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MAGMATIC EVOLUTION of the ALADAĞ VOLCANIC SYSTEM and SOUTHERN EDGE OF THE ERZURUM-KARS VOLCANIC PLATEAU (SARIKAMIŞ, CITY of KARS, NE TURKEY)

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The Erzurum-Kars Volcanic Plateau (EKVP) was formed by volcanic eruptions during the Messinian-Zanclean (~5.5 Ma) period, related to a continental collision event between Eurasia and Arabia, initiated ~15 Ma ago. The EKVP unconformably overlies a series of older sedimentary formations spanning in age from Cretaceous to Miocene. It starts with a ~400 m thick pyroclastic-rich layer at its bottom, named the Akkoz basal tuff, consisting of rhyolitic and dacitic ignimbrites, pyroclastic fall and surge deposits, which are intercalated with andesitic and dacitic lavas. Upper layers of the plateau are dominated by andesitic and basaltic andesitic lavas (~100 m).

In the northwest of the study area, an eroded stratovolcano, named Hamamlı volcano, which is possibly coeval with the plateau volcanism is present. It covers ~280 km² area and consists of a thick sequence of rhyolitic lavas, tuffs, ignimbrites, perlites and obsidians. The best preserved volcanic edifice in the study area is the Greater Aladağ Stratovolcano with a footprint of ~230 km². It is composed of intermediate lavas with andesitic, dacitic, trachy-andesitic compositions, erupted ~3.55 Ma in Piacenzian. A small volcanic cone, named in this study as the Lesser Aladağ volcano, sits on the northern flank of the Greater Aladağ. Lesser Aladağ has an elliptical shape and is composed of basaltic-andesitic and basaltic trachy-andesitic lavas. Three semi-circular shaped rhyolitic domes called the Odalar rhyolite sit on the southern and eastern slopes of the Greater Aladağ. In the N and NE, the Aladağ volcanic sequence is unconformably overlain by a younger (~2.7 Ma) sequence of olivine basalts and basaltic andesites, which is known as the Kars volcanic plateau.

All volcanic products in the study area are calc-alkaline in character with a clear subduction signature. Results from our petrological modelling studies indicate that the magmas that fed the Aladağ volcanic system were evolved in a chamber, which was periodically replenished by fresh and primitive basaltic magma. Our assimilation model results based on the equations of DePaolo (1981) and Aitchison and Forrest (1994) show that fractional crystallization was more important than crustal assimilation process in evolved lavas of the Aladağ system. Interestingly, EC-AFC model results indicate that some of the youngest basalts from the Kars volcanic plateau contain higher degrees of crustal assimilation relative to more evolved lavas.

Crystal chemistry of amphiboles by EMP from the amphibole-bearing lavas of the Akkoz basal tuff layer indicates that they had experienced crystallization pressures between 5.63 and 6.45 kbar and temperatures between 949 and 1026 °C during their magma chamber evolution. On the other hand, pyroxene thermo-barometry of the Aladağ units has given crystallization pressures between 0.8 and 4.8 kbar, and temperatures from 1025 to 1078 °C, implying polybaric fractionation. Calculated crystallization pressures and temperatures from the younger lavas of the Kars volcanic plateau are ~8.8 kbar and ~1179 °C respectively. Our partial melting models indicate that the primitive basaltic magmas might have been derived from a metasomatised spinel peridotite source with varying melting degrees from 0.7% to 2%.