Continental Spreading Boundaries

Seismotectonics

Peter Matheny

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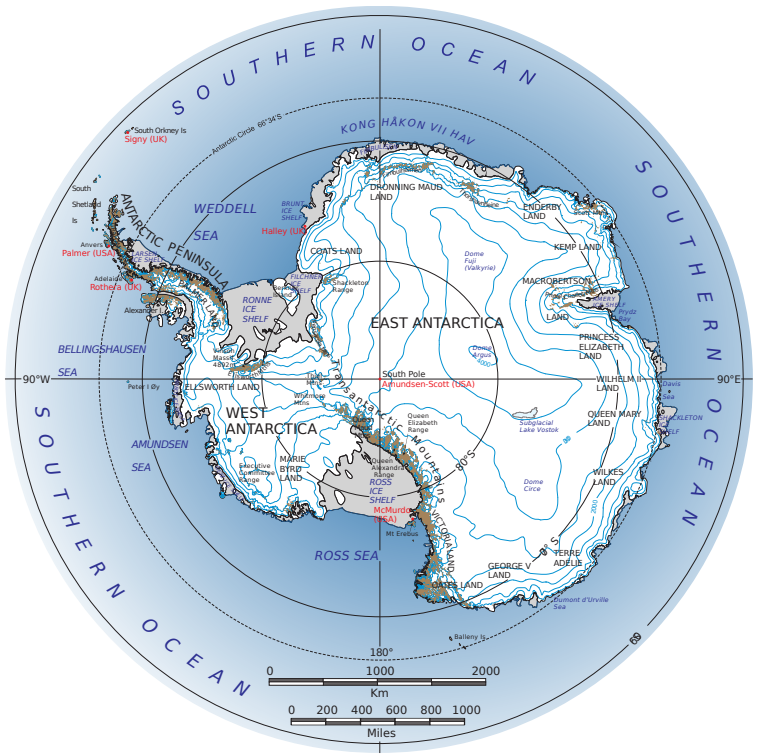
- Basin and Range?



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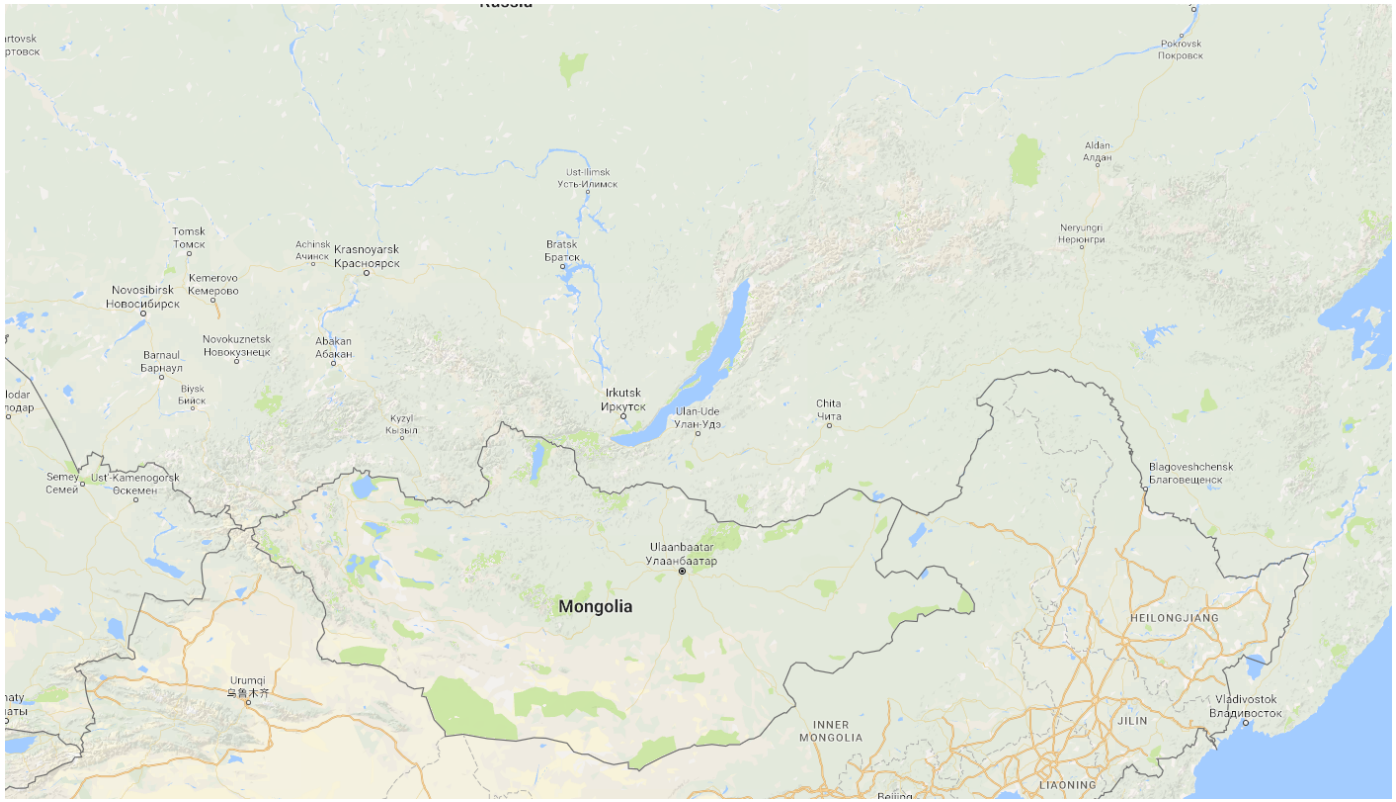

