Area zoning processing by overlay method as a basis for further area in the Levočské vrchy Mts., Slovak Republic

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Abstract
The paper deals with the unexplored region of Levočské vrchy Mts.. Between 1953 – 2010 the military district Javorina in the north-east part of Slovakia was officially closed for public. On 1 January 2010 it was reopened by the decision of the Government of the Slovak Republic with possibility for potentional development. The area of former military district was situated in the central part of Levoča Hills. Absence of any scientific research of this area currently offers wide-ranging survey of the territory from the point of view of different branches of science. The main aim of the paper is processing of the groups of geocomplexes and their spatial distribution. Importance of the paper overlaps a single scientific branch, as geocomplexes groups analysis localized in the studied territory and primary represent basis for development based on multiple branches of science.

Key words: development, geocomplexes, Levoča Hills, military district Javorina

INTRODUCTION

The area of Levočské vrchy Mts. is located in the northeastern part of Slovakia. The central part of the territory was almost to half of the century under the jurisdiction of the Ministry of Defence of the Slovak Republic. Entering the territory was officially banned. At the beginning of the year 2011 after the redevelopment of the area and legal settlement the area has been again opened to public after more than 50 years. Currently there are no implementation geotourism assumptions in the Levočské vrchy Mts. specifically in the military area Javorina (transit, catering establishment, accommodation facilities, services, trades, sports-technical facilities, special facilities). There are no official hiking trails. Natural conditions are not used in spite of great potential of the area. The area represents *"Terra incognita"* in the northeastern part of Slovakia.

The aim of this paper was processing geoenvironmental database with particular characteristics of developed spatial units - geoecological units respectively geocomplexes.

Geocomplexes are units of choric dimension which contain relatively small physical geographic complexes based on a legitimately organized group, or topical dimension unit groups – geotops (Mičian & Zatkalík, 1984).

Geotops can be defined as essential complex geophysical as well as mapping units that must have less ragged borders and must have territorial unity (Mičian & Zatkalík, 1984).

Geocomplex identification or processing

of complex spatial distribution of areas with particular characteristic of established spatial units, is one possible basis for a prospective development of the area in future.

The suitable choice of vectorized map data was needed to process geocomplexes. It used the method "overlay", which is based on placing a several maps for themselves and their overlay was acquired new knowledge (Molokáčová et al., 2011). Applying the overlay method on the selected map data the map of Levočské vrchy Mts. geocomplexes was formed. The effectiveness of the results of processing geocomplexes is not confined to the appropriate application of the overlay method on the data more over the given theory should be supplemented by appropriate field research. Synthesis of applying overlay method, field work and additional information of studied topic of the region we can get valuable results, that it used in appropriate way can lead to and development of any areas in the regions of the world.

GEOCOMPLEXES OF LEVOČSKÉ VRCHY MTS. AND THE METHODOLOGY OF PROCESSING

The lack of a scientific research had a significant impact on the choice of maps. The aim of scientific research had a significant impact on the choice of maps. The aim of this processing was to sort out the field of development of the studied area:

- areas suitable for development,
- areas suitable for transit,
- areas less promising for development.

For processing geocomplexes of choric dimension in Levočské vrchy Mts. following maps were selected:

- Geological structure (Fig. 2) – 1:500 000
- Geomorphological situation (Fig. 3) – 1:500 000
- Soils (Fig. 4) – 1:500 000
- Climatic regions (Fig. 5) – 1:1000 000
- Potential natural vegetation (Fig. 6) – 1:500 000
- Territorial system of stress factors (Fig. 7) – 1:500 000

