1 GEOPHYSICAL PROSPECTING

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Location of the field works of ELGI in 1978 is presented on Fig. 1.

The geophysical investigation of the *Transdanubian Central Range* continued according to the co-ordinated plans of coal and bauxite prospecting projects.

In *prospecting for brown coal* a definite sequence of drilling and geophysical exploration was established, as follows:

- from all geological-geophysical data available the Triassic basement contours are constructed;
- for each individual structural block a borehole is drilled;
- from borehole data, regarding stratigraphy and raw material, the geological interpretation of geophysical profiles are corrected;
- the boreholes of the second phase and further geophysical measurements are located according to the new interpretation.

In the eastern foreground of the Gerecse Mountains the contour map of the Triassic basement – according to the latest exploration data – are presented (Fig. 2. A). Fig. 2. B demonstrates the Bouguer anomaly map of the inner basin of Héreg and Tarján, while Fig. 2. C shows the residual anomaly map of the same area. Recognizing the main structural features of the area (elongated, NW–SE directed troughs) and localization conditions of the coal fields (at the southern end of each trough) the exploration of the next field was initiated by the residual anomaly map of Fig. 2. D, indicating minima along an E–W line. Borehole data later proved the validity of the assumptions. Fig. 3 shows profiles intersecting the troughs.

Reflection seismics in coal exploration means the possibility of tracing small scale faults. In Fig. 4 the processing steps of an experimental seismic reflection profile are presented: from top to bottom the stacking time section, the migrated time section and the migrated depth section. Detection of fault location and amplitude of dislocation correspond to the scale of 1:10,000.

From the field of *bauxite exploration* the case history of the Iharkút area is presented (Fig. 5). Fig. 5. *a* shows the geological informations available at the time of the discovery of bauxite body N° 1. The regional geophysical exploration (VLF, potential mapping) resulted in the map of Fig. 5. *b* and in recommendations for drilling and further geophysics. On the map prospective areas are marked with green, while possible bauxite containing indentions by yellow. The drilling follow-up found several bauxite bodies and cleared some of the structural problems. The second phase of geophysical exploration had been carried out by methods of higher resolution power (UPM, seismic reflection). In the resulting map (Fig. 5. *c*) the bauxite bodies could be contoured (marked by yellow) and further prospective areas located (green). In phase 3 the VLF—IR method was used (see chapter 2.2) to delineate all bauxite bodies. Its result is shown in Fig. 5. *d*. The contour map of the Triassic carbonate surface, underlying the bauxite bodies is presented in Fig. 5. *e*, while in Fig. 5. *f* those anomalies are contoured, which indicated the bauxite containing indentions the first time.

The course of VLF–IR mapping is demonstrated by Fig. 6. Fig. 6. *a* shows the results of potential mapping in a 25 m grid. The conventional VLF mapping using the signals of one transmitter only gives distorted results. Fig. 6. *b* and *c* shows VLF maps using the signals of two different transmitters. The "invariant resistivity" map of Fig. 6. *d* delineates the trough fairly well. On Fig. 6. *e* the resistivity ellipses of fourth order are displayed. The sedimentary complex is homogeneous where the ellipses are nearly circles. By using additional VES, PM and borehole data the exact contour map of the Triassic basement and the boundaries of the bauxite body could be determined (Fig. 6. *f*).

On Fig. 7 the effectiveness of the geophysical measurements and their computer processing is demonstrated. Fig. 7. *a* represents the situation before the geophysical exploration. Fig. 7. *b* shows the contour map of the Triassic basement from geophysical data. Fig. 7. *c* presents the computer constructed contour map from the data of Fig. 7. *b* and additional borehole data. The method of map compiling from randomly distributed points is described in Chapter 2.2.

Computer programs like cross section plotting from stored borehole data (Fig. 8) and determination of the spatial position of horeholes (Fig. 9) were written to improve integrated interpretation.

Geophysical exploration of the central area of the *Börzsöny Mountains* – except for a few methodological measurements – was completed. A characteristic cross section of the central area is given on Fig. 10. Geophysical anomalies suggest, that at some places subvolcanic bodies displaced the original marine sediments even up to the present surface. This was proved by boreholes P–7 and P–18.

