Geochemical Analysis from Rocks, Soil Samples and Stream Sediments Samples at Kwinthonze Gold Mineralization, Thabeikkyin Township, Mandalay Region

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Abstract

The study area lies within the Mogok Metamorphic Belt, about 115 kilometer far from north of Mandalay and 97 kilometer far from south west of Mogok, Mandalay Region. Geologically, the study area is situated along the western margin of the Shan- Thai block, composed mainly of high grade metamorphic rocks of the Mogok Belt, which are locally intruded by biotite microgranite, pegmatite and aplite. Dykes and veins are considered to have originated during the later stage of the granitic intrusions First-intrusion of biotite granite (59Ma), Paleocene. Local intrusion (biotite microgranite) is beneath the deposit. Second-growth of zircon rime at (47-43Ma),Eocene to Oligocene in age. Synmetamorphic melting produced garnet and tourmaline bearing leucogranite at 45.5+0.6 Ma and 24.5+ 0.7 Ma. Gold mineralization styles are wide spread occurrences of Placer Gold, Sediment hosted oxidized Gold mineralization along the fractures within the marbles and Massive sulphide Gold mineralization hosted by hydrothermally belong to quartz sulphide veins. Most of the gold minerals are very finely and associated with pyrite, arsenopyrite and chalcopyrite. Trace elements data can also provide to determine the tectonic origins of intrusive rocks as Volcanic Arc Granite (VAG) after Piearce et.al., 1984 .Based on the binary plot, the granite from the study area fall within syn-collisional granite setting .By XRD analysis and petrographic studies,the alteration patterns include propylitization, argilization, chloritization and skarn alteration. Altered mineral groups belong to chlorite group, illite group, sericite group, kaolinitite group and silica group mineral.

Keywords: Shan- Thai block, Mogok Metamorphic Belt, Synmetamorphic, skarn.

Introduction

The study area is located at the southeastern part of the Thabeikkyin Township, Mandalay Region.. It falls within one inch topographic map No. 93 B/1 and lies between Latitude 22° 44′ 10″ to 22° 51′ 00″ N and Longitude 96° 03′ 00″ to 96° 07′ 30″ E (Fig. 1). The main purpose of this research is to understand the ore mineralogy of skarn mineralization in Onzone area. Petrography, X-ray Diffraction (XRD) Analysis and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) were applied in this study.

The metamorphic rocks of the study area are generally regarded as high-grade regional metamorphism. Their trend is fairly uniform, but the style of folding is different from rock type to rock type. They are dominantly found in the northern and western part of the area. Marble units are more abundant than calc-silicate rocks in the area. Marbles contain constituents of phlogopite, fosterite, diopside, spinel and graphite in variable amount.

Metamorphic Petrology

The study area is mainly composed of metamorphic rocks, especially marbles, calc-silicate rocks and some dykes which are cut across by pegmatitic veins. They are nearly N-S trending. These are white marble, Phlogopite- graphite-marble, Spinel bearing graphite – phlogopite – chondrodite marble and Diopside calc - silicate rocks .

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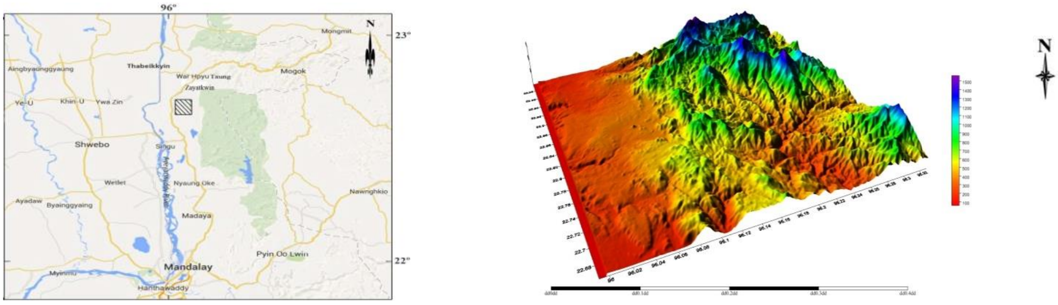

Figure (1). Location and 3D Map of the Study area

Types of Metamorphism

In the study area, there are two main types of metamorphis recogonized, regional metamorphism which prevailed in the metasedimentary rocks of prominent calcareous and pelitic compositions and contact metamorphism that locally influenced on the formation of skarn rocks.The regional metamorphism in the present area is occurrence of mineral linerations and segregation, recrystallization textures and neomineralization products such as diopside and forsterite.

