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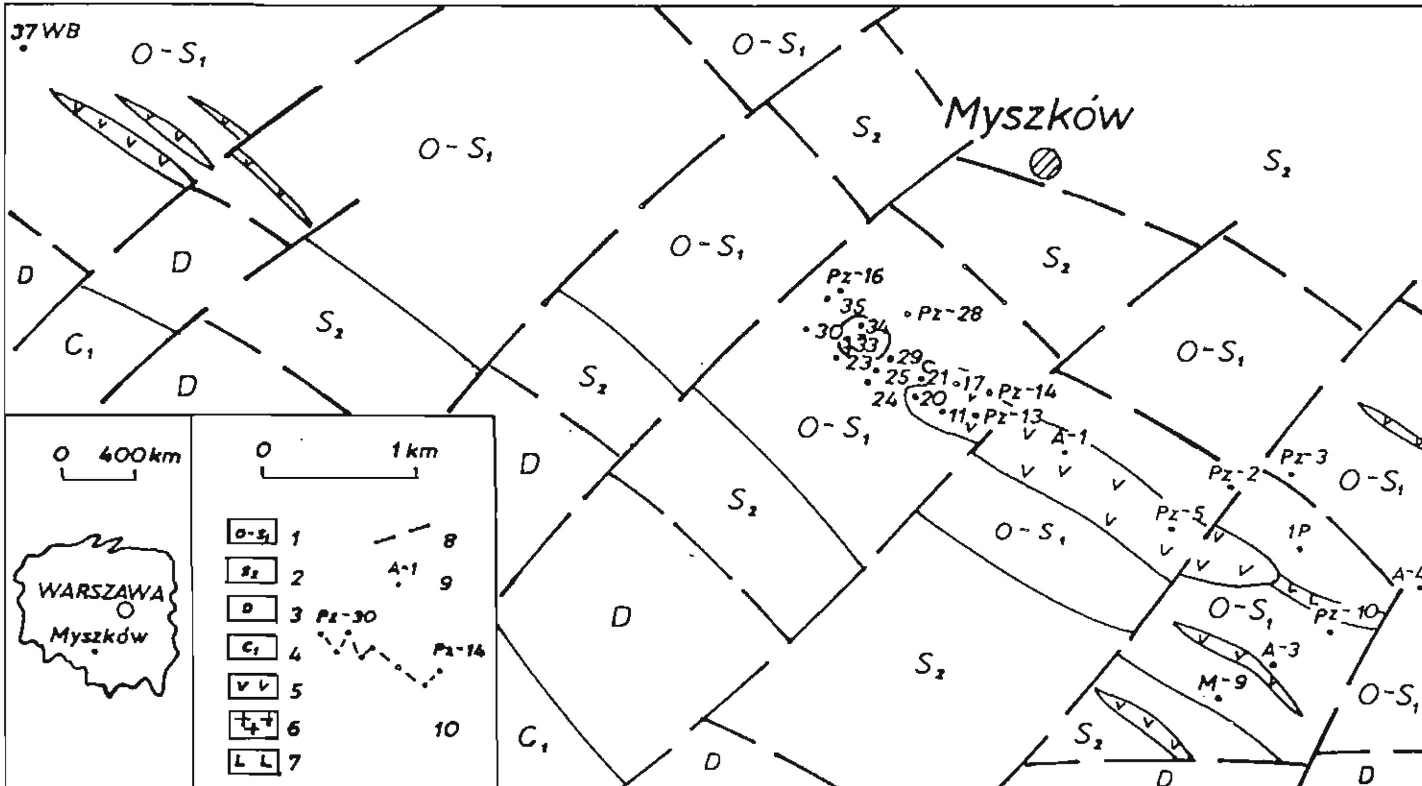
Old Paleozoic ore mineralization of the Myszków — Mrzygłód area (NE margin of the Upper Silesian Coal Basin)

