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GEOLOGICAL AND GEOMORPHOLOGICAL VALUES OF THE CASTLE HILL GEOLOGICAL AND EDUCATIONAL TRAIL SITUATED IN SZANDA (NORTHERN HUNGARY)

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Abstract: This article is about results of cadastre of unique geological and geomorphological values in the Castle Hill, in Hungary. The Castle Hill situated in Szanda (528,6 m) has preserved *the remnant of the dyke ridge developed during the Miocene volcanism (16-14 million years) in the Cserhát Mts., the special geological structure and landforms of the dyke and anthropogenic aspects of the mining activity.* We would like to show these particular geological structures and landforms with a *geological and educational trail extended new stages for tourists* today. During our field works, geological and geomorphological values of the Castle Hill have been mapped and surveyed by the *Cadastre data sheet of unique landscape values*. We have made detailed description of different objects, we have taken photographs of them, we have mapped the route of the new, more detailed geological trail and the topographic situation and landscape values of the stages. Where it was possible, we have measured dips and strikes. Our aim was to cadastre and survey unique geological and geomorphological values of this important *nature protection territory*. Our investigation has explored 28 new geological outcrops and landform values and these can be built to the route of the older geological and educational trail.

Keywords: Northern Hungary, the Cserhát Mts., andesite dykes, geological and geomorphological values, nature protection, geotourism

1. Introduction

The nationwide investigation, the classification and qualification of the Earth Scientific Values began in 1999 in Hungary. Lot's of geological, geomorphological and educational trail have been created in our country since that time. In this article we would like to introduce ***the Castle Hill situated in Szanda***, which has special geological (dyke) structure and many earth scientific values. This study area can be found in the Cserhát Mts, in the North Hungarian Mountains, 21 kilometres far away from Balassagyarmat. The dyke ridge characterised with the special NW-SE strike direction (Fig. 1.) has risen from its surroundings with 120 metre relative height next to Szanda and Szandaváralja. The Castle Hill is situated along the microlandscape border of the Central Cserhát Mts. and the Terényi foothill area (Marosi and Somogyi 1990). This territory, the doubled summit of the Castle Hill can be reached along the "blue" hiking trail from Becske, Szanda and Szandaváralja. We can find a large non-working mining site in the territory of the Peter Hill. The 20 ha area of the Castle Hill and the Peter Hill with mining sites were declared as a "*local importance nature protection area*" in 1976, then they were categorized as a "*most important nature protection area*" situated in the Bükk National Park in 2004 (275/2004. (X. 8.) Order in Council). ***The geological and educational trail of the Castle Hill*** is generally in neglected situation, but the Castle Hill and its surroundings are popular excursion site for tourists.

2. Materials and Methods

At the first stage of our investigation we gathered the geological, geomorphological and topographical maps and bibliography of the study area. We have done the research work on the field, where we have surveyed and cadastred the unique geological and geomorphological values of the Castle Hill, we have filled in the form of the Cadastre data sheet of unique landscape features (Hungarian Standard No. 20381/1999), we have made detailed description of different objects, we have taken photographs of them, we have mapped the route of the new, more detailed geological and educational trail and the topographic situation and landscape values of the stages. During our field research work, we have measured new dips and strikes. Our results have been represented by CorelDraw 12 and Golden Software SURFER 8.0 programs. Our aim was to investigate the geological and geomorphological development and fundamentals of the study area and to cadastre and survey unique geological and geomorphological values of this *important nature protection territory*.

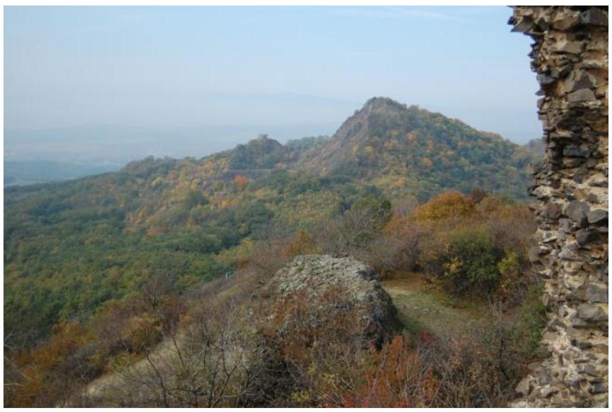

Fig. 1. The dyke ridge situated in direction of NNW and SSE in the Peter Hill (quarry) and the Castle Hill.

