UTILIZATION OF THE LIMESTONES FROM THE CRETACEOUS COMPLEX OF MOUNTAIN PLACHKOVICA AS A CONSTRUCTION-TECHNICAL AND DECORATIVE STONE

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ABSTRACT
Cretaceous complex on mountain Plackovica is located in the eastern part of the Republic of Macedonia about 13 km east of the town of Stip.
In the geological structure of the wider environment on the research field participate rocks of Precambrian, Paleozoic, Mesozoic (cretaceous), and tertiary and Quarter age.
The subject of the research in this paper are upper cretaceous limestone sediments that are found northeast of the village Shashavarlija in localities Kodza Kran, Kamnik and Kara Tarla. This series of limestone lies transgression through gneisses and amphibolite from Precambrian. On the northeast, scaly are addicted micashists gneisses. Through them are deposited upper Eocene sediments, ie they lie transgression over them. Based on the discovered fossil faunal material, in the upper cretaceous sediments are separated cenoman, turon and senon.
Plate and bank limestones are present only in senon sediments ($^1K2_3$ u $^2K2_3$).
With the microscopic examination is determined that the limestone are constructed of: calcite, quartz, muscovite, sericite and biotite. As an essential found mineral is calcite, and as secondary minerals encountered: quartz, muscovite, sericite, and to a lesser extent biotite.
For determining the possibilities for exploitation on these limestones and their usage as construction technical and decorative stone, besides field research were performed and mineralogical - petrographic and chemical research, and determine their physical - mechanical properties. The data obtained from research has shown that they can find wide application in construction. Plate varieties can be used as decorative stone for coating on vertical and horizontal surfaces, while bank series can be used as massive carving or crushed stone aggregate (crushed and separated material) for making some kinds on concrete and asphalt.
Keywords: *limestone, senon, construction-technical stone, decorative stone*

Introduction

Locality Kara Tarla is located in the eastern part of the Republic of Macedonia about 13 km east of the city of Stip (Fig. 1). The terrain is hilly - mountainous and characterized by rounded peaks whose altitude ranges up to 850 m.

Data for the geological structure of the site Kara Tarla and its wider environment can de found in the interpreter for basic geological map of the Republic of Macedonia 1:100 000 of the sheet Stip (Geological Institute Skopje Rakichevic T., Dumurdzhanov N. Petkovski P., 1969) [7].

Newer research in this area is carried by Petrusev E. 2010: (Project for geological investigations of mineral raw materials limestone on the locality Kara Tarla village Shashavarlija - Municipality Karbinci) [6] and Baara N., Mirchovski V., Stefanova V., (Elaborate of the results of detailed geological surveys of mineral raw materials limestone on the locality "Kara Tarla" village Shashavarlija Municipality Karbinci) [2].

