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# GEOGRAPHY OF THE SOILS IN THE WEST CARPATHIANS AND INNER-CARPATHIAN LOWLANDS

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In the work a modern geography of soils is given, namely of a territory with very complicated physicogeographical conditions. In the mountains the lines of vertical zonality of soils run about 800, 1400, 2000 and 2500 m above sea level. Intrazonal structure of the soil cover is characterized by soil toposequences and catenas. Many relic soils and relic soil phenomena have been stated in the soil cover, the occurrence of which regularly geographically arranged, too, but conditioned by other than recent climatic influences.

## INTRODUCTION

The soil — in a more accurate geographical meaning — the soil cover, is one of the basic elements of every terrestrial ecosystem and in a wider sense of word also landscape system. Bonds between abiotic and biotic landscape elements are concentrated in the soil, and namely not only in a matter-energetic sense, but also in that providing information (information as a property of the matter as well as a ratio of reflection).

This integrative character of the soil in a landscape space means consequently that on one hand the soil exerts a striking influence on both the matter and energetic balance of particular landscape, but on the other the soil and its particular properties are result of a concentrated acting of the other landscape elements as soil-forming factors. Along with the development of the landscape and with change of its constituents also the interacting influence of soil-forming factors was changed, to which the soil thanks to its ability of resistance, selfregulation and evolution reacted in various ways and to different extents.

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From the knowledge of coevolution of soil and landscape it results that without respecting that relationship it is impossible to solve any problems of protection, planning, or utilization of the landscape. The human possibilities in both managing and controlling the landscape development are relatively large, but they always are accompanied with reaction of all the constituents, that means not only of that changed by man. Therefore it is necessary a correct choosing of interventions into the landscape as well as foreseeing consequences of interventions in relation to the other components.

Significance of the soils results from the complex of its functions within the landscape. The primary one, but not the only, is its fertility, which is the basis for the nourishment of manking and significant in optimal land utilization as well as an inexhaustible source to produce a whole series of raw materials.

Another significant function lies in ability of water retention and water regime control in the landscape, sanitary and detoxication abilities and together with vegetation also landscape surface protection against destruction. Within the global significance the planetary-energetic function of the earth's soil cover is significant, i. e. the accumulation of solar energy in the humus, soil organisms as well as in the vegetable matter, which is of a great significance for the energetic balance on the earth's surface and for optimal development of human society in the future.

At the same time the soil cover is a very variable formation in the space and time and thus also the above mentioned functions are variable with their quantity. This variability, however, is not chaotic, certain regularities exist here, which are just the object of the study and definition of regularity in soil geography.

## AN OVERVIEW OF PRINCIPLES IN SOIL GEOGRAPHY

The geography of soils is based on real recognition of the regularity of spatial differentiation of soil cover, that means particularly on recognition of spatial differentiation regularities as to relationships between the soil and the other elements of the landscape. Geographical regularities must express such a relationship that also after empiric verification is truthful. Since the definition of mentioned regularities in a form of the soil-geographical law is (in a cybernetic interpretation by W. R. Ashby 1961 et al.) always a restriction of a variaty from a set of possible phenomena, the soil-geographical laws are of a significance from the viewpoint of structure prediction, behaviour and complexity of particular soil cover parts, but respective landscape, too.

Alas soil geography as a scientific branch did not developed in the above mentioned direction in its history. Attention was paid to either a simple description of the distribution of soil units and to a statement of local relationships between soils and soil-forming factors, or only the soil zonality law was accentuated too unilaterally, the law becoming in this way more or less an abstract axiomatic notion (B. G. Rozanov 1977, p. 45). In the space application of this law was accompanied with a great number of exceptions and irregularities, so that it was stated that it cannot be usable in this form (S. A. Harris 1968, V. Linkeš 1976, G. Dobrovoľskiy 1970, J. Hraško 1979 and others). By means of the zonality law also large spatial toposequences of soils were interpreted (named by J. Fink 1958 gross-catena), which is in a contradiction, as mentioned below, in relation to the basic law of thermodynamics.

Another imperfection of soil geography (but also pedology) lay in that the facts of different age of soil cover units, the polygenetic character of their origin and development as well as that of resistance, self-regulation ability, geochemical and petrographical soil convergence were relatively little accentuated.

