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COMPOSITIONAL CHARACTERISTICS AND Ta-Sn-Nb RARE METAL MINERALIZATION POTENTIAL OF EGBE PEGMATITE, SOUTHWESTERN NIGERIA.

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ABSTRACT

Pan African (600 ± 150) pegmatite which intrudes gneisses, amphibolites, quartzite and schists around Egbe area were studied for their compositional features. This is with a view to characterizing and assessing their potential for rare metal Ta-Sn-Nb mineralization. Twenty seven samples comprising eleven (11) whole rock, sixteen (12) muscovite extracts and four (4) feldspar extracts samples were analyzed using the Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). Major oxide geochemical assessment of the whole rock pegmatite indicates that the pegmatite is siliceous (79.82% SiO_2) and moderately high in Al_2O_3 (12.22%). The K_2O, Na_2O contents are averagely 2.25% and 2.87% respectively while Fe_2O_3, MnO, MgO are each less than 1.0%.
Average values of trace elements in the pegmatite are Ta (52.55ppm), Sn (92.3 ppm), Rb (1083.5ppm), Nb (109.35 ppm), Cs (32.12ppm), Sr (17.84 ppm), Y (9.86 ppm), and Zr (41.27 ppm), Ba (50.47ppm), Hf (12.38ppm), Zr (41.27ppm), Ga (32.12ppm) and W(2.91PPM) and ratios of diagnostic elements are K/Rb (30.27), Rb/Sr (298.93), Zr/Hf (7.23), Rb/Cs (65.80), K/Cs (1103.11), Ta/W (41.81), Nb/Ta (55.397) Na/Rb (41.77) and Na/K (92.25)
A/CAN >1and Al_2O_3>CaO+ Na_2O+ K_2O with enrichment of SiO2, Al_2O_3, Na_2O, K_2O and depletion of Fe_2O_3, MnO_2 and MgO suggests that Egbe pegmatite is of peraluminous bulk composition and plots of A/NK vs Al/CNK and Rb vs (Y+Nb) discriminates Egbe pegmatite in the peraluminous LCT (Li, Rb, Cs, Be, Ga, Nb <,> Ta, Sn, Hf, B, P, F) of syncollisional to within plate granitic family. The Ta/W vs Cs plot for the three sample media shows the relationship between increasing Ta/W ratio and elemental fractionation as indicated by Cs. The K/Rb vs Cs and K/Rb vs Rb plots for the three sample media further establishes the rare – metal nature and mineralization potential of Egbe pegmatite. Using the discriminant plots of TaVs Rb, Ta vs Cs .TaVs K/Cs, and Ta Vs (Cs+Rb) where most of the samples of the whole rock pegmatite and mineral extracts plots above the Beus line and about 30% plotting above the Gordinyenko line respectively. Overall geochemical assessment is that Egbe pegmatite is a rare metal, highly fractionated Beryl type with rare metal enrichment trend of Nb>>Sn>>Ta.

KEYWORD: Pegmatite, Peraluminous, Syncollisional, Within-plate, Discriminant, Fractionation, Sample media

INTRODUCTION

The Egbe granitic pegmatite occur as dikes and vein lets of varying sizes, intruding pelitic–to-semi-pelitic schist and calc-gneiss, amphibolites, the gneissic and granitic rocks in the area. Pegmatite all over the world are known as host to gemstones and rare earth (Ta-Nb-Sn) metals that are of strategic importance in the present day advanced technological world. The global demand for these metals informed a renewed research interest on pegmatite geology worldwide.
Previous geochemical studies on the Nigerian pegmatite has contributed significantly to the understanding of the Nigerian pegmatite geology (Okunlola, 1998 ; Okunlola and Ocan, 2003; Ajayi and Ogedengbe ,2003; Garba, 2003;Ekwueme,2004; Okunlola,2005; Adekeye and Akintola,2007; Okunlola & Ocan,2009; Okunlola and Onesimus,2009; Okunola and Oyedokun , 2009; Okunlola and Oluwatosin ,2010; Okunlola and Akinola,2010 and Akintola et.al , 2012).
The Nigerian Pegmatite field that was earlier believed to span within a 400km NE-SW trending belt (Jacobs and Webb, 1946, Wright, 1970; Kinnaird, 1984, and Kuster, 1990) was later established to spread across Nigeria (Okunlola, 1998; Garba,2002; and Okunlola, 2005) with over 3000 sizeable pegmatite bodies discovered. Also,

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by Okunlola, (2009) delineated a broad-based seven pegmatite belts located in Anka-BirniGwuari, Kabba-Isanlu, Nasarawa–keffi ,Ijero–Aramoko ,Ibadan–Osogbo , Oke Ogun and Share–Lema localities. These does not preclude several minor occurrences of pegmatite identified in the southeast and northeastern part of Nigeria (Garba,2003; Okunlola, 2005). Studies revealed that the Nigerian mineralized pegmatite trends in a NE-SW and NNE-SSW in accordance to recognized regional fault systems (Adekeye and Akintola,2007) and are enriched in strategic metals (Okunlola, 1998). This present study is located within Latitude 8^0 5' N, 8^O 17 ' N and Longitude 5^o 30' E, 5^o 40 ' E.

The low lying quartz-feldspar-muscovite pegmatite bodies in this area intrude Older Granite host rocks. Previous studies on pegmatite geology from the Nigerian pegmatite fields indicated that pegmatite in Egbe-Isanlu pegmatite field is mineralized in Nb-Ta-Sn metals but much is not recorded on the petrogenesis of the pegmatite and the classification not documented. This study is to advance knowledge in the field of the Nigerian pegmatite occurrence as relates to the occurrence of pegmatite in Egbe meta-sedimentary terrain. In this study, the geology is discussed, compositional characterization done and mineralization potential established.

MATERIALS AND METHODOLOGY

Systematic sampling of the pegmatite and the primary host rocks were carried out in the study area on a two week field exercise. Accessibility was made possible through untared roads, foot paths and bush cuts (Fig.1). Samples were collected strategically and properly labeled to avoid miss up during transportation to Aiayi Crowther University Geology Workshop in Oyo. Thin sections of the pegmatite and host rocks were done for petrographic studies. Twelve (12) muscovite, four (4) feldspar mineral extracts and eleven (11) whole rock pegmatite representative samples were prepared for geochemical analysis. The samples were analyzed for major and trace element using the Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) Instrumentation Method from Activation Laboratories Ontario, Canada. Efforts were made to ensure that the mineral extracts from only fresh pegmatite rock samples were prepared for the geochemical analysis. The representative samples were well preserved, air-dried at 60 °C and crushed to -80 mesh (-177µm) and 0.5g weight from each of the prepared samples ware weighed into platinum crucible. 5mls of perchloric acid ($HCLO_3$), trioxonitrate (V) (HNO_3) acid and 15mils of hydrofluoric acid (HF) ware added, stirred thoroughly and evaporated at low temperature for some hours. The salt was dissolved by adding 4mls of hydrochloric acid (HCL) , the solution warmed and allowed to cool before 50mils of distilled water were added. The solution was then introduced into the ICP torch. The light emitted by the ions in the ICP was converted to electric signal by the photomultiplier in the spectrometer. The intensity of the light signal so emitted by the ions was compared to a previously measured intensity of a known concentration of the elements.

