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Paleoseismological features and tectonic setting of the Fethiye-Burdur Fault Zone (SW Turkey)

Coşkun Sarı[1], Züheyr Kamacı[2], Fuzuli Yağmurlu[3], Emre Timur[1], Murat Şentürk[3] & Mustafa Bozcu[4]

Abstract. The Fethiye-Burdur fault zone is not a single line. Still, it consists of discontinuous northeasterly trending fault segments developed parallel to each other between the Gulf of Fethiye and Burdur Lake. The NE-trending and left-lateral oblique-slip Fethiye-Burdur fault zone bounds the Isparta Angle to the west and is probably a continuation of the Pliny fault zone of the Hellenic arc. Year 1914, 1957, and 1971 earthquakes occurred in the Fethiye-Burdur fault zone, with magnitudes of 7.1, 7.0, and 6.1, respectively. The epicenter distribution of the earthquakes of the last century indicates the continuation of the Fethiye-Burdur fault zone under the Gulf of Fethiye, probably to Rhodos Island.
According to GPS measurements, the Fethiye-Burdur fault zone is the southern limit of the Aegean extensional region. The Aegean region is characterized by coherent motion toward the SW at 30 mm/yr relative to the Eurasian plate. Field observations and fault plane solutions of recent earthquakes in and around the Burdur Lake region reflect normal and left-lateral oblique faulting considering the NE extension of the fault zone.
According to the proposed kinematic model, the different seismotectonic behaviors of the Fethiye-Burdur fault zone originate in the rigid influence of Yeşilova peridotite massif of the Lycian nappes that occur to the SW of Burdur Lake. The kinematic interactions between the mainly NE-trending enechelon fault constituents of the Fethiye-Burdur fault zone result in different seismotectonic characteristics. Consequently, a new kinematic model is obtained for Burdur Lake and its surroundings.

Key words:
Fethiye-Burdur fault zone, seismicity, fault-plane solutions, seismotectonic.

Апстракт. Раседна зона Fethiye-Burdur не представља један расед већ се састоји од дисконтинуираних раседних сегмената са североисточном вергенцом који су формирани паралелно један са другим између залива Fethiye и језера Burdur. Fethiye-Burdur раседна зона са североисточним трендом и левим бочним косим кретањем ограничава Isparta Angle на западу и вероватно представља наставак раседне зоне Плиније у хеленском луку. Земљотреси из 1914., 1957. и 1971. године догодили су се у раседној зони Fethiye-Burdur, са магнитудом од 7,1, 7,0 и 6,1. Дистрибуција

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епицентара земљотреса из прошлог века указује на наставак раседне зоне Fethiye-Burdur испод Фетијеског залива, вероватно до острва Родос.
Према GPS мерењима, раседна зона Fethiye-Burdur представља јужну границу егејске екстензионе области. Егејски регион се карактерише уједначеним кретањем према југозападу брзином од 30 mm/god. у односу на Евроазијску плочу. Теренска осматрања и модели раседних површи недавних земљотреса, унутар и око области језера Burdur, одражавају нормално и лево-бочно косо раседање имајући у виду СИ екстензију раседне зоне.
Према предложеном кинематском моделу, различита сеизмотектонска понашања раседне зоне Fethiye-Burdur потичу од ригидног утицаја Yeşilova перидотитског масива навлаке Lycian, а која се дешавају на југозападу језера Burdur. Кинематске интеракције, између углавном СИ вергентних паралелних раседних сегмената Fethiye-Burdur раседне зоне, резултирају различитим сеизмотектонским карактеристикама. Сходно томе, добијен је нови кинематски модел за језеро Burdur и његову околину.

Кључне речи:
Раседна зона Fethiye-Burdur, сеизмичност, модели раседних површи, сеизмотектоника.

Introduction

The boundary between the African and Eurasian plates in the eastern Mediterranean region is characterized by the Hellenic arc and Pliny-Strabo trench in the west (Fig. 1) and Cyprus and related fault systems in the east (McKenzie, 1978; Rostrein, 1984; Dilek & Moores, 1990; Anastakis & Kelling, 1991; Taymaz et al., 1991). The NE-trending and left lateral oblique-slip Fethiye-Burdur fault zone (FBFZ) bounds the Isparta Angle to the west and is probably the continuation of the Pliny fault zone of the Hellenic arc (Barka et al., 1995; Yağmurlu et al.,2005; Bozcu et al., 2007). Most of the researchers who investigated the region stated that the fault systems in the FBFZ may be faults accompanying a shear zone (Ocakoğlu, 2012; Özbakir et al., 2013; Hall et al., 2014; Elitez et al., 2016; Elitez & Yaltirak, 2016). As stated by all the authors who researched the region, the Fethiye-Burdur fault zone is not a single line. Still, it consists of discontinuous northeasterly trending fault segments developed parallel to each other between the Gulf of Fethiye and Burdur Lake**.**

In recent studies in the region by Dolmaz (2007), who stated that the contours in the Bouguer anomaly map generally extend NE–SW and NW–SE in the west of the study area and NW–SE in the east, these contours are in good agreement with the aeromagnetic anomalies and general geological directions. The crust in SW Anatolia had a thickness between 33 and 37.5 km obtained from the Bouguer gravity data. Öksüm et al. (2019) state that the modeled graben structure obtained from the interpretation of gravity anomalies along the regional direction of the Burdur Basin emphasizes a half-graben geometry and that the basin is deeper in the south and shallower in the North. They also explained that the deepest part of the depression is in the south of Burdur Lake at a depth of about 3.2 km. Elitez et al. (2016) stated that the Burdur-Fethiye Shear Zone started where the late Tortonian–early Pliocene age carbonate lakes were found in the Middle Miocene. They emphasized that this zone, claimed by new radiometric ages, previous studies, and geological maps, is in stark contrast with the Late Pliocene–early Pleistocene period.

Apart from these studies, Erdoğanet al. (2008) determined the tectonic movements of the Fethiye-Burdur fault zone with GPS. Coşkuner & Aksoy (2020) investigated the Northeastern section of the Fethiye-Burdur Fault Zone from a geomorphological point of view.

Year 1914, 1957, and 1971 earthquakes 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 of earthquakes delineates the continuation of the Fethiye-Burdur fault zone under the Aegean Sea to the Rhodos island (Barka et al., 1995; Yağmurlu, 2000).