Ore mineralization of the Old Paleozoic rocks making up the bedrock of the Myszków — Mrzygłód area is represented by many genetic types which developed in several phases and stages affected by tectonic movements. In the first phase, corresponding to the preliminary development of the Caledonian geosyncline, the pyrite-chalcopyrite and sphalerite-galenite-chalcopyrite syndiagenetic mineralization was formed. During the second and third phases embracing the period of regional metamorphism and main Caledonian foldings, the forming of the Myszków Elevation structure along with its core filling granitoid intrusion took place. At that time there originated small skarnoid and skarn bodies as well as chlorite-quartz veins with pyrite-chalcopyrite mineralization containing an admixture of magnetite and pyrrhotite. In the fourth and fifth phases connected with the period of the Caledonian Orogen inversion there developed the main mineralization of molybdenite-scheelite-chalcopyrite of stockwork type and copper mineralization of porphyry copper type. In the sixth phase, linked to the Variscan, Cimmerian and Alpine movements, there were formed quartz-carbonate and black quartz veins with chalcopyrite-galenite-sphalerite mineralization containing an admixture of fine-grained molybdenite and scheelite, as well as younger barite-carbonate and carbonate veins with galenite-sphalerite-anglesite mineralization.

INTRODUCTION

Systematic investigations of the ore mineralization in the Myszków — Mrzygłód area were intiated by K. Piekarski (1971*a*,*b*, 1974). Preliminary drilling and geophysical work carried out in the years 1972–1978 confirmed the possibility of the occurrence of Cu–Mo ore concentrations within the Old Paleozoic rocks of the examined area. The results of the investigations were the basis for general characterization of the occurring ore mineralization. They did not explain in detail the age, origin and relation


37 WB
O-S1
S2
D
C1
Myszków
Pz-16
Pz-28
Pz-14
Pz-13
A-1
Pz-2
Pz-3
Pz-5
1P
A-4
Pz-10
A-3
M-9
0 400 km
WARSZAWA
Myszków
0 1 km
1
2
3
4
5
6
7
8
A-1
9
Pz-30
Pz-14
10

of the ore mineralization, hosted in metamorphic rocks, to that linked with magmatic rocks (M. Banaś et al., 1972; F. Ekiert, 1971; K. Piekarski, 1982, 1983, 1988; J. Ślósarz, 1975, 1988). The data obtained from thc prospecting deep boreholes, drilled in the years 1982–1990 as well as from detailed mineralogical examinations, performed primarily by the co-author (Z. Migaszewski) indicated that the ore mineralization of the Old Paleozoic rocks is represented by numerous ore types that developed during several phases affected by tectonic movements.

PHASES OF THE ORE MINERALIZATION DEVELOPMENT

Based upon the results of the performed investigations, the existence of multi-phasal polygenetic ore mineralization, influenced by tectonic movements which took place in the area of interest was confirmed.

During the first phase of large-scale Caledonian tectonic movements, a lot of grabens, assigned to the inner zone of the Caledonian geosyncline from which internides appeared, were formed in the examined and adjacent areas. The strike and extension of that zone is not exactly known. It seems to have run along the north-eastern margin of the Upper Silesian Coal Basin, connecting southward under the recent Carpathians with Eastern and Western Carpathians Caledonides and northward through the area of the Western Pomerania with Scandinavian Caledonides, respectively. To the south-east it was constrained by the Precambrian central massif, buried beneath the Upper Silesian Coal Basin, whereas to the east by the Małopolska Massif. The present width of the discussed zone ranges from 30 to 50 km. Its original value, prior to the compression of the Caledonian geosyncline, is hard to decipher. According to J. Znosko (1983), it may have even been several times larger. As a result of intensive subsidence the grabens in the aforementioned zone were infilled with Cambrian, Ordovician and Silurian deposits, probably exceeding 10 km in thickness.

