GEOLOGY AND ORE GENESIS OF LEAD-ZINC-COPPER MINERALIZATION IN MYINHE TAUNG -YASAGYI AREA, YWANGAN TOWNSHIP, SHAN STATE (SOUTH)

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Abstract

Myinhe Taung-Yasagyi area is located about 35 km southeast of Ywangan Township, Taunggyi District, Shan State (South). Regionally the study area mainly composed of sedimentary rocks of the Pindaya Group (Wunbye Formation) of Ordovician age, Mibayataung Group (Linwe Formation) of Silurian age and Plateau Limestone Group (Nwabangyi Formation) of Mid-Permian-Triassic. The Ganaingya fault is the major structure which is trending nearly NW-SE. The present research work involves the carbonate rocks of the Wunbye Formation (Middle Ordovicain age) which hosts the lead-zinc-copper ore mineralization. In the study area, four lead-zinc-copper prospects are associated with the dolomitic limestone of Wunbye Formation. The lead sulfide mineralization is confined to the carbonate rocks of Wunbye Formation. The wallrock alteration zones are narrow, with dolomitization as the main alteration, and silicification as subordinate, which happen after the ore mineralization. The ore mineralogy is relatively simple where galena and barite form major constituents with minor amounts of sphalerite, pyrite, chalcopyrite, tetrahedrite , covellite, malachite and azurite. The gangue minerals are calcite, dolomite and quartz. Open-space fillings and replacement (irregular patches to massive aggregates) nature of ore mineralization are present. The lead-zinc-copper mineralization is localized by both structural and lithostratigraphical controls. Lead values range from 0.108% to 34.22% in Myinhe Taung near Yasagyi village. The contents of zinc range from 0.009% to 1.337%, copper ranges from 0% to 7.164% and barite ranges from 0% to 41.82% in the study area. Based on the geological, geochemical and mineralogical characteristics, the lead sulphide mineralizations in the study area are carbonate-hosted, stratabound, and epigenetic in origin and may be regarded as one of the sub-type of the Mississippi Valley-Type (MVT) deposits.

Keywords: Wunbye Formation, carbonate-hosted stratabound deposit, Mississippi Valley-Type

Introduction

Location, Size and Accessibility

The study area is located about 35 kilometres southeast of Ywangan and it is bounded by Latitudes 20°56´16´´N 20°59´04´´N and Longitude 96°34´32´´ E-96°36´51´´E. (UTM map sheet no. 2096/09, about 20 square kilometres). Location map of the study area is shown in figure 1.

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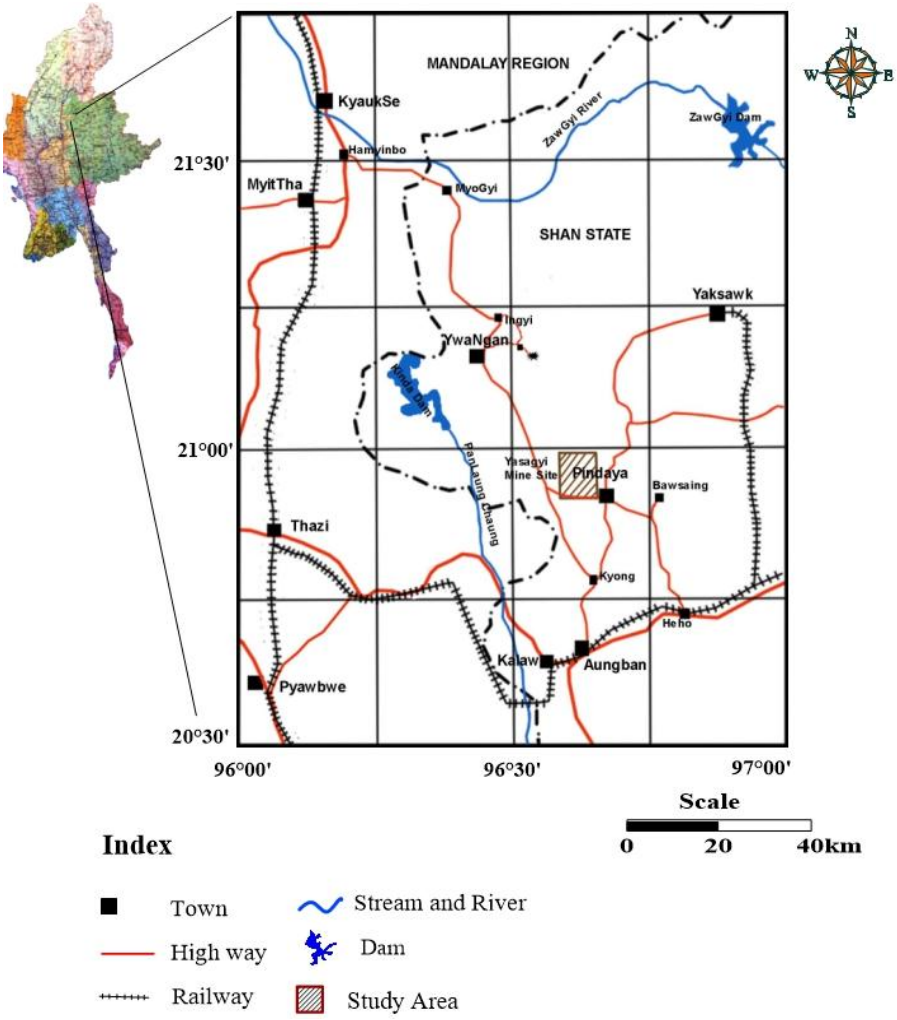

Figure 1 Location map of the study area, Ywangan Township, Shan State (South)

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-zinc-copper mineralization in the study area.

