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SOURCES OF MAGNETIC ANOMALIES IN THE PRE-TERTIARY BASEMENT OF EASTERN SLOVAKIA (CZECHO-SLOVAKIA)

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Abstract: Quantitative interpretation of magnetic anomalies,the sources of which lie in the Inner Carpathian subjacent rocks in eastern Slovakia, have made it possible to determine probable locations of these sources in a geological section. Derived aeromagnetic maps have provided information on areal distribution of these specific rocks partly underlying near-surface neovolcanic complexes. Petrophysical studies of rock drillcore samples have shown that the magnetic anomalies are caused by variously serpentinized (lizardite, chrysotile) peridotites resembling highly serpentinized spinel peridotites present in a number of tectonically confined bodies of the Meliata Group. The above-mentioned common characteristics make us assume mutual genetic relationships between these rocks, and their common spatial as well as temporal origin during the formation of the "Meliata–Vardar" oceanic crust.

Key words: Western Carpathians, Transcarpathian Depression, magnetic anomalies.

Introduction

First ground orientative investigations of geomagnetic field in eastern Slovakia (1 to 2 observation points per km^2) were carried out by Šutor and Hadamovský (1955) and later by Šutor and Čekan (1965). The results obtained were illustrated in maps of Δ Z isoanomalies with accuracy from 3 to 5 *nT*. In addition to anomalies due to Miocene volcanic rocks, first manifestations ot the Sečovce, Komárovce and Bzenov anomalies were also identified.

In 1959 and 1960 there followed more detailed investigation of the Eastern Slovakian Lowland (Man, 1961) with 3 to 4 observation points per km^2. This investigation delineated the regional Eastern Slovakian magnetic anomaly between the Slanské vrchy Mts. and Transcarpathian Ukraine whose source lies in rocks of the pre-Tertiary basement (Man, l. c.). The measurements also indicated the Nižný Hrabovec–Lúčky anomalous belt (Zbudza anomaly according to Gnojek, 1987a) that, until recently, numerous authors associated with volcanic rocks of the Vihorlat Mts. The Zbudza – 1 drillhole (Magyar et al. 1986) situated at the top part of this anomaly proved the presence of intensely serpentinized peridotites and confirmed earlier assumptions of Man (1961) as well as Pospíšil and Bodoky (1981) on the existence of magnetically anomalous rocks in the pre-Tertiary basement of the Transcarpathian Depression.

Magnetic measurements in western part of the Košice Basin (Filo, 1966) revealed extensive anomalies southwest of Košice. Follow-up Ko-1 drillhole at the village of Komárovce also proved a serpentinized ultramafic complex beneath the basin's Neogene filling (Snopko and Vass, 1966).

Regional airborne magnetic messurements (Beneš, 1972; Gnojek et al., 1981, 1982) defined in more detail the extent and intensity of some anomalies.

Realistic modelling of anomaly sources in the pre-Tertiary basement requires magnetic susceptibility data of rocks which give rise to magnetic anomalies. Susceptibility of rocks overlain by Neogene basinal fillings, however, can be measured only at samples from drillholes that penetrated into the pre-Tertiary basement. These drillholes, however, were not continuously cored. Although measured densities and susceptibilities of subjacent rocks (Píchová, 1986; Mořkovský and Píchová, 1988) are only of orientative character, their importance for modelling of anomaly source bodies is decisive.

To objectively evaluate sources of the magnetic anomalies, we have collected some more samples of subjacent rocks from drill cores. Their physical properties and petrology have been studied, the latter in detail. This concerns mainly the Rebrín-1 drillhole where neither densities nor susceptibilities were previously determined and Komárovce-1*drillhole which lacked data on rock susceptibility. The drillcore samples have been provided by the Moravské naftové doly Co. Michalovce and by one of the authors of this paper (D. Hovorka).

*Sečovce anomaly represents the more intensive, western part of the regional Eastern Slovakian magnetic anomaly, whereas southeastern part of this regional anomaly is designated as the Veľké Kapušany one. See page 170.

Position of magnetic sources in the pre-Tertiary basement

The magnetic measurements described earlier in this article have revealed extensive magnetic anomalies in broader vicinity of the Czechoslovak part of the Transcarpathian Depression (Fig. 1): – Sečovce⁺ anomaly, Zbudza anomaly, Bzenov anomaly, Komárovce anomaly and Kisvárda anomaly (in the Hungarian territory).

Parametrěs of these anomalies as well as drilling and seismic data suggest that the anomalies lie in the basin's pre-Tertiary basement.

Eastern continuation of the Bzenov anomaly obscured by the effects of the Prešov urban agglomeration remains problematic. West of the Bzenov anomaly there appears a similar, but smaller anomaly near the village of Široké, east of the Branisko Massif. No magnetic measurements have so far been made west of the Branisko Mts. Southeastern continuation of the Sečovce anomaly, i. e. the Veľké Kapušany tract of this extensive anomaly, still remains unresolved because its magnetic-field pattern is complicated by the presence of buried Neogene volcanic rocks of precisely unknown depth and thickness. Nevertheless, existence of a magnetic source beneath the Tertiary sequences cannot be ruled out in this territoty.

Sečovce and Zbudza anomalies

Nearly the whole eastern tract of the Transcarpathian Depression (TD in the following text) is occupied by a large magnetic anomaly whose highest values occur some 10 *km* southwest of Michalovce (Fig. 2). It has been designated as

