App. E1.1 - The earthquake of 25 May 1448 in Catalonia

study by Salicrú i Lluch R., 1995. The 1448 earthquake in Catalonia. Some effects and local reactions. Annali di Geofisica, 38, pp. 503-513

short comment by V. Castelli

For this earthquake the BEECD WF contains the following entry, coming from the input PEC MEM83. The root is to be considered "hidden" among the references supplied by this PEC.

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
MEM83	1448	05	24	01	30	CARDEDEU.B	HID	3C	-	0	80	41.633	02.333	-

This earthquake has been recently studied by Salicrú i Lluch (1995).

Brief analysis of the sources used by the study

The study starts from a summary of the available dataset, collected by the leading Catalan seismological compilation (Fontserè and Iglésies, 1971) and consisting of "several contemporary chronistic and narrative sources from Barcelona [...] Perpinyà [...] Vic [...] and Girona [...]".

The study then goes on to improve this reasonably good, but uneven dataset by adding new, unpublished contemporary sources and giving a new interpretation of a document already known to Fontserè and Iglésies (1971), which connected it to an earthquake occurred in September 1450. The study shows that it was written on July 1450 and could therefore be related to the previous event.

The new data come from the episcopal archives of Barcelona and the central archives of the Aragonese kingdom (ACA, 1453; Acords, 1424-1451; ADV, 1450; Dietari, 1411-1458; ADB, 1448-1453; Jornades, 1411-1484; Revista, 1881). They mostly record damage to single buildings (churches, monasteries) of the Barcelona diocese. The narrative sources - municipal and personal memoirs - record damages suffered by whole towns, public buildings (castles) and houses of private citizens.

The study doesn't quote the original texts in full, but summarizes seismologically relevant data (times, duration, places, descriptions) in two tables. A short description of each source, together with its location or place of publication is given in an appendix.

Comments on the methods of source criticism and interpretations of earthquake effects descriptions

The study analyses the sources mainly to verify the interpretation of earthquake records as suggested by Fontserè and Iglésies (1971). It pays special attention to the time as reported by the sources, and it concludes rejecting the hypotesis by Fontserè and Iglésies that documents refers to two earthquakes, one in the south, in the area of Barcelona, and the other in the north, around Perpignan (today France). The author also suggests that the large number of casualties should not be considered in itself as a sufficient evidence to evaluate the size of the earthquake, and that the state of repair of the buildings before it should be taken into account for evaluating the effects.

The author considers if there are sources available and which kind of sources could improve todate knowledge, stressing that the main information gap concerns the area between northern and southern available observations.

A detailed and critical analysis is devoted to three sources on just one affected place; as the time passes, the damage suffered is exaggerated to obtain larger refunds to be used for other purposes.

In conclusion, the study is well documented and developed and it supplies good quality information to be interpreted in seismological terms.

Comments on the quality of the study with respect to earthquake knowledge (including number and distribution of observations)

The study supplies data concerning 21 places where earthquake effects were observed. Most of them are to be found inside the boundaries of the Barcelona diocese. Outside this area, the few available observations are scattered over a large area to the North-East of Barcelona, with Perpignan as the northernmost affected locality.

The new root

This study is based on many primary sources and - though it doesn't supply the original texts - its descriptions of effects are detailed enough to allow a preliminary intensity assessment to be carried out with little effort.

The following New Root with Rc = 2A can be compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
ARESLT		1448	05	24			CARDEDEU	SAL95	2A	21	-

References

ACA (Arxiu de la Corona d'Aragó), 1453. Cancelleria, register 3158, ff. 164 r-166r, Barcelona, July 20.

Acords, Llibre d', 1424-1451. Arxiu Municipal de Vic, minutes for November 11th, 1448. A.de V. i de R. (ed.), 1917, Butlletì del Centre Excursionista de Vich, 22, pp. 157-158.

ADB (Arxiu Diocesà de Barcelona), 1448-1453. Gratiarum, vol. 35: - f. 14r, 1448 August 3, Barcelona; - f. 106r-v, 1449 September 5, Barcelona; - f. 109v, 1449 September 16, Barcelona. Gratiarum, vol. 36: - f. 193r, 1453 August 3, Barcelona.

ADV (Arxiu Diocesà de Vic), 1450. Lib. Just., July 14.

Dietari, 1411-1458. Dietari de la Deputaciò del General de Cathalunya, Colleción de la Corona de Aragón.

Jornades, 1411-1484. Llibre de J. de Jaume Safont. J.M. Sans i Travé (ed.), 1992. Fundaciò Nougera, Textos i Documents 28, pp. 52-53.

Revista de Gerona, 1881. vol. 5, p. 467: third-hand version of an inscription about the 1448 earthquake.

App. E1.2 - The earthquake of 1428 in Catalonia

study by E. Banda and A.M. Correig, 1984. The Catalan earthquake of February 2, 1428. Engineering Geology, 20, 89-97

short comment by A. Roca

For this earthquake the BEECD WF contains the following entry, coming from the input PEC MEM83. The root is to be considered "hidden" among the references supplied by this PEC.

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
MEM83	1428	02	02	08		CAMPRODON.GE	HID	3C	-	0	90	42.350	02.167	-

Brief analysis of the sources used by the study

Most of the available data concerning the 1428 earthquake were compiled by Fontserè and Iglésies (1971). The original documents they gathered range from reports of local town-clerks and chroniclers to letters written by individuals to the authorities to be feed from taxes due to the damage caused by the earthquake (ACA, 15th cent.; Dietari de Joan Torralles, 15th cent.; Dietari, 1411-1458; Flosculi, 15th cent.; Mengel, s.d.; Novell Ardits, 15th cent.; Rubriques de Bruniquer, 15th cent.). Despite the fact that some of the reports are fantastic and little weight can be done, other accounts are much more specific and report damage of great interest to be interpreted.

Comments on the methods of interpretations of earthquake effects descriptions

The new, available root by Banda and Correig (1984) constitutes a critical analysis of the well documented compilation of Fontserè and Iglésies (1971), who supply macroseismic data from 44 locations (villages, castles, churches and fortresses); Fontseré and Iglésies have interpreted data in terms of MSK intensity scale, considering that the castles, fortresses and churches are buildings of type B and houses of type A; quantity factors and damage degrees were also used.

Banda and Correig (1984) present an accurate analysis of the different sources used by Fontseré and Iglésies (1971) by means of a table, where these parameters are showed for each one of the 44 locations, together with the value of the estimated intensity. In several cases the felt intensity is difficult to assess and two intensity degrees have been used.

Comments on the quality of the study with respect to earthquake knowledge (including number and distribution of observations)

The number of localities with estimated intensity seems good in order to determine the macroseismic field. Moreover, the epicentral zone is well defined from the macroseismic field, in particular from the maximum intensities assigned to three localities.

The new root

The following New Root with Rc = 1B can be compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBESCC		1428	02	02	08		PUIG.-CAMPR.	BAC84	1B	44	90

References

ACA (Arxiu de la Corona d'Aragó), 15th cent. Cancelleria and Batllia, Letters.
Dietari de Joan Torralles, 15th cent. In: F. Bolos, s.d. Noticia de los extinguidos volcanes de la villa de Olot.
Dietari, 1411-1458. Dietari de la Deputaciò del General de Cathalunya, Colleción de la Corona de Aragón.
Flosculi (Baluze 238), 15th cent. Collection of letters received by and sent from the Jurors of the city of Girona. ms, Paris, National Library.
Fontserè E. and Iglésies J., 1971. Recopilació de dades sísmiques de les terres catalanes entre 1100 i 1906. Fundació Salvador Vives Casajuana, Barcelona, 547 pp.
Mengel O., s.d. Monographie des terratremols de la Region catalane. Barcelona.
Novell Ardits, 15th cent. Dietari de l'Antich Consell Barceloni (municipal record book).
Rubriques de Bruniquer, 15th. Municipal record book.

App. E1.3 - The earthquakes of 1427 in Catalonia

study by C.Olivera, A. Riera-Melis, B. Martinez and A. Roca, 1994. Revision of the 1427 earthquakes in the Eastern Pyrenees. Delimitation of the epicentral area and intensity assessment for the March 15 and May 15 events. In: P. Albini and A. Moroni (eds), Historical Investigation of European Earthquakes. Materials of the CEC project Review of Historical Seismicity in Europe, CNR, vol. 2, Milano, pp. 169-179.

short comment by A. Roca

For this earthquake the BEECD WF contains the following entry, coming from the input PEC MEM83, with Rc = 3C.

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
MEM83	1427	03	15	12		AMER.GE	HID	3C	-	0	80	42.000	02.583	-
MEM83	1427	05	15			OLOT.GE	HID	3C	-	0	90	42.200	02.500	-

This earthquake has been recently studied by Olivera et al. (1994).

Brief analysis of the sources used by the study

This study gives a complete set of references on publications on this series of earthquakes occurred in the Eastern Pyrenees area and starts with a critical review of Fontserè and Iglésies (1971). Such critical review has been carried out by a systematical classification and quality evaluation of sources. The majority of sources considered by Fontserè and Iglésies are published accounts not contemporary to the events. Research on these secondary sources has been carried out in the following archives and libraries in Barcelona: *Biblioteca de Catalunya, Biblioteca de la Secció d'Estudis Medievals de la Institució Milà i Fontanals (CSIC), Biblioteca de la Universitat de Barcelona, Biblioteca de la Facultat d'Història de la Universitat de Barcelona*; and the *Biblioteque National* in Paris.

Great effort is devoted to the investigation on how information was transmitted through different secondary sources and in trying to recover the references to original sources contemporary to the earthquakes. Many multiplicities in pieces of information that actually come from the same single source have been confirmed.

The next step was the retrieval of sources contemporary to the events used by former compilers and search for new original documents. The sources investigated are of different types: historiographic records, Royal Chancellor Registers, municipal records, ecclesiastical records, lawsuit record, calendars and notaries' documents. Intensive search for review of contemporary sources was undertaken in many archives (Llibre, 1432; Gavin, 1978-91; Gran Geografia, 1981; Prades, 1989).

The paper by Olivera et al. (1994) is only a summary of the investigation carried out in the frame of the RHISE CEC project and does not quote the original texts.

Comments on the methods of source criticism and interpretations of earthquake effects descriptions

The authors analyse the primary available sources in their historical context although they are not individually discussed in some extent. With this analysis they conclude that any event which had been previously catalogued on the basis only of secondary sources, from which it is not possible to identify the original primary source, should be considered as a fake earthquake. Also, given the historical context of Catalonia in the 15th century, when there was a quite well developed administrative system, they consider that a large earthquake has to be reported in more than one document. Thus, if a single source described important damage in a given area and no complementary documents supported this description then the authors looked for possible duplications of events due to confusion of data in successive transcriptions.

In conclusion, although the paper does not include the detailed analysis of each document it seems that the work carried out is rigorous and based on good quality primary sources.

Comments on the quality of the study with respect to earthquake knowledge (including number and distribution of observations)

The paper gives a list of events comparing them with the Fontserè and Iglésies (1971) and IGN (1991) data.

For the considered two events datapoints with intensity values (in a map, not table) are given only for the area of damage. 12 observation points are given for the March 15th event of 1427 and 10 for the May 15th earthquake.

The new root

Given the above information the following New, Available Roots with Rc = 1A have been compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBESCC		1427	03	15	12		AMER.GI	OLA94	1A	12	85

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBESCC		1427	05	15			OLOT.GI	OLA94	1A	10	90

References

Fontserè E. and Iglésies J., 1971. Recopilació de dades sísmiques de les terres catalanes entre 1100 i 1906. Fundació Salvador Vives Casajuana, Barcelona, 547 pp.

Gavin J.M., 1978-1991. Inventari d'Esglèsies. vols. 4, 11, 13, 14, 24. Artestudi, Barcelona.

Gran Geografia Comarcal de Catalunya, 1981. Fundació Enciclopèdia Catalana, Barcelona.

Llibre de Visites Pastorals, 1432. Arxiu Diocesà de Girona, P. 19, 590 pp.

Prades, I., 1989. Els terratrèmols de la sèrie olotina i el cas de la vila d'Amer. Quadern de la Selva-2 Sta. Coloma de Farners, s.d., pp. 103-112.

App. E2.1 - The earthquake of 1897, January 15, in Southern Albania

In: P. Albini et al., 1997. Internal report for the BEECD project on the Adriatic-Balkanic area. IRRS-CNR, Milano.

1. State-of-the-art

This earthquake is reported in Shebalin et al., 1974 (SHA74), Papazachos and Papazachou, 1989 (PAP89) and Sulstarova and Kociu, 1975a (SUK75) with the following parameters:

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
SHA74	1897	01	17				KVA	2C	-		85	40.000	20.100	-
SUK75	1897	01	17			DHIVER	HID	3C	-		85	39.900	20.100	-
PAP89	1897	01	17			DELVINO	82	1C	3		90	39.900	20.000	62

Shebalin et al. (1974) rely on Karnik (1971) and Sulstarova et al. (1971), the latter being a parametric earthquake catalogue.

Relying in his turn on Milne (1911), Mihajlovic (1927), Cavasino (1931), Morelli (1942) and Mihajlovic (1951) (Fig. 1), Karnik describes the event as follows:

"1897, Jan. 17, 40.0° N, 20.1° E, R.25, Io = ?, Io=IX (MD, CAM, MA), Io=VIII (MJD), Io=IX-X (MA). Delvinë almost completely destroyed (MD, MCA)".

Sulstarova and Kociu (1975a) quote: Milne (1911), Mihajlovic (1927), Cavasino (1931), Morelli (1942), Magnani (1946), Mihajlovic (1951), Montandon (1953), Karnik (1971).

All these sources describe the effects in the locality of Delvino only. The description which is repeated by many of these sources, almost with the same words, is the one by Mihajlovic (1927); he reports:

"1897. Un séisme ruineux le 17 janvier, quand Delvino fut detruit près que totalement".

Papazachos and Papazachou (1989) quote and summarise the compilation by Mihajlovic (1951), who reports:

"1897, 17-I, Delvinë, Arrondissement de Gjirokastër, Intensité IX. Remarques: Grande catastrophe séismique dans Épire nord. La ville Delvinë près que totalement detruite".

Mihajlovic (1951) supplies only a general list of references; most probably she also relied on her father's work (Mihajlovic, 1927) (Fig. 1).

The scheme of relationships (Fig. 1) shows that the roots of the three PEC considered (SHA74, SUK75, PAP89) quote only seismological compilations, which mainly refer to each other. As it is shown in Tab. 1, all of them supply data for Delvinë only.

