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Morphostructural analysis and geomorphological development of the Nedvědička River valley near Pernštejn

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ABSTRACT

Main results of morphostructural analysis based on detailed geomorphological mapping and analysis of joint and fault tectonics are presented. Field research was complemented by morphometric analysis and by study of airborne photos. A special attention is laid upon genetic relationship between landforms and geological setting.

Key words: morphostructural analysis, geomorphological development

1. Introduction

Geomorphological analysis of the area studied was realized for recognition of degree of its morphostructural stability. The analysis was based on a detailed general geomorphological map constructed within the established genetic concept. Manifestations of brittle tectonics in rock outcrops and their relation to the present landforms were studied as an important aspect of field research. The results of the field studies were complemented by a stereoscopic analysis of a series of black-and-white airborne photos, cartometric analyses of relief inclination and stream inclination characteristics, and analysis of joint tectonics. The principal analytical product of this study is a geomorphological map (Fig. 1), full-coloured and drawn to a scale of 1:10,000 in its original form.

2. Location and geomorphological character of the studied area

The area studied lies in the district of Žďár nad Sázavou, approx. 10 km south of the town of Bystřice nad Pernštejnem. The present study deals with a 4 km long part of the Nedvědička River valley (Fig. 2), up to 150 m deep, and its close neighbourhood between the Věžná railway station and the community of Pernštejn W of Nedvědice.

This area lies, as viewed by the regional geomorphological classification of the Czech Republic (Czudek et al. 1972, Demek et al. 1987, Hrádek 1985), at the western margin of the Nedvědická vrchovina Highland. This unit, posing a subunit of the geomorphological unit of the Hornosvratecká vrchovina Highland, belongs to the region (subsystem) of the

Českomoravská vrchovina Highland, which falls within the Bohemian-Moravian subprovince (system) of the Bohemian Highland. The whole area under survey is located in the N part of the district of the Pernštejnská vrchovina Highland.

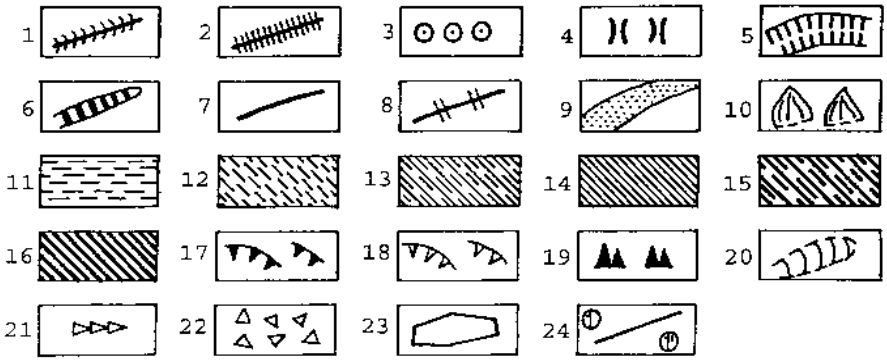

Figure 1: Geomorphological map of area studied. **A. Denudational forms:** 1 – wide and rounded ridges, 2 – structurally conditioned ridges, 3 – monadnocks, 4 – cols, **B.1. Fluvial erosional landforms:** 5 – erosional slopes, 6 – erosional gullies and gullies of balka type, 7 – erosional cuttings, 8 – rock bars in valley floors, **B.2. Fluvial accumulation landforms:** 9 – Holocene alluvial plains, 10 – alluvial cones, **B.3. Polygenetic landforms:** 11 – plateaus and slopes inclined at 0 to 2°, 12 – 16 slopes inclined: 12 – at 2 to 5°, 13 – at 5 to 10°, 14 – at 10 to 20°, 15 – at 20 to 35°, 16 – at more than 35°, **C.1. Nivation and cryogenic destruction landforms:** 17 – frost-riven cliffs, 18 – frost-riven scarps, 19 – tors, 20 – dells, **C.2. Nivation and cryogenic accumulation landforms:** 21 – rock flows, 22 – dispersed boulders, 23 – talus piles, **The others used signs:** 24 – settlements, 25 – lines of profiles.

The valley of the Nedvědička River forming a number of incised river bends is characterized by very steep slopes, locally exceeding 35° (Fig. 3), with numerous rock outcrops and rock forms. Most slopes are covered by bouldery talus and rock flows, reaching continuously down to the channel of the Nedvědička River in the narrow valley with no alluvial plain between Spálený Mlýn and Pernštejn. The wide altitude range (248 m: from 602 to 354 m a.s.l.) gives the valley segments in the study area relief amplitude corresponding to a high-amplitude highland; in contrast, areas N and S of the Nedvědička River valley have rather the character of high-amplitude hilly land. The Nedvědička River enters the area at 419 m a.s.l., which means that it descends by 72 m along a distance of 4.6 km (Fig. 2). The total area under study measures approx. 8.5 km^2.

