MINERAL OCCURRENCES AND DEPOSITS ALONG MUSE-MANDALAY PROPOSED RAILWAY LINE

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Abstract

Myanmar, the second largest country in Southeast Asia, occupies geologically and tectonically a key position. A railway line connecting from Muse and Mandalay has been proposed to construct and the paper is written about all known deposits and occurrences typically exposed along and around the proposed Muse-Mandalay railway line. There would be lead-zinc-silver, antimony, gold that could be expected in it. Coal and phosphorous deposits might also be found as well. As mineral deposits are trending approximately N-S direction, those could be probably found during construction of the line crossing that trend. It should be needed to officially inform local and central government if some deposits occur during construction. Legal enforcement should act to give penalty for those people who carry away it from the line or make mineral dressing in situ.

Keywords: Muse-Mandalay railway line, mineral deposits and occurrences,

Introduction

Myanmar, the second largest country in Southeast Asia, occupies geologically and tectonically a key position located in the northeast corner of the Indian Ocean. Tectonically Myanmar has collided with the Indian continent in the Naga Hills and is juxtaposed with the eastern end of the India-Asia collision zone and Himalayas to the east. It is found that Myanmar has a several number of world-class metallic mineral deposits, including copper, nickel, tin and tungsten, offshore and onshore reserves of oil and gas, and an abundance of gemstones especially ruby, sapphire and jade, etc. The paper is written about the mineral occurrences and deposits along Muse-Mandalay Railway Project.

For several decades, China has also been planning to build the China-Myanmar Economic Corridor (CMEC) to have access to the Indian Ocean. Consequently, a railway line connecting from Muse and Mandalay has been proposed. So, Muse is a significant and key border town in Myanmar on the China-Myanmar border. The proposed project is also a part of eastern corridor extension of the railway projects (Fig. 2) being undertaken in Yunnan Province of China, especially the construction of the Darui railway (short for Dali-Ruili railway) (Source: News from CGTN).

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(Source: Internet)

Figure 1 Economic corridors in Greater Mekong Sub-region.

Method of Study

Detailed geological study of the area, classification of rock units and the ore occurrences and deposits were carried out during the course of field study. Detailed geological data on dip and strike of the lithologic units, attitude of joints and other structural elements were measured and recorded. Tape-and-compass method and bore hole data are employed to determine the thickness of iron ore deposits, the nature of deposit types and the exposed rock units in the study area. The representative ore and rock samples were taken from each bore-hole and test-pit. The collected samples were analyzed by using PXRF. Photographs and sketches were taken for some significant features.

Result

Mineral deposits along and around the Muse-Mandalay Railway line

Lead-Zinc-Silver Deposits

Mohochang Prospect (Latitude 23° 25' N, Longitude 97° 30' E)

The Mohochang mine (Figs.1&2) is located 25 miles northeast of Bawdwin/ Namtu and the old workings are centered around Mohochaung. At present there are no existing roads to the area but during the dry season the present trails can be converted into mule tracks (Soe Win, 2016). The Mohochang mines are in an area of rugged terrain, the Mohochang Peak reaching an elevation of 6439 feet can be viewed from Namtu. It is far from railway line.

The Chaung Magyi Group is of great importance in the Mohochang area in that it contains horizons in which the main lead-zinc mineralization occurs. They comprise the oldest rocks in the area. The white sandstone occurs along the contact of the Chaung Magyi rocks with the overlying Pangyun Formation. Pb-Zn mineralization is confined to this horizon (having an average of 43% Pb). The Tawnpeng granite (a biotite granite) lies along the northwest margin of the area and it intrudes the Chaung Magyi rocks. The main faults strikes N-S, NNW-SSE and E-W.

