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Application of the ore accumulation coefficient to the interpretation of the structure of MVT Zn-Pb ore deposit (Rodaki — Rokitno Szlacheckie deposit, Poland)

Silesian-Cracow Mississippi Valley-type zinc-lead deposits are confined to the Middle Triassic carbonate rocks. They occur mainly within the „ore-bearing dolomites" replacing limestones. The discountinuity and irregular shape of the ore bodies makes it difficult to study the deposit structure when only the borehole data are avilable. Ore accumulation coefficient (k_r) defined as the ratio of the cumulated ore thickness in the borehole (despite of the number of ore intersections and their hipsometric position) and the thickness of the host ore-bearing dolomite was found to be a convenient tool for deposit modelling. Isarithmic maps of k_r values calculated for the mineralized sections defined by the selected cut-off grades make it possible to delimit the mineralized zone and show its structure. The k_r values for the cut-off grades of 0.1, 0.2 and 0.4% of zinc allow to delimit the zone with the dispersed mineralization confining ore bodies (over 2% Zn) and disclose tectonic control of the ore distribution.

PROBLEMS OF INTERPRETATION OF THE FORM OF THE SILESIAN-CRACOW Zn-Pb DEPOSITS

The Silesian-Cracow Zn-Pb ores display a distinctly variated structure and form of the ore bodies, similarly to the other stratiform MV-type deposits in the carbonate rocks. Difficulties with the interpretation of the deposit structure at the preliminary stage of the recognition — when only borehole data are avilable — lead to a presentation of ore distribution in the geometric manner applying a method of polygons. This fact often results in false conclusions concerning the model of the deposit and distribution of its reserves (R. Krajewski et al., 1979).

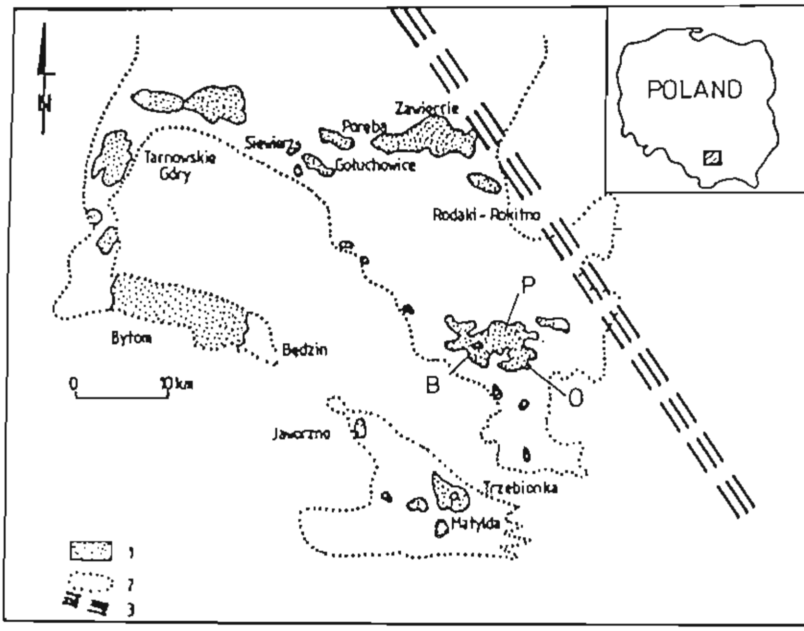


Fig. 1. Location map of Rodaki — Rokitno Szlacheckie ore deposit

1 — Zn-Pb ore deposits; 2 — area of ore-bearing dolomite distribution; 3 — dislocation zone of Zawiercie; mines: B — Bolesław, O — Olkusz, P — Pomorzany

Położenie złoża Rodaki — Rokitno Szlacheckie

1 — złoża rud Zn-Pb; 2 — zasięg występowania dolomitów kruszconośnych; 3 — strefa dyslokacyjna Zawiercia; kopalnie: B — Bolesław, O — Olkusz, P — Pomorzany

The ore intervals are pointed out in the borehole profiles. It is often difficult to correlate the intervals in the adjacent boreholes due to a differentiation position of the mineralized zones in relation to the lithological and stratigraphical section, and lack of additional data for interpretation of the shape of deposit as well.

Two following assumptions can be accepted for the interpretation of the deposit's structure:

1 — main ore bodies in the Triassic sediments occurs in the ore-bearing dolomites; outside the ore-bearing dolomites (T. Gałkiewicz, 1983) ore bodies appear sporadically only;

2 — rich parts of the deposit (of Zn+Pb content above 5%) display a nest form and are surrounded with the less mineralized rocks (1.5-5% of Zn+Pb); the mineralization zones of Zn+Pb content of 1.5% occasionally have a form of the stratoidal discontinuous bodies of a variated thickness (M. Nieć et al., 1976; R. Blajda, 1991).

The ore accumulation coefficient proposed by N. W. Baryshev et al. (1937) and applied to the desription of the discontinuous deposits of a hardly interpretable structure (W. W. Stefanowicz, 1972) is convenient for presentation of the ore mineralization intensity. This coefficient is defined as the ratio of the dimensions of the ore bodies and of the zone of the ore occurrence. Those dimensions can be determined by volume, surface or linear values (e.g., thickness; W. W. Stefanowicz, 1972; M. Nieć, 1990).

In case of the deposits recognized only due to the vertical boreholes the ore accumulation coefficient is defined as the ratio between the cumulated thickness of the ore intervals registred in the section (m_i) and the thickness of the whole ore zone (M). So:

$$k_r = \frac{\sum_{i=1}^{n} m_i}{M} \quad [1]$$

This coefficient is expressed either as decimal fraction or in percent.

An attempt of application of the ore accumulation coefficient to the interpretation of the structure of the Rodaki — Rokitno Szlacheckie Zn-Pb deposit (recognized in the stage corresponding to the C_2 category) has been done in the present paper.

LOCATION OF THE DEPOSIT AND THE EXPLORATION DATA

The Rodaki — Rokitno Szlacheckie deposit lies between Olkusz and Zawiercie and belongs to the Zawiercie ore-bearing region (T. Gałkiewicz, 1983, Fig. 1).

Ore exploration done by means of the vertical boreholes in the worknet with spacing of 250-500 m in this region has led to a discovery of the zones of the zinc and lead ores occurring in the Middle Triassic (Muschelkalk), Upper Buntsandstein and Middle Devonian (Givetian) rocks.

A part of the deposit, where mineralization occurs within the Devonian rocks, is not satisfactionary recognized due to the small number of boreholes deep enough.

Studies on the deposit structure have been limited to the ore-bearing dolomites. The ore mineralization in the Devonian rocks, although often very intensive, was not an object of the studies due to the small amount of data.

GEOLOGIC CONDITIONS OF THE DEPOSIT OCCURRENCE

The Triassic deposits in the area discussed lie discordantly on the folded Paleozoic rocks. The top surface of Paleozoie basement has varied morphology. The Devonian carbonate rocks form elevations which had been the islands in the Triassic sea through a long period of time and were covered only by the Muschelkalk sediments.

The Triassic sediments display a typical sequence for the Silesian-Cracow region.

