Geophysical imaging of magmas and fluids

Derek Keir - University of Southampton

Afar Rift Consortium

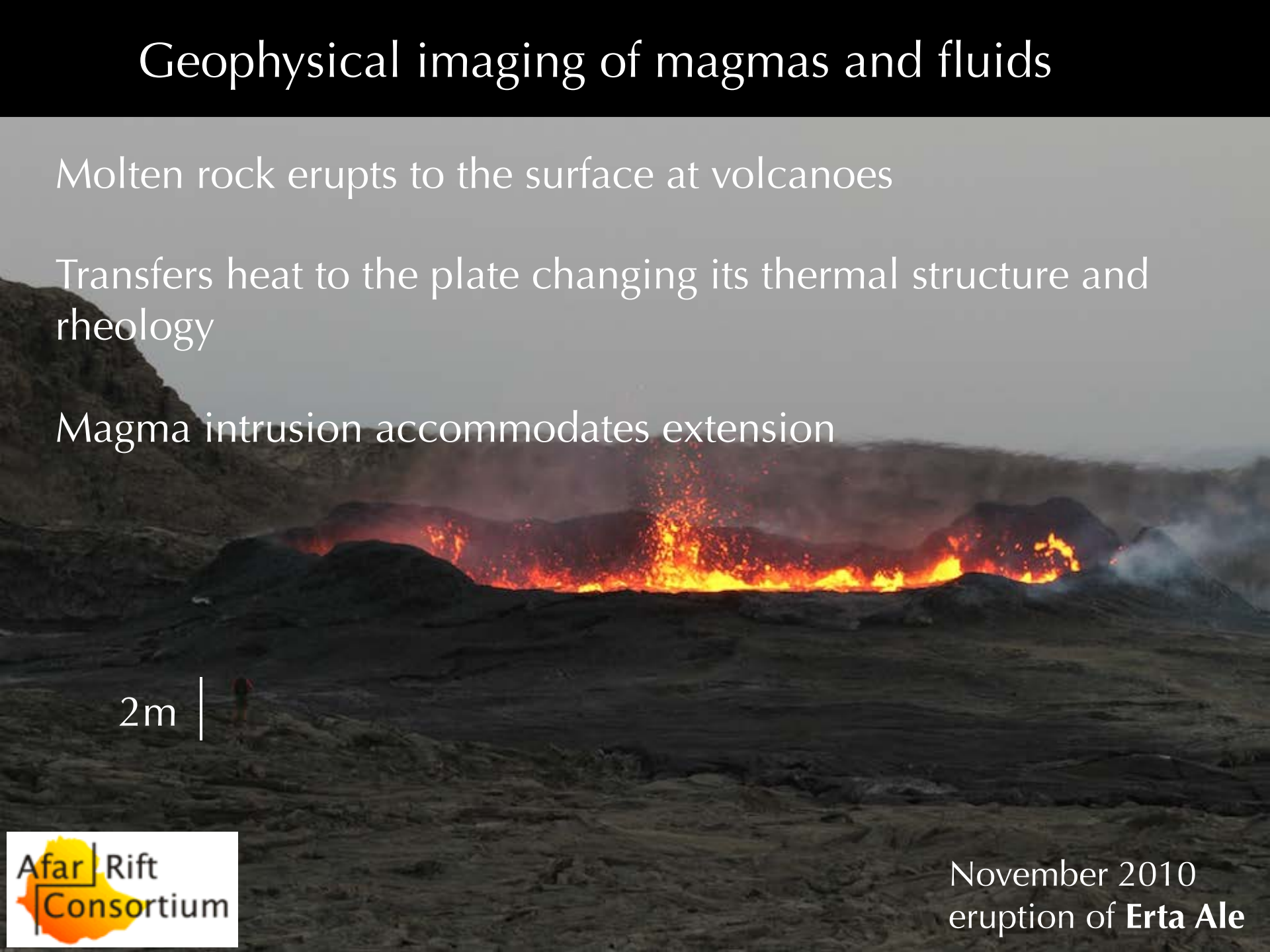
November 2010
eruption of **Erta Ale**

Geophysical imaging of magmas and fluids

Molten rock erupts to the surface at volcanoes

Transfers heat to the plate changing its thermal structure and rheology

Magma intrusion accommodates extension

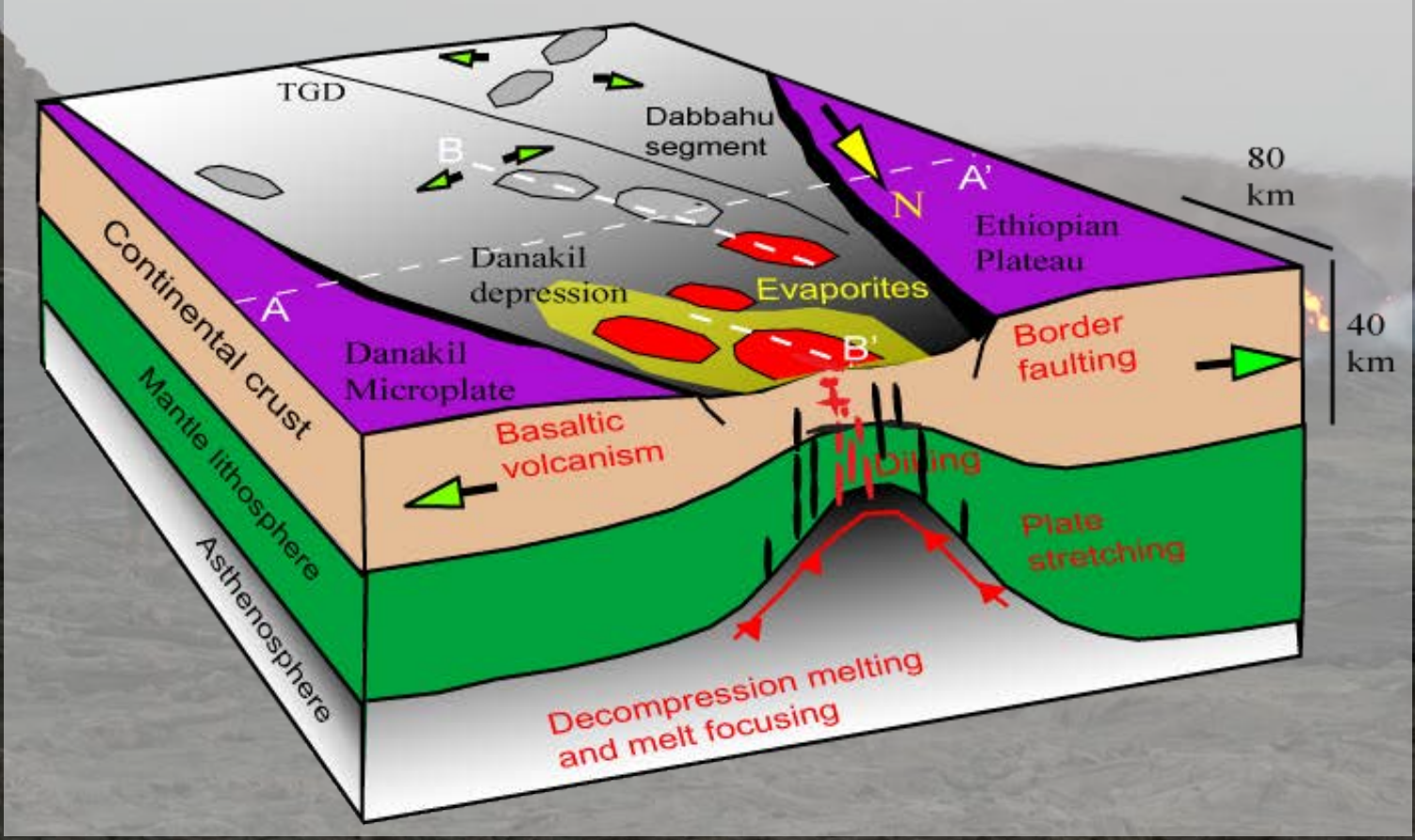


Afar Rift Consortium

