IVAN JURKOVIĆ and BOŽIDAR ZALOKAR

SILVER-BEARING GALENA AND SIDERITE OCCURRENCES IN THE PUTAO REGION, NORTHERN BURMA (ASIA)

With 2 figures (1. in the enclosure, 2. in the text) and 2 plates

INTRODUCTION

Prospecting of the vast area between Mali Hka and Nmai Hka, east of Putao, northern part of Burma, was carried out from 6th January till 9th February 1958. According to information received there existed in this region a very large iron deposit and several silver-bearing galena deposits, an extensive mining and metallurgical activity developing in the last century prior to the British occupation of this area, and a subsequent production of cheaper industrial goods.

During this trip (performed by B. Zalokar) two localities of silver-bearing galena-zink ores in the upper course of Nmai Hka (Nam Tamai) as well as a deposit of siderite in the upper reaches of Hkalaw Ti were prospected (figure 1). During a stay at Nogmung, information was received about additional ore occurrences of iron, copper and galena, nearer to or farther from these localities, but there was not enough time to prospect them and to get an idea about the general conditions as well as about the size and type of the deposits. In the sequence we are presenting a list of localities of copper and galena deposits as obtained by the former T. O. Nogmung Gushin Hpum:

Pb-Ag occurrences: Zekong Zatawng, Lvi Ngun Zatawng, Lang Zatawng, Lunghawng Zatawng, Ngahangsat Zatawng, Htahong Zatawng, Sangtuang Zatawng, Htayawng Zatawng, Sama Zatawng.

Cu occurrences: Daglang Wang Hka, Tsiyang Wang Hka, Htashu Laung, Hpasa hkyet.

The mineralized area is located between the following geographical coordinates: 97° 25′ – 97° 55′ of North Latitude and 27° 15′ – 27° 51′ of East Longitude. The area is mountainous, with elevations ranging from 1400 (Putao plain) to over 10.000 ft. (Hsamra Razi). The long and high ranges belong directly to the Himalayas, i. e. to a portion which took a turn in N–S direction. The topography is a very ragged one. Steep slo-

pes, fault scarps, bluffs, landslide scars, domes etc. are very frequent land forms. The relief is in the young stage of development. The main rivers of this area are the Nam Kiu (Mali Hka), the Nam Tamai (Nmai Hka) and the Nam Tisang, all the three of them flowing nearly in N–S direction.

There is little information to date about the petrography of this region. Murray Stuart was the first to visit this region and give brief information about the ore occurrences of silver-bearing galena and the iron ore-limonite. However, he does not give any details about the petrographic structure of the area. On the existing general maps of Burma this area is represented as built of paleozoic schists and limestones, further of granite and related rocks. H. L. Chibber (1934a and 1934b) in »The Mineral Resources of Burma«, page 106, states:

»According to Murray Stuart two huge isolated boulders of limonite occur in the upper reaches of Hkalaw Wang, at the foot of the south-eastern slope of Kaungtaung Hpong (situated at the head of the Daru Wang Valley in the Nam Tamai-Nam Tisang divide). He believed that the iron ore was originally a replacement deposit filling a fracture, but the author is inclined to think that the origin of these blocks of limonite is perhaps the same as above described from the Kamaing subdivision lateritic type«, and on page 149. he states:

»According to M. Stuart an old galena mine occurs in the northern side of the Pyit Wang. It is situated about 4 miles up the stream, above its junction with the Nam Tamai, and is high up on the left side of the gorge about 1000 feet above stream level, in a highly siliceous limestone. The mine is a natural cavity. The country rock is traversed by very thin veins of galena, while particles of galena and pyrites are scattered in the rock. M. Stuart did not consider the deposit of any economic value.«

PETROGRAPHY

In the sequence we are presenting a brief description of the rocks mapped on the way from Putao over Nogmung to Gawai. Microscopical investigation: Prof. Dr. Luka Marić.

Magmatic and orthometamorphic rocks

Granite is predominatly represented in the very coarse-grained porphyritic facies. It is slightly schistose owing to the foliation of biotite. The main mineral constituents are orthoclase, albite-oligoclase, biotite and quartz; tourmaline, zircon and apatite are accessory minerals.