3. Results and Discussion

3.1. Geological built up and fundamentals

The series of Oligocene (38-24 million years) grey and greenish grey coloured clays, claymarls, sands and glaukonite sandstones are built up the territory of the Szőr-part (Fig. 2.) and southern Szőlőkalja (end of the vineyard) next to the Castle Hill. These sediments refer to the shallow sea situation (Szécsény Schlier Formation, Pétervására Sandstone Formation) (Noszky 1940, Gyalog 2005). Somewhere, brown coal layers were deposited into the mentioned sedimentary layers (Becske – brown coal). In correspondence of Szava Orogenic Phase, more important denudational period appeared at the border of the Oligocene and the Miocene in the North Hungarian Mountains. The Szécsény Schlier F. and Pétervására Sandstone F. could be showed in the Cserhát Mts. during the Lower Miocene. ***Miocene Ottnangian staged*** (Lower Helvetian stage) (20-19 million years) terrestrial sediments were deposited next to the Castle Hill and the Peter Hill in direction of NW and SE. Because of the appearance of the marsh, new brown coal sediments and layers were developed here. Lot's of mud were sedimented in these layers and after that gravels were accumulated here. The gravel can be found in the overlying bed. Some sand, sandstone layers and Schlieren were deposited on the gravel layers (Noszky 1940).

A large, longer than 10 km fissure was developed with NNW-SSE direction into the Oligocene and the Lower Miocene sediments in case of the Szanda Hill and the Peres Hill (Fig. 2.). This fissure was filled in by thin ***andesite dyke*** in the Miocene Lower Badenian stage (Lower Tortonian stage) (14,3 – 13 million years). In consequence of ***the labial volcanic activity*** long and thin ***andesite nappe*** (Láng 1967) was developed here (Hasznosi Andesite F., Gyalog 2005.). Three summits could be found along the main part of this dyke ridge in the Szanda Hill originally. The Peter Hill was situated at the western part of the Castle Hill and it had larger andesite nappe and two 545 m height summits above the sea level. The body of the ***pyroxene andesite dyke*** passed through ***hydrothermal dykes and*** hydroandesite has explored by the mining activity (Noszky 1940, Csalagovits). The eastern,

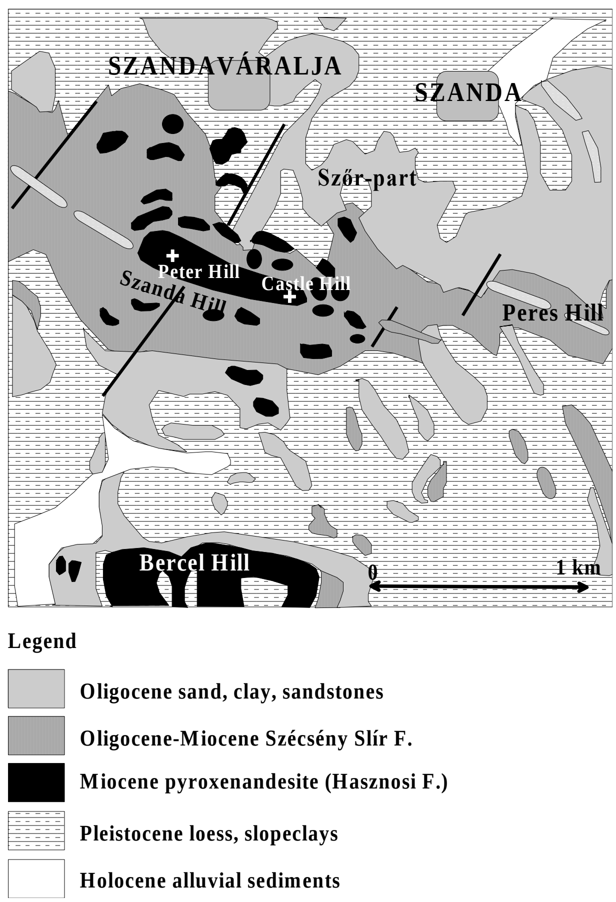

Fig. 2. The geological map of the study area (based on Noszky 1940).

