SCIENTIFIC CONTEXT

Thirty years ago a new ecological discipline was born at Marseille, allowing the reconstruction of ligneous ecosystems: pedoanthracology.

This discipline deals with the analysis (datation and anatomical identification) of charcoal pieces sampled not from archaeological context (archaeoanthracology), but from natural contexts: soils.

Today, this discipline is regularly applied in the framework of palaeoenvironmental reconstruction, but also in current ecology as indicated by the increasing number of publications on the topic.

However, it is still difficult to find a standard description of the method concerning the notion of burying, charcoal conservation in soil and the interpretation of data in terms of vegetation reconstruction. No real synthesis has been done during these thirty years of using, in France and other parts of the world. This restrains the extension of the discipline.

The aim of this meeting is to collect experiences and opinions of researchers, working with or interested in pedoanthracology, to exchange points of view and try to harmonize the methodology and find a consensus about its relevance and its limits. We explicitly invite people not yet working in the field of pedoanthracology, but are interested to do so in the future.

THEMATIC

The communication and discussion will be centered about two main axis of reflection:

- **How to use pedoanthracology**: Methodological aspects “from the field to the lab”, field sampling strategy, extraction process, identification, data interpretation, relevance and limits, taphonomical aspects, dating strategy, etc.

- **Pedoanthracology contribution to multi-/interdisciplinary approaches**: Role and place of the pedoanthracology in multi- and interdisciplinary approaches (interest and complementarity of pedoanthracology in multi- and interdisciplinary contexts, especially for environmental studies.

This workshop is organized by the “Institut Méditerranéen d’Ecologie et de Paléoécologie” (IMEP) and the Kiel University Graduate School "Human development in landscapes» respectively represented by:
Dr. Brigitte Talon (brigitte.talon@univ-cezanne.fr) and Prof. Dr. Oliver Nelle (onelle@ecology.uni-kiel.de)

Scientific committee

- Brigitte TALON (IMEP-University Paul Cézanne, France)
- Michel THINON (IMEP-University Paul Cézanne, France)
- Claire DELHON (CNRS, CEPAM, France)
- Oliver NELLE (Institute for Ecosystem Research, GS "Human development in landscape", CAU Kiel, Germany)
- Peter POSCHLOD (Institute of Botany, University of Regensburg, Germany)
- Gaetano DI PASQUALE (University of Naples Federico II/ Portici, Italy)

Organization committee

- Brigitte TALON (IMEP- University Paul Cézanne, France)
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- Oliver NELLE (Institute for Ecosystem Research, GS "Human development in landscape", CAU Kiel, Germany)
- Vincent ROBIN (Institute for Ecosystem Research, GS "Human development in landscape", CAU Kiel, IMEP, Germany)
- Maryse ALVITRE (IMEP-University Paul Cézanne, France)
- Christiane ROLANDO (IMEP-University Paul Cézanne, France)
- Pauline GUIOT (Student in media studies, Marseille, France)

PROGRAMME

Monday, June 14, 2010

10:00- 11:00 **Registration**/Inscriptions

11:00-11:15 **Welcome speech**/Discours de bienvenue
B. TALON, IMEP, FRANCE
O. NELLE, KIEL, GERMANY

11:15-12:00 **Invited speaker**/Conférencier invité
THIERRY DUTOIT, *IMEP, Professor Université d'Avignon*
Pedoanthracology: an important tool for the identification of reference ecosystems in ecological restoration projects

12:00-13:00 *lunch (buffet)*

13:00 **Session 1**: **How to use pedoanthracology** / pédoanthracologie mode d'emploi

Chair man/Président: B. TALON

13:00-13:30 **For a rational standardization of pedoanthracological methods**
MICHEL THINON, Marseille (France)

13:30-14:00 **Wood diameter analysis of charcoals – Application in pedoanthracology?**
OLIVER NELLE, Kiel (Germany)

14:00-14:30 **Charcoal taxonomical assemblages: is it possible to definite threshold of identification?**
VINCENT ROBIN & OLIVER NELLE, Kiel (Germany) & Aix-en-Provence (France)

14:30-15:00 **Differences in flammability and combustibility of subalpine trees in the French Alps. Implications for the charcoal production**
THIBAUT FREJAVILLE, Aix-en-Provence (France)

15:00-15:30 *Health Break/coffee and tea*

15:30 **Session 1**: **How to use pedoanthracology** / pédoanthracologie mode d'emploi

Chair man/Président: M. THINON

15:30-16:00 **Spatial variability of soil charcoal records**
PHILIPPE TOUFLAN & BRIGITTE TALON, Marseille (France)

16:00-16:30 **Charcoal in Upper Pleistocene loess and palaeosols from natural and archaeological contexts in the Eurasian Plain**
FREDDY DAMBLON & PAUL HAESAERTS, Brussels (Belgium)

16:30-17:00 **Pedoanthracology as a climato-stratigraphical tool: data from Cordillera Real, Northern Andes**
STEFANIA IMPAGLIAZZO *et al.*, Portici (Italy)

17:00-18:30 **Concluding discussion of session 1**

*20:00 "eat together" G*rand R, Aix-en-Provence, city center

Tuesday, June 15, 2010

9:00 Poster Session 1 How **to use pedoanthracology** / pédoanthracologie mode d'emploi

Chair man/Président: C. DELHON

Charcoal signal from pedoanthracological samples and charcoal site production samples: a qualitative and quantitative comparison
HANNES KNAPP *et al.*, Kiel (Germany)

Anatomical distinction of Larix and Picea charcoal pieces, using bordered pit in the ray tracheids
VINCENT ROBIN & BRIGITTE TALON, Kiel (Germany) & Aix-en-Provence (France)

Macroscopic-to-microscopic quantification of charcoal fragments and particles: contribution to the charcoal taphonomy from Upper Palaeolithic sites
LAURENT MARQUER, Paris (France)

Anthracology and Geomorphology combining approaches in field, laboratory and data interpretation
ANNEGRET KRANZ & UTA LUNGERSHAUSEN, Kiel (Germany)

Pedoanthracology : what is exactly a wood charcoal?
MELANIE SAULNIER & BRIGITTE TALON, Aix-en-Provence (France)

9:30 **Session 2**: **Pedoanthracology contribution to multi-/interdisciplinary approaches** / Apport de la pédoanthracologie aux approches multi-/interdisciplinaires

Chair man/Président: F. DAMBLON

9:30-10:00 **Holocene treeline fluctuations in the southern Pyrenees: Pedoanthracology, palinology and sedimentary macrocharcoal analysis as a transdisciplinary approach**
RAQUEL CUNILL *et al.*, Barcelone (Spain)