November 2010 eruption of **Erta Ale**

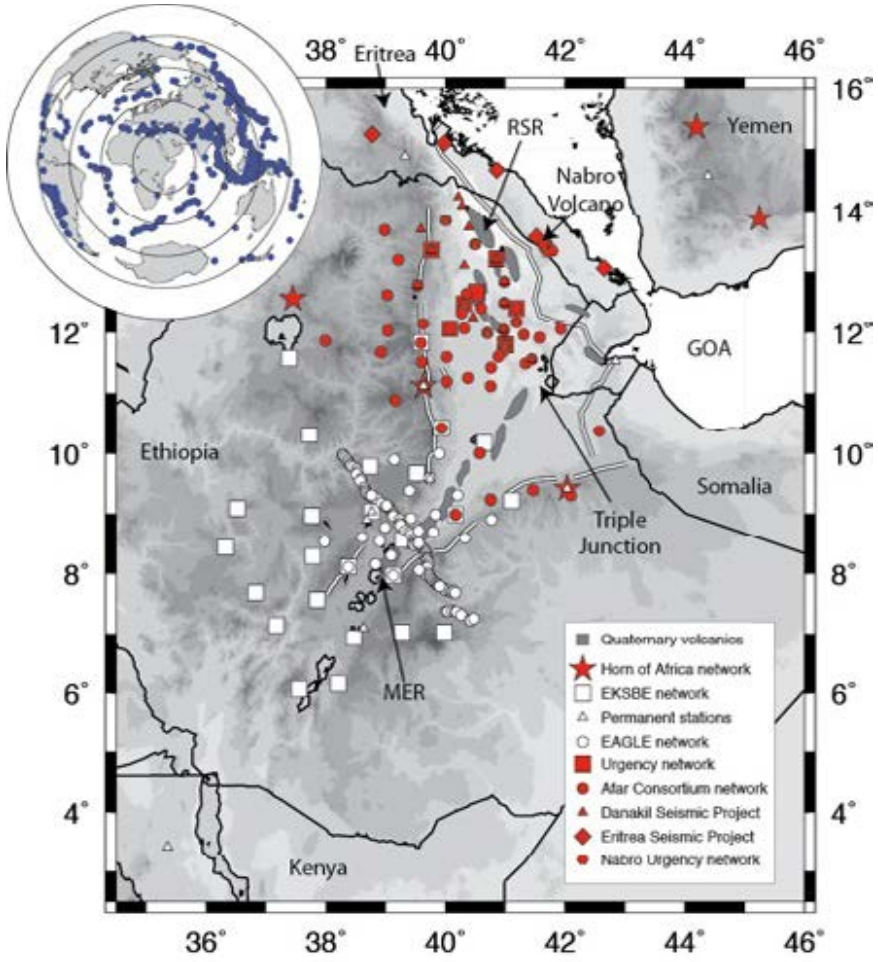
Production, migration and storage of magma beneath rifts

Seismic wavespeeds - Vp, Vs, Vp/Vs, anisotropy
Seismic discontinuities
Conductivity



Deep-crustal magmatism from seismology

Hammond et al., 2011, G-cubed



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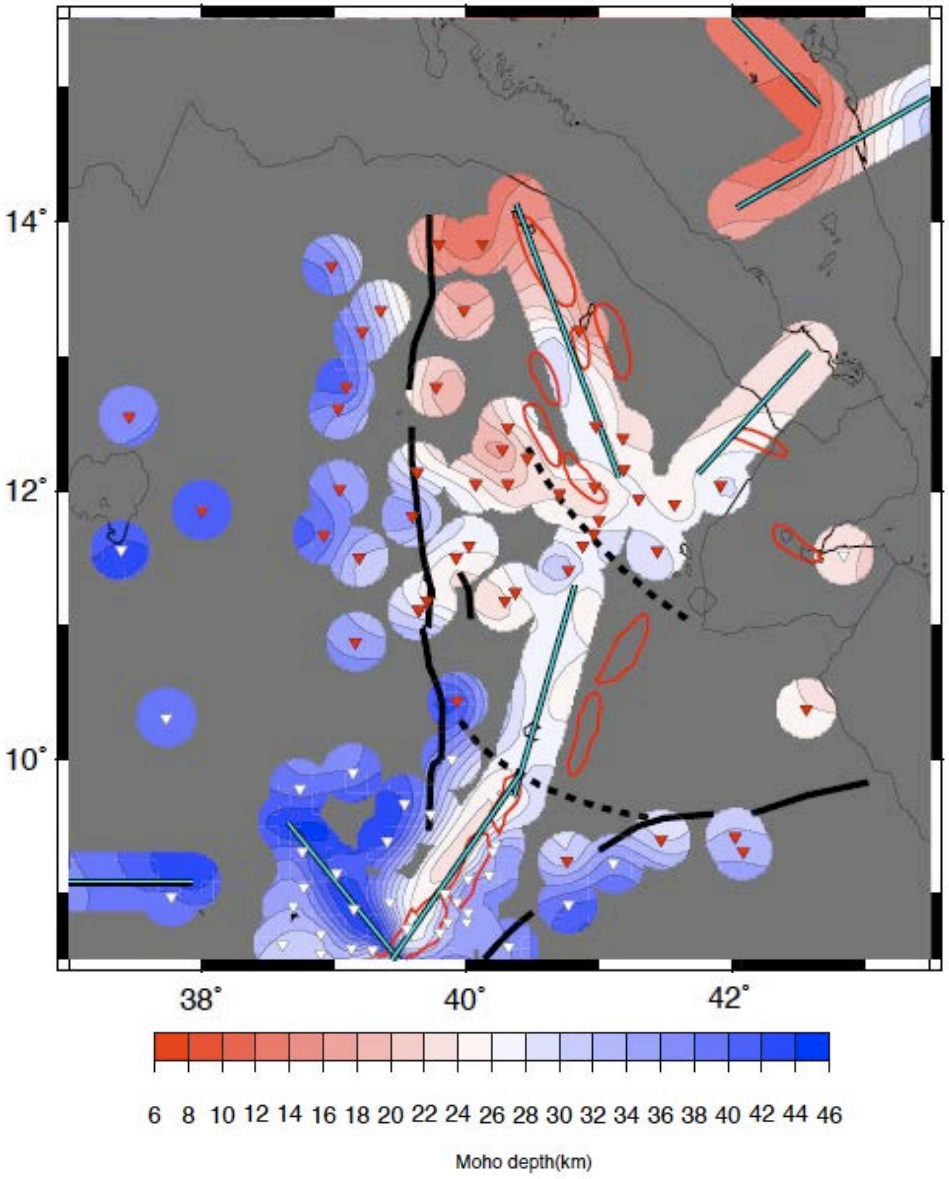
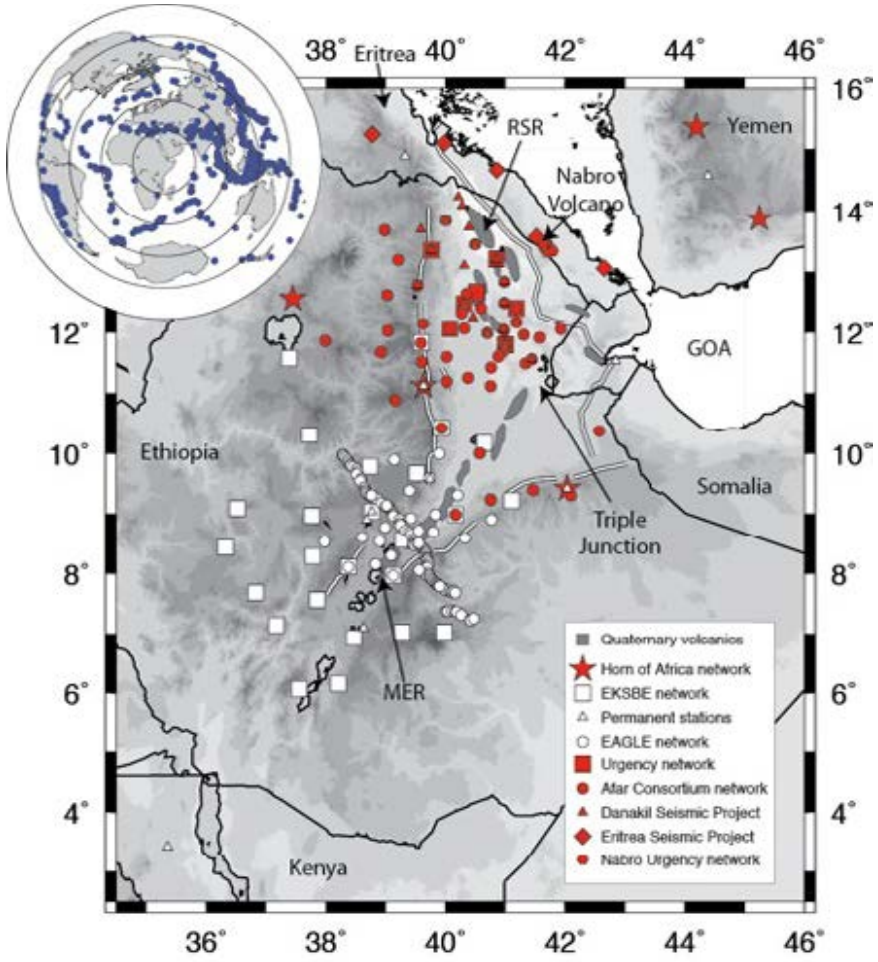


