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Late Eocene evolution of the Çiçekdağı Basin (central Turkey): Syn-sedimentary compression during microcontinent–continent collision in central Anatolia

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ABSTRACT

The Central Anatolian Crystalline Complex (CACC) exposes metasediment rocks overlain by Cretaceous ophiolites and intruded by granitoids. Following late Cretaceous exhumation of its high-grade metamorphic rocks, the CACC started to collide with the Central Pontides of southern Eurasia in the latest Cretaceous to Paleocene. Here, we present the sedimentary, stratigraphic and tectonic evolution of the Çiçekdağı Basin, located in the northwest of the CACC. Magnetostratigraphic dating, supported by $^{40}Ar/^{39}Ar$ geochronology, shows a late Eocene basin age. The basin fill unconformably overlies metamorphic basement in the south and ophiolites of the CACC in the north. It consists of red conglomerates, sandstones and siltstones, which overlie a sequence of nummulitic limestones. In the south, these limestones are ~10 m thick, are underlain by a few meters of conglomerate unit unconformably covering the CACC metamorphics. In the north, the limestones are underlain by a ~200 m thick sequence of volcanics and fine-grained clastics intercalating with shallow marine black shales. The upper Eocene sediments of the Çiçekdağı Basin were deformed into a syn-anticline pair. Progressive unconformities in the northern flank and a rapid and persistent ~180° switch in paleocurrent directions from southward to northward in the southern flank of the anticline demonstrate syn-sedimentary folding. We interpret the folding to result from a southward progression of the Çankırı foreland basin as a result of ongoing collision between the CACC and the Pontides.

1. Introduction

The Alpine belt of the (circum-) Mediterranean region is marked by a series of continental domains in which extension has led to the exhumation of high-grade metamorphic rocks. These extensional domains are commonly interpreted as extensionally thinned overriding plates exposing rocks that were metamorphosed in and above subduction zones (Bozkurt and Oberhänsli, 2001; Jolivet et al., 2009; Vissers et al., 1995). The Central Anatolian Crystalline Complex (CACC, also known as the Kırşehir Block) in central Turkey is one of the largest metamorphic terranes in the Alpine orogen now preserved in a 250×250×250 km triangular region (Göncüoğlu et al., 1991; Şengör and Yılmaz, 1981) (Fig. 1). It developed in a context of closure of the Neotethyan Ocean and exposes (a) high-grade metamorphic rocks (the Central Anatolian Metamorphics, CAM) with Cretaceous metamorphic ages, underlying (b) Cretaceous supra-subduction-type ophiolites (Central Anatolian Ophiolites, CAO), both intruded and overlain by (c) felsic and mafic magmatic rocks (Erkan, 1976; Seymen, 1981; Whitney et al., 2001; Yalınız et al., 2000a,b).

The CACC is separated from the Sakarya continental block of the Pontides towards the north, which belonged to Eurasia since at least Jurassic times (Meijers et al., 2010b; Torsvik and Cocks, 2009), by the İzmir–Ankara–Erzincan suture zone (Okay, 2008). This suture zone is marked by a mélange, which includes ocean-floor pillow basalts, commonly with MORB geochemical signatures, and deep-marine sediments of Triassic–Cretaceous age offscraped from an oceanic plate that subducted below the Pontides before the CACC–Pontide collision (Dilek and Thy, 2006; Gökten and Floyd, 2007; Tekin et al., 2002; Tüysüz et al., 1995). The CACC is overlain by ophiolites with Turonian–Santonian epi-ophiolitic cover sediments, and with a supra-subduction zone geochemical signature (Yalınız et al., 2000b). Fringing the CACC to the south, a belt of upper Cretaceous high-pressure metamorphic rocks separates the CACC from the non-metamorphosed Tauride fold-thrust belt (Fig. 1) marking the location of a late Cretaceous subduction zone

