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The disastrous Calabro-Messinese 1908 earthquake: the 100-year anniversary

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Four significant earthquakes of the past, which occurred in Europe and in the USA, are mentioned. Special attention is paid to disastrous European earthquake of 28 December 1908, which occurred 100 years ago, marked by some 100,000 casualities. A brief explanation of the high seismic activity of the Calabro-Messinese region is outlined, which is presented in agreement with the plate tectonics prospect of continental (= tectonic plates') drift. Problems of high seismicity of the Messina Strait are pointed out in context with the present technically "provocative" project of Italian engineers to interconnect Sicily and Calabria by means of a giant one-arch bridge.

Key words: significant historical earthquakes, 1908 Calabrian earthquake, seismicity of the Messina Strait

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INTRODUCTION

In the current first decade of the 21st century researchers in geoscience have a chance to commemorate a series of earthquakes of the past, which appeared notable either from the viewpoint of dimension of their fatal consequences or as milestones in seismology advancement.

Firstly, we have to mention the **Great Lisbon Earthquake** of November 1, 1755, commemorated in 2005, the strongest earthquake ever recorded in Europe (estimated at $I_o \approx$ XII, M ≈ 9), which excited and mentally engaged the intellectual part of European population and moved observational research in the "earthquake-science" forward substantially (Baptista et al., 1998; Fonseca, 2004; Kozák et al., 2005).

In the same year, 2005, we recalled the 150st anniversary of the 1855 **Visp earthquake** in southern Switzerland, for the evaluation of which the first modern isoseismal macroseismic maps were constructed by H. G. O. Volger who also – for his map construction – propounded his own macroseismic intensity scale (Volger, 1857–1858; Kozák, Vaněk, 2006).

In 2006 we noted 100 years from the occurrence of the **Great San Francisco Earthquake** (April 18, 1906), one of the greatest seismic disasters in the territory of the USA. This seismic event is remarkable especially due to a thorough report on the event composed by top US specialists (among them H. F. Reid, author of the analysis of the *shear-displacement earthquake mechanism*); the report was complemented by a large-size atlas of detailed maps of San Andreas fault and its vicinity and by a series of seismograms of the San Francisco event recorded all over the world (Lawson et al., 1908/1910).

CALABRIAN EARTHQUAKE EVENTS

In the present year of 2008, we cannot but commemorate the 100th anniversary of the disastrous **Calabrian earthquake Messina-Reggio** of December 28, 1908, which caused approximately 100,000 deaths – the largest number of victims ever recorded in Europe. Historical earthquakes' records confirm that the Messina Strait and the attached territory of NE Sicily & SW Calabria have always been seats of strong seismic events. To explain the high level of seismicity of this corner of Italy, the concept of local plate tectonic geomorphology and its space-time manifestations – including continental drift – can be discussed.

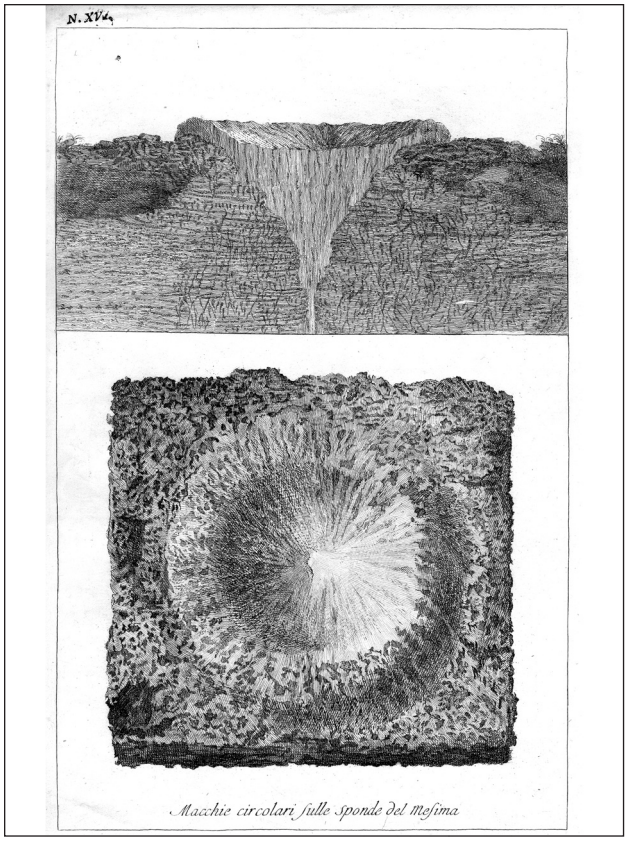
Reasons. As is well known, along the axis of the Mediterranean Sea a collision zone runs, separating the Euro-Asian tectonic plate in the north from the African plate in the south. This, in principle rectilinear, boundary running in the west-east direction from the Azores, through the Gibraltar Strait towards the Eastern Mediterranean Sea, however, turns to the north or even to the north-west in the region of eastern Sicily and southern Calabria. Afterwards, the collision zone runs along the axis of the Italian peninsula towards the Alps at the foot of which it turns to the east and south-east and continues to run along the east Adriatic coast towards south-west Greece where it returns eastwards, to its original west–east course. According to this concept, the Italian peninsula represents either a part of promontory-shaped African plate or it may be understood as a kind of a microplate between both large tectonic plates, Euroasian and African. And since both large plates are in mutual movements and both move eastward at a non-identical rate, any roughness

