ORE MINERALOGY AND GEOCHEMICAL INVESTIGATION OF LEAD MINERALIZATION IN KYAUKTAP AREA, KALAW TOWNSHIP, SHAN STATE (SOUTH)

Kyaw Thu Oo[1] and May Thawe Aye[2]

Abstract

Kyauktap area, the study area is situated about 17 kilometres north of Heho, Kalaw Township, Taunggyi District. Regionally, the Precambrian rocks of Chaungmagyi Group are surrounded by Lower Paleozoic rocks. The study area is located in the southern part of Bawsaing Range that lies in the southwestern part of the Shan Plateau. Sedimentary rocks of the Wunbye Formation, Nan-on Formation of Pindaya Group (Ordovician age) and Linwe Formation of Mibayataung Group (Silurian age) cropped out in the study area. According to petrographic classification, Wunbye Formation can be divided into six microfacies: Oolitic Dolomatized Grainstone, Dolomitic Limestone, Crystalline Limestone, Oolitic-PelloidalGrainstone, Pelloidal-Bioclastic Wackestone, Micrite or Limemudstone, and Ferruginous Lime Mudstone of Linwe Formation. The lead mineralization is confined to the carbonate rocks of Wunbye Formation of Middle Ordovician age. Absence of igneous rocks is conspicuous. Two types of wallrock alteration are dolomitization as the main alteration, and silicification as subordinate, which predate the ore mineralization. The major ore minerals are galena and barite, and its associated minerals are sphalerite, pyrite, chalcopyrite, covellite and anglesite. The gangue minerals are calcite, dolomite and quartz. Both open-space fillings (veinlets, disseminations, fracture fillings and solution collapse breccias) and replacement (irregular patches to massive aggregates) styles are the nature of ore mineralization. Lead mineralizations are localized by both structural and lithostratigraphical controls.There are two occurrences of lead mineralization in the study area. Pb values range from 3.746% to 58.34%. The content of Zn ranges from 0.0% to 16.45%, Cu ranges from 0.0% to 0.024%, Ba ranges from 0.0% to 0.729% in the study area. Based on the geological, geochemical and mineralogical characteristics, the lead mineralizations in the study area are carbonate-hosted, stratabounddeposits, and epigenetic in origin and may be regarded as one of the sub-types of the Mississippi Valley-Type (MVT) deposits.

Introduction

Location, Size and Accessibility

The study area is located about 18 kilometres north of Heho and it is bounded by Latitudes 20°50´00´´N 20°52´30´´N and Longitude 96°46´10´´ E-96°48´40´´E. (UTM map sheet no. 2096/03, about 25 square kilometres). It can be accessible from Heho by motorcycle and motorcar. Location map of the study area is shown in figure 1

[1] Student, Geology Department, University of Yangon, Myanmar
[2] Associate Professor, Geology Department, University of Yangon, Myanmar

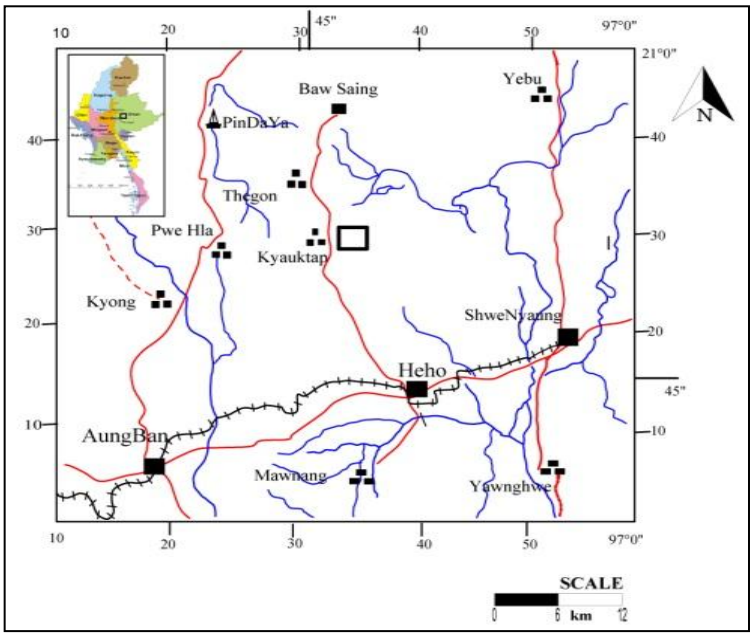


Figure 1 Location map of the study area, Kalaw Township, Shan State (South)

Scope and Objectives

The major purposes of the study area are to prepare fairly detailed geological map of the study area, determine the petrography of the rocks and study ore genesis and ore deposit type of lead mineralization in the study area.

Methods of Study

(1) Preliminary Study: Studies of previous literature on Kyauk tap area and its environs.

(2) Field Study: Systematic traversing, mapping, sampling and recording of rock units.

(3) Laboratory Techniques: Ore Microscopy and X-Ray Diffraction, X-Ray Fluorescence are used in this research.

Geology and Petrography

Regional Geology

Almost complete sequence of the Lower Paleozoic units are exposed in Kyauktap and its environs. (Figure 2)

