N. Jb. Miner. Abh.
2009, Vol. 186/1, p. 21–36, Stuttgart, July 2009, published online 2009
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K/Ar ages and geochemistry of the post-collisional volcanic rocks in the Ilica (Erzurum) area, eastern Turkey

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With 9 figures and 4 tables

Abstract: The Neogene Ilica volcanics in eastern Anatolia are of sub-alkaline affinity and present features of post-collisional volcanism. The lava flows in the Ilica area reveal K/Ar ages ranging from 13.9 ± 0.5 to 4.4 ± 0.3 Ma, corresponding to the Miocene- and Pliocene age. The volcanic rocks are composed of calc-alkaline basaltic trachyandesitic-, trachyandesitic-, andesitic- and minor dacitic lavas associated with pyroclastics, with the andesitic lavas being volumetrically the most abundant. Some special textures, such as the dissolution/melting and poikilitic type, and the normal, reverse, and oscillatory zoning in the plagioclase- and pyroxene phenocrysts are attributable to disequilibrium crystallization related to magma mixing. The rocks are characterized by enrichment in large ion lithophile elements (LILE) and light rare earth elements (LREE), with pronounced depletion of high field strength elements (HFSE). They show depletion in Nb and Ta, indicating the role of crustal contamination. The rocks also have moderately fractionated rare earth elements (REE) patterns with $(La/Lu)_N$ ratios of 10–19 for andesitic- and dacitic rocks, and 7–10 for basaltic trachyandesitic- and trachyandesitic rocks. Basaltic trachyandesites show slightly positive Eu anomalies, whereas the deepening of Eu through gradual increase from trachyandesite to dacite, indicating a genetic link between the basaltic trachyandesite and the dacites.

The main solidification processes consist of magma mixing and fractional crystallization with minor amounts of crustal contamination which were operative during the solidification of the volcanic rocks. All evidences support the theory that Ilica volcanic rocks were derived from partial melting of lower continental crust, having undergone interaction with subcontinental lithospheric mantle in a post-collisional geodynamic setting.

Key words: K/Ar age, post-collisional volcanism, geochemistry, magma mixing, eastern Turkey

1. Introduction

The eastern Anatolia region represents one of the most complete and well-exposed volcanic sequences related to a continental collision zone (Yilmaz et al. 1987, Keskin et al. 1998). The continental collision of the Arabian plate with the Eurasian plate in the Neogene led to the lateral tectonic extrusion of the Anatolian block and formation of the north Anatolian fault and the east Anatolian fault (Fig. 1). Volcanism, mostly calc-alkaline and partly alkaline, developed as a consequence of this collision (Şengör & Yilmaz 1981, Innocenti et al. 1982, Dewey et al. 1986, Yilmaz 1990, Ercan et al. 1990, Pearce et al. 1990, Güleç 1991, Notsu et al. 1995, Buket & Temel 1998, Yalçin et al. 1998, Keskin et al. 1998, 2006, Şen et al. 2004, Kurt et al. 2008, Kürüm et al. 2008, Varol et al. 2008).

The genesis of widespread Miocene to Plio-Quaternary post-collisional volcanism in eastern Anatolia (Yilmaz 1990, Pearce et al. 1990, Ercan et al. 1990, Notsu et al. 1995, Keskin et al. 1998, Yilmaz et al. 1998) has been connected with (1) post-collisional extensional tectonics resulting from the slab break-off which is considered to have taken place during the Middle Miocene following the collision between the Arabian and Eurasian plates (Şengör et al. 2003, Keskin 2003); and (2) strike-slip faulting mainly controlled by the convergence between the Arabian and Eurasian plates which has continued since the Late Eocene/Oligo-Miocene (Şengör & Yilmaz 1981, Innocenti et al. 1976, Bozkurt & Mittwede 2001). Based on new geophysical results Zor et al. (2003), Keskin (2003) and Şengör et al. (2003) proposed that the slab break-off mechanism, which resulted from the ongoing compression between the Eurasian and

DOI: 10.1127/0077-7757/2009/0134
0077-7757/09/0134 $ 4.00
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