The Roethian dolomites of the average thickness of about 30-35 m reduced at the boundaries of the Devonian „islands" lie on the discontinuous and thin sediments of the Buntsandstein.

An intensive epigenetic dolomitization comprising nearly in total the Górażdże, Terebratula and Karchowice beds and distinct top parts of the Gogolin Limestones is

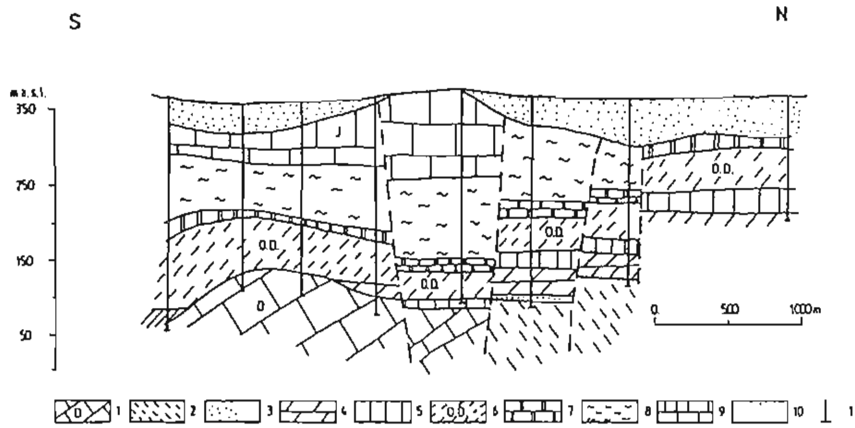


Fig. 2. Section across Rodaki — Rokitno Szlacheckie ore deposit (for location see Fig. 9a)
1 — Devonian; 2 — Carboniferous; 3 — Buntsandstein; 4 — Roethian dolomites; 5 — Gogolin Limestones; 6 — ore-bearing dolomites; 7 — Diplopora Dolomites; 8 — Keuper; 9 — Jurassic; 10 — Quaternary; 11 — boreholes

Przekrój przez złoże Rodaki — Rokitno Szlacheckie (lokalizacja na fig. 9a)
1 — dewon; 2 — karbon; 3 — pstry piaskowiec; 4 — dolomity retu; 5 — wapienie gogolińskie; 6 — dolomity kruszconośne; 7 — dolomity diploporowe; 8 — kajper; 9 — jura; 10 — czwartorzęd; 11 — otwory wiertnicze

the dominant feature of the deposits of the Lower and Middle Muschelkalk. The thickness of the non-dolomitized Gogolin Limestones remains, therefore, very variated — from the few to about 50 m.

The Diplopora Dolomites lie over the dolomitized series of the Middle Muschelkalk. In the tectonic grabens there have been preserved the clayish sediments of the Keuper and locally of the Rhaetian-Liassic (Fig. 2).

The structural map of the top surface of the Roethian dolomites gives an idea on the tectonics of the area discussed. That surface was not modified by the epigenetic dolomitization and its localization can be identified in the sections of the individual boreholes.

Basing on the map mentioned it can be stated (J. Jarrin, M. Nieć, in press) that there occur numerous faults of directions of NWW-SEE and SSW-NNE whieh divide the area studied into several blocks moved in different relation one to another (Fig. 3). The fault throw ranges from some to about 115 m.

The tectonie graben of direction of NWW-SEE and of width of 1000–1500 m, which divides the area studied into the elevated northern and the lowered southern parts deserves the special attention. The top of Roethian lies in the axial zone of the graben about 160–180 m and about 20–40 m lower than in the NE and SW wings, respectively.

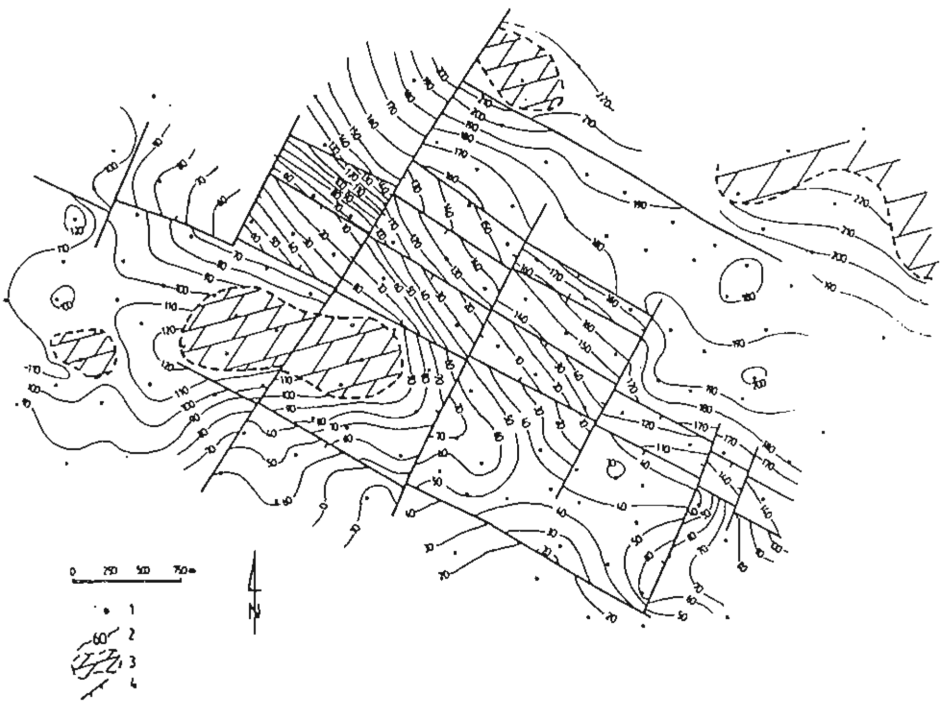


Fig. 3. Top surface of Roethian dolomites structural contour map

1 — boreholes; 2 — structural contours of the top surface of Roethian dolomites (m a.s.l.); 3 — Devonian „islands"; 4 — faults

Mapa strukturalna stropu dolomitów retu

1 — otwory wiertnicze; 2 — zarys stropu dolomitów retu (m n.p.m.); 3 — „wyspy" dewonu; 4 — uskoki

ORE-BEARING DOLOMITES AND MINERALIZATION

The ore-bearing dolomites in the cartographic meaning correspond to the lithosome of the dolomitic rocks with a dominance of the products of epigenetic dolomitization. Their thickness, interpreted basing on the sections of the boreholes, is very variated. The distribution of the thickness is slightly skew (Fig. 4) and the distinct modal value equals to 45 m.