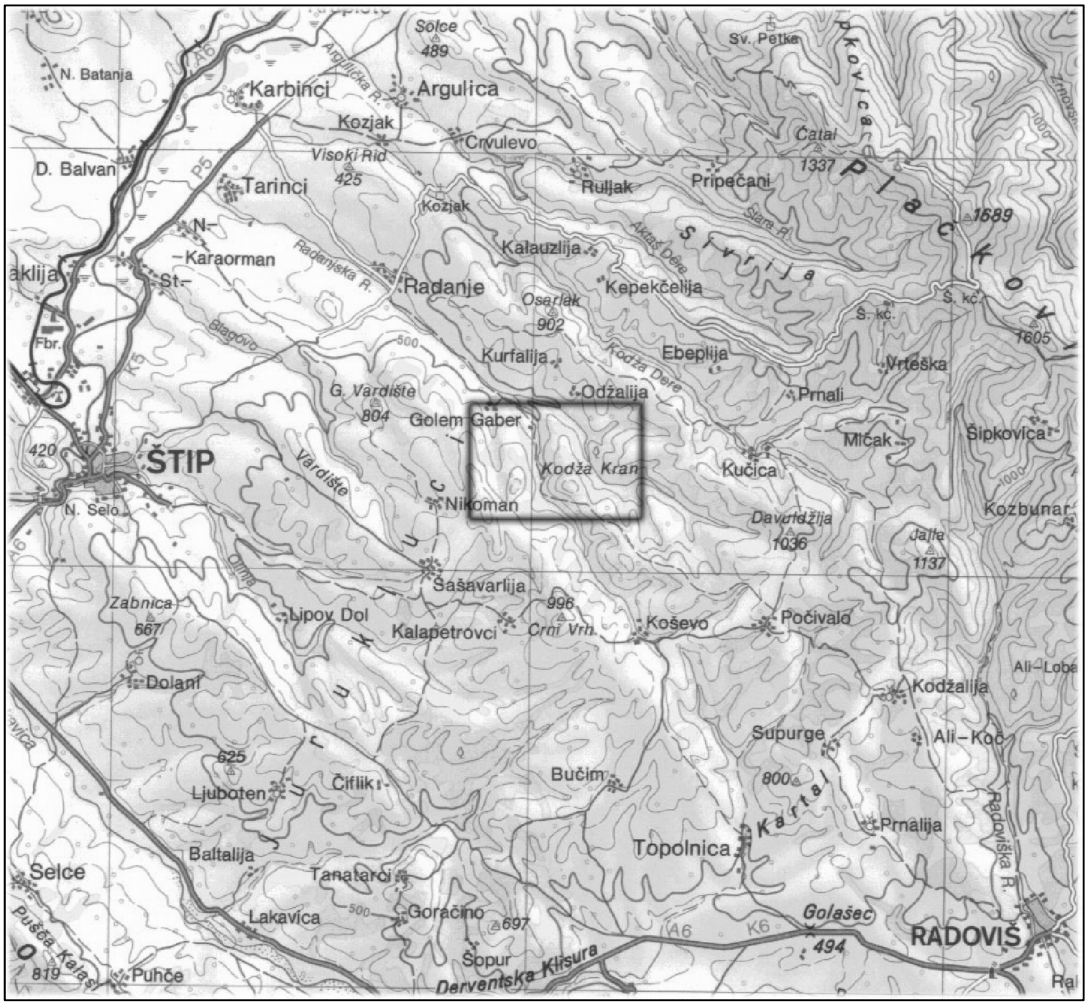

Fig. 1 Geographical position of investigating area

Geological structure and tectonics

The geological structure of the wider environment of the investigation area (Fig. 2) is shown on the geological map at a scale of 1:100 000 (OGK 1:100 000 R. Macedinia Sheet Stip - Rakichevic T., Dumurdzhanov N. Petkovski P., 1969).

From the geological map can be seen that the investigated area is built by paleozoic, upper cretaceous sediments and paleogene rocks.

Palaeozoic

Paleozoic in the closer vicinity of the investigated area is present with paleozoic chlorite-schist amphibolite schist (Scoam) which represent the oldest rocks of this area.

Upper Cretaceous

It was found south from village Mal Gaber in localities Kodzha Kran, Kamnik, Kara Tarla. It lies transgressive through gneisses and amphibolite from precambrian. Through them, from northeast, scaly are addicted micashists and gneisses. Upper Eocene sediments lie transgresiv through them. Based on the discovered fossil faunal material, Upper Cretaceous sediments are separated in cenoman, turon and senon.

Paleogene

Paeloge rocks build up the largest part of the investigation area and the terrain is represented only by sediments from the upper zone of the flysch ($^4E_3$).

Upper zone of the flysch ($^4E_3$).

The upper zone of the flysch is represented by sandstone, clays, marls, limestones and claystones. The largest expanse have claystones and sandstone which represent real flysch sediments.

On the investigating area are represented only by senon sediments ($^1K_2^3$ and $^2K_2^3$).

