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Late Miocene to Plio-Pleistocene fluvio-lacustrine system in the Karacasu Basin (SW Anatolia, Turkey): Depositional, paleogeographic and paleoclimatic implications

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ABSTRACT

The sedimentary record of the late Cenozoic Karacasu Basin, a long-lived continental half-graben from southwestern Turkey, is characterized by siliciclastic and carbonate deposits. Sedimentation was controlled by an active NW–SE trending major normal fault along the basin's southern margin and by climatically-induced lake-level changes. Detailed facies analysis subdivides the entire Neogene–Quaternary basin-fill into three distinct litostratigraphic units representing paleogeographic changes and sedimentation patterns throughout the basin evolution.

Sedimentation commenced in the late Miocene with the deposition of proximal–medial alluvial fan and fluvial facies (Damdere Formation; FA1). At this stage, alluvial fans developed in elevated areas to the south, prograding towards the basin center. At the beginning of the Pliocene, fresh to slightly alkaline, shallow lake deposits (FA2a) of the Karacaören Formation formed. The lake became open and meromictic conditions developed (FA2b). Pollen data from the FA2b facies show that climate was arid to humid. Climate probably changed cyclically through time producing alternation of *Artemisia* steppe (cold and dry periods) and more forested vegetation (warm and wet). The open lake facies passes upwards into lake margin facies (FA2c), but it was still dominated by alkaline to slightly saline lake conditions. Sedimentation was almost continuous from the late Miocene to Pleistocene.

In the early Quaternary, the basin was dissected by the re-activation of basin bounding faults. The unconformable base of the overlying Quaternary deposits (Karacasu Formation; FA3) reflected the basin's transformation from a half-graben into a full-graben system. Oxygen isotope data from carbonates show an alternation of humid climatic periods, when freshwater settings predominated, and semiarid/arid periods in which the basin hosted alkaline and saline water lakes. Neotectonic activity has rejuvenated many of the basin-bounding faults, causing development of talus aprons and local alluvial fans. The basin was progressively incised by modern rivers that have largely smoothed out the topographic relief of the graben margins.

1. Introduction

Western Anatolia contains one of the best examples of intracontinental tectonics. Widespread Neogene and Quaternary crustal extension formed a complex mosaic of NW–SE, NE–SW, and E–W trending basins hosted by the Paleozoic–Mesozoic metamorphic bedrock of the Menderes Massif and the Mesozoic Lycian allochthonous units (e.g., Pamir and Erentöz, 1974; Okay, 1989; Sun, 1990; Bozkurt, 2001). These extensional intramontane basins were filled by Cenozoic siliciclastic to carbonate deposits, such as in the Karacasu Basin. This basin is a NW–SE trending, arcuate half-graben that is approximately 18 km wide and 35 km long (Fig. 1) with Neogene to Quaternary fill which is the subject of this study.

The Neogene and Quaternary were marked by paleogeographic and paleoclimatic changes in the circum-Mediterranean area. The western Anatolian intramontane basins and their sedimentary basin-fill successions are well-exposed with little deformation and commonly contain abundant fossil fauna and flora remains that provide a regional interbasinal geochronologic correlation. There is a significant number of studies devoted to geodynamic setting and tectonic development of the area (Şengör, 1987; Bozkurt, 2001; Ring et al., 2003; Ten Veen et al., 2009; Alçiçek and Ten Veen, 2008; van Hinsbergen, 2010; van Hinsbergen and Schmid, 2012; and references therein), but studies regarding paleoenvironmental and paleoclimatic reconstructions of ancient lakes by means of sedimentologic, mineralogic, and stable isotope geochemistry techniques are rare (Alçiçek et al., 2005; Alçiçek, 2007; Alçiçek et al., 2007; Alçiçek, 2009, 2010).

