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Boulder accumulations produced by the 20th of February, 1743 tsunami along the coast of southeastern Salento (Apulia region, Italy)

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Abstract

The detachment of large boulders in the nearshore zone and their deposition farther inland are the main morphological effects of tsunamis on rocky coasts. Along the Otranto–Leuca coast (southeastern Apulia, Italy), two boulder accumulations have been recognized and studied. At the Torre Sasso locality, boulders weighing up to 31 t are scattered from sea level to about 5 m of elevation and clustered in groups of several imbricated elements. At Torre S. Emiliano an impressive accumulation made of large boulders has been recognized and studied. The accumulation is about 30 m wide and follows the present coastline for about 2.5 km at a variable distance of 15 to 40 m. Looking closer, it is compounded by two ridges. The ridge closer to the coastline shows a very steep slope seaward made of very large boulders emplaced in a vertical position; its top reaches about 11 m above m.s.l. The inner belt is lower than the outer one and consists of smaller boulders; it partly covers a 2 m thick colluvial deposit made of reddish sands. Huge blocks, weighing up to 70 t, cover the carved surface stretching from the coastline to the front of the first ridge. Analysis of the imbrication axes indicates that the catastrophic waves responsible for the development of the boulder accumulations most likely propagated from SSE to NNW direction.

Karstic features occurring on the surface of the innermost boulders indicate a very recent age for their deposition as no differences have been found between the aerial-exposed surface and the soil-covered one. Three AMS radiocarbon age determinations performed on marine shells found landward the boulders have accumulated recently, i.e. within the last three centuries. Moreover, archeological remains in the top layers of the colluvial deposits covered by the boulders can be referenced to 16th–17th centuries. This evidence suggests that the 20th of February, 1743 earthquake was responsible for the generation of two large tsunami waves which caused the boulder accumulations to deposit. This earthquake was particularly violent in the Salento region where it reached grade IX on the MCS scale. Interestingly, chronicles of this event record a withdrawal of the sea in the Brindisi harbour, north of the study area. This study highlights the tsunamigenic potential offshore the southeastern Salento coast requiring that further strategies be devoted to mitigate the tsunami risk.

Keywords: boulder ridge; tsunami; rocky coast; Apulia; Italy

1. Introduction

The 2004 tsunami in southeastern Asia has tragically put in perspective how much the risk of tsunami has been neglected in coastal planning in recent centuries. Recent

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catalogues of tsunami events in different regions of the world have been compiled (e.g. for the Mediterranean area: Ambraseys, 1962; Antonopoulos, 1979; Soloviev, 1990; Tinti and Maramai, 1996; Tinti et al., 2004); they comprise more than 2000 events from the past 4000 years (Scheffers and Kelletat, 2003). Present-day research has mainly been focused on tsunami-generative mechanisms, on propagation and deformation of tsunami waves, or on the physics of tsunami run-up and inundation. In contrast, there are still few studies compiling field evidence for tsunamis throughout the late Holocene. Most of this geological research has focused on the signature of tsunamis represented by anomalous sand layers contained within lagoonal muds (e.g. Atwater, 1987). However, palaeotsunamis can also be detected by the presence of unusually sized coastal landforms, i.e. huge washover fans at the back of a sandy coastal barrier (i.e. Andrade, 1992; Gianfreda et al., 2001) or accumulations of large boulders near the coastline (i.e. Mastronuzzi and Sansò, 2000, 2004). This paper attempts to infer the occurrence of past tsunamis in the southeastern Apulian region from a detailed morphological analysis of coastal boulder deposits.

2. Geological and geomorphological setting of the Apulian region

The Apulian region stretches for 350 km in the southern part of Italy, between the Adriatic and the Ionian Seas (Fig. 1). It represents the emerged part of the foreland domain of both the Apenninic and Dinaric orogens. It is constituted by a 3 to 5 km Variscan basement covered by a Mesozoic carbonate sequence thick which is overlain by thin Tertiary and Quaternary deposits. The Apulian foreland is slightly deformed and it is affected by Apenninic and anti-Apenninic trending

