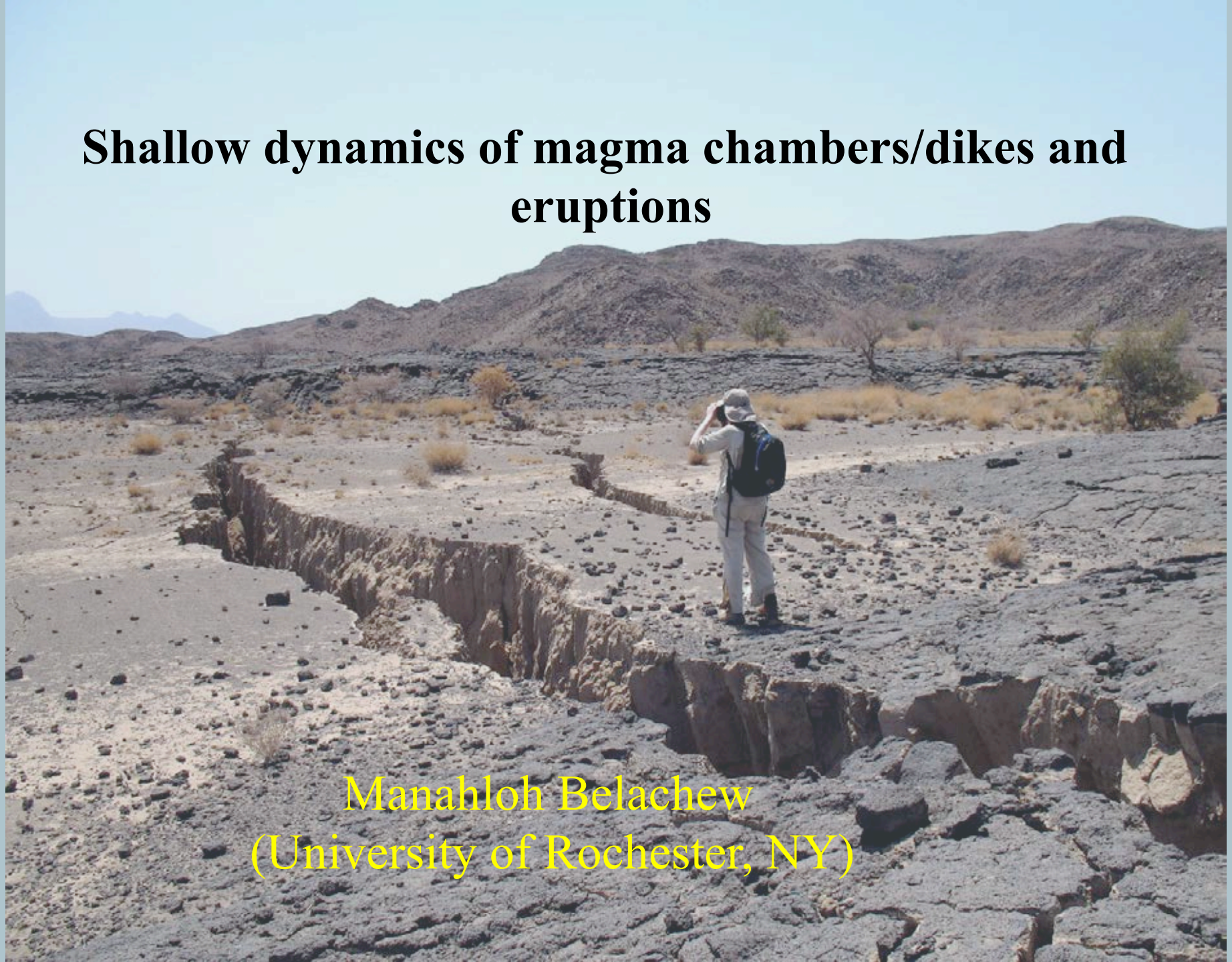
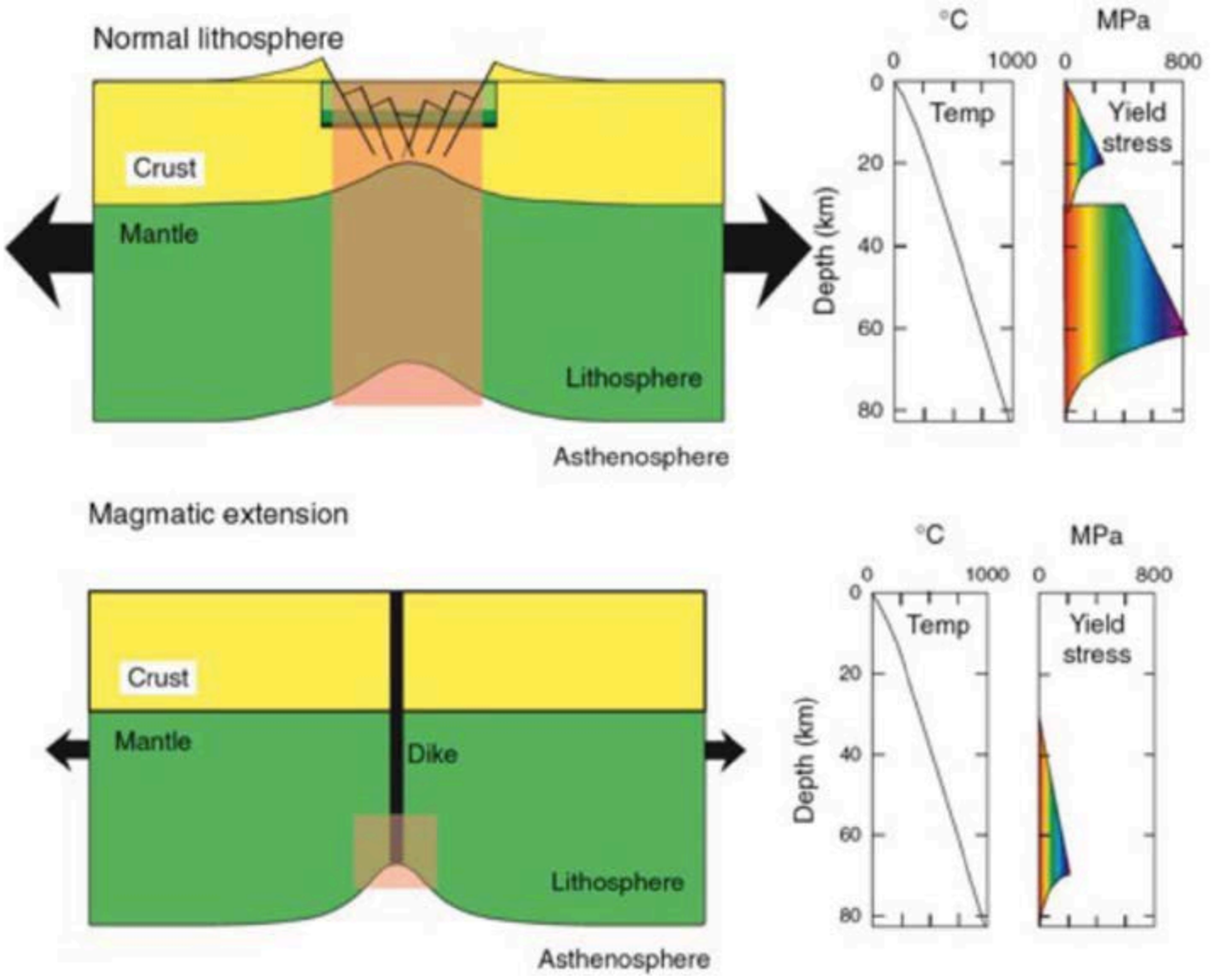
Shallow dynamics of magma chambers/dikes and eruptions