Distinct variation in thickness is illustrated by the map done by the point kriging method. The isoline of 45 m thickness corresponding to the lower limit of the modal class of the thickness frequency allows to delimit some regions of different thickness of the ore-bearing dolomites in the area studied (Fig. 5). The run of this line close to the direction of the NWW-SEE faults suggests that the fault limiting the graben from the north could be a kind of a barrier for the dolomitization process. North of this fault the dolomites displaying the increased thickness occur only in the zone of direction of NNW-SSE, which, in its turn, may suggest an existance of the uninterpre-

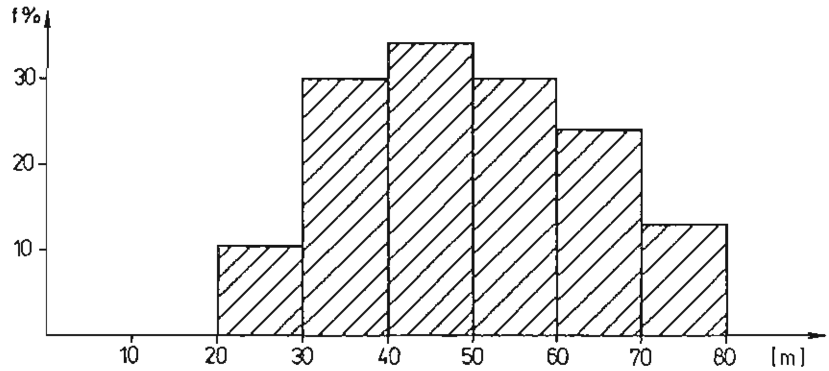


Fig. 4. Histogram of the thickness of ore-bearing dolomites
Histogram miąższości dolomitów kruszconośnych

table faults there. It should be mentioned here that the strike-slip faults of that direction were documented in the other deposit areas (M. Szuwarzyński, 1983; M. Szuwarzyński, S. Panek, 1983) and suggested in the Rodaków — Rokitno Szlacheckie region by J. Bednarek (1978). The direction mentioned above has been marked also in the distribution of the ore bodies in the Olkusz region (M. Nieć et al., 1976; R. Blajda, 1983).

The mineralization appears in different localization in the section of the ore-bearing dolomites (Fig. 6). Metal content (Zn+Pb) varies from 0.0*n*% to some percent. Rare borehole net does not allow to delimit the mineralization zones which can be correlated.

Impregnation and fine-vein forms of the ore occurrence are predominant (J. Konstantynowicz, 1978), more rare are the massive accumulations, while the mineralized breccia — totally exceptional.

The mineralized zones often occur dispersed in the section of the ore-bearing dolomites and do not form any compact ore body within the boundaries of the area studied (Fig. 6).

BACKGROUNDS OF THE METHOD APPLIED TO STUDY THE DEPOSIT STRUCTURE

Determination of the deposit boundaries is the first step to interpretation of the deposit structure. Those boundaries have been delimited by the cut-off values of the deposit parameters which result from either technical or economical demands. The parameters have, therefore, the contractual character as well as the boundaries based on them.

In the ore deposits the rich mineralized parts are usually surrounded with the aureole of the dispersed mineralization which forms a geochemical anomaly in rela-

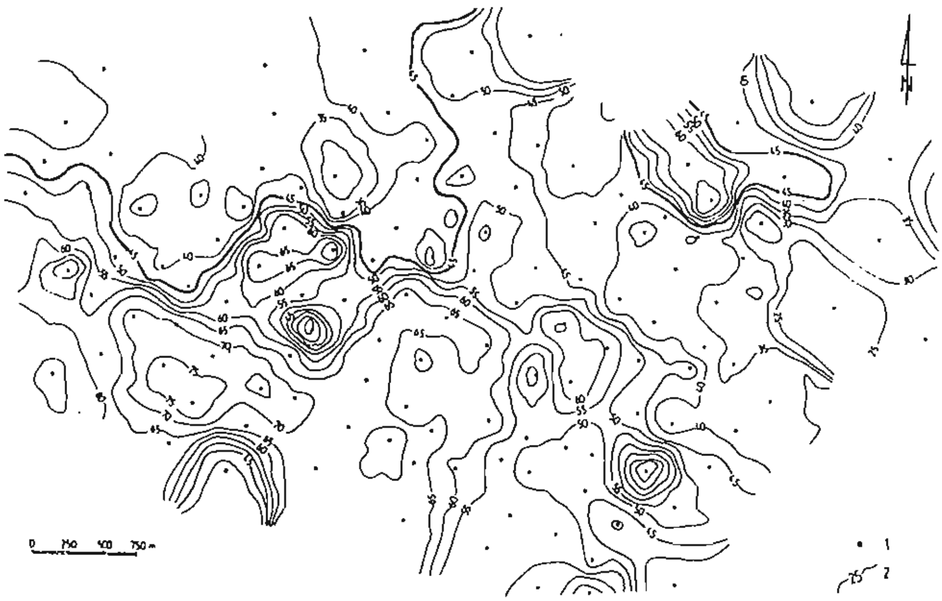
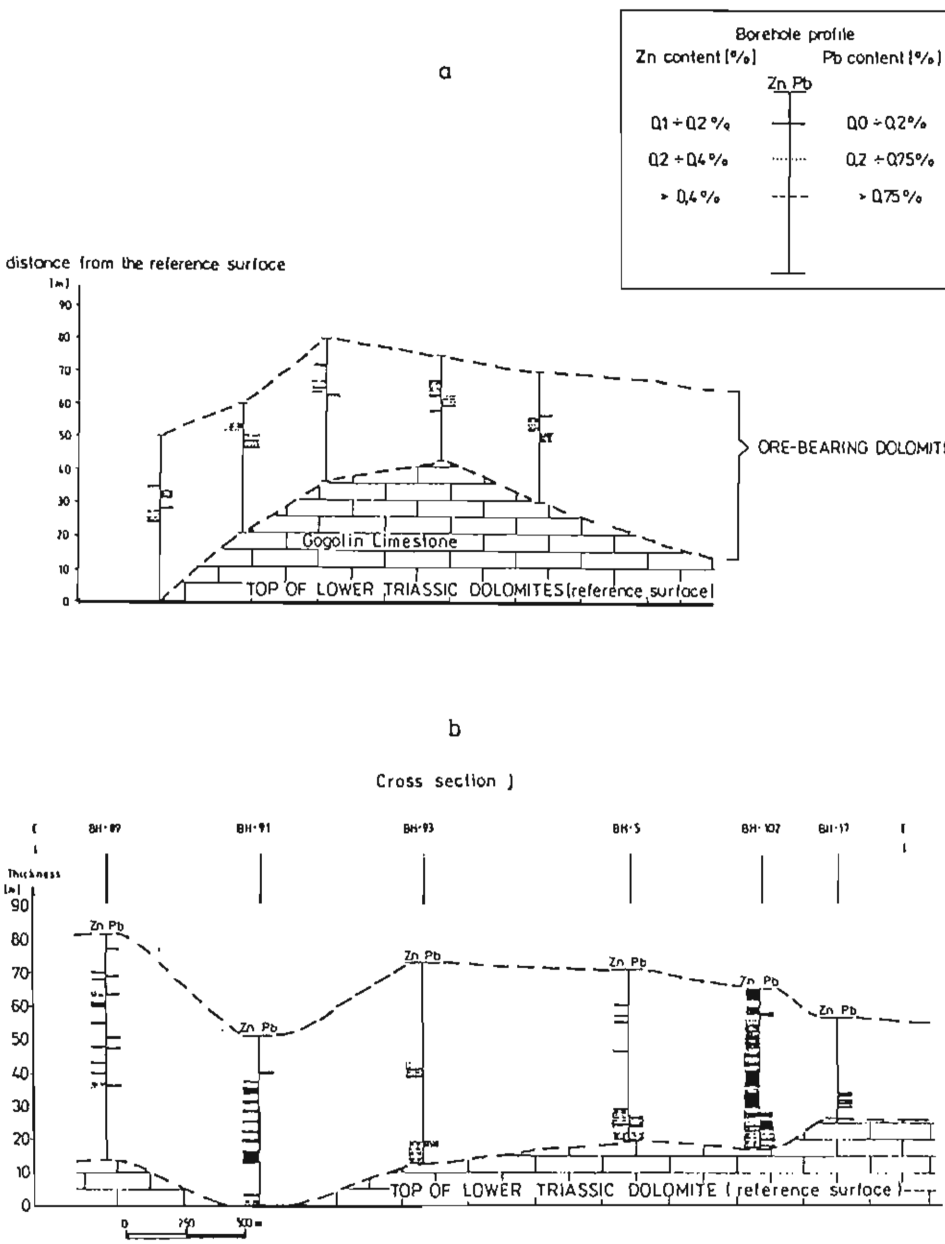