The development of syndiagenetic polymetallization is linked to the described phase. Its vertical extent is primarily confined to the Old Paleozoic metamorphosed complexes. No ore mineralization was recorded within the Upper Silurian unmetamorphosed rocks.

The metamorphic rocks reveal the ore mineralization in the whole drilled profile. The intensity of this mineralization is different in individual rocks series. The variation of its mineral composition, influenced mainly by lithological factors, is also observed. In all, two types of ore mineralization, i.e. pyrite-chalcopyrite and sphalerite-galenite-chalcopyrite can be distinguished.

Fig. 1. Geological map of the Paleozoic basement of thc Myszków area (compiled by K. Piekarski in 1991)
1 — Ordovician–Lower Silurian; 2 — Upper Silurian; 3 — Devonian; 4 — Lower Carboniferous; 5 — porphyries; 6 — granitoids; 7 — diabases; 8 — faults (probable); 9 — boreholes; 10 — geological cross-section line (see block-diagram in Fig. 2)

Mapa geologiczna paleozoicznego podłoża obszaru Myszkowa (opracowana przez K. Piekarskiego w 1991 r.)
1 — ordowik–sylur dolny; 2 — sylur górny; 3 — dewon; 4 — karbon dolny; 5 — porfiry; 6 — granitoidy; 7 — diabazy; 8 — uskoki przypuszczalne; 9 — otwory wiertnicze; 10 — linia blokdiagramu z fig. 2

The pyrite-chalcopyrite mineralization displays a connection with dark-grey or almost black metashales formed primarily under calm conditions of deposition in an anoxic environment. It often appears in the Cambrian, Ordovician and Silurian (including Lower Ludlow) profiles.

In the Myszków — Mrzygłód area, the greatest concentration of pyrite mineralization was observed within black-dark-grey metapelitic Silurian series assigned to the deep sea Llandovery, Wenlock and Lower Ludlow complexes. The zones of this mineralization, ranging from tens of centimeters to several meters in apparent thickness, were penetrated, among others, by boreholes M–2, 1–P, A–1, 61–Ż, Pz–5 and Pz–10 (Fig. 1). The most interesting chalcopyrite mineralization signs were recorded in borehole Pz–10 where, within a several meter portion of the Silurian chlorite-biotite metashales with lydite insertions the Cu content varied from 0.3 to 3.2%.

The zones of pyrite-chalcopyrite mineralization were also encountered in the horizons of metashales, primarily pelitic, assigned to the Middle and Upper Ordovician. They were penetrated by boreholes Pz–2 and Pz–3 in the vinicity of Mrzygłód and by numerous boreholes (for instance Pz–16, Pz–19, Pz–23, Pz–24, Pz–25 and Pz–28) drilled in the area of the reported ore deposit near Myszków (Fig. 1). The Cu content of these zones reaches 4.7% (borehole Pz–28).

Within the discussed black-dark-grey metashales of the Ordovician and Silurian, two textural types of pyrite-chalcopyrite mineralization, i.e. impregnated (dispersed) veined and massive, can be distinguished. The results of the investigation performed so far indicate that the first type of this mineralization is widely spread and predominant in the discussed area. The massive mineralization consists mainly of fine-grained pyrite (80–85% of ore) with an admixture of copper and other metals (Zn, Pb, As) sulfides. Massive concentrations of the pyrite, ranging between 0.1 and 0.8 m in thickness, were recorded in boreholes M–2, Pz–2, Pz–3, Pz–10 and Pz–28 (Fig. 1). They occur in the form of laminae and lenses running parallel to the bedding of the surrounding metamorphic rocks. The preliminary geochemical examinations performed recently revealed that the zones containing the massive pyrite concentrations are characterized by anomalously increased contents of As and Au and simultaneously decreased contents of Mo.

