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Original Research

Comparative Analysis of Mineralogical And Geochemical Properties of Afghan And Surrounding Countries Marbles And Granites: Challenges And Opportunities

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Abstract

Twenty-two different granite and marble sample are currently being examined in labs. Stones are cut into thin section and observed under a polarizing microscope (Leica DM750P) with XRF (X-ray Fluorescence). Analysis and evaluation of the samples are broken down into percentages of silicon oxide, sodium, and potassium in the granites with SiO_2 at (52-65 wt.%), Na_2O+K_2O at (4.7-12.1wt.%) and mineral composition and percentage of rock-forming materials are broken down into potassium feldspar minerals at (32-40 wt.%), plagioclase at (25-35 wt.%), quartz at (5-10 wt.%), and accessory minerals at <1% with fluidal structures being determined. The percentage ratio of oxides and minerals indicates that these rocks, mainly correspond with grano-diorites and intermediate igneous rocks, such as diorites and andesite.

Marbles, like granites, were also analyzed and interpreted by the above two methods, due to presence of fossils and large amounts of impurities like Mud, Mica, Iron oxide, and silicates, these marbles are categorized into carbonate rocks of sedimentary origin and law quality marble which were formed in the lower degree of metamorphism.

Individual rocks have different erosion resistances because of dissimilar constituent minerals, formation conditions, and origin. Those with less resistant minerals, less water absorption, and porosity are more likely to be negatively influenced. Granites whit a higher amount of quartz, for example, have a higher degree of hardness, greater strength and durability than intermediate igneous rock, so they are more resistant to erosion.

Keywords: Marble, Granite, Petrography, Geochemistry, Market, Royalty and Tariff.

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1. Introduction

The Afghanistan geological survey (AGS), United states geological survey (USGS) and British geological survey (BGS) estimated the value of marble reserves in Afghanistan around $150 billion [1], [2] . emphasizes that "Afghanistan has the potential to supply Middle Eastern and Asian markets with an almost unlimited supply of marble". Moreover, most Afghan provinces have marble mines. According to recent geological findings, Marbles developed in rocks of Proterozoic age are considered to be the highest quality for use as dimension stone Afghanistan has also the best quality marble known as "Onyx marble" which is called by its local name as "Sang-e Rokham". Onyx is a banded variety of chalcedony, a cryptocrystalline form of quartz. Afghan Onyx deposits are located in Bamyan, Helmand, Parwan, and Faryab provinces. So far, 66 marble and granite deposits have been discovered in Afghanistan [3]. Furthermore, it is worth mentioning that the British Geological Survey report (Mitchell 2008) found that Chesht and Khogiani marbles have better quality than Carrara marble, an Italian marble recognized to be one of the best quality marbles in the world [4], [5].

There are many thesis, papers and reports, written by various institutions, which address the quality and quantity of Afghan marble. The physical-mechanical, mineralogical and geochemical characteristics of a large number of marble and granite areas of the country have been studied by the students of the Department of Geological Engineering and Mine Exploration of Kabul Polytechnic University (KPU). OTF Group (2006), Stephen (2007) and export promotion agency of Afghanistan (2006) discussed the potential of marble industry in Afghanistan that can be a driving force of the Afghan economy. the paper by Yahya (2009), using Porter's Diamond Analysis model, found a series of problems such as absence of cluster. His paper thoroughly analyzed the weakness and strength of Afghan marble industry. The model he employed was a management model – more helpful for existing firms to draw strategy for future.

This is the first research on the mineralogical and geochemical characteristics of these decorative stones. It should be noted that the selection of appropriate building stone with regard to various factors such as mineral composition, chemical, structure and texture as internal factors and erosion processes such as physical, mechanical, chemical and biological erosion as external factors and other factors with Climatic-Geological and geomorphological conditions of the environment should be more compatible to ensure the durability of the building. It is an important point that should be considered by civil engineers. Architects and engineers often face the problem of choosing the right stone, and often make their choices based on what they have heard from others with the wrong criteria [6], [13]. With the right choice, the durability, strength and beauty of the building can be increased and the cost of future repairs and renovations can be reduced. The first point to consider when choosing building stones is that stone is a natural material and is extracted from the heart of the earth. Therefore, we should not expect to encounter a one-handed product like ceramics, mosaics, etc. without changing the texture, color and design. Building stone has a beauty hidden in the heart of nature, and whoever chooses stone as a natural product must accept its

color and design. Typically, spaces in buildings are divided into the following categories according to the necessity of building stone:

1. Foundation of buildings;
2. Body of buildings;

The main properties of the minerals that make up the stones that we consider in this article for our study are textures, structures, mineral composition, chemical and color, which are based on the physical-mechanical properties of the stones (percentage of water absorption, porosity, specific gravity and saturation). Resistance properties (uniaxial strength, models of elasticity, point load coefficient, tensile strength) Mechanical and chemical properties and building stones are affected, or in other words, physical-mechanical and chemical properties of stones are a function of them and they are considered as major indicators. To be able to identify the major factors that play a role in selecting favorable building blocks [6], [13].

These studies also addressed the issues that marble industry faces in a crude way. A critical assessment of these reports would suggest that they all focus on the quality, quantity and the potential demand and supply of Afghan marble within domestic and foreign markets. Neither these reports rigorously study the market characteristics in order to find all underlying problems that curb potential growth of the industry; nor do they look at the market from an investor's perspective, by adopting a clear cost-benefit approach or simply explaining the profitability of this business for investors [6], [13].

The main objectives of this paper are to:

1. Understand the quality of imported marbles and granites by determining the composition of minerals, chemicals, textures and structures.
2. Comparison of the domestic marble sales market with imported marbles and granites considering the current situation in Afghanistan.
3. Investigating the Challenges and Threats of Afghanistan's Decorative Stones Sector.

In this research, several questions have been raised that each of the different dimensions has addressed the characteristics of these stones. The questions that arise are as follows: Afghanistan has great potential in terms of decorative stones, especially marble and granite. The question is why these stones are less considered by domestic and foreign buyers and what are the challenges and threats facing this sector?

Which mineral and chemical compounds do imported marbles and granites have?

What effect does the mineral composition, structure, texture and chemical composition of these stones have on their quality or not?

The necessity of this research was that so far no scientific studies on the quality of imported marble and granite have been conducted by any governmental or non-governmental institution, while more than 80% of the country's decorative stone markets are related to these marbles and granites [5]. It is widely used in construction without knowing its quality and effects. Therefore, determining the geochemical and petrographic characteristics of these rocks will not be without interest.

The next section explains the methods used in this paper for studying the marbles and granites mineralogical and geochemical properties. Section 1 Studies of mineralogical and geochemical properties of marbles. Section 2 Studies of mineralogical and geochemical properties of granites. Section 3 Investigating Opportunities, Challenges, Threats and Evaluating and Comparing the Sales Market of Imported Marbles and Granites with Domestic Marbles. Section 4 presents some recommendations to both public and private sectors for further enhancement of the marble market in Afghanistan. As a final point, the last section concludes this paper.