Modern soil geography lately began to be interested in all the aspects of soil cover structure. Similarly as in any natural system also in the case of soil cover we can apply the aspect of qualitative composition (inventory of polypedons, i. e. elements of certain part, for instance, of a region), the aspect of relationships and bonds between its elements (toposequences and catenas expressing certain paragenetic relationships), the aspect of function of such systems (protecting, producing, ecological functions) as well as the aspect of qualitative complexity. Within the latter one we have proposed and evaluated the complexity and contrastness of part of the soil cover, i. e. of that agriculturally used, by means of both the entropic measure of complexity and the calculation of contrastness of the elements from the viewpoint of production (V. Linkeš 1985).

Our present-day opinions on the problems of geographical regularities of the soil cover are interpreted on example of the West Carpathians territory.

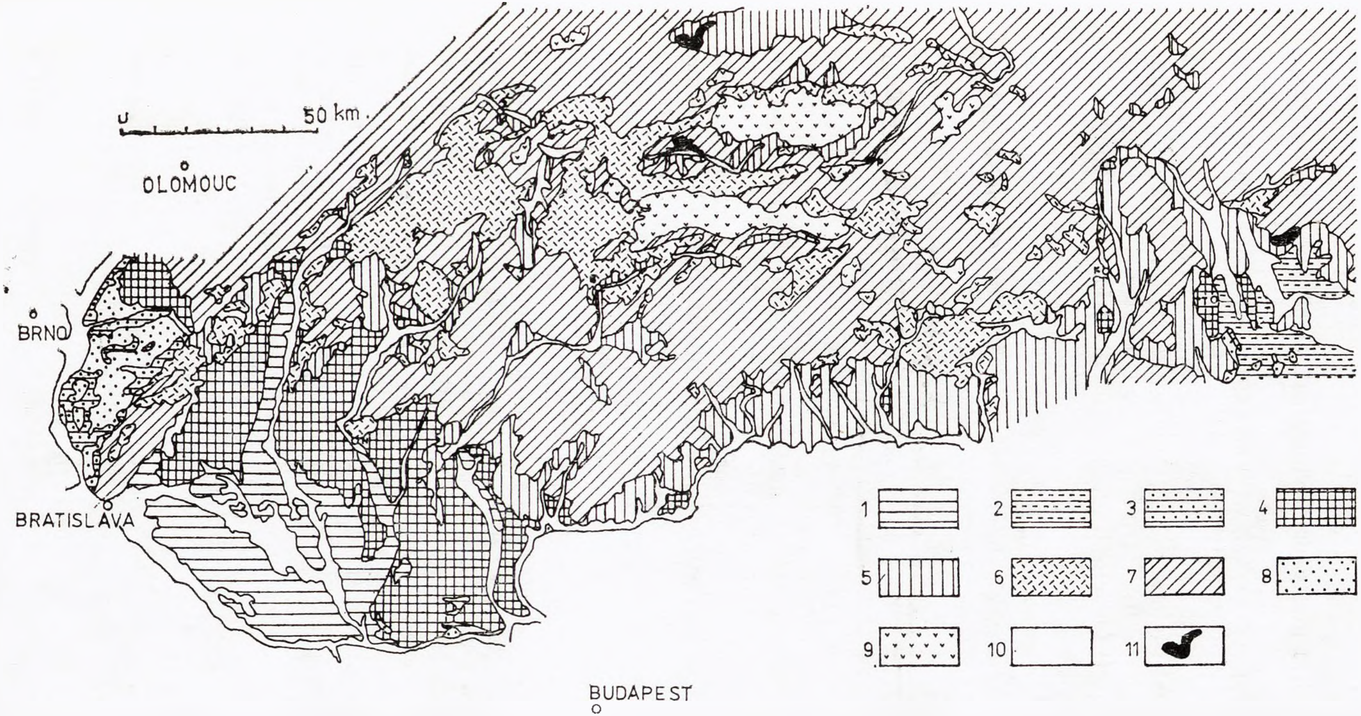
## TYPES OF SOIL-GEOGRAPHICAL REGIONS IN THE WEST CARPATHIANS AND ADJACENT PART OF THE INNER-CARPATHIAN LOWLANDS

Both the West Carpathians and the adjacent part of inner-Carpathian lowlands form, from petrographical and geochemical viewpoints, an exceptionally complicated territory. The complicated geomorphologico-geological structure, dissected relief (altitude of the territory above sea level ranging from 100 to 2655 m) and the corresponding differences in climatic factors (average annual temperature from 10.5 to —2 °C, precipitation from 550 to 2400 mm) have conditioned that in the soil cover of this territory most soils of the moderate belt occurs, but there are also several relict soils, which arose in other climatic belts as a result of the climatic oscillation since the end of the Tertiary. These soils possess many characteristics as a result of irreversible processes, which, in turn, make possible reconstructing the development of the whole country.

