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The geotourist potential of the Bialka River valley (in the Podhale Basin) – a project of a geotourist trail

Potencjał geoturystyczny doliny Białki (niecka podhalańska). Projekt ścieżki geoturystycznej

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Abstract: *The Białka valley is located in southern Poland. The middle part of the valley is build-up of the Paleogene Podhale Flysch. In common opinion, this region is not particularly attractive in respect to geotourism. To prove that it is not true, I proposed the project of geotourist trail in this area. The trail comprises 5 geosites, where the most attractive objects (according to the author) will be presented. These include calcareous tufa in Jurgow (first geosite), faults in the Bukowińska Grapa (second geosite), where pronounced effects of lateral erosion are evident, which lead to the shifting of the river bed. At this geosite there are also visible joints systems in sandstones (third geosite) and the sandstones show various types of lamination. At the fourth geosite, there occur clear neotectonic features revealed by granite boulders deposited several meters above the contemporary riverbed. Finally, at the fifth geosite, one can examine the thermal pools, which are examples of favorable geological conditions utilized for recreational purposes.*
Key words: *Podhale flysch, geotourism, Białka valley, fault zone, calcareous tufa*

Treść: *Dolina Białki znajduje się w południowej Polsce. Jej środkowa część zbudowana jest z paleogeńskiego fliszu podhalańskiego. Ogólnie uważa się, że obszar zbudowany z tych skał nie jest szczególnie atrakcyjny pod względem geoturystycznym. Aby udowodnić, że jest inaczej, zaproponowano projekt ścieżki geoturystycznej. Ścieżka składa się z pięciu najciekawszych (według autora) stanowisk. Składają się na nie kolejno martwice wapienne w Jurgowie (pierwsze stanowisko), uskoki w obrębie Bukowińskiej Grapy (drugie stanowisko), a także miejsce wyraźnej, lateralnej erozji bocznej, która prowadzi do przesuwania się koryta. Wyraźnie odsłonięte są tutaj ławice piaskowców o różnej laminacji, poprzecinane spękaniami ciosowymi (trzecie stanowisko). Na czwartym stanowisku widoczne są wyraźne dowody na zachodzące tutaj ruchy neotektoniczne (otoczaki granitowe wyniesione kilkanaście metrów nad poziom obecnego koryta), a na ostatnim, piątym stanowisku znajdują się baseny termalne, które są znakomitym przykładem wykorzystania sprzyjającej budowy geologicznej do celów gospodarczych.*
Słowa kluczowe: *flisz podhalański, geoturystyka, dolina Białki, strefa uskokowa, martwica wapienna*

Introduction

Podhale is build-up of Palaeogene Flysch. Its geotourist attractiveness in comparison with neighboring regions (Tatra Mts., Pieniny Mts.) is considered to be small (Migoń, 2012). This does not change the fact that within the Podhale Flysch, there are many attractive objects and structures in terms of geotourist potential (Hełdak, 2015). The first authors who paid attention to this fact were M. Krobicki and J. Golonka (2008). Inspired by their work and based on own observations made in the middle part of the Białka valley, I decided to present the main geotourism attractions of this part of the Podhale Basin. This was done through the project of a geotourist trail (Fig. 1), which takes into account calcareous tufa, faults, joints, various types of lamination in sandstones, effects of the activities of fluvial processes and neotectonic movements. The last element on the geotourist trail is Terma Bania, an example of using geological structures for economic purposes. Part of this paper is based on the results of the master's dissertation in the Department of Physical Geography at the Pedagogical University in Kraków, under the direction of dr hab. Józef Kukulak.

Location of the studied area

The geotourist trail is designed on the area of the Bukowina Tatrzańska commune, along the Białka valley, from Jurgów village in the south, to the central part of Białka Tatrzańska, in the north. This part of the valley is located in eastern Podhale (Fig. 1). The presented area is filled with Eocene-Oligocene Podhale Flysch (more specifically mainly with lower and upper Chochołowskie beds). The Podhale Basin is divided by transversal tectonic zones (Mastella, 1975; Mastella et al., 1996). In this regard, the trial runs through a zone of small dips. More details about the geological structure of the area will be discussed during the description of the geotouristic positions.