The contact metamorphism is recognized by the occourrence of hornfelsic texture and formation of Ca,Fe and Mg hydrous silicates minerals in carbonate rocks. Presence of fosterite and diopside indicates the metamorpiic transformation in the present area for the whole was prograde metamorphism.

Geochemical analysis of rock samples from study area

Ten samples were selected for the whole rock geochemical analyses from the several localities of the study area. Major, minor and rare earth elemental composition of the rock and ores were analyzed by Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) and Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES). Samples for major, minor and rare earth geochemistry were prepared and analyzed at Activation Laboratories (Actlabs), Ontario, Canada.

Major and Trace Element Composition

The major elements content of the metamorphic rocks and associated rock samples show slight variation within the same suite. Major and minor oxide composition of samples was plotted on the Harker diagram in order to see their variation between these elements. On the diagram, CaO, MgO and FeO concentration of the metamorphic rock samples show a coherent negative correlation with SiO_2. CaO, and to a lesser extent, TiO_2 and P_2O_5 also show a negative correlation with SiO_2. Na_2O is positively correlated with $SiO._{2.}$

Rare Earth Element (REE) Geochemistry

The REE concentrations of the metamorphic rocks from the study area were normalized to chondrite meteorite and primitive mantle. Normalization used the schemes of Nakamura (1974), Sun and Mc Donough (1989).Chondrite-normalized REE distribution patterns for the metamorphic rocks and associated rocks are presented in figure (2). Samples show gradient in the LREE side and parallel in the HREE side with strongly fractionated pattern. The metamorphic rocks are strongly enriched in light rare earth elements (LREE) and relatively depleted in heavy rare earth element (HREE).

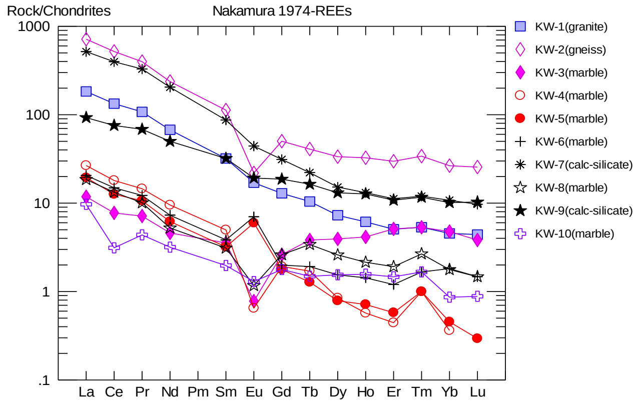

Figure (2). Chondrite-normalized REE patterns of metamorphic rocks from the study area (Nakamura, 1974).

Moderate to strong negative Eu anomilies was observed in some samples, especially in biotite gneiss (KW-2), ore with marble (KW-3), ore with marble (KW-4), marble (KW-8), and marble (KW-10). In contrast, two samples (ore withmarble-KW-5 and marble-KW-6) are characterized by strong Eu-positive anomaly. The depleted Eu-nomalies in the chondrite-normalized REE diagrams indicate a plagioclase-depleted Eu crustal source or fractionation during magmatic differentiation.

By Sun and Mc Donough (1989), the multi elements diagram of metamorphic rocks are strongly spiked and exhibit complex nature (Fig. 2) and (Fig. 3). In the primitive mantle normalized multi-element diagram of mable samples (Fig. 3), depletion was observed in the Rb, Ba, Nb, Ta, Sr, Zr, and Ti and enrichment was seen in the Th, U, K, Pb, Nd and Sm. But one marble sample (KW-8) exhibit enrichment of Nb, Ta and Zr.

