Quarrying, geoheritages and tourism development in the Medves region along the Hungarian-Slovakian border

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ABSTRACT
There are very few parts of the world which continue to possess a wholly natural landscape. Man's influence on the face of the Earth is pervasive and increasing dramatically. Studies of the physical geography of the artificial landscape are generally considered under the heading of 'anthropogenic geomorphology'. In spite of the fact that a great number of geographical studies deal with man's activities only a few authors analyse quarrying as an anthropogenic geomorphologic activity in detail. We show the anthopogenic relief transformation which has taken place in the Medves Plateau and the geological basis of the quarrying. We carried out analysis and classification of the characteristic forms created as a result of the quarrying. Since the size of the Medves quarries can be regarded as average (the heights of quarry walls are maximally a few tens of metres, and the size of quarry yards rarely exceed a width/length of one hundred metres), activities can be taken into account when planning after use, which are suitable for these dimensions. We have provided our genetic based classification system with illustrations. The Medves Region is a small (160 km^2) landscape unit in North Hungary, in the vicinity of the county town Salgótarján. This landscape is rather variegated from geological and geomorphological point of view. The geoheritage of the area could offer a base to develop sights for attracting the tourism and the quarries and its geological and geomorphological forms can play very important role in it.

Keywords: Medves, geoheritages, tourism

INTRODUCTION

There are very few parts of the world which continue to possess a wholly natural landscape. Man's influence on the face of the Earth is pervasive and increasing dramatically. Studies of the physical geography of the artificial landscape are generally considered under the heading of 'anthropogenic geomorphology'. In spite of the fact that a great number of geographical studies deal with man's activities only a few authors analyse quarrying as an anthropogenic geomorphologic activity in detail.

GEOLOGIC GROUNDS OF BASALT MINING ON THE MEDVES PLATEAU

On the research area limestone and sandstone formations were deposited in the Tertiary (Badenian stage). The area was a land in the Pliocene, which eroded seriously, ravines and valleys dissected its surface. The first basalt volcano started to erupt about 3 million years ago (Pliocene-Pleistocene) [6]. The material of the volcanic explosions filled up the erosion depressions of the surface, therefore the thickness of the basalt cover changes from place to place. The older, but not widely

appearing lava can be found in lower quantity with a columnar structure. The youngest lava layer, which is the bulk of the lava cover has a layered structure, with very good cleavage properties [5, 7, 14]. Therefore in Hungary the Medves Plateau became the most important site of the basalt mining (Fig. 1).

SURVEY OF THE ABANDONED QUARRIES OF THE MEDVES REGION

The first quarry of the Medves Plateau was opened in 1878 at *Bagókõ (a)*, and it was closed in 1962. On its 65,000 square meters (0,065 square kilometres) size territory compact, structured columnar basalt of good quality was extracted. Most of the reserve was extracted. The closed mine has not affected its environment adversely. A small lake in the quarry could be used for recreation if the surrounding area were cleared of waste. Its solid, safe walls expose spectacular basalt columns that would be suitable for educational and touristical purposes at low development costs.

The largest geological exposure in the Medves Region is at *Magyar-bánya (b)* where, in 1880, the first prospecting hole was deepened and intensive mining continued until the mid-1970s. Its first owner was the Somoskõ Basalt Mining Company which was later nationalised and eventually given to the local cooperative. Here the basalt appears in highly variegated forms, mostly bedded or aphrolith-like. Thick tuff covers the lava and it is sometimes wedging into the basalt layers. On the northwest part of the 80,000 square meters quarry is a well, supplying drinking water for the villages of Somoskõ and Somoskõújfalu. The water of the well enters from a bedding-plane of the basalt layers and it is therefore very sensitive for pollution. West of the quarry is its dump (25,000 square meters), now used as a geological park exhibiting the rocks typical of the area. The garden of the quarry is an open-air museum intended to display the mine's equipment, though only two rusty mine-cars remain. The top of the mine dump is not yet vegetated and visual evidence suggests that it is used for illegal stone and spoil extraction. The poor condition of the area detracts greatly from the neighbouring medieval castle, an important destination for international tourists, so reclamation is needed soon.

