Tertiary eclogites in the lower tectonic unit of East Rhodope (Kechros Complex, NE Greece)

Mposkos, E.* & Baziotis, I.

Section of Geological Sciences, Dept of Mining and Metallurgical Engineering, National Technical University of Athens, Greece (mposkos@metal.ntua.gr)

The Rhodope Metamorphic Province is one of the major tectonic units in northern Greece. It consists of different tectonometamorphic complexes involved in the Alpine collisional history between the Eurasian and African plates. In eastern Rhodope a Jurassic UHP metamorphism is documented in the uppermost Kimi Complex by the presence of microdiamond inclusions in garnets from pelitic gneisses [1]. Partially or completely amphibolitized eclogites are common recording P-T conditions >1.8 GPa and 750°C for the ecologic stage [2].

In the underlying Kechros Complex lenses of kyanite eclogites in orthogneisses with Permian ages of their gabbroic protoliths [3] and of common eclogites within metapelites the Kechros Complex. Ages for the HP metamorphism in the Kechros Complex are 49-55 Ma [4].

The mineral assemblage of the kyanite eclogites is Grt + Omp + Prp + Alm + Czo + Hbl + Zoisite + Phg + Qtz + Rt. Garnet shows growth zoning with core composition Grt86Alm13Prp6Sp6,0 and rim composition Grt83Alm2Alm6Prp26Sp6,0. Inclusions in garnet are abundant; they are clinozoisite, kyanite, omphacite (Jd0.5), quartz, actinolite, hornblende and very rare albite and paragonite. Matrix omphacite is in textural equilibrium with kyanite, but commonly it is replaced by Ca-amphibole. A decrease in jadeite component from the core to the rim indicates a re-equilibration tendency during exhumation. Temperatures of 550-600°C and minimum pressure of 1.5 GPa are obtained with Grt-Cpx geothermometry and the jadeite component (Jd3) in omphacite. However, the coexistence of matrix omphacite with kyanite constrains the minimum pressure to 2.1 GPa assuming H2O activity equal to unity.

In the common eclogites the HP mineral assemblage is Grt + Omp + Prp + Alm + Czo + Hbl + Mrg + Pg. Garnet shows compositional zoning with Grt86Alm3Prp6Sp5,0 in the core and Grt65Alm2Sp6,0 in the rim. It contains inclusions of glaucophane, actinolite, clinozoisite, paragonite, oligoclase/albite, omphacite (Jd2.25), titanite and rutile. Glaucophane is present only as inclusions in garnet, omphacite and hornblende and paragonite as inclusions in garnet and hornblende. The paragonite component in margarite ranges from 30-37%. Temperatures of 500-530°C and minimum pressure of 1.4 GPa are obtained with Grt-Cpx geothermometry and the jadeite component (Jd2.4) in omphacite.

In retrogressed samples Ca-amphibole replaces garnet and omphacite. Anorthite-rich plagioclase (An90) is formed replacing margarite+zoisite+quartz indicating isothermal decompression from the maximum pressure down to 0.7 GPa.

Ages for the HP metamorphism in the Kechros Complex are not available. A Rb-Sr white mica age of 37 Ma from an orthogneiss records probably a stage of exhumation. The HP event may occurred at the same time with the Eocene HP metamorphism (49-55 Ma) recorded in the Nestos Shear Zone (NSZ) in Central Rhodope [3,4]. The NSZ comprises lithologies of the overlying Sidironero Complex and the underlying Albite-Gneiss Series; the latter represents the westward continuation of the Kechros Complex.

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Chemical zonation in Ca-amphibole from the Jubrique unit (Betic Cordillera, Spain), and metamorphic P-T-t path

Ruiz Cruz, M.D.

Facultad de Ciencias, Malaga University, Malaga, Spain (mdruiz@uma.es)

Zoned Ca-amphibole from metaclastic rocks and veins of the Jubrique area (Alpujarride complex, Betic Cordillera, Spain), and its significance on the metamorphic evolution of these rocks are described for first time. Typical Al-rich metapelites from this area show assemblages consisting of dominant white mica (muscovite and paragonite) and chlorite, with sporadic biotite, kyanite, and chloritoid. Nevertheless, in some Ca-rich phyllites, fine-grained quartzites, and quartz-rich veins, amphibole crystalized with plagioclase and K-feldspar, epidote, titanite, chlorite and quartz. Two main types of amphibole have been identified: Ca-amphibole, the most frequent, and Fe-Mg-amphibole (calcian cummingtonite). Ca-amphibole appears as intergrowths of dominant radial grains and as euhedral crystals. Ca-amphibole displays zonation with actinolite or Si-rich hornblende cores, overgrown by magnesiohornblende (and edenite) and minor tschermakite, indicating growth at increasing metamorphic physical conditions. Retrogressive rims are variably developed in the several lythotypes (Fig. 1 left).

General zonation is well described in terms of the tschermak, the edenite and the Fe(3+)Al3, and MgFe2+ exchanges. The Al-in-amphibole thermobarometer [1] provides a range of temperatures between 350°C and 620°C (Fig. 1 right), for a pressure range from 0.9 to 6.2 kbar, respectively. Amphiboles define a prograde pressure-temperature path from low pressure-low temperature to medium pressure-medium temperature, typical of Barrovian-type metamorphism.

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