Analysis of paleosol-based proxies from the Turkana Basin through paleoenvironment and paleoclimate reconstruction

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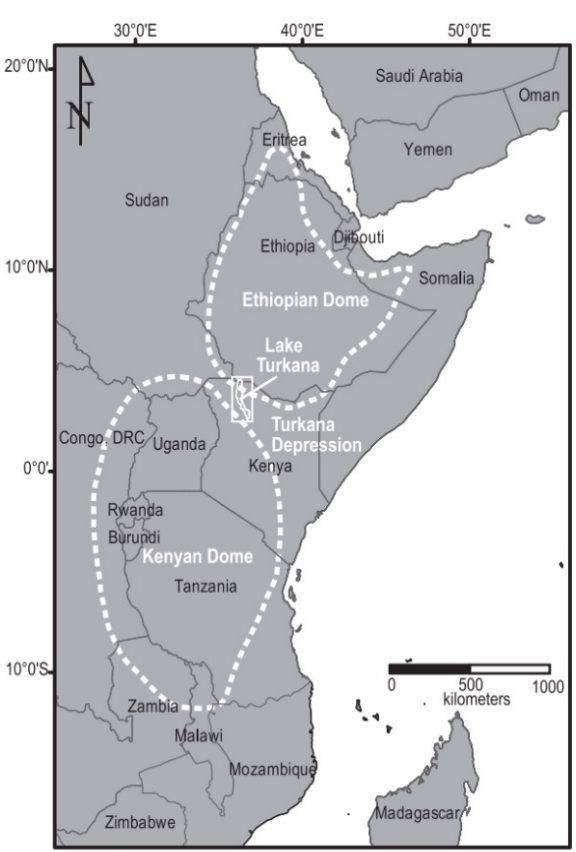
Beverly, 2015

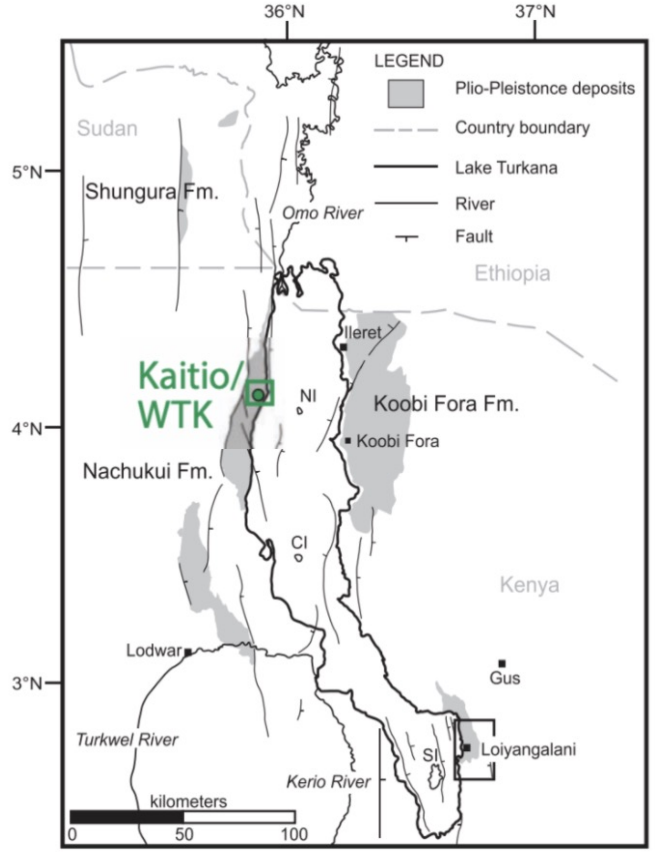
West Turkana Kaitio (WTK)

Four paleosols

Our outcrop samples were collected along Kaitio Laga, which flows into the western margin of Lake Turkana

(Hargrave et al., 2014)



