

An aerial photograph of a large, calm lake surrounded by lush green forests and rolling hills. In the distance, a small town or village is visible on the shore, with some white buildings that might be a monastery or temple. The sky is clear and blue. The entire image is framed by a thick blue border.

M Sc, DISSERTATION

BY

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GEOLOGY AND MINERALIZATION OF BARITE IN
YEGANZIN-YEWIN AREA,
PINDAYA TOWNSHIP, TAUNGYI DISTRICT,
SHAN STATE (SOUTH)

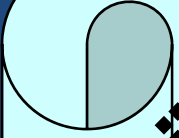
M Sc, Seminar

By

Mg Min Kyaw
2 M Sc. Geol - 39
Economic Mining Geology
15, March, 2012



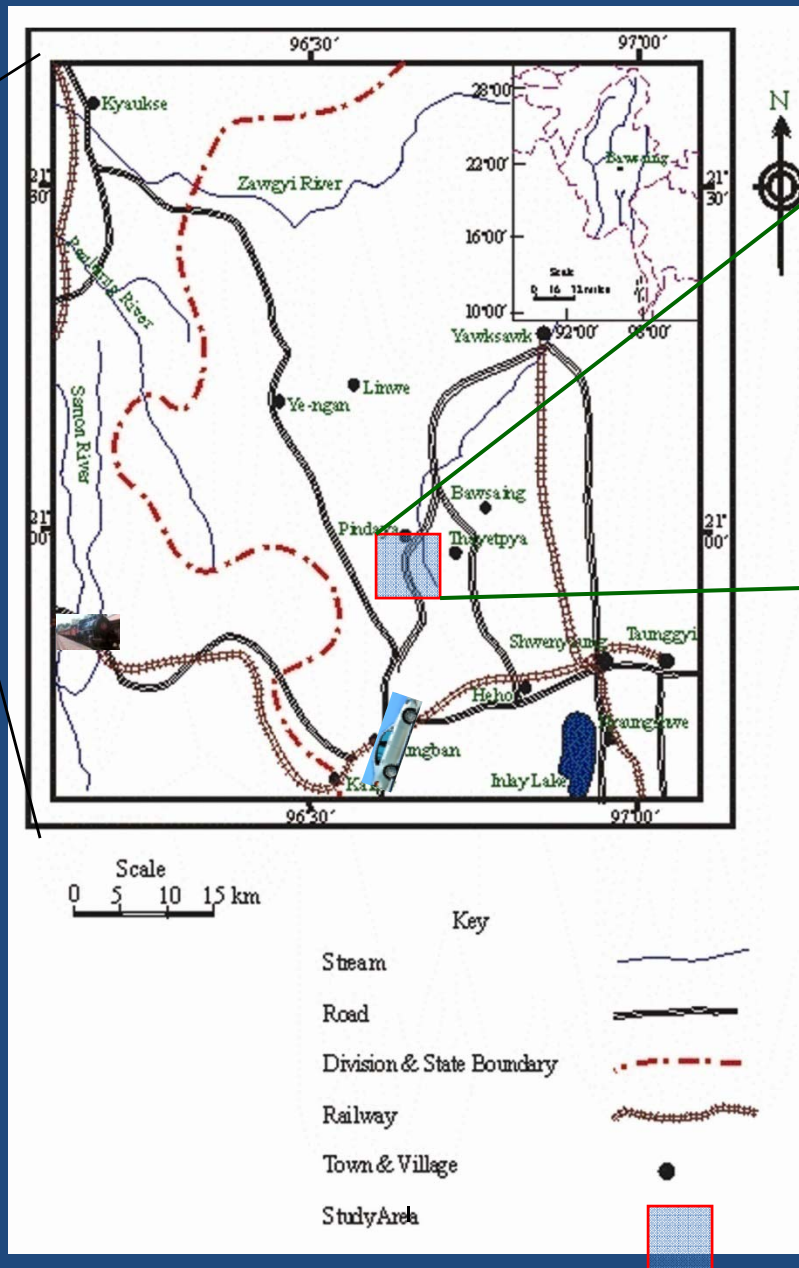
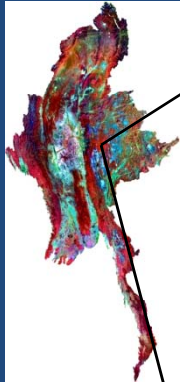
Seminar Program

- 
- ❖ Location, size and accessibility
 - ❖ Regional and detail geology with structure
 - ❖ Petrology and laboratory study
 - ❖ Mineralization of Barite
 - ❖ Mining method and Production of ore
 - ❖ Conclusions and references

PURPOSE AND SCOPE OF RESEARCH

- 1.To prepare a detailed geological and mineralization map of Yegyanzin-Yewin area.
- 2.To study ore sample collected of result both petrology (thin, polishing) and laboratory (A.A.S, X.R.F, X.R.D) test.
- 3.To study the major parameters and processes (structural, physical and chemical) controlling mineralization in the area.
- 4.Construction of an empirical ore deposits model from the above parameters.

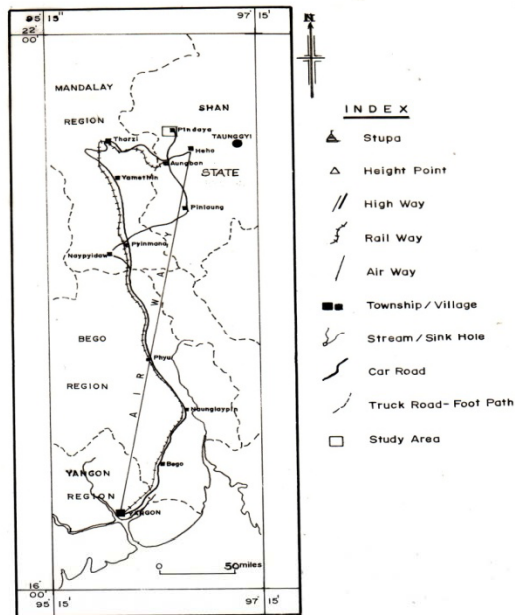
1.Location and accessibility



-latitudes $20^{\circ} 52' 00''$ to $20^{\circ} 57' 00''$ N and longitudes $96^{\circ} 35' 30''$ to $96^{\circ} 40' 30''$ E, Universal Transverse Mercator (UTM) reference of 2096 09 KD.

-- covers length of about 80.65 km in the east -west direction and width 90.15 km in a north-south direction.

- coverage is about 79 square kilometer.



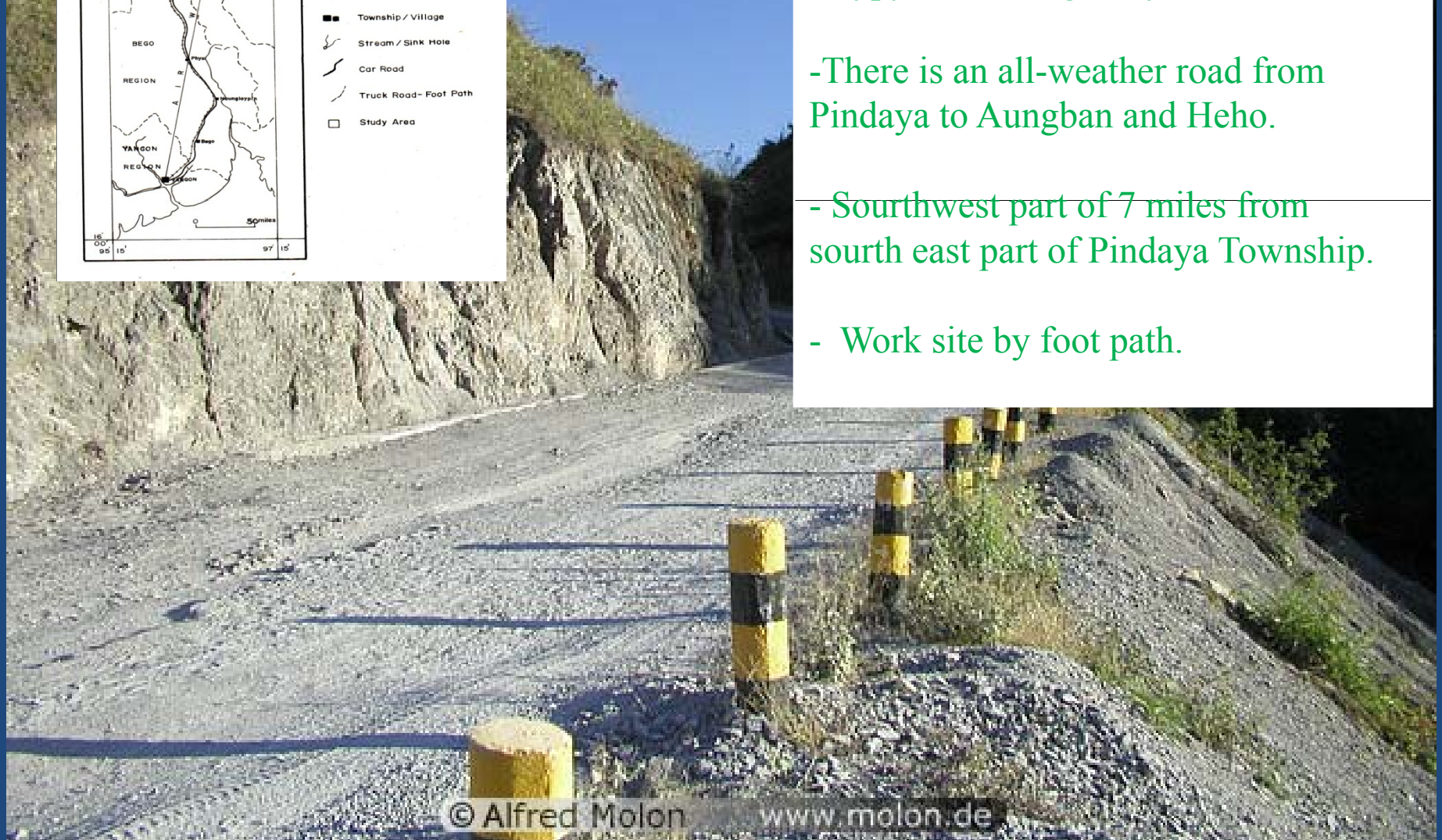
- Accessible Aungban-Yangon by car or train and Yangon- Heho by plane.

- Another accessible Aungban-Naypyidaw- Yangon by car.

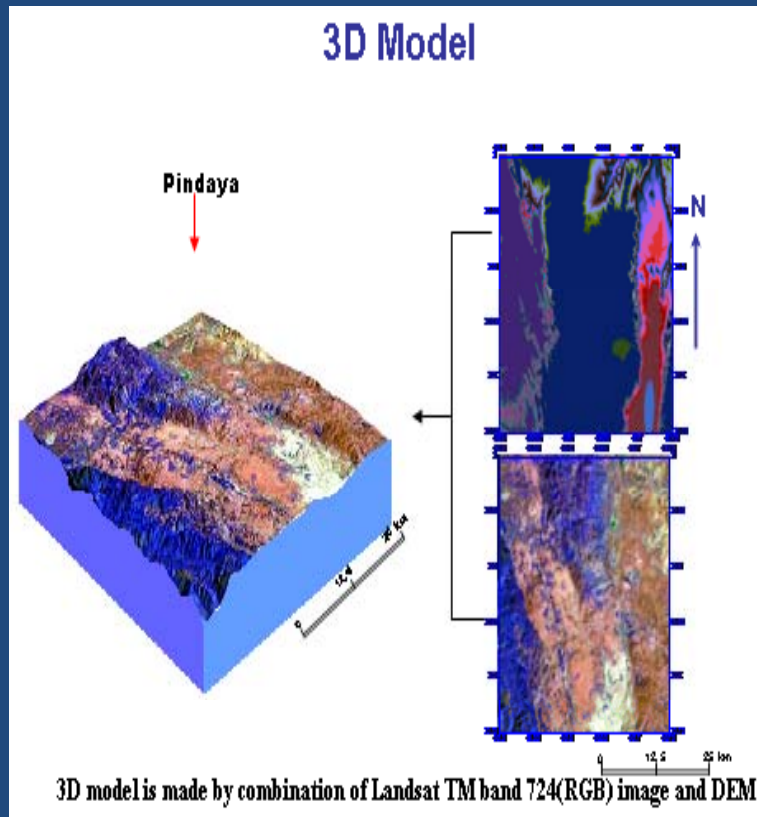
- There is an all-weather road from Pindaya to Aungban and Heho.

- Southwest part of 7 miles from south east part of Pindaya Township.

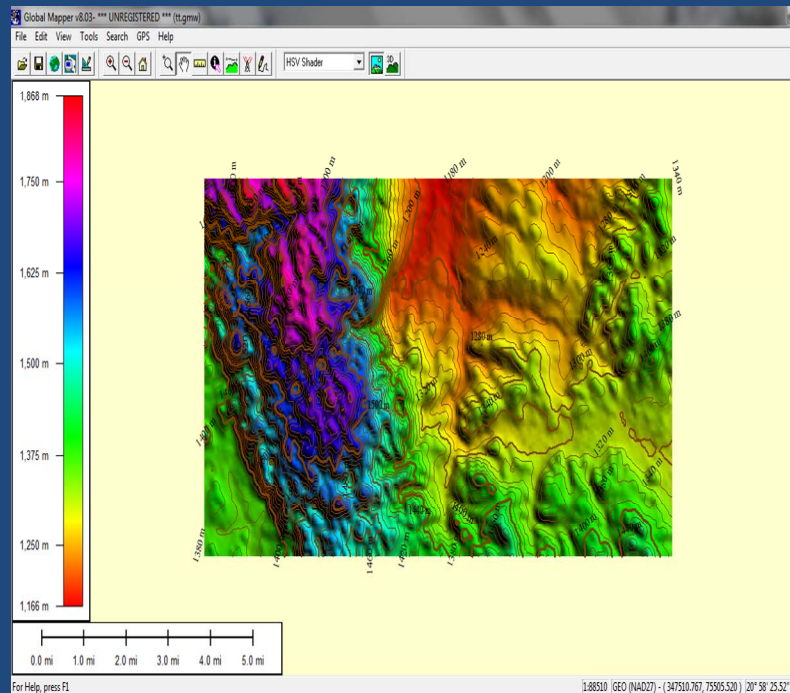
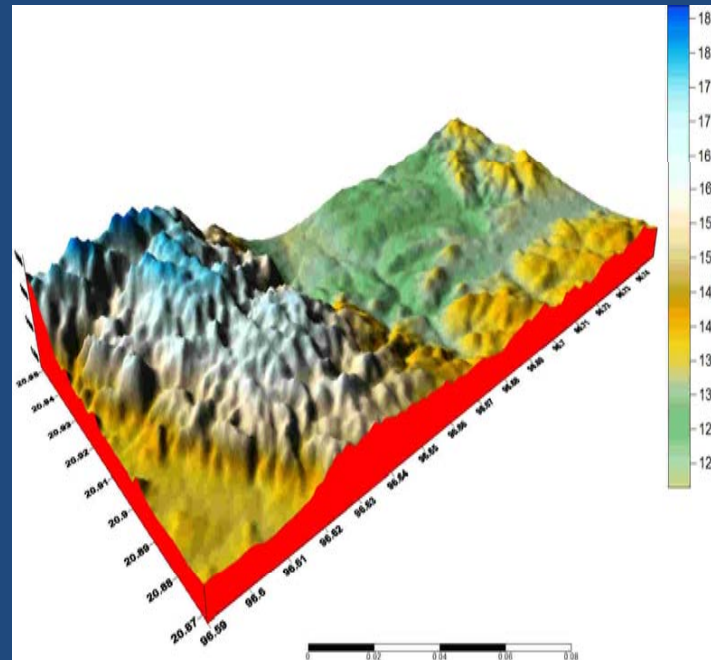
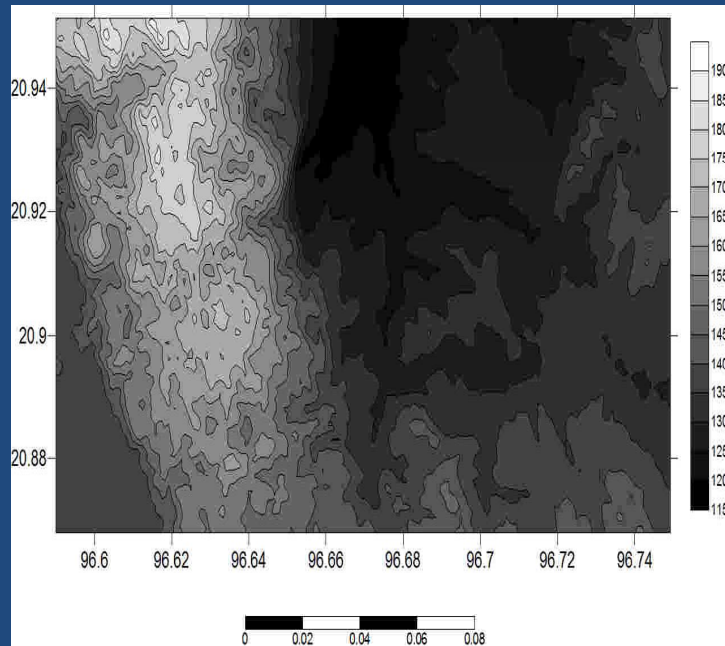
- Work site by foot path.



Morphology

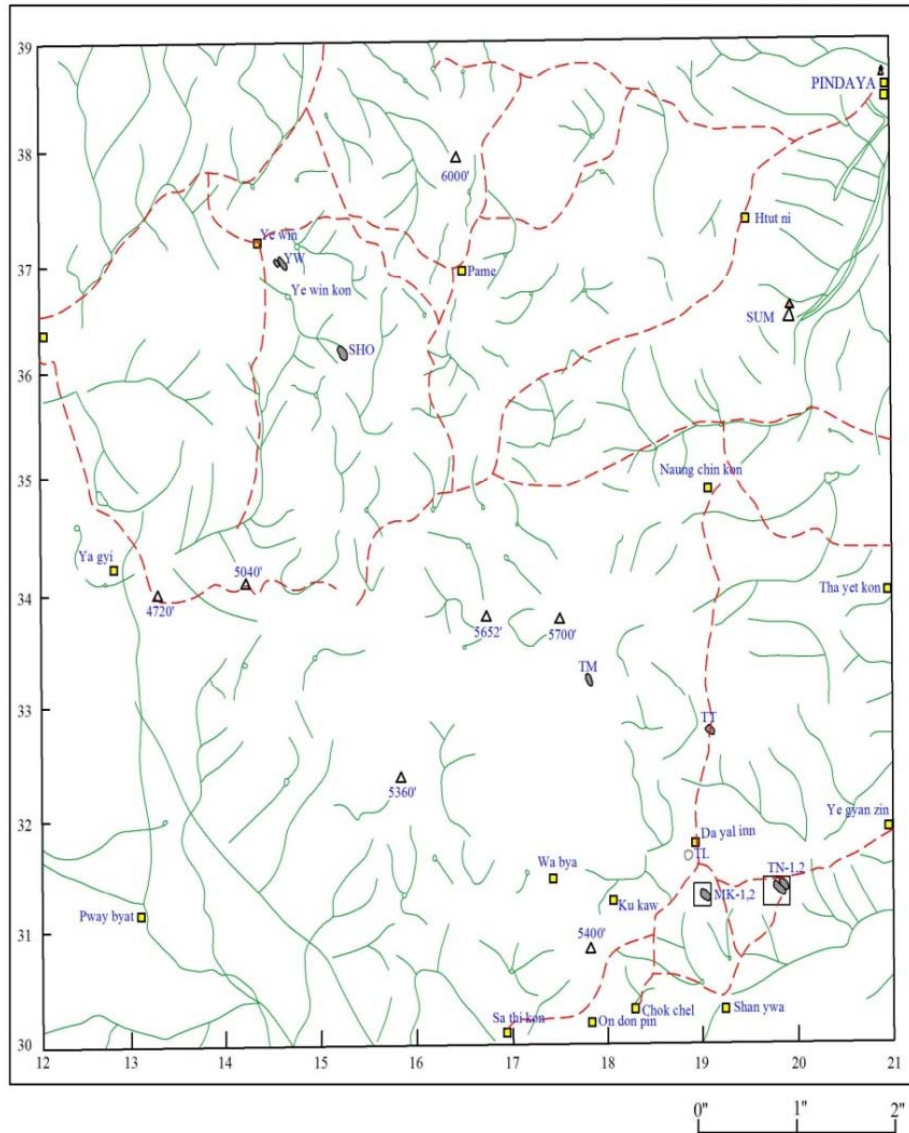


- the mountainous ranges terrain whereas moderate slope with high relief.
- 4500 ft above sea level a higher point 6260ft.
- divided on the Myinkyado and Pindaya basin.
- south planning asymmetrical anticline fold.



➤ used image both Land sat 7ETM, ASTER and SRTM (DEM) image as RS and GIS for physiographic data.

