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DOLOMITE OF GHUNDAI TARAKO (34° 13′ N: 72° 25′ 15″ E) PESHAWAR DIVISION

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Ghundai Tarako is a small hill on the boundary of Mardan district and Swat state and is mainly composed of marble. Four localities were observed to indicate high dolomite content. Composite samples were collected from each of these localities. The localities 2 and 4 have dolomite equivalent to 95.68%. Silica content ranges from 0.37 to 11.49%, whereas R_2O_3 from 0.85 to 0.88%. Other deletrious elements, like sulphur and phosphorous are either absent or present only in traces. Dolomites of Ghundai Tarako of localities 2 and 4 are of chemical grade and could be used in metallurgical and glass industries.

Introduction

Ghundai Tarako is a small hill at the boundary between the Swabi tehsil of Mardan district and the Buner tract of the Swat state (Fig. 1). It is largely composed of white and grey calcitic marble. Whitish grey dolomite and dolomitic marble occurs in the eastern and southern end of the hillock. Ahmad,[1] Ahmed,[2] Asrarullah[3] and Khan and Gauhar[4] have mentioned briefly the marble and dolomite occurrences of the hill. Coulson[5] has given excellent details of the calcitic marble of the hill. He has briefly mentioned the occurrence of dolomite in the south-eastern end of the main ridge. The present paper embodies the details of the dolomite occurrences in the Ghundai Tarako hill.

General Geology

Ghundai Tarako hill is mainly composed of calcitic and dolomite marble and quartzite. These rock types belong to the Swabi formation. Apart from these, some igneous rock formations are also exposed in the vicinity of the hill. The stratigraphic succession of the area established by Martin et al.[6] is as follows:

Formation	Member
Ambela granite (early tertiary)	Ambela granite
Shewa Formation (late palaeozoic/ early mesozoic)	Shewa volcanics
Swabi formation (Siluro-devonian)	Kala limestone and dolomite; Swabi quartzite; Swabi pebbly shale
	UNCONFORMITY
Chamla formation (Cambrian)	Chamla quartzite; Chamla phyllitic shales

Chamla formation, Shewa formation and the Ambela granite are exposed near the hill. Swabi quartzite, marble and dolomites members of the Swabi formation outcrop within the isolated Ghundai Tarako hill. A brief account of the exposed quartzite and dolomite is given here.

Swabi Quartzite.—The Swabi quartzite conformably overlies the Swabi shales. It is light grey to white in colour and thinly bedded. Its lithology is nearly similar to Chamla quartzite but it is distinguished, in the field, by its close association with the overlying calcareous rocks wherever it is exposed. In the Ghundai Tarako this quartzite is exposed only at the north eastern end of the

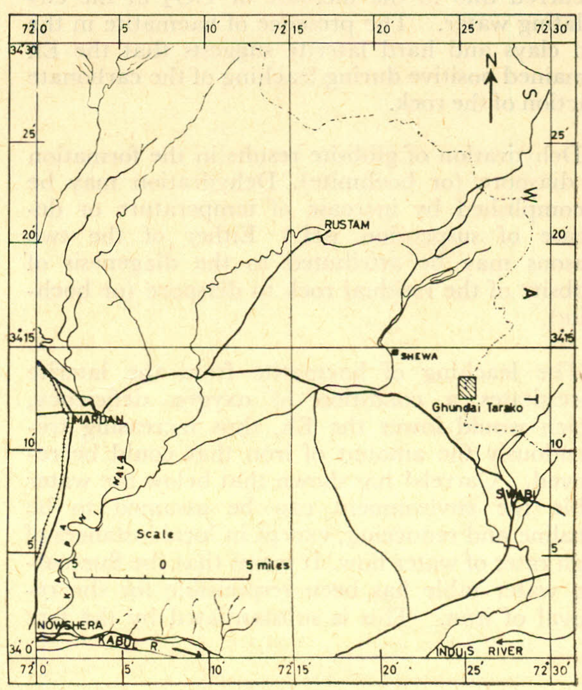


Fig. 1.—Location of Ghundai Tarako.

hillock where it is interbedded with the dolomitic and calcitic marbles. It appears to form the core of an overturned anticline (Fig. 2). Complete succession of this quartzite is exposed in the Kala outcrop just to the south of Swabi.

Kala Limestone/Dolomite.—(Including Maneri and Ghundai Tarako marbles and dolomites).

The name of the calcareous rock formation is after the outcrop near the village Kala (34° 6′N: 72° 28′E), 2 miles to the south of Swabi. In the Ghundai Tarako, 7 miles north-east of Swabi, the metamorphosed grey limestone and dolomite is exposed. Strike of the marbles and dolomite is NW–SE to NNW–SSE and the dip ranges from 45° to 55° towards NE. The marble varies in colour and texture. It is mostly sacchroidal in texture but fine grained. Massive marbles are also not uncommon. Basal 50 feet part of the marble unit is white, finely crystalline and uniform in texture. It is comparable in quality to the white marble of Carrara (Italy) and Makrana (India). Ahmad[1] estimated the reserves of good quality white marble at over 10 million cubic feet upto a dip depth of 50 feet.