Hammond et al., 2011, G-cubed



Deep-crustal magmatism from seismology

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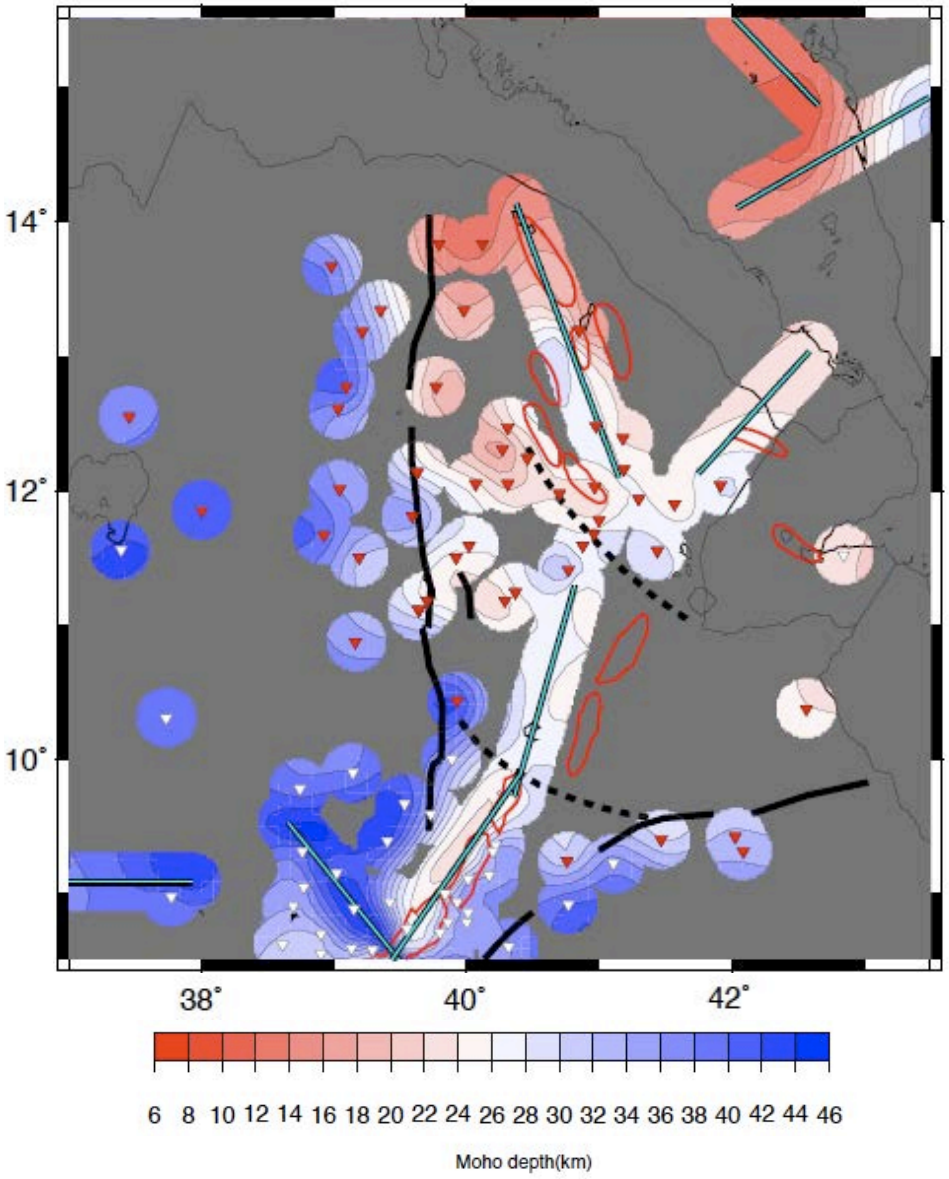
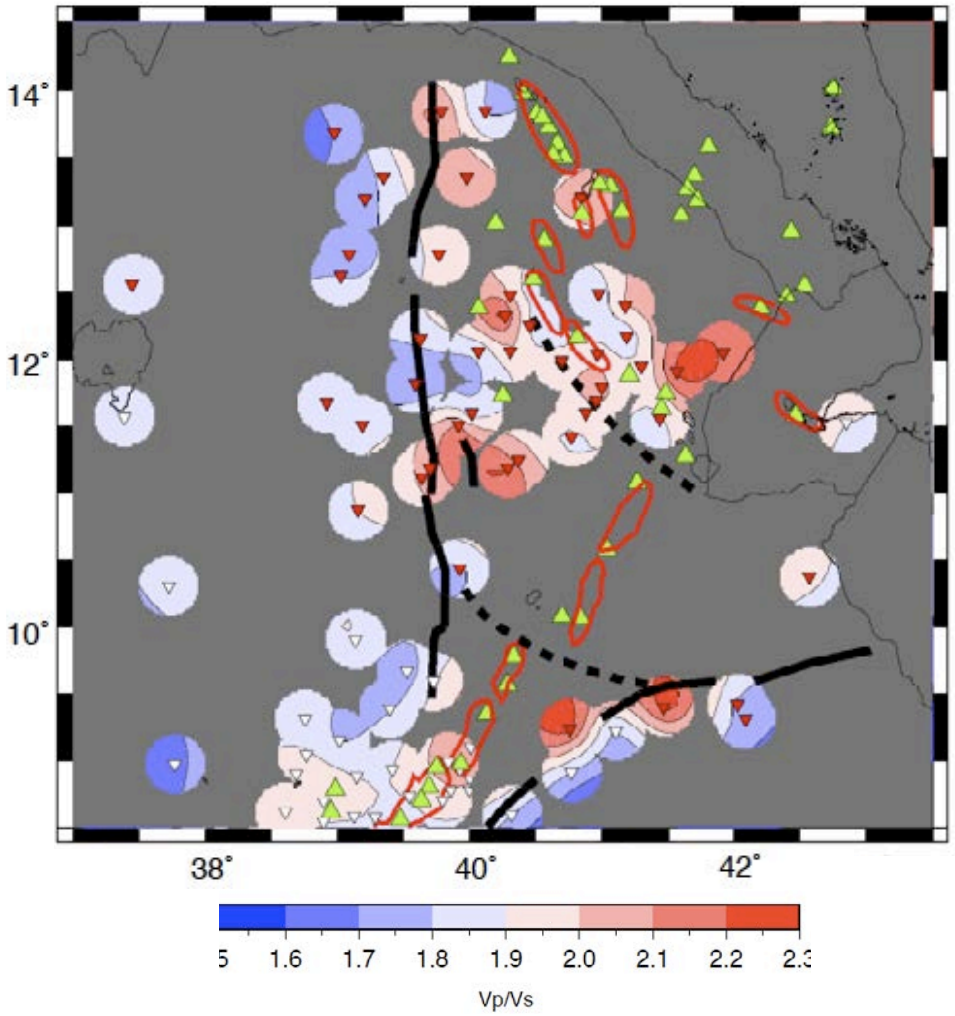