Fig. 1. Late 18th century image of the 1783 Calabria earthquake effects in the town of Calabria. Note large cracks in the ground. The depiction – *vue d'optique* – was made for projecting the picture on wall in a dark room (*camera obscura*): the projected depiction will turn right↔left and also the central inscription will appear converted and readable

1 pav. 1783 m. žemės drebėjimo vaizdas Kalabrio mieste

(asperity) on their boundary works as a stress concentration singularity, i. e. as a potential seat of the earthquake focus.

Groups. Such a description seems to fit namely the situation in the Strait of Messina and its vicinity. As for the occurrence of strong earthquakes in the region, a closer look to Italian catalogues and atlases of isoseismal maps (Postpischl, 1985; Postpischl, 1985a; Barbano et al., 1980) reveals that we may classify pertinent earthquakes as belonging to three of four groups: the first group of east Sicilian strong earthquakes (of the years 1114, 1169, 1542 and 1693) covers the Val di Noto region where the collision zone leaves Sicily and enters the Ionian Sea. The second group of earthquakes (1669, 1818, 1898, 1911 and 1914) is more or less linked with the volcanic processes of Etna, the largest active European volcano.



A bit anomalous in this division appears a single earthquake of 1823, the epicenter of which was located on the north coast of Sicily (by the Naso town); however, strong tsunami waves recorded during the event indicate that the seat of the epicenter could be offshore as well.

The last group of strong earthquakes in the region in question is directly related with south Calabria, north-east Sicily and the Messina Strait located inbetween. Among many others, mainly two dates have been fixed denoting the occurrence of the strongest earthquakes in Italy and in continental Europe: 1783, February 5 and 1908, December 28. Before a more detailed discussion on the 1908 event, whose 100-year anniversary we commemorate this year, we cannot but give the reader some facts and numbers (and few contemporary depictions) about the disaster which preceded the 1908 earthquake: the 1783 event.

The 1783 Calabria event was not actually limited exclusively to the year 1783: seismic activities in the region appeared first in 1780 and lasted up to ca. 1793, for more than 13(!) years during which strong aftershocks occurred repeatedly. The intensity of the main shock on February 5, 1783, was classified as I_o = XI° MCS (actually, there occurred two main shocks of the same epicentral intensity I_o = XI° on February 5, the first at 12 h 45 m in (38° 20”N, 16.00”E) and the second at 18 h 00 m in (38° 25” N, 15° 50”E); two more shocks of I_o = XI° followed after two days on February 7 (Postpischl et al., 1985a).

