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EARTHQUAKE PREDICTION IN AWI, AKAMKPA LOCAL GOVERNMENT AREA OF CROSS RIVER STATE, NIGERIA.

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ABSTRACT: *In earthquake prediction, the changes in the physical properties of the rocks are closely monitored. The parameters that are usually monitored include seismic P velocity, ground uplift, radon emission, electrical resistivity, number of seismic events, etc. This study monitored the seismic P velocity for a period of five years (2006 to 2010) in the study area. The data shows that the travel time of the seismic P waves did not change during the period under investigation and therefore the velocity of the P waves did not change. Consequently, we do not expect an earthquake to occur in the study area in the near future.*

KEYWORDS: Earthquake, Prediction, Seismic, P Waves, Velocity

INTRODUCTION

Nigeria is not located at any plate boundary and therefore one should not expect an earthquake to occur anywhere in Nigeria. However, because of the activities of many companies like the oil companies and other mineral exploration companies whereby explosives are used as a source of power, it is possible that the plate around these areas may be cracked and such areas will become prone to the occurrence of earthquakes.

Awi is located in Akamkpa Local Government Area in Cross River State, Nigeria. This area is chosen for the study because of the fact that many companies are quarrying for lime stone there. Many of these companies use explosives to blast the lime stones thereby causing artificial earthquakes in the said area. There is therefore a high possibility that the earth plate in the subsurface may be cracked. If the plate is cracked, then the entire area will become prone to the occurrence of earthquakes.

Earthquake prediction is the process whereby seismologists forecast the period within which an earthquake will occur, the location, the magnitude and its intensity. Once such a prediction has been made, it poses a lot of social and economic problems (Arthur, 1945). The problems include:

a) Reduction in public services
b) Reduction of public services
c) Financial changes such as change in investment patterns, and reduction in availability of insurance
d) There will be a decline in employment opportunities. A decline in efficiency of employers and employees, and a decline in property values and in property tax revenues.
e) There will be need for a temporary or even permanent relocation of the population.

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METHODS OF EARTHQUAKE PREDICTION

Seismicity patterns: The studies of the historical world seismicity patterns have made it possible to predict the probable places where damaging earthquakes can be expected to occur. However, we cannot forecast the precise time of occurrence from these records. In China, between 500 and 1000 destructive earthquakes have occurred within the past 2700 years. The statistical records have not been able to show sharply the periodicities between damaging earthquakes. The records have however shown that long periods of quiescence can elapse between great earthquakes (John, 1975). There is a time series in earthquake occurrence, and the technique of statistical analysis of point processes is used to locate the periodicities. This method of forecasting is essentially exploratory (Bruce, 1979).

Changes in seismic wave velocities: Precursory changes in a region cause the velocity of seismic waves through the region to change. This can be used to predict the occurrence of earthquakes. The fact that rock properties change before an earthquake, implies that the speed of seismic waves will also vary, and the travel times will vary according to the variation in speed. Such travel times can be measured with the help of seismographs and chronometers. If appropriate travel time residuals are plotted as a function of time, fluctuation will provide forewarning (Tarbuck et al, 1970). Some of the first information on precursory changes in travel times of waves in moderate earthquakes was published at the Todjikistan region of the then Soviet Union (Russia) in 1962. According the measurements, the P wave velocities decrease by about 10 to 15% for a while and then increase again to more normal value just before the main shock occurs (Mathew, 1972).

Changes in strain: There are always changes in the state of stress in the earth crust before an earthquake occurs. This may affect the water level in several ways, it may change the porosity of the rocks, causing pore pressure of the ground water to vary; it may change the passage ways of ground water such that initially isolated channels become connected and initially connected channels become isolated from each other; it may also tilt the ground to cause ground water to flow in seeking new equilibrium under gravity (Jeffreys, 1976).