The basis for the development of modern soil geography was both the complex soil survey of agricultural soils (J. Hraško, J. Němeček 1963, J. Němeček et al. 1967) and a modern investigation of agricultural and forest soils (J. Hraško 1965, 1971, 1974, V. Linkeš 1967, V. Linkeš, J. Čurlík 1973, Z. Bedrna 1977, R. Šály 1962, 1978, 1986, M. Koreň 1984 and others).

From an analysis of these factographic cartographical basal materials and works devoted to soil geography in a non-traditionalist approach (J. Hraško, V. Linkeš 1972, J. Hraško 1979, V. Linkeš 1976, 1981 and others) it results that the soil geography of the territory described is regularily conditioned by:

— position of the territory in the moderate belt,
— vertical dissection of the territory, which in turn makes conditions for differentiation of both the climate and vegetation,




Map 1. The soil-geographical regions in the West Carpathians and in adjacent part of the inner-Carpathian lowlands: *1* — region of paleo-hydromorphic to recent-hydromorphic accumulation of humus, Ca, Mg and locally also Na carbonates; *2* — region of recent-hydromorphic to paleo-hydromorphic accumulation of humus and non-carbonaceous clayey alluvial sediments; *3* — region of recent-hydromorphic to paleo-hydromorphic accumulation of humus and non-carbonaceous sandy sediments; *4* — region of humus accumulation and processes of carbonate pulsating, weathering and lessivage on loesses; *5* — region of striking lessivage and pseudogleyization on loessy loams and deluvial-fluvial sediments; *6* — region with lithogenetically conditioned accumulation of dark forms of humus on the deluvia of hard carbonate rocks; *7* — region of weathering and humus accumulation in an acid to slightly acid parent rocks, locally accompanied with pseudogleyization; *8* — region of slight accumulation of humus, non-striking weathering and locally non-striking podzolization on non-carbonate blown sands; *9* — region of podzolization and humus accumulation with a tendency to become peat; *10* — recent intra-regional and extra-regional fluvisols; *11* — artificial water reservoirs.

— petrographical and geochemical structure as well as evolution of covering formations (soil-forming substrates),
— geomophological structure and geomorphological development of the territory,
— anthropogenic influences connecting with soil cultivation and various forms of the landscape space utilization in a historical aspect.

Particular characteristics of such a conceived approach to soil geography is mentioned in the individual regions of the typological soil-geographical regionalization of Slovakia (J. Hraško 1979), which are defined on the principle of dominant association of soil-forming processes in historical development of the territory (Map 1).

### *The region of paleo-hydromorphic to recent-hydromorphic accumulation of humus, Ca, Mg and locally also Na carbonates*

It is formed by an area of river alluvia in the Danube Plain. Paleomorphic accumulation of dark mollic humus horizons, which come from a period at least 2500 years ago (J. Hraško 1974), but probably also from a much older period, is the dominant soil-forming process. Another form is a recent (subrecent) hydromorphic accumulation of light humus horizons and mud loams on aggradation levees of the streams. Concomitant soil-forming processes are both relic and recent gley processes in various depths of the soil profile, and in small localities those of salinization or forming peat. All the processes mentioned exist in conditions of high contents of autigenic and also allochthonous carbonates as well as in those of an intensive soil cultivation and land reclaiming. Development of the region, approximately since the 13th century displays a tendency of desiccation (becoming a steppe) of the soils. The soil cover is differentiated particularly in dependence from the altitude of underground water level and from the recent river inundation reached. The basic toposequence is formed by: calcaro-haplic chernozem[1] in the highest situated localities, which are out of the influence of underground water level, further an intermediate subtype of haplic phaeozem, and at last fluvi-calcaric pheozem in lower situated localities, which are under the influence of capillarily supported water during most part of the year. There are fluvi-mollic gleysols and very frequently eutric histosols in depressions. In depressions with a weak draining of water in contact with hilly lands and usually where impermeable Neogenic sediments occur near the surface mollic solonetz is constituent of the association. In areas with recent inundation the toposequence is formed by: calcaric fluvisol in the driest sites of the aggradation river levees, while in depressions fluvi-eutric gleysol to calcaric gleysol. Here the soil toposequence contents burried mollic horizons of phaeozems.

