Tectonics and climate: impacts on the evolution of fluvio - lacustrine environments in the Kenya Rift

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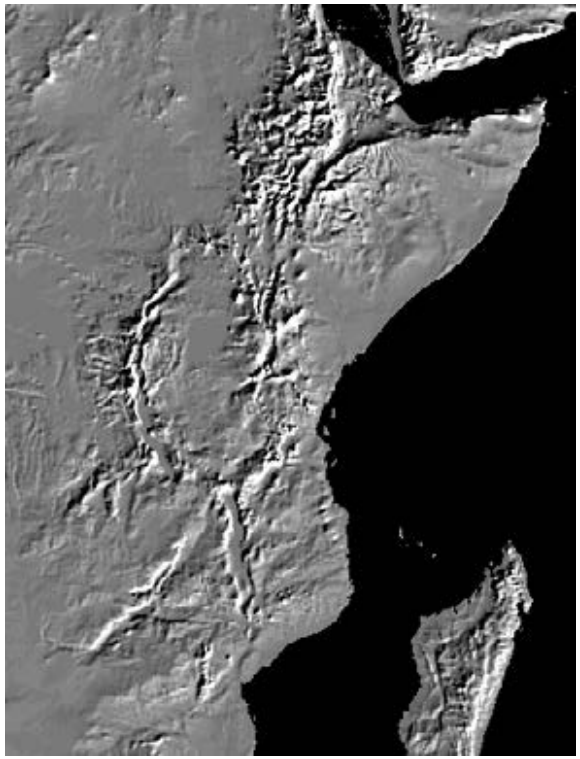
Key topics



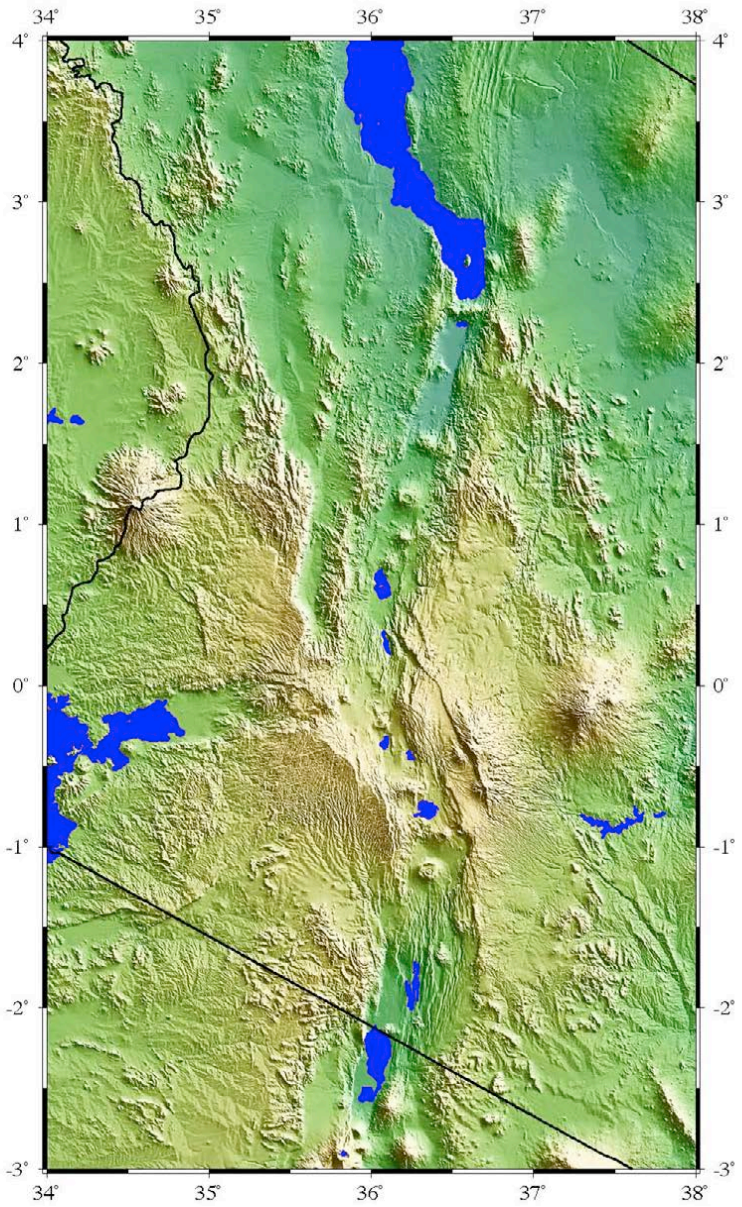
(I) Tertiary and Early Pleistocene basins may have repeatedly hosted large lakes – vestiges are limited

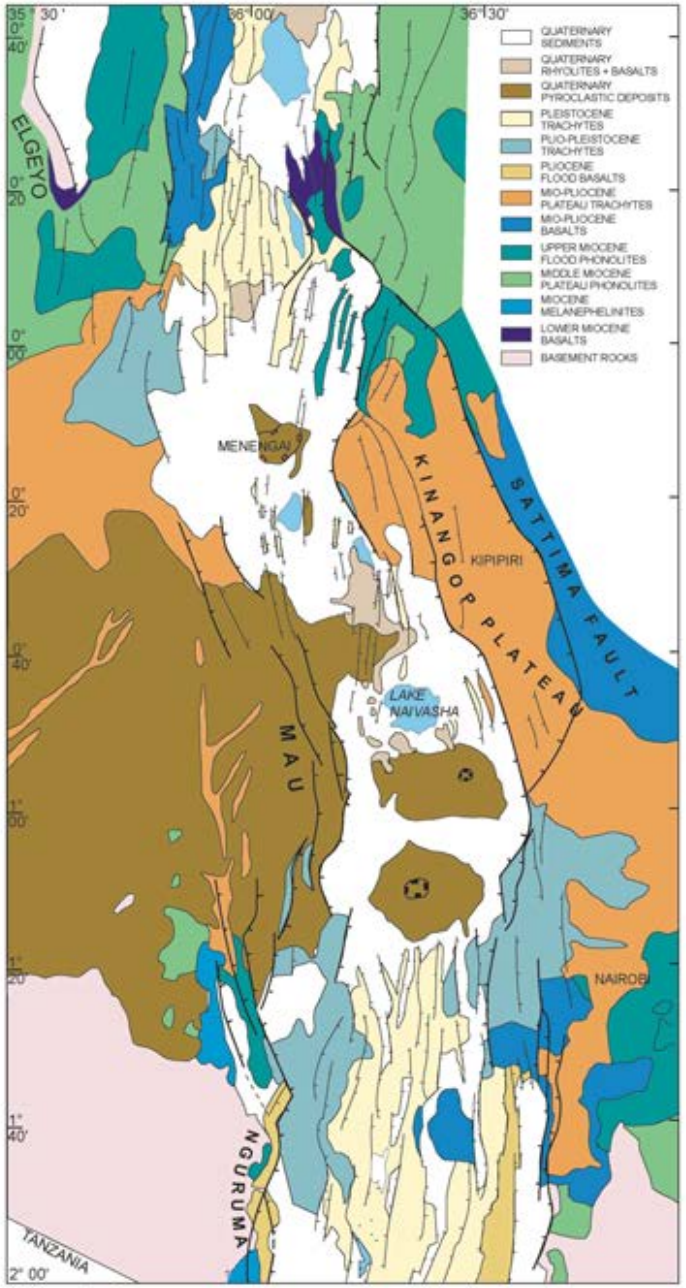
(II) Oblique extension and magmatic processes in Central Kenya Rift have compartmentalized the rift, ultimately causing disparate sedimentary environments

(III) Holocene lake-highstands caused fluvial connectivity between isolated basins and left shorelines that can be used to quantify extension on 10^3yr timescales

(IV) CRN erosion rates document that transitional environments are important in forcing erosion during climate change

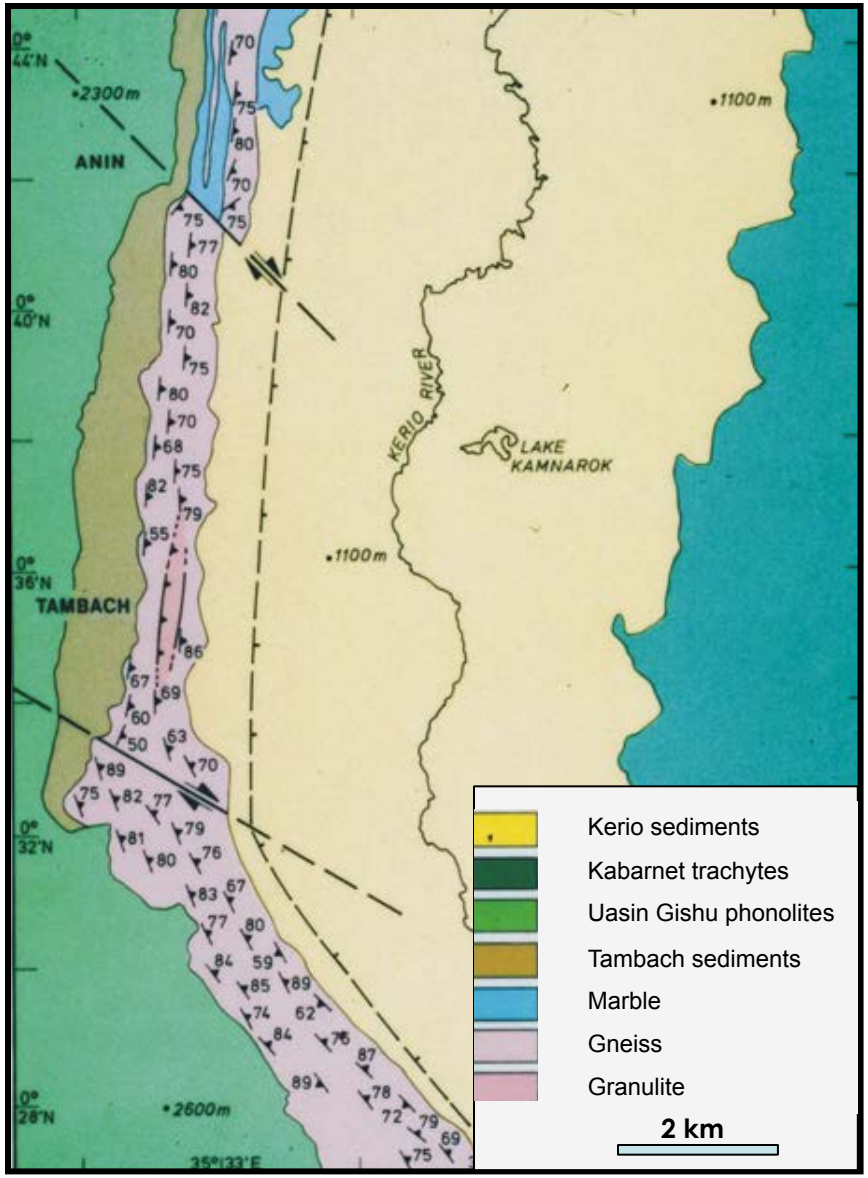
(I) Early sedimentary basins – we don't know much