Part of Map Sheet No. 93 D/9 197314



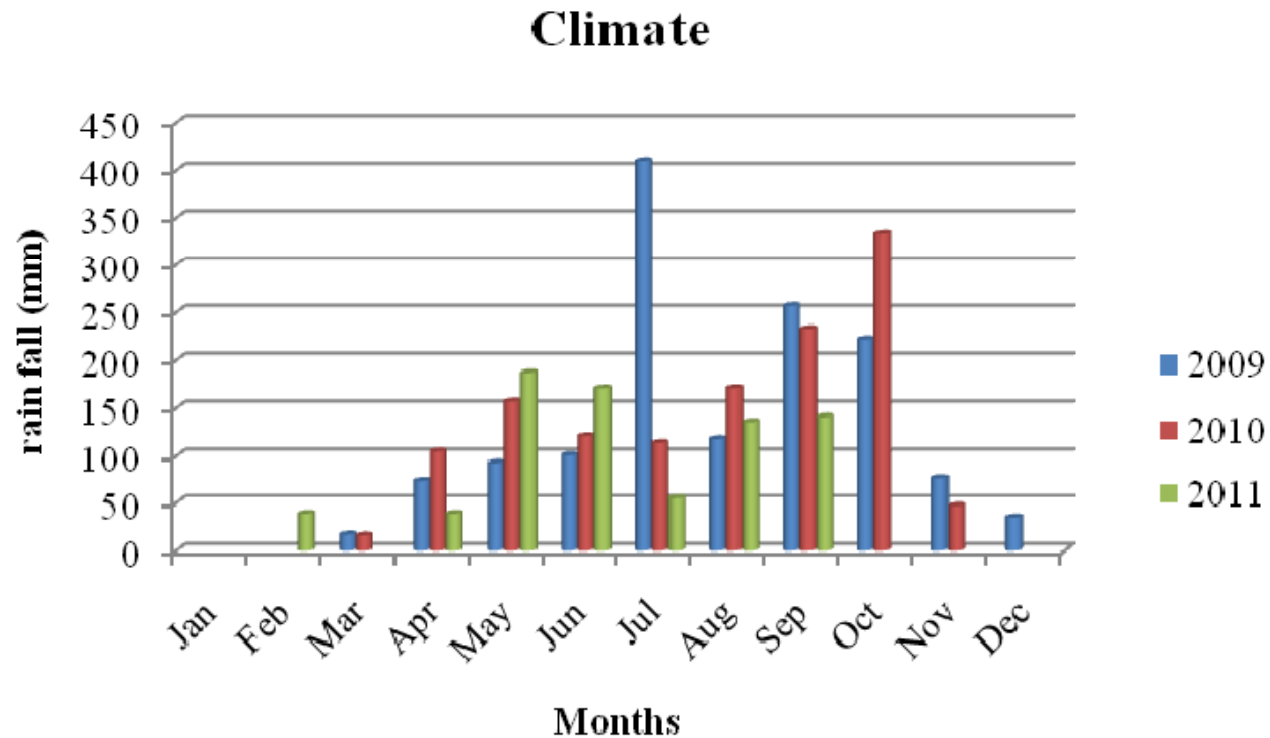
Drainage Pattern

- Centripetal drainage pattern are mostly found
- Coarse dendritic drainage pattern, angular dendritic pattern and short
- Radial patterns are distinctively occurred
- Small caves and sinkholes are characterized where carbonate rocks predominate



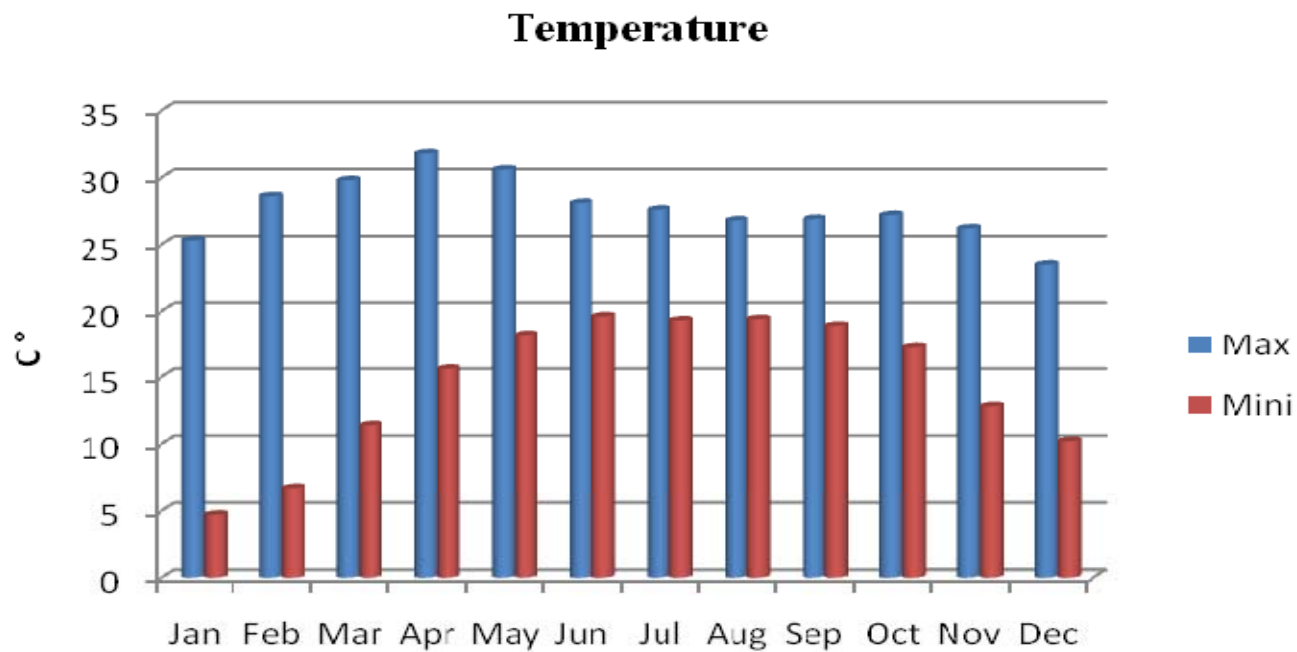
Climate & Temperature

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	-	-	17	73	93	101	410	118	257	222	76	35
2010	-	-	16	105	157	121	114	171	233	333	47	-
2011	-	39	-	39	187	171	55	136	141	-	-	-



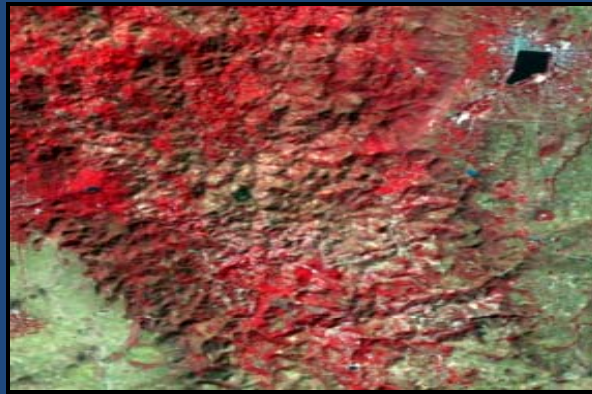
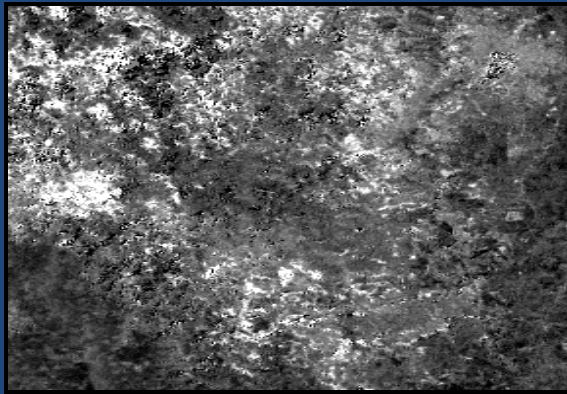
Temperature

Temp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	25.3	28.6	29.8	31.8	30.6	28.1	27.6	26.8	26.9	27.2	26.2	23.5
Mini	4.7	6.7	11.4	15.6	18.2	19.6	19.3	19.4	18.9	17.2	12.8	10.2



Natural Vegetation

Normalized Difference Vegetation Index (NDVI) of Study Area

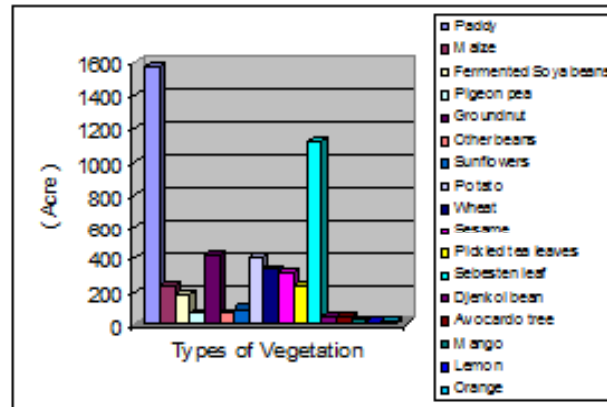


$$NDVI = \frac{\rho_{NIR} - \rho_{red}}{\rho_{NIR} + \rho_{red}}$$

- NDVI for estimating green vegetation cover in RS.
- Landsat bands 4 (NIR) and 3 (Red) were then converted into apparent reflectance values.
- Using apparent reflectance images in Red and NIR bands,
- the NDVI index was computed by the standard formula
- Light or red color is processing of hard wood natural vegetation. Grey or brown color is depending of long year tree. Dark grey or green is described of vegetation plant

Agriculture

No	Type of Vegetation	Land Use (Acre)
1	Paddy	1577.00
2	Maise	231.00
3	Fermented Soya beans	178.00
4	Pigeon pea	70.00
5	Groundnut	419.00
6	Other beans	69.42
7	Sunflower	92.00
8	Potato	401.00
9	Wheat	338.40
10	Sesame	311.40
11	Pickled tea leaves	232.00
12	Sebasten leaf	1127.00
13	Djenkol bean	52.00
14	Avocado tree	48.00
15	Mango	24.00
16	Lemon	13.00
17	Orange	18.00



– In, Pyinkado, Pyinma, Padauk and other timber, Bamboo, Thorn Bushes and Long- grasses.

– southern flat lying area of crops such as agriculture Paddy, Chilies, Peanut, Beans, Pigeon Pea, Potato, Tomato, Cabbage, Cauliflower and sugarcane are cultivated.

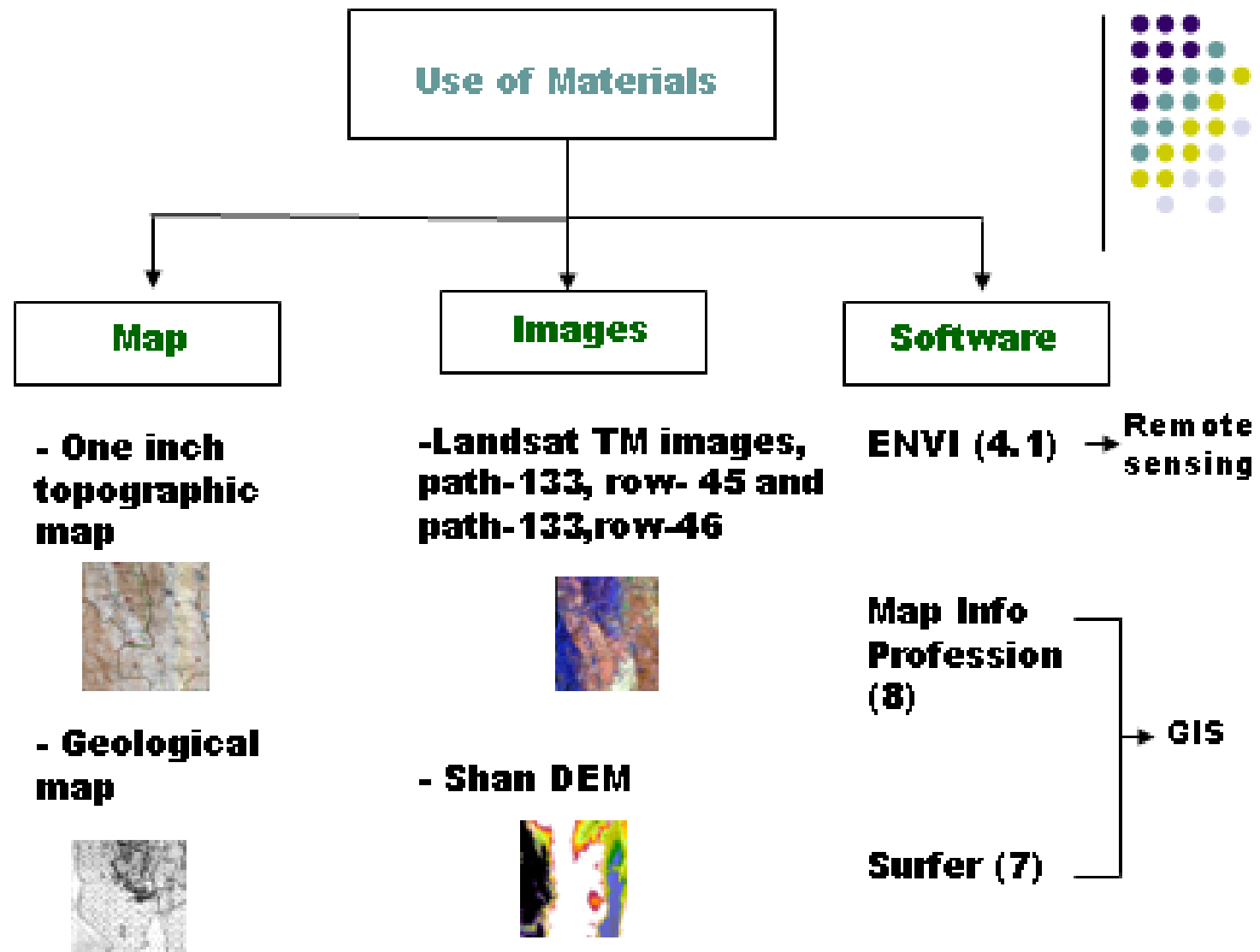
– hill ranges are perennial coals such as Tea Plant, Gurkha, Butter Plant.

Purposes of study

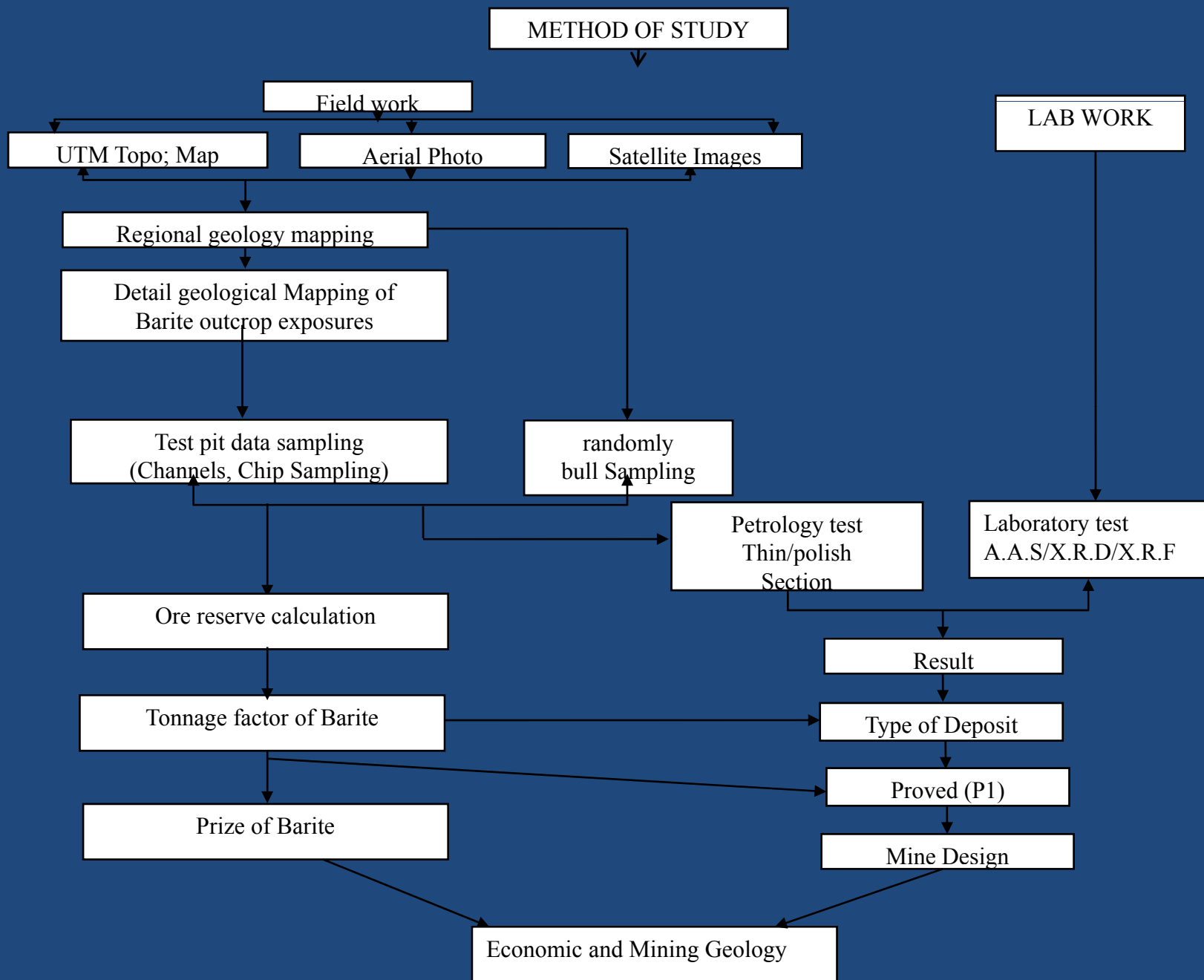
- used on the oil exploration product in the oil wells pressure force of underground by controlling.
- used of Strategic mineral in MOGE.
- mineral resource make field such as preliminary or regional geological mapping and detail geological mapping and outcrop survey of the barite deposits occurring in the Yegyanzin-Yewin Area.
- Such as sample collected of study both petrology and laboratory test.
- present investigation is also to select and study systematically from the geological mining aspect the mineral weather of any particular mineral zone in the Wunbye formation, Pindaya Group, Ordovician limestone at Lower Paleozoic.

Previous Works

- 1. Aung May Than - 1994. Geology and sedimentary of rock units, (ORDOVIAN TO PERMIUN exposed area) Taungbawgy Pindaya Township, Yangon University. M.Sc. 110-p.
- 2. Myint Lwin Thein - 1973. The lower Paleozoic stratigraphy of the western part of the southern Shan state. Burma, Geol, soc.Malaysia Bull,vol.6.143-163.
- 3. Maung Maung & Aye Ko Aung - 2005. The Occurrence of Early Devonian Units in Pindaya Township, Southern Shan State. Abstract Volume, fourth, Research paper Reading Session, Myanmar Geosciences (MGS),3.(MGS),3.
- 4. Ohm Myint, Mg - 1980. Detailed Stratigraphic & Structural Analysis of Litho – stratigraphic Units in Relationship to Mineralization at Bawsing Area, Southern Shan State, Yangon University M.Sc-122p.
- 5. Than Than Sint - 1994. Sedimentology of the Paleozoic Carbonate rock Units of the Pwela & Kyauktap Area, Pindaya - Kalaw Townships, University of Yangon p-130.
- 6. Thida Oo - 2002. Sedimentary Petrology of the lower Paleozoic Rock Units Exposed Along, The Eastern Part of Pindaya Township, Southern Shan State.
- 7. Win Naing - 1991. Supratidal, Inderal & Subtidal Carbonate rock of the Wunbye Fm, Panzit Southern Shan State. Geomports v.1 no.1 YU.
- Since 2006, the study area was still found on the barite reconnaissance that have not detail geology mapping of barite outcrop both tonnage and ore reserve calculation.



TM- Thematic Mapper, DEM- Digital Elevation Model, GIS- Geographic Information System



Study of aerial photo

10-12-58 1:50000

93-D - NE 6 562 - 184

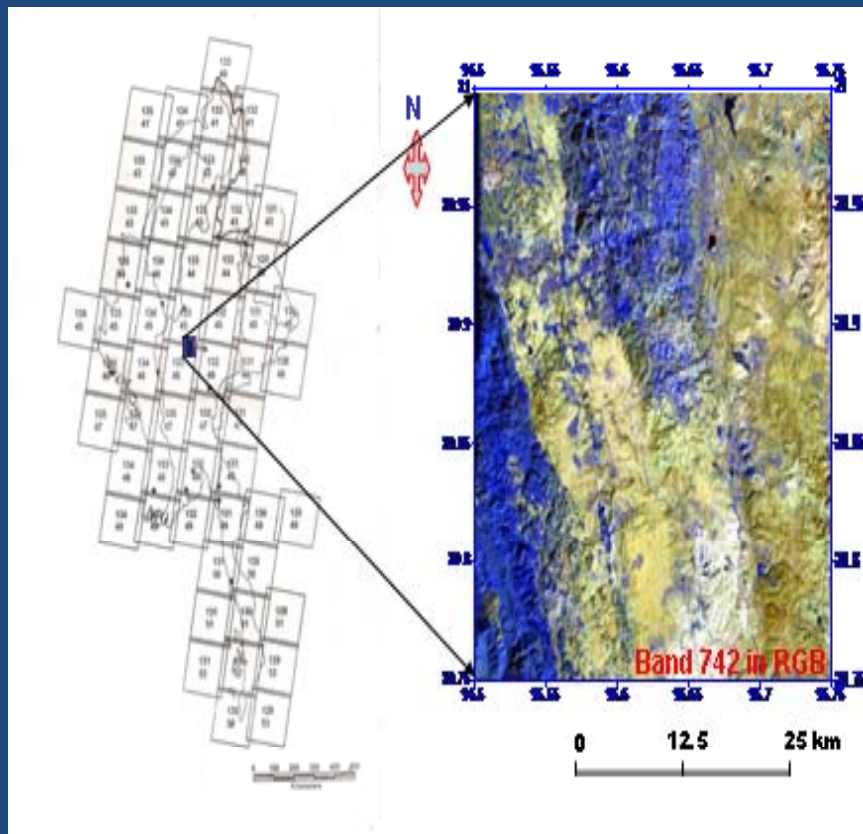


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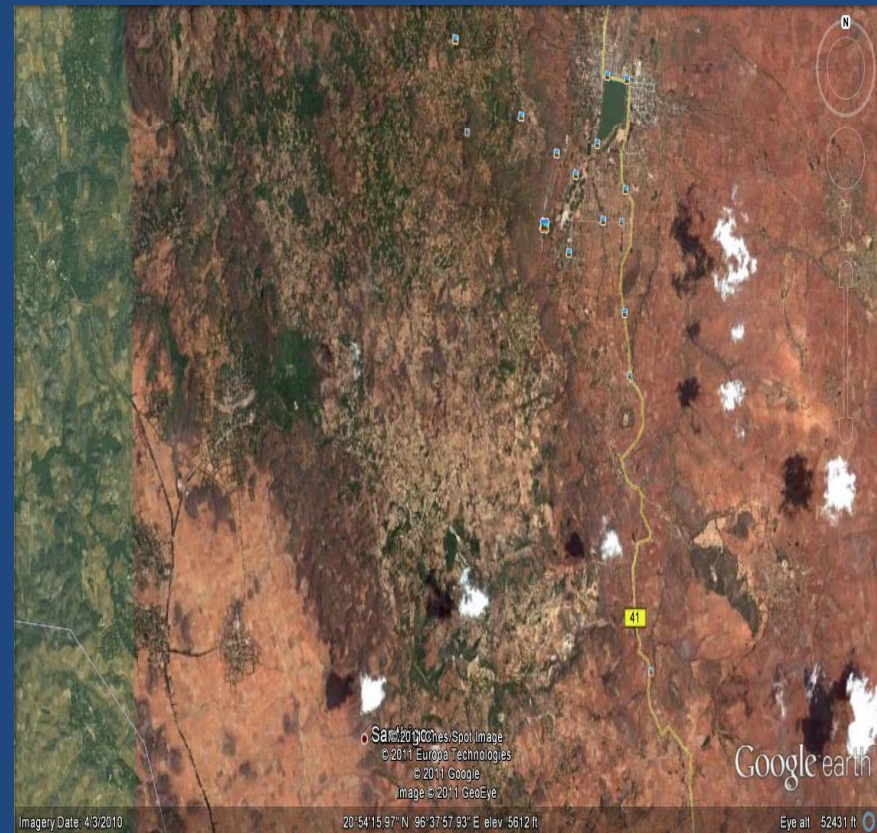
93-D - NE 7 562 - 171



Study of satellite image

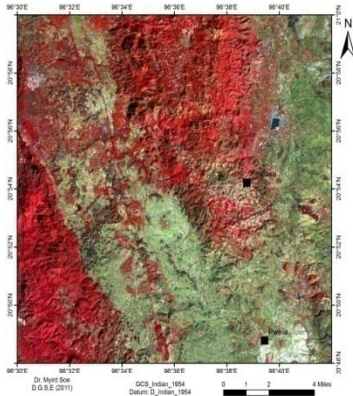


Study of google image



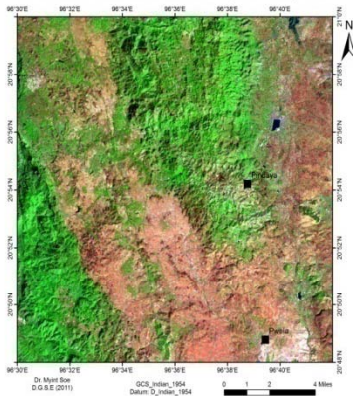
Part 133, row 45 and 46, study of satellite image

False Color Landsat Satellite Image of Study Area



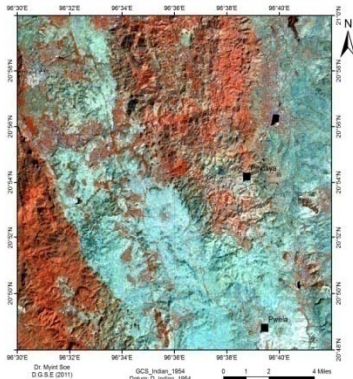
- Karts and dome Topography limestone, especially limestone of Thitsipin Limestone, Nwabangyi Formation which displays light blue-green or pink color in TM 742 color composite image and clearly different from other lithology units.

