Mapping the evolving strain field during continental breakup from crustal anisotropy in the Afar Depression

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Crustal anisotropy derived using S-wave splitting from local earthquakes

Aims

- Constrain spatial variations in dominant direction, strength and causes of rock fabric in the upper crust

- Interpret distribution and orientation of deformation during continental breakup

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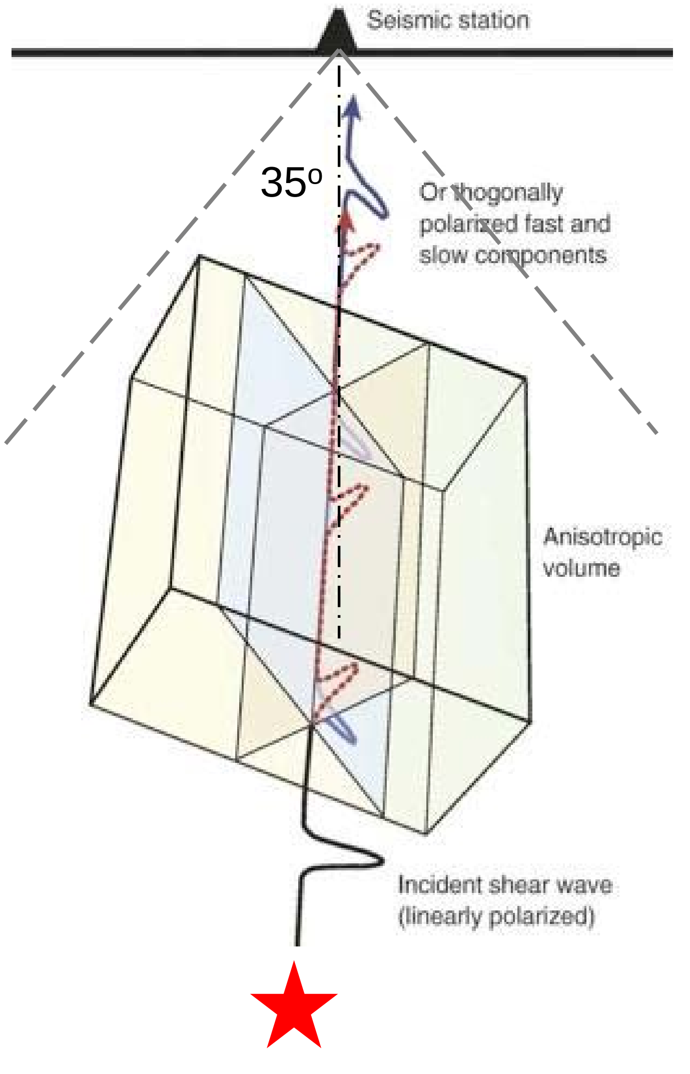
Shear-wave splitting measurements

Splitting parameters

Time difference between fast and slow shear-waves

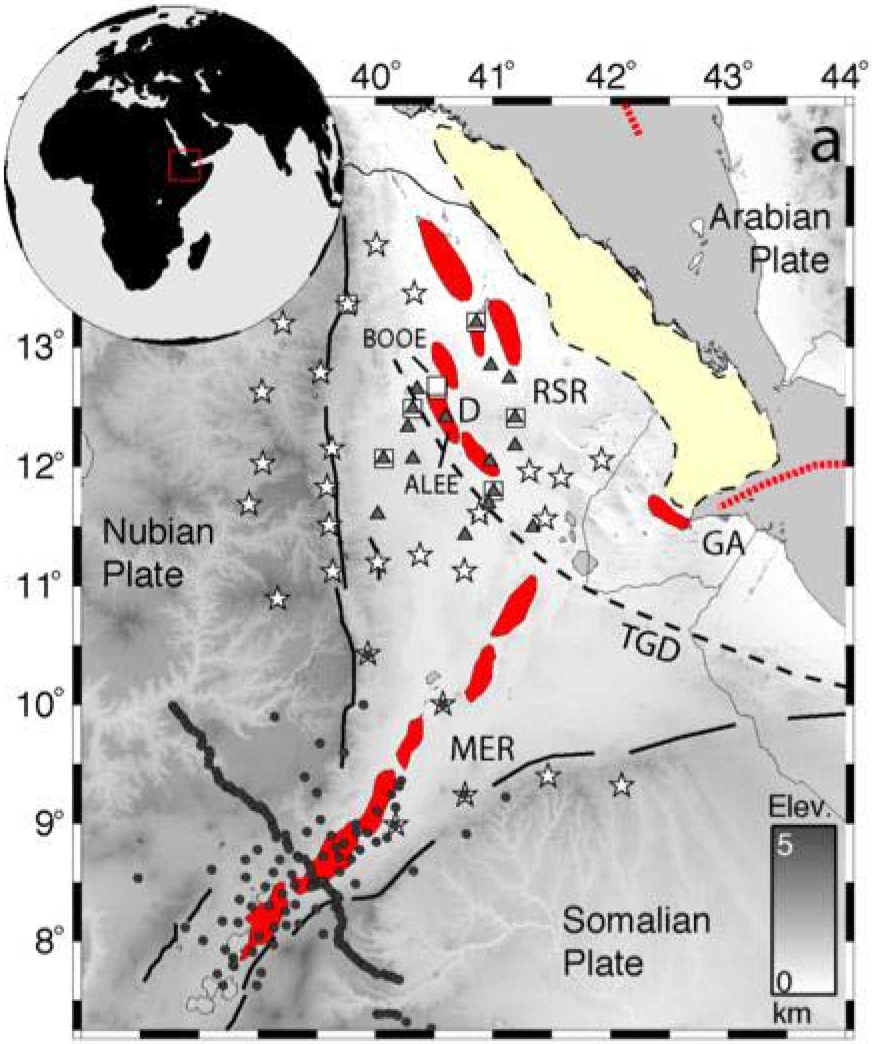
proportional to magnitude and spatial extent of the anisotropy

