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ORIGINAL PAPER

The Kefalonia Transform Zone (offshore Western Greece) with special emphasis to its prolongation towards the Ionian Abyssal Plain

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Abstract Information concerning two seismic lines, the first located northwest of the Lefkada Island and the second from the deep Ionian basin to the gulf of Patras, is used to trace the Kefalonia Transform Zone (KTZ) and to explore its relation with the sedimentary sequences and the deeper geologic structures in the study area. In addition, sea bottom topography and fault plane solutions are combined in order to explore the prolongation of the KTZ into the Ionian Abyssal Plain (IoAP) and to describe its properties. The boundary between the subduction of the eastern Mediterranean oceanic crust under the overriding continental crust and the KTZ is well constrained by the seismic data in association with seismicity and regional stress field. The southern prolongation of the KTZ is located in the IoAP towards the direction between Kefalonia and Zakynthos Islands at depth greater than 15 km. The southern part of the KTZ exhibits a strike–slip motion with a thrust component according to fault plane solutions of moderate and strong earthquakes. The seismic section mostly confirms the existence of the thrust component and gives information about the tectonic status east and west of the KTZ.

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Abbreviations

Bas	crystalline basement
Ca	Mesozoic carbonates of the Pre–Apulian Zone
CDP	Common Depth Points
HT	Hellenic Trench
IoAP	Ionian Abyssal Plain
KTZ	Kefalonia Transform Zone
Me	Mesozoic sequence
Mess, P–Q	Messinian, Plio–Quaternary sediments
Me/Pa	Mesozoic–Palaeozoic sediments
Mi–Pli	Upper Miocene–Lower Pliocene sediments
Moho	Moho discontinuity
MR	Mediterranean Ridge
my	million years
Pa	Palaeozoic sequence
Pli	Pliocene–Pleistocene sedimentary sequence
Pre–Mess	Pre–Messinian sediments
P–Q	Plio–Quaternary sediments
TWT	two way travel time

Introduction

The higher sea–floor spreading rate in the South Atlantic Ocean compared to the North Atlantic causes a counterclockwise rotation of the African plate resulting in an increasing lithospheric shortening from west to east, responsible for the major tectonic events in the Mediterranean–Alpine region (Mueller and Kahle 1993). Plate tectonic reconstructions (Olivet et al. 1982) show that for the last 80 my (million years), Africa has been moving north relative to Eurasia resulting in the gradual closure of the Tethyan ocean as Tethyan oceanic lithosphere is subducted. Convergence and eventual collision has led to the formation of the Alpine–Himalayan belt. Two major subduction zones, associated with the collision of the African and Eurasian plates, characterize the Eastern Mediterranean region, namely the Calabrian and the Hellenic arcs (Fig. 1A).

The Hellenic arc, along which the subduction of the eastern Mediterranean lithosphere under the Aegean Sea takes place (Papazachos and Comninakis 1971), constitutes the predominant tectonic feature of the Aegean region which is one of the most active seismic regions of the Alpine–Himalayan belt. The seismicity is very high throughout the arc, which is dominated by thrust faulting with a NE–SW direction of the axis of maximum compression. Thrust faulting is also observed along a belt that runs along the southwestern coasts of Yugoslavia and continues south along the coastal regions of Albania and northwestern Greece, which is connected with the continental collision between Outer Hellenides and the Adriatic microplate. The direction of the maximum compression axis is almost normal to the direction of the Adriatico–Ionian geological zone. Between continental collision to the north and oceanic subduction to the south, in the area of central Ionian Islands, dextral strike–slip faulting is observed, in agreement with the known relative motion of the Aegean and eastern Mediterranean. This dextral strike–slip faulting, namely the Kefalonia Transform Zone (KTZ), has been recognized as a major