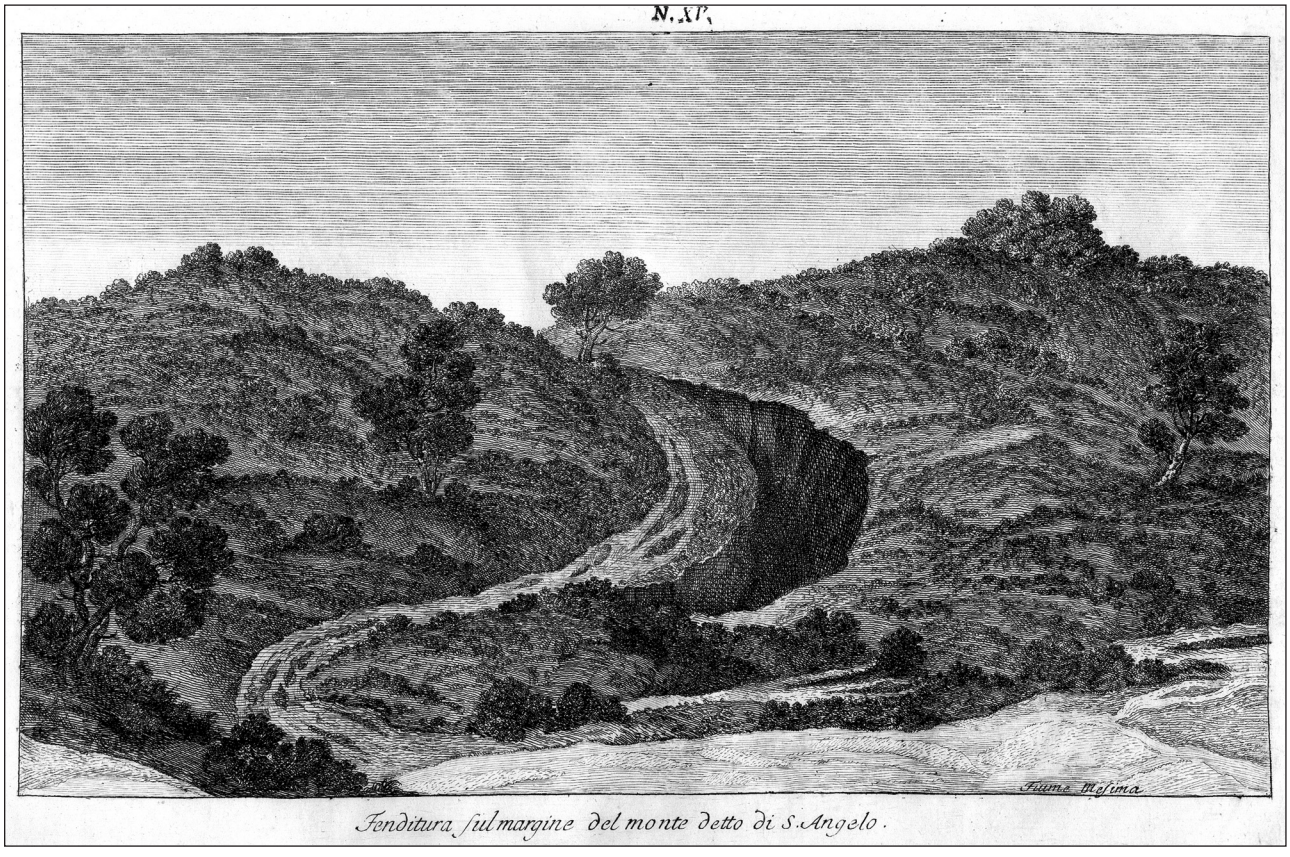


Fig. 2. During the 1783 earthquake numerous surface effects were observed and recorded, such as deep crevasses and moffets shown in our depiction: they mark the shallow focus of the event and the earthquake maximum intensity X or higher

2 pav. Per 1783 m. žemės drebėjimą buvo užfiksuota daugybė paviršiaus defektų – gilūs plyšiai, mofetės, kurie liudija žemės drebėjimo intensyvumą (10 balų ar net daugiau)

The epicenter area of all the series of earthquakes covered, in general, the whole narrow SW Calabrian promontory from the Taverna town in the north up to the Mélito town in the southern tip of the Italian Peninsula (together with some 100 km^2 of Sicily, north of Messina). The centre of main damage, however, during the occurrence of the strongest shocks (between February 5 and March 7, 1783) progressively migrated north-eastward along the Ligurian Sea coastal zone from Scilla at the Messina Strait up to the Gírifalco town in the north-east (Placanica, 1985). The area of macroseismic perceptibility extended into Basilicata and Campania and in all area of Calabria, Puglia and Sicily. The number of casualties was assessed as 30–35 thousands. The large occurrence of tsunami waves indicated vertical seismic displacements in the parts of the Liguria Sea floor off the north-west Calabrian coast.

The strongest European seismic event of 1783 (actually a long series of strong earth-quakes) was analysed in numerous works; the reader who is desirous to get detailed information on the event is recommended to visit the works by, e. g., Vivenzio (1783), Baratta (1910), Barbano et al. (1980), Placanica (1985) and Margottini and Kozák (1991); in the last two books, a rich image material related to the 1783 Calabria earthquake is given. To illustrate the 1783 event, two original images are reproduced in Fig. 1 and Fig. 2 showing pertinent earthquake effects; see also (Collection Kozak, 2001).

