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NOTES ON THE ORE OCCURRENCES ON THE
EASTERN AND SOUTH-EASTERN SLOPES OF
THE TAGAUNG-TAUNG, KATHA DISTRICT,
UPPER BURMA (ASIA)*

With 2 plates and 1 card

In this paper a brief account is given on the rocks and ore occurrences in the region of the eastern and south-eastern slopes of the Tagaung Mountain, Katha District.

INTRODUCTION

The Tagaung Mountain extends SE of the town of Tigyang on the left bank of the Irrawaddy River for some 15 miles. Nearly the whole area between the market-town of Tigyang and the village of Tagaung is very scarcely populated. Besides the villages of Mahlaingkor and Innet there are no other settlements in the vicinity. The seasonal fishermen's village of Innet, situated at Innet Lake – actually the Irrawaddy's back waters – can be reached by a 2 mile short cut from the bank of the Irrawaddy, or during the open season, by a 12 mile jeepable road from the village of Tagaung.

The whole Tagaung Taung area was prospected by I. Jurković and B. Zalokar during February and March, 1955. Microscopic studies of a large number of rock specimens were carried out by L. Marić, and mineralographic studies of ore specimens by I. Jurković. Due to technical reasons, there was no possibility to spend more than two days for a brief reconnaissance on the eastern part of the Tagaung Taung. Later on, in April 1957, ore deposits of the western slopes of the Tagaung Taung area were explored in detail by A. Ferencić, M. E., S. Kovačević and D. Sviben, geophysicists, and K. Rosenberg, surveyor. The results of these prospectations and explorations were summarized in the reports by I. Jurković–B. Zalokar, 1956, and A. Ferencić–I. Jurković–S. Kovačević–K. Rosenberg, 1958. According to these reports the central part

* Geological literature does not contain any geological data, and in the geological map of Burma (H. L. Chibber, 1934), this region is but a »white spot«.

of the Tagaung Taung Mountain, as well as its southern, western and northern portions, consist of ultrabasic rocks, among which saxonite, harzburgite, and diopside wehrlite are the most common types of rocks, which represent a transition to lherzolite (pyroxenite-peridotite) and saxonite-peridotite. These rocks are partially serpentinized. The vein differentiates - enstatite and pyroxenite were also noticed.

PETROLOGY AND ORE OCCURRENCES OF THE
EASTERN AND SOUTH-EASTERN SLOPES OF THE
TAGAUNG TAUNG MASSIF

1. The area of the upper part of the Mahlaingkor creek

This area consists of a series of quartzschists. Microscopically, the predominant constituent of pure schistose quartzite is quartz with elongated and linearly arranged grains. The rock is tourmalinized. Other varieties of these rocks contain sericite, muscovite, chlorite in various amounts, and represent transitional types to quartzschists. Some rocks contain columnar bluish-grey disthene, specularite, or pyrite.

No ore occurrences were noticed.

2. The area on the left bank of the Kanni Creek

This area consists of basic and ultrabasic rocks. The most widespread basic rock is gabbro. The rock is of massif appearance. It is composed of saussuritized plagioclases, brownish and slightly greenish amphibole (or brownish-red biotite), with a few (sometimes more) grains of clinopyroxenes-uralitized diopside. Supergene constituents are leucoxene, fibrous serpentine, and chlorite. The texture is of anhedral granular or ophitic type.

More scarcely noticed are diabases.

Ultrabasic rocks are represented by enstatitic dunite, saxonite, wehrlite, lherzolite and saxonite-harzburgite (partially serpentinized).

Saxonite is composed of olivine and enstatite, sometimes mechanically deformed. Olivine is serpentinized partially or in its greater part (reticular texture) with relics of olivine. Enstatite is metamorphosed to tremolite or biotite or altered on its rims to talc. Lamellae of talc are perpendicular to the rim of corroded enstatite. Chromite appears as accessory constituent, magnetite occurring as supergene mineral.

In some very strongly serpentinized saxonite we noticed relics of olivine and bastitized enstatite with accessory picotite and a lot of magnetite, as well as veinlets of fine fibrous chrysotile.

The most ultrabasic rock is coarsegrained enstatitic dunite, olivine being its main constituent.

