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Guest Editorial

An archaeology of fuels: Social and environmental factors in behavioural strategies of multi-resource management

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1. Introduction

The management of fuel resources by past societies has been mostly considered from the perspective of pyrotechnology and fire-related activities, all approached along the fire *chaîne opératoire*: combustible supply, energy production and fire use, and by-product disposal. Within this frame, combustible is widely assumed to have been for long mainly provided by fresh biomass resources (plant and animal). Therefore, the control of environmental factors on the availability of these resources is generally viewed to have exerted a major role on behavioural strategies of fuel management.

In this research context, the technology of fire and the identification of fire evidences have reached important contributions in specific historical periods (e.g. Palaeolithic, Oakley, 1956; Clark and Harris, 1985; James, 1989; Bellomo, 1993; Goren-Inbar et al., 2004; Karkanas et al., 2007; Stahlschmidt et al., 2015) and disciplines (e.g. Berna et al., 2012; Sorensen et al., 2014; Stahlschmidt et al., 2015). However research on fuel management and energy consumption does not occupy at present a pivotal role in the reconstruction of ancient cultural dynamics and their close linkages with past environmental factors based on archaeological data. Even more, the critical issue of fuel acquisition and energy consumption is not at present fully considered in archaeological studies, although these factors are by essence major components of the economic strategies and the natural resource management relevant to the understanding of societal dynamic.

In fact, most studies of soils, plant and animal remains developed along the last decades have been directed to provide basic information on the nature of fuel, fuel acquisition practices, energy production with respect to diverse fuels resources and fire uses based on a wide range of archaeological records with continuous improvement of analytical protocols (e.g. Miller, 1984; Albert et al., 2000; Théry-Parisot, 2001; Asouti, 2003; Marquer et al., 2010; Dufraisse, 2012; Miller and Marston, 2012; Smith et al., 2015).

At present, the articulation between the considerable database obtained on fuel and energy archaeological markers with theoretical and methodological issues on socio-economical and cultural dynamics remains to be consolidated. Surprisingly, the question was raised long ago by Heizer (1963) who pointed that only very few ethnographers and archaeologists are concerned by the importance of fuel and fire use. Heizer pointed that this situation reflects the general opinion of social scientists to consider fuel procurement and consumption as a routine and mundane activity, mainly performed by women and children, with apparently no connection with any relevant social, economic or cultural aspects.

Obviously, beyond the technical and methodological improvements that are essential to provide high quality sources of information, at present the major issue is to fully explore and exploit the social and environmental relevance of all data related to fuel and energy in the archaeological record. Both constitute a core issue of the present global societies, and from other disciplines, as sociology or political ecology, new approaches about the socio-environmental significance of energy consumption are arising (e.g. Fernández and González, 2014; Horta et al., 2014). The weak articulation of approaches related to fuel and energy with socio-economic issues in archaeology is possibly related to the segmentation of the scientific communities that are involved in the study of fuel and energy resources in order to match the diversity of all the basic data extracted from the archaeological record (e.g. charcoal, geoarchaeology, phytoliths, etc.). This high level of specialization has greatly contributed to confuse the exact contour of a coherent scientific domain that is fully devoted to the study of fuel use and energy consumption by past societies.

The sharing of knowledge about fuel and energy among specialists is, thus, a necessity not always easy to achieve. Journals, conferences and workshops are often centred in one kind of analysis and/or disciplines, and to reach a transversal approach to a specific issue is difficult in this sense. Moreover, in the case of the archaeological study of fuel and energy, there is also the difficulty of sharing knowledge and backgrounds between the so-called *archaeological scientists* and the *theoretical archaeology* (*sensu* Pollard and Bray, 2007). This gap existing between disciplines, centred in a specific fraction of the archaeological record or in the general interpretation of chronocultural periods and/or specific social issues, is a challenge to confront, and the study of fuel and energy issues is no exception to this.

In the archaeological literature, the technological dimension of research dealing with fuel procurement and consumption has not

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really emerged in contrast to the long development of technological studies in lithics, metallurgy or ceramic production. On a same way, there has been nearly no attempt to consider the evolutionary trend of fuel production and energy consumption among past societies through time and across cultural territories, while considerable research has been devoted to understand the long and complex processes of plants and animals domestication. As a consequence, there is a critical need to restore the central dimension of all aspects related to fuel and energy resources.

The development and application of analytical techniques to the archaeological record is providing, and will continue to provide, major information about fuel and energy consumption. The community of the involved archaeological scientists is expected to develop an increasing interest for socio-environmental issues related to fuel and energy consumption, far beyond simple technical aspects related to data collect and analytical methods. New archaeological questions – and not just *scientific techniques* – need to be raised in order to transform fuel and energy issues into a common ground for all different kinds of archaeological practices and narratives. This is to locate fuel and energy into the archaeological narratives as an arena of society and environment interactions and thus, a central and common topic for the entire archaeological community, regardless of any technical specialization or the time and space of the cases of study.

