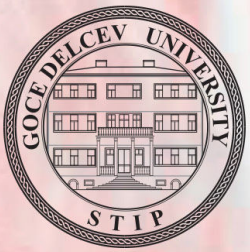

UNIVERSITY GOCE DELCEV - STIP
FACULTY OF NATURAL AND
TECHNICAL SCIENCES

ISSN:1857-6966

Natural resources and technology

No. 1 Volume XVI June 2022

UNIVERSITY "GOCE DELCEV" – STIP
FACULTY OF NATURAL AND TECHNICAL SCIENCES

Natural resources and technologies

JUNE 2022

VOLUME XVI

NO. 1

ISSN 1857-6966

NATURAL RESOURCES AND TECHNOLOGIES

Editorial Office
Goce Delcev University - Stip
Faculty of Natural and Technical Sciences

Contents

Manuscript received: 13.04.2022
Accepted: 04.05.2022

Natural Resources and Technology
Vol 16, No.1, pp. 47 - 52 (2022)
ISSN 1857-6966
UDC: 553.548:691(497.785)
DOI: https://doi.org/10.46763/NRT22161047s
Original research paper

QUALITATIVE-QUANTITATIVE CHARACTERISTICS OF THE MARBLES FROM PLETVAR AREA IN NORTH MACEDONIA AND POSSIBILITIES FOR THEIR EXPLOITATION

Orce Spasovski[1]

[1] *Faculty of Natural and Technical Sciences, Institute of Geology, "Goce Delcev" University of Stip, Blvd. Goce Delcev, 89, Stip, Republic of Macedonia*

**Corresponding author: orce.spasovski@ugd.edu.mk*

Abstract

The use of marbles as a building - architectural stone, because of their aesthetic - technical characteristics, has a long tradition in Macedonia from ancient times until today. Dolomitic white marbles are most prevalent in the studied area and clearly different from the gray-white and gray dolomitic marbles. The samples were determined as a fine-grained dolomitic marble, which mineralogically and chemically are quite pure. According to mineralogical and petrological characteristics, these dolomitic marbles can find wide application in civil engineering, in concrete mixtures, and in other hydrotechnical works. It can also be used as architectural stone, which allows removal of larger blocks. Based on calculations performed on mining stocks it can be concluded that the investigated area is promising in terms of exploitation of the white dolomitic marble.

Key words: *architectural-building stone, dolomitic marble, ore reserves, chemical-mineralogical composition*

INTRODUCTION

The Pletvar area is situated near the village bearing the same name some 10 km from Prilep. The site is situated 0,5 km south of the village in the marble series which is part of the Pelagonian metamorphic complex.

The use of marbles as construction-architectural stone has had a long tradition, from early times to the present day, due to its aesthetic and technical characteristics. The white marbles are also used for making art statues, colonnades, caryatids etc. This can be seen in many Roman archaeological sites such as Stobi, Heraclea and others.

The search for white marbles in a number of sites was the subject matter of investigations. The best known in the country are those of Sivec, Bela Pola, Pletvar, Kitka and others. The highest interest has been in the white marble in the Pletvar –Sivec - Bela Pola zone. Besides its whiteness, the marble has been in use for such a long time due to the fine-grained structure, which helped sculptors make their masterpieces.

In Macedonia marble has continuously been used as building material, but with variable intensity. The first large undertakings and organized economic interest in excavation and processing started after 1956.

The greater use of marbles called for intense geological investigations, starting with opening new quarries and the construction of new facilities for processing. Thus, in 1956 the production of marble blocks amounted to 8.000m^3 and the processing of 6.000m^3 slabs. In 1983, new mines emerged whose marble blocks output reached 22.000m^3 along with new facilities built in Prilep, Gostivar, Cer and Kumanovo. The entire annual nominal capacity of slab processing amounted to 500.000 m^2.

However, this trend of increase was followed by a period of stagnation in 1990s and in 1997 the production was reduced to 10 to 12.000m^3 of marble blocks and the processing of 80.000m^2 slabs annually. At the same time, this period was also characterized by the establishment of small processing plants almost in every town. The products were used mostly in erecting monuments.

The first investigations on the Pletvar marble started in 1891. [1] Later [2-4] mineralogical-petrographic examinations were performed on the rocks in the vicinity of Prilep, with special emphasis on the marbles around Prilep and Pletvar. With the preparation of the basic geological map of SFRY, the authors

of the Prilep sheet, scaled 1:100 000 [5,6] in the Interpreter, gave a detailed description of the lithological composition of the rocks near Prilep. In their description on the rock composition, they included an account of the dolomite marbles from the vicinity of Pletvar.

In the same period, during compiling the basic geological map of SFRY, the authors of the page for Vitoliste, scale 1:100 000 [7,8], gave an account of the lithological composition in the explanation.

