Structural and tectonic heterogeneity of the Primorsky fault (Baikal rift zone) based on remote sensing data

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In the field of fault tectonics, problems related to the specifics of the formation of fractures are becoming especially relevant. The complex internal organization of fault zones, along with the description of qualitative lithological, petrographic, structural features, requires a series of quantitative assessments.

The object of the study was the Primorsky fault of the Baikal Rift zone. It belongs to the Obruchev fault system and is the largest neotectonic structure. Due to its geomorphological severity, good exposure and accessibility for study, the Primorsky deep fault is a reference for paleotectonic reconstructions.

To identify the structural and tectonic heterogeneity of the Primorsky Fault at the first stage, a detailed digital relief model (DEM) was created based on SRTM data. For optimal allocation of lineaments, shadow relief schemes were created using the ENVI software based on the DEM. For this, nonlinear directional filtering of the image was used. At the next stage, using the "LINE"module of the PCI Geomatica software, automatic extraction of lineaments was carried out. Visualization and spatial analysis of the selected lineaments was carried out using free and open source cross-platform geoinformation system QGIS. To estimate the width of the damage zone of the Primorsky fault in QGIS, a lineament density scheme was built using the specialized module. The analysis of the lineament density scheme made it possible to identify the expected damage zone of the fault. Separate segments of the damage zone are identified, characterized by different spatial distribution of the feathering lineaments and, most likely, the parameters of the stress-strain field.

At the final stage of identification of structural and tectonic heterogeneity and reconstruction of shear stress fields of the Primorsky fault, the structural and geomorphological (SG) method of L.A. Sim was used. The orientation of the feathering fractures, the direction of the horizontal axes of compression and stretching, which caused the shear displacement, with respect to the fault plane vary depending on the geodynamic situation. As a result, the orientation of the compression and stretching axes in the horizontal plane is reconstructed, the direction of shear movement along the fault (right or left) is determined, and the geodynamic situation of the formation of the fault (compression or stretching) is reconstructed.

Based on the results of a comprehensive lineament analysis of the detailed DEM, in combination with the results of the SG method of L.A. Sim, it was possible to outline the damage zone of the Primorsky fault. Within the framework of the zone, segments characterized by various indicators of lineament density and, probably, parameters of the stress-strain field have been identified. For each segment, the rose diagrams of the orientation of the lineaments feathering the fault (megafractures) were interpreted, the kinematics of the fault segments and the orientation of the main axes of the stress field were established. The general tectonic heterogeneity of the structure under consideration is revealed. The used approach is universal and can be applied to the analysis of multi-scale discontinuous structures.