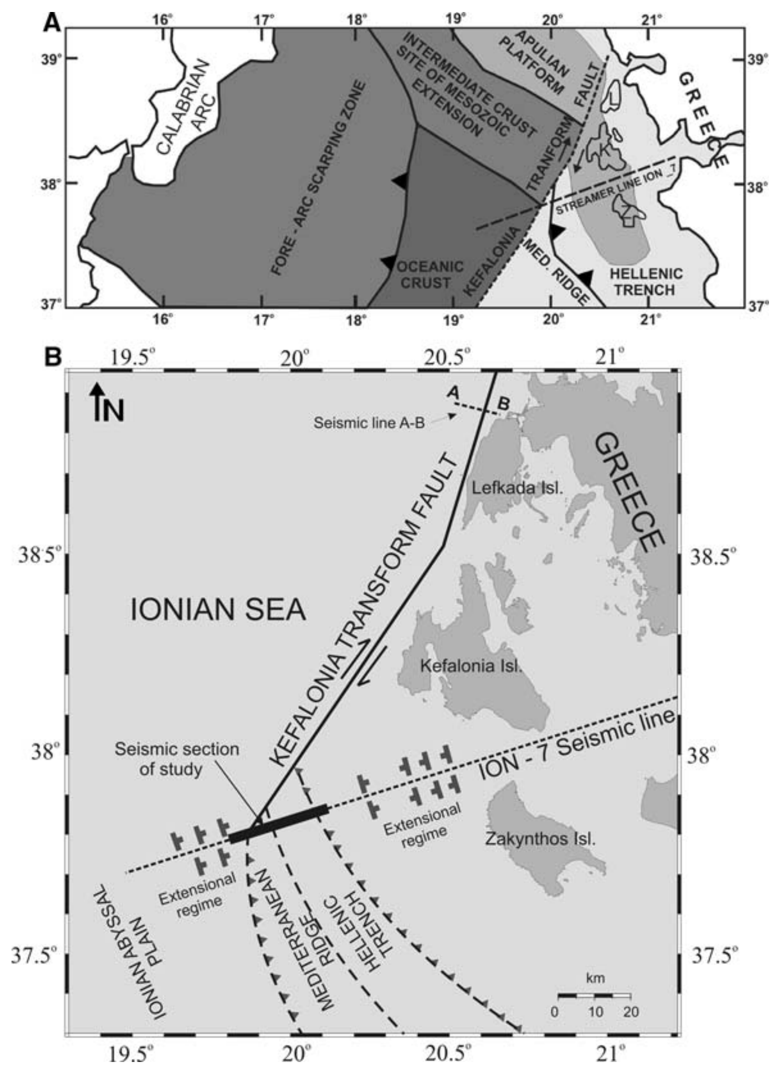

Fig. 1 (A) Map of the Ionian Sea based on Underhill (1989) structural configuration (modified after Finetti 1982). (B) Map of the studied area where the main tectonic structures are depicted. The seismic lines ION–7 and A–B are also illustrated

discontinuity between the Apulian platform and the West Hellenic arc. It was first suggested by Scordilis et al. (1985) who found that the 1983 Kefalonia earthquake (M7.0) has a dextral strike–slip mechanism. The importance of the KTZ is emphasized by structural trends onshore (Cushing 1985; Sorel 1989; Underhill 1989; IGME 1983) and offshore (Finetti 1982), by the alignment of earthquakes (Amorese 1993) and GPS observations (Kahle et al. 1993, 1995).

The area of the present study (Fig. 1B) is possibly floored by oceanic crust (Makris et al. 1986; Underhill 1989), which is being subducted beneath the Hellenic and Calabrian arcs. High Bouguer anomalies at the center of the Ionian Abyssal Plain (IoAP) (+300 mGal, Morelli et al. 1975) are consistent with the thinned crust proposed by Hinz (1974) in the southern IoAP. The KTZ, an active dextral wrench zone, separates the oceanic crust from the end–wedge of the Mediterranean Ridge (MR) (Finetti 1982).

In this paper, we confine the presence of the KTZ in two seismic sections (Fig. 1B) recorded obliquely and perpendicularly to its main strike, attempting to interpret the relation of strong deformed sedimentary sequences with this zone, along with its properties. The seismic section located in the northeastern part of the KTZ is presented for first time, while the seismic section located in the southwestern part of the KTZ comprises part of a seismic line (ION–7) that was already presented (Kokinou et al. 2003, 2005). In these publications there was not detailed interpretation of the KTZ in connection with seismological data. Seismic data and fault planes solutions of the strong and moderate events, occurred in the study area in the last four decades, are combined well in the present work, in order to study the KTZ attributes.

A smoothed and generalized velocity model is also presented that corresponds to the presented part of seismic line ION–7. This modeling approach includes identification of the properties of the southern part of the KTZ and shows the relation of the KTZ to the sedimentary sequences and deeper interfaces. This interpretation is combined with the sea bottom topography and used in order to define the southern prolongation of the KTZ to the IoAP, and thus the northwestern end of the Hellenic Arc, thus exploring its properties. For this purpose, reliable fault plane solutions of the stronger earthquakes that occurred in the study area, a segment of a deep reflection profile and information concerning the sea–bottom topography are pieced together. For simplicity reasons, in the next paragraphs we refer to segments of the KTZ by labeling them according to the near located island.

Seismotectonic properties

The study area constitutes the most active zone of shallow seismicity in the broader Aegean region. It has attracted the interest of various researchers since it accommodates the highest seismicity in western Eurasian area, being a key structure from the seismotectonic point of view. It comprises the northwestern part of the Hellenic arc and its complexity that is investigated in this paper, can be observed from the earthquake fault plane solutions, their location, and the bathymetry (Fig. 2). Information on the fault plane solutions of the strong and moderate events that occurred in the study area during the last four decades is taken either from waveform modeling studies or from CMT Harvard routine analysis and is given in Table 1. Earthquake location (Papazachos et al. 2005) evinces that the seismicity is well confined in a narrow zone running along the western coast of Kefalonia Island and in the sea area southwestwards, which is bounded by a steep bathymetric slop. Earthquakes are more widely distributed to the south in the area of Zakynthos Island.

Thrust faulting prevails in Zakynthos Island and the offshore area to its west, where the subduction front is fairly well constrained by earthquake location and fault plane solutions. A minor or considerable strike–slip

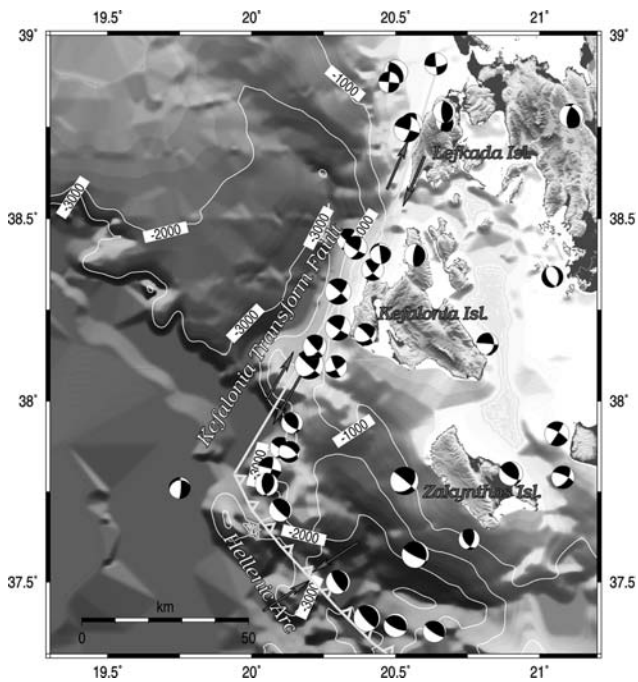

Fig. 2 Morphology and fault plane solutions of the stronger events that occurred in the study area during the last four decades. The major tectonic features, the Lefkada and Kefalonia Faults and the front of the Hellenic Arc, are also shown

