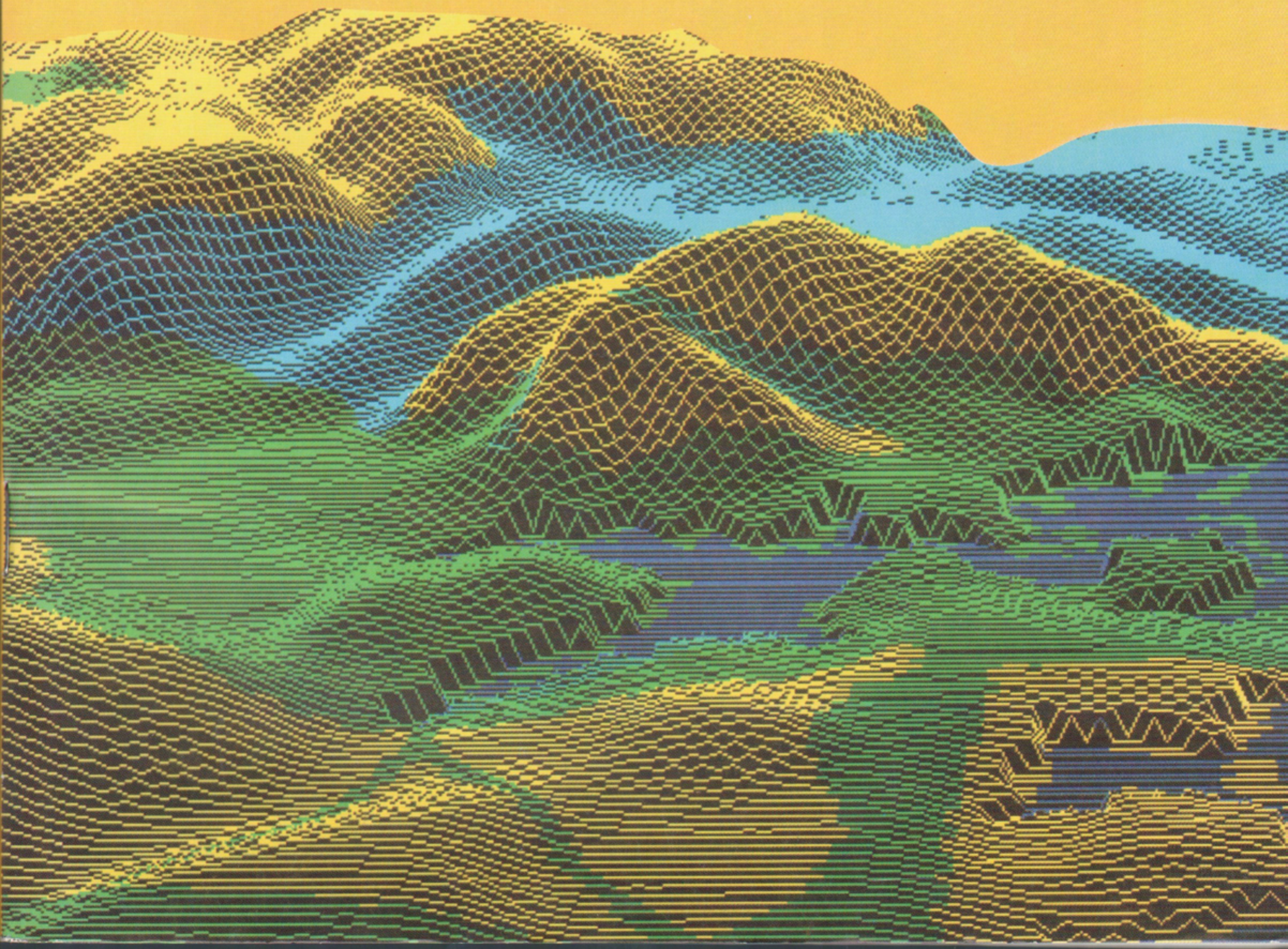
MORAVIAN GEOGRAPHICAL REPORTS

VOLUME 2 NUMBER 2 1994 ISSN 1210 - 8812



Owing to lateral erosion on outer side of the bends, the right bank which is composed of eolian sands is more than 7m high, very steep and without any vegetation (the locality is named "Loose sands").
Photo: K.Kirchner, V.Nováček

MORAVIAN GEOGRAPHICAL REPORTS

PRICE

Czech Republic, Slovakia 75 CZK
other countries 9.5 USD
mailing costs are invoiced separately
subscription (two numbers per year)
Czech Republic, Slovakia 145 CZK
other countries 17.5 USD
including mailing costs

MAILING ADDRESS

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(fax) 42 5 578031

PRINT

PC - DIR, Ltd., Brno, Technická 2

ISSN 1210-8812

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GEOMORPHOLOGY OF THE HODONÍN TOWN SURROUNDINGS

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Abstract

Landforms of the Hodonín surroundings (map sheet Hodonín 34-22 at the scale of 1:50 000) are very complicated. In a very interesting erosional and accumulation relief with important renewable and non-renewable resources different economic activities (mainly agriculture) led to many environmental problems and conflict of interests. This is the reason, why the presented geomorphological map of relief types and selected forms puts an emphasis on both direct and indirect relief tranformations. The main geomorphological unit of the area is the Dolnomoravský úval (Graben) which originated in the NW part of the Vienna Basin, bordered by flysch horsts of the Bílé Karpaty (Mts.) and Kyjovská pahorkatina (Hilly land). Special attention is paid to the Morava river floodplain, wind-blown sands and man-made landforms.