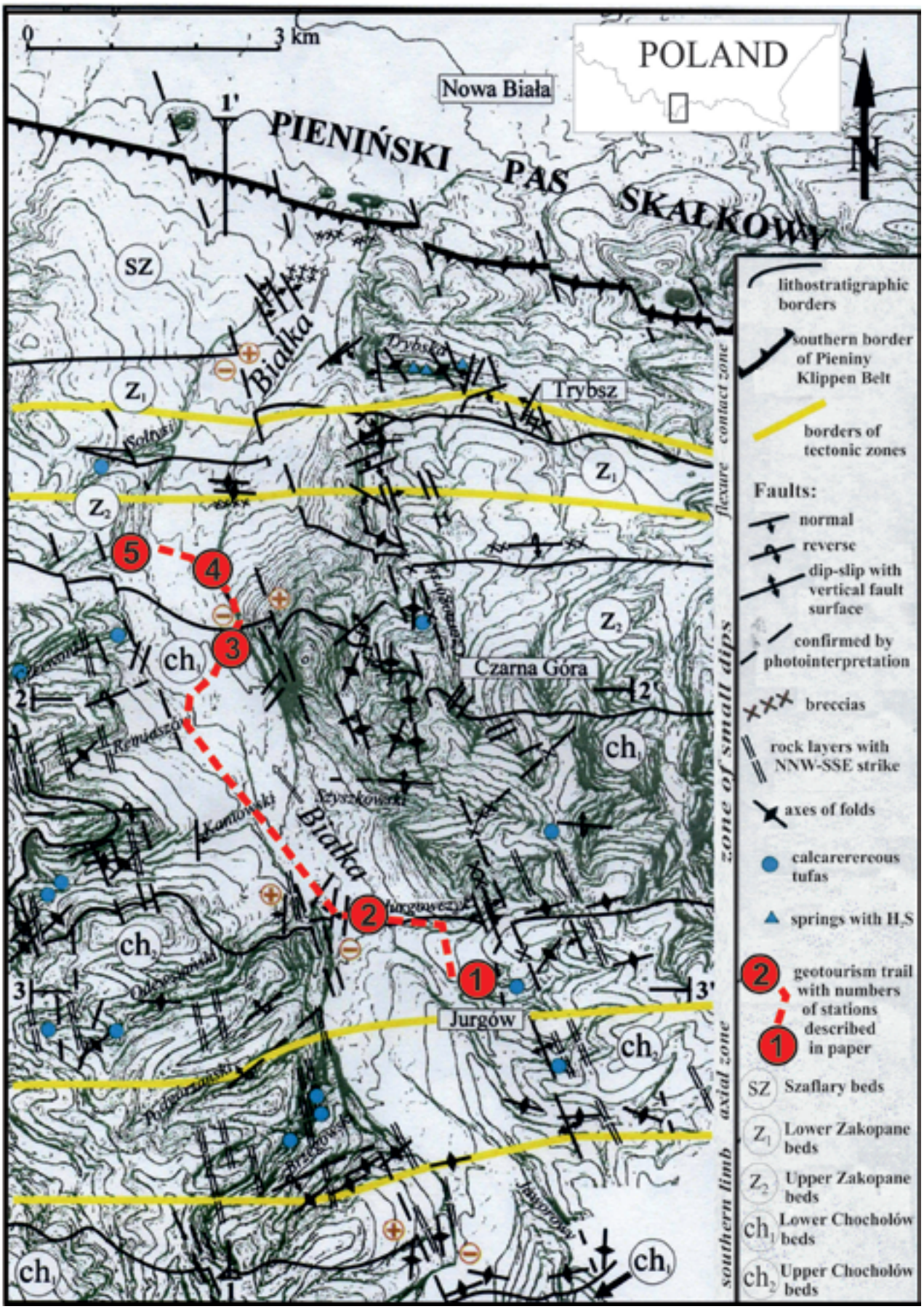

Fig. 1. Sketch of the geotourism trail in the middle part of Białka valley on the geological map of this area prepared by L. Mastella, A. Konon and T. Mardal (1996) • Szkic ścieżki geoturystycznej w środkowej części doliny Białki na tle mapy geologicznej tego obszaru sporządzonej przez L. Mastellę, A. Konona i T. Mardala (1996)