Since 1970 to the present time, special detailed investigations were carried out for the calculation of the ore reserves in Sivec for the writing of the main project for marble excavation from the deposit.

In his doctor's dissertation under the title Specific Methods for Economic Assessment of the Architectural - Dimension Stone in S.R. Macedonia and Long-Term Development, Paskalev [9] offered a special analysis of the marbles in Sivec.

The Pletvar dolomite marbles have been studied in detail by Spasovski [10], when their mineralogical-petrographic composition (Fig. 1) was determined.

The latest data regarding the geological composition, mineralogical- petrological and physical - mechanical characteristics of the marbles in close proximity to Pletvar can be found in the documentation of the Mike Company. Namely, the company has the concession for marble excavation close to the area under investigation and has started an open Pletvar marble quarry.

MATERIAL AND METHODS

The location Pletvar is explored using field and laboratory techniques. Field study provided an insight into the terrain, familiarization with its geological and structural-tectonic features, as well as the collection of representative samples of dolomite marbles for defining their chemical-mineralogical composition and structural-textural features. The mineralogical-petrographic study was performed at the Faculty of Natural and Technical Sciences in Stip. The mineralogical and petrographical characteristics of the samples that were taken has been determined by using the polarized light microscope Leitz Wetzlar, Germany.

Representative samples of dolomite marbles from the Pletvar locality are selected for mineralogical-petrological research as well as for chemical analyses.

A complete trituration, grinding, pulverization and automatic shortening are performed on the selected samples by receiving the samples for analysis and a duplicate of the sample weighing 50 grams.

The method of chemical analyses is the standard atomic emission spectrometry with inductively coupled plasma (AES-ICP) that provides high accuracy for the majority of chemical elements, but only the elements that are of high importance for the chemical characteristics of marbles are determined.

The purpose of the chemical examination is to determine the chemical content of the present rocks in the researched area with a special attention to the white dolomite marbles.

At the department of geotechnical engineering at the Faculty of Civil engineering certain examinations of the strength of monolith parts of the white dolomite marble from the locality Pletvar – Prilep were made.

Many samples were tested for the pressure strength, strength on one point, volume weight and the absorption of dampness as basic classification parameters.