Lherzolite is composed up to 60% of more or less serpentinized olivine, containing a lot of granular magnetite, large crystals of bronzite and clinopyroxene-diopside (sometimes uralitized). Further on, it contains brown picotite and secondary magnetite.

Saxonite-harzburgite is fresh, containing only partially serpentinized olivine, enstatite with lamellae of diopside and accessory picotite.

Wehrlite contains serpentinized olivine and tectonically deformed diallage. Secondary constituents are magnetite and in some places magnesite.

Besides some occurrences of some magnesite in wehrlite and accessory chromite in saxonite, no other mineralization was found.

3. *The area on the right bank of the Kanni Creek (Nattalin-Taung)*

This area is built up of serpentinite and schistose amphibolite.

Serpentinite originated from harzburgite or from pyroxenic peridotite. Only relics of black bastite and accessory brownish-black chromite were noticed under microscope. Serpentine has a reticular texture.

Some serpentinites are silicified and limonitized.

Found in the same area were pebbles of antigorite-serpentinite, with corroded grains of chromite.

Serpentinite-breccia is a rock very characteristic of this region. It is light green in colour, with brecciated structure. Microscopical study showed that fragments of limonitized serpentinite are cemented with finely crystallized fibrous chalcedony, finegrained quartz, and a yellowish-green powderly substance, i. e. nickelsilicate, probably garnierite. In order to determine the composition of this colloidal substance, some of it was dissolved in hot concentrated HCl, filtrated, and it precipitated iron hydroxide with NH_4OH . Solution of Dimethylglyoxime was added to the remaining solution, which resulted in the deposition of a red-coloured precipitate. The quantitative chemical analysis showed 17.6% Ni and 65.08% SiO_2 (Analyst K. Pavlič).

Amphibolites are schistose rocks, green in colour. They consist of green pleochroitic hornblende ($c : Ng = 18^\circ - 21^\circ$), feldspars (sometimes saussiritized) almost entirely metamorphosed into zoisite and epidote, further of accessory titanite and magnetite, and a lot of rutile.

West of the Nattalin Taung placers of chromite were noticed in the alluvions.

4. The area between the Nattalin Taung and the Thandwin Creek

This area consists of a series of quartzites and quartzschists, and along their contact with the ultrabasic rocks of the Nattalin Taung area contact-metamorphic rocks are also present.

Among the parametamorphic rocks the following have been identified: pure quartzite, cataclastic quartzite, muscovitic quartzschist, muscovite-chlorite quartzschist, quartzsandstone and arkose.

The most widespread contact-metamorphic rocks are garnetiferous quartzite and garnet-amphibolite. Special types are garnet-zoisite-amphibolite; garnet-quartz-albite-schist; contact-metamorphosed arkose with completely sericitized plagioclases and very strong rutilized albite-chlorite-schist.

No ore occurrences were noticed.

5. The area between the Thandwin and the Ngalinga Creeks

This area consists of diabases and green schists.

Coarsegrained ophitic diabase consists of columnar, polysintetic twinned, sometimes corroded plagioclases, uralitized or chloritized diopside, and aggregates of magnetite.

Finegrained, ophitic, dark-green diabase with columnar, saussiritized labradore, then diopside, further on magnetite and chlorite come as supergene minerals.

Chlorite-epidote-actinolite-schist is a very compact rock, schistose, dark-green in colour. The main constituents are light green-yellowish epidote, almost colourless chlorite, and then acicular actinolite ($c : Ng = 7^{\circ} - 9^{\circ}$). In some samples relics of diopside with an aureole of actinolite were noticed, as well as a small quantity of feldspars and albite.

Actinolite-schist is predominantly composed of columnar actinolite ($c : Ng =$ up to 14°). The feldspars albite and zoisite are present in subordinate quantities.

Epidote-actinolite-muscovite-schist, light-green in colour, schistose, is built up of transparent albite, epidote, columnar actinolite, and a lot of muscovite.

Chlorite-actinolite schist is composed of slightly coloured chlorite and greenish actinolite ($c : Ng =$ up to 12°).

In epidote-zoisite-amphibolite green hornblende ($c : Ng = 21^{\circ}$) is the main constituent, epidote and zoisite being accessory minerals, and titanite the supergene mineral.