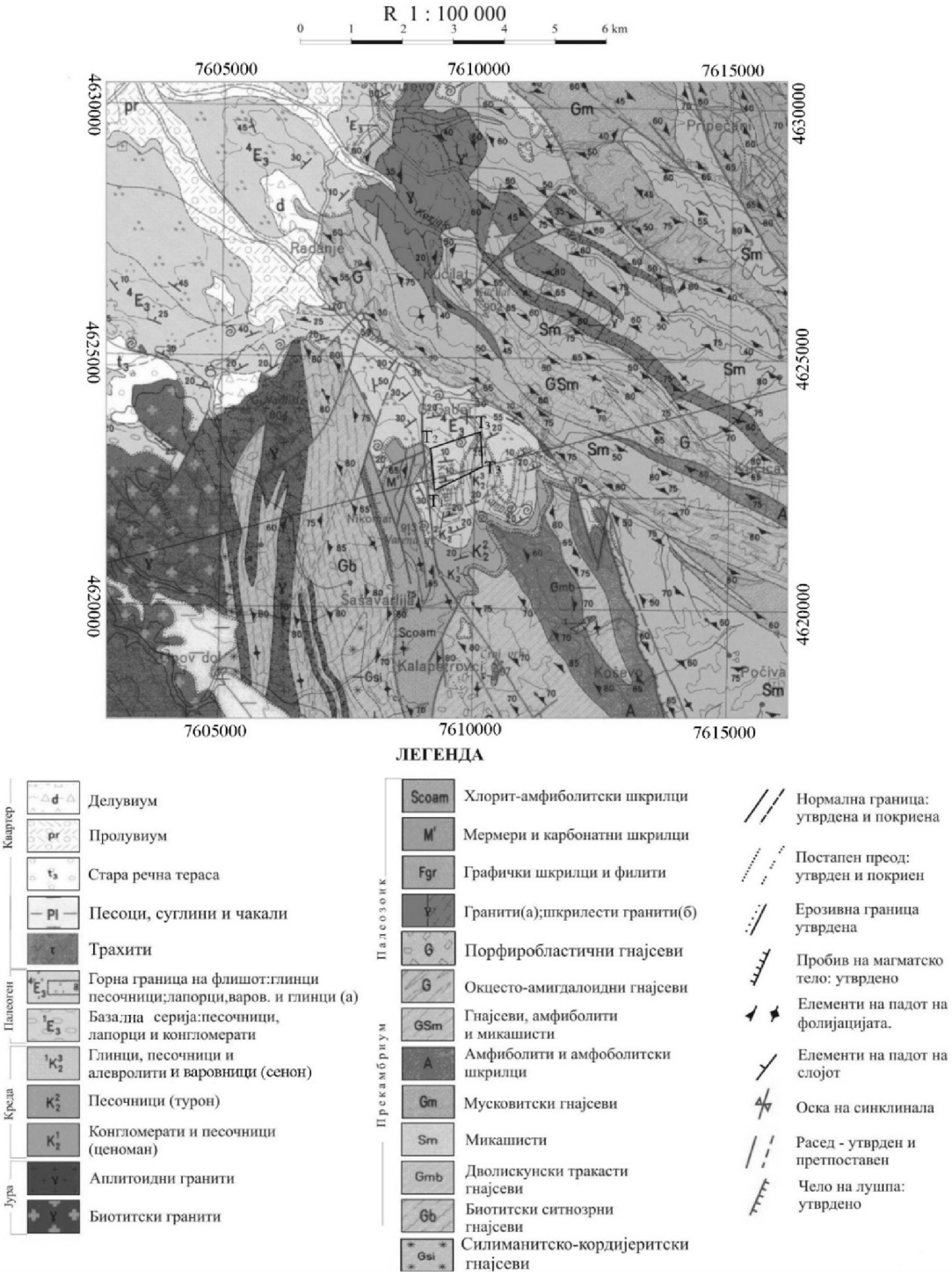

Fig. 2 The geological structure of the wider environment of investigating area

Senon (K_2^3)

The appearance of conglomerate, sandstone and carbonate represented in turon and cenoman sediments, pointing to the coastal environment of turbulent deposition. After this comes the deposition of finer

sediments. First is appearing the alevrolite and dilapidated claystones, and then thin laminated red and gray marls and limestones with a variety from pelastic fauna (Rgeoniceras tridorsatum, Neogaudroceras deuseplicatum and Micraster coranguinum etc..).

