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# Superimposed basin formation during Neogene–Quaternary extensional tectonics in SW-Anatolia (Turkey): Insights from the kinematics of the Dinar Fault Zone

M. Cihat Alçiçek [a,*], Andrea Brogi [b], Enrico Capezzuoli [c], Domenico Liotta [b], Marco Meccheri [c]

[a] University of Pamukkale, Department of Geology, 20070 Denizli, Turkey
[b] University of Bari, Department of Earth and Environmental Sciences, Bari, Italy
[c] University of Siena, Department of Physical, Earth and Environmental Sciences, Siena, Italy

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ABSTRACT

In the extensional province of SW-Anatolia, the cross-cutting relationship between the NW- and NE-oriented Neogene and Quaternary basins is an ongoing debate in the understanding of the tectonic evolution of this area. In order to contribute to this issue, we carried out a structural and kinematic study along the seismogenic NW-trending Dinar Fault Zone (DFZ). This structure was initially controlled by the sedimentary and tectonic evolution of the NE-oriented Neogene Baklan, Acıgöl and Burdur basins and, later, by the NW-oriented Quaternary Dinar Basin.

On the basis of > 1000 structural and kinematic data, in conjunction with basin stratigraphy, the DFZ can be divided into three almost parallel and continuous bands, that are: (a) the Hangingwall where Quaternary sediments are deformed by normal faults with mechanical striations; (b) the Inner Zone, corresponding to the present Dinar fault scarp, where NW-trending normal faults with mechanical striations are dominant, and (c) the Outer Zone, located in the footwall of the structure comprising the area between the fault scarp and undeformed bedrock, where faults exhibit variable orientation and kinematics, from strike-slip to normal dip-slip. These kinematics are mainly indicated by calcite shear veins and superimposed mechanical striations, respectively. This suggests that the DFZ changed kinematics over time, i.e., the DFZ initiated as dominant dextral strike-slip to oblique-slip fault system and continued with a dominant normal movement. Therefore, we hypothesize that the NW-trending DFZ was initially a transfer zone during the late Miocene–Pliocene, coeval to the sedimentary and structural evolution of the NE-trending Baklan, Acigöl and Burdur basins. During the Quaternary the DFZ, representing an already weakened crustal sector, played the role of a normal fault system providing the accommodation space for the Quaternary Dinar Basin. Hydrothermal circulation and volcanism at NE-/NW-trending faults intersection implies structurally-driven conduits channeling fluids from depth to surface.



## 1. Introduction

The closure of the Neotethys Ocean in the Eastern Mediterranean gave rise to the Tauride Orogeny during Late Cretaceous to Eocene times, and built the Lycian Orogenic belt (i.e. Lycian Taurides) in SW Anatolia (Robertson and Dixon, 1984; Şengör and Yılmaz, 1981; Şengör et al., 1985). After a micro-continental collision, the Lycian Orogen was affected by extensional tectonics since the latest Oligocene (Bozkurt, 2001, 2003; Yılmaz et al., 2000). The new deformational context derived from the favorable interplay between two different geodynamic processes (Fig. 1A): orogenic collapse and back-arc extension, the latter resulting from a combined effect of slab-pull along the Aegean–Cyprian trench system and the westward escape of the Anatolian microplate (Bozkurt and Mittwede, 2005), (Fig. 1A).

Although there is no general consensus on the age and number of extensional tectonic events in western Anatolia, most authors describe two distinct and superimposed extensional styles. The first one (latest Oligocene–middle Miocene) is characterized by exhumed and uplifted low-angle normal faults, with associated core complex structures and supradetachment basins. By contrast, the second extensional event is typified by high-angle normal faults, cross-cutting all previous structures and producing late Miocene–Quaternary tectonic depressions with different structural trends (Bozkurt, 2001, 2003; Koçyiğit et al., 1999; Purvis and Robertson, 2004; ten Veen et al., 2009; Yılmaz et al., 2000). From late Miocene to Pliocene, a broad array of NE-trending tectonic depressions (e.g., Çameli, Eşen, Çal, Baklan, Acıgöl, and Burdur basins) (Fig. 1B) developed influencing the palaeogeographic and sedimentary evolution of the area (Alçiçek, 2007; Alçiçek and ten Veen, 2008; Alçiçek et al., 2005; ten Veen, 2004; ten Veen et al., 2009). During

