

### **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  $R_c = 5$ , 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  $R_c = 1B$  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 Besides, there is also an isoseismal map prepared for publication in the second volume of the KSH82 catalogue (still unpublished).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 <sub>o</sub>					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 <sub>f</sub> = 75; aftershocks 10/27 01 hr and others

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**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 (Zemletryasenyi Ukrainy). Acad. Sci. USSR, Kiev. Yevseev S.V., 1969. Intensity of Earthquakes in Ukraine (Intensivnost' zemletryasenyi Ukrainy). Seismichnost' Ukrainy, Naukova Dumka, Kiev.
MO	Mushketov I.V., Orlov A.P., 1893. Catalog of the Earthquakes in the Russian Empire (Katalog zemletryasenyi 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 zemletryasenyi 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	Réthy A., 1952. A Karpatmedencek Foldrengeje, 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 zemletryasenyakh Kryma 1800-1967 - Opyt kriticheskogo kataloga). Geophys. Ab., 26.
SM	Smirnov M.V., 1931. Catalog of Earthquakes in Crimea (Katalog zemletryasenyi v Krymu), Soc. of Crimean Studies, Crimea, Simferopol', .
vk	Kárnik 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 Soyuzu). 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. Isoleisms of Earthquakes in the Ukraine (Izoseisty zemletryasenyi 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 Comission 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).

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**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.**

<p>1802, 26 October, 10:55 (45.7°N, 26.6°E); h = (150) km; M = 7.4; <math>l_0 = 9</math> [E, MO, M, DUSH, SR, MSH, Sm, r, f, vk, l-5, 21, 22, 32, 37, 38, 42]</p> <p>From reference [E]: "A devastating earthquake was felt over an area extending from Itaka Island (Greece) and Constantinople 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<sup>2</sup>. The centre probably was in the Carpathian fold in the Vrancea 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.</p> <p>"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 rang. 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.</p> <p>"The earthquake was felt also in Poland (Warsaw), in Bulgaria (Ruse, Varna, and Vidin), and in Turkey (Constantinople)."</p>
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**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

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**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	Birtheim, Bertan	46.15	24.5		r	7
13	Bitá		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

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26	Fenyőfalva	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	Höltövény		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	Kolozsvár	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	Ruzcsuk	Ruse	43.8	25.95		PJ	7-8
60	Segesvár	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	Szambul	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	Szárás Ajita	Aita-Syake	46.05	25.7		r	8-9
71	Sziliztria	Silistra	44.2	27.25		PJ	8
72	Timishoara	Temesvár	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

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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 Yuzhnyuyu 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 istoricheskoy seismichnosti Bolgarii. In: B'lgarska 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 prilgayushchikh 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 officers of General stab; in Russian).

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**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).

**Constantinople** (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 Constantinople 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 Constantinople 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 Constantinople Nov. 10: All news published in different foreign lists about damages in Constantinople 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 Constantinople 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	I x
DBEUPE		1802	10	26	10	55	VRANCEA	TAM98	1A	80	90