A geomorphological study from the early 1990s was focused on the principal morphostructural features of the area (Hrádek 1994). No detailed geomorphological mapping had been carried out in this area yet.

3. Geological and tectonic setting

The studied area represents the SE extension of the mesozonally metamorphosed crystalline complex of the Kutná Hora – Svratka Region (Mísař et al., 1983) of Proterozoic age, most commonly referred to as the Svratka Anticline (Svoboda et al., 1962, 1963). The principal rocks include two-mica orthogneisses, migmatites, mica-schist gneisses and mica schists conformably intercalated with amphibolites, skarns, crystalline limestones, calc-silicate rocks and usually small bodies of serpentinites.

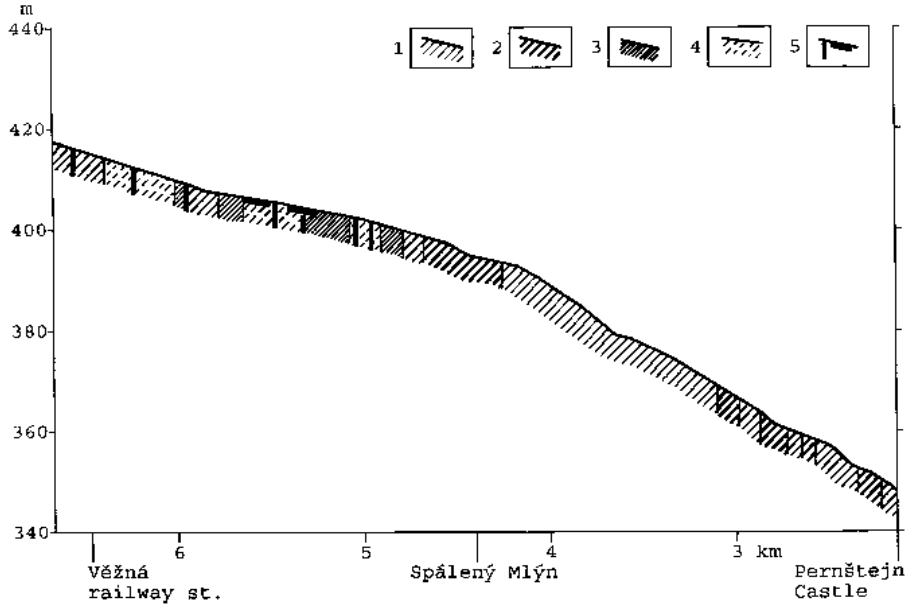

Figure 2: Longitudinal profile of the Nedvědička River valley within area studied (exaggerated by 27). The distances in km are taken from mouth of the Nedvědička River. Geological setting by Hájek et al. 1995: 1 – granitized two-mica gneisses of Svratka Complex (Svratka gneisses), 2 – mica schists and mica-schist gneisses of Svratka Complex, 3 – pyroxenites and eclogites of Moldanubic Complex, 4 – granitized gneisses and orthogneisses of Moldanubic Complex, 5 – dislocations.

As indicated by the unpublished geological map 1:20,000 (Hájek et al. 1995), the dominant rock types are fine- to medium-grained granitized two-mica gneisses (Svratka gneisses) with subordinate intervals of granitized biotite gneisses alternating with conformable bands and lenses of medium to coarse lepidoblastic mica schists to mica-schist gneisses, migmatitized to a variable degree.

The western margin of the area is formed by rocks of the catazonally metamorphosed Moldanubian complex, probably also of Proterozoic age (but older than rocks of the Svratka Anticline), intrusive pyroxenite bodies and eclogite bodies, and bands of fine- to medium-grained granitized two-mica gneisses and orthogneisses. The highest elevations are mostly composed of granitized two-mica gneisses; the same rocks, however, form depressions elsewhere.

The Pleistocene sediments include extensive colluvia, blocky and bouldery talus on slopes and rock flows on valley slopes of the Nedvědička River and some of its minor tributaries, and alluvial cones at gorge mouths. The Holocene deposits include flood loams from the Nedvědička River alluvial plain (the western half of the mapped part of the valley) and colluvio-fluvial sediments in the lower parts of dells.