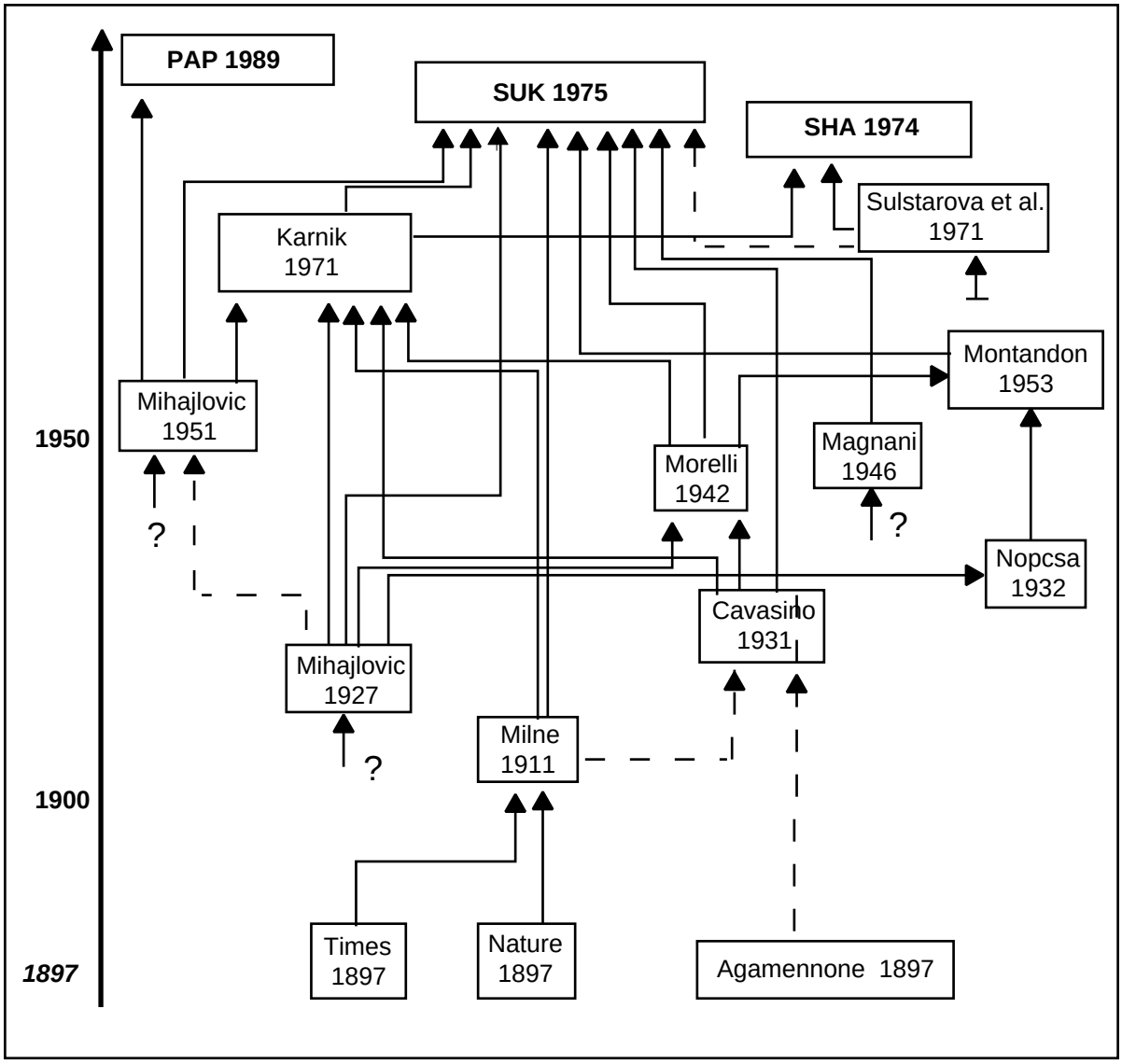

Fig. 1 - Scheme of relationships among parametric earthquake catalogues and their sources.

Tab. 1 - Sources, localities and effects.

HD = heavy damage. Figures with # are epicentral intensities.

affected locality	Mihajlovic, 1927	Cavasino, 1931	Magnani, 1946	Mihajlovic, 1951	Montandon, 1953	Karnik, 1971
Delvino	HD	9 #	9 #	9	HD	HD

2. Basic investigation

An improvement in the knowledge of this earthquake was obtained by retrieving some contemporary sources, which are quoted by Milne (1911) and Agamennone (1897a) (Fig. 2).

Milne (1911) took the information from The Times (1897) and Nature (1897), the latter reporting the same words of The Times, with the exception of the last sentence. The Times says:

> "Earthquake in Epirus, Athens, Jan. 20. A violent earthquake is reported to have occurred in the district of Delvino, in Epirus. Several villages are stated to have been destroyed and it is feared that there has been serious loss of life. The Vali of Janina has sent a supply of tents and provisions for the sufferers. - Our own correspondent" (The Times, 1897).

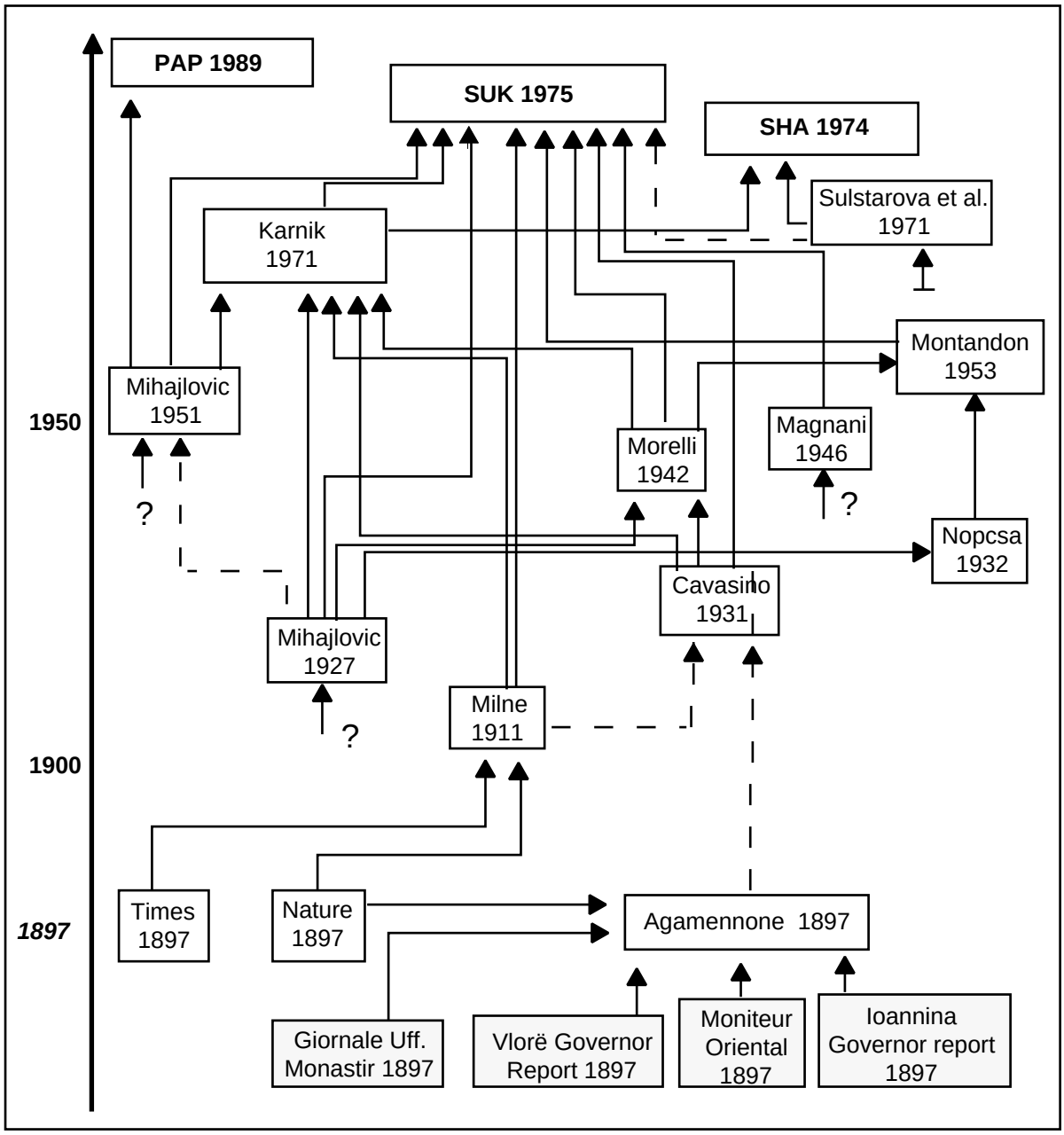

Fig. 2 - Scheme of relationships among parametric earthquake catalogues, their sources and the and newly retrieved sources (*shaded*).

The main source of information on this earthquake turned out to be the paper by Agamennone (1897a). He reports the investigation performed by himself on this earthquake and the effects as supplied by local and contemporary sources in the following localities:

- Divri (today **Dhiver**), where

  "the earthquake began in the district of Delvino on January 15, at noon and it lasted 30 hours with some intervals. [...] In the village of Divri 128 houses were destroyed, 58 were seriously damaged, three people died and 17 were injured" (Report of the Governor of Iannina to Agamennone, 1897a, translation from Italian)
  "sur dex cents maisons une quinzaine à peine restent debout et encore elles sont inhabitables. [...] La montagne de Divri a été fendue en plusieurs endroits et des crevasses sortaient des flammes et de la fumée. [...] A Divri trois personnes ont été tuées et une quinzaine blessées" (Le Moniteur Oriental, 1897)

- villages of Saint-André (identified with today **Sarande**), Koukouratés (**Kullurice**), Tchercovitza (**Cerkovice**), d'Avaritza (quoted as "Navarizza" by Agamennone and identified with **Navarice**), where

  "les dégâts ne sont pas aussi grands [as in Divri]" (Le Moniteur Oriental, 1897)
  "in the village of Navarizza a house collapsed and many other were damaged" (Report of the Governor of Iannina to Agamennone, 1897a, translation from Italian).

Agamennone (1897) reports that the governor of Valona (**Vlore**) informed him that the earthquake was not felt there, while the one at Ioannina did not supply any answer. No information is given on Delvinë .

In conclusion, according to Agamennone and his sources, it is possible to say that:

- the earthquake occurred on January 15, 12 a.m. (and not on January 17 or 27, the latter being the date given by Montandon, 1953);
- five localities were damaged, some people died, other were injured.

Tab. 2 and Fig. 3 show a preliminary assessment of macroseismic intensities and their distribution.

Tab. 2 - Newly retrieved sources, localities and effects.

Sources: 1. Moniteur Oriental, 1897; 2. Ioann. Gov. report, 1897; 3. Vlorë Gov. report 1897; 4. Nature, 1897; 5. Agamennone, 1897a
HD = heavy damage; D = damage; NF = not felt; NR = not reported.

reported locality	1	2	3	4	5	identified locality	I (EMS-92)
villages in Delvino district		D		HD	**HD**		
Divri	HD	HD			**HD**	**Dhiver**	**8–9**
Navarizza	D				**D**	**Navarice**	**7–8**
Saint-André	D				**D**	**Sarande**	**7–8**
Koulouratés	D				**D**	**Kullurice**	**7–8**
Tchercovitza	D				**D**	**Cerkovice**	**7–8**
Giannina		NR			**NR**	**Ioannina**	**NR**
Valona			NF		**NF**	**Vlorë**	**NF**

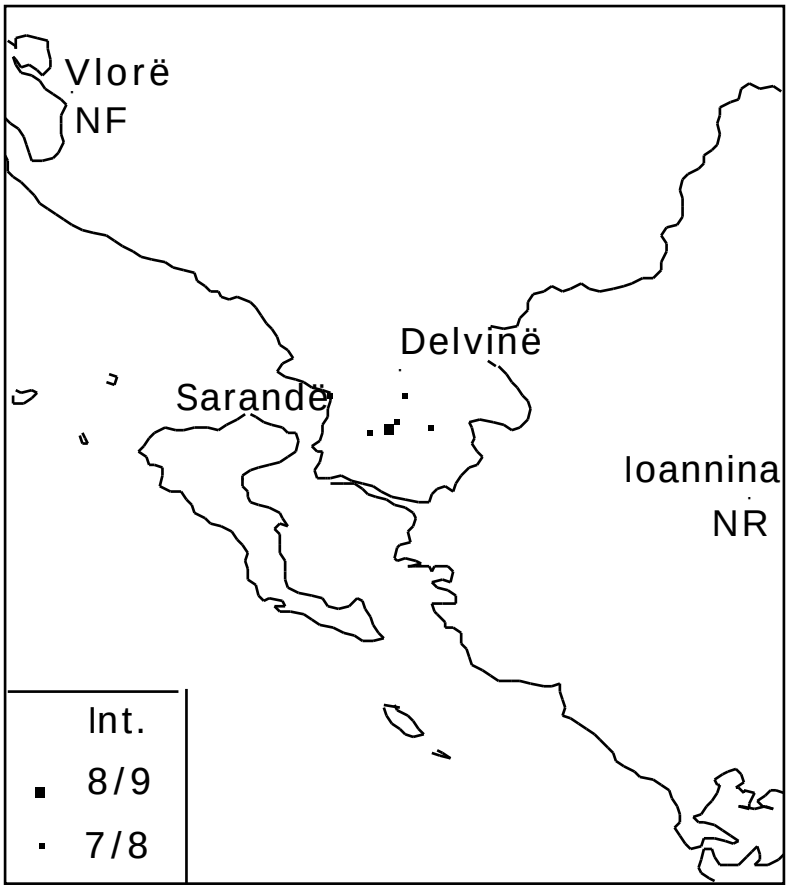

Fig. 3 - Intensity distribution for the 1897, January 15 earthquake.
* Epicentre by Papazachos and Papazachou (1989).

Moreover, Agammennone supplies information on a sequence of shocks felt since 17 January to 15 February:

- 17, 18, 19 January, during the night, in Biklista (**Bilisht**) two strong shocks and a light one were felt (Giornale Ufficiale di Monastir, 1897a)
- 18 January, around 4 p.m. (local time) in Monastir (**Bitola**) a light shock was felt (Giornale Ufficiale di Monastir, 1897a)
- 20 January, in Coriza (**Korce**) (Giornale Ufficiale di Monastir, 1897a).
- a newspaper from Monastir, dated 3 February, does not report the date when the earthquake occurred, but only that
  "we receive the news from Elbassan that in the small town of Peklin [today **Peqini**] an earthquake occurred. There were no casualties, but a house collapsed" (Giornale Ufficiale di Monastir, 1897b)
- 6 February, in Argirocastro (Gjirokaster) and Delvino (Delvinë)
- 15 February, at 5 p.m. (local time), in the region of Muricovo, E of Monastir.

Conclusions and new root

On the basis of the newly retrieved data, a new root of class 1B is now available.

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBEURS		1897	01	15			Dhiver	ALA97	1B	5	85

References

Agamennone G., 1897a. Il periodo sismico dell'Epiro nel gennaio 1897. Bollettino della Società Sismologica Italiana, Modena, III, pp. 5-8.

Cavasino A., 1931. Note sul catalogo dei terremoti distruttivi dal 1501 al 1929 nel bacino del Mediterraneo - Catalogo dei terremoti disastrosi avvertiti nel bacino del Mediterraneo dal 1501 al 1929. Memorie scientifiche e tecniche. R. Accademia Nazionale dei Lincei, Pubblicazioni della Commissione Italiana per lo studio delle grandi calamità, vol. II, pp. 29-60 + 1 map.

Giornale ufficiale di Monastir, 1897a. 27 January. *[reported by Agamennone, 1897a]*

Giornale ufficiale di Monastir, 1897b. 3 February. *[reported by Agamennone, 1897a]*

Giornale ufficiale di Monastir, 1897c. 15 February. *[reported by Agamennone, 1897a]*

Karnik V., 1971. Seismicity of the European area. vol. II, Dordrecht, 218 pp.

Le Moniteur Oriental, 1897. 1 February, Costantinoples. *[reported by Agamennone, 1897a]*

Magnani M., 1946. Tettonica e sismicità nella regione Albanese. Geofisica pura e applicata, VIII, fs. 1-2.

Mihailovic D. J., 1951. Catalogue des Tremblements de Terre Epiro-Albanais. Archive Séismologique de l'Institut Séismologique de Beograd, Zagreb, 73 pp.

Mihailovic J., 1927. Mouvements seismiques Epiro-Albanais. Union Geodesique et Geophysique Internationale, Comité Nationale du Royaume des Serbes, Croates et Slovenes, Section de Seismologie, Ser. B, Monogr. et Trav. Scient., 1, Beograd, 77 pp.

Milne J., 1911. A Catalogue of destructive earthquakes A.D. 7 to A.D. 1899. British Association for the Advancement of Science, London, 92 pp.

Montandon F., 1953. Les tremblements de terre destructeurs en Europe. Genéve, 195 pp.

Morelli C., 1942. Carta sismica dell'Albania. Reale Accademia d'Italia, Commissione Italiana di Studio per i problemi del soccorso alle popolazioni, vol. X, Firenze, 120 pp.

Nature, 1897. 28 January, 55, n. 1422, p. 299.

Nopcsa F. B., 1932. Zur Geschichte der Adria. Eine tektonische studie. Zeitschrift der Deutschen Geologischen Gesellschaft, Berlin, Band 84, pp. 280-316.

Papazachos B. and Papazachou K., 1989. The Earthquakes of Greece. Thessaloniki, 356 pp.

Report of the Governor of Iannina to Agamennone, 1897. January. *[reported by Agamennone, 1897a]*

Shebalin N.V., Karnik V. and Hadzievski D. (eds.), 1974. Catalogue of earthquakes of the Balkan region, I, UNDP-UNESCO Survey of the seismicity of the Balkan region. Skopje, 600 pp.

