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
Only surface expressions of magma in the Western Rift; not so much magma everywhere?

Wright et al., 2006
Ebinger et al., 1987
White paper by Gaherty et al.
Spatial patterns during early extension: Western Rift, East Africa Rift System

- 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

Rosendahl et al., 1992
Fault scarp height comparison

Livingstone Fault > 1 km – L. Malawi
Mweru Fault – 50-200 m – L. Mweru

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

White paper by Atekwana et al.
Afar triple junction
• Opportunity to characterize magma reservoirs at different crustal levels; spatial variability
• Combine geochemistry, geology, and geophysics
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

depth = 550 km

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  
   1/09-7/10 8/10-8/11

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