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The 1856 Tsunami of Djidjelli (Eastern Algeria): Seismotectonics, Modelling and Hazard Implications for the Algerian Coast

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Abstract—On August 21st and 22nd 1856, two strong earthquakes occurred off the seaport of Djidjelli, a small city of 1000 inhabitants, located 300 km east of Algiers (capital of Algeria). In relation to these two earthquakes, an important tsunami (at least one) affected the western Mediterranean region and the eastern Algerian coastline between Algiers and La Calle (Algero-Tunisian border). Based on historical information as well as on data recently collected during the Maradja 2 survey conducted in 2005 over the Algerian margin, we show that the tsunami could have been generated by the simultaneous rupture of a set of three *en echelon* faults evidenced off Djidjelli. From synthetic models, we point out that the area affected along the Algerian coast extended from Bejaia to Annaba. The maximum height of waves reached 1.5 m near the harbor of Djidjelli.

Key words: Djidjelli, Algeria, 1856 tsunami, Faults, Wave modelling, Runup.

1. *Introduction*

Although the Algerian margin demonstrated its ability to potentially generate hazardous tsunamis (e.g., Yelles *et al.*, 1991; Soloviev *et al.*, 2000; Lorito *et al.*, 2008, and references therein) as for instance during the recent May 21, 2003 Boumerdes earthquake, little is known about the size and impact of past or future tsunami events on the western Mediterranean coasts and mainly on the Algerian coast. This could be attributed mostly to the lack of historical informations and the fact that tsunamigenic events are rare (Yelles-Chaouche, 1991). Historically, although some reports mention a tsunami related to the destructive earthquake of Algiers in 1365 (Ibn Khaldoun, 1369) or to the moderate event of Gouraya of January 15, 1891 (Soloviev *et al.*, 2000), the first

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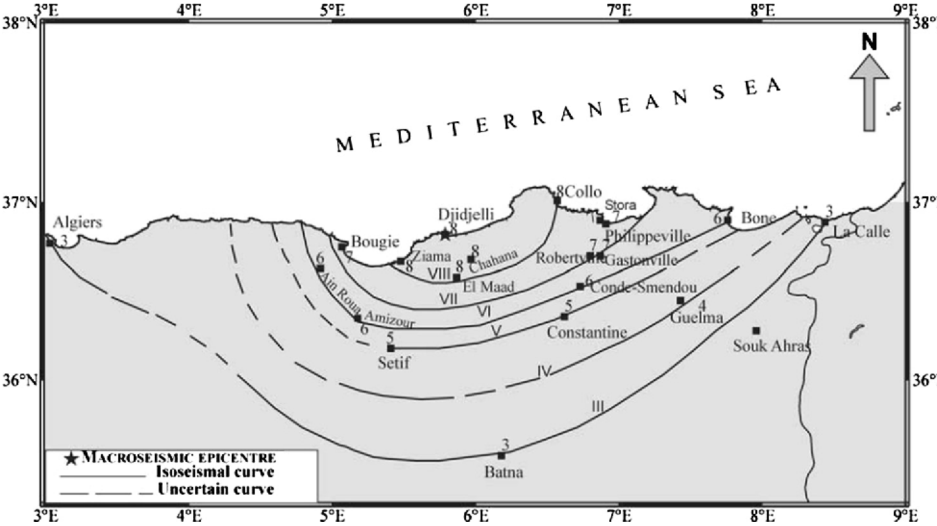

Figure 1
Isoseismal map of the Djidjelli earthquake of August 22, 1856 (I: VIII) after Harbi *et al.* (2003).

well documented event remains the Djidjelli tsunami associated with the seismic crisis of August 21–22, 1856 (Rothé, 1950; Ambraseys, 1982; Benhallou, 1985; Fig. 1).

During the instrumental period, two tsunamigenic events are evidenced as they were the first recorded by geophysical instruments. The first one occurred after the destructive El Asnam event of October 10, 1980 (M_s: 7.3; Ouyed *et al.*, 1981). Although located at a distance of about 60 km from the coast, the earthquake triggered a submarine landslide inducing a weak tsunami recorded by several tide gauge stations of southeastern Spain (Soloviev *et al.*, 1992; Papadopoulos and Fokaefs, 2005). The second tsunami, the more recent one, is the tsunami of Boumerdes of May, 21, 2003. This event, one of the most important in the western Mediterranean region within the last century, was generated by an earthquake of magnitude M_w 6.8 that occurred on the offshore reverse fault of Zemmouri (Yelles *et al.*, 2003; Alasset *et al.*, 2006). This thrust fault, with a length of about 50–55 km, is assumed to outcrop near the seafloor at about 10–15 km from the shoreline (Déverchère *et al.*, 2005). Effects of this tsunami were felt in the entire western Mediterranean region and especially along the Balearic coasts (Alasset *et al.*, 2006). The Boumerdes tsunami demonstrated for the first time the high potential of the Algerian margin for tsunami generation.

If the Algerian tsunamis are mainly related to strong earthquakes that could happen along the coastal region, landslides along the margin could also be another potential source of tsunamigenic events as discussed by some authors for the Orleansville and the El Asnam earthquakes (Ambraseys, 1982; Yelles, 1991).

The recent swath bathymetry survey, Maradja 2 survey, conducted along the eastern Algerian margin in November 2005 allowed us to map the seafloor of the region between

Dellys and Annaba by using a high resolution swath bathymetric system (DOMZIG, 2006) (Fig. 2a). These new bathymetric data, together with seismic sections recently carried out in the area, offer the opportunity through seafloor mapping and densification of the seismic sources, to revisit and discuss on a new basis the origin of the important historical Djidjelli tsunami event. Using numerical modelling of the tsunami waves triggered by the earthquake only, the aim of this study is to estimate and to discuss the effects of the tsunami due to the source inferred, and to compare this modelling to the available historical observations along the Algerian coast, and more particularly in the Djidjelli harbor area.

2. *The Djidjelli Earthquake of August 21 and 22, 1856*

The tsunami occurred during the French occupation of Algeria. Based on several historical archives available (newspapers, reports, etc) the seismic crisis of Djidjelli was well described by authors like ROTHÉ (1950) and AMBRASEYS (1982) who reported many details on its effects on the Algerian and western Mediterranean coasts.

