1 GEOPHYSICAL PROSPECTING

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The field work of ELGI for 1985 is presented in the map of *Fig. 1.*

The *regional exploration of the Transdanubian Central Range* continued —similarly to previous years—partly in the form of regional geological exploration and reconnaissance coal- and bauxite prospecting (coordinated by the Central Office of Geology), and partly in the form of direct raw material prospecting (by contracts with the relevant bauxite- and coal mines). These projects provide the study areas for testing new methods and adapting them to local conditions. From the methodological results of 1985, we should like to emphasize the application of the transient electromagnetic method to coal-, bauxite- and water exploration (methodological results are presented in Section 2.2.1). Our experiments with the engineering geophysical sounding equipment were successful in the detailing phase of the prospecting of near-surface bauxite bodies. Another experimental method—a special version of downhole–downhole geoelectrics—was used to determine the tectonics of the space between the boreholes.

The result of geophysical prospecting was that 30 boreholes were located for coal exploration out of which 26 found brown coal of economic value and 2 indicated coal occurrence. 23 boreholes were drilled in connection with the project "Assessment of bauxite resources"—this being a joint venture with the Hungarian Geological Survey; 8 hits resulted from this work. The Bauxite Exploration Enterprise drilled 207 holes in 1985—based on geophysical results—from which 40 found good quality bauxite and 28 indicated bauxite occurrence. Summing up the productivity of locating boreholes: 90% of all boreholes proved the accuracy of geophysical results, i.e. found the predicted structure or reached the horizon of interest within 15% error.

In the framework of the programme for *Eocene brown coal Exploration*, a seismic reflection survey was carried out in the area of "Lencsehegy-South". According to the residual gravity anomaly map *(Fig. 2.)*, two—nearly perpendicular—structural troughs may be supposed. Judging from the two neighbouring coal mines, good quality brown coal is prognosed in the troughs. From the seismic survey of six profiles, two are presented: LE–11/85 *(Fig. 3.)*

and LE–14/85 *(Fig. 4.)*. Boreholes K–24 and K–25, located on the seismic profiles, penetrated brown coal of economic value.

In the following, the results of *reconnaissance bauxite exploration* between 1981 and 1985, are presented. Reconnaissance exploration was directed to the least known but nonetheless promising areas with the intention of increasing the number and choice of possible areas for more detailed surveys. The geophysical methods used in these reconnaissance surveys depend on the expected depth of bauxite deposits. Accordingly, survey areas are classified into three types, with depths:

0–60 m   60–200 m,   200–400 m.

The first category means open pit mining, the second the lower limit of present mining, the third the lowest limit of exploration.

In areas of 0–60 m depth to basement, tectonic or karst depressions of small extension are the targets of exploration. The first step is to determine the physical parameters of the overlying and underlying rocks, after which the areas to be excluded from further exploration are delineated. In this first phase—for economic reasons—geophysical methods are used mainly along profiles. The most important method in this depth range is VLF resistivity surveying. In the range of 0–10 m, this is replaced by the RF (radiofrequency) resistivity method. The extent to which these methods are used is illustrated in *Fig. 5.*

In areas of 60–200 m depth to basement, the dominant geophysical method of exploration for lens-shaped and bedded bauxite bodies is Maxi-Probe electromagnetic frequency sounding. Prior to this, in order to find the main tectonic directions, gravity and geoelectric potential mapping is carried out. If the overlying sequence contains a high density, high resistivity screening layer, the TURAM mapping method is used. To determine actual depths, vertical electric soundings, are performed for the simpler cases; for more complicated cases the high resolution seismic reflection method is applied.

In areas of 200–400 m depth to basement the dominant methods are seismic reflection and Maxi-Probe electromagnetic sounding. Appropriate locations of these are planned on the detailed gravity anomaly maps. One of the most important tasks in methodological research is to maintain the resolution power of these methods with increasing depths. To speed up the preliminary phase of exploration of near-surface bauxite deposits, we plan to introduce airborne geophysical methods.

