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WALL-ROCK ALTERATIONS AND ASSOCIATED HYDROTHERMAL QUARTZ TEXTURES IN ANTIMONY DEPOSITS OF THABYU AREA, KYA-IN-SEIKKYI TOWNSHIP, KAYIN STATE

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Abstract

The research area is located in the southernmost part of Kayin State, near Myanmar-Thai border, Kya-in-seikkyi Township. In the research area, antimony mineralization is observed in the fracture zones which are NNW-SSE trending in the metasedimentary rock units of Taungnyo Formation. The common types of hydrothermal wall-rock alterations of ore deposits in the research area are silicification, vuggy silica (vuggy quartz) alteration, argillic alteration, prophylitic alteration, and pyritization/sulphidation. Quartz (chalcedony and vuggy), calcite, pyrite, hematite, barite and sericite are the alteration products. Hydrothermal alteration around the mineral deposits commonly forms alteration halos. Classification of quartz textures observed in the mineralized vines and wall-rocks of the research area are –primary growth texture, recrystallization texture, and replacement texture. . Primary growth textures of vein quartz are (1) Chalcedonic texture, (2) Comb texture and (3) Crustiform texture. Recrystallization texture of quartz in the mineralized veins can be classified into moss texture. Replacement textures represent partial or complete pseudomorphs of other minerals by silica minerals within veins. The samples from the mineralized vein are show bladed texture under microscope. The consistent pattern of distribution of textures and consistent assemblages of textures can be used to define a vertical textural zoning model. Thus model should be capable of determining vertical position within a boiling epithermal vein system and predicting the locus of mineralization. The mineralogy and some chemical composition of alterations and hydrothermal quartz textures of antimony mineralization of research area provide an indication of proximity of mineralization and provide information on reservoir and fluid characteristics.

Keywords: wall-rock alteration, hydrothermal quartz textures, antimony deposits, Thabyu area

Introduction

The Thabyu area is located in the southeastern part of Kayin State, near Myanmar-Thai border about 400 kilometres Southeast of Yangon and 160 kilometres Southeast of Mawlamyaing and about 11 kilometers north of Phayathonzu. It is located at north Latitude 15° 33′ to 15° 35′ and East Longitude 98° 25′ to 98° 26′ and between vertical grid no. 380-440 and horizontal grid no. 130-200 of topographic map index no. 95 I/6 (Figure .1). It is covered about 8 square km.

In the Thabyu area, the antimony mineralization is hosted in the slate, phyllite and quartzite of the Taungnyo Formation which occurred on the eastern limb of local anticlinal structure along the western side of NW-SE trending Tele-Chaung and continues along the Lenpya-Chaung in the north having the length about 5km.

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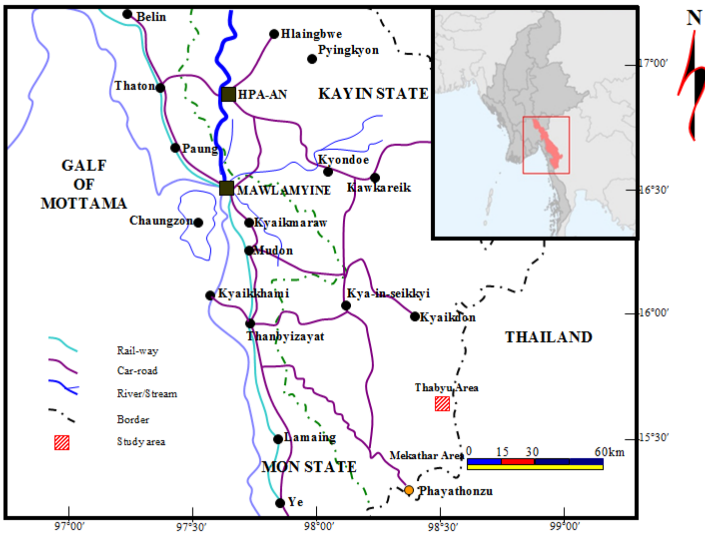


Figure 1 Location map of the study area

Geology

The lithologic units of Thabyu area mainly comprise metasedimentary units of Taungnyo Formation and carbonate units of Moulmein Limestone covered with thick alluvial soil and some lateritic soil.

