GEOLOGICA BALCANICA, 32.2-4, Sofia, Decemb. 2002, p. 27-31

Pseudomagmatic texture in ophiolites from Rhodope Massif

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The Precambrian ophiolites in the Rhodope Massif have been altered under different metamorphic conditions and as a result varied products were formed. Some of them show textures resembling to magmatic ones, and often were recognized by field investigations as basic magmatites. Here are presented three principal instances of pseudomagmatic texture appearance.

Formation of garnet-lherzolites into local shear zones of eclogitization

At the periphery of some serpentinite bodies a banded structure appears (Kozhoukharova, 1999a), demonstrated by alternation of dark green serpentine stripes with light beige-rose thin garnet-lherzolite bands, consisting of garnet, olivine, enstatite, diopside and spinel, sometimes considered for relics of cumulates (Kolcheva et. al.,1998). In reality, these phenomena are reaction structures, and their synmetamorphic origin is demonstrated by several facts: (i) garnet lherzolites are found only at the contact of serpentinite bodies in the most intensively folded metamorphic terrains, and the bands are entirely concordant with general stratifications and metamorphic schistosity; (ii) the mineral association of lherzolites is post-serpentinization one because it replaces the serpentine, but is not deformed and altered itself.

Formation of metasomatic gabbroids through pegmatite-aplitic veins

In some places, numerous pegmatite-aplite migmatic injections or branched veins had penetrated basic and ultrabasic ophiolites and include pieces of them (Kozhoukharova, 1999b). Consequently, bimetasomatic reactions took place. Chemical interaction between the rocks of contrast composition resulted in coarse-grained massive hybrid rocks, similarly often described as magmatic gabbroids. They form dyke-like small bodies. According to the chemical composition of the host rocks and temperature of reactions, different metasomatic gabbroids appeared — in case of amphibolite-host, the metasomatic gabbroids consist of edenite or magnesiopargasite, plagioclase (oligoclase, andesine, labradore), epidote, titanite, orthite, biotite, magnetite. In case of ultrabasite-host, the mineral composition is represented by zoisite, epidote, augite, diopside, phlogopite, titanite, hastingsite, actinolite, garnet, talc, chlorite and plagioclase of variable composition — from oligoclase to anorthite. The texture is commonly pseudomorphic, corrosional, and simplectitic one.

Formation of corona-gabbroids in migmatic fields

The corona-gabbroids usual are regarded as igneous rocks alterated in high-grade metamorphic terrains by developing of specific re-

Table 1
Representative microprobe analyses of minerals from metasomatic corona gabbroids

oxides	garnet	olivine	oPy	cPy	parg	labr	andes	spinel
SiO_2	39,53	37,53	55,55	49,19	42,10	54,26	56,94	0,00
TiO_2	0,02	0,00	0,00	1,71	0,22	0,00	0,00	0,00
Al_2O_3	22,38	0,00	0,16	7,25	14,56	29,52	26,93	62,73
FeO	23,38	27,35	16,67	6,79	9,76	0,00	0,00	22,75
MnO	1,22	0,29	0,71	0,31	0,31	0,00	0,00	0,24
MgO	10,92	34,76	27,58	12,29	14,19	0,00	0,00	13,39
CaO	3,61	0,00	0,00	21,09	11,20	11,60	8,82	0,00
Cr_2O_3	-	-	-	0,29	-	-	-	0,64
Na_2O	-	0,00	0,00	1,07	2,72	4,90	6,36	0,07
K_2O	-	0,00	0,00	0,00	0,28	0,00	0,14	-
H_2O	-	0,00	0,00	0,00	3,81	0,00	0,00	-
Basis	24(O)	4(O)	6(O)	6(O)	24(O)	32(O)	32(O)	32(O)
Si	5,995	1,002	1,995	1,818	6,043	9,659	10,279	0,000
Al_{IV}	0,005	0,000	0,005	0,182	1,957	6,249	5,725	15,657
Al_{VI}	3,977	0,000	0,004	0,138	0,508		-	-
Ti	0,000	0,000	0.000	0,046	0,026	0,000	0,000	-
Fe	2,941	0,609	0,500	0,211	1,172	0,000	0,000	4,035
Mn	0,154	0,006	0,022	0,009	0,034	0,000	0,000	0,038
Mg	2,443	1,379	1,475	0,777	3,034	0,000	0,000	4,226
Ca	0,579	0,000	0,000	0,835	1,724	2,238	1,702	0,000
Cr	-	-	-	0,013	-	-	-	0,127
Na	-	0.000	0,000	0,080	0,724	1,708	2,234	0,004
K	-	0,000	0,000	0,000	0,051	0,000	0,065	0,000
OH	-	0,000	0,000	0,000	3,638	0,000	0,000	0,000
	Al 48.05	Fa 30.84	En 73.86			An 56.72	An 42.54	
	Sp 2.52	Fo 69.16	Fs 26.14			Ab 43.28	Ab 55.84	
	Pr 39.96						Or 1.65	
	Gr 8.73							
	Ad 0.74							