Methods of study

(1) Preliminary Study: Studies of previous literatures on Myinhe Taung-Yasagyi area and its environs.

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

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

Geology and Petrography

Regional geology

Almost complete sequence of the Lower Paleozoic units are exposed in Myinhe Taung-Yasagyi area and its environs. (Figure 2)

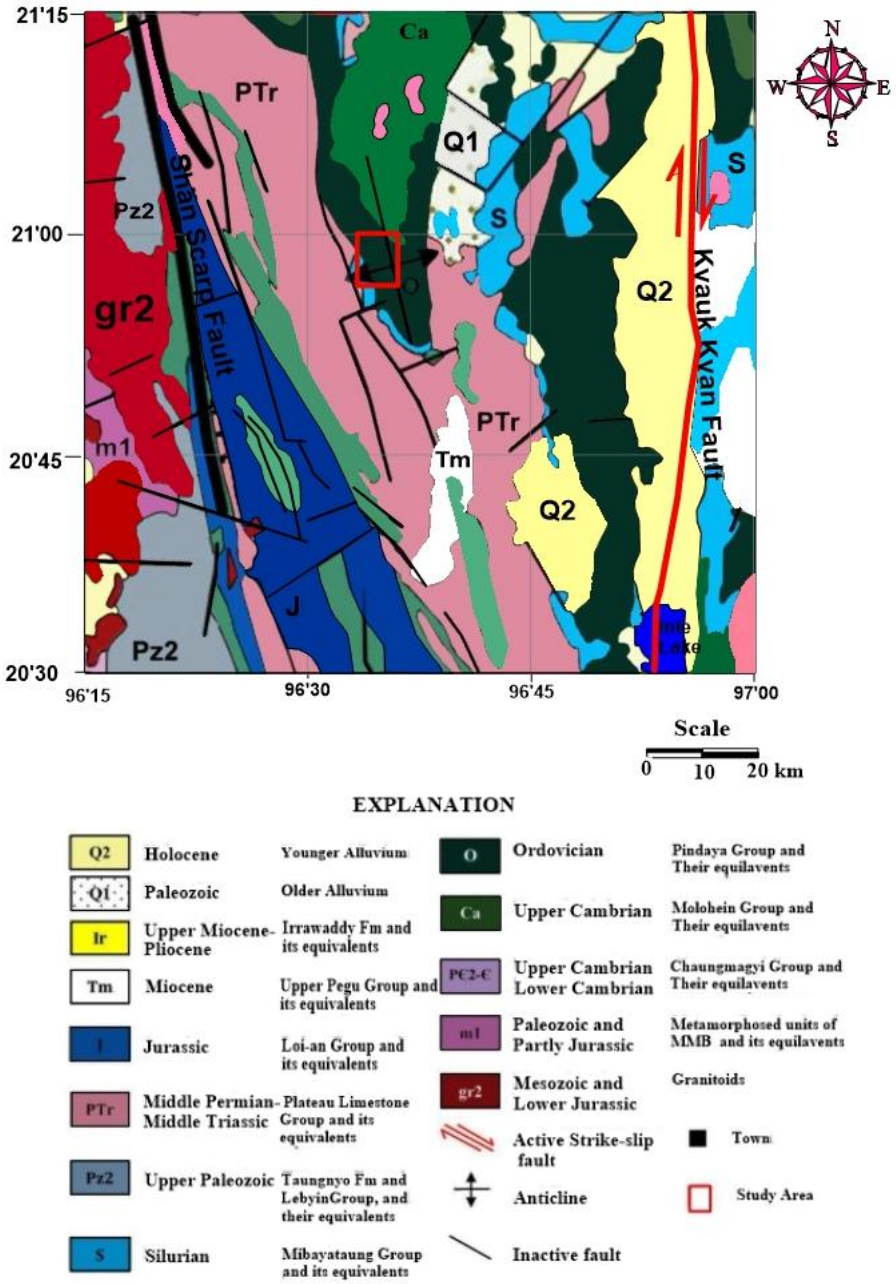

Figure 2 Regional Geological Map (MyanmarGeoscience Society, 2014)

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

Regional geological structures

The investigated area is located on the western limb of south plunging anticline. The prominent faults are Shan Scarp Fault and Kyaukkyan Fault. They are trending N-S to NNW-SSE direction, that is more or less parallel to regional trend of the rock units. The other faults are trending NE-SW direction, E-W direction and NW-SE direction. **(**Table 1)