Dolomitisation has been observed mostly along the eastern flank of the hill. Dolomite is medium to fine grained, grey to white in colour and breaks with a conchoidal fracture. Solution weathering is prominent. After weathering the dolomite tans to buff colour on the surface.

Ghundai Tarako hill is cut by epidioritic intrusions which are mostly dykes ranging in thickness from 2–25 ft and have the strike direction NE–SW, transverse to the carbonate rocks. It is probable that the Ambela granite coupled with the epidiorite intrusions were responsible for the metamorphism of the grey limestone and dolomite.

In Maneri area, barely 6 miles south of Ghundai Tarako ophicalcite marble is reported, at the southern flank of the hill, at the contact of a epidiorite dyke but no such marble was observed at Ghundai Tarako.

The dolomite in Ghundai Tarako seems to be of secondary origin formed by the subsequent dolomitisation of the early deposited grey limestone. Solutions responsible for dolomitisation may be hydrothermal or connate waters, rich in magnesia, circulating through the sediments.

Method of Sampling

Staining technique, developed by Heeger,[7] using dilute solution of hydrochloric acid (1:100) and a solution of potassium ferricyanide was used in the field to distinguish dolomite from marble/limestone. Dolomite stains blue while calcite (marble) remains unaffected. The reaction is due to the presence of ferrous iron in dolomite, which combines with the potassium ferricyanide to produce Turnbull's blue ($Fe_3(Fe\ C_6N_2)_2$). The proportion of the solution and the rock sample was the same for the tests throughout the field work. This gave a fair idea of dolomite concentration. The reconnaissance work showed that the dolomite content is limited to four areas on the eastern side of the hillock. Detailed examination of each area was carried out and dolomitised areas were demarcated (Fig. 3). Good quality dolomite containing above 93% of the mineral is shown on the map with close lines and the lower grade with thin lines.

Samples of dolomite for detailed chemical analysis were collected from the higher grade areas, taking chips of the fresh rock at a regular interval of 20 ft. Composite samples were made from each area for laboratory analysis.

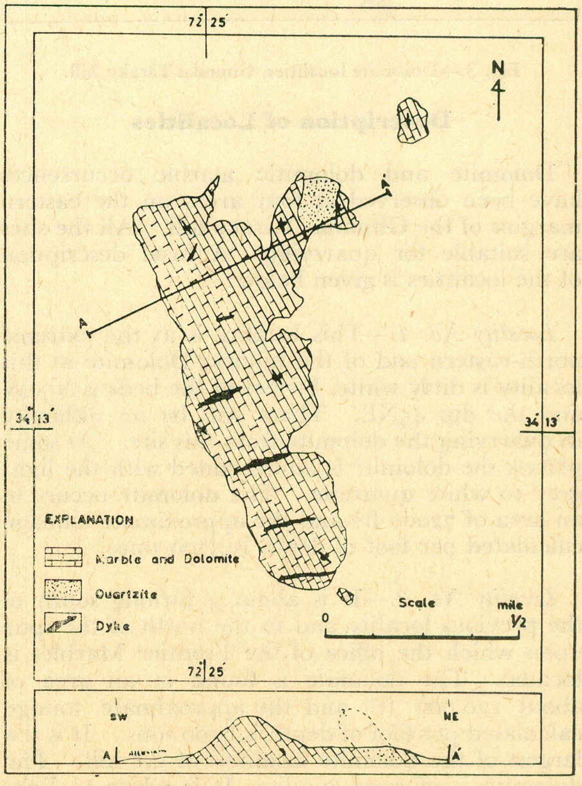
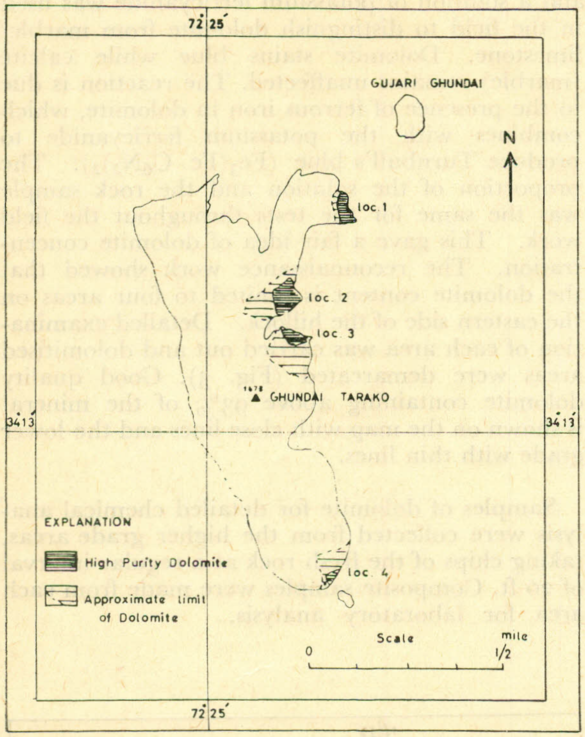


Fig. 2.—Geological sketch map and cross-section of Ghundai Tarako.



