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Methodology of geophysical investigations in the area of the Jeseníky Mts.

Metodika geofyzikálních výzkumů v oblasti Jeseníků

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Abstract: Within the framework of methodology of geophysical investigations in the area of the Jeseníky Mts. mathematical statistics was applied in evaluation of this area. The methods of resultant information content, of discrimination functions, and factor analysis were used. Geoelectric methods, namely the induced polarization method and the transient method were modified in order to achieve large depths of investigation. The procedure for constructing vertical sections of apparent resistivities and chargeabilities was proposed. It was shown that the actual distributions of resistivity and chargeability are best presented by deep vertical sections of standardized resistivities and chargeabilitis in a newly devised way which is described here.

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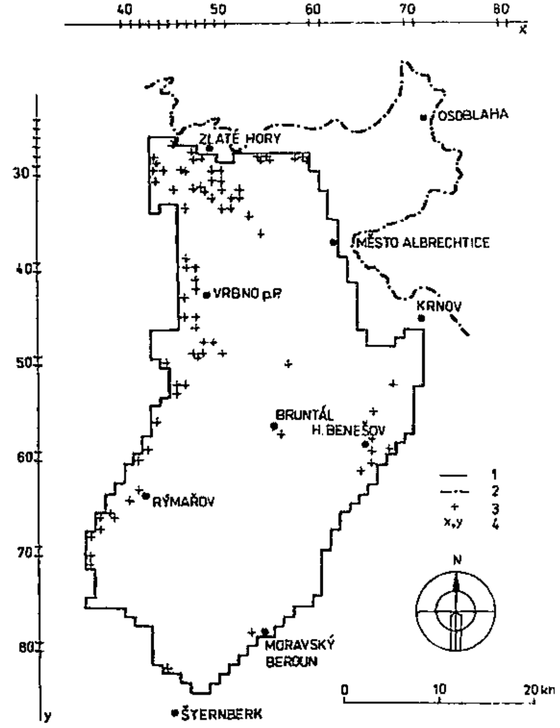
Introduction

The geological investigation conducted in the Jeseníky Mts. in the years 1975 – 85 were oriented towards resolving actual geological problems. On a smaller scale, also methodological research was carried out to develop the method of mathematical statistics for prediction purposes, an introduction of geoelectric methods with larger depth of investigation, and also new methods of geoelectric data processing.

Delimitation of prospective areas by mathematical statistics methods

Ore prospecting, using geophysical and geochemical methods, is not easy and requires a complex approach. But also the sequence of individual survey phases and the closest possible link with geological data must be taken into consideration. These principles were observed in the course of prospecting in the Jeseníky Mts. There, in the first phase, the survey by gravity, airborne, and geoelectric methods was applied on the scale of 1:25,000 for the purposes of regional hydrogeochemical and lithogeochemical investigation. In the next phase, a complex of geophysical methods was employed in prospective area in a regular network of profiles, on the scale of 1:10,000.

The choice of areas for the expensive complex survey on the scale of 1:10,000 is a very responsible task because it directly influences the success and cost of the prospecting. Owing to methods of mathematical statistics, individual types of geophysical and geochemical fields (indications) can be objectively evaluated and the information contained in them evaluated and summed up in one resultant parameter. Depending on the knowledge of deposits and geology of the investigated area, a larger or smaller number of positive and negative standards can be introduced. Thus an important methodological principle will be observed – the link between geophysical, geochemical fields, and data on the deposits and geology of the area.



1. Penetration of planes of followed phenomena. 1 – boundaries of the studied area; 2 – state border with Poland; 3 – positive etalon; 4 – coordinates of kilometer square net.

The following methods of mathematical statistics were used for making the deposit prognosis for the Jeseníky Mts.: the method of resultant information content, the method of discrimination functions, and the method of factor analysis.

The investigated area is built of Devonian rocks of the Rejvíz, Vrbno, and Šternberk-Horní Benešov series, of the Culm of the Nízký Jeseník Mts., of neovolcanites, and Quaternary and Neogene sediments. The Variscan hydrothermal Cu-Pb-Zn deposits are the most significant of all ore deposits. The study area is delimited by the intersection of planes (Fig. 1) on which the observed geophysical indications were detected, i.e. 1– magnetic field (Δ T), 2 – magnetic field pattern, 3 – residual gravity anomaly of zero order,4 – residual gravity anomaly of the third order, 5 – pattern of residual anomalies of zero order, 6 – pattern of residual anomalies of the third order, 7 – residual isostatic anomalies of the third order, 8 – spontaneous polarization field, 9 – spontaneous polarization field pattern, 10 – topofactor; hydrochemical indications: 11 – relative contents of Cu, 12 – of Pb, 13 – of Zn; physical properties of rocks: 14 – porosity, 15 – mineralogical density. The values of geophysical indications were read from a square kilometre grid in 1,200 elementary areas.

According to the method of resultant information content the information contained in each indication is given by the distribution of its positive and negative standards. If no negative standards are specified, the distribution of indications in the whole area can be used instead. The information content of each indication was tested using the Kolmogorov-Smirnov test.

$$D = \max_j \left| F_j^+ - F_j^- \right|$$

where F_j^+ and F_j^- represented relative cumulative frequency of the j^{th} gradation of indication values on positive and negative standards or on positive standards but in the whole area. The mutual dependences of individual indications were evaluated through a correlation matrix.

