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Geology of Angwan Jaba and its Environs Keffi Sheet 208 NE, North Central Nigeria

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Abstract: *The geology of Angwan Jaba and its environs, Keffi sheet 208 NE North Central Nigeria, where the study area is located within latitude of 8º 52' 6.68" N and 8º 54' 36.6" N to Longitude of 7º 55'0.8" E and 7º 57'35" E is part of the North Central Basement Complex of Nigeria. This research work is aimed at carrying out detailed geological mapping of the area to identify different rock units and their possible mineralization potential. The methodology adopted in this research involves conducting geological, petrological and geochemical investigation approaches to investigate for mineral potential. Fifteen (15) samples of both host rock (schist) and pegmatites were collected for thin section and another (15) samples for geochemical analysis. On the basis of field relationships and petrological studies the following two main rock units were identified in the area; the schists and pegmatites and minor quartz veins. Petrographic studies also show the rocks mainly contain quartz, plagioclase feldspar, orthoclase feldspar, mica, biotite; while tourmaline, zircon, lepidolite and opaque patches constitute the accessory minerals. Geochemical analysis of the rocks using X-ray fluorescence technique reveals the concentration of different major element and trace elements composition. Geochemical interpretation of both the major and trace elements using various geochemical discrimination plots such as the plots of TAS diagram (Na_2O+K_2O vs SiO_2) (after Cox-Bell, 1979); A/CNK vs SiO_2 (after Chappell &White, 1974) and AFM diagram for the classification and origin of the rocks, show all the rocks are essentially granitic and depicts the pegmatites and most of the host schists as strongly peraluminous and sedimentary in origin (protolith). In terms of tectonic affiliation (setting) plot of Log Nb vs Log Y (after Pearce et al., 1984) indicates the rocks of the study area to be within plate granite (WPG). On account of mineraliztion potentials the plots of Harker variation diagrams (major oxides elements Vs SiO2) of the pegmatites suggest the pegmatites are not only genetically linked to one another but also highly evolved. Structural features such as joints, faults and veins identified and recorded in the area are mainly trending in the N-S, NE-SW and NW-SE directions, which is interpreted to be related to the Pan-African Orogeny.*

Keywords: *Geology, Petrography, Geochemistry, Pegmatite, Mineralization.*

1. Introduction

The geology of Angwan Jaba and its environs, Keffi sheet North Central Nigeria primarily is concerned with field mapping which involves; the study of field occurrences, observation and measurements of geological features with respect to their relation with country rock in the field. The area under investigation is located within the latitude of 8º 52' 6.68" N and 8º 54' 36.6" N to Longitude of 7º 55'0.8" E and 7º 57'35" E on the part sheet of Keffi North Central Nigeria, which covers a total of about 25.9 km^2.

The study area Angwan Jaba and its environs which falls within the North Central Basement rocks is primarily influenced by the Precambrian Basement rock units; the migmatite-gneiss, schists granitoids and felsic and dykes. Based on the geological information of the region, the rocks that primarily underlain Keffi area and its environs are migmatite-gneiss, schists, granitoids and felsic and mafic dykes (Rahaman and Ocan, 1971; Rahaman , 1988; Ajibade , 1988; Tanko, 2014; Tanko *et al*., 2015).

Structurally, the North Central Basement rocks are characterized mainly by the common lineament features of the Nigerian Basement Complex, such as the fractures, faults, joints and folds,and most of thesefeatures trend in the NE-SW, NW-SE and N-S trends (Rahaman and Ocan, 1971; Rahaman, 1988; Ajibade , 1988; Dada, 2006; Tanko 2014; Tanko *et al*., 2015). Mineralization in the Keffi area where the study area falls, are mostly associated with the main regional structural trends (NE-SW, NW-SE and N-S) of the North Central Basement Complex rocks, especially the pegmatites (Rahaman, 1988; Ajibade , 1988; Tanko, 2014; Tanko *et al*., 2015).

Available work and previous geological mapping of the study area were conducted on regional scale, so smaller features and detailed information on the rock units in the area are lacking. Therefore, the need for detailed geological mapping on a larger scale that will reveal the nature of the rock units as well as identification and description of other features that will possibly lead to mineralization be conducted.

The aim of this project work is to carry out geological mapping and produce a detailed geological map and mineral potential of the study area.

2. **Regional/Geological Setting**

2.1 Overview of the Basement Complex of Nigeria

The Basement Complex of southwestern Nigeria lies in the rest of the West African Craton in the region of late Precambrian to early Paleozoic orogenesis. The Nigerian Basement Complex extends westwards and continued with the Dahomeyan of the Dahomey-Togo-Ghana region. Three main rock groups are identified in the Basement Complex of Nigeria namely: the Migmatite Gneiss Complex, the Schist Belts and the Pan African Older Granites (Fig 2.2).

1. The Migmatite-Gneiss Complexes;
2. The meta-volcano sedimentary (Schist Belt);
3. The Older Granites; And
4. The felsic and basic dykes

For the sake of these findings the older granites and felsic and basic dykes are additionally discussed in detail, because they cover the pegmatites of the area.