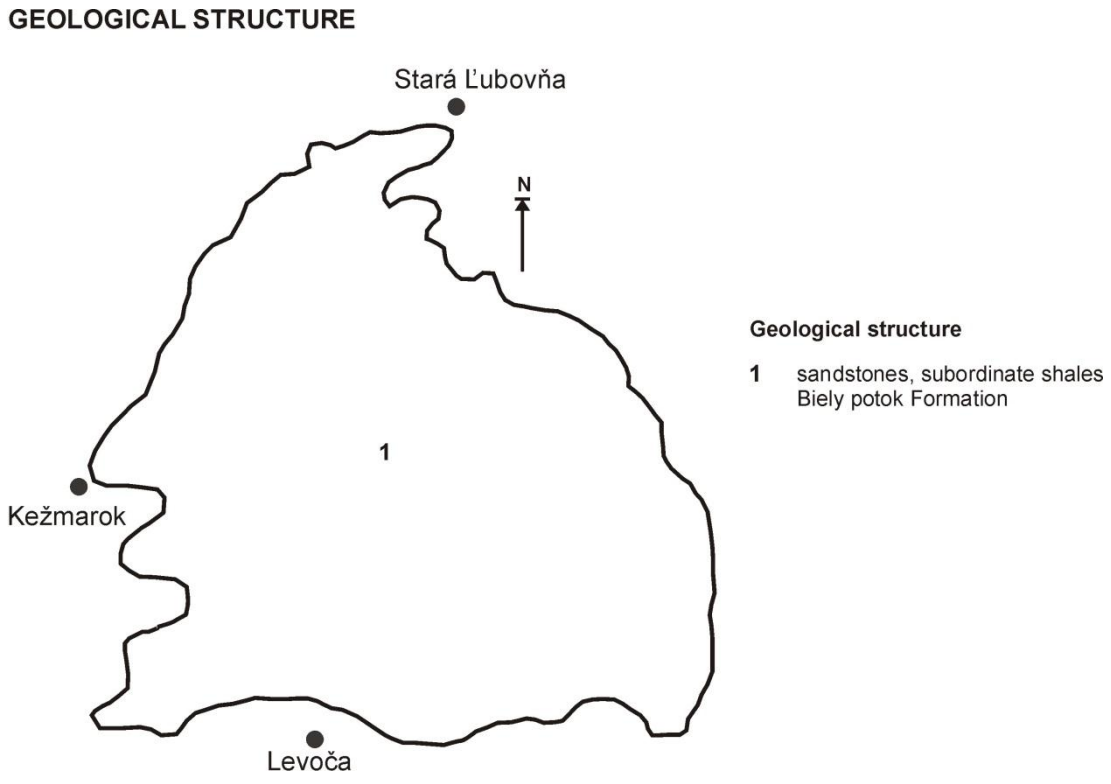

Fig. 1 Geological structure of Levočské vrchy Mts.

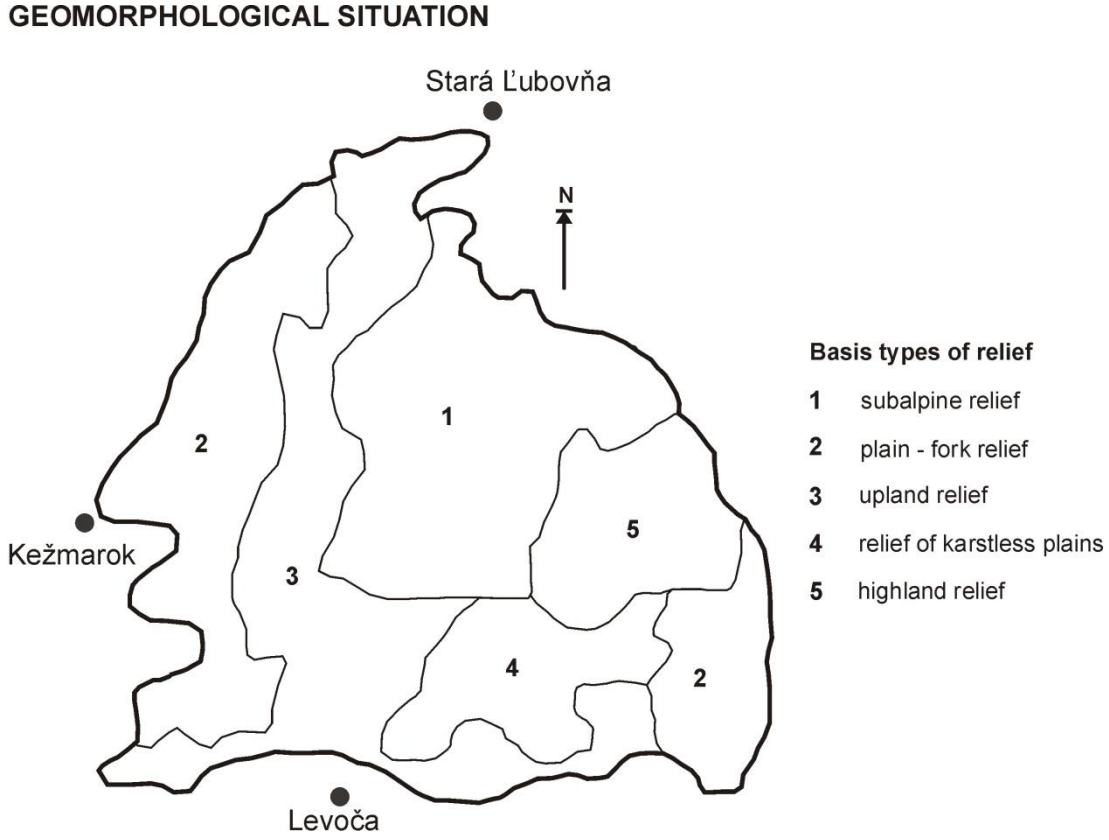

Fig. 2 Geomorphological situation of Levočské vrchy Mts.