2. Materials and methods

This research was carried using the three following methods:
Library Method: The method is considered the initial part of the study, the related literature using research and review articles, thesis, textbooks, authorized websites were reviewed. This method aimed to find out the unrevealed and weakness points of previous studies carried out on the imported marbles and granites markets and deposits, also to select the proper analysis being used for the mineralogical, geochemical properties of marbles. The general information including the opportunities and challenges of the study area was provided by this method.

Field Observation Method: Fieldwork and sampling make a critical part of such studies. Therefore, field works in this study were carried out through several geologic transverses to study the macroscopic properties and to collect the samples from the selected points. The sample collection for lab analysis was conducted within the two phases of field works in the study area. 22 samples were collected including 12 samples during the first phase and 10 samples through the second phase petrographic and chemical results as shown in (Table 1-2) with their photomicrographs (Fig. 1-2-3-4).

Laboratory Method: The purpose of this method was the mineralogical, chemical, analysis of the collected samples to reveal the selected properties of marbles and granites. For reliable results, the samples were sent to the Mineralogical Laboratory of Afghanistan geological survey (AGS), Diamond Geo Engineering Services and Afghan Geo and mining engineering services (AFGHANITE). For chemical and mineralogical composition, the samples were subjected to X-ray fluorescence and thine section for the determination of the petrographic properties of the imported marbles and granites.

3. Results and comparison

3.1. Overview and Current Status of the marble sector

Afghanistan is home to 60 known deposits with as many as 35 varieties of marble in 40 different colors. With numerous high-quality deposits, the Afghanistan dimension stone industries has the potential to become a significant player in the Afghan economy and provide thousands of rural jobs at the quarries and in the downstream processing industries [3]. [5], [12]. The quality and quantity of Afghan deposits provides a comparative advantage which the industries can leverage to build a competitive advantage. Afghan white marble, primarily from the Spin Ghar mountain range in Nangarhar Province, is well known internationally as a high quality stone, but is difficult to get to market. Also, the deposits in Chesht and Khogiani marble from Herat are of top quality white marble very similar to Carrara marble from Italy [5]. Buyers in the Gulf Countries, U.S., Italy and neighboring countries currently purchase this marble and demand for it exceeds the available supply. Nine white cities are being created in Turkmenistan using Afghanistan white marble which has replaced imports of Italian marble. As perhaps the only source of high quality white marble in the region, Afghanistan enjoys a comparative advantage with other regional competitors based on the availability of raw materials, and with respect to Italy as a result of its proximity to market. The high value of the marble covers the higher costs from inefficiencies within the marble sector's value chain. Besides Chesht and Khogiani, numerous other deposits with export potential have been identified. The onyx deposit in Helmand is one of the few in the world and reputed to be of the highest quality; onyx currently sells for multiples of 3 to 5 times the price of marble in global markets. Principal areas of activity for marble are Herat, Kabul, Jalalabad and Kandahar and there is a deposit of white onyx in Maymana [4]. The U.S. geological survey estimated the size of marble reserves in Afghanistan to be over 9 billion tons – with an estimated value around $200 billion.

Table 1. *Estimated marble reserves in Afghanistan after [3], [4], [12].*

Province	Marble (Million M^3)	Granite (Million M^3)
Wardak	1500	-
Jalalabad	3500	-
Bamyan	-	2400
Badakhshan	1300	-
Herat	30	-
Helmand	300	-
Others	2500	-

Table 2. *Number of marble and granite reserves per province after [3], [4], [12].*

Kabul	Pawan	Nangarhar	Wardak	Bamyan	Panjshir	Laghman	Herat	Balkh
13 (M)	4 (TRA) 1 (OX)	5 (M) 2 (G)	2 (M) 1 (G) 3 (TRA)	2 (M) 1 (G) 5 (TRA)	8 (M) 7 (G)	2 (M) 1 (G)	4 (M)	1 (M)

M: marble, G: granite, TRA: travertine, OX: onyx
Figures in front of the brackets are number of reserves

Afghanistan annual marble production is around 124,000 to 155,000 tons, with over 50% of unprocessed marble going to Pakistan and Iran markets. Afghanistan consumption of finished

marble is around 270,000 tons with approximately 80% of the domestic market being dominated by Pakistani finished marble. Currently the total value added of the Afghan marble industry is around $105 million which makes 0.6 percent of GDP [5]. In this research, more attention has been paid to the geochemical and mineralogical characteristics of imported marbles and granites, which are described below.

3.2. Petrography and Geochemistry of marbles from surrounding countries of Afghanistan

9 samples of different marble species were prepared for petrographic and geochemical studies from the samples brought from the market for this purpose and studied under polarizing microscopy and X-Ray Fluorescence (XRF). The summary of this study is as follows:

Imported marbles are classified into three categories in our opinion in terms of their degree of purity, mineral composition, structure, texture and their genesis.

Table 3. *Comparison of petrographic properties of Wardak and Chesht with the imported marbles.*

Major and accessory mineral of marble from the market and Chest (Herat) and Wardak	Samples	Description	Main mineralogy	Accessory minerals	AGS	MGS	Texture	Geneses	References
	M-1	Grey-White	Cal+Fossils	Clay+FeO	Medium	1.80	Bio	Carbonate Rocks	Research by Authors
	M-2	Dark grey	Cal+Fossils	Clay+FeO	Medium	1.10	Bio	Carbonate Rocks	-
	M-3	Yellowish	Cal	Clay+FeO+muscovite+Biotite	Medium	2.10	He	Marble	-
	M-4	White	Cal+Fossils	Clay+FeO	Medium	3.50	Bio	Carbonate Rocks	-
	M-5	Grey	Cal	Clay+FeO+muscovite+Biotite	Medium	2.40	He	Marble	-
	M-6	White/Striated	Cal	Clay+FeO+muscovite+Biotite	Medium	1.65	Ho	Marble	-
	M-7	White+Pinkish+veins	Cal	Clay+FeO+muscovite+Biotite	Medium	1.14	He	Marble	-
	M-8	White+many grey veins	Cal+Fossils	Clay+FeO	Medium	1.72	Bio	Carbonate Rocks	-
	M-9	White+few red/ grey veins	Cal+Fossils	Clay+FeO	Medium	2.03	Bio	Carbonate Rocks	-
	HA-01	White	Cal	FeO	-	-	Granoblastic	Metamorphic	After Asadi [15]
	WR-02	Withe	Cal	Clay+FeO	-	-	Granoblastic	Metamorphic	After Khpalwak [16]

Table 4. *Major oxide geochemistry of the studied marble as compared to those of Chesht (Herat) and Wardak marble after Asadi and Khpalwak [15], [16].*