Microcline granite of porphyritic texture with big microcline inserted in the reddish, granular matrix of orthoclase, with lots of quartz and chloritized biotite. In some specimens, especially in those from Langa Bum, it was noticed that microcline and plagioclase are myrmekitically intergrown. Some specimens of microcline granite represent a milonitized type of this rock.

Fine-grained granite was noticed on the left bank of the Nam Tamai, below Gawai. It consists of kaolinized feldspars, orthoclase and albite-oligoclase with poikilitic texture, pointing out the processes of migmatization, then of dark coloured biotite and amphibole.

Leucogranite respectively *granitite* is coarse-grained, with aplitic veinlets.

In the granite mass there were noted *pegmatitic* and *aplitic veins.* A vein rock from the marginal zone of granite mass is built of an aplitic matrix with needle-shaped black hornblende, enveloping apatite and sporadically tourmaline.

Amphibole-biotite granodiorite was observed on the outside rims of the granite mass, and it includes dark green hornblende, biotite, andesine and quartz. Accessory minerals are titanite, epidote, and magnetite. Granodiorite was found on the western slopes of Namhkam Bum, further on the western ascent to Langa Buma. It appears in the rim zones of the granite masses or cupolas. This rock shows a slightly shistose texture.

Certain portions of the exterior zones of the granite mass are caught by dinamometamorphosis, so that *gneiss-granite* and *biotite-gneiss* are very frequent members in this area.

Biotite gneiss or *gneiss-granite* contains kaolinized orthoclase, sericitized plagioclase (albite-oligoclase), partly fresh, partly chloritized biotite and homeoblastic quartz exibiting undulatory extinction. Accessory minerals zircon, magnetite and tourmaline are also present. In some specimens instead of orthoclase, anorthoclase is present. The rocks are fine-grained, coarse-grained or medium-grained porphyritic, sometimes milonitized. *Muscovite gneiss-granite* is rarer.

The contacts of granite are characterized by contact-metamorphic rocks: *garnet-zoisite-biotite skarn* and *cornite.*

Amphybolite was encountered in several places of the rim zones of the granite mass. It contains andesine, green hornblende and accessory minerals: columnar apatite and magnetite, furthermore epidote and biotite.

PARAMETAMORPHIC ROCKS

The clayey shists, arkose and graywackes were altered to *phyllite, paragneiss* and *quartzite* (graphite-muscovite or biotite types). *Marble* was found in the blocks along the way from Mayit to below Gaway and slight marmoratization was observed on the limestones of Hsamra Razi.

SEDIMENTARY ROCKS

Among the sedimentary rocks, *limestones* and *dolomites* developed to a great extent, thus, taking part in the construction of the high mountain peaks along the western bank of Nam Tamai from Kollek to Ga-

way. On Lumhung Zatong Razi and Hsamra Razi the limestones are in direct contact with the granite, and there is no contactolithe. *Arkoses* and *greywackes* are found on the way from Kollek to Singsonghka. *Greywacke* is composed of quartz, orthoclase, muscovite, microcline and acid plagioclases, further tourmaline and eventually fragments of quartz-sandstone and quartzite.

ORE OCCURRENCES

I. *Occurrences of galena on Lumhung Zatong Razi* are seen about 8 miles from Pangnamdin in a northerly direction, and they are located on the eastern slope of the mentioned hill 100 ft. about the present level of Nam Tamai. From Pangnamdin in a northerly direction the predominant country rock is a coarse-grained granite. After crossing the Nam Tamai, about 1,5 miles below the confluence of the Daru Wang, the first contact between granite and quartzite was encountered, closely followed by white marble and limestone; the granite on the contact is slightly altered, tinted brownish, and it contains veinlets and patches of opaque mineral (most probably galena). The quartzite contains minute grains of diopside or garnet.

The occurrence of galena consists of a vein about one foot thick, conforming to the strike and dip of the limestone (direction of dip N 240° incline 77°) and a veinlet which lies nearly horizontally and perpendicularly to the strike and dip of the first mentined vein. Both veins are exposed in a steep gully. The outcrops were rather inconspicuous, but for a cap of spongy »gossan«. Here and there in gossan there are incrustations of white minerals, most probably secondary minerals of galena and sphalerite. The direct wall rocks were completely altered to an earthy mass of a dark tint. In relatively fresh specimens of ore, fine-grained galena, black sphalerite, pyrite and some chalcopyrite could be seen with the naked eye. Of gangue minerals there is quartz, developed as minute crystals in vugs of ore, furthermore some calcite in veinlets crossing the ore.

