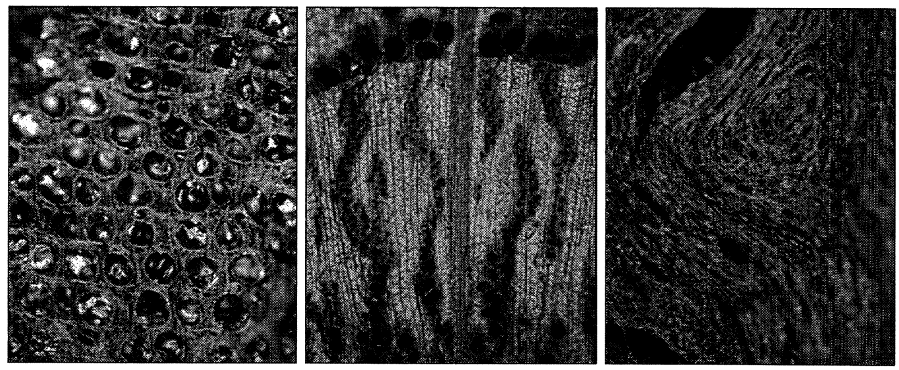
More than 2000 charcoal pieces were analysed. It was difficult, but in most cases possible, to identify special anatomical forms, such as reaction wood and curl wood, which is mechanically more resistant because of its thick-walled tracheids. *Quercus* sp. L., subgenus *Quercus* Oersted, (most probably *Quercus petraea*) dominates, making up over 90 % of the particles, followed by 12 other genera or species. The analysis aims at establishing the use of the wood as a fuel for "fire setting", the selection of stem wood and branch wood and the quality of the wood, as well as to reconstruct the vegetation at the time of the ancient mining. The present material particularly illustrates the difficulty of determining wood right down to the species level: *e.g.* in *Staphylea* sp., do we have different species or do we just see individual variations?

Key-words: Charcoal, Caucasus, Gold mining

Quercus sp.

From left to right:

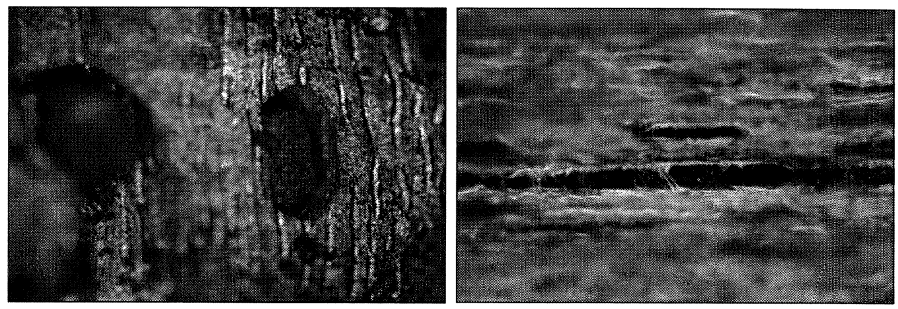
- stem wood
- branch
- curl wood



Staphylea sp.

From left to right:

- insect gallery
- fungal hyphae in vessel



[1] Section 4, Oral

ANTHRACOLOGICAL ANALYSIS FROM A MINING SITE IN THE EASTERN ALPS TO EVALUATE WOODLAND USES DURING THE BRONZE AGE [1]

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The palaeoecology of prehistoric mining activities in the Alps is poorly known. In the course of the large-scale project "HiMAT - The history of mining activities in the Tyrol and Adjacent Areas: Impact on environment and Human societies" a specific project part is up to subsistence strategies of prehistoric mining areas and focuses on woodland uses by pollen and anthracological analyses during the Bronze Age. This case study deals with the exploitation of timber in the vicinity of a Bronze aged settlement area in the Montafon, Eastern Alps. A fortified hilltop settlement and in its vicinity an additional settlement site were excavated in several archaeological campaigns since 2000. The settlement activities date from the early to the late Bronze Age and are associated with copper exploitation in the adjacent ore deposits. The studies on uses of wood by anthracological analysis were conducted on 16 systematic soil samples out of the archaeological excavations. This analysis is complemented by pollen analyses from nearby mire. The anthracological analysis ordered on a historical basis reflects the succession over time. During the early Bronze Age a spruce (*Picea*) forest mixed with beech (*Fagus sylvatica*) and maple (*Acer*) was dominant. Later the occurrence of pioneer species of birch (*Betula*), hazel (*Corylus avellana*) and rowan (*Sorbus*) indicates an early secondary successional stage. According to the size, curvature and numbers of annual rings of the charcoal fragments primarily branches and twigs of trees were gathered for fuel. The high deformed structures of the wood suggest that wet material was burnt at high temperatures. The complementary palynological record documents an immense demand on farming land or timber by the sudden decrease of spruce (*Picea*) and fir (*Abies*) linked to an increase of grasses (Gramineae) and cultural indicators in the pollen diagram. The extensive clearances, which match recent dimensions, happen within fifty to hundred years. They are superseded by a phase of woodland regeneration lasting one hundred years. Especially the bipartite middle Bronze aged clearances give an idea of ancient woodland uses. The first clearance is followed by a spread of the pioneer species birch (*Betula*), hazel (*Corylus avellana*), pine (*Pinus*), juniper (*Juniperus*) and then spruce (*Picea*) and fir (*Abies*). According to the chronology of events this forest succession lasts fifty years. Then a continuous woodcutting occurs for hundred years. Now the felled trees are not only spruce (*Picea*) and fir (*Abies*) but also pioneer species (*e.g. Pinus*), which induce that the coniferous forest was already thinned out in previous times. In this connection an extensive cyclic utilisation of the high altitude forest is suggested.

Key-words: Bronze Age, Anthracology, Woodland uses, Copper ore mining, Alps

[1] Section 4, Oral

CHARCOAL IN DEEP TIME AND THE ROLE OF FIRE IN EARTH SYSTEM PROCESSES [1]

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Fire has been an integral Earth System Process for at least 420 million years. Since the late Silurian, when smouldering fires charred a predominantly rhyniophytoid vegetation, wildfires have been documented in most terrestrial biomes and now, often at the hands of man, control the health and stability of many. The presence of charcoal in the fossil record acts as a proxy through which it is possible to track the changing occurrence and impact of fires in this diverse range of ecosystem settings. As charcoal frequently exhibits exceptional preservation and is often readily isolated by maceration, it not only acts as a proxy for wildfire activity but is a valuable palaeobotanical resource, providing both morphological and anatomical data. Fire systems are governed by complex suites of conditions. However, when considered over geological time, at least in the Palaeozoic, atmospheric oxygen concentration appears to be the overriding factor governing fire frequency. Our earliest records of wildfire come from the late Silurian and early Devonian (420-400 million years ago) but evidence of fire through the Devonian (400-350my) is rare possibly because of low atmospheric oxygen. Atmospheric oxygen levels are thought to have risen rapidly through the Carboniferous and Permian (350-250 my) and this coincides with the spread of fire into a range of environments from lowland tropical mires to floodplains and to upland regions. Fire is abundant through the Cretaceous but the claim of a global wildfire as a result of an impact at the end of the Cretaceous is disputed. Fire occurrence may, however, have played a role in the rapid global warming at the Palaeocene-Eocene boundary. Although fires are influenced by atmospheric composition they also have the potential to influence climate, both it and through it. Fires also influence other processes, most notably in sedimentary systems, as it has been shown that fire events greatly increase the potential for the erosion of terrestrial sequences. The full impact of fire related erosional/depositional systems has yet to be fully appreciated but, in combination with its influence on the atmosphere, climate and the evolution of plants and terrestrial ecosystems, wildfire must be considered a significant Earth System Process.

Key-words: Fire, Atmosphere, Charcoal, Ecosystems, Climate

[1] keynote

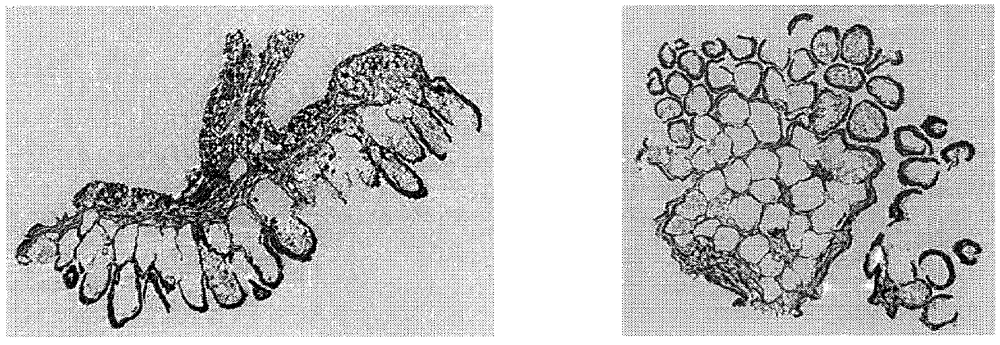
THE USE OF SYNCHROTRON RADIATION X - RAY TOMOGRAPHIC MICROSCOPY (SRXTM) IN THE STUDY OF FOSSIL CHARCOALIFIED PTERIDOSPERM FERTILE ORGANS [1]

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Abundant charcoalified pteridosperm pollen organs, ovules and cupules have been recovered from Late Viséan (Mississippian) limestones from Kingswood, Fife, Scotland that show a hitherto unknown diversity, especially in pollen organ types. To overcome limitations of data collection from these fossils, which may be only a few millimetres in all dimensions, we have used a combination of scanning electron microscopy (SEM) on uncoated specimens using low vacuum and backscatter electron imaging together with Synchrotron Radiation X-ray Tomographic Microscopy (SRXTM) to study the fossils, utilising the 4S and TOMCAT beamlines at the Swiss Light Source. This technique has not only revealed the internal structure of the fossils, but has also allowed three-dimensional reconstructions that permit virtual dissection, allowing a much deeper understanding of their anatomy. We compare results using this technique to more traditional methods for a pollen organ and an ovule. A greater diversity of taxa has been recognised using this technique.