In the area of Myszków — Mrzygłód, the distinct zonation in distribution of the primary Mo-mineralization is observed. The pyrite-bearing series of grey and green-grey, chlorite-biotite or biotite-chlorite-actinolite metashales enriched in carbonates, as well as metashale series yielding aleuritic structures, usually reveal low contents of Mo, in the range of 5 to 50 ppm. The increased contents of Mo are in turn referred to series of black metashales, revealing pelitic structure, high contents of Al and traces of carbonates. Petrographically, they are represented primarily by biotite metapelites which often as a result of feldspathization processes transform into fine-grained feldspar metasomatites. In the vicinity of Myszków and Mrzygłód these rocks were found in the Lower Silurian deposits by boreholes A–1, A–3, Pz–5 and 1–P and apparently in the Ordovician ones by Pz–17 (Fig. 1). The confirmed Mo contents vary from 0.005 to 0.2%.

Microscopic examinations revealed the presence of molybdenite in the aforementioned deposits. It occurs mainly in form of dispersed grains, macroscopically invisible, and thin veinlets often accompanied by quartz and feldspars. The latter ones are generally predominant in the zones affected by processes of feldspar metasomatosis. The associating pyrite-chalcopyrite mineralization is often developed as tiny impregnations showing low contents of Cu up to 0.6%. There is a correlation between Mo- and Cu-mineralization which resembles that in sedimentary ore deposits (K. Piekarski, 1982). No Mo-Cu correlation exists in the zones of black-dark-grey metashales, influenced by hydrothermal processes leading to feldspar metasomatosis, chloritization, sericitization and silicification as well as within magmatic rocks characterized primarily by veined forms of mineralization.

The second syndiagenetic mineralization of sphalerite-galenite-chalcopyrite is related to the bottom sections of green-grey metashales and metagreywackes with keratophyre sills, stratigraphically assigned to the Middle (Upper?) Ludlow, called the Kotowice Beds (S. Siedlecki, 1962).

Microscopic examinations of this mineralization revealed the presence of sphalerite, galenite, chalcopyrite, pyrite, marcasite and trace admixtures of bornite, tetrahedrite, cubanite and bismuthinite. The described minerals form single grains, veinlets and nest accumulations. They are irregularly distributed within the rocks. The contents of the main metals, i.e. Zn, Pb and Cu reach 1.9, 1.7 and 0.15%, respectively. The extent of this mineralization has not yet been identified. So far, it has been encountered in several boreholes (A–5 bis, 17–KM) localized east and south of Mrzygłód. Apparently, it is not of any industrial significance.

In the s e c o n d p h a s e, the weak regional metamorphism developed in greenstone facies. It was marked by common blastasy of rock-forming minerals, accompanied by remobilization and transformation of ore minerals. As a result of the blastasy processes, there were formed metamorphic rocks composed primarily of quartz, feldspars, biotite, chlorite, sericite, occasionally epidote, tremolite and actinolite. In addition, because of thermal alterations of organic matter, graphite disseminated in metashales, was formed.

The ore minerals, connected with this phase, were formed through remobilization and transformation of the primary disseminated mineralization and are mainly represented by pyrite, sporadically chalcopyrite, sphalerite, galenite and presumably bornite. At that time new mineral phases were also formed, i.e. magnetite, hematite, titanium minerals, pyrrhotite, tellurides and apparently the older generation of wolframite and molybdenite. The presence of intergrowths of molybdenite and chalcopyrite with magnetite is recorded here. The aforementioned ore minerals form scattered accumulations developed along rock lamination as well as pseudoveinlets associated with quartz.

The blastasy process was accompanied by a large scale expulsion of aqueous solutions ("hydrothermal") and silica from sediments. The final effect of these processes was the formation of metasomatic quartz and chlorite-quartz veins, ranging from several to tens of centimeters in thickness, often boudinaged and fissured because of later tectonic movements. The aforementioned veins were traced in the whole profile of metamorphic rocks. Their highest concentration was observed in metaaleurites and metagreywackes. The amount of these veins decreases within the series of metapelites (i.e. the rocks abundant in aluminium) and carbonates. The described processes were not accompanied on a large scale by migration of mineralizing fluids. The resulting displacements took place in some places only and display the connection with the mineral composition of lateral rocks.