Sulstarova E. and Kociu S., 1975a. The catalogue of Albanian earthquakes. Botim i Qendres Sizmologjike, Tirane, 223 pp.

Sulstarova A., Kociu S. and Uliaj S., 1971. Catalogue of earthquakes in Albania, prior to 1800, Io ≥ VIII; 1800-1970, Io ≥ VI, Tirana, 1971. Mimeographed. Enclosure to the study "Map of seismic regionalisation of the People's Republic of Albania, Tirana Seismologicak Station.

The Times, 1897. 21 January, p. 5.

App. E2.2 - The earthquake of 1695, September 26, Kozani (Greece)

In: N.N. Ambraseys, 1997. Internal report for the BEECD project. ICST, London.

Until very recently the region of Kozani in northern Greece was considered to be almost free from damaging or destructive earthquakes. Seismic maps and earthquake catalogues reflecting the short-term, 20th century seismicity of the region showed no significant activity, and instrumental data of the last few decades support this observation, demonstrating little more than occasional shocks of relatively low magnitude.

However, the recent, damaging earthquake of 13 May 1995 (Ms= 6.5, Mo = 7.6x1018Nm) in the region of Kozani demonstrates that, as in other parts of the world, the short-term seismic record may not be all that representative of long-term activity.

An Imperial order (ferman) dated in the second decade of Shawwal 1113 aH (11 to 20 March 1701), addressed to the kaza of Egri Buchak, refers to a petition submitted to the Porte with which it was made known that at the village of Quzna (Kozani) an earthquake some years previously had damaged the walls of the church of St. Nicholas, as a result of which the roof of the edifice was now threatening collapse so that prayers could not be performed. In response, the ferman instructs the local authorities to allow the repair and redecoration of the church, but under the condition that these works should not be allowed to lead to the enlargement of the edifice in plan and height.

It is very probable that this earthquake is the same event which is mentioned in a contemporary marginal note on a menology of the church of Holy Trinity of Velventos, a large village in the kaza of Egri Buchak, 38 km north-east of Kozani. This note says that: "... on 8 September 1695 they deposed Meidani from the leadership of the "armatoli" and his place was taken by Alimanis; and on the 16th of the month, Monday night, at midnight while it was raining with lightning and thunder, the earth really shook from its foundations... ". (Tsarmanides, 1995). The date, 16th of September 1695 (O.S.) was a Monday, and we know that during that period Meidani's men-at-arms were operating in the Pindos mountains where he was killed, at Gardiki, in March 1700 (Lampros 1910, p. 206).

The 1695 earthquake in Kozani deserves mention as it demonstrates the kind of embroidery that some modern writers use to describe and interpret their sources. In a recent publication Stiros (1997) reports a damaging earthquake in the region of Kozani not earlier than the middle of 1719. The same event is also mentioned by Karakaisis et al. (1997) on the authority of a personal communication from Prof. B. Papazachos and Mrs E. Papazachou. The latter authors (Papazachos and Papazachou, 1997, p. 212) date this event to about 1720, assign to it a magnitude of Ms 6.5, an intensity VII, and they add that in this earthquake several other villages such as Siatista, Lochme, Amigdalia, and Mikrokastro suffered considerable damage together with Kozani. Yet, the only source available to these authors is Papaioannou (1989), an interesting secondary source which refers only to the damage of the church of St. Nicholas in Kozani by "an earthquake" and to its reconstruction in 1721. On examination I find that Papaioannou took this information from Sigalas (1939) whose work is an annotated list of the material he examined in his search in various archives in western Macedonia for unpublished documents. Among the Turkish material Sigalas found kept in the sacristy of the church of St. Nicholas in Kozani, there was a ferman (an imperial Ottoman edict) that granted permission for the repair of the walls of the edifice.

Sigalas reads the date of issue of this document to the middle of Shawwal 1133 aH (August 1721) and adds that at the back of the document a note in Greek indicates that it concerned the repair of the church of St. Nicholas, which had suffered from an earthquake; the date of its occurrence is not given. A facsimile of this document was published by Papaioannou (1989), and reprinted by Stiros (1997).

Sigalas also mentions another document, from the same repository, an order (buyurultu) for the execution of the necessary repairs to the walls of the church, which he dates Rabi-I 1133 aH (Jan 1721). It is apparent that the dates of these two documents, that is, of the ferman and of the order, are incongruous. If the date of the latter document, which I have not seen, is correct, the date of issue of the ferman, as read by Sigalas, should be wrong as it is not usual for the order of execution of works to precede, in the present case by seven months, the issue of the permission to execute the works.

However, this problem arises only from the fact that neither Sigalas and Papaioannou nor more recent authors who quote these sources seem to have read the ferman. This document is dated to the second decade of the month of Shawwal 1113 aH (11 to 20 March 1701). The year is confirmed by the imperial cipher (tugra) it bears, of Mustafa II who reigned from 6.2.1695 to 28.08.1703 (Umur, 1980). It is obvious that this document was issued in 1113 aH (1701) and not in 1133 aH (1721) as Papaioannou and Sigalas maintain.

The second document, if the date of its issue as given by Sigalas is correct, implies that repairs had still not been carried out more than 20 years later. This is not an uncommon delay, often owing to the great length of time required to investigate the damage or to a dispute over who was to pay. A wall painting at the north enteric of the church, dated February 1720, confirms that the reconstruction and decoration of the church was gradual.

Coming to the effects of this event in Kozani, Papaioannou (personal communication, 1997) thinks that the earthquake damage to the church was not serious and that its damage by the earthquake was most probably used by the Christian community in Kozani as a pretext to secure permission from the Ottoman authorities to rebuild and in the process enlarge the edifice. This is a perfectly reasonable view since it was not uncommon, once permission for repairs was granted by the Ottoman authorities, for its terms of reference to be exceeded, and for the Christians to take the opportunity to pull down the edifice and rebuild it, in our case completing the works in 1721. The year of completion is recorded in a contemporary inscription on the interior face of the wall, to the right of the north entrance of the church, which tells us that the edifice was "... renewed from its foundations... on 12 October 1721... ". The same year is also shown on the exterior of the wall of the pulpit structure.

What this information tells us, therefore, is that sometime in the last years of 1600, Kozani was shaken by an earthquake which damaged the walls of the church of St. Nicholas and that the repair and reconstruction of the edifice was completed in 1721. There is no evidence that the church was destroyed by the shock or that in this earthquake the town itself or any other of its villages were damaged. The fact that the ferman does not mention the date of the earthquake by year or month, as is usual with large or damaging events, but says vaguely "some years ago" suggests that this was not an event with which the Porte was familiar from other petitions for reconstruction and repairs in the region.

The following New Root with Rc = 2A can be compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUIC		1695	09	26			Kozani	AMB97	2A	2	-

References

Karakaisis G., Hatzidimitriou P., Scordilis E. and Panagiotopoulos D., 1997. Seismicity of western Macedonia, Greece. P. Pavlides and G. King (eds.), Journ. Geodynamics, Special Issue on the Kozani-Grevena 1995 Earthquake.

Lambros S.P., 1910. Enthimiseon itoi chronikon simiomaton syllogi proti (Memory notes, first collection). Neos Ellenomnemon. Athens, 7, pp. 133-257 (*in Greek*).

Papaioannou L.A., 1989. O kathedrikos naos to Hagiou Nikolaou Kozanis. Publ. Mitroplolis Servion and Kozanis, Kozani, pp. 16-17.

Papazachos B. and Papazachou K., 1997. The Earthquakes of Greece. Thessaloniki, 304 pp.

Sigalas A., 1939. Archeia kai vivliothikai dytikis Makedonias. Thessaloniki, pp.93-98.

Stiros S., 1997. Seismicity and seismic risk in western Macedonia based on historical and archaeological evidence. In: P. Pavlides and G. King (eds.), Journ. Geodynamics, Special Issue on the Kozani-Grevena 1995 Earthquake.

Tsarmanides A.G., 1995. Symvoli stin historia ton Servion 1350-1912. Pub. Morphot. Homilos Serv., vol. 1, p. 34, Servia.

Umur S., 1980. Osmanli Padisah tugralari. Istanbul.

App. E2.3 - The earthquake of 1616, December (22) 18, Leipzig (Germany)

In: J. Fischer and G. Grünthal, 1996. Internal report for the BEECD project. GeoForschungsZentrum, Potsdam.

Introduction

The earthquake catalogue by Grünthal (1988) (GRU88) indicates several earthquakes located in the area of the today city of Leipzig with its suburbs. So far only events of the 19th and 20th century were catalogued. New investigations led to retrieve new sources on earthquakes in the first half of the 17th century for this well known focal area.

New sources

The previous German catalogues have not considered Vogel (1714) as a source. There the following information on the 22nd December can be found:

"Den 22. Decemb. Abends zwischen 6 und 7 Uhr / entstund ein Erdbeben / davon sich nicht allein die Häuser sehr beweget / sondern auch etliche Steine in der Nicl. Strasse vom Pflaster aufgehoben worden. Heidenr. ...".

The source mentioned by Vogel (1714) is "Heidenreich" without specification, which of his publication is meant. The source we could retrieve is the "Leipzigsche Chronick" by Tobias Heidenreich, published in 1635, with the following text:

"1616. 18. Dezember hat der Thürmer / weil er Feuer gesehen/ zweimal gestürmet...
Eodem die zwischen 6. Und 7. Uhr ist ein Erdbeben gewesen / davon die Häuser sich sehr beweget. Hat aber bald wieder auffgehöret."

It is strange that in the two texts the date differs while the hour of the day is the same. This implies that one and the same event should be meant. On the other hand, in contrary to Heidenreich, Vogel mentioned the name of a street, where paving stones were "lifted up". So, we cannot be sure that the retrieved source Heidenreich (1635) is the one mentioned by Vogel.

For the following considerations we will stick to the date of December 18th. This is supported by a further newly retrieved source for Zwickau, the "Chronicle Cygnea" by Schmidt (1656):

"Den 18. Dec. 1616 ein Erdbeben ohne Schaden".

Herzog (1845) presented the facts in the chronicle of Zwickau as follows:

"Großen Schrecken verursachte am 18. Dezember ein Erdstoß, der jedoch glücklicherweise ohne Schaden abging."

This is very similar to the chronicle by the vicar of Culitzsch (Anonym, 16th-17th cent.) on the 18th of December 1616:

"Ein Erdstoß verursachte großen Schrecken unter der Bevölkerung."

There arises the question, if the following events in the earthquake catalogue by Grünthal (1988) [GRU88] belong to the event on 18th December 1616:

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
GRU88	1616	12	04			ZEITZ	S40	2C	-	0	40	50.980	12.250	-
GRU88	1616	12	04			KRASLICE	S40	2C	-	0	40	50.250	12.430	-

The entry by Sieberg (1940b)

"*1616, Dezember 4. Merkliche Erderschütterungen zu Kayna bei Zeitz*"

is probably related to the information in the chronicle of Kayna near Zeitz (arranged in 1841) with the following text:

"1616; Den 4. Dezember hat man merkliche Erderschütterungen verspürt!"

The main source of the second event on December 16th, 1616, is Baum (1962), who only gave the date and the Vogtland region as the locality. Jacobi (1885) refers to this event by mentioning the year and a rough regional classification. Both gave no references.

Conclusion

What concerns the summary of localities, there can surely be mentioned Leipzig only. The other local chronicles mention this event without specifying that it was really felt in the respective localities, like Kayna, Zwickau or Culitzsch.

The following New Root with Rc = 3B can be compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUGF		1616	12	18	18		Leipzig	FIG96	3B	-	-

References

Anonym, 16th-17th cent. Pfarrchronik von Culitzsch. Manuscript.

Baum J., 1962. Erdbeben im Vogtland. Kulturspiegel des Kreises Auerbach. Vogtl., 11, pp. 133-135.

Chronicle of Kayna (arranged in 1841). Manuscript.

Grünthal G., 1988. Erdbebenkatalog des Territoriums der Deutschen Demokratischen Republik und angrenzender Gebiete von 823 bis 1984. Veröffentlichungen des Zentralinstituts für Physik der Erde Nr. 99, Potsdam, 139 pp.

Heidenreich T., 1635. Leipzigsche Chronick. Leipzig.

Herzog E., 1845. Chronik der Kreisstadt Zwickau. Zwickau.

Jacobi H., 1885. Zur Geschichte der Erdbeben im westlichen Erzgebirge. Mitt. Wiss. Ver. Scneeberg u. Umg., 2, pp. 14-22 and pp. 104-105.

Schmidt T., 1656. Chronica Cygnea oder Beschreibung von Zwickau. Zwickau.

Sieberg A., 1940b. Beiträge zum Erdbebenkatalog Deutschlands und angrenzender Gebiete für die Jahre 58 bis 1799. Mitt. Deutsch. Reichs-Erdbebendienst 2, 112 pp.

Vogel J.J., 1714. Leipzigsch Geschicht-Buch. Leipzig.

App. E2.4 - The earthquake of 1624, October 31, Leipzig (Germany)

In: J. Fischer and G. Grünthal, 1996. Internal report for the BEECD project. GeoForschungsZentrum, Potsdam.

Introduction

The earthquake catalogue by Grünthal (1988) (GRU88) indicates several earthquakes located in the area of the today city of Leipzig with its suburbs. So far only events of the 19th and 20th century were catalogued. New investigations led to retrieve new sources on earthquakes in the first half of the 17th century for this well known focal area.

New sources

This event was so far not considered in any German earthquake compilations including Lersch (1897 ca.) or Giessberger (1922).

In the chronicle by Vogel (1714) the following entry on 1624 can be found:
"Den 31.Oktober ist zu Nacht umb halb zwölff Uhr ein Erdbebn gehöret worden / davon die Häuser erschüttert / und die auff dem Rahthaus sitzenden Raben mit großem Geschrei davon geflogen."

Conclusion

It is clear that an earthquake was largely felt on 31st October 1624 at about 23.30 in Leipzig.

The following New Root with Rc = 3B can be compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUGF		1624	10	31	23	30	Leipzig	FIG96	3B	-	-

References

Giessberger H., 1922. Die Erdbeben Bayerns. Abhandlungen der Bayerischen Akademie der Wissenschaften, Mathematisch-physikalische Klasse, I, 29, 72 pp.

Grünthal G., 1988. Erdbebenkatalog des Territoriums der Deutschen Demokratischen Republik und angrenzender Gebiete von 823 bis 1984. Veröffentlichungen des Zentralinstituts für Physik der Erde Nr. 99, Potsdam, 139 pp.

Lersch B.M., 1897 ca. Erdbebenchronik für die Zeit von 2362 v. Chr. bis 1897. Handschrift, 19 Bd., Archiv des GeoForschungsZentrum, Potsdam.

Vogel J.J., 1714. Leipzigsch Geschicht-Buch. Leipzig.

App. E2.5 - The earthquake of 1631, November 3, Leipzig (Germany)

In: J. Fischer and G. Grünthal, 1996. Internal report for the BEECD project. GeoForschungsZentrum, Potsdam.

Introduction

The earthquake catalogue by Grünthal (1988) (GRU88) indicates several earthquakes located in the area of the today city of Leipzig with its suburbs. So far only events of the 19th and 20th century were catalogued. New investigations led to retrieve new sources on earthquakes in the first half of the 17th century for this well known focal area.

New sources

The only information on an event in 1631 was available so far from the Journal "Aus der Natur" (1872) in the article "Das Erdbeben vom 6. März 1872". But this information was so scarce that an entry for a parametric earthquake catalogue could not be derived.

Vogel (1714) provides the following information on time and location:

"Den 3.November frühe zwischen zwey und drey Uhr ist allhier ein Erdbeben gehöret worden / davon die Häuser sehr erschüttert / und die gantze Stadt rege geworden."

This expression can also be found in the contemporary chronicle of Leipzig by Heidenreich (1635):

"*Anno 1631 Den dritten November. Frühe zwischen zwei und drei Uhr ist allhier ein Erdbeben gehöret wurden*".

This event is mentioned also by Feske (1691):

"Wie Anno 1631 geschehen / da man am 3. November zu Leipzig / Dresden / Zwickau und anderen Orten mehr in Meissen und hochlöblichen Churfürstenthum Sachsen ein Erdbeben verspühret."