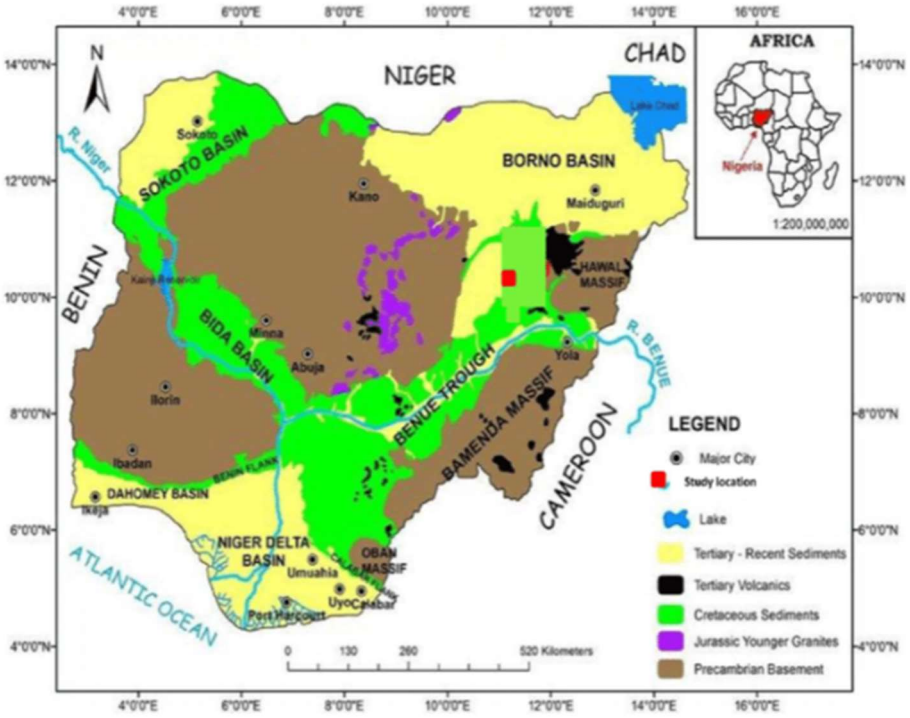


Fig.2.1: Map of the Basement Complex of Nigeria

2.2 The Older Granites and felsic and basic dykes

The Older Granite suite is notable for its general lack of associated mineralization although the thermal effects may play role in the remobilization of mineralizing fluids. Dada (2006) was of the opinion that the term “Pan-African Granitoids” be used for the Older Granites not only on the merit of the age which was not available at the time they were named Older Granites, because it covers several important petrologic groups formed at the same time.

3. Methodology

3.1 Field Mapping

The field investigation was carried out in two phases; the initial phase was a reconnaissance survey, where mode of occurrence of host rocks and pegmatite veins and their relationships were identified. Topographical features such as drainages (streams and rivers), relief, undulating nature of the area and other field features were noted for further studies. While the second stage is field mapping undertaken on a scale of 1:25,000. The geological field mapping was carried out using some tools such as topographic map, geologic hammer, compass-clinometer and global positioning system (GPS).

Traversing was done along the access routes which are minor roads as well as stream and river channels with the aid of a compass and in addition, outcrop along road cuts and stream or river

channels were studied. Thereafter, outcrops were observed, described, identified in order to determine the texture, colour and mineralogy. Structural features such as foliation, fractures and fold were observed in the rocks of which a total number of fifteen samples were collected in the field. Global Positioning System was used in locating sample collection points on the base map. Strike, dip directions and bearing of outcrops were measured using compass clinometer after which readings were located in base map. A total of fifteen representative samples were prepared and sent to Nassarawa State University Department of Geology and Mining Laboratory for thin section and Gombe State University Geology Laboratory for geochemical analysis.

5. Result and Discussion

4.1 Geology of the Study Area

Angwan Jaba area is situated within the Basement Complex of Nigeria on latitude8º 52' 6.68" N and 8º 54' 36.6" N to longitude of 7º 55'0.8" E and 7º 57'35", the area is underlain by biotite schist and is intruded by pegmatites containing intersecting small quartzofeldspathic veinlets,. The pegmatites are mainly oriented in the NW-SE with the schist striking in the NE-SW and E-W, directions. The major structural features observed in the area are microfolds, fractures and joints. The planar structures are mostly trending in the NW-SE, NE-SW and E-W directions (Figures 4.1 and 4.2).

Table 4.1 Strike of joints/Fractures

S/N	JOINT	S/N	JOINT
1	132	11	230
2	252	12	117
3	038	13	30
4	040	16	45
5	097	15	35
6	152	16	45
7	140	17	48
8	127	18	51
9	206	19	06
10	321	20	27

Figure 4.1 Rose plot of joint/fractures

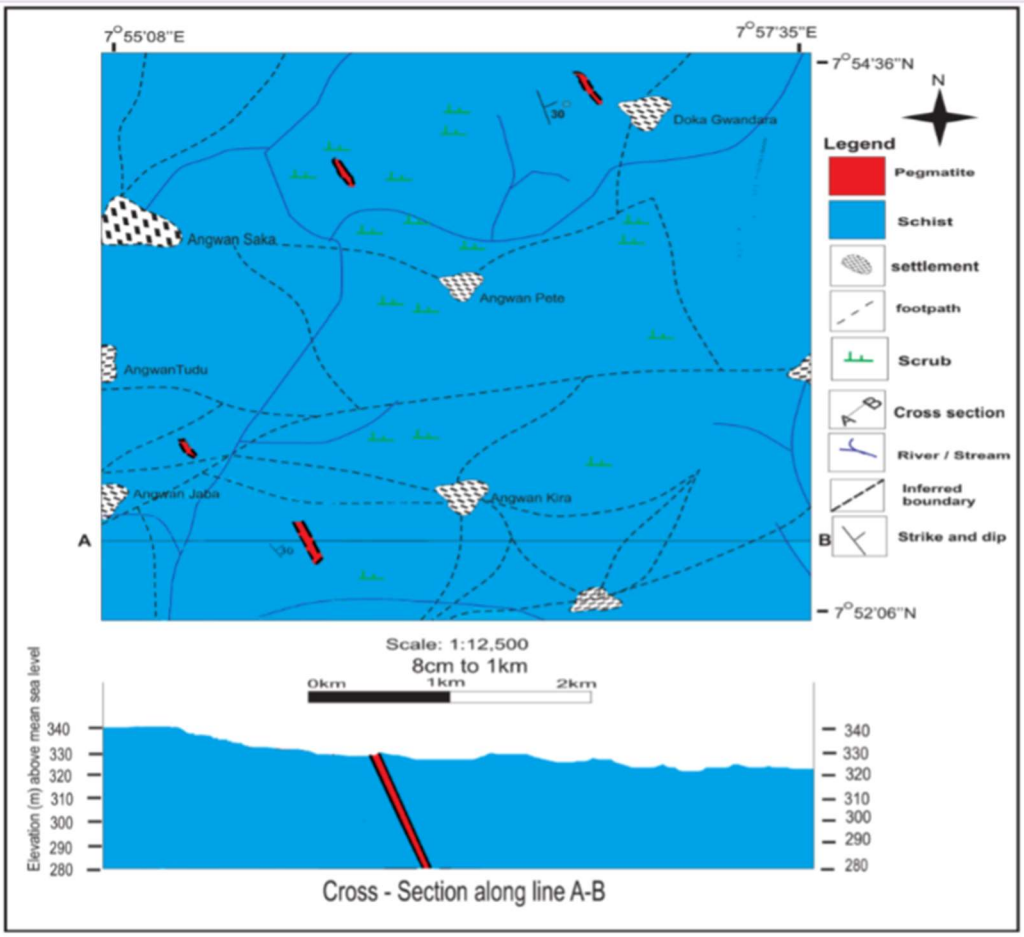


Figure 4.2: Geological Map of the Study Area

4.1.1 Schists

The outcrops are massively exposed and trending in the NE-SW direction while almost all the pegmatites trend in the NW-SE directions. The Schists are emplaced as low lying exposures which exhibits schistosity texture and cross cutting quardzofeldspathic veinlets. The schist is the hosting rock for the pegmatites. The observable minerals from the field are; dark patches of opaque minerals, hornblende, biotite, muscovite and quartz. The minerals are mostly foliated and texturally medium to fine grained. The representative schist samples were selected and labeled as Y2 and Y4, whilst the intruded pegmatites as YI, Y6, Y7 and Y8 respectively.

