Slovak Geol. Mag., 10, 3 (2004), 215 – 226

Wherefore a new Fe carbonate body have not been discovered within the Nižná Slaná region – reasons and consequences for geological structure interpretation

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Abstract: A Nižná Slaná depression creates a western portion of a historical mining region – Spišsko-Gemerské Ore Mts., situated in the Eastern part of the Slovak republic. From the economic geology point of view the most important element of the area are Late Paleozoic black phyllites sequences with occurrence of strata bound ore bodies – Fe carbonates (siderite, ankerite). There is only one deposit exploited up-to-date here – Manó-Gabriela deposit near Nižná Slaná village. A complex of geological works with a main goal – to find new ore body and to increase ore stock of the deposit have been carried out. The selected objects that had been possessed appropriate attributes have been proposed for drilling. In spite of finding out of several very promising places from deposit viewpoint, the results of prospecting point out that it is practically excluded to expect the occurrence of another Fe carbonate ore bodies.

Key words: Spišsko-gemerské Ore Mts., Nižná Slaná region, hidden Fe carbonate bodies prospecting, and a drill hole verification of data interpretation.

Introduction

The Nižná Slaná region has become due to results of geological survey (last 50 years) the most important basis of Fe-ore in the whole area of Western Carpathians. The geological structure of the area is very particularly described in many works – Abonyi et al., 1966, Varga, (1970, 1970a), Ilavský, (1974), Lörincz (1989), Bajaník, et al. (1994), Grecula et al. (1995), etc... and therefore there is neither purpose nor space here to repeat it. (Fig. 1).

We are concentrating only at several important factors substantial for Fe carbonates prospecting.

The basic tectonic structure of the Nižná Slaná region is an asymmetric anticline so called Hnilecká one, or the Volovec anticline (Snopko et al., 1972), with a crest W – E direction (Fig. 2). Its southern limb has shallow inclination against northern one. The core of this is created by the formation of black phyllites with lydites and carbonates – ore bearing horizon. Black phyllites represent footwall of carbonatic bodies. Porphyroids are underlying and overlying the horizon. The whole area belongs to the western part of known belt of carbonates bodies named Hanková village – Volovec hill.

The main portion of ore stock in the area is in the deposit Manó-Gabriela situated in the southern limb of anticline. The deposit has arc-like horizontal shape and its inclination deptward becomes gradually smaller. The thickness of ore bearing formation is to 450 m, the thickness of ore bodies is maximum 70 m, and the directional length reaches value 800 m, and inclined length 350 m. The depth of ore bodies is changed from 100 to 400 m. The main mineral mass is created by siderite and ankerite. Following minerals are quartz, pyrite, arsenopyrite, sphalerite, tetrahedrite, hematite, jamesonite, boulangerite, calcite, etc...From the prospecting point of view are important cinnabar impregnation and native mercury directly in the ore bodies.

From the genetic viewpoint, the stratiform deposits of this type are regarded to be of hydrothermal – metasomatic origin (Hanuš, 1960, Ilavský, 1974), although interpretation of their syngenetic origin has appeared too. (Turan & Turanová, 1993).

The result of gravity anomaly verification – Kobeliarovo deposit – is located in the northern limb of abovementioned anticline. This is the typical blind deposit, covered by layer of overlying porphyroids (30–50 m), the average inclination 30° towards NE, the maximum thickness is almost 50 m, directional range about 500 m (Ščuka, 1983). The quality of ore is similar as the quality of the Manó-Gabriela deposit.

Another important ore bodies (but much more smaller) are situated similarly in the northern limb of the anticline – the outcropping and the abandoned deposits Ignác and Gampeľ (inclination 70 degrees and more towards the North). Position of the all occurrences of Fe carbonates in the area is depicted on the Fig. 7.

Besides of stratiform Fe mineralization vein and stockwork – disseminative Hg mineralization (thin quartz veinlets containing cinnabar, native Hg + pyrite and arsenopyrite) in the area is developed. (Ilavský, 1956, Beňo, 1960, Lörincz, 1993). From prospecting point of view is substantial, that the known deposits of this mineralization (Trojica and Za baňami) are located always in the overlying position of deep-seated Fe carbonate bodies.

A newer idea of geological structure of the deposit area has been given by Grecula (1995). The basic tectonic

