The Government of the Union of Myanmar
Ministry of Education

Department of Higher Education (Lower Myanmar)
and
Department of Higher Education (Upper Myanmar)

Universities Research Journal

Vol. 1, No. 2 December, 2008.

Universities Research Journal 2008
Vol. 1, No. 2

Contents

Tin-tungsten Mineralization of Zingyaik-Kadaik Area, Paung Township, Mon State

Than Htoo Aung

Abstract

The research area is located near the Zingyaik and Kadeik villages, Paung Township, Mon State. It is situated within the western edges of the Shan-Thai Block composed mainly of slate, phyllitic slate, and quartzite units of Mergui Group which are intruded by the granitic rocks. The Tin-tungsten bearing veins occur in the granitoid and adjacent meta-sedimentary rocks along the Zingyaik range. These veins are trending NNW-SSE direction parallel to the regional structural trend. An alluvial Tin occurrence has been found near the Kadeik village. The Tin-tungsten mineralization occurs in the tourmaline-quartz veins, pegmatite and greisens. The alteration products of mineralization are silicification, tourmalinization, and greisenization. The Sn-W minerals associated with the pyrite, arsenopyrite, and chalcopyrite. Due to the XRF data, 0.125% to2.38 % of Sn and 2.125 % to 9.68 % of W were contained samples from Zingyaik mine. The Tin-tungsten mineralization occurred as fracture filling ore deposits developed mainly along the NNW-SSE trending fault zones. According to the field evidences and laboratory analysis, tin-tungsten ore is formed at pneumatolitic to hypothermal stages in the magmatic hydrothermal system.

Key words: Zingyaik-Kadaik area, Tin-tungsten Mineralization, NNW-SSE trending fault zone, pneumatolitic to hypothermal stage.

Introduction

The study area of Zingyik-Kadaik is lying at the eastern margin of Central Lowland and partly on the Western Shan-Taninthayi region. It also lies part of Central granitoid belt. The granite intrusion of study area may be northern continuation of Tin-Tungsten bearing granite of Taninthayi Division. Tin-Tungsten minerals are minded along the Zingyik range and Kalamataung range since 1940. In this research, systematically investigations of Tin-Tungsten and antimony mineralization of study area have been carried out.

Demonstrator, Department of Geology, Hpa-an university

Location, size and access

The study area covers an area of 30 square miles between Latitudes 16° 42' and 16° 47' N and longitude 97° 23' and 97° 29' E. By the military used topographic map, it is situated between vertical grid No. 970 to 070 and horizontal grid no 230 to 370 (Burma survey map no. 94 H/5 and 94 H/6 and 2). The Zingyik-Kadeik area lies 8 miles southeast of Thaton and 18 miles Northwest of Mawlamyine.

The study area lies beside and which run parallel to the Yangon-Moulamyin railway and highway car road. Therefore, the transportation and communication to the study area is easily asses. By motor road and cart tracks are taking to the investigated site (figure-1).