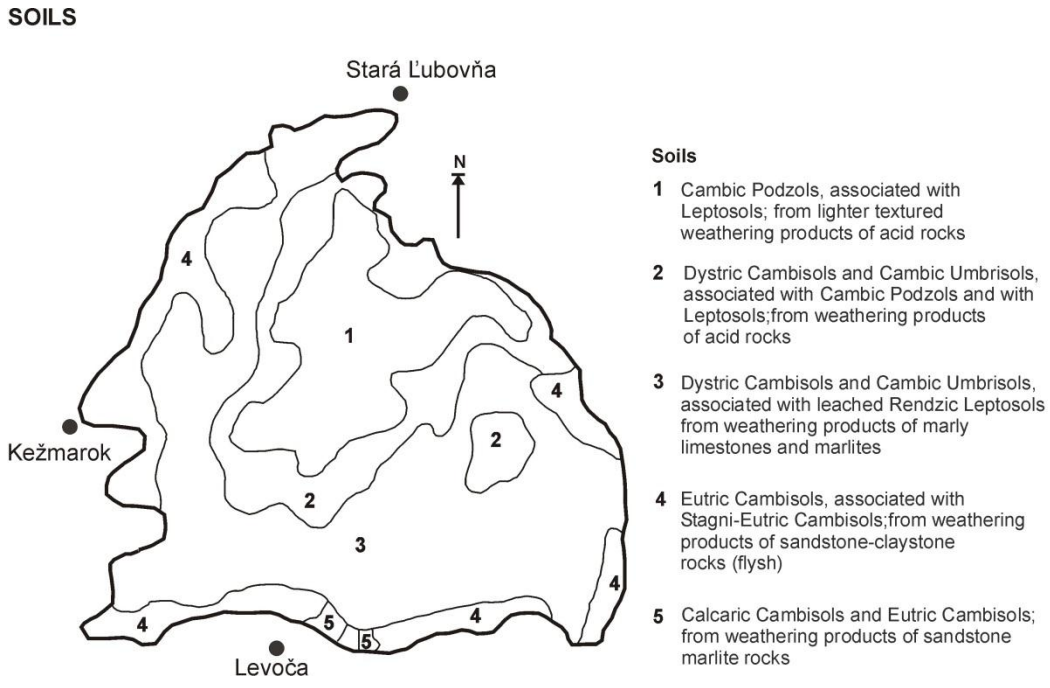

Fig. 3 Soils of Levočské vrchy Mts.

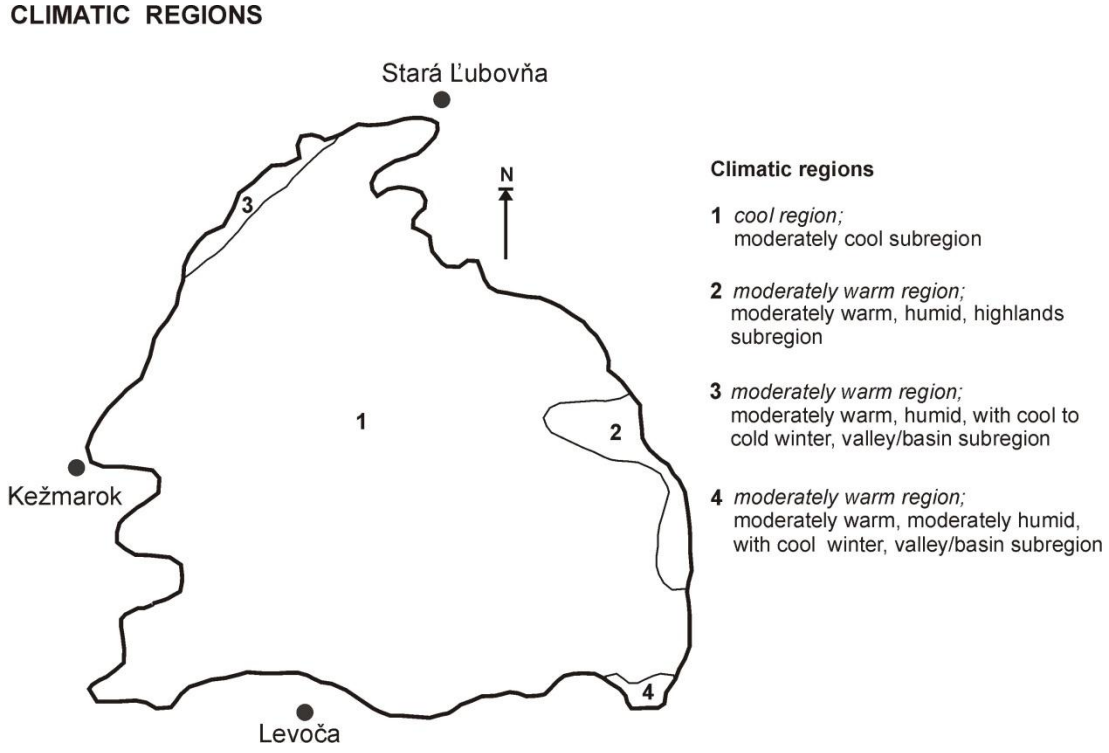

Fig. 4 Climatic regions of Levočské vrchy Mts.