IP anomalies were formed along the boundary zones of the subvolcanic masses, evidently in connections with fractured zones. For the detailed exploration of these IP anomalies additional IP measurements were carried out along a rectangular grid. From the results apparent polarizability (η)and MFT maps were constructed (Figs. 11 and 12). On this latter map anomalies, originated from resistivity increase only, disappear. It is worth noting that boreholes show copper indications only on MFT anomalies.

To determine the origin of the magnetic anomalies, the SP, ΔZ and IP anomalies were combined on Fig. 13. If the ΔZ anomalies are in connection with magnetite, formed in the same paragenesis as the calcopyrite, they can be used as indicators of copper-mineralization. The question could be cleared by the proposed borehole F–1.

IP methodological works were also carried out in the Börzsöny Mountains. As conclusion it could be stated, that within the resolution power of the measurements and the given penetration depth, the rock masses could be characterized by decay curves of similar shape. Differences are in their amplitudes only.

In the framework of geophysical exploration of the *Darno structural zone*, ore exploration was carried out in the Mountains of Rudabánya. Results of regional and detailed IP profiling are given on Fig. 14. Most of the anomalies show strikes of NE–SW direction which matches to the structural directions of the mountains. On all three areas of higher IP anomalies carbonaceous shales can be found. It is supposed that the carbonized organic matter, mixed with disseminated pyrite, causes the anomalies.

Together with the IP measurements, resistivity profiling was carried out as well, to help geological mapping. For the exploration of deep level mineralization reflection seismic profiles were shot, partly with the Vibroseis technique. Location of Ra–1 depth section, coloured according to reflection amplitudes (Fig. 15), is given on Fig. 14. From all boreholes, marked on the section, only those two (Rb–465, Rb–387) indicated copper which were drilled above the deep fracture zone.

Location map of the three reflection profiles, presented as examples, is given on Fig. 16. On the migrated time section, ÉK–3a coloured according to reflection amplitudes (Fig. 17), an interpretation sketch of the deep structure of the Uppony Mountains is given. The contact zone of the Ózd basin and the Uppony Mountains is to be seen on time section Csá–1 (Fig. 18). From the character of reflections of the Tertiary sediments it can be concluded, that all significant tectonic events happened before the Tertiary sedimentation. The basement elevation in the time section Ma–1 (Fig. 19) was interpreted – in accordance with the residual gravity anomaly trend – as the continuation of the Uppony Mountains, under sedimentary blanket.

The *regional study of the tectonics of Transdanubia* included two areas: 1. South of Lake Balaton, up to the Mecsek Mountains, and 2. the Transdanubian Central Range. In the first area magnetotelluric and telluric survey complemented the seismic profiles of former years, but the main method on both areas was still the seismic reflection (Fig. 20). Comparing the gravity Bouguer anomaly map with the telluric isoarea map (Fig. 21) masses of high density and low resistivity can be delineated. Such rocks already hit by boreholes in the south of Transdanubia proved to be of Carboniferous age. To compare seismic and magnetotelluric results, the depth and resistivity data of magnetotelluric soundings are marked on the seismic time sections (Fig. 22). Separation of sedimentary series was attempted by help of interval velocities and resistivities. In the area of the telluric minimum zone of Dombóvár–Kaposvár experimental TDEM and FDEM measurements were carried out. The results disaffirmed the interpretation of the previous year (Annual Report, 1977. Fig. 27). In Fig. 23 both interpretations are marked on seismic time section MK–6/78, which did not reach the centre of the telluric minimum. Because of the complicated geological situation the continuation of profile MK–6 is required.

Profile MK-2É/78 (Fig. 24) was shot in the northern foreground of the Mecsek Mountains. It shows structural elements unknown up till now. Profile MK–3/77 was shot in 1977 in the Transdanubian Central Range. Recording went till 10 s, but processing till 3.5 s only. In 1978 the processing of the 4–10 s time interval was completed. The portion, presented on Fig. 25 draws attention to several points of interest. To trace the areal distribution of the reflections of 2.0–2.4 s of MK–3/77, profile DK–1/78 was shot. Processing went till 10 s (Fig. 26). Because of unfavourable surface conditions the quality of the time section does not reach that of the 1977 profile. The reflection of 2.0–2.4 of MK–3/77 appears around 1.5 s.

