

Vltava River Terrace System between Lipno and Rožmberk nad Vltavou

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Abstract: The article is a contribution to the knowledge of the geomorphologic development of the Vltava river valley reach between Lipno and Rožmberk nad Vltavou using the terrace system reconstruction and comparison with Neogene gravel locations in the Vltava-Danube water divide.

Keywords: river terrace system, geomorphologic development

1. Introduction

As a topic once widely discussed in journals, the evolution of the Vltava valley in the Vyšší Brod area still remains open and ranks among classical issues of the Czech geomorphology. In 1991, in connection with the morphotectonic research of the Vyšší Brod area (Příbyl 1992, 1995), I got acquainted in greater detail with the Neogene river gravel locations in the surroundings of the Vltava-Danube divide described 70 years ago (Kinzl 1930a, 1930b) and tried to draw on old research using modern geomorphology methods.

Some geologists and geomorphologists contemplated the evolution of the Vltava river in the Šumava and Vyšší Brod areas as early as the late 19th century, usually being attracted by a remarkable course direction change from the north-west to south-east direction to the south-to-north direction with an abrupt bend in the area to the east of Vyšší Brod. Some authors (Bayberger 1886, Daniel 1892, Schneider 1908, e.g.) believed that the present-day Vltava valley had originated as a discharge from an iceberg lake in the Vltavice furrow, others (Puffer 1910, Grund 1913) presented the idea of an epigenetic origin in continuous Cretaceous sediments, which covered all the Šumava mountains but were removed without remnants. This idea was strongly opposed in particular by Sokol (1918a, 1918b), who, however, opposed Lehmann's opinion (1917) too on the effect of block mass tectonics. Grund (1913), however, also considered the Šumava Vltava reach beheading by the effect of retrogressive erosion, which opinion is, besides tectonic effects, one of the two main acknowledged views.

At the beginning of the 20th century, a rather great attention was paid to the idea of the original direction of the upper Vltava into the present-day Blanice or Volyňka (Sellner 1906 and 1908, Mayr 1910, Sokol 1911, Machatschek 1926), or Vydra river valleys (Sellner 1906 and 1908, Kettner 1923). A number of authors believed that the Šumava Vltava directed originally to the valley of Mühl (Woldřich 1904, Puffer 1910, Sokol

1916) or Rodelbach in Austria (Sokol 1916). None of these assumptions, however, was proved.

70 years ago, Kinzl published his research results from the water divide area between the Vltava and an Austrian river Feldaist in two works (1930a, 1930b). Having found a number of gravel locations of undoubtedly fluvial origin, he arrived at a conclusion that, in Neogene, the Vltava had flown from its bend to the east of Vyšší Brod via the western surroundings of Horní Dvořiště to the village of Summerau, Austria, and further through the present-day valleys of the Reinbach and Jaunitzbach streams and the Feldaist river to the Danube. His findings were adopted and partially extended by Moschelesová (1930) and reproduced by a lot of other authors later. Owing to World War II and the consequent division of this area by the Iron Curtain, Kinzl's preliminary, roughly schemed results, could not be verified by a detailed up-to-date terrain research until the opening of the boundary zone in 1989.

Since the issue of the geomorphologic development of the Vltava river valley around Vyšší Brod was not solved in the field for several decades and authors of various regional studies only presented alternatives to opinions published before, the most comprehensive overview and evaluation can still be found now, almost 40 years later, in a voluminous book by B. Balatka and J. Sládek on river terraces in the Czech lands (Balatka, Sládek 1962) I hereby refer to in this respect.

2. Basic Methodology

With regard to the two main views on the Vltava course change in the section to the east of Vyšší Brod as a result of a tectonic thrust of the today's Vltava-Danube divide near the Czech-Austrian frontiers and beheading by the effect of retrogressive erosion of the predecessor of the present-day Vltava to the south of Rožmberk nad Vltavou – research should be focused on two different, yet closely related directions: 1. learn the morphotectonic structure of the area, 2. perform a detailed research of the Vltava terrace system in this not well-known area between the spring and Český Krumlov, doing which one can easily draw on the Vltava middle course terrace system well-studied by Chábera and Novák (1975). While the work is still in progress in the neighbouring Lenora – Lipno nad Vltavou and Rožmberk nad Vltavou – Český Krumlov river valley reaches, the middle section around the Vltava course direction change has already been completed and the main research results including partial conclusions on the geomorphologic development of the Vltava valley are available herein.

Terraces of surface elevations ranging from 0.5 to 5 m above the flood plain are described in the not yet completed river reach above Loučovice in the area of the today's Lipno I dam lake (Šauer 1938, Žebera et al. 1951, Záruba et al. 1967, etc., lately Pelc et al. 1991), where three treads can be distinguished above the Dolní Vltavice, lower amalgamated in a single terrace. All locations are under the water level of the Lipno I dam lake nowadays, so we have to get satisfied with data included in studies before 1957. Gravel-sand sediments of the Vltava valley plain above Lipno have the thickness of up to 8 m according to Záruba et al. (1967). A full majority of data on river terraces in the area of the Lipno I dam lake are related to the dam building project.

