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# SEQUENCE OF SLOPE LANDSCAPE UNITS AS THE RESULT OF LANDSCAPE DEVELOPMENT. A CASE STUDY OF THE LOW BESKIDE

The Low Beskide situated between the Pass of Tylicz in the west and the Pass of Łupków in the east is the lowest part of the Beskide Mountains. It is built of folded series of sandstones, shales and Flysch marls. Brown soils occur mainly on slopes, skeleted soils on ridges and high plains, and alluvial warp in river valleys (L. Starkel 1978). Altitudes reaching 800—1000 m a.s.l. in the Low Beskide imply a storied system of climate and vegetation. Within the Highlands storey the *Tilio-Carpinetum* plant association occurs, while within the lower subalpine forest storey the community of *Fagetum carpaticum* prevails (J. Staszkiewicz 1973). The vegetation is strictly connected with the prevailing meso- and microclimatic conditions. Three mesoclimatic zones can be observed in the Low Beskide: the zone of inversion depressions, that of warm above-inversion slopes and the cool zone characterizing the highest summits and formed by the advection of air masses (B. Obrębska-Starklowa 1973).

The fragment of the Low Beskide situated on the border line between the mountain range and the Carpathian Foothills has a rich photographic documentation made in 1982 as part of the international research programme "Interkosmos". Spectrozonal and multispectral photos on the scale of 1 : 30,000 taken then permitted a detailed analysis of the landscape and distinguishing typological units of the rank of ranges. The stereoscopic model of the terrain made possible not only an analysis of the particular components of the landscape but also the study of reciprocal connections and interdependence of neighbouring geocomplexes. A certain regularity was observed in the disposition of landscape units on the slopes of the Low Beskide as the effect of developmental stages of the landscape; it refers to the catena principle, i.e. to the strict interaction, on the different sections of the slope, of such elements of the geographical environment as the parent rock, climate, water and vegetation (G. Haase 1965).

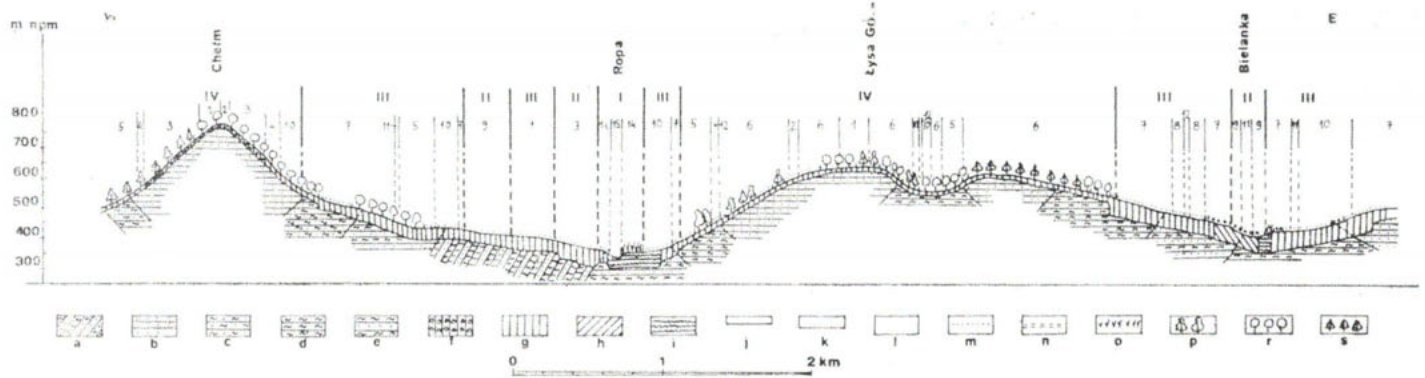


Fig. 1. Landscape profile Chełm—the Ropa valley—Łysa Góra—Bielanka basin

**Geology**: a — **Ropa** "window" series, b — Magura sandstones, c — hieroglyphic beds, d — Eocene shales series, e — inoceramus beds; **Soils**: f — skeletal soils, g — brown soils, h — grey brown podzolic soils, i — alluvial warp soils; Vegetation: m — *Chenopodietea* and *Secalieteo* community, n — *Molinio Arrhenatheretea* order, o — *Alno-Padion* aliance, p — *Tilio-Carpinetum* association, r — *Dentario-glandulosae Fagetum* association, s — *Fagetalia* order Name of the type of range Depth of soils: j — to 50 cm, k — 50—100 cm, l — 100—150 cm;