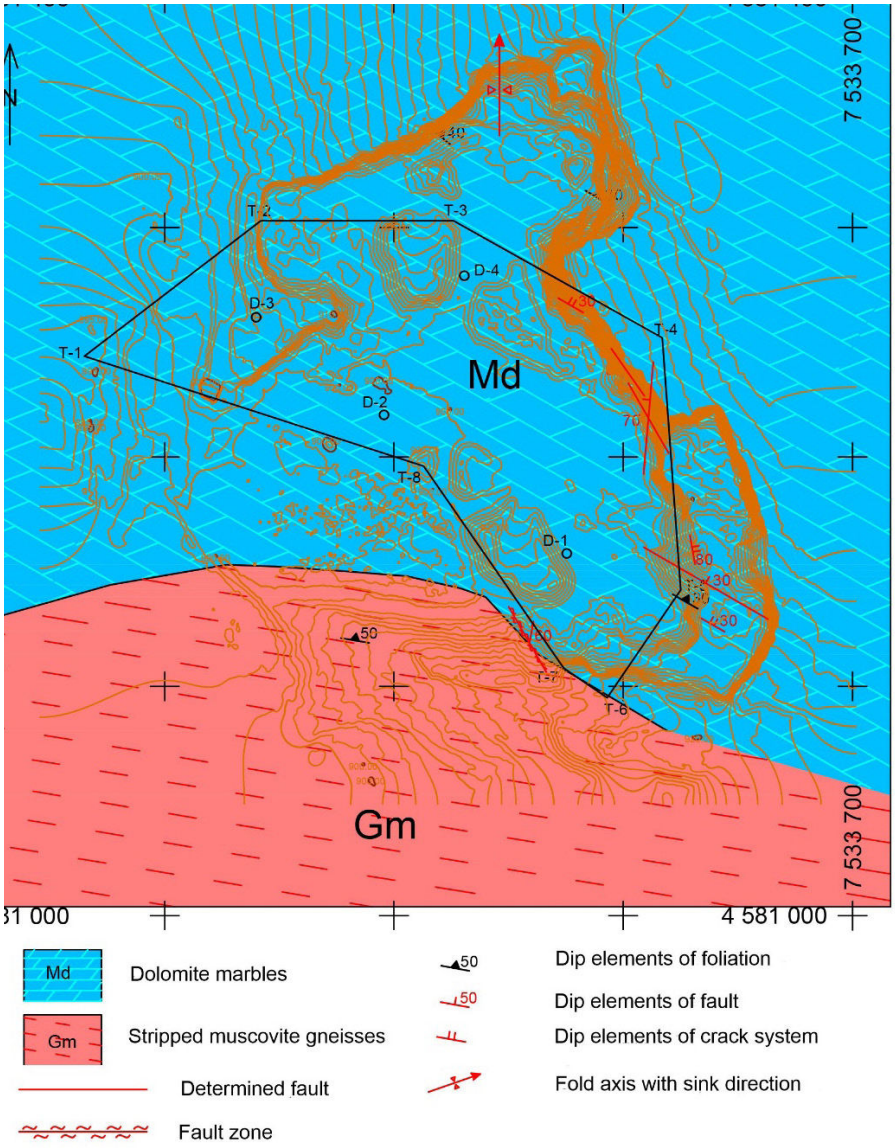

Figure 1. Geological map of the locality Pletvar [10]

RESULTS AND DISCUSSION

The purpose of the chemical examination is to determine the chemical content of the present rocks in the researched area with a special attention to the white dolomite marbles.

From the performed chemical, mineralogical and petrological examinations of the samples in the area around Prilep it can be stated that:

The samples are determined to be finely grained dolomite marble. The presence of MgO is over 20,66%; only in the sample marked II/5 MgO it is present with 20,32% (Table 1).

These dolomite marbles have white color (fig. 2) and the samples with light grey color are very rare. The structure is finely grained but with solid, massive, and compact texture with weakly distinguished oriented-striped texture. A homeoblastic-granoblastic structure is visible with a microscope with massive and very weakly distinguished oriented texture [10].

Figure 2. White dolomite marble from the locality Pletvar

From a mineralogical aspect, these are carbonate rocks made mostly of dolomite. Calcite is not very present – that is sample II/6. Dolomite crystals are mostly present in irregular to hypidiomorphic form and are slightly extended in the direction of the orientation of the rock. The extension of the crystals is more strongly pointed in sample II-5 (light grey dolomite marble). Average granulation of the dolomite crystals is from 45-65 microns seen in all samples. Microcavities are noticed in the sample marked II/8 but are very rare, while microcavities are also visible in sample II/2.

Table 1. Chemical analysis of the marble the Pletvar area

Components (%)/ sample	SiO_2	R_2O_3	CaO	MgO	Loss of ignition	Total
II/2	0,34	0,21	30,39	21,57	47,36	99,87
II/3	0,26	0,22	20,56	31,65	47,25	99,94
II/5	0,24	0,16	31,94	20,32	47,22	99,88
II/6	0,30	0,06	33,92	20,76	46,90	99,94
II/7	0,35	0,16	31,48	20.66	47,25	99,90
II/8	1,40	0,24	30,37	21,57	47,35	99,93

Note: Data taken from the Elaborate for detailed geological investigation since 2021

According to the petrological, mineralogical-microscopic examinations and chemical analyses of these dolomite marbles, they can be widely used in civil engineering mostly in low-buildings, concrete mixes, hydrotechnical works, etc. They can be also used as architectonic stone while allowing macrotectonics to be able to excavate larger blocks.

According to the examinations of the point load, the value of the physical - mechanical characteristics is in the following frame:

- Average value Js (50) = 2,72 to 3,63 depending on the testing
- The volume weight is in the range of = 27,87 - 28,24 kN/m^3
- Absorption of water is within U = 0,15 - 0,16 %
- The strength of the pressure is sp = 134 - 171,1 MPa, but in a certain number of samples there are also values of sp = 65,2 - 65,5 MPa.

In accordance with the performed examinations, it can be stated that the dolomite marbles have favorable characteristics to be used as an architectonic-building stone [10].

The present lower values point that the surface areas have weaker parts which should be taken into consideration in the process of exploitation.

It should be also noted that the samples are taken from the surface of the field and usually the more authoritative results are obtained from deeper zones, where the results are got through research drilling, testing, and examination.

Based on the performed evaluations of the mining reserves, it can be noted that the research space is promising in the perspective of exploitation of white dolomite marbles. The very fact that within field I were estimated 178.238 m^3 geological mining reserves from category B is a real indicator of the possibilities of the researched area. Here it is necessary to note that the performed evaluations of the geological mining reserves are made without deep research drilling, which is necessary for separating reserves from category A and, of course, confirming the reserves from category B, and the possibilities of the researched space.

CONCLUSION

Based on the results obtained from the mineralogical-petrological, chemical, and physical - mechanical examinations on the dolomite marble in the location Pletvar, the following conclusions can be made:

With the geological mapping three types of dolomite marbles are selected: stratified to massive dolomite marbles, tectonized dolomite marbles and stratified dolomite marbles.

