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Acta Geologica Polonica, Vol. 72 (2022), No. 1, pp. 137–139
DOI: 10.24425/agp.2021.139309

Discussion

Oszczypko, N., Oszczypko-Clowes, M. and Olszewska, B. 2020. Geological setting and lithological inventory of the Czarna Woda conglomerates (Magura Nappe, Polish Outer Carpathians). *Acta Geologica Polonica*, **70**, 397–418.

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Oszczypko *et al*. (2020), in reference to the earlier work by Oszczypko and Oszczypko-Clowes (2014), attempt to revolutionize the tectogenesis of the Pieniny Klippen Belt (PKB) through their documentation of Miocene age (NN2 zone, Burdigalian) strata in rocks previously belonging partly to the Jarmuta Formation of the Grajcarek Unit, partly to the Magura Formation of the Magura Nappe and partly to the autochthonous Paleogene forming a so called "younger mantle" (see Birkenmajer 1970, 1986). As a consequence of their discovery, the authors assume: 1) strong Miocene tectonic deformation responsible for thrusting the Grajcarek and PKB units onto the Miocene deposits of the Magura Nappe, and 2) a change in form of the PKB from a deep-rooted tectonic structure trapped between the Central and Outer Carpathians to a belt of tectonic remnants "floating" on the Magura Nappe. This proposal is accompanied by changes to the geological map of the Małe Pieniny Mountains in relation to their previous work (Oszczypko and Oszczypko-Clowes 2014), which are not supported by research results or explanation, but which are crucial from the point of view of the tectonic evolution of the PKB. The authors do not take into account the fact that the PKB is not an independent structural unit, but is only one element of the Carpathians, and that the PKB evolution is closely related to the growth of the accretionary wedge of the entire Carpathian orogen. Were they correct in their assertions, similar findings would also have to be documented in other parts of the klippen belt.

Such powerful orogenic movements cannot be reconciled with the presence of the overstepping sedimentary cover of the Central Carpathian Paleogene (CCP) which originated up to the Early Miocene (e.g. Garecka 2005) in an intra-mountain basin located on the folded Tatricum area, covering it with sediments several kilometers thick (Środoń *et al*. 2008). In Poland, CCP sediments occur in the Podhale Trough, which was formed in a slight syncline due to the Neogene rotational uplift of the Tatra Mountains (e.g. Jurewicz 2005), and which was responsible for the formation of the tectonic contact between the Tatricum with the CCP cover and the PKB units, the Podhale Fault (e.g. Gołąb 1959). The activity of this fault occurred simultaneously with the sub-Tatra fault, limiting the Tatra block from the south, and the amplitude of the displacement was at least as large as the current thickness of the Central Carpathian Paleogene, i.e. approx. 3.5–4.5 km (Środoń *et al.* 2008). The original thickness of the CCP sediments may have been greater by 2–5 km (Anczkiewicz *et al*. 2013). North of this fault, in the PKB, according to Oszczypko *et al.* (2020), there are no remnants of the CCP sediments (see: Birkenmajer 1970). Instead, the Miocene flysch of the Magura Nappe (Kremna Formation) comes out from under the rocks of the PKB (in tectonic windows). It is hard to imagine how horizontal tectonic movements on such a large scale which, according to Oszczypko et al. (2020), took place in the Miocene (i.e. after CCP sedimentation) were responsible for the formation of the thrust-nappe structure of the PKB, making this a series of tectonic caps but, at the same time, did not cause folding and decollement of the Central Carpathian Paleogene sediments. While the overlap of the PKB on the Magura Nappe is evident (Leško 1985, Jurewicz 1994), the

claim by Oszczypko and Oszczypko-Clowes (2014) that it formed in the Miocene (17–18 Ma) in the direct neighborhood of the Podhale Fault over a distance 5 km cannot be supported; there was neither space nor time for such strong tectonic movements and structural reorganization.