Fig. 5. Map of the thickness of ore-bearing dolomites
1 —boreholes; 2 — isothickness lines in m
Mapa miąższości dolomitów kruszconośnych
1 — otwory wiertnicze; 2 — izolinie miąższości w m

tion to the background of the adjacent rocks and acts as the background for the rich parts. Several modal values corresponding to the subsequent mineralization stages can be expected on the curves of metal content distribution in case of the multi-stage mineralization, as it is in the Silesian-Cracow lead-zinc deposits (M. Sass-Gustkiewicz, 1975, 1985). Multi-modal empiric distribution curves of Zn and Pb content support this assumption (A. Trembecki, J. Gągulski, 1969). The distribution curves of both the metals are in general distinctly positively skew (R. Krajewski, 1957; M. Nieć, 1977). As it has been proved by V. Janovici and A. Dumitriu (1967) such the curves can be formed due to the superposition of two or more normal or lognormal distributions of sub-populations characterized by different parameters and variated quantity of data.

Basing on those facts it has been, therefore, assumed by the present authors that the analysis of the empiric curves of the distribution of Zn and Pb content should allow to distinguish the sub-populations and determine the limits for zinc and lead ore concentrations, anomalies and geochemical background.

The ore-bearing dolomites represent the host rocks for the mineralization. Their formation has been explained due to the epigenetic dolomitization (K. Bogacz et al., 1975) prior to the appearance of the ores. The ore-bearing dolomites form an aureole around the ores.


a
Borehole profile
Zn content (%)
Pb content (%)
Zn Pb
0.1 ÷ 0.2 %
0.0 ÷ 0.2 %
0.2 ÷ 0.4 %
0.2 ÷ 0.75 %
> 0.4 %
> 0.75 %
distance from the reference surface
(m)
ORE-BEARING DOLOMITE
Gogolin Limestone
TOP OF LOWER TRIASSIC DOLOMITES (reference surface)
b
Cross section J
BH-89
BH-91
BH-93
BH-5
BH-102
BH-17
Thickness
(m)
TOP OF LOWER TRIASSIC DOLOMITE (reference surface)
0
250
500 m

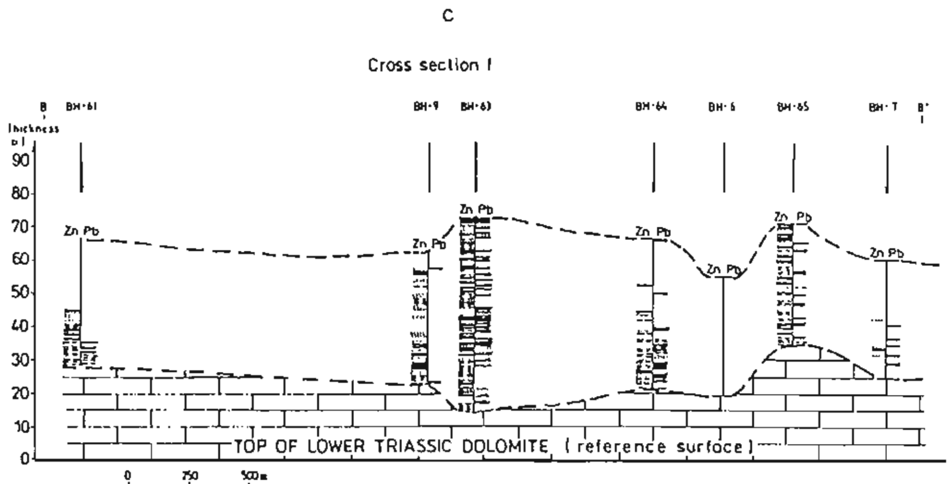


Fig. 6. Mode of presentation of mineralized intersections for calculation of ore accumulation coefficient (a) and selected section across the mineralized zone (b, c); for location see Fig. 9a

Sposób obliczania współczynnika rudonośności (a) i rozmieszczenie mineralizacji w dolomitach kruszconośnych (b, c); lokalizacja na fig. 9a

The amount of ore accumulation within the ore-bearing dolomite was determined by means of the linear ore-bearing coefficient calculated individually for each borehole using the equation [1]. Aiming at determination of the localization both of the ore bodies and of the aureole of dispersed mineralization, the k_r values were calculated assuming different limits for the anomalies in respect to the background. Those limits were determined due to the analysis of the metal content distribution curves in the ore-bearing dolomites.

VARIATION IN MINERALIZATION, LIMITS OF ORE BODIES AND DISPERSION AUREOLE

The mode of interpretation of the distribution curve depends on the assumption regarding the distribution model of the given parameter in the general population. In case of the complex distributions, i.e., those characterizing heterogeneous populations, the interpretation manner depends on the distribution models assumed for the partial populations as well as on their mutual relation. The problem is very complicated since, according to V. Janoviei and A. Dumitriu (1967), it is impossible to draw the totally inevitable conclusions on the partial distributions basing only on the character of the complex distribution curve. Different combinations of the distributions can result in the similar final complex curve.

Interpretation of the frequency curve of the complex distribution is usually not problematie in case of its multi-modal character. It is, however, much more complicated in case of one-modal curves. The skewness maybe the only suggestion for their composed nature. Such distributions complicated for interpretation can origin from the overlap of the numerous partial distributions and strongly variated contribution of different sub-populations, one of them being distinctly dominant. In such a situation it is possible either to accept one model of the skew distribution (e.g., log-normal or gamma) or to make the assumptions in respect to the eventual partial distribution models.

Metal content distributions in the ore-bearing dolomites can be approximated using gamma distributions (M. Nieć, 1977). Variated shape of distribution curves and values of their parameters suggests that they are complex. In some cases the multi-modal feature appears.

The eumulated distribution curves presented in the probability net usually display a broken run. It allows to accept the hypothesis that the partial distributions are broeken normal cut at the values corresponding to the breaking points. Abrupt changes in the ore eoncentrations often observed substantiate this hypothesis.