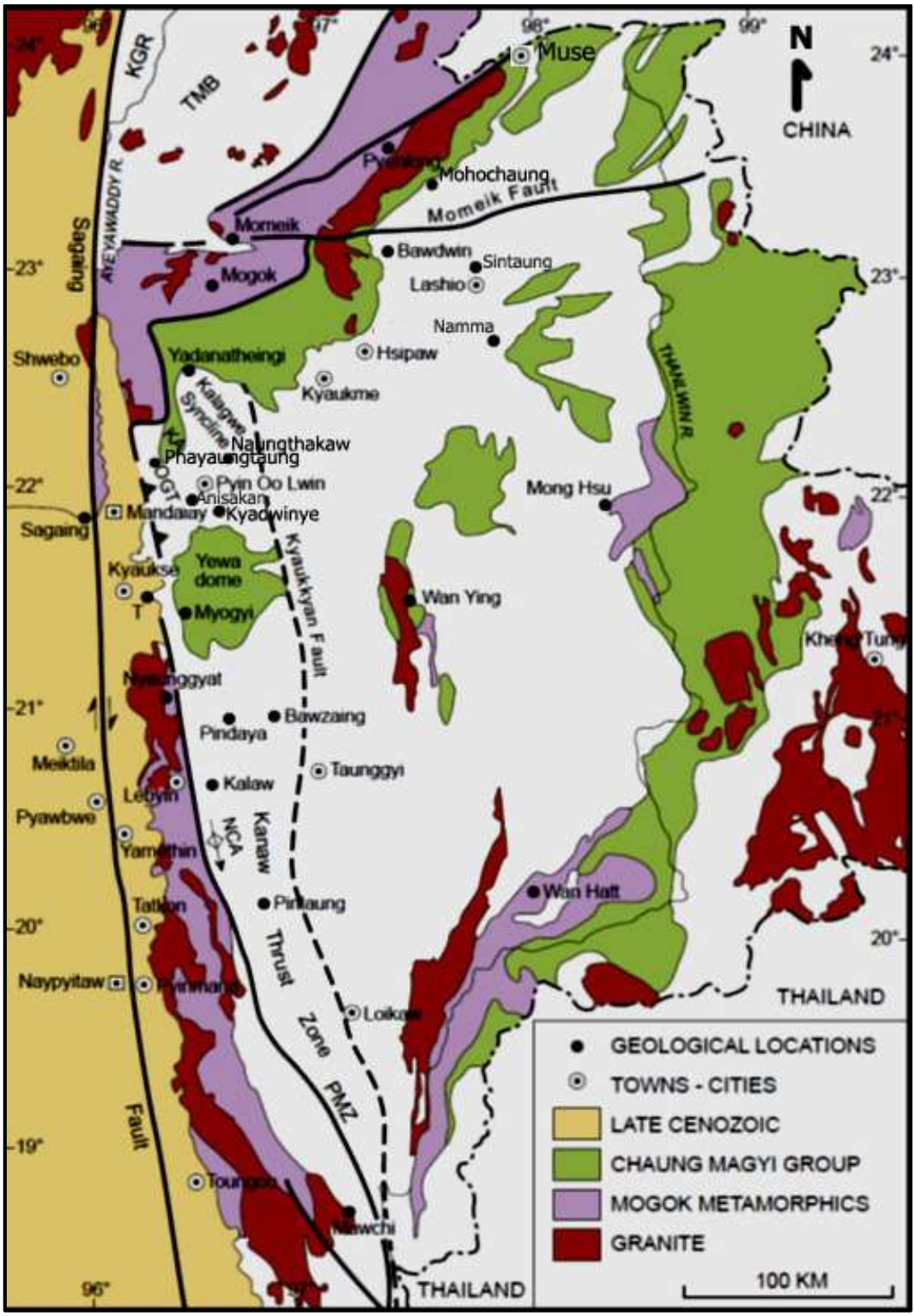

Figure 2 Map of part of Shan Plateau showing mineral and gemstone locations described in text. (Modified from Mitchell, 2018)