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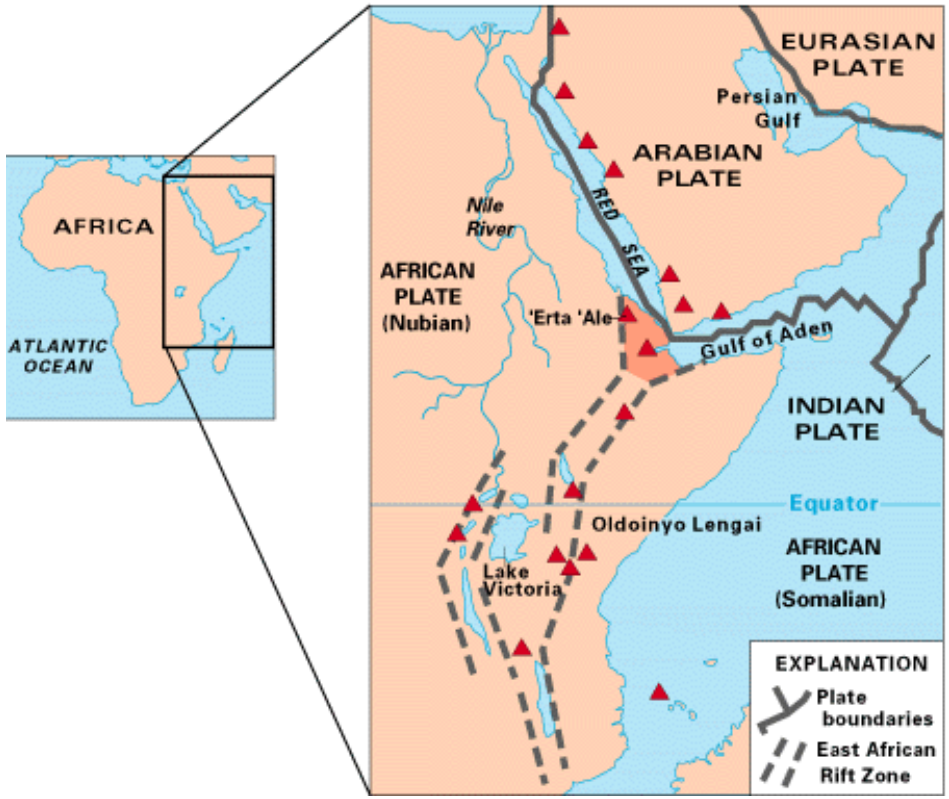