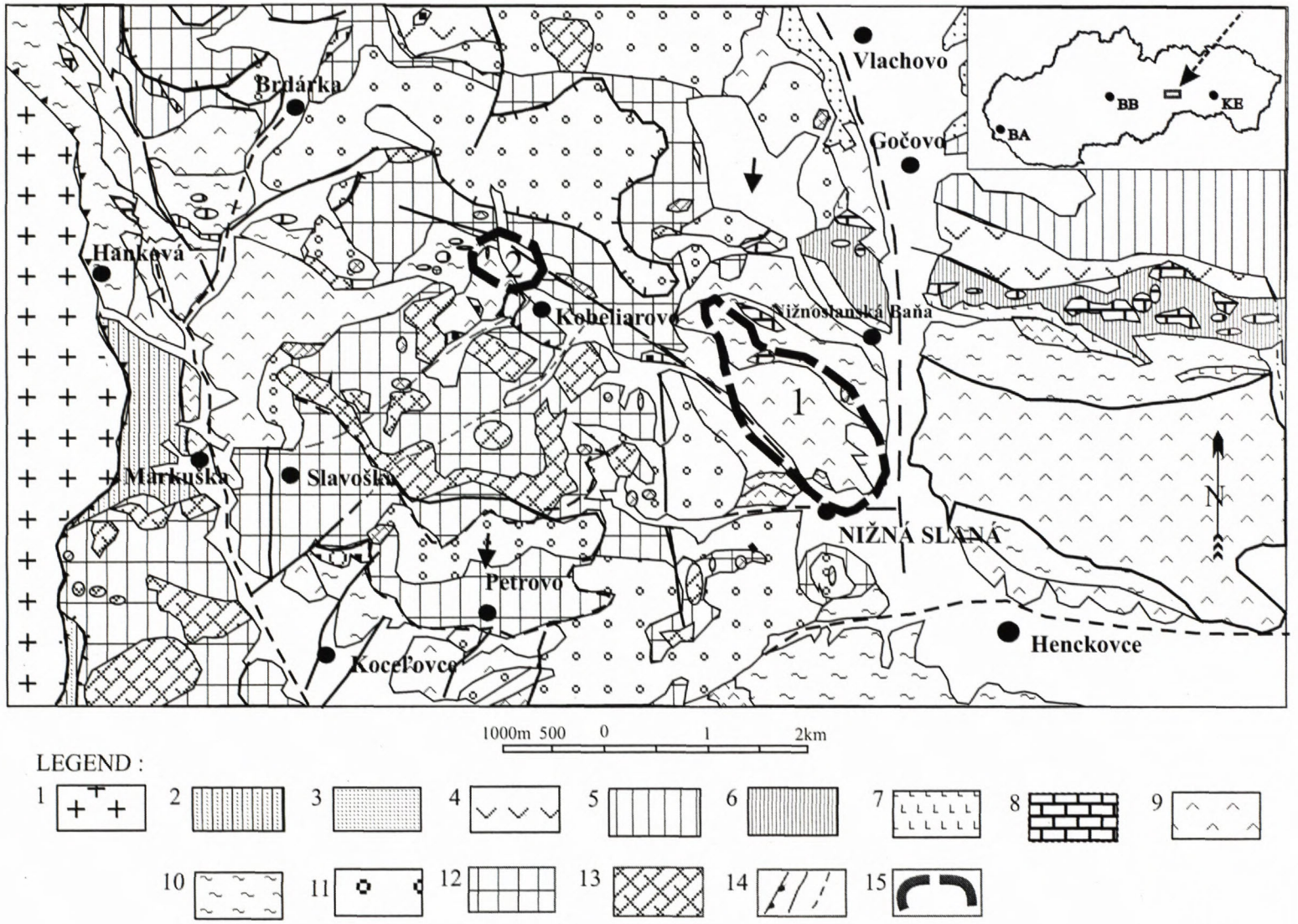

Fig. 1. The geological map of the Nižná Slaná area according to Bajaník et al. (1984), adopted by Kucharič, 2002
***VEPORICUM UNIT**: 1 – crystalline complexes mostly, 2 – **Slatvina Formation** (sandstones, cyclically alternating phyllite schists); **GEMERICUM UNIT**: **Vlachovo formation**: 3 – psammitic complexes mostly, 4 – metarhyolite products, 5 – green phyllites mostly, 6 – black phyllites mostly, 7 – lydites, 8 – carbonates ± Fe; **Bystrý potok Formation**: 9 – metarhyolite products, 10 – black phyllites;**PERMIAN – Rožňava Formation**: 11 – conglomerates and sandstone mostly Bôrka Nappe, 12 – schists facies mostly, 13 – carbonates facies mostly, 14 – younger units, 15 – overthrusts, faults, presumed faults, 16 – approx. projection of deposit bodies outline to the surface: 1) Manó – Gabriela, 2) Kobeliarovo*

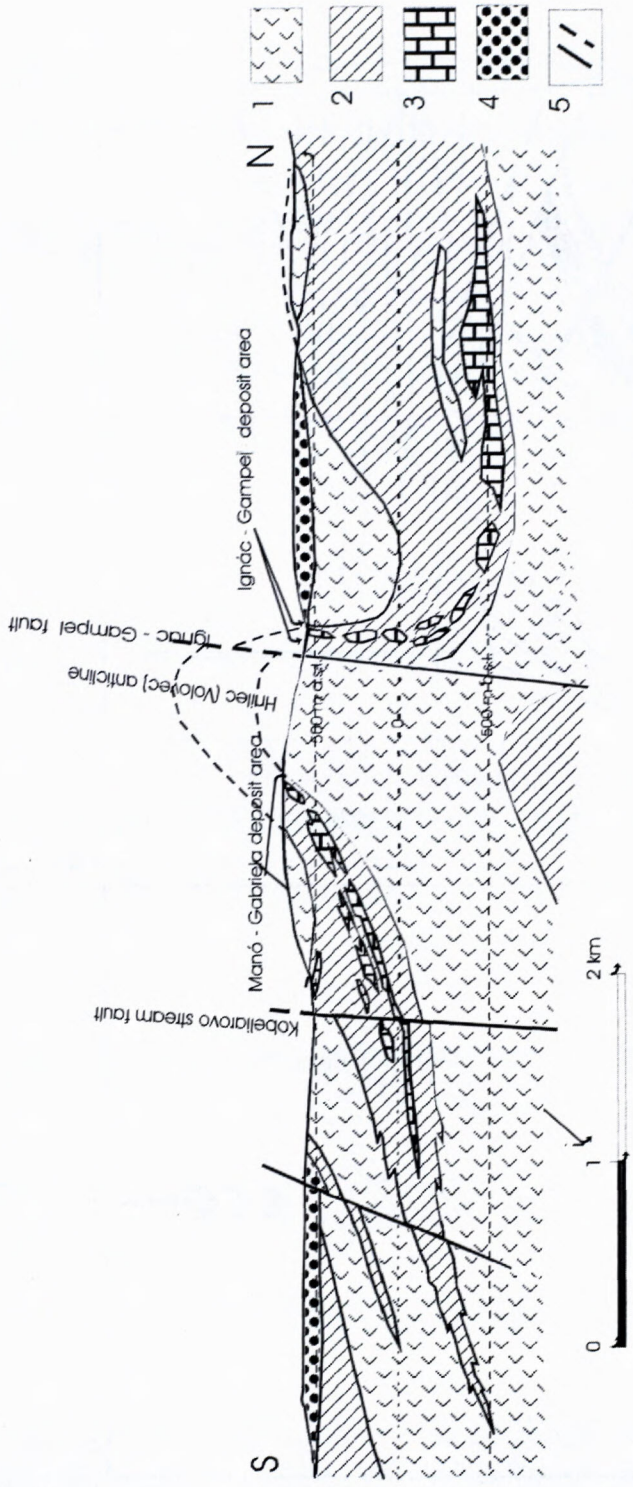

Fig. 2. The geological structure imagination of the area given by Abonyi et al. (1966), adopted by Kucharič, 2002
1 – porphyroids together, 2 – graphitic. – sericitic phyllites complex, 3 – carbonates (± Fe), 4 – younger units, 5 – faults

structure of ore field is the asymmetric anticline again, but its northern limb is strongly reduced and in the depth is recurvated to the South and therefore situated below southern one. Due to is the anticline in the form of incline isoclinal fold interpreted (Fig. 3). Such imagination is derived from the basic interpretation of the whole region of the Spišsko-gemerské Ore Mts., given by above-mentioned author, according to that the region is built by the eight superposed nappes with the direction of overfault to the North (Grecula, 1983).

A structural and mineralogical research was performed in the deposits Ignác, Gampeľ, and Manó. (Sasváry ľet al., 1996.) On the basis of the structural analyses, evaluation of mineralogical and litological relations the deep seated continuation of ore bodies between Ignác and Gampe¾ deposits is expected. Position of interpreted ore bodies would be in the northern limb of the Hnilec anticline, which is formed to the local syncline – minor fold – product of additional tectonic process (Fig. 4).

A philosophy of research

The main portion of geological works has been performed within framework of the project Lörincz et al. (1994). This research complex consisted of geological, geochemical, and geophysical methods as well as drilling works. (An additional geological mapping, geochemistry analyses, mercury content determination in soils, gravimetry, resistivity and induced polarisation profiling and vertical electrical sounding).

From previous knowledge of the area was obvious, that the problem concerns hidden Fe carbonate ore bodies and therefore the most relevant information have been expected from the results of geophysical methods. Regardless of two different opinions at the geological structure of the area itself and at the whole territory of the Spišsko-Gemerské Ore Mts. (Bajaník, 1984, against Grecula, 1983) that has been partly united only by location of the position carbonate bodies in the black phyllites formation (Betliar formation) it was inevitable to find suitable physical „deposit" feature.

Because of two deposits of Fe carbonate had been a direct reflect in the gravity field (positive anomalies) and there were accompanied by the high anomalies of Hg concentration in a back of ore (Manó-Gabriela and Kobeliarovo), the prospecting has been concentrated upon finding and the explanation of similar measured anomalies in the adjoining area. The selected objects that had been possessed such attributes have been proposed for drilling activity – the best verification of geological and geophysical data interpretation.

A leadership among research methods belongs to gravity due to the positive picture of known ore bodies (Manó-Gabriela and discovering of Kobeliarovo deposit) in the gravity field – where anomalies reached almost +2 mGal. (Kotásek, Popelář, 1963).

