

Direct cosmogenic nuclide isochron burial dating of early Acheulian stone tools at the T69 Complex (FLK West, Olduvai Bed II, Tanzania)

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Olduvai Gorge is one of the best-known paleoanthropological sites worldwide for the wealth of its Early Pleistocene paleontological and archeological record. This paper contributes to the ongoing effort to construct a solid geochronological framework for Olduvai archeological sequences by applying cosmogenic nuclide-isochron burial dating, for the first time, directly to stone artefacts. We apply the method to a new site named T69 Complex, located in the FLK West gully and positioned stratigraphically in Bed II.

The chronology of Olduvai Bed II is not well constrained compared to underlying Bed I, due to fewer tephra layers suitable for conventional K-Ar and Ar-Ar dating. Novelty of our contribution is twofold. First, this study applies a radiometric method that is still relatively new in archeology and has never been attempted before at Olduvai Gorge. Second, cosmogenic nuclide-isochron burial dating is significant because it can be applied directly to stone tools, rather than indirectly estimating ages from underlying or overlying sediments, or from surrounding sediments that are not always guaranteed to be the same age as the artefacts they contain. The stone tools selected for dating in this study were collected from the main archeological unit, T69L20. The dated artifacts are six quartzite cores and two quartzite hammerstones.

Cosmogenic nuclides are produced by cosmic rays interacting with elements on the Earth. The nuclide measurements in rocks and sediments allow us to study changes in landscapes at timescales of 1000 years to several million years. The isochron burial dating utilizes two cosmogenic isotopes (Be-10 and Al-26) measured in multiple samples collected from a stratigraphic horizon to determine a burial age. The approach is innovative by overcoming the uncertainty of conventional simple cosmogenic burial dating, which uses only one sample to calculate an age. The resulting isochron burial age in this study yields 1.48 ± 0.25 Ma age for this Olduvai Bed II sequence, which is consistent with previous dates from upper (~1.3 Ma) and lower bounding layers (~1.7 Ma).

To our knowledge this is the first attempt to apply the cosmogenic nuclide-isochron burial dating directly to stone tools. The result is promising and opens up a new opportunity for future archeological studies. This Middle to Upper Bed II stratigraphic interval at Olduvai Gorge is a key period for our understanding of the disappearance of *Homo habilis* and the emergence of the Acheulian. This paper helps to more narrowly constrain the chronostratigraphic context to interpret assemblage variability during the onset of the Acheulian, at ~1.5 Ma in Olduvai Gorge.