

Active tectonic structures and submarine landslides offshore southern Apulia (Italy): a new scenario for the 1743 earthquake and subsequent tsunami

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Abstract The southern Apulia foreland recorded a strong ($I_{max}=X$ MCS) earthquake in 1743 and a concomitant tsunami, which struck the southeastern Salento coast. The seismogenic fault and the triggering factors of the tsunami are unknown. Three-dimensional interpretation of multichannel seismic profiles calibrated by wells using a GIS software enabled the recognition of the stratigraphic succession, structural framework, and submarine landslides offshore Salento. A thin Pliocene unit overlying the Mesozoic-Cenozoic substrate is covered by a Pleistocene succession separated by a Middle Pleistocene unconformity that formed during the regional uplift of Salento. The latter gave rise to the morphologic conditions for the deposition of a prograding wedge off the Salento coast, with a shelf break located at 150 m depth. Normal faults, mainly oriented NW–SE, displaced the early Lower Pleistocene succession and are buried by younger deposits. Since the Middle Pleistocene, a compressional event gave rise to the Apulia uplift and large folds and basement-involved reverse faults that are active in the eastern part of Apulia. A huge (58 km³) slump affecting the Middle Pleistocene prograding wedge has been documented offshore the southeast coast of Salento. The proposed geological scenario of the 1743 earthquake and subsequent tsunami is (1) an initial strong earthquake ($I_{max}=X$ MCS) associated with a thrust fault located in the eastern sector of the Apulia offshore, (2)

a shacking-induced large-volume slump offshore Otranto, and (3) landslide-triggered tsunamis that struck the Salento coast.

Introduction

Tsunamis are caused by geological processes such as earthquakes, landslides, or volcanic eruptions that displace large volumes of ocean water (Farrell et al. 2015). An example of landslide-generated tsunamis occurred in 1998 in Papua New Guinea where a major earthquake (Mw 7.1) produced a shacking-induced slump with a volume of 6.4 km³ (Tappin et al. 2008). Recently it has been proposed that the tsunami following the Messina Straits 1908 catastrophic earthquake (M 7.1) was not earthquake-generated, but rather was likely generated by a large submarine landslide that occurred offshore Sicily in the Ionian Sea (Billi et al. 2008).

The present study area is the Apulia block (Fig. 1) formed by continental lithosphere (Anderson and Jackson 1987) and characterized by active tectonics, strong earthquakes, and subsequent tsunamis. Apulia has also hosted significant intraplate seismicity concentrated in an E–W trending deformation belt extending from the Gargano promontory to the Adriatic Sea (e.g., Gambini and Tozzi 1996; Di Bucci and Angeloni 2013). The 1627 Gargano earthquake ($I_{max}=X$ MCS) and subsequent tsunami caused widespread destruction (Tinti et al. 2004). The 1743 catastrophic earthquake ($I_{max}=X$ MCS; Galli and Naso 2008; Locati et al. 2016; Nappi et al. 2016) struck the Salento Peninsula, the most severe damage having impacted the towns of Nardò (where about 300 people died) and Francavilla Fontana on the Ionian Islands (Greece), and the western coast of Albania. Chronicles of this event record a withdrawal of the sea in the Brindisi harbor Scalese 1743, and the effect of the tsunami is documented by boulder accumulations along the Salento coast (Mastronuzzi et al. 2007;

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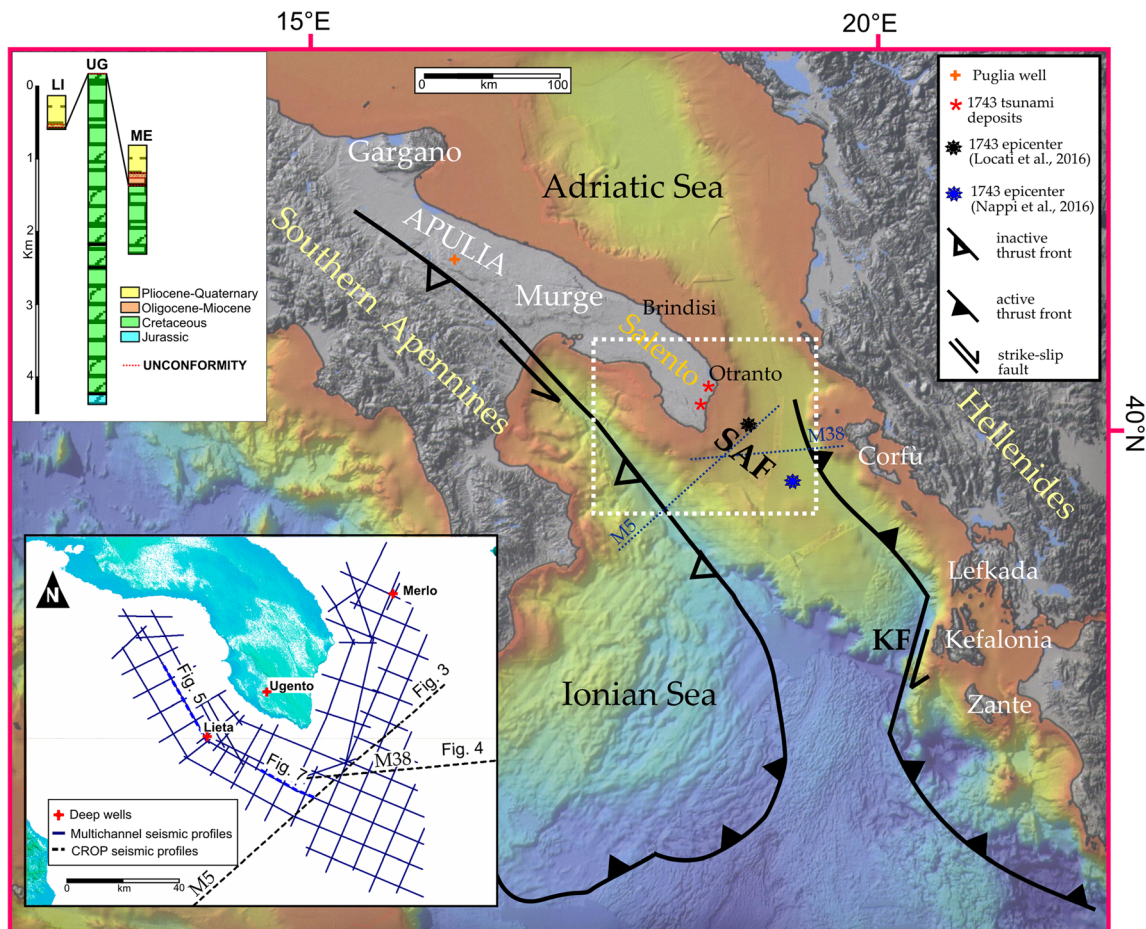