Previous geologic studies on the Karacasu Basin have primarily focused on its stratigraphy, geothermal potential, and sulfur occurrences (e.g., Nebert, 1955; Becker-Platen, 1970; Kastelli, 1971; Roberts, 1988; Açıkalın, 2005; Alçiçek and Mayda, 2009; and references therein). Comprehensive geologic mapping of the region and a lithostratigraphic division of the basin-fill were published by Nebert (1955) and Becker-Platen (1970), with a more recent refinement by Açıkalın (2005) and Konak and Şenel (2002).

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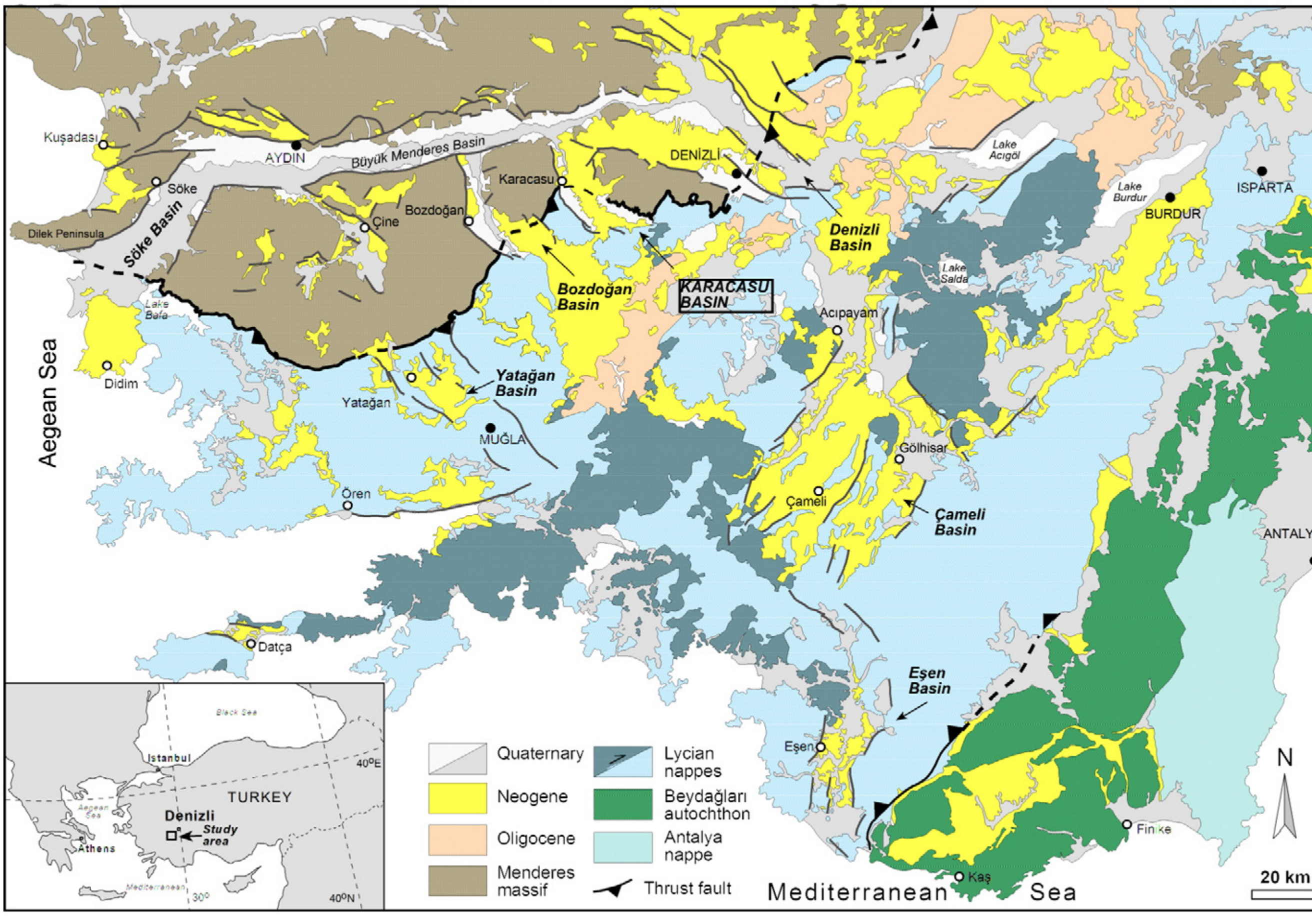

Fig. 1. Overview of the prominent extensional basins of western Anatolia surrounding the Karacasu Basin (Konak and Şenel, 2002).