The interconnection between ore bodies, ore bearing beds and mercury concentration has been known and proved in the previous works (Kucharič and Hojnoš, 1989, Grecula and Kucharič et al., 1992, Háber et al., 1993). This connection is visible from the extension of remarkable regional anomaly of mercury that has been detected in the space of the area in question (Fig. 7). This anomaly seemed to be the largest or probably one of the highest natural one of mercury element in the Western Carpathians region. (Maximum value has been occurred to the West of Kobeliarovo village almost 300 ppm.).

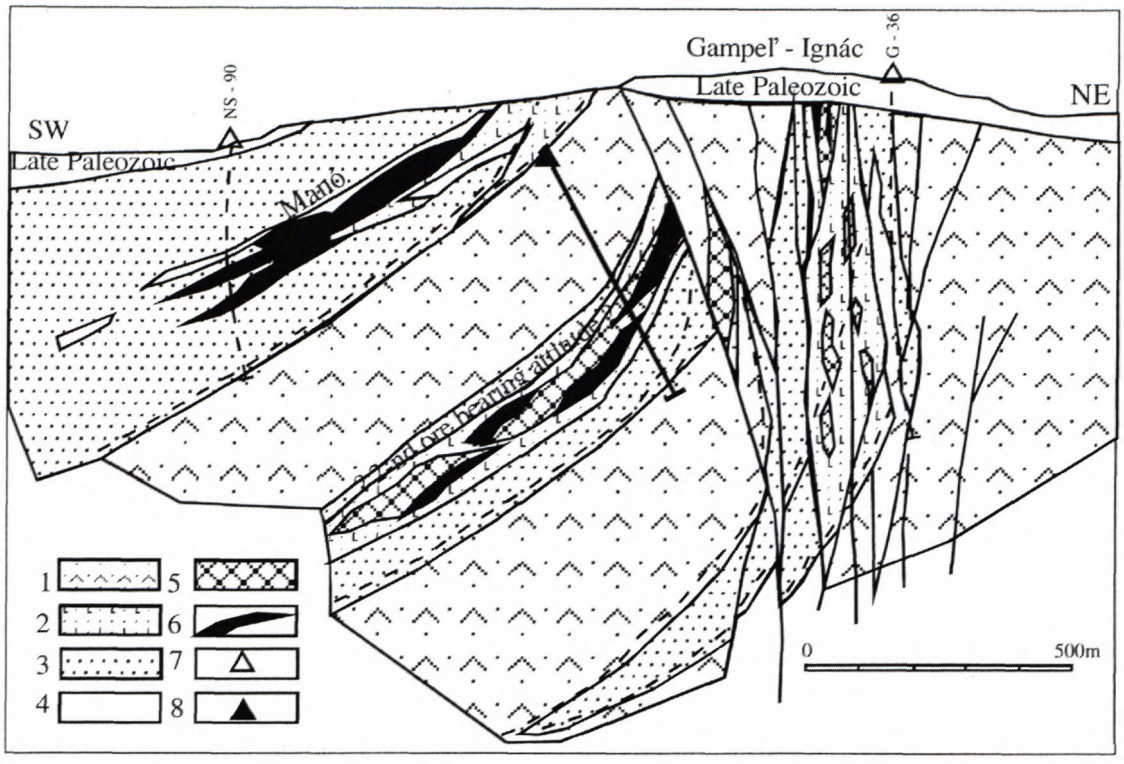

Fig. 3 Imagination of geological structure of the area by Grecula (1994)
1 – porphyroid, 2 – black phyllite with lydites, 3 – ceritic phyllite, 4 – limestone, 5 – ankerite, 6 – ciderite, 7 – previous boreholes, 8 – the projected underground borehole

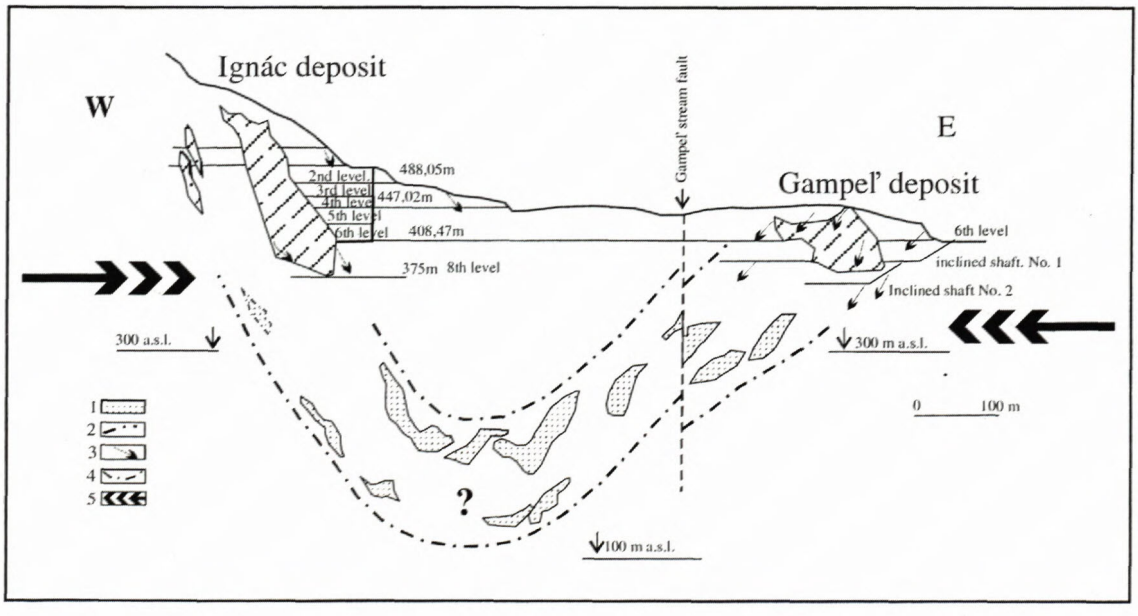

Fig. 4. The interpreted syncline Ignác – Gampeľ by Sasvári et al. (1996), adopted by Kucharič, 2002
1 – the interpreted siderite and ankerite bodies, 2 – the interpreted syncline of productive horizon, 3 – the dook of foliation S1, 4 – robbed space, 5 – the direction of side pressure (?)

According to above mentioned geological works in the ore field is obvious, that the Fe-carbonates horizon is situated in the surroundings of black phyllites environment what does mean conductive medium from geoelectrical point of view. Beside of this, the carbonates itself are non conductive material and therefore in the suitable condition is reasonable to expect their reflect in the resistivity field.

On the basis above-mentioned result the gravity method and the assessment of mercury content in the soils as direct prospecting symptoms can be considered.

In a favourable situation (a sufficient contrast between conductive ore bearing beds – black phyllites – and less, or non conductive carbonates, as well as remarkable geometry of carbonate body) the apparent resistity can be added to these symptoms.

The detection of ore bearing beds itself (which are not only conductive, but also polarizable) using methods of apparent resistivity – (profiling and vertical electrical sounding) and induced polarization in our imagination represents an indirect prospecting symptom.

The step of measured points in the gravimetry has been 100 m; all the other methods have been carried out with the step of 20 m.

Verification of the perspective places

In the coarse of the 50 years, several gravity anomalies have been detected in this area, but not all of them have been verified. On the base above mentioned proves, for purpose of the research it has been indisputable the checking all these object is essential apart of various attitudes to geological structure understanding.

The Petrovo area

This locality is situated in the surroundings of similar village in the SW direction of Manó – Gabriela deposit (Fig. 1, 7).

