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GEOMORPHOLOGICAL VALUES ON THE SOUTHERN FOOTHILL AREA OF THE BÜKK MOUNTAINS

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Összefoglaló

Az Egri-Bükkalja geomorfológiai értékei. Kutatásunk során az Egri-Bükkalja geomorfológiai értékeinek felmérését, azon belül legjelentősebb érték-típusainak bemutatását tűztük ki célul. A kutatási terület a Bükk hegység déli előterében, az északnyugat és délkeleti csapású eróziós völgyekkel tagolt hegylábfelszín nyugati részén fekszik, melynek területe 480 km^2. A Bükk hegység nagytájának 4,37%-át, míg a Bükkalja középtájának 26,7%-át fedi le. A vizsgált területen (Heves és Borsod-Abaúj-Zemplén megye) az alábbi 17 település helyezkedik el: Andornaktálya, Bogács, Bükkzsérc, Cserépfalu, Cserépváralja, Demjén, Eger, Egerbakta, Egerszalók, Egerszólát, Felnémet, Nagytálya, Noszvaj, Novaj, Ostoros, Szomolya és Tard.

Felszínalaktani értékek megjelölésével az Egri-Bükkalján hivatalosan védett formákat nem találtunk, ezek vagy földtani értékkategóriaként, vagy kultúrtörténeti kategóriaként védettek! A vizsgált terület geomorfológiai térképezése azt bizonyítja, hogy számos, még a helyi önkormányzatok és a lakosság által sem ismert érdekes morfológiai formák találhatóak itt. Szinte minden település esetében 10-15 olyan mezo-, vagy mikroformát tudunk kijelölni, amelyek a táj sajátos és jellegzetes képviselői, s hűen tükrözik a Bükkalja kialakulási fázisait, eltérő éghajlati és felszínfejlődési időszakait. E felszínalaktani formák védelme, valamint a településfejlesztési, idegenforgalmi és turisztikai vagy tájrendezési tervekbe való beépítése mindenképpen ajánlott. Jelen tanulmányunkban a kutatási terület főbb geomorfológiai értékkategóriáit mutatjuk be: (1) *idősebb hegylábfelszín maradványok (aszimmetrikus kuesztták);(2) fiatalabb hegylábfelszín maradványok; (3) eróziós fő völgyek negyedidőszaki teraszmaradványokkal (pleisztocén II. a. és II. b. sz. terasz, illetve holocén I. sz. terasz); (4) szurdokok; (5) deráziós völgyek, delle sorozatok; (6) tömegmozgásos jelenségek (csuszam-*

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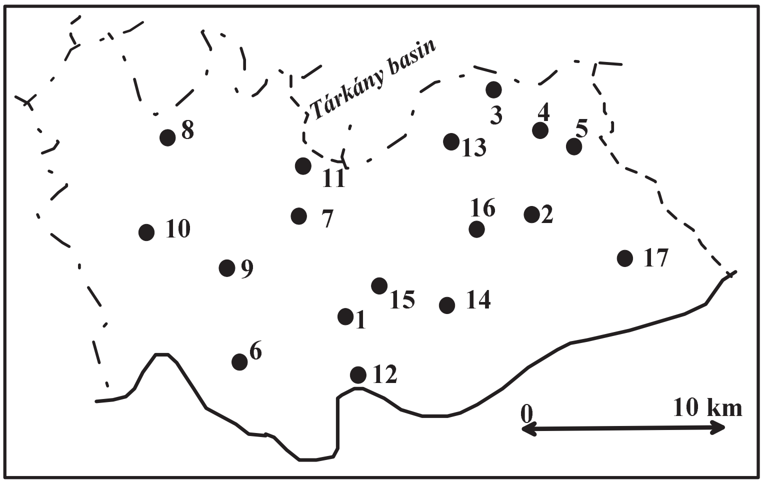
lás, omlás, geliszoliflukciós jelenségek stb.); (7) krioplanációs és periglaciális formák; (8) mésztufa kiválások mikro- és makroformái; (9) vizes élőhelyek, lápok, alluviumok; (10) antropogén morfológiai elemek; és a (11) kaptárkövek.