This study aims to (1) review the geological setting of the Fethiye-Burdur fault zone within the SW-Anatolian structure, (2) demonstrate the relationship

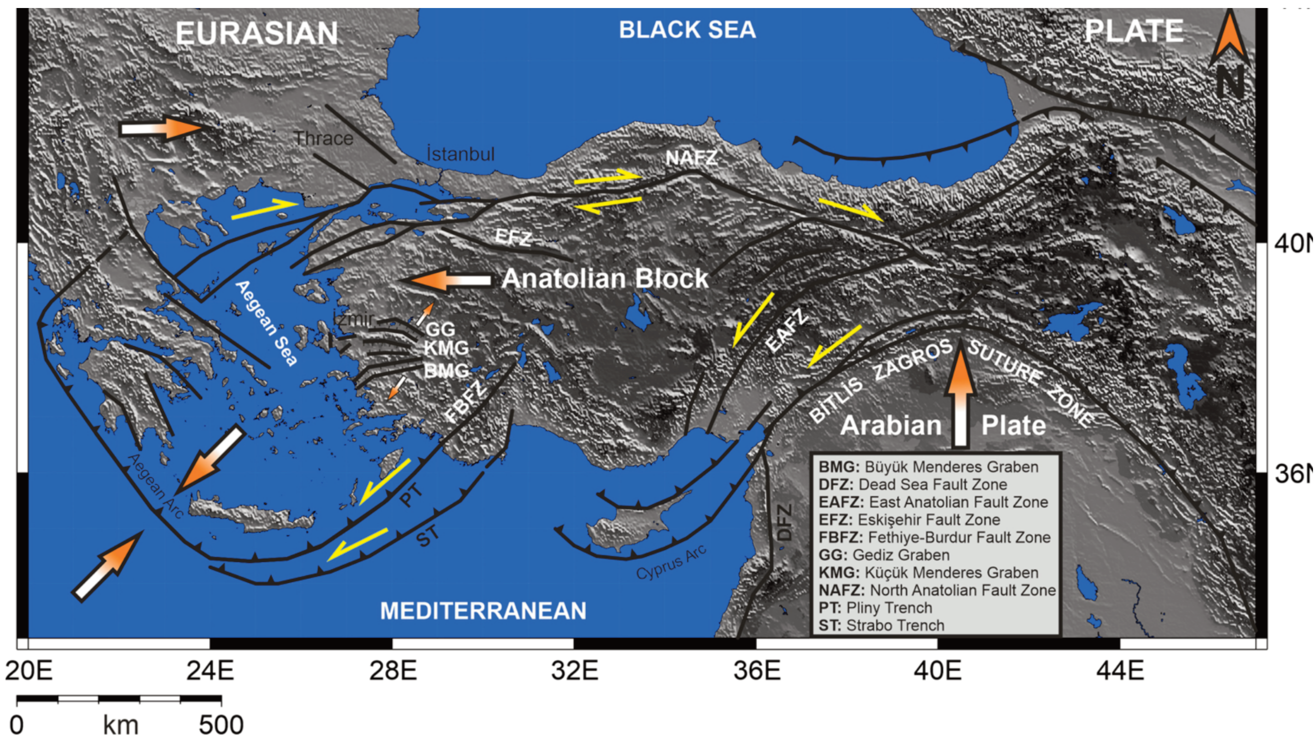

Fig. 1. *The distribution of major fault systems in Western Anatolia and surroundings and the geological setting of the Fethiye-Burdur Fault Zone (modified from Glover & Robertson, 1998; Bozcu et al., 2007). It is shown in this figure that the FBFZ is also a discontinuity separating the Cyprus and Hellenic arcs.*

between the seismic character of the Fethiye-Burdur fault zone and regional geological structure in the SW-Anatolia and surroundings, and (3) present paleoseismological evidence based on trench studies and fault-plane solutions of recent small to moderate earthquakes.

Present tectonic structures of Western Anatolia

Western Anatolia is characterized by a 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 & Scott, 1991, 1992; Price&Scott, 1991; Zanchi et al., 1990; Barka et al., 1995; Temiz et al., 1997). According to Yilmaz (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 the central and southern Aegean region toward SW at 30±1 mm/yr relative to Eurasia (Fig. 2) (McClusky et al., 2000).

The southeastern Aegean region deviates significantly from this coherent motion, rotating counterclockwise and moving SW towards the Hellenic trench at 10±1 mm/yr relative to the southwestern Aegean (Barka et al., 1995; McClusky et al., 2000).

The above kinematic model, supported by GPS data for Anatolia and the Aegean Sea region (McClusky et al., 2000), is very similar to that initially proposed by McKenzie (1970).

According to the studies mentioned above, the extensional velocity of the SW Aegean-Peloponnisos plate is approximately 30±1 mm/yr relative to the Isparta Angle. This differential extensional rate between the Aegean and Isparta Angle resulted in the NE-trending and left lateral oblique-slip Fethiye-Burdur fault zone within SW-Anatolia.

Regional geology of SW-Anatolia

The Isparta Angle is one of the most prominent neo-

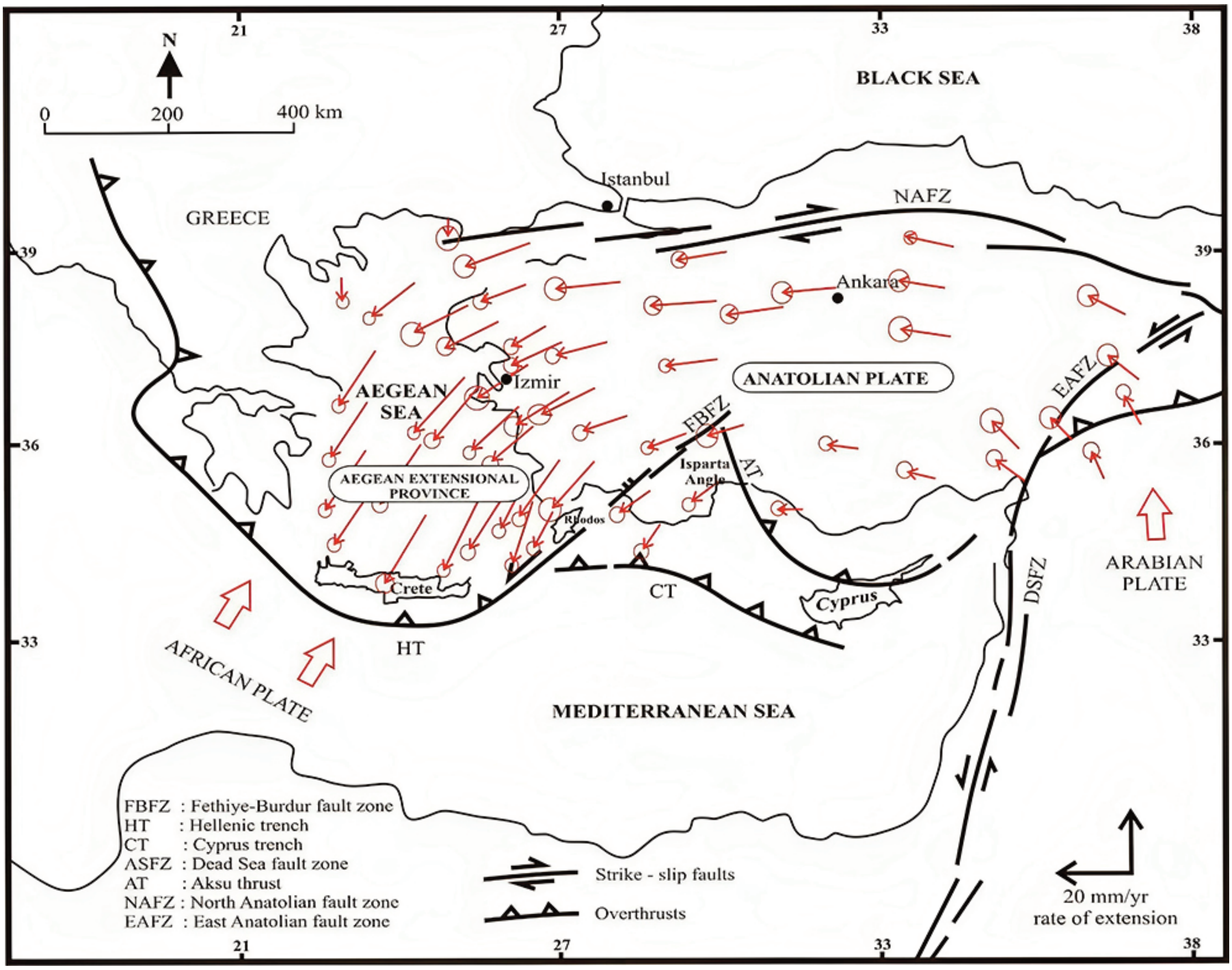

Fig. 2. *GPS horizontal velocities in Western Anatolia and surrounding area for period 1988-1997. There is a slight motion in the Isparta Angle (modified from Barka et al., 1995; McClusky et al., 2000). Accordingly, the FBFZ also forms the southern border of the Aegean extensional region.*