In the Thabyu area, Taungnyo Formation mainly consists of metasedimentary rocks such as quartzite, slate, phyllite and sedimentary rocks of shale and sandstone. The general trends of rock units of Taungnyo Formation are NNW-SSE in direction and steeply dip at (56 ˚ to 75˚) to the east. The Taungnyo Formation is succeeded by the Moulmein Limestone with unconformity. The Moulmein Limestone consists of calcitic limestone, dolomitic limestone and dolomite. The rock units of Moulmein Limestone are strike NNW-SSE and gently dip at about 23˚ to 35˚ to the east.

Taungnyo Formation

In the Thabyu mine area, the Taungnyo Formation is well-exposed in the road-cut sections, quarries and mine site which is mainly composed of phyllite, and slate with minor sandstone and shale unit, quartzite with minor slate and phyllite unit and sandstone, and shale unit.A minor amount of quarzite is found only near the antimony mineralized area. It is fine to medium-grained, poorly foliated and massive. They are often interbedded with shale and slate. Phyllite unit is medium- to thick- bedded, hard and compact, fine- to medium-grained, bluish grey to dark grey in colour, and fairly jointed. Phyllite unit is often interbedded with minor sandstone and shale. Several quartz veinlets associated with antimony mineralization are scattered throughout the phyllite unit.

Slate intercalated with phyllite is fine-grained, grey to dark grey or black coloured on fresh surface and light grey on weathered surface. It is soft and friable, highly jointed and well foliated. Highly brecciated slate occurred at the antimony mineralized localities. In some places, hard and compact, slightly foliated phyllitic slate is observed. Shale unit with minor sandstone and phyllitic shale occupies largest portion among the other units of Taungnyo Formation. It is fine-grained, thin-bedded, highly weathered, sometime bracciated, and ferruginous.

Moulmein Limestone

In the Thabyu area, thick-bedded to massive, grey to dark grey coloured calcitic limestone, laminated limestone, dolomitic limestone and dolomite are occur in the Moulmein Limestone. The calcitic limestones unit is mostly fine to medium-grained, medium to thick bedded, light grey when fresh and yellowish grey when weathered. Individual bed thickness varies from place to place ranging form10 cm to 25 cm. Several calcite veinlets are observed throughout the unit and slightly dolomitized in some places. It is poorly fossiliferous and some unidentifiable fossil fragments are observed. Laminated limestone unit is well-exposed along the crestal portion of study area. It is thick-bedded to massive, fine- to medium-grained, light to dark grey in colour and laminated.

Dolomitic limestone with minor dolomite is mostly observed among the limestone units of Moulmein Limestone Group. Dolomitic limestone unit is fine to medium-grained, thick to massive and show crystalline texture, light grey to grey on fresh surfaces and dark grey colour in weathered outcrop. Strongly dolomitized limestone shows criss-cross joints on its surface and some are brecciated and form karst topography.

Antimony Mineralization

In the Thabyu area, mine No. 1, 1.7, 2, and 3 , where most of the quartz-stibnite-barite veins are found as lenses in the NW-SE trending fracture zone of slate, phyllite and quartzose sandstone unit of Taungnyo Formation and disseminated within the alteration zone and host rocks. The mineralization zones strike between 300° and 325°, dip between 60° and 75° to the northeast parallel with the alignment of Tele-chaung which is probably a fault aligned stream running NW-SE.

Large antimony mineralized veins having 2-3 metres width and about 30 metres high in surface exposure occur parallel or slightly parallel to the foliation plane of quartzite and phyllite units of Taungnyo Formation generally dipping northeast at 65° to 75°. Therefore, the directions of these veins are aligned parallel to the major NNW-SSE structural trends of host rocks. The mineralization zone can be traced along the Tele-chaung and through Lampha Chaung about 10 kilometres. There are about 10 separate worksites within the Thabyu area.

