The Calabrian seismicity during the Viceroyalty of Naples: sources silence or silent sources? The case of the strong 1744 earthquake

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(Received May 23, 2005; accepted September 13, 2005)

ABSTRACT In the Italian seismic catalogues, Calabria is characterized by an earthquakes time-distribution confined almost exclusively between the catastrophic events of 1638 and 1905-1908. The outward absence of seismicity before the first half of the 17th century could be related to a dormancy of the seismogenetic sources or to the silence or loss of historical contemporary sources. With the aim of casting light on this issue, we performed research archive for the period 1500-1750. The investigation was addressed towards recent and coeval Calabrian historiographical works and local chronicles, but above all toward "unusual" 16th-19th century manuscripts, such as notarial deeds, *Relationes ad Limina* and sheets of *Avvisi*. Thanks to the discovery of hundreds of inedited news, we pinpointed an unknown earthquake (Mw=6.2) that struck central-eastern Calabria on March 21, 1744; besides, new parameters for other, four, strong events (1609, 1624, 1640, 1743), which were poorly-characterized or absent in previous seismic compilations were provided. These results put in evidence the existence of a "subterranean" strong seismicity that occurred in modern times (i.e., in the period of catalogue completeness) that still awaits to be discovered in archives and libraries. Finally, the highest-intensity datapoint distribution suggests some hypotheses on the geometry and location of the seismogenic sources of the region.

1. Introduction

The seismicity of Calabria is characterized by earthquake occurrences confined – more than in all the other Italian regions – in only 270 years, between the first half of the 17th century and the beginning of the 20th century, and in particular between the 1638 and 1908 catastrophic events. During this period, fault ruptures and earthquakes migrated roughly from north to south (i.e., seismic cluster of 1638, 1783 and 1905-1908), but with an energy release that was concentrated mainly in the last quarter of the millennium with respect to the preceding one (Fig. 1). In fact, just by summing the seismic moment deducible from the magnitude reported in CPTI (2004), the corresponding energy release during the time-span 1750-2000 is four times the one obtained for the period 1500-1750, being incommensurably larger than in the previous periods.

The cause of this different energy release in-time could be related to the "dormancy" of the seismogenic sources that, starting from 1638, progressively ruptured southwards instead, with a catastrophic *domino*-effect. Or, it could also be related to the loss of historical sources, certainly due to the documented destruction of public, private and ecclesiastical archives during the above-

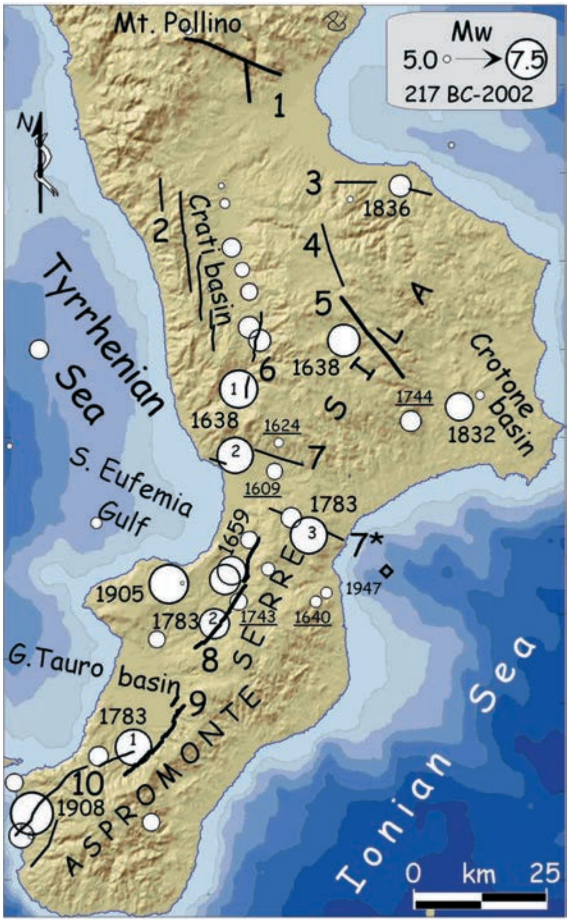

Fig. 1 – Earthquake distribution in Calabria [modified from CPTI (2004); Mw>5.0; underlined dates evidence the five events studied in this work] and primary seismogenetic faults [bold certain, i.e. investigated by paleoseismological analyses; modified from Galli and Bosi (2002)]. 1, Mt. Pollino fault; 2, W-Crati fault system; 3, Corigliano-Calopezzati fault; 4, Cecita fault; 5, Lakes fault; 6, Piano Lago-Decollatura fault; 7, Catanzaro Straits faults: Feroleto-Sant'Eufemia fault and 7*, Stallettì-Maida fault system; 8, Serre fault system; 9, Cittanova fault; 10, Reggio Calabria fault system.

mentioned earthquakes. Or, it could be due to a generic silence of the contemporary main sources (i.e., government, journalistic, historiographic), aggravated by the scarce circulation of the news in-and-from Calabria (i.e., toward Naples or outside the Kingdom) in the past centuries. Or, finally, the cause could be the shortage of current specific studies on the local seismicity. All these factors are highlighted by the great quantity of data and extensive studies on the major Calabrian earthquakes against the scarcity of information on the events of moderate energy (M~6), often characterized by few intensity datapoints.

Thus, with the aim of filling part of this gap, we carried out research in several regional and national archives and libraries, focusing, in particular, on the period of the Naples Viceroyalty (1503-1734) and its neighborhoods. The results have been strongly encouraging, since we have found dozens of unedited pieces of news concerning poorly constrained earthquakes (1609, 1624,

Table 1 – Earthquake parameters of the reviewed events, according to previous catalogues and to this paper. Mw [=Maw in CPTI (2004)] for Postpischl (1985) have been recalculated using the Mm value deduced from the quoted Io values [i.e., in CPTI (1999)], and, finally, through the Ma value (which equal Mm in all the cases) we obtained the Mw using the relationship in CPTI (2004; Mw=0.673Ma+1.938). USSN is Ufficio Servizio Sismico Nazionale, i.e. this paper. NP is the number of localities with evaluated effects.

Catalogue	Date	Latitude	Longitude	Mw	Io	NP	Epicentral Area
CPTI	1609 07 20	38.968	16.353	5.57	8	3	NICASTRO
USSN	1609 07 20	38.924	16.372	5.84	8.5	5	AMATO VALLEY
POS85	1624 02 03	38.5	16	5.17	7	0	CALABRIA
USSN	1624 02 03	38.989	16.384	5.37	7.5	4	REVENTINO
POS85	1640 06 19	38.5	16.5	5.57	8	1	STILO
POS85	1640 06 22	38.5	16.5	5.57	8	1	STILO
USSN	1640 06 19	38.63	16.49	5.84	8.5	4	BADOLATO
CPTI	1743 12 07	38.58	16.139	5.98	7.5	7	CALABRIA MER.
USSN	1743 12 07	38.704	16.354	5.92	8	27	CENTRAL SERRE
USSN	1744 03 21	39.037	16.761	6.18	9	27	MARCHESATO

1640 and 1743; Fig. 1) and, above all, we investigated an unknown earthquake which struck a vast area of central-eastern Calabria (in 1744), with an Io = IX MCS, and an evaluated Mw = 6.2 (Table 1). The highest intensity datapoint distribution (HIDD) of both the 1743 and 1744 events allowed us, finally, to make some seismotectonic considerations about the region.

