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Microtectonic-assisted P-T determination on low-grade Alpine metamorphic rocks from the „Tisia Mega-Unit“ of the Slavonian Mountains in Croatia

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The internal structure of the Tisia (Tisza) Mega-Unit in the Alpine–Carpathian–Dinaridic orogenic system encompasses large Alpine nappe systems brought to its present-day position by complex regional-scale movements. The Slavonian Mountains are part of the Bihor nappe system which is below the Codru and above the Mecsek nappe systems. The low-grade metamorphic schist unit of the Slavonian Mountains includes numerous rocks which were previously related to Precambrian and/or Lower Paleozoic orogeneses. However, recent studies (e.g. Balen, 2014, European Geosciences Union General Assembly, EGU 2014-6122) show that the metapelites of this unit should be attributed to the Alpine orogeny and the poorly known P-T conditions, which they experienced, should be refined.

Although metapelites can be sensitive to changes of metamorphic conditions and, therefore, be suitable for the P–T estimation of metamorphic event(s), the extraction of mineral assemblages, being in equilibrium, and associated microtectonic data for particular low-grade metamorphic rocks is not straightforward. On the contrary, due to lack of suitable minerals and complex mictotectonic features, one can be faced with a severe problem concerning (dis)equilibrium. To avoid this, the observation scale in the research was set to the sub-mm level taking into account microtectonic positions of minerals.

The investigated samples from the Slavonian Mountains are fine-grained schists consisting of chlorite (15-30 vol. %), white mica (15-25 vol. %), quartz (10-25 vol. %), feldspars (albite 10-15 vol. %; some K-feldspar), biotite (<5 vol. %), opaques (<5 vol. %), and accessory minerals (zircon, monazite, xenotime, apatite, chalcopyrite, pyrite, barite, parisite-(Ce), rutile). The schists show complex microtectonic fabric including well-developed foliations, pervasive folding, crenulation and cleavage. Foliations are defined by the preferred orientation of phyllosilicates and thin quartz and feldspar ribbons. Chlorite and white mica oriented along the S1 foliation are up to 50 μm long grains whereas those oriented along the S2 foliation are as large as 500 μm. Chlorite is ripidolite; potassic white mica is muscovite to phengite. Both minerals show a systematic variation in chemical composition such as higher Si contents in white mica and lower XFe in chlorite of the S1 assemblage compared to the S2 assemblage. The application of classical chlorite thermometers, based on Si, Al, Fe, and Mg contents of chlorite, and phengite gave P-T conditions of 325-350 °C around 4.6 kbar and 315-330 °C around 3.8 kbar for the S1 and S2 minerals, respectively. Constructions of pseudosections in the system MnNCKFMASHTO with PERPLE_X confirmed these P-T ranges yielding 3.1-4.7 kbar and 300-360 °C based on intersections of XFe (chlorite) and Si (phengite) isopleths. The P-T range is in accordance with the critical reaction chlorite + K-feldspar = biotite + K-white mica in the presence of quartz and H_2O.

The presented refinement of the P-T data for the studied metapelites combined with two sets of known monazite ages (113±20 and 82±23 Ma; Balen, 2014) has a significance in clarifying details of the geodynamic evolution during the Alpine orogeny.

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