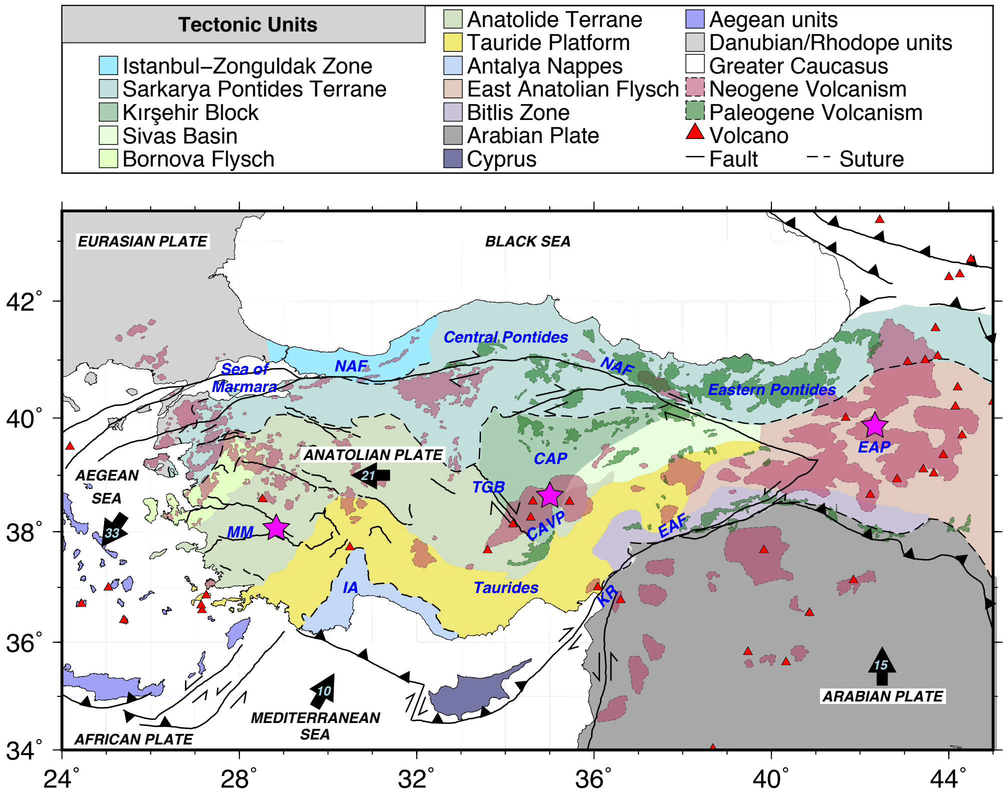
Anatolian Plateau Uplift Mantle Flow: Evidence From Broadband Seismology

✦ Central & Eastern Anatolian plateau high elevation: maintained isostatically, or do other processes (e.g., dripping & slab break-off) also play a role?

✦ Mantle flow field below Anatolia often considered relatively simple. But is it?

- A new Moho depth map for Anatolia.
- Insight from seismic anisotropy & mantle tomography.