2. Research methodology

The study started with a careful analysis of the main contemporary seismic catalogues [Baratta (1901), Postpischl (1985), CPTI (2004) and related compilation], after which we turned our attention to archives and libraries both in Calabria, Naples and Rome (Fig. 2).

It is worth noting that the primary, and often only sources of the ante-18th century seismic history of Calabria are Di Somma (1641) and Fiore (1691). The latter reports an earthquake list from 1184 to 1690, quoting "veracious manuscripts", as his own sources, and works by Vincenzo Durante and Francesco Bruni, still unknown.

However, the research focused mainly on "unconventional sources", namely handwritten reports, ledgers and letters of bishops and priests describing the state of their parishes, and notarial deeds in which, "between-the-lines", extemporary mention of an earthquake are often reported.

In particular, in the Archivio Segreto Vaticano [ASV; see insights in Castelli (1993)] and in the Diocesan and Episcopal archives and libraries of Calabria, we found and inspected more than two hundred *Relationes ad Limina* ("reports" about the state of the diocese that, starting from the Council of Trento, were sent every 3 years to the Vatican by the local bishop*)*, "*Visite Apostoliche"* (apostolic visits) and Letters from all the dioceses of central-southern Calabria, for the period 16th-18th centuries, describing the condition of the ecclesiastical goods, and, sometimes, the damage caused by earthquakes.

In the Biblioteca Apostolica Vaticana (the Vatican Library; BAV) we analysed 17th century "*Avvisi*" (= handwritten sheets of miscellaneous news) and hundreds of monographs, treatises,

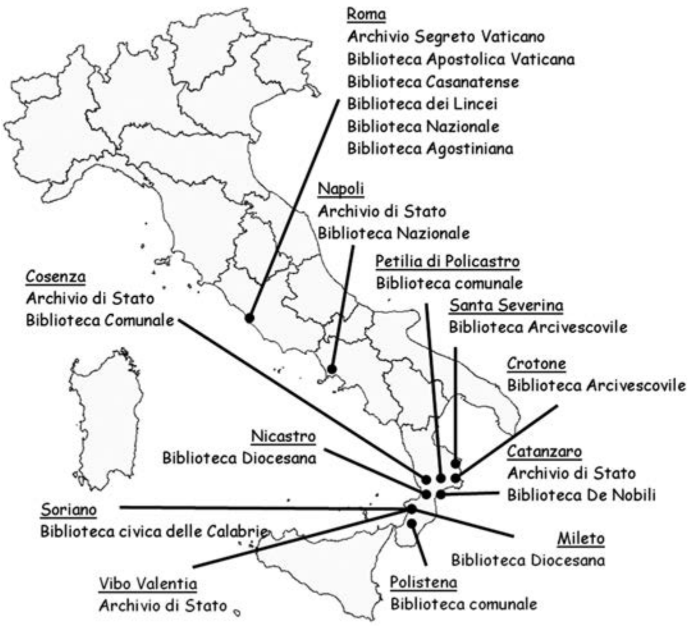

Fig. 2 – Geographical distribution of the visited archives and libraries.

chronicles concerning Calabria and the Kingdom of Naples, from the 16th century to the present.

In the Archivio di Stato of Naples (=State Archive, ASN) we inspected hundreds of documents of the *Affari Esteri* and of the *Regia Camera della Sommaria*, and in particular the 18th century "*Dispacci*" (dispatches) in which tax exemption (referred to earthquakes) is sometimes requested.

In the Archivio di Stato of Catanzaro (ASCZ), we inspected hundreds of 16th-18th century notarial deeds, written by dozens of notaries from the provinces of Catanzaro, Crotone, Cosenza, besides many "*Platee*" (=ledgers), where all the annual expenses of each single parish church were annotated by the priests (i.e., costs due to repair earthquakes damage).

In the Civic Library of Catanzaro, we found three long 18th century manuscripts written by local erudites on the basis of former family chronicles and diaries [i.e., the same quoted by Fiore, (1691)], which report detailed information on earthquakes, mainly focusing on the effects in Catanzaro.

Thanks to this collection of new information, it was been then possible to attribute the intensity values by using the MCS scale [Mercalli-Cancani-Sieberg, in Sieberg (1930)] to each single locality (Table 2). Afterwards, by using the BOXER (Gasperini, 2002) algorithm, we computed the earthquakes epicentre parameters (latitude, longitude, epicentral intensity, moment magnitude, source length and azimuth; Table 1).

For completeness, in the References chapter, we report all the documents that provided useful information about the earthquakes. They are not all analytically quoted in the text and figures, being recalled as a group of documents for one or more years (i.e., ASV, 1744).

3. The July 20, 1609 earthquake

3.1. Previous studies

This event is quoted in the CPTI (2004) as deriving from an unpublished and unavailable report (GDTCS, 1994), being characterized by an Io = 8 MCS and Mw = 5.6. The localities reported in Monachesi and Stucchi (1997) are Feroleto antico, Nicastro and Messina.

According to our research (see Fig. 3), the primary sources from which the 19th-20th historians (Colosimo, 1832; Giuliani, 1894; Baratta, 1901) derived their information are Di Somma (1641) and Fiore (1691). They report only Nicastro, while Arcovito (1843), according to Gallo (1784) and Salfi (1787), also mentions other small nearby villages.

3.2. New data and earthquake description

We have found additional coeval information (Fig. 3) both in some *Relationes ad Limina* (years, 1609-1613; ADN, 16th-19th cent.) and *Visite Apostoliche* (ASV, 1613-1614), and in De Nobili (18th cent.). The news deal with the villages of Feroleto, Cortale and Nicastro, where severe damage and many casualties are described, and with Catanzaro, where the earthquake was felt without damage.

