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FieldGeological description of Pegmatites Occurrence inIdah Sheet 267, Nigeria

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---***ABSTRACT***---

Field Geological description of Pegmatites Occurrence in Idah Sheet 267, Nigeria was carried out. The pegmatites in the Sheet occurs and are distributed around two main locations in the Sheet, that is around Ogodo (Ajaokuta) and Itobe areas respectively. The pegmatites in the Ogodo (Ajaokuta) occur as swarms of discrete dykes and ridges to form large N-S trending bodies whereas, those around the Itobe area occur mainly as dykes and trends in similar manner with the Ogodo (Ajaokuta) pegmatites. The main strike directions of the pegmatite dykes is N-S (80-89). The pegmatites intrudes into the basement granites and schist in both the Ogodo (Ajaokuta) and the Itobe areas respectively. The Mineralogy of pegmatites around the Ogodo (Ajaokuta) area consist of simple to complex mineralogy. The simple pegmatites (barren) comprise of Quartz, Feldspar (largely pinky K feldspar) and Mica (Muscovite) .The complex mineralogy besides Quartz, Feldspar and Mica also contain well developed crystals of Tourmaline and disseminated Tourmaline. Whereas, the pegmatites in the Itobe area is complex and more diverse in terms of assemblages of gemstones than the pegmatites in Ogodo (Ajaokuta) area. The pegmatites around the Itobe area consist of three distinct mineralogical zones viz: (1) Qaurtz, Feldspar (plagioclase), Mica (Muscovite) and Beryl zone, (2) Quartz, Feldspar (plagioclase), Mica (Muscovite), Beryl and Tourmaline zone and (3) Quartz, Feldspar (plagioclase), Mica (Muscovite), Beryl and suspected Lepidolite /tin bearing zone. The style of zonation of mineralogical assemblages across the Ogodo (Ajaokuta) and Itobe pegmatites field from simple to complex type pegmatites may suggest that the pegmatites evolve by fractional crystallizations of the residual melt generally of granitic composition.Field geologic descriptionsprovide a preliminary insight into the evolution, class and mineralization potential of the pegmatites in the study area.

Keywords: Pegmatites, Field geologic description, dykes, mineral assemblages, evolution

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I. INTRODUCTION

Pegmatites are important resources for their economic concentrations of rare elements Sn, Li, Ta, Rb, and Cs, presence of high quality industrial minerals such as muscovite, spodumene, feldspar and mica, and occurrence of gem minerals(e.g. tourmaline, beryl). Akoh *et al.*, 2015.

Pegmatites may occur singly or in swarms forming pegmatite fields (Olobaniyi *et al*., 2019), and these in turn may be strung out in a linear fashion to form pegmatite belts (Trueman and Černý 1982).

The Nigerian pegmatites belt contains hundreds of pegmatites dykes, which have been reported to occur as intrusion into the associated host rocks, mainly metasediments and granitoids belonging to the Pan-Africa granites suites (Akoh *et al*.,2015,; Okunola, 2005, Okunola and Ocan, 2009, Olabaniyi *et al*., 2019).

Field descriptions of lithologies,textures and mineralogy of pegmatites and its associated host rock have been employed as a critical tool in preliminary mineral exploration research (Ako and Onoduku, 2012, Akoh and Ogunleye, 2005, Olobaniyi *et al.*, 2019, Onimisi *et al.*, 2013).

Field description of textural, spatial and mineralogical variations across pegmatites field, indicates zoning in the pegmatites (Akoh *et al*., 2015, Olobaniyi *et al.*, 2019 Cerny 1982, Linnen *et al*., 2012). Thus, field description of lithologic textures and mineralogy within each zones of the pegmatites may, provides valuable insight into the evolutionary history of magma Crystallization Akoh *et al*., 2015, Olobaniyi *et al.*, 2019 Cerny 1982, Linnen *et al*., 2012.