With respect to the limited scope of this work, I focused on the Vltava terrace system only. The morphotectonic analysis performed in 1991 – 1992 (Příbyl 1992, 1995) and extended later will be dealt with in my next contribution to the knowledge on the Vltava river valley evolution in the area of Vyšší Brod.

3. Present Knowledge on the Vltava Terrace System between Lipno and Rožmberk and Vltavou

The Vltava terrace system reconstruction has a key position in the understanding of the geomorphologic evolution of the Vltava river valley section concerned. The river terraces, however, were not investigated systematically here so far. Therefore, the first task was to acquire as complete as possible supporting data for the construction of a longitudinal section of the terrace system. Data on the studied river valley section in older publications are too laconic and vague to be used for this purpose. The most knowledge on river terraces in this reach can be found in the 1 : 25 000 Vyšší Brod map (Slabý red. 1989) and explanatory notes to this sheet (Slabý et al. 1991). The locations briefly described in the map are concentrated on two sites. The first is the Vltava bend under Čertovy proudy (Devil's Streams) near the village of Dolní Jílovice, the largest area of occurrence, which, however, according to the authors, is assigned exclusively to the lowest terrace tread included in the Würm. The other site is Vyšší Brod and its close surroundings, where several small-area locations or mere remnants of denudation can be found, which, according to the authors of the map and explanatory notes, belong to all glacials from the Donau to Würm. In the remaining parts of the Vltava river valley in the section investigated, no terrace or denudation remnants thereof have been recorded. Some locations to the south of Dolní Jílovice and at Vyšší Brod are also included, in an adequately generalised form, in the 1:50 000 geological map of Vyšší Brod (Slabý red. 1991).

As far as other works are concerned, Prokop (1961) mentions the Vltava terraces above and below Rožmberk nad Vltavou saying that rare occurrences are often covered by up to several metres thick deluvia. This is probably why the 1 : 25 000 Rožmberk nad Vltavou geological map (Vrána red. 1988) does not include any river terraces. This is also confirmed by Záruba et al. too (1967), mentioning the Vltava gravel location on the right valley slope to the north-west of the Mýto yard at the altitude of about 545 m, covered by about 6 m thick solifluction material. The similar situation is on right Vltava valley slopes to the south of Rožmberk nad Vltavou too. A number of specific data on the area of Vyšší Brod are mentioned by Marek (1969).

4. Field Research Results

A research carried out in 1990s verified that the Vltava river valley section between the Lipno I dam and Rožmberk nad Vltavou is very poor in river terraces. Only 34 river gravel locations were found altogether at elevations of 75 m to 3 m above the non-swollen river level. 17 of them are mentioned or mapped in the above included publications and

confirmed basically by new research, although in some cases they were assigned to different terrace treads. No other occurrences are known so far. New river terraces and remnant gravel locations including elevations were incorporated in topographic 1:10.000 scale maps. In low-occurrence locations, the elevations were measured directly above the non-swollen river level.

The said amount of terrace locations may seem sufficient for the reconstruction of a 20.3 km long river reach, but it mostly, with 4 exceptions of the youngest terraces, includes low occurrences or negligible remnants of denudation. The thickness of the accumulated material, again with the exception of the youngest terrace, is low (up to 2 m) or practically zero, where the gravel remnants are added to the underlying rock weathering products. In many locations, the fluvial material is obviously covered with deluvial, prevailingly solifluction accumulations, which, according to earlier research (Záruba et al. 1967), may be up to several meters thick. An up to 30 m thickness of slope sediments around the present-day Lipno I dam lake was found (Roth 1950, Chábera 1953). It can be assumed that some terraces are covered with these deluvia completely due to a high intensity of slope processes in cold periods of the Pleistocene Epoch (Chábera 1955).

5. Longitudinal Section of the Vltava Terrace System

The river terrace and river gravel remnant locations are drawn in an 80-times exaggerated longitudinal section. At the mouth of the Rybnický brook into the Vltava, the longitudinal section of the course is linked to the present-day terrain section including gravel locations found by Kinzl (1930a) on the territory of our country. These Neogene gravel locations, however, have not been taken over from a schematic map included in Kinzl's work, but drawn on the basis of data obtained by detailed mapping in the 1 : 10 000 scale. Connecting of both sections provides a comparison of elevation relations between Neogene gravel locations and some Vltava terrace profile elements.