This event struck the western side of the Catanzaro Straits (Fig. 4) with an epicentral intensity valuable to Io=VIII-IX MCS (Mw=5.84), being felt all along the region. The maximum intensity has been attributed to Feroleto antico (Imax=IX, Table 2), where the main church and the Santa Chiara nunnery collapsed, with the death of many people. In Cortale (I=VIII-IX, Table 2) the church collapsed too, although the amount of casualties is not clearly defined. We shifted the CPTI (2004) epicentre

EQ	Locality	Latitude	Longitude	Intensity MCS
1609.07.20	Feroleto Antico	38.962	16.388	9
	Cortale	38.838	16.411	8-9
	Nicastro	38.974	16.318	8
	Catanzaro	38.914	16.586	5
	Messina	38.187	15.549	F
1624.02.03	Martirano	39.080	16.248	7-8
	Cosenza prov.	-	-	7-8
	Nicastro	38.974	16.318	7
	Catanzaro	38.914	16.586	5
1640.06.19	Badolato	38.568	16.524	8-9
	Isca	38.600	16.519	8-9
	Centrache	38.728	16.43	8-9
	Prince of Satriano's lands	38.667	16.482	8
	Stilo (?)	38.477	16.468	7 ?
1743.12.07	Olivadi	38.726	16.425	9.5
	Capistrano	38.693	16.289	8.5
	Monterosso	38.717	16.289	8
	Chiaravalle Centrale	38.68	16.412	8
	Vallelonga	38.646	16.294	7.5
	Soriano	38.598	16.23	7.5
	San Nicolada Crissa	38.663	16.285	7.5
	S. Vito sullo Ionio	38.709	16.407	7.5
	Nicastrello	38.681	16.288	7.5
	Mileto	38.592	16.080	7.5
	Grancia di Sant'Anna	38.744	16.515	7.5
	Gagliato	38.676	16.462	7.5
	Castelmonardo	38.783	16.292	7.5
	Arena	38.562	16.209	7.5
	Terranova	38.323	16.008	7
	Squillace	38.781	16.519	7
	Serra San Bruno	38.576	16.330	7
	San Giorgio Morgeto	38.386	16.107	7
	Nicotera	38.551	15.938	7
	Moladi	38.590	16.002	7
	Dasà	38.564	16.196	7
	Amantea	39.131	16.081	6.5
	Reggio Calabria	38.108	15.647	6
	Belcastro	39.017	16.785	6
	Catanzaro	38.914	16.586	5.5
	Miglierina	38.947	16.471	5
	Messina	38.187	15.549	5
1744.03.21	Policastro	39.114	16.787	9
	Rocca Bernarda	39.133	16.868	9
	Simeri	38.934	16.663	8.5
	Soveria Simeri	38.947	16.681	8.5
	Belcastro	39.016	16.785	8
	Catanzaro	38.914	16.586	8
	Mesoraca	39.077	16.789	8
	San Mauro Marchesato	39.106	16.928	8
	Crotone	39.080	17.127	7.5
	Cutro	39.033	16.982	7.5
	Santa Severina	39.146	16.913	7.5
	Sellia	38.980	16.630	7.5
	Squillace	38.781	16.519	7.5
	Altilia	39.182	16.882	7
	Borgia	38.827	16.514	7
	Cropani	38.967	16.782	7
	Le Castella	38.912	17.021	7
	Marcedusa	39.029	16.837	7
	Papanice	39.072	17.030	7
	San Floro	38.839	16.520	7
	Scandale	39.124	16.963	7
	Stalettì	38.763	16.541	7
	Andali	39.013	16.77	6.5
	Carpanzano	39.147	16.303	6.5
	Cosenza	39.303	16.251	6.5
	Cotronei	39.158	16.778	6.5
	Isola	38.959	17.096	6

Table 2 – MCS intensity values assigned to the reported localities, for the five reviewed earthquakes.

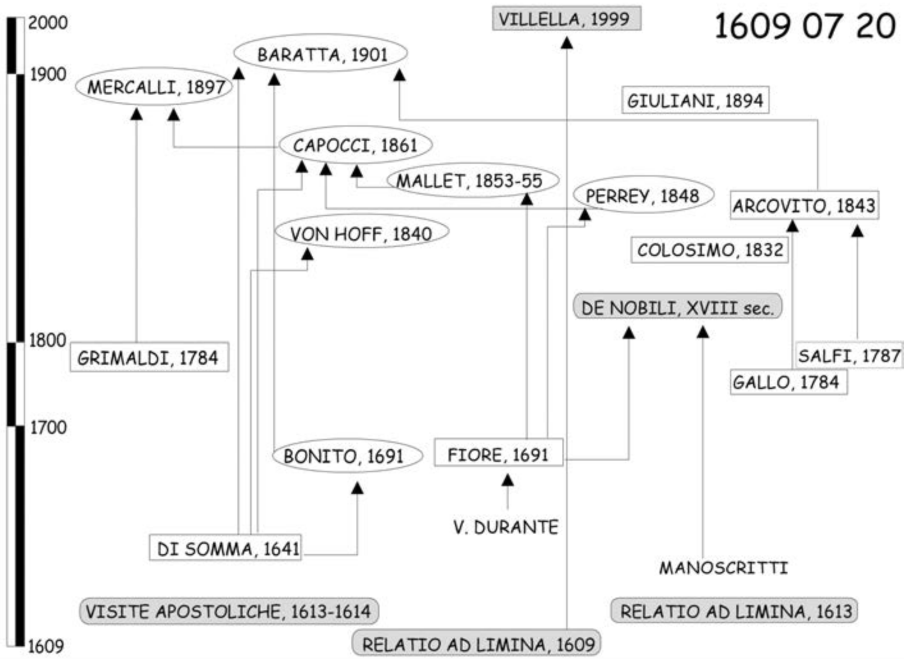

Fig. 3 – Family-tree of studies and sources collected in this study for the 1609 earthquake (ellipses envelop seismic catalogues; rectangles, printed studies; rounded rectangles are manuscripts. Not-bounded sources have not been found). Shaded sources are the new sources inspected in this work and were not related to this earthquake by previous scholars. Note that almost all the previous works were based upon Di Somma (1641) and Fiore (1691). Our sources are the only contemporary reports of the event.

