Gedrite-anthophyllite bearing rocks from Eastern Rhodopes – main features and origin

Жедрит-антофилит съдържащи скали от Източни Родопи – особености и произход

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Introduction

Orthoamphibole (gedrite and anthophyllite) bearing rocks are not uncommon, but they are not abundant in typical metamorphic belts. This mineral association has been reported only from metamorphosed ultramafic or basic magmatic rocks. We report data on gedrite-anthophyllite formation in more acid (SiO_2=69.1%) and aluminous (Al_2O_3=12.9%) rocks. The “strange” mineral composition implies many origins proposed for these rocks. There are three major hypotheses (Spear, 1993): 1) metasomatism accompanying metamorphism; 2) residium of partial melt and 3) pre-metamorphic alteration by weathering or hydrothermal alteration by seawater.

Petrology

The investigated rocks belong to the Krumovitza Lithotectonic Unit (Sarov, 2012) which consists of different lithologies: marbles, gneisses, amphibolites, mica schists. A characteristic feature of the unit is the presence of large metaultramafic bodies incorporated at different stratigraphic levels. The rocks were metamorphosed under high temperature up to migmatization of the rocks. The continuation of the Krumovitza unit on the territory of Greece is known as Kimi complex. There, in garnet-kyanite gneisses from that complex has been discovered the first evidence for UHP metamorphism in rocks (microdiamonds, pseudomorphs after coesite) from the Rhodopes massif (Mposkos, Kostopoulos, 2001).

The studied rocks outcrop in the area around the village of Avren. They represent strongly schistose dark-grey rocks intercalated with white-gray impure marbles adjacent to a metaultramafic body. The mineral assemblage observed in the rocks comprises gedrite (dominant orthoamphibole), anthophyllite, garnet, staurolite, plagioclase, quartz, talc, rutile, cordierite, and accessories (apatite, zircon, opaque).

The gedrite (strongly pleochroitic in blue-gray colors and with parallel extinction is observed as two morphological types of crystals. The first one represents strongly elongated (up to 8 mm) idioblastic crystals forming the foliation and lineation of the rocks. The second type forms idioblastic but resorbed crystals oriented nearly perpendicular to the first type as they are streamed from it, indicating that these minerals may have formed at different time during the crystallization process. In both cases the contacts with the anthophyllite are sharp (Fig. 1). The two orthoamphiboles have similar Fe/(Fe+Mg) ratio – 0.35–0.39 for the gedrite and 0.33–0.35 for the antophyllite i.e. both min-

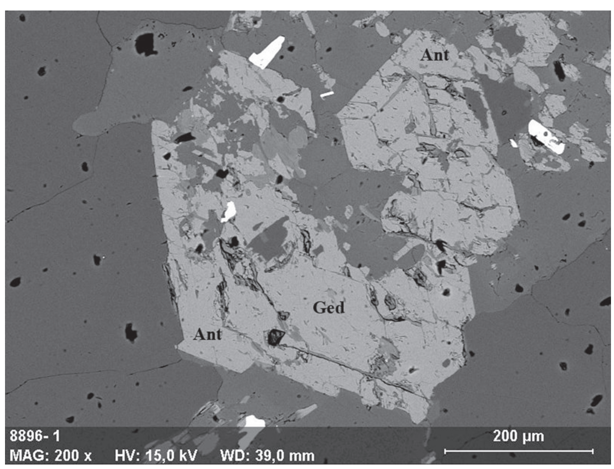

Fig. 1. Sharp contacts between gedrite (Ged) and anthophyllite (Ant) in quartz-plagioclase matrix, BSE image

erals are enriched in Mg, but not enough to be classified as magnesio-type. Their composition is determined by the bulk rock composition ($X_{Fe\ rock}$ = 0.39) and this feature can explain the presence of talc in the rocks.

The plagioclase ($An_{16.3–20.1}$) forms dominantly large twined porphyroblasts with abundant drop-like inclusions of quartz, idioblastic needle-shaped rutile and rare gedrite. Such texture may be a breakdown product of former mineral phase(s).

The garnet and staurolite (X_{Fe} = 0.69–0.70) are relatively rare being observed as isolated resorbed grains replaced by chlorite.

The talc flakes occur in the foliation plane but they are never observed in contact with the orthoamphiboles.

The coexistence of gedrite and anthophyllite with garnet, staurolite and cordierite poses more questions than answers. In first place comes the question about the gedrite-anthophyllite solvus. Spear (1980) suggested that the solvus closes at approximately 600–625 °C at ≈ 5 kbar. Therefore, this assemblage in the studied rocks represents a later stage of their metamorphic evolution close to the peak of the solvus curve. The assemblage garnet+cordierite was formed at earlier stage and was probably stable up to 750 °C and ≈ 5 kbar. Above 5 kbar the assemblage sillimanite+gedrite (orthoamphibole) is stable according to the reactions: cordierite+garnet = sillimanite+orthoamphibole and cordierite+staurolite = sillimanite+gedrite. Unfortunately no evidence for HP metamorphism has been found in this case.

Conclusion

The investigated rocks have an unusual mineral composition and they represent polyfacies metamorphic rocks. The HT mineral assemblage includes garnet+cordierite replaced under MP conditions by the association gedrite+anthophyllite+talk. The occurrence of this assemblage was favored by the bulk composition of the rocks but a limited influence of the ultramafic body can be presumed, too.

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