10:00-10:30 **Forest and Steppe in the sub mediterranean Grands Causses area (South Massif Central, France): how a century old problem, formerly studied with ecology and archaeo anthracology was recently solved by pedo anthracology.**
JEAN-LOUIS VERNET, Montpellier (France)

10:30-11:00 Health Break/coffee and tea

11:00 **Session 2**: Pedoanthracology and multi-/interdisciplinary approaches

Chair man/Président: O. NELLE

11:00-11:30 **Between archaeoanthracology and pedoanthracology : charcoal records from pedosedimentary contexts. A look back on the "TGV-Méditerranée" experience.**
CLAIRE DELHON *et al.*, Nice (France)

11:30-12:00 **Pedoanthracology and dendroecology : two complementary approaches applied to old forests history.**
BRIGITTE TALON *et al*., Marseille (France)

12:00-12:30 **Pedoanthracological contribution to forest naturalness assessment**
VINCENT ROBIN *et al*., Kiel (Germany) & Aix-en-Provence (France)

12:30-13:30 Lunch (buffet)

13:30 Poster Session 2 Pedoanthracology and multi-/interdisciplinary approaches

Chair man/Président: V. ROBIN

Anthracology between natural and anthropogenic deposits. Current research in SE Europe
TIM SCHROEDTER & OLIVER NELLE, Kiel (Germany)

Combination of charcoal data from archaeological and soil context – preview and first results
DORIS JANSEN & OLIVER NELLE, Kiel (Germany)

Fire history assessment at the local scale: Complementary usage of pedoanthracology and macro-charcoal analysis – Illustration from Northern Germany
VINCENT ROBIN & OLIVER NELLE, Kiel (Germany) & Aix-en-Provence (France)

Wood in Roman Age: cultural landscapes, forest exploitation and timber circulation. The contribution of pedoanthracology
DANIELA MOSER *et al.*, Kiel (Germany)

Pedoanthracology and geoarchaeology: an example of methodological approach in the Eastern French Pyrenees
MARIE-CLAUDE BAL, Barcelone (Spain)

Holocene environmental change in Northern Apennines
CHIARA COMPOSTELLA, *et al.*, Milano (Italy)

14:00 **DISCUSSIONS – ROUND TABLES**

General and concluding discussion
Planning of a joint publication
"Handbook of pedoanthracology" project

Wednesday, June 16, 2010

Excursion to the Mont Ventoux

8:00 Bus Departure (previsional back to the workshop place: 18:00)

Detailed programm in preparation

The mountain, Mont Ventoux (two hours from Aix-en-Provence, 1912 metres high), also called the "Giant of Provence", stands sovereign over the region, as its nickname suggests. This mountain has become a myth in the history of Provence. From its summit you can discover one of the most splendid panoramas of Europe, taking in the Vallée du Rhône, the Baronnies and the Vaucluse plateau.
Its vegetation and landscapes, of particular interest, vary according to the altitude: 400 different flowers and more than a thousand types of plants adorn its slopes over five levels between 400 and 1900 metres.

Classed by UNESCO, it is a reserve with the label MAB - Man and the Biosphere. Pedoanthracological investigation has been done for the first time there few decades ago. An overview of it will be present during the day. Moreover, the fertile land that spreads out from the foot of Mont Ventoux supports the character laden vineyards of the local wines with their Appellation d'Origine Contrôlée (AOC) label, which we should taste, of course!

ABSTRACT OF COMMUNICATION

ORAL COMMUNICATIONS

HOLOCENE TREELINE FLUCTUATIONS IN THE SOUTHERN PYRENEES: PEDOANTHRACOLOGY, PALYNOLOGY AND SEDIMENTARY MACROCHARCOAL ANALYSIS AS A TRANSDISCIPLINARY APPROACH

Raquel Cunill, Joan-Manuel Soriano, Marie-Claude Bal, Albert Pèlachs and Ramon Pérez-Obiol

Grup de Recerca en Àrees de Muntanya i Paisatge (GRAMP), Departament Geografia, Universitat Autònoma de Barcelona (Spain)

The main objective of this research is to determine the dynamics of the treeline from analyses of paleobotanic registers from the meridional slope of the Pyrenees, taking into consideration both environmental and anthropic changes in high mountain areas. The primary analytical approach is pedoanthracology, which has not previously been applied to studies in the Iberian Peninsula.

In a transect from 2,000-2,600 m a.s.l (from the Udes plateau to Montarenyo peak), seven soil profiles were sampled, with an altitudinal resolution of 100 m., nearly 4,000 soil charcoal fragments were identified and the 13 samples that had sufficient mass were dated. In the same area, at an altitude of 2,247 m, the Estanilles peat bog was sampled for palynological and sedimentary macrocharcoal analysis. Finally, a core sample was taken from a *Sphagnum* peat bog (close to Montarenyo lake, 2,297 m) to determine the current pollen rain and complete the most recent phase of the pollen diagram. Charcoal in the soil provides information with high spatial resolution to study the evolution of woody vegetation on the slope itself, while pollen and macrocharcoals contribute to higher temporal resolution and a more regional paleoenvironmental context of the fires found in the pedoanthracological record. The combination of these data permits us to analyze human and physical factors that explain the dynamics of this zone and reveal the role of fire as a change agent in high mountain areas.

The time interval for the pedoanthracological and sedimentary data begins in 10500 Cal BP with the oldest dated charcoal. Soil charcoals were dated to four chronocultural periods: Paleolithic-Mesolithic (10500-9500 Cal BP), middle Neolithic (5200 Cal BP), Iron Age/Roman period (2,300-1,800 Cal BP) and Medieval age (1100-700 Cal BP). Charcoals were found at all of the sampled sites, without exception. In contrast to other European high mountain zones, we identified only two arboreal taxa, finding mostly *Pinus sylvestris/uncinata* charcoals throughout the entire transect up to 2,460 m and also *Betula* sp. charcoals, but only below 2,200 m and in much smaller quantities. The current arboreal vegetation consists only of isolated pines that do not grow above 2,200 m.

Charcoals of two shrub taxa were identified at most of the sampled sites: Ericaceae (found all the way to the peak) and *Genista balansae*, found to an altitude of 2,200 m. In this zone, *Genista balansae* is currently a species found in large scrubby areas and closely linked to pine forest fires, while Ericaceae such as *Calluna vulgaris* are part of pasture vegetation at these altitudes. The zone now contains shrubs of *Rhododendron ferrugineum* and *Vaccinum myrtillus*, although they occupy much smaller areas. The pollen data and fire signals that resulted from sedimentary macrocharcoal analysis were associated with the different periods identified by pedoanthracological methods and contribute key elements to the debate about the role of forest fires and the influence of natural and human factors in the historical and current range of the treeline.