Suggested points on the geotourist trail apply only to a part of the Białka valley (its geotourism potential is considerably higher). These may be:
– a separate educational trail about the Podhale Flysch;
– part of longer geotourist trail in the Białka valley (which will include Białka and also points located in the Tatra Mts. and in the Pieniny Klippen Belt).

Project of a geotourism trial in the central part of Białka valley

The first point on the trail is the position of calcareous tufa in Jurgów (Fig. 2). This is young, Quaternanary deposits (Alexandrowicz, 2009), of which the presence is often correlated with fault zones. They are precipitated as a result of physic-chemical or biological processes, which include CO_2 release, when the differential pressure of the gas is in the solution and the air (for examples at the springs), raising the temperature, the turbulence of flow (for example by the waterfalls) or increasing the pH (for example by decomposition of organic substance). These deposits may also be precipitated as a result of the physiological processes of plants (Alexandrowicz, 2009). In the case of calcareous tufa in the Białka valley the first factor is decisive, which is the differences in gas pressure in the solution and the air, connected with deep-seated fault zones. The described position of calcareous tufa is low thickness (a few millimeters).

In geological research, calcareous tufa are important. For example, their composition of malacofauna is useful in identifying climate change, including defining the boundary between the Pleistocene and Holocene (Alexandrowicz, 2013).

The Bukowińska Grapa is located near the bridge over the Białka River in Bukowina Tatrzańska (by the roundabout). This landform is very interesting. It is situated between the two watercourses – from the east side, its slope is undercut by the Białka River and from the west, by the Odewsiański Stream. From the west, the slopes are very steep forming a scarp, with a height exceeding 30 meters (Fig. 3A). In this place, overhanging sandstone layers – Fig. 3B – can be seen. The Bukowińska Grapa tapers from the bottom to the top (at the ridge even less than 2 meters wide – Fig. 3C).

At the bottom of this form, explicit talus fans can be seen, with visible segregation of the material (Fig. 3D). They are proof of erosion processes occurring here (mainly fall), although there large sandstone boulders are also present, which testify to the fact that there are rockfall too.

Apart from interesting morphology, the Bukowińska Grapa has eye-catching tectonic. It is generally believed, that the course of the only scarp of Bukowińska Grapa is the part of the Białka Fault Zone, in the NNW-SSE direction (Mastella et al., 1996).

