GEOCHEMICAL FEATURES AND RARE - METAL (Ta-Nb) POTENTIALS OF PRECAMBRIAN PEGMATITES OF SEPETERI AREA, SOUTH WESTERN NIGERIA

O.A.OKUNLOLA[1] and A.I. AKINTOLA[2,+]
1. Department of Geology, University of Ibadan, Ibadan Nigeria
2. Department of Earth Sciences, Olabisi Onabanjo University, Ago-Iwoye, Nigeria

(*Received*: October, 2005; *Accepted*: December, 2007)

Abstract

Geochemical analysis of twenty-five muscovites extracts sampled from pegmatites of Sepeteri area was carried out using Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP--AES) analytical method. Results indicate they are generally highly siliceous (SiO_2, 54.05-77.64%) while Al_2O_3 content ranges from 14.18-31.37%., with an average of 66.17 and 25.51 respectively. Fe_2O_3, TiO_2, P_2O_5 are generally low (less than 3.00 %). The samples are fairly enriched in Rb, Ba, Sr, Zr but comparatively poor in the rare metals Ta, Nb, W and Sn. Cs values are also usually less than 90 ppm. Be is also marginally low (6-49 ppm) while Na/K ratio are slightly less than 1.0 indicating some degree of albitization. The degree of albitization is further revealed by the Ti-Sn (Nb+ Ta) discriminant diagram with sample plotting in the zone of albitization. Plots of K/Rb against Rb; K/Rb against Cs; and Ta against Ga indicate marginal to low level of rare metal mineralisation.

Geochemical potentials of Ta - mineralization is also revealed by Ta against Cs discriminant plot with most of the pegmatites samples plotting in the central area of the data field, thus showing similarities to those of Noumas, Central claims, Silverleaf, and Odd west deposits which are known to contain fairly low level of Ta mineralization endowments.

1. Introduction

The Nigerian Basement Complex forms part of the Pan-African mobile belt which lies between the West African and Congo Cratons and south of the Tuareg shield (Black, 1980). Precambrian Pegmatites (~625 Ma) of Nigeria occur mostly as dyke-like intrusions, which vary from few metres to several kilometers in length and few centimeters to meters in width. They were hitherto thought to be confined to a broad 400 km long NE-SW trending belt stretching from Wamba area, Central Nigeria, to Ibadan area, South Western Nigeria (Jacobson and Webb, 1946; Wright, 1970). However, recent studies (Garba, 2003; Okunlola, 2005) have shown that they are not restricted only to these confines. The occurrences in the southeastern part of the country notably around Obudu hills are even thought to extend into northeast Brazil (Garba, 2003; Ekwueme, 2004). The Nigerian pegmatites evolved during the time span of 600-530 Ma, (Matheis and Vachete, 1983), which indicates formation during the periods of Pan African magmatism.

In recent times, there has been a resurgence of interest in the study of these pegmatites occurrences because of their associated economic rare metal and gem mineralization. These have led to concentration of study on discrimination of the pegmatites into the rare metal mineralized and barren ones in order to elucidate modes and features of mineralization (Matheis, 1981; Matheis *et al.*, 1982; Kuster, 1990; Garba, 2003). Recently, Okunlola, (2005) also defined the metallogeny of the rare metal Ta-Nb pegmatites of Nigeria outlining 7 broad fields namely Kabba-Isanlu, Ijero-Aramoko, Keffi-Nasarrawa, Lema-Ndeji, Oke Ogun, Ibadan-Osogbo and Kushaka-Birnin Gwari. The Sepeteri pegmatites occurrences (Fig. 1) which are members of the Oke-Ogun field occurrences have therefore been studied with the aim of elucidating their petrography and geochemical features and thus understanding their genesis and economic potentials.

2. Regional Geological Setting

Rocks of the Precambrian Basement Complex underlie the project area. The Precambrian Basement of Africa can be divided into three large masses or cratons. These are the Kalahari Craton, Congo and West African Cratons. They are separated from each other by a number of mobile belts active in late Precambrian and early Paleozoic times. The Nigerian Basement Complex lies east of the Congo Craton in a mobile belt affected by the Pan African Orogeny (Fig. 2). These rocks crop out in two large areas; the south-western and north-central parts of the country

+ *corresponding author* (email: busayoakins@yahoo.com)

and in smaller areas in the north-eastern and the south-eastern parts, notably around the Oban massif and Obudu area (Ekwueme, 2000). Three main lithologic groups are usually distinguished. They are the gneiss-migmatite complex with evidence of polycyclic metamorphism, mainly of amphibolite facies grade with ages ranging from 2800-600 Ma. A north-south trending schist belt of low-grade supracrustal rocks with minor volcanic assemblages. They are concentrated in the western half of Nigeria although minor occurrences have been noted in the northern-eastern and southern-eastern part . The schist belts, despite paucity of agreements in terms of their nomenclature, geographic delimitation and geodynamic setting are composed largely of metamorphosed pelitic and psamitic assemblages. Secondary lithologies such as ferruginous rock, carbonate, and meta-ultramafic bodies are often used to discriminate them. Syn to late tectonic Pan-African Granite, which is collectively termed, the Older Granite intrude the schist belts and the gneiss-migmatite complex. They comprise mainly granites, charnockites, diorites and syenites. No precise genetic subdivisions have been established yet for the Older Granites.

3. Lithological Association and Petrography

The Pegmatite of Sepeteri area, with average dip of 60 °E striking mainly in the N-S direction, intruded into the older lithology of amphibole schists (Fig. 3). The amphibole schists are usually greenish, fissile and in some cases weathered. In the amphibole schist major minerals include quartz, plagioclase, microcline, biotite and hornblende while accessory minerals include sphene, zircon, apatite and opaque. These amphibole schists serve as major hosts for the pegmatite intrusions. The mica schists are mostly light grey in colour and composed mainly of muscovite and minor biotite with intergranular fine grained quartz. Pegmatite occurs as coarse inequigranular veins, milky white in appearance. Thin section study (Fig. 4) shows that the predominant mineralogical constituents include quartz, microcline, albite, muscovite and minor amounts of biotite. Microcline is the most abundant of these minerals often graphically intergrown with quartz. They display characteristic pericline twinning. Quartz is well distributed in all the samples and it is next in abundance to microcline. It occurs as highly cracked anhedral grains varying from colourless to milky white in plane polarized light and from colourless to blue under crossnicols. Plagioclase feldspars are colourless in thin section having characteristic albite twinning with anorthite composition, An_5 (Albite). Muscovite is colourless under thin section. Biotite occurs interstitially between the microcline, quartz and muscovite as fine dark brown platy grains.

Fig. 1: Location of the schist belts in Nigerian sector of the Pan-African province showing location of project area (modified after Elueze, 2000)

