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Leibniz-Zentrum für Archäologie (LEIZA)
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Tool Choice in Prehistory

Neuwied/Faro. An international study reveals how early humans, as far back as 1.5 million years ago, deliberately selected specific stones for their tools in the Ethiopian Highlands. The findings, published in the journal PLOS ONE, provide insights into the cognitive abilities and technological expertise of our ancestors.

At the Melka Wakena site in the Ethiopian Highlands, researchers discovered a wide array of tools. But why were certain types of stone chosen over others? The answer lies in the properties of the rocks. Using state-of-the-art technologies, including robot-assisted experiments and imaging techniques, the team demonstrated that early humans sought an optimal balance between functionality and durability.

The research relied on advanced technologies developed at the Laboratory for Traceology and Controlled Experiments (TraCEr). This laboratory is part of the Archaeological Research Center and Museum for Human Behavioral Evolution, MONREPOS, which is a department of the Leibniz-Zentrum für Archäologie (LEIZA) in Germany.

“Our research shows that the material properties of the stones—such as suitability, quality, and durability—were likely crucial factors in the selection process by early hominins,” explains study leader Dr. Eduardo Paixão from the University of Algarve, Portugal. “This suggests that they had a deep understanding of their environment and made deliberate choices.”

Dr. João Marreiros, head of the TraCEr Laboratory, adds, “The deliberate selection of materials influenced the surface changes of the tools. This demonstrates that differences in archaeological finds are not random.”

An International Team Deciphers Early Technologies

The study is the result of collaboration between the Interdisciplinary Center for Archaeology and Evolution of Human Behaviour (ICArEHB) at the University of Algarve, the TraCEr Laboratory and the Imaging Plattform at LEIZA (IMPALA), and the Hebrew University of Jerusalem. Excavations at the site are led by Prof. Erella Hovers and Dr. Tegenu Gossa.

“These findings open new perspectives on understanding technological innovations in early human history,” says the study leader. “We plan further research to better comprehend the complex decisions made by these early toolmakers.” The research was funded by the Fritz Thyssen Foundation and the Portuguese Foundation for Science and Technology (FCT).

About the Laboratory for Traceology and Controlled Experiments (TraCEr)

TraCEr focuses on elements of human behavioural evolution by analysing use-wear traces on artefacts from archaeological and experimental contexts. 3D imaging technologies, the characterisation of material properties and the

results of controlled experiments replicating such traces will all be used to quantify use-wear evidence. Comparative data bases partly serve to enhance the reproducibility of the obtained results, so that TraCEr ultimately consolidates traceology as a sub-discipline within archaeology.

Original Publication

Paixão E, Gossa T, Gneisinger W, Marreiros J, Tholen S, Calandra I, et al. (2025) Exploring early Acheulian technological decision-making: A controlled experimental approach to raw material selection for percussive artifacts in Melka Wakena, Ethiopia. PLoS ONE 20(1): e0314039.
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MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution
MONREPOS is at the same time museum and research institute. It is a department of the Leibniz-Zentrum für Archäologie, based in Mainz, a Leibniz-Association research institute, located in the Monrepos stately home near Neuwied, where research has been conducted for more than 35 years. The research centre and museum is closely linked to the Pre- and Protohistoric Archaeology section at the Institute of Ancient Studies of the Johannes Gutenberg-University Mainz.
Our research focuses on the inheritance we carry within us, which is worth millions: Our human behaviour has evolved over more than 2.6 million years. This early human history spans the longest and defining period of our behavioural evolution that is central to our research at MONREPOS. Our archaeology thrives on working together, on questions, impulses, discussion. And, not least, on criticism and on tolerance. It needs people who are curious, creative and courageous – whether these are scientists, pro bono helpers, media or visitors. MONREPOS sees itself as a platform for everyone who wishes to understand how we evolved and what unites us.

Leibniz-Zentrum für Archäologie (LEIZA)
As a Leibniz Research Institute and Museum for Archaeology, LEIZA studies humans and their development based on material remains that span three million years across time and space. The fundamental insights we gain improve our understanding of human behaviour, actions and the development of societies. In this way, LEIZA enriches our knowledge of humans from an archaeological perspective and creates essential foundations for reflecting on the present and shaping the future. With archaeology, LEIZA views human beings in context and shares the knowledge gained in international dialogue. LEIZA is active worldwide and has successfully and comprehensively conducted research in various regions of Africa, Asia and Europe. The unique concentration of archaeological, scientific, restoration and information technology expertise, combined with important workshops, laboratories and archives, makes it possible to

conduct object-oriented research into the archaeology of the ancient world (Asia, Africa, Europe) from the beginnings of human history to modern times. As one of eight research museums in the Leibniz Association, LEIZA combines excellent science with exhibitions and, with its educational mission, is also a place for dialogue with the public.
Until its renaming on 1 January 2023, LEIZA was known internationally as the Römisch-Germanisches Zentralmuseum (RGZM), which was founded in Mainz in 1852 by resolution of the German Historical and Antiquities Societies. Since 2024, LEIZA is represented at four locations in Germany: Mainz, Neuwied, Mayen, and Schleswig. www.leiza.de