The Djidjelli sequence was marked by the occurrence of two main shocks, one on the night of August 21, and the second**,** more violent, on the night of August 22, 1856. The first shock, considered as a foreshock, happened at 21 h 45 mn (local time). It destroyed the old Genoese tower of the city and claimed the lives of a few people. Following the shock, ROTHÉ (1950) and AMBRASEYS (1982) indicated that the sea receded for some distance and suddenly flooded the low-lying parts of the coast. Damage was equally serious in the region between Djidjelli and Collo (Fig. 1). The earthquake was felt over a large area from Algiers in the West to La Calle in the East and from Batna in the South to Nice (France) to the North. At Mahon in Minorca (Balearic Islands), the shock was followed by a rapid flooding of the harbor. As a result of it, many boats broke their moorings (AMBRASEYS, 1982, SOLOVIEV, 2000).

The second shock occurred on August 22, at 11 h 40 min (local time). It was more violent than the first one and it is generally considered as the main shock. It destroyed what remained of local houses and killed few people, as the population was evacuated the day before. The shock triggered a sea wave of 2 to 3 meters high (observed at Djidjelli) that flooded the eastern Algerian coast several times. At Bougie (Bejaia) and Philippeville (Skikda), small towns located eighty kilometers west and east of Djidjelli, AMBRASEYS (1982) and SOLOVIEV (2000) reported that the sea rose from about 5 meters, flooding the shore five to six times. In Bone, the sea rose by about one meter, flooding the parade grounds in a succession of waves that continued for twelve hours. These authors also reported that the shock was felt at Cagliari (Island of Sardinia) and Caloforte (Island of S. Pietro) as well as at Mahon in Spain. There the shock was less intense than that of the previous day but it was stronger in Nice and in Genoa in Italy.

Considering all these pieces of information and on the basis of the isoseismal map (Fig. 1), the earthquake was located a few kilometers offshore of Djidjelli, with an

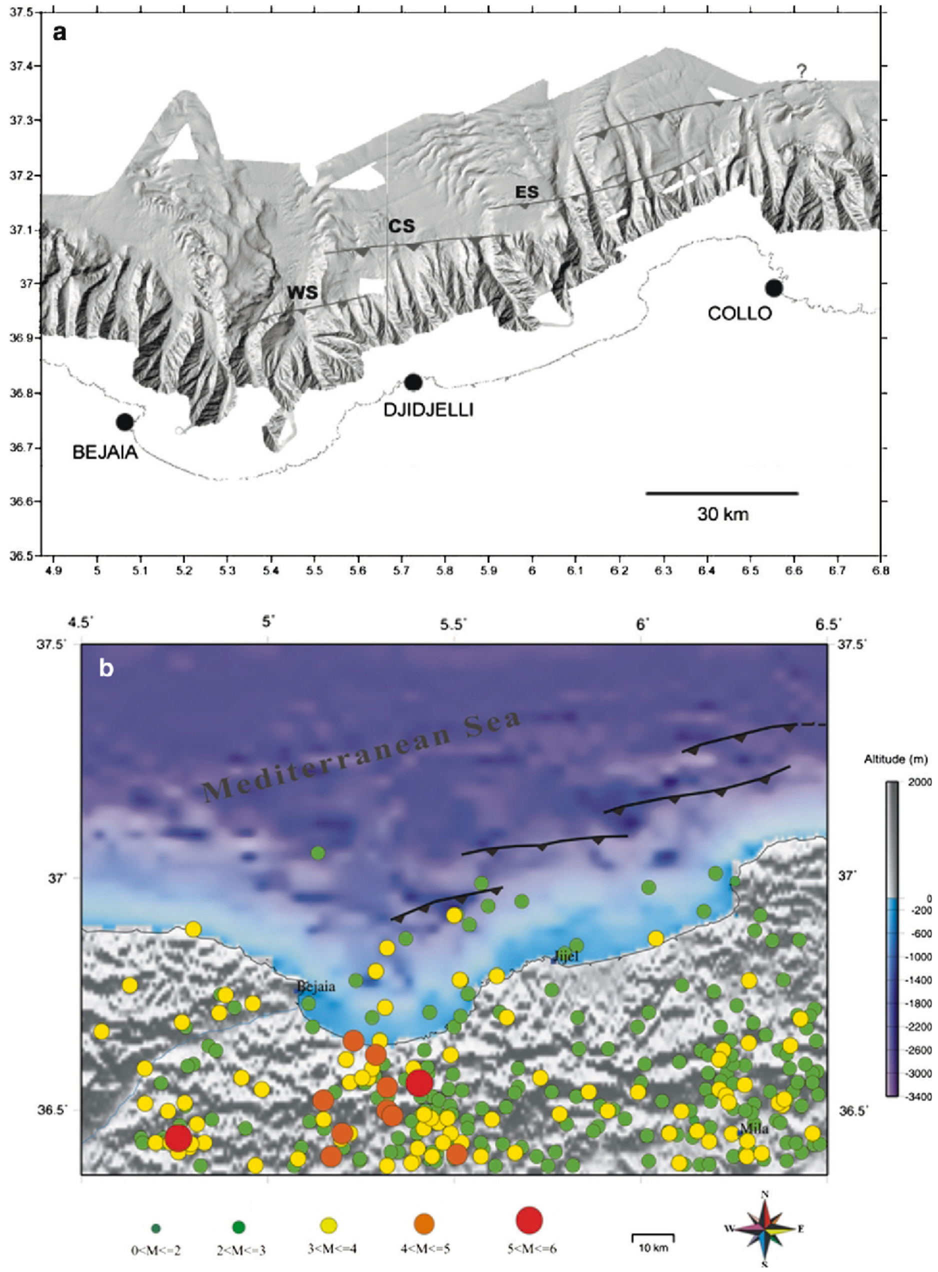

Figure 2

(a) Bathymetry offshore of Djidjelli with the four overlapping structures assumed active (Domzig, 2006). The three faults named WS (West Segment), CS (Central Segment), and ES (East Segment) are used in this study because they are thought to be at the origin of the 21 and 22 August, 1856 earthquakes and associated tsunamis (see text for details). (b) Recent seismic activity off Djidjelli (1980–2007 period, from CRAAG seismic catalogues).

estimated maximum intensity of VIII. Papadopoulos and Foakefs (2005) estimate that the tsunami intensity of 21 August 1856 was equal to 3 on the 6-point tsunami intensity scale and 5 on the 12-point scale. This places this particular tsunami among the significant ones observed in the Mediterranean Sea in the last two centuries.