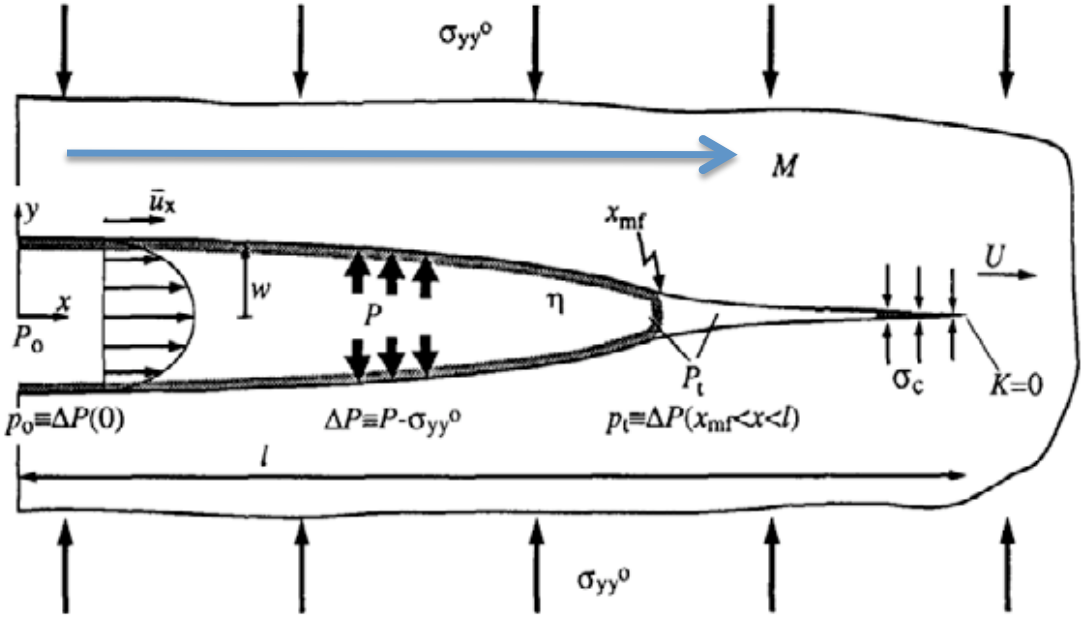
Manahloh Belachew
(University of Rochester, NY)