Fig. 1 Morpho-bathymetric map of Italy and surrounding seas (from Brosolo et al. 2012), and locations of the 1743 epicenter, tsunami deposits (Mastronuzzi et al. 2007), as well as the CROP M5 and CROP M38 profiles. *Dashed white polygon* Study area. *SAF* Southern

Apulian foreland, *KF* Kefalonia transfer fault. *Lower inset* Index map of wells, seismic grid and ship tracks reported in the text. *Upper inset* Stratigraphic successions of onshore and offshore deep wells: *UG* Ugento 1 well, *LI* Lieta 1 well, *ME* Merlo 1 well

Maramai et al. 2014). Medium-energy earthquakes ($3 \leq M_w \leq 5$) occurred off Salento in the XX century (Locati et al. 2016).

Adria represents the foreland of two fold-and-thrust belts (Fig. 1; e.g., De Alteriis 1995): to the west, the NE-verging Apennines, characterized by a Plio-Pleistocene foredeep and, to the east, the SW-verging Dinarides-Hellenides, featuring an Oligocene-Pleistocene foredeep (Marnelis et al. 2007; Pérouse et al. 2016). The southern Apennines wedge migrated toward the ENE over the Apulia foreland, and interplayed with the syn-tectonic sedimentation of Late Miocene-Pliocene siliciclastic units in the Bradanic foredeep. It is characterized by allochthonous thrust sheets transported for several tens of km over mostly autochthonous, 6–8 km thick Apulian platform carbonates stratigraphically overlain by Late Miocene-Pliocene marine sediments, which form the seal of the unlocked hydrocarbon traps. These buried carbonates are displaced by low-displacement high-angle reverse faults involving the basement (Butler et al. 2004). Thus, in the southern Apennines a switch from thin-skinned to thick-skinned

thrusting seemingly occurred as the Apulian carbonates—and the underlying thick continental lithosphere—were deformed (Lacombe and Bellahsen 2016). It is generally assumed that active thrusting at the main leading edge of the southern Apennines ceased around the beginning of the Middle Pleistocene (Cinque et al. 1993; Patacca and Scandone 2001; Bonini et al. 2011), and current deformation in the Apennines is referred to normal and strike-slip faulting (Pantosti and Valensise 1990; Catalano et al. 1993, 2004; Montone et al. 2004; Boncio et al. 2007).

The southern part of the Apulia foreland is weakly deformed, and consists of an emerged area (Salento) and a submerged area (Fig. 2). The Apulian region exposes thick Mesozoic-Cenozoic carbonate units deposited above the crystalline basement of the Adria plate (Ciaranfi et al. 1988). The Mesozoic-Cenozoic paleogeography of Adria reveals a carbonatic platform that passes to basinal facies (Del Ben et al. 2015, and references therein).

The internal deformation of the Salento Peninsula-Apulia offshore is poorly known, and its recent tectonic framework is