Key-words: Techniques, Fossil, Charcoal, Pteridosperm, Microscopy



SRXTM images of charcoalified pteridosperm pollen organ from the Mississippian (Carboniferous) of Scotland.
A. Virtual longitudinal section B. Virtual transverse section, images 5mm width

[1] Section 1, Poster

PENNSYLVANIAN EXTRA-BASINAL FIRES: EVIDENCE FROM COMBUSTION PRODUCTS PRESERVED IN A PENNSYLVANIAN CAVE FILL [1]

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In general, our understanding of ancient vegetation comes from plants living in lowland basin sites. These are the main areas of the accumulation of terrestrial sediments. Our understanding, therefore, of extra-basinal vegetation, and upland vegetation in particular, is limited. At the end of the Mississippian (320 million years ago), Lower Paleozoic limestones surrounding the Illinois Basin were karstified during a sea level low and during a wet climatic phase. During the subsequent early and mid Pennsylvanian (320-310 my), caves and fissures in these limestones were filled with clastic sediment eroding from the extra-basinal areas. Extensive caves with cave-fill deposits have been discovered north of the Illinois Basin within Ordovician limestones of the Galena Group in Morris County, Illinois. The sediments comprise coaly sediments at the base, sandstones, siltstones and fine clays at the top of the cave-fill sequences. The sediments contain abundant plants and arthropods. These are uncompressed and have undergone minimal thermal alteration. Charcoal occurs throughout the sedimentary sequences but becomes increasingly abundant near the top of the cave fills. The charcoalified plant assemblages in the upper part are dominated by cordaites and conifers. This floral assemblage is the remains of an extra-basinal, possibly upland, vegetation which was frequently ravaged by wildfire. The conifer leaves have stomata with overarching papillae, indicative of plants growing in drier climates. The sediments at the top of the cave fill sequences contain abundant poly-aromatic hydrocarbons (PAH) further attesting to the importance of wildfire in preserving this vegetation.

Key-words: Charcoal, Fire, Poly-aromatic hydrocarbons, Carboniferous, Paleokarst

[1] Section 2, Oral

ANTHRACOLOGICAL ANALYSIS FROM HIERAPOLIS (TURKEY): CHARCOALS IN THE RITUALS OF SANCTUARY OF APOLLO [1]

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Hierapolis of Phrygia has been centre of one of the greatest sanctuaries and oracular centres sacred to the god Apollo in Anatolia, from the period of her foundation with Seleucidis until to the following phases in Roman age and to the constitution of the important Byzantine centre. In the archaeological excavations of 2002, a particular area has been shown, to the NE of the Sanctuary of Apollo, said *ESCHARON*, characterized by levels and artificial archaeological tied to particular fire activities of clear cultual and ritual nature. Such levels were constituted by layers rich of ashes and charcoal remains contained in pits where the sediment of wall resulted to have been in a direct contact with some provoked combustions.

The context has been analyzed in microstratigraphical way in the attempt to reconstruct the dynamics of formation of this particular deposit through the investigation of charcoal remains.

The *escharon* results are constituted by a series of identical structures in negative (pits) filled of material such as ash and charcoal remains. The taxonomical analysis has allowed mostly underlining some specific differences in the spatial distribution of the two present taxa in the area: *Pinus brutia/halepensis* and *Prunus* cf. *dulcis*.

The distribution of the charcoal remains and the formalities of formation of the deposit seem to underline particular formalities and times in the execution of the rituals and they postpone the cult of Apollo to an Anatolian version in relationship to the presence of particular taxa.

Key-words: Hierapolis, Turkey, Cultual site, Sanctuary of Apollo, Anthracological analysis

[1] Section 4, Poster

WODAN: DATABASE FOR ARCHAEOLOGICAL WOOD AND CHARCOAL [1]

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Objectives:

This project is aimed at developing an archaeological wood and charcoal database: WODAN. This project was designed with the goal of archiving archaeological wood and charcoal data from Ireland in a manageable way. This three year project allows for incorporation of views from the sector into the conceptualisation of a central data storage or database. Year 1 is the design and feasibility phase, Year 2 is the creation of the database, while Year 3 will be the application and maintenance of the database. Funding was received for the first phase of work in 2008 from the Heritage Council under the INSTAR programme (Grant 16679). The database, once complete, will store published and unpublished material (when accessible), and will be updated annually with new data.

A second aim of the database project is to store results in a standardized manner that can be used for regional to continental scale analysis. The development of an international database requires the participation of wood and charcoal specialists internationally and will provide new opportunities for research and collaboration.

Method:

Questionnaires will be distributed to all people involved with excavated wood and charcoal in Ireland, to determine the viability of the project, and to assess the amount of unpublished material within Ireland. This will be followed by more detailed questionnaires regarding the various fields necessary within the database to be created. A working database model will be suggested in the autumn. The results of this year will be submitted to the Heritage Council in December.

Summary:

The feasibility study for the creation of an archaeological wood and charcoal database is a collaborative effort. The study is being carried out by the Discovery Programme (main investigator: Dr Ingelise Stuijts) and is supported by the Heritage Council. Collaborating partners are: IWAA (Irish Wood Anatomist Association), RACM (Dutch State Service for Archaeology, Cultural Landscape and Monuments, Dr Otto Brinkkemper) and DIT (Dublin Institute of Technology, John McAuley). Research assistants are Lorna O'Donnell and Susan Lyons. Discussion partners are BIAX-Consult (Netherlands) and Ranketing (Germany).

Further information can be obtained via website www.wodan.ie.

Key-words: Archaeology, Database, Charcoal, Wood, Standard

[1] Section 1, Poster

WOODLAND RESOURCES AROUND A LATE-MESOLITHIC SITE IN LOUGH KINALE, IRELAND [1]

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Derragh Island is located on the edge of Lough Kinale, in an area that has seen extensive environmental research since 2002. Excavations on this island have revealed the presence of Late-Mesolithic remains with good anaerobic preservations conditions for bone, charcoal, beetles, pollen and macro-remains. Other finds are lithics (chert and some flint). The site is put into further context by extensive peat stratigraphical research, geomorphology and soil studies.

This lecture presents some results from the wood and charcoal studies. The results suggest an episode of woodworking at this site. Combined with the information from other proxies the movements of Mesolithic people through the landscape can be followed. There is no doubt that Mesolithic people were versatile and well-adapted to the area, and moved around freely, making good use of the landscape resources. Understanding of the local landscape is shown as vital to interpreting an archaeological site and placing it within its wider context.

Key-words: Mesolithic, Woodworking waste, Pine tapers, Ivy

[1] Section 4, Oral

ON THE CONTRASTED ORIGINS OF HERBACEOUS PLANT COMMUNITIES IN EUROPE: A VIEW FROM THE SOUTH [1]

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Dry grasslands are considered to be the result either of land clearing in the Neolithic, grazing impact of wild herbivores in the Mesolithic or the installation of the Mediterranean climate in the South of Europe. For the first time, a study was carried out in the pseudo-steppic area of La Crau in South-Eastern France by using soil wood charcoal analysis, a technique in which charcoal found in the soil are identified and dated. Fourteen soil sampling and twenty three ^{14}C dating were realised. Our results showed that any species of ancient forests dominated by *Quercus ilex* were present at the end of the Neolithic and during the Bronze Age. Only earlier succession species such as *Phillyrea angustifolia* and *Prunus* sp. have been burnt in these periods. The others charcoal fragments identified from the Roman Empire, Middle-Ages and Modern Times periods seem to be correlated with human settlements (sheepfolds).