The geological map of Oszczypko *et al.* (2020) has changed significantly from the maps of Birkenmajer (1970, 1977); part of the Jarmuta Formation has become the Kremna Formation, and the boundary between the Jarmuta and Kremna formations since 2014 (Oszczypko and Oszczypko-Clowes 2014, fig. 2) has shifted southward in the 2020 map. As presented in the cross-section the thrust-fault (Oszczypko and Oszczypko-Clowes 2014, fig. 11) of the Grajcarek unit on the Kremna Formation in the field, does not differ in a structural sense from ordinary faults, of which the klippen belt contains a significant number, and has no surface indicating a large displacement, the amplitude of which would reach 5 km. In the 2014 map (Oszczypko and Oszczypko-Clowes 2014, figs 2 and 10D–E), Krupianka Hill is built of thick-bedded sandstone of the Magura Formation cut by andesites and outcroping in a tectonic window whereas, in the 2020 map (Oszczypko *et al*. 2020), it is oddly built of the thick-bedded sandstone of the Jarmuta Formation (Maastricht–Lower Eocene) belonging to the Grajcarek Unit as a tectonic cap with unrooted andesites. WP250 from 2020 is the same point as WP242 from 2014 (Sielski Creek, Szlachtowa), but according to the text by Oszczypko *et al.* (2020) it is a ridge between the Stary Stream and the Czarna Woda Stream with sandstones and conglomerates. There are two WP 330 on the map, but no WP449. The GPS coordinates of WP381 and WP385 are not correct (Oszczypko *et al.* 2020, table 1).

In the paper by Oszczypko and Oszczypko-Clowes (2014, fig. 8E), the Czarna Woda conglomerates are described as: "exotic pebbly mudstones of the Jarmuta Formation, middle section of the Czarna Woda Creek", while on the map (Oszczypko and Oszczypko-Clowes 2014, fig. 2) and on figures in Oszczypko *et al.* (2020, text-figs 2, 5) they are allocated to the Miocene. There is no documentation of the age of the titled "Czarna Woda conglomerates", but only an intermediate specified age for the sandstone lenses from the Kremna Formation. Oszczypko *et al.* (2020, p. 755) state that "the PKB is separated from the Magura Nappe, by a narrow, strongly tectonically deformed zone, belonging to the Grajcarek Unit" but on the map (Oszczypko *et al.* 2020, text-fig. 2) the Grajcarek Unit lies at the bottom of the PKB units thrusted onto the Kremna formation of the Magura Nappe (see else Oszczypko and Oszczypko-Clowes 2014, fig. 10). The present author has already made the same remark regarding the article by Oszczypko and Oszczypko-Clowes (2014) that the text is not compatible with the map and cross-sections (Jurewicz 2018).

In sum, the new idea of the PKB thrust-folding processes, Miocene in age, cannot be correlated either with evolution of the Carpathian units adjacent to the PKB (Tatrikum and CCP sediments on the S and the Outer Carpathians on the N) based on the plate tectonics theory (e.g. Plašienka 2018), nor with the evolution of other parts of the PKB. The unexplained changes in the content of the map in relation to the version from 2014 (border shifts, change in the stratigraphic affiliation of formations) and the discrepancies between the text and conclusions that can be drawn based on the cartographic image, make the work inconsistent and difficult to accept. If the idea of the work was to "rejuvenate" the Jarmuta Formation into the Miocene age, when its age was previously determined as Maastricht–Paleocene, then the entire evolution of the Carpathians would have to be explained anew. It would be necessary to specify what happened in the PKB area between Late Cretaceous and the Miocene; where and how a majority of the klippen belt disappeared, the remains of which are tectonic caps; why the movements responsible for the present build and evolution of the PKB in the Małe Pieniny Mountains do not reach the CCP sediments; and what is the relation between the Podhale Fault and the thrusting processes in the PKB? The Authors should decide which location of the well seen tectonic contact of the Grajcarek Unit and the Kremna Formation is correct. At the moment, there are too many discrepancies between the two papers: Oszczypko and Oszczypko-Clowes (2014) and Oszczypko *et al.* (2020), and the whole new idea of the PKB origin raises too many doubts.

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Manuscript submitted: 12th August 2021
Revised version accepted: 1st October 2021