As shown by a number of geological studies (Mísař et al. 1983, Svoboda et al. 1962, Hájek et al. 1995), faults of three principal orientations are present in the area: 1. longitudinal faults striking NW-SE along the western margin of the study area, bending to N-S strikes at the

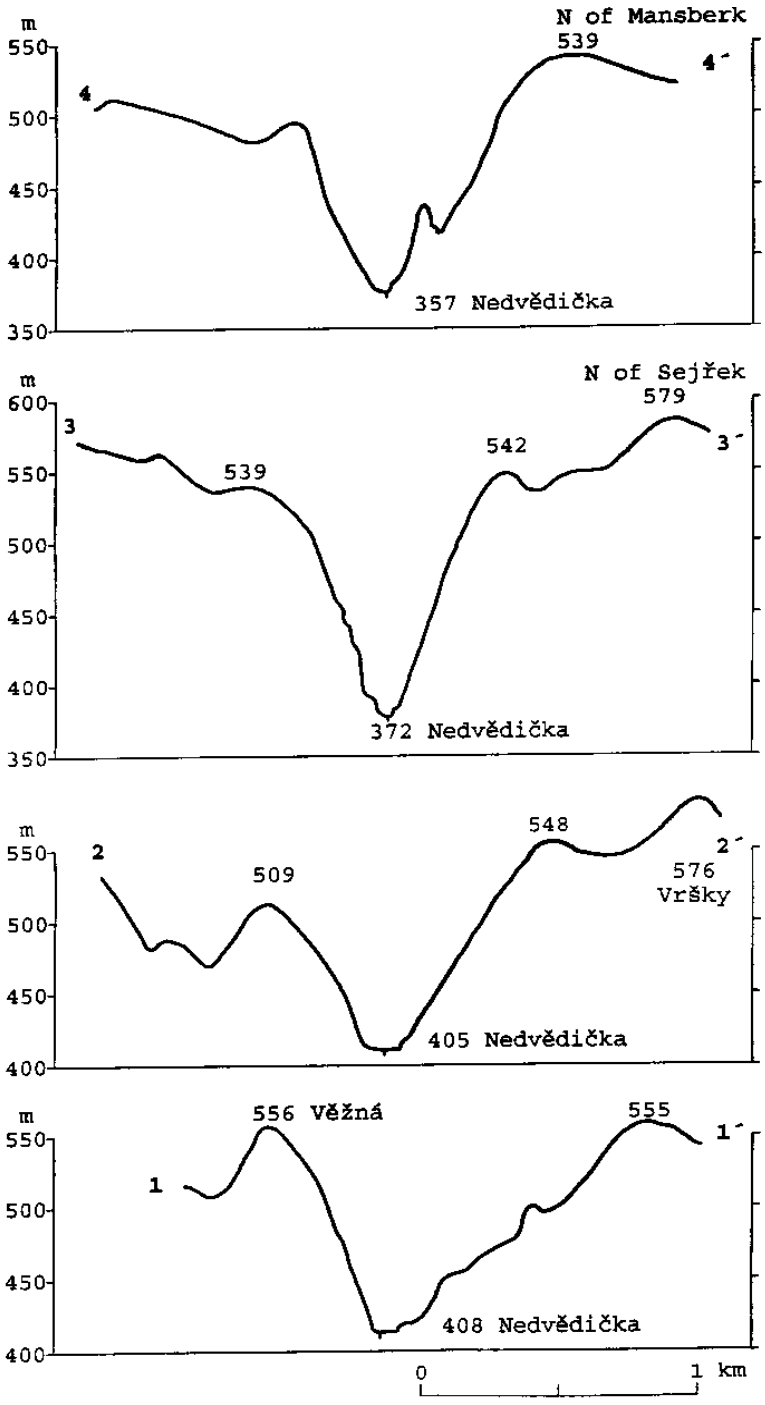

Figure 3: Profiles across the Nedvědička River valley and its vicinity (exaggerated by 5).

level of the Nedvědička River, and immediately beyond the eastern margin of the area (a NW-SE-striking fault running across Smrček and W of Pernštejn Castle), 2. transverse faults striking NE-SW in the western part of the area called Teplá, 3. faults striking WSW-ENE, which are considered the youngest (the only such fault, parallel to the deep-seated Křídla Fault, transects the mapped area from the S neighbourhood of the Věžná railway station to the S neighbourhood of Smrček, where it is terminated on a NW-SE-striking fault). It has to be noted that none of these faults are morphologically manifested in the relief.

Joints are markedly dominated by NE-SW strikes, while other important strikes are NW-SE and W-E (the latter two strikes concentrate to the W part of the area, according to the newly taken measurements). Apart from rare exceptions, foliation planes strike between NNW-SSE and N-S.

4. Geomorphological analysis

All landforms in the study area are of exogenous origin. Despite its considerable vertical amplitude, the relief is relatively uniform from a geomorphological viewpoint. Morphostructurally, the absence of tectonically induced landforms, belevelled surfaces and river terraces is, particularly, very significant.

In the paragraphs below, a brief morphographic and genetic, or morphostructural, characteristics of the individual landforms are presented. Anthropogenic landforms are not discussed due to the limited extent of this paper.

4.1. Denudational landforms

Wide and rounded ridges were formed by the approaching of the slopes of neighbouring valleys (incl. dells) during the deepening and widening of the valley system. They can be found in two different geomorphological positions: short ridges connecting monadnocks at the highest elevations, and ridges on high slopes of the Nedvědička River valley separating the valleys of its tributaries.

