

WHAT WE KNOW ABOUT THE EARTHQUAKES LOCATED AROUND THE GULF OF PATTI?

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Introduction. An accurate revision of the 1739 Naso seismic sequence has been carried out with the main purpose of better defining seismic parameters of these earthquakes and understanding the seismogenic potential of north-eastern Sicily. In the area of the Gulf of Patti two composite seismogenic sources were defined (DISS Working Group, 2015): the Tindari Fault system and the south Tyrrhenian seismic source. The Tindari Fault is a near-vertical, NNW-trending, SW-dipping, right-lateral strike-slip fault, that possibly belongs to the strike-slip system that dissects and advances the Calabrian arc toward SE. The south Tyrrhenian seismic source is an E-W narrow contraction belt that runs from north of Ustica to the Aeolian Islands, about 50 km off the northern Sicilian coast (e.g. Billi *et al.*, 2006; Barreca *et al.*, 2014). This belt is thought to accommodate 4-5 mm/y of the Africa-Europe convergence.

The maximum magnitude for these seismogenic sources is based on few earthquakes that damaged the northern coast of Sicily. Historical catalogues (Guidoboni *et al.*, 2007; Rovida *et al.*, 2016) report a scant moderate seismicity ($4.5 < M_w < 5.5$) all over the region (Fig. 1). The main damaging earthquakes affecting the coastal area are the 10 March 1786 (M_w 6.14), the 5 March 1823 (M_w 5.8) and the 15 April 1978 (M_w 6.03). Being magnitudes and epicentre

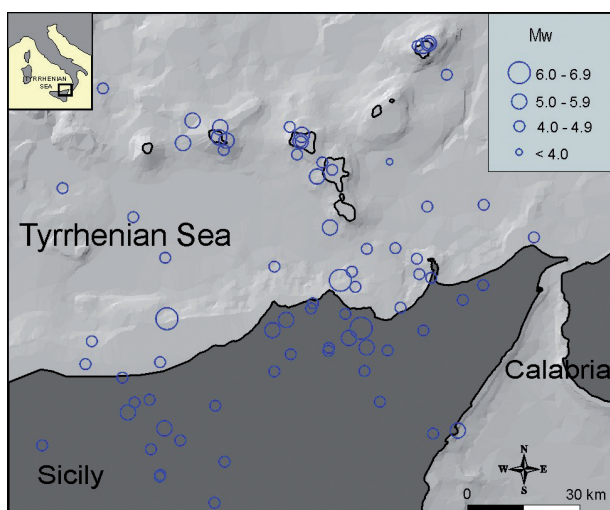


Fig. 1 – Earthquakes located in the studied area in the period 1400-2014, after CPTI15 (Rovida *et al.*, 2016).

locations based on macroseismic data, they can be mistakenly estimated, especially considering that these data are distributed along coastal areas. Therefore, an offshore location for some of these events cannot be ruled out and magnitudes could be underestimated (e.g. Azzaro *et al.*, 2004). In the past 30 years several events with $M > 5$ occurred offshore, including the M_w 5.9 Palermo earthquake of 2002 (e.g. Pondrelli *et al.*, 2006).

We analysed the earthquakes located in the area (Barbano *et al.*, 2016) and show that most of the events are poorly defined and probably underestimated like the 1739 earthquake.

Historical earthquakes. In north-eastern Sicily very few earthquakes with $M_w > 5$ are reported (Tab. 1). Some of these events are located east of the Tindari-Line, near the village of Naso. The seismic history of this area starts from the 1490 and looking at the temporal distribution of the events (Fig. 2) it is evident that the catalogue is not complete. Only two events with $M_w > 6$ are reported and both occurred after the 1786. Most of the earthquakes are poorly defined and **catalogue parameters are based on 2-10 observation points**. Obviously information on the hit area is more complete going in more recent time. **The analysis of the events shows that they are centered in the same area and are probably linked to the same seismic source located around the Gulf of Patti area.** Therefore it is likely that the **unexpected low magnitude results from lacking of data.**

Tab. 1 – Earthquakes of $M_w > 5.0$ in northern Sicily in the Gulf of Patti after CPTI15 (Rovida *et al.*, 2016).