Table 1 Source parameters of earthquakes that occurred in the area of Lefkada, Kefalonia and Zakynthos Islands and for which fault plane solutions are available

Year	Origin		Epicenter		Depth (km)	M	Mechanism (deg)			Ref.
	Date	Time	Lat. (°N)	Long. (°E)			Strike	Dip	Rake	
1959	Nov. 15	170843.00	37.780	20.530	12.0	6.8	46	37	–173	1
1968	Mar. 28	073959.00	37.800	20.900	23.0	5.9	354	34	+137	2
1969	Jul. 8	080913.00	37.500	20.300	12.0	5.9	353	18	+116	1
1972	Sep. 17	140715.00	38.300	20.300	8.0	6.3	45	68	–174	1
1973	Nov. 4	155213.9	38.900	20.500	23.0	5.8	324	50	+81	2
1976	May 11	165945.00	37.400	20.400	16.0	6.5	335	14	+106	1
1976	June 12	005920.30	37.380	20.500	24.0	5.8	297	20	+90	3
1981	June 24	184127.80	37.872	20.100	20.0	5.2	27	60	+171	4
1981	June 28	172023.01	37.814	20.063	14.0	5.7	15	76	+180	5
1983	Jan. 17	124131.00	38.100	20.200	11.0	7.0	39	45	+175	1
1983	Jan. 19	000213.99	38.149	20.219	9.0	5.7	41	49	+171	5
1983	Jan. 31	152701.25	38.182	20.394	12.0	5.6	41	82	–177	5
1983	Feb. 21	001308.53	37.860	20.131	24.0	5.2	75	42	–134	4
1983	Mar. 23	235106.32	38.200	20.300	7.0	6.2	31	69	+174	1
1983	Mar. 24	041731.72	38.095	20.292	18.0	5.4	62	70	+172	5
1983	May 14	231347.94	38.442	20.335	13.0	5.5	36	86	+167	5
1985	Sep. 7	102049.60	37.375	21.229	29.0	5.4	24	57	+168	6
1987	Feb. 27	233453.85	38.420	20.360	13.0	5.7	26	61	+168	5
1988	May 18	051742.23	38.360	20.420	23.0	5.4	45	70	+163	5
1988	Oct. 16	123404.00	37.910	21.060	29.0	6.0	32	87	–166	7
1989	Aug. 24	021314.21	37.940	20.140	16.0	5.2	36	46	+142	5
1991	June 26	114333.88	38.340	21.044	22.0	5.2	151	51	–105	6
1992	Jan. 23	042418.68	38.400	20.570	9.0	5.6	345	19	+68	5
1993	Mar. 26	115818.47	37.660	21.300	14.7	5.4	30	86	+150	7
1994	Feb. 25	023049.54	38.758	20.555	9.0	5.4	22	58	+168	5
1994	Apr. 16	230934.19	37.364	20.634	22.0	5.6	304	14	+90	5
1994	Nov. 29	143030.36	38.872	20.477	9.2	5.1	185	90	–180	7
1996	Feb. 1	175759.00	37.770	20.052	20.0	5.6	173	55	+71	5
1997	Nov. 18	130741.08	37.576	20.568	23.0	6.6	352	17	+144	6
1998	May 1	040014.57	37.618	20.755	13.0	5.1	19	53	+31	6
1999	June 11	075016.43	37.700	21.273	60.0	5.2	304	82	–177	7
2000	May 26	012822.54	38.922	20.640	15.0	5.5	176	89	–159	7
2002	July 28	171637.20	38.156	20.819	22.2	5.3	7	42	–178	7
2002	Dec. 2	045901.40	37.790	21.081	15.0	5.6	36	56	–160	7
2002	Dec. 9	093506.10	37.760	19.750	15.0	5.2	3	81	–116	7
2003	Aug. 14	053224.30	38.744	20.539	13.0	6.3	16	72	+178	8
2003	Aug. 14	121814.65	38.766	20.675	6.0	5.1	211	68	+118	8
2003	Aug. 14	161803.18	38.792	20.669	8.0	5.4	179	67	+95	8
2003	Nov. 16	72252.86	38.404	20.447	15.0	5.1	173	89	+114	7
2005	Jan. 30	010527.00	37.700	20.100	15.9	5.7	344	16	+117	7

1. Papadimitriou (1993); 2. Baker et al. (1997); 3. Anderson & Jackson (1987); 4. Benetatos et al. (2004); 5. Louvari et al. (1999); 6. Louvari (2000); 7. Harvard solution; 8. Benetatos et al. (2005).

component is present in some of these fault plane solutions, being more clearly from the west to the east. The transition from thrusting to strike–slip faulting north from about 37.8°, is manifested by both epicentral alignment and fault plane solutions. The identification of a dextral strike–slip fault with a thrust component that strikes in a SW–NE direction and dips to SE was done by Scordilis et al. (1985). They used first onsets of long period waves for the strong 1983 Kefalonia earthquake (17.1.1983, $M = 7.0$) and for its larger aftershock (23.3.1983, $M = 6.2$) as well as the spatial distribution of aftershocks to determine their focal properties. The mainly strike–slip motion of the Kefalonia fault segment was confirmed by waveform modeling for the 1983 earthquake by Kiratzi and Langston (1991) and for the 17 September 1972 ($M = 6.3$) earthquake by Papadimitriou (1993). The entire strike–slip fault zone follows the submarine Kefalonia valley west of the island chain from Lefkada to Kefalonia. Historical data show that the seismicity rate of the strong ($M \geq 6.5$) main shocks in this zone remained stable during the last four centuries with an average of about one such shock per decade (Papadimitriou and Papazachos 1985). Several large ($M \geq 7$) events have repeatedly destroyed urban areas as it is reported by historical information, while smaller magnitude earthquakes ($6 \leq M \leq 7$) that occurred during the 20th century, also produced extensive damage and loss of life in this area. Maximum earthquake magnitude reported for this fault is equal to 7.4 (Papazachos and Papazachou 2003). North of Kefalonia Island the dextral strike–slip zone is continued with the Lefkada segment that strikes in a north–northeast direction, dips to the east–southeast and is characterized by dextral strike–slip motion combined with a small thrust component (Louvari et al. 1999). The seismotectonic properties and the geometry of this fault segment were further detailed by the study of the 2003 seismic sequence (Karakostas et al. 2004). Historical information and instrumental data show that earthquakes with magnitudes up to 6.7 have repeatedly struck this fault segment (Papazachos and Papazachou 2003).