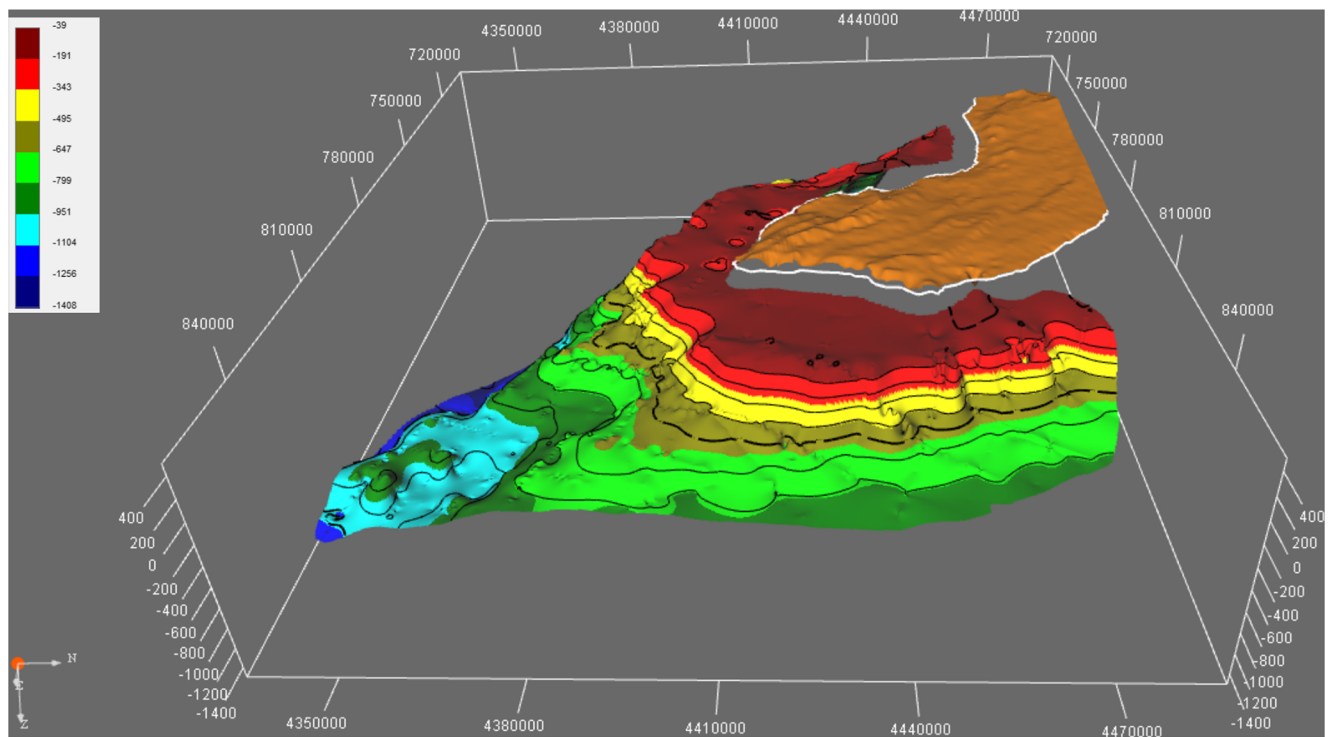


Fig. 2 3D digital model inserted into the spatially oriented grid of the southern Apulia morphology. View is toward the west. Topography and bathymetric data from the TOPO TOPEX project (Smith and Sandwell 1997)

controversial. Indeed, the most popular tectonic model of the Apulia bulge consists of a foreland affected by NW–SE normal faults (Ciaranfi et al. 1988; Argnani et al. 2001; Finetti and Del Ben 2005), but the earthquakes focal mechanisms suggest transpressional tectonics (Favali et al. 1990) and on-shore geological evidence of Quaternary shortening has been reported (Di Bucci et al. 2009). NW–SE faults of the Salento Peninsula gave rise to elongated grabens (Ciaranfi et al. 1988) that were successively reactivated as strike-slip faults (Pieri et al. 1997; Santaloia et al. 2016). The Apulian offshore presents low-displacement faults with normal throws that offset the intra-Messinian unconformity and are sealed by Pliocene-Quaternary deposits (Butler 2009). Some of these normal faults displace the seafloor, and Merlini et al. (2000) proposed that these active or recent faults have determined the seismicity of the Salento region. On the contrary, Argnani et al. (2001) suggested that inner arc compression within the Adriatic upper crust is responsible for that seismicity as outer arc extension produced the NW–SE graben and associated recent faults.

The aim of this paper is to analyze the recent geological evolution of the Apulian offshore. The interpretation of a multichannel seismic grid calibrated by well logs within a GIS environment enabled the reconstruction of the fault pattern as well as two- (2D) and three-dimensional (3D) models of the subsurface. These geological data are relevant for a better comprehension of (1) the active tectonic structures of the Apulian foreland, (2) the relationship between offshore active

faults and the location of the epicenter of the 1743 earthquake, and (3) the triggering factors of the tsunami.

Materials and methods

The Apulian foreland was investigated using two sets of multichannel seismic profiles with different resolution and penetration, calibrated by well logs (Fig. 1). The first seismic grid was acquired from the Western Geophysical Company in 1968 after the commitment of Italy's Minister of Industry to carry out a regional survey of the entire Italian continental shelf (ViDEPI 2009). The second seismic grid comprises the CROP seismic profiles collected jointly by the Consiglio Nazionale delle Ricerche of Italy CNR, the national oil company Agip, and the national electricity company Enel; it was acquired and processed in the 1980s and 1990s, and an atlas of the seismic profiles was published more recently by the CNR (Scrocca et al. 2003).

Seismic interpretation is based on seismic stratigraphy: seismic units are groups of seismic reflections, the parameters of which (configuration, amplitude, continuity, and frequency) differ from those of adjacent groups. Sedimentary units were delineated on the basis of contact relations as well as internal and external configurations (Mitchum et al. 1977). The seismic units were calibrated using the lithostratigraphic data of deep offshore and onshore boreholes (ViDEPI 2009).

Raster images of the overall seismic profiles were converted to segy format and then collected in a dedicated geographic information system (GIS) environment. Line drawing, interpretation of profiles, and modeling of geological surfaces were performed using Kingdom® software (copyright HIS Inc.); gridding and contouring were performed on geologic horizons in order to generate 2D models and isochron maps. Faults were interpreted on the seismic reflection profiles, mapped in a GIS environment, and displayed as lines on structure contour maps and isochron maps.

Seismic depth conversions were achieved by applying the average velocity model using the “Dynamic Depth Conversion” tool. The seismic time-depth conversion enabled the generation of several outputs with a vertical depth scale: cross-sections, seismic profiles, structure contour maps, and isopach maps. The final step was the construction of 3D digital models using the “Vu-PACK” module that enables more accurate geological interpretations.

Results

The regional tectonic framework of the Apulia region is well represented (Figs. 3 and 4) by CROP seismic profiles extending from the southern Apennines to the Hellenic thrust belts. The western sector of the CROP M5 profile features the Apennine nappes that overthrust the Apulia foreland and an interposed small foredeep (Fig. 3). However, the Quaternary deposits overlying the Apennines fold-and-thrust belt are deformed and offset by oppositely dipping steep reverse faults associated with a transpressional zone; the latter can be interpreted as the result of left-lateral wrench faulting developed at the margin of the Apennine thrust belt since the Middle Pleistocene (e.g., Bonini and Sani 2000; Catalano et al. 2004; Del Ben et al. 2008; Milia et al. 2016, and references therein). The narrow foredeep corresponds to a wedge-

shaped basin (Fig. 3) filled by approximately 700 m thick Quaternary deposits (assuming a V_p of 2,000 m/s for the depth conversion). The Hellenic thrust belt (Fig. 4) is separated from the Apulia foreland by a 50 km wide and 1,500 m thick Pliocene-Quaternary foredeep (cf. V_p of 2,000 m/s for depth conversion). Interpretation of the Crop M38 profile, calibrated with the geology of western Greece (Marnelis et al. 2007), reveals SW-vergent folds and reverse faults in the Hellenic thrust belt and an important angular unconformity at the base of the Plio-Quaternary succession.