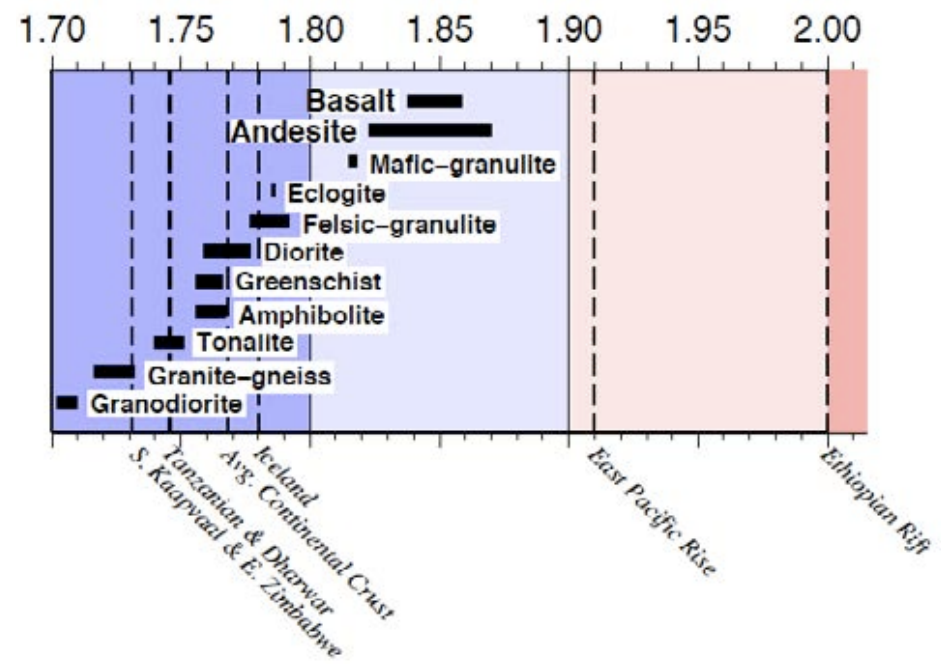


Deep-crustal magmatism from seismology

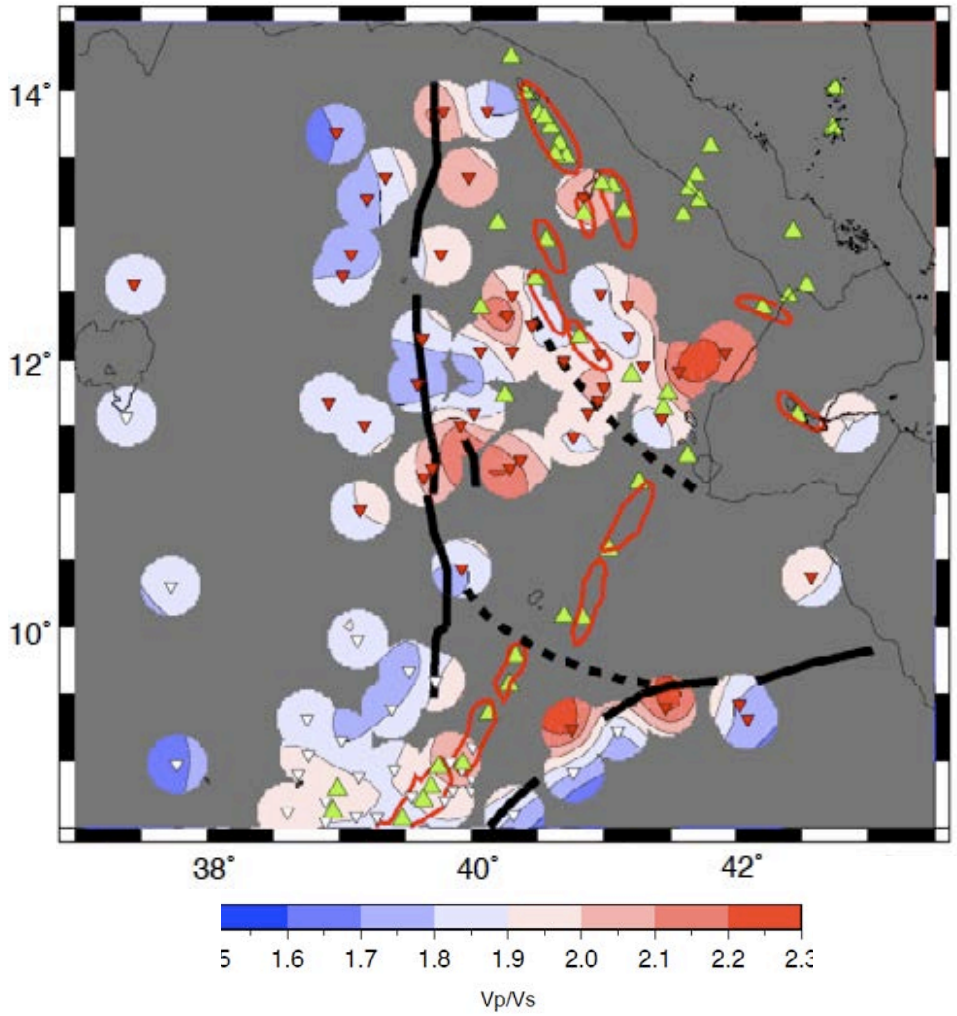
VpVs ratio over ~1.9 requires presence of fluid such as melt

