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# Marble Deposits of Khyber Pakhtunkhwa and FATA, Pakistan

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**Abstract:** Use of dimension stone dates back to very early history of the human civilization. It is one of those few industries which had its inception with the early human life and is still among the leading industries in the construction world. Marble has always been on top in the list of the names of dimension stones because of its variety of colors, shades and patterns and especially the good polish it takes. There are huge reserves of marble in Khyber Pakhtunkhwa (KPK) and Federally Administrated Tribal Areas (FATA). Most of these deposits have been reported earlier but there are many others which have not been discussed in detail regarding their quality reserves and mine ability.

**Keywords:** Marble, dimension stone, huge reserves, Khyber Pakhtunkhwa and FATA.

## Introduction

Dimension stone is a natural stone or rock that has been selected and finished (i.e., trimmed, cut, drilled, polished etc.) to specific sizes or shapes. Dimension stones have been used since earliest history and it is one of the largest and oldest industries in the world. A variety of igneous, metamorphic, and sedimentary rocks are used as structural and decorative stone. These rock types are more commonly known aragonite, marble, limestone, sandstone, quartzite and slate. Pakistan has approximately 300 billion tons of marble reserves occurring mainly in KPK, the tribal belt and Balochistan and around 98 percent of these reserves of about 40 varieties of marble are believed to be occurring in NWFP and FATA (Ali, 2009).

Marble is associated with meta-sedimentary rocks which range in age from Precambrian to Paleozoic. Generally, the specific gravity, water absorption and flexural strength of the marble meet the standard specifications of a dimension stone. Marble deposits of Khyber Pakhtunkhwa and adjoining FATA areas have been reported to occur in Peshawar, Malakand, Swat, Dir, Chitral, Hazara Division and FATA region (Fig. 1, Asrarullah, 1962).

## Regional Tectonics

Pakistan is a collage of many terrains, each of which has had its own tectonic, magmatic and metamorphic history. Kohistan magmatic arc was welded to Karakorm plate during late Cretaceous and to the Indian plate during Paleocene. The collisional processes have led to episodes of magmatism, deformation, metamorphism and exhumation. The Himalayas are known as a prime example of continent-continent collision, i.e. the result of closure of Tethys and indentation of the Indian plate into the collage of terranes which made up Central Asia (Searl and Treloar, 1993). A broader aspect of metamorphism in various units include Chagai and Ras Koh, the ophiolite thrust belt and Indus suture zone, Karakoram plate, Kohistan arc and Indian plate.

Dominant structures in the Hazara-Besham-Lower Swat area are a series of north trending folds that die out or swing east to west along the southern margin of the area in conformity of Khairabad Thrust. These folds deform foliation with which are associated an earlier set of folds (DiPietro et al., 1998). The Himalayan metamorphism increases from south to north both in Hazara and Swat. The rocks in the northern margins of Peshawar basin are of low-grade, with recognizable sedimentary structures and fossils. Metamorphic intensity reaches kyanite and silliminite grade in the Lower Swat region and in Hazara similar situation prevails (Calkins et al., 1975).

## Important Marble Deposits of KPK

**Peshawar Division.** Peshawar division has resources of marble of varying grade and quality occurring at several places in Peshawar Division (Asrarullah and Hussain, 1985; DMD, 1983). The marble is associated with meta sedimentary rocks belonging to Paleozoic age and found in white, pink, grey, and greenish grey colors. The major marble deposits reported and described so far are located near Nowshera in Peshawar district (Kidwai and Imam, 1959, Din et al., 1993). White crystalline limestones are calcite marble of high purity comparable to world class marbles.

**Nowshera Deposits:** A number of physical tests of Peshawar marbles meet the ASTM specifications (2008). Most of the marble deposits of Peshawar district occur in low lying hills to the North of Nowshera town along the Kabul River and are comprised of impure limestone with some argillaceous and arenaceous rocks of Siluro-Devonian age

(Asrarullah and Hussain, 1985). The hills north of Nowshera and Pir-Sabak occurring between Nowshera and Akora Khattak contain marble deposits of economic significance. The blocks from these areas have a blending of colors from pink to all shades of brown, grey and white. The marble takes good polish and large blocks can be obtained (Bilqees et al., 2017).