Key-words: Palaeoecology, Dry grasslands, Plant communities, Charcoal analysis, France

[1] Section 3, Oral

HOLOCENE FOREST COMPOSITION AND DYNAMICS FROM SOIL CHARCOAL OF A SILICEOUS FRENCH PROVENCE AREA (MASSIF DES MAURES) [1]

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The Holocene history of siliceous Provençal forests remains unknown. The main objective of this study was to reconstruct with high spatial accuracy pre-fire forest composition and post-fire forest dynamics at a given siliceous site based on a detailed study including the count, botanical identification and radiocarbon dating of the charcoal content in mineral soils. We analysed the charcoal assemblages of well-drained soils from five sites dominated by cork oak (*Quercus suber* L.) and chestnut tree (*Castanea sativa* Mill.) located in the Massif des Maures, in the North-Western part of the siliceous Provence area. Results show the importance of both *Quercus pubescens* and *Q. suber* in forest dynamics since more than 7000 BP, along with *Erica*. The native status of cork oak is been proved for the first time. Since 3000 BP, increase in human activities (fire, slash and burn cultivation) is responsible for forest opening and degradation along with decrease in *Quercus pubescens* whereas human activities contributed to the development of *Quercus suber*.

Key-words: Charcoal analysis, Post-fire vegetation dynamics, Holocene, Disturbance, Cork oak

[1] Section 3, Poster

ANTHRACOLOGICAL STUDY IN THE ZIWAY-SHALA LAKES BASIN, MAIN ETHIOPIAN RIFT (ETHIOPIA) [1]

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The Main Ethiopian Rift and specially its central section, the Ziway-Shala lakes basin, is globally considered as a reference area for palaeoclimatic reconstructions in the Tropics (Street, 1979; Gillespie *et al.*, 1983; Dagnachew Legesse *et al.*, 2002; Chalié & Gasse, 2002). A series of investigations, aimed at defining the stratigraphy and chronology of Late Quaternary sediments and at reconstructing landscapes and vegetation evolution in their interactions with climatic oscillations, were carried out since the nineties (Benvenuti *et al.*, 2002; Sagri *et al.*, 2007).

In order to create a better understanding of the local woodland environment during the Late Quaternary, an anthracological study, coupled with radiocarbon dating, was conducted following a pedostratigraphic approach.

The results obtained show the predominance of *Acacia* sp. in all the charcoal assemblages examined, pinpointing to a relative stability of the vegetation during the time interval considered.

Keywords: Ziway-Shala lakes basin, Late Quaternary, Vegetation stability

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[1] Section 5, Oral

FROM WOOD TO CHARCOAL, EXPERIMENTAL STUDY OF A TAPHONOMIC AGENT: THE COMBUSTION [1]

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The charcoal deposit as it appears in archaeological contexts is the result of successive taphonomic agents: intervening at many stages from the gathering of wood, to combustion and post-depositional processes. These taphonomic agents constitute filters between the past vegetation and the studied charcoal. Therefore, the interpretation of charcoal assemblages should take into account the potential deformation between the anthracological spectrum and initial burned wood.

This paper presents the methodological issues and the first results of an experimental cycle whose aim was to study one of these taphonomic agents: the combustion process. Does combustion involve differential preservation of burnt wood species? Does charcoal quantification reflect the real proportion of burned species? Is it necessary to define a correctional index for anthracological data?

In order to answer these questions, 110 experiments were carried out under standardized laboratory conditions and more than 295000 charcoal fragments were studied (counted and weighed by class of size). Such factors as humidity rate, wood density, or temperatures are often considered as having an active part in the fragmentation process of charcoal during combustion. As expected the results indicate a differential behaviour of species but which proved to be independent of the expected factors, tending to show that the parameters which interact in the combustion process are of different nature. These factors increase the difficulty to define a correctional index. Nevertheless, it seems that quantification of charcoal reflects in a satisfactory manner the initial proportion of each of the burnt species.

Key-words: Taphonomy, Experimentation, Combustion, Fragmentation, Representativity

[1] Section 1, Oral

UMM EL TLEL: ENVIRONMENT AND FIREWOOD USE BY HUNTER - GATHERERS DURING THE MIDDLE PALAEOLITHIC [1]

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The site of Umm el Tlel in Syria preserves well-defined Palaeolithic complexes that have been the focus of intensive archaeological and palaeoenvironmental research. The VII, VI4, VI3, VI2, VI1 and V2 Middle Palaeolithic complexes were sampled for anthracological analysis with the aim at studying the local vegetation in relation to the long-term use of the area by Pleistocene hunter-gatherers. The available charcoal results indicate the existence in the area of two distinct types of plant formations; open parkland-steppe with an arboreal component represented by *Pistacia* and gallery-forests growing in humid areas or along water-courses. The existence of open, quite dry formations around the site is in agreement with the TL dates from the relevant complexes, 75-70 ka BP, indicating the environmental conditions of the MIS 4. Moreover, the vegetation image formed by anthracology fits the chronologically broader palynological record from the site and points out the role of insect-pollinated species, *e.g.* the Labiatae, which is usually underestimated. The anthracological results allow us to put forward some hypotheses concerning hunter-gatherer activities related to firewood use and the availability of biomass.

Key-words: Steppe, Gallery-forests, Middle Palaeolithic, MIS4, Firewood

[1] Section 4, Poster

ARCHAEOLOGICAL CHARCOAL RECORDS: EXPERIENCE AND PERSPECTIVES [1]

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The main goal of this lecture is to remember the place and the contribution of the analyses of charcoal from archaeological settlements to our knowledge of the relation between man and its environment. Since the beginning, the discipline was linked with prehistory (Boucher de Perthes, 1864). We will treat the evolution of archaeological anthracology and its development through the third part of 20th century and get onto new perspectives in relation with the research engineering in next years.

Key-words: History of anthracology, New perspectives

[1] Keynote, Wednesday morning

RECONSIDERATION OF PEDOANTHRACOLOGY AND ITS METHODS [1]

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Nowadays, then the pedoanthracology is spreading, it seems convenient to consider some fundamental points concerning this discipline.

- Although its methodology can largely be applied to the archaeological layers, it also concerns soils and sedimentary deposits and not archaeological context.

- The pedoanthracological analysis implies an almost exhaustive recovery (until the minimal size of 0.4 mm) of charcoal and other charred plant tissues or organs. The study of charcoal collected by eye on a soil profile or during the incomplete treatment of samples not taken in this purpose (without exclusivity) is not a pedoanthracological study. During the sifting process, the floatation pulls out only a variable part of the charred material. It is important to extract heavy charcoal from sandy refuses.

- Identification is the fundamental stage of the methodological process. It is often difficult because of the weak size of charcoal (generally millimetre-length or sub-millimetre-length) and their deformation. Transversal plan is often useless and it is important to remove the most of deposits hiding the anatomical features. The anthracologist has to have a full knowledge of wood anatomy and must be able to use all the residual features observable on the sample, notably those of small size, like different types of pits on tracheary elements and their possible vesturing. In this connection, reference atlas relative to wood, are often inadequate and the anthracologist should establish its own collection of charred wood of woody species (anthracothèque). This collection will serve to make an anatomical data base for charcoal identification.

- The topographical position of the sampling determines the spatial precision of the analysis. Transports of charred material to downstream side by water and wind or strong convection plumes during fires are evident, but dispersal in the same height or upper is much reduced. This transport concerns other elements that the xylem.

To measure the mass of charcoal may allow comparisons between different soils and within the same profile. These comparisons can be made from the calculation of the different specific anthracomasses (AS: « Anthracomasse Spécifique », expressed in mg of charcoal by kg of grains of sediment lower than 5 mm). For example, the partial specific anthracomass (ASP: Anthracomasse Spécifique Partielle) refers to taxa identified, not identified and not recognizable charcoal. Some authors present results by means of an anthracological diagram. This type of presentation can mislead the not experienced reader who will intuitively convert the proportions of charcoals in relative phytomasses and vegetation.

The chances of the charcoal production and those of taphonomic processes do not authorize such interpretations, especially since in numerous soils exist chronological mixing. In this respect, to date a charcoal does not date the fire but the time of the development of the charred tissue. The same fire can carbonize the oldest heartwood and the young twigs of the even old tree. The clear dominance of a much reduced number of taxa (2 - 3 at most) can have a real meaning. On the other hand, the use of the frequency from several samples on the same site is completely justifiable. Nevertheless, only qualitative information deriving from the ecology of the taxa identified can allow reliable elements for vegetation interpretations.

Key-words: Methodology, Charcoal, Pedoanthracology, Ecology, Vegetation history

[1] Section 1, Oral

FIRST PEDOANTHRACOLOGICAL STUDIES IN THE GUINEO - CONGOLIAN FOREST (TOGO, WEST AFRICA) [1]

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Pedoanthracology was used for the first time in the region of dense forests of the Guineo-Congolian domain in West Africa. This study was carried out in South-Western Togo, in the region of the Akposo Plateau where six pedoanthracological pits were dug between 600 and 900 m a.s.l. Annual precipitation is about 1400-1500 mm with 2-3months of dry season. Vegetation consists in remains of drier type tropical rain forest with evergreen and deciduous trees (*Antiaris toxicaria*, *Milicia excelsa*, *Parinari excelsa*, *Erythrophloem suaveolens*, *Cola nitida*, *Ceiba pentandra*, etc.), savannas and forest-savanna mosaic. The region is affected by numerous agricultural fires (coffee and cacao plantations).

All the soils contain numerous charcoal fragments, sometimes until an important depth (4.7 m). Their identification will bring information about man-environment relationships during the last millennia, notably on the age of agriculture in these forested regions.