Conclusion

Based on the information that the earthquake was felt in Leipzig, Dresden and Zwickau a first estimation of focal parameters can be drawn with the help of a comparison with a similar but well investigated later earthquake in this area. As such a master event the earthquake on the 19th December 1908 can be used. On the basic assumption of a similarity of these two events the epicentral intensity can be assessed between IV and VI. Further investigations will be necessary for a better parameter specification of the earthquake in 1631 as well as for the two others in 1616 and 1624 described before.

The following New Root with Rc = 3B can be compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUGF		1631	11	03	02		Leipzig	FIG96	3B	-	-

References

Feske G.E., 1691. Sieben historisch und theologische Abhandlungen von Erdbeben.
Grünthal G., 1988. Erdbebenkatalog des Territoriums der Deutschen Demokratischen Republik und angrenzender Gebiete von 823 bis 1984. Veröffentlichungen des Zentralinstituts für Physik der Erde Nr. 99, Potsdam, 139 pp.
Heidenreich T., 1635. Leipzigsche Chronick. Leipzig.
Journal aus der Natur, 1872.
Vogel J.J., 1714. Leipzigsch Geschicht-Buch. Leipzig.

App. E2.6 - The earthquake of 1427, March 19 in Catalonia

C. Olivera, E. Redondo, A. Riera, J. Lambert and A. Roca, 1998. Problems in assessing focal parameters to earthquake sequences from historical investigation: the 1427 earthquakes in Catalonia. Proc. I Asamblea Hispano-Portuguesa de Geodesia y Geofísica, 6 pp. (in printing)

1. State-of-the-art

The earthquakes of 1427 and 1428 in Catalonia have been reported by different seismic catalogues as the most severe seismic events in the Eastern Pyrenees.

Two damaging events of the 1427 series were identified, analyzed and source parameters were given in a recent study (Olivera et al., 1994) in the frame of the RHISE project (see App. E1.3).

In the frame of the BEECD project various types of sources have been analysed for the study of the 1427 earthquakes. First, already known sources have been re-evaluated and second, new sources have been searched.

2. New sources

The new considered sources are listed below.

- Some letters from the *Cancelleria Reial* and *Batllia* and some records from the *Dietari de l'Antich Consell Barceloní (Novells Ardits)* not considered in previous studies.
- Documents from the *Arxiu Històric Comarcal d'Olot* reporting the effects in Olot and Besalú towns (Puigvert, 1996; 1998).
- Hebrew Source: Chronicle-like document by a contemporary Jew of Girona who finished to write it on June 18th, 1427. This manuscript, which is kept in the Baviera National Library (Ms. 307), has been transcribed and translated by del Valle (1994).
- *Registre de les deliberacions del Consell Municipal* from the city of Pamiers (France).

Some of these sources give a relatively good description of damage but do not provide the chronology of the events. Some other sources give a highly accurate timing but they only report that the event was felt in relatively distant places such as Barcelona and Pamiers, with no information of damage.

3. New Chronology

The new investigated sources, some of them from the far field and some other from the near field, allow the former chronology by Olivera et al. (1994) of the studied events to be modified, in particular for the events occurred in March. In fact what it is observed is a continuous sequence of earthquakes that are difficult to be separated in individual events.

With the now available information the most reasonable interpretation is that the largest event in March was that of the 19th as it was reported in distant sites as Pamiers and Barcelona. This earthquake must have had an important role in completing the destruction initiated by former events.

The following New, BEECD Root with RC = 1A has been compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBEUCC		1427	03	19			AMER	OLA98	1A	15	85

References

Del Valle C., 1994. Los terremotos de Girona de 1427 en la fuente hebrea. Autores judios de Catalunya. Aben Ezra Ediciones / Ajuntament de Girona, 133 pp.

Fontserè E. and Iglésies J., 1971. Recopilació de dades sísmiques de les terres catalanes entre 1100 i 1906. Fundació Salvador Vives Casajuana, Barcelona, 547 pp.

Instituto Geográfico Nacional, 1991. Earthquake Database for the Iberian Peninsula.

Olivera C., Redondo E., Riera A., Lambert J. and Roca A., 1998. Problems in assessing focal parameters to earthquake sequences from historical investigation: the 1427 earthquakes in Catalonia. Proc. I Asamblea Hispano-Portuguesa de Geodesia y Geofísica, 6 pp. (*in printing*).

Olivera C., Riera-Melis A., Martínez B. and Roca A., 1994b. Revision of the 1427 earthquakes in the Eastern Pyrenees. Delimitation of the epicentral area and intensity assessment for the March 15 and May 15 events. In: P. Albini and A. Moroni (eds.), Materials of the CEC project "Review of Historical Seismicity in Europe", CNR, Milano, vol. 2, pp. 169-180.

Puigvert X., 1996. La reconstrucció de la vila d'Olot després dels terratrèmols (1427-1433). Col.lecció Beques Ciutat d'Olot/1, Arxiu Històric Comarcal d'Olot i Museu Comarcal de la Garrotxa, 176 pp.

Puigvert X., 1998. Personal communication.

App. E2.7 - The earthquake of 6 October 1863 in Hereford (UK)

In: Musson R.M.W., Marrow P.C. and Henni P.H.O., 1998. UK intensity database (unpublished).

1. State-of-the-art

The earthquake is reported in the catalogue of Musson (1994) principally on the authority of Soil Mechanics (1982). This was a study that produced an intensity map of the earthquake, but no listing of places and intensities, and no parameters for the earthquake. A similar (but less detailed) account of the earthquake was published by Principia Mechanica (1982). The parameters in Musson (1994) were estimated on the basis of the effects reported by Soil Mechanics (1982) with some consideration given to other data for the earthquake in BGS files.

2. Basic investigation

Because this earthquake occurred in the second half of the 19th century, the prime source of data was reports from local newspapers. These provided a copious amount of material. The newspapers used were the following:

Newspaper	Date and page number
Bedale and Northallerton Times	10 Oct. p. 4
Brecon Reporter	10 Oct. p. 10
Birmingham Daily Post	7 Oct., p. 4; 8 Oct., p. 5; 10 Oct., p. 8; 19 Oct., p. 3
Bristol Daily Post	7 Oct., p. 3; 8 Oct., p. 3; 9 Oct. , p. 3; 12 Oct., p. 4; 15 Oct., p. 3; 19 Oct , p. 3
Cambria Daily Leader	7 Oct., p. 2; 8 Oct., p. 2; 9 Oct., p. 2; 10 Oct., p. 3
Cambridge Independent Press	10 Oct., p. 8
Cardiff and Merthyr Guardian	9 Oct., p. 5; 16 Oct., p. 5
Carmarthen Journal	9 Oct., p. 5
Carmarthen Weekly Reporter	10 Oct., p. 1
Cheltenham Examiner	7 Oct., p. 4
Cheltenham Free Press	10 Oct., p. 4
Cirencester Times	12 Oct., p. 8
Croydon Journal	14 Oct., p. 3
Derby Mercury	7 Oct., p. 5; 14 Oct., p. 3
Denbighshire and Flintshire Telegraph	10 Oct., p. p 4,5
Gloucester Chronicle	10 Oct., p. 5
Gloucester Journal	10 Oct., pp. 5,6; 17 Oct., p. 2
Gloucester Mercury	10 Oct., p. 5
Guildford Journal	13 Oct., p. 2
Hampshire Independent	10 Oct., pp. 5,7
Hereford Times	10 Oct., pp. 2,3; 17 Oct., p. 2; 24 Oct., p. 10; 31 Oct., p. 2; 7 Nov., p. 2; 14 Nov., p. 5
Irish Times	13 Oct.
Leeds Mercury	7 Oct., p. 3; 8 Oct., p. 4; 9 Oct., p. 4; 10 Oct., p. 11; 12 Oct., p. 4

Liverpool Daily Courier	7 Oct., p. 5; 8 Oct., p. 4; 10 Oct., p. 5
Man of Ross	8 Oct., p. 1
Manchester Guardian	7 Oct., p. 3; 9 Oct., p. 3; 13 Oct., p. 3
Morning Post	7 Oct., p. 4; 8 Oct., p. 4
Merthyr Telegraph	10 Oct., pp. 3,4
Merionethshire Herald	10 Oct.
Monmouthshire Beacon	10 Oct., p. 8
Monmouthshire Merlin	10 Oct., pp. 3,5,8
Morning Star	7 Oct., p. 2
Oswestry Advertiser	7 Oct., p. 5; 14 Oct., p. 7
Oxford Chronicle	10 Oct., pp. 5,7,8
Shrewsbury Chronicle	9 Oct., p. 5
South Essex Independent	14 Oct.
Star of Gwent	10 Oct., pp. 3,7
Stroud Journal	13 Oct., p. 4
Tewkesbury Register	10 Oct., p. 1
Times	7 Oct., p. 9; 8 Oct., p. 9
Western Daily Mercury	7 Oct., p. 2; 8 Oct., p. 2; 9 Oct., p. 2
Western Daily Press	9 Oct., p. 4
Worcester News	10 Oct., p. 8

A number of other newspapers, not listed here, were searched but failed to provide additional information. A contemporary investigation of the earthquake by Lowe (1864) was also used.

Tab. 1 - Excerpt from the table of 298 intensity datapoints.

Locality	lat	long	I (EMS 92)
Abergavenny	51.82	-03.03	5
Barnstaple	51.08	-04.07	5
Beaufort	51.79	-03.22	5
Birkenhead	53.38	-03.02	5
Bootle	53.44	-02.99	5
Brecon	51.94	-03.40	5
Brinsop	52.09	-02.82	5
Congleton	53.15	-02.22	5
Crickhowell	51.85	-03.15	5
Crosby	53.47	-03.04	5
Dudley	52.51	-02.09	5
Ewyas Harold	51.95	-02.90	5
Gloucester	51.86	-02.25	5
Knighton	52.34	-03.06	5
Leominster	52.23	-02.75	5
Littleworth	52.15	-02.18	5
Llanelly	51.82	-03.12	5

3. Conclusion

As a result of this study data points were obtained for 298 places (see excerpt in Tab. 1), which can be used for further analysis. These are shown in **Fig. 1**.

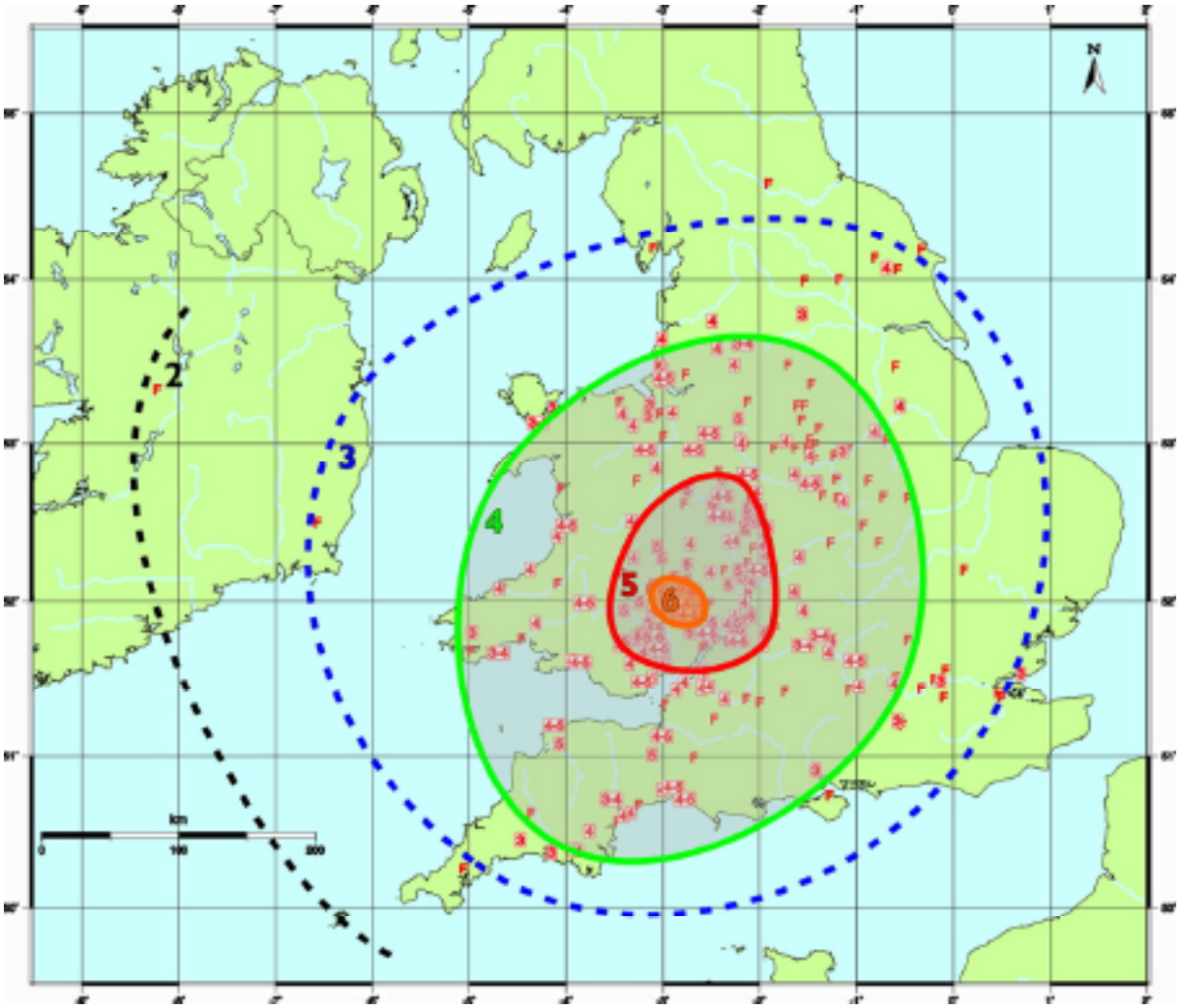

Fig. 1 - Intensity distribution for the 1863 earthquake.

The study provides a new root of class 1A.

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBEUBG		1863	10	06	03	22	HEREFORD	MUA98	1A	298	60

However the previous root was also 1A because the Soil Mechanics (1992) root did have data points on a map although not as a listing or digital file.

References

Lowe E.J., 1864. History of Earthquake of 1863, October 6. Proc. British Met. Soc., 2, pp. 55-99.
Musson R.M.W., 1994. A catalogue of British earthquakes. British Geological Survey, Technical report WL/94/04, Edinburgh, 99 pp.
Principia Mechanica Ltd, 1982. British earthquakes, PML, Cambridge.
Soil Mechanics Ltd., 1982. Reassessment of UK seismicity data, SML, Bracknell.

App. E2.8 - The earthquake of 1618, January 14, in the Nice area

In: R. Camassi R. et al., 1997. Internal report for the BEECD project on the Italian area. IRRS-CNR, Milano.

1. State-of-the-art before the investigation

This earthquake is reported in Postpischl, 1985 (POS85) with the following parameters:

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
POS85	1617	01	14	04		NIZZARDO	75	2C	-	0	80	43.750	07.250	51
LAA96	1618	01	18	05		VESUBIE	HID	3B	-	80	80	43.883	07.283	-

Postpischl (1985a) quotes two seismological compilations: Mercalli (1897) and Baratta (1901). The root for this entry was identified in Baratta, who simply summarizes a part of Mercalli's information, as follows:

"1617, gennaio 14, Nizzardo.

Verso le 5h italiane (notte) terremoto rovinoso nel Nizzardo: danneggiò vari luoghi fra cui Lantosca, ove fracassò molte case senza però causare vittime. Nella campagna di Utelle cinque persone restarono oppresse sotto le rovine. Per parecchio tempo si sentirono delle repliche" (p. 116).

Since Mercalli's work is a seismological compilation, the root class was assessed as 2C.

2. Basic investigation

The investigation started from the reappraisal of Mercalli's study on the earthquakes in Liguria and Piemonte (1897). In fact, the information he supplies on this earthquake is much more detailed and consistent than the summary provided by Baratta could suggest.

