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THE FORMATION OF THE ORE-DEPOSITS IN SLOVENIA

Abstract. — The ore-deposits in Slovenia are connected from the temporal and structural point of view with the ore-deposits of the Dinaric geosyncline in Yugoslavia. After the data collected in the last time it would have been possible to determine particularly the formation of the ore-deposits in this region. The Slovenia's ore-deposits are formed in the several periods. Therefore the author has complited the conclusions of former researchers on the new data basis. Some metallogenetic cycles are characteristical, indicating certain particularities. It is specific, that the Tertiary magmatism is almost sterile in Slovenia although it has been ascribed it up to now, with some exception, the most important role at arising of ore-deposits. The Triassic metallogenesis represents on the region treated a particularity, while the Paleozoic metallogeny represents a normal continuation of mineralization in a wider surroundings of Slovenia. Some ore-deposits in this region represent only a genetic characteristic. We do not know any ore-deposits with high-temperature paragenesis, which could give more detailistic explanation on the formation of ore-deposits, in connection with several cycles of magmatism.

It has been often discussed by many researchers about the metallogenesis in the Eastern Alps, but the origin of Slovenian ore-deposits hasn't been studied in detail. For that reason the deposits in Slovenia have been ranged into different periods and also a different source has been attributed to them.

Granigg (1912) divided the ore deposits in the Eastern Alps into five geotectonic units and nine mineralized zones. Later on Petraschek (1945, 1952) added all the deposits in the Eastern Alps between the Austrian and Sava tectonic phase. He classified they in the zones (1928) supposing that the deposits are connected with the tertiaric plutonism, whereto the effusions of dacites and andesites are indicating. According to the complicated position Schwinner (1934, 1942, 1949) supposed that each particular group of the East-Alpine deposits belongs to a special magmatic source. In this way he approximately explained the zonic « disorder » in the deposits location. Tornquist concluded (1928, 1929, 1930, 1931, 1933) that the mineralization is connected with a unitary magmatic source, excepting that the ore-deposits were origi-

nating in phases and that for single phase a zonality has been significant. DAL PIAZ, BIANCHI, DI COLBERTALDO (1949, 1952, 1955, 1956, 1958) the formation of eastern - and southern alpine deposits impute to the tertiaric intrusive batholite. In CLAR'S, FRIEDRICH'S and ANGEL'S opinion the ore-deposits genesis is connected with the methamorphosis in the High Tauern (as the methamorphosis took place under the influence of magmatic solutions) ranging the ore-deposits to tectonic structure of the entire mineralized territory (1933, 1937, 1939, 1940, 1942, 1945, 1948, 1953). SCHNEIDERCHÖHN in his earlier proceedings supposed the genesis given by PETRASCHEK (1941, 1942) while he in 1952 all the East-Alpine deposits considered to be regenerated. According to the data of HEGEMANN, MAUCHER, SCHNEIDER, and TAUPITZ numerous deposits in the Eastern-Alps are sedimentary (MAUCHER 1957, HEGEMANN 1957).

When explaining the origin of deposits in the Eastern Alps many researchers were discussing also the formation of the deposits in Slovenia. For that the most important are: TORNQUIST (1929) who published the paper of lead-zinc deposits in the Posavske gube (not adding hereto other reports, where he in short mentioned the Slovenia's ore deposits at least); CLAR (1929) with his article about mineralization at Šoštanj; FRIEDRICH (1953) with CLAR'S supplements; CISSARZ (1951, 1956) and DUHOVNIK (1956).

Different opinions arise only if there are too moderate geological data at the disposal. In the last ten years we have collected numerous facts, which in many cases ilustrate the position of ore-deposits in detail. We have, of course, at the same time, to emphasize, that some questions have remained unsolved either for the reason as we cannot get more detailistic data in the field, or as there is lack of the latest results. On discussing the site and origin of the ore-deposits in Slovenia, we have to take into consideration the fact, that they have been formed in different periods. Generally we can say that in this view our ore-deposits coincide with similar ore-deposits on the territory extensing over Croatia, Bosna, Hercegovina, and Crna Gora even into a part of Macedonia.

The Paleozoic Metallogenesis.