Az Egri-Bükkalja geomorfológiai értékeit részletes terepi bejárásokkal és térképezésekkel mértük fel. A kiszállások során a legjelentősebb felszíni formákról fotódokumentációt készítettünk. A formák kialakulási körülményeit, éghajlati adottságait, korát, valamint mai állapotát is felmértük. A kiemelkedő felszínalaktani értékekkel rendelkező települések esetében vizsgáltuk a védett, nem ismert és védelemre javasolt értékek kvantitatív arányait is.

Az említett kategóriákon belül a Bükkalja egyes karakteres formáit mindenképpen védelemre javasoljuk és azok megfelelő bemutatását szorgalmazzuk helyi, önkormányzati szinten is. Az ismeretlen felszínalaktani értékek kataszterezését, bemutathatóvá tételét és fejlesztési tervbe való beépítését szintén kezdeményeztük. Erre az utóbbi időben szép példaként hozható fel Cserépfalu, Cserépváralja, Noszvaj, Egerszalók és Felsőtárkány terület- és tájrendezése, valamint tanösvényeinek útvonal kijelölései. A kiemelkedő értékkel bíró és a táj megjelenését meghatározó felszínalaktani formák egy-egy példáját tanösvényekbe beépítetten javasoljuk bemutatni, hiszen így védelmük és későbbi kezelésük is nagyobb óvatosságra inti a helyi lakosságot és a hivatalos közigazgatási, gazdasági szerveket. A kihelyezett bemutató táblákat ez esetben is állandóan pótolni kell.

Introduction

The Southern Foothill Area of the Bükk Mountains is situated in the Northern Hungarian Mountains and is dissected by erosion valleys direction to the northwest and southeast. This is a pediment surface of the Bükk Mountains and its territory is 480 km^2. This area is 4,37% of the macroregion of the Bükk Mountains and 26,7% of the mesoregion of the Southern Foothill Area of the Bükk Mountains. We can find the following settlements in this study area (Heves and Borsod-Abaúj-Zemplén County): Andornaktálya, Bogács, Bükkzsérc, Cserépfalu, Cserépváralja, Demjén, Eger, Egerbakta, Egerszalók, Egerszólát, Felnémet, Nagytálya, Noszvaj, Novaj, Ostoros, Szomolya and Tard (Marosi S. – Somogyi S. 1990).



Settlements: 1 – Andornaktálya, 2 – Bogács, 3 – Bükkzsérc, 4 – Cserépfalu, 5 – Cserépváralja, 6 – Demjén, 7 and 11 – Eger (Felnémet), 8 – Egerbakta, 9 – Egerszalók, 10 – Egerszólát, 12 – Nagytálya, 13 – Noszvaj, 14 – Novaj, 15 – Ostoros, 16 – Szomolya, 17 – Tard.

Fig. 1. The topographical map of the study area (Somogyi S. – Marosi S., 1990).

We could not found ***landscape forms, which were categorized as protected geomorphological values*** in this study area (Fig. 1.). Some landscape forms could be protected only as geological or cultural values here. We have mapped this territory in detail and we have found many interesting and beautiful geomophological forms, which are unknown by the local inhabitants and local governments. 10 or 15 meso or macro landforms could be indicated, which are special and characteristic landform types in the Souhern Foothill Area of the Bükk Mountains in case of each local settlement territory. These landforms provide a lot of information about the development of the pediment surface or its climatic conditions. According to our research work, we could supply that these unprotected and various geomorphological forms can integrated into the local settlement, tourism and landscape development plans. In this article, the most important and characteristic categories of the geomorphological values will be presented.