The largest quarry complex on the Medves Plateau was in production from 1910 until the 1970s. The *Eresztvény Quarry Complex (c)* consists of several quarries: *Felsõ-bánya (c1)*, *Kisbánya (c2)*, *Középbánya (c3)* (very often mentioned together with the *Nagy-réti-bánya [c4]*), *Új-bánya (c5)*. The largest of them is the Felsõ-bánya (Upper Quarry) with a 140,000 square meters territory, including dumps occupying 55,000 square meters. The long walls of the quarry are 21 meters high and consist of highly variegated layers of basalt lava, basalt tuff, and conglomerate. A smaller amount of reddish clayey sand can be found in the quarry as well. The most important task is to pull down the buildings of the former quarry and remove these building materials. This is important because the quarry is very close to the tourist centre of Eresztvény as well as to a water well that must be protected. Much industrial waste covers the area including tires, abandoned automobiles, cartridge shells, and pieces of mining equipment. After cleaning the area, reclamation should be aimed at promoting natural revegetation. The 'crystal-tuff', which is so often noted in the Hungarian geological literature, has its best exposure at this site. During the mining two outcroppings were exposed. One was protected earlier, the other can be seen along the northeast wall of the quarry. Their protection is important as a means of preserving important geological specimens.

Close to Felsõ-bánya *Kis-bánya* (90,000 square meters) and *Közép-bánya* (or *Régi-*

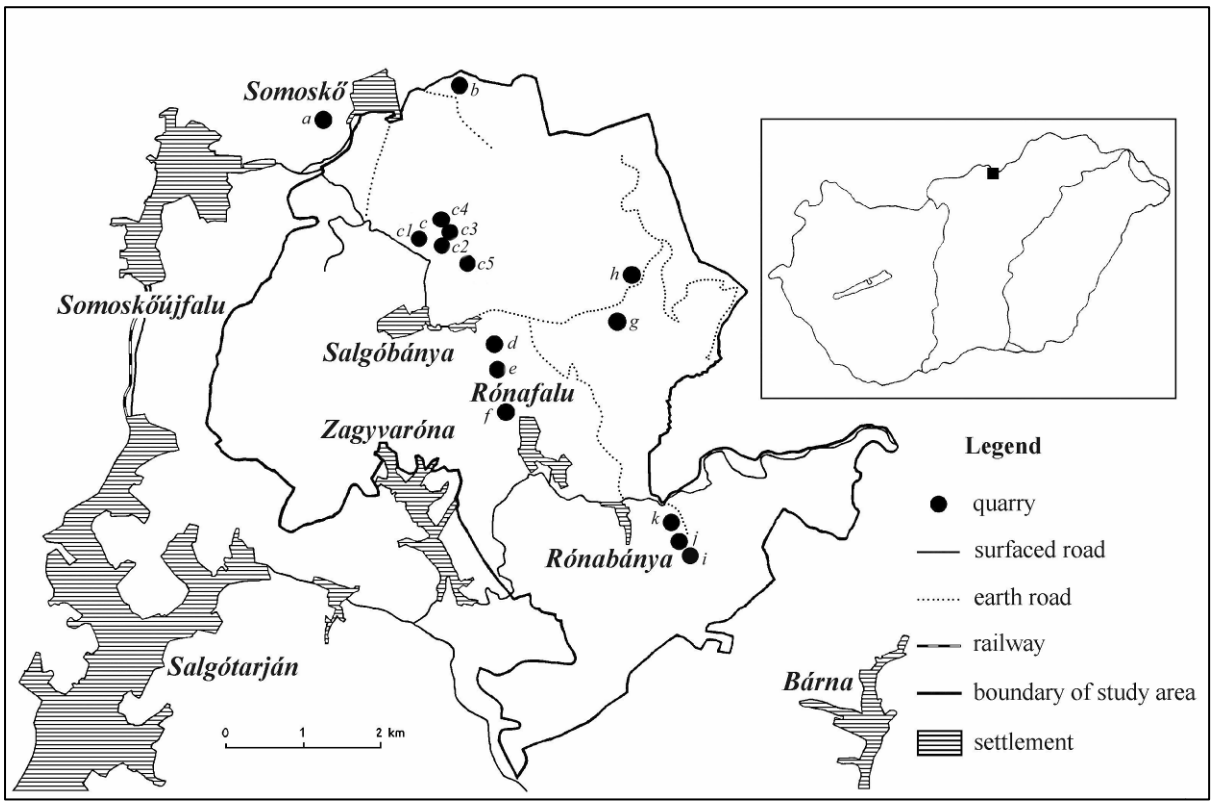

Fig. 1 Medves Region and its quarries (Compiled by Karancsi, Z.)