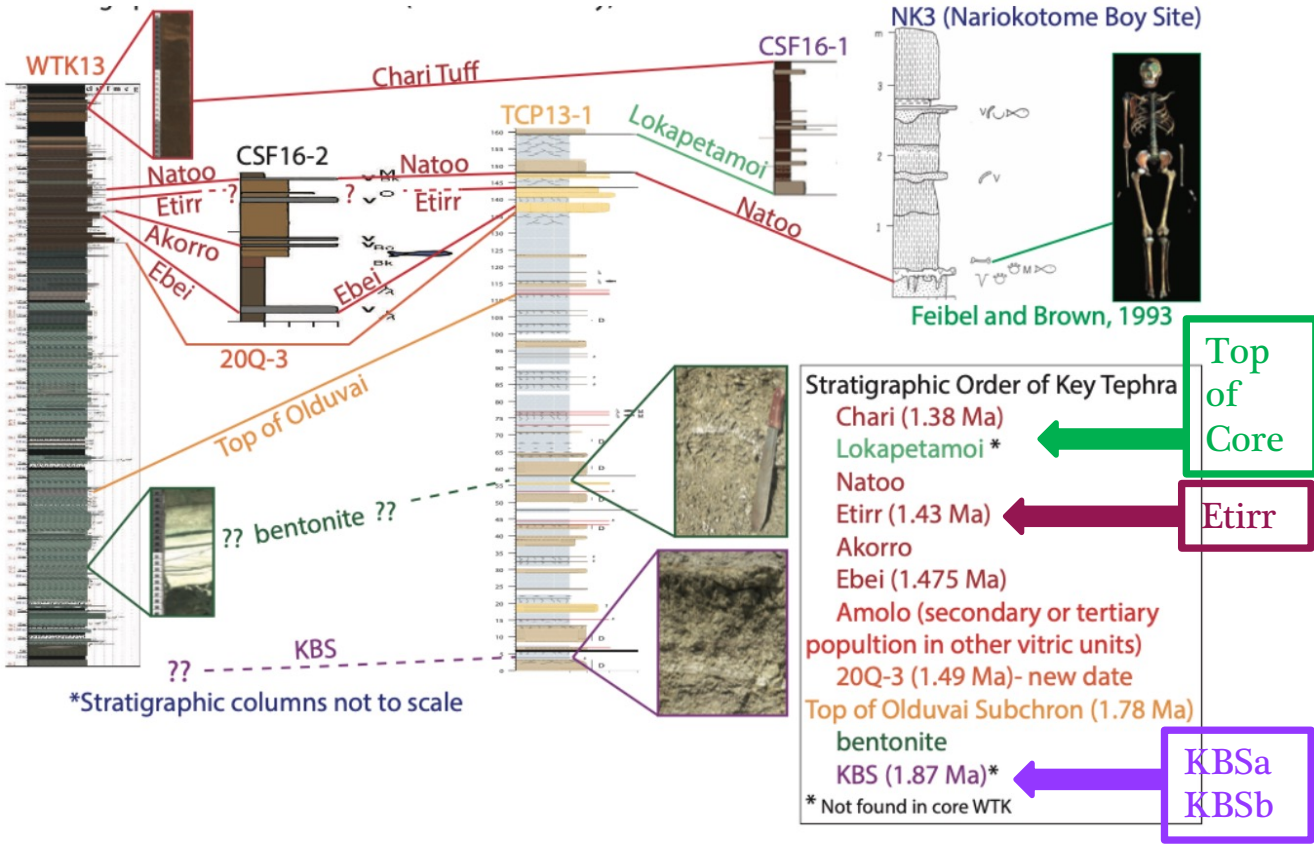


Stratigraphy of WTK13 Core

Our soils can be correlated to the microstratigraphy of the HSPDP core WTK13

**Top of core soil is most likely associated with Nabelete Tuff

(Beck and Feibel, 2019)



Methods

XRF

Major and trace element analysis used as proxy for mean annual precipitation (MAP) from CIA-K and CalMag indices (Sheldon et al., 2002; Nordt and Driese, 2010)