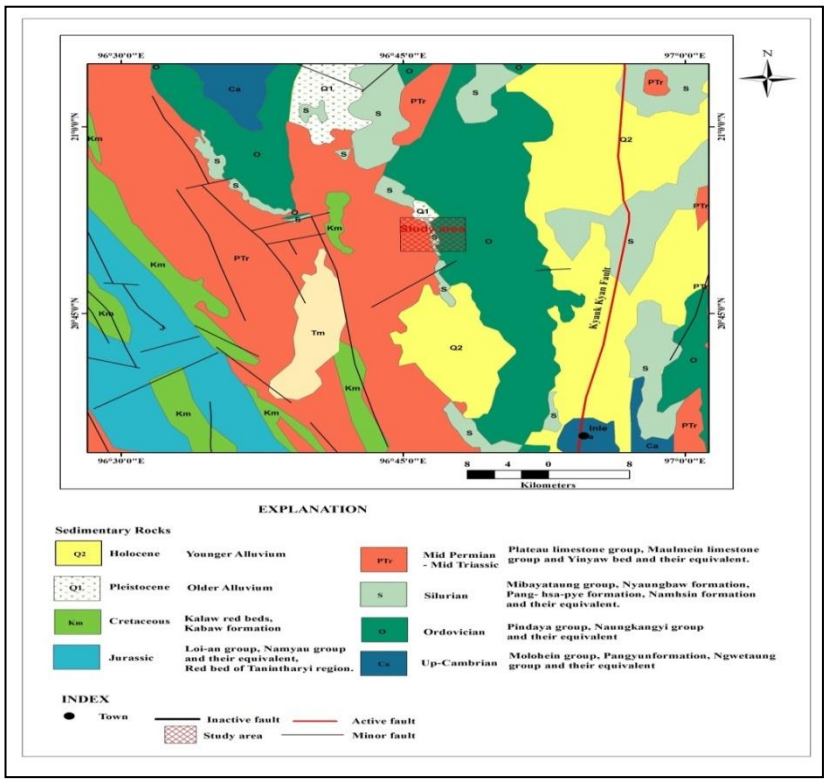


Figure 2 Regional Geological Map (Myanmar Geoscience Society, 2014)

Regional Geological Structure

Regionally, the structure of Bawsaing-Heho area is double plunging anticline (Myint Lwin Thein 1972). The investigated area is located on the western limb of south plunging anticline. The dip amount ranging from 27° to 37° on the eastern portion and on the western portion it varies from 37° to 50° because of tectonic movements, the faulting were developed. Regional structural map is shown in (Figure 3).

Table 1 Rock Unit Sequence of Regional and Environs of the Study Area (After Myint Lwin Thein, 1973 & Garson *et al*., 1976)

Group	Formation	Age
Plateau Limestone Group	Nattiek Formation	Middle Triassic
	Nwabangyi Dolomite Formation	Late Permian to Early Triassic
	Thitsipin Limestone Formation	Middle Permian
Unconformity		
Mibayataung Group	Taungmingyi Member	Late Silurian
	Wabya Formation	Late Silurian
	Linwe Formation	Early Silurian
Pindaya Group	Tanshauk Member	Late Ordovician
	Nan-on Formation	Late Ordovician
	Wunbye Formation	Middle Ordovician
	Lokepyin Formation	Early Ordovician
Molohein Group	Myet-ye Formation	Late Cambrian
	Pandaung Formation	Early Cambrian
Chaungmagyi Group		Precambrian

Geology of the study area

The study area is located in the nearly southern part of Bawsaing range. It is mainly comprises the Pindaya Group (Ordovician age) and Mibayataung Group (Silurian age). Sampale location map of the study area can be seen in Figure 4 and the geological map and cross section of the study area shows in Figure 5. The stratigraphic classification of the study area is adopted from Myint Lwin Thein (1973) for Lower Paleozoic rocks. In the study area, Wunbye Formation, Nan-on Formation of Pindaya Group, and Linwe Formation of Mibayataung Group were observed. Detailed stratigraphic succession of th present study area is shown in Table 2.

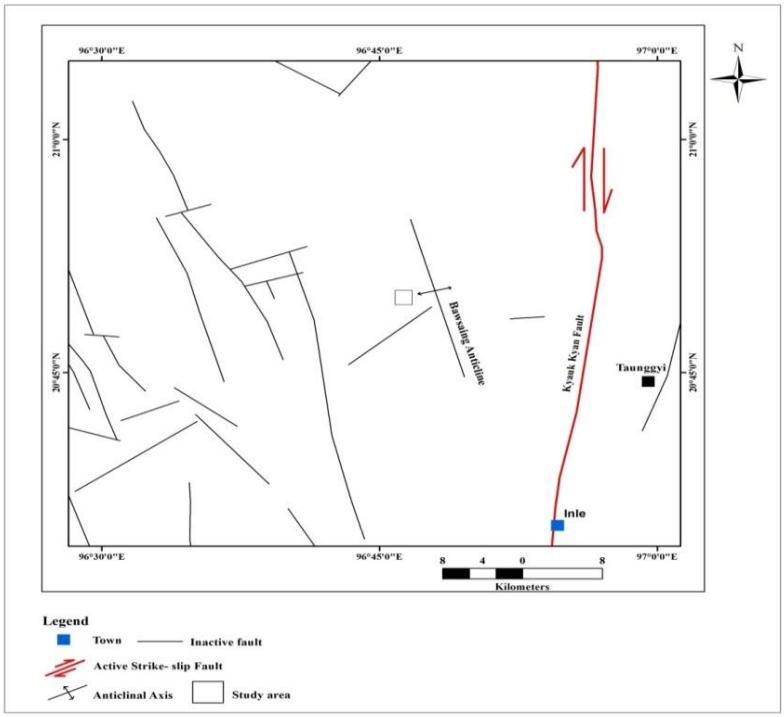


Figure 3 Regional Geological Structural Map (From Tectonic Map of Myanmar and Surrounding Regions, Soe Thura Tun, 2007)

Pindaya Group

Wunbye Formation (Middle Ordovician)

Fine grained, grey to dark grey coloured, massive limestones medium- to thick-bedded and with typical burrow structure are shown in Figure(6 &7).Hand specimen and thin section photomicrograph of oolitic- dolomitize grainstone is shown in Figure (8 & 9), dolomitic limestone in Figure (10 & 11), crystalline limestone in Figure (12 & 13), Oolitic-peloidal grainstone in Figure (14 & 15), Peloidal-bioclastic Wackestone in Figure (16 &17) and Micrite limestone in Figure (18 &19).

