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Prognosis of structure of the main baundaries for the Earth's crust based on data of deformations estimations in a folded Alpine sedimentary cover, the example of the Great Caucasus.

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Foundations of the methodology. Characteristic features of deformations is most completely reflected in fold-thrust structures, which are accessible for detailed studying, however, within narrow vertical outcrop bands. The developed complex of quantitative methods for studying the geometry and deformations of different-scale structures (from rock samples to mega-anticlinorium) allows a complete quantitative description of deformations of all these structures. Estimation of deformation values is performed successively, from small to larger structures, i.e., from better studied structures to less known ones [Yakovlev, 2002]. Knowledge of deformation values and the capacity of the rock massif, subjected to these deformations, allow a reasonable prognosis of the crust structure down to the depths, compared with the length of the studied cross-section.

The results of study of the fold structure. Fold-fault deformations are studied of three main tectonic zones of the Great Caucasus, covering its structures from the southern to the northern boundary. The consisting of stratigraphic columns of Transcaucasian massif and Chiaurskaya tectonic zone (the most southern one in the Great Caucasus) combined with the deformation pattern allows us to suppose a presence of a large normal fault with the dip of its plane to the north, which exists as a boundary between the Great Caucasus and the Transcaucasian massif. The magnitude of the relative subsidence of the Great Caucasus structures, which is synchronous with accumulation of sediments, is as high as near 8 km, if measured for the base of the Upper Jurassic layers. Fold deformations of the Chiaurskaya zone were accompanied by double shortening, which lead to double increase of the sub-vertical thickness of the whole sedimentary cover and to the increase of the normal fault magnitude, measured from the base of the Upper Jurassic layers, to near 16 km. Considering the thickness of lower laying Lower and Middle Jurassic sediments, we can estimate the total magnitude of subsidence due to normal fault for marker boundary basement/cover as about 20-25 km. The depth locations of this marker boundary to the north, to the large fault between of the Great Caucasus and Scythian Plate, may be determined with regard to the thickness of the sedimentary cover and deformation values. These locations are characterized by a relatively smooth increase to the depths of 5-7 km. We consider these data, obtained by the developed methods of structural geology and tectonophysics, as reliable empiric ones. Data, obtained by geophysical studies within the limits of the North-West Caucasus [Shempelev et.al., 2001], confirm in the whole the obtained character of the distribution of depths of the basement/cover marker boundary.

Mechanical interpretation of the structure and assumptions of the general mechanism of deformation occurrence. The obtained structure and the character of the Great Caucasus development contradict to a number of statements of standard collision schemes. First of all, a simple scheme of subduction of the Transcaucasian massif structures under the Great Caucasus contradicts to the structure of the Great Caucasus southern boundary (modelled reverse fault instead of natural normal fault). The presence of an active normal fault during folding formation contradicts to the scheme of the lateral compression, corresponding to the existence of thrusts. The presence of a sub-vertical large-magnitude normal fault allows us to presuppose its penetration to substantial depths, up to tens of kilometers, to mantle. Estimation of a possible displacement of the position, occupied by the Moho boundary within the Great Caucasus before the Alpine sediments accumulation at the end of Triassic (considering for the platform standard of 40 km) indicate a possible present depth of this former boundary of 100-110 km at the southern part of the Great Caucasus. Since the recent Moho boundary is located at substantially higher levels, we assume a transformation of some part of rocks of the crust in the Caucasus into the mantle material. Physical-mechanical mechanism of such transformations is unclear and should be studied in the future. Transformations of the type gabbro - eclogith and substitution of light ions of K and Na by heavy ions of Fe and Mg, which may be induced by fluid flows, are possible, or the combinations of these mechanisms. The possibility of the existence of processes of transformations of the crust material to the mantle material allows us to suppose that just these processes lead to the subsidence of the Great Caucasus structures at the stage of sediments accumulation, and that their abrupt intensification results in collapse down of all the structure and to the induced (not active, but reactive) gathering (pulling) of the neighboring continental blocks. Some essential features of deformations and the development history of the Great Caucasus agree with this scheme and contradict to the scheme of a pure block compressing. Probably, these processes can be also considered, within the frameworks of the traditional representations of compressing, created by moving plates, as additional and complicating ones. One of the main conclusions is that the Moho boundary in the modern fold-thrust area of the Great Caucasus is a newly-formed boundary, which appeared after substantial horizontal and vertical movements of rock massifs within the limits of the crust and the upper mantle. This result prevents using of this geophysical baundary as a marker of displacements and deformations.

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