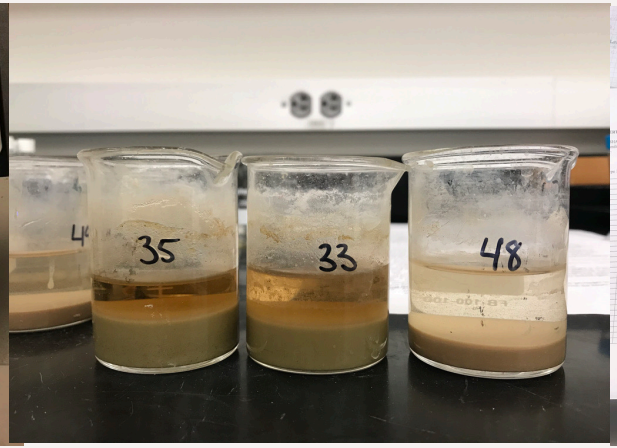
Mass Spectrometry

Stable carbon isotope data, $\delta^{13}C$ ($^{12}C/^{13}C$), used as proxy for percent woody cover and vegetation type (Cerling et al., 2011)

Malvern

Grain size analysis used for depositional environment reconstruction

*Samples taken every 10 cm



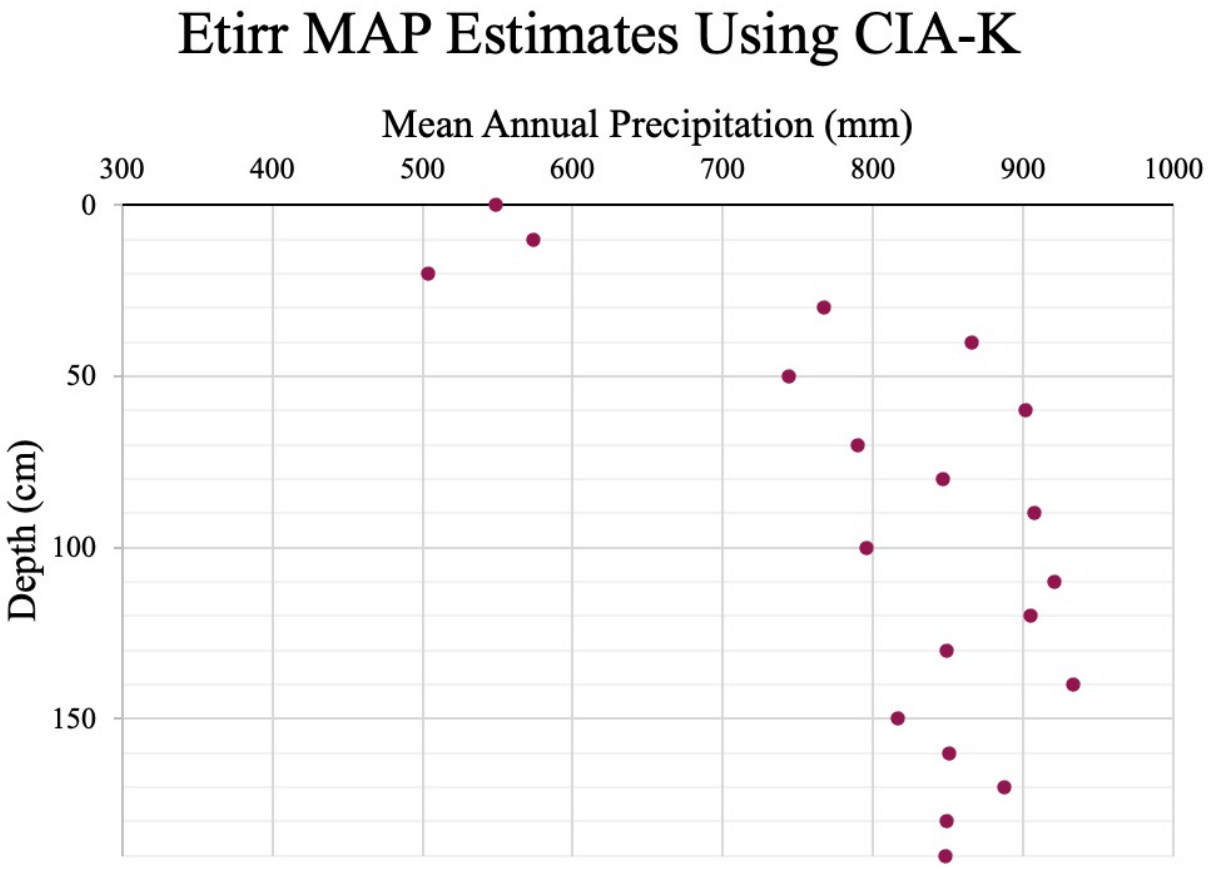
Results

XRF & Mean Annual Precipitation (MAP)