Key words: Pedoanthracology, Palinology, Macrocharcoal, Treeline, Fire, Pyrenees, Holocene

CHARCOAL IN UPPER PLEISTOCENE LOESS AND PALAEOSOLS FROM NATURAL AND ARCHAEOLOGICAL CONTEXTS IN THE EURASIAN PLAIN

Freddy Damblon & Paul Haesaerts

Royal Belgian Institute of Natural Sciences, Brussels (Belgium)

Charcoal is present in Upper Pleistocene loessic deposits throughout the Eurasian loess belt but more frequent in the continental area from Germany to Siberia (Damblon & Haesaerts, 2002). The study of long loess sequences including numerous successive accumulations of natural or anthropic charcoal, charred remains or wood concentrations give information on the past environment, the succession of geological, climatic and anthropic events that may be radiocarbon dated on charcoal, wood or bone remains. In this line, pedo-anthracology together with micro-stratigraphy is implemented as an efficient tool for dating and interpreting the significance of the plant remains in terms of sedimentary dynamics and soil formation. In this way, a detailed record of some 24 climatic oscillations between 42 and 10 kyr BP has been obtained from complementary loess sequences in Central and Eastern Europe and South central Siberia (Haesaerts et al., 2009; 2010).

The present contribution will especially deal with the methodology of stratigraphic drawing, of sampling in well delimited geological layers, of laboratory treatment to clean the material and provide safe charcoal or wood fragments for identification and radiocarbon dating, of implementing the best adapted method of treatment in the ^{14}C laboratory (ABA or ABox) and finally of critical screening of the results with respect to the pedo-stratigraphic records. Comparisons with pollen data, when available, are also discussed.

Key words: charcoal assemblage, loess, stratigraphy, methodology, radiocarbon, pollen

References

Damblon, F., Haesaerts, P., 2002. Anthracology and radiochronology of the Upper Pleistocene in the loessic areas of Eurasia. In : Thiébault , S.(ed.) *Charcoal Analysis. Methodological Approaches, Palaeoecological Results and Wood Uses*. Proc. 2nd Intern. Meet. Anthracol., Paris, September 2000. *BAR International Series*, 1063: 65-71.

Haesaerts, P., Borziac, I.A., Chekha, V.P., Chirica V., Damblon F., Drozdov N.I., Orlova L.A., Pirson, S., van der Plicht J., 2009. Climatic signature and radiocarbon chronology of middle and late pleniglacial loess from Eurasia: comparison with the marine and Greenland records. *Radiocarbon*, 51 (1), 301–318.

Haesaerts , P. Borziac, I., Chekha , V. P., Chirica , V., Drozdov , N.I., Koulakovska , L., Orlova , L.A., van der Plicht, J., Damblon, F., 2010. Charcoal and wood remains for radiocarbon dating Upper Pleistocene loess sequences in Eastern Europe and Central Siberia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 291 (3-4), in press.

BETWEEN ARCHAEOANTHRACOLOGY AND PEDOANTHRACOLOGY: CHARCOAL RECORDS FROM PEDOSEDIMENTARY CONTEXTS. A LOOK BACK ON THE "TGV-MÉDITERRANÉE" EXPERIENCE

Claire Delhon[1], Stéphanie Thiébault[2] & Jean-François Berger[1]

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Originally, anthracology is an archaeological discipline. The fragments of charcoal studied result from the combustion of wood gathered by men, most of the time to be used as fuel. As ecofacts, they are at the interface between natural resources and human practices. A rich literature shows how to interpret them according to the context and the addressed issues either in terms of palaeoenvironment or in terms of technical choice / cultural tradition. As they are sampled in archaeological layers, they are most of the time well dated and related to a chronocultural framework.
The pedoanthracological approach, developed aroud the 90's, deals with charcoal fragments found in soil profiles. As they are produced by vegetation fires, they directly record the *in situ* woody vegetation, without any bias created by human selection (gathering, choice). Their spatial resolution is extremely fine (stationary level), but they are also subject to mixing by pedological processes that disrupts the chronological information. Only numerous ^{14}C datings of previously identified charcoal fragments allow to discuss vegetation changes.

Wood charcoal is also present off archaeological sites, in pedosedimentary formations separate from soil covers. Charcoal analysis in these so-called "natural" sequences has been referred to as "geoanthracology" by J.-L. Vernet (2002). Their study is based on the methodological advances in archaeoanthracology and pedoanthracology but the approach is different. The later considers frequent changes in spatial and temporal scale according to the sedimentary and chronological contexts, and constant questioning about the deposit nature (anthropic or natural).

In the framework of rescue excavation previously to the construction of the TGV-Méditerranée railway, numerous colluvio-alluvial sequences from the middle Rhône valley (south of France) have been sampled. This exceptional corpus allowed us to explore the potential of charcoal analysis in pedosedimentary sequences and to propose an approach based on interdisciplinary dialogue (with archaeologists and geoarchaeologists) and on the consideration of vegetal and sedimentary dynamics as a whole, on the scale of the watershed.

In that talk, we intend to 1/ sum up the specificities of these sequences (location in "anthropized natural context", chronostratigraphic coherence, multiscale records, charcoal assemblages size and reliability) and the new issues they raise and 2/ present a few representative examples of what charcoal studies can bring forth in these contexts in terms of society-environment relationship.

Vernet J.-L., 2002. Preface. *In* S. Thiébault (ed.): *Charcoal analysis : methodological approaches, palaeocological results and wood uses*. BAR international series 1063: V-VI.

