

PHYSICAL - MECHANICAL CHARACTERISTICS OF DIABASE FROM THE AREA OF STRUMICA, THE REPUBLIC OF NORTH MACEDONIA

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ABSTRACT

The paper shows the physical and mechanical, mineralogical, petrographic and chemical characteristics of the mineral raw material - diabase from the locality in the area of the Municipality of Strumica, and a possibility to use it for construction - technical stone. Appropriate tests were performed on samples taken from the surface and deep parts of the deposit. The obtained results show that the mineral raw material - diabase meets the requirements for application as construction-technical stone.

Investigated terrain is located in the south east part of the Republic, in the vicinity of the village Kosturino and occupies an area of about 0.18 km².

Keywords: diabase, physical – mechanical characteristics, mineral composition, chemical composition.

Introduction

The location on which detailed geological research of the mineral raw material diabase were carried out is a research area called "Gavran" and is located in the southeastern part of the Republic of North Macedonia, and administratively belongs to the Municipality of Strumica. The nearest inhabited place is the village of Kosturino (Fig. 1). [2]

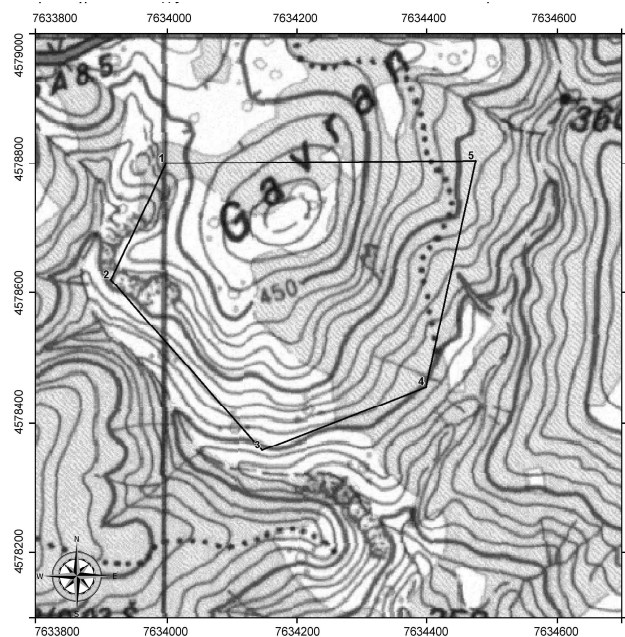


Fig. 1: Geographical position of the investigated area

The hydrographic network in the Strumica region is quite rich with several sources, rivers and their tributaries. The research area "Gavran" is located near the village of Kosturino, where there are temporary watercourses and springs that gravitate towards the Strumica - Valandovo field.

In the investigation area, no sources, water phenomena or more significant surface water course were found.

In the wider vicinity of the research area there are numerous of different lithological compositers that were

formed during different periods of the earth's crust development. The Old Paleozoic rocks of the Strumica valley occupy a very large area. They occur in two belts, in which they are completely different in mineralogical - petrographic and metamorphic characteristics.

The investigated terrain belongs to the inner zone and it is represented by different types of schists, marbles, phylites, serpentinites. Jurassic is presented by diabase – chert formation, gabbros, diabases, granites and rhyolites. Tertiary is presented by Upper Eocene and Pliocene sediments and Quaternary is represented with proluvium (fig. 2).

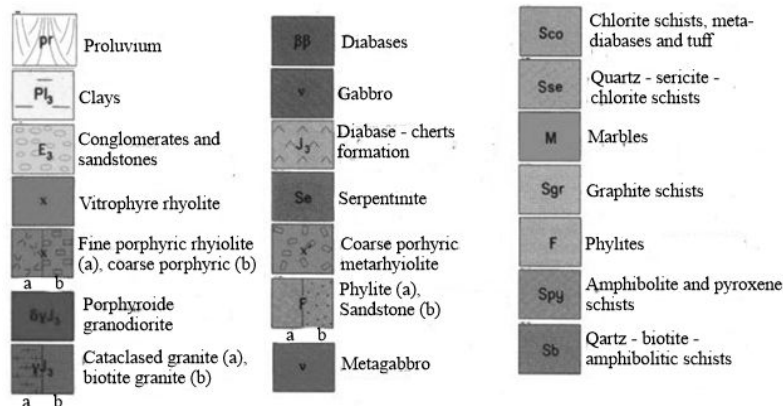
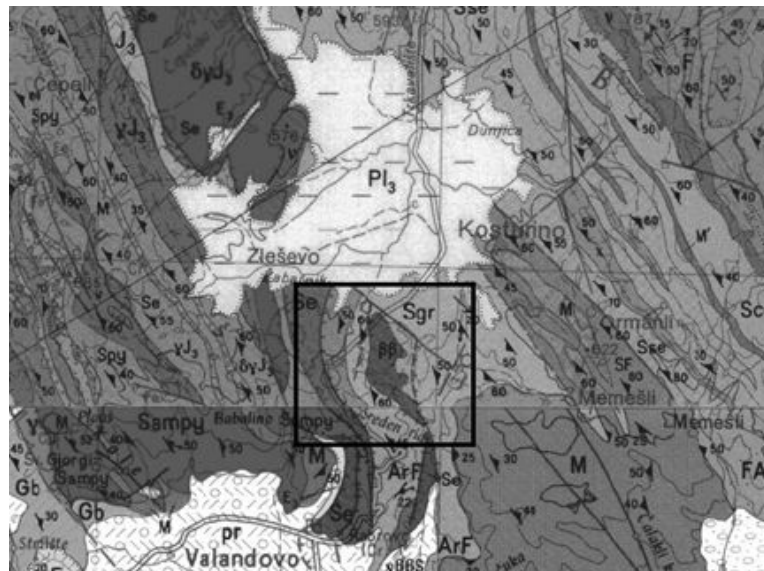


Fig. 2: Geological map of the vicinity of the investigated area [3]

The rocks present in the investigated field, in terms of their hydrogeological function can be classified as relative hydrogeological insulators with fractured porosity where diabases are classified.