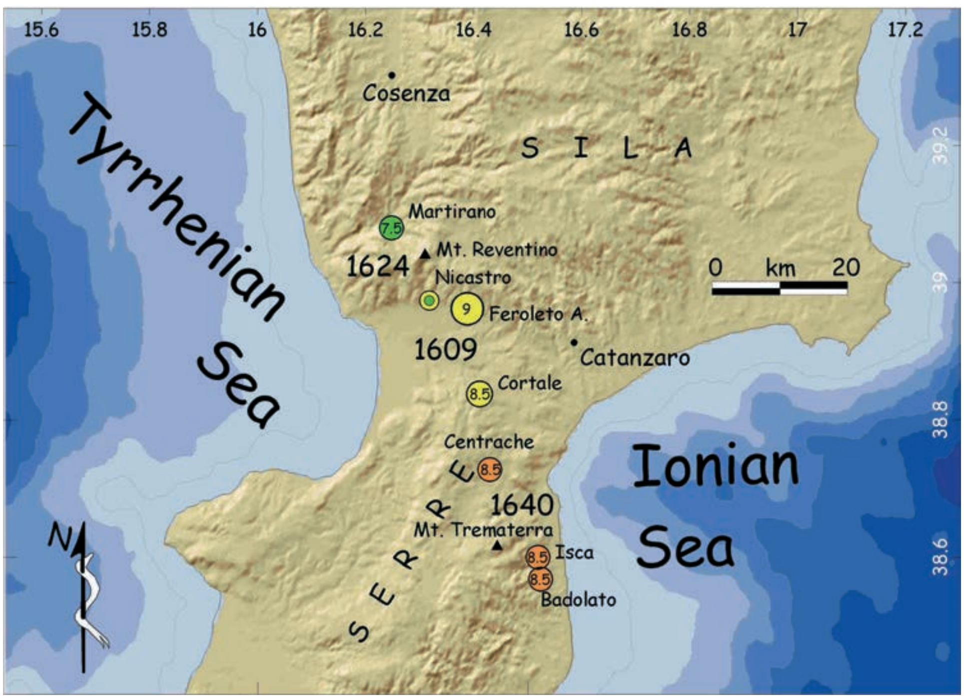

Fig. 4 – Highest intensity datapoints distribution of the 1609 (yellow), 1624 (green) and 1640 (orange) earthquakes, according to this study.

from Nicastro towards the village of Feroleto Antico, close to the Amato river. Less than thirty years later, this area was the epicentral zone of the catastrophic March 28, 1638 earthquake (Io=XI MCS, Mw=6.8; Galli and Bosi, 2003), whereas no other events are known, except the one described in the next chapter (1624 event).

4. The earthquake of February 3, 1624

4.1. Previous studies

This event is absent in CPTI (2004), while in Postpischl (1985) is reported with an Io=VIII and Mk=4.86, the reference study being Baratta (1901).

According to our researches (Fig. 5), the only source known by all the authors (i.e., Perrey, 1848; Mallet, 1853-55; Capocci, 1861; Baratta, 1901) is Fiore (1691), who tells about a long and "very strong earthquake", without mentioning localities or damage.

4.2. New data and earthquake description

The most significant news (Fig. 5) was gathered from the inspection of the *Relationes ad Limina* from Martirano (ADN, 16th-18th cent.) and Nicastro (ADN, 16th-19th cent.). In the investigated manuscripts, which are the first compiled after the earthquake, the churches are described as "*ex terremotibus fere diruta*". The use of the plural (*terremotibus*) probably indicates that more than one shock concurred to bring the destruction. Moreover, two manuscripts (Marincola Pistoja, 18th cent.; De Nobili, 18th cent.) mention the earthquake as striking the Cosenza province, but without damage to Catanzaro.

Although the notices are few and vague, it is reasonable to think that the epicentre was in the

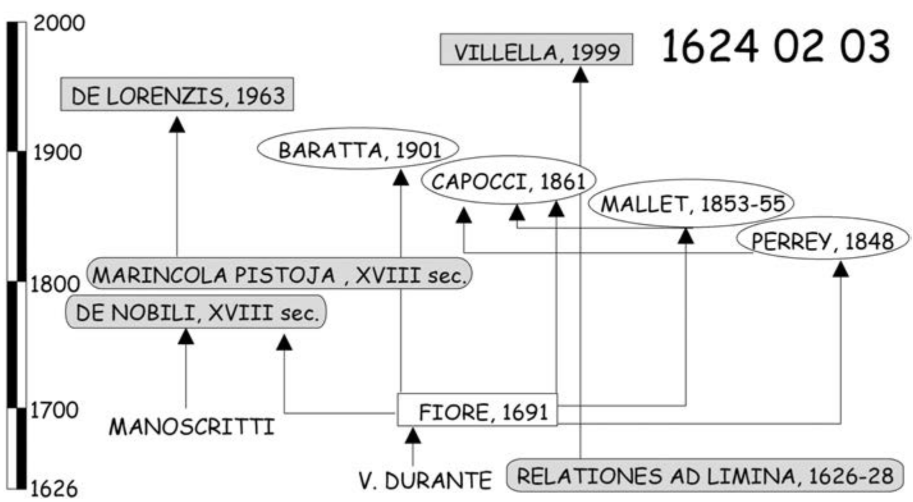

Fig. 5 - Family-tree of studies and sources collected in this study for the 1624 earthquake (ellipses envelop seismic catalogues; rectangles, printed studies; rounded rectangles are manuscripts. Not-bounded sources have not been found). Shaded sources are the new sources inspected in this work and were not related to this earthquake by previous scholars. Note that all the previous works were based only upon Fiore (1691). Our sources are the only contemporary reports of the event.

northwestern part of the Catanzaro Straits, and probably in the scarcely inhabited Reventino mountains (Fig. 4), between Martirano and Nicastro, that is towards the Cosenza province, as recalled by some sources. A rough parameterization could finally suggest an Io=VII-VIII (Mw=5.37). Also this earthquake falls with in the area that will be devastated in 1638.

5. The earthquake of June 19, 1640

5.1. Previous studies

This earthquake is absent in CPTI (2004), while in Postpischl (1985) two events are reported in Stilo on June 19 and 22 (Io=VIII; Mk=5.1), but linked to an unavailable reference (i.e., "personal communication").

The primary source where almost all the historians derive their information (Fig. 6) is Di Somma (1641), who describes the two shocks that destroyed Badolato, causing 300 casualties, and an aftershock (July 18), with no damage. According to him, the seismic period lasted until the beginning of 1641. Recently, Camassi and Castelli (2005) provided new primary source for this event.

5.2. New data and earthquake description

Several unknown pieces of information (Fig. 6) have been extrapolated from *Relationes ad Limina*, *Avvisi*, Letters and local handwritten chronicles. In particular, two different *Relationes* of the dioceses of Squillace (ASV, 1641, 1661) describe the huge damage caused in Badolato, where 200 casualties are reported. In a letter from Naples (ASV, 1640), but in particular in the *Avvisi* (BAV, 1640), the death toll is much higher (1000 people), whereas other localities besides Badolato, are cited as Isca, Centrache and the other unmentioned villages belonging to the Prince of Satriano (i.e., the Ravaschiesi family, owner of a vast region of Ionian southern-central Calabria). Curiously, the lands ruled by the Prince of Satriano in that period along the Ionian side of Serre, were all around the Mt. Trematerra, which literally means "tremble-earth".

Finally, one manuscript from Catanzaro (Marincola Pistoja, 18th cent.) speaks about a strong earthquake that hit the whole of Calabria.

From the above, it seems that the earthquake affected the Ionian slopes of the Serre range (Fig. 4; Table 2), damaging the localities of Centrache, Isca, Badolato and the nearby villages of the Prince of Satriano (Ionian Serre range slopes). The number of casualties differs among the different sources, being probably related to Badolato as far as the minor value is concerned [200 or 300 casualties; ASV (1641), Di Somma (1641)] and to the whole area as far the larger one is concerned [1000 casualties, BAV (1640)]. However, according to the description of Di Somma (1641), the fact that part of the collapses and casualties in Badolato were due to an earthquake-induced landslide cannot be excluded.