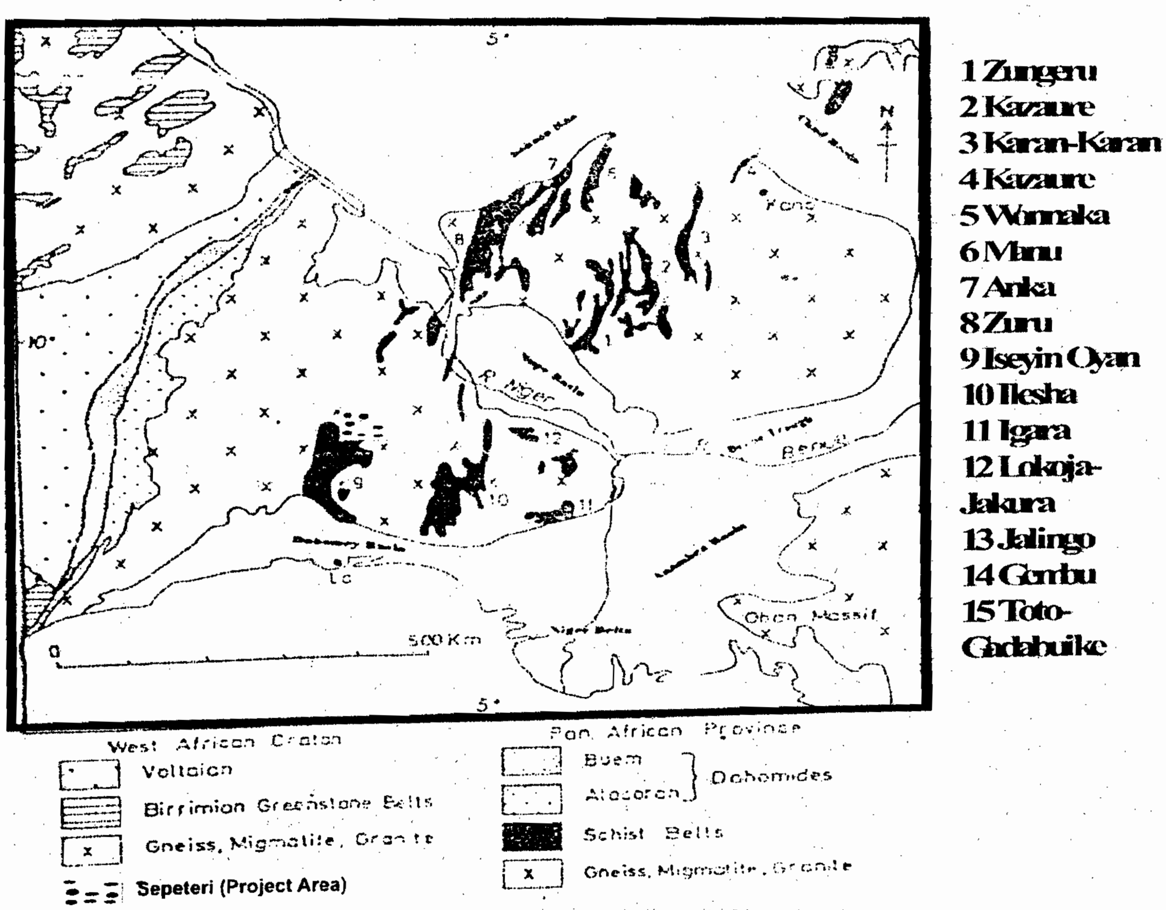


Fig. 2: Map showing location of the Nigerian sector of the Pan-African province of West Africa (adapted from Elueze, 1980)