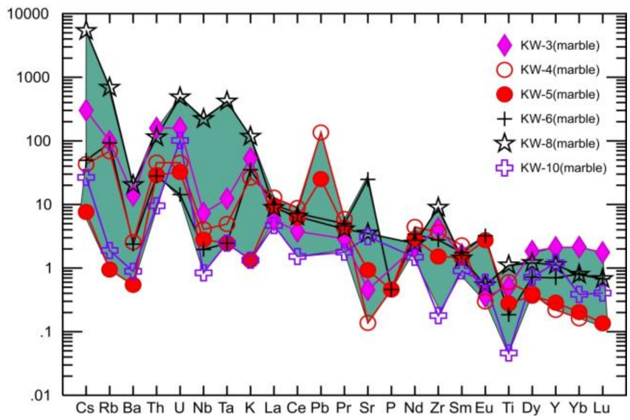

Figure (3). Incompatible element patterns of metamorphic rocks (marble) of the study area normalized to primitive mantle. The normalized values of primitive mantle abundances are used by data of Sun and McDonough (1989).

For other rocks such as calc-silicate and granitic samples (Fig. 4), they show similar patterns on the primitive mantle-normalized diagram which is a characteristic of calc-alkaline rocks.

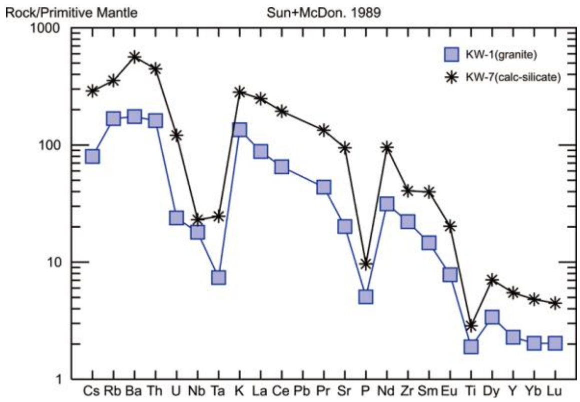

Figure (4). Incompatible element patterns of calc-silicate, gneiss and granite of the study area normalized to primitive mantle. The normalized values of primitive mantle abundances are used by data of Sun and McDonough (1989).

Geochemical Soil Sampling at Kwinthonze area

Detailed geochemical soil sampling was carried out on a square grid pattern. Grid lines were spaced 8m apart and substations were pegged at 8m interval.The base line was trending NS about 8m in length and the traverse lines were run perpendicular to base line. A total of 9 lines were surveyed by Brunton Compass and tape in Kwinthonze area (UTM-2296-01) (Fig. 5).

A detail soil geochemical survey is the main objective of the present investigation. A geochemical soil sampling plan map of Kwinthonze area is show in (Fig. 5). Samples were collected at 25 ft interval on traverse lines. Soil samples were collected from the B horizon which is one of the illumination zone at the depth about 18-24 inches.

The total numbers of soil samples were 63 numbers, sizing of the soil samples to (-80) mesh size fraction, were done in the field. The samples were digested with aqua-regia and trace elements analyses were done with an atomic absorption spectrophotometer AAS. The following element Au, Ag, Zn, Pb, Cu and Fe were determined.In the study area, Au, Cu and Pb are closely associated and their trend are nearly north-south in direction. Since silver and zinc are the most mobility elements so their anomalies are all directions.

Gold, silver, copper and lead distribution map of Kwinthonze area are shown in figures (6) and (7).