Microscopical investigations (performed by Dr I. Jurković)

The following paragenesis was determined:

Quartz, pyrite, sphalerite with exsolution of chalcopyrite, pyrrhotite and *chalcopyrrhotite, and galena* as hypogene minerals *cerussite, anglesite, smithsonite, hemimorphite, goethite, lepidocrocite* as hipergene minerals.

Quartz is the main gangue mineral. It is younger than pyrite, or it cements the cataclased pyrite. Quartz and pyrite are replaced by younger sphalerite, and especially by galena, which contains a lot of corroded grains and minute masses of quartz (sometimes with included pyrite). Quartz and coarse-grained pyrite are considerably cataclased.

Pyrite is the oldest mineral of the ore occurrence. Coarse-grained aggregates of pyrite are associated with quartz. In sphalerite were noted minute euhedral cubic crystals of pyrite (phot. 1). Galena replaces very

abundantly pyrite, thus forming an »island texture«. Pyrite was evidently cataclased or crushed, and then cemented by quartz and galena. Pyrite is present in various stages of weathering to *lepidocrocite* and *goethite.*

Sphalerite is younger than quartz and pyrite, sometimes including them. Sporadically a growth of sphalerite crystals on the rims of the quartz masses was observed. Sphalerite is strongly corroded by galena. It occurs in corroded (rounded) grains thus forming a »sieve-like« or »island« texture in galena. Sphalerite shows reddish-brown or dark brown internal reflections, suggesting that it is rich in iron (so called marmatite).

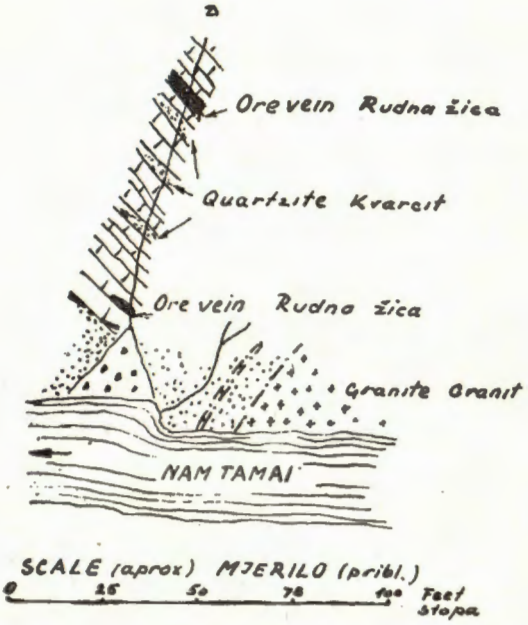

Fig. 2. Galena ore veins on Lumhung Zatong Razi
Sl. 2. Žice galenitne rude kod Lumhung Zatong Razi

Discs, lamellae and minute irregular bodies of *chalcopyrite* or *pyrrhotite* or both minerals are exsoluted in sphalerite (phot. 2). The quantity of these exsolutions varies from one to another polished section. The main characteristic of sphalerite is the appearance of minute rosy euhedral anisotropic crystals of *chalcopyrrhotite,* i. e. a mixture of chalcopyrite, which is characteristic of sphalerite crystallizing at temperatures above 240° C. This is usual with hydrothermal deposits of high tempe-

rature formed near the surface. Sphalerite weathers to *smithsonite* (phot. 3) and *hemimorphite*, or to an earthy mixture of undeterminable minerals.

Galena is the youngest hypogene sulphide mineral, embedding and replacing all other minerals, especially sphalerite. It is a coarse-grained mineral. Along the cleavage planes galena is replaced by supergene *anglesite* and *cerussite*. In some polished sections *secondary* (redeposited) powdered galena was observed.

*

Coarse-grained pyrite, quartz, galena, furthermore iron-rich marmatite with exsolutions of chalcopyrite, pyrrhotite and the appearance of chalcopyrrhotite in sphalerite suggest undisputably that the ore deposit of Lumhung Zatong Razi, was formed near the surface and at a temperature high above 240° C connected genetically with granitic magma.