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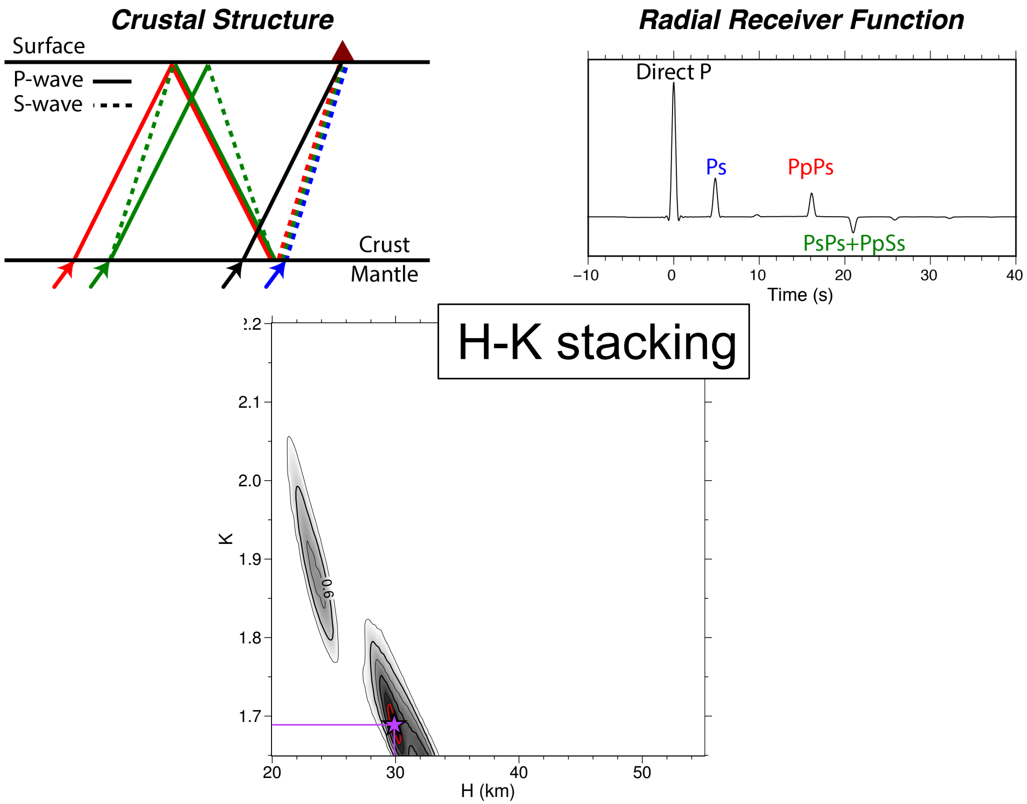
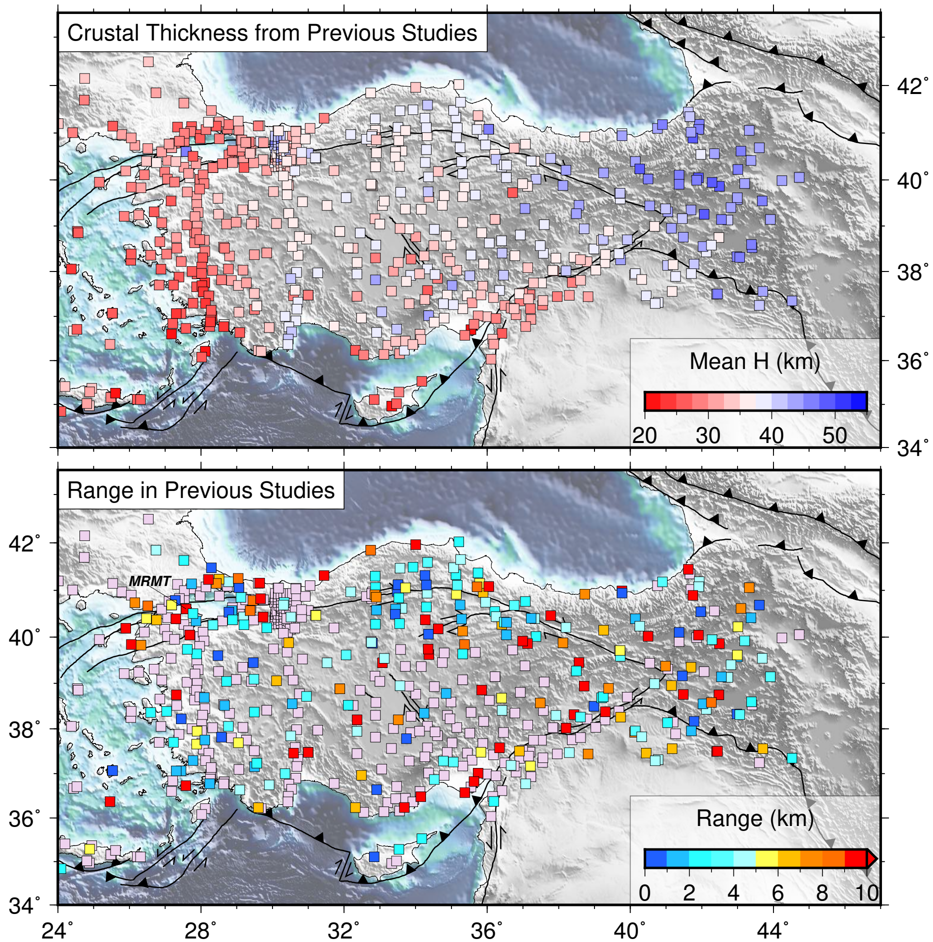
Previous H-κ stacking in Anatolia



