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STONE STRIPES AND THUFURS IN THE KRKONOŠE

Abstract

On the main ridge of the Krkonose stone stripes composed of confused boulders have been encountered. Fine particles have been completely washed out of them. The stripes occur in channels most often along fissures. They developed in result of weathering processes and gravitational mass movements. The authors believe that they are of postglacial, subrecent age. On the slopes of Lucna hora (1555 m) occur thufur hummocks. They are smaller than similar phenomena in the Tatras and as such masked by vegetation. Thufurs are believed to be fossil phenomena.

STONE STRIPES

In May 1954, the present writers discovered in the main ridge of the Krkonoše, both in the part consisting of granite, and in the one overlying quartzites and gneiss, some forms similar to those found recently on the flattened ridges of the granite massive of the Nízne and the Vysoke Tatry (*1*, *2*).

The so-called „grooved block-fissure stripes" (*puklinové hranáčové závrtové strouhy*) are small morphologic forms occurring also in the Krkonoše. They here show different stages of development, and vary widely in size and shape. The stone stripes consist of granite, quartzite, gneiss and other boulders accumulated in the shape of straight bands lying in deeper or shallower channels. They average from 2 m to over 10 m in length and from 30 to over 150 cm in width and distinctly differ from all the other surface of the high mountain area whether overgrown with grass, moss and prostrate schrubs or bare, clayey-sandy and characterized by a fine fraction. These forms occur either separately or in groups but are rather irregularly scattered and never too closely spaced. Thus they are easily distinguishable from the „furrowed soils" (*brázděné pudy*) as the writers have termed the soil stripes (*sols striés*, *Streifboden*) which are of common occurrence in the Krkonoše.

In the Krkonoše stone stripes are found at different stages of development. They appear in unglaciated areas i.e. on the ridges and the upper, flattened parts of slopes. At their initial stage they form short, simple concentrations of a small quantity of rubble, which is neither distinctly raised above surface level nor lying below. The largest forms

assume the shape of long stripes, containing a large quantity of boulders incoherently accumulated (pl. 2) in fissures or shallows as shown in pl. 1. The boulders bordering the stripes mostly maintain the position adopted after the disintegration of either larger rocks or their parent rock. In other elongate forms the furrow filled with a smaller quantity of rubble is plainly visible. Stone stripes in the Krkonoše are, in contrast with those occurring in the Tatras not so deep, the boulder-filled channels being not over some tens of cm in depth while the Tatra type of stripes is about 2 m.

The arrangement of the boulders which contain neither sandy nor sandy-clayey fine weathering products, shows no traces of cryoturbate, frost-caused segregation of the weathered material like in polygonal and furrowed soils. Thus stone stripes are not structural forms of residual soils, their boulders being not the product of frost-splitting of the rock along its cracks and their striped pattern being mainly the result of passive accumulation of coarse weathering products along the fissures that developed in weathered rock surface.

Nor do stone stripes represent any forms particularly characteristic of high mountain areas for they were found as well in lower regions such as the Kašperka ridge NNE of Kašpersky Hory, and the Šumava at 920 m elevation.

Stone stripes form in the tectonic cracks of crystalline shists and in granites along the fissures of the L Q S system. In the subsurficial part of the fissure, the rock becomes gradually disintegrated by weathering which is originally frost-caused but increases eventually owing to the accumulation of surface water in the interstices that serve as drainage outlets by melt- and rain-waters escape from the saturated ridge-surface. Into the fissure, that widens gradually under the action of weathering, fine weathering products are being deposited by down-wash and accumulate in its deeper parts, while on sloping surfaces the same products are being washed out of the fissure. As neither water nor fines are left in the surficial part of the debris and ice does not form in it, the debris weathering products are segregated by frost-action. Only locally, when waters derived from melting snow happen to be abundant, there may be some slight gravitational movement of the weathering products, provided the direction of the fissure parallels its gradient. From such stone stripes, fines are being more rapidly outwashed; forms of that type are therefore usually much deeper. Such a development of stone stripes is comparable with that of small rocks in freestones in northern Bohemia and of gullies, dales rel. straits and bays of the „gjogve" type in the Faroe Islands that form in the vertical,

columnar fissures of basaltic rocks. These are the largest geomorphic forms of that type. The processes contributing to the formation of the small rocks are outwash and erosion while the processes giving rise to forms of the „gjogve" type, are erosion and abrasion.

The lack of reliable data does not permit to define the age of the stone stripes. They are presumably post-glacial or sub-recent.