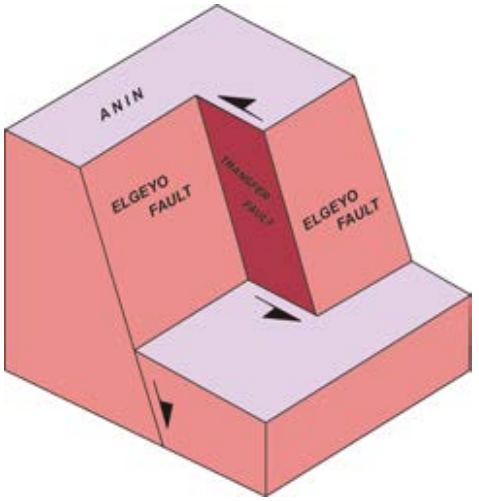


Compilation of Kenyan geologyBaker et al., 1988; Geol. Survey of Kenya, 1989

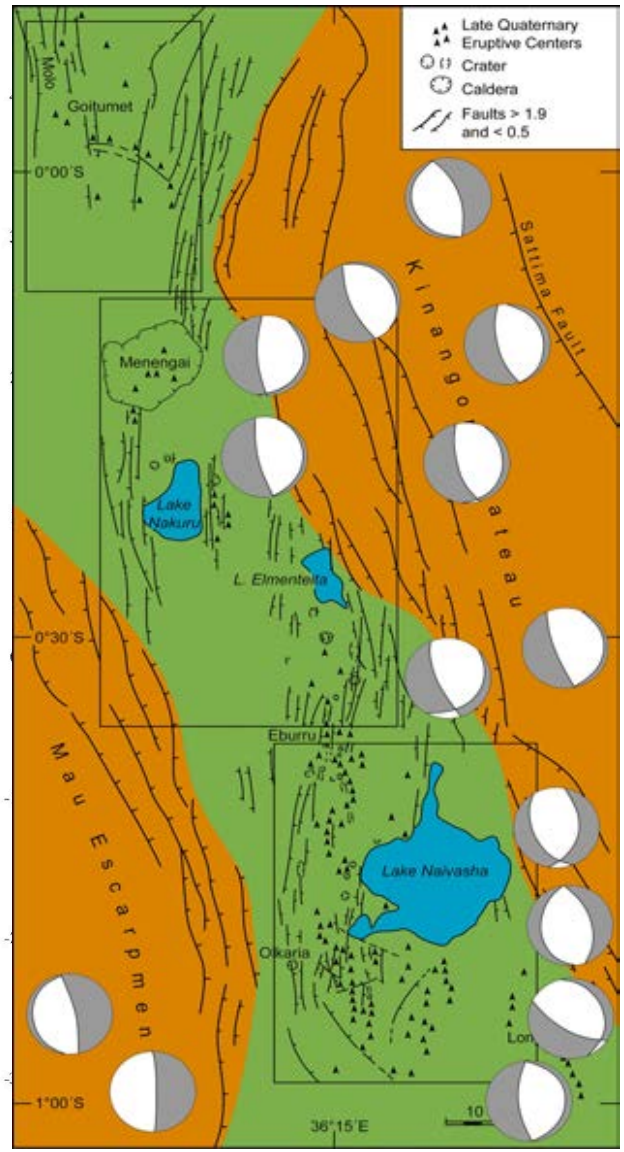
Basement anisotropies, fracture propagation and basins

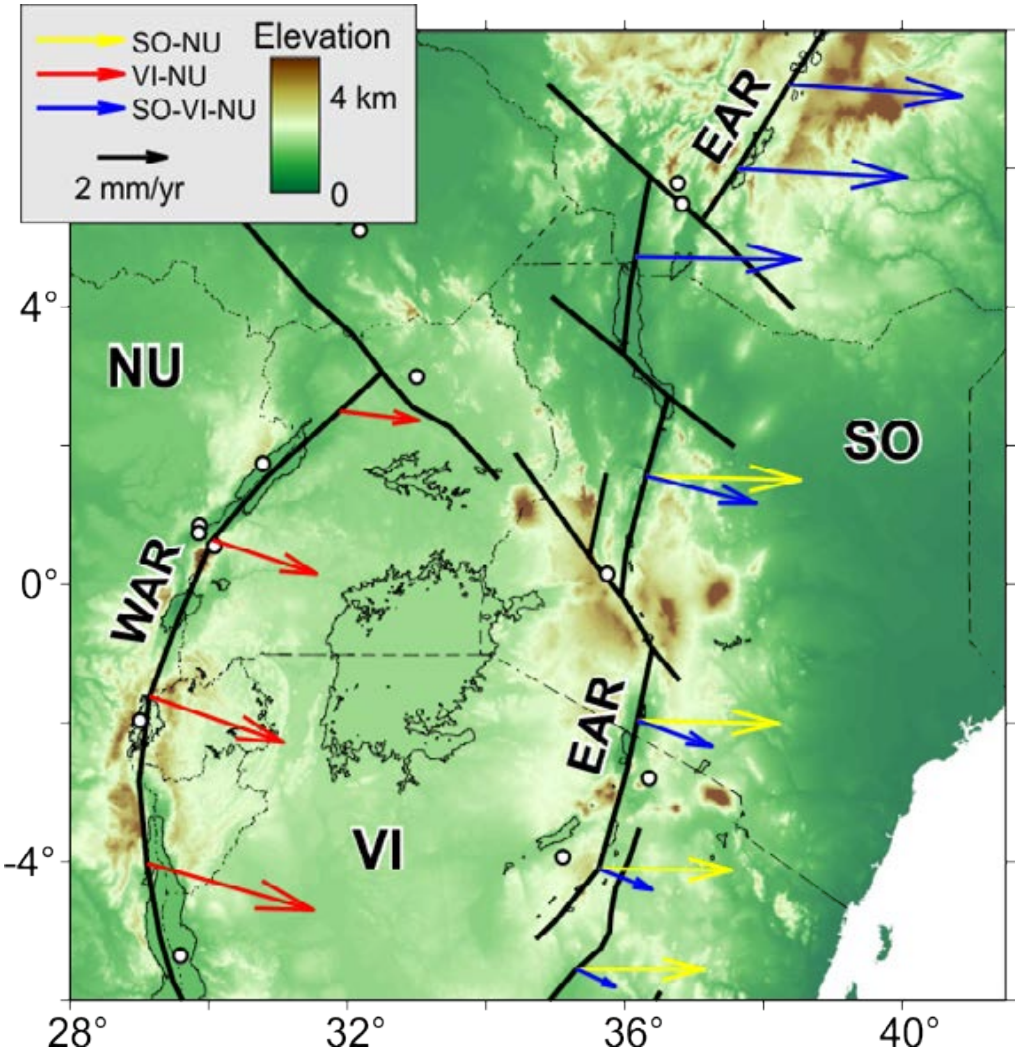


Hetzel & Strecker, 1991, J. Structural Geology



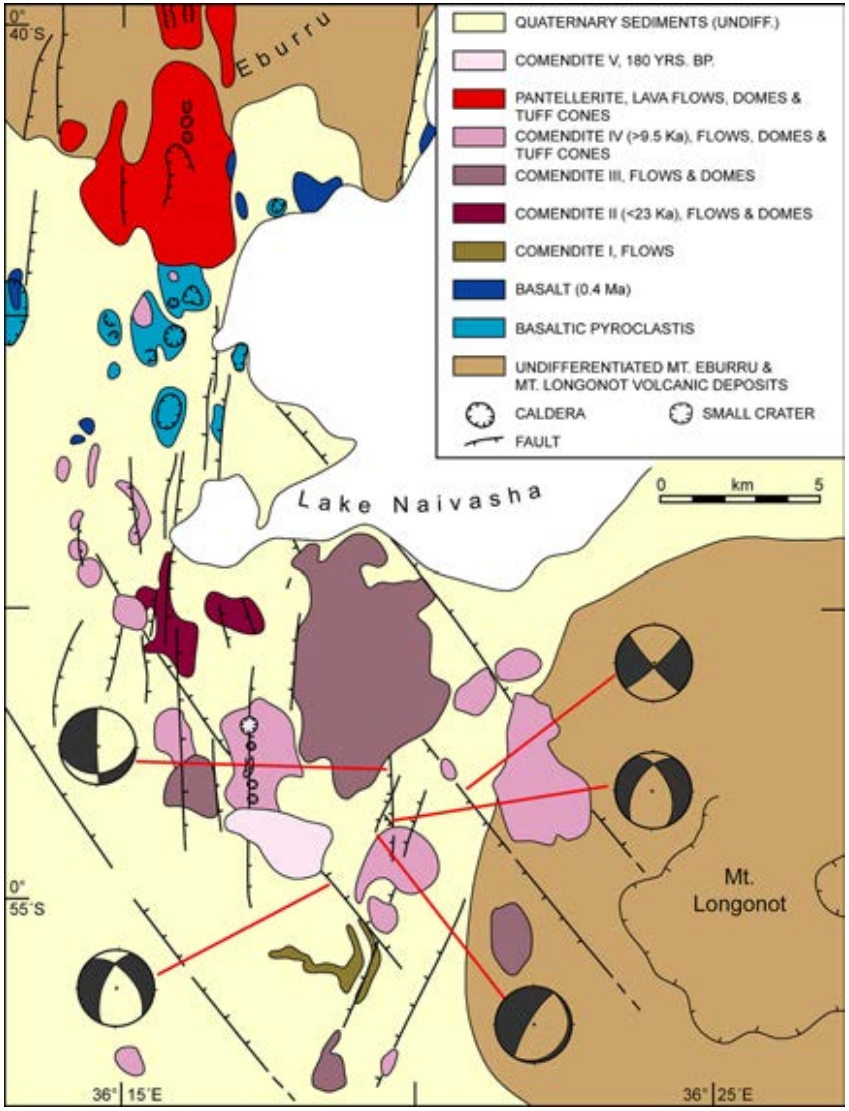
(II) Pleistocene basins in central Kenya: changing obliquity of plate-slip vectors along the rift