A chain of lenticular ore bodies have been found along the general strike of the ore vein. The chief mineral is stibnite and chalcopyrite, saphlerite and galena are occur as accessories. Mainly quartz (vuggy quartz, chalcedonic quartz) and other calcite, barite and pyrite are observed as vein minerals. In Mine-No.1, such mineralization is associated with barite.

Hydrothermal Wall-Rock Alteration

In the study area, as the antimony ore bearing solution penetrate along and between the impervious layers of metasedimentary rock units (slate, phyllite and quartzite) of Taungnyo Formation, the wall rock alterations are less common in the mineralization area. However, some hydrothermal alterations such as kaolinization and sulphidation observed along mineralized veins and nearby area and some are observed under microscope. The nature of alteration products controlled by such factors as (1) the characters of the original rocks, (2) the characters of invading fluid and (3) the temperature and pressure conditions at which the reaction took place (Park and Mac Diarmid, 1970).

The common types of hydrothermal wall-rock alterations of ore deposits in the Thabyu area are; (1) Vuggy silica (vuggy quartz) alteration, (2) Silicic alteration, (3) Argillic alteration, (4) Prophylitic alteration, and (5) Pyritization/sulphidation.

Vuggy /Silica (vuggy quartz) Alteration

This alteration typically occurs in the structural zones or as replacement bodies in permeable lithologies. This extreme form of leaching is more common at higher epithermal levels. The mineral assemblages occur in this type of alteration are quartz, hematite, pyrite and barite. Vuggy quartz alteration is characterized by fine-grained quartz with numerous open spaces that may be partly filled by a variety of minor minerals. Vugs in the alteration zone may be filled by late quartz, sulphides, sulphates or sulphur. Vuggy quartz is characterized by the fine grained quartz with numerous open-spaces that may be filled by variety of minor minerals.

In thin section, quartz forms a dense mosaic texture. Vugs are lined with euhedral quartz and other minerals and may be filled (Figure .2). Quartz may contain irregular clots of rutile, pyrite and other sulphides. In some cases, quartz is cut by veinlets of secondary quartz.

Silicic Alteration

Quartz, chalcedony, barite, pyrite, and hematite are mineral assemblages of silicic alteration. This type of alteration represents the addition of silica to the rock, resulting in the replacement or more commonly, fill to vugs created during leaching. Silicification is common in high-sulphidation system at porphyry to epithermal deposits (Arribas, 1995). It sometime confused with quartz stock-work veining (Figure. 3, 4 & 5). Silicification caused greater compactness and hardness of the altered rocks.

Argillic Alteration

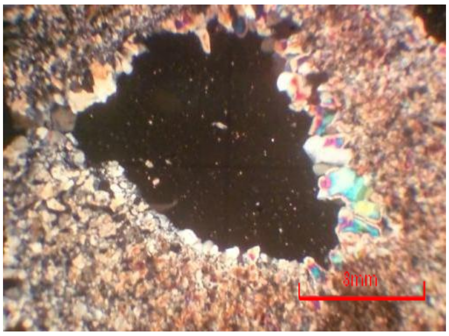
Argillic alteration or argillization refer to the dominance of clay minerals (kaolinite/dickite) altered from K-feldspar of the country rock. It can occur as zone of alteration between advanced argillic alteration and propylitic alteration, particularly in the high sulphidation epithermal setting. It occurs as surface expression around the ore deposits which are hosted in the feldspathic sandstone of the study area (Figure .6& 7).Kaolinite may form during supergene weathering. Kaolinization could have weakened the country rock.