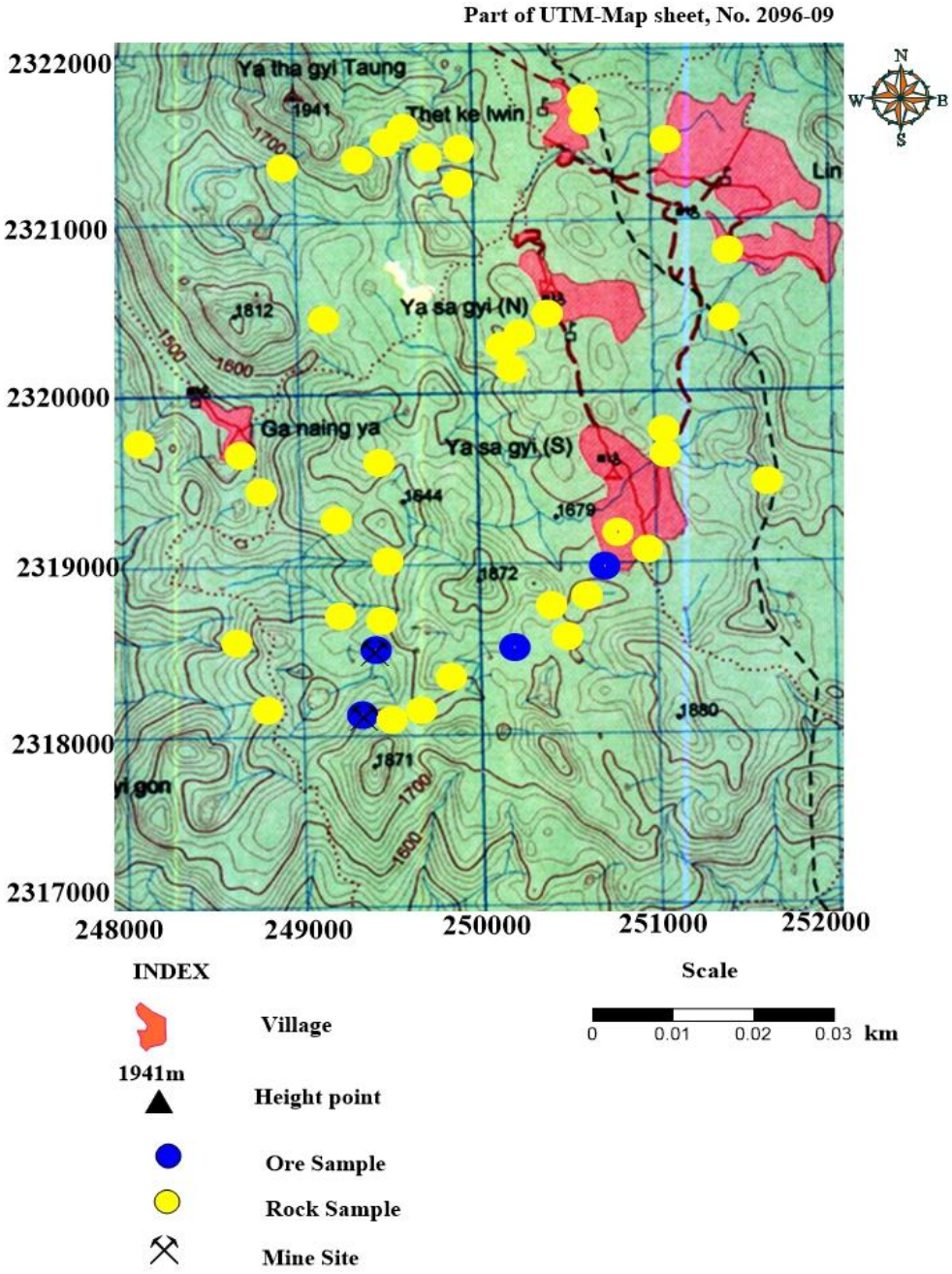

Figure 3 Sample location map of the study area

Geology of the study area

The study area is located in the nearly western part of Pindaya anticline. 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 MyintLwinThein (1973). In the study area, Wunbye Formation of Pindaya Group, Linwe Formation of Mibayataung Group and Nwabangyi Formation of Plateau Limestone Group were observed. Detailed stratigraphic succession of the present study area is shown in Table 2.