tectonic structures within SW-Anatolia in the northern region of Antalya Gulf (Fig. 3). The NE-trending Fethiye-Burdur fault zone and NW-trending Akşehir fault limit the Isparta Angle from the west and east, respectively. The Isparta Angle province contains two Mesozoic carbonate platforms, the Beydağları west of the Gulf of Antalya and Akseki-Anamas to the east (Yağmurlu et al.,2005). The platforms are separated and tectonically overlain by the allochthonous nappe systems of the Antalya ophiolitic complex in the south (Dilek & Moores, 1990; Dilek & Rowland, 1993).

Dilek & Rowland (1993) suggested that a NE-trending rift zone developed between the Beydağları and Anamas-Akseki carbonate platforms during the Early Triassic–Jurassic and that rift assemblages and oceanic crust constituents formed in this triangular-shaped rift zone. This ocean probably started to close by E–W compression during the Late Maastrichtian-Early Paleocene period. The rift sediments and ophiolites were thrust over the Beydağları and Anamas-Akseki carbonate platforms in the west and east, forming the Antalya nappes (Fig. 3).

The Lycian and Beyşehir-Hoyran ophiolitic nappes are thrust over the Isparta Angle to the west and east, respectively. According to previous studies (Hayward & Robertson, 1982; Dilek & Moores, 1990; Poisson et al., 2003), both the Lycian and Beyşehir-Hoyran nappes were emplaced from North to South

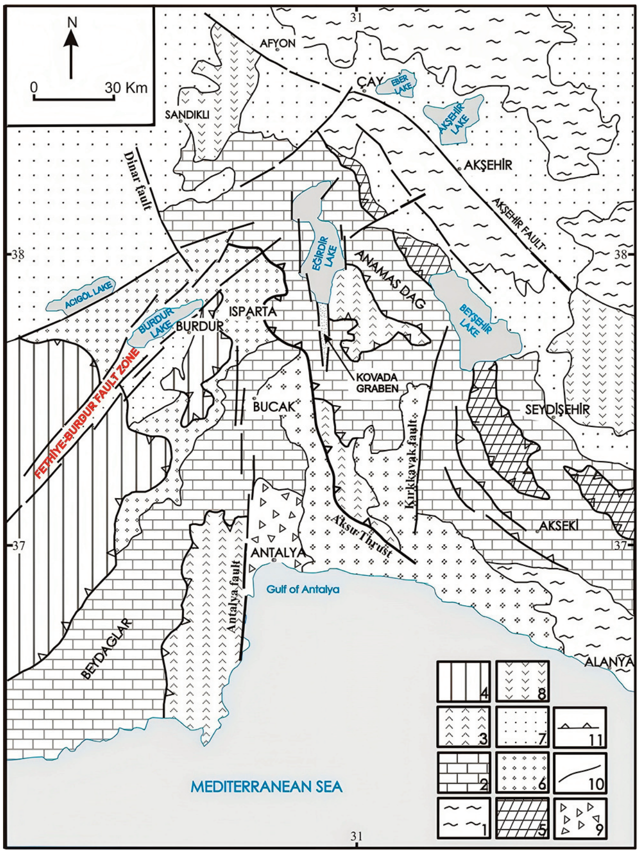

***Fig. 3.** Simplified geological map of the Isparta Angle and surrounding areas (modified from Glover & Robertson, 1998; Yağmurlu et al., 2005). **1.** Paleozoic metamorphic rocks; **2.** Platform-type Mesozoic carbonate sequence; **3.** Antalya nappes; **4.** Lycian nappe complex; **5.** Beyşehir-Hoyran nappes; **6.** Marine Tertiary sediments; **7.** Continental Neogene sediments; **8.** Neogene volcanic rocks; **9.** Antalya travertines; **10.** Normal faults; **11.** Overthrusts.*

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.

The Lycian nappes between Lake Burdur and the Gulf of Fethiye region consist mainly of chert, radiolarite, diabase, serpentinite, and limestone blocks within a turbiditic matrix. Also, there are some giant peridotite nappes such as Yeşilova and Fethiye-Göcek peridotite massifs in this region. Further to the southwest of the Burdur Lake area, local chromite-bearing Yeşilova peridotites cover about 100 square kilometers and occur within the NE-trending Fethiye-Burdur fault zone (Fig. 4). The NE-trending fault segments cut the Yeşilova peridotite massif in several places. Also, the Yeşilova peridotites are limited by the NW-trending Acıpayam graben faults to the southwest.

Paleomagnetic studies (Kissel et al., 1993) indicate that the Lycian block west of the Isparta Angle was rotated anticlockwise. In contrast, the Anamas-Akseki platform on the eastern side of the Isparta Angle rotated clockwise by about 40° since the Eocene due to the Aegean's N–S extension and the Anatolian block's westward motion.

Recent geodynamic analysis (Barka et al., 1995; McClusky et al., 2000) suggests that the Isparta Angle has very little motion relative to Eurasia. In contrast, central Anatolia moves SW at about 30 mm/yr. For this reason, the NE-trending enechelon Fethiye-Burdur fault zone, which limits Western Anatolia to the south, is left lateral oblique in character and exposed for 400 km in SW-Anatolia (Figs. 1–3). Locally the fault bounds several Plio–Quaternary basins within the Fethiye-Burdur fault zone, developed between the Gulf of Fethiye and the Burdur region, such as Burdur Lake.

The Fethiye-Burdur fault zone contains four main structural segments more than 40 km long (Fig. 4). From SW to NE, the main FBFZ segments are the Fethiye segment (indefinite length, ruptured in 1958 earthquake), Gölhisar segment (50 km, ruptured in antic period), Tefenni segment (40 km), and Burdur segment (more than 50 km, ruptured in 1914 and 1971).

NE-trending normal and left-lateral fault systems forming the FBFZ around Burdur Lake are mostly observable between recent alluvium and weakly consolidated Neogene lacustrine sediments. For this reason, fault surfaces of the FBFZ can be found very rarely around Burdur Lake. These faults, which feature a stepped structure, developed parallel to each other and cut the recent lacustrine sediments and coarse-grained slope deposits in most places. Therefore, the stepped topographic structure is controlled by faults typically observed around Burdur Lake and in the city center of Burdur. In addition, the folding and dipping of the Quaternary sedimentary layers, sand and mud dykes, and discharges of H_2S gas can be seen locally along the fault zone (Figs. 5, 6).