Sample ID	SiO_2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	K2O	P2O5	SrO
M-1	4.68	0.04	0.92	0.23	0.23	0	61.14	0.24	0.04	0.35
M-2	2.12	0.03	0.85	0.09	0.123	0	67.3	0.10	0.056	0.03
M-3	0.97	0.01	0.51	0.06	0.456	0	66.74	0.03	0.07	0.02
M-4	2.45	0.01	0.59	0.11	0.89	2.45	65.05	0.11	0.08	0.05
M-5	0.69	0.03	0	0.04	0.58	0	68.46	0.03	0.09	0.02
M-6	1.56	0.02	0.62	0.14	0.89	0	66.72	0.02	0.12	0.03
M-7	3.09	0.02	0	0.07	0.011	0	65.66	0.01	0.13	0.03
M-8	1.41	0.03	0.54	0.09	0.30	0	67.5	0.04	0.45	0.05
M-9	1.15	0.03	0	0.76	0.24	0	67.8	0.04	0.23	0.03
HA-01	0.86	-	-	-	-	-	99	-	-	-
WR-02	1.32	-	-	-	-	-	98.5	-	-	-

On the basis of macroscopic and petrographic observation, the rock samples are subdivided into three different category (Figure. 1-2-3).

1. First Category

These marbles are up to 96% pure and are composed of pure calcite, have a low degree of mineralization and are considered as a hidden crystalline structure. And a high degree of metamorphism are formed. And 4% of impurities in these marbles have caused the quality and quality of these marbles (Figure 1).

2. Second Category

In this category, the impurities are slightly more than the first category, which mostly interferes in the crystal lattice of calcite, minerals and other elements and changes the color and marble structures of the building. Is located. Marbles are formed due to the presence of calcite grain crystals in a low degree of metamorphism. The degree of mineralization of these marbles has reduced the attractiveness of the marble façade (Figure 2).

3. Third Category

In this category, in addition to the large amount of impurities, most of the slides are fossils that can be seen even by the naked eye. Geologically, they are among the sedimentary rocks. And most of the samples taken from the decorative stones market of Kabul city, except for 4 types of marble, most of them have been stabilized as carbonate rocks. Also, major impurities are clay and silicate minerals that are secondary to the joints and joints created by tectonic movements, and are seen as streaks (Figure 3).

Figure 1. Photomicrograph of imported marble under A, B, C, D XPL and PPL. The minerals identified in the thin section are calcite, biotite and muscovite.

Figure 2. Photomicrograph of imported marble under E, F, G, H XPL and PPL. The minerals identified in the thin section are Calcite, Clay and FeO.

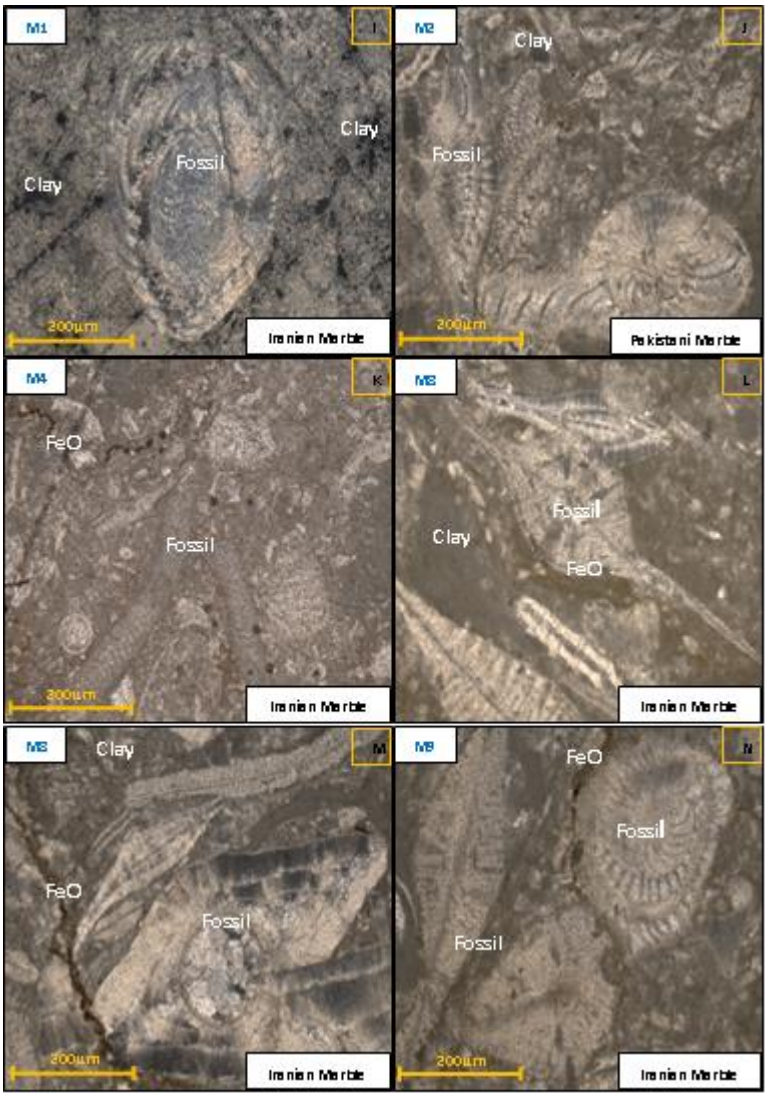


Figure 3. Photomicrograph of imported marble under I, J, K, L, M, N XPL and PPL. The minerals identified in the thin section are Calcite, Fossils, Clay and FeO.

3.3 Petrographic, Mineralogical and Geochemistry of selected granite varieties from the markets

13 different types of imported granites were taken from all markets in Kabul and the samples were numbered in order and other specifications such as exporting country, sampling date, sampling purpose and other specifications were entered and sent to the laboratory to prepare slides or thin sections. Section) and transferred for geochemical testing by XRF machine and after its completion have been studied under a polarizing microscope (Leica DM750P) and with the results of these slides are made of different types of imported granites. In the composition of these slides, the minerals of Potash-Sodium feldspar, plagioclase, quartz, biotite, muscovite and mineral minerals such as mineral and apatite are observed.

Microscopic images of 13 different types of granite, which are mostly imported to Afghanistan from Iran, Pakistan, China and India, and are sold under the name of granite. The percentage proportionality of the basic minerals shown in Figure 6 indicates that most of these granites belong to the medium composition magmatic rocks, which undoubtedly plays an important role in its quality.

Based on the percentage of sodium-potash chemical feldspar, on average 50%, plagioclase 25%, quartz 10%, biotite and muscovite < 5%, apatite and mineral ores less than 1 percent in the composition of these rocks. Sodium-potash chemistry feldspar, plagioclase and quartz, each of which is more than 5%, are the major minerals in the rock composition, and biotite and muscovite minerals, which are < 5%, are minor minerals, and apatite and sediment, each of which is less. From 1 percent, they are considered as accessory minerals in the composition of stones. The main petrographic features of these stones are clearly seen in Figure 4 and Table 4.

