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Geodiversity of the Earth's surface and environment

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Geologic and geographic objects can be successfully systemized based on the mathematical theories of diversity and sets. This can give us a clear understanding of the nomenclature of the Earth's surface: its elements, forms, as well as their combinations and structures. All these surface structural units are closely related to elementary landscapes, or geotops (other elementary locations such as biotops, lythotops, edafotops, hydrotops, climatops, and etc. can also be considered). Both surface structural units and corresponding geotops should be studied on two systematic levels: 1) the morphological one that provides us with the taxonomic (by unit size) and meronomic (by unit complexity) information, and 2) the dynamical one that allows working out various interpretations: geo-flows and their influence on the Earth's surface (including new formation and complete destruction of elements and forms), sustainability of geodiversity, etc. At the present time, the dynamical level is in a process of defining clear criteria and developing relevant classification.

The morphological level has in turn three sub-levels: a) relief elements, b) landforms (geomorphosystems), and c) regions (super-geomorphosystems).

The entire set of two-dimensional surface elements comprises 52 variants (elementary surfaces) and more than 2,700 three-dimensional geotops. Each of the geotops is characterized by four different exposures: gravitational (hypso- and bathymetric position, steepness, vertical and horizontal curvature), insolational (dip azimuth of the location), circulating (orientation against prevailing flows – frontal, rear or flank position), and anthropogenic ones. The most contrasting geotops are tied to the upper (tops, crests and their adjacent areas) and lower (bottoms, thalwegs and their adjacent areas) relief elements. Slope elements (faces, cliffs, terraces, and feet) serve as the linking areas and determine not the diversity as such but, first of all, commonalities of the territory.

The second morphological level – landforms – comprises 145 variants of geomorphosystems. They are classified according to the sign and shape in plan and profile, inner structure presented by vector lines (circle, ellipse, hyperbola, parabola, and lattice figures), outer structure presented by contours (isometric, brachy-, hemi-, bilateral, and linear ones), as well as their determinants and dominants. The determinants (in the number of 18) are the elements - mainly structural lines - that determine the whole landform (ridge, valley, trough, swell, volcanic cone, etc.); elementary surfaces dominating the landform serve as its dominants (37).

The third morphological level – geomorphologic regions – reflects geodiversity of a larger scale. It follows to a certain extent the classification on the first, elementary, level but is also supplemented with the analysis of extended symmetry and anisotropy carried out on a geomorphologic map.

All abovementioned fundamentals in a much more detailed way can be easily found in the monograph by Alexander Lastochkin "General theory of geosystems" (St. Petersburg, 2011, in Russian) and in the "Geomorphologic Atlas of the Antarctic" (St. Petersburg, 2012 - in Russian; 2013 – in English) produced by the team of authors.