The distribution curves of Zn and Pb content in the ore-bearing dolomites in the area studied are distinctly positively skew with the modal value for zinc and lead below 0.1%. Diagrams of the eumulated frequeney distribution curves presented in the probability net distinetly display a broken run (Fig. 7). It allows to accept the hypo-

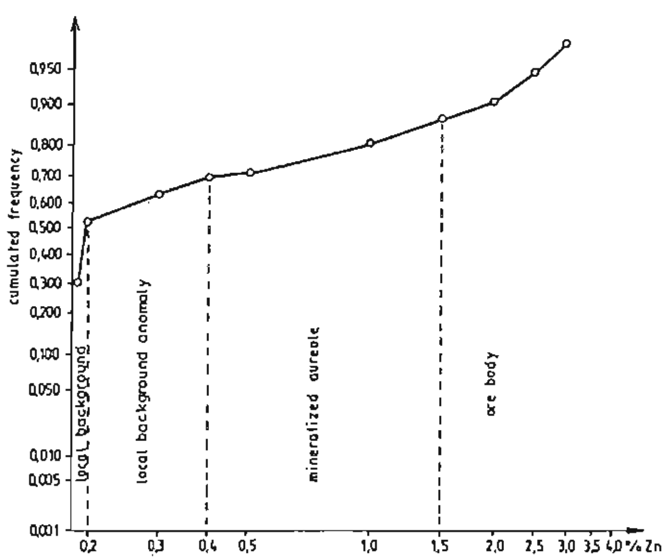
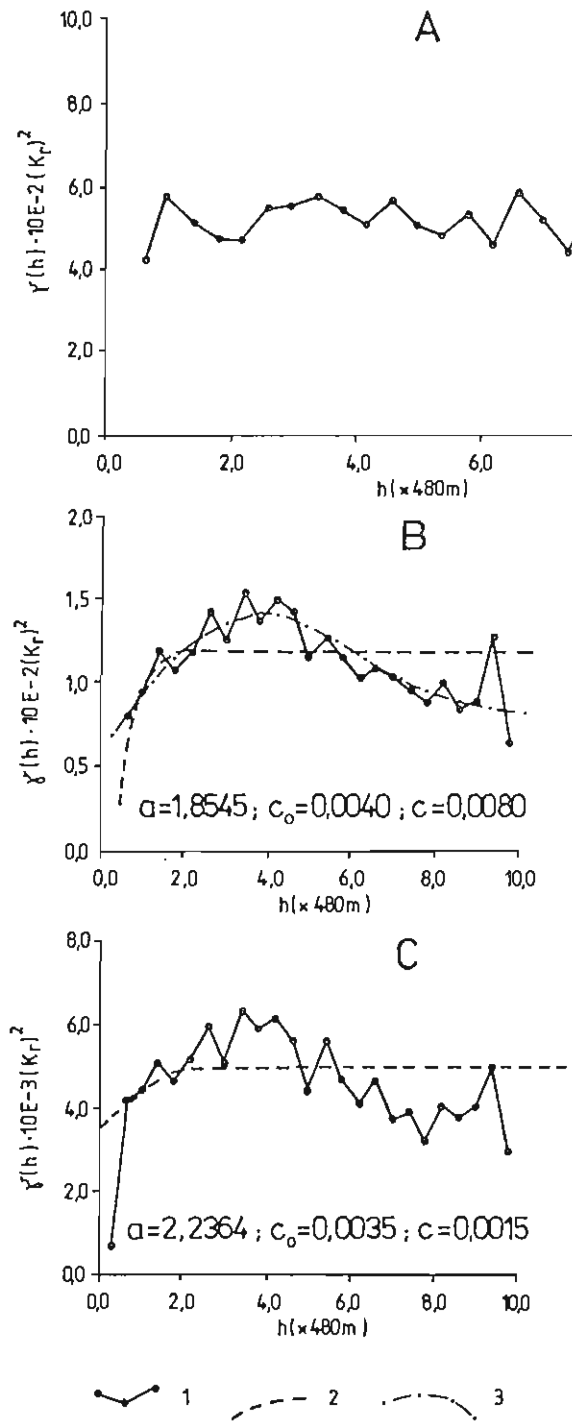


Fig. 7. Cumulated frequency distribution of Zn content within ore-bearing dolomites
Skumulowana krzywa rozkładu zawartości cynku w dolomitacb kruszconośnych


A
$\gamma(h)\cdot 10E-2(K_r)^2$
10,0
8,0
6,0
4,0
2,0
0,0
0,0
2,0
4,0
6,0
8,0
10,0
h(×480m)
B
$\gamma(h)\cdot 10E-2(K_r)^2$
2,0
1,5
1,0
0,5
0,0
a=1,8545 ; c_o=0,0040 ; c=0,0080
0,0
2,0
4,0
6,0
8,0
10,0
h(×480m)
C
$\gamma(h)\cdot 10E-3(K_r)^2$
8,0
6,0
4,0
2,0
0,0
a=2,2364 ; c_o=0,0035 ; c=0,0015
0,0
2,0
4,0
6,0
8,0
10,0
h(×480m)
1
2
3

thesis on the complex character of those distributions and to determine limits of sub-populations of zinc and lead content in the slope changing points of the diagram. On the distribution curves based on the data from the individual boreholes and their groups the limits are variated although grouped in some intervals. Subpopulation limits are less visible on cumulated frequency curve composed on data from the deposit as a whole, due to their varied values in particular borehole groups. That is why the cut-off grades for the deposit must be arbitrarily accepted in the limits resulting from the curves plotted for the individual boreholes and borehole groups.

A distinct change of the slope is at 0.1% for zinc. It can be assumed that the values below 0.1% characterize the background content of this metal in the ore-bearing dolomites and non-dolomitized rocks. In the interval above 0.1% of zinc distinct curve slope correspond to the values of 0.2, 0.4–0.5 and 2%. The distinct cut-off grade at 2% can be treated as the deposit concentration threshold (in the natural meaning). Intervals of 2–0.4, 0.4–0.2 and 0.2–0.1% would correspond to: the aureole of dispersed mineralization (in relation to the concentrations assumed as the deposit ones), local anomalies and local background.

For lead the corresponding values are equal to: — for the „deposit" concentrations and the aureole of the dispersed mineralization — over 0.75%, — for the local anomalies of the geochemical background — 0.2–0.75% and for the local geochemical background — 0.1–0.2% of lead.

The complex and skew distribution curves for lead and zinc content have also been noticed in the other deposit regions (S. Przeniosło, 1974; J. Serafin-Radlicz, 1972; T. Smakowski, 1990). In those areas the curves are also regarded as characterizing the geochemical background, dispersion aureoles and deposit concentration. They are also very variated which makes it difficult to determine precisely limit metal contents for the ore bodies, aureole and the background.

According to S. Przeniosło (*op.cit.*) the mean regional value of the geochemical background in the ore-bearing dolomites equals to 0.055% of Zn. The upper 3σ limit of the confidence level for this mean would be 0.1% in case of the normal distribution. It results from the studies of S. Przeniosło and J. Serafin-Radlicz (1978) in the Zawiercie region that the marginal zinc content for the aureole of the dispersed mineralization around the ore bodies is 0.5%. Similar value of 0.54% of Zn reports T. Smakowski (1990) in the Olkusz region. The limits determined for zinc content in the investigated area equal to 0.1 and 0.4% seem, therefore, to be similar to those in the other regions.

