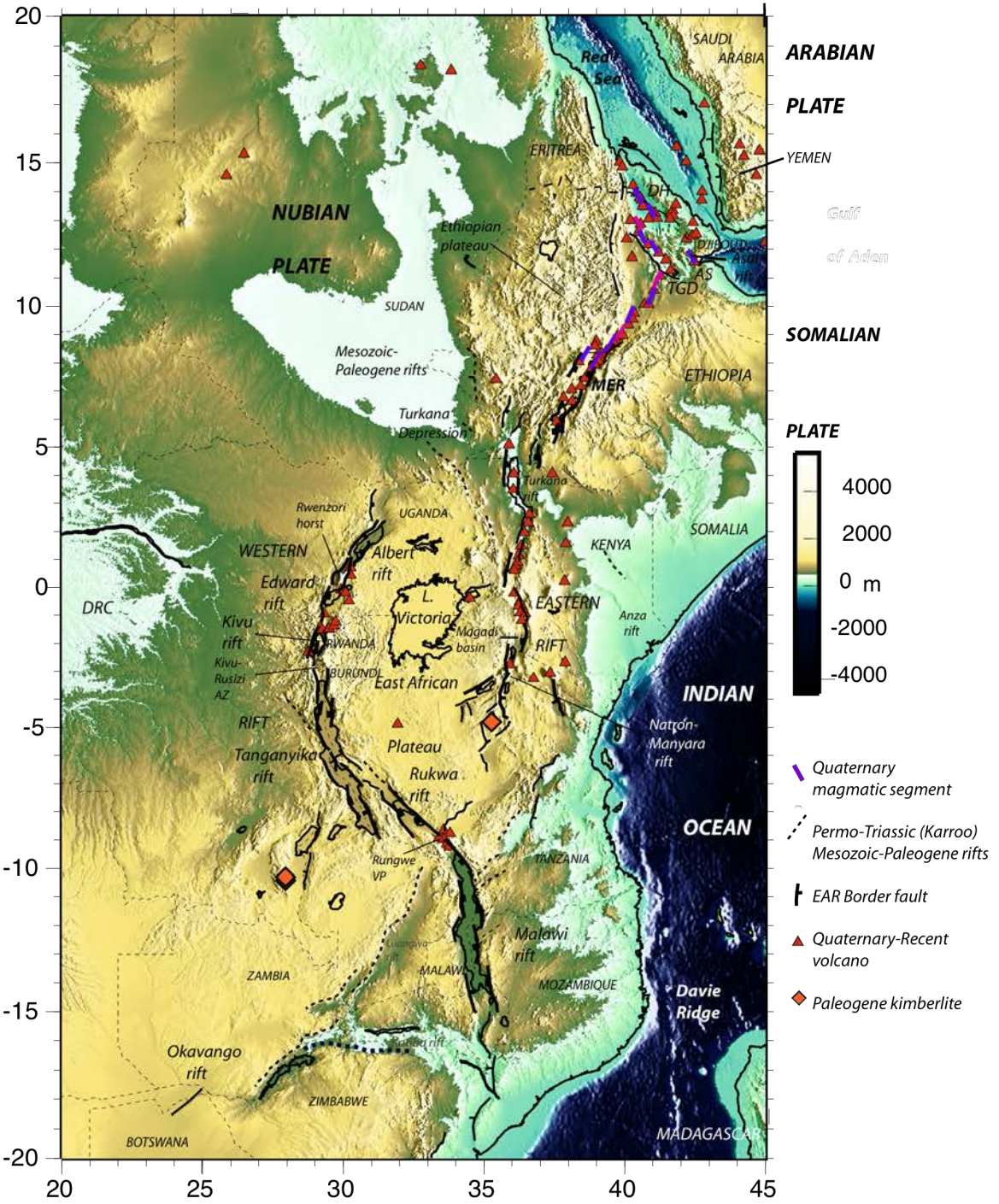
The East African Rift System

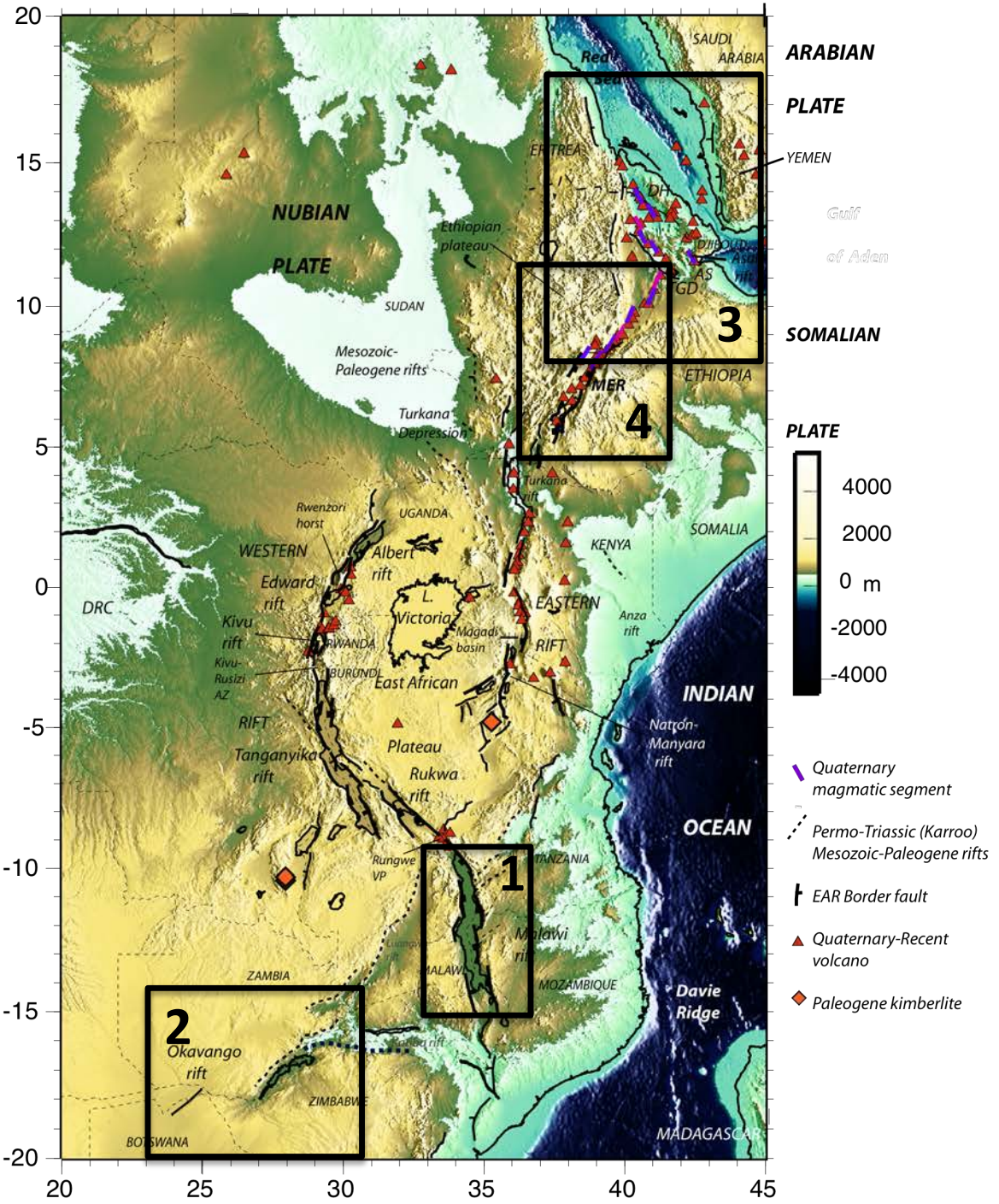
A possible primary or thematic site

Atekwana et al.
Ebinger
Gaherty et al.
Reilinger et al.
Rooney et al.



