Forestalling the Drilling of False Prospects in the Abraka Area of Delta State: The Weathered Layer (A Case for Consideration).

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ABSTRACT

In-line profiling (LVL Survey) was carried out in site 2 of Delta State University, Abraka, latitude 5.77^0N and 5.85^0N and longitude 6.08^0E and 6.17^0E. the source of energy was dynamite buried in 1m holes at offset distances of 40m, 105m and 170m. Twelve (12) Geophones were used as the detectors and the recording instrument used was the portable OYO Mcseis –160. the analysis of the data obtained revealed two prominent layers with velocities: V_0 = 308m/s and V_1 = 1653 m/s, for the weathered and sub-weathered layer, respectively, and a thickness of Z = 3m for the weathered layer. With knowledge of the thickness of the weathered layer, depth to which shot holes should be drilled is ascertained.

(Keywords: geology, in-line profiling, Niger Delta, geophones, weathered, sub-weathered)

INTRODUCTION

Before now, the search for oil and solid minerals was confined to deposits easily observable on the surface, in the form of seeps and outcrops or other exposures. These days however, as a result of advancement in technology and the huge sum involved in exploration and drilling, the earth scientist no longer requires any geological observations on the surface to deduce internal earth content; with physical measurements at the surface and with appropriate adjustments or corrections, he can infer the presence of deposits (Taner, 1974). The earth scientist will need to make some corrections because, a few meters below the earth, the soil is characterized by loose unconsolidated rock or soil material (the weathered layer), which attenuates high frequency component of seismic energy by absorbing it. Since this high frequency component contain more information about the sub-surface, this layer must therefore be removed, so that, shots be taken below it (Dobrin, 1988). The weathered layer, with its quite low seismic velocity often between 230m/s and 1,000m/s,(Schneider, 1985) also causes a disproportionately great and variable time delay in the arrival of the desired deeper reflections. A knowledge of the velocity and thickness of this layer in Abraka which this work seeks to ascertain, increases the accuracy and validity of surface measurements, thus forestalling the drilling of a false prospect in that region.

STUDY AREA

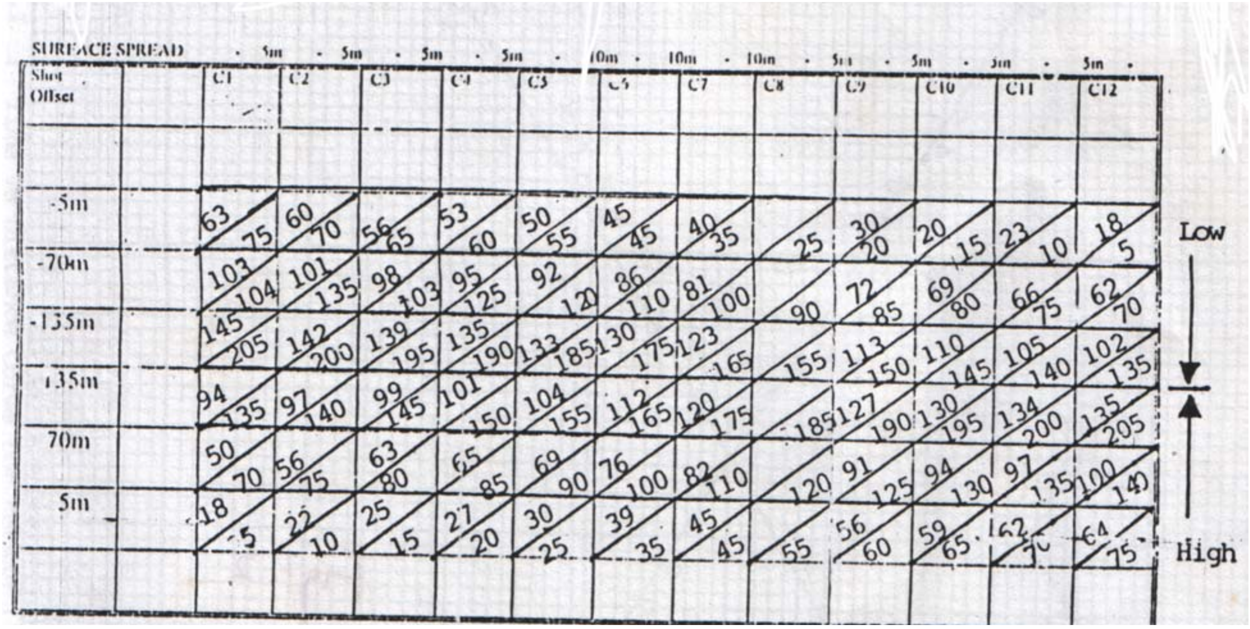
The site of the project was site 2 (Campus 2) of Delta State University, Abraka (see Figure 1). Abraka lies between latitudes 5.76^0N and 5.85^0N of the equator and 6.08^0E and 6.17^0E of the Greenwich meridian, in Ethiope-East Local Government Area. It is connected to big towns/cities like: Agbor, Sapele, Warri and Benin by a good network of roads. Abraka in the recent past hosted companies like: Integrated Data Services Ltd, (IDSL) and United Geophysical Nigeria Ltd, (UGNL).

