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Cenozoic Tectonics and Magmatic Evolution of Central Anatolia (Turkey): From Collision to Slab Breakoff to Delamination

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The latest Mesozoic-Cenozoic tectonic evolution of Central Anatolia was controlled largely by the behavior of the subducting lithosphere of the Inner-Tauride Ocean and the mantle response to it. Following the demise of the Inner-Tauride oceanic lithosphere at a NE-dipping subduction zone and the emplacement of the late Cretaceous, incipient arc-forearc ophiolites onto the northern edge of the Tauride ribbon continent, subduction was arrested by the underplating of the buoyant Tauride continental crust. The leading edge of the subducted Tethyan slab broke off from the rest of the Tauride continental lithosphere, resulting in the development of an asthenospheric window. The juxtaposition of this asthenospheric heat source against the overlying continental lithosphere caused melting of the metasomatized mantle layers, producing the high-K shoshonitic magmas of the latest Cretaceous monzonitic plutons and then the more-enriched alkaline magmas of the syenitic plutons in the Central Anatolian Crystalline Complex (CACC). Continued convergence between the Tauride and CACC blocks resulted in a continental collision in the Paleocene that led to deformation, crustal thickening, and metamorphism in the hinterland, and to southward transport of the already-emplaced Tauride ophiolites and mélanges and flysch formation together with fold and thrust belt development in the foreland. Significant crustal thickening and development of a dense mafic lower crust beneath the young orogenic belt resulted in foundering of the orogenic root and eventually in partial delamination of the thickened lithosphere. Asthenospheric upwelling around and above the delaminated root provided excess heat and enhanced geothermal gradient that triggered partial melting of the hydrated lithospheric mantle and mafic lower crustal rocks. This melting event produced the high-Al adakitic magmas of the Horoz granitoid (55 Ma) and other similar plutons along the northern edge of the Tauride micro-continent. Asthenospheric upwelling beneath the young orogenic belt thermally weakened the crust, and caused uplift and tectonic extension leading to core complex formation (Nigde massif), development of an extensional volcanic province (Cappadocia), and initial surface uplift followed by tectonic collapse of the Central Tauride block (Bolkar Mountains) by the early Neogene. The Cappadocian volcanic province developed within a fault-controlled, broad topographic depression during the middle to late Miocene. The early and intermediate stages of volcanism in Cappadocia (13.5-2.7 Ma) are mainly characterized by the eruption of widespread ignimbrite and felsic lavas accompanied by high-K dacitic and andesitic flows. Intrusion of domes and plugs dominated the magmatic output during these stages which was contemporaneous with the extensional deformation and crustal exhumation in and across Central Anatolia. The bimodal nature of volcanism with increasing amounts of alkaline basaltic (OIB-like) lava eruption during this phase suggests the involvement of the asthenospheric mantle in melt generation in response to further lithospheric extension and thinning.