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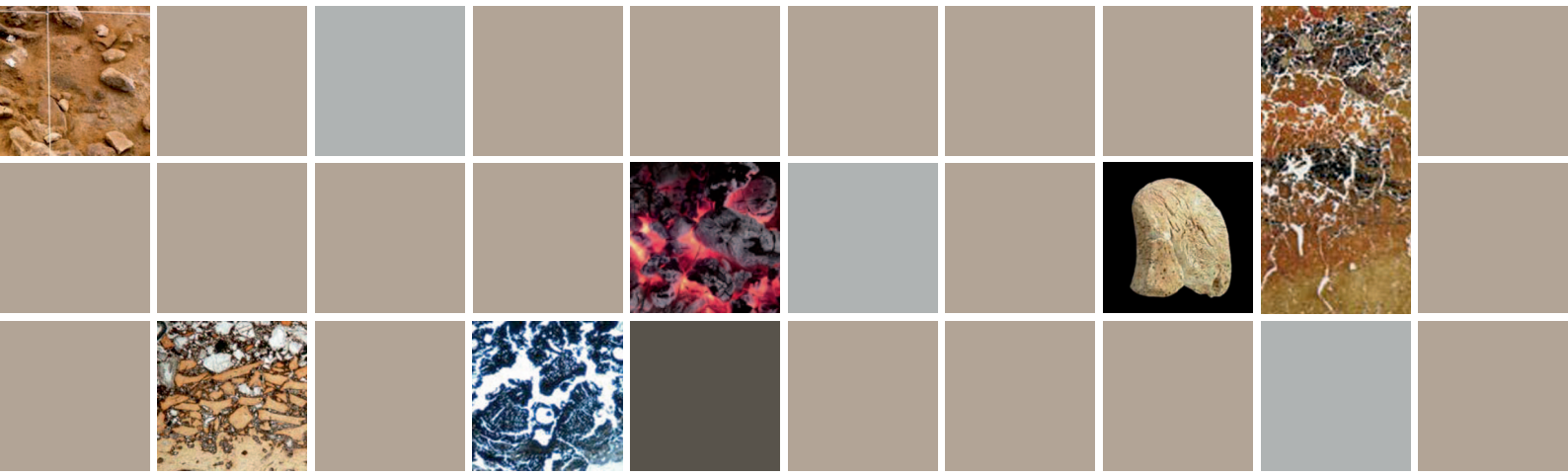
THE TAPHONOMY OF BURNED ORGANIC RESIDUES AND COMBUSTION FEATURES IN ARCHAEOLOGICAL CONTEXTS



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INTRODUCTION

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The articles in this volume are the result of a round-table entitled "The taphonomy of burned organic residues and combustion features in archaeological contexts", held on May 27-29, 2008 at the CEPAM (UPR 6130) laboratory in Valbonne, France. This encounter took place partly in the context of the Multidisciplinary Thematic Network, "Taphonomy", directed by Jean-Philip Brugal. The objective of this workshop was to review current and past taphonomic studies of burned organic remains and combustion features, to facilitate the sharing of knowledge and reference bases, as well as to initiate transdisciplinary collaborations and the development of collective research programs between different teams.

The burned "organic residues" at the heart of our reflections include diverse remains: human and animal bones, wood charcoal, seeds and fruits, phytoliths, etc. These can be the residues of intentional combustions (firewood, cremation, waste, for example) or accidental ones (proximity to a fireplace or wildfire). These remains document practices and knowledge and attest to technical choices and behaviors associated with a broad range of activities (funerary practices, food cooking, thermal treatment, waste management, etc.).

The materials that we study are the result of simultaneous or successive "processes" whose effects invariably lead to transformations, which, regardless of their nature, modify the assemblages and/or features in question and introduce biases that can influence our identification and/or interpretation of them. Having a greater knowledge of these "processes" and their effects is therefore a pertinent prerequisite to interpretation. But are we really speaking here of "taphonomy"?

The term Taphonomy (from the Greek *taphos*, burial, and *nomos*, law), first used by Ivan Efremov in 1940, designates in paleontology all the processes occurring after the death of an organism until its fossilization. Though these processes are rich and complex, the definition of the field of study is simple since it is traditionally considered as the transition of organics from the biosphere into the lithosphere. Archaeology has a wider definition of taphonomy,

including not only the natural processes that modify the thanatocoenose, but also all the cultural choices and gestures that have an impact on the plant, animal or human materials, from their natural environment to their fossilization. This use of the term is not accepted by all members of the scientific community, some preferring to limit the field to its strict paleontological definition.