Considering the minerals that make up the rocks and the characteristics of the studied slides, their texture is mass and fluidal, and the names of the rocks except G1, G2 and G3, which in terms of their petrographic and geochemical characteristics correspond to the rocks of the acid composition rocks. The rest have been diagnosed with moderate composition (andesite, diorite).

It should be noted that granites, including magmatic rocks of acidic composition with a quantity of silicon oxide more than 65% and the expansion of quartz mineral in which the basic mineral role is 25 to 30, which during studies by polarizing microscopy and XRF results The percentage of silicon oxide and the percentage of potassium, sodium and calcium oxides correspond to the average composition stones. The results of these studies and their comparison are shown in Figure 4 and 5.

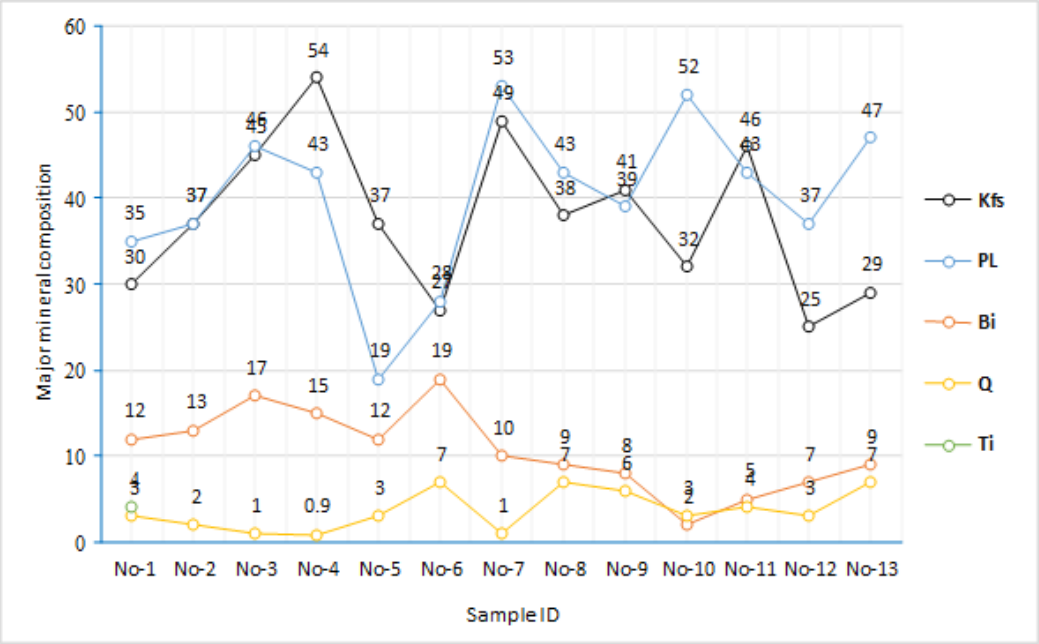


Figure 4. Modal mineralogy (normalized to 100%) of selected samples from surrounding of Afghanistan countries'.

*Abbreviations: Pla=Plagioclase, Kfs= K-Feldspar, Qtz=Quartz, Biot= Biotite, Mus=Muscovite, Epi=Epidote, Apt=Apatite, Hor=Hornblende, Cpx=Clinopyronene, Orx=Orthopyroxene, Cal=Calcite.

Table 4. *Major oxides geochemistry (wt. %) of granite from the markets.*

No-13	No-12	No-11	No-10	No-9	No-8	No-7	No-6	No-5	No-4	No-3	No-2	No-1	Samples
51.09	6.52	58.0	58.31	51.6	52.1	63.55	56.02	56.9	52.2	55.4	80.66	73.80	SiO_2
11.6	62.3	2.86	3.3	12.11	11.10	2.61	3.65	2.68	3.39	1.98	4.06	3.36	CaO
11.65	1.76	10.15	12.08	17.15	14.13	12.91	11.75	10.01	11.09	9.96	9.98	9.13	Al_2O_3
0.80	0.25	2.90	4.25	0.79	3.13	4.31	4.08	3.85	4.02	4.84	3.71	3.22	K_2O
3.52	0	0	0.77	3.54	0	0	0	0	0	0.91	0	0	MgO
11.23	0.39	1.67	2.64	9.73	4.50	3.60	2.99	2.03	2.15	1.44	1.51	0.48	Fe_2O_3
0.18	0.05	0.04	0.09	0.11	0.11	0.07	0.06	0.05	0.04	0.03	0.04	0.04	MnO
0.89	0.04	0.11	0.37	1.02	1.19	0.49	0.24	0.19	0.19	0.14	0.11	0.02	TiO_2

Granites of surrounding country of Afghanistan are composed more then 50% of K-Feldspar and Plagioclase except in the markets poor in silica minerals (Qtz=<10%) in most occurrence granites show Phaneritic texture with medium to coarse-grain size (1-10mm). A selection of microphotographs in crossed polarized light images is shown in figure 5.

