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A Review of the Petrography and Geochemical Characteristics of the Pan African Granites in the Nigerian Precambrian Basement Complex

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Abstract: *A compilation and review of the grantoids within the Nigerian Precambriam Basement complex is presented. The granitoids or granitic rocks in the Nigerian Precambrian basement complex have been studied by several researchers for about sixty decades now. The studies had included their field relationship, petrography, and major element chemistry only. In recent times, detailed geochemical data, including major-, trace-and rare-earth elements have been obtained and used in assessing the petrogenetic and tectonic evolution of the granitoids. The rocks consist of porphyritic/porphyroblastic muscovite granites, biotite granites, hornblende-biotite granites/granodiorites, non porphyritic/non-porphyroblastic granites, aplites, granodiorites, diorites, quartz diorites, syenites/syenogranites, quartz-charnockite/charnockites. They are predominantly alkali-calcic to calc-alkalic and strongly peraluminous and were most likely derived from partial melting of crustal materials in an orogenic (post-collisional) tectonic setting. The granitoids are products of anatectic melting of the highest grade of amphibolite facies regional metamorphism of the surrounding peraluminous schists and gneisses. Some are, however, products of partial melting of hornblende-rich (igneous) crustal sources due to their metaluminous character. Radiometric age data reveal that they were emplaced at about 638 to 539 ± 8 Ma (Neoproterozoic-Pan-African).*

Keywords: *Precambrian; Granitoids; Peraluminous; Pan African; Partial melting; post-collisional*

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1.0 Introduction

The Precambrian Basement Complex of Nigeria is a part of the Pan-African mobile belt which lies between the West African and the Congo-Gabon craton and is related to Hoggar, Cameroon and Borborema Pan-African provinces (Fig 1a). An important feature in the Precambrian geology of most of these provinces is the occurrence of widespread granitoids distributed within the Basement, contemporaneous with the high-grade regional metamorphism that affected the terrain. In Nigeria and its environment, the granitoids belong to the Older Granite suites, which are related to the Pan-African Orogeny. the older(Pan African) Granites suites in Nigeria were so named by Falconer (1911) to distinguish them from the Mesozoic tin bearing Younger Granite Suites, which are volcanic/granitic ring complexes in the Jos Plateau area.The Pan-African granites includes a wide range of rocks with different-composition which intrude both the Migmatite-Gneiss Complex and the Schist belts (Fig 1b).

The pronounced and widespread distribution in basically N-S trend is as a result of the extreme regional metamorphism which accompanied and preceded the Pan-African Granitic intrusions . They have been dated severally at 500-750Ma (Van Breemen et al 1977; Rahaman et al 1983; Kroner,1998). These granitoids are distributed mainly in five (5) regions in Nigeria: viz: North-central Basement, North-eastern Basement (Hawal massif), South-western Basement, South-eastern Basement (Bamenda massif) and South-southern Basement (Oban massif) complex (Fig 1b). The aim of this review is to collate data on the Pan African granites studied in these five regions in terms of rock types, petrography and geochemistry, thereby confirming their compositional characteristics, petrogenesis and geotectonic setting.

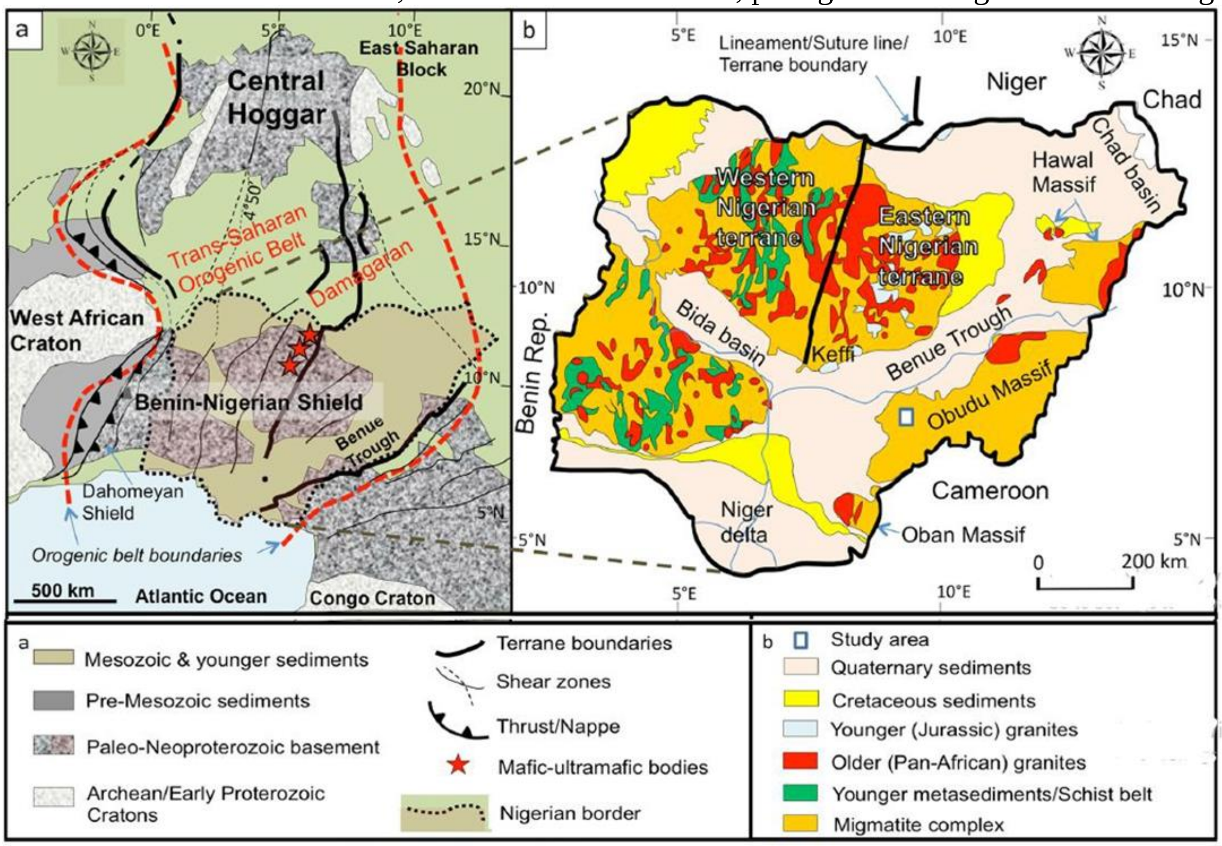

Fig. 1 (a) the geologic map of Nigeria in relation to the Trans-Saharan Orogenic Belt (Ugwuonah et al, 2019) (b) the geological map of Nigeria (Ugwuonah et al, 2019).

2.0 Characteristics of The Pan African granites

A good number of studies have been carried out on the granitoids distributed in the different zones within the Nigerian Basement complex and the results so far is presented with emphasis on the rock types, petrography and geochemical characteristics.

2.1 Northcentral basement complex

The Pan-African granites of this Complex occur as boulders, inselbergs (isolated hills) and ridges within tense cross-cutting joints and digested xenolith of schists (Fig 2). They are mesocratic-leucocratic, medium-coarse grained and porphyritic. The mineral composition includes; quartz, plagioclase, microcline, biotite, hornblende, few muscovite and hypersthene (fig 4). The accessory minerals include chlorite, sericite, zircon, apatite and epidote. Retrograde reaction biotite minerals transformed to chlorites while alteration of plagioclase formed the epidotes and sericites (Nwanosikeetal.,2019). The North-Central Pan-

African Granites are well exposed around Patta, Keffi, Guguruji and Kagara, etc. In the Northwest of Akwanga, the rocks are two-mica (muscovite-biotite) granites. They are Al-rich to slightly Al-excess and characterized by negative Eu anomaly, high Th contents, an abundance of partially digested xenoliths of older schists and gneisses (Obiora, 2012). They also have REE abundances and REE trends similar to those of rocks known to have been derived through partial melting of crustal rocks (Onyeagocha, 1986). Near the southernmost basement-sediment contact in north-central Nigeria around Nasarawa Eggon, the granitic rocks, hypersthene-bearing biotite granites, are magnesian, calc-alkalic and strongly peraluminous (Obiora and Ukaegbu, 2009). The rocks are primarily peraluminous due to their low alkali-lime and high alumina concentration. The peraluminous nature of the rocks infers derivation from partial melting of a sedimentary protolith during the high-grade metamorphism that affected the area.

