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UTILIZING GABBRO OF SITES PANTELEJ AS CONSTRUCTION-TECHNICAL STONE

Vojo Mircovski[1], Violeta Stefanova[1], Tena Sijakova – Ivanova[1], Gorgi Dimov[1], Vasko Mircovski

[1]Faculty of Natural and Technical Sciences, University Goce Delcev Stip, R. Macedonia

vojo.mircovski@ugd.edu.mk

violete.stefanova@ugd.edu.mk

tena.sijakova@ugd.edu.mk

gorgi.dimov@ugd.edu.mk

ABSTRACT

This paper presents the results of the detailed field and laboratory investigations of gabbro from the locality Pantelej. These investigations are conducted in order to determine the mineralogical-petrographic and technical characteristics of gabrro in order to use as construction stone.

The main minerals that build rock are plagioclase and pyroxene.

Pyroxene is the dominant mineral in this sample, and it is represented by about 80%. In most pirochsene crystals are occupied with the process of metamorphosis - uralitisation where they transform to amfibol type: actinolite- tremolit and uralit.

Plagioclase in terms of pyroxene is present in smaller quantities and represented approximately 20%. It occurs like allotriomorphic to hypidiomorphic crystal belongs to basic plagioclase.

For the determination of the possibilities for the exploitation of this gabbro as constructing-technical stones, were carried out mineralogical - petrographic and chemical research, as well as, determine the physical - mechanical characteristics of the samples of these rocks. These performance show that they be able to find wide application in the construction as crushed stone for constructing for making of all types of concrete and asphalt.

KEYWORDS: *Pantelej, gabbro, yurasic, construction-technical stone, mineralogical - petrographic features, physical mechanical properties*

INTRODUCTION

Pantelej locality is located in the eastern part of the Republic of Macedonia near the monastery of St. Pantelej 15 km southeastern from city Kocani (fig.1).

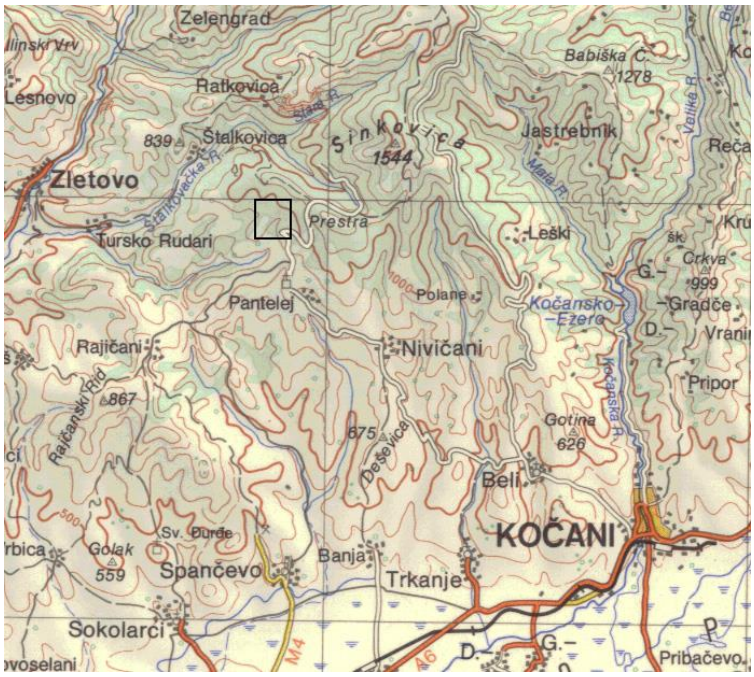

Figure 1: Geographical location of the site Pantelejmon

Geological data for gabbros from site Pantelej and its wider environment can be found in interpreter for basic geological map of the Republic Macedonia in the scale of 1:100 000 sheet Stip (T Rakicevic., N. Dumurdzanov., P Petkovski., 1969).

Further research on gabbros from site Pantelej carried out by (V. Mircovski and Nauaf Baara 2013).

1 GEOLOGICAL FEATURES

The geological structure of the wider environment of the investigated site is presented according to data from OGK 1:100 000 sheet Stip. (T Rakicevic., N. Dumurdzanov., P Petkovski., 1969). (Fig. 2).