The longest ridge on the map forms an extension of the elongated rib of Dlouhá skála Hill (610.2 m) lying some 300 m N of the mapped area limits.

Structurally conditioned ridges are also mostly of denudational origin. Nevertheless, their formation was controlled to a high degree by the underlying geological structures, such as strikes of foliation planes or occurrences of relatively resistant rock intercalations. The most prominent structurally conditioned rounded ridge runs from the ENE environs of the Věžná railway station across the monadnock of Věžná Hill (556.4 m) almost straight southeast, to the slopes of the Nedvědička River valley. The most prominent of the subgroup of narrow, rocky ridges is the asymmetrical, SW-NE-orientated ridge SW of the community of Pernštejn, with gneiss cliffs and boulders on the crestline.

Monadnocks, usually prominent elevations formed at occurrences of more resistant rocks, are relatively rare in the study area. The most prominent monadnock is Věžná Hill (556.4 m) formed by granitized two-mica gneisses with silicified zones. It rises 136 m above the Nedvědička River alluvial plain and 33 m above the col in the NW.

Formation of the most extensive monadnock south of the Nedvědička River valley, the highest portion of the extensive asymmetrical elevation of Vršky Hill (576 m) 700 m WSW of Bor, is linked with the occurrence of silicified and ferritized granitized gneiss of Svratka type. The peak of the monadnock lies at the intersection of tectonic lines (zones) running N-S and NE-SW (Hájek et al., 1995), which indicates structural control in the formation of this elevation.

Cols, depressed parts of divides, generally formed by the effect of retrogressive erosion of two opposed valley or slope dells usually in areas of less resistant rocks, are indicated on the map only if prominent enough. Their overdeepening relative to the neighbouring elevations usually ranges between 5 and 10 m, being exceptionally higher (up to 39 m N of the monadnock of Vrška Hill, 33 m NW of the monadnock of Věžná Hill).

4.2. Fluvial erosional landforms

Erosional slopes, formed by direct action of lateral and depth stream erosion, were defined in only several cases where direct erosion obviously dominated over the usual polygenetic development of old valley slopes. These cases largely include cut-banks of the Nedvědička River bends within the reach of lateral erosion, inclined at 20 to 35°. Such slopes are developed near Spálený Mlýn and – to a lesser degree – also in other parts of the trunk valley.

Erosional gullies, generated by intensive linear erosion in weathering products and colluvial sediments, are relatively rare in the area studied. They are incised into boulder- and block-sized colluvial material in the lower parts of some slope dells in the Nedvědička River valley, e.g. between Spálený Mlýn and the community of Pernštejn. They reach 80 to 250 m in length and only about 2 m in depth. Although they were formed in the Recent, none of the gullies were found to show erosional activity at present.

Erosional gullies represent a rather significant geomorphologic element especially in the western, higher-amplitude part of the study area i.e. the "Teplá" area. They are usually incised into colluvio-fluvial sediments of dells, or elluvia of crystalline rocks, to depth of 1 to 3 m.

Erosional cuttings pose a characteristic geomorphological element of the mapped area. A large proportion of valleys of minor streams, or even valleys with no permanent streams, are incised by Recent erosional cuttings as products of linear erosion. They reach 2 to 8 m in depth. The total lengths of the cuttings range between 200 and over 500 m. Their bottoms are bouldery and steeply inclined (20 to 25°), with frequent low rock bars in the floor. Erosional cuttings are separated from the above lying valley slopes (inclined at 15 to 30°) by a prominent edge. Adult arborescent vegetation on slopes of these erosional cuttings indicates the Subrecent origin of these young landforms.

Erosional gullies of balka type, with typical graben-like cross-sections, are found only exceptionally: usually as a transitional element between parts with an alluvial plain and erosional cuttings, mostly in valleys of minor tributaries of the Nedvědička River between Spálený Mlýn and the community of Pernštejn. Their lengths range between less than 100 m and 200 m. Their depths of ca. 2 m may exceptionally reach 5 m in the middle reach of the "Teplá" stream and the lower reach of its right tributary. They are characterized by flat bottoms 2 to 6 m broad.

Rock bars in valley floors, structurally controlled by occurrences of more resistant rocks or transverse strikes of foliation planes, were registered in several instances in valleys of minor streams. Their heights mostly range between 0.5 and 1 m, exceptionally higher (up to 4 m). Two bars are developed in the erosional cutting of the minor left tributary meeting the Nedvědička River downstream of Spálený Mlýn. The lower bar is almost 4 m high, producing an inclined waterfall at elevated water-bearing periods.

