Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36010

Volcanism and Human Origins: Insights from High-Resolution Tephrochronological Tools in the Turkana Basin, Kenya - *IAG Early Career Researcher Award Lecture*

SAINI SAMIM, HAYDEN DALTON, DAVID PHILLIPS AND JANET HERGT

The University of Melbourne

The Turkana Basin in NW Kenya preserves fossil-rich Plio–Pleistocene sedimentary sequences interbedded with widespread silicic volcanic ash layers (tuffs) that provide critical chronostratigraphic markers for constraining the timing of hominin evolution and associated paleoenvironmental change. However, age uncertainties of 20–30 ka associated with many key tuffs limit the temporal resolution at which eruptive events and fossil horizons can be resolved. In addition, similar major element compositions amongst multiple tuffs hinder reliable correlations across different parts of the Basin and beyond Kenya. Importantly, these distal tephra deposits may represent the only preserved record of silicic volcanism during the early evolution of the East African Rift System, providing unique insights into magma storage, recharge, and eruption triggers in source volcanic systems that are no longer preserved.

Here, we apply an integrated high-resolution tephrochronological framework combining novel raster-based laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) trace element analysis [1] with high-precision single-crystal $^{40}Ar/^{39}Ar$ geochronology of feldspar crystals from key Pleistocene tuffs of the Nachukui Formation, West Turkana. High-resolution trace element analysis of tephra glass and pumice fragments establishes robust geochemical fingerprints for previously indistinguishable tuffs [2], and in some cases reveals previously unrecognized intra- and inter-clast geochemical heterogeneity. These compositional variations record complex magma chamber processes, including magma recharge, mixing, and remobilization prior to eruption. High-precision $^{40}Ar/^{39}Ar$ geochronology provides complementary constraints, yielding eruption ages with uncertainties of ±2 ka and revealing significant age dispersion among individual feldspar crystals, recording prolonged crystal residence prior to eruption.

Overall, these results refine the chronological framework of hominin-bearing sequences while demonstrating the power of high-precision analytical approaches to resolve both eruption histories and magma dynamics and provide improved age constraints for Turkana hominin fossils and associated artefacts.

[1] Samim, S., Dalton, H., Hergt, J., Greig, A. and Phillips, D. 2024. An improved methodology for high-resolution LA-ICP-MS trace-element fingerprinting of tephra layers: Insights from the Upper and Lower Nariokotome Tuffs, Turkana Basin, Kenya. Chemical Geology, 660, 12208

[2] Samim, S., Dalton, H., Phillips, D. and Hergt, J. 2025. High-resolution tephrochronology resolves stratigraphic complexities in archaeologically significant Nariokotome tuffs, Turkana Basin. PNAS, 122 (38), e2424142122.