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Reserve Estimation from Geoelectrical Sounding of the Ewekoro Limestone at Papalanto, Ogun State, Nigeria.

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Abstract

Formed consequent to the opening of the South Atlantic in the early Cretaceous, the Dahomey Basin is an arcuate coastal Sedimentary Structure, the on-shore part of which underlie the coastal plain sands of Southwestern Nigeria and Benin and is limited eastward by the Okitipupa basement ridge among other localities. Papalanto (long. $3^0 13^0$E and Lat. $6^0 54^0$N) harbours one of the largest surface outcrops of Ewekoro Limestone that easily attracts attention. 17 Schlumberger array Vertical Electrical Sounding (VES) were done in Papalanto to determine the overburden to and thickness of the Limestone and to quantitatively estimate its reserve. Results which were buttressed by some well information reveal a thick overburden of between 3m and 16m made up of silt, clay, sand and shale. The thickness of the limestone is between 3m and 40m: (the thickest being at Fashola, VES 17) averaging about 28m. The reserve was therefore calculated to be 7.7×10^8 m^3 for the limestone deposit at Papalanto.

Key words: Vertical Electrical Sounding, Reserve estimation, Limestone thickness, Schlumberger array, Geoelectric layer.

1.0 INTRODUCTION

The Dahomey Basin within which Papalanto falls extends from South East Ghana in the West to the Western flank of the Niger Delta. It was formed consequent to the opening of the South Atlantic probably during the Cenomanian (Adegoke and Omatsola, 1981). There was a rift generated basement subsidence during the lower cretaceous along an RRR triple junction (Hurley and Rand, 1969). This resulted in the deposition of a thick pile of continental grits, limestone and pebbly sands over the entire basin.

It contains about 3000m thickness of sediments which is thickness off shore (Coker and Ejedawe, 1983). The basin is an accurate coastal depression and the on -shore part of it underlies the coastal plains sands of South-Western Nigeria, Benin and Togo. A faulted high, the Okitipupa basement ridge separates the Dahomey basin from Southern Benue Trough.

2.0 LOCATION AND GEOLOGY

The area is approximately bounded by longitude 3^o 13'E and latitude 6^o 54'N (fig 1). It extends from Abesse, 4km east of Papalanto along Papalanto – Shagamu road to Ogun River, 3km east to Iro community. The Ewekoro Formation at the type locality Ewekoro is composed of 11m – 12m of limestone. It is sandy at the base grading downward into Abeokuta formation. The Ewekoro Formation is overlain of Phosphatic Glauconitic grey shale (Jones and Hockey, 1964). The limestone is classified (based on microfacies) into biomicrosparite, shelly biomicrites, algal biosparite and phosphatic biomicrites in that stratigraphic order.

3.0 MATERIALS AND METHOD

Field survey was undertaken in the dry season (November – December, 2008) and later in the raining season (late April, 2009). 17 Schlumberger array Geoelectrical sounding were made in the area and the distribution is seen in figure 2.

Field data were plotted as usual on a log-log scale and was smoothened. They were subsequently interpreted following the conventional standard and procedure as outlined by Parasnis (1972). Figure 3a shows a typical H-type curve from the area studied. The Geoelectric parameters derived from the aforementioned interpretation (i.e. resistivity and thickness) were subsequently used as starting models (input) for a computer assisted iterative programme – RESIST developed by Vu7ander (1988). Available well data conformed to VES results (see for example fig 3b).

4.0 RESULTS AND DISCUSSION

The sounding curves reflect the presence of between three and five Geoelectric layers. The curves are of the H, HA, HK, QH, QQH, QHK, HKH types. The interpretation results are in Table 1 while Figure 4 shows the cross section AB across VES 13, D8, and 01 around Ajio.

The limestone of Papalanto has a very thick overburden ranging between 3m and 16m and its thickness ranges from 1.5m in Jaguna to as high as 38.2m in Fashola. It is 10.2m at Abesse, 11.0 in Apode and 9.3m in Sokan, with resistivity ranging from 59 – 9659 ohm in Table 2. At Fashola, limestone thickness is 38.3m and mean overburden of 7.7m; giving a stripping ratio of about 1:4 suggesting that mining the deposit will be economical in principle.

5.0 ORE RESERVE DETERMINATION

The area in consideration has a dimension of 9.5km by 18.0km, the thickness of the limestone is 16.m while the specific gravity is 2.7g/m^3 (Kearey and Brooks, 1992), therefore the reserve is 9500m x 18000 x 16.8 x 2.7 =7.75 x 10^8 m^3 (cubic meters).