On the other hand, Burdur Lake and the surrounding area have different seismotectonic characters,

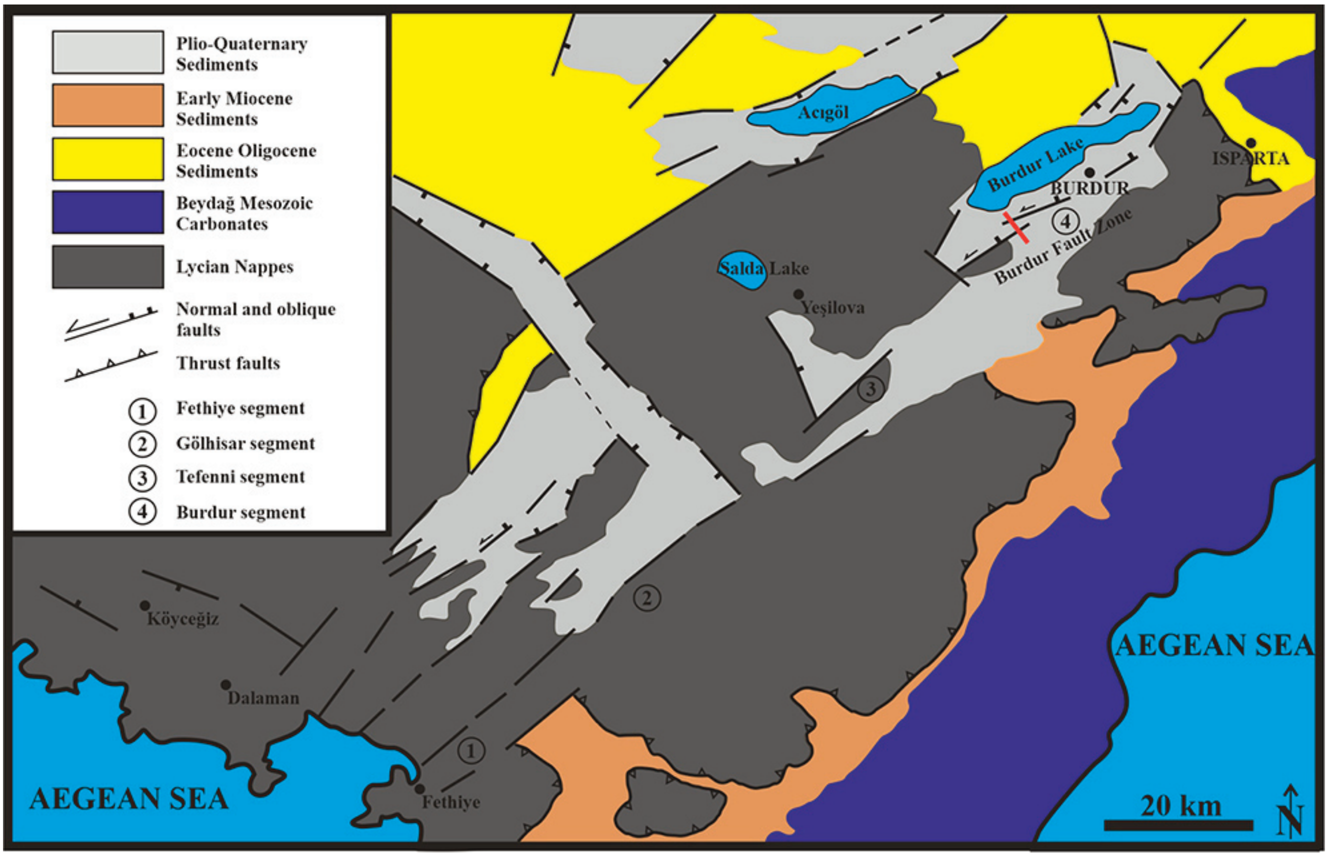

Fig. 4. *Distribution and locations of major fault systems and segments in the Fethiye-Burdur fault zone. Accordingly, the FBFZ, which dominantly extends NE, is divided into four segments by faults striking NW between Burdur Lake and Fethiye Bay (Yağmurlu et al., 2005). The red line indicates the geological cross-section.*

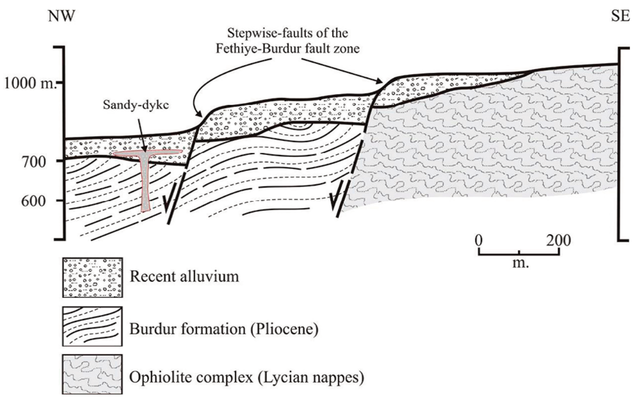

Fig. 5. *A geological cross-section showing the tectonic settings of the stepwise fault branches in the south of Burdur Lake within the Fethiye-Burdur fault zone (Yağmurlu et al., 2005). There are syntectonic deformation structures (such as dipping of beds, muddy-dykes, and surface rupture fills) in the Plio-Quaternary lacustrine sediments and recent slope deposits along the fault zone.*

Fig. 6. *The fault plane within the Burdur segment of the FBFZ in an outcrop. This fault plane, which cuts the current soil cover and slope debris in the region, must have been a hereditary surface rupture from the 1914 earthquake (Burdur Kum Ocakları location).*

mainly indicating normal and left lateral oblique faulting. Field investigations in the southern part of Burdur Lake also show normal and left lateral oblique faulting characteristics on several fault scarps. In addition to field observations of these fault surfaces, stereographic analyses are essential to show that the faults in the region are primarily normal and left oblique-slip (Figs. 7, 8). The stereographic

