Research the formation of a stressed-deformed condition of the Japanese zone of subduction before and after Tohoku earthquake by numerical modeling

Myagkov D.S., Pogorelov V.V.

Schmidt Institute of Physics of the Earth of the Russian Academy of Sciences, Moscow, Russia

e-mail: dsm@ifz.ru

This paper presents the results of numerical modeling of the formation of the stress-strain state of the Japanese subduction zone of the Tohoku region (North Honshu), both at the stage immediately before the 2011 Tohoku earthquake and after (the current state). The aim of the work is to determine the geodynamic process responsible for the formation of the stress state of the region under consideration obtained from the seismological data at the above stages. Namely, according to the results of tectonophysical reconstructions [1], before the Tohoku event, both in the continental lithosphere of the Japanese microcontinent and in the oceanic lithosphere of the Pacific Plate to the West, the situation of horizontal compression was observed from the boundary of trench, horizontal stretching. After the Tohoku earthquake, a restructuring of the stress state occurred on the eastern margin of the continental plate, and near the channel in the region under consideration, a situation of lateral extension also began to be observed. The described spatial and temporal patterns of the structure of the stress state require a geodynamic explanation, which in the framework of the current study was sought by numerically solving the direct problem of geodynamics

In the framework of this study, based on seismic data [2], a mathematical two-dimensional model of the Japanese subduction zone of the North Honshu region was created, capturing the Tohoku earthquake (presented in [3]). The finite-difference scheme developed by Wilkins [4] and modified by Yu.P. Stefanov. As a source responsible for the formation of the stress-strain state of the region, the following were considered: 1) small-scale thermogravitational asthenospheric convection, 2) pressure from the Pacific Plate, 3) the action of tangential mass forces. When modeling the state after an event, a weakened zone was directly specified in the model, whereby the event itself was modeled. Separately, the question of the nature of the influence of exogenous processes on the emerging stress state of the region was studied. The simulation results showed the greatest compliance with the natural data of the model with asthenospheric convection and the existing tangential mass forces.