CIA-K

- Max = 934 mm/yr
- Min = 503 mm/yr
- Avg = 851 mm/yr
- Stdev = 55 mm/yr

*NOTE: avg and stdev exclude bottom three samples



CIA-K = 14.265(CIA-K) - 37.632
(Sheldon et al., 2002)

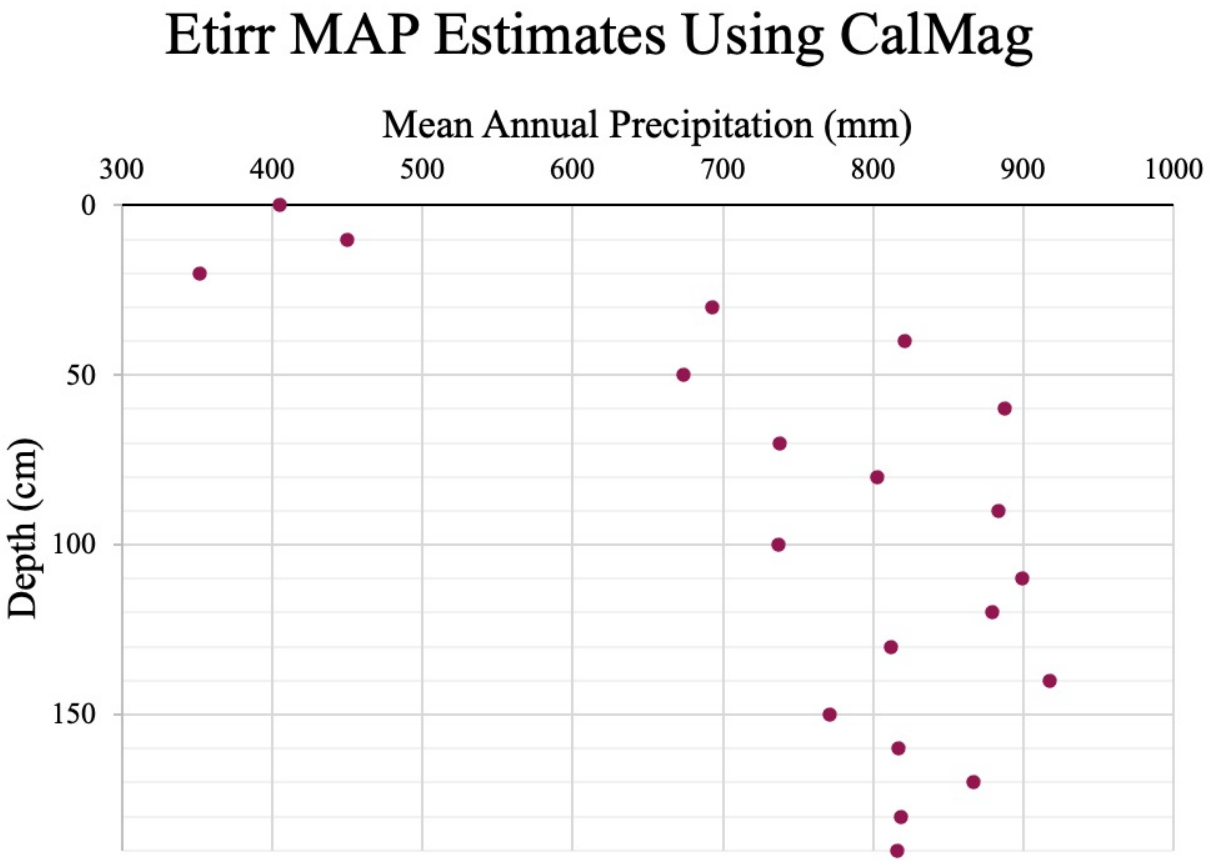
Results

XRF & Mean Annual Precipitation (MAP)

