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“THE RELIEF OF EUROPE” AND THE PARADIGM OF GEOMORPHOLOGY OF THE FUTURE (CONCLUSIONS TO THE FIRST TRAINING MANUAL ON THE RELIEF OF CONTINENTS WRITTEN IN THE UKRAINIAN LANGUAGE)

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Abstract. The article emphasizes the need to prepare training manuals on the geomorphology of large land areas. The relief of continents (their parts) and parts of the world is an object of regional geomorphology. The author substantiates the structure and content of the textbook "The relief of Europe", the first written in Ukrainian on the geomorphology of the continents. The manual consists of an introduction, 2 chapters, conclusions and a list of references. The manual uses 6 schematic maps, 9 digital maps, 2 tables, and 28 color photos. The first section of the manual is devoted to issues of planetary geomorphology – the main regularities of Earth's relief forms. Geotexture, morphostructure and morphosculpture are the categories of their are considered as parts of their size-genetic classification and its critical assessment is given (1.1). In 1.2 the planetary features of the Earth's relief at the level of the largest geotextures – continental ridges and ocean depressions are considered (the time of formation and the main trends in the process of the Earth's evolution - the increase in the area of the oceans at the expense of the continents; the sequence of the appearance of the main types of the Earth's crust in the process of the geological evolution of the Earth; the scheme of the geological evolution of the Earth's lithosphere: oceanic-type crust > transition-type crust > continental crust). In 1.3 the considered geomorphological stage of the Earth's development (the beginning of the end of the Paleozoic – the beginning of the Mesozoic – the breakup of Pangea), during which the main features of the modern relief were formed. It is characterized by the following trends: oceanization (expansion and deepening of ocean depressions through the destruction of ancient platforms; increasing the area of continents due to the joining of young platforms (plates); tectonic activation of continents (epiplatform orogeny and the formation of reborn mountains). In 1.4 general regularities of the Earth's morphostructure are considered – 14 types of main morphostructures of plain-platform areas, mountain (orogenic) areas, high platforms and revived mountains, the age and history of the development of land morphostructures, the role of the neotectonic stage, the importance of studying alignment surfaces and hydrographic basins in the study of morphostructure. General regularities of the morphosculpture of the Earth – modern zonal and ancient and the influence of the latter on the development of modern, azonal types of morphosculpture are considered (1.5). The second section consists of general and regional parts. The main regularities of geotexture, morphostructure and morphosculpture of Europe are considered in the general part. In the regional part, modern and ancient geomorphological formations of the author's accepted taxonomic units of geomorphological zoning of Europe (4 zones and 13 countries) are considered. In the conclusions, the author, using data from geology, geomorphology, planetology, substantiates, in his opinion, the content of the future paradigm of geomorphology.

Key words: relief of Europe, geotecture; morphostructure; morphosculpture; morphochronodynamic concept; thermodynamic evolution of the Earth.

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“РЕЛЬЄФ ЄВРОПИ” І ПАРАДИГМА ГЕОМОРФОЛОГІЇ МАЙБУТНЬОГО (ВИСНОВКИ ДО ПЕРШОГО НАВЧАЛЬНОГО ПОСІБНИКА З РЕЛЬЄФУ МАТЕРИКІВ НАПИСАНОГО УКРАЇНСЬКОЮ МОВОЮ)