Eig. 3.—Dolomite localities, Ghundai Tarako hill.

Description of Localities

Dolomite and dolomitic marble occurrences have been observed at four areas on the eastern margins of the Ghundai Tarako hill. All the sites are suitable for quarrying. A brief description of the localities is given below:

Locality No. 1.—This locality is at the extreme north-eastern end of the hillock. Dolomite at this locality is dirty white. Strikes of the beds is N50W and the dip 45NE. There will be no difficulty in quarrying the dolomite from this site. At some places, the dolomite is inter-bedded with the light grey to white quartzite. The dolomite occurs in an area of 72000 ft^2 and the approximate tonnage calculated per foot of depth is 5700 tons.

Locality No. 2.—It is about ½ furlong south of the previous locality and in the north of the spur upon which the office of the Frontier Marbles is located. The dolomite is found in an area of about 120,000 ft^2 and the approximate tonnge calculated per foot of depth is 9500 tons. It is the largest of the dolomite localities of the hill. The dolomite is of good quality. It is white to light grey when fresh and buff on weathering. Solution weathering is quite prominent.

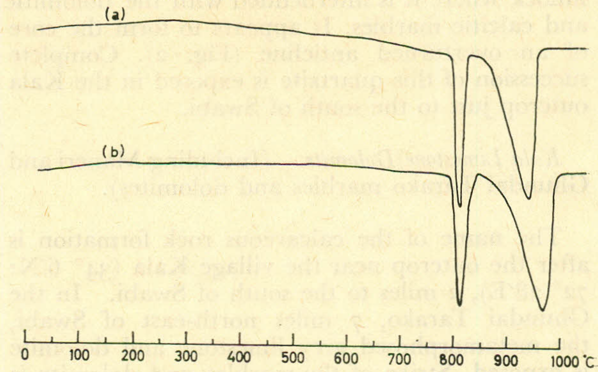


Fig. 4.—DTA curves of dolomites, (a) Dolomite of sample No. 1 from locality 1, (b) Dolomite from Sinalengrun near Wunsiedel, West Germany.

Locality No. 3.—It is on the eastern side of the peak of the hill. The colour of the dolomite varies from light greyish white to creamish. It is massive and breaks with sub-conchoidal fracture. The pattern of the joints is such that blocks of 3′×2′×2½′ average size can easily be taken out. Dips and strikes follow the regional dip and strike. The area of the dolomite occurrence is about 500,00 ft.^{2} The approximate tonnage calculated per foot of depth is 4000 tons.

Locality No. 4.—It is the oldest known locality at the extreme south east end of the Ghundai Tarako, first mentioned by Coulson. The colour of this dolomite is greyish white. It is massive and of very good quality, suitable for metallurgical purposes. For quarrying of the stone, there is no problem of over-burden. Blocks of average size may be extracted. Dolomite is found in an area of about 22,500 ft.^{2} The approximate tonnage calculated per foot of depth is 1800 tons.

Petrography of the Dolomite

Study of carbonates by routine petrographic methods is difficult. Much help has been taken from the staining techniques developed by Evamy[8] and the scheme of Warne[9] in the study of thin sections. DTA curve of dolomite from the locality No. 1 is given in fig. 4. The curve is comparable to that of dolomite from the Sinalengrun near Wunsiedel, West Germany.

Thin section studies of the dolomites from the 4 localities generally show xenotopic texture (Fig. 5). The coarse grannular varieties are composed of grains strongly interlocked in a rather uniform mosaic. In general, the dolomite is equigranular and patches of coarser and finer crystals are not common. Detrital grains of anhedral

Fig. 5.—Photograph of dolomite showing Xenotopic texture. Grains are interlocked in a uniform mosaic. Muscovite flakes can also be seen. Magnification x (ordinary light).