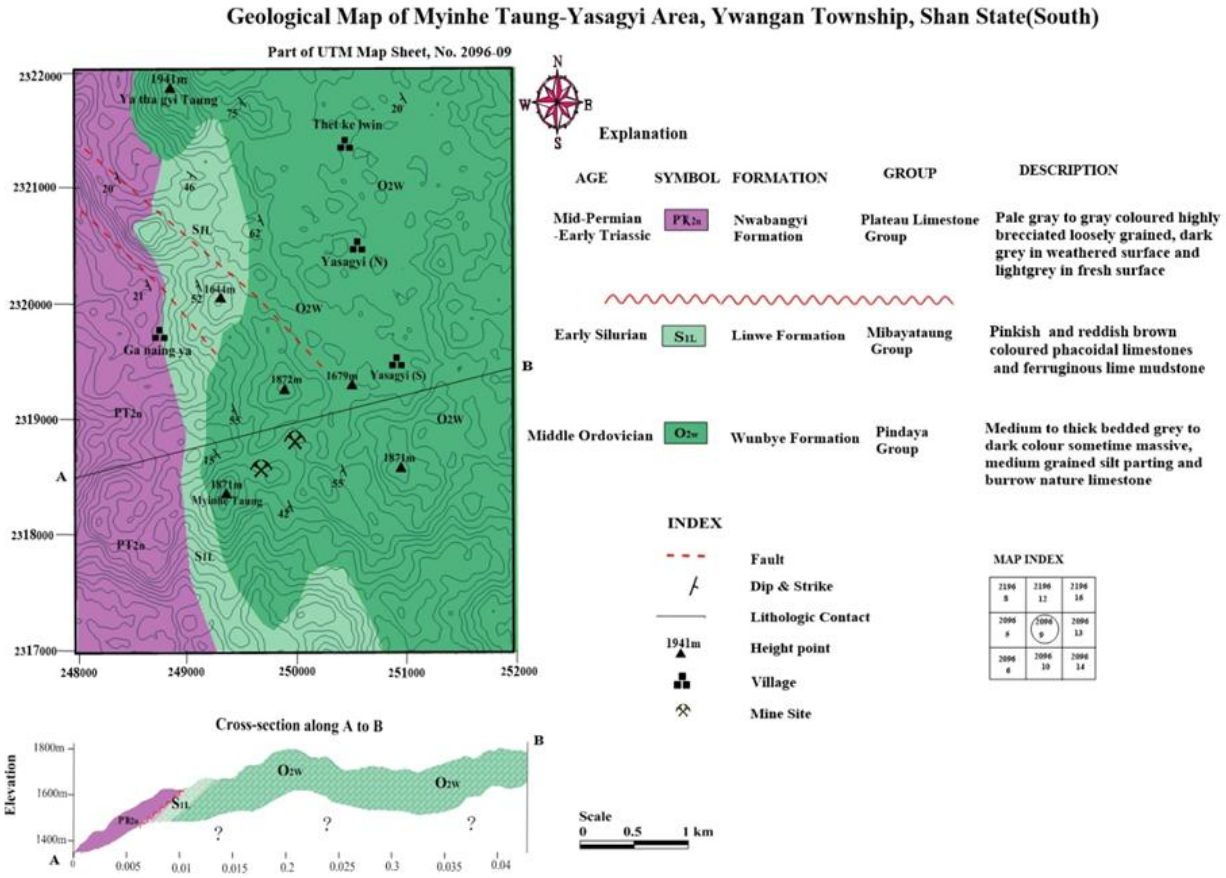

Figure 4 Geological map and cross section of the study area

Table 2 Detail stratigraphic succession of study area.

No	Group	Formation	Age
3	Plateau Limestone Group	Nwabangyi Formation	Middle Permian to Early Triassic
	Unconformity		
2	Mibayataung Group	Linwe Formation	Early Silurian
1	Pindaya Group	Wunbye Formation	Middle Ordovician

Pindaya Group

Wunbye Formation *(Middle Ordovician)*

Fine grained, grey to dark grey coloured, medium to thick-bedded and massive limestones with typical burrow structure shown in Figure 5 & 6. Rhomb shape dolomite mineral in dolomitc limestone is shown in Figure 8. Hand specimen of dolostone and coarse-grained crystalline texture (PPL) are shown in Figure 9 & 10.

Figure 5 Outcrop nature of limestone (Wunbye Formation, Location: 47Q 0250175 E 2320339 N

Figure 6 Outcrop nature of thick-bedded limestone, Location: 47Q 0249701 E 2321482N

Figure 7 Hand specimen of reddish brown limestone, Location: 47Q 0249887E 2318333N

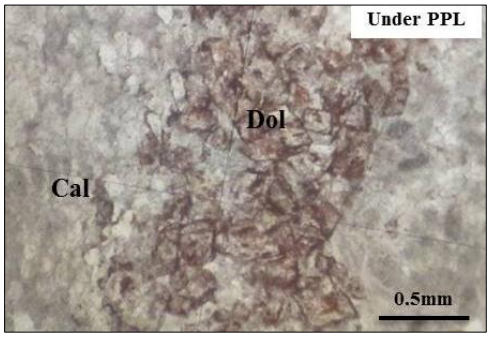

Figure 8 Photomicrograph of rhomb shape dolomite mineral in dolomitc limestone, Sample No.YSG-R-10

Figure 9 Hand specimen of dolostone, Location: 47Q 0250127E 2320220N

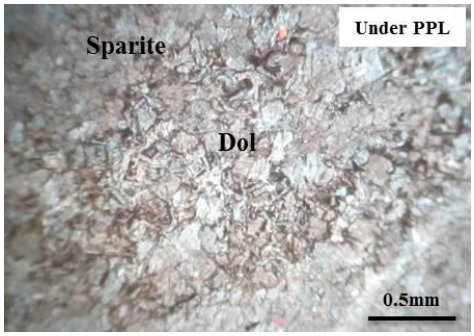

Figure 10 Photomicrograph of medium to coarse-grained crystalline texture, Sample No.YSG-R-17

Figure 11 Hand specimen of Limestone (Wunbye Formation), Location: 47Q 0249701E 2321482N

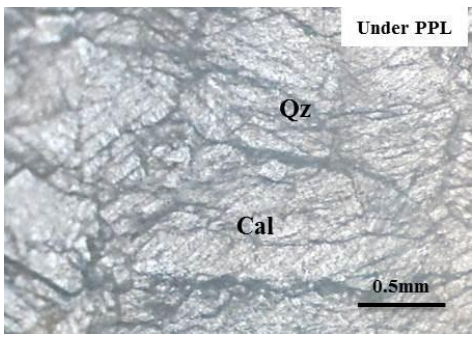

Figure 12 Photomicrograph showing 80% of crystalline calcite grains, Sample No.YSG-R-27

Figure 13 Hand specimen of Limestone (Wunbye Formation), Locati on: 47Q 0249201E 2321582N

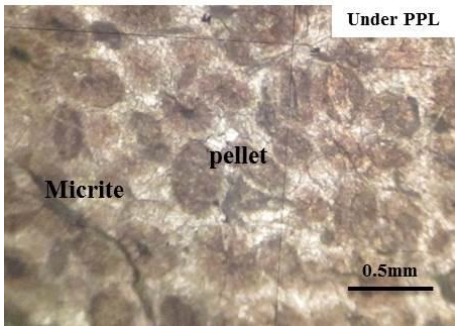

Figure 14 Photomicrograph showing dolomite and a minor amount of pellet, Sample No.YSG-R-33

Figure 15 Hand specimen of Limestone (Wunbye Formation), Location: 47Q 0250395E 2318573N

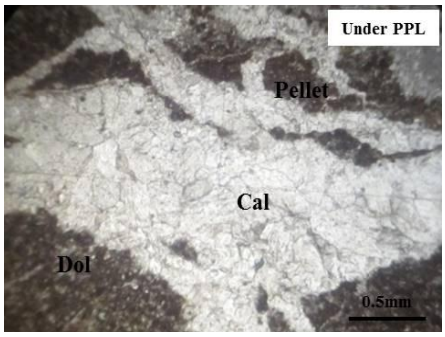

Figure 16 Photomicrograph showing subrounded shape of pellets or peloids, Sample No.YSG-R-7

Minor amount of pellet and subrounded shape of pellets or peloids under PPL are shown in Figure 14 &16. Hand specimen of pink and purple limestone and *Ostracod* funnas inferruginous lime mudstone (Linwe Formation) are shown in Figure 17&18.