These are the data supplied by Mercalli:

- 1617 January 14, around 5 hours in the night (Italian time), a damaging earthquake in "Nizzardo"; according to the manuscript by Scaliero (1792), the county of Nizza was hit, many houses collapsed in Lantosca and in the countryside of Utelle 5 people died;
  (NB: this is what Baratta reports)
- 1618 January 14 and 16, "Nizzardo": strong earthquakes, but no damage, according to Scaliero (1792)
- 1618 January 18, around 8 hours (Italian time? - the question mark is by Mercalli), a very strong earthquake in "Nizzardo"; according to Scaliero (1792), the walls of the castle of Saorgio were fissured and some prisoners were near to die
- the shocks lasted until May 4th.

Three other seismological compilations report information on this earthquake:

- Prost (1855), who mentions three earthquakes in 1618, on January 14th, 16th, 18th; he indicates the January 18th, 8 h in the morning, as the strongest one; no damage in Nizza, but heavy damage at Roccabigliera and Lantosca; the shocks lasted until May 4th;
- Montandon (1953), who relies on Milne (1911) and dates the earthquake 1617 January 14th;
- Milne (1911), who relies on Baratta (1901) and dates the earthquake 1617 January 14th.

Since the information supplied by Mercalli suggests some duplications and some confusions about the places involved and the other studies considered do not help in clearing up such aspects, it was decided to perform some ad hoc investigation to prepare a new root, of a better quality than the existing one.

3. Ad hoc investigation

The investigation was oriented to:

- retrieve the original text by Scaliero (1792), stored at the Municipal Archive in Nice;
- check contemporary or near-contemporary sources for the same area, quoted by the same Mercalli for other earthquakes, but not for this one.

The set of sources collected and the relationships among them is presented in Fig. 1.

The newly retrieved sources supply more data, especially on 1618; the information is summarized in Tab. 1.

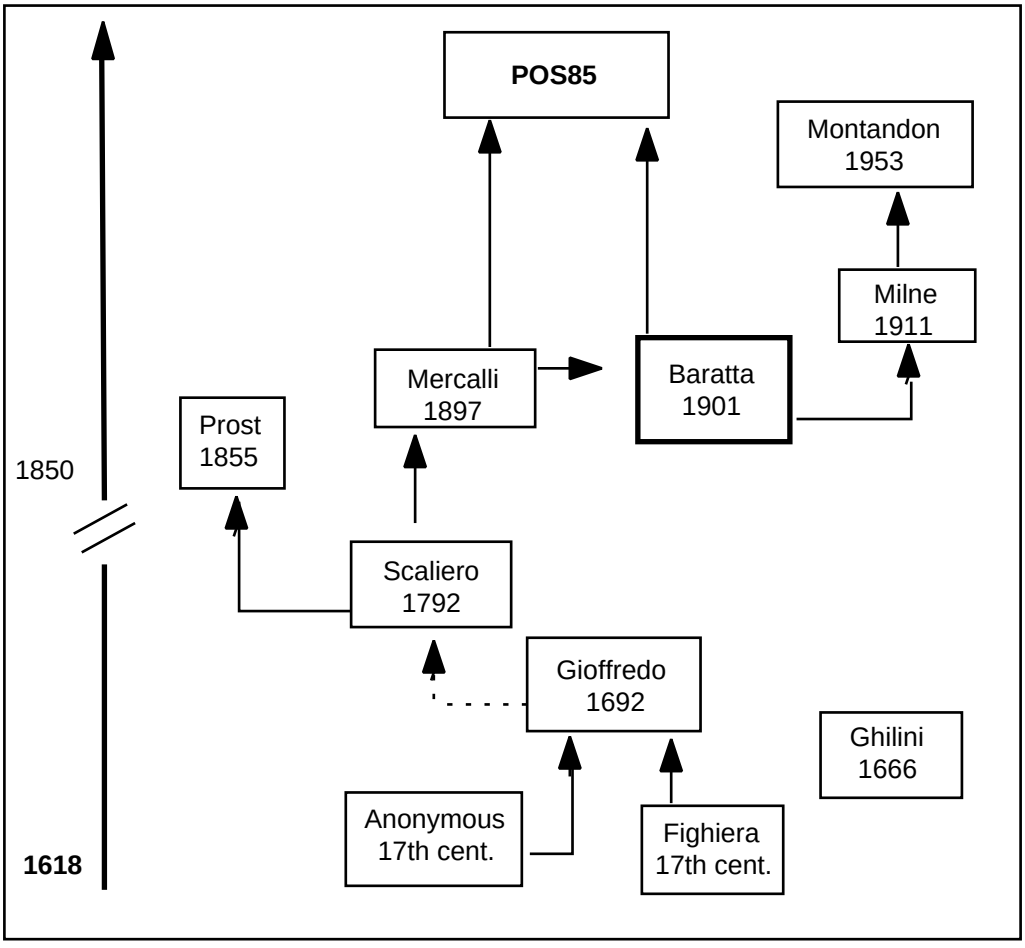

Fig. 1 - Scheme of relationships among the sources.

Tab. 1 - Sources, localities and effects.

******* this information is written on a small piece of paper inserted in the manuscript binding.*

reported locality	identified locality	Gioffredo, 1692	Ghilini, 1666	Scaliero, 1792 **	Scaliero, 1792	Prost, 1855	Mercalli, 1897	I (EMS 92)
		1618, January 14, night	1618, January 14, 4 h, night	1617, January 14, 5 h, night	1618, January 18, 8h, morning	1618, January 18, 8h, morning		
Roccasparviera		Damage			Damage			7
Coarasa		Damage			Damage			7
La Bolena		Damage			Damage			7
Lantosca		Damage		Damage	Damage	Damage	Damage (1617)	7
Roccabigliera						Damage		7
Saorgio (castle of)		Damage			Damage		Damage (1618)	6-7
countryside of Utelle				5 people died			5 people died (1617)	
Nizza						Felt		F
Alessandria			Felt					F

Ghilini (1666) and Gioffredo (1692) are the sources closest in time to the event and both agrees in putting the earthquake in the night between 13 and 14 January 1618.

Scaliero is clearly copying Gioffredo's text, but he also relies on an unknown source for the information dated 1617 and added later to its maunuscript. It can be suggested that this unknown source is the work of a French author, using another calendar (beginning of the year in March instead of January), so that both sources are in fact dealing with one and the same earthquake.

Both Prost and Mercalli did not trace back Gioffredo and simply presented the information supplied by Scaliero.

4. Conclusion

On the basis of the newly retrieved information:

- the entry by POS85 is considered as fake, and the following root (ZZ) was prepared:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREURS	ZZ	1617	01	14			NIZZARDO	CAA97	2B	-	-

- a **new root** is available, which is classified as 1B**.**

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBEURS		1618	01	18			NIZZARDO	CAA97	1B	8	70

References

Baratta M., 1901. I Terremoti d'Italia. Saggio di Storia, Geografia e Bibliografia Sismica Italiana con 136 sismocartogrammi. Torino, 950 pp.

Ghilini G., 1666. Annali di Alessandria. Milano.

Gioffredo P., 1692. Storia delle Alpi Marittime. ms., ASTo, Fondo mss., H.IV.26.

Mercalli G., 1897. I terremoti della Liguria e del Piemonte. Napoli, 146 pp.

Milne J., 1911. A Catalogue of destructive earthquakes A.D. 7 to A.D. 1899. British Association for the Advancement of Science, London, 92 pp.

Montandon F., 1953. Les tremblements de terre destructeurs en Europe. Genéve, 195 pp.

Postpischl D. (ed.), 1985a. Catalogo dei terremoti italiani dall'anno 1000 al 1980. Quad. Ric. Scient., 114, 2B, Bologna, 239 pp.

Prost O., 1855. Notice sur le tremblement de terre du 29 décembre 1854 comparé à ceux de siécles précédents. Nice.

Scaliero J., 1792. La città di Nizza insigne per li sacri monumenti. ms., 3 vols., Archive Municipale, Nice.

App. E2.9 - The earthquake of 1580, Phokida

In: V. Kouskouna et al., 1998. Internal report for the BEECD project. UAT.DGG, Athens.

1. State-of-the-art before the investigation

This earthquake is reported in Papazachos and Papazachou, 1989 (PAP89) with the following parameters:

Ds	Ye	Mo	Da	Ho	Mi	Ax		R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
PAP89	1580						PHOKIDA-Mynia	118	2C	0		100	38.400	22.300	67

The root of Papazachos and Papazachou is Sathas (1865), which is a historical compilation on the area of Galaxidi.

Other seismological compilations, such as Schmidt (1879), Issel and Agamennone (1894), Sieberg (1932a) and Montandon (1953) contain information on this earthquake. All of them rely upon Sathas (1865) only, and mainly, such as Sieberg and Montandon, on part of the information he forwards only.

2. Basic investigation

The information on this earthquake is supplied by Sathas on the basis of two contemporary chronicles.

The first chronicle to appear is a summary account of the earthquake effects. It says:

> *"In the year 1580 when the destructive earthquake occurred Salona* [today Amfissa], *together with Loidorikion, Galaxeidion, Naupaktos, Zakinthos and other places suffered a lot"* (p. 93).

This is the passage in Sathas to which mainly refer Issel and Agamennone (1894), Sieberg (1932a) and Montandon (1953).

Schmidt (1879) only seems to have read the whole text of Sathas. In fact, he summarises also the content of second chronicle edited by Sathas. In it, more details are contained and of some other places are mentioned:

> *"In this year* [1580] *a great and terrible earthquake destroyed many houses in Galaxeidi, Salona, Loidoriki and Epachto, and all the cells of the Monastery of Sotiras collapsed and three monks were killed, but the church was not damaged at all ... the nearby village Mygia* [today Myonia] *was destroyed and its inhabitants stayed outdoors ... Saint Euthymios appreared to them and advised them to rebuild their village, which they called Ayia Euthymia ... The earthquake also damaged the villages of Kalopetritza, Vounochora and Pente-Ornia and other villages of Salona"* (pp. 219-220).

Sathas reports also, without any explicit reference, that "*it is reported that the earthquake was destructive also in the Ionian Islands and the Peloponnese"* (p. 160).

A complete revaluation of the effects and the identification of all the place names mentioned by Sathas is presented in Tab. 1.

Tab. 1 - Intensity datapoints.

locality as reported	identified locality	lat	lon	Int
Mygia Ayia Euthymia	Mynia	38.483	22.367	8
Monastery of Sotiras	Moni Sotiros	38.483	22.367	8
Loidoriki Loidorikion	Lidhorikion	38.533	22.200	7
Galaxeidion Galaxeidi	Galaxidi	38.383	22.383	7
Salona	Amfissa	38.533	22.383	7
Naupaktos Epachto	Epakhtos	38.400	21.833	7
Kalopetritza	Kalopetinitsa	38.450	22.367	6
Pente-Ornia	Pendeoria	38.417	22.317	6
Vounochora	Vounikhora	38.450	22.300	6
Zakinthos	Zante	37.783	20.900	F

3. Conclusion

The earthquake is sufficiently documented as it was possible to assess a macroseismic intensity for 10 places. Such data will permit to evaluate a better location of the macroseismic epicentre as well.