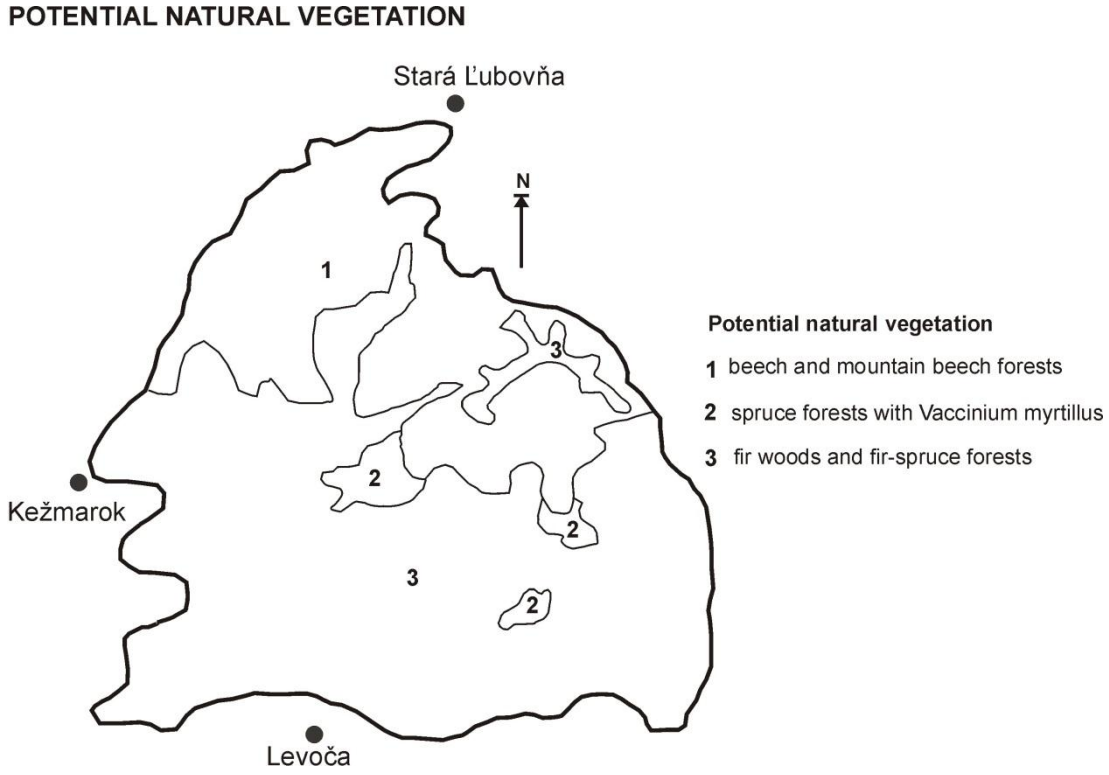

Fig. 5 Potential natural vegetation of Levočské vrchy Mts.

