

## THE GEOTOURIST ASSESSMENT OF THE VOLCANIC SITES IN VTÁČNIK MTS. (SLOVAKIA, WESTERN CARPATHIANS)

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**Abstract:** The evaluation of resources is one of the most important tasks of geotourism research. This paper presents the method of geotourist assessment, which was applied on the example of sites presenting the Neogene volcanic activity within Vtáčnik mountain range. Two stages of assessment are proposed: inventory and valorization. The inventory includes identification of resources, initial selection and characterization. During the valorization, a researcher uses the point bonitation method and takes into account the following indicators: scientific value, location and additional values. The result of valorization process is presented in table which allows comparison and categorization of the selected sites. The assessment of considered region revealed, that selected sites like rock walls, rock forms, abandoned quarries and hills with ruins are characterized by high or medium geotourist value. Consequently, Vtáčnik is an example of area of a great potential for geotourism development.

**Keywords:** geotourist assessment, Neogene volcanism, Vtáčnik Mts.

### 1. Introduction

Geotourism, understood as a combination of applied geology and active tourism (Słomka and Kicińska- Świdorska, 2004), is a way to promote geological heritage among general public (Hose, 2000). Geotourism research is a multidisciplinary activity encompassing primarily recognition of geotourist potential. The assessment of entire regions and single sites is a key element of geotourist potential, furthermore, it is particularly important for the future geotourism management. The results of the assessment enable to compare and classify the sites and offer suggestions for their promotion, protection and development. The aim of this paper is to present the pattern of geotourist assessment on the example of the volcanic sites in Vtáčnik.

### 2. Methodology of geotourist assessment

The sites, which belong to the sphere of geotourism interest, can be divided according to their individual features into the following categories:

- geotourist resources- all elements which relates to geotourism,
- geotourist sites- resources which are characterized by science, educational and aesthetic value; they can be potential destination of geotourist excursions,
- geotourist attractions- places/ sites which are ap-

propriately developed and promoted.

In order to identify the resources and select the most valuable geotourist sites out of them, the assessment process is essential. This procedure includes two stages: inventory and valorization. The first step consists of identification of potential sites, their initial selection and characterization. During the second step, numerical assessment is assigned to the features of selected sites, on the basis of established criteria. The results of valorization allow comparison of the sites and creating the ranking list which can be useful with regard to future protection, geotourist development or other initiatives.

#### 2.1. Step 1- inventory

One of the essential aims of this stage is to determine the amount and the types of sites in the described area. This task is executed on the basis of literature data and field work. During the initial selection, location, accessibility for tourists and condition of outcrop are taken into consideration. This process also includes the detailed descriptions of each of selected sites, that is: location (with GPS co-ordinates), information on geology and geomorphology, accessibility, present uses and infrastructure, protection, condition of outcrop (visibil-

ity), other information (cultural, historical values) and photographic documentation. The data collected here are indispensable for the next stage of assessment.

## 2.2. Step 2- valorization

This part of assessment is carried out with using the point bonitation method. This method assumes the assignment of the numerical values (points) to individual features of the site, according to the established criteria and scale (Sołowiej, 1992). The framework of valorization is based on 3 principal and 13 secondary indicators (Tab. 1). Part of the criteria was taken from existing literature on related field (for example: Oteška-Budzyn, 1992; Pralong, 2005; Reynard et al., 2007). The scale value is from 1 to 2 (for 3 indicators) or from 1 to 3 (for 10 indicators). The value of feature may equals 0 when it is below the proposed criteria.

The sum of all indicators determines the total value of sites (maximum 36) which are taken into account under final categorization. Consequently, the sites with scores over 70% of maximum total value can be considered as sites with high geotourist value, the sites with scores between 69 and 40 %- as sites with medium geotourist value and the sites with scores under 39%- as sites with low geotourist value in the assessed area. The results of valorization stage should be recorded in a table.