3. *Physiography of the Margin off Djidjelli*

Off the coast of Djidjelli, the bathymetric map has been obtained from the Maradja 2 survey data (Fig. 2a). This survey was conducted in November 2005 on the French R/V Suroit and aimed firstly at obtaining a precise bathymetric map of the structures between Dellys and Annaba (eastern Algeria). For this purpose, a Kongsberg EM300 Simrad multibeam echosounder (EM 1000 for the continental shelf) for bathymetry and reflectivity was used. Simrad EM300 is a 32-kHz multibeam system which allows for an overall swath coverage up to 5 times water depth, increasing with depth to a maximum width of 5000 m at 1000 m depth. The reached resolution was of 15 × 35 m at 1000 m depth with a vertical accuracy from 2 m (central beam) to 10 m (lateral beam).

The survey was limited to the continental slope and part of the deep basin (Domzig, 2006). Between Bejaia and Collo, the margin is marked by a narrow shelf and a steep slope in front of the massif of Lesser Kabylia. The continental shelf disappears totally near Collo. In the bay of Bejaia, the slope is outlined by two main canyons with a N-S direction (Fig. 2a). They correspond to the marine extension of the Soummam River (Domzig, 2006). Further east, between Djidjelli and Collo, the slope of the margin is incised by several canyons. Off Djidjelli, these canyons are short whereas off Collo they extend down to the abyssal plain. According to the bathymetric map (Fig. 2a), the deep basin depicts a series of elongated ridges that can be interpreted as sediment waves or contourites developing at the foot of the slope. However, several linear topographic anomalies that can hardly be due to sedimentary processes only are also observed at the foot of the slope and upslope. They present a general NE-SW to E-W strike as presented in Figure 2a.

4. *Seismotectonics of the Djidjelli Margin*

Northern Algeria lies along the Eurasian-African plate boundary. With an average rate of about 5 mm/yr in a N 60°W, the convergence between the two main plates is responsible for the seismic activity which affects Algeria. Seismicity on land is generated by active faults oriented mostly NE-SW, located along the Atlasic mountains and the Neogene basins. Strong earthquakes could occur in the northern region, as the last one of Boumerdes of May 21, 2003. For a long time, offshore seismicity remained poorly known due to the lack of investigations along the margin.

In the Djidjelli region, the seismic activity deduced from historical catalogs (Mokrane *et al.*, 1994; Benouar, 1994) seems to be low with an activity mostly focused along the southern suture between the internal and external domains. Nevertheless, since the recent installation of the Algerian Digital Seismic Network by the CRAAG (Centre de Recherche en Astronomie, Astrophysique et Géophysique), many seismic events were recorded recently along the coastline between Bejaia and Djidjelli. An updated seismic map of the region of Djidjelli (Fig. 2b) shows activity in proximity to the four scarp segments reported hereafter, which favors possible activity of these faults, and therefore, their ability to generate tsunamis.

From the analysis of the seismic lines carried out during the Maradja survey and of Sonatrach (Algerian Oil Company) commercial seismic lines (see location on Fig. 3a), cross sections along the margin in the region of Djidjelli were obtained. We observe that the central part of the margin is uplifted (Figs. 3b and c), whereas the lower slope is dominated by low-angle normal faults and slides rooted at the base of the Messinian salt layer (Fig. 3c). By correlating the bathymetry and the seismic lines, we find that uplifts are related to reverse faulting near the slope break or below the lower slope, although the geometry of thrusts is hardly visible (Figs. 3b and c). Thereafter, we could identify four *en echelon* segments, widely overlapping, which can be followed near the foot of the slope or in the lower slope (Fig. 2a). In front of Djidjelli, a first segment (named west segment) oriented NE-SW (N 75°E) has a surface extent of ∼25 km. This is a thrust fault related to an asymmetrical fold which produces the growth of a basin on its backlimb that is tilted towards the continent (Fig. 3b). The second one (named central segment) is observed north of the City of Djidjelli. This segment, about 30 km far from the coast is apparently slightly longer than the previous one (∼35 km). This reverse fault striking N85°E is also related to another asymmetrical fold. Finally, two other scarps, with apparent lengths of ∼40–45 km and ∼30 km, are found northwest of Collo City. Among these two segments, the one located in the deep basin and striking N 80° is not clearly related to a deeper fault activity and could only result from salt tectonics; a process quite well identified in the eastern part of the studied area (Fig. 3c). We will therefore consider in the following only the segment located upslope and designate it east segment. Note that this segmentation pattern of the fault zone with similar lengths has also been observed during the May 21, 2003 Boumerdes earthquake rupture: Indeed, two main slip zones have been identified from a joint inversion of seismological waveforms and ground displacement observations (DELOUIS *et al.*, 2004) which are interpreted as being related to the two main cumulative scarps evidenced at the sea floor (DÉVERCHÈRE *et al.*, 2005).

Then, from bathymetric maps and seismic lines, the main characteristics of these three fault segments (length, width, depth) are determined (Table 1). It is worth to note that these parameters are only mean values deduced from the combination of observations made on bathymetry, seismic sections, and assumptions deduced from literature. Uncertainties remain, especially for strike and dip of faults that cannot be accurately determined from the available data set, since there is no means to directly describe the geometry of faults at depth and their spatial continuity.