Shrnutí

Geomorfologie okolí Hodonína

Reliéf listu geomorfologické mapy Hodonín (34-22) 1:50 000 je velmi složitý. V erozně-denudačním a akumulačním reliéfu vede využívání obnovitelných i neobnovitelných zdrojů spolu s dalšími ekonomickými aktivitami k mnoha geoekologickým problémům a četným střetům zájmů. Tyto skutečnosti se odrážejí i v mapě typů reliéfu a vybraných tvarů. Dominantní geomorfologickou jednotkou v daném prostoru je Dolnomoravský úval vzniklý na struktuře sz. části Vídeňké pánve. Je lemován flyšovými hrástěmi Bílých Karpat a Kyjovské pahorkatiny. Zvláštní pozornost je věnována údolní nivě Moravy, eolickým pískům a antropogenním tvarům.

Key words: Dolnomoravský úval (Graben) as a part of Vienna Basin, geomorphological mapping, floodplain of the Morava river, wind-blown sands, man-made landforms.

1. Introduction

The territory of map sheet Hodonín (34-22) at the scale of 1:50 000 is situated in southeastern Moravia at the border with Slovakia. From geomorphological and geological point of view it is a contact area of the Pannonian Basin composed of mainly Neogene and Quaternary sediments and Outer West Carpathians consisting of Cretaceous and Paleogene flysch. In this typical agriculture area of low to medium altitude, there are many valuable renewable and non-renewable natural resources together with a very favourable climate and fertile soils, of which some are being mined at present and are of considerable value for economic use. The important strategic position of the area as well as existing and planned international traffic lines (including the proposed Danube - Elbe - Oder canal) is yet more significant after disintegration of former Czechoslovakia in 1992. Thus, the Hodonín district with its rural landscape is characterized mainly by very intensive and productive agriculture. Other economic activities, such as industry, water management and tranport are also important and contribute to high economic standard. No wonder that recent development is also accompanied by many conflicts of interests and serious environmental problems. Moreover, Hodonín as a district town is situated quite eccentrically in the SE corner of its administrative territory and now it is also a frontier town direct on the border with Slovakia. The present landscape is deteoriorated by activity of man and therefore the middle-scale geomorphological mapping of the area at the scale of 1:50 000 is intended to gather all data about direct and indirect anthropogenic relief transformations, significant for improving of present situation. In our opinion, together with a land-use map of the same scale, the geomorphological map facilitates an insight to the spectrum of present geoecological problems of the area.

2. Basic features of relief and geological structure

Surroundings of Hodonín belong to parts of Moravia with the lowest altitude (mostly 170- 250 m a.s.l). They are situated in a broad shallow depression of the Dolnomoravský úval (Graben), from geological viewpoint a part of intermontane depression of the Vienna Basin. The graben is the only NW marginal part of the huge Pannonian Basin wedged between the Western Carpathians and Eastern Alps. The Moravian part of the basin with its longer NE axis is paralell with the bend of the

