ANNALI DI GEOFISICA, VOL. XXXIX, N. 5, October 1996

Two strong historical earthquakes in Transylvania (Romania): November 19, 1523 and October 3, 1880 (*)

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Abstract
The investigation into the historical seismicity of Romania evidences the occurrence of two strong earthquakes in Transylvania (central part of Romania) near the localities of Medias (1523) and Târnåveni (1880). Historical information on the 1523 earthquake, though poor, shows that it was felt on Saint Elizabeth's Day, which is celebrated on November 19, not on June 19 as proposed by previous studies and catalogues. Historical information on the 1880 earthquake allows a detailed study. The investigation concentrated on time, epicentral location and intensity distribution. The new macroseismic map shows a large area of I = VII (r_7 = 20.7 km), the centre of which is proposed as the epicentral location, different from the previous ones.

Key words *historical earthquakes – Transylvania – Romania – macroseismology*

1. Introduction

The investigation of historical seismicity of Romania evidences the occurrence of two strong earthquakes in Transylvania (central part of Romania) near the localities of Medias (1523) and Târnåveni (1880).

The analysis of the two strong earthquakes, based on primary data and on different catalogues, allowed the assessment of intensities and earthquake parameters. These data had a significant role in the elaboration of the new seismic zoning map of Romania.

(*) This paper, presented by C. Radu at the XXIV ESC General Assembly, Athens, 1994, was prepared in written form after his death by his daughter Sylvia. Obviously it is just a short summary of the research and some elements are not given in due form; however the editors felt it their duty to publish the paper and to honour the memory of the author.

2. The earthquake of November 19, 1523

Given the time in which this earthquake occurred, only poor information was found. The analysis of historical seismological data contained in primary sources provides information concerning four localities only (fig. 1).

Medias «Saint Elizabeth's Day. Strong earthquake at Medias where the small towers of St. Martin statue, located on townhouse tumbled down». (Hutter Chronicle);

Sibiu «Strong earthquake felt». (Templa Cibinensis);

«Saint Elizabeth's celebrated Day. Strong earthquake felt, that at Sibiu 20 houses collapsed». (Album Oltardianum);

The specification «20 houses collapsed at Sibiu» was considered as uncertain; probably this refers to an other earthquake;