Limits for zinc content in the ore bodies are equal to 1.5 and 1.15% of Zn according to S. Przeniosło, J. Serafin-Radlicz (1978) and T. Smakowski (1990), respectively. The last value may increase to 2% of zinc as may be suggested from the distributions

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Fig. 8. Variograms of the ore accumulation coefficients calculated for selected cut-off grades

A — cut-off grade 0.1% Zn; B — cut-off grade 0.2% Zn; C — cut-off grade 0.4% Zn: 1 — empirical data, 2 — spherical model, 3 — periodical model

Wariogramy uśrednione współczynnika rudonośności

Brzeżna zawartość Zn: A — 0,1%; B — 0,2%; C — 0,4%: 1 — wariogram empiryczny, 2 — model sferyczny, 3 — model okresowy presented by the last author quoted. It is possible that in the zone of the deposit concentrations there exist several step values (about 1%, 2% and possibly even more) difficult to be determined since only relatively low number of data is available from the mineralized zones in contrary to the total number of data, especially those from the barren dolomites.

For lead — S. Przeniosło and J. Serafin-Radlicz (1978) have determined the following values: 0.015% of Pb as the regional geochemical background, 0.25% for the aureole and 1% of lead for the ore bodies. T. Smakowski (1990) reports those values in the Olkusz region as 0.24 and 0.68% of Pb respectively. The reference values do not distinctly differ from those characteristic for the Rodaki — Rokitno Szlachec-kie deposit.

It is worth mentioning here that in many MV-type deposits the values of 1.5–2.5 have been assumed for the contouring of the ore bodies.

ORE ACCUMULATION WITHIN ORE-BEARING DOLOMITES AND ITS VARIABILITY

The intervals of ore and dispersed mineralization were delimited in borehole profiles according to the Zn and Pb limits presented above (Fig. 7). The „ore" and „aureole" zones appear in the ore-bearing dolomite section in different position in relation to the top and the bottom. Ore accumulations and zones of the increased metal content are irregulary distributed. The mineralized zones are also very variated in thickness and there occur rapid transitions from the rich mineralized parts to the poor or barren ones. Some tendency of concentration of the rich mineralized zones (above 0.4%) in the close-to-bottom part of the ore-bearing dolomites can be noticed similarly to the other deposit regions (R. Blajda et al., 1977; P. Sobczyński, M. Szuwarzyński, 1974). Frequency of the ore intervals decreases towards the top of the section.

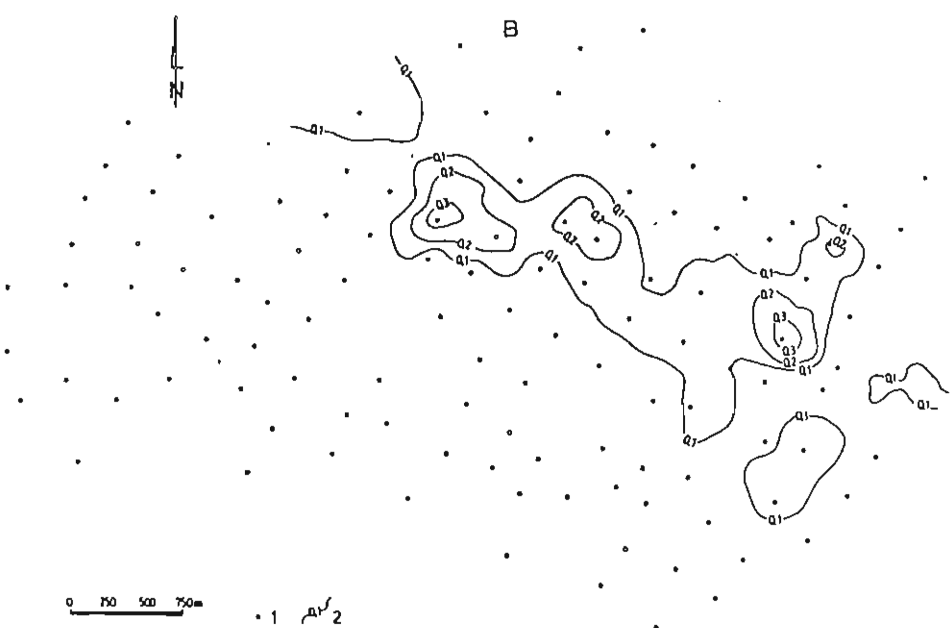
The ore accumulation is, therefore, very variated. It is impossible to interpret the horizontal and vertical range of the ore zones and ore bodies. Its variation remains, however, distinct as it can be illustrated on the isarithmic maps of the ore accumulation coefficient.

Variograms constructed for the $k_{r(b)}$ values calculated for different cut-off grades (b) show the mode of variation in the ore accumulation (Fig. 8).

Lack of anisotropy of this parameter can be noticed basing of the analysis of the semivariograms done for the directions of 0, 45, 90 and 135°. The mean semivariogram of the ore accumulation coefficient for the zinc grade of 0.1 can be described using the random model. The random character of this semivariogram $k_{r(0.1)}$ suggests that the zinc content below 0.2% but increased in the relation to the clark value for the carbonate rocks (0.002% — A. Polański, 1988) is not related to the ore mineralization of the ore bodies. An increase in zinc content in relation to the geochemical background can be connected with the mineralization accompanying the dolomitization.

For the zinc cut-off grades over 0.2 and 0.4 there can be noticed the not random variation of the ore-accumulation between the boreholes. The empirical variograms


A
0 250 500 750m
1
2
3
4


B
0 250 500 750m
1
2

may be described using the spherical model. The range of variogram for $k_{r(0.2)}$ and $k_{r(0.4)}$ equals to 890 and 1070 m, respectively. Some periodieity of variation can be observed, possibly due to the nested oeeurrenee of the rieher zones in both the eases.

DEPOSIT STRUCTURE IN RELATION TO MINERALIZATION AUREOLE

Maps of ore aeeumulation eoeffieient have been prepared separately for $k_{r(0.2)}$ and $k_{r(0.4)}$ (Fig. 9) with help of point kriging method. The isarithms of k_r of 10 and 20% have been distinguished there delimiting zones of the most intensive mineralization. The maps diseussed illustrate dispersion of the mineralization which forms the deposit and the adjacent aureole. It is possible to notice that the zones displaying ore aecumulation coeffieients above 10% lie parallelly to the main fault direction, i.e., to NWW–SEE. This fact points to a relation between ore aeeumulation intensity and the faults mentioned, i.e., the teetonie eontrol of mineralization.

The directional tendeney in the distribution of mineralization is still more evident on the maps of trends done for both coeffieients (Fig. 10). Trend analysis with the use of polynomials — from the first to the sixth degree. Only the seeond degree polynomial was performed trend of the ore aeeumulation is statistically significant on the significance level of 0.05. In case of $k_{r(0.2)}$ the forth degree polynomial allows to discover some additional tendencies.