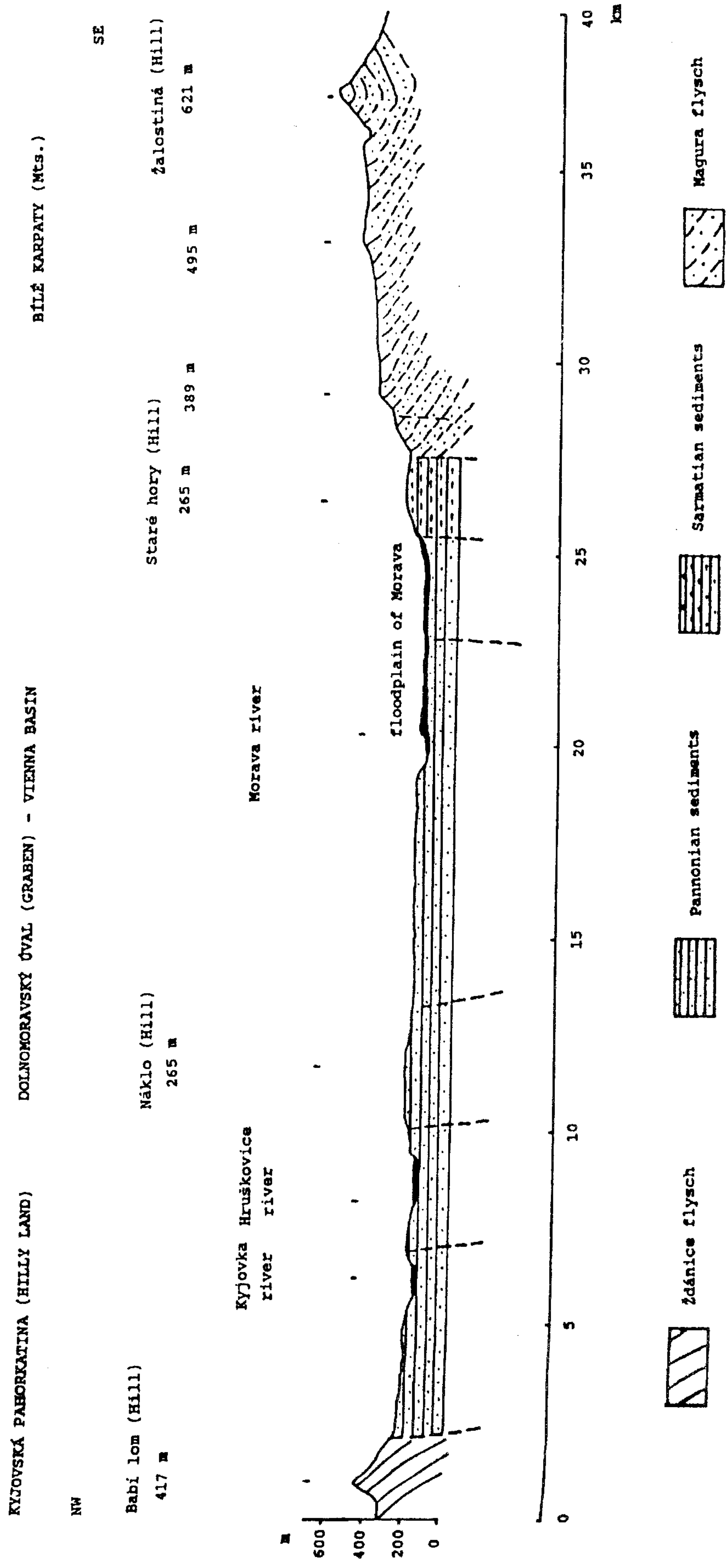

Fig. 1. Profile across the Dolnomoravský úval (Graben)

West Carpathians and is bordered with flysch elevations, namely by the Bílé Karpaty (White Carpathians Mts.) on the SE and Kyjovská pahorkatina (Hilly land) on the NW. The axis of Dolnomoravský úval (Graben) is followed by river Morava, the major watercourse of Moravia flowing to the SW and also an important left tributary of Danube. In Slovakia the part of Vienna Basin is Záhorská nížina (Lowland) and in Austria, the Östliches Weinviertel and Marchfeld, each of them having specific landscape features. Boundaries of the Dolnomoravský úval (Graben) coincide with margins of the Vienna Basin only in the East, while there are great differences in the West.

3. Morphostructures and relief development

3.1 The Dolnomoravský úval (Graben) as a part of the Vienna Basin

The paleogeography and structure of the Vienna basin is exhaustively explained by R.Jiříček and P.H.Seifert (1990) and by H. Hamilton, R.Jiříček, G.Wessely (1990). Very complex evolution of the basin started already in the Lower Neogene in connection with thrusting of the Magura nappe composed mainly of Paleogene flysch (Pyrenean or Helvetic phase). Very important was also the Savian phase at the beginning of Neogene which created not only the younger Ždánice nappe (NW of the Magura nappe) but also a forerunner of the present Vienna Basin. In the present form, the Vienna Basin is a pull-apart type structure originated in Middle Miocene (L.H.Royden, F.Horváth, B.C.Burchfiel, 1982) and filled with Neogene and Quaternary sediments. Configuration of the basin was controlled by the course of pre-Neogene structural lines (T.Buday 1963).

In the opiniom of Z.Roth (1975), the Magura nappe was an erosion (subaerial) thrust, rapidly denuded into low relief in altitude of 200 - 400 m, which corresponded to the "Augensteinlandschaft" (e.g. H.Riedl 1977) of the Eastern Alps. This is partly confirmed by Lower Miocene basal sandstones and conglomerates resting with angular unconformity on folded flysch structures both in southern part of Bílé Karpaty (Mts.) and on the bottom of the Vienna basin (A.Ivan 1980). It is possible, that also the Nesvačilka Graben continued far southeastwards, probably into the Inner Carpathians. This is also indicated by the presence of a depression in surroundings of Kobylí and Čejč situated on the crossing of the Nesvačilka Graben and NW marginal fault (Bulhary - Schrattenberg fault system) of the Vienna Basin. In our opinion, faults of the Nesvačilka Graben also control tne SW end of the Bílé Karpaty (Mts.) and their brachyanticlinal closure. The basin functioned as a piggy-back structure and its Lower Miocene filling is moderately folded. According to Z.Stráník et.al.(1993) " the presence of Karpatian sediments below the nappes and at their fronts indicates submarine nappe movements during Karpatian sedimentation".

Thus, the most dynamic changes occurred in Karpatian and Badenian. First, in connection with extension of the Pannonian Basin the Vienna Basin was reshaped and opened due to left-lateral strike-slipa faults as a pull-apart basin accompanied by rapid subsidence and sedimentation (L.H.Royden, F.Horváth, B.C.Burchfiel 1983). According to Z.Roth (1980), amplitude of the lateral movements along the system of west marginal Bulhary - Schrattenberg fault was about 80 km. Second, during the short stage of Karpatian (17.5 -16.5 m.y, with some uncertainty, see D.Vass, K.Balogh 1989), maximum rate of sedimentation 22 cm per 100 y. took place in the basin (D.Vass, K.Čech 1989). Third, thrusting of the Magura nappe over the younger Ždánice nappe as well as the Ždánice nappe over Karpatian (in southern Moravia) or Badenian sediments (in northern Moravia) during the Styrian tectonic phase was finished. L.Pospíšil, T.Buday and O.Fusán (1992) define the neotectonic movements in West Carpathians as Sarmatian - Quaternary, following the latest folding and overthrusting". Thus, from this point of view, the Vienna Basin is not a neotectonic structure. As to geomorphology, the problem calls for a more detailed discussion. Moreover, the issve is complicated by radial and longitudinal migration of orogenetic phases (R.Jiříček 1979).

