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Evolution and provenance of Neoproterozoic basement and Lower Paleozoic siliciclastic cover of the Menderes Massif (western Taurides): Coupled U–Pb–Hf zircon isotope geochemistry

O. Zlatkin [a,*], D. Avigad [a], A. Gerdes [b,c]

[a] *Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem 91904, Israel*
[b] *Institute of Geosciences, Goethe-University Frankfurt, Altenhoeferallee 1, 60438 Frankfurt am Main, Germany*
[c] *Department of Earth Sciences, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa*

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ABSTRACT

In the Menderes Massif (western Taurides) a Neoproterozoic basement comprising metasediments and intrusive granites is imbricated between Paleozoic platform sediments. U–Pb–Hf zircon analyses of Menderes rock units were performed by us using LA-ICP-MS. The U–Pb detrital zircon signal of the Neoproterozoic metasediments is largely consistent with a NE African (Gondwana) provenance. The oldest unit, a paragneiss, contains significant amounts (~30%) of Archean-aged zircons and εHf (t) values of about a half of its Neoproterozoic zircons are negative suggesting contribution from Pan-African terranes dominated by reworking of an old crust. In the overlying, mineralogically-immature Core schist (which is still Neoproterozoic), the majority of the detrital zircons are Neoproterozoic, portraying positive εHf (t) values indicating derivation from a proximal juvenile source, resembling the Arabian–Nubian Shield.

The period of sedimentation of the analyzed metasediments, is constrained between 570 and 550 Ma (Late Ediacaran). The Core schist sediments, ~9 km thick, accumulated in less than 20 My implying a tectonic-controlled sedimentary basin evolved adjacent to the eroded juvenile terrane. Granites, now orthogneisses, intruded the basin fill at 550 Ma, they exhibit ±0 εHf (t = 550 Ma) and T_{DM} ages of 1.4 Ga consistent with anatexis of various admixtures of juvenile Neoproterozoic and Late Archean detrital components. Granites in the northern Arabian–Nubian Shield are no younger than 580 Ma and their εHf (t) are usually more positive. This implies that the Menderes does not represent a straightforward continuation of the Arabian–Nubian Shield.

The lower part of the pre-Carboniferous silisiclastic cover of the Menderes basement, comprises a yellowish quartzite whose U–Pb–Hf detrital zircon signal resembles that of far-traveled Ordovician sandstones in Jordan (including 0.9–1.1 Ga detrital zircons), supporting pre-Triassic paleorestorations placing the Tauride with Afro-Arabia. The detrital signal of the overlying carbonate-bearing quartzitic sequence indicates contribution from a different source: the majority of its detrital zircons yielded 550 Ma and ±0 εHf (t = 550 Ma) values identical to that of the underlying granitic gneiss implying exposure of Menderes-like granites in the provenance.

260–250 Ma lead-loss and partial resetting of the U–Pb system of certain zircons in both basement and cover units was detected. It is interpreted as a consequence of a Permian–Early Triassic thermal event preceding known Triassic granitoid intrusions.

1. Introduction

It is commonly accepted that prior to opening of the eastern Mediterranean in the Triassic, the Tauride Block was originally a part of northern Gondwana and was attached to NE Africa (Gutnic et al., 1979; Şengör and Yilmaz, 1981; Garfunkel and Derin, 1984; Robertson et al., 1991; Göncüoglu and Kozlu, 2000; Monod et al., 2003; Garfunkel, 2004; Ghienne et al., 2010). The basement of the Tauride, exposed mainly in the Menderes and Bitlis massifs, and in the Karacahisar and Sandıklı regions (Kröner and Şengör, 1990; Gürsu et al., 2004), was taken to represent the northern continuation of the Neoproterozoic Pan-African basement of Afro-Arabia (Şengör et al., 1984; Gessner et al., 2004; Ustaömer et al., 2009) that was imprinted by "Cadomian" orogeny (e.g. Neubauer, 2002; Stampfli et al., 2002; Nance et al., 2008). The latter has been delineated as an Andean-type orogenic belt fringing the north Gondwana margin at the closure of the Precambrian (Neubauer, 2002; Nance et al., 2008 and references therein; Ustaömer et al., 2009, 2012).

Although there is a general consensus that during the Paleozoic and until the opening of the eastern Mediterranean the Tauride had

* Corresponding author. Tel.: +972 2 6584859.
E-mail address: olga.zlatkin@mail.huji.ac.il (O. Zlatkin).

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resided on the NE African margin of Gondwana, the exact geological properties of its basement and whether it represents a fragment of the Arabian–Nubian Shield (e.g. Ustaömer et al., 2009) or of another Pan-African edifice (e.g. Oberhänsli et al., 2010) are not fully resolved. This is due in part to the fact that subsequently to northward drift from the current SE Mediterranean the Tauride terrane and its Neoproterozoic basement were involved in Alpine orogeny (Robertson et al., 1991; Hetzel and Reischmann, 1996; Bozkurt and Oberhansli, 2001; Okay, 2008) and in post-Alpine extensional tectonics (e.g. Bozkurt and Park, 1994; Bozkurt, 2007; van Hinsbergen et al., 2010). The precise original position of the Tauride block during the Neoproterozoic and prior to the onset of Lower Paleozoic platform sedimentation is thus poorly constrained, and the set of processes shaping and leading to the consolidation of the Taurus basement is not completely clear.