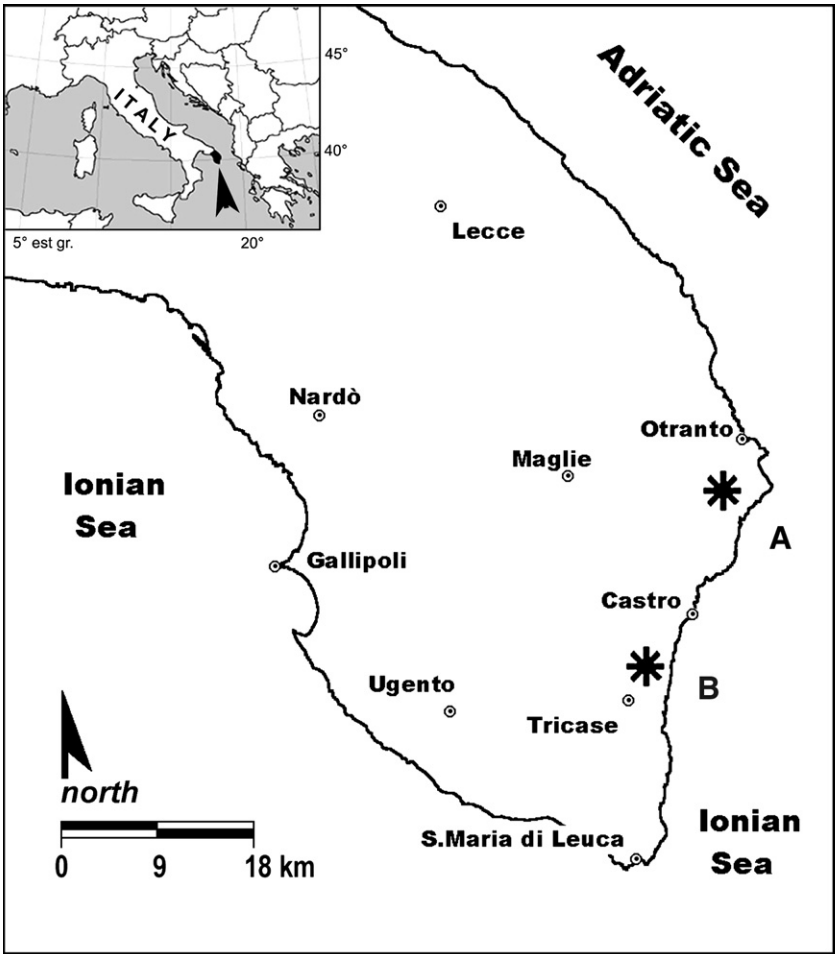

Fig. 1. Geographical position of southern Apulia. Legend: A — The Torre S. Emiliano boulder accumulation; B — The Torre Sasso boulder accumulation.

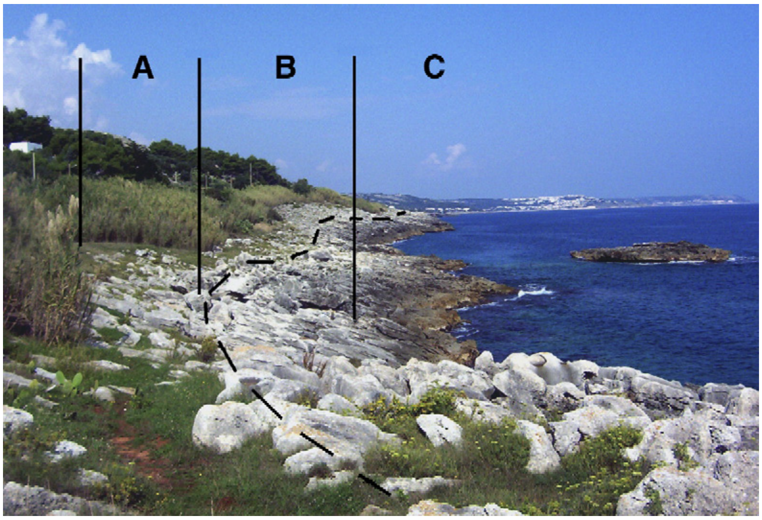

Fig. 2. A view of the Torre Sasso boulder accumulation. The dashed line marks out the crest of boulder accumulation; belt B is the area marked by boulder presence; belt C is the zone of boulder detachment; belt A is the steep coastal slope not affected by boulder deposition.

faults. In particular, Apulia is a low seismic region surrounded by highly seismic zones: the coast of Albania and the Ionian Islands (western Greece) to the east, the Calabrian arc and the southern Apennines to the west, and the Gargano promontory to the north (Slejko et al., 1999).

Numerous earthquakes in this region have been recorded during the last millennium which explains tsunamis that have historically struck the southern Adriatic and Ionian coasts (Antonopoulos, 1979; Soloviev, 1990; Tinti and Maramai, 1996; Mastronuzzi and Sansò, 2004; Tinti et al., 2004).

The presence of large boulders transported and deposited above the limit of storm waves along the coast of the Apulian region marks out some catastrophic events that occurred in historical times. One of these events was most likely due to a submarine mass movement triggered by the 5th of December, 1456 earthquake; its effects are widespread along the Ionian coast of the Salento peninsula (Mastronuzzi and Sansò, 2000). A detailed geomorphological study of boulder accumulations occurring along the coast between Bari and Brindisi individuates the effects of two other distinct tsunamis, most likely produced by the strong earthquakes that occurred in Ragusa (present day Dubrovnik) on the 6th of April, 1667 and in the Ionian Sea on the 20th of February, 1743 (Mastronuzzi and Sansò, 2004).

Fig. 3. The boulder accumulation at the Torre Sasso locality is marked by boulders emplaced in a very unstable assemblage.

