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2021 Kiel, 6-11 Sept.

Widening Horizons

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ABSTRACT BOOK

the material properties of the experimental tools are addressed in concert with the affordances of multiple contact materials to understand the dynamics of their interactions. These ideas are discussed within the framework of material agency to understand how objects are positioned within broader material/human networks. Through the exploration of tools' interactions with multiple contact materials, we can get closer to understanding how people were positioned in past networks and how they may have interacted with the world around them.

2 ROBOTS IN ARCHEOLOGY

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Abstract format: Oral

Use-wear analysis relies on reference collections to identify the use of archeological tools, and these collections are created via experimentation. Traditionally, experiments are performed manually by the experimenters themselves (actualistic, pilot or first-generation experiments). While such experiments are important to identify which factors (raw material, contact material, action, duration, ...) influence use-wear formation, a mechanistic, cause-effect relationship is out of reach. On the other hand, mechanized, controlled (second-generation) experiments can resolve such causal relationships. However, the way to bridge the two types of experiments to answer archeological questions is still debated.

Here we present a series of experiments that does just that: go from a highly controlled setup characteristic of material testing experiments to human actions. First, we used a material tester (Inotec SMARTESTER) in a straight uni-directional cutting action. Second, we used a collaborative robot (Universal Robots UR10e) in a similar action. Third, we recorded a manually-guided uni-directional cutting action (human-like, i.e. not perfectly straight) on the robot with a custom-made software. Fourth, we introduced variability in the recorded movement: small random variation in position and force exhaustion. Finally, we performed the action manually.

In order to isolate the effect of the movement itself, force, speed and acceleration (except for the manual experiment), as well as number of strokes and movement length, were kept constant. Additionally, both the tool and the contact material were standardized. The flint tools were cut to a standardized 45° edge angle with a diamond band saw. The contact material was synthetic bone plate. Such bone plates have similar physical properties to true bone, but make it easier to compare across experiments thanks to their homogeneity and flat morphology.

We quantified use-wear polish on each sample at the end of the experiments and applied Bayesian modelling to test for the presence of significant differences.

3 ABRASIVE WEAR FORMATION ON CHERT FROM DIFFERENT RAW MATERIALS: A CONTROLLED TRIBOLOGICAL EXPERIMENT

Abstract author(s): Rodríguez, Alice - Yanamandra, Kaushik - Wittek, Lukasz - Behera, Rakesh Kumar (New York University) - Iovtva, Radu (New York University; Eberhard Karls University of Tübingen)

Abstract format: Oral

The identification of ancient worked materials is one of the fundamental goals of lithic use wear analysis and one of the most important parts of understanding how stone tools were used in the past. Given the documented overlaps in wear patterns generated by different materials, it is imperative to understand how individual materials' mechanical properties might influence wear formation. Because isolating physical parameters is necessary for such an endeavor, controlled rather than replicative experiments and surface topography measurements are necessary to better grasp how polish formed on stone tools. Therefore, we used a tribometer to wear natural flint surfaces against five materials (bone, antler, two kinds of wood, and ivory) under the same force, speed, and angle over one, three, and five hours. The study aimed to test if there is a correlation between polish formation and the hardness of the worked material. We measured each raw materials' hardness using nano-indentation test, and we compared the surface texture of the polished chert bits using a metrology microscope. The interfacial detritus powder was analyzed with a scanning electron microscope to look for abraded flint particles. We demonstrate that, contrary to expectation, softer materials, such as wood, create smoother polishes than hard ones, such as ivory.

4 OBJECT IMPERMANENCE: USING 3D MICROSCOPY TO ASSESS PERISHABLE MATERIALS THROUGH BONE MICROWEAR

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Abstract format: Oral

Ancient people undoubtedly used a variety of materials that are not often found in the archaeological record due to their tendency to decompose over time. Perishable materials such as animal skins or vegetal matter would have been used for clothing, footwear, containers, and other objects. Direct evidence for such items is often lacking, especially in very old deposits, but indirect evidence in the form of microwear traces can be found on more durable materials that came in contact with these items prior to deposition. Tools made out of bone are an ideal candidate for assessing wear from perishable materials because they tend to be used repetitively for long stretches of time, accumulating well-developed microwear traces.