Within the series of greywackes and green sericite-chlorite metashales, assigned to the flysch formation, the basic ore mineral of these veins is pyrite whereas in the series of dark-grey Cu-bearing metapelites there also appear chalcopyrite, sometimes sphalerite, magnetite, pyrrhotite and bornite.

The described processes of regional metamorphism were probably accompanied by formation of pyroxene-amphibole-epidote skarnoids of infiltration type. They are occurring locally within the metashale series enriched in carbonates, yielding no relation to magnetic intrusions. These skarnoids were recorded in the Ordovician profile in boreholes A–4 and 37–WB as well as in the Lower Silurian one in borehole A–3 (Fig. 1). They mostly comprise polymetallic mineralization. The main ore minerals are: chalcopyrite, pyrite, pyrrhotite, magnetite, sphalerite, sometimes galenite and apparently scheelite and molybdenite. In the light of the hitherto investigation, the size and extent of skarnoid bodies is small and like in the metasomatic quartz and chlorite-quartz veins their ore mineralization is not economically important.

In the t h i r d p h a s e of tectonic development falling to the period of young Caledonian foldings structural elevations with granitoid intrusions were formed. This fact is evidenced by the presence of the intrusions in the cores of these structures. As a result of contact-thermal metamorphism the hornfels zones and in places small skarn bodies originated within metashales (in a close contact with granitoids). The skarns have been traced so far in boreholes Pz–10 and Pz–33 (Fig. 1). However, their extent is small and their thickness does not exceed several meters.

Association of ore minerals, assigned to the contact-thermal metamorphism, resembles that of the pyroxene-amphibole-epidote skarnoids and chlorite-quartz veins. In the mineral composition chalcopyrite, pyrrhotite, magnetite and hematite are prevailing. These minerals reveal vein-massive texture. In some places, within the skarns, accumulations of scheelite, wolframite and molybdenite, apparently connected with younger phases of ore mineralization, were found to occur. It should be emphasized that the very granitoids show the presence of strongly disseminated pyrite-chalcopyrite mineralization probably formed by melting and assimilation of surrounding rocks.

During young Caledonian tectonic movements, small intrusions of diabase as well as non-quartz and slightly quartz porphyry, deprived of significance admixtures of ore minerals, were formed.

In the f o u r t h p h a s e , linked to the period of inversion of the Caledonian orogen, the main polymetallic (molybdenite-scheelite-chalcopyrite) mineralization of stockwork type was apparently developed. It is represented by quartz and quartz-feldspar veins and veinlets of several generations dipping at various angles (20–80°), generally ranging from 1 mm to 2 cm, sporadically 2 m in thickness. They are cutting mainly granitoids and surrounding rocks assigned stratigraphically to the Cambrian(?) through Lower Ludlow. In places, the polymetallic mineralization of stockwork type also affected diabases, non-quartz and slightly quartz porphyries as well as skarnoids, chlorite-quartz veins and skarns.