Geomorphological values' categories in the Southern Foothill Area in the Bükk Mountains

1. The most important values' categories in the study area:

1. *remnants of the older pediment surfaces (asymmetric questas);*
2. *remnants of the younger pediment surfaces;*

3. *erosional main valleys with Quaternary fluvial terraces (Pleistocene No. II. a. and No. II. b. fluvial terraces, and Holocene No. I. fluvial terraces);*
4. *canyons;*
5. *derasional valleys and dells;*
6. *mass movements (breakage, landslides, gelisolifluctional movements, etc.);*
7. *cryoplanational and periglacial forms;*
8. *micro and macroforms of the travertines;*
9. *wetlands, alluviums;*
10. *antropogenic forms,*
11. *„Hive stones".*

2. Research methods:

The geomorphological values of the foothill area had been mapped by detailed field work. The most important values' categories had been registered and photographed. The climatic conditions, the age of landforms and their development conditions had been investigated too. In some case of settlements, we had investigated the quantitative rate of the protected, unprotected geomorphological values and landscape forms supplied for the protection.

Presentation of the geomorphological values' categories

1. Remnants of the older and younger pediments

The most interesting macro landforms in the study area are remnants of the older and younger pediments. There was a large surface plannation (pedimentation) in the southern rim of the Bükk Mountains during the Miocene and Pliocene/Pleistocene (Pinczés 1968, 1970, 1980; Hevesi 1978, 1986, 1990; Pinczés-Martonné Erdős-Dobos 1993; Martonné Erdős 2000; Dobos 2001). The pedimentation was appeared in warm and dry climatic conditions, when sudden shower caused expressive areal erosion: (1) Miocene *Ottnangien-Carpathien-Badenien* period (20-14 Ma); (2) Miocene *Sümegium and Bérbaltavárium period* (8-5,5 Ma), and (3) at the boundary of Pliocene and Pleistocene in the *Villanyium period* (2-1,8 Ma). According to the orogenic phases and valley deepening activities these pediments could be appeared as destroyed summits or remnants (Fig. 2-5.).

Fig. 2. Asymmetric older pediments (Karud and Mangó Hill) with younger, larger pediments

Fig. 3. Cserépfalu: cryopediments and cryoglacis in front of the Kút Hill and Perpác

Fig. 4. The Southern part of Nagy-Eged

Fig. 5. Eger: Tihamér – younger pediment with Pleistocene fluvial terraces

The remnants of the older plannated surface (*Sümegium-Bérbaltavárium*, 8-5,5 Ma) can be found in 300-360 m above the see level. In some cases these land-forms are situated at the boundary between Southern Bükk Mts. and the Southern Foothill Area of the Bükk Mountains. Asymmetric questas can be seen in the Southern Foothill Area of the Bükk Mountains:

- Kút Hill (350 m), Perpác (341,2 m)
- Summits northwest of Bükkzsérc (330,8 m), Southern part of Nagy-Galya (330 m)
- Ravaszlyuk Hill (358,4 m)
- Nyomó Hill (340,2 m), Kecet Hill (350,2 m), Major-house (333,5 m), Nagy-Dobrák Hill (349,9 m)
- Mész Hill (367,8 – 353 m), Kőkötő Hill (318-309 m), Karud (371,2 m), Mangó Hill (305 m)
- Nyírjes (332,7 m), Barát peak (336,3 m)
- Dobogó peak (327 m).

The younger pediment surface is wider and more uniform. It was developed under the remnants of older pediments at 200-250 m above the see level (Fig 5.). This surface has been developed under semiarid climatic conditions and after that it was planned, lowered and breaked up by the periglacial pedimentation under cooler climatic circumstances. The most characteristic peaks of this area are the following:

- Almagyar Hill (269,5 m)
- Pünkösd Hill (266,9 m), Kolompdugó peak (254,4 m)

- Kerek Hill (270,5 m), Hidegkút valley (250-270 m), Ortvány (285,6 m)
- Aranybika peak (265,8 m)
- Vilasmár (270 m), Égés peak (280 m)
- Őr Hill (271,8 m), Gyűr Hill (293,3 m)
- Berezd peak (273,9 m), Cseres wood (240-270 m), Sugaró Hill (222,6 m).