528,6 metre high summit of the Castle Hill is built up with ***pyroxene andesite dyke and smaller andesite nappe***. These rocks were deposited above Upper Oligocene clayey sands. The dyke ridge of the Castle Hill continues toward east in the Peres Hill (Fig. 2.). The Miocene gravel layers can be investigated under the andesite nappe of the Castle Hill in original deposition and thickness. That is why the Szanda Hill can be categorised as ***a residual. Pleistocene loess and slopeclay*** can be found at the edge of the pediment surface of the Castle Hill and the Peter Hill, where the surface has been dissected by erosional and derasional valleys. ***Holocene fluvial gravel, sand, mud and clay*** were deposited in the territory of alluviums and in valleys of surrounding settlements.

3.2. Landscape development and geomorphological surfaces

The ridge of the andesite nappe and the dyke situated in direction of NNW and SSE were originated from the Miocene and after that they were ***eroded and peneplanated*** by exogenic processes during the ***Upper Miocene Sarmatian (14,3 – 11,5 million years) and Pannonian stages (11,5 – 5 million years).*** Therefore the dyke structure has appeared on the surface and it has eroded upon the surrounding territory and it has lowered. New denudated period was probably during the Miocene Sümegium period (8,5 – 8 million years) and at the border of the Miocene and the Upper Pliocene Bérbaltavárium period (5,6 million years). At that time, ***pediments*** began to develop under the semi-arid climatic condition (Schweitzer F., 1993) at the edge of hills. Today, we can see and investigate the pediment of Villanyium period clearly, which was developed at the border of the Pliocene and the Pleistocene (1,8 – 1,4 million years) around the Castle Hill. Derasional valley heads cut into this surface during the Pleistocene.

This Villanyium pediment was dissected by derasional and erosional valleys later, that is why it could be observed and investigated at the edge of the Castle Hill in direction of NE, SE, N and S. (Fig. 3.). During the Pleistocene (1,8 – 0,01 million years) *glacial periods*, the frost weathering, the formation of cryoplanation walls/frost-riven cliffs, tors, periglacial sorted talus slopes, stone fields, cryoturbation processes, derasional valleys, forms of gelisolifluction and the formation of fluvial terraces were developed. During the *interglacial periods*, the chemical weathering, the formation of forms of solifluction, and the deepening and creating of the valleys or development of new fluvial terraces were dominated (Láng 1967, Martonné Erdős 2003). In the Holocene period (0,01 million years - todays), the deepening of erosional valleys and water cuts, mass movements, the denudation of older surfaces, and the movements and the accumulation of Holocene sediments in alluviums and basins can be recognised. Wider alluviums develops along the streams (Gólya stream).