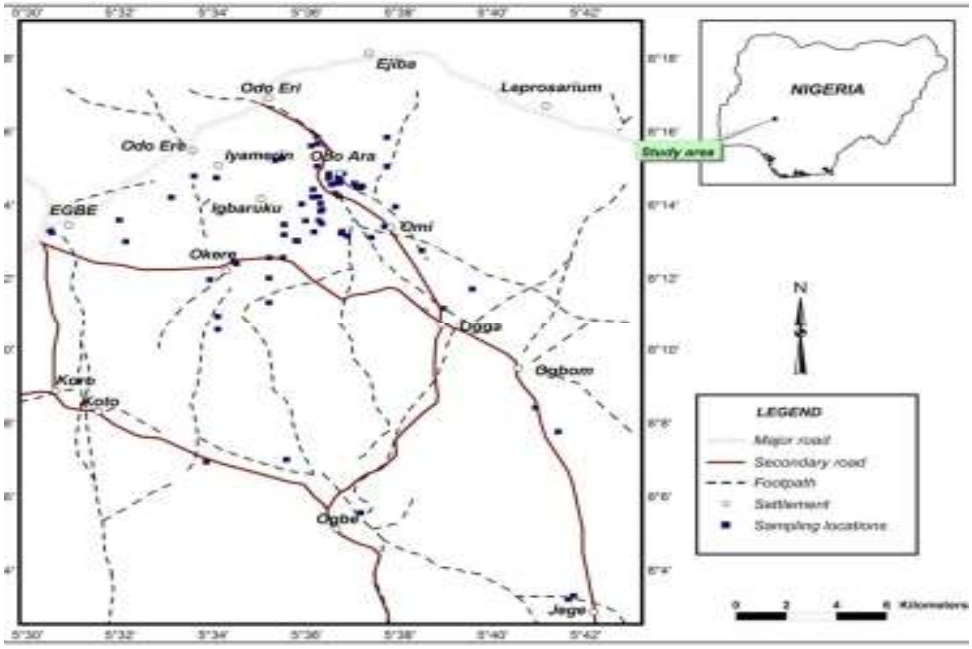

Fig. 1: **Sample Location and Accessibility Map of Study Area**

GEOLOGICAL SETTING, FIELD DESCRIPTION AND PETROGRAPHY

Egbe pegmatite lies within Kabba-Isanlu pegmatite field, located in the Precambrian basement complex of southwestern Nigeria. Egbe falls within the thick southwestern rainforest zone, characterized by undulating topography creating a NE-SW trending inselberges in most places. The basement rocks of Nigeria is the product of the Pan-African Orogenic events delimited by the West African Craton, east of Congo craton (Black,1984). Lithological and geochemical evidence characterizes the rocks of the basement complex as the migmatite-gneiss complex, the schist belts and the older granites (Ogezi, 1988; Rahaman, 1988; Turner, 1983; Dada *et al*., 1987; Mathesis and Caen-Vachette,1983; Umeji and Caen-Vachette, 1984; Rahaman*et al*., 1988, Akande and Reynolds, 1990, Elueze,2000). The schist belt of Nigeria is a low–grade metasediments and metamorphosed pellitic and psamatic assemblages, characterized by a N-S trending synformal troughs into migmatite-gneiss complex. The older granites consist of a wide range of rocks compositionally different from each other like tonalities, granites, granodiorites, admellites, quartz monzonites, syenites, and pegmatite (Rahaman,1988).

Egbe granitic pegmatite discordantly intrudes the older granites, the migmatite-gneis and the metasedimentary rocks in the area (Fig. 2). In this study area is a N-S trending quartzite ridge that forms a continuous hill from Iyamerin to Ikoro towards the southern part. The study area is generally underlain by amphibolites schists and amphibolitic rocks, biotite gneiss, banded gneiss, granite gneiss and coarse–porphyritic granite. The coarse-grain- textured porphyritic granite occur as distinct outcrop in Egbe town. The microscopic examination of the rock revealed the mineral composition and the modal percentages as quartz (42.55%), albite (9.86%), orthoclase (3.28%), microcline (13.15%), hornblende (15.70) and augite (15.70%) respectively. The occurrence of banded-gneiss is not widespread in the study area but a mapable unit of this rock was encounter towards the eastern flange of Egbe where the mineral composition was identified from microscopic study as quartz (36.14%), biotite (23.24%0, microcline (5.13%), muscovite (21.37%), amphibole (8.89%) and augite (5.13%).

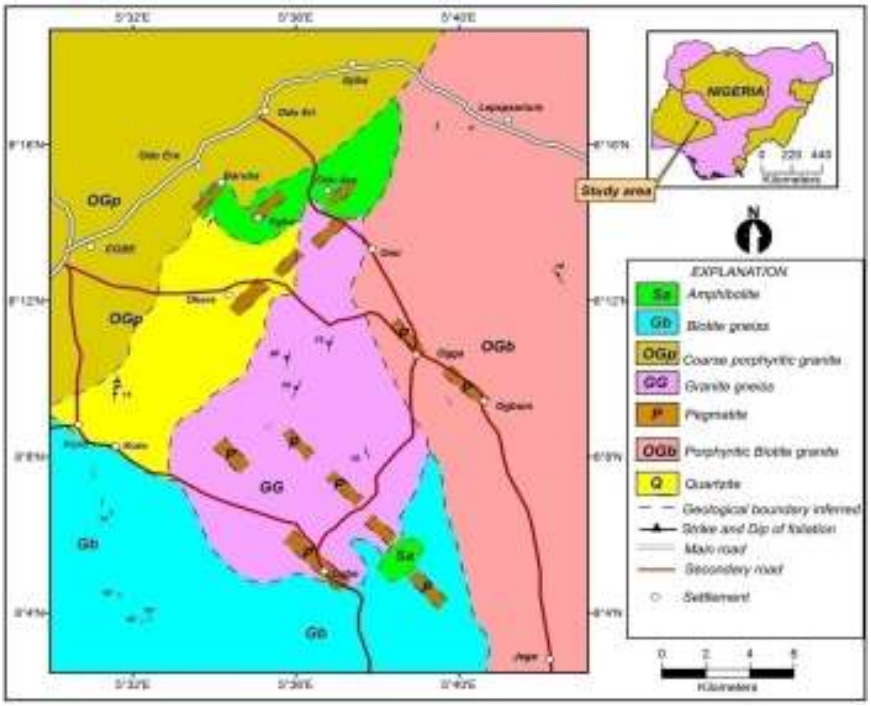

Fig. 2: Geology map of the area around Egbe

The pegmatite in the area occur as distinct dykes of varying dimension comprising quartz (44.86%), albite (15.05%), microcline (11.2%), Orthoclase (2/06%), muscovite (26.92%) and accessory minerals (0.02%) as shown in table 1. Petrographic configuration of minerals in the pegmatite showed an irregular mass of euhedral quartz crystals with strong cross-hatched twining and variable microperthite intergrowth and large platy grains of muscovite as observed under petrographic microscope (Fig.3).

