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Human impact on the Medves region, N-Hungary

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with 2 figures

Summary. In the study area, part of the Karancs-Medves Protected Landscape (6709 hectares, founded in 1989), the ecosystems have been largely transformed and a cultural landscape was created. The extension of areas free of human impact has been drastically reduced.

The environmental consequences of natural and man-induced processes have been analysed and the ecosystems in (semi)natural conditions have been mapped. It was studied how the survival of such ecosystems can be promoted.

The methods of research applied included a GIS (MicroStation, IDRISI and ERDAS programmes) complemented with field checking. The information collected on the investigated area was digitised from topographic maps and satellite images were also used as sources of information.

Slope category and exposure was demonstrated by a Digital Terrain Model. The maps representing topography were integrated into a data base acquired from satellite images. The factors controlling the ecological functions of the landscape were mapped.

Introduction

In the 20th century human activity is changing the physical environment rapidly. As evidence, open-cast mining, where huge areas of excavation reduce the aesthetic value of the landscape, can be mentioned. In lack of reclamation plans, abandoned quarries are used as illegal waste disposal sites. In fact, such quarries add to derelict land. Because of the limited amount of land available for various uses and also from the aesthetic point of view, the reclamation of quarries has come to the fore.

The paper aims at disclosing the extent and manner of human impact on an area where abandoned quarries are common. Taking natural processes into consideration, geomorphic evolution can be reconstructed and certain processes in landscape evolution (eg. valley incision) can be predicted.

The studied area is located in N-Hungary, near the Slovakian border. The N part of this landscape unit even belongs to Slovakia (Fig. 1). The Karancs-Medves Protect Landscape is one of the largest basalt plateaus in Central Europe with basalt cones such as Salgó (625 m above sea level) and Szilváskő (628 m). Of the total area of ca 13 km^2, 8 km^2 belongs to Hungary. The economic significance of basalt quarrying here has continuously decreased by the mid-1970s.

Methods

A digital elevation model was constructed using IDRISI software and the contour lines were digitised from topographical maps (scales 1:10,000 and 1:25,000) in MicroStation 5.0. The properties of the study area were investigated through a satellite image of July 21,

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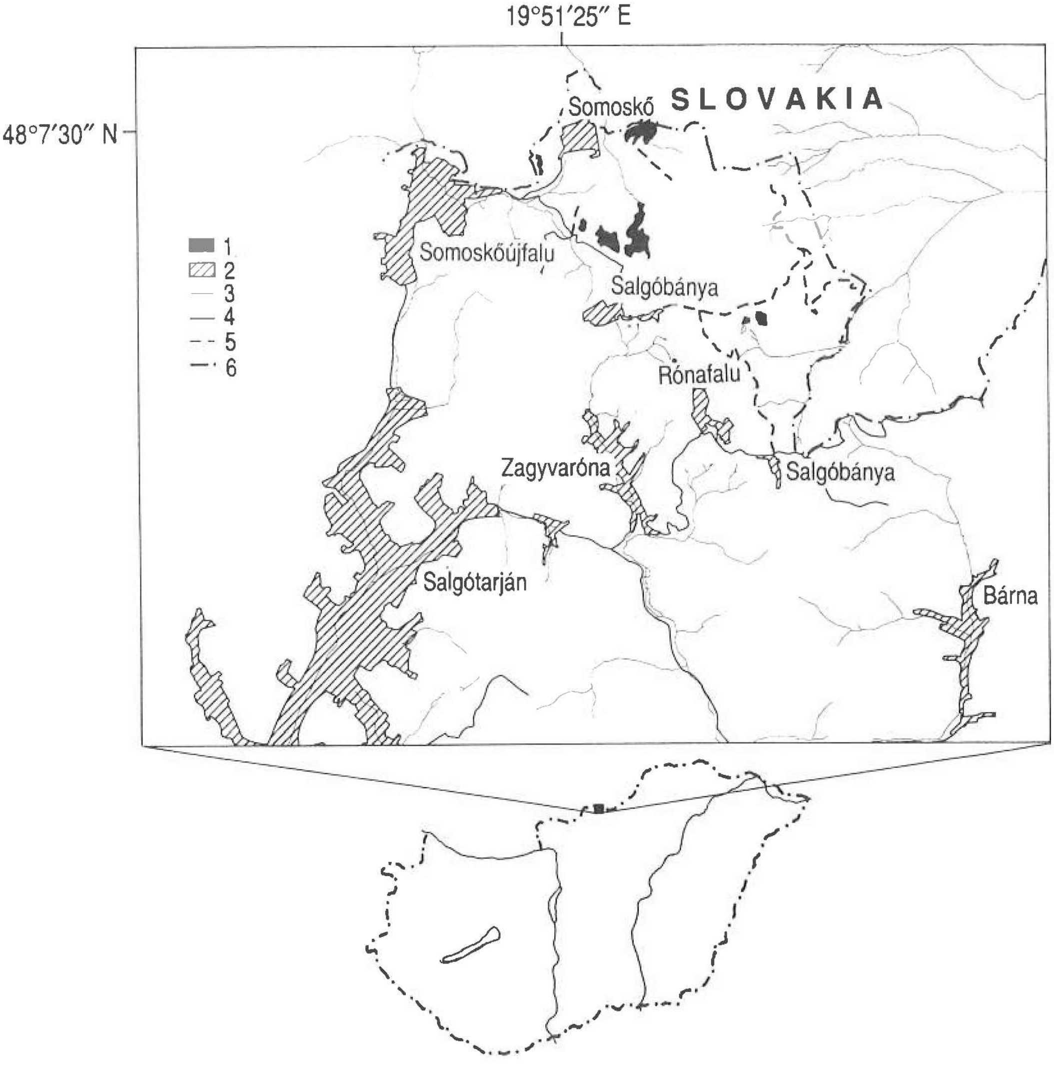