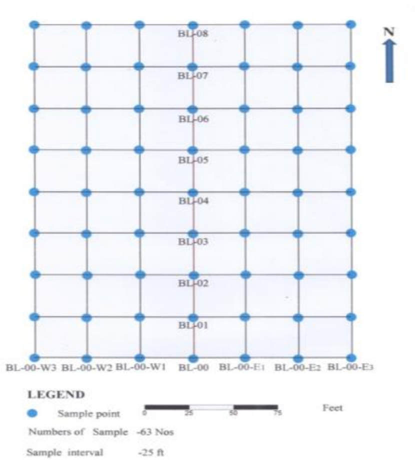

Figure (5). A geochemical soil sampling plan map of Kwinthonze area

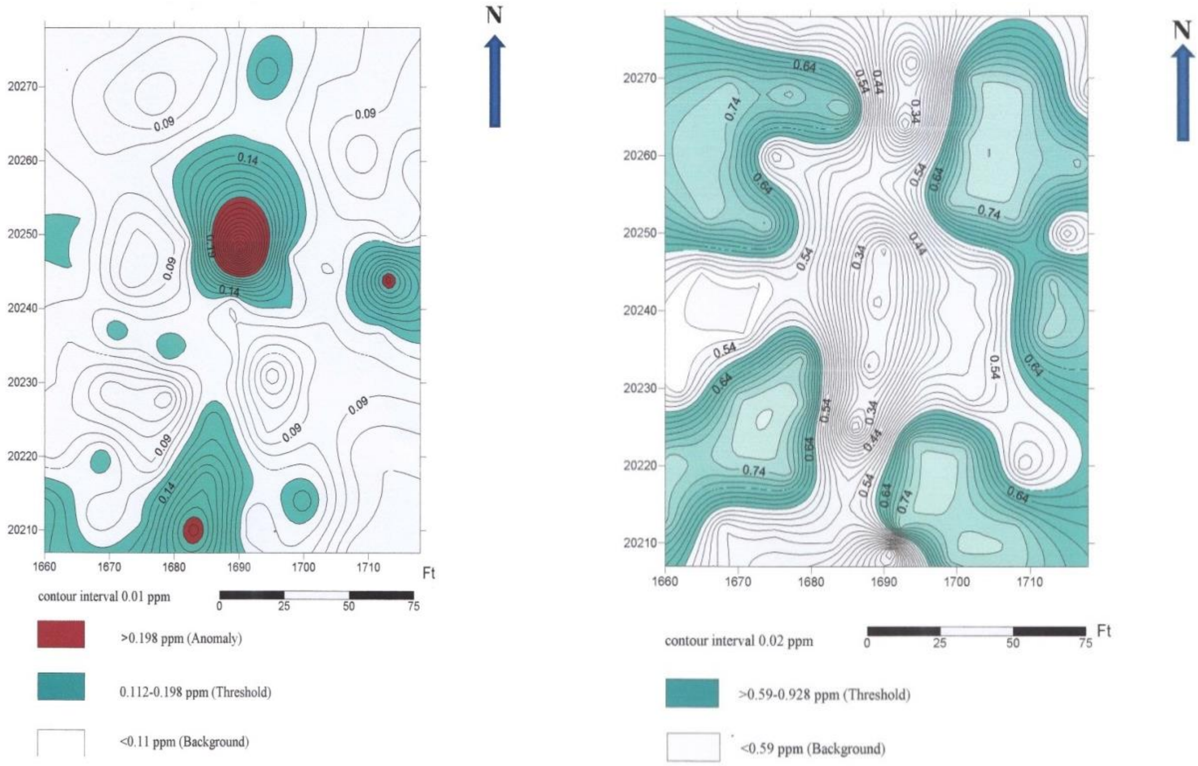

Figure (6). Gold and Silver distribution map of Kwinthonze area

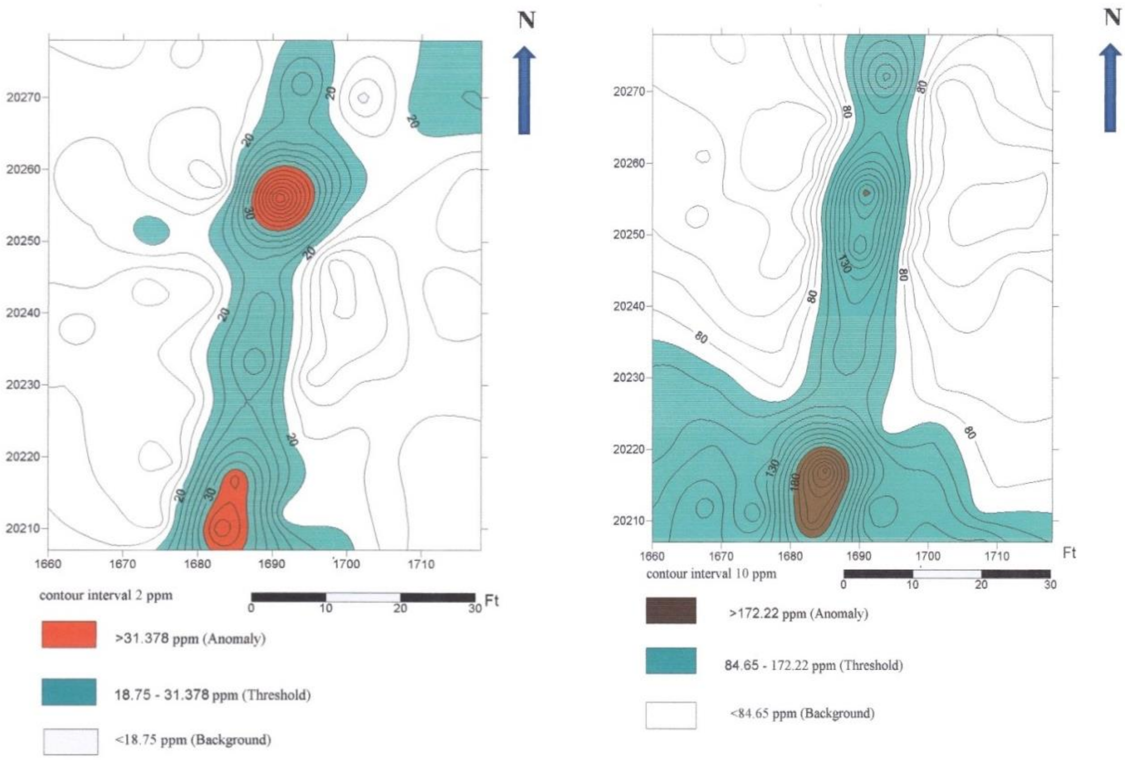

Figure (7). Copper and Lead distribution map of Kwinthonze area

