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EDITORIAL COMMENT

Glory and adoration to the **Almighty God** for making it possible to see the end of another year and another issue of ZJPAS.

I take this opportunity to express my sincere gratitude to the reviewers who contributed to the success through the reviewing of the manuscripts given to them. ESS Consult (ESSCON) Business Centre in Ogbomoso is commended for her skill.

Finally, I take this opportunity to thank the contributors and the Reviewers alike for your tremendous support. God bless you all. **AMEN**

Prof. J.S.A. Adelabu
Editor – in – Chief
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ZUMA JOURNAL OF PURE AND APPLIED SCIENCES
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Papers should be typewritten, doubled-spaced, 1.0 in on top and bottom margins and 1.5 in left and right. Each page should be numbered. The first page should include a title, the names of the authors, their affiliations and postal addresses. The title should be concise and should contain no complex symbols. The authors are responsible for the use of proper spelling, punctuation and grammar. Text style should be concise and direct. Word to be printed in *italics* should be underlined. Text footnotes are not acceptable. The authors have to secure the rights of reproduction of any material that has already been published elsewhere. All scientific names should be italicized and the first letter should be title case and the second name lower case.

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Mathematical symbols that must be drawn by hand should be superscripted clearly. Place number of equations referred to in the text between parentheses at the right hand margin.

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Each table should be typed on a separate sheet as the authors expect it to appear in print. Each table must be numbered, contain a brief title on top and each column should contain a heading and units. Table should be referred to in the text.

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Illustrations should be drawn with ink on good quality tracing paper. The originals or sharply focused glossy photographic prints (maximum format 21 × 29.7 cm) should be submitted together with the manuscript. Each figure must be referred to in the text and its number clearly indicated at the top right-hand corner of the page. A set of figure captions must be provided on a separate sheet. Extreme care should be taken in preparing the figures; lettering should be large enough so that it may be clearly reproduced after reduction.

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Citation from an edited book

MAHANAM, S.E.. 1990: Hazardous Waste Chemistry, toxicology and treatment, Lewis Publishers Inc., New York.

MBONU, P.D.C., J.O. EBENIRO, C.O. OFOEGBU and A.S. EKINE., 1991: Geoelectric Sounding for determination of aquifer characteristics in parts of the Umuahia area of Nigeria. Ceophysics, 56, p. 284 – 291.

Unpublished Work

MEJEHA, I.M. 1988: Optical Spectra and Energy Level of Divergent Ytterbium and Samarium Ions in Some Alkali Halides, University of Warwick, Coventry, United Kingdom (Unpubl.)

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Seismic Refraction Study of the Influence of Basement Topography on Existing Run-Off Channel at Television Village Campus of Kaduna Polytechnic, Kaduna Nigeria

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Abstract

A run-off channel or course of a stream behind Kaduna Polytechnic Staff Quarters at College of Arts and Business Studies, (CABS) Express Bypass or Television campus at Television village, Kaduna was surveyed using seismic refraction method. The main aim of the survey was, to determine the influence of the basement topography if any, on the run-off channel. The length of the field was 1000m while the width of the field was 500m. Ten channel geophones were vertically and firmly planted from the shot point at 5.0m separations along the profile to pick up the seismic wave that propagated through the ground. From the data collected, travel-time curves were drawn. From the travel-time curves, layer velocities were deduced. Three layers were encountered in this field of survey. The average depth to basement was found to be about 9.0m. The deepest depth to the basement was found to be about 14.0m, while the shallowest depth was about 4.0m.

The stream course was superimposed on depth to basement map. From this it was deduced that the stream course preferred the shallowest depth to the basement.

Introduction

The area of survey is on the south- eastern part of Kaduna City. This is shown in Figure 1 below. The city is in the north central region of Nigeria. It is located in the basement complex of central Nigeria. Barbour, *et al* (1982). It is on Television Village campus of Kaduna Polytechnic, Kaduna. The survey field covers a square area of 1000m by 500m. Other methods could be used for this survey, but seismic surveying provides a clear and, indeed uniquely detailed picture of the subsurface geology, so it was used for this work.

Geology of the Area.

The survey area is geologically within the basement complex, and is generally overlain by undifferentiated igneous and metamorphic rocks. The Basement Complex underlies the entire area, which include all rocks older than the late preterozoic (McCurry 1976). The Nigerian Basement Complex lies within the pan-African mobile belt of West Africa, and is believed to have a polytecto- metramoiphic nature (Oyewole 1964; McCurry 1976; Grant 1978) and consequent metamorphism, migmatization and gneissification, have extensively modified the original rocks. Recent works by Grant (1978) and Wright *et al* (1985) among others however, indicate that part of these sediments may have been formed in the Kibaran (1,000 + 200 Ma) time.

