Heavy mineral-based provenance analysis of Cretaceous synorogenic sandstones from the Klape Unit, Poruba Formation and some controversial units

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Presence of exotic detrital components in the synorogenic sedimentary rocks of the Western Carpathians result from large-scale tectonic processes in the Tethyan realm during the end of the Early Cretaceous. These paleogeographic changes led to formation of accretionaly wedges, obductions and in the end to massive input of detritic material to adjacent basins. This exotic material occuring in the Albian–Cenomanian sandstones is the only one preserved imprint of the closing old Triassic ocean branches in Western Carpathian area. The oldest appearance of exotic components is recorded in the sandstones of Klape Unit in Pieniny Klippen Belt and in Poruba Formation, which reflects flysch development of Tatric and Fatric Unit in the northern (external) zones of Central Western Carpathian. The topic of psephitic exotic material was the subject of long-years interest of several scientists and numerous analyses were done, but psammitic fraction has not been analyzed in detail up to this day.

Our research provides results of the first comprehensive analysis of the heavy mineral assemblages from the oldest exotic-bearing units in Western Carpathians. We collected 37 samples from sandstones of Klape Unit, Tatric & Fatric Unit (Poruba Formation) and some adjacent units for heavy mineral analysis in total. Majority of the studied rocks are calcite-cemented litharenites. They have very low content of feldspars and variable ratio of quartz and lithic grains (mostly quartzites, carbonates, basaltic volcanics, less phyllites, mica-schists and silicites). Comparison of the heavy mineral assemblages from the above mentioned units showed that the composition of majority analyzed samples is mainly rich in chrome-spinels, zircons, tourmalines, apatites and rutiles in various ratios. The studied sandstones are poor in garnets but there occur also sporadic enriched samples. The amount of titanite, kyanite, monazite and epidote is low, silimanite and staurolite are very rare. Some samples are enriched by blue amphiboles, pyroxenes and kyanite.

According to the provenance analysis, the spinels were derived from harzburgitic ophiolites. However, their composition overlaps in some parts with chromitites and cumulates fields. The TiO_2 vs. Al_2O_3 diagram showed that most of the spinels come from the supra-subduction zone peridotites; some aluminium-depleted and higher-titanium grains best fit to the volcanic arc field. The examined blue amphiboles were identified as glaucophanes to ferroglaucophanes. They were derived from HP/LT metamorphosed basaltic rocks in a subduction zone. The pyroxenes are represented by orthopyroxenes (enstatite) and less clinopyroxenes (augite, diopside). Because of their common euhedral shape and fresh look we assume that they probably did not share the same ophiolitic source as Cr-spinels and blue amphiboles. They rather come from some nearby and time-parallel volcanic rocks rather of calc-alkaline provenance. Majority of the studied tourmaline grains was unzoned however, some of grains were intergrown in a poikiloblastic patterns. Tourmaline grains come from different types of metasediments. Almost all tourmalines from Havranský vrch Hill rather come from Li-poor granitoid rocks.

First, the research results showed that presence of Cr-spinels, blue amphiboles and possibly mosaic tourmaline is linked with an ophiolitic source. Second, rest of heavy minerals like zircon, tourmaline and rutile probably were derived from older sediments. Metamorphic rocks of various degrees of metamorphism were relatively rare, as evidenced by garnet, staurolite, kyanite and sillimanite. Third, the examined units probably shared the same source as no considerable distinctions were noticed among them.

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