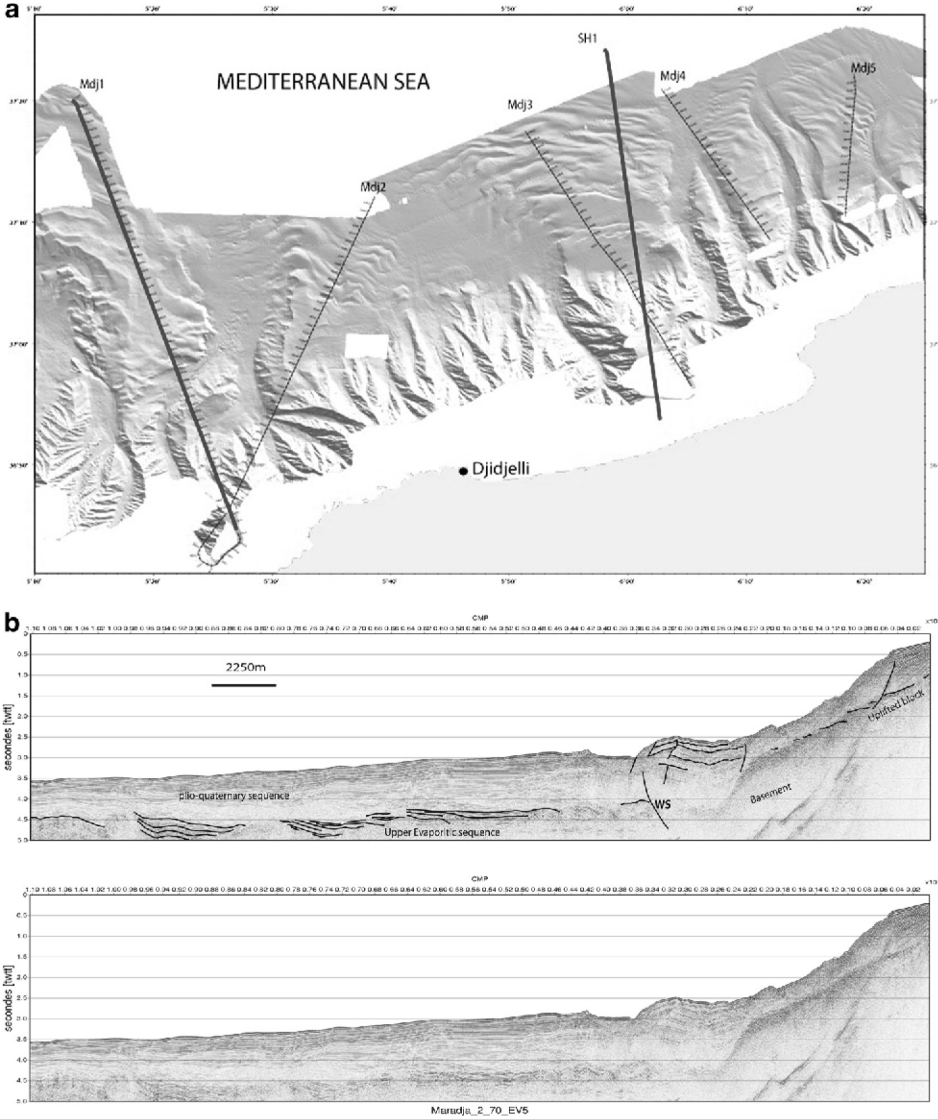

Figure 3

(a) Location map of the bathymetry with seismic lines shot during the Maradja 2 survey. Bold lines are the location of the seismic lines shown. One line from the industry (SH1) (dark line) is also plotted; (b): Seismic profile MDJ1 (in two-way travel time, TwT) across the West Segment WS (Fig. 2a) – Black line depicts the inferred position of WS according to the deposition pattern (growth strata) near the surface; (c): Processed commercial seismic section SH1 (480-channel, stacked and migrated) across the margin off Djidjelli and crosscutting the Eastern Segment ES (see location Fig. 2a). For (b) and (c) the upper one is the interpreted line, the lower one is the raw data.

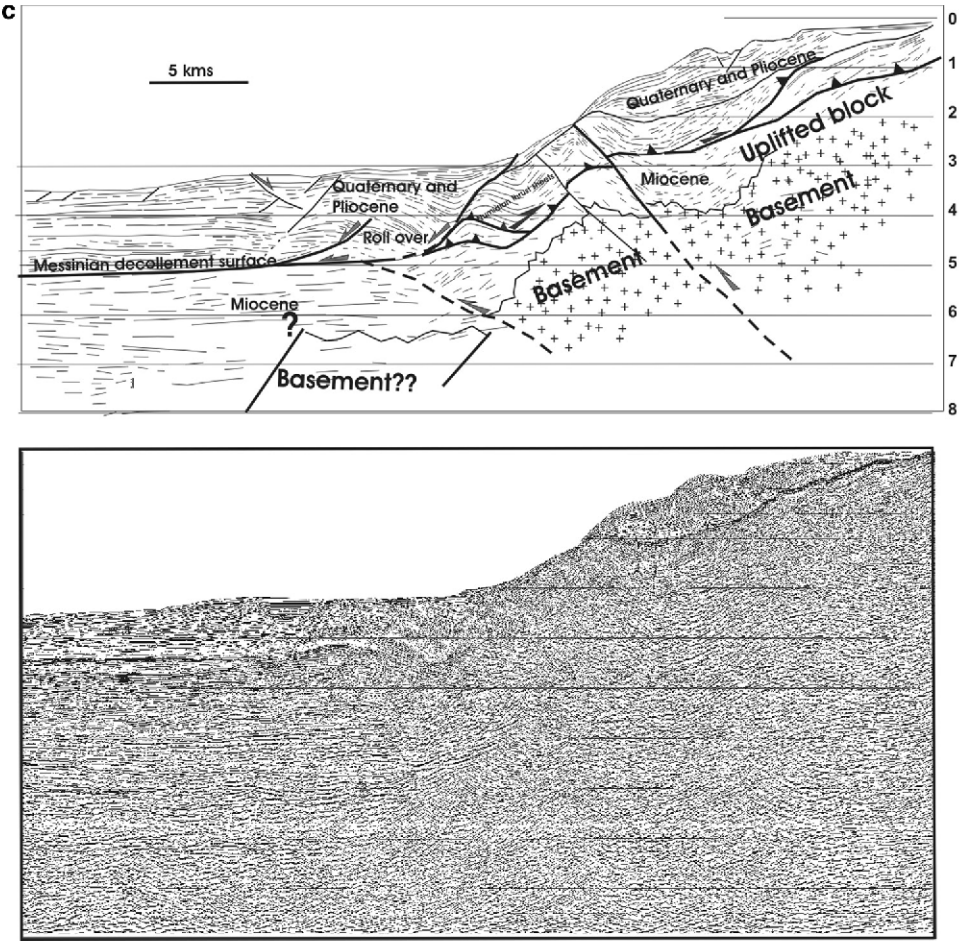

Figure 3
contd.