## 3. Case study

### 3.1. Research area

The mountain range Vtáčnik constitutes a western part of the Slovenské stredohorie, in the Inner Western Carpathians (Figs. 1, 2). It extends between Previdza by the Nitra river and Žarnovica by the Hron river (Nacher et al. 2004). The central part of Vtáčnik is included in the Ponitrie Pro-

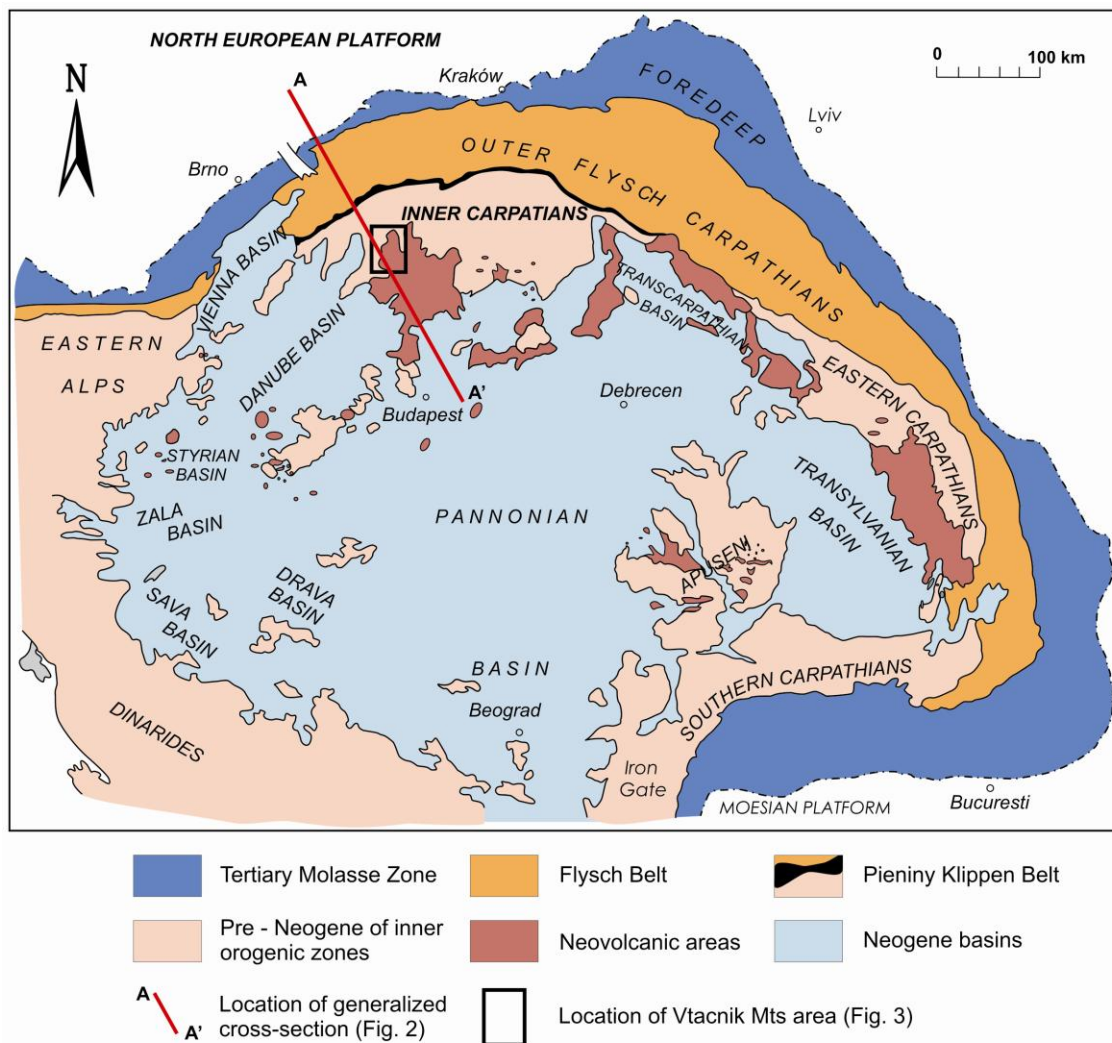


Fig. 1. Tectonic sketch map of the Alpine-Carpathian-Pannonian-Dinaride basin system (after Kováč et al., 1998) with location of Vtáčnik area and generalized cross-section A-A'.

tected Landscape Area. Moreover, 20 individual protection forms like reserves or natural monuments can be found within the considered region.