CalMag

- Max = 917 mm/yr
- Min = 352 mm/yr
- Avg = 814 mm/yr
- Stdev = 72 mm/yr

*NOTE: avg and stdev exclude bottom three samples



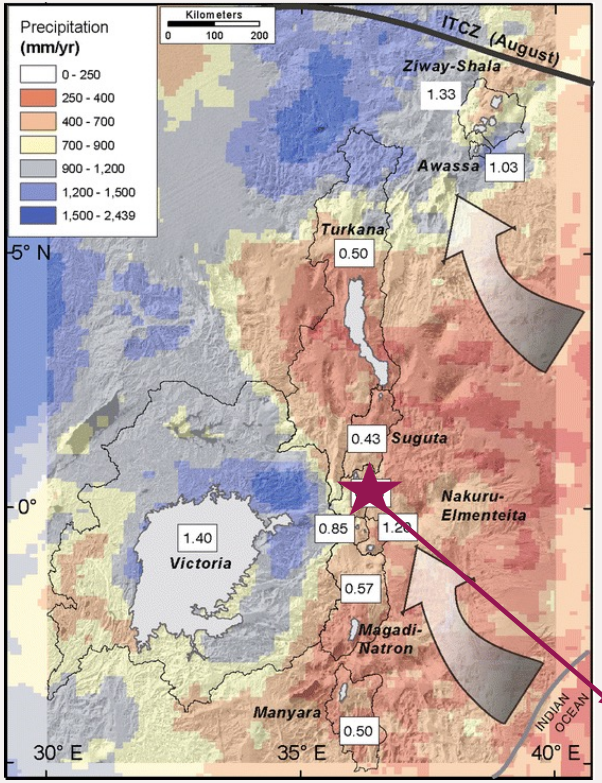
CalMag = Al_2O_3 / (Al_2O_3 + CaO + MgO) × 100
(Nordt and Driese, 2010)

Results

Mean Annual Precipitation (MAP) in East Africa

Average MAP for the **Etirr** paleosol is **~832 mm/yr**, which is reflective of modern-day **Lake Borgoria, Kenya**

(Olaka et al., 2010)