In geological structure of the rocks participate Precambrian, Paleozoic, Mesozoic, Tertiary and Quarter old age.

Precambrian rocks are represented by two-mica stripped gneisses (Gmb), micaschists (Sm), gneisses, and amphibolite micachists (GSm).

Paleozoic rocks are made of quartz-chlorite-sericite schist (Sco), epidote-quartz -sericite-chlorite schist (Sep), amphibolic gabbro (νam), Amfibol-chlorite- sericite shale (Samco), quartz-schist and graphitic phylites (Sgr).

Mesozoic rocks are represented by Jurassic gabbro (ν) which are the subject of research in this paper.

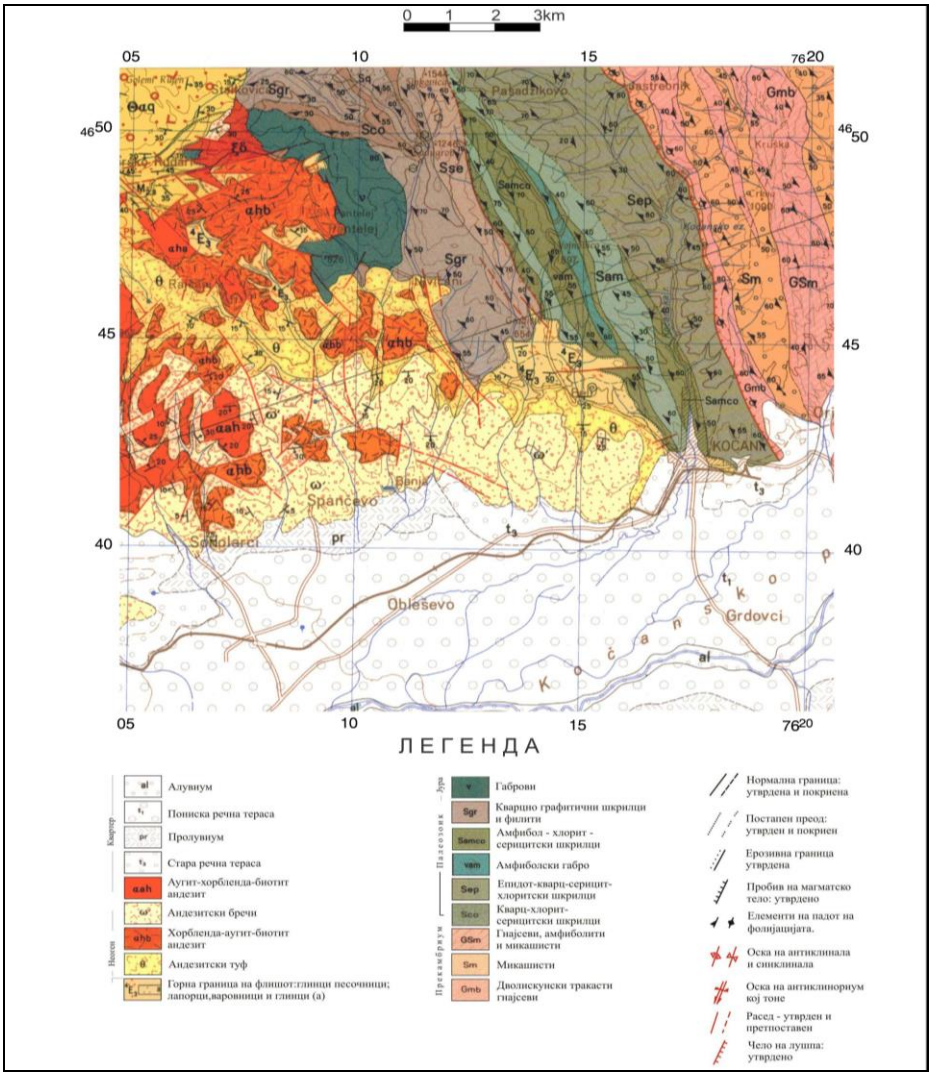

Figure 2: Geological map of the surrounding terrain to investigate

Gabbro from this locality occur in the form of a large irregular mass between village Stalkovica and Nivicani village and penetrate paleozoic chlorite - sericite and quartz - graphite shale. In the area of the monastery Pantelej through gabbro lie eocene sandstones and limestones, while in other parts they are get trought with quartz-monconite or covered with hornblenda augit biotitic andesites. The age of these gabbro defined as jurasic because they penetrate paleozoic shale, and upper eocene sediments accumulated through them.