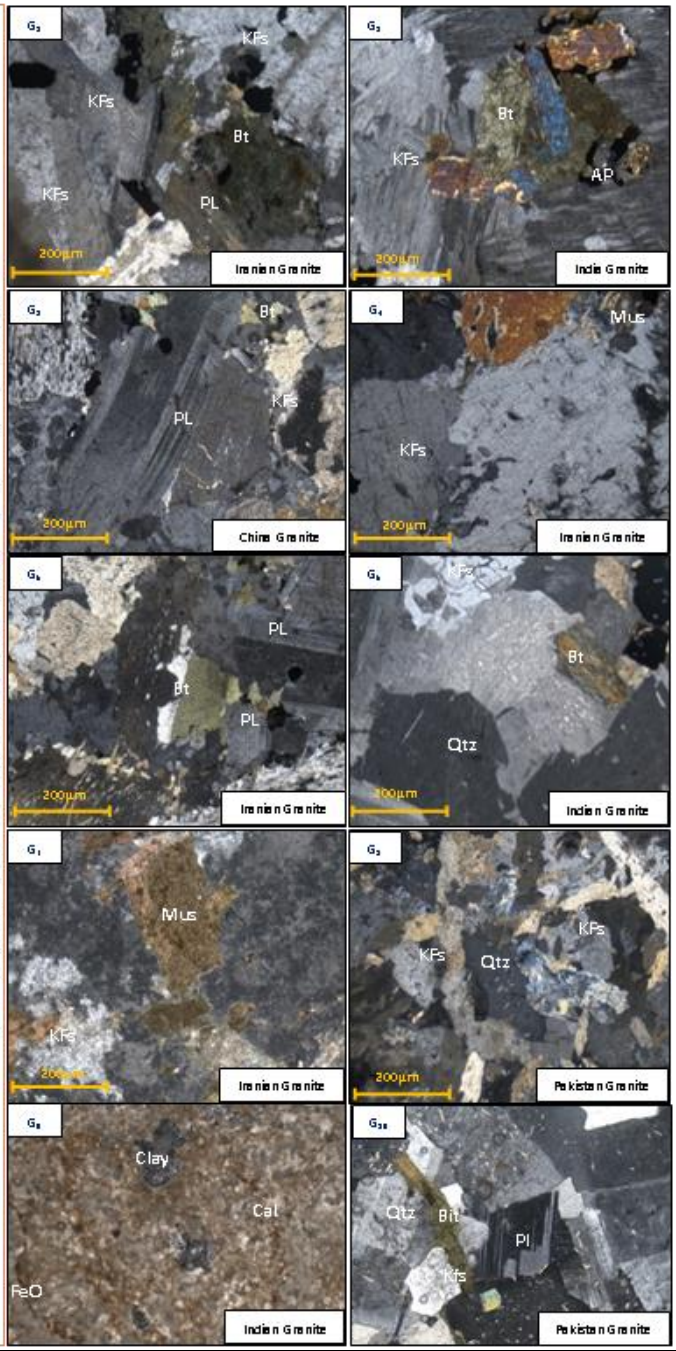


Figure 5. Polarized light photo micrographs of thin-sections showing minero-petrographic features in the investigated samples of granite having mass, coarse-grained, fine-grained and porphyritic texture with straight, curved, embayed, grain boundaries. Polarized light photo micrographs of plagioclase grain showing poly-synthetic twining, Alkali feldspar, quartz, biotite, muscovite, apatite and titanite. All photographs are taken ender cross Nicolas; 4^{x} and 10^{x}. See text and figure 4 for details.

Another issue to be discussed in this article is the market evaluation of these marbles and granites, which has been compared with domestic marbles and granites in the current situation. Afghan marbles, despite their excellent quality, do not have a very good market because these marbles are sold at very high prices to domestic and foreign markets, which only a few people can afford. The price comparison per square meter of domestic and imported marble and granite is shown in Figure 6 and Table 3.

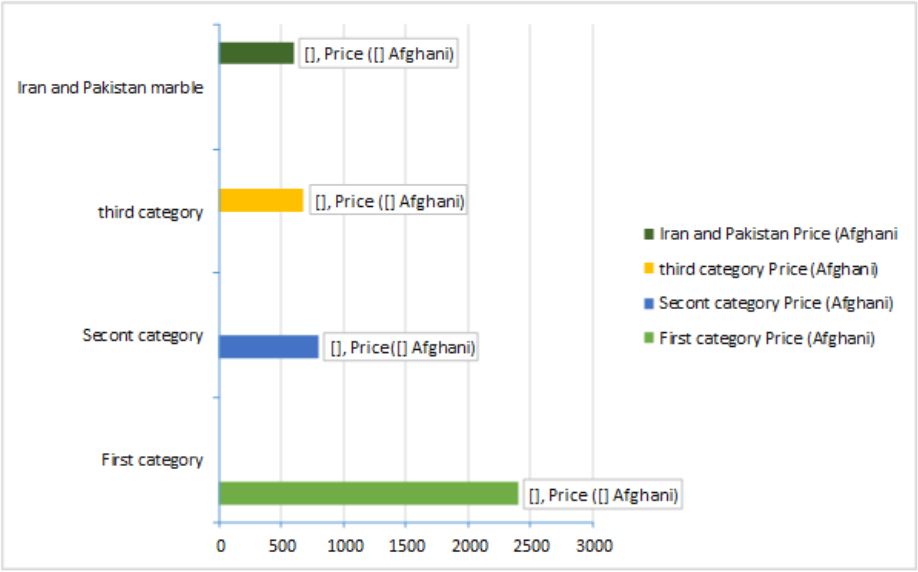


Figure 6. Price comparison of Afghanistan, Iran and Pakistan marbles from markets.

Despite having large reserves of magmatic rocks (granite and diorite) throughout the country, there are no such rocks in the market, while it can satisfy the domestic market and be exported to countries in the region. In the table below, the price per square meter of granite is sold in the domestic markets based on its color.

Table 5. *Price comparison of China, Iran, Indian and Pakistan Granite form markets.*

Price (Afghani)	Quantity	Name and origin of product
1800	100cmx60cmx2.5cm	Iran
2500	100cmx60cmx2.5cm	China
2000-4000	100cmx60cmx2.5cm	Indian
2400	100cmx60cmx2.5cm	Pakistan

As the price per square meter of marble is reflected in the chart above, in contrast to imported marbles, especially Pakistani and Iranian marbles are offered at a very low price in the market.

According to the analysis of the situation in the country and the security situation in the mining fields and other factors that were studied and researched during the authors' study of the decorative stone market, among other factors, more than 10 main

reasons have caused the high price of Afghan marbles, which are shown and described in figure 7 below.

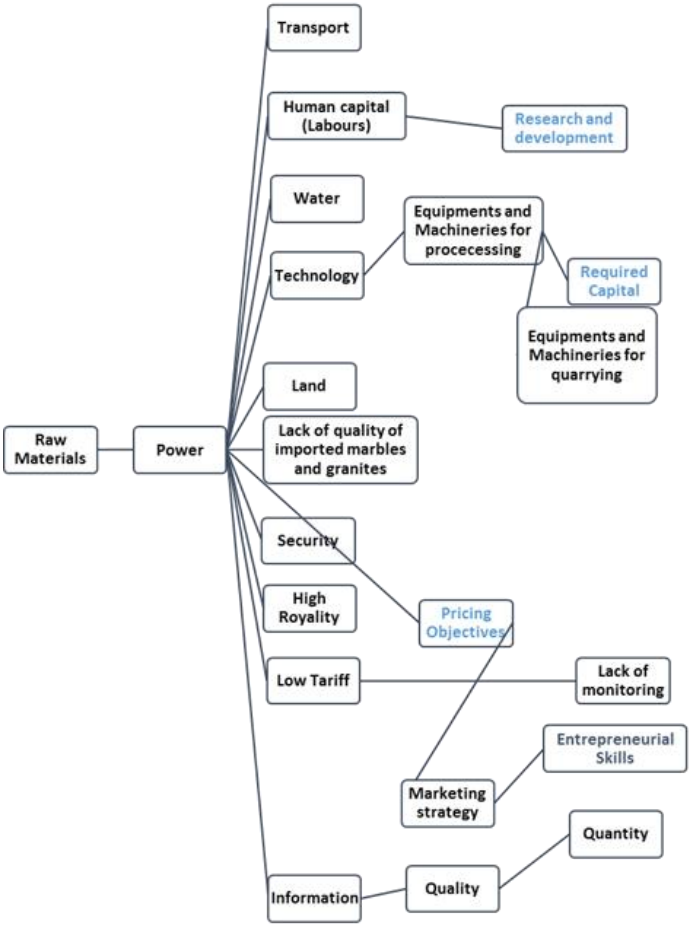


Figure 7. Summary of marbles and granites challenges and constraints [4].