Nan- On Formation (Late Ordovician)

Yellow to buff, sub-indurated to soft, thin to medium bedded siltstones (Figure 20), mudstones and marlstones (Figure 21). Phacoidal limestone is shown is Figure (22 &23). Hand specimen of ferrugenious lime mudstone is shown in Figure 24 and its thin section photomicrograph (Figure 25).

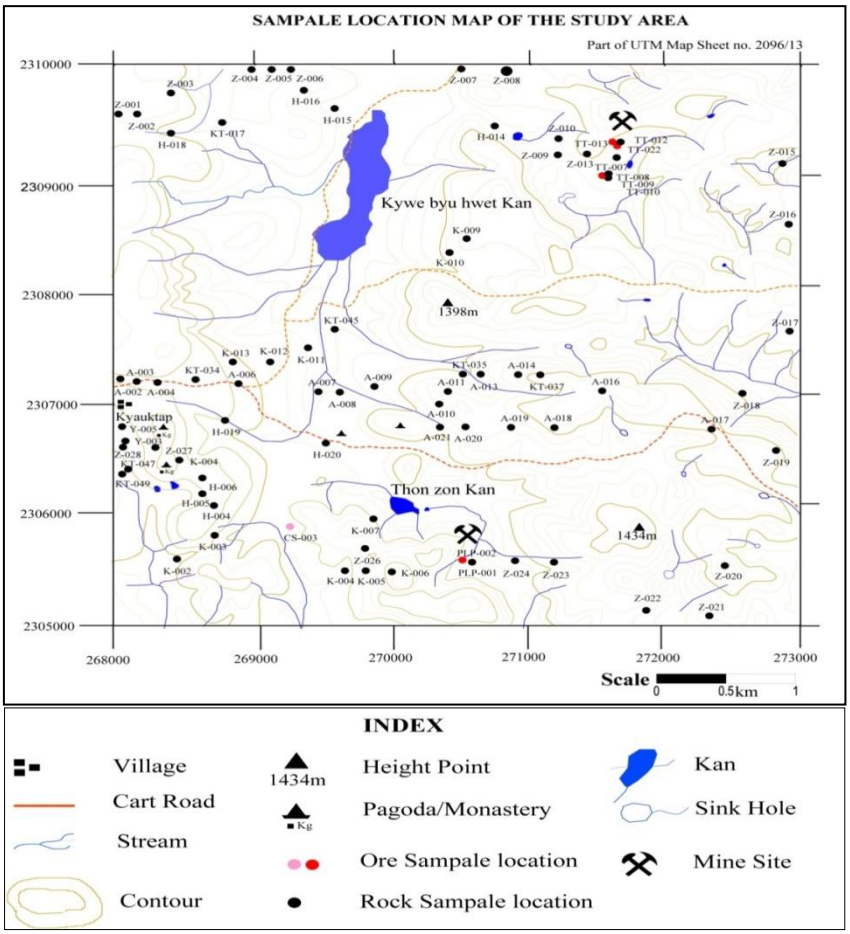


Figure 4 Sample location map of the study area

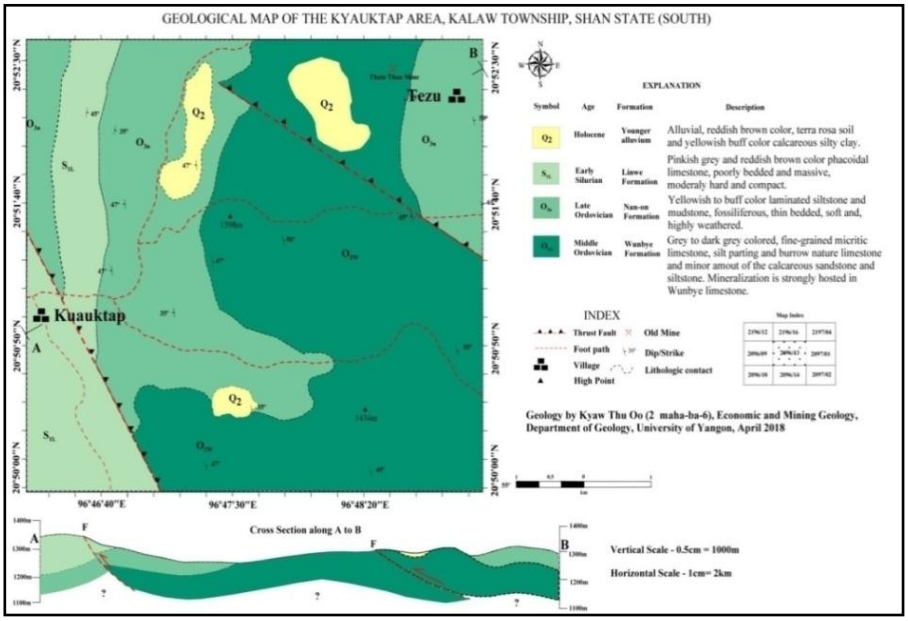


Figure 5 Geological map and cross section of the study area

Table 2 Detail stratigraphic succession of study area.

Group	Formation	Age	Lithology	Occurrence
MibayaTaung	Linwe	Early Siluriun	Pinkish grey and reddish brown colouredphacoidal limestone	West and southwest of the study area
Pyindaya	Nan-on	Late Ordovician	Yellow to buff coloured, liminated silt stone and mudstone	West, northwest and northeast of the study area
	Wunbye	Middle Ordovician	Grey to dark coloured, fine-grained to micritic, silt parting and burrow nature limestone and minor amount of the grain calcareous sandstone an silt stone	Central portion of the study area

Mibayataung Group

Linwe Formation (Early Silurian**)**

Purple, pink and grey color, phacoidal limestones, argillaceous limestones, calcareous mudstones and shale.

