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The Eclogite to Amphibolite metamorphic path from the Sredna Gora terrane in the Variscan orogenic segment of Bulgaria (SE Europe))

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In the eastern part of the Balkan peninsula, to the SE of the former Laurasia margin, several peri-Gondwanan structural units were accreted during the Variscan collision: I) the Moesian plate II) the Balkan terrane (Haydoutov and Yanev, 1997) III) the Sredna Gora terrane and IV) the Thracian composite superterrane (Haydoutov et al., 2003). Eclogitic rocks, overprinted by amphibolite facies decompressional events, occur, associated with predominant, high grade gneisses and migmatites in the basement of the Sredna Gora terrane (Central western Bulgaria) and, to the south, in the South Rhodopean terrane (Haydoutov, 2002) of the Rhodope massif at the Bulgaria – Greece border. Following the Devonian convergence of the Moesian terrane and Dobrudgea periphery of Palaeo-Europe, the collision between peri-Gondwanan Moesian and Balkan + Thracian terranes, and their accretion to Palaeo-Europe took place during the Carboniferous (Yanev, 2000).

In the Sredna Gora basement a distinction in two suites has been proposed by Katskov and Iliev (1993). Biotite $\pm$ muscovite $\pm$ Al-silicate gneisses and micaschists with interlayered amphibolites and ultramafic rocks represent the southernmost, tectonically lower, suite. The amphibolite layers, extending in continuity for more than 1 km, locally include eclogite lenses. The ultramafites are chrysotile- antigorite serpentinites preserving relics of olivine, clinopyroxene and chromian spinel.

The upper, northernmost suite is built up by biotite and biotite-hornblende gneisses, amphibolites and orthogneisses whose protolith age is about 615 Ma (Carrigan et al., 2004). Diffuse migmatisation is reported to occur associated with amphibolite fa-

cies overprint in both suites (Zagorchev et al., 1973; Dimitrova and Belmustakova, 1982, 1982a). The metamorphic basement was intruded by Variscan (307.7$\pm$4.5 and 285.5$\pm$5.2 Ma; Carrigan et al., 2003) granitoid plutons.

Metabasites from the southernmost suite were sampled from two localities: A) partially retrograded eclogites and amphibolites are embedded within Alm-, Sill-, Ky-micaschists and migmatites as decameter-thick lenses interlayered with amphibolites. The contact between eclogites and amphibolites is abrupt. Garnet, omphacite (Jd_{22-37}), quartz, colorless amphibole, ilmenite and rutile represent the equilibrium assemblage with diffuse apatite and pyrite, rarer allanite and zircon as accessory phases. Evidence for the following decreasing pressures is given by: 1) Omphacite breakdown (Jd_8). 2) Kelyphite (plagioclase + reddish-brown -tschermakite to Mg-hornblende- to brown-green amphibole) coronas. They involve fluid consuming reactions such as garnet + diopside + albite + rutile + fluid $\rightarrow$ reddish-brown amphibole + plagioclase ($20 < An < 30$). 3) Reddish-brown amphibole replacing and overgrowing the colorless amphibole. 3) Rutile replaced and overgrown by ilmenite.

In B, striped amphibolites, hardly preserving relic rutile and pseudomorph after garnet, are interlayered with augen metagranites, within two-micas paragneisses along a main schistosity.

The earlier amphibolite facies re-equilibration occured under static condition and was characterized by poikiloblastic, brown-green to green amphibole (Mg-hornblende) biotite, granoblastic plagioclase and clinozoisite. The early static re-equilibration is followed by the development of a S_a foliation pervasive in amphibolites, host gneisses and micaschists, poorly penetrative in eclogites.

The ^{40}Ar-^{39}Ar dating carried out on hornblende separate provides a 398.4 $\pm$ 5.2 Ma age.

In the amphibolites from A zone, and less commonly in B zone, the pre-kinematic textures are preserved within the foliated domains,

In eclogites, millimetric shear zones and microfractures developed in response to the schistogeneous event.

A later, low-grade overprint results in chlorite $\pm$ albite $\pm$ white mica alteration.

Most analyzed eclogites (7) and amphibolites (11) are in the andesite-basalt subalkaline field. On the whole, a tholeiitic, transitional affinity can be hypothesized for the remaining sub-alkaline samples; relatively wide deviations from average compositions can be due to igneous fractionation processes.

Based on jadeite contents in omphacite, estimated pressures are between 1.3-1.5 GPa.

In the lack of stable plagioclase in the assemblage, the calculated pressures are calculated as minimum values.

The several calibration applied (Ellis and Green (1979), Ganguly (1979), Krogh (1988), Dahl (1980), Pattison and Newton (1989), Ai (1994) and on jadeite mole fraction of omphacite in the presence of quartz (Holland, 1983; Essene and Fyfe, 1967) yield values in a relatively wide range, with highest frequencies between 650˚ and 700˚C; the GTB Thermobarometry 2.1 program (Spear and Kohn, 1999) allows to restrict the range between 680˚ and 700˚C for pressures = 1.4 GPa.

In the diopside + albite and diopside + plagioclase ± tschermakite amphibole assemblage, the jadeite content in clinopyroxenes suggests pressures about 0.8 GPa. The Hbl – Plg thermometer (Holland and Blundy, 1994) yields average T values in the range 640˚ – 680˚C.

The occurrence in the upper suite of the Sredna Gora basement, of migmatites, associated with garnet migmatites and retrograded eclogites, and of two-micas paragneisses, associated with amphibolites, indicates that sequences of terrigenous and basic igneous protoliths, were likely issued from similar geodynamic environments. Here they were involved in a subductive event and attained different metamorphic peaks along similar PT conditions and were later exhumated up to amphibolite facies conditions, associated with a main folding event.

The PT- retrograde trajectory reflects decompression and cooling under high uplift rate due to tectonic processes. The Sredna Gora eclogites, as several Variscan eclogites associated with migmatites, should represent basic protolith associated with sediments and with felsic protoliths. The high volumes of metagraywackes and metapelites associated with basic protoliths point to an environment of continental rift basin.