Key-words: Charcoal, Pedoanthracology, Ecology, Vegetation history, Togo

[1] Section 3, Poster

SOIL CHARCOAL ANALYSIS: A RELIABLE TOOL FOR SPATIALLY PRECISE STUDIES OF PAST FOREST DYNAMICS [1]

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Soil charcoal analysis (pedoanthracology) in an old subalpine forest in the Southern French Alps allows us to propose a reconstruction of the ancient woodland and to assess the role of anthropogenic fire in the forest dynamics. This research comprises high-resolution spatial sampling (five pits per 0.5 ha) where the aim was to assess the homogeneity of the results obtained by charcoal analysis at a small scale. The results demonstrate heterogeneous patterns of charcoal distribution in terms of quantities and anthracological assemblages. The high resolution data obtained from a multisampling strategy is more effective in the investigation of heterogeneity in this soil anthracological assemblage. In addition, it is apparent that care is needed in the interpretation of data derived from the analysis of just one sample. The radiocarbon dates obtained demonstrate that arolla pine (*Pinus cembra)* has been present since 7600 cal. BP and that larch (*Larix decidua*) was present in the area from *ca.* 6061 cal. BP. The identification of fir (*Abies alba*) at 1980 m a.s.l, dated to 5907 cal. BP, supports the long-term presence of this tree, as well as its ecological flexibility. Influenced by anthropogenic practices, the larch forest cover increased since the second half of the Holocene. However, today, owing to the abandonment of pastoral practices, the arolla pine has become dominant as it is favoured by vegetation dynamics, thus modifying forest structure and landscape.

Key-words: Charcoal analysis, High-resolution, Holocene, *Larix decidua*, *Pinus cembra*



[1] Section 3, Oral

THE "ALTAMIRA TERRITORY" REVISITED: LANDSCAPE AND WOODFIRE MANAGEMENT FROM ANTRACOLOGICAL STUDIES OF THE EL LINAR, CUALVENTI AND LAS AGUAS CAVES (ALFOZ DE LOREDO, CANTABRIA, NORTHERN SPAIN) [1]

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Charcoal analyses from the El Linar, Cualventi and Las Aguas caves are presented. These sites have recorded Upper Solutrean and Lower Magdalenian human occupations and are located on the Western Coastal Plain of Cantabria (Northern Spain) in the so called "Altamira territory", the eponymous cave being distant of 2 to 5 km from the caves concerned in this work.

Chronology obtained (18-14 kyr BP) place these archaeological deposits on the Upper Pleniglacial-Lateglacial transition.

Anthracological studies have revealed an open environment for the Cantabrian coastal plain characterised by pioneer taxa: *Juniperus,* Leguminosae (*Ulex, Cytisus*) and *Hippophae rhamnoides.*

Salix high values suggest an important exploitation of the valleys' woody resources in alternation with those from the coastal plain. These valleys located between the pre-littoral mountain ranges with an East-West disposition resulted in a *refugium* for other mesophilous taxa (*Quercus, Corylus* and probably *Betula*) identified by charcoal spectra.

Betula poor and discontinuous values recorded at this period are dramatically in contrast with those obtained in the 40-30 kyr BP Cantabrian human occupations. Beech data indicate its absence of the coastal plain and a diffuse location of some occurrences along these pre-littoral valleys between 18-15 kyr BP. From 14.5 kyr BP beech values become more relevant but are still low.

Anthracological data agree with palaeoenviromental conditions recorded in the SW Europe continental pollen deposits (Pyrenees, Northern Spain) as well as in the NW Iberian margin (MD 99-2331).

Key-words: Altamira territory, Charcoal, Anthracology, Vegetal landscape, Lateglacial, Woodfire management.

[1] Section 4, Oral

THE ARCHAEOBOTANICAL RECORD FROM SW SPAIN: HOLOCENE ENVIRONMENTAL CHANGES AND FIREWOOD USE AT THE PALMONES (ALGECIRAS, CÁDIZ) AND RETAMAR (PUERTO REAL, CÁDIZ) ARCHAEOLOGICAL SITES [1]

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Archaeobotanical records (pollen and charcoal analyses) from two archaeological sites on the Atlantic coast of Cadiz (SW Spain) were compared in order to establish the sequence of human occupation from the last signs of hunter-gatherer societies (Palmones site) to the first Neolithic communities (El Retamar site), and to provide a reconstruction of the environment.

The Palmones archaeological site (the Bay of Algeciras) contains a hunter-gatherer occupation level with an estimated chronology prior to occupation of the Retamar site (Bay of Cadiz). This latter, dated to around 6,780 BP (5,025 BC) was occupied by tribal Neolithic communities and contained evidence of domesticated animals.

The Palmones site pollen data indicate the existence of an open environment (NAP high values) characterised by dry conditions inferred from the composition of the herbaceous plants (*Artemisia*, Asteraceae, Poaceae, Caryophyllaceae, Fabaceae, *Rumex* and *Urtica*). *Olea* and *Pinus* suggest Mediterranean affinities. The presence of riverbank and aquatic taxa point to local humid conditions related to the proximity of water resources (the Palmones River).

Anthracological analyses from the Palmones site indicate the presence of an arboreal stratum, with deciduous *Quercus* (probably *Q. canariensis*), *Quercus ilex-coccifera*, *Pinus halepensis-pinea*, *Quercus suber* and *Fraxinus*, alternating with varied shrubs species comprising *Olea europaea* var. *sylvestris*, *Pistacia lentiscus*, *Phillyrea*, *Crataegus*, *Prunus*, *Erica*, *Cytisus*.

The Retamar settlement did not provide pollen data but the anthracological assemblage is characterised by *Olea europaea* var. *sylvestris* and deciduous *Quercus*, followed by Leguminosae, *Phillyrea* and *Pistacia lentiscus*.

Anthracological data obtained agree with the pollen record deposits of SW Spain. Nevertheless the different geographical position of both sites is responsible of biodiversity degree variations observed on the charcoal spectra. Mountain ranges separating Cadiz (West) and Algeciras (East) Bays have stopped high rainfall extent to the East causing the deciduous/evergreen *Quercus* fluctuations observed in both sites.

The use of wood from ignition species combined with those from slow combustion taxa is the best mixture to ensure optimum combustion processes and a good production of embers for open and unprotected cooking hearths such as those found in the El Retamar settlement.

Key-words: Palynology, Anthracology, South-Western Spain, Holocene vegetation dynamics, Woodfire management

[1] Section 4, Poster

CHARCOAL ANALYSIS OF LIME KILN REMAINS IN SOUTHERN FRANCE: AN ORIGINAL PROCESS OF MEDIEVAL AND MODERN TRADITIONAL LIME BURNING [1]

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In Southern France, little has been known concerning the techniques used for lime burning. Recent archaeological research (excavations and surveys) provides evidence of a new lime burning process using a small sole to shaft and high stokehole. These lime kiln elements have been recognized in sites such as Saint-Blaise-de-Bauzon (13th century, Bollène, Vaucluse), earthenware factory Favier (17th century, Montpellier, Hérault) and the Homme Mort Valley (17th century, Peynier, Bouches-du-Rhône). These new archaeological data allow the re-evaluation of the development of this activity and associated firewood management. Several kilns have been excavated in Lower Provence (France), especially in the high Arc Valley area, aiming at a better understanding of the links between kiln construction and architecture and fire control. A sampling protocol of charcoal has been defined, experimented and improved during excavation work. The careful excavation and sampling of the charcoal layers followed the microtopography of the kiln in order to identify the morphology / pattern of the fireplace. Fine sieving (0.2 mm mesh) allows the recovery of even the smallest charred biological remains (twigs, spines, leaves) and the reconstruction of the technical process of supplying the fire with wood. Charcoal analysis has taken in account diverse factors. After the anatomical identification of the species, all the specimens have been calibrated; statistical results thus obtained testify to the use of kindling wood (from scrub vegetation). The bark is often preserved allowing us to identify the cutting season. Further charred botanical remains (leaves and spines) were studied in Montpellier (Institut de Botanique) and point to the use of a taper at the bottom of fireplace to light the fire, at the very beginning of the burning. This process is well suited for a lime burning kiln provided with a high stokehole. This new conception of lime production leads to the re-interpretation of the results from old excavations all over the Western Mediterranean basin, especially in Tunisia and Central Italy.