DIFFERENCES IN FLAMMABILITY AND COMBUSTIBILITY OF SUBALPINE TREES IN THE ALPS: CONSEQUENCES FOR THE CHARCOAL PRODUCTION

Thibaut Frejaville[1,2], Thomas Curt[2] & Christopher Carcaillet[1]

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Subalpine forests have experienced surface fires during the last millennia, resulting a charcoal load, that are sequestrated in soil for millennia. Charcoal of *Pinus cembra* is the most frequent and abundant within subalpine soil charcoal, whereas taxa such as *Larix* are infrequent or not abundant. Based on a neutral hypothesise of species biomass equitability, this difference in charcoal of the different species would results from the different burning properties of their wood. We hypothesize that the fire sensitivity of subalpine trees is mainly due to the flammability and combustibility (*C*) properties of the trunk, these properties contributing also to the intensity of fires and to the production of charcoal.
We considered eight subalpine trees among angiosperms (*Betula pendula*, *Salix caprea* and *Sorbus aucuparia*) and gymnosperms (*Pinus cembra*, *Pinus uncinata*, *Larix decidua*, *Picea abies* and *Abies alba*). The study of *C* of theses species was carried out by experimental burnings. Samples of barky wood (3 × 2 × 1.5 cm) taken on the outer part of the trunk of 10 individuals per species (7-10 cm dbh) were dried 5-6 month in a room. Before burning, samples were dried in an air-oven (24 h, 30°C) to remove all residual moisture. Samples were then exposed to constant heat (epiradiator, 230°C). A set of variables describing the flammability and the combustibility (*C*- parameters) were selected: (**i**) the released temperature during the first 200 sec., namely T_{200} that describes the potential of the species to ignition, (ii) the released heat (i.e., released temperature per mass unit during the flaming duration, T_m) and, (iii) the lost mass rate during the first 200 sec., C_{200}.
Principal Component Analysis show that the maximal of flammability is for *Pinus cembra*, contrasting to minimal values for *Abies alba*, *Salix caprea* and *Betula pendula*. The angiosperms species (*Betula pendula*, *Salix caprea* and *Sorbus aucuparia*) exhibit maximal combustibility while *Larix decidua* is characterized by a minimal combustibility. A quantitative hierarchy was obtained by the integration of the experimental *C*- parameters in a synthetic index. An ANOVA followed by Duncan's multiple comparison tests resulted in the following ascending order of *C* (i.e. from the worst material to the best for burning): *Larix decidua*, *Abies alba*, *Pinus uncinata* and *Picea abies*, *Betula pendula*, *Salix caprea*, *Pinus cembra*, *Sorbus aucuparia*.
The interspecific differences are discussed in light of previous pedoanthracological studies. Among gymnosperms larch (*Larix*) appears the most fire-resistant tree of subalpine forests, while arolla pine (*P. cembra*) is the most flammable and is thus expected to compose, first, the main fuel for wildfires in subalpine ecosystems and, second, the best material for charcoal production. This study provides rational elements for the calibration of soil charcoal assemblages in paleoecology.

Keywords: forest fires, subalpine ecosystems, fire sensitivity, pedoanthracology, *Larix decidua*, *Pinus cembra*.

PEDOANTHRACOLOGY AS A CLIMATO-STRATIGRAPHICAL TOOL: DATA FROM CORDILLERA REAL, NORTHERN ANDES

Impagliazzo Stefania[1], Di Pasquale Gaetano[1], Lubritto Carmine[2] & Allevato Emilia[1]

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[2]*CIRCE, Dipartimento di Scienze Ambientali, II Università di Napoli, and INNOVA Caserta, Italy*

This work is part of a wider project aimed to investigate the past vegetation and the human impact in the Northern Andes by mean of soil charcoal analysis. Detailed information concerning the chronology of the Holocene palaeofires aimed to assess the value of this proxy as palaeoclimatic marker was presented.
Twenty AMS dating were obtained from charcoals coming from six soils located in the Guandera Biological Reserve (0°35'N, 77°42'W) (Northern Andes, Western Real Cordillera, Ecuador), between 3400 and 3900 m a.s.l. The soils were analyzed and classified according to the Word Reference Base for Soils Resources.
Our data revealed that the macro-charcoals preserved in these soils were time-stratified.
A strong correspondence was highlighted between the age of the oldest Guandera fires and the El Abra stadial (Younger Dryas equivalent in South America).
The Holocene fires until ca. 2500 cal yr BP fall in the dry periods identified from Mayewsky et al. Thus, probably in this area the fires can be judged as anthropic only from this date onward.

As a strong correspondence was highlighted between the age of the Guandera fires and the arid phases we state that the study of the palaeofires chronology is a very relevant methodology also for palaeoclimatic investigations.

Key words: Late Pleistocene, Holocene, Climate/human paleofires

WOOD DIAMETER ANALYSIS OF CHARCOALS – APPLICABLE IN PEDOANTHRACOLOGY?

Oliver Nelle

Palaeoecology Research Group, Institute for Ecosystem Research / Graduate School "Human Development in Landscapes, Christian-Albrechts University of KIEL, Germany

Several approaches exist to determine the diameter of charred wood, to both reconstruct the usage of different diameters by humans, and the stand structure of the used woodland. These approaches use the curvature of the tree rings and the angles of the wood rays and differ in the use of different size classes and the way to determine or measure the characters. One precondition of the analysis is that the wood charcoal fragments have a sufficient size to enable the measurement of curvatures and angles. In Pedoanthracology, the size of charcoals is usually very small (usually between 1 mm^3 and 1 cm^3) and thus too small for an accurate analysis of the diameter or the minimum diameter, if the last growth ring is not present. In this presentation, a simplification of the five class diameter system by Ludemann/Nelle is presented and it is discussed whether the application of diameter analysis to soil charcoals yields reliable information on the size of the wood which was charred. Though not as accurate as the use of size classes with bigger charcoal fragments from archaeological sites, especially charcoal production sites, the method gives valuable additional information on the question whether branches/small trees or bigger trees were affected by fire events, their legacy being stored in the soils.

Key words: Forest stand structure; wood diameter; methodology of pedoanthracology

PEDOANTHRACOLOGICAL CONTRIBUTION TO FOREST NATURALNESS ASSESSMENT

Vincent Robin[1,2], Brigitte Talon[2] & Oliver Nelle[1]

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The notion of naturalness is more and more used by scientist and manager to guide towards sustainable forest management, conservation, or as base for restoration projects. The naturalness degree of a forest system is commonly evaluated based on forest ecology indicators, spread on a relative short time resolution (e.g. dendroecological indication). However, the current state of ecological systems is the result of processes occurring in interaction at different and hierarchically connected spatial and temporal scales, including long term resolution (e.g. Holocene scale).Consequently, to assess the naturalness degree of ecological systems it is important to deal with their various temporal and spatial scales. To do that palaeoecological approaches are needed. But at the moment palaeoecological data are not often used in naturalness investigation.

Indeed the difficulties of interpretation in terms of spatial resolution of the main used palaeoecological approaches (e.g. palynology) and the presence of archive sites favourable to provide relevant palaeoecological proxy, seems to be a limiting factor for the use of palaeoecological data for naturalness assessment, which concerned generally specific and localized areas and ecological systems (e.g. subalpine forest).