The Neoproterozoic and Paleozoic rock sections of the Menderes Massif in western Anatolia are the targets of the present study. Herein we define the geologic properties of the Menderes Massif basement and its Lower Paleozoic platform sediments by using coupled U–Pb–Hf zircon isotope geochemistry with the aim of clarifying aspects of the Late Neoproterozoic to Early Paleozoic geological evolution of this region. Specifically, the present study focuses on clarifying the age of deposition and the provenance of Neoproterozoic metasediments, on reassessing the age but mainly on defining the respective roles of juvenile magmatic additions versus crustal reworking in the generation of the Late Neoproterozoic Menderes granitoids. The U–Pb–Hf of detrital zircons from the Lower Paleozoic cover helps assessing the provenance of these quartz-rich sandstones and their link to Gondwana.

1.1. Geological setting

The Menderes Massif in western Anatolia (Bozkurt and Oberhansli, 2001; Okay, 2008; Fig. 1) is a Tertiary extensional metamorphic core complex (e.g. Bozkurt and Park, 1994; Ring and Collins, 2005) that

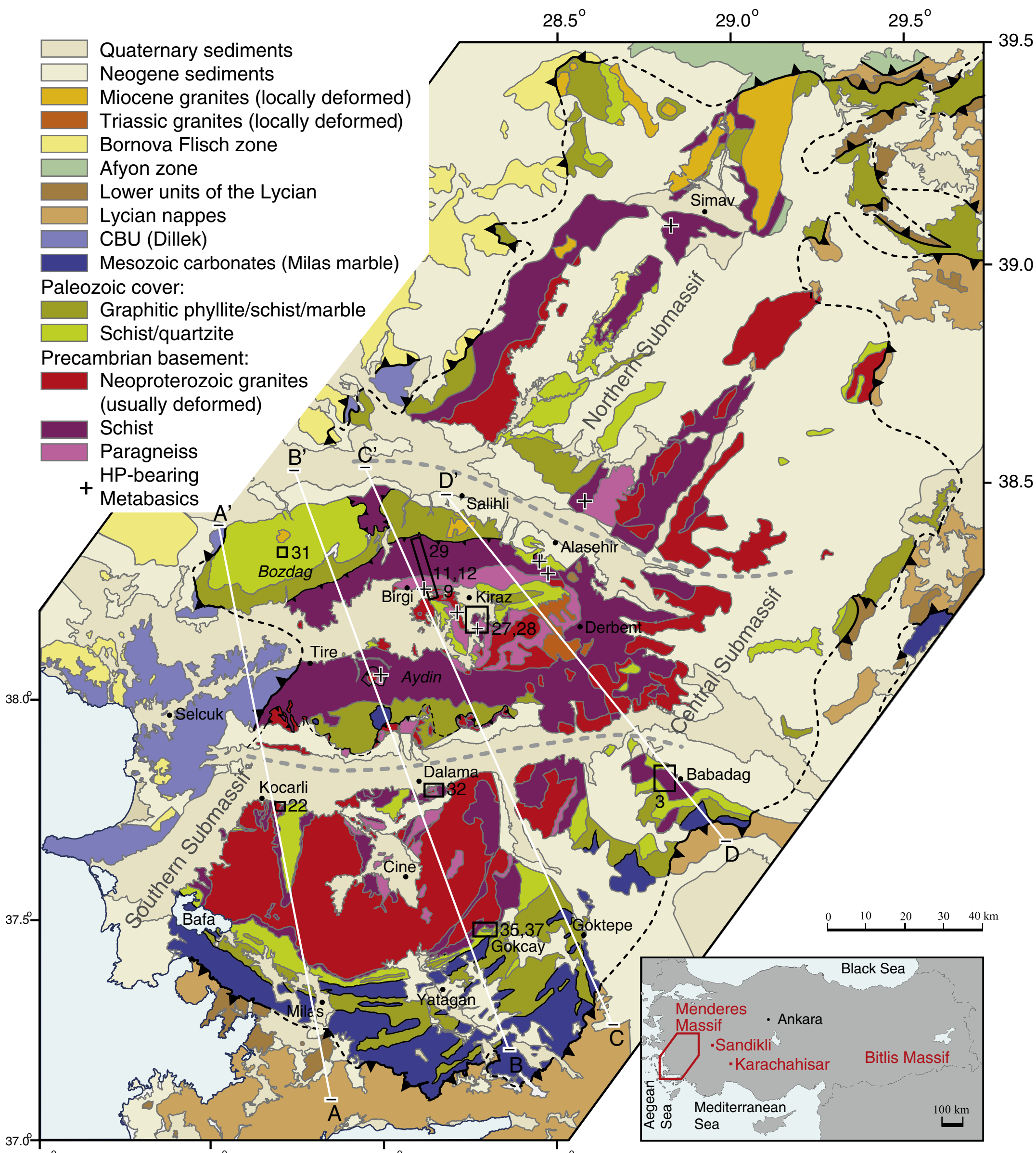

Fig. 1. Geological map of the Menderes Massif (based on the Geological Map of Turkey 1:500,000, 2002; modified after Oberhänsli et al., 1997, 2010; Candan et al., 2001; Dora et al., 2001; Okay, 2001; Özer and Sozbilir, 2003; Rimmele et al., 2003; Şengün et al., 2006). Sampling localities and collected samples are marked. Cross sections along A–A′, B–B′, C–C′, D–D′ are shown in Fig. 2.