The following New, BEECD Root with Rc = 1B has been compiled:

```
  Ds    Set   Ye  Mo Da Ho Mi Ax          R        Rc  Nmo   Ix

DBEUAG       1580             Mynia        KOA98    1B   10   80
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References

Issel A. and Agamennone G., 1894. Cronistoria sismica di Zante. Annali dell'Ufficio Centrale di Meteorologia e Geodinamica, XV, I, pp. 92-262.

Montandon F., 1953. Les tremblements de terre destructeurs en Europe. Genéve, 195 pp.

Papazachos B. and Papazachou K., 1989. The Earthquakes of Greece. Thessaloniki, 356 pp.

Sathas K.N., 1865. Chronikon anekdoton Galaxeidiou (Unpublished chronicle of Galaxidi). Publ. Kassendreus and Co., Athens, 221 pp. (*in Greek*).

Schmidt J.F.J., 1879. Studien über Erdbeben. Leipzig, 360 pp.

Sieberg A., 1932a. Erdbebengeographie. In: Gutenberg B. (ed.), Handbuch der Geophysik. Berlin, 4, 3, pp. 687-1005.

App. E2.10 - The earthquake of 1897, July 15 in the Ljubljana area

I. Cecic, 1999. Potres v Ljubliani 15. julija 1897. In: J. Lapaine (ed), Potresi v Slovenji leta 1997, URSG, Ljubljana (in printing).

1. State-of-the-art before the investigation

The earthquake on 15 July 1897, seven minutes before seven o'clock in the morning local time (05:53 UTC) was among already investigated events from the seismic history of Slovenia. The isoseismal map was published by Ribaric in the frame of the "Balkan" project (Shebalin et al., 1974). The earthquake was, due to its high epicentral intensity (VIII MCS and MSK) mentioned in the numerous catalogues, like the Italian (Postpischl, 1985).

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
POS85	1897	07	15	05	57	Ljubljana	504	4C	-		80	46.050	14.500	52
RIB82	1897	07	15	05	57	Ljubljana	HID	3B	-		75	46.050	14.500	49
SHA74	1897	07	15	05	57	Ljubljana	RV	4C			80	46.000	14.500	-

Ribaric quotes four sources; three among them are seismological reports (Mazelle, 1898; Mojsisovics, 1898; Hoernes, 1899), and one is another catalogue (Bernardis et al., 1977). The sources for the mentioned reports are the original messages from the seismological observers, as well as the authors themselves.

2. Used historical material

The big Ljubljana earthquake on 1895 helped a lot in more precise and organised monitoring of the natural phenomena in Slovenia. Therefore there are seismological reports available for the earthquake on 15 July 1897 in Ljubljana. In the yearly publication "Mitteilungen der Erdbeben-Kommission - Allgemeiner Bericht und Chronik der im Jahre 1897 innerhalb des Beobachtungsgebietes erfolgten Erdbeben", published by the Earthquake Commission under the title "Chronik der Erdbeben im Jahre 1897", the data were collected by E. von Mojsisovics (1898). It is a report on earthquake effects on people, objects, buildings and nature. the effects were described by the voluntaries following the same set of questions, so the shape of their reports is quite homogeneous. The comprehensive report on the effects in Trieste and its surroundings was given by Mazelle (1898), and on the effects in Italy by Agamennone (1898).

There are other contemporary sources of information about the earthquake, like the daily ("Slovenski narod", "Slovenec" in "Laibacher Zeitung", all published in Ljubljana) and weekly ("Edinost", published in Trieste) newspapers in Slovene and German language.

Some of the damaged houses in Ljubljana were located by the help of "Zapisnik his dezelnega stolnega mesta ljubljanskega" from 1901 and "Ljubljanske metamorfoze" (Kladnik, 1991).

The coding of the used sources was as follows: if something was already mentioned in the reference list of the Ribaric's catalogue (1982), the original code was kept preceded with the letters VR (e.g. VR39). All the new material was coded as IC followed by the number under which the material is kept in the macroseismic archives of the Geophysical Survey of Ljubljana.

The overview of the used material is in the following table:

Tab. 1 - Codes and references of the used material.

Code	Year	Author	Title
VR5	1899	Hoernes	Erdbeben in Steiermark waehrend des Jahres 1897
VR20	1902	Mojsisovics	Chronik der Erdbeben im Jahre 1901 (Mitt. Erdb. Comm.)
VR39	1898	Mazelle	Bericht ueber die im Triester gebiete beobachteten...
VR40	1898	Mojsisovics	Chronik der Erdbeben im Jahre 1897 (Mitt. Erdb. Comm.)
VR45	1899	Seidl	Uebersicht der Laibacher Osterbebenperiode fuer die Zeit..
VR134	1919	Heritsch & Seidl	Das Erdbeben von Rann, II. Teil
VR273	1976	Ambraseys	The Gemona di Friuli Earthquake of 6 May 1976, Part II
IC4	1984	Ribaric	Potresi
IC8	1994	Ribaric	Potresi v Sloveniji
IC12	1982	Ribaric	Teoreticne zasnove makroseizmicnih intenzitetnih polj
IC89	1898	Kispatic	Petnajsto potresno izvjesce za godinu 1897
IC116	1980	Ribaric	Studija seizmicnosti HE Mavcice
IC124	1897		Slovenski narod, no.158, 159, 160, 161
IC137	1935		Kronika slovenskih mest, pp. 35
IC149	1897		Slovenec, no. 158, 159, 160, 162, 163, 168
IC150	1897		Edinost, no. 84, 85, 86, 87
IC158	1897		Laibacher Zeitung, no. 158, 160
IC366	1901		Zapisnik his dezelnega stolnega mesta ljubljanskega
IC367	1991	Kladnik	Ljubljanske metamorfoze
IC368	1898	Agamennone	Notizie sui terremoti osservati in Italia durante l'anno 1897 ...

3. The evaluation of the macroseismic data

While evaluating the intensity of the earthquake in any locality, all the available data was used. Many problems, that usually go with the evaluation of the older earthquakes, were present. Numerous localities were having different, German or Italian names 100 years ago. Some sources of the data, especially the newspapers, were tending to dramatise and exaggerate the facts; it was of course possible to notice only for the localities for which more independent reports existed.

While evaluating the damage in Ljubljana one should not forget that many houses, damaged in 1895 earthquake, was rebuilt, but not with great care. Even Albin Belar (who later became famous as the first seismologist in Slovenia, who was the professor on the Higher real school in Ljubljana at the time of the earthquake) reported to Agamennone, that in Ljubljana mainly the old cracks reopened, that were not fixed carefully after 1895 (Agamennone, 1898). There are data that also the new buildings were damaged (e.g. new Godec house in Zidovska steza street). The part from the report in "Slovenec" is illustrative: "...especially new buildings suffered a lot; some repaired rooms, that were painted not long ago, lost all the plaster."

The worst damage was on the older buildings; the reports mention very rarely the partial collapses of the outer walls, as it happened in the Kolodvorska street no. 8, where "...the side wall collapsed and one can see into the apartments." (Slovenski narod, no. 158). The same newspaper in its report summarises the situation in town after the earthquake and establishes that the damage was mainly on the roofs and chimneys (at least 150 chimneys fell down); in the interior of the houses the walls were cracked and plaster fell off in hundreds and hundreds of rooms. "Slovenec" mentions also the collapse of some new building in Soteska street, but there is no evidence of it in any other report.

The monumental objects also suffered the damage. The majority of descriptions is about the churches. On "ursulinska" church the cross on the tower was completely bent and the church was

somewhat cracked; on the St. Francis church the angels on the towers and the lightning rod were bent; from the roof of "trnovska" church the heavy new stone cross fell down; St. Jacob church was heavily damaged etc. But "Slovenec" adds: "Like two years ago again now the cathedral felt the earthquake the least; only some plaster fell off and the stick from the hand of St. Rok." Among the public buildings the majority of reports mention the damage in the land museum (today National museum). Damage was reported also on the new post office, Narodni dom, "Kazina", land hospital, railway station, concert hall, real gymnasium etc.

The damage was not concentrated on the centre of the town. Except in the villages that are today the suburbs (Glince, Vic, Polje, Sentvid, Crnuce, Sostro, Kozarje, Jezica etc.) there are reports on damaged houses also in Skofja Loka, Smarje-Sap, Brezovica pri Ljubljani, Dobrova, Logatec, Mozirje and numerous other places.

Among the hidrogeological effects, reported by the observers, there is a description from Gunclje (a village north from Ljubljana at that time), where the villagers saw that the water in the spring was coloured, what was the first time since 1895.

"Slovenski narod" mentions also the estimates that the repairs would cost about 1 million golddinars. Next day after the earthquake the mayor of Ljubljana, Hribar, called the special session of the town council, on which the damage and the measures to be taken were discussed. The civil engineers started to evaluate the damage and to visit the damaged houses two days after the earthquake.

4. Results

The final results of this research are different from the existing studies. The highest intensity, which did not exceed VII EMS-92, was in the centre of Ljubljana. Big amount of data made the statistical processing of the data possible.

For all the intensity estimations the EM macroseismic scale, version 1992, was used. The final intensity file consists of the data for 323 localities (excerpt in Tab. 2). The intensity map of the earthquake is in Fig. 1.

Tab. 2 - Excerpt of the table of 323 intensity datapoints.

Locality	Name in the source	State	Lat	Lon	Intensity (EMS-92)	Source code	Time in source
Ljubljana-Center	Laibach, Ljubljana, Lubiana	SLO	46.0527	14.5098	VII	many	06:53
Ljubljana - Viè	Waitsch	SLO	46.0438	14.499	VI-VII	VR40	
Ljubljana -Glince (Viè)	Gleinitz	SLO	46.04	14.495	VI-VII	VR40	
. . . .							
Brezovica pri Ljubljani	Brezovica bei Laibach	SLO	46.021	14.4225	V-VI	VR40	06:52-53
Dobrova	Dobrova bei Laibach	SLO	46.0536	14.4192	V-VI	VR40	06:54
Èrnuèe	Tschernutsch	SLO	46.1066	14.5348	V-VI	VR40	06:55
Ljubljana - Brdo	Brdo	SLO	46.05	14.47	V-VI	IC149	
Ljubljana - Jezica	Jezica	SLO	46.09	14.52	V-VI	VR40	06:55
Ljubljana - Kozarje	Kozarje	SLO	46.04	14.45	V-VI	VR40	
Ljubljana - Sostro	Sostro	SLO	46.04	14.62	V-VI	IC149	07
Logatec	Logatec	SLO	45.917	14.2344	V-VI	IC149	07:00
Mozirje	Prassberg	SLO	46.3383	14.9626	V-VI	VR40	06:58
Naklo	Naklo	SLO	46.2756	14.3214	V-VI	IC149	
Poljèane	Poeltschach	SLO	46.3138	15.584	V-VI	VR40	06:55
Preska	Preska	SLO	46.1327	14.4132	V-VI	VR40	06:53
Sora	Zeyer	SLO	46.1423	14.3776	V-VI	VR40	06:55

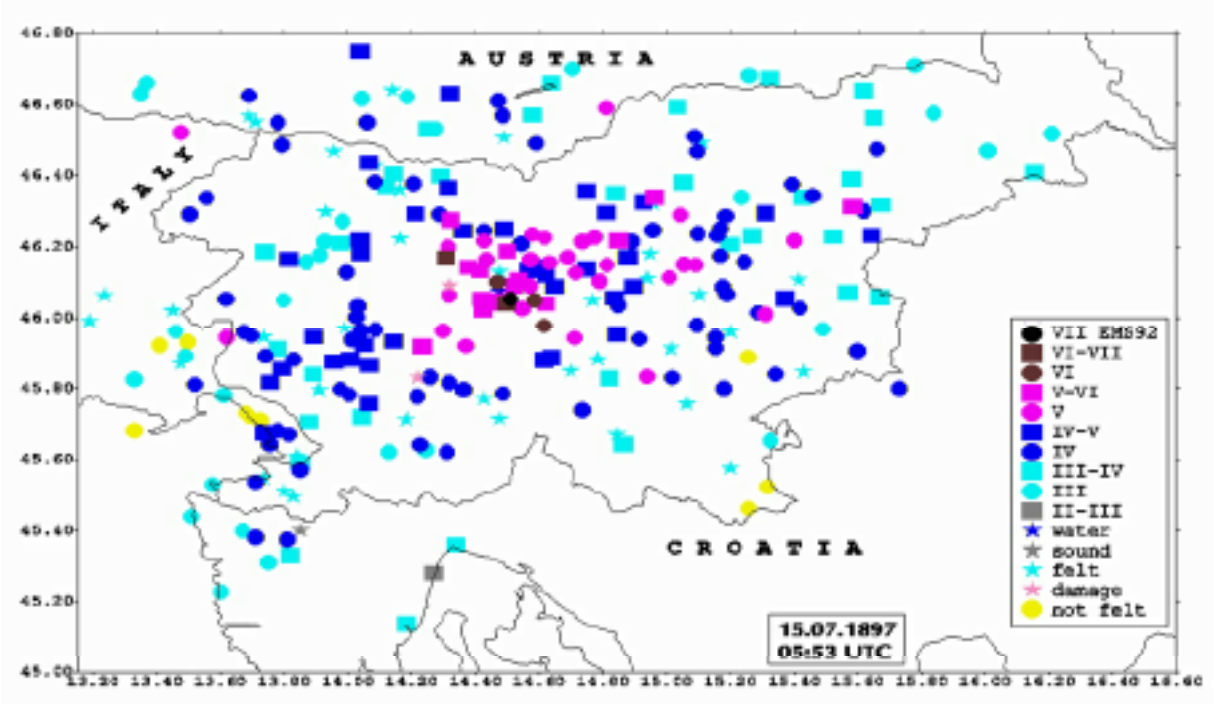

Fig. 1 - Intensity distribution for the 1897 earthquake.

The following New, BEECD Root with Rc = 1A has been compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBEUSS		1897	07	15	05	53	LJUBLJANA	CEC99	1A	323	70

References

Anderes Neuer Allgemeiner und Oesterreichisch-Hungarischer Handatlas, 1904. Wien.

Archives of the URSG, Ljubljana.

BEECD - A Basic European Earthquake Catalogue and a Database for the evaluation of long-term seismicity and seismic hazard. 12-month Technical Progress Report. Milano, 1996.

Cecic I., 1999. Potres v Ljubliani 15. julija 1897. In: J. Lapaine (ed.), Potresi v Slovenji leta 1997, URSG, Ljubljana (*in printing*).

Grünthal, G. (ed.), 1993. European Macroseismic Scale 1992 (up-dated MSK-scale). Conseil de l'Europe, Cahiers du Centre Européen de Géodynamique et de Séismologie, 7, Luxembourg, 79 pp.

Krajevni leksikon Slovenije I-IV. Ljubljana, 1971.

Postpischl D. (ed.), 1985a. Catalogo dei terremoti italiani dall'anno 1000 al 1980. Quad. Ric. Scient., 114, 2B, Bologna, 239 pp.

Ribaric V., 1982. Seismicity of Slovenia. Catalogue of the earthquakes (792 A.D.-1981). Publications of the Seismological Survey of the SR of Slovenia, Series A, Nr. 1, Ljubljana, 649 pp.

Shebalin N.V., Karnik V. and Hadzievski D. (eds.), 1974. Catalogue of earthquakes of the Balkan region, I, UNDP-UNESCO Survey of the seismicity of the Balkan region. Skopje, 600 pp.

Zivcic M. and I. Cecic, 1998. Revised magnitudes of historical earthquakes in Slovenia. XXIII General Assembly of European Geophysical Society, Nice, April 1998 (*abstract*).

App. E2.11 - The earthquake of 1802, October 26, Vrancea

R. Tatevossian and N. Mokrushina, 1998. The 1802, October 26, Vrancea deep earthquake. Internal report for the BEECD project, Moscow.

0. The choice of event

We choose this particular earthquake for detailed study and improvement of supporting dataset, as there are some specific problems associated with deep earthquakes. The earthquake prone area is very large, usually affecting localities in several countries. For historical earthquakes with poor timing (and dating) this leads to problems of correct effect identification with event at large distances. Besides, deep seated earthquake often determines the hazard level of the neighbouring low active areas (as in case of Vrancea region and European part of Russia).

1. State-of-the-art before the investigation

There were 4 entries in the BEECD WF reporting on that earthquake:

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
ADBUL	1802	10	26	10	55			5				45.700	26.600	70
COM82	1802	10	26	10	55		CBE	4C			100	45.700	26.600	77
SHA74	1802	10	26	10	55		HID	3C			90	45.700	26.600	-
KSH82	1802	10	26	10	55	Vrancea	ATL82	1B	22		90	45.700	26.600	74

The entry from ADBUL has the lowest Rc = 5, the entry in COM82 is a duplication from SHA74 (the R code CBE in COM82). The PEC SHA74 and its sources has been discussed in many other cases. The best Rc = 1B is given to KSH82 on the base of following considerations.

The original information on this earthquake in KSH82 appears as a parametric entry (Tab. 1) and textual description in Appendix. Besides, there is also an isoseismal map prepared for publication in the second volume of the KSH82 catalogue (still unpublished).

Tab. 1 - Parametric entry from KSH82.

Date	Origin time				Epicenter			Depth of focus		Magnitude		Intensity at epicenter		Z	Remarks	Ref.	Remarks in English
	h	m	s	C	N Lat (°)	E Lon (°)	C	h (km)	C	M	C	I_o	C				
1802 oct 26	10	55 ±10m		6	45,7 ±0,5	26,6) ±0,5	5	(150) 100-170	4	7,4 ±0,5	3	9 ±0,5	5 22	K	8-120(4); 7-250(4); 6-410 (3); 5-750 (7); 4-1300(4)	E, MO, M, DUSH, SR, r, f, MSH, SM, vk, 5, 21, 22, 32, 37, 38, 42	Macroseismic epicenter 45.5, 26.5 ±1°; h_I = 75; aftershocks 10/27 01 hr and others

Tab. 2 - Decoding of References (in the order as they referenced in the entry).

Code	Title
E	Yevseev S.V., 1961. Earthquakes of the Ukraine (Zemletryaseniy Ukrainy). Acad. Sci. USSR, Kiev. Yevseev S.V., 1969. Intensity of Earthquakes in Ukraine (Intensivnost' zemletryaseniy Ukrainy). Seismichnost' Ukrainy, Naukova Dumka, Kiev.
MO	Mushketov I.V., Orlov A.P., 1893. Catalog of the Earthquakes in the Russian Empire (Katalog zemletryaseniy Rossiyskoy Imperii). Notes, Russian Geog. Soc., 26, St. Petersburg. Mushketov I.V., 1891 and 1899. Materials for a study of Earthquakes in Russia (Materialy dlya izucheniya zemletryaseniy Rossii). News, Russian Geog. Soc., 27, 1, 2; 35, St. Petersburg.
M	Medvedev S.V., 1949. Attempt at Regionalization of the Moldavian SSSR (Opyt novogo rayonirovaniya Moldavskoy SSSR). Trudy Geophys., No. 5 (132), Inst. Acad. Sci. USSR.
DUSH	Drumya A.V., Ustinova T.I., Shchukin Yu.K., 1964. Problems of Tectonics and Seismology of Moldavia (Problemy tektoniki i seysmologii Moldavii). Kartya Moldovenyaske, Vol. II, Kishinev.
SR	Regional Seismicity of the USSR (Seysmicheskoye rayonirovaniye SSSR), 1967. Nauka, Moscow.
r	Réthly A., 1952. A Karpatmedencek Foldrenqesi, 455-1918. Akad. Kiado, Budapest.
f	Florinesco A., 1958. Catalog of Earthquakes felt in the Territory of the People's Republic of Romanis (Catalogue des Tremblements de Terre Ressenti sur le Territoire de la RPR). Bucharest.