Mibayataung Group

Linwe Formation (early Silurian**)** Purple, pink and grey color, phacoidal limestones, ferruginous lime mudstones are exposed near the monastery of Ganaya village.

Figure 17 Photograph showing hand specimen of pink and purple limestone (Linwe Formation) Location: 47Q 249064E 2320456N

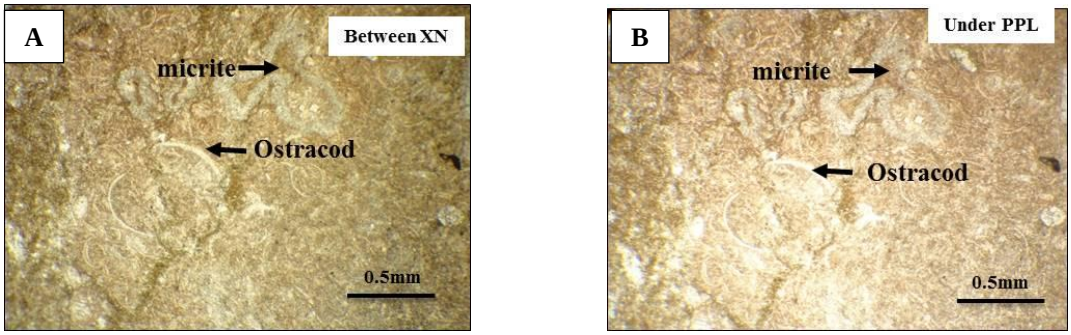

Figure 18 Photomicrograph of ferruginous lime mudstone (A and B) showing *Ostracod* funnas inferruginous lime mudstone (Linwe Formation), Sample No.YSG-R- 54

Nwabangyi Formation

Petrographic classification of limestone used in the present study are adopted from Dunham (1962). Hand specimen of dolomitie (Nwabangyi Formation) and its subhedral to euhedral with planar boundries (Nwabangyi Formation) are shown in Figure 19(A/B) & 20(A/B).

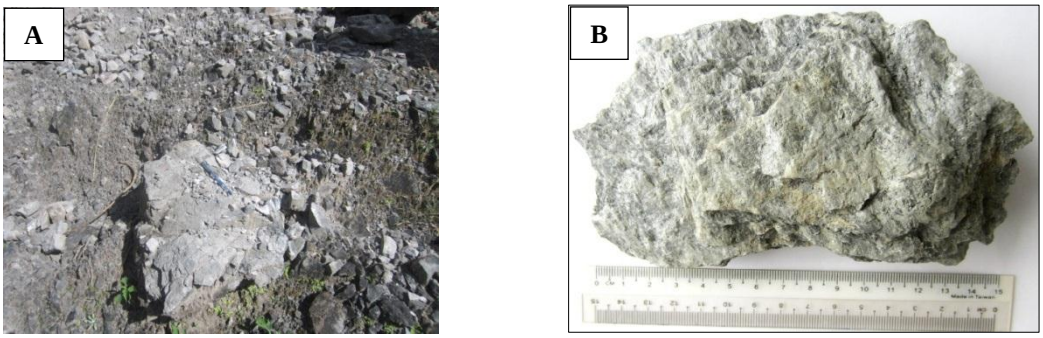

Figure (19-A/B) Photograph showing hand specimen of dolomitie (Nwabangyi Formation), Location: KD 488 182

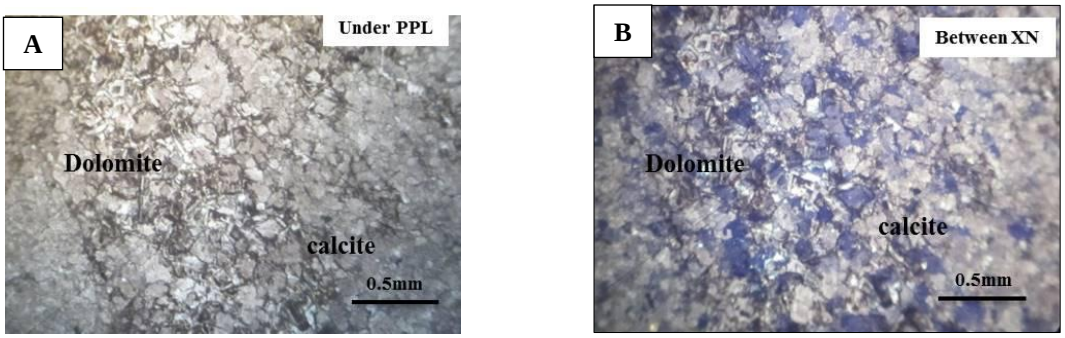

Figure 20 Photomicrograph of dolomite (A and B) showing subhedral to euhedral with planar boundries (Nwabangyi Formation), Sample No. YSG-R- 61

Alteration

In the study area, main host rock is limestone. By the field observation and microscopic study, the dominant alteration is dolomitization accompanied by minor silicification. Dolomitization with Pb mineralization (Thin section) is shown in Figure 21(A /B). Silicification with Pb mineralization (Thin section) is shown in Figure 22(A /B).