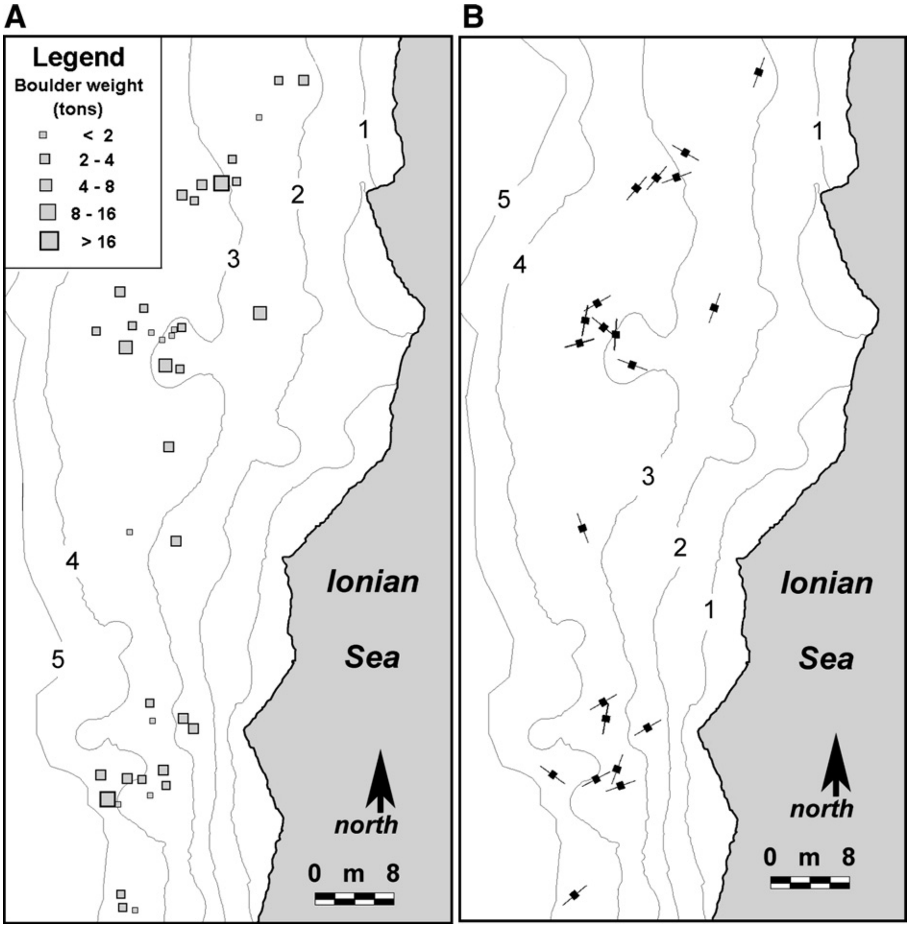

Fig. 4. A — Weight and distribution of some largest boulders at the Torre Sasso locality. B — *A*-axis of elongated boulders and perpendicular to imbricated boulders at the Torre Sasso locality.

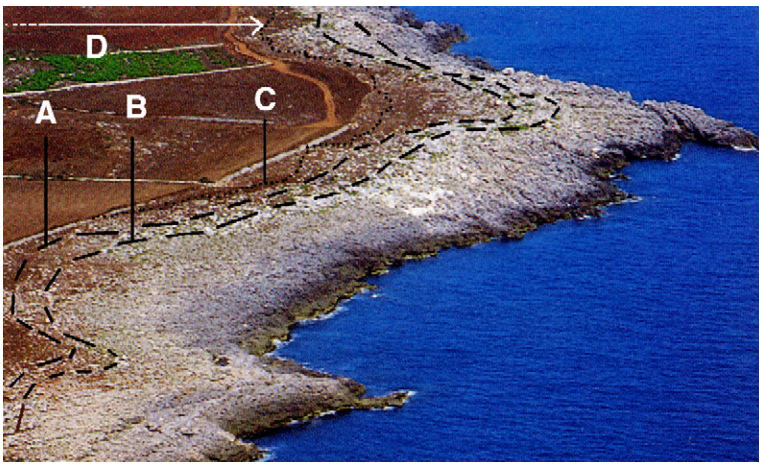

Fig. 5. A view of the Torre S. Emiliano boulder accumulation. Legend: A, B — Crests of the two ridges that compound the boulder accumulation; C — landward margin of the boulder accumulation; D — marine terrace surface covered by reddish colluvial deposits.

3. The boulder accumulations along the southeastern coast of Salento

The coastal landscape from Otranto to Leuca, stretching along the southeastern coast of the Apulian region, is dominated by a steep slope extending from about 120 m above sea level to about 50 m below sea level. This surface has generally been interpreted by several authors as a high, degraded fault scarp. However, recent studies consider it a relict form inherited from pre-Quaternary times (Mastronuzzi et al., in press). In fact, according to Bosellini and Parente (1994) and Bosellini et al. (1999) this regional slope roughly coincides with the Late Cretaceous margin of the Apulian platform. Along this margin several carbonate systems are laterally disposed and grafted one upon the other. Three of these systems