Active continental rift

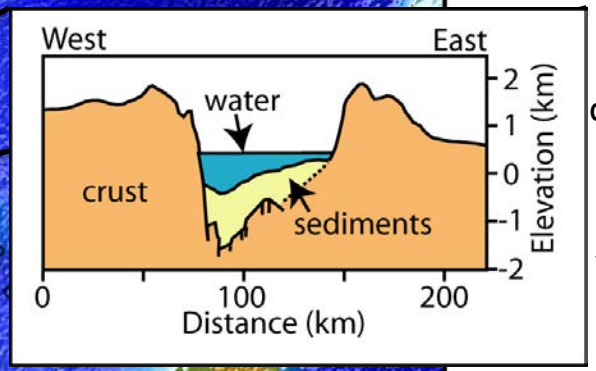
- Strain rates of 1-6 mm/yr
- Northern end – Afar plume
- Lithospheric blocks (e.g. Tanzanian, Kaapval cratons)
- Pan-African orogeny, older rifting events
- Volcanic, tectonic



East Africa Rift: not so much magma everywhere?

Only surface expressions of magma in the Western Rift

Indian Ocean

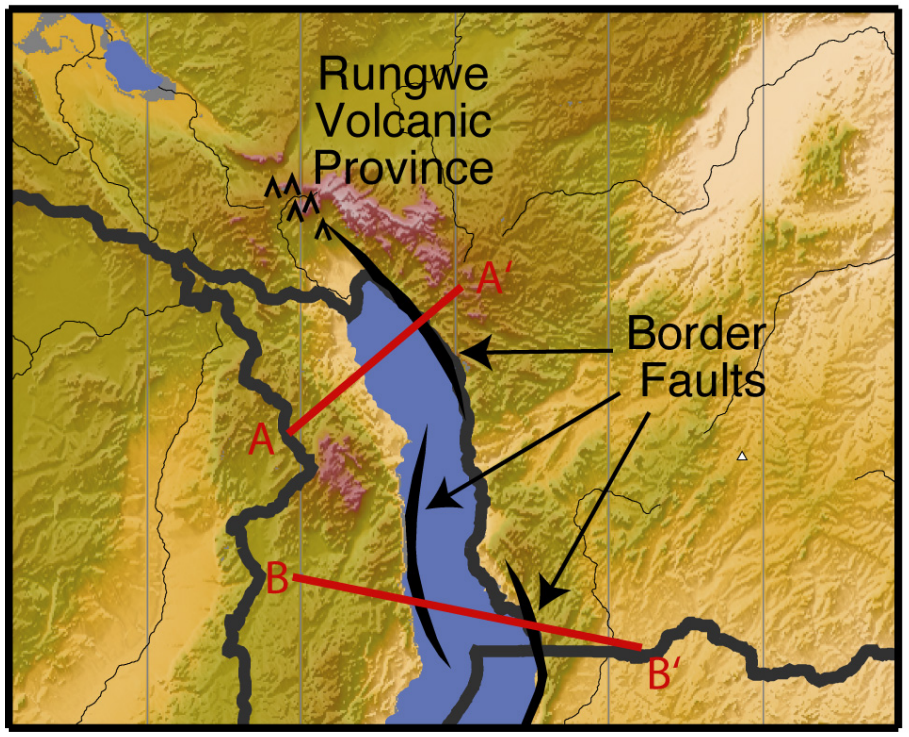


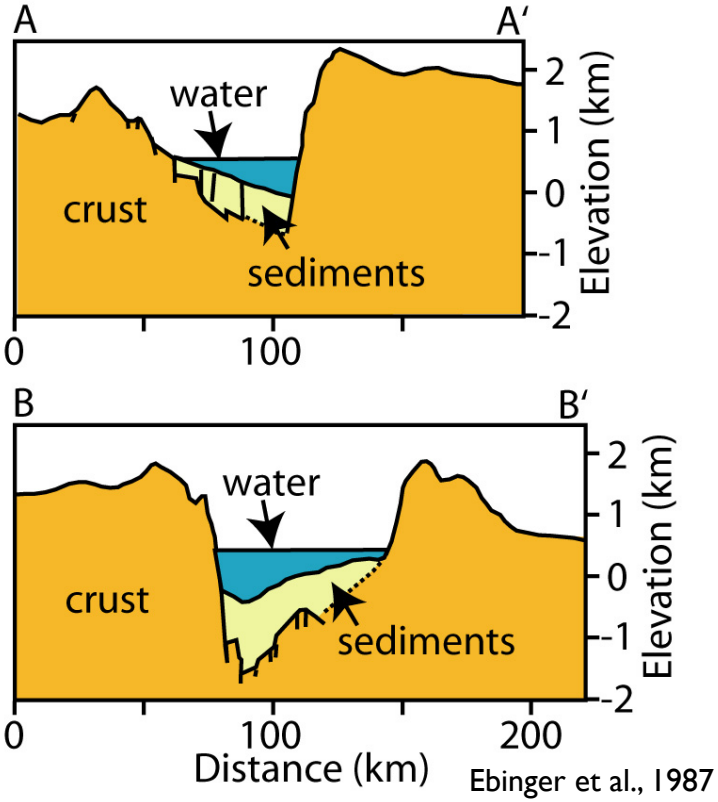
Ebinger et al., 1987

km
0
500

White paper by Gaherty et al.

Spatial patterns during early extension: Western Rift, East Africa Rift System

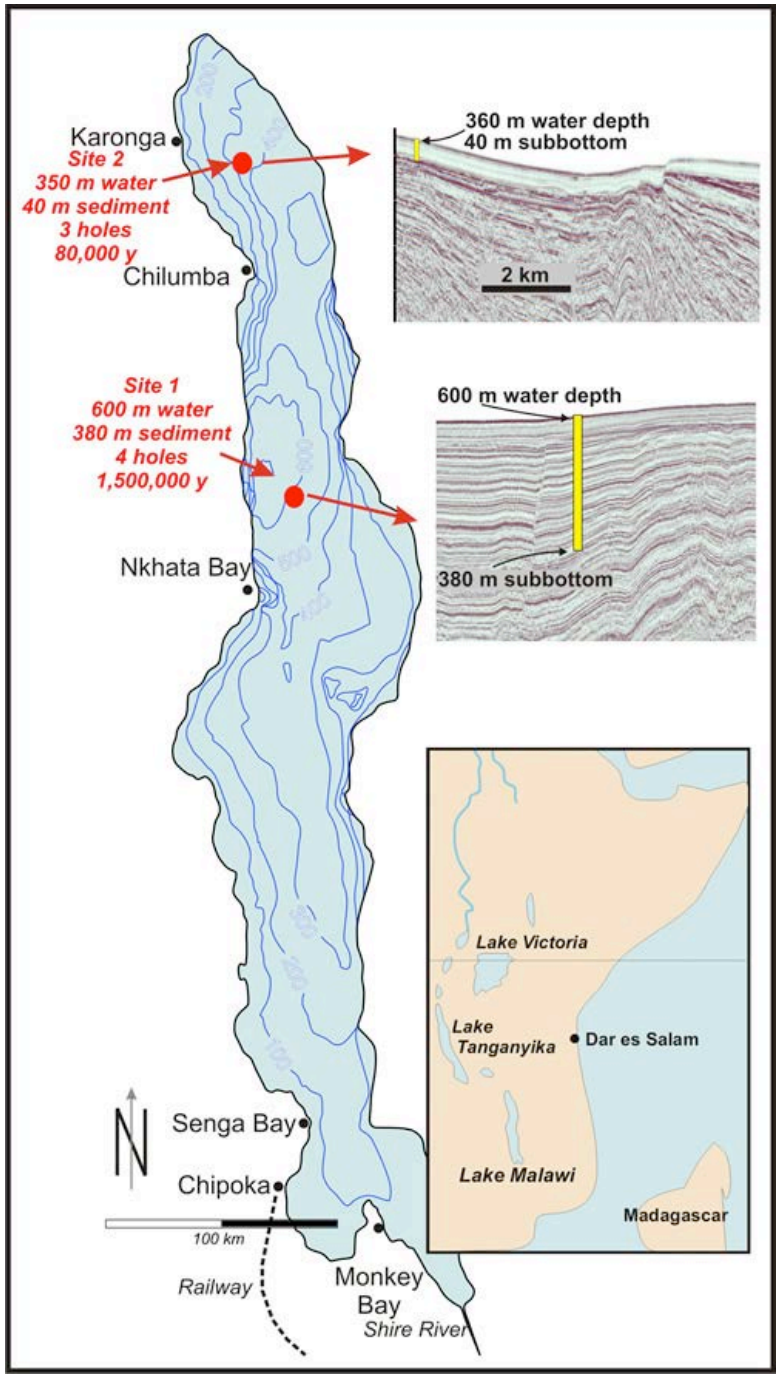




Ebinger et al., 1987

- Pronounced tectonic segmentation at the surface defined by ~100-km-long border faults and accommodation zones

White paper by Gaherty et al.



