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Full Length Research Paper

Potential for rock polishing enterprises in Southwestern Nigeria

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Various igneous and metamorphic rocks constitute the basement complex especially much of southwestern Nigeria. They are composed of different proportion of felsic to mafic constitutions. Textural characteristics are also wide ranging. Based on petrographic and physical parameters, the majority holds good promise to be utilized for polished items. However, industrial exploitation may be constrained by a number of features, in some cases. On the other hand, sustaining viable projects in ornament stones, would demand support for further geological appraisals, technical facilities, adequate capital and relevant manpower.

Key words: Mining of rocks, porosity, environmental degradation, specific gravity.

INTRODUCTION

The basement complex of Nigeria, which outcrops prominently in the southwest, is composed of a variety of igneous and metamorphic rocks, host diverse types and grades of dimension stone or polished stones.

Dimension stone in its manifold uses, is an ubiquitous material in the industrial world. The desire and necessity to produce non-weathering high quality dimension stones at reasonable cost have increased the search for potentially viable production centers. The longevity and relative important of centres of stone processing has been and still is largely determining by the quality of the rock formation being mined (Elueze and Olugbenga, 2003).

As in most developing countries, these deposits of rock stones or high-grade geomaterials are commonly blasted indiscriminately in Nigeria and especially in southwest, thus the need to provide awareness and precaution for conservation and environmental protection (Elueze and Ogbe, 1998). In addition, undertakings in rock polishing are yet to be given appropriate attention; thus allowing for massive importation of finished decorative stones. The need therefore for evaluation of the crystalline rocks in Nigeria, is considered exceedingly worthwhile and desirable, not only for our local use, but also for exportation.

Geological Overview and Petrological Characteristics

The Precambrian terrain of southwestern Nigeria comprises igneous and metamorphic bodies such as gneisses, migmatites, pelitic and semi pelitics schists, psammitic rocks, matebasites, intrusives and associated massas including Older Granite ridges and pegmatites. The basement rocks often form well elevated topographic ridges and inselbergs, especially the gneisses and granites (Elueze, 1995).

A number of classification schemes have been proposed for the bodies. However, in this paper, it is considered rather appropriate adopting an essentially descriptive approach to grouping the following main varieties. Gneisses and migmatites, Quartzites and micaceous schist, Amphibolites and mafic schist Marble and calc-gneisses Bauchites, syenitic and charnockitic rocks. Gabbros, dolerites and lamprophyres.

Descriptions on the field and petrographic characteristics of the different rock types are readily available (Oyawoye, 1972: Elueze, 1982). Textural and compositional attributes are wide ranging. Directional fabrics such as foliation, lineation and lamination are often developed in the gneisses, schists, quartzites and

Table 1. Physical parameters of some of the basement rocks in southwestern ,Nigeria (mean values, with ranges in brackets) .

Rock type	Specific gravity	Standard strength index	Water absorption capacity (%)	Oil absorption capacity (%)
Gneisses and Migmatites	2.64 (2.48-2.80)	7.65 (4.30-10.50)	0.39 (0.29-0.51)	0.13 (0.08-0.22)
Quartzites and schists	2.52 (2.42-2.70)	5.49 (3.20-8.80)	0.56 (0.36-0.72)	0.23 (0.17-0.30)
Amphibolites	2.79 (2.73-2.89)	7.16 (5.40-10.07)	0.34 (0.28-0.42)	0.06 (0.05-0.08)
Granites and Granodiorites	2.67 (2.53-2.78)	7.13 (3.75-10.85)	0.36 (0.23-0.58)	0.08 (0.06-0.09)
Syenites and charnockites	2.79 (2.62-2.90)	9.38 (7.30-11.77)	0.31 (0.13-0.59)	0.09 (0.08-0.10)
Gabbros and dolerites	2.86 (2.72-2.93)	10.91 (6.75-14.50)	0.26 (0.18-0.32)	0.08 (0.06-0.12)

tectonized rocks. Granoblastic, porphyroblastic, nematoblastic, lepidoblastic and decussate textures are variedly found in rocks such as quartzites, schists, migmatites, amphibolites and marble.