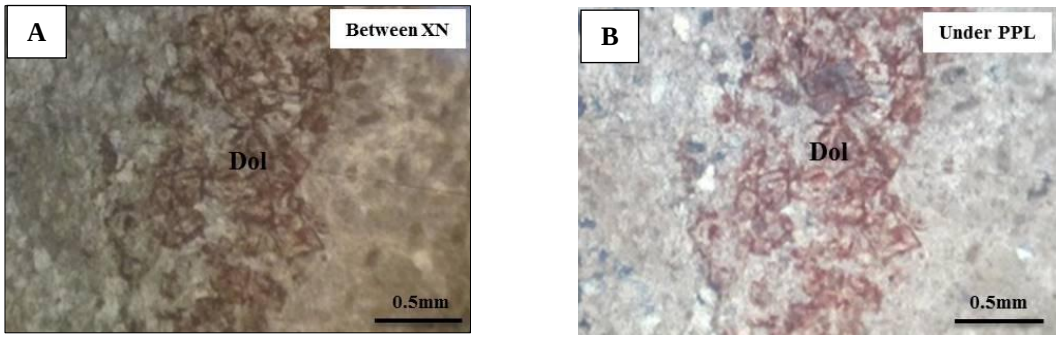

Figure 21 Photomicrograph showing dolomitization (A and B) with Pb mineralization (Thin section) (Dol= Dolomite)

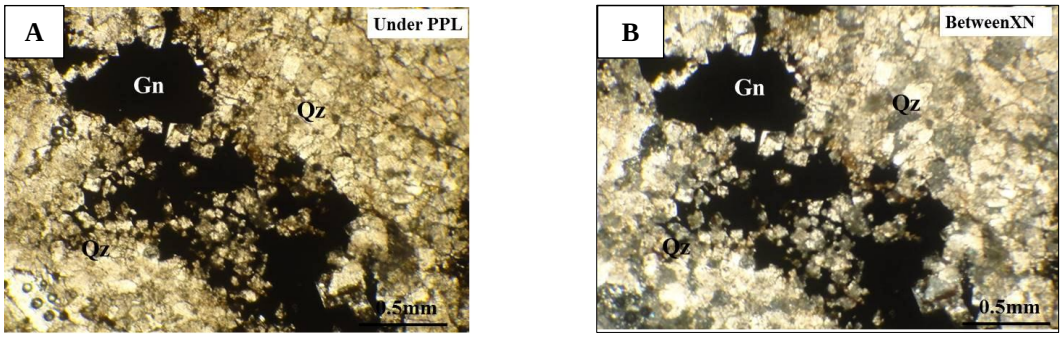

Figure 22 Photomicrograph showing silicification (A and B) with Pb mineralization (Thin section) (Gn= Galena, Qz= Quartz)

Mineralization

In the study area lead and copper ore mineralization can be found at two localities.; Myinhe Taung Lead and Copper Occurrences, they are mainly produced lead sulphide ore (Galena-PbS) and lead carbonate ore (Cerussite-$PbCO_3$). Yasagyi Copper Occurrences;which consist of azurite and malachite minerals found on the rock surface. In the study area, main copper ore are tetrahedrite.

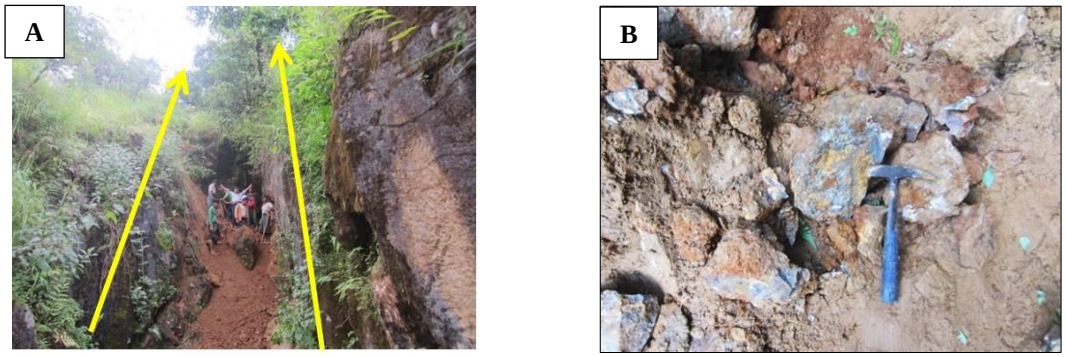

Figure 23 Photograph showing long trench Mine site-1(A and B) (facing NE) at Myinhe Taung; Location 47Q 249350E 2318199N

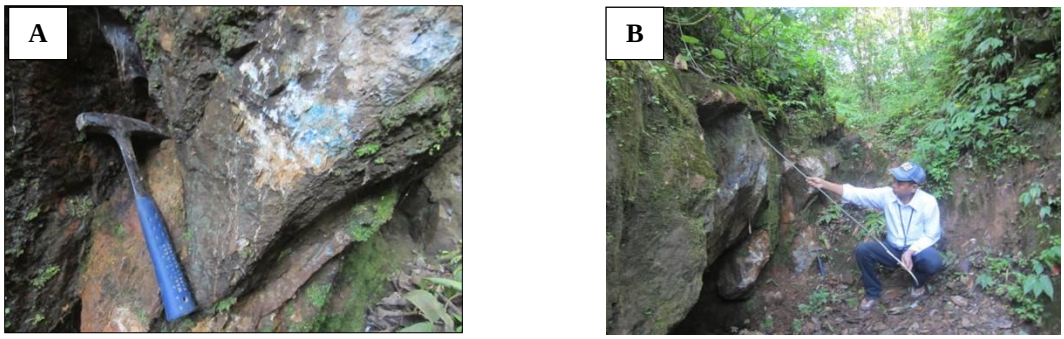

Figure 24 Photograph showing copper ore veinlet(A and B) near Yasagyi(S) village, Location: 47Q 243683 E 2347071N

The mineralization mainly occured as veinlets (fracture filling) and disseminated in the host rock.The major ore mineral is galena and associated minerals are sphalerite, pyrite, azurite, malachite, covellite and little or no amount of argentite. Long trench Mine site-1 copper ore veinlet(A and B) near Yasagyi(S) village are shown in Figure 23(A /B) and Figure 24(A /B).