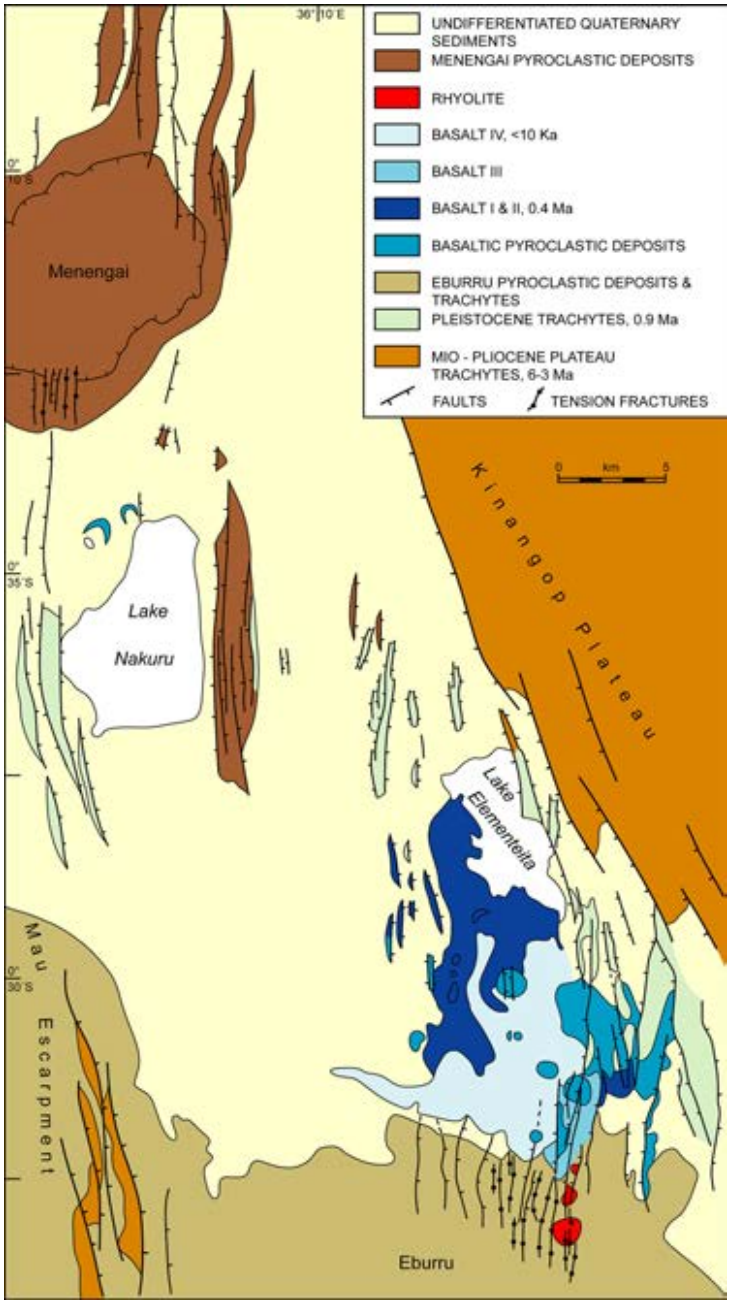


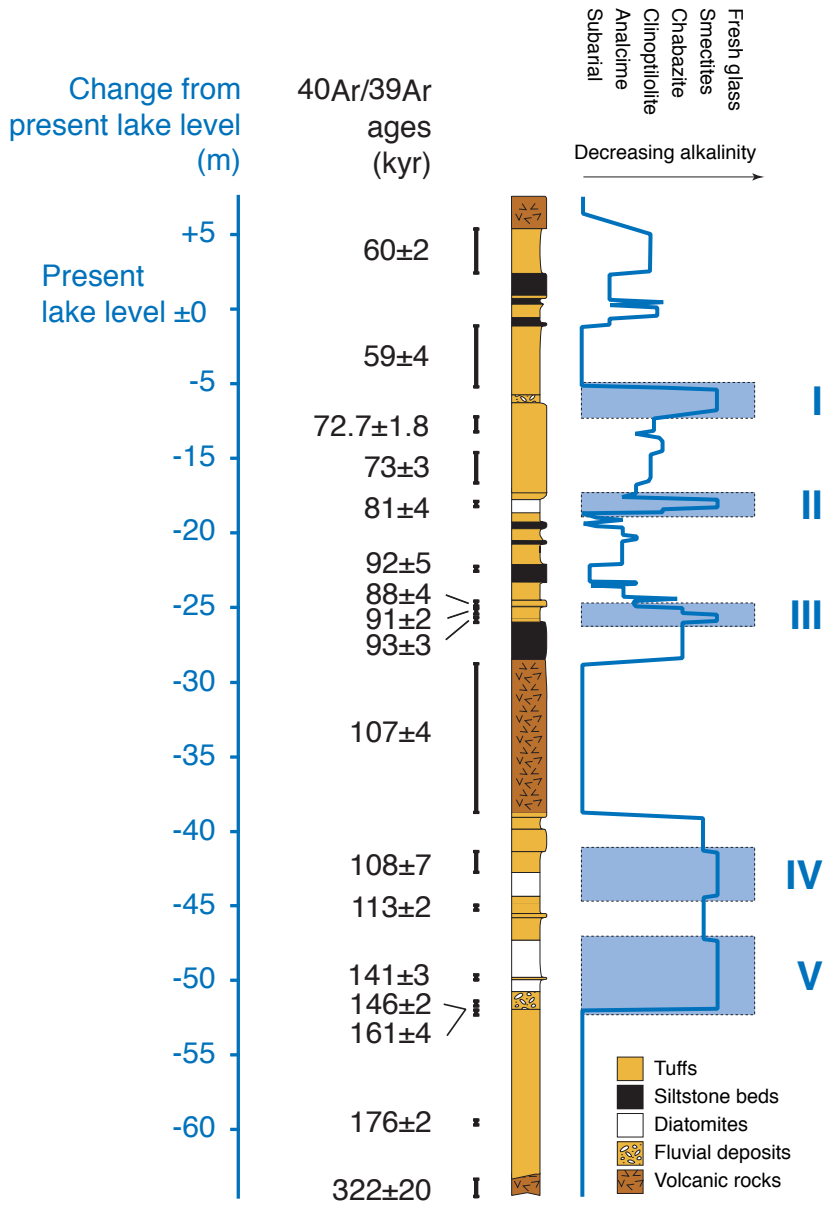


Stamps et al., 2008 GRL

En échelon zones of extension and semi-independent basins

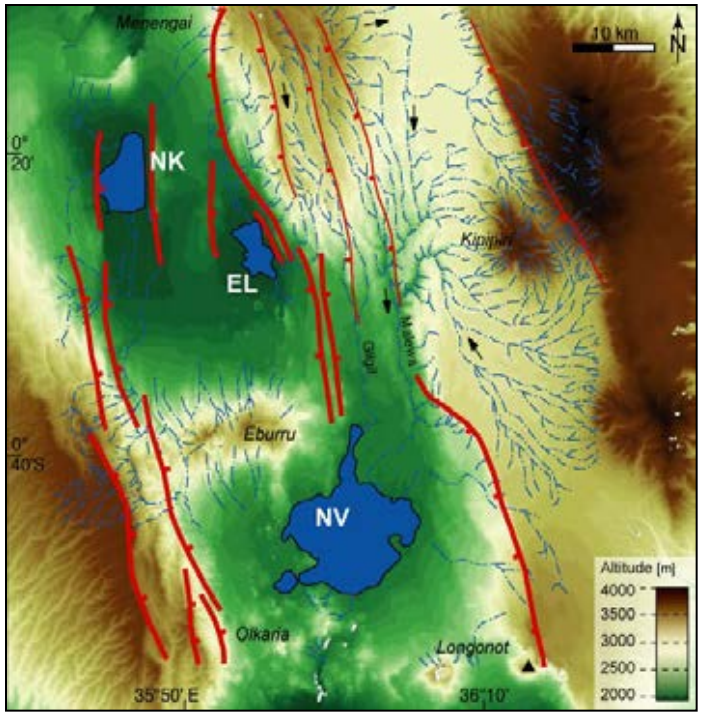


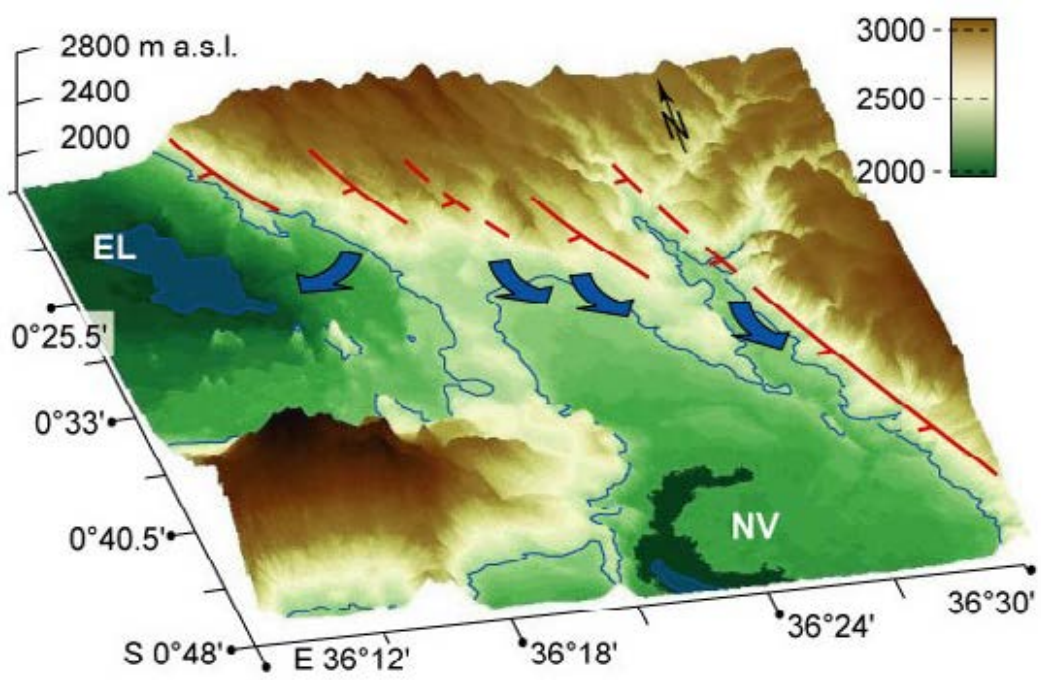




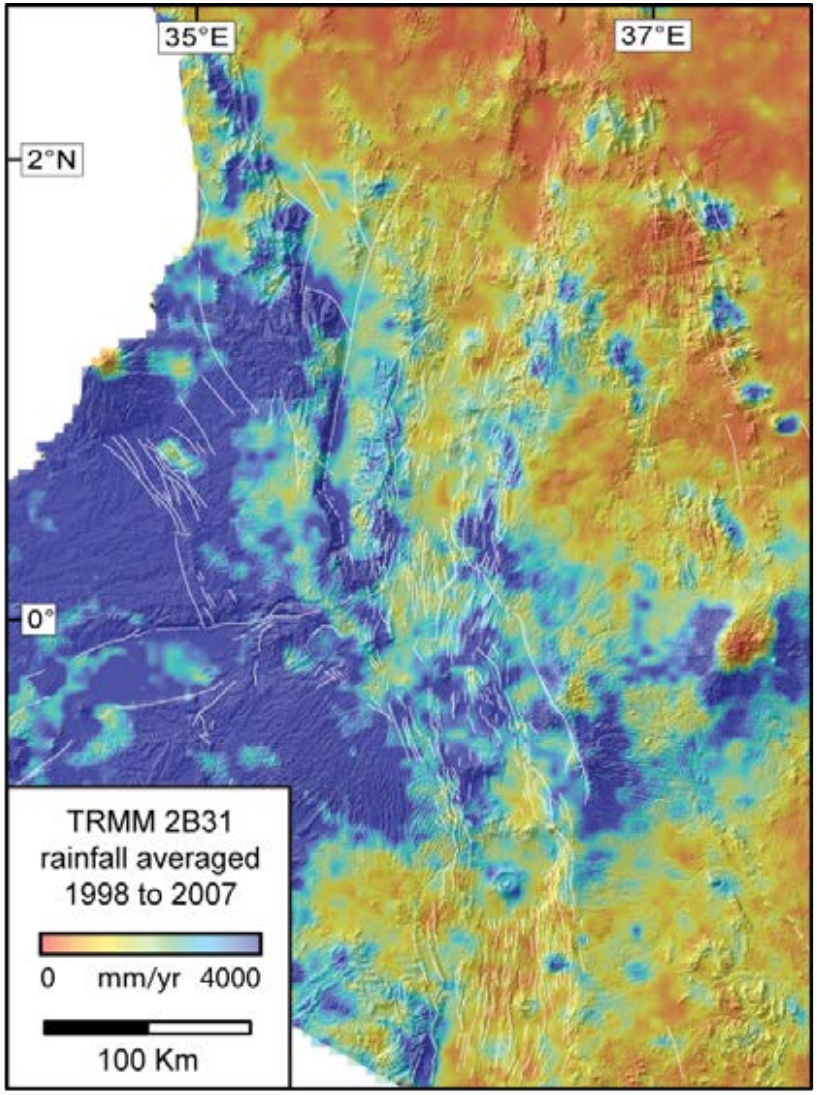
Trauth & Strecker, 2000, E African Lakes; Trauth et al., 2002, Geology; Trauth et al., 2005, Science

