Intratooth isotope profiles of fossil suids: environmental variability in the Pleistocene deposits of the Koobi Fora Formation

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Introduction

Previous studies investigating the changing environment in eastern Africa have used stable isotope analysis in tooth enamel for paleodietary and paleoenvironmental reconstruction. Despite an extensive isotopic record of the Pleistocene fossil fauna, most studies utilized a single sample from each tooth, which averages the animal's diet and body water over the time represented in the sample. Intratooth isotope profiles can reveal seasonal changes in diet and body water, which can serve as a proxy for environmental variability. Most suids in the Pleistocene have high-crown molars or long canines, both of which are ideal for intratooth profiles.

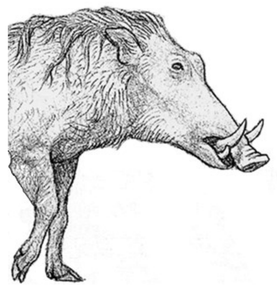
Research Objectives

Exploring intratooth isotope profiles of early Pleistocene suids of the Koobi Fora Formation provides insights into seasonal variation of vegetation and hydroclimate of their habitats.

- Quantify isotopic composition of enamel among early Pleistocene suid species using serial sampling technique.
- Investigate inter-individual variability in carbon as a proxy for dietary and habitat heterogeneity, and in oxygen as a proxy for body water and rainfall seasonality.