Symbols: oPy - orthopyroxene, cPy - clinopyroxene; parg - pargasite, labr - labrador, and - andesine; Al — almandine; Sp — spessartine; Pr — pyrope; Gr — grossular; Ad — andradite; Fa — fayalite; Fo — forsterite; En — enstatite; Fs — ferrosilite; An — anorthite; Al — albite; Or — orthoclase.

action corona microstructures between crystals of olivine and plagioclase. However, some beds of corona gabbroids in the Rhodope Massif put under question their magmatic origin. The geological situation around it as well the petrological data suggest as more acceptable a metamorphic formation of these gabbroids as products of an interaction between ultramafic rocks and pegmatite veins.

In the example here chosen, it was established gradual transformation of serpentinite to corona gabbro under influence of pegmatites. The serpentinite body, situated amongst intensely migmatized gneisses, is cut by a zone enriched of pegmatites. Four zones of alteration between ultrabasic rock and pegmatites can be observed (Fig. 1).

Zone A — initial pegmatization. The rocks are dark green to black-green, fine coarse metamorphozed serpentinites, consisting of antigorite, chlorite, olivine — replaced by serpentine, iddingsite, talc and magnetite, pyroxene and sporadic grains of garnet intergrown with gedrite. Thin (1-3 mm.) forking veins of plagioclase penetrate into serpentinite with amount less of 15%.

Zone B — partial pegmatitization. The rocks possess an irregular spotted texture (Fig 2a). The dark spots dominate. Their center is built up of anthophyllite, olivine, antigorite, iddingsite, talc, chlorite, magnetite, which are enveloped by fibrous bundle of pargasite. The light spots — irregular lenticular or streaky, take up about 25-30% of rocks are filled of labradore — An65-68, with pale violet colour.