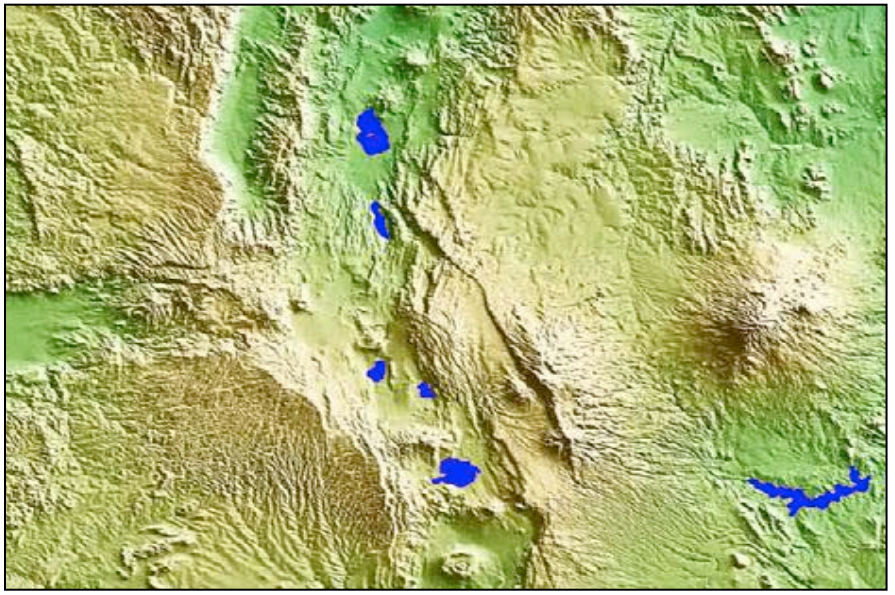
Contrasting sedimentary environments: orographic barriers, volcano-structural barriers, and forcing of fluvial networks





A. Bergner et al., 2009, Quat. Sci. Reviews





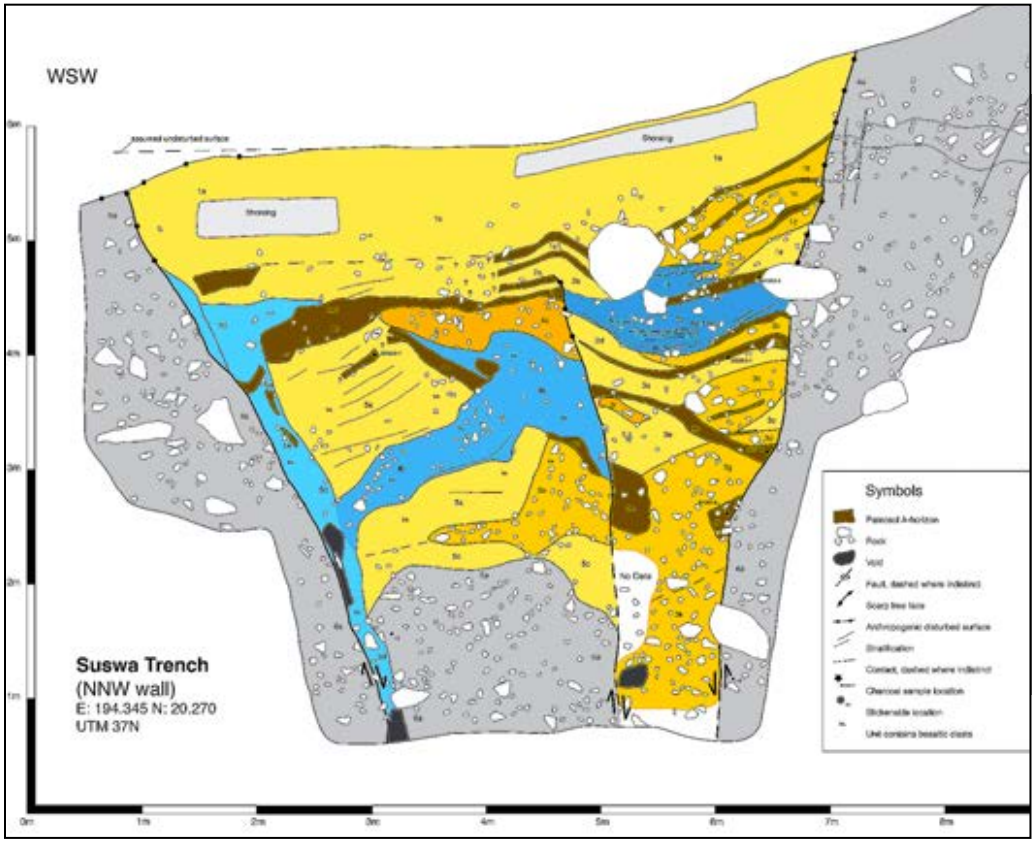
Bergner et al., 2009, Quat. Sci. Rev., V. Torres, ongoing PhD work