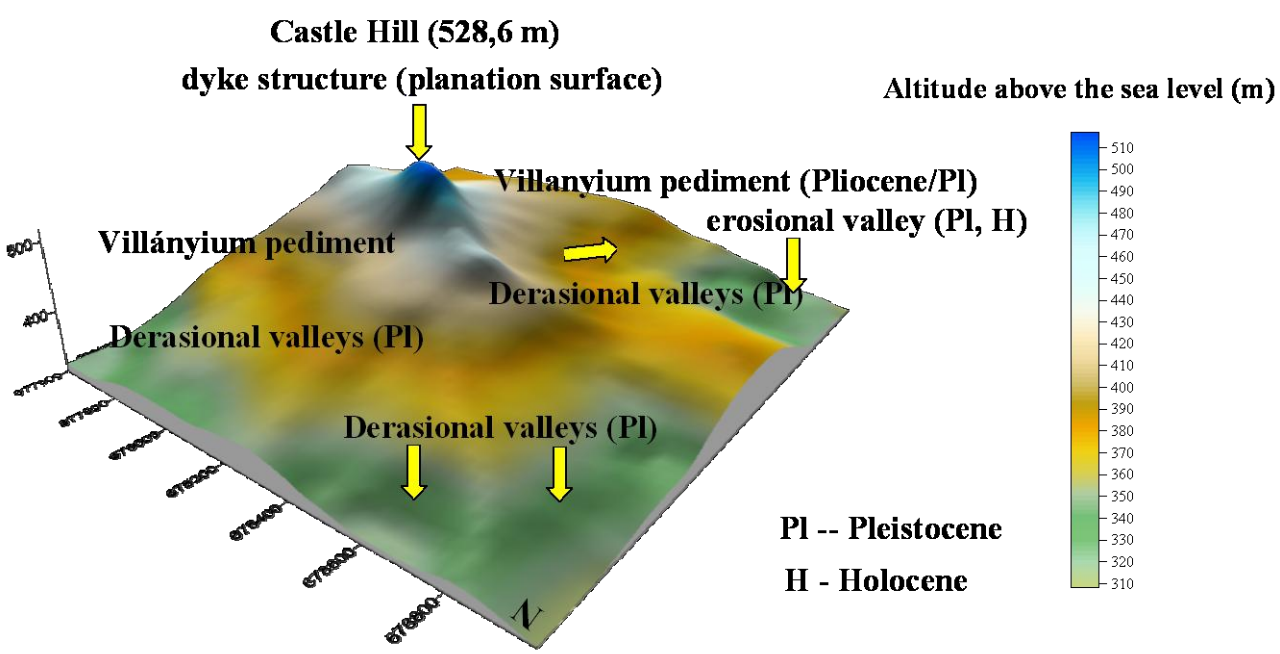

Fig. 3. The geomorphological surfaces of the Castle Hill in Szanda (Northern Hungary, Cserhát Mts.) (Dobos and Gali, 2009).

3.3. Surveying and cadastre of geological and geomorphological values

The geological and educational trail was planned and built up in the Castle Hill in 1996 (Cene 1996). This geological trail can show the *thick bedded, columned and foliated andesite outcrops*, the *processes of denudation of andesite in the Pleistocene and the Holocene, and the landforms of mining activity* (Fig. 4.). The older geological and educational trail can present the following geological values in case of different stages:

(15/I) – 5-8 m wide, 2-3 m height ***small quarry***, where grey coloured, andesite columns are situated in dip of 70-80° and strike of SW direction. (16/II.) – ***rock stream*** built up with thicker and thinner, 1,5 metre long andesite columns. (III.) – ***smaller mining site*** (20 x 30 metres), where volcanic landforms could not be seen because of its neglected situation. (IV.) – the territory of important ***rock stream and cylindrical andesite columns.*** (12/V.) – The most beautiful ***outcrop of the columned andesite*** in the Castle Hill, where we can investigate the central part of the labial volcanism. (VI.) – ***The outcrop of the thick bedded andesite*** with dip of 20-30° (This is the deepest section of the labial volcanism.). (VII. or 11.) – The ***canyon*** developed by mass movements and the dissection of volcanic nappe.

We began the cadastre of unique geological and geomorphological values of the Castle Hill in the summer of 2009. We used the *Hungarian Standard* (Hungarian Standard No. 20381/1999.) and *its cadastre data sheet and its system of landscape values* and *our cadastre data sheet and the category of geological and geomorphological values*, which has improved during nature protection research work in the Bükk Mts. (Dobos et al., 2001). We strived for present the most important and the most characteristic geological structures, outcrops and landforms of the Castle Hill during our investigation. We can fail to point out such stages along "blue" hiking trail and its surroundings, where the dyke structure, its landforms and the remnant of geomorphological surfaces and landforms created during the Pleistocene and the Holocene periods can be investigated well. We can show the most important and the most characteristic geological and geomorphological values by development of older geological and educational trail along the hiking route used by tourists (Fig.4.). The mapped and measured geological and geomorphological values or unique landscape values can be seen in Table 1.