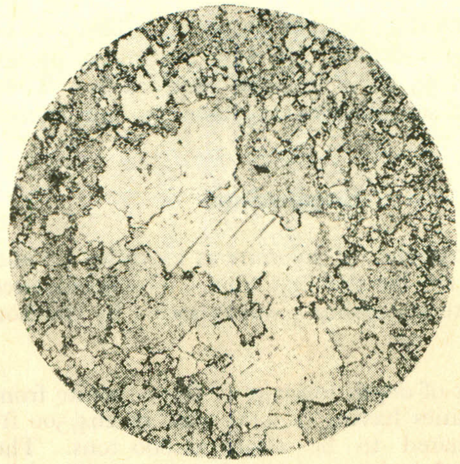


Fig. 6.—Dolomite showing porphyrotopic texture. Magnification x (ordinary light).

quartz, flakes of muscovite and sparse tremolite needles are the minor constituents in some of the thin sections. In some of the thin sections porphyrotopic fabric was also observed (Fig. 6).

During the petrographic studies, carbonate minerals showing polysynthetic twining and other characteristic properties were among the abundant minerals observed besides the accessories mentioned above. It is probable that the original carbonate rock was almost pure at the time of metamorphism and the temperature and pressure did not exceed 350°C and 3000 bars respectively. As such no further dissociation of dolomite and calcite could occur to give rise to minerals of high temperature and pressure like brucite and its associates. Perhaps the mosaic fabric in the carbonate rock is the reflection of such environment. The presence of sporadic tremolite needles in the dolomite from the north-eastern flank of the Ghundai Tarako hill, where it is interbedded with quartzite, is because of the contact of dolomite with Swabi quartzite. The formation of tremolite in such an environment may be represented by the following reaction

$$\underset{\text{(dolomite)}}{3CaMg(CO_3)_2} + \underset{\text{(silica)}}{4SiO_2} \rightleftharpoons \underset{\text{(tremolite)}}{CaO.\ 3MgO.\ 4SiO_2} + \underset{\text{(calcite)}}{2CaCO_3} + 4CO_2$$

Chemical Composition

The results of the chemical analyses of the samples, collected in the field, are presented in table 1. The silica and R_2O_3 were determined by the classical method. The rest of the elements were estimated by rapid method as described by Riley.[10] Dolomite contents were calculated on the basis of loss on ignition.

TABLE 1.—CHEMICAL ANALYSIS OF DOLOMITE FROM GHUNDAI TARAKO HILL.

	(a)	(1)	(2)	(3)	(4)
SiO_2	—	11.49	1.86	2.73	0.31
Al_2O_3	—	0.23	0.58	0.66	0.72
Fe_2O_3	—	0.28	0.27	0.21	0.16
TiO_2	—	Nil	Nil	Nil	Nil
CaO	30.4	27.68	30.21	30.04	30.88
MgO	21.9	20.35	21.29	20.42	21.41
Na_2O	—	0.08	0.04	0.09	0.05
K_2O	—	0.01	0.16	0.17	0.15
MnO	—	Traces	Traces	Traces	Traces
P_2O_5	—	Nil	Nil	Nil	Nil
SO_3	—	Traces	Nil	Nil	Nil
Loss on ignition	47.7	39.85	45.78	45.16	45.98
Total	100.0	99.97	100.19	99.48	99.66
Sp gravity		2.85	2.88	2.87	2.89

(a) Theoretical composition of ideally pure dolomite; (1) Result of composite sample of dolomite from locality 1, at the north-east end of the Ghundai Tarako hill; (2) Result of composite sample of dolomite from locality 2, one furlong south of previous locality, on the eastern flank of the Ghundai Tarako hill; (3) Result of composite sample of dolomite from locality 3, spur north-east of main peak (1673 ft), just south of previous locality; (4) Results of composite sample of dolomite from locality 4, on the south-eastern end of the Ghundai Tarako hill.

The dolomite of the locality 1 is rather impure. It contains only 83.17% of dolomite. Silica content is 11.49% and is mostly in the form of quartz; the presence of quartz was confirmed by thin section studies. Adjoining Swabi quartzite might have been responsible for the increase of silica content in the dolomite. The amount of R_2O_3

is low ranging between 0.51 to 0.88%. The samples of localities 2,3 and 4 contain 95.68, 93.84 and 95.68% dolomite respectively. Total silica and sesquioxides together do not exceed 3.6%.

Conclusions

The occurrence of dolomite at localities 1,2 and 3 is reported for the first time. The occurrence of dolomite at locality 4 was reported by Coulson in 1937.

Per foot of depth tonnage of the dolomite from four localities having a total area of 264,500 ft^2 was estimated to be about 21,000 tons. The deposit is of moderate size and worth exploitation.

The localities 2 and 4 provide the best grade dolomite, the dolomite content being above 95%. The locality 3 provides slightly inferior dolomite. Locality 1 contains objectionable amount of silica for metallurgical industry. The dolomites from localities 2, 3 and 4 seem to be suitable for glass and metallurgical industries.

Dolomitic rocks are used in the manufacture of special glasses. Attempts could be made to use the dolomite from locality 1 in the glass industry, high silica content could be an added benefit.

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