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Geology, Geochemistry and Geochronology of the Upper Cretaceous high-K volcanics in the southern Part of the Eastern Pontides: Implications for Mesozoic Geodynamic Evolution of NE Turkey

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The Eastern Pontide Orogenic Belt is one of the most complex geodynamic settings in the Alpine-Mediterranean region. Its geodynamic evolution is very controversial due to lack of systematic, quantitative structural, geochemical and geochronological data. This belt is divided into three subgroups: northern, southern and axial zones, distinguished from north to south by different lithological units, facies changes and tectonic characteristics. Especially, the southern zone is very attractive with its numerous rock associations such as alaskan-type mafic-ultramafic intrusions, shoshonitic and ultrapotassic volcanics, adakitic magmatics, glaucophane-bearing gabbros, metamorphic and ultramafic massifes. This study focuses on the petrology, geotectonic setting and evidence for subduction polarity of the Upper Cretaceous shoshonitic and ultrapotassic volcanics exposed in the most southerly part of the eastern Pontide magmatic arc.

Geological, geochemical and isotopic data indicate that there were two distinct cycles of high-K volcanic activity in the southern part of the eastern Pontide magmatic arc during the Late Cretaceous. The first cycle (Early Campanian), represented by shoshonitic trachyandesites and associated pyroclastics, containing high K2O (2.74-4.81 wt %) and Na2O (3.60-5.51 wt %), overlies the Middle-Cretaceous ophiolitic-olistostromal melange formed during the rifting stage of a back-arc basin (Neotethys). The second cycle of high-K volcanism is characterized by potassic or ultrapotassic analcime-bearing volcanics, erupted in a lagoonal environment during the Maastrichtian. Progressive shallowing of the basin indicates that Upper Cretaceous high-K volcanism developed during the final stage of pull-apart basin development in the southern zone of the eastern Pontides. These volcanic rocks, intercalated with continental detritus, are characterized by high Na2O (3.22-7.16 wt %) concentrated in secondary analcime crystals. Their K2O contents also range between 0.83 and 6.05 (wt %). Volcanic rocks belonging to both cycles have remarkable similarity in their trace and rare earth element concentrations and display variable enrichment in large ion lithophile elements (LILE), high field strength elements (HFSE), light rare earth elements (LREE) and heavy rare earth elements (HREE) with respect to primitive mantle and chondrite. Negative Nb, Ta, Zr, Hf and Ti anomalies are typical of subduction-related arc magmas. In addition, Nd-Sr and Pb isotope ratios of the investigated volcanics support that they are products of a similar mantle source.

Undoubtedly, the existence of the subduction-related high-K volcanics in the southern part of the eastern Pontide magmatic arc is very important for interpretation of subduction polarity. Southward subduction of the Paleotethys oceanic crust during Mesozoic can be separated into two main stages. The first stage of southward subduction ended with slab break-off of the old and dense part of the Paleotethys oceanic crust during the Mid-Cretaceous. This process caused upwelling of the asthenospheric mantle and opening of the back-arc basins in the eastern Pontides. Middle Cretaceous olistostromal ophiolitic mélange formed on the transitional crust or on true oceanic crust restricted by deep spreading troughs of the pull-apart basins. Deformation of the deep-spreading troughs, in which the mélange formed, was initially extensional (drifting stage) but became increasingly compressional (infilling stage) as the strike-slip cycle was completed. Southward migration of the Upper Cretaceous volcanism in the eastern Pontides (arranged TH-CA in the north, CA-A in the south and shoshonitic-ultrapotassic in the far south) implies that the remaining undepleted part of Paleotethys oceanic crust continued to subduct southward. In addition, intense volcanic activity and emplacement of granite, gabbro and diorite intrusions in the northern part of the arc caused break-up of the Malm-Lower Cretaceous carbonate platform during the Upper Cretaceous.