Physical Properties and Appraisals

To evaluate the polishing qualities of the rocks, relevant physical variables, namely specific gravity, strength, porosity, abrasiveness and aesthetic luster were determined on representative samples as shown in Table 1.

From the basement rocks of southwestern Nigeria the specific gravity values was found differ from about 2.4 to 2.9; being highest in fine grained compact mafic varieties, notably dolerites and charnockites. Lower determinations are mostly from micaceous and schistose rocks and intermediate values are usually typical of the felsic and gneisses assemblages.

Strength discrimination of the rocks based on the point load tests, using the standard ranking of Deere and Miller (1966) and the modification by Bieniawski (1975) mean point load strength indices show that the specimens are of moderate to very high strengths. Again, the melanocratic types are commonly of very high strength (>8.0Mpa).

Porosity estimations were calculated as liquid absorption capacities. Both water and oil were considered, though the trends of variations are generally similar. Values for water and oil absorption capacities range respectively from 0.26 to 0.56 and 0.06 to 0.23%. the least percentages were obtained from units of high density and strength. Greater void ratios are applicable to the less compact samples.

Further scrutiny reveals that strength index which is notably anisotropic, is the most variable within each rock group. The metamorphic bodies having penetrative preferred orientations like banded gneisses. Laminated quartzites and micaceous schists record the highest levels of variability. In most cases, the minimum and maximum values were derived from specimes aligned correspondingly parallel and perpendicular to the pervasive directional fabrics. Of the granitic rocks, the porphyritic or porphyroblastic and coarse-grained types usually have the lower determinations of strength index and specific gravity.

Abrasiveness and aesthetic luster as ascertained on polished slabs likewise portray the differences in petrographic features of the rocks. Wide ranges of commercial products are obtainable as summarized in Table 2.

On the whole, sample generally display good abrasiveness, yielding attractive colour tints, varying from light to dark, as usually determined by the ratio of felsic to mafic constitutents. Besides, the more even-textured, finergrained and darker ones such as dolerites, amphibolites, charnockites and syenites yield better polished surfaces. On the other hand, the foliated rocks tend to provide tiles and slabs of changeable aesthetic qualities, with alteration in orientation of slicing.

Economic Evaluation and Investment Potential

The potential of rocks for polishing purposes are often based on some parameters (Table 1) notably, field attributes and relations, petrographic patterns and physical properties. In particular outcropping style, extent of exposure and degree of petrographic consistency are important indices in economic assessment.

In terms of the physical appraisals of density, strength, porosity and polishing tone, the basement units largely have good prospects to produce a wide range of commercial brands of products (Table 2). However, the restricted exposure and occurrences of veins, veinlets, enclaves, xenoliths, boudins, structural dislocations and weathering effects are obvious limitations to the

Table 2. Characterization of polished slabs of some basement rocks in Nigeria after (Elueze, 1995).

Rock Type	Potential commercial products	Application and Function uses.
Gneisses and Migmatites	Multicolor, diadema, nylandia orieta, vibro verde, spriana, African juparans and others.	Interior and exterior decoration, tiles
Quartzites and schists	Oakley schiefer, favang verde fundres, verde vermion, schiefer brands etc.	Interior and exterior, tiles.
Amphibolites and mafic schists	Verde shades, nero tones	Interior and exterior, momunentals.
Marbles and calc gneisses	Bianco brands, zebrino, maharani and so on.	Interior and exterior, monumental pulpit and altar slabs.
Granites, granodiorites and diorites	Grigio, star flash, serizzo verde lights, nero tijucas	Interior and exterior tile, stone items.
Syenites and charnockites rocks	Nero 'icheku', verde coloured tijucas	Interior and exterior, monumentals, counter, altar tops etc.
Gabbros and dolerites and lamprophyres	Nero oriental, verde, nero assoluto, grunporphyry.	Monumentals, tiles, stone items decoratives.