### *The region of recent-hydromorphic to paleo-hydromorphic accumulation of humus on predominantly non-carbonaceous clayey alluvial sediments*

The region is formed by the river alluvia of the East-Slovakian Lowland with a characteristic soil-forming process of a recent hydromorphic accumulation

[1] Nomenclature of FAO/UNO soil classification has been employed in the work.

of humus and intensive gleyic processes, which are pointed up with a clayey soil texture together with indications of vertic effects (self-mulching, striking changes in soil volume when dry and moist). Relic phenomena of sulphate saline processes occur locally in a depth under 1 m and also solonetz processes in non-drained depressions. The region is combined particularly in the southern part with occurrence of blown sand dunes. The differentiation of soil cover is conditioned by the microrelief, the depth of underground water level and sporadic occurrence of blown sand dunes. The basic toposequence of the alluvium is formed by: eutric fluvisol typical in the driest and highest sites of river aggradation levees and in lower parts of alluvia, fluvi-eutric gleysol to eutric gleysol in sites with a clayey texture, verti-eutric gleysol with indications of vertic effects, somewhere with a deep relic saline phenomena. On the blown sand dunes there are eutric regosols. In depressions of the alluvia of some rivers also very heavy fluvi-mollic gleysols and sporadically also solonetz occur. The whole region is intensively cultivated and reclaimed.

### *The region of a recent-hydromorphic to paleo-hydromorphic accumulation of humus on non-carbonaceous sandy alluvial sediments*

It occurs on alluvia of the Morava with its tributaries and is characteristic with the same soil-forming processes like the previous regions except for saline processes, which are missing here. Another characteristic feature is a large representation of sandy alluvial sediments. Also the differentiation of soil cover is conditioned by analogical factors, i. e. by the altitude of ground water level and the recent inundation too. The basic toposequence is formed by eutric fluvisol and fluvi-eutric gleysol to eutric gleysol in the area of the Morava river aggradation levee. Another part of the alluvium is formed by sandy phaeozems and in depressions by fluvi-mollic gleysols to eutric histosols. The two types of topesequence determinate also the two types of landscape units.

### *The regions of humus accumulation and processes of the carbonate „pulsating“, weathering and lessivage on loesses*

The regions are formed by loessy hilly lands, which are most extensive in the Danube Lowland, the Lower Morava Vale and in relatively small localities also in the East-Slovakian Lowland. The altitude of loessy hilly lands ranges from 140 to 300 metres above sea level and within this the following soil catena occurs: In higher and more dissected parts of hilly lands (300—200 m a. s. l.) orthic luvisols and eroded orthic luvisols occur. In the lower part of the hilly lands, only slightly undulate (200—140 m a. s. l.), there are luvi-haplic chernozems, haplic chernozems and calcaro-haplic chernozems successively. In depressions mollic gleysols occur and locally (if the loesses are at the level of alluvia) solonetz, too (Tvrdošovce, Poľný Kesov). This soil differentiation is visibly conditioned by position of the individual members of the catena in the micro- and mesorelief and originated in different conditions of the primary water regime. The first part of the catena formed by luvisols developed in terrestric conditions during the whole period of their existence (i. e. probably since the Late Würmian) as a result of carbonate leaching, weathering and lessivage processes, which are, however, little intensive, because the horizon of autigenic carbonates is, up to the present day, in a depth of about 0.8 m under the surface. The second part of the catena formed by chernozems developed probably in the initially semi-hydromorphic conditions with a gradual transition to terrestric conditions. This opinion is substantiated by the results of studying carbonates, especially by the occurrence of autigenic dolomite (found by J. Hraško 1974), indirectly by analyzing the humus age by $^{14}C$ method, which in bottom parts of A horizons ranges from 6000 to 10,000 years (E. Vaškovská, Z. Bedrna 1985 and others) as well as by pedogeographical analyses in studying the catena (V. Linkeš 1975). Lately we have found a linear dependence of the altitude of autigenic carbonate occurrence in chernozem profiles, namely on the relative altitude of locality with respect to the alluvia of water streams in loessy hilly lands. This shows the influence of underground water level altitude with its capillary periphery on both the origin and the altitude of carbonate horizon as well as the so called pulsating of the horizon (J. Hraško 1965). The carbonate pulsating is to be conceived in both the recent meaning (the dry and moist period of the year) and in that of historical evolution of underground water levels. The occcurrence of luvi-haplic chernozems is not conditioned by the so called degradation, but location in the contact between luvisols and chernozems. The semi-hydromorphic origin of the chernozem part of the catena is proved beside this area also from other ones by several authors (V. A. Kovda 1973, R. Turski 1985 and others). The traded hypothesis of the mentioned soil cover differentiation in inner-Carpathian lowlands as influenced by the climate cannot be adopted, inter alia, also because of being in contradiction to the basic laws of thermodynamics. According to V. R. Volobuyev 1973 and B. G. Rozanov 1977 the zonality of soils, that is to say, is caused by differences in the balance of solar energy ad moistening, in other words, by differences in values of the energy of solar radiation entering the soil (Q). It is apparent that the soil zones, the belts, as areas of zonal soils distinguishable at a high taxonomic level of their classification arose only at sufficiently striking differences in parameters Q. If we compare the values Q calculated for the particular soil zones beginning from the zone of chernozems up to the zone of tundra soils (V. R. Volobuyev 1973) with those calculated for the territory being described by us, we can see that while the range (min-max) of Q for mentioned part of the Earth's latitudinal zones reaches a value of 135 $kJ.m^{-2}$ per annum, the range for the West Carpathian mountain ranges is represented only by 21 $kJ.m^{-2}$ per annum and for northern part of the inner-Carpathian lowlands only by 8.4 $kJ.m^{-2}$ per annum. This is a too small difference to give rise the same soil spectrum like in the part of the Earth's soil zones above mentioned, which, however, is not in a contradiction with the differences found in parameters of the hydrothermic regime — the catena of lowlands (as found by Z. Bedrna 1978).