Meanwhile, in the case of burned organic archaeological residues and their associated features, is it pertinent to limit our studies to the combustion processes and post-depositional processes by which they are modified? The analysis of these materials indeed raises many questions. For example, it is necessary to take into account all the stages of the "life of a fireplace", even before the combustion itself. The intentional or unintentional burning of organic materials, fire maintenance methods, culinary practices and ash clearing, for instance, are all factors that are linked to the rhythms and actions that determine the final effects of the combustion on the remains. Therefore, isolating the strictly physical and chemical processes of combustion may prevent us from considering numerous other variables that also contribute to the nature of the final buried residues that we study.

And what about the gathering, splitting, storing and drying of wood? Shouldn't we expect these actions, also related to the making of fire, to be significant as well? In zooarcheology, should we take into account the carcass processes that occur before culinary actions or intentional bone burning? In carpology, an ensemble of human activities is associated with the unintentional burning of seeds and fruits (drying, roasting, culinary preparations), but must we look as far back as the threshing, storage and cultivation of seeds? In physical anthropology, should we consider the funerary rituals that occur before the act of cremation itself? In other words, when we study combustion, how far back into the process must our questions reach? In broader terms, we must not forget that the archaeological deposits that we attempt to understand are the result of numerous actions and natural processes whose effects cannot forcibly be isolated.

In addition, it is evident that the experiments we conduct to imitate taphonomic processes must also take into account the practices and actions associated with combustion. Whatever the combustion method employed, choices must be made concerning the manner of burning: for example, the type and duration of ignition, whether or not to refuel the fire, whether or not to concentrate the embers, etc. Even if we standardize our experiments by limiting the variables analyzed, we necessarily influence the results through our manner of proceeding.

There are thus many arguments in favor of considering the totality of processes that affect burned organic residues and combustion features, ranging from sociocultural choices to the effects of climatic-edaphic agents and of course the phase of combustion itself. For this reason, drawing on numerous archaeological examples and discussions inspired by experimentation, a significant goal of this publication is to clearly define what we can and what we wish to analyze.

This workshop was organized around three themes: "Combustion or waste discard structures", "Physical anthropology and taphonomy", "Archeobotany and taphonomy" and "Archeozoology and taphonomy".

Chapter 1, "Combustion or waste disposal features and taphonomy", presents four contributions. The article by B. Masson addresses interpretations of the morphology of combustion features. Based on modern examples of periglacial processes, archaeological examples and experiments, the author reveals formal convergences between periglacial structures and combustion features attributed to Mousterian groups at the site of Saint-Vaast-la-Hougue. The contribution by C.E. Miller, N.J. Conard, P. Goldberg and F. Berna proposes an interpretation of features in terms of the function and functioning of fireplaces. This work is based on a micromorphological analysis of experimental combustions whose results are applied to the study of the site of Hohle Fels in Germany. Two other contributions concern the detrital contents of combustion features. In their paper, D. Bosquet, A. Salavert and M. Golitko show how the floristic contents of Linearbandkeramik

pits at three sites in Hesbaye (Liège Province, Belgium) can contribute information on the formation of pits and the formulation of hypotheses regarding the occupation duration of sites. Following a similar procedure, this time based on experimental data, G. Fiorentino and C. d'Oronzo study the formation of anthracological deposits and the contents of experimental combustion features to obtain information on the functioning of particular features (*escharon*) of the Sanctuary of Apollo at Hierapolis (Turkey) and the associated rituals.

Chapter 2, "Archeobotany and Taphonomy", includes five contributions. The first two present experimental studies of vegetal macroremains. The experimental analysis by M.-P. Ruas and L. Bouby addresses the effects of carbonization on carpological remains in function of diverse parameters such as temperature, heating duration, oxygenation and the condition of the seeds. The taphonomic biases generated by carbonization are evaluated for a range of cultivated and wild taxa, as well as other remains such as grain chaff. In their contribution, Théry-Parisot I., Chabal L., Ntimou M., Bouby L. and Carré A. present the results of wood combustion experiments in open fires. Through their analysis of the rate of disappearance of materials in carbonized residues and their fragmentation, they attempt to determine the degree of deformation of anthracological frequency spectra. In the domain of microremains, the contribution of C. Delhon proposes an experimental evaluation of the potential of phytoliths for the characterization of a carbonized ligneous biomass. This work analyzes the impact of ash dissolution processes, the difficulties associated with the taxonomic determination of the ligneous species phytoliths and the question of their origin (combustion or wood decomposition). The study of L. Marquer consists of a granulometric analysis of infra-millimetric wood fragments and proposes a quantification method based on image analysis, followed by its application to Paleolithic contexts in order to reveal the presence of these fine fractions in contexts in which wood charcoal fragments over 0.5 mm have disappeared through the actions of taphonomic processes. Finally A. Dufraisse, D. Sordoillet and O. Weller present an archeological, anthracological and micromorphological analysis of combustion features at the Neolithic site of *Poiana Slatinei* at Lunca (Neamt, Romania). In this work, the authors attempt to determine the origin, be it taphonomic or due to the salt production techniques employed, of the observed anatomical modifications of wood charcoals.