The Vltava terraces are distributed unevenly in the section. The first group of locations is, with the exception of a terrace at Loučovice, under Čertovy proudy, to the south of Dolní Jílovice, 6.5 km from its beginning at the Lipno I dam. These locations are the largest area of occurrence of the whole section, but are assigned to the two lowest treads. The other group of terraces is around the town of Vyšší Brod, where, on the contrary, all terrace treads are represented, starting from the rare highest tread of the relative surface elevation of 75 m above the river level (Donau?) down to the lowest tread of 4 m above the river (Würm). The case mostly includes mere denudation remnants of fluvial gravel. Two locations only were found in the following 3.5 km and the remaining locations are relatively scarce and situated in the section segment between the Mýto yard and Rožmberk nad Vltavou.

With exceptions, all occurrence locations can be easily classified into 5 treads, which are, for simplicity, designated A to E from the highest to the lowest terrace.

Terrace A is the highest one. The only occurrence in the segment investigated was found at the southern margin of the town of Vyšší Brod. The gravel layers are located in a continuous slope at the altitude of 625 m, about 75 m above the Vltava level. Marek

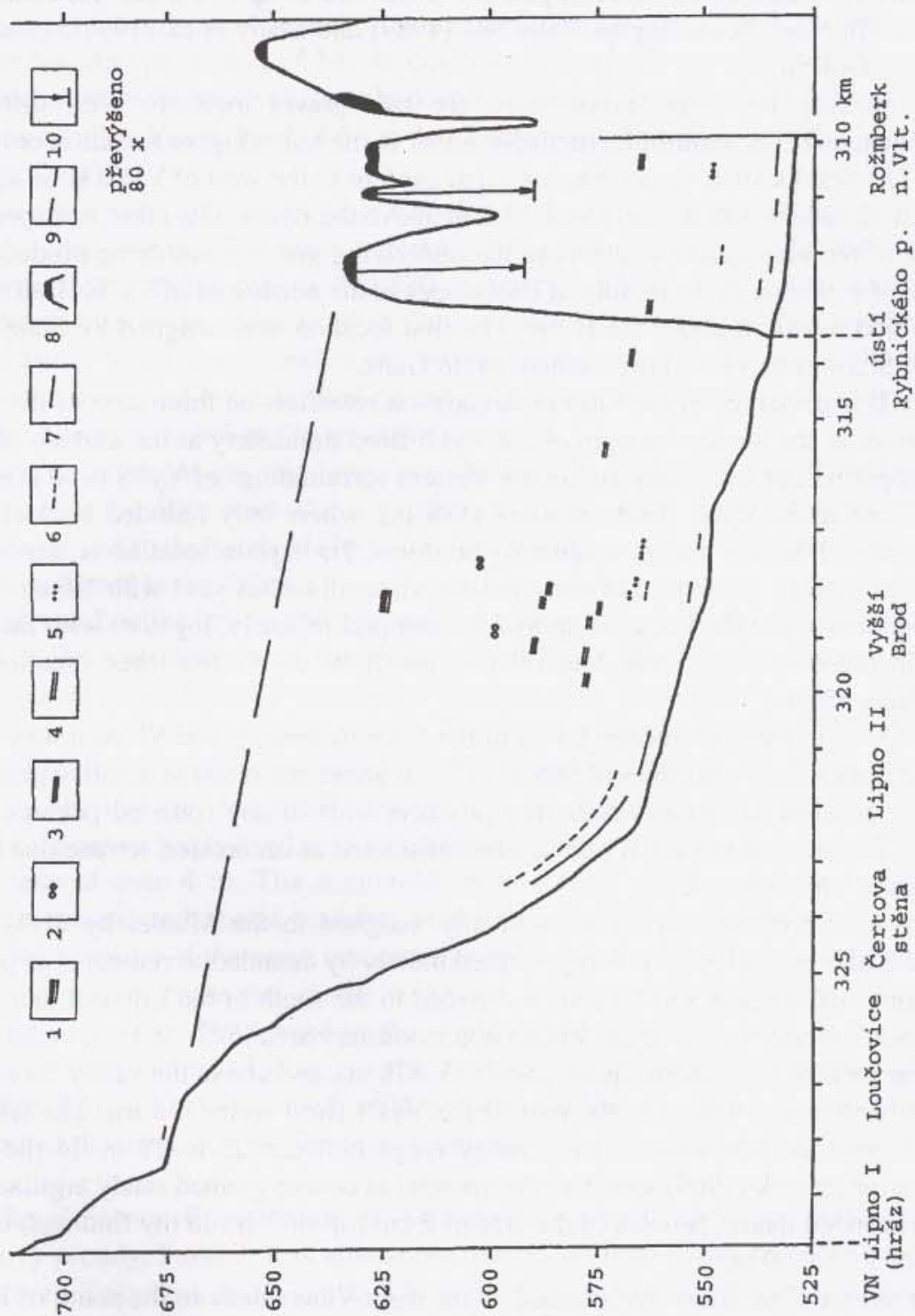


Fig. 1: A longitudinal section of the Vltava terrace system between Lipno and Rožmberk nad Vltavou (80-times exaggerated). 1 – river terrace A (Donau), 2 – river gravels of indefinite position (probably Günz), 3 – river terrace B (Günz), 4 – river terrace C (Mindel), 5 – river terrace D1 (Riss), 6 – river terrace D2 (Riss), 7 – river terrace E (Würm) 8 – Neogene sediments, 9 – relation of altitudes between Neogene sediments and highest part of Čertovy proudy (Devil's Streams) in the Vltava river valley below Loučovice, 10 – boreholes to base of Neogene sediments