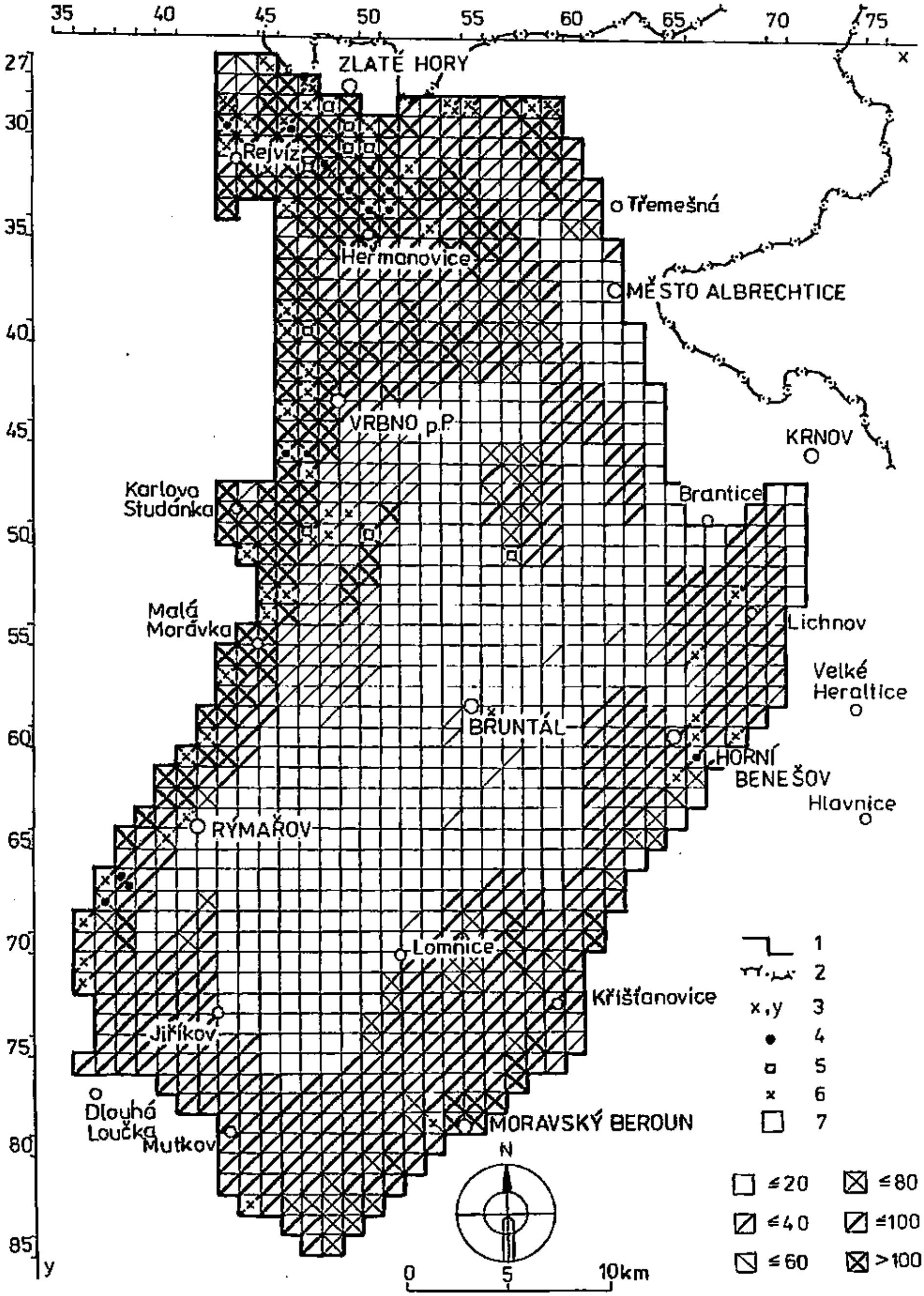
The resultant information content was obtained by the equations:

$$I_P = \sum_{m=1}^{s} \frac{P\,(A_{mi}^{+})}{P\,(A_{mi}^{-})}, \text{ or } I_L = \sum_{m=1}^{s} \log \frac{P(A_{mi}^{+})}{P\,(A_{mi}^{-})}$$

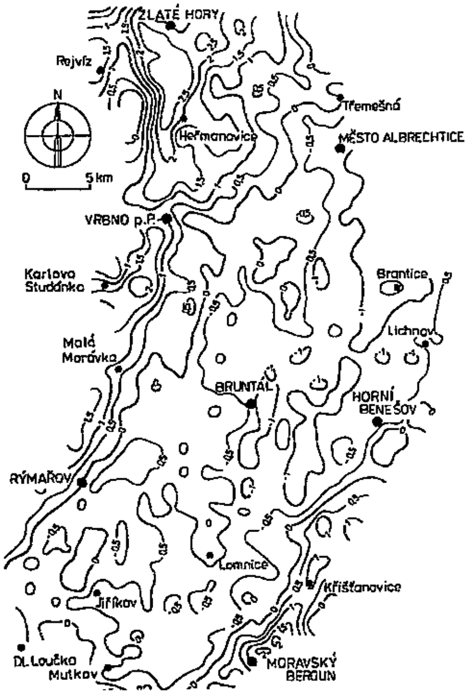
where $P\ (A_{mi}^{+})$ or $P\ (A_{mi}^{-})$ represent the probability of the i^{th} gradation of the m^{th} indication on positive or negative standards, s represents the number of indications from which the parameter is calculated. The probability is expressed by relative frequency. I_P or I_L is calculated for each elementary area on the basis of indication values in that area, and the resulting map is constructed.