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Анотація. Наголошено на необхідності підготовки навчальних посібників з геоморфології великих ділянок суші. Рельєф материків (їх частин) та частин світу є об’єктом регіональної геоморфології. Обґрунтовано структуру і зміст першого навчального посібника з геоморфології материків “Рельєф Європи”, написаного українською мовою. Посібник складається зі вступу, 2 розділів, висновків і списку використаної літератури. В посібнику використані 6 схематичних карт, 9 цифрових карт, 2 таблиці, 28 пейзажних світлин. Перший розділ посібника присвячений питанням планетарної геоморфології – головним закономірностям форм рельєфу Землі. В підрозділі 1.1 розглянуто категорії геотектура, морфоструктура, морфоскульптура як частини їх розмірно-генетичної класифікації та подано її критичну оцінку. В 1.2 – розглянуто планетарні риси рельєфу Землі на рівні найбільших геотектур – материкових виступів і океанічних западин (час утворення й основні тенденції у процесі еволюції Землі – зростання площі океанів за рахунок материків; послідовність виникнення основних типів земної кори в процесі геологічної еволюції Землі; схема геологічної еволюції літосфери Землі: кора океанічного типу > кора перехідного типу > континентальна кора). В 1.3 – описано геоморфологічний етап розвитку Землі (початок і кінець палеозою–початок мезозою – розпад Пангеї), упродовж якого в основних рисах утворився сучасний рельєф. Для нього характерні тенденції: океанізації (розширення і заглиблення океанічних западин шляхом руйнації древніх платформ; збільшення площі материків за рахунок приєднання до них молодих платформ (плит); тектонічна активізація материків (епіплатформенний орогенез і утворення відроджених гір). В 1.4 – схарактеризовано загальні закономірності морфоструктури Землі – 14 типів головних морфоструктур рівнинно-платформних областей, гірських (орогенічних) областей, високих платформ і відроджених гір, вік та історію розвитку морфоструктур суші, роль неотектонічного етапу, значення вивчення поверхонь вирівнювання і гідрографічних басейнів у вивченні морфоструктури. В 1.5 – подано загальні закономірності морфоскульптури Землі – сучасної зональної і древньої та вплив останньої на розвиток сучасної; азональні типи морфоскульптури. Другий розділ складається із загальної та регіональної частин. В загальній частині розглянуто головні закономірності геотектури, морфоструктури і морфоскульптури. В регіональній частині описано сучасну і древню геоморфологічні формації прийнятих автором таксономічних одиниць геоморфологічного районування Європи – 4 зони і 13 країн. У висновках автор обґрунтовує, на його погляд, зміст майбутньої парадигми геоморфології, використовуючи дані з геології, геоморфології, планетології.

Ключові слова: рельєф Європи; геотектура; морфоструктура; морфоскульптура; морфохронодинамічна концепція; термодинамічна еволюція Землі.

Introduction. The "relief" of large areas of the Earth (continents, parts of the world) is an object of regional geomorphology. In tutorial, when describing the *relief of Europe*, certain taxonomic subdivisions of the geomorphological zoning of the continents were used, within which the characteristics (aspects) of "relief" accepted in geomorphology were considered – *morphology, genesis, history of development*, *modern relief-forming processes, subsoil (lithospheric) basis* of the **relief**. The specified characteristics of the "relief" of individual territories differ, but their study

and comparison allow us to identify common patterns that allow us to move to the *planetary* level of studying the Earth's relief.

"Relief of Europe" is the first textbook on the geomorphology of the continents written in Ukrainian.

Research methodology. When developing the structure of the textbook and choosing regional objects (units) of zoning, the author took into account almost all the previous experience of similar works, used the approaches and principles outlined in monographs and textbooks devoted to the directions of planetary (Bondarchuk, 1972; Katterfeld, 1962; King, 1967; Carrie, 1991; Makhachek, 1959, 1961; Relief of the Earth, 1967) and regional, in particular, the former USSR, Ukraine, other countries (Geomorphology of the Ukrainian SSR, 1990; Relief of Ukraine, 2010; Sokolovsky, 1973; Tsys, 1962) of geomorphology.

The manual consists of an introduction, 2 chapters, conclusions and a list of references. The manual uses schematic maps (6), digital maps (9), 2 tables, landscape photos (28). The *first* chapter examines the *main patterns* of the Earth's relief, which are the main goal of *planetary geomorphology*. For their disclosure, with certain caveats, *the size-genetic classification* of Earth's relief forms at the level of its elements - *geotexture, morphostructure, morphosculpture* - can be used. The formation of the planetary features of the Earth's relief of the largest geotextures (continental protrusions and oceanic depressions) takes place against the background of 2 main planetary *trends*: the increase in the area of the oceans due to the destruction of the continents; the evolution of the earth's crust from the oceanic type (through the transition type) to the continental type. Despite the existing criticism of the idea of distinguishing *the geomorphological stage of the Earth's development* (which began with the disintegration of Pangea), in our opinion, it can be used. During the geomorphological stage, *most* of the morphostructures, which are the *basis of the modern relief of the Earth*, were mainly formed. In this stage, there is expansion and deepening of ocean depressions, the destruction of ancient platforms, an increase in the area of continents by joining them to young platforms (plates), tectonic activation of continents (epiplatform orogeny and the formation of reborn mountains). During the geomorphological stage, 14 types of main morphostructures of plain-platform areas, orogenic areas, high platforms and revived mountains emerged. During the formation of morphostructures, synchronicity and metachrony were manifested. The evolution of morphostructures was significantly influenced by *neotectonic activation*, which has been manifested since the Oligocene. The analysis of the *leveling surfaces* allows to reproduce the dynamics of morphostructures and the study of the *historical dynamics* of the *hydrographic basins* of the continents establishes systemic connections of morphostructure and morphosculpture. The *second* chapter consists of general and regional parts. The *general* part shows *the main regularities* of the geotexture, morphostructure and morphosculpture of Europe. In the regional part, the "relief" of the used taxa is considered in its zoning for Europe - *4 zones* and *13 countries*.