(1969) says that the thickness of the terrace is about 2 m and is composed of rusty-red-brown loamy sand with small rounded pebbles of the size of up to 0.5 cm. He considers the location Pliocene. According to Slabý rev. (1989) and Slabý et al. (1991), its age is preliminarily Donau.

In considerably lower positions, there are two gravel locations with different elevations that, however, **cannot be included** either in the much higher terrace A or lower terrace B. The first location lies in the municipal gardens to the west of Vyšší Brod square (the highest altitude is 578 m, i.e. about 47.5 m above the river). The other is a sporadic occurrence of rounded quartz boulders in the underlying gneiss weathering products on the surface of a plateau in the middle of backslopes to the north-east of Vyšší Brod at the altitude of 603 m (54 m above the river). The first location was assigned by Slabý red. (1989) and Slabý et al. (1991) preliminarily into Günz.

Terrace B is preserved in the form of denudation remnants on three sites of the town of Vyšší Brod: at the western margin of the Vyšší Brod monastery at the altitude of 590 m, in the upper part of the square and in the western surroundings of Vyšší Brod (surface at 589 m), and at the Vyšší Brod cemetery (588 m), where only rounded boulders are admixed to the underlying gneiss weathering products. The square location is, according to Slabý et al. (1991), composed of rusty-red-brown argillaceous sand with 1-5 cm sized rounded pebbles of the thickness of up to 2 m, and preliminarily, together with the first location, included in the Günz. The relative elevation of all the three locations is approximately 38 m.

About 200 m to the south of the limits of the town Rožmberk nad Vltavou, there is a remarkable plateau at the altitude of 566 m (37.5 m above the river) in a valley position. The surface consists of gneiss weathering products without any rounded pebbles. The elevation is the same as terrace B and can be considered as an erosion terrace due to its position in the Vltava bend core.

Terrace C is preliminarily stratigraphically assigned to the Mindel by Slabý red. (1989) and Slabý et al. (1991). It is represented mostly by denudation remnants of gravel in 7 locations, mainly near Vyšší Brod: at the road to the south of the Lipno II dam (577 m), at the north-western edge of the Vyšší Brod monastery area (577–580 m), in the town centre to the west of the bottom square part (575–578 m), and above the valley cut on the left Vltava bank, about 150 m to the east of the Vyšší Brod weir (575 m). The relative elevations above the non-swollen river valley range between 25 to 27 m. In the last-named location, Marek (1969) specifies the material as coarse-grained sandy argillaceous earth with rounded quartz pebbles of the size of 2 cm (up to 7 cm in my findings) of the thickness of 1.2 to 2.9 m.

Further terrace C locations are situated on the right Vltava bank to the south of Horní Mlýn (574 m), to the east of the Rožmberk nad Vltavou railway station (568 m), and to the west of the Mýto yard (563 m), where rounded, mostly quartz and granite boulders of the size of up to 30 cm are found. According to Záruba et al. (1967), most of this accumulation of the thickness of about 1 m is covered by up to 6 m thick solifluction slope loams.

Terrace D has developed at two elevations. *The higher level D1* is preserved on the left Vltava bank in the bend core close to Vyšší Brod at the altitudes of 568 m and 567 m, and on the right Vltava bank to the west of the Bučinský stream mouth with the surface

at the altitude of 565 m. In all the three cases mentioned above, the relative elevation is about 17.5 m. According to Prokop (1961), the third location mentioned above is composed of loamy-sand gravel with rounded, mostly quartz and two-mica or aplitic granite boulders of the size of 5 to 40 cm. Sporadic occurrence of gravel remnants on the left river bank to the south of Rožmberk nad Vltavou at the altitude of 548 m (19 m above the non-swollen Vltava level) 6.5 km downstream can be included in the higher level of terrace D too.

The lower level D2 is observable from Přední Loučovice at the bottom end of Čertovy proudy, where we can find three largest locations (together with the lowest terrace E) on both river banks at 595-590 m, 590-580 m, and 574-572 m. The relative elevation above the river level is approximately 10 m. Other terrace D locations lie in the bend core below Vyšší Brod, to the north-west of the railway bridge, at the altitude of 563 m (13.5 m above the river) and 6 km further, on the right Vltava river bank, to the north-north-east of the Mýto yard at 546 m (15 m above the river).