Polarization of fast shear-wave constrains symmetry of anisotropy

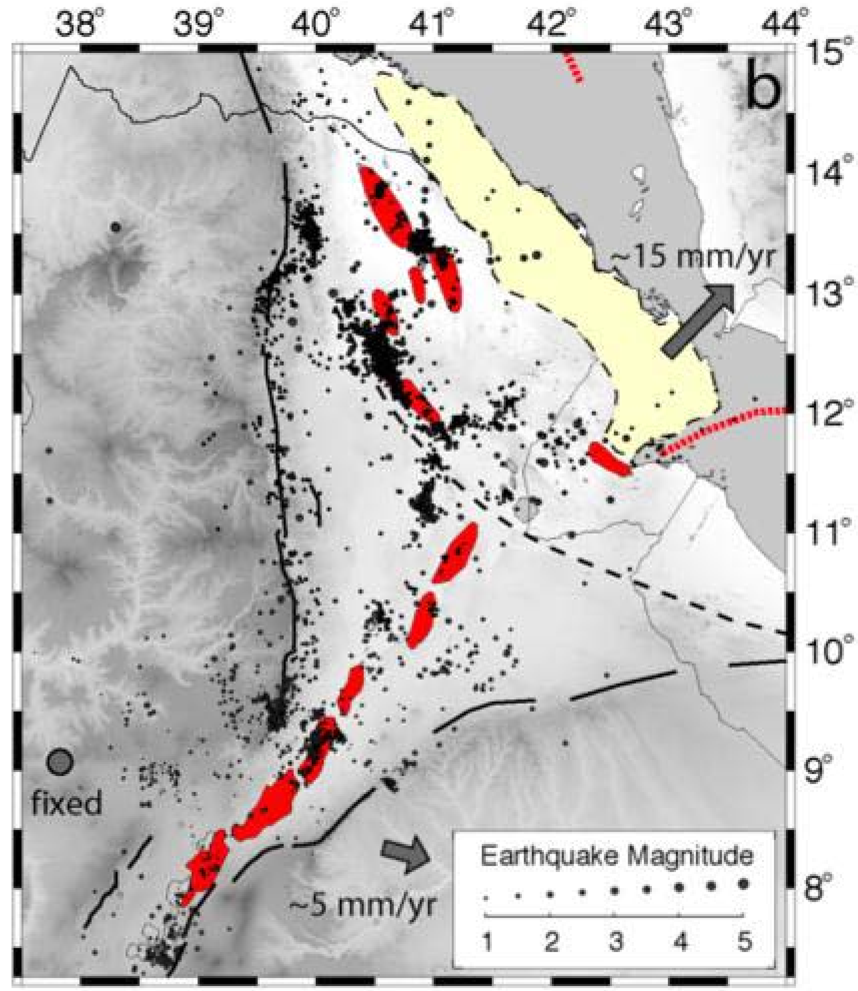


Data

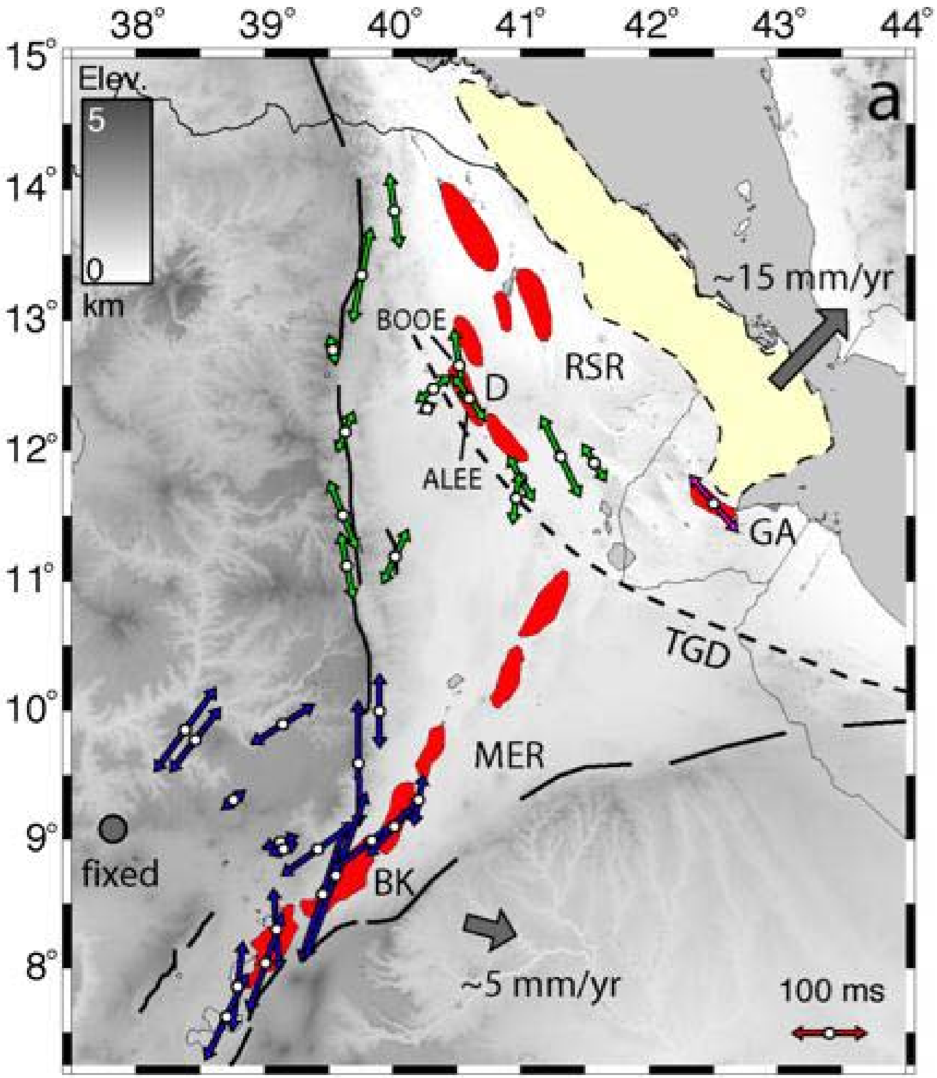
Stations

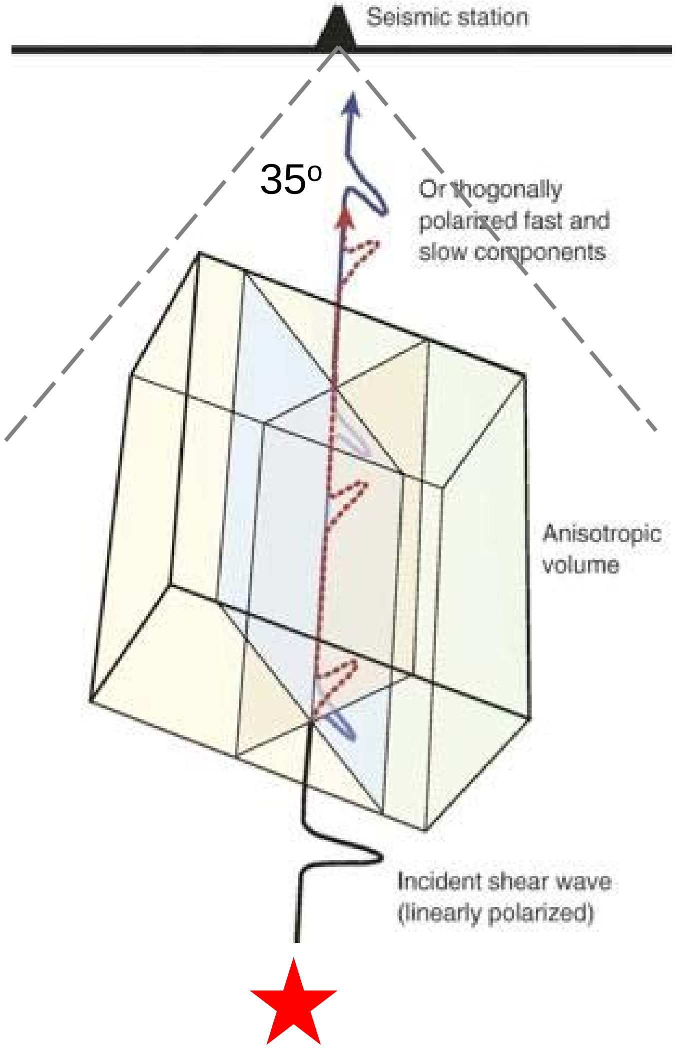


Earthquakes



Shear-wave splitting results





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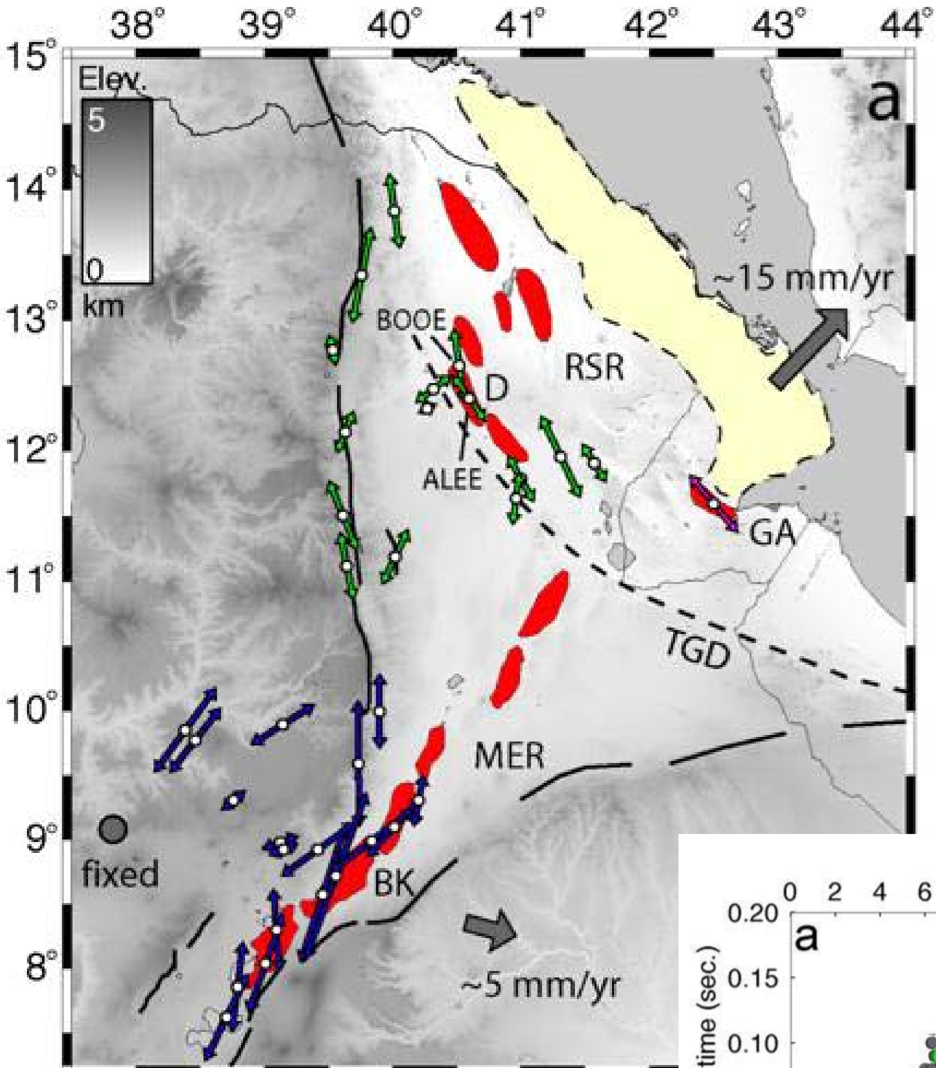