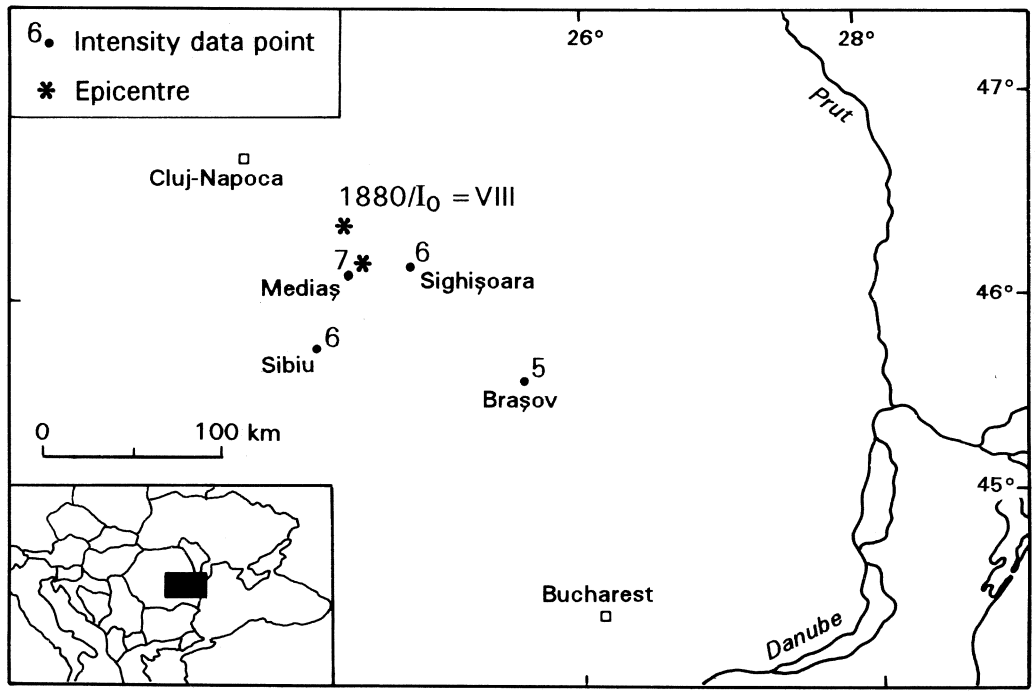

Fig. 1. Intensity map of the November 19, 1523 earthquake.

Brasov «Strong earthquake felt». (Templa Coronensis);
Sighisoara «A strong earthquake on Saint Elizabeth's Day which is on November 19». (Chronik der Markt-Nachbarshaft).

However, data supply the evidence that the earthquake occurred on Saint Elizabeth's Day (November 19) and not on June 19, as reported by previous seismological studies and compilations.

The epicentre can be located at Medias. Both epicentral and maximum observed intensities are assessed as 7. No information on foreshocks or aftershocks was found.

The epicentral parameters assessed for this earthquake by other studies and earthquake catalogues are given in table I. This study finally adopted the following parameters: November 19, 1523 (night); lat. = 46°20′N, long. = 24°40′E (Medias); h = 10 km; M = 4.7.

3. The earthquake of October 3, 1880

Historical information on the earthquake of October 3, 1880 is very rich and allows a detailed study. Schuster (1881), Koch (1881) and Réthly (1907) carried out special studies based on the same macroseismic information from 250 localities in Romanian territory.

For his study M. Schuster, a professor in Sibiu, drew up a seismic questionnaire with several questions concerning the time of occurrence and duration of the earthquake, the effects on houses and on other buildings, etc. Analysing the available macroseismic information, Schuster (1881) delimited three «areas of seismic severity» described as follows:

– area S_1: cracks in the walls;
– area S_2: falling down or oscillations of objects, stopping of pendulums;
– area S_3: the earthquake was felt.

On the basis of the same information, A. Koch, a professor of geology in Cluj-Napoca

Table I. Epicentral parameters for the November 19, 1523 earthquake proposed by studies and earthquake catalogues.

No.	Author and year	Time	I_{max}	I_0	Lat. N	Long. E	h km	Epicentral area	M_m	Remarks
1	Hain, 1854	Night								
2	Bielz, 1862-1863	Night						Sibiu?		
3	Koch, 1881	Night								
4	Réthly, 1952	Night	≥ 9 (CFM)	9 (CFM)	46°10′	24°22′		Medias		
5	Florinesco, 1958							Transylvania		Strongly felt at Sibiu and Medias
6	Radu and Petrescu, 1963	Night		9 (MSK)	46°20′	24°40′	n	Medias		
7	Radu, 1971, 1974, 1979, 1982	Night		8 (MSK)	46°17′	24°37′	n	Medias	5.3	
8	Shebalin *et al.*, 1974	Night		8 (MSK)	46°20′	24°40′	n	Transylvania		
9	Radu and Toro, 1979	Night		7 (MSK)	46°20′	24°40′	n	Medias		Damage at Medias and Sibiu (?) Felt at Sighisoara and Brasov
10	Constantinescu and Mârza, 1980	Night		8 (MSK)	46°20′	24°40′	n	Târnăveni-Medias area		
11	Radu and Toro, this paper	Night	7	7 (MSK)	46°20′	24°40′	10	Medias	4.7	

n = normal depth earthquake (h < 50 km).

Table II. Epicentral parameters for the October 3, 1880 earthquake proposed by studies and earthquake catalogues.

