

Introduction

The Ledi-Geraru Paleanthropology site in the Afar Depression of Ethiopia is a complex area known for its early hominid fossils and unique geology. The Afar Depression was created through crustal thinning and extension as a result of the East African Rift¹. Volcanic events since the Miocene have deposited tephra, which is volcanic ejecta such as lapilli, bombs, and ash². Tephra deposits can act as time-parallel markers that allow for stratigraphic correlation over long distances which is a valuable tool in such complex areas. This can assist with geologic mapping, dating of fossils, and aid in the understanding of the region's volcanism. In this study, we asked the following questions:



Location of the Ledi-Geraru Paleanthropology site. Map credit to Dr. Erin DiMaggio.

1. Does the Docco Tuff at Lee Adoyta correlate with Gongoyta Tuff-1 from Asboli?
2. Does the unnamed Ambare Tuff at Lee Adoyta correlate with Asboli Tuff-4 and Asboli Tuff-5 from Asboli?

Methods

Trace element chemistry of tephra samples was analyzed using laser-ablation inductively-coupled mass spectrometry (LA-ICP-MS) by targeting glass shards. The tephra samples that were used in this study are listed in Table 1 below. We compared trace element data with major element data from previous electron microprobe analyses^{3,4}. Bivariate plots and a primitive mantle comparison were generated from the data to support or oppose tephra correlation.

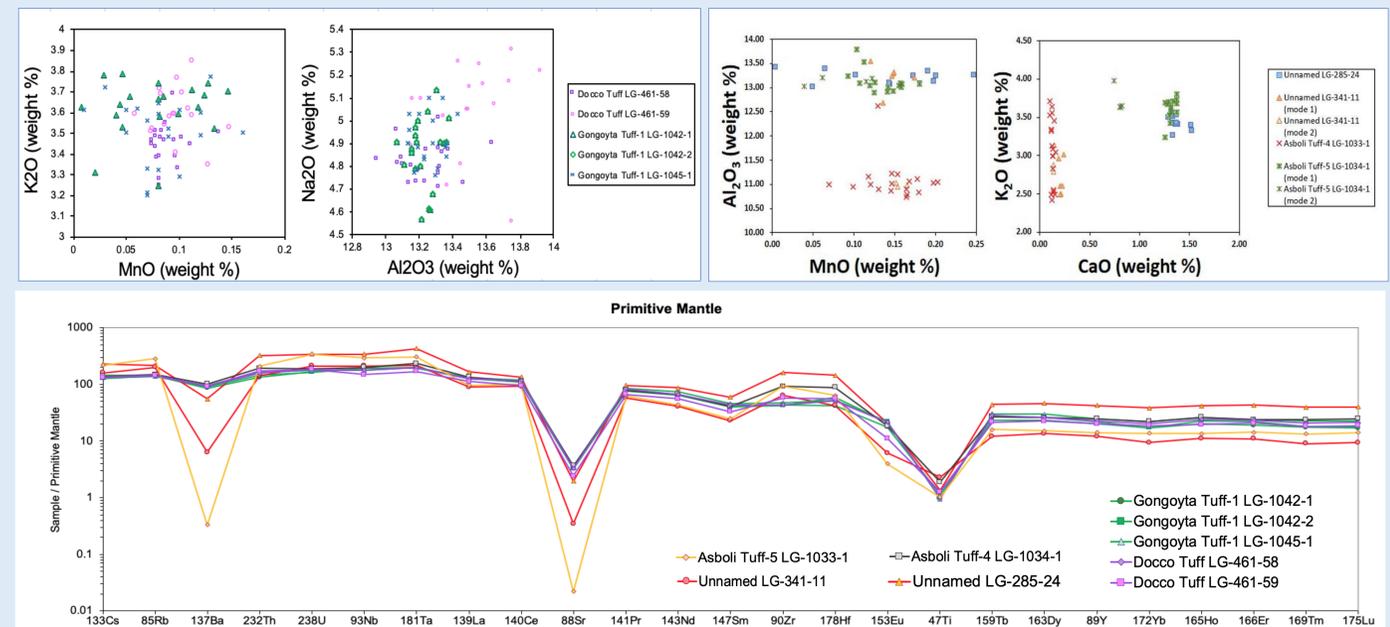
Table 1: Summary of sample locations and names.

Sample	Tuff	Location
LG-1042-1/2	Gongoyta Tuff-1	Asboli
LG-1045-1	Gongoyta Tuff-1	Asboli
LG-1033-1	Asboli Tuff-4	Asboli
LG-1034-1	Asboli Tuff-5	Asboli
LG-461-58/59	Docco Tuff	Lee Adoyta
LG-285-24	Unnamed	Lee Adoyta
LG-341-11	Unnamed	Lee Adoyta



Examples of glass shards that were manually selected to be ablated through LA-ICP-MS analysis.

Results



Discussion

The general overlap of major element data shown in bivariate plots supports correlations for each of the tuff pairs, but trace element data must be investigated as well. The plot of trace element data compared to primitive mantle values has a similar trend for all the Gongoyta Tuff-1 and Docco Tuff samples, which confirms a correlation. However, the unnamed Ambare Tuffs compared to Asboli Tuff-4 and Asboli Tuff-5 show differences between certain trace element concentrations when compared to primitive mantle values. This is especially evident for 137Ba, as well as 163Da through 175Lu. These differences raise the likelihood of no correlation between the samples.

Conclusion

Trace element chemistry supports a strong correlation between Docco Tuff and the Gongoyta Tuff-1, which suggests the five samples came from the same volcanic eruption 2.45 mya. The Docco Tuff can therefore be renamed Gongoyta Tuff-1. Results do not support a definitive correlation between the unnamed Ambare Tuffs and Asboli Tuff-4 and Asboli Tuff-5.

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References

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