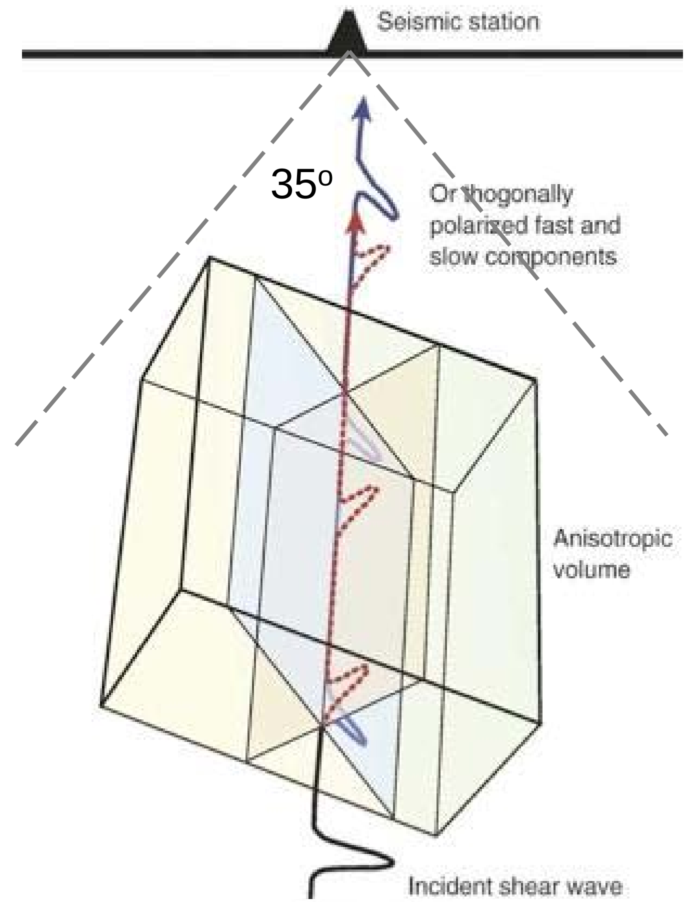

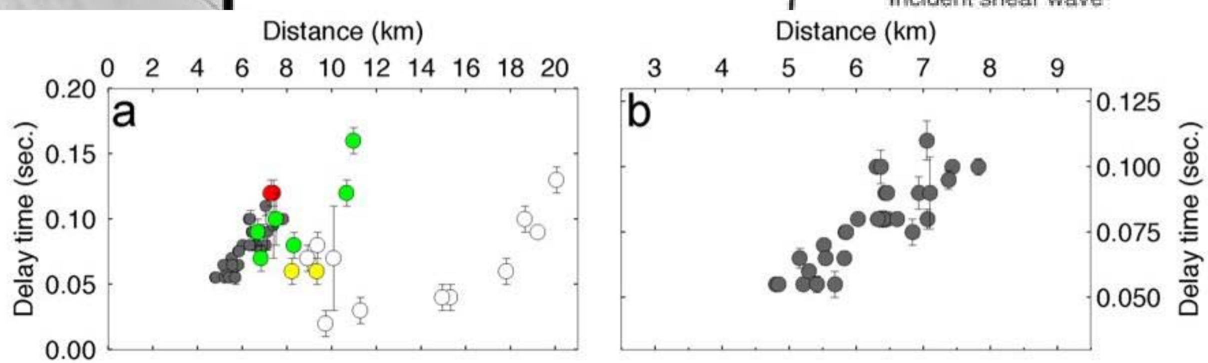

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