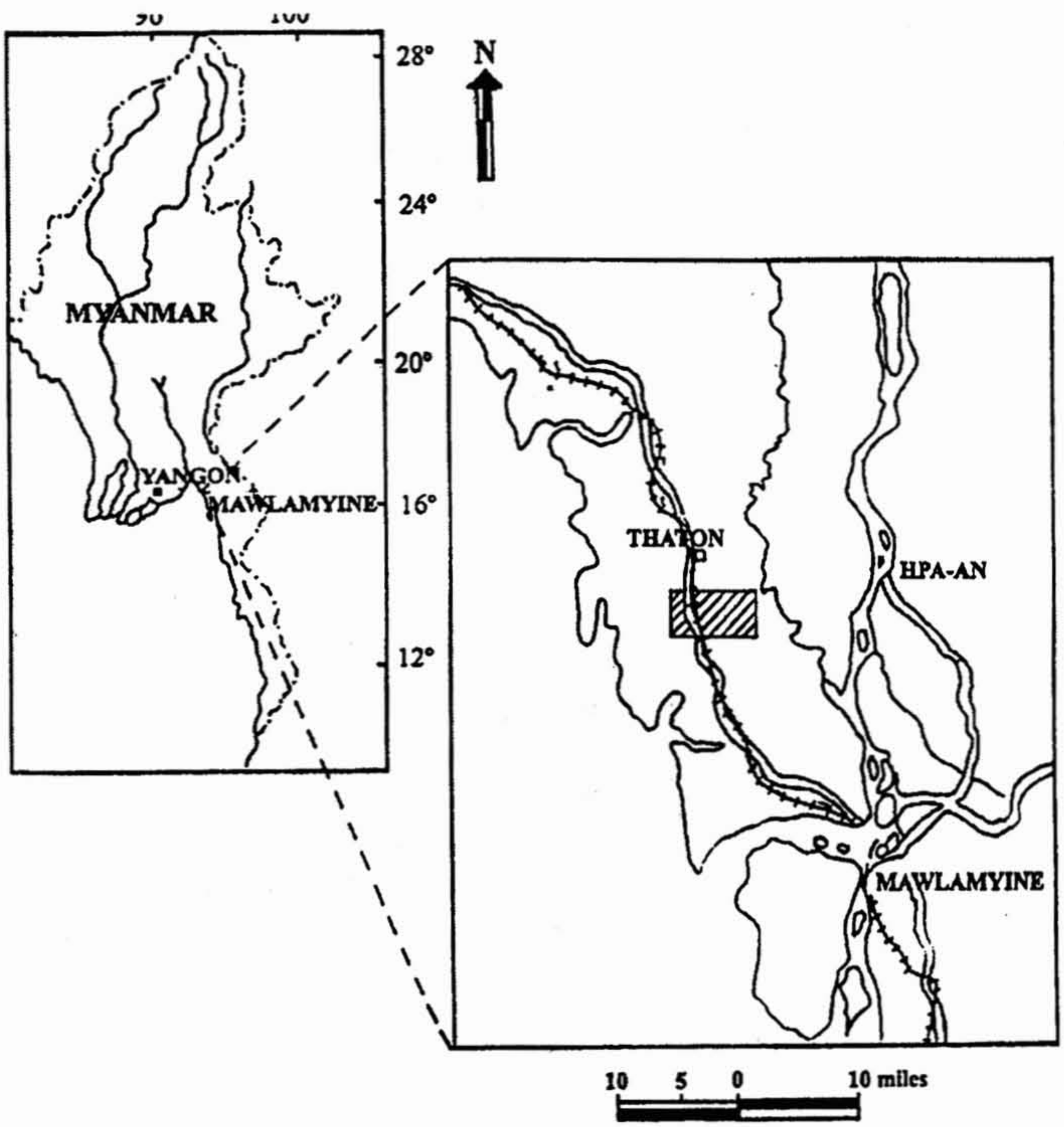


Figure 1: Location map of study area.

Geology

There are three mapable units in the study area, namely, the Meta-sedimentary rocks of Mergui Group, Granitoid rocks of Zingyaik plutonic mass and Meta-igneous rock of so-called Mogok metamorphic rock. The mineralizations of Tin-tungsten are associated with the granitoid rock and neighboring country rocks. The antimony mineralizations are associated with the meta-sedimentary rocks of Mergui Group.

Mergui Group

Lithologically, the Mergui Group comprising mainly of reddish to light grey quartzite, quartzitic sandstone, gray to dark gray or black slate, phyllitic slate and yellowish colored shale exposed at the Kalamataung rang, eastern part of the study area.

Quartzite is fine to medium-grained, poorly foliated and massive nature. It is whitish grey color on fresh surface and brownish grey color on the weather surface. It is hard and compact and well jointed. They are often interbedded with the shale and slate.

Along the crest and top of the Kalamataung range, fine to medium grained micaceous quartzite is observed. It is white to light grey color on the fresh surface and grey color on the weather surface, massive or banded nature well foliated and highly jointed.

Slate is fine-grained, grey to dark grey or black colored on fresh surface and light grey on weather surface. It is soft and friable, highly jointed and well foliated. Highly brecciated slate occurred at the antimony mineralized localities probably cause of structural deformation. In some places, hard and compact, slightly foliated phyllitic slate is observed.

Shale unit is intercalated with the slate and quartzite unit occurred along the western flank of Kalamataung range. It is fine-grained, yellowish to grey color, soft and well bedded, also well jointed.

The up rise of the granitic magmas appears to be controlled by the pre-granite tectonic features of the intruded Mergui Group.

The Zingyaik Taung Granite

In the study area, the plutonic (Intrusive) igneous rocks can be divided into two units; they are (1) Biotite granite and (2) Micro-granite.

Biotite granite is extensively exposed along the Zingyaik range. These exposures are mostly weathered and highly jointed with prominently NNW-SSE striking joint sets. They are also occurred exfoliation weathering nature. Sometime they are exposed as boulder. It is medium to coarse grained texture, whitish grey color on fresh surface and dark grey color on weather surface. The slightly foliated granite (granite gneiss) occurred along the contact between granite and meta-igneous units. Tourmaline granite is also observed at some places, especially associated with the Tin-tungsten mineralization.

Microgranite is well exposed at the Zingyaik hill, Seikmin taung, Mintayartabar taung, Thinkanlang taung and Kadeik quarry and western part of Zingyaik range. Microgranite intruded as dike into the biotite granite trending NNW-SSE direction

The granite here is different from the Beik and Dawei. It contains tourmaline accessories and foliation and joint system running from North West to south east. Generally, cassiterite found as accessory in tourmaline granite. The mineral bearing veins occur parallel to the strike of joints and foliations in NW-SE direction in granite.

