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THE ROLE OF RELIEF GEODIVERSTY IN GEOMORPHOLOGY

ANDRZEJ KOSTRZEWSKI
Institute of Geoecology and Geoinformation, Adam Mickiewicz University,
Dzięgielowa str. 27, 61-680 Poznań, Poland
E-mail: anko@amu.edu.pl

Abstract: Geodiversity is an important characteristic of Earth surface. Geodiversity is meaning the diversification of Earth surface in the scope of geology, terrain relief, soils, climate, surface and underground water, taking into consideration modifying anthropogenic activity (Kostrzewski 1986, 1993, 1997, 1998, 2001). The program of geodiversity protection and preservation include the assessment of studied spatial unit (geoecosystem) actual geodiversity state, on the base of detailed knowledge of geographical environment and the stage of its evolution. In terrain relief geodiversity, young and old – restited forms, very often exhumed, are taken into consideration, that are giving the relief of studied area special meaning and appearance. Thematic maps (e.g. of terrain relief geodiversity, soils, surface water and complex maps e.g. landscape) are the cartographic presentation of geodiversity. Geodiversity studies should be included in geomorphological research priorities, that is very important from substantive and practical point of view.

Keywords: geodiversity, terrain relief geodiversity, maps of geodiversity, geodiversity protection

INTRODUCTION

The Earth's surface relief is an important index feature of contemporary landscape changes, observed on different spatial and temporal scales. The Earth's surface landscape structure, where the terrain relief is an important factor, is undergoing constant changes due to observed climate variability and growing human impact. Increased frequency of extreme processes and diverse forms of human activity lead to the degradation of various terrain landforms. At the same time it is worth to note that the Earth's surface relief protection is insufficient in relation to the protection of fauna and flora.

Geodiversity is an important characteristic of the Earth's surface, a direct base of functioning of geomorphological processes and human activity. It is justified to state that the terrain relief, determined by geodiversity, plays one of the most important functions in the modern Earth's surface geoecosystem (Kostrzewski, 1997, 1998, 2001).

In the physical-geographical studies, the diagnosis of geodiversity and biodiversity determining the individuality of the landscape of a region, country and continent, is very important. The character of terrain relief has direct impact on water circulation, course of geochemical processes within the lithosphere, spatial distribution of soil profiles and physiocoenosis. The terrain relief is a dominant factor determining the direction of landscape structure changes of the analysed spatial unit. It is an important indicator of landscape changes.

In the present paper, the methodological and methods-oriented basis of geodiversity will be described, with special attention paid to the concept of Earth's surface relief geo-

diversity as the subject of geomorphological research (Kostrzewski et al., 1997).

METHODOLOGICAL AND METHODS-ORIENTED ASSUMPTIONS OF THE GEODIVERSITY CONCEPT

The Earth's surface treated as a system (excluding biosphere), within which we delimit subsystems or spheres (atmosphere, morphosphere, lithosphere, pedosphere, hydrosphere, anthroposphere), is the research subject of geodiversity.

From the methodological point of view, the determination of subject individuality of geodiversity in relation to physical geography and its individual branches is a basic issue. Geodiversity means the diversification of Earth surface in the scope of geology, terrain relief, soils, climate, surface and underground waters, taking into consideration modifying anthropogenic activity (Kostrzewski, 1986, 1993, 1997, 1998, 2001).

Geodiversity investigations include as well detailed field studies of individual Earth surface spheres, and qualitative and quantitative descriptions of their elements. These studies provide the basis for extraordinary and unique elements delimitation for their protection and preservation on the background of a specially prepared program.

The program of geodiversity protection and preservation includes the assessment of the actual state of geodiversity of the studied spatial unit (geoecosystem), on the basis of detailed knowledge of geographical environment and the stage of its evolution. Geodiversity analysis is carried out in relation to selected geoecosystems, of various sizes and development stages.

From the methods-oriented point of view, it is very important to elaborate the criteria of geodiversity valorization, taking into account the assumptions of the studied Earth's surface elements classification and the degree of their transformation by natural and anthropogenic factors.