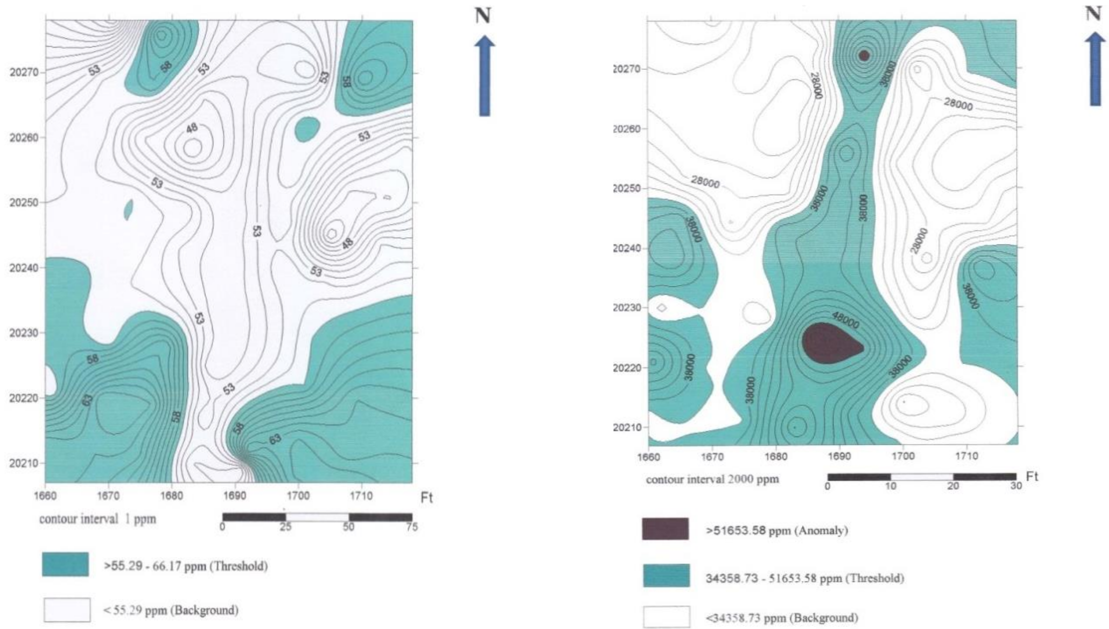

Figure (8). Zinc and Iron distribution map of Kwinthonze area

According to the geochemical survey using rock chip sampling were useful tool in locating mineralization. At the study area, the rock chip samples measurement of Au, Ag, Cu, Pb, Zn and Sb.