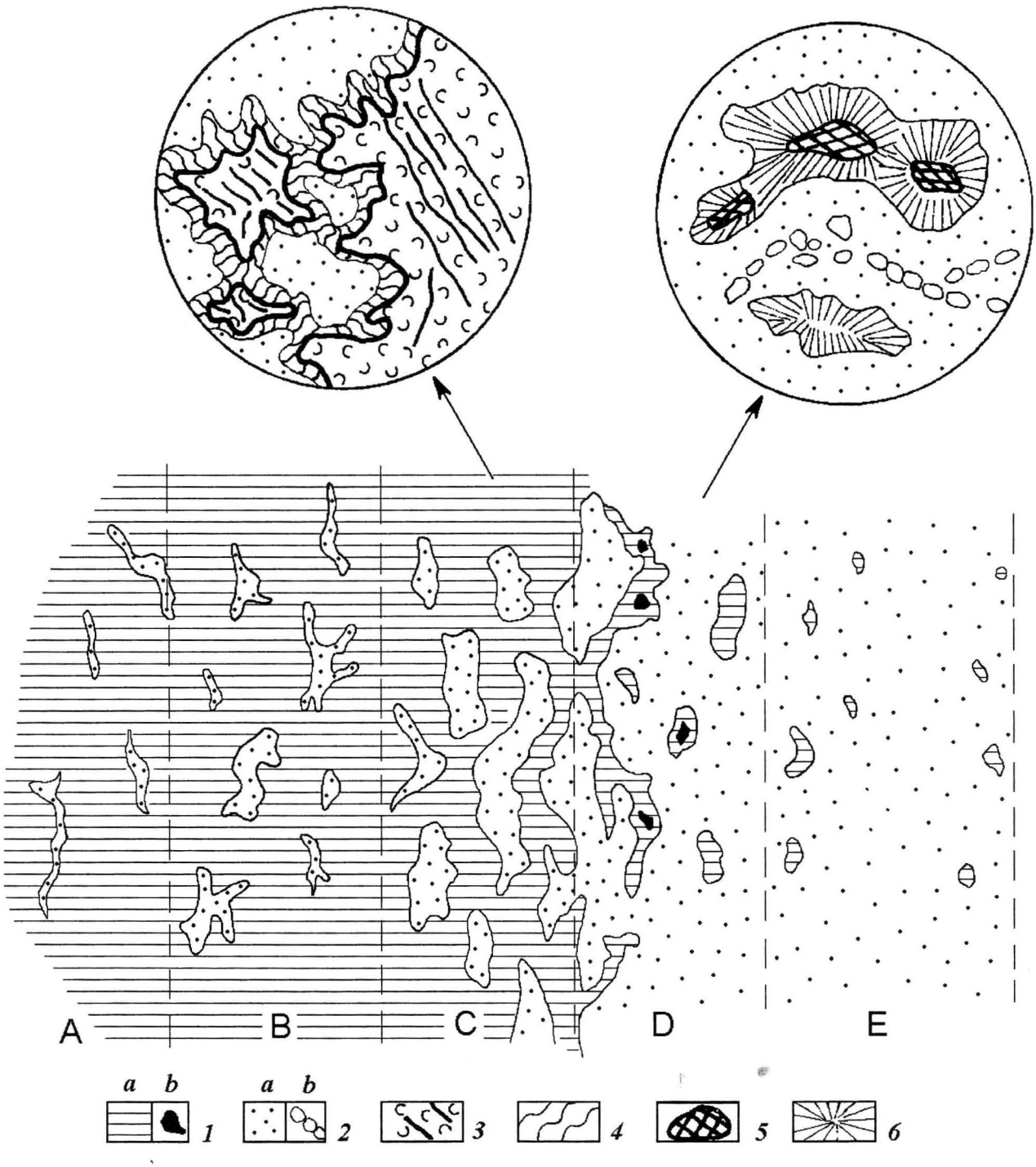

Fig. 1. Zones of alteration between ultrabasic rocks and pegmatites.
A — zone of initial pegmatization; B — zone of partial pegmatization; C — zone of corona gabbros; D — zone of advances assimilation; E — pegmatite vein.
1 — ultrabasic rocks; *2* — plagioclase: a. labradore, b. andesine; *3* — olivine; *4* — anthophillite; *5* — garnet; *6* — pargasite

Zone C — corona gabbroids. The appearance of the rocks is parti-colored, with spotted texture. The violet plagioclase forms lens-shaped or nearly rectangular segregations (2-3 cm), resembling to porphyroblasts and covers about 40-50% (Fig. 2a). In some places the texture is almost massive and homeoblastic like that of igneous rock.

The microscopic picture is particularly specific. The dark ultrabasic parts with angular form, are built up of olivine, in its inside filled with antigorite, iddingsite and magnetite while the periphery is clear. Around the olivine are formed reaction zones (Fig. 3) consisting of pyroxene, spinel and hornblende. The full sequence is:

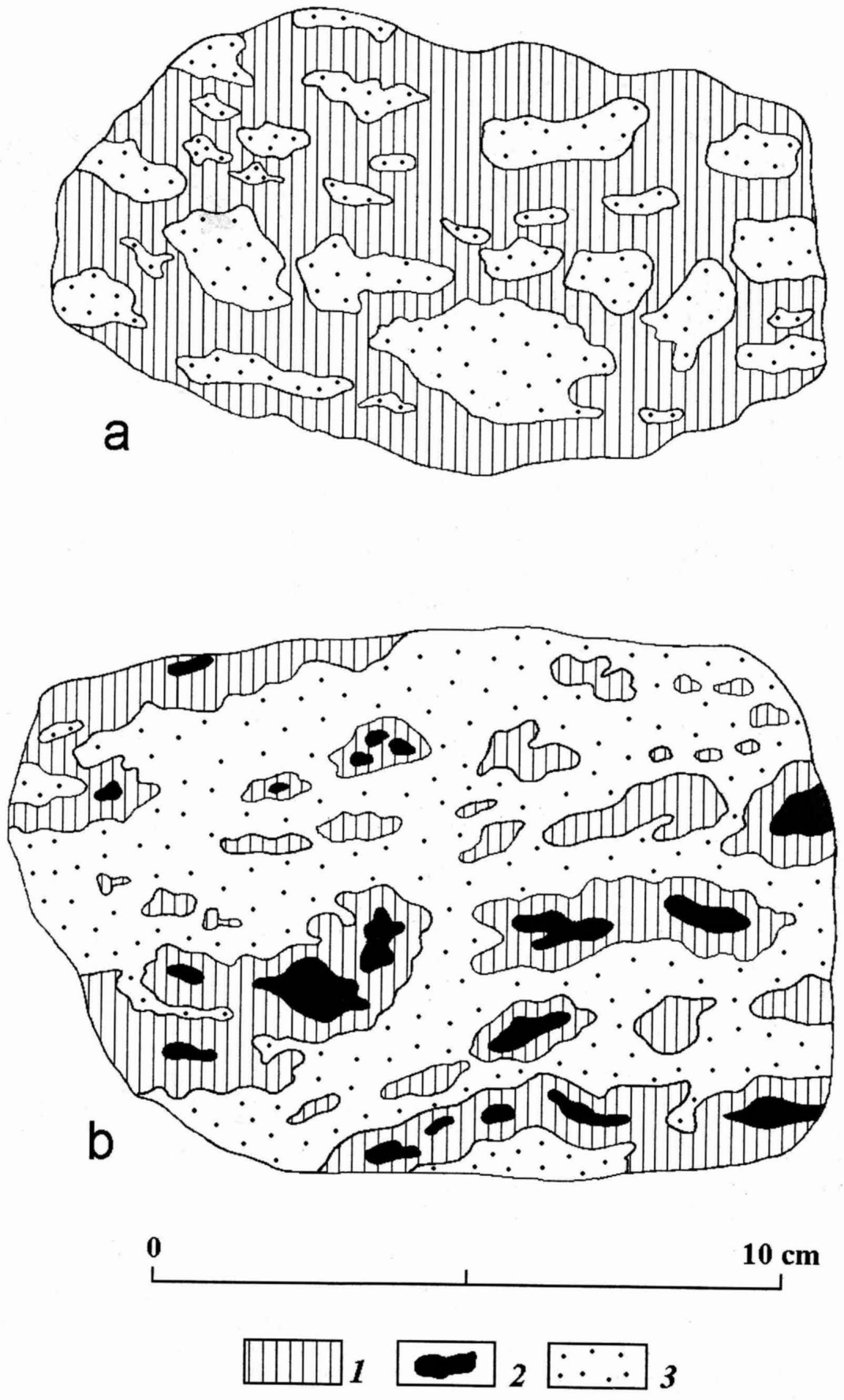

Fig. 2. Drawing of the structures of two samples from: a — zone C; b — zone D
1 — ultrabasic rocks; *2* — olivine — pyroxene-garnet segregation; *3* — plagioclase