Fig 2: Field exposures of granitoids in the Northcentral Basement complex

From the spider diagram (Fig 3a), the depletion of trace elements such as Nb, Ti, Sr and enrichment in Rb, K and Th are congenial with typical crustal melts and suggests evolution from partial melting of crustal materials (Obiora and Ukaegbu, 2009). The granites have medium to high calc-alkaline affinity due to their potassic composition (Table 1). The granites plot within the post-collisional field on the Rb vs (Y+Nb) discrimination diagram of Pearce *et al.*, (1984) in Nwanosike et al, (2019) (Fig 3b)(Obiora and Ukaegbu (2009).

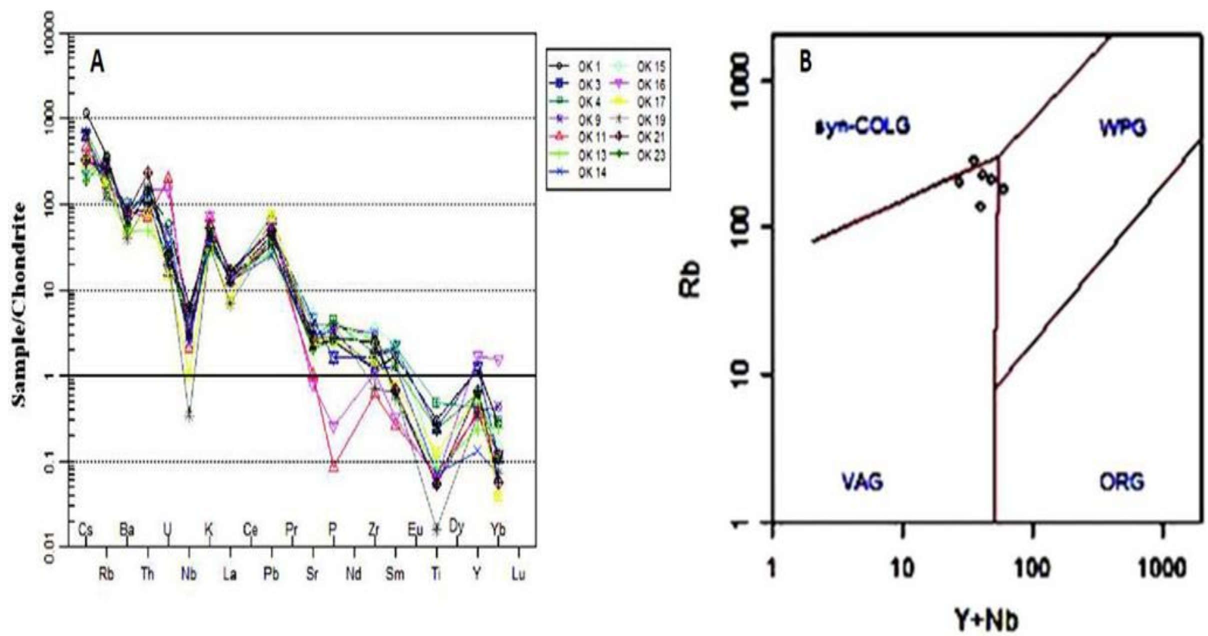

Fig 3: (A) Spider gram of trace elements (B) Rb vs Y+Nb discrimination diagram of areas in the North central Basement Complex plotting within the post collisional field (Nwanosike *et al,* 2019).

2.2 North-Eastern basement Complex (Hawal Massif)

In Northeastern Nigeria (Northern Plateau), the rocks include biotite ± muscovite ± garnet granites, porphyritic biotite ± amphibole-monzo- and syeno-granites, porphyritic amphibole-biotite-clinopyroxene ± orthopyroxene ± fayalite quartz-monzonites and equigranular amphibole-biotite-clinopyroxene + ortho-pyroxene, quartz monzo-diorites (Obiora, 2012). They are medium-to coarse-grained with slight variation in texture and mineralogy. Their foliations are weak and make gradational contact with the Migmatite-Gneiss Complex. Veins of fine-grained granite (aplite) (Fig 5) cross-cut the porphyritic granites in some places within this Complex. Essential mineral constituents include; quartz, microcline, plagioclase, biotite, muscovite, hornblende and occasional politic minerals (Bala, 2015) (Fig 7). They showed the enrichment of incompatible trace elements (Rb, Ba and Th) concerning the LREE, strong Nb and Ti anomalies for the most fractionated rocks, high fractionation factor, (La/Yb) and moderate negative EU-anomalies (Ferre *et al.*,1998) (Fig 6a). Their variation diagrams are generally similar suggesting that they are co-genetic irrespective of their partial distribution. The granites are shoshonitic and strongly metaluminous due to high and low concentrations of alumina and alkali respectively. Trace element spider plot shows depletion of Sr as well as enrichment of Rb and K suggesting partial melting of crustal source (Bala, 2015)**.** Mandara hills and North Adamawa granites show a decrease in Sr and Baand enrichment in Rb, K and Th, indicating that they are derived from partial melting of meta-igneous protolith (Haruna, 2014). The granites plot within the post-collisional field on the tectonic discrimination diagram of Pearce et al. (1984) (Fig 6b). In Northwestern Nigeria, the granitoid includes syenite sand biotite granites, which have been described as calc-alkaline, I-type granites (Olarewaju and Rahaman, 1982; Egbuniwe *et al.*, 1985; Fitches *et al.*, 1985). The syenites have mildly alkaline affinities (Egbuniwe *et al.*,1985).

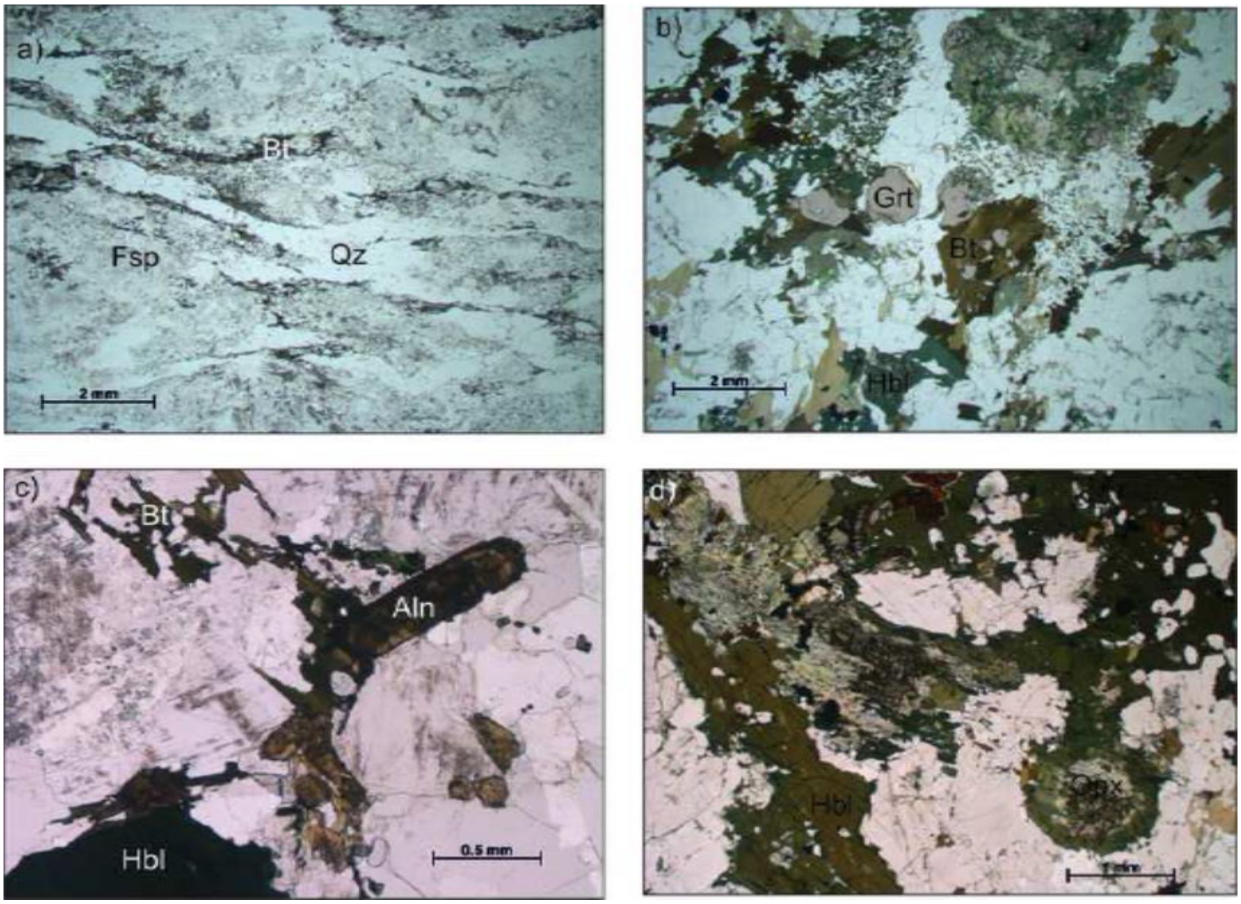

Fig 4: Photomicrographs of Granitoids of North-Central Basement Complex (Goodenough *et al;* 2014)

