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Investigating the relationship between asthenospheric upwelling, volcanism and uplift across Anatolia

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The topography of Anatolia is dominated by low-relief plateaux at elevations of 1-2 km. Elevated Neogene marine sediments demonstrate that significant uplift has occurred across Anatolia between ∼20 Ma and the present day. Inverse modelling of river profiles implies that uplift began in Eastern Anatolia before propagating westwards. Coeval with uplift, abundant Neogene magmatism has occurred throughout Anatolia. Asthenospheric processes have been invoked to explain both magmatism and uplift, either through active upwelling of anomalously hot material or as a passive response to slab fragmentation or delamination. The geochemical compositions of basaltic lavas reflect the conditions and compositions in which they are generated. To discern the relative contributions of potential mechanisms for generating magmatism and uplift we have compiled an extensive database of Neogene basaltic lavas. Analysis of whole-rock and isotope geochemistry reveals a pronounced transition from subduction-derived to intraplate-style magmatism at ∼10 Ma in Western Anatolia. Such a transition is not evident in Central or Eastern Anatolia. After isolating high-MgO, un-enriched basaltic samples, we utilise two independent techniques to estimate asthenospheric mantle potential temperatures across Anatolia. Our results suggest that magmatism is largely generated by adiabatic decompression of upwelling asthenospheric material. Melting occurs at depths as shallow as 60 km in the presence of potential temperatures as high as 1400 oC. We observe a westward-decreasing gradient in potential temperature, with temperatures approximately those of ambient mantle beneath Western Anatolia. This temperature gradient is also observed in a range of tomographic models as a decrease in wave speed from East to West. Consistent patterns linking the timing and magnitude of uplift, magmatism and asthenospheric potential temperatures suggest that a principle control on the evolution of Central and Eastern Anatolian topography throughout Neogene times has been the propagation of sub-plate thermal anomalies. For Western Anatolia, our results are consistent with passive upwelling through an inferred slab-tear, generating a more modest topographic response.