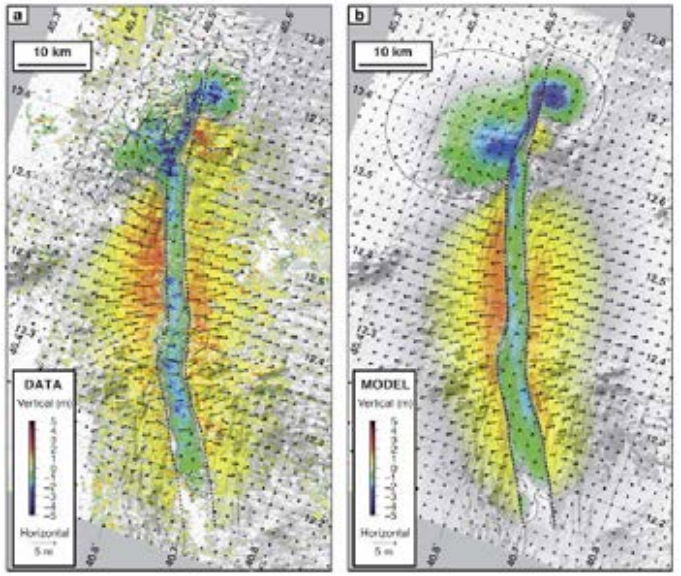
Buck 2004

Dike intrusions significantly decrease lithospheric strength ➔ rift focusing

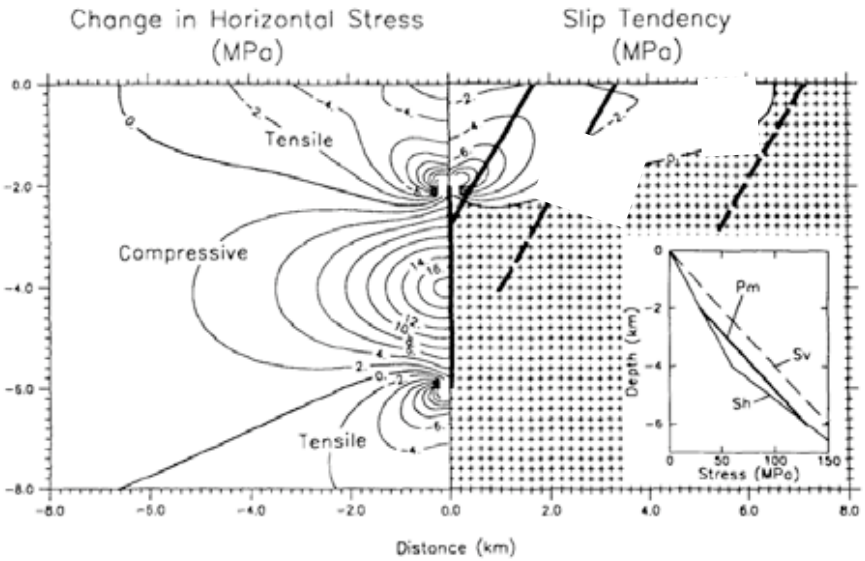
Models and Observations



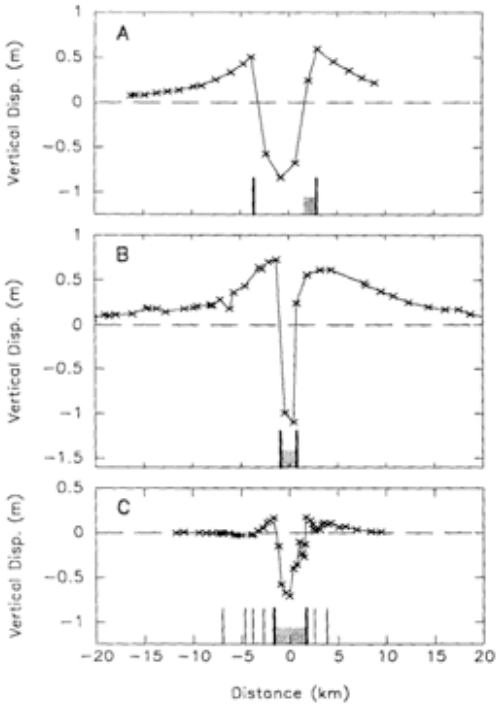
Rubin 1995



Grandin et al., 2009



Rubin & Pollard 1988



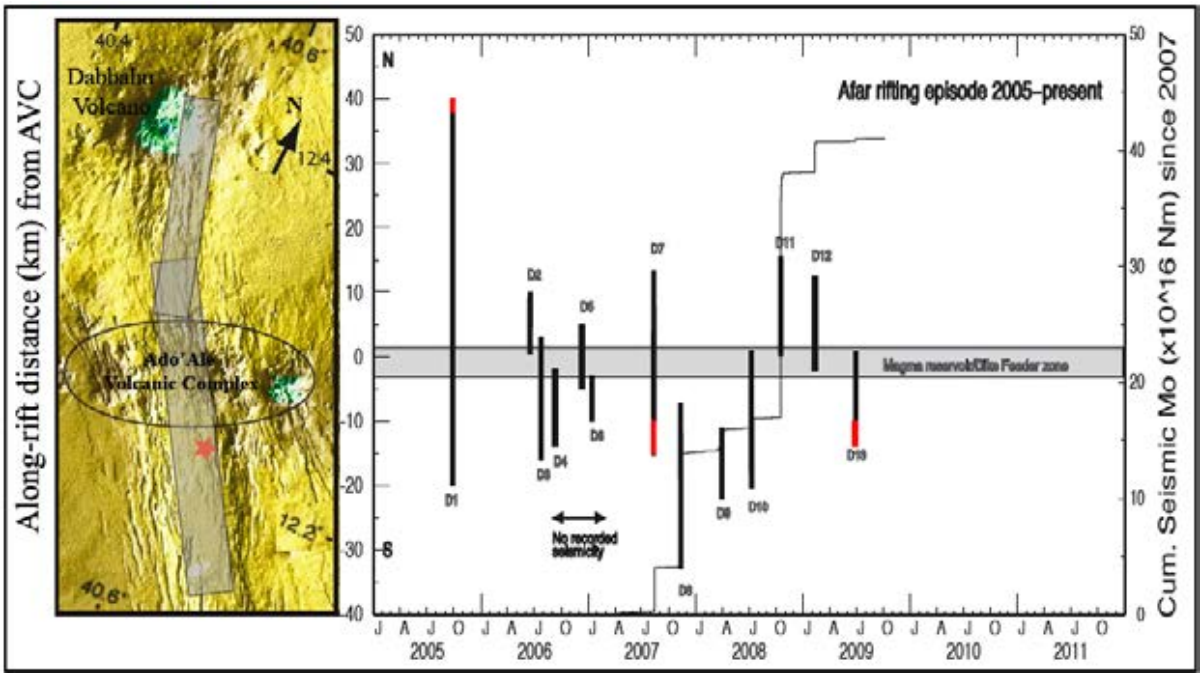
- ✓ Time and length scales of dike intrusions