Fig. 1. Location of study area. 1 – quarry; 2 – built-up area; 3 – water-course; 4 – surfaced road; 5 – earth road; 6 – national border.

1992, by ERDAS Imagine 8.2. Land use mapping was carried out by supervised classification through the statistical analysis of training sites defined on the basis of reference data. The land use map was superimposed on the slope map produced from the DTM (Fig. 2). Land use changes can be detected from the data of cooperative farms and land offices. During field observations the state of the abandoned quarries have been surveyed and, in addition to the natural processes of landscape evolution, direct and indirect impacts of human activity have also been identified.

Landscape evolution

During the Upper Miocene, andesitic magma penetrated into the sedimentary layers (Upper Oligocene marine and Lower Miocene terrestrial sediments) and an uplift took place. Subsequently, due to the effect of erosion, the *laccolith* was exhumed and now constitutes the most important geomorphological feature of the Karancs Mountains. Locally, andesite reached the surface (eg. in the Sátoros Hill). After the volcanic phase, transgression followed and in the Badenian Leitha Limestone and sandstone deposited. In the Pliocene, under terrestrial conditions, there was a period of intense erosion; deep gullies and valleys incised into the surface. Where erosion was the heaviest, most of the sediments were removed and even Miocene brown coal measures were affected by erosion. Ca 2 Ma BP basalt volcanism began (Nógrád-Gömör basaltic volcanism). While at the major centres of eruption alternating volcanic tuff layers and lava flows built stratovolcanoes, minor eruption centres only produced lava. The volcanic material filled erosional depressions and this fact explains the variable thickness of basalt lava layers (Horváth 1989; Jugovics 1934, 1940, 1942; Noszky 1912, 1916, 1923; Szentes 1935).

Around Salgótarján *symmetrical volcanic cones* are found (Somoskő, Salgó). The well-developed joint system in basalt allowed heavy fragmentation, particularly through gelisolifluction during the Pleistocene. Therefore, periglacial features are rather common. This is the reason why even young basalt volcanoes have been significantly eroded (Horváth 1991; Székely 1994).

Another widespread landform in the area is a *flat lava plateau*. The average elevation is the plateau is 520–570 m and the peak in the centre (Medves magosa) rises to 671 m. From the comparison of volcanic landforms, the following geomorphic evolution can be reconstructed. Due to intense erosion and valley incision, the volcanic cones of originally regular shape were fragmented. Widening of joints and exhumation of basalt dykes are the most important processes of erosion in the region.

The deepest basalt flows and tuff accumulations are found on the Medves Plateau. There were several eruption centres there but it is difficult to locate the one-time craters on the basis of present-day landforms. The only unanimously identified crater is the Medves peak, rising 120 m above the plateau. The upper third of the peak is built up of basaltic lava, which marks the site of the vent. The products of consequtive eruptions, basalt tuffs and lavas, had various thicknesses, ranging from 11 m to 107 m, accumulated in erosional depressions. In the formation of the volcanic mantle of the Medves region, basalt lavas played a decisive part. The mass thickness of lava flows exceed those of tuff deposits (Jugovics 1971).

