A contribution of reflection seismic surveying for studying the structure of the Komárno basin

1. Introduction

The Komárno region is one of seismically most active regions in Czechoslovakia. An attempt was made by workers of the Geophysical Institute of the Czechoslovak Academy of Sciences in 1955 and 1956 to mark out zones of tectonic microtremors in the Komárno basin on the basis of direct observation carried out by special seismic apparatus [1, 2]. A belt of increased seismic microactivity was found north-east of Komárno at the district of Marcelová. To the west of Komárno no such zone was found. Zones of increased seismic microactivity are explained by the existence of seismogenetic faults [3, 4]. Seismogenetic faults are actually weakened zones which divide blocks of the earth's crust having relatively different stability. The relative movements between the individual blocks lead to the origin of tension in these weakened zones which then are balanced in a form of weak tremors. We can thus assume that in regions of increased seismic microactivity north-east of Komárno two relatively different stable blocks of the earth's crust are in contact. The existence of these blocks can be shown on the basis of the study of the geological structure of the Komárno basin. Reflection seismic surveying, carried out in this part of basin, as well as basic stratigraphic bore holes contributed to a large extent to explaining the geological structure of the basin. Serious tectonic observation was carried out. The finding of a large tectonic zone of a subsided nature north-east of Komárno, which territorially coincides with a zone of tectonic microtremors, is an important contribution and support to our explanation of the existence of a belt of increased seismic microactivity.

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2. Brief Survey of Geological Conditions

The Little Danube Lowlands (of which the Komárno basin is part) is part of the Great Pannonian lowlands which is one of the large neogene basins situated inside the Carpathian arch. The underground of the basin is formed of crystalline rocks (Bernolákovo bore hole, Trnava) and mesozoic rocks and possibly depth eruptive rocks. The younger basement are also paleogene rocks; the inner Carpathian flysh (changing of sandstones and shales) in the northern bays of the Little Danube Lowlands, oligocene and eocene rocks in the south-east part of the basin (Nová Vieska bore hole). The filling of the basin is formed of a neogene incomplete series of sediments of the older and young miocene and pliocene periods, of which the most powerful are the Pannonian sediments (Diakovce bore hole 2405 m). Due to the thick covering quaternary formations (alluvial sands and gravels, with loess drifts in places), it was not possible without boring and geophysical work to obtain a broader knowledge of the structure of the basin [5, 6].

3. Results of Reflection Seismic Surveying

The most important method of surveying in the Little Danube Lowland is at the present time reflection seismic surveying. The surveying has a regional character. Measurements were carried out from 1952 to 1956 by 24-channel seismic recorder truck of Soviet production and later by 26-channel recorder truck of Hungarian production. The distance between the shot points was 575 m or 625 m according to the type of apparatus. The charges of gelatine astralite 8—16 kg in size were set off in shot holes 12—20 m deep, and in exceptional cases deeper. The interpretation of the seismic records was carried out by the usual methods. For the whole region the same curve of the mean velocity, was used which was plotted as deep as 2,500 m according to the data obtained by means of the seismic logging on the Báhoň depth bore hole and further for greater depths computed from travel time-curves of reflected waves. The use of one velocity curve is justified by the concording results of the seismic logging measurements at various depth bore holes. The curve of the mean velocities is given in Fig. 1. The reflecting plots were plotted by the method of image shot points, or the method of time gradients in the end points of symmetrical travel time-curves. The seismogeological conditions for carrying out reflection seismic surveying are very favourable in the majority of regions of the Little Danube Lowland. No key horizon exists due to the monotonous petrographic development of the neogenous group of strata. According to a number of basic bore holes it is however possible to take the stratigraphic position for corresponding with the imaginary seismic horizons [7, 8, 9, 10].

Let us study the seismic profile, leading (Fig. 2) perpendicular to the Little Carpathians north from Bratislava in the direction to the Dunajská Streda, where the profile is interrupted and continues further south of Kolárovo in the easterly direction to Nová Vieska. At this part of the profile (Fig 7) there lie the depth bore holes Kolárovo and Nová Vieska. At the district of Marcelová the profile crosses the territory where seismic microtremors have been observed. The profile, shown in Fig. 2, was measured in 1954—56. The individual parts of the profile are denoted by the original numbers according to the final reports of the seismic groups which carried out the surveying [7, 8, 9, 10]. If we study the profile from the Little Carpathians in the easterly direction the notation of the individual parts of the profile is as follows: No. 50 [9]; No. 5 [7]; No. 103 [8]; No. 155 [10]. The seismic sections of the individual parts of the profile are given in figures 3, 4, 5 and 6. The horizontal and vertical scale is the same; the thousand metre depths are denoted by horizontal lines at the edge of the figures.

The boundary of the miocene-pliocene periods in the northwest part of the profile is drawn into the seismic sections on the basis of the Bernolákovo bore hole (Figs. 3, 4). This boundary is led further according to the seismic results-reflecting-plots. We observe the monoclinal dipping of this horizon to the centre of the basin at an angle of about 6°. East of the Dunajská Streda we see that the imaginary horizon runs from the reflecting plots and cannot be followed any farther (Figs. 4, 5). It probably ends here on the underground of the basin. The disappearance of the reflecting plots (reflected waves) approximately marks the boundary of the bottom of the basin, as can be seen from refraction seismic measurement on another profile (Fig. 7).