4.3. Fluvial accumulation landforms

Holocene alluvial plain is well developed only in the Nedvědička River valley. In the western part of the mapped area, between the Věžná railway station and Spálený Mlýn, the alluvial plain is up to 150 m wide, inclined at 10.2 ‰ in longitudinal profile. Besides finer flood sediments at the surface and imperfectly rounded sandy gravels below, the sediment fill of the valley bottom consists of considerable amounts of angular talus derived from the valley slopes or supplied by short side valleys. The alluvial plain almost disappears downstream of Spálený Mlýn, where the markedly narrow valley with a steeper-inclined bottom (22.8 ‰) cuts into the rocks of the Svratka Complex. Exceptionally, alluvial plains not exceeding 30 m in width were formed in the valleys of some minor streams.

Alluvial cones, fan-like in plan view, are relatively common in the mapped area. They developed at the mouths of minor streams and dells into the Nedvědička River valley. The largest one, approx. 100 m long and up to 100 m wide, lies at the mouth of a left valley 400 m S of the monadnock of Věžná. Its Holocene activity is shown by the shifting of the Nedvědička River channel within the alluvial plain. The same effect can be also observed in the case of a somewhat smaller alluvial cone upstream of Spálený Mlýn. Other cones are of smaller size, but still prominent. They are composed of loam and sand with a strong admixture of angular rock fragments and numerous large blocks and boulders. The surfaces of the alluvial cones are most frequently inclined at 5–15° or more; their inclinations are however generally more gentle than those of erosional cuttings, from which the cones extend. Gully-like incisions of minor streambeds into sediments of alluvial cones can occasionally be observed. Larger cones in the mapped area were generally established in the Würm and their formation was significantly contributed to by cryogenic processes. The present activity of the cones is practically imperceptible.

4.4. Polygenetic landforms

Plateaus and slopes inclined at 0 to 2° of polygenetic denudational origin in the mapped area N of the Nedvědička River are present only exceptionally. South of the river, they are restricted to flat areas of divides (530 to 545 m), cols between monadnocks or extensive intervalley elevations (500 to 576 m), as well as the highest portions of broad ridges (590 to 602 m).

As for their genesis, the highest locations of this category can most probably be considered as re-modelled relics of a basal weathering plane of the Paleogene belevelled surface of etchplain type. Some lower levels, mostly lying at 500–576 m a.s.l. (100–190 m above the Nedvědička River alluvial plain), probably represent relics of the Pliocene denudational surface.

Slopes inclined at 2 to 5° cover only very small portions of the land surface in the N part of the mapped area, e.g. in a broader area between the Nedvědička and Loučka Rivers.

Slopes inclined at 5 to 10° are relatively widely distributed in the mapped area. They are the most frequent landform around the highest point near the northern map limit, and significantly contribute to the geomorphology of the southern part of the area as well.

Slopes inclined at 10 to 20° pose the most common landform, especially above the valley incision of the Nedvědička River and some of its tributaries in the western and central parts of the map. With a few exceptions only, slopes inclined at 10 to 20° generally flank the upper reaches of the valleys and slope dells. They are morphographically characterized by planes with straight gradient lines, showing convex profiles only at contacts with medium-inclined slopes (5–10°), and indistinct convexo-concave morphologies at transitions into steeper slopes (20–35°).

Slopes inclined at 20 to 35°, mostly of erosional polygenetic origin, were formed in explicit connection with the deepening of the valley system. With a few exceptions, they form the erosional cut of the Nedvědička River and the lower reaches of its tributaries. Most slope surfaces generally show smooth, straight courses of gradient lines, and are covered by blocky and bouldery talus of cryogenic origin. These slopes are associated with occurrences of frost-riven cliffs and scarps. The altitude difference between the upper limits of erosional slopes and alluvial-plain margin or erosional cut of the Nedvědička River locally exceeds 100 m (over 130 m W of the community of Pernštejn).

Slopes inclined at more than 35°, the steepest portions of erosional polygenetic slopes (exceptionally up to 45°), are of small areal distribution. They are restricted to some parts of the erosional slopes of the Nedvědička River valley. The fact that surfaces inclined at more than 35° mostly occur in the neighbourhood of frost-riven cliffs indicates a possible genetic relationship between these two features.

4.5. Nivation and cryogenic destruction landforms

Frost-riven cliffs pose a rather characteristic landform in the area N of the Nedvědička River, on steep erosional slopes (mostly 20 to 35°) of the Nedvědička River valley, especially between Spálený Mlýn and the community of Pernštejn. Almost all occurrences are situated in the lower halves of the valley slopes, most frequently 15 to 60 m above the valley bottom level. Frost-riven cliffs at higher locations are of much smaller dimensions but still prominent.

Walls of the frost-riven cliffs are generally very steep to vertical, with overhanging walls being no exception (up to 5 m). Several occurrences show cliff walls with cavities formed by destruction of less resistant portions of rock, or by frost-induced transport of blocks (dilated joints) up to 3 m deep. The heights of frost-riven cliffs reach up to 15 m in their most prominent portions but usually range between 3 and 5 m. Cliff lengths range between approx. 10 m and 110 m. Cliff heights gradually decrease upslope, which means that the highest walls are developed in the lowermost parts of the cliffs. Cliff bases are always covered by blocky talus, often having large extent, with blocks up to 1 m large.

