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KARST TOPOGRAPHIC STUDIES OF EKINTAE EAST, NEAR MFAMOSING, SOUTH-EASTERN NIGERIA

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ABSTRACT: Karst topography in Mfamosing limestone area has been observed to have little or no accurate information on the topography and relief of the area, which are the major determing factor for surface features such as Hills and valleys. Processes such as erosion, weathering, and denudation are seen to be relief control. Twenty one (21) locations in Ekintae East, proposed limestone quarry phase II sites, near Mfamosing village were accurately measured using Global Positioning System (Germin Oregon 550). The results indicates that elevations ranges from 12.0-76.0m and mean of 33.52m. Arch GIS suffer 10 softwares was used in contouring of the elevation map and 3-D surface elevation of the study area.The contour map of the area reveal South-West of the study area to be high relief with North-West, North-East and Southeast as low relief controlled by denudation. The limestone conduit systems are not necessarily constrained by surface topography, and hence the catchment for a particular karst unit may bear little or no relation to the surrounding topographic divides. Water from adjacent or adjoining non-karst landscapes can also contribute significantly to the catchments of karst units. This paper therefore is aimed at providing answers to the lowest and highest elevation points as well as the 3D surface elevation of Ekintae East, proposed Limestone quarry phase II as well as identifies diagnostic surface karst features and distinct differences in lithologies or disrupted surface drainage patterns in the area.

KEYWORDS: Karst Topography, Contour Map, Elevation, Relief, Global Positioning ystem, Mfamosing Limestone

INTRODUCTION

Man was intrigued with karst, particularly cave development, long before the word "karst" carne into use. In pre-historic times caves provided humans with a living space, water supply, and protection. Karst as a type of landscape found on carbonate rocks (limestone, dolomite, marble) or evaporites (gypsum, anhydrite, rock salt) is characterized by a suite of landforms comprising springs, dolines, caves, collapsed sinkholes and carbonate depositional landforms (Gun, 2004; Hyland *et al.*, 2006; Ford & Williams, 2007). A map may indicate the topography of land, detailing the location and spatial relationships of the map features and details: distances, coordinates, shapes and anything else to do with location. Topographic maps are flat. If a map also reflects relief, the map will show the degree of elevation or depression of features in relation to the horizontal plain of the land (Gao *et al.*, 1995). A topography map can be created for any kind of land surface, whether on earth or underwater (i.e. ocean floor topography and relief), the surface of the moon or planets other than earth. Relief will be relative to size and scale of the map, showing the height in relation to the lowest and highest points of the shown surface where topographic maps with elevation contours have made "topography" synonymous with relief (Pearsan, 1968).

Karst areas are dynamic and environmentally sensitive. The geologic structure, solubility of the rocks involved, and the climatic conditions determine to a great degree how rapid these

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changes can take pIace. A karst is a sensitive environment, which imposes specific management constraints on environmental domains, such as water protection, problems of pollution or site conservation (Theilen-Willige, *et al.*, 2014). The use of modern technologies has allowed new methodological approaches for karst studies. This especially applies to computer-aided investigations, such as remote sensing and geographic information systems (GIS), which improve the generation of geomorphic maps and help monitor and mitigate karst geo-hazards (De Carvalho *et al.*, 2014; Pardo-Iguzquiza *et al.*, 2013). With regard to karst morphological studies, landform mapping based on the merging of different datasets with different resolutions in a GIS environment have proven to provide better results (Siart *et al.*, 2009).

Oseji *et al*, 2007 used measuring tape, Global positioning system and ArcGIS soft wares to determine Thermal Gradient in vicinity of Kwale/Okpai Gas Plant produced topographic map Kwale/Okpai, 2009 a similar studies was undertook in Atagba – ogbe Kingdom and 2010 in Ndoka all in parts of Delta State.