Notwithstanding the small number of localities, we hypothesize an Io=VIII-IX MCS (Mw=5.84), and an epicentral location which falls very close to the macroseismic epicenter of an event that occurred on May 11, 1947 [Io=VIII, Mw=5.7, CPTI (2004)]. This earthquake struck the same area and localities as in 1640 (the main damage was in Isca, Imax=IX MCS), being characterized by a mesoseismic (I>VII MCS) area apparently elongated N-S (yet conditioned by the absence of datapoints in the Ionian sea). Actually, since its instrumental

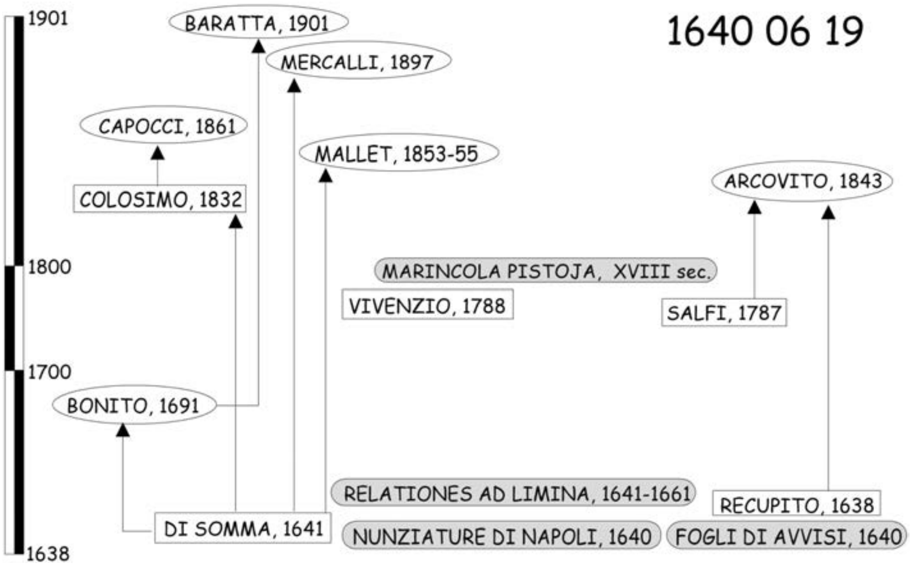

Fig. 6 - Family-tree of studies and sources collected in this study for the 1640 earthquake (ellipses envelop seismic catalogues; rectangles, printed studies; rounded rectangles are manuscripts). Shaded sources are the new sources inspected in this work and were not related to this earthquake by previous scholars. Note that all the previous works were based only upon Di Somma (1641), while we added several other contemporary sources.

epicentre falls offshore [Fig. 1; see in Vannucci and Gasperini (2004)], it could be possible that the 1640 event shares the same localisation.

Considering the large number of casualties and the similarity with the strong 1947 event, we think that the 1640 event deserves further research, in order to increase the number of affected localities, certainly much greater than the few investigated in our study.

6. The earthquake of December 7, 1743

6.1. Previous studies

This earthquake is present in CPTI (2004), being related through Monachesi and Stucchi (1997) to a study not available (reported as GDTCT, 1994). Its epicentral area is located in southern Calabria (Io=VIII MCS, Mw=5.92), whereas there are seven localities reported in Monachesi and Stucchi (1997) (Mileto, Soriano, Catanzaro, Nicotera, San Giorgio Morgeto, Reggio Calabria e Messina).

Almost all the published notices, as those compiled by Capocci (1861), Mercalli (1897), Baratta (1901), or those reported in Colosimo (1832), Spanò Bolani (1857), Carbone Grio (1884) and De Rossi (1889), are confusing and contrasting. According to our study (Fig. 7), the only primary sources quoted by some of them derived from the news collected by Malvasia (in De Rossi, 1889), which mention an "horrible" shock that damaged Nicotera and other villages of Calabria, but particularly Mileto, where many houses and the cathedral collapsed. Actually, according to a late source quoted by Mercalli (1897; i.e. De Lorenzo, 1873-1877), the church of Mileto did not suffer any damage in 1743.

6.2. New data and earthquake description

On the basis of all the new investigated sources (Fig. 7), we were able to evaluate the MCS intensity for twentyseven localities (Table 2), although it must be stressed that notices and/or effects were, in some places, complicated and/or cumulated by other two events that happened in 1743. In fact, on February 20 an earthquake located in the Ionian Sea struck the Salentina peninsula disastrously (southern Apulia) and the islands of Lefkada and Kerkira (Greece), but its effects seriously also hit the whole Calabrian peninsula. On the other hands, an epidemic of pestilence caused many casualties in the same period. Actually, the February earthquake caused severe damage and one casualty in Catanzaro (Marincola Pistoja, 18th cent.), while at Reggio Calabria all the buildings were damaged, and at least two collapsed (Spanò Bolani, 1857).

The December sequence started on the 6th at 5.15 p.m. (local time), being felt by many people in Catanzaro, but with no damage (Moio and Susanna, 18th cent.; De Nobili, 18th cent.). The mainshock occurred the day after at 7.45 a.m., followed by other strong events on December 12 and 30. In the four *Relationes ad Limina* [dioceses of Mileto, Catanzaro, Belcastro and Squillace, ASV, 1743, 1744, 1745, 1746, 1747, 1750)], damage is referred to the December 7 event. In the dispatch of Naples (ASN, 1743, 1744) we isolated six new localities of southern and one of central Calabria which were heavily damaged by the earthquake (Vallelonga, San Nicola da Crissa, Chiaravalle Centrale, Nicastrello, Gagliato and Amantea). While other important news are in the report sent on February 1744 (Affari Esteri: ASN, 1744).