Three types of soil are distinguishable in the Abraka region: alluvial mud, humus soil and clayey sandy soil

METHODOLOGY

Refraction seismology using In-one profiling (LVL survey) was employed, one meter holes were drilled within the weathered layer, for burying of explosive charges, at both sides of the M-peg, at offset distances of 40m, 105m and 170m. Twelve (12) geophones are connected via a 105m telemetric cable to the OYO Mcseis-160 recording instrument (seismograph).

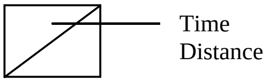
Table 1: Table of Values for Spread 1.



SURFACE SPREAD · 5m · 5m · 5m · 5m · 10m · 10m · 10m · 5m · 5m · 5m · 5m ·

Shot Offset		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	
-5m		63 75	60 70	56 65	53 60	50 55	45 45	40 35	25	30 20	20 15	23 10	18 5	Low
-70m		103 104	101 135	98 103	95 125	92 120	86 110	81 100	90	72 85	69 80	66 75	62 70	
-135m		145 205	142 200	139 195	135 190	133 185	130 175	123 165	155	113 150	110 145	105 140	102 135	
135m		94 135	97 140	99 145	101 150	104 155	112 165	120 175	185	127 190	130 195	134 200	135 205	
70m		50 70	56 75	63 80	65 85	69 90	76 100	82 110	120	91 125	94 130	97 135	100 140	
5m		18 5	22 10	25 15	27 20	30 25	39 35	45 45	55	56 60	59 65	62 70	64 75	High

Data for Shot Location
State: Delta, Nigeria
Date: March 5, 2008
Recording Instr.: McSeis
Channels: 1-12
Energy: Dynamite



The cable has twelve (12) take out points for the geophones (G1 to G12). The first geophone was planted at 5m offset. This is followed by four (4) geophones separated by 5m, then three (3) geophones at 10m separation, followed by another set of four (4) at 5m separation. To record data, the charges are detonated in order of increasing shot distance, from one side of shot-point normally regarded as low end (G12 to G1), and data is recorded. The traces of shots are shown in the wiggles below. For each shot we have 12 traces, with first break picks decreasing as offset increases and vice-versa.

With first break times and their respective distances known we now plot a graph of time against distance two curves are obtained, representing the curves for the low and high side, (see Figure 1 and Table 1) and then employing Snell's law of refraction and the crossover distance method, we obtain the thickness of the weathered layer as:

$$Z \quad = \quad \frac{1}{2}\,\frac{(V_1 - V_0)^{½}}{V_1 + V_0}\ \text{Xcros}$$

where V_0 and V_1 are the velocities of the weathered and sub-weathered layers for a 2 layers earth with $V_1 > V_0$ and Xcros is crossover distance; and for the direct wave, slope $=1/V_0$ and for the refracted wave slope $= 1/V_1$. The crossover distance is the point where the direct ware meets with the refracted ware, at this point $T_0 = T_1$

RESULTS AND DISCUSSION

Processing of the LVL data consist of picking and analysis of the first arrivals. Because of the problem of easy accessibility to a computer processing software, first break pick was done manually (by reading out the values of the kick – up positions on the trace). The traces are presented below and the first break times and their respective distances are shown in Table 1. The Time V_s Distance graphs for the values in Table 1 are represented by Figure 1.