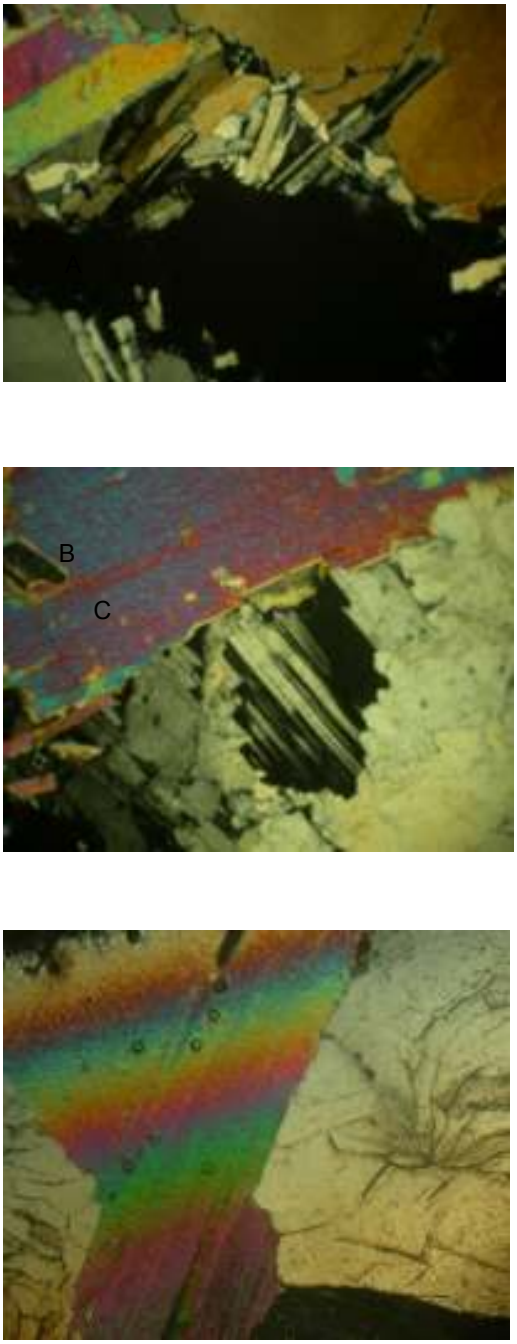

Fig.3: A, B & C Showing Photomicrograph of pegmatite in transmitted light (cross polar) ×100

Table 1: Modal Analysis of Minerals in the pegmatite

Minerals	(%)
Quartz (%)	44.86
Albite (%)	15.05
Orthoclase (%)	2.06
Microcline (%)	11.12
Muscovite (%)	26.92
Accessory minerals (%)	0.02
Total	100.03

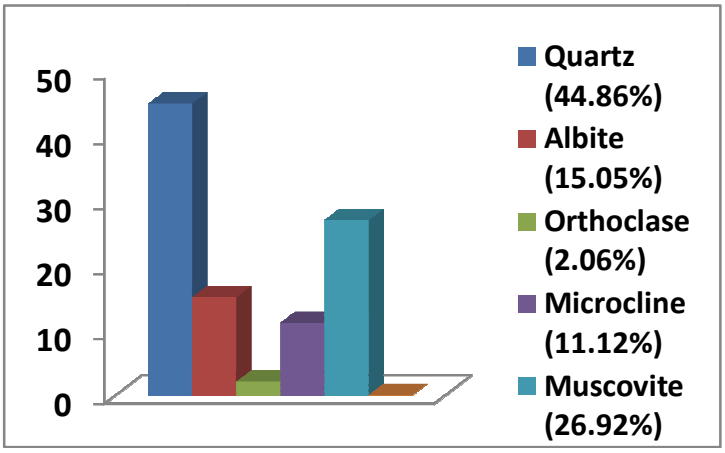

Fig.4: histogram of mineral composition of Egbe pegmatite

GEOCHEMICAL FEATURES AND MINERALIZATION POTENTIAL

The geochemical results of major and trace elements of Egbe whole rock pegmatite is presented in table 2 showing that the pegmatite is siliceous (aveg. 79.82wt%) with high alumina content (aveg. 12.22wt%). Silica and alumina constitute the bulk of the oxides in the pegmatite. There is a moderately high contents of K_2O (3.75wt%)and Na_2O (2.25wt%) but Fe_2O_3, CaO , MnO, MgO,TiO_2 and P_2O_5 are each less than 1.0%. The K_2O content in the mineral extracts have relatively elevated values where muscovite is 7.81 wt% and 8,68 wt% in the feldspar extracts. The trend is a little different for Na_2O in the mineral extracts with 1.31wt% in the muscovite and 4.71 wt% in the feldspar extracts. These values are comparable with results from other Ta-Nb pegmatite of Nigeria like the Oke Asa pegmatite of 71.46 %SiO_2 (Okunlola et.al, 2010) and Ago Iwoye of 73.74 %SiO_2 (Akintola et.al,2011).

The trace elements in the pegmatite (Table 2) show substantial enrichment of Rb (1083.55ppm), Nb (109.35ppm) and Sn (92.27ppm) but moderately enriched in Ta (52.55ppm), Ba(50.37ppm),Zr (41.27ppm),U (41.0ppm), Cs (21.14ppm) and Sr (17.84ppm). In the mineral extracts, average values of trace element in muscovite extracts are Rb (4121.66ppm), Nb (169.90ppm), Ta (115.43ppm), Hf (0.84ppm), Sn (481.93ppm), Cs (123.73ppm), Ga (738.15ppm), Zn (738.15ppm) and feldspar extracts has average values of Rb (770.55ppm), Nb (20.49ppm), Ta (43.53ppm), Hf (0.84ppm), Sn (13.08ppm), Cs (35.28ppm), Ga (23.85ppm) and Zn (6.48ppm). The three sample media show clear enrichment of Rb but moderately enriched in Ta, Cs, Ba, Zr, Sr, and Nb