All frost-riven cliffs N of the Nedvědička River developed in granitized two-mica gneisses of the Svratka type. The frost-riven cliffs show a markedly uniform exposure towards SE at rock-wall orientation SW-NE, which is in agreement with the prevailing strikes of joint planes (Fig. 4).

The distribution of frost-riven cliffs south of the Nedvědička River is less significant, and their dimensions are smaller (less than 10–12 m in height and 25 m in length). Minute cryoplanation terraces were usually formed near their bases (gentler slope inclination), being covered by bouldery and blocky talus. The most distinct forms lie 10 to 35 m above the Nedvědička River bed. They lithologically correspond to occurrences of more resistant portions generally formed by granitized gneisses of the Svratka type and less commonly by migmatitized mica-schist gneisses or orthogneisses. Caves (joint caves, dilation caves) and niches were formed at cliff bases at some localities.

Frost-riven scarps can be found only occasionally in the mapped area: north of the Nedvědička River. They usually do not exceed 5 m but exceptionally reach 10 m in height.

Tors were identified only rarely south of the Nedvědička River. Several small destructed occurrences having relative heights of 2 to 4.5 m, mostly composed of granitized gneisses, are found on exposed parts of ridges.

Cryoplanation terraces of mappable dimensions are represented by only a single locality N of the Nedvědička River, below the base of a frost-riven scarp 500 m S of the community of Smrček. The terrace is elongated NW-SE, parallel to the frost-riven scarp, to a distance of ca. 200 m. It is max. 20 m wide.

Dells are bowl-shaped or even more elongated in plan view, often branching. They are commonly developed in head parts of valleys (valley dells) or on valley slopes (slope dells). North of the Nedvědička River, the dells are 40 to 850 m long. Their usual widths are 50 to 60 m, max. 100 m.

South of the Nedvědička River, numerous dells were formed on slopes of almost all inclination categories. The most prominent forms are up to 500 m long, 70 to 120 m wide and over 10 m deep.

4.6. Nivation and cryogenic accumulation landforms

Rock flows, slope accumulations of cryogenic origin, are elongated, linguoid in plan view. Their prominent examples up to 150 m long were recorded in two cases only on the N slope of the Nedvědička River valley below frost-riven cliffs W and NW of the community of Pernštejn.

Dispersed boulders, spread across slopes due to the effect of Pleistocene solifluction, are common N of the Nedvědička River especially on lower levels of slopes inclined at 20 to 35°. The boulders are most frequently 0.5 to 1 m in size, with exceptional blocks attaining almost 2 m. The boulders were abundantly dragged by solifluction processes also to the Nedvědička River channel, where they concentrate to the narrow part between Spálený Mlýn and the southern map limit, and to the erosional cuttings of the Nedvědička River tributaries.

Dispersed boulders also occur in the southern part of the study area, usually around frost-riven cliffs and scarps or isolated cliffs.

Talus piles cover a considerable part of steep, approximately southerly-exposed slopes of the valley of the Nedvědička River and its tributaries. Formation of talus piles in cold periods of the Pleistocene was probably controlled by the southerly exposition of the slopes.

5. Analysis of joint tectonics

Joint systems were studied in outcrops in the whole area under survey. Joint strikes were measured and the character of joint planes was described. Altogether 1410 joints were measured in the area and their strikes were plotted in the form of a rose diagram (Fig. 4). Manifestations of old tectonic movements were rarely encountered (slickensides).

A part of the mapped area north of the Nedvědička River is characterized by locally abundant outcrops (largely frost-riven cliffs), thus enabling 1171 joint-plane measurements to be collected (Fig. 4). The clearly prevailing strikes are WSW-ENE to SW-NE (41 %), i.e. approx. perpendicular to the principal foliation-plane strikes in the