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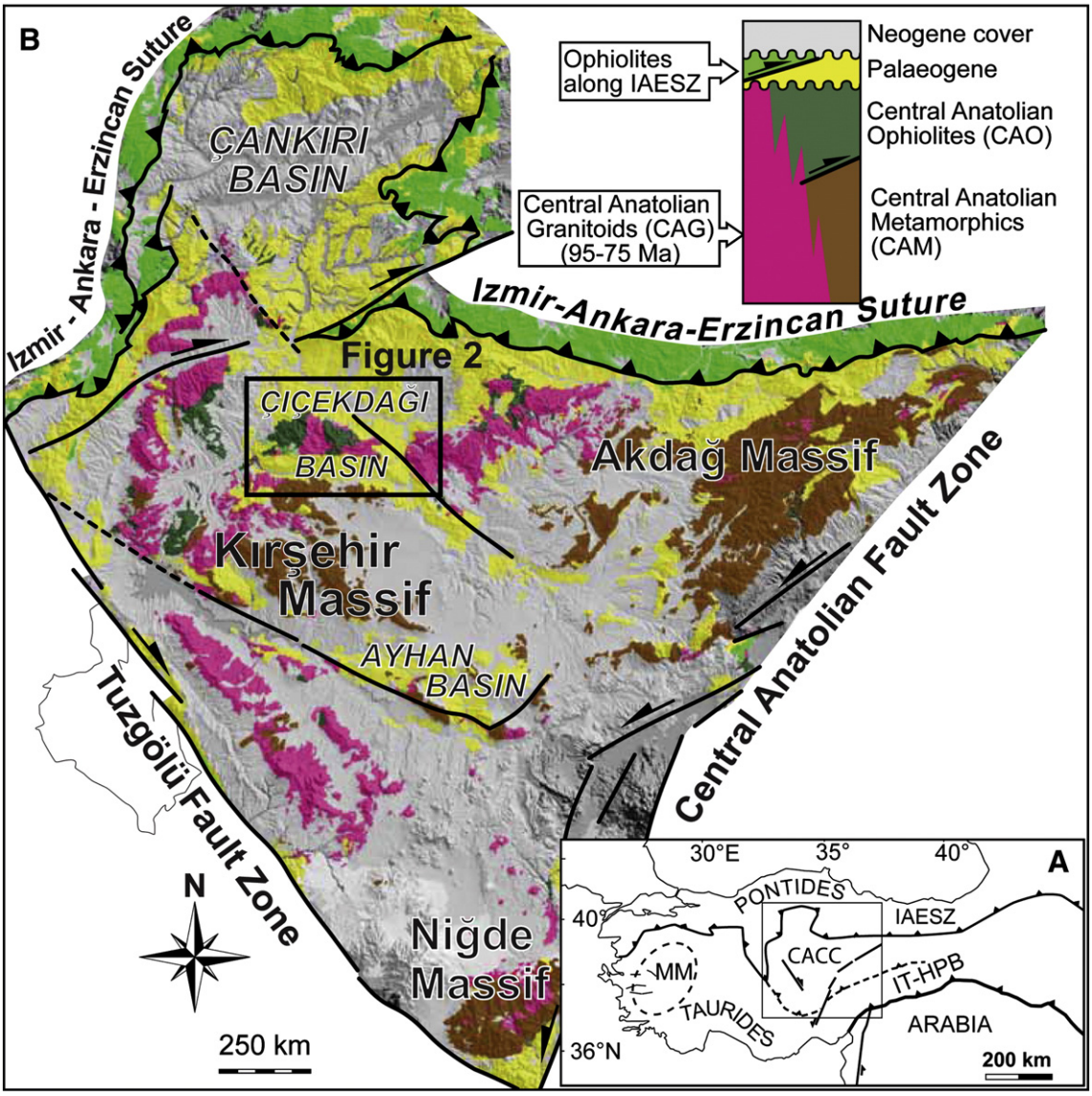

Fig. 1. (A) Location of the Menderes Massif (MM), the CACC, İzmir–Ankara–Erzincan Suture Zone, (IAESZ), and the Intra–Tauride High Pressure Belt (IT-HPB) in the Turkish orogenic system. (B) Simplified geological map of the CACC draped on a Digital Elevation Model. The black rectangle indicates the study area. Top right: simplified tectono-stratigraphic column showing the relationship between the main units of the CACC (not in scale).

(Okay, 1984, 1986; Pourteau et al., 2010). The Taurides and the CACC were derived from a continental fragment, or fragments, that rifted away from Gondwana, probably in the Triassic (Frizon de Lamotte et al., 2011; Okay et al., 1996; Şengör and Yılmaz, 1981).

The geological history of the CACC can roughly be subdivided into three major tectonic episodes. (1) Ophiolite emplacement: in late Cretaceous times (~95 Ma), platform carbonates and continental clastics, underthrusted an oceanic overriding plate (Boztuğ et al., 2007; Floyd et al., 2000; Yalınız et al., 2000a,b,c). This was followed by high-temperature metamorphism at low to intermediate pressures and intrusion of widespread plutons (Boztuğ et al., 2007, 2009b; Kadıoğlu et al., 2003; Whitney and Hamilton, 2004; Whitney et al., 2001). (2) Exhumation: thermochronological data show that CACC rocks exhumed in late Cretaceous to Paleogene times (Boztuğ and Jonckheere, 2007; Boztuğ et al., 2009a; Gautier et al., 2002), and in a few places, discrete extensional shear zones within the granitoids (Isık, 2009; Isık et al., 2008), and extensional detachments exhuming metamorphic rocks (Gautier et al., 2008; Lefebvre et al., 2011, submitted for publication) have been demonstrated. (3) Collision with the Pontides: exhumation of the CACC was followed by renewed contraction (Boztuğ et al., 2009b; Clark and Robertson, 2005; Dirik et al., 1999; Göncüoğlu et al., 1991; Yılmaz and Yılmaz, 2006) related to Paleogene collision of the CACC with the Pontides (Kaymakcı et al., 2000, 2003a,b, 2009; Meijers et al., 2010a; Rice et al., 2006). Recently, Genç and Yurur (2010) argued that extension and exhumation of the CACC were contemporaneous with compression around the margins of the CACC. These authors argued that all compression related to gravitational collapse of the CACC. We will come back to this issue in the discussion.

Since late Miocene time, the present-day boundaries of the CACC were formed by strike-slip faults (Aydemir and Ateş, 2006; Kaymakcı et al., 2010; Koçyiğit and Beyhan, 1998), probably related to westward Anatolian extrusion away from Arabia (Şengör et al., 1985).

The CACC is in places covered and surrounded by folded and thrusted Paleogene sediments and volcanics (e.g., Göncüoğlu et al., 1993; Seymen, 1981; Yürür and Genç, 2006). The late Cretaceous to Miocene Çankırı sedimentary basin to the north of the CACC (Fig. 1) has been used to constrain the Paleogene collision history of the CACC with the Pontides,