Table 2: Major and Trace metals of Egbe Pegmatite and Ratios of Strategic Metals

Oxides (wt%)	1	2	3	4	5	6	7	8	9	10	11	Average
Si 0_2	73.8	74.8	95.7	63.4	71.5	82.7	82.1	82.2	73.6	90.2	88.1	79.82
Al_2O_3	15.6	15.5	1.4	23.4	14.8	10.9	12.6	11.4	14.35	6.96	7.59	12.22
Fe_2O_3	0.14	0.14	0.23	1.44	0.06	0.25	0.89	0.85	0.18	0.33	0.25	0.44
MnO	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.05	0.03	0.02
MgO	0.02	0.03	0.03	0.05	0.01	0.01	0.29	0.07	0.01	0.01	0.01	0.05
CaO	0.19	0.2	0.01	0.02	0.08	0.07	0.05	0.01	0.29	0.01	0.01	0.09
Na_2O	7.17	6.08	0.05	0.54	1.91	0.68	0.36	0.26	7.16	0.27	0.23	2.25
K_2O	0.88	1.17	0.27	6.3	10.0	2.45	3.45	2.24	0.53	1.72	1.89	2.81
P_2O_5	0.18	0.12	0.07	0.02	0.02	0.05	0.02	0.22	0.22		0.01	0.09
LOI	1	1.3	0.9	4.44	0.1	4.89	1.8	1.3	1.7	1.0	1.79	1.84
Total	99.00	99.35	98.67	99.62	98.49	102.02	101.58	98.56	98.05	100.55	99.91	99.2
Trace Elements (ppm)												
Ta	113	167.5	2.1	64.2	0.4	53.7	31.8	40.5	15.7	46.6	42.6	52.55
Cs	9.44	9.21	0.96	19.6	7.76	23.3	26.6	80.1	3.33	24.5	27.7	21.14
Rb	423	531	104	2350	480	1640	1485	1890	251	1320	1445	1083.55
Sn	135	69	10	159	4	116	149	208	16	64	85	92.27
Nb	64.1	57	6.9	233	233	32.7	425	42.5	38.7	36.9	33	109.35
Sr	37.7	22.9	4.7	13	66.7	4.9	27.7	1	8.1	2.5	7	17.84
Y	1.9	0.5	0.7	0.7	53.7	1	46	2.1	0.9	0.5	0.5	9.86
Ba	8.6	16.7	28.1	57.2	269	9.3	129	8.5	14.1	3.5	11.2	50.47
Hf	5.1	1.1	0.2	1.1	1	1.8	4.6	120	0.5	0.4	0.4	12.38
Th	3.6	1.28	0.31	1.53	3.16	0.6	0.46	7.7	1.59	0.11	0.24	1.87
W	1	1	1	13	1	1	6	5	1	1	1	2.91
Zr	25	2	2	8	19	23	32	337	2	2	2	41.27
Ga	31.7	28.3	4.7	21.5	17.3	40.2	40.6	65.6	29.5	36.7	37.2	32.12
Zn	9	10	8	92	5	62	29	53	15	103	65	41
U	1.64	0.63	0.05	0.74	2.3	0.31	0.64	11.8	0.43	0.18	0.16	1.721
K	7304	9711	2241	52290	83000	20335	28635	18592	4399	14276	15687	23315
Na	53194	45108	371	4006	14170	5045	2671	1929	53120	2003	1706	16666
Ratios												
K/Rb	17.27	18.29	21.55	22.25	172.92	12.40	19.28	9.84	17.53	10.82	10.86	30.27
Rb/Sr	11.22	23.19	22.12	180.77	7.196	334.69	53.61	1890	30.99	528	206.43	298.93
Na/Rb	124.06	83.80	3.52	1.68	29.12	3.03	1.77	1.007	208.78	1.49	1.16	41.77
Na/K	7.18	4.58	0.16	0.08	0.17	0.24	0.09	0.10	11.92	0.14	0.11	2.25
Ba/Rb	0.02	0.03	0.27	0.02	0.56	0.006	0.087	0.0045	0.056	0.003	0.008	0.097
Zr/Hf	4.90	1.82	10	7.27	19	12.77	6.96	2.81	4	5	5	7.23
Sr/Rb	0.09	0.04	0.045	0.006	0.14	0.003	0.017	0.0005	0.03	0.002	0.005	0.034
Rb/Sr	11.22	23.18	22.13	180.77	7.19	334.69	53.61	1890	30.99	528	206.43	298.93
Rb/Cs	44.81	57.65	108.33	119.89	61.86	70.39	55.82	23.59	75.38	53.88	52.17	65.80
Ta/W	113	167.5	2.1	4.94	0.4	53.7	5.3	8.1	15.7	46.6	42.6	41.81
K/Cs	773.73	1054.39	2334.37	2667.85	10695.88	872.74	1076.504	232.11	1321.02	582.69	566.32	2016.15
Nb/Ta	0.57	0.34	3.29	3.63	582.50	0.61	13.36	1.05	2.46	0.79	0.77	55.40

Table 3: Average Values of Trace Metals (ppm) in Whole Rock Pegmatite and Mineral Extracts

	Whole rock pegmatite	Muscovite extracts	Feldspar extracts
Ta	52.55	106.719	43.525
Cs	21.14	118.575	35.275
Rb	1083.55	4086	1385.25
Sn	92.27	428.019	13.075
Nb	109.35	163.875	20.488
Sr	17.84	12.538	9.5
Y	9.86	1.469	0.153
Ba	50.47	126.825	
Hf	12.38	0.806	0.843
Th	1.87	0.793	0.933
W	2.91	10.594	0.366
Be	-	20.583	35
Zr	41.27	4.226	8.1
Ga	32.12	570.567	23.85
Zn	41	198.331	6.475
U	1.721	0.6231	0.3
Ti	2.92	14.1	
Cu	5.09	6.413	5.138
Li		373.092	16.7
Ag	1	76.2	28
Co	1.414	1.966	
Cr	12.727	6.75	2.75
Mo	2	1.156	0.09
Ni	5	3.352	0.475
Pb	5.364	5.985	16.29
V	5.545	4.293	
Mn	-	601.636	45.25
As	-	1.8125	1.5

Egbe pegmatite is enriched in Nb, Ta, Rb, Sn, and Cs (Table 2) which suggests possible mineralization of this pegmatites in the rare metal columbo-tantalite minerals (Moller and Morteani, 1987). A common anomaly found in pegmatites according to Heier and Taylor, (1959b), is low K/Rb ratio (less than 100 ppm) suggesting a Rb- enriched-pegmatite where the pegmatite is rich in Rb but deficient in K.

The pegmatite manifests characters typical of Lithium, Caesium and Tantalite (LCT) pegmatite family with Li, Rb, Cs, Ga, Sb>N, (B,P,F) and the silisic with peraluminous (A/CNK >1) character points to the LCT granitic family for the pegmatite (Cerny, 1992 and London,2005). Solodove, (1971) and Cerny, (1982,1991a, 1991b) reported that the origin of the LCT granitic pegmatite family was derived from the intrusion of pegmatitic fluids into schists and gneissic host rocks. Schistose rocks are ductile and this probably influenced the fracture-filling-dykelike pegmatite occurrence in Egbe field. Egbe dyke-like pegmatite bodies intrudes schistose host and other older granite rocks in the study area. The Maniar and Piccoli,(1989) plot of A/NK vs A/CNK further elucidated the peraluminous nature of the pegmatite as shown in Fig.5 where the whole rock pegmatite samples and mineral the extracts plots in the peraluminous field. The Rb (ppm)Vs Rb/ (Y+Nb) discriminant plot for the pegmatite after Pearce et al., (1984) presented in Fig.6, classifies the pegmatite within a mixed origin of syncollisional (SCG), within plate granite (WPG) orogenic granite (ORG) fields.