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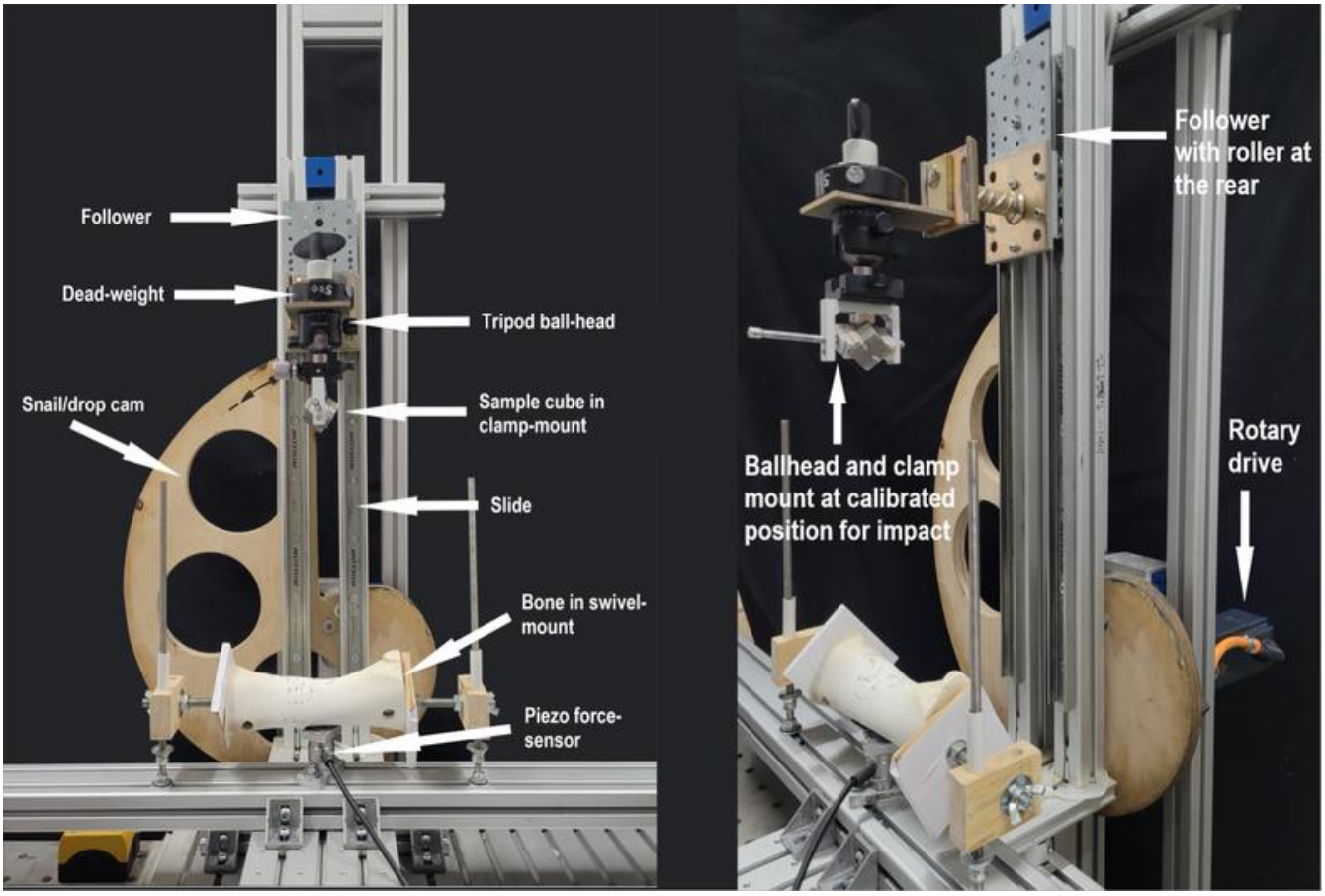
Anhang Press release (PDF) http://idw-online.de/de/attachment108526

Left: experiential activity on long bone; Top right: imaging the experimental samples; Bottom right: map with the location of the study case (Melka Wakena).
Eduardo Paixão
Photos by Eduardo Paixão, Map by Tegenu Gossa



Experimental mechanical setup (SMARTTESTER®, manufactured by Inotec AP GmbH, with adaptations made by Walter Gneisinger) at TraCEr laboratory in Monrepos.
Eduardo Paixão
Eduardo Paixão, Walter Gneisinger