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Calc-alkaline I-type plutons in the eastern Pontides, NE Turkey: U–Pb zircon ages, geochemical and Sr–Nd isotopic compositions

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ABSTRACT

The Köprübaşı intrusion from the eastern Pontides of NE Turkey consists of granodiorite and monzogranite, and contains a number of mafic microgranular enclaves (MMEs). We report here U–Pb zircon age, geochemical and Sr–Nd isotopic data for these rocks in order to determining magma sources and magma production processes. On the basis of U–Pb zircon sensitive high-resolution ion microprobe dating (SHRIMP), the magma emplacement age of the granodiorite is 79.3 ± 1.4 Ma. The rocks of the pluton are calc-alkaline, metaluminous to peraluminous characteristics, and display features of I-type granites. They are enriched in large ion lithophile elements (LILE) and light rare earth elements (LREE) with negative Eu anomalies ($Eu/Eu^* = 0.60–0.76$), but are depleted in high field strength elements (HFSE). They have small range of $^{87}Sr/^{86}Sr_{(i)}$ (0.7067–0.7070) and $\varepsilon_{Nd(i)}$ (−3.2 to −4.4) values. Fractionation of plagioclase, hornblende and Fe–Ti oxides played an important role in the evolution of the Köprübaşı intrusion. A relatively shallow intrusion depth (~2–8 km) was estimated from the Al-in-hornblende geobarometry. All these characteristics, combined with the low values of K_2O/Na_2O, SiO_2, $Al_2O_3/(FeO^T + MgO + TiO_2)$ and $(Na_2O + K_2O)/(FeO^T + MgO + TiO_2)$, suggest an origin by dehydration melting from a metabasaltic lower crustal source.

1. Introduction

I-type, calc-alkaline granitoid rocks are common in many different convergent tectonic settings and include subduction-related and collisional magmatic suites. In modern tectonic regimes, I-type granitoids are mainly tonalite, trondhjemite and granodiorite, and these as well as chemically equivalent volcanic rocks occur in intra-oceanic island arcs (Whalen, 1985; Haraguchi et al., 2003) and along Andean- or Cordilleran-type active continental margins (Kay and Kay, 1993). There is a strong link between mineralogy, geochemical and isotopic composition and the geodynamic setting of granitoids. To better constrain the geodynamic evolution of arc settings, it is important to study the petrogenesis and age relationship of such plutons.

The Eastern Pontide magmatic arc in NE Turkey includes various eruptive and intrusive rocks, and many of them are related to the convergence of Gondwanaland and Eurasia plates (Fig. 1a). The intrusive rocks have three distinct ages: (1) *Permo-Carbonifeous* (Çoğulu, 1975); (2) *Cretaceous-Paleocene* (Delaloye et al., 1972; Giles, 1974; Taner, 1977; Gedikoğlu, 1978; Moore et al., 1980; Jica, 1986; Okay and Şahintürk, 1997; Yılmaz et al., 2000; Köprübaşı et al., 2000; Yılmaz-Şahin, 2005; Boztuğ et al., 2006; Kaygusuz et al., 2008; Boztuğ, 2008; İlbeyli, 2008; Kaygusuz and Aydinçakir, 2009; Kaygusuz et al., 2009); and (3) *Eocene* (Boztuğ et al., 2004; Arslan et al., 2004; Yılmaz-Şahin, 2005; Topuz et al., 2005; Karslı et al., 2007) (Fig. 1b). They were formed in different geodynamic environments and the emplacements of these plutons occurred in a wide range of tectonic settings, such as from arc-collisional through syncollisional to postcollisional (e.g., Yılmaz and Boztuğ, 1996; Okay and Şahintürk, 1997; Yılmaz et al., 1997; Yeğingil et al., 2002; Boztuğ et al., 2003). In the Köprübaşı (Torul) region of the eastern Pontides, arc-related magmatism developed under a compressional regime and is characterised by the predominance of calc-alkaline granitoids.

Most of the previous works in the eastern Pontides dealt with the general characteristics of the granitoids within the overall framework of the geological evolution of the region. However, research on the various other aspects of granitoid rocks (age, origin and source) is scarce. The present article focuses mainly on the arc-related granitoids in the eastern Pontides and the interpretation of these granitoids based on their ages and magma sources. We examine the Köprübaşı intrusions, which are geochemically and Sr–Nd isotopically the least-studied plutons in the eastern Pontides, to improve the knowledge about age and geochemical composition. In this paper, for the first time petrographic, geochemical, Sr–Nd isotopic and SHRIMP zircon data as well as field observations and

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