Fig. 3. Destruction of the Messina town during the 1908 earthquake, tsunami effects in the city gulf and panic of the inhabitants. The illustration is reproduced from an unidentified French periodical. The number of victims – 200,000 – is evidently exorbitant

3 pav. Mesinos miesto griūtis 1908 m. žemės drebėjimo metu. Nenustatyto Prancūzijos periodinio leidinio Iliustracija. Skelbiamas 200 000 žuvusių skaičius yra aiškiai perdėtas

Fig. 4. After-earthquake situation in the Messina town streets; the sketches were drawn by August Sieberg who visited the ruined town shortly after the earthquake

4 pav. Mesinos miesto gatvės po žemės drebėjimo. Augusto Siebergo, aplankiusio miesto griuvėsius netrukus po žemės drebėjimo, piešiniai

Fig. 5. Newspaper photograph of the Messina town damaged by the 1908 earthquake. In the foreground, ruins of the US consulate can be seen

5 pav. JAV konsulato pastato griuvėsiai po 1908 m. Mesinos žemės drebėjimo (laikraštyje skelbta fotografija)

The 1908 event. On December 28, 1908, the Messina Strait was visited by a disastrous earthquake again. According to Malaroda and Raimondi (1957) and Peterschmidt (1956), the earthquake intensity was assessed as I_o = XI–XII; among the twenty aftershocks that followed the main shock on the same day, two reached the intensity I_o = VIII (Kárník, 1968). Since the earthquake was relatively shallow (h = 10 km) and the epicenter zone embraced the towns of Messina and Reggio Calabria, the number of causalities was assessed high – between 60,000 (Baratta, 1910) and 120,000 (Mercali, 1909). Vertical movements in the earthquake source under the Messina Strait generated tsunami waves which culminated at S. Alessio on the Calabrian coast, where they reached 12 m in height (Carcione, Kozák, 2008).

The 1908 event was described, studied and commented on by many seismologists in the beginning of the 20th century, among them G. Mercalli, M. Baratta, A. Sieberg, F. E. Suess, F. Omori and others (surprisingly, also by M. Gorkij who was occasionally present in the region during the earthquake; see Gorkij, Meyer, 2005). According to F. Omori who had a large experience as concerns the earthquake impact on population, an extremely high ratio of victims in Messina, about one half, was caused by the common negligence of principles of seismic resistivity when building Messina houses and other civic edifices (Davison, 1927) (Fig.3–5).

FINAL NOTE

The turbulent and restless region of the narrowest part of the Messina Strait continues to attract engineers and constructors even today: a new bold project to connect Sicily and Calabria by a large bridge needs specific considerations, measurements and tests, especially as concerns determination of the natural vibration frequency of portly bridge piers and suspensions. At present, 3-D bridge-model simulations are tested in order to determine the parameters of the desirable seismic resistance of the bridge construction (Carcione, Gei 2006).

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PRAGAIŠTINGAS KALABRIO-MESINOS 1908 M. ŽEMĖS DREBĖJIMAS

S a n t r a u k a

XXI šimtmečio pradžioje prisimenami didieji žemės drebėjimai: Lisabonos (1755), Visp Šveicarijoje (1855), San Francisko (1906). Šiais metais sukanka 100 metų, kai 1908 m. gruodžio 28 d. įvyko Kalabrio-Mesinos žemės drebėjimas, nusinešęs apie 100 000 žmonių gyvybių.

Kalabrio-Mesinos regiono seisminis aktyvumas yra susijęs su žemyninių litosferos plokščių dreifu. Anksčiau šioje zonoje seisminis aktyvumas vyko net 13 metų ir yra žinomas Kalabrio 1783 m. žemės drebėjimų vardu. Dėl seisminio aktyvumo Mesinos giluminių lūžių zonoje statyboms keliami specialūs priešseisminiai reikalavimai.

Ян Т. Козак

ГИБЕЛЬНОЕ ЗЕМЛЕТРЯСЕНИЕ КАЛАБРИЯ–МЕССИНЫ 1908 ГОДА

Р е з ю м е

В начале 21-ого века вспоминают крупнейшие землетрясения: Лиссабонское (Португалия, 1755 г.), Виспское (Швейцария, 1855 г.), Сан-Францисское (США, 1906 г.), а также принесшее около 100 000 человеческих жертв Мессинское (п-ов Калабрия в Италии, 28 12 1908), со дня которого в этом году исполняется 100 лет.

Сейсмическая активность в регионе Калабрия–Мессины связана с дрейфом континентальных литосферных плит. Ранее сейсмическая активность в этой зоне длилась в течение целых 13 лет и известно под названием Калабрийского землетрясения 1783 г. Из-за сейсмической активности в зоне глубинных разломов Мессины к инженерным сооружениям здесь предъявляются специфические требования.