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Miocene tectonic history of the Central Tauride intramontane basins, and the paleogeographic evolution of the Central Anatolian Plateau

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A B S T R A C T

Marine Lower-Upper Miocene deposits uplifted to > 2 km elevation in the Tauride mountains of southern Turkey are taken as evidence for the rise of a nascent plateau. The dynamic causes of this uplift are debated, but generally thought to be a regional dynamic topographic effect of slab motions or slab break-off. Immediately adjacent to the high Tauride mountains lie the Central Tauride Intramontane Basins, which consist of Miocene and younger fluvio-lacustrine basins, at much lower elevations than the highly uplifted marine Miocene rocks. These basins include the previously analyzed Altınapa and Yalvaç basins, as well as the until now undescribed Ilgın Basin.

In this paper, we aim to constrain the paleogeography of the Central Tauride Intramontane Basins and determine the role of the tectonics driving the formation of the high Miocene topography in southern Turkey. Therefore, we provide new data on the stratigraphy, sedimentology and structure of the continental Ilgın Basin. We provide an $^{40}Ar/^{39}Ar$ age of 11.61 ± 0.05 Ma for pumice deposits in the stratigraphy. We provide paleostress inversion analysis based on growth faults showing that the basin formed during multi-directional extension, with NE-SW to E-W dominating over subordinate N—S extension. We conclude that major, still-active normal faults like the Akşehir Fault also controlled Miocene Ilgın basin formation, with proximal facies close to the basin margins grading upwards and basinwards into lacustrine deposits representing the local depocenter. The Ilgın Basin was a local depocenter, but it may have connected with the adjacent Altınapa Basin during high lake levels in late Serravallian time. The Ilgın Basin and the other continental basins provide key constraints on the paleogeography and tectonic history of the region. These continental basins were likely close to the paleocoastline during the Late Miocene after which there must have been major differential uplift of the Taurides. We suggest that the extension we documented in the Central Tauride intramontane basins are in part responsible for the major topography that characterizes the Central Taurides today. The causes of extension remain engmatic, but we suggest that the tomographically imaged Antalya Slab may have caused the contemporaneous formation of NE-SW trending *syn*-contractional basins in the west and NW-SE trending Central Tauride intramontane basins in the east by slab retreat. Our study highlights that the Neogene deformation history, and perhaps even active tectonics, may be strongly affected by complex slab geometry in SW Turkey, and that crustal deformation plays an important role in generating the Miocene Tauride topography. The role of this crustal deformation needs to be taken into account in attempts to explain the ride of the Taurides and the evolution of the Anatolian Plateau.

1. Introduction

The Tauride mountains of southern Anatolia underwent spectacular uplift of > 2 km in the last ~8 Ma (Cosentino et al., 2012; Schildgen et al., 2012a, b; Cipollari et al., 2013). This uplift created the southern margin of the modern internally drained elevated region in central Anatolia known as the Central Anatolian Plateau (Lüdecke et al., 2013; Schemmel et al., 2013; Meijers et al., 2016). The most prominent example of highly risen marine sediments are found in the Mut basin that unconformably overlies the Upper Cretaceous-Paleogene Tauride fold-thrust belt (Fig. 1a and b), but also in the Central Taurides west of Beyşehir highly elevated marine sediments are found (Şenel, 2002, Schildgen et al., 2012a, b), while deep-marine Pliocene sediments are exposed in the Adana basin (Radeff et al., 2017). Because no intense

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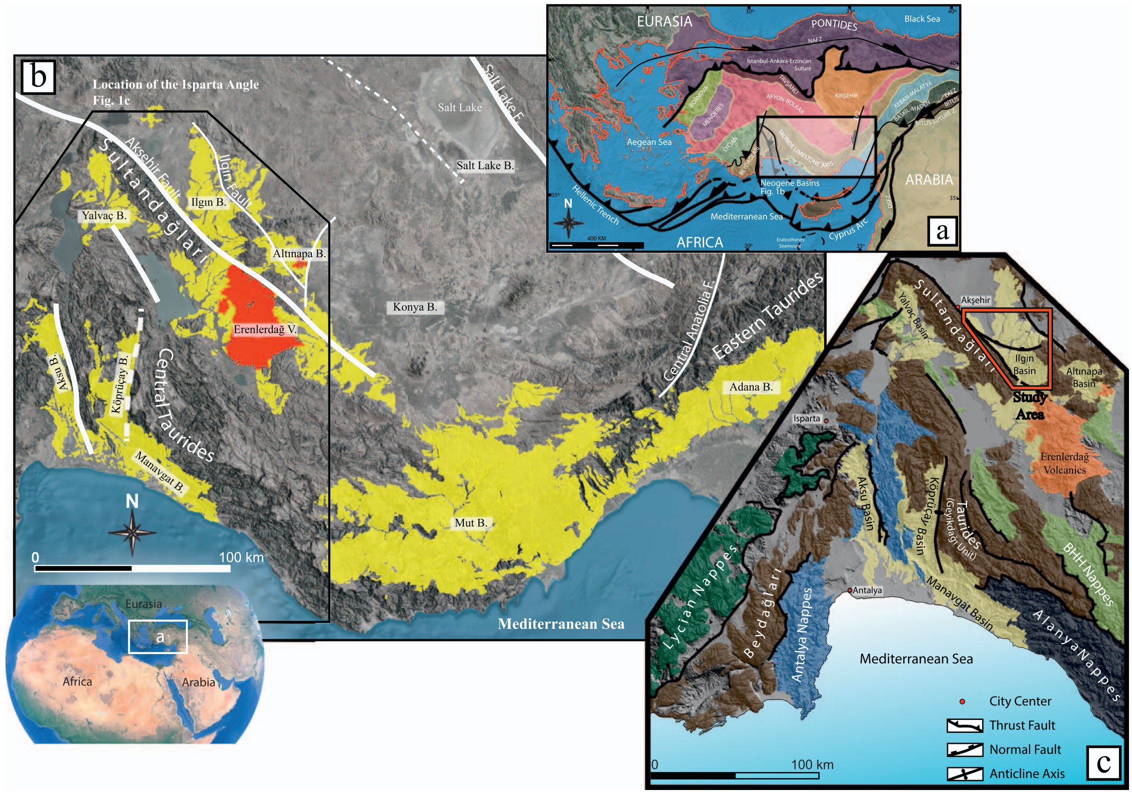