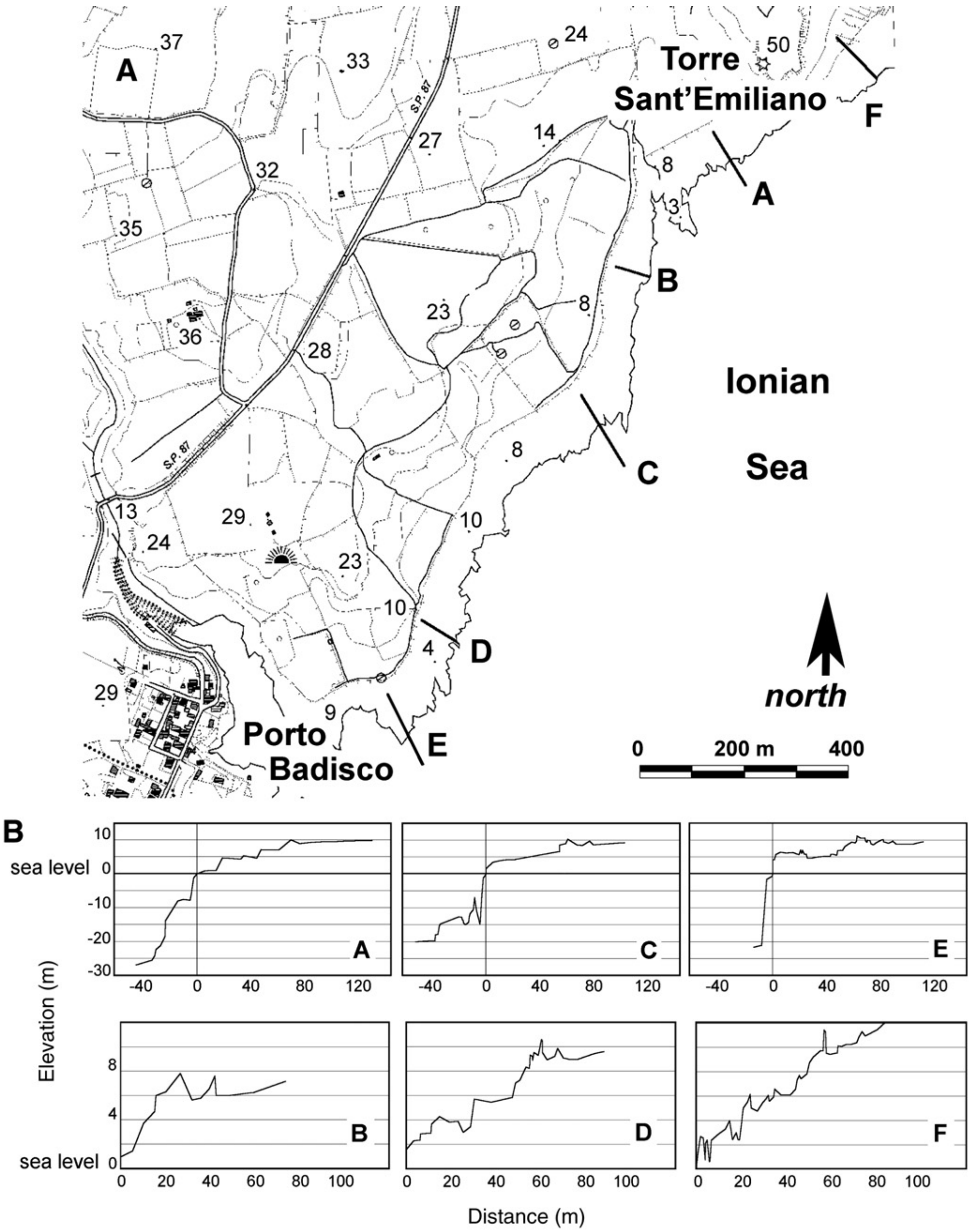

Fig. 6. A — Position of the detailed topographical profiles carried out at the Torre S. Emiliano locality. B — Detailed topographical profiles (A–F) carried out at the Torre S. Emiliano locality.

are clinostratified and include well developed reef tracts from the Priabonian, early Chattian and early Messinian age. The cause of this unusual stratigraphic architecture is the relative tectonic stability of the Salento Peninsula which, since the late Cretaceous, has acted as an elevated area in the centre of the Mesozoic wider Apulia carbonate platform.

The coastal slope is affected by a number of normal faults with a NW–SE or NNW–SSE orientation which in some cases cut Lower Pleistocene deposits (Bosellini et al., 1999), cropping up in some patches along the coast. According to Auroux et al. (1985), some of these faults can be traced on the submerged part of the Apulian Ridge and would have been active at the end of Lower Pleistocene and in very recent times as indicated by some offshore seismic profiles from the Otranto–Leuca area. They point out that the Apulian foreland is affected by several normal faults, some of them presently active since they displaced the sea floor by about 200–300 m (Merlini et al., 2000).

The coastal landscape is marked by a staircase of abrasion platforms which have been recognized both above and below the present sea level. The submerged part of the coastal slope is marked by two discontinuous platforms, placed at about 5 m and between 7 and 10 m of water depth, and by a wide plain stretching offshore below the 20 m depth (Parroni and Silenzi, 1997; Mastronuzzi and Sansò, 2003). The emerged part of the steep coastal slope is marked by five raised abrasion platforms placed between 70 and 50 m and at 40 m, 20–15 m, 10–8 m and about 2 m above the sea level.

3.1. Torre Sasso boulder accumulation

A remarkable accumulation of large boulders has been surveyed along the eastern coast of southern Salento, few kilometers to the north of the Marina di Tricase locality (Fig. 2). The accumulation is on a steep slope which joins the outer margin of a 10 m marine terrace with the present sea level.

Boulders are placed from sea level to about 5 m of elevation and clustered in groups made of several imbricated elements. In one case, boulders are arranged in a very unstable configuration (Fig. 3). A total number of 40 boulders have been surveyed. Most of them are slabs composed of very well cemented calcarenite, from 0.5 to 1.0 m thick. The maximum volume of boulders is 13.5 m^3, and considering the unit volume weight of calcarenite (2.27 g/cm^3), a maximum weight of about 31 t can be estimated (Fig. 4A).

The analysis of imbrication axis azimuth and the *A*-axis elongated boulders also indicates the prevailing direction of the catastrophic wave responsible for their deposition to be from the SSE sector (Fig. 4B).

Tilted solution potholes characteristically mark the boulder surface. They formed in the supratidal zone and were placed in the new position because of boulder detachment and transport; a new sub-horizontal generation of flat potholes developed after transport. An incipient alveolar weathering and, more rarely, boreholes of *Lithophaga* can also detected.

3.2. Torre S. Emiliano boulder accumulation

An impressive accumulation of large boulders has been recognized between the Torre S. Emiliano and Porto Badisco localities (Fig. 5). The morphological analysis of this landform has been realized by means of detailed topographical and scuba surveys, by measuring boulder volumes and imbrication or elongation axis azimuth.

The boulder accumulation rests on a wide marine terraced platform, about 150 m wide, and stretches from 10 m to about 4 m above sea level. A 13 m high paleocliff, marked by the flows of small river valleys, borders the platform landward; the outer border is a steep cliff, deeply modified by coastal karstic features (pinnacles, grooves, and so on). The marine terraced surface is mantled by a thin colluvial cover made of red clayey sands which thickens seaward. Geophysical survey reveals that this cover reaches the maximum thickness of about 2 m at a distance of about 100 m from the shoreline.

The boulder accumulation is about 40 m wide and follows the present coastline for about 2.5 km, with a variable distance from 15 to 40 m. Six detailed tranverse profiles along the emerged tract of coast and three submarine morphological transects have been carried out (Fig. 6A, B). They reveal the submerged part of the coast to be composed of a wide plain stretching at a depth of −20 m and joined to the coastline by a very

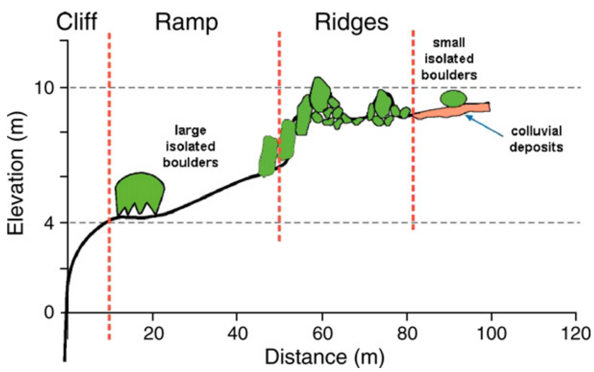

Fig. 7. Geomorphological scheme of the Torre S. Emiliano boulder accumulation.