Olabaniyi *et al*., 2019 stated that in determining evolution, class, degree of fractionation, potential and type of mineralization with which a pegmatite suite is associated, the degree of fractionation of the pegmatite is important. This degree of fractionation is usually reflected in the manner in which a pegmatite is zoned in the field.

Ako *et al*., 2015 reported that, The pegmatites in Angwan Doka, north central Nigeria are genetically related to the basement granites formed during the Pan-African orogeny, 550 -530 Ma ago. The pegmatite in Angwan Doka occurs as sharply discordant dykes in the granitic and metasedimentary basement rocks. Akoh *et al*., 2015 also reported that, the pegmatite population comprises of mineralogically simple and complexly zoned types based on field description and geochemical signatures.

Field geologic occurrence and petrographic characteristics of Precambrian marble body in Itobe area, Central Nigeria was carried out by Onimisi *et al*., 2013 at a scale of 1:25000. Their research,reveals the occurrence of two marble outcrops (described as mass I andmass II). Mass I, which occurs as a minor lensoid body, is light gray, fine grained and outcrops at a road cut about150m from Alo Village. Mass II, which outcrops on the Ayanka hill about 800m from mass I along a NE–SW axis, isdark gray and medium grained. The Itobe marble body and the host rocks of mica/quartz schist and quartzite trendin the NNE – SSW direction; parallel to the dominant foliation trend of the associated basement rocks. Their work also shows pegmatite occurrence as intrusion between the granitic rock and schist (Onimisi *et al*., 2013).

Ako and Onoduku in 2012 carried out a research on the geology and economic evaluation of the Ogodo feldspar mineral deposit. The adopted methodology for their work consists of intensive fieldwork, geochemical analysis and reserve estimation of the feldspar mineral deposit. The result of the fieldwork revealed that Ogodo area is part of the basement complex of Nigeria and is underlain mainly by schists and intrusive granitic and pegmatitic rocks along with sediments weathered from these rocks. Ako and Onoduku, 2012, concluded that field and petrographic evidence show that the area has a potential source of gemstones such as tourmaline and tantalite.

The study area (Idah Sheet 267) is bounded by latitudes 07^0 00′ 00″N and 07^0 30′ 00″N, and longitude 06^0 30′ 00″E and 06^0 60′E 00″ (Fig.1) and covers an area of 3025 km^2. The study area is easily accessible from Abuja-Lokoja-Ajaokuta-Itobe (NW), Itobe-Ojodu-Ojuwolijo-Aloji-Ogbabo-Ugwolawo (NE), Ajaka- Idah-Ogbobo-Oforachi (SE) Idah-Aganebode waterways, Iyare-Aganebode road, Lokoja-Auchi-Fuga-Estako East road (SW) and a network of secondary roads that provide good access to the study area.