Western branch:

Sedimentary record in lakes records tectonics and climate change

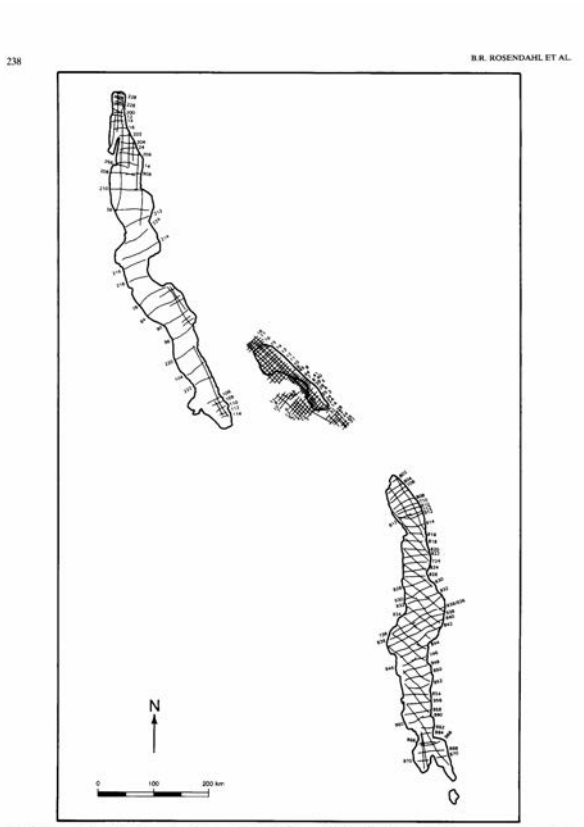
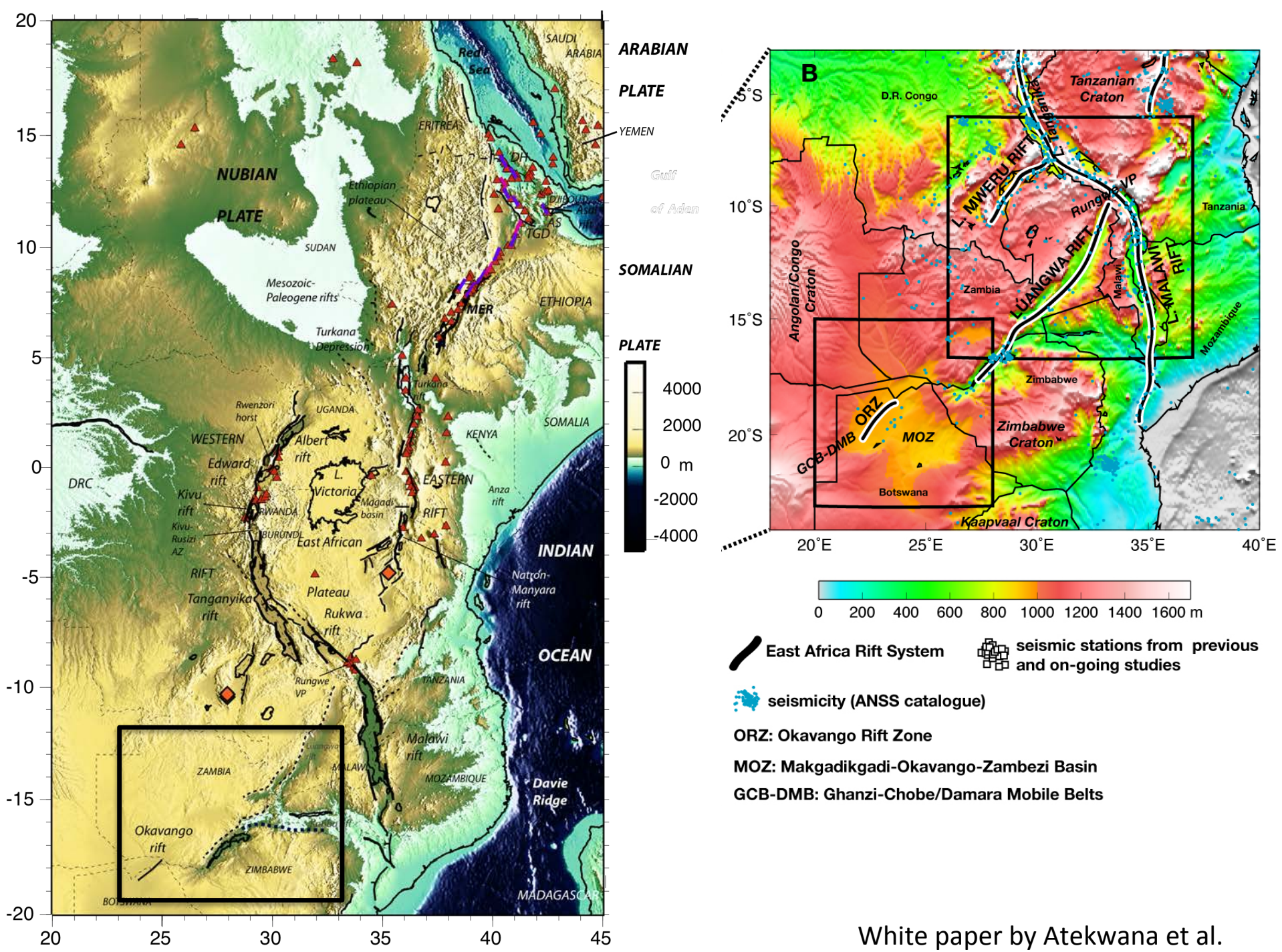


Fig. 2. Map portfolio of the Tanganyika, Rukwa and Malawi Rift Zones. (A) Multifold seismic reflection coverage used in analysis. Lines with numbers refer to line drawings shown in Fig. 3. (B) Permo-Triassic, Cretaceous and Cenozoic sedimentary cover associated with known rift basins. (C) Structure map on acoustic basement. Compiled from Rosendahl (1987), Sholz and Rosendahl (1988), Versfelt and Rosendahl (1989) and Scott et al. (in press). (D) Possible pull-apart geometry linking Kalemie, Rukwa and Livingstone Basins.

Rosendahl et al., 1992



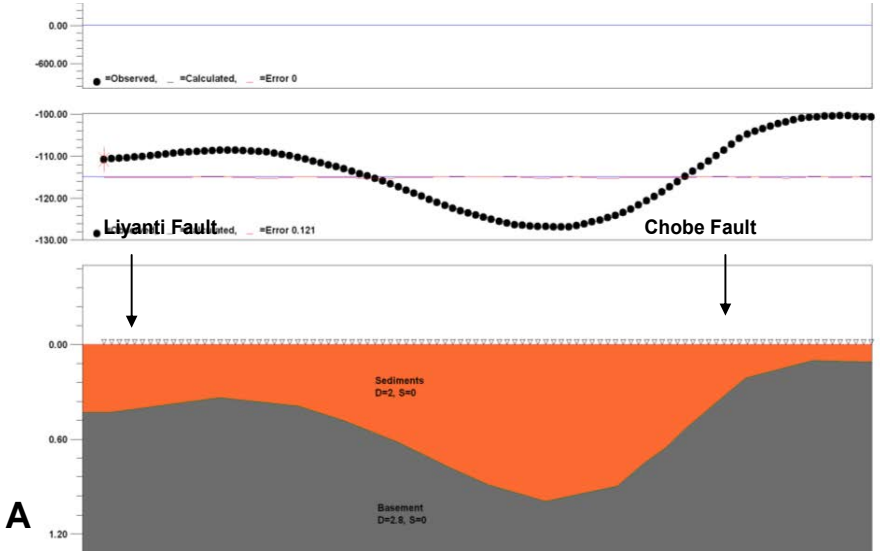
White paper by Atekwana et al.

Fault scarp height comparison

The SWB is geologically less evolved than either the eastern or western branches.