In Kozjansko — territory, one part of Strojna, as well as between Crna and Uršlja gora metamorphic rocks — mica schists and schists have been developed. To the south of Pohorje predominate among

them are gneisses and amphibolites. In some places also layers and lenses of marbles are developed among mica schists. The latter pass over to schist and these into clay-shales being ranged to the Paleozoic. Between Crna and Veluna there are spilitized diabases in them (HINTERLECHNER, 1959). The age of this belt is rather questionable, as many researchers are ranging it to the period of Sillurian-Kulm (TELLER, 1896, VETTERS, 1947, KAHLER, 1953), while it is ranged to the Postkulm-period by GRABER (1933), HERITSCH, and KÜHN (1951).

The oldest sedimentary strata developed in Slovenia, are deposited in extreme northern part in the surroundings of Jezersko. RAMOVŠ (1956) ranges them to the Lower-and Middle-Devonian. The Upper-Sillurian beds (Gotlandium) should have been developed probably in this part of the territory but there is a shortage of detailistic geological data.

Carboniferous strata are widely represented in Slovenia. Their stratigraphic position is — what is referring to the lower part of these strata — determined by a lithological comparison with equal sediments in the Carnian Alps. The stratigraphical sequence of this strata has been supplemented here by the latest investigations. Up to lately it predominated the opinion that the Upper Carboniferous strata in the Central and the Southern part of Slovenia have been carried away by erosion; yet the latest results indicate to some preserved parts of the Upper Carboniferous beds in this region (Pleše, Ortnek). This date of course demands a renewed revision of the strata, being ranged to the Lower Carboniferous. The Upper Carboniferous beds are to be found in the northern part of Slovenia predominantly (Karavanke, Konjiška gora, Boč, Julijske Alpe). Between the Lower Carboniferous being represented by shales, sandstones, conglomerates, and rarely, nearly exceptionally by limestones, and the Upper Carboniferous shales, sandstones, limestones, and Conglomerates, there exists a discordance (a Sudetian tectonical phase).

The Upper Carboniferous strata are passing over in the Karavanke, on Jezersko and at Ortnek into Lower Permian Ratendorf - beds. They are generally represented by limestones, less by shales, sandstones, and conglomerates. On them are deposited Trogkofel - limestones and dolomites, strongly extended in Slovenia. This horizon is according to the present data developed neither in the Loka and Polhovgradec mountains nor in the Posavske gube. In the northern part of Slovenia is - after the Saal orogenetic phase, the breccia of Trbiz deposited.

The mostly extended Permian sediments are the Grödenian ones. They are extended all over Slovenia except in the Julian Alps, and deposited in different thickness. They are laing on various older strata. This argues either for a transgressive deposition or this horizon represents different Permian stages.

To the Upper Permian belong calcareous strata being found on the entire Slovenian territory except in the Posavske gube. Yet also here were found lithologically similar strata in such a stratigraphic position indicating that the Upperpermian beds have been deposited probably also in this territory (GRAD).

On looking at the Paleozoic magmatism in Slovenia, we may state that the data about it are pretty moderate. In the surroundings of Pohorje and Crna they are existing in metamorphic rocks and clay-shales of undefinite age besides of amphibolites and serpentines arisen according to the data of GERMOVŠEK from harzburgites, also spilitized diabases. This magmatism is probably older then the Carboniferous and belongs either to the Sillurian or Devonian. According to the data being at our disposal in the territory of Slovenia, we nearly are not able to discuss the matter about tectonics in this time. We can find very similar examples of such magmatism in Macedonia and East-Serbia also.

Lately GRAD and RAMOVŠ have found on the southern slope of Blegaš some igneous rock in the Grödenian horizon which is the first datum about the Permian volcanism in Slovenia. In the vicinity of the spilitized diabas a autcrop of hematite and magnetite is found in the clay-shales of the Hamun vrh. Somewhere also the diabas is impregnated with magnetite.