bánya) can be found. On the floor of the last section of the quarry that was worked surface waters have collected into a lake (60 x 40 m) below a 20 meter wall. The lake has become a popular resting place. Reclamation should be aimed at saving this pond and recultivating the rest of the quarry and its dump.

The *Salgó-bánya (d)* quarry was opened on the rim of the Medves Plateau in 1940 but closed at the end of the 1950s because of the poor quality of the extracted basalt. On the west border of the quarry is a stream with several springs that merits protection. The natural planation of the area encourages landslides, so a debris slope already covers the entire floor of the quarry and only the upper 5 meters of the wall are visible. On these naturally developed slopes, forest cover has spread without human intervention.

South of the village Salgóbánya is the former *Lauffer-bánya (e),* where small paving and curb stones were cut between 1920 and 1930. Basalt debris is still removed from this abandoned mine. On the south rim of the Medves Plateau, west of Rónabánya, mining activity occasionally took place in *Rónai-bánya (f).*

The basalt of the *Tehenesi-bánya* (*Quarry of the Vecseklõ Cooperative*) *[g]* was established in the 1940s on the south-east edge of the Medves Plateau. By the time extraction stopped in the mid-1970s, the quarry occupied 37,000 square meters including a dump of 15,000 square meters. Extraction was supervised for a time by a coal mining company, then transferred to the Cered Cooperative. The quarry is divided by a dump on its south side and the materials found in the dump are still used for stone-carving, though most are carried away illegally. The quarry has two levels, is highly dissected, and encompasses five smaller holes that were opened to extract basalt from deeper layers. The dump can be used for filling these holes. The main rock body is a columnar basalt dissected by a very dense fault system. Precipitation drains into the nearby fish-pond (Tehenesi Lake)

through this fissure system, so protection is needed. Sulphuric smoke rising from the cracked surface signals that burning coal deposits lie below. The walls are unstable due to fissures, so rock slides are common and fallen blocks abundant. There is a high risk of mass movements. The continuous slides, the rolling rocks, and the debris flows create unstable, changeable conditions. The quarry is contrasts greatly with the surrounding forest and can be seen from far away. Reclamation is needed to stabilise and re-establish vegetation-particularly treessince this portion of the Medves is generally characterised by forests alternating with meadows.

The *Vecseklõ Forest Quarry* (2,000 square meters) *[h]* was opened to serve the needs of forestry for building roads. It was worked between 1940 and 1958. The quarry is right on a paved road. It has a relatively low walls (approximately 5 meters), so it would be easy to reclaim.

South of the Medves Plateau is a separate basalt area, the Szilváskõ Ridge that stretches south to north along three basalt cones. The southernmost is the *Kis-Szilváskõ (i)* with a steep sloped summit (615 meters). In the middle is the *Nagy-Szilváskõ (j)* which is famous for the spectacular basalt columns exposed by mining and by the deep splits at the surface caused by underground mining. The third basalt cone is the *Bagókõ* (565 meters) *[k]*. Along its flank is a former quarry that exposes several different strata, the lowest being coal beds covered by eroded sandy layers. On the top of these can be found basalt layers of two different geologic ages. The lower one has a vertical columnar structure, while the columns of the younger lava lie horizontally.

THE NEED FOR LAND RECLAMATION

After mining has ended, the most important aim should be to stop as soon as possible the environmental harm caused by quarrying. The huge holes and dumps of the quarries all damage nature both physically and aesthetically. But is there a need to return the land it its original condition, and is this even advisable or possible? The destructive practices produce new and sometimes productive environments. The issue is choosing a 'less bad' solution acceptable to both nature and society, one that minimises harmful destruction.