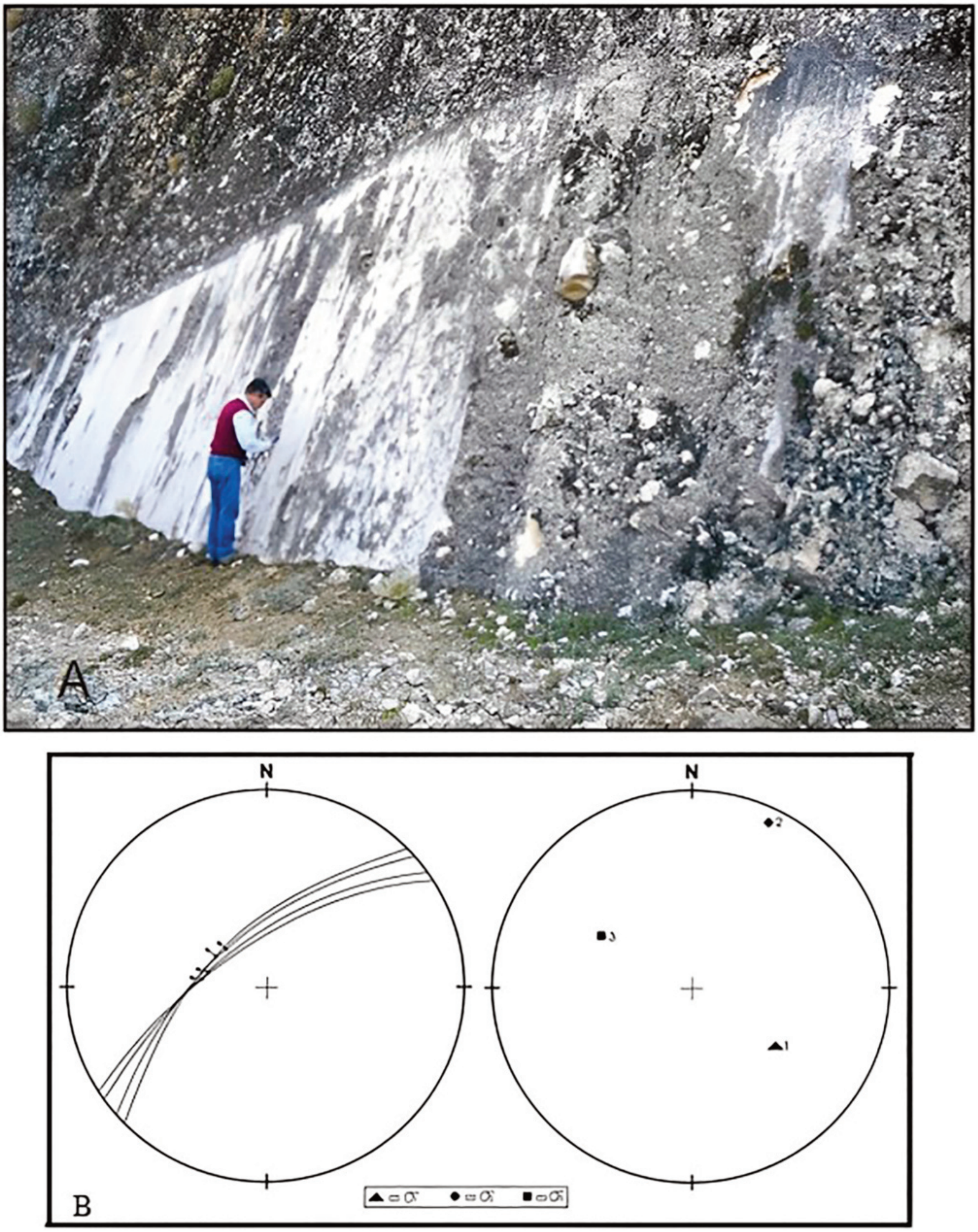

Fig. 7. A) *The fault scarp and slip-strike stereographic plots of normal fault plane measurements and* ***B)*** *direction of main stress (max., s_1; average, s_2; and min., s_3), Pınarbaşı-Tefenni location, (Yağmurlu et al., 2005).*

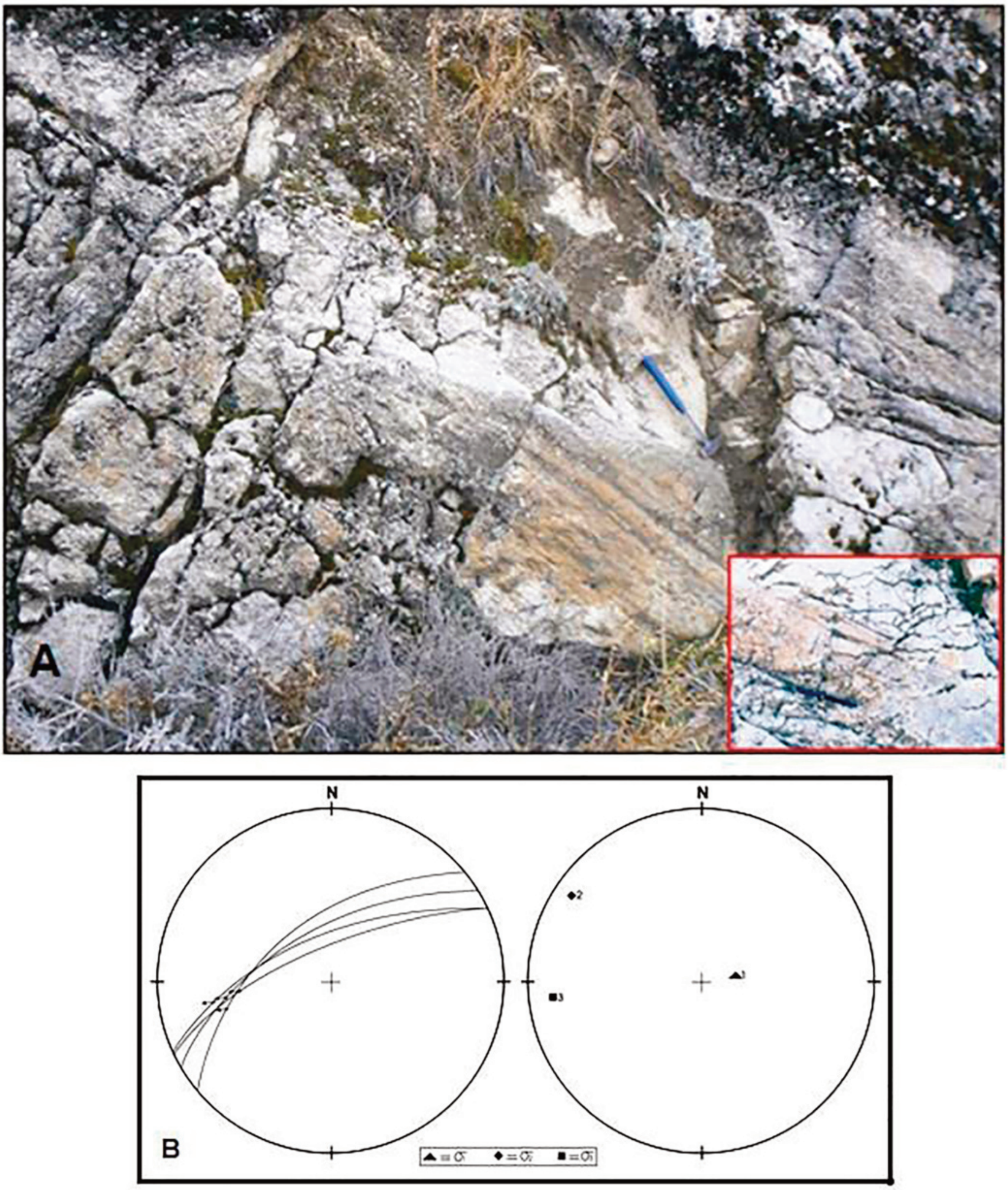

***Fig. 8. A)** Fault scarp and their slip-strike (above), stereographic plots of left lateral oblique fault plane measurements and **B)** direction of main stress (max., s_1; average, s_2; and min., s_3), near Yassıgüme location, (Yağmurlu et al., 2005).*

analysis results of the fault surfaces reveal that NW–SE and NW–SSE extensional forces have affected the region. These results are consistent with the regional geological and tectonic structure of the Aegean-Peloponnisos plate north of the FBFZ.

Paleoseismological characteristics of the Fethiye-Burdur fault zone

The Fethiye-Burdur fault zone is one of the most essential active tectonic lineaments in SW-Anatolia.