High VpVs in the rift both on- and off-axis

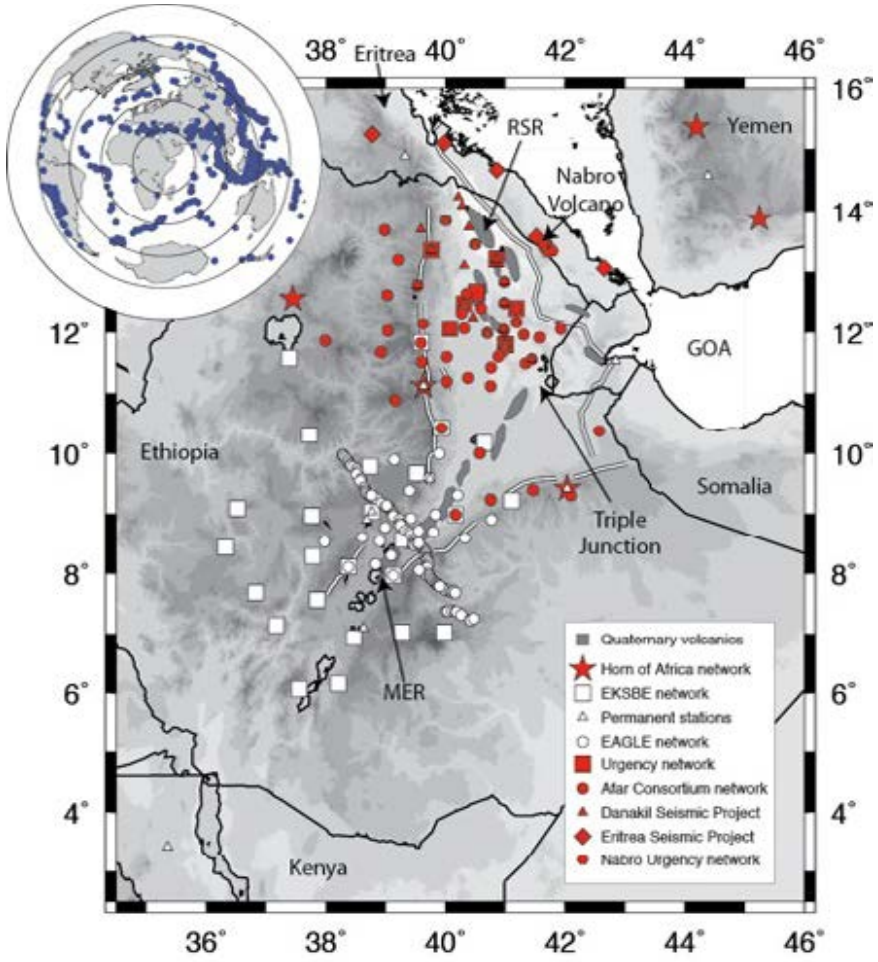
High VpVs in the lower crust



Hammond et al., 2011, G-cubed



The locus of melt production



Hammond et al., in review, Geology

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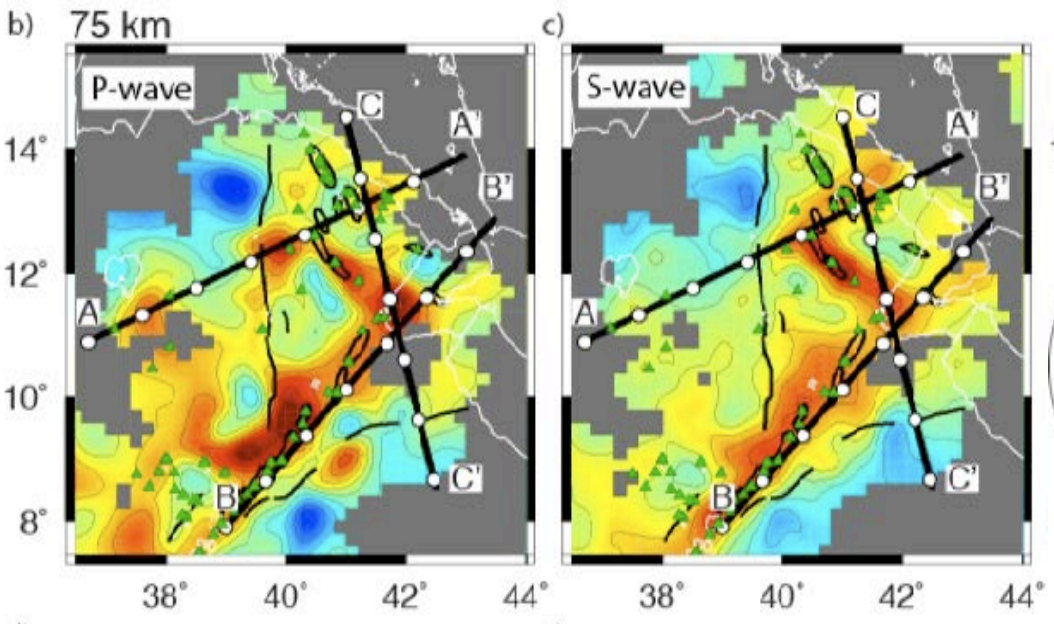

