

E. SARIFAKIOGLU, Y. DILEK, M. SEVIN, Ş. PEHLIVAN, Ö. KANDEMİR, A. MÖLLER, T. BAYANOVA, I. UYSAL and M. KELES, 2017. Permo–Triassic and Liassic Tethyan Oceanic Tracts within the Pontide Belt Along the Southern Margin of Eurasia, Northern Anatolia. *Acta Geologica Sinica* (English Edition), 91(supp. 1): 33-34.

## Permo–Triassic and Liassic Tethyan Oceanic Tracts within the Pontide Belt Along the Southern Margin of Eurasia, Northern Anatolia

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### 1 Abstract

The Pontide belt in northern Turkey includes three major tectonic terranes, the Strandja Massif (SjM), and the Istanbul (ISZ) and Sakarya Zones (SZ) (Fig. 1). We present new age and geochemical data from ophiolites and ophiolitic mélanges within the Sakarya Zone and show that these mafic–ultramafic rocks are the remnants of Tethyan oceanic lithosphere formed in different tectonic settings. The main ophiolite occurrences investigated in this study along the Karakaya Suture (KS) are associated with the latest Triassic Cimmeride orogeny, and in the Küre–Yusufeli ophiolite belt are part of the Alpidic orogeny.

The Karakaya Suture Zone ophiolites in northern west Turkey are comprised mainly of the Denizgören (Çanakkale) ophiolite, Boğazköy (Bursa), Geyve (Sakarya), Almacık (Düzce) and Çele (Bolu) metaophiolites. The Denizgören ophiolite largely contains upper mantle peridotites, which are equivalents of the Permo–Triassic Lesvos peridotites and mélange units farther SW in the northern Aegean Sea. The Boğazköy ophiolite includes serpentinite and metagabbro, and the Almacık and Geyve ophiolites display an almost complete Penrose–type sequence consisting of serpentinitized upper mantle peridotites, cumulate ultramafic–mafic rocks, isotropic gabbros, dolerite and plagiogranite dikes, and extrusive rocks. U–Pb zircon dating of plagiogranite dikes from Çele has revealed an igneous age of 260 Ma, and 255, 235, 227 Ma from Almacık (Bozkurt et al., 2012a, b). Consistent with the previously

published Permo–Triassic age, we obtained a  $268.4 \pm 6.3$  Ma U–Pb zircon age from a plagiogranite dike within the Almacık ophiolite to the west. This KS ophiolite belt containing the Çele, Almacık, Geyve ophiolites within the SZ extends westward into the Armutlu Peninsula and then into the Biga Peninsula (i.e. Denizgören ophiolite) and most likely connects with the remnants of the Triassic Meliata–Meliac ocean basin (Stampfli and Borel, 2002) in the Balkan Peninsula. The KS ophiolites also continue eastward within the Pontide Belt into the Elekdağ ophiolite (eastern Kastamonu) and then to the Refahiye ophiolite in NE Anatolia.

Triassic granites in the SZ represent a magmatic arc that formed as a result of the northward subduction of the Izmir–Ankara–Erzincan oceanic lithosphere existing during the late Paleozoic through Cretaceous (Sarifakioglu et al., 2014) beneath the Pontides. We obtained a U–Pb zircon age of  $231 \pm 2$  Ma from a metagranitic intrusion into the Variscan basement of the SZ in the Kastamonu region of the central Pontides. This metagranite is enriched in LILE (Rb: 63 ppm; Ba: 65 ppm; Sr: 200 ppm) and depleted in HFSE (Y: 12.58 ppm; Yb: 1.26 ppm; TiO<sub>2</sub>: 0.2 wt.%; Nb: 7.6 ppm; Hf: 3.9 ppm), characterizing it as subduction–related calc–alkaline pluton. Lead (3.9 ppm), U (1.6 ppm) and Ce (59 ppm) contents are interpreted as evidence for contamination by continental crust. The Küre basin to the north opened during the late Triassic to Liassic, following a backarc rifting episode in the central Pontides. Metabasic dike intrusions in the Devrekani metamorphic massif represent the first magmatic stage of this backarc rifting event. Whole-rock <sup>40</sup>Ar–<sup>39</sup>Ar dating of