Table 1. *Destructive earthquakes and their magnitudes and locations within the last century between the Burdur and Fethiye regions (after* Demirtaş *et al., 2000).*

DATE	LOCATION	MAGNITUDE (M)
03.10.1914	BURDUR	7.1
07.08.1925	Dinar/AFYON	5.9
08.02.1926	Milas/MUĞLA	4.7
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
15.12.2000	Sultandağı/AFYON	5.8
03.02.2002	Çay/AFYON	6.4

The epicenters of 1914, 1957, and 1971 destructive earthquakes arewithin the Fethiye-Burdur fault zone, with magnitudes of 7.1, 7.0, and 6.1, respectively. The location of these significantevents is an obvious manifestation of the NE-SW extent of the FBFZ zone, which continues under the Meditteranean Sea toward Rhodos (Barka et al., 1995; Yağmurlu, 2000). The fault plane solutions of more minor recent earthquakes (Mw>3.0) from 1997-2023 within Burdur Lake and its surrounding area are given in Tables 1 and 2 (Kamaci et al., 2005).

Bozcu et al. (2007) stated that the FBFZ is one of the essential active faults of SW Anatolia and is dominated by NE-trending fault systems developed parallel to each other. Based on field data, the same authors pointed out that NE trending fault systems within the FBFZ are mostly left oblique-slip normal in character and are locally interrupted by NW trending

Table 2. *Focal mechanism parameters and fault plane solutions for earthquakes between 1997 and 2023 (after* Kamaci *et al., 2005).*

No	Date	Time	Lat (N)	Long (E)	Strike (deg)	Dip (deg)	Rake (deg)	Mw	Depth (km)	VR (%)
1	14-06-1997	02:21	37.91	30.26	101	23	62	3.3	6	93
2	17-04-1998	10:36	37.78	30.48	52	70	-26	4.0	15	86
3	17-04-1998	10:38	37.78	30.48	48	69	-34	3.7	15	76
4	17-04-1998	16:16	37.78	30.48	46	70	-32	4.2	15	81
5	17-04-1998	16:24	37.78	30.50	49	75	-18	4.4	15	80
6	24-04-1998	05:23	37.80	30.50	52	71	-20	4.2	15	75
7	26-04-1998	12:12	37.80	30.50	49	75	-18	3.7	15	84
8	29-06-1999	00:54	37.70	30.90	4	22	-54	4.2	6	95
9	06-07-1999	18:45	37.68	30.84	336	13	-71	3.3	6	88
10	26-08-1999	05:37	37.85	31.00	18	49	-92	4.1	6	85
11	02-02-2001	09:51	37.64	30.19	252	49	-78	4.5	6	86
12	03-04-2002	22:57	37.71	30.26	234	57	-78	4.0	3	81
13	05-04-2002	07:38	37.61	30.25	245	53	-75	3.9	6	82
14	19-11-2002	19:12	37.79	30.41	82	68	-89	3.8	6	93
15	06-03-2003	01:22	37.98	30.50	218	57	-42	3.4	14	82
16	08-04-2003	10:41	37.99	30.98	63	75	-78	3.9	3	81
17	06-06-2003	02:54	37.74	29.89	73	12	-116	3.4	3	87
18	26-02-2004	18:31	37.77	30.97	40	48	26	3.3	20	62
19	14-05-2004	16:34	37.50	29.58	222	71	-100	4.5	6	81
20	10-04-2005	20:03	37.60	29.99	187	24	-125	3.9	7.9	87
21	30-03-2007	21:22	37.99	30.90	221	46	-82	4.0	5.0	94
22	17-04-2010	12:40	37.89	30.64	65	76	-42	3.9	6.59	91
23	17-04-2014	19:34	37.77	30.88	214	39	-69	3.8	13.72	88
24	24-08-2014	19:43	37.64	30.63	238	50	-77	4.8	7.58	95
25	23-07-2018	02:40	37.53	29.84	160	16	-133	4.6	17.58	93
26	08-08-2019	14:19	37.82	29.61	100	48	-83	4.2	17.70	89
27	26-11-2019	20:03	37.84	29.61	308	50	-92	4.0	7.0	91
28	07-09-2021	09:42	37.79	29.63	286	38	-87	3.9	15.22	90
29	27-01-2022	06:38	37.79	30.85	12	34	-46	3.2	6.9	84

grabens and normal faults (for example, Acıpayam and Ören faults). On the other hand, these investigations pointed out that the FBFZ continues to the SW under the sea, south of Rhodos Island, up to the Pliny trench. In these articles, the authors emphasize that the FBFZ also meets the continuation of the fault systems limiting the Pliny trench in SW-Anatolia. According to the authors, the FBFZ and its submarine continuation in the Pliny fault system have the characteristics of a transform fault, as it separates the Cyprus and Hellenic trenches.

After Bozcu et al. (2007) evaluated the FBFZ, geological investigations of the SW-Anatolia region gained momentum. Some authors (Ocakoğlu, 2012; Özbakir et al., 2013; Hall et al.,2014; Elİtez & Yaltirak, 2016; Elİtez et al., 2016) stated that the FBFZ is a continuation of the Pliny and Strabo trenches on land and forms a shear zone, based on field observations and geophysical data. The authors emphasized that this shear zone corresponds to a transform zone separating the Hellenic and Cyprus trenches. This result was used by Bozcu et al. (2007) to confirm the tectonic model related to FBFZ.

The fault plane solutions and the present-day earthquake activity within SW-Anatolia are given in Fig. 9. The alignment of epicenters of recent earthquakes is generally parallel to the FBFZ and mainly extends to the NE. Fault solutions of these earthquakes are important in showing that normal and left oblique faulting developed dominantly in the region.

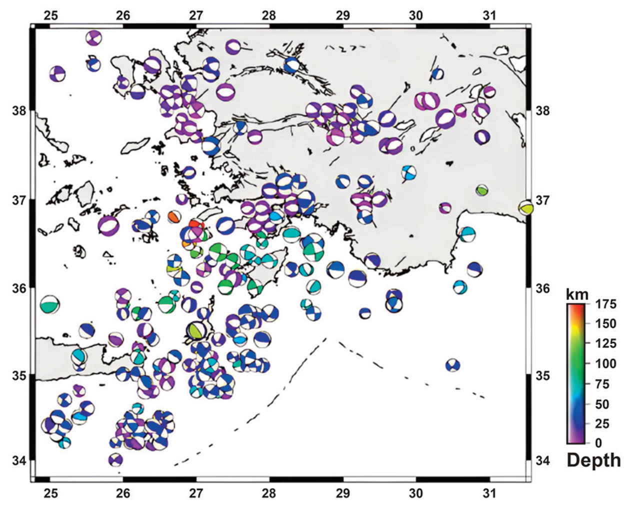

Fig. 9. Faulting mechanism distribution of earthquakes occurring along Southwest Anatolia and the FBFZ (Canbay, 2009). The NE direction of earthquake epicenters in the region between Burdur Lake and Rhodes Island on this map is essential in terms of showing that the FBFZ continues under the sea.

The locations of damaging earthquakes that occurred in Lake Burdur and its vicinity in the last century and their fault-plane solutions, and the elongation of the surface fractures are shown in Fig. 10. As can be seen, most of the earthquakes represent the activity of normal and left oblique-slip faults, which predominantly extend NE in the region.