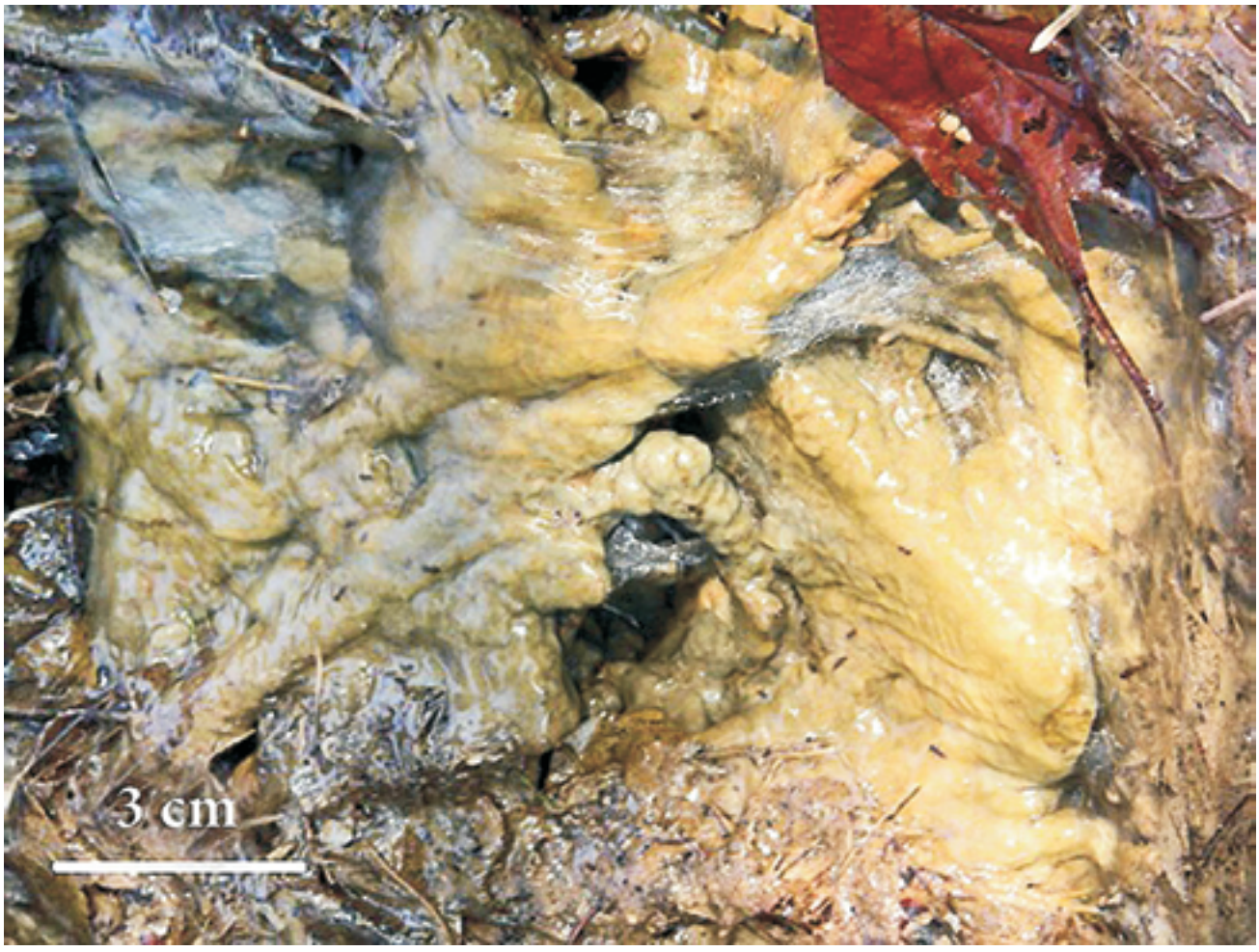

Fig. 2. Calcareous tufa in Jurgów village, photo J. Kukulak • Martwica wapienna w Jurgowie, fot. J. Kukulak

Fig. 3. Geomorphologic and tectonic features of Bukowińska Grapa: A – outcrop of the Chochołowskie beds from the eastern side; that outcrop is a part of the Białka Fault Zone; B – overhanging sandstone layer; C –thin ridge of the Bukowińska Grapa (less than 2 meters); D – talus fans with visible segregation of the material at the bottom of the Bukowińska Grapa; E – one of the normal faults in the Bukowińska Grapa; well visible different heights of the same layers on both sides of the fault line; F – visible rotation of the layers in the footwall of the fault (hanging wall is higher, line of trees is correlated with the fault line), photos D. Hełdak • Struktury geomorfologiczne i tektoniczne Bukowińskiej Grapy: A – odsłonięcie warstw chochołowskich widoczne od strony wschodniej; odsłonięcie to jest częścią strefy uskokowej Białki; B – przewieszona warstwa piaskowca; C – wąska powierzchnia grzbietowa Bukowińskiej Grapy (niecałe 2 metry); D – stożki usypiskowe z widoczną segregacją materiału u podnóża Bukowińskiej Grapy; E – jeden z uskoków normalnych w obrębie Bukowińskiej Grapy; dobrze widoczne położenie tych samych warstw skalnych na różnym poziomie po obu stronach linii uskoku; F – widoczna rotacja warstw skalnych w skrzydle zrzuconym uskoku (skrzydło wiszące jest wyżej, linia rosnących drzew pokrywa się z linią uskoku), fot. D. Hełdak