In the open-air quarries it is nearly impossible to reconstruct the original conditions, not only because of the great expense but because the necessary fill can only be obtained by creating new quarries elsewhere. The reclamation or re-use means finding a use for the quarries for forestry, farming or cultural purposes [11].

The 'Mine Law' specifies that arable fields damaged by mining must be restored to their original, arable condition when mining is finished. To reach this goal the mining companies must fill holes, level surfaces, and form ramps between the terraces so that the reclaimed area can be used for other purposes. As a general rule, the mining activity is supposed to be confined to the minimum necessary area and reclamation must be started as soon as mining ends. The law favours reclamation through forestry because Hungary has so little forest cover.

The reclamation plans of the greatest quarries of the Medves Plateau have been completed or are underway. In each case the most important aim was to minimise the possibility of accidents and to rehabilitate the landscape. The first problem is addressed by wrenching loose rocks from the quarry walls, planting bushes on the edges of the walls, building protective fences, and erecting warning signs. The reclamation of mine infrastructure like roads, rail-tracks, rail beds, and buildings is much more difficult. They are normally in very bad condition and facilitate illegal dumping. The solution is to usually to bury the roads leading to the quarries with material from the dumps. In this way, illegal

mining and dumping are stopped. The rehabilitation is accomplished by landscaping the different levels aesthetically and by establishing conditions favourable to the re-establishment of vegetation.

The areas can be blended into their surroundings if the walls of the quarry are not so steep and the holes are filled. It should not be overlooked that mining has opened spectacular geological exposures which can be studied more easily than natural outcrops. These walls should not be destroyed, but instead used for education. They might also attract tourism if connected by nature trails. The quarry-lakes could be used for recreation and tourism, too. The most important aspect of reclaiming the dumps is to promote the establishment of pioneer plants that will stop intensive erosion. The best way to do this is to establish plants on the slopes between the different levels so that their roots weave through the upper part of the slope and decrease the rates of erosion. The geometrical arrangement of the dumps must also be changed to create a more naturalistic landscape.

Although it was not in the original plans, efforts should be made to have larger towns like Salgótarján use some of the quarries for cultural purposes such as open-air theatres, drive-in movies, and campsites. However, little of this reclamation has been undertaken, even after twenty years. The cost remains high, as much as $ 50,000 (HUF 10 million) today.

SURFACE FEATURES OF QUARRIES-TYPIFYING AND CHARACTERIZING FORMS OF QUARRYING

Alterations to surface morphology are the most obvious results of quarrying activities (Table 1 and Fig. 2):

A/ Forms created as a result of mining can be classified into two main groups [1, 2, 3, 12, 13]: excavated (negative) forms and accumulated (positive) forms.

B/ Forms destroyed by quarrying activities can be classified into another group on the basis of quarrying activities. This virtually means the levelling of the surface, which is called a planing activity in geography.

The morphological study of forms of quarrying noted in A has been undertaken in three categories, distinguished on a genetic basis and size.

Macroforms are the most obvious landscape-forming remains of mining:

1.a.) *Excavated macroforms* created as a result of mining can virtually be regarded as surfaces lacking materials.

1.b.) *Accumulated macroforms* are the so-called mine dumps.

2.a.) Excavated macroforms created as a result of mining are composed of smaller elements (*excavated mesoforms*): mine walls (*B*), mine floors (*A*) and debris aprons can be distinguished in almost every mine.

2.b.) The morphological components of accumulated macroforms (the so-called mine dumps) are plateaux and slopes (*accumulated mesoforms*).

3.) The surfaces of mesoform components can be divided into smaller and bigger excavated depressions. These are called *microforms*.

In addition to the influence of mining techniques and technology, and working rate, the characteristic features of the landforms in all three categories are also determined by the geological characteristics of the area (structure, bedding), the feature of the rocks and the natural processes affecting them.

A.1. Excavated (negative) forms

The *excavated macroforms* of quarrying activities usually appeared before accumulated forms because examples of them can be found in the first period of quarrying history. Mainly in the form of small quarries they can be found in the surroundings of almost every town and

Table 1 Surface features of quarries - typifying and characterising forms of quarrying (Compiled by Dávid, L.)