Most locations of the said levels are classified by Slabý red. (1989) and Slabý et al. (1991) into the Riss with the exception of three lower level locations near Přední Loučovice and to the south of Dolní Jílovice, which are, together with local lower gravel levels, assigned to the Würm.

Terrace E is the lowest and youngest one. According to Slabý red. (1989) and Slabý et al. (1991), it belongs to the Würm. It includes the only location in the section investigated above Čertovy proudy, on the right river bank at Loučovice, at the altitude of 674 m (3 m above the Vltava level). Further, the largest locations are to the south of Dolní Jílovice on both river banks (575-570 m and 575-564 m, i.e. 3.5 to 5 m above the river level). The only terrace E location at Vyšší Brod lies on the left river bank in the bend core below Vyšší Brod with the surface altitude of 554 m (4 m above the level) and thickness of over 4 m. The accumulation is composed of gravel-sand with rounded granite, gneiss, and quartz boulders of the size of 5-10 cm in the upper layer, and of rounded boulders of the same composition and size of up to 40 cm at the bottom. There is no terrace E preserved in the following 5.5 km section. Further, there are four locations after the Vltava bend to the south: on the right river bank to the north-north-west of the Mýto yard (538 m), on the left bank 500 m further downstream (534 m), on the right bank 1 km to the south of Rožmberk nad Vltavou (534 m), and at the southern margin of the town (534 m). The elevations are 4-5 m above the non-swollen Vltava level here.

The Holocene fluvial plain is not formed between Lipno and the bottom end of Čertovy proudy. Further, it is almost continuous on both banks but only several metres wide until Rožmberk nad Vltavou. The widest place (50 m) in the section investigated is found to the north-west of the Mýto yard. The flood plain surface is mostly about 1.5 m above the non-swollen river level, sometimes indications of the second plain level with the surface at about 2.5 m can be observed. The sediments are mostly composed of loamy-sand material at the upper layer, there are more and more rounded boulders downwards, and boulders often of the size of over 20 cm and big rock blocks of up to 2 m (Kodymová 1958) prevail at the bottom of the Holocene accumulation. According to Marek (1969), the thickness of the sediments is over 4 m.