Vtáčnik is the second highest volcanic mountain range of Slovakia. It is located in the north-west part of the area called the Central Slovakia Volcanic Field (Fig. 1). The Neogene volcanic activity was contemporaneous with the origin of the horst and graben system induced by back-arc extension processes (Šimon 1999; Konečný and Lexa 2002). According to Seghedi et al. (2004) the subduction-related calc-alkaline magmatism responsible for the first (Badenian) phase of Central Slovakia Volcanic Field was followed by asthenosphere derived magmatism widespread in the Carpathian-Pannonian region (Figs. 1, 2). Decompressional melting of old asthenosphere upwelling replaced lower lithosphere or heating and melting former subducted slabs. The volcanic rocks rest on variable Mesozoic and Paleogene deposits. The remnants of the Vtáčnik stratovolcano cover the prevailing part of described area. In the south and east the remnants of the Štiavnica and Kremnica stratovolcano also can be found. The oldest volcanic rocks (Lower/ Middle Badenian) are the products of explosive-effusive activity of the Štiavnica stratovolcano which reached the south part of this region. During the Late Badenian to Early Sarmatian the subsidence of the large Kremnica graben was accompanied by floods of basaltic, pyroxene and leucocratic andesite flows and then by amphibole-pyroxene andesite flows. The andesite Vtáčnik stratovolcano was formed from the Early to Middle Sarmatian, as a result of the most significant volcanic activity in this region. The extensive rhyolitic volcanism took place during the Late Sarmatian to Early Pannonian, mainly in south. The Ostrovica

dykes and necks are the remnants of the youngest manifestation of volcanic activity in considered region (Pannonian) (Konečný et al. 1983; Šimon 2000). The most common rocks are the pyroxene andesites. The basaltic andesites, rhyolites, dacites, volcanic tuffs and breccias are rarely occur. The present relief of Vtáčnik is a result of the neotectonic movement and denudation processes.

Vtáčnik is characterized by a large number of the representative, valuable and magnificent rock outcrops which are the witnesses of geological history and can be use in geotourist context.

### 3.2. Results of geotourist assessment

Within the range of Vtáčnik four groups of sites are distinguished: rock walls (4), rock forms (small and single outcrops were passed over) (33), abandoned quarries (3) and hills with ruins (2). All of them are generally located in the northern part of the described area (Fig. 3). Predominantly, the outcrops are the relics of andesite lava flows. The rock walls can be found in the main and lateral ridge of the range. The most spectacular walls are 1000 m long (Biely Kameň) and 80 m high (Hrádok, fig. 4). The rock forms are located nearby the ridge and on sides of valleys. They were formed by the selective weathering of rock of vertical fissures and platy jointing and/or by gravitational slopes slide (Vitek 1986). Several sites can be called the rock cities- with rocks towers, gates and windows (Kláštorská skala, fig. 5, Končítá). In several cases, the block fields called stone seas appear at the foot of the rock forms (Jaseňová skala, Krivá skala). The frost weathering was the reason of their origin. In the abandoned quarries, the andesites (in Vel'ká Lehôtka and Župkov) and the rhyolites (Štamproch in Nová Baňa, fig. 6) were