Dilatancy model: The term dilatancy is generally used in describing an increase in volume relative to an elastic change. When rocks are stressed to fracture, they may become dilatants. The increase in volume begins when the stress reaches half the value needed to break it. Dilatancy affects various measurable parameters of the earth's crust. These parameters are seismic velocities which are the best known, ground and surface water levels, electrical resistivity, etc.

Dilatancy can be explained as follows, let the grains in a heap of rock particles be closely packed. If the rock is further compressed, it can only be compressed in the direction of the push. It will move in the opposite direction for compensation, because it was very tightly packed. The shape of the rock thus changes and occupies a bigger volume. As a result of increased pressure within the grains at the point of contact the rock becomes stronger and consequently able to store more elastic energy before collapsing (Leet, 1954).

The rocks inside the earth have their pores filled with liquid and dilatants materials. The volume of the pore space is increased by dilation caused by external pressure. Minute cracks are formed in the rocks which become bigger and the pressure subsequently falls. The pressure in the non dilatant area remains normal. The pore liquid therefore flows from the non dilatants region to the dilatants region, until the pressure is once again equalized. A dilatant rock loses its strength,

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and thus easily subjects itself to the occurrence of an earthquake. The velocity of the P waves through the region falls with the fall of pressure in pore fluid. The correction of the pressure deficiency causes the velocity of the P waves to return to normal (press et al, 1978).

Seismologists therefore keep a watch on the velocity of the P waves through a region and are therefore able to predict the occurrence of earthquakes. The warning is normally given in two stages. When the region is dilatant enough to produce a significant earthquake, the first alert is normally sounded. The magnitude of the expected shock depends on the time of delay; it also depends on the strength of the rocks and the rate at which the strain accumulates. If the magnitude of the earthquake is 7 in Richter,s scale, the first warning comes at least a year before the shock. When the velocity of the P waves and other anomalies start their return to normal, the danger period is reached, and the final warnings are normally given days before the shock (Bruce, 1979).

The physical clue of earthquake prediction is given in figure 1 below.