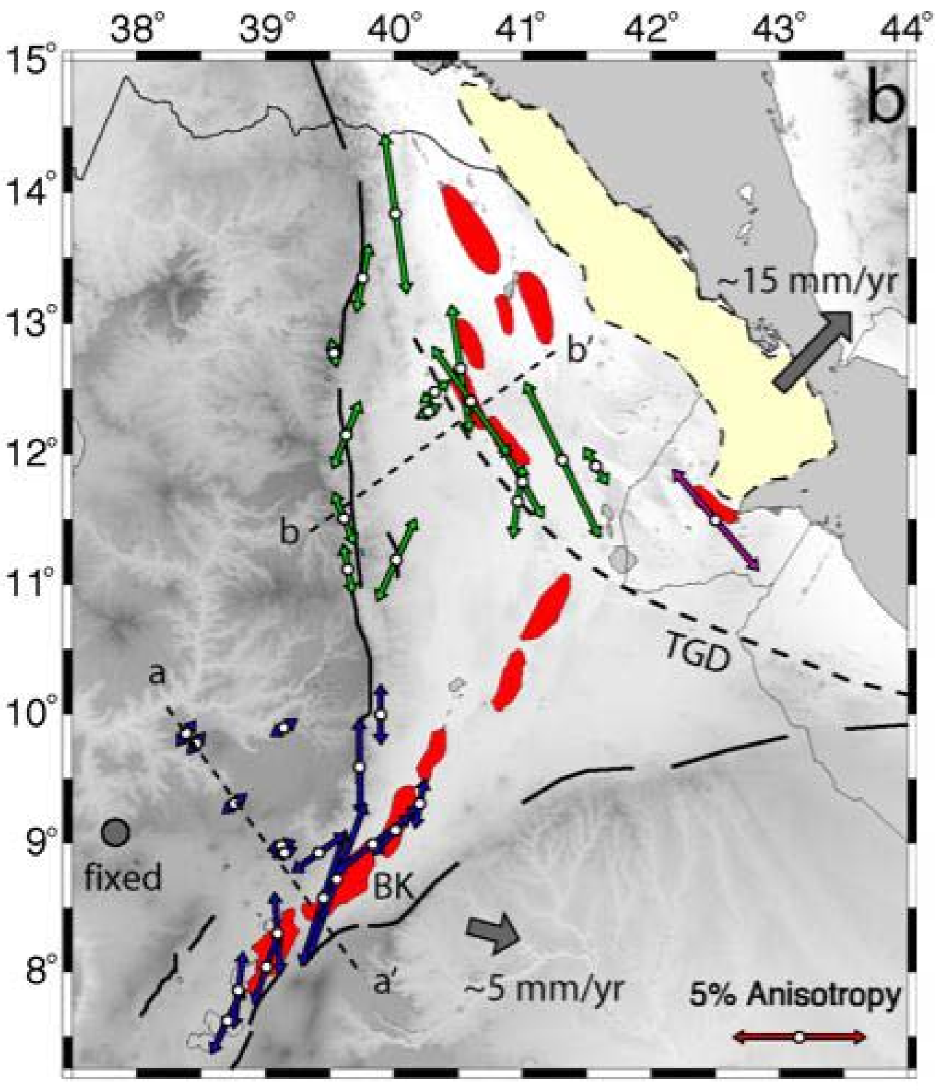
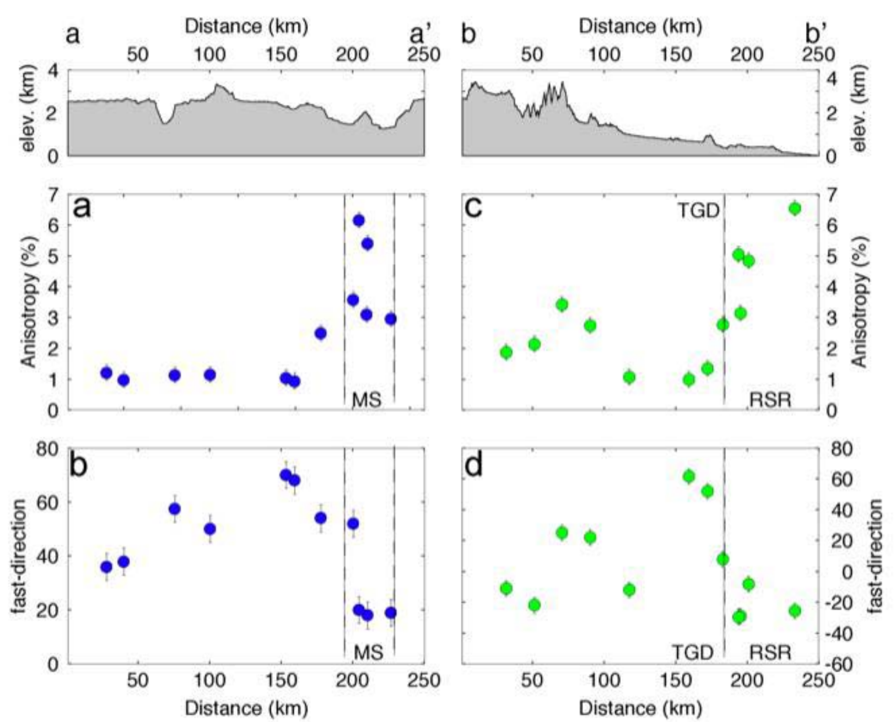
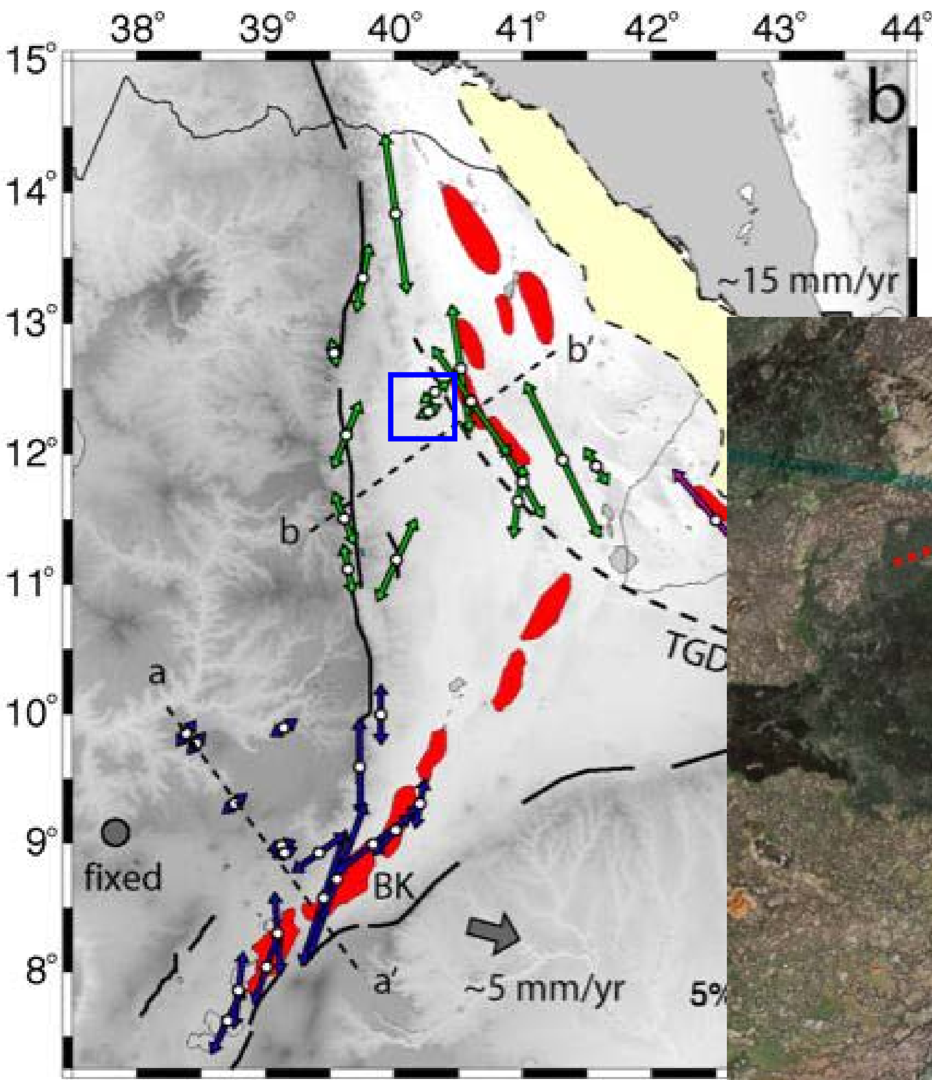
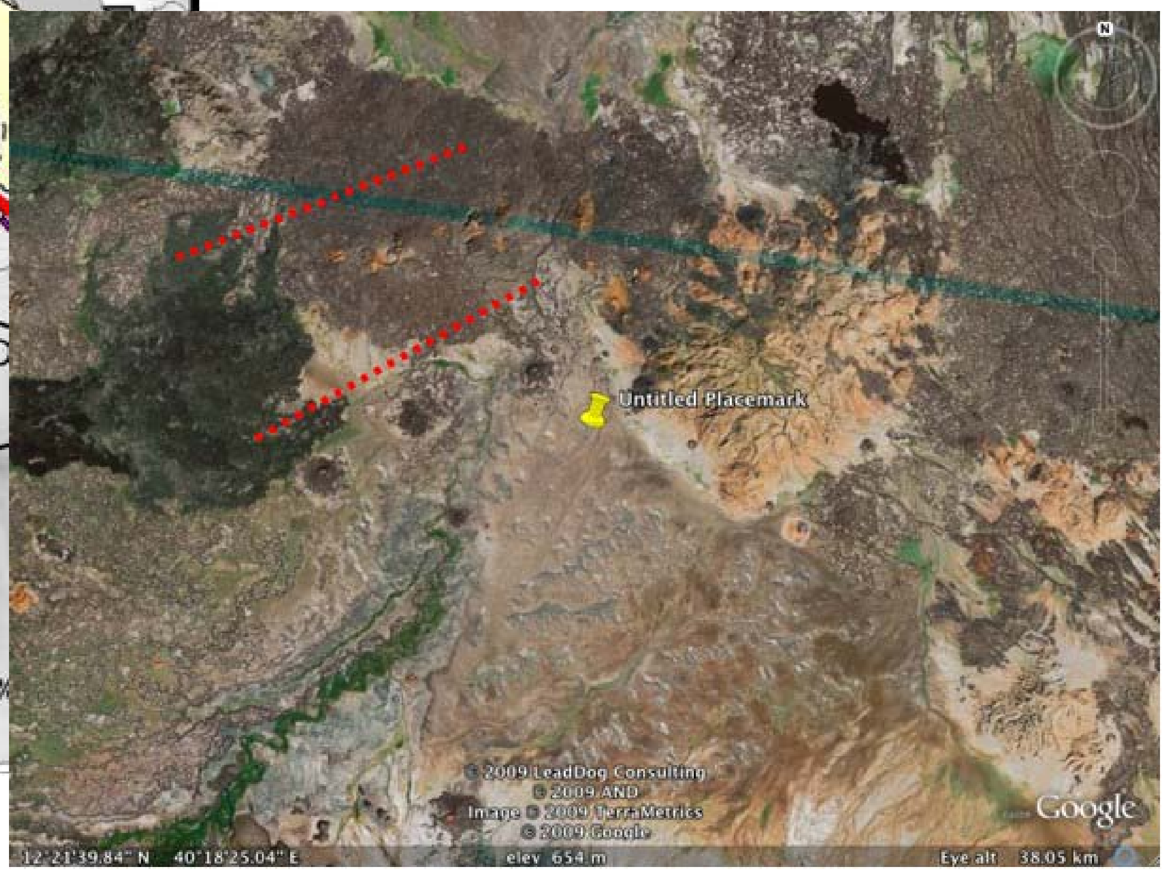