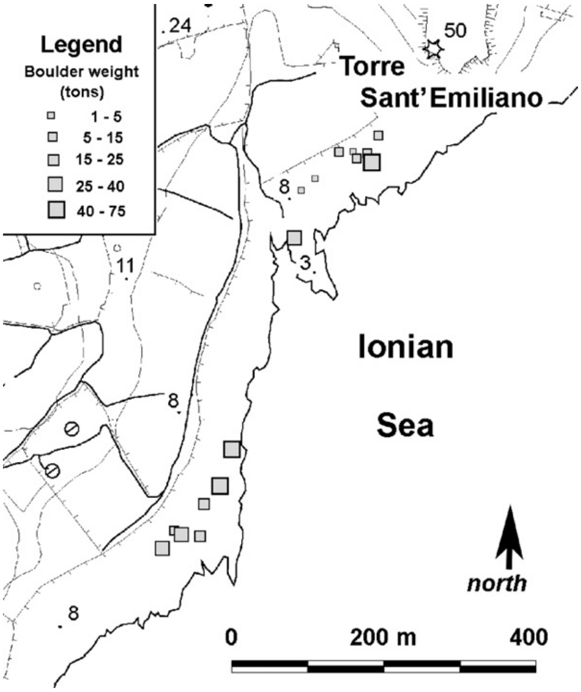

Fig. 8. Weight and distribution of some largest boulders at the Torre S. Emiliano locality.

steep surface. The coastline is marked by a cliff, up to 4 m high, followed landward by a more or less relevant rampart. A ramp produced by the carving of boulders and stretching from 20 to 60 m from the coastline follows landward; it is studded by some of the largest blocks, weighing up to 70 t. The boulder accumulation starts at the inner margin of the ramp, represented by a small step covered by very large boulders emplaced in a near-vertical position.

In detail the studied boulder accumulation is compound by two ridges. The ridge closest to the coastline has a very steep slope seaward; its top is placed at about 11.5 m above the mean sea level. The inner belt is about 1 m lower than the outer one and is generally compounded by smaller imbricated boulders and, landward, by sparse boulders. The two ridges are separated by a trough about 15–20 m wide and 2 m deep. The landward margin of the boulder accumulation partly covers the marine terrace colluvial cover (Fig. 7).

Both ridges are made of limestone imbricated boulders. Most of these elements come from the supratidal zone, detached from the carved platform along joints and strata planes which locally dip seaward. However, some spheroidal boulders which can typically be found inside potholes in the wave breaking zone have been detected on the landward border of the accumulation. No significant differences in the morphological appearance of the boulder surfaces have been found between the two ridges.

The 18 largest boulders have been surveyed; they weigh up to 70 t and are entrapped into fractures widened by storm waves and karst processes occurring along the carved surface or rest on the crest of the outer, higher ridge (Figs. 8 and 9).A further analysis has been carried out on the *A*-axis orientation of the

Fig. 9. A view of the largest boulder detected at the Torre S. Emiliano locality. It is 5.0 × 3.5 × 1.5 m large and weigh about 70 t. Note the coastal karstic features at the base.

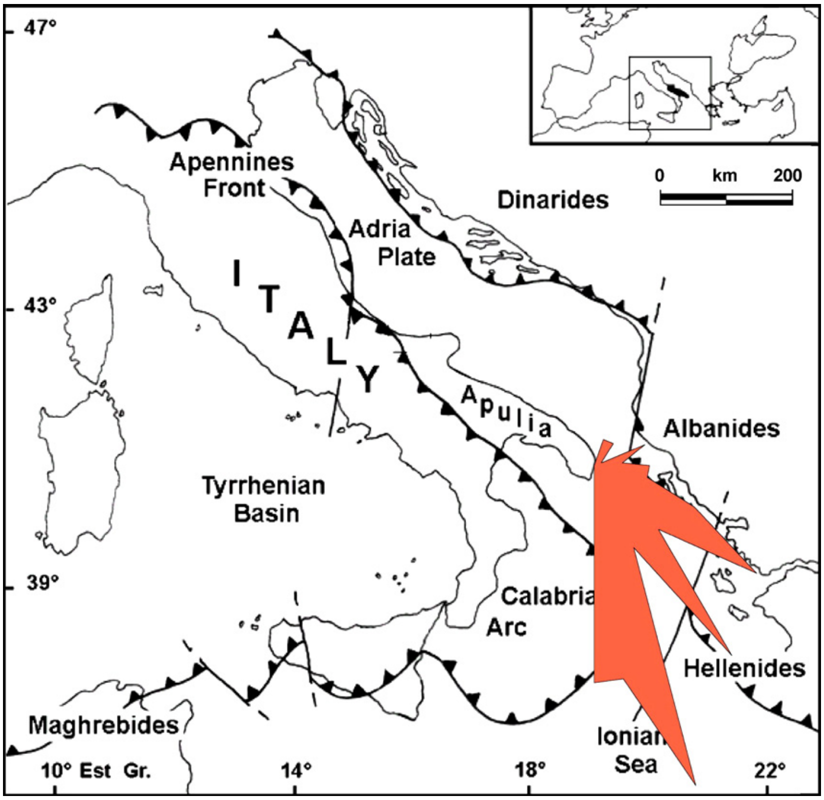

Fig. 10. Distribution of the perpendicular to the *A*-axis orientation of elongated boulders and embrication axes at the Torre S. Emiliano boulder accumulation.

elongated boulders and on the imbrication axis. The collected data are comprised into the ESE–S sector with a slight prevalence in the SSE direction (Fig. 10).