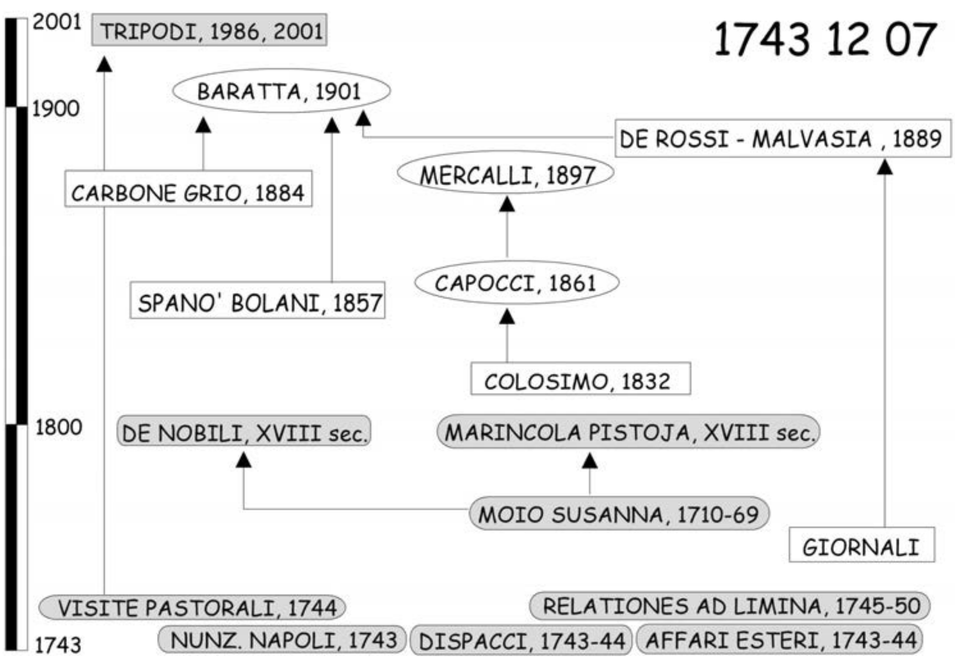

Fig. 7 - Family-tree of studies and sources collected in this study for the 1743 earthquake (ellipses envelop seismic catalogues; rectangles, printed studies; rounded rectangles are manuscripts). Shaded sources are the new sources inspected in this work and were not related to this earthquake by previous scholars. Note that all the previous works were based only upon newspapers read by Malvasia (in De Rossi, 1889), whereas our sources are almost all contemporary to the event.

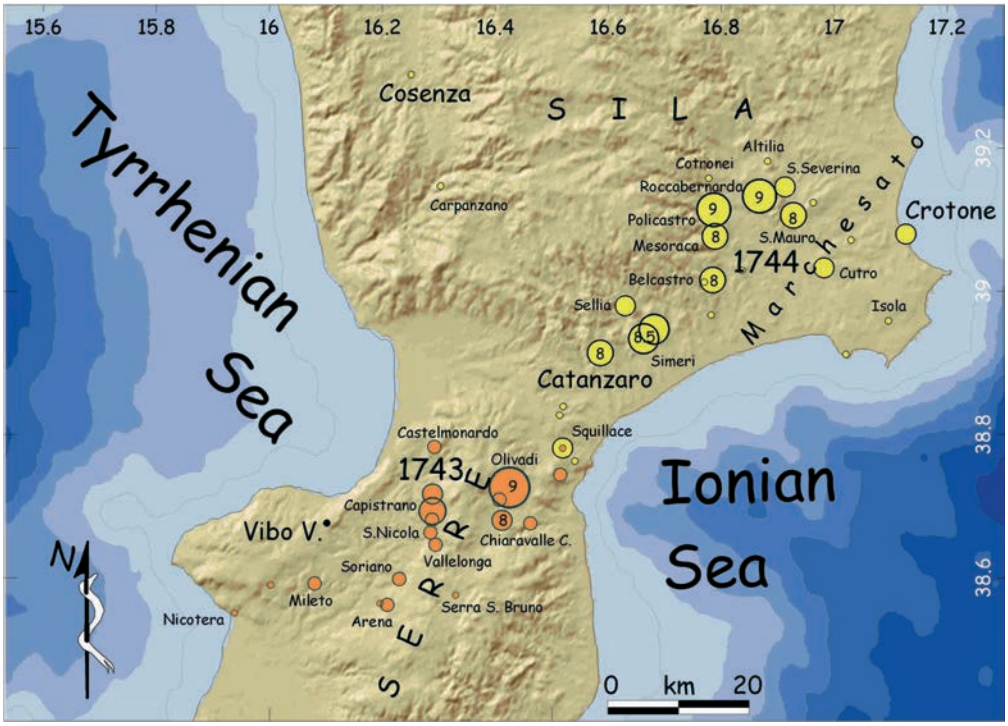

Fig. 8 - Highest intensity datapoints distribution of the 1743 (orange) and 1744 (yellow) earthquakes, according to this study.

Further contemporary news was found in the Archive of Mileto [see also Tripodi (1996, 2001)], where some churches in Arena and Castelmonardo have been reported as destroyed and abandoned due to the earthquake.

The collected data depict a roughly ENE-WSW mesoseismic area located in the central part of the Serre range (Fig. 8), with strong effects felt all over a wide part of central-southern Calabria. The earthquake parameters evaluated through Gasperini (2002) are Io = VIII and Mw=5.92. Although the earthquake caused strong damage and collapse of buildings and churches (many people were obliged to live for a long time in barracks in the fields), it is difficult to provide any death toll, since notices of casualties are often cumulated with those caused by the pestilence epidemic.

The area with the strongest effects was previously hit by the disruptive 1659 earthquake (to the north), and will be struck again in 1783 (February 7, to the south; Fig. 1). The epicentre then falls between the two epicentres, filling a small seismic gap in the area.

7. The earthquake of March 21, 1744

7.1. Previous studies

This earthquake is not reported in any previous seismic compilation. During this review (Fig. 9), extemporaneous references relatable to it have been found in Carbone Grio (1884), De

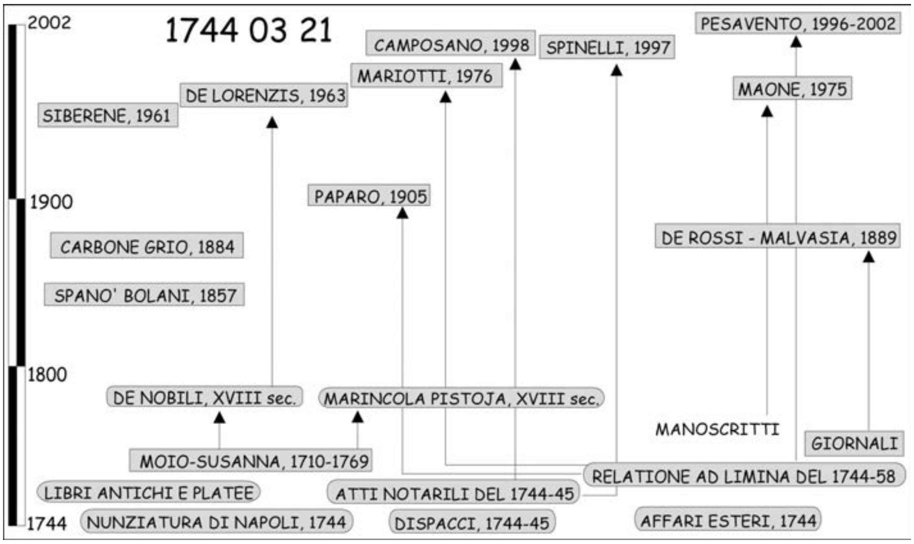

Fig. 9 - Family-tree of studies and sources collected in this study for the unknown 1744 earthquake (rectangles envelops printed studies; rounded rectangles are manuscripts. Not-bounded sources have not been found). Note the amount of contemporary reports of the event.