Table 1

	Longitude (°)	Latitude (°)	Center of fault plane deep (km)	Slip (m)	Strike (°)	Dip (°)	Rake (°)	Half length (m)	Width (m)	Shear modulus (Pa) = rigidity
West	5.4764	36.95	10	1.0	75	40	90	12500	20000	$4,5*10^{10}$
Center	5.736	37.0791	10	1.5	85	40	90	18500	20000	$4,5*10^{10}$
East	6.15	37.1784	10	1.5	75	40	90	22000	20000	$4,5*10^{10}$

Finally, we note that the overall length of the three segments considered here is about 100–105 km. According to Wells and Coppersmith law (1994), this value is consistent with the approximate magnitude inferred for the 1856 earthquake sequence from the isoseismal map, i.e., $7^{1/2}$ (Fig. 1; Harbi *et al.*, 2003, and references therein). Therefore, considering their effects at the surface, their apparent connection to deformed areas at depth (see e.g., Figs. 3b and c) and the consistency of cumulative length with the magnitude hypothesized, we assume that these segments, which are distributed as *en échelon* faults, could be (for at least two of them) responsible for the Djidjelli events of August 1856 (Yelles *et al.*, 2007; Roger and Hébert, 2008). Subsequently we propose to take into account these three western segments in order to model the tsunami of August 21–22, 1856, and we combine them in order to determine a range of possible triggering effects.

5. *Modelling of the Tsunami*

5.1. *Method*

For the generation of the tsunami wave, the coseismic deformation corresponds to an elastic dislocation model which involves the vertical deformation of the seafloor in the epicentral area as a function of the ground elastic parameters and the fault plane geometry (Okada, 1985). The different parameters used are also related to each other by the seismic moment relation: $\mathbf{M_0 = \mu ULW}$ (Aki, 1966), where $\boldsymbol{\mu}$ is the rigidity constant, $\mathbf{U}$ the average slip in the fault, and $\mathbf{L}$ and $\mathbf{W}$ the length and width of the fault plane, respectively.

In order to model the propagation of the sea waves, we use the depth averaged, nonlinear hydrodynamical equations of continuity (1) and motion (2) conservation describing the conservation of mass and momentum:

$$\frac{\partial(\acute{\eta} \pm \mathrm{h})}{\partial \mathrm{t}} + \nabla \cdot [\mathrm{v}(\acute{\eta} + \mathrm{h})] = 0 \tag{1}$$

$$\frac{\partial \mathrm{v}}{\partial \mathrm{t},} + (\mathrm{v} \cdot \nabla)\mathrm{v} = -\mathrm{g}\nabla\acute{\eta} + \Sigma \mathrm{f} \tag{2}$$

where **h** is the water depth, $\boldsymbol{\acute{\eta}}$ the water elevation above mean sea level, **v** the depth-averaged horizontal velocity vector, **g** the acceleration of gravity and **f** the bottom friction and Coriolis forces. Thus nonlinear terms are taken into account, and the resolution is carried out using a Crank Nicolson finite-difference method centered in time and using an upwind scheme in space.

Amplification of the sea waves from the seafloor are based on the use of the available bathymetric data. In this study we use the GEBCO world bathymetric dataset (British Oceanographic Data Centre, 1997) mixed with the Maradja 2 data (200 m resolution) along the eastern Algerian margin. Near the coast and due to the lack of swath bathymetry coverage of the continental shelf where the depth is less than 200 meters (a band of about 5 miles wide) digitized bathymetric maps from LECLAIRE (1972) were used.

On the other hand and in order to be complementary from other studies related to tsunamis in the western Mediterranean region (LORITO *et al.*, 2008; ROGER and HÉBERT, 2008), we choose to focus our study on the impact of the tsunami along the Algerian coastline and more specifically in Djidjelli. Figure 4 depicts the topography of the region of Djidjelli. The city is located along the coastline, at the foot of the Lesser Kabylian massif. This particular location could influence the runup on land, by stopping invasion of the water on the continent. One can also note that the present-day configuration of the lower part of the city with the old and new port of Djendjen (suburb of Djidjelli) is very different from the one of August 1856. Indeed, the harbor of the city, situated in the western part of the Djidjelli bay, depicts structures that directly develop over the seafloor