The dendogram draw from cluster analysis of geochemical rock samples from Kwinthonze area indicates that there are four associations (Fig.9).

Cu – Pb

Cu – Pb, – Fe

Cu – Pb, – Fe, – Au

Ag – Zn

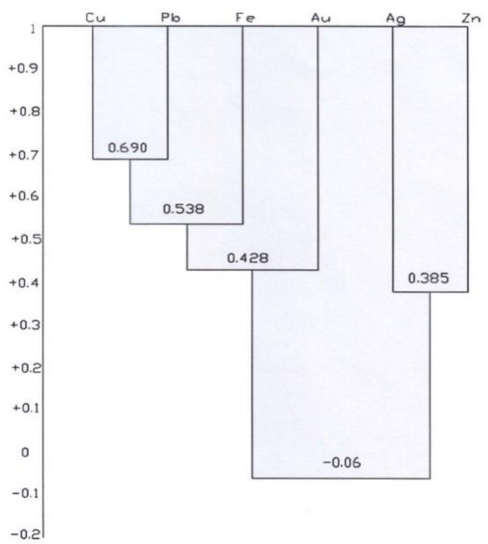

Figure (9). Dendrogram constructed by weight pair group method of rock chip samples Kwinthonze area

The first group of elements is copper and lead, the second group of elements is Iron and the third group of gold, moderately associated with the first group and second group of elements. The fourth group of zinc and silver are weakly associated the first group, second group and third group of element.

Geochemical Investigation of Stream sediment samples at research area

Geochemical prospecting stream sediment samples were collected from Ngapyawdaw Chaung area. These samples were sent to D.G.S.E chemical laboratory. The stream sediment samples were collected middle of the stream. These samples are taken 30 meter interval and were survey by tape and Brunton compass. Total numbers of stream sediment samples were 22. All of the samples were digested with aquaregia and trace elements analysis was done by an Atomic Absorption Spectrophotometer (AAS). The elements Au, Ag, Cu, Pb, Zn, Sb were determined.

Statistical Treatment of Stream Sediments Geochemical Data from Ngapyawdaw Chaung

The stream sediment samples were collected at Ngapyawdaw Chaung (Fig. 10. a) and data obtained from geochemical analysis have been treated by statistical method using Geostatistical software. That was done by calculating the value of Mean (X) and Standard deviation. The normal background values were taken as mean and the threshold values were taken at (X+ 2S The results of the statistical analysis are shown in table (1). The statistical anomalies of Au,Ag, Cu, Pb ,Zn and Sb are shown in (Fig. 10. b) to (Fig. 10. g).

Table (1). Result of the statistical analysis of Stream Sediment Samples (ppm) in Ngapyawdaw Chaung

Categories	Au	Ag	Cu	Pb	Zn	Sb
Anomalous Value	>0.254	>0.318	>15.244	>32.672	>13.656	>166.18
Threshold Value	0.14-0.254	0.08-0.318	3.95-15.244	19.41-32.672	9.82-13.656	122.05-166.18
Mean value	<0.14	<0.08	<3.95	<19.41	<9.82	<122.05

The results indicate the following range of value in Ngapyawdaw Chaung.