The stratigraphy of the Apulia offshore was calibrated by well data and onshore geology (Fig. 1). In Salento the Ugento well drilled a 4,500 m thick Jurassic-Cretaceous carbonatic platform succession. However, in the Apulia region the Puglia well encountered a 7,000 m thick succession, Permian-Cretaceous in age. In the eastern study area the substrate is covered by Oligocene-Miocene clastic deposits. In particular the Merlo well (Fig. 1) drilled (from younger to older) 300 m thick Pleistocene deposits, 65 m thick marls and clays of Pliocene age, and 160 m thick Oligo-Miocene deposits; the latter deposits repose unconformably on Cretaceous limestones. In the western area the Lieta well (Figs. 1 and 5) encountered 40 m of Pliocene calcareous breccia and marls lying unconformably above a Cretaceous calcareous succession; the Pliocene deposits are covered by a 350 m thick succession of clays and silts, Lower Pleistocene in age.

Cross correlation of the seismic grid enabled the recognition of a regional strong reflector separating the acoustic basement from a seismic unit characterized by parallel reflectors that corresponds to a Lower Pleistocene succession (Figs. 3 and 4). This latter unit is bounded at the top by an erosional surface (unconformity) occurring widely in the Apulia region and overlying thin Pliocene deposits. This unconformity affects a large fold set (anticlinorium) corresponding to the Apulia offshore (Fig. 3). It is suggested that this regional

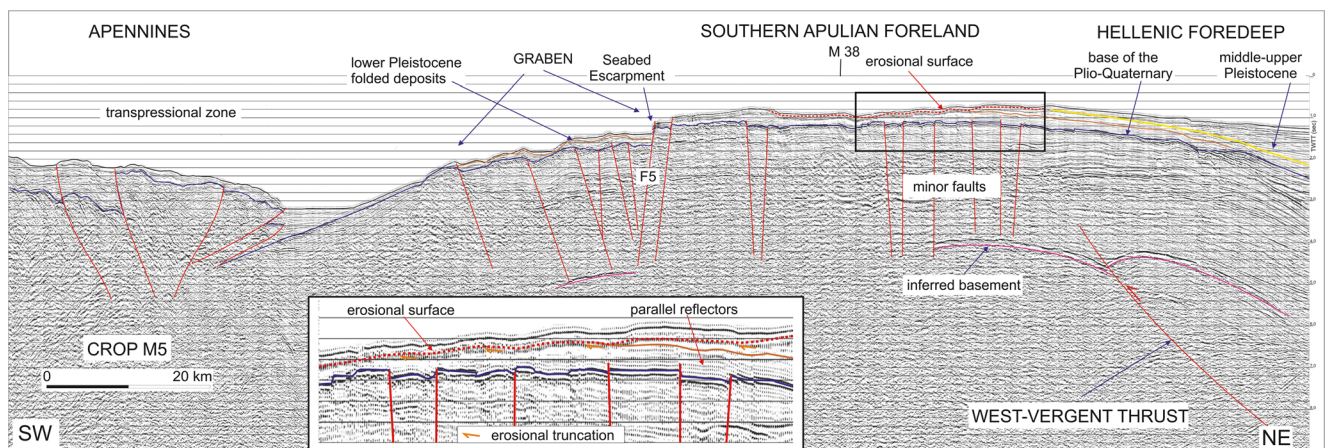


Fig. 3 CROP seismic profile M5 and interpretation showing the Apennines transpressional zone, a small foredeep, and the Apulian anticlinorium. For seismic line location, see Fig. 1

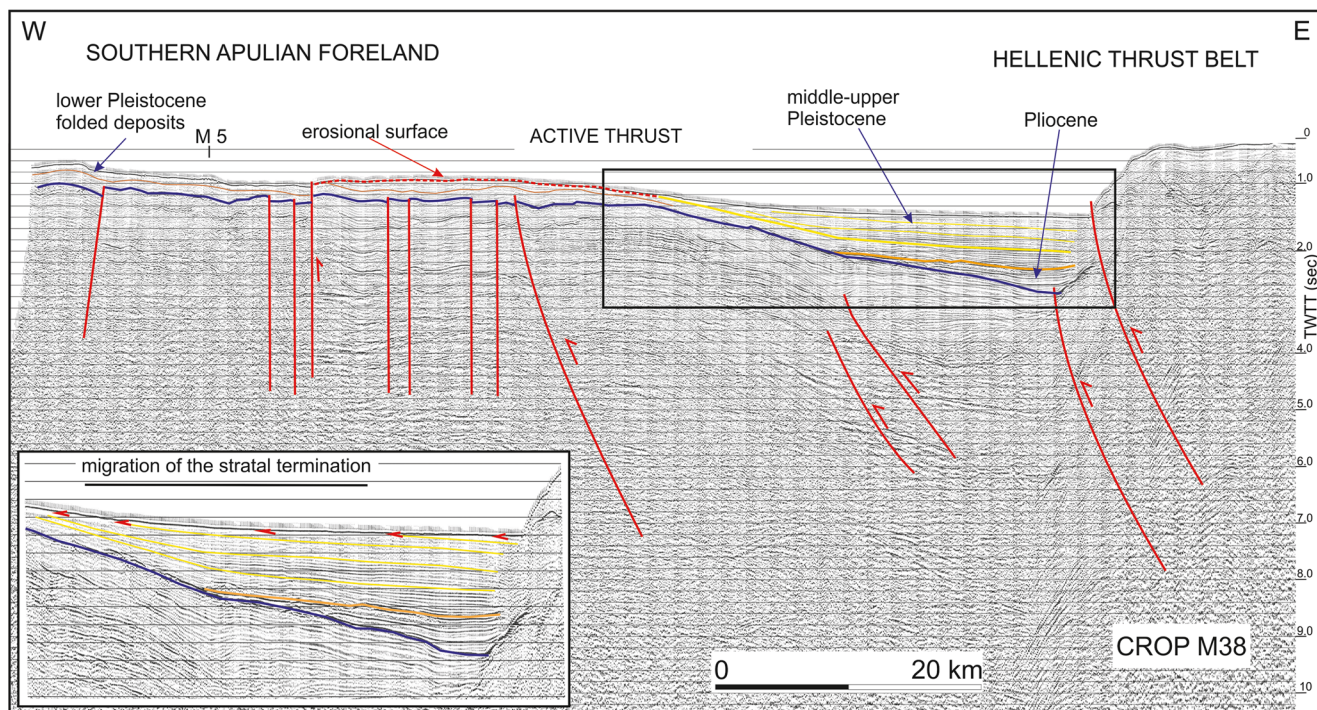


Fig. 4 CROP seismic profile M38 and interpretation displaying the Hellenic thrust belt, a large Pliocene-Quaternary foredeep, and the southern Apulian foreland. Lower inset Eastward migration of stratal terminations. For seismic line location, see Fig. 1