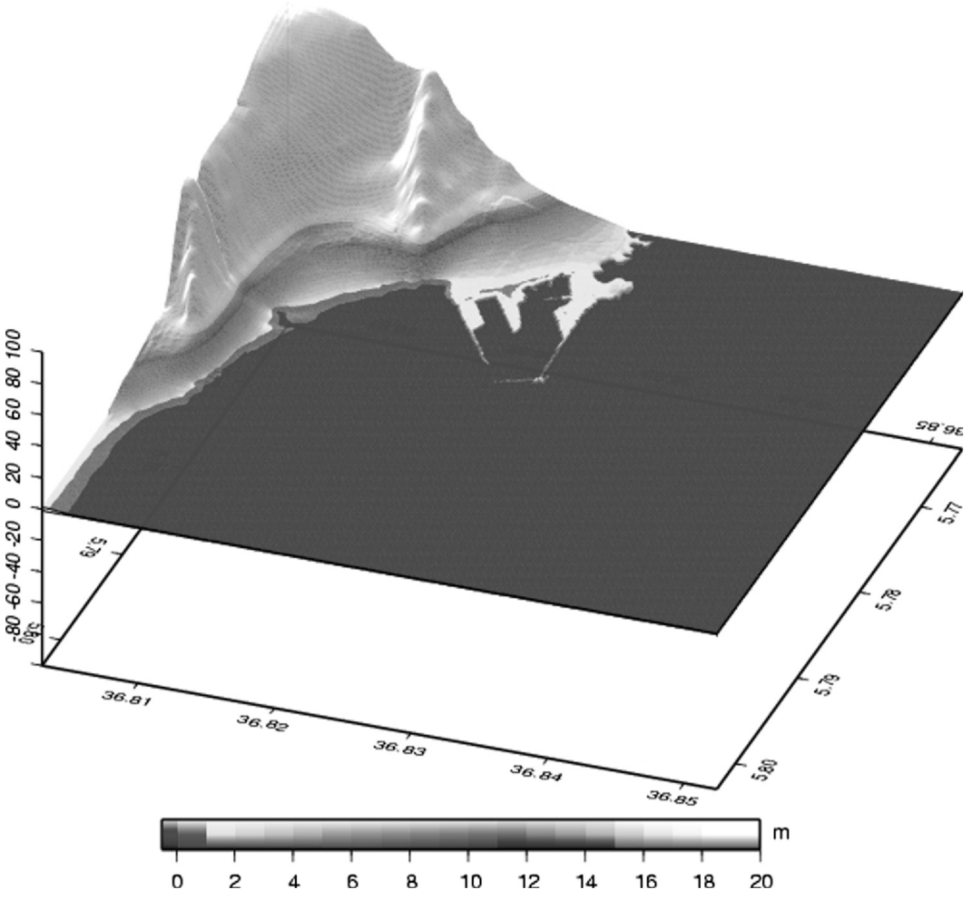

Figure 4
Topographic map on land in the region of Djidjelli.

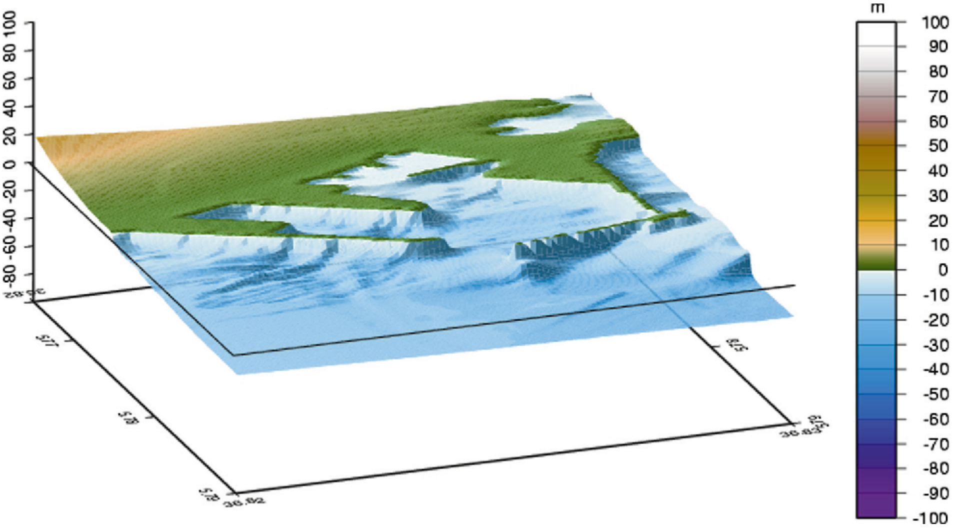

Figure 5
Submarine topography off the Djidjelli harbor.

(Fig. 5). Unfortunately, it was not possible to obtain topographic data of the new Djendjen harbor built in the 1990s. These structures could therefore play a role in the sea-wave propagation and amplification and seem to constitute a protection for the City of Djidjelli thanks to its long piers.

To set up our modelling, we created a set of three imbricated grids, the first one containing the sources with a resolution of 200 m; the second one being a zoom on the Djidjelli bay area with a resolution of 50 m; and the last one a zoom on the Djidjelli harbor with a resolution of 10 m (Figs. 4 and 5). Each grid has been built using krigging interpolation in order to unify the data coming from different origins. The last grid has been created from a combination of the previous cited data and from georeferencing and manual digitizing of a nautical bathymetric chart of the Djidjelli harbour with the same method as proposed by ROGER and HÉBERT (2008). Finally, the resolution of the bathymetric data increases from the abyssal region to the coast from a grid to another one, which is in direct relation with the slowdown of the waves and their amplification as they approach the coastline.

5.2. Tested Seismic Sources

In order to reproduce the tsunamis inferred by the two earthquakes, we tested several seismic sources in relation with the *en echelon* fault system evidenced by DOMZIG (2006) and further detailed in this study (Fig. 3). Different combinations of one fault, two or three faults (Fig. 6) were introduced in the model. As explained above, the fourth segment (the most eastern one) is apparently not related to an active fault and was not considered.

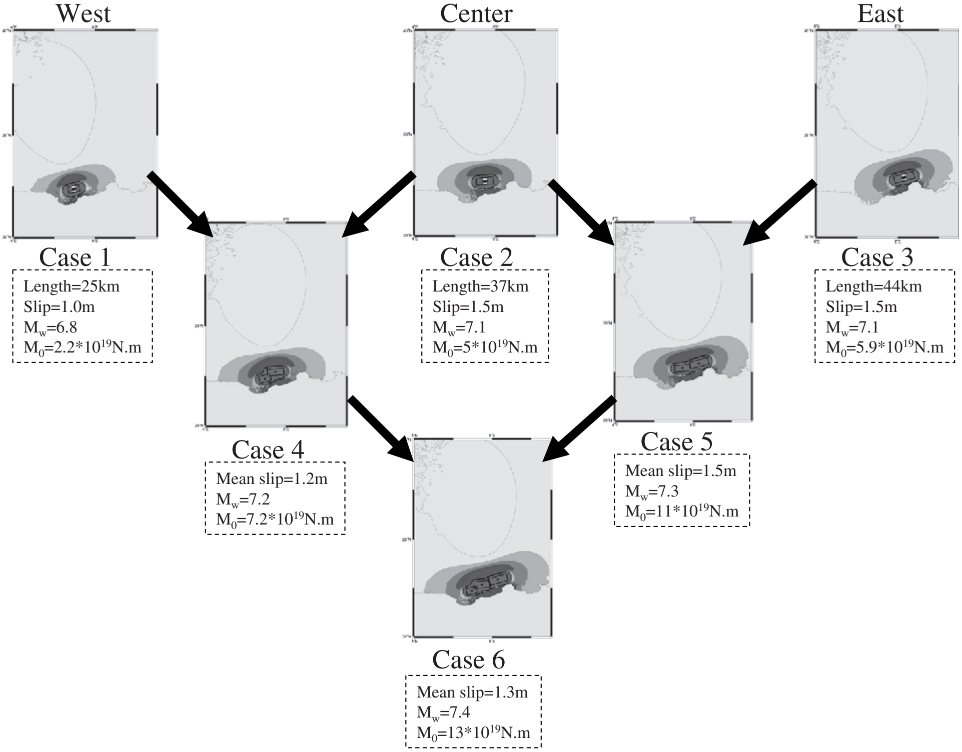

Figure 6
Initial deformation and location or assumed fault planes (black rectangle). Six models are proposed due to the complexity of the rupture and due to the presence of three active faults. The upper line is for each segment. The middle one corresponds to the combination of two segments. The lower model is the combination of the effects of the three segments.