The display of results of statistical processing of regional geophysical and geochemical data is variable. The quality of the resulting prediction map depends on the number of indications included and on the manner of calculating the information content which can be, according to the formula chosen, either proportional or logarithmic. Out of the thirty resulting maps, the map of proportional resultant information content of indications 2, 3, 7, 8, and 10 is presented as an example in Fig. 2.

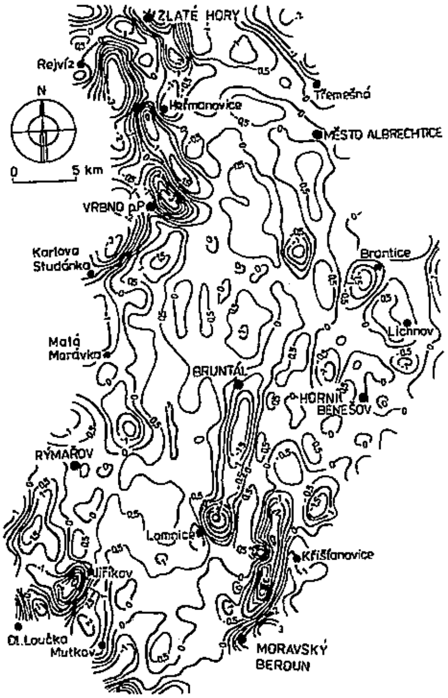
The Zlaté Hory ore district and its broad surroundings, especially the prolongation of the Zlaté Hory ore structure in the SE direction under the Culm sediments are the most conspicuous in the prediction map. Well indicated is also the adjoining part of the Rejvíz series and the whole Devonian Vrbno group stretching in the direction of the towns of Vrbno, Karlova Studánka, Rýmařov, Horní Město to the Upper Moravian depression. Also the Devonian Šternberk-Horní Benešov belt, the deposit of Horní Benešov, and all



2. Map of summary ratio informativeness of indications 2, 3, 7, 8 and 10. 1 – boundaries of the studied area; 2 – state border with Poland; 3 – coordinate of kilometre square net; 4 – deposit; 5 – ore occurrence; 6 – ore indications; 7 – values of summary informativeness.



3. Map of isolines of physicochemical factor.



4. Map of isolines of structural tectonic factor.

ore occurrences found in the places with high resultant information content show positive indications. Less conspicuous are the indications west of Třemešná, south of the town of Albrechtice and between the municipalities of Bruntál, Lomnice and Mutkov. These indications are distributed along the boundary between the Andělská Hora and Horní Benešov Culm series. In these places an elevation of the Devonian can be anticipated beneath the Culm.

The results obtained by the method of discrimination functions are similar, the future prospect of individual areas is not, however, graded.

The method of factor analysis was applied on the same basis as the method of resultant information content. Its task is to study the inner structure of covariance matrix obtained from the set of m indications characterizing a certain phenomenon, in this case the geological structure and prospects of the investigated area as to the polymetallic ore deposits. The individual indications are usually statistically interconnected. Some indications can significantly contribute to resolving the problem under study while the remaining ones do not contribute to it at all. It is advisable to reduce the number m of the variables (indications) so that a smaller number p of new variables $(p < m)$ contained as much information from the original non-reduced variables as possible. At the same time it can be assumed that the new variables (factors) gather the initial indications in such a way that they always characterize a certain aspect of the investigated phenomenon.

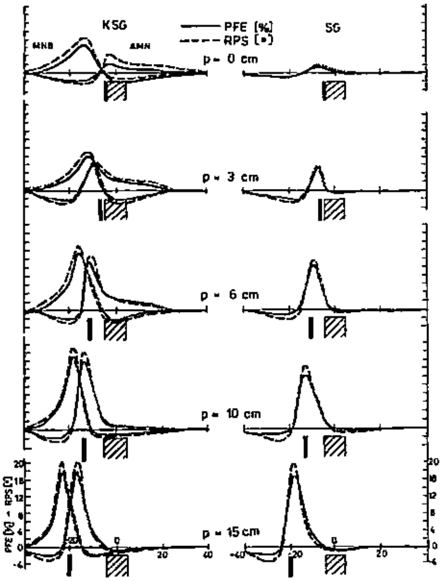
This assumption is clearly confirmed in contour maps of the resultant factors in Figs. 3 and 4. The factor in Fig. 3 can be regarded as a physical- chemical factor closely related to ore mineralization because a prevailing influence of the spontaneous polarization (electrochemical) method is obvious. The factor in Fig. 4 detects a structural-tectonic situation. Methods reflecting the geological structure (residual gravity anomalies of the third order, Δ T field) contribute to its value most.