False Color Landsat Satellite Image of Study Area

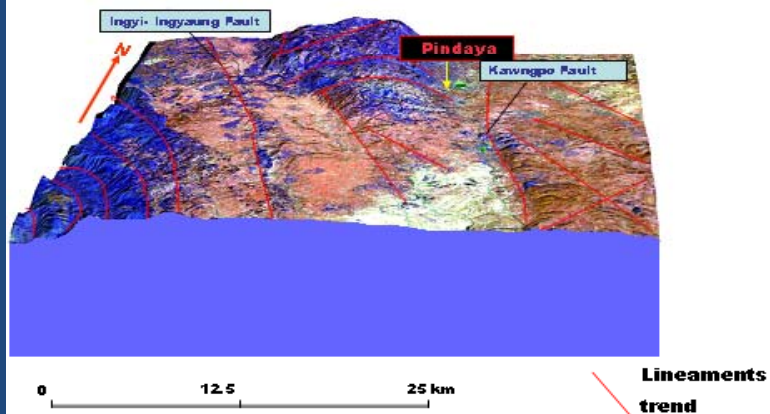


- Linwe or Wabya Formation terrain which displays white with spotted light blue and pink color for low lying topography and pink color is hilly topography.

False Color Landsat Satellite Image of Study Area

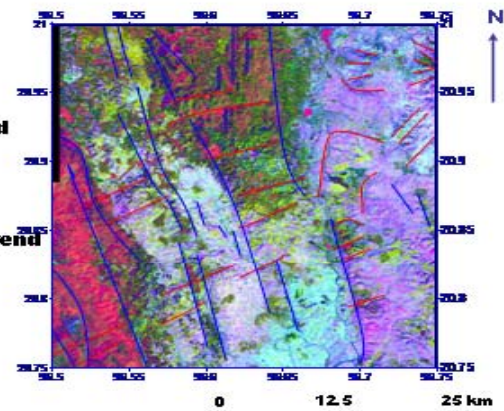


- Wunbye or Nan-on Formation displays red and pink color with light blue mottled in TM 432 color composite image and coarse texture.
- Alluvium terrain which is covered by mangroves displays dark red color in TM 754 color composite images and fine texture.



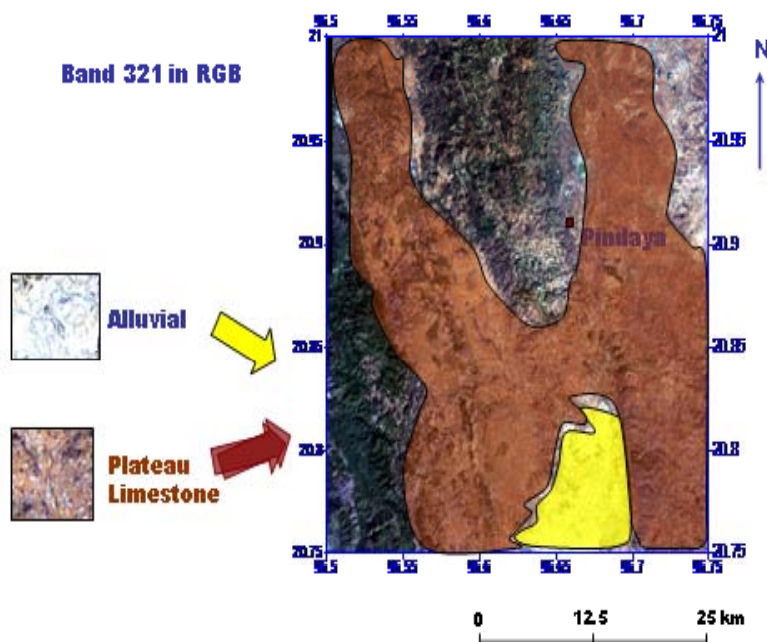
Two types of Lineaments

- Order lineaments trend
- Younger lineaments trend

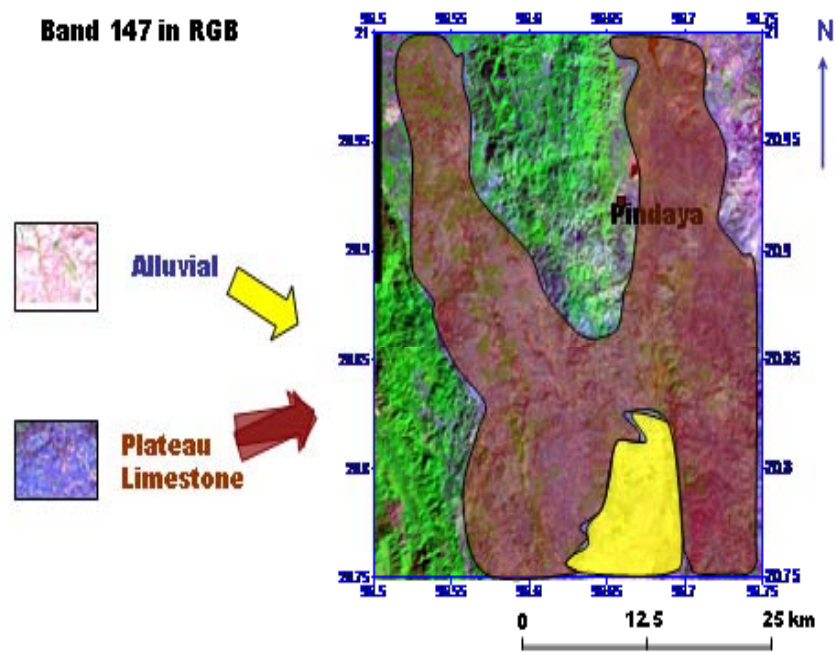


Color transform of band 246 in RGB to HSV

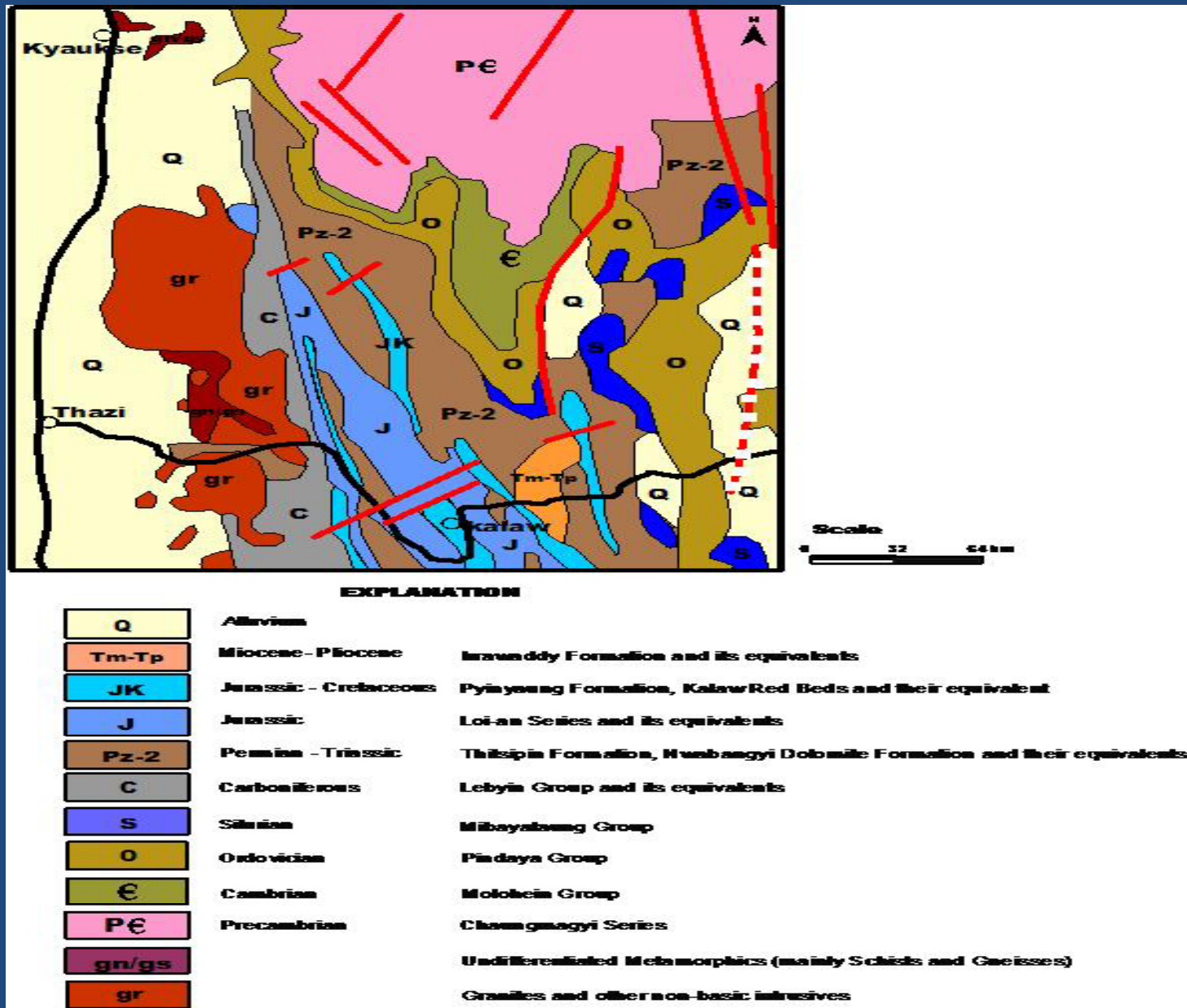
Band 321 in RGB









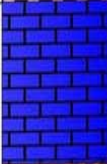

Band 147 in RGB



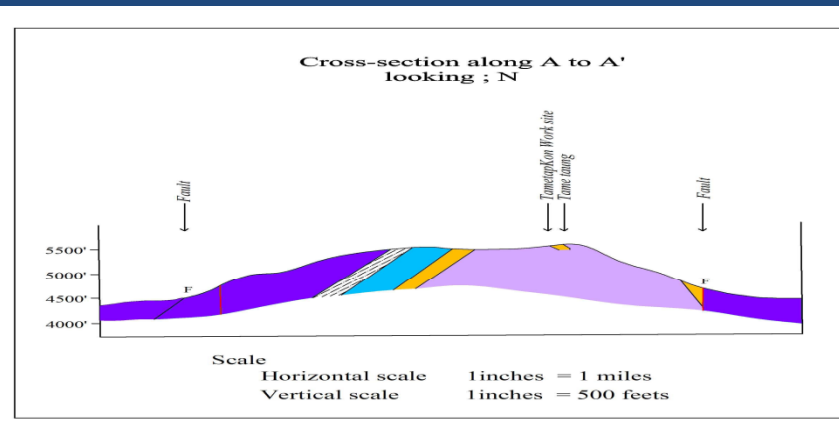
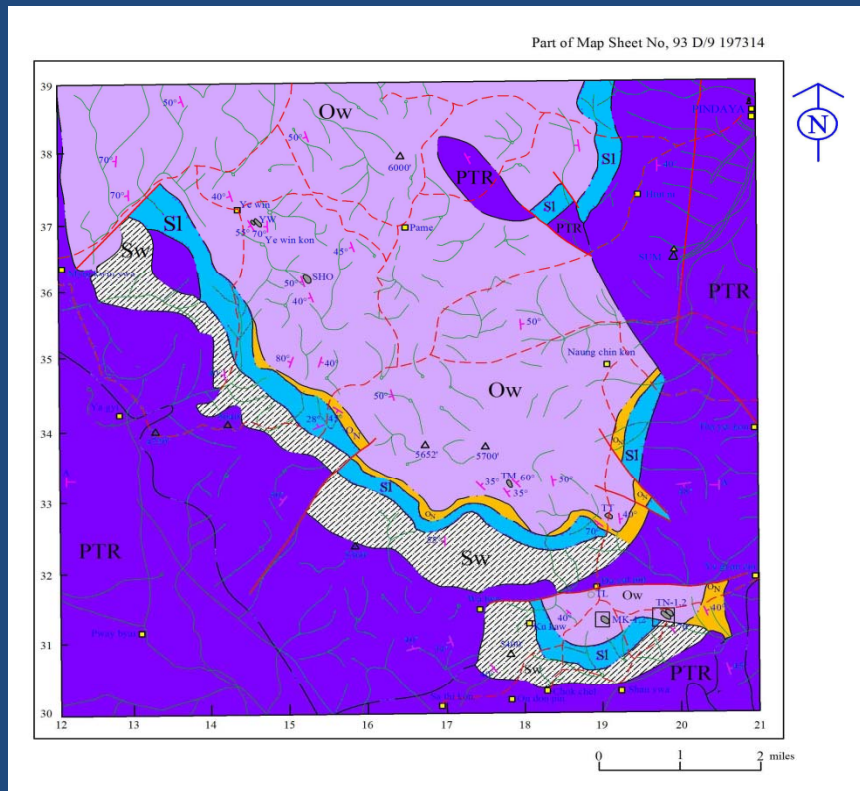
Regional geology of the study area



General Stratigraphic section of the study area.

ERA	Period	Group	Geological Units	Section not in scale	Distinct locality in the study area	Lithology	Sedimentary Structures	Fauna contents	Thickness (m)
UPPER PALEOZOIC	PERMO-CARBONIFEROUS TO LOWER TRIASSIC	Plateau limestone Group			Yagyi to Pway byat village rounded, Yegyanzin village to Pindaya Township are widely found.	light gray to dark gray dolomitic limestone, calcitic limestone and some limestone with chert nodules dolostones are common	Massive, some medium to thick bedded; some thin parallel lamination, some cross lamination	Fusulinids, Ammonites, Crinoid, Gastropods, other numerous shell fragments, some unfossiliferous units	203
LOWER PALEOZOIC	SILURIAN	Mibayataung Group	Taungmingyi Member		Wabya village are common	reddish colour, quartzose sandstone	Massive, poorly bedded	Rare fossils	-
			Wabya Formation			Bluish gray shale to ash gray	Thinly laminations	Monograptus, orthograptus, climacograptus	296
			Linwe Formation		Yagyi to Tale-in village, western part of along the Htutni village	Pinkish gray, gray to reddish gray, nodular bedded limestone, intercalated calcareous siltstone marls and shales.	Discontinuous wavy lamination, nodular bedding, linguoid, ripple, breccia, wedge shaped bed	Cephalopods, Brachiopods, Gastropods, Crinoids, sponges	375
	ORDOVICIAN	Pindaya Group	Tanshauk Member		W of Yegyanzin village and Nyaung chidauk to Tale-in village along mountain ranges	Purple to pink calcareous shale, marls and bioclastic limestone	Parallel lamination, wavy lamination, cross lamination some bioturbated structures	Brachiopod, Pelecypods, Crinoids, Cystoids, Conularia, Bryozoans, sponge and Gastropods	64
			Nan-on Formation			Arenaceous to calcareous, buff colour siltstones			
			Wunbye Formation		Thanitaung, W of Yegyanzin vilage and central part of the widely formed (Thutawtaung, Yewin, Naung Chinkon village	Grey to dark grey, thick bedded calcitic limestone, dolomitic limestone, dolostone and siltstone	Discontinuous wavy lamination, parallel lamination, cross lamination, stromatolite burrows scour and filled, channels	Brachiopod, Pelecypods, Crinoids, Cystoids, Bryozoans, sponge, Gastropods and algae	218
			Lokepyin Formation		Pindaya range	Buff to yellow, micaceous siltstone with subordinate sandstone, limestone, mudstone and shale	Parallel lamination, cross lamination, limestone lense burrow common in upper part	Abundant orthid, brachiopods	263

General geology of the study area



AGE	SYMBOL	GROUP	FORMATION	DESCRIPTION
Permian-Triassic	PTL	Shan Dolomite	Thitspin Formation	Light to dark grey color, medium grained, thick bedded to massive, Crip-cross jointing, conchoidal structures, shattered or brecciated faces with terrarosa soil.
			Unconformity	Light to dark blue color, fine to coarse grained, the thick bedded to massive, calcitic limestone with siltstone, shale, travertine cements and colonial rugose coral fossil.
Silurian	Sw	Mibaya Group	Wabya Formation	Bulf-light green color, thin to medium bedded, discontinuous wavy laminations structures, indurated mud stone, shale, micaceous siltstone, marl with graptolite fossil.
			Linwe Formation	Pink-purple color, thick bedded phacoidal structure, limestone, silt pathes and calcareous shale with orthoceras fossils
Ordovician	On	Pindaya Group	Non-on Formation	Yellow-bulf color, thin to medium bedded, bioturbated structure, dominated by highly jointed silt stone shale with orthids brachiopods fossils.
			Wunbye Formation	Light to dark colour, medium to thick bedded, burrow structure, limestone, dolomitic limestone (or) dolomite and siltstone with coil gastropod, Michlinoceras fossils.

GEOLOGICAL SYMBOL

- STRIKE & DIP OF BEDDING
- JOINT
- FAULT
- LITHOLOGIC CONTACT
- FOSSIL

GEOGRAPHIC SYMBOL

- STUPA
- HEIGHT- POINT
- STREAM / SINK HOLES
- TOWN / VILLAGE
- CAR ROAD
- TRUCK ROAD-FOOT PATH

MINERAL OCCURRENCE

- Primary Barite & Lead Occurrence
- Primary Copper Occurrence
- Raw Material (Limestone)
- Primary Coal Occurrence

WUNBYE FORMATION

Lithology- Finely crystalline, silty layers thick bedded limestone, dolomitic limestone or dolomite and siltstone. Straight rows of sinkholes may indicate the course Limestone with silt patches and burrows sub-unit is medium to thick bedded, light to darkgrey, highly burrowed in several directions and larger silt patches are occurred stylolites and pinkish calcite veinlets are occurred abundantly in this unit.

Fauna- nautiloid cephalopods, small amount of brachiopods, *Actinoceras* sp., *Ormosera* sp., *Orthis* sp.,

Distribution- Widely are formed of central part of Tale-in to Yewin-Pame village in Pindaya Township.

Age- Middle Ordovician (Llanvirnian)

Underlying: Lokeyin Formation.

Overlying: Nan-on Formation.

Correlations :- Sitha Formation, Pyin Oo Lwin township, Mandalay Division

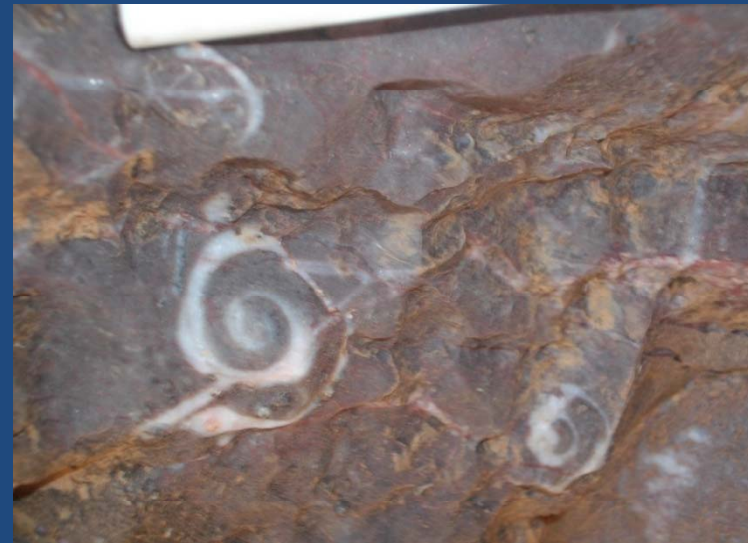
Remarks: Algal remains in a growth position and the burrows have been formed in shallow clear water of a marine environment.



Silt patches and burrow in Wunbye Formation
93 D/9 LM 189312,



Michilnoceras in Wunbye Formation,
93 D/9, LM-213315,



Coil gastropod in Wunbye Formation
93 D/9 LM 197314,

NAN-ON FORMATION

Lithology - buff to yellow, loosely cemented, arenaceous to calcareous thin to medium bedded siltstones or marl which are subindurated to soft.

Fauna - *Orthis* sp., *Nanorthis* sp.

Distribution - NW of study area, near the cart road of Yeganzin and Talein to Naungchidaik, Yewin village.

Age- Late Ordovician (Caradocian)

Stratigraphic- Nan-on Formation overlies conformably the Wunbye Formation and relationship, Underlies the Tanshauk Member.

Underlying: Wunbye Formation.