The seismic sections of ION–7 and A–B

The seismic line ION–7 (Fig. 1b, 3, 4) is located at the western part of the External Hellenides that formed during Tertiary times as a result of the convergence between the Eurasia continent and Apulian Platform (African plate) which initiated at the end of Cretaceous. The seismic section of line ION–7 used for the present study is located between 35 and 55 km of the seismic line. A detailed presentation of the reprocessing and the velocity structure involving the present seismic line has been done by Kokinou et al. (2003), while the interpretation and the model revealed has been presented by Kokinou et al. (2005). As reported by Kokinou and Vafidis (2002) the reflection data along the seismic line ION–7 exhibit strong sea–bottom and internal multiples from deep and shallow water–bottom, lateral reflections, and coherent noise. The above-mentioned seismic events imposed difficulties in recognizing the reflections, especially from deeper horizons. In order to eliminate the above-mentioned events and trace the main interfaces we applied prior stacking multiple rejection filtering, based on wave equation, in combination with predictive deconvolution.

For the purpose of the present work, we used a portion of the smoothed velocity model (Fig. 5) from line ION–7 corresponding to the study area. The initial velocity model of ION–7 seismic line was revealed by analyzing a few thousands of CDP based on semblance method. The interfaces in the velocity model represent reflection points from the migrated seismic section (Fig. 4). Additionally, the KTZ is presented in this velocity model based on the velocity discontinuities as well as the interface discontinuities traced on the migrated section (Fig. 4). The seismic line A–B (Fig. 1B,