II. *Occurrence of silver-bearing galena on Hsamra Razi* is located on the northern slopes of the high and very steep range of this hill at an elevation of 6250 ft. above the sea. The predominant country rock of the terrain from Mayit towards Gawai is a coarse-grained granite, but immediately north of Mayit, the granite is crossed by a multiple system of veins and dykes of more basic rocks and by some intermediate effusive rocks. The latter are slightly foliated. This zone is followed by a medium-grained granite, which is probably younger than the coarse-grained granite.

The old mining workings, abandoned a century ago, are now caved in. Only a subsidence of the main adit, immediately above the mouth of the adit, could be observed. The subsidence is about 8–10 ft. deep and of circular form. The average diameter is about 4–5 feet. The wall rocks (limestones or dolomites) are very much weathered, producing a yellowish to reddish earthy mass, which – with depth – turns to a dark brownish, earthy or sandy mass, crossed by a network of veins and veinlets of secondary (hypergene) lead ores (or maybe some zink too).

Only one piece of relatively fresh ore was found embedded in the reddish earthy mass. It consisted predominantely of fine-grained galena and aggregates of minute crystals of quartz. No other minerals were noted.

The ore occurrence is in limestones (dolomites) near to contact with huge masses of granites. To the west of Mayit there are four or five additional localities marked as »Old silver mines« on the »Half inch map«. The author was trying to get more detailed information about these mines, but without avail.

The long contact-line between granite and limestone and intensive tectonic movements are very favourable conditions for the development of ore deposits in this region.

Microscopic investigations (performed by dr. I. Jurković).

The following paragenesis was noted: *pyrite, quartz, galena* with *freibergite, calcite, barite, chalcedony* as hypogene minerals and *anglesite, cerussite,* as hipergene minerals.

Pyrite and *quartz* were noticed in galena in form of corroded grains. They are the oldest minerals of the paragenesis. Sporadically the cataclistic texture of pyrite was observed. The cataclases are cemented with chalcedony (phot. 4).

Galena is the main and almost the only ore mineral. It is coarse-grained, the grains ranging from 1–4 mm. The cleavage is very distinct. Along the cleavage planes the alteration (weathering) into *anglesite* and sporadically *cerussite* started (phot. 5.) Besides the well expressed cleavage planes there are also tension cracks and fissures, filled with supergene minerals.

Galena contains exsolutions of *silver-bearing tetrahedrite,* i. e. freibergite phot. 6. Those are drop-like masses of microscopical dimensions (up to 50 microns) unevenly scattered in galena. Freibergite is of typical greenish-grey colour and isotropic in crossed nicols.

Specimens of the altered wall rocks represent an earthy mass consisting of products of alteration of galena with quartz, *calcite* and barite.

The ore deposit is a mezo-epi-hydrotermal ore occurrence.

III. *The siderite deposit of Nogmung* is actually placed in the upper reaches of Hkalaw Ti, about 26 miles in a northernly direction from this village, on the southern slopes of the Kaung Teng Hpawng peak (7119 ft.). Accessibility to this area is very difficult. The iron ore from this deposit has been well known since time immemorial as a source of fine quality of iron used in the local manufacture of Kuives (dahs).

The country rocks are the following:

a) coarse-grained granites mainly west of Kasang Ti (Nam Tisang) respectively Hkalaw Ti and in a nameless tributary of this creek;

b) clay and phyllitic slates and sandstones, area east of the mentioned creeks, in contact with the iron deposit;

c) silicified rocks and quartzites, most probably on the north-eastern and northern parts of the area.

The first huge outcrops (4500–6000 cft) were found in the bed and on the right (western) bank of the Hkalaw Ti at an elevation of 5950 feet, in contact with clay and phyllitic slates (direction of dipping N 240°, dip 80°). The fresh ore is of a dark greyish tint, medium-grained and of a glassy luster. By weathering it produces limonite and in some places wad (psilomelane), suggesting that the ore contains a considerable amount of manganese (manganosiderite, or oligonite). In siderite, stringers of pyrite could be seen. As informed by T. O. Nogmung and the local people, the deposit extends in two nearly perpendicular direc-

tions for 2 miles (in both directions), building a range of considerable height, which leads us to the conclusion that the thickness of the ore body is also considerable. Besides, a number of iron ore deposits and occurrence were reported in Nogmung area. Below, the iron ore occurrences are listed: Hpan du tawng, Dabu du tawng, Hpung Ring du tawng, Hkan Nam du tawng, Durbang du tawng, Shoung Rawn du tawng, Madim Wang Hka.