Overlying: Either Tanshauk Member or Linwe Formation.

Correlation; - Kunlein Fm and kyaingtaung Fm, Pyin Oo Lwin township, Mandalay Division.

Remark; shaly limestone with interbedded mud stone containing abundant sponges in a deeply weathered calcareous matrix including shell fragments and scattered corals.



Outcrop of Nan-on Formation
93 D/9 LM 204314,



Orthids brachiopods in Nan-on Fm,
LM-204314,

Age			Stratigraphic Unit (S.S.S)
Silurian	Late	Pridolian	
		Ludlovian	Taungmingyi Orthoquartzite
	Early	Wenlockian	Linwe Wabya Shale Member
		Llandoveryan	Formation

- divided the Mibayartaung Group into two formation; Linwe Formation and Wabya Fm.

LINWE FORMATION

Lithology: pinkish gray, gray to reddish gray phacoidally limestone, argillaceous limestone, calcareous mudstone and shale.

Age: Late Ordovician age of the Linwe Fm.

Distribution: NW Part of the Yegyanzin-Talein-Naungchidauk.

Sedimentary structure: Discontinuous wavy laminations, nodular bedding, languid ripple marks and stylolite seams are characteristic features.

Fossils: Brachiopod, Michelinoceras crinoid and sponges.

Age: Late Ordovician age of the Linwe Fm.

Underlying: Tanshauk Member.

Overlying: Panghsa-pye Formation.

Correlation Early Naungbaw formation of Northern Shan State and Panghsa-pye shale Member.

Remark: Lithology and fauna suggest a shallow marine sedimentation environment.



Phacoidally textured in Linwe Fm,
93 D/9 LM 190315,



Discontinuous wavy laminations in Linwe Fm,
93 D/9 LM 160335



Orthoceras in the Linwe Fm,
93 D/9 LM, 160335,

WABYA FORMATION

Lithology: bluish gray to ash gray, soft to sub indurate, graptolite bearing shale. Thinly limited, highly jointed shale with various size and shape of lenticular body of carbonaceous matter.

Stratigraphic thickness: 296 meters. Early Silurian.

Sedimentary structure: highly jointed shale.

Fossils: abundant graptolites, *Monograptus cyphus* minor LAPWORTH *Orthograptus*, *Climacograptus*.

Age; Middle Silurian age of the Mibayataung Fm.

Underlying: Minbayataung Group of the Linwe Formation.

Overlying: Taungmingyi Member

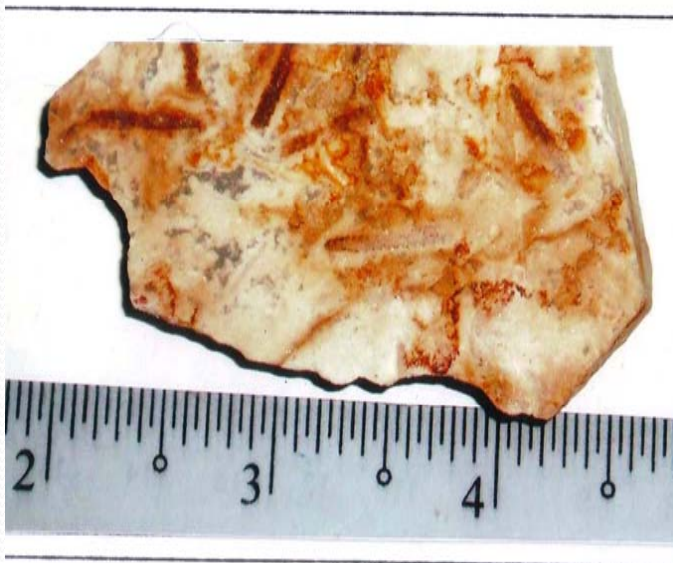
Distribution: area of wabya village.

Correlations: early Panghsa-pye shale member of Naungbaw formation of Pyin Oo Lwin District in Northern Shan State.

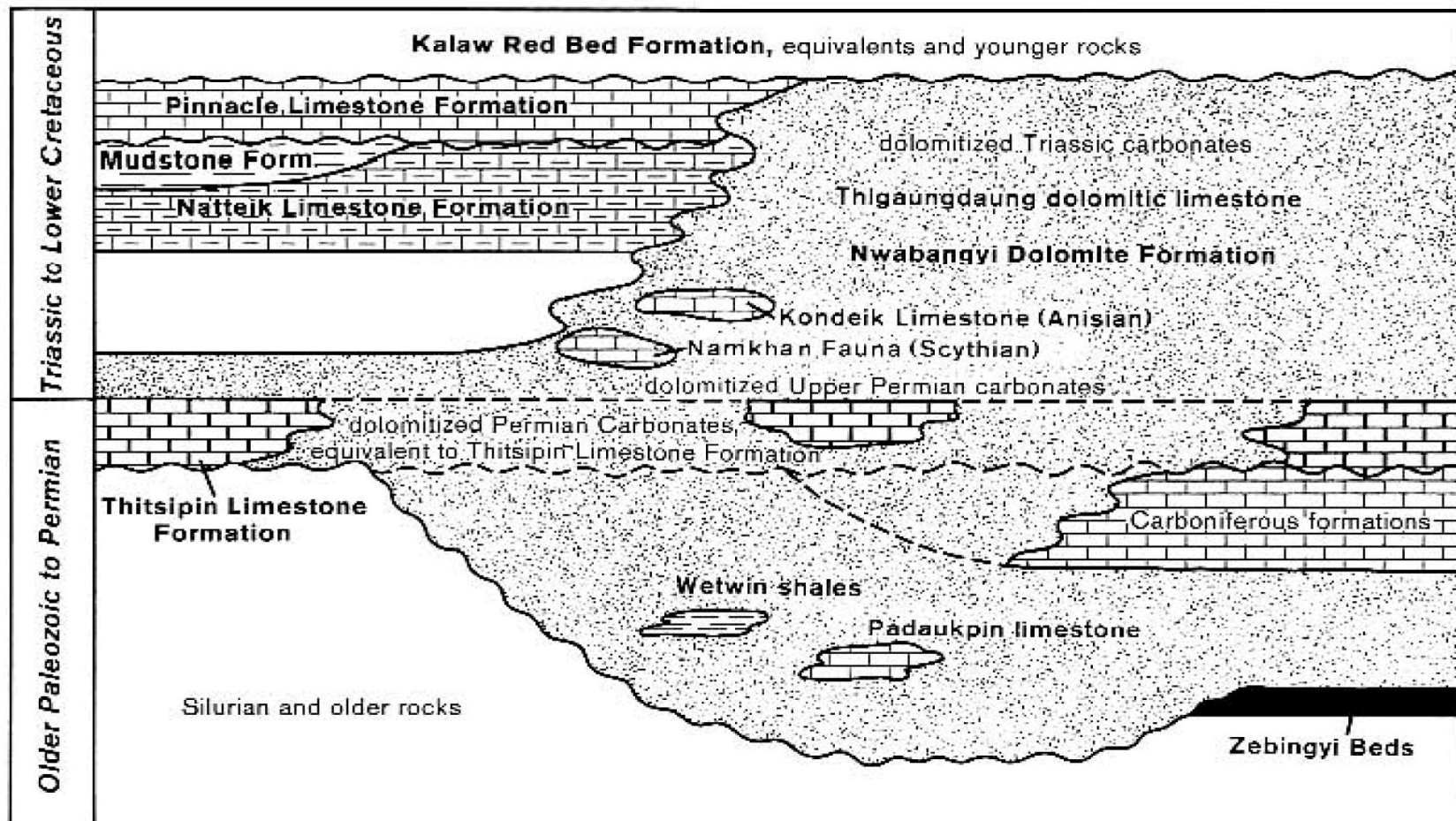
Remark; Lithology and fauna suggest a shallow marine sedimentation environment.



Highly jointed shale in Wabya Fm
93 D/9 LM -189320,



- Graptolite
- *Diplograptus* sp.,
- *Monograptus*
- *priodon*,
- *Demirasrite*
- *triangulatus*,



- divided the Shan Dolomite Group into two formation; Thitsipin Fm and Nwabangyi Fm.

THITSIPIN FORMATION

Lithology: There are three facies, a massive limestone facies with abundant big brachiopods, a massive cherty limestone facies, and a well bedded calcarenite facies.

The massive limestone: big shells, pale to dark grey or blue grey micritic limestone, commonly massive, only locally poorly bedded. Limestone contains large, globular shells of brachiopods associated with large solitary and compound corals.

The massive cherty limestone facies: only scattered occurrences of fossils; bedding planes are in the type of rock generally defined by the orientation of the chert lenses.

The well bedded calcarenite facies: massive calcite limestone; bedded cherty limestone and calcarenite. Texture varies from fine to medium grained, hard and color also changed grey to bluish grey color limestone with medium to high of karst topography with travertine features, minor contain of grey color siltstone, buff color shale and nodular limestone.

Sedimentary structure: massive, medium to thick bedded, some thin parallel lamination and cross lamination with travertine cements.

Fossils: Corals, *Fusulinids*, *Brachiopods* and *Bryozoa* etc.

Age: Permian age of Thitsipin Limestone Fm.

Underlying: Unconformable with lower Paleozoic rocks.

Overlying: Dolomitic Nwabangyi Formation .

Distribution: Pindaya Township and Pwaypyat village.

Correlations: Plateau Limestone Units expose at Kayah, Kayin and Mon States, they can be called Moulmein Limestone.

Remarks: an open part see environment according to the presend of fusulines. Abundant large brachiopod shells.



karst topographic limestone in Plateau limestone
93 D/9 LM 208314



Calcitic limestone in Plateau limestone.
93 D/9 LM 208315



Colonial rugose coral, Fusulinids Fossil in the Plateau limestone.
93 D/9, LM 208319;





Dolomitic Lst with terrarosa soil in Nwabangyi dolomite.
93 D/9 LM 190325;



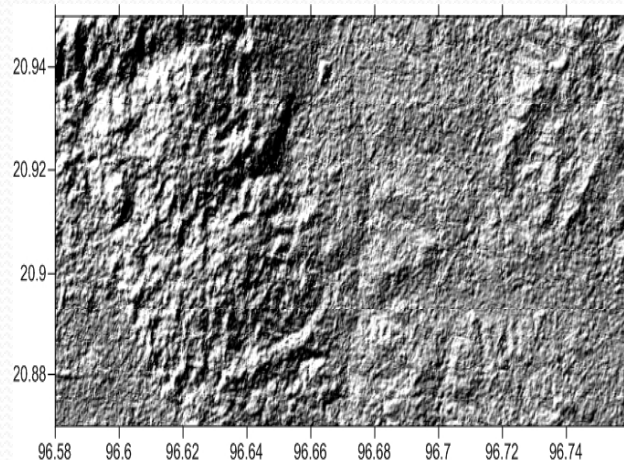
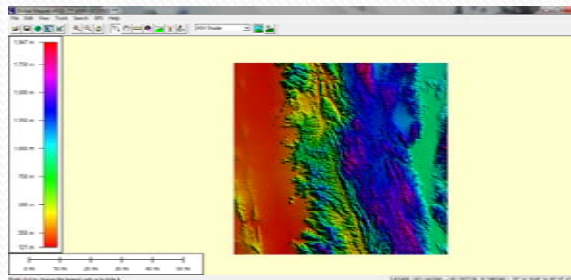
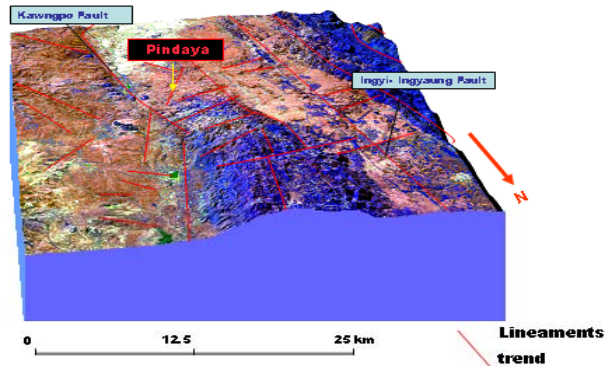
Brecciated dolomitic Lst with quarry in Nwabangyi dolomite.
93 D/9 LM 191325;



❖ Shatter or brecciate
dolomitic limestone with
terra rossa red soil.

❖ Dolomitic bricks.

Structure Geology



Folds

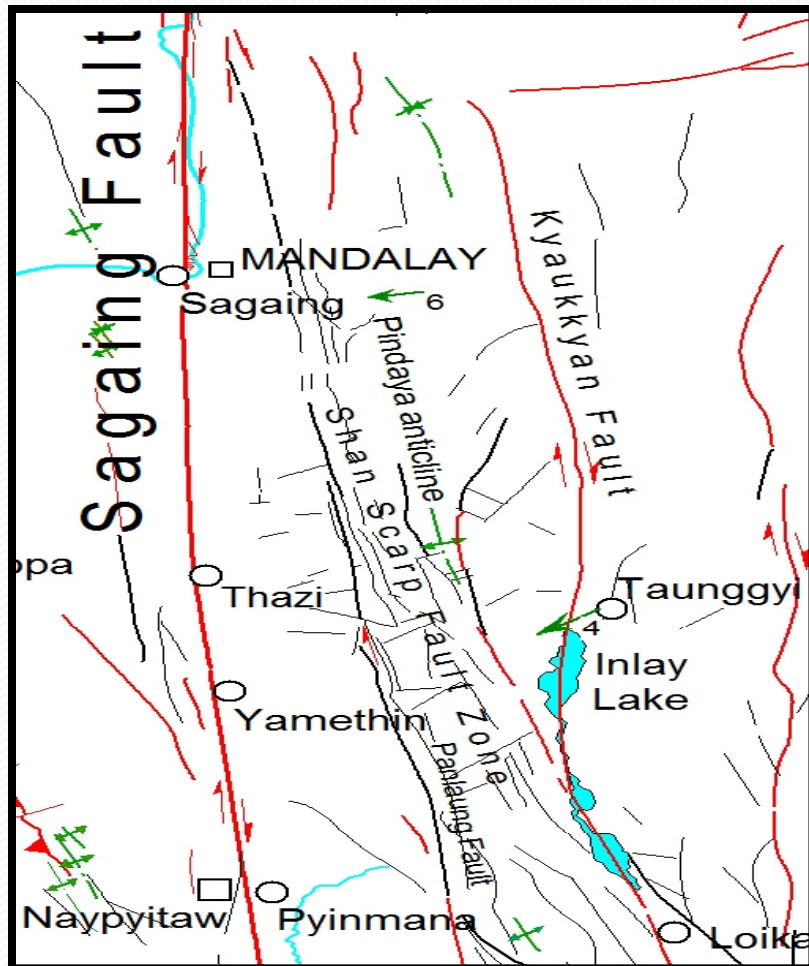
SE plunging asymmetrical anticlinal fold.

Hinge of the fold can be traced about 18 miles.

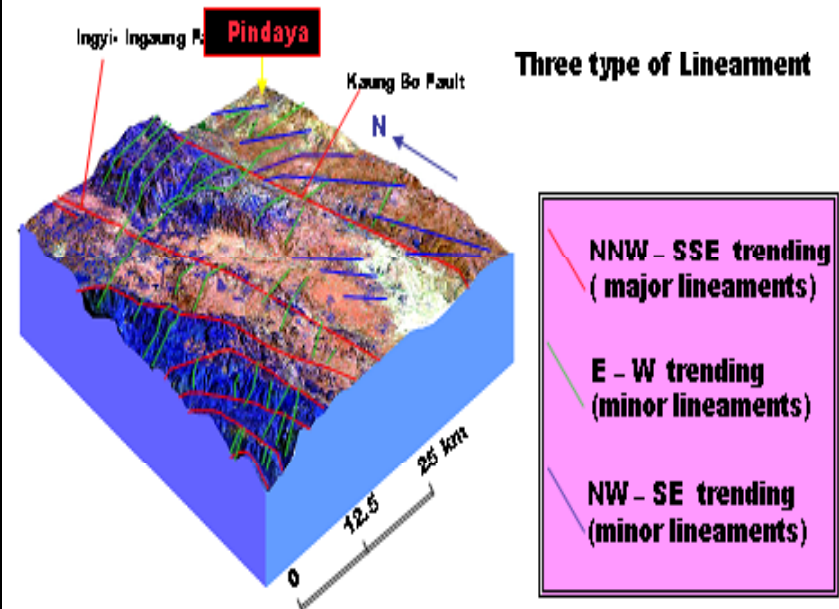
Towards the South-eastern part of Tame range and Pame range runs in SSE-NNW direction near the central part of the south-west margin of the study area.

Plunge of the fold axis is 30, trending towards 330Az. SSE (or) NNW plunging, asymmetrical anticlinal fold.

FAULTS



3D Model interpretation with Tectonic Model Of Myanmar



- The major lineaments are older than the minor lineaments.



Faults of the system A

Largest and oldest fault trending N-S alignment. Near Shwe U Min Pagoda cave.

Faulted contact with Nwabangyi dolomite and Plateau Limestone contact, length 8 miles.

Faults of the system B, NW-SE Kyedwinkon (F1)

Nauk Taung, Thitsipin Limestone Formation and Wunbye dolomite formation are contact exposed. NNW-SS fault is observed of length 7 miles.

Thayetkon (F2)

Thitsipin Limestone and Nwabangyi dolomite formation are contact exposure. NNW-SSE trending cross fault length about 4 miles.

Kyauktaung (F3)

Linwe Fm, Non-on Fm and Thitsipin lot Fm are contact exposed with right lateral strike-slip fault, the NN cross fault is observed, about 7 miles.

Midpoint diverse, NWW-SEE trending cross fault is observed, minor fault is about 3 miles.

Thunitaung (F4)

Wabya Fm, Nwabangyi dolomite Fm and Nan-on Fm are complex contact exposure the NWW-SEE trend is observed, 3 miles of nearly fault the barite occurs.

Fault of the system c, Kalar chaung fault (F1)

Cut across fault by NE-SW alignment in the Linwe Fm and Wunbye Fm, 4 miles of nearly fault the mineralization

Nyaung chidauk fault (F2)

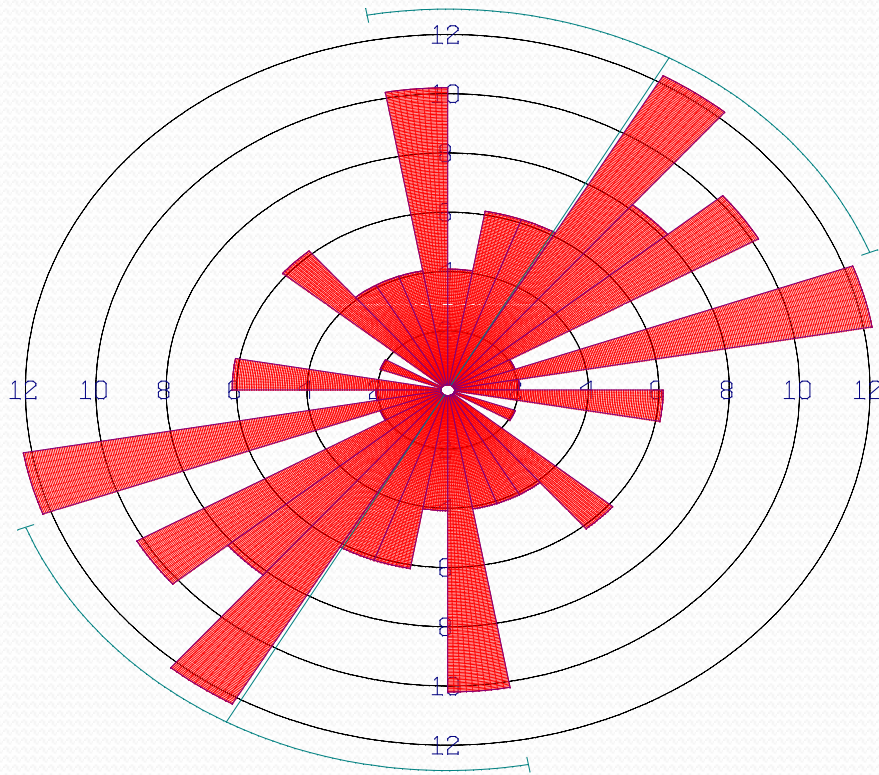
NE-SW alignment this fault cut across the Nan-on Fm, Linuse Fm and Wunbye Fm, north – western part of Yeduet is slip fault. The fault length is about 9 miles.

Fault of the system D, Talein fault (F1)

Talein village, it is trending E-W position, length is 8 miles, and this fault cut across the south of Thitsipin Nwabangyi dolomite Fm are contact exposure.