The occurrence of karst phenomena and their continual evolution can pose serious problems related to subsurface stability and may require caution in the maintenance and planning of infrastructure, especially in areas, such as Mfamosing. Therefore, caution in land use planning is required in urban areas, due to damage to buildings, roads, water supply systems, and in rural areas, through the loss of arable land. Thus, when dealing with the construction and maintenance of infrastructure (pipelines, sewage), areas of high intensity karst development should be carefully monitored. An important concept in karst hydrology is the notion of the “karst catchment” (i.e., the drainage area that contributes water to a particular karst landscape unit). Karst catchments can cross beneath topographic divides because the water flowing in underground conduit systems is not necessarily constrained by surface topography, and hence the catchment for any particular karst unit may bear little or no relation to the surrounding topographic divides. Water from adjacent or adjoining non-karst landscapes can also contribute significantly to the catchments of karst units. This paper is aimed at providing answers to the lowest and highest elevation points as well as the 3D surface elevation of Ekintae East, proposed Limestone quarry phase II. This study identifies diagnostic surface karst features and distinct differences in bedrock lithologies or disrupted surface drainage patterns.

Location and Geology of Study Area

The study area lies between latitudes 4°45′ N and 5°15′ N and longitudes 8°05′ E and 8°45′ E. It covers the Calabar South, Calabar Municipality, Akpabuyo and parts of Odukpani Local Government Areas of the Cross River State (Figure 2). The Calabar area belongs to the lowland and swampland of South-eastern Nigeria (Iloje, 1991). Elevations, here are generally less than 100m above the mean sea level. Three main rivers dominate the landscape of the study area. These are the Calabar, Great Kwa and Akpayafe rivers – flowing southwards into the Cross River. The climatic data show that the monthly temperature varies between 23.1°C and 28.7°C and the monthly precipitation varies from a low of 26.7 mm (February) to a high of 459.1 mm (July) (Edet & Okereke, 2002). The climate of the study area is that of equitorial belt which is characterized by wet and dry season, the wet season start from April to September with a peak in June and July while the dry season start from October to march with a break in August, The meteorological parameters recorded at the study area: a mean annual rainfall of about 2600mm, a mean annual temperature of 32^0C. The study area is located at Ekintae East, bounded by Mfamosing to the west, to the East by Ekonganaku, to the North by Mborokp, and to the South

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by Mbobul. It covers an estimated area of about 4200m^{2}and lies between latitudes N0452240, N0453420 and longitudes E005122, E005062 (Figure 2).

Geologically, (Figure 1) the area is composed of Tertiary to Recent, continental fluvialite sands and clays, known as the Coastal Plain Sands. This formation is characterized by alternating sequence of loose gravel, sand, silt, clay, lignite and alluvium (Short & Stauble, 1967). It is underlain mostly by rocks of the Cretaceous Calabar Flank and pre-Cambrian Oban Massif. The Coastal Plain Sands (Benin Formation) is by far the most prolific aquiferous hydrogeologic settings in the area and all the water boreholes are located in this Formation (Esu & Amah, 1999). Alluvial deposits aquifer overlies the Benin Formation in the Southern parts of the study area. Recently, (Edet & Okereke, 2002; Amah & Esu, 2008) identified two water bearing units within the Coastal Plain Sand of the area. These are upper gravelly sand aquifer (UGSA) and lower fine sand aquifer (LFSA).