6.0 CONCLUSION

The typical 3 – layer sequence that overlies the Ewekoro limestone is composed of clay, sand and shale. There are also some alluvium and lateritic deposits in some places. Limestones occur below this rock sequence with varying thickness and resistivity. The range of overburden thickness is between 2m to 16m while the limestone thickness ranges between 1.5m to 38.2m. The reserve estimation was calculated to be 7.75 x 10^8 cubic meters and adjudged to be of economic value if exploited especially around Fashola town.

TABLE 1: Summary of Layer Interpretation of VES

	RESISTIVITY (OHM-M)					THICKNESS (M)			
VES NO.	LAYER 1	LAYER 2	LAYER 3	LAYER 4	LAYER 5	LAYER 1	LAYER 2	LAYER 3	LAYER 4
01	2114	620	15	3910	-	0.8	3.1	4.6	
02	26	6	2	4	113	1.1	0.2	0.6	16.5
03	21	10	15	75	-	1.6	0.2	0.6	
04	51	12	16	150	-	0.7	1.5	15.4	
06	125	15	15	18	-	0.5	0.5	4.7	31.4
07	155	5	376	161	139	0.6	2.9		
08	483	287	198	18	2827	0.5	2.9	1.7	6.4
10	1418	240	15	15	10,000	0.8	2.4	1.3	1.4
11	34	10	60	10	528	1.6	5.7	5.1	32.5
12	516	56	30	4131	-	1.7	8.3	3.5	
13	244	1057	451	130	80	1.1	1.7	1.5	8.9
14	1200	510	109	18	48	1.6	1.7	1.5	3.9
15	814	147	19	80	35	1.2	1.5	2.5	12.5
16	598	15	85	-	-	1.0	15.5	-	-
17	401	14	54	20	-	1.2	6.5	39	-

TABLE 2: Summary of results at specific locations

LOCATIONS	DEPTH TO LIMESTONE (M)	LIMESTONE THICKNESS
ABESE	8.6	10.2
APODE	5.6	11.0
SOKAN	16.7	9.3
FASHOLA	7.7	38.3
IJU	5.0	12.4
JAGUNA	3.5	1.6

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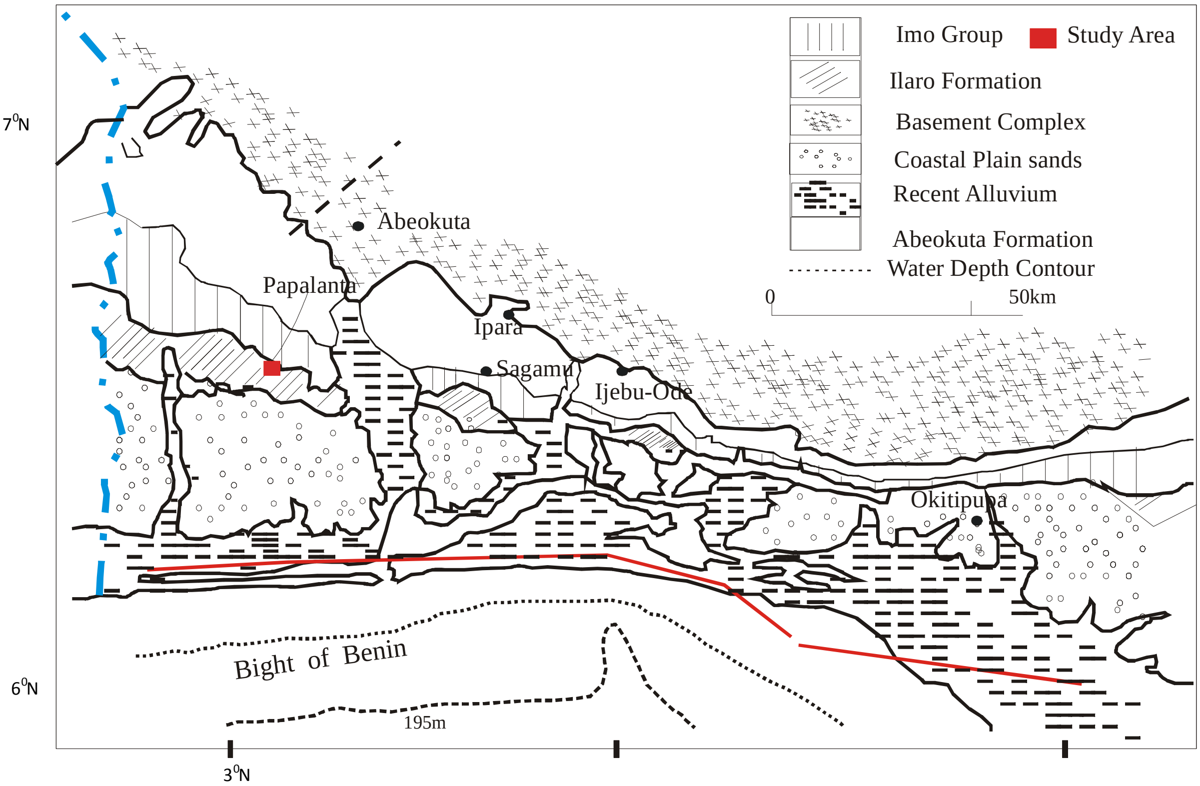