Each hypothesis leads to a maximum earthquake magnitude (Fig. 6). In Table 1, we summarize the parameters chosen for the three main fault segments (West, Central and East) possibly involved in the rupture and the tsunami process. From the bathymetry and seismic lines, the strike, length, and width of the faults are estimated. The existence of some uncertainties discussed above on the different parameters (strike and length essentially) of these segments makes these tests only indicative. The main magnitude range expected is from 6.8 for the western segment to 7.4 for the combination of the three segments. This latter value is in agreement with the magnitude that can be assumed from the damage reported after the two earthquakes of 1856 (Rothé, 1950; Ambraseys, 1982).

5.3. Maximum Amplitude of the Sea Waves for Historical Sites

Based on a selection of several sites on the Algerian coastline and the Balearic Islands, we plot on Figure 7 the maximum sea-wave amplitudes in several places affected

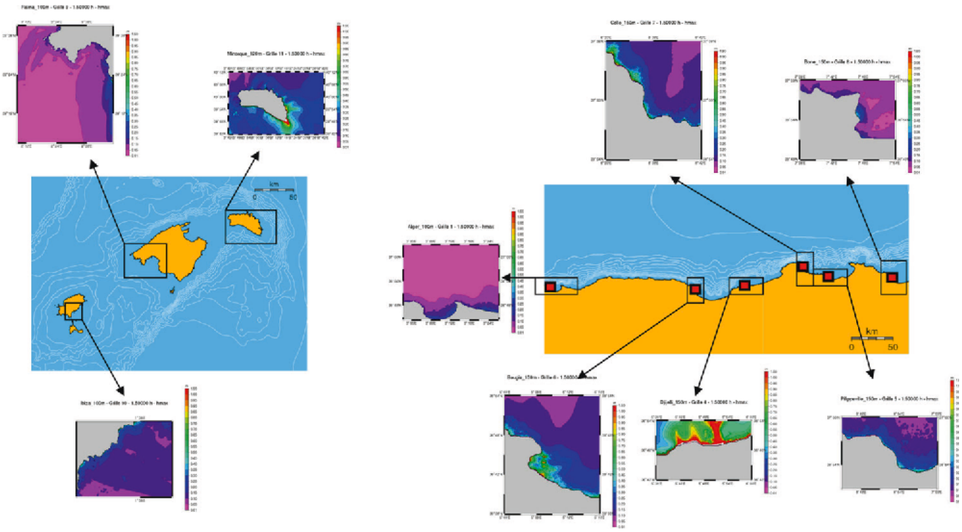

Figure 7
Maximum wave calculated amplitude for historical observations sites. This result is obtained from the combination of the three segments (case 6) and after a time propagation of 5400 s.

by the tsunami. We observe first, that in the Balearic Islands, some sites where the waves arrived an hour after the earthquake are more affected than others (ROGER and HÉBERT, 2008). The maximum is observed in the Minorca Island where the height reached 1.5 m at the southeastern point of the Island. This could be explained by the exposure of the sites to the sea wave propagation and also by the seafloor topography (HÉBERT *et al.*, 2007; ROGER and HÉBERT, 2007, 2008).

Secondly six sites were selected between Algiers in the west and Annaba in the east along the Algerian coastline. The maximum amplitude of the sea waves is measured near Djidjelli and Bejaia. Thus, in this region the maximum sea wave amplitude reaches respectively 1.5 m between 5° 42 E and 6° E. In Bejaia City the height does not exceed one meter. From Figure 7, one can see that on the Algerian coastline, the influence of the tsunami does not extend further than Algiers to the West and Annaba to the East. From our model, one can consider that the maximum energy of the tsunami dissipates more easily towards the North than laterally, indicating that the majority of exposed areas are located southward and northward of the seismic sources.

In order to measure the flooding of the lower part of the city of Djidjelli, a map of the zones invaded by the sea is proposed. Figure 8 shows a first attempt to quantify the maximum wave height and flooding limits in the Djidjelli coastline area. It is obtained by using the model of the three seismic sources with a maximum magnitude of $M_w = 7.4$. On this map we can see that the eastern part of the city is the most affected area, and that the runup may reach a height of 1.5 m. However, the use of our model does not allow us to reach runup values higher than two meters, whereas historical observations locally