Propylitic Alteration

Calcite is a common gangue mineral occurring as open-space fill and associated with quartz, pyrite, barite and sericite. Calcite forms over a wide temperature range, and its stability is mainly sensitive to aqueous CO2 concentrations. It occurs both at proximal and distal to low sulphidation epithermal mineralization where it is characteristic of propylitic assemblages. In open space, calcite deposit in response to boiling and exsolution of CO2. Platy calcite occurrence is intimately associated with epithermal mineralization (Thompson and Thompson, 1996). Rhombic and scalenohedron forms occur in massive coarse calcite (Figure .8) that typically fills late open-spaces formed subsequent to metal deposition.

Sulphidation or Pyritization

Pyrite minerals occur as euhedral to anhedral crystals in polished section and they are the most abundant sulphide mineral of the mineralization zone. Euhedral pyrite occurred in quartz veins, vesicles and fractures and as disseminated in wall-rock groundmass (Figure .9). Very fine-grained pyrite in vein quartzs is intergrown with very small amorphous stibnite particles along the quartz veinlets.



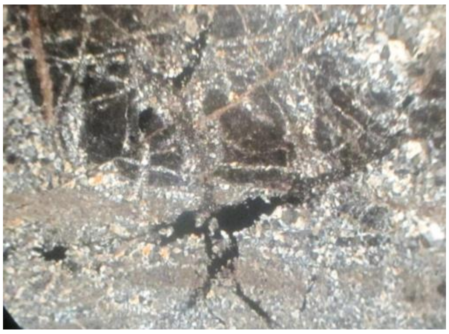
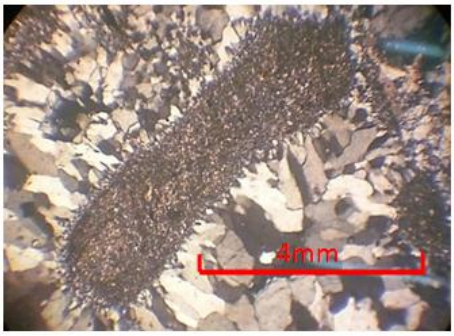


Figure 2 Vuggy quartz (open-space lining quartz) formed next to the alteration of chalcedonic quartz (fine-grained crystocrystalline quartz) (Between XN)

Figure 3 Silicification of country rock within the fracture zone and silica flooding by means of small vein-lets stock-work structure. (Between XN)



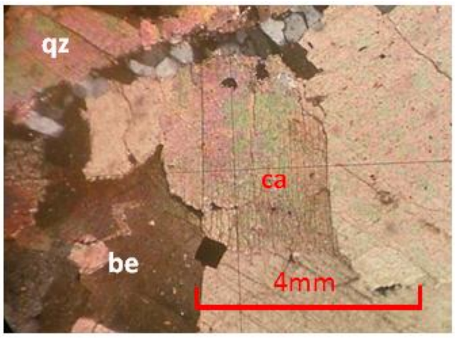


Figure 4 Cryptocrystalline variety of silica (chalcedonic quartz) filling in the cavity and lining along crystalline quartz rim. (Between XN)

Figure 5 Silicic alteration mineral assemblages; quartz (qz), calcite (ca), barite (be) and pyrite (py), (Between XN)

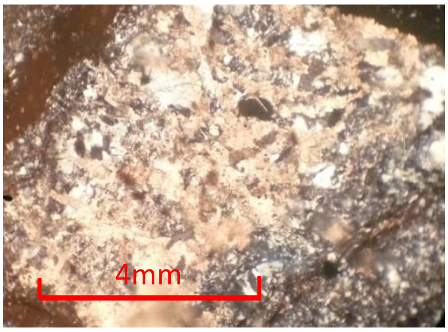
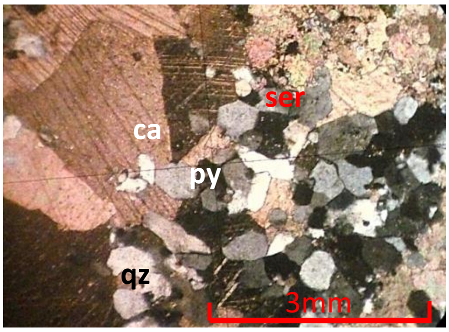