The area of survey gently slopes downwards from both sides towards the run off channel. In addition to this, it slopes downwards along the direction of flow of the stream, which is southwards. A mixture of clay and granite or clay and sand was seen in varying proportions over the field. The granite rocks of this region were either medium or coarse grained. According to Russ, (1957) rocks of this complex probably evolved by sedimentation, followed by successive migmatization, granitization and intrusions.

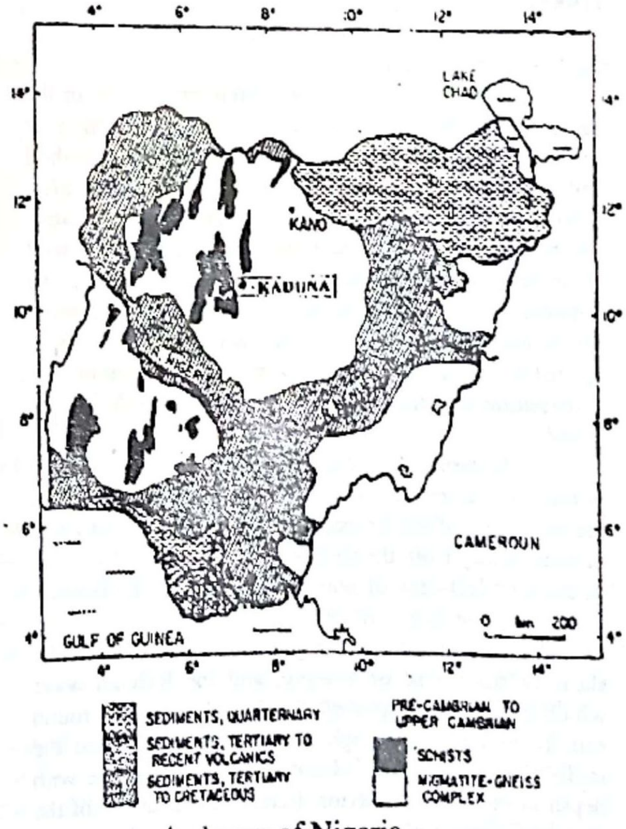

Fig. 1Geological map of Nigeria

Drainage

The stream was contained between 100 and 250m from the edge of the field.

Along the drainage paths, rocks were poorly fractured. Downstream the soil was mainly sandy and loamy thus there was marked gully erosion along the run off channel there. Stream meandering was pronounced throughout the stream course surveyed. Upstream along the drainage channel, the soil was mainly a mixture of clay, sand and granite. The channel bed was therefore harder at these places.

Theory

Parcels of elastic strain energy that propagate outwards from a seismic source such as an earthquake or explosion are called seismic waves. Kearey & Brooks (1988). Velocities of propagation of seismic pulses are determined by, the elastic moduli and densities of the materials through which they pass.

There are two groups of seismic waves, namely body waves and surface waves.

The velocity V of a body wave in any material is given by V = (appropriate elastic modulus of material)/(Density ρ of material) Kearey & Brooks (1988)

Seismic Refraction Surveying.

Seismic surveying was first carried out in the early 1920s. Seismic survey can be by reflection or refraction method. Seismic refraction surveying method utilizes seismic energy that returns to the surface after travelling through the ground along refracted ray paths. To ensure that the relevant cross over distance is well exceeded, refraction profiles typically need to be between five and ten times as long as the required depth of investigation. Although the actual profile length required in a particular case depends upon the distribution of velocities with depth. Kearey & Brooks (1988)

Seismic refraction techniques require the initiation of a seismic wave by impact or explosion, and the recording of the propagated seismic energy at some distance away from the source.

In the simplest case of homogenous, elastic half-space, three separate types of waves can be generated and recorded. These are the compressional or P- wave, the shear or transverse or S-wave, and the Raleigh wave which is a surface wave often referred to as the ground roll. In practice, Rayleigh waves travelling round the surface of the earth are observed to be dispersive with depth in the earth's interior. Indeed, the analysis of the observed pattern of dispersion is a powerful method of studying the velocity structure of the lithosphere and asthenosphere. Knopoff, (1983). Of these waves, the most important for the interpretation of the structure is the refracted P-wave.

The first arrival of seismic energy at a detector offset from a seismic source always represents either a direct ray or a refracted ray, this fact allows simple refraction surveys to be made in which attention is concentrated solely on the first arrival (or onset) of seismic energy. The time – distance curves for these first arrivals are interpreted to derive information on the depth to the refracting interfaces. Telford, *et al* (1976).

