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A CONTRIBUTION TO THE STRUCTURE OF SOIL COVER IN THE WESTERN CARPATHIANS

Juraj Hraško, Vladimír Linkeš: Contribution à la structure de la couverture du sol dans les Carpathes Occidentales. Geografický časopis, Bratislava 1972, XXIV, 2, 4 diagrammes, 11 travaux cités.

Les auteurs décrivent les types des structures de la couverture du sol dans la région des Luvisols et Cambisols des Carpathes Occidentales comme des groupements spécifiques paragénétiques d'individus de sol, des aires élémentaires de sol, qui présentent des horizons diagnostiques de haute corrélativité et une disposition caractéristique et toposéquence caractéristique.

Structure de la couverture du sol, type de la structure, composants homogènes de la couverture du sol, composants hétérogènes de la couverture du sol, aire élémentaire du sol, dimensions topiques, dimensions choriques.

In the last years, in Czechoslovakia too, the structure of soil cover becomes object of intensive interest, based on detailed pedological investigations (J. Hraško, V. Linkeš 1971). When understanding the components of pedosphere as systems (E. Ehwald, V. M. Fridland etc.) then, from methodological aspect, soil survey is merely a parametrical aspect of the object, with a certain precision. An overal analysis of the object, as a system (in our case of the pedosphere), must also include the study of its structure, inclusive its individualization and correlative elements which condition the system's integrity (ex V. N. Sadovskij, E. G. Judin 1967). Thus, the study of soil cover structure is a logical continuation in recognizing soils, with emphasis on their territorial and geographical aspect.

1. Structural components of the soil cover

1.1 Homogeneous components

The fundamental building unit of soil cover is a physical individual having a concrete morphology, specific pedological content and an extent, the smallest limit of which is given by its geographical relevancy. In this sense, such units are soil-geographical individuals with topical (E. Neef 1963) dimensions. The definitions of such individuals as polypedon (W. M. Johnson 1963), pedotop (G. Haase 1968), elementary soil area (V. M. Fridland 1965, 1970), according to the criteria above mentioned, are substantially identical and differ by the criteria of homogeneity only. But their general use is relative, because the lowest taxons of individual soil classification systems, determining or determined by the soil individual, are not equivalent (conf. soil series,

Bodenformen, razriad). The most universal and to the soil classification system of Czechoslovakia nearest definition (J. Němeček et al. 1967) is that of the „elementary soil area". In the applied paraphrase, that's the area of a „fundamental soil representative", i. e. a lithogenically conditioned variant of a certain soil subtype or variety having the same degree of destruction by erosion or accumulation.

1.2 Heterogeneous components

By more detailed soil mapping, it was ascertained that the soil cover was a continually heterogeneous object. Therefore now, in pedology and soil geography, more attention is paid to combinations of typological characters which are in detail studied and typified. By evaluating such soil groups, as systems, we receive units of new qualities, conditioned by the integral properties and intern connections of their components.

The continuity and variability of soil cover causes unsharp transitions, in topical dimensions, between its homogeneous components and, in choric dimensions, between its heterogeneous units (E. Neef 1963, see the classification systems of W. M. Fridland 1970, G. Haase, R. Schmidt 1970).

The soil combinations, as structural wholes, have many properties which may be divided (as did I. P. Rooma 1969) in morphological (largeness, dominance, frequency, form, character of the borders or characteristics of the components distribution) and functional properties (composition of the pedological content and its contrastness, inner connections and common evolution of the components). Typization of the structures is then possible based on the mentioned properties and their repeated occurrence.

2. Principles of typifying the structure of soil cover

In our work, we do not deal in detail with problems of the taxonomical system of heterogeneous structures (pedochores). In our opinion, on territories with complicated soil covers, as in the Western Carpathrians, we must first define and typify the heterogeneous structures according to their functional qualities, especially to the paragenesis of their components. Such units can be divided in lower taxons according to their morphological properties and then a complete taxonomical system for their classification can be elaborated.

As types of structure, we denote groups of elementary soil areas having a distinct paragenesis, which exhibit highly correlative (especially diagnostical) horizons and specific combinations and properties of azonal soil-forming factors. If a combination of soils is significantly zonal, then we consider it as a separate structural type in each zone. In the further part of our work, we give some examples of structure types of illimerized soils (Luvisols*) and brown soils (Cambisols*).

2.1 The structure of soil cover in the region of Luvisols

In the intermountain basins of Western Carpathians, at their contact with the sub-Carpathian lowlands, and on some lower relict levels of the southern part of neovolcanic mountains, a specific type of soil cover structure occurs. The typomorphous components of soil components consist of the elementary soil areas of albo-gleyic

* In this work, we use the nomenclature of soils and horizons according to the FAO/UNESCO Project 1968, 1970.