JOINTS

Strike of bedding of Ordovician rocks



Calculation Method ... Frequency

Class Interval 10 Degrees

Filtering Activated

Minimum Azimuth ... 0 Degrees

Maximum Azimuth ... 360 Degrees

Data Type Bidirectional

Rotation Amount 0 Degrees

Population 49

Maximum Percentage ... 12.2 Percent

Mean Percentage 6.3 Percent

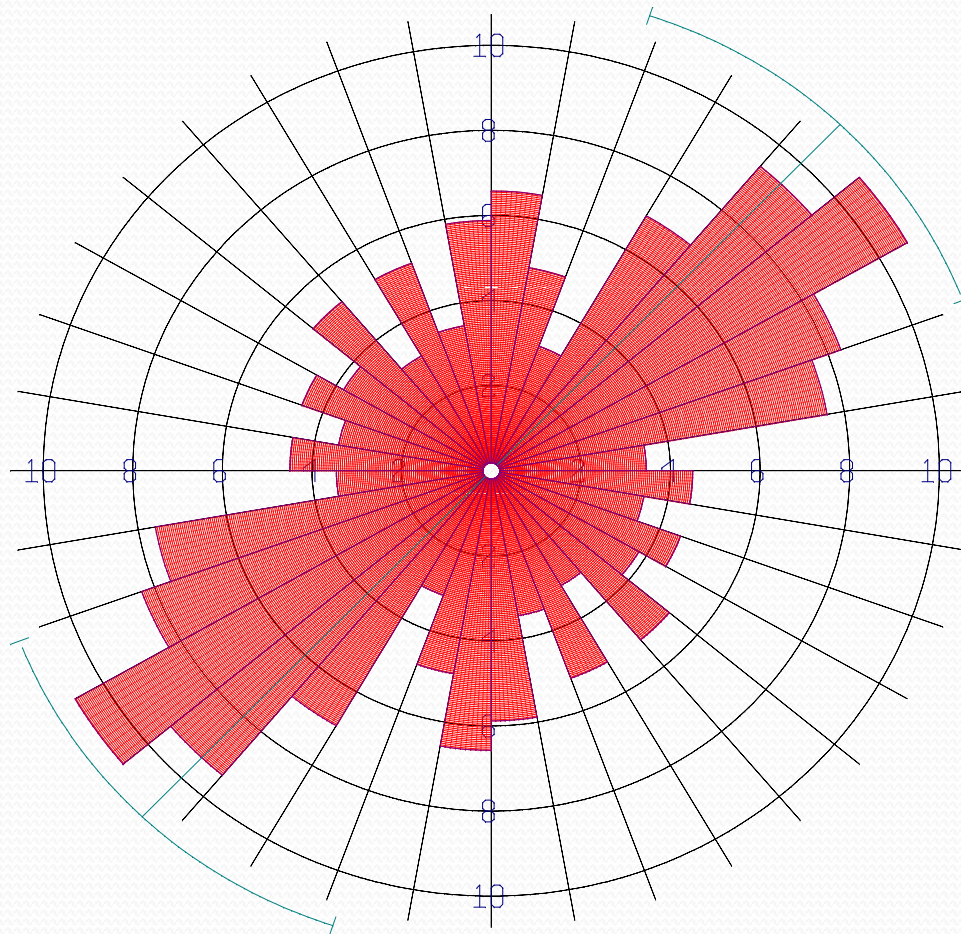
Standard Deviation ... 3.4 Percent

Vector Mean 29.29 Degrees

Confidence Interval .. 39.56 Degrees

R-mag 0.28

Joint strike rose diagram of Ordovician rocks



Calculation Method ... Frequency

Class Interval 10 Degrees

Filtering Activated

Minimum Azimuth ... 0
Degrees

Maximum Azimuth ... 360
Degrees

Data Type Bidirectional

Rotation Amount 0 Degrees

Population 289

Maximum Percentage ... 10.7
Percent

Mean Percentage 5.6 Percent

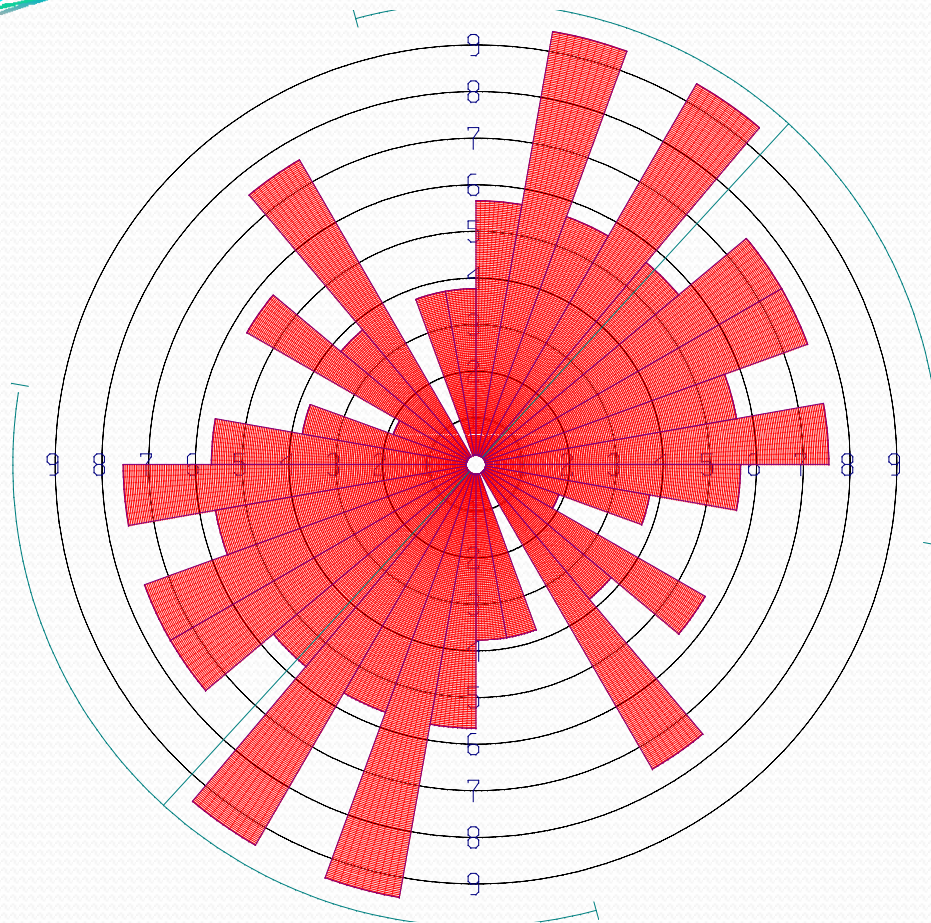
Standard Deviation ... 2.23
Percent

Vector Mean 43.74
Degrees

Confidence Interval .. 25.44
Degrees

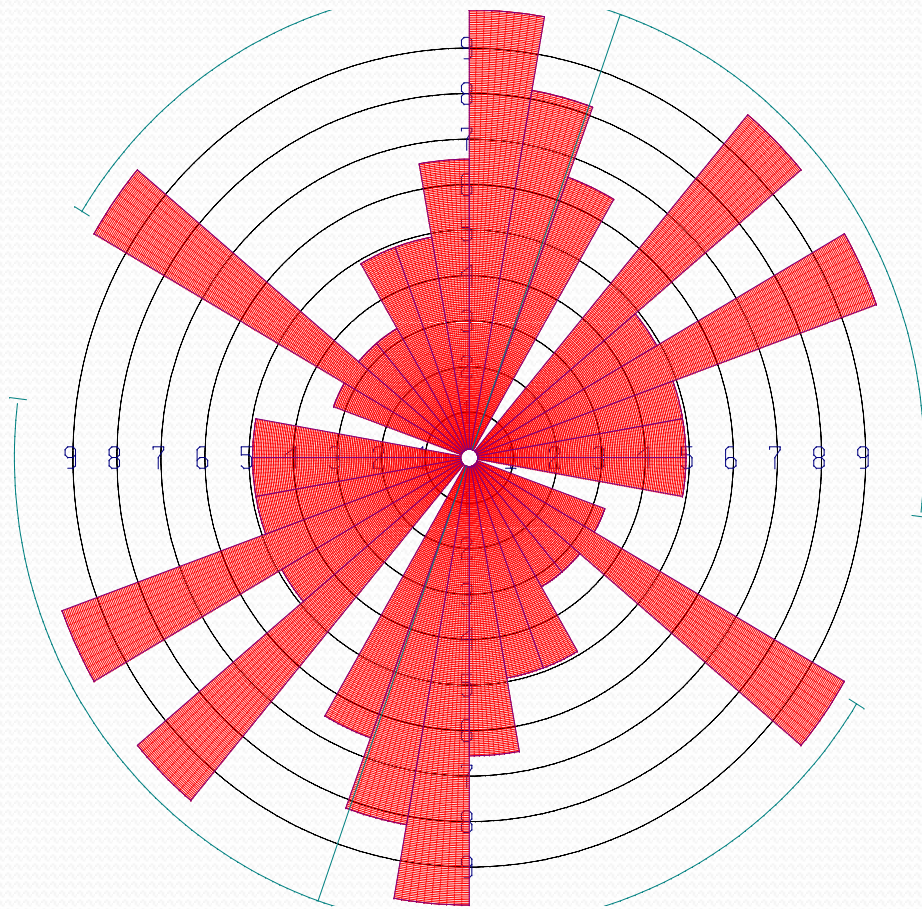
R-mag 0.18

Joint strike rose diagram of Silurian rocks



Calculation Method ... Frequency,
Class Interval 10 Degrees
Filtering..... Activated,
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 360 Degrees,
Data Type..... Bidirectional
Rotation Amount 0 Degrees,
Population..... 53
Maximum Percentage ... 9.4 Percent,
Mean Percentage 5.9 Percent
Standard Deviation ... 2.07 Percent,
Vector Mean 42.44 Degrees
Confidence Interval... 57.49 Degrees,
R-mag 0.19
Fig (3.33) Joint strike rose diagram in
Silurian rocks

Joint strike rose diagram of Plateau Limestone rocks



Calculation Method ... Frequency,
Class Interval 10 Degrees
Filtering..... Activated,
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 360 Degrees,
Data Type..... Bidirectional
Rotation Amount 0 Degrees,
Population..... 61
Maximum Percentage ... 9.8 Percent,
Mean Percentage 6.3 Percent
Standard Deviation ... 2.44 Percent,
Vector Mean 19.4 Degrees
Confidence Interval... 77.8 Degrees,
R-mag 0.13

Fig (3.34) Joint strike rose diagram in
Plateau Limestone rocks

Economic Minerals Aspect

Barites

- Tanitaung barite deposit
- Moekyoetaung barite deposit
- Tale-in(Daw Loun, house) barite deposit
- Phothutawtaung barite deposit
- Tametak-koun barite deposit
- ShanOthei barite deposit and
- Yewin barite deposit

Copper in kyadwinkon, Nattaung

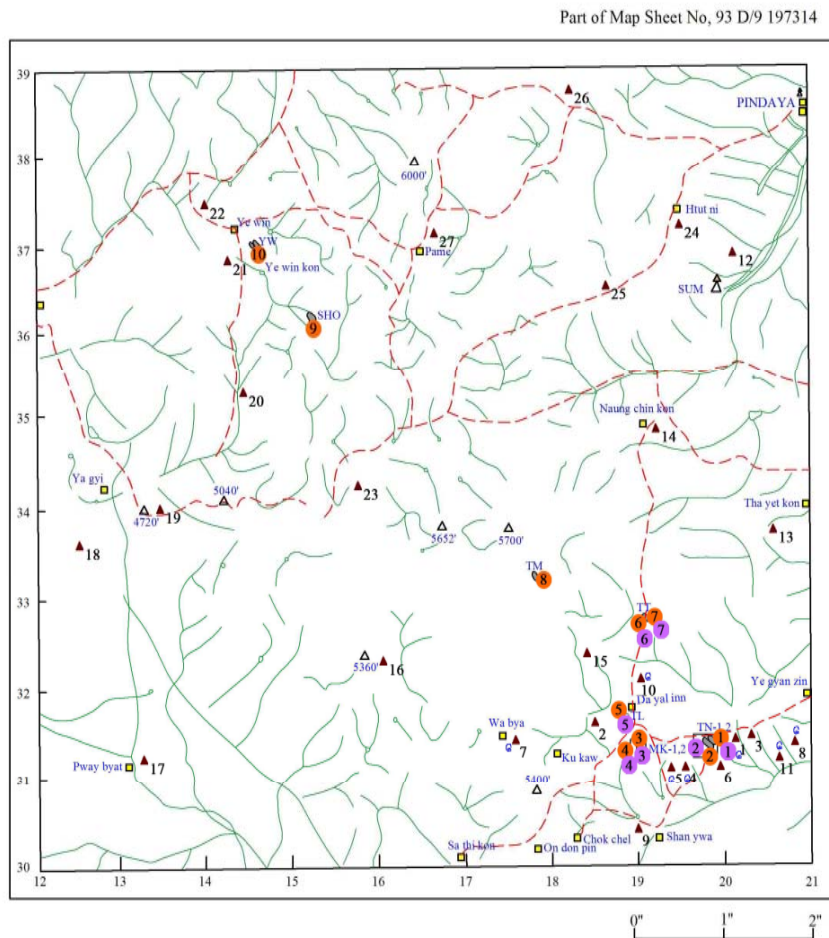
- Malchite & Azurite copper, oldest test pit

Coal seam in Wabya

- coal seam in Wabya Shale Namplan Chaung



Sample location map of the study area



- ❖ Consist of rock, ore and fossils sample
- ❖ Rock sample as petrology study
- ❖ Ore sample as A.A.S & X.R.F lab test study
- ❖ Fossils sample is interpreted by geology age

- Minimum – 84.06 %
- Maximum – 93.62 %
- Average – 89.4 %

X.R.F Results

2011-11-16 11:02

SQX Calculation Result							
Sample : SnO2 0619 (H2O-04)				Date analyzed : 2011-11-16 10:45			
Application : Oxide Powder Qua Model : Bulk				Balance : 11			
				Matching library: 16.11.2011 01			
				File : 16.11.2011 01			
No.	Component	Result	Unit	Det.limit	El.line	Intensity	w/o normal
1	Na2O	0.163	mass%	0.02658	Na-KA	0.1942	0.1210
2	MgO	0.0098	mass%	0.00963	Mg-KA	0.0272	0.0073
3	Al2O3	0.125	mass%	0.00374	Al-KA	0.9990	0.0926
4	P2O5	0.0041	mass%	0.00260	P-KA	0.0733	0.0030
5	Cr2O3	0.445	mass%	0.01789	Cr-KA	2.8213	0.3301
6	MnO	0.0305	mass%	0.01531	Mn-KA	0.3154	0.0227
7	Fe2O3	1.14	mass%	0.07727	Fe-KB1	2.3910	0.8451
8	NiO	0.0586	mass%	0.00790	Ni-KA	1.2857	0.0435
9	SrO	1.56	mass%	0.00381	Sr-KA	198.8076	1.1691
10	BaO	96.5	mass%	0.14126	Ba-LA	209.3416	71.5659
11	CeO2	0.0000	mass%	0.19235	Ce-LA	25.6881	0.0000

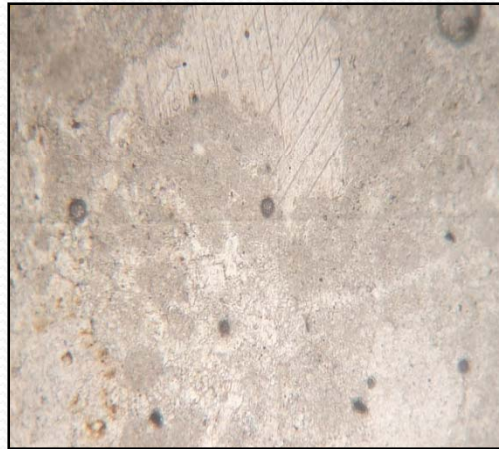
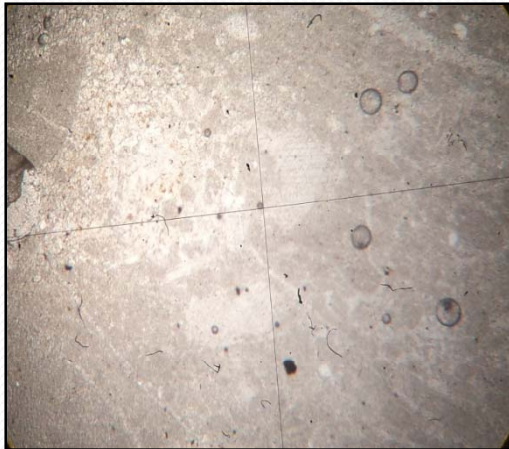
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စာတိုက်ကြီးကြီးကြီးကြီး

Rigaku

X.R.F, Results BaO

- Minimum – 80.1 %
- Maximum – 96.5 %
- Average – 91.3 %

Petrology of the study in Wunbye Fm .



PPL

0.3 mm

XL

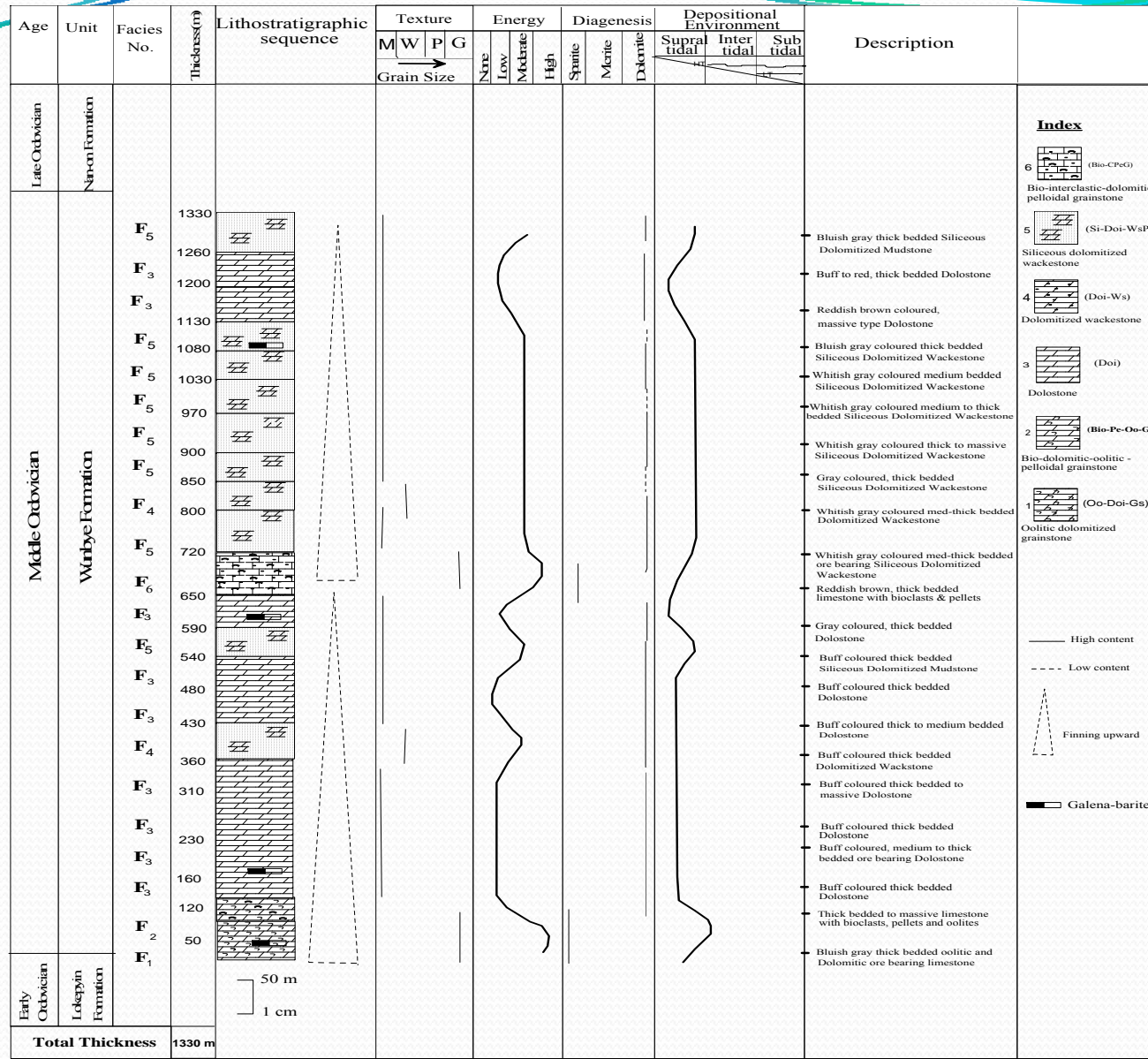
Dolomitic Limestone

- Above the sample is mainly composed of fine grained (1.8 mm) turbid calcite inherited with 80 % amount of thumb shape oolites.

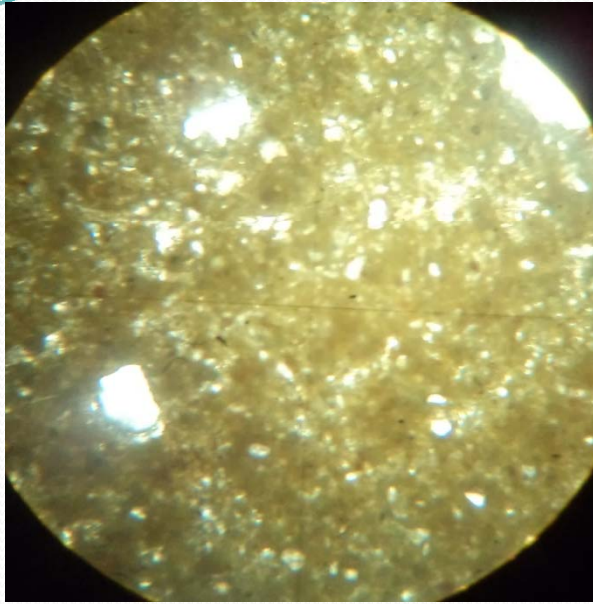
- Few derided quartz and thinly mica flakes are also present. Hydrous in oxide filled stripers and calcite filled vein lets are also whole that cut across the stratification of associated lime stones.

Dolomitic Limestone under PPL and XL

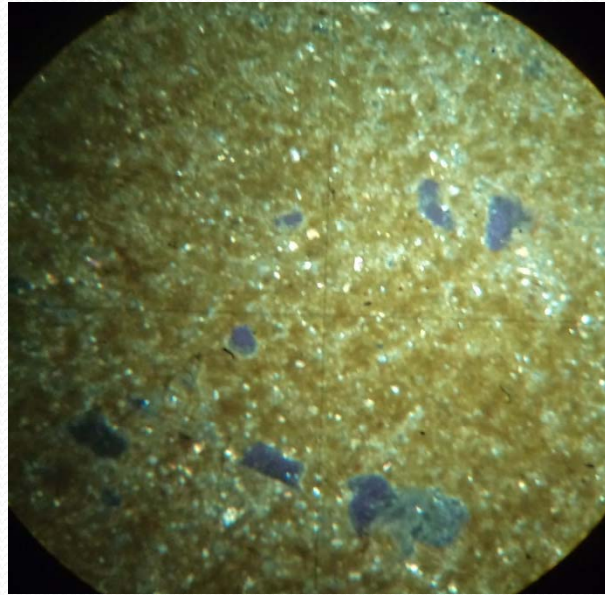
Stratigraphic section of the Wunbye Fm, Pindaya range



Petrography of the study in Nan-on Fm .