For the investigation of the deep structure of the Mecsek Mountains the 4–10 s time interval of profile Gö–5 of 1977 (Annual Report, 1977. Fig. 40) was processed (Fig. 27). Beside the Mohorovičić discontinuity having outstanding energy (M_1, M_2), other features, like the separation of blocks by differing seismic characteristics (A, B, C) are worth mentioning.

From the projects of *water- and engineering geophysics* of 1978, two topics of remarkable methodological innovation are briefly discussed.

To solve the water supply problems of south-east Hungary the alluvial cone of the river Maros has been investigated. The geoelectric methods were dominant. The vertical electric soundings detected a series of layers of 20–40 ohmm resistivity below the heterogenous surface layers of a few m thickness. Some parts of these series – because of the higher ratio of the porous beds – are most favorable for water production (Fig. 28). The IP measurements proved that the polarizability of layers of similar resistivity can differ considerably (Fig. 29). It is assumed that the higher polarizability is in connection with the increased permeability.

The experimental FDEM measurements proved to be successful in the investigations of high resistivity layers, lenticular sedimentation and pinching out (Fig. 30).

From the field of engineering geophysics the measurements of the planned damsite of Dunakiliti is briefly reviewd (Fig. 31). For the investigation of the topmost 5–25 m, the following methods were used: resistivity profiling, vertical electric sounding, engineering-geophysical sounding. The essence of the engineering-geophysical sounding – developped in ELGI – is as follows: with hydraulic equipment a probe, indicating the mechanical resistance, is pressed down to the medium. Afterwards other physical parameters can be determined by logging inside the boring rod. The diameter of the resistance sensitive probe is 36 or 45 mm, at down pressing it does not change the natural conditions of the layers, thus the parameters can be regarded as in situ data.

The *geophysical survey of the great Hungarian Plane* stepped into a new phase by completing the Hajdúság area and starting two new projects. The location map of the reflection profiles of the Abony area can be seen on Fig. 32. A total of 247 km reflection profiles were shot, with the following parameters: geophone base spacing–50 m, offset–575 m, coverage–12×100%, length of linear geophone array–45 m, the arrays consisting of 32 GSC–11D geophones, recording instrument–SD–10/21. The migrated time section of reflection profile Ab–11/78 is presented as an example (Fig. 33).

On the Hortobágy area (location map Fig. 34) supplementary gravity measurements made it possible to construct a Bouguer anomaly map suitable for secondary processing. From the filtered maps the residual anomaly map with parameters $s = 250$ m, $\varkappa = 3$ is presented on Fig. 35. The magnetotelluric soundings were located along regional profile A–14. Measurements were carried out by digital recording instrument DEF–1, in the frequency range of 20–0.004 Hz. The results and their geological interpretation are presented on Fig. 36.

Reflection profiles were recorded by the VIBROSEIS system, partly because of the national park regulations, partly because of the stong ground roll, hindering conventional seismic work. From the total of 122 km profiles 31 km were recorded by 24×100% coverage, 91 km by 12 fold coverage. Data processing is in progress.

For the investigation of the structure of the *Mecsek Mountains* seismic profiling is continuously carried out since 1976. The location map of the 1978 profiles is presented on Fig. 37. As an example for the refraction profiles cross section OaR–4 is shown on Fig. 38. The horizon of velocity 5,400–6,300 m/s can be identified as the surface of the middle Triassic and old Paleozoic sediments, which represents the bedrock of the coal seam.

Time section Or–7/78 (Fig. 39) is presented as an example for the reflection profiles. The data of borehole O–3 were used to identify the overlying (J_1s_2) and underlying (T_2) layers of the coal seam. The coal seam is pinching out towards the end of the profile.

A seismic profile shot in connection with the telluric–magnetotelluric survey of the north western foreground of the Mecsek Mountains is presented on Fig. 40. For the geological interpretation of the cross section – in lack of borehole data – interval velocities, discordance horizons and the gravity and telluric anomalies were used.