Fig.1 Geological map of Eastern Dahomey Basin (after Agagu 1985)

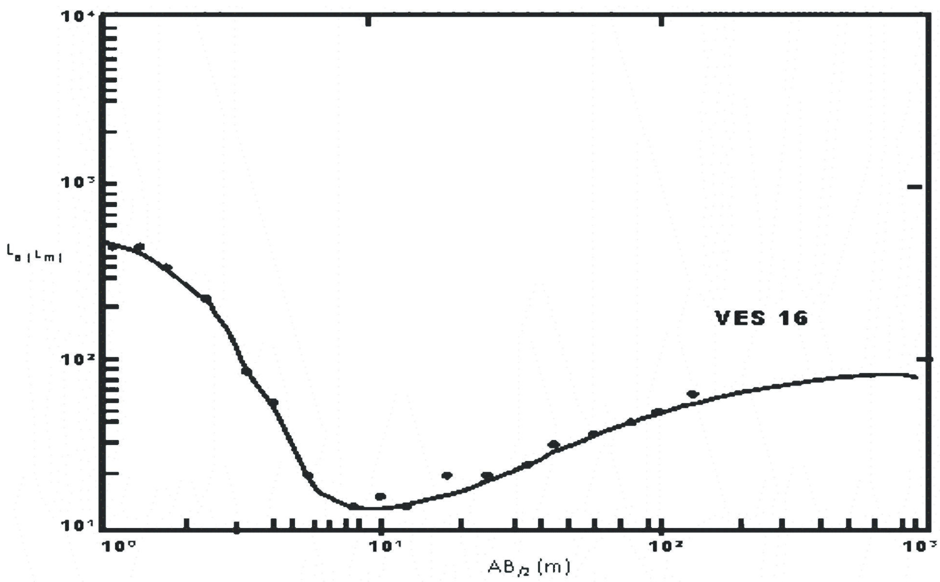

fig.2: Typical H type curve in the area

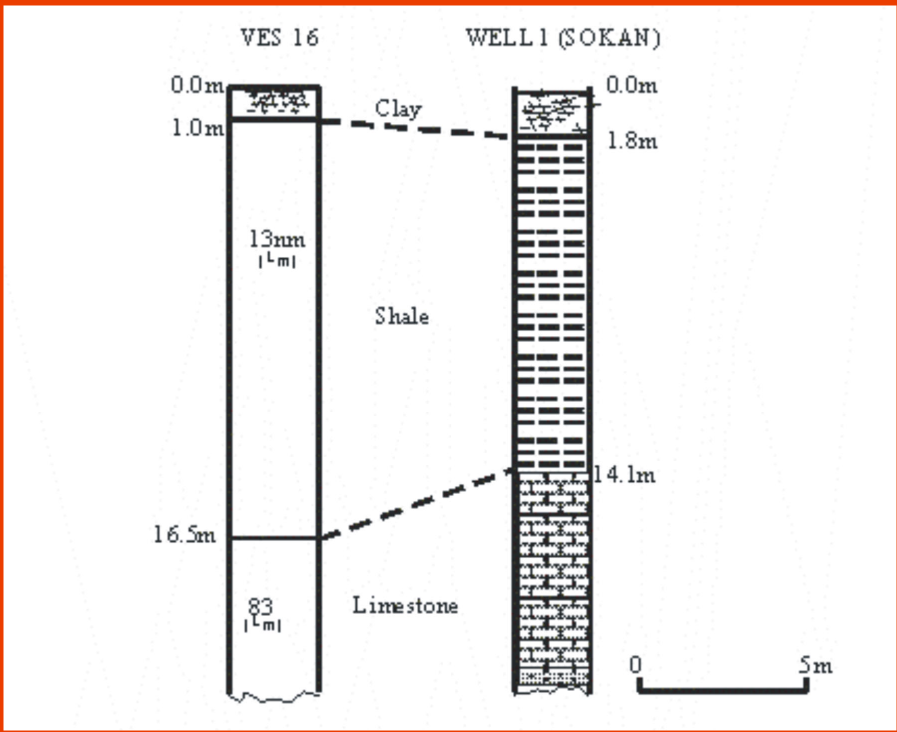

fig.3 : Correlation of resistivity interpretation with available well data for the H type curve in the study area

