Abstract No. mche666

Trace Element Composition of Alkali Feldspar Phenocrysts and Associated Volcanic Glass

L. McHenry, J. Delaney, G. Ashley (Rutgers U.), A. Lanzirotti (U. Chicago)

Beamline(s): X26A

Introduction: Olduvai Gorge, Tanzania, is a world-famous archaeological site which has produced fossils of at least four hominid species. It also preserves a 100-m sequence of Plio-Pleistocene volcaniclastic sediments interbedded with at least 10 predominantly trachytic tephra layers. These tuffs form a stratigraphic framework for the analysis of the temporal and spacial distribution of hominid fossils and artifacts found at Olduvai, but difficulties in distinguishing the tuffs in the field has limited their usefulness as marker beds in some areas. This research project aims to find a unique geochemical "fingerprint" for each of the major Olduvai Gorge Bed I tuffs, using electron microprobe and synchrotron XRF analyses of volcanic glass and alkali feldspar phenocrysts. This project could help resolve some outstanding issues regarding the origin of our species by providing better age control for some important archaeological sites.

Methods and Materials: Microanalytical techniques were chosen over more conventional bulk chemical techniques due to inhomogenous samples (multiple glass shard compositions within a single tuff, extensive zoning in some feldspar crystals). Glass and feldspar separates from two extensive (and frequently confused) Olduvai Tuffs (IF and IB) were mounted in epoxy and analyzed for major element composition by electron microprobe. Select grains were then analyzed by synchrotron XRF for trace elements (Ba, Sr, Rb, Ga, Cr, Zn, Ni, Pb, Br, Cu, Mn). Multiple spots were analyzed on zoned grains, and the distribution of various trace elements (Ba, Sr, Rb, Ga, Au, Pr, Zn) for two highly zoned feldspars were mapped. A total of 75 analyses were made by synchrotron XRF.

Results: With the exceptions of Sr and Ba, most elements measured showed little or no difference between Tuffs IB and IF. A population of feldspar grains (~28% of total) from Tuff IF showed high Ba and Sr concentrations (up to 4% and 900 ppm, respectively). Ba and Sr are more concentrated in the cores, decreasing in concentration towards the grain boundaries. The presence of these unique feldspar grains may serve as a useful fingerprint for Tuff IF.

The glass shards do not show the same Ba and Sr rich composition as the feldspar, suggesting that these phenocrysts were not formed in equilibrium with the associated glass (Ba ~0.1%, Sr ~20 ppm). They are more likely contaminant grains or older grains incorporated within the magma but not reequilibrated. Their presence in three samples from different localities suggests that they are not local detrital contaminants, but were erupted with the rest of Tuff IF.

Conclusions: The ability to distinguish Tuffs IB and IF using the Sr and Ba concentrations in alkali feldspars could allow archaeologists to identify these tuffs in the western part of Olduvai Gorge, where many fossiliferous sites go unexcavated due to poor stratigraphic age control. These sites have the potential to yield significant faunal and archaeological records which could improve our understanding of how our ancestors interacted with their environment.