However, pedoanthracology allows investigating forest dynamics on a long time resolution, at the local spatial scale, for every time of site, since there is some centimeter of soil.

In this presentation we illustrate that by several study cases from forest sites in the south of France, and central and northern Germany. On these sites several soil samples have been taken to extract soil charcoal. Those have been quantitatively and qualitatively analyzed. Some radiocarbon date, combined with soil description, allows to interpret the data on a definite time and spatial framework. We used those data to establish the reference forest systems and its dynamic along millennium scales, and from local to the landscape spatial scale, and so contribute to assess the naturalness of the study site.

CHARCOAL TAXONOMICAL ASSEMBLAGES: IS IT POSSIBLE TO DEFINITE THRESHOLD OF IDENTIFICATION?

Vincent Robin[1,2] **& Oliver Nelle**[1]

[1]*Palaeoecology Research Group, Institute for Ecosystem Research / Graduate School "Human Development in Landscapes", Christian-Albrechts University of KIEL, Germany*
[2]*Institute Mediterannen of Ecology and Palaeoecology, Paul Cézaenne University, Aix-en-Provence, France*

The representativeness of the wood charcoal taxonomical assemblages from soil samples, as well as from archaeological context, is an important discussion issue.
Indeed, no conventional number of charcoal pieces which should be taxonomically analyzed to get a pertinent representation of the past forest taxa composition is existing.
However, a definition of a threshold of identification would be interesting to improve the strength of the taxonomical assemblage interpretation, and for the use of a pertinent strategy of analysis.
In this work we present a quantitative and qualitative analysis of the possibility to definite thresholds of identification from different data sets for two classes of charcoal piece size. We quantified the increase of identified taxa, correlated to the number of charcoal pieces analyzed for different data set (e.g. including/excluding rare taxa, etc.).
Our general conclusion is that based on our data set it is possible to identify a threshold. Indeed, up to about 25 pieces analyzed we reach a "plateau" and only few new taxa have been identified after that. However, this threshold value and the "plateau" stability are variable, depending on the data set type and the setting of analysis. In the end this work provides information helping to fix the quantitative and qualitative analysis strategy, depending on the research question.

PEDOANTHRACOLOGY AND DENDROECOLOGY: TWO COMPLEMENTARY APPROACHES APPLIED TO OLD FORESTS HISTORY

Brigitte Talon[1], Philippe Touflan[1], Mélanie Saulnier[1], Jean-Louis Edouard[2] & Frédéric Guibal[1]

[1]*Institute Mediterannen of Ecology and Palaeoecology, Paul Cézaenne University, Aix-en-Provence, France*
[2]*Maison Méditerranéenne des Sciences de l'Homme, Aix-en-Provence, France*

Concerning palaeo-environmental studies, the complementarity is an advantage. Every discipline does not have the same spatial and temporal resolution. Aiming to better study the forest ecological systems, we crossover two disciplines:

The first, the pedoanthracology allows reconstructing the ligneous composition along time, with a high spatial resolution (study plot scale) and with a large temporal resolution (from 9000 BP to our days). However the temporal resolution depends on the dating method (radiocarbon absolute dating) and on the calibration to calendar years.

The second, the dendroecology, allows approaching the processes implicated in the forest spatial structure (e.i. disturbances, regeneration, and competition). The dendrochronology allows analyzing the forest history with great temporal resolution (i.e. one-year scale), dealing with multi-century resolution, depending of the age of the oldest trees.

Those two disciplines share the same spatial resolution. That makes easier the study of the forest dynamics history at a local scale, as we have shown concerning subalpine forest of Southern Alps.

NECESSITY OF A RATIONAL NORMALISATION OF THE PEDOANTHRACOLOGICAL METHOD

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Building the basement of a new discipline like the pedoanthracology is a fundamental research work. However, the academic research orientation, mainly practical and applied since the three last decades, has been not favorable to this necessary phase, prior to every development.

The increase in practitioner, sometimes coming from other discipline than vegetative ecology, provides a diversification of the methodology and of the data interpretation.

Designer of the discipline, we tried, during some years and without specific resources, to answer to some fundamental questions about the soil charcoal methodology and data extraction and interpretation.

However the improve of the methodology could be done only base on concrete observation and experimentation, detached from the dogma tyranny of the time.

However, looking of invariant, beginnings of every law, need a lot of observations, under different condition. Concerning the pedoanthracology, that means working in various, climatic, pedologic and ecologic conditions. Regarding the number of pedoanthracological and their investigation field over the world, refer to an existing and communal methodological corpus seems to be premature and even more suspect.

Since the human and financing resource for pedoanthracology are increasing, it is important to start to rationally build this methodological corpus, base on the experience and the experiment of the practitioner.

SPATIAL VARIABILITY OF SOIL CHARCOAL RECORDS

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Pedoanthracological studies are generally able to provid accurate spatial resolution on plant distribution. But what is the true spatial variability of the pedoanthracological data? Spatial high-resolution sampling within two 0.5 ha sites (five pits per 0.5 ha) has been carried out to assess the heterogeneity of the results obtained by soil charcoal analysis at a small scale. The results show heterogeneous patterns of soil charcoal distribution in terms of concentrations and botanical assemblages. Plant identifications and anthracomass values were analysed by principal component analyse (PCA). PCA show that between 48 % and 32 % of variance can be explained by inter-pit variability. The high resolution data obtained from a multisampling strategy is more efficient in the investigation of heterogeneity in soil anthracological assemblage. In addition, it is obvious that care is needed in the interpretation of data derived from the analysis of one single sample.

Key words: Charcoal analysis, high-resolution, Larix decidua, Pinus cembra, subalpine belt, soil, method.

FOREST AND STEPPE IN THE SUB MEDITERRANEAN GRANDS CAUSSES AREA (SOUTH MASSIF CENTRAL, FRANCE): HOW A CENTURY OLD PROBLEM, FORMERLY STUDIED WITH ECOLOGY AND ARCHAEO ANTHRACOLOGY WAS RECENTLY SOLVED BY PEDOANTHRACOLOGY

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The Causse Méjean is a limestone sub mediterranean low mountain with a contrasted vegetation : secondary *Pinus sylvestris* forest and afforestations in the west, "steppe" lawns secondaries in the east. According with de Martonne (1909) the causses dry lawns are the heritage of steppes of glacial ages. On the contrary Flahault (1934) and Marres (1935) explain that the lawns represent a regressive succession - since a former forest state - caused by fires and pasture. In 1965, Lorblanchet underline connections between forest and prehistoric settlement.