Table 1: Major Element composition (wt.%) of areas in the North-Central Basement {Ekeleme et al, (2017); Nwanosike et al, (2019); Olaolorun & Akintola (2003); Obiora & Ukaegbu (2009)}

Oxides	Guguruji Granites	Tegara Granites	Bashini Granites	Keffi Granites	Akwanga Granites	Southern N.Central Granites	Average
SiO_2	68.46	72.11	70.22	74.55	70.19	75.66	71.87
Al_2O_3	15.29	16.41	13.22	16.10	14.55	15.54	15.01
Fe_2O_3	3.60	4.84	3.04	3.55	3.29	4.84	3.86
MgO	0.99	0.93	1.06	3.33	2.07	4.54	2.15
CaO	1.65	2.01	1.48	1.94	2.56	1.56	1.86
Na_2O	3.96	4.26	3.58	2.67	3.34	1.76	3.26
K_2O	4.56	4.23	4.52	5.55	4.78	5.03	4.77
MnO	0.07	0.04	0.035	0.033	0.06	0.08	0.053
TiO_2	0.54	0.84	0.39	0.45	0.67	0.99	0.64
P_2O_5	0.22	0.34	0.11	0.64	0.34	0.54	0.37

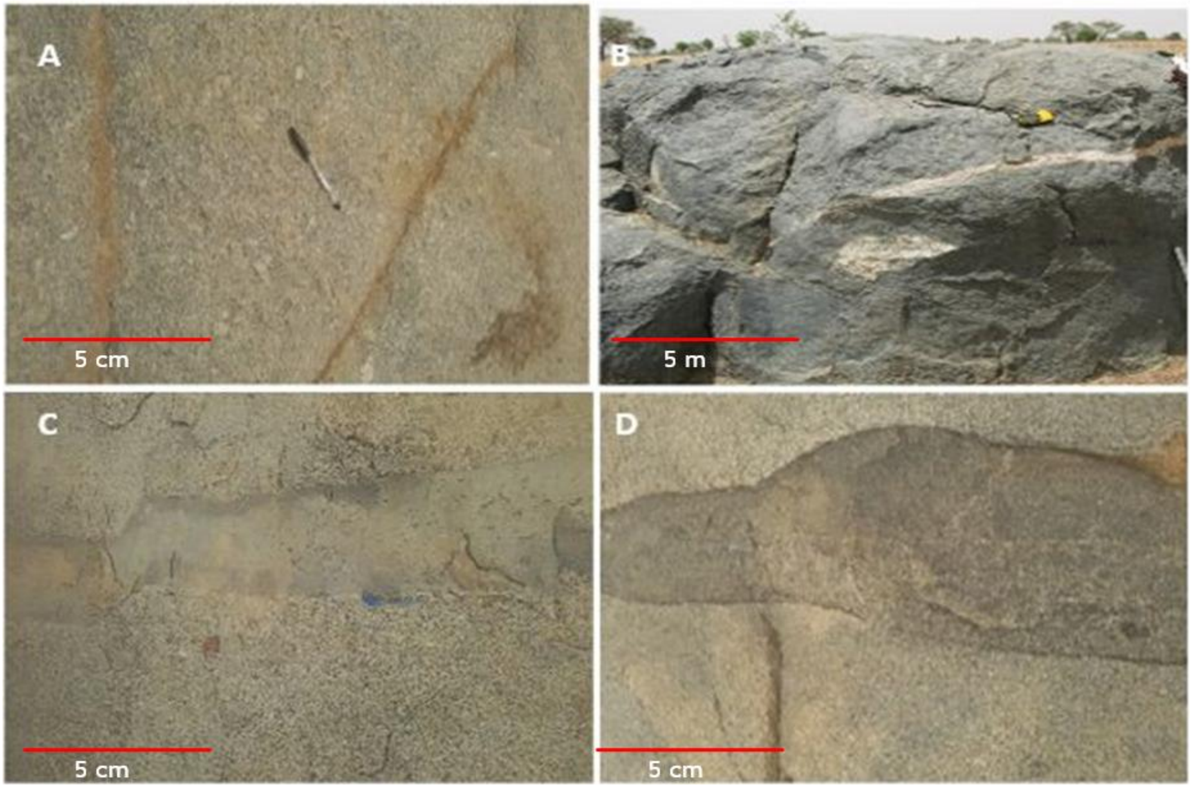

Fig 5: Photographs of Northeastern (A) Porphyritic granite (B) Massive charnockite boulder (C)Aplitic vein in biotite granite (D) Xenolith of Diorite in Granite.

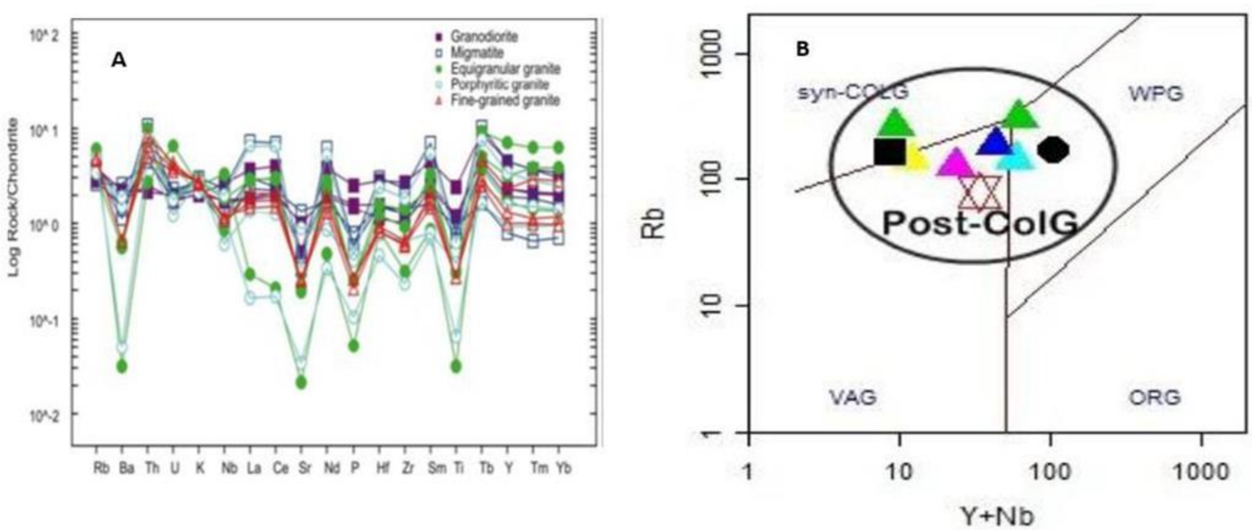

Fig 6: A. Spider gram of North-Eastern Pan-African Granites (Haruna, 2014) B. Mandara and North Adamawa granites plot within the Post-collision field (Bala, 2015).

