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Investigation of Upper Palaeolithic adhesive residues from Cueva Morín, Northern Spain

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ABSTRACT

This paper presents the results of a multi-methodological approach to investigate residual spots preserved on several artefacts from the lithic assemblages at Cueva Morín (Cantabria, Spain), dating from the Aurignacian and Gravettian periods. In analysing their composition, our focus was twofold: to determine whether their origins are natural or anthropogenic and verify their presumed Pleistocene age assignment. The latter point was particularly important since being stored for more than 40 years in a museum complicated the surface preservation of many of the lithic artefacts. A combination of analytical techniques was used: Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, and scanning electron microscopy/energy-dispersive X-ray spectrometry (SEM/EDX). Using these techniques, both the anthropogenic background and the Pleistocene dating were verified. Furthermore, the results of the spectral analysis of residues led to their functional interpretation as adhesives with diachronic chemical alternations in the production process. Further use-wear analysis could add important information about the functions of these artefacts.

1. Introduction

Given the shift in lithic analysis towards rather functional interpretations in the 1960s and 1970s (*cf.* Binford, 1980), one would have expected an increased focus on the analysis and implications of possible hafting arrangements. As L. H. Keeley (1982) noted, however, the influence of hafting technology is often neglected for interpretation in lithic studies. This is an important point since this kind of information seriously affects our knowledge of tool functionality and handling (Rots, 2009). Other implications of hafting are linked to the settlement function; as proposed, hafting and retooling activities would be conducted more intensively in long-term occupation sites (Keeley, 1982). The reasons for this discrepancy between the significance of hafting and its absence from the agenda of lithic analysis are twofold. First, the methodology for the standardised indirect microscopic classification of hafting traces was only recently developed (Rots, 2003; Lombard and Wadley, 2007). Second, the required skills, equipment, and money (*e.g.* conducting direct chemical analysis of preserved residues) pose obstacles. The latter is also affected by the generally poor preservation conditions of organic residues on non-porous materials (Evershed, 2008).

Artefacts that provide both the implements and the shaft are therefore of great interest for our general understanding of hafting technology. Well-known ethnographic examples from Australia and Africa provide analogies, or at least a range of possibilities, for archaeological reconstructions (but see Urquijo et al., 2015 for a critical discussion). In contrast, examples of preserved composite tools from the Pleistocene are rare. One of the oldest example is a bilateral bone projectile from the Upper Palaeolithic site of Ostrovskaya/Talicki in the Ural Mountains, where Micrograveltes were attached to the shaft in a groove using glue. However, due to decomposition of the shaft, an exact reconstruction of length and diameter is not possible (Abramova, 1982). Other examples include antler points from the Magdalenian Level of Pincevent (Leroi-Gourhan, 1983) and a fragment of an antler point with two unilateral implemented unretouched bladelets from Karakovo I (Abramova, 1982). The latter was found inside the scapula of a wisent, which supports the hypothesis that many pointed composite tools were used as hunting weapons.

1.1. Traces of lithic hafting technology during the Pleistocene

Aside from the few abovementioned examples of preserved composite tools, most Palaeolithic studies only deal with the one class of

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artefact still preserved—lithic implements. The earliest examples are two artefacts with birch tar residues from the MIS 6 occupation at Campitello, Italy (Mazza et al., 2006). Others include the adhesive remains on lithics from South African MSA cave sites (Lombard, 2008; Wadley et al., 2009), Middle Palaeolithic artefacts from Inden-Altdorf in Germany (Pawlik and Thissen, 2011), or Umm el Tlel and Hummal in the Levant (Boëda et al., 2008; Monnier et al., 2013).

The compositions of adhesives vary from acacia gum, mastic, beeswax, and ochre in South Africa to natural bitumen in the Levant. Although analysed artefacts from Europe have mainly shown birch tar remains, a recent residue analysis from Gura Cheii-Râşnov Cave in Romania provides information about the use of natural bitumen from the late Mousterian to the Mid-Upper Palaeolithic as well (Cârciumaru et al., 2012). Regarding the connection between hafting and function, Aurignacian artefacts from Hohle Fels in Germany have provided interesting results (Hardy, 2009). Many of the analysed tools show traces of hafting, alterations in function, and a long use life, which was unexpected based on their classical morphologic/typological classification. Similar patterns were observed on three burins from the Proto-Aurignacian assemblage at Les Vachons (Dinnis et al., 2009). While birch tar was reconstructed as the adhesive for these burins, use-wear analysis pinpointed their function in two cases as projectile implements, which differs from previous functional interpretations of this tool class. The use of diverse, composed adhesives, along with variations in functional biographies, also played a role in the Upper Palaeolithic of Cueva Morín, as discussed below.

1.2. Framework of the studied artefacts: the Upper Palaeolithic of Cueva Morín

Cueva Morín, also known as Cueva de Villanueva and Cueva del Rey, is located 6 km south of the Bay of Santander in Villanueva de Villaescusa (Fig. 1). It is part of several other cavities inside a small hill of Cretaceous limestone, with an entrance approximately 20 m above the valley bottom. The scientific significance of this site for the regional Palaeolithic stems from a long research history, beginning in 1915, which has resulted in a comprehensive number of investigated square metres, documented artefacts, and a chronological depth with several metres of stratigraphy (Maíllo-Fernández et al., 2014). Recent fieldwork by two teams lead by J. González-Echegaray and J. M. Maíllo-Fernández and J. Gonzalez-Urquijo and G. Chr. Weniger involved only small excavation areas with final publications still pending. As such, current knowledge about the site is still based on the Spanish–American project led in the 1960s by J. González-Echegaray and L. Freeman, who conducted three major campaigns covering ~31 m^2 (González-Echegaray and Freeman, 1971, 1978). They revealed a complex stratigraphic sequence of 22 levels, spanning from the Mousterian to the Azilian, and recovered thousands of artefacts.

