

# GRANITOID FORMATIONS IN THE REPUBLIC OF MACEDONIA

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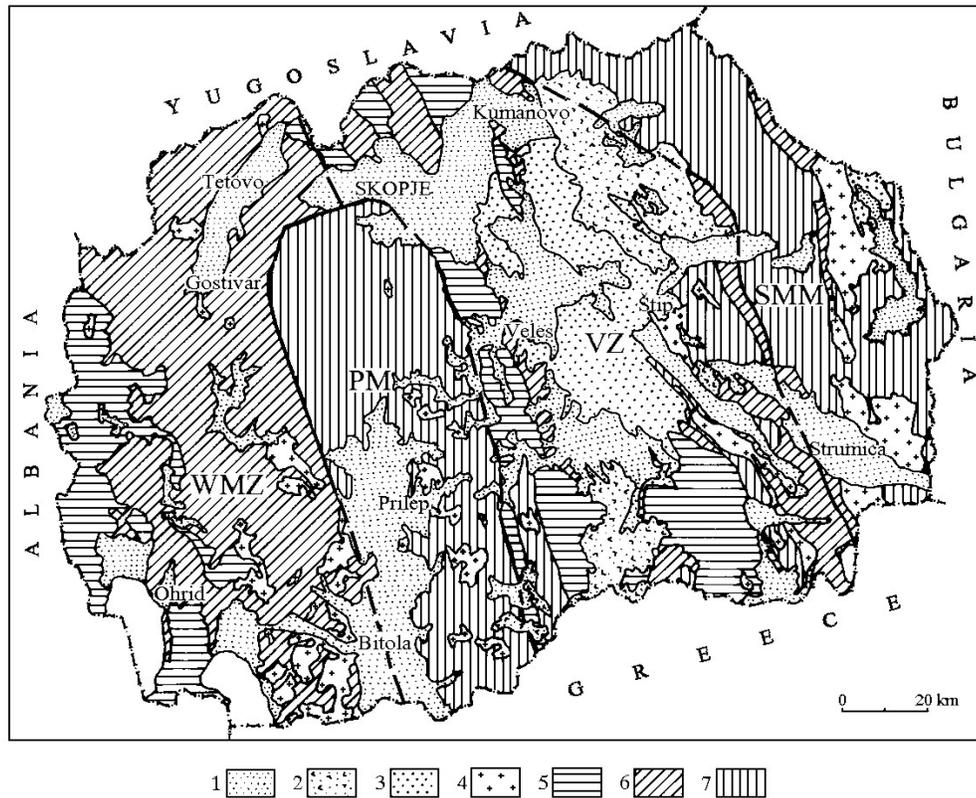
**Abstract:** Granitoid formations can be found in all geotectonic units in the territory of the Republic of Macedonia: the Western Macedonian zone, the Pelagonian massif, the Vardar zone and throughout the Serbo-Macedonian mass. The rocks of these formations occur in smaller or larger magmatic bodies. They are granitic, granodioritic, syenitic and monzonitic in composition varying in age from Tertiary to Precambrian ( Fig.1).

**Key words:** Granites, granodiorites, monzonites, syenities.

## **Granodiorite formation in the Pelagonian massif**

The rocks of the formation occur as irregular magmatic bodies predominantly of N - S strike, and mainly along the axis of the Pelagonian massif (Kajmakalan - Mt Selecka - Babuna). The bodies are forced into the gneiss-micaschists series of the Precambrian complex.

The most widespread rocks of the formation are massive medium- to coarse-grained granodiorites and porphyroid granodiorites. Granites, quartz-monzonites and quartz-diorites are less developed. They are fairly abundant in quartz, plagioclases and biotite, whereas the content of potassium feldspar is variable. Apatite, titanite, hornblende, zircon, garnet, orthite and magnetite are the most common accessory minerals and those of epidote, zoisite, sericite, chlorite and kaolin occur as secondary minerals. Potassium feldspars occur as orthoclase and microcline and plagioclases as oligoclase, andesine seldom albite as well.



**Fig. 1.** Tectonic map of the Republic of Macedonia

WWZ - Western Macedonian zone, PM - Pelagonian massif, VZ - Vardar zone, SMM - Serbo-Macedonian mass, 1 - Neogene-Quaternary sediments, 2 - volcanic and volcanogene-sedimentary rocks, 3 - Paleogene sediments, 4 - granitoids, 5 - Mesozoic complex, 6 - Paleozoic complex, 7 - Riphean-Cambrian and Precambrian complexes.

Intense alteration processes have affected the granodiorite rocks, which is especially pronounced with plagioclases and femic minerals. The rocks have been intensely tectonically distorted in some places and possess pronounced schistosity. The large number of pegmatite bodies is related to the series of gneisses. Aplitoid granites and quartz veins have also been found.

Investigations carried out on the isotopic age indicated that intrusions of granodiorite magmas took place during the Precambrian (Deleon, 1966). This is consistent with certain understanding of the geology of the terrain e.g. the area of Mariovo where granodiorites intrude Precambrian metamorphites causing their feldspatisation. Cambrian schists and marbles, with no feldspatisation processes and no granodiorite intrusions, transgressively overlie the metamorphites.

### **Granodiorite formation of the Serbo-Macedonina mass**

Elongated masses of metamorphosed granites (orthogneisses) have been found in the area of Kalimanci and Carev Dvor in Mt Osogovo. They are of NW - SE strike and forced into the complex of Precambrian metamorphic rocks (gneisses, micaschists and amphibolites).

The formation is present as medium-sized, partially cataclised granites or orthogneisses, made up of quartz, potassium feldspars and plagioclases with rare occurrences of muscovite. The rocks are presumably of Precambrian age.