<table>
<tr><th colspan="4">FORM-MAKING ROLE OF QUARRYING ACTIVITIES</th></tr>
<tr><td colspan="4">A. On the basis of surface features</td></tr>
<tr><td colspan="2">EXCAVATED FORMS</td><td colspan="2">ACCUMULATED FORMS</td></tr>
<tr><td colspan="4">on genetic basis and size</td></tr>
<tr><td colspan="2">EXCAVATED MACROFORMS
(surfaces lacking in materials)</td><td colspan="2">ACCUMULATED MACROFORMS
(mine dumps)
cone-shaped
truncated cone-shaped
terraced</td></tr>
<tr><td colspan="4">on the basis of mining techniques</td></tr>
<tr><td>Simple
excavated type:
excavation pit
delph</td><td>Complex
excavated type:
horizon mining</td><td>Simple
accumulated type:
single quarry dump</td><td>Complex
accumulated type:
quarry dumps in
groups</td></tr>
<tr><td colspan="2">EXCAVATED MESOFORMS
mine wall
debris apron
mine floor</td><td colspan="2">ACCUMULATED MESOFORMS
plateau
slope</td></tr>
<tr><td colspan="4">MICROFORMS</td></tr>
<tr><td>Excavated
microforms:
rock buttress and pillar
pinnacles
rock benches
small shallow ponds</td><td colspan="2">microforms created as
a result of natural processes:
mass movements
linear erosion</td><td>Accumulated
microforms:
heap
boulder</td></tr>
<tr><td colspan="4">B. On the basis of the type of geotechnic activity</td></tr>
<tr><td colspan="4">PLANATIVE ACTIVITIES (PLANATION)</td></tr>
<tr><td colspan="2">ABRAIDING</td><td colspan="2">FILLING UP</td></tr>
</table>

village situated in mountainous areas. The most common type of excavated form is an excavation pit or a delph in the surface (*simple excavated type*).

The other type of excavated forms is horizon mining (*complex excavated type*). The appearance of complex excavated forms is characteristic of modern times. The technical condition for the appearance of these forms was the increase in the capacity and efficiency of excavating equipment, and the geological condition was the presence and exploration of thick stratums.

The form components of excavated macroforms (*excavated mezoforms*) are:

a.) mine wall (*B*): the steepest form component, whose angle of inclination with the mine flat is determined by the mining techniques (blasting, hand or power excavation) as well as the rock quality; normally it is nearly vertical. The mine floor is usually surrounded by mine walls on three sides.

b.) debris cones, debris aprons (*G*): a form component with a smaller angle of rest lying at the foot of mine walls whose material partly derives from mine working and partly from natural processes (rockfalls). As the amount of material in debris cones grows they may coalesce to

form a continuous debris apron.

c.) mine floor: an approximately flat ground surface surrounded by mine walls and debris aprons.

The most common *microforms* of mining are rock buttresses (*D*) and pillars (*C*), rock benches (*E*) and pinnacles. If these forms can resist the damaging effects of natural processes we find only a little material derived from rock falls in front of them. Precipitation derived small shallow ponds (*I*) can evolve in the holes of mine floor.

A.2. Accumulated (positive) forms

Accumulated macroforms are called quarry dumps. They are formed through the accumulation of materials currently of no value from an economic point of view. They can be found singly (*simple accumulated type*) or in groups (*complex accumulated type*). The shape of a positive form is determined by several factors: the original ground surface, the mode of accumulation and the physical features of the dump material. Cone-shaped, truncated cone-shaped and terraced dumps are the most common.

Form components of *accumulated mesoforms*:

a.) plateau (*K*): the approximately flat ground surface surrounded by the slopes of dumps. Its extent is determined by the type of the dump. The largest plateaux can be found on terraced dumps. The plateaux of truncated cone-shaped dumps are usually smaller.

b.) slope (*L*): the sloping ground surface which surrounds the plateau or the peak in the case of a cone-shaped dump. Its angle of dip can vary within wide limits depending on the mode of accumulation, the dump material and the original ground surface. The most obvious microforms of dumps, formed through natural processes, are rainwater grooves (*H*) cut into slopes, which lie radially on cone-shaped or truncated cone-shaped dumps. The dump material carried by rainwater settles in small alluvial cones (*J*) at the foot of slopes. Plateaux with approximately flat ground surface may be dissected by rainwater grooves cutting back into them. The *accumulated microforms* of mine floors formed as a result of mining activities are the larger heaps and boulders (*F*) cutting up the approximately flat ground surface.