No ore occurrences were noticed.

6. The area of the upper of That-htu Creek

The metamorphic rocks from the Thandwin Creek area stretch to the upper part of the That-htu Creek.

The widespread rocks are actinolite-epidote schist, chlorite-epidote schist, green schist (epidote, actinolite, feldspar, polysynthetic albite, muscovite) – feldspathic epidote-actinolite schist. Special rocks are metamorphosed arkose (completely sericitized plagioclases, corroded and cataclased quartz grains) and schistose rock, which is composed of coarsegrained calcite, then chlorite, epidote, corroded quartz and fan-shaped agglomerations of prehnite. This rock is a product of carbonate metasomatism.

Copper-bearing pyrite occurrences

In the zone of these epimetamorphic rocks we found a narrow belt, about 30 feet wide, with a larger and two smaller banks, of pyrite ore placed conformably with the schistosity of the schists. Each deposit consists of a string of pyritic lenses in a clayey gangue material. The largest lense is one foot in size. Besides pyrite, some chalcopyrite, »limonite«, and malachite were noticed by unaided eye. Clayey gangue is very often impregnated with pyrite. »Limonite« and malachite occur as coatings, films, impregnations, dispersed tinting material, system of thin veinlets etc.

Paragenesis of the ore occurrences

Hypogene minerals: quartz, pyrite, chalcopyrite I, sphalerite and chalcopyrite II.

Supergene minerals: covellite, chalcocite, goethite, lepidocrocite, and malachite.

Pyrite is the main and the most widespread ore mineral. Chalcopyrite is very frequent, but it is always present in small quantities. Sphalerite is rare in this mineral assemblage. Quartz is only gangue mineral.

Pyrite is finegrained and anhedral. The pyrite grains are very often cataclased, sometimes even completely crushed, fragments being stretched in stringers and corroded. It is replaced by sphalerite, sometimes along hexahedral crystallographic planes (photo 1).

Chalcopyrite I occurs as minute exsolved drops and discs in sphalerite.

Sphalerite is younger than pyrite and replaces it, to be replaced in turn by chalcopyrite II. In such way the typical island texture of the sphalerite originated (photo 2). Sphalerite exhibits reddish-brown internal

reflections, an indication that the iron-rich variety of sphalerite – *marmatite* – is present. Locally, sphalerite contains exsolutions of chalcopyrite I. Similarly to pyrite, sphalerite grains are cataclased too.

Chalcopyrite II occurs as smaller and larger masses, especially in vugs of quartz. Chalcopyrite grains are lamellarly twinned. Chalcopyrite replaces pyrite and specially sphalerite, but it is found strongly weathered itself. It alters along an irregular system of veinlets to *covellite*, *chalcocite*, *goethite* and *malachite* (photo 3).

Quartz is the main and only gangue mineral. It is coarsegrained, optically anomalous and cataclased. Corroded grains of quartz are occluded in sulphides.

The ore occurrence is of mesothermal origin. Characteristic are very strong epigenetic tectonic movements.

7. The area of the middle course of the Shwedaung Creek

The area of the Shwedaung Creek, upstream of the Ngalinga Creek is built up of a series of hornstones with occurrences of manganese ore, and still farther of a series of green schists. About one kilometer upstream of the dry waterfall, at a distance of several hundred meters, there are large boulders of green schists impregnated with malachite and azurite (coatings, crusts, veinlets and impregnations).

The typical epimetamorphic rock is chlorite-epidote schist. It is dark green in colour, schistose, finegrained and composed of apple-green pleochroitic chlorite, then epidote and small quantities of muscovite and albite. While muscovite, actinolite or zoisite, predominate, other types of rocks originate: actinolite-muscovite-epidote schist, actinolite-epidote-zoisite schist, and eventually epidote-actinolite schist.

By mineragraphic studies of polished sections of copper-bearing boulders of epidote-actinolite schist the following paragenesis was determined: *malachite*, *azurite* (photo 4), *goethite*, *lepidocrocite*, and *pseudomorphosis* of *goethite* and *lepidocrocite* on *pyrite*. (Photo 5) Hypogene minerals have not been found.