Plate 4.1: Field photograph of biotite schist in the Study Area (8º 54' 28.29"N. and 7º 57' 21.94"E).

4.1.2 Pegmatite

Pegmatite in the study area occurred as dykes and veins. The rock found in this study is very coarse grained in nature. The pegmatite out crop covers about 10% of the study area.

In the field in-situ pegmatites show very coarse grained texture with crystals of about 30cm and above in length, usually granitic in composition which typically formed during the final stages of magma chamber crystallization. The mineral content of the pegmatite is essentially quartz and orthoclase feldspars with little mica which can be seen with naked eye.

Plate: 4.2: Field photograph of pegmatite (8º 50' 18.28"N. and 7º 57' 30.37"E).

Table 4.2 Field features of the rocks of the study area

S/N	Field Features								General specimen description and major and accessory minerals composition
	Identity	Location	Orientation		Size		Contact with Host Rock	Host Rock	
			Strike	Dip	Length	Thickness			
1	Doka Gwandara Y1 Schist	8º 54' 28.29"N. and 7º 57' 21.94"E.	N90ºW	70ºNW	150m long	1.6m wide	Sharp	Schist	Medium -Coarse grained constitute of quartz +biotite +microcline.
2	AngwanTudu Y2 Schist	8º 52' 45"N. and 7º 55' 24.4"E	N97ºE	86ºNE	400m	3m wide	Sharp and aligned	Schist	Medium grained metamorphic grade constitute of quartz +biotite +muscovite.
3	DokaGwandara Y4 Massive Schist	8º 54' 36"N. and 7º 57' 01"E.	N85ºE	31ºNE	200m	2.4m wide	Sharp	Schist	Fine grained lighter and darker bands constitute of plagioclase + biotite + quartz + opaque.
4	Angwan Saka Y5 Massive Schist	8º 53' 27"N. and 7º 55' 31"E.	N76ºE	60ºNS	200m	2m wide	Sharp	Schist	Fine grained lighter and darker bands constitute of plagioclase + biotite + quartz + opaque.
5	Doka Gwandara Y1 Schist	8º 54' 28.29"N. and 7º 57' 21.94"E.	N90ºW	70ºNW	150m long	1.6m wide	Sharp	Schist	Medium -Coarse grained constitute of quartz +biotite +microcline.
6	BeforAngwanTaimako Y3 Schist	8º 53' 54.97"N. and 7º 55' 49.32"E.	N95ºE	72ºNE	300m	5m wide	Sharp	Schist	Fine grained lighter and darker bands constitute of muscovite + biotite + quartz + opaque.
7	Before Angwanpete Y7 Schist	8º 52' 53.60"N. and 7º 55' 53.67"E.	N87ºE	62ºNE	250m	2m wide	Sharp	Schist	Medium - Fine grained lighter and darker bands constitute of plagioclase + biotite + quartz + opaque.
8	Angwarkira Y8 Schist	8º 52' 23.34"N. and 7º 56' 31.96"E.	N97ºE	71ºNE	200m	3m wide	Sharp with narrow zone	Schist	Fine grained lighter and darker bands constitute of plagioclase + biotite + quartz + opaque.
9	AnguwanTaimako L1 Pegmatite	8º 52' 44"N. and 7º 55' 20"E.	N90ºW	70ºNW	15cm	1.7cm wide	Sharp	Pegmatite	Lighter coloured very coarse grained composed quartz + microcline + opaque + biotite
10	AngwanTudu L2 Pegmatite	8º 52' 56.55"N. and 7º 55' 24.6"E.	N84ºW	65ºNW	20cm	2cm wide	Sharp with narrow zone	Pegmatite	Coarse to medium grained reddish to greyish colour consist mainly of muscovite +quartz
11	AngwanJaba L3 pegmatite	8º 52' 6.01"N. and 7º 55' 1.6"E.	N330ºW	85ºNE	20cm	1.2cm wide	Sharp, zoned, cross-cutting other pegmatite	Pegmatite	Coarse to very coarse grained texture observable biotite + muscovite + quartz + opaque
12	AngwanJaba L4 Pegmatite	8º 52' 40"N. and 7º 58' 6.0"E.	N201ºS	90ºNW	20cm	1.3cm wide	Sharp	Pegmatite	Coarse to medium very coarse grained texture observable biotite + muscovite + quartz + opaque

13	AnguwanTaimako L1 Pegmatite	8º 52' 44"N. and 7º 55' 20"E.	N90ºW	70ºNW	15cm	1.7cm wide	Sharp	Pegmatite	Lighter coloured very coarse grained composed quartz + microcline + opaque + biotite
14	AngwanJaba L6 Pegmatite	8º 50' 18.26"N. and 7º 57' 30.36"E.	N237ºW	78ºSW	20cm	1.5cm wide	Sharp	Pegmatite	Coarse to very coarse grained texture consist biotite + plagioclase + quartz + opaque
15	Angwan Kira L7 Pegmatite	8º 50' 18.28"N. and 7º 57' 30.37"E.	N155ºE	80ºSW	15cm	2cm wide	Sharp	Pegmatite	Coarse to very coarse grained texture consist plagioclase + muscovite + quartz + biotite
16	Angwan Jaba L8 Pegmatite	8º 52' 6.30"N. and 7º 56' 34.70"E.	N76ºE	20ºSE	20cm	1.5cm wide	Sharp and aligned	Pegmatite	Very Coarse to very coarse grained texture observable biotite + microline + quartz + opaque