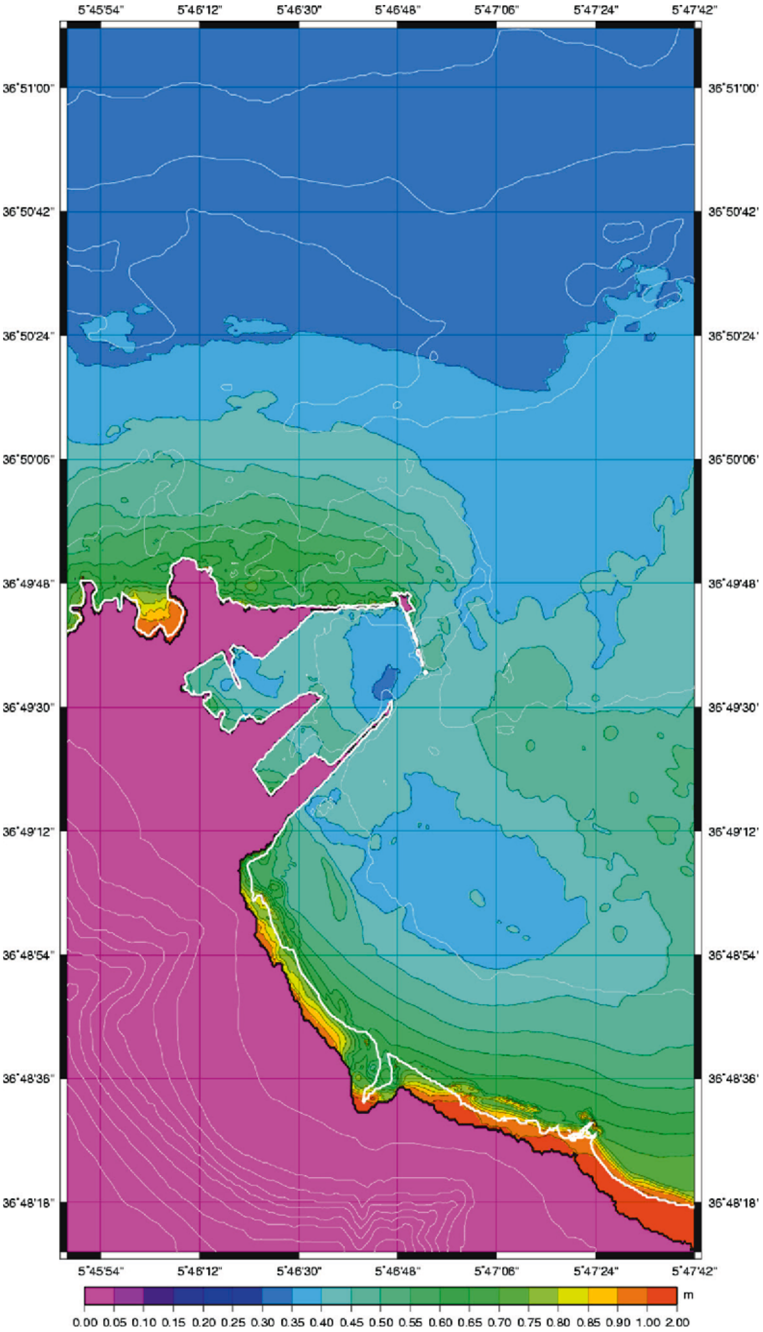

Figure 8

Maximum wave heights for a propagation of 30 minutes for the three segments source over bathy/topo grid (10 m each line). The blank line is the actual coastline of the city of Djidjelli. The dark line corresponds to the flooding limit area (runup).

provide values of more than 4 meters. This discrepancy could be attributed to the inaccuracy of the values reported by the observers at that time or to the poor bathymetric coverage near the shoreline, preventing us from predicting local wave amplifications. We also note that no flooding is evidenced in the western part of the city near the harbor, therefore the harbor with its present-day structure could play the role of a barrier to protect the old city.

6. Discussion and Concluding Remarks

The Djidjelli tsunami of August 1856 could be considered as one of the significant events in the Mediterranean region. Indeed, this is one of the well described tsunamigenic events which took place in the western Mediterranean region during the 19th century. Numerous observations on the impact of this event are available in literature, newspapers or reports. However, no attempt was made until now to explore the possible range of coastal impact of such an event, mainly because of the lack of knowledge related to the source of the event and regarding the bathymetry of the area. The Maradja 2 cruise conducted in 2005 is the first modern bathymetric survey carried out along the eastern margin and offers the opportunity to make a first approach of the implications of this active faulting occurring offshore. Based on the data collected during this survey and on a deep seismic section from the industry, the possible seismic sources of the Djidjelli tsunami (Algeria) of August 21 and 22 are hypothesized, and the possible triggered tsunami is presented. The *en echelon* pattern of the faults (3 segments) that have been identified for the first time near the foot of the margin expresses the deformation process of the margin as observed in other regions of the margin recently studied as Boumerdes or Annaba (DÉVERCHÈRE *et al.*, 2005; DOMZIG, 2006; KHERROUBI *et al.*, in press). This set of faults with an NE-SW or E-W direction is in agreement with the deformation pattern on land (MEGHRAOUI, 1988) which results from the slow convergence of the African and Eurasian plates with an estimate rate of about 0.5–0.7 cm/yr (DE METS, 1990). In accordance with literature, which mentioned two main shocks and many series of waves, we propose that the western fault segment (WS, Fig. 2) may have ruptured first, followed by the rupture of one or two other fault segments (CS and/or ES, Fig. 2) located further east. Despite the complexity of the rupture process, we propose that the use of the model with the involvement of the three segments is the more realistic scenario.

Based on the historical information on the area affected by the tsunami, our work proposes several sea-wave propagation scenarios, trying to reach the best fit to the historical observations. The tsunami affected mainly the eastern Algerian coast and the coast of the Balearic Islands. We would like to emphasize that, because of the proximity of the epicenter from the shoreline, all the tested sources gave the same effects in the harbor area. The discrepancy of sea-wave predictions with the historical observations could be explained by several factors, such the poor bathymetry coverage near the shore, which do not allow the creation of a very realistic bathymetric map for modelling.

Furthermore, we must mention the lack of precise temporal information on the arrival times of the tsunami on the Algerian and Balearic coasts. Indeed, the available archives do not report any approximate time delay between the earthquake and the sea-wave arrival on the coast. This could be related to the time occurrence of the first earthquake which struck in the evening and to the induced panic. Therefore, more temporal investigations of these data will be necessary to precisely determine the propagation of the tsunami.

In spite of our effort to build a realistic grid for the harbor with respect to the structures as piers, docks, etc. for the Algerian coast, the lack of very precise bathymetry as approaching the coast and especially in harbors prevents us from better knowing the role of the bathymetric structures, as submarine canyons for example, near the shore, on the wave amplification. Future bathymetric surveys on the Algerian continental shelf will allow to refine the runup model. Whatsoever, the occurrence of the Djidjelli tsunami indicates that waves of some meters could reach the different coastlines of the western Mediterranean region. LORITO *et al.* (2008) also demonstrate that the coastal area of Djidjelli could be affected by tsunamis triggered in the Sicily channel.

The tsunami hazard in Algeria became more obvious by the occurrence of the last Boumerdes tsunami of May 2003, also evidencing that the Algerian margin hosts several important active tsunamigenic faults that can cause damage on both parts of the western Mediterranean Sea. The acquisition of the recent data through the Maradja 1 and 2 surveys along the margin will allow us to re-assess the tsunamigenic hazard in Algeria, poorly constrained in the past owing to the lack of accurate and up-to-date surveys in this region.

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