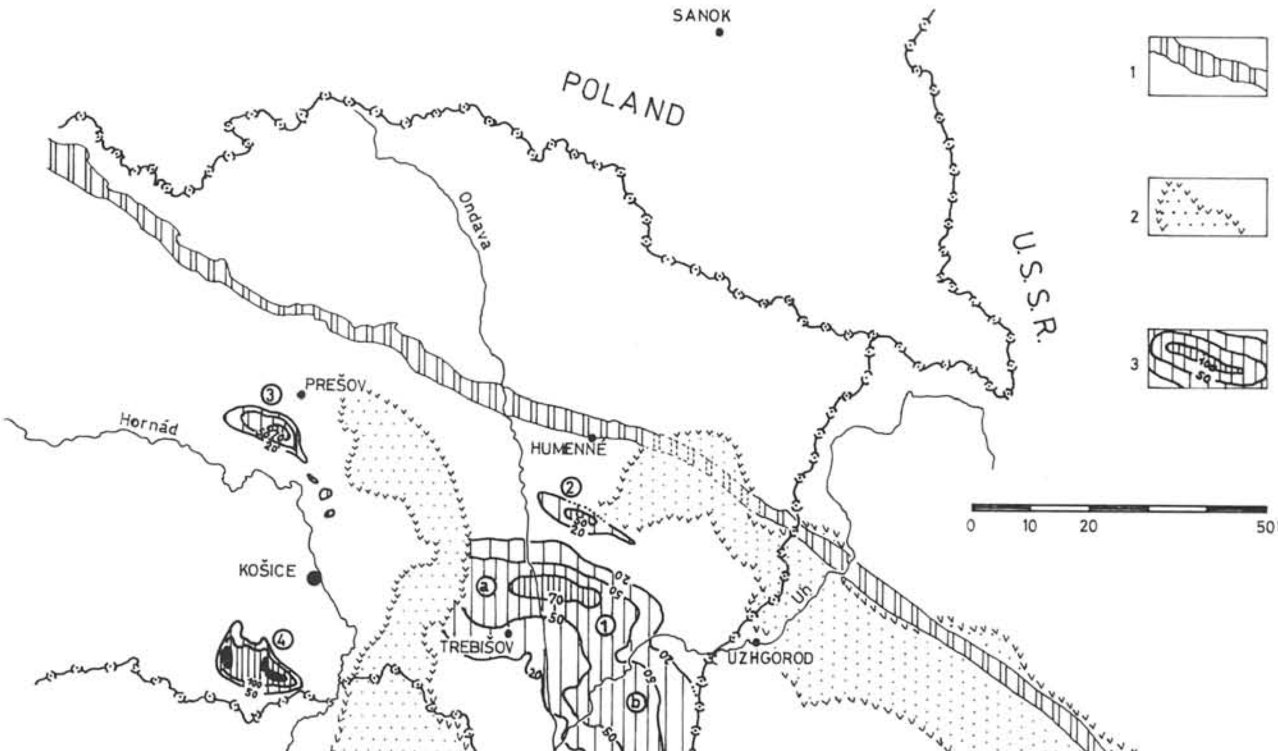


Fig. 1. Magnetic anomalies caused by geological sources situated in pre-Tertiary basement in the SE Slovakia and NE Hungary.
1 – Klippen Belt dividing the Outer Carpathians (NE of the belt) and the Inner Carpathians (SW of the belt); 2 – contours of the outcropping magneticaly anomalous neovolcanic rocks (predominantly andesites); 3 – schematic position of magnetic anomalies caused by basement rocks: 1 ... magnetic anomaly of the East Slovakian Lowland a) the Sečovce W-part; b) the Veľké Kapušany SE-part. 2 ... the Zbudza magnetic anomaly, 3 ... the Bzenov magnetic anomaly, 4 ... the Komárovce magnetic anomaly, 5 ... the Kisvárda magnetic anomaly, numbers on contours in nT (nanotesla), magnetic response of neovolcanics omitted.

the Sečovce anomaly (Man, 1961). Near the TD northern margin, NNW of Michalovce there lies an elongated, smaller anomaly denominated the Zbudza anomaly. In the area of the Sečovce and Zbudza magnetic anomalies, many drillholes penetrated into the pre-Tertiary basement and thus provided data useful in the geophysical and geological interpretations. The drillholes allowed to characterize the principal rock complexes and their physical parametres.

Rock characteristics

Zbudza-1 drillhole: An ultramafic body intersected at a depth interval from 2730 to 2900 *m* yielded small fragments of an ultramafic rock with abundant light-green fault-polish serpentines. The rocks is characterized by the presence of lizardites (= bastites in earlier nomenclature) up to 5 *mm* in size and exceptional accessory brown spinels ("chromites"). Fragments of the ultramafic rocks contain hair-like (asbestos-type) chrysotile. The rock is a chrysotile-lizardite variety of the original spinel harzburgite-type peridotite with abundant magnetite (2–3 vol. %) produced by serpentinization. The degree of serpentinization is high, amounting to nearly 100 %.

Mineral composition and structural development of the rock (subjected to serpentinization) are very similar to those of other serpentinite bodies present in Mesozoic sequences (Meliata Group) of the Western Carpathian Gemeric (Inner) zone.