The auspicious data have been obtained from the regional profile No. 87 of the SGR – geofyzika project. (Mikuška, in Grecula and Kucharič et al., 1992). A conformity of these data with a data from the Kobeliarovo deposit obtained is very explicit visible on the Fig. 5. The borehole PE – 1 has been suggested and drilled on the place of the anomaly near Petrovo village. Its position is marked on the Fig.7 and data depicted in the Tab.1.

From the Tab. 1 is clear, that any carbonate body has not been reached. The attitude of graphitic-sericitic phyllites with the small content of lydites on the bottom part of the borehole is probably the representative of ore bearing beds. The reason of gravity anomaly has been quartzites, which are usually as light rocks considered. Similarly, the tuffaceous phyllites do not belong to heavy rocks too. The chemical analyses have not confirmed increased concentration of some heavy metal. From the Hg content point of view the maximum value are concentrated equally in the upper part of the borehole in rocks of Bôrka nappe. The anomalies of the density and higher contents of mercury are not synergistic and were generated by the different rocks set. The mutual combination of geochemical and density parameters caused that the anomalous object has been interpreted as an exhibit of Fe carbonate body. From the technical part of interpretation has been confirmed occurrence of the anomalous objects but the more important part – a practical one was not fulfilled, because expected output has not been achieved. Therefore, the result has to be as an unsuccessful considered.

The Henckovce area

The locality is situated 5 km to the SSE of Manó – Gabriela deposit approximately. A place for the borehole has been selected based on the occurrence of the positive gravity anomaly (+0.5 mGal). Besides of this, the space of the anomaly has exhibited increased concentration of Hg, the presence of black phyllites in the depth (IP) and exactly the same type of V E S curve as was above productive part of Manó-Gabriela deposit detected. These four favourable symptoms was strengthened by geological map information, due to ore bearing beds from the deposit area Manó-Gabriela have a continuation to SE to the locality in question (Bajaník et al. 1984). In spite of these very promising signs, we were preadmonished on possible shadiness and risks of our interpretation. However a necessity to verify of the auspicious object conducted to setting out of the place for the borehole NO – 1 in the extension of the anomaly. (Kucharič et al., 1997).

The borehole No. NSO – 1 has been situated very close to the eastern part of Henckovce village. The results are exhibited in the Tab 2.

The carbonate bodies were not inquired again.

Content of Hg has been in the whole course of the borehole very low; it means that our interpretation was not true. We supposed some possibility – see above-mentioned shadows – but unfortunately, it was confirmed. From the mercury content point of view, in the porphyroids, these porphyroids on the surface developed can assume as the underlying ones. The enrichment of metapsammites about dispersion of pyrrhotine caused the increasing of density the rocks and the gravity effect of the object has been misinterpreted. On the other hand, the interpretation against situation ascertained by the borehole is quite correct but only from the physical viewpoint and therefore its importance is practically inapplicable. The situation is similar as on the area Petrovo, where quartzite (from younger unit) possessed the high volume density too.

The borehole NSO – 2

The borehole has been situated on the base of geological assumptions – likely prolongation of deposit area to the East, though geological map (Bajaník et al., 1982) adverted at changing the direction of the productive horizon to the SE–NW direction. (Fig.1). There was not any positive gravity anomaly in this space and another methods were without promising results. The data obtained from the borehole are as follows: Tab. 3. Data from the borehole No-NSO-2.

The average density of rocks in the borehole was 2.72 g/cm3. The carbonate rocks have not been reached. The complex of graphitic – sericitic. phyllite did not exhibit the accompanying marks of the ore bearing beds – egz. lydites, carbonates. The content of Hg in the care has been very low.

The Manó – Gabriela deposit area

The borehole V – NSO 1P

This borehole has been drilled out of geophysical prepositions, but its peculiarity was in its position on the 6-th horizon of the Manó–Gabriela deposit, as well as its dip. The main task of the borehole has been to verify a

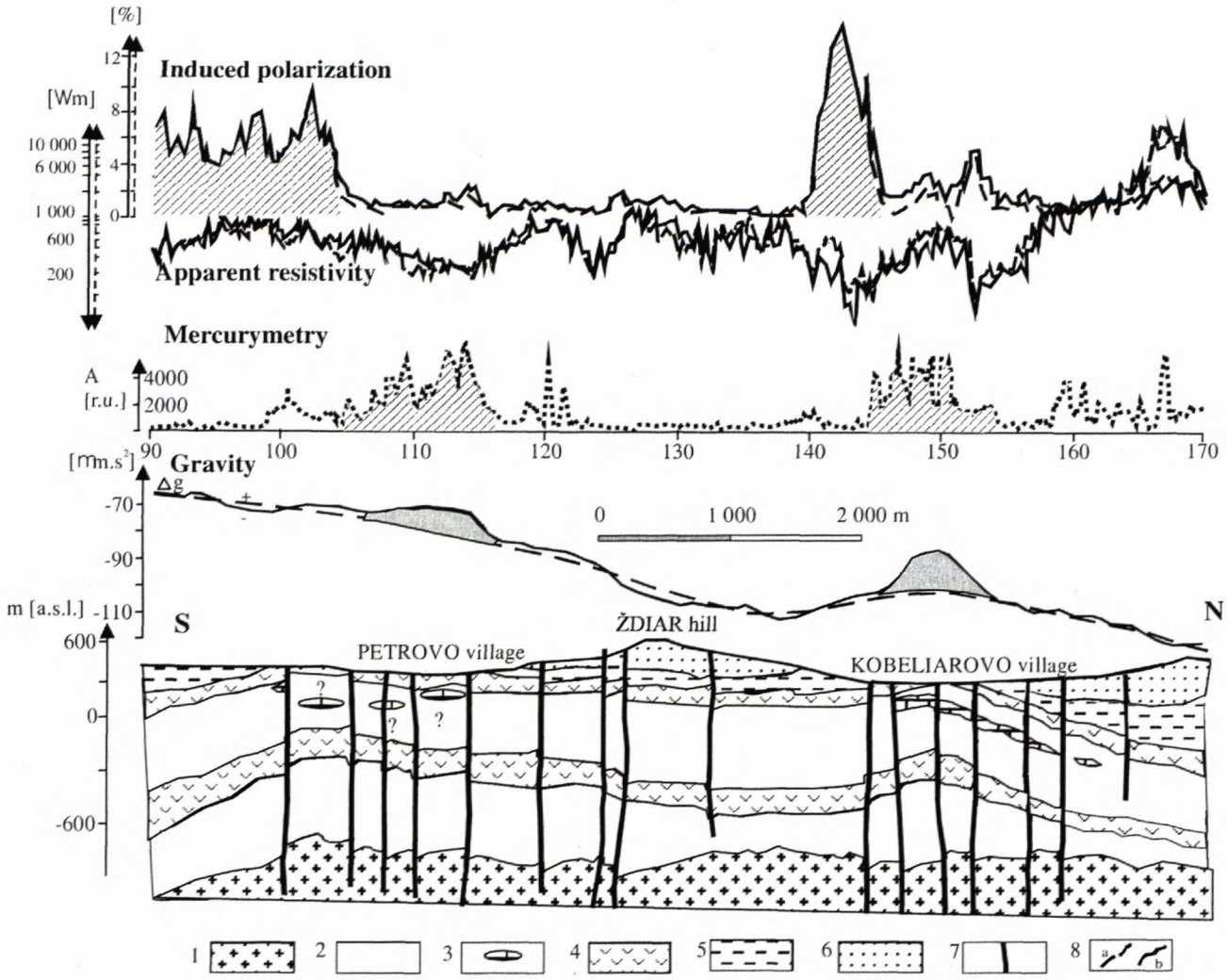

Fig. 5. The showings of ore similarity (Kobeliarovo deposit versa Petrovo perspective area) by Kucharič, 1993
1 – granite, 2 – black phyllite, 3 – Fe carbonate, 4 – porphyroid, 5 – black slate (Late Paleozoic), 6 – younger units together, 7 – fault, 8 – a) gravity regional field, b) gravity residual field

