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Evaluation report of doctoral dissertation „Vývoj údolí Kladské Bělé“, submitted by Mr Jakub Stemberk at the Univerzita Karlova in Prague

Introduction

The doctoral dissertation of Mr Jakub Stemberk „Vývoj údolí Kladské Bělé“ (Białej Lądeckiej) addresses a problem situated at the borderline between geomorphology and structural geology, aiming to recognize the pattern and relative timing of crustal deformations in the drainage basin of Kladská Bělá, mainly through an analysis of topography, although various other methods were used in a complementary or supportive role. The author is correct saying that the dissertation fills a gap in our understanding of this part of the East Sudetes, since no previous studies comprehensively explored the issue of gross landform development for this moderately large area. Previous studies were focused on the Kralický Sněžník massif, especially on the Kleśnica valley with its karst landforms (notice though that the most recent publications of A. Sobczyk, highly relevant to this study, have been overlooked), with only occasional publications dealing with the Złote (Rychlebské) Mountains. Moreover, only very general proposals how to interpret the regional landform pattern were offered, not matched by any attempts to resolve the topography in more detail. In addition, some of these proposals are clearly outdated or were carried out before modern elevation datasets have become available. The author himself has already been involved in research in the adjacent area of the Rychlebské Mountains, drained straight to the Sudetic Foreland, so extending the study area more to the south and west was entirely logical. Therefore, the selection of the study topic, study area and approach are very appropriate. To me, it is also a good example to demonstrate that research issues know no political borders.

Structure of the dissertation

The structure of the dissertation is a bit unusual (at least, to the reviewer), as it combines large parts containing original, unpublished materials with four full-size scientific papers, co-authored by the author, considered relevant to the study. Two among them have not yet been published and have “under review” status and hence, contain also material that is “unpublished”. One problem that I see with these four papers is that their relevance to the main theme of the dissertation is only partial (papers no. 1 and 3). Of course, they focus on an area adjacent to the Kladská Bělá basin, but if so, they should be better integrated with the rest of the dissertation. Another issue is that all these four papers are joint works, some involving large research teams, and it would be expected to indicate the specific contribution of the author of the dissertation, but this seems missing. But I admit that specific requirements in Czechia may differ from those in Poland. Otherwise, the structure is logical and takes the reader from setting up the problem through literature review, presentation of methods, presentation of factual evidence, to interpretations and conclusions.

Relation to past research

The dissertation is well-referenced and solidly based on the existing literature, which is used as a background. One of the problems the author faced working in the territory of another country was to get familiar with relevant literature sources available in Polish. He handled it generally well, although some missing concepts and missing references were noted, even though some were rather marginal to the main subject (but provide a background). For example, periglacial morphogenesis of Mt. Kralický Sněžník was studied by A. Traczyk (1996), gneissic tors near Lądek-Zdrój were studied by A. Sobczyk (2008), whereas anthropic landforms, including human-conditioned gullies and stream incisions were dealt with by A. Latocha in the series of publications (e.g., 2005, 2007, 2009). The last point is particularly relevant, as the author emphasizes the presence of contemporary incisions and uses them as indicators of tectonic control, without discussing their alternative origins and probable complexity (addressed by Latocha in her papers). Minor issues here include naming of geological units (subdivision of the Sudetes by Aleksandrowski and Żelaźniewicz (2011) should have been followed), factual errors in reporting the state-of-the-art of karst research and perhaps too much confidence in results of some older work referred to in the dissertation (see below).

Specific comments

For obvious reasons, most of my comments relate to geomorphological component, presented in section 4 of the dissertation and on the supplementary map. This is then used to support the evolutionary schemes presented in section 5. First, I would like to show appreciation of the hard and meticulous work carried out in the field, which resulted in such a comprehensive mapping of various erosional features. The resultant map is very impressive and gives a very good overview of spatial distribution of different landforms, whereas detailed maps and graphs (SL diagrams in particular) embedded in the main text provide additional information. Nevertheless, some decisions are not entirely clear to me, for example why rather irrelevant mining grounds were included, whereas karst landforms were not. Particularly, however, I miss areas of planar relief in watershed positions ("planation surfaces"). Even though their significance can be disputed and a viable conclusion might be that they cannot be unequivocally interpreted, they are too important to be ignored.

Furthermore, seeing the map as a result of time-consuming field research I am truly wondering why its content was not strengthened by applying some elementary geomorphometry, to show terrain properties such as slopes, relief energy, or curvatures. DTM for the area is freely available and can be easily worked with. Maps of such morphometric variables would strengthen the author's argument regarding indirect role of tectonics and assessment of relative uplift. They would also quantitatively validate the appropriateness of some landform identifications, which I am rather sceptical about. This comment applies particularly to the extension of the depressions of Hřibov and Travna onto the Polish territory – neither can be safely demonstrated, and certainly not quantitatively, and to the recognition of faceted slopes south of the village of Trzebieszowice (p. 91). Only slope and curvature maps will give a solid basis for their identification and delimitation, otherwise they remain unconvincing.