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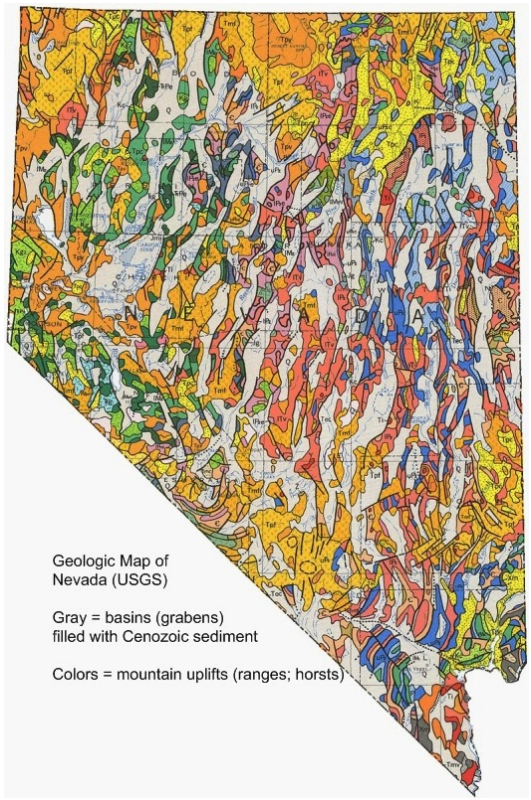

History of EAR

- Oceanic spreading rates from the Red Sea and Southwest Indian Ridge (Jestin et. al., 1999)
- Addition of GPS angular velocities and slip vectors (Calais et. al., 2006)
- More GPS angular velocities (Saria et. al., 2014)

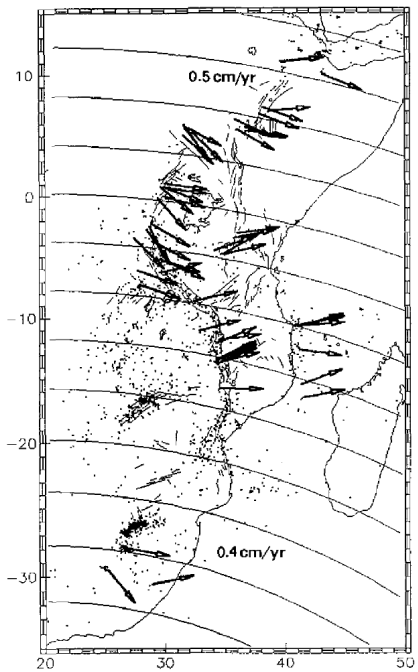

Figure 10. Main tectonic features (from Chorowicz & Sorlien 1992), seismicity and earthquake slip vectors [from CMT catalogues; Shudovsky (1985) and Grimison & Chen (1988)] along the EAR compared with small circles around our SOMA–AFRI solution (Table 4).

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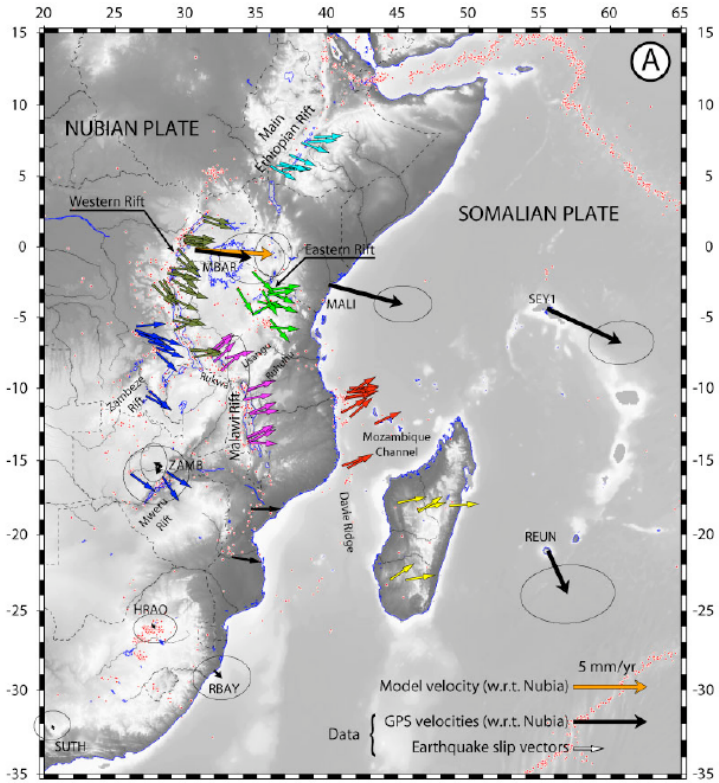