It is for that and for a better comprehension of this landscape and respective roles of man and natural conditions, we have initiated in the middle of the Sixties a research of archaeological charcoal, because the karstic environment was unsuitable to pollen analysis. In the Nineties, with the progress of AMS dating and isotopic δ C13 measurements, this work was continued based on pedo anthracology. Samplings close to small depressions or dolines bring us information about dating of early fires in the present non forested area. Moreover sandy dolomitic sediments were recorded as primary charcoal deposit for Holocene vegetation history .

Pedo anthracology attest than change from open glacial landscape to the present vegetation biodiversity does not took place before the mid Holocene on the causse on the contrary of the warmer valleys as archaeo anthracology record. The "steppe" lawns of the eastern causse would have their origin in the early Holocene pre steppic forest. This explains the persistence of steppic or alpine species in the east of the Causse Méjean. During the Neolithic and the Bronze age, man builds megaliths there, burns pine forest, then the herd preserved the open state of the landscape to beech natural reafforestation. On the contrary, in the western part of the Causse Méjean, mixed forest of *Pinus sylvestris* and *Quercus pubecens* there better developed were used by gallo roman for the extraction of pitch by distillation of branches of pines. This economic characteristic would protected the forest that was however strongly breaked in the XVIII-XXth century to reconstitute itself nowadays according to its prehistoric limits. However, a recent change begins because of the reafforestation of the eastern part of the Causse Méjean with *Pinus nigra* and *Pinus sylvestris*.

ABSTRACT OF COMMUNICATION

POSTERS

PEDOANTHRACOLOGY AND GEOARCHAEOLOGY: AN EXAMPLE OF METHODOLOGICAL APPROACH IN THE EASTERN FRENCH PYRENEES

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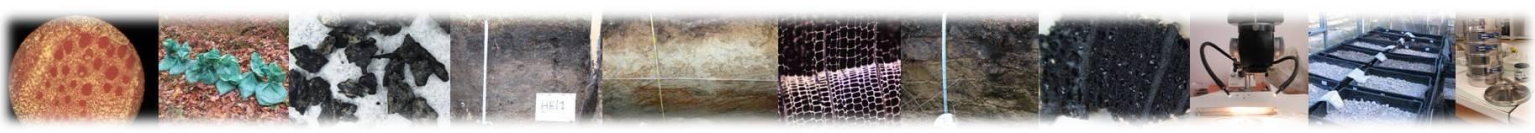
Soil terracing, present in most of mountainous regions of the world, is one of the most spectacular human modifications of the landscape. The study of ancient agricultural terraces, in association with their soils, represents an essential historical source and enables a better understanding of the anthropic change of landscape. We propose in our poster to demonstrate the role of a method that combines pedoanthracological and pedo-archaeological approaches to reconstruct the history of ancient agricultural terraces. This study shows a new application of pedoanthracoloical method in a geoarchaeological context.

Charcoals from paleosol and soil of agricultural terraces are good bio-indicators for reconstructing local vegetation dynamics related to agricultural practices and for showing the role of fire in ancient agriculture. The two stages of terraces are linked to successive phases of vegetation and correspond to different phases of construction and use. The Bronze Age seems to have been a turning point in the agro-pastoral construction, land-use ad transformation of the mountain landscape.

Key words: charcoal, paleosol, chronology, vegetation dynamics, taphonomy, agricultural terraces



HOLOCENE ENVIRONMENTAL CHANGE IN NORTHERN APENNINES

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The aim of this study is the reconstruction of the Holocene environmental changes of Northern Apennines through data coming from field observation, pedoanthracological analysis, dendrochronology and soil micromorphology.
The study area is located on the northern slope of Mt Cusna (2120 m a.s.l.). The present vegetation is characterized by deciduous forest dominated by *Fagus sylvatica,* up to 1700 m (potential treeline: about 1730 m). The areas above the treeline host herbaceous vegetation and *Vaccinium*-dominated heathland.
The area was settled during the Boreal and Atlantic by mesolithic hunters; occasional frequentation during the Subboreal, Iron and Roman Age has been recorded.
Entisols, Spodosols and Inceptisols can be observed. Paleosols, relict and buried by colluvial deposits, also occur, with frequent sedimentological and pedological discontinuity and stone lines; recent soils are developing on these colluvial deposits. Buried paleosols characterize an ancient surface extensively glacialized during the glacial maxima, then subjected to pedogenesis and finally superficially eroded and buried during the Holocene.
In the present study we described 10 soil profiles between 1700 and 2000 m; samples were taken from each soil horizon for physical and chemical analyses; a selective sampling was performed for the pedoanthracological and micromorphological analyses.
We identified two anthracological assemblages, the first one dominated by *Abies* and *Laburnum,* and the second one by *Abies* and *Fagus.* The AMS radiocarbon dating of a *Laburnum* charcoal sample to 3920-3700 y cal BP allowed to assign this vegetation to the Subboreal.
Previous dating of the deciduous species charcoal suggested the decrease of mixed forest during the first anthropic frequentation phase (Boreal and Atlantic); our charcoal analysis date the fire event and the lowering of the treeline within the Subboreal, the period of the second anthropic frequentation phase. Our results suggest the permanence of the woody vegetation at high altitude for a longer time than expected and could give a minimum age for the colluvial episodes and the burial of paleosols.

COMBINATION OF CHARCOAL DATA FROM ARCHAEOLOGICAL AND SOIL CONTEXT – PREVIEW AND FIRST RESULTS

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Charcoal from archaeological sites give us information about the wood usages of human in former times. Especially when charcoal belong to different archaeological find categories, different wood usages and a selection for special purposes can be distinguished. Further the dating of samples by archaeological findings and 14C datings gives the possibility to explore the development of forest composition and in connection with that human impact on their surroundings.

But for interpretation of wood usage by human, one key information is the environmental forest composition. This can be explored by pollen analysis and/or by soil charcoal analysis. Pollen analysis is not always possible near archaeological sites and some woody species are underrepresented in pollen assemblages. Further pollen diagrams exhibit a bigger catchment area than soil charcoal analysis but a better time resolution.

Comparing archaeological On-Site data with pedological Off-Site data brings further options for interpretation than natural forest compositions. This contains the range of human impact on forest composition in his surroundings. Near settlements human used the land for agriculture and pasture. With bigger distance to the settlement the impact diminished. The wood composition is influenced toward more open stands with light demanding species like *Corylus* and Pomoideae. This is shown by charcoal from archaeological sites. For soil sediments there are two possibilities: 1) near settlement was a normal or high fire frequency and the indicators of human impact like Pomoideae can be found or 2) near settlements was a low fire frequency and the signal of human disturbance is not directly stored.