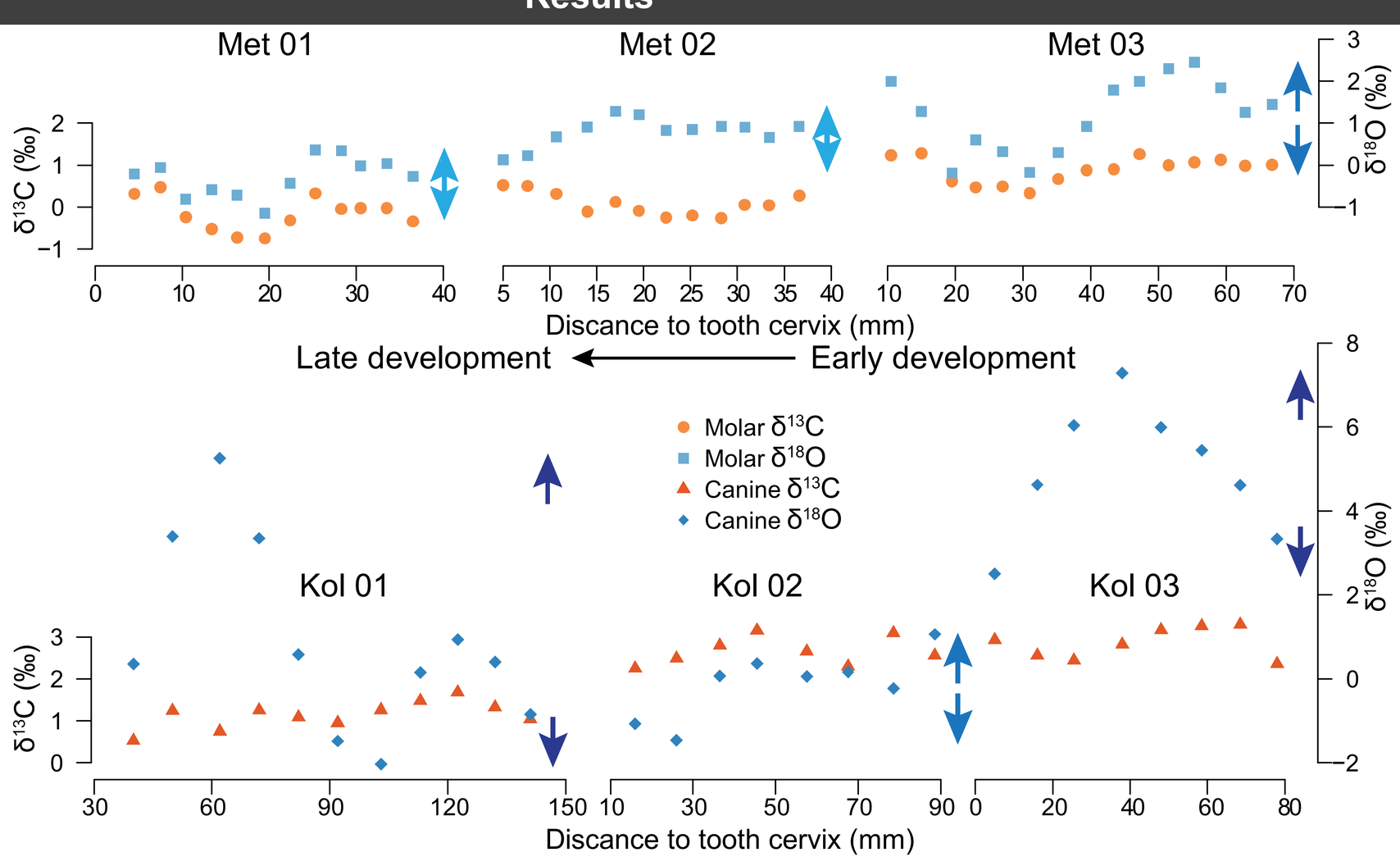
Results

Figure 1



Metridiochoers spp.

Kolpochoerus limnetes



***Kolpochoerus* and *Metridiochoerus* profiles (Figure 1)**

We selected three canines of Kolpochoerus and three M3s of Metridiochoerus from Upper Burgi, KBS and Okote members of the Koobi Fora Formation (2.1 – 1.38 Ma, **Table 1**). We investigated their dietary response to seasonality by examining carbon and oxygen isotopes in enamel that was sequentially sampled along the growth axis of each tooth (**Figure 2**).

Table 1

ID	Museum/ Field #	Taxon	KF Area	Member	Age Estimate	Kendall's *tau*
Met 01	F17001	*Metridiochoerus andrewsi*	10	KBS	1.9-1.5 Ma	**0.545***
Met 02	F22333	*Metridiochoerus hopwoodi*	1A	Okote	1.5-1.4 Ma	-0.273
Met 03	F21258	*Metridiochoerus compactus*	1A	Okote	1.5-1.4 Ma	**0.562****
Kol 01	ER 4304	*Kolpochoerus limnetes*	?	Okote?	1.5-1.4? Ma	-0.0182
Kol 02	ER 3256	*Kolpochoerus limnetes*	103	KBS	1.9-1.5 Ma	0.214
Kol 03	ER 1154	*Kolpochoerus limnetes*	130	Upp. Burgi	2.1-1.9 Ma	-0.0714

Methods

Stable isotope serial sampling technique was used to investigate seasonal variation in carbon and oxygen isotopes in enamel. We sampled *Kolpochoerus* canines and *Metridiochoerus* third molars. The canines were sampled at 10mm intervals and molars at 3mm intervals (**Figure 2**). $^{13}C/^{12}C$ and $^{18}O/^{16}O$ ratios of enamel were analyzed using phosphoric acid digestion with pre-treatment. Results were reported as a sequence from the cervix to the top of the crown using the per mil notation (‰) relative to the VPDB standard. Kendall's *tau* correlation test was used to detect whether the two isotope series are concordant or discordant.

Figure 2. Specimens sampled and plotted in Figure 1. A) *Kolpochoerus* canine (Kol 01, KNM-ER 4304), B) *Metridiochoerus* third molar (Met 03, F21258). Scale bar in centimeters.

Conclusions

- *Kolpochoerus* and *Metridiochoerus* diets are C_4-dominant in the early Pleistocene.
- $\delta^{18}O$ data from Kol 01 and Kol 03 indicate high seasonal variability in body water.
- The $\delta^{13}C$ and $\delta^{18}O$ values in Met 01 and Met 03 are positively correlated ($P < 0.05$), suggesting similar dietary response to rainfall seasonality.
- It is not possible to directly compare data from the two tooth types, but due to higher maturation rate and lower appositional angle, canines seem to provide a less damped signal of seasonal variations in diet and body water.

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