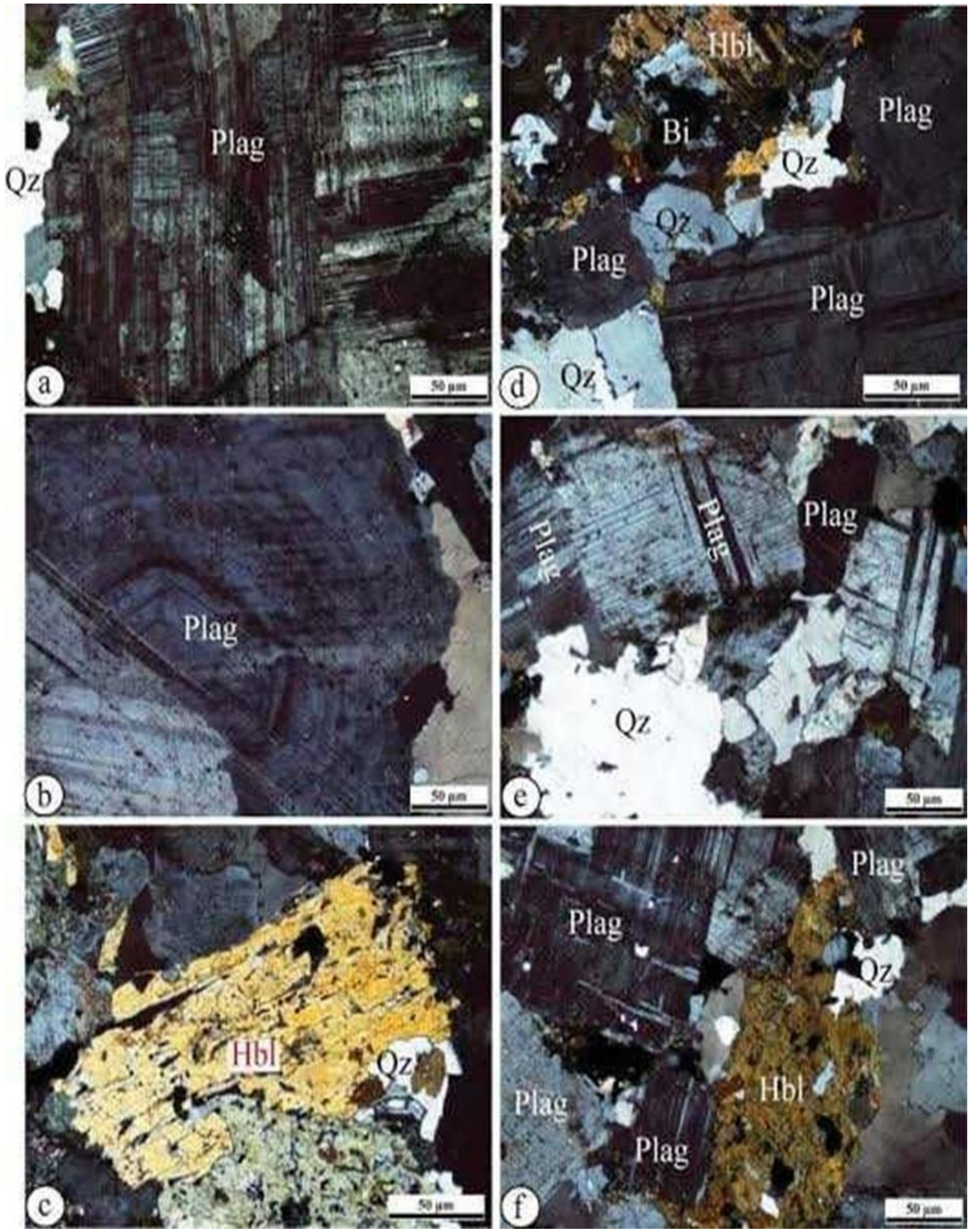

Fig 7: Photomicrographs of porphyritic granites from Northeastern Basement complex (Bala, 2015)

Table 2: Major Element composition (wt.%) of areas in the North-Eastern Basement (Bala, 2010; Haruna, 2014; Uche & Ideozu, 2015).

Oxides	Wadili	Mandara	Kirawa	North Adamawa	Average
SiO_2	67.18	72.85	69.86	73.87	70.94
Al_2O_3	14.65	12.76	13.56	16.14	14.28
Fe_2O_3	1.88	2.86	3.18	3.46	2.85
MgO	2.27	0.66	0.44	1.23	1.15
CaO	0.82	1.78	2.43	1.43	1.62
Na_2O	2.00	2.56	3.65	4.00	3.05
K_2O	3.88	7.88	5.34	3.78	5.22
MnO	0.10	0.04	0.07	0.03	0.06
TiO_2	0.70	1.44	0.46	0.18	0.69
P_2O_5	0.56	0.24	0.01	0.05	0.22

2.3 Southwestern basement complex

The granitoids around Jebba, southwestern Nigeria which includes gneissic granites, tonalite, diorite, granodiorite, syenite and charnockites (Fig 8) have been shown to contain a substantial amount of alkalis and are peraluminous with corundum appearing in the norm (Odeyemi, 1977; Olarewaju and Rahaman, 1982; Okonkwo and Ganev, 2012). Mineral constituents include; quartz, microcline, plagioclase, biotite, muscovite, hornblende and occasional political minerals (Akinola *et al*; 2021) (Fig 10). They are different from granitic rocks in Igbeti (SW Nigeria) which are metaluminous (Rahman et al.1988). The metaluminous character suggests evolution from partially melted igneous protolith and some assimilation of metasedimentary materials in the melt (Akindele and Romanus 2006). The ferric nature of the granites is closely related to conditions of limited availability of H2O and low oxygen fugacity during partial melting of their progenitors as well as the crystallization of anhydrous silicates (Okonkwo and Folorunso, 2013). On the Rb versus (Y+Nb) diagram, the rocks plot largely in the late to post-collisional tectonic setting (Fig 9a). The presence of monazite in the mineralogy of the granites infer incorporation of crustal or sedimentary materials into the magma formed within convergent tectonic settings (Akindele and Romanus, 2006).

2.4 Southeastern basement complex

The granitoid in the southeast of Obudu plateau (southeastern Nigeria) are predominantly muscovite-biotite granites and biotite granites occurring in boulders (Fig 11a, b, c and d). They are high-K calc-alkaline and peraluminous, S-type granites (Beka and Ukaegbu, 2008). There is incomplete assimilation of granite in some of the gneissic exposures in the area (Fig 11d). In Ogoja areas, also in southeastern Nigeria, the granitic rocks include biotite granites, hornblende-biotite, garnetiferous granites and granodiorite (Fig 13). They are sub alkaline, highly potassic and metaluminous (Obiora, 2006). In the southeast of Ogoja, the granitic rocks which include garnetiferous biotite granite, porphyritic aplitic granite, porphyritic biotite hornblende granite, porphyritic biotite muscovite granite weakly foliated leucogranodiorite are sub alkaline (calc-alkaline), shoshonitic and peraluminous (Ibe and Obiora, 2019). Partial melting of pelitic or semi-pelitic gneisses is inferred as the progenitor of the rocks owing to its strong peraluminous characteristic. Possible evolution from the hydrous melt of pelitic or semi-pelitic rocks was recorded by Frost *et al* (2001) and Obiora and Ukaegbu (2008). In

Ityowanye-Katsina-Ala area (south eastern Basement), the granitoids, which include porphyritic and non-porphyritic amphibole- biotite granites are shoshonitic, alkali calcic to alkali and metaluminous (Obiora, 2012).The strong peraluminous nature of the rocks in the south-east of Ogoja suggest evolution from partial melting of sedimentary material (Ibe &Obiora, 2019). The trend with Nb, Zr, La, Ba and Sr generally decreasing and Rb and K increasing with increasing SiO2, is a typical calc-alkaline trend (Fig 12c). The Rb vs (Y+Nb) tectonic plot shows that the granites were emplaced in a post-collisional setting (Fig 12 a and b).

Fig 8: Photographs of exposures of Granitoids at Igarra in Edo State Southwestern Basement complex

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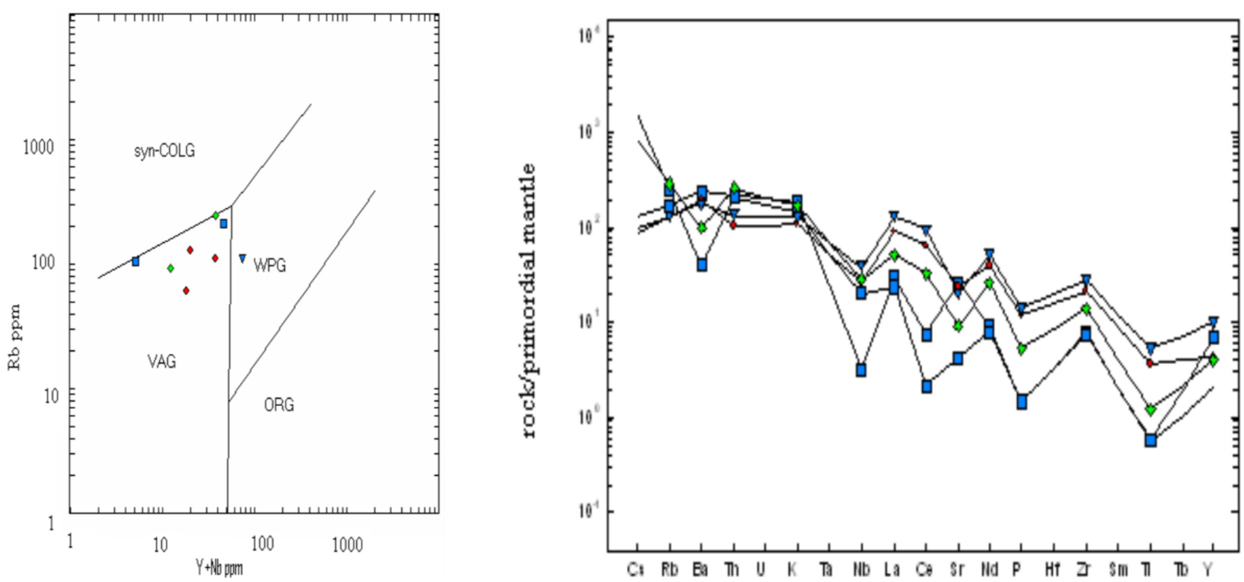

Fig 9: (A) Rb vs Y+Nb discrimination (B) Spider gram of trace elements diagram of areas in the South-western Basement Complex plotting within the post collisional field (Okonkwo and Folorunso, 2013, Obasi & Talabi,2019).