Coeffieients of determination of the second degree trend surface for $k_{r(0.2)}$ and $k_{r(0.4)}$ are equal to 25.2 and 21.2%, respectively. 20 to 25% of observed variation of ore aecumulation can be explained as not random one.

Both the maps of the second degree trend (one of them being presented in Fig. 10) show distinet similarity. Trend surface gradient is the lowest to the NWW–SEE direction. The axis zone of this surface runs almost parallelly to the directions of the faults limiting the Rodaków — Rokitno Szlaeheckie Graben. The analysis of trends presents even more evidently than the maps of the ore accumulation coefficient the general tendeney of loealization of the mineralized zones parallelly to the main faults in the area studied.

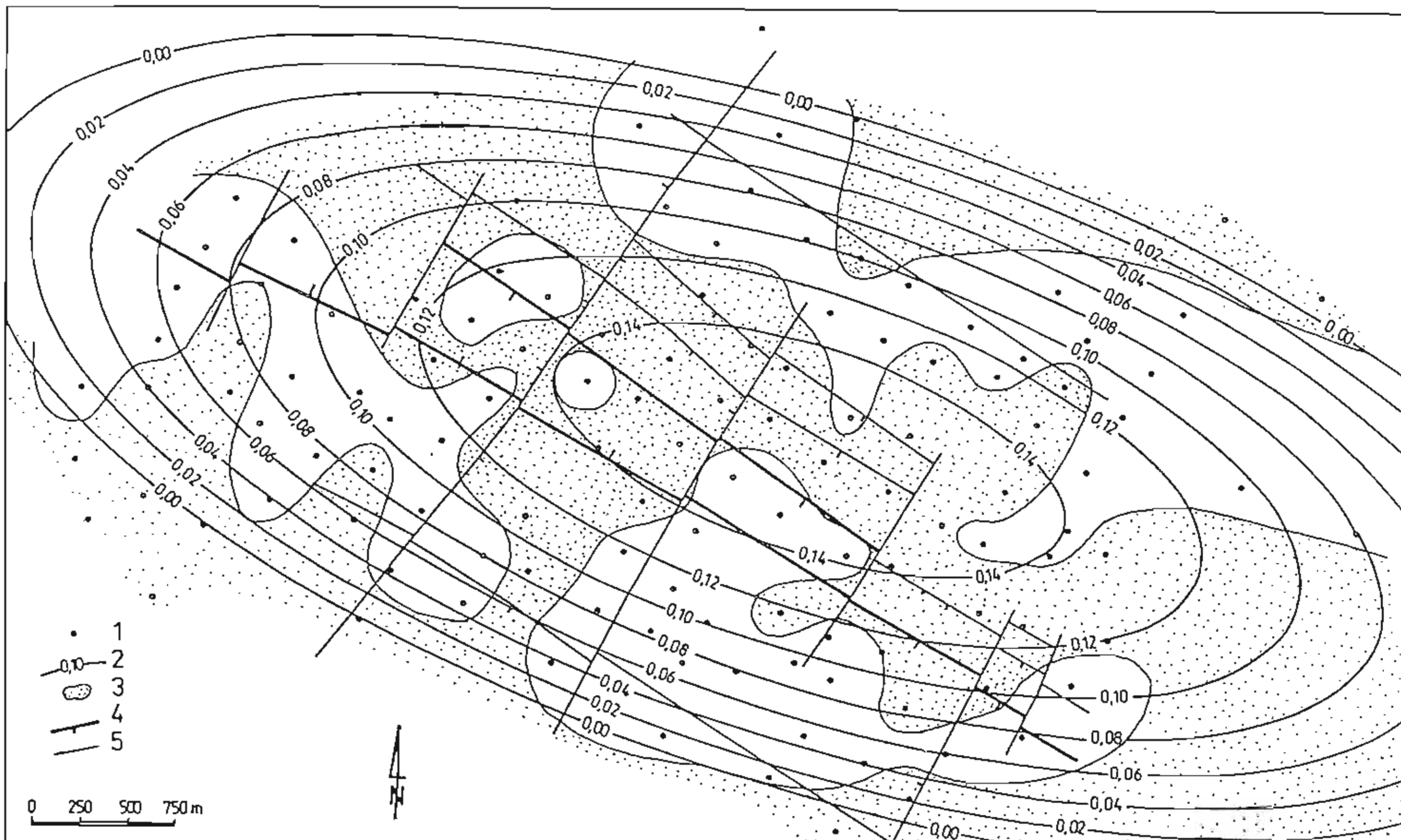
The more strongly mineralized dolomites occur in the area discussed in distinct „patches", i.e., irregularly. The biggest area of their occurrenee lies north of the graben (Fig. 11). It displays an irregular shape of the length of about 4 km and of the width of 1 km. Other areas of occurrence are much smaller, some of them being restricted only to the individual boreholes.

Fig. 9. Ore accumulation coefficient contour maps

A — for the cut-off grade 0.2% Zn: 1 — boreholes, 2 — ore accumulation coefficient isovalues, 3 — cross-section on Fig. 2, 4 — cross-sections on Fig. 6b, c; B — for the cut-off grade 0.4% Zn: 1 — boreholes, 2 — ore accumulation coefficient isovalues

Mapy współczynnika rudonośności

Brzeżna zawartość Zn: A — 0,2%: 1 — otwory wiertnicze, 2 — współczynnik rudonośności, 3 — przekrój z fig. 2, 4 — przekroje z fig. 6b, c; B — 0,4%: 1 — otwory wiertnicze, 2 — współczynnik rudonośności


1
0,10 2
3
4
5
0 250 500 750 m
N
0,00
0,02
0,04
0,06
0,08
0,10
0,12
0,14

Images obtained on the maps $k_{r(0.2)}$ and $k_{r(0.4)}$ are similar in the main mineralization area north of the graben. The area delimited by the respective isarithms of k_r values decreases with an increase in the cut-off grade of zinc. The southern boundary of the mineralized area runs approximately parallelly to the fault limiting the graben from the north (with the throw over 50 m) — Fig. 11. This fault possibly represents a barrier for mineralization southwards. In the western part of the area studied the intensively mineralized dolomites are limited by the NNE–SSW fault. It seems that this fault could also act as the barrier for mineralization.

The richest parts of the deposit, considered as the economic ones, occur in the small discontinuous zones (Fig. 11). The biggest zones are 400–600 m in length and 250–350 m in width. They occur in the northern wing of the graben within the zones delimited by isarithms of $k_{r(0.4)}$ = 10 and 20%. The thickness of the ore-bearing dolomites is there below 45 m (Fig. 11).

As it is presented above, the richest, economically significant ore bodies are surrounded by the wide aureole of the dispersed mineralization where zinc content over 0.2% appears irregulary distributed within the ore-bearing dolomites. Small thickness of the ore-bearing dolomites favours the occurrence of the ore bodies.

H. Gruszczyk and A. Paulo (1976) pointed to the fact that the lead and zinc deposits in the Olkusz region occur in the transition zone between the limestones and dolomites, the zone determined as the interfacial one. Relation between the ore distribution and the thickness of the ore-bearing dolomites in the Rodaki — Rokitno Szlacheckie area support this thesis.