No.	Author and year	Time	I_{max}	I_0	Lat. N	Long. E	h km	Epicentral area	M_m	Remarks
1	Koch, 1881	06:19 EC						Mihai Viteazu		
2	Réthly, 1952	06:19 EC	≥ 9	9 (CFM)	46°22′	23°45′	10	Mihai Viteazu		$S_3 = 62400$ km^2/$r_3 = 120.3$ km $S_6 = 7020$ km^2/$r_6 = 52.9$ km $S_8 = 1750$ km^2/$r_8 = 28.4$ km $S_9 = 650$ km^2/$r_9 = 14.2$ km
3	Florinesco, 1958	06:19		9 (CFM)	46°22′	23°45′		Turda		$S_9 = 650$ km^2 $S_3 = 62400$ km^2
4	Atanasiu, 1961	06:46 EC	8					Transylvania Basin		Diffuse epicentre $S_2 = 62000$ km^2
5	Radu and Petrescu, 1963	05:46		8 (MSK)	46°30′	24°10′		Târnăveni		
6	Radu, 1971, 1974, 1979, 1982	05:46 Gr.		7 (MSK)	46°30′	24°14′	n	Târnăveni	4.7	
7	Kárník, 1971	04:46 Gr.		8 (MSK)	46°40′	23°80′	n			$I_0 = 9$; $S_3 = 68000$ km^2 h = 10 km (R); $I_0 = 8$ (PR)
8	Shebalin *et al.*, 1974	05:46 Gr.		7 (MSK)	46°30′	24°10′		Târnăveni		
9	Constantinescu and Mârza, 1980	05:46 Gr.		8 (MSK)	46°30′	24°10′	n	Târnăveni		
10	Radu and Toro, this paper	05:19 Gr.	7-8	8 (MSK)	46°35′	24°05′	10	Silivas	5.3	$r_7 = 20.7$ km; $r_6 = 53.4$ km $r_5 = 67.2$ km; $r_4 = 91.7$ km

Table III. Intensity data available for the October 3, 1880 earthquake (this paper).

No.	Denomination of localities in			*I*
	Romanian	Hungarian	German	
1	Abrud	Abrudbanya	Altenburg	4
2	Acåtar	Akosfalva		5
3	Agnita	Szentagota	Agnetheln	5
4	Aiud	Nagyenyed	Gross-Enyed	6
5	Alba Iulia	Gyulafehervar	Weissenburg, Karlsburg	5
6	Archita	Erked	Arkeden	4
7	Atel	Ecel	Hetzeldorf	6
8	Atintis	Cintos		7
9	Avrig	Felek	Freck	4
10	Baciu	Bacs		5
11	Baia de Aries	Aranyosbanya	Offenburg	5
12	Batos	Batos	Bootsch, Batesch	4
13	Båteni	Bagyon		6
14	Bålcaciu	Bolkacs	Bulkesch	7
15	Bårbosi	Mezoszakal		6
16	Bårdesti	Bardos		
17	Beia	Bene	Mehburg	4
18	Bichis	Magyarbukkos		7
19	Biertan	Berethalom	Birthalm	5
20	Bistrita	Beszterce	Bistritz	4
21	Blaj	Balazsfalva	Blasendorf	6
22	Bogata	Marosbogat		7
23	Borsa	Borsa		5
24	Bradu	Fenyofalva	Gierelsau	4
25	Brâncovenesti	Marosvece	Wetsch	4
26	Cecålaca	Csekelaka		7
27	Cetatea de Baltå	Kukullovar	Kokelburg	7/8
28	Chendu Mare	Nagykend	Grosskend	5
29	Ciucea	Csucsa		3
30	Ciumbrud	Csombord		6
31	Câmpia Turzii	Aranyosgyeres		7
32	Cluj-Napoca	Kolozsvár	Klausenburg	5
33	Coltesti	Torocko szent György		5
34	Comsesti	Komjatszeg		6
35	Copsa Micå	Kiskapus	Kleinkopisch	6
36	Cristuru Secuiesc	Szekelykeresztur		4
37	Cuci	Kutyfalva		7
38	Daia	Dolmany	Thalheim	4
39	Deda			4
40	Dej	Dezs		4

Table III (*continued*).