In the Carboniferous and Permian strata we may distinguish two phases of mineralization, the first limited to Carboniferous strata, and the second in the Permian strage. In the Upper Carboniferous beds below the Golica and in the Vitanje - series a mineralization is to be found with siderite, in general joined to limestone layers. Siderite is rarely existing in sandstones and clay-shales. Next to siderite there are existing in subordinated quantities sphalerite, galena, and realgar. As all the autcrops are excavated, it is impossible to present a detailistic mineral paragenesis. In Slovenia there are no data about the magmatic activity in that period. In the east in the vicinity of Fojnica,MARIC (1954) has discovered a rock which may belong to the metamorphous granite or granitporphyr. Here are present also numerous masses of

quartzporphyrs. Still more to the east the magmatism in this time is more significant in Macedonia and Serbia. The siderite in the Ljubija (Bosna and Hercegovina) id deposited according to the latest data by JURKOVIC (1961) in the same stratigraphic horizon as the siderite in Slovenia and Croatia. Alongside the typical white siderites in these ore-deposits exist also dark ones, by degrees passing over to the barren rock. In most cases the siderites clearly indicating that they were arising syngeneticaly with calcareous sediments. If the postcarboniferous mineralization took place in the case of the Golica, then the Mesozoic strata being sedimented above the deposit should be mineralized. Yet such a case hasn't been found anywhere. A part of mineralization is presedimented into Oligocene strata scarsely distinguishing from the Carboniferous ones. There are namely numerous pieces of siderite existing in them. In the Vitanje - series the tectonics is extremely strong. Yet we have not found here any mineralization in the younger strata as Carboniferous. The postmineralized tectonics has on many places strongly changed the original position of the ore bodies. The questions of rejuvenations, secondary transportations, metamorphosis have not been treated yet. By any means it is possible to connect iron ore-deposits of this type at least regarding our territory, to the occultic Carboniferous magmatism.

Besides these, numerous deposits with lead and zinc, in some places accompanied by cinnabar and barite are deposited in the Lower Carboniferous beds. In general the ore-deposits are located in the Posavske gube. Characteristical for these ore-deposits is that often a mineralization with predominant single mineral componente is to be found, which is either galena or sphalerite. An exceptional case represent Litija, Pleše and some smaller ore-deposits near Litija (Zagorica, Zavrstnik) where as a characteristical componente barite is making its appearance. Antimonite is to be found only in one ore-deposit (Trojane) together with pyrite and quartz; while cinnabar is developed at Litija, Knapovze, Marija Reka, Sentjanz, and Srednik together with barite and other sulfide minerals. The ore bodies are prevailingly veins and sharply limited. In most cases ore bodies have no big dimensions. In some places there are to be found twists of veins and irregular ore bodies. It is impossible to distinguish numerous phases in the mineralization between PbS and $BaSO_4$ (TORNQUIST, 1929), because here is only the question of balance between both minerals and hydrothermal

solutions having changed from point to point. According to geochemical and petrofabrics investigations in the case of the biggest ore-deposit in this region (Litija) open fissures are mineralized. The ore bodies are destroyed by a postmineralized tectonics. The mineral paragenesis is extraordinarily simple, as there appear in moderate quantities only pyrite, halcopyrite, siderite, and sphalerite, by a tectonic phase separated from barite and galena with included grains of tetrahedrite, and burnonite. Also oxyde minerals of lead, zinc, and iron are numerous. Cinnabar represent the center of individual ore bodies. Under a certain level in Litija there appears a new system of ore veins, where barite with a depth is diminishing by its quantity; at this occasion the quartz-quantity is enlarging. In this part of the deposit also the first phase of mineralization with sphalerite, halcopyrite, and pyrite is missing. The lower system of veins is almost vertical while the upper system is deposited relatively gently (45-50°). Very like Litija is the ore-deposit Knapovze.

But a proper opposite to Litija represents the ore-deposit Pleše. Barite, nearly without sulfide minerals, appears in Carboniferous strata, and at their conjunction with Triassic dolomite. In some places the barite lenses appear also in the dolomite, yet they are to be found only at the conjunction with Carboniferous beds. The sulfide minerals galena, sphalerite and in some places halcopyrite as a very subordinate quantity, appear in deeper levels being usually separated from barite. They make their appearance in thin lenses and small veins; there were not to be found any ore-bodies like those in the Litija deposit. Similar conditions as at Pleše dominate also in the Marija Reka deposit, where there a mineralization with cinnabar, galena, pyrite, and small quantities of tetrahedrite has developed. According to the data of some authors besides Carboniferous also Scytian beds have been mineralized. Yet we dispose of a lythological datum of sandstones only, what is not a sufficiently proved argument, for determining the age of strata. Perhaps it is the question of Permian sandstones, or only Carboniferous ones.