**Pir-Sabak Deposit.** The marble deposit lies at a distance of about 6 kilometers to the northeast of Nowshera (Fig. 1). It is found in the strike extension of the Nowshera marble deposit (Asrarullah and Hussain, 1985). The Pir-Sabak hillock extends in length for


Fig. 1 Map showing marble locations in KPK and FATA (modified after Asrarullah and Hussain, 1985).

about 300 meters with an average width and height of 150 and 22 meters respectively. The hillock is comprised of poorly metamorphosed limestone and dolomite. It contains a marble horizon which varies in thickness from 8 to 12 meters. The color is pink with patches of white, grey, red and brown. Its reserves have been estimated as 0.13 million cubic meters.

**Swat District.** The best quality marble of Pakistan is found in Swat district. These are extensively mined due to their good quality and occurrence in accessible areas. There are widespread occurrences of good quality marble in different parts of Swat district. The marble occurs in attractive colors of white, grey, brown and in Bagh, Swabi, Barkili, Tursak, Bampkha, Devana Baba, Dagger, Dandai, Upal and Spinkari (Asrarullah and Hussain, 1985).

**Bagh Deposit:** This deposit occurs in north and northwest of Bagh village, district Swat (Fig. 1). The marble beds are surrounded by granitic intrusions. It strikes generally N 85˚W and dips 45˚-75˚W. Dolerite dykes and sills are also associated with the marble. According to Asrarullah and Hussain (1985) the marble is white light grey, compact and fine to medium textured. The bedding is thin to medium and massive at places and small veinlets of loosely cemented calcite are sparsely distributed. The marble is jointed, fractured and larger size blocks can be extracted with great difficulty. The marble extends intermittently in length for 2 kilometers with an average width of 300 meters. Its reserves above the ground level have been estimated at 30 million cubic meters (Asrarullah and Hussain, 1985). The physical properties reveal its specific gravity as 2.7, water absorption 0.17% and modulus of rupture 1,520-1,820 psi.

**Barkili Deposit:** The marble deposit occurs at a distance of about 2 kilometers to the southwest of Barkili village, district Swat (Fig. 1). The marble is found at the contact of granite and formed mainly as a result of contact metamorphism. Its strike is N 60˚E with a dip of 65˚southeast. It is green in color and contains streaks and patches of white, grey and black colors (Asrarullah and Hussain, 1985). The marble is hard, compact and finely crystalline. It is traversed by numerous calcite veins and veinlets. Ferruginous coatings and patches of yellowish to dark brown colors are commonly found on the surface. The jointing and fracturing are widely spaced and blocks as big as 1.5mx 1.2m x 1m can be obtained easily. The physical tests show its specific gravity as 2.71, water absorption 0.153% and modulus of rupture 2,000 psi. These values compare favorably with the standard specifications for marble. The marble is 200 meters thick and extends for one kilometer in strike length. Its reserves above the ground level have been estimated as 5 million cubic meters (Asrarullah and Hussain, 1985).

**Tursak Deposit:** This is the only deposit known so far in Pakistan where excellent quality black hard and fine to medium textured marble occurs (Asrarullah and Hussain, 1985). It contains irregular veinlets of white calcite, which are mostly stained with reddish brown ferruginous material. The bedding is medium to thick and massive at places. Joints and fractures are widely spaced and larger blocks upto 1.5m x 1.2m x 1m size can be extracted. The marble deposit extends in length for 900 meters with an average thickness of 200 meters and its reserves are estimated at 5.4 million cubic meters (Asrarullah and Hussain, 1985). The marble is in great demand in local and foreign markets. It has pleasing appearance, attractive black color and takes excellent polish. The physical tests show its specific gravity, 2.7, water absorption, 0.74% and modulus of rupture, 1,900-2,000 psi. These values conform with the standard specifications for marble.

**Bampokha Deposit:** The Bampokha marble is considered as one of the best marbles of Pakistan on the basis of its uniform texture and grain size, pleasing appearance, capability of taking good polish and extractability of larger blocks. The physical tests indicate its specific gravity 2.71, water absorption 0.142% and modulus of rupture 1,658 psi (Asrarullah and Hussain, 1985). The marble is thick bedded, and contains widely spaced joints and fractures. Although, the marble has comparatively low strength yet it has the advantages of superior quality. The reserves of marble are estimated as 10 million cubic meters (Asrarullah and Hussain, 1985).

**Matwanrai Deposit:** The marble is located along the tributary of Barbura Khawar, near Matwanrai village, District Swat (Fig. 1). The marble is white medium to coarse textured and is medium to thick bedded. It is jointed and fractured, traversed by irregular and wavy pattern of calcite veinlets and sparse intercalations of quartz mica schist.. The marble is about 75 meters thick and extends in length for about half a kilometer. Its tentative reserves upto ground level are estimated at 1.12 million cubic meters and is being quarried locally and blocks upto 1.5m x 1.2m x 1m can be extracted (Asrarullah and Hussain, 1985).