- ✓ Location (s), size and shape of magma feeder zone (s) during discrete rifting episode

- ✓ How is seismic energy release distributed during dike intrusions?

- ✓ Where and when during a dike intrusion certain types of faulting mechanisms occur?

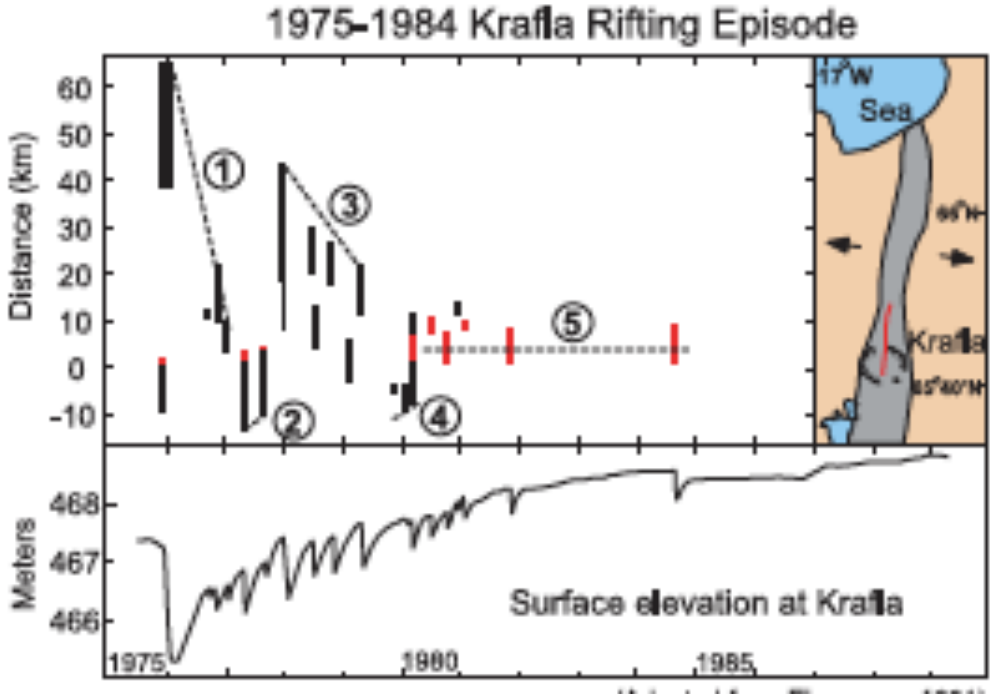
- ✓ What portion of plate divergence occurs seismically and variation with rifting stage?



