Short, but repeated Neanderthal visits to Teixoneres Cave (MIS 3, Barcelona, Spain): a combined analysis of tooth microwear patterns and seasonality

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ARTICLE INFO

ABSTRACT

A new approach combining two proxies is presented with the aim to provide valuable data to better understand the patterns of human occupations in Palaeolithic sites. We employed the analysis of tooth microwear patterns combined with an estimation of the seasonality through tooth eruption and wear patterns of the ungulates. Each proxy brings different types of information. The variability in tooth microwear patterns allows for the estimation of the duration of occupational events at a site while the estimation of seasonality permits to situate temporally these events through the year. The research involved four Middle Palaeolithic archaeological levels from Teixoneres Cave (Moià, Spain). The combined analysis allowed for the identification of different patterns of occupation at the site: (1) short seasonal occupations at a single season such as in level IIa at the beginning of the summer and in level IIb in autumn and early winter, (2) repeated seasonal occupations of the site at all seasons such as in the underlying level IIIa, and (3) repeated seasonal settlements at two specific seasons (summer and winter) as in level IIIb. Our results show congruence between the two methods which imply that combined approaches would allow a better knowledge about the occupations that occurred in the cave, in particular about the duration of Neanderthal occupations.

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1. Introduction

Mobility patterns of human groups are the result of decisions associated with social and environmental factors (Kelly, 1992, 1995). The concept of "mobility" is defined as the strategic displacement of residential sites from one location to another in search of resources necessary for the subsistence of a group (Ignold, 2000). These factors influence the subsistence strategies (Butzer, 1982) and the choice of location for the settlement (Díez and Rosell, 1998). Neanderthal groups are characterized by a high behavioral diversity which depends on many factors such as the environment and its variability (de la Torre et al., 2013, Miller and Barton, 2008). Neanderthals are also characterized by a high mobility (Conard et al., 2012, Niven et al., 2012, Richards et al.,

2008). An example of this high mobility during the Middle Palaeolithic is observed at Teixoneres Cave (MIS 3, Barcelona, Spain). The predominant hypothesis suggests human occupations by small groups of *Homo neanderthalensis* during short periods of time in a context of high mobility (Rosell et al., 2010b). In between these short occupations, carnivores used the cave with a constant dynamic through time. The duality of the archaeological record (Neanderthal and carnivore occupations) and the existence of palimpsests determined by the low rate of sedimentation in the cave should be noted (Rosell et al., 2010a, 2010b). Thus, duality is due to the differential accumulation of the assemblage by two agents from the action of large carnivores (*Crocuta spelaea* and *Ursus spelaeus*) and that generated by Neanderthals. The materials accumulated by each of these groups (carnivores and humans) are distributed in two distinct areas: the Neanderthal occupation is mainly located at the entrance of the cave, while the carnivore activities are developed inside the cave (Rosell et al., 2010a).

The purpose of this study is to estimate the duration of human occupations in four archaeological levels (levels IIa, IIb, IIIa, and IIIb)

at Teixoneres Cave using a new approach. We propose to use the analysis of tooth microwear patterns combined with an estimation of the seasonality through tooth eruption and wear patterns on ungulates with the aim of obtaining results that allow a better understanding of the occupations that occurred in the cave. This will allow us to characterize the behavioral patterns associated with this environment in which these human groups developed their activities.

The application of the tooth microwear technique ensures a study of high temporal resolution. This is possible because tooth microwear patterns are produced in short periods of time. They have a high turnover of hours or days, and consequently, reflect the feeding activity of the last days of life of an animal. Therefore, this pattern reflects the animal's diet and the environmental conditions at the time of its death. This pattern will vary annually according to seasonal dietary changes. The variability of the microwear pattern is known to be correlated with the duration of accumulation of an assemblage (Rivals et al., 2009b). Therefore, by comparison with extant ungulates, it allows for an estimation of the duration of human occupations in a particular locality. The information obtained corresponds to the exact moment in which the occupation has occurred at the site. The technique is presented as a great complement to the classical zooarchaeological studies especially because it can be considered as a non-destructive method.

Studying the season of death of ungulates can provide some clues on when a site was occupied. Various studies, conducted using wild species, provided information on the replacement of deciduous teeth with permanent teeth in wild animals (Azorit et al., 2002, Greenfield and Arnold, 2008, Morrison, 1997). Assuming birth synchrony and a single calving period per year, the observation of tooth eruption sequence and replacement allows for an estimation of the age at death of the young individuals, and thus an assessment of the season of death of each individual. The application to archaeological contexts is now widely used (Álvarez-Lao et al., 2013, Carter, 1998, Morin, 2012). However, the resolution of the method is crude and identifying a single hunting season does not discern between occupations lasting only a few days and longer occupations of a few months. Nevertheless, the combined approach with tooth microwear can provide more precise data about the duration and the seasonality of the events. If an assemblage contains animals that were hunted during one season, then the data indicate a minimum estimate of seasonal use. Of course, absence of game from other season(s) does not prove that the site was then unoccupied. It is important that seasonality studies incorporate as many species as possible. We intended to include here all species and specimens available (i.e. all deciduous teeth).

