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Post-collisional calc-alkaline lamprophyres in Eastern Sakarya Zone, NE Turkey: implications for initiation of early Cenozoic lithospheric thinning

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The Eastern Sakarya Zone in NE Turkey preserves the records of a long-lived magmatic arc that vanished during early Paleocene period, decreasing in age to the north. Late Mesozoic to early Cenozoic magmatic rocks of the zone range in composition from mafic to felsic. Among these, lamprophyre stocks are rare, but unique. In this paper, we report detailed study of new ^{40}Ar/^{39}Ar dating, mineral chemistry, major and trace elements and Sr-Nd-Pb isotopic composition of the Kov lamprophyre intrusion in the Gümüşhane area, in an attempt to provide constraints on the timing of initiation of lithospheric thinning and their petrogenesis as well as the early Cenozoic mantle characteristics. The lamprophyres intruded early to middle Jurassic volcano-sedimentary rocks. They exhibit fine-grained textures and are mineralogically uniform. Hornblende ^{40}Ar/^{39}Ar dating yielded a plateau age of 50.02$\pm$1.20 Ma. Based on their geochemistry, mineral compositions and paragenesis, the lamprophyres are classified as calc-alkaline lamprophyres in general and spessartites in particular, which are rich in large ion lithophile elements (e.g., Rb, Ba, K) but depleted in Nb and Ti. The Kov samples exhibit moderately fractionated LREE patterns approximately 30 times compared to chondrite but HREE abundances less than 10 times that of chondrite. These calc-alkaline lamprophyres display a range of I_{Sr} (50Ma) values from 0.70510 to 0.70533 and εNd (50Ma) values from -1.3 to 3.3, with T_{DM}= 0.52 to 1.32Ga. Their Pb isotopic ratios are in accord with an enriched mantle source. The metasomatic agent of a large quantity of H_2O-rich fluids is responsible for the chemical enrichment of subcontinental mantle prior to the partial melting. All of the geochemical features and the trace element modeling demonstrate that the primary magma of the calc-alkaline to high-K calc-alkaline spessartites was generated at depth by a low degree of partial melting ($\sim$1-5%) of a previously enriched lithospheric mantle wedge consisting of phlogopite-bearing spinel peridotite. The rising melts were accompanied by fractional crystallization, with minor crustal contamination en route to the surface. All of the geochemical features combined with regional data suggest that the Kov calc-alkaline lamprophyres originated in an early stage of post-collisional extensional environment throughout the early Eocene. Such an extensional event, acting as upwelling of hot asthenosphere, led to the thinning of continental lithosphere beneath the Sakarya Zone in an intra-continental setting.

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