* Corresponding author. Tel.: +90 2582963378; fax: +90 2582963382.
*E-mail address:* alcicek@pau.edu.tr (M.C. Alçiçek).

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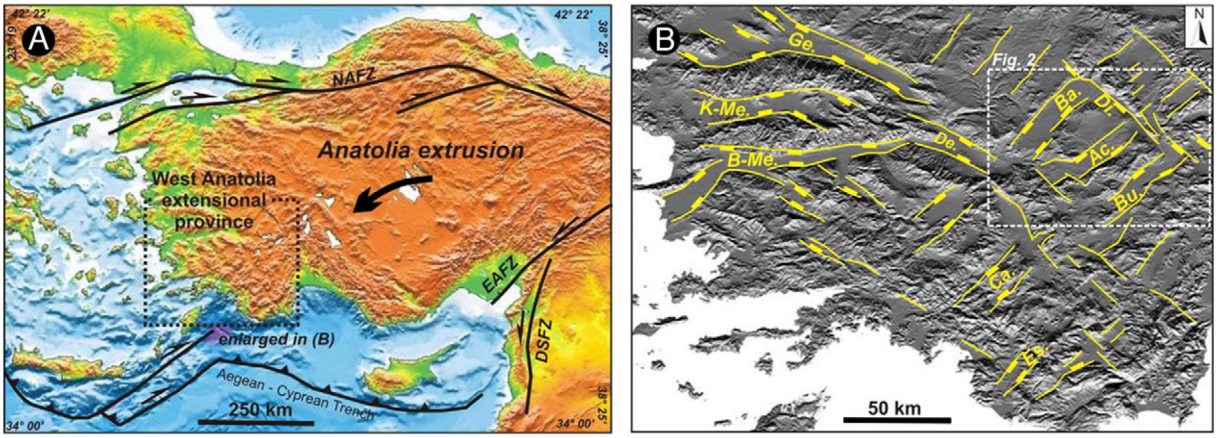


**Fig. 1.** A) physical map of Turkey with the main structures of the region. B) DEM of the southwestern part of Turkey illustrating the main Neogene–Quaternary tectonic depressions. Ge: Gediz Basin; K-Me: Küçük Menderes Basin; De: Denizli Basin; Ca: Çameli Basin; Es: Eşen Basin; Ba: Baklan Basin; Ac: Acigöl Basin; Bu: Burdur Basin; Di: Dinar Basin.

Quaternary, in addition to the NE-trending structural depressions, new NW-trending basins, partially superimposed to the previous ones, developed in response to the activation of the NW-trending normal faults (e.g., Dinar, Denizli, Gediz, Küçük Menderes and Büyük Menderes basins). Both the NE- and NW-trending fault systems are considered active today, as indicated by the location of earthquake epicenters (Ambraseys and Jackson, 1998; Angelier et al., 1981; Barka and Kandinsky-Cade, 1988), hydrothermal circulation, geomorphological features, and travertine deposition (Kele et al., 2011; Maddy et al., 2012; Wiersberg et al., 2011). The causes for the coexistence of differently oriented fault systems are related to the interaction between the progressive Anatolian plate escape, subsequent anti-clockwise rotation

