Development of geodynamic models of the formation of the stress state of the earth's crust in the Caucasian region

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The paper presents a series of geodynamic numerical models for the formation of the stress-strain state of the lithosphere. The issue of geodynamic sources of deformation and the formation of the stress-strain state of the lithosphere of the Caucasian orogen, as well as the structures surrounding it (the Kura-Rion depression, the south of the Scythian Plate, the Lesser Caucasus) is being studied. The purpose of the study is not to accurately reproduce the structure of the orogen from some initial model, but, to a greater extent, to study the stress field in the lithosphere of orogens and correlate them with tectonophysical data on their stress state.

For the Caucasus region, modeling was carried out according to the numerical method developed by Wilkins for the study of elastoplastic bodies [1] and improved by Yu.P. Stefanov [2] for application in geomechanics. The features of this approach are as follows: an explicit finite-difference scheme is used, and the equations of motion are written in a dynamic form with the preservation of the inertial term as for real dynamic problems. Each impact on the system is considered as a transient process, for which an effective "artificial" time is introduced, usually proportional to the p-wave travel time through the entire model. Artificial viscosities are introduced into the algorithm, which are selected individually for each task in such a way that after the effective time interval has elapsed, the elastic waves caused by the impact are damped. In this way, quasi-static processes are modeled. The modeling technique and the process of creating a digital seismic-density and geomechanical model using this technique are described in more detail in [3].

Based on the created models, a series of calculations was carried out. For each profile of the Caucasus region and for the model of the lithosphere of the Central Asian orogens, stress fields were calculated for each geodynamic factor considered in this study (small-scale asthenospheric convection, pressure from neighboring areas of lithospheric plates, and the effect of erosion). Each calculated stress field within the framework of solving the inverse problem of geodynamics was compared with the initial tectonophysical data. The loading type "horizontal compression and erosive action"for the Caucasian orogen was determined to be the most consistent with natural stress state data.

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