The map of contours of the factor in Fig. 3 delimits the area prospective for ores. The results are in agreement with the map of proportioned information content (Fig. 2). However, the delimination of prospective areas is more detailed and the contour pattern is clearer.

Methodology of frequency domain IP measurements

The induced polarization method (IP) is the most important geoelectric method in direct ore prospecting. This is why it was used in all field geophysical investigations in the Jeseníky Mts. The methodological research was focused on the application of frequency domain IP measurements and on the development of modification with great depth of investigation.

The frequency domain IP measurements were carried out using the Canadian device IPRF-2 Scintrex operating at frequencies 0.1, 0.3, 1, and 3 Hz. The correct function of the instrument was verified by laboratory model measurements and by comparative measurements at the Rejvíz-Bleskovec locality. During the following phases frequency domain measurements were carried out in the Jeseníky Mts. at the Zámecký vrch, Vidly, Bleskovec, and Zlaté Hory-Pařenec localities. In general the measurements confirmed the main advantage of IP measurements in frequency domain, that means a three times higher field work productivity and the possibility of obtaining sensible data in areas with high background noise caused by disturbing fields. The only disadvantage of the frequency domain IP method is the influence of induction for resistivities under 100 Ωm. The experience with the application of frequency domain IP measurements in Czechoslovakia were described in detail by Kněz (1980).



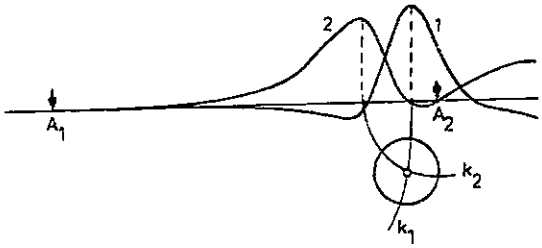
5. Model measuring of IP by combined middle gradient (KSG) and middle gradient (SG) above conductive and nonconductive sheets at variable mutual distance of the sheets *p*.

In order to achieve the greatest possible depth of investigation by the IP method, the electrode arrays with a fixed current circuit are the most advantageous. The corresponding methods are the combined middle gradient method (MG) or the three-electrode gradient method. Besides the standard middle gradient method which was used at the Zámecký vrch and Bleskovec localities, also the in-line middle gradient method was applied at the Zlatý Chlum locality. Using the in-line middle gradient configuration, maximum IP anomalies can be detected as it was already proved by earlier laboratory model measurements (Kněz 1972).

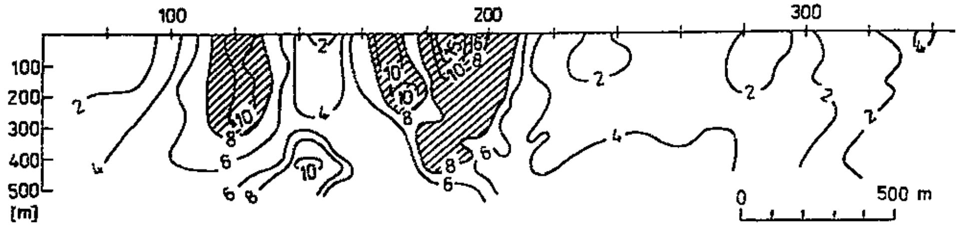
The combined middle gradient modification represented another improvement in applications. This assumption was verified through a series of laboratory model measurements. The results of model monitoring confirmed the advantages of the combined middle gradient method over the classical middle gradient method, namely at resistivity inhomogeneous environment (Fig. 5). The IP anomalies obtained by the combined middle gradient method are more striking and the position of the conductive body can be much more accurately located by the point of intersection of both branches of the curve. These obvious advantages of the combined middle gradient method outweigh the only disadvantage as compared with the classical middle gradient method, which consists in a more complicated technology of field works (the third grounding electrode is placed in the "infinity"). The combined middle gradient method was used with success at the Supíkovice locality.

Another modification of IP measurements with fixed current circuit is the three-electrode (one pole) gradient profiling which, with regular intervals (200 m) between fixed current electrodes, makes it possible to present the results in the form of depth sections. The way of acquiring and processing the data was described in detail in previous publications and reports (e.g. Gruntorád - Kněz 1973). A number of such measurements were taken in the Zlaté Hory ore district and also at the Vidly locality.

There are several ways of transforming the results of measurements into vertical depth sections: situating the measured value of chargeability (resistivity) to various depths (according to the length of the array) below the current electrode, below the centre of potential electrodes or below the centre between the current electrode and the potential electrodes of the array. However, in all these cases the distribution of anomalous values in the depth section does not correspond to the real position of the sought body as it was proved by model monitoring. That is why another way of presenting the depth sections was sought that would correspond better to real positions of the studied objects. The suggested method of constructing multiple parameters sections makes use of the Komarov method (Komarov 1980) of interpreting the centres of isometric bodies (spheres) from two measurements with current electrodes at different positions (Fig. 6). The body



6. Determination of centre position of isometric bodies by IP method at two different positions of a current electrode.



7. Vertical section of standardized polarizabilities at the locality Vidly.

centre lies at the point of intersection of circles whose centres lie in the corresponding current electrodes and the radii are given by the distance of the IP curve maximum. Generalizing this principle the points of intersection of individual circles can be attributed the value of normal product of chargeabilities at corresponding points of curves obtained from measurements in various positions of current electrodes. The values are used for construction of depth sections. This method was used for the processing of measured data at the Vidly locality (Fig. 7). In the depth interval 180 – 200 m the values in the product chargeability section correspond to known ore mineralization. The course of contours indicates its continuation to depth.