*The regions of striking lessivage and pseudogleyization on loessy loams and deluvial-fluvial sediments*

These regions are formed by hilly-land areas along the contact between the mountain ranges and the lowlands, frequently also with a deep penetration into the lowlands, as well as by predominant part of the intramountain basins. The sites with their occurrence range between 150 and 800 m above the sea level, and thus also difference in value of the solar radiation energy entering into the soil is greater than in the previous regions. Within this part of soil cover the vertical zonality of soils, however, manifests itself only slightly (approximately from 700 m above sea level), namely in the amount and quality of humus and also in the character of humus horizon. Differentiation of this part of soil cover of the regions in influenced by mineralogical and geochemical differences in the soil-forming substrates (including their stratification) and microrelief. The basic catena of these regions is formed by albo-gleyic luvisols to stagnogleyic luvisols, in microdepressions planogleyic luvisols, or in altitudes above 700 m above sea level histo-humic planosols and on edges of the alluvial cones eroded forms of these soils. The characteristic feature of the soils mentioned is a striking textural differentiation of their profile. The silty humus and eluvial horizon (A + E) with an average thickness of about 0.40 m is the matter, under which there is mostly a very coarse clay-loamy to clayey argillic B horizon with pseudogley phenomena. At present these horizons are considered as results of the geological stratification more than of pedogenetic processes. Within the described area (Bátka) it is reflected also by the age of humus from the humus horizon of a stagno-gleyic luvisol buried under the A + E horizon, which in a depth of 50—60 cm was dated by means of $^{14}C$ to 7 358 ± 95 years AMRT. At a carbon contamination in later periods, which in this depth is topical, we may suppose that these soils were covered by silty A + E horizons towards the end of the Late Würmian. The relic character of B horizon of luvisols to stagno-gleyic luvisols with phenomena of cryogenesis and paleohydromorphism is presupposed by several authors (E. Mückenhausen 1963, L. A. Gugalinskaya 1980 and many others).

In the area described we have ascertained in them both solifluction phenomena (Lipt. Kokava) and B horizons covered with Late-Würmian glaciofluvial sediments (the foot of the High Tatras, V. Linkeš 1984).

*The region with lithogenetically conditioned little striking processes of accumulation of humus, brunification and podzolization on silicate blown sands*

This is represented by the hilly-land area of the Záhorská Nížina Lowland with blown sands and with their transitions to low river terraces. The composition of soil association is formed by eutric regosols with thin ochric humus horizon, under which there is a substrate, probably water-transported blown sands with a relatively higher share of silty and clayey particles. This part of the association is intensively utilized in agriculture. On higher portion of the hilly land formed by dunes of blown sands, under the forest vegetation with predominant pine ferro-orthic (humic) podzols occur with a non-apparently developed spodic horizon or also soils with a touch of cambic horizon (cambic arenosols). Very small localities of this soil association occur also in other regions in the sub-Carpathian lowlands.

