



## DEPTH AND MAGNITUDE ESTIMATION OF THE TWO STRONGEST EARTHQUAKES OCCURRED ON THE ROMANIAN TERRITORY IN 19<sup>TH</sup> CENTURY

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Nowadays, great attention is given to re-evaluation studies of macroseismic information and to re-determination of the earthquakes parameters that occurred in the pre-instrumental era.

The present paper aims to recalculate the main macroseismic parameters of the strongest earthquakes occurred on the Romanian territory in the 19th century, based on new data resulted after the review, interpretation and evaluation of some new historical accounts and descriptions, obtained during of some complex research activities. In general, for the evaluation of the historical earthquakes parameters, the only major problem is referring to the location both in time and space of sources that contain historical information about earthquakes. As we know, the collecting of data that are found under the form of descriptive accounts on the manuscripts and old books, illustrates, maps, newspaper articles, chronicles, scientific papers, and seismograms is the first step which usually requires most time and financial resources.

Using both original and primary compiled historical records we re-evaluated the macroseismic intensities and we re-determined the focal depth and magnitude for two earthquakes from the first half of the 19th century. These are two strong earthquakes October 26, 1802 ( $M_s = 7.7$ ,  $M_w = 7.9$  respectively) and January 23, 1838 ( $M_s = 7.3$ ,  $M_w = 7.5$  respectively) intermediate-depth Vrancea region, having as a result numerous casualties, as well as great damages as it comes out of the contemporary people's notes.

The earthquake occurred on the 26<sup>th</sup> October 1802 on a Tuesday, at 12:55 the local hour has affected the whole Romanian territory and also the adjacent areas. The earthquake was felt on a large area (more than 2 mil. km<sup>2</sup>) up to Istanbul, Kiev, Moscow, St. Petersburg, Warsaw, Varna, Vidin (Stefanescu, 1901). The duration of the seismic shaking reached about one minute (Radu and Utale, 1993). This seismic event was followed by a sequence of aftershocks among which the largest aftershock had a magnitude  $M$  of 5.5, and it occurred about 14 hours after the main shock. The 1802 earthquake has an uncontested scientific signification, not just through the fact that it is considered the biggest known Romanian earthquake, but because of the huge macroseismic effects caused in the territories of the neighboring countries, thus representing a study subject of international interest (Constantin et. al., 2011).

The earthquake from the 23<sup>rd</sup> January 1838 has occurred at 20:45 being felt strongly in Bucharest and also all over the country up to Lvov (Lviv), Sevastopol, Istanbul, Odessa etc. (Atanasiu, 1961). In Bucharest the earthquake was felt for 30 seconds (Florinesco, 1958), being followed by a large number of aftershocks.

New elements regarding the research of these earthquakes were obtained after reevaluating the information from certain areas (especially from the epicentral zone), concerning the environmental

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effects. Each new discovered information comes to confirm and complete the image of the disaster caused by the 1802 subcrustal earthquake on the population and all the buildings from that period, especially high buildings which were considered very important and solid (e.g. churches, towers etc.).

For the determination of the focal depth, we will use an attenuation relation obtained by Moldovan (2007) based on Kövesligethy formula, for intermediate-depth Vrancea earthquakes. Magnitudes of the pre-instrumental earthquakes are usually deduced from macroseismic observations such as: epicentral/maximum intensity ( $I_0/I_{max}$ ) or epicentral distances ( $r_i$ ) for various values of the intensity ( $I_i$ ) and focal depth ( $h$ ) using different empirical relationships established for these parameters. For the calculation of the focal depth and the macroseismic magnitude will be used only the intensity data points, without drawing isoseismals; in this way any subjectivity induced by the drawing of the isoseismals will be excluded.

In spite of a thorough effort in re-calculation of earthquakes parameters and quality and quantity of the macroseismic data, some inaccuracies remain in the improved depth and magnitude estimations. The studied earthquakes have occurred in Romanian high seismic active region therefore the reconstruction of the macroseismic effects in order to recalculate the earthquake parameters is very important for the analysis and assessment of seismic hazard and for the mitigation of seismic risk in this area and in the whole country's territory.



Figure 1- The area with major damage during October 26, 1802 Vrancea earthquake.

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