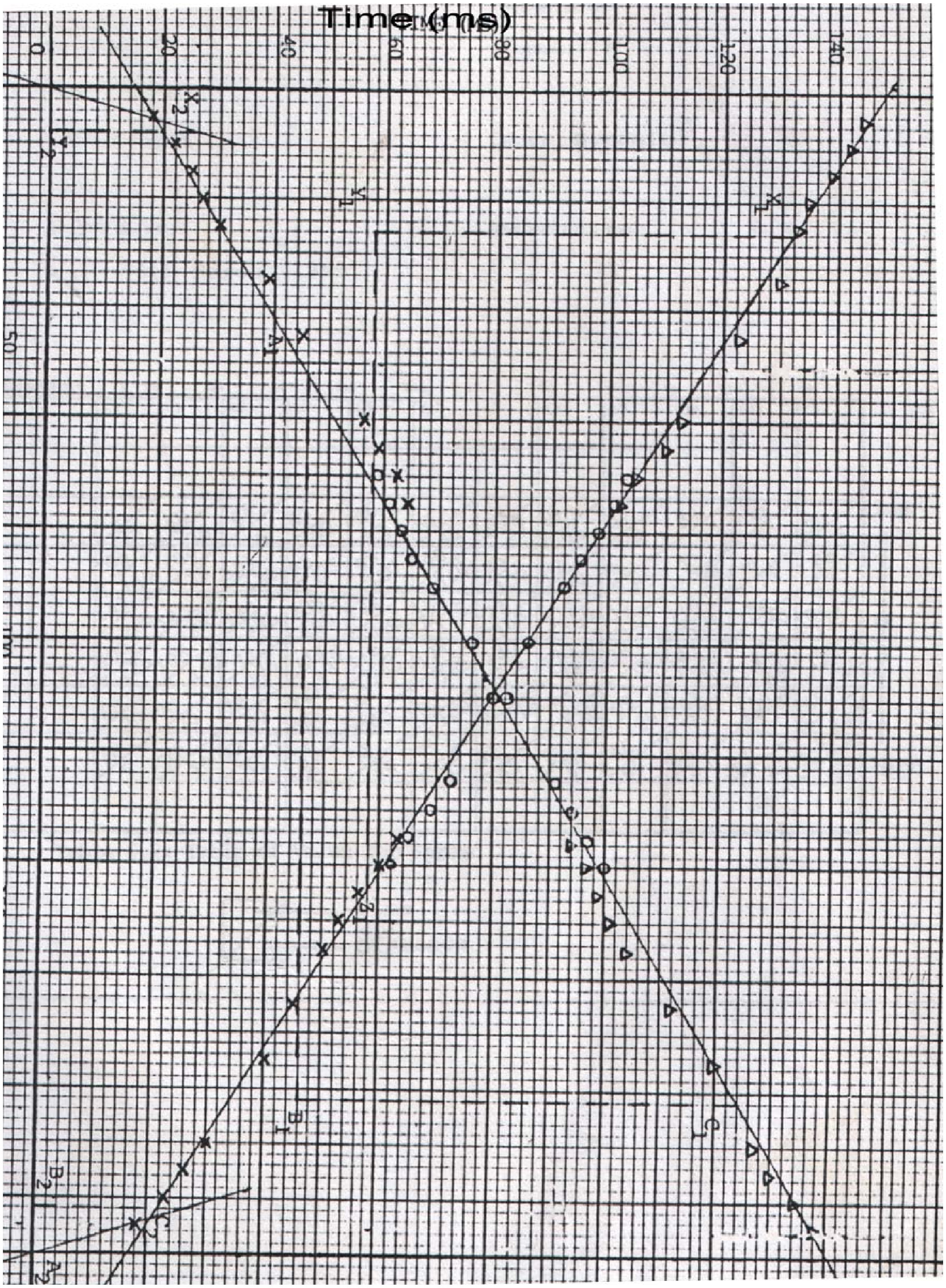


Figure 1: Time vs. Distance Curve for Spread 1.

From the Time V_s Distance curve, the crossover distance is obtained thus:

$Xcros_1$ = 5.9M - first curve
$Xcros_2$ = 6.1m - second cure
Xcros = $(Xcros_1 + Xcros_2)/2$ = 6m

V_0 is the same for both curves, and

$$\text{Slope } \frac{(1)}{(V_0)} = \frac{X_2 - Y_2}{Y_2 - Z_2} = \frac{26 \text{ X } 10^{-3}}{8}$$

and V_0 = 308 m/s

Also, V_1 is obtained thus:

$$\text{For first curve, slope } \frac{(1)}{(V_{II})} = \frac{X_1 - Y_1}{Y_1 - Z_1}$$

$$= \frac{76\text{x}10^{-3}}{30}$$

and V_{II} = 1711 m/s

$$\text{For second curve, slope } \frac{(1)}{(V_{II})} = \frac{C_1 - B_1}{B_1 - A_1}$$

$$= \frac{74\text{x}10^{-3}}{118}$$

and V_{I2} = 1595 m/s

$V_1 = (V_{11} + V_{12})/2 = 1653$ m/s

and the thickness of the weathered layer, Z now becomes:

$$Z = \frac{1}{2} \frac{(V_1 - V_0)^{½}}{(V_1 - V_0)^{½}} \frac{\text{Xcros}}{\text{Xcros}} = \frac{1}{2} \frac{(1653 - 308)^{½}}{1653 + 308}$$

$$\simeq 3.0$$

$$Z = 3.0\text{m}$$

The velocities of the weathered and sub-weathered layer were found to be 308 m/s and 1653m/s respectively. A knowledge of these velocities helps in among other things to:

- Ascertain the nature of the soil at this and other locations.

- Determine refraction static correction simply to prevent good reflection arrivals from stacking out of phase and prevent all layers from being located deeper or shallower than they really are:

- Determine the thickness of the weathered (overburden) layer, the purpose of this work.

- Establish suitable optimum charge depth.
The thickness of the weathered layer was found to be approximately 3m, with this known, appropriate near surface corrections can be applied.

CONCLUSION

This work focused on ascertaining the thickness of the weathered layer, a knowledge of which is needed in applying appropriate near surface corrections. Seismic refraction prospecting was employed in this work. The LVL survey data obtained was processed with a basic knowledge of the principle of refraction (Snell's law).

From the results obtained, two prominent layers were discernable with velocities: V_0 = 308 m/s and V_1 = 1653 m/s. These velocities were then used to compute the thickness of the weathered layer which was found to be approximately 3m, the implication of this is that charge depths should be located below 3m.

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