### *The regions with lithogenetically conditioned accumulation of dark forms of humus on hard carbonate rocks*

Within the area of the West Carpathians there are large territorial units built of various kinds of limestones and dolomites, namely from 150 up to 2100 m above sea level. In the soil cover of these regions we have ascertained an apparent zonality manifesting itself in leaching-out intensity in carbonates and in properties of the humus horizons. Up to an altitude of about 800 m a. s. l. orthic and cambic rendzinas occur in association of the soils, from 800 to 1300—1400 m a. s. l. leached and histo-humic tangle rendzinas prevail, with higher contents of humus with wider relation C : N, and in altitudes above 1300—1400 m there are complexes of rendzinas with a relatively thick humus horizon overlying. A something different composition of vertical zones is in mountain ranges built of marly limestones and marlites, where cambic rendzinas to cambisols prevail (V. Linkeš, J. Čurlík 1973, J. Koreň 1984). Significant element in the soil cover of these regions is the occurrence of relic rubification phenomena in relic soils allied to (terra rossa — terra fusca). They occur only on remnants of the so called mid-mountain and river levels as well as in localities of Pleistocene travertines. Thus, the relics come from a period of the mid-Pleistocene up to the Upper Miocene. This fact supports a great stability of basal parts of the soil cover in these parts of the regions, but at the same time also an older age of the soils overlapping them. The basic type of catena in areas with rubification phenomena consists of lithic and orthic rendzinas on convex forms of the relief (where the rubified soils were removed by denudation processes from), and in depression positions it consists of chromic rendzinas and chromic luvisols, or of albo-gleyic luvisols in localities of loessy loams coverings. In the other regions the catena consists of lithic and orthic rendzinas on convex forms of the relief and in depression positions it consists of cambic rendzinas as a result of erosion-accumulation differentiation in non-carbonate products of limestone and dolomite weathering.

### *The regions of primary minerals weathering and humus accumulation on acid to slightly acid parent rocks, in places accompanied with pseudogleyization*

These form a most extensive area. The soils of these regions arose predominantly on weatherings of acid rocks of the crystalline complex, further on weatherings of slightly acid neovolcanic rocks, flysch claystones and sandstones as well as Mesozoic slates. Mineralogical, geochemical and textural character of these rocks manifests itself, in general, strikingly in intrazonal regularities of the soil cover structure and also in the vertical zonality proper. Approximately up to 800 m a. s. l. on acid rocks dystric cambisols occur, while on weatherings of the other rocks eutric cambisols are present. From 800 to 1300—1400 m on acid rocks there are spodo-dystric cambisols with an extremely low basic saturation of the cation-exchange complex and on the other ones dystric cambisols with a lowered saturation of the cation-exchange complex. The zones mentioned differ from each other also in contents of the humus, which increases strikingly with the altitude. A significant contribution of the geography of soils of these regions were in recent years the results of studying structure of the West-Carpathian slope sediments (R. Šály 1986) indicating a large difference rate in the age of particular strata and in correlation with this fact also that in the age of the soil horizons (a polygenetic and polychronic character of these soils in extent from the Early Würmian up to the Pre-Boreal). Another contribution consists in ascertaining and characterizing andosols, or also andic cambisols among the forest soils (R. Šály 1978) on weatherings of neovolcanites, which have lately been found by us also in an area of agricultural soils (environs of the Sitno, or of the Poľana Mt). The basic catena of these regions modified according to the vertical belt and the type of rock consists of cambic rankers in the places where solid rocks come to light, further slopewards it consists of dystric or eutric cambisols and in depression positions and in lower parts of the slopes there are stagno-gleyic cambisols or even gleysols.

### *The regions with podzolization process and accumulation of humus*

In most cases they cover summit parts of the mountain ranges built of rocks of the crystalline complex or quartzites and quartz sandstones. In small localities, however, they occur also on quartz blown sands (Záhorie land), so that the extent of podzol occurrence ranges from 200 up to about 2500 m a. s. l. The podzol occurrence is not bound to certain altitudinal range and on most morainic sediments, but also on some glaciofluvial and older periglacial cones they run up to the foreland of mountain ranges (High Tatras, Western Tatras, northern part of the Lower Tatras). A vertical zonality within this part of soil cover, however, exists too, but on the basis of parameters of properties of these soils, particularly as to the thickness and character of AE horizon, the contents of humus in B horizon or also as to the ratio C : Fe in B horizon (S. Skiba 1977, V. Linkeš 1981). The main belt of ferro-humic podzols occurs from 1300—1400 up to 1800—1900 m a. s. l. Above this altitude there is a belt of podzols, in which AE horizon grades into an overlying histic horizon. According to several features (those of solifluction, cryogenesis, correlation with geomorphological elements) we have found large part of podzols in the Tatras to be relic, evidently of a pre-Holocene age. The catena of these regions consists always of lithosols, spodic rankers and podzols. Relationship between the elements of the catena and the relief is not regular, for instance, orthic podzols occur even on slopes with a gradient of about 30°. In general, we may state that podzols occur on very stable elements of the relief (stable parts of slopes, the surface of moraines), supposing that their compact B and B/C horizons contribute strikingly to the surface to be stable, for instance, against erosion acting.