To illustrate our reconnaissance bauxite exploration activity in the past five years, results obtained from the Tükrös area are presented. The result of the first phase is a Bouguer anomaly map of the area (see *Fig. 6/a*). This correlates fairly well with the basement contour map *(Fig. 6/b)*. The state of exploration, as of 31st December 1985, is presented in *Fig. 7.* A characteristic electromagnetic profile of the area can be seen in *Fig. 8.*

The *regional exploration of the Danube–Rába* Lowland has been continued according to the plans coordinated by the Hungarian Geological Survey. From the results achieved for various areas and different depth intervals, the region covered by map No. 402 is discussed in detail, especially the medium depth range *(Fig. 9)*. A unified Bouguer anomaly map, containing all gravity measurements carried out for oil-, coal-, or bauxite exploration between 1960 and 1984, was completed (construction of the former regional map was closed in 1960). Telluric measurements were carried out on about 400 points. The isoarea map, containing the anisotropy ellipses as well, is presented in *Fig. 10*. Interpretation of magnetotelluric measurements caused difficulties: determination of depth to the high resistivity basement and that of the conducting zone within the basement meant no problem in areas of shallower basement (map No. 403), but with increasing depth both horizons became ambiguous. One possible interpretation of profile MK–3 is given in *Fig. 11*.

The study area of the medium depth range is characterized by three geoelectric curve types: KQHK, QHKQ, AKQQ. These mark out three regions, as can be seen from the geoelectric cross sections of *Fig. 12*. Because of the frequently changing lithology and the loose observation network, no contour map of geoelectric horizons could be constructed but—as in previous years—average resistivity and polarizability maps were constructed for different depth ranges. *Figure 13* presents the areal distribution of average resistivity from the surface to 100 m depth, *Fig. 14* the same to 500 m depth. The apparent polarizability map for the first depth range can be seen in *Fig. 15*. From the ϱ–P parameter pairs, so called lithological sketches were constructed for three different depth ranges; *Fig. 16* presents the shallowest (from the surface to a depth of 100 m). These maps give an overview of the hydrogeology of the area. From the exploration results of the near-surface, an engineering geophysical cross section is presented in *Fig. 17*. These data offer an important contribution when mapping for the following purposes: hydrogeology, agrogeology, soil mechanics, and construction engineering.

The *reconnaissance ore exploration of the Central and Western Mátra* Mts. was completed in 1985. Induced polarization mapping—together with metallometry—delineated the area of hydrothermal polymetallic mineralization. This area coincides with a section of a gravity residual maximum of arch-like shape *(Fig. 18)*. This arch is limited to the east by the Darnó structural line, to the west by the Zagyva trough. The telluric isoarea map of the Zagyva trough, containing the anisotropy ellipses, is presented in *Fig. 19*. This map reflects the steep western boundary of the Mátra and the asymmetry of the Zagyva trough. The same can be seen on migrated time sections Ma–13/85 *(Fig. 20)*, and Ma–9/84 *(Fig. 21)*, the latter coloured according to amplitude strength.

To study the connection between structure and mineralization, we have plotted the IP anomalies on the Bouguer anomaly map continued upward to the level of 1100 m *(Fig. 22)*. The two areas of maxima coincide, in general, but individual IP maxima are elongated and follow the direction of dykes connected with transverse faults *(Fig. 23)*. To be able to see the connection between different physical parameters and geological structure, all anomaly curves and parameter data are plotted on the seismic reflection time sections *(Figs. 24* and *25)*.

On the southern rim of the *Bükk Plateau* geological mapping and structural observations were carried out on an area of 10 km² (see observation map of *Enclosure 1*). This part of the Plateau is built up mainly of shales, but bedded chert and limestones are frequent as well. Limestones can be classified (see *Table I*) into two main groups: grey, chert-free, "Plateau Limestone", and variegated "transitional limestone" with or without chert. The first group marks shallow sea, the latter one the slope environment. Some of the structural elements can be seen in the observation map (Enclosure 1), such as the folds in the limestone bands, the Z-form folds of Vöröskő and Feketelen, and the strike arching in the western part of the area. We differentiate between folds: the first type, consisting of tight folds of similar type, is simultaneous with the foliation *(Figs. 27* and *28)*; the second type, the chevron folds *(Figs. 29* and *30)* were formed later. Faults could rarely be found: they are either reverse faults of E–W strike, or normal faults of NW–SE strike. The fold system, reconstructed by tectonic analysis, is presented in *Fig. 26*.

