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ABSTRACTS

Petrology of the Demir Kapija – Gevgelija ophiolite complex

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The Demir Kapija – Gevgelija ophiolite complex is the largest part of the ancient Vardar oceanic crust preserved and situated in the central subzone of the Vardar zone. The complex has a NW-SE strike dipping towards northwest. In the territory of the Republic of Macedonia it is 50 km long and 25 km wide. The complex extends further south in the territory of neighbouring Greece where it is known as Gevgelli series. The northwest portion of the complex situated in Macedonia is covered by Upper Eocene – Pliocene layers of the Tikves valley. Towards southeast it is covered, in part, by Pliocene – Quaternary layers extending further south to the territory of northern Greece.

Investigations carried out so far on the geology, tectonics and lithostratigraphy of the ophiolite complex determined the following geologic structure:

— a formation of gabbros and accompanying plutons,

— a vein complex,

— a formation of massive basalts,

— a formation of spilitized pillow basalts,

— a spilite-keratophyre level,

— a basalt chert formation,

— a flysch formation

— a titonic carbonate formation.

This paper deals particularly with the magmatic members of the complex.

1. A formation of gabbros and accompanying plutons

The gabbroic formation is composed predominantly of fine-grained and medium-grained clinopyroxene gabbros, rarely of olivine gabbros, pyroxene gabbros with olivine, troctolites and amphibole gabbros and quite rare are serpentinized dunites and hornblende peridotites as well as dikes of basalts, gabbropegmatites, aplites, granite-porphyry and quartzdiorites. This fan of various types of intrusive and vein type rocks is a result of the magmatic differentiation and the processes of amphibolitization.

Pyroxene gabbros are developed mainly in the western part of the gabbroic mass and are found as fine-grained and medium-grained varieties of gabbroic to subophitic composition. They consist mainly of plagioclases (labrador-bytownite) and clinopyroxene, rarely secondary amphibole, magnetite etc.

Cleavage and lamellar twinning were noticed in plagioclases. They are classified as bytownite based on their microscopic characteristics.

Pyroxenes occur as alotriomorphic grains with frequent occurrences of uralitization along the rims. Prismatic cleavage is rare. They are normal twins and seldom occur as individual crystals. Mutual inclusions of plagioclase and pyroxene minerals lead to the conclusion that the two minerals developed contemporaneously. A characteristic feature of this mineral assemblage is that it consists only of plagioclase and diallage with no visible olivine presence. In addition to the occurrence of quite fresh gabbro, metamorphose of minerals can be seen in the thin section as saussuritization. Uralitization is quite noticeable and advanced in the cases where primary pyroxene (diallage) is completely replaced by secondary uralite.

The amphiboles present in the rocks are a result of transformation of pyroxenes.

Olivine gabbros are developed mainly in the eastern part of the gabbroic mass. They are medium-grained dark green rocks made up of bytownite, olivine, seldom clinopyroxene as well as secondary hornblende and subordinate magnetite. Olivine content is variable and in some parts it is more abundant

so that gabbros grade into troctolites, whereas in the parts where olivine is less abundant gabbros grade into pyroxene gabbros with olivine.

Olivine gabbros are of typical gabbroic structures. They are medium-grained and based on their degree of idiomorphism they can be classified as panidiomorphic grained gabbros. Plagioclases occur as fairly fresh minerals and comprise the dominant rock mass. Plagioclase grains are isometric in shape.

Diallage occurs as alotriomorphic individual grains whose prismatic cleavage is not exhibited. Most commonly they are individual grains and are seldom found as normal twins. Olivine is fairly common mineral occurring in variable quantities in the rocks. In cases where it is more abundant olivine gabbro grades into troctolite. There are cases of increased content of pyroxene at the expense of olivine in which the rock changes to pyroxene gabbro.

Olivine grains occur as xenomorphic forms which are relatively fresh with occasional visible transgression to serpentine. Kelyphite rims with pleochroic reddish hypersthene or diallage (sometimes amphibole) can occasionally be seen around olivine grains. Olivine grains become smaller in size, the slightly greenish actinolit being more common. Fractured olivine gabbros sometimes contain biotite as well as brown or green hornblende.

The diallage and plagioclase relationship is an evidence of the contemporaneous crystallization that took place after olivine crystallization.

Troctolites occur as red grey rocks along with olivine gabbros as a typical troctolite structure. They are composed of olivine, subordinate serpentine, rarely clinopyroxene and magnetite. Troctolite occasionally grades into melanotroctolite.

Ultrabasics are present as tectonically forced masses along fault structures or occur along with troctolites. They are present as serpentinized dunites, amphibolized peridotites as well as wehrlites. They are made up of hornblende, serpentine, actinolit, olivine and accessory magnetite.

Wehrlite is predominantly made up of serpentinized olivine, serpentine, diallage with subordinate minerals such as amphibole, hypersthene, chlorite, plagioclase, uvarowite and large quantities of magnetite.