Keywords: Charcoal, kilns, Southern France, Middle Ages, Modern Times

[1] Section 4, Oral

THE WOOD FUEL SUPPLY TO POMPEII 4TH CENTURY BC TO 79 AD: ECONOMIC, CULTURAL AND TAPHONOMIC CONSIDERATIONS [1]

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Four sites in Pompeii, excavated by three different international teams have provided a large charcoal dataset for a study of the wood fuel economy of the city c. 350BC to AD79. After analysis of over 3,000 fragments, a diachronic picture which is consistent across the four sites provides evidence of extensive use of *Fagus sylvatica* (beech) as the dominant taxon. This result suggests the presence of a sophisticated wood fuel economy for the city – even in the Samnite period, since the nearest source would have been at least 15 kilometres away by road (approximately one day's journey). Following Roman colonisation ca. 80 BC, the dominance of the city's use of beech remains, but is reduced. Wood fuel use shows an increase in diversity, especially in the use of orchard cuttings. This may reflect an increase at least in Roman farming practice and taste, and/or pressure on the main fuel supply. Most contexts are secondary reflecting average wood fuel use for heating and cooking over time. Some are associated with particular types of cultural activities, such as iron working, and ritual use. These show selection of higher quality woods (in the case of iron working) and special, sometimes fragrant woods, (in the case of domestic ritual). Taphonomic differences in the four subsets are seen, even within the one small city, depending upon a range of factors including: individual team excavation and recovery methods and micro-topographical site differences. Particular aspects of preservation of some of the excavated charcoals can be seen to uniquely contribute to archaeological interpretation. The research is approached from a strong archaeo-centric viewpoint. The author has had the privilege of returning each year for six years now to Pompeii to act as sole charcoal specialist and provide field support to excavators, and real-time identifications to aid archaeological interpretation. The study is ongoing and forms part of the author's doctoral dissertation. The work would not have been possible without the gracious consent of the *Soprintendenza di Pompei* to excavate the sites and to use the Environmental Laboratory at Pompeii; the provision of the charcoal by the excavation teams for analysis (and their permission to participate in excavation seasons): the Universities of Oxford, Bradford and Sheffield (UK); the Universities of Stanford, Michigan and Cincinatti (USA); and the support of the University of Sydney Carlyle Greenwell Bequest.

Key-words: Charcoal analysis, Pompeii, Wood fuel economy, Taphonomy, Archaeological interpretation

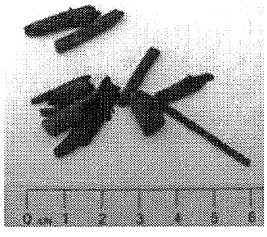


Figure (i) *Vitis*

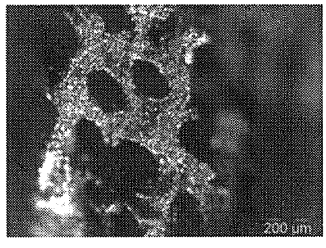


Figure (ii) *Vitis* sp. TS



Figure (iii) *Vitis* sp. TLS

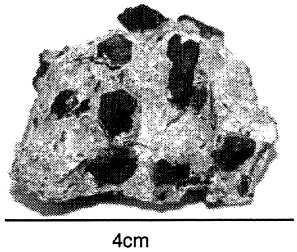


Figure (iv) *Fagus sylvatica* in lime

Fragile but almost perfectly preserved two- and three-year cuttings of *Vitis* cf. *vinifera* (Figures (i)-(iii)) and *Fagus sylvatica* embedded in lime (Figure (iv)), found in otherwise highly mixed secondary contexts, provide excavators with immediate useful interpretive detail, not necessarily available after packing and transport to a distant laboratory for analysis.

[1] Section 4, Oral

THE SETTING OF THE FRENCH MEDITERRANEAN PRIMARY FOREST AND ITS CHANGE DURING THE HOLOCENE: QUALITATIVE AND QUANTITATIVE CHARCOAL ANALYSES [1]

Jean-Louis VERNET

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The present state of the Mediterranean forest is generally well described on the basis of bioclimatic stages. These ecosystems are growing between 30th and 45th parallel from arid to humid ombro-climate and a large scale of temperatures (generally between +7°C to -10°C). In the South of France, qualitative evolution of the Mediterranean forest during the Lateglacial and the Holocene is to day well recorded. It begins with semi arid pre-forest and arid steppes from the Last Glacial Maximum to the beginning of the Holocene warming (late Palaeolithic and Mesolithic). Then, the setting of the primary Mediterranean forest during early and middle Neolithic is that of a meso-sclerophyllous deciduous and evergreen oak forest at meso-mediterranean stages, more later woodlands of *Pinus sylvestris/salzmanni* types and deciduous oaks at a supra-mediterranean stage. Afterwards, there is the development of secondary forest and matorrals with evergreen trees and shrubs, mainly evergreen oaks, at low altitude or open landscape with box tree at a supra-mediterranean stage. Holocene fires were recently recorded in limestone and dolomitic deposits and charcoal may be used in palaeo-forest studies. Quantitative information on the biodiversity will be discussed to understand these vegetation change especially related to climate. To compare, present meso-mediterranean oak forest, described as *Quercetum galloprovinciale,* includes 69% of sclero-mediterranean trees and shrubs. In the South of France, primary forest always includes sclero-thermophilous mediterranean trees and shrubs, between Mesolithic to Early Neolithic Cardial. Their frequencies are between 20% and 40% in continental area where deciduous mediterranean oaks were the main forest component (>50%). These results do not allow a simple explanation of change in Mediterranean biodiversity with a South-North gradient of mediterraneity. Indeed, some researchers relate the spreading of the evergreen oaks as a sign of the installation of the Mediterranean climate in the region. The setting up of these formations would spread gradually out from 10,000 to 3,300 BP from Southern Iberian Peninsula to the South of France. But early in the Holocene many places on the French littoral were in the thermo-mediterranean stage as comparable zones of Iberian Peninsula. This bio-geographic position was later disturbed by man. Recently biodiversity and climatic data are interpreted based on the isotopic ratio 13C/12C or 13C. Fluctuations in the 13C are generally studied on cellulose of dendrochronological sequences, allowing the recording of wet-dry variations. As regards charcoal, preliminary studies on *Pinus* type *sylvestris* were recorded on the total carbon giving the first information on dry-wet variations during the last 20,000 years. More recently, 13C measurements were made on charcoal of *Pinus* type *sylvestris* and *P. salzmanni.* In conifers 13C variations depend on dryness, the closing of stomata leading to an increase in 13C. In hardwoods, especially Mediterranean oaks, high values of 13C are also dependent on dryness. As the experimental protocol required the creation of a standard reference, several *Pinus sylvestris* three populations from supra-mediterranean Causse Méjean in the Southern French Massif Central were sampled. The 13C mean is –26.72‰ with a standard deviation of 0.238. I consider this present data as relatively 'wet'. Measurement of 13C in fossil *Pinus* charcoal was coupled with ^{14}C AMS dating. Thirty measurements were made. All 13C values are higher than those provided by the current reference standard with interesting variations between -26 (relatively wet) and 22‰ (dry). Fluctuations occurred during Little Ice Age (dry), Neolithic-Bronze (dry), middle and early Neolithic (wet), early Holocene (dry). Several examples and comparisons will be contributed to illustrate this synthesis.

Key-words: Charcoal analyses, Mediterranean forest, Biodiversity, Climate, 13C

VERNET J.-L., 2006. History of the *Pinus sylvestris* and *Pinus nigra* ssp. *Salzmanni* forest in the Sub-Mediterranean mountains (Grands Causses, Saint-Guilhem-le-Désert, Southern Massif Central, France) based on charcoal from limestone and dolomitic deposits. *Vegetation History and Archaeobotany*, 16: 23-42.

[1] Section 5, Oral

ANALYSIS OF CRETACEOUS CHARCOALIFIED WOOD FROM JAMES ROSS ISLAND, ANTARCTIC PENINSULA: PRELIMINARY RESULTS [1]

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2. Setor de Estratigrafia, Sedimentologia e Geologia Histórica, Departamento de Geologia e Paleontologia, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, CEP 20940-040 Rio de Janeiro, BRAZIL.

The Cretaceous period was characterised by a hot climate, with a wide latitudinal temperature gradient and warm poles. Forests grew in high latitudes (82°N and 75°S), inside the polar circles, and were very well adapted to a combination of two parameters not witnessed in any extant vegetation type: the polar light regime, characterised by dark winters and luminous summers, and the high levels of atmospheric carbon dioxide. The intense tectonic activity and volcanism experienced by the Southern Gondwana during this period eventually resulted in the breakup of the supercontinent. Factors related to the fragmentation of Gondwana and to the Angiosperms Cretaceous radiation had a key role in the establishment of disjunct patterns of plant groups in the Southern Hemisphere. The Antarctic Peninsula was crucial to this process, for it promoted a terrestrial connection to floristic exchange among Western (South America and Africa) and Eastern (Great Antarctica, Australia, New Caledonia, and New Zealand) Gondwana. The Antarctic Peninsula is an important fossiliferous area. Sediments from the North of the Peninsula have a rich assemblage of petrified and charred fossil wood with well preserved anatomy. Besides floristic reconstructions, charred fossils are an important source of data for palaeoenviromental and climatic reconstructions. Their study may contribute to the understanding of Angiosperm radiation patterns in high latitude areas of the Southern Hemisphere, supply data on the importance of natural fires for the Antarctic Peninsula Cretaceous ecosystems, and give taphonomic data on the preservation of different anatomical wood characters. The James Ross Island, in Northeastern Antarctic Peninsula, presents important Cretaceous fossiliferous outcrops. An expedition to this locality was held during the 2006-2007 austral summer by members of the Department of Geology and Palaeontology from the National Museum, Federal University of Rio de Janeiro, Brazil, in order to prospect macro- and micro-fossils in the Brandy Bay and Col Crame area, where Whisky Bay, Hidden Lake, and Santa Marta formations outcrop. These highly fossiliferous sedimentary rocks, formed in marine environments of a back-arc basin, are probably among the most significant Cretaceous sequences in the Southern Hemisphere. The field campaign was very productive, resulting in the collection of leaf impressions, fossil woods, and marine invertebrate samples. A particular highlight was the great quantity of charcoalified fossil wood collected. Most samples appear to be in a very good preservation state, allowing floristic characterization as well as palaeoenvironmental information. Most charcoal samples are secondarily mineralized, while those coming from Santa Marta formation look almost as recently charred material. These charred remains, produced by forest fires related to the volcanic events associated to the Antarctic Peninsula formation process, were probably transported by fluvial systems, gravitational mass wasting or pyroclastic flows to inside the Larsen back-arc basin, where they were fossilized. This study presents preliminary results of the analysis of approximately 200 charred wood samples collected from Whisky Bay, Hidden Lake, and Santa Marta formations. Charcoalified pieces, when possible, were broken by hand along the three fundamental wood sections; when secondarily mineralized, thin slides or polished sections were made. Most charred samples belong to Gymnosperms and basal Angiosperms groups; only one sample analysed so far belongs to a more evolved Angiosperm.