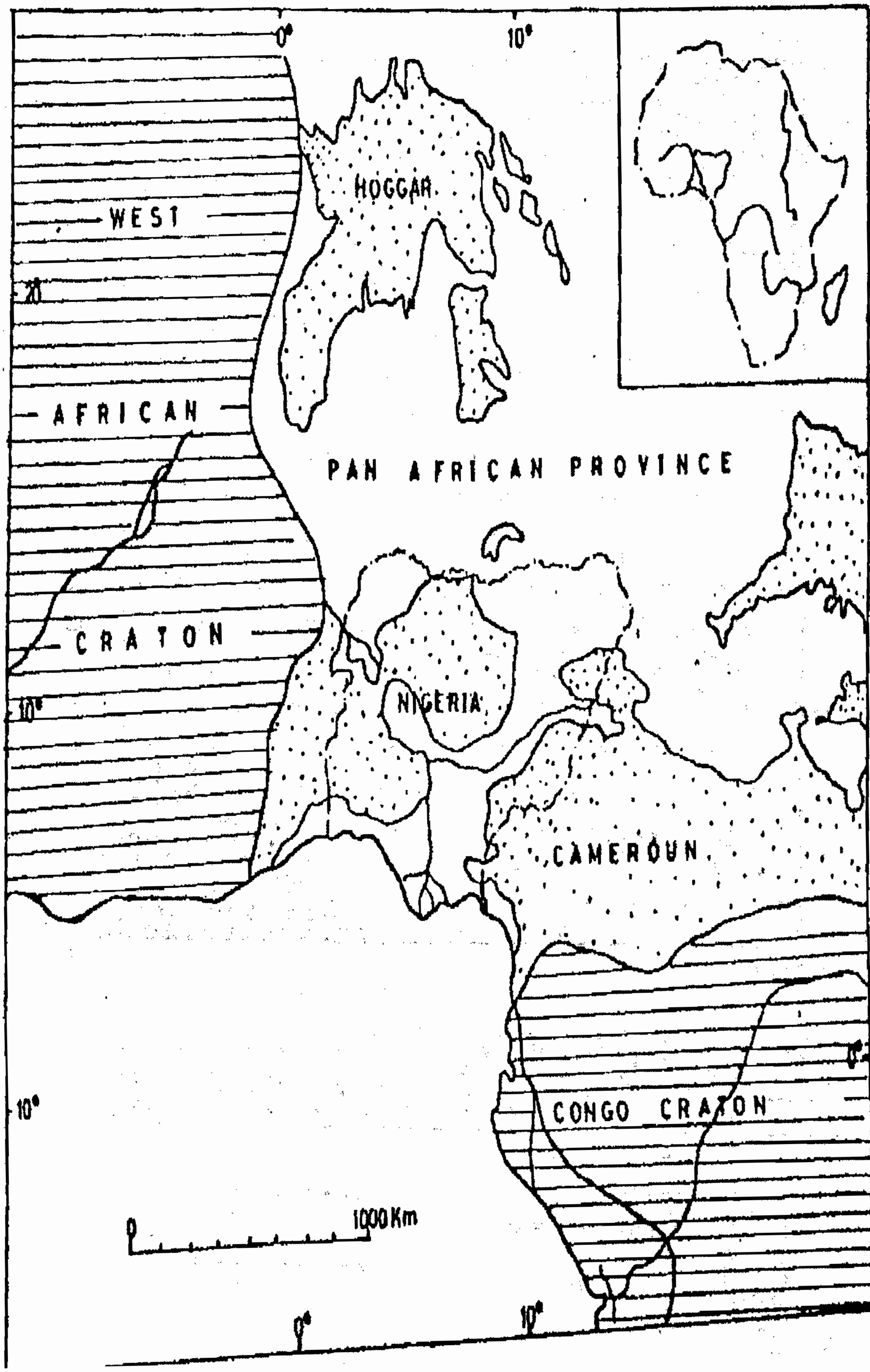


Fig. 3: Geological Map of Sepeteri Area

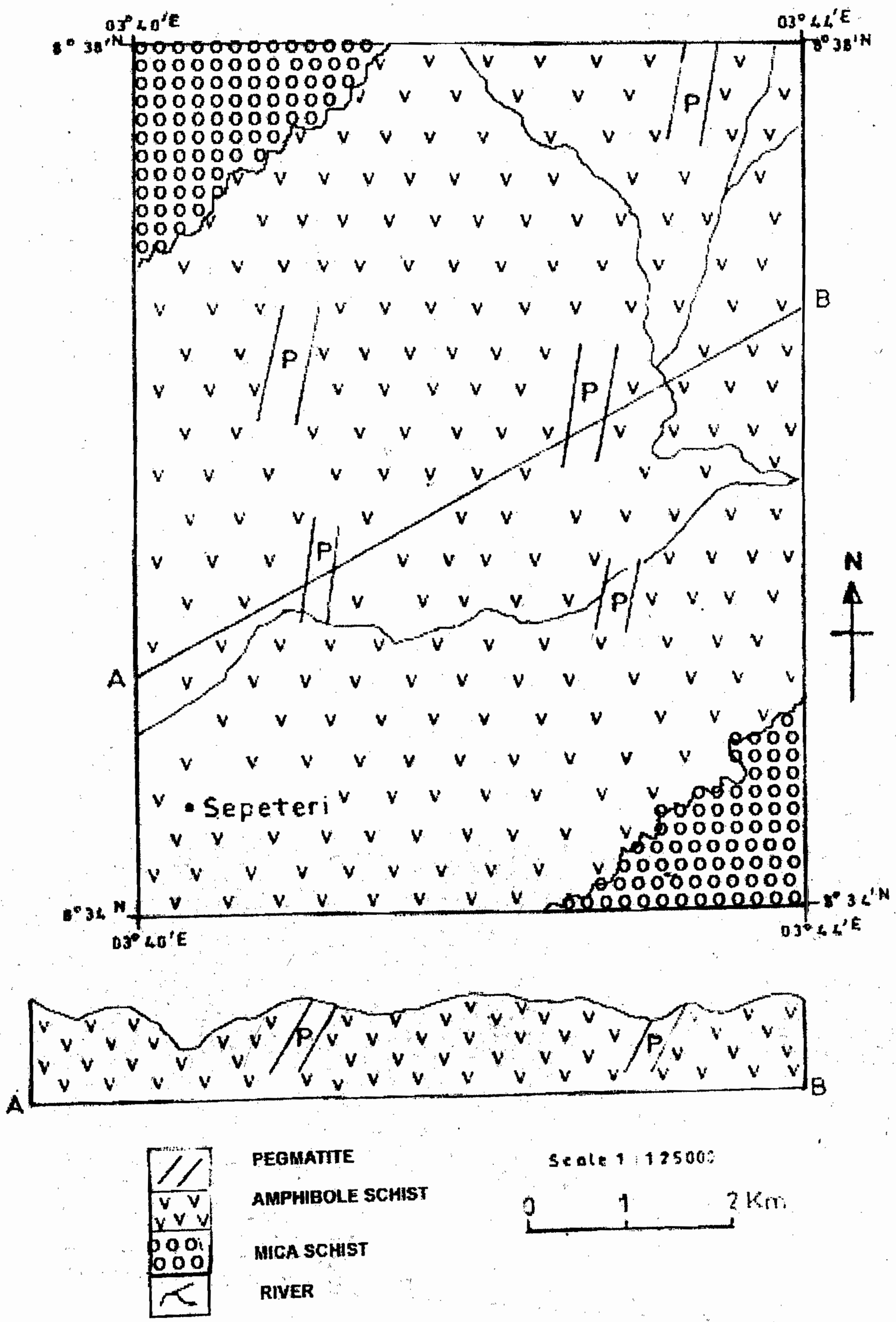
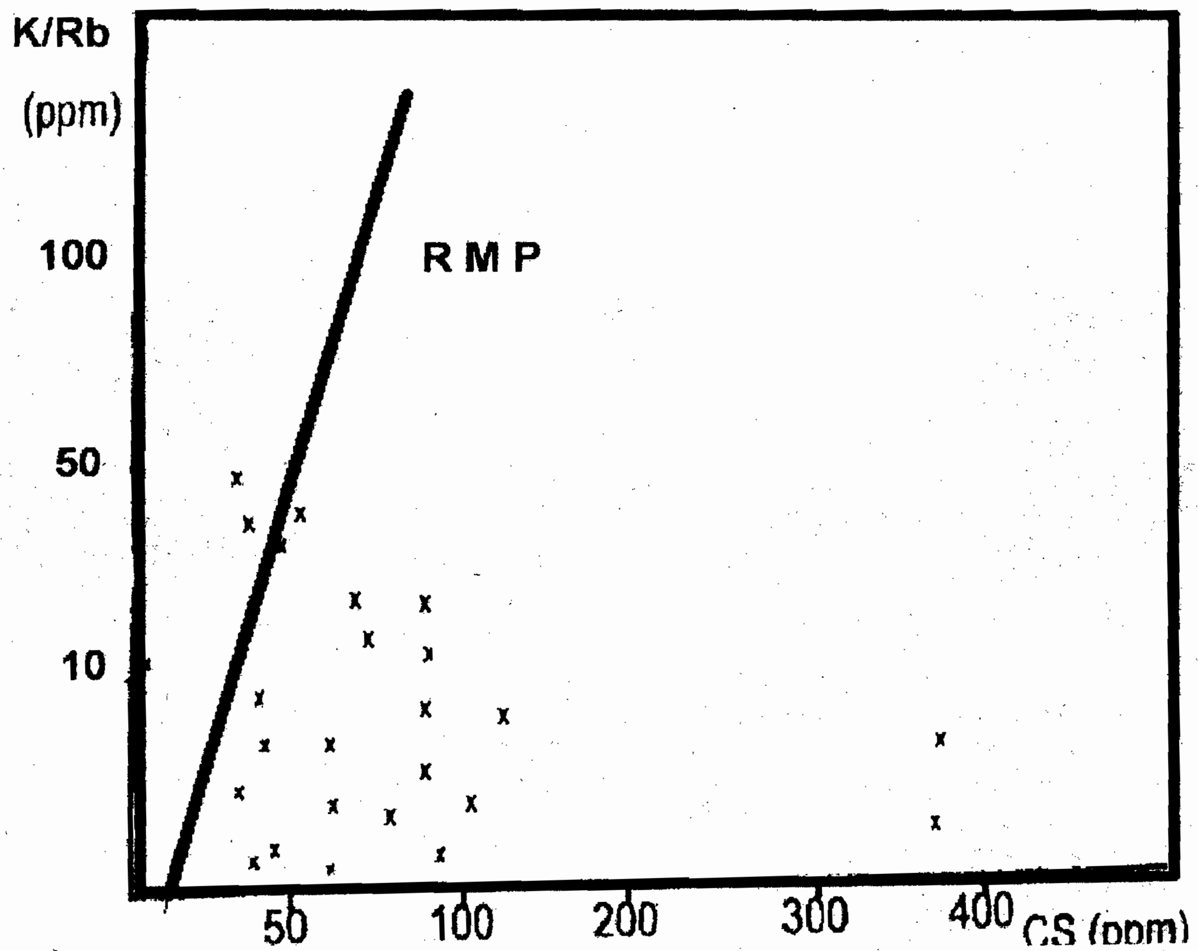


Fig. 4: Photomicrograph of Sepeteri pegmatite in transmitted light (cross polars), showing microcline (M), albite (alb), and quartz (q).

Bar scale = 20 mm

Fig. 5: K/Rb vs Cs Plot for Sepeteri pegmatite on the diagram of Cerny *et al.*, 1995



4. Geochemical Features

Due to relative stability during chemical weathering processes under humid tropical and arid conditions, and relative enrichment of Ta-Nb in the muscovites mineral phase, analysis of muscovites of pegmatites has been established as a reliable exploration indicator for rare metal Ta-Nb mineralization (Gaupp *et al.*, 1984; Kuster, 1990; Cerny *et al.*, 1995). Thus in this study, reference to analytical data of pegmatites is essentially those of their muscovite extracts. Twenty-five muscovite extracts from representative samples were analysed for major, trace and rare earth elements using Inductively Couple Atomic Emission Spectrophotometry (ICP - AES) at Activation Laboratories Ltd, Ontario Canada. A sample weight of 0.5 g and about 75 micron was put in the platinum crucible. 5 ml perchloric acid, HNO_3 and 15 ml hydrofluoric acid were added. The solution was stirred properly and allowed to evaporate to dryness after it was warmed at a low temperature for some hours. 4 ml hydrochloric acid was then added to the cooled solution and warmed to dissolve the salts. On cooling, the solution was diluted to 50 ml with distilled water. This was then introduced into the ICP torch as aqueous - aerosol. The emitted light by the ions in the ICP was converted to an electrical signal by a photo multiplier in the spectrometer, The intensity of the electrical signal produced by emitted light from the ions were compared to a standard (a previously measured intensity of a known concentration of the elements) and the concentration then computed. The chemical data of the representative samples are shown in Table 1.