According to our opinion, this ore occurrence is of the same genesis and morphologically similar to the pyrite deposit found in the That-htu Creek.

8. The area among the Ngalinga, That-htu, and Shwedaung Creeks

This area consists of hornstones and jaspers. These rocks are red, brownish, or yellow-brownish in colour, very compact and dense. By microscopic studies of thin sections it was determined that the main

rock-forming minerals are microcrystalline chalcedony (fibers, laminae), then relics of radiolarian fauna and a lot of limonitic and psilomelane powder. About one mile southward of the place where the That-htu and Ngalinga Creeks join, in a small leftside tributary of the Shwedaung Creek, big boulders and a lot of pebbles of very good quality manganese ore were discovered. There are boulders up to three to four feet in size, which means that the outcrops of the original deposit are very near.

Manganese ore is greyish-black in colour, of conchoidal fracture and alternates with reddish-brown hornstones.

By mineragraphic studies of the polished sections the following was determined:

Manganese ore has colloform texture, compact or porous. Chemical analyses have shown an average content of 56 % MnO_2 .

Psilomelane is extraordinarily fine crystallized, crystals being smaller than one micron (very rarely they reach up to 10 microns in size). The *chalcedony* matrix contains very small acicular crystals of *psilomelane* (photo 6).

Due to alateral and descedant secretion, *psilomelane II* developed in fissures and cracks of manganese ore as minute veinlets (photo 7 and 8).

Genetically, manganese ore belongs to the series of hornstones; it is of a sedimentary origin.

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**BILJEŠKA O RUDNIM POJAVAMA NA ISTOČNIM
I JUGOISTOČNIM PADINAMA TAGAUNG TAUNG,
KATHA DISTRICT, GORNJA BURMA (AZIJA)**

Područje je prospektirano u proljeću 1955. godine. Uzorke stijena je mikroskopski istražio L. Marić, a rudne uzorke I. Jurković.

Središnji dio Tagaung Taung, kao i njegove južne, zapadne i sjeverne padine izgrađeni su od ultrabazičnih stijena između kojih su saksonit, harcburgit, diopsidski verlit najraširenije stijene i predstavljaju prelazne tipove ka lercolitima i saksonit-peridotitima. Te stijene su parcijalno serpentinizirane. Uočeni su i žični diferencijati.

Područje gornjeg toka potoka Mahlaingkor je izgrađeno od raznovrsnih kvarcita i kvarcitičnih škrljavaca. Neke stijene su zamjetljivo turmalinizirane. Dalje južnije, na lijevim obalama Kanni potoka rasprostranjeni su gabrovi i rjeđe dijabazi te raznovrsne ultrabazične stijene, djelomične serpentinizirane. U verlitima smo zapazili omanje pojave *magnezita*, a u saksonitima jače koncentracije *akcesornog kromita*.

U području Nattalin Taunga, na desnim padinama Kanni potoka rašireni su serpentiniti i škrljavi amfiboliti. Serpentiniti su nastali metamorfozom saksonita i harcburgita. Dosta su česte serpentinne breče, u kojima smo našli na pojave *garnijerita* u cementu odlomaka serpentina. Garnijerit se javlja u vidu žućkasto-zelene praškaste mase zajedno s vlaknatim kalcedonom i finozrnatim kvarcom. U aluvionima zapadno Nattalin Taunga nalaze se *kromitski pijesci*.

Područje između Nattalin Taunga i Thandwin potoka izgrađeno je od kvarcita i kvarcitičnih škrljavaca. Neke su stijene značajno granatizirane i kontaktno metamorfozirane.

Južnije od Thandwin potoka utvrdili smo seriju zelenih škrljavaca i dijabaza.