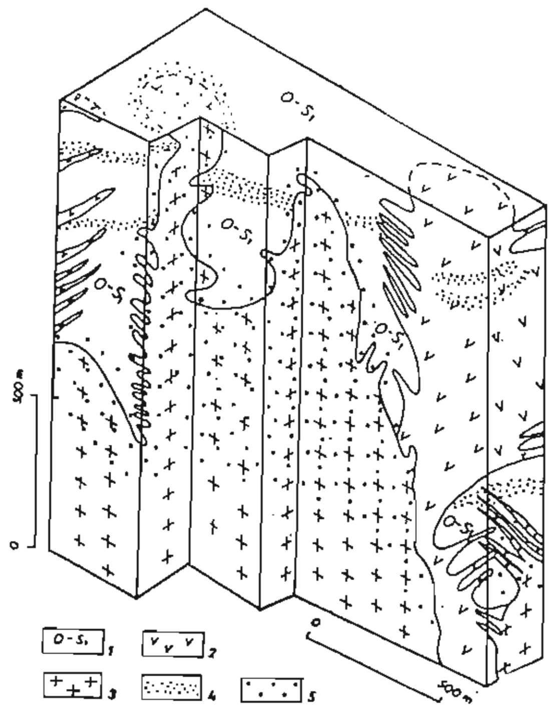


Fig. 2. Block-diagram of copper-molybdenum-tungsten ore deposits of the Myszków area (compiled by K. Piekarski in 1991)

1 — Ordovician–Lower Silurian; 2 — porphyries; 3 — granitoids; 4 — zones of copper mineralization; 5 — zones of copper-molybdenum-tungsten mineralization

Blokdiagram złoża rud miedziowo-molibdenowo-wolframowych obszaru Myszkowa (opracował K. Piekarski w 1991 r.)

1 — ordowik–sylur dolny; 2 — porfiry; 3 — granitoidy; 4 — strefy mineralizacji miedziowej; 5 — strefy mineralizacji miedziowo-molibdenowo-wolframowej

The spectrum of ore minerals is represented by molybdenite, scheelite, chalcopyrite and pyrite, occasionally magnetite, bornite, cubanite, sphalerite, wolframite, galenite, Ag and Bi tellurides and aikinite. They are present in form of disseminated, lenticular and banded accumulations, both within quartz and quartz-feldpar veins and veinlets, and also in their close neighbourhood — in zones of fissures and hydrothermal alterations (primarily feldspathization, sericitization and sometimes secondary biotitization). The aforementioned processes are traced mainly within magmatic rocks (granitoids and older porphyries) and are likely to be of autometasomatic character.

The described mineralization is widely spread within the Caledonian orogen, but its largest development has been confirmed in the outskirts of the town of Myszków. It is related here to granitoid intrusion intensively fissured and altered by hydrothermal action and to metamorphosed rocks of its cover comprising primarily metashales and fine-grained greywackes. The presence of this intrusion, striking along the structural elevation (NW–SE), about 1 km long, 300–500 m long and up to 1250 m deep, was confirmed. There is vertical and lateral zonation in the mineralization of stockwork veins. In the middle portions of the granitoid, at the climax of the elevation, the quartz veins are mineralized by chalcopyrite, molybdenite and scheelite while towards the periphery of the structure (NW and SE) the decrease of scheelite and chalcopyrite contents is evident — the main ore mineral here is molybdenite. Across the elevation (NE–SW), the extent of rich scheelite mineralization is confined to the very granitoid body. In the zones of intrusion cover the main vein ore mineral is molybdenite whereas in the outer portions (in metashales) — chalcopyrite. Vertically, the upper portions of granitoids are enriched in chalcopyrite while deeper ones, in molybdenite and sheelite. In turn, the stockwork veins of the upper portions of the cover yield increased amount of chalcopyrite. The molybdenite contents of these veins are increasing with the depth. In all, Mo, Cu and W contents are changeable, exceptionally reaching 2.4, 2.5 and 1.6%, respectively.

The described mineralization was confirmed in boreholes Pz–11 to Pz–35. Its general structure is illustrated by enclosed block-diagram (Fig. 2).

In the f i f t h p h a s e , probably connected with the period of postorogenic movements, mineralization of porphyry copper type was formed.

The ore minerals are represented mainly by pyrite, chalcopyrite, occasionally molybdenite, forming impregnations and microveinlets within quartz porphyry. The porphyry intrusions are reaching considerable thickness (several hundred meters), occurring only in the Old Paleozoic rocks. They were not detected in the complexes assigned to the Variscan structural stage. Magmatic rocks (dacitic porphyries, lamprophyres and trachyandesites), linked to Variscan tectonic movements, are devoid of ore mineralization.