Veins are usually quartz and pegmatite veins. The chief constituents are wolframite and cassiterite. Pyrite, chalcopyrite, molybdenite and arsenopyrite are the associated metallic minerals. Tourmaline, quartz, muscovites and feldspars are the vein minerals of the loads.

Meta-igneous unit

Due to the latter phase intrusion of granitic magma, pre-existing igneous is metamorphosed and transform to granite gneiss. Granite gneiss is widely exposed along the western flank of Zingyaik range, notably at the Zingyaik water-fall. Granite gneiss is hard and compact with gneissose texture and well foliated. It is coarse grained and consist of augen shaped feldspar porphyroblast, quartz, and biotite. Feldspar phynocrysts are ranged from about 0.5cm to 2cm. sometime medium grained gneiss can be observed. It shows whitish grey color on fresh surface and grey color on weather surface. It has numerous joints sets and sheet jointed nature. The foliation planes are generally striking NNW-SSE and dipping Southwest with steeply inclination.

Tin-Tungsten Mineralization of Zingyaik Area

In the Zingyaik area, the Tin and Tungsten deposits are all on the elongated ridge of Zingyaik ranges that run parallel to the Yangon-Mawlamyaing rail line. These mineral deposits are found in tourmaline granite as veins and in the stream sediments as alluvial deposit. The mineral bearing veins occur parallel to the strike of joints and foliations in NNW-SSE direction in gneissic tourmaline granite.

Veins are usually greisen bordered quartz veins and pegmatite. The chief constituents are wolframite and cassiterite. Pyrite, chalcopyrite, molybdenite and arsenopyrite are the associated metallic minerals. Tourmaline, quartz, muscovite and feldspars are the vein minerals of the lodes.

The main tin-tungsten mines of study are from north to south are Kadeik mine, Katun mine, Zingyaik mine and Pahtantaung mine. The Kadeik alluvial tin deposit is situated near the Kadeik village at about 10 miles to the NW of Thaton and constitutes the extreme north of Zingyaik. It is small and tin rich alluvial deposits.

The Katun tungsten occurrence is near Katun at the north end of Zingyaik Granite. The two vertical lodes about 100 to 200 feet apart occurs striking NNW. The ore mineral is wolframite.

The Zingyaik mine is located near Zingyaik, thin stringer of quartz and pegmatites penetrated into the gneissic tourmaline granite and the adjoining sedimentary rocks. These veins contain tin and wolfram minerals with other metallic sulphide minerals.

The Pahtantaung mine is located near the south of Zingyaik peak. The minerals are occur as muscovite quartz veins in the granite gneiss striking NNW-SSE and dipping SW with the 40-45° inclinations.

Controlling factors of Tin-tungsten Mineralization

Along the Zingyaik Range, the Tin-Tungsten mineralization is associated with the biotite granite, micro-granite, and granite gneiss units. These mineral deposits occurred as vein type (tourmaline quartz veins) and pegmatite dikes and other placer deposit. Therefore, the primary formation of Tin-tungsten deposit is epigenetic ore deposit. The minerals bearing veins are parallel to the strike of the joints and foliations of the granite gneiss, such mineralization may be related to the structural deformation of the host rocks. The NNW-SSE trending fault probably related to the Shan-boundary fault may be took placed such mineralization. The evidence of structural data and field observations confirm this idea, i.e., the occurrence of brecciation of host rocks bear the Sn-W minerals in some place and some Sn-W mineralization occurs in the small-scale faulted veins. Present of fluorine in the ore forming environment of the Sn-W deposits in the study area is evident by the presence of fluorite and fluorine-bearing minerals such as biotite, muscovite, tourmaline and apatite. This abundant fluorine would be responsible for the transport of the Sn-W metals as fluoro hydroxyl complexes. The widespread greisenization and the presence of fluorite and abundant fluorine bearing minerals in the Sn-W deposits suggest that fluorine would have been important as a complexing agent in the transportation and deposition of tungsten and tin. This is the chemically controlling factor of Tin-tungsten mineralization.