Microscopical investigations (performed by Dr I. Jurković).

The following paragenesis was found: a) hypogene minerals: *siderite, magnetite, hematite, pyrite, arsenopyrite, pyrrhotite,*

b) hypergene minerals:

microcrystalline pyrite, marcasite, goethite, lepidocrocite, psilomelane

Siderite is the main ore mineral; it is coarse-grained, the size of grains ranges from 0,5–2 mm, forming a heterogranular texture. Siderite is impregnated with minute grains and masses of *magnetite*, then *hematite*, but here and there there are microcristalline aggregates of *pyrite* and *marcasite* and more rarely *pyrite* along with *arsenopyrite.*

Many siderite grains are rimmed by continuous or discontinuous wreaths of grains and masses of magnetite (phot. 7). This magnetite contains inclusions of *pyrrhotite.* The pyrrhotite is mainly fresh, but in some masses the beginning of weathering to micro (or crypto) – crystalline pyrite and marcasite was observed. Decomposition started in the form of veinlets or along cleavage planes. In siderite, stringers of magnetite could be noted (phot. 8). Siderite weathers to *goethite* along rhombohedral cleavage planes. In view of the considerable amount of manganese in the molecule of siderite it is not surprising that pulverent microcrystalline) *psilomelane* was found along with goethite.

Magnetite is greyish brown in colour, thus differing from the colour of the typical magnetite, which suggests that magnetite is manganese-bearing. Magnetite shows very often a poikiloblastic (sieve-like) texture owing to inclusions of siderite. It includes oval forms of pyrrhotite and more or less euhedral grains of pyrite. Some masses of magnetite are rimmed by a *hematite* of characteristic red-coloured internal reflections and a very high relief.

Pyrrhotite is observed only in the form of inclusions in magnetite and arsenopyrite. It is rose-brown in colour and weathers to micro or crypto-*cristalline masses of pyrite or marcasite.* In the advanced stage of weathering the pyrite- marcasite masses convert into aggregates of *lepidocrocite* and *goethite,* i. e. pseudomorphoses of both minerals on pyrite-marcasite.

Arsenopyrite appears in the form of idioblasts or xenoblasts, containing oval inclusions of pyrrhotite. In some veins intersecting the siderite mass there are rather big idioblasts of arsenopyrite.

Pyrite occurs in siderite in the form of small masses and grains (phot. 7, 8).

CHEMICAL ANALYSIS OF AN ORE SPECIMEN:

Moisture	0,1%
Loss by heating	29,7% (mainly CO_2)
SiO_2	0,2
Al_2O_3	–
Fe_2O_3	8,5
FeO	45,8
Cr_2O_3	–
NiO	–
MnO	7,8
CuO	0,8
MgO	3,4
SO_3	3,6
P_2O_5	–
S	1,4
Total	101,3%

The coarse-grained texture of siderite on the one hand and the presence of minute grains and masses of magnetite along the rims of siderite grains as well as the frequent poikiloblastic structure of magnetite and idioblastic or xenoblastic development of arsenopyrite on the another suggest that the ore mass underwent idioblastesis. The presence of pyrrhotite shows that this blastesis developed under a relatively high temperature.

REFERENCES

Chibber, H. L. (1934a): Geology of Burma.
Chibber, H. L. (1934b): Mineral Resources of Burma.

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POJAVE SREBRONOSNOG GALENITA I MANGANONOSNOG SIDERITA U PODRUČJU PUTAO, SJEVERNA BURMA

Jedan od autora (B. Zalokar) izvršio je početkom 1958. god. prospekciju područja između rijeka Mali Hka i Nmai Hka istočno od grada Putao u Sjevernoj Burmi. Mineragrafsko ispitivanje sakupljenih rudnih uzoraka izvršio je Dr I. Jurković.