Tertiary rocks are represented by the upper limit of flish ($^4E_3$), andenzite tuff (θ), hornblenda - augit-biotit andesite (αhb), andenzite brachia (ω), and quarter is present with the old river terraces (t_3), proluvia (pr) , lower river terrace (t_1) and aluvium (al).

At the surface gabbro in some parts of the field are heavily modified with very poor physical-mechanical characteristics, and the rest of the field they are fresh and compact with good physical-mechanical characteristics (Fig. 3).

Also gabbro from the northeastern parts of the investigated area of some parts go directly to the surface and is fresh (Fig. 4), and other parts that are covered with proluvial material mixed with humus (Fig. 5). The thickness of the cover material and humus is different and it ranges from 0,5-3 m. The average may be taken that the exploitation of gabbro in the investigated area to be removed this material with a thickness of about 1 m.

Figure 3: Fresh gabbro covered with altered gabbro with poor physical-mechanical characteristics

Figure 4: Fresh gabbro that appears on the surface of the ground

Figure 5: Fresh gabbro covered with proluvial material mixed with humus

The formation of ground ie structural forms is conditioned by tectonic movements that occurred during the pre-Paleozoic, Hercin and Alpine orogeny.

According geotectonic regionalization of Macedonia (M. Arsovski 1997) the investigated field located at the contact between the Serbo-Macedonian Massif and the Vardar Zone. These two units are separated by a fault structure of regional character, which on NW is losing in the kratovo-zletovo volcanic area, and the SE in Kocani valley. Gabbro as a result of the tectonic processes is intensely crushed in decametric blocks.

2 MINERALOGICAL - PETROGRAPHIC FEATURES

By color gabrro is gray greenish, they have grainy compact massive texture and allotriomorphic to hypidiomorphic grainy structure with homogeneous size of crystal grains. The size of the mineral grains ranging up to 2 mm.

Mineralogical petrographic investigations were performed of the representative samples of core from bore holes which are perforated in gabbro. Microscopic investigations and microphotographs were made with Polarization optical microscope with light missed mark LEICA DM 4500 P from Swiss production.

Under the microscope gabbro has allotriomorphic to hypidiomorphic grainy structure with homogeneous size of the crystal grains which usually moves to 0.5 mm (Fig. 6 and 7). The main minerals that build up the rock are plagioclase and pyroxene.

Pyroxene is the dominant mineral in gabbro and its amount ranges from 60-80%. In most piroxene crystals are occupied with the process of metamorphose ie uralization where they pass into amfibol like aktinolit - tremolit and Uralit (Fig. 8 and 9). These minerals occur in the form of fineleaf and needle crystals. Also appear fresher diopside crystals in the shape of fine leaf form or as relics in rectangular shapes in less affected by metamorphose piroxene primary crystals. Typical for diopside that in most crystals comes to separating the Fe - component in the form of the fine black aggregates found in the crystal (Fig. 8).

Plagioclase in terms of the pyroxene is present in smaller amounts (20-40%) It occurs to allotriomorphic to hypidiomorphic crystal and belongs to the basic plagioclase. The size of the grains typically range up to 0.5 mm (Fig. 6 and 7) a rarely occurring crystal size reaching up to 2 mm. Plagioclase also is occupied with the process of metamorphose when he goes in fine aggregates of the small chalk sosirite (Fig. 9). The individual crystals larger and cooler in plagioclase appear polisintetical plate ie lamellar twining (Fig.10).