PPL



XL



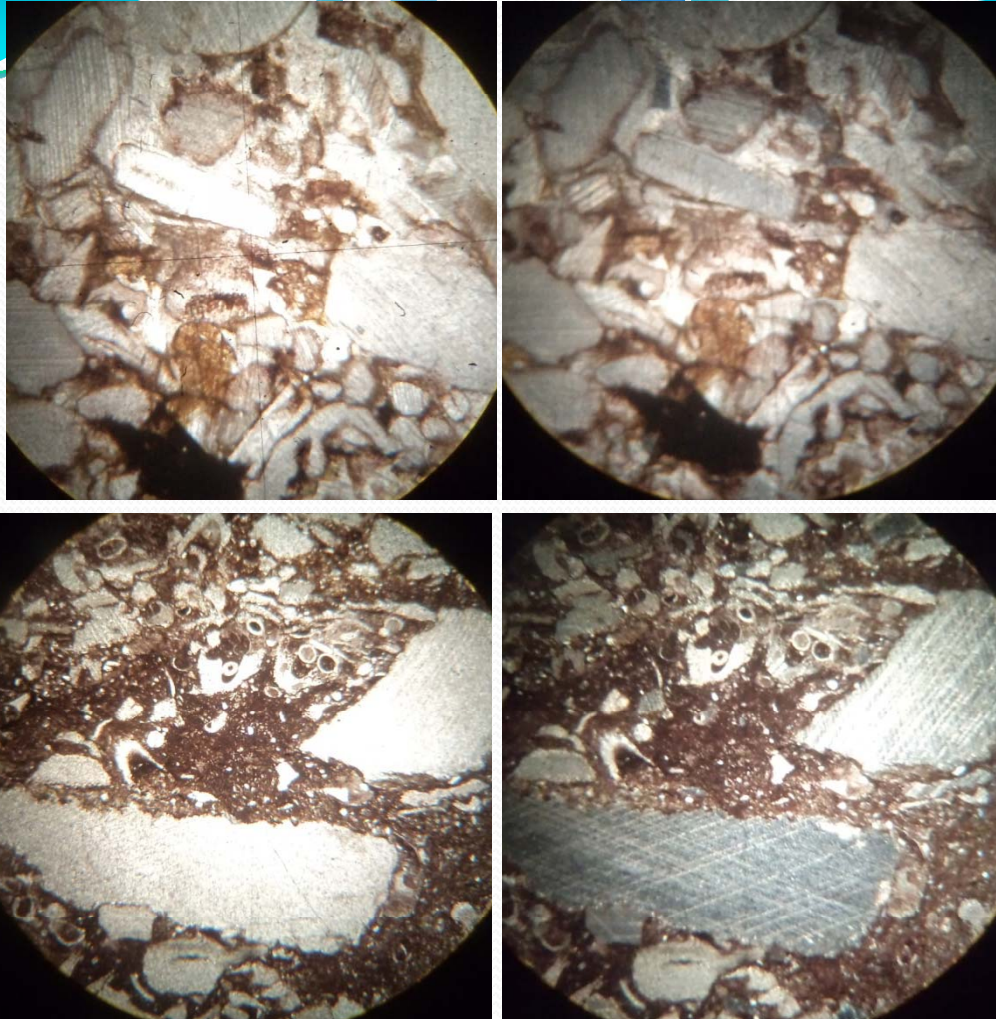
0.3 mm

Sandy mudstone under PPL and XL

- **Sandy mudstone**

This Formation above sample is composed of sand size detrital quartz embedded in hydrous iron oxide stained argillaceous matrix.

Petrography of the study in Linwe Fm .



PPL

0.3 mm

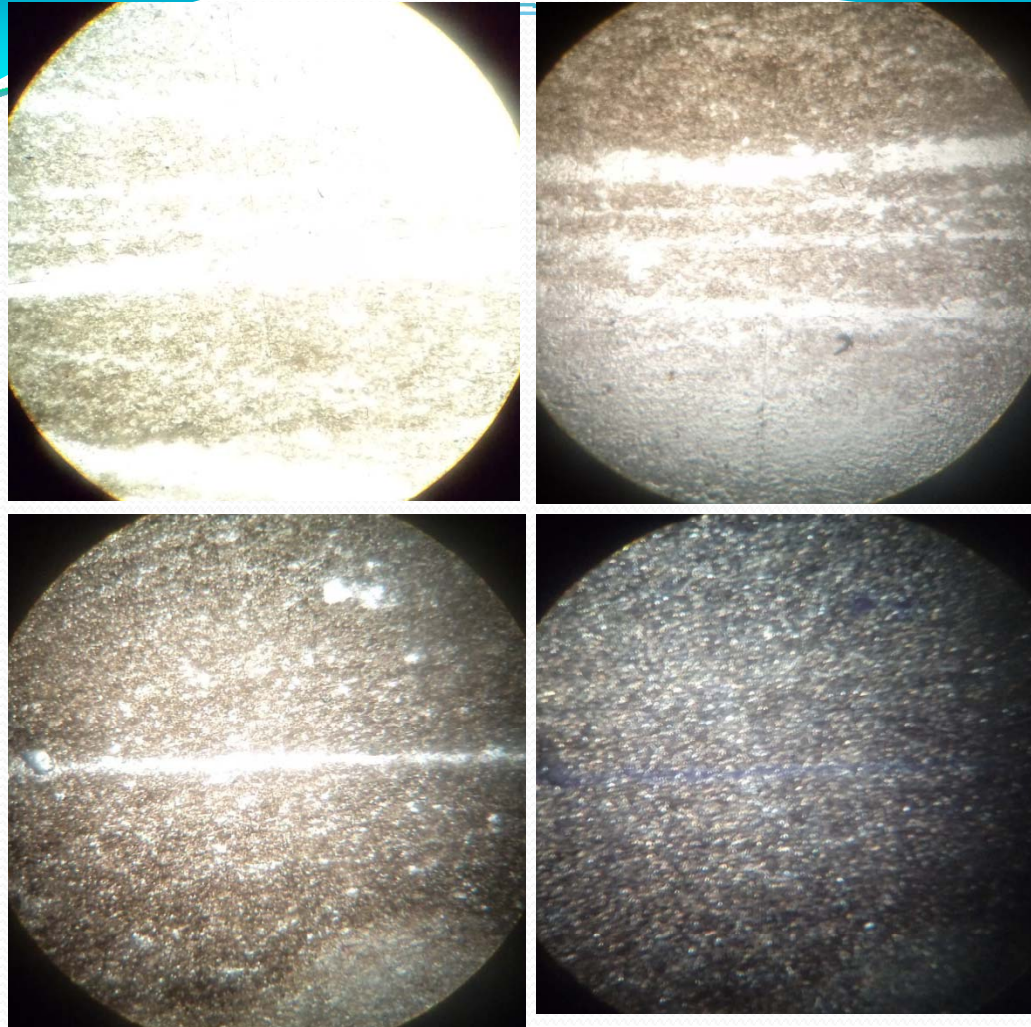
XL

Calcarcenite Limestone under PPL and XL

Calcarcenite (Calstic Limestone)

- This Formation above sample is mainly composed of poorly sorted, calcite fragmented, calcite filled microfossils, oolite embedded in ferruginous lime mud.
- Few fine sand size detritus quartz present too.

Petrography of the study in Wabya Fm .



PPL



0.3 mm

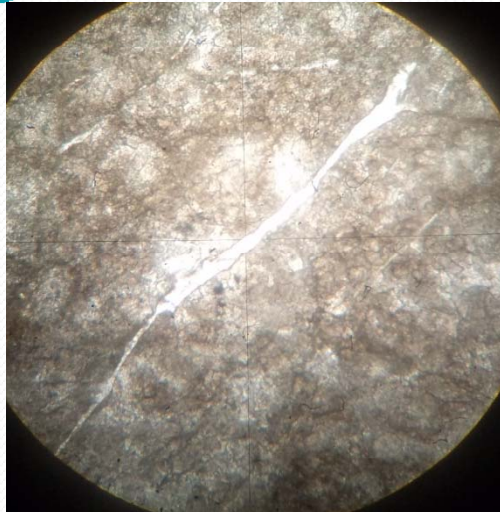
XL

Shale under PPL and XL

Shale

- flakes of the clay minerals tend to lie nearly parallel to the bedding.
- made up of shale consisting of microcrystalline micaceous clay, oriented so that tiny flakes of clay minerals are roughly parallel to the bedding.
- Some angular silt particles composed of quartz are recognizable. Very finely laminated structure is caused by streaks and minute lenticels of a dark-brown organic substance which clouds and masks the clay.

Petrography of the study in Thitsipin Fm .



PPL



XL

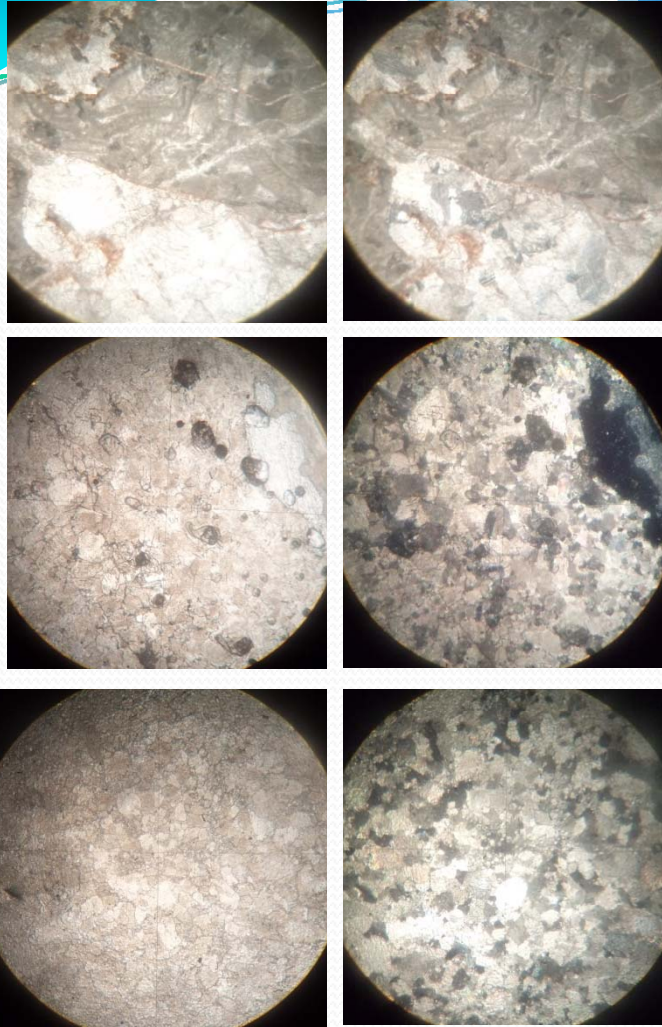
0.3 mm

Fossiliferous Limestone under PPL and XL

Fossiliferous Limestone

- Calcarenites contain carbonate a particle of three different types-namely, organic fragments, oolites and bits of older carbonate rocks.
- Clastic organic limestone, in particular are apt to contain abundant inorganic impurities, consists of fibrous calcite having irregular orientation. The sample is made up of calcite filled fossils completely cemented by of fined-grained calcite minim amount.
- The sample is crisis-crossing with oxide filled vein let present too.

Petrography of the study in Thitsipin Fm .



PPL 0.3 mm XL

Dolomitic limestone

- In dolomitic limestone and calc-dolomites, texture relationships between calcite and dolomite are particular interest, rocks, aggregates composed of little besides dolomite are in contact with others composed largely of calcite.
- The sample is mainly composed of rhombohedra shape euhedral dolomite interpreted with anhedral calcite.
- May dolomite rhomhedral crystals are made up of zones of varying iron content.

Dolomitic Limestone under PPL and XL

Petrology of the study in Barite ore deposit

Sr.No	Mineral	Chemical Properties	Physical Properties								
		Chemical Composition	Crystal System	Form	Cleavage	Colour	Streak	Lustre	Fracture	Hardness	Sp. Gr
1	Barytes	BaSO ₄	Orthorhombic	Prism, Basal Plane, Dome	Parallel Perfect	Brown, White	White	Vitreous	Uneven, brittle	3-3.5	4.5
2	Witherite	BaCO ₃	Orthorhombic	Bipyramids	Parallel Poor	White	White	Vitreous	Uneven, brittle	3.5	4.3
3	Brenelite	(Ba,Ca)CO ₃	Orthorhombic	Bipyramids	Parallel Perfect	White	White	Vitreous	Uneven, brittle	3.5	4.3
4	Baryocalcite	BaCa(CO ₃) ₂	Monoclinic	Prismatic	Perfect Prismatic	Greyish	White	Vitreous	Uneven	4	3.6



PPL 0.3 mm



XL

Barite mineral under PPL and XL

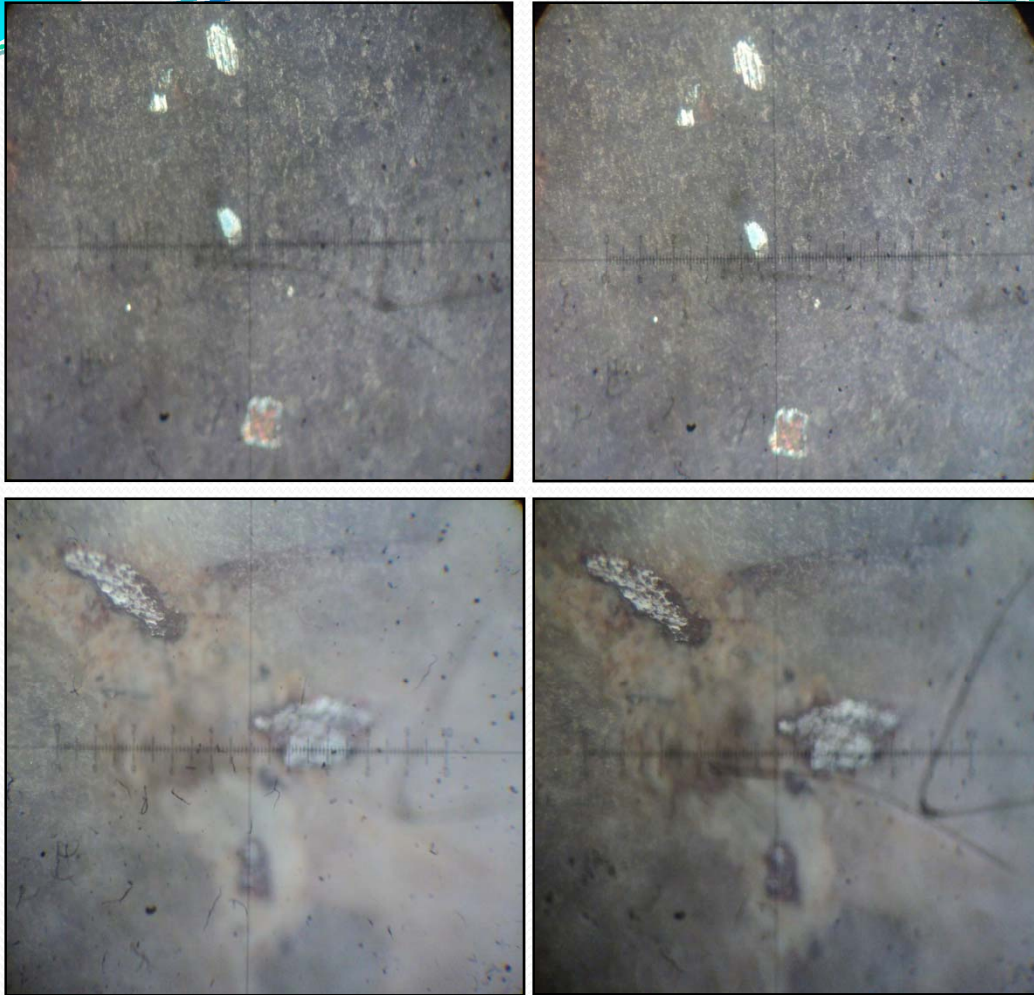
Barites

- mainly composed coarse grained sandy crystallite bladed barite with a grain size made up to several mm, 7 cm dissemination pyrite speck also detected.

- Barite are strained with hydrous iron oxide outcrop cleavage, striper of polished but hydrous iron oxide are also polished. No visible galena detected.

- polished thin section process.

Petrography of the polish study in Barite ore deposit



PPL 0.3 mm

XL

Barite mineral under PPL

Barite

- Collected from Thanitaung Work sites are mostly oxidized ores. In most cases, barite ore occurs either as orthorhombic free from in the matrix of dolomite limestone or as well as closely associated with galena, pyrite.

- Barite from are irregular in shape and relatively larger in size.

Sample No	BaSO ₄	Fe ₂ O ₃	Cu	Pb	Zn	CaO	MgO
1	899900	900	9	10	6	260	1
2	935800	400	8	7	3	106	0.9
3	936200	900	40	26	3	600	0.8
4	842200	1600	7	160	22	123	0.9
5	911800	900	12	14	2	256	0.7
6	929100	600	11	237	3	235	0.9
7	871400	600	23	23	10	167	1
8	840600	5000	24	500	120	500	0.8
9	885400	900	8	4000	3	314	1
10	887600	1400	19	1200	14	304	1

Geochemical Investigation

- Seven barite ore deposits in 10 ore samples A.A.S (ppm) results BaSO₄, Fe₂O₃, Cu, Pb, Zn, CaO and MgO.

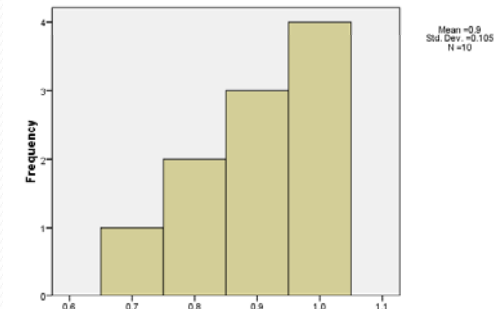
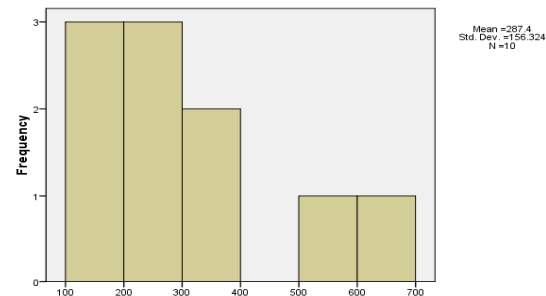
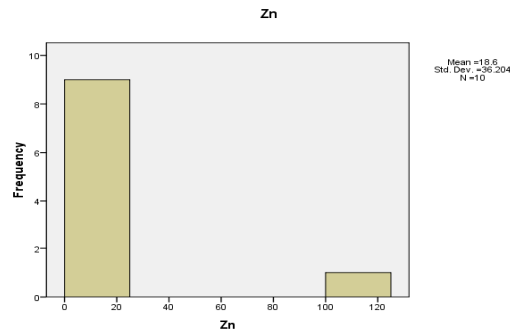
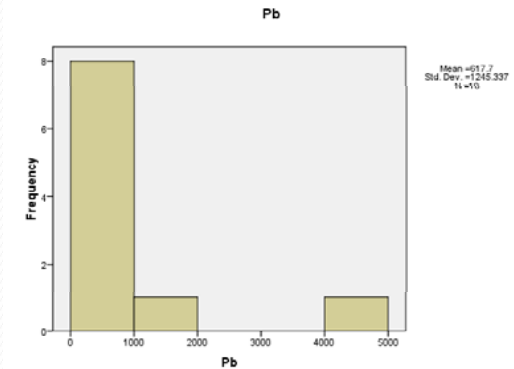
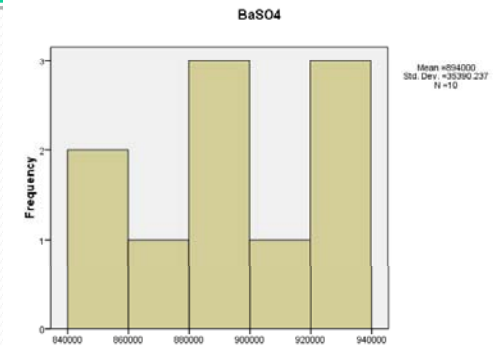
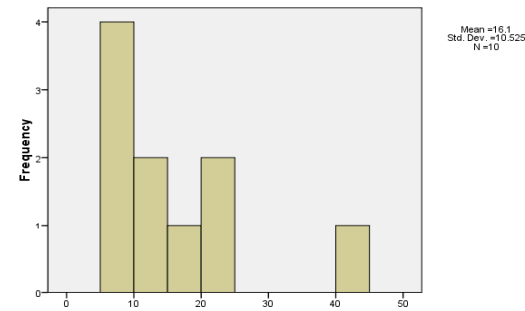
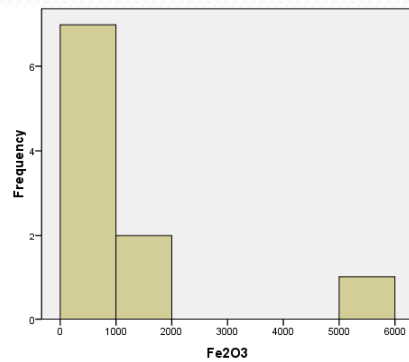
Element	Mean()ppm	Standard deviation (S)	Threshold (+ S)
BaSO ₄	894000	35390.237	929390.237
Fe ₂ O ₃	1320	1342.303	2662.303
Pb	617.7	1245.337	1863.037
Zn	18.6	36.204	54.804
Cu	16.1	10.525	26.625
CaO	287.4	156.324	443.724
MgO	0.9	0.105	1.005

Statistical Investigation

- Mean, Standard deviation, Threshold, Element in rock obtained by Statistical and Mathematical method for ore Samples in the study area

The Element Distribution

- elements distribution is contain of BaSO₄, Fe₂O₃, Cu, Pb, Zn, CaO and MgO.

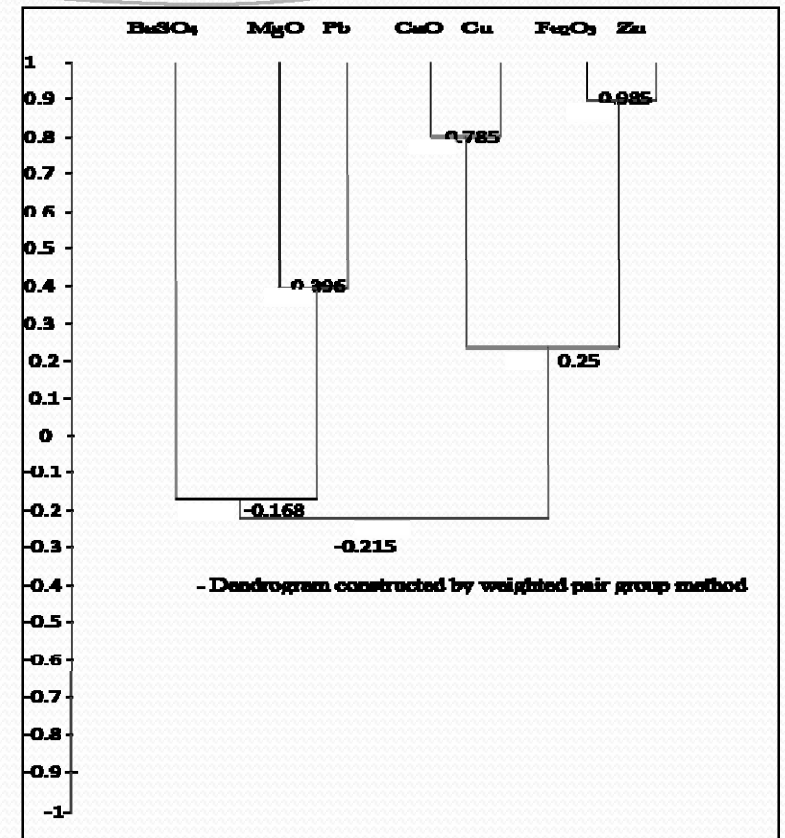


Cluster Analysis

Construct a dendrogram

Construct a dendrogram stepel A.A.S (ppm) result as D.G.S.E lab study of elements distribution is contain of BaSO₄, Fe₂O₃, Cu, Pb, Zn, CaO and MgO.