PHYSICAL CLUES FOR EARTHQUAKE PREDICTION

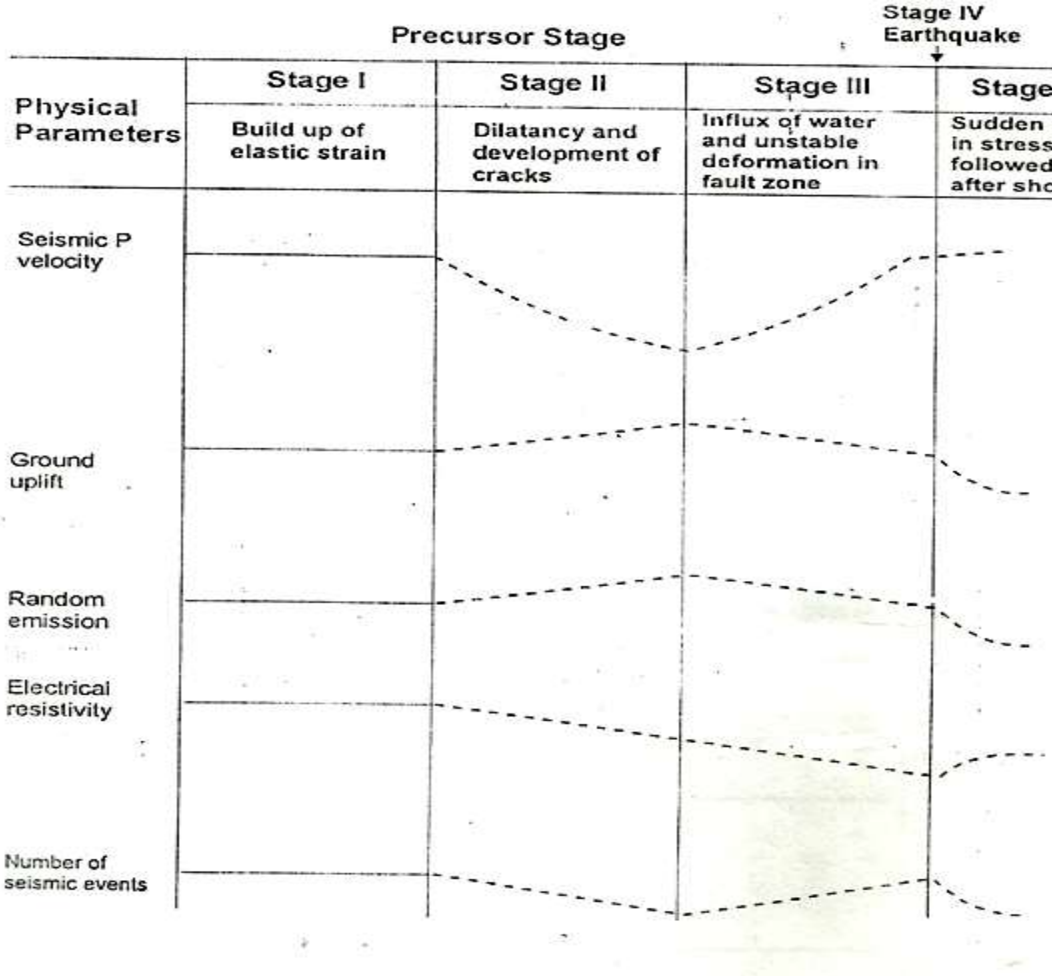

FIGURE 1 : PHYSICAL CLUES FOR EARTHQUAKE PREDICTION
(Source: Culled from G. A. Eiby 1982)

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Data collection: The data was taken at near market Awi (NMAW), town hall Awi (THAW) and forestry quarters Awi (FQAW). The travel time for the period of five years for the same distance did not change. The result for the period is as shown in the table below.

Distance (m)	TIME OF TRAVAL (SECS)		
	2006 to 2010 at NMAW (10^{-3})	2006 to 2010 at THAW (10^{-3})	2006 to 2010 at FQAW (10^{-3})
5	09.2	10.1	5.0
10	14.4	22.2	13.3
15	18.1	34.2	15.4
20	32.1	45.4	27.0
25	40.0	56.0	33.3
30	44.2	65.3	34.1
35	47.4	67.9	36.0
40	50.1	76.1	37.2
45	53.8	88.8	45.1
50	56.2	90.0	47.3

Table 1: Distance traveled and corresponding time taken in NMAW, THAW and FQAW, from 2006 to 2010.

Result and discussion: The data was obtained by seismic refraction method. The velocity of the different layers of the earth in the area was calculated. This was obtained by plotting a graph of travel time against the distance traveled. The result showed that within the limit of the measurement, the earth has two layers. The velocity in each of these layers is obtained by estimating the slope in the said layer and taking the inverse of the slope.