5. Results and Interpretation

From the analytical results presented in Tables 1-4, major element oxides distribution show that the SiO_2 content in the muscovite extracts of the pegmatite range between 54.05% and 77.64% with an average value of 66.17%. This is marginally lower than average values of rare metal Ta-Nb pegmatite of Nigeria (Okunlola, 2005) but comparable with the Ipetu Ijesha pegmatites (Matheis, 1981). Fe_2O_3 (0.77-18.31%), CaO (0.03-1.97%), MgO (0.09-1.09%) and TiO_2 (0.18-2.61 %) values are slightly lower when compared to other rare-metal -bearing pegmatites of Nigeria. (Garba, 2003; Okunlola, 2005). Mean contents of Al_2O_3 (25.51%), Na_2O (1.18%) and K_2O (1.16%) compare favorably with the values of rare metal pegmatite occurrences across Nigeria (Okunlola, 2005). Trace elements, Rb (547.69 ppm), Nb (36.73 ppm), Be (16.56 ppm), Li (192.14 ppm), W (3.25 ppm), Sn (50.41 ppm), Sr (87.52 ppm), Zr (41.98 ppm), Ta (33.08 ppm),Y (6.52 ppm) are comparable with the average values for the marginally endowed rare metal pegmatites of Ijero-Aramoko area of Nigeria but lower than those for Kushaka - Birni Gwari, Oke-Ogun, Ilesha-Osogbo, Isanlu Egbe and Share, Nigeria, (Garba, 2003; Okunlola, 2005). The Rb/Sr ratio value is also low when compared to other rare-metal pegmatites of Nigeria (Matheis *et al.*, 1982, Okunlola and Ocan, 2002; Garba, 2003; Okunlola, 2005) but compares well with the barren Nasarawa pegmatites (Garba, 2003). Average K/Rb value (785 ppm) is significantly higher than those of the rare-metal pegmatites of Nigeria but is comparable with values of some pegmatites and granitoids of Wamba area, Central Nigeria (Kuster, 1990; Garba, 2003).

Plots of K/Rb versus Cs (Fig. 5), Ta Versus Ga (Fig. 6) and K/Rb Versus Rb (Fig. 7), show that almost all the pegmatites samples are mineralized and are low to moderately differentiated. The degree of albitization is revealed by the triangular Ti-Sn-(Nb+Ta) discriminant plot in which most of the samples plot in the zone of albitization (Fig. 8). This degree of albitization which can be examined also through Na/K ratio (Jacobson and Webb, 1946; Matheis and Emofurieta, 1990; Okunlola, 1998) has a maximum value of 0.634 suggesting moderate levels of albitization. Tantalum pegmatites have been known to show the most complex internal structures and varieties of textural and parageneticallly different units amongst the rare-metal pegmatites (Moller and Morteani, 1987). Sometimes, however, the primary zone structure is often obliterated by later lepidolization or albitization. In the case of Sepeteri pegmatites, albitization is observed in the central parts as well as marginal parts of the pegmatite body.Other geochemical potentials of rare-metal Ta-mineralization of Sepeteri Pegmatite is revealed by plots of Ta versus Cs (Fig. 9), Ta versus Cs + Rb (Fig. 10), and Ta versus K/Cs (Fig. 11). On the Ta versus Cs diagram, most of the samples plot in the central area of the data field, thus showing similarity to those of Noumas, South Africa, Silver leaf (Canada) and Odd west pegmatites (Canada) which contain low amounts of tantalite mineralization (Moller and Morteani 1987; Gaupp and Morteani, 1984). Using the plot of Ta versus Cs + Rb Gaupp and Morteani 1984 (Fig.10), the samples also plot close to those of Noumas and Central claims pegmatite. Similarly, on the plot of Ta versus K/Cs (Fig. 11) they plot above the Gordiyenko (1971) (A) and Beus (1966) (B) lines. Most samples however plot below the highly mineralized pegmatites of Tanco (Canada).

6. Conclusion

Results of this study show that the Precambrian pegmatites of Sepeteri which intruded the amphibole schist are rare-metal pegmatites. Average length of each body is about 500 m with variable width but usually not less than 5 m. They are usually complex albitised pegmatites. Microcline and albite are the dominant feldspars with subordinate muscovite and anhedral quartz. Typical enhancement of Rb, Li, Be, Y are noticed while there is corresponding depletion

Table 1: Analytical results of muscovite extracts from Sepeteri pegmatite (averages and ranges)

Major Elements (%)	**Average (n =25)**	**Range**
SiO_2	66.17	54.05-77.64
TiO_2	0.73	0.184-2.65
Al_2O_3	25.51	14.18-31.37
Fe_2O_3	3.91	0.77-18.31
MnO	0.19	0.01-0.70
MgO	0.37	0.09-1.094
CaO	0.35	0.028-1.973
Na_2O	1.18	0.04-4.14
K_2O	1.16	0.265-4.4
P_2O_5	0.20	0.032-0.57
Total	99.87	
Trace element (ppm)		
Ta	33.08	01-253.0
Cs	72.29	4.2-381.3
Rb	547.69	25.8-2850.7
Sn	50.41	11.2-279.0
Nb	36.73	21.9-91.8
Li	192.14	61.7-422.3
Sr	87.52	13-445
Y	6.52	0.8-20.9
Ba	237.08	48-511
W	3.25	1.2-6.0
Be	16.56	6-49
Zr	41.98	13.0-73.9
Ga	30.15	26.3-33.8

Table 2: Trace-elements (ppm) and element ratios in muscovite extracts from pegmatite samples of Sepeteri area

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Ta	48.80	0.1	15.1	83.0	0.7	8.6	15.0	15.1	12.3	30.5	253.0	39.7	20.4	47.5
Cs	43.10	90.6	59.6	381.3	7.0	49.7	48.3	40.5	4.2	58.7	41.1	50.5	42.1	43.4
Rb	2163.20	72.8	72.8	76.1	202.4	283.5	5782.2	2850.7	60.3	215.4	25.8	279.0	198.4	43.8
Sn	36.70	11.2	44.1	11.7	28.1	44.0	29.2	15.3	67.4	48.4	23.7	279.0	198.4	11.2
Nb	41.30	26.2	38.7	47.4	31.8	28.6	21.9	32.7	30.7	38.3	91.8	36.70	46.12	40.1
Li	422.3	209.1	178.3	208.5	230.3	240.3	419.3	195.5	195.6	156.4	198.9	61.7	174.0	355.3
Sr	59	43	13	122	69	47	50	97	20	70	445	51	15	58
Y	7.8	8.6	1.7	20.9	13.3	5.9	4.5	13.0	1.3	8.3	5.9	5.7	0.8	0.9
Ba	271	511	68	214	423	163	167	395	86	146	458	175	48	49
W	3.1	3.3	1.2	3.5	4.9	6.0	2.1	3.0	1.8	5.4	2.8	3.2	1.2	1.3
Be	8	6	12	8	11	9	6	16	11	25	11	26	49	12
Zr	40.7	64.5	27.5	64.8	73.9	49.7	25.9	57.8	40.4	38.4	55.6	49.7	13.0	40.5
Ga	30.1	26.5	33.9	26.3	28.3	30.2	33.8	29.3	32.01	31.5	33.7	35.03	27.38	28.3