The stratigraphy of the area is illustrated in *Enclosure 2*. South of the Plateau the stratigraphic sequence is the following: grey limestone, transitional limestone, bedded chert, shale. On the southern rim of the Plateau, we find the same series reversed. Since the foreground has a normal depositional sequence, the Plateau rim must be overturned. The geological map and cross sections *(Fig. 31)* were constructed according to these conditions.

In 1984 and 1985 the *seismic survey of the Kiskunfélegyháza area* continued in the framework of a contract with the National Oil Gas Trust of Hungary. The location map is presented in *Fig. 32**. For the interpretation of seismic profiles, data of three new boreholes (Alpár–1, –2 and –I), the magnetic ΔZ anomaly map *(Fig. 33)*, and the gravity residual anomaly map *(Fig. 34)* were at our disposal. From the seismic material a few time sections are presented *(Figs. 35–40)*. We marked with yellow the Pannonian (Upper and Lower Pannonian contact, and the steeply dipping Lower Pannonian layers of the prograding delta sequence). We would like to draw attention to the erosional surface cutting into the delta sequence. Above it the seismic character is reflection-free, suggesting a fast, homogeneous sediment accumulation. This phenomenon may be linked with a quick decrease in lake level. In time, it coincides with the Upper and Lower Pannonian contact determined for this

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* Figures 32–44 are to be found at the back of the volume

area *(Fig. 41)*. The distribution and the thickness of this "channel fill" are presented in *Fig. 42*, but one can see that its dimensions are much bigger than an ordinary channel, it might be more appropriate to call it an alluvial fan. Two more maps are presented: the time contour map of the Pannonian basin floor *(Fig. 43*, shown as an orange horizon in the time sections) and that of the so-called pre-Austrian basement (*Fig. 44*, coloured dark green in the time sections). This latter horizon could not be traced in the southern part of the study area. In this map a dotted line marks the change of character in the Upper Cretaceous while its pinching out can be linked with the fault zone, marked with red. At some places reflections appear from below the dark green horizon, either from older Mesozoic rocks or from Precambrian granite. Intensive magmatic activity occurred in this area during the Lower Cretaceous. Where magmatic bodies could be identified, they were marked with purple in the time sections.

From our exploration tasks in *water- and engineering geophysics* the project of prospecting the *alluvial cone of the Danube on the Mohács island* is presented. In 1985, a summarizing report was prepared on the four-year period of work. The task of the geophysical survey was to delineate the extension of the Pleistocene alluvial cone, to determine changes in thickness and physical parameters, to study communication between the Danube and the water-bearing layers, and to provide information on the vertical and horizontal filtration properties for the Regional Waterworks of Pécs. To solve the tasks, the following methods were used: four-parameter engineering geophysical sounding, and vertical electric soundings ($AB_{max} = 800$ and 4000 m) combined with induces polarization soundings. We could trace, on the whole area, the near-surface sediments, the fluvial deposits (alluvial cone) the Pannonian argillaceous seal, and the high resistivity basement. The thickness of the alluvial cone is mapped in *Fig. 45*. Most favourable for water yield is the lower part of the cone, consisting of bedded sand, sandy gravel and gravel with mud interbeddings. These mud stripes are the sources of methane gas in the water. The structure of the alluvial cone is illustrated by a longitudinal and a transversal cross section *(Fig. 46)*. As a result of the integrated geophysical–hydrogeological study, it could be established that from the shore segment between Dunafalva and Mohács a daily yield of 100,000 m^3 drinking water can be provided. A further 50,000 m^3/day water can be exploited from the shore segment below Baja.

The contour map of the high-resistivity basement is presented in *Fig. 47*. The fault zone, marked in red, is a possible location for thermal water exploration. In the north-eastern corner of the area, we find a medium-resistivity layer below the low-resistivity Pannonian argillaceous sediments, which can be correlated with the Miocene of the boreholes of Baja.