Afghan marble is divided into three types in terms of cost. Premium or high quality category costs at least 2000 Afghani per square meter. This type of marble can not compete in the domestic market, because Pakistan and Iran marble is sold in the market for about 400 to 600 Afghani per square meter. Second and third grade marble, priced at up to 800 Afghani per square meter, can compete by raising tariffs on imported decorative stones. The chart below compares the maximum tariffs imposed on imports in neighboring countries, the region and Afghanistan. As can be seen, the lowest tariff has been set by Afghanistan.

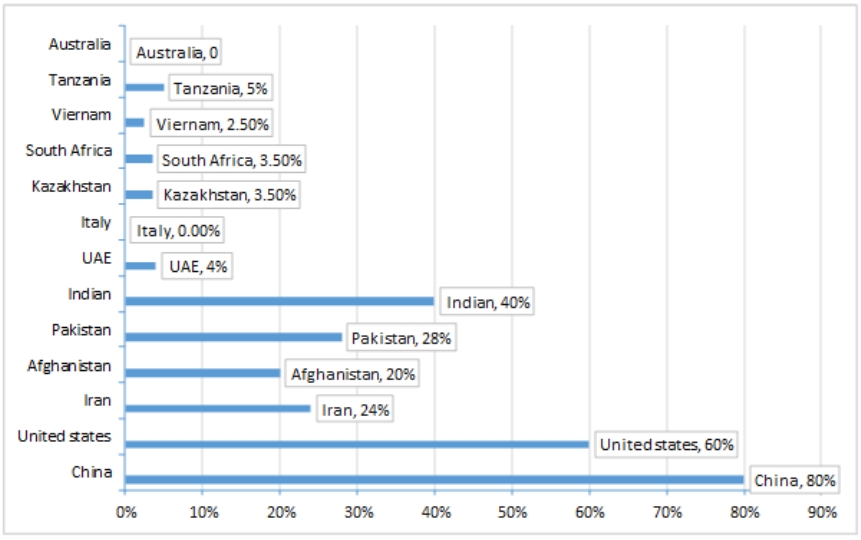


Figure 8. The maximum tariff imposed on the import of marble, adapted after ministry of finance [5], [12].

In Afghanistan, the royalty rate for marble (and other decorative stones) is not fixed and is determined by contract. The realities of Afghanistan are greater than in any other country.

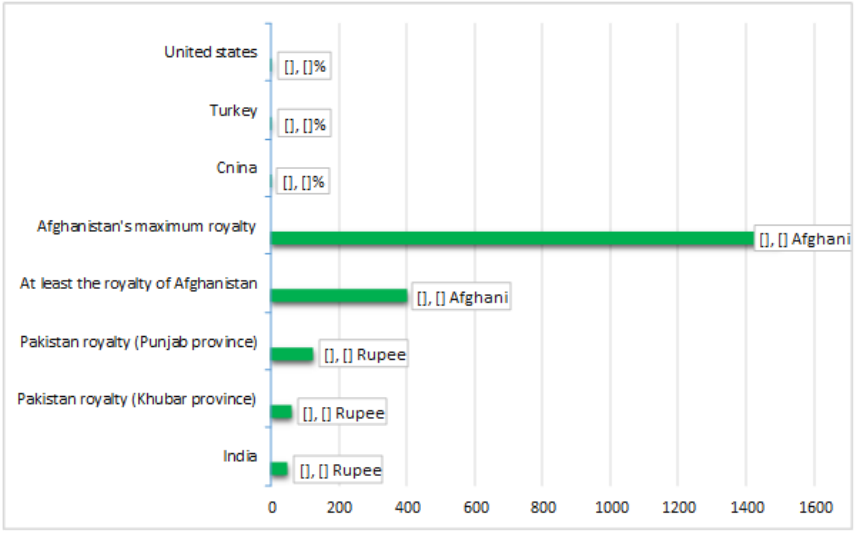


Figure 9. Royalty comparison of Afghanistan with top 7 importing and exporting countries, adapted after ministry of finance [5], [12].

Note: Most countries impose marble royalties after sales, subtracting transportation and tax costs.

According to our calculations, the cost of extraction, transport, processing, polishing and finishing of one ton of Chesht and Khogiani marbles is around $100, whereas that of Tara Khil marble is around $60. This cost variation is due to location and availability of public goods such as energy, road and market access. Also we found that, if quarries and processing plants employ standard technology, one ton of marble can produce 10m2 of slab or 30 slabs – each having 1m length, 30cm breadth, and 2cm thickness (see Figure 10). For further details of calculation, please refer to Figure 11.

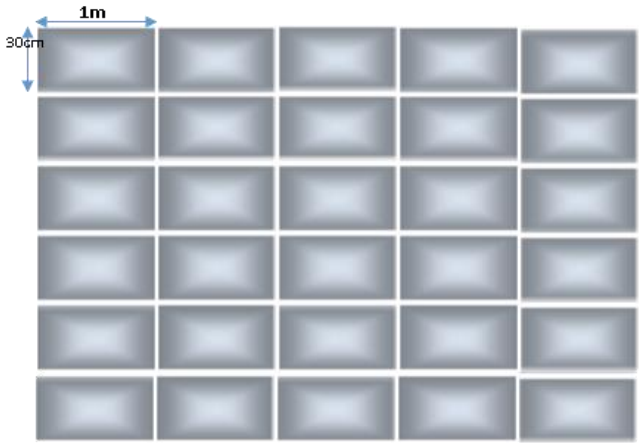


Figure 10. One ton of marble can produce 30 slabs [4], [7].

The market price of 1m Chesht marble (with 30cm breadth, and 2cm thickness) is $24 to $28, while 1m Afghan White marble is sold at a price between $16 and $20, and the Tara Khel marble is priced $10 to $12. Normally, 30 percent of the final price is the profit of retailers. Therefore, the net profit of marble producers (both in quarrying and processing activities), calculated as the total revenue minus total cost and retailers' profit, is $476 for the Chesht marble, $322 for Afghan White marble and $222 for Tara Khel marble. Table 6 estimates the profit margin for different types of Afghan marble [9].

Table 6. *Profit margin estimates for different types of marble adapted after MOMP* [4].

Products	Total revenue from 1 ton	Total Cost per ton	Retailers profit	Net Profit	Profit Margin
Chesht (Herat)	$780	$100	30%	$476	61%
Khogyani (Jalalabad)	$540	$85	30%	$322	60%
Tara Khil (Kabul)	$330	$60	25%	$202	61%

Table 6 shows that the average profit margin of marble quarrying and processing in Afghanistan is over 60 %, whereas in countries such Italy, Egypt, and India, which

are the largest producers of marble, the profit margin in the marble business ranges between 20 and 40 %. Among all firms working in marble quarrying and processing, only two firms (one in Herat and the other in Jalalabad) use standard equipment and technology. The rest of the firms in Afghanistan employ traditional and unproductive methods such as blasting, cutting with hummer, polishing with hands, etc [9].
There are two reasons that firms do not employ standard and productive technology. one is the lack of competition among firms, which is influenced by market structure, and the other is lack of public goods–such as industrial parks, access to electricity, transport infrastructure, etc. – that firms cannot do much about it.