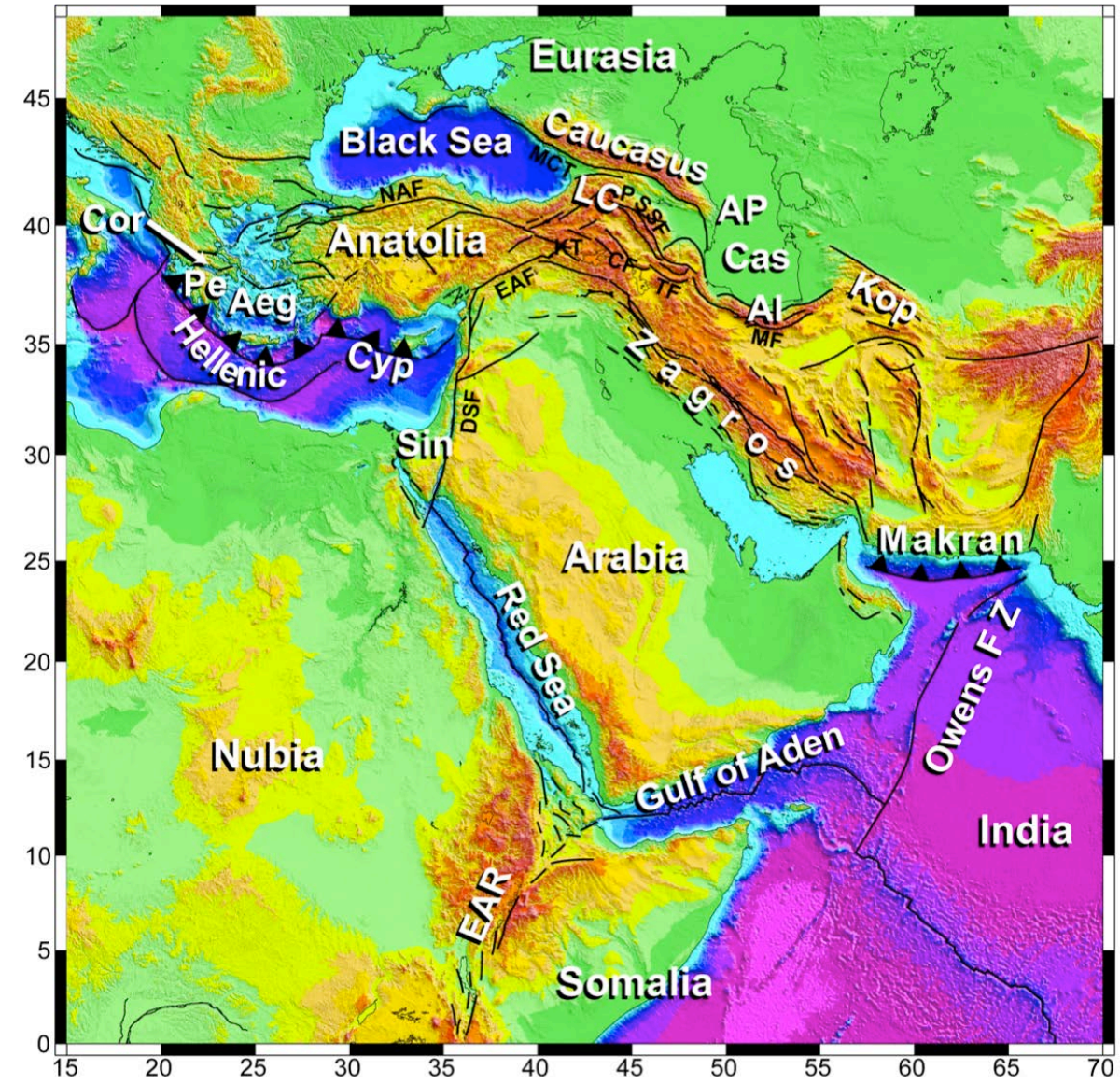
Livingstone Fault > 1 km – L. Malawi

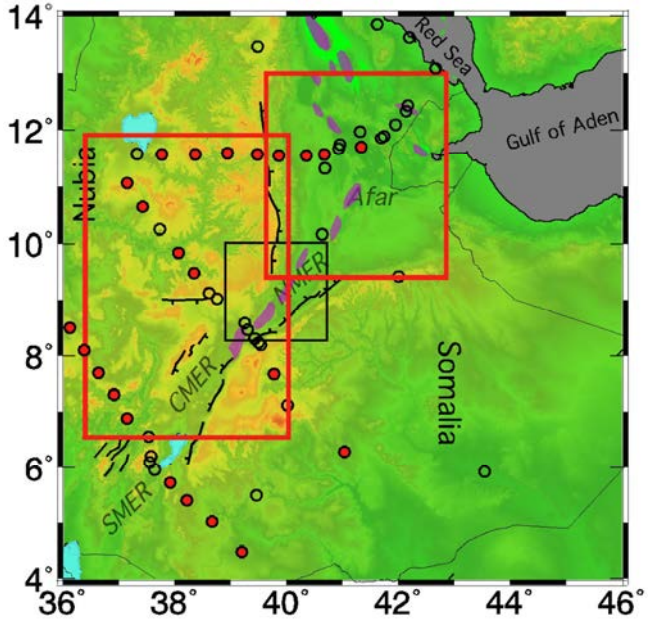
Mweru Fault– 50-200 m – L. Mweru



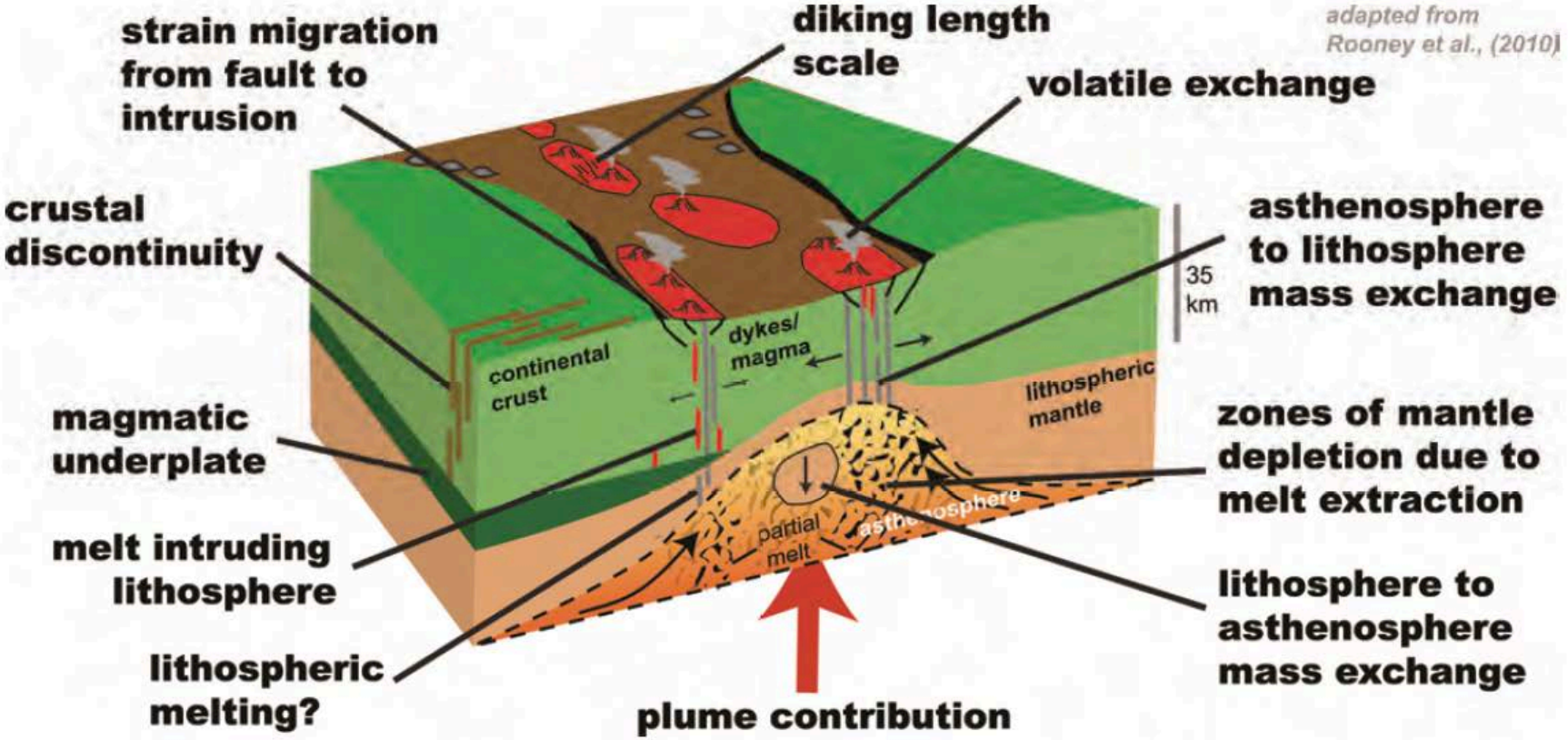
White paper by Atekwana et al.