Financial support: CNPq, CAPES.

Key-words: Charcoal, Fossil wood, Cretaceous, Antarctic Peninsula, Palaeobotany

[1] Section 2, Oral

CARBON ISOTOPES ON WOOD MATERIAL: A TOOL FOR CHEMOSTRATIGRAPHY ? EVIDENCE FROM THE WEALDEN FACIES SEDIMENTS (MONS BASIN, BELGIUM) [1]

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3. Laboratoire de Paléobotanique, Université de Liège, Allée du 6 Août, Sart Tilman, 4000 Liège, BELGIUM.
4. Faculté Polytechnique de Mons, rue de Houdain 9, 7000 Mons, BELGIUM.
5. Geology, Vreij Universitaet van Brussel, Pleinlaan 2, 1050 Brussel, BELGIUM.

Carbon isotope ratios are a powerful tool reflecting geological events through their connection to the global carbon cycle. They are used as a potential chemostratigraphic tool for geological successions, including the main boundaries. Correlations are found through matching carbon isotope profiles in different sections from pelagic to continental environments. The reliability of carbon isotopes has been demonstrated for bulk rocks, pedogenic nodules, calcitic shells, dispersed organic carbon, but no systematic study has been done until now on fossil woods. A thick succession of the "Wealden" facies sediments of the Mons Basin (Belgium) crops out in the Danube-Bouchon quarry at Hautrage (Hautrage Clays Formation). This 235 m-thick succession encompasses mainly dark to grey clays and sands, rich in organic matter and fossil woods, deposited in an alluvial plain. The palynomorphs, including the primitive pollen of angiosperms, suggest middle Barremian to earliest Aptian age. We measured the carbon isotope ratios (110 levels) of dispersed organic carbon (DOC) and one fossil wood (WOOD) collected in the same geological level. We aim at comparing the two signals (DOC and WOOD) to have a direct comparison in a continental stratigraphic section. The ^{13}C of DOC and WOOD from the same geological level are significantly different (average difference about 0.9‰). The ^{13}C of the fossil-woods are usually more positive than the ^{13}C of DOC. The variability within the WOOD ^{13}C is more important than in the DOC ^{13}C. Four main hypotheses may explain these results. Firstly, the ^{13}C on DOC averages the isotopic signal of different compounds and tissues (leaves, wood, seeds) as they become mixed and dispersed. The ^{13}C on WOOD reflects the carbon isotope ratio of a small part of one single tree. It is known that a single tree is a complex system where we can observe ^{13}C variations over a range of 4‰. Secondly, there is strong ^{13}C variability between different species of plants. In Hautrage, several families were collected. Thirdly, diagenesis can affect the ^{13}C of the DOC and the various kinds of woods in a different way. Fourthly, the fossil woods may be reworked several times from more ancient geological levels, especially in the alluvial plain environment of Hautrage where thick levels of fluviatile coarse sands are observed. However, in the whole succession, both DOC and WOOD ^{13}C profiles show a positive trend. This can be due to several causes, including global pCO_2 variations and/or changes in bioproduction and/or other environmental conditions in the alluvial plain. This shows that carbon isotope profiles on wood material can be matched to carbon isotope profiles on DOC, suggesting that fossil woods are a powerful chemostratigraphic tool when sufficient samples are measured in the studied succession. Whenever possible a control of the wood taxon is recommended.

Key-words: Carbon isotopes, Wood, Wealden facies, Mons Basin, Belgium

[1] Section 1, Oral

4th International Meeting of Anthracology, Brussels,

Royal Belgian Institute of Natural Sciences, 8-13 September 2008

CHARCOAL AND MICROCHARCOAL : CONTINENTAL AND MARINE RECORDS

THE WORKSHOPS

Andrew C. Scott: Charcoal recognition / taphonomy
(Wednesday 10th, 9 - 12.30, room WiFi)

Mitchell Power: The importance of databases in anthracology and possible connection with other databases in Palaeobotany
(Thursday 11th, 9 - 12.30, small auditorium)

Freddy Damblon: International Association of Charcoal Research
(Thursday 11th, 17 - 18, Auditorium)

Workshop 1 on Wednesday 10th am.

CHARCOAL RECOGNITION / TAPHONOMY WORKSHOP

Led by Prof. Andrew C. SCOTT

Department of Earth Sciences, Royal Holloway University of London, E-mail:

This course, through lectures, practical demonstrations and exercises aims to introduce all those interested in charcoal to a range of topics, some of which may be familiar but also others that will be new. This is NOT a course on wood anatomy.

The presentation part of the workshop will outline aspects of charcoal formation (both natural and experimental), charcoal taphonomy, including the relationship of the vegetations that was burnt to the initial charcoal assemblage and consider the taphonomic processes leading to a final assemblage. This will be done using examples from recent fires and through experimentation (tank and flume studies). The ways in which charcoal assemblages are extracted from the field site and extraction in the laboratory will be considered in relation to additional biases. The range of charcoalified plant (and even animal) organs will be discussed and a wide range of study methods outlined (including Light Microscopy, Dark Field Light Microscopy, Reflectance Microscopy, Scanning Electron Microscopy and Synchrotron X-Radiation Micro-Tomography. Emphasis will be on the study of macro- and meso-charcoal (above 125μm). Finally there will be a consideration of the broad use of charcoal from plant evolution studies, fire history studies, vegetation studies, anatomical studies, utilization studies and the wider importance of charcoal for the Earth, Archaeological and Biological Sciences.

The practicals will use charcoal assemblages from a range of burnt vegetation collected within days of a fire and compared to assemblages that have undergone a range of taphonomic processes over weeks, months and years. Material will be used to compare methods of study in relation to interpretation. Fossil material will also be used to illustrate a range of problems with charcoal studies but also its broader potential. The practical session will be designed to be both interactive and illustrative and it is hope that this will give all participants new insights to the study of their own charcoal assemblages.

Wednesday 10th am. **Room Wifi**

9.10 - 10.10. Presentation 1.
10.10.- 10.30. Coffee and discussion.
10.30 - 11.30. Practical session, discussion and interaction.
11.30 - 12.30. Presentation 2, feedback and discussion.

Workshop 2 on Thursday 11th am.

THE IMPORTANCE OF DATABASES IN ANTHRACOLOGY AND POSSIBLE CONNECTION WITH OTHER DATABASES IN PALAEOBOTANY

Led by Prof. Mitchell POWER

University of Utah, Department of Geography, Salt Lake City, USA. E-mail: mitch.power@ed.ac.uk

The workshop will be devoted to the possibility of coordinating and homogenizing the diverse databases in different fields of research as palaeofire regimes, pedocharcoal, archaeocharcoal, pollen databases, etc.

Thursday 11th, am., Small auditorium

Workshop 3 on Thursday 11th pm.

Led by Dr. Freddy DAMBLON

Royal Belgian Institute of natural Sciences, Brussels, E-mail: Freddy.damblon@naturalsciences.be

Discussion on (and formation of?) an International Association for Charcoal Research (IACR)

Discussion paper by Andrew C. Scott and Freddy Damblon

Preamble: importance of the name.

Although it was considered that the term 'Anthracology' should be used (as for this conference) this term is either poorly known or not known at all amongst many charcoal workers worldwide. It has been tended to be used predominantly by European and some other Archaeologists . To allow for a broader reach, it is suggested that we use the term charcoal research as this would be clearer to the wider scientific community.

Aim:

To coordinate and promote charcoal research internationally amongst a broad range of Scientific disciplines.

Areas covered (Major subdisciplines). A particular problem in charcoal research is that there is a lot being published but in a vast array of journals covering a range of scientific disciplines. Below are some examples of disciplines and examples of papers that have to be enlarged.