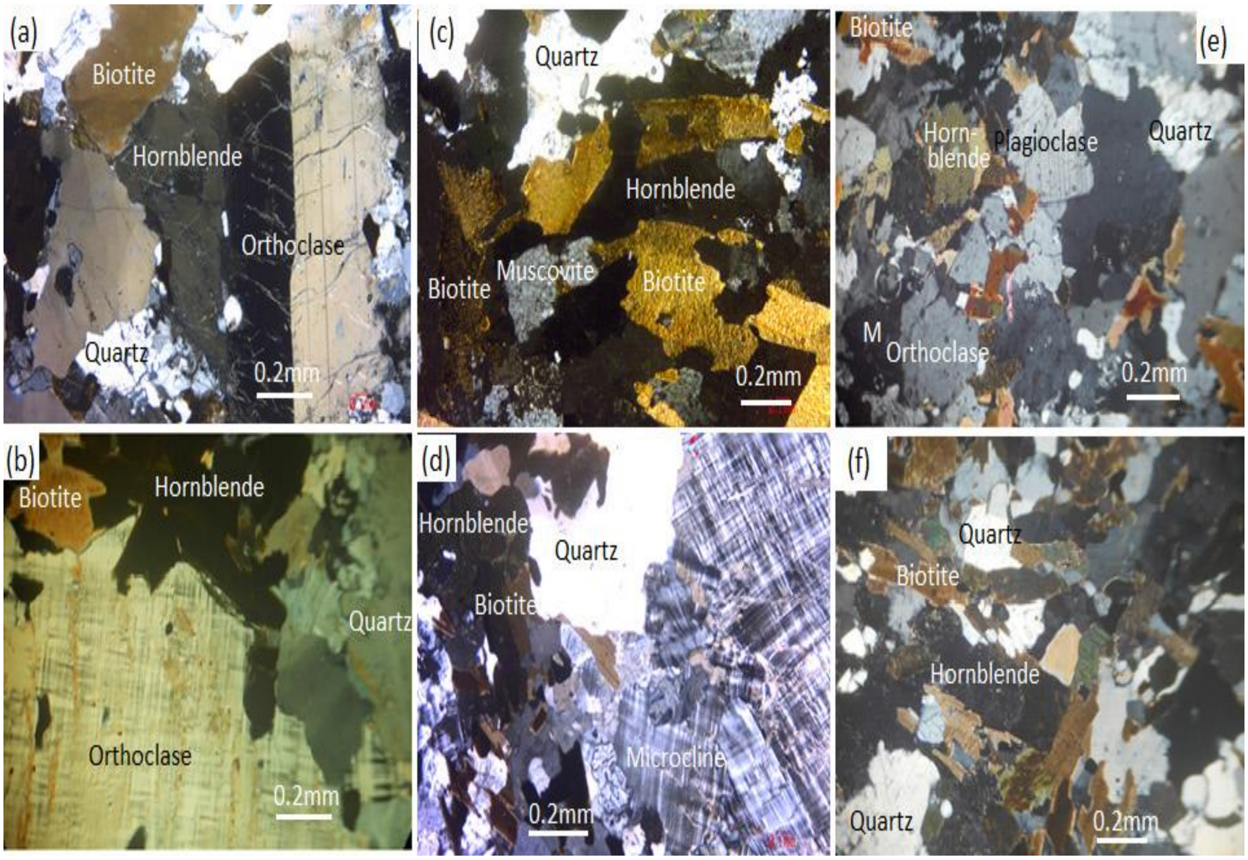

Fig 10: Photomicrographs of Granitoids in Idanre Batholith South-Western Basement Complex (Akinola *et al.*, 2021)

Table 3: Major Element composition (wt.%) of areas in the Southwestern Basement (Akindele & Obasi, 2006; Okonkwo & Folorunso, 2013; Olusiji, 2013)

Oxides	Aderan	Igbeti	Iwokoro	Oka-akoko	Average
SiO_2	76.52	59.20	64.33	74.18	68.56
Al_2O_3	13.69	14.87	12.08	13.15	13.45
Fe_2O_3	3.93	3.87	10.75	4.55	5.78
MgO	0.03	0.06	0.47	3.90	1.12
CaO	2.72	1.51	5.40	3.18	3.20
Na_2O	2.66	3.70	2.81	4.57	3.44
K_2O	5.14	6.04	4.96	2.80	4.74
MnO	0.15	0.10	0.22	0.79	0.32
TiO_2	0.09	0.13	0.26	0.22	0.18
P_2O_5	0.02	0.01	0.55	1.01	0.39

Fig 11: Photographs of Southeastern (A) Porphyritic granite (B) Coarse porphyritic granite overlying migmatite (C) boulders of medium grained granite (D) Incomplete assimilation of granite

2.4 South-Southern basement complex (Oban Massif)

In the Oban Massif the rocks are mainly granodioritic in composition (porphyroblastic hornblende-biotite granodiorites) with local variations of dioritic or tonalitic to granitic compositions (Obiora, 2012). They are sub alkaline (calc-alkaline), peraluminous and highly rich in potassium (Rahman *et al*., 1988). Their high content of bases, with potash greater than soda may be as a result of alkali-metasomatism during emplacement. Emplacement through granitization is possible and might have taken place during the Pan-African thermotectonic event (Obiora,2006). The granitic rocks show strong positive anomalies in Th, K, La, Tb and negative anomalies in Ba, U, Nb, Ta and Zr (Fig 15A). The metaluminous and peraluminous character of granitic rocks suggest evolution from partial melting of both igneous and sedimentary protoliths and were emplaced during the Pan-African orogenic event. Compressional tectonism is evident from the geochemical variation diagrams and the granites were most likely to be emplaced towards the end of the reactivation event, resulting from the collision of the West African Craton with the Tuareg shield (Obiora, 2012).