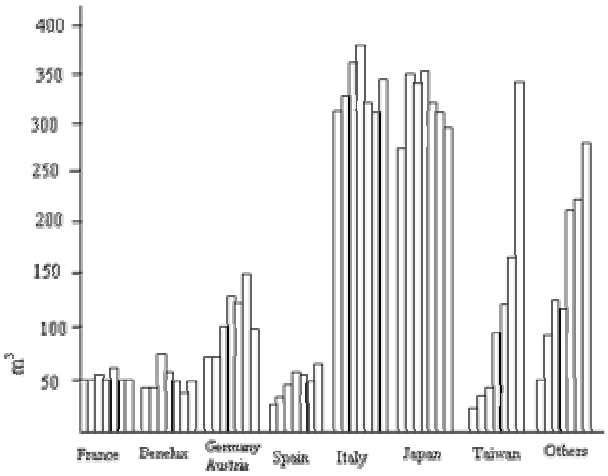

Figure 1. Raw granite block exports – principle receiving countries

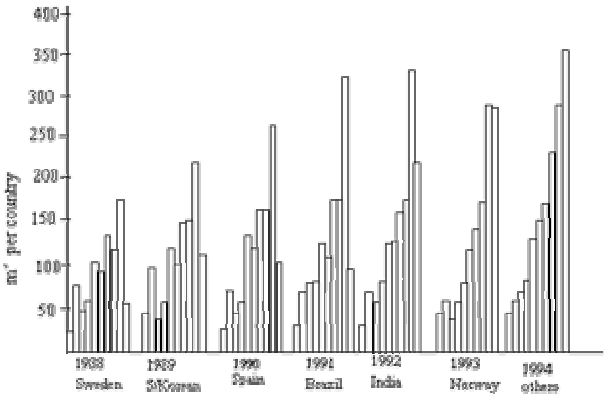

Figure 2. Raw granite block exports-principle exporting countries.

application of some of the assemblages. For instance, most of the mafic units such as dolerites, gabbros and lamprophyres which yield high quality polished slabs, are generally not extensive, being often found as dykes or minor bodies. On the other hand, the large charnockitic and syenitic masses, around Ikerre, osuntedo and Iseyin respectively plus the granitic and gneisses rocks of various colour tones around Igbo Ora, Komu, Okeho and north of Ibadan (reddish, pinkish, grayish, and darkish) hold better promise for utilization. A number of discrete deposits were estimated to have over 10m tones of readily workable materials.

Mining of rocks commonly results in environmental degradation consequently, there is need to design adequate monitoring and conservation strategies, for effecttive exploitation. Also, the current indiscriminate blasting and weakening of the outcrops would need to be checked, while further geological investigations and provision of geo-extension services are other prerequisites for developing the envisaged undertakings. As in most mineral based projects, especially where the raw materials are bulky and non-metallic, factors like the availability and cost of transportation access, utilities, labour, machinery and market, are likewise relevant to the viability of the enterprises. In particular the techniques and machines for drilling, jet piercing, splitting, cutting, shaping and polishing of rocks are more specialized, and would require greater investment funds compared to producing stone aggregate. It is hence advisable to locate the factories for the processing or finishing stages, proximate to the working sites, to reduce haulage expenses. The wastes should in addition, be utilized to source aggregates.

CONCLUSION

On the whole, the demand for embellishing and aesthetics rock products is considerably high in Nigeria and Africa in general and prospects for exportation are considerably bright (Elueze, 1994). Similarly, market potential for unfinished rock blocks are favourable especially in countries where greater emphasis is placed on environmental protection and regulation. (Figures 1 and 2). Therefore about $1m^3$ lock can be shipped abroad for cutting, shaping and polishing.

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