Fissures of the L Q S type play a considerable part in the formation of both small and large morphologic structures in the Krkonoše. The fact has been frequently emphasized in the literature on the geomorphology of this region. The orientation of the fissures in the other rocks of the Krkonoše on the Czech side, has been described in detail by M. Maška (*3*) in 1954. This work affords a basis for further studies of the small morphological forms occurring in the area of crystaline shists.

Our observations are derived from the western part of the Krkonoše from Krakonoša, the slope of Labské louky as well as from the eastern part of the ridge, from Lučna hora and the slopes of Bílého Labe. These forms are typical in structure and their material consists of quartzite gneiss and granite. They are wide-spread, perhaps even of common occurrence. Our present knowledge of the orientation of the Krkonoše-fissures (H. Cloos, M. Maška) renders them easily recognizable among the granites and crystalline shists. On the other hand, stone stripes may afford clues to geological investigations. Stone stripes belong to those small geomorphic forms that are characteristic of the Krkonoše.

THUFURS

During the geopedological investigations carried out in the years 1954-55 by the IV department of the Institute of Geography of the Karol-University some other periglacial phenomena, namely thufur hummocks were found and mapped. There is no mention of them in the existing literature on the Krkonoše, neither are they represented in detailed maps. This is thus the first locality of that type described from the Sudeten.

The thufurs occur on the slopes of Lučna hora (1555 m) at a place where the flat-domed ridge and the petrographical rock-composition promote the development of periglacial phenomena. While polygonal soils appear on the NW slope of the Lučna hora, the area of thufur hummocks extends over the E and as far as the ENE slope of the Lučna hora (1500 m) throughout the saddle-like plain that gently slopes toward the little chappel.

The slope on which the thufur area is lying grades 4—7°; roughly in the middle of the slope it spreads into a small plain. The hummocks are low, relatively inconspicuous, their maximum dimensions being 250—200 cm and their height not over 50 cm. The surface of the entire area slopes mainly N and involves about 80 × 60 m.

In our country, thufurs are found only in the Bělske Tatry, Vysoke and Nízke. In all these areas, like in the Krkonoše thufurs occur at 1500 m elevation and above, i.e. in a humid, altitudinal climatic zone. In contrast with the hummocks occurring in the area of Slovakia which are morphologically distinct, regularly domed and only occasionally dragged out along-slope by solifluction, the Krkonoše thufurs are comparatively indistinct, low, easily masked by high grass. Hence, they occupy a much larger surface that similar phenomena in the Tatras. Both soil profiles are essentially conform, though different rocks are involved in each: quartzites, granites and epigranites in Slovakia and quartzites in the Krkonoše.

The cross-section of a hummock, 190 × 160 cm of dimension and 40 cm in height (along the azimut N-45°) revealed the following profile:

0—3 cm — sod-cover;
3—7 cm — whitish gray sand with coarser quartzite- and gneiss-pebbles;
7—18 cm — blackish-brown peaty material, rather mucky with tiny quartzite fragments and living plant roots;
18—22 cm — rosty-brown peaty material, highly clayey with admixture of pulverulent fraction and quartzite fragments;
22—50 cm — light-brown strongly sandified clay (almost clayey sand) with fragments of weathered quartzite and quartz grains.

Small plates of mica and tiny weathered feldspar grains appear scattered throughout the whole profile. The curvature of each single level parallels the surface of the hummock. None of these horizons which are extremely regular shows either wedge-like extensions, or increase in thickness. The entire profile plainly reveals that the original peaty cover was buried by solifluction under fine weathering products. The sod is underlain with a distinctly podsolic grayish horizon passing abruptly into peaty material. At a depth from 20 to 50 cm, the peaty material passes through a brownish horizon into the proper quartzite weathering material which is strongly reminiscent in colour of the weathering products typical of high mountain regions. These products

contain an abundance of mica, of tiny weathered quartzite fragments and grains of quartz.

In consideration of the well-developed podsolic profile as well as of the fact that the stratification of each single horizon parallels the hummock surface, these thufurs are thought to be fossil phenomena.

Translated by T. Dmochowska

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photo by J. Kunsky

Pl. 1. Stone stripe N 180—195° in the quartzites of the north-facing slope of the Lučna hora

photo by J. Kunsky

Pl. 2. Stone stripe N 150° in the quartzites of the north-west-facing slope of the Lučna hora

photo by J. Kunský

Pl. 3. Thufurs on the gently grading east-facing slope of the Lučna hora

photo by J. Kunský

Pl. 4. Thufur field on the north-east-facing slope of the Lučna hora