Rossi (1889) and Baratta (1901), yet without a conclusive seismological parameterization of the event. Conversely, in recent local histories (e.g., Pesavento, 2002a, 2002b, 2002c, 2002d; Spinelli, 1997) the earthquake is correctly mentioned (month, day), although without any spatial characterization (e.g., news is reported for one locality).

7.2. New data

The research has been addressed toward the analysis of different source typologies, as *Relationes ad Limina*, notarial deeds, manuscripts, *Avvisi*, and letters coeval to the event (Fig. 9). Positive news has been deduced from twelve *Relationes ad Limina* (ASV, 1744, 1745, 1747, 1750) of the dioceses of Catanzaro, Crotone, Squillace, Santa Severina and Belcastro, all containing damage description concerning several villages belonging to the mentioned dioceses. The handwritten diary of Moio and Susanna (18th cent.), on which the accounts of other local erudites (De Nobili, 18th cent.; Marincola Pistoja, 18th cent.) are partly based, describes precisely the several shocks that hit Catanzaro and the neighbouring villages in 1744. The mainshock is reported on March 21, at 5.30 p.m. (local time), whereas the second strongest shock occurred on March 24, at 2.30 a.m. The earthquake caused severe damage to all the houses, with disruption and sparse collapse; the churches of Salvatore and San Domenico and the Cathedral suffered partial collapse. Many other strong shocks followed in July (5, 11 and 30), in August (2, 21 and 24), in September (26 and 28) and on the morning of Christmas.

Six *Dispacci* (ASN, 1744, 1745) sent to the *Regia Camera della Sommaria* of Naples from Michele Reggio (the President of the *Giunta Marina* of the Kingdom of Naples) contain both requests of tax exemption for the *Università* (town) of Catanzaro and Policastro (the latter temporarily abandoned due to the damage) and request for repairing the tribunals of Cosenza and

Catanzaro and to build a barrack suitable for hosting the royal *Udienza* of Catanzaro. In fact, hundreds of inhabitants were obliged to live in barracks in the fields [e.g. in ASN, *dispacci (*1744, 1745), ASV, letters (1744)], for many months. Other reports [Affari Esteri: ASN (1744)] provide further details of different localities.

An interesting comparison emerged from the examination of thirty-two *Platee* of the dioceses of Catanzaro and Crotone (ASCZ, 1744), which analytically reports the credits and debits of each single parish church, i.e. the cost for repairing and/or rebuilding what the earthquake damaged. Finally, a great analytical contribution to the earthquake-induced effects on the civilian building estate came from the inspection of hundreds notarial deeds for the province of Catanzaro and Crotone, written by forty notaries over a long period (ASCZ, 1744, 1745). These documents report many actual pieces of news about the earthquake, but contain also information on religious beliefs, as the request for a procession in order to invoke the God's help, with the official and subscribed renting of the holy relic from the Sanctuary and the Congregation.

7.3. Earthquake description

The earthquake of March 1744 affected a vast area belonging to the present province of Crotone and Catanzaro, with marginal effects in those of Cosenza (Fig. 10) and Vibo Valentia. The mesoseismic zone is confined instead to the high Marchesato region (Fig. 8), where we evaluated an epicentral intensity of Io = IX MCS and an equivalent magnitude of Mw = 6.2 (Gasperini, 2002). Our macroseismic epicenter falls between the villages of Roccabernarda, Mesoraca and Policastro. All the collected data allowed the evaluation of the intensity felt in twenty localities (Table 2). However, we did not find descriptions of casualties, but only of severe damage, extensive destruction and collapse of private, public and ecclesiastical buildings. The lack of casualties might be probably due to the alarm generated by the foreshocks, that induced the people to leave their houses in time. The maximum intensity has been assigned to the village of Policastro and Roccabernarda, (Imax = IX MCS), that were abandoned after the earthquake due to the diffuse unusability of the building estate [e.g. in ASCZ (1744): Atti del Notaio Fanele]. For other six localities we attributed an Is ≥ VIII MCS.

On the basis of all the inspected documents, the second strong shock (March 24) which followed the main event of March 21, damaged only the Catanzaro area or, alternatively, was not

Fig. 10 – Memorial inscription of the strong effects felt in Carpanzano (CS) due to the 1744 event. The text has been recently erroneously reintegrated by an anonymous person.

mentioned by the sources of the epicentral area. Although the earthquake effects may be affected by site amplification (all the area is characterized by soft sediments and complex morphologies), the mesoseismic area (cumulated effects of the two shocks) shows an outward elongation on a NE-SW direction, overlapping to the smaller one related to an earthquake that occurred on March 1833 (Io = VII-VIII, Chiodo *et al.*, 1992). On the other hand, considering only the effects of the mainshock (Marchesato area), one could hypothesize a WNW-ESE seismogenic structure, yet the scarcity of datapoints does not permit us to constrain a definitive strike.

Many of the localities damaged in 1744 had already been hit by the June 1638 earthquake [Mw = 6.7, Galli and Bosi (2003)], and would be damaged again by the March 1832 event (Mw = 6.6; Io = IX-X MCS). Anyway, by observing the mesosemic area of both these disruptive events, it is evident that the 1744 earthquake filled a seismic gap between them.

8. Discussion and conclusions

Thanks to all the investigations performed in archives and the library, from Rome to Calabria, it has been possible to enhance the information of the effect distribution and to improve the epicentral parameter of four 17^{th}-18^{th} century earthquakes (namely, 1609, 1624, 1640 and 1743). All these events were poorly known or absent in the current seismic catalogue (CPTI, 2004; Table1). Moreover, we pinpointed an unknown strong earthquake (1744, Mw=6.2) missing from all the present and previous compilations (e.g., CPTI, 2004; Postpischl, 1985; Baratta, 1901), for which twenty localities have been characterized in terms of MCS intensity. It is worth noting, that the age of this event falls within a period of historical completeness for such a class of magnitude [~1530 AD in Ionian Calabria, according to GdL (2004)]. Its previous invisibility was then probably due to the fact that it probably laid behind the shadow zone of other large incidents of the age, as the M > 7 earthquake of February 20, 1743 (Ionian Sea), and/or the 1743-1744 Calabrian pestilence.