- Magnitude of anisotropy increases into magmatic segments
- Crustal anisotropy highly sensitive to major strain fabrics



Shear-wave splitting results





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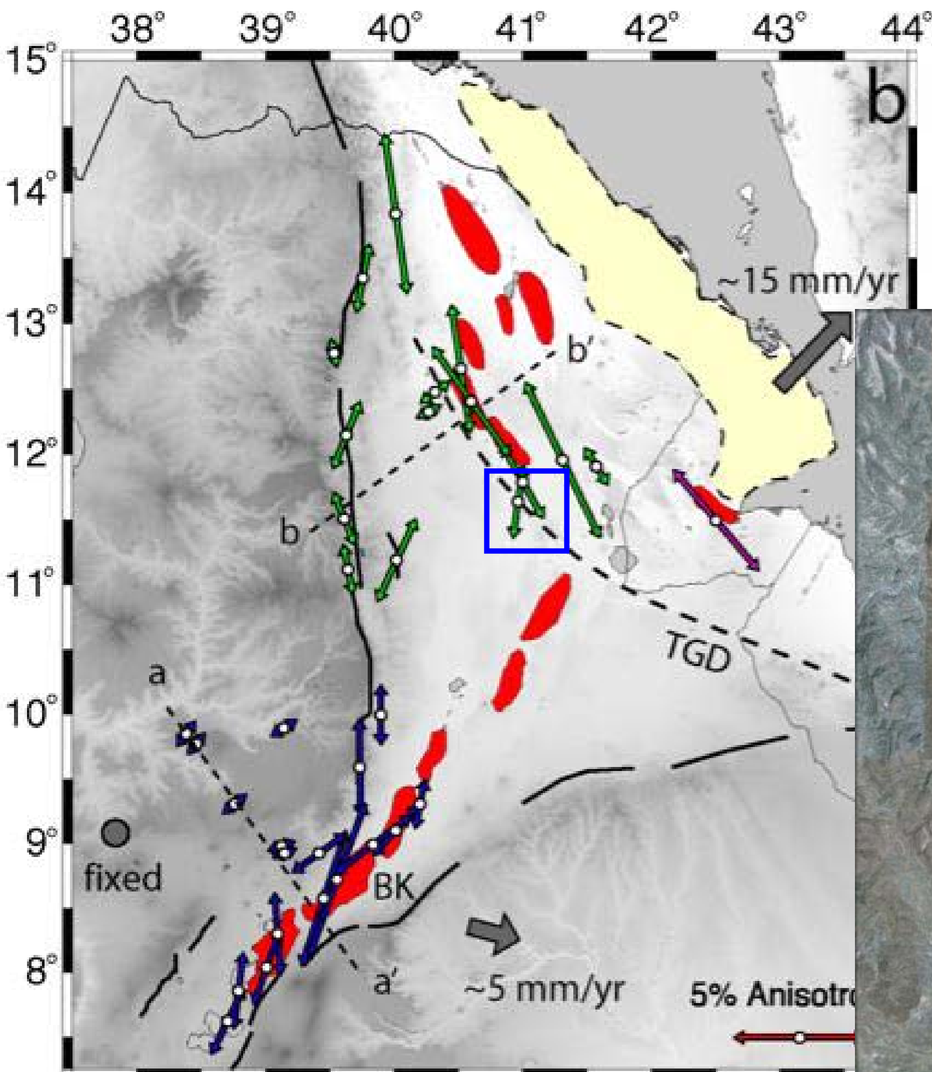