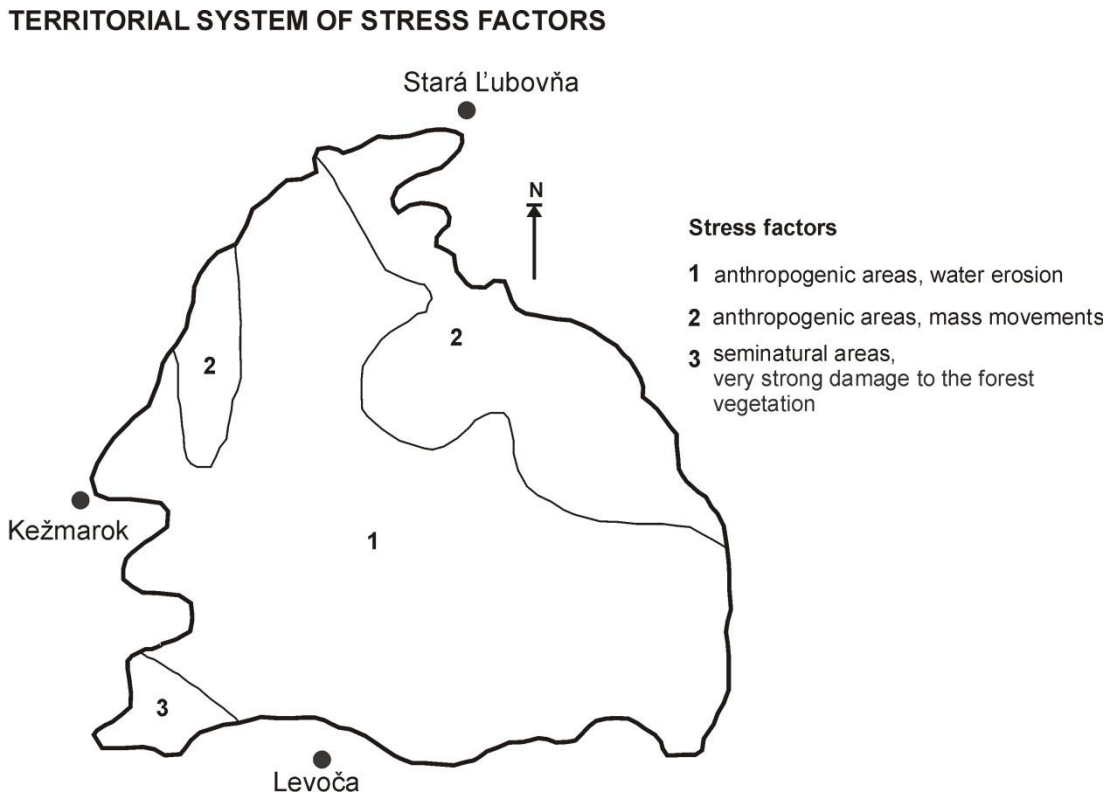

Fig. 6 Territorial system of stress factors of Levočské vrchy Mts.

Loading map is technically based on loading sites selected for substantive analytical properties so that boundaries of the integral geoecological units are becoming all the boundaries of the original analytical units. Formed complexes are then characterized by the set of all analytic properties displayed on the loaded analytical maps (Tremboš et al., 2009).

Integration of analytical information is in the process of loading maps being carried out in particular:

- by the coordinates uniting different map
- content unification of legends and measurement scales
- by the control of logical oversight characteristics and removal of found discrepancies
- utilizing "georeferencing," which stands for the technique for the integration of geodetic data (Rybár et al., 2010).

The overlap of analytical maps created territories – geocomplexes. Each geocomplex has six attributes, subsequently each geocomplex has six-digit code which describes it. The first number describes geological structure, the second number geomorphological situation, the third number soil types, the fourth number climatic regions, the fifth number potential natural vegetation and the sixth number territorial system of stress factors. As part of Levočské vrchy Mts. 123 geocomplexes were established, the list is processed in the table 1. Spatial differentiation of all geocomplexes is shown in the figure 7.

Based on statistical processing geo-complexes of the territory Levočské vrchy Mts. following unique geocomplexes arosed (in parentheses is the multiplicity geocomplexes):

111121, $111212_{(4)}$, $111112_{(3)}$, 111331, $111231_{(4)}$, $111131_{(4)}$, $111132_{(4)}$, $111111_{(7)}$, $111211_{(4)}$, 111221, 111311, 111232, $121431_{(5)}$, $121331_{(2)}$, 123411, 123412, 121412, 121332, 122331, $121311_{(3)}$, $121411_{(3)}$, $124431_{(2)}$, 124331, 121433, 121333, 122431, 122332, 121232, 122432, $121432_{(3)}$, $121312_{(2)}$, $131331_{(3)}$, $131231_{(2)}$,