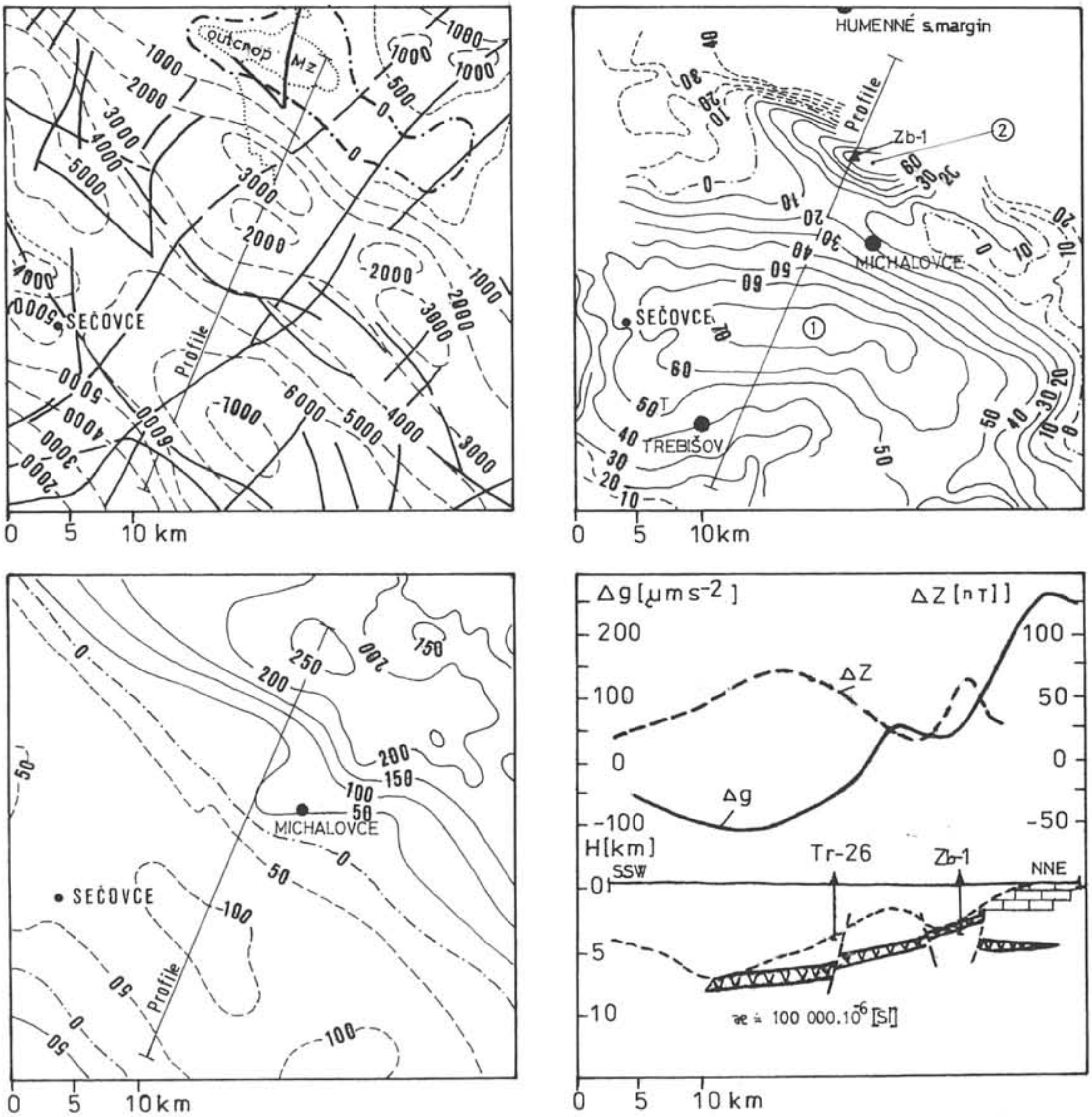


Fig. 2. The Sečovce and the Zbudza magnetic anomalies (i. e. the NW part of the "regional" anomaly of the East Slovakian Lowland). Upper left – pre-Tertiary basement relief, based on the gravity, seismic and borehole data; numbers on contours are altitudes in meters below sea level. Upper right – magnetic anomalies – vertical component (according O to Man 1961); numbers on contours are in *nT* (nanotesla): 1 ... the Sešovce anomaly, 2 ... the Zbudza anomaly with the borehole Zbudza (Zb-1). Lower left – gravity anomalies; numbers on contours in $\mu m.s^{-2}$ Lower right – interpretation profile along the line shown on all previous squares, dashed line-basement surface, v-hatched area – magnetic rocks in cross-section; Tr-26 and Zb-1 – boreholes that reached the basement, brick-like area – Mesozoic. Note: The bodies of the sources of anomalies shown in section in Figs. 2, 3, 4 and 6 (lower right) are reduced and generalized from the original results of modelling on more detailed scales.

Table 1. Additional assesments of volume (D_o) and mineralogical (D_m) densities, porosity (P) and magnetic susceptibility (KAPA) and magnetic anomaly (by Dr. E. Píchová, Geofyzika, St. Co., Brno).

dillhole/depth	D_o	D_m	P	KAPA	rock type
m	$g.cm^{-3}$	$g.cm^{-3}$	%	$10^{-6}u.SI$	
Zbudza — 1					
2803—2808					
core 11a	2.835	2.866	1.1	64 018	serpentinized peridotite
core 11b	2.596	2.676	2.9	127 167	serpentinized peridotite
Rebrín — 1					
3575—3578					
core 60	2.746	2.765	0.7	188	laminated siltstone to silty shale
3599—3602.8					
core 61	2.791	2.808	0.6	298	laminated siltstone to silty shale
	2.795	2.802	0.2		
3624—3626					
core 62/A	2.898	2.914	0.5	413	laminated siltstone to silty shale
	2.899	2.905	0.2		
3624—3626					
core 62/B	2.801	2.824	0.8	247	laminated siltstone to silty shale
	2.802	2.816	0.5		
3650—3653.6					
core 63	2.815	2.820	0.2	535	laminated siltstone to silty shale
	2.816	2.819	0.1		
3678—3681					
core 64	2.810	2.816	0.2	554	laminated siltstone to silty shale
	2.813	2.815	0.1		with volcanic admixture
Senné — 8					
3432—3436					
core 10	2.587	2.695	4.0	357	serpentinized peridotite
core 10a	2.559	2.673	4.2	404	serpentinized peridotite
core 10b	2.499	2.662	6.2	501	chlorite phyllite
Iňačovce — 1					
3110—3115					
core 13a	2.728	2.735	0.3	296	tectonite, originally
core 13b	2.791	2.799	0.3	361	volcano-sedimentary rock
Blat. Polianka					
1495—1500					
core 7	2.739	2.768	1.0	152	silty shale

All determined magnetic susceptibilities of this serpentinite (Píchová, 1986; Gnojek, 1987a) have reached very high values: 232 000, 136 440, 99 220 and 109 160.10^{-6} units (SI). We have carried out additional measurements of remaining drillcore fragments (Tab. 1). That is why new modelling of the bodies capable of explaning measured magnetic fields employed volume susceptibility amounting to 60−100.10^{-3} units (SI), i. e. average susceptibility of the "Zbudza" serpentinized peridotite rounded down.

Rebrín-1 drillhole: 6 samples of subjacent rocks from various depths have been studied. They represent thin-laminated clayey-silty shales with multiply alternating clayey and quartzy laminae, mostly folded in detail. They are dominated by quartz of silt grainsize. Clay minerals were locally recrystallized into sericite aggregates. The shales contain accessory chlorite and pyrite. The rock is carbonatized in places, with carbonate-filled veinlets.

Physical property studies of rocks intersected by the Rebrín-1 drillhole in the pre-Tertiary basement have revealed high-density rocks with minimum magnetic susceptibilities (Tab. 1). Measured densities as well as manifestations of carbonatization suggest possible occurrences of dolomitic rocks in the neighbourhood.

Senné-8 drillhole: We have studied dark gray-green, macroscopically aphanitic serpentinite fragments from a depth of 3432−3436 *mm*. The serpentinite is intensively tectonically fractured, the fragments being cemented by thin (1−2 *mm*) to hair-like carbonate veinlets.

The rock contains no relics of the original mineral assemblage. It falls into the group of lizardite-chrysotile serpentinites. Its serpentinization was followed by intensive carbonatization (largely hair-like veinlets – diffusion replacement carbonatization of the rock is very rare) and intensive steatization. Talc forms: a) diffusion-type macroscopic aggregates replacing serpentinite; b) fracture fillings made up of distinctly scaled talc.

The rock contains accessory magnetites and dark-coloured aggregates of fibrous-scaled minerals with distinct brown pleochroism (Mg-silicate and/or brucite). Very low susceptibility of the serpentinite probably results from its intensive tectonic fracturing and subsequent carbonatization. The drillhole is located at the northeastern margin or outside the source of the Sečovce anomaly.

Iňačovce-3 drillhole: Studied samples from a depth of 3110–3115 *m* are represented by locally recrystallized (sericite), originally clayey-quartzy shales with laminated as well as homogenous structure. The rock contains quartz and plagioclase lithoclasts of volcanic origin. Studied drillcore samples is tectonite of an original volcanosedimentary rock.

Blatná Polianka-7 drillhole: drillcore No. 7 (1495–1500 *m*) was available. It is represented by a laminated sedimentary rock composed of ligth-coloured illitic mica laminae. These are intensively folded and locally contain abundant admixture of organic matter. Layers of silt-grain-sized quartz comprise also variable amounts of carbonates.

Interpretation

The extensive Sečovce anomaly has been attracting attention since the date of its discovery. Man's (1961) interpretations indicating the depth of the source's upper plane of 6–8 *km* were followed by those of Rudinec (1976). Pospíšil and Filo (1977) assumed that susceptibility of the source body amounts to a mere 5000.10^{-6} units (SI), the ceiling of this 12 *km*-wide body being at a depth of 5.5 *km*. They also expected that the mafic body assumed in the Sečovce tract of the central depression immediately underlies its Neogene filling. These authors indicated that the body plunges towards the northeast, its lower boundaries being unknown.

The latest analysis of the Sečovce and Zbudza anomalies has been provided by Mořkovský and Čverčko (1987) and Gnojek (1987a). They have already taken advantage of data from drillholes that penetrated into the pre-Tertiary basement. Very valuable information came from the Zbudza-1 drillhole located 7 *km* NNW of Michalovce that, at a depth of 2730–2900 *m*, intersected highly serpentinized peridotite which may be regarded as the source of the Zbudza anomaly.