Au values range from 0.05 ppm to 0.25 ppm

Ag values range from 0 ppm to 0.25 ppm

Cu values range from 3 ppm to 10 ppm

Pb values range from 10 ppm to 35 ppm

Zn values range from 8 ppm to 15 ppm

Sb values range from 98ppm to 212 ppm

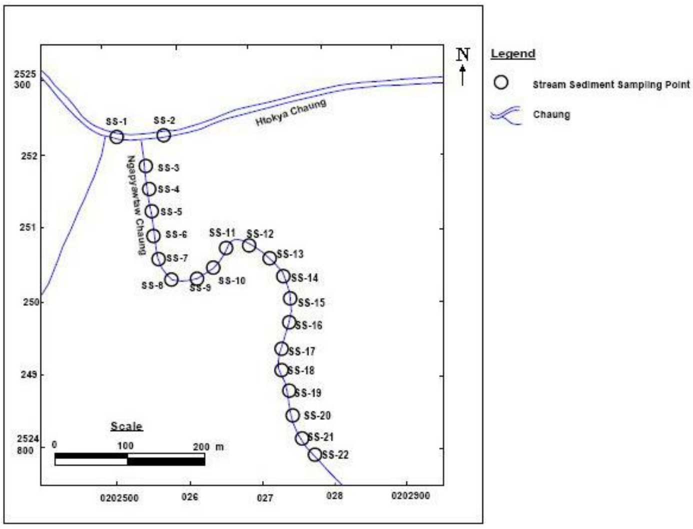

Figure (10). (a). Stream Sediment Samples Location Map of Ngapyawdaw Chaung

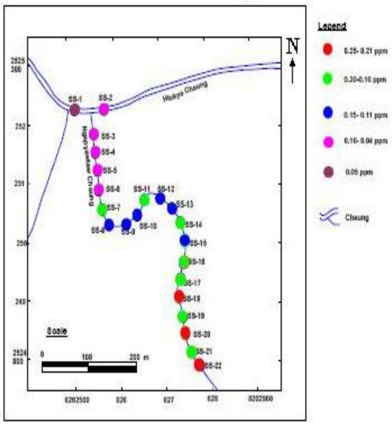

Figure (10). (b). Stream Sediment Anomalies of Gold

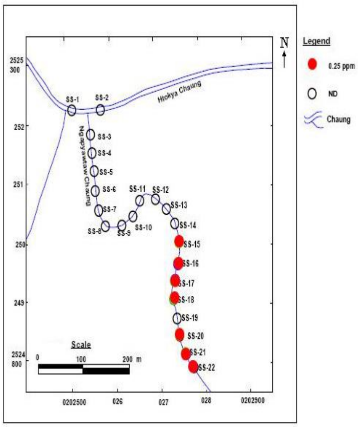

Figure (10). (c). Stream Sediment Anomalies of Silver

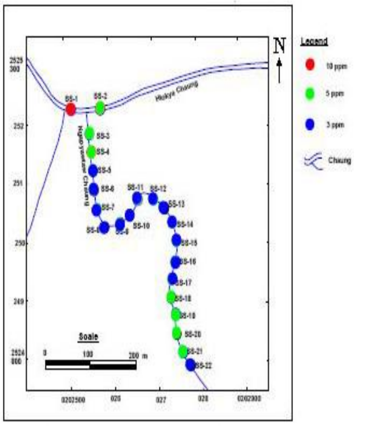

Figure (10). (d). Stream Sediment Anomalies of Copper

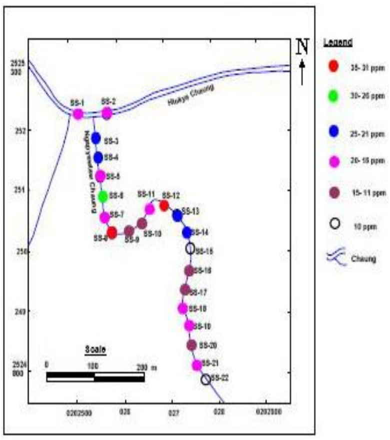

Figure (10). (e). Stream Sediment Anomalies of Lead

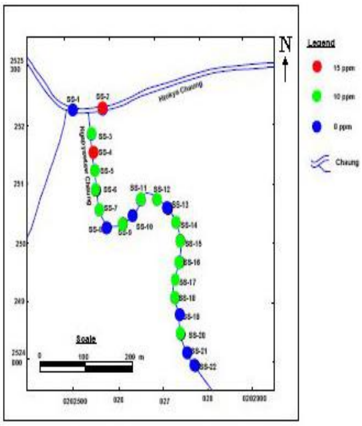

Figure (10). (f). Stream Sediment Anomalies of Zinc

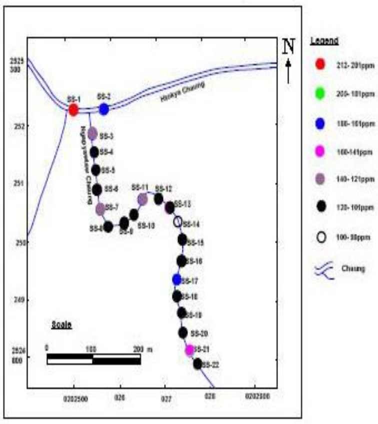

Figure (10). (g). Stream Sediment Anomalies of Antimony

Trace Elements Distribution

Distribution of Gold (Au)

The gold contents vary from 0.05 ppm to 0.25 ppm in the stream sediment of Ngapyawdaw Chaung. The anomalous zone of gold value is (>0.254) ppm. The mean value of gold is 0.14 ppm and itis located at (UTM – 2524912N / 202734 E). The dispersion of gold anomaly has not been designated in the survey area because the maximum value of gold is less than anomalous value. The distribution pattern of gold frequency histogram of Ngapyawdaw Chaung gold prospect is shown in (Fig.10.b).

Distribution of Silver (Ag)

The silver contents vary from 0 ppm to 0.25 ppm in the stream sediments of Ngapyawdaw Chaung. The anomalous zone of silver value is (>0.318) ppm. The mean value of silver is 0.08 ppm. The dispersion of silver anomaly has not been designated in the survey area because the maximum value of silver is less than anomalous value.(Fig. 10.c).

Distribution of Copper (Cu)

Minimum contact of copper in stream sediment is 3 ppm and the maximum contact of copper is 10 ppm. The mean value is 3.95 ppm. The highest value of copper contact is located at (UTM – 2525233 N / 202524 E). The anomalous value of copper is (> 15.244 ppm). The distribution frequency histogram of copper is shown in (Fig. 10.d).

Distribution of Lead (Pb)