### **Granite-granodiorite formation of the lower complex of the SMM**

The rocks of this formation are present as a huge batholith in Mt Ograzden, a smaller mass in Mt Belasica and several smaller bodies between Radovis and the village of Radanje. The Ograzden batholith and the other granitoid bodies are of NW - SE extension intruding the metamorphic complex of Precambrian age and Early Paleozoic rhyolite formation along fault structures in the western margin of SMM and the eastern margin of the Vardar zone. The formation consists of biotite granites, biotite granodiorite and alkali two-mica granites as well as muscovite granites, aplites and granitoporphry as accessory minerals. The age of the formation was determined as Early Paleozoic.

### **Granite-granodiorite formation of the upper complex of the SMM**

The Delcevo granitoid batholith and several smaller bodies occur in Mts. Males, Obozna, Golak, Vlasina and the south-eastern part of Osogovo. The batholith and the bodies occurring in the periphery are of N - S strike intruding the rocks of Precambrian complex, Ryphean Cambrian volcanogenic-sedimentary complex, the Early Paleozoic formations as well as the rocks of the Strumica diorite volcanogene sedimentary formation. The formation is made up of medium- to coarse-grained granites, quartz-monzonites and granodiorites. Fine-grained leucocratic granites, quartz-diorites, aplites and graniteporphyry also occur as accompanying minerals. The age of the rocks was determined as Hercynian.

### **Granodiorite-granite-quartzmonzonite formation of Western Macedonia**

The rocks of this formation occur on the Pelister-Krusevo-Gostivar-Mt Sara strike. The Pelister massif extends as far as the Macedonian-Greek border to the south and the River Crna to the north. The massif is raised and deeply eroded, particularly in Pelister (2600 m). It is made up of diorites in the marginal parts, and quartzdiorites, syenite-diorites, granodiorites and monzonite granites in the central parts. In the south-west the Pelister massif intruded early Paleozoic metamorphic rocks and caused thermal alteration (pyroxene-cordierite-sillimanite schists) intruding also Devonian volcanogene sedimentary occurrences.

The Krusevo granodiorites and monzonite-granites extend from Krusevo in south-east to the River Treska in north-west, to the west side of Makedonski Brod. A similar but smaller mass occurs south of Gostivar and a larger one, consisting of granodiorites and monzonite-granites, has been found in Mt Sara. The three granodiorite-monzonite-granite masses intrude Early Paleozoic volcanogene and Devonian volcanogene sedimentary occurrences. The age of the formation was determined as Hercynian (Dumurdzanov, 1972). Determination of the isotopic age of the Pelister granites yielded an age of 450 m.y. (Soptrajanova, 1967).

### **Monzonite-syenite formation of Western Macedonia**

The magmatic rocks of the formation can be found close to the Macedonian - Greek border east of Lake Prespa as far as the Crni Drim River near Globocica. The formation consists of small intrusions and loads of monzonite-syenite-granosyenite composition. The rocks intrude Devonian volcanogene sedimentary occurrence causing thermal contact alterations (cordierite-andalusite schists).

### **Alkali-granite formation of Western Macedonia**

The rocks of this formation have been found in the southmost parts of the Western Macedonia between Lake Prespa and Pelister. They are leucocratic granites intruding Paleozoic schists (Mala and Golema Cuka, Vrteska). Similar rocks can be seen in Mt Bigla present as a large mass of leucocratic granodiorite-granites of north-west extension.

The granodiorite-granites intrude Devonian schists. The rocks can be seen between Krusevo and Ljuban as well as in the vicinity of Vrutok, west of Gostivar.

### **Granodiorite-granite formation of the Vardar zone**

The rocks of this formation comprise elongated magmatic bodies extending NNW - SSE along fault ruptures particularly along the eastern margin of the Vardar zone (Lojane - Stip - Serta - Mt Gradeska - Plaus - Furka), seldom in the zone itself (Gradec - Gurnicet). The bodies intrude the Precambrian complex, the Paleozoic rocks of "the Veles series" and the Mesozoic volcanogene sedimentary formation as well as the Dren granodiabase massif.

Monzonite granites with transitions to granodiorites or real granites prevail. The smaller granite phase found as intrusions into the older granites is present as leucocratic granites. In general, although the mineralogical composition and chemistry are fairly similar, the most acid varieties occur further south where they are less abundant in biotite and more abundant in quartz. Locally, due to the assimilation of surrounding rocks, granodiorites grade into dioritic or syenitic varieties (such as those near Lojane and Stip). They often grade into granodiorites with the occurrence of hornblende.

Quartz-monzonite, granodiorite and granite rocks in the formation are intensely cataclised, commonly magmatically sericitised and post magmatically clayey altered (plagioclases in particular).

Isotopic studies indicated that the consolidation of these magmatites took place at the end of Jurassic and the beginning of Cretaceous which is consistent with the data obtained in the field - the granites of Gradec and Gurnicet intrude Jurassic basic rocks, whereas such granites can be seen as alluviums (Stip granites) in the Albian-Cenomanian conglomerates (near Mocarnik and the village of Goracino). Based on the poorly pronounced primary orientation of component parts, it can be concluded that the intrusion took place during pre-tectonic period. Later, tectonics made possible the deep cutting in the south parts which, due to compression, were significantly uplifted. Thus, the erosion level of these granitoids is shallower in the north and west, but significantly deeper in the south and east. Isotopic determinations of the rocks yielded an age between 150 and 110 m.y. (Soptrajanova, 1967, Stojanov, 1985).

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