Ore Mineralogy

Galena (PbS)

The primary lead ore as galena can be observed in the Wunbye Formation. It is constantly associated with sphalerite and barite. Galena (PbS) is the most common lead ore mineral.Under ore microscope galena is characterized by light or light-grey colour and high reflectivity. It is also readily identified by the presence of triangular pits in Figure (25).

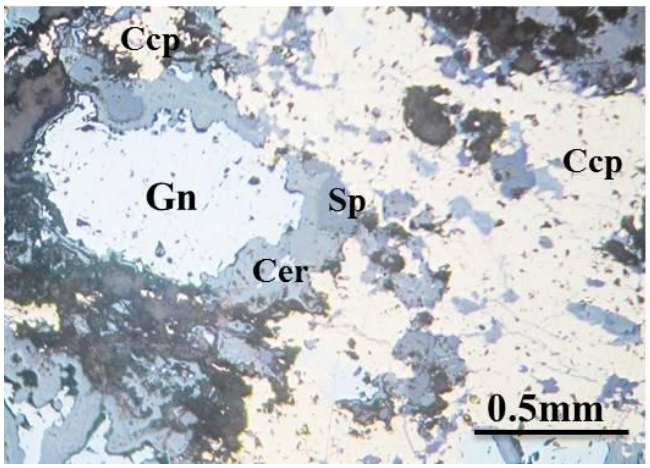

Figure 25 Photomicrograph showing galena with sphalerite (Under Reflected Light) (Gn=Galena, Sp=Sphalerite, Cer=Cerussite, Ccp=Chalcopyrite)

Cerussite ($PbCO_3$)

Cerussite is a lead carbonate mineral, usually found in oxidized zone of lead ore deposits. It is a very common weathering product of galena and other lead ore minerals. Its colour is colourless, white, gray blue or green. It shows colourless in transmitted light as well as vitreous, pearly, dull and earthy lustre. Under microscope, cerussite is observed as pale gray minute grains filled along the crack and cleavage of galena in Figure (25).

Sphalerite (ZnS)

The sphalerite is light-grey in colour with low iron content. It occurs as irregular anhedral masses in galena and other gangue minerals. In the study area, the sphalerite is characterized by its gray colour with brown tint and yellowish brown to reddish brown internal reflection under the microscope Figure (25).

Tetrahedrite

Under ore microscopie, tetrahedrite is the most common copper ore. It shows olive grey colour, medium relief and fairly internal reflection. Tetrahedrite occurs as groundmass. Irregular grain of chalcopyrite (Ccp) and tennantite(tn) are guest in the groundmass. Sphlerite(sp) is replaced in the groundmass of tetrahedrite(td). In Fig. (6.26), tetrahedrite(td) is replaced by chalcopyrite(Ccp).

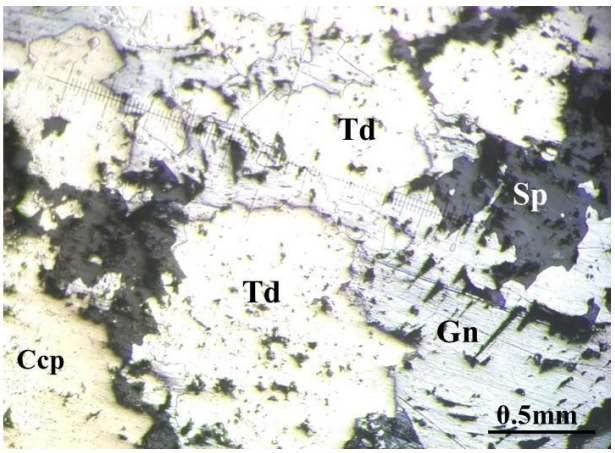

Figure 26 Photomicrograph showing tetrahedrite (Td) (Gn = Galena, Sp = Sphalerite, Ccp = Chalcopyrite) (Under Reflected Light)

Paragenesis

The purpose of the paragenetic study is to understand the principles of ore deposition, character of the minerals deposited during each period, and the trace elements they contain and shown in (Table-3).

Table 3 The Paragenetic Sequence of Ore Minerals in the Study Area

Mineral	Early	Middle	Late
Barite			
Pyrite			
Chalcopyrite			
Tetrahedrite			
Sphalerite			
Galena			
Covellite			
Malachite			
Azurite			

Geochemical Investigation

Fourteen representative ore samples were selected randomly from the occurrences of carbonate-hosted galena and copper mineralization and oxidized breccia zones. X-Ray Fluorescence analysis is conducted to determine the lead and other metals at Ministry of Science and Technology laboratory (Pyin Oo Lwin). Statistical data of the study area is shown in Table 4 and dendrogram of Myinhe Taung-Yasagyi Lead-Zinc-Copper Prospects is also shown in Figure 27.