Figure 6 The kaolinization (argillic alteration), Loc – 416166, Facing – NW

Figure 7 The incomplete kaoliniation of potash-feldpspar that occurs in the wall rock of feldsapathic sandstone of deposited area. (Between XN)



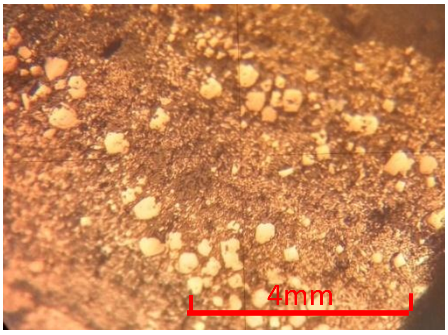


Figure 8 Propylitic alteration mineral assemblages such as calcite (ca), quartz (qz), sericite (ser) and pyrite (py). (Between XN)

Figure 9 Microphotograph showing euhedral pyrite grains scattered through the wall-rock ground mass (Polished section, Under PPL)

Hydrothermal Quartz Textures

General Characteristics

The textures of vein quartz offer not only a rapid reconnaissance tool to evaluate the character of mineralizing environments but also a means of identifying mineralized loci within vein systems (Dowling & Morrison, 1990). In simple veins there is a consistent pattern of distribution of textures and consistent assemblages of textures that can be used to define a vertical textural zoning model. Thus the quartz model should be capable of determining vertical position within a boiling epithermal vein system and predicting the locus of mineralization.

Classification of quartz textures observed in the mineralized veins and wall-rocks of the study area are -(1) Primary growth texture, (2) Recrystallization texture and (3) Replacement texture

Primary Growth Textures

Primary growth texture represents the open-space filling. There is a textural subdivision of the primary growth textures into those characteristic of cryptocrystalline quartz and those characteristic of crystalline quartz. Primary growth textures of vein quartz found in the study area are (1) Chalcedonic texture, (2) Comb texture and (3) Crustiform texture.

Chalcedonic texture

It is cryptocrystalline quartz with a waxy lustre and commonly a fibrous microscopic habit. Massive chalcedonic quartz is a uniform dense aggregate of cryptocrystalline quartz (Figure ure .10). Massive chalcedonic texture forms under conditions of intermediate silica super-saturation with respect to quartz. Low temperature (below about 180° C) during and after deposition is responsible for low crystallinity maintained in this texture.

Comb texture

Comb texture represented by groups of parallel or subparallel crystals oriented perpendicular to vein walls thus resembling the teeth of a comb. Normally crystals have euhedral terminations at their free ends (Figure .11). Comb texture is typically formed in open space from a hydrothermal solution which is slightly super-saturated with respect to quartz, but under-saturated with respect to chalcedony (Fournier, 1985). This slight silica super-saturation is possibly brought about by slow cooling of the system and uniform growth from multiple nuclei along a vein wall.

Crustiform texture

It is successive bands oriented parallel to vein walls and defined by differences in mineralogy, or texture, colour (Figure .12). Some are concentric crustiform bands surrounding isolated rock fragments. Crustiform texture is common that is considered a diagnostic feature of epithermal veins (Buchanan, 1981). Repetitive bands of different composition or texture reflect fluctuating concentrations of elements in solution and fluctuating fluid conditions during precipitation. These fluctuations are commonly ascribed to periodic boiling of hydrothermal fluid.

Recrystallization Texture

Recrystallization textures reflect the transformation of amorphous silica or chalcedony to quartz. They are most commonly associated with cryptocrystalline quartz textures and may partly obscure them where recrystallization is extensive. In the study area, recrystallization texture of quartz which has been observed in the mineralized veins which can be classified as moss texture.