Characteristic for this part ($^1K_2^3$) is frequent and fine removing members of marley - sand series. The appearance of red and gray marls and limestones can be explained by oscillation in the basin, where the influx of iron component was interrupted (Fig. 3).

Fig. 3 Red and gray limestone

After deposition of marls comes to shallowing and occurrence of limestone and kalkareniti ($^2K_2^3$) with Hipurites orreli. The upper part from profile is completed with white marls, which we again suggests deepening and quieter conditions in the basin. Senon sediment thickness is about 200-250 meters. Except bioglife are not found another textured signs in the cretaceous sediments. Senon sediments ($^1K_2^3$) are constructed from flat limestone, sandstone and marls which are the main focus of research in the investigating area.

A common feature of the rocks that are present in the zone of the investigated area is that almost all (some more some less) are susceptible to cleavage by layering surfaces.

From the geotectonic point this site belongs to the Vardar Zone or more precisely its tectonic structure called Buchimski block [1]. This tectonic unit is allocated between the village Teranci and Radovish in the east and Stip Granite massif to the west. It consists from a single deformed syncline, on which west wing are two-mica porfiroblastici gneisses. Through this structure transgressiv lies the Upper Cretaceous that is exactly area of interest in our case.

In general terms Upper Cretaceous is intersected by two systems of cracks normal to each other. The first system is stretching NW-SE dipping toward NE with dip angle of 20-30°. These cracks represent the layered of deposits and after them rocks are divided into panels of varying thickness. The second system is perpendicular to the first with stretching E-W with dip angle of 40 -75 °.

Mineralogical - petrographic features

To determine the mineralogical - petrographic characteristics of the mineral resource microscopic preparations were made. By studying them in detail is determined mineralogical composition, scale, form and interrelationships of mineral grains which in turn contributes to more accurately define the structural - textured properties of limestone.

The limestones have a fine-grained cryptocrystalline to microcrystalline structure and layerd texture.

With the microscopic examination is determined that the limestone is built by: calcite, quartz, mucovite, sericite and biotite.

As an essential mineral meets the calcite, and as secondary minerals encountered: quartz, mucovite, sericite, and to a lower extent biotite. On sample also shows a well-preserved fossil forms or organic bituminous.

Calcite is a mineral that is dominant in the rock. It is found as fine-grained from that presented itself on the rock, and in some cases can be seen in something larger grains. After the color is greyish black, and instead is found and colorless.

Quartz is a light gray, white and colorless and has no cleavage. It appears in very small grains and characteristic about him is that darkens four times by turning the chair to 360 °. With the analyzer off is white to gray.

Micas in preparation are less presented, and as the most common is found sericite. It occurs in very small microcristalline pieces which have live interfering colors. Sericitot has no pleochroism.

The mica is a second representation mica in preparation. It occurs in leaf form larger pieces from sericite and has vivid interfering colors. It darkens parallel to the cracks of cleavage.

Percentages the biotite is least present mineral in the preparation and has brown, yellowish brown, and local and dark green. Interferes in brownish yellow color. Has a intense pleochroism, in all shades of brown and darkens parallel with directions of cleavage.

Considering the mineral composition, shape, size, orientation and interrelationships of minerals in the preparation, it can be concluded that it is sediment rock of the order of limestone.

Chemical investigations

The chemical composition of the rocks is an important feature which is necessary not only for classification in terms of their chemical composition but also to solve a series of important questions relating to their formation and their mutual relationship with the rocky material in the earth's crust.

To determine the chemical composition of rocks from the investigated terrain were made chemical analyzes of three samples with the method of inductively connected plasma (ISR-AES), in the Faculty of Natural and Technical Sciences, Institute for Geology Stip, and the results are shown in Table 1.