No.	Denomination of localities in			*I*
	Romanian	Hungarian	German	
41	Deva			3
42	Dragu	Drag		4
43	Dumbråveni/Ibasfalau/ Dumbråvioara	Erzsebetvaros Saromberke	Elisabethstadt Scharenberg	5
44	Fågåras	Fogaras	Fogarasch	4
45	Geoagiu	Algyogy		4
46	Gherla	Szamosujvar	Armenerstadt	4
47	Ghimbuti	Gambuc		7/8
48	Gilåu	Gyalu		5
49	Giulus	Gyulas		6
50	Gârbova	Szaszorbo	Urwegen	4
51	Gurghiu	Gorgenyszentimre	Gorgen	4
52	Herepea	Herepe		7
53	Heria	Hari		7
54	Hida	Hidalmas		4
55	Huedin	Banffihunyad		4
56	Iernut	Radnot	Ernot	7
57	Jeica	Zselyk	Schelken	4
58	Ludus	Marosludas		7
59	Luncani	Gerend		7/8
60	Medias	Medgyes	Mediasch	6
61	Miercurea Sibiului	Szerdahely	Reussmarkt	5
62	Motis	Martontelke	Mortesdorf	5
63	Nådåselu	Magyarnadas		5
64	Nemsa	Nemes	Nimesch	5
65	Ocna Mures	Marosujvar		7
66	Odorheiu Secuiesc	Szekelyudvarhely		4
67	Oråstie	Szaszvaros	Broos	4
68	Ozd			7
69	Påuca	Pokafalva	Tornen	5
70	Påucea	Pocstelke	Puschendorf	6
71	Praid	Parajd		4
72	Råzboieni-Cetate	Szekelyfoldvar		7
73	Råzboieni-Garå	Kocsard		7
74	Reghinul Såsesc	Szaszregen	Sachsisch-Reen	5
75	Rimetea	Torocko		5
76	Rosia Montana	Verespatak		4

Table III (*continued*).

No.	Denomination of localities in			*I*
	Romanian	Hungarian	German	
77	Rusi	Rusz	Reussen	5
78	Sibiu	Nagyszeben	Hermannstadt	5
79	Silivas	Romanszilvas	Romanisch-Szilvas	7
80	Sânbenedic	Szentbenedek		7
81	Sâncraiu	Kalota-Szentkiraly		4
82	Sânmiclâus	Betlenszentmiklos		7
83	Streza-Cârtisoara	Sztrezakercisora	Oberkerz	4
84	Sihot	Alkenyer	Unterbrodsdorf	4
85	Silea	Magyar-Sulye		
86	Teaca	Teke	Tekendorf	5
87	Târgu-Mures	Marosvasarhely		6
88	Târnâveni	Dicsoszentmarton		7
89	Toplita	Marosheviz		3
90	Trinenii de Jos	Also Detrehem		6
91	Turda	Torda		6
92	Uila	Vajola	Weilau	4
93	Uioara de Sus	Felsoujvar		7
94	Unirea	Felvinc		7
95	Valea Lungâ	Hosszumezo	Langenthal	
96	Vâlenii de Mures	Disznajo	Gassen	4
97	Velti	Volz	Weltz	7
98	Veseud	Szasznagyvesszos	Michelsdorf	5
99	Voila	Vojla	Woila	4
100	Zimbor	Nagy-Zsombor		4
101	Zlatna	Zalatna	Goldmarkt	5

University, assessed macroseismic intensities and located the epicentre in Mihai Viteazu, outside the maximum intensity area (Koch, 1881).

A. Réthly, professor in Budapest, proposed in his study the delimitation of areas of intensities from III to IX, located the epicentre near Mihai Viteazu and calculated the focal depth.

The epicentral parameters assessed for the earthquake by these and other studies and earthquake catalogues are given in table II.

Taking into consideration the rich macroseismic data base, this investigation was concentrated on checking the time of occurrence, epicentral location and intensity distribution.

4. Earthquake parameters

The analysis of the available information shows a large range of timings: the time 6 h 19 m (Central Europe) was adopted.

