# Reconstruction of Pliocene-Pleistocene sediment sources and weathering intensity in the paleo-life rich Olduvai and Laetoli basins of northern Tanzania using major and trace element geochemistry and Sr isotopic data

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**Abstract**

Major and trace elements and Sr isotopic compositions were analyzed for samples from the Pliocene-Pleistocene to Recent Olduvai and Laetoli basins of northern Tanzania with the aim of constraining their provenance and paleo-climatic conditions. The Olduvai samples are characterised by La/Cr ratios of 0.69–3.73, Th/Sc = 1.12–24.6 and $^{87}Sr/^{86}Sr$ = 0.70448–0.70563; features which suggest the volcanic facies of the nearby Olmoti as their possible source. The relatively lower values for the Laetoli basin (Th/Sc = 0.4–0.9 and $^{87}Sr/^{86}Sr$ = 0.70412–0.70508) coupled with Zr/Nb, Nb/Ta ans Zr/Hf ratios are suggestive of a mafic protolith inferred to be the Sadiman lavas. The calculated Chemical Index of Alteration (CIA) values for the Laetoli samples are 58–78% (mean = 65%) indicating higher weathering intensities of the source compared to 45% in the Olduvai samples. The calculated Mean Annual Precipitation (MAP) values are higher at Laetoli (mean = 950 ± 181 mm/yr) relative to Olduvai (mean = 694 ± 181 mm/yr) consistent with increased rainfall in the Pliocene during the deposition of Laetoli strata when compared to the Pleistocene times when the Olduvai sediments were deposited.

The CIA and MAP patterns observed at Laetoli and Olduvai can be related to temporal changes in weather conditions during the Pliocene and Pleistocene, respectively. The Lower CIA and MAP values at Olduvai imply the prevalence of arid to semi-arid climatic conditions during the Pleistocene whereas the higher values at Laetoli correspond with wetter conditions during the Pliocene times. This could have the potential for improved eutrophication at Laetoli. The climatic inferences drawn from CIA and MAP data may point to a more favourable habitat for life proliferation in the wetter environment of Laetoli compared to the drier Olduvai. This inference is consistent with archaeological evidence which indicates a greater abundance of hominin fossils including the well preserved footprints in Laetoli.

**Keywords**

Olduvai;
Laetoli;
CIA;
MAP;
Paleo-weathering;
Protolith