unconformity formed contemporaneously to the tectonic deformation of southern Apulia and uplift of Salento dated at the onset of the Middle Pleistocene (e.g., Doglioni et al. 1994; Pieri et al. 1997). The lack of thick Middle-Upper Pleistocene deposits in the western and central Apulian offshore, and their occurrence in the Hellenic foredeep (Figs. 3

and 4) suggest that both uplift of the Apulian foreland and strong subsidence of the Hellenic foredeep started in the Middle Pleistocene.

The structure of the Apulia foreland is characterized by normal faults, larger graben structures, and local compressional folds and reverse faults. Minor faults are sub-vertical low-

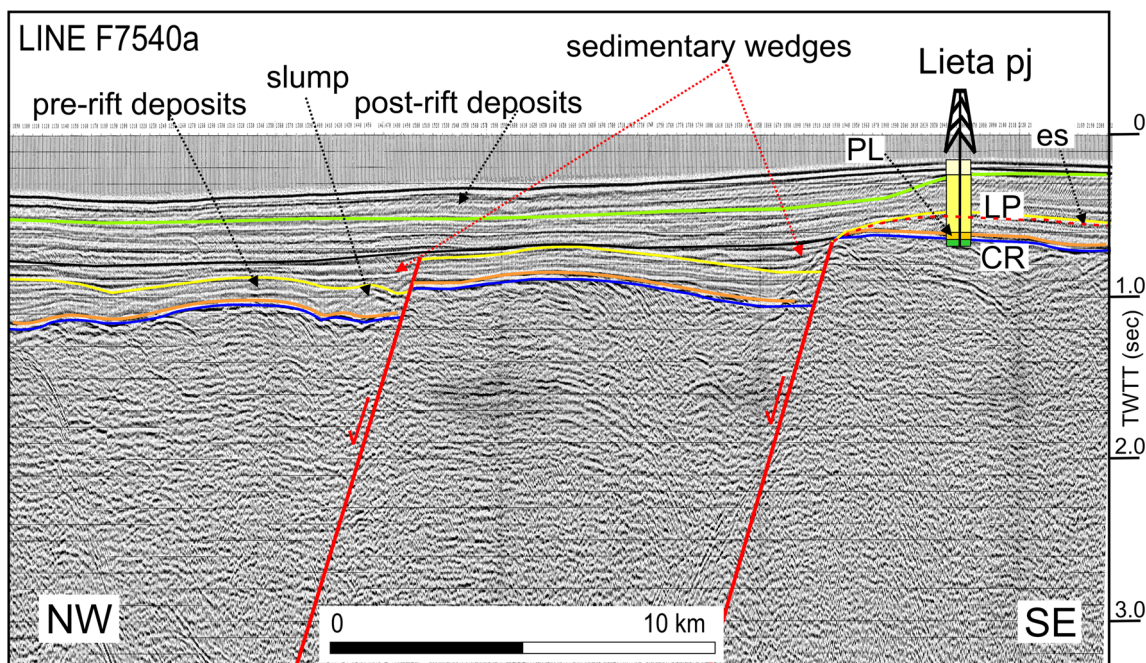


Fig. 5 Multichannel seismic profile and interpretation calibrated by the stratigraphy of the Lieta well. CR Cretaceous, PL Lower Pliocene, LP Lower Pleistocene, es erosional surface. For seismic line location, see Fig. 1

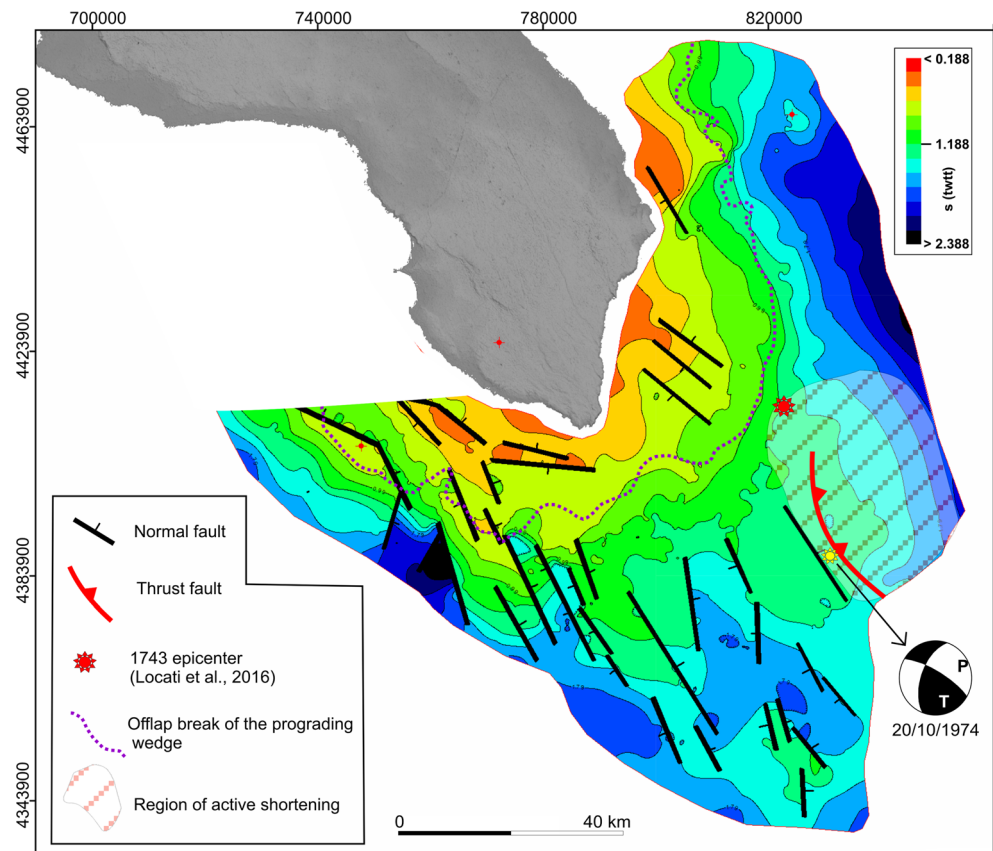
throw (≤ 100 m) structures that extend on the hinge of the Apulian foreland (Fig. 3). They are generally buried by Lower Pleistocene deposits and show (Fig. 5) sedimentary wedges of the syn-rift unit in the hanging wall blocks, and an isopach pre-rift unit characterized by parallel reflectors and locally (in correspondence to the Lieta well) erosion (see the erosional surface in the eastern fault block), probably due to the footwall's uplift. In the western Apulian offshore, a NW–SE graben structure and a 300 m thick basin fill bounded by synthetic and antithetic normal faults were identified and mapped (Figs. 3 and 6). These faults, mainly buried by Pliocene-Quaternary deposits, locally down throw the seafloor up to 200 m (F5 fault; Fig. 3). The mapped faults affecting the seafloor were also imaged in a multibeam map by Savini and Corselli (2010), who interpreted them as NW–SE en echelon faults due to Recent tectonics. Nevertheless, these faults that displace Lower Pleistocene deposits are buried landward by younger sediments (Fig. 7), thereby discarding the hypothesis that they are active structures.