Geological features of diabase

Diabase ($\beta\beta$) appears as large mass southwest of the village Kosturino within the slates, alevrolites and sandstones. Diabase is mostly decomposed, cracked and crushed. Fresh diabases have a dark green color, are characterized by a fine-grained and ophitic structure. The rim of this diabase mass is very schistose, limonitized and cataclased, while the central parts of the massif have a very pronounced network of cracks.

The composition of these rocks is represented by idiomorphic crystal forms of plagioclases (labrador or bitovnite), and rarely occur uralitized and chloritized pyroxenes and amphiboles. [3]

Since diabases are closely related to Jurassic sediments, the age of the diabases has been determined

as Jurassic.

Mineralogical - petrographic analysis of the diabase

According to the macroscopic description, the diabase is very hard and tough with a zonal color and a massive textural structure. An irregular dark gray to black halo with a fine-grained composition stands out in the central parts. The other part of the rock is characterized by a very clear greenish gray color. The boundary between these two varieties is sharp with visible concentric cracks created by magma cooling (fig. 3).

According to the microscopic description, it is a holocrystalline allotriomorphic rock with a fine-grained to medium-grained ophitic structure. The groundmass is made up of: plagioclase (andesine, labrador and rarely bitovnite), amphibole and pyroxene as the main primary minerals. From the secondary ones, epidote, chlorite, uralite, sossarite and prenite are represented. Ore minerals occur as accessories. Plagioclase occurs in hypidiomorphic rod-like crystal forms of 0.8 - 2.0 mm in size. They are involved in processes of transformation into sousirite (epidote, chlorite). Pyroxenes occur in allotriomorphic and hypidiomorphic crystal forms that fill the space in and around plagioclase with a grain size of 0.5 – 1 mm. Fresh pyroxenes are rarely found, they are affected by the process of epidotization and chloritization. The amphibole is regularly uralitized, forming a halo of the uralite around the amphibole grain itself. [2]



Fig. 3. Diabase from the investigated area [1]

Physical - mechanical parameters of diabase

The examinations for compressive strength of the diabase were performed on dry and water-saturated cubes with size 5 × 5 × 5 cm, and the abrasion resistance test was performed on cubes with size 7 × 7 × 7 cm in dry condition.

The obtained results of the laboratory examinations of the physical-mechanical characteristics of the diabasites from the locality "Gavran" expressed as mean arithmetic value are presented in Table 1.

The following characteristics were examined: [5]

1. Compressive strength in dry state
2. Compressive strength in a water saturated state
3. Water absorption
4. Volume mass
5. Persistence of effect of ice
6. Porosity
7. Abrasion resistance

Table 1. Physical - mechanical characteristics of diabase

No.	Test	Unit	Standard	Results
1	Compressive strength in dry state	MPa	B.B8.012	159,7
2	Compressive strength in a water saturated state	MPa	B.B8.012	156,95
3	Water absorption	%	B.B8.010	0,15
4	Volume mass	kg/m ³	B.B8.032	2950
5	Persistence of effect of ice	%	B.B8.002	0,2
6	Porosity	%	B.B8.032	1,3
7	Abrasion resistance	cm ³ /50cm ²	B.B8.015	12,23

It can be seen from the table that diabase is characterized by high compressive strength, high abrasion resistance, low water absorption, frost resistance, etc.

Chemical analysis of the diabase

The average composition of the studied samples has been listed in table 2.

Table 2. Average chemical composition of the diabase

SiO₂	48.04 %
Al₂O₃	14.22 %
Fe₂O₃	11.56 %
CaO	10.47 %
MgO	6.7 %
Na₂O	2.45 %
K₂O	0.78 %
LOI	5.87 %

Based on the performed mineralogical - petrographic, chemical and physical-mechanical characteristics, it is concluded that the diabase mineral raw material from the "Gavran" locality is of good quality and has good characteristics for further application for the production of crushed material.

This diabase can be used to make fractions for high value concretes (with high strength characteristics) according to standard MKS B.B2.009 (EM 12620; EM 206-1) for all types of concrete. The stone can also find another application.

Crushed material divided into fractions can be used for upper bearing layers - bituminized bearing layers and production of lower bearing layers - tampons for all types of roads and highways. Also, for finished asphalt - concrete layer for roads for all groups of traffic loads. [4]

Conclusion

The investigation location of the mineral raw material diabase is located in the southeastern part of the Republic of North Macedonia, and administratively belongs to the Municipality of Strumica.

Construction - technical stone from magmatic deposits due to their specific physical - mechanical characteristics (primarily high resistance to abrasion and hardness) has a wide application and use as a material for finishing layers in road construction, and can also find application both in construction and in the production of insulating materials.



The research area of the "Gavran" locality is composed of Jurassic diabases. In most of the space, diabases appear directly on the surface of the terrain. As can be seen from the above, all the prescribed research that defines the quality of the mineral raw material has been carried out. From the results obtained from the physical - mechanical, mineralogical - petrographic and chemical characteristics of the diabases from the "Gavran" locality, it can be concluded that they meet the conditions for their use for the production of fractions for high - quality concrete, fractions for upper loads layers - bituminized bearing layers and fractions for lower bearing layers – tampons, for all types of roads and highways.

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