Our interpretation section shown in Fig. 2 beginning 4 *km* SSE of Trebišov, passing through Bánovce n. O., Zbudza-1 drillhole and ending on the northern periphery of the Humenné Mesozoic intersected at an appropriate azimuth the maxima of the Sečovce and Zbudza anomalies. The major Sečovce anomaly may be explained by the existence of a source with magnetic susceptibility of $100\,000.10^{-6}$ units SI. This some 1 *km* thick body lies almost subhorizontally at a depth of 6 to 6.5 *km* and is tectonically confined in the south (contact between the Zemplín and Iňačovce-Kričevo units?) as well as in the north (probably by the Močarany-Topľa fault system). NNE of this fault system, the model source body ascends to approx. 4.5 *km* and its thickness diminishes. Different levels of regional magnetic field in northern and southern tracts of the Slanské vrchy Mts. noted by Filo (in Pospíšil and Filo, 1977) as well as magnetic-field pattern in derived maps compiled by us in 1988 suggest that the Sečovce anomaly source extends further beneath the southern part of the Slanské vrchy Mts., presumably as far as the fault system confining the Herľany elevation in the south (sensu Pospíšil, 1980).

A more complicated tract of the investigated field, i. e. transient area between the Sečovce and Zbudza anomalies as well as the Zbudza anomaly itself including its northern minimum is explained by Gnojek (1987a) in two ways: one-layer or two-layer models. Both these model solutions respect principal tectonic elements so far known in the area, and magnetic effects of model bodies correspond very well to the measured field. The two-layer model assuming two superposed subhorizontal subjacent bodies in the Zbudza anomaly area so far lacks geological evidence.

Additional quantitative information on slightly magnetic subjacent rocks from the Senné-8 drillhole has resulted from a study on temperature-magnetic properties relationships in core samples from this drillhole. This study indicates (P. Muška, pers. comm.)that the subjacent rocks representing sources of the magnetic anomalies are unlikely to have undergone temperatures above 100 °*C*. Metamorphic manifestations in these rocks therefore probably resulted from dynamometamorphic processes that took place at fairly low temperatures (below 100 °*C*).

Bzenov anomaly

Airborne geophysical mapping in the Branisko–Čierna hora area (Gnojek and Dědáček, 1981) has confirmed a significant magnetic anomaly with an amplitude of 70 nT situated 2 *km* east of the village of Bzenov on the southeast periphery of the Šarišská vrchovina Upland (Fig. 3). Its existence was first noted by Šutor and Čekan (1965), but little interpretation attention was paid to it. As late as 1980s, Pospíšil (1983) emphasized its importance. The source of this anomaly has not yet been intersected by drilling.

Gnojek (1987b) has worked out the latest quantitative interpretation of this anomaly in two variants: One of them suggests that the anomaly source is represented by a major subjacent crystalline body. This interpretation, however, is contradicted by the results of seismic investigations (Daněček et al., 1982) and vertical electric sounding (Májovský and Tkáčová, 1983) and is therefore regarded by us as improbable. The other, more likely model assumes that the anomaly is due to mafic to ultramafic rocks present amidst Mesozoic carbonate formations whose existence under the Innercarpathian Paleogene at depths over 1000 *m* is indicated by seismic investigations. Assuming susceptibility of $20\,000.10^{-6}$ units (SI), which is typical of gabbros and peridotites (unaffected by intensive serpentinization), the Bzenov anomaly may be explained as an irregular body of these rocks mildly plunging towards the NNE whose top is approx. 1900 *m* below below the ground.

The importance of this anomaly for geotectonic analysis of the territory is increased by two facts: 1) the anomaly extends further beyond the Hornád line; and 2) serpentinites were intersected by the V-1 drillhole on the southern periphery of Prešov at a depth of 18 *m* (Slávik, 1974). This discovery of near-surface ultramafic rocks justifies speculations that, like in the sedimentary basin of the Merník conglomerates, also in the vicinity of the "Bzenov source" in Innercarpathian

Paleogene sediments there might have occurred olistolith bodies made up not only of Mesozoic carbonates, but also of ultramafic rocks (e. g. near Sedlice). The olistoliths might have represented "traces" towards a deep-seated magnetic source.

Komárovce anomaly

The anomaly has been identified in the SW part of the Košice Basin. This magnetic anomaly is extensive, complex-structured (Fig. 4), with local amplitudes of the Z-component approaching 500 nT (Filo, 1966). The Komárovce (Ko-1) drillhole located in the southern part of the anomaly intersected serpentinized peridotites to serpentinites at the depth of 944 m and bottomed at 1534 m without reaching their footwall.

This anomaly is therefore caused by a major ultramafic body. Its northwestern part approaches the surface, the fact indicated by fossil lateritic-weathering products found in shallow drillholes.

Rock characteristics

The most abundant rocks in the drillholes here are highly serpentinized spinel peridotites (harzburgites and lherzolites) along with lesser amounts of dunites and pyroxenites.