According to Kuster, (1990), a moderately low K/Rb ratio sugests a late stage progressive fractionation crystallization and mineralization which Egbe pegmatite satisfies. Also , plot of K/Rb Vs Rb (Fig 7) seperates fractionation sequence and barren from mineralised pegmatite while K/Rb Vs Cs plots the samples in the rare metal pegmatite field (Fig.8). Extreme fractionation of lithophile elements like Rb and Cs is a common geochemical feature of granitic pegmatite (Garba,2003)). Okunlola and Oyedokun, (2009) further expounded on Garba's finding that the extreme fractionation of lithopile element is expecially peculiar to rare metal (Ta-Nb) bearing pegmatites. Egbe pegmatite samples recorded a moderately low value of K/Rb ratio (Table 2) which favorably compares with rare metal pegmatites of Nigeria suggesting, that Egbe pegmatite is extremely fractionated and probably originated from a product of late stage progressive fractionation cryatallization of the source magma. The ratio of Ta/W plotted against Cs (Fig. 9) for Egbe pegmatite indicates that Ta/W ratio increases with increasing elemental fractionation of Cs and this satisfies the findings of Moller and Morteani, (1987)

The correlation plot (Fig.10) of major and trace elements (Ta/ (Ta+Nb) vsMn/ (Mn+Fe) after Cerny, (1991) for whole rock pegmatite and mineral extracts classifies the

pegmatites as mineralized and of the Be-bearing family. The pegmatite belongs to the LCT petrogenetic family (Li, Rb, Cs,Be, Ga, Sn, Ta <> N (BPF) and Beryl sub type. Previously, Cerny, (1992) reported that the LCT family of pegmatite has a mild to extremely peraluminous granitic parent composition which is confirmed from plot of Al_2O_3/Na_2O+K_2O Vs $Al_2O_3/CaO+Na_2O+K_2O$for Egbe Wholee Rock Pegmatite in fig.11 (after Maniar and Piccoli,1989).

The pegmatite whole rock, muscovite and feldspar extracts plots within the Ta-Nb mineralization line of Beus (1966) and Gordiyenko (1971). The Ta vs. Ga plot (Beus,1966) *Fig.12*, Ta vs Rb (Morteani,1987) Fig.13 and Ta vs K/Cs (Gordinyenko,1971) Fig.*14* establishes Egbe pegmatite as potentially mineralized.

The mineralization potential of the pegmatite of Egbe area was further evaluated using the plot Ta vs Cs (fig. 15) and Ta vs Cs+Rb (*Fig.16*) and both plots indicated a positive mineralization potential for the pegmatite.

High LiO_2 content in muscovite (>1.0 wt. % LiO_2) is believed to be generally peculiar to muscovite from Spodumene ($LiAlSi_2O_6$) carrying pegmatite, petalite or Li-phosphates (Wise and Brown, 2010). It was further reported by the authors that pegmatite carrying Columbite and Cassiterite group of minerals in their muscovite extracts are generally enriched in Tin to the tune of between 25 to 1800 ppm (Table 3)

Columbite $(Fe,Mn)(Nb,Ta)_2O_6$ is a common mineral in granitic pegmatite and Cassiterite are niobium- tantalite to tantalum – rich mineral. The moderately enriched values of these metals in the muscovite extracts from Egbe pegmatite is an indication that the pegmatite is probably mineralized in the Lithium- bearing minerals like Spodumene. Jacbson and Webb (1946) earlier reported the potential of Egbe-Isanlu pegmatite as a columbite -tantalite to Cassiterite minerals - carrying source rock.

According to Wise and Brown (2010), high values of Cesium are suggestive of high magmatic fractionation peculiar to Pollucite–bearing pegmatite. Pollucite ($CsAl_4Si_9O_{26}.H_2O$) occurrence in pegmatite is characteristic of pegmatite of complex mineralogical composition.

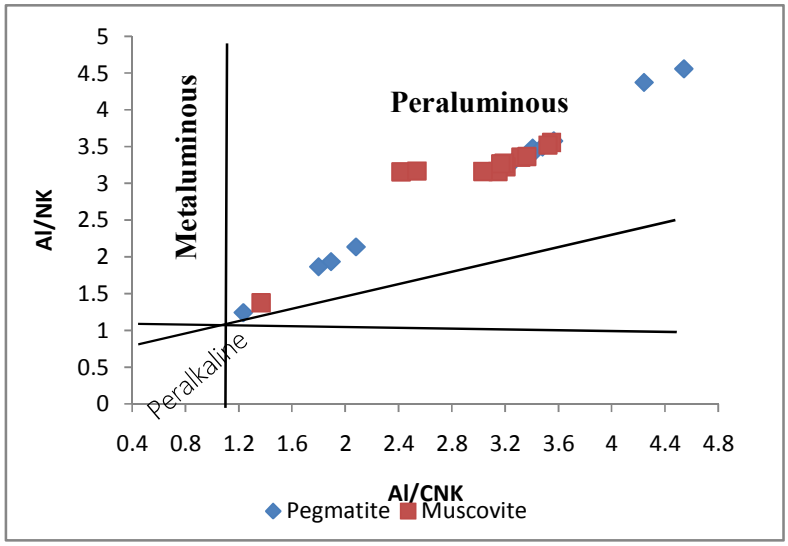

Fig. 5: A/NK vs A/CNK for Egbe pegmatite and Muscovite Extracts (Maniar and Piccoli,1989)

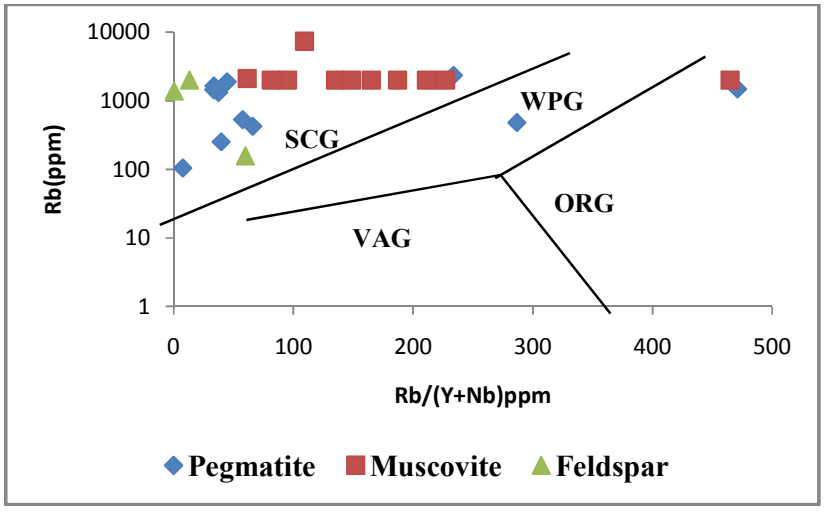

Fig 6: The Rb vs Rb/(Y+Nb) discriminant plot for the sample media (After Pearce et al., 1984). VAG-VOLCANIC ARC GRANITE; ORG-OCEANIC RIDGE GRANITE; WPG-WITHIN-PLATE GRANITE; SCG-SYN-COLLISIONAL