B. Planative activities (planation)

Quarrying does not only have a landform-making effect but it can also result in planation.

a.) Spreading of dump material over natural or artificial dips (slopes, valleys, pits or depressions) cause them to be filled.

b.) Excavation of whole mountains during quarrying activities.

GEOHERITAGES, QUARRIES AND TOURISM DEVELOPMENT IN THE MEDVES REGION

The geoheritage of the area could offer a base to develop sights for attracting the tourism and the quarries and its geological and geomorphological forms can play very important role in it. For making whatever development plan, the knowledge of the landscape and its natural, cultural, industrial historical values is an unavoidable condition. Of course, there are some interesting points which have considerable natural value but can not be blocked from the tourists (typical examples are the Salgó Mount and the Szilvás-kő Mount). Therefore, we are working on creating new tourism development zones based on the following principles.

Areas where tourism should be avoided

To this category belong the valleys and forests on the north-eastern and eastern rim of the Medves Plateau. These valleys are very vulnerable and therefore strictly protected; although especially the Gortva Valley is one of the most remarkable geoheritage in the region, it must be preserved from the tourists. For the

protection also that is necessary, that the roads above the Gortva Valley would be used only by ecotourists. In the region only in four cases can be suggested exception, like at the Rock Park (open-air exhibition of rock types of Hungary); at the "Medves magosa" (the highest point of the Medves Plateau, where a loop-trail should be created); at the so-called Tehenes Quarry (where a look-out tower should be erected, which could be a good goal for the tourists); and at the unpaved road which goes from Medvespuszta to the state boundary (the former settlement Medvespuszta is nowadays ruined, its revitalization as a farm-stead would be reasonable: orchards should be resettled, exhibitions for showing the former life manner should be created).