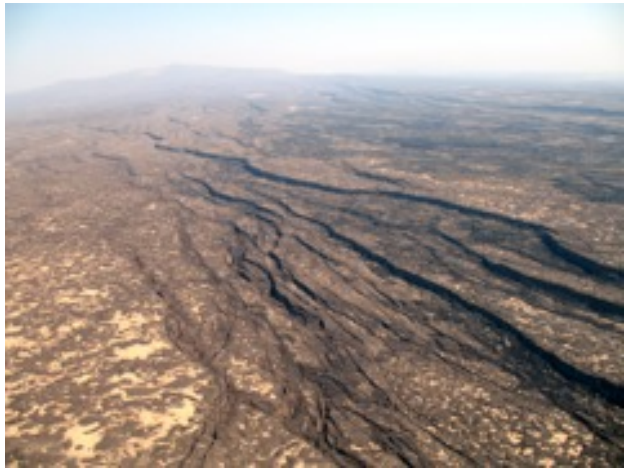
Afar triple junction





White paper by Reilinger et al.





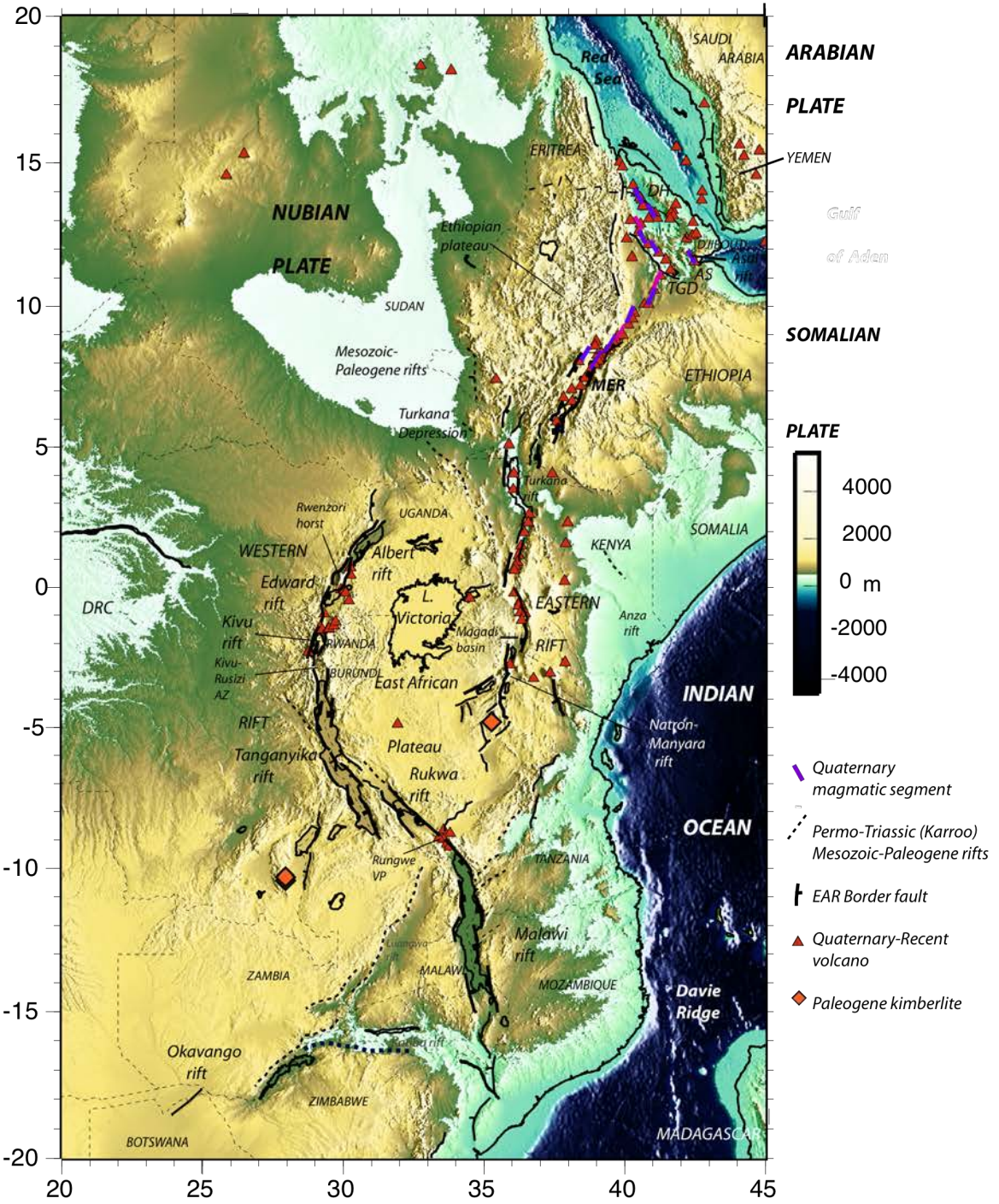
D. Keir

- Opportunity to characterize magma reservoirs at different crustal levels; spatial variability
- Combine geochemistry, geology, and geophysics

White paper by Rooney et al.

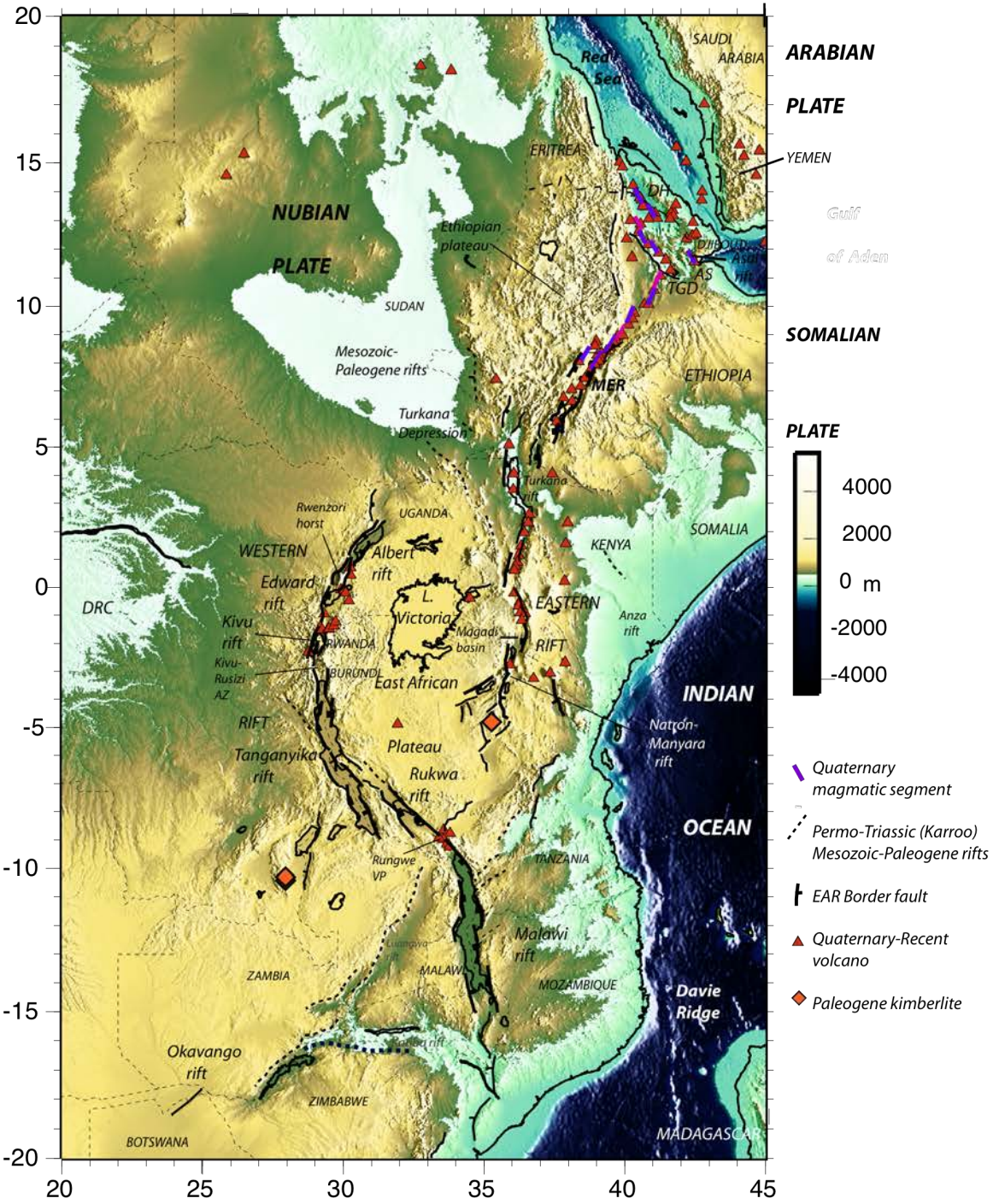
Also: NW branch, Kenya, Eastern Tanzania