Year	Mo	Da	Epicentral Area	Np	Imx	Lat	Lon	Io	Mw
1490	06	10	Sicilia Settentionale	4	7	37,816	14,614	7	5.1
1613	08	25	Monti Nebrodi	2	9	38,122	14,788	8	5,56
1718	02	20	Sicilia orientale	7	6-7	37,599	14,619	6-7	5,25
1739	05	10	Monti Nebrodi	6	8-9	38,098	14,744	8	5,41
1780	03	28	Sicilia nord-orientale	10	7-8	37,866	15,316	7-8	5,52
1780	09	14	Golfo di Patti	5	8	38,081	14,982	7-8	5,33
1786	03	10	Golfo di Patti	10	9	38,102	15,021	9	6,14
1823	03	05	Sicilia settentrionale	107	8-9	38,185	14,344	8	5.81
1908	12	10	Monti Peloritani	64	7	38,059	15,036	7	5,11
1967	10	31	Monti Nebrodi	60	8	37,862	14,413	8	5,33
1978	04	15	Golfo di Patti	330	8	38,385	15,086	8	6,03
1980	05	28	Tirreno meridionale	44	6-7	38,483	14,270	5-6	5.66
2002	09	06	Tirreno meridionale	132	6	38,364	13,687	6	5.92

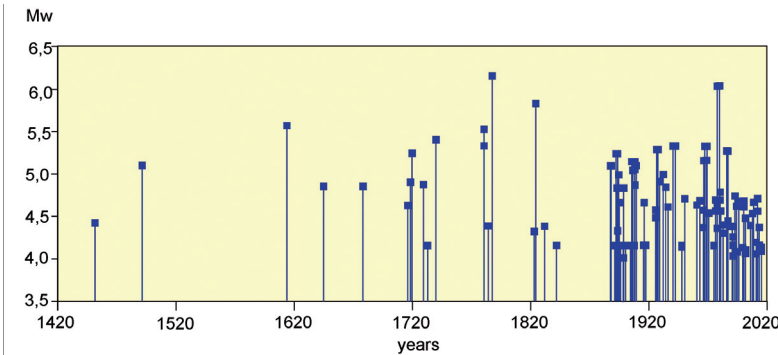


Fig. 2 – Temporal distribution of earthquakes in the area around the Gulf of Patti according to CPTI15 Catalogue (Rovida *et al.*, 2016).

The 1739 Naso earthquake. This earthquake is known to parametric catalogues (e.g. Rovida *et al.*, 2016) and has been the subject of several studies (e.g. Guidoboni *et al.*, 2007). According to aforementioned works, Naso and San Marco d’Alunzio were heavily damaged and in nearby locations the earthquake was simply felt (Fig. 3). A new study (Barbano *et al.*, 2016) identified two new sources, describing the event (Breve ristretto, 1739; Meli, sec. XVIII) not used by previous studies. **Meli (sec. XVIII) reports that the earthquake “fece grandissimo danno nella marina, mentre che al Serro del dottor don Antonio Cardinale al Stazzone caddero due case ed un casaleno olim solarato. Nel serro di Marzo caddero tre case, nell’altro serro seguente ne cadde una, con aver tirato una parte di mura di un’altra casa; nell’altro serro dello**

Stazzone ne caddero tre. Nel fondaco di Pietra di Roma cadde la camera alta verso occidente. La generalità poi delle case nella marina patì gran detrimento avendosi conquassato le mura, e molti angoli di case benché non caddero si disunirono e fu bisogno poi di rifabbricarsi.” A historical map allowed identifying these small villages located in the nowadays site of Torrenova (Fig. 3). Furthermore, the earthquake fairly damaged a vast area between the Nebrodi Mts and the Tyrrhenian coast: “*Quell’istesso che sin ora s’ha inteso aver successo in questa nostra terra, si sentì dalle terre vicine come Mirto, Frazzanò, Capri, Naso, da Longi, Alcara, come pure quelle della terra del Santissimo Salvatore, e quelle della terra di Sant’Angelo, non meno di questi di San Marco, si sentirono in Militello, benché non così gagliardi in san Fratello*” (Breve ristretto, 1739). The number of places affected by the events was increased (from 6 to 15 points), and the seismic sequence better defined. The area hit by the earthquake was larger than known and macroseismic data suggest a location offshore of the event with a magnitude larger than the estimated one.



Fig. 3 – The May 10, 1739 earthquake. Comparison of data (old) from the catalogue CPTI15 (Rovida *et al.*, 2016) and those (new) after our research (after Barbano *et al.*, 2016).

Conclusion. New coeval sources describing the 1739 earthquake allow better defining its parameters suggesting that its magnitude is greater than reported in the parametric catalogue. The seismicity in the Gulf of Patti can be stronger than known, because using few intensity points on land to compute magnitudes the events can be underestimated. Other earthquakes for which we have little information such as the 1450, 1490, and 1613 events could be linked to the same source and could be stronger than appears from the scant available data.

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