Metamorphic evolution of spinel clinopyroxenites with clinopyroxene megacrysts from Ograzhden Mountain, SW Bulgaria

Метаморфна еволюция на шпинелови клинопироксенити с клинопироксенови мегакристали от Огражден планина, ЮЗ България

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Near the village of Gega, Petrich district, on the southern slopes of the Ograzhden Mountain an orthoamphibolite body sized 1400×350 m crops out. In this body spinel clinopyroxenites containing clinopyroxene megacrysts were recognized (Zidarov et al., 1994), and a transition toward coesite-containing kyanitic eclogites was established (Zidarov et al., 1995). This metamorphic transition appears a manifestation of ultrahigh pressure metamorphism. A retrograde alteration that had led to the formation of orthoamphibolites was also distinguished (Zidarov, Nenova, 1996).

The orthoamphibolite body discussed is a part of the Ograzhdenian Block of the Serbo–Macedonian Massif and is hosted by two-mica gneisses. The body is a metamorphosed tectonic mélange and is composed mainly of orthoamphibolites. Metamorphosed at various extent blocks of different protoliths and small lenses, boudins and bodied of eclogites were distinguished among the orthoamphibolites (Zidarov, Nenova, 1995). The protoliths are represented by olivinic gabbro-norites cross-cut by aphyric gabbro-norite dykes, leucocratic gabbro, spinel pyroxenites with clinopyroxene megacrysts, and serpentinized ultramaphics, all of them co-genetic being cumulatives of tholeite parental magma with MORB affinity. The chemical composition of accessory spinels from the clinopyroxenites, olivinic gabbro-norites and gabbro-norite dykes was investigated on purpose and the results obtained confirmed that these rocks appear a part of tectonically reworked ophiolitic body formed under high pressure and temperature in the upper mantle (Ivanova, Zidarov, 2010).

In the present work the metamorphic evolution of spinel clinopyroxenites with clinopyroxene megacrysts, kyanitic eclogites, and banded amphibolites is reported, expressed by structural and textural, mineral, and PT transitions (Table 1). It confirms the metamorphism of multi-phase type, previously reported by Zidarov and Nenova (1995, 1996), being now divided into 5 stages: M 1 (A, B) – granulitization; M 2 – prograde eclogitization; M 3 – ultrahigh pressure metamorphism; M 4 – retrograde metamorphism; M 5 – multi-phase amphibolitization.

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Table 1. Metamorphic evolution of spinel clinopyroxenites from Ograzhden mountain

	Magmatic stage	Subsolidus and epimagmatic stages	First amphibolization stage M 1A	Granulite stage (garnetization) M 1B	Eclogite stage (prograde) M 2	UHP metamorphim M 3	Eclogite stage (retrograde) M 4	Amphibolite stage (myltiphase ampibolitization) M 5
Rock type	clinopyroxenite	clinopyroxenite	amphibolitized clinopyroxenite	amphibolitized and garnitized clinopyroxenite	kyanitic eclogite with blasto-porphyries of pyroxene megacrysts	coesite-bearing kyanitic eclogite with porphyroblastic garnet	coesite-bearing kyanitic eclogite with porphyroblastic garnet and quartz	amphibolitized coesite-bearing kyanitic eclogite and banded amphibolite
Texture	massive	massive	massive	massive	massive, oriented, parallel	massive, oriented, parallel	oriented, parallel	banded
Structure	panidiomorphic, poikilitic and porphyric to megaporphyric	exsolution in clinopyroxene, symplektitic, corona	secondary pseudomorphic (co-axial pseudomorphs of amphiboles after pyroxenes), corona	relict-magmatic, secondary pseudomorphic, corona	granoblastic with relicts of blastoporphyric pyroxene megacrysts of exsolution	granoblastic with traces of plastic deformation and mylonitization	porphyroblastic, symplektitic (exsolution of alkali pyroxene), blastesis	corona, symplektitic, nematoblastic, granonematoblastic, relicts of porphyroblastic garnet
Minerals	clinopyroxene (Aug, Pig), enstatite 1, ±plagioclase, ±olivine, spinel, chromite, ilmenite, magnetite	exsolution to diopside and enstatite 2	amphiboles, rutile (sagenite), magnetite	garnet in lamella, garnet in coronas, garnet in pseudomorphs	omphacite, garnet, kyanite, quartz, rutile, magnetite	omphacite, garnet, coesite kyanite, ilmenite	omphacite, garnet, quartz after coesite, kyanite, rutile, magnetite	exsolution of omphacite to: 1) diopside or augite and plagioclase; 2) calcium amphibole and plagioclase; amphibole, plagioclase, zoisite, muscovite, rutile, titanite, magnetite
PT conditions	1230–1050 °C, 15 kbars	subsolidus exsolution: 1080–980 °C, 9–18 kbars		600–790 °C, 5–11 kbars	456–631 °C, 10–17 kbars	1020–1150 °C, 22–30 kbars		525–600 °C 4–8 kbars