U području gornjeg toka That-htu potoka, koje je izgrađeno od zelenih škrljavaca i metamorfoziranih arkoza, kao i od stijena karbonatne metasomatoze našli smo unutar zelenih škrljavaca omanja lečasta ležišta *bakronosnog pirit*a, konkordantno uložena u škrljavce. Ispitivanjem u rudnom mikroskopu utvrdili smo *kvarc*, *pirit*, *halkopirit I*, *sfalerit (marmatit)* i *halkopirit II* kao hipogene minerale, te *kovelin*, *halkozin*, *getit*, *lepidokrokrit* i *malahit* kao hipergene minerale u paragenezi. Pirit je glavni mineral rudnih pojava i najrašireniji; halkopirit je čest mineral, ali ga ima u malim količinama. Sfalerit je rijedak. Kvarc je jedini mineral jalovine. Hipergeni minerali se javljaju kao prevlake, filmovi, žilice, kolorirajuća supstanca i impregnacije.

U srednjem toku potoka Shwedaung koje je izgrađeno od rožnaca i zelenih škrljavaca nađene su valutice i blokovi zelenih škrljavaca sa pojavama hipergenih bakrenih i željeznih minerala: *malahita*, *azurita*, *getita*, *lepidokrokita* te *pseudomorfoza* tih *željeznih oksihidroksida po piritu*.

Područje donjih tokova potoka That-htu, Ngalinga i Shwedaung sastoji se od rožnaca i jaspisa. U potoku Shwedaung našli smo krupne blokove manganske rude visokog kvaliteta, sa 56% MNO_2 . Ta ruda je genetski vezana za rožnace i sedimentnog je postanka. Sastoji se od kriptokristalastog *psilomelana* u kojem ima lokalno krupnije kristalastog mikrozrnatog *psilomelana*. Jalovina je *kalcedon*. Vrlo fine mikrožilice *psilomelana II* nastale su sekrecijom u hipergenoj fazi.

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PLATE I

1. Copper-bearing pyrite ore in the That-htu Creek. Pyrite (white) replaced by sphalerite (dark grey) along hexaedral crystallographic planes. Mag. 130 X.

Bakronosna piritska ruda u That-htu potoku. Pirit (bijelo) potiskivan po sfaleritu (tamno siv) duž heksaedrijskih kristalografskih ravnina. Poveć. 130 X.

2. Copper-bearing pyrite ore in the That-htu Creek. Sphalerite (dark grey) replaced by chalcopyrite (white) - »island structure«. Mag. 70 X.

Bakronosna piritska ruda u That-htu potoku. Sfalerit (tamnosiv) potiskivan halkopiritom (bijelo) - »otočna struktura«. Poveć. 70 X.

3. Copper-bearing pyrite ore in the That-htu Creek. Cataclased chalcopyrite (ch) weathered on the rims to covellite, chalcocite, goethite and malachite. Quartz is black in colour. Mag. 230 X.

Bakronosna piritska ruda u That-htu potoku Kataklažirani halkopirit (ch) troši se uz rubove u kovelin, halkozin, getit i malahit. Kvarc je crn na slici. Poveć. 230 X.

4. Copper-bearing iron ore in the Shwedaung Creek. On the left side there is fibrous and finegrained malachite, on the right side is microcrystalline goethite (g). In the middle part we see pseudomorphoses of goethite and lepidocrocite on pyrite. Mag. 80 X.

Bakronosna željezna ruda u potoku Shwedaung. Na lijevoj strani slike vidi se vlaknat i sitnozrnat malahit, na desnoj strani mikrokristalast getit (g), a u sredini pseudomorfoze getita i lepidokrokita po piritu. Poveć. 80 X.