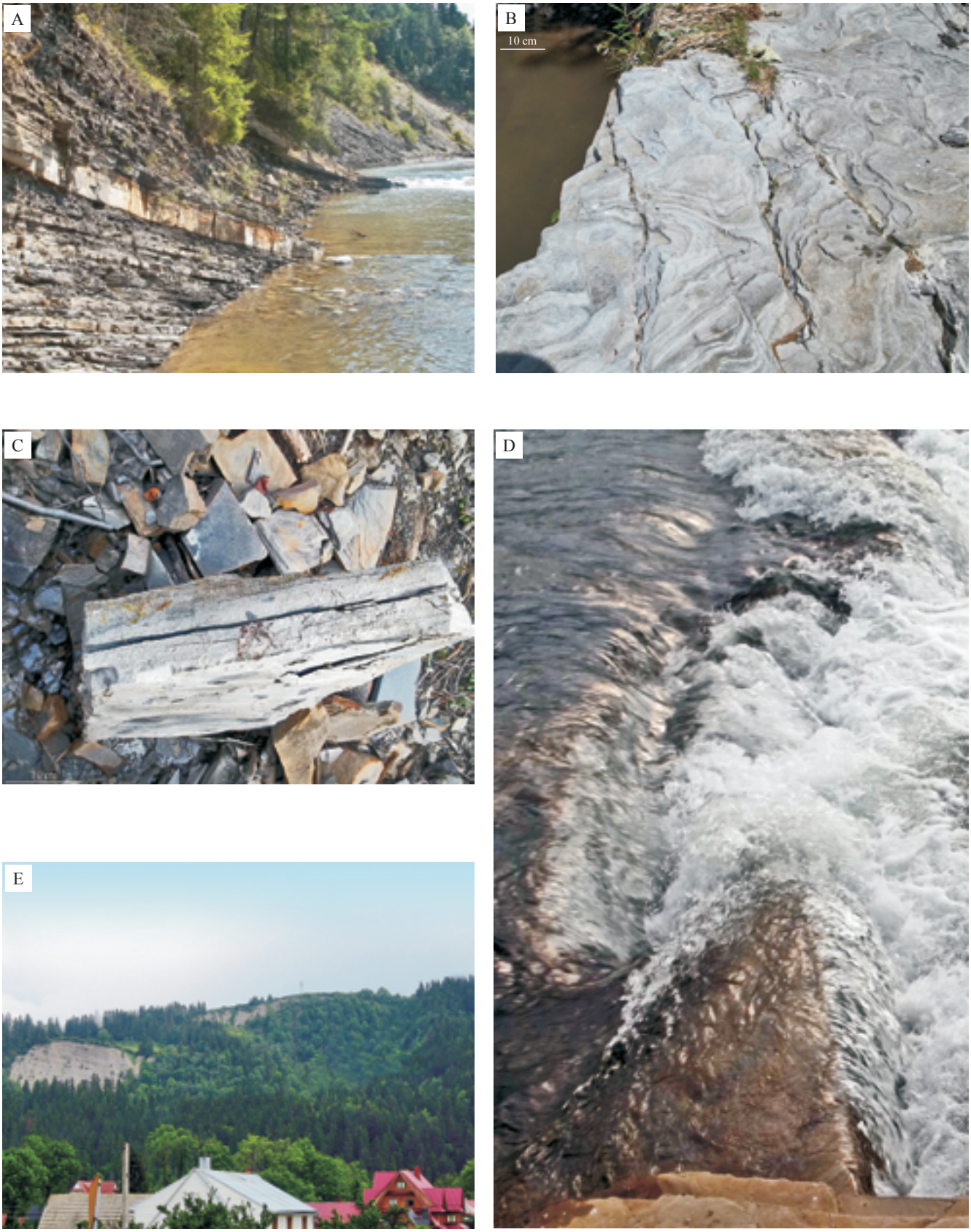

Fig. 4. Features of third position: A – waterside scarp, resulting from lateral shifting of the Białka bed; B – sandstone with slump structure; C – sandstone with parallel lamination; D – river rapid, which was created along the joint; E – scarps on the western side of Czarna Góra as a result of the activation of the Białka Fault Zone, photos D. Hełdak • Charakterystyka trzeciego stanowiska: A – skarpa brzegowa jako efekt lateralnego przesuwania się koryta Białki; B – piaskowce ze strukturami spływowymi; C – piaskowce z laminacją równoległą; D – próg rzeczny, który został utworzony wzdłuż spękania ciosowego; E: skarpy zachodniej części Czarnej Góry jako rezultat aktywacji strefy uskokowej Białki, fot. D. Hełdak

In this place two cross faults are exposed (Fig. 3E). L. Mastella et al. (1996) concluded, that these are normal faults. J. Pepol (1972) in connection with the fact, that there are two normal faults states, , a step fault, of which the values of vertical displacement reach several meters. What is more, during my own observations in preparation of a master's dissertation, it was found that in case of one of the normal faults, its hanging wall is rotated about 4–5° (Fig. 3F). So in addition to being a normal fault, or a step fault, it is also interesting, that one of these faults has a rotational component.

The third position includes an outcrop of the rocks directly by the Białka River (Fig. 4A). It can be seen as thick-bedded sandstone, with slump structure layers (Fig. 4B) and sandstone with parallel lamination (Fig. 4C). Different types of lamination are associated with different conditions of sea sedimentation.

In this place, it is worth paying attention to the visible joints in sandstones and their origin. It is easy to see different types of their strike in the parallel-laminated and slump-structured sandstones (in the first case joints are rectilinear, in the second, they run irregularly). This is connected with the sandstone texture.