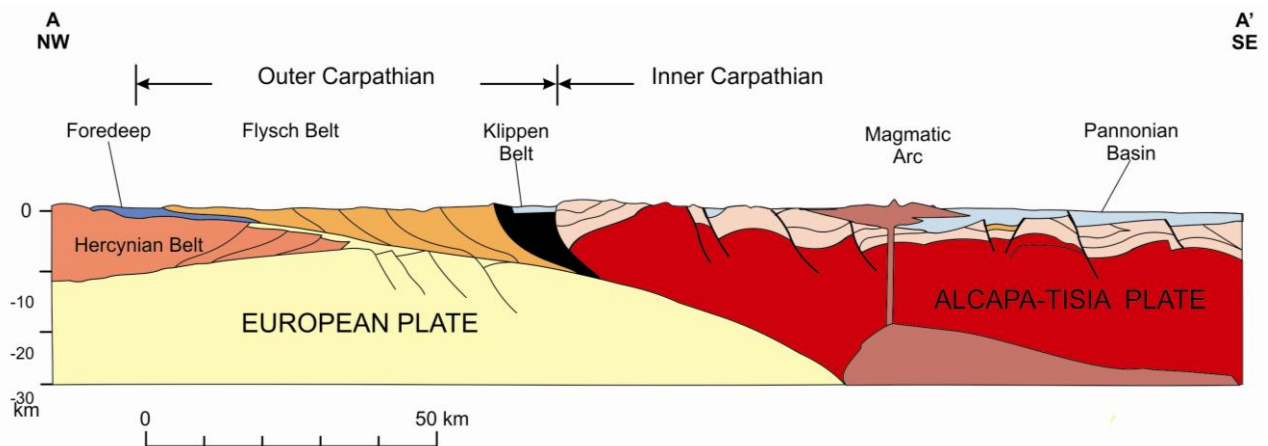


Fig. 2. Generalized cross-section A-A' across Carpathian-Pannonian region (after Picha, 1996). Cross-section location on figure 1.

exploited. It is worth emphasizing that the stone from Štamproch quarry often occurs as an element of buildings in Nová Baňa and vicinity. In the case of hills with ruins, rock ground was considered, as well as the material used to building. Both Gothic castles were built from local andesite rocks. The ruins in Revištské Podzámčie (Fig. 7) are in better condition than in Podhradie (Sivý Kameň).

As it turned out, the most magnificent rock walls and quite a lot of rock forms and quarries are unavailable because of restriction of legal protection, their location (away from tourist trails) or lack of access (relief, vegetation). Out of 42 sites, 15 were

selected to further characterization.

The results of the second stage of assessment and categorization of sites are presented in table 2. Six sites obtained the score over 70% of maximum total value and they were recognized as the most valuable for geotourism. The middle geotourist value was attributed to nine sites. The Hrádok-magnificent rock wall with a small abandon quarry appears to be the most valuable geotourist sites in the assessed region (Fig. 4). It is worth noticing that no site in Vtáčnik is developed with a view to geotourism. It is also essential, that 11 sites are under legal protection, 7 of them because of geologi-

Table 1. The indicators and their numerical assessment used during valorization process.