For the intensity assessment, according to the MSK scale special attention was paid to the following aspects: number of buildings, type of building (classes A, B, C) and reliability of the information (table III). Probably intensity is

underestimated in the villages and overestimated in the towns: a correction of ± 1/2 degree might be suggested. The identification of the localities (given in Romanian, Hungarian and German) was made using the «Dictionary of localities in Transylvania» (Suciu, 1968).

The new macroseismic map (fig. 2), in comparison with those drawn by Schuster (1881) and Atanasiu (1961; fig. 3) shows a large area of intensity VII (r_7 = 20.7 km). The centre of this area was adopted as the epicentre. This differs from the locations given by Koch (1881), Réthly (1907) and Radu (1971). In the new macroseismic map the isoseismal lines have a circular shape and are slightly oriented to NW.

The determination of the focal depth was performed using Sponheuer graphical method. The graph of intensity attenuation (fig. 4) suggests a focal depth of 10 km.

The final adopted parameters of October 3, 1880 earthquake are: T_0 = 05 h 19 m; lat. = 46°35′N, long. = 24°05′E (Silivas); h = 10 km; I_0 = VIII; M = 5.3.

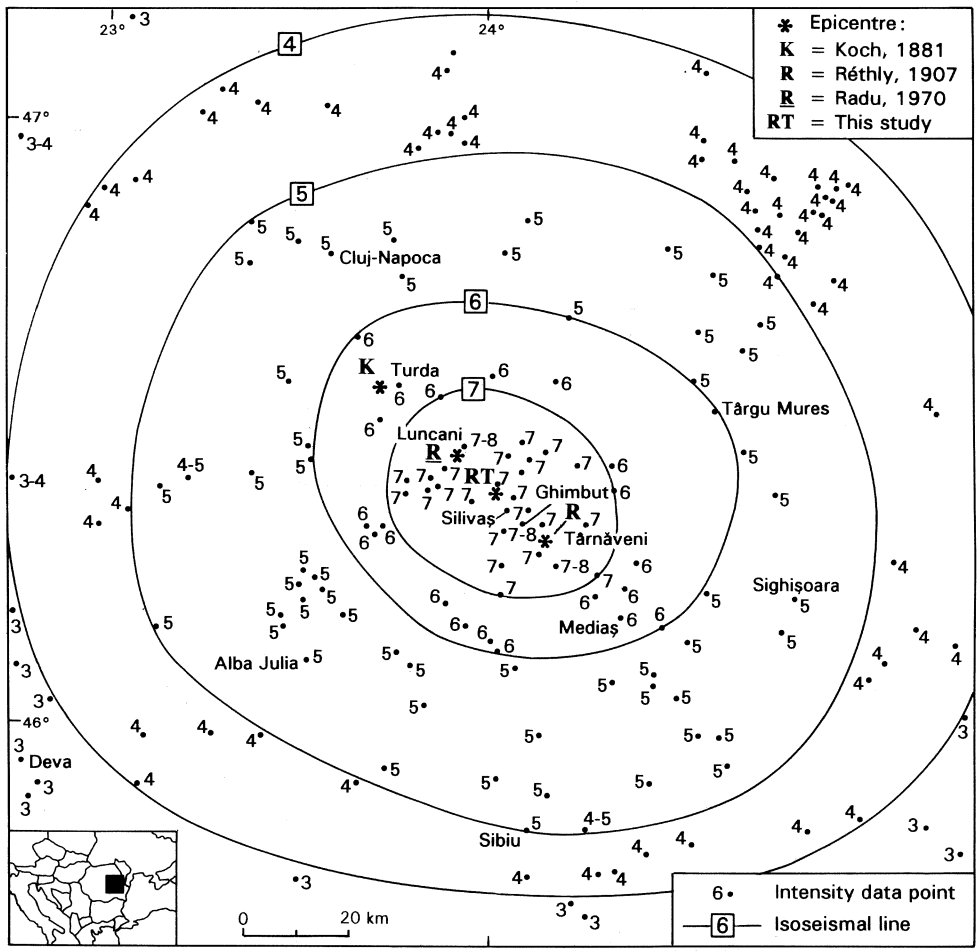

Fig. 2. Intensity map of the October 3, 1880 earthquake (this study).