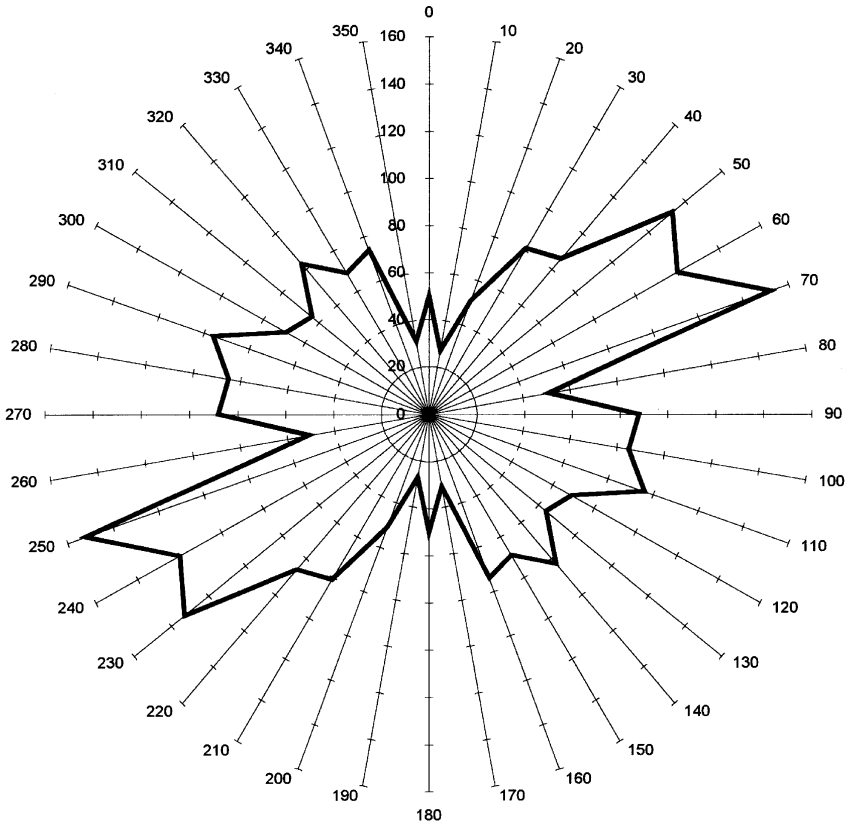

Figure 4: Fissure diagram from the area studied. Total number of joints measured is 1410.

local crystalline rocks. Correlation of the fit of the joint system with landforms permits the following conclusions.

The orientations of valley segments, erosional cuttings, gullies, balkas, dells and ridges are, with a negligible number of exceptions, completely different from the principal joint-plane strikes oriented WSW-ENE to SW-NE. On the other hand, the correlation between this principal joint-plane strike and the orientations of frost-riven cliffs is obvious (practically 100 %). The NW-SE strike of joint planes coincides with the directions of some valley segments and ridges. The W-E to WNW-ESE strikes of joint planes do not correspond, with a single exception, with the orientations of linear landforms.

The central and eastern parts of the area are dominated by SW-NE to WSW-ENE joint-plane strikes (49 %), while NW-SE strikes (15 %) and WNW-ESE strikes (8 %) are much less common. The western part is dominated by W-E joint-plane strike; NW-SE (21 %) and NNE-SSW (10 %) strikes are also present.

A larger set of joint measurements could not be taken (239 in total) from the southern part of the mapped area (right slope of the Nedvědička River) due to the much lower number of outcrops. The synoptic diagram for the area of the right bank of the Nedvědička River clearly shows different frequencies of the individual joint-plane strikes relative to the area north of the river. The diagram shows no prominent dominance of any joint-plane strike. A higher frequency was recorded in strikes ENE-WSW and ESE-WNW, represented by 20 % each. Less significant are strikes N-S to NNW-SSE (12 %).

Strikes of joint planes in pyroxenites and eclogites in the W part of the area (an abandoned quarry) are different. Strikes WNW-ESE prevails, being represented by more than 50 % of the total number of measurements. Strikes N-S is represented by 22 %.

6. Morphostructural setting and geomorphological development of the area

The study area S of the Nedvědička River can be geomorphologically characterized as a type of erosional-denudational relief with no clear manifestations of young tectonic movements in the present landforms. Some parts of the area (particularly in the SW) were, however, affected by structural elements of crystalline rocks, or by pre-Cainozoic faults or tectonic zones. Directions of tectonic lines and strikes of foliation planes (NNW-SSE) coincide with the course of some straight valley segments of "Teplá" and its major branches. The same orientations can also be found among inter-valley ridges.

Relief of the studied area was modelled primarily by erosional-denudational processes related to the valley system development. Intensive erosive activity of the Nedvědička and its tributaries was induced by differentiated neotectonic movements (uplifts of blocks of highland relief, subsidence of basins or grabens in the Svratka area). The local base level of the Svratka River valley conditioned the deepening of the valley system in the lower Nedvědička River basin and the origin of deeply incised valleys. The narrow erosional valley of the river downstream of Spálený Mlýn runs

transversally across the structures of the Svratka Complex; it thus represents a gap segment. The valleys of short tributaries of the Nedvědička River are characterized by steep, ungraded profiles of overdeepened valley bottoms. Conspicuously, no landforms of young linear erosion were formed on these practically straight and smooth slopes. The markedly wavy relief above valley incisions with tops of flat elevations, lying up to 200 m or more metres above the Nedvědička River alluvial plain, poses a strongly destructed relict of a former Tertiary belevelled surface of etchplain type. The onset of the valley system incision is probably older than the Pliocene/Pleistocene boundary.