<b>Scientific value (maximum 12) Sc</b>			
<b>Rar</b> Rareness in relation to the area	1	Site one from several similar	
	2	One of the most important	
	3	The only occurrence	
<b>Con</b> Condition of outcrop (visibility)	1	Partly covered with vegetation, partly damaged as a result of human activity or natural processes	
	2	Partly covered with vegetation	
	3	Well exposed	
<b>Ilu</b> Illustrativeness	1	Low illustrativeness	
	2	Good example of geo(morfo)logical feature or processes	
	3	Excellent example of geo(morfo)logical feature or processes	
<b>Div</b> Diversity of geo(morfo)logical features/ processes	1	Low diversity	
	2	Medium diversity	
	3	High diversity	
<b>Location (maximum 12) Lo</b>			
<b>TT</b> With respect to tourist trails	1	More than 200 m from tourist trail, easy to find	
	2	Less than 200 m from tourist trail	
	3	By tourist trail	
<b>Ro</b> With respect to roads (accessible by car)	1	Between 2,5 and 5 km from parking place	
	2	Between 1 and 2,5 km from parking place	
	3	Less than 1 km from parking place	
<b>SS</b> With respect to support service (accommodation, catering)	1	Between 10 and 15 km	
	2	Between 5 and 10 km	
	3	Less than 5 km	
<b>Acc</b> Accessibility	1	Difficult, only with special equipment	
	2	Difficult for some tourists	
	3	Available for all tourist	
<b>Additional values (maximum 12) Add</b>			
<b>Aes</b> Aesthetic value	1	Low	Subjective value, based on visual singularity of outcrop, quality of panorama, attractiveness forms
	2	Medium	
	3	High	
<b>DU</b> Development and use	1	Present use as tourist/cultural/other site	
	2	Present use as geological site (element of educational trail)	
	3	Present use as geotourist site (with interpretative materials)	
<b>AI</b> Access to geological information	1	Difficult access or only scientific knowledge	
	1,5	Access to general information (Internet, tourist guidebooks)	
<b>LP</b> Legal protection	2	Easy access, special geotourist publications	
	1	Protected as a part of larger area	
<b>CH</b> Cultural/ historical value	1,5	Individual protection as historical, nature site	
	2	Individual protection as geo(morfo)logical site	
<b>CH</b> Cultural/ historical value	To 2	Historical value- 1	
		Cultural value- 1	



cal values. The relation between geotourism and geoconservation affects the popularization of Earth science. Thus, the protected areas are predisposed to practise geotourism (Alexandrowicz, 2006).

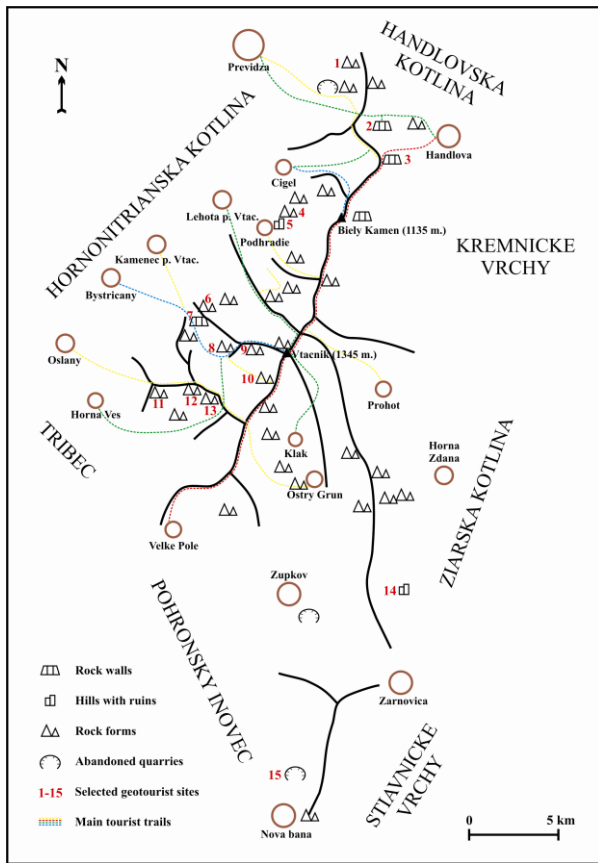


Fig. 3. The sketch map of Vtáčnik with location of the identified and selected sites. 1-Hradisko, 2-Malý Grič, 3-Velký Grič, 4-Krivá skala, 5-Sivý Kameň, 6-Končitá, 7-Hrádok, 8-Jaseňová skala, 9-Kostolík, 10-Kláštorská skala, 11-Žarnov, 12-Sladná skala, 13-Buchlov, 14-Revištské Podzámčie, 15-Štamproch. For map location see fig. 1.

