SEISMOTECTONIC FEATURES OF AEGEAN-PELOPONNISOS PLATE AND THE POSITION OF THE FETHİYE-BURDUR FAULT ZONE, SW TURKEY

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ABSTRACT

The subduction of the African plate under the Aegean-Peloponnisos plate (APP) in NE direction along the Creta trench is one of the most important geotectonic events in the Eastern Mediterranean region. Close to westwards movement of the North Anatolian Fault (NAF), the APP moves to SW with a great velocity and extends in connection with this subduction. This study aims to find out seismotectonic features of the Fethiye-Burdur Fault Zone (FBFZ) representing southern boundary of the APP as well as its accompanying tectonic and geographic structures in SW Anatolia. The geographic structure in SW Anatolia, the so called "Isparta Angle" corresponding with the geometry of Gulf of Antalya, is one of the most important geotectonic structures located in the S of the APP. In neotectonic period, the Isparta Angle created by bending of Mesozoic carbonat axis of Taurides in N of Gulf of Antalya is delimited from FBFZ in the W and Akşehir-Simav fault in the E generally. The carbonate sequence located in the W of symmetric axis of Eğirdir-Kovada graben is Beydağ autochthonous, and autochthonous carbonates in the E form the Akseki-Anamas plattform. The FBFZ forming the southern boundary of the APP and delimiting the Isparta-Angle from the W is a sinistral fault of an en-echalon structure in NE direction. The FBFZ is a fault system consisting of parallel-semi parallel discontinous fault segments. The width of this fault zone, which displays about 300 km length between Burdur Lake and Gulf of Fethiye, ranges from 3 to 10 km. Mud dykes and collovial formations in the southern part of the Burdur Lake, remnants of topographic scarps around Hacılar and fracture fillings associated with earthquakes of 1914 can be considered as active fault imprints.

Recent GPS data prove that the APP in the northern part of the FBFZ extends with a velocity of 3 cm/year in SW direction. However, the same data indicate that no significant extention or movement in the S of the FBFZ within the Isparta-Angle occurred. In addition, the movement in SW direction of the APP surrounded by FBFZ resulted in the formation of active normal faults, such as Muğla-Yatağan, Acıpayam-Honaz, Dinar-Çivril and Akşehir-Simav in SW Anatolia. Paleomagnetic data indicate that the western part of the Isparta-Angle in SW Anatolia caused a 35-40 degrees counter clockwise rotation during Late Miocene to Early Pliocene. On the other side, the SW movement of Anatolian plate due to activities of North Anatolian Faults and East Anatolian Faults resulted in at least 45 degrees of clockwise rotation of the eastern part of the Isparta-Angle until Late Miocene. The inverse rotation of E and W parts of Isparta Angle caused imbricate thrust systems, reverse faults and conjugate strike-slip faults, such as Aksu-Anamas and Akdağ thrusts in SW Anatolia, which are still active today.

INTRODUCTION

The boundary between the African and Eurasion plates in the eastern Mediterranean region is characterized by the Hellenic arc and Pliny-Strabo trench in the west and Cyprus and related fault systems in the east (McKenzie, 1978; Rostrein, 1984; Dilek and Moores, 1990; Anastakis and Kelling, 1991; Taymaz et al., 1991; Glover and Robertson, 1998). The NE-trending and left lateral oblique-slip Fethiye-Burdur fault zone bounds the Isparta Angle to the west and is probably the continuation of the Pliny fault zone of the Hellenic arc (Yağmurlu et al., 1997). Also, the Fethiye-Burdur fault zone is not a single line, but consist of discontinuous northeasternly trending fault segments developed parallel to each other between Gulf of Fethiye and Burdur Lake (Fig. 1). The 1914, 1957 and 1971 eartquakes occurred within the Fethiye-Burdur fault zone, with magnitudes of 7.1, 7.0 and 6.1, respectively. The epicenter distribution of the last century eartquakes delaminates the continuation of the Burdur fault zone under the Aegean Sea to the Rhodos island (Yağmurlu, 2000).

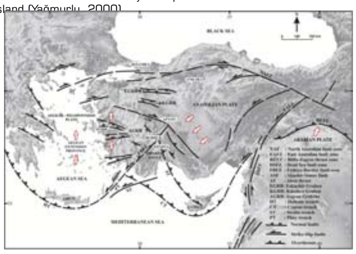

Fig. 1: The main tectonic lineaments and forces within the Western Anatolia (modified from Glover and Robertson, 1998; and Yağmurlu at al., 1997).

PRESENT TECTONIC STRUCTURES OF WESTERN ANATOLIA

Western Anatolia is charecterized by N-S and SW-NE oriented extensional neotectonic regime and with E-W, NE and NW-trending depression fields (McKenzie, 1970; Şengör, 1987; Şengör et al., 1985; Dumont et al., 1979; Koçyiğit, 1984; Seyitoğlu and Scott, 1991 and 1992; Price and Scott, 1991; Zanchi et al., 1990; Temiz et al., 1997). According to Yılmaz (2000), the Aegean region has been subjected to active N-S extensional tectonics, under the control of the westward movement of the Anatolia plate bounded by the North Anatolian and East Anatolian faults. The last measurements in and around Turkey reveal a coherent motion of central and southern Aegean region toward SW at 30±1 mm/yr relative to Eurasia (McClusky et al., 2000).