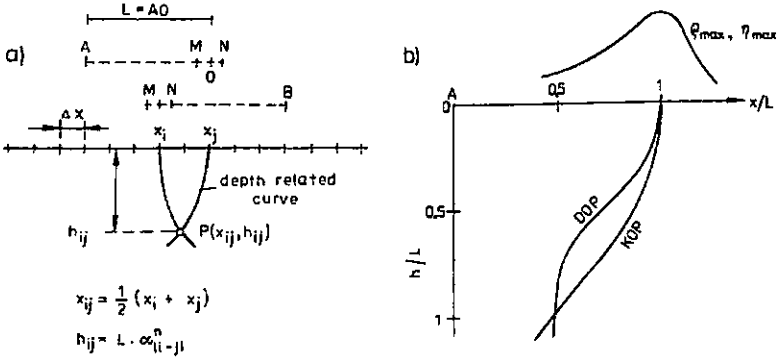
Processing of measured resistivity and IP data into vertical sections

The method of constructing vertical sections of apparent chargeability or of apparent resistivity was gradually developed and generalized also for other configurations with mobile current electrodes. To construct sections of normal chargeabilities or resistivities it is necessary to have two values from each point obtained by measurements with current electrodes or current dipoles at two different positions. The sections can therefore be constructed from data obtained by methods using composite arrangements, i.e. the above mentioned combined middle gradient method, combined profiling or dipole profiling.

While with the combined middle gradient method the analysis of both theoretical and model curves showed that the isometric inhomogeneity lies on the circle below the anomaly extreme, with other electrode configuration the curve differs from the circle (Fig. 8b).

The position of the anomalous object must therefore be sought at the point of intersection of the two curves corresponding to two different positions of grounding the current electrodes. It is possible to construct vertical normal pseudosections manually using the above mentioned curves but it is not suitable to process them by computer.

For computer processing it is convenient to record the values of normal chargeabilities at the points P_{ij} defined by positions x_{ij} on the profile and by depths h_{ij} below the measured profile



8. Principles of construction of vertical sections of standardized polarizabilities or standardized resistivities from a combined dipole-dipole profiling. a – position of points P_{ij} in vertical section below the measured profile, b – so called depth-related curves for localization of an isometric body below the anomaly extreme.

$$\eta_n = \frac{\eta_{zA}\ (x_j)\ .\ \eta_{zA}\ (x_i)}{\eta_{zO}}$$

or to record the values of normal resistivity

$$\rho_n = \frac{\rho_{zA}\,(x_j)\ .\ \rho_{zB}\,(x_i)}{\rho_{zO}}$$

where $\eta_{zA}\,(x_j)$ and $\rho_{zA}\,(x_j)$ correspond to measurements at the point x_j with grounding at point A (at dipole measurements it is the centre of current dipole) and the values $\eta_{zB}\ (x_i)$ and $\rho_{zB}\ (x_i)$ correspond to measurements at the point x_i with grounding at point B. The values η_{zO} and ρ_{zO} are the estimated mean values on a certain profile or in a certain area.

In the vertical sections below the profile the positions of points P_{ij} are specified by coordinates (Fig. 8a):

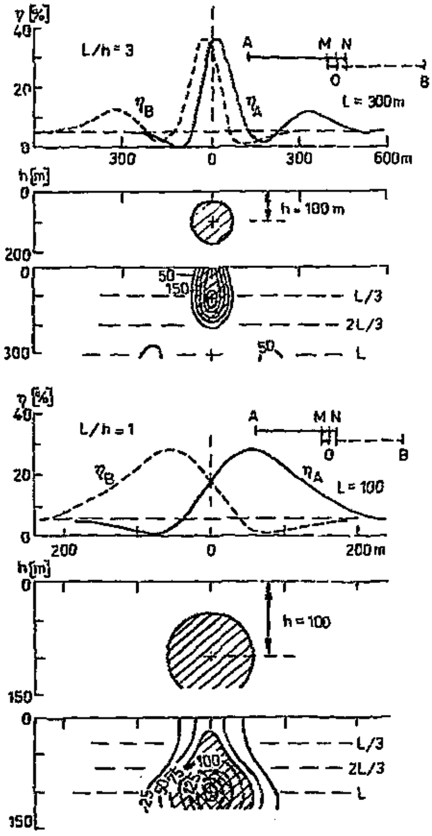
$$x_{ij} = \frac{1}{2}\ (x_i + x_j) = \frac{i+j}{2}\Delta x\ ,\ x_i = i.\ \Delta x,\ x_j = j.\ \Delta x$$

$$h_{ij} = h_m = L.\ \alpha^n_{j-i} = L.\alpha^n_m\ , n = j - i,$$

where $n = L/\ \Delta\ x$ is the ratio of the measurement interval $\Delta\ x$ and the array length $L = AO = OB$ (with combined profiling) or $L = OO' = AM = BN$ (with dipole profiling). Depth coefficients α^n_m are derived from depth curves for isometric inhomogeneity and listed in Table 1.