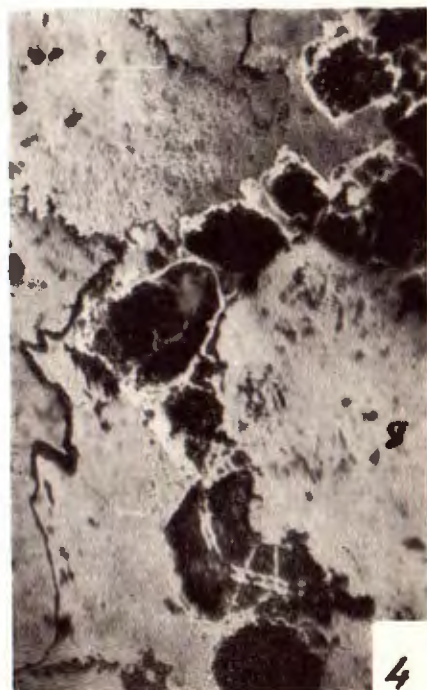
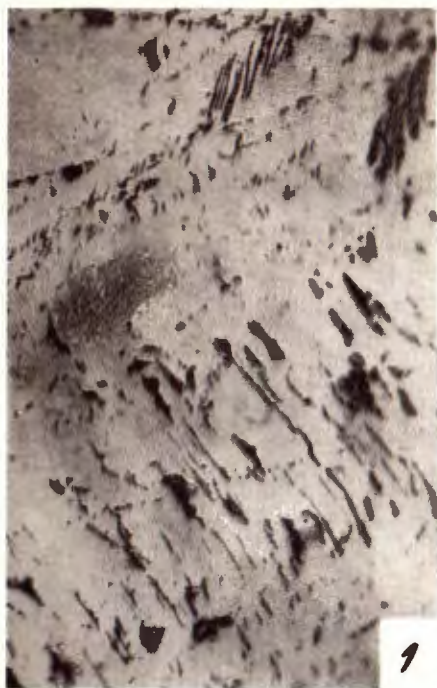


PLATE II

5. Copper-bearing iron ore in the Shwedaung Creek. Very fair pseudomorphoses of goethite (g) and lepidocrocite on pyrite in green schists. Mag. 130 X.

Bakronosna željezna ruda u potoku Shwedaung. Vrlo lijepe pseudomorfoze getita (g) i lepidokrokita po piritu u zelenim škriljavicima. Poveć. 130 X.

6. Manganese ore in the Shwedaung Creek. Colloform texture of psilomelane (white) in the matrix of cryptocrystalline chalcedony (black). Mag. 130 X.

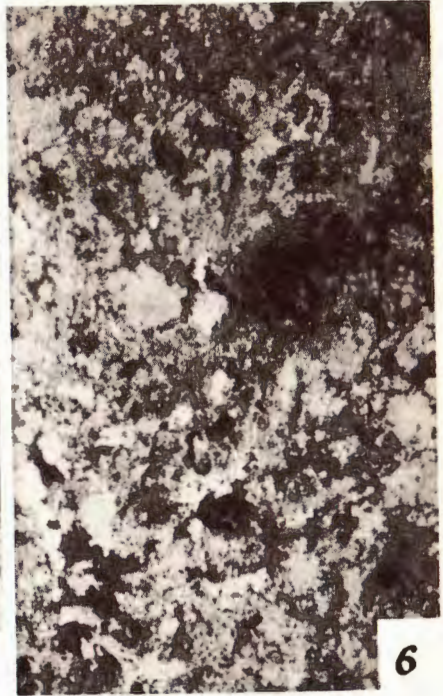
Manganska ruda u potoku Shwedaung. Koloidne teksture psilomelana (bijelo) u matriksu kriptokristaliničnog kalcedona (crno). Poveć. 130 X.

7. Manganese ore in the Shwedaung Creek. Very porous manganese (psilomelane) ore with younger veinlets of psilomelane II. Mag. 80 X.

Manganska ruda u potoku Shwedaung. Vrlo porozna manganska ruda (psilomelan) s mladim žilicama psilomelana II. Poveć. 80 X.

8. Manganese ore in the Shwedaung Creek. Porous microcrystalline psilomelane with a veinlet composed of younger psilomelane II. Crystals are perpendicular to the walls of the fissure. Mag. 80 X.

Manganska ruda u potoku Shwedaung. Porozni mikrokristalasti psilomelan sa žilicom izgrađenom od mlađeg psilomelana II. Kristali rastu okomito na zidove prsline. Poveć. 80 X.