The lead contents vary from 10 ppm to 35 ppm. The minimum value of lead content10 ppm. The maximum value of lead contact is 35 ppm and it is located at (UTM – 2525079 N / 202698 E). The anomalous zone of lead value is (> 32.672 ppm). The mean value of lead contact is 19.41 ppm. The distribution frequency histogram of lead is shown in (Fig. 10.e).

Distribution of Zinc (Zn)

The zinc contact varies from 8 ppm to 15 ppm in the stream sediment of Ngapyawdaw Chaung. The anomalous zone of Zinc value (>13.656) ppm has been observed in area. The minimum value of zinc is 8 ppm. The maximum value of Zinc contact is 15 ppm and it is located at (UTM – 2525239 N / 202575 E). The mean value is 9.82. The range is 11.5 ppm. The distribution pattern of zinc in stream sediment and frequency histogram of zinc is also shown in (Fig. 10.f)

Distribution of Antimony (Sb)

Minimum contact of antimony in stream sediment is 98 ppm and the maximum content of stibnite is 212 ppm which is located (UTM – 2525233 N / 202524 E). The mean value is 122.05 ppm. The anomalous value of stibnite is (>166.18 ppm). The distribution frequency histogram of antimony is shown in (Fig. 10.g).

Conclusions

Gold and base-metal mineralizations associated with hydrothermal alteration types include skarn alteration, propylitization, sericitization (argillitization) and hematization. Common ore minerals of the characteristics and genesis of gold mineralization in the Kwinthonze area include chalcopyrite, galena, sphalerite, pyrite, gold and Fe-oxides minerals such as (hematite and goethite). Common ore textures include replacement, exsolution, and banded texture In Kwinthonze area, leucogranite are intruded into the host rock of dolomitic crystallined marble and Calc-Silicate-Rock. Minreals assemblages are pyrite, forsterite, galena, sphalerite, magnetite and electrum. Minreals association are Au –Pb-Zn-Ag and Ore grade is 4-6g/t. Fineness of gold 980. Based on the host rocks/associated rocks, types of alteration, mineralization style, ore and gangue mineralogy, the ore mineralization in the Kwinthonze area is identified as intrusion-related base-metal **Gold-Lead skarn** mineralization.

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