In the area of the reported deposit, major intrusive bodies of porphyry copper type were traced in boreholes Pz–13, Pz–14, Pz–17, Pz–20 and Pz–30 among others.

Cu contents in unaltered sections with impregnated mineralization are ranging mostly from 0.05 to 0.15%, exceptionally reaching 0.7% (borehole Pz–20). In the zones influenced by hydrothermal processes, yielding vein mineralization, these contents are even higher, reaching sometimes 1.5%. The porphyry copper mineralization is not accompanied by typical cementation zone, enriched in chalcosine. Therefore, the described mineralization is probably deprived of major economic significance.

In the s i x t h p h a s e , apparently linked to Variscan, Cimmerian and Alpine tectonic movements, vein mineralization was formed. Based upon the investigation performed so far, two sub-phases of formation of this mineralization can be distinguished.

The oldest sub-phase is connected with quartz-carbonate and black quartz veins, ranging from a few millimeters to some meters in thickness (borehole Pz–10). They are cutting the zones of granitoids, porphyries and surrounding rocks, strongly disturbed by tectonic movements. The share of these veins in the total mineralization balance of the ore deposit amounts to about several percent. The described zones are affected by metasomatic processes — feldspathization, albitization, sericitization, kaolinization, chloritization, carbonatization and sometimes epidotization.

The main ore minerals are chalcopyrite, pyrite, sphalerite and galenite. In small quantities molybdenite, scheelite, bismuth minerals and tellurides are present. The aforementioned minerals are forming disseminated, veined, impregnated and massive accumulations. The remarkable feature of the oldest sub-phase is the occurrence of strongly scattered microcrystalline molybdenite colouring quartz black. In addition, the youngest molybdenite mineralization developed as "dry" veinlets (up to 1 cm thick), incrustations of fault polished surfaces and fissure infillings (together with clayey substance) may be refered to this sub-phase.

The described type of mineralization was confirmed in the Myszków — Mrzygłód area, among others, in boreholes Pz–5, Pz–10 and Pz–29.

The younger sub-phase of the ore mineralization is connected with barite, barite--carbonate and carbonate veins, varying from several to tens of centimeters in thickness. The mineral composition of these veins is differentiated. The ore minerals are forming tiny grains and are represented by galenite, sphalerite, pyrite and marcasite, sometimes anglesite and celestine. This mineralization is recorded in all rocks. However, it is deprived of major economic importance because of its small extent.

The described sub-phase of vein mineralization was confirmed in reported area, mainly in boreholes Pz–16, Pz–24, Pz–29 and Pz–34.

CONCLUSIONS

The general picture of the presented types of ore mineralization is often obliterated because of overlapping hydrothermal and remobilization processes. This makes impossible the correct interpretation of the sequence of mineralization. The results obtained from deep boreholes indicate the presence of numerous phases and sub-phases of the polygenetic ore mineralization. One of the most important phases, taking part in metallization of the Old Paleozoic rocks, is the syndiagenetic (syndepositional — early diagenetic) mineralization. The regional and contact metamorphic mineralization was formed at the expense of the primary mineralization. The highly disputable is the problem of the origin of metal source for the main polymetallic mineralization of stockwork type. The two alternatives are considered in this respect. According to the authors, the primary syndiagenetic mineralization was the source of metals. Other investigators (C. Harańczyk, 1982; J. Ślósarz, 1983, 1988; M. Nieć, 1988) refer this mineralization to hydrothermal activity, regarding it as the porphyry copper type. The youngest hydrothermal mineralization represented by barite, barite-calcite and calcite veins is genetically related apparently to Zn-Pb mineralization of the Triassic rocks.