Table 1. Chemical analysis of limestone

Oxides	(%)	(%)	(%)
CaO	47,10	49.32	46.06
MgO	0,119	0.269	0.240
FeO	0,354	0.853	0.809
$A1_2O_3$	0,156	3.18	1.07
Na_2O	0,0016	0.937	0.025
K_2O	0,0056	0.899	0.279
MnO	0,073	0.063	0.059
TiO_2	0,007	0.224	0.093
P_2O_5	0,029	0.0516	0.0497
Loss on ignition	37,10	36.299	36.295
Trace elements	**(mg/kg)**		
Sr	515.61		
Ba	30.61		
As	6.40		
Ni	2.91		
Cr	4.59		
Zn	9.85		
Cu	5.09		
Cd	<1		
Co	<1		
Ag	<0.1		

From the analysis it can be concluded that the most common is with CaO 47.10%, and also the loss on ignition is large (37.12%), ie they represent CO_2 that is produced by the decomposition of $CaCO_3$ on CaO and CO_2.

From other components much less are represented and MgO, FeO, Al_2O_3, MnO, P_2O_5, TiO_2, Na_2O and K_2O, with their total percentage does not exceed 1% (correct 0.7452%).

Also in one sample is analyzed trace elements and the results are shown in table 1. From the elements in trace the most abundant is Sr with 515,61 mg, followed Ba 30,61 mg, Zn 9,85 mg, 6.40 As mg, Cu 5,09 mg, Cr 4,59 mg, Ni 2,91 mg, and the lowest representation Cd, Co (<1 mg) and Ag(<0,1 mg).

The chemical data indicate that it is sediments from rock from the order of limestone.

Physical - mechanical characteristics

For the examination of the physical - mechanical characteristics of the limestone were examined two samples. Physical - mechanical tests were conducted in the Engineering Institute "Macedonia" AD

In determining of the physical and mechanical characteristics an appropriate methodology is applied of the laboratory testing according to existing standards. The results are shown in Table 2.

Table 2. Results from physical- mechanical tests of the limestone

Strength of the pressure in dry condition (medium)	σ_{psr} – 97.7 – 108.7MPa
Strength of the pressure in the water saturated state (medium)	σ_{psr} – 74.22 – 96.10 MPa
Resistance to abrasion by scraping by the method of Bohme	11.80 – 18.80 cm^3/50 cm^2
The water absorption	0.37 – 1.22 %
Volume mass	2580 - 2630 kg/m^3
Specific mass	2680 - 2700 kg/m3
Degree of density	96.3 – 97.4 %
Porosity	2.6 - 3.7 %

Conclusion

Based on the results from performed tests for physico-mechanical, mineralogical - petrographic and chemical characteristics, we can conclude that the investigated limestone from the site Kara Tarla can be used as in construction.

decorative stone for interior and exterior decoration for wall and floor surfaces. Also it can be used as crushed aggregate, but for its application should be made further examinations. The results show that this is a mono mineral raw materials with calcite composition with small admixtures of the other minerals that are not harmful to its use

References

1. **Arsovski M., 1997:** Tectonics of the Macedonia. RGF - Stip.
2. **Baara N., Mirchovski, V., Stefanova V., 2011:** Elaborate for the results of detailed geological surveys of the mineral raw materials lime on the locality "Kara Tarla" v. Shashavarlija Municipality Karbinci. Geohidroinzhenering-Konsaltant Tetovo
3. **Vaknjac. B.. 1992:** Geology bearings of non metal mineral raw materials. Faculty of Mining and Geology Belgrade.
4. **Gjuzelkovski D., 1997:** Groundwater (aquifer) to solve the water supply in the Republic Macedonia and their protection. Institute Geohidroproekt. Skopje.
5. **Jankovic S. Milovanovic D .1985.:** Bases of economic geology and economic for mineral raw material. Faculty of Mining and Geology Belgrade.
6. **Petrusev E. 2010**: Project for detailed geological surveys of the mineral raw materials lime on the locality Kara Tarle village. Shashavarlija Municipality Karbinci. Geohidroinzhenering Tetovo.
7. **Rakichevic T., Dumurdzhanov N. Petkovska P., 1969:** Interpreter for basic geological map of the Republic of Macedonia 1:100 000 sheet Stip. Geological Institute Skopje.