Table 1. Depth-related coefficients α_m^n

combine profiling						dipole profiling					
m =	n =					m =	n =				
	3	4	5	6	7		3	4	5	6	7
0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
1	0.54	0.47	0.42	0.39	0.36	1	0.38	0.32	0.28	0.25	0.23
2	0.77	0.66	0.60	0.54	0.50	2	0.54	0.46	0.42	0.38	0.34
3	0.99	0.92	0.73	0.66	0.62	3	0.92	0.58	0.50	0.46	0.42
4		0.99	0.85	0.77	0.72	4		0.91	0.62	0.54	0.49
5			0.99	0.88	0.80	5			0.91	0.66	0.56
6				0.99	0.89	6				0.92	0.68
7					0.99	7					0.91



9. Standardized vertical pseudo-sections of polarizability derived from theoretical curves of combined profiling above isometric polarized body at two different ratios of the length of arrangement to the depth of body center *L/h*.

The above ways of the vertical section construction were verified by processing the chargeability curves above isometric bodies for various electrode arrangements (combined middle gradient and dipole profiling). For example, there are sections of normal chargeabilities above the sphere derived from combined profiling surveys in two different modifications :

a) for the array length *L* much greater than anomalous body depth (Fig. 9a), and

b) for the *L*, the same as the depth (Fig. 9b).

In both cases the contour patterns in normal chargeability sections correspond, unlike in classical sections, to the anomalous body shape. Extreme values in sections define almost precisely a centre of the disturbing body. This conclusion holds also for other electrode arrangements.

The distribution of normal chargeability values or of resistivities in sections correspond very well to an actual physical section even under very complicated circumstances. In Fig. 10 vertical section of normal resistivities from the locality Rejvíz is presented as an example, together with interpreted geological profile.

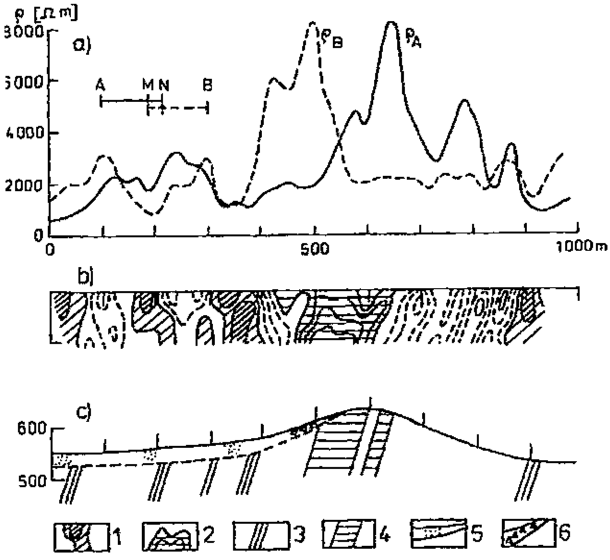
In conclusion the suggested way of processing tested in the Jeseníky Mts. areas promising as it is another step to objectivization of geophysical data interpretation.

Methodology of measurements by the transient EM method

The transient EM method is an inductive electromagnetic method for ore prospecting. It is one of electromagnetic methods which have recently undergone a rapid development both from the instrument and the interpretation point of view. The ground, airborne and well logging versions of this method are used worldwide. The method can be used for direct prospecting for conductive ore bodies and for resolving structural problems in sedimentary basins.

So far only ground variant of the method has been used in Czechoslovakia due to lack of instrumentation. The methodology was oriented towards direct prospecting for single conductive geological bodies (Vacek 1979). The time constant τ of the conductive body, which characterizes the quality of the conductor, was studied as a function of the conductive body shape. From profile curves it is possible to deduce, under favourable conditions, the shape, extent and depth of the conductive body. As interpretation processes and technical equipment abroad were improved, transient EM sounding is more and more used. The sounding can be carried out either in a far or in a near zone.

The principle of the transient EM sounding in the far zone is very similar to that of frequency sounding. Magnetic and electric field components of the horizontal field of the electric dipole are registered most frequently. The values of the electric field



10. Example of standardized vertical resistivity pseudo-section derived from terrain measuring using combined profiling at the locality Rejvíz.
a – resistivity curves of combined profiling; b – vertical resistivity standardized section; c – interpreted geological section;
1 – conductors in isoohmic section; 2 – non-conductors in isoohmic section; 3 – interpreted conductive sheets (graphitized rocks); 4 – interpreted non-conductive sheets (quartzitic rocks); 5 – weathering products of graphitized rocks in eluvium; 6 – debris of quartzitic rocks.

component and time derivation of the magnetic field component do not depend on time in the wave zone. The wave zone is given by the equation:

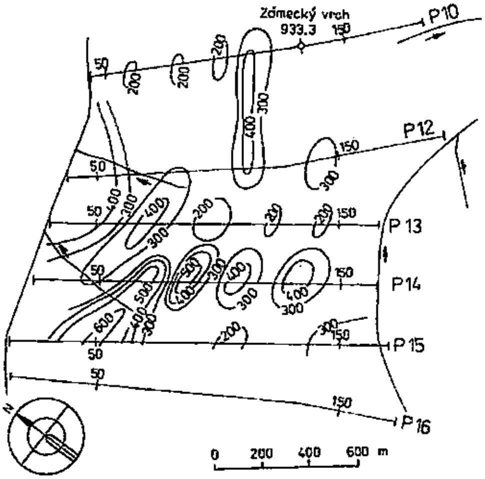
$$u = r\sqrt{\frac{\sigma\mu}{2}t} \gg 1$$

where r is the interval between the generating (electrical) and measuring (magnetic) dipole, the interval corresponding approximately to the depth of the investigated interfaces, σ is the conductivity, t is the time and μ is the magnetic permeability. The registration point is in the middle of the arrangement. At discrete times induced voltage $\varepsilon(t)$ is registered. Values $\varepsilon(t)$ for different times t and calculated resistivities ρ_τ correspond to various depths of investigation. For the interpretation asymptotes and extreme points on the curves are used.

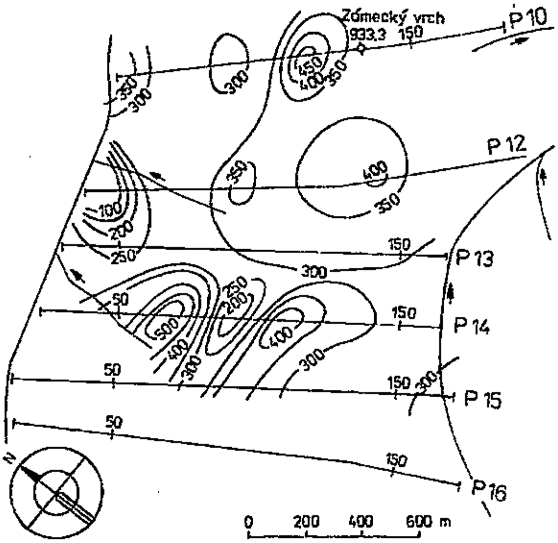
In remote zone, sounding is, in regard to the large size of the arrangement, unsuitable. A way of measuring in near zone for small distances between source circuit and measuring circuit was therefore developed. At first, electric dipole was used as a source. Vertical magnetic element was measured. This methodology is very sensitive to changes in inclination of the underlying rock and therefore it was abandoned. Nowadays the loop-loop systems are largely used. The most common arrangement is a concrete configuration of emitting and receiving loops of equal dimensions. In this case EMS $e(t)$ induced in the measuring loop for $\mu \ll 1$ can be defined by the equation (valid only for thin conductive layer)

$$e(t) = \frac{3M_G M_M}{16S\pi}F, \quad F = \left(H + \frac{t}{\mu_0 S}\right)^{-4}$$

where $M_G = L^2 I$ and $M_M = l^2$ are the moments of the generating and measuring loops,



11. Transient electromagnetic method, map of isolines ρ_τ [Ω m] for t = 1 [ms], locality Zámecký vrch.



12. Transient electromagnetic method, map of isolines H_τ [m] for locality Zámecký vrch.

L and l are the side lengths of the generating and measuring loops and I is the current flowing through the generating loop. S is the longitudinal conductivity of the layer and H is the depth of the position of equivalent conductive layer. The solution of the $e(t_i)$ and $e(t_{i+1})$ set of equations provides us with expressions for longitudinal conductivity S and for the corresponding depth H (Isajev 1979).

$$S = \frac{2}{\mu_0}\left(\frac{2\pi}{3\,M_G M_M \mu_0}\right)^{\frac{1}{3}} \left(\frac{t_{i+1} - t_i}{\dfrac{1}{e\,(t_{i+1})^{\frac{1}{4}}} - \dfrac{1}{e\,(t_i)^{\frac{1}{4}}}}\right)^{\frac{4}{3}}$$

$$H = \left(\frac{3\,M_G M_M}{16\,\pi\,S\,e\,(t_i)}\right)^{\frac{1}{4}} - \frac{t_i}{\mu_0 S}$$

In this case of sounding for isometric bodies and generally deposited sheet-like bodies extreme points on the sounding curve ($t_{\min}$, $\rho_{\tau\,\min}$) are used to determine the depth of conductive objects.

The measurements carried out at the Zámecký vrch locality in the Jeseníky Mts. exemplify the use of the above described method. The measurements were carried out along five profiles P10 – P15 using the Soviet device MPP-3 with a 100 x 100 m loop. Different kinds of gneisses are mapped on the whole territory. Only ends of profiles P10 and P12 reach the area where quartzites are mapped. In the study area the average noise level was found out to be about $8\ \mu V$, which is quite low. In Fig. 11 the course of apparent resistivity ρ_τ is shown. The course of conductive structures depths is in Fig. 12 where the isolines H_τ are depicted. In the western part of the investigated area comparatively regular variations of conductive plane depths can be observed. It may be due to e.g. several slab-like or lenticular conductive bodies that are dipping roughly in the southeast direction. The conductive zone can occasionally be folded. In order to confirm the interpreted data, it would be necessary to carry out measurements in a denser grid and to measure the transition characteristics at earlier and later times which could be done with a better-quality Soviet device Impuls-C.