	15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Ta	0.3	18.4	82.0	0.9	9.7	15.4	16.3	13.1	12.1	30.7	38.5
Cs	91.2	58.4	379.2	6.8	48.5	49.1	38.4	6.1	28.7	40.3	60.5
Rb	75.9	78.1	295.1	75.3	71.8	40.3	24.3	270.1	150.1	78.9	236.3
Sn	45.1	11.8	25.3	43.0	30.1	16.4	65.3	47.4	22.5	48.7	56.3
Nb	27.2	26.3	28.5	43.5	32.1	21.8	30.5	32.1	37.9	40.7	45.3
Li	203.1	207.2	151.1	190.2	241.1	208.1	62.3	61.8	61.7	85.3	86.3
Sr	40	14	123	68	49	96	23	68	440	52	56
Y	1.4	1.3	7.2	6.9	5.7	4.5	5.9	13.4	1.8	8.5	7.9
Ba	265	270	69	213	332	432	390	87	88	145	450
W	3.2	3.3	3.7	4.2	4.4	6.0	9.9	1.7	1.8	5.4	2.8
Be	9	13	6	23	12	48	47	15	13	6	12
Zr	60.2	25.3	63.8	48.5	23.8	50.1	48.5	43.0	13.2	40.3	22.5
Ga	26.4	28.3	30.1	32.1	33.6	33.7	28.5	26.3	30.1	26.5	31.5

Table 3: Elemental rations of muscovite extracts from Sepeteri pegmatites.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
K/Rb	0.83	7.10	5.90	3.80	2.50	1.80	0.80	0.80	10.9	1.25	8.50	1.65	4.10	5.0
Rb/Sr	36.66	1.014	5.60	0.624	2.933	6.03	115.6	29.39	3.02	3.08	0.058	5.47	13.23	0.76
Mg/Li	0.50	0.70	2.30	1.10	0.90	0.60	0.20	1.20	3.30	0.30	0.00	1.00	0.50	0.50
Na/K	0.108	0.142	0.656	0.214	0.133	0.146	0.040	0.071	0.271	0.122	13.95	0.085	2.880	0.346
Ba/Rb	0.125	11.72	0.934	2.615	2.134	0.575	0.029	0.139	1.476	0.678	17.752	0.627	0.242	1.119
Zr/Hf	21.42	28.04	25.0	24.92	29.56	26.16	21.58	26.90	22.44	20.22	5.62	33.13	5.58	10.20
Sr/Rb	0.027	0.986	0.179	1.603	0.341	0.166	0.008	0.034	0.332	0.325	17.248	0.183	0.076	1.324
Rb/Ce	50.19	0.48	1.22	0.199	28.19	5.704	118.73	70.39	14.36	3.67	0.628	5.525	4.713	1.01
Ta/W	15.74	0.030	12.58	23.71	0.143	1.433	7.143	5.033	6.83	5.65	90.38	30.64	6.00	15.83
K/Ce	0.042	0.0034	0.0072	0.0007	0.0728	0.0104	0.0766	0.06	0.157	0.0045	0.0053	0.0001	0.0194	0.0050
Zr/Sn	1.109	5.759	0.624	5.538	2.629	1.129	0.887	3.778	0.599	0.752	2.346	1.096	0.302	0.890

	15	16	17	18	19	20	21	22	23	24	25
K/Rb	8.50	3.30	6.0	4.10	5.90	6.60	20.95	1.90	24.50	29.70	2.60
Rb/Sr	1.89	5.58	2.39	1.11	1.47	0.42	1.06	0.97	0.34	1.52	4.20
Mg/Li	1.90	1.10	1.40	1.20	0.60	0.60	2.70	1.60	1.60	1.90	7.60
Na/K	0.112	0.585	0.109	0.138	0.637	0.204	0.119	0.148	0.649	0.019	0.059
Ba/Rb	3.491	3.457	0.234	2.829	4.629	10.719	16.049	0.322	0.588	1.838	1.812
Zr/Hf	43.0	14.88	53.17	18.85	13.22	26.37	4.80	11.82	11.0	21.21	2.29
Sr/Rb	0.527	0.179	0.417	0.903	0.682	2.382	0.946	0.252	2.931	0.659	0.238
Rb/Ce	0.832	1.337	0.778	11.074	1.480	0.821	0.833	44.28	2.185	1.958	3.89
Ta/W	0.063	8.318	25.63	0.169	3.593	4.667	4.528	2.729	2.574	9.029	11.667
K/Ce	0.071	0.0044	0.0047	0.04	0.0088	0.0054	0.0132	0.0852	0.0537	0.0583	0.010 7
Zr/Sn	0.732	1.423	0.631	4.197	4.07	0.732	1.419	0.272	0.552	1.783	0.768

Table 4: Major element content (wt%) of muscovite extracts from Sepeteri pegmatites

	1	2	3	4	5	6	7	8	9	10	11	12
SiO_2	64.13	57.38	64.13	57.40	63.02	66.01	66.90	64.30	65.32	60.89	70.00	72.2
TiO_2	0.98	1.53	0.39	2.65	1.65	0.98	0.54	1.25	0.59	0.54	0.29	0.78
Al_2O_3	27.44	21.67	28.66	29.60	28.84	28.70	22.32	28.47	29.88	31.37	21.30	24.28
Fe_2O_3	4.34	18.31	2.48	3.35	2.06	2.45	5.05	1.77	0.77	4.62	3.10	1.65
MnO	0.01	0.12	0.60	0.06	0.03	0.11	0.01	0.12	0.15	0.01	0.02	0.13
MgO	0.37	0.27	0.69	0.39	0.37	0.24	0.23	0.39	1.09	0.09	0.19	0.17
CaO	0.17	0.19	0.08	1.97	0.21	0.14	0.09	0.34	0.08	0.03	0.19	0.13
Na_2O	0.26	0.06	2.38	4.08	3.09	0.10	0.20	0.23	1.24	2.04	4.14	0.04
K_2O	2.17	0.37	0.52	0.35	0.62	0.63	4.47	2.93	0.79	0.33	0.27	0.55
P_2O_5	0.14	0.08	0.05	0.12	0.12	0.57	0.23	0.19	0.07	0.09	0.49	24.28
Total	100.01	99.98	99.98	99.97	100.01	99.93	100.04	99.99	99.98	100.01	99.99	100

	13	14	15	16	17	18	19	20	21	22	23	24	25
SiO_2	77.64	69.85	66.43	64.59	61.97	68.85	65.76	64.81	72.76	72.71	54.05	72.77	70.45
TiO_2	0.18	0.19	0.19	0.24	0.88	1.52	0.39	0.59	0.29	0.19	0.58	0.53	0.19
Al_2O_3	14.18	23.10	26.32	28.35	28.22	26.34	28.56	24.20	20.26	20.30	30.22	19.18	25.88
Fe_2O_3	2.93	4.00	3.75	2.74	5.36	1.56	3.67	5.95	4.64	3.95	5.06	3.14	1.04
MnO	0.60	0.10	0.02	0.03	0.11	0.03	0.02	0.18	0.65	0.70	0.01	0.68	0.14
MgO	0.17	0.36	0.67	0.39	0.36	0.39	0.25	0.24	0.29	0.17	0.17	0.29	1.09
CaO	0.08	1.85	0.03	0.34	0.03	0.08	0.09	0.34	0.09	0.19	1.74	0.08	0.09
Na_2O	3.19	0.10	1.09	1.21	0.26	0.06	0.37	2.07	0.08	0.10	3.23	0.06	0.05
K_2O	0.98	0.27	0.79	0.32	2.15	0.38	0.52	0.33	0.61	0.63	4.45	2.83	0.78
P_2O_5	0.03	0.03	0.45	0.53	0.41	0.55	0.11	0.04	0.08	0.14	0.23	0.19	0.03
Total	100.58	99.85	99.74	99.74	99.75	99.76	99.74	99.75	99.75	99.08	99.74	99.75	99.74