2. Erosional main valleys with Quaternary fluvial terraces (Pleistocene No. II. a. and II. b., or Holocene No. I. fluvial terrace)

The second typical landforms are main valleys trended from northwest to southeast in the Southern Foothill Areas of the Bükk Mountains: valleys of Szólát stream, Laskó stream, Eger stream, Ostoros stream, Kánya stream, Hór stream and Lator stream. The ancient and periodic water races appeared here and took part in the planation processes of pediments. In the Pleistocene, these water races became larger streams and began to deep and cut their watersteads into the surface during different climatic and tectonic phases. Their valley slopes are steep and they have got 50-100-200 m wide alluviums developed by linear erosion processes in the Quaternary period (Fig. 6-7.). The slopes were cut by lots of narrow and new water cuts during the warmer and rainy weather in the Holocene period. Because of the alternating valley deepening processes Pleistocene fluvial terraces No. II. b. and II. a. and Holocene fluvial terraces No. I. had been appeared along valley slopes (Fig. 6-7.).

Fig. 6. Erosional main valley with water cuts at the southern boundary of Bogács

Fig. 7. Erosional valley head in Szomolya

Fig. 8. Erosional watershed in the southern part of Szomolya

3. Canyons

In the studied settlements, *deep and narow canyons* can be found at the boundary between the Southern Bükk Mts. and the Southern Foothill Area of the Bükk Maountains. These fluvial forms were developed under special geological conditions, because Triassic limestone, Jurassic shale series and Oligocene Kiscell Clays meet with Miocene rhyolite and dacite tuff layers along the Hór valley, Stone valley in Cserépváralja, and Upper valley in Cserépváralja. Similar linear erosional canyons and parts of canyons can be seen along Miocene ignimbrites and non-welded rhyolite tuff layers in this foothill area for example in Cserépváralja valley south of Nyúl valley mouth and upper part of the Novaj stream. These valleys, canyons are generally epigenetic valleys. These areas were covered by different sediment layers where valley downcutting began and this water races, streams appeared first. Water races began to deep their waterstead into the surface and because of different tectonic and climatic phases these waterstead were transmitted into the hard stones and rock masses lying under the cover sediments. The welded rhyolite tuff layers, ignimbrites and limestones had come in sight and had begun to destroy. Karst landforms, karts springs, microkarst forms had been developed on the limestone layers and rock walls. *Cryoplanation towers, walls, debris or smaller tributary valleys* based on the rhyolite and dacite tuff layers or ignimbrites had been appeared along the deeper canyons and valley's slopes.

4. Derasional valleys and dells

The wide or narrow tributary valleys, which look like a dish form are derasional valleys and dells in the hilly regions in Hungary. They were formed under the cooler periglacial climatic conditions in the Pleistocene. The deeper soil and sediment layers were frozen and the upper parts of the soils and sediments (active layer) could freeze and thaw per day. The mass movements, gelisolifluction processes and areal erosion were taken part in forming this special landforms. Pleistocene slope clays covered the deeper valley slopes and summits, that is why the *mass movements, landslides, solifluction processes and soil degradation* were typical here. These forms can be seen along the larger erosional valleys' slopes everywhere in the foothill area (Fig. 9-10.).