Oblique slip along border faults: earthquakes with ground ruptures

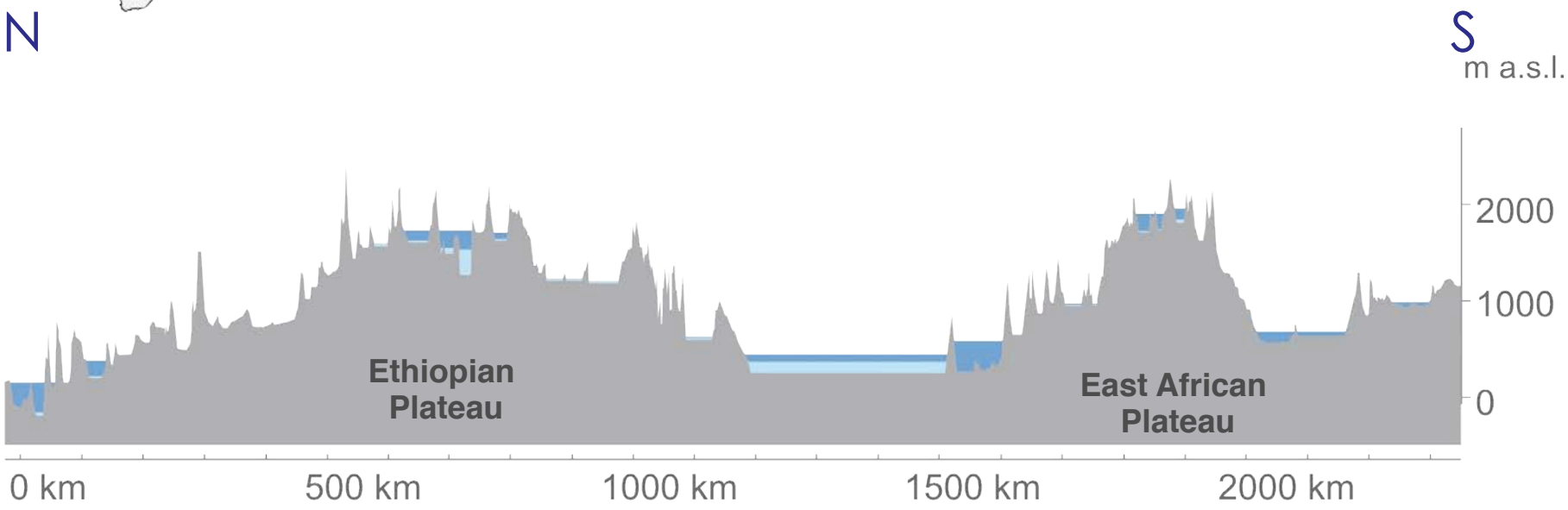
Subukia M 6.9 earthquake in 1928

Alluvial fan and landslide deposits at escarpments

Zielke & Strecker, 2009, Bull. Seism. Soc. America



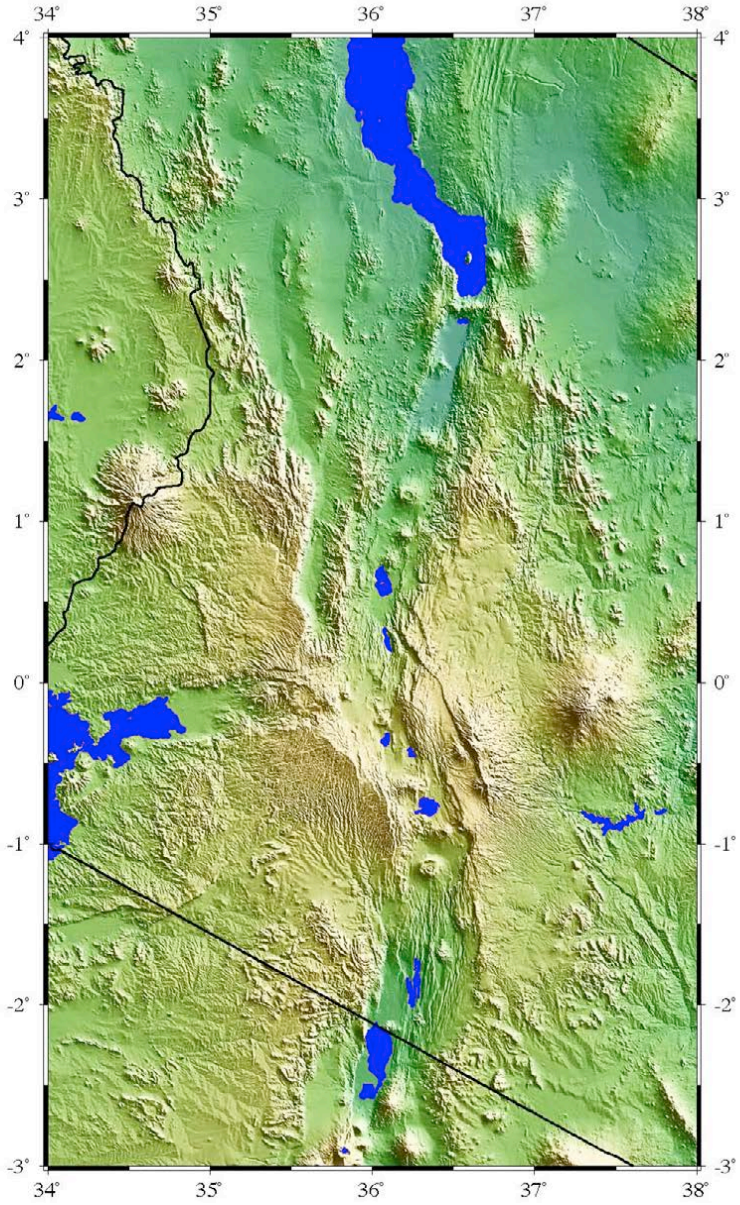
(III) Holocene rift-normal extension in N Kenya and the ups and downs of lakes during the African Humid Period (AHP)

