GEOPHYSICAL AND GEOTECHNICAL ASSESSMENT OF A NEAR SURFACE GRANITE DEPOSIT

Abass Olusegun K[1], Bayewu O.O.[2]

1. *School of Environmental Studies, China University of Geosciences, Wuhan 430074, P.R China. (segunabass1@gmail.com)*
2. *Department of Earth Sciences, Olabisi Onabanjo University, Ogun State, Nigeria. (tejubpositive@yahoo.com)*

ABSTRACT

Geophysical and geotechnical assessment of a granite deposit at Ofagada, South-western Nigeria has been undertaken and the exploitation suitability of the deposit established.

The ground elevation of the area varies from 160m in the southeast to 195m (Ordinance/Elevation Datum) in the northern part. The soil thickness ranges from 1.5m to 23.6m consisting of weathered-rock cover or overburden; with the thickest overburden of 10m and above occurring in the north-western and south-eastern parts.

Taking a deposit; overburden minimum thickness ratio of 1:1 and a limiting 10m overburden, granite reserve estimates obtained for 170m, 160m and 150m elevation datum are respectively 442,410 tons, 1,717,263 tons and 3,708,544 tons. The granite deposit was found in viable quantity for quarrying. Geotechnically, the deposit has an average Compressive Strength of 28N/mm^2 and Young Modulus of 633N/mm^2

comparable to normal granites and related competent rocks suitable for use as aggregate material. .

Geophysical investigation was undertaken using the ABEM SAS 300C Terrameter. This equipment is equipped with an in-built digital display and recording system. Rechargeable 12-volt batteries coupled to the equipment provide the energy for the equipment operation. Schlumberger array method was used for the VES data acquisition and successive geo-electric layers beneath the surface were isolated.

The maximum current electrode spread (AB/2) between 15m to 80m was used throughout the study depending on the nearness of the basement in each location. The potential electrode spacing of between 0.25m and 2.5m was also employed, while equally maintaining the potential electrode and current electrode geometric relationship at MN < 1/5 AB. This is aimed at revealing the resistivity variation of the subsurface layers encountered and hence to determine the depth to bedrock in the entire area. The resistivity data and their contrast is then employed to infer the thickness(es) of the overburden and the underlying unweathered or altered basement rock(s).

The instrument displays the resistance of the area. The result was then multiplied by the 'Geometric Factor' to calculate the apparent resistivity of each point. The values obtained were then plotted on a log-log paper as points with the apparent resistivity values being on the vertical axis and the electrode spacing (AB/2) on the horizontal axis. The points were joined and curve matched manually using pre-calculated master curves and their auxiliaries. The resulting number of layers and the corresponding values and thickness, from the manual curve matching technique form the in-put model for the follow-up computer aided iteration of WINRESIST Program.

Fourteen (14) VES were conducted around the study area to determine the overburden thickness and depth to bedrock. The depth to bedrock obtained in the different VES points was used to produce an isopach map of the area. The depths obtained varied from 1.5m to 23.6m. The thickest overburden was observed at the north-western and south-eastern parts while relatively thin (under 7m) overburden were observed at the central-north, western and eastern parts.

The tonnage estimate was derived from elevation readings obtained from GPS, rock density and the overburden thickness of the area. Different grid methods were adopted in this exercise, the elevation map of the area was divided into 5 by 6 grids and average elevation was calculated for each grid. The length and breadth of each grid was measured to be 62m and 52.3m respectively.

The appreciation of the overburden thickness to the fresh basement rock surface is provided by the depth profiles along traverses 1, 2 and 3. The average thickness of the overburden over the whole area is 9m; an overburden thickness that is grossly high for convenient and profitable quarrying. Therefore, there is the need for selection and consideration of parts of the area for exploitation adoption. The criteria employed for area selection are

- minimum rock overburden thickness ratio of 1:1
- elevation differences of the fresh basement surfaces and,
- provision for quarrying infrastructure sitting on the area.

The reserve estimate calculations show that although high volume of overburden need to be removed to get to the fresh granite at the different elevation levels, the prospective granite tonnage is significantly very high to ensure satisfactory profitability. The granite overburden thickness ratios of 2 to 2.6 very much satisfy the universal profitability factor of thickness ratio of 0.5 for mineral deposits.

The overburden materials are not waste as they could be excavated and marketed as 'bulk-fill materials'. This will very much assist to mitigate the cost of accessing the fresh granite. The quarrying of the granite could thus be undertaken in stages to target the above considered 170m, 16om and 150m Ordinance Datum. If an exploitation rate of 250tons per day is adopted, the duration for exhausting the reserve estimates will successively be 6.7years, 26years and 56years.

In conclusion, the granite deposit has been found to possess geotechnical properties comparable to competent rocks commonly exploited as building and construction materials.