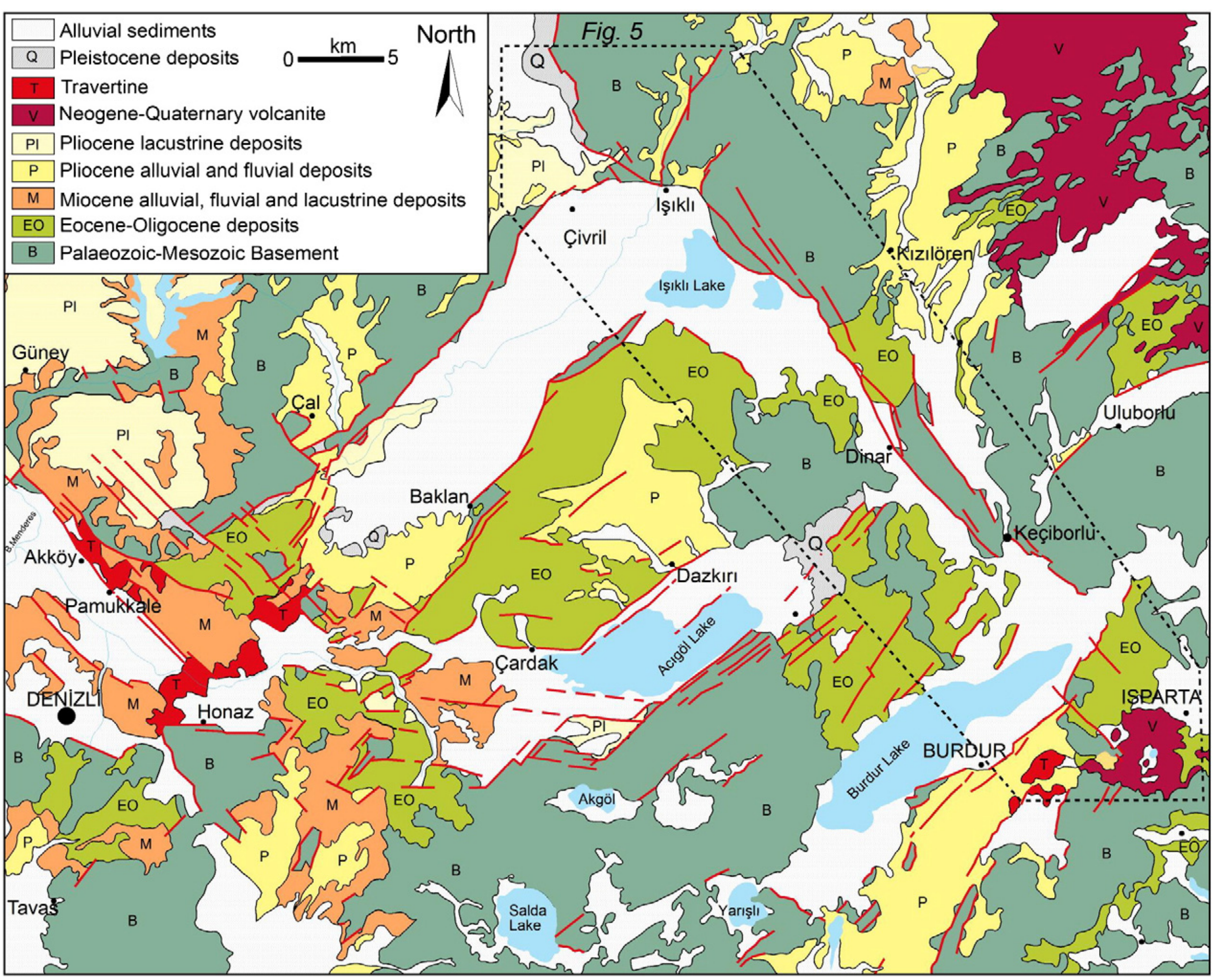


**Fig. 2.** Geological map of the Dinar Basin and surroundings (see Fig. 1 for location). The dashed line encompasses the area where structural and kinematic data have been collected (based on Konak, 2002; Konak and Şenel, 2002; Şenel, 2002; Turan, 2002; ten Veen et al., 2009).