Instrumentation and Data Collection

Terraloc Mk 6, a split channels seismograph with 12 geophones for either side of the input connection an ABEM instrument was used for this survey. The upper cut off frequency for the seismic wave was set at 15Hz. 11 geophones were used, so the first one was dedicated as hammer trigger and was planted at the shot point, and the rest employed as channels inputs. This is because there was a fault with the 12^{th} geophone input. Therefore, each shot point was made up of ten pairs of travel time values besides the 0 ms assigned to the shot point. Geophone to geophone separation was 5.0m along a straight profile line from the source or shot point. So that every traverse was 500m long. When the geophones were completely laid, a seismic wave was initiated by impact of a heavy, hand-held sledgehammer with the shock plate that was placed close to the trigger geophone. The wave that propagated through the ground from this shot point was picked up by each of the geophones and its travel time recorded. The whole system was then moved forward along the profile line such that, the geophone, which was then 50m away from the shot point, became the current trigger geophone. This process was repeated profile by profile until the whole field was covered. The instrument was carried manually from shot point to shot point throughout the survey.

Data Analysis and Interpretation

The receiver distance from the shot point, otherwise called the travel was plotted on the horizontal axis and the corresponding time on the vertical axis to obtain the travel – time graph. The time taken for the ray to travel through the profile was so short that it was better recorded in milliseconds (ms). The slopes of the graph for each shot point was then used to calculate direct wave velocity V_1, second layer wave velocity V_2 and third layer wave velocity V_3 beneath it where applicable. The values of V_1 so obtained are shown below in Table 1.

Table 1. First layer velocities, V_1 (m/s).

SHOT POINT						PROFILE					
	A	B	C	D	E	F	G	H	I	J	K
0	466	772	978	590	864	820	1009	676	940	505	664
50	600	830	933	648	613	959	799	670	962	792	692
100	500	801	753	732	1134	938	754	758	539	625	563
150	470	781	648	694	931	720	764	683	949	785	595
200	530	796	440	756	595	635	801	987	1000	590	1013
250	533	789	666	727	802	772	619	822	791	710	1004
300	735	946	713	796	987	1136	694	781	972	796	899
350	670	728	662	827	883	1167	673	723	1042	1035	830
400	635	769	626	746	724	799	1057	1387	1142	1214	580
450	640	499	625	676	761	877	738	762	758	807	752
500	595	541	654	564	577	777	725	590	631	815	685

Second layer velocities, V_2 (m/s).
The values of V_2 so obtained are presented below in Table 2. Notice that
$V_2 > V_1$ at every shot point when one compares Tables 1 and 2.

Table 2. Second layer velocities, V_2 (m/s).

SHOT POINT						PROFILE					
	A	B	C	D	E	F	G	H	I	J	K
0	1831	1486	1577	1623	1563	1563	2778	1015	1407	1108	1136
50	1463	1659	1702	1397	1761	1486	2147	1217	1866	1191	2206
100	1984	1670	1683	1316	3049	1584	1600	1471	1506	1229	1881
150	1603	1514	1636	1569	2404	1866	1851	1786	3018	1336	1345
200	1059	1675	1136	1524	2083	1667	1656	1605	3271	1651	1737
250	933	1542	2054	1894	2735	1812	1761	1701	1696	1747	1350
300	1037	1563	1445	1429	1302	2315	1906	1603	1471	1544	1626
350	3378	1712	3731	1191	1506	1838	1944	1941	2141	1984	1468
400	807	2359	2717	1504	2660	2778	1421	2907	2193	1712	1037
450	1953	1894	3205	2155	1712	1471	2333	1454	1201	1498	1253
500	1953	2907	1168	1295	2083	963	1323	1295	1087	1437	1439

Third layer velocities, V_3 (m/s).
The values of V_3 so obtained are presented below in Table 3. Notice that
$V_3 > V_2$ at every shot point when one compares Tables 2 and 3.
V_3 was recorded at only 42 of the 121 shot points made during the survey as shown in Table 3 below.