Moss texture

It resembles fine botryoidal (grape-like) aggregates with a massive irregular form similar to moss vegetation. In thin-section, individual spheres typically have a cryptocrystalline core and a crystalline rim. In the core, impurities or fluid inclusions define a concentric or radiating pattern and in the rim the extinction is radiating (Figure .13).

Replacement Texture

Replacement textures represent partial or complete pseudomorphs of other minerals by silica minerals within veins. The samples taken from the mineralized vein shows bladed texture under microscope.

Bladed texture

It is crystalline or cryptocrystalline quartz aggregates arranged in a bladed or platy form (Figure .14&15). They are parallel within a group but adjacent groups may have different orientations thus giving parallel bladed. Parallel bladed texture could result from replacement of granular calcite by quartz along repeated lamellar parting planes.

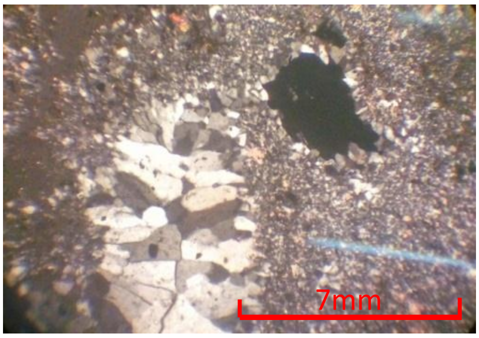
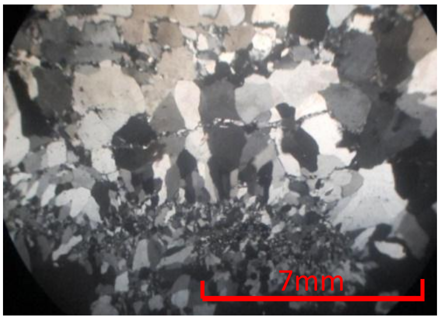


Figure 10 Chalcedonic cryptocrystalline texture, a uniform dense aggregate of cryptocrystalline quartz (Between XN)

Figure 11 Comb texture, euhedral teeth of a comb terminating at their free ends. (Between XN)



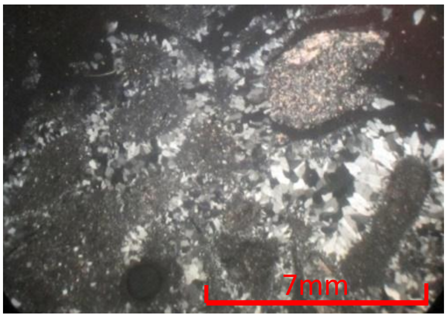
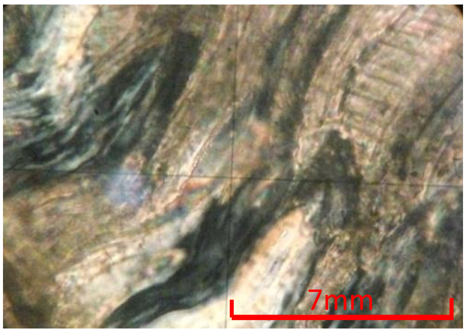


Figure 12 Crustiform texture which is successive bands oriented parallel to vein walls and defined by differences in mineralogy, or texture, colour, (Between XN)

Figure 13 Moss texture: aggregate of spheriodal cryptocrystalline core and crystalline rim forming botryoidal (grape-like) texture. (Between XN)



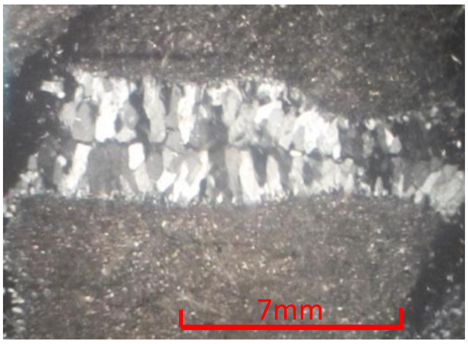


Figure 14 Bladed texture: parallel bladed could result from replacement of granular calcite by quartz along repeated lamellar parting planes, (Between XN)

