EARTHQUAKE ACTIVITY AND HAZARD IN THE CARPATHIAN BASIN I

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The seismicity and seismic hazard of the Carpathian Basin are studied in this paper based on a recent comprehensive database cataloging over 20 thousand earthquakes between 456 and 1995. The epicentre distributions of these events indicate the geographical positions of the most active tectonic processes in the region. Among them the south-eastern bend of the Carpathians (Háromszék-Vrancea zone, Romania) and the area of south-eastern Alps have the highest seismic activity. The former source area is very specific by its strong seismicity from the intermediate depth domain (70–170 km).

The intermediate-depth sources are deepening nearly vertically but in somewhat SW direction and the separation of the crustal earthquakes from the events connected to the lithospheric plate subsiding into the asthenosphere is well observed at about 50 km, which is the depth of the Mohorovičić discontinuity (MOHO) in this region. The lithospheric plate subsiding to the depth of 150–200 km is supposed to be disconnected around 50 km. Some weakness of this slab can also be assumable based on the lower seismic activity observed between 100–120 km.

Keywords: Carpathian Basin; earthquake; earthquake catalog; epicenter; focal depth; Hungary; magnitude

1. Introduction

For studying of the seismic activity of an area we need to know first of all the earthquakes occurred in the past. The first scientific description of the earthquakes in the Carpathian Basin was compiled by János Grossinger, a Jesuit from Komárom (today Komarno in Slovakia), who published his work Dissertatio de Terrae Motibus Regni Hungariae in 1783. In the 19th century the most important earthquake catalogues of Hungary were compiled by Henrik Jeitteles (1860a, 1860b) a secondary school teacher of Kassa (today Kosice in Slovakia), and by Ede A Bielz (1862–1863) a natural scientist from Nagyszeben (today Sibiu in Romania). Similarly important works are the seismological compilations of some significant earthquakes of the Pannonian Basin: Jan. 14, 1810 – Mór (Kitaibel and Tomtsányi 1814), Jan. 15, 1858 – Zsolna /Zilina/ (Kornhuber 1858, Schmidt 1858, Hunfalvy 1859, Jeitteles 1859), Oct. 3, 1880 – Central-Transylvania (Koch 1881, Schuster 1881), Nov. 9, 1880 – Zágráb /Zagreb/ (Hantken 1882, Torbar 1882, Wahner 1883), Apr. 14, 1895 – Ljubljana /Laibach/ (Suess 1897). The work of Kitaibel and Tomtsányi (Dissertatio de Terrae Motu in genere, ac in specie Mórensi anno 1810 die 14. Januarii orto. Budae, 1814) has a special importance, namely the authors firstly used the concept of isoseismal delineating an area having the same level of shaking. In the great

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earthquake catalogues of the world (e.g. Hoff 1840–1841, Perrey 1846, Mallet 1858, Fuchs 1886) there are also some Hungarian events, but their contributions are much less comparing to the former works.

In this field Antal Réthy did a great step in the middle of the 20th century, by publishing the descriptions of the Hungarian earthquakes in chronological order between 456 and 1918. He collected the observations until the end of World War I, when Hungary was seriously truncated. His collection (A karpathmedencék földrengései /Earthquakes of the Carpathian Basins/ (455–1918), Budapest, 1952) has still been a major source of earthquakes not only for Hungary, but also for the newer states (e.g. Romania, Slovakia) of the region. The parametric catalogue of Csomor and Kiss (1962) contains only the events occurred in Trianon Hungary (in the present territory of the country) between 1880-1956. The first digital earthquake catalogue was published by T Zsiros, P Mónus and L Tóth in 1988. The content of the last three databases is shown in Table I comparing with the most recent one (Zsíros 2000). The systematic collection of earthquake observations started in the years of 1880–1881 by the establishment of the Seismological Committee of the Hungarian Geological Society. (After Switzerland the Hungarian Earthquake Committee was the second in Europe.) In Hungary the instrumental seismology started at the turn of the 19th and 20th centuries and by the beginning of the First World War (1914) the seismological network of the country (see Fig. 1) belonged to the most developed ones (Biszticsány and Csomor 1981, Szeidovitz 1994, Ferrari 1997). At that time however the instruments were very insensible, so they can record only the extremely large or the very near earthquakes, and the hegemony of macroseismology lasted until the '60s of the 20th century. Among the countries having changeable borders in the Carpathian Basin, Hungary has the most advanced position for the establishment of the most comprehensive database of historical earthquakes of this region, since the whole Carpathian Basin was Hungary for one thousand years and since this country occupies the center part of the Basin.

The source parameters of earthquakes have become to known from the evaluation processes of the macroseismic and/or the instrumental observations. In the earthquake catalogues the basic (source) parameters are usually the following ones: date and time of the event, co-ordinates of the epicenter, focal depth, magnitude, epicentral or maximum intensity. The reliability and the accuracy of the source parameters are naturally determined by the quality of the (literature) sources used. In the case of historical earthquakes (macroseismic data) we always relied on the primary (root) sources (Stucchi and Albini 1991) if they were available. In instrumental observations — if we have more network determinations — the most reliable and accurate parameters were intended to select based on e.g. the similarity with macroseismic results, the number of stations used, error estimations. In the following paragraphs some seismicity and seismic hazard results are presented based on the latest database (Zsíros 2000) for the Carpathian Basin.