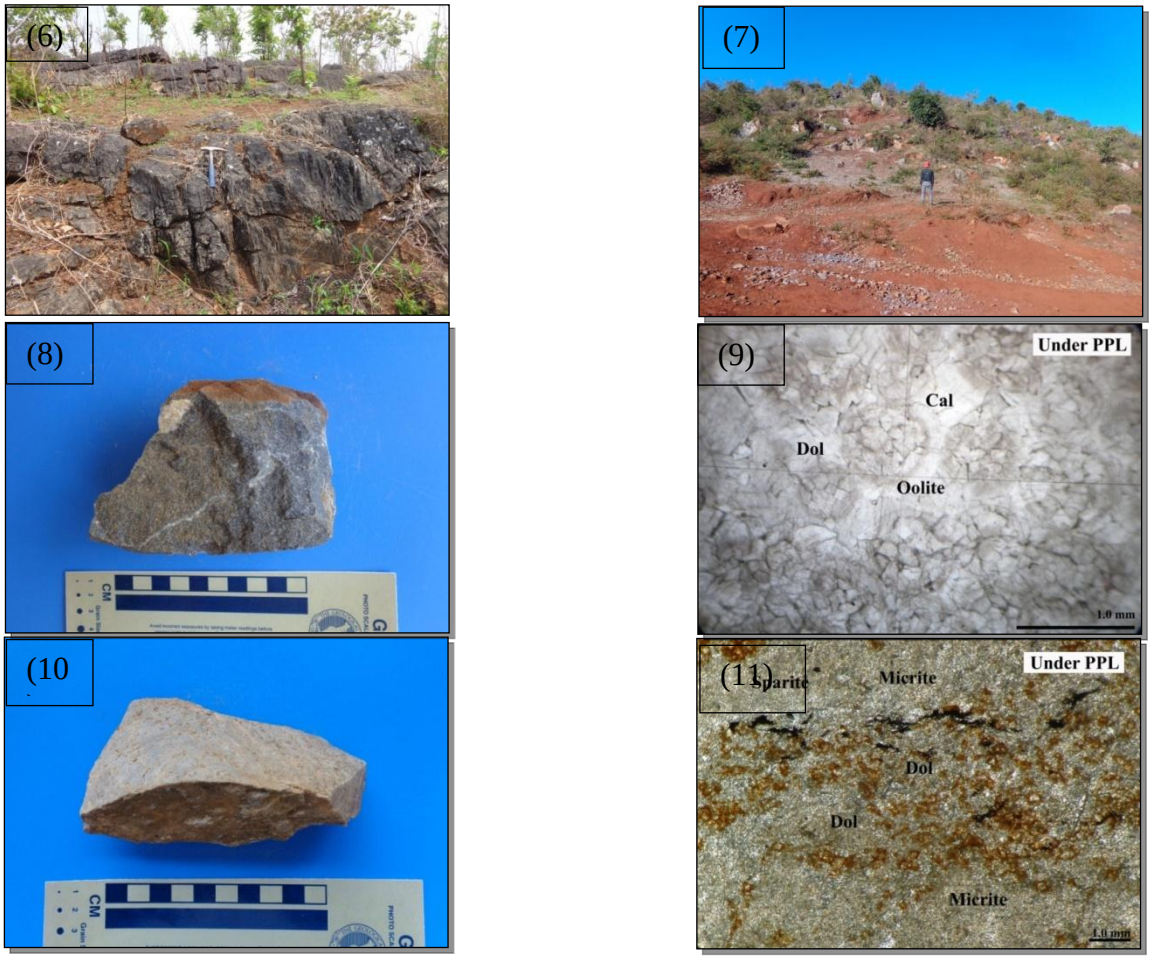


Figure 6 Light grey to dark grey, medium- to thick-bedded limestone, Location: 47Q 271074 E2307332 N, Facing 110°. Figure (7) Massive, finely crystalline, grey to bluish grey limestone, , Location: 47Q 269395 E 2309826 N, Facing 85° Figure (8)Medium - to thick-bedded, bluish grey limestone, Location: 47Q 269395E 2309826N. Figure(9) Oolitic-dolomitized grainstone , thin section photomicrograph of Sample No.KT-TT-017, Under PPL Figure(10) Medium to thick bedded, Pale yellow to reddish brown limestone Location: 47Q 270115 E2307313 N. Figure(11) Dolomitic limestone, thin section photomicrograph of Sample No.KT-TT-037 Under PPL

