INVESTIGATION ON RECENT CRUSTAL MOVEMENTS BY MICRO-TRIANGULATION NETWORKS

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Abstract

The horizontal component of recent crustal movements (surface movements) of tectonic origin is known very slightly in the territory of Hungary because of the low velocity of these deformations and the insufficient accuracy of earlier triangulations.

Within the research work of the Geodetic Institute, Technical University of Budapest authors intend to carry out investigations of slow horizontal deformations by periodically re-observed micro-triangulation nets, settled along tectonic faults. Localization of the fault sections was accomplished by interpretation of aerialphotos and space-images. The sketch of the first micro-net built in the vicinity of the village Sóskút (Transdanubia) is to be seen in the figure.

Direction and velocity of recent *vertical* crustal movements (surface movements) in Hungary are sufficiently known through the results of national and international investigations carried out so far [1, 2, 3]. However, the *horizontal* component of recent movements is known very little, in spite of the fact, the data of repeated horizontal measurements (national triangulations) too, covering the whole of the country, are available:

The accuracy of earlier triangulations — realized for the purposes of practical engineering — did not prove to be sufficient, because of their low velocity to determine the recent horizontal surface movements in the entire country. Although there were remarkable experiments when investigating local horizontal motions [4, 5 etc.], these, however, were also based on the results of earlier measurements.

For a reliable determination of horizontal deformations of tectonic origin — which are probably very small here — quite new observations are needed. Besides, the present-day surveying instruments and methods (first of all as a consequence of errors) are not yet suitable to detect slow horizontal motions in vast territories. They are sufficient only for local investigations, on selected smaller areas.

When control-points (measurement stations) are only a few hundred meters far from each other, one can point out the relative horizontal motions, by repeated observations — first of all by small range distance measurements — even if they are in the order of magnitude of millimeters, only.

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Such local investigations are recently carried out by periodical re-observation of micro-triangulation nets. In a number of countries the networks were established and measured generally in areas, where considerable surface deformations occurred in former times [6, 7 etc.].

In Hungary — according to our knowledge — areas characterized by exceptional big present-day horizontal deformations do not exist; therefore to find the best sites for the micro-networks requires a very careful condiseration. In any case, it is practical to establish them along major faults, because the recent surface movements take place, in all certainty, along existing faults.

According to geo-scientific investigations and considerations, the earth crust in Hungary consists of rock-masses strongly dissected by faults. However, these are not clearly visible on the surface but often appear as wide fault-systems, covered generally by sediment. Therefore their localization is difficult, although — for the sake of the desired high accuracy of observations — to limit the geodesic measurements to a small area is absolutely necessary.

Considering the possibilities of localization of tectonic faults (fault sections) [8], a method seems to be the most suitable,

— which gives some basis for the discovery of areas where the existense of recent tectonic movements are rather to be expected,

— which helps to find the course of the fault on the surface as well as possible,

— which gives some information on the depth of the structures appearing on the surface as faults.

All the above are mostly recognizable by interpreting aerial-photos and space-images, comparing the results continuously with geological, geophysical and hydrographical evidences [9].

To detect fault-systems in the Pannonian basin (in the central part of the area surrounded by the Carpathian Mountains) and in the Carpathian basin itself — until the late 70's — aerialphotos were used. Their interpretation resulted in significant new information [9, 10].

The most inportant, from the point of crustal movement investigation, are:

1. Beside the numerous structural lines, unknown earlier, important connections became identifiable between the faults, which cut across parts or the whole area of mountains. As a result of these regional investigations curved structural lines, lines encircling closed formations and concentric arrangements of linear features had been recognized for the first time.

2. The closed and concentric lines surround so-called diapiroid structures, which are probably spots of rather recent or even present-day crustal movements.

3. On the aerialphotos one can trace fairly well the concealed sections of structural lines, too.

4. General direction of saw-toothed ("en echelon") structural lines running zigzag, are discernible rather well, too.

5. Wide fault-systems, which cannot be traced well on site are clearly outlined and generally the boundaries between the undamaged block of rock-masses can be detected.

6. The existence and direction of relative movements of adjacent blocks can be often determined, too.

7. Between the separated blocks along structural lines, sections can be found where geodesic measurements may be carried out within the smallest areas (with the shortest distances in the micro-triangulation network).