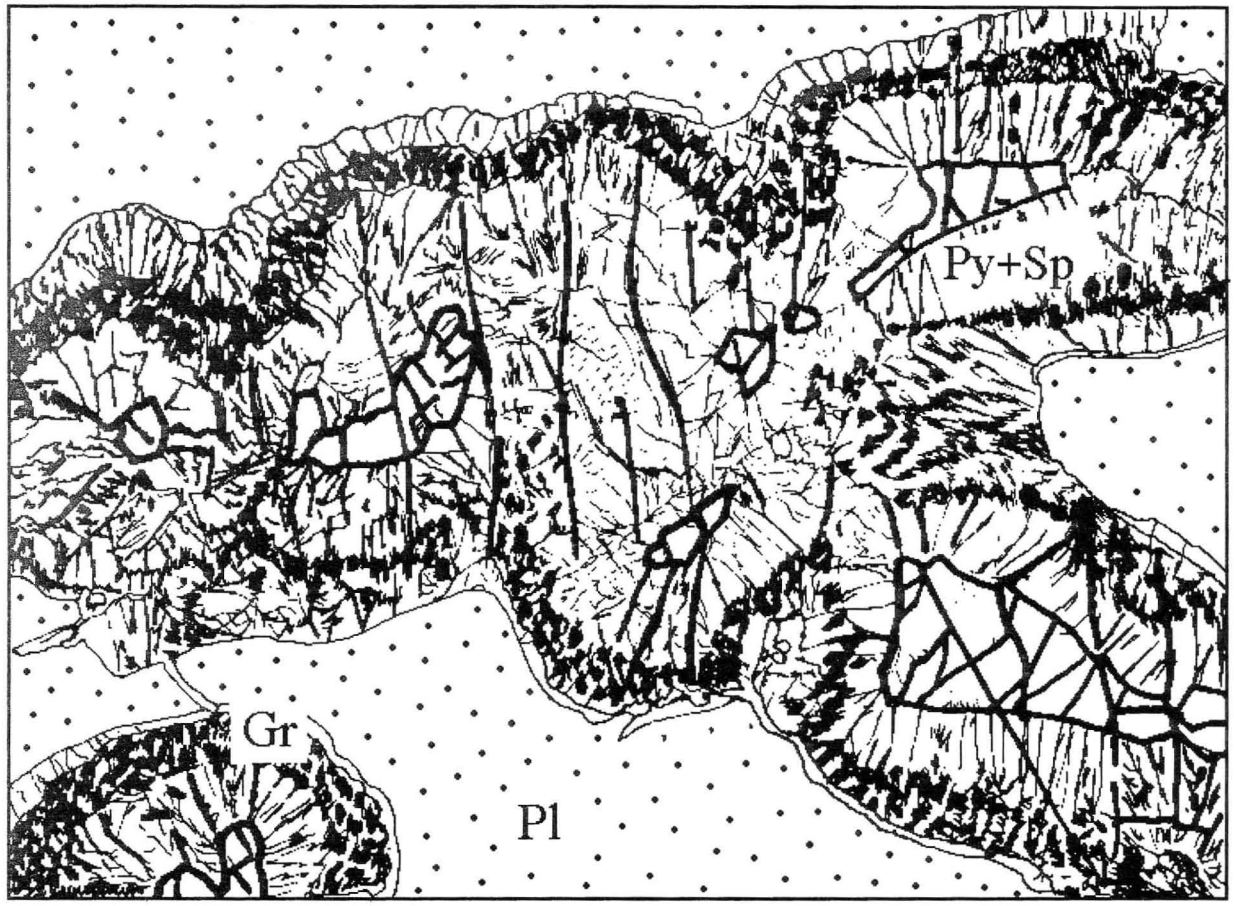

Fig. 3. Sketch of corona microtexture
Symbols: Ol — olivine, Pyr — pyroxene, Gr — garnet, Pl — plagioclase.

Olivine — orthopyroxene — clinopyroxene — pargasite — garnet — edenite — plagioclase.

Intergrowths between pyroxenes and spinel are common.

Olivine is forsterite (Fo70 Fa30); the orthopyroxene — bronzite (En74Fs26), pale rose, medium-grained, often build large zone with symplectites of spinel; the clinopyroxene — diopside is fine-grained with columnar fabric; pargasite — pale green, fibrous; garnet-isometric fine grains, almandine-pyrope, edenit-fine-grained. The medium to coarse-grained plagioclase in segregations appears in two species: labradore — An 57-60 and andesine — An37-38.

Some of the zones are reduced to: — olivine — bronsite — plagioclase.

Zone D — advanced assimilation. The rocks possess slight banded or spotted texture and resembles to migmatite. The plagioclase part dominates, among it dark green ultrabasic inclusions are arranged (Fig. 2b). The larger pieces contain still olivine with reaction zones but the smaller ones represent radiate-fibrous segregations of pale green pargasite often with anthophyllite in the center of segregation. The plagioclase is medium-grained andesine — An 37-42, on some places cut by later oligoclase An 28. The andesine includes lots of fine crystals of edenite, rutile, monazite and others.

Zone E — pegmatite vein where only too small (1-2 cm) inclusions are present. The vein consist of quartz and oligoclase.

Nobody doubts about the reaction character of corona microstructures whose formation is interpreted as exchange of atoms of Si, Al, Na, Mg, Fe between olivine and plagioclase. The reaction is now considered in terms of a balanced equation, atomic migration, crystal growth and the change of temperature during reaction (Kretz, 1994). But usually it is believed in primary magmatic crystallization of the corona gabbros and later appearance of kelyphitic zones under influence of metamorphism. The example described here, however, shows that it is possible the same corona microstructures to be formed by reaction between two

chemical contrasting substances as ultrabasite and pegmatite. The gradual transformation of ultra-basite to gabbros is a clear indication for the reality of such a process.

The last petrological investigation indicate that the metasomatic gabbroids with pseudo-magmatic fabric are much more widely distributed in Rhodope Massif rather than it was regarded so far. Most probably the future revision study of ophiolitic association there to ascertain that a lot of so named "metagabbros" in reality are metasomatic hybrid rocks, and their chemical composition does not have any significance for to determine a presumed magmatic protolith.

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