MSH	Morozova R.N., Shebalin N.V., 1968. Earthquakes in the Crimea from 1800-1967 - An Annotated Catalog (O zemletryaseniyakh Kryma 1800-1967 - Opyt kriticheskogo kataloga). Geophys. Ab., 26.
SM	Smirnov M.V., 1931. Catalog of Earthquakes in Crimea (Katalog zemletryaseniy v Krymu), Soc. of Crimean Studies, Crimea, Simferopol', .
vk	Kàrnik V., 1969-1971. Seismicity of the European Area. I-II, Dordrecht.
5	Gorshkov G.P., 1949. Earthquakes in the Soviet Union (Zemletryaseniya na territorii Sovetskogo Soyuza). Geografizdat, Moscow.
21	Sagalova Ye.A., 1969. On problems of Regional Seismicity in Bukovina Territory (K voprosu o seysmicheskom rayonirovanii Bukoviny). Seismicity of Ukraine, Naukova Dumka, Kiev, .
22	Sigalova R.M., 1963. Isoseisms of Earthquakes in the Ukraine (Izoseysty zemletryaseniy na Ukraine). Catalog of Carpathian Earthquakes No. 6 (9), 1960, Acad. Sci. Ukcaine SSR, Kiev, .
32	Laska W., 1902. Earthquakes in Poland (Die Erdbeben Polens). Mitteilungen der Erdbeben Comisssion der K. Ac. d. Wissenschaft, N.F., 8, Wien.
37	Petrescu G., Radu C., 1963. Seismicity in Romania before 1900 (Seismicitatea Teritoriului R.P.Romine in Perioda Anteriora Anului 1900). Probleme de Geofizica, I, II, Acad. Rep. Pop. Romine, Bucharest.
38	Petrescu G., Radu C., 1961. Seismicity and Seismic Regionalization in the Territory of the Pop. Rep. of Romania for the Period 1900-1958 (Seysmichnost' i seysmicheskoye rayonirovaniye territorii RNR v period 1900-1958 gg.). Studii si Cercetari de Astronomie si Seismologie 2, VI.
42	Popescu I.G., 1938. Earth Tremors in Dobrogea. An. Dobr., 19, Cernanti.

In Tab. 1, some codes are used to reflect the accuracy of solution, evaluated by authors. These codes duplicate the values given in the entry and do not contain additional information. For example, origin time code 6 means the accuracy of timing is 10 minutes, which is already given in the entry. Explanations has to be done to Intensity C(lass) column, Z(one) column, and Remarks (see Tab. 3).

Tab. 3 - Content of some parameters in KSH82.

Intensity C(ode)	5/22	5 isoseismals drawn based on 22 datapoints
Z(one)	K	Vrancea deep
Remarks	8-120(4)	Isoseismal radii of intensity 8 is 120 km, plotted based on 4 datapoints

The source of textual description is E. This description (as it appears in the Appendix) is included in Tab. 4. The earliest compilation referenced in KSH82 is MO. Most sources of MO are contemporary to the earthquake origin time (except A. Perrey (1846); see Tab. 5).

Tab. 4 - Textual description of the earthquake.

1802, 26 October, 10:55 (45.7°N, 26.6°E); h = (150) km; M = 7.4; I_o = 9 [E, MO, M, DUSH, SR, MSH, Sm, r, f, vk, I-5, 21, 22, 32, 37, 38, 42]
From reference [E]: "A devastating earthquake was felt over an area extending from Itaka Island (Greece) and Constantinopole to as far as St.Petersbourg and Moscow.
"Its greatest impact was noted in Valackiya, Moldaviya, and the southern Transilvaniya. The macroseismic zone extended over 23.200 km^2. The centre probably was in the Carpathian fold in the Vranch region. The earthquake was felt most strongly in the village of Khegig where a palace, a Reformation church, a tower, and many buildings were brought to their foundation. The earthquake lasted 4-5 minutes. According to witnesses, water that spewed from cracks in the ground reached the heights of towers. Rivers flooded and overflowed banks in many places. The chimneys of almost all the homes in Brashova toppled; many houses were destroyed; and church walls and towers shook. The direction of the shaking was east to west. In Tur'ya ceilings and floors cracked; items hanging on walls fell. A tower and many houses collapsed. People were unable to stand on their feet. In Sibiu, the earthquake was less damaging, and several successive east-west shocks were noted. The walls of a tower quivered, and chimney of a house collapsed. In Bucharest, the earthquake lasted about 2 minutes and caused a major damage to churches. In several areas, a greenish-coloured water smelling like sulphur spewed from ground cracks.
"The greatest impact of the earthquake in the Ukraine occurred in the vicinity of Moldaviya and in Chernovtsy, where several houses were destroyed and much damage was wrought. It was less severely in L'vov. An Armenian Polish Roman Catholic church cracked in several places. In Dubno a smokestack caved in. Six shocks were felt in Kiev. The direction was south to east, and the city bells range. Several houses collapsed in Moscow. The earthquake was felt only mildly in Petersburg. It was also felt in whole shore of the right bank of the Oka River, in the cities of Tula, Orel, and Kaluga, but on the left bank of the river it was not even noticed.
"The earthquake was felt also in Poland (Warsaw), in Bulgaria (Ruse, Varna, and Vidin), and in Turkey (Constantinopole)."

Tab. 5 - References of MO.

Note. The references 5 and 6 are the same for A. Perrey.

1	Perrey A., 1849. Earthquakes (the reference is to the Russian translation, published in St.Peterbourg in 1849; original publication in France is in 1846).
2	Zach's Monatl. Corresp., VII, 20.
3	Mall's Annalen, II, 453
4	Hamburg. Corresp., 1803. nn. 177, 183, 189, Beilage.
5.	Moniteur, 1803. 6, 14, 17, 18, 20, 21, 24, frim. et 13 nivôse, an 11
6	Jour. des Débats, 1803. 14, 18, 19, 21, 23 frim. et 12 nivôse

2. Criticism of the sources

1. All mentioned sources are compilations.
2. The manner in which references are given in KSH82 let no possibility to distinguish information on which datapoint is supported by exactly which source.
3. The earliest and more comprehensive compilation cited in KSH82 (MO) was interested mostly in the effect in epicentral area and in large cities.
4. The strange note in remarks in KSH82 (macroseismic epicenter 45.5, 26.5, hI = 75 - what other kind of epicenter could be determined for the earthquake in 1802?) leads us to conclusion that possibly some prejudice existed on the location of the earthquake epicenter, not supported with the data.
5. The geographical map used had special distortions (the correct maps were considered as secrete in the former USSR).

3. Basic investigation

We concentrated in our investigation mostly on sources where it is possible to find the information at the distant area, as the citations in Réthly concerning epicentral area based mostly in primary sources.

We also verified the location of datapoints on the maps where their original names could be distinguished (Tab. 8).

Tab. 6 - Summary datapoints.

ATL82 is for the isoseismal map from which parameters of the earthquake are supposed to have been derived.

N	Locality name (modern)	Locality name (original)	N°	E°	ATL 82	References of this study	Intensity (of this study)
1	A.Torja	Turiya	46.05	26.05		r	8-9
2	Albis		45.93	26.0		r	8-9
3	Al Doboly		45.78	25.73		r	8-9
4	Barátos		45.82	26.1		r	8-9
5	Barot	Baraolt	46.1	25.6		r	8
6	Belenyes	Belin	45.93	25.6		r	8-9
7	Belev		53.78	36.15		NAA	4-5
8	Beltsi		47.75	27.9		r	7
9	Bendery		46.82	29.45		r	7-8
10	Bereck	Bretsku	46.05	25.7		r	8-9
11	Berestechko		50.35	25.12		E	4-5
12	Berethalom	Birthelm, Bertan	46.15	24.5		r	7
13	Bita		45.84	25.98		r	8-9
14	Botfalva	Bod	45.78	25.65		r	8-9
15	Brassó	Kronstadt	46.65	25.6	8	PJ	8-9
16	Breila		45.29	27.95		r	8
17	Bucuresti		44.45	26.1	8-9	MV99, MV100	8-9
18	Chernovtsi		48.3	25.9	6-7	PJ	7
19	Czófalva		45.82	26.05		r	8-9
20	Deva		45.87	22.9	6	MO	6
21	Dubno		50.4	25.7		Vasilev	6
22	Ekaterinoslavl'	Dnepropetrovsk	48.45	35.0		Vasilev	4-5
23	Evpatoria	Kozlov	45.5	33.4		Sumarokov	5
24	Fagaras	Fegerash	45.85	25.96		MO	7
25	Feketehalom		45.71	25.43		r	8-9

26	Fenyöfalva	Girelsay	45.7	24.3		MO	7-8
27	Galats		45.43	28.0		PJ	7-8
28	Gerbovets		47.35	28.32		Zashchuk	7-8
29	Illyefalva		45.85	25.77		r	8-9
30	Il. Ithaka		-	-		MV100	-
31	Izbishchi		52.97	39.38		IV	4-5
32	Hidveg	Hegig	45.85	25.6		MO	9
33	Höltöveny		45.78	25.53		r	8-9
34	Jassy		47.15	27.6	6-7	Demidov, PJ	7-8
35	Kalikino		52.95	39.8		IV	4-5
36	Kaluga		54.5	36.25	5	NAA	5
37	Kanta		45.97	26.15		r	8-9
38	Kapriyany	Kipriyany	47.12	28.5		Zashchuk	7-8
39	Kezdi Vasárhely		46.0	26.15		r	8-9
40	Kiev		50.45	30.5	5-6	NAA, PJ	5-6
41	Kishinev		47.0	28.85	7-8	r	7-8
42	Kolozsvar	Klausenburg	48.6	23.6		PJ	5-6
43	Kökös		45.78	25.82		r	8-9
44	Kozelsk		54.05	35.75		NAA	5
45	Krajova		44.3	23.8		Spisanie	7
46	Krakow		50.05	19.9		Vasilev	4-5
47	Likhvin		54.07	36.3		NAA	4-5
48	Lvov	Lemberg	49.81	24.07	5-6	MV99	5-6
49	Medgyes	Medwich	46.15	24.35		r	7
50	Mordovka		52.1	40.75		IV	5
51	Moscow		55.82	37.5	5	VE, PJ	4-5
52	Sebesh,	Mühlbach Shashsebesh	45.95	23.58		MO	7
53	Nagy Ajita		45.93	25.6		r	8-9
54	Odessa		46.45	30.7		IV	6-7
55	Orel		52.95	36.12	felt	NAA	4-5
56	Peremyshl		54.26	36.0		NAA	4-5
57	Pomoryany		49.65	24.95		E	4-5
58	Posnyo	Roshnyo	45.58	25.48		MO	8-9
59	Ruszcsuk	Ruse	43.8	25.95		PJ	7-8
60	Segesvar	Sigishvara	46.2	24.8		r	7
61	Sepsiszentgyörgy		45.88	25.8		r	8-9
62	Sevastopol		44.6	33.55		Sumarokov	5
63	Shumen		43.26	26.95		Spisanie 2	6
64	Sibiu	Hermanstadt	45.8	24.18	6-7	MV100, PJ	7-8
65	Simferopol		44.95	34.08	4-5	Sumarokov	4-5
66	Smolensk		54.78	32.05		IstSm	5
67	Soroki		48.15	28.3		21	6-7
68	Stambul	Constantinopol (Pera, Galata)	41.0	29.0	5-6	MV102, MV103; MV1; PJ	5
69	St.Peterbourg		59.9	30.25	3-4	PJ	3-4
70	Száras Ajita	Aita-Syake	46.05	25.7		r	8-9
71	Sziliztria	Silistra	44.2	27.25		PJ	8
72	Timishoara	Temesvar	45.75	21.23		PJ	5
73	Tula		54.19	37.55	felt	MO	4-5
74	Tysmenitsa		48.9	24.8		E	5-6
75	Varna		43.2	27.95	felt	MO	6-7
76	Veresmart		45.83	25.53		r	8-9
77	Vidin		44.0	28.0	7	PJ, MV99	7
78	Warsow		52.32	21.0	4	MV93	4-5

79	Yablonivets		52.45	40.45		IV	4-5
80	Zemlin		44.85	20.4		MV95, MV96, PJ	5
81	Zamartyn'e		52.85	39.68		IV	4-5

Tab. 7 - Codes of references used in Tab. 6.

References r, and MO (Mushketov, Orlov) are the same as in KSH82.

Code	Title
Demidov	Demidov A., 1853. Puteshestvie v Yuzhnuyu Rossiyu i Krym cherez Vengriyu, Valakhiyu i Moldaviyu, sovershennoe v 1837 g. . . (Travelling to South Russia and Crimea via Hungary, Valakhiya and Moldova, accomplished in the year 1837; in Russian).
IstSm	Murakevich N., 1804. Istoriya goroda Smolenska ot drevneyshikh vremen do 1804 g. (The history of town Smolensk from ancient times to 1804; in Russian)
IV	Dubaev I. , XIX. Istoricheskiy Vestnik. Tambovskiy kray v kontse XVIII i nachale XIX stoletiya (Tambov land at the end of XVIII and beginning of the XIX centuries)
MV1	Moskovskie Vedomosti, n. 1, Jan. 3, 1803 (Moscow new; in Russian)
MV93	Moskovskie Vedomosti, n. 93, Nov. 19, 1803 (Moscow new; in Russian)
MV95,	Moskovskie Vedomosti, n. 95, Nov. 26, 1802 (Moscow new; in Russian)
MV96	Moskovskie Vedomosti, n. 96, Nov. 29, 1802 (Moscow news; in Russian)
MV99	Moskovskie Vedomosti, n. 99, Dec. 10, 1802 (Moscow news; in Russian)
MV100	Moskovskie Vedomosti, n. 100, Dec. 13, 1802 (Moscow news; in Russian)
MV102	Moskovskie Vedomosti, n. 102, Dec. 20, 1802 (Moscow news; in Russian)
MV103	Moskovskie Vedomosti, n. 103, Dec. 24, 1802 (Moscow news; in Russian)
NAA	Nova Acta Academiae Scientiarum Imperialis Petropolitanae, 1802, XV, p.91.
PJ	Politicheskiy zhurnal, ili sovremennaya istoriya sveta na 1802 g. v.IV, book III, 232-236. (Political journal, or modern history of the World for 1802; in Russian)
Spisanie	Spisanie na B'lgarskata akademiya na naykit. XLII. 22. 1930 (Notes of the Bulgarian Ac. Sci.; in Bulgarian).
Spisanie 2	Babachkova B., Rizhikova Sn. Nekotorye novye dannye ob istiricheskoy seismichnosti Bolgarii. In: Bílgarska geoph. spisanie, XIX, 4, 83-100, 1993 (Some new data on historical seismicity in Bulgaria. In: Bulgarian geophysical journal; in Bulgarian)
Sumarokov	Sumarokov P., XIX. Dosugi Krymskogo sud'i ili II puteshestvie v Tavridu. v.I, p.216-217 (The hobby of the Crimean judge or the II voyage in Tavrida; in Russian)
Vasilev	Vasil'ev P., 1908. Seismichnost' Yuzhnoy Rossii i prilegayushchikh k ney territoriy. Zapiski novogo obshchestva estesvoispytateley. XXXI (Seismicity of the Southern Russia and adjusting territories; in Russian)
VE	Vestnik Evropy. Karamzin 1802, IV 21 p.69 (European news; in Russian).
Zashchuk	Zashchuk A., 1862. Materialy dlya geografii i statistiki Rossii, sobrannye ofitseramy General'nogo shtaba. (Materials for geography and statistics of Russia, collected by the oficiers of General stab; in Russian).

Tab. 8 - Maps used for the location of datapoints.

1.	Mappa generalis Regni Hungariae partium que adnexarum Croatiae Slavoniae et Confinorum Militarium magni item principatus Transilvaniae. Compyled by Joannes de Lipsky. Pesthini, 1849, Scale 1:475000
2.	Die Kaiserlich Oesterreichischen Ungarischen Erbstaaten das ist Ungaru, Siebenbürgen, Delmatien und die militair Graenze. Entworfen u. gereichn von C.F.Weiland. Wieman. geograph. institut, 1849. Scale 1:522000
3.	Karta des Grossfürstenthums Siebenbürgen nach der definitiven politischen und geoichtlichen Landesentheilung. Hermannstadt, Mersich, 1854.
4.	E. Petry, Yu.Shokal'skiy. Bol'shoy vsemirniy nastol'niy atlas. 1909, red. 1916. A.F.Marks. (Big all over the World atlas).

4. Important corrections of intensity for some distant points.

Moscow. The intensity for Moscow is given 5 in ATL82 map based on the information from E which repeats the MO: "Several houses were collapsed in Moscow". In Vestnik Evropy (Karamzin, 1802, IV 21 p.69) is written "We felt a weak earthquake which lasted ca. 20 s. [...] The quakes were stronger in high buildings; almost everywhere lamps were oscillating, somewhere tables and chairs [...] Those who were on the streets did not notice anything, and most of the people knew on the next day only that in Moscow was an earthquake" (original text in Russian; translated by R.Tatevossian).

Constantinopole (Stambul). The intensity 5-6 is given (not clear on basis of which source). It is very probable that somehow the information from MV103, Dec. 24, 1802, p. 1489 was used: "From Hungary, Nov. 30. Waiting for the more reliable news from Constantinopole on the earthquake felt there in the public lists is given: Earthquake felt in our countries, in Poland, and other lands, was affecting Serbia, Bosnia and even Black sea. Most strong it was in Constantinopole because the sea is near. Many houses in Seral and most of the old houses and "mechet'" in Galata were damaged by the earthquake. It was lasted there over a half an hour... Seral was shacked so strongly that sultan went to Sofia "mechet'", where many peoples gathered" (original text is in Russian; translated by R.Tatevossian). But very soon a correction appeared in the MV1, Jan. 1, 1803 (from the local correspondent): From Constantinopole Nov. 10: All news published in different foreign lists about damages in Constantinopole caused by the earthquake on 26 Oct. are absolutely wrong. It is true, that the earthquake was felt on the mentioned day; but it was very weak" (original text is in Russian; translated by R.Tatevossian).

So the intensities in Moscow and Constantinopole are greatly exaggerated, which could leads to overestimation of depth and magnitude of the earthquake. The intensities which could be suggested for these cities should be 3-4.

5. Conclusions

The use of the primary sources (mostly for distant localities) allows to do some corrections of intensity and find much more earthquake records. We did not re-determine earthquake parameters looking for the roots of primary information. Taking into account the available sources, the Rc could be considered as 1A.

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
DBEUPE		1802	10	26	10	55	VRANCEA	TAM98	1A	80	90

App. E3.1 - The fake quake of 22 August 1456 in Siena

In: R. Camassi R. et al., 1997. Internal report for the BEECD project on the Italian area. IRRS-CNR, Milano.