Fig. 9. Bogács: Derasional valley

Fig. 10. Derasional valleys and dells in the western part of Eger

5. Mass movements (landslides, falls of ground, solifluction processes, etc.)

Interesting and various landforms are the different types of mass movements in the study area. We can find stepped, slided sediment layers along slopes, which were moved downwards by *landslides, solifluctional processes or gelisolifluction* (Fig. 10-12.). Talus cones and angular shaped debris can be seen in front of the rock walls, cryoplanation steps and towers. They were developed by *fall of ground*. Mass movements were appeared on special geological fundamentals here. Pleistocene slope clays, Oligocene clays and sands or weathered Miocene rhyolite and dacite tuffs cover the slopes. These surface layers can absorb the water easily during the warmer, wet climatic period and slide on the dry and harder sediment layers, which were deposited in the deeper soil and sediment layers. These processes can produce quick landslides (Fig. 11.) or slower movements (some cm movements per year). The special type of the mass movements is the *gelisolifluction*. It was developed under the cooler, periglacial climatic conditions in the Pleistocene. The soil was frozen in the deeper sediment layers (0,5-1-2 m deep layers), but the upper layers (active layers) can receive the water because these layers thawed per a day. That is why the sediments in the upper parts could slide here and created new, various microlandforms on the slopes (Székely 1992). Some territory characterized by mass movement activities are under the agricultural production nowadays. The loosening of the soil, soil milling and spade-work can cause intensive soil degradation and soil devastation here (Fig. 12.).

Fig 11. Water-basin and landslides in Egerszólát

Fig. 12. Landslides in Bogács

6. Cryoplanation and periglacial landforms

Cryoplanational debris and talus cones could be mapped in front of the *cryoplanation walls, towers* and *cryoplanation steps* at the edge of plannated surfaces and valley slopes (Nyomó Hill, Kőkötő Hill, Karud, Pipis, Szaduszka peak, Felső valley, Cseres peak, Szomolya Király-széke /King's chair/, etc.). These landforms had been developed by frost activity. The shape of the debris is angular, poligonal and its size is about 10-20 cm in diameter depending on geological conditions. Larger, gentle sloped landforms are *cryoplanation pediments and glacis* at the boundary of the Southern Bükk Mts. and The Southern Foothill Area of Bükk Mts. (Cserépfalu, Nagy-Eged, Egerszólát és Egerszalók, Fig. 13.).

These forms are formed by *intensive frost weathering, cryoturbation and cryopedimentation* during the Pleistocene period.

Fig. 12. Cryoplanational debris in the Nagy-Eged

Fig. 13. Cryopediment and glacis in front of the Kút Hill and Perpác

7. Travertine mound, micro and macro landforms in the travertine concretion

We can see smaller travertine mounds in some places in the study area. The travertine had got separated from the meteoric water on the surface of debris or different geological outcrops. They could conservate some places of ancient springs. Larger and well-known forms are in Eger (the western side of tower of the Castle) and in Egerszalók. Petroleum drill (No. De-42.) was deepened into the lower part of the Maklányi valley in 1961, where 8 000 000 m^3 water flow to the surface and about 1000 m^3 limestone was deposited in Egerszalók. The territory of this mound is 2500 m^2. The temperature of the water is 67 °C, the composition of this karst water is natrium, sulphur and $CaMg(CO_3)_2$ (Vasi et al. 2002). We can investigate small, some cm sized stepped, microkarst landfroms, meanders and travertine tetaratas here (Fig. 14.). Beautiful white rock layers can be seen where the continuous water cover has been guaranteed. In some places, the surface of the travertine layers are grey. These layers have begun to erode by insolation weathering, deflation, areal watersheds, frost activity and antropogenic processes. The surrounding area of this travertine mound was rebuilt in the last few years because of the building operations of wellnes and tourist centrum. The sight planning is the most important building activity here now, that is why the wider and new travertine mounds and slopes will be created. The area of the original travertine mound is under the environmental protection.