Since consecutive lava flows filled the valleys, these valleys became elevated surfaces and former ridges acquired lower positions (geomorphological inversion). The removal of sedimentary layers slowed down, but did not stop. The formerly uniform basalt plateau was dissected by the deep valleys of the newly developed drainage network. Denudation was most intensive over surfaces without a basalt cover. Erosion exhumed the features of basalt volcanism. The outcome is clear on the shaded relief map (Fig. 2), produced from the DTM and by IDRISI. The local streams are mighty agents of erosion throughout the year (see the V-shaped valley of the Gortva stream). On valley floors resistant sandstone layers are exposed and waterfalls of various size developed. Apart from natural processes (such as tree-logs drifted along the streambed), human wastes (pneumatic tyres) cause impounding and change the stream bed.

Landscape change caused by human impact

In medieval times landforms and vegetation had an important part in economic activities (hunting, cultivation). The geomorphology of the region was favourable for fortifying settlements. In the vicinity, four castles were erected (Salgó, Somoskő, Baglyaskő and Zagyvafő). The basalt cones had strategical importance.

The strongest impact on the natural environment was exerted by agriculture. Forest clearance was followed by the emergence of meadows and arable land. On steep slopes sheet wash was typical (gullies, V-shaped, deep valleys). After heavy dissection the area could not be used as arable land. Secondary vegetation was characterised first by bushes *(Crataegus crus-galli, Prunus spinosa)* and later *Robinia pseudoacacia* (Nógrád megye... 1989).

Vegetation was analysed from a LANDSAT TM image and NDVI was computed. Arable land was identified on the satellite image. The DTM shows that slopes of loess than 5 degrees angle are cultivated and steeper slopes are forested. The forests along the edges of the plateau are fragmented by strips of arable land, but smaller groves still function as ecological corridors. The acacia forest was planted in the early 20th century, replacing cleared *Quercus petraea* forests. Plantations of *Pinus sylvestris, Pinus nigra* are also found as small patches enclosed by *Quercus cerris* stands. On the N slopes *Fagus silvatica* stands are seen without undergrowth.

Using the data base of the local cooperative farm, training sites were established in the study area. With the help of these data, a *land use map* was constructed in ERDAS Imagine 8.2. Six land use classes were identified (arable land, meadow, pasture, deciduous forest, coniferous forest and quarry). Through the analysis of earlier and new satellite images, land use change for the last 15 years could be detected.

A major change took place in the environment in the 19th and 20th centuries. In the mid-18th century *brown-coal mines* were opened in the region. Evidence of autochtonous brown coal formation is an ancient tree-trunk of 1.5 m perimeter, which stands vertically in a mine shaft at Salgóbánya. Deep mining under the Medves plateau called for infrastructural development. In 1867 Pest and Salgótarján were linked by railway. New settlements (Salgótarján, Rónabánya) were founded. The first steam-operated rack railway in Hungary was built between Salgótarján and Salgóbánya in 1881. For timber the forests of the Medves region were intensively cleared (A salgótarjáni 1962). Because of the depletion of coal reserves, the last mine was closed down in 1960.

Direct impacts of coal mining can be observed on the surface. Inactive shafts collapsed and depressions, cracks appeared in the caprock. These phenomena are common in the area of the Vecseklő Cooperative Farm, in the central part of the Medves Plateau. Due to gravity movements of layers, coal seams come into contact with air and, therefore, spontanous combustion began in the coal layer of 10,048 to 13,339 kJ per kg calorific value (A salgótarjáni 1962). This very slow process lasts for a few months and significantly influences microclimate, particularly in winter, when in the neighbourhood of hor fissures relatively high temperatures (10°C) are measured. Consequently, snow melts and rare