Afar rifting episode

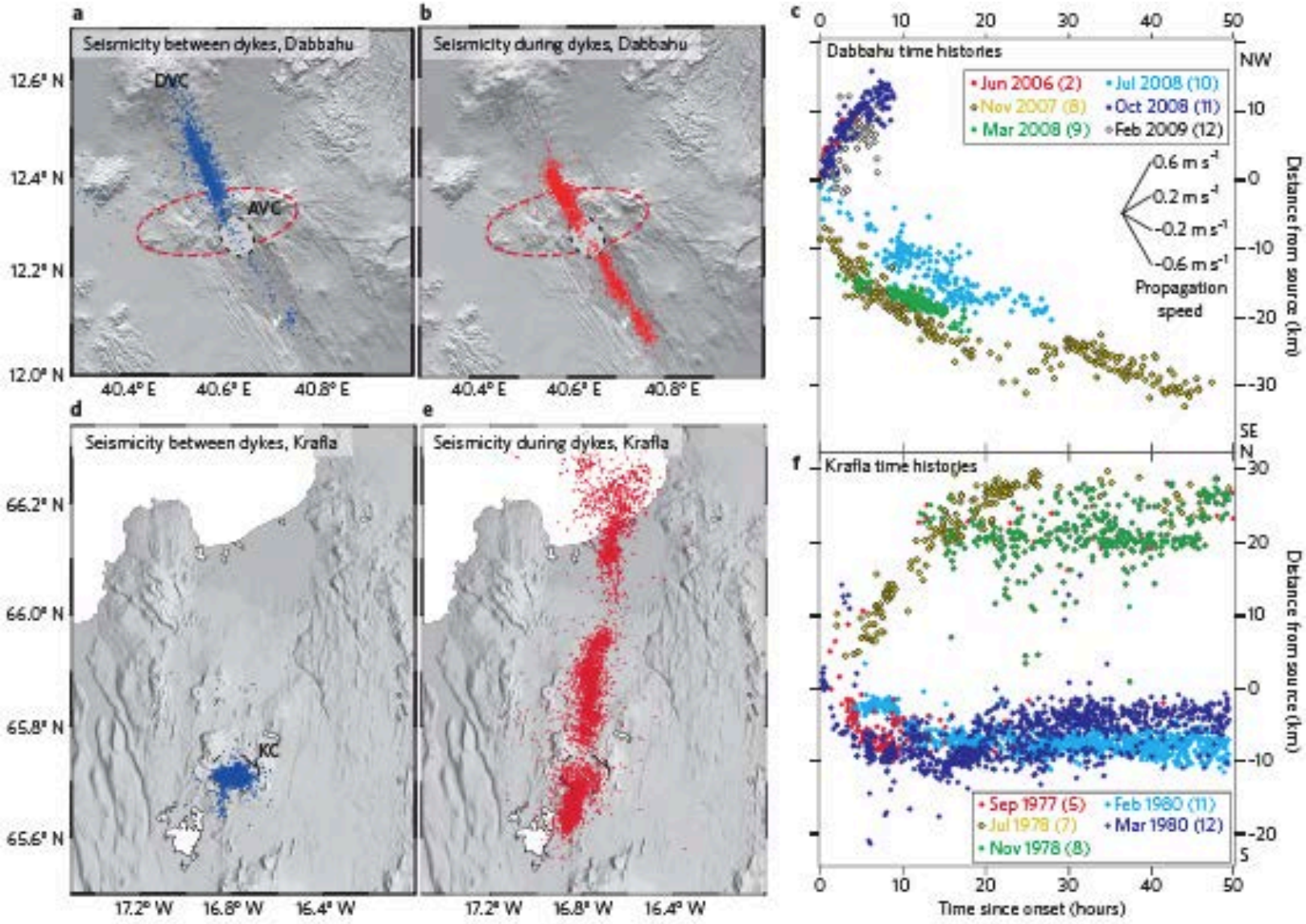
Belachew et al., 2011

Mid-segment feeding



Krafla rifting episode

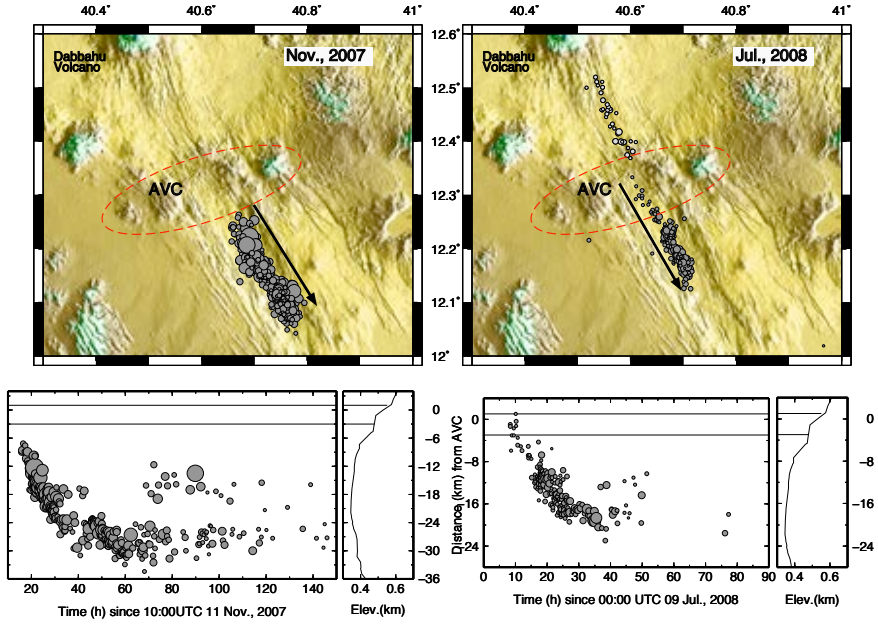
Buck et al., 2006



Wright et al., 2012

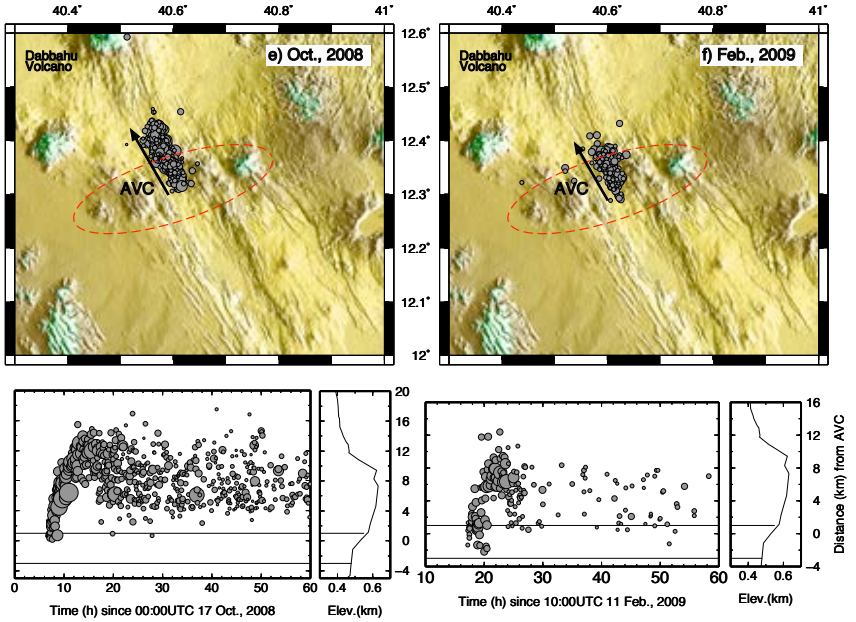
Level of Tectonic stress vs Fracturing/faulting