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# GEOGRAFIA PÔD ZÁPADNÝCH KARPÁT A VNÚTROKARPATSKÝCH NÍŽIN

Výsledky moderných prác, týkajúce sa geografie a genézy pôd z územia Západných Karpát a priľahlej časti vnútrokarpatských nížin, prinášajú nové informácie o zákonitostiach diferenciácie, resp. stavby pôdneho pokryvu. Tieto informácie sú dôležité až kľúčové pre pedológiu, poľnohospodárstvo a fyzickú geografiu.

V práci konštatujeme, že v popisovanom území existujú prejavy klimaticky podmienenej zonálnosti pôd, ale nie v tej forme, ako sa donedávna uvádzalo. Zóny výškovej pásmovitosti sú nasledovné:

Do výšky 700—800 m n. m., kde patria hodnotené nížiny aj nižšia časť pohorí, sa zonálna diferenciácia pôdneho pokryvu neprejavuje ani na úrovni najnižších taxonomických jednotiek pôd, iba v malých zmenách parametrov termického režimu pôd. Toto pásmo je veľmi pestré z hľadiska kompozície pôdnych i pôdnotvorných procesov, preto je veľmi ťažké nazvať ho podľa zonálnej pôdy alebo pôdotvorného procesu. Ďalšia zóna predstavuje územie vo výške od 700—800 do 1300—1400 m n. m., ktorá sa líši od predchádzajúcej zreteľne klimatickým vplyvom na vylúhovanie báz, zvýšenie kyslosti pôdnej reakcie a hromadenie obsahu humusu aj v tendencii tvorby výraznejších nadložných humusových horizontov, a to u pôd na všetkých druhoch pôdotvorných substrátov. Zóna od výšky 1300—1400 do približne 2000 m n. m. a zóna nad touto hranicou sa vyznačujú a líšia viac v parametroch niektorých pôdnych vlastností ako v taxonomických jednotkách, ale v definíciách týchto jednotiek sa nedostatočne zohľadňujú uvedené zmeny (nie sú definované osobitné taxóny pôd so zreteľne hrubším nadložným humusovým horizontom). Uvedené zóny výškovej pásmovitosti sú zdôvodniteľné aj z termodynamického aspektu, pretože vo výškovom rozpätí Západných Karpát je dostatočne veľká diferenciácia hodnôt slnečnej radiácie vstupujúcej do pôd a hodnôt zavlaženia.

Pre geografiu pôd a oblasti jej aplikácie je však rovnako dôležitá intrazonálna stavba pôdneho pokryvu, ktorá vykazuje preukazné zákonitosti vo vzťahu k stavbe, vlastnostiam pôdotvorných substrátov, geomorfológii i vo vzťahu k rôznemu veku pôd a ich fenoménov. V práci uvádzané základné pôdne toposekvencie a katény charakterizujú jednotlivé typy pôdnych regiónov ako paragenetické zoskupenia pôd, opakujúce sa v priestore. To znamená, že môžu byť zovšeobecnené ako pôdnogeografické zákony s možnosťou ich využitia pre predikciu stavby i správanie sa konkrétnych štruktúrnych celkov pôdneho pokryvu. V definovaných typoch toposekvencií a katén je konštatovaný polygenetický a polychrónny charakter pôdneho pokryvu s veľkým zastúpením reliktných pôdnych fenoménov.

Mapa 1. Pôdno-geografické regióny Západných Karpát a priľahlej časti vnútrokarpatských nížin: *1* — región paleo-hydromorfnej až recentne-hydromorfnej akumulácie humusu, karbonátov Ca, Mg a lokálne aj Na, *2* — región recentne-hydromorfnej až paleo-hydromorfnej akumulácie humusu a nekarbonátových ílovitých aluviálnych sedimentov, *3* — región recentne-hydromorfnej až paleohydromorfnej akumulácie humusu a nekarbonátových piesočnatých sedimentov, *4* — región akumulácie humusu, pulzácie karbonátov, zvetrávania a lessivácie, na sprašiach, *5* — región výraznej lessivácie a pseudooglejenia na sprašových hlinách a deluviálno-fluviálnych sedimentoch, *6* — región litogénne podmienenej akumulácie tmavých foriem humusu na delúviách tvrdých karbonátových hornín, *7* — región zvetrávania a akumulácie humusu v kyslom až slabo kyslom prostredí, lokálne sprevádzané procesmi pseudooglejenia, *8* — región slabej akumulácie humusu, nevýrazného zvetrávania a lokálne i nevýraznej podzolizácie na nekarbonátových viatych pieskoch, *9* — región podzolizácie a akumulácie humusu s tendenciou rašelinenia, *10* — recentné intraregionálne a extraregionálne fluvizeme, *11* — umelé vodné nádrže.