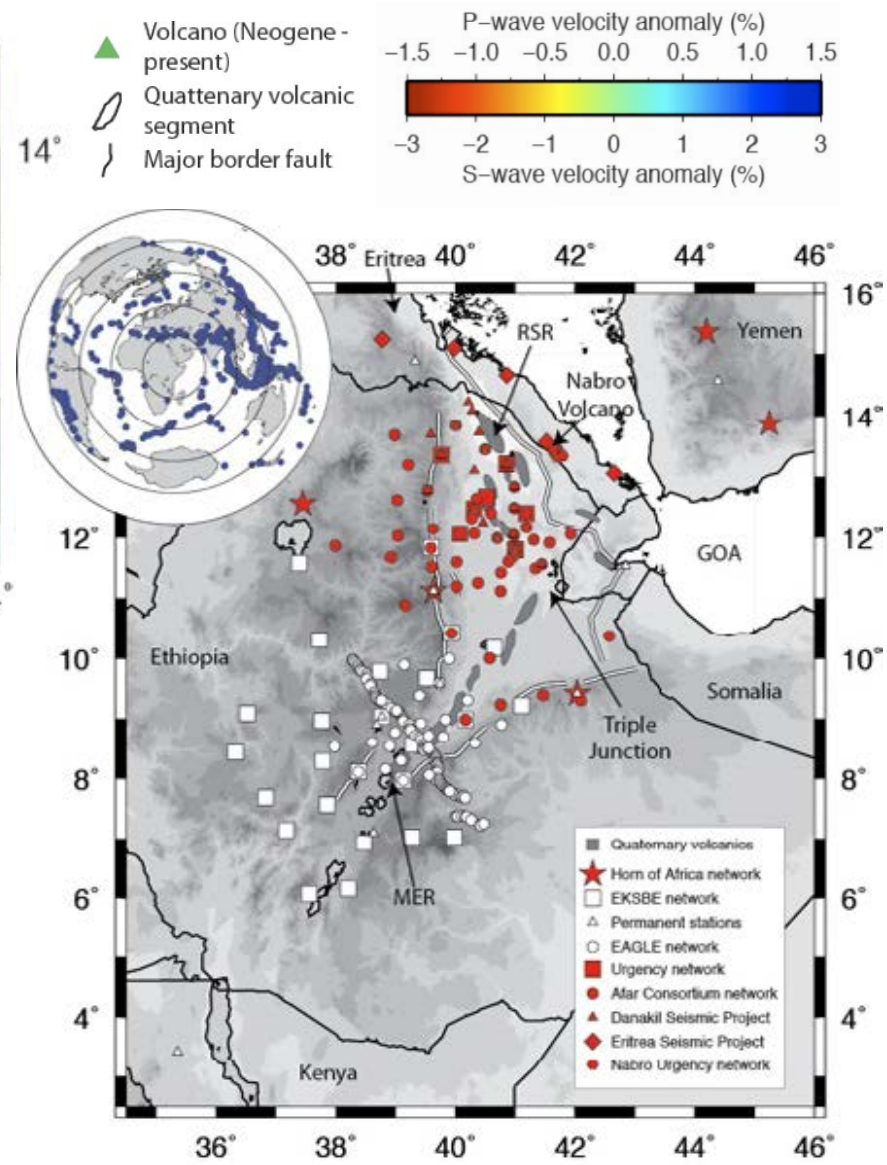

Hammond et al., in review, Geology

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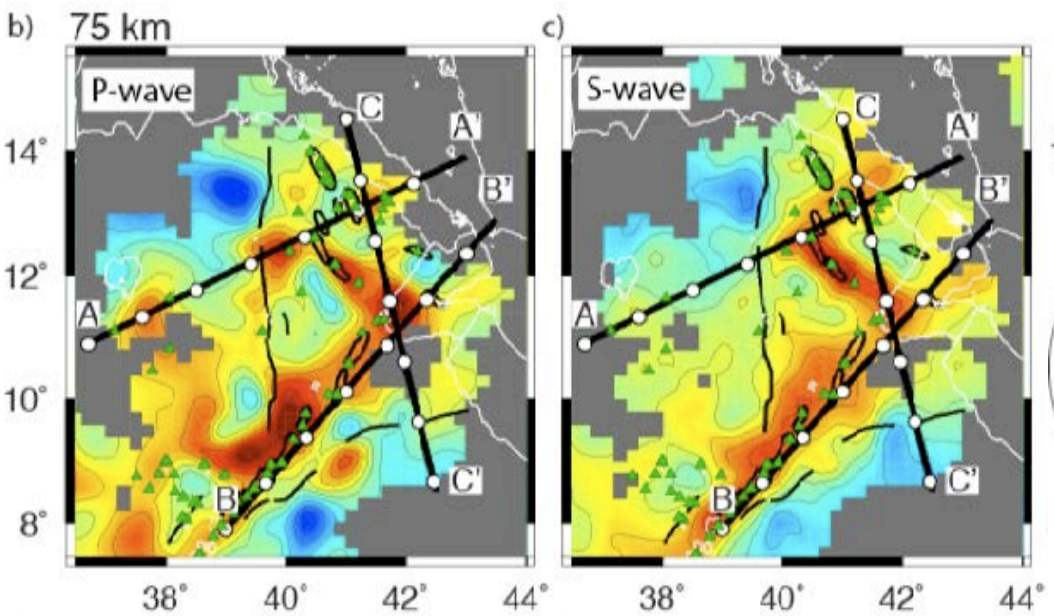
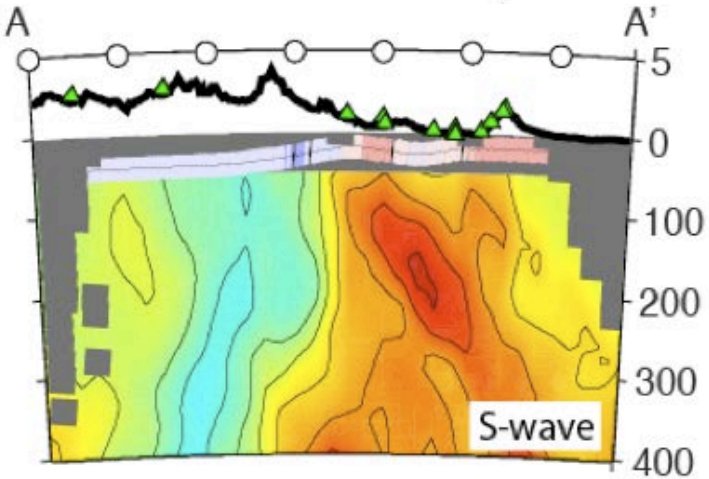
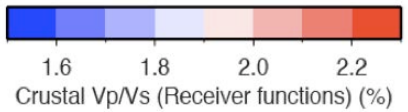
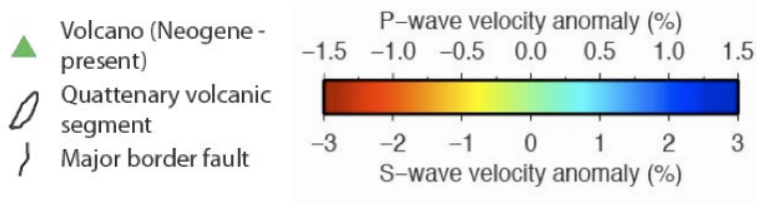
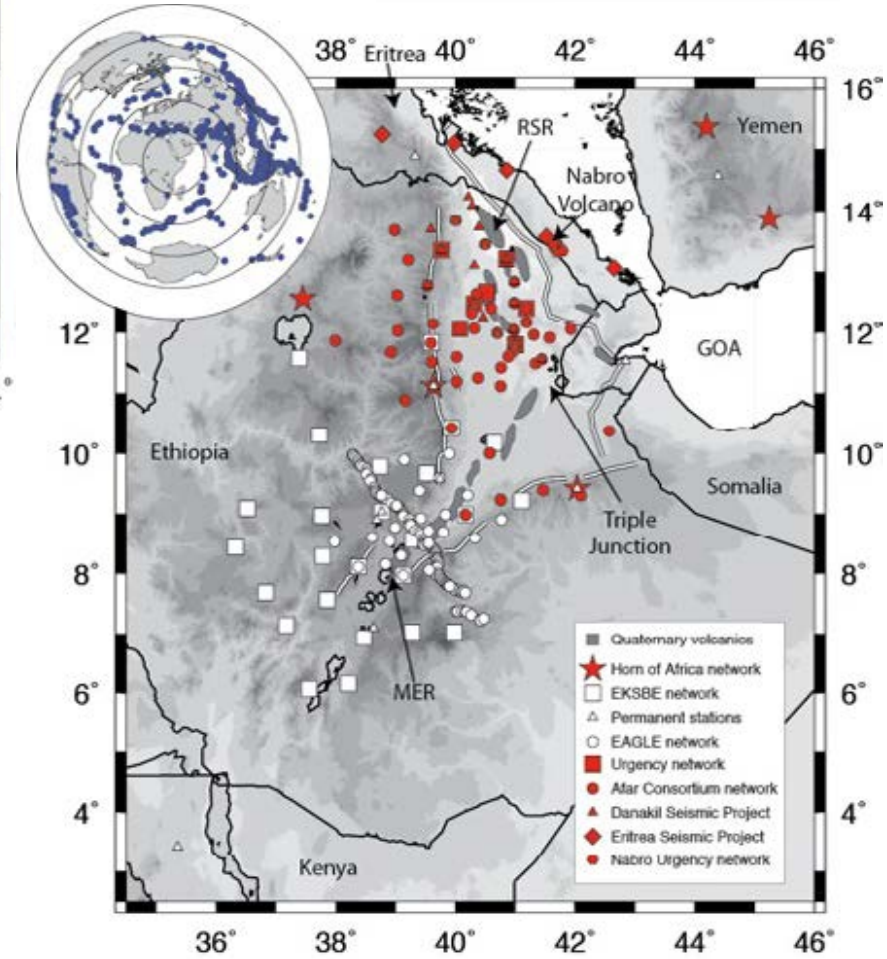