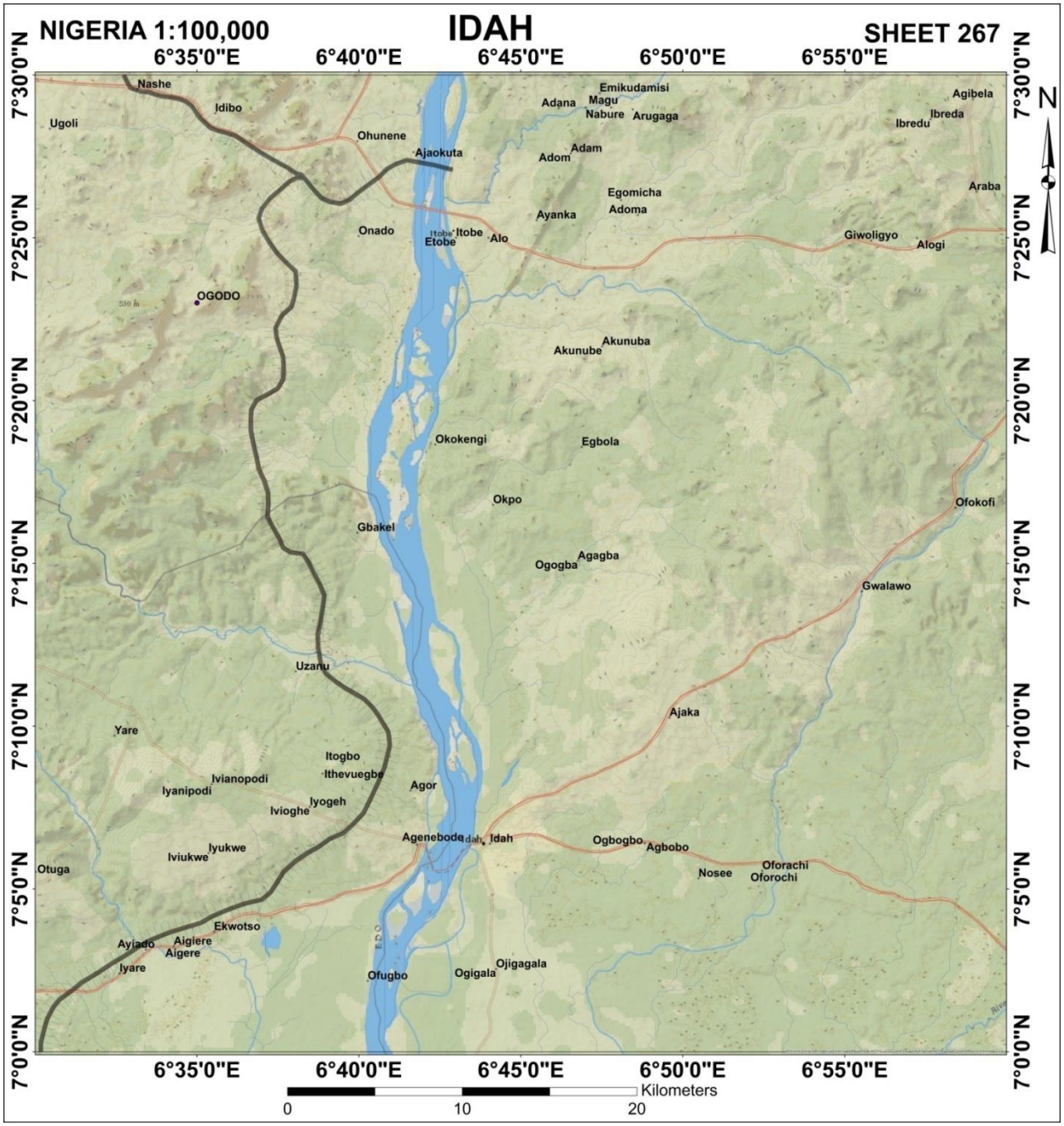

Fig.1 .Map of the study area produced from google earth

Detailed field geologicdescription, distribution, mineralogy of the pegmatites occurrence inIdah Sheett 267 are poorly documented. This implies that the textural, distribution and mineralogical variations (zoning) across the pegmatites field are not known. In view of the above, this present research aim to:

1. Carrying out a field geological mapping of the study area and preparing a geologic map of the area with a view to establishing from the field occurrence, distribution, textural, structural features and mineralogyof the pegmatites, this information will provide a preliminary insight into the evolution of the pegmatites in the study area.

II. MATERIALS AND METHODS

Geological mapping of the pegmatites and its associated rocks was done along very closely spaced compasstraverses, rivers and bush paths. Mapping was done using a topographic map on a scale of 1:50,000 (prepared fromthe Idah topographic map sheet - sheet 267, on a scale of 1:100,000). Strike and dips of the rocks were measured at regular intervals using the compass clinometer. Measurements/observations made on rock

outcrops wereplotted on the topographic map, and the Geologic map was produced by drawing the contacts between the rockTypes.

Measurements/observations of structural features like joint, fault, folds and foliations made on rock outcrops and the joint values wereplotted on the rosette diagram inorder to determine the principal joints directions.