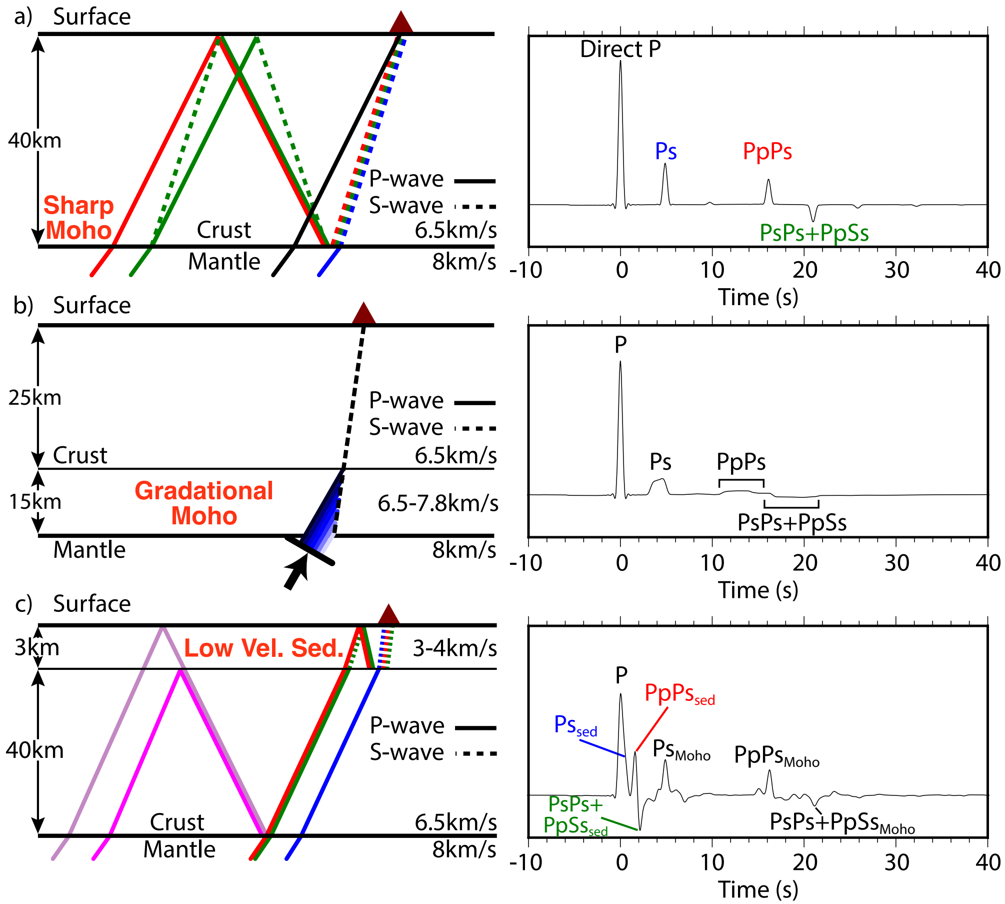


✦ Previous receiver function studies of Anatolian crustal structure find Moho depths increase west to east.