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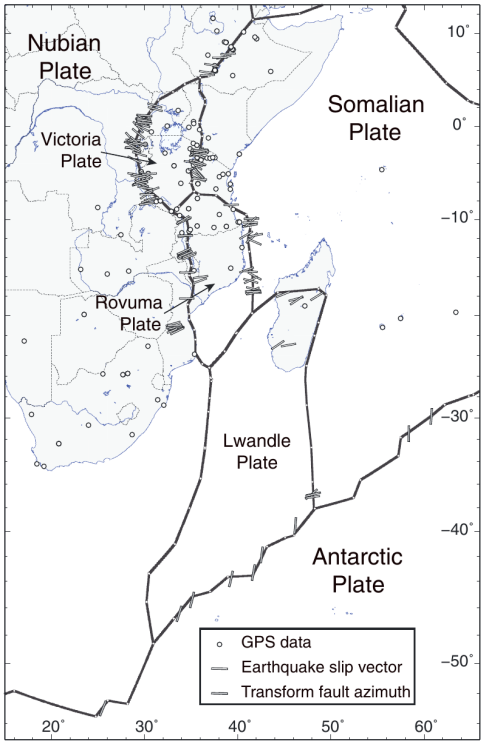

Figure 2. Spatial distribution of the GPS, earthquake slip vector, and transform fault azimuth data used in this paper. Solid black lines show the block boundaries used in the kinematic model (explanations in the text).

Regional Setting

- African superswell supporting topography in the region (Ritsema et. al., 1998)
- Western branch
- Eastern branch

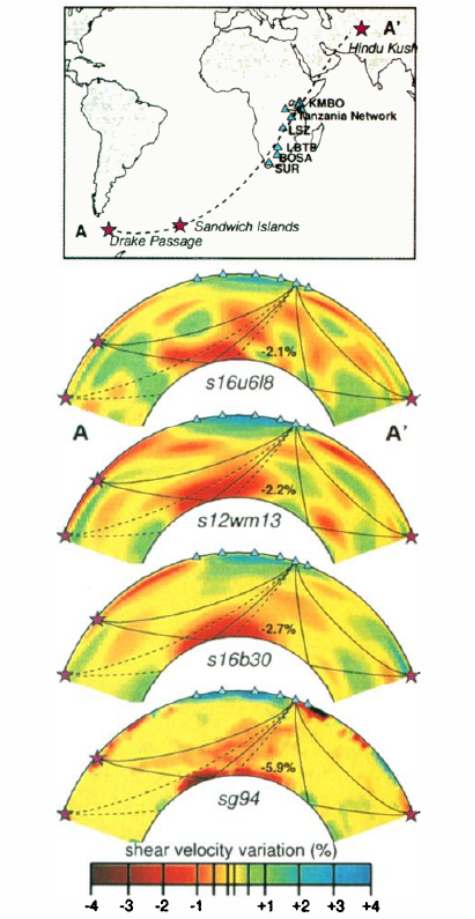

Figure 1. (top) Map indicating the location of seismic stations (triangles) and earthquakes (stars) used in this study. The dashed line indicates great circle arc A–A′. (bottom) Mantle cross-sections along A–A′ through models s16u6l8 [*Liu and Dziewonski*, 1997], s12wm13 [*Su et al.*, 1994], s16b30 [*Masters et al.*, 1996], and sg94 [*Grand*, 1994]. The solid lines superposed on the cross sections represent *S* and *ScS* ray paths from events in the Sandwich Islands and Hindu Kush regions to station MBWE in the center of the Tanzania Network. Dashed lines represent *S* and *SKS* path from an event in the Drake Passage to this station.

