EGU22-13052
https://doi.org/10.5194/egusphere-egu22-13052
EGU General Assembly 2022

Connecting subduction, extension, and shear localization across the Aegean Sea and Anatolia

Sylvain Barbot[1] and Jonathan Weiss[2]
[1]University of Southern California
[2]University of Potsdam

The Eastern Mediterranean is the most seismically active region in Europe due to the complex interactions of the Arabian, African, and Eurasian tectonic plates. Deformation is achieved by faulting in the brittle crust, distributed flow in the viscoelastic lower-crust and mantle, and Hellenic subduction, but the long-term partitioning of these mechanisms is still unknown. We exploit an extensive suite of geodetic observations to build a kinematic model connecting strike-slip deformation, extension, subduction, and shear localization across Anatolia and the Aegean Sea by mapping the distribution of slip and strain accumulation on major active geologic structures. We find that tectonic escape is facilitated by a plate-boundary-like, trans-lithospheric shear zone extending from the Gulf of Evia to the Turkish-Iranian Plateau that underlies the surface trace of the North Anatolian Fault. Additional deformation in Anatolia is taken up by a series of smaller-scale conjugate shear zones that reach the upper mantle, the largest of which is located beneath the East Anatolian Fault. Rapid north-south extension in the western part of the system, driven primarily by Hellenic Trench retreat, is accommodated by rotation and broadening of the North Anatolian mantle shear zone from the Sea of Marmara across the north Aegean Sea, and by a system of distributed transform faults and rifts, including the rapidly extending Gulf of Corinth in central Greece and the active grabens of western Turkey. Africa-Eurasia convergence along the Hellenic Arc occurs at a median rate of 49.8 mm/yr in a largely trench-normal direction, except near eastern Crete where variably-oriented slip on the megathrust coincides with mixed-mode and strike-slip deformation in the overlying accretionary wedge near the Ptolemy-Pliny-Strabo trenches. Our kinematic model illustrates the competing roles the North Anatolian mantle shear zone, Hellenic Trench, overlying mantle wedge, and active crustal faults play in accommodating tectonic indentation, slab rollback, and associated Aegean extension. Viscoelastic flow in the lower crust and upper mantle dominate the surface velocity field across much of Anatolia and a clear transition to megathrust-related slab pull occurs in western Turkey, the Aegean Sea, and Greece. Crustal scale faults and the Hellenic wedge contribute only a minor amount to the large-scale, regional pattern of Eastern Mediterranean interseismic surface deformation.