



Hominin Technology Flourished amid Pliocene Environmental Variance in the Turkana Basin

Dan V. Palcu^{1,2,3}, David R. Braun^{2,4,5}, Eldert Advokaat¹, Will S. Archer⁶, René Bobe^{7,8}, Susana Carvalho^{7,8}, Frances Forrest^{9,10,11}, Ashley S. Hammond^{10,11}, Rahab Kinyanjui^{2,19}, Ana Martini³, Paul Mason¹, David B. Patterson^{4,12}, Mark Sier^{1,13}, Priyeshu Srivastava^{3,14}, Kevin Uno¹⁵, Amelia Villaseñor¹⁶, Jonathan Wynn¹⁷, Luigi Jovane³, John W. K. Harris¹⁸, and the Koobi Fora Research & Training Program (KFRTTP)*

¹Earth Sciences, Utrecht University, Netherlands

²Koobi Fora Research & Training Program, National Museums of Kenya, Kenya

³Oceanographic Institute, University of Sao Paulo, Brazil

⁴Center for the Advanced Study of Human Paleobiology, Anthropology Department, George Washington University, USA

⁵Technological Primates Research Group, Max Planck Institute for Evolutionary Anthropology, Germany

⁶National Museum Bloemfontein, South Africa

⁷Gorongosa National Park, Mozambique

⁸Universidade do Algarve, Portugal

⁹Fairfield University, USA

¹⁰American Museum of Natural History, New York, USA

¹¹New York Consortium for Evolutionary Primatology (NYCEP), USA

¹²University of North Georgia, USA

¹³Cenieh, Burgos, Spain

¹⁴Indian Institute of Geomagnetism, Navi Mumbai, India

¹⁵Department of Human Evolutionary Biology, Harvard University, USA

¹⁶Department of Anthropology, University of Arkansas, USA

¹⁷Jonathan Wynn, University of South Florida, USA

¹⁸Department of Anthropology, Rutgers University, USA

¹⁹Department of Archaeology, Max Planck Institute of Geoanthropology, Jena, Germany

*A full list of authors appears at the end of the abstract

This study explores the emergence of Oldowan technology in the northeastern part of the Koobi Fora Formation, focusing on a poorly understood spatial and temporal context. It highlights the dynamic interplay between hominins, landscapes, and climate during the late Pliocene. The archaeological findings present a comprehensive analysis of stone artifacts from the Fwjj52 locality that spans the terminal Pliocene- earliest Pleistocene. The technological patterns at the archeological site Fwjj52 align with early Oldowan sites, emphasizing an astute understanding of raw material properties by hominins in the region.

Chrono-stratigraphic investigations reveal that the Fwjj52 represents a unique locality, corresponding to the Tulu-Bor and Burgi Members of the Koobi Fora Formation, the latter

member containing a stratigraphic interval largely absent in the geologic record of East Turkana due to a widespread unconformity. Multi-proxy geochronology (paleomagnetism, tephrostratigraphy) establishes a robust late Pliocene age estimate for the artifact-bearing horizons from Fwjj52. Paleoenvironmental proxies (e.g., phytoliths, microcharcoals, plant biomarkers, pedogenic carbonates, soil geochemistry) indicate the area around Fwjj52 experienced significant environmental changes. This includes shifts from humid floodplains to semi-arid plains alternating with paleoriver systems, probably triggered by the retreat of paleo-lake shorelines.

This Interdisciplinary approach, combining *archaeology*, *chrono-stratigraphy*, and *paleoenvironmental reconstructions*, unveils a complex paleoecological narrative, indicating changes in vegetation, water availability, and climate, coinciding with the emergence of Oldowan stone tool technology in East Turkana. The landscape and climatic shifts we document in the northeastern Turkana Basin, Kenya mirror broader trends in eastern Africa during the late Pliocene, influenced by orbitally- forced climate change, tectonics, and reorganizations of paleogeography. These changes had cascading effects on ecosystems, including the expansion of grasslands and alterations in plant and animal species composition in the late Pliocene.

Paleogeographical and paleoecological shifts in the late Pliocene in eastern Africa likely imposed selective pressures on early hominins that could have influenced their behavior. This study emphasizes the reciprocal relationship between landscapes and tool-making endeavors, suggesting that the environments associated with ancient river systems acted as both witnesses to, and catalysts for, the evolution of stone tool technology.

Koobi Fora Research & Training Program (KF RTP): Kay Behrensmeyer, behrensa@si.edu
Amanda McGrosky, amanda.mcgrsky@gmail.com Joanne Munga, joannem@gwu.edu Jonathan S. Reeves, jonathanscott.reeves@gmail.com Kristen Tuosto, k.tuosto@gmail.com