Fig. 6: Plot of Ta-Ga for pegmatite of Sepeteri

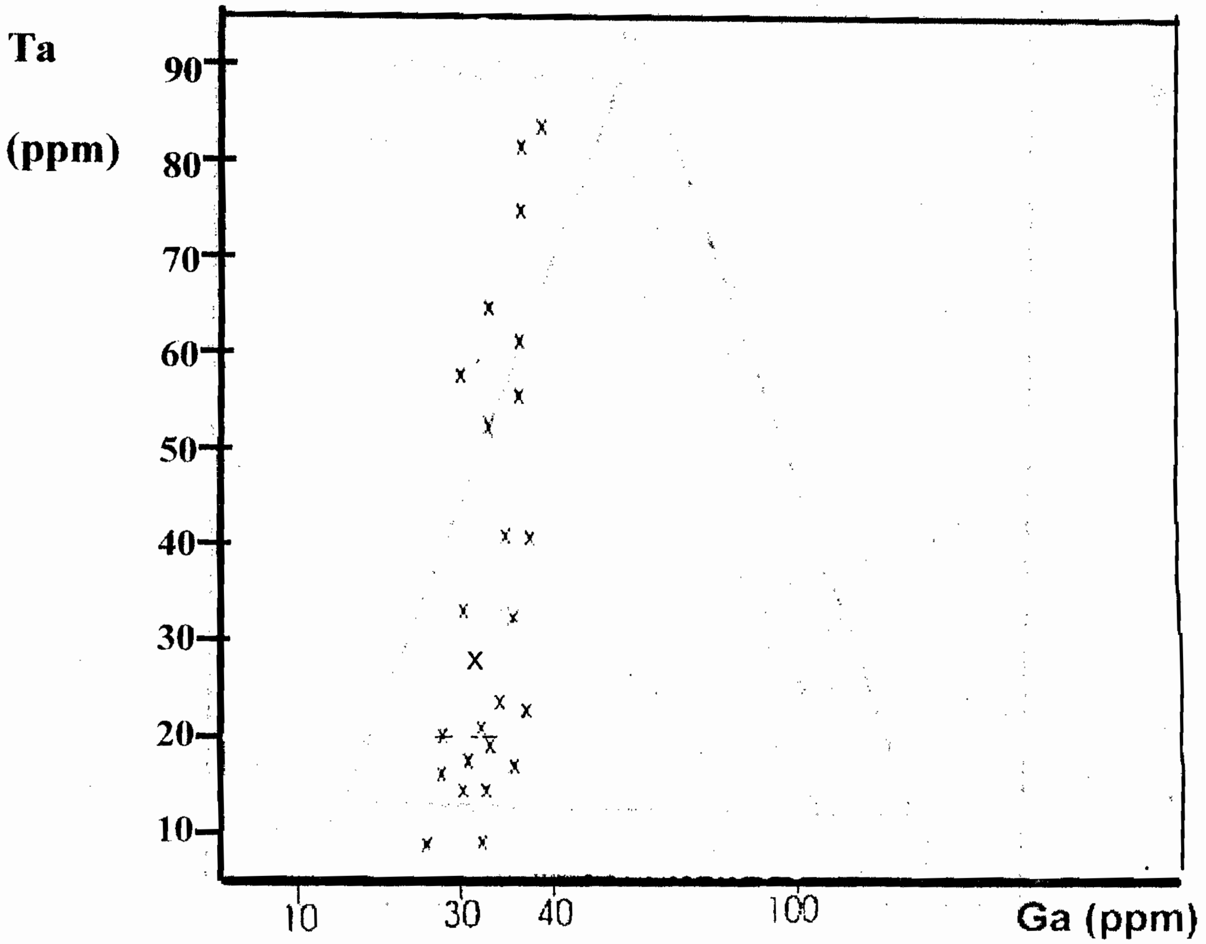


Fig: 7: K/Rb vs Rb distribution pattern in Sepeteri pegmatite.
Arrow indicates normal differentiation trend on the diagram of Stanrov *et al.*, 1969

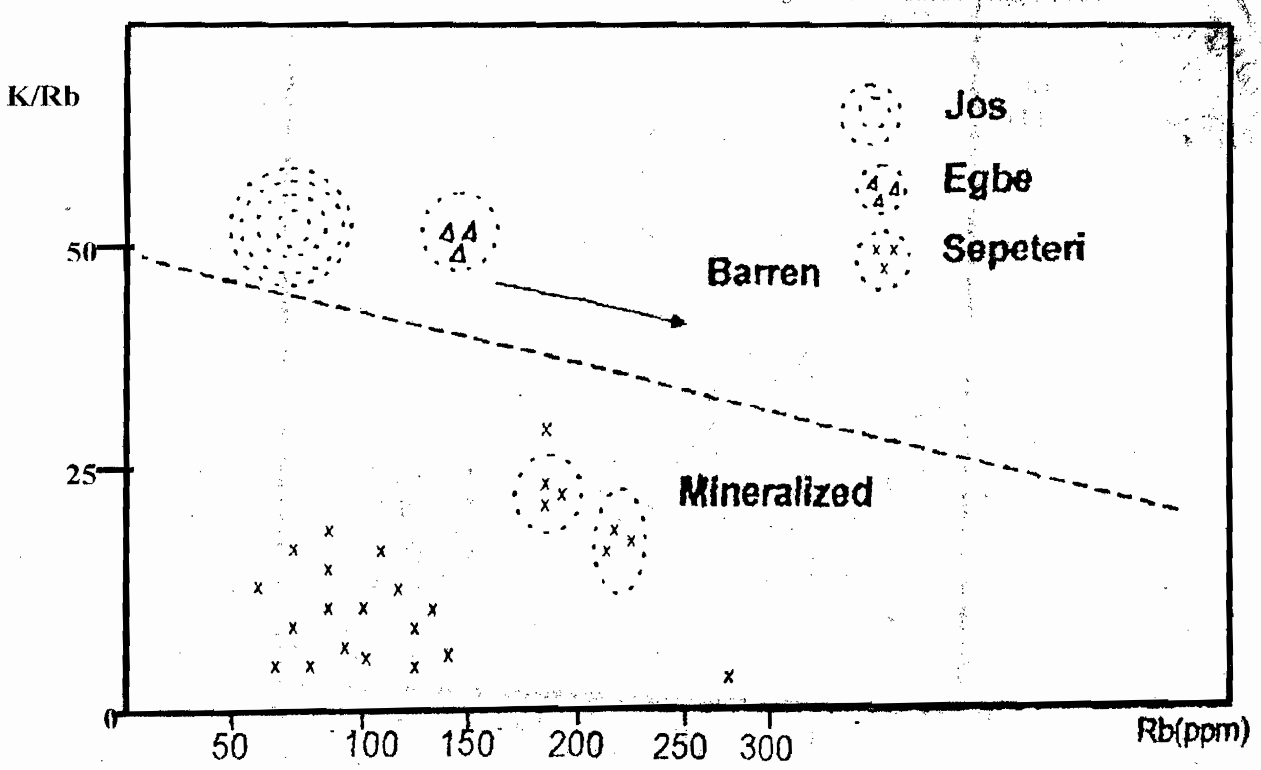


Fig. 8: Triangular Ti-Sn-(Nb + Ta) plot for Sepeteri pegmatite on the diagram of Kuster, 1990