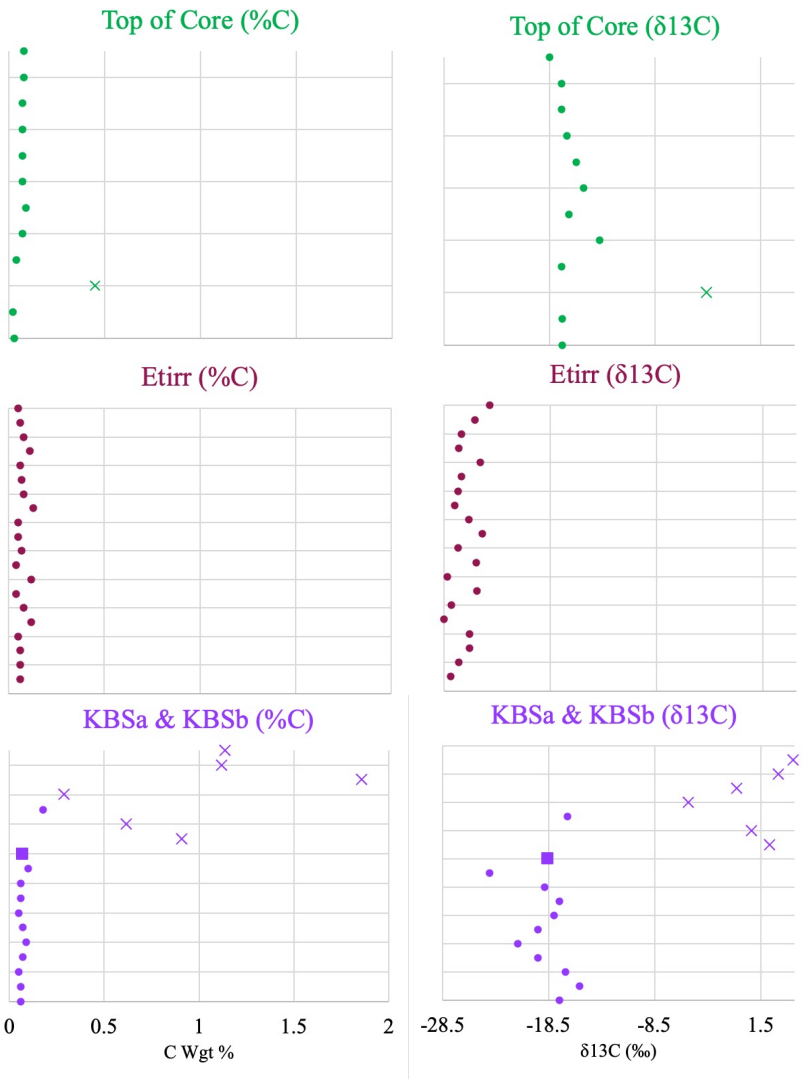
Lake Borgoria National Reserve, Kenya

Results

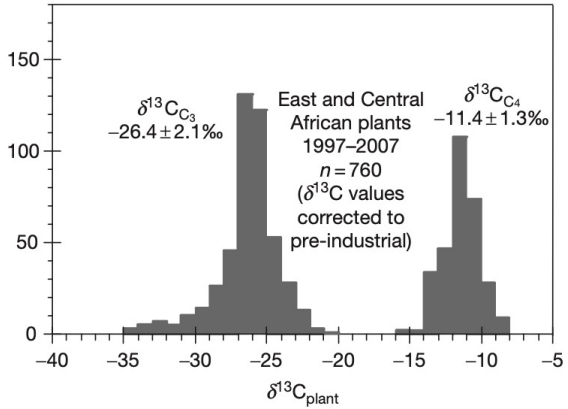
Mass Spectrometry

- Very little carbon in soils
- Varying $\delta^{13}C$ values reflect changes in C_4 vs. C_3 vegetation
- Dominantly C_3 vegetation

(Cerling, 2014)



