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Geology of 1:50000 Sheet 291 (Obudu northwest): a preliminary report.

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ABSTRACT

The northwest Obudu area belongs to the southeastern Nigeria basement complex. It is underlain by metamorphic, igneous and sedimentary rocks. The sedimentary rock, a part of the Markurdi Sandstone, underlies approximately thirty five percent of the map area. The metamorphic rocks are essentially migmatites, schists, amphibolites and quartz rock. Intrusive rocks into these metamorphic rocks are aplites, pegmatites and dolerites. The dominant tectonic signatures defined by foliations, lineations, folds, faults and long axes of inclusions are mostly trending N – S to NE – SW. Minor variations in trends include ENE – WSW and NW - SE. The area was pervasively affected by the Pan-African thermotectonic episode and the underlying rocks are similar to those occurring in the northeastern part of the Obudu Plateau and the Precambrian terrains of the adjoining western Cameroon.

INTRODUCTION

The northern part of the Obudu Plateau has not received much geological attention when compared to its southern part. The southern part has recently attracted the attention of workers such as Orajaka, (1964, 1971), Umeji (1998), Ekwueme (1990, 1991 and 1994; Ekwueme and Kröener, 1998, 2006;Ekwueme and Nganje, 2000; Ukwang, 1998, 2008; Ukwang et al., 2003; Ukaegbu, 2003 and Ukaegbu and Beka, 2007. In contrast, only a part of the northern Obudu Plateau has been researched on by Umeji (1991), Ejimofor et al. (1996), Ephraim(2005) and Ephraim et al. (2006). Umeji (1991) reports the occurrence of monzogranites in Jato Aka area while Ejimofor et al (1996) document the existence of Precambria migmatites and granitic gneisses. Occurring with these rock are amphibolite lenses and inclusions relate to Jato Aku. Ephraim (2005) and Ephraim and Adamu (2006) describe such rocks as amphibolites, migmatitic gneiss, meta-gabbro and dolerites.

The present study was carried out on a scale of 1:50,000 and is intended to complement the information so far documented in the adjoining northeast and southern Obudu Plateau. It is also intended to correlate and define the geodynamic setting and evolutionary trend of the area with the events of the southwestern Cameroun Basement Complex.

The study area

The map area lies between latitudes 06° 45' and 07° 00'N and longitudes 9° 00' and 9° 15'E (Fig.1). This defines the Nigerian topographic sheet 291 (Obudu NW).

The total coverage is approximately 756km^2 within a zone transitional between the forested southern Nigeria and the Sudan Savanna vegetation of the north. The area consists of vast lowlands as part of the Middle Benue Trough, and hilly segments towards the eastern portion. This hilly part is an extension of the Obudu Plateau into the fringes of the Benue Trough. The general elevation of the lowland is about 150m above mean sea level. This is punctuated by isolated hills rising up to 200m, examples being the Ayungue and Mbakum hills in Mbakyaha District of Vandeikya L.G.A. The area east of Adikpo in the northeastern part of the map area forms high relief. The Shangev-Ya hills form a ridge-like trend and is a part of the Obudu Mountain ranges.

The main watershed lies roughly to the western margin of the hills. Principally, the map area is drained by the Aya, Sambe and Dura. River Aya washes the southern portion of the area into the Cross River plains whereas the Sambe and Dura drain the north and eastern portion flowing northward into the Benue Basin. Climatic condition is that of the tropical regime. This is expressed by two major seasons: the rainy season spanning between April and October; the dry season which prevails between November and March. According to Obudu Dam monitoring station (2006), the maximum average temperature of 32°C is usually recorded between January and April. The highest average rainfall is normally recorded between June and September. Humidity is relatively low (about 25%) during the dry season when the desiccating harmattan wind blows.