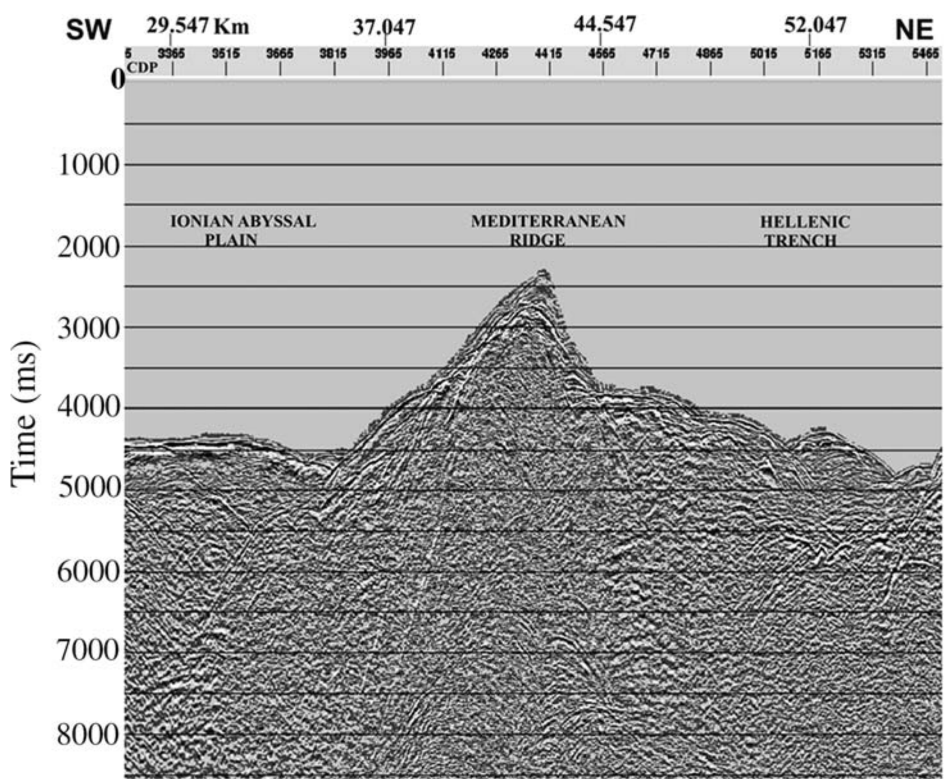

Fig. 3 Stacked seismic section of line ION–7 for the study area

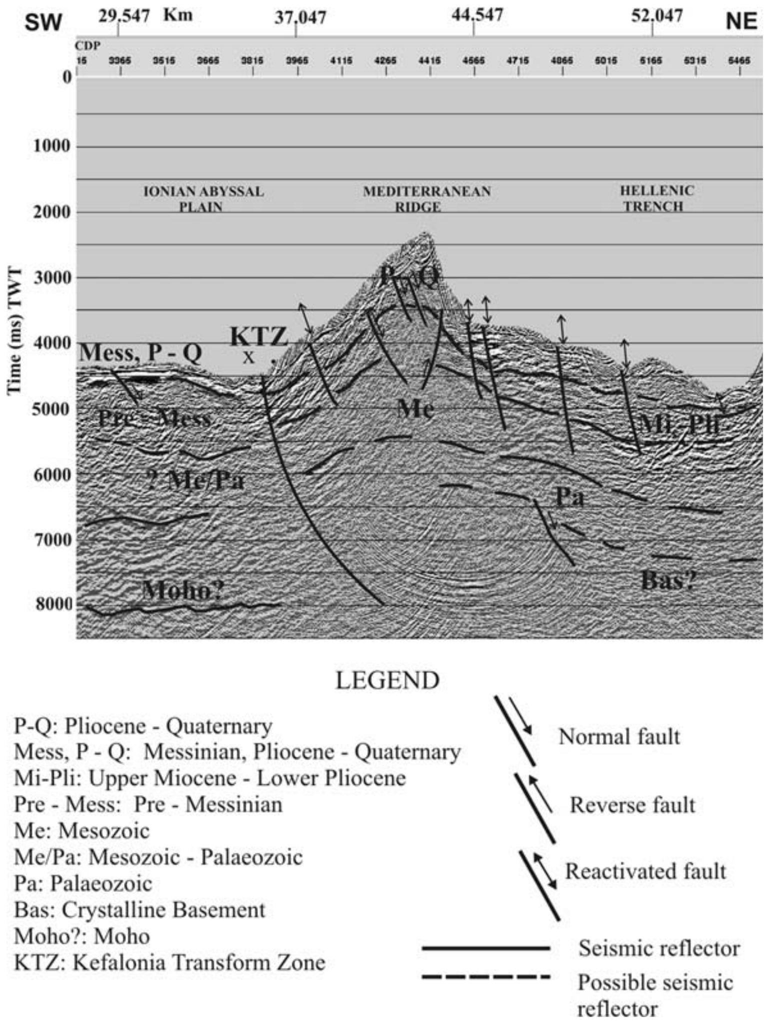

Fig. 4 Interpretation of the migrated section of line ION–7

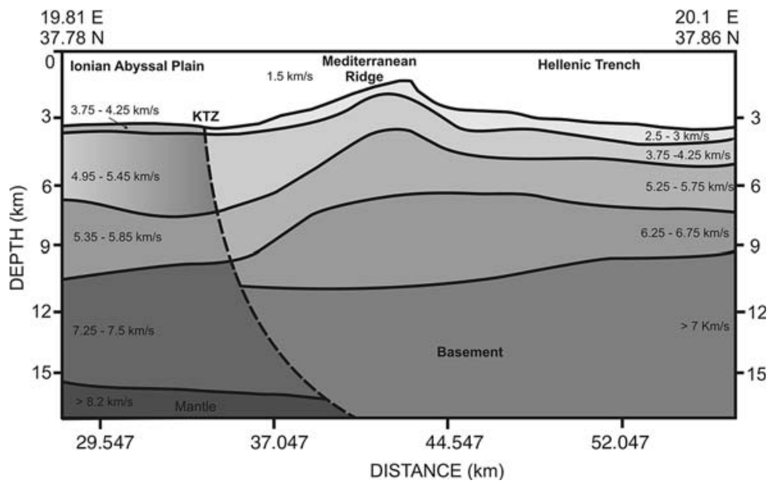

Fig. 5 Sedimentary and crustal structures of the P–wave velocity along the studied segment of ION–7 seismic line. The thick lines are reflection points from the migrated seismic section. The KTZ is projected onto the model for the interpretation

6, 7) is located northwest of Lefkada Island almost perpendicular to the Lefkada fault. In the next paragraph we interpret the seismic line A–B based on the interpretation of line ION–7 (Kokinou et al. 2005) and geological information (Cushing 1985; Sorel 1989; Underhill 1989).

Interpretation of seismic sections

In order to combine seismic, seismological, and topographic data from the study area and to explore the relation of KTZ to the near lying sedimentary successions, we present the interpretation of both the

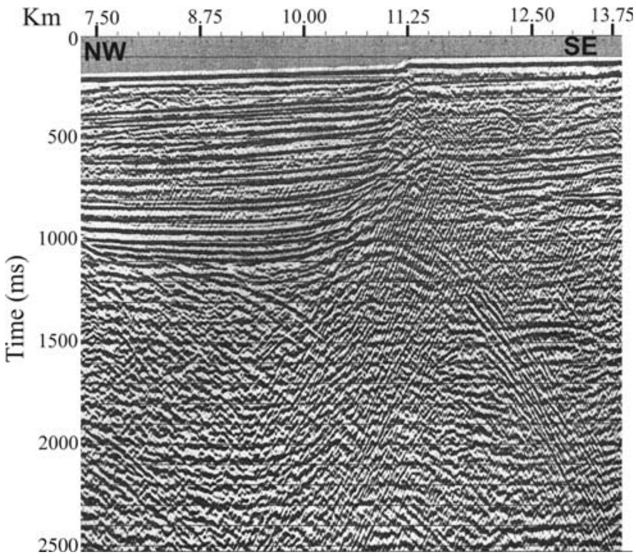

Fig. 6 Stacked seismic section of line A–B

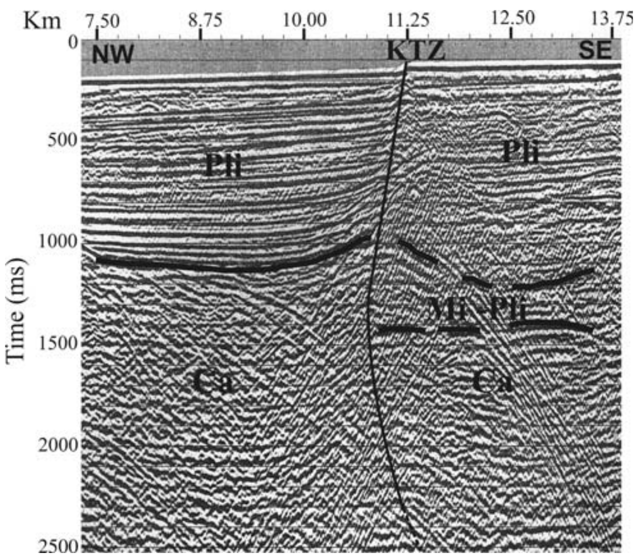

Fig. 7 Interpretation of stacked section from line A–B. Pli: Pliocene-Pleistocene sedimentary sequence, Mi–Pli: Upper Miocene–Lower Pliocene sedimentary sequence, Ca: Mesozoic carbonates of the Pre–Apulian Zone (Paxos), KTZ: Kefalonia Transform Zone