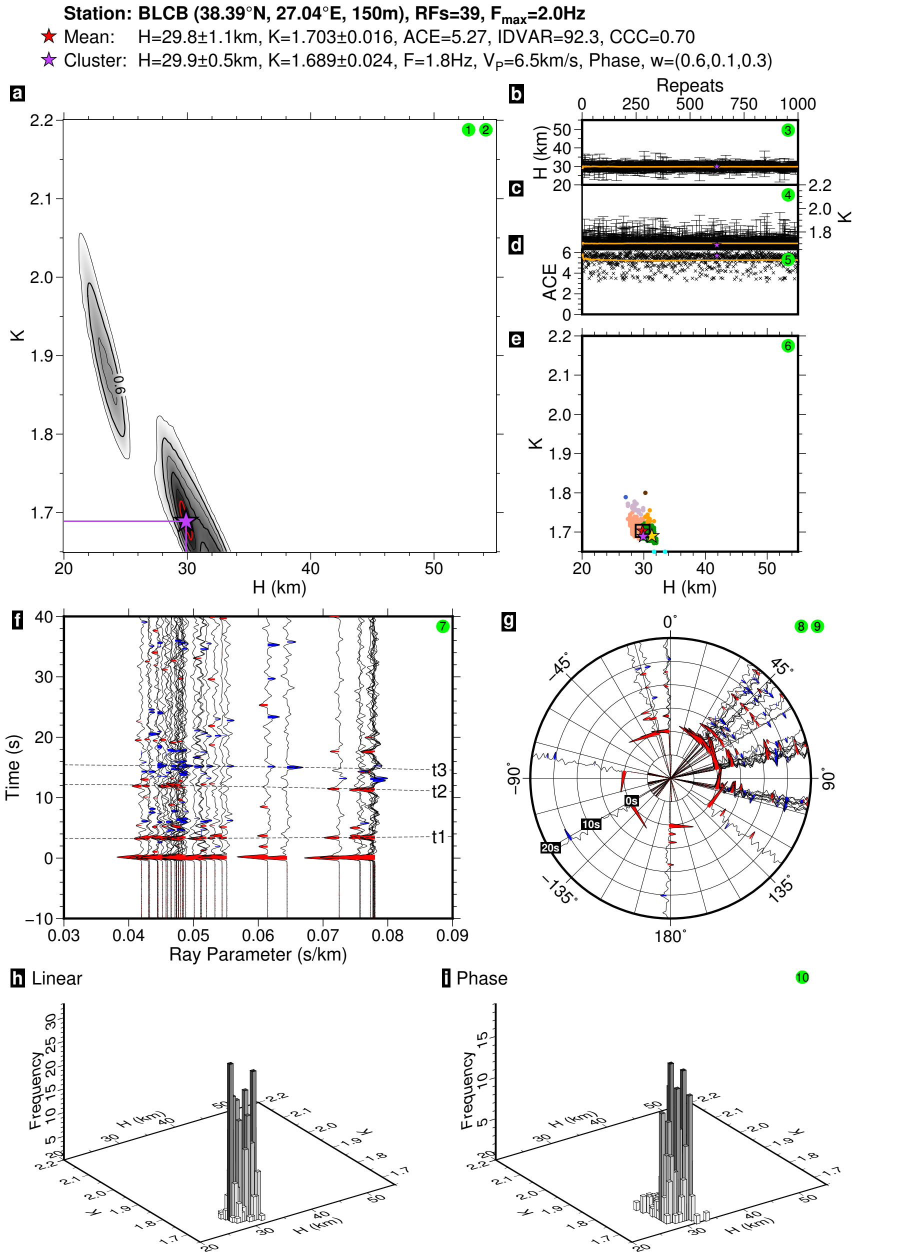
✦ However…..big discrepancies exist (sometimes >10km) between studies.

Ogden et al., (*GJI*, 2021)