Apart from the direction of the ore-bearing zone and the economic ore bodies parallel to that of the faults, i.e., of NWW–SEE, there can be noticed another one oblique to the first mentioned and running latitudinally (Fig. 11). It suggests that the distribution of the mineralization could have been also dependant on the other tectonic phenomena not evident in the cartographic image. The latitudinal run of the distribution of the ore bodies in the Olkusz region was discovered by R. Blajda (1983). Occasionally also the tendency of their arrangement in the longitudinal direction (M. Nicé et al., 1976) may be observed there. In the area north of the graben the ore-bearing dolomites spread into NNW, so there appears some obscured tectonic plan influencing the mineralization distribution, too. The interpretation of this plan is not simple. That can be e.g., an assemblage of fissures feathering the faults of NWW–SEE directions.

In the Trzebionka mine M. Szuwarzyński (1983) has stated a connection between the occurrence of mineralization and the latitudinal strike-slip faults as well as those close to the direction of NWW–SEE. The tectonics pattern is there similar to that in

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Fig. 10. Ore accumulation coefficient trend surface map; cut-off grade 0.4% Zn; 2nd degree polynomial approximation

1 — boreholes; 2 — trend surface isolines; 3 — areas of positive deviations from the trend surface; 4 — main faults bordering Rodaki Graben; 5 — other faults

Mapa trendu współczynnika rudonośności przy brzeżnej zawartości cynku 0,4%; aproksymacja wielomianem drugiego stopnia

1 — otwory wiertnicze; 2 — izolinie powierzchni trendu; 3 — pola odchyłek dodatnich od powierzchni trendu; 4 — główne uskoki ograniczające rów Rodaków; 5 — inne uskoki

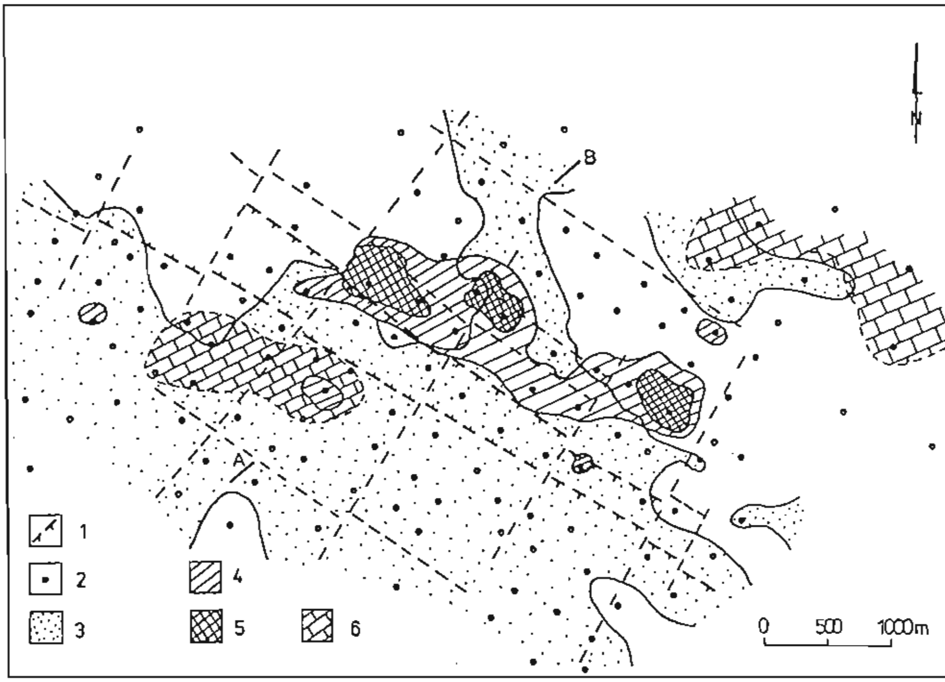

Fig. 11. Interpretation of structure of Rodaki — Rokitno Szlacheckie ore deposit (based on ore accumulation coefficient data)

1 — faults; 2 — boreholes; 3 — ore-bearing dolomites over 45 m thick; 4 — k_r at 0.2% Zn cut-off grade over 0.1; 5 — k_r at 0.4% Zn cut-off grade over 0.1; 6 — Devonian „islands"

Interpretacja budowy złoża w dolomitach kruszconośnych (na podstawie danych współczynnika rudonośności)

1 — uskoki; 2 — otwory wiertnicze; 3 — dolomity kruszconośne o miąższości powyżej 45 m; 4 — rudonośność powyżej 10% przy brzeżnej zawartości Zn 0,2%; 5 — rudonośność powyżej 10% przy brzeżnej zawartości Zn 0,4%; 6 — „wyspy" dewońskie

the Rodaki — Rokitno Szlacheckie area. The present state of recognition of the deposit discussed does not encourage to explain totally the relation between tectonic and mineralization. Still that possibility should be concerned in the future exploration.

The presented cartographic image of the mineralized zone suggests that the ore bodies significant in size can be expected in the NE wing of the graben. The occurrence of large ore bodies seems to be less probable in the other parts of the area studied.

The occurrence of the ore bodies in the Devonian rocks represents a separate problem not analysed till present. There exist not satisfactionary data to apply any specific deposit model there (S. Kurek, 1988) since the showings of mineralization occur in the separated boreholes being abundant but with no clear mode of occurrence.

The data of the present paper presented above suggest a distinct dependance of mineralization on the tectonics. Those suggestions should be also taken into account when analysing the mineralization in the Devonian rocks.

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WYKORZYSTANIE WSKAŹNIKA RUDONOŚNOŚCI DO INTERPRETACJI MODELU ZŁOŻA RUD Zn-Pb (NA PRZYKŁADZIE ZŁOŻA RODAKI — ROKITNO SZLACHECKIE)

Streszczenie

Interpretacja formy ciał rudnych w złożach Zn-Pb obszaru śląsko-krakowskiego na podstawie danych z otworów wiertniczych napotyka trudności ze względu na zmienne ich położenie w profilu dolomitów kruszconośnych goszczących mineralizację. Do interpretacji formy złoża Rodaki — Rokitno Szlacheckie, rozpoznanego otworami wiertniczymi w kategorii C_2, zastosowano liniowy współczynnik rudonośności, definiowany jako stosunek sumy długości (miąższości) odcinków rudnych, stwierdzanych w profilu dolomitów kruszconośnych w otworze, do miąższości tych dolomitów w tym otworze. Współczynniki rudonośności obliczono przy przyjęciu zawartości brzeżnych wyznaczających odcinki „rudne" wynoszących: 0,1, 0,2 i 0,4% Zn. Określają one odpowiednio granice: lokalnych anomalii wokółzłożowych i stref okołozłożowej mineralizacji rozproszonej. Mapy izolinii współczynników rudnonośności, sporządzone metodą krigingu punktowego, ujawniają koncentrację skupień rudnych w strefie o kierunku NWW-SEE w skrzydle rowu tektonicznego o tym kierunku. Pozwalają zatem na wyznaczenie prawdopodobnego obszaru złożowego kontrolowanego przez tektonikę. Strefa objęta najintensywniejszą mineralizacją występuje w obszarze, w którym miąższość dolomitów kruszconośnych nie przekracza 45 m.