Geomorphological zoning of the continents allows dividing the "relief" into taxonomic units of different rank and giving its characteristics taking into account large-scale generalization. Taxonomic units of zoning "relief" of large territories combine analytical and synthetic methods of presenting information, that is, they are *analytical-synthetic*. Taxonomic units of zoning "relief" reflect *natural-geographical* (zone, country, province) and *geostructural* (geotectures, morphostructures)

approaches. Their differences lie in different types of the earth's crust, neotectonic movements, the substrate on which the relief is formed, and the different intensity of denudation and accumulative processes.

The principle of genetic conditioning also requires taking into account changes in factors and their relationship in space and time. The topography of the surface was constantly changing due to the action of the mentioned factors. The relief of large areas was mainly formed over millions – hundreds of millions of years. Thus, the plain relief of the ancient platforms was formed almost immediately after the completion of the geosynclinal stage of their development, and the basement plains could have been formed as early as the early Paleozoic. The modern topography and its associated deposits reflect the last or latest stages of its development, but they will also show more ancient stages. That is, all features of the relief are determined by the history of the territories.

In our opinion, the zoning of the relief of the continents should use the taxa *zone, country, province*. Geomorphological *zones* are distinguished by differences in the structure of the earth's crust, the type and intensity of neotectonic movements. The geomorphological *country* is a part of the geomorphological zone, it is clearly distinguished by the geostructure and orography, the similarity of the type and intensity of neotectonic movements, the uniformity of denudation and accumulative processes, which corresponds to geostructures of the third order (on platforms are shields, slabs, avlakogens; in folded belts – folded systems, intermontane depressions). Geomorphological *provinces* correspond to geostructures of the fourth order (on platforms, these are syneclises, anteclises; in folded belts, megaanticlinories and megasynclinories). For provinces, the main features of zoning are the type and intensity of denudation-accumulative processes, the type of substrate. Geomorphological provinces do not always completely coincide with fourth-order structures.

The results. The study guide "Relief of Europe" consists of two sections. The *first* chapter is dedicated to the main regularities of the Earth's planetary relief at the levels of its size-genetic division into *geotextures, morphostructures*, and *morphosculptures*. In the second chapter, the "relief" of the main taxonomic units of the geomorphological zoning of Europe is considered – 4 *zones* (1 – plains, mountains, plateaus of Eastern Europe; 2 – plains, plateaus, mountains, highlands of Western Europe; 3 – mountains and plains Alpine-Himalayan belt of Europe; 4 – mountains of the Black Sea-Caucasus region – Caucasus, Crimean mountains, Eastern Carpathians) and their parts – 13 *countries.* The main information about the "relief" of these territories was obtained within the framework of *morphogenetic* and *historical-genetic* concepts of geomorphology. But this information contains direct and indirect data, which are important for the use of the most popular nowadays among many geomorphologists, the *morphodynamic* concept.

The morphodynamic concept introduced the concepts of "geomorphological formation", "upward lithodynamic flow", "downward lithodynamic flow" into the theory of geomorphogenesis. Geomorphological formation is considered as a possibility of synthesis in geomorphology based on a new *paradigmatic* idea of "relief" as "geomorphosystem". The geomorphological formation combines, at the same time, *typological* (relief, modern exogenous processes, climate, neotectonics, loose deposits combined with the relief) and r*egional* aspects. Each taxon of the zoning of a

geomorphological formation reflects, with a certain generalization, its typological elements and a certain regional type of geomorphological formation. An important goal of geomorphological formations is to detect in them indicators of ascending and descending lithodynamic flows – elements of the ascending and descending branches of *the circulating matter-energy systems* that cover and integrate *the Earth's surface and the Earth's bowels* (Komliev, 1997; Komliev, 2001; Komliev, Komliev, 2002a; Komliev, 2002b; Komliev, 2003; Komliev, 2005; Komliev, 2022).