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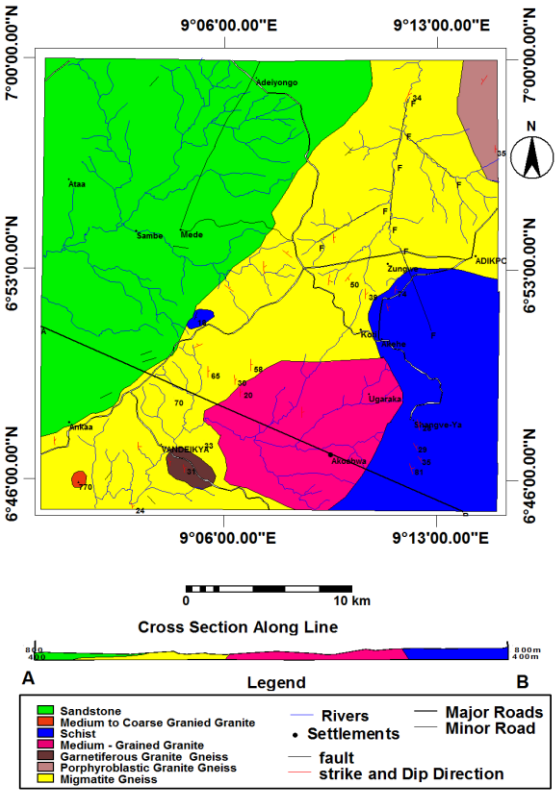

Fig. 1. Geological map of sheet 291 (Obudu NW).

MATERIALS AND METHODS

Geological field mapping method adopted in this study involved traversing with conventional instruments. Grid mapping was made impossible by the topography and thick vegetation. Hence field exercise involved studying geological features along road cuts, dug pits, erosion surfaces, stream channels and sporadic exposures. The global positioning system (GPS) and compass clinometer were very valuable of all the instruments. The base map was updated to reflect the positions of major towns and villages as well as smaller settlements.

The detailed work was carried out during the dry season when the exposure situation is better. The nature of topography and vegetation is a reflection of the underlying geology; hence, particular attention was paid to these surface terrains. Important and relevant features were described, sketched and photographed. Samples were collected of representative rock types for laboratory analyses

RESULTS

General geology of northwest Obudu

The northwestern Obudu Plateau is underlain by approximately 65% basement complex and 35% sediment series. The different rock types mapped in the Basement Complex domain within the area include migmatite gneiss, amphibolites, schist, granite gneiss, quartz rock, granite, dolerite, aplite and pegmatite (Fig. 1). The sedimentary series occurring in the northwestern portion of the map area is dominantly the Markurdi Sandstone of the Benue Trough.

Migmatite gneiss

The migmatite-gneiss-quartzite complex is made up of the following groups: the grey gneiss, mafic component and the felsic component constituting quartzo-feldspathic rocks, aplite, and pegmatite and quartz vein.

The grey-gneiss is scanty in terms of exposure and the outcrops are low-lying. This rock is exposed along River Aya and in Adikpo town, Mbawhue and Nende village in Baggar district. The light grey coloured rock is medium to coarse grained and strongly foliated with alternating dark and light coloured bands. The dark coloured bands consist of biotite and probably hornblende. The light coloured bands are rich in feldspars and quartz and ranges in size from 2cm to about 40cm. In certain locations, the bands are generally discontinuous forming pinch and swells as well as boudins. The foliation is equally defined by the alignment of the ferromagnesian minerals (e.g. biotite).The general foliation trend is N-S and NE-SW with dips varying between 08^{o} at Vandelkya Park and 068^{o} at Mbakon where the rocks are highly deformed (Figs. 2 and 3)

Fig.2. Diktyonitic structure in migmatite gneiss at Mbakum, Mbakyaya

Granite gneiss

Granite gneiss constitutes about 14% of the map area, occurring in Mbanatu, Ugaraka and Nende Mbagbera, up to the Ayanges hill. In the northeastern flank, the granite extends into the adjoining sheet 291 (Obudu NE) in Ushongo area along Katsina- Ala road. The three types of granite gneisses in the map area are:

(i) Medium to coarse grained granite gneiss.