Hands specimen description of the pegmatites was done after the fieldwork with the aid of a hand lens of magnification 10X at the Geological Engineering department of the University of Mines and Technology, Tarkwa, Ghana. This will ensure a more detailed description of the rock samples collected in terms of textural and mineralogical variation across the pegmatites field prior to petrographic analysis.

III. RESULT AND DISCUSSION

Field mapping result of the pegmatites and associated rocks

The rock types in the study area consists of basement rocks, sedimentary rocks and minor rocks (Pegmatites) (Fig.2). The basement rocks are mainly found in the north-western part of the Sheet and to a smaller extent in the north-eastern part. Whereas, the sedimentary rocks account for the larger parts of the study area, covering entirely the south- western part, South Eastern part and parts of the north-eastern portion of the sheet (Fig.2).

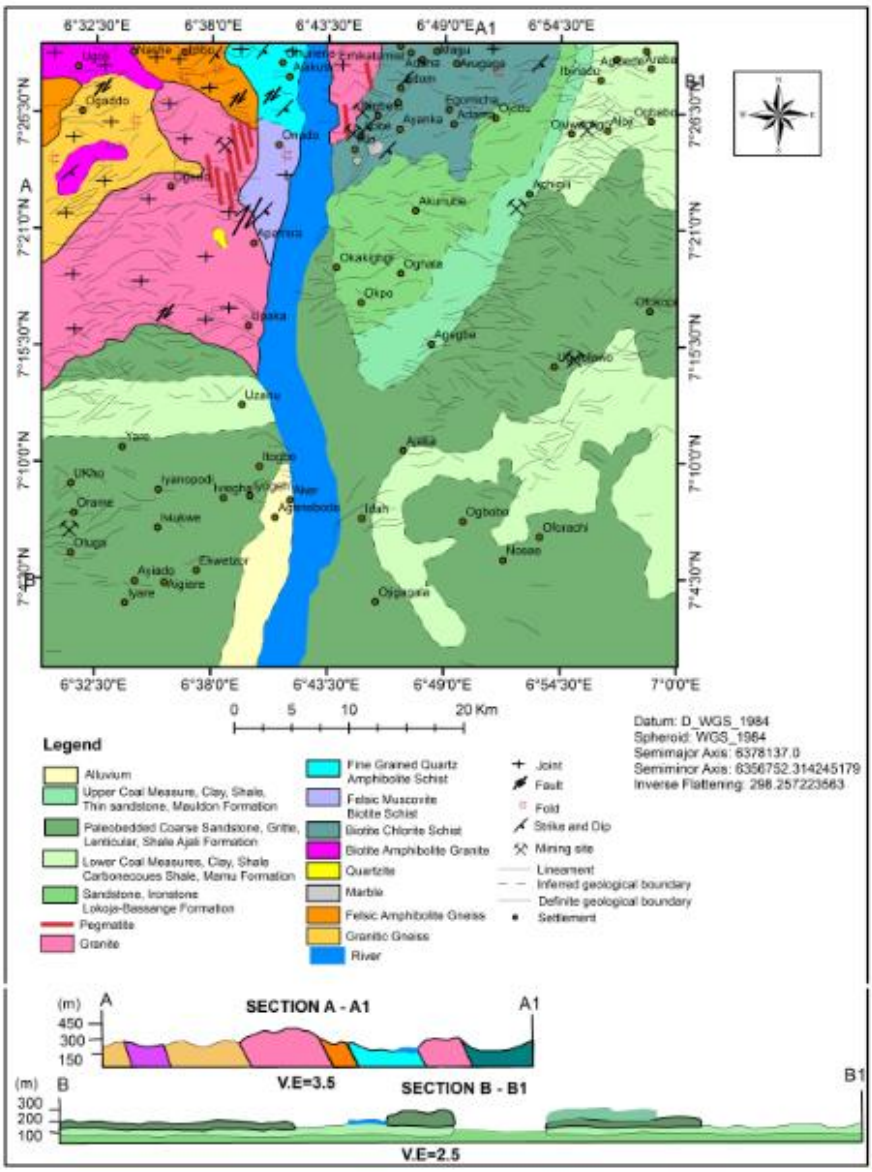

Fig.2. Geological map and cross-sections of Idah sheet 267 showing the basement complex rocks and the sedimentary rocks, including the pegmatites intrusion into the basement granites and sedimentary rock mainly within the northern part of the study area.