Tab.1. The data from the borehole PE – 1 obtained

The Depth (m)	Lithology	Density (g/cm3)	Content of Hg (ppm)
0 – 27.0	Rauhwacke	2.17	0.76; 0.10; 0.06
27.0 – 48.9	Black schist, tectonic. decomposed	–	5.0; 1.37
48.9 – 57.4	Violet quartzite	2.88	0.17; 0.08
57.4 – 78.0	Tuffaceous phyllite	2.88	0.27;0.39;1.38;0,51
78.0 – 88.1	Conglomerate ± Hg	2.65	2.10;1.54
88.1 – 94.3	Quartzose phyllite	–	0.48
94.3 – 215.5	Porphyroids	Average 2.70	Average 0.27
215.5 – 224.0	Hematitzose phyllite	2.88	0.2
224.0 – 232.8	Tuffaceous phyllite, basic	2.85	0.35
232.8 – 246.7	Porphyroids	–	0.45
246.7 – 450.0	Graphit.-sericitic.phyllites ±lydites	2.77	0.18

geological assumption of nappe structure of the area (Grecula et al., 1995) – see Fig. 3. In the common sense of research, it meant to find out an existence of the northern limb of the above-mentioned anticline (ore bearing formation) but here in the position of inclined isoclinal fold in flat wall of underlying porphyroids. This interpretation supposed occurrences of Fe carbonate bodies here in the northern limb of anticline. The direction of the borehole has been 45 degrees to the North and its length 460.2m. Besides, of attitude of black phyllites in the interval 43.2 – 72.7 m the whole borehole has been drilled in the rock environment of porphyroids. The content of mercury has been steady below level of 1 ppm. According to our knowledge about position and settlement of the

Tab.2. The data from the borehole NSO – 1 obtained

Depth drilled (m)	Depth interpreted (m) (acc. VES)	Lithology
0 – 49.8	0 – 40	debris of porphyroids
49.8 – 102.2	40 – 140	porphyroids
102.2 – 126.7	140 –	seric. phyllites
126.7 – 308.6	– 330	graphitic.-seric. phyllites
308.6 – 503.0	330 –	green porphyroids, compact

Tab.3. The data from the borehole NSO-2 obtained

Depth drilled (m)	Depth interpreted (m) acc. VES	Lithology
0.0 – 6.3	0 – 20 quaternary deposits	quaternary deposits
6.3 – 95.4	20 – 88 porphyroids	porphyroids
94.4 – 142.7	88 – 188 black phyllites	sericitic phyllites
142.7 – 302.1	188 – 255 carbonates ?	black metapsammites with attitudes of black phyllites, veinlets of quartz ± calcite, ankerite
302.1 – 369.6	255 – 400 black phyllites	tuffaceous phyllites
369.6 – 373.0	400 – porphyroids	quartzit.black phyllites

element near deposit and within the deposit itself, it has been obvious, that these porphyroids are really „underlying" ones and therefore occurrence of ore bodies in the depth is excluded. Equally the results of the borehole verified, that the presumption of nappe structure in the area has not been quite correct.

The Kobeliarovo area

Further procedure carrying out and interpretation of geological works set to proving of productive horizon development in this part of the area only, because lack of proper (more distinctive) gravity objects has been obvious. Geological and mining data as well as our geophysical results manifested prolongation of this element to the locality. After analysis of the gravity field was supposed a continuation of attenuated Kobeliarovo anomaly here (The western part). The whole area is created by attitude of porphyroids on the surface of the terrain, which possess abundant concentration of mercury. The average values of this element in the soil cover are 10 – 20 ppm, maximum almost 300 ppm (!) what is item belonging to an ore body (Kucharič et al., 1998). The stockwork – disseminative ore mineralization has been found out by the verification of metasomatic siderite bodies (Lõrincz, 1993). The ore mineralization is developed in the overlay of the Fe-carbonate bodies. It is present in the form of cinnabar disseminations, and quartz veinlets of cm thickness, containing of cinnabar, pyrite, and arsenopyrite, locally disseminated native Hg (Ilavský, 1956, Beňo, 1960). Host rocks are schistose porphyroids. Therefore, these porphyroids (enriched by mercury) as the overlying ones have been considered.

The next borehole NSO-3 (Brdárka–Ježovec) has been situated between old ones Br-6 and Br-10. Both above mentioned boreholes had been perforated Fe carbonates (ankerites), and therefore similar development was expected. This borehole had to be served as guarantee one (Fig. 7.) In spite of assumption, the carbonates were catching in the thickness several cm only. The bottom of the borehole has been in the depth 316 m in the porphyroids environment.

Finally, the boreholes NSO-4 (Brdárka) and NSO-5 (Slavoška) had to verify productive complex below overlying porphyroids. The first one was located on the positive gravity anomaly margin, the second one directly to the shallow gravity maximum. The depth was 348 m, resp. 302.5 m in the porphyroids surroundings only. The abundance of diminutive carbonate veins (ankerite, siderite) was appeared especially in the bottom part of the borehole NSO-4 in the depth 313–320.8 m. The veinlets of siderite (max. 0.5 m thickness) possessed remarkable prospective signs – density 3.56 g/cm3 and mercury concentration 23.6 ppm. It is obvious, that such small objects cannot produce disturbance of gravity field due to small extension and considerable depth. According to RTG analyses, the content of Fe has been 27.7%–30.58 %, Mn 0.925 %–1.081 % and SiO_2 21.94 %– 26.35% and therefore as the breunerite, even mesitite this carbonate can be classified (Turanová, Turan 1989). The similar object in the porphyroids surroundings had been found in the older borehole GS-2 SE of Petrovo village (Varga, 1970a). In our opinion the inherence of carbonate, veinlets can be the possible symptom of productive ore bearing beds neighbourhood.

Owing to shallow positive gravity anomaly is almost impossible to expect larger volume of Fe carbonate bodies in this space. As additional criteria, the interpretation the VES data have been considered, but distance of profiles 200 in this case seemed to be inadequate for exact situation of the borehole.

Prospecting results discussion

The all seven boreholes, to drill in the framework of the project (Lörincz et al., 1994) have been negative from the subject of the prospecting. It is very serious signal for expectation another occurrences of Fe carbonates in this area. There is the place to discuss about reason of such results obtaining and whether is possible to set some perspective places.