The studied rocks represent dolomite marbles characterized with white color and saccharine, sugar like appearance, massive, stratified to bedded - sheet like. With geological research, the massiveness and compactness of the marbles was completely defined.

According to their color, on the geological map mostly predominate the dolomite marbles with clearly apparent white color and dolomite marbles with grayish-white color.

Dolomite marbles with white color are mostly found in the research space and can clearly be differentiated from the grayish-white and grey dolomite marbles.

The examined samples are determined as finer grained dolomite marble, which are very clear in their mineral and chemical content. The presence of MgO is over 20,66 %, only in the sample marked II/5 MgO it is present with 20,32 %.

According to petrological and mineralogical characteristics, these dolomite marbles can be widely applied in civil engineering, mostly in low-construction, for concrete mixtures, hydro-technical works, etc. They can also be used as an architectonic stone provided the micro-tectonics allows larger blocks to be detached.

In the researched field, three promising parts are selected that will be the research subject in the second phase i.e., a research drilling is planned in the selected parts. These promising parts will be presented afterwards with the supplement on topographic base where the designed research drills will be presented.

In accordance with the completed research, the dolomite marble is evaluated with favorable characteristics for its use as architectonic-building stone.

Notable lower values point out that areas even have weaker components, which needs to be taken into account before eventual exploitation.

It is noted that the samples are taken from the surface of the field, even though the more trustworthy results are usually obtained from deeper zones; normally, that data is received with research drilling, sampling and examination.

The research space has a good perspective for exploitation of white dolomite marbles.

REFERENCES

1. Boue, A.: Geological sketch of European Turkey. Geological Analogies of the Balkan Peninsula, 3rd Belgrade, 1891.
2. Cvijic, J.: Fundamentals for the Geography and Geology of Macedonia and Old Serbia. Special. izd. SAN, book. And, Belgrade, 1906.
3. Cvijić, J.: Fundamentals for Geography and Geology of Macedonia and Old Serbia, Special. izd. SAN, book. III, Belgrade, 1911.

4. Baric, Lj.: Report on field work in Prilep. God. Geol. Inst. Kr. South. for 1939. Belgrade, 1940.
5. Dumurdzanov, N., Hristov, S. (1976): Basic geological map 1:100 000 for the page Prilep, Geological Institute, Skopje.
6. Rakicevic, T., Stojanov, R., Arsovski, M., (1965a): Explanation for the page Prilep, BGM SFRY 1: 100 000, Geological Institute, Skopje. pp. 67
7. Dumurdzanov, N., Hristov, S., Pavlovski, B., Ivanov, V., 1976: Explanation for the page Vitoliste - Kajmakcalan, BGM SFRY 1: 100 000, Geological Institute, Skopje.
8. Rakicevic, T., Stojanov, R., Arsovski, M., (1965b): Explanation for the page Vitoliste, BGM SFRY 1: 100 000, Geological Institute, Skopje. Pp. 65
9. Paskalecv, V., (1983) Specifics of the methodology of economic evaluation of architectural-construction stone of SR Macedonia and long – term of its base. RGF Belgrade.
10. Spasovski, O., (2021): Elaboration for geological investigation with the calculation of ore reserves on the technical-grade stone in the locality Pletvar-Prilep. Misa MG Skoje.

КВАЛИТАТВНО-КВАНТИТАТИВНИ КАРАКТЕРИСТИКИ НА МЕРМРИТЕ ОД ОКОЛИНАТА НА ПЛЕТВАР ВО СЕВЕРНА МАКЕДОНИЈА И МОЖНОСТИ ЗА НИВНА ЕКСПЛОАТАЦИЈА

Орце Спасовски[1]

[1] *Факултет за природни и технички науки, Институт за Геологија, Универзитет "Гоце Делчев" Штип Р. Македонија*

*Контакт автор: orce.spasovski@ugd.edu.mk

Резиме

Употребата на мермерите како градежно-архитектонски камен со нивите естетско-технички карактеристики има долга традиција во Македонија од античко време до денес. Доломитските бели мермери се најзастапени во проучуваната област и јасно се разликуваат од сиво-белите и сивите доломитски мермери. Испитуваните примероци се утврдени како ситнозрнест доломитски мермер, кој минералошки и хемиски е доста чист. Според минералошко-петролошките карактеристики овие доломитски мермери, можат да најдат широка примена во градежништвото, бетонски мешавини и други хидротехнички работи. Може да се користи и како архитектонски камен бидејќи овозможува добивање на поголеми блокови. Врз основа на пресметаните рудни резерви може да се заклучи дека истражуваното подрачје е ветувачко по однос на експлоатација на доломитски мермер.

Клучни зборови: *архитектонско-градежен камен, доломитски мермер, рудни резерви, квалитет на карпите, хемиско-минералошки состав*