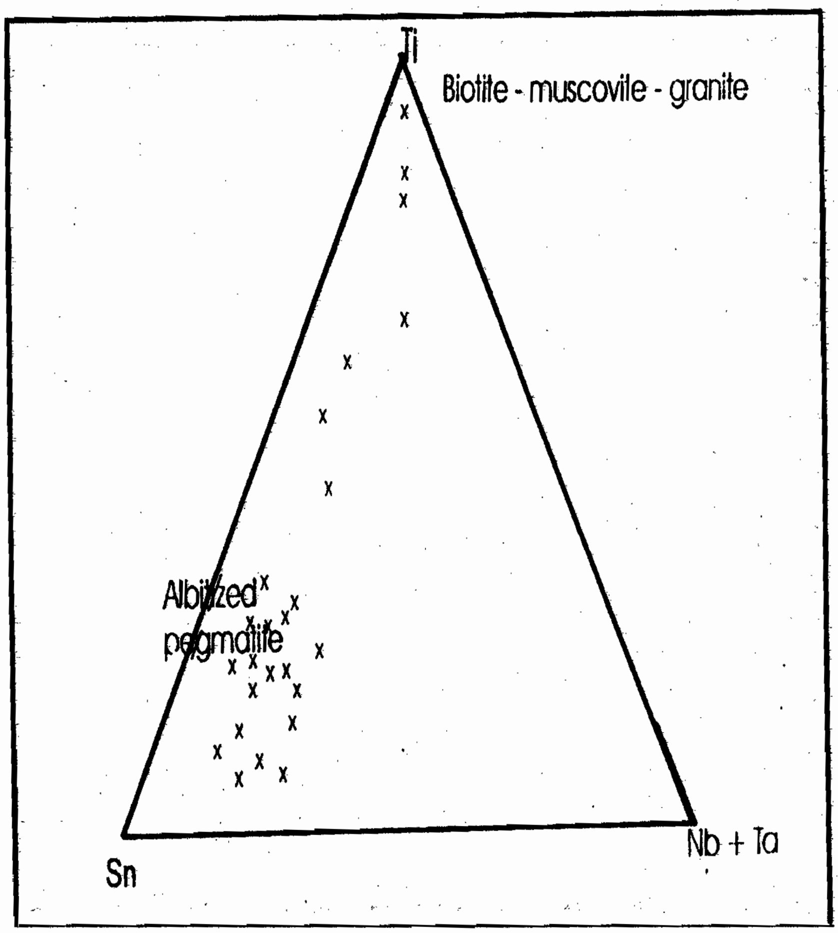


Fig. 9: Plot of Ta vs Cs for pegmatite of Sepeteri on the diagram of Moller and Morteani, 1987.

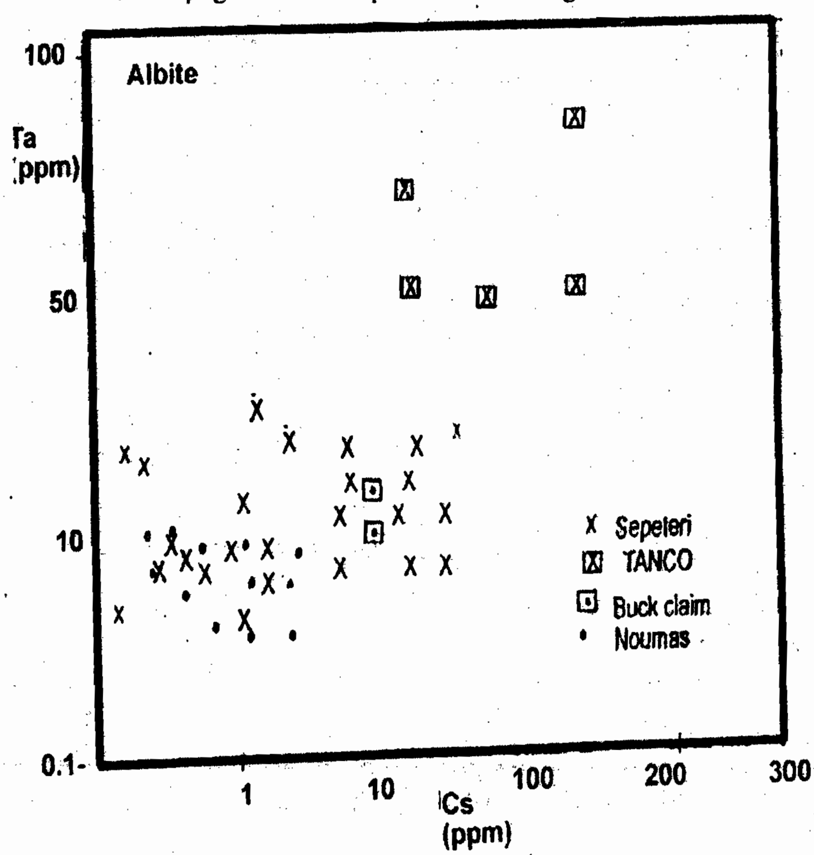


Fig. 10: Plot of Ta Vs Cs + Rb for Sepeteri pegmatite on the diagram of Gaupp *et al.*, 1984

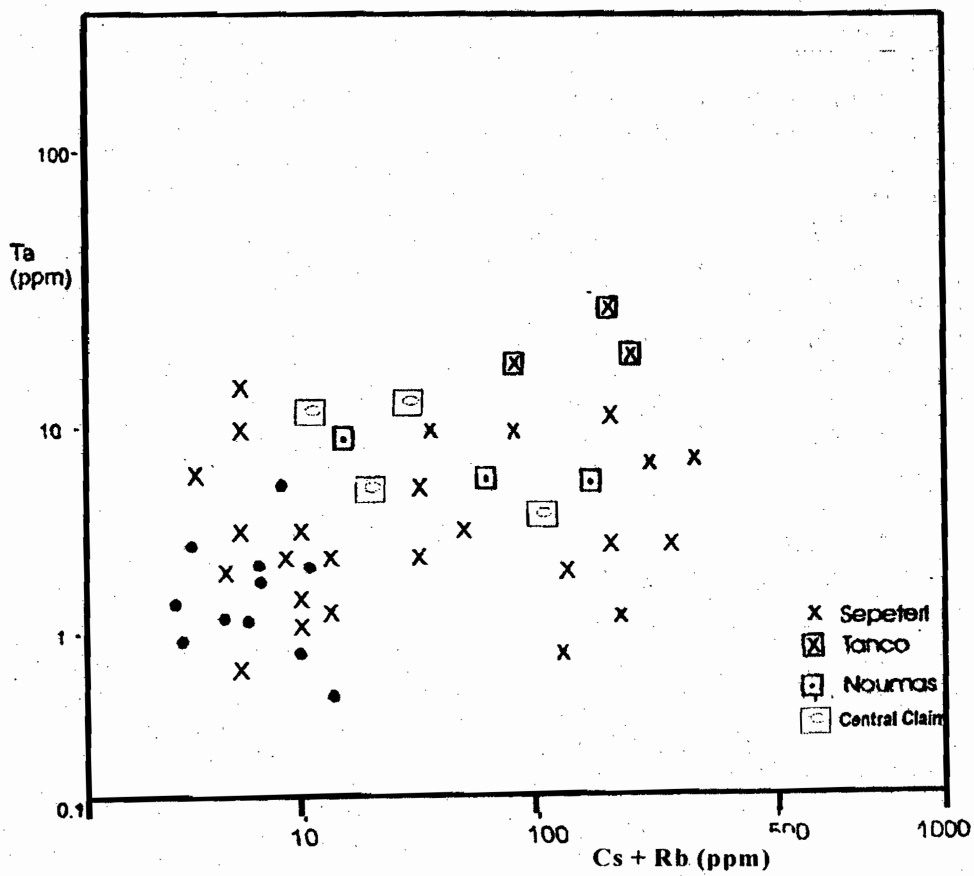
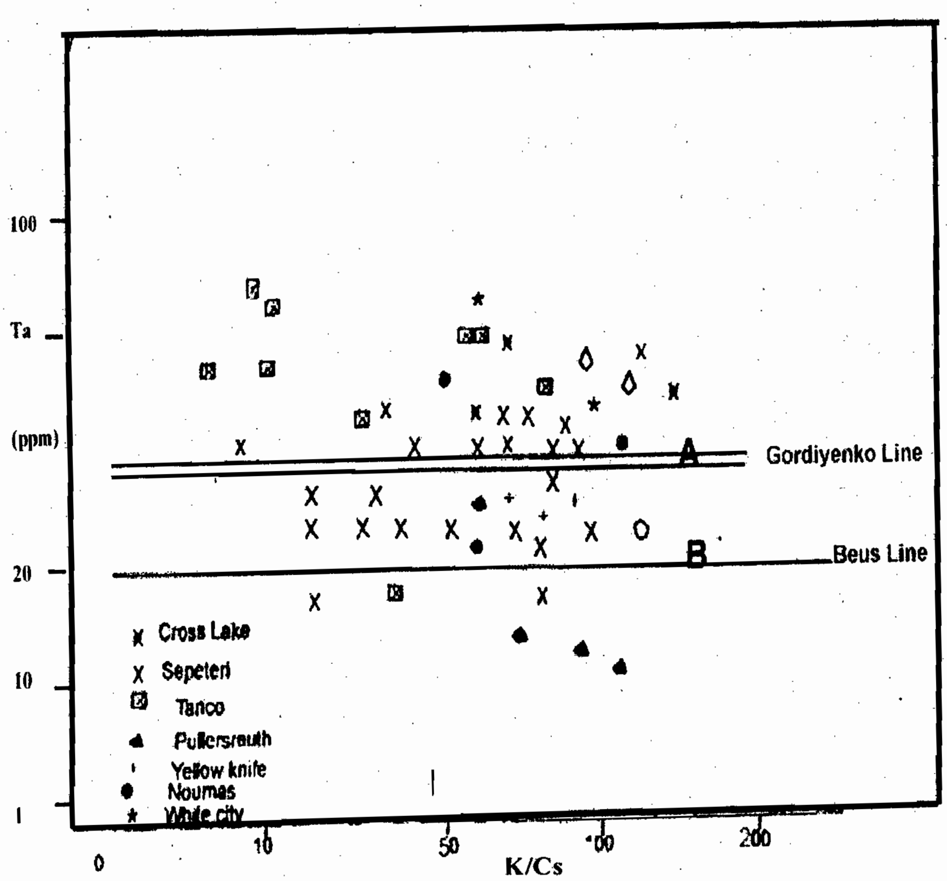