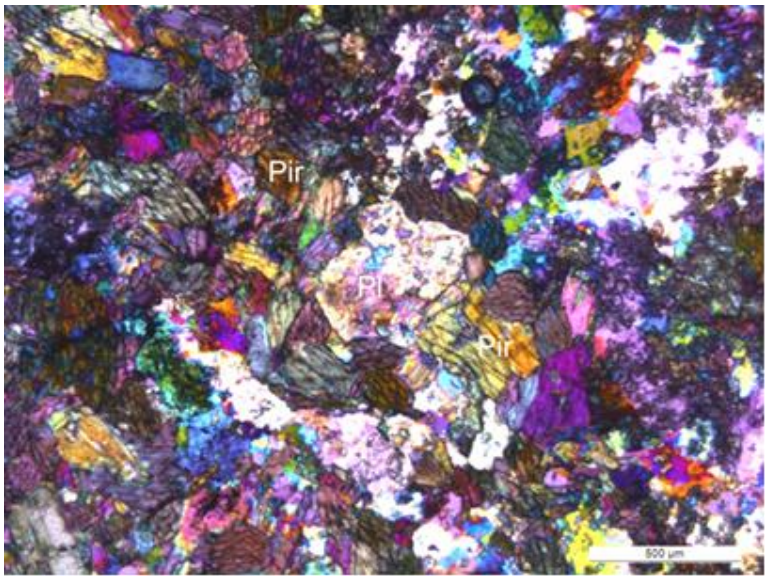

Figure 6: Allotriomorphic-hypidiomorphic grainy structure (Pir - pyroxene, Pl - plagioclase). N^+

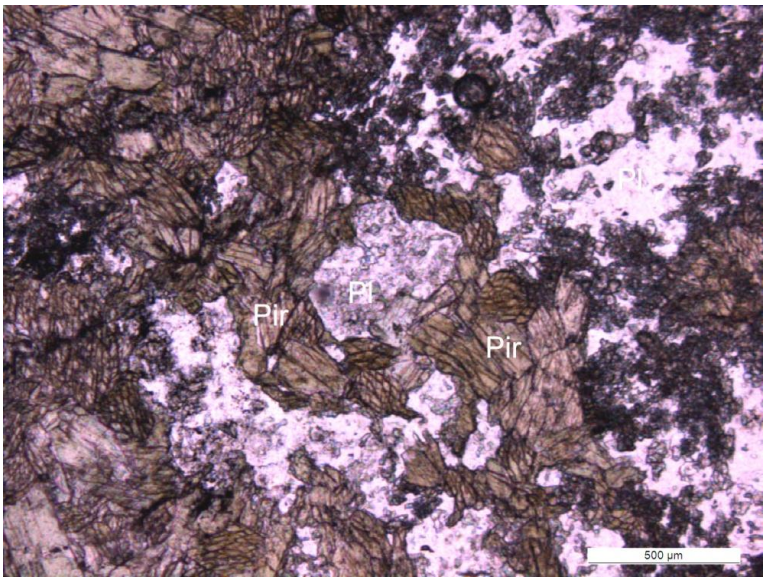

Figure 7: Allotriomorphic-hypidiomorphic grainy structure (Pir - pyroxene, Pl - plagioclase). N^-

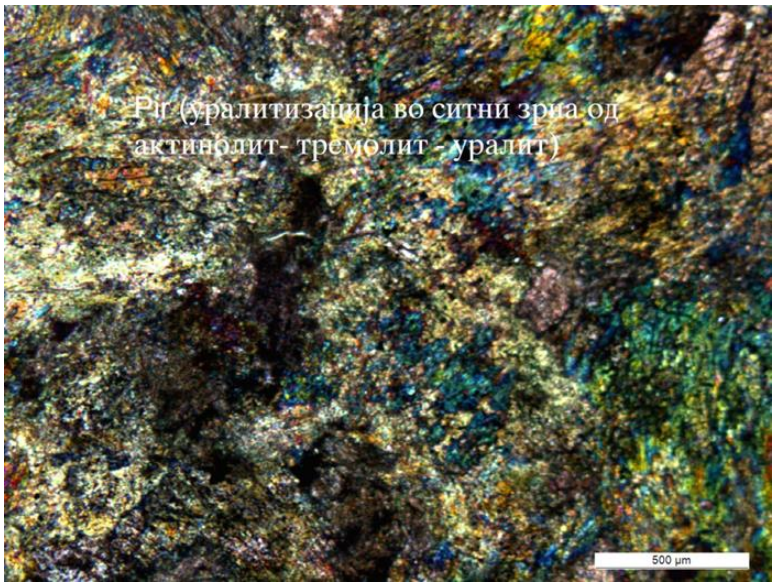

Figure 8: Process of uralization of the pyroxene where he spends in amfibol the type of actinolite - tremolite and uralite., (Pir - pyroxene). N^+