A new H−κ Strategy & Application to Anatolia



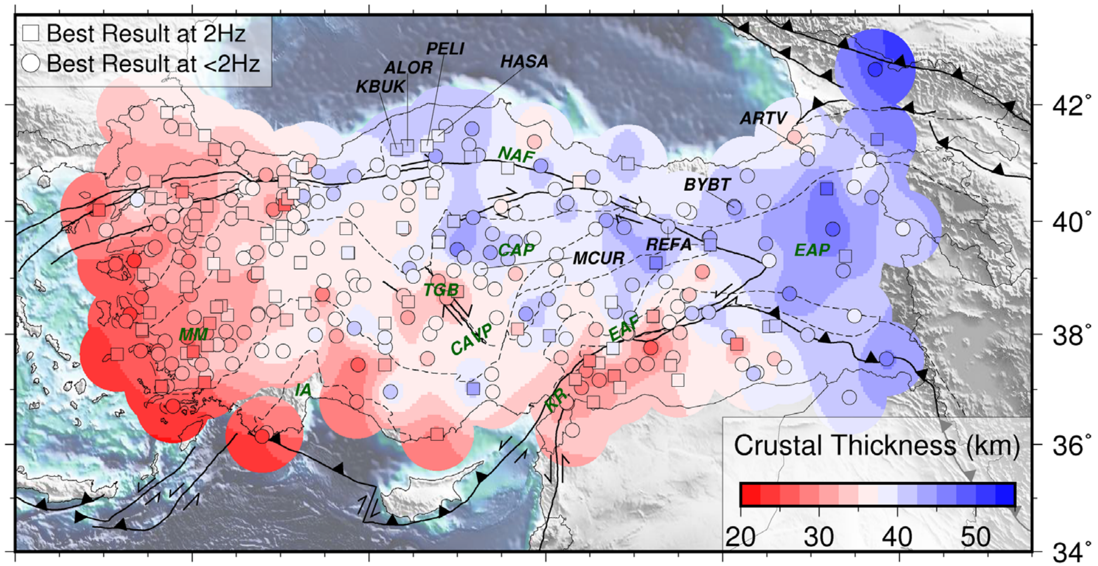
Ogden et al., (*GJI*, 2019)



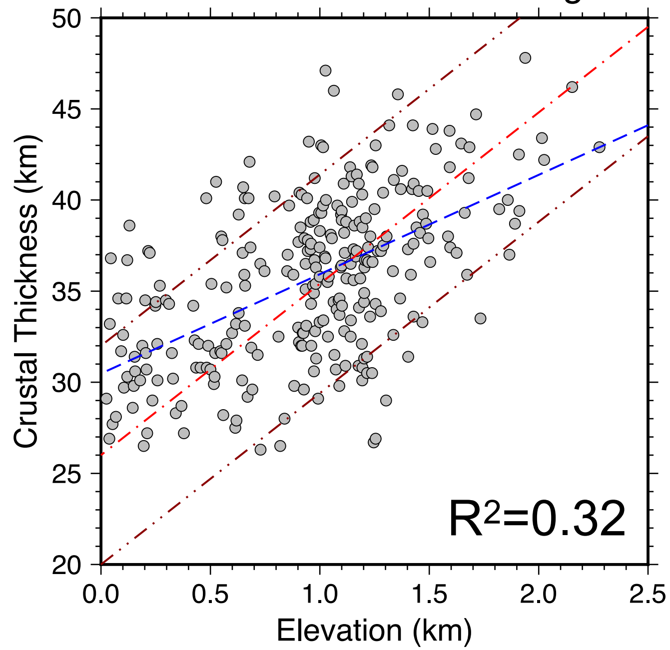
Ogden et al., (*GJI*, 2021)

A New Crustal Model for Anatolia (ANATOLIA-HK21)

- ✦ Moho depths constrained at 582 stations, including 100 for which H−κ stacking results have never before been presented.
- ✦ 182 previously-analysed stations abandoned for H−κ stacking.
- ✦ Crust ~45 km below uplifted Eastern Anatolian Plateau; ~25 km below western Anatolia.
- ✦ But… changes sometimes occur on quite short length-scales.
- ✦ Moho depth correlates poorly with elevation.