The basement rocks consist of different lithologic units from the oldest to the youngest from literature and field relation are Granite gneiss (GG) which are fine to medium grain size, Felsic amphibolite gneiss (FAG) which are medium grain texture and comprises of melanocratic to leucocratic felsic minerals on them, Marble (M) are fine to midum grain, dark-gray colored minerals, typical of dolomite (Onimisi *et al.*,2013) Quartzite (Q) are leucocratic in colour,fine to medium grain texture, Biotite amphibolite Granite (BAG) are fine grained ,dark colored typical of mafic minerals present, Biotite chlorite Schist (BCS) are dark to grey colour, fine grain texture, Felsic Muscovite Biotite Schist (FMBS) are light to slightly dark colour,fine grained texture, Fine grained Quartz Amphibolite Schist (FGQAS) characterized by fine grained, light to dark colured minerals. Granite are general medium to coarse grain texture (G) pegmatites generally coarse grained in texture. Whereas, the sedimentary rocks consists of various formation namely; Lokoja-Bassange Formation (Sandstones, Ironstones), Mamu Formation (Clay, Shale, Carbonaceous Shale, Coal Seams), Ajali Formation (False Bedded Coarse Sandstones, Tin Shale, Grits), Nsukka Formation (Clays, Shale, Tin Sandstones and Coal Seams) and Alluvium (Loose Sands, Muddy Sand, Mud) (Fig.2).

The pegmatites in Idah Sheet 267 occurs and are distributed in two main locations that is around Ogodo (Ajaokuta) and Itobe areas (Fig.2).The pegmatites in the Ogodo (Ajaokuta) occur as swarms of discrete dykesand ridges to form large N-S trending bodies .The mainstrike directions of the pegmatite dykes is N-S (80-89 from N). Whereas, thepegmatites intrudes into the basement granites and schist in both the Ogodo (Ajaokuta) and the Itobe areas. The style of intrusion is similar to the Angwan Doka, pegmatites (Akoh *et al*., 2015), Kabba-Isanlu and Nasarawa-Kefi pegmatites (Olobaniyi *et al.*, 2019) and host of other pegmatites belts of Nigeria ((Olobaniyi *et al.*, 2019).

Texturally, the pegmatites found within the study area is generally coarse grain typical of most pegmatites occurrence (Akoh *et al*., 2015, Olobaniyi *et al.,* 2019).

A total of seven pegmatites body was mapped in the Ogodo (Ajaokuta) area, out of which five of the pegmatites bodies occurs as dykes, intruding into the granite and schist boundary and the remaining two occur as ridgesof ranging from 400-500 m above sea level, 400-600 M long. Xenoliths of schist occur as a foreign body in the pegmatite (Fig.3).

Fig.3 Xenoliths of schist occur as a foreign body in the pegmatite around the Ogodo (Ajaokuta) area of the Idah Sheet267.

e pegmatites varies in size from 1-2 M high, 2-10 M wide (Fig.4).

Fig .4. Pegmatites varies in size from 1-2 M high, 2-10 M wide.

Old mining pit where Tourmaline was mined was observed on the field. Adjacent to the mining pit, is large weathered muscovite book found within the Ogodo (Ajaokuta) area (Fig.5).

Fig .5. Weathered muscovite book around abandoned mining pit in the ogodo (Ajaokuta) area of the Sheet

Besides, the pegmatites textures across the field are largely consist of large grain size crystals of minerals which are very visible in the field and in the hand specimen.
Besides, the pegmatites textures across the field are largely consist of large grain size crystals of minerals which are very visible in the field and in the hand specimen (Fig.6)

Fig.6. large grain size of pegmatites of crystals of minerals which are very visible in the field and in the hand specimen.

