U-Pb and K-Ar geochronology of the subvolcanic rock pebbles from the Cretaceous and Paleogene gravelstones and conglomerates of the Pieniny Klippen Belt (Carpathians; Poland, Slovakia) – relevance for tectonic evolution and palaeogeography

Paweł Poprawa[1]*, Michał Krobicki[1], Krzysztof Nejbert[2], Ewa Krzemińska[3], Richard Armstrong[4], Zoltan Pecskay[5]

[1] AGH University of Krakow, Faculty of Geology, Geophysics and Environment Protection; al. A. Mickiewicza 30, 30-059 Krakow, Poland
[2] University of Warsaw, Faculty of Geology; Żwirki i Wigury 93, 02-089 Warsaw, Poland
[3] Polish Geological Institute – National Research Institute, Rakowiecka 4, 00-975 Warsaw, Poland
[4] Australian National University, Canberra 0200, Australia
[5] Hungarian Academy of Sciences, Institute of Nuclear Research, Bem tér 18/c, 4026 Debreczyn, Hungary
** ppop.ecr@gmail.com*

In the Pieniny Klippen Belt (PKB), the Cretaceous and Paleogene conglomerates and cohesive debrites commonly contain pebbles and blocks of the subvolcanic rocks among other, mainly sedimentary rocks (e.g. multicoloured sandstones, oolitic limestones, dark bivalve coquinas, dolostones, etc.). This detritus was interpreted as derived from the Andrusov Ridge located south of the PKB basin (Birkenmajer, 1988). Age of these subvolcanic rocks, regarded to represent subduction-related igneous activity, was previously constrained by K-Ar whole rock dating as c. 140–90 Ma, leading to suggestion that during Late Jurassic to Early Cretaceous PKB basin developed on oceanic lithosphere, subducted during at the end of Early Cretaceous (Birkenmajer, 1988).

Within this study, the geochemical composition, the K-Ar whole rock age and the U-Pb zircon ages of the above mentioned subvolcanic rocks were studied. The pebbles are well rounded. They are represented by granitic and subvolcanic andesitic-type rocks (mainly andesite, basaltic andesite, basaltic trachyandesite, trachyandesite and rhyolitic pebbles, and rare dacite, tephrite, trachybasaltic and basaltic pebbles). Domination of andesitic pebbles, bimodal spectrum of volcanic rocks with high content of SiO_2 (rhyolites, dacites) and Na_2O and K_2O within mafic and transitional ones is observed. Their petrographic character and geochemical analysis of concentration of rare elements with MgO > 2% ratio and La/Yb 4–35, Sc/Ni < 1.5, Sr/Y < 20, Ta/Yb > 0.1, Th/Yb > 1 values, indicate magmatic island arc of active continental margin similar to Andean-type subduction regime.

The K-Ar whole rock dating was performed for 17 samples. The obtained ages cover mainly the Early Cretaceous time span, with the most data representing the Barremian-Albian, therefore are coherent with Birkenmajer (1988) results. However, the U-Pb SHRIMP zircon dating reveled different results. Most of the analyzed subvolcanic rock samples (9) give ages in the narrow range of c. 270–266 Ma. The ages are based on concordant data with amount of measured point in a range of 20–30, and are characterized by low error bars, usually lower than ±2 Ma. In addition, one sample of subvolcanic rock gave lower quality results, with a few youngest, partly concordant, zircons grains giving the age of 251.0 Ma ±8.5 Ma. Moreover, one sample of orthogenesis was analyzed, which is regarded to represent crust on which the volcanic arc developed. In this case the U-Pb SHRIMP zircon dating result is 493.9 Ma ±4.1 Ma.

We regard these pebbles/blocks to be derived from the Inner Carpathians, assuming therefore lack of the Andrusov Ridge located south of the PKB basin (comp. Plašienka, 2018). The results of K-Ar whole rock dating is representative for intensive diagenetic overprint, rather than age of the rock. The U-Pb data clearly indicate, that subduction-related magmatic arc developed during the middle Permian (Guadalupian). This follows, that the oceanic crust was of the middle Permian or older age, and thus cannot be related to the Jurassic-Early Cretaceous development of the PKB basin. The magmatic arc was presumably connected with southern margin of Laurusia and subduction of oceanic crust of the Paleotethys (proto-Vardar Ocean?).

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