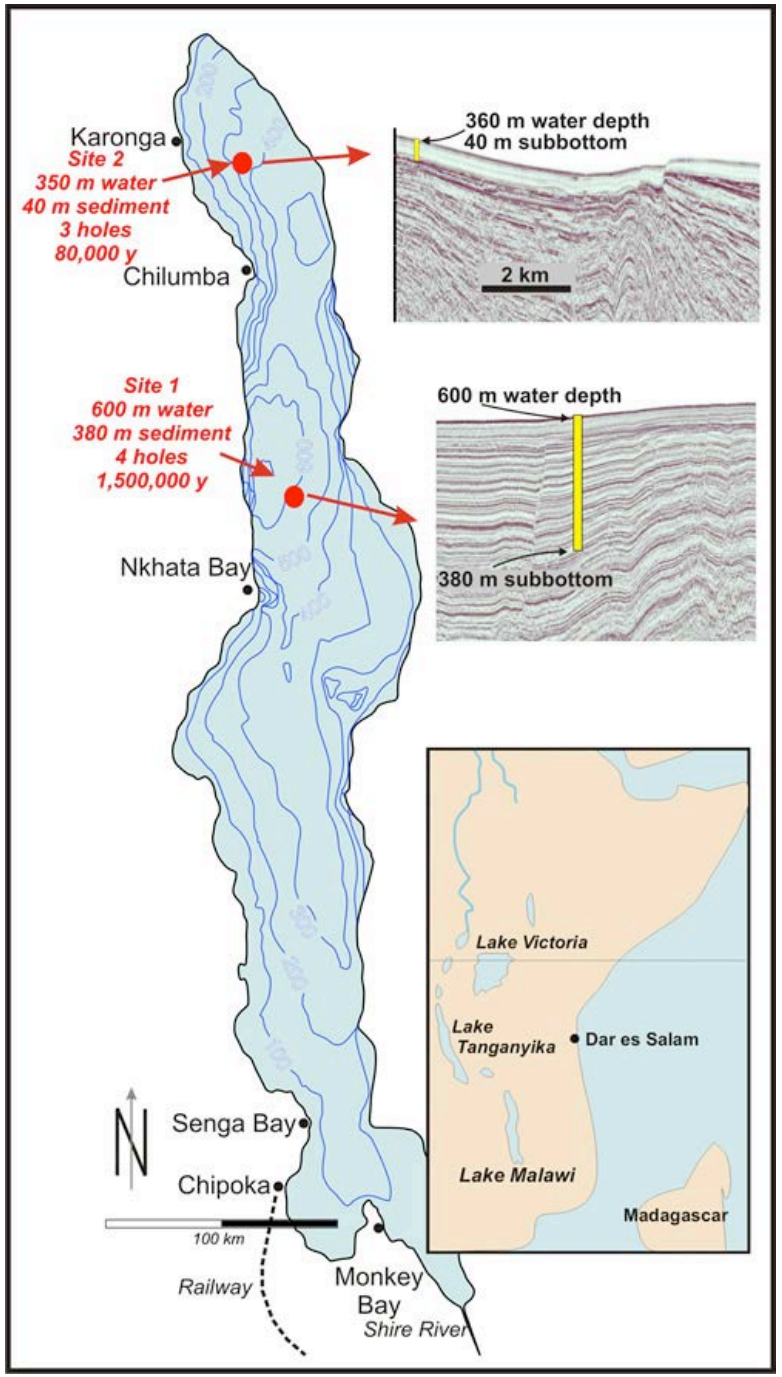
- Nyamulagira, Lake Kivu, etc.
- Resources: Petroleum, geothermal
- Deep earthquakes, sedimentation records
- Intermediate



Spatial variability; change in rift maturity

- Spectrum of fault system structures and magmatic influence
- Botswana to Afar
  - Incipient rifts to rift grabens to diking
  - Rift initiation with large faults, no surface volcanism
  - Plume, no plume
- Kenya to Rwanda
- **Comparative studies within one system**

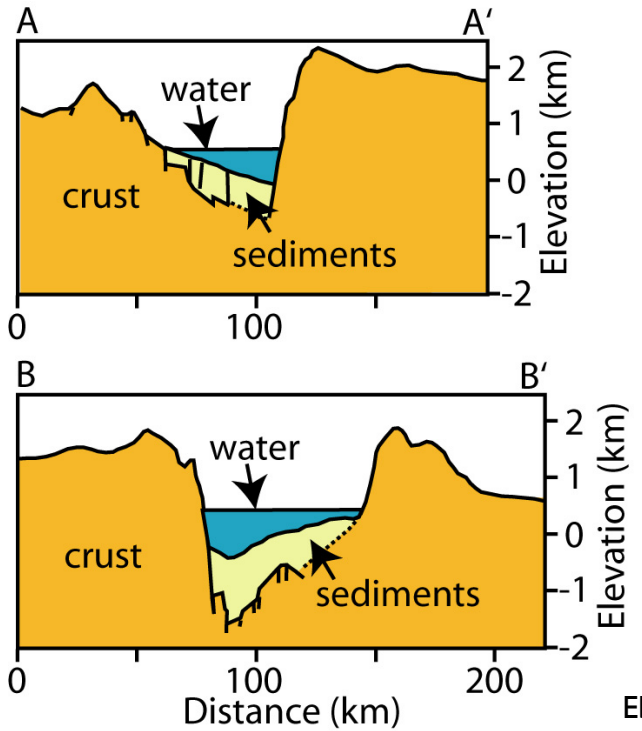




Fault-bounded basins along the length of the rift

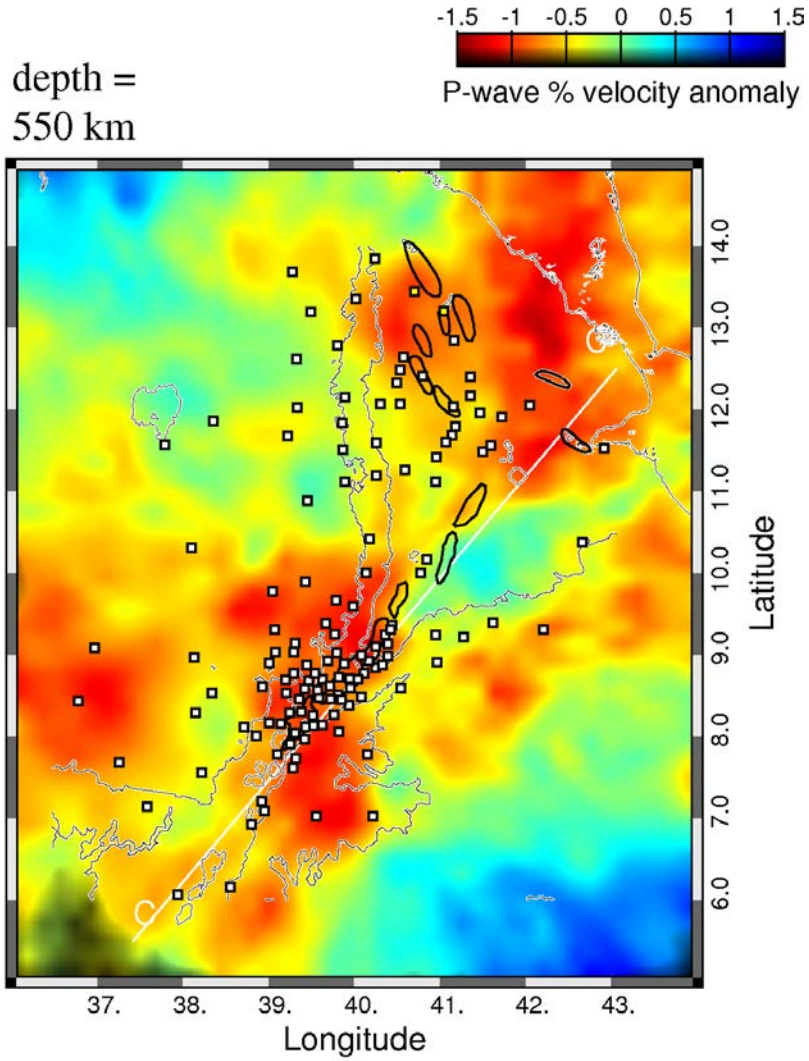
Sedimentary record of deformation and climate; represent all stages of rift evolution