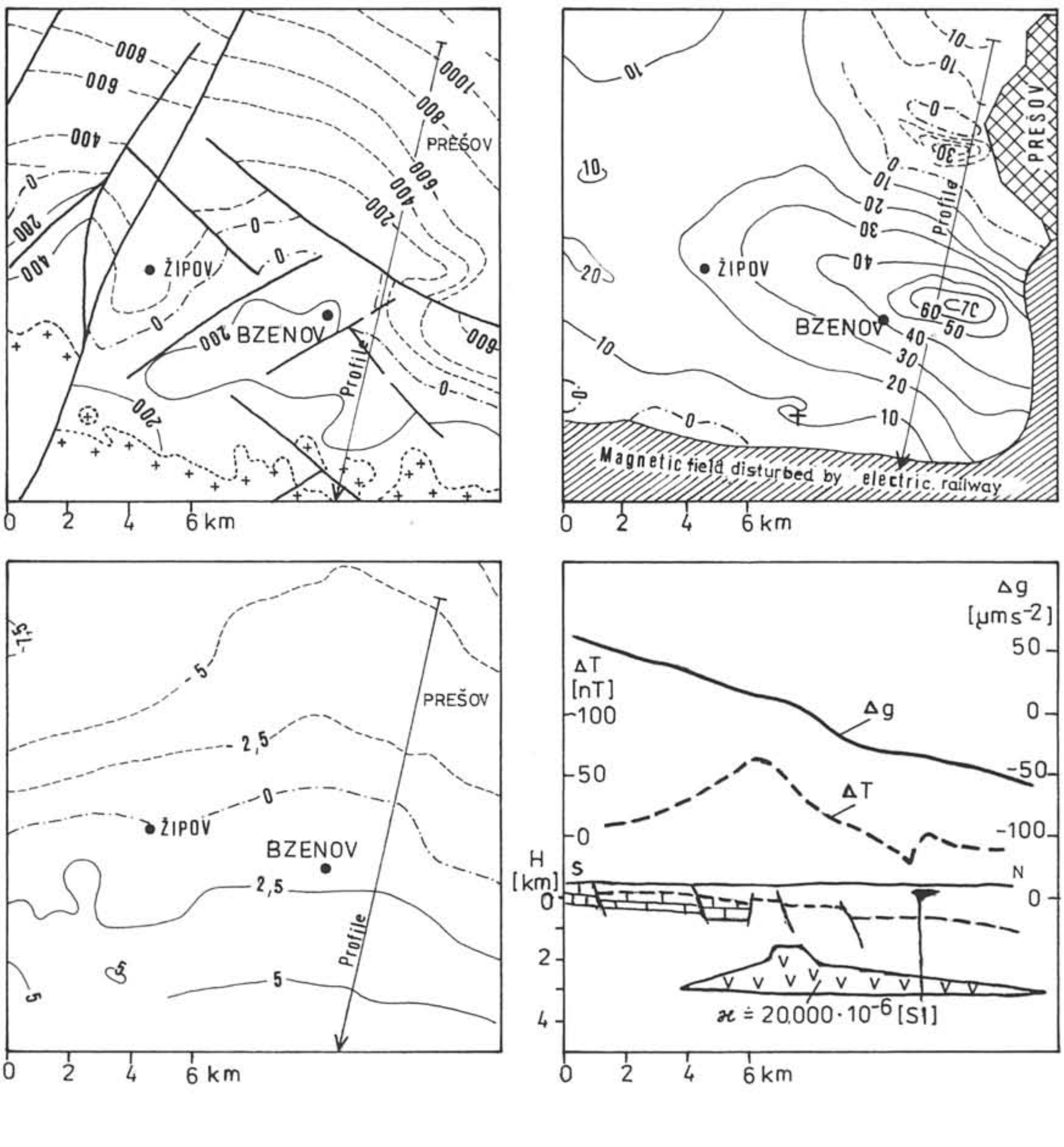


Fig. 3. The Bzenov magnetic anomaly.

Upper left – pre-Tertiary basement relief scheme, based on gravity and seismic data; numbers on contours are altitudes in meters below sea level.

Upper right – the Bzenov magnetic anomaly; numbers on contours in nT (nanotesla).

Lower left – gravity anomalies; numbers on contours in $\mu m.s^{-2}$.

Lower right – interpretation profile along the line shown on all previous squares, dashed line-basement surface according to seismic data, v-hatched area – cross-section of the magnetic anomaly source body, shaded area – neovolcanics.

Serpentine minerals are dominated by lizardite and chrysotile, the latter forming not only the rock mass together with lizardite but also fillings of hair-like veinlets. Composition of this ultramafic body equals those of similar bodies in the Meliata Group of the Gemeric Mesozoic.

Physical-properties study of rocks collected from the Ko-1 drillhole (Tab. 2) has demonstrated considerable variability of their physical properties depending upon the degree of serpentinization. Relationship trend between densities and susceptibilities is shown in Fig. 5. In general, we may say that magnetic susceptibility increases and densities drop with the increasing degree of serpentinization.

Interpretation

Analysis of the Komárovce magnetic anomaly was first worked out by Plančár et al. (1977) who not only determined the top of the ultramafic complex but also delineated faults dissecting this complex body. They assume that the ceiling of the magnetic body gradually plunges from the north to the south and from the northwest to the southeast; from some 50 *m* as deep as approx. 1000 *m* in the vicinity of the village of Seňa.

Kubeš and Gnojek (1989) investigated mainly the lower boundary of the ground concerned which they expect to be

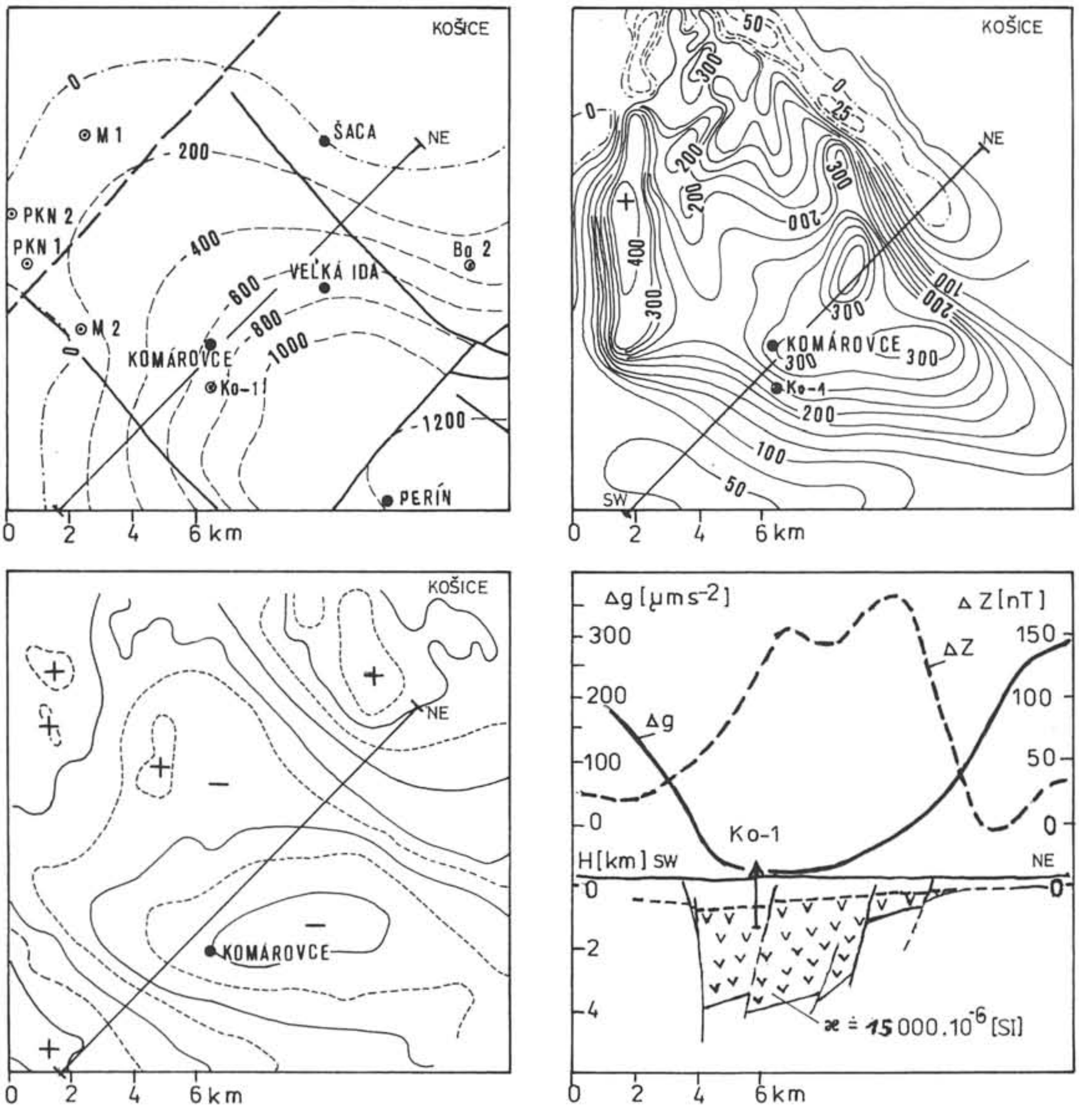


Fig. 4. The Komárovce magnetic anomaly.