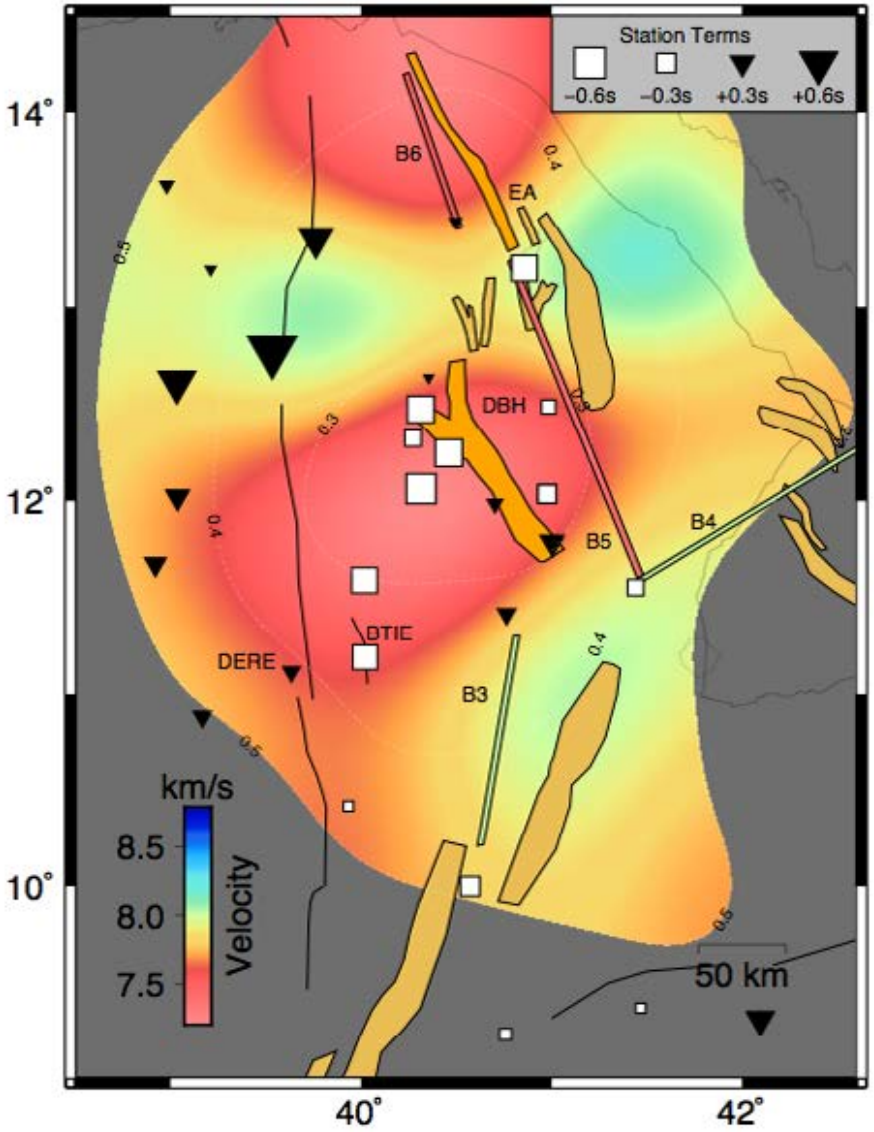






Hammond et al., in review, Geology

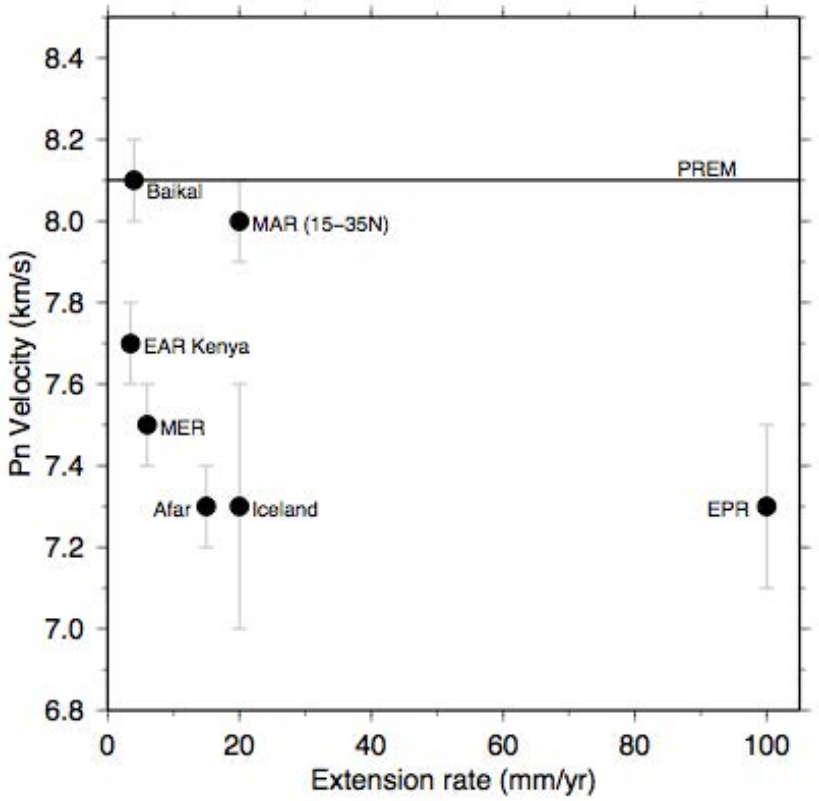
Magma transport and storage through the lithosphere



Stork et al., in review, GJI

Pn velocity - refracted waves below the Moho

Slow Pn in Afar

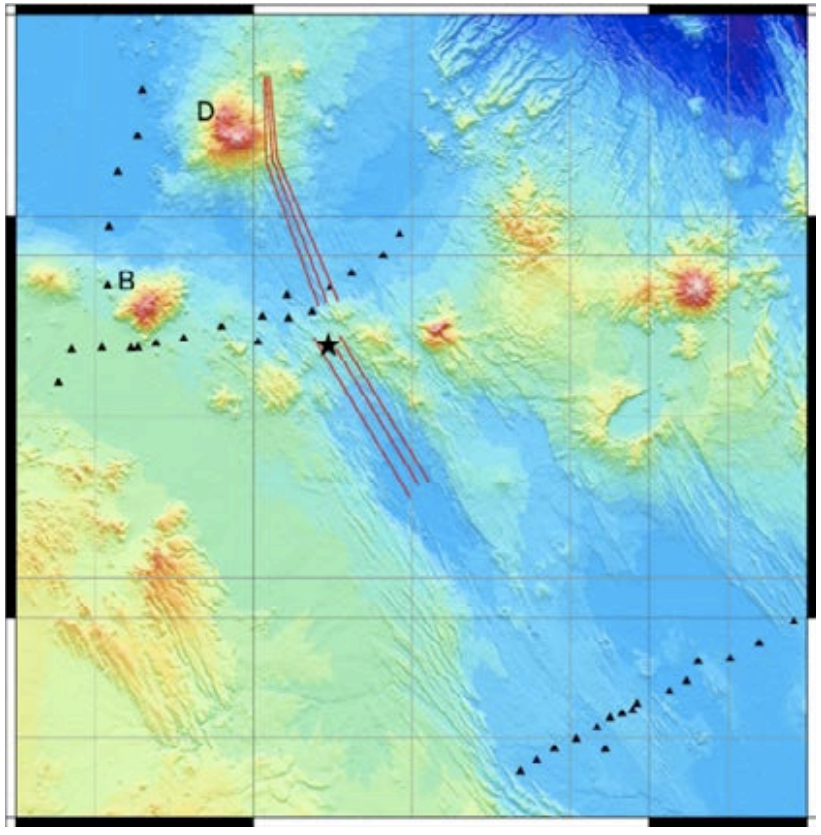


Keir et al., in press, Tectonophysics

Magma transport and storage through the lithosphere

Connected pockets of partial melt are highly conductive

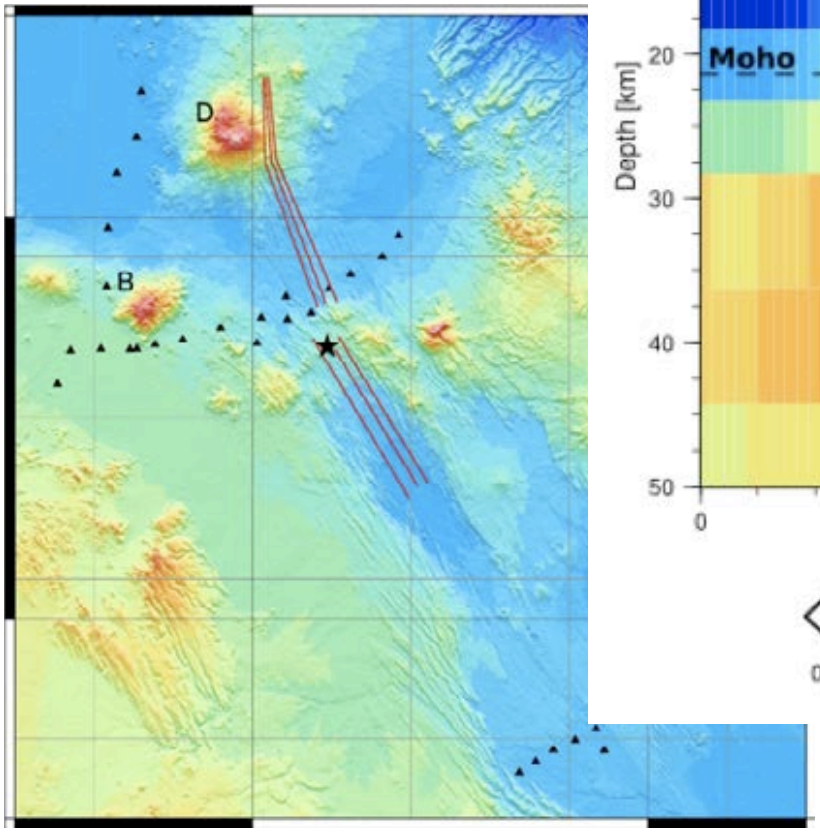
Magnetotelluric surveys across the Dabbahu segment and Tendaho Graben