Figure 2: Katun Tin-Tungsten mine.
Loc- 016271, 94 H/5
Facing – 50°

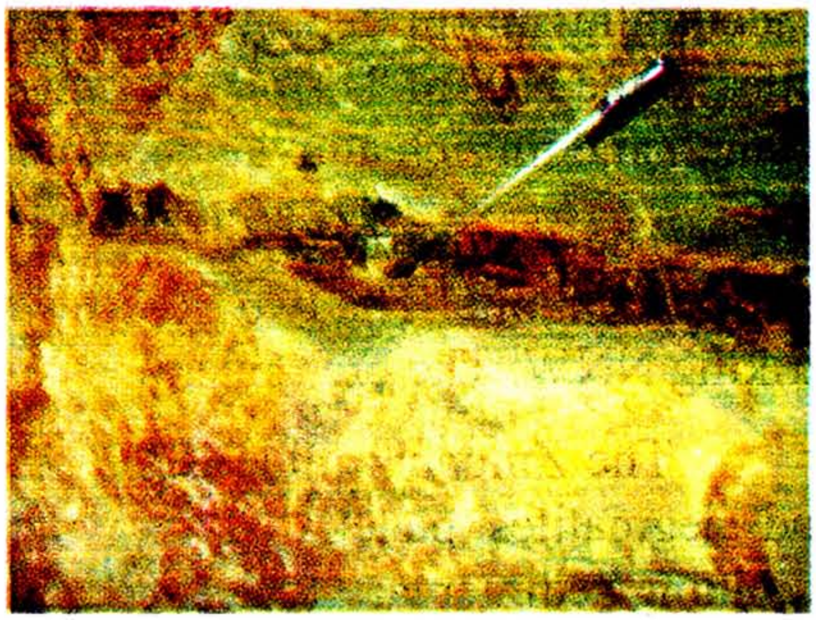


Figure 3: The Tin-tungsten mineral bearing quartz veins intruded to the gneissic granite at Katun mine.
Loc- 016271, 94 H/5
Facing – 50°

As epigenetic mineral deposit, this is restricted to an area that had undergone a favorable per mineralization changes. Such a change may make the country rock more result or more reactive to ore bearing solution. The association of Sn-W mineralization with the silicification, greisenization, and tourmalinization is the chemically controlled ground preparation.

Figure 4: Zingyaik Tin-tungsten mine. Loc - 018271, 94 H/5 Facing – 55°

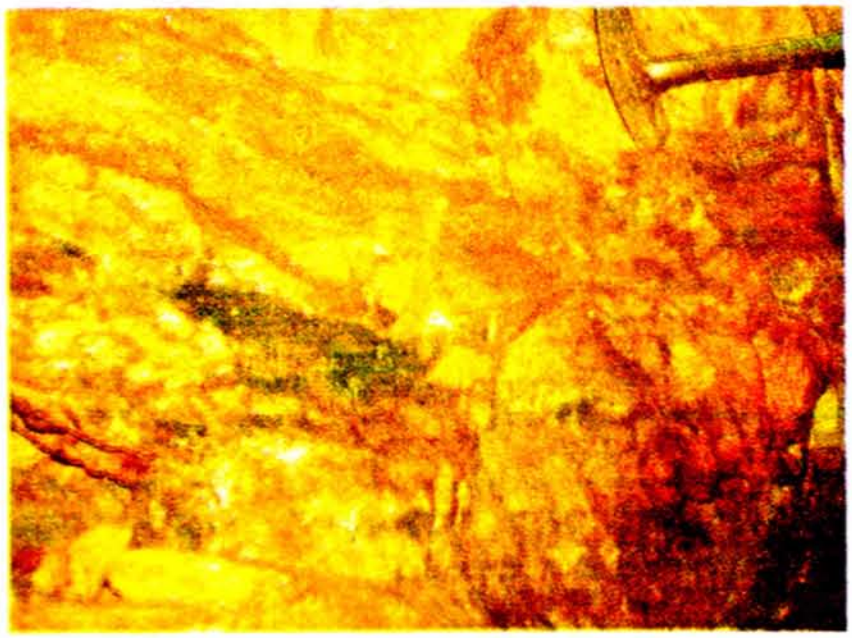


Figure 5: Tin-tungsten bearing tourmaline quartz veins occur in the brecciate microgranite gneiss. Loc - 018271, 94 H/5, Facing – 55°

Geochemistry

Rock samples of all mines on the Zingyaik ranges were analyzed, by the XRF method, in order to determine the geochemical characteristics of Sn-W mineralization and other chemical element concentrations. The rock samples contain cation W, Sn, Fe, Ti, Mn, Zr, Cu, Ga, As, Rb, Nb, Y, etc. As a result of XRF data, 2.125% to 9.688 % of W and 0.120% to 2.385% of Sn were detected in the study area. The Rb, Nb and Y elements are the particular appear to be excellent pathfinders and the host rock geochemical indicators of the Sn-W mineralization of the study area. These elements indicate the Sn-W mineralization is concern with the pneumatolitic to hypothermal deposit.

