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A second life: Recycling production waste during the Middle Palaeolithic in layer L at Grotta del Cavallo (Lecce, Southeast Italy)

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ABSTRACT

This paper presents the modalities of recycling in lithic assemblage in layer L at Grotta del Cavallo (Middle Palaeolithic, Southeast Italy). The layer exhibits a high diversity of exogenous (>50 km) and local (<5 Km) raw material, including marine shells for producing retouched tools. Recycling is attested in local raw material and in shell valves. I identified four recycling modalities, related to four object categories, and analysed each one separately: lithic retouched tools, macro tools, short products with sharp edges, and marine-shell tools with two orthogonal edges. I interpreted this behaviour in relation to a time-cost model. The aim was to evaluate the role of recycling in changing technological costs and to investigate if recycling was a planned strategy and how it was incorporated into the techno-economic organisation of the human group. The lithic assemblage displays a high spatio-temporal segmentation of productive sequences based on discoidal methods, the production of small flakes, the majority less than 3 cm in length, and a high technical investment in retouch. The results of the recycling cost-benefit analysis suggest that this behaviour was integrated into an economic setting regulated by time constrictions during tasks performed at the site within a logistic mobility. In this layer, recycling was an occasional behaviour, which allowed humans to respond to unplanned needs, and was facilitated by the low degree of volumetric constraints in the productive methods applied and by the short dimensions of the tools used. Recycling was an element that contributed to define the cultural entity, appearing as a specific trait in a given human group.

1. Introduction

Recycling involves a time gap between two use events (Baker, 2007), meaning that an object has finished its life history and is dumped and considered waste before being picked up again and transformed into a new tool. Within this definition, some authors have argued that an artefact's radical transformation between two use events provides evidence of recycling (e.g., Camilli and Ebert, 1992; Amick, 2007) and allows researchers to distinguish between resharpening (or re-use) and recycling. In many archaeological cases (e.g., considering retouched tools dumped and then retouched again), the change of function is only detectable through use-wear analysis. This paper focuses on a technological perspective and uses the broadest definition, considering a time gap between two use events as a proxy for recycling. During this temporal lapse, the object has lost its original value and can be considered a waste. The reuse of previously discarded waste is repeatedly reported in contemporary hunter-gatherer human groups (Kelly, 1964; Gould, 1968; Smith, 1974; Binford, 1977; Wandsnider, 1989; Fowler, 1992). Widespread findings of lithic scavenging in ethnographic contexts suggest recycling to have been a diffuse provisioning strategy during prehistoric times, and recent studies have attested that recycling was widespread and spanned a large chronological range during Prehistory (e.g., Almeida, 2008; Thiébaut, 2010).

In technological studies on stone tool assemblages, the time gap can be highlighted through two data categories: stone tool transformations (both chemical and mechanical) and spatial distribution of linked artefacts. The clearest clue of a temporal lapse is the presence of alterations on artefact surfaces. The patina is a chemical alteration that develops on the external surface of a stone tool, and each tool can show several different patinas, due to the

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transformation sequence to which it has been subjected. Archaeological lithic recycling has been detected from patina due to air exposure (Mora et al., 2004; Amick, 2007; Barkai et al., 2009) or thermal alteration (Sergant et al., 2006; Vaquero et al., 2012). Within the mechanical transformations that help identify recycling, we can consider core transformed into tools and flake (which could or not be retouched) transformed into core. Both cases describe two distinct life histories of an artefact, between and after the recycling event. In the first case, a previous technical event in which the core was used as a volume to product blanks is followed by a phase in which the core itself was used as a blank and recycled into a functional tool. This case is clearly detectable if retouching precedes its use as a tool. A flake transformed into core is usually an expedient way to obtain a few short products. This recycling clue is more difficult to identify because short flake extractions can also occur when finishing the tool (e.g., for the regularisation of the shape for hafting). The temporal shift defining recycling can also be detected through the spatial analysis of intrasite anthropic transport events of stone tools identified through refitting analysis (Vaquero, 2008, 2011; Vaquero et al., 2015).

The interpretation of this behaviour is still uncertain. Published studies attempt to explain recycling as it relates to a single factor. Recycling is usually assumed to be a response to a scarcity of raw material (Kelly, 1988; Dibble and Rolland, 1992; Close, 1996; Amick, 2007; Galup, 2007; Hiscock, 2009); it is also sometimes explained as an economic strategy related to "microproduction" (Cuartero, 2007). It is considered an aspect of curated technology (Binford, 1977; Bamforth, 1986) or, alternatively, of expedient technology (Vaquero et al., 2012). It is explained as related to the long duration of site occupation (Rolland, 1981; Kelly, 2001) or, alternatively, to high human group mobility (Kuhn, 1995). These interpretations may not be mutually exclusive.