Reasons

The all-remarkable positive gravity anomalies in the area in question have been checked. It means that besides two anomalies detected above known deposits (Manó–Gabriela and Kobeliarovo) all the others (Petrovo and Henckovce) have being generated by the rocks complexes, which were not the subject of the prospecting and

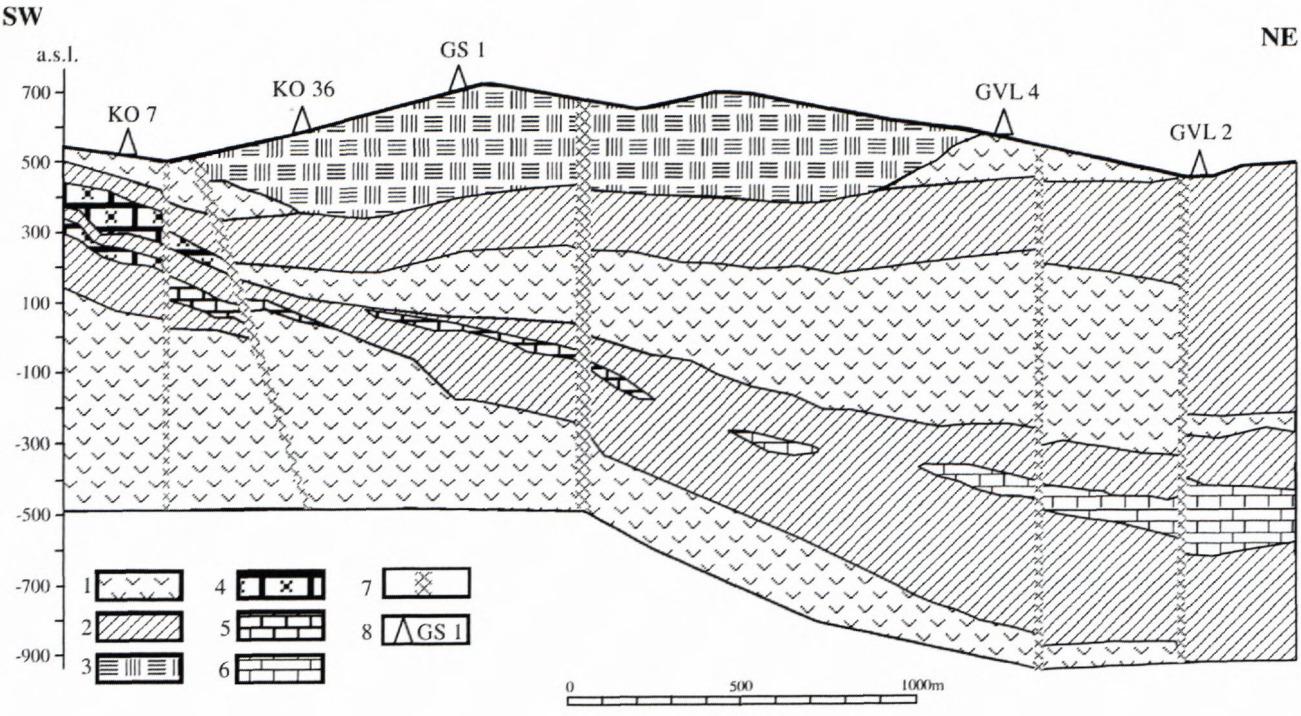

Fig. 6. The example of metamorphose increasing – resulting of gradual conversion from siderite to magnesite between the Kobeliarovo deposit and the GVL boreholes area (to the west of Vlachovo village), compiled by Kucharič, 1997.
1 – porphyroids together, 2 – black phyllites together, 3 – siderite, 4 – ankerite, 5 – magnesite, 6 – faults, 7 – boreholes

source of anomalies has been not syngenetic but it has been generated by the composition of anomalous impacts of various rocks types.

According to our consideration given at the beginning of this paper, the first attention has been concentrated on the positive gravity anomalies. Unfortunately, the source of anomalies Petrovo and Henckovce has been confirmed, but only from physics point of view. The sources of complex anomaly (gravity, resistivity, induced polarization and mercury) were besides of above-mentioned remarks created unusual rocks types, from petrophysical point of view.

It is caused by insufficient knowledge about physical properties of rocks. In spite of the fact that a large portion of the West Carpathians rocks complexes were studied in the last 30 years, the main attention has been concentrated at the assessment of average values and dispersion characteristic only. If we take to consideration the Gauss´ curve of a distribution of an accidental selection, the typical values for a statement of the characteristic features studied rocks complex are modal one. Nevertheless, deposit areas seemed to be often anomalous objects itself, and therefore they are reflected by equally anomalous physical values, which create the marginal parts of the Gauss´ curve, and therefore they are not typical ones. Thus, quartz rocks and quatziferous rocks are usually considered as the light ones, but if they are long time under weathering processes, an abundance of iron minerals in these rocks is often appeared (Kuhnen et al., 2000). This premise is respectable satisfied by temporary interpretation of the completely Early Paleozoic rocks assemblage from the time standpoint. Due to the density of quartziferous rocks is increased as we learned in the boreholes.

The connection between petrophysical features assessment and a particular petrographical description, chemical analysis is dominantly missed, therefore a reason of physical anomaly leaves unknown. The work as has been given by Varga, (1966) is only the objection, which confirms of the rule. This is very weak and unfortunately, the typical feature of petrophysical studies in the West Carpathians region.

It is necessary to stress that prospecting in such complicated litological and tectonic conditions requested higher density of profiles as has been used in this event. The distance of 200 m seemed to be a bit inadequate. That is the most probable reason, why the boreholes NSO -5 and NSO-6 did not reach the ore-bearing horizon.

In the case of an accidental small positive gravity anomaly occurrence (smaller than anomaly caused by Kobeliarovo deposit) which would be due to the scale of the investigation omitted, such object cannot be remarkable for practical exploitation. The deeper situated siderite bodies (hanging wall more than 400m below surface) have not been detected. The explanation of this is in accordance with a metamorphic model of siderite mineralization (Radvanec in Grecula et al., 1995) according to this siderite seemed to be low metamorphic product, (green slate metamorphic facies) whereas magnesite is connected with the higher level of metamorphose – closer to amphibolite facies (ankerite is situated between its). In our case, we suppose an increasing of metamorphose to-