Fig. 1. (a) Simplified structural map and major tectonic zones of Turkey overlain on an SRTM topographic image. (b) Location of the Miocene basins (marine and continental) and major tectonic structures in the Central Anatolia (based on 1/500000 scale geological map (Ankara, Konya and Adana maps) produced by The Mineral Research and Exploration Directorate of Turkey (MTA)) (c) Simplified geological map of the Isparta Angle and location of the study area from 1/500000 scale geological map (Konya map) produced by The Mineral Research and Exploration Directorate of Turkey (MTA).

folding and thrusting of these Mio-Pliocene sediments has been recognized (e.g., Schildgen et al., 2012a, b; Fernández-Blanco, 2014), it is generally assumed that crustal deformation played no significant role in the rise of southern Anatolia. This rise is instead thought to be the result from a dynamic topographic response to processes in the underlying plate, such as slab break-off, slab segmentation, or mantle delamination (e.g., Schildgen et al., 2014; Bartol and Govers, 2014; Govers and Fichtner 2016).

Adjacent to the Central Taurides along the western limit of the Tuzgölü Basin (Fig. 1b), however, Miocene fluvio-lacustrine sediments and volcanics – here termed the Central Tauride Intramontane Basins – are exposed in a region with a current elevation of ~1000 m, i.e. > 1 km lower than the contemporaneous marine deposits exposed in the high Tauride mountains. For instance the elevations of Altınapa and Yalvaç basins (e.g., Koç et al., 2012, 2016a) (Fig. 1b and c) ranges around 1000–1250 m. This illustrates that the major uplift in southern Turkey is associated with the developement of differential relief on length scales of tens of kilometers. To understand which features must be explained by dynamic topographic responses to inferred mantle processes, it is key to decipher the role of crustal deformation in the recent uplift and resultant topography.

In this paper, we therefore analyse the paleogeography of the southern Central Anatolian Plateau. To that end, we here provide new constraints on the age, infill, and tectonic history of Ilgın Basin, which together with the Altınapa and Yalvaç basins hosts the best-exposed Miocene stratigraphic succession of the Central Tauride intramontane basins (Fig. 1b and c). We provide a new $^{40}Ar/^{39}Ar$ age of volcanic rocks in the basin. In addition, we show results from kinematic analysis combined with remote sensing and field mapping techniques, and are used to unravel tectonostratigraphical evolution of the basin and provide constraints on the spatio-temporal positions of paleoshorelines that prevailed during the Neogene on the southern margin of the Turkey.

2. Geological setting

The tectonic evolution of the Eastern Mediterranean region has been dominated since the Cretaceous by Africa-Eurasia convergence, which was accommodated by northward subduction of a complex paleogeographic mozaic of Neotethyan oceanic and Kırşehir-Tauride microcontinental lithosphere (Şengör and Yilmaz, 1981; Görür et al. 1984; Kaymakci et al. 2009; van Hinsbergen et al., 2016) (Fig. 1a). To the north, Neotethys subduction has been active beneath the Pontides along the southern Eurasian margin since the Jurassic (Okay et al., 2013; Dokuz et al., 2017). To the south, a second subduction zone formed in Late Cretaceous time below oceanic lithosphere, around 95 Ma, within which supra-subduction zone spreading centers formed upon subduction initiation that are now widely preserved as ophiolites that also overlie the Taurides (Yalınız and Göncüoğlu, 1998; Çelik et al., 2006; Kaymakci et al., 2009; Parlak et al., 2013; Parlak, 2016; van Hinsbergen et al., 2015, 2016; Gürer et al., 2016). Below these ophiolites, an overall foreland propagating fold-thrust belt formed that derived from a microcontinental domain that was separated by an ocean basin from Africa and Arabia. From this microcontinental domain, internal, crystalline units were accreted, including the Tavsanlı, Kırşehir, and Afyon zones (Pourteau et al. 2010, 2014; Plunder et al., 2015) (Fig. 1a), that accreted in Cretaceous time, and the external Tauride fold-thrust belt that accreted in Paleogene time (van Hinsbergen et al., 2016). The southern of these subduction zones is still active today., whereas the subduction zone below the Pontides stopped being active in central Turkey following the collision of the Kırşehir-Tauride nappe stack below the Cretaceous ophiolites with the Pontides starting in the latest Cretaceous (Kaymakci et al., 2009; Meijers et al., 2010).

The Taurides were separated in the south from Arabia and Africa by an oceanic branch of the Neotethys that closed north of the Arabian plate in Eastern Turkey along the Bitlis suture zone at the end of the

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