Mineral indicators of high-grade Alpine metamorphism in Mesta and Slashten lithotectonic units, Western Rhodopes

Минерални индикатори за високостепенен алпийски метаморфизм в Местенската и Слащенската литотектонска единица, Западни Родопи

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Introduction

Equilibrium mineral assemblages of metacarbonates and amphibolites from two lithotectonic units in the Western Rhodopes are defined to obtain data about the P-T metamorphic conditions. This study emphasizes the role of coexisting metamorphic minerals as an useful criteria for P-T determination for terrains, where no geothermobarometric data exists.

Geological setting

Three lithotectonic units in a superposition build up the metamorphic section in the Western Rhodopes (Sarov et al., 2008), divided by shear zones as a result of Late Alpine synmetamorphic thrusting. Mesta lithotectonic unit (MLU) is considered as the lowermost part of the section. Metamorphic rocks are dominated by biotite or two-mica orthogneisses and marbles. Carbonate-silicate schists and amphibolites are scarce. The rocks of the unit are strongly mylonitized, concordantly intruded by granite sills of Dolno Dryanovo pluton. Mesta shear zone restricts the unit with the upper Slashten unit (SLU) that consists of parametamorphic rocks (marbles, carbonate-silicate rocks, gneisses, kyanite- and garnet-bearing schists), orthoamphibolites, associating with small lenticular ultramafic bodies and orthogneisses. Sarnitsa lithotectonic unit is the uppermost in the metamorphic section in Western Rhodopes. All three units are attached to the regional-scale Sideronero-Mesta unit (Georgiev et al., 2010).

Field relationships and petrography

Investigated area covers rocks from MLU and north outcrops of SLU, exposed as a thin sheet to the north of Gotse Delchev–Satovcha road. Thin sections of amphibolites and metacarbonates have been chosen for this study, because they are more sensitive to the metamorphic changes than the wide spread quartz-feldspar orthogneisses.
zoisite). This mineral assemblage coexists with irregular amounts of calcite, quartz, plagioclase, microcline, titanite ± biotite, ± phlogopite(?). Dynamically recrystallized quartz often forms ribbons, parallel to the main foliation. Pure marbles are mid- to coarse grained with isolated lenses of polygonal high limpid calcite and minor mica (phlogopite?). Low-temperature mylonites of impure marbles contain small rounded clasts of quartz, epidote, microcline, tremolite and hornblende, floating in a fine grained calcite matrix.

Pure white marbles, containing also minor graphite, quartz, phlogopite(?) and diopside are dominant metacarbonates in MLU. Grain size depends on strain rates, so calcite is mostly slightly elongated, with irregular boundaries. Direct contacts with granites from Dolno Dryanovo pluton caused growing in calcite size. Silicate minerals from impure marbles and carbonate-silicate schists are presented by hydidioblastic diopside, plagioclase, quartz, microcline, titanite, ± mica, ± tremolite, ± zoisite. Well marked foliation is defined by elongate mineral phases and quartz ribbons. Vesuvianite is rare and elongated to the foliation, while scapolite grows in thin mylonite zones probably caused by fluid infiltration. Relicts of previous plagioclase-quartz intergrowths are observed too. Well marked foliation is defined by elongate mineral phases and quartz ribbons. Diopside is partially overgrown by tremolite or altered by fine sheet silicates and calcite.

Discussion and conclusions

The equilibrium mineral composition, determined for amphibolites from both lithotectonic units is Hb + Pl + Qtz ± Ep. Mineral assemblage represents a prograde regional metamorphic event in the field where epidote is still stable (up to 600 °C). Kyanite bearing schists from the southern part of SLU predict prograde path of metamorphism in the Ky stability field (P≥4.5 kbar).

Mineral paragenesis in metacarbonates reflects differences at initial rock compositions within the both units and presumes metasomatic reactions, caused by unsteady fluid rock infiltration, connected with open paths for fluids after mylonitization, followed by concordant intrusion of granites. Mineral equilibrium for SLU is defined by Cal + Di + Hb + Qtz + Pl + Ep + Tit. For MLU Cal + Di + Qtz + Pl + Tit ± Ep ± Tr represent a stable mineral assemblage. Few points are significant for determination of metamorphic conditions. Dol + Cal + Di ± Fo paragenesis is typical for the middle-temperature part of amphibolite facies. Higher-temperature phases as wollastonite (Wo) or forsterite (Fo) were not identified in the investigated rocks. If the system is low-magnesium (CAFSCH) and Fo do not appear, the T peak of metamorphic conditions is limited by Wo-producing reactions in the diopside stability field. The presence of zoisite is an indicator for a H2O-rich fluid composition during metamorphism (Storre, Nitsch, 1972). Hydrous phases (amphibole and epidote) are stable at temperatures lower than 600 °C if H2O is introduced in the system (Rios et al., 2008), which corresponds to the above information.

According to obtained data we suggest a single clockwise metamorphic event in the low-temperature part of amphibolite facies for metacarbonates and amphibolites from MLU and SLU. Mineral assemblages restrict the metamorphic peak conditions between 550–600 °C in the stability field of kyanite.

References