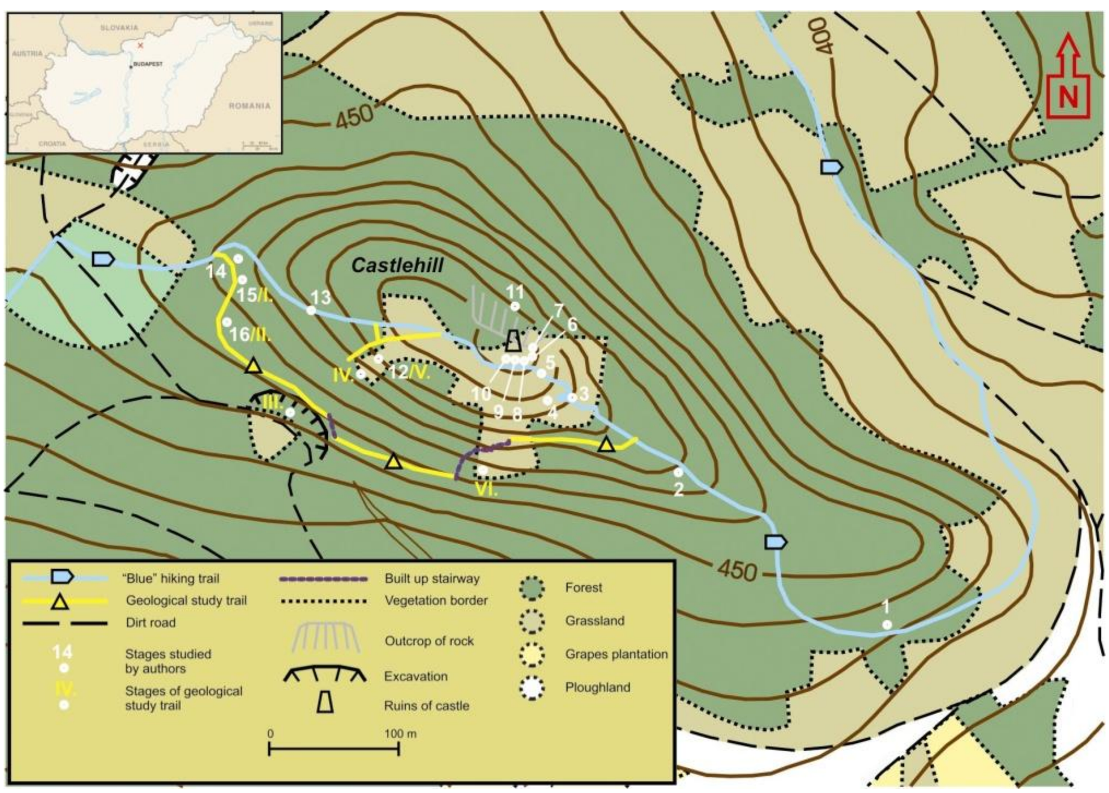

Fig. 4. The stages of the geological and educational trail and the new stages marked out along the "blue" hiking trail in the Szanda Hill (Gali and Dobos, 2009).

Table 1. The unique landscape values of the Castle Hill situated in Szanda

Number	Mark	The name of the unique landscape value	The type of the unique landscape values (Dobos A. et al, 2001)	Genetical date of rocks and landforms
1	SZD1/A	Outcrop of pyroxene andesite	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD1/B.	Frost-riven cliffs, remnants of frost-riven cliffs, series of talus cones	2.9.2.	Pleistocene
	SZD1/C	rockfall (mass movement)	2.5.1.	Pleistocene, Holocene
2	SZD2/A	Outcrop of pyroxene andesite: thick-bedded and foliated types	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD2/B	Cryoplanation terraces	2.9.2.	Pleistocene
3	SZD3/A	Outcrop of pyroxene andesite, thick bedded types	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD3/B	Bedding plane and the rim of beds	2.4.1.	Upper Miocene, Pliocene and Quaternary
4	SZD4/A	Outcrop of columned pyroxene andesite	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD4/B	Outcrop of columned pyroxene andesite, Bedding plane and the rim of beds	2.4.1.	Upper Miocene, Pliocene and Quaternary
5	SZD5	Outcrop of pyroxene andesite, Foliated types	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
6	SZD6/A	Outcrop of pyroxene andesite, foliated and thick bedded types	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD6/B	Folds and faults, discordance	2.4.1. 2.4.2.	Miocene Lower Badenian stage, younger structural movements
7	SZD7/A	Outcrop of pyroxene andesite, thick bedded types	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD7/B	Folds and faults	2.4.1. 2.4.2.	Miocene Lower Badenian stage, younger structural movements
8	SZD8/A	Outcrop of pyroxene andesite,	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD8/B	Folds and faults	2.4.1. 2.4.2.	Miocene Lower Badenian stage, younger structural movements
9	SZD9/A	Outcrop of pyroxene andesite, thick and thin bedded types	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD9/B	Folds and faults	2.4.1. 2.4.2.	Miocene Lower Badenian stage, younger structural movements
10	SZD10/A	Outcrop of pyroxene andesite, bedding plane	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD10/B	Folds and faults, anticline	2.4.1. 2.4.2.	Miocene Lower Badenian stage, younger structural movements
11	SZD11	Polygenetical canyon	2.12.2.	Tertiary, Quaternary
12	SZD12/A	Outcrops of columned pyroxene andesite	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
	SZD12/B	Periglacial block facies	2.9.2.	Pleistocene
	SZD12/C	Periglacial stone streams	2.9.2.	Pleistocene
13	SZD13	Series of talus slopes	2.9.2.	Pleistocene
14	SZD14	Cryoplanational walls, periglacial talus slope	2.9.2.	Pleistocene
15	SZD15	Outcrop of pyroxene andesite, quarry	2.1.2.	Miocene, Lower Badenian stage: 16-14 million years
16	SZD16	Cryoplanational walls, remnants of frost-riven cliffs, and talus cones and stone stream	2.9.2.	Pleistocene