4.2 Petrography

4.2.1 Pegmatites

Petrographic studies show that, the major and accessory minerals présent are mostly: quartz, plagioclase, biotite, muscovite, microcline and opaque minerals. The quartz crystal occurs as groundmass invariably clear and unaltered and display grey to yellow interference colour, show no alteration, lack cleavage and no twinning was observed, however, the mineral goes into extinction about four (4) times on rotating the stage at angel 360^0 with an anisotropic property exhibited, however, muscovite show one (1) distinctive cleavage and non pleochroic with lath-like and indicates third order blue-purple interference colour on rotation of the stage at 75°, and goes completely extinct at about 90° on continuous rotation of the microscope stage with no twinning. Biotite appears brown to dark brown, lath-like, slightly pleochroic, moderate to high relief with one distinctive cleavage, in the other hand, it shows no twinning, it goes into extinction at an angle of 75° - 90° on rotation of the stage, the mineral tend to get elongated and orient to the same direction as it was observed. Plagioclase shows a non-pleochroic property with no cleavage, however, plagioclase exhibit a first order grey-white interference colour, with an albite twinning being one of the distinctive known properties of a plagioclase, it goes into extinction four (4) times on a 360° rotation and shows little or little alteration margins, however; in (plate 4.18) Plagioclase display anhedralcrystalwith multiple (polysynthetic, Carlsbad) twinningwhich display dark and light bands. The garnetcrystals appears to beisotropic (birefrigence) and has high relief which display subhedralcrystal texture. The orthoclase issurrounded by biotite and quartz crystalwhich show a darkgreycolour. The microcline occurs as non-pleochroic and indicates two (2) cleavages that are not right angle to each other, however, the mineral show tartan twinning with a first order grey interference color and indicates no alteration. Opaque minerals were equally observed and indicate euhedral texture, which appears darkish in color.High relief and inclusion of some small proportion of opaque minerals which may possibly be host for ore mineralisation.

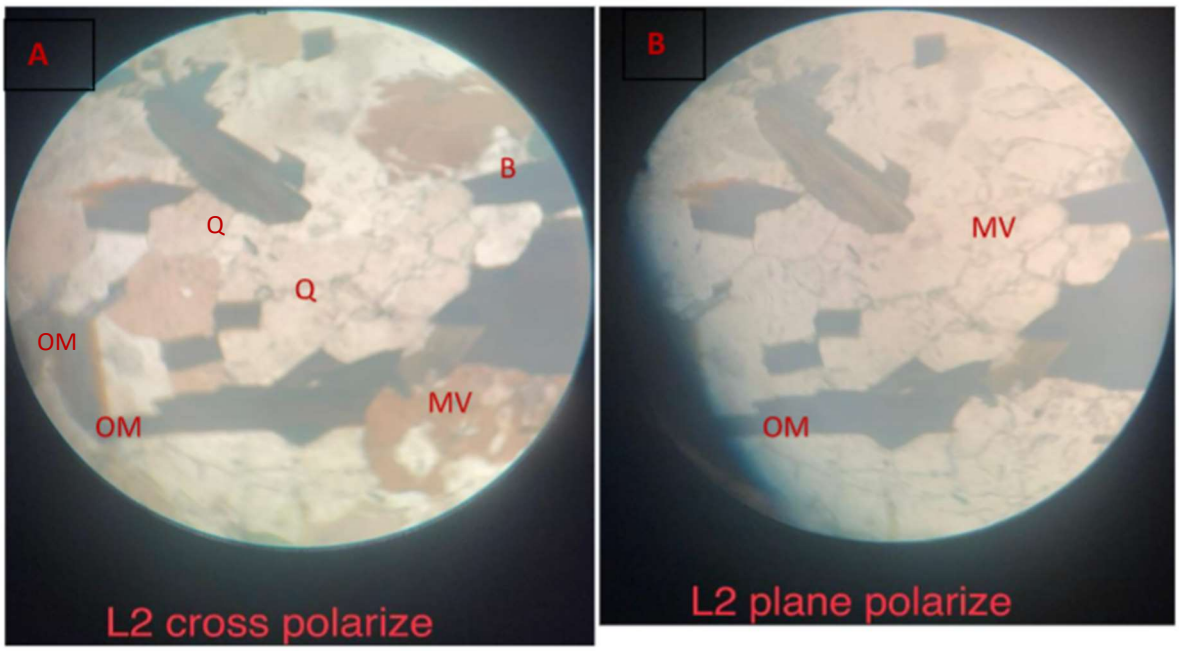


Plate 4.3: IM L1: XPL & PPL x 10 Q-Quartz, MV-Muscovite and B-Biotite

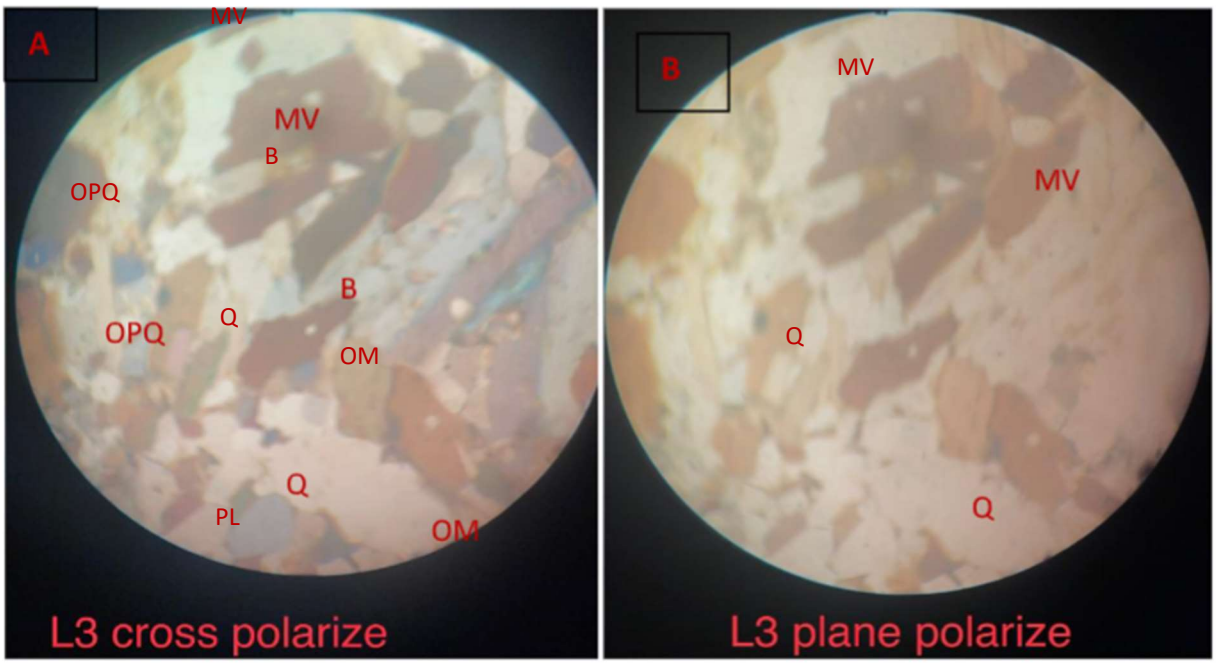


Plate 4.4: IM L2: XPL & PPL x 10 Q-Quartz, B-Biotite, P- Plagioclase, and O- Opaque