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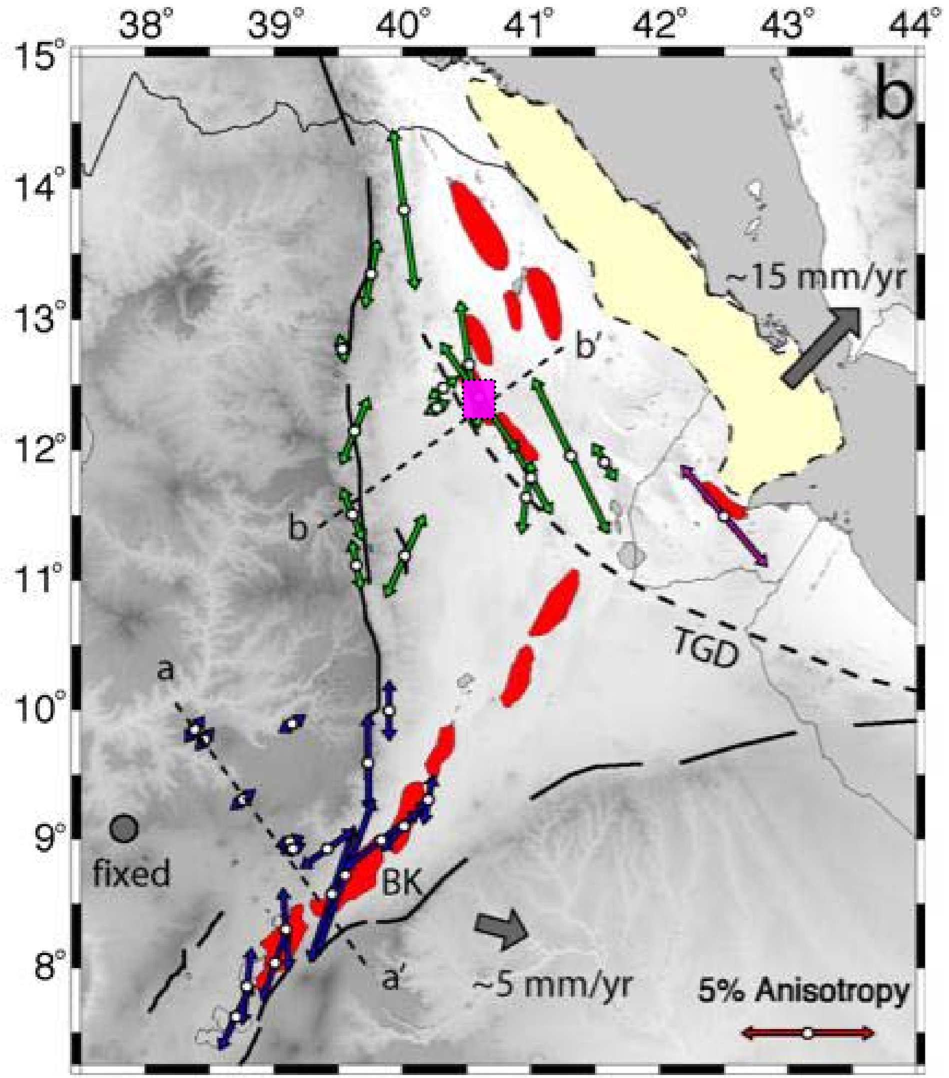
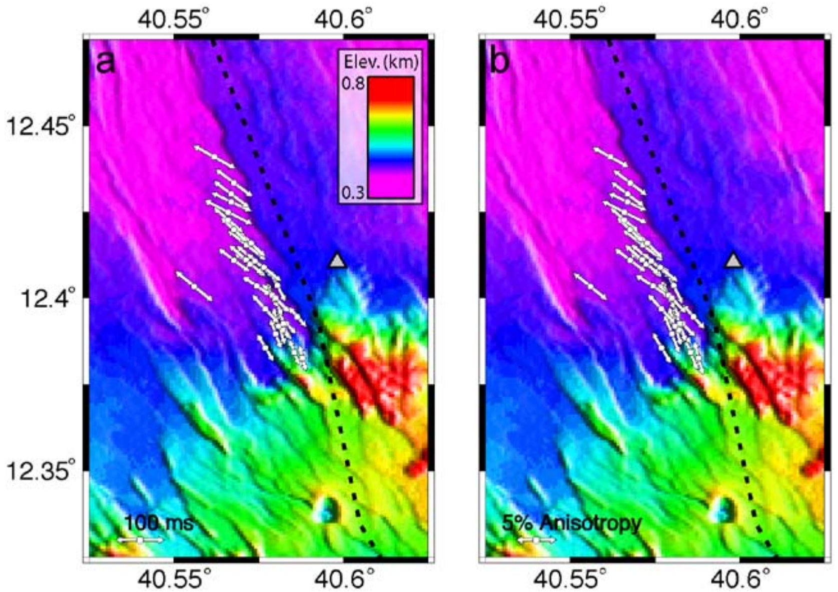
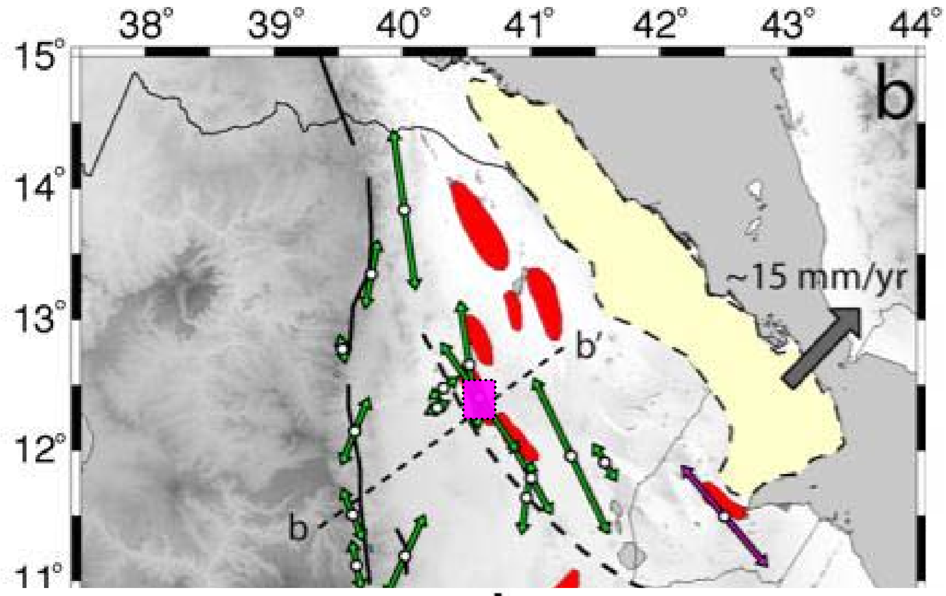