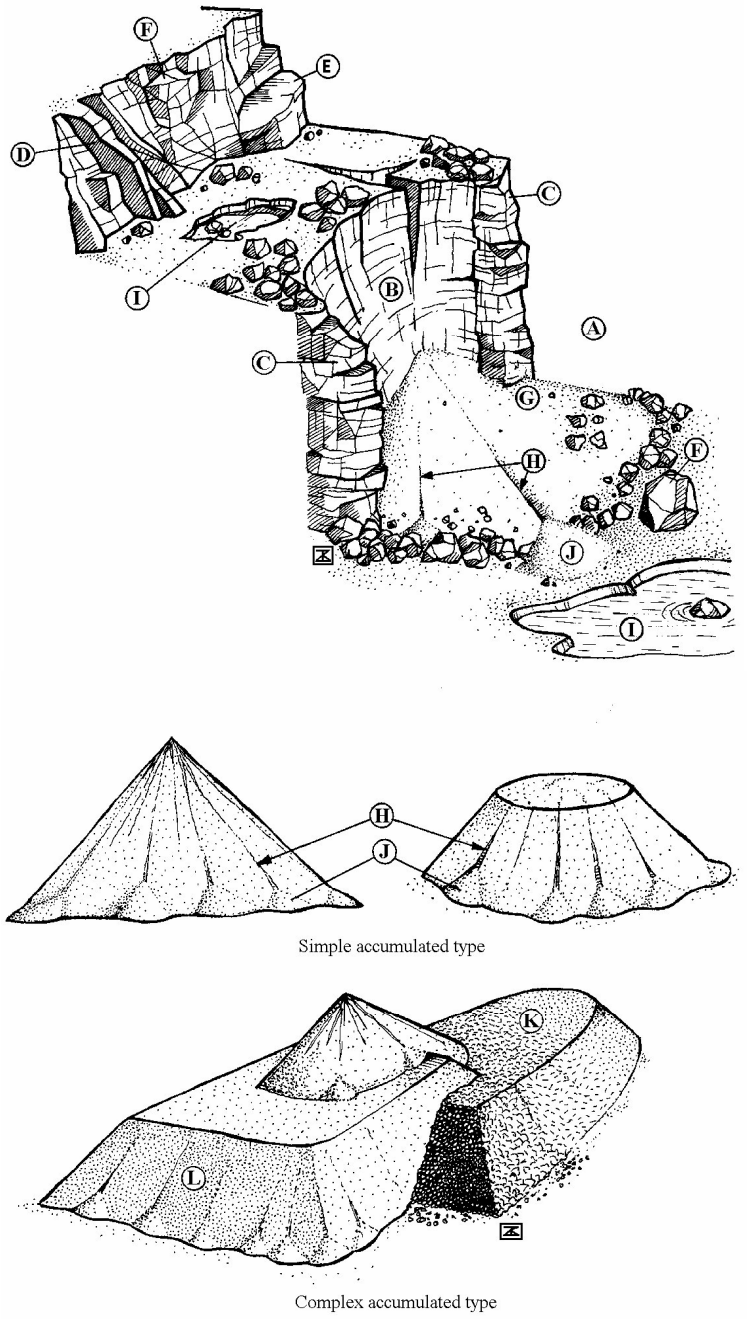

Fig. 2 Forms of quarries - explanations in the text (Compiled by Karancsi and Dávid)

Areas where controlled and managed tourism is allowed

It is desired that on these areas it would be strictly prohibited to leave the marked ways and some parts could be visited only with guide. Tourist attractions and activities could be created or implemented only after reconciliation with the officials of the local nature conservancy agencies. To this category belongs the most famous geological and geomorphologic values of the region, e.g. the basalt cones and necks (Salgó, Kis [Small]-Salgó [or Witch Stone], Szilvás-kő), the deep erosional valleys mainly in sandstone, and the from biological point of view protected areas, having the living-space of some rare species. Regarding their extent these associations are sometimes only small spots, have very special microclimatical condition or rare soil-subtype, therefore they are very vulnerable, even a very small disturbing can result the destruction of these values.

Areas which claim cautious planning of tourism

To this zone belong living-spaces which are protected and rich in rare species but have only nature-close condition and were created only secondarily. Such living-spaces are forests or forested steppes with different kind of oaks, beeches, species of meadows and alkaline-like meadows, alkaline lakes etc. These objects do not claim special protection either because they are rather wide-spread in the region or because they are not so vulnerable concerning the disturbance made by (civilized) tourists.

Areas which can be loaded and proposed for new attractions

Especially lands within or next to the inhabited areas are appropriate for such kind of development. One of their group consist of the "linear attractions of tourism", like walks, tourist paths, nature trails, roads etc. On the map (Fig. 3, ed. by Karancsi, Z.) can be seen the existing