4. Discussion

The impact of tsunamis on coasts has been neglected in coastal geomorphology notwithstanding such high-magnitude low-frequency events are considered to have played an important role in the evolution of many coastlines (Dawson, 1994; Scheffers and Kelletat, 2003).

This is particularly true for the Italian coasts which are prone to relevant tsunami hazard since they are placed along or close to active seismogenetic structures and numerous destructive tsunamis have already struck them during the last millennium producing relevant loss of lives and damage (Tinti et al., 2004). Notwithstanding this, only two papers on the geological records of past tsunamis can be found in the international scientific literature (Mastronuzzi and Sansò, 2000, 2004).

Main morphological effects of tsunamis on rocky coasts are represented by the detachment of large boulders in the nearshore zone and their deposition farther inland (Dawson, 1994, 2000), and by the sculpturing of bedrock resulting in the production of both smooth, small and large scale features (Bryant and Young, 1996; Bryant, 2001).

Table 1
Hydrodynamic calculations made according to Nott (2003) relations

Torre S. Emiliano	Axis (m)			H_{storm}	$H_{tsunami}$
Boulder	*a*	*b*	*c*		
B084	2.40	2.20	2.00	21.82	5.45
B089	3.00	2.00	1.80	27.27	6.82
B098	3.50	2.10	1.60	31.82	7.95
B115	3.40	2.40	1.90	30.91	7.73
B077	3.80	2.60	2.30	34.55	8.64
B120	5.00	3.50	1.50	45.45	11.36
Torre Lupo					
Boulder					
215	2.20	1.80	0.90	15.06	3.76
210	2.50	1.40	1.30	17.11	4.28
220	2.70	0.90	0.90	18.48	4.62
204	2.30	1.50	4.10	15.74	3.94
234	4.50	1.50	2.00	30.80	7.70

Fig. 11. Torre S. Emiliano locality. Appearance of a spheroidal boulder surface capsized by a caterpillar. Note the absence of morphological differences between the air-exposed (below, grey) and soil-covered (above, white) surface of the boulder.

Large boulder depositions have been observed along numerous coastal tracts all over the world: Gran Cayman (Jones and Hunter, 1992); Bahamas (Hearty, 1997); Caribbean islands (Scheffers, 2002, 2005); Venezuela (Schubert, 1994) Chili (Paskoff, 1991); French Polinesia (Bourrouilh - Le Jan and Talandier, 1985; Harmelin-Vivien and Laboute, 1986); Hawaii (Moore and Moore, 1984, 1988; Felton et al., 2000; Noormets et al., 2002, 2004); Indonesia (Shi et al., 1993, 1995); Japan (Miyoshi et al., 1983; Nishimura and Miyaji, 1995); Australia (Davies and Hughes, 1983; Young et al., 1996; Nott, 1997; Bryant and Nott, 2001; Nott, 2003). Along the Mediterranean coast, in particular, boulder accumulations have been investigated in Italy (Mastronuzzi and Sansò, 2000, 2004), in Cyprus (Kelletat and Schellmann, 2002) and in Spain (Whelan and Kelletat, 2003).

Boulder accumulations as an indicator of tsunamis have been a matter of debate because they could also be formed by storm waves action. However, recent and detailed studies (Noormets et al., 2004; Nott, 2004; Scheffers, 2005) point out that extreme storm waves are

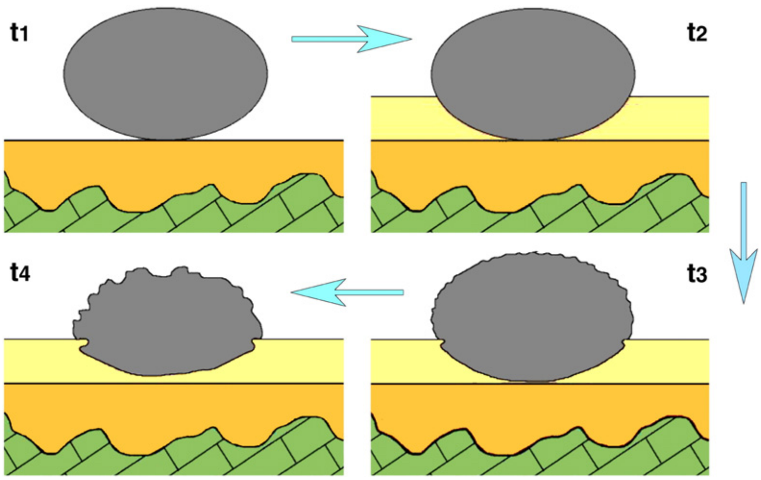

Fig. 12. Geomorphological model of a partly covered boulder. t1 — a spheroidal boulder is transported from the wash zone inland, covering a colluvial cover. t2 — Sheet surficial waters produce the partly covering of the boulder. t3–t4 — the difference of karstic processes acting above and below soil surface determines a different morphological appearance of boulder surface; a solution notch forms at soil surface.

Table 2
List of marine shells sampled inside the Torre S. Emiliano boulder accumulation

Bivalves	Gastropods
Arca noe L.	*Columbella rustica* (L.)
Arca tetragona (Poli)	*Conus mediterraneus* Hwass
Pteria hirundo (L.)	*Murex brandaris* L.
Modiolus barbatus (L.)	*Calliostoma conulum* (L.)
Venus sp.	*Gibbula magus* (L.)
	Haliotis lamellosa Lamarck
	Luria lurida (L.)
	Bittium reticulatum (Da Costa)
	Cerithium vulgatum Bruguiere
	Gibbula sp.
	Luria sp.
	Patella sp.
	Vermetus sp.

not as efficient as tsunamis in the detachment and transport of large boulders. In particular, Noormets et al. (2004) indicate that tsunamis as well as large swell waves are capable of quarrying large boulders, provided that sufficient initial fracturing is present. However, swell waves are seldom capable of emplacing large blocks onto the emerged platform due to their rapid disintegration after breaking. On the contrary, tsunamis are likelier to emplace large boulders onto the coastal platform due to the longer duration of their action.