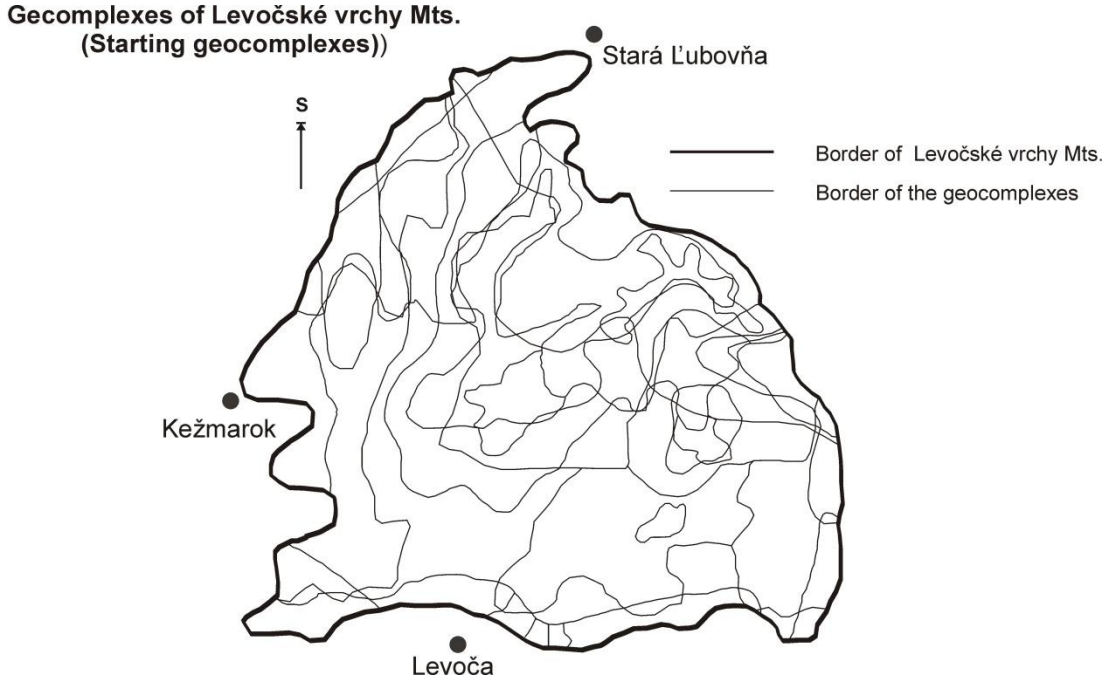

Fig. 7 Starting geocomplexes of Levočské vrchy Mts.

Tab. 1 The list of defined geocomplexes in the territory Levočské vrchy Mts.

Serial num.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Geokomplex	111121	111212	111212	111112	111331	111231	111131	111132	111131	111231
Serial num.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Geokomplex	111132	111111	111132	111111	111211	111111	111221	111131	111311	111212
Serial num.	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Geokomplex	111112	111232	111112	111111	111111	111212	111132	111111	111211	111231
Serial num.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Geokomplex	111231	111211	111111	111211	111131	121431	121331	121331	123411	121411
Serial num.	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
Geokomplex	123412	121412	121332	121431	122331	121311	121411	121411	124431	124331
Serial num.	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Geokomplex	124431	121431	121433	121333	122431	122332	121232	122432	121432	121311
Serial num.	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
Geokomplex	121312	121432	121312	121432	121431	121311	121431	131331	131331	131231
Serial num.	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Geokomplex	131131	131312	133312	133311	131311	131212	131112	131211	131431	131531
Serial num.	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
Geokomplex	131431	131531	131431	131431	131333	131333	131331	131111	131231	131111
Serial num.	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
Geokomplex	133311	131411	141331	141321	141531	141431	141431	151331	151231	151221
Serial num.	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
Geokomplex	152432	151431	151332	151312	151321	151231	151232	151212	151211	151231
Serial num.	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**
Geokomplex	151231	151332	151331	151211	151231	151232	152232	152212	152332	152312
Serial num.	**121**	**122**	**123**	-	-	-	-	-	-	-
Geokomplex	151232	151212	151212	-	-	-	-	-	-	-

131312, 133312, $133311_{(2)}$, 131311, 131212, 131112, 131211, $131431_{(4)}$, $131531_{(2)}$, $131333_{(2)}$, $131111_{(2)}$, 131411, 131131, 141331, 141321, 141531, $141431_{(2)}$, $151331_{(2)}$, $151231_{(5)}$, 151221, 152432, 151431, $151332_{(2)}$, 151312, 151321, $151232_{(3)}$, $151212_{(3)}$, $151211_{(2)}$, 152232, 152212, 152332, 152312.

In the studied area 65 unique geocomplexes were identified. The resulting choric dimensions units were

united of into groups based on chosen analogy. The main criterion for joining them was the similarity in geomorphological situation, potential natural vegetation and territorial system of stress factors. The impact of a geological structure and climatic factors have been neglected for small differentiation within Levočské vrchy Mts.. The influence of soils on potential land use was neglected because is minimal. In this process basic groups of the geocomplexes listed in the Table 2 were created (number of geocomplexes in the certain group along with recurrent geocomplexes is in parenthesis brackets).

By viewing of basic groups, their the analysis and application on the territory unequal number of groups and territory areas were created. Therefore on the basis of existing knowledge about the studied territory, obtained current field of knowledge and subsequent processing of the basic groups resulted final groups of the geocomplexes. These which are also potential development zones in the region Levočské vrchy Mts. (Table 3). The territory zoning in pursuance of defining geocomplexes Levočské vrchy Mts. is shown in the Figure 8. Based on the results seven groups geocomplexes were definitely allocated in the Levočské vrchy Mts. The two groups were divided into subgroups. Geocomplexes not listed within the groups are original and represent only a small part of Levočské vrchy Mts. therefore can be neglected.