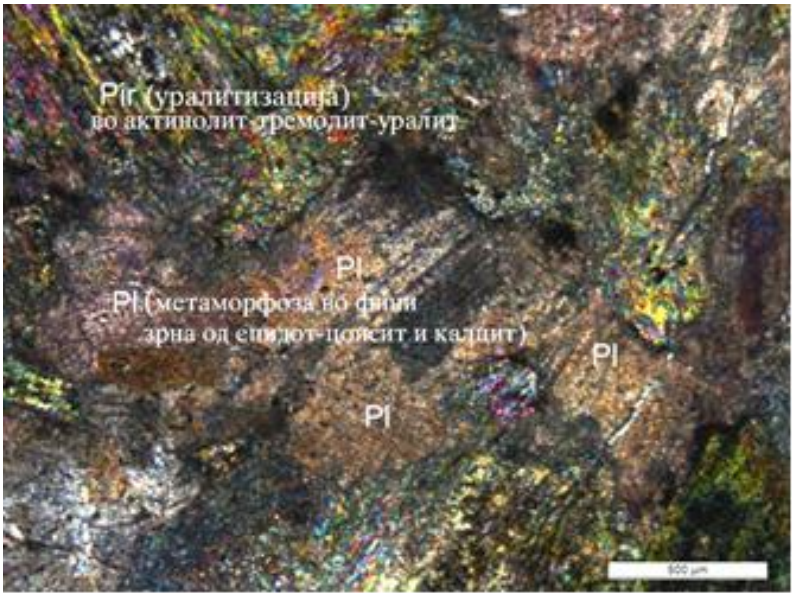

Figure 9: Metamorphosis of plagioclase into fine grains of the epidote-coesite and calcite. (Pl - plagioclase, Pir - pyroxene). N^+.