Due to serpentinization of ferromagnesian minerals, the primary composition has almost been lost. The remaining unchanged minerals are linked in a typically serpentine net.

Olivine grains are characterized by alotriomorphic shapes (of 1 mm in size) being totally serpentinized in numerous magnetite veins that comprise the prevailing rock mass. Thin rims made up of randomly arranged fine crystals of diallage and amphibole comprising specific cephelite structure are also noticeable.

The thin section exhibits round olivine grains related to the diallage that are either present or enclosed in it. The round shapes are related to the magmatic history. Due to their conspicuous transformation to serpentine the remaining fresh olivine grains are characterized by pronounced high relief.

Diallage is less common than olivine and occurs as large individual grains always enclosing olivine grains. Prismatic cleavage, which is characteristic of them, is slightly exhibited in pyroxene grains.

Rhombic pyroxene (hypersthene), which is in genetic relationship to diallage, can sometimes be found in association with it.

Primary amphibole is present as actinolite occurring as fan-like aggregates or small flakes round olivine grains.

Secondary fibrous amphibole always occurs along diallage rims. Chlorite is found as large accumulations and is characterized by indigo blue interference colour.

Plagioclases belonging to the bytownite group are either rare or absent in the rock. Uvarowite occurs as small green grains especially in amphibolic accumulations, but like amphiboles, chlorite and plagioclases it is less common in the rock.

Magnetite grains are included in olivine minerals being, no doubt, the product of primary magmatic crystallization, not the secondary which would develop due to olivine serpentinization. In actual fact, the magnetite veinlets define the manner of later serpentinization.

Amphibolic gabbro occurs due to the general process of amphibolization of pyroxene and olivine gabbros with clear tendency of increase in the process of amphibolization starting from the upper levels of the complex. Amphibolic gabbros are often heavily tectonized to fractured. They are composed of zonar plagioclases, their central parts being made up of basic bytownite and the rims being more acid and composed of andesine. Quartz occurs in heavily tectonized kinds where gabbros grade into quartzdiorite. In addition to plagioclases, the gabbros also contain amphibole (hornblende) as well as variable quantities of clinopyroxene, magnetite, sphene, quartz, biotite, epidote, zoisite and chlorite.

Vein rocks occur in different levels in the gabbroic mass. They are found as gabbropegmatites, basalts, aplites, granite porphyry and quartzdiorites. Aplites are composed of quartz, andesine, biotite and secondary epidote, zoisite, magnetite as well as accessory apatite and albite. Graniteporphyries

are made up of albite-oligoclase, quartz, magnetite, epidote, hornblende, chlorite and apatite, whereas gabbropegmatites are made up of labrador, clinopyroxene, hornblende, chlorite and epidote. Basalts are made up of labrador-andesine, clinopyroxene, epidote, chlorite, hornblende, clinozoisite, seldom calcite and sulphides.

A vein complex occurs in the contact parts of the gabbroic formation and the formation of massive basalts as a well developed 200 to 300 (maximum 500) meters zone made up of basalt-dolerite dikes and segmented gabbro masses. The mineralogical composition is similar to the massive basalts and gabbroic mass.

Massive basalts are found in the central and eastern portions of the ophioltite complex. They are present as fine-grained ophiolite and intersertal composition with occasional occurrences of entire recrystallization of the glass groundmass. They are alterated rocks in which feldspars are heavily albitized. Basic plagioclases occur as relic kinds (labrador-bytownite), whereas albite- oligoclase-andesine are present as plagioclases. Femic minerals as found as augite, hornblende, secondary chlorite, epidote, magnetite, apatite.

Serpentinized pillow basalts occur uninterruptedly across the massive basalts. Pillow shapes of variable sizes, sometimes reaching 2 meters in size, are heavily spilitized basalts with pronounced albitization, amphibolitization, epidotization and zeolitization. They are of typical amygdaloidal structure made up of plagioclases (albite-oligoclase), augite, glass mass, amphiboles, chlorite, epidote, clacite, magnetite, zeolites and titanite.

Spilite-keratophyre level occurs in the top most portions of the formation of basaltic pillow lavas. It is present as a concentration of dikes and outpourings of keratophyre masses, quartzkeratophyres, rhyolites and seldom andesites which form keratophyre level together with spilitized basalts. These acid differentiates occur as pink to red, grey-green to grey-white rocks with micro porphyritic to porphyritic structure composed of alterated feldspatic mass with relics of plagioclase (oligoclase-albite), K-feldspar, also chlorite, quartz, epidote, seldom crystals of hornblende, chloritized biotite and calcite.

All petrologic members in the ophiolite complex with relatively small degree of alteration have been investigated in terms of their chemistry. The present study of minerals included plagioclases, olivines, pyroxenes, amphiboles, serpentines, magnetites and chromite.