1. Broad crestal flats
2. Narrow crestal flats
3. Steep flysch slopes wth rubble cover in angle cross 20°
4. Steep flysch slopes in angle cross 20°
5. Steep flysch slopes in equal angle 10°—20°
6. Flysch slopes in varying angle 5°—20°
7. Gentle flysch slopes in angle 5°—10°
8. **Flattering on low slopes and humps**
9. **Foothills**
10. Landslides
11. V-shaped valleys
12. Dry and boggy flat-bottomed troughs
13. Pleistocene river terrace plain
14. Holocene river terrace plain
15. Zone of the river channel

Name of type of terrain

I. **Terraced bottoms of valleys**
II. Hills and slopes flattened at the height of "near river" level
III. Gentle slopes on Flysch
IV. Steep slopes on Flysch

This connection can be very well observed on the landscape profile (Fig. 1) drown through the summit of Mount Chełm (779 m a.s.l.), the valley of the Ropa river and two summits belonging to the Magura range: Łysa Góra (641 m a.s.l.) and Suchy Wierch (578 m a.s.l.).

The insular upland of Chełm is built of resistant, thickbedded Magura sandstones of the micaceous facies. On a large area of the upper part of the slope there occurs a debris cover which is gradually sinking in weathering material. The cover changes its mechanical composition, and its thickness increases towards the base of the slope. The change of lithologic complexes, in the lower part of the slope, into less resistant hieroglyphic and inoceramus layers causes the attenuation of the terrain inclination degree, the increase in thickness of the weathering waste cover to 2—4 m and the change of its mechanical composition from light and medium loam to clays and heavy clays.

Such differentiation of parent rocks on the slope must be reflected in the differentiation of landscape units. In the highest, summit part of the slope plateau-type *uroczysko* occur with initial, well permeable soil and advection climate. Soil, climate and water conditions form the dry site of the Carpathian beechwood *Dentario-glandulosae Fagetum.* The debris cover reaches, on the Chełm mt., 600—650 m a.s.l. and is connected with strongly inclined mountain slopes. The good permeability of the substratum conditions the infiltration type of water circulation. We observe here the type of *uroczysko* of steep Flyschslopes covered with debris.

Moving down the slope its inclination decreases gradually, the debris-and-stone weathered waste becomes thicker and contains more and more fine-grain fraction becoming the foundation of brown soils. The soils are still very shallow and skeletal. The amount of skeletal fraction in the upper layer may reach 90% but the soils have already a full genetic profile. Well permeable Magura sandstones favour infiltration and water diversion in the covers. The forest community is that of the lower subalpine forest. The transition from steep Flysch slope *uroczysko* covered with debris to steep Flysch slope *uroczysko* is mild. Those *uroczysko* types are usually accompanied by Flysch slope *uroczysko* of various inclination from 5° to 20°.

The contact zone of Magura sandstones with the hieroglyphic sandstone-and-shale layers is a distinct zone of landscape change. Within the Magura sandstones there occurs a terrain of steep Flysch slopes, hieroglyphic layers give rise to a type of terrain of mild Flysch slopes. There appear in the landscape numerous *V*-shaped valleys which cut the mild slopes by a dense dendritic and radial network. The slopes,

with accumulating waste from the upper parts, are long and convex. The thick waste cover is a base for the formation of brown soils mechanically composed of heavy and medium clays, clays and dust. Shales and clay shales occurring in the substratum are an impermeable layer and deteriorate the water-oxygen conditions of soils which show features of gleyification. The primeval forest vegetation has been supplanted by ploughland where more favourable soil and climate conditions occur.