migrated seismic section from line ION–7 and stacked section of line A–B. On the migrated seismic section from line ION–7, the IoAP exhibits almost flat sea–bottom (Figs. 3, 4). Extensional faults occur on the migrated seismic section to 5 s two way travel time (TWT) as it is clearly seen in the area west of the KTZ. The velocity distribution is presented in Fig. 5. The upper unit extended from 4.2 to 4.5–4.75 s TWT reveals a seismic velocity of about 4 km/s (Fig. 5) and is attributed to Messinian, Plio–Quaternary (Mess, P–Q) sediments deformed by the Messinian evaporites, identified in the area of deep Ionian Sea by Finetti and Morelli (1973). The high velocity of the upper unit could be explained by the intrusions of Messinian evaporites. The depth and thickness of the Messinian agrees well with the wide-angle data (Truffert et al. 1993; de Voogd et al. 1992). The Messinian and Plio–Quaternary formations are dipping eastward near KTZ (Fig. 4). Beneath the abyssal plain, the seismic profile reveals a thick stratified sequence underlying the Messinian succession, which could be interpreted as the Pre–Messinian (Pre–Mess, 5.2 km/s, Fig. 5) sediments. A strong reflection marks the base of the Pre–Messinian sediments (Pre–Mess), possibly of Tertiary (or Upper Mesozoic) age.

The horizon at about 6.75 s TWT possibly represents the bottom of the Mesozoic/Paleozoic (Me/Pa, 6.5 km/s, Fig. 5) sediments, underlying by a unit exhibiting high amplitudes and characterized by a velocity of about 7.5 km/s (Fig. 5). The last horizon at about 8.2 s TWT may correspond to the limit of crust–upper mantle (possibly related to Moho discontinuity) at a minimum depth of 12.2 km below the sea–floor.

The MR is a broad bathymetric high between the deeper waters of Hellenic Trench (HT) and the IoAP formed by accretionary processes (Lallement et al. 1994; Chaumillon and Mascle 1995; Jones et al. 2002). A part of the sedimentary cover of the subducting eastern Mediterranean plate beneath Eurasia scraped off and accreted to the overriding plate as a huge pile of deforming and dewatering sediments. The migrated seismic section (Fig. 4) images the end–wedge of the MR (Underhill 1989). The upper unit of the MR in the present seismic section consists of Plio–Quaternary sediments (P–Q, 2.5–3 km/s). By the term P–Q in the present study is thought to be sands and muds, partly influenced by normal faults and possibly sporadic intrusions of Miocene evaporites (Camerlenghi et al. 1995) in the form of reactivated inverse faults. The Plio–Quaternary layer is underlain by a unit exhibiting a velocity of about 4 km/s (Fig. 5), possibly consisted of Upper Miocene–Lower Pliocene sediments (Mi–Pli). The bottom of the Mesozoic sequence (Me, 5.5 km/s, Fig. 5) is observed at 5.4–6 s TWT (Fig. 4). The Me overlies the Paleozoic sequence according to well–data from Puglia–1 well (Flores et al. 1991), which show that the total thickness of the known sedimentary succession is 10–12 km.

The deeper reflector corresponds to the Paleozoic sequence (Pa, 6.5 km/s, Fig. 5), underlain by the slightly eastward dipping crystalline basement (Bas, 7 km/s, Fig. 5), identified by seismic refraction studies (Truffert et al. 1993). Aeromagnetic modeling