Luvisols. The geological composition of these structures is specific too. Its stratigraphic scheme is as follows: in the base, there are Tertiary clay sediments on which Tertiary or Quaternary gravelly sediments lay, covered by loessial loams with a characteristic superposition of a texturally lighter and marked silt layer on the surface, The relief of these structures has a characteristic form, it is plain or but moderately undulated.

The described type of structures has a specific development not only in the pedological, but also geogenetic sense, resulting in a characteristic disposition of the components (pattern and toposequence). In the central, most stable part of the areas of this structural soil cover type, there are elementary soil areas of non-eroded Albo-gleyic Luvisols, in a lesser extent Albic Luvisols, in the depressions, areas of gleyic Luvisols and, fewer, stagno-gleyic Luvisols. The stable part is contoured by erosional forms of Luvisols and Rankers (Eutric or Dystric), in some cases of Rendzinas. On places where the gravel accumulation is thinner or absent, the stable part is also contoured by erosional forms of soils on Tertiary clays — Pellic Vertisols (Fig. 2). In linear illustration, the grouping of components of this structural type is visible as a complete toposequence (Fig. 1).

The paragensis of described structural cover type is proved by the presence of the diagnostic argilluvic B horizon or argilluvic to gleyic horizon. The other components of this type are represented by soil wrecks, without subsurficial diagnostic horizons.

The structure type of Luvisols in the Western Carpathians is not expressively zonal. The chemical and physical properties of their components, in different bioclimatic zones,** do not markedly change, but depend more on the substrata's origin. Components which are acid or of slight base saturation occur both in cool and warm regions. Components of high base saturation or little acid ones occur also in cool and temperate regions, principally on piedmonts and terraces, the material of which is derived from mountains built of neovolcanic or carbonaceous rocks (the hollws of Liptov, Turic and others).

Very dissimilar structural types are formed by soil combinations with typomorphous components of the Chromic Luvisols (terra rossa, terra fusca) which, owing to their specific genesis and fabric of the components, should not be included in the type described above.

The structural type of Luvisols has variable properties, but its variants repeat as well. From the functional properties, particularly the physico-chemical ones of the components, its water regime and the pedological fabric of accessory components are variable (when the underlying gravels consist of carbonaceous rocks, then the countouring components are represented by rendzinas to calcaric regosols). From the morphological properties mainly the extent, dominance and frequency (complexity) of the elementary soil areas are variable.

2.2 Structure of the soil cover in the region of Cambisols

From typological standpoint, the structures of Cambisols are by far more variable. In Western Carpathians, we can distinguish two groups of structural types of Cambisols. The first grup occurs in hollows and at the contact of mountains with plains, the second one in the mountains.

The first group of types consists, on principle, from combinations of elementary soil areas which, in their most stable parts, are represented by typomorphic, medium deep

** In the regions of their occurrence, the mean annual temperatures are 4,5—8,5 °C,the mean annual totals of precipitations are 550—850 mm.

