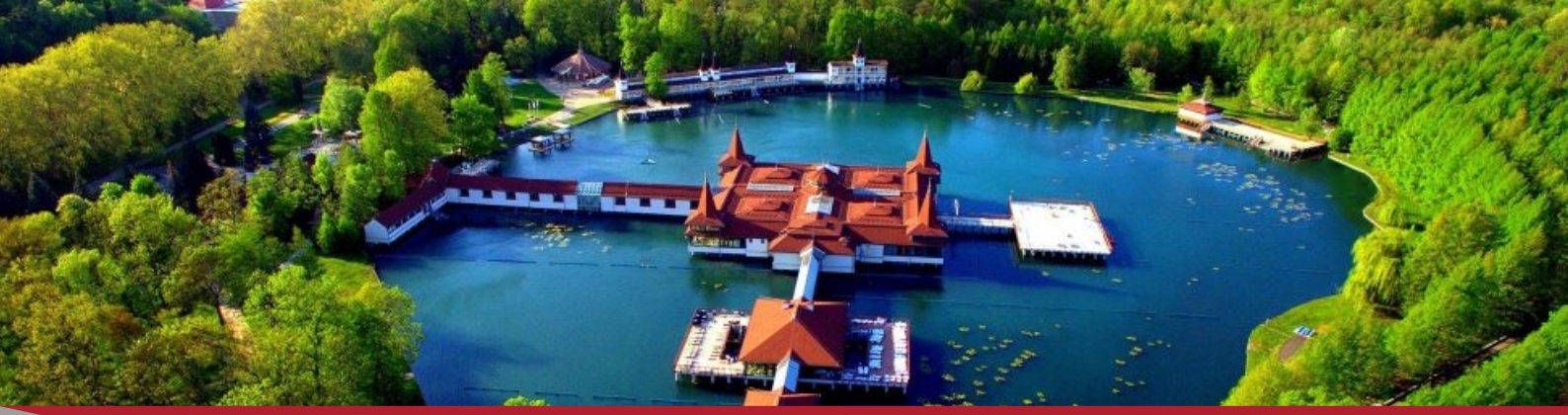

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Abstracts

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Combinations and an interaction of mechanisms of formation of the folded and the mountain structure of the Greater Caucasus in scales of (a) the sedimentary cover and (b) the Earth crust (to the problem of planning of geodynamic modeling)

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Introduction. The study of the mechanisms of formation of folded structures of the internal parts of the folded-thrust structures is important, because they lead to growth of the continental crust, and are involved in the formation of mountain building. The presented material was collected during realization of several types of research, and it can be used for integrated planning of experiments on modeling of complex structure on the example of the Greater Caucasus.

Materials and basic method of studying of a folding. The folded structure of the Greater Caucasus is characterized by a large amount of information in 24 structural profiles of more than 500 km total length. At least four hierarchic levels of structure (from seven ones, [Yakovlev, 2015]) were used in a study. The structure of each profile was divided into domains (level III of hierarchy) that combine folds with homogeneous morphology. Deformation of the domain is described by structural elements associated with the strain ellipsoid (fig. 1A). A method of balanced section reconstruction [Yakovlev, 2017], based "on geometry of folded domains", was used. Pre-folded states of domains were combined into "structural cells" (level IV), which allow to measure the shortening value of “cells” (Fig. 1B). The method [Yakovlev, 2017] allows also to determine the depths of the basement top for structural cells (for the pre-folded, post-folded and modern stages) and the amplitudes of uplift after folding and mountain building (Fig. 1B, sign 6).

The geometry of the structure in the scale of the sedimentary cover. At the scale of the “structural cells” (for 78 cells), the shortening values were determined in range from 0.63 to 0.33 for the Eastern part of the Greater Caucasus with average shortening 0.43, 0.45 and 0.51 for three “tectonic zones” (level V of hierarchy). The estimated depths of the basement top after folding and neotectonic uplift for the present stage of development for the same structures are, for example, -10.2 km, -12.0 km and -20.5 km (with range -13.6 ÷ -26.3). It was determined that in many cases the cells are separated by subvertical faults with the displacement amplitude on the level of basement top up to 10-15 km (Fig 1 B, sections 6, 5, 4). The reproduction of these parameters of particular natural structures can be planned as the purpose of physical or computing experiment.

Compilation of a list of possible mechanisms for the formation of the folding of a sedimentary cover; a decision-making. The concept of "folded domains" description in form of a strain ellipsoid

[Yakovlev, 2015] made it possible to clarify the problem of diagnostics of the mechanisms of structure formation (Fig. 2). Several series of physical models of mechanisms from literature, such as “lateral pressure”, “gravitational sliding”, “diapiric” and “convective” structures were investigated. Own cinematic models "advection plus the shortening (flattening)", "quasi-buckling" on the scale of the sedimentary cover, as well as a local "thrust related” mechanism [Yakovlev, 2015] were studied also. It was determined that each mechanism is characterized by its specific path of displacement (trends) in the feature field (Ax, En, K). Comparison of natural structures with reference mechanisms, using the same quantitative parameters of morphology, allows us to give a list of mechanisms, acting in nature.

The natural structures of the three tectonic zones of the Eastern Caucasus showed a good similarity of their contours in the most developed domains (Fig. 2, blue arrows), as it shown in the diagrams by the letters "A, B, C, F, G, J, K". Folded structures are cinematically well described by a combination of the synthetic model “advection plus shortening” (Fig. 2, sign 4) with “inclined zones of simple ductile shearing”, i.e. “thrust-related” mechanism (Fig. 2, sign 5, 6). These data as well as the shortening values of natural structures (noted above) may be used for a planning of folded structures simulation. The “mechanism” of displacement on the vertical faults (fig. 1B) remains unknown at this stage of study of the folding process.

The geometry of the structure at the scale of the crust. The structure of the Greater Caucasus on the scale of the crust and the upper mantle (“folded system”, level VI) for different stages of development can be obtained by summarizing the above data in the scale of tectonic zones. Formation of a folded structure with an average shortening 0.50, as well as the growth of the mountain structure can take place only with an increase in the density of a large volume of crust rocks up to the density of mantle one [Yakovlev, 2012].

Recognition of mechanisms in the scale of the crust and upper mantle. Six parameters of the structure on the “cells” scale relates to the geodynamics of Greater Caucasus formation (fig. 1B, sign 6). The study of their pair correlations and the use of factor analysis [Yakovlev, Gorbatov, 2018] allowed to identify two main factors, i.e. geodynamic mechanisms. First factor (F1, "isostasy") shows the dependence of the modern depth of the basement top from its depth at the pre-folded stage. It is associated finally with an increasing of the density of crustal rocks up to the "mantle" values. The second factor (F2, "shortening") shows the dependence of the neotectonic uplift value (stage 3) on the shortening value (stage 2).

Relationship of mechanisms on the scale of the sedimentary cover and mechanisms on the scale

of the crust and the upper mantle. Data on the mechanism of "isostasy" (which acts constantly) well explains the vertical movement of crust blocks, including large displacements of basement top along vertical faults (fig. 1B). Thus, the possibility of a detailed description of the mechanisms of the structure formation acting in different scales and in a certain way interconnected is revealed. The geodynamic nature of the horizontal shortening (acting episodically) in these scales of generalization has not yet been explained.

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