This study deals with the analysis of depositional, paleoenvironmental and paleohydrological evolution of the lacustrine system(s) developed in the Karacasu Basin by using sedimentologic, mineralogic, geochemical and palynologic analyses. One of the aims is to establish the response of this system to the short- and long-term tectonic, geomorphologic, and climatic changes that affected the basin's catchment system. The lacustrine archives of this basin will add to the synthesis of regional data with paleogeographic, paleoclimatic, biogeographic, and paleoecologic information and will contribute to regional Neogene paleogeography and paleoclimatology in the eastern Mediterranean.

2. Geologic setting and basin stratigraphy

The pre-Oligocene bedrock in southwestern Anatolia (Fig. 1) consists of: (1) the metamorphic Menderes Massif; (2) the Beydağları crustal block with an unknown basement overlain by a thick platform of Mesozoic carbonates; (3) the Lycian nappes composed mainly of Mesozoic cherty carbonates and late Mesozoic–Paleogene ultramafic rocks; and (4) the Antalya nappes dominated by ophiolites. These bedrock units represent the closure of the Neotethyan oceanic basin during the Mesozoic–early Cenozoic that involved the genesis and emplacement of large-scale carbonate platforms and ophiolitic units (Collins and Robertson, 1997, 1998).

The Karacasu Basin rests on metamorphic rocks of the Menderes Massif and ophiolitic and carbonate rocks of the Lycian nappes. The southern margin of the Karacasu Basin is defined by a prominent, NE-dipping normal fault separating the basin fill deposits from bedrock (Fig. 2). The fault-bounded SW margin of the basin corresponds to the escarpment of the Karıncalıdağ Mountain range (altitude ~1699 m), whereas the NE margin has a more subdued topography bounded by a plateau with an altitude of ~850 m. The basin interior is characterized by a series of NW–SE trending normal faults that accentuate the half-graben structural configuration, with a mean elevation of the basin-floor at ~150 m.

The Neogene to Quaternary basin-fill succession of the Karacasu Basin, up to 430 m thick, consists of siliciclastic alluvial deposits and lacustrine lutites and carbonates, which are best exposed along the basin margins. The lithostratigraphy of the basin-fill succession was studied by Nebert (1955), Becker-Platen (1970), and Roberts (1988). More recently, Açıkalın (2005) designated the main late Miocene–Pliocene part of the basin-fill succession as the Dandalas Group and divided it into the Damdere Formation (late Miocene) and the Karacaören Formation (Pliocene). The Dandalas Group is the stratigraphical equivalent of the fluvio-lacustrine series in the neighboring basin of the Bozdoğan (Fig. 1) to the west in which a Pikermian fauna (MN11–13 biozone, late Tortonian–Messinian) was determined by Roberts (1988). They are overlain by relatively thin Pleistocene deposits [MN17-Gelasian-biozone by Açıkalın (2005)] of the Karacasu Formation and are covered unconformably by younger Quaternary alluvium deposits (see Figs. 2 and 3). The stratigraphic correlation of the Karacasu Basin to the neighboring basins was done by Alçiçek (2010).

2.1. The Damdere Formation

This unit forms the lower part of the basin-fill succession and overlies the bedrock unconformably, passing upwards into the Karacaören Formation (Becker-Platen, 1970; Açıkalın, 2005; Fig. 2). Sedimentation was controlled by the basin's southern boundary