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# Volcanostratigraphy, petrography and petrochemistry of Late Cretaceous volcanic rocks from the Görele area (Giresun, NE Turkey)

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In this study, we have reported for lithological, petrographical and geochemical features of late Cretaceous volcanic rocks from the Çanakçı and the Karabörk areas in the south-eastern part of Görele (Giresun, NE Turkey) in order to investigate their origin and magmatic evolution. Based on the previous ages and recent volcano-stratigraphic studies, the late Cretaceous time in the study area is characterized by an intensive volcanic activity that occurred in two different periods. The first period of the late Cretaceous volcanism (Cenomanian-Santonian; 100-85 My), conformably overlain by Upper Jurassic-Lower Cretaceous massive carbonates (Berdiga Formation), is represented by bimodal units consisting of mainly mafic rock series (basaltic-andesitic lavas and hyaloclastites, dikes and sills) in the lower part (Çatak Formation), and felsic rock series (dacitic lavas and hyaloclastites, crystal- and pyrite-bearing tuffs) in the upper part (Kızılkaya Formation). The second period of the late Cretaceous volcanism (Santonian-Late Campanian; 85-75 Ma) is also represented by bimodal character and again begins with mafic rock suites (basaltic-basaltic andesitic lavas and hyaloclastites) in the lower part (Çağlayan Formation), and grades upward into felsic rock suites (biotite-bearing rhyolitic lavas, ignimbrites and hyaloclastites) through the upper part (Tirebolu Formation). These bimodal units are intercalated with volcanic conglomerates-sandstones, claystones, marl and red pelagic limestones throughout the volcanic sequence, and the felsic rock series have a special important due to hosting of volcanogenic massive sulfide deposits in the region. All volcano-sedimentary units are covered by Tonya Formation (Late Campanian-Paleocene) containing calciturbidites, biomicrites and clayey limestones.

The mafic rocks in the two volcanic periods generally include basalt, basaltic andesite and minor andesite, whereas felsic volcanics of the first period mainly consists of dacite but those of the second period have biotite-bearing rhyolite. The basalts and basaltic andesites exhibit subaphyric to porphyritic texture with phenocrysts of calcic plagioclase and augite in a fine-grained to microcrystalline groundmass, consisting of plag+cpx+mag. Andesite samples display a porphyritic texture with phenocrysts of calcic to sodic plagioclase and augite in a hyalopilitic matrix of plag+cpx$\pm$amph+mag. Zircon and magnetite are common accessory minerals, whereas chlorite, epidote and calcite are typical alteration products. On the other hand, the dacitic and rhyolitic rocks commonly show a porphyritic texture with predominant feldspar, quartz and some biotite phenocrysts. The microgranular to felsophyric groundmass is mainly composed of aphanitic plagioclase, K-feldspar and quartz. Accessory minerals include zircon, apatite and magnetite. Typical alteration minerals include late-formed sericite, albite and clay minerals.

Late Cretaceous mafic and felsic volcanic rocks have a largely sub-alkaline character with typical arc geochemical signatures. N-MORB-normalised multi-element patterns show that all rock samples are enriched in LILEs (e.g. Rb, Ba, Th) but depleted in Nb and Ti. The chondrite-normalized REE patterns are concave shapes with low to medium enrichment, suggesting a common mantle source for the studied bimodal rock series. All geochemical data reflecting typical characteristics of subduction-related magmas are commonly attributed to a depleted mantle source, which has been previously enriched by fluids or sediments.

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