The bottom of the basin as well as bordering horsts on the NW and SW are composed mainly of folded Magura flysch. A dense pattern of normal synsedimentary faults segmented the basin in many fault blocks (Fig. 1). In the deepest part of the basin, thickness of Neogene sediments is about 5 000 m. The sediments are mostly marine, but also deltaic, limnic and fluviatile.

3.2 The Bílé Karpaty (Mts.)

The Bílé Karpaty (Mts.) to the NE of the Vienna basin consist of flysch of Bílé Karpaty unit, which is a partial nappe of the Magura nappe (however, see M.Potfaj, 1993) with broad folds (E.Menčík 1969). In their NW part, their contact with the Vienna Basin is formed by a series of step like faults distinct in present topography mainly on the territory of Slovakia. The lowest foot blocks are composed of or partly covered with Miocene sediments. This is also the case of the lowest fault step in Moravia south of the town of Strážnice. The foot step (Sudoměřice step) is situated between the Strážnice and Skalica faults trending to SW (T.Buday et al. 1963b). The flat erosion surface of the step is in the altitude of 260 m and about 100 m above the floodplain of the Morava river. The Skalica fault between this block and a more uplifted block (Žerotín, 322 m) is remarkable by rectilinear course, flat facette and shalow saddle at the foot. The SW part of Bílé Karpaty (Mts.) named the Žalostinská vrchovina (Highland, according to the highest point Žalostinná 622 m) is characterized by subdued forms on low to medium resistant flysch sediments and thus without the rock forms. Inversion of the relief, as compared with other flysch areas suggests a deep level of denudation. Generally gentle slopes prevail even in the highest part of the Žalostinská vrchovina (Hillgland) with many shalow landslides (outside the map). Characteristic are also accumulation fans of left tributaries of the Morava river and also low river terraces (J.Demek, M.Vilšer 1957, A.Zeman et al.1980; D.Minaříková 1982).

3.3 The Kyjovská pahorkatina (Hilly land) and its contacts with the Dolnomoravský úval (Graben)

The Kyjovská pahorkatina (Hilly land) NW of the Vienna Basin is more complicated, composed of the Magura nappe (but here its Rača unit has rather a different internal structure in comparison with the Bílé Karpaty unit), partly of the younger Ždánice nappe. However, a great part of the Kyjovská pahorkatina (Hilly land) consists of unconsolidated Neogene deposits accumulated originally in the Vienna Basin. Their present position is due to neotectonic uplift.

The thrust line between the Bílé Karpaty nappe and Rača nappe is buried by Miocene sediments of the Vienna Basin. On the other hand, the thrust line of Rača nappe (and at the same time of the whole of Magura nappe)) over the younger flysch of Ždánice nappe north of the Kyjov town is a surface feature (not on the map) complicated by normal or strike-slip faulting. Towards southwest (SW of Kyjov) this line coincides with the Bulhary- Schrattenberg fault, i.e. NW marginal fault of the Vienna Basin (Z.Roth 1980). Here the Paleogene - Lower Miocene flysch of the Ždánice nappe is in contact with unconsolidated Pliocene sediments of the Vienna Basin.

Structure of the frontal part of the Magura nappe is very complex and addition to NE trending anticlinal and synclinal zones, also younger cross faults of NW - SE direction are important, continuing also into the northernmost part of Vienna Basin (J.Dornič, J.Kheil 1963). The most important cross disturbance is the Boršice fault.

The intensively folded and faulted flysch of the Rača unit crops out on the surface only in the northern part of the map sheet (E of Kyjov). Here, on uplifted blocks, the weak Pannonian sediments were denuded and flat buried relief (planation surface ?) in the altitude of above 300 m was exhumed. However, the southern part of the uplifted block consists only of Pannonian sediments and between the small town of Bzenec and the village of Vlkoš ends with a gentle slope of about 100 m high. This WNW - ESE running slope faces the low accumulation relief of the Dolnomoravský úval (Graben) on eolian sands. Foot of this marginal slope of the northern part of the Kyjovská pahorkatina (Hilly land) is followed by the brook of Syrovinka, right tributary of the Morava river. In our opinion, the slope is of tectonic origin.

In the western surroundings of Kyjov the topographic contact between the Kyjovská pahorkatina (Hilly land) and the Dolnomoravský úval (Graben) is less distinct. Very gradual transition into higher relief is in weak Pannonian sediments in the altitude of 200 - 260 m. In this subdued relief, the important NW marginal fault (Bulhary - Schrattenberg) of the Vienna Basin runs contacting the Pliocene sediments and Paleogene flysch of the Ždánice nappe. Higher parts of this hilly land consist of untypical flysch (rather a molasse). Rests of the erosion surface truncate the folded structures of the nappe approximately in 320 m. The highest point of the hilly land, Babí lom (417 m) composed of Paleogene conglomerate protrudes above this surface.