1. The parametric catalogue and its root

Postpischl (1985) lists the following entry:

Ds	Ye	Mo	Da	Ho	Mi	Ax		R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
POS85	1456	08	22				SIENA	75	2C	-	0	80	43.333	11.333	-

The root of this entry is the seismological compilation by Baratta (1901) that reports:

"1456 [...] *Al 22 agosto terremoto che arrecò grave disastro in Siena."*
[1456, August 22, an earthquake that caused very heavy damage in Siena.]

Baratta quotes Pilla (1846) a compilation listing earthquakes felt in Tuscany between the 11th and the 19th century. Pilla does not quote any previous source for this event.

2. The original information

Pilla (1846) reports:

"1456. 22 agosto. Tremuoto in Siena che arrecò grave disastro."
[1456, August 22. Earthquake in Siena. It caused very heavy damage.]

The earthquakes listed by Pilla in Siena are taken from the seismological compilation by Soldani (1798) or from published Sienese chronicles. The entry of 1456 is the only one without any source. Neither Soldani nor the Sienese chronicles mention any earthquake on August 22, 1456.

3. Comments: most likely causes of the distortion of the original information

A large sample of seismological compilations has been analysed without finding evidence for the event listed by Pilla on August 22, 1456. Bonito (1691) reports an hurricane which hit the Florentine countryside at dawn of August 23, 1456. His source is a contemporary Florentine chronicle (Palmieri, XV c.). Other first-hand descriptions of the hurricane (sometimes dated on August 22) are available but none mentions a destructive earthquake occurred in Siena at the same time. Among the people speaking of the hurricane there is a prominent Sienese citizen, which would hardly omit to mention an equally destructive event in his home-town. All Sienese occurrences recorded by contemporary chronicles in the summer of 1456 are of a political nature.

The similarity between the dates of the hurricane near Firenze and the earthquake located by Pilla in Siena (60 km S from Firenze) lead to think that either Pilla relied on an unidentified intermediate source identifying the hurricane as an earthquake or he misunderstood a description of the hurricane effects (which caused grievous damage to rural buildings) relating it, arbitrarily, to an earthquake.

4. Conclusions

The 1456, August 22, Siena event is a non-existent earthquake, probably resulting from the inaccurate reading of data on an hurricane which affected the Florentine countryside on August 22 or 23, 1456.

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREURS	ZZ	1456	08	22			SIENA	CAA97	2B	-	-

References

Baratta M., 1901. I Terremoti d'Italia. Saggio di Storia, Geografia e Bibliografia Sismica Italiana con 136 sismocartogrammi. Torino, 950 pp.

Bonito M., 1691. Terra tremante. Napoli (reprint, Bologna 1981), 822 pp.

Palmieri M., 15th cent. Annales seu historia Florentina. G. Scaramella (ed.), RIS2, 26/1, Città di Castello, 1906-1915.

Pilla L., 1846. Istoria del tremuoto che ha devastato i paesi della costa toscana il 14 agosto 1846, Pisa, 226 pp.

Soldani A., 1798. Relazione del terremoto accaduto in Siena il 26 maggio 1798. Siena, 98 pp.

App. E3.2 - The spurious event of 12 June 1542, Thrace

In: N.N. Ambraseys, 1997. Internal report for the BEECD project. ICST, London.

This event, apparently a destructive earthquake in Thrace which caused extensive damage and much loss of life, appears, however, to be spurious, or at the very least, the subject of greatly exaggerated accounts.

In an Italian dispatch dated Constantinople, 15 July 1542 we read that amongst myriad calamities, "... on 12 June, about midnight, there was a terrible earthquake that cast to the ground many noble and worthy buildings, among which half of the palace of the Signor, and there were here 2,000 people killed. It ruined almost all of the New Palace killing 24 favourites of the Sultan ... all the janissaries who were on guard were either killed or injured; the ruin was great, but more important was the loss of human and animal life. There are 120,000 dead and innumerable animals lost in the cities of Constantinople, Adrianople, Callipoli and in their respective districts...".

Another, more sober version in German, again from Istanbul and with the same date, says that "... in June 1542 there was an awful earthquake in Constantinople, Adrianople, Cassiopol (Gallipoli/Gelibolu) and within twenty miles (150 km) circuit from them ...".

In a letter, dated Augsburg, 21 Nov. 1542, we read that as a result of an earthquake in Constantinople on 20 August 1542, 1,700 houses in the city collapsed killing 4,500 people, details which are subsequently reproduced in later sources.

This earthquake is often reported by later writers together with a destructive earthquake in Scarperia in Tuscia (Tuscany), in Italy, which occurred on almost the same date, 13 June 1542; a misprint in a contemporary fly-sheet, transformed "Tuscia" into "Turcia".

About the same time an unnamed place a day's march from Thessaloniki was overwhelmed by a landslide (?), which caused the death of all its inhabitants, but it is unlikely that this was associated with an earthquake.

The anonymous pamphlets in which is reported this earthquake are essentially similar in form and content, indicating translation and revision from a common source. A modern study of these pamphlets proposes that the contemporary European press was wont to publish "news" concerning the Ottomans at times when relations were unstable, or on the occasion of an Ottoman military victory, in order to encourage confidence that they would be overcome by the West.

The probability that this event was spurious is compounded by the fact that we have been unable to locate corroborating evidence in Ottoman sources; moreover, a detailed, new history of the Topkapi Palace, based on contemporary sources, makes no reference to such an event. Several of the pamphlets also refer to a conflagration and thunderstorms at this time; if not fabricated, the exaggerated damage ascribed to an earthquake could possibly have been due to these calamities.

The following New Root with Rc = 2A can be compiled:

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUIC	ZD	1542	06	12			Thrace	AMB97	2A	-	-

App. E3.3 - The fake quake of 13 January 1881 in Palau de Noguera (Catalonia)

In: T. Susagna i X. Goula, 1998. Catàleg de Sismicitat. Atlas Sísmic de Catalunya. Vol I, Institut Cartogràfic de Catalunya. (in printing)

1. The parametric catalogue and its root

Mezcua and Martinez Solares (1983) (MEM83) list the following entry:

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
MEM83	1881	13	01			PALAU DE NOG.	-	3C	-	0	70	-	-	-

2. The original information

Sources of Mezcua and Martinez Solares (1983) are the documents referenced by Fontserè i Iglésies (1971) as "Revista Minera" (1881).

They describe the presence of cracks and ground deformations appeared on the 13th of January 1881. date. Only a few citations concerns "earth-movements".

3. Comments: most likely causes of the distortion of the original information

The above mentioned documents clearly indicate the non-seismic origin of the event. Fontseré and Iglésies themselves interpret this event as a landslide. It is not possible that a seismic event with an intensity VII only was felt on one site: Puigcercós. Consequently; it seems really clear the existence of ground failures in Puigcercós of a non-seismic origin.

4. Conclusion

The event of 13 January 1881 is a non-seismic phenomenon mistaken for an earthquake.

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUCC	ZZ	1881	01	13			PAL.NOGUERA	SUG98	2B	-	-

References

Fontserè E. and Iglésies J., 1971. Recopilació de dades sísmiques de les terres catalanes entre 1100 i 1906. Fundació Salvador Vives Casajuana, Barcelona, 547 pp.

Mezcua J. and Martines Solarez J.M., 1983. Sismicidad del Area Ibero-Mogrebi. Instituto Geografico Nacional, Publ. 303, Madrid, 189 pp.

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App. E3.4 - The fake quake of 1576, April 27, Magdeburg (Germany)

In: J. Fischer and G. Grünthal, 1996. Internal report for the BEECD project. GeoForschungsZentrum, Potsdam.

1. The parametric earthquake catalogues and their root

Leydecker (1986) and Grünthal (1988) list the following entries

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
GRU88	1576	04	27	10		LÜNEBURG	S40	2C	-	0	40	50.130	11.640	-
LEY86	1576	04	27	10	30		S40	2C	-	0	45	52.000	11.670	-

2. The original information

A local earthquake is mentioned in the earthquake catalogue by Grünthal (1988) for April 27th, 1576, for the area south of Magdeburg with the maximum intensity of IV. Leydecker (1986) assigned an intensity between VI and V to this event.

In both catalogues the following text by Sieberg (1940b) is interpreted:

"*... zwischen 10h und 11h. Erdstoß in Magdeburg [1], schwach in Gerbstedt und Sandersleben. [3]*".

The sources are [1] Lersch (1897 ca.) and [3] a handwritten unknown manuscript by Sieberg. Lersch mentioned:

"1576 27 Apr., Vorm. 10-11. Magdeburg. Vulpius Herrl. Magd."

Vulpius (1702), who indeed gave the year 1576, refers to Pomarius (1587) and Olearius (1667). While Pomarius used, as it is shown later, the correct year 1578, Olearius gave the year April 27, 1576 with the comment that some sources use the year 1578. Additionally he mentioned an earthquake on 27 May 1578 (at noon at 11), where definitely April 27 is meant.

3. Comments: most likely causes of the distortion of the original information

The entries on the other localities south of Magdeburg were found in a chronicle by Busch (1849). He reports:

"*1576 ... Auch ist am 27. April zu Mittag gegen 11 Uhr ein kleines Erdbeben gewesen, welches zu Gerbstedt und Sandersleben merklich in den Gebäuden gespürt worden*."

The fact that an earthquake occurred is clear. But the information on his date is doubtful. On the 27th April two years later, in 1578, there was an intense, well known earthquake with its epicentre in the area of the town Gera, which definitely caused macroseismic effects in the area of Magdeburg. It is obvious that Busch (1849), and befor him Vulpius (1702) and Olearius (1667), gave a wrong year in their chronicles, which caused the confusion in the 20th century catalogues. The catalogued event of April, 27, 1576, has to be regarded as a fake quake.

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUGF	ZT	1576	04	27			Gera	FIG96	2B	-	-

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Vulpius J., 1702. Magnificentia Parthenopolitana ... Magdeburg.

App. E3.5 - The fake quake of 1595, June, Mosel Valley (Germany)

In: J. Fischer and G. Grünthal, 1996. Internal report for the BEECD project. GeoForschungsZentrum, Potsdam.

1. The parametric earthquake catalogue and its root

Leydecker (1986) lists the following entry;

Ds	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix	Io	Lat	Lon	Mm
LEY86	1595	06				ALF/MOSEL	S40	2C	-	0	70	50.050	07.130	-

2. The original information

Modern earthquake catalogues mention a damaging earthquake in June, 1595 at the river Mosel. Relying on Sieberg (1940b), Leydecker (1986) derived the parameter for such an event and assigned an intensity of VII. Sieberg (1940b) gives the following text:

> *"1595, im Juni. Kräftiges Erdbeben an der Mosel, Herd in der Gegend von Alf, wo es zur Entstehung von Bodenrissen und zu Bergstürzen kam. Dabei soll die Thermalquelle von Bertrich entstanden sein. Gefühlt wurde das Beben weithin im Moseltal und dem Gebirge, so zu Ülmen, Bertrich und im Gebiet des Laachersees."*
> (translation:
> "1595, June. Heavy earthquake at the river Mosel, origin in the area of Alf, where earthcracks and rock falls occurred. The thermal spring of Bernich should be caused by this earthquake. The quake was felt far away in the Mosel valley and in the mountains, especially in Ülmen, Bertrich and in the area of the Lake Laach (Laachersee).")

Damages were not reported, solely seismogeological effects are the base for the assigned intensity. Sieberg (1940b) refers to an unknown manuscript of himself. This earthquake is also mentioned by Lersch (1897) in his handwritten catalogue and by Nöggerath (1870). Both give no references. The task was, to find other sources for this event.

3. New sources

A hint on the roots of this earthquake of 1595 in the Mosel valley gives Bögner (1847). Other authors of articles on the history of the Mosel area took this event also into their considerations. Only indicated a source. He refers to "Danitz. Die Mosel". This source is a monography by K. von Danitz entitled "Die Mosel mit ihren Ufern und Umgebungen" (translation: "The river Mosel with its banks and surroundings") from 1838. At page 230 there is the essential sentence:

> *"Das heftige Erdbeben, welches Mitte Juni 1395 die Umgebung von Laach, Ulmen, Bertrich ec. erschütterte, war besonders hier und in der Nachbarschaft fühlbar. ..."*
> (translation:
> "The intense earthquake, which in the middle of June 1395 the surroundings of Laach, Ulmen, Bertrich etc. has shaken, has been felt especially here and in the neighbourhood...").

4. Comments: most likely causes of the distortion of the original information

So it becomes obvious that the oldest source, on which all following data rely, reports about the well known earthquake from 1395 and not about an earthquake in 1595. In 1395, June 11, an intense earthquake took place in the Lower Rhine area. Alexandre (1994) could prove several contemporary sources and concluded an intensity of V-VI for Köln and Liège. This earthquake, which was felt to the south in the Mosel area, in Laach and in Limburg, is mentioned by Sieberg (1940b), but not by Leydecker (1986).

5. Conclusion

Further investigations in local chronicles gave no information on a relevant Mosel earthquake in the year 1595. All data about an earthquake in June 1595 in the Mosel valley are based on a regrettable mistake by Bögner (1847).

Ds	Set	Ye	Mo	Da	Ho	Mi	Ax	R	Rc	Nmo	Ix
AREUGF	ZT	1595	06				Alf/Mosel	FIG96	2B	-	-

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Appendix: Schematic course of the series of literature to the alleged earthquake of 1595

year	author	contents
1940	Sieberg	*„1595, im Juni. Kräftiges Erdbeben an der Mosel, Herd in der Gegend von Alf, wo es zur Entstehung von Bodenrissen und zu Bergstürzen kam. Dabei soll die Thermalquelle von Bertrich entstanden sein. Gefühlt wurde das Beben weithin im Moseltal und dem Gebirge, so zu Ülmen, Bertrich und im Gebiet des Laachersees.[3]"*
1897	Lersch	*1595, Juni. Moseltal, Laach, Ülmen, Bertrich, bes. Alf*
1870	Nöggerath	*„Im Juni im Moselthal. Dieses heftige Erdbeben, welches die Umgebungen von Laach, Uelmen, Bertrich u.s.w. erschütterte, war besonders in Alf an der Mosel fühlbar. Felsen spalteten, eine halbe Stunde von Alf sprudelte heisses Wasser. Wohl die Thermalquelle von Bertrich."*
1847	Bögner	*„**1595 im Juni**, Moselthal. Das heftige Erdbeben, welches um Mitte Juni die Umgebungen von Laach, Ulmen, Bertrich u.s.w. erschütterte, war besonders in Alf an der Model und in der Nachbarschaft fühlbar. Thaleinwärts spalteten sich Felsen, rissen Blöcke los, versiegten Quellen. Dagegen sprudelte in halbstündiger Entfernung von Alf heißes Wasser hervor. Danitz. Die Mosel, S. 230."*
1838	Danitz	*„Das heftige Erdbeben, welches um Mitte **Juni 1395** die Umgebungen von Laach, Ulmen, Bertrich ec. erschütterte, war besonders hier und in der Nachbarschaft fühlbar. Thaleinwärts spalteten sich Felsen, rissen Blöcke los, versiegten Quellen. Dagegen sprudelte in halbstündiger Entfernung von Alf heißes Wasser hervor: ... "*