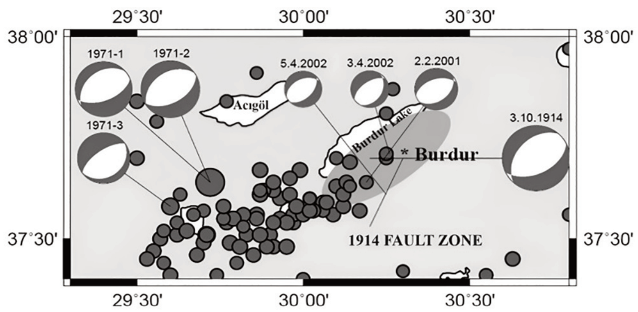

Fig. 10. Faulting mechanisms of some earthquakes in Burdur Lake and its vicinity. The dates on the fault mechanism diagrams reflect the earthquake dates. The solid grey ellipse shows possible surface faulting for the 1914 earthquake. In the charts associated with the 1971 Burdur earthquake, the earthquakes numbered 1971-1, 1971-2, and 1971-3 are the faulting mechanisms of the largest foreshock, mainshock, and the largest aftershock, respectively (Eyİdoğan et al., 1991).

Interpretation of gravity data of the Burdur-Isparta-Antalya region

The study area is between the coordinates of 30.0–31.0 E and 37.0–38.5 N (MTA, 1979), including the Burdur, Isparta, and Antalya regions. Gravity data were digitized from the Turkish Regional Bouguer Gravity map prepared by MTA on the 1/500.000 scale. The sampling interval was set at 5 km, and the data were evaluated with 2-D and 3-D data analysis methods.

The Bouguer gravity map (Fig. 11) indicates a clear anomalous zone with low values between –75 and –85 mGal trending NE–SW near the Isparta-Burdur region. This trend is closely related to the Fethiye-Burdur fault zone and the Pliny Trench to the SW of the fault. A negative anomaly is observed

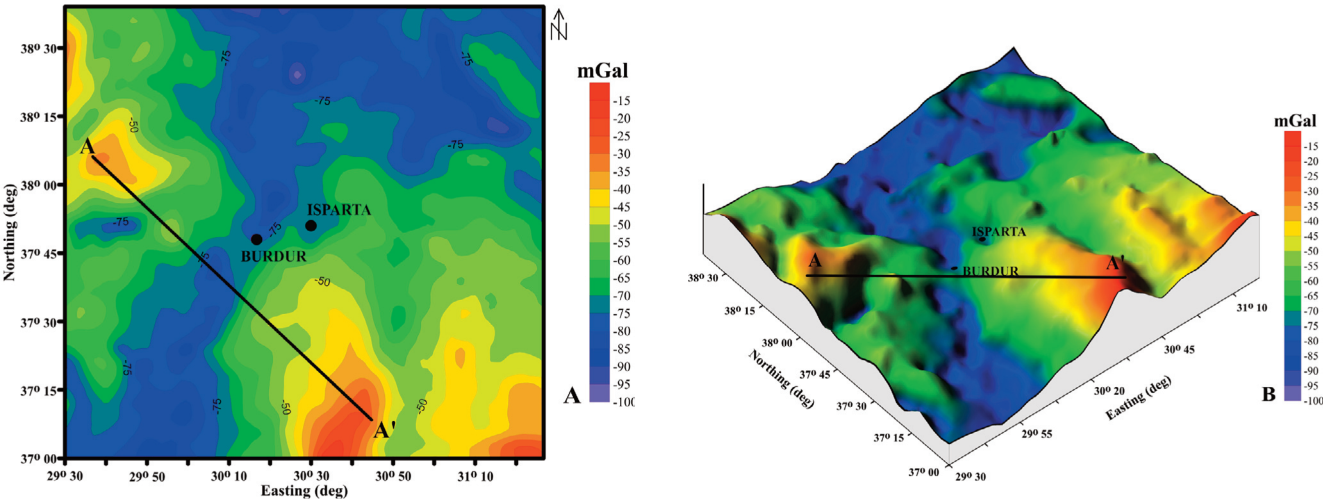

Fig. 11. A) *Bouguer gravity anomaly map (contour interval 5 mGal),* ***B)*** *Bouguer gravity anomaly map 3-D Relief showing (contour interval 5 mGal).*

in the N–NE of the region where Neogene sediments and Paleozoicmetasediments exist. Anomaly values increase towards Antalya Bay gradually and reach a maximum over the bay. The reason seems to be the uplift of the brittle upper crust due to divergence in Antalya Bay. The Fethiye-Burdur fault zone can be observed in the 4th-degree residual trend map (Fig. 12) in the NE–SW direction. Besides, the N–S extending KovadaGraben, invisible in the Bouguer map, can be traced clearly in the trend map.

2-D inversion of gravity anomalies for the basement structures was carried out according to procedures by Murthy & Rao (1989). This procedure determines depths to the top of the basement below each point of gravity along a profile. The density structure is equated to a series of juxtaposed prisms, one below each anomaly point, and the depths to their tops are determined. The 3-D inversion scheme with variable densities developed by Rao & Babu (1991) was employed to determine the base topography of the field from residual Bouguer-anomaly maps. For this, a sedimentary basin may be viewed as several vertical prisms of half-thickness T and half-width W placed in juxtaposition at each observation point. Each prism is assumed to be placed just below the observation point, and Δx and Δy are the station spacing in the x and y directions. This method was used to calculate the basement topography of a sedimentary basin using a constant density value.

The depth of the base structure in the NE-SW direction in the residual gravity anomaly map (Fig. 13) was calculated as 20–24 km (for a density contrast of –0.35 g/cm^3). The base topography shows an evident rise near Antalya Bay of up to 5–6 km. The depth of the base of the BurdurBasin was determined to be approximately 16 km by applying 2-D inversion to the residual gravity data in the cross-section A–A' using a sampling interval of 2.5 km (Fig. 14).

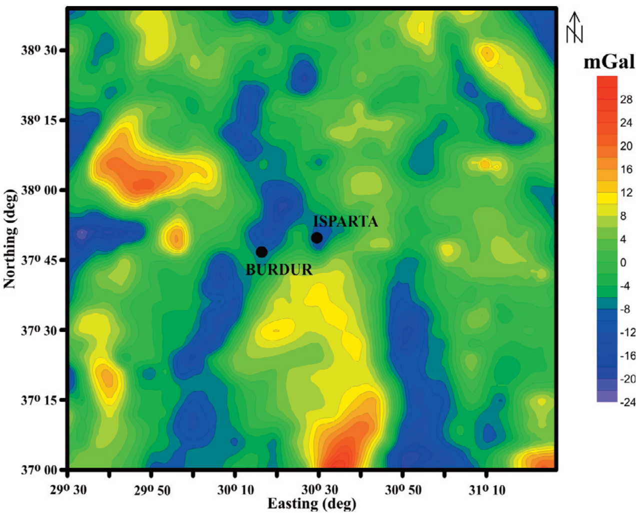

Fig. 12. *Fourth degree trend map of gravity residual.*

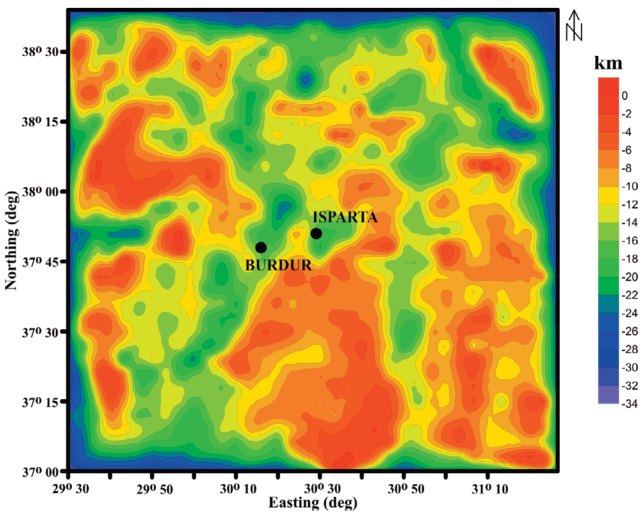

Fig. 13. *Depth of subsurface topography by gravity inversion using a constant density contrast of –0.35 g/cm³ (contour interval 2 km.).*