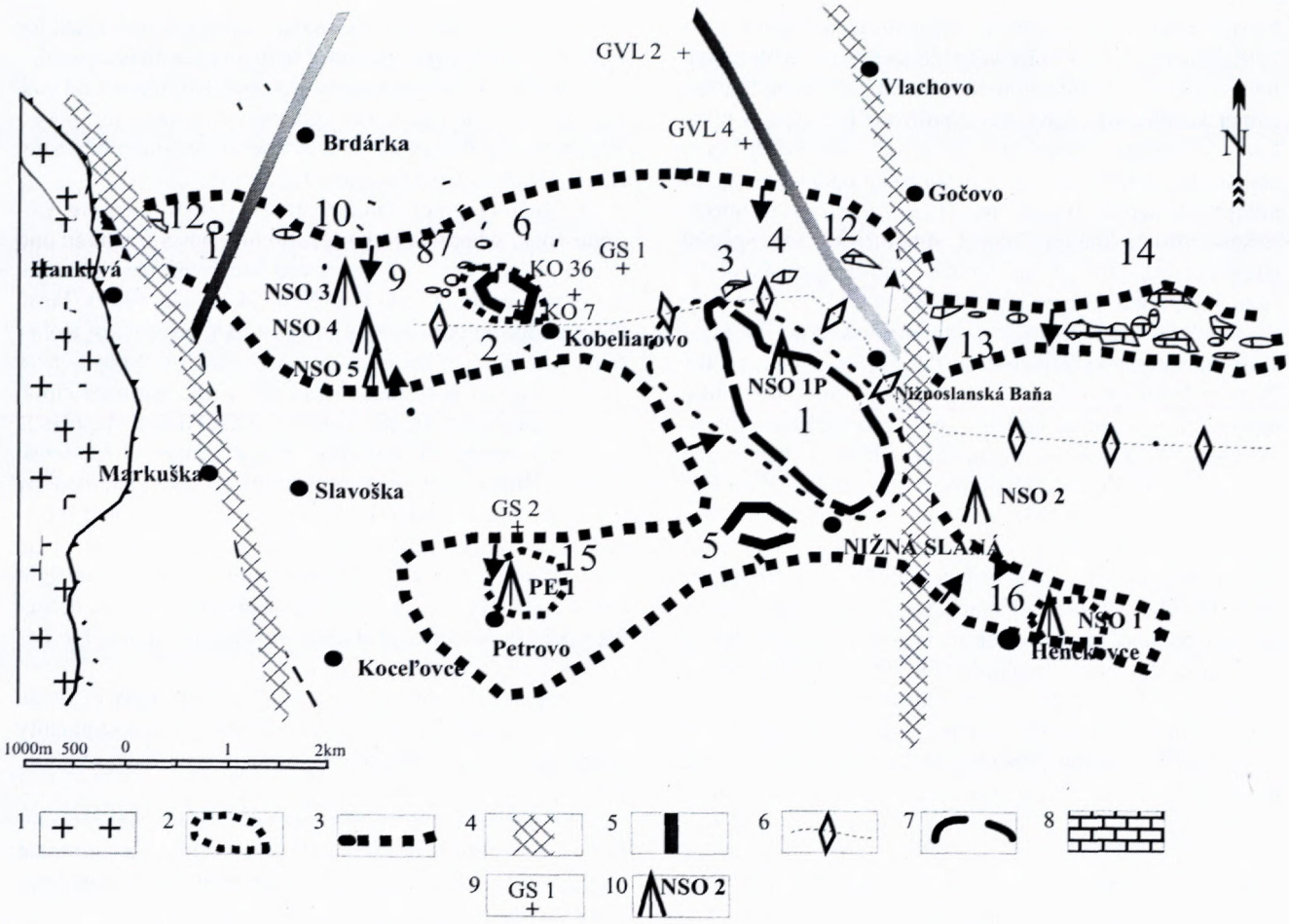

Fig. 7. The sketch of anomalous zones, tectonic delimitation of ore and drilling works.
1. Veporicum unit together, 2. Positive residual gravity anomaly, 3. Extension of regional Hg anomaly, 4. Main faults, 5. Faults „en echelon", 6. Interpreted anticlinal axis, 7. Ore bodies outline projection to the surface, 8. Known Fe carbonates bodies and verified gravity anomalies: 1) Manó – Gabriela, 2) Kobeliarovo, 3) Ignác, 4) Gampe¾, 5) Manó – depth, the south, 6) Jarok baòa – ankerite, 7) Vybraná Michaeli – siderite, 8) Amália – ankerite, 9) Kobeliarovo – ankerite, 10) Álmoš – siderite, 11) Hanková – Brdárka – ankerite, 12) Gočovo – ankerite, 13,14) Zoltán, Atilla, Koloman, Viktor, Leontína, Peter, Bonaventúra – ankerite, 15) Petrovo gravity anomaly, 16) Henckovce gravity anomaly; 9. Selected old boreholes, 10. New boreholes

wards the depth. This model is fully proved and demonstrated on the Fig. 6. (The schematic cross section through boreholes from the Kobeliarovo to the Vlachovo area). The loosing of iron component with increasing metamorphose level connotes increasing of Mg amount what results to diminishing of volume density of this raw materials.

That is the reason why extensional positive gravity anomalies expected from deeper parts of the locality are not detected. If any positive gravity anomalies were appeared, in term of this metamorphic model they could to be generated by magnesite disturbing bodies only. From the previous works is visible (Lörincz et al., 1989) that in he depth bellow 0 m a.s.l. are siderite bodies developed only scarsely in the thin attitudes.

Due to the whole part of the locality on the eastern riverside of Slaná is not perspective from occurrence of siderite bodies, because in the bottom part of the borehole NSO-2 the higher level of metamorphose has been observed – biotite facies (Pramuka, in Lörincz et al., 1997). Furthermore, the lack of the positive gravity anomalies supported by detection of thick complex of porphyroids forced to classified this part of the locality as the non-perspective.

The belt of Fe carbonates Hanková – Volovec to the north of the borehole NSO-2 comprises ankerite and dolomite members only.

The results of the boreholes NSO-2 and NSO-1P (underground) mainly adverted, that function of the Late Variscan nappes tectonic has been a bit overestimated in this case. The porphyroids bored in the bottom part of the borehole NSO-1P were very compact, without some demonstration of tectonic reprocessing. If we compare imaginations of geological structure of the area given on the Fig. 2 with the Fig. 3, based on data from the other boreholes, as well as previous boreholes data is very probable, that geological structure of the area due to Abonyi (1966) has legitimacy. Similarly, the detailed prospecting on the magnesite-talc deposit Gemerská Poloma, approx. 13 km to the east of the locality, verified by boreholes does not em-

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body the relevant feature of nappe structure (Killík et al., 1992, Kucharič, 1993). Equally the results of the deep seismic profile G – 1 situated in the central part of the Spišsko-gemerské ore Mts. have not confirmed the system of the Late Variscan nappes, in spite of theoretically very convenient differences in the waves propagation on the interpreted nappes boundaries. Based on above-mentioned seismic results the geological structure of the Spišsko-gemerské ore Mts. as the Alpine north-vergent nappe has been interpreted. (Vozár et al., 1996).

If we compare geological situation given on the Fig. 1 with interpretation depicted on the Fig. 6 – cross section through known boreholes – is obvious, that belt of carbonates bodies is in the underlying bed of rocks complexes belonging to Vlachovo Formation, which is due to geological map of the area (Bajaník et al., 1984) as the oldest member of the Early Paleozoic sequence interpreted. This is very serious discrepancy pointing out, that the geological map is not in concordance with our interpretation (Fig. 1). The complex of black schists is divided on the eastern bank of Slaná river to two Formations (Bystrý potok and Vlachovo one) according to occurrence of carbonates and lydites. The black schists with lydites bodies are incorporated to the Bystrý potok Formation, while the same rocks with the presence of carbonates bodies belongs to Vlachovo Formation. On the western bank of Slaná river is situation in this map ambiguous and anticline structure has disappeared (the northern limb) in the space under younger carbonates of Radzim hill. (See cross section 3 – 3´ in the map Bajaník et al., 1984). This interpretation would not be accepted situation given on the Fig. 2.

Based on physical features of the black beds – the Betliar one – (induced polarization, spontaneous polarization and apparent resistivity), as well as radioactivity and content of Hg, we consider both, bodies of lydites and carbonates as components of non divided Betliar beds on the locality. This is in accordance with the definition of the beds due to Grecula (1982). Similar interpretation of the Betliar beds based on the deposits areas data from the most important deposits of the Spišsko-gemerské Ore Mts. has been given by Tréger et al. (2003). From this aspect the whole area of Spišsko-gemerské Ore Mts. had to be interpret, for creation of metalogenetic models and raw material prognosis.