Southward propagation

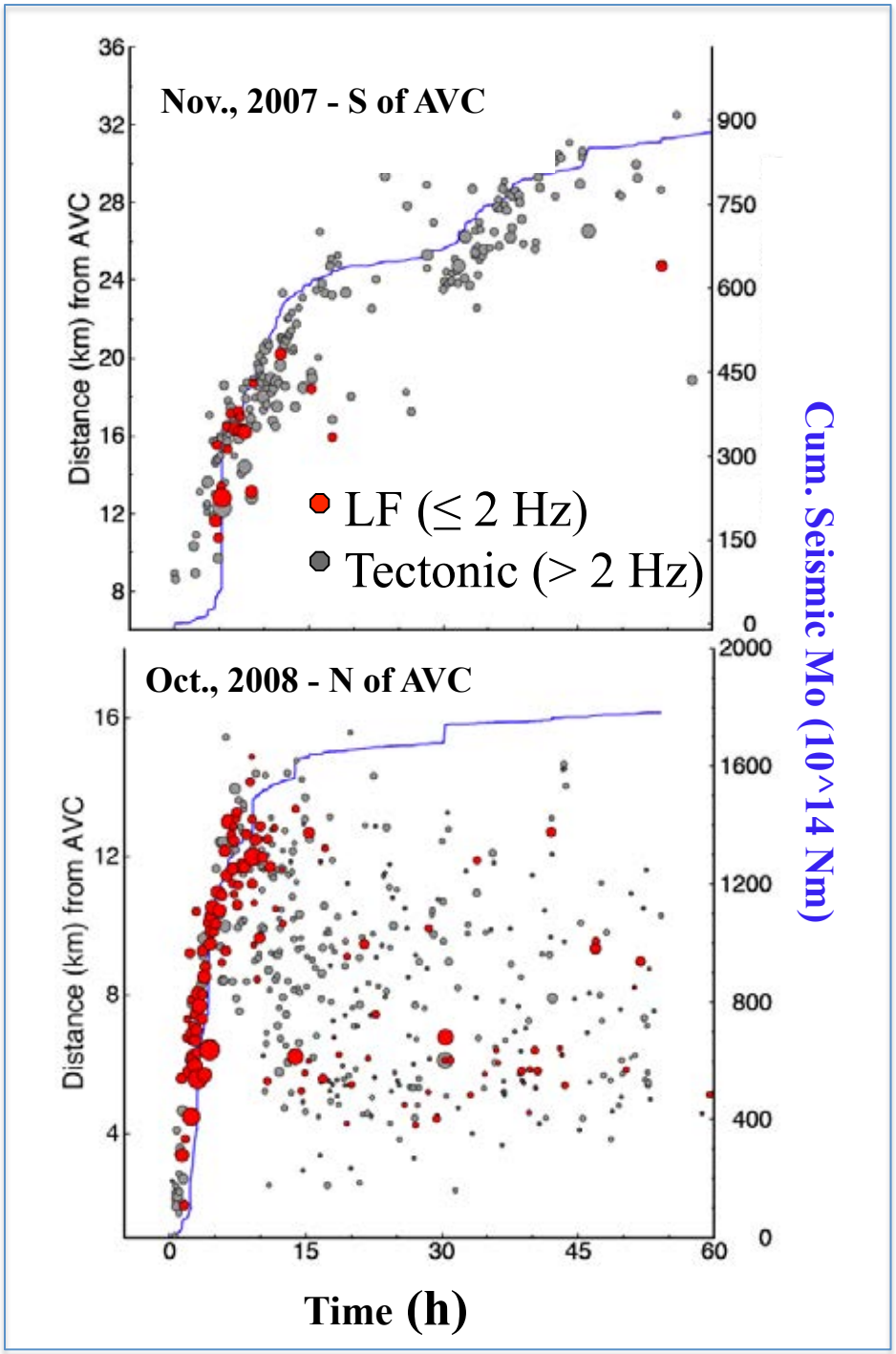


- Slower propagation rates
- Less post-diking seismicity
- Longer propagation duration (up to 44 hr)