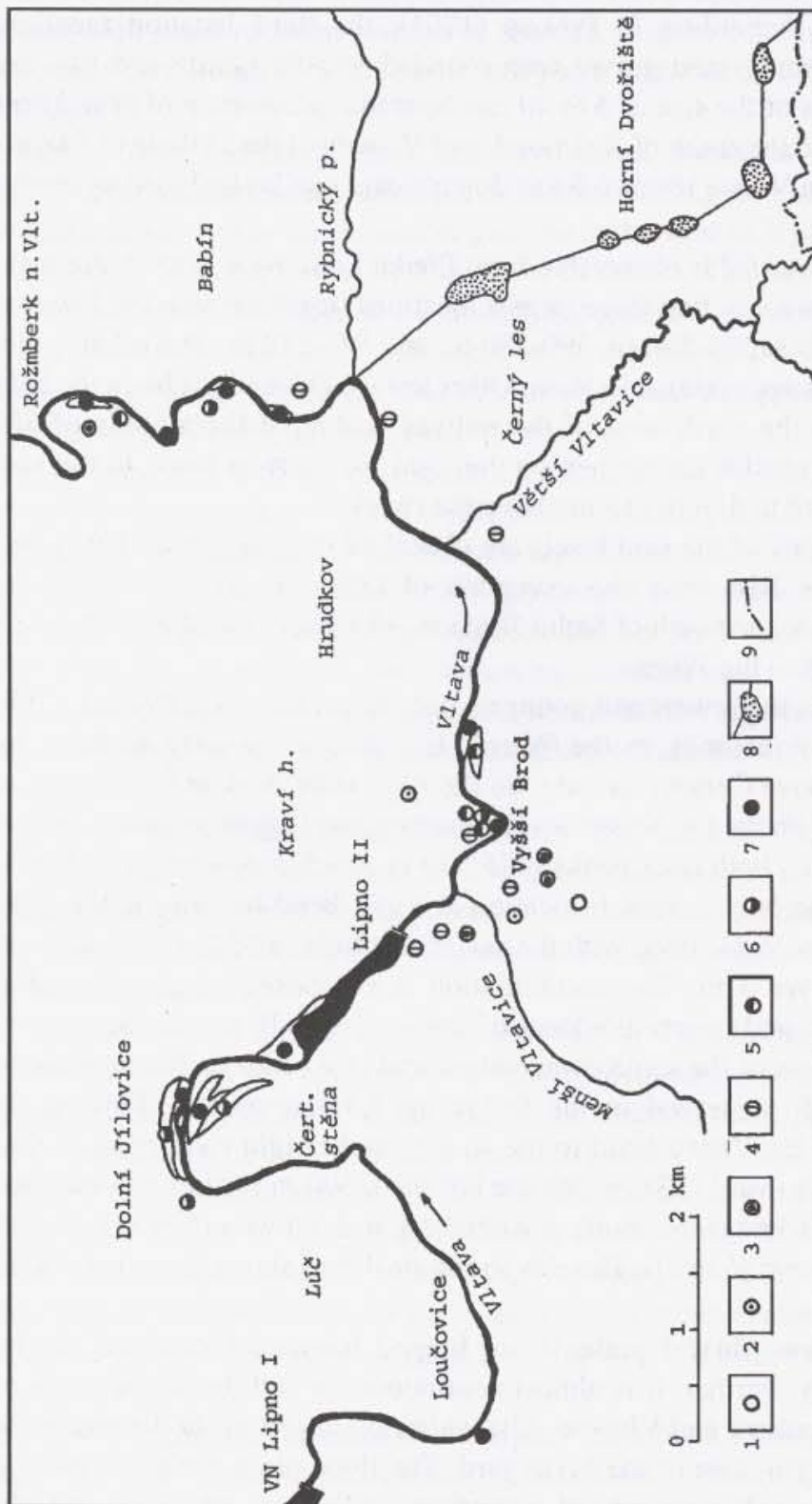


Fig. 2: A schematic map of Vltava river terraces and fluvial gravel remnants in the Lipno – Rožmberk nad Vltavou section. 1 – river terrace A (Donau), 2 – river gravels of indefinite position (probably Günz), 3 – river terrace B (Günz), 4 – river terrace C (Mindel), 5 – river terrace D1 (Riss), 6 – river terrace D2 (Riss), 7 – river terrace E (Würm), 8 – longitudinal section with Neogene sediments between Rybnický brook mouth and State Frontier near Horní Dvořiště, 9 – State Frontier

Tab. 1: River Terraces and Fluvial Gravel Remnants in Most Significant Locations (The data are in m above the non-swollen Vltava river level, known base elevations are given behind the slash.)

| Terrace Treads | Preliminary Stratigraphic Classification | South of Dolní Jílovice | Vyšší Brod | NW-NNW of Mýto Yard | South of Rožmberk |
|----------------|--|-------------------------|------------|---------------------|-------------------|
| Terrace A | Donau* | - | 75/73 | - | - |
| ?? | Günz* | - | 47.5 | - | - |
| Terrace B | Günz* | - | 38/36 | - | 37.5 |
| Terrace C | Mindel* | - | 25-27 | 29/28 | - |
| Terrace D1 | Riss* | - | 17.5-18 | - | 19 |
| Terrace D2 | Riss | 10** | 13.5 | 15 | - |
| Terrace E | Würm | 3.5 -5 | 4 | 4-5 | 4-5 |

* according to Slabý rev. (1989) and Slabý et al. (1991)

** part of Würm terrace E according to the same authors

6. Neogene Gravels Between Vltava River Bend at Rybnický Brook Mouth and State Frontier

There are 6 locations of Neogene gravel locations on the Czech territory, found by Kinzl (1930a, 1930b) for the first time, who assumed that they had been deposited by the Vltava in the Šumava mountains that, in the late Tertiary Period, had flown from its present-day bend at the Rybnický brook mouth to the south-east into the valley of the present-day Austrian river Feldeist and, through its mediation, to the Danube. All locations were, in the connection with the above mentioned work, re-mapped in detail and rounded boulder analyses were made, whose results are included in the table. The inclusion of the locations into the longitudinal section of the Vltava terrace system allows for a better comparison of the relative height relations, despite the fact that I have come to a conclusion on the basis of research performed so far that the gravel locations cannot be considered remnants of fluvial deposits in the sense of Kinzl's original conclusions.

Gravel location N1 is situated in a forest area to the south-east of the Rybnický brook mouth, on the way to Horní Dvořiště. The altitude of the absolutely flat gravel surface is 644-648 m. On the south-eastern side, however, there are gravel layers at much lower altitudes, which might be due to slope movements. The gravel is relatively low-processed, 70% of it is composed of white, off-white and slightly rusty-red quartz. Other rocks include coarse-grained granite, high-mica paragneiss, aplite, and pegmatite. The size ranges between 5-7 cm, exceptionally up to 15 cm. It is important, however, that the gravel, and thus the "fluvial" character is on the surface only. According to a core trial borehole, Bezvoda, Novák, and Vrána (1983) claim that the thickness of the Neogene sediments is 42 m of grey-green, mostly coarse-grained sand with argillaceous partings with rounded boulders and half-processed fragments of up to 20 cm. The authors regard the sediments as equivalents of Mydlovary series of strata.

