

Heavy mineral assemblages and garnet chemical composition as tools in discerning deep-sea Cretaceous-Miocene formations of the Skole Nappe (Polish Flysch Carpathians)

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Heavy mineral assemblages in the Cretaceous-Miocene deep-sea flysch formations of the Skole Nappe in the Polish Flysch Carpathians have been analyzed. The study area is located SE of Rzeszów. The formations studied include the Ropianka Formation (Senonian–Paleocene), the Kliva Member of the Menilite Formation (Oligocene: Rupelian), "Transitional Beds" (Jutna Member of the Menilite Formation; Chatian–Aquitania), and the Krosno Formation (Miocene). The Ropianka Formation and the Kliva Member in the northern part of the Skole Basin were supplied from the foreland located to the north-west. The Krosno Formation and probably a part of the Transitional Beds display evidence of palaeocurrents flowing from the south and south-east. For geology the mentioned units see Kotlarczyk (1966, 1978); Kotlarczyk & Leśniak (1990); Kotlarczyk et al. (2006).

The investigations carried out so far reveal differences of heavy mineral assemblages (within 0.06–0.25 mm fraction) between the formations. The older lithostratigraphic members, i.e. the Ropianka Formation and the Kliva Member, are zircon, rutile and tourmaline dominated (ZTR index = zircon + tourmaline + rutile up to 95% and 80%, respectively), which are accompanied mostly by staurolite, kyanite, lesser amounts of apatite and in some places by andalusite. Contrary to them, the younger sediments of the "Transitional Beds" are garnet dominated (up to 70%), whereas zircon, tourmaline and rutile occur in lesser amounts (ZTR up to 33%). The youngest sediments, represented by the Miocene Krosno Formation, display diverse heavy mineral composition depending on the area of sampling. In the southern part of the Skole Nappe, the heavy mineral assemblages resemble in composition the garnet-dominated "Transitional Beds" (garnet up to 67%; ZTR up to 28%). Towards the northern part of the nappe, where the lower part of the Krosno Formation was deposited probably later than in the south, the assemblages are garnet and amphibole dominated (up to 51% and 31%, respectively), accompanied mainly by apatite, staurolite, kyanite, epidote, zircon, tourmaline and rutile. The characteristic feature of the Krosno Formation in general is the significant contribution of apatite (up to 25%), while the additional specific feature of the garnet and amphibole dominated part of the Krosno Formation is the presence of single grains of a blue sodic amphibole.

Garnet from the Ropianka Formation and the Kliva Member displays composition typical of medium- and high-grade metamorphic conditions. Composition of garnet from

the Krosno Formation points to their provenance from amphibolite, mainly medium-grade facies rocks, which is in agreement with composition of the heavy mineral assemblages. The garnet population of the Krosno Formation nearly lacks grains formed in high-grade granulite facies conditions.

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