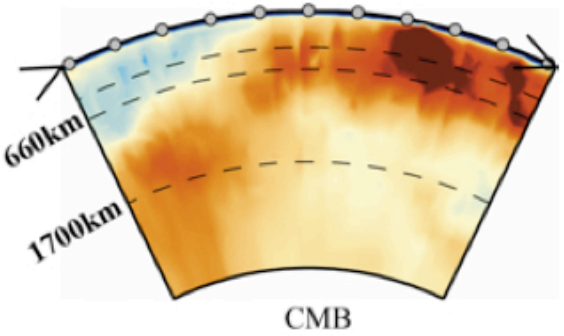
Feedbacks between faulting, flank uplift, sedimentation, further deformation

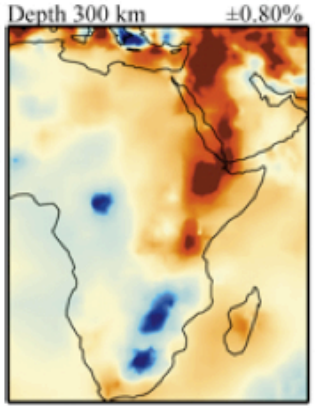


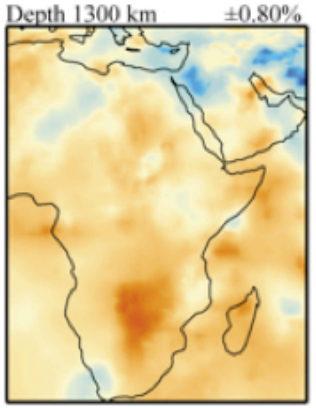
Ebinger et al., 1987

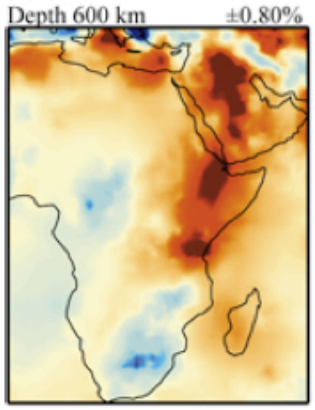
Backbone geophysics: Mantle tomography











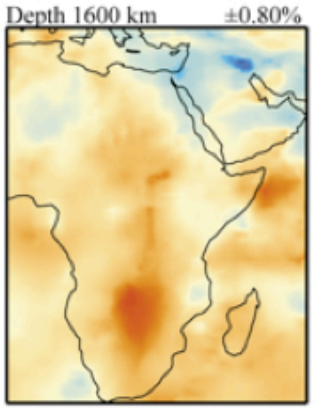
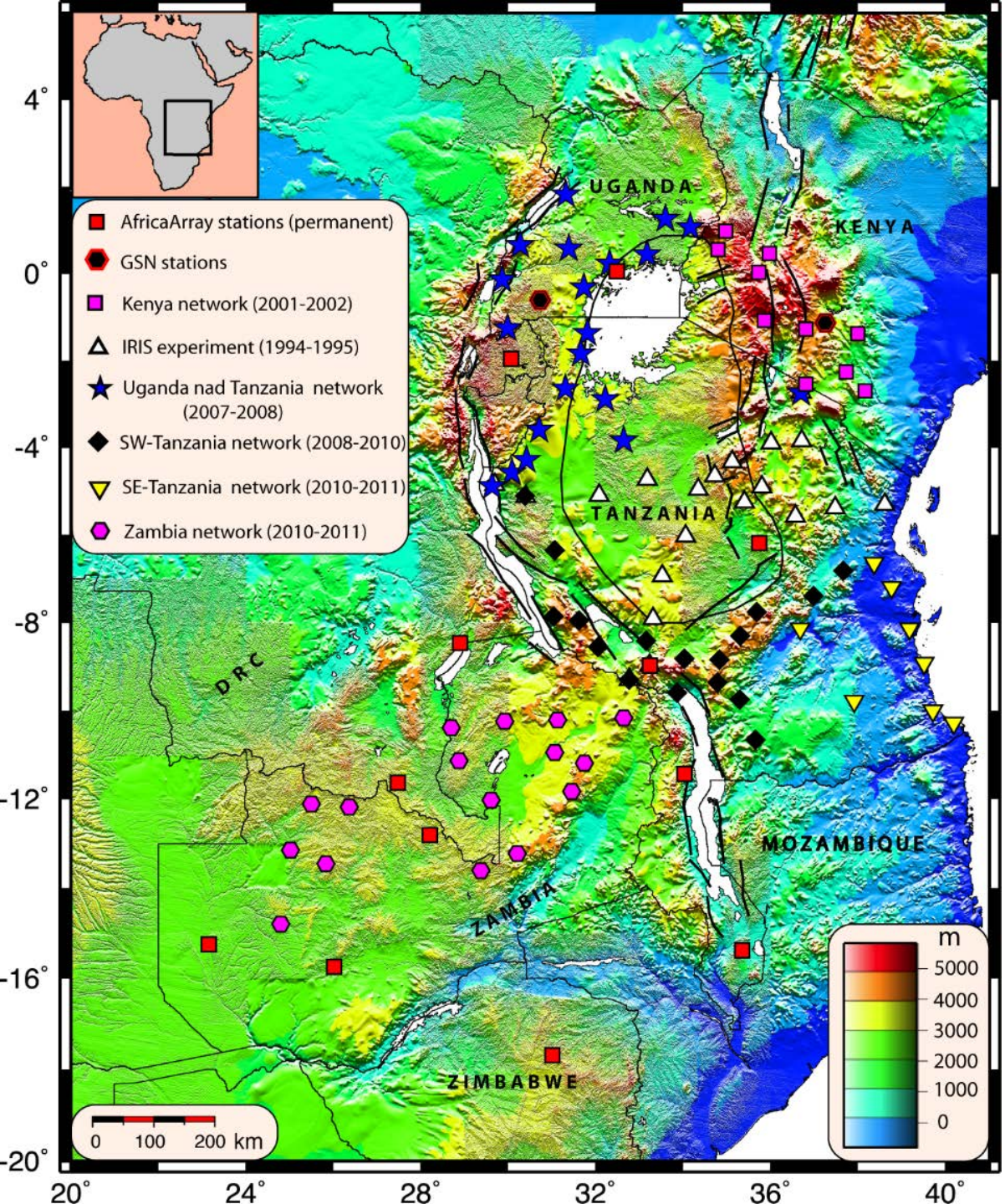