Location N2 lies about 1 km to the south-south-east of the preceding one, in fields and at the forest edge to the west-north-west of Horní Dvořiště. The surface gravel layers occur on an area of about 150 times 200 m at the altitude of about 630 m and are least-processed of all locations investigated. Over 80% of the rounded boulders and fragments are composed of white, off-white, and yellowish quartz, the rest mostly consists of sharp-edged granite fragments. The size of the rounded boulders ranges between 2 and 5 cm, exceptionally up to 15 cm. Bezvoda, Novák, and Vrána (1983) also found a similar sediment character in the borehole as in the preceding location and a thickness of 41 m.

Location N3 is directly to the west of Horní Dvořiště and its surface has a similar character as location N2. It creates an about 100 m wide belt running from the north to the south at the altitude of 624-627 m. 80% of the material is white, transparent, yellowish, red, and grey quartz, the rest is granite. The size is mostly 5-10 cm, the biggest elements are up to 35 cm big.

Location N4 lies to the west-south-west of Horní Dvořiště. Its surface has the same character as the two locations mentioned above and is separated from location N3 by a shallow depression only. The gravel, however, continues almost smoothly to the south as far as behind the road from Horní Dvořiště to Studánky. The surface is at the altitude of 624-629 m. The gravel material is considerably more processed than in the preceding locations. Again, 80% of the material is composed of milk-white, off-white, yellowish and red quartz, of aplite, and, to a lesser extent, granite and paragneiss. The most frequent size is 4-8 cm, the maximum size is 30 cm.

Location N5 lies in the fields about 700 m to the south-west of Horní Dvořiště, to the north of the boundary Hajský stream. The surface is rather inclined, ranging between the altitudes of 612 and 635 m. The main difference from the preceding locations is an extremely high number of rounded boulders and higher rate of processing. 90% of the rounded boulder material is quartz of various colours as the case is in the preceding locations, further aplite, migmatite, and granite.

Location N6 is situated in a location called Holý vrch (Bare Hill), to the south of Horní Dvořiště. The gravel is dispersed in the arable land on an oval area of about 100 times 200 m at the altitude of 652-654 m. The material is slightly processed, the most frequent size is 3-5 cm, exceptionally up to 10 cm. Over 80% of the round boulders and fragments consists of quartz of various colours, and light small-grained granite.

Tab. 2: Gravel Processing on Neogene Sediment Surfaces near Horní Dvořiště (in %)

| Location | Perfectly Processed | Well Processed | Half-Processed | Sharp-Edged |
|----------|---------------------|----------------|----------------|-------------|
| N1 | 1 | 35 | 39 | 25 |
| N2 | - | 14 | 47 | 39 |
| N3 | - | 39 | 37 | 24 |
| N4 | 3 | 42 | 46 | 9 |
| N5 | 7 | 47 | 33 | 13 |
| N6 | 2 | 27 | 43 | 28 |

7. Final Discussion

The longitudinal section of the Vltava river terrace system between Lipno and Rožmberk nad Vltavou is another step in the effort to make up a complete profile of the whole Vltava course. It cannot be connected so far with the completed section of the area below Český Krumlov due to the unfinished Rožmberk nad Vltavou – Český Krumlov section. As results obtained so far from the unfinished section show, the parallelisation of the terrace treads will not be free of troubles even after the said section is finished, because the section is even poorer in river terraces than the Vyšší Brod section. The latter will have to be more precise and completed with new data such as thickness values, terrace accumulation base elevations, and newly discovered gravel layers hidden under thick deluvia in particular.

Kinzl's original approach to Neogene gravel from the 1930 can probably be, with respect to the sediment thickness and character found later in holes drilled into the fossil-weathered granite bed (Bezvoda, Novák, Vrána 1983), considered residual gravel layers (Vrána et al. 1988) accumulated on the surface in connection with the loss of finer material as known from lower positions rather than river terraces of a former water course. A comparable material for the Vyšší Brod basin is also missing, although Kinzl (1930a) mentions quite specifically partially cross-bedded coarse-grained sediments with quartz rounded fragments covering light fine-grained sand similar to Miocene sediments in the Danube drainage area. The only Neogene location near Kleštín (Kodym 1956) is quite different, being composed of sand clay. On the contrary, there are Neogene sediments of the same character as at Horní Dvořiště to the south-west and north-east of Dolní Dvořiště and further to the north, near Kaplice.

Comparing the longitudinal section of the Vltava river terraces with the section of Neogene sediments, we get an elevation relation between the Neogene gravel surface level and the highest part of the extremely inclined reach of the Vltava river below Lipno. If the case is actually a huge wave of retrogressive erosion that went gradually through the whole Vyšší Brod basin, then no trace of Neogene sediments if any, could be left here – everything was cleaned away.

Another comparison can be made between the Neogene bases touched by the said holes and lower positions of large flattened surfaces in the Vyšší Brod basin between the Hrudkov sanatorium and Hrudkov farm at the southern foot of Kraví hora (Cow's Mountain). If there were a similar Neogene in the basin as to the west and north-west of Horní Dvořiště, the apparent level of flattened surfaces could be its former base. Then, remnants of this Neogene might be hidden under a huge solifluction coat at the foot of the Kraví hora mountain in the location of the assumed fault (Slabý rev. 1989).