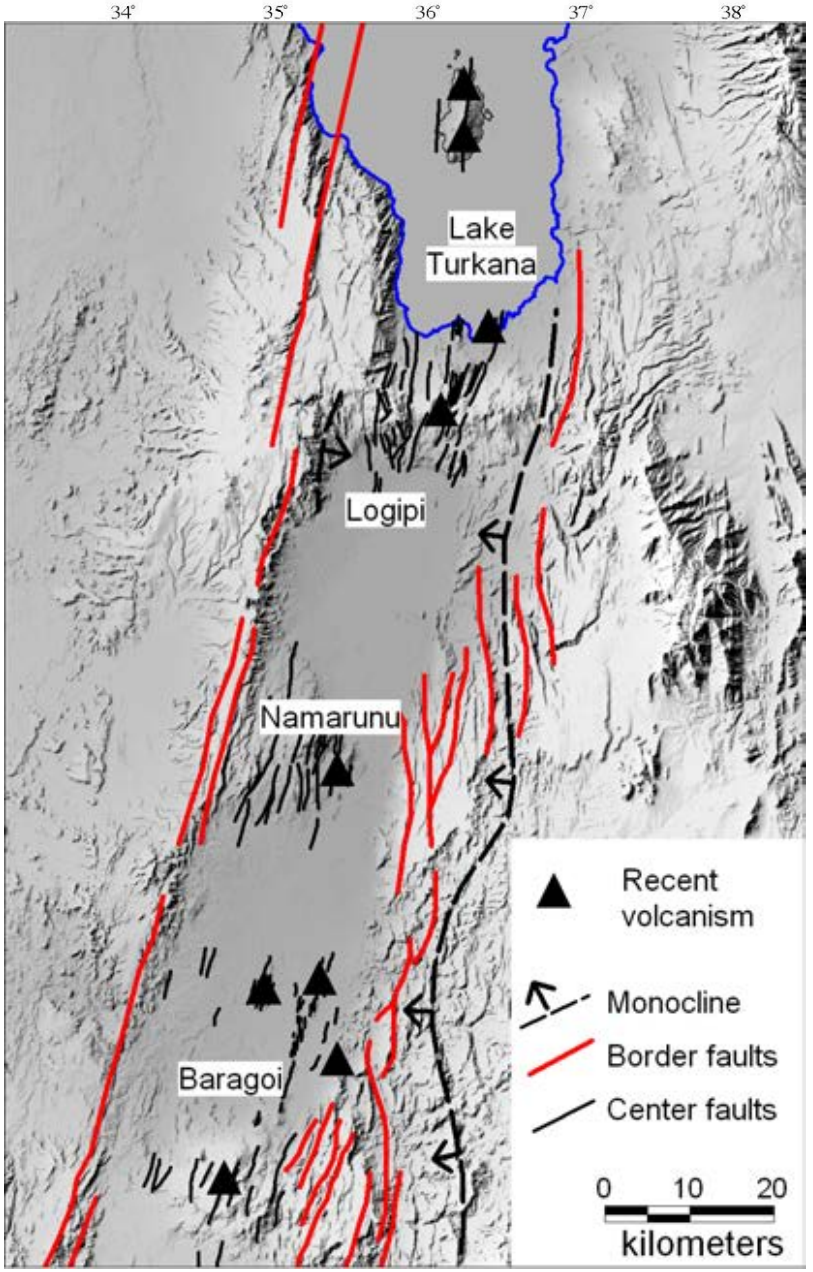


Paleo lake levels during the AHP

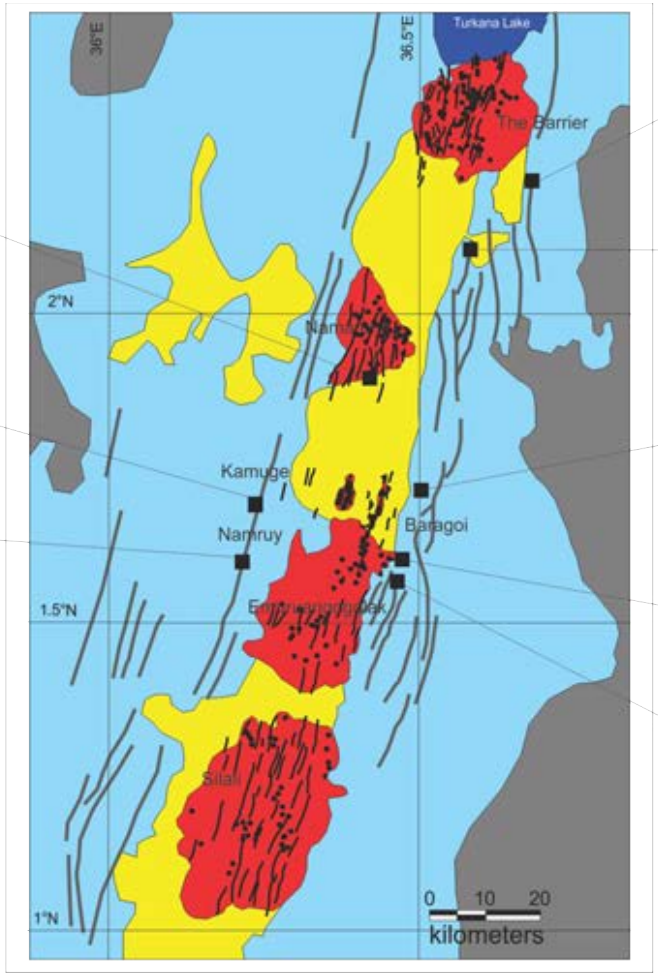
present-day lakes

modified after Junginger, 2012, PhD thesis U Potsdam



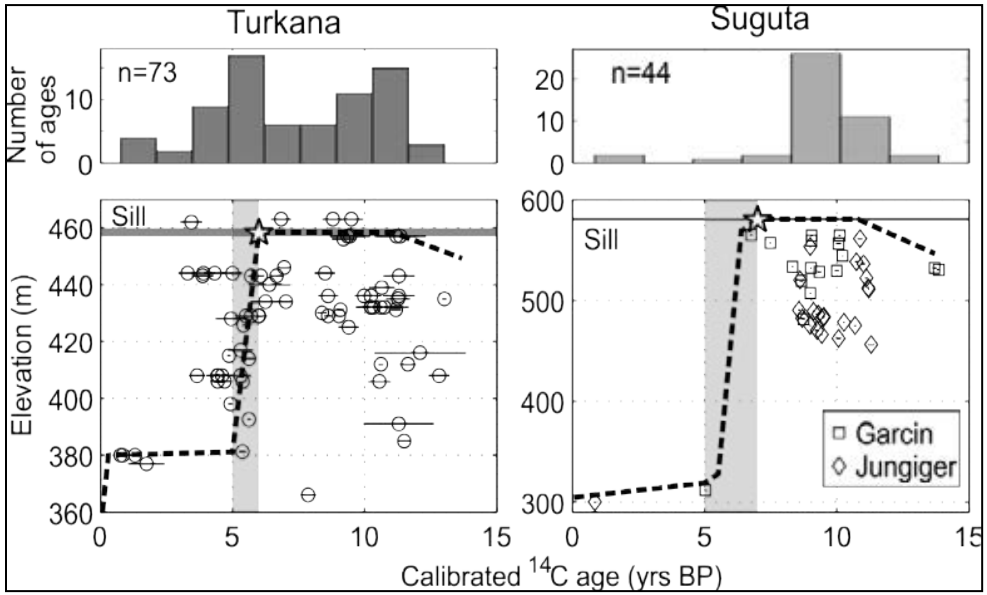


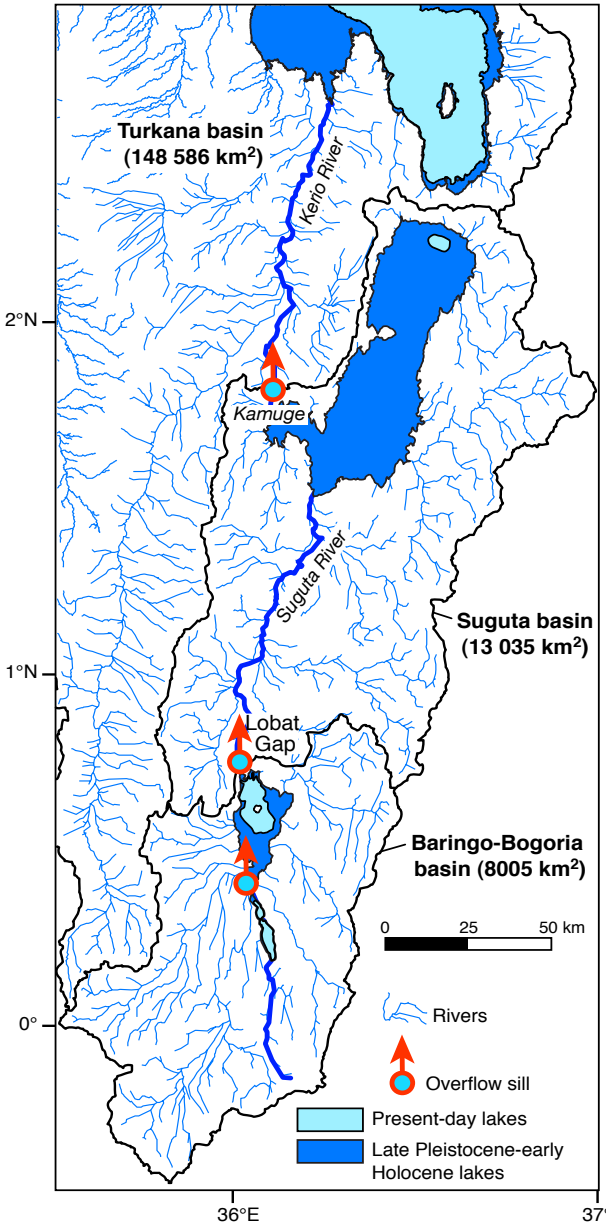
Melnick et al., 2012, EPSL; Garcin et al., 2012, EPSL



Strecker, Melnick & Olago, work in progress

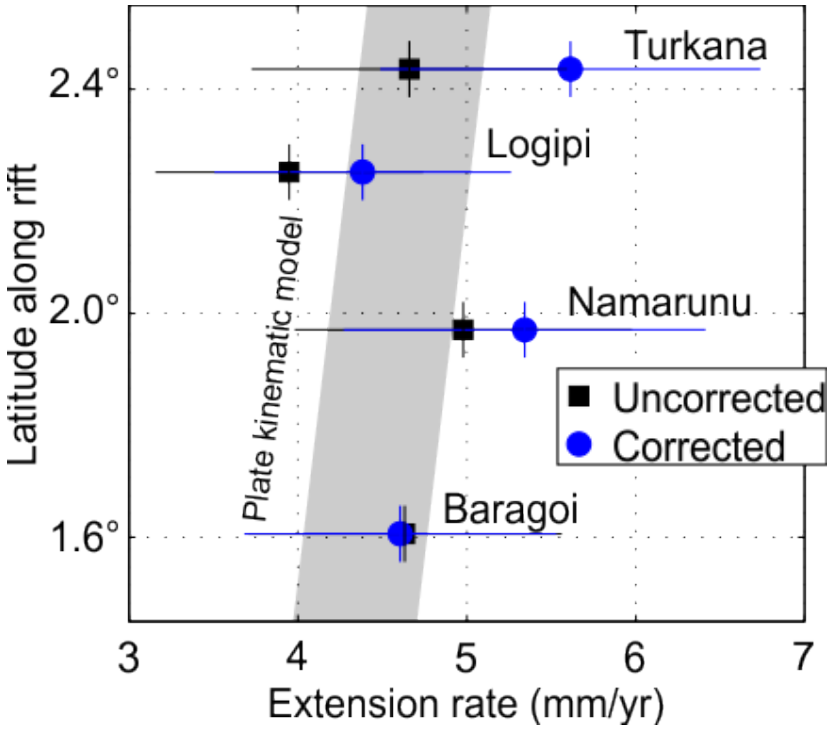
Protracted lake-highstand and formation of shoreline during African Humid Period – an ideal marker to assess tectonism



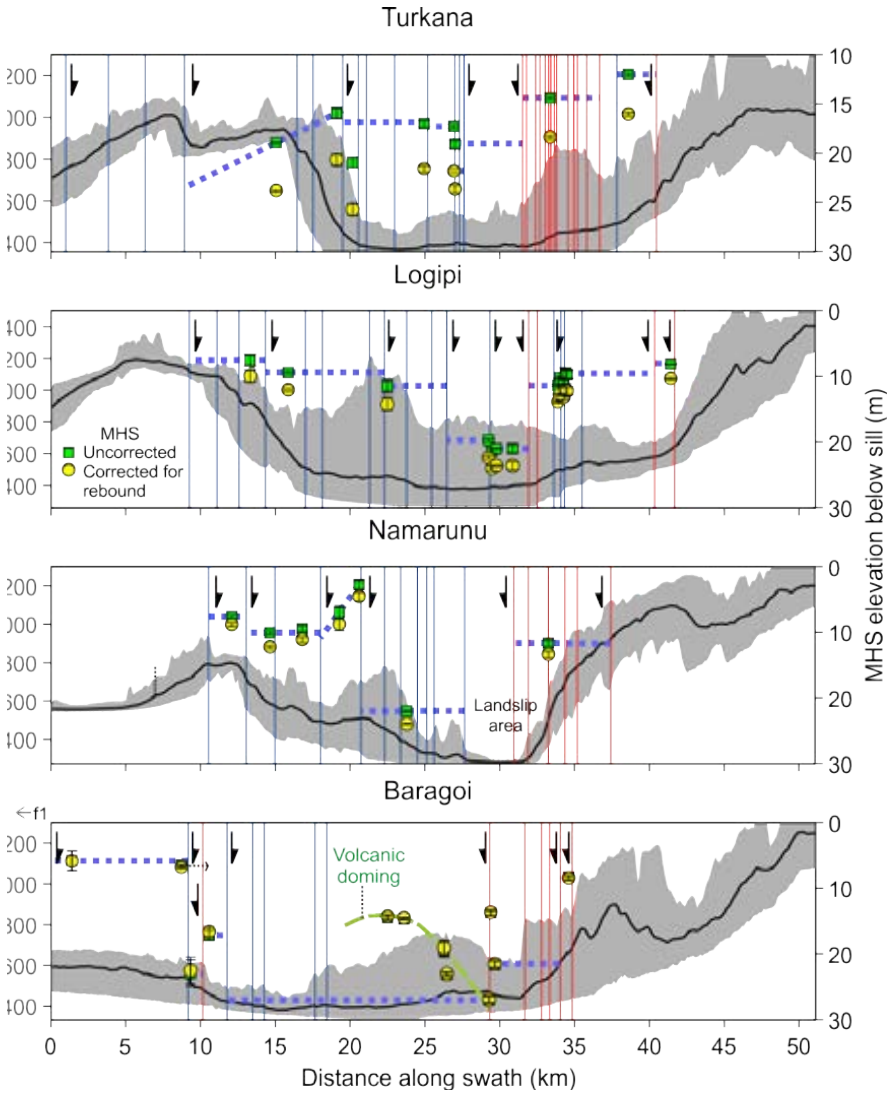


Owen et al., 1982, Nature; Garcin et al. 2009, Quat. Sci. Rev.; Garcin et al., 2012, EPSL; Junginger, 2012, PhD thesis, Potsdam