Boundary of the Kyjovská pahorkatina (Hilly land) between the towns of Kyjov and Hodonín runs in a very shallow valley of the small rivulet of the Kyjovka flowing southwards to the Morava river.

4. Some landforms of the Dolnomoravský úval (Graben)

1. The most remarkable feature of Dolnomoravský úval (Graben) is a ring structure situated between Hodonín and Bzenec delimited by a broad floodplain of the Morava river on the East and its small right tributaries, Syrovinka on the N and Kyjovka on the W and SW. The structure developed on intensively faulted Neogene deposits (Ratíškovice - Bzenec blocks, T.Buday et al.1967) but these sediments (Pannonian and Pontian) crop out only in its highest SW part (the hill Náklo 265 m). This higher relief corresponds probably to the Vacenovice elevation composed of Neogene sediments and flysch of Rača unit. In flysch rocks the search for oil and gas was succesful long ago (see e.g. E.Menčík 1962).In this part of structure also Pannonian lignite is mined (the Dubňany seam).
2. However, the structure is also the largest area of wind-blown sands in the Czech Republic and this presents great interest both for geologist and geomorphologist. Although extensive literature exists (F.Vitásek 1942; J.Pelíšek 1943, 1968; M.Dlabač, M.Plička 1959; P.Havlíček 1980; P.Havlíček, A.Zeman 1986; A.Zeman et al.1986; D.Minaříková 1982), the problems of origin of eolian sands and formation of dunes are not fully understood. The greatest thickness occurs in northeastern part of the structure between Rohatec (village) and Bzenec (small town) up to 35 m. Here the sands are also intensively mined. A very difficult problem consists in relation of the wind-blown sands to floodplain sediments of the Morava river. Between the town of Strážnice and the largest sand pit the floodplain is only 2-3 km wide (in

comparison with more than 5 km upstream between the towns of Bzenec and Veselí nad Moravou (see profiles in P.Havlíček, A.Zeman 1986 and in P.Havlíček 1977). In a relatively short reach between the road from Strážnice to Bzenec and the village of Rohatec, the Morava river flows in a natural meandering channel (K.Kirchner, V.Nováček 1994). Owing to lateral erosion on outer side of the bends, the right bank which is composed of eolian sands is more than 7 m high, very steep and without any vegatation (the locality is named "Loose sands") .It is apparent, that before channelization, the floodplain was in process of widening also upstream of the road from Strážnice to Bzenec. Whereas in the profile at Strážnice only Neogene sediments are present under the floodplain deposits (P. Havlíček 1977, fig. 1b), in the profile at Veselí nad Moravou (5 km upstream) the fluviatile sandy gravels are underlained also by fluviolimnic sandy clays or clayey sands of Mindelian age (c.f. P.Havlíček, fig, 1a). These Lower Pleistocene sediments, some ten meter thick, fill deep depressions in Neogene sediments. Thus, thick Quaternary sediments (referred to by Z.Kouřil 1970, but without a more precise specification) in boreholes in the floodplain near its west margin composed of eolian sand are probably also of Lower Pleistocene age, but with regards to recent westward shift of the river, another explanation is cannot be excluded.

Although the continuous cover of wind-blown sands accumulated mainly in Uppermost Pleistocene, many individual dunes are probably of Holocene age (see F.Vitásek 1942). The longitudinal dunes (mostly of NNW-SSE direction) and also crescentic dunes occur mainly among the villages of Rohatec, Vacenovice and Moravský Písek. In the past, deforestation of territory activized eolian processes. Original deciduous woods (local name Dúbrava means the oak forest) were substituted with pine in the last century.

But eolian sands are known also from other parts of the Dolnomoravský úval (Graben), in adjacent part of Slovakia (Záhorská nížina Lowland, D.Minaříková 1973), and from small dunes in the floodplain of the Morava river. It is interesting that extensive area of eolian sands in the Záhorská nížina (Lowland) is on the left side of the Morava river, opposite than sands in the area Hodonín - Bzenec. Importance of fault tectonics in the Záhorská nížina (Lowland) is evident (D.Minaříková 1973) and is also proved in adjacent part of the floodplain of the Morava river (e.g. V.Baňacký 1993).

As regards isolated eolian sands in the floodplain, the main problem is again their relation to fluvial sands and gravels. According to P.Havlíček and A.Zeman (1986), the wind-blown sands are everywhere underlained with river sands and gravels. The authors suggest that the end of eolian accumulation was in the Uppermost Pleistocene or at the beginning of Holocene. Dune formation started probably in braiding floodplain and its microrelief was important.

