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Geochemistry and petrology of Late Cretaceous subvolcanic rocks (Macka-Trabzon) in the north of the eastern Black Sea region, NE-Turkey

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In this study, geochronological, geochemical and isotopical data for the early Campanian subvolcanic rocks (Macka-Trabzon) in the north of the eastern Blacksea region, northeastern Turkey, have initially been presented with the aim of determining its magma source and geodynamic evolution. The subvolcanic rocks cutting the subduction-related Late Cretaceous volcano-sedimantary rocks in the region are characterized by several sills and dykes with columnar structures and they consist of amphibole-rich quartz-diorite and quartz-tonalite porphyries, with some dioritic mafic microgranular enclaves.

The host rocks have a microgranular porphyritic texture, and they contain 15-25% phenocryst of plagioclase and amphibole and have a matrix that is composed primarily of fine-grained quartz, orthoclase, and plagioclase. Accessory apatite, zircon and Fe-Ti oxides are present in all of the rocks. Secondary minerals such as epidote, calcite, sericite and clays are sometimes observed in the matrix or as hydothermal alteration products of some amphibole and plagioclase phenocrysts. When compared to the host rocks, the magmatic enclaves without quartz are fine-grained, and they contain higher ferromagnesian phases and lower feldspar minerals.

Ar-Ar geochronology studies on the amphibole separates reveal that the porphyries have a crystallization ages of 81$\pm$0.5 Ma. All samples show a high-K calc-alkaline differentiation trend and I-type features with metaluminous character. The rocks and magmatic enclaves are characterized by enrichment of LILE and depletion of HFSE with negative Nb, Ti, Zr and P anomalies. The chondrite-normalized REE patterns are not fractionated [(La/Yb)N = 9-11] and do not display Eu anomalies (Eu/Eu* = 0.7-0.9).

The porphyritic rocks and their enclaves are almost isotopically similar. Sr–Nd isotopic data for all of the samples display initial Sr = 0.7085–0.7087, epsilon Nd (81 Ma) = -6.0 to -6.9, with TDM = 1.38–1.63 Ga. The lead isotopic ratios are (206Pb/204Pb) = 18.61–18.69, (207Pb/204Pb) = 15.66–15.69 and (208Pb/204Pb) = 38.78–38.90. The geochemical results and the Ar–Ar crystallization age, combined with regional studies, suggest mixed-origin magma generation in a subduction setting. The beginning of subducting of Neotethys oceanic crust beneath the eastern Black Sea region in Late Cretaceous could account for the subduction-related volcanism. With ongoing subduction, the slab-derived fluids added to mantle component cause partial melting of the subcontinental lithospheric mantle, which induced underplated mafic melt, and this results in partial fusion of the lower part of the crust in the region. Thus, two magma mixed to generate hybrid magma in an extensional arc environment at least early Campanian. Then, the hybrid magma, which subsequently underwent a fractional crystallization and minor crustal assimilation processes, could ascend to shallower crustal levels to generate the quartz-diorite to quartz-tonalite porphyries.