The lithic artefacts investigated in the present study were discovered during those campaigns. Apart from the long Middle Palaeolithic Sequence, the time frame for the Upper Palaeolithic occupation at Cueva Morín comprises a total of nine levels. For this study, Levels 4, 5a, and 9 are of importance. Levels 4 and 5a can be attributed to the Gravettian techno-complex (Bradtmöller, 2015), and Level 9 is classified as Proto-Aurignacian (Maíllo-Fernández, 2001). All levels preserved relatively large amounts of lithic assemblages. There are traces of local lithic exploitation with various reduction techniques and diverse activities in the domestic sphere, represented by tool types such as scrapers and truncations. However, there are also remains of the maintenance and production of projectiles. Level 4 represents a 'classic' Gravettian assemblage with Gravette points and Microgravettes, while typical Noailles burins are missing (cf. Calvo et al., in press). Level 5a also exhibits the typical backed tool types, though a higher percentage of simple retouched blades is observed here (Maíllo-Fernández et al., 2014). Level 9 exhibits only a small amount of backed tools and a larger proportion of typical Dufour bladelets. With a subdivision of the Cantabrian Gravettian actually not possible (Arrizabalaga and Peña, 2013; Bradtmöller et al., 2015), the two recently obtained radiocarbon dates of 23,640 ± 190 BP (Poz-66758) and 23,790 ± 190 BP (Poz-66759) assign Level 4 to a later phase of the Gravettian time frame (Bradtmöller, 2015). The radiometric ages of Levels 5a and 9 are unavailable, but a coherent dating from Level 8 gives a *terminus antequem* for Level 9 (GifA-96263 36,590 ± 1100 BP) (Maíllo-Fernández, 2001).

2. Materials and methods

2.1. Materials

The Upper Palaeolithic lithic artefacts studied in the present research are from Levels 4, 5a, and 9 of Cueva Morín. The lithics from these assemblages are generally well preserved without intensive traces of storage. They exhibit 'fresh' edges, while many pieces are still covered with Pleistocene sediment (especially the smaller debris). Furthermore, several artefacts show adhering residues. Some could be macroscopically preliminary assigned as ochre, while others present a black, compact material. These residues were first described and assigned as possible adhesives during lithic analyses of Levels 4 and 5a in a PhD thesis on Gravettian lithic technologies and cave-use patterns in Northern Spain (Bradtmöller, 2014). Unfortunately, it was not possible at that point to verify their Pleistocene assignation or determine their anthropogenic or natural origin. This problem is related to the long history of artefact labelling, which causes diverse alterations to the original surfaces.

The first indication of Pleistocene origin is found in the distribution patterns of the residues. These are generally absent from the surfaces of old, patinated fractures—an unexpected situation with randomly adhering sediment or recently applied modern glue for exhibition or

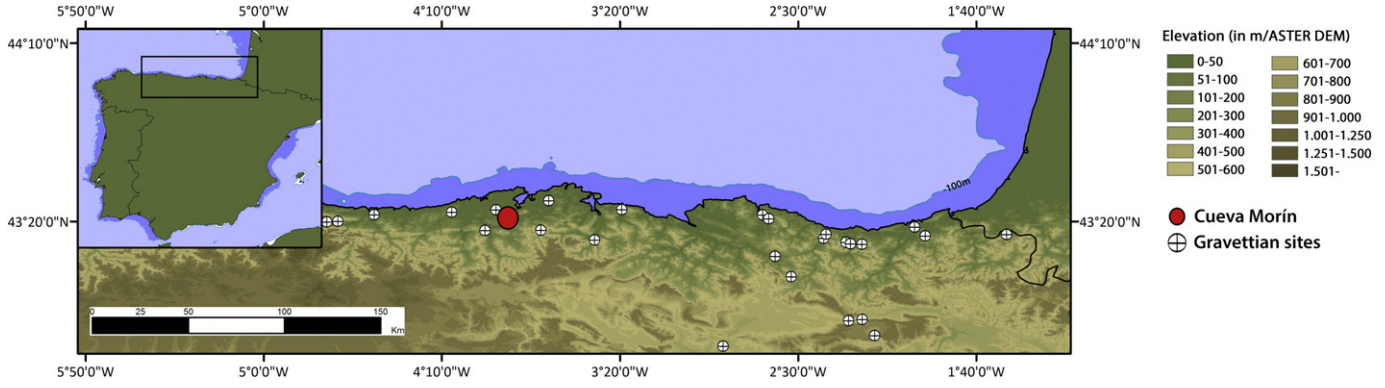

Fig. 1. Geographic map showing the location of Cueva Morín (red dot) and further sites with Aurignacian and/or Gravettian occupations (white dots). The figure was done with ArcGIS and Adobe Photoshop.