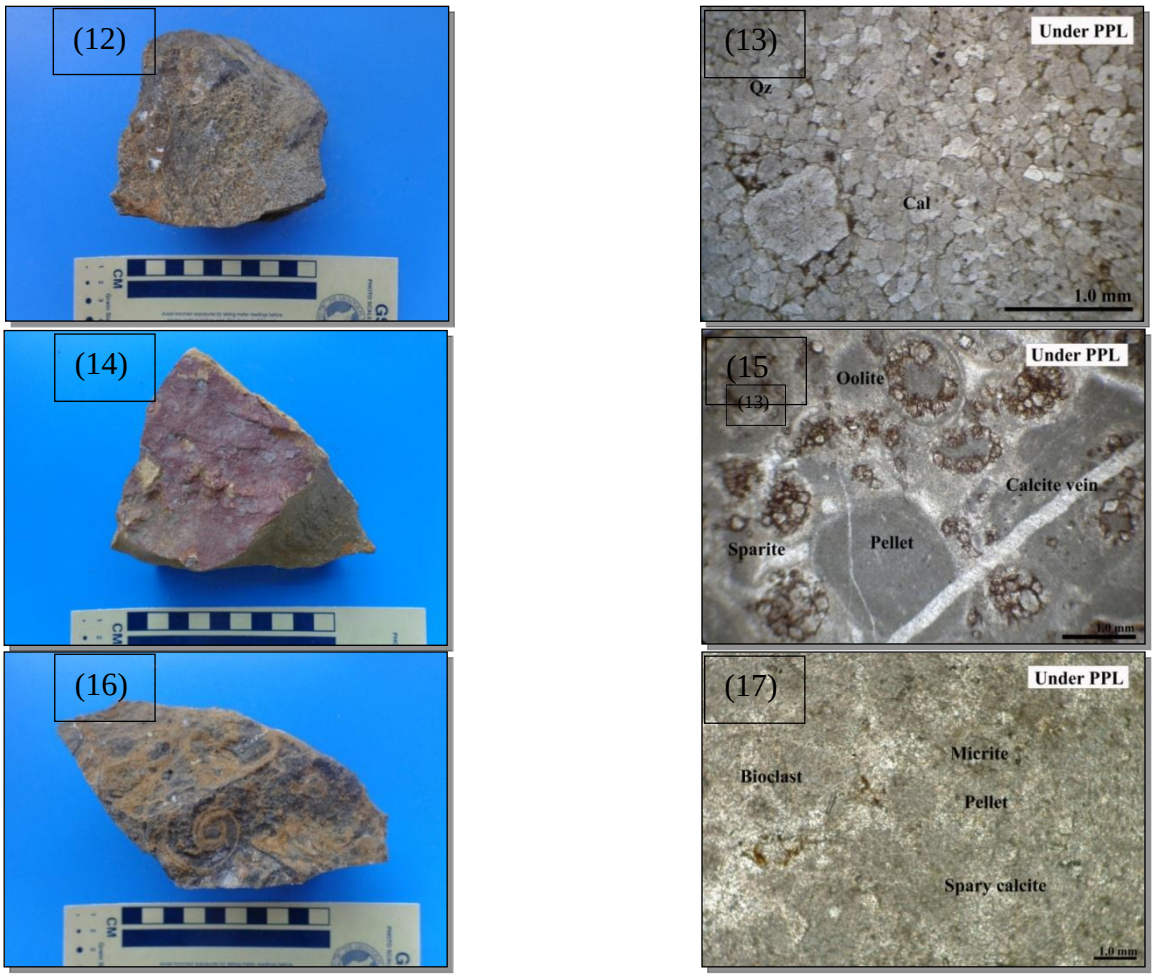


Figure 12 Medium to thick bedded, brown to dark grey limestone, Location: 47Q 269712 E 2307714 N Figure(13)Crystalline limestone, thin section photomicrograph of Sample No. KT-TT-045, Under PPL Figure(14) Medium to thick bedded, grey or blue grey limestone, Location: 47Q 270749 E 2307361 N Figure(15) Oolitic-peloidal grainstone, thin section photomicrograph of Sample No. KT-H- O35 Under PPL. Figure(16) Medium- to thick-bedded, grey or darkgrey limeatone, Location: 47Q 268743 E 2307301 N. Figure(17) Peloidal-bioclastic Wackestone , thin section Photomicrograph of Sample No. KT-H-O34 Under PPL

Figure 18 Medium- to thick-bedded, grey or dark grey limestone, Location: 47Q 267913 E 2306622 N Figure(19) Micrite, thin section photomicrographs of Sample No.KT-H-047 Under PPL Figure(20) Poorly bedded siltstone, Location; 47Q 268098 E 2307305 N , Facing 340° Figure(21) Thin bedded marlstone, Location: 47Q 268585E 2306268 N, Facing 55° Figure(22) Grey phacoidal limestone, Location: 47Q 268105 E 2308424 N Facing 270° Figure(23) Phacoidal limestone near Kyauktap village Location:47Q 268584E 2306327 N Facing 55°

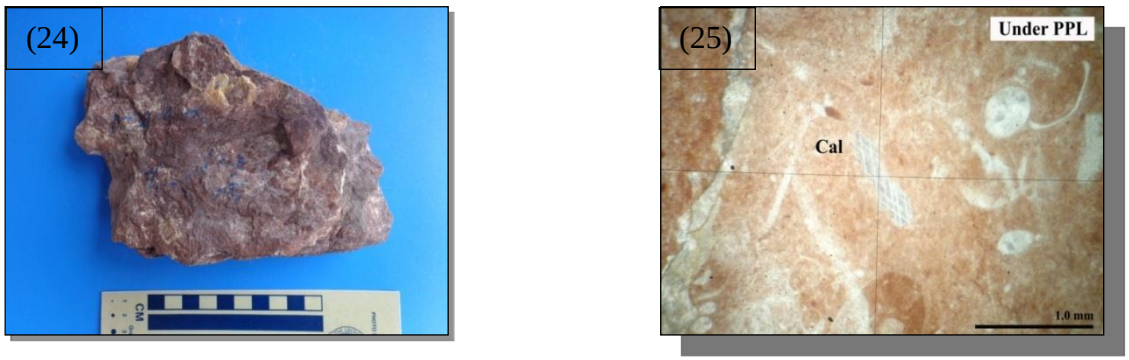


Figure 24 Massive, and grey, pink and purple limestone, Location: 47Q 268150 E 2308424 N Figure(25) Ferrugenious lime mudstone, thin section photomicrograph, Sample No.KT-H-049Under PPL

Alteration

There are two type of alteration; dolomatization (Figure 26 A & B)and silicification (Figure 27 A & B), the former one is mainly occured and the latter is occured as subordinately. Sulphide mineralization is post-date the wallrock alterations.