Northward propagation

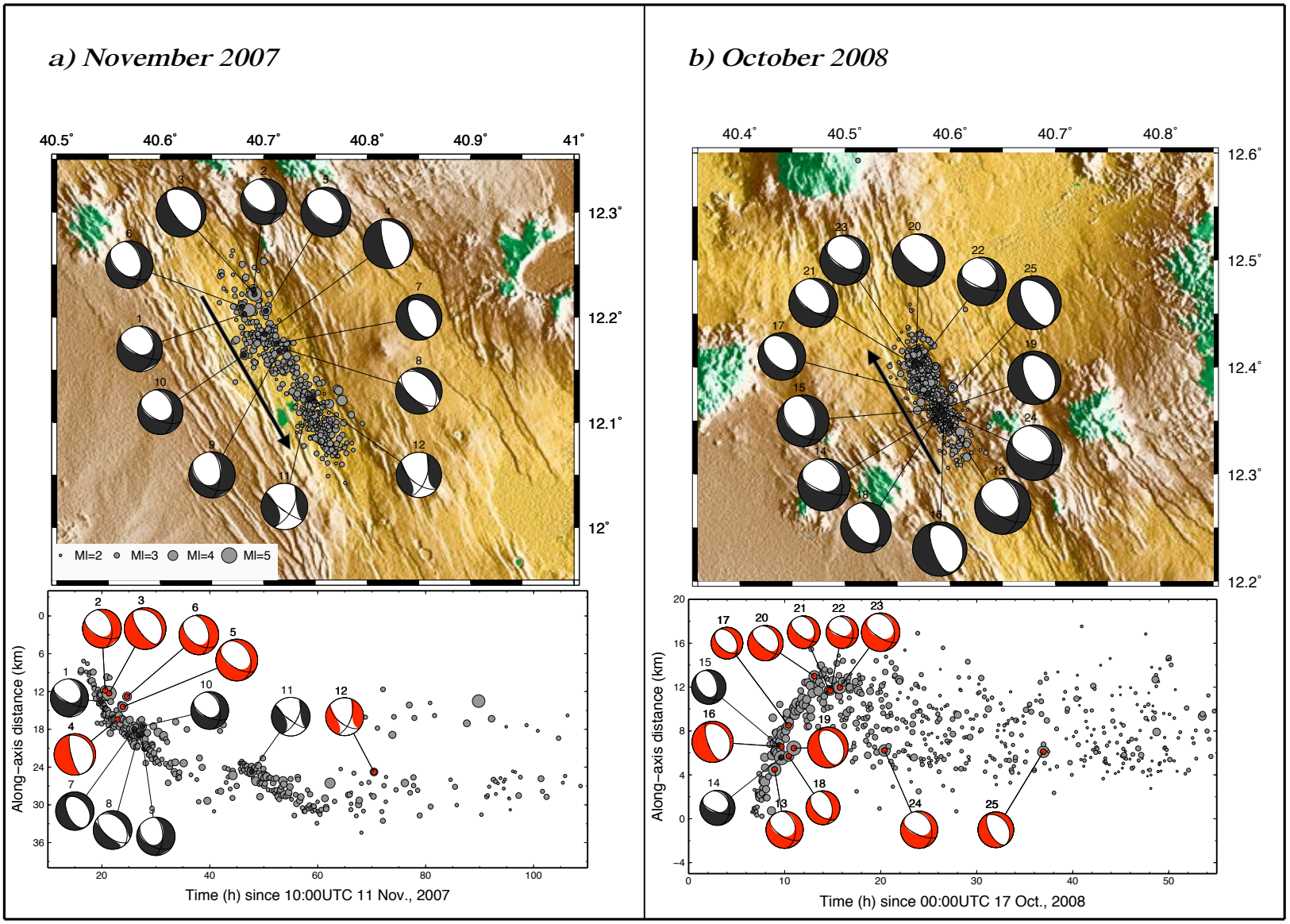


- Faster propagation rates
- High-level of post-diking seismicity
- shorter duration (~ 8 hr)