The pegmatite body on the Itobe area of the study trend N-S like the Ogodo (Ajaokuta) area, however, they occur mainly as a single dykes which intrudes into the granites and biotite chlorite schist (Fig. 7).

Fig.7. pegmatites intrusion into the granites and schist around the Itobe area of the Sheet.

The pegmatites around the area exhibit very sharp contact with the granites (Fig.8).

Fig.8.the pegmatites around the Itobe area exhibit very sharp contact with the granites.

The pegmatites occurrences as dykes and exhibition of sharp contact between the host granites and the schist in the Idah Sheet 267 is very much similar to other pegmatites occurrences in the Angwa Doka area (Akoh *et al.,* 2015) and other Nigeria pegmatite belts (Olobaniyi *et al*.,2019).However, contrary to the Nigeria pegmatites occurring as dykes, some of the pegmatites in the study area occur as swarms and ridges. However, the occurrence of some of the pegmatites around the Ogodo (Ajaokuta) area as ridges was also reported by Ako and Onoduku (2012).

The occurrence of the Pegmatites around the Itobe area of the study as intrusion into granites and schist agrees with the work of Onimisi *et al.,* 2013on field geologic occurrence and petrographic characteristics of Precambrian marble body in Itobe area. However, contrary, to Onimisis *et al*., 2013, the pegmatites around the Itobe area is a major intrusive rock since they are very extensive as revealed by the quarrying work on going in the Itobe area, about 700-900 M long and vary in width from 5-20 M wide.

Structural geology

Field studies of the rocks in the study area show that the structural features of the basement rocks are mainly evidence of shearing of the rocks (Fig.9).

Fig.9. Shearing of rocks in the Ogodo (Ajaokuta) areas is associated with major fault zones

Folds were observed in some of the rocks in the Ogodo (Ajaokuta) area (Fig.10)

Fig .10. Folds were observed in some of the rocks in the Ogodo (Ajaokuta) area

Joints fractures and fault were other structure attribute found among the basement rocks in the study area (Fig.11)

Fig .11. Joints fractures and fault were other structure attribute found among the basement rocks in the study area

Generally, the pegmatites trends N-S direction across the pegmatites field in the study area. This pegmatites trends agrees with the principal joint directions as plotted on the rose plot (Fig.12) and also agrees largely with the rose plot of the foliation trends of Itobe area (Onimisi *et a*l.,2013).

The presence of shear zone is an indication of fault zone in the study area and may suggest pegmatites emplacement partly by faulting system (Kuster, 1990, Ajibade *et al., 1979).*Thegeneral foliation trends dominantly observed in the rocks of the area foliation trend is N - Sdirection.

