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Replicative experimental use of Palaeolithic Ground Stone Tools: Tracing and quantifying wear

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ABSTRACT

Advancements in microscopy technology have supported the traceological community in the pursuit of developing a quantitative approach in the field of use-wear analysis. The application of profilometry as a typical tribological tool, by providing micro-topographical scanning of artefact surfaces, has significantly expanded our capabilities, allowing us to (i) capture highly detailed micro-to-submicron-scale surface texture features, and (ii) attempt the calculation of various quantitative indices for characterising surface topography. The acquisition and statistical analysis of micro-topographical maps of the surface pose challenges when applied to Ground Stone Tools (GSTs), given their inherent petrographic and geometrical characteristics, as well as the diverse tasks these tools might have been involved in. In this pursuit, experimental replicas become indispensable, laying the groundwork for meaningful comparisons. By organising experiments sequentially and capturing surface texture at various stages of the replicative use, we achieve a dynamic comprehension of the evolution of the selected features over time. This study specifically hones in on task-specific experimental GSTs employed for the processing of various plant organs selected among those present across the Pontic steppe during the Marine Isotopic Stage 3 (60–25 kyr). Exploiting confocal profilometry, the data acquired support a robust quantitative approach, enabling the discernment of specific features and trends linked to the treatment of different plant organs. This methodological advancement plays a key role in distinguishing the varied activities undertaken by these tools, thereby establishing a fundamental basis for future comparisons with archaeological artefacts and eventually contributing to expanding the range of tool use in the Palaeolithic.

1. Introduction

In archaeological lithic studies since the 1990s, various efforts have been made to achieve a quantitative description of tool's surface texture (for discussions, see Stemp et al. 2016 and the literature therein). These efforts have been motivated by the need for univocal, objective descriptors and parameters shared among the scientific and archaeological communities, which aim to avoid subjective terms derived from qualitative approach to imaging data analysis and thus enabling the comparisons among different studies. This involves the use of various techniques for acquiring 2D surface profile data (e.g., Astruc et al. 2003; Stemp and Stemp 2003; Evans and Donahue 2008; Delgado-Raack et al. 2009; Bofill 2012; Bofill et al. 2013; Evans et al. 2014; Stemp 2014; Dubreuil et al. 2015; Gyurkovics et al. 2017; Macdonald et al. 2018; Delgado-Raack et al. 2022) and more recently 3D areal data (e.g., Goodall et al. 2015; Macdonald et al. 2019; Calandra et al. 2019a; Calandra et al. 2019b; Pedergnana et al. 2020; Zupancich and Cristiani 2020; Chondrou et al. 2021; Ibáñez and Mazzucco 2021; Paixão et al. 2021; Paixão et al. 2022; Sorrentino et al. 2023a). The latter allow the creation of detailed topographic maps that capture surface features at multiple scales of observation. However, it is important to note that previous efforts have predominantly concentrated on the analysis of the flaked industry. Applications to Ground Stone Tools (GSTs) have been limited, partly due to historically lower interest in this artefact category, which has only recently gained recognition for their high informative value as suitable multitasking tools. Additionally, distinct analytical

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