The existence of a parasitic synform in the anticline (the northern limb of anticline) setting up by Sasvári et al. (1996) between abandoned deposits Ignác and Gampeľ is possible, but from ore body occurrence viewpoint there are several serious objections:

– there is not detected any larger positive gravity anomaly in this space. The estimated exploited quantity of siderite was about 3 000 kt in the Ignác deposit and 500 kt in the Gampeľ one. For comparison, the Kobeliarovo deposit posse's amount almost 9 500 kt economical reserves. Together with non economical storage the deposit generate positive gravity anomaly + 2 mGal (Ščuka, 1982)

– the Hg anomaly is present in this place, but it is only sufficient condition for occurrence of Fe ore body,

– the space between these two deposits is too small for expectation of larger ore body with an economic benefit,

– in the case supposing of deep-seated minor fold (see Fig. 4) we could reach the higher level of metamorphoses, where occurrence of siderite is due to metamorphic criteria (Radvanec, 1995) is excluded,

– Ignác-Gampeľ fault represents very intensive tectonic zone, where were lenses of carbonates fractured and decomposed. The carbonates are becoming plastic by the temperature about 200 °C (Nemčok et al., 1995). From this standpoint is interesting to compare position of Kobeliarovo deposit. This is in the same structural position as the position of both discussed object (the northern climb of the anticline). In the case of Kobeliarovo deposit is interlimb angle of anticline bigger (open fold sensu Fleuty, 1964)) and probably therefore less disturbed by the tension faults what resulted to surviving of more quantity of ore bodies in this deposit (compare Fig. 2 and Fig. 6). The interlimb angle depicted on the Fig. 2 is tight (tight fold, (Fleuty, 1964)) and tension faults of Ignác-Gampeľ fault took probably substantial place by destruction of carbonates bodies.

– finally, the drill prospecting of deep parts of Ignác deposit was negative and Gampeľ deposit is tectonically amputated in the depth 50 m under surface (Mihók, 1994).

The all these points naturally do not bracket a possibility of occurrences of small, or smaller Fe-carbonate bodies, but with regard to its supposed reserves is very inconceivable to expect an ore body suitable for nowadays miner and economical conditions in this area.

If we take to consideration the all occurrences of siderite on the locality (Fig. 7), they are strongly amputated by faults of quasi-meridian direction – Štítnik fault in the western part of the area and Slaná River fault in the eastern one. The more clean-cut is in the northern part of these main faults according to faults types „en échelon" – divergent faults (Hills, 1963). There are Brdárka fault in the western part and Gampeľský potok in the eastern part of the locality. There are not any occurrences of siderite bodies out of this en echelon area. It would mean that this block boundered by above-mentioned faults is sunken against neighbouring ones. The function of Štítnik fault by the demarcation ore deposits – especially part south of Brdárka village has been defined by Snopko too (1990). Besides, of this we can observe dextral movement (stress of folding) on the Slaná River fault. The southern limb of productive beds is replaced along N – S direction (see Fig.2, or Fig.7) to the South. The stress towards the west (Kobeliarovo) gradually is decreased based on form of anticline. In term of Nicolas (1984) this fault can be as oblique slip classified. The block situated on the eastern bank of Slaná river seemed to be relatively deeper due to higher degree of metamorphose and big distance between limbs of anticline – what in our interpretation represents the lover, or bottom part of anticline. The southern limb was probably drilled near Henckovce village, but without carbonate facies development and near Petrovo village, where in the bottom parts of PE-1 borehole, where lydites attitudes were found only. Its continuation to the east is

going to the northern slopes of Turecká hill, where an occurrence of carbonates with the dip to the south was observed (southern of Betliar village), out of our area.

Consequences

The main task of works that had been carried out on the locality Nižná Slaná had to find new siderite body, convenient for exploitation. Besides of this to support or reprove probability one of the both geological structure imaginations, or at least to contribute to discussion about this problem. The summarization of obtained results and verification of interpretation by the boreholes results are as follows:

- The one of the basic keystones in geology - principle of analogy – especially in deposits areas is valid within the very narrow interval only, and above-mentioned experience shoved, that existence of 5! identical favourable symptoms has not to be sufficient for obtaining positive picture about ore perspective in this area. From the deposit viewpoint it is necessary very carefully, to manage by generally accepted this principle which use to be usually one of the most powerful feature by an assertion of projects proposals.
- Results obtained from the all boreholes have been unfortunately negative from the deposit viewpoint. The four boreholes have been drilled on the base of geophysical methods interpretation; next, three were situated according to geological data imagination.
- The presence of the carbonate bodies in the depth is always reflected on the surface by the higher or high content of mercury in the soils, but this dependence is not reverse.
- On the other hand the results from the boreholes have confirmed that preposition of Late Variscan nappes structure of the area in the form given by Grecula (1982 is not quite well founded and therefore should be corrected. The geological map of the area (Bajaník et al., 1984) points out ambiguosities with regard to development of productive black beds, and therefore its using for solution of deposit problems in this area is limited.
- The old geological picture – an existence of the anticline structure – anticline of ore bearing horizon – given witness by Abonyi (1966) has been confirmed by the drilling works and therefore this imagination ought to be directory for solution of various geological problems not only in the area in question but also in the whole territory of Spišsko-gemerské Ore Mts.
- The locality is typical example of area, which is considered as well known and inspected on the very high level, but by solution of determinant deposit problems we meet to shortage of geological structure basic definition.
- A similar structural position of potential ore object as Manó–Gabriela deposit could be possible expect to the south of Kobeliarovo village, but old boreholes were negative here.

Conclusion

The complex of geological works had been performed in the last decennium of the previous century for the purpose to find new siderite bodies, suitable for exploitation. Because of ore bodies have been expected in the form of the hidden deposits, the complex consist of geophysical and geochemical methods, together with the geological mapping. An additional geological mapping, geochemistry analyses, mercury content determination in soils, gravimetry, resistivity and induced polarisation profiling and vertical electrical sounding. The all-previous knowledge about geological structure of the locality and results from the old boreholes and mining works had to take to consideration.

The places for the situation of the drilling works had been selected on the base of gravity positive anomalies detection and on the base of supposition geological structure development.

The seven boreholes have been drilled in the adjacent area of Nižná Slaná deposit area, as well as in the deposit itself for purpose spreading of ore storage. The four boreholes, PE-1 (Petrovo), NSO-1, (Henckovce area), NSO-5 and NSO-6 (Brdárka area) were located on the base of geophysical and geochemical indications. These indications were very similar, as indication directly reflected by the ores bodies of the Fe carbonates. Next four boreholes were traced a posteriori of geological imaginations – the borehole NSO-2 in the Henckovce area, the boreholes NSO-3 and 4 in the Brdárka area and finally the inclined borehole NSO-1P situated in the underground directly in the deposit Manó-Gabriela. The last drill-hole had to besides of new ore bearing horizon discovering, to confirm the variscan nappe structure of this region simultaneously.

In spite of finding several suitable anomaleous objects (very similar to anomaleous object directly above deposit detected) the results obtained from the all boreholes have been negative from the deposit viewpoint. Presence of positive gravity anomalies was the most important, but not only criterion by assessment of Fe carbonates prognosis in the area in question. The metamorphic model of siderite creation as well as tectonical delimitation of ore mineralization were take to consideration.

The all results obtained have been analysed by critical approach pointing to „gaps" in our wraparound knowledge about strata bound siderite bodies development.

On the other hand the results from the boreholes have confirmed that preposition of variscan nappe structure of the area is not well founded and therefore should be corrected. The old geological picture – an existence of the anticline structure – given witness by Abonyi (1966), has been confirmed by the drilling works and therefore this imagination should to be directory for solution of various deposit problems not only in the area in question but also in the whole territory of Spišsko-gemerské Ore Mts.

Based on above mentioned reasons and the conclusions we can proclaim: The new occurrence of Fe carbonate bodies in the area in question which would be satisfied to up-to-date economic and exploitation conditions is practically excluded.

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