#### 4. Discussion

This paper focuses on assessment process from the perspective of geotourism. The proposed method, with quantitative and qualitative aspects, allows an overall and detailed assessment which results can be comparable. Its framework bases on two stages: inventory (with identification, initial selection and description) and valorization (with numerical assessment and classification). The valorization includes 3 principal and 13 secondary indicators. In the case of geotourist assessment, it was affirmed, that the scientific value is as crucial as location or additional values. The most attractive geotourist sites should be valuable, as well as picturesque, unusual and conveniently located. It is worth emphasizing that the criterion like size of site was not



Fig. 4. Hrádok- the highest rock wall in Vtáčnik, remnant of the andesite lava flow.

considered. In the case of Vtáčnik initially only sites with the size distinguishing them from the surroundings were taken into account, thus this feature was not considered as a significant one during the following valorization. The gathering all results into one table facilitate the quick comparison of sites, their total values and also their assessment of each of established indicators. The disadvantage of the propagated point bonitation method is an element of subjectivity because the given value depends on the opinion of the assessor.



Fig. 5. The part of rock city Kláštorská skala. Well developed platy jointing is visible.



Fig. 6. Štamproch abandoned quarry- the only selected outcrop of rhyolite.



Fig. 7. The andesite hill with ruins of the Gothic castle in Revištské Podzámčie.

However, elaborated criteria and scale allow recognizing the general assessment as relatively objective.

geotourist attractions. Moreover, the project of geotourist trail in this region should be considered.

Tab. 2. The result of geotourist assessment of volcanic sites in Vtáčnik.

Indicators	Rar	Con	Ilu	Div	$\Sigma$ Sc	TT	Ro	SS	Acc	$\Sigma$ Lo	Aes	DU	AI	LP	CH	$\Sigma$ Add	Total value	HIGH GEO TOURIST VALUE
Sites																		
Hrádok	2	3	3	3	11	3	2	3	2	10	3	1	1,5	1	1	7,5	28,5	
Končitá	2	2	2	3	9	3	3	3	3	12	2	1	1,5	2	0	6,5	27,5	
Krivá skala	2	2	3	3	10	1	3	3	3	10	2	1	1,5	2	0	6,5	26,5	
Sivý Kameň	1	2	2	3	8	1	3	3	3	10	3	1	1,5	2	1	8,5	26,5	
Buchlov	2	2	2	3	9	3	1	2	3	9	2	2	1,5	2	0	7,5	25,5	
Kláštorská skala	2	3	3	3	11	3	0	2	3	8	3	1	1,5	1	0	6,5	25,5	
Jaseňová skala	2	2	3	3	10	3	1	2	3	9	2	2	1	1	0	6	25	
Revištské Podzámčie	1	1	2	3	7	1	3	3	3	10	3	1	1,5	0	1	6,5	23,5	
Sladná skala	0	2	2	2	6	3	1	2	3	9	2	2	1,5	2	0	7,5	22,5	
Kostolík	0	2	2	3	7	3	1	2	3	9	2	2	1	1	0	6	22	
Štamproch	3	2	2	3	10	1	2	3	3	9	2	0	0	0	1	3	22	
Hradisko	0	2	1	1	4	1	3	3	3	10	1	1	1,5	2	1	6,5	20,5	
Malý Grič	1	2	1	2	6	3	1	3	3	10	2	1	1,5	0	0	4,5	20,5	
Žarnov	0	2	1	1	4	3	1	2	3	9	1	2	1,5	2	0	6,5	19,5	
Velký Grič	1	2	1	1	5	3	1	3	3	10	1	1	1,5	0	0	3,5	18,5	

## 5. Conclusions

The presented method is distinguished by two main advantages: simplicity and comprehensiveness. What is more, it can be applied to diverse areas, independently of their size or number and kind of sites in their limits. With using this method, the assessment of volcanic sites in Vtáčnik was carried out. On the basis of its results, it was affirmed that a large number of sites related with Neogene volcanic activity are characterized by geotourist potential. Thus, several sites with the highest value should be properly developed and promoted as

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