Both deposits (Pleše and Marija Reka) where the mineralization of Postcarboniferous strata is making its appearance in zones of strong tectonical movements. In Pleše there are numerous overthrusts of the Carboniferous to Triassic beds. At Marija Reka the stata as well as the mineralization are tectonically highly destructed.

Al the ore-deposits at the Posavske gube are distinguished by some characteristics in the geological point of view. Galena is relatively

rich on silver (cca 2o gr/t), while the quantity of copper minerals is only mineralogically characteristical with exception of the ore-deposit Zlatenik and Cirkuše. Here namely appear in the quaitz veins small quantities of halcopyrite and arsenopyrite. Siderite and barite are confined merely to the ore-deposits at the Posavske gube. The sphalerite is dark-brown and contains usually pyrite or halcopyrite. CISSARZ (1956) ranged these deposits to regenerated ones, while DUHOVNIK (1956) imputes them the triassic age. The deposits anyhow are older than the latest tectonic phase as the ore-bodies are tectonically destructed and torn. According to the mineralogical structure the deposits of the Posavske gube are heavily distinguished by characteristical and indubitably triassic deposits. The deposits were arisen probably in the Younger Paleozoic in genetic connection with the siderite-formation of the Upper Carboniferous, to what the siderite-admixture is indicating. At the same time a certain differentiation of mineral components has been carried out in some deposits, while the bigger ore-deposits were arising only there where several components have been deposited together. This indicates to the fact that the fissures on such places were open for a long time. The transportation of individual components is of relatively small circumference involving only easily soluble minerals (Pleše). This again indicates that we cannot range the ore-deposits mentioned to regenerated ones. We are anyhow in lack of detalistic data, being able to explain the age of these deposits. It is impossible to expect such data on the terraine, where the sediments have been developed, which even do not indicate to any particularities in the sedimentation, as been shown through sedimentalogy studies. Quartz-veins with pyrite and halcopyrite, admixtures of cobalt and nickel in the pyrite, appearances of siderite and barite-mineralization join these ore-deposits to those of Croatia and Bosna with Hercegovina which are indubitably of Paleozoic origin (JURKOVIC, 1957, 1959). The position of individual deposits with characteristical particular mineral-components does not indicate any special space-position; for instance the deposits containing besides other minerals, cinnabar as well, are extending through the entire belt of the Posavske gube. This is valuable for the deposits with barite too, appearing in a part of the Posavske gube. If a detailistic analysis of Carboniferous strata succeeded then we believably could explain also the real space-position of these deposits.

The ore-deposits appearing in Permian beds are joined to the Grödenian horizon. In the lower parts of this horizon are deposited the

layers of gray sandstones that are mineralized with copper at some places. Characteristical deposits are Skofje, and the Radeče surroundings. The copper deposits are in accordance with other phenomena of such deposits in the Grödenian beds in the world, and we may impute them merely the syngenetic origin. Supplementary processes probably changed the primary structures and consequently the ore deposits indicate at investigations a « hydrothermal paragenesis ». This is of course understandable as the Permian beds are strongly destructed by the characteristical cleevage, which enabled a certain transportation of ore minerals inside the later fissures. Recently in this horizon also uran deposits have been discovered.

The Mezozoic Metallogenesis.

The sedimentation was continued without interruption at the Permian beds. In some places the connecting passage between Permian and Triassic beds is clear, while in some territories this connection is obviowsly discordant. The question is of the influence of the paleorelief, which caused the aparently discordance on places where the Permian rocks are raised. There are joining different Triasic strata with older rocks. The sedimentation is continuing still to the Anysian stage. In the early Ladinian there occurred heavy tectonic movements, and consequently the Buchenstein horizon has not been developed. These movements moreover have their influence only in some zones and occasionelly it came to effusing of eruptive rocks (keratorphyres, porphyres, and porphyrites with quartz or without it) as well as their tuffs. A great part of this magmatism arose in the Wengenian period. In some districts the volcanism was going on still in the Carnian stage with a short interruption in the Cassian. Excepting in efusives and their tuffs we find in the northern part of Slovenia granitite. Its age is lower than the Lower Scytian one, yet is not greater than the Anysian one (Berce, 1960).