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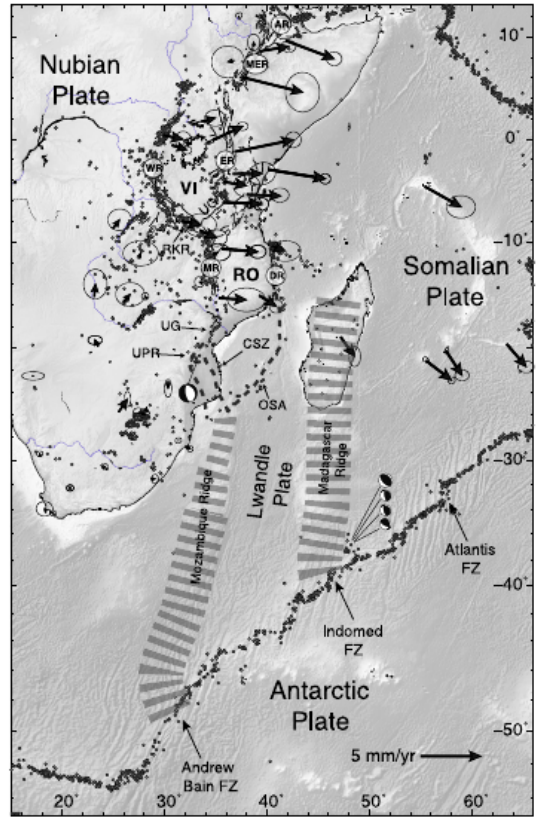

Figure 1. Present-day tectonic setting of the East African Rift. Solid black lines show major active faults [from *Skobelev et al.*, 2004], small back circles show seismicity (National Earthquake Information Center (NEIC) catalog), dashed lines indicate inferred plate boundary traces, and hatched areas over Madagascar and the Madagascar Ridge show the possibly diffuse Lwandle-Somalia plate boundary. Black arrows show a selection of the GPS data set used here, with 95% confidence ellipses. The focal mechanism of the *M*7.5, 22 February 2006, Mozambique earthquake is shown [*Fenton and Bommer*, 2006], as well as the focal mechanisms of a cluster of thrust events at the southern end of the Madagascar Ridge (NEIC). MER = Main Ethiopian Rift, WR = Western Rift, ER = Eastern Rift, MR = Malawi Rift, DR = Davie Ridge, CSZ = Chissenga seismic zone, UG = Urema graben, UPR = Urrongas protorift, USA = Quathlamba Seismic Axis, RK = Rukwa, and UG = Usangu basin.

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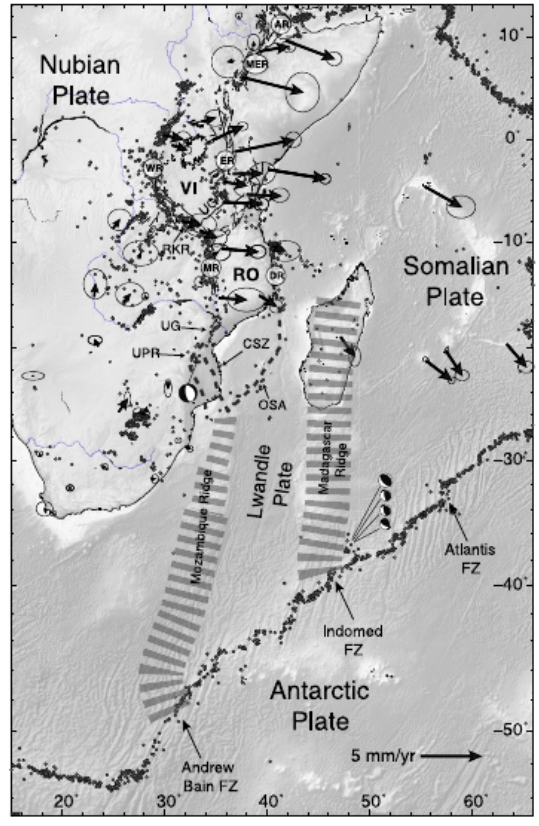