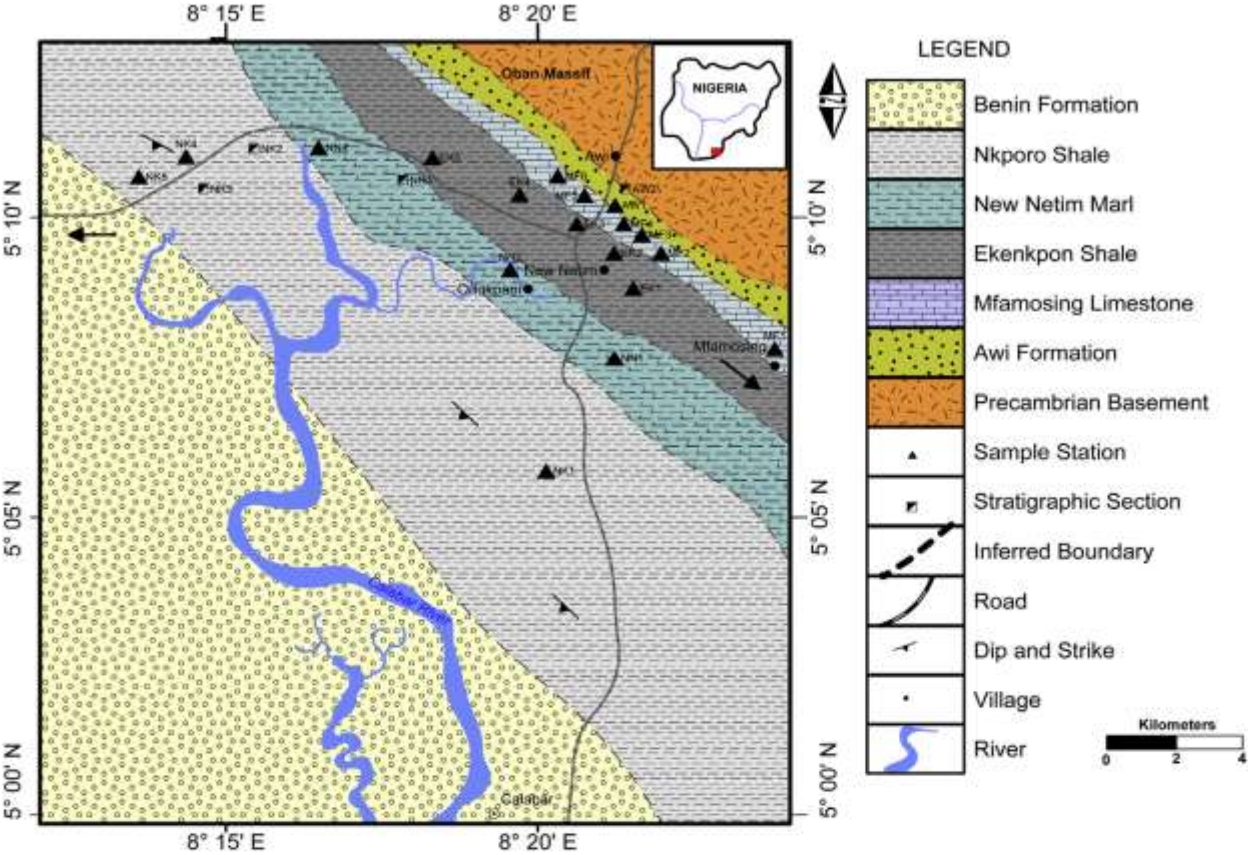

Figure 1: Geological map of the Calabar Flank (adapted from Nyong and Ramanathan, 1985)

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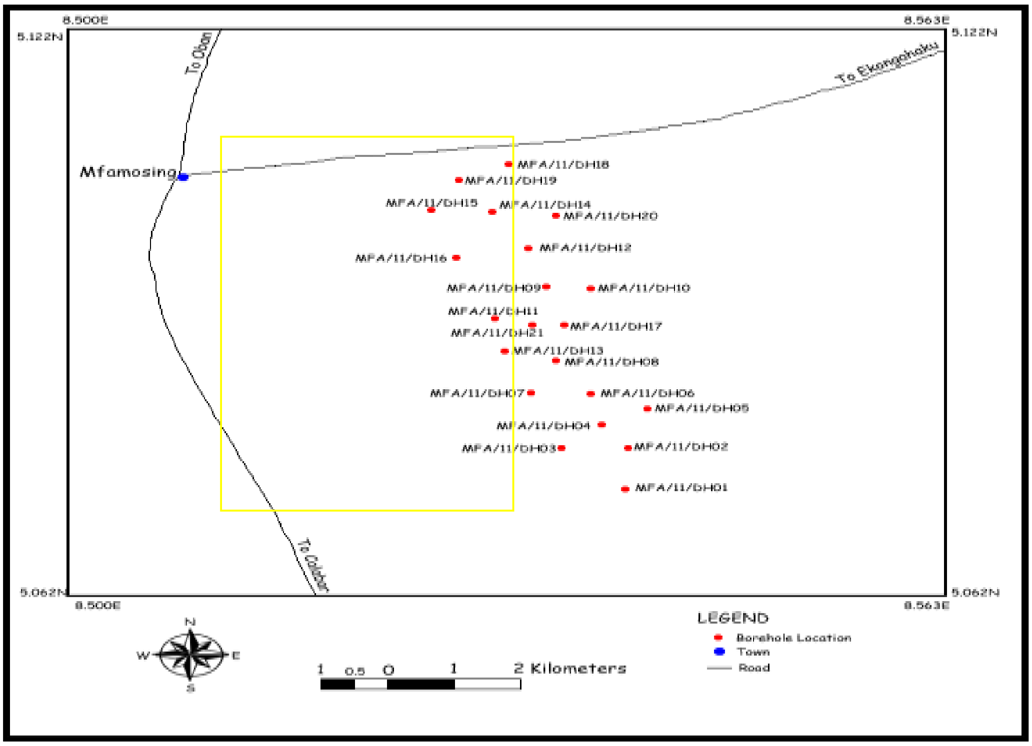