The volcanism in the Carnian strata is according to the up to present known data limited only to the Idrija district. At the passage between Ladinian and Carnian stage a hiatus has been developed, comprising a great part of Slovenia. In the Norical stage the sedimentation was similar all over Slovenia. We can determine the Ladinian tectonics in a great part of Slovenia, yet it includes only certain zones. The pre-

wengenian strata were folded, fractured are faulted to differently steep positions by forming a charasteristical angle-discordance with Wengenian strata. It is characteristical that the intrusive activity is limited merely to the environment of the Mezica deposit while the volcanic activity is extended on a greater part of Slovenia. In the Ladinian a different sedimentation between the Alpine and Dinaric space began. Yet in the Wetterstein limestone were found lenses of Wengenian effusives (environment of Polena).

Ore-deposits, appearing in Triassic, can be divided into magmatogened and decomposed deposits. Lead-zinc deposits appear in two types, being separated to each other also by time. To the former belong singenetic deposits in carbonaceous beds of Anysian stage rich on organic admixture. Such ore deposits are to be found at Topla, Puharje, Ljubno, Strangrob, Korošica, Bohor, Mokronog, Skovec, Srednik, and Trebelno. It is characteristical for the deposits mentioned, that they point to a certain zonality. At Topla and Puharje sphalerite predominates galena, while in others galena is dominant with exception of Bohor. Here namely apear among thes strata of Anysian dolomite lenses consisting in general of calamine and other oxyde Zn minerals and galena. Nearly in all ore-deposits a regular component of mineralization is pyrite. The mineral is of extremely fine grains and indicates clear textural characteristics of singenetic minerals. There are similar ore-deposits in Bosna and Hercegovina (Borovica). All mineralizations of this type are developed to a certain stratigraphic horizon although it is not yet known, whether the mineralization is deposited everywhere in the same level of this horizon. There is a lack of more detailistic data too, whether here is the mineralization in lenses, or of more extensive mineralized zones. The mineralization — thickness is oscillating and is reaching the first ten meters.

On the Rudnica there is appearing the ankeritizing of dolomite and in some places small quantities of siderite, galena, and pyrite. The dolomite belongs credibly to the Anysian, what is indicated only by its position. The appearances of ankerite are limited merely to a part of the Rudnica.

The next Triassic mineralization by time and space something divided by the mentioned one, represents the mineralized zone of Mezica between the Peca and the Uršlja gora. The mineralization is appearing in the Upper part of the Wetterstein limestone benath the Carnian beds. We find mineralogical appearances of sufides Pb-Zn also in the

Lower part of the Carnian beds. Besides the lenses and irregular ore-bodies in two fissure-systems, we find the mieralization also in the so-called « layers ». It is characteristical for them that they are almost parallel with the stratification and that they represent as a matter of fact a similar type with the ore-deposits in the Anysian strata. The quantity of Pb and Zn in the Wetterstein beds in the entire zone has been increased. Apart from this at Mezica the system of fractures is developed, which is mineralized in the verticale over 300 m. Characteristical for Mezica is the mineralization with wulfenite, appearing in the highest parts of the ore-deposit.

According to STRUCELJ's data the traces of some elements in ore in the different types Pb-Zn ore deposits are very different, what is shown through the figure as follows:

	Cu	As	Sb	Ag	BaO	
Litija	3000	400	1600	15	858	in p.p.m.
Mezica	68	55	167	trace	trace	
Topla	3	32	—	3	3	

This once more argues the genetic diference among individual mineralizations in the Carboniferous and Triassic beds.

The isotopic investigations of galena at Mezica have indicated that here was developed the anomalous lead, as the mineralization age determined on its basis would be greater than age of the strata, where it is deposited. This fact is once more, arguing that in accordance with STANTON's and RUSSELL's (1959) opinion such type of deposit belongs to a « conformable deposit ».