We propose to test the hypothesis that all occupations (in the four levels) correspond to short occupations (i.e. seasonal occupations or shorter). We expect the combination of the two methods, tooth microwear and seasonality from tooth eruption and wear, to provide valuable data to better understand the patterns of occupations at Teixoneres.

2. Cova de les Teixoneres

Teixoneres Cave is located in Catalonia, near the town of Moià (Barcelona, Spain) at an altitude of about 900 m a.s.l (Fig. 1). Its coordinates are 2°09′02″E and 41°48′23″N. The formation of the cave is related to the drainage system of the Torrent del Mal, resulting in the formation of a karst system that developed in a Neogene limestone (Collsuspina Formation). The cave, which is U-shaped, has an approximate length of 30 m. It is composed of three different chambers (namely X, Y, and Z). It has two entrances corresponding to chamber X (main entrance) and chamber Z (smaller access).

A first chronology of the site was established by U-series dating on samples from the stalagmite layers present in levels I and IV, respectively overlying and underlying the levels studied here (Fig. 1). Levels IIa, IIb, IIIa, and IIIb range between 14 ka BP (level I) and 100 ka BP (level IV) (Tissoux et al., 2006).

More recently, on the basis of the rodent assemblages (presence of *P. lenki*, *Microtus* (*Iberomys*) *cabrerae* and *Hystrix* sp.) the chronology was reduced for Levels II and III to between ca 30 and 90 ka BP (López-García et al., 2012). The study of the microfauna from Level III shows warm and humid conditions that would be associated with an Interstadial period of the MIS 5a, while Level II presents cold and dry conditions probably associated with the Heinrich Event (H3 to H5) of MIS3 (López-García et al., 2012). The pollen analysis suggests that conditions at Levels II and III are characterized by a predominance of open forest landscapes.

The study of the macro-faunal and lithic assemblages indicate the presence of human groups in the cave during short and sporadic occupations (Rosell et al., 2010b). A wide diversity of taxa has been identified in levels II and III. This includes carnivores such as *U. spelaeus*, *Crocuta crocuta*, *Canis lupus*, *Vulpes vulpes*, *Lynx spelaea* and *Meles meles*; as well as a large range of herbivores, such as *Stephanorhinus hemitoechus*, *Equus ferus*, *Equus hydruntinus*, *Cervus elaphus*, *Capreolus capreolus*, *Bos primigenius* and *Capra* sp. Small animals (leporids and, to a lesser extent, Erinaceidae, tortoises and birds) are also present. The faunal assemblage represented by a high proportion of proximal appendicular and cranial (mandibles and maxillae) elements indicates a primary access to the ungulates and a selection of the most nutritious elements (limb bones). All the processing and consumption activities took place at the site, indicated by a high degree of fragmentation and use of fire (Rosell et al., 2010b). From the horizontal distribution of the remains at the site, faunal remains with anthropogenic evidences, lithic artifacts, and charcoals are clustered and located in the area at the entrance of the cave (Rosell et al., 2010b). The remains with evidences of carnivore activity are more dispersed and located at inside of the cave. This spatial differentiation permits to distinguish the accumulations generated by the two agents (Rosell et al., 2010a).

The lithic assemblage from levels IIa and IIb is very scarce (N = 41) and fragmented because no technological attributes or typological morphotypes allowed for an association to a clear chronocultural period (M.G. Chacón Navarro, pers. comm.). The lithic assemblage from level III, which was studied without differentiating between sub-levels IIIa and IIIb, has an expeditive character with final products and nucleus in the final phase of the reduction sequence, and flakes, retouched elements and exhausted core introduced into the cave from other sites (Rosell et al., 2010b). The diversity of materials and the combination of local raw materials (orthogonal and discoid debitage) with non-local materials (Levallois method) seem to support the hypothesis of high mobility of the groups.

3. Material and methods

The sample analyzed comes from the material recovered during the archaeological excavations performed between 2003 and 2011 at Teixoneres Cave. As the assemblage is the result from both anthropic and carnivore accumulations (Rosell et al., 2010a), the material sampled was selected from the area at the entrance of the cave where evidences of Neanderthal activities are observed. The material recovered inside the cave was discarded because it is associated to carnivore occupations. The selection of teeth suitable for microwear analysis is determined by various factors such as the occlusal surface in apparent good condition and visible wear facets on the surface. The teeth that do not show these features were automatically discarded. We sampled and analyzed dental material