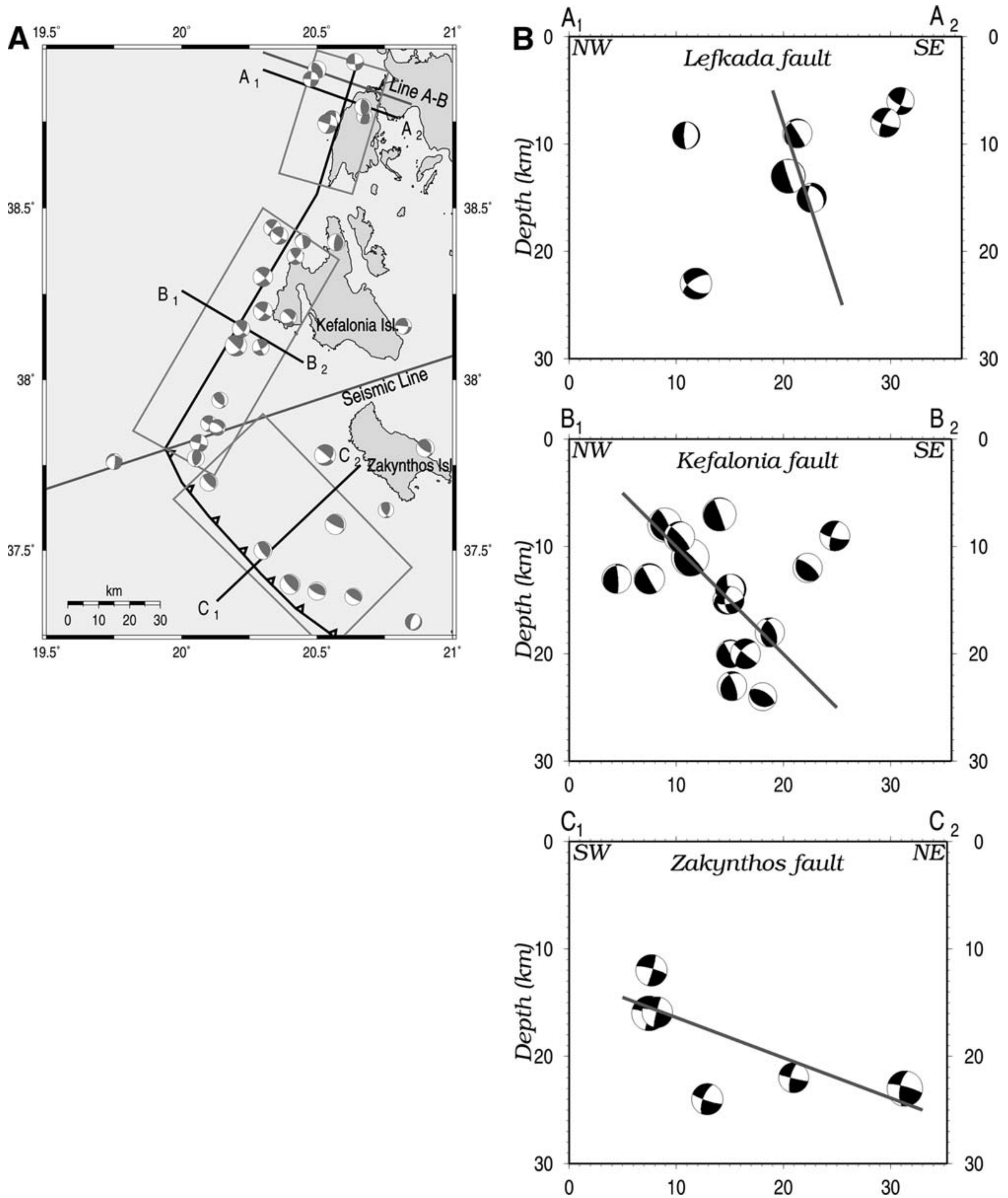

Fig. 8 (A) Fault plane solutions of earthquakes listed in Table 1. Boxes delimit the three earthquake groups of which the front projection was performed along sections A_1A_2, B_1B_2 and C_1C_2. The Kefalonia and Lefkada faults, the subduction front, and the seismic lines A–B and ION–7 are also depicted. (B) Depth section of the earthquakes within the three boxes shown in Fig. 8a. The mechanisms are shown as equal area projections of the front hemisphere

(Maltezou and Stefanopoulos 2003) further supports the existence of the basement along the eastern part of the present seismic line.

The HT, interpreted as consisting of narrow fore–arc basins, is considered as the major tectonic boundary between the compressive deformation of the MR and the extensional tectonics of the Hellenic Arc (Le Pichon et al. 1982; Lallement et al. 1994). In the migrated seismic section of ION–7 (Fig. 4) the HT exhibiting large water depths (about 3.4 km) is characterized by reactivated thrust faults (Underhill 1989). The velocity distribution of the HT is also presented in Fig. 5. The P–Q (to 5 s TWT) are underlain by the Mi–Pli (to 5.5 s TWT). The Mesozoic to 6.5 s TWT and Paleozoic to 7.5 s TWT sequences are also observed. The underlying layer represents the continuously eastward dipping crystalline basement (Bas).

The sedimentary sequences traced in seismic reflection segment of line A–B (Figs. 6, 7) belong to the Pre–Apulian geotectonic zone (Underhill 1989). The sea–floor is almost flat extended up to 0.2 s TWT (at a depth of about 150 m). Strong diffractions dominate the deeper section and the shallower eastern part of the seismic segment of line A–B. The western part (up to 1.1 s TWT) of the seismic section is characterized by lack of diffractions. The presence of the KTZ dominates the present section and deforms the sedimentary succession from sea–floor up to 2.5 s TWT. Especially at times greater than 1.3 s TWT the seismic section exhibits strong diffractions possibly related with the lower part of the KTZ. The Pliocene–Pleistocene (Pli) sedimentary succession west of KTZ is almost horizontally layered, underlain by Mesozoic carbonates (Ca) of Pre–Apulian zone. The Pli–sequence west of KTZ is shown deformed in a very narrow zone near to it. On the contrary, the Pliocene–Pleistocene sequence in the area east of KTZ is shown strongly deformed and rests on an Upper Miocene–Lower Pliocene (Mi–Pli) succession.

Faulting geometry in association with the seismic sections

Information on fault plane solutions used in this study was acquired from waveform modeling studies and Harvard CMT solutions and is given in Table 1, as above-mentioned. The goal is to determine the crustal structure identified by segments of the seismic line A–B and the seismic profiling of ION–7 and the velocity variation within the studied part of the seismic line ION–7 in conjunction with faulting geometry, as this later can be derived from reliable fault plane solutions of strong events, and thus to define the southward extension of the Kefalonia transform fault and the northwestern subduction boundary of the Hellenic arc. Therefore, in order to investigate faulting geometry, cross sections perpendicular to the strike of the Lefkada, Kefalonia and Zakynthos fault segments were performed (A_1A_2, B_1B_2 and C_1C_2 in Fig. 8A). Fault plane solutions that are comprised into the polygons shown in Fig. 8A are considered, and their front projections are shown in Fig. 8B.

The seismic line A–B being almost perpendicular to the strike of Lefkada fault segment, can be directly compared with the section A_1A_2 (Fig. 8B). Thus, a steep dip angle and the strike slip faulting with a thrust component are revealed by both interpretations. By assuming a mean velocity of 4.5–5.0 km/s for the sedimentary sequences traced in the segment of seismic line A–B we could define a depth of more than 5 km for the KTZ in the specific seismic section.