Morphogenetic and historical-genetic concepts include the Earth's crust and lithosphere as additional and auxiliary objects in geomorphology. Instead, the morphodynamic concept, which arose chronologically later, significantly *narrows* its object sphere of geomorphology, leaves for it only the exposed earth surface and the adjacent part of the lithosphere to a depth of only tens to hundreds of meters (local and regional bases of erosion), maximum up to 1 km (the base of the World Ocean), in which *exogenous morpholithogenesis* takes place. At the same time, the morphodynamic concept forms the modern understanding of the object of science, according to which the object of geomorphology is *the geomorphosystem*. This allows applying the methodology of systems theory, general scientific approaches and methods (*analogy, symmetrical analysis, modeling,* etc.), modern technical means and methods of using geomorphological information, in particular for creating formalized models of geomorphosystems of the Earth's surface. The morphodynamic concept, which takes into account the criterion of *conformity* to the object and the method, narrows the space-time framework of the object of geomorphology and violates the general logic of the development of *sciences* that expand the scope of their objects. Therefore, the morphodynamic concept can correspond to the status of *a partial* concept of geomorphology.

Almost simultaneously with the morphodynamic paradigm, geomorphology began to be covered by the general trend of Earth sciences - the creation of *integral megasystems* that use the data of geology, geophysics, geomorphology, and paleogeography. The first model of such *a synthetic megasystem* was created by L. King (1967), and later others appeared [Komliev, 2005]. In these models, ***the earth's surface, lithosphere*** and ***asthenosphere (Gutenberg's)*** *interact* at different levels of planetary organization (from local to planetary), processes of denudation of the earth's surface, accumulation of debris material in the depressions of continents and oceans, physico-chemical and petro-mineral transformations in the upper mantle and asthenosphere, as well as tectogenesis, magmatism (plutonism), metamorphism. Thanks to the continuous interaction of these factors, the megasystem is constantly *reproduced*, *self-oscillating*.

In our opinion, the morphodynamic paradigm and integral megasystems reflect 2 *different* forms of *self-organization* (*self-defense*) of humanity and the body of the planet Earth from trends *dangerous* for their *existence*: by *mobilizing* internal resources of individual sciences (*differential* approach); *integration* of their capabilities (*integral* approach).

Leaders of humanity understand the inevitability of *a change* in the social paradigm. It is necessary to understand that in the myths of peoples, the Bible, the Koran, the Vedas, the Puranas, parables, fairy tales, sayings, etc*., the historical-genetic* memory of *humanity* and the planet is *encoded*, which indicates events that repeat themselves *cyclically*.

Science, as an independent, independent (*from religion*) institution of Western civilization, began to take shape in the Renaissance (15–16 centuries). Then there was a *division* of social worldview, which led to the emergence of its new form – *scientific*. Science, which uses its own theories, methodologies, methods, has accumulated concrete knowledge that confirms ancient myths. The current social paradigm was created on a differential basis ("divide and rule") and must be replaced by another – the integration of science and religion (one religion) and the facts of its inevitability are given by mythological source studies.

Thus, some knowledge obtained by science clearly consists of logical chains that confirm the realism of some myths. For example, the myth about the death of the planet Phaeton, which existed between the planets Mars and Jupiter, is now proven by the data of comparative planetology. In our opinion, they indicate a real threat to the existence of the Earth as a *cosmic* body. Thus, the model of the *Earth's chemical evolution* (Semenenko, 1975) shows that the Earth will be *completely* ***petrified*** in the future. After all, the visco-plastic *asthenosphere (Gutenberg),* where the foci of volcanism are located, and *others* asthenospheres (in particular, the outer liquid core) make the planetary body of the Earth *flexible*, capable of *resisting* the gravity of massive and invisible space objects, and their extinction will lead to loss of this ability. The once invisible forces of gravity tore apart *the petrified* planet Phaeton, leaving only the "asteroid ring." On Mars, located next to us, the following facts have been established: *the absence of modern volcanism*; *Martian earthquakes* recorded by seismographs cause *internal collapses* in the body of Mars; mysterious "Martian channels" are *cracks* that appear on the visible surface and appear in the Martian crust as a result of *petrification* of the planet; the *weakened magnetic field* of Mars indicates that the liquid outer core that generates it is dying; there is almost no atmosphere on Mars – one of the protections of life on Earth; data show that there is *a hydrosphere* on Mars – *water* is in the Martian *glaciers*, which, in *the seasons* of the Martian year, either cover a significant area of the planet or retreat. In the images of Mars, a huge crack almost parallel to the equator line is clearly visible in its equatorial region (where the centrifugal forces are greatest) – a convincing sign of the destruction of the solid planetary body of Mars.