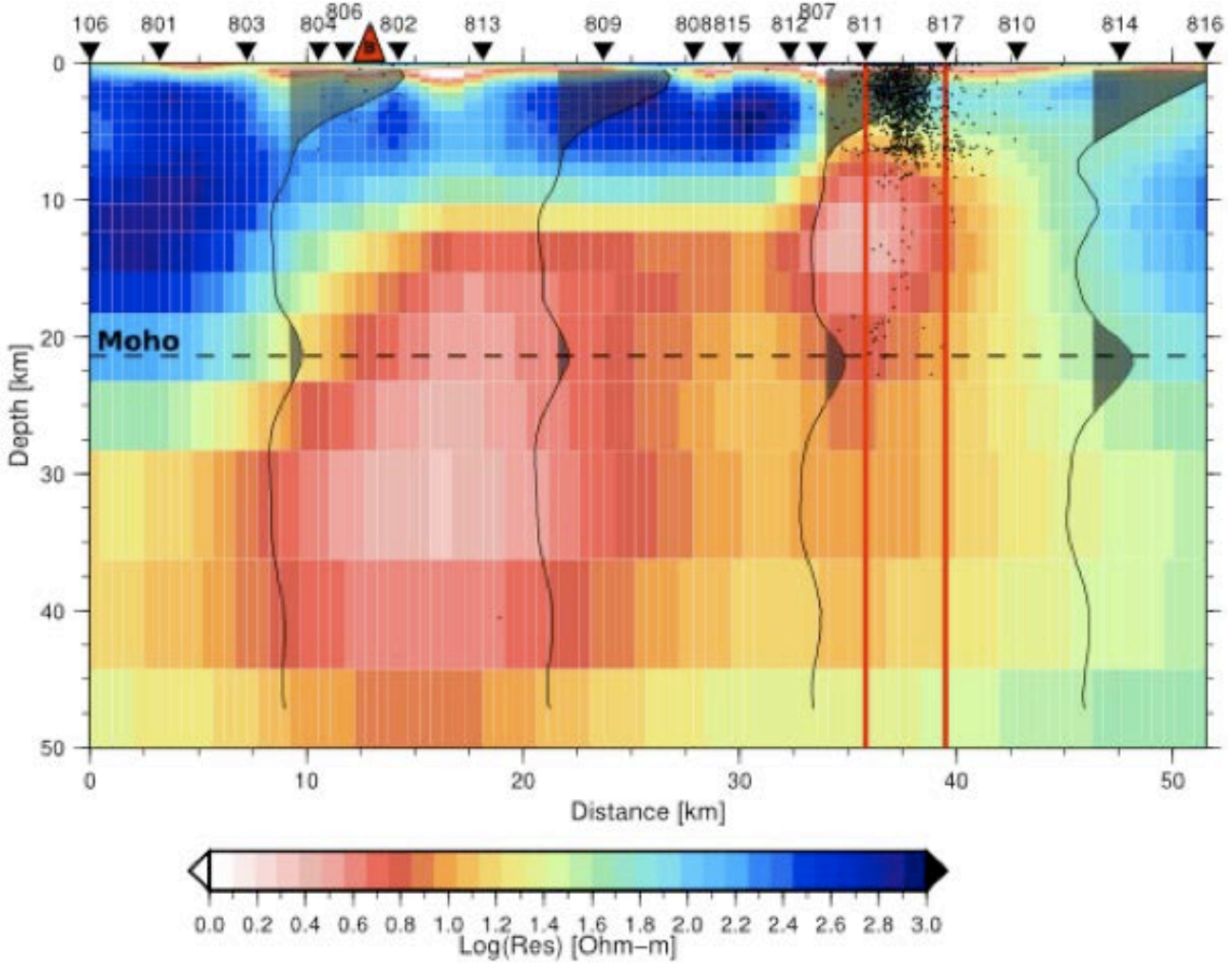


Desissa et al., in review, Nature Geoscience

Magma transport and storage through the lithosphere

Dabbahu segment



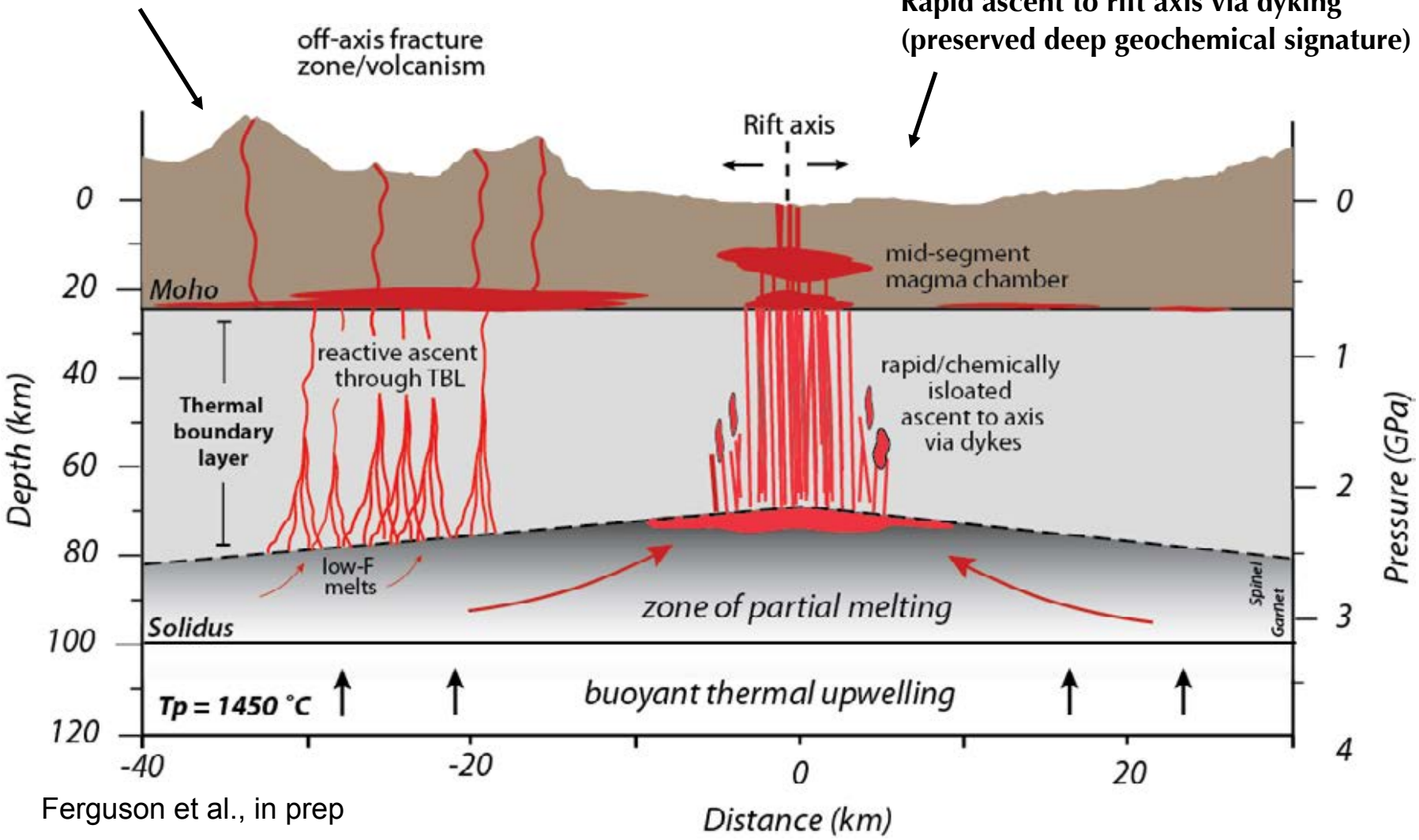


Desissa et al., in review, Nature Geoscience

Melt generation and ascent model

Diffuse melt transport on rift margin – melt-rock reaction during ascent

Rapid ascent to rift axis via dyking (preserved deep geochemical signature)



Ferguson et al., in prep