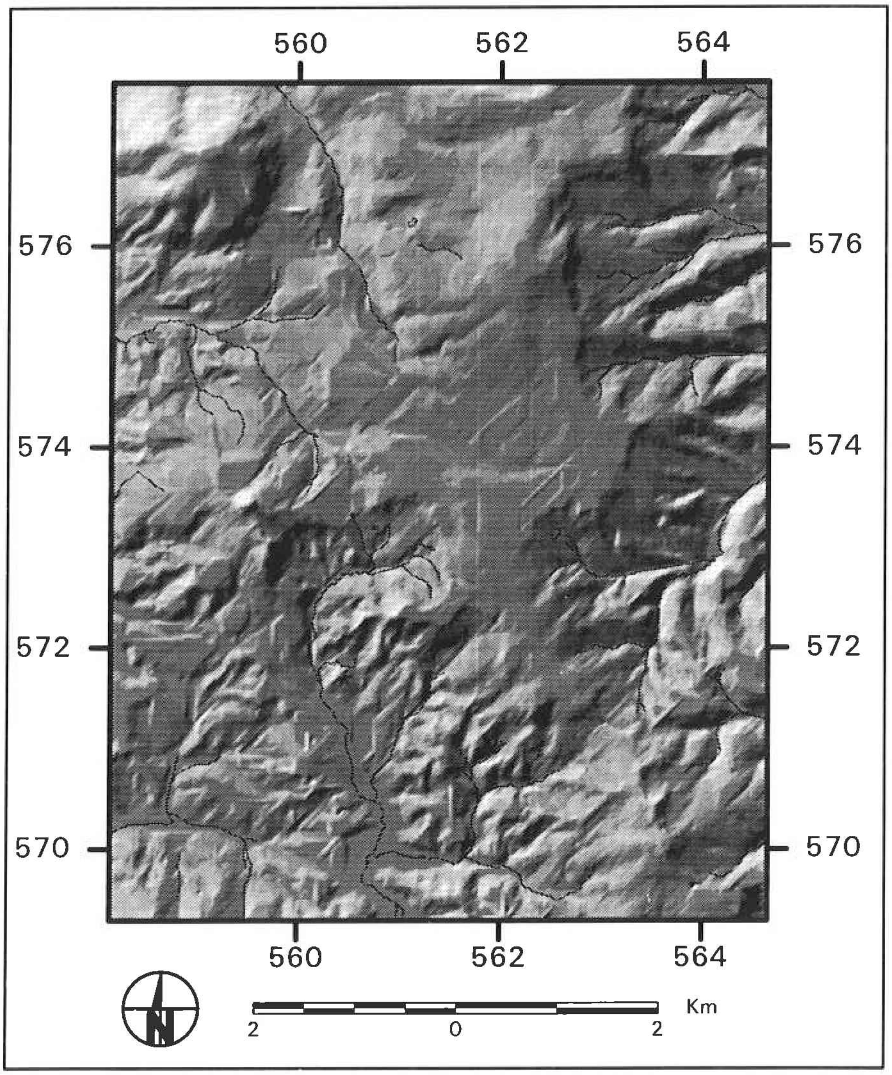

Fig. 2. Shaded relief of Medves Plateau.

moss and fern species settle here. The same happened in Szilváskő, where cracks are large and deep.

Another important mineral reserve is the *basalt* of Medves. *Quarrying* began at Bagókő in 1878. Owners aiming at a high profit neglected the conditions of quarries. The quarried basalt was transported by road and rail to road and railway constructions and also to the Tisza river, along which flood-control dykes were being built. Although new quarries were opened at the beginning of the 20th century (eg. at Medvesközépbánya and Magyarbánya and in the 1940s at Salgóbánya), the market became restricted and an increasing concern emerged for nature conservation (the foundation of the Salgó Nature Reserve in 1964), these quarries closed down in the 1970s.

Today abandoned basalt quarries occupy 32 hectare area, 20 hectares of which serve as waste disposal sites. Lacking plans for reclamation, wastes were deposited onto layers of valuable basalt. On the whole, the quarries remained untouched for the past 25 years. Only one of them has been managed as a recreation area within the framework of the Development Programme of the Bükk National Park.

Mining activities also affected agriculture and forestry. Because of the technology applied, geological structures and stability were altered and subsurface water and faune were modified. In quarries a special microclimate developed, different from the microclimate of the neighbourhood. Therefore, these are anthropogenic ecotopes, different from the local natural ones. Human activity became a factor of secondary ecotope formation.

In the environs of open-cast mines, drainage has changed and the quarries became the local base level of the new drainage. They are described as basins where sediments deposit either by gravity or by sheet or stream erosion. Along the feet of steep quarry slopes debris accumulates. The sedimentary layers overlying volcanic rocks dip towards the centres of excavation. Water infiltrating into these layers reduces slope stability and triggers landslides. Due to frost shattering, rock fragments fall to the quarry floor. The rate of the mentioned processes is measured by the amount of rock debris accumulated on the ice of an artificial quarry pond in Középbánya in winter.

On debris slopes a secondary vegetation relatively rapidly develops, particularly *Robinia*. Vegetation is a major issue in the reclamation of such areas. Filling up quarries is a hopeless task, since it makes reclamation very expensive and the materials used have to be excavated from another quarry. A simpler solution is to form a gentle slope, where natural processes could start. The ecotopes created by mining and other human activities should be managed to fit into the natural landscape ecosystem.

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