Due to the lack of technology, 73% of Afghan marble is exported in raw form to neighboring countries. And a ton sells for about $ 40. This is while a ton of marble is obtained for 30 slabs, and each slab with a size of 1cmx30x2cm is sold in the market for 600 to 800 Afghani. If you have the necessary standards in the processing and extraction sector, several times the benefit will be obtained. The calculation of one ton of marble is shown in the figure below.

It is clear that $1M^3$= 100cmx100cmx100 (accept bellow figure is $1m^3$ marble).

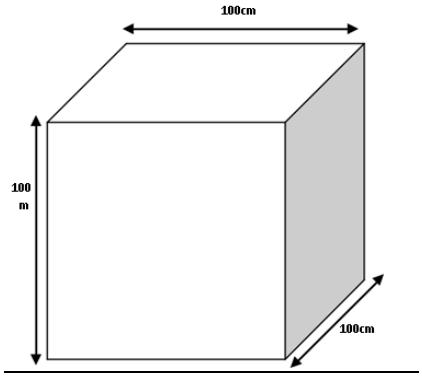


Figure 11. Marble cube [4], [7].

When you cut the above cube into slabs with 2cm thickness, it will produce 50 slabs each will be $1m^2$. But during sliding the cube, there is 1cm wastage in each slide (0.8cm is the thickness of saw and 0.2cm is the wastage from polishing). Therefore, the above cube can produce 33.3 m^2 marble slabs. Again, if you cut each m^2 into 30cmx100cm slabs, each slab (100cm length, 100cm breadth) can produce 3.33 slabs with 100cm length and 30cm breadth. Hence,

$1M^3$ marble = 33.3 x 3.33 = 111 slabs (with 100 cm length, 30 breadth, and 2 cm thickness). Because 1M3 marble = 2.5 tons marble, 1 ton marble can produce 111/2.5= **44.4 slabs**

During all process of production, we assumed 33% wastage (this is the highest possible wastage during processing, we tried to be very conservative, firms can easily reduce the percentage of waste).

Now, 1 ton marble can produce = 44.4 – (44.4x33%) = 30 slabs, each has 1m length, 30cm breadth and 2 thickness [7].

In addition, the issues mentioned above, lack of electricity, security, land, water, etc. play an important role in the high price of Afghan marble. This study also explains the low quality of imported marbles, which has led to a lower price of imported marbles compared to Afghan marbles, which domestic marbles are currently not able to compete with imported marbles [4].

4. Discussion

Tables 3, 4 and Figures 1, 2, 3 shown that the major oxides and minerals that make up marble, with an average content of about 0.1% or more then 1>, are the oxides of CaO, SiO2, MgO. , Al2O3, SO3, BaO and Fe2O3, these marbles have a strong resistance to acid (HCL), due to the presence of more elements of calcium and oxide than magnesium, the major impurities in these marbles are clay minerals, iron oxide and Silicate minerals such as biotite, muscovite and quartz have also improved the quality of imported marbles. Figure 1-2 shows the characteristics of the first and second categories, which include four samples (M3-M6-M5-M7) that have granoblastic, homeoblastic and heteroblastic textures and are formed in a low degree of metamorphism. The third degree category includes five samples (M1-M2-M4-M8-M9) which are shown in Figure 3. They are carbonate rocks.

In Table 4, the major oxides of granites, on average, have a larger share of SiO2 (52%), CaO (6.3%), Al2O3 (12%), K2O (3.13%), MgO (0.1%) than other oxides.

In imported granites, most minerals such as; K-Feldspar (30-38%), plagioclase (25-30%), quartz (5-10%), biotite (1%) and muscovite (> 1%) are spread over all slide areas where minerals can be found in percentage To cooperate in the classification of these rocks into different categories of magnetic rocks. Accordingly, Quartz, which plays the role of basic mineral in acidic composition in magmatic rocks, is less than 10% in this rock, and its geochemical and mineralogical results are in full accordance with the rocks of medium composition. We have named them Andesite (α) and Diorite (δ).

All the above specifications show that the decorative rocks imported to Afghanistan are of very low quality, and therefore have a cheaper price than the decorative rocks of the country. And the existing challenges have caused the price of Afghan marble and granite to be several times higher than imported marbles and granites and is not able to compete in domestic and foreign markets.

Despite the low value recorded at customs, TRADEMAP estimates that a ton of Afghan marble (block and slab shape) sells for up to $ 500, which is far more expensive than the top six countries. Countries that cost less and cost around $ 200 per ton make up the bulk of the world's marble production [8]. There is a direct relationship between price and the share of major players in the market. The authors of this article consider the high value of one ton of Afghan marble as the reasons mentioned in figure 7.

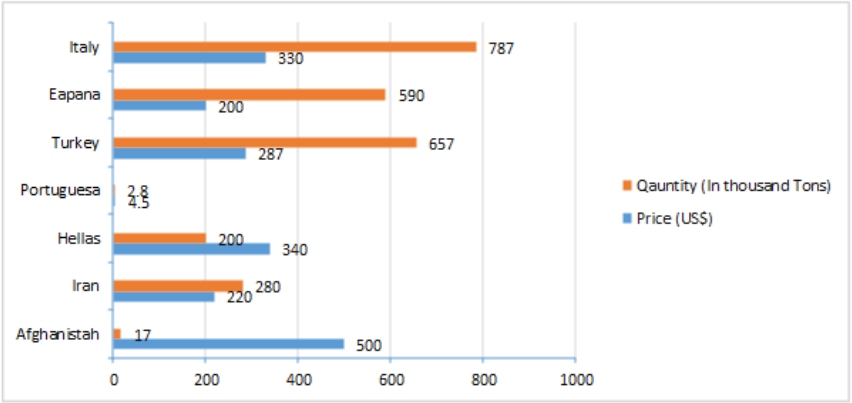


Figure 12. The relationship between the original price and the amount of production by the top exporters of raw marble in 2016, Adapted after trade map-2017 [1].

Whenever the government can meet these challenges, the authors are confident that the mines and reserves of decorative rocks (marble, granite, travertine and aragonite) in addition to the domestic market, can export millions of dollars annually, which in the current situation The best markets for these marbles are China, the United Arab Emirates and the Gulf countries .

By strengthening current miners and encouraging other foreign and domestic miners to invest heavily in marble and granite, the government can earn far more than it currently earns from understanding these mines. The US Geological Survey estimates Afghanistan's marble reserves at 1.3 billion tones[8], [9].