	BaSO ₄	Fe ₂ O ₃	Cu	Pb	Zn	CaO	MgO
BaSO ₄	1						
Fe ₂ O ₃	-0.662	1					
Cu	0.096	0.244	1				
Pb	-0.170	0.006	-0.229	1			
Zn	-0.647	0.985	0.237	-0.053	1		
CaO	0.043	0.484	0.785	0.113	0.416	1	
MgO	-0.167	-0.306	-0.290	0.396	-0.274	-0.382	1



Construct a dendrogram

First class = Fe₂O₃, Zn = 0.985 and CaO, Cu = 0.785

Second class = MgO, Pb = 0.396

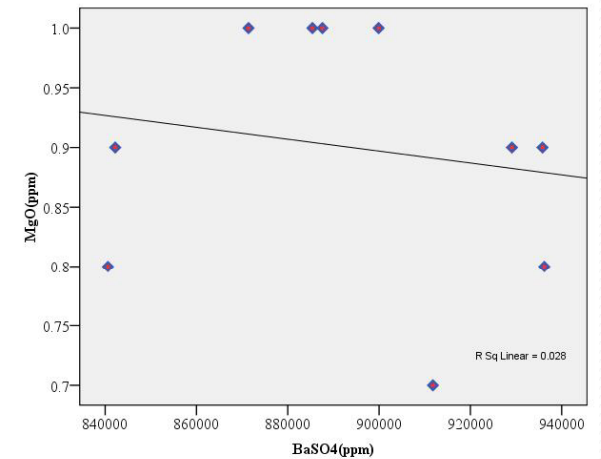
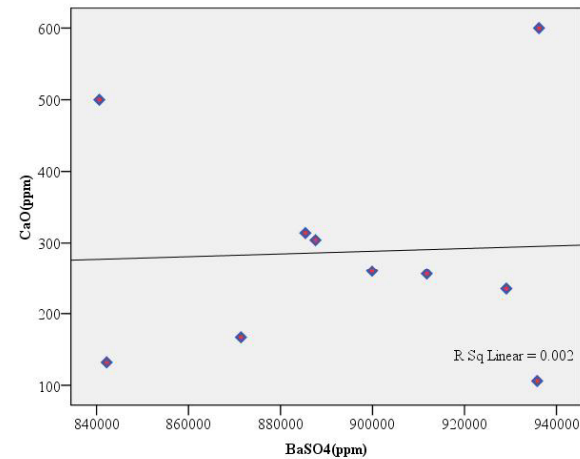
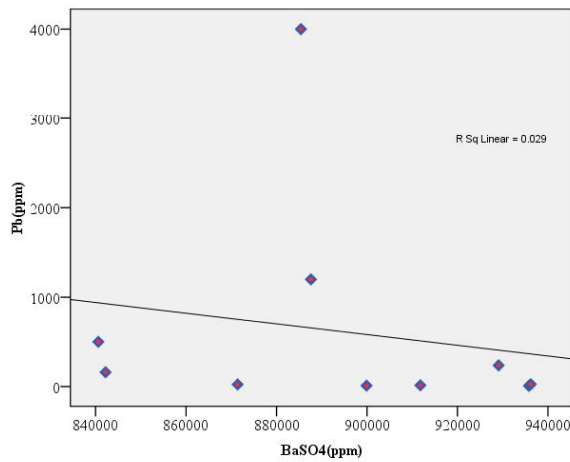
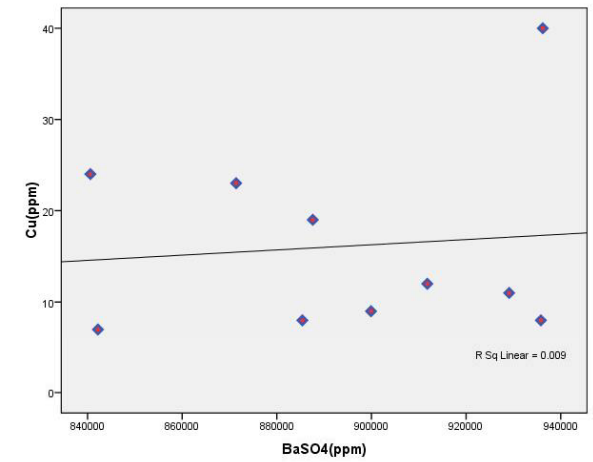
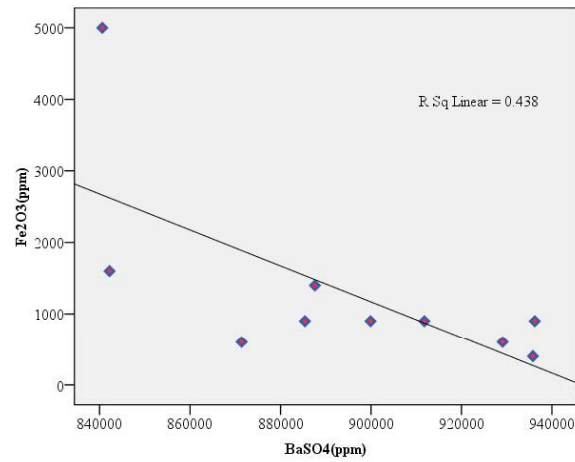
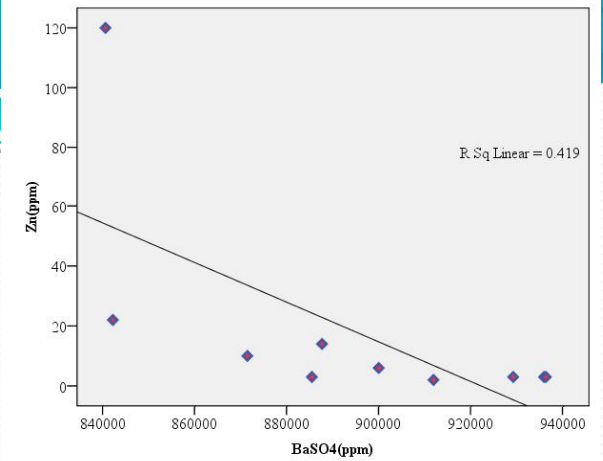
Third class = CaO, Cu, Fe₂O₃, Zn = 0.25

Fourth class = BaSO₄, MgO, Pb = -0.1685

Five class = BaSO₄, MgO, Pb, CaO, Cu, Fe₂O₃, Zn = -0.2154

Regression Analysis

- Regression analysis has been carried out for correlation between BaSO₄ and other elements in vein samples.
- Correlation between BaSO₄ and other metal values is represented as positive, negative and 0 levels correlation.



STYLE OF MINERALIZATION

- The ore deposits are controlled by structure and stratigraphy.
- The western part of the deposits lies along the NNW- SSE trending faults.
- The rock units in the western part dip at an angle of 52° to the northwest.
- Mineralization veinlets also dip consistently to the NW at about 35° .
- Mineralization also occurs along the tension fractures, trending in the (330° , 120°), Ba Than Haq, *et al.*, (1972),
- Some Galena veinlets are seen cross-cutting the Burrowed Limestone Formation (Fig.A)
- Galena associated with barite occurs generally as sills intruded conformably along the bedding planes of the Burrowed Limestone Formation.

HOST ROCKS



Bedded Limestone (Host Rock) with barite (LM 197314) looking NE

- Sulphide Mineralization is confined to the Mid. Ordovician Wunbye Formation and certain specific stratigraphic horizons.
- The mineralization of the galena is observed to occur in the oolitic dolomitic limestones with some stromatolitic limestones.
- The presense of oolites had created the development of primary intergranular openings favouring permeability.

BARITE is an ubiquitous mineral in the Pindaya-Bawsaing Lead District.

- Barite is associated with galena in the upper horizons of the Wunbye Formation in bedding deposit and as rare occurrence as interlamination and associations of galena in the lower horizons of the Wunbye Formation.

- A barite outcrop measuring 500 ft, 35 ft was observed in the Wunbye Formation, Thanitaung, northwest of Yegyanzin village.



Photographs showing massive barite outcrop in the Wunbye Fm, Thanitaung, NW of Yegyanzin village.(GPS .Loc. 197314).

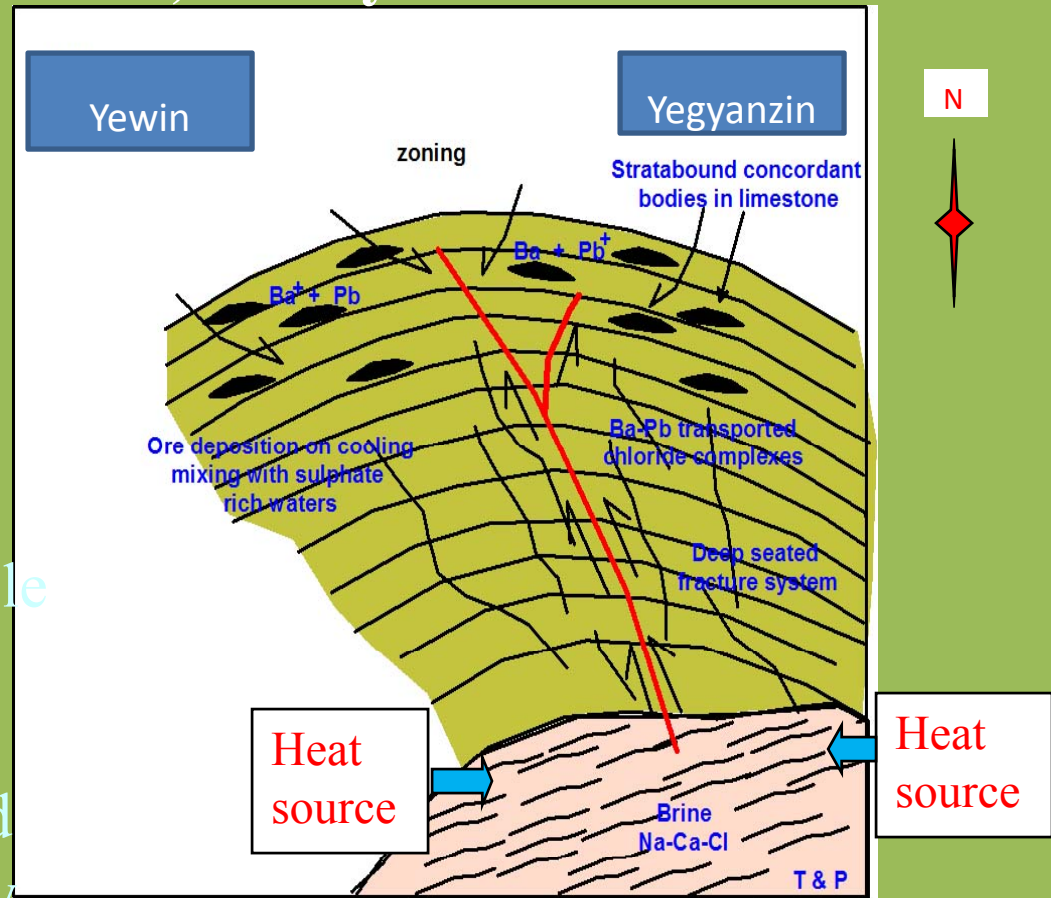
ORE GENESIS

- the mode of occurrence of barite and galena deposits within definite stratigraphic horizons with trends are congruent to the trends of the regional sedimentary rocks
- This phenomenon is stratabound in the sense of Amstutz (1959), and as enumerated by several authors including Hoffman (1966), Heinrichs and Reimer (1977).
- ore mineralization in the study area is stratabound, confined to a carbonate unit of the Ordovician Wunbye Formation commonly vein and cavity filling, bedding and residual deposit.
- the formation of lead and barite were of undoubtedly epigenetic origin.

Sequence of events leading to the formation of Barium sulphide and barite at Yegyanzin-Yewin area, Pindaya North Lead District.

Fluid source : Connate brines with high concentration of NaCl trapped in the sedimentary piles.

Heat source : Possible heat source from progressive burial of the thick sedimentary pile and conductive heat from the interior of the earth and or from the shallow-seated volcanism and igneous intrusion as evidenced by the occurrence of rhyolitic tuff diorite and pegmatite intrusions within a few miles both to the west and east of the study area.

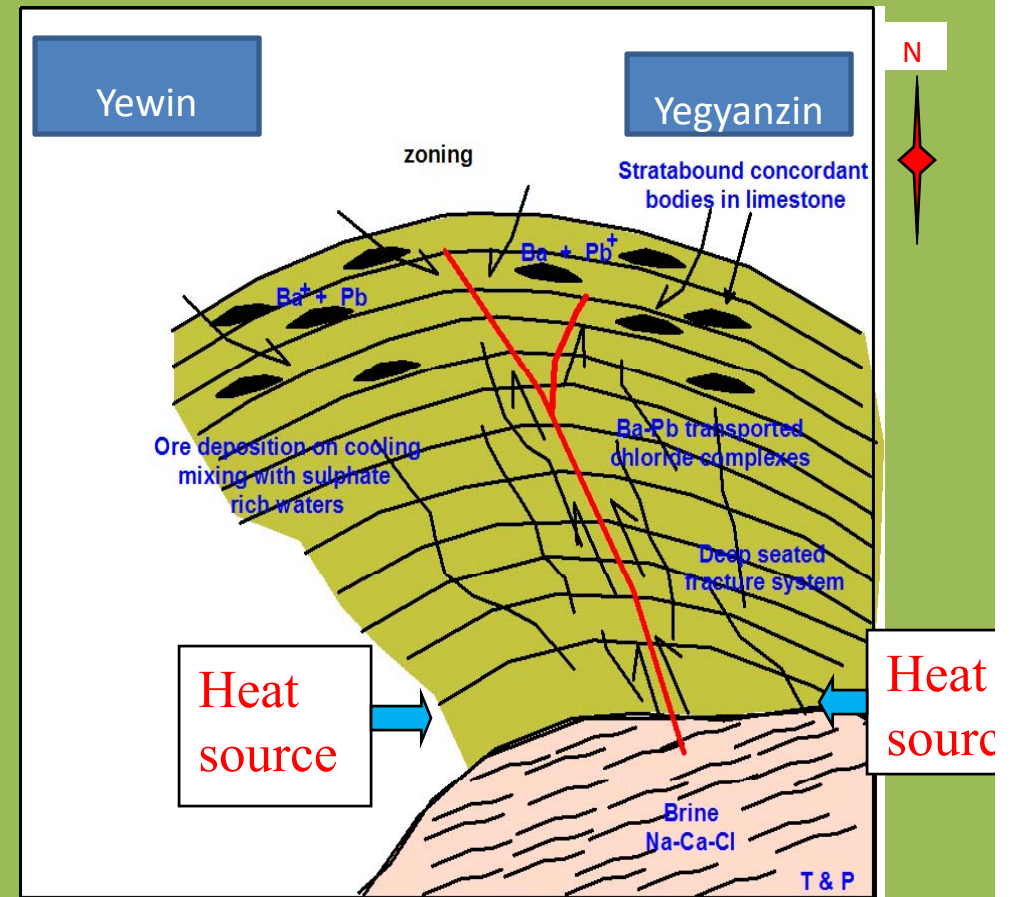


Not to Scale

Fig. A proposed conceptual model for the Ba-Pb deposits at Yegyanzin-Yewin area, Pindaya North Lead District, Shan State (south).

Transport : Transport in solution as chloride complexes.

Deposition : Pb deposition is caused by decrease in temperature, pressure and salinity and in the reducing environment . Barium chloride solution reacted with the sulphate from sulphate rich water to precipitate barium sulphate.

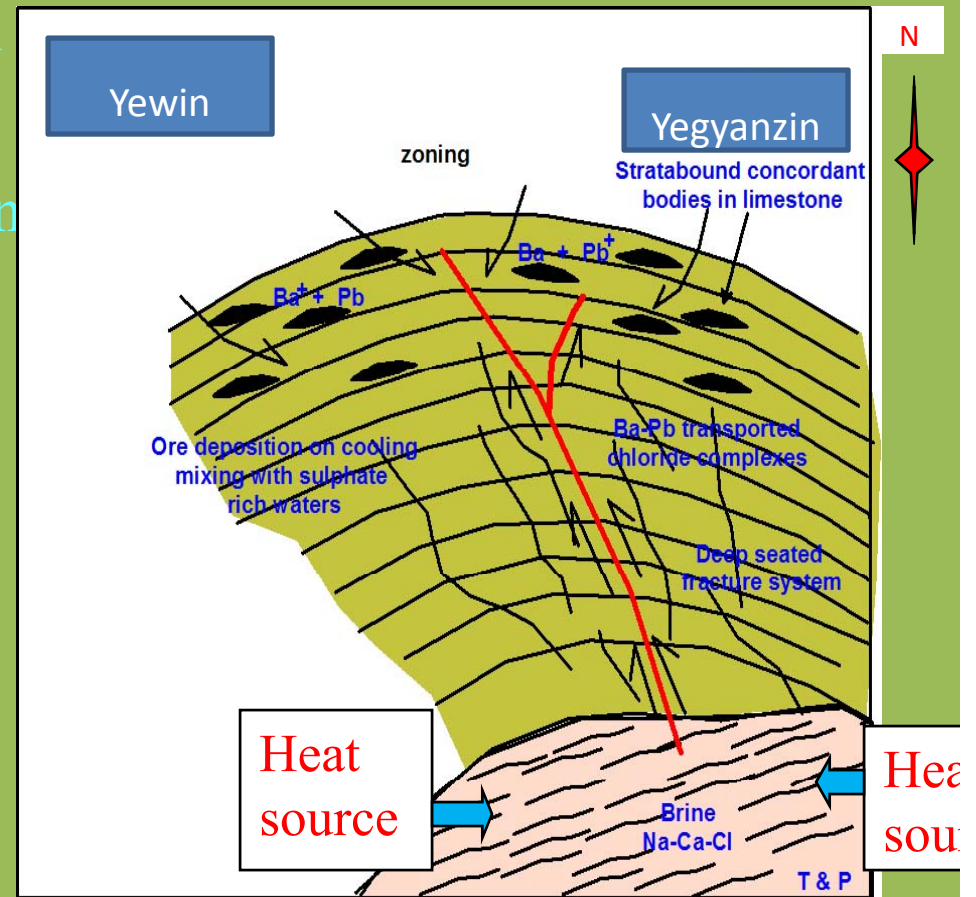


Not to Scale

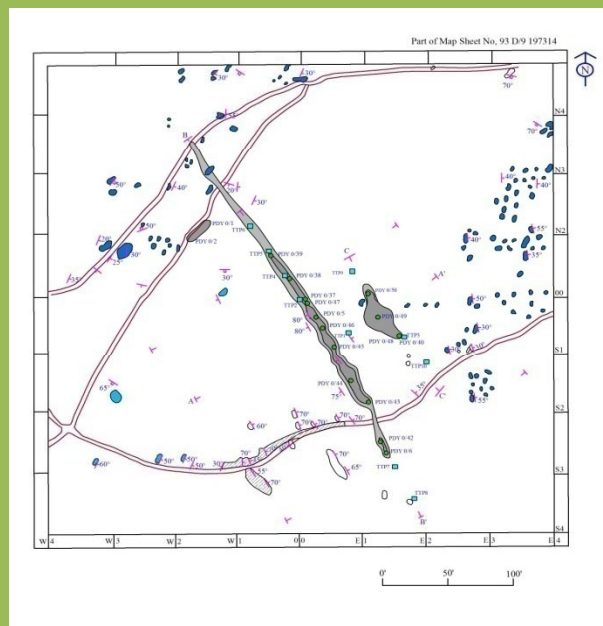
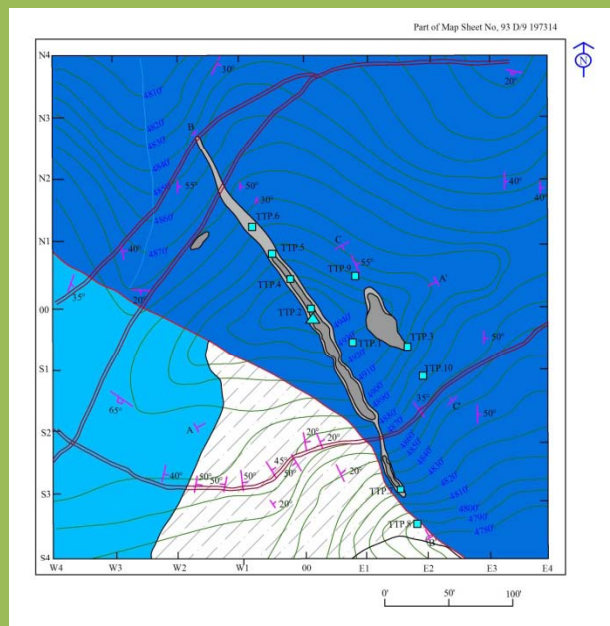
Fig. A proposed conceptual model for the Ba-Pb deposits at Yegyanzin-Yewin area, Pindaya North Lead District, Shan State (south).

Oxidation : Lead ores are partially oxidized although galena appears without destruction on the surface .The lead oxides probably occur as films on the galena and as interstitial fillings.