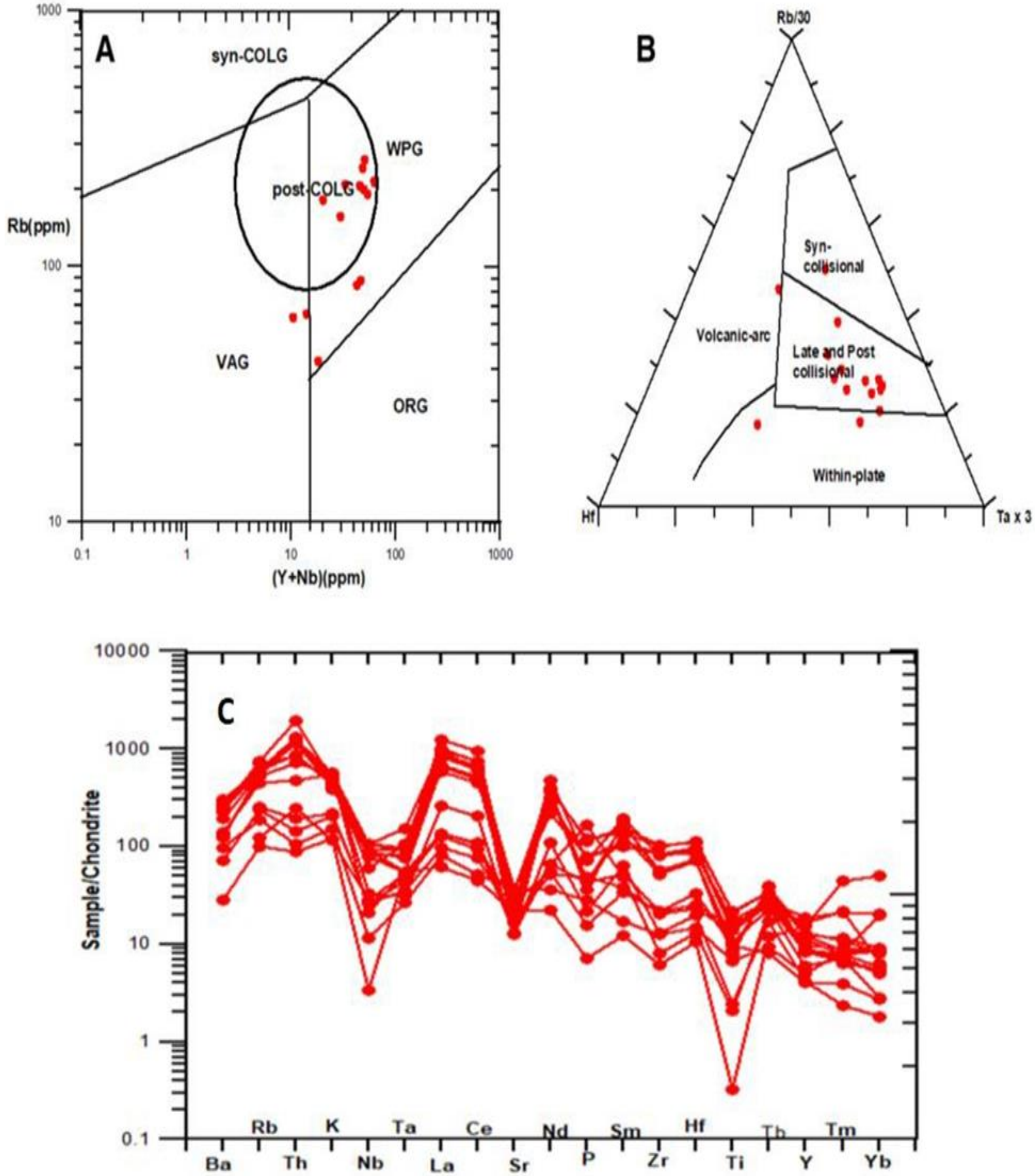

Fig 12: A. Rb vs (Y+Nb) tectonic discrimination diagram B. Rb/30-Hf-3Ta ternary tectonic discrimination diagram C. Spider gram of southeastern Pan-African Granites (Ibe and Obiora, 2019).

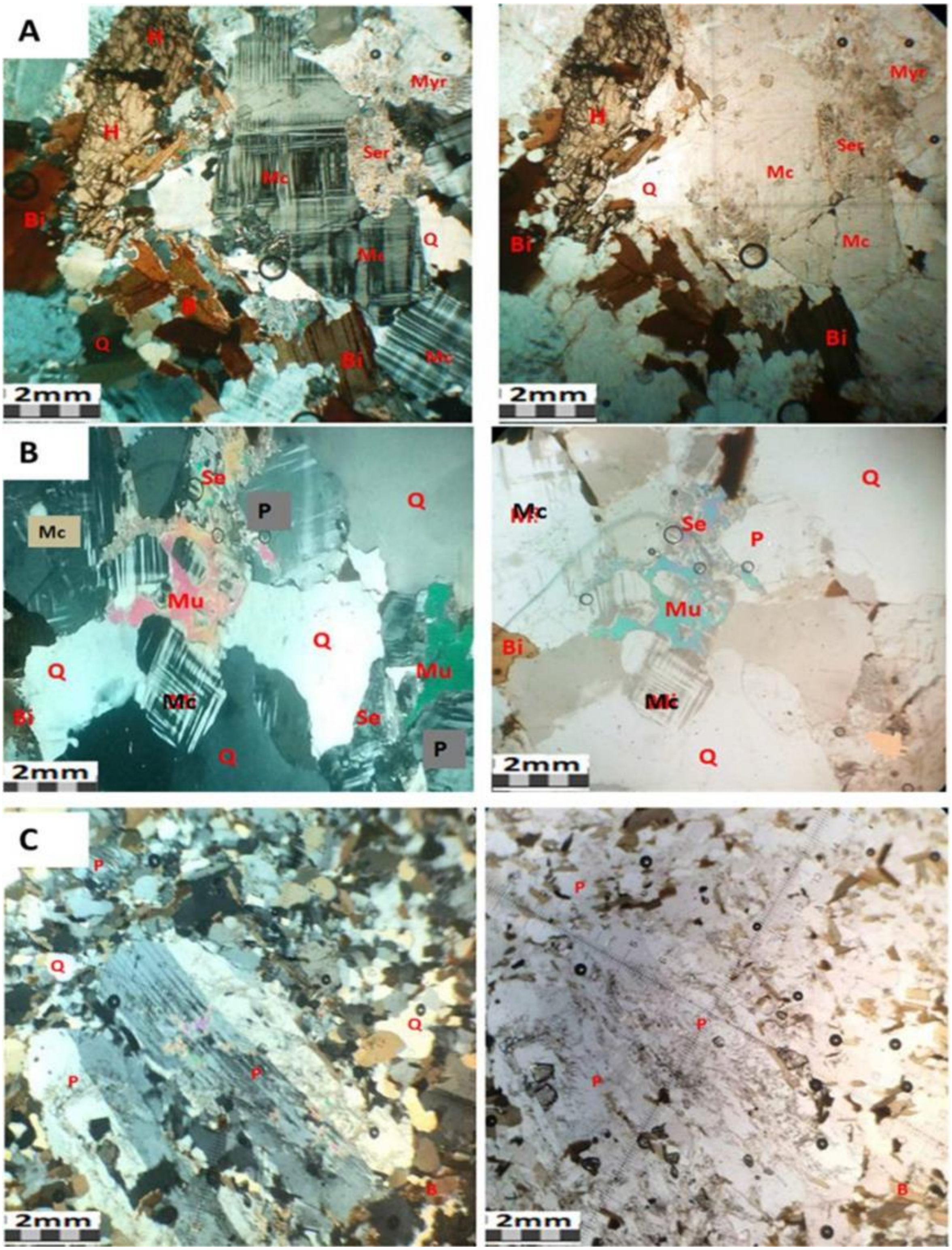

Fig 13: Photomicrographs of A. Porphyritic Hornblende biotite granite B. Two-mica granite and C. Porphyritic aplitic granite from southeastern Basement complex (Ibe & Obiora, 2019). ***Mc=Microcline, P=Plagioclase, Q=Quartz, Mu=Muscovite, Se=Sericite, Bi=Biotite, H=Hornblende***

Table 4: Major Element composition (wt.%) of areas in the Southeastern Basement Complex (Ibe & Obiora, 2019)

Oxides	Kakwagom	Katchuan – irruan	Bawop	Ekuntak	Araghan	Average.
SiO_2	64.55	70.43	70.84	66.09	63.19	67.02
Al_2O_3	15.1	13.7	13.9	16.1	13.6	14.48
Fe_2O_3	5.71	3.83	3.28	4.68	2.82	4.06
MgO	1.25	0.42	1.76	1.35	0.08	0.97
CaO	2.82	3.09	0.82	2.18	3.07	2.39
Na_2O	3.16	3.09	2.85	3.88	1.90	2.98
K_2O	5.53	6.04	4.99	5.16	2.64	4.87
MnO	0.07	0.05	0.06	0.13	0.03	0.07
TiO_2	1.36	0.15	0.42	0.85	0.02	0.56
P_2O_5	0.55	0.52	0.76	0.19	0.03	0.41

