Deep lithospheric controls on the formation and evolution of the East Anatolian Fault Zone and Anatolia-Arabia-Africa Triple Junction

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The North and East Anatolian Fault Zones represent plate-bounding transform faults that enable the westward tectonic escape of the Anatolian Plate away from the Arabian-Eurasian collisional zone. These fault zones are both capable of hosting large (Mw > 7) seismic events, as most recently demonstrated by the extremely damaging February 2023 Kahramanmaraş earthquake sequence. This earthquake sequence highlighted that plate boundary forces in this area are distributed over a very broad region, however what controls the location, distribution, and character of this plate-bounding strike-slip system remains enigmatic. To better understand potential contributions to deformation, we compare seismic images of the lithosphere (e.g., crustal and lithospheric mantle thickness and velocity) to deformational features and seismicity near the EAFZ, as well as further west where it joins with the Anatolia-Arabia-Africa (A³) triple junction along the southeastern margin of the Anatolian escape system. We interpret that although controls on surface deformation are commonly linked to stress in the brittle upper crust, the complex deformation and seismicity patterns in this region are likely related to variations in the location and extent of the strong lithospheric mantle of the Arabian plate, which currently underthrusts Anatolia as far north as the Sürgü-Çardak fault zone (~50 km). In addition, the Arabian lithospheric mantle extends at least as far west as at least the central Adana Basin, coincident with a zone of relatively deep (>30 km) strike-slip seismogenesis that has produced Mw > 6 earthquakes. By investigating the relationship between recent geological deformation since the inception of the East Anatolian Fault (ca. 5 Ma) and the modern record of seismic structure and seismicity, we infer that the Sürgü-Çardak fault zone and its associated near-orthogonal bend reaching into the Adana Basin will be the future southeastern boundary of the Anatolian Plate escape tectonic system.