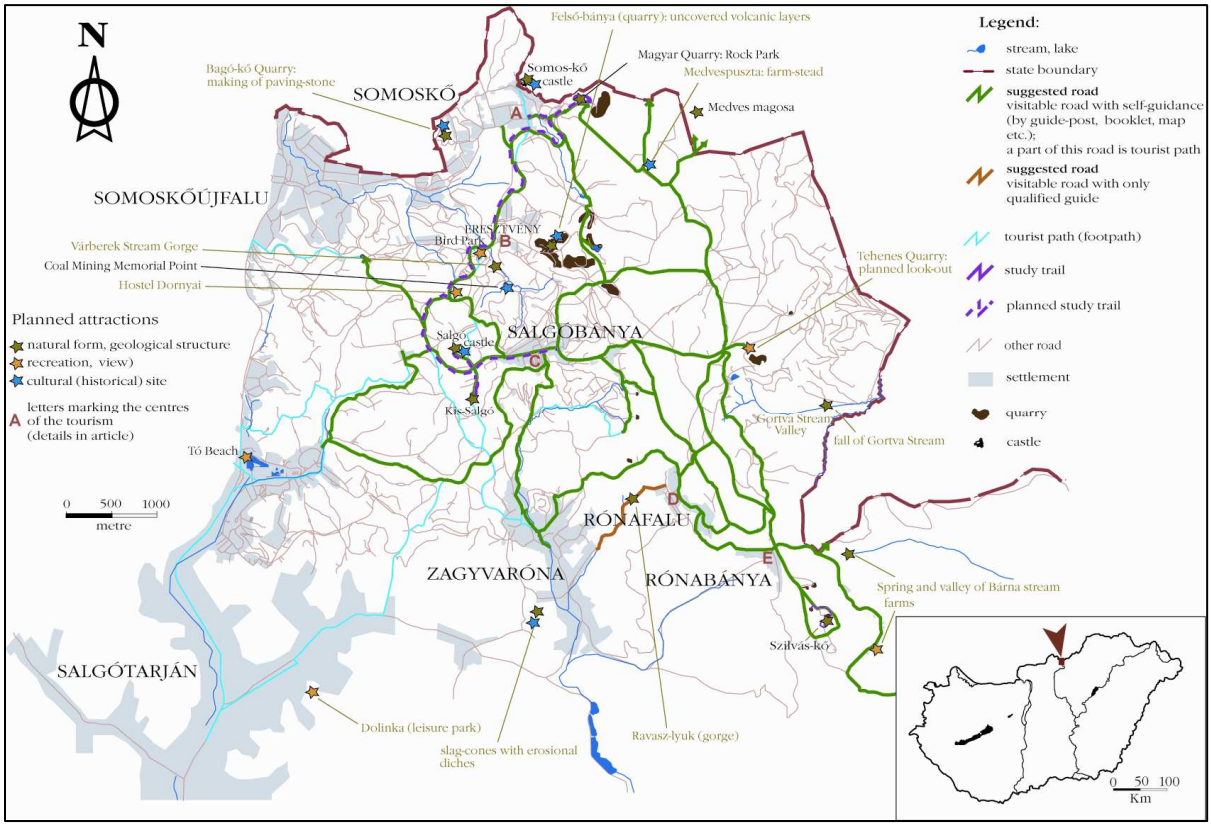

Fig. 3 Tourism development map of the Medves Region (Compiled by Karancsi)

and the proposed trails for the tourists. Planning their direction, the following point of views should be taken into consideration: from every centre of the tourism should start ways making accessible other centres and attractions; loop-trails should be built up, avoiding the aimless roaming on the protected areas; along the trails the angle of the slopes ought to be not greater than 10%; planning the lines of the trails the above mentioned zoning of the area must be taken into consideration; on trails other usage (riding, cycling) must be prohibited; closed ways for passenger cars must be pointed out. Beyond these "linear" elements other types of lands which can be loaded are such areas which can be offered for arranging occasional programmes in natural environment, like great sport camps, groves, parks etc.

Beyond the geoheritage of the area, for developing the tourism also other possibilities are hidden e.g. in the folklore. Revival of the popular traditions and the landscape-like husbandry could be very advantageous; its activities, tools and buildings can be very spectacular. Setting up further attractions, creating regular landscape-characteristic programmes (annually), drawing-away the season, organization of attractive programmes in spring and autumn, increasing the number of the comfortable accommodations offering rural atmosphere and increasing of the information could result significant growth in the tourism.

In the following we give suggestions on the land-use from the viewpoint of tourism. The following map can be considered as a tourist plan, which offers a satisfactory possibility for the development of the Medves Region. The tourist centres and their planned attractions are labelled with green letters. On the map we indicated some abandoned quarries, because these geological sites can play very important role in the tourism development. However, to examine how abandoned quarries play a part in tourism and regional development and management is such an exiting task as well. There are many cases when an area can be used in several ways at the same time or considering the purposes its use can be successful by subsequent methods. A system of this kind provides better flexibility and adaptability for the case when circumstances change but an after-use specialized considerably can satisfy a unique function much more efficiently. At the same time various uses have to be planned when neither of them would be realizable alone. The ways of use below can be combined with each other successfully, for example the tourism, regional development and nature conservation. On the basis of the international experiences the possibilities of after-use of abandoned quarries can be worked out in the Medves Region as well (Fig. 3).

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