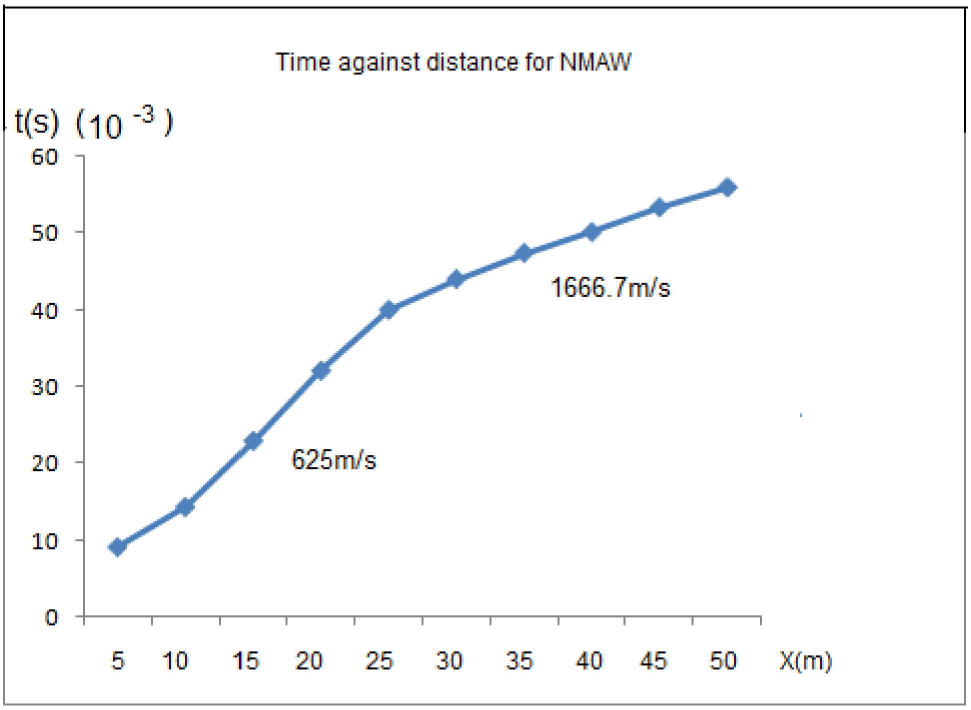

Fig. 2: Graph showing the relation between travel time in seconds and distance traveled in meters at Near Market Awi (NMAW)

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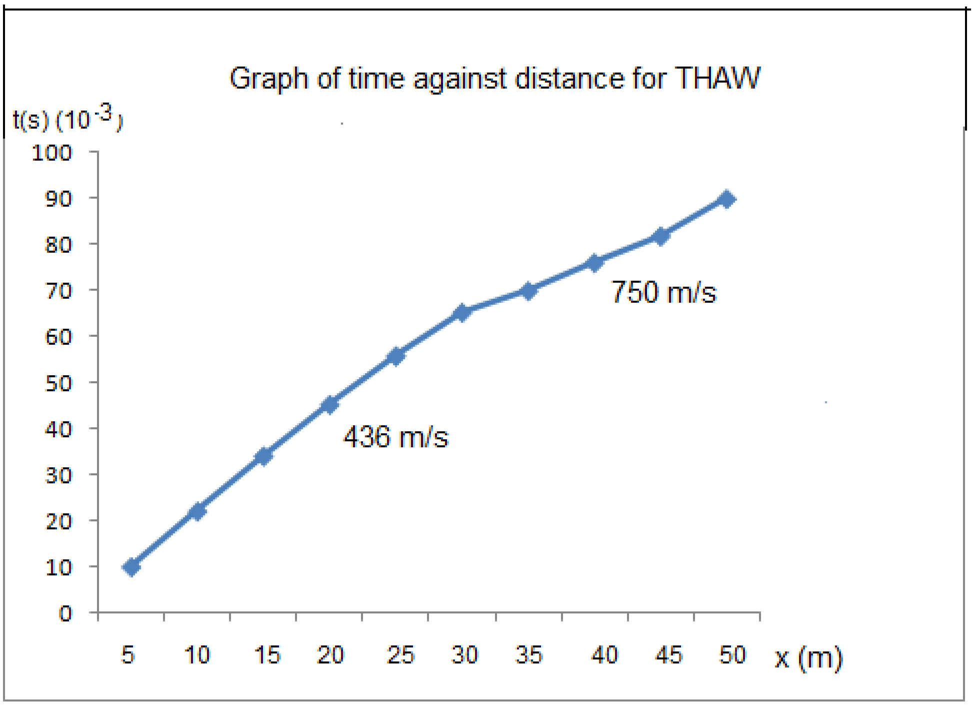

Fig.3: Graph showing the relation between travel time in seconds and distance traveled in meters atTown Hall Awi (THAW)