Fig. 14a. Egerszalók: travertine mound, prtotected landform

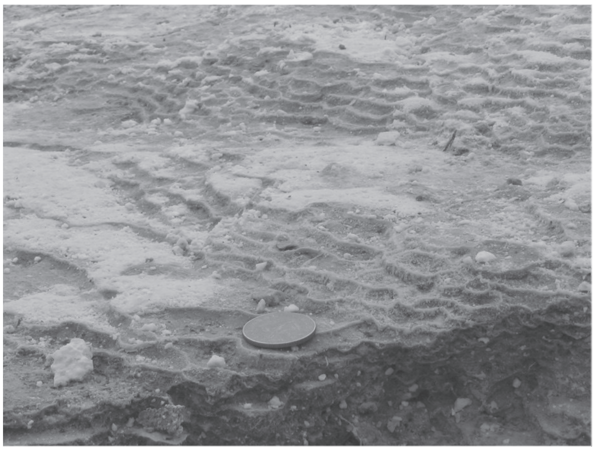


Fig. 14b. Egerszalók: Travertine's microforms

8. Wetlands, swampy area, alluviums

The alluvium of main erosional valleys are generally under the agricultural activity. We can find valuable alluviums, wetlands and swampy areas in some places only in the Southern Foothill Area of the Bükk Mountain. These areas consist of the protected territory called NATURA 2000. Interesting, romantic and valuable swampy areas are along the Rét valley (Ostoros stream), in the southern part of Noszvaj (south of Hosszú-Szél field, Fig. 15.-16.); and in front of the Szék valley. Fine fluvial sediments (sand, silt, clay) were deposited here in the Holocene period. These layers can keep the water for a long time, because the clay is a permeable rock type. We can find smaller opened water surface in some place among valuable and rich swampy vegetation.

Fig. 15. Noszvaj Holocene moor

Fig. 16. Noszvaj Holocene alluvium

9. Antropogenic forms (mines)

Our research area is built up with Miocene volcanic rocks, welded and non welded tuff series as Gyulakeszi Rhyolite Tuffs, Tar Dacite Tuffs, and Felnémet Rhyolite Tuffs. Pleistocene slope clays, loess, and loess like sediments cover the surface of these rhyolite and dacite tuffs. Because of the fluvial erosion, alluviums is built up with Holocene fluvial sediments (clay, silt, sands, gravel) (Pelikán 2002). New rock outcrops have appeared along the valley's slopes and *the extraction by mining* explore these rock layers. Numerous open mines are inactive in the foothill area today. We need to solve the recultivation programmes of mines and their environmental management (Berva valley, Mész valley, Demjén, Egerszalók, Noszvaj, Cserépfalu, Cserépváralja, Egerszólát, etc.). More outcrop mines were taken place under the environmental protection, or new geological trails were created along the cross sections and mining discrict in the last few years.

10. "Hive stones"

"Hive stones" are known as cultural landscape elements in the foothill area, which are under the local protection. Their natural development fundamentals had been investigated by Martonné Katalin Erdős (1972, 2000), Balázs Borsos (1991) and Csaba Baráz (2005). These tower shaped "hive stones" could be created by *complex natural processes* in the Quaternary period. They have got *a lot's of various meso and micro landforms* (Fig. 17–20.). In the Pleistocene and Holocene period, main erosional valleys cut their waterstead into the surface and the deeper sediment layers were rised into the surface. *The frost weathering, mass movements, areal slope wash and linear erosional activities* formed these sediment layers under the different climatic effects. We can observe the influence of the retrogressive erosion of the tributary valleys in case of forming rhyolite tuff cone and tuff comb. The *bioerosional activities* are intensive today on the rock surface.

Fig 17. Cserépfalu: Hive stone

Fig. 18. Cserépfalu: Erosional valleys and meanders in the Hive stone

Fig. 19. Cserépfalu: Devil Tower

Fig 20. Cserépváralja: Furgál valley

Summary

We can advise the most characteristic landforms inside the presented geomorphological values' categories for the protection in the Southern Foothill Areas of the Bükk Mountain. We suggest these values to present in the field too. Some settlements had begun to integrate these mapped geomorpholgical values into the development plans of the local authority and created new tourism centres, trails and wellnes complexum for example in Cserépfalu, Cserépváralja, Noszvaj, Egerszalók and Felsőtárkány. We suggest geomorphological values, which are possessed prominent interests to integrate into the geological or geomorphological trails because their protection and management can be control better for the future.

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