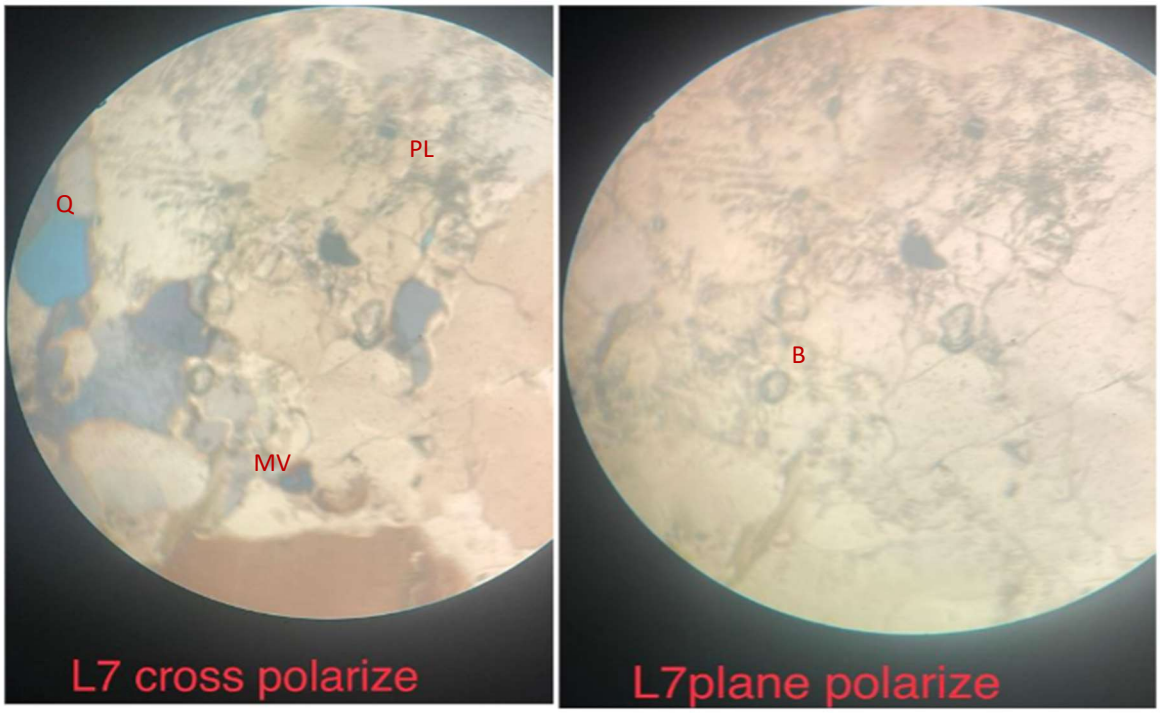


Plate 4.5: IM L3: XPL & PPL x 10, Q-Quartz, P- Plagioclase, B-Biotite and M- Muscovite

Table 4.3: Average Modal Estimation of Minerals composition in pegmatites

S/N	Mineral	% of Estimation
1	Quartz (Q)	30
2	Plagioclase (P)	25
3	Biotite (B)	20
4	Opaque (OPQ)	10
5	Muscovite (M)	05
6	Microcline (MC)	05
7	Others (OM)	05
	Total	100

4.2.2 Schists

The quartz occurs as groundmass with non-pleochroic, and no cleavage. It shows yellow milky, with a first order grey and yellow interference colour, and no twinning were observed. It also show intergrowth with plagioclase (plate 4.9), The mineral quartz shows some form of alteration probably due metamorphism, it goes extinct about four (4) times on 360° rotation with an anisotropic property exhibited. Biotite show brownish-dark brown, lath-like, slightly pleochroic, with a moderate to high relief with one distinctive cleavage and shows no twinning, it goes extinct at 75° - 90°like in (plate 4.8). Biotite tends to get elongated and orient to the same direction as

the quartz observed. Plagioclase shows a non-pleochroic property with a non-distinctive cleavage, it exhibit a first order grey-white interference colour, with an albite and polysynthetic twinning being one of the distinctive known properties of a plagioclase, it goes into extinction four (4) times on a 360° rotation and it also shows little or little alteration margins. Microcline appears non-pleochroic, and shows two cleavages that are not at right angle to each other in (Plate 4.7A), microcline shows a tartan twining, with a first order grey interference colour and shows no alteration. Muscovite shows one distinctive cleavage in (plate 4.9), with non pleochroic, it appeared as lath-like and exhibit a third order blue-purple interference colour, and goes extinct at about 90° on rotation of the microscope stage with no twinning. The Opaque Minerals have a euhedral structure, which appears dark. Other Minerals (OM): These minerals were also seen and observed.

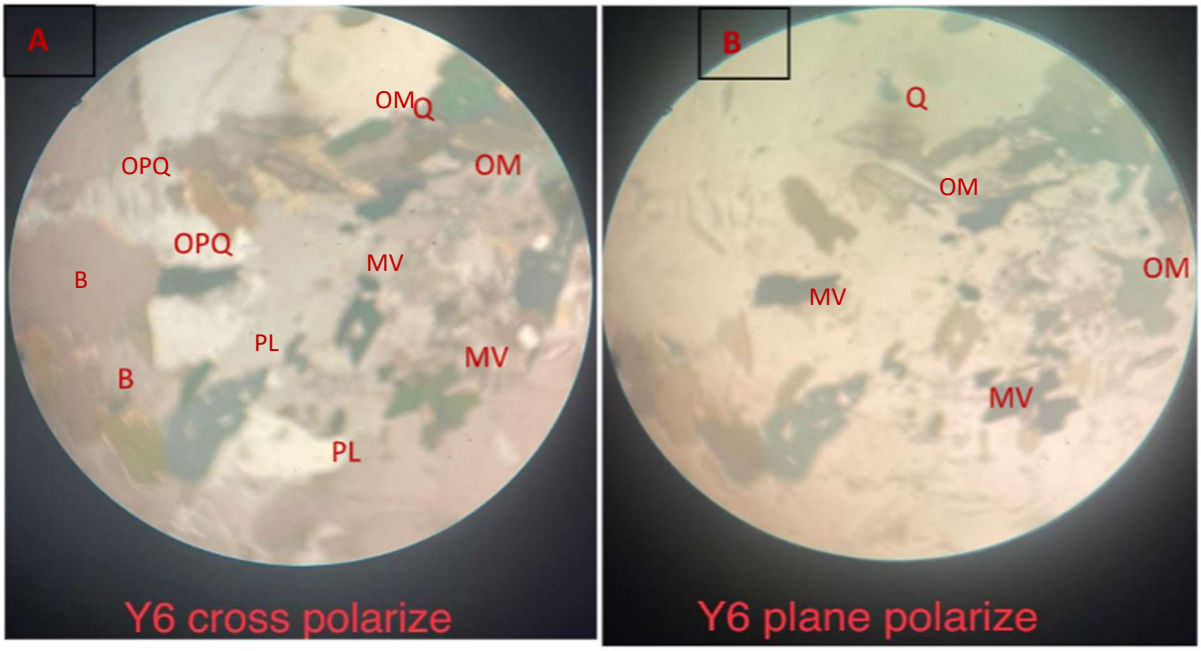


Plate 4.6 (a) and (b): Photomicrograps of IM Y2: XPL & PPL x 10, Q-Quartz, M- Muscovite, B-Biotite, P-Plagioclase and O- Opaque Minerals.