A change of the terrain type also accompanies the contact of inoceramus layers with the unit underlaying the Magura plateau and outcropping in the window of the Ropa river. The window unit cut by numerous faults and built of layers of sandstones, shales and clay shales of different thickness is characterized by a relatively uniform landscape. More resistant series were the base of development of *uroczysko* on mild Flysch slopes, less resistant ones formed *uroczysko* at the base of slopes. Both *uroczysko* types are cut by a dense network of *V*-shaped valleys, gullies, ravines and badlands. The abrupt transition between the deposits of the window unit and the inoceramus layers also changes the landscape. The mild Flysch slopes and slope bases change, in a disinct bent, into a terrain of terraced valley bottoms.

It results from the analysis of the first part of the landscape profile that the elevation of Chełm is characterized by a typical sequence of *uroczysko* in the slope profile reflecting all the stages of the landscape formation. In the upper part there occur the oldest upland *uroczysko* dating from the close of the glacial period and *uroczysko* of steep slopes covered with debris passing gradually, as the waste cover grows, into *uroczysko* of steep Flysch slopes. The middle parts of the slope modelled by Holocene denudation processes, of a smaller inclination, belong to the *uroczysko* type of Flysch slopes, their inclination running from 5° to 20°. The foot of slopes built of less resistant layers presents a different type of terrain. Since the Sub-Atlantic phase it has been covered up with fine-grain denudation and weathering waste material and cut by a dense network of *V*-shaped valleys, gullies, ravines and badlands. The slope bases are separated from river valley bottoms by a distinct bent which is also a lithologic and stratigraphic border line. The *uroczysko* types succeeding one after the other are sometimes disturbed by the occurrence of landslides. The oldest landslides date from the close of the glacial Epoch when slope covers saturated with thaw and precipitation water began to slide down forming deep and vast landslides. The youngest are connected with the anthropogenic phase of landscape forming. The grubbing of forests in the time of the Lusatian culture led again to an increase of denudation

processes which resulted in new shallow landslide movements in shaly and clay-shaly areas. Landslides constitute a separate type of landslide slope *uroczysko* characterized, in the first place, by a considerable content of shales in the substratum, a disturbed type of water conditions and by their specific microrelief. Owing to landslides the relief and landscape of this area assume a specific "restless" character.

A slightly different system of *uroczysko* occurs on the slopes of Łysa Góra and Suchy Wierch. The fragment of the Magura Mountain range to which the named summits of an inversion character belong is built of resistant Magura sandstones and of less resistant Eocene mottled shales. Culminations were formed on second-rate synclines into which the syncline of Magura Małastowska is divided (A. Kotarba, 1970) and gave the whole range a very irregular run with a high relief. Thus tectonics and lithology strictly connected with it condition the character and structure of landscape units. Resistant complexes of Magura sandstones alternating with less resistant layers of mottled Eocene have brought about the formation of alternating upland *uroczysko* flattened slopes in the Highlands level, steep Flysch slopes, slopes of varying inclination separated by beddlands, ravines and gullies or by landslides. Landslides which begin on slopes with a large content of shales frequently spread onto areas where sandstones occur.

On long slopes of various lithology the sandstone complex covers forming the upper part of the slope often overlap on shale-and-sandstone layers occurring in its lower part and due to this differences of inclination and lithology are not always reflected in other components of the geographical environment, such as soils, water conditions or vegetation. This results in blurring the primitive differences in the structure of landscape units making it very difficult to trace them, and it strongly refers to the catena principle which essentially consists in the ecological differentation of the slope built of uniform rocks.

The sequence of *uroczysko* types on the slope from the upland type, through slope ones to valley *uroczysko* is the result of landscape development stages and the reflexion of its complexity. This sequence depends, first of all, on the tectonics and lithology and on the mechanism of water circulation.

The number of typologic units and their position in the slope profile indicates the direction of changes occurring in the environment. A larger number of *uroczysko* types is connected with the multistage development of the landscape taking place during tectonic mouvements in the glacial Epoch, in the periglacial period and nowadays. Man formed the landscape as early as the late Holocene and he brought about changes of

the natural environment. It resulted in the individual development of the particular slope sections differently exploited and thus the uniformity of the slope as a geosystem was disturbed. In the same way valley geosystems were changed as Man trained river fragments, raised water structures and took out stones.

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