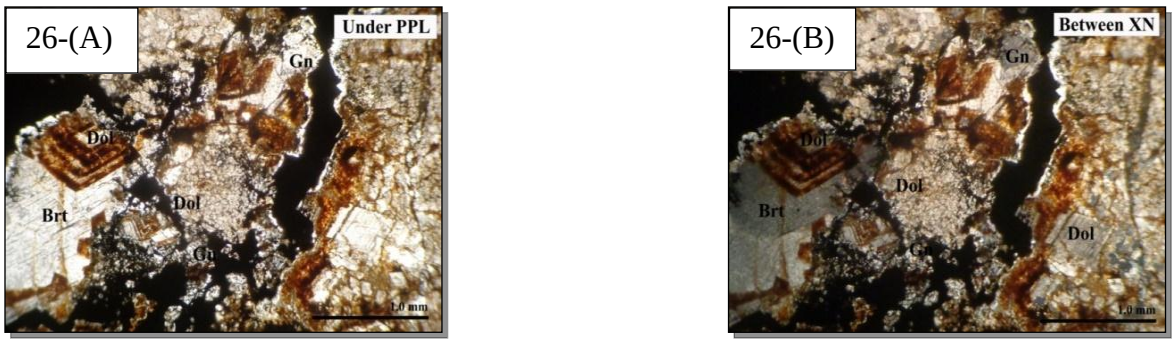


Figure 26 Thin section Photomicrographs showing dolomitization with Pb mineralization Under PPL & Between XN (Dol= Dolomite, Gn= Galena, Brt=Barite)

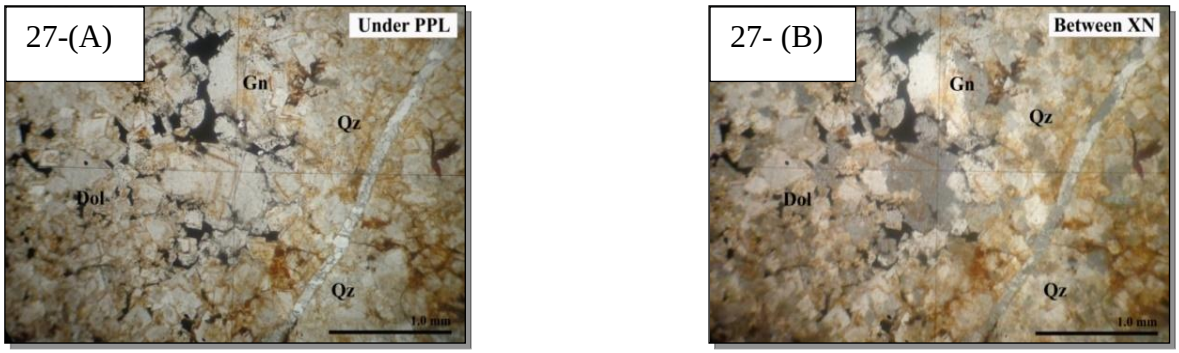


Figure 27 Thin section Photomicrograph showing silicification with Pb mineralization (Under PPL & Between XN) (Dol=Dolomite, Gn=Galena, Qz= Quartz)

Mineralization

`There are three occurrences of lead mineralization; Thein Than lead occurrence and Pyae Hlan Paing lead occurrence, they are mainly produced lead sulphide ore (Galena-PbS) and Myae Ni Taung lead occurrence (Figure 30), which is produced lead carbonate ore (Cerussite-$PbCO_3$). The mineralization mainly occured as veinlets (fracture filling) and disseminated in the host rock are shown in (Figure 28, 29 & 31).The major ore mineral is galena and associated minerals are sphalerite, pyrite, anglesite, covellite and little or no amount of argentite.

Mineralization style

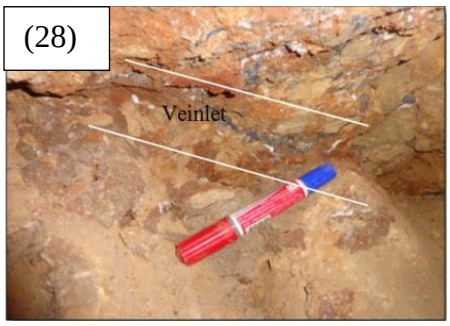


Figure 28 Fracture filling of Pb veinlets in host dolomitic limestone (Thein Than Occurrence)

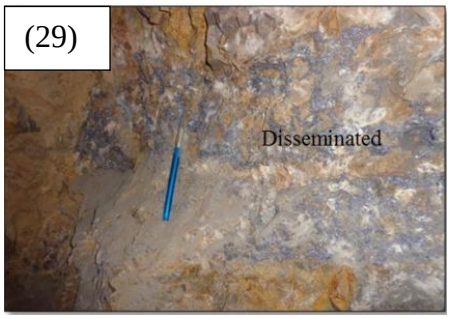


Figure 29 Disseminated Pb mineralization in host rock (Thein Than Occurrence)

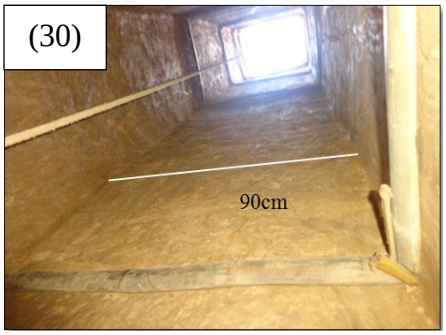


Figure 30 Myae Ni Taung artisinal mine (vertical shaft)

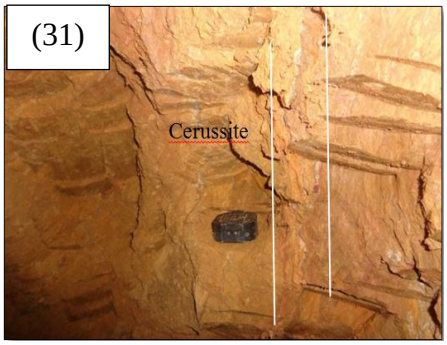


Figure 31 Disseminate or aggregate of lead carbonate (Myae Ni Taung Occurrence)

Ore Mineralogy

Galena (PbS)

It is the most common lead ore mineral and constantly associated with sphalerite and at some places with barite. In hand specimen, it shows cubic form and occurs as fine grained aggregate crystal with lead grey to silvery colour and shows submetallic lusture. Under microscope, it exibits bright white colour and numerous triangular pits and absence of internal reflection(Figure 32 A & B).