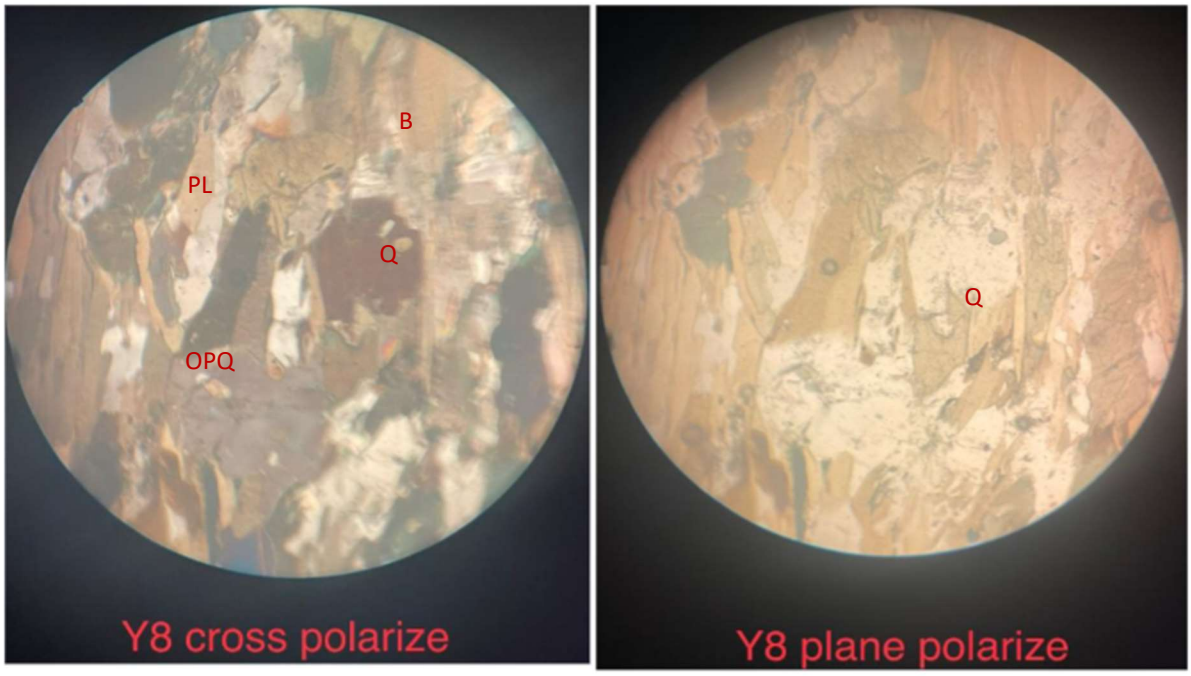


Plate 4.7(a) and (b): Photomicrographs IM Y8: XPL & PPL x 10,P- Plagioclase, Q- Quartz, B-Biotite and O- Opaque Minerals.

Table 4.4: Average Modal Estimation of minerals composition in schists

S/N	Mineral	% of Estimation
1	Plagioclase (PL)	30
2	Biotite (B)	20
3	Quartz (Q)	20
4	Opaque (OPQ)	15
5	Muscovite (MV)	05
6	Microcline	05
7	Other Mineral (OM)	05
	Total	100

4.3 Geochemistry

This section presents the results and interpretation of the geochemical analysis of both the schist and the pegmatite samples collected from the study area.

Table 4.5 Major Oxides concentration of the both the schist and the pegmatites of the study area

Element	L1	L2	L3	L4	L5	L6	L7	Y2	Y4	Y5	Y6	Y7	Y8	L7	Y2
SiO2	67.4	65.7	71.3	68.4	71.4	75.3	69.8	70.3	61.4	59.5	58.9	60.5	59.1	69.8	70.3
TiO2	ND	0.0199	ND	ND	ND	ND	ND	0.708	1.44	1.76	1.57	1.47	1.39	ND	0.708
Al2O3	12.9	17.3	13.3	12.4	14.1	11.3	14.4	11.1	12.8	10.8	11.4	10.2	12.7	14.4	11.1
Fe2O3	3.76	2.26	0.855	4.46	1.21	1.07	2.58	3.39	11.7	13.4	14.5	12.6	13.4	2.58	3.39
MnO	0.961	0.124	0.203	0.491	0.274	0.25	0.427	0.0852	0.117	0.148	0.162	0.199	0.188	0.427	0.0852
MgO	ND	ND	ND	ND	ND	ND	ND	0.11	1.29	1.47	1.34	1.32	1.17	ND	0.11
CaO	0.614	0.269	1.24	0.497	1.64	1.22	0.747	3.57	1.11	3.77	2.49	3.29	2.05	0.747	3.57
Na2O	1.97	ND	3.1	2.11	2.43	2.31	1.14	1.81	ND	1.41	1.64	1.83	1.14	1.14	1.81
K2O	8.2	11.5	5.51	8.16	4.3	4.42	7.52	6.11	7.73	4.52	5.32	5.58	6.3	7.52	6.11
P2O5	3.37	1.82	3.66	3.12	3.59	3.08	2.54	1.88	1.87	2.42	1.73	2.32	1.85	2.54	1.88
Li2O	-	-	0.32	0.11	0.45	0.26	0.36	0.54	0.44	0.41	-	-	-	-	-

Table 4.6 Trace Element Concentration of both the schist and the Pegmatites of the Study Area