3. The Hradiště Graben. The narrow Hradiště Graben is a northeast promontory of the Vienna Basin and the Dolnomoravský úval (Graben). Only its small southernmost part situated NE of the between Bzenec and Veselí nad Moravou is shown on the geomorphological map. The graben originated by downfaulting of flysch of the Rača nappe. Bordering uplifted structures are the Hlucká pahorkatina (Hilly land) on the E and Kyjovská pahorkatina (Hilly land) on the W . The graben is filled with Upper Miocene, Pliocene and Quaternary deposits (J.Dornič, J.Kheil 1963; P.Havlíček 1986). But some sediments originally believed to be Pliocene have recently been redated as Quaternary (see P.Havlíček 1986). Together with longitudinal faults continuing from the main parts of Vienna Basin also the cross faults of NW-SE direction were important in formation of the graben. This applies especially to the Boršice fault between the villages of Boršice and Uherský Ostroh. The cross faults are apparent in the adjacent part of the Kyjovská pahorkatina (Hilly land) where Pliocene sediments are preserved on uplifted blocks. Their high position is due to post-Pliocene uplift (E.Menčík, V.Pesl 1961). Almost a whole bottom of the graben is occupied by wide floodplain of the Morava river. Up to now, only in this part of the Dolnomoravský úval (Graben) the high river terraces have been described (P.Havlíček 1986). On the other hand, below the floodplain deposits of Würmian to Holocene age, the fluviolacustrine sediments (Mindel) occur. With this correspond also anostomosing channels of the Morava river, well preserved to the NE of Moravský Písek.

5. Anthropogenic relief transformations

In the southern Moravia and especially in the Dolnomoravský úval (Graben) traces of very ancient settlements have been evidenced. In the floodplain of the Morava river even three significant centres of Great Morava existed in 8th and 9th century, namely Mikulčice (about 10 km S of Hodonín), Staré Město in Uherské Hradiště (in middle part of Hradiště Graben) and Pohansko, south of the town of Břeclav near the junction of rivers Morava and Dyje .

Although anthropogenic influences in the present landscape are innumerable, most direct and indirect anthropogenic transformations of the relief (ATR) have originated in this century.

Exploitation of oil and gas as well as underground mining of lignite have only relatively a small impact on the landscape. Oil and gas were found not only in Neogene sediments,but also in flysch. The most productive structures of oil and gas were found mainly in Badenian and Sarmatian (T.Buday et al. 1961). On the territory of geomorphological map the thickness of Neogene sediments is limited and important deposits are only those of Hodonín and Vacenovice. At present, deep parts of the basin and its basement (including the buried Bohemian Massif) are explored. South of Hodonín the former gas deposit Hrušky is used as a reservoir for imported gas.

Lignite deposits are widespread in the surroundings of Hodonín, but their mining is very limited at present. The lignite is of Pannonia age. The present state of research and reserves has been published by B.Krejčí (1979), B.Krejčí-S.Žídková (1987) and B.Michálek (1987). Two lignite seams are the Kyjov seam, mined mainly at the NW margin of the basin and the Dubňany seam. The underground mining of lignite is complicated by fault tectonics and underground water. Impact of the mining on the landscape is relatively weak.

In the Vienna Basin there are also other great resources: building and ceramic materials, clays, sands, loess and sandy gravels there. Many pits and open mines exist there. In the past, there were many mining places there (see J.Kalášek 1950) but after the revolutionary change of 1948, especially small pits were closed and filled with municipal waste. At present, the wind-blown sands are intensively mined mainly west of Strážnice with undesirable aesthetic impact (K.Kirchner, V.Nováček 1991).

Soil erosion also presents a serious problem, especially in the area composed of weak Pliocene sediments (Kyjovská pahorkatina - Hilly land). This is often apparent in thin incomplete soil profiles (R.Schwarz 1950). Intensive processes of gully and rill erosion during thunderstorms were studied in detail by O.Stehlík (1953) in the surroundings of Bzenec. In the past, many slopes were terraced. Many of these forms are product of unintentional long term evolution and have not any impair effect on the landscape. However, in the 70 s, the large areas were terraced insensitively as emergency drive with the use of heavy machines. In some cases the impact was terrible.

In the last century, the greatest changes were made in floodplains, namely those of the Morava river. As in other areas, the study of floodplains in South Moravia shows that great thickness of fine-grained floodplain deposits was in connection with deforestation, agriculture and changes of hydrological regime in the Middle Ages (e.g. E.Opravil 1983). Many subfossil soils occur in floodplains of the Dolnomoravský úval (Graben) (P.Havlíček 1977,1980; P.Havlíček, M.Smolíková 1994).

The prevailing part of the flooplain was deforested and changed into meadows and pasturelands. With the exception of a short reach downstream of the road from Strážnice to Bzenec, the Morava river was channelized and even the canal for transport of lignite to Otrokovice was built by fa Baťa in the 40 s. After World War II, the meadows were gradually transformed into arable land with necessary destruction of floodplain micrforms. Due to the use of heavy machines in agriculture, surface of the flodplain was very rapidly nivellized, perhaps in less than 20 years (A.Ivan 1980).

Because the Morava river is the only larger river in the Czech Republic without any important dam, danger of periodic floods still exists. In the geomorphological map special attention was given to direct anthropogenic transformations and these are very distinct in the floodplain of the Morava river.