The above mentioned questions, however, remain unanswered. More can be indicated by an evaluation together with a detailed morphotectonic analysis after the terrace system research in the adjacent sections is completed.

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TERASOVÝ SYSTÉM ŘEKY VLTAVY MEZI LIPNEM A ROŽMBERKEM NAD VLTAVOU

Résumé

Úvahami o vývoji šumavské Vltavy a o příčinách náhlé změny směru toku k S v úseku v. od Vyššího Brodu se zabývali někteří geologové a geomorfologové již koncem 19. století. Sdělením o nálezech štěrku patrně fluviálního původu v rozvodní oblasti mezi Vltavou a rakouským tokem Feldaist nejvíce zaujal před 70 lety Kinzl (1930a, 1930b). Na základě těchto nálezů usoudil, že ještě v neogénu směřovala Vltava od ohybu východně od Vyššího Brodu přes z. okolí Horního Dvořiště k rakouské obci Summerau a dále nynějšími údolními potoky Reinbach a Jaunitzbach a řekou Feldaist do Dunaje.

Předběžné poznatky H. Kinzla, dokumentované pouze na málo podrobném náčrtku, bylo možno ověřit podrobným geomorfologickým terénním výzkumem až po roce 1989, po uvolnění přístupu do hraničních území. Výzkum bylo třeba zaměřit na poznání morfotektonické stavby území a na dosud málo známý terasový systém Vltavy. Tato práce přináší poznatky o systému říčních teras Vltavy v úseku mezi Lipnem a Rožmberkem nad Vltavou, zpracované do podélného profilu. Většina do profilu vnesených výskytů fluviálních sedimentů jsou však pouhé denudační zbytky, mnohdy pouze valouny na povrchu zvětraliny podložní horniny. Na podélný profil toku je v místě předpokládaného náčepního ohybu v. od Vyššího Brodu napojen profil dnešním terémem s výskytem štěrku zjištěných Kinzlem (1930a, 1930b) na našem státním území, zakreslených na základě nového zmapování v průběhu 90. let v měřítku 1 : 10 000. Propojení obou profilů umožňuje porovnání výškových relací mezi výskyty neogenních štěrku a některými prvky v profilu říčními terasami Vltavy.

Výzkum z 90. let potvrdil, že úsek vltavského údolí mezi přehradní hrází Lipno I a Rožmberkem n. Vlt. je na říční terasy velmi chudý. Celkem byly ve zkoumaném úseku zjištěny říční štěrky ve výškách od 75 m do 3 m nad úrovní nevzduté hladiny řeky. Až na výjimky se všechny výskyty dají výškově zařadit do 5 stupňů, jejichž předběžné stratigrafické zařazení (viz tab. 1) je převážně převzato z geologické mapy a vysvětlivek (Slabý red. 1989, Slabý et al. 1991).

Neogenní štěrky v původním pojetí Kinzlově z r. 1930 zřejmě nelze s ohledem na nověji zjištěné mocnosti a charakter těchto sedimentů po jejich provrtání až do fosilně zvětralého žulového podloží (Bezvoda, Novák, Vrána 1983) jednoduše pokládat za říční terasy dávného toku. Spíše se jedná o reziduální štěrky (Vrána et al. 1988), nahromaděné na povrchu v souvislosti s odnosem jemnějšího materiálu. Výsledkem je slabá štěrkovitá povrchová vrstva, napodobující fluviální štěrkopísčitého materiálu. Kromě toho jsou neogenní sedimenty stejného charakteru známy také v okolí Dolního Dvořiště a ještě dále na S u Kaplice.

Ze srovnání podélného profilu říčními terasami Vltavy s profilem neogenními uloženinami se nabízí výškový vztah mezi úrovní povrchů s neogenními štěrky a nejvyšší částí extrémně sklonitého úseku údolí Vltavy pod Loučovicemi. Zároveň je však zřejmé, že v údolí Vltavy nad předpokládaným místem načepování se nevyskytují žádné zbytky štěrků odpovídající výškové úrovni, o kterých se Kinzl (1930a) zmiňuje. Mohly by však být skryty pod mohutným soliflukčním pláštěm ve vyšších polohách dnešních údolních svahů.

Základní otázky geomorfologického vývoje zůstávají i nadále nezodpovězeny. Více může naznačit dosud pokračující výzkum terasového systému v okolních dvou úsecích, a připravovaná podrobná morfotektonická analýza.



Photo 1: A view from the right Vltava river bank downstream of the valley segment with the Vltava bend to the north considered as elbow of capture. On the right side mouth of the Rybnický brook



Photo 2: The northern margin of the Neogene sediment location N1 of the thickness of 42 m with residual, prevailing quartz gravels on the surface. A view to the east