Figure 15 Microphotograph showing crystalline quartz aggregates arranged in a bladed or platy form. (Between XN)

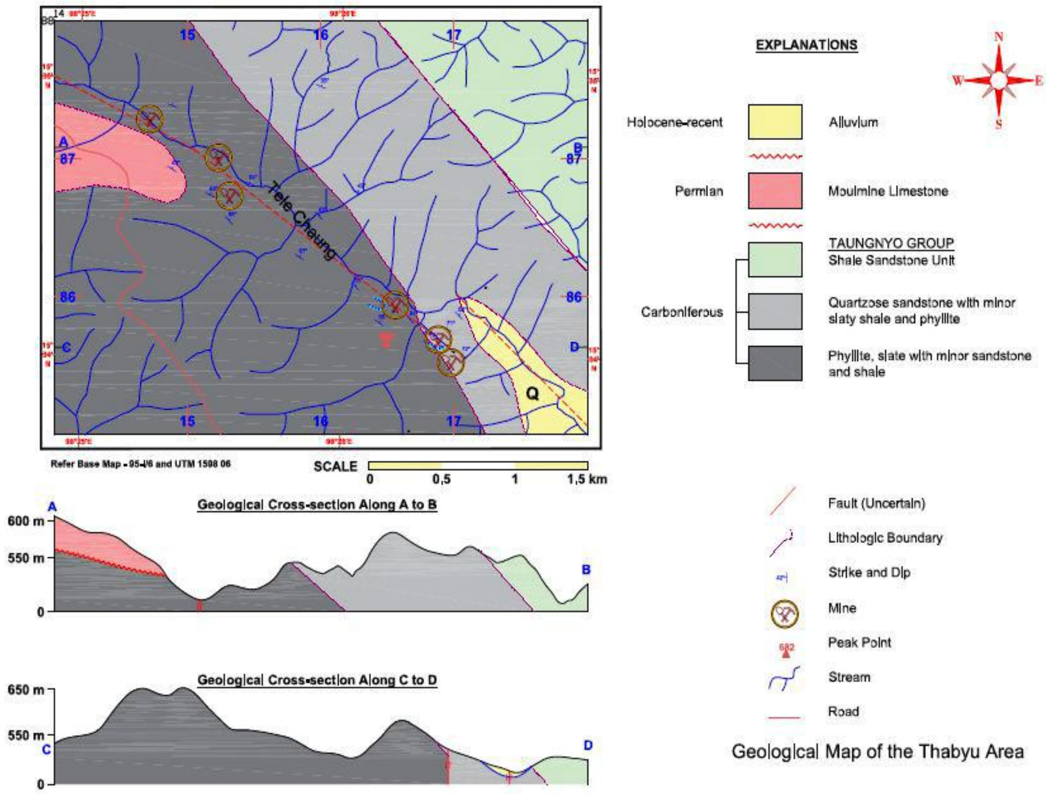


Figure 16 Geological map of the Thabyu Mine area.

Conclusions

In the research area, quartz (chalcedonic and vuggy), calcite, pyrite, hematite, barite and sericite are the alteration products of mineralization. The common types of hydrothermal wall-rock alterations of ore deposits in the study area are silicification, vuggy silica (vuggy quartz) alteration, argillic alteration, propylitic alteration, and pyritization/sulphidation. Classification of quartz textures observed in the mineralized veins and wall-rocks of the study area are –primary growth texture, recrystallization texture, and replacement texture.

Chemically interaction between the intruding ore bearing hydrothermal fluids and wall-rocks of fracture zone occur and then formation of wall-rock alterations are produced i.e. silicification, recrystallization etc. Much of the ground preparation that takes place prior to the introduction and deposition of ores is really chemical. The effects of temperature and pressure are important in the deposition of ores. Moreover, quartz textures (vuggy texture), mineral association and nature of hydrothermal alterations point to an epithermal system at temperatures between 200˚ C and 80˚ C.

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