The overall structure of the Apulian offshore reveals a huge anticlinorium (“Apulian swell” of Doglioni et al. 1999), folding the Lower Pleistocene deposits, and reverse faults located in the eastern Apulian offshore. A large W-vergent antiformal fold occurs approximately 40 km west of the Hellenic thrust front (Figs. 3 and 4). This thrust fold displays, on the western flank, Lower Pleistocene deposits overlain by an erosional

truncation and, on the eastern flank, a Middle-Upper Pleistocene stratal pattern featuring a wedge geometry and an eastward migration of the stratal terminations (Fig. 4); these erosional and depositional features record the Middle Pleistocene-Present growth stage of this active thrust fault. Another view of the W-vergent thrust discloses (Fig. 3) a deformed deep high-amplitude reflector (>4 s two-way travel time). Assuming a V_p of 2,000 and 5,000 m/s for the Plio-Quaternary deposits and Mesozoic carbonates, respectively, and consistent with the stratigraphy of the Puglia well (ViDEPI 2009), this 10 km deep reflector corresponds to the crystalline basement that is involved in thrusting. Furthermore, a thick-skinned tectonic interpretation of the Apulia carbonates has been already proposed for the southern Apennines (Butler et al. 2004). It is noteworthy that an active basement-involved thrust fault in southern Apulian would be compatible with the earthquake transpressional focal mechanisms recorded at the external margin of the Hellenic foredeep (Favali et al. 1990). Interestingly, the area of active shortening of the southern Apulian foreland corresponds to that of the 1743 earthquake's epicenter proposed by Locati et al. (2016; Fig. 6).

The uplift and emersion of Salento produced a source area for sediments that were deposited on the continental margin along the coast. These deposits overlie the Lower Pleistocene basal unit forming a Middle Pleistocene-Present oblique/

Fig. 6 Structure contour map of the acoustic basement and offlap break of the Middle Pleistocene-Present prograding wedge. The focal mechanism obtained for the 20th October 1974 event is from Favali et al. (1990)



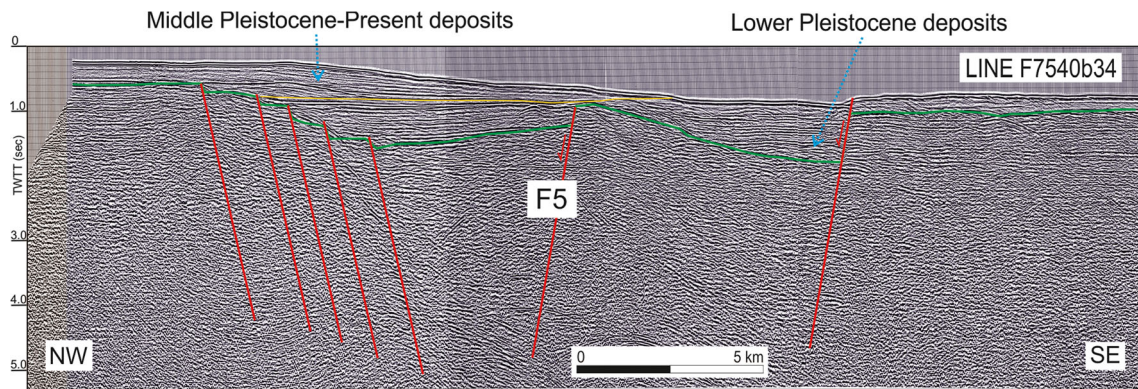


Fig. 7 Multichannel seismic profile and interpretation displaying faults that displace Lower Pleistocene deposits and are buried by a Middle Pleistocene-Present prograding wedge. For seismic line location, see Fig. 1

sigmoid prograding wedge. The offlap break of this wedge was mapped at a depth of approximately 150 m (Fig. 6). The slope of the foresets dips 6° offshore Otranto.