Thematic maps (for instance, those of terrain relief geodiversity, soils, surface waters and complex maps, e.g. landscape ones) are the cartographic presentation of geodiversity. It is worth to remember that the state of geodiversity presented on maps refers to the given time of observation. However, the geodiversity observations for protection purposes need to be performed continuously in the frame of realization of the established environmental programs, e.g., referring to the Integrated Monitoring of Natural Environment (Kostrzewski, 1991, 1995a, b, 1996a, b; Kostrzewski et al., 1995).

Another important issue from the methods-oriented point of view is the elaboration of geodiversity indexes referring to, e.g., the state of geodiversity preservation or the assessment of their attraction.

Basic methodological and methods-oriented assumptions of geodiversity studies entitle one to accept geodiversity as an important research branch within physical geography and its detailed disciplines (e.g., geomorphology, hydrology, soil sciences). Geodiversity studies realize assumptions of empiric sciences, i.e., take into account the functions of space and time based on organized observation, use the comparative methods, consider unique character of objects, and are the basis for formulating generalizations having the character of regularities.

The presented concept of the Earth's surface geodiversity research is of great substantive and practical importance.

EARTH'S SURFACE RELIEF GEODIVERSITY

Geodiversity studies may be performed in either analytical or complex manner (Kostrzewski, 1997, 1998). The analytical trend of geodiversity studies is based on the recognition of individual Earth surface spheres (geology, relief, climate, waters, soils), determination of their actual state, hazards, and presentation of selected objects of extraordinary character for their protection and preservation. The complex current of geodiversity researches is spreading over the recognition of the whole geoecosystem (landscape), its actual state, hazard forms,

and presentation of selected geoecosystem parts (landscape types) to be protected and preserved.

The Earth's surface relief is especially important in the structure of past and present geoecosystems; it is the surface expression of relation between internal and external processes in the conditions of given geology, climate and human impact.

The Earth's surface is treated as a geodiversity research subject in various spatial and temporal scales. The Earth's surface geodiversity studies are related to morphogenetic identification of single terrain forms, form assemblages, and relief types.

The geomorphological map is a cartographic presentation of terrain relief, comprising morphogenetic and chronologic features. Explanations pertaining to geodiversity need also to be included in the content of such a map. The terrain relief has a dynamic character, is under constant transformations, both due to natural and anthropogenic processes. In conditions of contemporary economic development, the terrain relief and its protection gain special meaning. The Earth's surface relief still can not find due place in geo-protection programs.

Geodiversity of terrain relief is the research branch of geomorphology (Kostrzewski, 1997, 1998; Kostrzewski et al., 1997), and its basic aim is to indicate chosen landforms, landform assemblages and terrain relief types of an extraordinary and unique character for their protection and preservation.

The terrain relief geodiversity presents contemporary differentiation of the Earth's surface. A constant in time process of the evolution of the Earth surface is causing that terrain relief is not a constant and unchangeable element of the geoecosystem. In general, two tendencies may be observed, namely: the increasing or decreasing terrain relief geodiversity, both in time and in space. This situation causes that the observation of the state of the terrain relief should be covered with a monitoring program.

In terrain relief geodiversity, young and old-resisted forms, very often exhumed ones and giving the relief of the studied area special meaning and appearance, are taken into consideration (Klimaszewski, 1978; Starkel, 1991). It is worth to add that features of terrain landforms selected for protection are determined by relief, lithology, age, and appearance properties (Kostrzewski, 1997).

An important stage of geodiversity elaboration is preparation of analytical and synthetic maps of relief diversity (Kostrzewski, 1997; Kostrzewski et al., 1997). Analytical terrain relief diversity maps include: the relief energy map, the relief dismembering map, and the map of relief conservation. The proposed maps inform well about spatial distribution of relative heights and are important documentation of terrain relief geodiversity.

The relief energy map, prepared on the basis of a 1:2,000,000 map of relative heights, provides data about height differences in the area of the studied geoecosystem. Delimitation of energy classes is dependent on the character of the studied geoecosystem. It should include areas of high, medium and small relief energy (possibly with some classes in between).