The formation of charcoal: Physical and Chemical aspects
Charcoal in relation to fire science
Charcoal and biogeochemical cycles (including Black Carbon, pyrogenic carbon and elemental carbon)
Geological history of charcoal
Charcoal and human history
Anthropogenic uses of charcoal
Charcoal and human health
Charcoal utilization
Charcoal and combustion technology
Charcoal taphonomy in natural conditions
Charcoal taphonomy in archaeological conditions
Charcoal as a dating and chemostratigraphic tool
Charcoal and environmental science
BIOCHAR
Soil charcoal including studies on Terra Preta.

This range is also amplified by the wide range of nomenclature, translation, different usages of terms in different sub-disciplines.

Organization: Officers to be elected every four years at the International meeting (see draft constitution below).
President
Vice Presidents (3) from a broad range of continents and sub-disciplines.
Secretary
Treasurer
Newsletter editor
Web Manager
Regional/subdiscipline representatives

EXAMPLES OF RESEARCH AREAS AND JOURNALS (TO BE ENLARGED)

The formation of charcoal: Physical and Chemical aspects

Bustin, R.M, and Y. Guo, 1999. Abrupt changes (Jumps) in reflectance values and chemical compositions of artificial charcoals and inertinite in coals. *International Journal of Coal Geology* 38: 237-260.Cohen- Ofri, I., Weiner, L. et al. 2006. Modern and fossil charcoal: aspects of structure and diagenesis. Journal of Archaeological Science 33, 428-439.

Forbes, M.S., R.J. Raison and J.O. Skjemstad, 2006. Formation, transformation and transport of black carbon (charcoal) in terrestrial and aquatic ecosystems. *Science of the Total Environment* 370: 190-296.

Guo, Y. and R.M. Bustin, 1999. FTIR spectroscopy and reflectance of modern charcoals and fungal decayed woods: implications for studies of inertinite in coals. *Int. J. Coal. Geol.* 37: 29-53.

Jones, T., A.C. Scott, and M. Cope, 1991. Reflectance measurements against temperature of formation for modern charcoals and their implications for the study of fusain. *Bull. Geol. Soc. France* 162: 193-200

Masiello, C.A., 2004. New directions in black carbon organic geochemistry. Marine Chemistry 92, 201-213.

McParland, L., Collinson, M.E., Scott, A.C. & Steart, D. 2007. Ferns and Fires: Experimental charring of ferns compared to wood and implications for paleobiology, coal petrology and isotope geochemistry. Palaios 22, 528-538

Petersen, H.I. 1998. Morphology, formation and palae-environmental implications of naturally formed char particles in coals and carbonaceous mudstones. *Fuel* 77:1177-1183.

Prior, J. and K.L. Alvin, 1983. Structural changes on charring woods of *Dichrostachys* and *Salix* from Southern Africa. *IAWA Bull.* 4: 197-206.

Scott, A. C. and T.P. Jones, 1991. Microscopical observations of Recent and fossil charcoal. *Microscopy and Analysis* 25: 13-15.

Sun, HW; Zhou, ZL. 2008. Impacts of charcoal characteristics on sorption of polycyclic aromatic hydrocarbons. CHEMOSPHERE 71, 2113-2120

Treusch, O; Hofenauer, A; Troger, F, et al. 2004. Basic properties of specific wood-based materials carbonised in a nitrogen atmosphere. WOOD SCIENCE AND TECHNOLOGY 38: 323-333

Charcoal terminology

Jones, T P., W.G. Chaloner and T.A.J. Kuhlbusch, 1997. Proposed bio-geological and chemical based terminology for fire-altered plant matter. In: Clark, J S et al (eds). *Sediment records of biomass burning and global change* pp.9-22. NATOASI Series I 51, Springer Verlag, Berlin.

Scott, A.C. and I.J. Glasspool, 2007. Observations and Experiments on the Origin and Formation of Inertinite Group Macerals. *International Journal of Coal Geology* 70: 55-66.

Charcoal and the carbon cycle

Carcaillet, C., H. Almquist, H. Asnong and 20 others, 2002. Holocene biomass burning and global dynamics of the carbon cycle. *Chemosphere* 49: 845-863.

Herring, J.R. 1985. Charcoal fluxes into sediments of the North Pacific Ocean: the Cenozoic record of burning. In: The carbon cycle and atmospheric CO2: natural variations Archean to Present. *Geophysical Mongraphs* 32: 419-442.

Charcoal in relation to fire science and ecology

Hockaday, W.C., Grannas A.M., et al 2007. The transformation and mobility of charcoal in fire-impacted watershed. Geochimica et Cosmochimica Acta 71, 3432-3445.

Scott, A.C., Cripps, J. , Nichols, G. & Collinson, M.E. 2000. The Taphonomy of Charcoal Following a Recent Heathland Fire and some implications for the Interpretation of fossil charcoal Deposits.Palaeogeography, Palaeoclimatology, Palaeoecology, 164, 1-31

Wardle D.A, Zackrisson O, and Nilsson M.-C. 1998. The charcoal effect in boreal forests: mechanisms and ecological consequences. Oecologia **115**, 419–426.

Charcoal and biogeochemical cycles (including Black Carbon, pyrogenic carbon and elemental carbon)

Duffin, KI; Gillson, L; Willis, KJ. 2008. : Testing the sensitivity of charcoal as an indicator of fire events in savanna environments: quantitative predictions of fire proximity, area and intensity. HOLOCENE 18, 279-291

Hammes, K., Smernik, R.J. et al.,2006. Synthesis and characterization of laboratory charred grass straw and chestnut wood as reference materials for black carbon quantification. Organic Geochemistry 37, 1629-1633

Preston, C.M. and Schmidt, M.W.I. 2006. Black (pyrogenic) carbon: a synthesis of current knowledge and uncertainties with special consideration of boreal regions. Biogeosciences 3, 397-420.

Wardle, DA; Nilsson, MC; Zackrisson, O. 2008. Fire-derived charcoal causes loss of forest humus. SCIENCE 320, 629-629

Geological history of charcoal

Friis, E.M., Pedersen, K.R. and P.R. Crane, 2006. Cretaceous angiosperm flowers: Innovation and evolution in plant reproduction. *Palaeogeography, Palaeoclimatology, Palaeoecology* 232: 251– 293

Glasspool, I.J., D. Edwards, and L. Axe, 2004. Charcoal in the Silurian as evidence for the earliest wildfire. *Geology* 32: 381-383.

Scott, A.C. 2000. The Pre-Quaternary History of Fire. Palaeogeography, Palaeoclimatology, Palaeoecology, 164, 281-329.

Scott, A.C. 2008. Forest Fire in the Fossil Record. In: Cerdà, A. & Robichaud, P. (eds). Restoration Strategies after Forest Fires. Science Publishers Inc. New Hampshire.(in press).

Scott, A.C. and T.P. Jones, 1994. The nature and influence of fire in Carboniferous ecosystems. *Palaeogeography, Palaeoclimatology, Palaeoecology* 106: 91-112.

Charcoal and Earth Systems Processes

Chaloner, W.G. 1989. Fossil charcoal as an indicator of palaeo-atmospheric oxygen level. *Journal of the Geological Society London* 146: 171-174.

Scott, A.C. & Glasspool, I.J.2006. The diversification of Paleozoic fire systems and fluctuations in atmospheric oxygen concentration. Proceedings of the National Academy of Sciences, U.S.A. 103, 10861-10865.

Wildman, R.A., L.J. Hickey, M.B. Dickinson, R.A. Berner, J.M. Robinson, M. Dietrich, R.H. Essenhigh and C.B. Wildman, 2004. Burning of forest materials under late Paleozoic high atmospheric oxygen levels. *Geology* 32: 457-460.

Charcoal and human history

Granstrom, A., Niklasson, M. 2008. : Potentials and limitations for human control over historic fire regimes in the boreal forest. PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES 363, 2353-2358.

Millspaugh, S.H. and C. Whitlock, 1995. A 750-year fire history based on lake sediment records in central Yellowstone National Park, U.S.A. *The Holocene* 5: 283-282.

Anthropogenic uses of charcoal

Labarta, RA; White, DS; Swinton, SM. 2008. Does charcoal production slow agricultural expansion into the Peruvian Amazon rainforest? WORLD DEVELOPMENT 36, 527-540

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Constitutional model (Adapted from The International Organization of Palaeobotany)

Article 1. NAME.

The name of the organization is
INTERNATIONAL ASSOCIATION FOR CHARCOAL RESEARCH (IACR)

Article 2. AFFILIATION

The ACR shall be affiliated to xxx

Article 3. AIM

The aim of IACR is to promote international co-operation in the study of charcoal. This includes:
3.1 The encouragement of the work of regional groups of charcoal researchers and of groups of specialists within the broader field of charcoal research.
3.2 Publication of an informative newsletter that will announce all charcoal meetings, report on their proceedings as well as other pertinent information of wide interest. Some articles of topical interest may also be included. These will not be refereed and will not have any formal status as a formal publication.
3.3 Collaboration with officers responsible for programmes of International Congresses to ensure the inclusion therein of items of interest to charcoal researchers. To organise and sponsor other conferences from time to time at the discretion of the Executive Committee.
3.4 Co-operation with other international organizations have interest allied to charcoal research such as the International Organization of Palaeobotany, the International Palaeontological Association, the International Association for Plant Taxonomy, Quaternary and Archeological research associations and the International Federation of Palynological Societies.
3.5 Any other activities considered appropriate by the Executive Committee for warranted by interest shown by the membership.