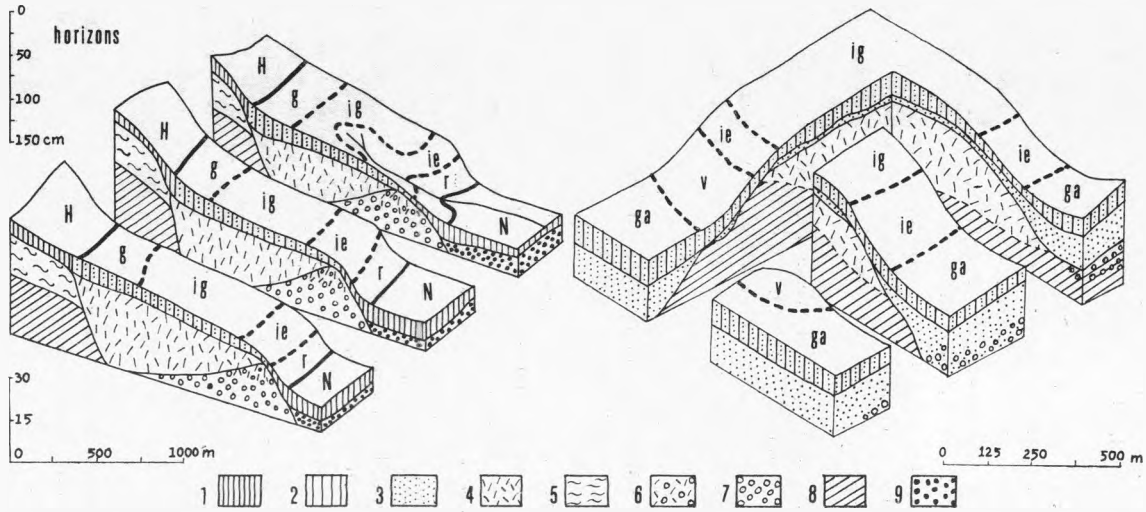

Fig. 1 and 2. Soil cover structural type of Luvisols. Elementary soil areas: ig — Albo-Gleyic Luvisols, ie — eroded Luvisols, g — Stagno-Gleyic Luvisols, ga — Accumulated stagno-Gleyic Luvisols, r — Rhegosols and Rankers, v — Vertisols?, H,N — Soil cover structural types of Cambisols and Fluvisols. Horizons: 1 — A (pallid), 2,3 — A+E (pallid+albic)-silty loesslike loam, 4 — Btg to g (argilluvic to gleyic)-silty clay loess-like loam, 5 — B (v) (cambic), 6 — IIBt (argilluvic), 7 — IIC-underlying gravelly material of Quaternary terraces, 8 — C, IIC-clayey Paleogene (flycsh) and Neogene sedimentary rocks, 9 — C-alluvial deposits.

or deep Gleyic Cambisols. On convex relief elements, mainly on the slopes of valleys — dividing or bordering this type of areas — there are shallow Cambisols to Rankers. In depresssions, there are elementary soil areas of gleyosols. The disposition of components here is similar as in the structural type of Luvisols, i. e. the stable typomorphic components are contoured by soils in a juvenile evolutional stage (Fig. 4). In linear expression, the grouping of these structural type components appears to be a complete toposequence (in this case, we can consider it for a catena).

The paragenesis of described group of soil cover structural types is proved by the presence of a diagnostic cambic horizon which, as for the typomorphic components, is combined with the gleyic horizon. The juvenile components have poorly expressive cambic horizons or are lacking it completely. The paragenesis of such soil groupings is also indicated by the specific geological composition, consisting of Pleistocene or Neogene gravelly sediments (the material of terraces, fluvioglacial complexes and proluvia), which are deposited on Tertiary clayey series of strata. Likewise the colour of their relief (terraces, alluvial cones) demonstrates the specific development of these soil combinations.

In the described group of structure types, in Western Carpathians, we can distinguish two types. One in the zone of Eutric Cambisols, the other in the zone of Dystric Cambisols. In conformity with the soil zone, in which the types occur, their typomorphic elementary soil areas belong to the gleyic variants of Eutric or Dystric Cambisols respectively.

The properties of various structural types vary especially as for the morphological qualities of their components (largeness and shape). On the whole, they are types of a higher degree of complexity, than the type of Luvisols.

The second group of the Cambisols soil cover structural types, occurring in the mountains, is by far more complicated. The types of this group, on principle, always consist of elementary soil areas of medium deep to deep typomorphic subtypes of the Cabisols, situated on the slopes most stable parts. On protruding solid rocks, there lie deluvia of coarse skeleton and on them Lithosols to Rankers. On the slopes lower parts, there are deep, sometimes accumulated Cambisols, in places, Glyic Cambisols. This grouping. of soils, both spatially and in catena form, is illustrated in Fig. 3.

The paraganesis of the described soil cover structural types is proved by the presence of a diagnostic cambic B horizon or a cambic to spodic horizon, which occurs in the majority of their components. Paragenesis is also indicated by their uniform geomorphological and Quaternary geological evolution, by the microrelief and soil-forming substrata differentiation, conditioned by their essentially deluvial modellation.

Within this soil cover structural types, in Western Carpathians, several particular types exist. This is caused by the expressive structural zonality of Cambisols and by the very dissimilar petrographical characters of the substrata. As in which soil the types occur, the typomorphic components of soil combinantions belong to the Eutric Cambisols, Dystric Cambisols or Eutric, Dystric Lithosols respectively.

From the standpoint of the soil-forming substrata characters, on the level of type, we must also take into account some marked, lithologically conditioned structures. The structure of Cambisols, on flysch sediments with predominating claystones, is an independent type of the individual zones. Their components, namely, are particular representatives of Cambisols (Vertic? Cambisols) and their diagnostic cambic B horizon is always combined with a gleyic horizon.