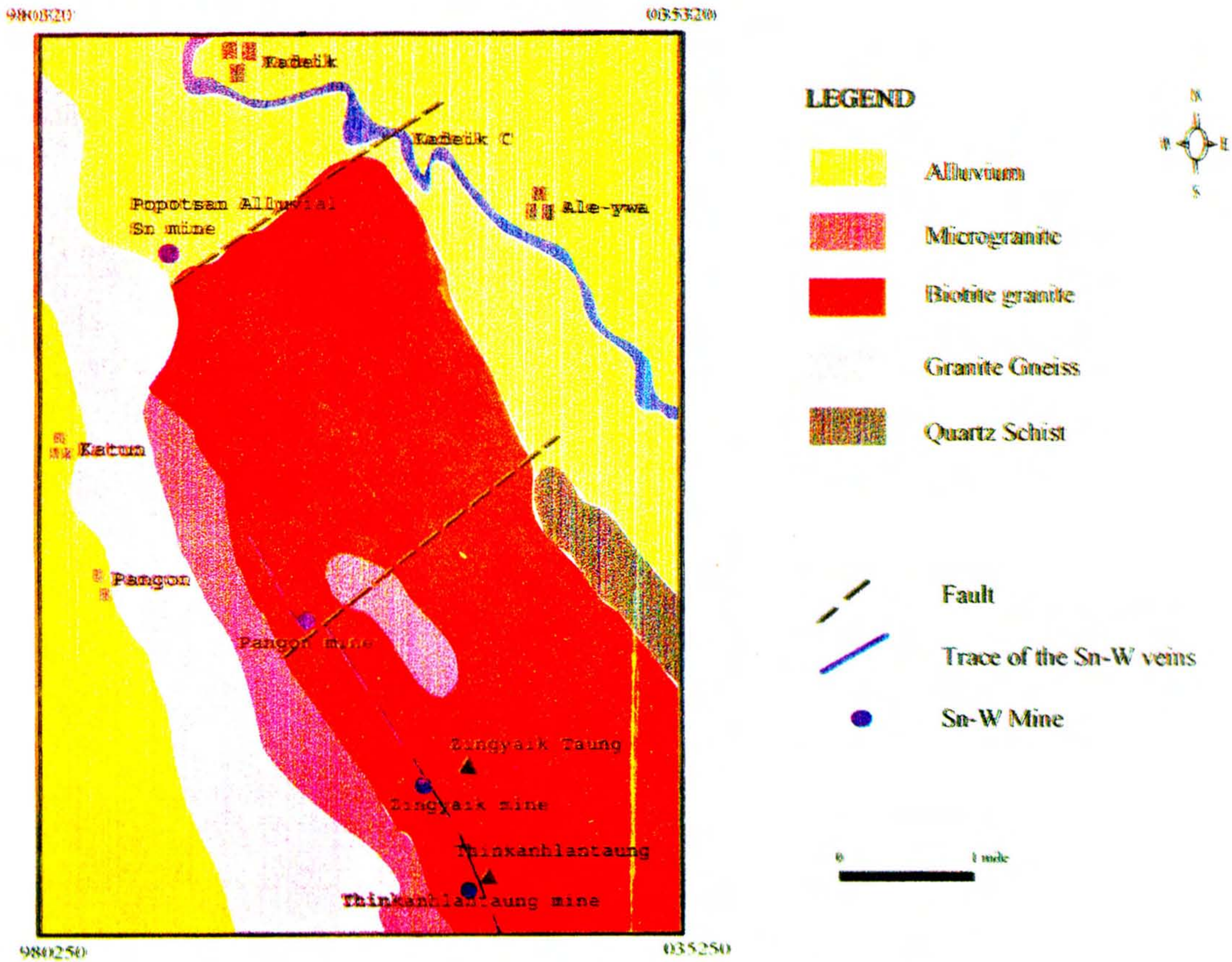


Figure 6: Local Geology and Sn-W Mineralized location map of study area.

