Provenance of the detrital garnets from Aptian/Albian sediments of the Czorsztyń Unit (Chmielowa Formation, Pieniny Klippen Belt, Western Carpathians, Slovakia)

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The Pieniny Klippen Belt is the most tectonically complicated zone separating the Outer and the Central Western Carpathians. The Pieniny Klippen Belt thus represents a mélange with mixed numerous paleogeographically different units. One of them is Czorsztyń Unit. The Czorsztyń Succession is the shallowest Pienidic unit of the Western Carpathian Pieniny Klippen Belt. After the Valanginian, a hiatus encompassing almost the whole Hauterivian, Barremian and Aptian occurred in this unit. The Tithonian-Lower Cretaceous limestones are
overlayed by pelagic Albian-Cenomanian marlstones, marly limestones and cherts (Chmielowa and Pomiedznik Formations). The nature of this hiatus was so far unclear, either representing a submarine non-deposition and erosion, or subaerial exposure. Unequivocal indicators of subaerial exposure and karstification were revealed, supporting the exposure theory showing that. The emersion was followed by the deposition of Upper Aptian organo-detritic limestones and pelagic Albian marlstones. In the Upper Aptian/Albian sedimentary rocks the following heavy minerals: Cr-spinels, garnets, zircons and rutiles were found. Garnets were found at six sites: Vršatec, Horné Štrnie Quarry, Lednica Castle Klippe, Jarabina Quarry and Kamenica Klippe. Chemical composition of detrital garnets at two localities (1) Vršatec and (2) Jarabina was studied.

Locality Vršatec is situated at the southern end of the ridge of Vršatec Castle Klippe, 6 km NW of the Ilava town. Locality Vršatec contains a very large stratigraphic interval probably from the Bathonian to the Campanian. The locality was previously studied by Mišík (1979), Cenomanian cherts (Podmiedznik Formation) and Albian sedimentary rocks were studied by Šykora et al. (1997) and rocks of Czorsztyn Succession were studied by Aubrecht et al. (2006). The uppermost parts breccias of Lysa limestone Formation (Berrissian-Valanginian) are covered by dark-gray bioturbated limestones with clastic admixture. It is a lower part of the Chmielowa Fms. which contains planktonic and benthic foraminifers - the association indicating the Upper Albian age (Birkenmajer, 1977; Šykora et al., 1997; Aubrecht et al., 2006). Apart from foraminifers, echinoderm ossicles, echinoid spines, fish teeth occur there. The terrigenous admixture is formed by clastic undulatory quartz (silt to sand size, about 1 ?) and rare grains of glauconites, phosphates and heavy minerals. The garnets where found in the breccia and grey limestones of the Chmielowa Formation (Fig. 3, in Šykora et al. 1997).

Locality Jarabina is situated in the southern part of the two uppermost steps of a large quarry, at the northern margin of the Jarabina village, 8 km northwest from Stará Lubovňa in the Eastern Slovakia. The main volume of the rocks in this locality is represented by pale Bajocian crinoidal limestones (Smolegowa Limestone Formation) which are overlain by several metres thick Bathonian-Kimmeridgian micritic limestones (Bohunice Formation). Micritic limestone of Bohunice formation in quarry near Jarabina village were covered by red marlstones, marly limestones and breccias of the Albian age. They often fill irregular surface underlying limestones. The Albian sedimentary rocks contain numerous grey-yellow spherical phosphatic oncoes. Lithoclasts of other rocks were mostly derived from underlying limestones. Albian rocks contain clastic admixture - terrigenous quartz (Aubrecht et al., 2006). The garnets where found in the red marlstones and marly limestones of the Chmielowa Formation (Fig. 12, caption 5 in Aubrecht et al., 2006).

The garnet compositions of the detrital garnets from Aptian/Albian sedimentary rocks from the Czorsztyn Unit (Chmielowa Formation) suggest the source area of the parental rocks including ultra-high metamorphosed rocks (UHP), rocks metamorphosed under eclogite and granulite facies conditions, rocks metamorphosed under amphibolite-facies conditions (high and medium grade) and rocks metamorphosed under epidote-amphibolite facies conditions (Fig. 1). The microprobe analyses of detrital garnet grains from the localities Vršatec and Jarabina suggest that detrital garnets were derived from the parental rocks such as: (A) garnet peridotites (diamond filled - Grt from Vršatec). (B) granulites (box filled - Grt from Vršatec, box open - Grt from Jarabina) and (C) eclogites (circle filled - Grt from Vršatec, circle open - Grt from Jarabina). (D) gneisses (triangle filled up - Grt from Vršatec, triangle open up - Grt from Jarabina) and (E) amphibolites (triangle filled down - Grt from Vršatec) metamorphosed under high amphibolite-facies condi-

![Fig. 1. Composition of the detrital garnets from the Aptian/Albian sedimentary rocks of the Czorsztyn Unit.](image-url)
Ugrandites garnet group: A new type of detrital garnets from the clastic sequences of the Gosau Group (Dobšinská Šladová Jasíkyňa, Western Carpathians, Slovakia)

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Sedimentary rocks of the Upper Cretaceous to Paleocene age in the area of Dobšinská Šladová Jasíkyňa (DLJ) village are regarded as an equivalent of the Gosau Group sediments of the Northern Calcareous Alps (Mello et al., 2000). Sediments of the Gosau Group near DLJ village are composed by two sequences: (1) Sequence of brownish marly slates and marls contains thin coal beds in its lower part. (2) Upper part of the Gosau group is represented by polymict conglomerates (complete ophiolite association have been found). Pebbles of Triassic and Jurassic limestones, radiolarites, ophiolites, blueschists, porphyroids, freshwater limestones were found in conglomerate bodies (Ivan et al., 1998). Conglomerates alternate with brown–reddish sandstones - lithic greywackes.

The sediments of the Gosau Group are in transgressive position on the Triassic carbonate sediments of the Silurian Unit or Jurassic melange of the Meliatic Unit (Mello et al., 2000).

Garnets and spinels have been found in the conglomerate matrix and in the sandstones (Šýkora et al., 2007). Also magnetite, zircon, rutile and apatite have been identified among the most frequent heavy minerals.

Based on chemistry of detrital garnets and spinels from the clastic sequences of the Gosau Group near Dobšinská Šladová Jasíkyňa village three probable sources could be supposed: (1) the first source with gneisses, amphibolites, metagabbros, metamafics and eclogites could be correlated with the leptynite-ambibolite complex in the

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Acknowledgement. This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0571-06 and the VEGA grant agency by the grant No. 1/4035/07.