Table 3. Third layer velocities, V_3 (m/s)

SHOT POINT						PROFILE					
	A	B	C	D	E	F	G	H	I	J	K
0		1786			3571			2193		1108	5682
50	2155			1838	2232			2119		2451	
100	2778		3205	1712					4808	1812	
150	2273	2660			4167	4167					2525
200	1786		2232	2874	3571	2212					
250				2439		3906	2315	2155			
300						4032		3846	1572		
350						2778					
400	3125						2404				1736
450								2717	1645		
500						1969	1880	2544	1389		

Distribution of dept to basement or refractor, Z (m).
As derived by Dobrin (1976), $Z = t_i V_1 V_2 / 2(V_2^2 - V_1^2)^{1/2}$
Where t_i is the intercept time given by,
$t_i = 2Z(V_2^2 - V_1^2)^{1/2}$
$= (2Z\cos\theta)/V_1$ Johnson, S. H. (1976)
This equation was employed to obtain Z for a ray critically refracted at the interface to the 2nd dipping layer.
The values of Z obtained following this equation are hereunder shown in Table 4. To see the distribution of Z_1 often referred to as dept to basement beneath the field, the values in this table were contoured. The contour map of Z_1 is hereunder shown in Figure 2.

Table 4. Dept to basement or first refractor, Z_1(m).

SHOT POINT						PROFILE					
	A	B	C	D	E	F	G	H	I	J	K
0	4.07	3.73	4.01	4.07	4.32	6.09	14.9	2.55	4.09	4.36	3.95
50	2.95	3.91	3.32	3.49	3.63	3.59	9.34	4.44	7.56	3.5	5.67
100	3.47	3	3.02	3.53	9.53	4.42	4.57	6.29	4.43	3.25	3.9
150	3.69	2.62	4.19	2.54	5.23	4.92	4.74	6.36	7.29	2.12	1.66
200	4.11	4.31	3.17	3.73	3.17	3.36	2.35	5.13	5.24	3.11	3.63
250	6.13	5.35	9.88	2.98	6.93	3.3	3.46	4.04	3.22	3.28	3.43
300	6.65	12.11	8.53	3.81	6.62	2.11	4.17	2.76	3.89	2.47	6.66
350	15.21	10.24	14.52	6.55	8.97	3.44	3.83	4.28	6.38	6.79	5.73
400	4.43	11.75	13.89	8.95	12.57	12.17	2.74	8.46	7.44	3.96	3.28
450	12.27	8.85	15.06	9.28	10.65	6.97	0.86	3.04	3.36	6.01	5.08
500	12.32	13.65	8.21	11	10.33	2.05	5.27	2.71	2.48	6.89	7.54

Results

Topography of Basement in the area surveyed.

From the Z_1 contours in Figure 2, the basement topography beneath the area surveyed can be seen.
The shallowest regions were about 4.0m deep and the deepest areas were about 14.0m deep. Therefore the average depth to basement was about 9.0m. Generally, the depth to the basement was found to increase in a direction that is along the stream course. This increase was more rapid in the area represented by the south-eastern corner of the map. In this area the contours are more close to each other than in other places.
The existing run-off channel flows through the area such that, it tends to move over the shallowest regions

of the basement. It can be seen that wherever the stream encountered a deeper basement it meandered away to flow over the shallower basement. Thus it could be said that the basement topography among other things, directs the course of the stream. This does not mean that water does not flow over the basement where the depth to it is deeper.

It does so, but underground and so is not seen at the surface.

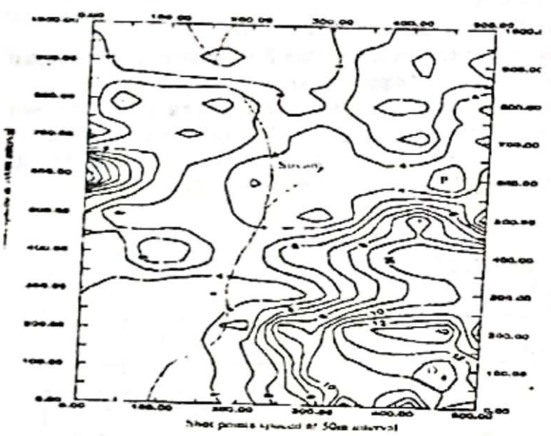

Fig. 2: Depth to basement contours

Discussions and Conclusions

The depth to the bedrock beneath the area surveyed was determined, mapped and contoured as shown in Figure 2. From this contour map it could be seen that the basement topography influences the run-off channel or stream course. The stream meanders as it flows downwards, in such a way as to be contained over the shallowest depth to the basement. The stream or run-off flows lengthwise and roughly centrally through the field.

This work was carried out to establish whether basement topography could affect the course of a run-off channel. In the work it was observed that the run-off channel studied meandered so as to sit on the shallowest basement available.

More run-off channels should be studied with a view to generalizing this claim. At the moment let it be held that the basement topography has a lot of influence on the course of this channel. Probably other run-off channels too could be directed by the basement topography over which they flow.

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