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Explanations to the map - Appendix No.1

RELIEF TYPES

1. Gently undulated highland composed of flysch, with remnants of planation surface
2. Dissected hilly land composed of Neogene sediments with preponderance of slopes
3. Foot hills composed of Neogene sediments with remnants of planation surface and discontinuos cover of eolian and slope sediments
4. Undulated hilly land composed of Neogene sediments with extensive planation surface
5. Undulated hilly land composed of Neogene sediments with discontinuos cover of Quaternary sediments
6. Undulated hilly land composed of wind-blown sands

SELECTED FORMS

7 - Knobs
8 - Landslide area
9 - Tectonic lines along foot of slope
10 - Great gullies
11 - Active lateral erosion
12 - Low river terraces
13 - Alluvial cones
14 - Floodplains
15 - Shallow floodplain depressions filled with swamp deposits
16 - Less distinct oxbow lakes
17 - Well distinct owbow lakes
18 - Distinct dunes
19 - Area strongly affected by man
20 - Area of underground mining of lignite
21 - Active mines
22 - Inactive mines
23 - Active open mining of sand
24 - Small active sand and loam pits
25 - Small inactive sand and loam pits
26 - Dumps of waste
27 - Setting pits
28 - Dikes
29 - Channelized watercourses
30 - Agricultural terraces
31 - Deep road cuttings changed in gullies

OTHERS

32 - Significant view-points
33 - Distinct landforms boundary
34 - Undistinct landforms boundary

Explanations to the fig.

1 - Ždánice flysch
2 - Magura flysch
3 - Sarmatian sediments
4 - Pannonian sediments

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Reviewer

Doc. RNDr. Alois HYNEK, CSc.

The locality "Osypané písky" (Loose sands) is unique area with relatively natural development of the Morava river bed on the broad floodplain with collection of the vegetation association.

Photo: K.Kirchner, V.Nováček

In the west of Strážnice territory (built of wind-blown sands) is situated large sand-pit. The nothern part is already computely explited and the lateral face of the sand-pit is succesively suitable recultivated.

Photo: K.Kirchner, V.Nováček

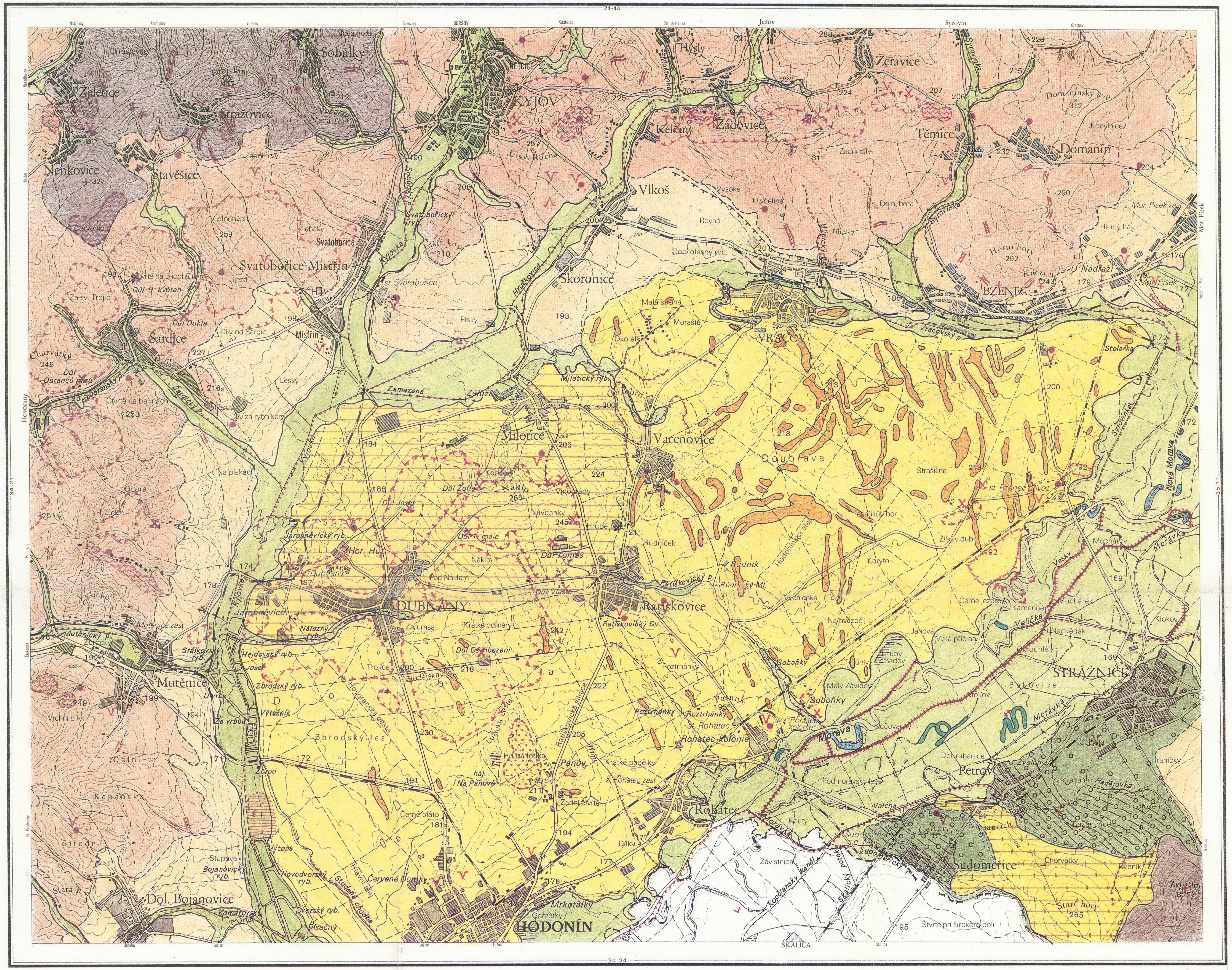
The Morava floodplain near Strážnice (SE Moravia) belongs among such valuable territories, the river forms here large meanders in the meander belt.