Scheffers (2005) using relations proposed by Nott (1997, 2003) inferred that no storm wave recorded along any of the world's coastlines is able to overturn boulders weighing more than 20 t at sea level. Moreover, tsunamis can mobilize an impressive amount of material, in contrast to storm waves, which cause large boulder detachment and transport only occasionally.

With regards to the studied boulder accumulations, the huge number of mobilized boulders, their great weight and position clearly indicate the action of a tsunami. Hydrodynamic calculations made according to Nott (2003) relations indicate a tsunami wave height for the five largest boulders surveyed at the Torre S. Emiliano locality that ranges from about 6.5 to more than 11 m (Table 1). By contrast, the mobilization of such large boulders requests wind breaking waves marked by heights ranging from 27 to 45 m.

Similar calculations have been made on larger boulders surveyed at Torre Sasso locality. The calculated tsunami wave height ranges from 3.7 to 7.7 m whereas wind wave breaking heights comprise between 15 and 31 m.

The surveyed boulder accumulations are clearly out-of-size coastal landforms in respect to local storm wave power. Mastronuzzi and Sansò (2004) calculated by using Nott (1997) relations that along the Adriatic side of Apulia extreme storm waves can not transport boulders weighing more than 2.5 t.

Finally, calculations agree with boulder accumulation morphology that suggest a minimum run-up at Torre S. Emiliano of about 11 m. Moreover, the uniform morphological appearance of the boulders' surfaces suggests that the two ridges of the Torre S. Emiliano accumulation most likely formed as a consequence of two tsunami waves occurring during the same catastrophic event.

4.1. Inferred chronology of Torre S. Emiliano tsunami

The boulder accumulation of Torre S. Emiliano has been dated by using morphological, radiocarbon and archaeological data; unfortunately the Torre Sasso boulders accumulation does not retain elements useful for its chronological attribution.

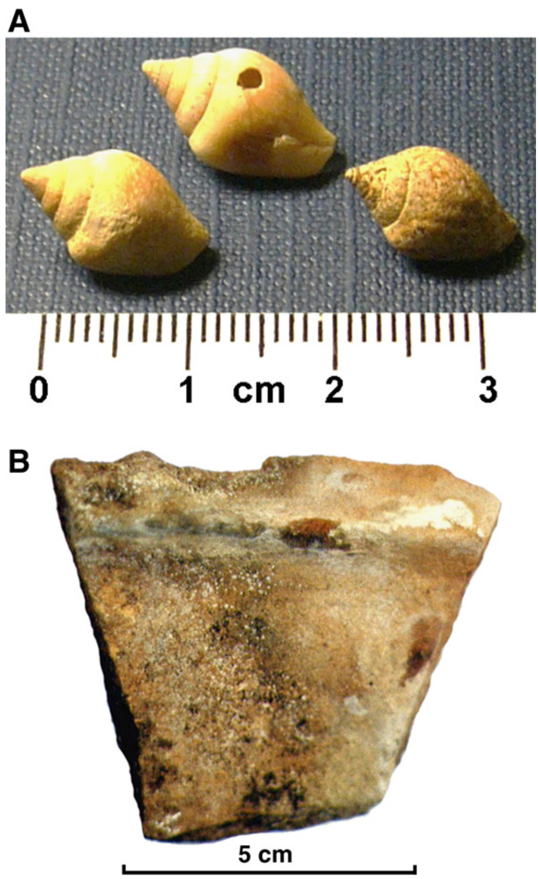

Fig. 13. The three specimens of *Columbella rustica* dated by means of AMS radiocarbon determinations (A) and the pottery fragment (B) found within the soil cover below a group of imbricated boulders at the landward margin of the accumulation. The pottery has been attributed to the 16th–17th centuries.

A first, relative indication of the age of the Torre S. Emiliano boulders accumulation comes from the analysis of spheroidal boulders that at present form inside large potholes in the wave breaking zone. Some of these boulders have been found at the landward margin of the accumulation, partly covered by the colluvial cover. Some of them have been capsized by a caterpillar aiming to detect some morphological differences between the aerial-exposed surface and the colluvium-covered one (Fig. 11). In fact, the presence or absence of a cover is a very important factor, because karstic processes operate differently on exposed rock surfaces and at cover-rock surface interface (Jennings, 1985). On the bare rock surface small rainpits, solution flutes and bevels develop producing an irregular appearance of the surface. On the contrary, a smooth surface is produced on limestone below a cover surface because its presence promotes solution since water retained in the cover provides a biogenic CO_2 supply. The rock surface below the cover surface is smoothed and characteristically bleached white; a solution notch generally develops just below cover surface.

It would be expected that the greater the morphological difference between exposed and cover boulder surfaces the longer the time of boulder emplacement will be (Fig. 12). The removal of some boulders occurring at the innermost margins of the accumulation and the analysis of karstic features occurring on their surface reveals no morphological differences between exposed and covered rock surfaces. In conclusion, karstic features would indicate a very recent age for boulder depositions.

