



# Composition, pressure, and temperature of the mantle source region of quaternary nepheline-basanitic lavas in Bitlis Massif, Eastern Anatolia, Turkey: A consequence of melts from Arabian lithospheric mantle

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## ARTICLE INFO

### Article history:

Received 12 November 2018

Accepted 16 January 2019

Available online 22 January 2019

### Keywords:

Eastern Anatolia  
Arabian Lithosphere  
Ne-basanite  
Mineral chemistry  
Petrology

## ABSTRACT

The Quaternary (0.66–0.63 Ma) nepheline basanites (*ne* - basanite) are the firstly observed volcanic products of Arabia-Eurasia collision on Bitlis Pötürge Massif. They composed of clinopyroxene, olivine, Ti-magnetite, Cr spinel, and nepheline. The forsterite compositions of olivines range between 73 and 83%, calcic clinopyroxenes show modest variations in  $W_{0.48-57-En_{37-45}-Fs_{5-7}}$  and nephelines occur as minor minerals within the networks of other groundmass minerals. They are characterized by low  $SiO_2$  (40.16–41.96 wt%), high MgO contents (8.54–9.73 wt%) and similar Sr–Nd isotopic compositions with Arabian Plate volcanics. Mineral and whole rock thermobarometry yield crystallization pressure and a temperature range between 8 and 20 kbar and 1301 °C – 1035 °C respectively. Lavas have high Mg-number (>0.58), high Cr and Ni contents and strong LREE enrichment but depletion in Rb, K, and Pb. Trace elements together with Sr isotopic compositions inferred negligible assimilation of the local upper crustal material. The calculated average pressure and temperature of mantle melting for *ne*-basanites is 2,85 kbar and 1353 °C respectively. FC3MS (wt% FeO/CaO–3\*MgO/SiO<sub>2</sub>) parameter and melting models using REE data reveal Çatak basanites are products of amphibole and phlogopite bearing metasomatised lithospheric mantle in garnet stability field. They seem to originated from depths of ~ 85 km which corresponds to the base of the Arabian lithosphere in the region.

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## 1. Introduction

Cenozoic Eastern Anatolian post-collisional volcanism was started in Middle Miocene as a result of the collision between the Anatolian and Arabian plates. The ongoing convergence has given rise to the uplift of the Eastern Anatolia (Şengör and Kidd, 1979) and widespread volcanism within the plateau (e.g. Oyan et al., 2017; Özdemir, 2016; Özdemir et al., 2006, 2011).

Volcanism in the region characterized by mainly stratovolcanoes, basaltic lava plateaus and is mainly spread between Bitlis Suture Zone (BSZ) and Erzurum-Kars plateau (Fig. 1). Generally Miocene and Quaternary represented by stratovolcanoes and small volume basaltic lava flows, however Pliocene characterized by voluminous basaltic plateaus. Many studies have been proposed to explain the origin of the post-collisional volcanics in Eastern Anatolia, however melting region and time-space distribution of volcanics still remain as a matter of debate. Considering the petrological studies on the northern parts of the Bitlis

Suture Zone, proposed petrogenetic models on those volcanics divided into three major groups: first group assumed lithospheric origin (Kaygusuz et al., 2018; Pearce et al., 1990; Şen et al., 2004; Yılmaz et al., 1998); in the second group, an asthenospheric source with or without subduction component is considered (Keskin 2007, 2003; Lebedev et al., 2016; Şengör et al., 2008, 2003); in the third group variable mixed melts from asthenosphere and lithosphere and increase in lithospheric contribution from Miocene to Quaternary are suggested (Oyan et al., 2016; Özdemir and Güleç, 2014) for the source of the eastern Anatolian volcanics. Additionally lower crustal-derived volcanics (e.g. Çoban et al., 2007; Karlı et al., 2008) and sub-slab derived volcanics after the onset of Northern Anatolian and Eastern Anatolian strike slip tectonics are also described in the region (Di Giuseppe et al., 2017). The triggering mechanisms for the onset of volcanism proposed as whole scale or small scale removal of lithospheric mantle, slab break-off and mantle convection in the region. All these models have been proposed for the Cenozoic volcanism at the northern parts of the BPM. However, there is no data regarding the young Neogene volcanism within the BSZ. This is the first study on Quaternary post-collisional volcanic products in BSZ and also on the low silica highly alkaline rocks

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