In this study, I employed 3D microscopic methods to quantitatively evaluate traces from three perishable materials on replicated bone spatulas, a common bone tool form used over millennia. All objects were made from *Cervus elaphus* ribs and were manufactured similarly using a ground stone. Next, each object was used for 40 minutes on one of three perishable materials (fresh animal skin, processed leather, and dry bark). Bones were scanned with a confocal microscope and evaluated using 3D surface texture parameters including surface roughness [Sa], peak curvature [Sp_c], and isotropy [Ist]. Quantitative measurements of the bone surfaces varied, but some patterns were evident and reflective of the differences in properties of the three perishable materials. The two different states of animal skin tended to round the upper reliefs of the bone surfaces, while bark flattened the surface reliefs. Fresh animal skin was the most abrasive of these materials and resulted in smoother surfaces overall. This study indicates that 3D microscopic methods have the potential for indirectly evaluating perishable materials that once came into contact with ancient bone artifacts, contributing to our understanding of ancient human behavior.

5 COMBINATION OF PETROLOGICAL, GEOCHEMICAL AND NON-USE-WEAR FOR THE TRACEOLOGICAL ANALYSIS OF THE MOST REPRESENTATIVE RAW MATERIALS FROM OLDUVAI GORGE (TANZANIA)

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Abstract format: Oral

The traceological discipline has been characterised by a constant theoretical and practical revisionism, which has led to the application of increasingly precise methods and techniques that allow for more integrated analyses and interpretations to be developed from both reference collections and archaeological material. The progressive incorporation of a wide lithological variety in the study of use-wear traces, such as quartzite, quartz and volcanic rocks, has contemplated new methodological and technical challenges for their traceological analysis. The lithological variability recorded from the lithic industry found in the archaeological deposits of Olduvai Gorge, presents a favourable scenario for the combination of different analyses that allow a more detailed understanding of the formation and development of use-wear. In this communication we present, in a preliminary way, the experimental results obtained from the most representative raw materials (Nabor Solt quartzite and basalts) of the Bed I archaeological sites after the integration of petrological, geochemical and non-use-wear traces analyses to our experimental traceological study. The combination of these analytical methods permit us to characterise the micro-topography of each lithology and determine the degree of influence that the structural and mineral variability of each raw material has on the formation and development of the use-wear traces. In order to characterize more precisely the structural and geochemical influence on the formation and development of the use-wear traces, a wide range of activities as well as organic materials (wood, non-woody plants, animal carcasses and bone) have been included in the experimental reference collection. This organic variety in different states of preservation and under the exercise of different actions presents an important challenge for the characterisation of the formation and development of use-wear traces. Seeking a more concise characterisation of the use-wear traces, the incorporation of analytical methods such as petrology, presents significant advantages for the traceological interpretations.

6 USE-WEAR ANALYSIS OF NEOLITHIC FLAKED AND GROUND STONE AXES AND ADZES FROM THE EASTERN GOBI DESERT

Abstract author(s): Evoy, Angela (Cosumnes River College)

Abstract format: Oral

This paper presents results for the first use-wear analysis of Neolithic flaked and ground stone axes and adzes from the eastern Gobi Desert. The aim of this study is to define patterns of wear development on basalt and siliceous stone axes and adzes resulting from contact with various materials. I hypothesize that the axes and adzes were primarily used for tree felling and woodworking but include other economic activities. With limited paleoenvironmental reconstructions for this region, and no evidence for the presence of trees during this temporospatial period, hypotheses for the probable use of these tools were based on the body of ethnographic