**Chitral Area:** In Chitral district, good quality marble deposits are found widespread but they could not be developed due to their remote occurrence in rugged and hilly terrain. Calkins et al. (1981) and Gaetani (1991) had mentioned marble in Kafiristan area alongwith other mineral resources in Chitral-Partsan area, Hindukush Range and northern Pakistan. These marbles have been used locally for construction (Calkins et al., 1981). The Gawuch Formation comprises highly tectonic green schist with common intercalations of limestone and marble in its upper part (Khan et al., 2000). Arkari Formation hosts the stratabound tungsten mineralisation at Miniki Gol, Chitral. This formation is dominantly composed of garnet mica schist, phyllite, calc-silicate quartzite and marble (Zahid and Moon, 1998). In Chitral district, the marble deposits are found widespread in Reshum Formation of early Cretaceous age (Asrarullah and

Hussain, 1985). The important marble occurrences are located near Ghariat, Kidori, Chitral Gol in Topographic Sheet. 38 M/N.E. and Shaghor in topographic sheet. 37 P/SE (Fig. 1). Two of the marble deposits i.e. Ghariat and Shaghor have better prospects due to their location along the main roads. The marble of these localities is white, grey, compact and finely crystalline. It is of good quality and compares favorably with other known marble deposits (Asrarullah and Hussain, 1985).

**Federally Administered Tribal Area:** Small and medium occurrences of marble are reported at a number of places in Khyber, Mohmand, Bajaur and Kurram Agencies. Many traverses in Mohmand Agency and Bajaur Agency reveal that the area is underlain by a variety of metamorphic and igneous rocks and extensive marble reserves of various grades and shades have been encountered (Saif, 1971). The major marble deposits are located at Shahid Mena and Kambela in Mullaghori area of Khyber Agency, and near Nawagai in Bajaur Agency (Asrarullah and Hussain, 1985). The marble deposits are found in recrystallized limestone associated with schistose rocks belonging to Palaeozoic age. It is white, grey, greenish grey, compact and fine to medium textured. The white variety obtained from Mullaghori is of high quality and is comparable with best marble deposits of the world. However, the larger production of consistent quality marble cannot be assured (Asrarullah and Hussain, 1985).

**Khyber Agency**

**Shahid Mena Deposit:** The deposit is located along Peshawar-Mullaghori road near Shahid Mena village, Khyber Agency (Fig. 1). The marble occurs as layers and lenses in a thick sequence of recrystallized limestone, phyllite and schists of Silurian-Devonian sequence. The general trend of the rock sequence is nearly east-west with varying dips from 45$^{o}$S to 85$^{o}$S. The marble deposit is covered at places by overburden which ranges from 2 to 5 meters. The marble is 200 meters thick on an average and extends for about 1,000 meters in length and its reserves up to a dip depth of 50 meters are estimated as 10 million cubic meters (Asrarullah and Hussain, 1985). This marble has bulk specific gravity of 2.72, water absorption 0.16% and flexural strength of 2,227 psi. Large blocks upto 1.5m x 1.2m x 1m can also be obtained (Bilqees et al., 2017).

**Bajaur Agency**

The marble deposits of Bajaur Agency are found near Nawagai, Bar Kamangara, and Kharai Kamangara (Asrarullah and Hussain, 1985). The marble is found in recrystallized limestone associated with schistose rocks belonging to Paleozoic age. This marble is grey, whitish grey and zebra green in pattern. Amongst the above mentioned localities, the Nawagai marble deposit has better access, extensive reserves, consistent grade and can yield large size blocks.

**Nawagai Deposit:** The marble deposit is located at about three kilometers to the northeast of Nawagai village, Bajaur Agency (Fig. 1). It is found in crystalline limestone, which is associated with the schistose rocks containing interlayering of serpentinite. The general trend of the rocks is N80$^{o}$E with moderate to high angles of dips in south direction. The marble is greyish white to grey in color with occasional greenish grey varieties. It is hard, compact and fine to medium textured. Micro-cracks are common, which contain reddish brown coatings of ferruginous material. The marble has bulk specific gravity of 2.691, water absorption 0.149% and modulus of rupture 1,983 psi. It takes good polish and larger blocks can be obtained without any difficulty and the reserves are estimated at 9 million cubic meters (Asrarullah and Hussain, 1985). It is being mined on a small scale and supplied to different marble factories for processing (Fig. 1). The marble is found in white and green colors and some selected blocks take good polish. The deposits could not be developed due to difficult access and inconsistency in quality.

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