Obrađene su pojave srebronosnog galenita kod Lumhung Zatong Razi i Hsamra Razi i pojava manganonosnog siderita sjeverno od Nogmunga. O spomenutim pojavama postoje vrlo skromni podaci u radovima H. L. Chibbera (1934a, 1934b).

Prospektirano područje je izgrađeno od magmatskih, metamorfnih i sedimentnih stijena.

Najvažniji petrografski član su graniti: krupnozrnati, porfirski, mikroklinski, finozrnati i leukograniti. U granitskoj masi nađene su pojave aplitskih i pegmatitskih žica. U rubnim zonama granita nalaze se granodioriti, amfiboliti te gnajs-graniti. Na izvjesnim kontaktima granita nalaze se pojave kontaktnometamorfnih stijena: granatsko–coisitsko–biotitskog skarna i kornita.

Od parametamorfnih stijena uočeni su filiti, paragnajsevi i kvarciti te mramori.

Sedimentni vapnenci i dolomiti su jako razvijeni, pokrivajući najviše vrhunce na terenu. Mjestimice ima arkoza i pješčenjaka.

RUDNE POJAVE

I. *Srebronosni galenit kod Lumhung Zatong Razi* nalazi se u vapnencima blizu kontakta sa granitima. Orudnjenje je žično, žica je debela jednu stopu. Mikroskopskim ispitivanjem utvrđena je ova parageneza:

Kvarc, pirit, sfalerit (marmatit) sa izdvajanjima *halkopirita, pirotina* i *halkopirotina* te *galenit*. U oksidacionoj zoni su primjećeni *ceruzit, anglezit, smitsonit, hemimorfit, getit* i *lepidokrokit*.

Kvarc je glavni mineral jalovine, a galenit je glavni rudni mineral. Krupnozrnati pirit, kvarc i galenit, zatim željezom bogati sfalerit sa izdvajanjima halkopirita i pirotina te pojavom halkopirotina nedvojbeno ukazuju da je rudna pojava nastala blizu površine kod relativno visokih temperatura iznad 240° C, genetski povezana sa granitskom magmom.

II. *Srebronosni galenit kod Hsamra Razi* nalazi se također u vapnencima (dolomitima) blizu kontakta sa granitima. Rudna pojava je ranije eksploatirana te se vide ostaci nekadašnjih radova u obliku kaverni. Na haldama i u jami opažaju se samo hipergeni minerali s neznatnim ostacima neoksidiranog galenita.

Mikroskopiranjem je utvrđena ova parageneza:

pirit, kvarc, galenit s izdvajanjima *frajbergita, kalcit*, i *kalcedon* te hipergeni *ceruzit* i *anglezit*.

Svi primarni minerali osim galenita su vrlo skromnih količina, najčešće uočeni tek u mikroskopu.

Rudna pojava je mezo-epi hidrotermalna rudna pojava također u genetskoj vezi sa granitskom magmom.

III. Pojava manganosiderita kod Nogmunga. Orudnjenje se nalazi u glinovitim i filitičkim škriljavcima. Glavni rudni mineral je zrnati siderit u kojem se vide vrpce i proslojci pirita. U oksidacionoj zoni siderit je oksidiran u limonit i psilomelan.. Rudna pojava je znatne debljine i poznata je po pružanju na dužini od 2 milje. U okolici se nalazi još nekoliko sličnih rudnih pojava.

Mikroskopiranjem je utvrđena ova parageneza: krupnozrnati *siderit* sa 7,8% MnO sa impregnacijama i vrpčastim agregatima *magnetita* (djelomice hematitiziranog), zatim s malo zrnaca i masica *pirita* te vrlo rijetko *arsenopirita.* U magnetitu i arsenopiritu vide se ovalni ili okrugli uklopci *pirotina,* koji je u manjoj ili većoj mjeri metamorfoziran u kriptokristalaste do mikrokristalaste agregate *pirita* i *markazita.* U oksidiranim uzorcima uočeni su *getit, lepidokrokit* i *psilomelan.*

Struktura rude je krupnozrnata. Magnetit je dobrim dijelom razmješten po obodima zrnja siderita. Veće masice i zrnje magnetita su poikiloblastično prorasli sa sideritom. Arsenopirit i pirit su često razvijeni kao idioblasti ili ksenoblasti. Strukturno-teksturne karakteristike ukazuju da su primarni sastojci prekristalizirali. Blasteza se odvijala kod relativno viših temperatura obzirom na prisutnost pirotina, magnetita i hematita u paragenezi.