Nevertheless, the landform maps are very relevant as means to show facts. However, their interpretation in terms of direct/indirect tectonic effects is more problematic and our opinions (the author's and mine) diverge in this respect. Although I appreciate the efforts to distinguish between tectonic and non-tectonic reasons for increasing gradients of streams, the occurrence of particularly deep incisions, and lateral shifts of channels, they seem to me too readily ascribed to direct tectonic causes. Lithology is one factor, often called for, but propagation of knickpoints in response to climatic alternations and anthropogenic perturbations seems hardly discussed. Regarding lateral offsets, they seem to be taken as direct evidence of strike-slip movements (page 74), but an alternative option that the streams simply used a zone of structural weakness to erode, was not explored. I also noted a tendency to propose a certain solution as hypothetical, where it is presented for the first time, but in the subsequent parts of the dissertation these proposals become almost established facts. An example is on page 84, where the author says that "Uplift and tilting of the main ridge is confirmed by the assumed reconfiguration of the drainage pattern…" (my translation). This is particularly true for the alleged drainage pattern changes, for which there is no solid evidence (except probably the diversion of Nysa Kłodzka river near Międzylesie, but this is beyond the study area). Otherwise, any attempts to find abandoned fluvial reaches failed and neither geophysics nor geomorphology provided definite answer. On page 82, in turn, the author mentions "small remnants of fluvial gravel", but without proper documentation it is difficult to evaluate the finding.

In this context, a commentary regarding ERT surveys and interpretation of their results is also necessary. Looking at cross-sections, I do not think that it is justified to speculate about the presence of fluvial gravels at localities Růženec and Karkulka (Fig. 4-14, 4-15). In both cases the alleged gravels, represented by fairly thick bodies of higher resistivity themselves (>10 m), would have to occur under 10–20 m of slope sediments. No such thicknesses of hillslope deposits have ever been documented in the Sudetes, and certainly not in water-divide positions. Neither gravel bodies of this thickness are known from anywhere in the higher parts of the Sudetes. Furthermore, the alleged gravels (FŠ) show relatively higher (Fig. 4-14) or lower resistivity (Fig. 4-15) in respect to adjacent materials. What would be the reason of this inconsistency?

This is not to say that the suggested drainage diversions did not occur, but that they remain highly speculative. In fact, even though I generally like the idea of the author how the area may have developed morphologically in the late Cenozoic, nicely illustrated diagrammatically on Fig. 5-7, the model remains rather tentative to me, despite various anchoring points such as paleostress determinations. The timing of fluvial reorganizations (chapter 5.2, Fig. 5-13) seems even more tentative. Moreover, the proposed scenario skips over and does not answer several relevant questions such as: (1) why this semi-circular course of the upper Kladská Bělá (upstream of Stronie Śląskie)? The model shown on Fig. 5-7 would work well if the boundaries between crustal blocks were parallel to one another, but they are not; (2) what is the origin of N–S trending topographic depression separating the Kralický Sněžník massif in the west and Bialskie Mountains in the east? It is a very prominent topographic low, used by Morawka and Biała Lądecka rivers (and Krupa river further south), and never explained. It does not coincide with any known major fault zones…; (3) The drainage pattern change no. 1 (Fig. 5-13) differs from the other ones suggested in the dissertation in that it represents complete drainage reversal of quite a sizeable river rather than capture, hypothesized for other reconfigurations. At the same time(?), minor streams were still able to go through the ridge of Złote/Rychlebské Mountains (Fig. 5-13B). Why this peculiar situation? Moreover, why the paleo-Morawka river was diverted, whereas the Nysa Kłodzka river was apparently able to cut through, forming the famous antecedent gorge? Surely, to find evidence-based answers to these questions may not be possible and we may be bound to speculations. I just want to point these questions out, if only to encourage the author to further explore these fascinating issues.

Another point to raise is that in my view the author relies too much and has too much confidence in the accuracy of findings presented in older publications, if they somehow fit the model. This criticism is pertinent to section 5.2 and discussion section of paper no. 2 included into the dissertation (Stemberk et al., under review). Careful reading of publications by S. Dyjor shows that factual basis is often missing and chronologies are highly speculative. Later on, J. Badura, B. Przybylski and particularly D. Krzyszkowski provided proper documentation of outcrops and, occasionally, borehole logs, but had hardly any age determinations for the sediments. Thus, the entire Neogene to Middle Pleistocene sedimentary history of the Sudetic Foreland is poorly known and temporarily essentially unconstrained, including a great deal of uncertainty regarding the origin and age of the Gozdnica Formation. Likewise, much more reservation is recommended regarding some designations on geological maps. The most evident example is the alleged recognition of Tertiary sediments to the south-west of Lądek-Zdrój – solid basis of such age determination is missing (actually, there is a relevant comment from the author on page 85), but chronologies of terrace formation along the Biała Lądecka river are also speculative. Perhaps an ongoing project implemented by the Polish Geological Survey – updating of detailed geological maps at 1:25,000 scale, will provide more solid anchoring points in the future. A small-scale example of a similar issue is the reference to Czudek (2005) on page 41, regarding the origin of alluvial fans. Recent events, such as the flood in 1997, demonstrated their role in the build-up of fans, whereas increased fluvial transport after deforestation is another reason for fan deposition (explored by K. Klimek and his collaborators in the East Sudetes) – none accounted for by Czudek.

Concluding remarks

Having said all that, in the closing part of the review I have to emphasize that these questions, missing items and divergent opinions should be mainly read as an invitation to explore the problem further rather than strong criticism invalidating the efforts of the author. Pointing the observed tendency of the author to interpret the origin of geomorphic features without sufficient attention to alternative solutions or with excessive confidence in what others have written long ago may be hopefully helpful in ongoing studies. The dissertation as a whole is an very solid piece of work and documents the ability of the author to identify a research problem, to select appropriate methods to solve it, to present results, to link with existing knowledge, and to propose original solutions. In the field of geosciences, dealing with past changes, we will never know for sure how things occurred and tentative scenarios will be part of our work. But we should strive to limit the speculative component and the work by Jakub Stemberk is a major step forward to unravel the history of the SE part of the Kłodzko Basin. I have no doubt to say that the thesis fulfils the criteria for a doctoral dissertation and is sufficient for the title Ph.D. to be granted. It was pleasure to see how the big gap in our knowledge is being filled.

Wrocław, 12 November 2021