The above cited literature has pointedly revealed that recycling was part of the technical choices of Palaeolithic hunter-gatherer communities. Analysing this behaviour could be an interesting approach to investigate how and why prehistoric hunter-gatherers structured their technical strategies and could improve our understanding of past technical behaviours. Tools were clearly produced to fulfil needs in relation to subsistence strategies in a specific environment and played a societal role. Therefore, described as the combination of human activities that have been finalised to produce tools, technology must be analysed as it relates to the overall economic strategies and cultural traditions of the group that has produced and used these tools. In this analysis, we must also consider that the environment is a dynamic entity, which changes due to climate, ecosystems and biodiversity. This dynamicity influenced human choices, which also depended on many other factors, such as group size, gender organisation of activities, individual or group hunting strategies, and restricted resource access. Lithic data are limited and have to be integrated into a holistic and multidisciplinary analysis to interpret why prehistoric hunter-gatherers organised their technology as they did. Despite this limitation, a detailed technological analysis, including geoarchaeological data, human mobility and the technological cost-benefit evaluation, could allow us to propose a technological model for the comprehension of recycling. This "time-cost" model is integrated with foraging theory and provides a framework that helps link the strategies for the creation and use of stone tools and waste products to hunter-gatherer behaviours.

Foraging models consider the costs and benefits of acquiring different resources and are normally applied to subsistence activities, such as acquiring and handling food (Winterhalder, 1981; Stephens and Krebs, 1986; Jochim, 1988; Lowe, 1990). According to Bousman (1993), handling costs (i.e., time spent in providing, preparing and consuming food) should also include the costs of technological production and tool transportation (e.g., the costs of procuring and knapping raw materials and maintaining tools). Palaeolithic evidence suggests that technological costs influenced human economic strategies and that resource availability and abundance in turn influenced technological strategies. Changes in land use and mobility seem to be reflected pattern changes in stone tool manufacture and use. The two extreme strategies relating to technological costs are as follows: (1) using expensive technological gears or (2) using inexpensive ones. Hunter-gatherers show a mix and different degrees of these opposing strategies depending on the risks associated with different activities (e.g., Binford, 1979; Shott, 1986; Torrence, 1989; Cashdan, 1990; Nelson, 1991; Bousman, 1993; Bamforth and Bleed, 1997). A technological cost evaluation could be performed according to Bleed tool design theory (1986), which considers (a) production time (both time in raw material procurement and the complexity of the knapping method used); (b) the tool's use-life (from potential to resharpening); (c) the tool's efficiency (the highest investment in the functional cutting edge); and (d) the productivity of the applied knapping method (considering the number of products per a given volume of raw material). In relation to which parameters they considered the most important, hunter-gatherers produced (a) expedient tools, (b) maintainable tools, (c) reliable tools, or (d) a highly productive technology. Because these options are not mutually exclusive in the toolkit, technological costs and strategies must be evaluated separately within each tool category.

Analysing recycling in this perspective helps to evaluate its role in changing technological costs (e.g., reducing production costs or raw material procurement costs) and to develop a hypothesis to account for the expediency of this behaviour. This approach helps to investigate if recycling was a planned strategy and how it was incorporated into the technological organisation of the human group, as discussed later. The Middle Palaeolithic evidence presented here from layer L at Grotta del Cavallo hints to recycling as a technological behaviour integrated into the economic context and influenced by many factors (e.g., task time restrictions, dimensional production standards, and occupation duration). The data suggest that recycling was part of a rich technology and represented a specific strategy of the human group.

2. Material and methods

2.1. Grotta del Cavallo: geological setting

Grotta del Cavallo is a karst cave located on the west coast of Salento in southern Apulia (southeast Italy; Fig. 1). The cave is a single circular cavity approximately 9 m in diameter. The entrance faces northwest and opens in Cretaceous limestone on the Baia di Uluzzo, approximately 15 m above present day sea level.

The southwest coast of Salento is rich in karst caves with archaeological deposits related to the Middle Palaeolithic (Palma di Cesnola, 2001). As is the case in most of the Apulia region, Salento's geology is composed of limestone units (Serre Salentine) that crop out in long ridges arranged northwest to southeast. These units depend on tectonic events that occurred during the Cretaceous and early Pleistocene. The lithostratigraphy of the cliff where the cave opens is related to one of these units, denominated locally as "Calcari di Melissano". The Calcari di Melissano formation is composed of fine or medium-fine grained microcrystalline limestone and dolomitic limestone, both with conchoidal fractures with variable degrees of regularity; marlstone layers are also observed (Martinis, 1968; Largaiolli et al., 1969; Commissione Italiana di Stratigrafia, 2003). All along the formation, joint sets split the rock into quite regular blocks of dimensions variable between few centimetres and more than 30 cm. It means that the blocks were big