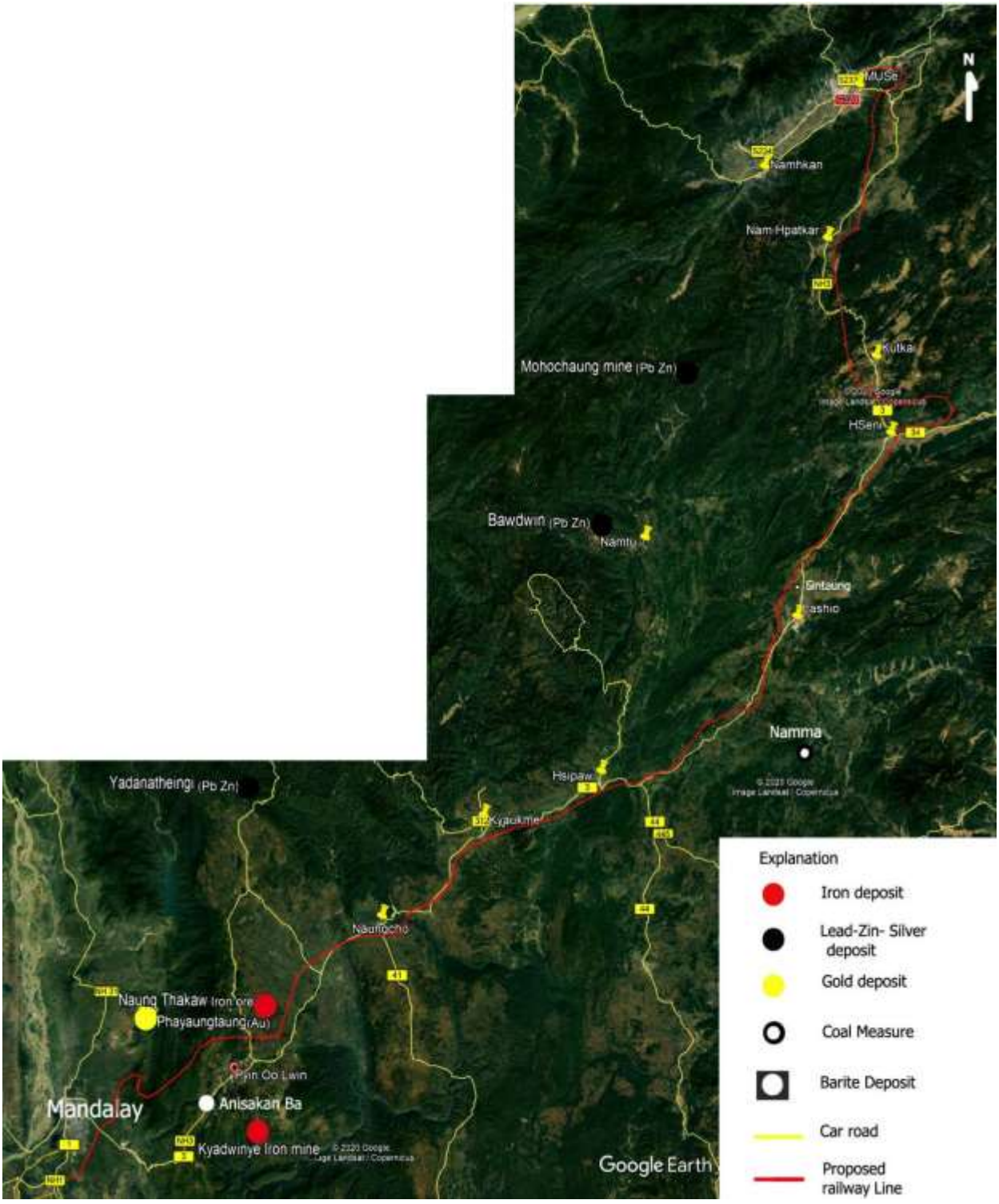

Figure 3 Satellite image showing the location of proposed railway line and localities of known mineral deposits along and around it. (Tin Aung Myint, 2020)

Mineralization is confined to the magnesian limestone horizon of the Chaung Magyi Group. Quartz veins occupy fracture and carry the sulphides, pyrite, little chalcopyrite, sphalerite, and galena. The gangue minerals are quartz, calcite and siderite. The views on the control of mineralization are varied. Seaton assumed that the mineral solutions owe their origin to the Tawnpeng granite and that the granite mass may have contributed to the process of mobilization

and flow of solutions. Deposition took place along fractures in the magnesian limestone. It is 50 feet thick near the village of Kong Namlek and its general strike is NE-SW with a 25-35 degrees dip to NW.

Bawdwin Mine (23° 6'23.57"N & 97°17'52.62"E)

The Bawdwin mine (Figs.1&2) in Myanmar has been one of the world ranking lead mine before the World War II. This mine is situated about 8 miles west of Namtu and 60 miles from the border with the peoples' Republic of China. This mine is also far from railway line. According to the historical records, the Chinese first extracted silver from this area in 1912. Bawdwin stands at an elevation of more than 3000 feet above sea level. The terrain is rugged and devoid of vegetation, thought to be result of deforestation of crude smelting operations by the early Chinese artisanal mining. The main drainage is the Nam Pangyun river that flows through the mine camp.