Figure 2: Map of study area showing the distribution of limestone

‘MATERIALS AND METHODOLOGY

The field work was achieved with the Global Positioning System and writing materials. The Global positioning system (GPS) of type 8210 was used for measuring the latitude, longitude, and the surface elevation of each of the boreholes sites and recorded on the field notebook as presented in Table 1.

The contoured maps of elevation (Figure 2) were produced by joining lines of equal values together in such a way no one overlap each other. The elevation map was also modeled in 3D with the help of Arch GIS suffer 10 computer software (Fig. 3). Arch GIS suffer 10 softwares was used in contouring of the elevation map and 3-D surface elevation of the study area.The contour map of the area revealed South-West of the study area to be high relief with North-West, North-East and Southeast as low relief controlled by denudation.

RESULTS AND DISCUSSION

The result of Twenty one (21) locations were visited and surveyed accurately within Ekintae East, near Mfamosing and its environs (Figure 2 and Table 1) indicate that the results of the elevation ranges from 12-76m. The irregularities of the surface in karst areas are caused by surface and subsurface removal of rock mass by dissolution of limestone or dolomite. Karst toporaphy is caused by precipitation and surface water while caves are caused by groundwater through joints (Gaiser, 1951).

The elevation map was also modeled and the results indicates that elevations ranges from 12.0-76.0m and mean of 33.52m. Arch GIS suffer 10 softwares was used in contouring of the elevation map and 3-D surface elevation of the study area (Figure 4). The contour map of the

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area reveal South-West of the study area to be high relief with North-West, North-East and Southeast as low relief controlled by denudation.

Table 1: Borehole Data and Static Water Level within the Study area

S/N	LOCATION NAME	COORDINATES		ELEVATION
		NORTHING X	**EASTING** Y	Z (E) metres
1	MFA/11/01	450,240	559,936	32
2	MFA/11/02	450,700	559,958	27
3	MFA/11/03	450,703	559,422	39
4	MFA/11/04	450,975	559,741	30
5	MFA/11/05	451,170	560,104	37
6	MFA/11/06	451,341	559,188	76
7	MFA/11/07	451,345	559,651	40
8	MFA/11/08	451,715	559,378	42
9	MFA/11/09	452, 593	559,316	27
10	MFA/11/10	452,578	559,659	34
11	MFA/11/11	452,217	558,888	33
12	MFA/11/12	453.040	559,153	26
13	MFA/11/13	451,825	558,966	41
14	MFA/11/14	453,465	558,874	21
15	MFA/11/15	453,490	558,385	12
16	MFA/11/16	452,864	558,592	29
17	MFA/11/17	452,137	559,441	42
18	MFA/11/18	454,035	559,006	28
19	MFA/11/19	453,836	558,611	24
20	MFA/11/20	453,420	559,383	34
21	MFA/11/21	452,141	559,188	30
Minimum				12
Maximum				76
Mean				33.52