Joints have considerable importance in scientific research. For example, their azimuths are correlated with the strikes of faults (Kukulak, 1999), and with the course of the stream valley (Majewski, 2013). Moreover, at this geosite the position of river rapid presumably follows the strike of a joint (Fig. 4D).

The inherence of the waterside scarp is connected with the lateral shifting of the Białka bed in this area in an easterly direction, which causes intense erosion of the right bank. Looking up, we can see several consecutive scarps (Fig. 4E). They all are connected with the deep-seated Białka Fault Zone. The zone was created no earlier than 12.5 mln years ago, probably in the Styrian Tectonic Phase (Mastella et al., 1996).

Fig. 5. Granitic pebbles several meters above the current Białka riverbed (in the red framed zoomed in image of the pebbles), photo D. Hełdak • Otoczaki granitowe kilka metrów powyżej aktualnego poziomu koryta Białki (w czerwonej ramce powiększenie otoczaków), fot. D. Hełdak

The height of the deposition of material from the Białka riverbed makes it interesting for geologists and geomorphologists. It is enough to say that the deposition of granitic pebbles from that river was discovered even 100 meters above the present river bed. The subjects of geomorphologists' and geologists' studies are related to the causes of such high deposition of that material. D. Małecka (1973) claimed, that on the western part of the Białka valley, there is a transversal tectonic zone, which elevated that part of the valley (and of course granitic pebbles to) up to 40 meters.

A large height deposition of the sediment is also associated with the existence of a scissor fault along the Białka River (Mastella et al., 1996) and neotectonic movement. In addition to tectonic factors, there is important river vertical erosion, which leads to the riverbed deepening (Baumgart-Kotarba, 1978).