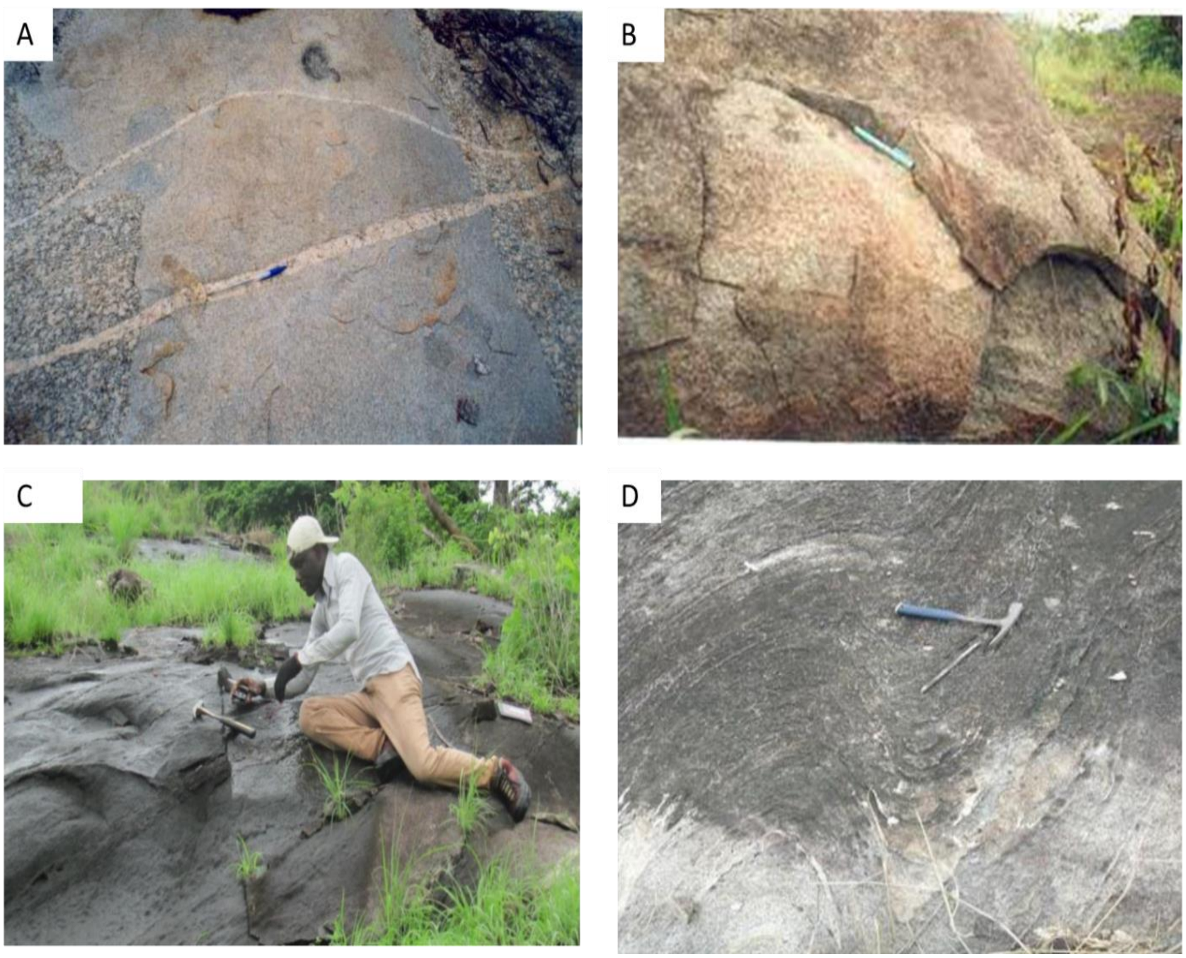

Fig 14: Outcrop exposure of Granitoids at South-South Basement Complex (Bassey, 2012 and Ominigbo *et al;*2021)

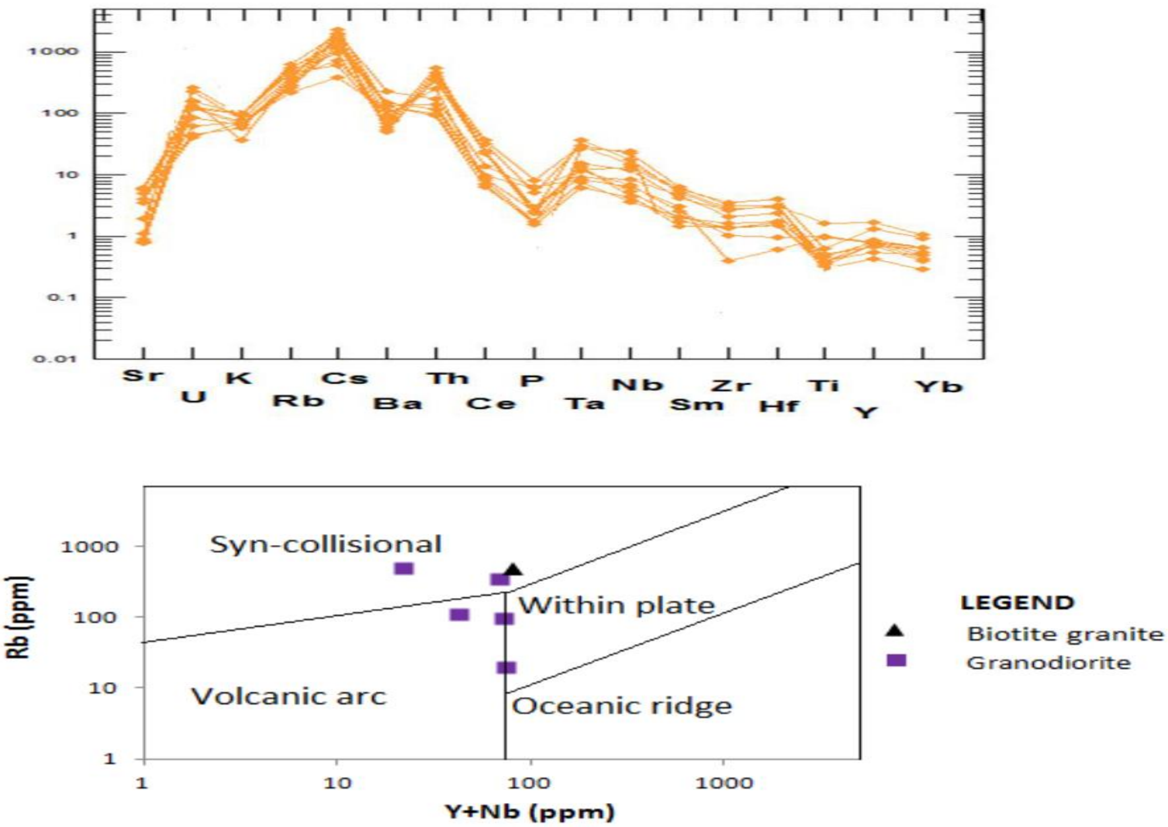

Fig 15: (A) Spider gram of trace elements (B) Rb vs Y+Nb discrimination diagram of areas in the South-Southern Basement Complex plotting within the post collisional field (Ominigbo *et al;*2020)

3.0 Age Data on some Granitoids in the Nigerian Precambrian Basement Complex

Radiometric age data on various granites and granitic rocks in the Nigerian Precambrian Basement Complex modified from Obiora (2012) are presented in Table 6. The ages, which include both emplacement and cooling ages based on the different dating techniques adopted range from 638 (U-Pb age) to 539± 8Ma (Rb-Sr age) (Neoproterozoic) (Pan-African).

4.0 Tectono-magmatic Origin of the Granitoids based on Geochemical Data

The predominantly alkali-calcic to calc-alkalic and strongly peraluminous characteristics of the granitoids suggest a close affinity to relatively hydrous, oxidizing melts in source regions, which are common in subduction-related settings (Obiora and Ukaegbu, 2009).The subduction that gave rise to these rocks could be linked to the orogenesis at the active continental margin of the Tuareg-Shield (Fig.1) and may have culminated in a collision between this active margin and the passive continental margin of the West African craton, at about 600 Ma. From trace and rare-earth elements data that has been made available, the granitoids generally show depletion in Ti, Nb, Ta, Sr and enrichment in the LILE (Rb, K and Th) suggesting a crustal source. According to Harris *et al* (1986) and Chappell and White (1992), high Rb, K, Th and low P, Sr and Ti values are compatible with typical crustal melt sand suggest evolution from partial melting of crustal materials