The new paradigm will not be able to fully rely only on science, which, in general, explains ***why, what*** and ***how***, but does not answer the question ***why***? Therefore, *nomogenesis* (certainty) is being mentioned more often in the scientific literature. According to the concept of nomogenesis, the biosphere, man, society, ethnic groups, states, and consciousness can exist only in a certain natural-geographical environment that arose on our planet gradually.

According to modern ideas, the Sun was formed 7 billion years ago, and the planets – 4–5 billion years ago, as a result of the accretion of cosmic dust. In the first 50-100 million years of our planet's history (*gadey*), the following occurred: compression and interaction of particles at the atomic-molecular level until a *thermonuclear explosion* (like the Big Bang) occurred, when the huge released thermal energy quickly heated up the entire mass of the planet, and then its sharp cooling and *gravitational stratification* of the planet into inner and outer *geospheres* took place. This is how the open thermodynamic system of the Earth was formed, in which the main cosmic process was *the scattering (dissipation*) of the allocated energy into the environment and, almost simultaneously with it, *the concentration* of energy

(*negentropy*) in the formed geospheres. Gravitational stratification of planetary matter and the formation of geospheres was the first manifestation of *the self-organization* of *the thermodynamic system* of *the Earth's cosmic body*. This determined its further development into the next, planetary stage of the Earth's history, which continues to this day. The content of which is *the evolution* of geospheres and the continuous emergence of new geosystems, initially inanimate, and with the emergence of the biosphere, biostem and living nature. All of them are manifestations *of the self-organization* of the planet. New geosystems are still emerging, which indicates the growth of the coefficient of useful action of the combined energy concentration processes of the Earth's thermodynamic system and its progressive evolution. At the same time, there is a structural and functional complication of geosystems, caused by the need to save their energy resources, and their transition from the mode of *extensive* to the mode of *intensive* functioning.

At the beginning of the planetary stage of development, the conditions for the emergence of a ***geomorphosystem*** began to develop on Earth. After the separation of the atmohydrosphere into *the atmosphere* and *the hydrosphere*, a decrease in the temperature of the atmosphere, the sedimentary geological process began and the conditions for the emergence of an *exogenous* branch of morphogenesis arose. Even during gravitational stratification, the first manifestation of *magmatism* occurred - the melting of the basaltic "protocrust", which now forms the lower continuous layer of the earth's crust. High surface temperatures caused surface metamorphism of the first sedimentary rocks. Increased lability of the crust led to *the first tectonic episodes*. This is how *the endogenous branch* of morphogenesis was born. The well-known postulate that relief is the result of the joint action of endogenous and exogenous processes is correct in the morphogenetic concepts of geomorphology. The morphodynamic paradigm considers *the relief* as a *geomorphosystem*, for which endogenous and exogenous factors are *the external environment*, and the main contradiction in it is the relief (*form*) and the processes that transform it (*content*) and between which there are cause-and-effect relationships. *Balances of loose deposits* are a material expression of these relations, which also express the content of the geomorphosystem - *morpholithogenesis.*

At the planetary stage of the Earth's development, the land area gradually increased, and the earth's surface freed from under water was covered with plant and soil cover, became more and more contrasting, and its relief was more *complex*. Over time, the geomorphosystem could not only *reflect*, but also perform certain synergistic acts. Long-term, directional, rhythmic-cyclical development of the geomorphosystem during the planetary stage gives reason to call it *historical-dynamic*. It is one of the factors in the formation of the sedimentary and granite-metamorphic layers of the earth's crust and in the space of which it forms its *material space-time* – ***the geomorpholithospher***e (Komliev, 1997; Komliev, 2001; Komliev, 2002a; Komliev, 2005).

From the standpoint of the methodological model "paradigm", which is often used by science, the current state of geomorphology can be diagnosed as "crisis", since *all its* paradigms, expressed in *morphogenetic, historical-dynamic, morphodynamic* concepts, aimed at solving the actual problems of the physical existence of mankind, are not enough take into account the above trends and facts provided by planetology. Geomorphology needs a *paradigm shift*. In our opinion, all the necessary *internal*

(exhaustion of the leading paradigm) and *external* (requirements of *the new social paradigm* and new acquired knowledge) reasons have developed for it.

