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The evolution of bimodal volcanism in NW Anatolia (Turkey): Petrologic and geodynamic implications for the origin of compositional gaps in calc-alkaline and shoshonitic lavas.

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The Aegean province is a site of nearly continuous magmatism since the Early Eocene although the tectonic settings and melt sources of this widespread magmatism appear to have varied through time. NW Anatolia (Turkey) is part of the Aegean extensional province, which is one of the most seismically active and rapidly deforming domains of the Alpine-Himalayan mountain belt. The geological record of the Cenozoic magmatic events in the Aegean province is almost complete in western Anatolia, where both the modern landscape and the surface rocks are predominantly volcanic.Neogene young magmatism in NW Anatolia is associated commonly with NNE-SSW-trending lines of vents and/or fault systems that were also bounding local lacustrine depocenters. Magmatism evolved from all association of medium to high-K calc-alkaline, to shoshonitic to mildly alkaline and alkaline series. The early magmatic pulse in the region is represented by the Oligo-Miocene granitoid plutons and volcanic units . Volcanic rocks of this stage is characterized by medium to high-K calc-alkaline andesite, dacite to rhyolite that are overlain by ignimbrite flows, pumiceous air-fall and ash fall deposits that are intercalated with Lower to Middle Miocene lacustrine rocks and coal seams in NW Anatolia. Following this stage of volcanism, compositionally bimodal volcanism occurred by fissure eruptions and formed small cones in the wide area. The change from large-volume outpourings of intermediate magma to small-volume bimodal volcanism started in the the Early Miocene in the north and Middle Miocene in the south. Basic parental magmas of Early Miocene volcanism were produced from sources related to EM1-type mantle previously modified by subduction, whereas silicic rocks were probably produced through fractional crystallization implying the compositional gap between CA basalt and rhyolite has been generated by fractional crystallization. Assimilation of silicic crust has also occurred along with fractionation. Significant crustal component was recognized only in some slightly peraluminous granites and rhyolites with low contents of HFS elements in the south.

The younger (Early-Middle Miocene) bimodal volcanism belongs to shoshonitic-mildly alkaline series is represented by transitional basalts, basaltic trachy-andesites and trachytes-phonolites-rhyolites. The ensuing Middle Miocene volcanism produced mildly alkaline lavas that are spatially associated with NNE-trending transtensional fault systems. The Early and Middle Miocene bimodal basic-acid volcanism presents a transitional chemical affinity from calc-alkaline collision related affinity to within plate alkaline series. Sr-Nd isotope data suggest that coexisting mafic and felsic magmas derived from lithospheric mantle source yielding depleted but LILE-enriched compositions, with subsequent contamination. The inferred crustal contamination appears to have been diminished by the Middle Miocene, while the asthenospheric mantle source became more dominant. These findings, combined with the bimodal character of the post-collisional volcanism in the study area, suggest that the geochemical changes in the nature of volcanism from calcalkaline to alkaline through time may have been caused by lithospheric delamination and/or partial convective removal of the subcontinental lithospheric mantle beneath western Anatolia.

The geochemical and temporal evolution of Cenozoic magmatism in Western Anatolia clearly shows how the plate tectonic events and the mantle dynamics can be closely in tune with each other during the evolution of orogenic belts. The mantle responds to delamination, and lithospheric tearing swiftly within geological time slices, resulting in whole-scale extension and accompanying magmatism and thereby in the collapse of tectonically and magmatically weakened orogenic crust. The change from large-volume outpourings of intemediate magma to small-volume bimodal volcanism is similar to volcanism occurred in East central Nevada (USA), Carpathian region where magmatism and extension associated in space and time.