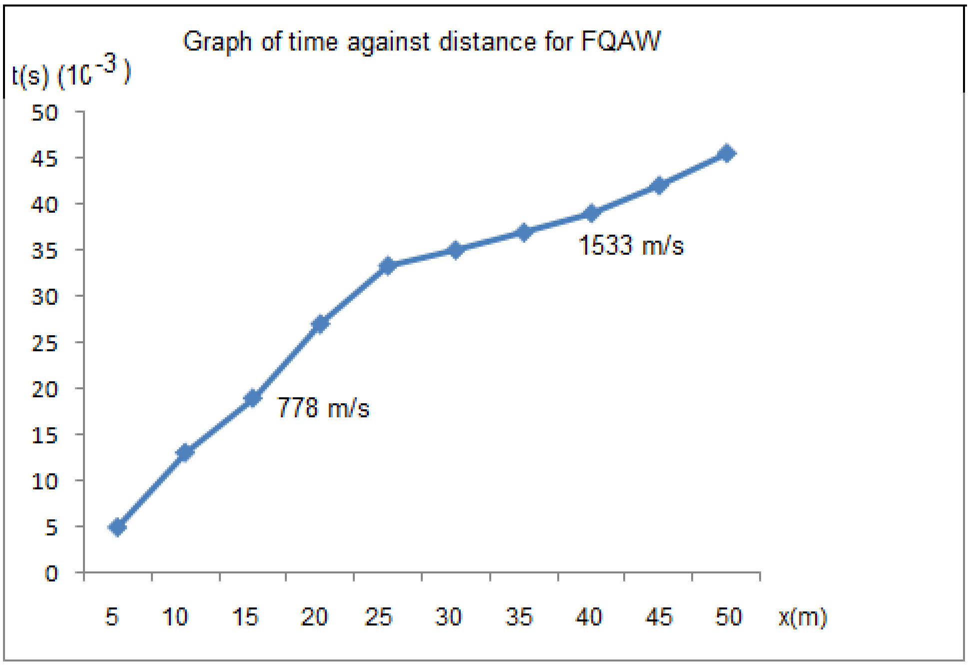

Fig. 4: Graph showing the relation between travel time in seconds and distance traveled in meters at Forestry Quarters Awi (FQAW)

The computation shows that the velocity of the first layer in new market Awi (NMAW) within 2006 to 2010 was 265m/s, while the second layer is a high velocity layer with a velocity of 1666.7 m/s. Within the same period, at Town Hall Awi (THAW), the velocity in the first layer was 436 m/s, while the second layer had a velocity of 750 m/s. Furthermore, at forestry quarters Awi (FQAW), the velocity in the first layer was 778m/s, while the second layer being a high velocity layer had a velocity of 1533m/s.

Warning would have been sounded if the velocity had fallen for a while before returning to its normal value.

CONCLUSION

This study shows that the velocity of the P waves across Awi has not changed from 2006 to 2010. It follows that there has been no change in the properties of the rocks around the area, consequently, an earthquake is not expected to occur in the said area in the near future.

REFERENCES

Arthur, N. S., (1945). Physical Geography. John Wiley and sons, inc. New York, London. Fourth edition.
Bruce, A. B., (1979). Earthquakes a Primer. W. H. Freeman and company, San, Fransisco.
Eiby, G. A., (1982). Earthquakes by Beight Sun Printing Press Co., Ltd. Hong Kong, Second edition.
Jeffreys (1976). The Earth. Syndics of Cambridge University Press, Sixth Edition.
John, E. O., (1975). Physical Geography, principles and applications. Duxbury, press, Massachuselts.
Leet, L. D., (1954)Physical Geology. Prentice Hall Inc.,England Cliffs, New Jersey, fourth edition.
Mathew, W. H., (1972). The story of volcanoes and earthquakes. Harvey house, inc. publishers, New York.
Press/Siever, (1978). Earth. W. H. Fleeman and Company, second edition
Tarbuck/ Lutgens, (1970). The Earth. An introduction to Physical Geology. Charles E Publishing Company.

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