Chapter 3, "Archeozoology and Taphonomy", includes seven contributions. The first three specifically address the physico-chemical transformations of bones associated with heating. With the aid of various physico-chemical methods, I. Reiche describes modifications to the mineral phase of bone induced by heating and diagenetic processes. When applied to the archaeological remains from Chalain 19, these analyses reveal that analysis of the structural heterogeneities of of bones is an effective method for identifying the heating methods employed. Using infrared spectroscopy, M. Lebon proposes a new method based on the study of the $\nu_1\nu_3PO_4$ domain, which allows evaluation of three heating temperature ranges. This protocol can contribute to a more reliable identification of bones heated at low temperatures and a distinction of modifications related to heating from those of diagenesis in an archaeological context. The study conducted by A. Zazzo indicates that the mineral fraction of bones heated at high temperatures cannot be used for the reconstruction of diets due to a modification of the $\delta^{13}C$. On the other hand, calcined bone is a reliable material for radiocarbon dating, allowing us to test, in certain cases, the reliability of dates obtained on carbonized bones whose age can reduced in certain burial contexts. The four other contributions treat burned bones on a macroscopic scale according to two distinct approaches, one experimental Costamagno *et al*.; Gerbe), the other archaeological (Rillardon & Bracco; Morin). The objective of the experiments realized by M. Gerbe was to document the modification of burned bones exposed to the actions of atmospheric agents. She observed a high fragmentation of the materials, particularly for calcined, spongy bone fragments. In their paper S. Costamagno, I. Théry-

Parisot, D.Kuntz , F. Bon and R. Mensan analyze the impact of a prolonged combustion on bones used as fuel. An increase in the heating duration leads to an increase in the intensity of fragmentation and combustion, in particular for the spongy portions. Since these latter are more sensitive to the actions of certain processes, depending on the taphonomic history of the assemblage, a potential use of bone as fuel can be masked. The contribution of M. Rillardon and J.-P. Bracco presents a study of calcined bones found in a context unfavorable for the preservation of bones. Finally, E. Morin discusses the consequences of bone combustion for interpretations of skeletal part representations. He emphasizes the problem of equifinality in the use of bone as fuel and the differential preservation of bones.

A synthesis of the studies in each domain emphasizes the need to combine experimental approaches and analytical tools in order to reach a level of analysis that allows an integrated approach to combustion features and residues.

To conclude, we would like to express our gratitude to all of the protagonists of this project who contributed to its realization. First, both the organization of the workshop and the publication of these proceedings benefitted from the financial support of numerous institutions: the RTP Taphonomy, the CEPAM (UMR 6130, Sophia-Antipolis), LAMPEA (UMR 6636, Aix-en-Provence), TRACES (UMR 5608, Toulouse) and CBAE (UMR 5059, Montpellier) laboratories, the MSH's of Nice and Toulouse, ArScAn (UMR 7041, MAE Nanterre), the University of Neuchâtel/Laténium, the University of Liège, INRAP and the SRA Midi-Pyrénées. We also wish to thank all of the contributors who through their interest in this theme insured the scientific success of the workshop both in terms of the quality of the presentations and the richness of the discussions. The scientific organization of this encounter, as well as the significant editorial work, were realized with the active participation of the scientific committee, to whom we express our heartfelt thanks: Jean-Philip Brugal (LAMPEA, UMR 6636, Aix-en-Provence), Claire Delhon (CEPAM, UMR 6130, Valbonne), Henri Duday (PACEA, UMR 5199, Talence), Paul Goldberg (Boston University), Marie-Pierre Ruas (CBAE, UMR 5059, Montpellier), Brigitte Talon (IMEP, UMR 6116, Aix-en-Provence) and Benoit Devillers (UMR 5140, Lattes). Finally, we express our appreciation to the editorial committee of *P@lethnogie*, which very favorably welcomed our request to publish these proceedings, including Yann Beliez, who realized the layout, for the rigor of his editorial work, and Magen O'Farrell for the ensemble of French to English translations. We also thank Jeannine Francois and Françoise Trucas who efficiently aided us in the organization of the workshop, as well as Monique Clatot and Sabine Sorin for the realization of the editorial work.

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