Upper left – pre-Tertiary basement relief scheme, based on the gravity, borehole and partly also seismic and magnetic data; numbers on contours are altitudes in metres below sea level.

Upper right – magnetic anomaly – vertical component (according to M. Filo); numbers on contours in *nT* (nanotesla), Ko-1 – borehole Komárovce-1.

Lower left – gravity anomalies; numbers on contours in $\mu m.s^{-2}$. Lower right – interpretation profile delimited on all previous squares, dashed line – basement surface, v-hatched area – cross-section of the magnetic anomaly source body.

3−4 *km* below the surface at the body's susceptibility of about 15 000.10^{-6} SI units, or even deeper using the mean susceptibility lesser than 10 000. 10^{-6} SI units.

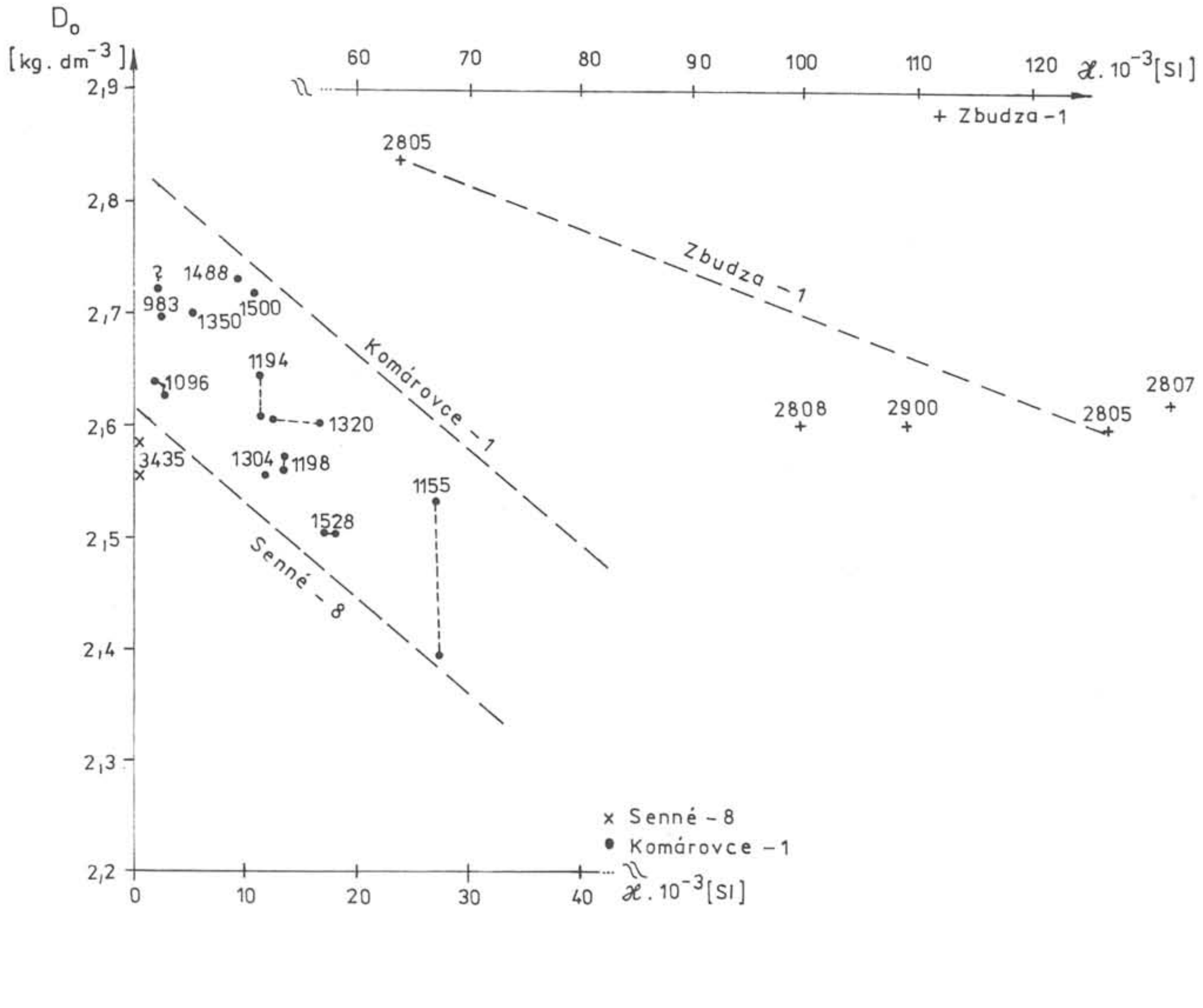
Kisvárda anomaly

The magnetic anomaly near the Hungarian town of Kisvárda (Fig. 6) was first analysed by Posgay (1967). The source was assigned into the pre-Tertiary basement but was not geologically interpreted in detail. Its upper boundary was determined at a depth of 2 *km*.

Later seismic survey (Bodoky et al., 1974) and a complex evaluation of gravimetric, magnetic and seismic data (Pospíšil and Bodoky, 1981) once again indicated the presence of magnetic rocks in the pre-Neogene basement, probably on the tectonic northern margin of a basement elevation south of Kisvárda. The Kisvárda-1 drillhole (1200 m) did not reach the lower boundary of the Neogene filling and therefore did not intersect the magnetic source. Latest maps of the pre-Tertiary basement relief in this area (Kilényi and Rumpler, 1985), however, indicate greater thicknesses of the Tertiary including occurrences of Sarmatian−Badenian volcanics 3200 *m* proved by Komoró, K-1 drillhole. Magnetic effects of the volcanic rocks give rise to an additional component superimposed in the top part of the Kisvárda magnetic anomaly itself. This complicates interpretation of

Table 2. The Komárovce Ko-1 drillhole (finished in 1966). Additional assesments of volume (D_o) and mineralogical (D_m) densities, porosity (P) and magnetic susceptibility (KAPA); by Dr. E. Píchová, Geofyzika, St. Co., Brno, 1988.

depth		D_o	D_m	P	KAPA
m		g.cm^{-3}	g.cm^{-3}	%	10^{-6} j.SI
983		2.699	2.706	0.2	2 609
1 095.5	a	2.636	2.641	0.2	1 673
	b	2.627	2.634	0.3	2 759
1 155.5	a	2.395	2.581	7.2	20 746
	b	2.533	2.567	1.3	20 710
1 194.0	a	2.643	2.648	0.2	11 259
	b	2.607	2.615	0.3	11 493
1 198	a	2.572	2.578	0.3	13 547
	b	2.561	2.569	0.3	13 285
1 304.2		2.556	2.592	1.4	11 693
1 320.5	a	2.601	2.609	0.3	16 781
	b	2.605	2.615	0.4	12 412
1 350		2.699	2.710	0.4	5 251
1 488	a	2.730	2.737	0.3	9.152
	b	2.717	2.725	0.3	10 699
1 500		2.731	2.736	0.2	11 133
1 528	a	2.506	2.551	1.7	17 114
	b	2.505	2.547	1.7	18 007
depth unknown		2.717	2.803	3.1	2 026



the basement sourse which, as is indicated by gradient courses, causes an anomaly up to 50 *nT*. Assuming susceptibility corresponding to the mean value of the Komárovce-1 and Zbudza-1 drillholes, we may also model the geometry of a tabular magnetic body in the pre-Tertiary basement, the majority of the source's material being at a depth of 3 to 4 *km*.