Geomorphologic analysis of the study area indicated some genetic relationships between landforms and geological setting. No landforms of undoubtedly endogenous origin, i.e. controlled by neotectonic movements, were encountered in the mapped area. Some landforms in the study area can be considered as controlled by passive morphostructure, such as lithology, fracturing, foliation and pre-Cainozoic tectonic elements. Some ridges and valley segments show dependence of their spatial arrangement on foliation, or, coincide with the course of tectonic lines.

Height levels of relicts of destructed belevelled surfaces above valley incisions indicate that the areas on the two banks of the Nedvědička River are neotectonically homogeneous and belong to the same tectonic area. The markedly increased gradient of the Nedvědička River channel in the eastern part of the study area results from intensive retrograde erosion in more resistant rocks of the Svratka Complex depending on the local base-level history of the Svratka River valley. Neither the landforms documented nor the present geomorphologic processes in the study area show any indications of the existence of young tectonic activity.

Based on the above given geomorphologic conclusions, the study area can be considered morphostructurally relatively stable throughout the Late Cainozoic.

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MORFOSTRUKTURNÍ ANALÝZA A GEOMORFOLOGICKÝ VÝVOJ RELIÉFU ÚDOLÍ ŘEKY NEDVĚDIČKY V OKOLÍ PERNŠTEJNA

Résumé

Podrobná geomorfologická analýza území, ležícího asi 10 km jižně od města Bystřice nad Pernštejnem v okrese Žďár nad Sázavou při západním okraji Nedvědické vrchoviny, byla uskutečněna za účelem zjištění stupně morfostrukturní stability v období mladšího kenozoika. Za základ byla zvolena metoda podrobného obecného geomorfologického mapování. Důležitou součástí terénních výzkumů bylo studium dokladů působení disjunktivní tektoniky ve skalních výchozech a souvislostí s tvary dnešního reliéfu, které vyústilo v analýzu puklinové a zlomové tektoniky. Terénní práce jsme doplnili kartometrickou analýzou sklonitosti reliéfu a spádových poměrů vodních toků ve spojitosti s morfotektonickou analýzou a stereoskopickou analýzou série černobílých leteckých snímků. Hlavním analytickým výsledkem výzkumu je v originálním provedení podrobná geomorfologická mapa v měřítku 1:10 000.

Všechny tvary reliéfu zkoumaného území jsou exogenního původu. Reliéf je přes značnou vertikální členitost geomorfologicky poměrně jednotvárný. Nejvíce jsou rozšířeny různé kategorie polygenetických svahů, významné zastoupení mají tvary nivační a kryogenní. Z hlediska řešení morfostrukturní stavby území a geomorfologického vývoje je velmi významná zejména absence tvarů tektonického původu, starých zarovnaných povrchů a říčních teras. Z důvodu omezeného rozsahu se v tomto příspěvku nezabýváme tvary antropogenního původu. Tvary zobrazené na přiložené černobílé verzi geomorfologické mapy musely být oproti původní (barevné) podobě mapy poněkud zjednodušeny a v některých případech sloučeny.

Zkoumané území představuje z geomorfologického hlediska typ erozně denudačního reliéfu bez zjevných projevů mladých tektonických pohybů v dnešních povrchových tvarech. V některých částech se však zřetelně uplatnily strukturní vlastnosti hornin a stará zlomová tektonika. Reliéf byl modelován v prvé řadě erozně denudačními procesy v souvislosti s vývojem údolní soustavy zahlubování řeky Svratky jako místní erozní báze.

Geomorfologická analýza reliéfu studovaného území naznačila genetické souvislosti mezi povrchovými tvary a geologickou stavbou. V mapovaném území nebyly zjištěny žádné tvary nesporně endogenního původu, podmíněné neotektonickými pohyby. V reliéfu se však nacházejí některé tvary, které pokládáme za podmíněné pasivní morfostrukturou, tj. zejména litologií, rozpukáním a starou tektonikou. U některých hřbetů a údolních úseků se projevuje závislost jejich prostorového uspořádání na foliaci, popř. je shoda s průběhem tektonických linií. Zbytky destruovaných zarovnaných povrchů nad údolními zářezy vodních toků svojí výškovou polohou naznačují, že území na obou březích Nedvědičky je neotektonicky homogenní a patří ke stejné tektonické oblasti. Výrazně zvýšený sklon koryta Nedvědičky ve východní polovině studovaného území je výsledkem intenzívní zpětné eroze v odolnějších horninách svrateckého komplexu v závislosti na vývoji místní erozní báze údolí Svratky.

Zjištěné tvary reliéfu ani současné geomorfologické procesy ve zkoumaném území nevykazují žádné z příznaků existence mladé tektonické aktivity. Na základě uvedených geomorfologických poznatků lze toto území pokládat za morfostrukturně stabilní v období mladšího kenozoika.