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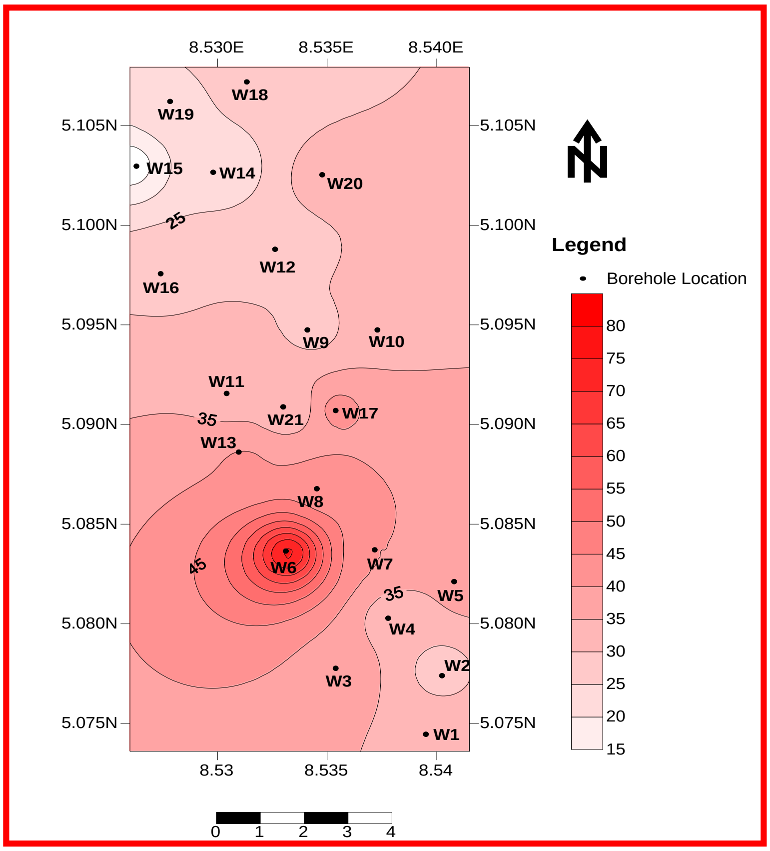

Figure 3: Contour elevation control map

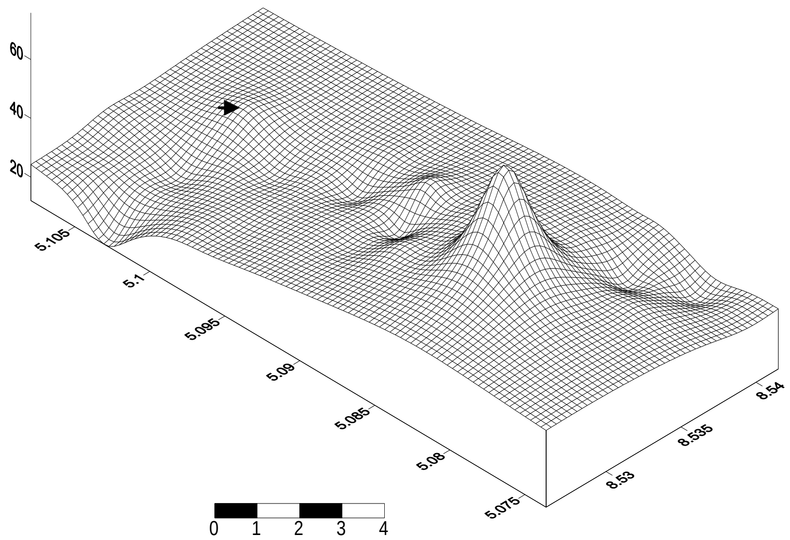

Figure 4: Contour Elevation Map

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CONCLUSION

Topographic information data from this research work from the twenty one (21) locations in Ekintae East, proposed limestone quarry phase II sites, near Mfamosing village were accurately measured using GPS (German Oregon 550). The results indicates that elevations ranges from 12.0-76.0m and mean of 33.52m. Arch GIS suffer 10 softwares was used in contouring of the elevation map and 3-D surface elevation of the study area. The contour map of the area reveal South-West of the study area to be high relief with North-West, North-East and Southeast as low relief controlled by denudation.

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