To get the required information the archaeological site should contain information about wood usage preferable from different times and different archaeological find categories. The soil samples should be taken in a linear transect with growing distance from the archaeological excavation to estimate a gradient of human impact to soil charcoal composition and amount.

CHARCOAL SIGNAL FROM PEDOANTHRACOLOGICAL SAMPLES AND CHARCOAL PRODUCTION SITE SAMPLES: A QUALITATIVE AND QUANTITATIVE COMPARISON

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The pedoanthracological signal directly represents the locally burnt forest vegetation. The burnt vegetation is the result of a natural or anthropologic fire ignition. However, in some areas pedoanthracological assemblages could be influenced by the inclusion of charcoal pieces coming from charcoal production sites (i.e. kilns). Indeed, charcoal pieces could be transported along the slope, more or less far from their site of production, per example by water. Such pieces could be buried in the soil as secondary deposited, from where they are extracted for pedoanthracological analyses.

This transportation and secondary inclusion into the soil causes an enrichment in soil charcoal. Such enrichment could make it difficult for pedoanthracology to quantitatively compare the data between profile and soil. Moreover, if charcoal pieces from kiln are, as pedoanthracological data, representative of the forest vegetation of the surrounding of the kilns, they are significant through the "filter" of human production (i.e. they are not the direct record of the local forest vegetation). This aspect changes the qualitative interpretation of the charcoal assemblages.

In the Harz Mountain, in central Germany, the density of charcoal site production is quite high (estimated 30.000 kilns) and dates back to early medieval times. The combination of two PhD projects, one using pedoanthracological sampling and another one using kiln site sampling, allow to use both approaches on one area, and compare the results.

The study area is about 15000 m², with a slope of 25°, under a *Picea abies* forest. Four soil samples and five kiln sites have been sampled. The localization of the soil samples and the kiln site samples as well as the strategy of sampling, allow their comparison. This comparison will concern three main aspects: (1) the anthracological richness (quantitative comparison), (2) the taxonomical assemblage (qualitative), and (3) the chronological information. A second aim of the study is the developing of a tool to quantify charcoal evidence in respect to separating primary and secondary charcoal deposition in soil samples.

ANTHRACOLOGY AND GEOMORPHOLOGY COMBINING APPROACHES IN FIELD, LABORATORY AND DATA INTERPRETATION

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Using examples from two multidisciplinary projects on landscape reconstruction, we try to provide some suggestions for a combining geomorphological and anthracological approaches in field, lab and data interpretation. The two projects deal with different sedimentation processes; fluvial vs. aeolian erosion and accumulation.

The different processes result in distinct stratigraphic records. Charcoal recovered from these records enable a joined anthracological and geomorphological approach, which sides strengthens the interpretations of both approaches. We present some ideas, thoughts, and possibilities to improve the linkage between these two disciplines deriving from experiences we have gained throughout our projects.

MACROSCOPIC-TO-MICROSCOPIC QUANTIFICATION OF CHARCOAL FRAGMENTS AND PARTICLES: CONTRIBUTION TO THE CHARCOAL TAPHONOMY FROM UPPER PALAEOLITHIC SITES

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Within archaeological sites, charcoal deposits can result from cultural factors. Through time, human occupation soils were disturbed by many taphonomic processes changing the charcoal original deposits. Thus it becomes more difficult to interpret the charcoal presence and number due to ante- and post-depositional activities. From many Palaeolithic sites, a taphonomic approach of burnt residues could be taken into account to explain the absence and scarcity of charcoal in hearths. Wood is essential to ignite a fire and residual woody combustion material may still be enclosed at some archaeological levels. Thus far, archaeological excavations have rarely considered <0.5-mm-sized wood charcoals. The smallest wood charcoal particles produced by combustion processes and intense fragmentation processes have not yet been investigated, suggesting that some of the information on the presence of wood charcoal might have been lost.
Several quantification methods were developed in Quaternary sciences based on microscopic burnt plant remains named microcharcoal. We have developed an image analysis method, using these analytical methods, for a macroscopic-to-microscopic quantification of combustion remains, with the aim of evaluating burnt plant signal in hearths, archaeological features and sediments. Samples from the French sites of Abri Pataud (ca. 34–20 kyr BP) and Abri Castanet (ca. 33 kyr BP), and the Ukrainian site of Mezhyrich (ca. 15 kyr BP) were collected.

Our analysis method demonstrates the continuous presence of charcoal remains across all the levels. In many cases, charcoal is fragmented into microcharcoal amongst the finest particles of the sediments. It may be argued that the low frequencies of preserved macrocharcoal may be due to a high mass reduction and some taphonomic processes. Charcoal fragments and particles quantification provide more than just an observation of burnt macroremains in hearths, it actually relates to fundamental information on the presence of charcoal and the taphonomic processes, which took place in these archaeological sites.

WOOD IN ROMAN AGE: CULTURAL LANDSCAPES, FOREST EXPLOITATION AND TIMBER CIRCULATION. THE CONTRIBUTION OF PEDOANTHRACOLOGY.

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Pedoanthracology can help us to reconstruct the man-environment relationship in the past. We believe that it, together with archaeoanthracology, could have fundamental importance in analyzing the relationship between Roman civilization, forests and wood resources, which is the goal of our research project. In particular we are going to investigate wood and charcoal remains from archaeological contexts and soils in a very important area of the Roman empire: southern Italy (ancient Campania and Calabria regions), a place very rich in archaeological materials, but still relatively poorly studied from this point of view. The aim of our project is: 1) to define the Italian "cultural landscape" composed not only by cereal fields, vineyard and olive groves, but also by fruit and wood arboretums (for ex. chestnut and walnut) and managed forests; 2) to verify if and when Romans could have had a role in the diffusion of these typical cultivations; 3) to verify if a climatic optimum had really existed during the Roman Age; 4) to deepen the aspects regarding the timber circulation on a large scale in the Empire territories; 5) to verify if the fall of the Roman economy could be read by archaeoenvironmental *proxies*. Pedoanthracology, in association with archaeoanthracology offers an important method to vegetation reconstructions by providing records with high spatial detail on a local scale. It, therefore, allows us to have a comprehensive image of the vegetation in the examined area, to verify the occurrence of vegetation changes or the presence of signals of forest resources crisis. To do it, we are going to apply the pedoanthracology methods in a particular way. First, in collaboration with a team composed by pedologists, geomorphologists and geoarchaeologists, we will focus the charcoal analysis on soils dated to the Roman epoch, rather than on the whole pedological profile. The possibility to distinguish the more useful soil, by a chronological point of view, for our analysis is provided by different methods: the traditional radiometric dating, the observation of the morpho-stratigraphic relationships possibly present in the profile or the presence *in situ* of archaeological remains in, over or under the soil. It is what we are going to do, for example, in the vicinity of the Cecita Lake on the Sila Massif (Calabria), where the combination of pedological characterization of the soils and pedoanthracological analysis has already proved the transition from a *Quercus* dec. forest to a *Pinus* group *sylvestris* forest probably due to an overexploitation of woodland resources between Neolithic and Roman Age.At the same time we are going to apply the methods of pedoanthracological analysis to the archaeological soils: it is the case, for example, of the Poppea's Villa in Oplontis (Naples), where we will analyze the charcoals found in the last topsoil of the Roman garden saved by the primary *lapilli* fall of the volcanic eruption in 79 AD.