The seismic line ION–7 is not perpendicular either to the strike of Kefalonia fault segment or to the strike of the Hellenic arc at this location. The KTZ (Fig. 5) determined in the previous paragraph, which dips northeastward with an angle of about 45 degrees, is consistent with the majority of the nodal planes of the earthquake focal mechanisms of earthquakes associated with the Kefalonia fault segment, especially for the larger strike slip events. The dips of the nodal planes along the Zakynthos segment of KTZ are considerably shallower, thus evidencing that this is associated with the subduction process. Although we have to mention here the uncertainties concerning location and focal depth determination, the earthquake focal mechanisms support the configuration of the KTZ in the seismic lines A–B and ION–7.

The southern segment of the KTZ

The isobaths in the Ionian Sea (Morelli et al. 1975) have a NW–SE trend south of Kefalonia and west of Zakynthos Islands, but further up, west and southwest of Kefalonia Island, the isobaths exhibit a NE–SW trend (Fig. 2). The NE–SW trend of the isobaths is in accordance with the direction of the KTZ, especially for its southern part. The sea–floor depth in the area under investigation (Figs. 3–5) ranges from 3.225 km in the IoAP and HT to 1.9 km above the MR.

According to previous paragraphs, the southern limit of the KTZ is traced on the seismic section of line ION–7, separating two areas with extremely different geologic conditions (i.e. the IoAP and the wedge–out of the MR). A significant number of fault plane solutions, exhibiting strike–slip motion with a thrust component, confirm the presence of the KTZ in the specific area (Fig. 2). The thrust component of the KTZ is also identified on the seismic section of ION–7 (Fig. 4, 5). By studying the three seismological sections, A_1–A_2, B_1–B_2 and C_1–C_2 (Fig. 8B) in combination with the seismic sections A–B and ION–7 (Fig. 4), and the velocity model (Fig. 5) revealed from line ION–7 we may emphasize the following points:

- Seismic and seismological data show to agree for the Lefkada segment. The shallower sedimentary succession of Pliocene–Pleistocene is strong deformed in the eastern part of KTZ.
- The thrust component of the southern KTZ is well defined by both seismological and seismic sections.
- The southern segment of the KTZ is extended at depths greater than 15 km, affecting not only the sedimentary succession but also the basement and probably intersects the Moho in the studied area. It is well known from previous seismic studies (Makris et al. 1986; Nicolich et al. 1995; Kokinou et al. 2005) that the IoAP comprises an area with a very thin crust (approximately 12–18 km). In the present work, the depth of the southern segment of KTZ is defined to be greater than 15 km. Consequently the presence of the southern KTZ segment in the IoAP could affect not only the sedimentary sequences but also the basement and possibly the Moho.
- The thrust component of the southern segment of KTZ, located in the IoAP, is probably related with the westward moving Hellenic thrust front, traced in the area of the HT, being possibly the main reason for the impressive thickness of the sedimentary succession and basement in the MR area.
- The compressive regime in the area east of the southern segment of KTZ, located in the IoAP, shows to be active up to nowadays, because even the youngest sediments are shown deformed. In the area west of the southern segment of KTZ extensional regime dominates, as it is derived from seismic interpretation alone, since only fault plane solution of a moderate event is available there.

Discussion and conclusions

Hirn et al. (1996) interpreted the seismic profiling of the line ION–7 in combination with wide-angle seismics. A major reflector at a depth of about 13 km is detected, possibly representing the lower limit of western Hellenides, while the seismic image of disruptions of the Me suggests a more westerly position for the Ionian thrust than previously assumed. The effect of the more westerly migration of the Hellenic thrust front is also supported by the present study (area of the HT, Fig. 4).

Ryan et al. (1982) and LePichon et al. (1982) proposed that virtually the entire section between the HT and the deformation front (the abyssal plain) consisted of accreted sediments. In these models, the Greek continental margin at the HT would represent the backstop and the Ridge abutting the Trench would be characterized by the backthrusts of a doubly vergent accretionary system. Le Pichon at al. (2002) traced the MR backstop on a gravimetric map deduced from satellite altimetry (Smith and Sandwell 1997). The prism–backstop coincides approximately with the northwest–southeast rectilinear 450 km long negative anomaly trough at the foot of the similarly rectilinear western Aegean continental margin. The northwestern end of the prism–backstop coincides with the intersection of the KTZ and MR presented in Fig. 1B of the present work.

Nicolich et al. (1995) presented the results deduced by processing the reflection data from the lines ION–1 to ION–6. The most interesting conclusion was the detection of a deep crustal layer thick to 1–1.5 s TWT (two–way traveltime), corresponding to a wide (3.5–4 km thick) laminated lower crust or crust–mantle transition which suggest a velocity range of 6.9–7.1 km/s. In the context of the present study, the previous called crust–mantle transition zone is traced in the area west of the KTZ, exhibiting a velocity of about 7.25–7.5 km/s and is limited by the KTZ. The small thickness of the crust in the IoAP could be explained either by the presence of an extremely thinned continental crust or an oceanic crust (Hinz 1974; Makris et al. 1986; Nicolich et al. 1995).

Our interpretation supports shallow seismicity reported by previous studies (Clément et al. 2000; Sachpazi et al. 2000) and especially for the southern part of the KTZ, where the focal depths range between 5 and 30 km. The continuation of the KTZ along the Lefkada segment, as previously suggested by seismological studies is also revealed by the seismic data. The KTZ is traced in the migrated seismic section of ION–7 at about 35 km and separates two areas with very different geologic conditions, namely the thinned and possibly stretched crust under the IoAP and the MR. Only the presence of the KTZ could explain the very different tectonic conditions between the extensional deformed area of the IoAP and the compressional deformed area of the MR. Compressive tectonic acts up to nowadays in the area eastern of this zone deforming the Plio–Quaternary, the Upper–Miocene and possibly the Mesozoic sediments.

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