A further particular type of the Cambisols soil cover structure is formed by soil combinations on some petrographically very complicated mesozoic series of strata (the

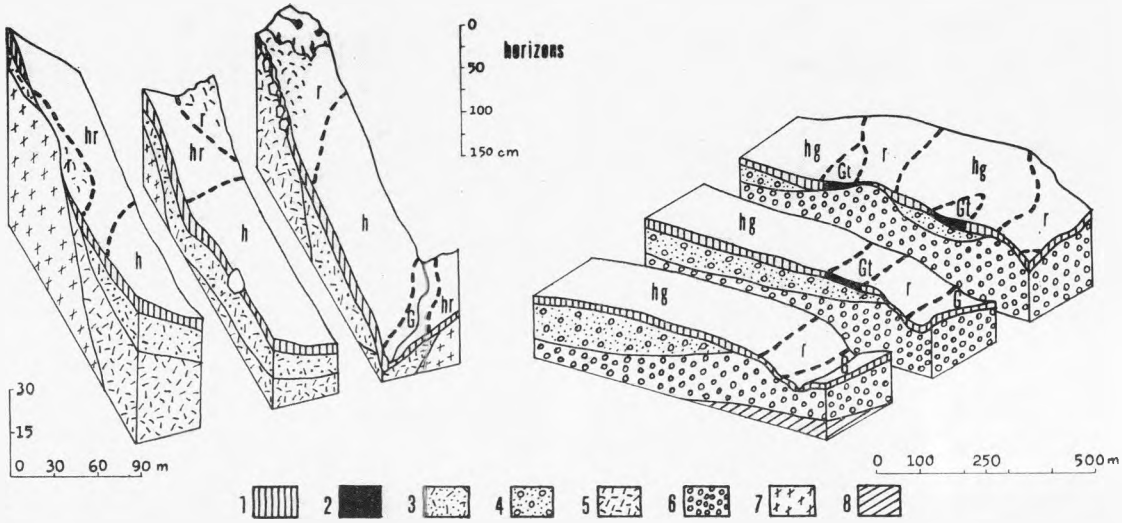

Fig. 3 and 4. Soil cover structural types of Cambisols. Elementary soil areas: h — Dystric Cambisols, hr — shallow Dystric Cambisols, hg — Gleyic Cambisols, r — Lithosols and Rankers, G — Gleyosols, Gt — Humic Gleyosols. Horizons: 1 — A (pallid), 2 T (histic horizon), 3 — Bv (cambic)-deluvium of gneiss, 4 — Bvg (cambic+gleyic)-gravelly material of fluvioglacial deposits, 5 — C-strongly stony deluvium of gneiss, 6 — C-gravelly material of fluvioglacial deposits, 7 — R (hard rocks — gneiss), 8 — IIC-clayey flysch sedimentary rocks.

carpathian keuper and others). In fact, these structures include soils on thin layers of weathered limestones and dolomites. This type also exhibits a marked zonality of the majority of its components.

The morphological properties of these structures are very variable, similarly as in the previous group of types.

From the Slovak translated by J. Belaj

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PRÍSPEVOK K ŠTRUKTÚRE PÔDNEHO KRYTU V ZÁPADNÝCH KARPATOCH

Štúdium štruktúry pôdneho krytu je po podrobnejšom pôdoznaleckom prieskume logickým pokračovaním poznávania pôd s dôrazom na geografický aspekt. Jeho základné stavebné komponenty — pôdne indivíduá v topických dimenziách sú označované ako polypedon, pedotop, elementárny pôdny areál. Pre náš klasifikačný systém je najbližšia definícia „elementárneho pôdneho areálu". V parafráze je to areál „základného pôdneho predstaviteľa", t. j. litogénne podmienenej varianty určitého pôdneho subtypu alebo jeho variety s rovnakým stupňom narušenia eróziou alebo akumuláciou.

Predmetom štúdia štruktúry pôdneho krytu sú aj jeho heterogénne komponenty typologického charakteru v chorických dimenziách. Takéto charakteristické zoskupenia pôdnych indivíduí sa typizujú podľa ich morfologických a funkcionálnych vlastností. V pôdne komplikovaných územiach považujeme z aspektu klasifikácie aj regionalizácie chorických jednotiek za prvoradé funkcionálne vlastnosti, najmä paragenézu ich komponentov.

V našej práci opisujeme niekoľko typov chorických komponentov pôdneho krytu. Ako typ štruktúry označujeme zoskupenie elementárnych pôdnych areálov so zreteľnou paragenézou, ktorá sa prezentuje vysokokorelatívnymi, najmä diagnostickými horizontmi a špecifickou kompozíciou a vlastnosťami azonálnych pôdotvorných faktorov. Ak je takáto kombinácia pôd preukazne zonálna, posudzujeme ju ako separátny typ v každej zóne.

