Petrogenesis of the Upper Cretaceous volcanism in the Kefken region, Western Pontides, NW Turkey

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The Upper Cretaceous volcanic and volcanoclastic rocks crop out along the Black Sea coastline in Turkey. They are part of a magmatic arc that formed as a result of northward subduction of the Tethys ocean beneath the southern margin of Laurasia. The lower part of the Upper Cretaceous volcanism in the Kefken region, 100 km northeast of Istanbul, is represented by basaltic andesites, andesites, agglomerates and tuffs, which have yielded Late Cretaceous (Campanian, ca. 83 Ma) U-Pb zircon ages. The volcanic and volcanoclastic rocks are stratigraphically overlain by shallow to deep marine limestones, which range in age from Late Campanian to Early Eocene. Geochemically, basaltic andesites and andesites display negative anomalies in Nb, Ta and Ti, enrichment in large ion lithophile elements (LILE) relative to high field strength elements (HFSE). Light rare earth elements (LREE) show slightly enrichment relative to heavy rare earth elements (La$_{cn}$/Yb$_{cn}$ =2.51-3.63) and there are slight negative Eu anomalies (Eu/Eu* = 0.71-0.95) in basaltic andesite and andesite samples. The geochemical data indicate that Campanian volcanic rocks were derived from the partial melting of the mantle wedge induced by hydrous fluids released by dehydration of the subducted oceanic slab.

There is also a horizon of volcanic rocks, about 230 m thick, within the Late Campanian-Early Eocene limestone sequence. This volcanic horizon, which consists of pillow basalts, porphyritic basalts, andesites and dacites, is of Maastrichtian age based on paleontological data from the intra-pillow sediments and U-Pb zircon ages from the andesites and dacites (72-68 Ma). The Maastrichtian andesites and dacites are geochemically distinct from the Campanian volcanic rocks. They show distinct adakite-like geochemical signatures with high ratios of Sr/Y (>85.5), high La$_{cn}$/Yb$_{cn}$ (16.4-23.7) ratios, low content of Y (7.4-8.6 ppm) and low content of heavy rare-earth elements (HREE). The adakitic rocks most probably formed as a result of partial melting of the subducting oceanic slab under garnet and amphibole stable conditions.

The Upper Cretaceous arc sequence in the Kefken region shows a change from typical subduction-related magmas to adakitic ones, accompanied by decrease in the volcanism.