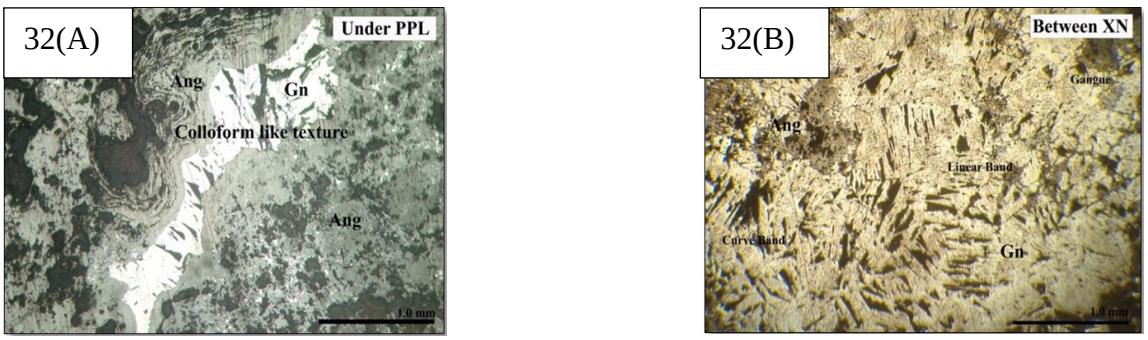


Figure 32 (A)Photomicrograph showing Galena ore (Gn=Galena,Ang=A nglesite),Under Reflected Light, (B) Between X.N.

Anglesite ($PbSO_4$)

Under ore microscope anglesite shows pale grey colour and situated along the crack and cleavage of galena. It is occasionally found in place, as a result of oxidation of lead sulphide to lead oxide and then galena has been replaced by anglesite with curving inward texture. (Figure 32 A)

Sphalerite (ZnS)

Under microscope sphalerite is observed by its gray colour with brown tint and yellowish brown to reddish brown internal reflection. It occurs as irregular anhedral masses in galena and other gangue minerals. It is harder than galena recognize by its higher relief in polish section. (Figure 33)

Pyrite (FeS_2)

It occurs in the main mineralized zone as tiny isolated crystals with subhedral to anhedral form in galena and host rocks. The earliest pyrite was probably formed during the late diagenesis of the host rock and late pyrite was formed during the hydrothermal stage associated with the galena and sphalerite mineralization. It can be distinguish by its reflectance, polishing hardness and its yellowish colour. (Figure 34)

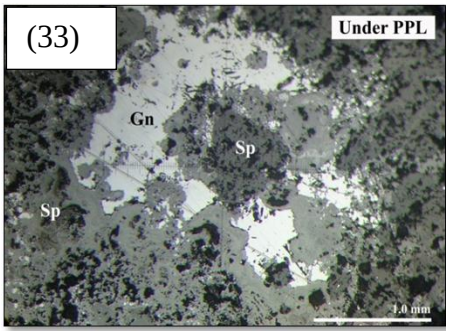


Figure 33 Photomicrograph showing Sphalerite with galena (Gn=Galena, Sp=Sphalerite), Under Reflected Light

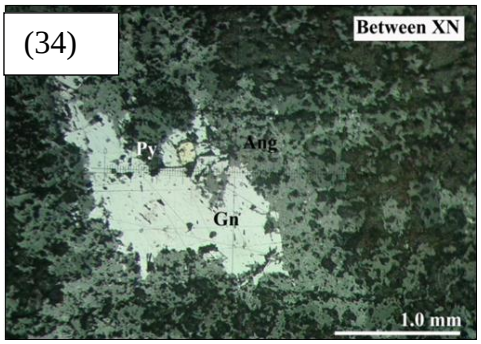


Figure 34 Photomicrograph showing subhedral to anhedral pyrite (Py=Pyrite, Gn= Galena) Under Reflected Light

Chalcopyrite ($CuFeS_2$)

It is a iron copper sulfide mineral and has brassy to goldern yellow colourd. It is hard to see in hand specimen. Under ore microscope, it shows yellow coloured and its reflectance is less than that of pyrite. (Figure 35)

Covellite (CuS)

It is altered from chalcopyrite as a result of oxidation and shows indigo blue colour and at some portion it is partially mixed with chalcopyrite. (Figure 36)

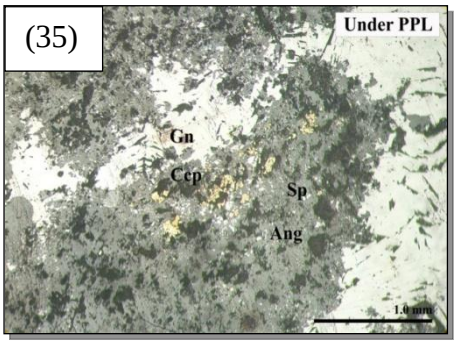


Figure 35 Photomicrograph showing Yellowish coloured chalcopyrite mineral in the lead ore (Gn=Galena, Sp=Sphalerite, Ccp=Chalcopyrite, Ang=Anglesite) Under Reflected Light

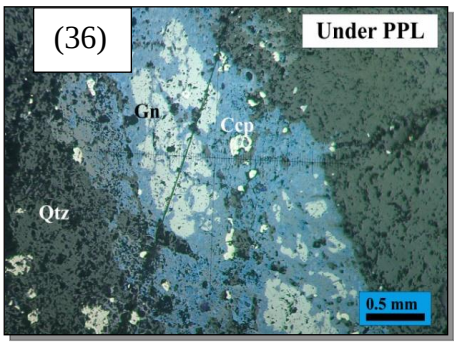


Figure 36 Photomicrograph showing indico blue coloured covellite mineral in the lead ore. (Gn=Galena, Ccp=Covellite, Qtz=Quartz) Under Reflected Light

Paragenesis

Mineral	Early	Middle	Late
Pyrite	———	———	
Chalcopyrite	———	———	
Sphalerite	———	———	
Galena	———	———	
Covellite			———
Anglesite			———
Cerussite			———

Geochemical Investigation

Seven representative ore samples are collected from Thein Than lead occurrence and these sample were tested by X-Ray Fluoresence (XRF) analysis method. These results from geochemical analysis were treated by geostatistical software and the following dendrogram is constructed by weight pair group method.

