

Provenance analysis of the heavy mineral assemblages from the Albian to Cenomanian exotic flysch deposits of the Klape Unit, Tatricum, Fatricum and some adjacent units

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Systematic heavy-mineral analysis of the oldest exotics-bearing units in the Western Carpathians has been performed. Samples the Klape Unit, Poruba Formation (Tatric and Fatric units), Manín Unit and Orava Unit were analyzed. The samples are dominated by chrome-spinels, zircon, tourmaline, apatite and rutile in various ratios. Garnet occurs in small amounts, with excess in some a few samples. Titanite, kyanite, monazite and epidote occur only rarely; sillimanite and staurolite are very rare. Locally, blue amphiboles, pyroxenes, garnet and kyanite were rich in in some samples. The analyzed spinel grains predominantly match the harzburgite field, with some overlap to the fields of podiform chromitites and cumulates in the Mg/(Mg⁺ Fe²⁺) vs. Cr/(Cr⁺ Al) diagram. The TiO₂ vs. Al₂O₃ diagram indicates the predominant origin of spinels from the supra-subduction zone peridotites for most of the analyses, whereas the other, aluminium-depleted and higher-titanium grains best match the arc volcanic field. The analyzed blue amphiboles are glaucophanes to ferro-glaucophanes and were most likely derived from HP/UHP metamorphosed basaltic rocks in a subduction zone. Pyroxenes are mostly represented by orthopyroxenes

(enstatite) and less by clinopyroxenes (augite, diopside). Their common euhedral shape and fresh appearance indicate that they were probably not derived from the same ophiolitic source as the Cr-spinels and blue amphiboles, but rather from some adjacent and nearly coeval volcanics which might be of calc-alkaline provenance. Detrital tourmaline grains in the analyzed samples were mostly unzoned except of some grains; some even possessed a complex intergrowing pattern with a mosaic (poikiloblastic) appearance. Most of the grains were derived from various sorts of metasediments. Almost all tourmaline grains from Havranský vrch Hill were likely derived from Li-poor granitoid rocks. The results indicate input of minerals of dominantly ophiolitic provenance, such as Cr-spinels, blue amphiboles, and eventually poikiloblastic tourmaline. Zircon, rest of the tourmaline and rutile were likely derived from older sediments. Garnet, staurolite, kyanite, sillimanite occurring in relatively small amounts were mostly derived from metamorphic rocks of various degrees of metamorphism. No significant differences were observed among the individual units which most likely shared the same source.