North of the area of active folding and offshore the southeastern Salento coast (Fig. 6), the architecture of the prograding wedge changes laterally from smooth parallel (oblique/sigmoid configuration) in an undisturbed area (Fig. 8, upper and lower profiles), to a chaotic and uneven morphology (Fig. 8, intermediate profiles). This chaotic seismic facies unit is characterized by a concave upward lower boundary, and an upper irregular and hummocky surface (with counter-slopes) corresponding to the seafloor morphology. On the basis of its geometric features, the chaotic unit is interpreted as a large slump (hereinafter referred to as the Otranto landslide) extending from the shelf edge to the base of the slope, and recording a gravitational instability of the area in Recent times. Landslide top and bottom surfaces were interpreted on several seismic reflection profiles and mapped in a GIS environment. A V_p of 1,800 m/s for slump deposits was adopted for the depth conversion. Based on the isopach map (Fig. 8) and areal distribution (ca. 227 km^2) of the slump, a landslide volume of ca. 58 km^3 is estimated. Notably, the large-volume Otranto landslide (Fig. 8) is adjacent to the Salento coast affected by the 1743 tsunami.

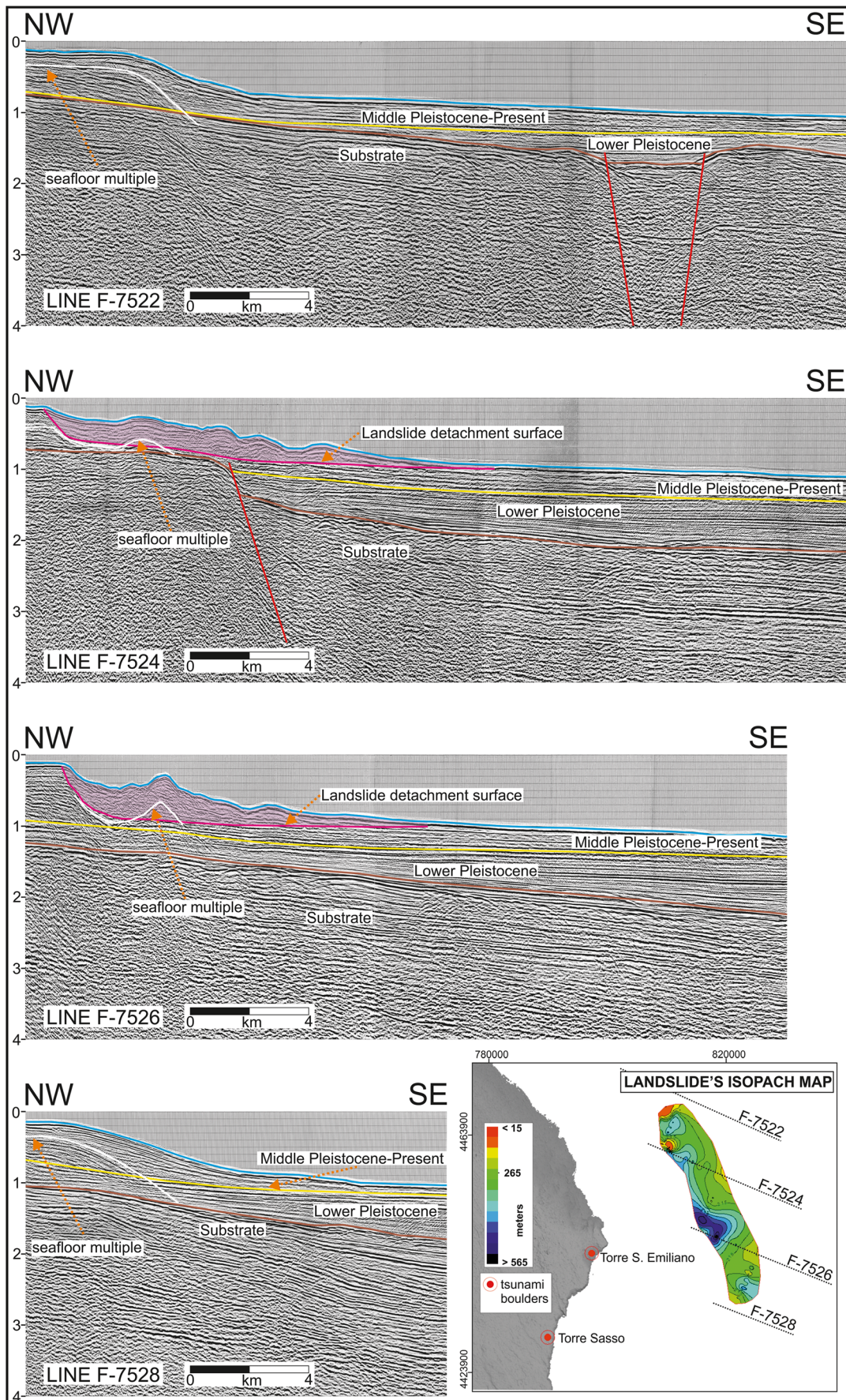
Discussion

The open geological questions of the Apulian offshore concern (1) the Quaternary tectonic evolution, (2) relationships between active faults and the 1743 earthquake, and (3) triggering factors of the 1743 tsunami. Previous researchers agree that the main structures of the Apulian offshore correspond to normal faults. However, Merlini et al. (2000) and Argnani et al. (2001) claimed that these faults are active structures, whereas Butler (2009) documented that these faults are buried by younger deposits and suggested they are not active. The

relative age of the Apulia tectonic structures reveals older normal faults (displacing Lower Pleistocene deposits and buried by Middle Pleistocene-Recent deposits) oriented NW–SE, and younger (Middle Pleistocene-Present) compressional folds and upthrusts formed in eastern Apulia. The region of active shortening structures is located in front of the Hellenic foredeep where a $>10 \text{ km}$ deep basement-involved thrust fault is present. The latter can be interpreted as the seismo-genetic source of the 1743 earthquake. Such an interpretation is supported by the hypocentral depth $>10 \text{ km}$ and transpressional focal mechanisms (Favali et al. 1990) of the moderate earthquakes ($3 \leq M_w \leq 5$) that hit off Salento in the XX century (Locati et al. 2016), and the map position (Figs. 1 and 6) close to the epicenter of the 1743 earthquake (Fig. 1). A link between this seismo-genetic source and the Hellenides thrust system is confirmed by regional data. Indeed, the Hellenides thrust front is active (Pérouse et al. 2016) as the southern Apennine thrust front stopped in the Middle Pleistocene (Cinque et al. 1993; Patacca and Scandone 2001; Bonini et al. 2011).