The new paradigm in geomorphology must rest on its *own* solid foundation: a recognized general theory of its own object and significant accumulated informational and methodological potential. It is formed under the following conditions: *awareness* by the leaders of society of *the limitations* of living space, natural resources, and own capabilities; *formation* of the post-industrial information society; the failure of major social and historical projects; negative consequences of *liberalization* of many spheres of society. It is also necessary to take into account other trends that are manifested in modern science: the deepening of the research of one's own objects; taking into account the multiplicity and multivariateness of the obtained conclusions; reinterpretation of the results that were obtained earlier and not just the establishment of regularities; gradual departure from strict formalization; commercialization in the use of acquired knowledge, which affects more on their storage and processing, rather than multiplication; restoration of a simple accessible language of explanations in science; the emergence of active subjects that influence research directions and their results.

The relief of the Earth is *described, explained, its history is researched*, it is *predicted* and *constructed*. *General* and *partial* theories of the relief of the Earth have been created. The general theory of geomorphology - *cyclicity of morphogenesis* is still able to conceptually include new trends arising in its traditional directions, to rebuild itself methodologically, to use the accumulated informational and methodological potential (maps, methods).

The new paradigm in geomorphology should be based on the new social paradigm of ***humanism*** and scientific achievements. The *social paradigm of* ***humanism*** is a *protective* reaction of the society of its own habitat - planet Earth from the consequences of irrational nature use and an attempt to replace them with new ones (environmentalization, biosphere nature management). It is realized through the spiritual sphere: in the *aesthetic* perception of the surrounding natural environment (in particular, the development of cognitive nature tourism), *ethics* – the education of new traits in an individual person. *The achievements of modern science* have influenced the general methodology of scientific research – *the theory of systems*. It was greatly enhanced by *synergy*. The general trend of increasing *the systematicity* of scientific research is noted. The development of space research provides valuable comparative material, important for the study of the Earth and other planets. They provoke a revision of established ideas about the structure and functioning of the Earth supersystem and its subsystems from the general, planetary, cosmic, and more recently, from the positions of *nomogenesis*.

The *nomogenetic (teleological*) aspect will be present in the new paradigm of geomorphology. According to the concept of nomogenesis, the biosphere and man exist only in *a certain* natural and geographical environment, where the basic elements are geology, relief and climate. By correlating these elements and layer by layer complicating this frame with new natural components, it is possible to reproduce the implementation of a certain *metaproject* before the appearance of man, the formation of human societies, ethnic groups, and states, before the appearance and development of consciousness. *The historical-dynamic geomorphosystem*, which is also one of its *key system-forming elements*, is located in *the structural framework* of this

metasystem. And the new paradigm of geomorphology can be called *morphochronodynamic*, just like the concept developed by the author of the manual.

The morphochronodynamic concept uses *paleogeomorphology* as a factual basis for studying the history and evolution *of the historical-dynamic morphosystem* of the Earth and its material *space-time – the geomorpholithosphere*. The morphochronodynamic concept is based on ideas about the causes of the emergence of geosystems, on the rational knowledge obtained by previous concepts (paradigms), which are reflected in their fundamental provisions, which it develops, concretizes, and clarifies. Thus, the cyclical development of the historical-dynamic geomorphosystem is manifested in the rhythmic structure of the body of the geomorpholithosphere. It reveals the *evolutionary* trends of the geomorphosystem (and the geomorpholithosphere): *complication, increase* in *the contrast of the heights* of *the exposed surface*, a *decrease* in *the duration* of *the morphogenesis cycles* (as an example: the height differences of the Earth’s surface were tens to first hundreds of meters at the beginning of the Archaean, and now – 20 km; the duration of the morphogenesis cycles in the Precambrian was tens to hundreds of million years old, and the Cenozoic is the first millions – hundreds of thousands of years). The morphochronodynamic concept allows for the creation of static models of the geomorpholithosphere and their dynamic interpretation based on the analysis of maps of statics and dynamics. Maps of *statics* convey the composition, structure, structure of the geomorpholithosphere. Maps of *dynamics* reflect the historical, evolutionary, functional dynamics of the historical-dynamic geomorphosystem.

The morphochronodynamic concept examines the historical-dynamic geomorphosystem at the *local, regional,* and *planetary* levels.

The morphochronodynamic concept creates a theoretical and methodological basis for *end-to-end forecasting (retrospective, current, prospective*) of material-energy *movements-transformations*, information-entropy *exchanges*, which can be used not only in traditional areas of work – the search for various minerals, the implementation of ecological and nature conservation projects, but also in solving the problems of humanity and planet Earth discussed above.

In the opinion of the author of the textbook, the presented actual material of geomorphological formations of different regions of Europe can be used in solving traditional tasks of regional geomorphology (establishing regional differences and common patterns), but also become an informational basis for new directions of geomorphology.

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