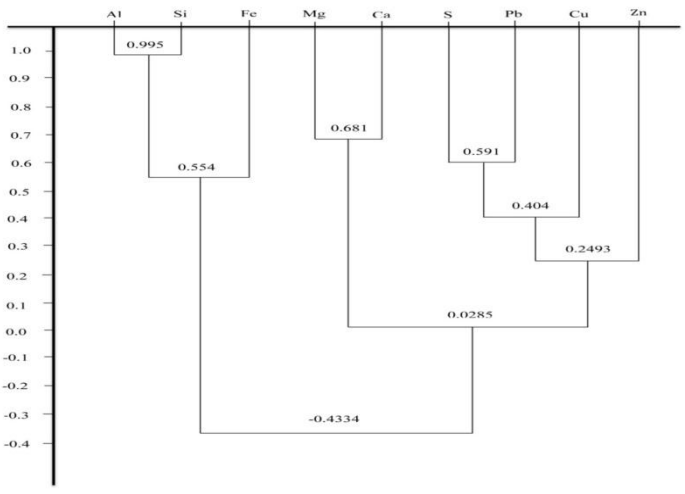
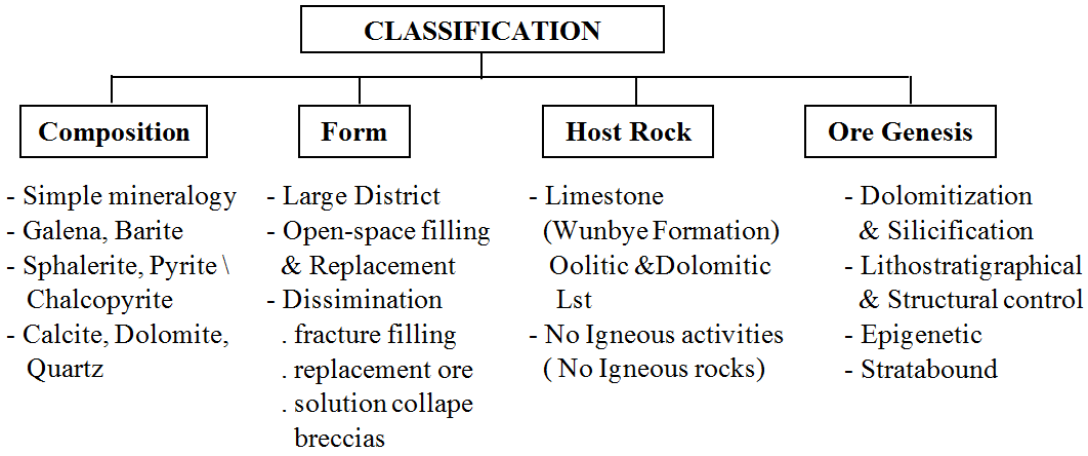


Figure 36 Dendrogram constructed by weighted pair group method

Ore Deposit type of Kyauktap Area



-

Due to all the above deposit features, the type of ore deposits is Carbonate-hosted, stratabound deposits and epigenetic in origin one of the sub-types of the Mississippi Valley-Type (MVT) deposits

Summary

The study area, Kyauktap is situated about 18 kilometer north of Heho, Taunggyi District, Shan State (South). The covering area is approximately 25 square kilometers. Regionally, it is situated in the southwestern part of Shan Plateau. The major structure, Bawsaing Range, regarded as a south-plunging anticline where the Precambrian rocks of Chaungmagyi Group are surrounded by Early Paleozoic rocks. The study area comprises the Pindaya Group of Ordovician age (Wunbye, Nan-on Formations) and Mibayataung Group of Silurian age (Linwe Formations). The ore occurrences have simple mineralogy that consists of galena, barite, sphalerite, pyrite, chalcopyrite, covellite and anglesite with little or no amounts of argentite. Dolomite, calcite and quartz are gangue minerals. Lead mineralization is spatially hosted by oolitic and dolomitic limestones. Texture of sulphide minerals are mostly related to open-space fillings of breccias, fractures and vugs and replacement of carbonate host rocks. Wallrock alterations took place after the formation of the carbonate host rocks mainly as dolomitization and silicification as subordinate process. They definitely predate the ore mineralization. So that the ore deposits are epigenetic in origin. The ore deposits occurred in the zones of highly brecciated dolomite, collapse breccias, bedding planes, faults and fractures, and these zones are arranged in linear patterns. Both structural controls and lithostratigraphical controls are important parametres for lead mineralization. Therefore they are stratabound deposit type. There is no igneous rocks and igneous activities in and around the ore deposits in the study area, so these ore mineralization cannot be attributed by magmatic ore forming process. As a result of above finding and reliable conclusions, the lead mineralization in the study area is carbonate hosted, stratabound deposit and epigenetic in origin and most probably belong to one of the sub-type of the Mississippi Valley-Type (MVT) deposit.

Acknowledgements

I would like to acknowledge all the respectful teachers of Department of Geology, University of Yangon. I would like to thanks deeply the members, who helps me in the literature review work, field work and drawing and applying geological software.

References

Aung Than (2013): *Occurrence of Lead Mineralization in Shwe Taung-Yebok Area, Ywangan Township, Shan State (South)*, MSc Thesis, Department of Geology, University of Yangon. (Unpublished). 148p

Hnin Min Soe, (2008): *Economic Geology of North Ywangan Township, Taunggyi District, Shan State (South), Myanmar*, PhD Dissertation, Department of Geology, University of Yangon. (Unpublished). 168p.

Myint Lwin Thein, (1979): "Barite and Galena Occurrences in the Ordovician Rocks of the Western part of the Shan Plateau", A paper read at Burma Research Congress.

Thein Min Swe, (2017): Occurrence of Lead Mineralization in the Mogyo Taung, Thapanbin Area, Ywangan Township, M.Sc. Thesis, Department of Geology, University of Yangon. 89p