Fig. 11: Plot of Ta vs K/Cs for white mica of Sepeteri pegmatite on the diagram of Gordiyenko, 1971 and Beus, 1966.



of Ba, Sr and Zr. The rare-metal content Ta, Nb is low when compared with other mineralized Pegmatites of Nigeria. K/Rb versus Rb and plots of Ta Versus Cs, Ta Versus Rb also confirm the low-medium level of Ta-Nb mineralization potential comparable with other pegmatites across the world such as those of Noumas (South Africa), Silver Leaf and Odd west (Canada).

Acknowledgement

The authors acknowledge Prof. O.O. Kehinde-Phillips, Mr R.O. Egbeyemi, Mr O. Olaifa and Mr J.O. Somorin, all of Earth Sciences Department, O.O.U Ago-Iwoye, Nigeria for their considerable support. Numerous colleagues and friends who contributed in various ways are also acknowledged. Chemical analysis was executed at Actlabs laboratories Canada. Dr O.O. Oshin was exceptionally supportive.

REFERENCES

Beus. A.A., 1966. Distribution of Tantalum and Niobium in Muscovites from Granitic Pegmatites.Geokhimiya. 10. 1216-1220.

Black. R., 1980. Precambrian of West Africa. Episode 4. 3-8.

Cerny, P., Staneк, J., Novak, N., Baadsgaard, H., Rieder, M., Ottolini, L and Chapman, R., 1995. Geochemical and Structural Evolution of Micas in the Rozna and Dubravoda Pegmatites, Czech Republic. Mineralogy and Petrology, 52. 4-9.

Ekwueme. B.N., 2000. Single Zircon Evaporation Ages from Obudu Plateau. First Evidence of Archean Components in the Schists of Southeastern Nigeria. Precambrian Res., 34. 269-289.

Ekwueme, B.N., 2004. Pan Africa Schist of Southeastern Nigeria and their Relationship with Schists of NW Cameroon. Book of Abstracts.40th Conference of the Nigerian Mining and the Geosciences Society Maiduguri, Nigeria, 24.

Elueze, A.A., 1980. Geochemical Studies of Proterozoic Amphibolites and Ultramafic Schist in Nigerias Schist Belts in Relation to Precambrian Crustal Evolution. University of Ibadan Ph.D Thesis (unpublished). 28-30.

Elueze, A.A., 2000. Compositional Appraisal and Petrotectonic Significance of Imelu Banded Ferruginous Rock in the Ilesha Schist Belt Southwestern Nigeria. *Jour. Min. Geol.*, 36 (1). 9-18.

Garba, I., 2003. Geochemical Discrimination of Newly Discovered Rare Metal Bearing and Barren Pegmatites in the Pan-African (600±50 Ma) basement of Northern Nigeria. Applied Earth Science Transaction Institute of Mining and Metallurgy 13. 112. 287-292.

Gaupp. R. and Morteani, G., 1984. Tantalum Pegmatite:Geologische. Petrologische und Geochemische unterschugen. Monograph series min dep 23. Borntraeger Berlin Stuttgart.

Gordiyenko, V.V., 1971. Concentration of Li, Rb, and Cs in Potash Feldspar and Muscovite as Criteria for Assessing the Rare Metal Mineralization in Granite Pegmatites. *Internat. Geology Rev.*, 13. 134-142.

Jacobson, R.R.E. and Webb, J.S., 1946. The Pegmatites of Central Nigeria. *Geol. Surv. Nig. Bull.*, 17. 40-61.

Kuster, D., 1990. Rare Metal Pegmatite of Wamba, Central Nigeria, their Formation in Relationship to Late Pan-African Granite. *J. Mineral. Deposita*, 25. 25-33.

Matheis, G., 1981. Trace Element Pattern in Lateritic Soils Applied to Geochemical Exploration. *Geochm. Exploration* 15. 471-480.

Matheis, G., Emofurieta, W.O. and Ohweriei, S.F., 1982. Trace-element Distribution in Tin-bearing Pegmatites of Southwestern Nigeria. In *Metallization Associated with Acid Magmatism*, Evans, M. (Ed.). Wiley London. 205-220.

Matheis, G. and Vachete, C.M., 1983. Rb-Sr Isotopic Study of Rare-Metal Bearing and Barren Pegmatites in the Pan African Reactivation Zone of Nigeria. Journal of African Earth Sciences. 1. 35-40.

Matheis, G. and Emofurieta, W.O., 1990. The Older Tin province Rare-Metal Pegmatite in Nigeria. Technical University of Berlin (West). Special Research Project. Arid Areas and University of Ife, Nigeria. 10.

Moller, P. and Morteani, G., 1987. Geochemical Exploration Guide for Tantalum Pegmatites. Economic Geology 12. 1885-1897.

Okunlola, O.A., 1998. Specialty Metal Potentials of Nigeria. Proceedings of 1st Mining in Nigeria Conference, Fed. Ministry of Solid Minerals, Abuja, Nigeria. 67-72.

Okunlola, O.A. and Ocan, O.O., 2002. The Expected Environmental Impact and Mitigation Studies of Organized Mining of Rare-Metal (Ta-Sn-Nb) Pegmatites around Keffi Area, Northcentral Nigeria. *J.Env.Ext.*, 3, 64-68.

Okunlola, O.A., 2005. Metallogeny of Tantalum-Niobium Mineralization of Precambrian Pegmatites of Nigeria. Book of Abstracts, Nigeria Mining and Geosciences Society, International Conference, Maiduguri, 24.

Stanrov, O.D., Stolyarov, I.S. and Isochewa, E.I.,1969. Geochemistry and Origin of Verkh Iset Granitoid massif in Central Ural. *Geochem.Intern.*, 6. 1138-1146.

Wright, J.B.,1970. Control of Mineralization in the Older and Younger Tin fields of Nigeria, Economic Geology. 65. 945-951.