Ogden et al., (*GJI*, 2021)



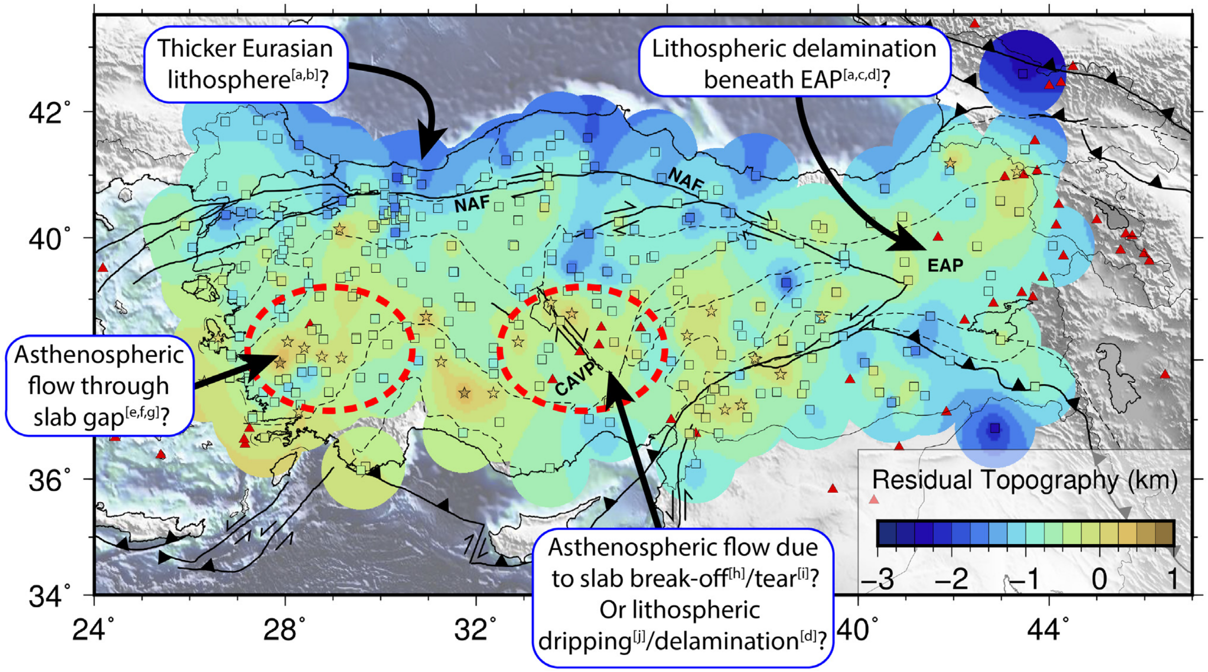
Residual topography (ϵ_{res})

Observed elevation

$$Residual\ Topography,\ \epsilon_{res} = \epsilon - (H_c - H_o)$$

e.g., Gvirtzman et al. (2016)

Elevation expected from crustal buoyancy alone



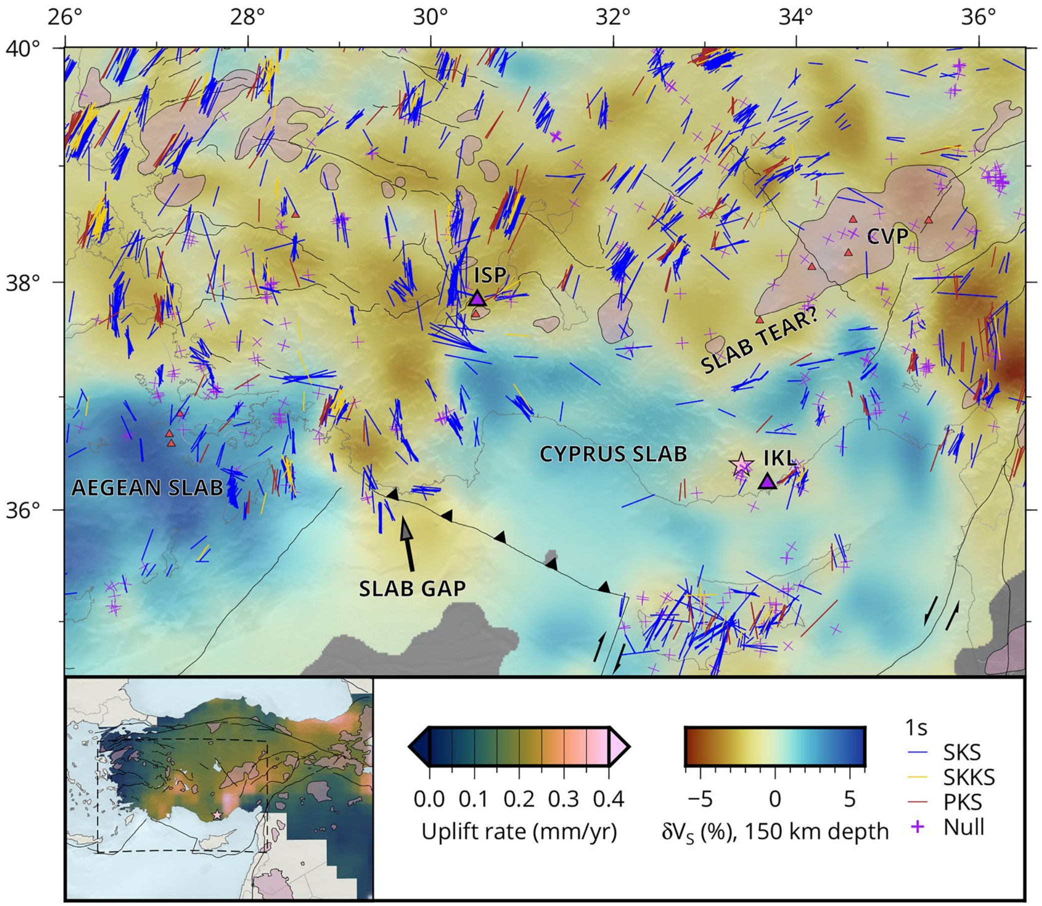
Ogden et al., (*GJI*, 2021)