In non-volcanic tectonically active regions, the rapid displacement of the water mass that gives rise to a tsunami can be generated by a seismo-genetic fault displacing the sea bottom or a shaking-induced landslide. The strong 1743 Basso Ionio earthquake had significant environmental effects including a tsunami that struck the southeastern Salento coast (Scalese 1743; Mastronuzzi et al. 2007; Galli and Naso 2008; Nappi et al. 2016). The present research provides information on the triggering factors of the 1743 tsunami: it excludes the occurrence of an active fault displacing the seafloor of the Apulian offshore, and favors a shaking-induced landslide source.

In non-volcanic areas, destructive tsunamis that can devastate nearby coastal communities have often been generated by shaking-induced landslides (e.g., Bardet et al. 2003; Satake 2012). The relationships between landslides and fault scarps



◀ **Fig. 8** Multichannel seismic profiles showing the undisturbed Middle Pleistocene–Present prograding wedge and a recent slump. *Lower inset* Isopach map of the submarine slump; tsunami deposits are from Mastronuzzi et al. (2007)

suggest that the largest controlling factor on the spatial distribution of the submarine landslides is the local gradient of the continental slope. A slope angle exceeding 4° can be considered as the critical angle for slope stability (Masson et al. 2006; Brothers et al. 2014; Katz et al. 2015). The number of Quaternary submarine slides is much less than the number of major earthquakes that occurred in a determined area (see, for example, the Kumano Basin offshore Japan), and when a slide occurs it does not extend along all the margin but is localized. Consequently, earthquake shaking might have been the final trigger for these slides, but the regions were preconditioned to fail prior to the quakes. For instance, many surficial slides were generated as failures along normal fault scarps (Moore and Strasser 2016). In general, factors that may cause landslides include a combination of a series of causative agents such as slope failure induced by gravity tectonics and high sediment influx onto the shelf edge and upper slope in areas with a steep local gradient of the continental slope (Reis et al. 2016). In Naples Bay, eastern Tyrrhenian Sea, slumps with a volume of 0.2 km^3 were characterized by different concomitant triggering factors: angle of slope margin, seismic activity, basement architecture, rapid sea-level changes, sea currents, and high pore-fluid pressure (Milia et al. 2006).

It has been hypothesized that the tsunami (Tinti et al. 2004; Maramai et al. 2014) associated with the 1627 Gargano earthquake ($I_{\text{max}}=X$ MCS) was generated by a seismically triggered submarine mass failure (Di Bucci and Angeloni 2013). Indeed, the southern Adriatic basin is characterized by the occurrence of many submarine landslides, some of impressive sizes. The most prominent of these landslides is the Gondola Slide, a large, deep-seated landslide involving up to 40 km^3 of sediments that developed in the last 55,000 years and that possibly generated a tsunami in the past (Minisini et al. 2006).

Even if low-volume sub-surficial mass-transport deposits have been reported off the Salento Promontory (Savini and Corselli 2010; Savini et al. 2016), these small landslides could not have been the source of the strong 1743 tsunami that deposited huge boulders along the Salento coast (Mastronuzzi et al. 2007). On the contrary, the present research documents, for the first time, a massive submarine landslide (Otranto landslide) east of the Salento Promontory, characterized by a huge volume ($>50 \text{ km}^3$) and Recent emplacement; furthermore, the slump scar breached the shelf break and the Recent progradational wedge that dips 6° (in the area unaffected by the slide). The Otranto landslide

features strongly support the hypothesis that the 1743 tsunami was the effect of a nearby seismically triggered submarine landslide. The large volume of the Otranto slump can be responsible for the amplitude increase of the tsunami waves and damages along the eastern Salento coast.

The 1743 earthquake shaking might have been the final trigger for the Otranto landslide, but the offshore Salento was preconditioned to fail prior to the quake by two factors. First, the value of 6° of the slope off Salento is higher than 4° , which is considered the critical angle for slope instability in an area (Masson et al. 2006; Brothers et al. 2014; Katz et al. 2015). Second, the abrupt lateral lithological change of the landslide's substrate (due to a buried fault) possibly gave rise to a geologically induced site amplification.

Conclusions

Southern Apulia is an area of active tectonics that hosted moderate earthquakes in the XX century, and a strong earthquake and subsequent tsunami in 1743 that struck the Salento Peninsula and the Greek coast. Even if it is usually accepted that the 1743 epicenter was located offshore, both the seismo-genetic fault and tsunami trigger were long unknown.

3D interpretation of multichannel seismic profiles calibrated by wells using a GIS software enabled the reconstruction of the stratigraphic and structural evolution of the southern Apulia offshore, and to propose a new scenario for the 1743 earthquake and concomitant tsunami that struck the Salento coast. An area of active crustal shortening has been identified in the eastern Apulia offshore near the macroseismic epicenters of the 1743 earthquake, and it is proposed that a $>10 \text{ km}$ deep thrust fault is the seismo-genetic source of this earthquake. Moreover, a huge submarine slump with a volume of $>50 \text{ km}^3$ has been mapped approximately 10 km eastward of the Salento coast, which affected the Middle Pleistocene–Present prograding wedge. This Recent submarine landslide located off Otranto is an important candidate for the tsunami trigger.

The proposed geological scenario of the 1743 earthquake and subsequent tsunami is (1) an initial strong earthquake ($I_{\text{max}}=X$ MCS) associated with a thrust fault located in the eastern sector of the Apulia offshore; (2) a shaking-induced large-volume slump offshore Otranto; (3) landslide-triggered tsunamis that struck the Salento coast. Taking into account that the areas of gravitational instability are reactivated with time, the identification of events of flank instabilities affecting the continental shelf margin may have significant tsunami potential and should be considered when evaluating the risk that tsunamis pose to the southern Apulia coast.

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Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest with third parties.

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