

## Determination of parameters of historical earthquakes based on macroseismic data

© 2020 V.Yu. Cardanets

IGS, Chisinau, the Republic of Moldova

**Abstract** The paper attempts to determine the main parameters of historical earthquakes of the Carpathian region based on macroseismic data, using the macroseismic field equation, indirect parameters and complex comparison with modern earthquakes. So far, the main source of information about the parameters of historical earthquakes in the Carpathian region has been “New catalog of strong earthquakes ...”. In this catalog, all parameters are defined very approximately, with a wide range of values. In addition, over the forty-year period since the release of the catalog, the initial macroseismic data of Carpathian region earthquakes have been substantially replenished and re-evaluated using the MSK-64 macroseismic scale. The study determined such basic parameters of historical earthquakes as macroseismic epicenter, intensity at the epicenter, focal depth, and magnitude. As well as additional parameters: direction of the maximum macroseismic effect, area of intensity zones, distance and azimuth to the extreme point where the earthquake was felt. The earthquake parameters were calculated using the attenuation formula of the macroseismic field with coefficients obtained by the R.Z. Burtiev for intermediate earthquakes of the Vrancea zone of the Carpathian region, separately in four azimuthal ranges. For crustal earthquakes, the general Blake-Shebalin macroseismic field equation was used. Despite possible errors associated with correct assessment of intensity at observation points, as well as the accuracy of the coefficients of the macroseismic field equation used for specific seismic events, it was possible to determine the type of each historical earthquake and obtain more accurate values of their parameters. The refined parameters of historical earthquakes will allow making more holistic picture of the seismic hazard in the Carpathian region.

**Keywords** earthquake parameters, macroseismic field, attenuation of intensity, Carpathian seismic region.

**For citation** Cardanets, V.Yu. (2020). [Determination of parameters of historical earthquakes based on macroseismic data]. *Rossiiskii seismologicheskii zhurnal* [Russian Journal of Seismology], 2(1), 62-75. (In Russ.). DOI: <https://doi.org/10.35540/2686-7907.2020.1.06>

### References

- Atanasiu, I. (1961). *Cutremurele de pământ din România* [Earthquakes of Romania]. București, Romania: Acad. RPR, 275 p. (In Rom.).
- Burtiev, R.Z. (2017). *Metodologiia otsenki seismicheskoi opasnosti na osnove veroiatnostnykh modelei seismichnosti*. Diss. dokt. fiz.-mat. nauk [Methodology for seismic hazard assessment based on probabilistic seismicity models. Dr. phys. and math. sci. diss.]. Kiev, Ukraine. (In Russ.).
- Cardanets, V.Yu. (2016). [Peculiarities of macroseismic manifestation of Carpathian earthquakes, depending on the mechanism and depth of the source]. *Buletinul Institutului de Geologie și Seismologie al AȘM* [Journal of the Institute of Geology and Seismology of the Academy of Sciences of Moldova], 2, 106-112. (In Russ.).
- Shebalin, N.V. (Ed.) (1974). *Catalogue of Earthquakes (of the Balkan Region), Part III: Atlas of Iseismal Maps*. UNDP/UNESCO Survey of the seismicity of the Balkan region. Skopje, 275 p.
- Drumea, A.V., & Shebalin, N.V. (1985). *Zemletriasenie: gde, kogda, pochemu?* [Earthquake: where, when, why?]. Chisinau, Moldova: Shtiintsa Publ., 169 p. (In Russ.).
- Drumea, A.V., Stepanenco, N.Ya., Simonova, N.A., Alekseev, I.V., & Cardanets, V.Yu. (2009). *Atlas kart intensivnosti zemletriasenii Moldovy (XVIII–XXI vv.)* [Atlas of intensity maps of Moldova earthquakes (XVIII–XXI centuries)]. Chisinau, Moldova, 170 p. (In Russ.).
- Eshanu, V.M., Skovitin, A.I., & Chekan, M.S. (1988). [Catalog of Carpathian earthquakes (macroseismic data)]. In *Otchet Moldavskoy opytno-metodicheskoy partii* [Report of the Moldavian Experimental Methodical Party]. Chisinau, Moldova, 1256 p. (In Russ.).
- Evseev, S.V. (1961). *Zemletriaseniia Ukrainy* [Earthquakes of Ukraine]. Kiev, Ukraine: AS UkrSSR Publ., 76 p. (In Russ.).
- Kronrod, T., Radulian, M., Panza, G., Popa, M., Paskaleva, I., Radovanovich, S., Gribovszki, K., Sandu, I., & Pekevski, L. (2013). Integrated transnational

macroseismic data set for the strongest earthquakes of Vrancea (Romania). *Tectonophysics*, 590, 1-23.

*Novyi katalog sil'nykh zemletriasenii na territorii SSSR s drevneishikh vremen do 1975 g.* [New catalog of strong earthquakes on the territory of the USSR from ancient times to 1975]. (1977). Moscow, Russia: Nauka Publ., 536 p. (In Russ.).

Medvedev, S.V., Shponhoyer, V., & Karnik, V. (1965). *Shkala seymicheskoy intensivnosti MSK-64* [MSK-64 seismic intensity scale]. Moscow, Russia: MGK Academy of Sciences USSR Publ., 11 p. (In Russ.).

Shebalin, N.V. (2003). [Quantitative macroseismic. Macroseismic problems]. In *Vychislitel'naia seismologiya*, vyp. 34 [Computational seismology, V. 34] (pp. 57-201). Moscow, Russia: Nauka Publ. (In Russ.).

Stepanenco, N.Ya., & Cardanets, V.Yu. (2016). [Comparison of regional definitions of focal mechanisms of Carpathian earthquakes with solutions of the centroid moment tensor]. *Uchenye zapiski Krymskogo federal'nogo*

*universiteta imeni V.I. Vernadskogo. Geografiia, Geologiya* [Scientific notes of the Crimean Federal University V.I. Vernadsky. Geography, Geology], 2(4), 220-248. (In Russ.).

Stepanenco, N.Ya., Drumea, A.V., & Simonova, N.A. (2006). [Strongest earthquakes of Carpathian region in XVIII–XX centuries]. *Buletinul Institutului de Geologie și Seismologie al AȘM* [Journal of the Institute of Geology and Seismology of the Academy of Sciences of Moldova], 1, 37-64. (In Russ.).

Stepanenco, N.Ya., Simonova, N.A., & Cardanets, V.Yu. (2011). [Macroseismic effect of crust earthquakes on the territory of Moldova.]. *Buletinul Institutului de Geologie și Seismologie al AȘM* [Journal of the Institute of Geology and Seismology of the Academy of Sciences of Moldova], 1, 31-50. (In Russ.).

*Zemletriaseniia v SSSR za 1960–1994 gg.* (1963-2000). [Earthquakes of USSR in 1960-1994]. Moscow, Russia: Nauka Publ. (In Russ.).

#### Information about author

**Cardanets Vladlen Yur'evich**, Doctoral Student, Researcher of the Institute of Geology and Seismology (IGS), Chisinau, the Republic of Moldova. E-mail: igs-seismolab@yandex.ru