Early–Middle Jurassic intra-oceanic subduction in the İzmir-Ankara-Erzincan Ocean, Northern Turkey

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The İzmir-Ankara-Erzincan suture zone near Çankırı comprises an ophiolite-related rock suite of amphibolite, pyroxene-amphibolite and epidote-amphibolite. The geochemical data reveal that the basaltic protoliths of the Çankırı amphibolite suite are derived from different mantle sources. Amphibolites showing a LREE enrichment in chondrite-normalized REE pattern, relatively high LaN/YbN (8.5–13.1), Sm/Yb (2.8–3.7), Ce/Sm (8.8–9.8), Nb/Yb (14.4–20.5), Th/Nb (1.1–2.6) originate from an OIB-like (Type I amphibolites) mantle source. Those with flat chondrite-normalized REE pattern, low LaN/YbN (~0.6), Sm/Yb (~1.0), Ce/Sm (~2.7) Nb/Yb (~0.6), suggest derivation from a depleted MORB-like (Type II amphibolites) mantle source. A third type of amphibolite is characterized by LaN/YbN (~1.54), Sm/Yb (~1.1), Ce/Sm (~4.5), Nb/Yb (~1.1) and Th/Nb (0.3). It is derived from an enriched MORB source and shows characteristics similar to island arc basalts. Amphiboles from these rocks yielded 40Ar/39Ar plateau ages between 177.08 ± 0.96 Ma and 166.9 ± 1.1 Ma. These dates are interpreted as metamorphic ages of the amphibolitic rocks. They differ significantly from previous ages of amphibolitic rocks (the metamorphic sole rocks) related to Turkish ophiolites. However, similar metamorphic ages have been reported for metamorphic sole rocks of the Hellenic-Dinaric ophiolites further west. The metamorphic sole rocks have been generated in intra-oceanic environments via intra-oceanic subduction/thrusting events. The new age data of the Çankırı amphibolite suite suggest that the İzmir-Ankara-Erzincan ocean was subducted around Early–Middle Jurassic times, i.e. roughly coeval with the oceanic basin(s) generating the Hellenic-Dinaric ophiolites. In the Early–Middle Jurassic time, the tectonic regime in the İzmir-Ankara-Erzincan ocean was compressional and the ocean was closing at that time. The new age data presented here could imply that Jurassic granites which cross-cut basement rocks of the Pontides are related to the northward subduction of the İzmir-Ankara-Erzincan ocean during Jurassic time.

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1. Introduction

Suture zones defined by ophiolite belts and ophiolitic mélanges are the relics of former ocean basins, which existed between continental blocks (e.g. Moores, 1981). They bear information on the evolution of ancient oceans, which is relevant for paleogeographic reconstructions and for unraveling mantle–crust dynamics. Turkey is a key region for understanding the geologic evolution of the Tethyan Ocean, which was located between the Gondwana and Laurasia supercontinents (e.g. Okay and Tüysüz, 1999; Şengör and Yilmaz, 1981; Stampfl, 2000). The ophiolitic rocks in Turkey define three main belts (i) the Northern Ophiolite Belt, (ii) the Median or Tauride Ophiolite Belt and (iii) the Southern or Peri-Arabic Ophiolitic Belt (Juteau, 1980). The Northern Ophiolite Belt is defining the İzmir-Ankara-Erzincan (İAE) Suture Zone, and represents the northern branch of the Neo-Tethys (İAE Ocean Domain), which was located between the Pontide (Sakarya) and the Anatolide-Tauroide blocks (Okay and Tüysüz, 1999; Fig. 1).

Ophiolite belts similar to those in Turkey occur in the Balkan region to the east and west of the Pelagonian microcontinent which was separating the Vardar and Pindos oceanic basins during much of the Mesozoic (e.g. Dilek et al., 2007; Robertson, 2002; Stampfl and Borel, 2004). East of Pelagonia, ophiolites of the Vardar Zone (e.g. the Guevgueli ophiolites), also referred to as the Eastern Hellenic Ophiolites, are Jurassic–Early Cretaceous in age (e.g. Robertson, 2002). The ophiolitic rocks of the Vardar Zone (e.g. the Guevgueli ophiolites), also referred to as the Eastern Hellenic Ophiolites, are Jurassic–Early Cretaceous in age (e.g. Robertson, 2002). The ophiolitic rocks of the Vardar Zone (e.g. the Guevgueli ophiolites), also referred to as the Eastern Hellenic Ophiolites, are Jurassic–Early Cretaceous in age (e.g. Robertson, 2002).