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Karst Features initiated by the Uprooting of Trees during Storms, a Case Study.

Christine Embleton-Hamann

Department of Geography and Regional Research, University of Vienna, Austria

(christine.embleton-hamann@univie.ac.at)

Objective:

This study deals with a special microrelief landscape consisting of hummocks alternating with pits, which is peculiar to some of the cultivated pastures in the subalpine spruce-dominated forests of the Alps. In the German scientific literature this pit and mound microrelief is commonly interpreted as a fossil, late–glacial relief of cryogenic origin. This paper suggests an alternative hypothesis, namely that relief formation was initiated by the uprooting of trees during storms. In the rootstock-pits, karst processes gradually amplified the initial relief. This alternative hypothesis is tested in the hummocky pastures of the Kräuterin Massif (Northern Limestone Alps), where pit-to-mound vertical relief amounts to 52 cm and mounds are 250 to 510 cm long and 170 to 270 cm wide and the density of pits and mounds is 400 ha^{-1}.

Investigation methods:

Field investigations included a ground survey of the relief using a Zeiss Elta R55 tacheometer and the excavation of a trench through two mounds and a pit to study their internal structure. In one of the two trenches the site specific solution rates in the subsurface material of pits and hummocks were measured. The trenches were further used to collect samples for lab analysis of the soil properties and for radiocarbon dating. The ground survey data were used for digital terrain modelling and subsequent morphometric analysis. Aerial photos provided further data.

Results:

Experimental short-time recording of the solution rate in the test pit suggests a lime-

stone solution rate of 77.2 mm/1000 years. Soil profile morphology and soil properties of the mound soil are consistent with the typical mixed and random horizonation of treethrow disturbance. The results of the morphometric analysis show that the mounds are distinctly elongated, that their long axes are remarkably well aligned and that mounds and pits are arranged side by side. This pattern of parallel-lying pairs of mounds and pits perfectly fits the arrangement of rootstock-pits and adjacent mounds of weathering rootstocks in an area of uprooted trees. The ^{14}C age of a buried humus horizon in the core of the mound indicates a treethrow event at the test site between 1120 and 1280 AD; thus the corrosional evolution of the present microrelief must have started at the beginning of the 13^{th} century.

The investigation further provides information for dating and assessing the historical extent of human interference with the forest cover of the study area. Persistence and amplification of the tree throw topography depend largely on forest management practices. In the study area it can be assumed that the windthrown timber was used for fire wood to serve the local iron industry.

Keywords: Windthrow topography, Soil-water flow, Carbonate solution.