Conclusions

The Castle Hill (528,6 m) situated in Szanda has preserved *the remnant of dyke ridge developed during the Miocene volcanism (16-14 million years) in the Cserhát Mts., its special geological structure and landforms and anthropogenic aspects of quarry*. During our research work, we have investigated and categorised 12 different outcrops of andesite, 7 landforms of folds and faults, 1 rock fall (mass movement), 7 periglacial landforms and 1 polygenetical canyon among Earth Scientific Values in the study area.

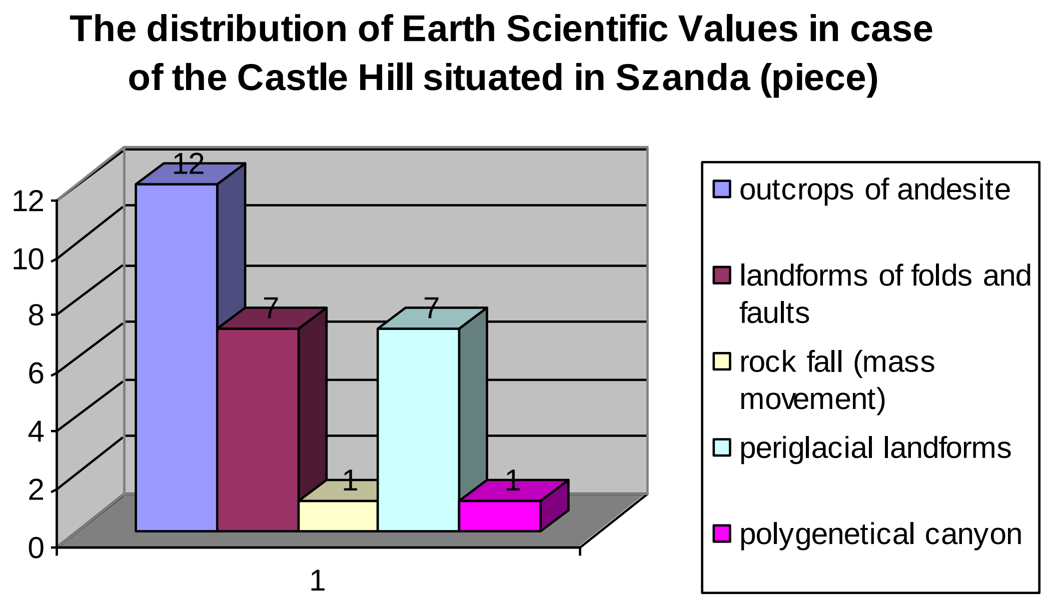

Fig. 5. The distribution of Earth Scientific Value categories in case of the Castle Hill in Szanda.

These cross sections, outcrops and landforms (Fig. 4. and 5.) simply reflect the most important phases of geological development and remnants of landforms in the study area. We suggest to showing and building up these unique geological and geomorphological values in case of the geological and educational trail in the Castle Hill for the future.

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