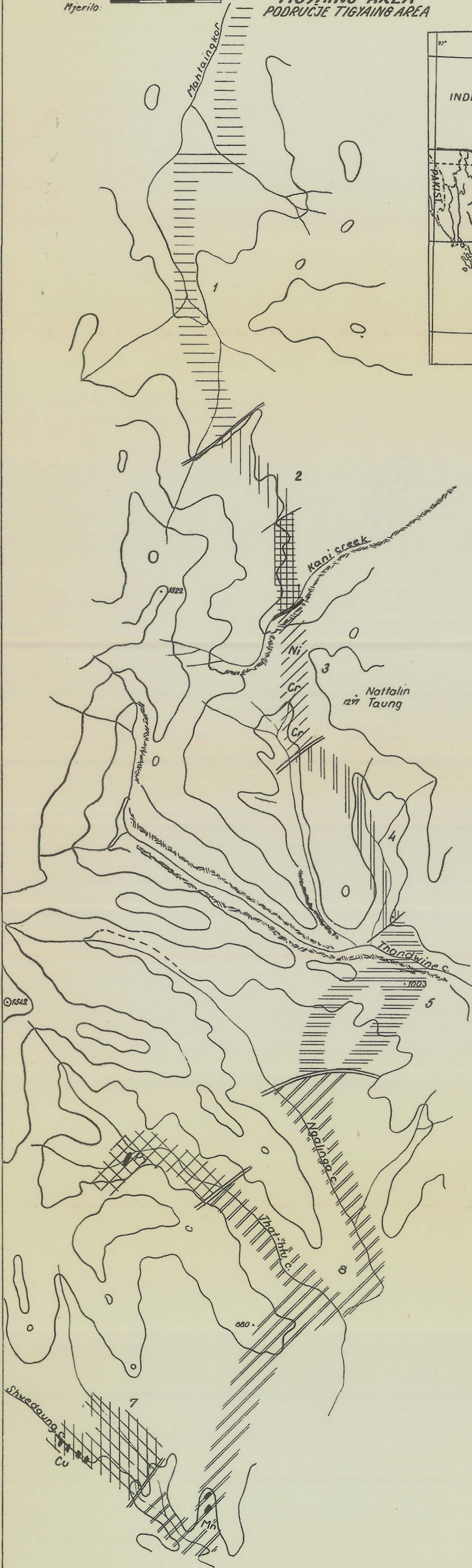
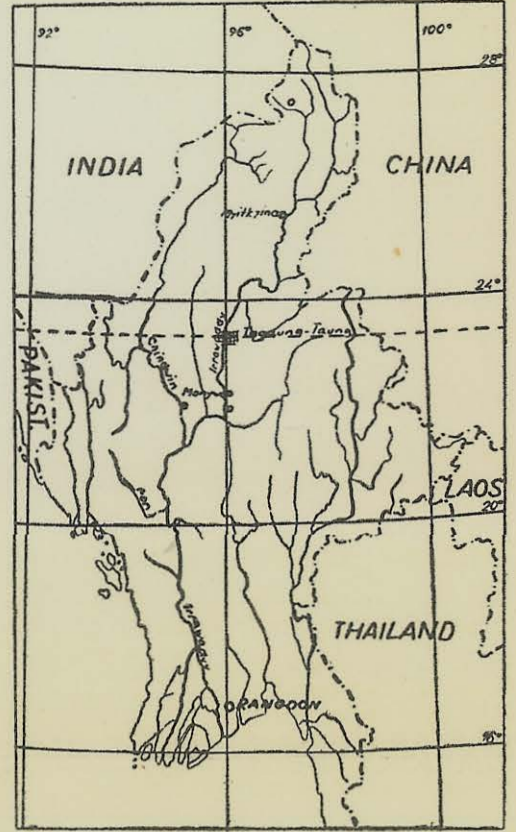


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EASTERN AND NORTHEASTERN SLOPES OF TAGAUNG-TAUNG
 ISTOČNE I SJEVEROISTOČNE PADINE TAGAUNG-TAUNG

Scale: 0 100 200 300 400 m
 Mjerilo:

TIGYAING AREA
 PODRUČJE TIGYAING AREA



LEGEND

- quartzschists
- Gabbros and diabases
- saxonites, wehrlites, (herzolithes, enstatitic dunites (partially serpentinized))
- Serpentinities and schistose amphibolites, serpentine breccia
- quartzites, quartzschists
- diabases and green schists
- green schists, arcoses, carbonate metasomatic rocks
- hornstones, green schists
- hornstones and jaspers
- Ni Garnierite occurrence
- Cr Chromite placers
- Py Copper-bearing pyrite occurrence
- Cu boulders with copper and iron supergene minerals
- Mn boulders with manganese ore minerals