REGIONAL GEOLOGY OF SW ANATOLIA

The Isparta Angle is one of the most prominent neotectonic structure within the SW-Anatolia located in the northern region of Antalya Gulf (Fig. 2). The NE-trending Fethiye-Burdur fault zone and NW-trending Akşehir fault limits the Isparta Angle from the west and east, respectively. The Isparta Angle province contains two Mesozoic carbonate platform, the Beydağları west of the Gulf of Antalya and Akseki-Anamas to the east (Yağmurlu et al., 1997). The platforms are seperated and tectonically overlain by the allocthonous nappe systems of Antalya ophiolitic complex in the south (Dilek and Moores 1990; Dilek and Rowland, 1993).

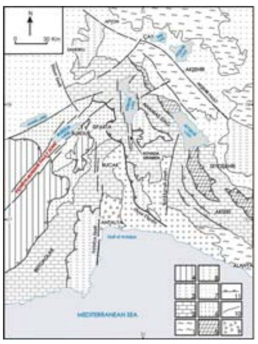

Fig.2: Simplified geological map of the Isparta Angle and surrounding areas (modified from Yağmurlu et al., 1997; Glover and Robertson, 1998). (1) Paleozoic metamorphic rocks, (2) Platform-type Mesozoic carbonate sequence, (3) Antalya nappes, (4) Lycian nappe complex, (5) Beyşehir-Hoyran nappes, (6) Marine Tertiary sediments, (7) Continental Neogene sediments, (8) Neogene volcanic rocks,(9)Antalya travertines, (10) Normal faults, (11) Overthrusts

The Lycian and Beyşehir-Hoyran ophiolitic nappes are thrust over the Isparta Angle to the west and east, respectively. According to previous studies (Hayward and Robertson, 1982; Dilek and Moores, 1990; Poisson et al., 2003) both the Lycian and Beyşehir-Hoyran nappes were emplaced from North to South on the Mesozoic carbonate platforms during the Middle to Late Tertiary. The Lycian ophiolitic nappes are thrust over the Menderes metamorphic massif to the north along the Muğla-Denizli line.

Isparta Angle was rotated anticlockwise, whereas the Anamas-Akseki platform in the eastern side of Isparta Angle rotated clockwise by about 40° since the Eocene, due to N-S extension of Aegean and westward motion of Anatolian block, respectively (Kissel et al. 1993). Recent geodynamic analysis (Oral, 1994; McClusky et al., 2000) suggests that the Isparta Angle has very little to no motion relative to Eurasia, in contrast, central Anatolia moves in a SW-direction about 30 mm/yr.

SEISMOTECTONIC CHARACTERITICS OF THE BURDUR FAULT ZONE

The NE-trending en-echalon Fethiye-Burdur fault zone which limits the Western Anatolia to the south has left lateral oblique in character and is exposed for 400 km in the SW-Anatolia (Figs. 1 and 3). Locally the fault bounds several Plio-Quaternary basins within the Fethiye-Burdur fault zone which are developed between the Gulf of Fethiye and the Burdur region, such as Burdur Lake . Along the fault zone the Plio-Quaternary lacustrine sediments and recent slope deposits cut with the stepwise active faults branch of Fethiye - Burdur fault zone (Fig. 4). Locally, the folding and dipping Quaternary sedimentary beds and sandy and mud dykes and also erupsions of H2S gases can be seen along the fault zone .Also, the epicenters are arranged along the faults zone (Fig. 5).

The epicenters of the 1914, 1957 and 1971 destructive eartquakes are within the Fethiye-Burdur fault zone, with magnitudes of 7.1, 7.0 and 6.1, respectively (Table 1). The location of these large last century events is an obviuous manifastation of the NE-SW extent of the Burdur fault zone which continues under the Meditteranean Sea toward the Rhodos (Yağmurlu, 2000).

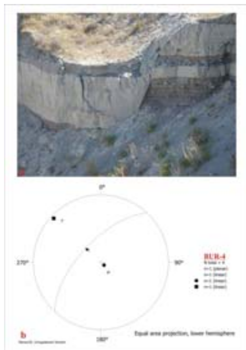

Fig. 3: Positions of the segments within the Fethiye-Burdur fault zone between Gulf of Fethiye and Burdur Lake (Yağmurlu ve diğ., 2005).

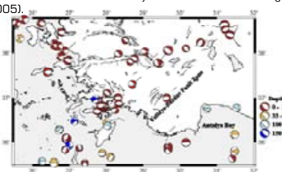

Fig. 4: Showing of the active faulting of the segment of Burdur-Tefenni in the field of Kum Ocakları location: (a) equal area projection from measurements of strike and dip and (b) P: Pole; T: Tensor.

Fig. 5: The distribution of the recent earthquakes in SW Anatolia and their fault solutions.

Table 1: The destructive eartquakes and their magnitudes and locations within the last century between Burdur and Fethiye region (Demirtaş et. al. 2000)

Date	Location	Magnitude (M)
07.08.1925	Dinar, Afyon	5.9
08.02.1926	Milas, Muğla	4.7
03.10.1914	Burdur	7.1
23.05.1941	Muğla	6.0
13.12.1941	Muğla	5.7
25.04.1957	Fethiye, Muğla	7.1
25.04.1959	Köyceğiz, Muğla	5.7
14.01.1969	Fethiye, Muğla	6.2
12.05.1971	Burdur	6.2
01.10.1995	Dinar, Afyon	5.9

CONCLUSIONS

According to GPS measurements (Oral, 1994; McClusky et al., 2000), the Burdur fault zone is the southern limit of the Aegean extensional region. This region characterized by a coherent motion toward the SW at 30 – 1 mm/yr relative to the Isparta Angle. Seismic data for SW Anatolia from the last century indicate that the Burdur fault zone continues to the under the sea of the Gulf of Fethiye to Rhodos. According to field observations and fault plane solutions of recent earthquakes, the Burdur fault is a left lateral oblique fault and consists mainly of several NE-trending en-echalon fault systems.

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