If the time constant τ, which reaches the maximum value of 9,6 ms on profile 15 at 150 m, is used for the interpretation there is either an inconspicuous ore mineralization or several conductive zones reflecting tectonic lines or resistivity inhomogeneities in rocks.

It can be said that the first results of sounding with the transient EM method suggest new possibilities of this method in ore prospecting and in resolving some structural-geological problems.

Conclusions

In the course of investigations in the area of the Jeseníky Mts. the following main results were obtained:

a) It was proved that the mathematical statistics methods can markedly contribute to the prognosis concerning the evaluation of areas where regional geophysical and geochemical data are at disposal. It is possible to evaluate the contribution of individual methods to the resolution of the given problem and to delimit prospective areas for detailed geophysical investigations.

b) The induced polarization method is the most important geoelectric method for ore prospecting. Advantages and disadvantages of IP frequency measurements were verified and higher productivity of field measurements using its modifications was proved. The method can successfully be applied also in areas with high industrial noise. In order to study the depth of polarizable bodies it is recommended to use either three-electrode gradient or combined middle-gradient profiling methods.

c) Vertical sections of normal resistivities and chargeabilities can be constructed using the data obtained by the three electrode gradient profiling, combined middle gradient method, and combined and dipole profiling. The proposed way of processing the data provides resistivity and chargeability patterns which are close to reality.

d) In the course of research in the methodology of TM measurements a new way of interpretation was proposed for the construction of contour maps of apparent resistivities and of depths to conductive bodies. Time constant can be used to determine the character of the studied conductor.

K tisku doporučil J. Daňko
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Metodika geofyzikálních výzkumů v oblasti Jeseníků

(Resumé anglického textu)

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V rámci metodických geofyzikálních výzkumů v Jeseníkách byly ověřeny možnosti metod matematické statistiky při prognózním ocenění ploch, na nichž jsou k dispozici kompletní geofyzikální a geochemické podklady. Byly použity metody sumárních informativností, diskriminačních funkcí a faktorové analýzy.

Dále byly rozpracovány geoelektrické metody s velkým hloubkovým dosahem, především metoda vyzvané polarizace a metoda přechodových jevů. Byly navrženy postupy měření vhodné ke konstrukci vertikálních řezů zdánlivých polarizovatelností. Bylo zjištěno, že nejlepší představu o skutečném rozložení odporů a polarizovatelnosti poskytují vertikální hloubkové řezy normovaných měrných odporů a polarizovatelností, konstruovaných nově navrženým způsobem.

Vysvětlivky k tabulce a obrázkům

Tabulka 1. Hloubkové koeficienty α_m^n.

1. Průnik ploch sledovaných příznaků. 1 – hranice zpracovávaného území,2 – státní hranice s Polskem,3 – kladný etalon, 4 – souřadnice kilometrové čtvercové sítě.
2. Mapa sumární podílové informativnosti příznaků 2, 3, 7, 8 a 10. 1 – hranice zpracovávaného území, 2 – státní hranice s PLR, 3 – souřadnice kilometrové čtvercové sítě, 4 – ložisko, 5 – rudní výskyt, 6 – rudní indicie, 7 – hodnoty sumární informativnosti.
3. Mapa izolinií fyzikálně chemického faktoru.
4. Mapa izolinií strukturně tektonického faktoru.
5. Modelová měření VP kombinovaným středovým gradientem (KSG) a středovým gradientem (SG) nad vodivou a nevodivou deskou při proměnné vzájemné vzdálenosti desek p.
6. Určeni polohy středu izometrických těles metodou VP při dvou různých polohách proudové elektrody.
7. Hloubkový řez normovaných polarizovatelností na lokalitě Vidly.
8. Princip konstrukce vertikálních řezů normovaných polarizovatelností příp. normovaných měrných odporů z kombinovaného a dipólového profilování. a – poloha bodů P_{ij} ve vertikálním řezu pod měřeným profilem, b – tzv. hloubkové křivky pro lokalizaci izometrického tělesa pod extrémem anomálie.
9. Normované vertikální pseudořezy polarizovatelnosti odvozené z teoretických křivek kombinovaného profilování nad izometrickým polarizujícím se objektem při dvou různých poměrech délky uspořádání k hloubce středu objektu L/h.
10. Příklad normovaného vertikálního odporového pseudořezu odvozeného z terénního měření kombinovaným profilováním na lokalitě Rejvíz. a – odporové křivky kombinovaného profilování, b – vertikální odporový normovaný řez, c – interpretovaný geologický řez.

    1 – vodiče v izoohmickém řezu, 2 – nevodiče v izoohmickém řezu, 3 – interpretované vodivé polohy (grafitizované horniny), 4 – interpretované nevodivé polohy (kvarcitické horniny), 5 – zvětraliny grafitizovaných hornin v eluviu, 6 – sutě kvarcitických hornin.
11. Metoda PJ, mapa izolinií ρ_τ [Ω m], pro $t = 1$ [ms], lokalita Zámecký vrch.
12. Metoda PJ, mapa izolinií H_τ [m] , lokalita Zámecký vrch.