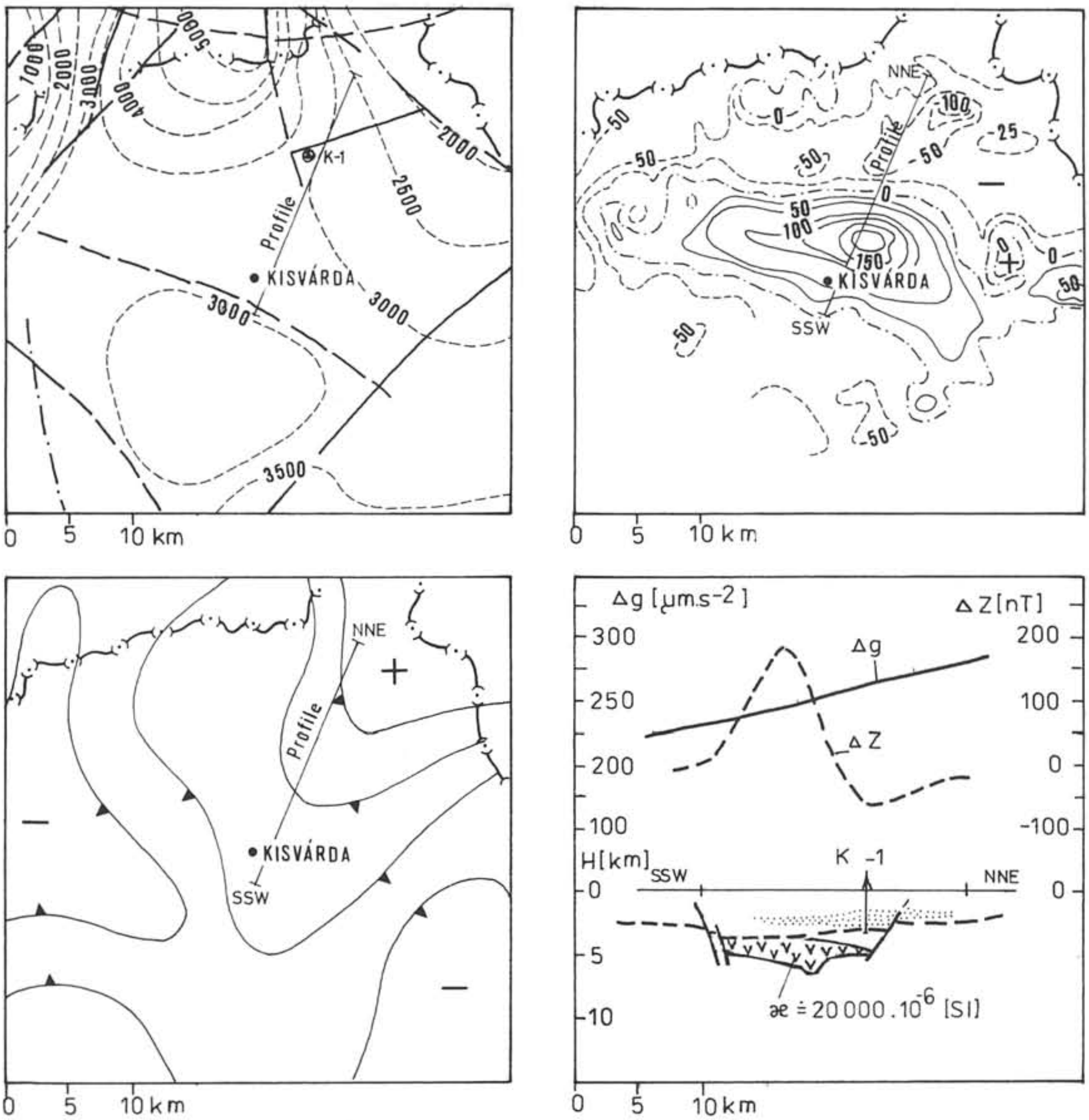


Fig. 6. The Kisvárda magnetic anomaly (NE Hungary).

Upper left – pre-Tertiary basement relief scheme, based on gravity, seismic and borehole data; numbers on contours are altitudes in meters below sea level.

Upper right – magnetic anomaly – vertical component; numbers on contours in *nT* (nanotesla).

Lower left – gravity anomalies, contours interval 25 $\mu m.s^{-2}$. Lower right – interpretation profile delimited on all previous squares, dashed line–basement surface, v-hatched are – cross-section of the supposed basement magnetic anomaly source body, dotted area – volcano-sediments.

Fig. 5. Relations between volume density (D_0) and magnetic susceptibility (χ) determined on samples taken from cores of the boreholes Komárovce-1, Senné-8 and Zbudza-1.

Numbers accompanying the point data represent the depth from which the sample was taken. Points connected with dashed line mean the couple of samples taken from the same depth.

General trend: increasing serpentinization brings the increasing magnetic susceptibility, which is accompanied by the decrease of the density.

Discussion and summary

Interpretation analysis of derived aeromagnetic maps has allowed us to express a hypothesis that subjacent mafic to ultramafic rocks in the vicinity of Trebišov at a depth of some 6 km, which are the source of the Sečovce anomaly, extend further west- and southwestward plunging beneath southern portion of the Slanské vrchy volcanics. Beneath the volcanic mountains, the subjacent rocks are likely to occur at shallower depths of some 3 to 4 *km* their western margin being represented by a tectonic line running from the village of Seňa through the Strechov volcano as far as the vicinity of the town of Vranov n. T. The tectonic line continues further southwest towards the village of Seňa where it is interpreted by us as eastern boundary of the Komárovce anomaly source (Fig. 7).

Similarly, in the southeastern tip of Czecho-Slovakia near Ptrukša and Čierna nad Tisou, the source of the Veľké Kapušany tract of the Eastern Slovakian regional anomaly probably ends at a fault which further south limits western margin of the Kisvárda anomaly source. We thus interpret a sheared belt of upper-mantle mafic to ultramafic rocks penetrated to the crust which might originally have been a continuous body.

In recent years, mineralogy of serpentinized peridotites present in various tectonic Western Carpathian units was studied in detail (Hovorka et al., 1980, 1983). Lizardites and chrysotiles identified in serpentinites intersected by the Senné-8 and Zbudza-1 drillholes as well as in ultramafic bodies southwest of Košice allow us to assume that the composition of these bodies equals that of highly serpentinized spinel peridotites found in the Meliata Group Mesozoic and/or at the base of the Silica nappe allochthon.