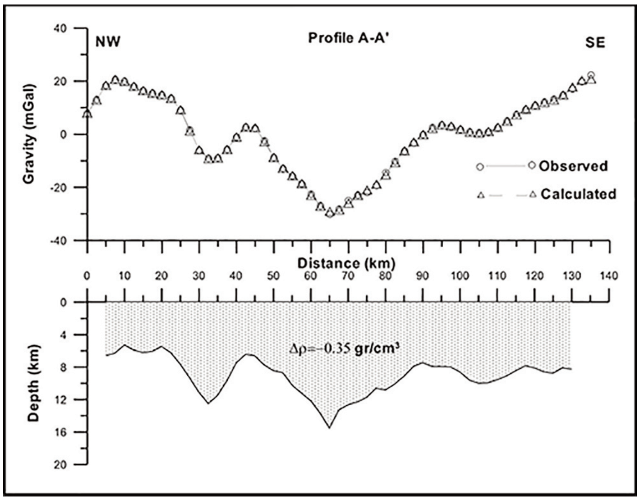

Fig. 14. *Interpreted Bouguer gravity profile A–A' by 2-D inversion method (density contrast of –0.35 g/cm³).*

Discussions and Conclusions

The FBFZ, which constitutes SW-Anatolia's most crucial active fault zone and limits the Isparta Angle from the west, also forms the southern border of the Aegean extensional zone. Most NE trending fault systems within the FBFZ consist of normal and left oblique-slip faults. The region's geological, morphological and seismic data show that the FBFZ continues under the sea to the SW and up to the Pliny trench south of Rhodos Island. Most regional researchers have stated that the FBFZ and its submarine continuation as the Pliny fault system that separates the Cyprus and Cretan trenches in the area have the characteristics of a transform fault.

A geodynamic model has been developed and is summarized in Fig. 15 to explain the normal and left lateral oblique faulting mechanism shown in present earthquakes in and around the Burdur Lake area. As shown in Fig. 15, Burdur Lake and the surrounding district are mainly influenced by two tectonic forces, NE–SW, and NW-SE trending extensions, due to the SW motion of West Turkey and the development of the Aegean graben systems.

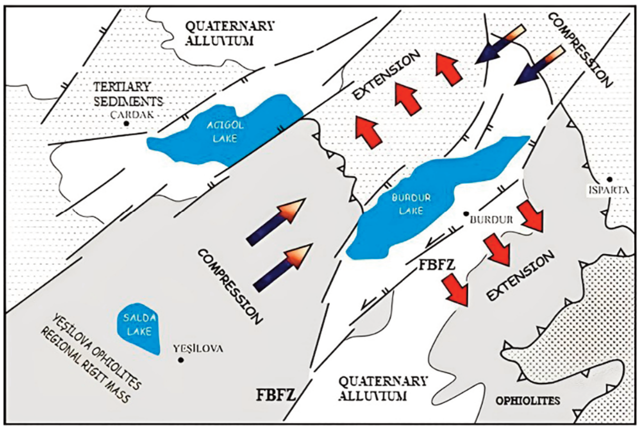

Fig. 15. *Geodynamic model for the formation of normal and left-lateral oblique faulting along the Fethiye-Burdur Fault Zone (FBFZ) in Burdur Lake and the surrounding area (modified from* Yağmurlu *et al., 2005).*

Our proposed model is based on field observations, gravity, and focal mechanism data. The GPS data in Fig. 2 show that SW Turkey moves uniformly south-westward. The slip vectors of several significant events in these regions coincide with these GPS vectors' azimuth. For example, the October 1, 1995, earthquake occurred on an NW-SE extending normal fault where the hanging-wall block moved SW. However, the field observations (Figs. 5–8) and the focal mechanisms of the events (Figs. 9, 10) depict the NW-SE sense of motion around Burdur Lake, where the events in the southern part of the lake show NW motion and the events to the north of the lake show motion to the SE. Although the SW Turkey region moves SW on a regional scale, activity at the local scale around Burdur Lake contradicts the regional scale motion. This motion implies that the tectonic driving forces acting in the Burdur Lake region are different from the regional ones. It is evident from the gravity data that the roots of the Lycian nappe complex extend down to 16 km. This rigid mass could be the obstacle causing NW-SE differential motion. This rather exotic model needs to be tested using GPS data. Unfortunately, the present-day GPS network lacks stations in the regions of the NE and SW of Burdur Lake. We, therefore, leave the testing of our claims to further studies.

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Резиме

Палеосеизмолошке карактеристике и тектонско окружење раседне зоне Fethiye-Burdur (ЈЗ Турска)

Границу између Афричке и Евроазијске плоче у источном Медитерану карактеришу Хеленски лук и Pliny-Strabo ров на западу, као и Кипар и одговарајући системи раседа на истоку. Раседна зона Fethiye-Burdur ограничава Isparta Angle на западу и вероватно представља продужетак Pliny раседне зоне из Хеленског лука. Овај рад има за циљ да: (1) прикаже геолошке карактеристике раседне зоне Fethiye-Burdur у оквиру ЈЗ Анадолије, (2) укаже на везу између сеизмичког карактера раседне зоне Fethiye-Burdur и регионалних геолошких структура у ЈЗ Анадолији и околини, и (3) да представи палеосеизмолошке доказе засноване на проучавању рова и моделима раседних површи недавних малих до умерених земљотреса.

Isparta Angle је једна од најистакнутијих неотектонских структура унутар ЈЗ Анадолије у северном делу Анталијског залива. Раседна зона Fethiye-Burdur са североисточном вергенцом и расед Akşehir са северозападном вергенцом ограничавају Isparta Angle са запада и истока. Провинција Isparta Angle је изграђена од две мезозојске карбонатне платформе. Beydağları карбонатна платформа се налази западно од Анталијског залива, а Akseki-Anamas карбонатна платформа је на истоку. Платформе су раздвојене и покривене алохтоним системима навлака Анталијског офиолитског комплекса на југу. Рифтна зона са СИ трендом се развила између ове две карбонатне платформе у периоду од раног тријаса до јуре. Океан је вероватно почео да се затвара током касног мастрихта-раног палеоцена. Рифтни седименти и офиолити који су навучени преко карбонатних платформи Beydağları и Akseki-Anamas на западу и истоку, формирали су Анталијску навлаку.

На основу предложеног геодинамичког модела, језеро Burdur и околина су углавном под утицајем две тектонске силе са СИ–ЈЗ и СЗ–ЈИ екстензионим трендом, услед кретања Западне Турске ка ЈЗ и развоја егејског грабенског система.

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