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# ГЕОГРАФИЯ ПОЧВ ЗАПАДНЫХ КАРПАТ И ВНУТРИКАРПАТСКИХ НИЗМЕННОСТЕЙ

Результаты современных трудов, касающихся географии и генезиса почв на территории Западных Карпат и к ним прилегающих участков внутрикарпатских низменностей, приносят новые информации о закономерностях дифференциации или же строения почвенного покрова. Эти информации играют важную, даже ключевую роль для педологии, для сельского хозяйства и даже для физической географии.

В настоящей статье нами отмечается, что на данной территории существуют проявляющиеся признаки климатически обусловленной зональности почв, однако, не в такой форме, как это считалось до сих пор. Нами выявлены следующие высотные зоны:

До высот 700—800 м над уровнем моря, куда относятся оцениваемые низменности и более низкие участки гор, зональная дифференциация почвенного покрова не проявляется даже на уровне самых низовых таксономических единиц почв. Она проявляется лишь в незначительных изменениях параметров термического режима почв. Эта зона имеет очень пестрый состав почвенных и почвообразовательных процессов, поэтому для нее очень трудно найти название в зависимости от зональной почвы или от почвообразовательного процесса. Следующая зона представляет собой территорию на высотах от 700—800 м до 1300—1400 м над уровнем моря, отличающуюся от предыдущей отчетливым климатическим влиянием на процесс выщелачивания баз, на повышение кислотности почвенной реакции и на накопление содержания гумуса, а также и в тенденции образования более отчетливых налегающих гумусных горизонтов, причем это касается почв на всех видах почвообразовательного субстрата. Зона, находящаяся на высотах от 1300—1400 м до примерно 2000 м над уровнем моря, а также зона, находящаяся выше этой границы, отличаются как параметрами некоторых почвенных свойств, так и таксономическими единицами, но в дефинициях этих единиц недостаточно учитываются данные изменения (не дефинированы особые таксоны почв с отчетливо мощным налегающим гумусным горизонтом). Эти высотные зоны обусловлены также с термодинамического аспекта, так как в интервале высот Западных Карпат наблюдается достаточно значительная дифференциация значений солнечной радиации, входящей в почвы и в значения обводненности.

Для географии почв и сфер ее применения, важно, однако, интразональное строение почвенного покрова, которое связано явными закономерностями со строением, со свойствами почвообразовательного субстрата, с геоморфологией, а также с разным возрастом почв и их феноменов. Приводимые в статье основные почвенные топосеквенции и катены характеризуют отдельные типы почвенных регионов как парагенетические совокупности почв, повторяющиеся в пространстве. Это значит, что они могут быть обобщены в качестве почвенно-географических законов с возможностью их приложения для предикции строения и поведения конкретных структурных комплексов (единиц) почвенного покрова. В дефинированных типах топосеквенций и катен констатируется полигенетический и полихронный характер почвенного покрова со значительным участием ископаемых почвенных феноменов.

Карта 1. Почвенно-географические регионы Западных Карпат и прилегающих участков внутрикарпатских низменностей: *1* — регион палеогидроморфной вплоть до современно гидроморфной аккумуляции гумуса, карбонатов кальция, магния и локально также натрия, *2* — регион современно гидроморфной вплоть до палеогидроморфной аккумуляции гумуса и некарбонатных илистых аллювиальных отложений, *3* — регион современно гидроморфной вплоть до палеогидроморфной аккумуляции гумуса и некарбонатных песчаных отложений, *4* — регион аккумуляции гумуса, пульсации карбонатов, выветривания и лессиважа — на лессах, *5* — регион отчетливого лессиважа и псевдооглеивания на лёссовых глинах и делювиально-флювиальных отложениях, *6* — регион литогенно обусловленной аккумуляции темных форм гумуса на делювии твердых карбонатных пород, *7* — регион выветривания и аккумуляции гумуса в кислой и слабокислой среде с локально сопутствующими процессами псевдооглеивания, *8* — регион слабой аккумуляции гумуса, неотчетливого выветривания и локально также неотчетливой подзолизации на некарбонатных перевеваемых песках, *9* — регион подзолизации и аккумуляции гумуса с тенденцией оторфления, *10* — современные интрарегиональные и экстрарегиональные флювиозёмы, *11* — искусственные водохранилища.