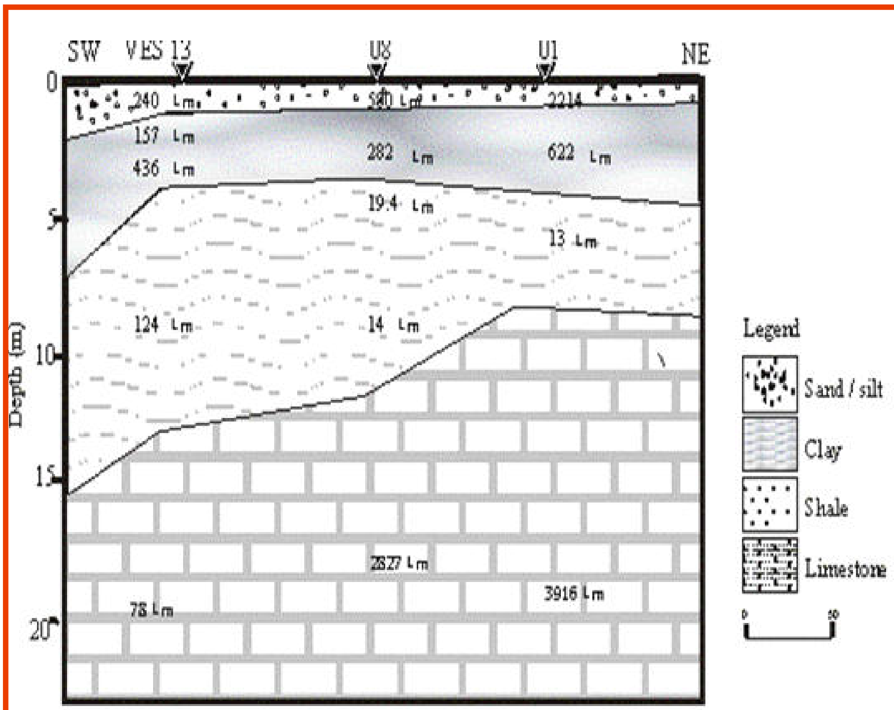

fig.4 : Geoelectric section through VES 12-08-01 around Ajio

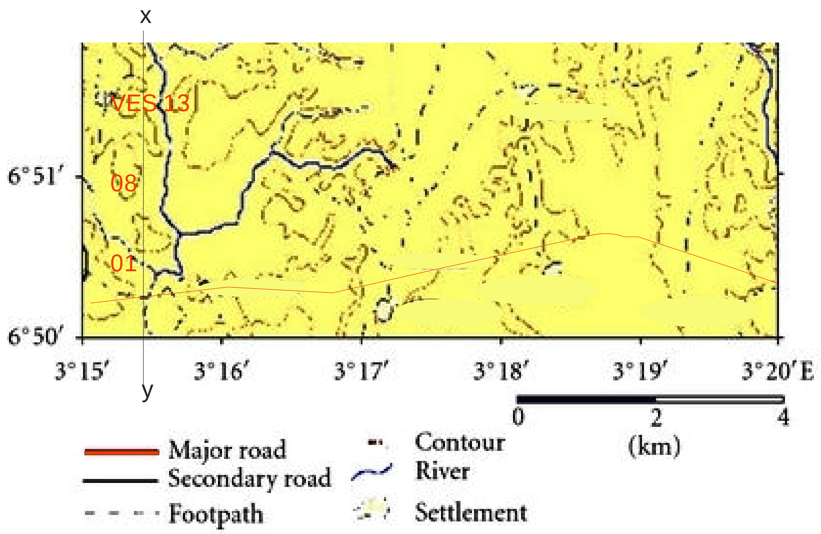

fig.5: Geoelectric contour map of study area showing shot points(VES 18-08-01)

Fig.6 : Chart comparing depth-to-limestone and limestone thickness