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Current Best Fit Model

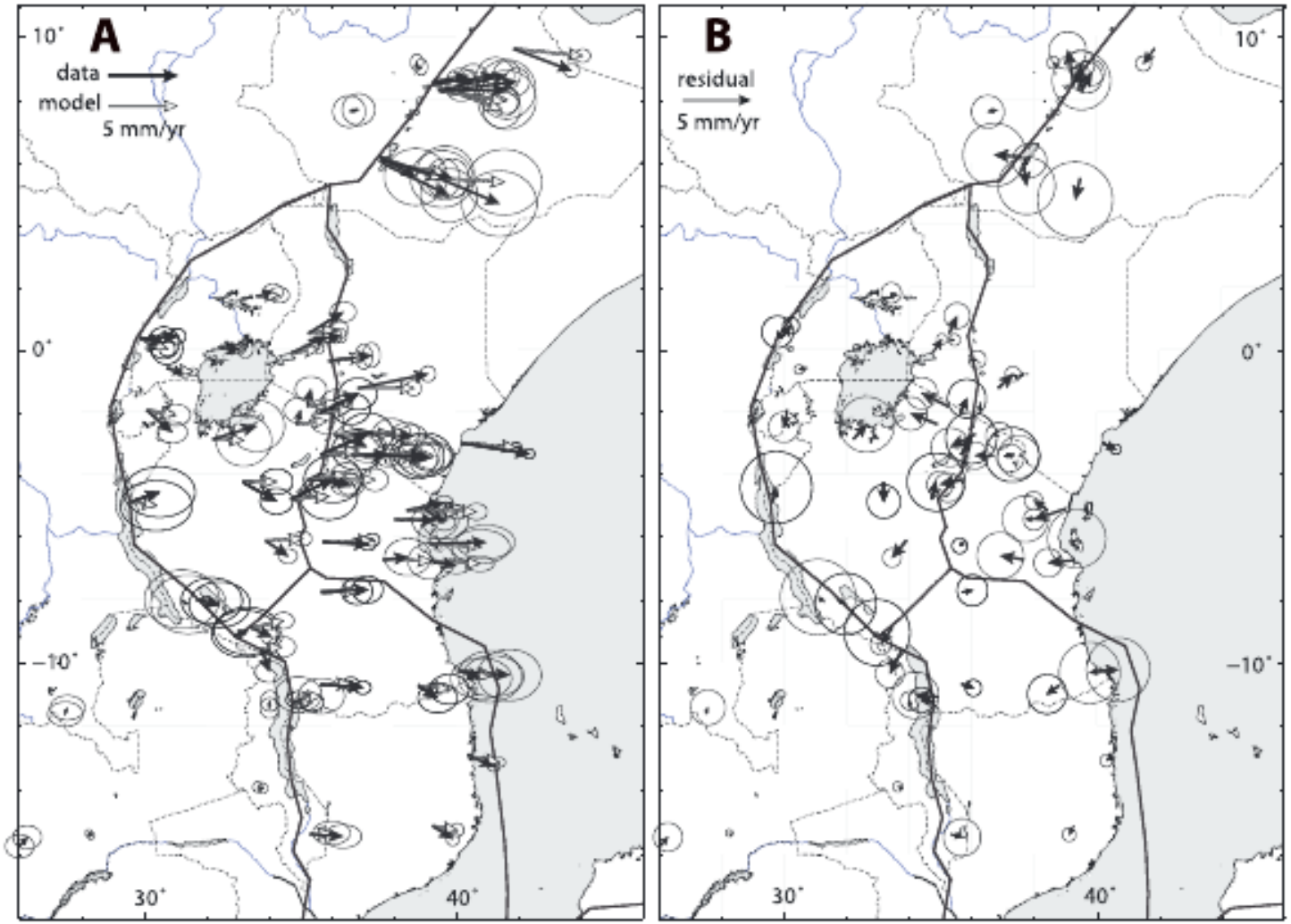

Figure 3. (a) GPS observations and kinematic block model predictions in the central part of the East African Rift. (b) Residual velocities (model minus observation). Error ellipses are 95% confidence.

What's Going on Underneath?

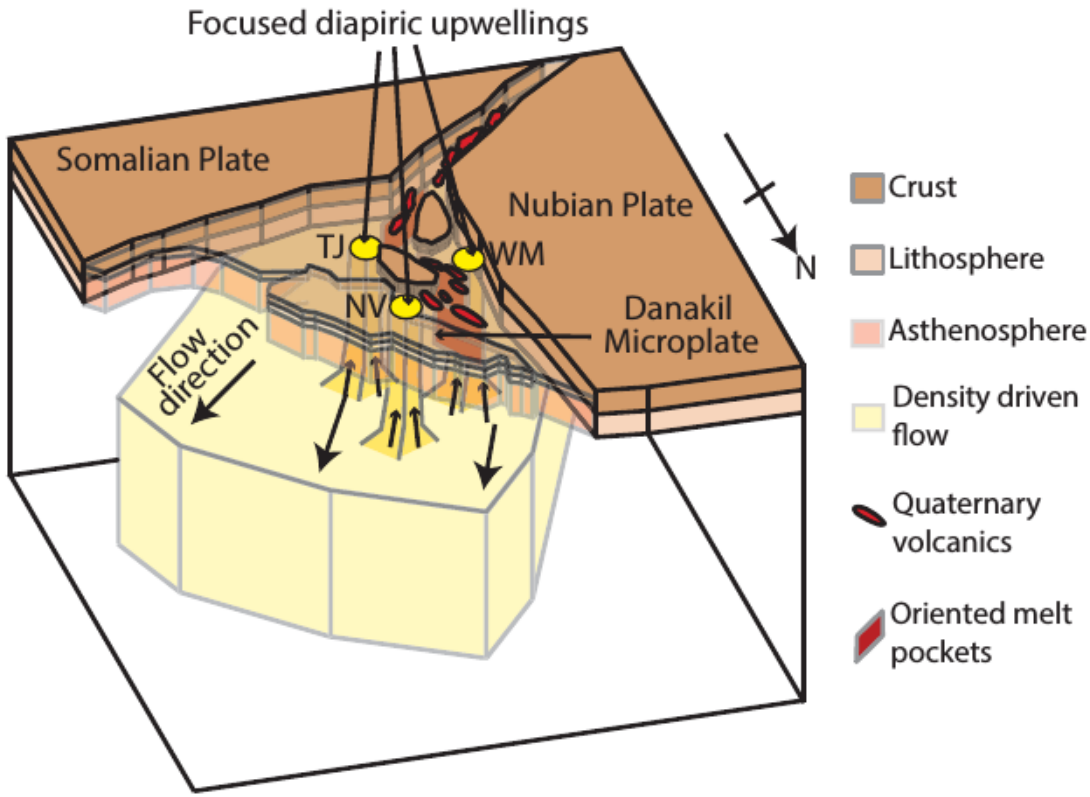

Figure 3. Proposed model where passive upwelling of asthenosphere in mantle beneath Afar, Ethiopia, gives rise to melt-filled mantle above 75 km (Rychert et al., 2012), with melt oriented at rift axis causing significant seismic anisotropy (Kendall et al., 2006; Gao et al., 2010) and large velocity anomalies. Superimposed on this are focused diapiric thermal upwellings. These focused anomalies cause enhanced melting at three locations: triple junction (TJ), Nabro volcano (NV), and western margin (WM).

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