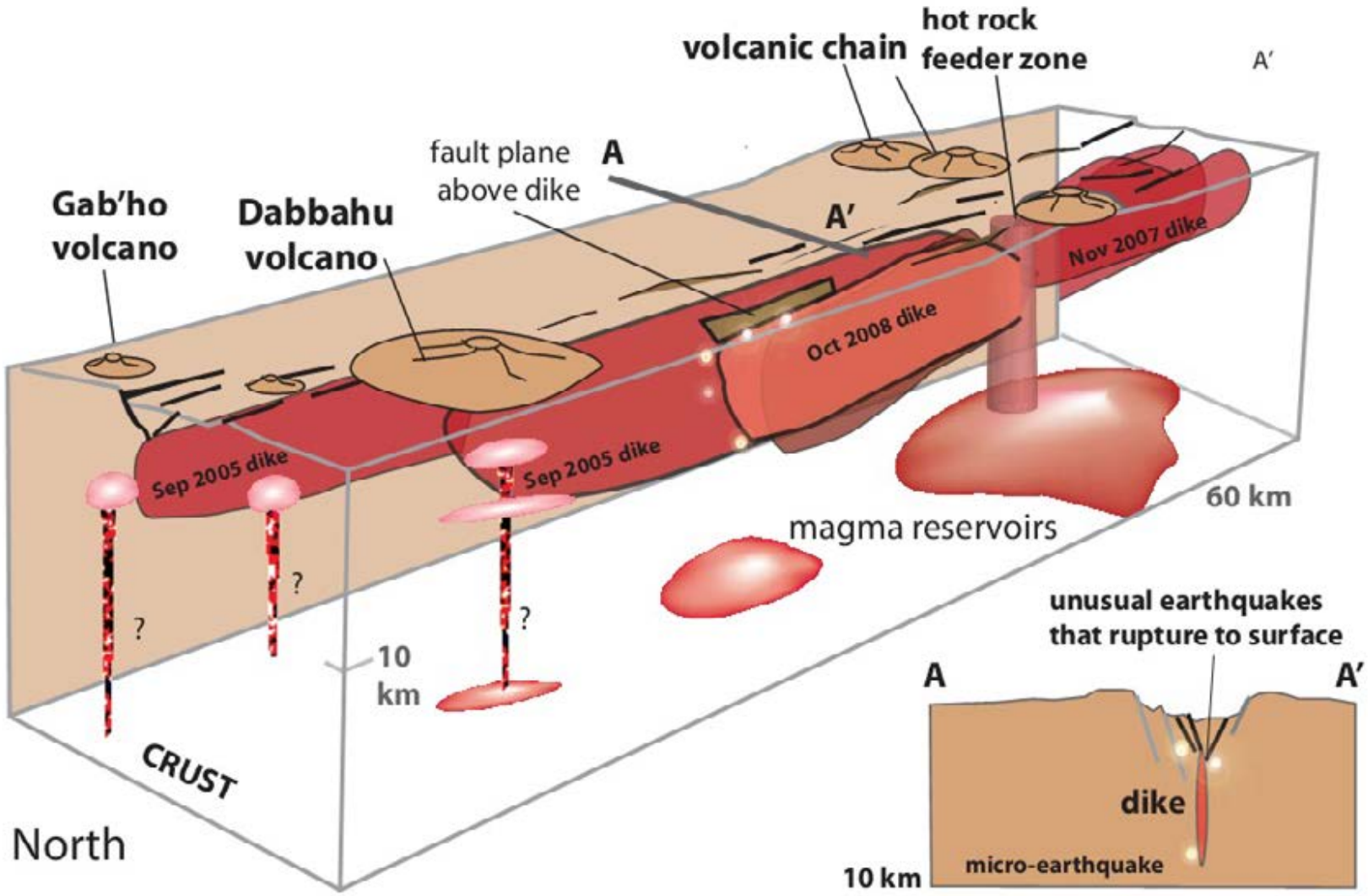


Seismic Moment Distribution

- **AFAR** - The seismic Mo < 3% of the geodetic moment estimates.
- **NATRON** - 65% of opening accommodated aseismically
  - ✓ seismic Mo << geodetic moment
  - ✓ dike opening occurs 'aseismically'
- ~80% of seismic energy is released during the propagation phase for each dike



Belachew et al., 2012



Modified from *Ebinger et al., 2008*

Future directions

✓ Dense seismic and GPS stations to better determine the time and length scales of dike intrusions

✓ Image magma chamber size, shape and depth

✓ Define empirical scaling relations for fault characteristics applicable for magmatic rifts

✓ Better modeling of deeper dikes that are usually missed using geodetic techniques but seismically

✓ Partitioning of strain at different stage of rifting