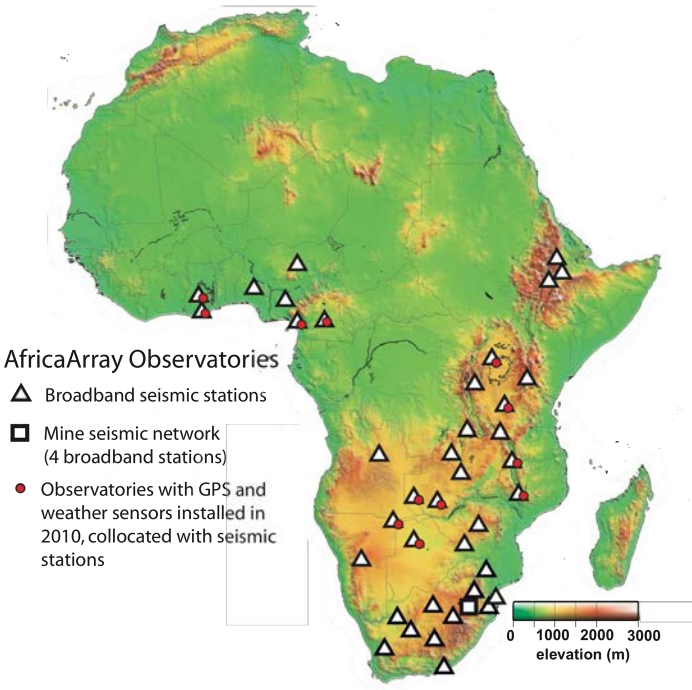
Image from James Hammond, Bristol

Li et al., 2008

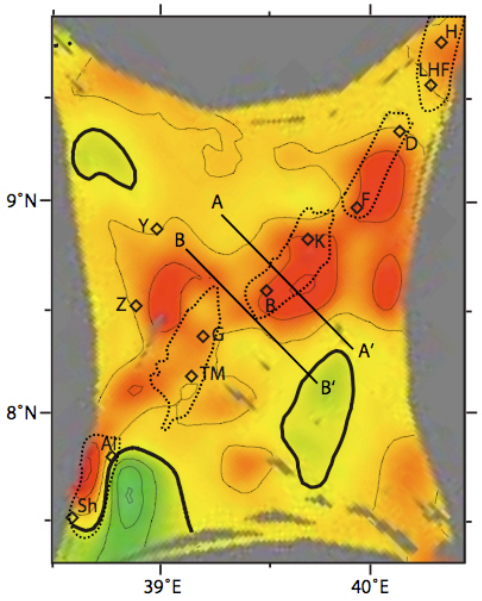
AfricaArray temporary and permanent seismic networks

1) Uganda/NW Tanzania
8/07-12/08
2) Southern Tanzania
1/09-7/108/10-8/11
4) SE Tanzania 2/10-3/11



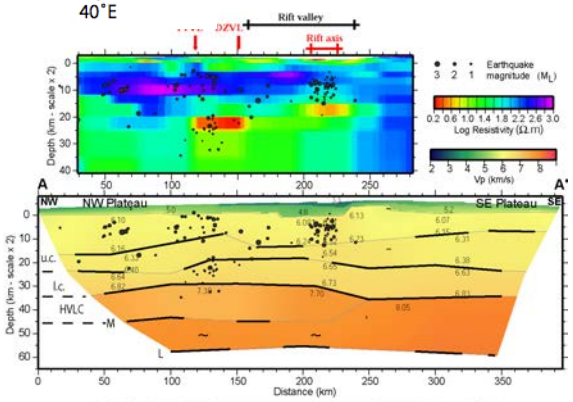


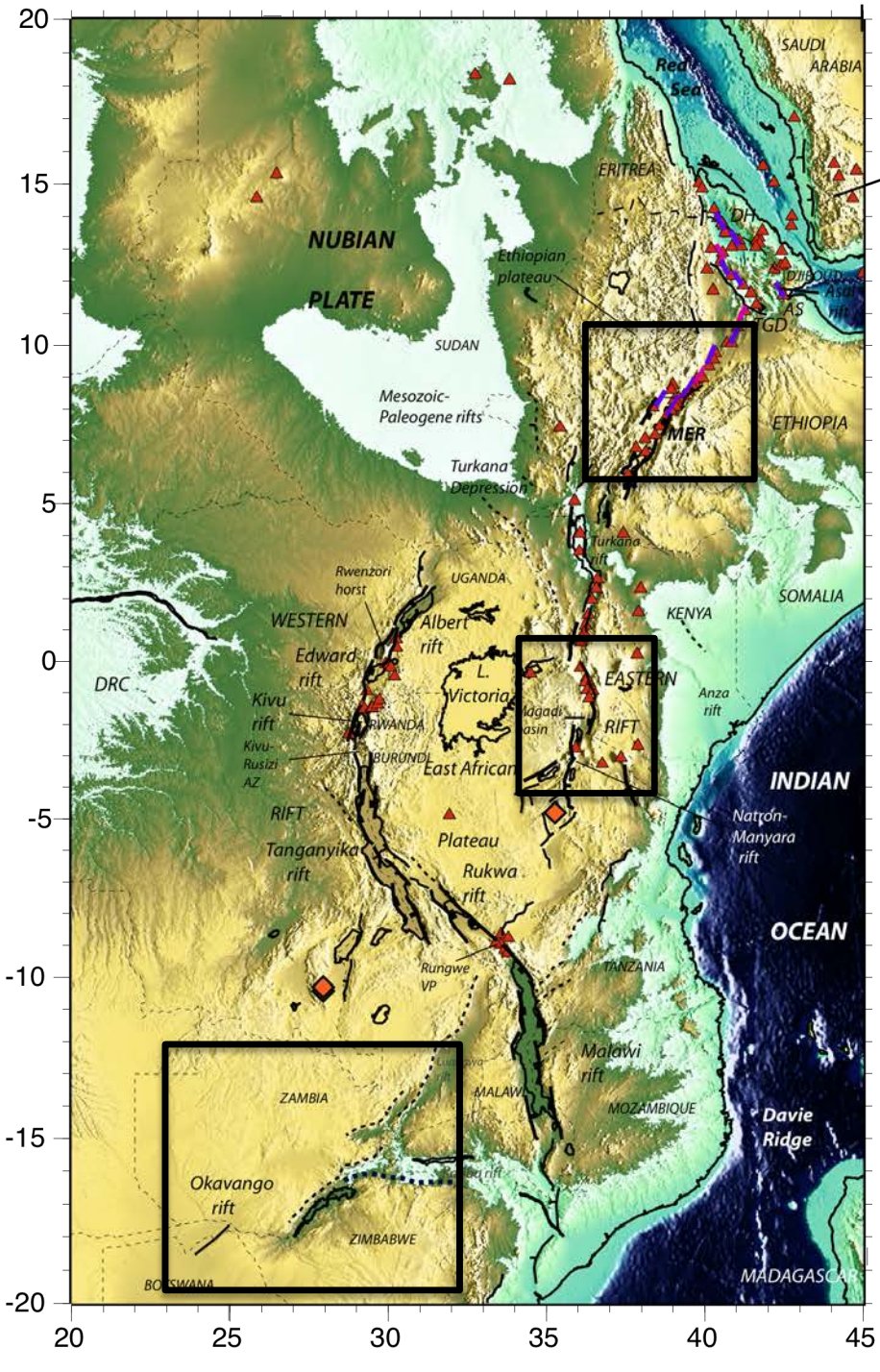
Backbone geophysics: Crustal seismic studies, MT



KRISP – Kenya Rift
EAGLE - Ethiopia
SAMTEX – S.Africa
CD Project – SW Rift*

Gravity, magnetics





Summary – ability to address science objectives of RIE within the EARS

- Where and when do continental rifts initiate?
- How do rift processes and feedbacks evolve in time and space?
- What controls the structural and stratigraphic architecture before and after breakup?
- What are the mechanisms and consequences of fluid and volatile exchange?

Summary – logistics, leveraging

- Amphibious (?)
  - Sub-aerially exposed, but crosses from continental to oceanic crust
- Readiness
  - Significant backbone geophysics, **Africa Array**
  - Existing ancillary studies, *but also a great opportunity for more work (immediate, long-term)*
- Accessibility and safety
- Availability of infrastructure
  - No EarthScope; Africa Array
- Foreign resources and collaboration
  - Strong existing relationships with African scientists at universities, geological surveys, etc.
  - Collaborations with European scientists working in East Africa
- Broader impacts
  - Geohazards – faulting (e.g. Malawi), volcanoes, CO2 emissions (Kivu)
  - Resources: petroleum, geothermal
  - International field experience and community-building

What can GeoPrisms do for East Africa?

- Bring together loosely-linked groups working on related problems throughout the rift system
  - Develop a strong community; enhance research results; leverage ongoing work

- Bring a new group of scientists, new methods, new enthusiasm
  - Fill gaps in geochron, paleoseismology, fault linkages, magmatic volumes, etc. to test and develop models of rift processes; rift hazards