✦ Residual topography calculations confirm the requirement for a mantle contribution to plateau uplift.

✦ Localized asthenospheric upwellings in response to slab break-off and/or lithospheric dripping/ delamination example candidate driving mechanisms.

a: Kounoudis et al. (2020), **b**: Portner et al. (2018), **c**: Göğüş & Pysklywec (2008), **d**: Bartol & Govers (2014), **e**: Paul et al. (2014), **f**: Merry et al. (2021), **g**: Confal et al. (2018), **h**: Schildgen et al. (2014), **i**: Confal et al. (2020), **j**: Göğüş et al. (2017).

Supporting Evidence From Mantle Tomography & SKS Splitting



Mantle wave speeds from Kounoudis et al., (G3, 2020)
Shear wave splitting data from Merry et a.., (G3, 2021)

- ✦ Anisotropy consistent with asthenospheric flow through slab gaps, and driven by Hellenic trench retreat.
- ✦ Evidence for westward mantle flow driving Anatolian plate motion is lacking.
- ✦ Small δt/nulls in central Anatolia suggest vertical mantle flow patterns (e.g., lithospheric dripping/asthenospheric upwelling).
- ✦ Lithospheric anisotropy beneath the North Anatolian Fault is consistent with a mantle shear zone deforming coherently with the surface.

References

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1. Kounoudis, R, Bastow, I, Ogden, C, Goes, S, Jenkins, J, Grant, B & Braham, C. Seismic Tomographic Imaging of the Eastern Mediterranean Mantle: Implications for Terminal-Stage Subduction, the Uplift of Anatolia, and the Development of the North Anatolian Fault. *Geochem. Geophys. Geosyst.* doi:10.1029/2020GC009009 (2020).

2. Merry, T, Bastow, I, Kounoudis, R, Ogden, C, Bell, R & Jones, L. The influence of the North Anatolian Fault and a fragmenting slab architecture on upper mantle seismic anisotropy in the eastern Mediterranean. *Geochem. Geophys. Geosyst.* doi:10.1029/2021GC009896 (2021).

3. Ogden, C, Bastow, I, Gilligan, A & Rondenay, S. A Reappraisal of the H-κ Stacking Technique: Implications for Global Crustal Structure. *Geophys. J. Int.* **219,** 1491–1513. doi:10.1093/gji/ggz364 (2019).

4. Ogden, C & Bastow, I. The crustal structure of the Anatolian Plate from receiver functions and implications for the uplift of the Central and Eastern Anatolian Plateaus. *Geophys. J. Int.* **229.** doi:10.1093/gji/ggab513 (2022).