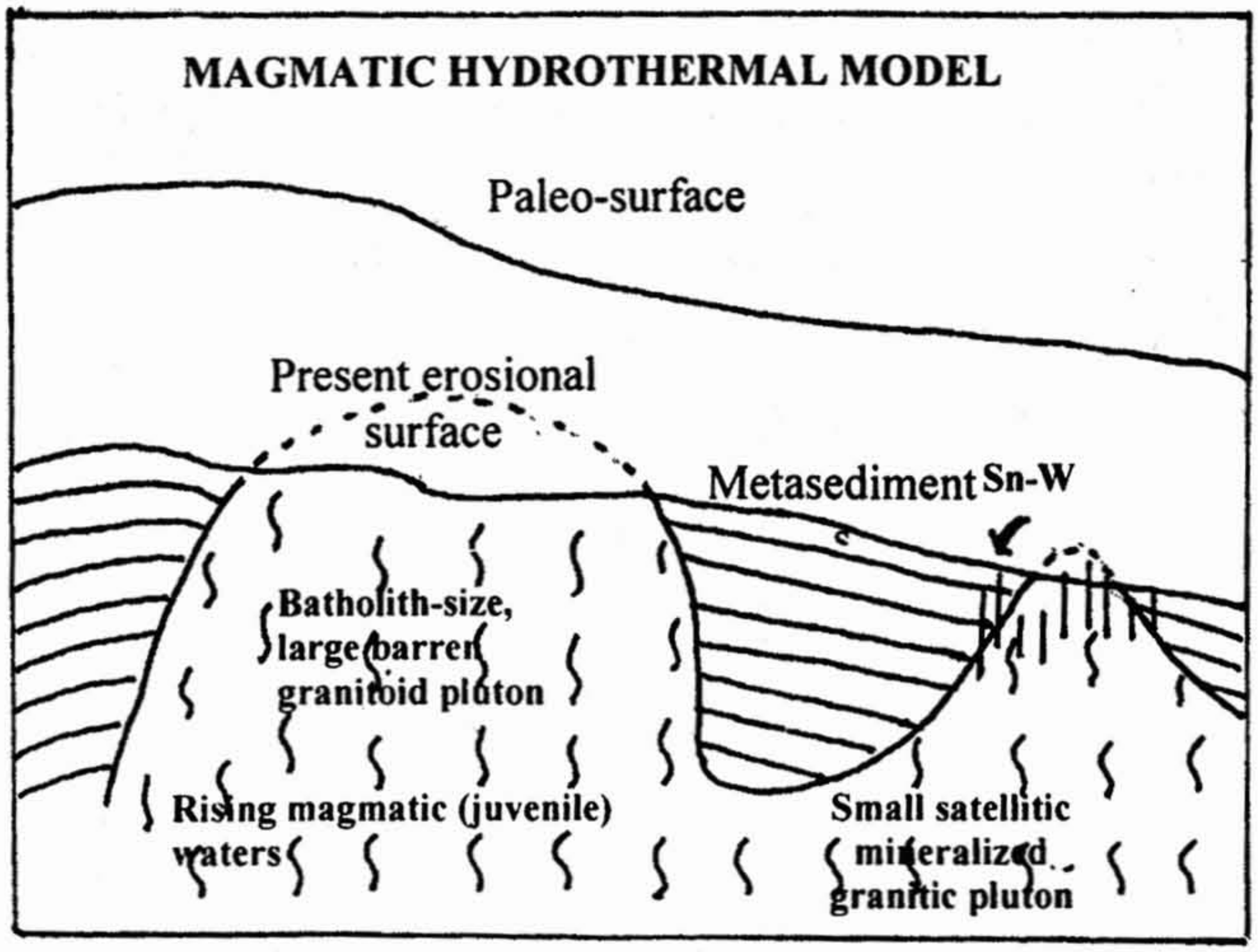
Table (1). Quantitative result of EDXRF method analyzing on the samples taken from the Tin-tungsten mines along the Zingyaik Ranges (measure in wt %).

Sample No.	ZTT.1	ZTT.2	ZTT.3	ZTT.4	ZTT.5	ZTT.6	ZTT.7
W	9.688						
Sn				0.120	2.385	0.141	
Ca	1.763						
Fe	1.378	7.768	12.041	6.611	62.750	3.244	0.205
Mn	0.674	2.031	0.517	0.185	1.615		
Nb	0.047						
K		1.401		7.888	29.235	5.031	
As		0.437	0.538			0.045	
Cu		0.079	0.104	0.090	0.964	0.065	0.038
Ti				0.400			
Rb				0.288		0.266	
Zr				0.101	0.932	0.097	
Ga				0.048			
Y					1.234		
Zn					0.885	0.055	0.042
Se							0.017

Deposition Style of Tin-tungsten Mineralization of study area

Tin-tungsten mineralization occurs along the Zingyaik ranges of study area, as the Sn-W bearing tourmaline-quartz veins and often pegmatite dyke associated with the foliated biotite tourmaline granite. The Sn-W bearing quartz veins are bordering greisen. The W commonly more or less occurs associated with the tourmaline in the veins and Sn in the greisen and also in the pegmatite dykes. The associated minerals are pyrite, chalcopyrite, arsenopyrite, galena, etc, small amount of fluorite is present. Pyrite, probably the most common sulfide in ore zone and widely distributed. Gungue minerals and products of wall-rock alteration include black tourmaline (schorl), muscovite, topaz, and apatite. These minerals are characteristic of igneous metamorphic deposits but are also found with hypothermal veins. Wall-rock alteration is inconspicuous, the veins and their accompanying alteration products are grade into the country rocks, rather than have sharp boundaries. The country rocks are sheeted and often observed shear characters represented by the mylonitic rock and bending of muscovite cleavages.