Fig. 6. Terma Bania – good example of using geological structures for economic purposes, photo D. Hełdak • Terma Bania – dobry przykład wykorzystania warunków geologicznych do celów ekonomicznych, fot. D. Hełdak

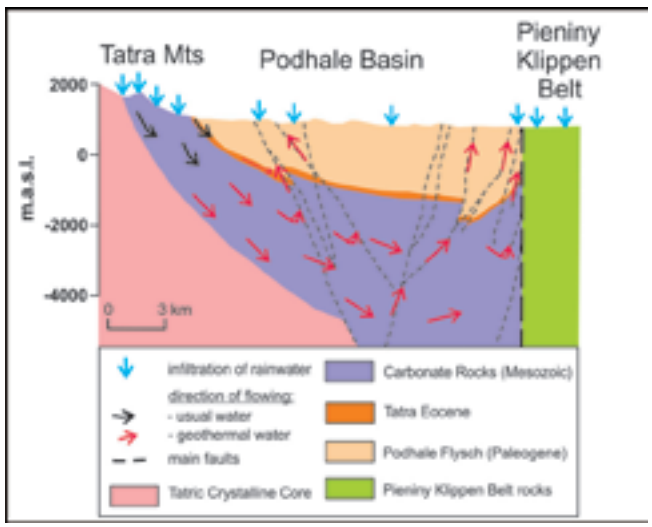

Fig. 7. Geological cross-section of the Podhale Basin with the outline of groundwater flow (by J. Chowaniec, 2012, simpliefied) • Przekrój geologiczny przez niecką podhalańską ze szkicem przepływu wód podziemnych (opracowane przez J. Chowaniec, 2012, uproszczone)

At the analyzed position, granitic pebbles are visible several meters above the current riverbed (Fig. 5). It seems that at this point, the bed is deepened by vertical erosion and lifting tectonic movements as well.

The last point on the presented geotourism trail is the building of Terma Bania (Fig. 6). Geological conditions of the Podhale Basin and its neighbouring regions favor the formation of geotermal waters (Chowaniec, 2012). In the Tatra Mts., its main recharge area is in the sedimentary series of the High-Tatric Unit and of the Sub-Tatric units. In connection with the fact that the units are built-up mainly of carbonate rocks, rainwater easily infiltrates into them (which heats them due to the increasing temperature according to geothermal degree). Then the water moves in a northerly direction. This is facilitated due to underlying isolation of Tatric Crystalline Core. In this way, these waters reach the Podhale underground. From the north, there is a barrier in form of Jurassic and Cretaceous rocks of the Pieniny Klippen Belt. This is where the water flow direction is changing from meridional to latitudinal. Geothermal water reaches the surface along the faults surface and by geological drilling (Chowaniec, 2012). It is illustrated in Figure 7. Good properties of these waters have led to their economic use, which is exemplified by the Terma Bania.

Summary, conclusion

The Podhale Paleogene Flysch has lot of geotourism potential. This is evidenced by objects presented at the trail. It seems that it has a good chance for the implementation and promotion among tourists in connection with good development of tourist facilities and presence of many sectors of tourism in the Białka Tatrzańska, Bukowina Tatrzańska and the neighboring villages.

What is more, the geotourist trail is well suited for educational purposes. It seems that could be used successfully, for example, for field practice in geology.

The proposed trail can successfully be visited not only by geologists, because it has great cognitive potential. What is more, the attractive landscape of the river valley and the picturesque slopes partly covered by vegetation show its considerable esthetic potential. It is important that in the future, this potential can by supplemented with additional points (not only dedicated to geology, but also in the field of, for example, biology, ecology or hydrology). This trail can be also elongated to the area of the Tatra Mts. and the Pieniny Klippen Belt.

This does not change the fact that the financial outlay would be required for its implementation. It is related to the construction of appropriate tables in these positions and land development for this area (preparation terrain for passing it freely along the Białka River, building footbridge etc.). However, with the help of local government it would not be impossible.

Acknowledgments

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