The relief dismembering map shows the character of terrain relief fragmentation, which is an effect of activity of denudation-erosional processes. The proposed map is prepared on the basis of the relief types map (with consideration of heights) and the geomorphological map. Class delimitation is controlled by spatial distribution of altitude and genetic relief types within the borders of the analysed geoecosystem.

The map of relief conservation covers anthropogenic relief transformations, including urban and industrial-mining areas.

The geodiversity synthetic maps, in turn, are the effect of overlapping analytical maps, including relief energy, relief dismembering and relief conservation maps. As a result of such an operation, a synthetic image of morphological changeability of the studied geoecosystem is obtained. In the elaboration of geodiversity of Poland, a basic square field, 15 km x 15 km large, was implemented at the map scale giving the length of 1 cm (Ko-

strzewski, 1997; Kostrzewski et al., 1997). Delimitation of geodiversity classes depends on points sum attributed to each basic field of the analytical maps.

The basic methodological and methods-based approach of geodiversity maps elaboration can be adopted to geoecosystems of various heights and relief rhythm. The presented geodiversity maps provide the base for monographic elaboration of geodiversity, applied to geo-protection plans.

THE IMPORTANCE OF RELIEF GEODIVERSITY STUDIES IN THE PROTECTION OF EARTH SURFACE

Contemporary development of population and world economy causes intensive, very often uncontrolled, degradation of the Earth's surface, discordant with assumptions of eco-development politics (Kozłowski, 1997). Of basic importance is to present new propositions in the subject of the Earth surface shaping and protection.

In Earth's surface studies applied to geo-protection, a static approach is used, based on single terrain mapping of the relief, used as a base to determine the state of geodiversity. On the other hand, the dynamic approach uses a repeated mapping of terrain relief in order to determine geodiversity character and the degree of transformations (Kostrzewski, 1997, 2001). The results of geodiversity studies should provide a base for systematic verification of the running geo-protection programs, to plan accurate protection activities and preservation of exceptional, unique Earth's surface natural values.

The program of geodiversity protection and preservation (i.e., terrain relief) in the landscape structure, should be obligatory on the state scale and should contain the following:

- identification of conditions of particular Earth's surface spheres (including morphosphere), on the basis of actual field mapping and prepared geodiversity maps;
- monographic elaboration of the actual state of geodiversity, including qualitative and quantitative descriptions;
- presentation of documentation of sites chosen for protection, i.a., selected landforms, landform assemblages and relief types;
- elaboration of a geo-protection plan, guarantee of its realization (legislative and financial background);
- in the frame of didactics and education, presentation of an university course "protection and monitoring of the geosphere".

The presented frames of realization of the relief geodiversity program (including also other elements of the Earth's surface), might be realized within the activities of the Integrated Monitoring of Natural Environment (Kostrzewski et al., 1995), including nine Base Stations representing major types of the Polish landscape. The initiation of geodiversity research on the Integrated Monitoring of Natural Environment Base Stations will allow for systematic observations of the actual state of geodiversity and its transformations.

CONCLUSIONS

The basic aim of geodiversity protection, according to eco-development assumptions (Kozłowski, 1994), is the formal and legislative protection of the Earth's surface in an international collaboration, to prevent the irreversible degradation of natural resources.

The main substantive and organizational tasks, referring to realization of the program of geodiversity protection of the structure of Polish landscape in particular regions, are as follows:

- elaboration of analytic and synthetic maps and geodiversity monographs of the studied geoecosystems, as a base for delimitation of geo-protection sites;
- elaboration of a geodiversity protection plan in the scale of the country, county, district, etc., in relation to appropriate formal and legislative regulations;

- introduction of the geodiversity program from the level of Ministry of Natural Environment to the activities of Integrated Monitoring of Natural Environment Base Stations.

Geodiversity studies should be included in geomorphological research priorities, which are very important from the substantive and practical points of view.

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