The oldest rocks belong to the Chaung Magyi Group of Pre-Cambrian age comprising slate, phyllites, greywackes and schists exposed to the west of the Bawdwin mine and Pangyun Formation of Cambrian age overlying unconformably on the Chaung Magyi Group form the main host to mineralization.

The Tawnpeng granite occupies an extensive area especially west and northwest of Bawdwin and intrusive into the Chaung Magyi metasediments. The Loi Mi quartz porphyry occurs as a small stock and as sills and irregular masses along the Bawdwin ore zone. The Bawdwin lead zinc silver ore deposit consists of three sulphide high grade Pb-Zn ore and small pyire-chalcopyrite ore body. The mineralization is approximately 2.5km in length and about 140 m wide within fault zone. At Bawdwin three main lodes are known. The Shan Lode in the north, the Chinaman the central lode and Meingtha in the south.

Table 1 Three main lode exposed in Bawdwin mine.

Name	Max. Length	Max. Vert Dimension	Avg. Width
Shan Lode	380m	350m	6m
Chinaman Lode	400m	350m	42m
Meingtha Lode	550m	450m	6m

The ore reserve given by the Bawdwin in 1982-83 is 142877 tons (with 7.73%Pb, 3.45%Zn and 4.8602Ag) by underground mining, 105402 tons (with 5.98%Pb, 0.99%Zn) by open-cast mining.

Yadanatheingi Mine *(22°34'35.26"N, 96°29'43.54"E)*

The Pb ores of Yadanatheingi is located about 50 miles NE of Pyinoolwin (Figs. 1 & 2). Yadanatheingi is in the northeastern limb of the regional southeast-plunging Kalagway Syncline some 100km southwest of and along strike from the Bawdwin mine. A high Ag content of the ores is a noteworthy feature of this mine. It is mined from a shear zone about 30 feet thick which cuts across the Chaung Magyi Group in an NW-SE direction. Some similarity between the geological setting of Yadanatheingi and that of Bawdwin is suggested by the presence at Yadaantheingi of mineralized structures extending from the Chaung Magyi into quartzites of the Cambrian Pangyun Formation (Mitchell, 2018).

The ore is found as fissure veins and stockworks and the Pb content is about 5-10%. In 1974-75, the mine produced 1600 tons of lead concentrate containing 50% Pb and 1% Zn (Bender,

1983). In 1986-87, 1322 tons of lead concentrate was produced. After privatization the Yadantheingi mine (about 1207000 tons of Pb) is operated by the Lin Pyae Mining Co., which is extracting the remnants from old deposits. Apparently no efforts have been made to search for ore extensions laterally or at depth.

Barite Deposits

Anisakan Barite deposits

The barite deposits in the vicinity of Anisakan area (Figs. 1 & 2) are located at Peinnegon, Taunggyun, Indon-ye, Sitha, Dattaw, Bayaw and Byingyi. Barite occurs along fissures and fractures trending NNW-SSE to nearly N-S, in the Ordovician limestones and siltstones. The veins dipping steeply 50 to 90 degrees and their thickness vary from a few feet to more than 20 feet. The proved reserve amounts to about 213,000 tons with 97% barite, and the probable reserve amounts over 400,000 tons.

Iron Ore Deposits

Kyadwinye (21°53'39.64"N, 96°30'58.67"E)

It is located on the eastern limb of a major anticline (Kyaingtaung anticline) (Fig. 3) whose anticlinal crest is located about six miles to the west. Iron ore occurs entirely in Maymyo Formation of Devonian age. Kyadwinye deposits contain high iron content (50%-60% Fe).

Moreover, numerous small scale iron occurrences which are economically unfeasible are found throughout the area. In Kyadwinye mine, (Figs. 1&2) the iron deposit occurs on the Main hill (Foot wall) (3498') and mine site in lower hill (Hanging Wall) separated by Kyadwinye normal fault. The area coverage is about 6725640 square feet (624811.9 sq.m.). The thickness of iron deposit on the Main hill is only 12.8' (4m) thick. However, at the mine, the iron ore deposit is much thicker, reaching up to 70' (22m) in thickness. The deposit is sedimentary in origin and the hematite and limonite ores occur in the cavities and depressions of the underlying. Plateau Limestone (Maymyo Dolomite). Field investigation shows that the mine is situated on the down thrown side of the fault (Tin Aung Myint, 2002).

