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Modelling the complex metamorphic evolution inside a mobile zone on the south-eastern margin of Cretaceous Europe (Moslavačka Gora, Croatia)

Z. Petrinec, J. Bolanča, and D. Balen

University of Zagreb, Institute of Mineralogy and Petrology, Department of Geology, Zagreb, Croatia (zoricap@geol.pmf.hr)

Moslavačka Gora (MG) is a small (∼180 km2) exposure of the crystalline basement located on the SW margin of the Pannonian Basin (PB), geotectonicaly assigned to the Adria-Europe plate boundary. Crystalline part of the MG is made up of granite body (S-type granites) partly surrounded by medium- to high-grade metamorphic rocks (different varieties of metapelites, amphibolites, migmatites). Present geological relations inside the MG crystalline reflect a complex history of the metamorphic and igneous evolution during multiple, closely related Cretaceous events.

Phase equlibria modelling of texturally and mineralogically variable metapelitic samples in the NCKFMASH system done using THERMOCALC v. 3.33 software gave insight into mineral assemblage stability fields and P-T values of different stages of the Cretaceous metamorphic evolution of the MG complex. Based on the petrographic and field data from the previous research in the MG area, combined with P-T pseudosections, the first metamorphic episode has been recognized as a regional metamorphic event characterized by medium pressures (relic assemblages with garnet and sillimanite, like Bt+Grt+Kfs+Pl+Sil+Qtz and Bt+Ms+Pl+Sil+Qtz). Transformation of sillimanite to the mixture of white mica and quartz has been also noticed in some samples.

The onset of the second episode, the high-temperature/low-pressure one, is recognized in the occurrence of andalusite-bearing assemblages. The observed peak metamorphic assemblage in the samples, Bt+Crd+And+Kfs+Pl+Qtz, represents a Cretaceous prograde episode and yields P-T conditions of 3 kbar and 640°C for the part of the P-T path that is ascribed to the same thermal event that is held responsible for the generation of the main Cretaceous S-type granite pluton. The peak metamorphic assemblage including cordierite and andalusite is thus regarded as a part of this second episode of HT/LP Cretaceous metamorphic evolution.

Smaller, cm- to dm-sized metapelitic enclaves from S-type granite that have been modelled, show different mineral assemblages (Crd+Bt+Pl+Qtz±Sil) compared to the metapelitic blocks. Nevertheless, they also recorded medium pressure parts of the P-T path (e.g. biotite aggregate developed after garnet) that correspond to certain episodes of the MG Cretaceous evolution as previously noted in the metapelite blocks from the marginal parts of the pluton. Temperatures (∼640 °C) obtained with Ti-in-biotite thermometry fit well with results from P-T pseudosection modelling for both, metapelitic blocks and smaller enclaves.

It is evident that the pre-existing metamorphic complex became the source for the xenoliths that were encapsulated by the intruding MG granite, recording the P-T conditions of the Cretaceous activity. The characteristic HT/LP Cretaceous signature recorded in the various MG metamorphic lithologies opens new perspectives for the future investigation of the complex P-T path of the MG crystalline outcrop and processes that took place in the mobile zone on the south-eastern margins of the Mesozoic Europe.