- Spatial variations in delay-time and fast polarization direction at a single station

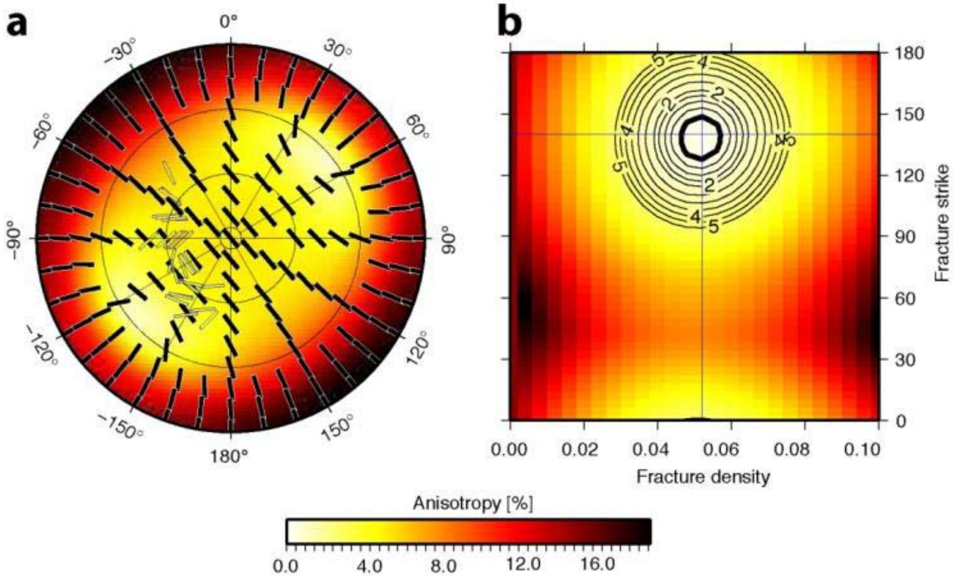


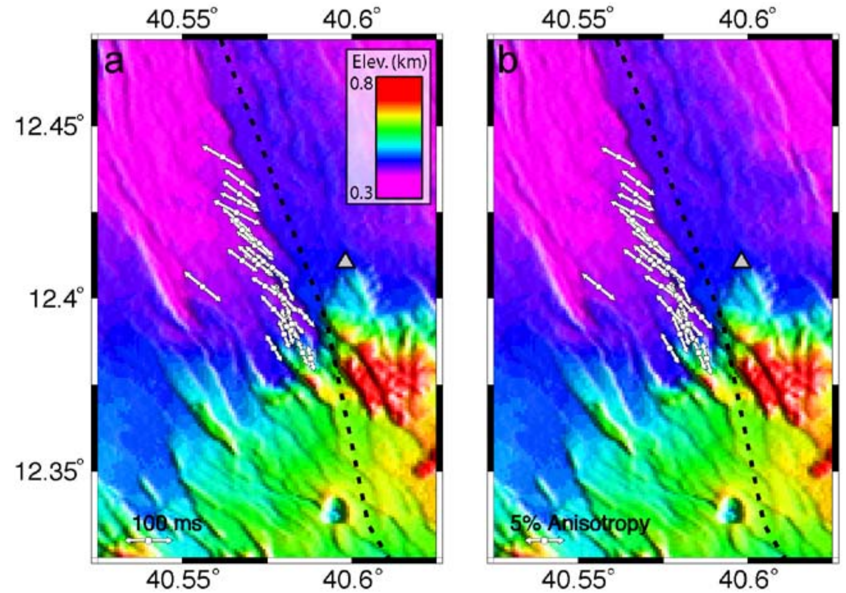
Shear-wave splitting results



- Spatial variations in delay-time and fast polarization direction at a single station