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the metabasic dikes has yielded cooling ages of  $160.5 \pm 1.2$  Ma. We infer that this age was reset due to thermal heating during the emplacement of the Middle Jurassic granitoids as the Küre oceanic basin was closing. The Küre ophiolite contains upper mantle peridotites and oceanic crustal rocks composed mainly of pillow–massive–breccia basalts, dacitic and rhyolitic lavas–tuffs, diabase dyke swarms, massive gabbros and a limited extent mafic cumulates. We obtained  $182.6 \pm 1.9$  Ma as a whole-rock  $^{40}\text{Ar}$ – $^{39}\text{Ar}$  age from a pillow basalt and a U–Pb zircon age of  $171 \pm 1$  Ma from the granitic intrusion cross-cutting the peridotites. The easternmost representatives of the Küre ophiolite occur in the Yusufeli (Artvin) area in the eastern part of the Pontide belt. Here, oceanic crustal rocks are tectonically related to metamorphic rocks of the Variscan basement of the SZ. The ophiolitic crustal rocks contain isotropic gabbro and mafic and felsic dikes. Serpentinized upper mantle peridotites are scarce. Pillow lava basalts are overlain by a thick metasandstone–metashale association with locally foliated meta–lava and some manganiferous chert and mudstone interlayers. We obtained a U–Pb zircon age of  $172.5 \pm 1.4$  Ma from the granitic intrusion cross-cutting the Yusufeli ophiolite and of  $181.9 \pm 0.9$  Ma from a felsic dike (plagiogranite) in the Yusufeli ophiolite. The Middle Jurassic granites are related to the closure of the Küre–Yusufeli marginal ocean basin. The Küre and Yusufeli ophiolites have been previously interpreted as the remnants of the Paleotethys or the Intra-Pontide Ocean. However, we posit that these ophiolites represent a

marginal, short-lived (~10 Ma) ocean basin, which opened during the late Triassic through Liassic, and then closed in Dogger. This oceanic lithosphere is similar to the Evros ophiolite in the northeastern Greece in terms of its ages and geochemical characteristics.

### Acknowledgements

This study was supported by a grant from the General Directorate of Mineral Research and Exploration of Turkey (MTA, Ankara; project no: 2009.30.14.09.4; 2010.30.14.08.3; 2011.30.14.08.3).

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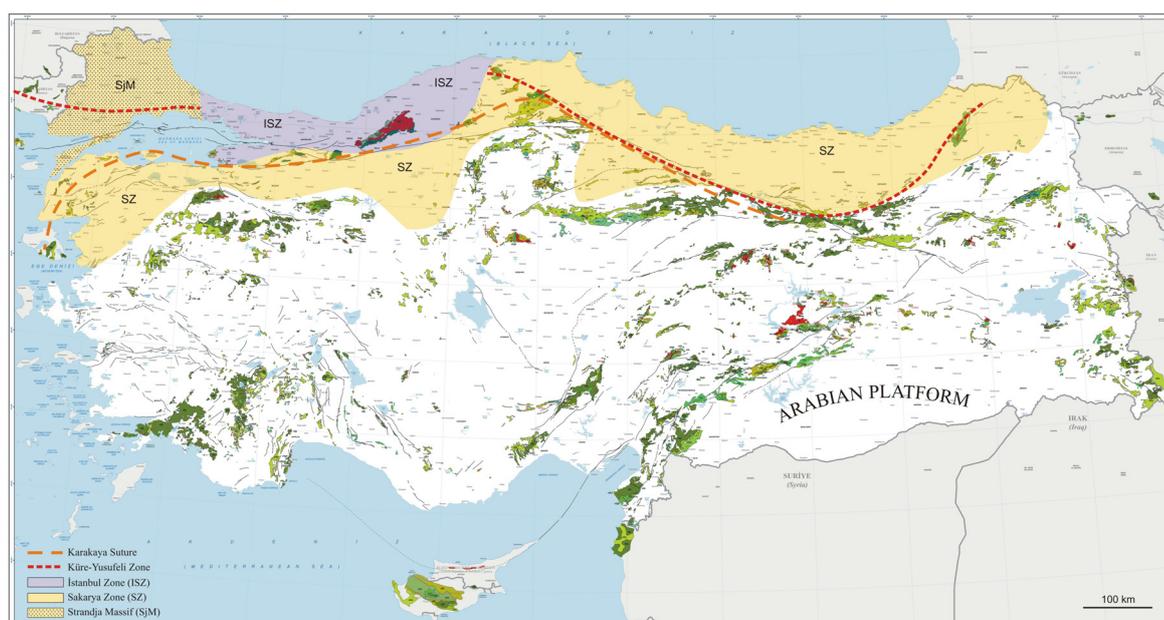


Fig. 1. The suture zones within the Pontide belt of northern Turkey.