Tab. 2 The list of basic groups of geocomplexes

Basic groups	Geokomplexes	Basic groups	Geokomplexes
1	131333 (2)	**12**	141331, 141531, 141431 (4)
2	141321 (1)	**13**	151331, 151231, 151431 (8)
3	151211 (2)	**14**	123411, 121311, 121411 (7)
4	111121, 111221 (2)	**15**	131312, 133312, 131212, 131112 (4)
5	111132, 111232 (5)	**16**	151312, 151212, 152212, 152312 (6)
6	121433, 121333 (2)	**17**	131331, 131231, 131431, 131531, 131131 (12)
7	151221, 151321 (2)	**18**	121332, 122332, 121232, 122432, 121432 (7)
8	111212, 111112, 111312 (7)	**19**	133311, 131311, 131211, 131111, 131411 (7)
9	111331, 111231, 111131 (9)	**20**	152432, 151332, 151232, 152232, 152332 (8)
10	111111, 111211, 111311 (12)	**21**	121431, 121331, 122331, 124431, 124331, 122431 (12)
11	123412, 121412, 121312 (4)		

Tab. 3 List of defined groups of geocomplexes in the territory of Levočské vrchy Mts.

Group	Subgroup	Numeric attributes of geocomplexes
1. group	**-**	131331, 131231, 131431, 131531, 131131
2. group	**-**	121431, 121331, 122331, 124431, 124331, 122431
3. group	**-**	111212, 111112, 111312
4. group	**-**	111331, 111231, 111131
5. group	**A**	131312, 133312, 131212, 131112
	B	133311, 131311, 131211, 131111, 131411
	C	123411, 121311, 121411, 123411
6. group	**A**	152432, 151332, 151232, 152232, 152332
	B	151312, 151212, 152212, 152312
	C	151331, 151231, 151431
7. group	**-**	141331, 141531, 141431, 141321

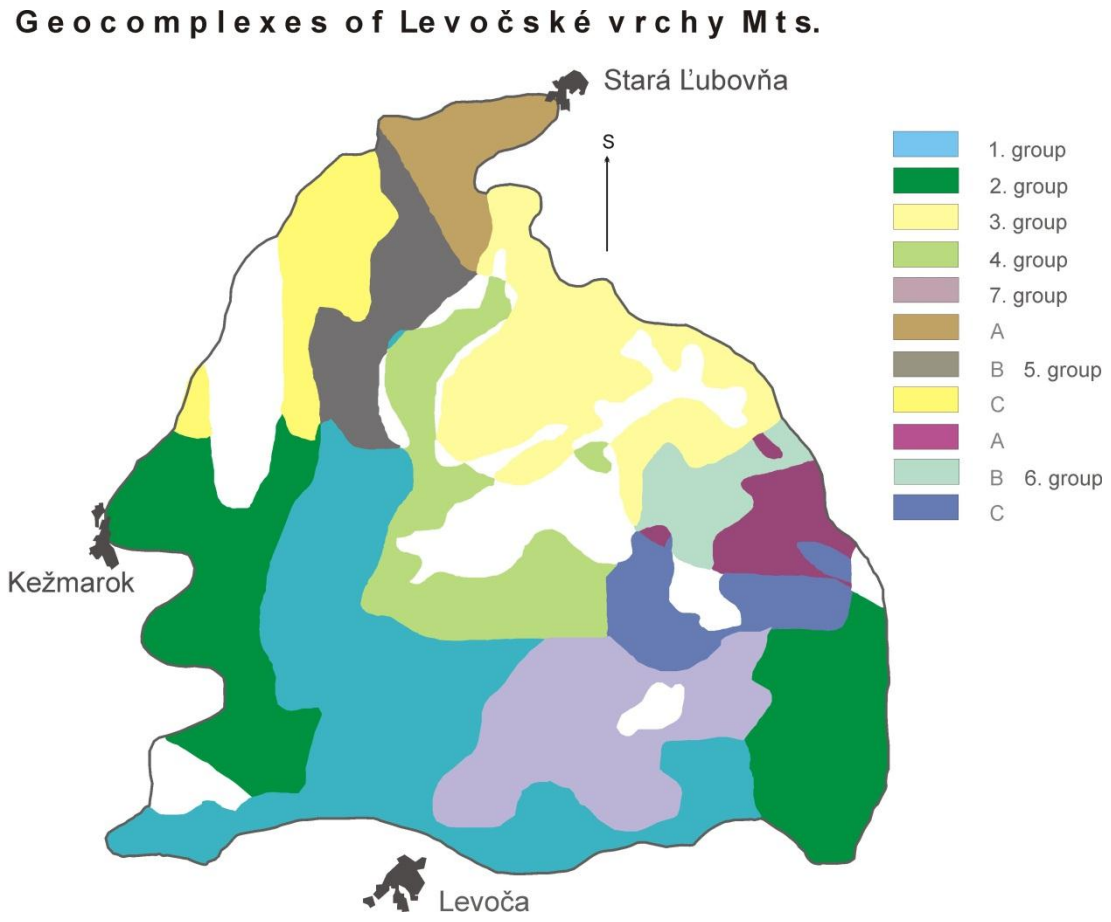

Fig. 8 Geocomplexes of Levočské vrchy Mts.