Linking different timescales of extension



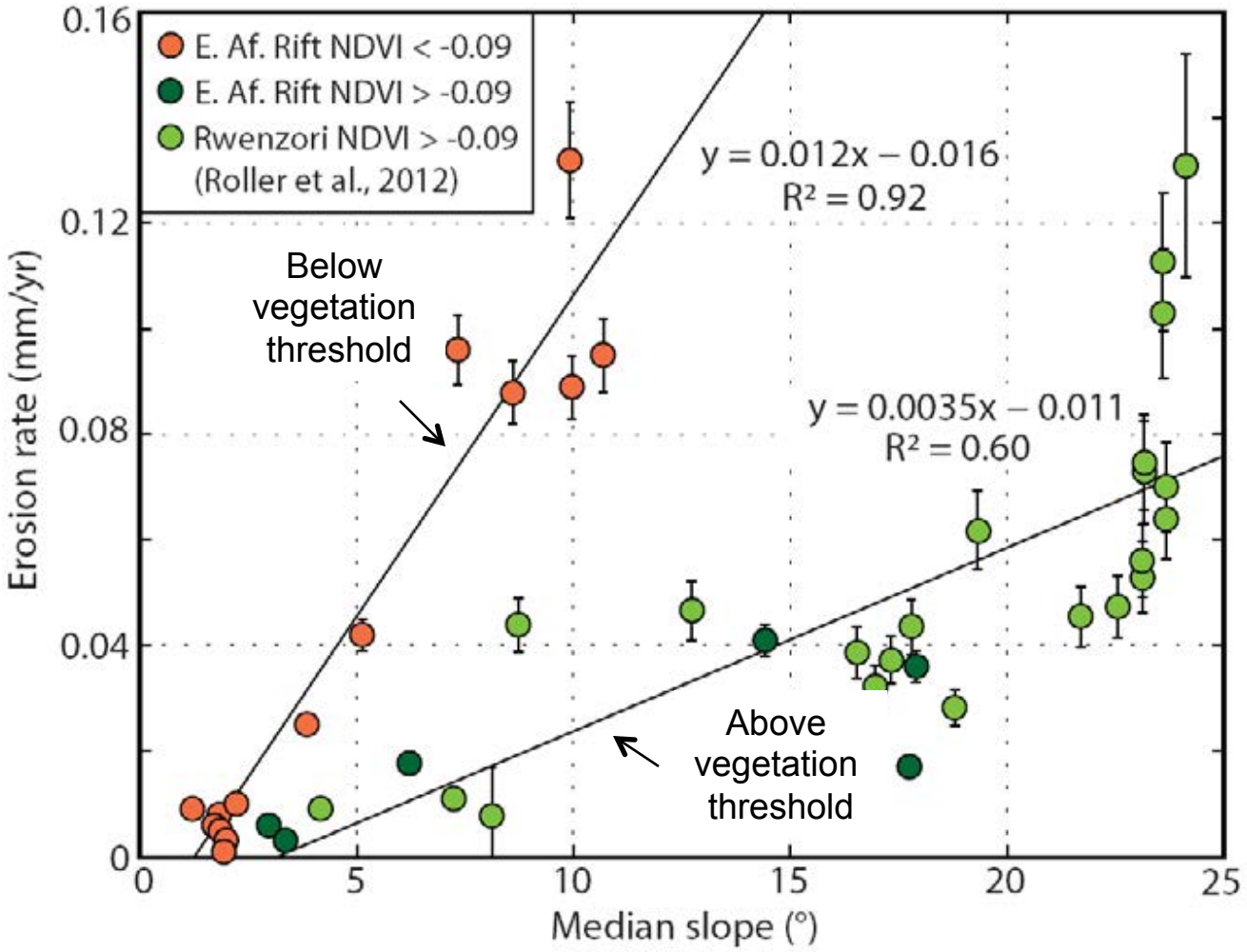
Stamps et al., 2008, GRL



Melnick et al., 2012, EPSL

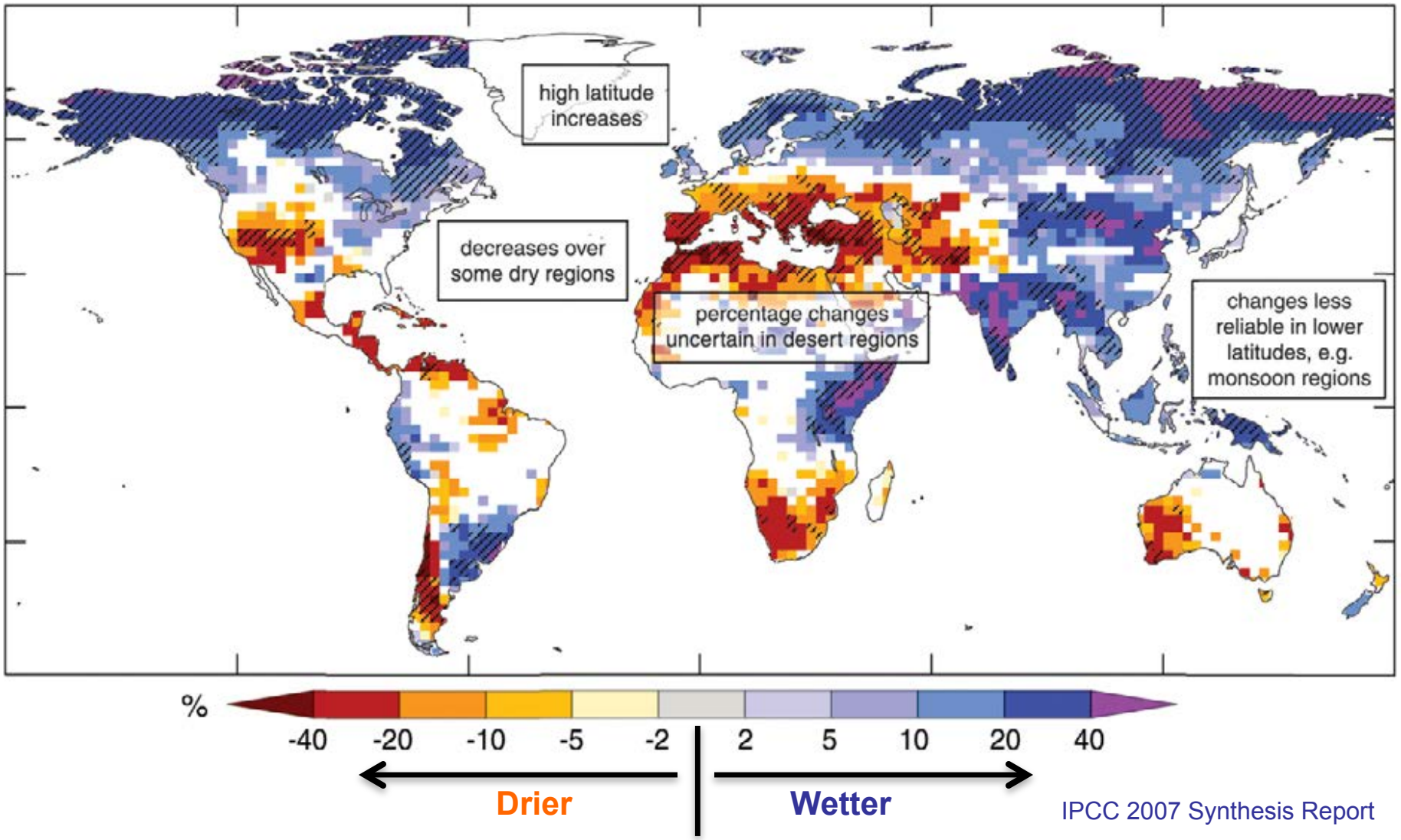
(IV) Were these humid periods characterized by greater erosivity, sediment production, and mass transfer?