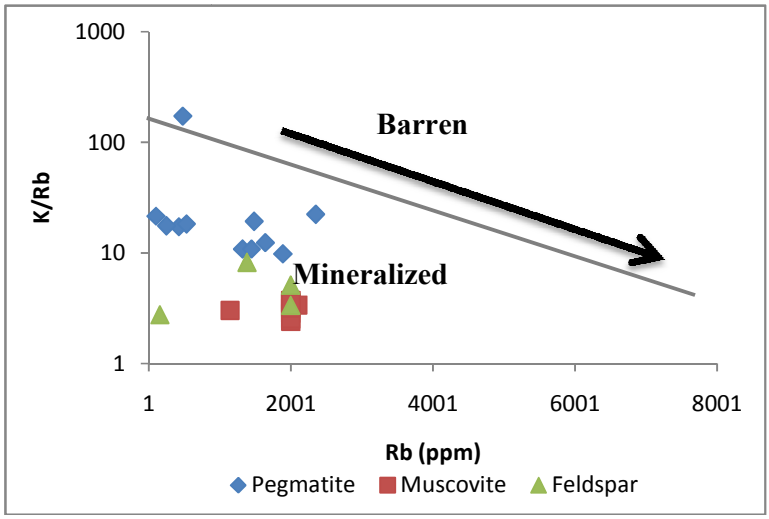

Fig. 7: Plot of K/Rb vs Rb for Whole Rock Pegmatite and Mineral Extracts of Egbe Pegmatite after Staurov et. al, (1969)

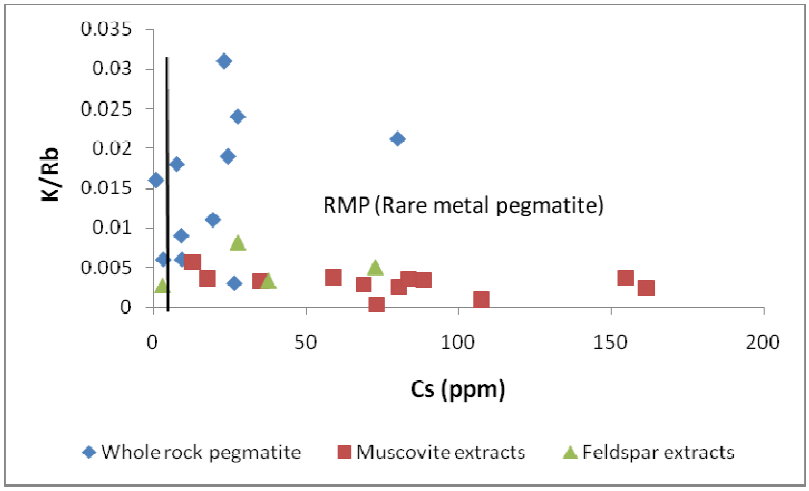

Fig.8: Plot of K/Rb vs Cs for whole rock pegmatite and mineral extracts (After Cerny, 1982 **)**

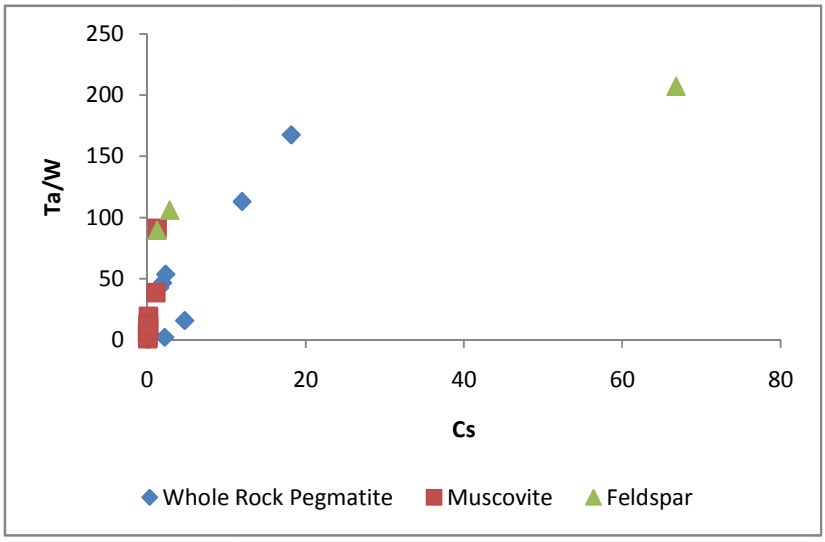

Fig.9: Plot of Ta/W ratio vs. Cs for Egbe Pegmatite and mineral extracts

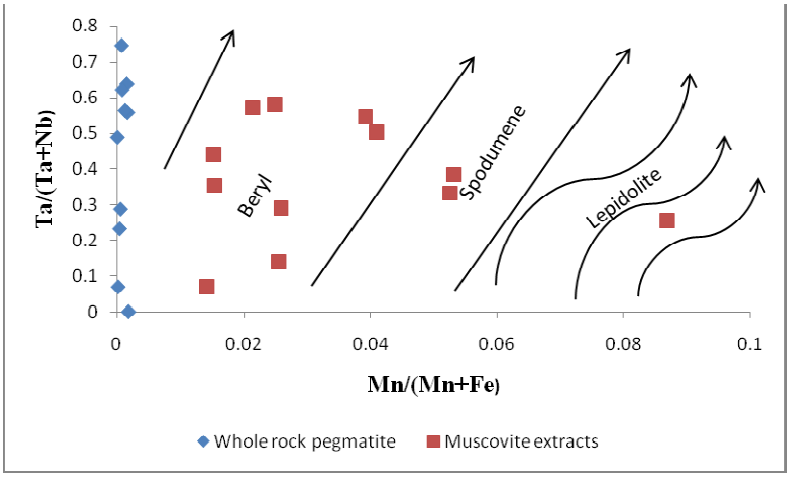

Fig.10: Ta/ (Ta+Nb) vs Mn/ (Mn+Fe) after Cerny, (1991)

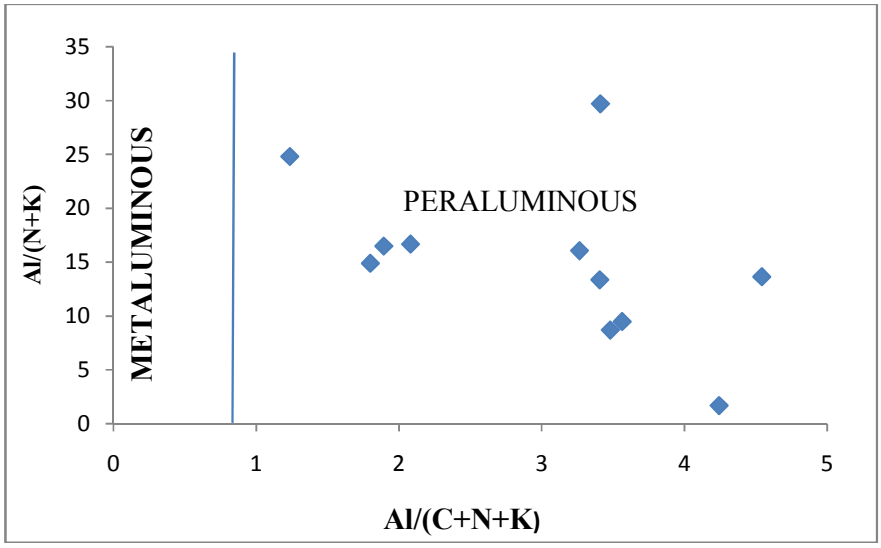

Fig.11: Plot of Al_2O_3/NA_2O+K_2O Vs $Al/CaO+Na_2O+K_2O$ (after Maniar and Piccoli, 1989)