Table 4 Statistical data of the study area

No	Element	Mean ($\bar{X}$) Value	Standard deviation (S) value	Threshold ($\bar{X}$+2S) value	Range	
					Minimum	Maximum
1	Pb	4.760	7.296	19.352	0.000	22.220
2	Zn	0.264	0.423	1.11	0.009	1.337
3	Cu	0.855	2.022	4.899	0.000	7.164
4	Fe	1.564	1.725	5.014	0.179	5.398
5	S	2.694	3.021	8.736	0.0859	8.274
6	Ba	12.430	15.891	44.212	0.000	41.82

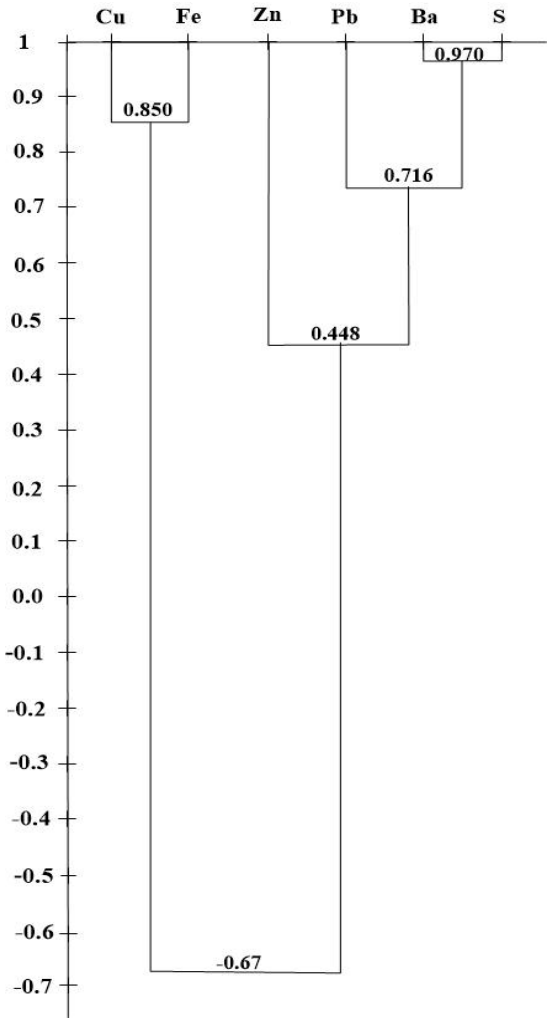

Figure 27 Dendrogram of Myinhe Taung-Yasagyi Lead-Zinc-Copper Prospects

Ore Deposit Type of The Myinhe Taung-Yasagyi Area

The carbonate-hosted base metals deposits in Myinhe Taung – Yasagyi area occurred within the dolomitic limestone of Wunbye Formation of Middle Ordovician age. A cluster of lead-copper deposits in the study area are found along on the western flank of the Pindaya Range and formed in a shallow marine environment.The Lead prospects have simple mineral assemblages comprising galena, barite, sphalerite, tetrahedrite , pyrite, chalcopyrite, azurite and malachite. The ore deposits occur in the zones of highly brecciated dolomite, collapse breccias, bedding plane, faults and fractures and these zones are arranged in linear patterns suggesting a distinct structural control. All the above deposit features strongly indicate that the lead-zinc-copper mineralization of Myinhe Taung-Yasagyi area probably belong to one of the sub-types of the Mississippi Valley-Type (MVT) deposits with their own slightly different characteristics.

Summary

The study area, Myinhe Taung-Yasagyi area is located about 35 kilometres southeast of Ywangan, Taunggyi District, Shan State (South). Area of coverage is approximately 20 square kilometres. Regionally, it is situated at the western part of Pindaya Range. The study area is located between the Shan Scarp Fault and Kyaukyan Fault.The highest peak is Yathagyi Taung 1941m. The study area comprises the Pindaya Group of Ordovician Age (Wunbye, Formation), Mibayataung Group of Silurian Age (Linwe Formation) and Plateau Limestone Group of Mid-Permian-Triassic Age (Nwabangyi Formation). The present research work involves the carbonate rocks of the Wunbye Formation (Middle Ordovicain age) which hosts the lead ore mineralization. The wallrock alteration zone is narrow where dolomitization alteration forms the main alteration predating the lead sulfide mineralization and silicification is subordinate. Most of the lead ore mineralized host rocks are dolomitic limestone as well as oolitic limestone. The major constituents are galena, barite, and minor as malachite and azurite, and also with minor amount of sphalerite, pyrite and chalcopyrite,tetrahedrite, covelite and ceruccite. Lead-Zinc-Copper mineralization extensively occurred in Myinhe Taung range in three distinct styles, namely, disseminations, fracture fillings (veinlets) and replacement ores (irregular patches to massive aggregates). From the above mentioned findings and plausible conclusions, the lead sulfide mineralizations in the study area are carbonate-hosted, stratabound, and of epigenetic in origin and most probably belong to one of the sub-types of the Mississippi Valley-Type (MVT) deposits.

Recommendation

Currently, local miners are mining artificially lead sulfide ore at Myinhe Taung and Yasagyi area. Moreover lead sulfide ore prospects need further and more detailed explorations whether to make them minable lead deposits. There are distinct and useful structural and lithostratigraphical ore guides that could help for any future exploration activity in the study area. As structural controls, regionally the NNW-SSE and NNE-SSW trending lineations, locally faults and fractures are well examined the lead prospects. As lithostratigraphical controls, both regionally and locally oolitic limestone and dolomitic limestone within the Wunbye Formation of Middle Ordovician age are also important.

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