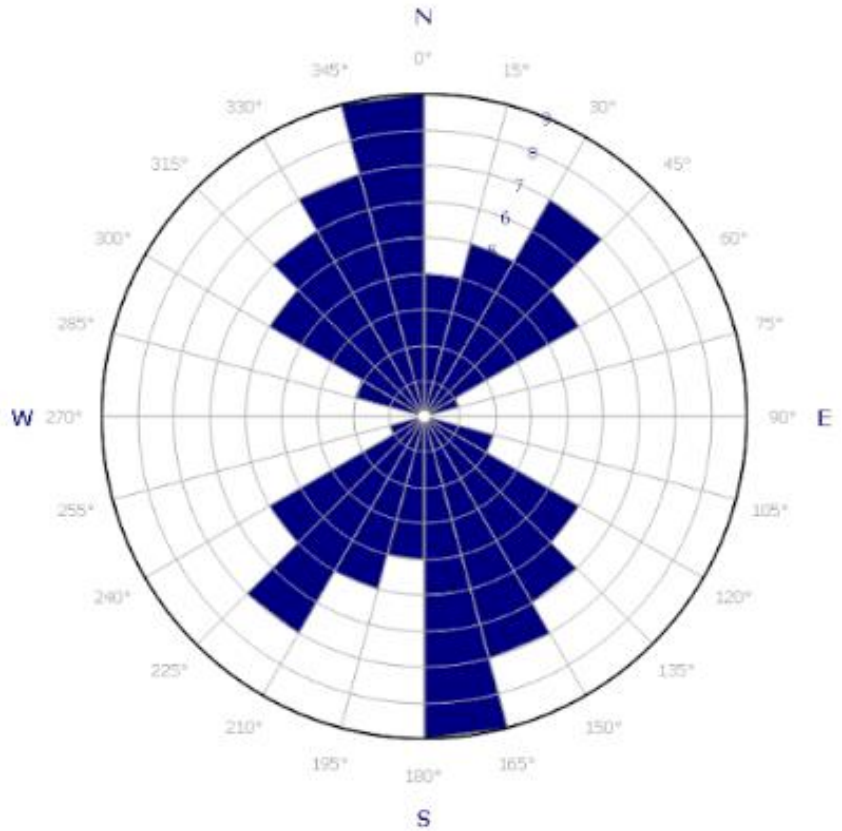

Fig.12. Rose plot of the principal joint direction of the study area showing major N-S and minor NE-SW trend

IV. CONCLUSION

The pegmatites in the Idah Sheet 267 occurs and are distributed around two main locations in the Sheet, that is around Ogodo (Ajaokuta) and Itobe areas respectively. The pegmatites in the Ogodo (Ajaokuta) occur as swarms of discrete dykes and ridges to form large N-S trending bodies whereas, those around the Itobe area occur only as dykes and trends in similar manner with the Ogodo (Ajaokuta) pegmatites.The main strike directions of the pegmatite dykes is N-S (80-89 from N). Texturally, the pegmatites are generally, large grain size crystals across the pegmatites field .The occurrence of the pegmatites as swarms of dykes hundreds of meters in length, may suggest emplacement partly by faulting as evidence in the shear zone) of the basement rocks (Kuster, 1990). Shear belts are usually associated with faulting and fault zones (Ajibade *et al., 1979*,Kuster, 1990*).* The pegmatites intrudes into the basement granites and schist in both the Ogodo (Ajaokuta) and the Itobe areas respectively.

Field Mineralogical evidence of pegmatites around the Ogodo (Ajaokuta) area consist of simple to complex mineralogy. The simple pegmatites (barren) comprise of Quartz, Feldspar (largely pinky K feldspar) and Mica (Muscovite) .The complex mineralogy besides Quartz, Feldspar and Mica also contain well developed crystals of Tourmaline and disseminated Tourmaline.Whereas, the pegmatites in the Itobe area is complex and more diverse in terms of assemblages of gemstones than the pegmatites in Ogodo (Ajaokuta) area of the study.The pegmatites around the Itobe area consist of three distinct mineralogical zones viz: (1) Qaurtz, Feldspar (plagioclase), Mica (Muscovite) and Beryl zone, (2) Quartz, Feldspar (plagioclase), Mica (Muscovite), Beryl and Tourmaline zone and (3) Quartz, Feldspar (plagioclase), Mica (Muscovite), Beryl and suspected Lepidolite /tin bearing zone.

The style of zonation of mineralogical assemblages across the Ogodo (Ajaokuta) and Itobe pegmatites field from simple to complex types pegmatites may suggest that the pegmatites evolve by fractional crystallizations of the residual melt generally of granitic composition (Akoh *et al.*, 2015, Olobaniyi *et al*., 2019).

The more evolve pegmatites (Itobe area) is at a greater distance (8km-15 km) northward-eastern from the Ogodo (Ajaokuta) pegmatites. Thus, the exhibition of a more diverse zonation than the Ogodo (Ajaokuta) may be expected. This trends agrees with the fact that at greater distance, pegmatite fluid travel more and display greater zonation and assemblages of minerals compare to those closer to the parents granitoids (Olobaniyi *et al*., 2019).

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