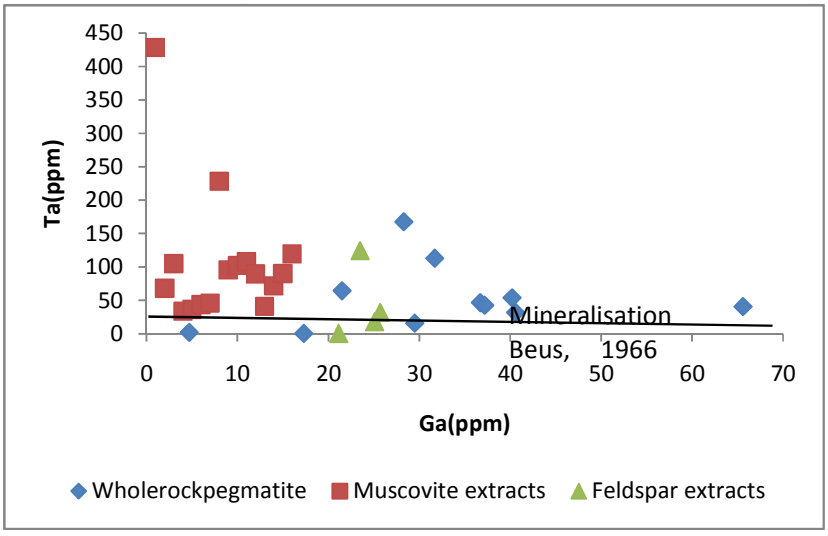

Fig. 12:- plot of Ta (ppm) vs Ga (ppm) after Beus, 1966

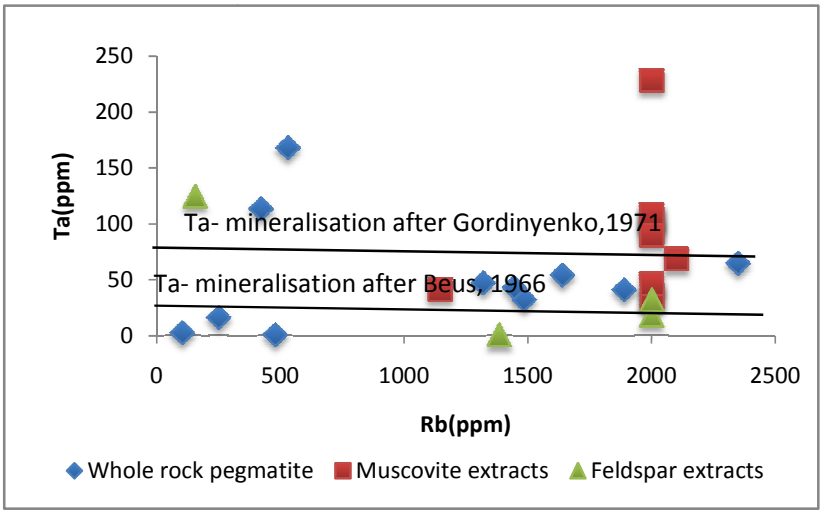

Fig. 13:- Plot of Ta (ppm) vs Rb (ppm) after (Morteani, 1987)

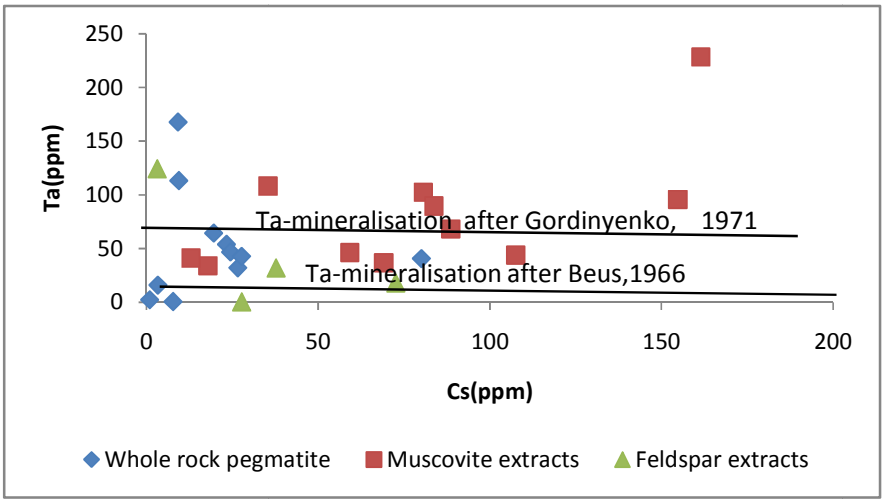

Fig. 14 :- Ta vs Cs for Whole rock pegmatite and miner

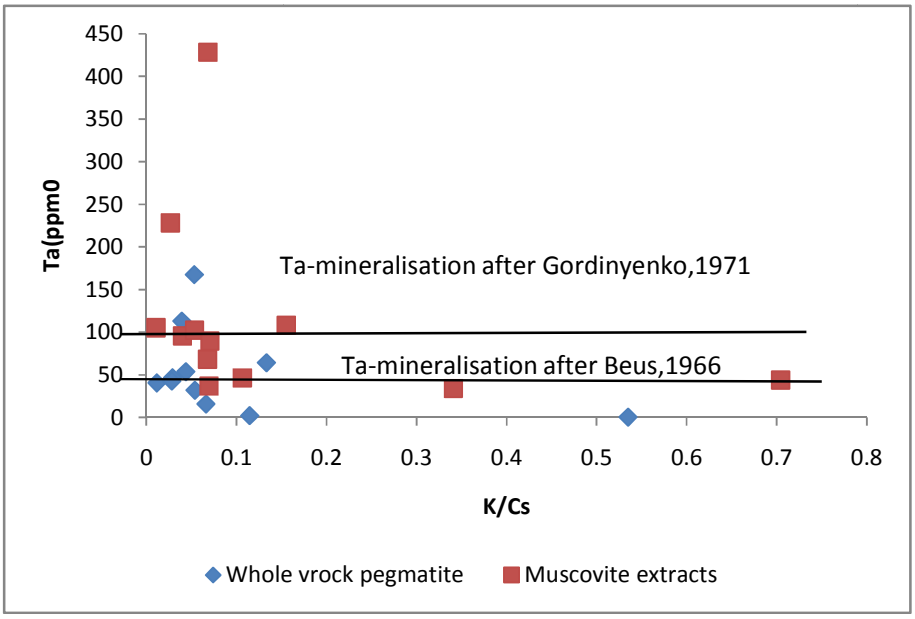

Fig. 15: Plot of Ta vs K/Cs for Whole rock pegmatite, Muscovite and Feldspar Extracts of Egbe Pegmatite (after Gordinyenko, 1971)