If there were in the case of Mezica the question of a regenerated or Tertiaric ore-deposit, the Alpine fractures should be mineralized. It is characteristical for the ore-deposit, that it is cut off with a postmineralized fault in the South, and where the south-part is submerged for about 300 m. At this occasion the foult cut some ore-bodies. In the same way the entire mineralized zone is overthrust to the Sarmat in the north. In the Kotlje at the overthrust surface there is a fractured ore-body. Also the tectonic data are clearly indicating that the ore-deposit is older than the Alpine orogenesis.

Besides Pb-Zn deposits there appear also Hg-deposits in the same metallogenetic cycle. The Upper limit of mineralization is extending up

to the Lower part of the Carnian beds. Here belong Idrija and Sv. Ana above Trzič. Mineralization at Idrija is appearing in Permian, Lower Triassic, Middle-Triassic, and Carnian beds. The structure of ore-deposits is tectonically heavily complicated as the deposit is laiing at the overthrust of the Trnovski gozd, which in this part is of a schuppen structure. The last i. e. the fourth schuppe covers the ore-deposit all over. The entire Alpine structure of the territory arose after the mineralization. The mineralized schuppe indicates an angle discordance between the Paleozoic, Lower Triassic and the Ladinian beds. Mostly is mineralized the zone where the Wengenian breccias are covered with the pseudogailtaler shales; yet we can find big ore-bodies still along the stratification, in the Triassic tectonic lines as well as in single limestone lenses, deposited in the shales. A similar deposition in the immediate vicinity of Triassic eruptives offers also the ore-deposit Sv. Ana, where have been mineralized Lower Triassic strata. The mineralization appears here at the sincline.

Both deposits — Idrija and Mezica have been investigated in detail, and the geological data proving their time-origin rather precisely. The most characteristical in this respect are the structural elements and the dependency of individual ore-bodies from the Triassic structures. The tectonics of Alpine orogeny is always postmineralized. Apart of it also different other elements (dispersed aureoles, trace elements in individual sulphides, paragenesis) prove their age.

At Lepa njiva there is a smaller mineralization with antimonite at the contact of the Middle-Triassic limestone with hornfels lenses. Some detailistic data about the ore-deposit are not at hand, consequently we can range it merely by its deposition into Triassic deposits.

The shales of the Scytian stage are at Hrastno mineralized with hematite, arisen as an arid concentration of iron in these beds (Berce, 1954). This mineralization represents an exceptional example at shale beds of Slovenia, but pretty numerous are such ore-deposits in Bosna and Hercegovina.

In the Pirešica environment lenses with pyrite together with small quantities of arsenopyrite appear in Wengenian tuffs. The lenses are partiably changed to limonite.

In the Carnian beds also oölite bauxites rich on iron appear, which are strongly approaching to the known Salzgitter ore-deposits by their

composition. Such appearances are particularly developed in the belt between the Pajsarji and Vintarji. The appearances are pretty numerous, as differently big lenses have been developed in the Carnian beds. According to the mineralogical composition we range they in a type of resedimented bauxites.

The Jurassic beds are lythologically very uniform and appear generally in the limestone facies. Although badly investigated, it yet points to the fact that they are developed in the entire stratigraphical sequence. Probably the Jurassic sediments have been deposited in a sea somewhat deeper, in northern Slovenia and in a shallower on in southern Slovenia.

In the lower part of the Jurassic beds there appears a horizon enriched with manganese. Whether it maters in this horizon the secondary enrichment or the locally bigger primary concentrations of manganese oxides, it is not yet known. We also do not know, where from have arrived the enlarged concentrations of manganese into the Jurassic beds. On the Begunjščica where there was a manganese deposit, and by the open-pit at Mirna we may judge, that it matters the primary manganese concentrations. A manganese horizon is appearing on the Porezen in the environment of Zelezniki and in the enviroment of the Crna prst - Kobla also.

Besides manganes in the Upper part of Jurassic beds lenses of oölitic bauxite are developed in the environment of Raket and between Ribnica and Kočevje; they reach a thicknes of 7-8 meters. By the appearance it entirely reminds to Triassic bauxite (BUSAR).

Bauxites appear in the Slovenian part of Istra still in the Cretaceous beds (turone, senone) in the surroundings of the Crni vrh and Tršenje.