- Consistent with that expected from a single fracture set





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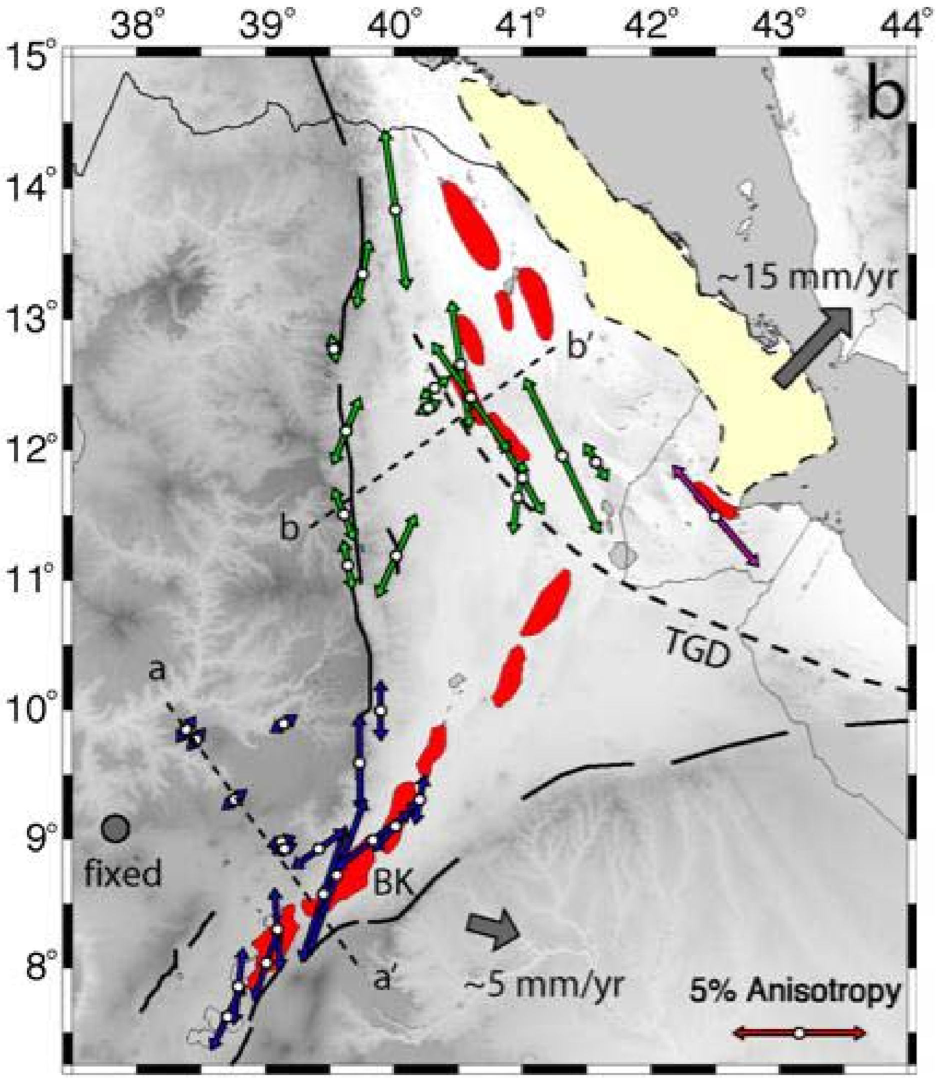
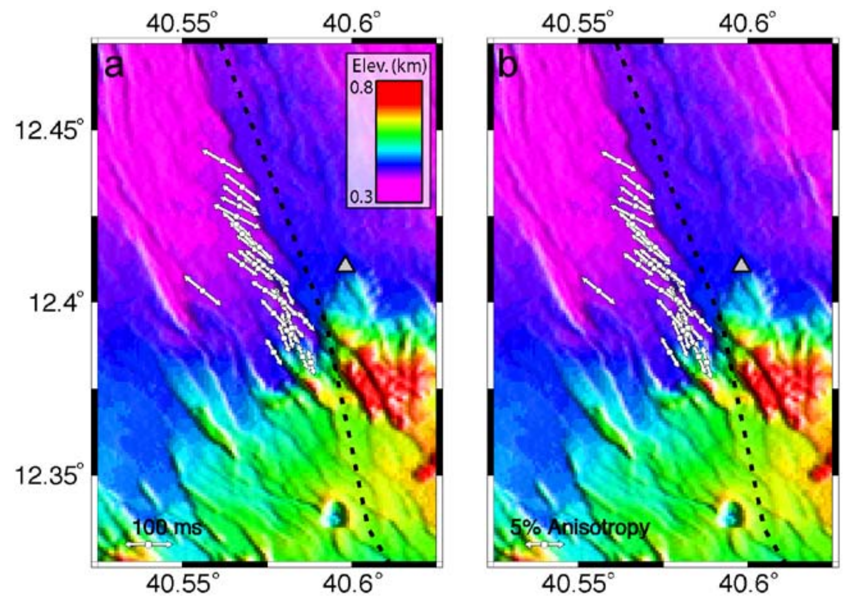


- Spatial variations in delay-time and fast polarization direction at a single station

- Consistent with that expected from a single fracture set

- Correlation between magnitude of anisotropy and degree of magmatism in some regions



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Conclusions

- We constrain spatial variations in dominant direction and strength of anisotropy over the three rifts of the Afar Depression
- Anisotropy increases in magnitude into the magmatic segments and rotates to perpendicular to extension
- Crustal anisotropy is a useful tool for mapping out distrbution and orientation of deformation in Ethiopia

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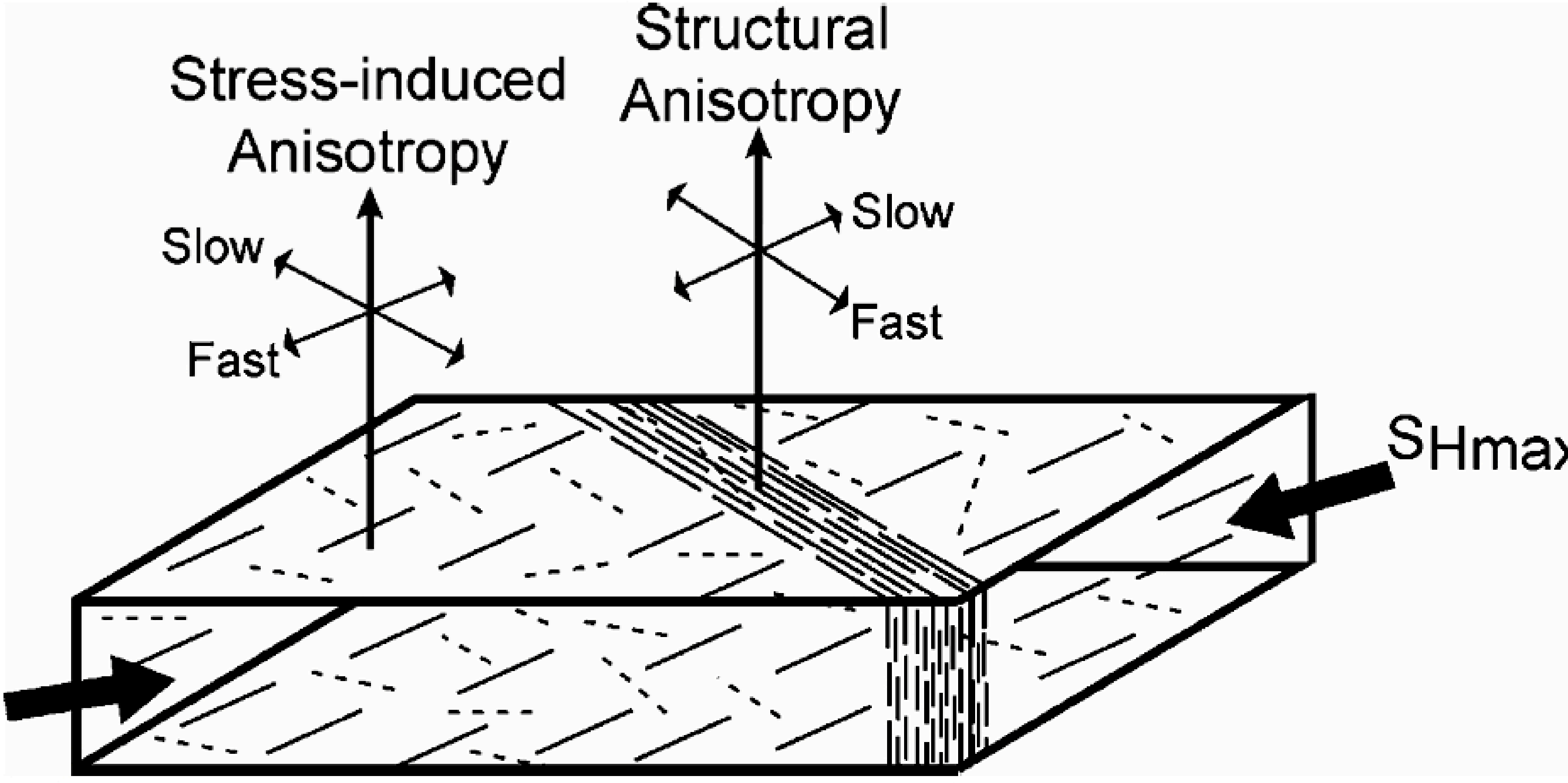
Anisotropy in the upper-crust



Boness et al., 2006