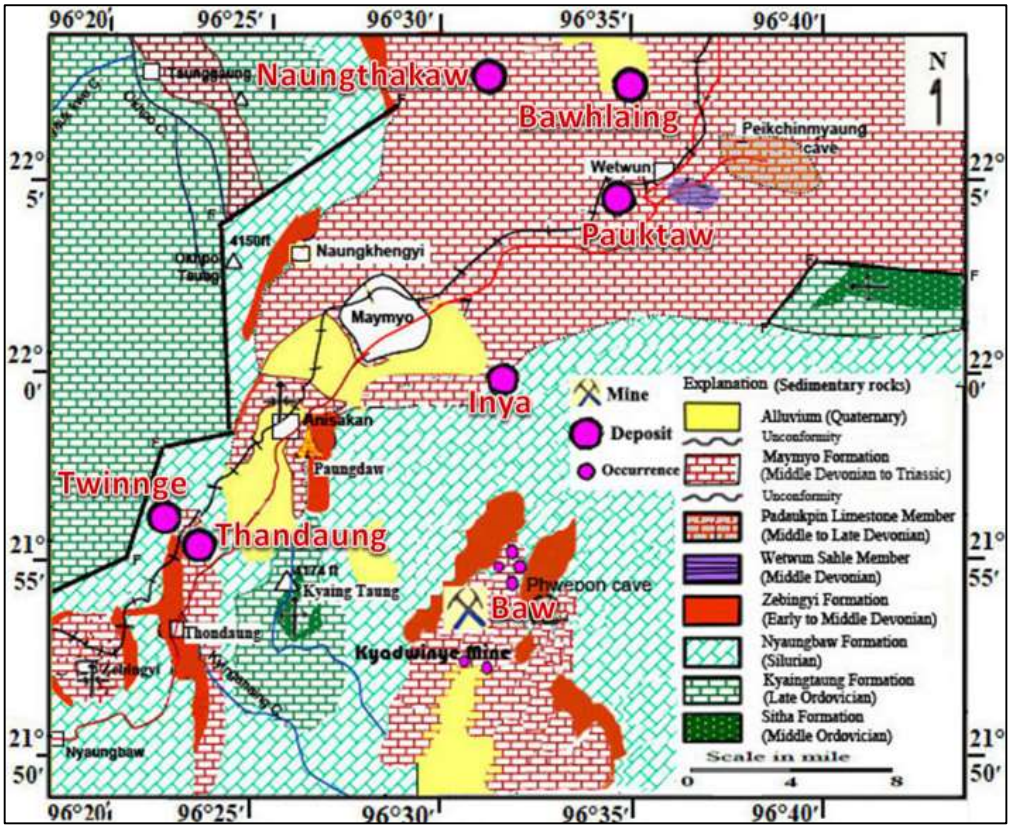

Figure 3 Geology map of Pyinoolwin area including iron localities. (Tin Aung Myint, 2014)

In Kyadwinye, the iron ore deposit comprises limonite and hematite with minor amount of pyrite and magnetite found in dolomite and sandstone of Maymyo Formation. The bore-hole data indicates gradual increase of limonite content with depth. The surface of the ground shows scattered light brown ferruginous gravel and larger pieces of iron ores. Iron ore occurs in different forms: as boulders, nodular masses, gravels or floats. The biggest one is reaching up to 15 cubic meters (530cubic feet). The ore is trucked to the No.1 Iron and Steel Plant at Aniskan located about 16 km west of Pyinoolwin. The plant produces pig iron, steel billet, rounded bars and steel grinding balls (Soe Win, 1994). Although Krupp and BGD (1961-62) gave a reserve of 3 million tons, the estimated iron ore reserve is less than 2 million tons with average iron content of 58.5% (Tin Aung Myint & Mi Mi Ko, 2004).

Inya (22° 0'57.77"N, 96°32'53.19"E):

It is located 9 km SE of Pyin Oo Lwin (Fig.3). Brecciated limonitic ore occurs in dolomitic limestones. 4.5 million tons with an average Fe content of 35.2 %, Ti O_2 content of 1.5 %. The deposit although favorable for open cast mining, the ore is difficult to dress (intergrowth of hematite ore / laterite / bauxite). The Fe content is generally low and high TiO_2 content renders the ore difficult to smelt.