(A)



(B)

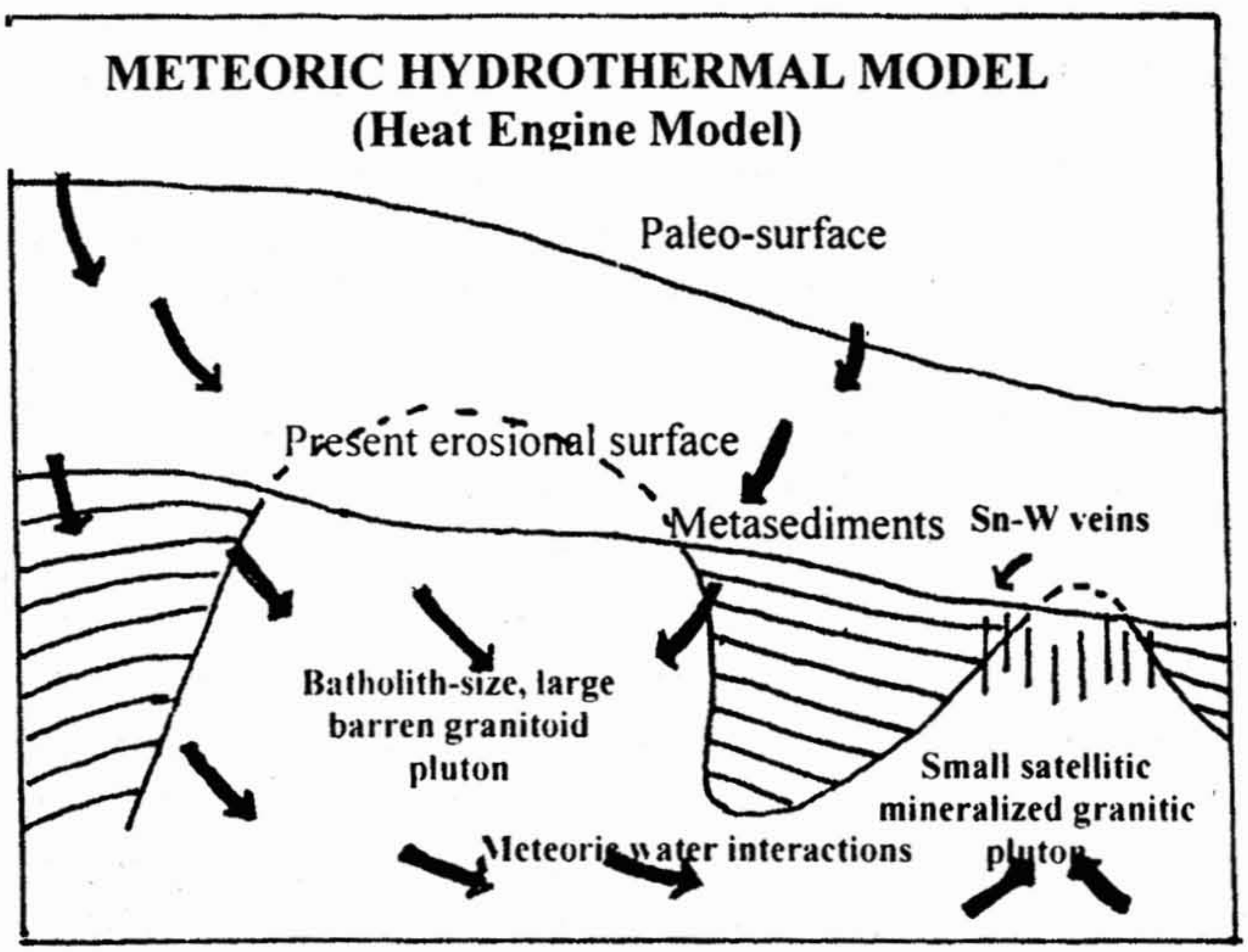


Figure 7: Schematic models for emplacement of vein-type Sn-W mineralization in the central granitoid belt, Myanmar. (After Dr. Khin Zaw, 1990)

In fact, according to the mineralogical analysis, geochemical analysis and nature and characteristics of ore minerals, country rocks, wall-rock alteration products and mineralization can be suggest that the Sn-W mineralization of study area is epigenetic, pneumatolitic to hydrothermal stage as well as hypothermal deposit. It is form high temperature and great depths where connection with the surface is impeded.

Locally, deposits of hypothermal zone grade into pegmatite. For example, the deposit at the Passagem mine, Minas Gerais, Brazil, has been described both as a pegmatite dyke and as a hypothermal vein (Charles. F. Park and et.al, 1964).