An interesting seismotectonic implication related to this event is that the March 21, 1744 seismogenic box [*sensu* Gasperini(2002)] is "inserted" between the seismogenetic sources of the two strongest earthquakes of the region, the June 9, 1638 and March 8, 1832 events, both characterized by Mw>6.5 (Fig. 11). The former was ascertained to have been caused by the Lakes fault, a N140° normal to left-lateral structure located in the inner Sila massif [5 in Fig. 11; Galli and Bosi (2003)], while the latter, yet lacking of a known surficial fault, is depicted by a ~NW-SE HIDD (Galli and Scionti, 2006), aligned SE to the Lakes fault. It is thus reasonable to think that in 1744 a minor segment of the Sila fault system [namely, Cecita fault, Lakes fault and 1832 seismogenetic structure (Galli and Scionti, 2006); Fig. 11] ruptured. Considering that for this normal-oblique faults the Coulomb stress rises laterally to the fault tips (Galli and Scionti, 2006), it is possible that the Lakes fault rupture in 1638 "loaded" the nearby 1744 structure, and the same occurred one century later to the 1832 one. Thus, on the whole, this fault system is composed of several segments, with lengths ranging between ~10 to ~30 km, responsible for earthquakes with magnitude 6.2-6.7. The seismic historical suite shows a migration of fault-rupture from NW to SE (1638-1744-1832), with the exception of the Cecita fault, which has been "silent" in the past centuries (see Fig. 11).

Farther south, by observing the epicenter of the 1609 and 1624 earthquakes, it looks as they

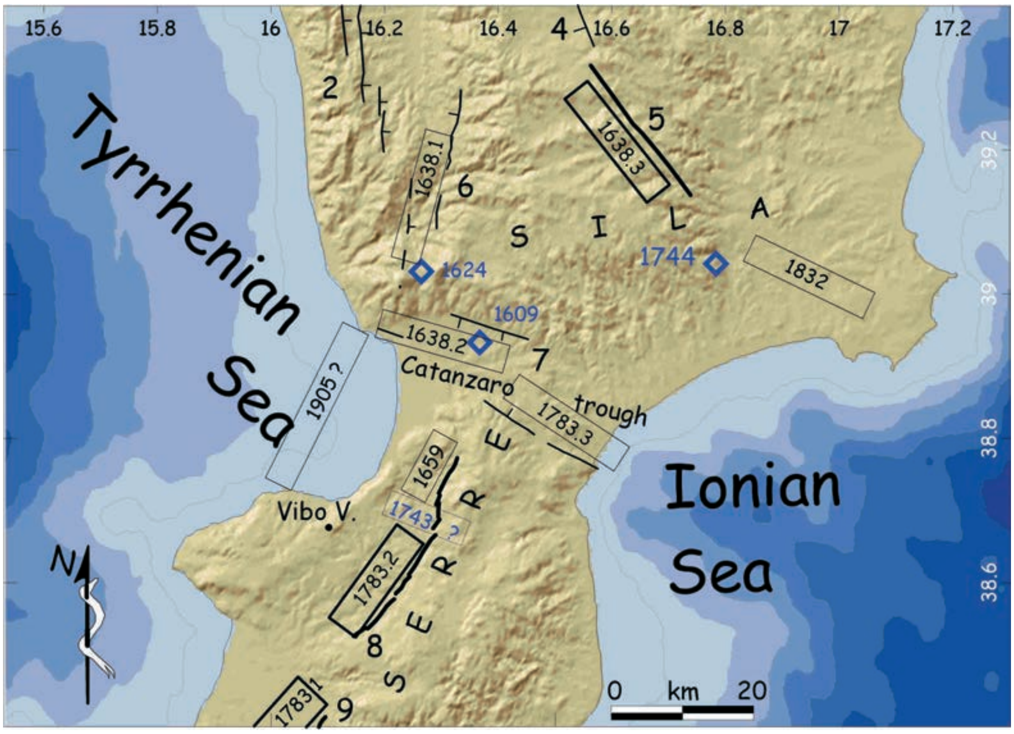

Fig. 11 – Shaded relief image of central-southern Calabria, showing the primary seismogenetic faults (label as in Fig. 1) and the possible source of the main earthquakes (boxes are the surficial projection of the seismogenic structure at depth). Bold lines are the fault which have been investigated through paleoseismological analyses, associated with the bold boxes containing the date of the last certain earthquake rupture. Thin lines are Quaternary faults, somewhere associated to thin seismogenic boxes containing the date of the last earthquake. Stand-alone boxes depict the possible seismogenic source of the earthquake quoted inside, and were traced on the basis of the highest intensity datapoints distribution (i.e., Gasperini, 2002). The seismic gap filled by the 1744 and 1743 events is worth noting, as well as the geometrical relationship between the 1609-1624 earthquakes and the possible seismogenetic structure responsible for the March 1638 sequence.

forestalled the catastrophic sequence that occurred in March 1638 (Mw > 6.7). In particular, the epicenter of 1609 suggests that the seismogenetic source of the disruptive shock that struck the western Catanzaro trough on March 28, 1638 [Mw = 6.6, Galli and Bosi (2003)] could be located in the same area, being possibly related to the N110° Feroleto-Sant'Eufemia fault [7 in Fig. 11; Galli and Bosi (2003)]. In other words, it is reasonable to suppose that in 1609 a small portion of the 1638-structure slipped, preparing the larger rupture which devastated the region two dozen years later.

Finally, also the 1743 HIDD provides some information concerning the seismotectonic characteristics of southern Calabria. Its epicenter falls, in fact, in the step zone between the southern and northern N220° Serre fault array [8 in Fig. 11; Galli and Bosi (2002)]. As recently shown by paleoseismological analyses (Galli *et al.*, 2006), the former was responsible in February 7, 1783 for a Mw = 6.6 earthquake, while the latter fits geometrically with the Mw = 6.5 event of November 5, 1659. As a consequence, the 1743 event was generated by the outcropping fault set accommodating the step between Serre-north and Serre-south fault system, or by an unknown ~N130° transfer fault between the two. Thus, it could be possible that this event filled a seismic gap between the 1659 and 1783 sources, reflecting a southward migration of the stress release quite similar to the 1638-1744-1832 sequence of the Ionian Sila.

As a concluding remark, according to our research and to the paleoseismological studies carried out in Calabria in the past few years it seems that the "major" seismicity of the region is effectively clustered between the early 17th and the early 20th centuries, being characterized by disruptive sequences migrating along conterminous primary and secondary seismogenic structures, with a "*domino*" rupture effect. At the same time, our work shows that some earthquakes occurred during the Modern Age, with magnitude also larger or close to 6, still simply waiting to be discovered in the archives of southern Italy.

Acknowledgments. We are grateful to the staff of the following archieves: Segreto Vaticano; Stato di Napoli; Catanzaro; Arcivescovile di Santa Severina; and the Libraries: Apostolica Vaticana, Civica di Catanzaro and many other of the several Dioceses of Calabria, but in particular we thank S. Pagano and G. Castaldo who showed such sensitivity in encouraging our research in the ASV. This work was realized within the frame of the projects of the Civil Service of Italy, on behalf of the Civil Protection Department of Italy. Criticisms by M. Mucciarelli and by an anonymous referee improved our manuscript. The view and conclusion contained in this paper are those of the authors and should not be interpreted as necessarily representing the official policies, of the Italian Government either expressed or implied.

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