(ii) Porphyritic granite gneiss encountered at the northeast along Katsina-Ala road and at Mbagwazo- Ushongo road junction by Mbanor road.

(iii) Garnetiferous granite gneiss southeast of Vandeikya- Obudu road

Medium to coarse grained granite gneiss.

Exposures could be seen at Ayanya hill, Ugaraka and Ute. The exposure occurs as very large outcrop in Ugaraka area. The light grey coloured rock is weakly foliated (with phenocrysts of feldspar) and occurs both as boulders and in situ exposures. It forms hill in the Agunger area. Minerals like biotite, feldspar and quartz are distinguishable in hand specimen.

Porphyroblastic granite gneiss

Porphyroblastic granite gneiss is exposed along Ushongo-Lesse road, north of Mbaikyon, close to the Community Secondary School, Ugbe village. This granite gneiss forms high relief. The rock occurs as large exposure with weak foliation as observed at Ugaraka-Ayunger axis. The dark grey coloured rock contains leucocratic components that range in size from coarse to very coarse. Dark inclusions abound in this rock and may be angular and in some cases rounded. These inclusions which are rich in hornblende and biotite are foliated and mostly lenticular in shape. The long axis of the inclusions and foliation are in the same orientation with the foliation of the enclosing gneiss.

Fig.3.Phlebitic structure in migmatite gneiss at Mbakum, Mbakyaya

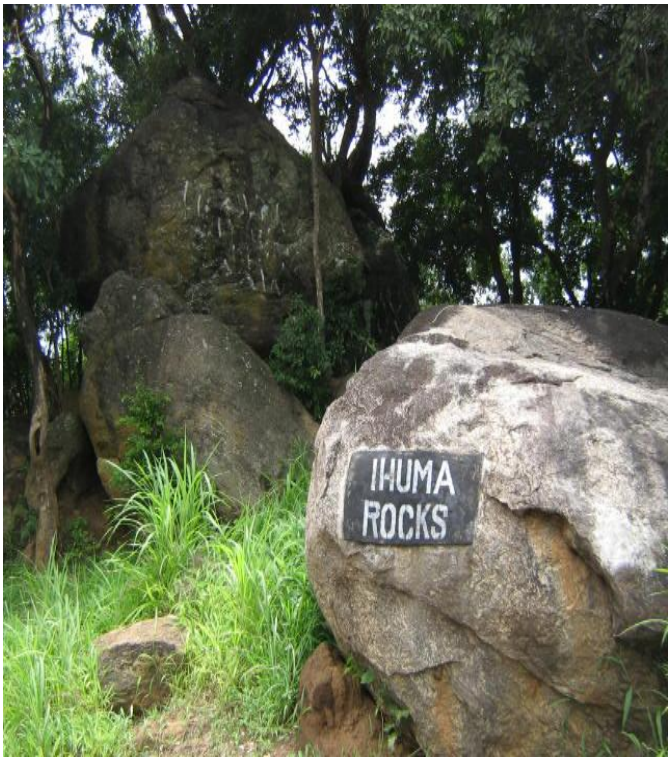

Fig. 4. Boulders of garnetiferous granite gneiss as exposed along Obudu road at Vandeikya.

Garnetiferous granite gneiss

This rock occurs as large boulders in the southeastern part of Vandeikya along Obudu road. Here it is locally called Ihuma rock (Fig. 4). The garnetiferous granite gneiss ranges in colour from light pinkish to dark grey. This medium to coarse grained rock is highly foliated and fractured. The foliation is marked by alternating light and dark bands apart from the concordant granite veins and mafic inclusions. The long axes of the feldspar phenocrysts also define preferred orientation. Minerals like garnet, biotite, feldspar and quartz are easily distinguishable in hand specimen.