More precise data have been obtained by radiocarbon dating. Most of the boulders were carved by the supralittoral zone so that no biogenic encrustations able to supply a radiocarbon age for this tsunami event have been found on the boulder surface. However, numerous marine shells have been found inside the seaward boulder ridge, in correspondence with the outer slope (Table 2). Three AMS radiocarbon age determinations have been performed on *Columbella rustica* (L.) (Fig. 13A); since it is not edible any possible accidental contamination due to the human and bird frequentation of the area has been excluded. The results of the AMS analyses have been calibrated by using the CALIB 5.0 software (Stuiver and Reimer, 2005) and adopting a delta R value of 121±60 (Table 3). Results indicate that the samples have a very recent age; their deposition would have occurred about two or three centuries ago. Unfortunately, radiocarbon analyses on recent marine samples do not allow us to obtain very precise age determinations (Stuiver and Polach, 1977).

However, the removing of one of the innermost groups of imbricated boulders allowed the finding of intertidal bioconcretions (*Lythophyllum lichenoides* Phil.) clasts and pebbles; as well as some archeological

Table 3
Radiocarbon age determinations performed on marine biogenic materials collected at the Torre S. Emiliano boulder accumulation

ID sample	Description	δ^{13}C‰	Radiocarbon age	Age uncertainty	ΔR	Calibrated age	1σ	2σ	Lab.
Emilio X1 GX-31838-AMS	*Columbella rustica*	0,5	620	±50	121±60	1724 AD÷1745 AD	0,115		A
						1750 AD÷1790 AD	0,218		
						1801 AD÷1897 AD	0,581		
						1935 AD÷1951 AD	0,08		
						1685 AD÷1951 AD		1	
Emilio Y1 GX-31840-AMS	*Columbella rustica*	1,3	600	±40	121±60	1770 AD÷1775 AD	0,071		A
						1804 AD÷1951 AD	0,921		
						1702 AD÷1951 AD		1	
Emilio Y2 GX-31839-AMS	*Columbella rustica*	0,5	530	±40	121±60	1533 AD÷1599 AD	0,465		A
						1617 AD÷1671 AD	0,534		
						1739 AD÷1751 AD		0,009	
						1764 AD÷1802 AD		0,04	
Emilio E1 LTL 1180 A	*Lithophillum licheinoides*	1.7±0.1	519	±40	121±60	1533 AD÷1597 AD	0,38		B
						1617 AD÷1682 AD	0,62		
						1495 AD÷1699 AD		0,88	
						1733 AD÷1806 AD		0,11	

Conventional ages have been calibrated using CALIB 5.0 software (Stuiver and Reimer, 2005). Legend: A = Geochron Laboratories, Cambridge, Massachusetts, USA; B = CEDAD, Università degli Studi Lecce, Mesagne, Brindisi Italy.

Fig. 14. The 20th of February, 1743 earthquake. Circles size supplies an indication of MCS earthquake intensity at different localities. The dotted circle marks the estimated position of the epicentre (data from www.ingv.it).

remains and bones of vertebrates found within the top layers of the colluvial deposits covered by boulders. The AMS radiocarbon age determination of bioconcretions fits with the other available radiometric data. Moreover, the occurrence of a pottery fragment allows the attribution of the archeological material to the 16th–17th centuries (Fig. 13B).

The whole of this evidence indicates that the investigated boulder accumulations were produced about three centuries ago by at least two large tsunami waves propagating from the SSE, with a run-up of about 11 m.

Taking into account these data and the available strong earthquakes catalogue (Boschi et al., 2000) the best candidate for the generation of this tsunami is the strong earthquake that struck southern Apulia on the 20th of February, 1743.

This strong earthquake reached its maximum intensity (IX grade of Mercalli scale) in the area of the Otranto Strait causing the most relevant damage to the villages of Nardò and Francavilla Fontana in southern Apulia and Amaxichi, on the Lefkada island, in Greece. The epicenter has been placed in the northern Ionian Sea, between the Greek Ionian Islands and southern Apulia (Fig. 14). Chronicles report three main shocks which could justify the recorded occurrences of multiple tsunami waves and a withdrawal of the shoreline at the Brindisi harbour (Margottini, 1981). The absence of written records of this catastrophic event which severely struck the coast stretching from Otranto to S. Maria di Leuca could be explained by the lack of settlements along the coast, with the only exception of Otranto, placed in a sheltered position at the back of the Torre S. Emiliano area, and Castro, situated on a ridge at 90 m above sea level.

Morphological effects of the 1743 tsunami have also been reported by Mastronuzzi and Sansò (2004) along the coast to the north of Brindisi. In this locality, the tsunami impact produced large sparse boulders quarried from the intertidal zone and transported on a low elevated platform. Hydrodynamic calculations made on the largest boulders define a tsunami height of about 1.5 m.

5. Conclusions

Along the southeastern coast of the Apulian region, large boulder accumulations mark the coastal landscape. The detailed survey of these accumulations reveals that they are out-of-size landforms whose development has to be attributed to a tsunami event and not to the local much less powerful storm waves. In particular, the boulders' weight and arrangement suggest that this coastal tract has been struck by two consecutive large tsunami waves coming from the SSE and marked by a run-up of about 11 m.

Numerous chronological data indicate a very recent age for this event which would have occurred about three centuries ago. Available earthquake catalogues indicate the 20th of February, 1743 earthquake to be the best candidate for the generation of this tsunami. It was responsible for severe damage to villages along the opposite coastal regions of the Otranto Strait. The epicentre was most likely placed in the Ionian Sea, some tens of kilometres to the SSE of the surveyed area.

It is interesting to note that notwithstanding the effects of this tsunami which can be found up to the north of Brindisi, only a brief historical report is available. This is most likely due to the past diffused presence of coastal swamps and *malaria* causing the coastal area to be practically deserted up through to the beginning of the last century.

In conclusion, the collated data identify the presence of a tsunami-generative seismic structure offshore of the southeastern Salento coast and increase the need for studies that would define the tsunami vulnerability and risk along southern Apulian coast and for strategies devoted to tsunami risk mitigation.

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