Relationship between $\delta^{13}C$ and C_3 vs. C_4 vegetation



*Note: x's mark samples with extra sources of carbon; square = KBS Tuff

Results

Percent Woody Cover

Top of Core

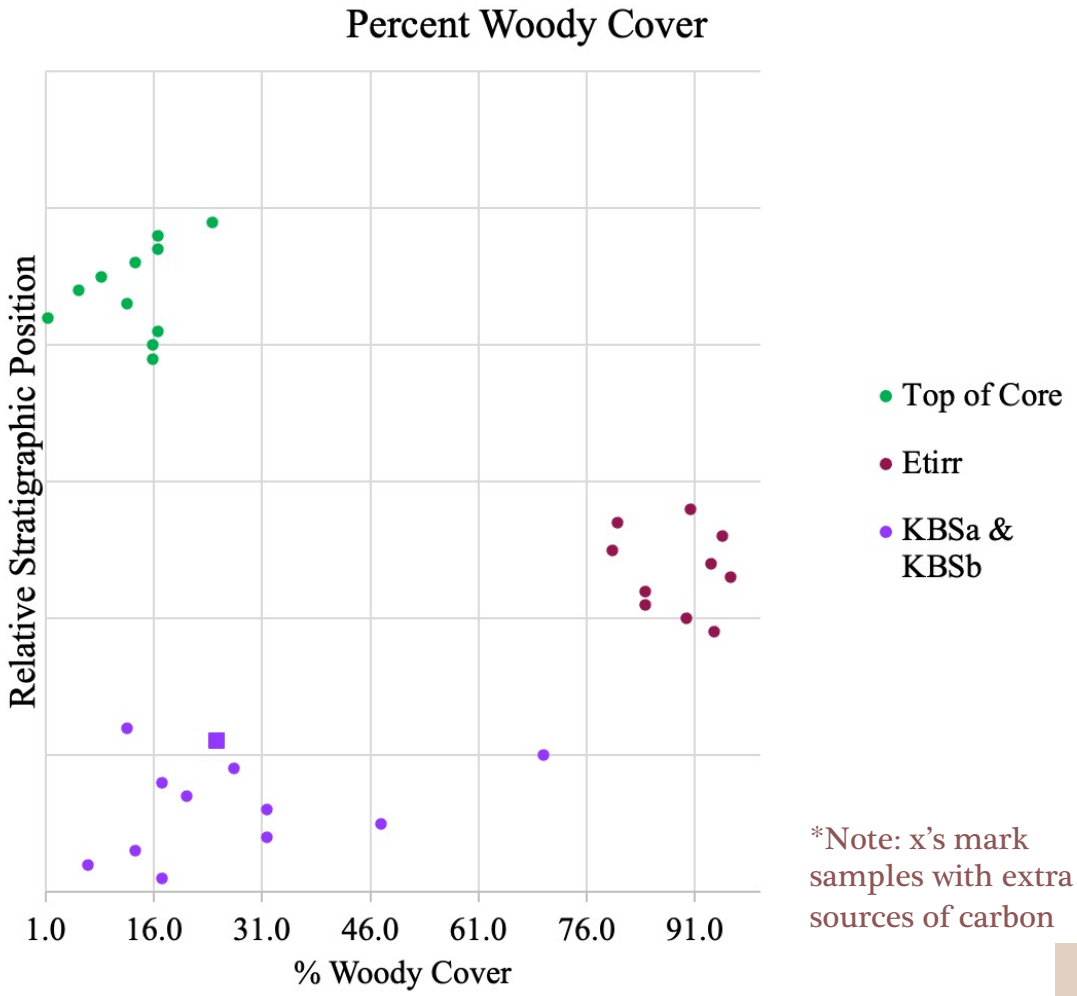
- Avg = 13%
- Wooded grassland

Etirr

- Avg = 86%
- Forrest

KBSa & KBSb

- Avg = 23%
- Wooded grassland

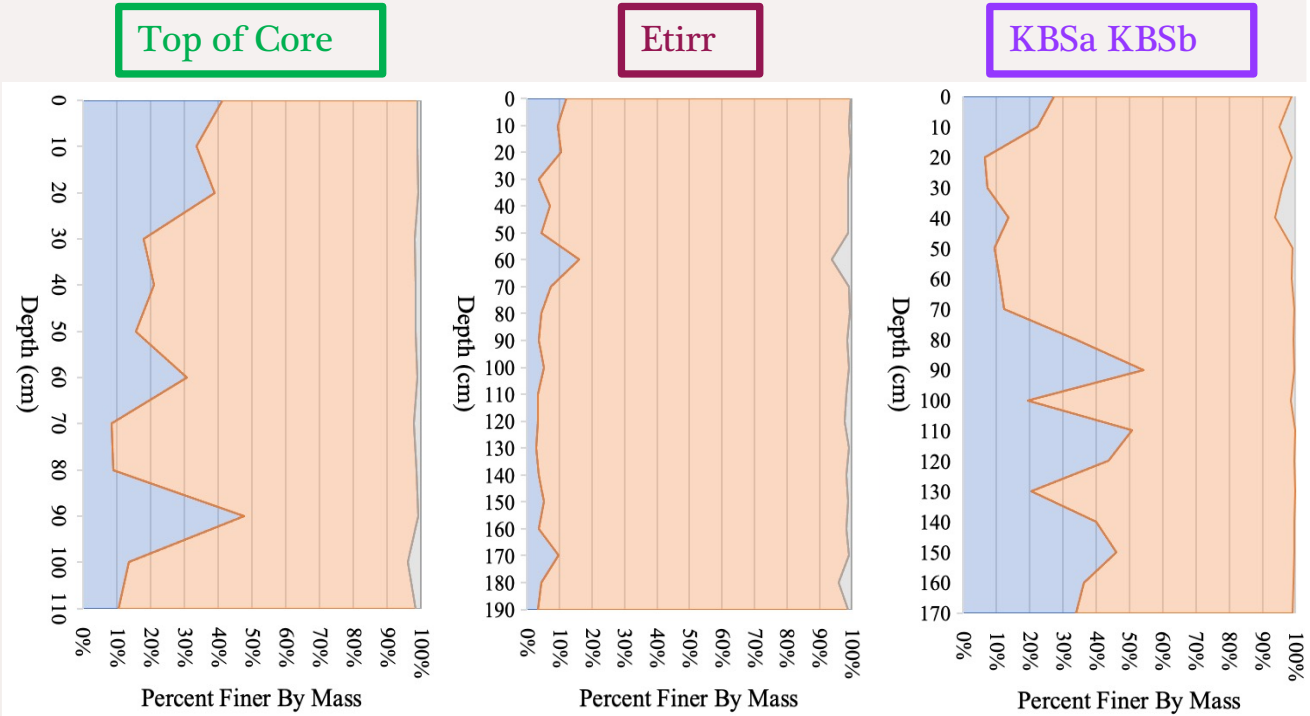


*Note: x's mark samples with extra sources of carbon

Results

Malvern Grain Size

- Dominantly silt with some sandy samples
- Top of Core and KBSa & KBSb have higher percentages of clay than Etirr



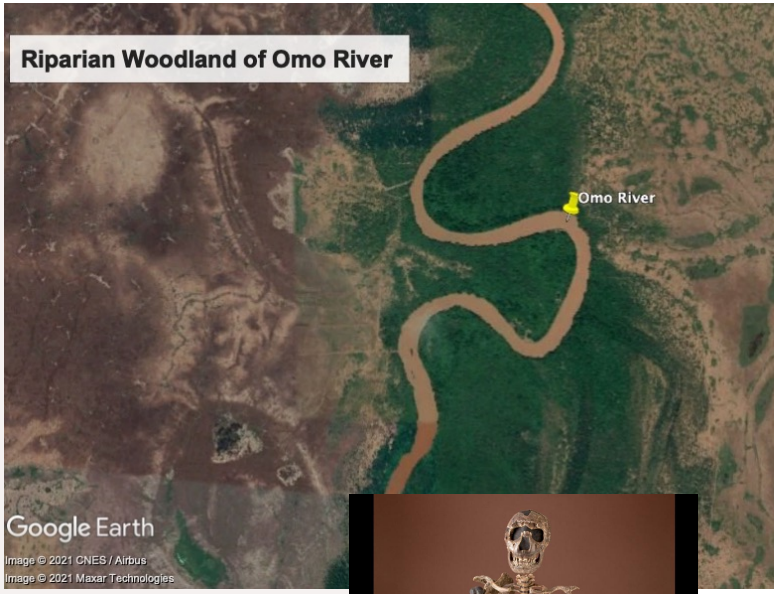
Conclusions

- Based on MAP estimates and % woody cover, our results indicate the basin was **wetter** and **more vegetated** than modern Omo-Turkana

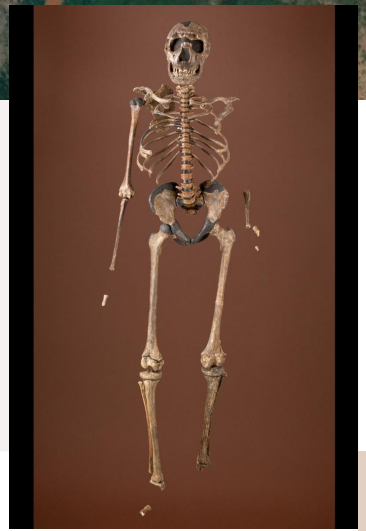
- Our results shows **more vegetation (Etirr)** located within the **fluvial-deltaic environment** rather than the lacustrine environment seen in the basin's stratigraphy

- Based on existing paleogeography, we can interpret the **Etirr** to be located near a **secondary drainage**

- Therefore, the resting place of **Nariokotome Boy** can be interpreted as a **riparian woodland**



Example of modern riparian woodland



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