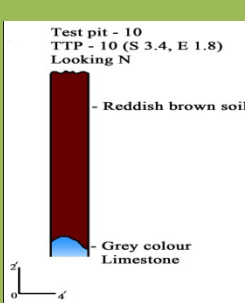
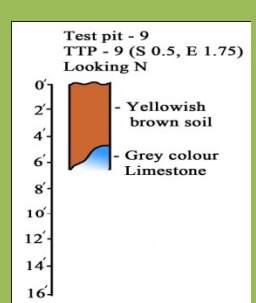
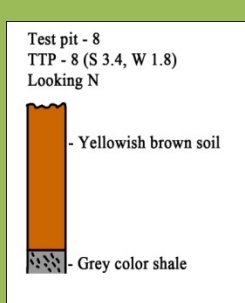
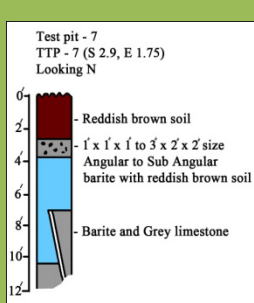
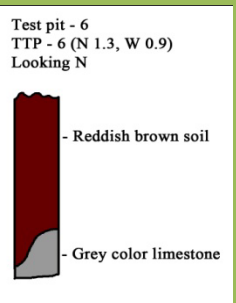
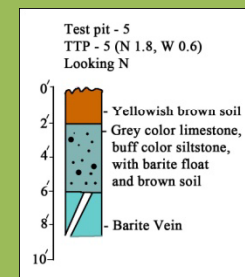
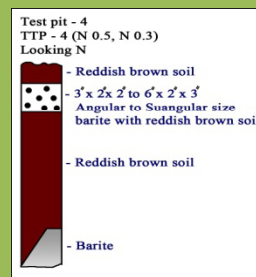
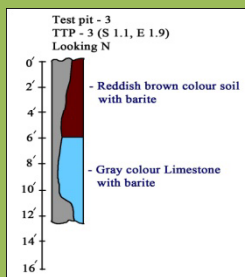
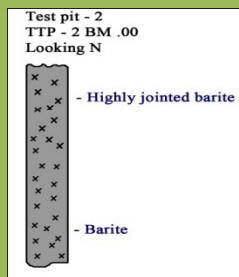
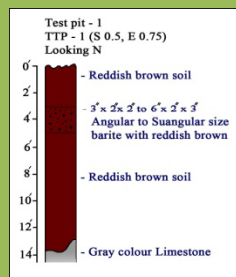
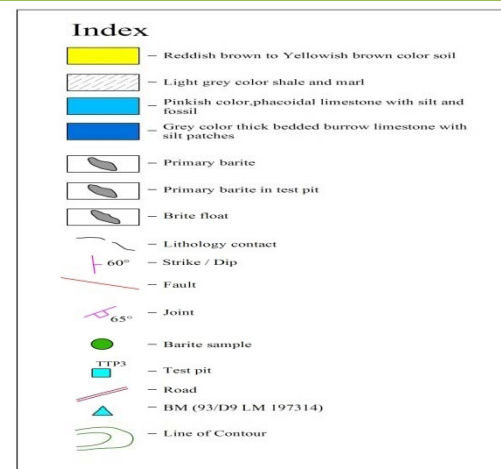
Zoning :The field evidence and laboratory results indicated a barite dominant zone in the west of the Ingyi-Ingaung Fault and lead dominant zone to the east of this fault.



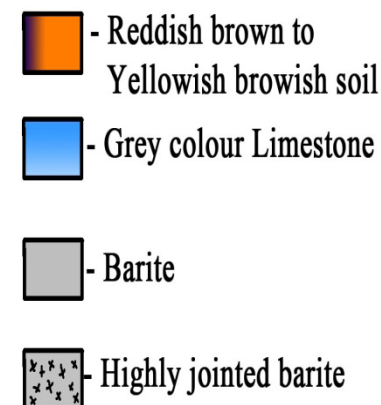
Not to Scale
A proposed conceptual model for the Ba-Pb deposits at Yegyanzin-Yewin area, Pindaya North Lead District, Shan State (south).



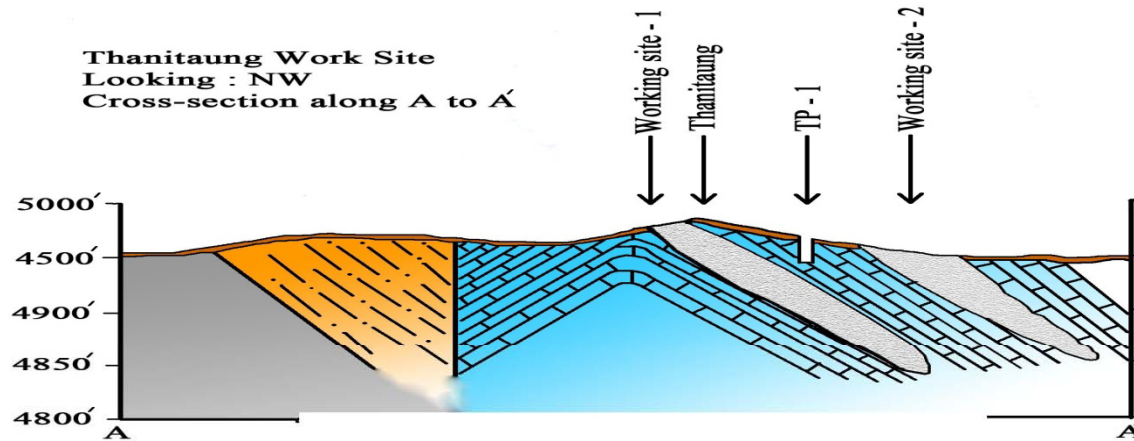
Thanitaung barite work site



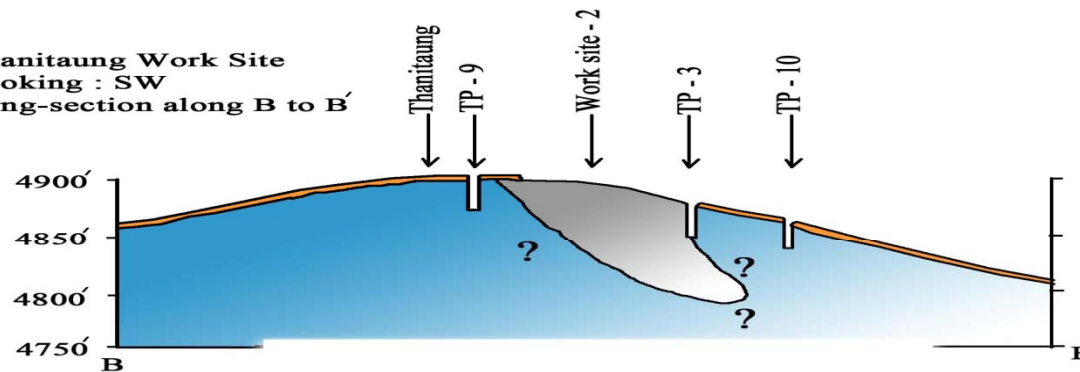
Index



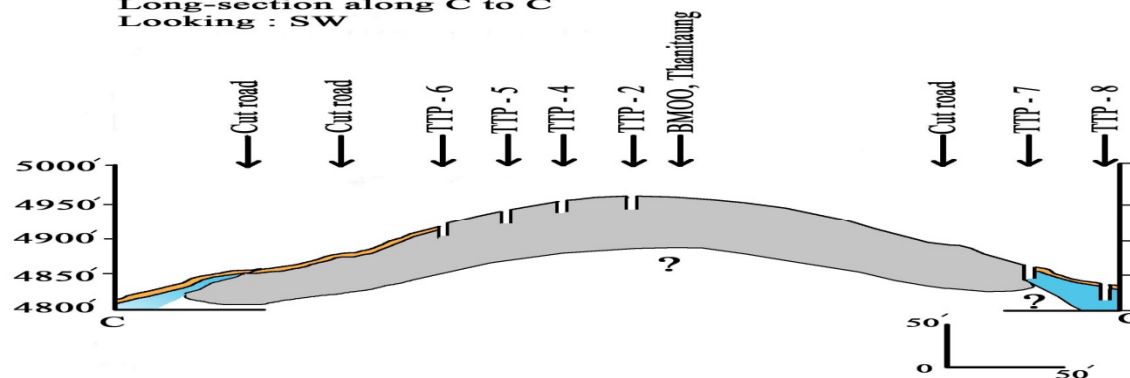
Thanitaung Work Site
Looking : NW
Cross-section along A to A'










Thanitaung Work Site
Looking : SW
Long-section along B to B'



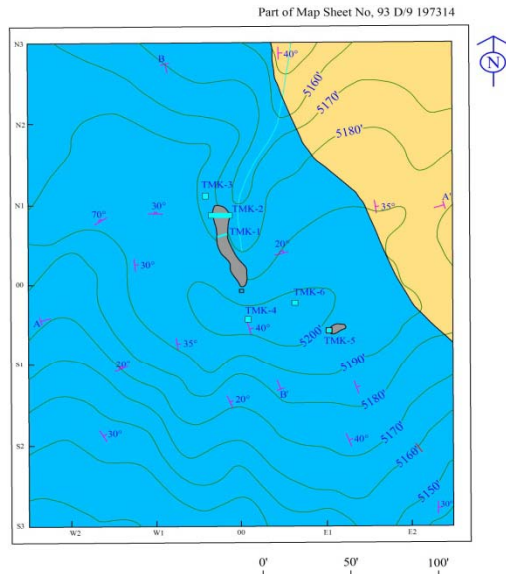
Long-section along C to C'
Looking : SW



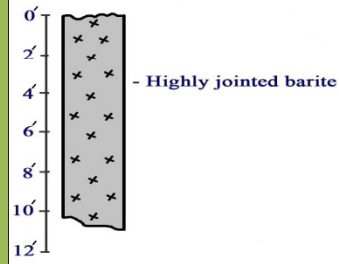
Index

-  - Reddish brown to Yellowish brown colour soil
-  - Light-grey colour shale/Marl
-  - Pinkish colour, Phacoidal limestone with silt patches
-  - Grey colour, thick bedded burrow limestone
-  - Barite
-  - Fault
-  - Test pit

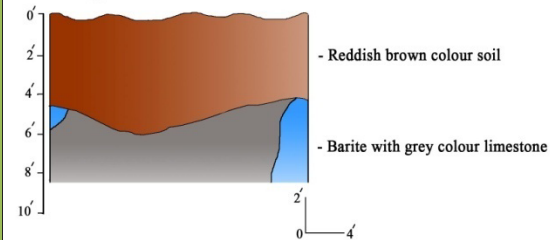
Moekyotaung barite work site



Test pit - 1
TMK - 1 (N 0.7, W 0.2)
Looking : N



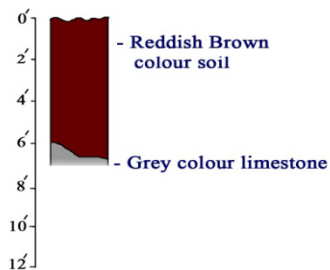
Test pit - 3
TMK-3 (N 0.9, W 0.3)
Looking : N



Index

- Reddish brown to Yellowish brown color soil
- Medium bedded, Yellowish color silt stone
- Grey color thick bedded burrow limestone with silt patches
- Primary barite
- Primary barite in test pit
- Barite float
- 30° - Strike / Dip
- 30° - Joint
- TMK-4 - Test pit
- Line of Contour
- Barite sample
- BM (93/D9 LM 1973/14)

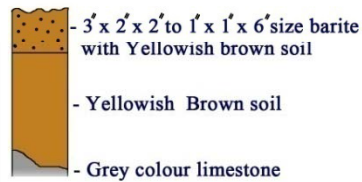
Test pit - 3
TMK - 3 (N 1.15, W 0.4)
Looking : N



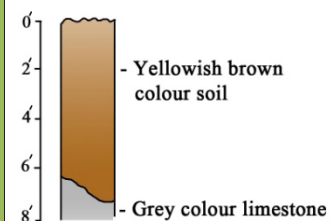
Test pit - 4
TMK - 4 (S 0.4, E 0.1)
Looking : N



Test pit - 5
TMK - 5 (S 0.5, E 1.0)
Looking : N



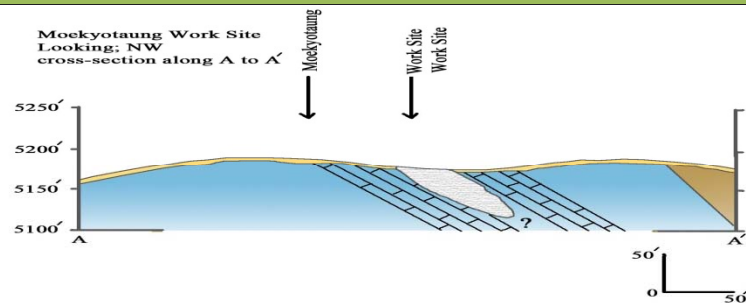
Test pit - 6
TMK-6 (S 0.2, E 0.7)
Looking : N



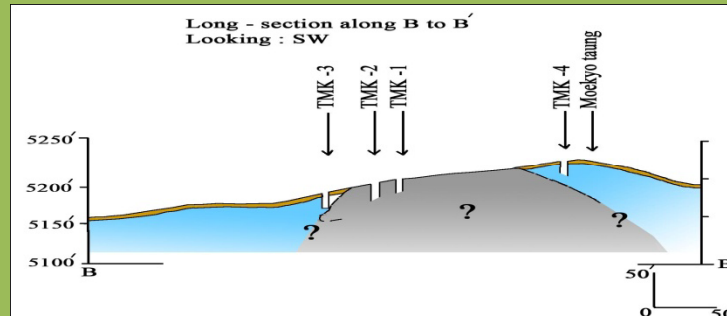
Index

- Reddish brown to Yellowish brown soil
- Grey colour Limestone
- Barite
- Highly jointed barite

Moekyotaung Work Site
Looking: NW
cross-section along A to A'



Long - section along B to B'
Looking : SW



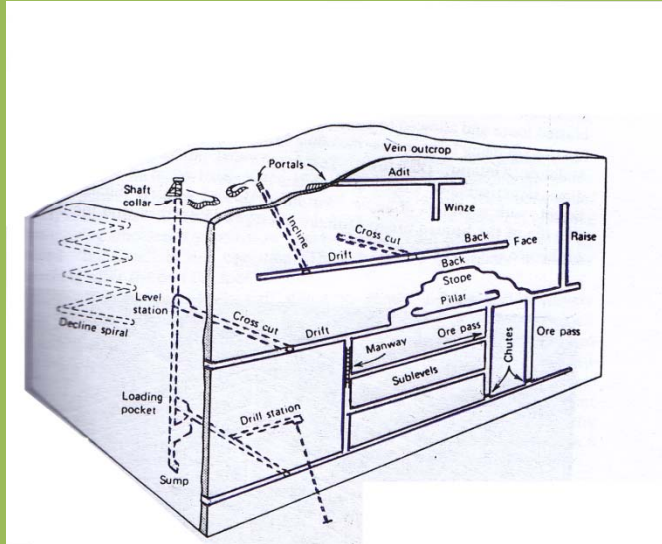
Index

- Reddish brown colour soil
- Medium-thick bedded, buff colour silt stone
- Grey colour, burrow limestone with silt patches
- Barite
- Test pit

Barite (seven) deposit ore reserves calculation of the study area

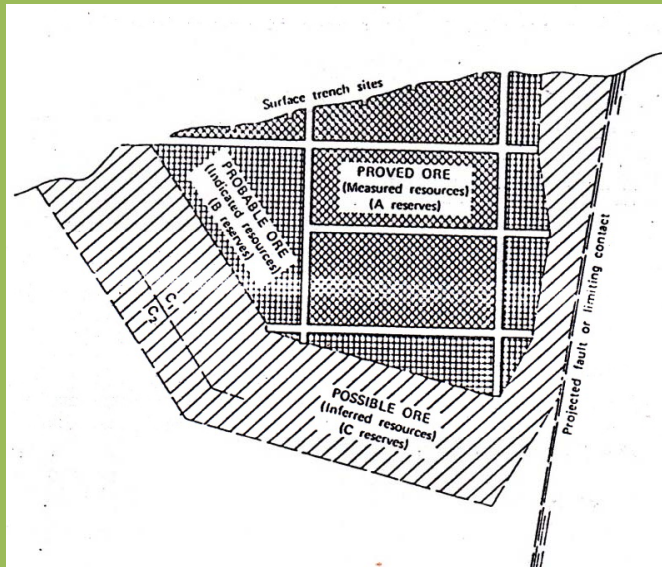
Sr No	Work Site	Location	Type of Deposits	Area			Volume (ft ³)	Tonnage (Short Ton)			Average Grade BaSO ₄ %	Sp-Gr	Remark
				Length (ft)	Depth (ft)	Thickness (ft)		P-2	P-3	P-4			
1	Thanitaung	93-D/9-LM 197314	Primary	500	35	20	350000	49295.77	-	-	91.78	4.30	
				200	30	25	150000	21126.76	-	-			
2	Moekyotaung	93-D/9-LM 188312	Primary	90	15	7.5	10125	1426	-	-	89.67	4.33	
				90	5	7.5	3375	-	475	-			
3	Tale-in	93-D/9-LM 188315	Primary	30	7.5	10	2250	-	-	316.9	92.91	4.35	
4	Phothutawtaung	93-D/9-LM 191327	Primary	50	12.5	10	6250	-	-	880	97.14	4.20	
5	Tametak	93-D/9-LM 180334	Primary	100	25	9	22500	-	-	3169	84.06	4.24	
6	ShanOthe	93-D/9-LM 153361	Primary	40	10	10	4000	-	-	563.3	88.54	4.22	
7	Yewinkom	93-D/9-LM 141371	Primary	30	7.5	10	2250	-	-	316.9	88.76	4.39	
Total tonnage								71848.53	475	5246.1	90.40	4.29	

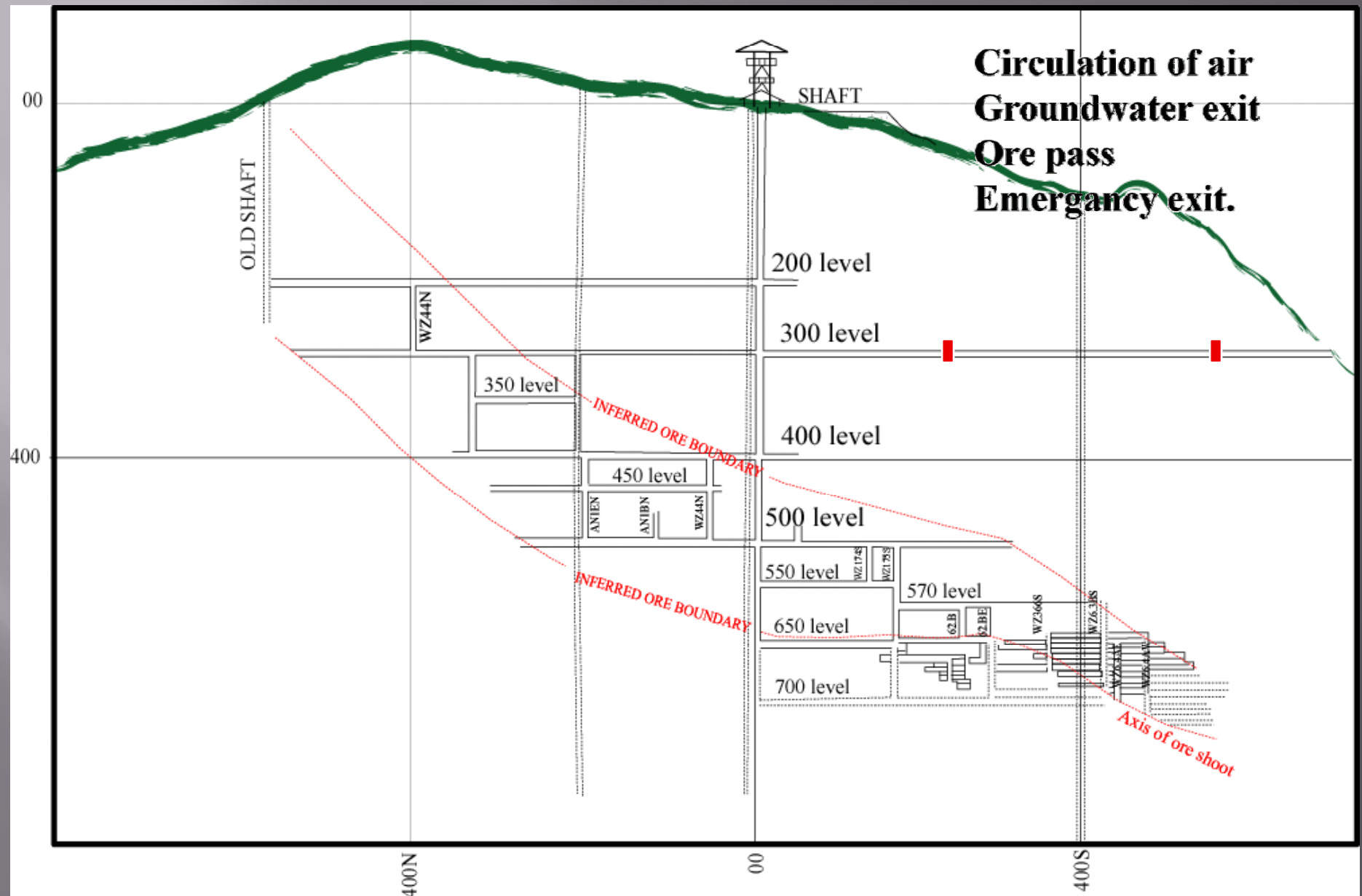
MINING METHOD AND PRODUCTION OF ORE



UNDERGROUND MINING METHOD

1. Adit
2. Drift
3. Shaft
4. Cross-cut
5. Raise
6. Winze
7. Stope
8. Level
9. Drilling
10. Blasting
11. Mucking
12. Timber support.







Adit: These positions are near horizontal opening of small cross-section driven from the surface which gives access to the ore body.



Hand picking of barite ore sample selected



Blasting: Drilling and blasting used of RQ 37 air compressor, in Underground Mining Method



Crushing machine of barite ore sample selected

SUMMARY AND CONCLUSION

Yeganzin-Yewin area Bawsaing North Lead District covers the rock sequences including of Wunbye Fm in the Pindaya Group, Ordovician Age.

Carbonate rocks of the Wunbye Formation are subdivided into six microfacies, namely: Oolitic dolomitized grainstone, Ba-Pb mineralization, Depositional environment indicates very shallow marine conditions.

Structurally, NNW-SSE or N-S direction and NW-SE dipping that plunge towards a southerly direction.

Lead and barite ore bodies generally occur as sills intruded conformably along bedding planes of the Burrowed Limestone Fm.

Barite and galena occur as the major constituents of the ore and are associated with accessory or minor sulphide minerals including of sphalerite, pyrite, covellite, dolomite, quartz, and calcite.

Analysis by XRD, XRF and AAS methods results.

Such as host rock, stratigraphy, structural setting of the ore body, mineralogy and styles of mineralization. Yeganzin-Yewin barite-galena deposits are carbonate-hosted, strata bound (concordant) and epigenetic in origin.

Above of the data to Underground mine design and production of ore.

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HAZAR COX

THANK YOU

HAZAR COX



Pindaya.kmz