It is with this aim that the session *An Archaeology of fuels: social and environmental factors in behavioural strategies of multi-resource management*, held in the past XVIIth World Congress of the International Union of Prehistoric and Protohistoric Sciences (Burgos, Spain, September 2014), took place. The gathering of specialists from different archaeological disciplines, dealing with diverse historical periods in the five continents has greatly contributed to provide a broad overview on present trends of research related to fuel management in the archaeological record through cultural periods and across cultural territories.

The contributions presented allow to discuss the integrated characterization of fuel resources from all environmental related disciplines: archaeobotany, zooarchaeology, geoarchaeology, and geochemistry. Their contextual interpretation in terms of energy production at all scales of occupation units within the frame of archaeological data has been an aspect of particular interest. The participants of the session critically analyzed the relevance of field-analytical procedures, experimental archaeology and ethnoarchaeology to provide a comprehensive database of indicators with respect to fuel sources, combustion processes, firing products and related residues. The open debate among researchers issued from various scientific backgrounds has allowed questioning our ability to trace changes in the availability of fuel resources through time, and to decouple the complex interaction of environmental and social factors on fuel management practices. These exchanges have allowed discussing further how to explore the data extracted from archaeological records in terms of social behaviour, particularly with respect to energy production and consumption in diverse contexts (domestic households, manufactures, ritual and funerary practices, etc.).

As a result of these fruitful discussions and exchange of knowledge, this special issue of *Quaternary International* provides an overview of the diverse research trends that are emerging on fuel and energy related issues. This research effort aims to create a common ground for all the environmental and archaeological communities in relation to the challenging issues linked to the role of fuel and energy resources on human evolution from a socio-environmental perspective. The contribution of diverse disciplines and the presentation of multi-proxy approaches intends to offer to the archaeological community an opportunity to critically discuss how the socio-environmental relevance of fuel procurement and energy consumption has been so far considered and what can be done further to improve our knowledge. The diverse contributions to the volume illustrate how to erase borders between disciplines and how to encourage a joint research effort to consolidate a common technical, methodological and theoretical background related to this ubiquitous research topic.

2. Different subjects for a common approach: fuel and energy in archaeological research

A diverse group of issues is considered in this volume, departing from different sources of archaeological information and diverse historical contexts. A common topic considered in some of them is the role of fuel procurement and consumption among hunters and gatherers communities in the past. These contributions study how fuel acquisition and energetic demands have integrated and influenced the global economic and territorial strategies of these groups.

E. Allué and colleagues examine archaeological evidences of fuel and energy practices among Neanderthals in Abric Romaní (NE Iberian Peninsula) on the basis of anthracology and taphonomy (Allué, in this volume). Through these datasets, different aspects of the Neanderthal's community life are approached during the time-span covered by the stratigraphic sequence of the site. Key aspects, like natural resources acquisition, mobility patterns and type of occupations conducted in the site are approached from an energy and fuel point of view.

Fire uses among Neanderthals are also discussed by Rodríguez-Cintas and Cabanes (in this volume) in their approach that combines phytolith and FTIR analyses to distinguish anthropogenic and natural evidence from combustion structures in the site of El Salt (Eastern coast of the Iberian Peninsula). This integrated research allows the authors to distinguish between natural and anthropogenic evidences recorded in the studied combustion structures and to characterize the diverse fuel sources used by the occupants of the site. A. Rodríguez-Cintas and D. Cabanes are thus able to interpret the retrieved data as evidence of ephemeral occupation involving the use of fire, enlarging the characterization of the activities carried out in the context of Neanderthal campsites.

Regarding recent hunter–gatherers, Monteiro et al. (in this volume) analyse the role of fuel in Mesolithic societies occupying a shellmidden site in the Atlantic coast of the Iberian Peninsula. The authors confront anthracological data from both domestic and funerary contexts of the same site with pollen analysis in order to infer firewood acquisition strategies among Mesolithic hunter–gatherer groups during successive occupations.

Alcolea-Gracia (in this volume) interrogates anthracological sequences from different sites in the Mediterranean region of the Iberian Peninsula to approach fuel acquisition strategies among the last hunter–gatherer communities. She confronts environmental data with the anthracological sequences of sites occupying different biogeographical areas (plains and mountain) to create a general picture of the strategies of the Mesolithic groups in a vast area and in relation to a period of environmental changes preceding the beginning of the productive economies in the area during the Neolithic.

Hunter–gatherer's fuel practices are also examined by Bachelet and Scheel-Ybert (in this volume) during the Holocene occupation of the Santa Elina rock shelter in the Mato Grosso region of Brazil. During the long Holocene sequence excavated in the site, vegetation changes are described and, through anthracological analysis, the authors approach how firewood acquisition patterns interact with these ecological changes. Different firewood procurement practices are described, as well as shifts on fuel preferences from one occupation to the others.

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