The problem of the wolfram (wolframite and, formed from it, scheelite) mineralization has not been solved yet. According to C. Harańczyk (1983), it is linked to the Caledonian magmatism whereas to J. Ślósarz (1975, 1983, 1988), to the Variscan, respectively. According to the present authors, the wolframite and scheelite are occurring nearly in the whole profile of the metamorphosed Old Paleozoic rocks, representing the early phase of the development of the Caledonian geosyncline (Cambrian through Lower Ludlow). The minerals mentioned above are forming strongly disseminated accumulations, often accompanied by quartz. They do not build abundant ore zones. The presence of the wolframite and sheelite is also being recorded beyond zones of the pyrite-chalcopyrite and main polymetallic stockwork mineralization. It should be emphasized here that the occurrence of the wolframite-scheelite mineralization is characteristic of metamorphosed geosyncline deposits, assigned primarily to the Ordovician and Silurian, from all over the world. The classical examples are deposits of this type from Eastern Alps, the origin of which is connected with the development of synsedimentary — early diagenetic processes (L. Lahusen, 1972; A. Maucher, 1965).

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OKRUSZCOWANIE UTWORÓW PALEOZOICZNYCH W OBSZARZE MYSZKOWA — MRZYGŁODU (NE OBRZEŻENIE GZW)

Streszczenie

Prace geologiczno-poszukiwawcze w obszarze Myszkowa — Mrzygłodu pozwoliły stwierdzić, że w okruszcowaniu utworów staropaleozoicznych bierze udział wiele różnych typów genetycznych mineralizacji rudnej, które rozwijały się w kilku etapach i stadiach, uwarunkowanych długookresowymi ruchami tektonicznymi.

W pierwszym etapie, wstępnego rozwoju geosynkliny kaledońskiej, powstała syndiagenetyczna mineralizacja pirytowo-chalkopirytowa i sfalerytowo-galenowo-chalkopirytowa. Pierwsza wykazuje związek z ciemnoszarymi lub prawie czarnymi seriami metałupków, pojawiających się w profilu utworów kambru, ordowiku i syluru (po ludlow dolny włącznie). Druga występuje w spągu kompleksu szarozielonych metałupków i metaszarogłazów i należy do ludlowu środkowego (górnego?).

W drugim i trzecim etapie, obejmującym metamorfizm regionalny i główne fałdowanie kaledońskie, powstała elewacyjna struktura Myszkowa i wypełniająca jej jądro intruzja granitoidowa. W wyniku metamorfizmu regionalnego i kontaktowo-termicznego utworzyły się w obrębie metałupków niewielkie ciała skarnów, skarnoidów i żył chlorytowo-kwarcowych, głównie z mineralizacją pirytowo-chalkopirytową z domieszką magnetytu i pirotynu.

W czwartym etapie, związanym z inwersją górotworu kaledońskiego, doszło prawdopodobnie do rozwoju głównej mineralizacji molibdenowo-szelitowo-chalkopirytowej typu sztokwerkowego, nakładającej się na granitoidy i skały osłony.

W piątym etapie, związanym z ruchami postorogenicznymi, powstały intruzje ryodacytowe z mineralizacją miedziowo-molibdenową typu *porphyry copper*.

W szóstym etapie, przypuszczalnie w wyniku tektonicznych ruchów waryscyjskich, kimeryjskich i alpejskich, rozwinęła się wielostadialna mineralizacja żyłowa, reprezentowana przez żyły kwarcowo-węglanowe i czarnego kwarcu z mineralizacją chalkopirytowo-galenowo-sfalerytową z domieszką drobnoziarnistego molibdenitu i szelitu oraz przez żyły barytowo-węglanowe i węglanowe z mineralizacją galenowo-sfalerytową i niekiedy anglezytową.

Z powyższych mineralizacji do najbardziej interesujących pod względem gospodarczym należy zaliczyć mineralizację molibdenitowo-szelitowo-chalkopirytową typu sztokwerkowego oraz pirytowo-chalkopirytową pochodzenia osadowego.