Based on these statistics, with an estimated 40 percent of waste and utilization at $ 200 per tons, while the world average price of raw marble is $ 270, we can easily say that marble reserves alone are worth more than $ 150 billion [1], [10]. And it can host more than a thousand extraction companies, which will strengthen the country's economy in two ways, first, it will employ thousands of compatriots and through them thousands of families will have a good and prosperous life. Secondly, the level of production has increased, which can meet domestic consumption and free the country's economy from dependence on foreign aid for export [11].

5. Conclusion

1. The following conclusions are drawn on the basis of field petrographic, and geochemical studies:
2. Imported marbles and granites account for more than 80% of the domestic market. Which exported the country more than Iran and Pakistan.
3. The majority of the samples studied petrographically and geochemically are not marble and granite, but most of the marbles are carbonate rocks of sedimentary origin and the majority of granites, due to their chemical and mineral composition, are related to the magmatic rocks of the intermediate composition.
4. During laboratory studies, it has been found that a large number of samples of harmful minerals in marble composition are more than usual and are formed in a low degree of metamorphism, and the amount of quartz that increases the hardness of the stones in granites, in the composition of stones. Medium plays a minor mineral role. Therefore, it is concluded that the type of stones, mineral composition, harmful mixtures, etc. have a negative effect on the parameters of physical-mechanical properties of these stones.
5. Carbonate rock is one of the sedimentary rocks that after transformation (certain pressure and temperature) turns into marble transformed rocks, which according to geological logic, sedimentary rocks have more porosity and water absorption than transformed rocks, which has a negative effect on strength and durability.
6. The marble texture has been developed in the form of straight parallel lines as well as zonal curved lines, which has resulted in the quality of toroidal marbles. As a result of the presence of clay materials and other silicate minerals and other major elements, especially iron in the form of oxides can be seen in the joints and voids of marble.
7. The color of marble and granite is one of the basic factors that can have many effects on the economic value and market of marble and granite. For this reason, imported decorative stones are more considered by buyers in the country than interior decorative stones, which meet the needs of construction in terms of quality.
8. At present, Afghanistan's stone sector is facing many challenges that can not compete with imported decorative stones, given that the price of the country's marble is sold several times higher in the market that buyers can not afford.
9. In the last part, specific recommendation have been presented to attract investment in standard mining, export reduction and development of Afghan marble exports, which can be used optimally as a solution in the country's stone sector.

6. Recommendation

1. Afghan marble is classified into three types in terms of cost. Premium or high quality category that costs at least 1800 to 2400 Afghanis. This type of marble can not compete in the domestic market because Pakistani and Iranian marbles are sold in the market for about 450 to 600 Afghanis. Second and third grade marble, which costs between 650 and 900 Afghanis per square meter, is still more expensive than Pakistani and Iranian marble in the market; Therefore, the government should create a solution to support domestic production, for example, increase the import tariff on marble and reduce its reality in order to increase the share of the country's marble market in the domestic market.
2. Lack of security, lack of electricity, lack of standard transportation routes and bitumen roads are among the major challenges faced by traders and miners who lose millions of afghanis this year and the price of marble has a significant impact and with Foreign marbles can not compete. Therefore, it is suggested to the Ministry of Mines and Petroleum to take action to resolve these challenges with the relevant departments before concluding the country's mines contract.
3. It is suggested that the zoning of the building stones of the territory of Afghanistan be done quantitatively and qualitatively, this will help to identify the marbles of the country accurately and the areas with a high quantity of stabilization as well as its characteristics are clearly stated.
4. It is suggested that the relevant study of Afghan marbles in terms of industry be done by relevant authorities and academic institutions, because determining the industrial value of Afghan marbles helps to accurately introduce these mines to global markets and attract more investment in the field. Because the volume of marble imports in world markets is estimated at $ 3.5 billion, Afghanistan can export $ 700 to $ 800 million worth of world stone annually.
5. Due to the lack of geological studies and the lack of a regular and efficient extraction system, the waste is more than the size of the extraction, from which thousands of cubic meters of rock are lost annually and great financial losses are incurred by the Afghan government and people that must be considered.
6. The results of petrographic and chemical tests of marble and toroidal granites show that most of these decorative stones do not belong to marble and granite from their petrographic point of view, despite their categorization; Because marble and granite, based on their physical and mechanical properties, have more durability and strength than other stones. Therefore, it is suggested to the relevant departments to hold cinemas and conferences in this field to inform about the quality of imported stones.
7. Marble smuggling from Pakistan to Afghanistan must be stopped to strengthen domestic industries and develop the domestic marble market.
8. Requiring professional staff at the time of the contract, including: mining engineer, geologist, technical staff for mining and processing machinery, and trained workers.
9. Requiring machinery in accordance with international standards for mining companies at the time of the contract.

10. Construction of specialized industrial parks for marble and granite in different areas of the country.
11. According to research on the economy of the country's mines and marble reserves, traders and miners separate only that part of the mine as a block, extract it from the mine and load it on vehicles and waste the rest. Stone cars are weighed at the gate of the city. Bank tariffs are given to traders. In other words, in order to separate a block, no matter how much it is lost, no reconstruction is done by any body, so it is suggested that the government or the top of the mines appoint a supervisor or contract the mines with the miners in volume and displacement at the time of the contract. And traders should feel responsible for every gram of stone.
12. Removing marble and granite from the small mining category to attract foreign investors.
13. Because Afghan marbles are at a high level in terms of quality and quantity, in order to find more global markets, it is necessary to create an exhibition of different types of marbles in Afghanistan.
14. In order to market processed marble, it is suggested that conferences on national export strategy materials be held in the United Arab Emirates, Saudi Arabia, Italy, Qatar, Germany, and other countries in the Persian Gulf, Central Asia, and Central Europe. Provide more exports.
15. Currently, the only mines that are mostly contracted are marble. Numerous documents and reports from the Ministry of Mines, Petroleum and Finance show that a significant amount of tax on various decorative stones, especially marble, enters the state treasury, so it is suggested that the proceeds be invested in the construction of industrial estates and marble processing plants. Employment and the creation of job opportunities for our compatriots, on the other hand, increase government revenues.
16. It is suggested to the relevant department that petrographic, geochemical and major physical-mechanical parameters of the mentioned stones be studied before using decorative decorative stones to make the buildings durable and strong inside the country.
17. Given the ever-changing developments in the construction sector, the advancement of prefabricated technology for the natural stone industry and the growing artificial marble industry in the world is affecting the demand for natural marble and is considered a serious threat. Therefore, it is suggested that the decorative stones of the country be contracted as soon as possible in accordance with the financial interests of the country and the long-term goals of sustainable development.
18. Therefore, considering the opportunities, threats and challenges, we suggest that instead of large mining contracts, which require a lot of experience and expertise. Therefore, considering the current capacity and conditions of the Government of the Islamic Emirate of Afghanistan, it should focus on small and medium mines at the top of those marble and granite mines. Because marble is easy to extract, does not require any special enrichment and has a very good sales market, which is useful and effective in every way, because by extracting or contracting such

mines, the experience and expertise of engineers is added and the country's economy is useful. It happens.

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