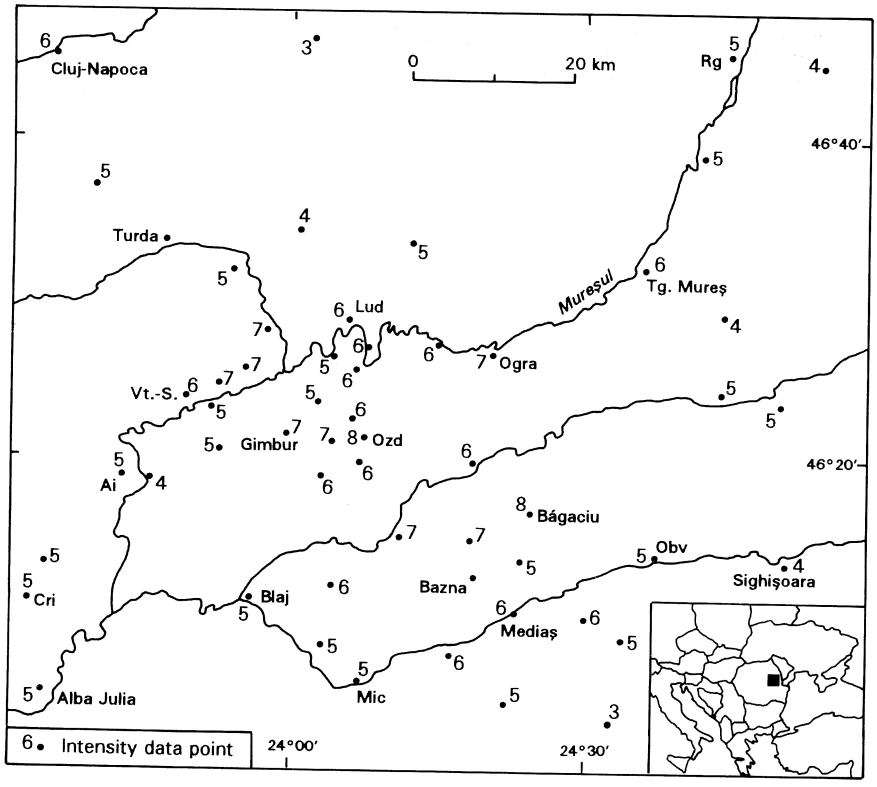

Fig. 3. Intensity map of the October 3, 1880 earthquake (from Atanasiu, 1961).

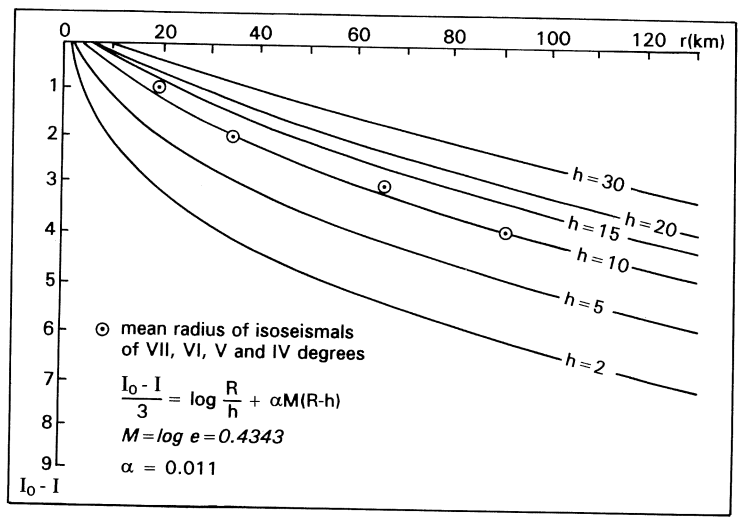

Fig. 4. Determination of focal depth for the October 3, 1880 earthquake, using the Sponheuer graphical method.

Acknowledgements

The Radu family wishes to thank Dr. M. Stucchi for encouragement in the preparation and publication of this paper.

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