Lizardite-chrysotile serpentinites are also abundant in the "Merník Conglomerates". Ultramafic bodies near the eastern margin of the West Carpathians may have been partially exposed on the surface in the pre-Neogene times thus supplying coarse detritus into this conglomerate horizon of Paleogene age.

Numerous works, e. g. Brezsnyanszky and Haas (1986), Fülöp et al. (1987), Balla (1988), Rakús et al. (1989) have recently contributed to the explanation of the position of the

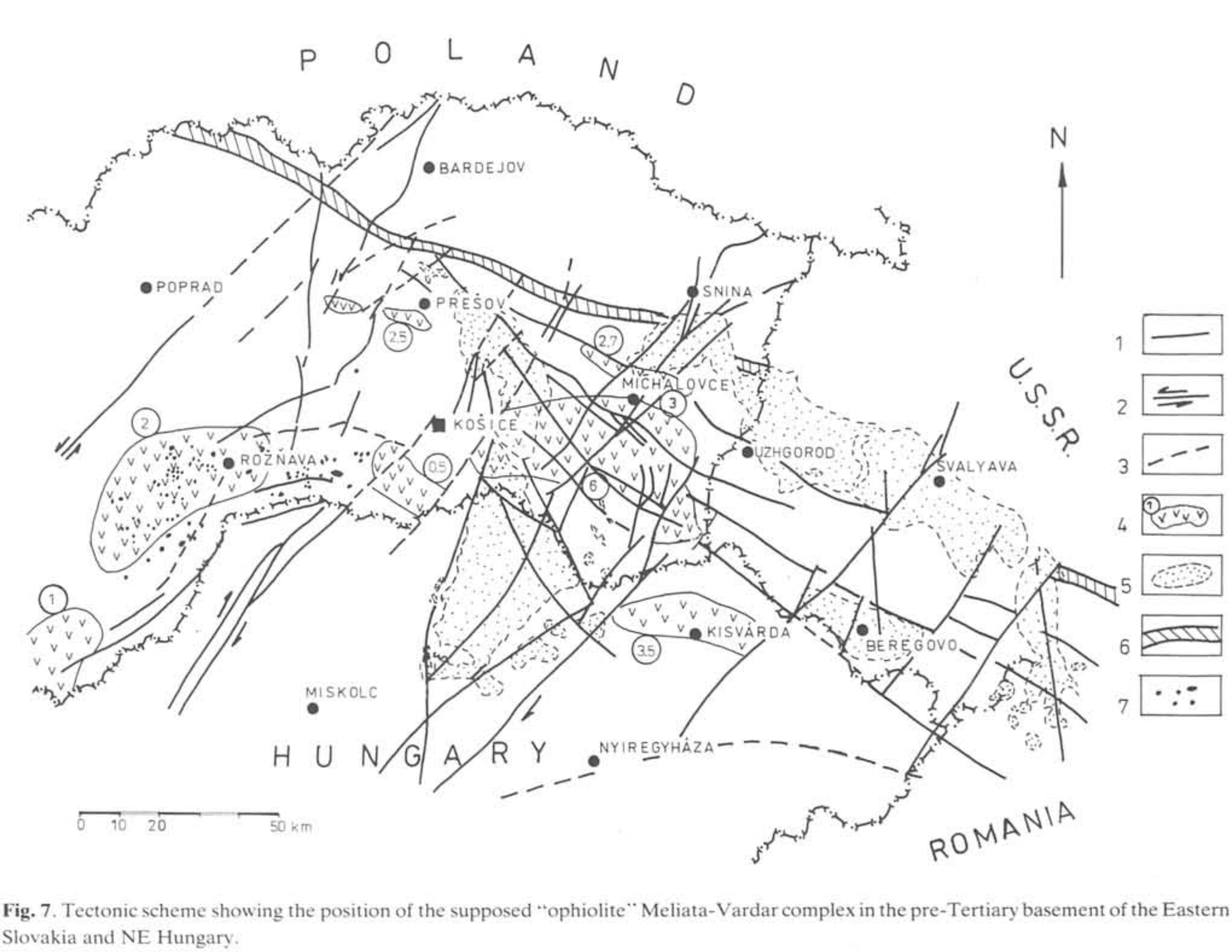


Fig. 7. Tectonic scheme showing the position of the supposed "ophiolite" Meliata-Vardar complex in the pre-Tertiary basement of the Eastern Slovakia and NE Hungary.

1 – fault; 2 – transcurrent fault; 3 – supposed (interpreted) fault; 4 – magnetic rocks (ophiolites?) in the pre-Tertiary basement; (numbers of circles indicate the depth of upper margin of magnetic rocks; 5 – neovolcanics; 6 – Klippen Belt; 7 – near-surface (incl. outcropping) basic and ultrabasic rocks in the Gemer tectonic unit; predominantly small tectonicaly limited bodies.

mafic and ultramafic complexes in the Inner Western Carpathians and Pannonian Basin.

Paleogeographic models put forward by Rakús et al. (pers. comm.) and Haas (1987) indicate that serpentinized peridotite complexes inferred from the magnetic anomalies as well as those intersected by drilling near Komárovce, Zbudza and Senné, and exposed on the surface in tectonically limited fragments of the Meliata Group were originally part of the Meliata-Vardar Ocean area. The ocean became closed as a result of the collision between the Eurasian plate and a tip of the African plate in the Barremian to Albian. The collision area with obducting fragments of the African plate and/or perishing ocean floor was made even more complicated by the development of a transcurrent-fault zone connecting the Pieniny and Meliata-Vardar oceans.

Present-day position and areal distribution of the investigated rock complex are dissected and complicated. This resulted mainly from two tectonically significant periods: *1.* Cretaceous–Oligocene in which Transdanubian Central Range units were displaced as was found out by Kázmer and Kovács (1985); and *2.* Miocene–Pliocene when geological bodies moved into their present-day positions, particularly in the area between the Rába-Muráň line (in the north) and Central-Hungarian line (in the south) as is indicated by Haas (1987) or Pospíšil et al. (in press).

Our models of magnetic-anomalous serpentinized peridotite bodies largely represent plates thinning towards the north, dissected by significant faults in the vicinity of the exposed Transdanubian Central Range units in the south. Geophysically interpreted models of the magnetic-anomaly sources thus suggest their scaled structure. Transcurrent movements in the Transdanubian Central Range, however, bear signs which do not rule out possible effects of lithospheric processes. If lithospheric processes really took place, then no Meliata-Vardar mafic and ultramafic rocks should be found in the lower part of the Transdanubian Range, because they would have been molten in the course of subduction-obduction processes in the Noegene and Paleogene.

On the contrary, if we exclude the effects of these processes thus accepting a meganappe model, we may expect dissected remnants of the original Pieniny and Meliata-Vardar ocean floor beneath the Carpathian-Pannonian complexes (Leško and Varga, 1980; Rakús et al., 1989). Presence of such oceanic rocks is indicated by the numerous magnetic anomalies in northwestern Hungary (in the Pelsó unit which includes also the Transdanubian Central Range). The fact that magnetic-anomalous belts are accompanied by positive gravity anomalies (Pospíšil, 1983) indicates presence of heavy, oceanic-type crust rock complexes.

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