Štruktúra pôdneho krytu v oblasti illimerizovaných pôd

V oblasti rozšírenia illimerizovaných pôd opisujeme zatiaľ len jeden typ štruktúry. Typomorfnými sú elementárne pôdne areály illimerizovaných pôd slabo oglejených až oglejených (Albio,

Albo-Gleyic Luvisols), ktoré sú kontúrované indivíduami silne erodovaných illimerizovaných pôd, rankrov až primitívnych pôd (Rankers až Rhegosols), miestami rendzín (Rendzinas) alebo pôd na terciérnych ílovitých sedimentoch (Pellic Vertisols). Priestorové usporiadanie a toposekvenciu komponentov vidieť na obr. 1 a 2. Paragenézu komponentov indikuje podpovrchový diagnostický textúrny iluviálny horizont B, kombinovaný viac alebo menej intenzívnym oglejením (argilluvic + gleyic B horizon).

Typ štruktúry illimerizovaných pôd v Západných Karpatoch nie je výrazne zonálny a vlastnosti jeho komponentov závisia viac od pôdotvorných substrátov (v zmysle petrografickom a geochemickom).

Štruktúra pôdneho krytu v oblasti hnedých pôd

V Západných Karpatoch v oblasti hnedých pôd existujú dve skupiny typov štruktúry pôdneho krytu. Prvá pozostáva principiálne z typomorfných indivíduí hnedých pôd oglejených (Gleyic Cambisols), ktoré sú sprevádzané pôdnymi indivíduami rankrov až primitívnych pôd (Rankers až Rhegosols) a v depresiách glejových pôd (Gleysols). Priestorové usporiadanie a toposekvencia je znázornená na obr. 4. Paragenézu vždy indikuje metamorfický B horizont kombinovaný s oglejením (cambic B horizont + gleyic horizon).

Popisovaná skupina typov štruktúr — pôdnych kombinácií vykazuje zreteľnú zonalitu. Ako samostatné typy ich hodnotíme v zóne hnedých pôd nasýtených a v zóne pôd acidných.

Druhá skupina typov štruktúry pôdneho krytu pozostáva principiálne z typomorfných pôdnych indivíduí hnedých pôd (Cambisols). Na hruboskeletnatých zvetralinách sú primitívne pôdy až rankre (Lithosols až Rankers) a na eróznych bázach hnedé pôdy oglejené až glejové pôdy. Priestorové usporiadanie a toposekvencia je znázornená na obr. 3. Paragenézu indikuje metamorfický B horizont (Cambic horizon), vo vyšších zónach kombinovaný so sesquioxidovým iluviálnym B horizontom (Cambic až spodic B horizon).

Ako samostatné hodnotíme typy v zóne hnedých pôd nasýtených (Entric Cambisols) a hnedých pôd acídnych (Dystric Cambisols). Pre špecifickú litogénne podmienenú kompozíciu a pedogenetický charakter komponentov posudzujeme v každej zóne ako samostatné typy, hnedé pôdy na mezozoických bridličnatých súvrstviach a ílovitých sedimentoch flyšu.

Obr. 1 a 2. Typ štruktúry pôdneho krytu illimerizovaných pôd. Elementárne pôdne areály: ig — illimerizované pôdy oglejené, ie — illimerizované pôdy erodované, g — oglejené pôdy, ga — oglejené pôdy akumulované, r — primitívne pôdy a rankre, v — vertisoly ?, H, N — typy štruktúr hnedých pôd a nivných pôd. Horizonty: 1 — A, 2,3 — A a E horizont — ľahká spražová hlina, 4 — Btg až g — ílovitá hlina, 5 — B/v/, 6 — IIB, 7 —IIC terasové štrky, 8 — C, IIC ílovité sedimenty flyšu, resp. neogénu, 9 — C aluviálne sedimenty.

Obr. 3 a 4. Typy štruktúr pôdneho krytu hnedých pôd. Elementárne pôdne areály: h — hnedé pôdy kyslé, hr — plytké hnedé pôdy kyslé, hg — hnedé pôdy oglejené, r — primitívne pôdy a rankre, G — glejové pôdy, Gt — glejové pôdy zrašelinené. Horizonty: 1 — A, 2 — T zrašelinený, 3 — Bv — delúvium ruly, 4 — Bvg fluvioglaciálne štrky, 5 — C silne kamenité delúvium ruly, 6 — C fluvioglaciálne štrky, 7 — R pevná hornina-rula, 8 — IIC ílovité sedimenty flyšu.