Summary and Conclusion

1. The Zingyik-Kadaik area is lying at the eastern margin of Central Lowland and partly on the Western Shan-Taninthayi region. The granite intrusion in the study area is considered to northern continuation of Tin-Tungsten bearing granite of Tanintnayi Division, which intruded a series of metasedimentary rocks of Mergui Group of Carboniferous in age.
2. The Metamorphic rocks of the study area shows distinct structural characters related to the deformation processes. In the study area, the compressional deformation, ductile extensional deformation, ductile shear deformation, and brittle deformations are represented by folded structure, boudinage structures, sheared structures and fractures.
3. Tin-tungsten bearing quartzo-feldspathic veins is reported to occur in the granitoid along the Zingyaik ranges and adjacent metasediments of study area. The main tin-tungsten mines of study are from north to south are Kadeik mine, Katun mine, Zingyaik mine and Pahtantaung mine. The veins trend is NW-SE direction which is parallel to that of prominent jointing in the granitoid. An alluvial Tin occurrence has been reported at Kadaik area, about 16km SE of Thaton.
4. Veins are usually greisen bordered quartz veins and pegmatite. The chief constituents are wolframite and cassiterite. Pyrite, chalcopyrite, molybdenite and arsenopyrite are the associated

metallic minerals. Tourmaline, quartz, muscovite and feldspars are the vein minerals of the ores.

5. The minerals bearing veins are parallel to the strike of the joints and foliations of the granite gneiss, such mineralization may be related to the structural deformation of the host rocks. The NNW-SSE trending fault probably related to the Shan-boundary fault may be took placed such mineralization.

6. The widespread greisenization and the presence of fluorite and abundant fluorine bearing minerals in the Sn-W deposits suggest that fluorine would have been important as a complexing agent in the transportation and deposition of tungsten and tin. This is the chemically controlling factor of Tin-tungsten mineralization.

7. The products of alteration in the Sn-W mineralization are silicification, tourmalinization, and greisenization. As a result of XRF data, 2.125% to 9.688 % of W and 0.120% to 2.385% of Sn were detected in the ore samples. The Rb, Nb and Y elements are the particular appear to be excellent pathfinders and the host rock geochemical indicators of the Sn-W mineralization.

8. In fact, according to the mineralogical analysis, geochemical analysis and nature and characteristics of ore minerals, country rocks, wall-rock alteration products and mineralization can be suggest that the Sn-W mineralization of study area is formed as pneumatolitic to hypothermal stage. The sources of metal and hydrothermal fluids and the extent to which the mixing of meteoric and magmatic fluids had occurred (Heat Engine Model). The close association of Sn-W deposits and the granitoid rocks also implies that the metals have a similar crustal origin as granitoids (Khin Zaw, 1990).

Acknowledgement

The author would like to thank Dr. Mya Mya Aye (Pro-Rector), Hpa-an University for her permissions to work this research project. The author also deeply indebted to Daw Kyi Kyi Swe, Assistant Lecturer and Head, Department of Geology, Hpa-an University for her permission to carry out this research. Financial support was provided by the Department of Higher Education, Lower Myanmar. I thank Professor Dr Ye Myint Swe with my heart for their help in various ways in my research, guiding, giving valuable suggestion, supervising and also providing with literature findings and the manuscript for reading and constructive criticism.

References

Bateman A.F., 1965. Economic Mineral of the mineral deposits of Burma. *Record of the Geological Survey of India*, 56, Deposits, *John Wiley & Son, Inc, New York*, 483p.

Bender, F., 1983. Geology of Burma, *Gebruder Borntrager, Berlin Stuttgart*. 294pp

Brown, J.C., 1924. A geographical Classification 1:65-108

Brunnschweiler, R.O., 1970. Contributions to the post-Silurian geology of Burma (Northern Shan State and Karen State). *Geol. Soci. Australia, 17: 59-79, Sydney*

Chhibber, H.L., 1934. The Geology of Burma. 538 pp, *London: Mac Millan*

Charles, F.P and et.al., 1964. Ore deposits, *W.H. Freeman and Company, San Francisco and Landon,* p 312-324

Clegg, E.L.G., 1944. The Mineral Deposits of Burma. 38pp., *Bombay: Time of India Press.*

Hutchison, C.X., 1984. The tin Metallogenic provinces of Southeast Asia and China: A Gondwanaland inheritance. In: Geology of Tin deposits in Asia and the Pacific, mineral concentrations and Hydrocarbon *Accumulation in the ESCAP Region series*, Vol. 3, ESCAP. ST/ESCAP/547

Khin Zaw, 1990. Geological, petrological and geochemical characteristics of granitoid rocks in Burma: with special references to the associated W-Sn mineralization and their tectonic setting. *Journal of Southeast Asian Earth Sciences, Vol. 4 No. 4, pp 293-304, Elsevier Science, UK.*

Nyan Thin, 1984. Some aspects of granitic rocks of Tenasserim Division. *Dept.Geol., Yangon University, Yangon, Myanmar* (unpublished)

Ramdohr P.,1969. The Ore Minerals and Their Intergrowths, *Pergamon. Press Ltd, Headington Hall,* Oxford. 1174p

Tin Aye and Kyaw Nyein, 1970. Review of tin and tungsten deposits of Burma. Union of Burma J. Sci. & Tech. (1970), 3, 39-74

United Nations publication, 1996. Geology and Mineral Resources of Myanmar, *Atlas of mineral resources of the ESCAP region, UN*, Vol-12, 1-193