Key words: anthracology, pedology, archaeological contexts, deforestation, landscape changes.

FIRE HISTORY ASSESSMENT AT the LOCAL SCALE:COMPLEMENTARY USAGE OF PEDOANTHRACOLOGY AND MACRO-CHARCOAL ANALYSIS – ILLUSTRATION FROM NORTHERN GERMANY

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Fire history investigations are based on the assessment of fire events along time. For this, the chronological context is essential. Pedoanthracological information is not sufficient chronologically to be used alone to assess fire history. From pedoanthracological assemblages we can detect phases with more or less fire occurrences, based on radiocarbon dating of single charcoal pieces. But the detection and the temporal definition of such phases is highly dependent on the number of radiocarbon dates available.In contrary, the analysis of charcoal accumulation amounts and rates from chronologically stratified archives (e.g. lake sediments, peat sequences) allow to investigate fire history with a relevant chronological reference. But data from sediment anthracology do not provide direct information about the forest dynamics, and about which forest type burnt. However such information could be provided by soil charcoal analysis. Moreover, to assess fire history at the local scale (i.e. forest stand) using charcoal analysis from chronologically stratified archive seems to be still problematic in terms of spatial resolution of the fire signal. Concerning the spatial resolution of pedoantharcological, this seems to be less problematic because of the big size of the analyzed charcoal pieces (i.e. bigger than about 1 mm).
So, the combination of pedoanthracological data and sediment anthracology data, seems to provide a relevant complementary for the fire history assessment, improving the possibility of fire regime definition. In this presentation we illustrate this with two study cases from northern Germany.
For each of these study sites we did several soil samples. From them charcoal bigger than one millimeter have been extracted, quantified and taxonomically analyzed. Then some charcoal pieces, from the two sites, have been dated by C14 AMS. Moreover, from these two study site peat sequences have been cored. One them we did macro-charcoal analysis.

ANATOMICAL DISTINCTION OF LARIX AND PICEA CHARCOAL PIECES, USING BORDERED PIT IN THE RAY TRACHEIDS

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Pedoanthracological investigation in alpine, subalpine, boreal forest is particularly useful because of the rarity of any other palaeobotanical indicators, especially on a fine spatial resolution. However, the interpretation of the pedoanthracological signal of such conifer woodland is limited because of the difficulty to anatomically distinguish larch (*Larix* sp.) and spruce (*Picea* sp.). Based on their respective wood anatomy, larch and spruce are identifiable. But due to the small size of the charcoal pieces coming from pedoanthracological samples (i.e. millimetric size), most of the time, general anatomical criteria are not usable.
In this poster we present an anatomical comparative analysis of *Picea abies* and *Larix decidua*, based on previous work (Talon, 1997). The identification criteria used are bordered pit in the ray tracheids. We did series of "blind" identification of charcoal pieces coming from different specimen of a reference collection. We analyzed three series corresponding to three classes of charcoal piece sizes. For every series we analyzed two per two (i.e. pairs) 3 specimen per taxa. Every pairs include a set of 100 pieces of charcoal, randomly distributed between the two species.

For each pieces of charcoal identified the type of pit allowing the identification have been noted. Then we calculated the proportion of mistake for the different classes of size and the different pit type identified. First results indicate that the bigger proportion of wrong identification deals with the pit type L2 and P1. In contrary the proportion of wrong identification is small with the pit type L1 and especially P2. That allows us to definite the bordered pit in the ray tracheids L1 and P2 as better diagnostic pit type, and that indicates pit type L is more difficult to use alone as diagnostic pit type than the pit type P.
Then we observed that the proportion of wrong identification increase with the decrease of the charcoal size. These results confirm the conclusion from previous analysis. Finally our results suggest that, in the case of a big number of charcoal pieces to analyzed, looking for specific bordered pit type in the ray tracheids is very time consuming. Nevertheless the observation of diagnostic pit type allows the formal distinction between *Picea abies* and *Larix decidua*, with a relatively small risk of mistake, especially based on the presence of the pit type P2. Such information could be helpful concerning the interpretation of pedoanthracological assemblages and also for the selection of charcoal pieces to dating.

Talon, B., 1997: Etude anatomique et comparative de charbons de *Larix decidua* Mill. et de Picea abies (L.) Karst. C R Acad Sci Paris, Sciences de la vie 320, 581-588.

ANTHRACOLOGY BETWEEN NATURAL AND ANTHROPOGENIC DEPOSITS. CURRENT RESEARCH IN SE EUROPE

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In Context of my PhD-project "Tell in the woods-anthracological investigations in SE Europe and Turkey" samples from colluvial layers in the vicinity of archaeological sites will be investigated. The comparison of on-site and off-site analyses can give insight into the selection of single woody species used by man. It is also possible to detect the human impact on the surroundings. In addition it is possible to conduct the results of different disciplines to establish a clearer picture of the landscape dynamics by combining the results of pedological, anthracological and archaeological research.

Thus charcoal analyses can help to establish a better reconstruction of the woody vegetation around the archaeological sites, it is helpful because on the one hand anthracological investigations can lead to a better dating of soil layers and thus give insight to the degree of human impact during different (pre-)historical periods. On the other hand pedoanthracological analyses can be supplemented by archaeological investigation according to the formation of colluvial layers and landscape formation.

As example of pedological investigations in addition to archaeological work it is aimed at presenting first results from one site in Bosnia and Herzegovina.

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