Based on the resulting groups of geocomplexes three main zones as basis for directing future development were selected:

- Areas suitable developing: 1., 2., 7. group
- Areas suitable for transit: 4. group
- Less promising areas for development: 5., 6., 3. group

In dealing maps incure often a large amount of small, independently difficult interpretable areas, which need to generalize (assigned to the closest neighboring areas, or split between them) (Tremboš et al., 2009).

White processing geocomplexes for the territory Levočské vrchy Mts. generalization to unclassified geocomplexes was not applied. That can be adding geocomplexes to the closest neighboring areas respectively distribution between areas, so certain parts of geocomplexes shown in white on the map was not included for any group. We can assume that these same geocomplexes, or geoecological units, will study the issue in the future divided between neighboring groups geocomplexes or will be added to the whole. This fact will be affected by further research, so no generalization will have to be applied.

PRIMARY CHARACTERISTICS OF DEVELOPMENT ZONES

A) Areas suitable for development

1. group

At present the area in terms of tourism is the most used and developed. An important fact is a connection to the Gothic route and the existence of Levočská valley, which is already being developed for tourism. It represents the best potential in the field of tourism, for all defined groups of

geocomplexes. It will be necessary to improve contractor conditions, artificial conditions, and also socioeconomic or political respectively selective conditions of tourism, and also promote the area.

2. group

The area lacks propagation, road marking, locations. The area is marked particularly in the western part by the existence of the Military Training Area. Restoration of dissolved Ľubické kúpele with its neighborhood or village Ruskinovce, would mean a new direction in development progress for this area. The potential of this group can be defined mainly in terms of the existence of cultural and historical monuments, natural attractions, protected areas of smaller and larger scale (Kežmarok, Spišský hradný vrch, Ostrá hora, Travertínová kopa-Sobotisko, Spišská kapitula, Jazierko na Pažiti, Sivá Brada, Levoča with its surroundings) in the vicinity of this group geocomplexes and possible links with these areas of tourism. a group of geocomplexes in the western part of is starting position fot the Tatra National Park.

7. group

The area creates connection between the city of Levoča and its surroundings with Spišské Podhradie and its surroundings and is connected to the Gothic route. Potential of this area is particularly its location. Completion of feasible preconditions of tourism, marked touristic routes leading towards the military space Javorina and plans for development in cooperation with the first and the second group of geocomplexes can significantly enhance the area for tourism development in terms of Levočské vrchy Mts.

B) Tranzit areas

4. group

At present this part of Levočské vrchy Mts. is not specifically used. An unmarked trail from Ľubica passes it. Entering the view spots might hypothetically be interesting. This area could considered as a transit part of Levočské vrchy Mts..

C) Areas less suitable for development

3. group

The territory is currently also used via an unmarked trails also by visitors who are interested in this area. The area is significantly affected by logging due to storm damage, respectively mining. The potential of this area can be highlighted mainly in terms of appropriate tourist links between the town of Levoča and villages Ihľany and Lubica. White considering the starting village Jakubany also to Ľubovnianske spa, the town Stará Ľubovňa and village Šambron. This geocomplexes group has also satisfactory transport system connecting it with the Pieniny National Park.

5. group

Currently no marked trail crosses the defined geocomplexes group. The potential for the area represents connection to Tatras National Park respectively Pieniny National Park.

6. group

The potential of this area is mainly in opening pseudokarst, which undergoes a scientific research and the protected area Bišar. Marking hiking trails leading directly to Military Training Area Javorina plays also an important role in development. Connecting this area to the pseudokarst field in Čierna hora hills may be a significant pseudokarst location of the Slovak Republic

CONCLUSION

The important result and benefit is creation of zoning based on geocomplexes, which could provide basis for future study of the territory, which was nearly half a century affected by the existence of the Military Training Area. Selection of the

area development zones, transit zones, development zones offers space for the right direction of development. 123 gecomplexes have been studied in the area of the interest. After eliminating recurring types of geocomplexes 65 unique geocomplexes were created. When processing basic groups of geocomplexes 21 groups were created from proportional terms did not target the problem, for the groups undergo further processing in which 7 groups of geocomplexes were created, and subsequently classified into three zones. Between areas suitable for development were included in three geocomplex groups number 1, 2 and 7. The fourth group of geocomplexes is ranked between transit areas. The less promising areas for development included three groups of geocomplexes numbers 3, 5 and 6.

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