PLATE — TABLA I

1. Sphalerite (dark grey) with euhedral cubic crystals of pyrite (py). Magnified 370 diameters.

   Sfalerit (tamnosivo) s idiomorfno razvijenim kubičnim kristalićima pirita (py). 370 ×.

2. Sphalerite (dark grey) with crystallografically orientated exsolutions of pyrrhotite and chalcopyrrhotite (light grey). Magnified 250 diameters.

   Sfalerit (tamnosiv) sa kristalografski orijentiranim izdvajanjima pirotina i halkopirotina (svjetlosive lamele i tjelešca). 250 ×.

3. Alteration of sphalerite to smithsonite along cleavage planes (111). Magnified 47 diameters.

   Trošenje sfalerita u smitsonit duž pukotine kalavosti (111). 47 ×.

4. Cataclastic texture of pyrite; cataclases being cemented with chalcedony (black). Magnified 47 diameters.

   Kataklastična struktura pirita. Kataklaze su cementirane kalcedonom (crno) 47 ×.

1

2

3

4

PLATE — TABLA II

5. Alteration of galena to anglesite (dark grey) and cerussite along cleavage planes (100). 47 ×. Trošenje galenita u anglezit (tamnosivo) duž pukotina kalavosti (100). 47 ×.

6. Exsolutions of freibergite (f) in galena (g). Magnified 90 diameters.

   Izdvajanja frajbergita (f) u galenitu (g). 90 ×.

7. Magnetite grains (white) along rims of coarse-grained siderite (dark-grey). Sporadically grains of pyrite (white with high relief). Magnified 47 diameters.

   Zrna magnetita (bijelo) po rubovima zrnja krupnozrnatog siderita (tamnosivo). Sporadički zrnca pirita (bijela sa visokim relijefom). 47 ×.

8. Stringers and impregnations of magnetite (light grey) in coarse-grained siderite (dark-grey). Sporadically minute white masses of cryptocrystalline pyrite (previously pyrrhotite). Magnified 90 diameters.

   Vrpce i impregnacije magnetita (svijetlosivo) u krupnozrnatom sideritu (tamnosivo). Sporadički bijele sićušne masice kriptokristalastog pirita, koji je nastao iz pirotina. 90 ×.

5

6

7

8

PLATE — TABLA III

9. Alteration of siderite (grey) to goethite (black) along rhombohedral cleavage planes. In siderite impregnations of magnetite (white). Magnified 60 diameters.

   Oksidacija siderita (sivo) u getitu (crno) po romboedrijskim pukotinama kalavosti. U sideritu fine impregnacije magnetita (bijelo). 60 ×.

10. Porphyroblast of arsenopyrite (as) with inclusions of pyrrhotite (ph). Magnified 250 diameters.

    Porfiroblast arsenopirita (as) s inkluzijama pirotina (ph). 250 ×.

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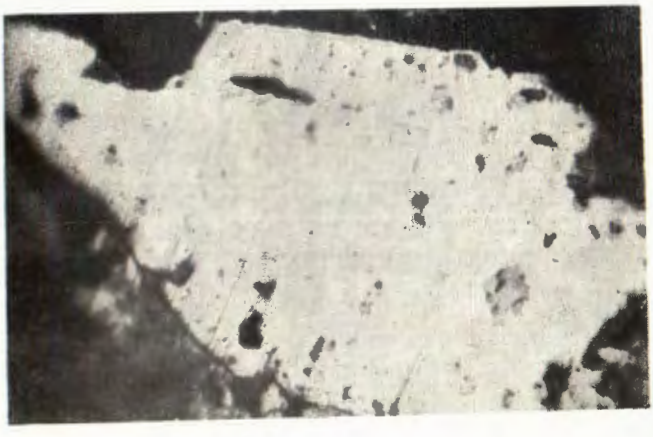

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GALENA & SIDERITE DEPOSITS PUTAO AREA, BURMA

Ležišta galenita i siderita područja Putao, Burma

Fig. 1