Erosion rates in different precipitation/vegetation compartments: effects of vegetation on cosmogenic nuclice (^{10}Be,^{26}Al) basin-wide erosion rates



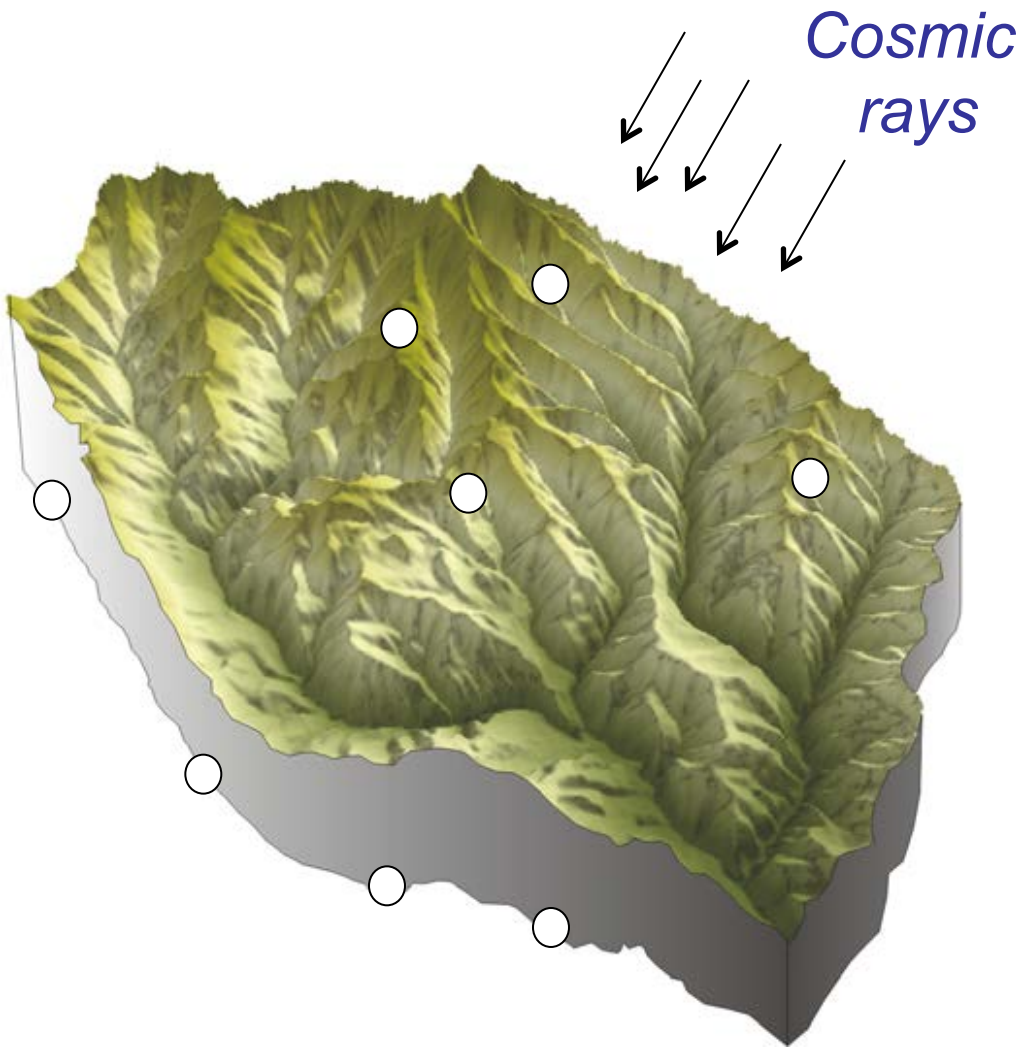
Veronica Torres, PhD thesis in preparation, Potsdam University

(IV) Can we learn about past humid episodes and sediment production from climate modeling?



Predicted changes in annual runoff, 2090-2099 compared to 1980-1999

Basin-wide erosion rates using CRN (10Be, 26Al)



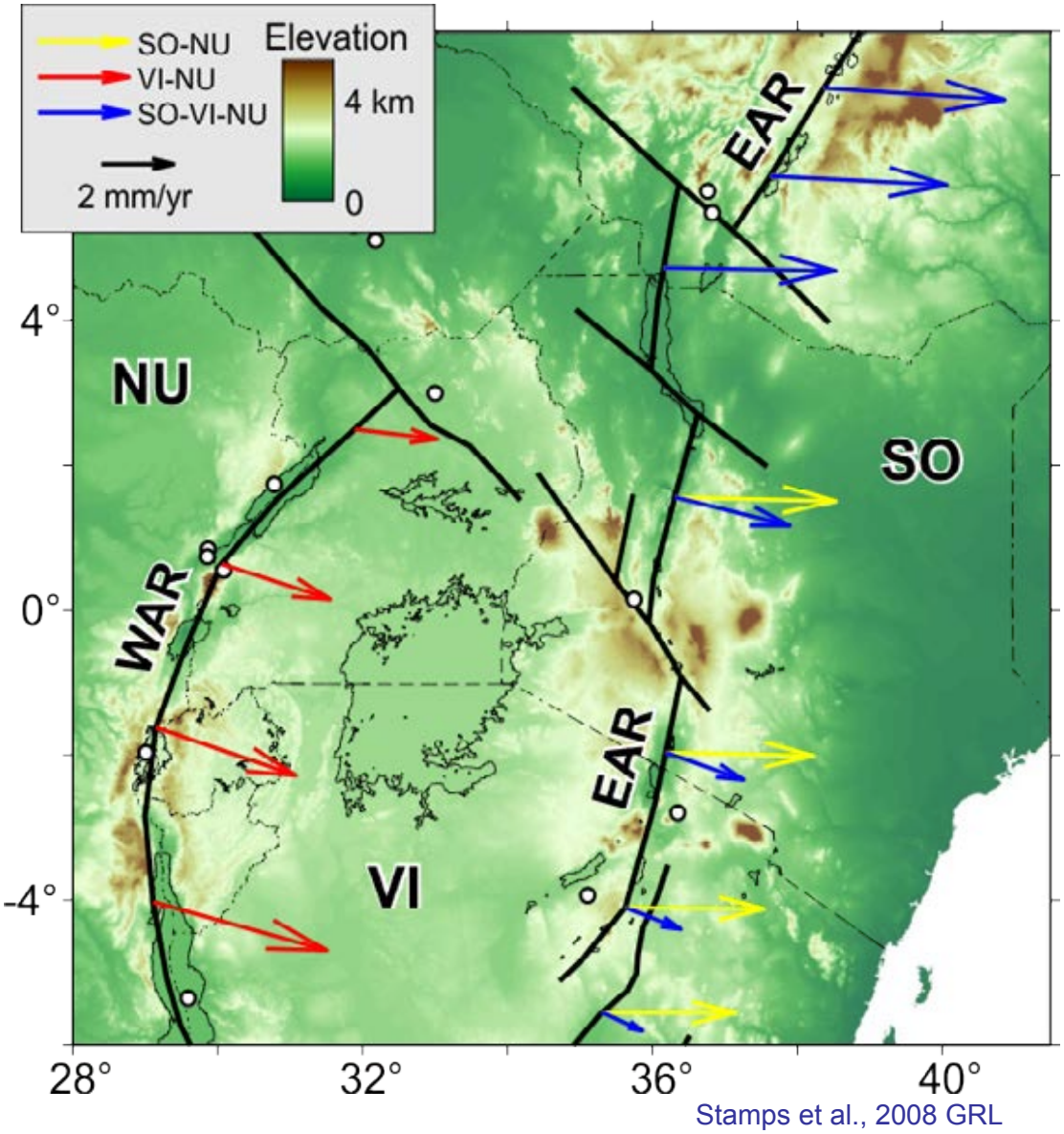
Animation by Kevin Norton 2010

- GPS measurements agree with long-term extension rate (3.2 Ma) and geologic rates

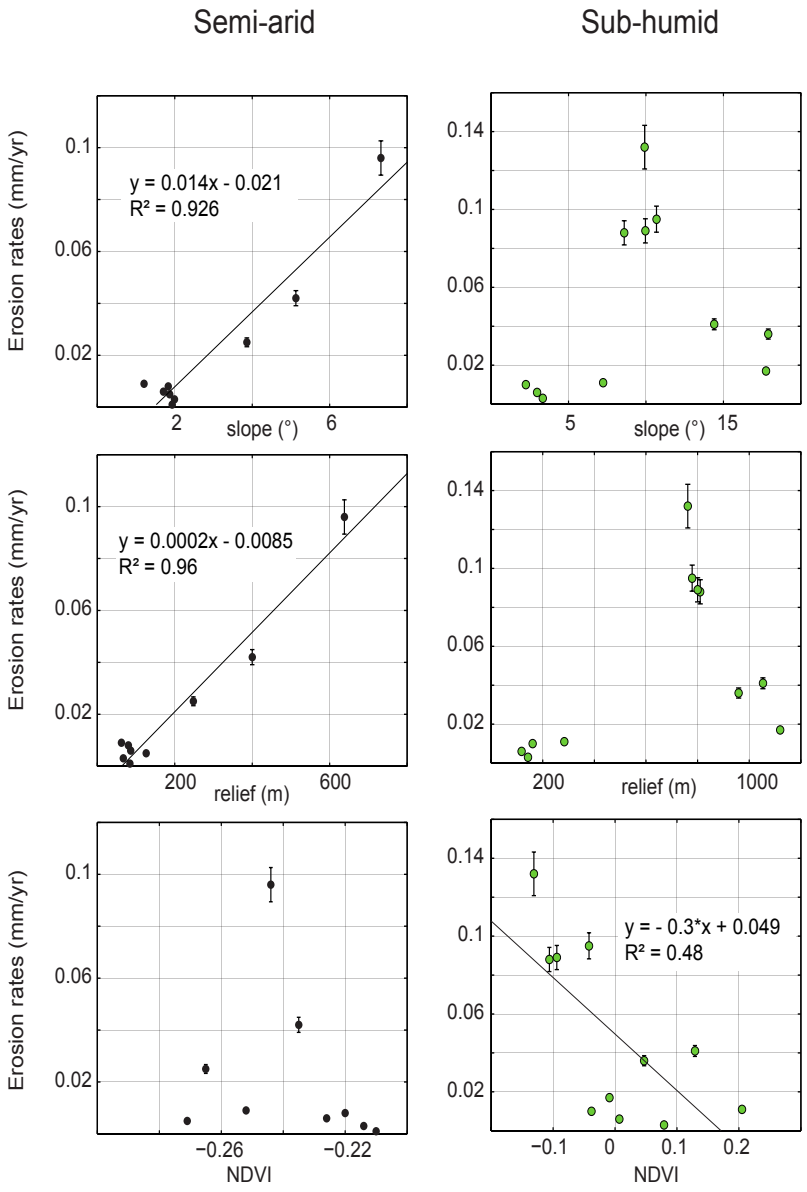
- Kinematic model predicts ~4 mm/a of extension in North Kenya between Victoria and Somalia plates

- Strain localized along narrow rift zone that isolates large lithospheric blocks

- Oblique rifting generates en échelon zones of extension



Stamps et al., 2008 GRL


Semi-arid
Sub-humid
Erosion rates (mm/yr)
y = 0.014x - 0.021
R² = 0.926
slope (°)
y = 0.0002x - 0.0085
R² = 0.96
relief (m)
NDVI
y = - 0.3*x + 0.049
R² = 0.48