During the 70's, beside aerialphotos also the opportunity to study space-images became available. In this way, new structural connections became known [11].

By careful investigation of aerialphotos and space-images, numerous terrains became known in the country, where the structural lines appear sharply, the structure itself seems to penetrate deep and crustal movements along the structural line are expected also at present.

Looking over the selected spots, the areas most suitable for the establishment of micro-triangulation networks were chosen. The principal view-point of selection were the following: the shortest distances between measurement stations, the most favourable possible form of the network, the best possibilities of the construction of stations (marks), the applicability of the most up-to-date measurement method. All these circumstances were examined from the point of the possibly highest accuracy, that has to be achieved by the measurements. Besides, a very important view-point is to ensure the possibility of identical re-observation after several years, even decades.

The measurement stations are settled on both sides of the chosen fault section. From the point of measurement accuracy the optimum may be achieved, when the arrangement of the stations forms quadrilaterals.

Our first micro-triangulation network was developed in a hilly area, which is practically free of a sediment-cover, in the vicinity of the village Sóskút. The layout of the network is shown in the Fig. 1. Mean length between the stations is 410 m, the length of the whole net is about 600 m. The control-point marks of a new type were designed and constructed.

The first measurement of the network will be accomplished in 1985. By the periodical and highly accurate re-observation of distances, angles and height differences in the net, after a few years or decades, evidence should be achieved as to, whether the fault in question is active, and if so, the direction and velocity of movements occurring along the fault section can be determined.

By this method, in a network of this size, a horizontal displacement of about 2 mm can be measured.

Although the micro-triangulation networks in question are planned first

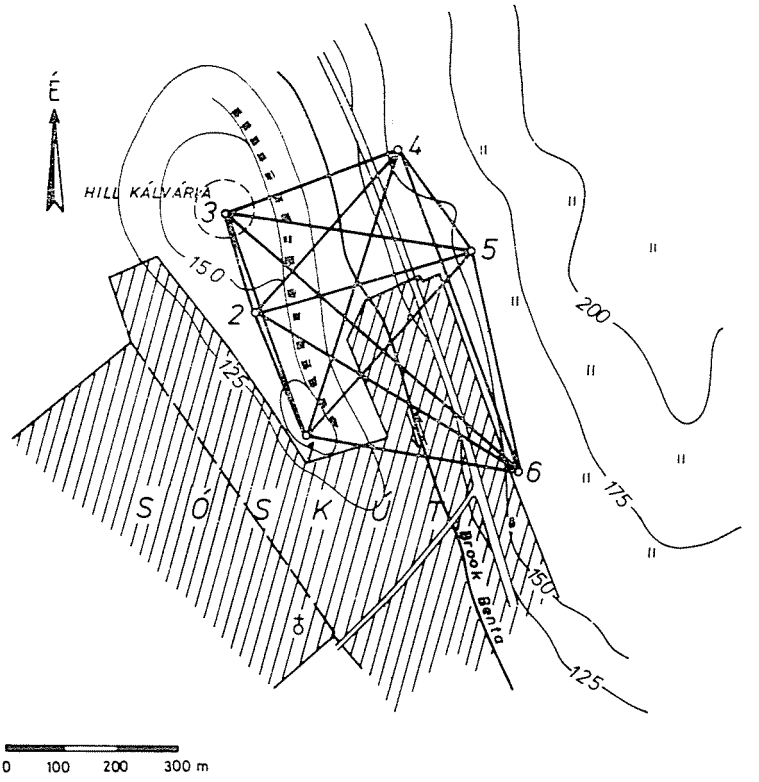

Fig. 1

of all for the observation of the horizontal component of the movements, one can carry out different kinds of measurements (e.g. geophysical observations) in the area.

It is intended to continue these investigations (within the research work of the Geodetic Institute, Technical University of Budapest) and to develop further micro-networks in the country, similar to the mentioned one. Of course, one cannot hope to clear up the nature of recent horizontal crustal (surface) movements in the entire country by this way. Our purpose is only to ascertain, whether present-day horizontal movements of tectonic origin of measurable size, do exist in the territory of Hungary.

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