Schist (metasediment)

Along Obudu road approximately 400m south of the Secondary School, Shangev-Ya, a schist exposure was observed. This highly weathered rock was equally observed at Mbashwan village, Quality Secondary School road Bar-Azor in Mbausu (Fig. 5) and at BAM camp. Biotite - garnet schist also occurs along Dura stream channel at Zungwe-Ute This highly schistose rock generally strikes 6^{o}NE with SW dip of 12^{o} in the Ute area but in the Shangev-Ya District the general strike is 160^{o} (NW-SE) and the dip varies between 20^{o} and 81^{o} NE. The rocks of the schist belt identified in the area are pelitic schist and biotite-garnet schist. The few outcrops observed in the map area are highly weathered exhibiting rusty-brown and reddish-brown coloration. The landforms in this schist belt are characterized by gently dipping plains and mostly masked by lateritic covers. The rock is composed mainly of micas (biotite and muscovite), feldspar, quartz

and garnet. The high fracture density and schistosity planes enhance the weathering of the rock.

Quartz rock

Quartz rock was observed in the Mbajor Forest Reserve area. It occurs as a small ridge measuring about 3m in width and striking 175°. Within the same Forest Reserve, boulders of this same rock were observed and cover an area of about 300m by 200m. The rock is generally whitish to dirty white in colour and consists predominantly of quartz. Conjugate fractures with some parallel to strike have highly dissected the rock into blocks.

Amphibolite

Amphibolite occurs mainly as lenses in the migmatite gneiss. In localities such as Bashalagba Mbaakon in Mbadede, behind Assemblies of God Church Vandeikya Town and under the bridge at Mbakaanga stream, this rock occurs as boulders. The rock is dark-grey to dark-greenish brown in colour. The fine to medium-grained rock is strongly foliated with foliation marked by mineralogical banding. The rock also occurs as narrow discrete bands within the migmatite gneiss and as xenoliths in the medium grained granite at Nende (Fig. 6). Widespread occurrence of dark masses with sub-rounded to lenticular outlines and varying in sizes from several centimeters to few meters in width were observed. The dark portions are rich in amphibole and plagioclase feldspar.

Fig.6. Xenolith of amphibolite in the medium grained granite at Nende.

Fig. 5. Schist exposure at Bar-Azoz road near Mbashwan village.

Intrusives

Intrusives into the Precambrian rocks include the granite, dolerite, aplite and pegmatites. These rocks occur mostly as veins and dykes.

Fig. 7.Exposure of dyke (black portion) in abandoned RCC quarry at Mbakum.

Granite

The biotite granite in the map area occurs at Nende hill, Mbakaange hill and Atini in Abakaange. This granite intruded into the migmatiite gneiss and must have been responsible for the slight elevation in the topography of such areas. At Nende village, it is restricted to the small rounded hill spanning approximately 150m in diameter. The rock massively caps the hill and large boulders are strewn around the entire

area. The colour variation ranges from light grey when fresh to pinkish at the weathered and eroded surfaces. The medium grained rock is jointed with imprint of exfoliation weathering. Xenoliths of the amphibolites are found to be enclosed in the granite. The dominant and observable minerals include biotite, quartz, feldspar (K-feldspar). Evidence of boron concentration in the parent magma is in the schorl mineralization. Vein rich in black tourmaline was observed in Nende hill

Dolerite

Dolerite dykes were found to have intruded the migmatite and granite gneiss. This dark to dark-grey coloured rock varies in texture from fine to medium grained. A typical hand specimen is quite dense and shows no evidence of deformation or metamorphism. The contacts with the host rocks are always sharp. These dykes are discordant to the foliation of the host gneiss. In certain localites like Igbu in Mbaybara and Nege Ayu village they occurred as boulders. Along Ako Abwa Mbaratu near the Aya River Bridge, the dyke cuts across the road striking N-S with a width of about 5m. At the abandoned RCC quarry at Mbakum, the dyke measures up to 10m in width (Fig. 7).