Article 4. OFFICERS

The officers of IACR form the Executive Committee
4.1 The officers of IACR shall be: President; three Vice-Presidents; Secretary; Treasurer; Webmaster; Newsletter Editor; three Members at Large; Conference/Congress Member.
4.2 The President shall chair meetings of the Executive Committee and the General Assembly.
4.3 If the Office of President becomes vacant, one of the Vice-Presidents shall be elected by the Executive Committee to succeed to the office for the remainder of the term.
4.3. The Secretary is the driving force behind the Organization. He/she shall transmit suggestions from the membership to the President and Executive Committee and liaise with the newsletter editor. The newsletter shall be the Secretary and Treasurer's chief medium of communication. One officer will maintain an ICRA web site on the internet, maintain contact with regional and local groups of charcoal researchers, maintain contact with partner association by the assistance of one of the Vice-Presidents. The treasurer will control the income and expenditure of IACR and maintain a central treasury.
4.4. The Secretary, Treasurer and Newsletter editor and Webmaster may be re-elected for a second term.
4.4 The Conference/Congress Member is chosen by the Executive Committee. He/she shall be responsible for the co-ordinating with the appropriate authorities, concerning the programme at the next International Charcoal Conference or International Archaeology Congress. He/she normally be a resident of the country in which that conference or congress is to be held. The President and Vice- presidents shall not serve more than one consecutive term of office. One of the three Vice-Presidents is selected by the Executive Committee to take special responsibility for the Committee with affiliate affairs. He/she will instigate creative projects, in consultation with the Executive Committee, which will be part of the activities of the affiliate relevant to the aims of the ICRA.
4.5 The three Members at Large must be from different countries: they may not serve more than two consecutive terms of office.
4.6 One term of office is from the end of one International Charcoal Conference (or its equivalent as defined by the Executive Committee) to the end of the next.
4.7 If any office other than that of President becomes vacant, the Executive Committee is empowered to select a replacement.

Article 5. MEMBERSHIP

5.1. Any charcoal researcher who subscribes to the aims of IACR is eligible for membership.
5.2 The Treasurer shall maintain a roll of members' names and institutional addresses. This will comprise information received from all Regional Representatives. It will be revised at least once a year. It will serve as an electoral roll for the election of officers to the Executive Committee, as well as a useful world list of charcoal researchers.
5.3 Membership takes effect immediately upon receipt of membership dues by the appropriate Regional Representative.
5.4 Membership gives voting rights, the privilege of holding office, access to the most recent issues of the newsletter, reduced registration fee for the International Association for Charcoal Research Conferences (IACRC), financial assistance and reduced IACRC costs for student members, as funds are available, and other benefits that are made available from time-to-time.
5.5 Institutions such as libraries and publishers may receive the newsletter by paying the annual dues set out in the By-Laws. They may not vote at elections or nominate candidates for election to office, and shall not be regarded as members.
5.6 The amount to be paid for annual dues shall be laid down from time to time by the Executive Committee and incorporated by the By-Laws.
5.7 Membership may be terminated for non-payment of dues extending over two years.

Article 6. REGIONS AND REGIONAL REPRESENTATIVES

5.1 To help produce the newsletter, the Secretary is empowered to select, invite, and appoint as many and as diverse Regional Representatives and Correspondents as are required to ensure effective coverage of world charcoal research. Regional representatives and Correspondents will serve at the pleasure of the Secretary, and their appointment is open to review on a regular basis.
5.2 The role of each Regional Representative is to:
Maintain a full list of names and addresses of members in that region, and to transmit these to the Treasurer each year.
5.3 Collect membership dues from each member, and after deduction of operational expenses, to transfer the surplus to the Treasurer.
5.4 Stimulate contributions to the newsletter from members in the region. Contributions should include announcements and reports of national meetings, news of individuals and their projects, obituaries, and articles of general interest. Books for review should be solicited from publishers in the region and their reviews appointed in consultation with the Secretary.
5.5 Receive one master copy of each ICRA newsletter from the Newsletter editor, and arrange for duplication and distribution to members in the region. Communications and distributions will be via electronic media (e.g., e-mail and posting on the ICRA Web Site, etc.), except for those members without electronic communications capabilities. For the latter members, hard copies will be provided by the Regional Representatives to the members by post.

Article 7. ELECTIONS

The election of officers should take place at each General Assembly during the International Association for Charcoal Research Conferences, (or its equivalent as determined by the Executive Committee).
7.1 The Executive Committee shall seek nominations for eleven of the places (see Article 4) by advertising in the newsletter.
7.2 Nominations may be made in writing, by any member of IACR. The call for nominations must be made by the Secretary in the IACR newsletter no later than six months before the Conference at which the election shall take place.
7.3 All candidates must be current members of IACR, defined by their inclusion of the membership election roll (see Article 5.2 above).
7.4 The Executive Committee shall determine the status of the nominees, ascertain that they are prepared to stand for election, and shall publish a list, in the form of a ballot in the newsletter at least one month before the start of the Conference (or equivalent as determined by the Executive).
7.5 Each member whose name appears on the electoral roll (Article 5.3 and 5.4) may vote. Member voting must have paid their membership dues to their Regional Representative for the year of the election.
7.6 Any member not in attendance at the General Assembly who wishes to vote may send their ballot to the Secretary, to be received before the time of the vote tabulation Ballots will be accepted by the Secretary either by e-mail or by post. E-mail ballots can either be sent as attachments or in the body of the e-mail (with authenticity established by the member's registered e-mail address). Each paper ballot should be enclosed in a sealed envelope with the voter's name clearly written on the reverse side of the envelope to establish authenticity.
7.7 Election of the President and of the Secretary and Treasurer shall be declared for the respective candidate who receives a simple majority of the votes cast.
7.8 Election of the three Vice-Presidents and of the three Members at Large of the Executive Committee shall be awarded to the candidates in each category who receive the largest number of votes.

Article 8. ADMINISTRATION

8.1. The General Assembly consists of all current members of IACR, meetings of the General Assembly shall be held at each meeting of the International Association for Charcoal Research Conference and at such other International conferences as may be designated, with a adequate prior notice, by the Executive Committee.
8.2. Meetings will be conducted in accordance with the customary Rules of Order (e.g., Robert's Rules of Order as kept online at http://www.rulesonline.com/.)
8.3 The agenda of a General Assembly shall be determined by the Secretary and the Executive Committee and published in a newsletter in advance of the meeting.
8.4. The Executive Committee undertakes such business as may be delegated to it by the Constitution and By-Laws or by decisions of the General Assembly, or by requests of the President or Secretary or Treasurer.
8.5 The Executive Committee should meet at least once at each International Association for Charcoal Research Conference, and/or and at such other International conferences as may be designated prior to the meeting of the General Assembly. Otherwise, much of its business will be conducted by either e-mail or by mail.

Article 9. FINANCES

Membership dues shall be determined by the Executive Committee and laid down in the By-Laws. Dues are payable to the appropriate Regional Representative on January 1st each year. Any surplus money, after payment of postal and duplication costs should be forwarded to the Treasurer by the Regional Representatives.

Article 10. AMENDMENTS

10.1 These statues of the IACR may be amended only at a meeting of the General Assembly.
10.2 Amendments may be proposed by the Executive Committee or may be submitted to that committee by any member.
10.3 The Secretary will cause the proposed amendments to be published in the newsletter at least six months before the next General Assembly together with any comments the Executive Committee offers.
10.4 Amendments shall be effective if ratified by a two-thirds majority of members present at a General Assembly

Article 11. LANGUAGE

The Official Languages of ICRA will be those of xxx. The use of English is advocated.

BY-LAWS

1. Membership dues - Dues for Individual and Corporate members are US $20.00, 15 Euros, or UK £10.00 per year. For some of the old "Independent Regions" the amount will be as agreed by the Treasurer and Regional Representative until such a time as economic conditions allow for the regular dues to be assessed.
2. Dues are payable to the appropriate Regional Representative and thence to the Secretary, who will use them in the production of the newsletter and for the business of the organization.
3. A computer print-out of members' names and addresses is available to members from the Secretary, upon payment of a fee to cover costs determined by the Secretary.
4. A series of informal leaflets, named IACR Circulars, may be produced from time to time, with the authority of the Executive Committee. Production costs shall be paid by the author from whom members may obtain free copies, though postal charges are discretionary.
5. These By-Laws may be amended by a two-thirds majority of the Executive Committee provided that the proposed amendments have been circulated to the Committee at least three months before a vote is taken.

4th International Meeting of Anthracology, Brussels,

Royal Belgian Institute of Natural Sciences, 8-13 September 2008

CHARCOAL AND MICROCHARCOAL :

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