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Early Triassic change in the erosional level in the eastern part of the Bohemian Massif revealed by detrital garnet assemblages from the Buntsandstein siliciclastics of southern Poland

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Garnets, as constituents of various magmatic and metamorphic rocks, show different chemical compositions depending on the type of magma or primary rock, the temperature, and the pressure. This diversity of chemical compositions makes detrital garnets a very useful tool for provenance analysis and deciphering changes in erosional levels of source areas. Preliminary works reveal that the Lower and Middle Buntsandstein terrigenous and marine sandstones cropping out in southern Poland (50˚28’20”N, 18˚04’33”E and 50˚27’35”N, 18˚07’23”E) are characterized by very different heavy mineral assemblages (HMA) and types of detrital garnets. The aim of the research is to recognize the source areas and causes of these distinct variations using petrographic analysis, heavy mineral analysis, and electron probe microanalysis. During the Early Triassic, the area under study was located between two landmasses: the eastern margin of the Bohemian Massif (BM) to the west and Pre-Carpathian Land (PCL) to the east. Presently, the sampled area is situated ∼50 km from the NE margin of the BM, which consists of many garnet-bearing rocks and is a presumable source area for the examined grains. The PCL was hidden under the Carpathians during the Alpine orogeny and knowledge of its composition is very limited.

Petrographic analysis shows that the older sandstones are red to rusty quartz arenites with a hematite-rich matrix and well-rounded grains (aeolian deposits). The younger sandstones are bicolored quartz wackes (dirty pink with grey patches) with a calcite matrix and angular to rounded grains (shallow marine deposits). The arenites contain zircon, tourmaline, and rutile grains accompanied by garnet, staurolite, apatite, and topaz. The opaque heavy minerals include ilmenite, ilmenite–rutile aggregates, magnetite and rarely chromian spinel. In contrast, the HMA from the wackes consist mostly of garnets, while the minerals listed above occur in subordinate amounts.

The garnets from the older sandstones are rich in pyrope molecule. They include peridotite-derived pyropes ($Prp_{(62)66-73}Alm_{4-21(23)}Grs_{(1)4-9(14)}Uv_{(1)2-9(14)}Sps_1And_{<1}$), which are accompanied by pyrope–almandine–grossular garnets with a wide range of compositions ($Prp_{(11)18-62}Alm_{17-49}Grs_{10-38(44)}Uv_{<1-3}Sps_{1-2}And_{<1-1}$), derived from garnet pyroxenites and eclogites. By contrast, the garnets occurring in the wackes reveal definitely higher content of almandine molecule. The most abundant are the HP felsic granulite-derived almandine–pyrope garnets with low content of grossular molecule ($Prp_{(25)27-49(54)}Alm_{(42)45-65(68)}Grs_{1-15}Uv_{<1}Sps_{1-2}And_{<1}$). They are accompanied by almandine–pyrope–grossular garnets derived from mafic granulites, amphibolites, and eclogites. The other types of garnets occur with lower frequency. The examined HMA and garnet assemblages show different compositions in comparison with all the previously investigated Carboniferous, Permian, and Early Triassic HMA from the nearby areas in Poland and the Czech Republic.

Detailed comparative analysis indicated the Moldanubian Zone as the most probable and important source area for the majority of the detrital garnets. The differences between the HMA and the garnet assemblages suggest a distinct change in the erosional level of the eastern part of the Moldanubian Zone during the Early Triassic. Combined tectonic and surficial process likely caused the change in the types of the exhumed rocks subjected to erosion.

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