Element	L1	L2	L3	L4	L5	L6	L7	Y2	Y4	Y5	Y6	Y7	Y8	L4	L5	L6	L7	Y2	Y4	Y5	Y6	Y7	Y8
S	ND	766	ND	ND	962	ND	ND	ND	ND	ND	733	ND	ND	ND	962	ND	ND	ND	ND	ND	733	ND	ND
Ar	3000	3020	5700	2740	6450	7730	2540	4850	2530	3330	3240	1140	2160	2740	6450	7730	2540	4850	2530	3330	3240	1140	2160
V	ND	ND	ND	ND	ND	ND	ND	167	470	430	487	287	447	ND	ND	ND	ND	167	470	430	487	287	447
Cr	ND	ND	ND	ND	ND	ND	ND	50.2	248	254	230	232	211	ND	ND	ND	ND	50.2	248	254	230	232	211
Ni	ND	9.14	9.43	ND	18.2	14.9	ND	21.9	118	138	146	68.6	131	ND	18.2	14.9	ND	21.9	118	138	146	68.6	131
Rb	3450	4830	2150	3930	1630	1380	4590	393	355	318	381	1850	375	3930	1630	1380	4590	393	355	318	381	1850	375
Sr	162	219	162	276	222	67.1	93.1	1550	299	827	755	711	605	276	222	67.1	93.1	1550	299	827	755	711	605
Zr	51.5	38.5	39.2	86.9	100	30.7	18.5	357	343	491	459	486	427	86.9	100	30.7	18.5	357	343	491	459	486	427
Y	ND	ND	ND	ND	ND	ND	ND	25.3	72.9	95.5	89.5	79.3	104	ND	ND	ND	ND	25.3	72.9	95.5	89.5	79.3	104
Sr	162	219	162	276	222	67.1	93.1	1550	299	827	755	711	605	276	222	67.1	93.1	1550	299	827	755	711	605
Sn	69.8	376	31	66.2	91.9	49.5	211	ND	5.66	9.17	ND	26.9	5.59	66.2	91.9	49.5	211	ND	5.66	9.17	ND	26.9	5.59
Cs	42.2	66.2	39.5	53.2	15.7	23	71.3	ND	ND	ND	ND	57.8	ND	53.2	15.7	23	71.3	ND	ND	ND	ND	57.8	1050
Ba	159	213	53.3	241	65.1	51.3	152	1390	790	765	1020	715	1050	241	65.1	51.3	152	1390	790	765	1020	715	ND
Ta	ND	77	74.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

4.2.1 Classification of rocks in the study area

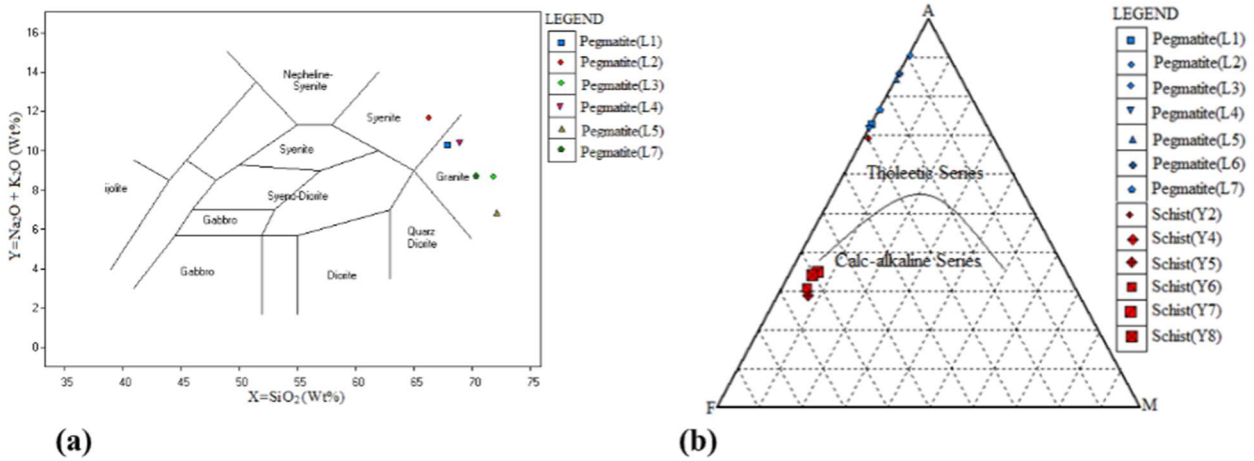


Figure 4.3(a) and (b): Plots of Na2O+K2O vs SiO2 and QAP .

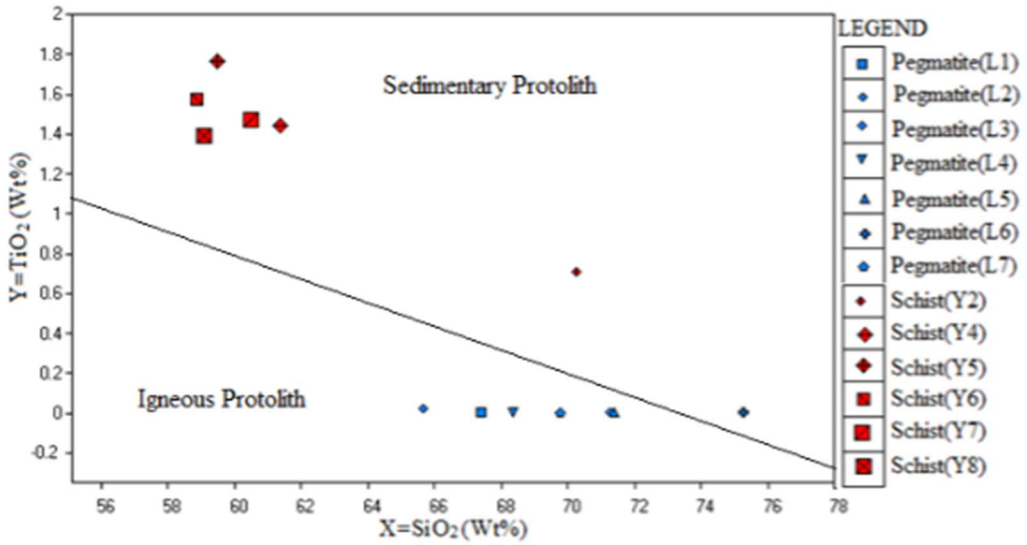
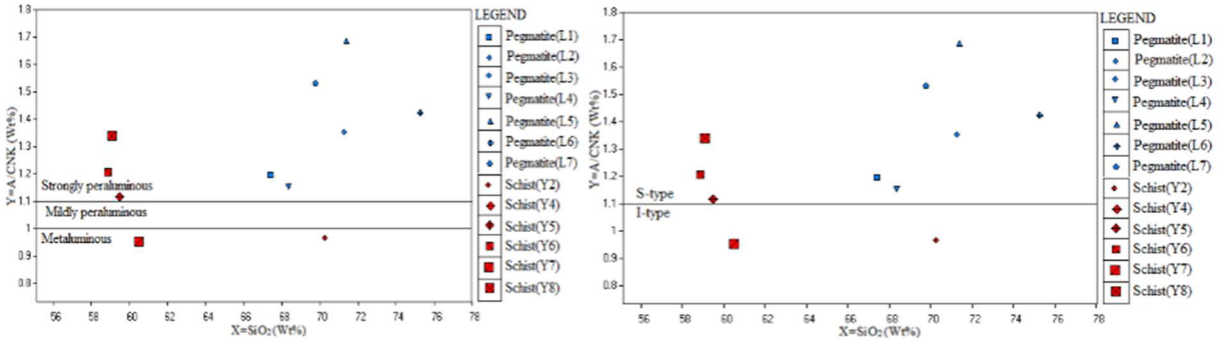