Photo: K.Kirchner, V. Nováček

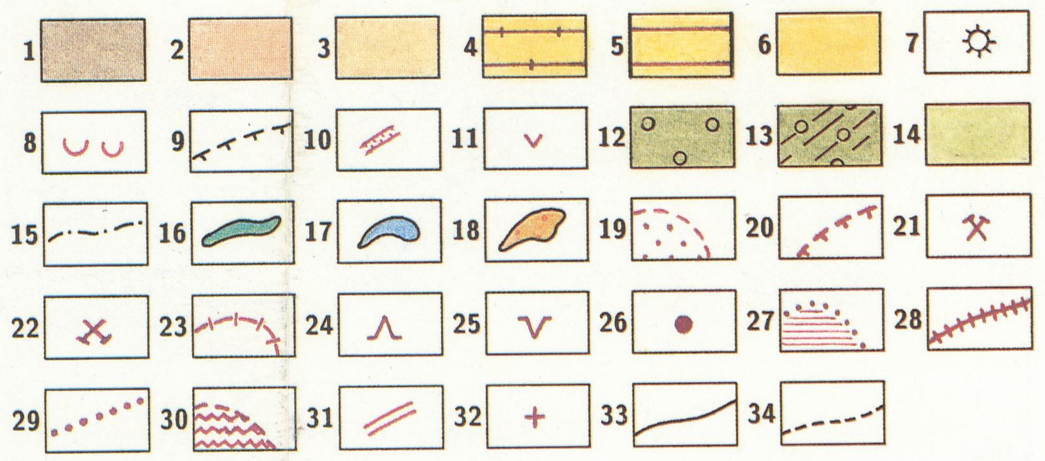
1

TYPY RELIÉFU A VYBRANÉ TVARY

34-22 Hodonín



LEGENDA:



TYPY RELIÉFU:

1 - plochá vrchovina na flyši se zbytky plošinných tvarů; **2** - členitá pahorkatina na neogenních sedimentech s převahou svahových tvarů; **3** - úpatní pahorkatina na neogenních sedimentech s plošinnými tvary a nesouvislým pokryvem eolických a svahových sedimentů; **4** - plochá pahorkatina na neogenních sedimentech s převahou plošinných tvarů; **5** - plochá pahorkatina na neogenních sedimentech s nesouvislým kvartérním pokryvem; **6** - plochá pahorkatina na eolických píscích.

VYBRANÉ TVARY:

7 - suky; **8** - plochy postižené sesouváním; **9** - úpatí svahů vázaná na tektonické poruchy; **10** - významnější strže; **11** - výrazné projevy boční eroze; **12** - nízké říční terasy; **13** - větší náplavové kužely; **14** - údolní nivy; **15** - mělké deprese v údolní nivě, zaplněné hnilokaly; **16** - málo výrazné zbytky mrtvých ramen; **17** - výraznější zbytky mrtvých ramen; **18** - větší individualizované přesypy nebo skupiny přesypů; **19** - území výrazně přemodelované antropogenní činností; **20** - hranice poddolovaných území; **21** - hlubinné doly - aktivní; **22** - hlubinné doly - opuštěné; **23** - rozsáhlé tvary vzniklé povrchovou těžbou písků - aktivní; **24** - tvary vzniklé lokální povrchovou těžbou (hliníky, pískovny) - aktivní; **25** - tvary vzniklé lokální povrchovou těžbou (hliníky, pískovny) - opuštěné; **26** - skládky odpadů; **27** - odkalovací nádrže; **28** - inundační hráze; **29** - upravená koryta vodních toků; **30** - větší plochy kultivačních teras; **31** - větší a hlubší úvozy polních cest.

JINÉ:

32 - vyhlídkové body; **33** - hranice tvarů - ostré; **34** - hranice tvarů - méně zřetelné.

1 : 50 000

1 cm = 500 m

1000 m 500 0 1 2 3 4 km

Základní interval vrstevnic 10 m

SOUBOR GEOGRAFICKÝCH MAP ŽIVOTNÍHO PROSTŘEDÍ

TYPY RELIÉFU A VYBRANÉ TVARY

List 34 - 22 Hodonín, měřítko 1 : 50 000. Zpracováno v rámci projektu E 5.5 "Inventarizace, evidence a evaluace ekosystémů České republiky". Odpovědní řešitelé podprojektu "Evidence stavu a geografické hodnocení biotopů České republiky": ing. Jan Lacina, CSc., RNDr. Vítězslav Nováček, CSc.

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Tisk: GEODÉZIE BRNO a.s., 1993

Vydáno péčí Ústavu geoniky AV ČR, pobočka Brno