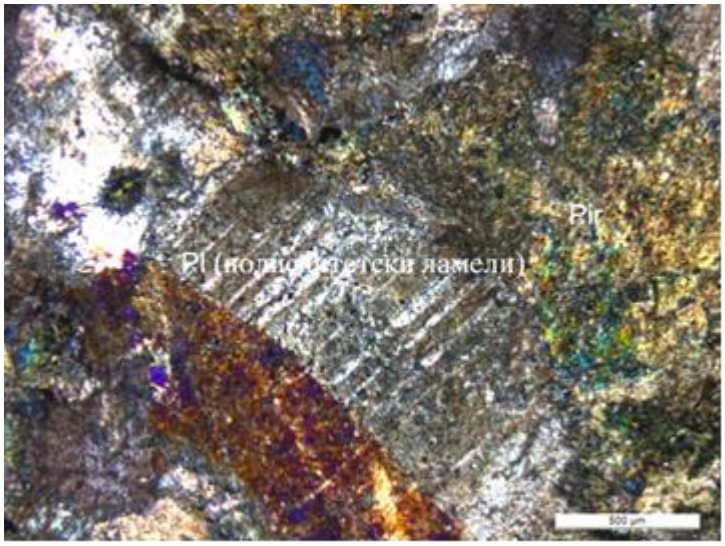

Figure 10: Lamellar twining in plagioclase. (Pl - plagioclase). N +

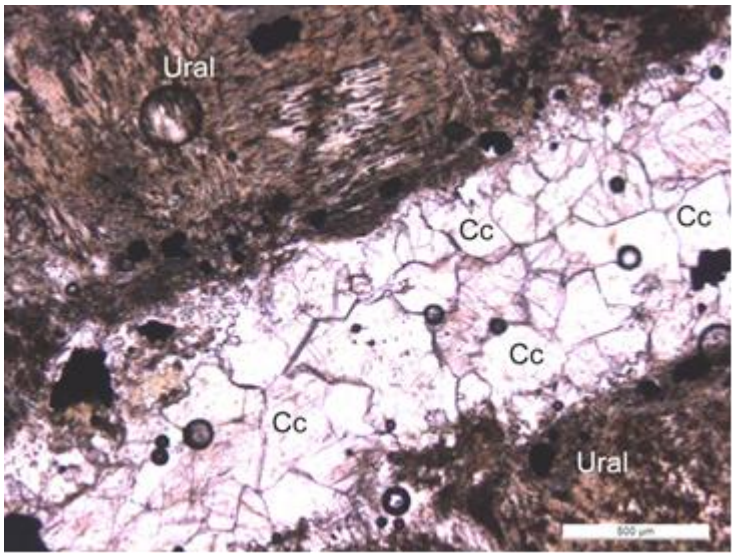

Figure 11: Calcite thin wire with a thickness of about 1 mm and separation of the Fe - component in pyroxene in the shape of the black fine aggregates. (Cc - calcite, Ural - uralization in pyroxene). N-.

3 CHEMICAL TRAILS

The chemical composition of gabbro is determined at the three samples at the Faculty of Natural and Technical Sciences from Stip with a method of inductively connected plasma (ICP-AES). The obtained data are shown in table 1.

From the analysis we can conclude that the most common is SiO_2 which ranges is between 44.89 - 45.25 %, then the representation have been Al_2O_3 with content of 23.95 - 24.67 % and CaO content from 15.10 to 15.40 %. The other components are represented in smaller amounts. The content of SiO_2 and other components indicates that it is a basic magmatic rocks.

Table 1: Chemical analyzes of the gabbro from the site Pantelej - Kocani

	P-1	P-2	P-3
Oxide	(%)	(%)	(%)
SiO_2	45.01	44.89	45.25
TiO_2	0.24	0.21	0.25
Al_2O_3	24.02	23.95	24.67
Fe_2O_3	3.10	2.90	3.35
FeO	4.55	4.90	4.40
MnO	0.20	0.23	0.19
MgO	2.85	2.98	2.95
CaO	15.40	15.70	15.30
Na_2O	0.69	0.73	0.72
K_2O	0.67	0.69	0.68
P_2O_5	-	-	-
H_2O^+	2.30	2.10	2.50
H_2O^-	0.04	0.01	0.02
Вкупно	99.07	99.29	100.05

4 PHYSICAL MECHANICAL PROPERTIES

Physical - mechanical characteristics of gabbro been studied in Civil Engineering Institute in Skopje, Macedonia. The survey methodology has been applied to laboratory tests according to existing standards for this kind of stuff. The results of physical mechanical tests are shown in table 2.

From physical mechanical parameters especially should be noted the strength of pressure in dry condtion which ranges from 215-240 MPa. The results of the examinations of physical - mechanical, mineral - petrographic and chemical features of the the gabbro from site Pantelej can conclude that gabbro has extremely high strength of the mole fracture pressure, resistance to the action of frost, extremely high abrasion resistance and scraping, minimal or blip water absorption and high volume weight.

The mineral - petrographic and chemical analyzes are not determined harmful mineral and chemical components. According to the established features gabbro can find wide application in building for preparing all types of concrete, asphalt and other purposes.

Table 2: Results obtained from tests performed on same physical - mechanical parameters

	Tested parameter	Unit measure	Label	Result
1	Strength of pressure in dry conditions	MPa	σ_p sred	230.2
2	Strength of pressure in wet conditions	MPa	σ_p sred	199.8
3	Water absorption	%	U	0.02
4	Resistance to abrasion by scraping	$cm^3/50cm^2$	Ab	3.85
5	Volume mass with pores and cavities	kg/m^3	Ỳz	3000
6	Porosity	%	P	0.7

CONCLUSION

Based on completed mineralogical - petrographic, chemical and physical - mechanical tests can say that the gabbro from site Pantelej are characterized by high quality and they can find wide application in the construction industry as a raw material for technical-building stone for preparing all kinds concrete, asphalt, etc.

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