Tertiary Metallogenesis.

Tonalite represents the only Tertiary intrusive rock of Slovenia. The tonalite of the Pohorje mountains is intruded Post Cretaceous, as it metamorphizes the Upper Cretaceous limestones; to the eastern the tonalitic belt, we ascribe the same age. The upper age-limit of intrusion is probably defined by porphyres of Leše sincline which by their chemical composition are very like to the tonalite and breaking through the Miocene beds.

In the environment of the Mala kopa in the Pohorje mountains the skarn-mineralization is making its appearance. It is joined to the former limestone horizons. The immediate environment is built by dacite, here is appearing hedenbergite - andradite - and epidote - skarn. For the first mentioned a mineralization with magnetite and pyrite is characteristic. Next to them also ilmenite pyrotin, hematite, halkopyrite, and sphalerite are to be found. Hematite certainly belongs to a later phase for otherwise we were not able to explain its appearance accompanied by paragenesis pyrhotin - magnetite - pyrite.

In the vicinity of tonalite we find the veins mineralization in the environment of the Okoška gora, Remšnik, Ozbolt, and Bistrica. To the same type belong probably also Razbor and Zavodenj, appearing in the Carboniferous beds. It is characteristical for these ore-deposits that beside sphalerite and galena in a bigger concentrations halkopyrite is developed. Among the barren minerals there exists only quartz, we nowhere found either siderite or barite. The ore-deposits have not been detailistically investigated, so we do not know anything about the traces-elements in individual ore-minerals, which could accomplish the data of mineralization age. By the mineralogic composition it matters a characteristical mineralization which is not being found aut in any other place of Slovenia.

At the tonalite intrusion there arose in the schists also single lenses rich on graphite. Such lenses are numerous in the Kozjansko district. In Bela Krajina — and Savinjska dolina district are appearing resedimentary oölitic bauxites in the bassis of Oligocene strata on differently old strata as bedrock. As the bauxite through passages is connected with Tertiary sediments we may range it to the Tertiary age. The effusing of Smrekovec — andesites and their tuffs extending far to the east isn't connected with any mineralization. The age af this volcanism is Oligo - Miocene, what could be connected also with the tonalitic intrusion.

The basalts of Prekmurje represent the youngest volcanism in Slovenia, and of which the Pliocene age has been proved.

If we wanted to describe also secondary ore-deposits respectively, then we should range here also secondary iron-deposits on the surface of limestones, the local enrichments with iron in clay, as well as local enrichments Fe in glacial moraines (Berce, 1956).

Conclusions.

By the data about magmatism and mineralization we may recognise, that the metallogenesis in Slovenia is very different. Some metallogenetic cycles are characteristical, indicating certain particularities. We may in general state that the metallogenetic relations of the ore-deposits in Slovenia are in accordance with the relations of the Dinaric geosynclinale in other parts of Yugoslavia and likewise with the stated metallogenesis in the Paleozoic. It is characteristical, that the Tertiary magmatism is almost sterile in Slovenia, although it has been ascribed it up to know, with exception of CISSARZ and partially DUHOVNIK, the most important role at arising of ore-deposits. In the volume of this article we have not treated the development and the classification on magmatism. This question treated partially CISSARZ (1957). This problem demands a particular treatment in broader conditions, as it is impossible to explain it only in a relatively small territory.

The Triassic metallogenesis represents on the region treated a particularity, while the Paleozic metallogeny represents a normal continuation of mineralization in a wider surroundings of Slovenia.

Some ore-deposits of Slovenia represent only a genetic characteristic, yet it is possible estimate also their economic importance on basis of individual cycles of mineralization and investigated ore-deposits. In Slovenia we do not know any ore-deposits with high-temperature paragenesis; in this case probably the question is merely of moderately discovered upper parts of ore-deposits, or the reasons are in the kind of formation and processes of mineralization. The further investigations anyhow will answer many of these questions.

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METALLOGENETICAL MAP OF THE SLOVENIAN ORE-DEPOSITS

Geology after: Dreger, Teller, Kossmat, Lipold, Germovšek, Grad, Hamrla, Munda, Nosan, Pleničar, Rakovec, Ramovš, Šlebinger and author