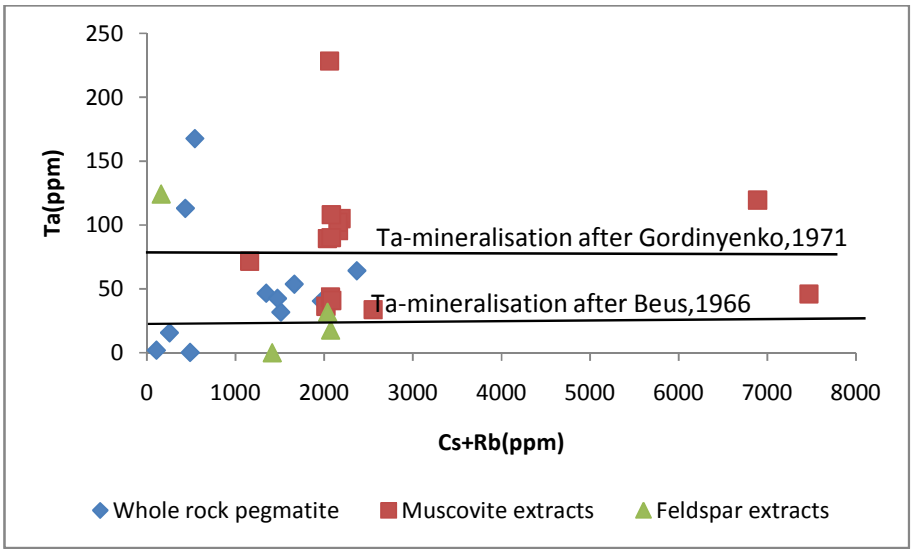

Fig. 16: Plot of Ta vs Cs+Rb for Whole rock pegmatite, Muscovite and Feldspar Extracts of Egbe Pegmatite (after Gaupp et. al, 1984)

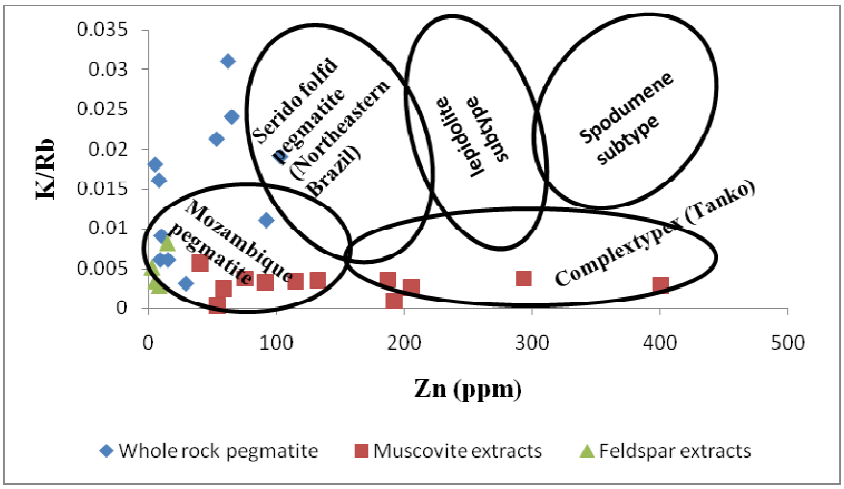

Fig. 17: Plot of Ta/ (Ta+Nb) vsMn/ (Mn+Fe) after Cerny, (1991a; 1991b) For Egbe whole rock pegmatite and mineral extract (after Baumgartner, 2001)

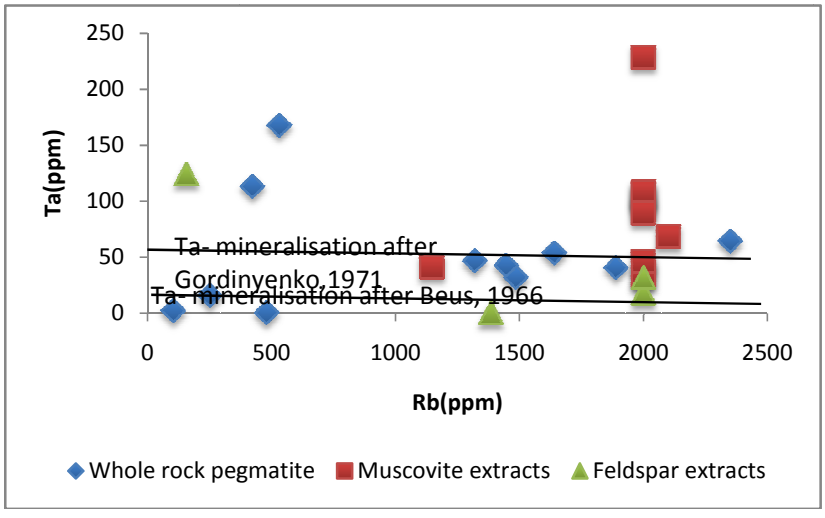

Fig. 18:- plot of Ta (ppm) vs Rb (ppm)

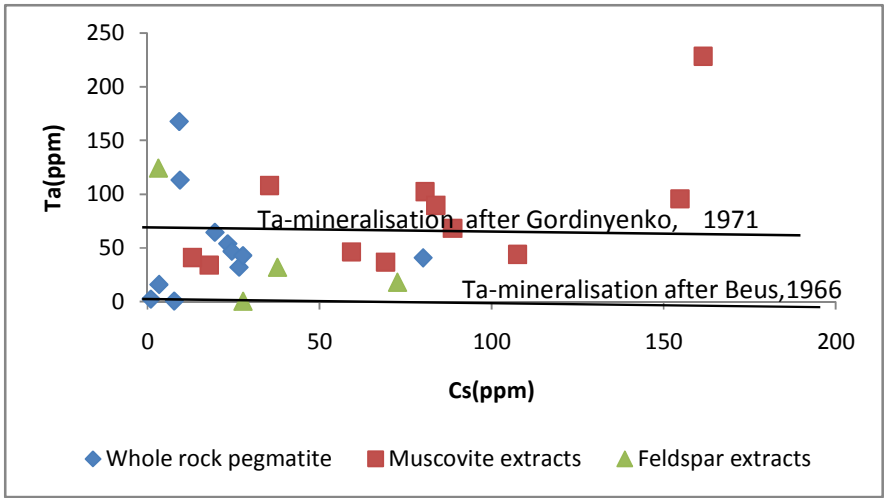

Fig. 19 :- Ta vs Cs for Whole rock pegmatite and mineral Extracts of Egbe Pegmatite after Cerny, (1991)

CONCLUSION

The plot of A/CAN >1 and Al_2O_3>CaO+ Na_2O+ K_2O coupled with enrichment of SiO_2, Al_2O_3, Na_2O, and K_2O and depletion of Fe_2O_3, MnO_2 and MgO values suggests that Egbe pegmatite is of peraluminous bulk composition. The correlated samples of whole rock pegmatite, muscovite and feldspar extracts plots above the Beus and the Gordinyenko lines using the discrimination plots of Ta vs Rb, Ta vs KCs, Ta vs Cs and Ta vs (Cs+Rb). Also the plots of Ta/W vs Cs for whole rock pegmatite, muscovite and feldspar extracts show that they are clearly discriminated with more enrichment of the rare metals in the muscovite extracts.
The coarse nature of the quartz, muscovite and feldspar in Egbe pegmatite could make separation by hand-sorting and air floatation methods an asset to mineral processors. Quartz is a major phase in Egbe granitic pegmatite and it could be processed to produce ultra - high purity quartz that can be of value in electronic industries and for high purity quartz glass.
Overall geochemical assessment show that the Egbe pegmatite is highly fractionated with enrichment and are mineralized with Ta >>Nb>>Sn.

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