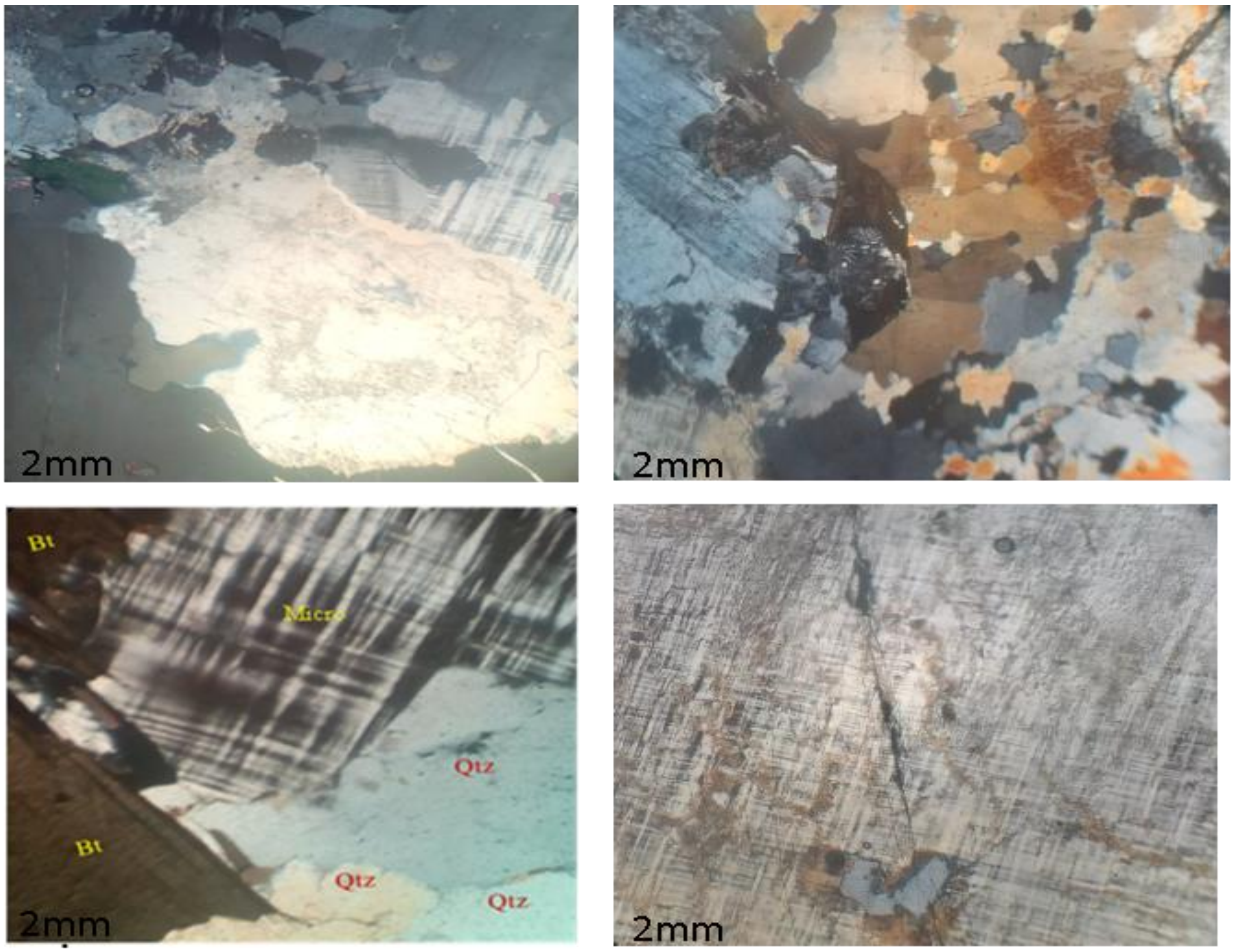

Fig 16: Photomicrographs of Granitoids of South-Southern Basement Complex

Table 5: Major Element composition (wt.%) of areas in the South-Southern Basement Complex (Obiora, 2006 & 2012; Opara, K.D. et al., 2014)

Oxides	Okom-ita	Ogoja	Itowanye	Kastina-ala	Average
SiO_2	68.97	66.28	70.33	65.76	67.84
Al_2O_3	12.41	14.09	13.79	12.09	13.09
Fe_2O_3	5.34	3.86	4.21	6.08	4.87
MgO	0.32	0.29	0.17	0.21	0.25
CaO	1.92	2.00	1.24	2.24	1.85
Na_2O	2.85	2.27	2.50	3.05	2.67
K_2O	6.64	7.52	5.33	4.85	6.09
MnO	0.06	0.04	0.09	0.05	0.06
TiO_2	0.55	0.32	0.48	0.62	0.49
P_2O_5	0.11	0.21	0.34	0.09	0.19

Table 6: Ages of granitoids in the Nigerian Precambrian Basement Complex (Modified from Obiora, 2012).

Method /Radiometric age	Granitic rock	Epoch/Event	Reference
U-Pb zircon evaporation age. 598 ± 11 Ma	Hornblende-biotite granite from Soli Hillsand Rahama	Neoproterozoic (PanAfrican)/Intrusion	Ferre et al. (1998)
Ar-Ar amphibole ages. 564 ± 5 Ma	Hornblende-biotite granite from Soli Hillsand Rahama	Neoproterozoic (PanAfrican)/Intrusion	Ferre et al. (1998)
Rb-Sr whole rock Isochron. 547 ± 33 Ma	Granite from Mkar,Gboko	Neoproterozoic (PanAfrican)/Intrusion	Umeji and Cean-Vachette (1984)
Rb-Sr biotite age. 539 ±8 Ma	Biotite granite fromNasarawa Eggon	Neoproterozoic (PanAfrican)/Intrusion	Umeji and Cean-Vachette (1984)
Rb-Sr whole rock isochron. 535 ± 8 Ma	Granite from Nasarawa Eggon	Early Paleozoic/Intrusion	Umeji and Cean-Vachette (1984)
Rb-Sr whole rock/biotite age. 525 ± 8 Ma	Monzonite from Rahama	Early Paleozoic /Intrusion	Rahaman and Van B. (Unpublished)
Rb-Sr Bi-age. 512 ± 10 Ma	Granite from Mkar, Gboko	Early Paleozoic /Intrusion	Umeji and Cean-Vachette(1984)
Rb-Sr whole rock. 511 ± 10 Ma	Hornblende-biotite granite from Jato Aka	Early Paleozoic /Intrusion	Umeji and Cean-Vachette(1984)
Rb-Sr age. 605 ± 15 Ma	Pegmatites from Gubi	Neoproterozoic (Pan African)/Emplacement	Van Breemen *et al.* (1977)
U-Pb zircon age. 609 ± 23 Ma	Foliated pink granite from East of Bauchi	Neoproterozoic (Pan African)/Emplacement	Van Breemen *et al.* (1977)
U-Pb zircon age. 605 ± 10 Ma	Foliated granite from Panyam	Neoproterozoic (Pan African)/Emplacement	Van Breemen *et al.* (1977)
Pb-Pb single zircon evaporation. 607 Ma	Biotite hornblende granite from Toro	Neoproterozoic (PanAfrican)/Intrusion	Dada *et al*. (1989)
Pb-Pb single zircon evaporation. 616.9 ± 1 Ma	Granodiorite in banded gneiss from Oban massif (Uwet)	Neoproterozoic (PanAfrican)/Intrusion	Ekwueme and Kroner (1998)
U-Pb age. 621 Ma	Porphyritic granite from Akure	Neoproterozoic (PanAfrican)/Intrusion	Tubosun *et al*. (1984).
U-Pb Zircon Upper intercept. 623 ± 20 Ma	Metadiorite from Toro	Neoproterozoic (Pan African)/Metamorphism	Lar (1988)
U-Pb age. 630 Ma	Charnockites from Ikare	Neoproterozoic (PanAfrican)/Intrusion	Tubosun *et al.* (1984)
U-Pb age. 634 Ma	Gneissic Charnockites from Akure	Neoproterozoic (Pan African)/Metamorphism	Tubosun *et al*. (1984)
U-Pb age. 638 Ma	Quartz-fayalite monzonite (Bauchite)from Toro	Neoproterozoic (PanAfrican)/Intrusion	Dada *et al*. (1989)

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The moderate to high fractionations with pronounced negative Eu anomalies are shown in the REE pattern for the granitic rocks is a typical behavior of crustally-generated granites (Frost *et al*, 2001). According to Ferre *et al.* (1998) as cited by Obiora (2012), the metaluminous character of some of the granitic rocks preclude an origin from the melting of strongly peraluminous sedimentary protoliths, but favours an origin from a metaluminous protolith such as the mantle orother igneous rocks which would not have undergone alterations, leading to increase in A/CNK ratios. Obiora (2012) suggested that the granitic rocks in his study were derived from hornblende-rich (igneous) crustal sources. The granitoids in the Nigerian Precambrian Basement Complex plot on the Post-collisional (POST-COLG) field on the Rb vs Y+ Nb tectonic discrimination diagram of Pearce *et al* (1984) (Fig. 4), which suggests that they were formed in a compressional setting. Therefore, the post-collisional background is favored as the geodynamic setting for the granitoids in the Nigerian Precambrian Basement Complex. Radiometric age-data reveal that they were emplaced about 638 to 539 ± 8Ma (Neoproterozoic) (Pan-African).

5.0 Conclusion

So far, the studies carried out on the Precambrian Basement Complex of Nigeria have tried to unravel the petrogenesis and tectono-magmatic origin of the granitic rocks using field characteristics, major-, trace-, and rare-earth element geochemistry. The granitoids of the Nigerian PrecambrianBasement Complex include a suite of rocks varying in composition from tonalite and diorite through granodiorite to granite, syenite, charnockite, gabbroic rock, dolerites, granodiorites and quartz diorites, porphyritic hornblende granite, porphyritic biotite granite, pegmatite and aplite dykes. In the light of geochemical evidence, they are predominantly alkali-calcic to calc-alkalic and strongly peraluminous and were most likely derived from partial melting of crustal materials in an orogenic (post-collisional) tectonic setting. It is a popular opinion by workers in the Precambrian Basement Complex in Nigeria that the granitoids are products of anatectic melting of the highest grades of amphibolite facies regional metamorphism of the surrounding schists and gneisses. The rocks later suffered K- metasomatism that led to the widespread occurrence of megacryst/porphyroblasts of K-feldspars in the granitic rocks. All the simply origins through rejuvenation or re-activation and re-mobilization of the Basement Complex rocks (Oyawoye, 1972). The metaluminous character of some of the granitic rocks, however, favors derivation from hornblende-rich (igneous) crustal sources.

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Conflict of Interest

The authors declared no conflict of interest