Fig. 8. Aplite and pegmatite veins parallel to one another at Mbayer, Ushongo.

Aplite and pegmatite

Aplite and pegmatite veins are found to occur in most of the major rock units, especially the migmatite gneiss. In the area of Mbayer aplite and pegmatite veins lay side by side, running parallel to each other (Fig.8). At Tswakar village and along Usung stream pegmatite is quite extensive. Large aplite and pegmatite veins have attitude of 015^{o} and 41^{o}NW (strike and dip respectively) as observed at Dura. The feldspar crystals in this pegmatite appear light green in colour. Many pegmatite veins ranging in width from 10cm to greater than 3m and trending $040^{o} – 045^{o}$ occur at Abena village in vandeikya. A large aplite vein measuring about 74cm in width is discordant to the foliations of the migmatite gneiss at Imande Demeungwa Makon, Tsambe. The aplite and pegmatite are texturally different but mineralogically similar. Dominant minerals in the pegmatite include quartz, feldspar and muscovite. Euhedral garnet grains occur in pegmatite at Tswarkar village. The garnet bearing pegmatite is impoverished in muscovite. The field relationship shows that more than one generation of pegmatite occurs in the map area.

Fig. 9.Boulders of sandstone as exposed at Ager, Tsambe.

Sedimentary rock

The Markurdi Sandstone overlies the gneiss unconformably (Nwajide,1990). This sandstone was observed at Akaa, Mbapakaa, Atsor and Mbago in the southwest; Mbede, Geri and Agule Ningev in the west. It was observed that other areas are covered by this rock unit, forming about 35% of the entire map area. The sedimentary terrain has been heavily cultivated by local farmers. At Mbede, the rock is massive but occurs as boulders of consolidated sandstone in the Ager, Tsambe region (Fig. 9). At St. Anthony Catholic Church premises around Ataa, the colour of the sandstone is whitish but at Nyikombo the rock assumes a light-grey to pinkish colour with the weathered surfaces being reddish. The sandstone as exposed in Mbede contains small rounded openings with U-shapes They are presumed to be solution structures that resulted from the wearing off of rocks by the rotation of gravels in an eddy current of running water. Mineralogically, the sandstone is quartz and feldspar dominated. Micaceous materials are also distinguishable.

DISCUSSION

The geology of the northwestern Obudu Plateau (Sheet 291) is clearly a fragment of the southeastern Nigeria Basement Complex as well as a part of the sedimentary series of Makurdi sandstone in the Benue Trough. The basement units within the area include migmatite and granite gneisses, schists and amphibolites. These are intruded by dolerite, granitic, aplitic and pegmatitic materials.

Structural signatures of well over 120 measurements were made and these include foliations, lineation, folds, faults and long axes of inclusions. The orientations of these structures statistically analyzed (Ayara and Ukwang in preparation) reveal that the dominant trends are N – S to NE – SW. Minor trends of ENE – WSW and NW – SE are also documented in the map area. The pervasive Pan-African thermotectonic event affected the area as evidenced in these signatures.

The northwest Obudu area is geologically therefore an extension of the northeastern part of Obudu Plateau as similar rocks have been described by Ephraim et al. (2006) in the region. The migmatite gneiss, granite gneiss and the schists are probably parts of the rocks described in southern Obudu Plateau by Ekwueme (1991), Ekwueme and Kröener (2006) and Ukwang (1998). The schist and other basement rocks of northwest Obudu Plateau have common similarities with the Poli schist and gneisses of northwestern Cameroon (Toteu et al., 2001; Penaye et al., 1993).

The northwest Obudu, hitherto undifferentiated, is now open to further studies. This contribution, preliminary though, has given an insight into the vast economic potential which may be lying unutilized in rocks of the northwestern Obudu Plateau. More detailed studies in future may further reveal more.

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