Pauktaw (22° 4'46.78"N, 96°35'13.07"E):

It lies close to the Mandalay- Lashio railway old line, 4 miles SW of Wetwin railway station (Fig.3). It is a small excavation worked in 1920 and 1921 by the Burma Corporation. 1,700 tons of ore, with an average iron content of 56- 57 %, have been removed from this working. The analysis of pisolitic materials contains 25.2 % Fe, 19.0 % $Al_2 O_3$, 6.2 % MgO, and 10 % Si O_2 (Soe Win, 1994).

Naungthakaw (22°8'47.03"N, 96°31'45.46"E):

It lies about 6 miles to the NW of Pauktaw (Figs. 1, 2 & 3). Workable hematite ore vary from thin bands of few inches to thick ones of several feet thick. The deposit is covering the area of about 8 sq. miles. It is of residual type in Plateau Limestone. The iron content is 56 % Fe. This was mined by the Burma Corporation Ltd, in pre- war years with an annual production between 35,000 and 40,000 tons. The deposit is very close to the proposed railway line (Tin Aung Myint et al., 2019a).

Gold Deposit

Phayaung Taung Gold Mine (22° 7'39.79"N, 96°16'36.97"E)

It is situated about 32 km northeast of Mandalay (Figs. 1 & 2). It is located at the junction of Slate Belt, eastern part of Mogok Metamorphic Belt and Shan Plateau bounded by two dextral strike-slip faults, namely the Sagaing fault (W) and the Shan scarp fault (E). The stratigraphic units exposed in the area are Chaung Magyi Group (CMG). Mineralization is commonly formed in quartzite (aks Maukkaw Quartzite) and mica schists. Phayaung Taung fault plays an important role to form large concentration of fluid flows. The Phayaung Taung gold mineralization is characterized by the gold bearing quartz with variable comb and ribbon textures. Ore mineral assemblage includes gold, chalcopyrite, pyrite, hematite, malachite and azurite. The Kin sandy phyllite of CMG, mica schists, garnet-staurolite schist of MMB at Baw Taung area and Maukkaw quartzite of the CMG are potential hosts for gold mineralization (Tin Aung Myint et al., 2019b). It has done already 12 drill holes and the estimated reserve is about 3.23Mt @ 4.78 g t−1 Au. Now the mine is operated by Htawaya mining company (DGSE, 2013).

Coal Occurrences

The occurrences of coal measure along the railway line is mainly Tertiary coal-bearing layers occurred in Muse (?) and Lashio Basin (Figs. 1 &2). Here, it is mainly emphasized on the coal occurrences around Lashio. Sintaung (23° 0'16.45"N, 97°45'9.18"E) near Lashio is very close to the line. It is an open pit mining of approximately 120m (L) x 72 m (W), with the thickness of 0.5-7m dipping 20˚N. Other occurrences are found at Namma (22°39'14.71"N, 97°45'27.61"E) which is an old open coal mines and there are also some underground mines to the E of area. It has about 1600m (L) x 100m (W) with the thickness of 3-15m (including 3 layers), dipping 30˚-60˚ NW. Since it is found as layers in Tertiary sediments, the age could be Late Miocene-Pliocene.

Conclusion and Suggestion

All known deposits and occurrences mentioned here are typically exposed along and around the proposed Muse-Mandalay railway line. But some exposed the line between Nanhphtka-Muse are missing because of insurgent area and difficulty to do field works. Consequently there is also missing some geological information for that area. According to the existing geological records and possible structural trends, there would be lead-zinc-silver, antimony, gold that could be expected in it. Coal and phosphorous deposits might also be found as well. Some deposits are a little far from the proposed railway line. Why mentioned here is that mineral deposits are trending approximately N-S direction and those could be probably found during construction of the line such as tunneling, bridge, station and railway line etc.,. For example, although Phayaung taung gold is far from the construction, gold occurrences are sporadically found along the western margin of Shan scarp, trending N-S direction. For Yadanatheingi lead-zinc-silver deposit, similar deposits and occurrences could be estimated in Pyin Oo Lwin, Naungcho and Kyaume as regional structural trending passing in these areas. Similarly, deposits at Bawdwin mine and Mohochaung mine, they

might also be extended more or less into Hsipaw, Lasho, Kutkai and Nam Hpatkar areas. For those reason, those deposits are plotted on the map as well.

Suggestion here is that if some precious mineral deposits or occurrences found along the line, it is needed to officially inform the authorized person from government and local community as well. Those communities should do monitoring work and help the construction railway project for mutual benefit. Legal enforcement should act to give penalty for those people who carry away it from the line or make mineral dressing in situ.

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