SOME REGULARITIES OF FOLD-NAPPE STRUCTURES FORMATION OF THE CARPATHIAN MTS. ON MULTILAYERED MODELS.

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Abstract. Using the multilayered model section of the Cretaceous-Paleogene complex a disharminical folding was obtained the structure of which is determined by coarse overlapped-folded structures. The thrusts and folds of different rank and genesis were revealed. The process of formation of complete similar disharmonical folding and structural storeys of this folding was reproduced. The deformational processes were regulated by quantitative relation of competent and non-competent layers and their thickness.

Key words: modeling, flysch, folds, thrusts, folding, formation.

This laboratory study is a continuation of the previous one (1). The preceeding experiments have showed a physical probability of formation of fold-nappe structures of the Ukrainian Carpathians Mts. in the process of continental subduction, have revealed an influence of rough surfaces of deforming section (ledges, depressions) upon the character of deformation and destruction, availability of hard geological bodies in it in a form of burried uplifts, remnants etc.

The aim of this study is to estimate the role of material composition of flysch complex of rocks, their rheological properties, led thickness, a character of bedding in the process of deformation. To solve this task two approaches were undertaken. The gist of the first one is the following: combining the layers with different deformational properties and thickness in different-type modelling sections the changes in character of folded forms and dislocations with a break of continuity were revealed. Such a way a study is put is found within the framework of solution of the basic task of tectonophysics (2) and modelling results can be used in other regions of the Alpine folding. The second approach is contained in that the model sections were created taking into account a stratigraphical sequence, thickness and deformational properties of the layers of the Cretaceous-Paleogene flysch of the Carpathians Mts.

The field observations over intensity of crushing of natural layers and thickness and literary data on the values of sedimentary rocks viscosity (2, 3) served as the grounds for estimation of deformational properties of constituent parts of the Carpathians flysch. Multilayered cross sections were built from clays of different sort and modern oceanic silts by means of consolidation of the flysch formations with similar deformational properties into one modelling layer.

The layers represented in the model by oceanic silts, have imitated the least viscous rocks: massive argillites, aleurolites and formations of thin-rhythmical flysch. They are non-competent layers. The layers built of fine-dispersed clays, have imitated the most viscous rocks: massive coarse-layered sandstones and formations of coarse-layered flysch. They are competent layers.The layers with intermediate values of viscosity were built of mixture of clays and silts.

Tangential pressure created as a result of underthrust of horizontally moving "plate" at the rate of 12 cm per hour is an active force of the models. The modelling process was conducted on modified installation created earlier (1) and intended for the models testing in the conditions of horizontal compression.

The principal results of the study, which isn't completed yet, can be formulated in the following way:

1. Using the multilayered models, a process of formation of complete disharmonical folding represented by folds and fractures of different rank and genesis was reproduced. On the whole, its structure is defined by the large asymmetrical lying folds the short wings of which are cut off by the large thrust-through which one fold is thrusted over another (areal-twisting).

2. There were distinguished three-types of thrusts in the folded-thrusted structures: 1) *secants-the largest*; 2) *average scale thrusts of fold-thrust* after V. Belousov's terminology; and 3) small *intralayered* and *bedding thrusts*.

The *secant thrusts* are splitting all or the majority of the model's layers. Their angle of incidence in different areas changes and depends upon the layers viscosity splitted by it. The thrust, developing upwards, is sloping (in some places up to subhorizontal position) in the thin non-competent layers or on the contacts of the layers and, on the contrary, it becomes steeper in the competent layers. The common steepness of the thrust increases by the surface and it acquires a form of arched curve in the section. The form of thrust in the plan: curved - winding.

Average scale thrusts cut off the twisted wings of the large lying folds with which they are genetically connected and are formed simultaneously. They are characterized by low-angle (up to horizontal) occurrence at the basement of lying folds and by sharp rise in angle of incidence at the front parts of these folds. In such places, the basic thrust is splitted into a series of much less and steep. This phenomenon can be probably explained by dispersion of the stresses in non-competent layers. The common steepness of the thrust dip-through the area increases in the direction of overthrusting "plate".

More often *intralayered* and *bedding thrusts* were observed in competent layers in the conditions when they were underlaid and overlapped by the competent layers. In homogenous competent layers occurred at the basement of the model's section, were mainly formed the thrusts of one direction with equal withdrawal one from another, but the thrusts of the opposite direction were observed too. In the small viscous layers , limited by low-viscous layers, the steep dipping thrust of the opposite direction were developed through which the wedge-shaped anticlinal structures of squeezing were formed as well as the bedding thrusts-that cause a formation of the structures of multilapping of the same layer.

3. Availability of thick low-viscous layer in the middle part of the multilayered section causes a formation of two storeys of folds with non-coincidence of their structural plans. Incidentally, the larger is thickness of low-viscous layer, the more favourable conditions are created for formation of disharmony of structural forms of lower and upper storeys. The low-viscous layer serves as if a

screen dispersing the stress concentration according to single plan of deformational process.

4. The process of crushing into folds of the multilayered section of the model represented by competent and non-competent layers of approximately equal thickness at first leads to formation of direct similar folds and then to asymmetrical disappearing folds. The process is finished by formation of a large trust along which a folded part of the section occurred overthrusted on horizontal layers.

Carrying out a combination of the layers with different deformational properties and their thickness, we obtained the folded forms and faults of different morphology and size. Degree of harmonical and disharmonical crushing of model sediments into the folds is regulated by quantitative relation of competent and non-competent layers of the model. Predominance of competent layers in the section leads to formation of folds with great degree of harmonical construction and on the contrary, increase in amount of non-competent layers leads to its disharmony. The more is thin-layered section of the model, the easier and more intensive it is crushed into small folds (intensive folding).

The modeling has showed that material composition of flysch complex of rocks, deformational properties and thickness of some layers and formations, a character of folding, location of the layers in geological section play a determinative role in the formation of genetic types of folding forms and fractures.

Consideration of these criteria is an obligatory condition in positing of the modeling of real structures and the more accurate are defined and considered in the model the physical and rheological parameters of geological section, the peculiarities of its structure, the more real picture of folded forms and fractures will be obtained using the model. In these experiments the geological section of the Cretaceous-Paleogene flysch is represented in rather generalized form, and absence of quantitative rheological parameters of rocks for directly given region didn't allow to take into account completely in distinguishing the layers of the model. That is why obtained picture of disharmonical folding reflects in the main more characteristic peculiarities of geological structures of the region. In future there is more detail division of the section of the Cretaceous-Paleogene flysch on tectonophysical complexes lies ahead of us as well their detail substantiation by quantitative parameters of deformational properties. This will make it possible to reveal the details of the Carpathian structure at a depth.

Determined in the process of modeling, the regularities of the development of folded-thrusted structures will promote correct interpretation of seismic data and forecasting of deep structure of flysch complex of Ukrainian Carpathian Mts. and other region with overlapped-folded construction.

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