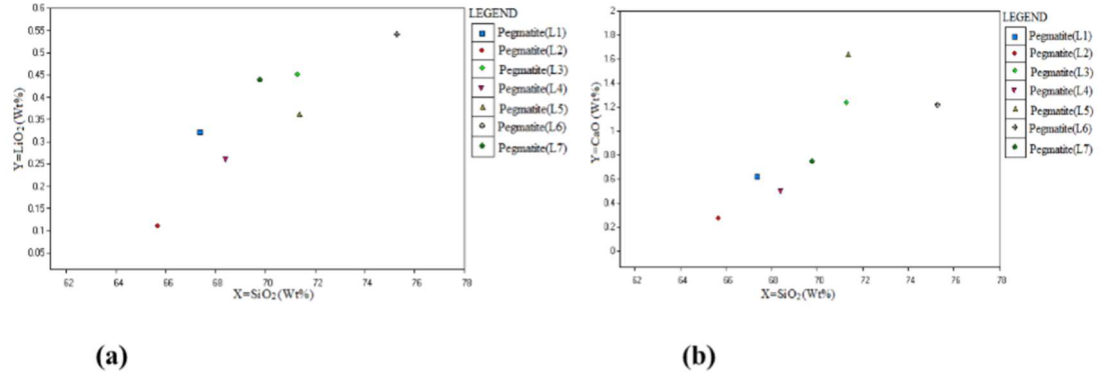
Figure 4.4(a) and (b): Plots of TiO2 vs SiO2 after (Chappel and White, 1974)



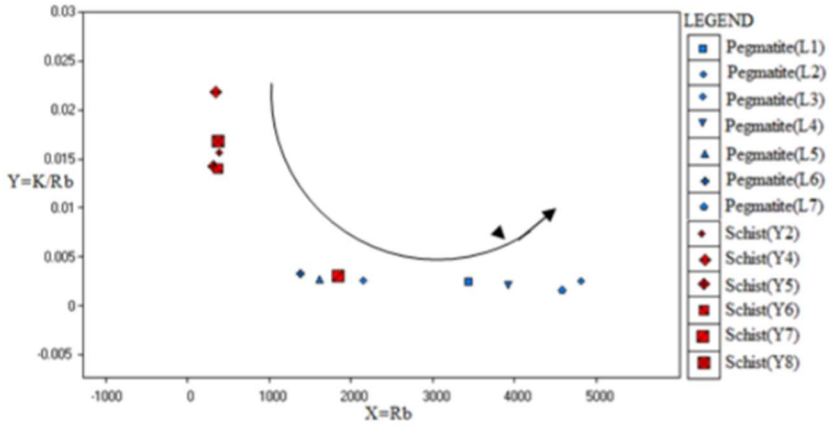
(a) **(b)**

Figures 4.5 (a) and (b): Plots of A/CNK vs SiO2

5.2.1 Genetic relationship and Mineralization Potential



(a) **(b)**



(c)

Figure 4.6 (a), (b) and (c): Plots of Li_2O vs SiO_2, CaO vs SiO_2 and K/Rb vs Rb show the relationships amongst the rocks and pegmatites of the study area

5. Discussion

Pegmatite in the study area occurred as dykes and veins. The rocks found in this study are very coarse grained in nature and are granitic in composition. The pegmatite out crop covers about 10%, whilst the schist occupies about 90% of the study area. In the field in-situ pegmatites show very coarse grained texture with crystals of about 30cm and above in length, usually granitic in composition and typically appear to have been formed during the final stages of magma chamber crystallization. The mineral content of the pegmatite is essentially quartz and orthoclase feldspars with little mica which can be seen with naked eye in the field. This study shows that the rocks found in the area are made up of quartz, plagioclase feldspar, and biotite and orthoclase feldspar with a structural trend of NE-SW which is in conformity with the general structural deformation of Pan-African Orogeny. Geochemical analysis on those rocks reveals various elemental constituents that are valuable and those that are toxic to human health.

Geochemical analysis of the samples, from the plots of TAS diagram of $Na_2O + K_2O$ vs SiO_2 adapted by (after Cox-Bell, 1979) display the rock classification plots, and show the rocks are essentially granitic. Also the plots of molecular ratio A/CNK vs SiO_2 depicts the pegmatite and most of the schists as strongly per aluminous indicating their high enrichment in Al_2O_3 relative to alkaline lime (Al_2O_3>Na_2O+K_2O+CaO) as the ratio. Furthermore, the plots of A/CNK vs SiO_2 modified after (Tarney, 1976) and TiO_2 vs SiO_2 depict most of the rocks as essentially S-type, because of the absence of normative diopside in all the rocks in the area supports the nortion that the normative corundum is greater than 1% in all the rocks which according to Chappel and White (1974) is a confirmation that they are probably S-type, hence having sedimentary progeny and potential for mineralization.

AFM plots of both the pegmatites and schists displayed the classification of the rocks into tholeiitic and calc-alkaline series based on the proportion of their CaO, K_2O, FeO* and MgO content. The schists plots in the field of calc-alkaline series owing to the fact that these rocks have high percentage of CaO and K_2O relative to FeO* and MgO and the pegmatites mostly indicate high potential for rare metal and gemstone mineralization in the study area.

6. Conclusion

In conclusions this studies show that the rocks found in the study area mainly schists and pegmatites, and these rocks are generally made up of quartz, plagioclase feldspar, and biotite and orthoclase feldspar as main minerals whilst opaque, sericite as accessories. The lineaments observed in the area are mostly joints and fractures with common trend in the NE-SW directions. These trends are in conformity with the general structural deformation pattern of Pan-African Orogeny.

Geochemical analysis of the pegmatites reveals various elemental constituents that are valuable and indicate potential for rare metal ore minerals and gemstones.

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