Herder land-use in southern Kenya: geochemical analysis of soil enrichment

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1 Objectives

- East African herder land-use & livestock penning practices enriching savanna soils, positively affect biodiversity (Little 1996; Porensky & Veblen 2015).
- What is the time-depth of this pattern? How long does nutrient enrichment on ancient herder sites persist?
- Broader goal to understand the deep time impacts of herder land-use on East African savannas.

2 Methods

In 2011 we (S.A., F.M., S.G. & A.W.) excavated/sampled sedimentary profiles at 5 ancient herder sites in southern Kenya with ashy-grey horizons associated with degraded animal dung. Off-site profiles were sampled for comparison. These sites were Olokia 1 & 2 and Indapidapo in Narok, and Gulm 44 & 48 at Lukenya. Sites dated to between 3200-2000 BP.

We performed ICP-MS elemental analysis on sediment samples with an Agilent 7750 ICP-MS. 100mg samples were digested in HNO3 in a microwave at 180 °C for 1 hour, diluted to a 10x solution, passed through a 22 μm filter, & diluted again to a 100x solution. Internal reference standards & HNO3 blanks were run every 5 samples for calibration and to minimize drift and memory effects.

3 Results

Several elements (see right) were consistently elevated in archaeological “dung” layers relative to off-site sediments. Enrichment was strongest in lower portions of dung-derived deposits.

Metals like iron & aluminum were relatively depleted in archaeological layers.

Principal components analyses (PCA) shows calcium, magnesium, iron explain >95% of variability for Narok & Lukenya site groups (see plots below).

Specific enrichments and depletions match expectations for dung accumulations (McBride & Spiers 2001; Nielson et al. 2014). Variation in elemental values between sites are affected by diet/species of dung producing livestock (Shahack-Gross 2011), local geology, ecology, taphonomy.

4 Conclusions

- Ancient herder sites have much higher levels of elements important as plant macro-nutrients.
- Anthropogenic nutrient enrichment from ~3,000 years ago was reinforced & maintained into the present.
- Expansion of herding in East Africa had a significant positive role in shaping current savanna ecologies.

References


Animal dung accumulates in livestock enclosures at short-term homesteads

Homestead is abandoned, dung decays into fine grey sediment. Micro-nutrients in dung become bio-available

Micro-nutrients support diverse cohort of grasses preferred by wild and domestic animals

Multiple patches of micronutrient enriched grasslands are established.

Questions?

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