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Architecture and kinematics of kimberlite-controlling fault zones of the Yakutsk diamond-bearing province (Siberian platform)

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We have studied the regularities in architecture of kimberlite-controlling fault zones in the sedimentary cover of the Siberian platform. According to our data, the kimberlite pipes and fields are controlled by old preexistent deep-seated N-S and near E-W faults in the platform basement. In the upper layers of sedimentary cover they are strike-slip fault zones varying in width from the first kilometers to tens of kilometers. These zones are of complex architecture. The tectonophysical analysis has shown that the architecture resulted from two imposed structural parageneses of the strike-slip type (including R-, R‘-, t- and n-type ruptures). It is indicative of the fact that the displacements along the investigated faults were of strike-slip kinematics and sign-variable character. That is, there were the stages at which the sign of displacement along the stated faults changed to the opposite because of the change of effective tectonic stress field. The results obtained in the field data analysis have been tested by physical modeling. The experiments have been carried out for two-layer models imitating the “basement - sedimentary cover” system. The bottom layer imitating the platform basement is made of montmorillonite clay and the top layer imitating the sedimentary cover is made of bentonite clay. The lines of faults have been cut in the basement-imitating layer in accordance with their natural analogues fixed by geophysical methods. At the first stage the model has deformed in the right-lateral strike-slip mode, and at the second stage - in the left-lateral strike-slip mode. The integrated scheme of faulting modeled at the two-step deformation correlates well with similar fault zone schemes obtained from the field observations. The strike-slip regional tectonic stress fields that determined the kinematics of displacements and formation of structural parageneses of faults in kimberlite-controlling fault zones have been sequenced in the following way: 1) NE compression - NW extension; 2) NW compression - NE extension and

3) near N-S compression - near E-W extension. The obtained data show that the first stage was on the Low-Middle Paleozoic, the second stage - on the Middle-Upper Paleozoic, and the third stage - on the Mesozoic. Each of these stages was marked by kimberlite material intrusion. It resulted in formation of new kimberlite pipes in some cases and in complication of the pre-existing kimberlite pipes (multiple-phase bodies) in the others. The further analysis has allowed linking the spatial attitude of the pipes with parageneses of the faults that architect the investigated fault zones. It has been stated that both individual kimberlite bodies and their bunches are within the local extension structures occurring in the formation and reactivation of strike-slip fault zones. First of all these are pull-apart structures and extension duplexes that occur in the places of convergence of en echelon faults of the R-shear type. So, the basic feature of geodynamics of the Yakutsk diamond-bearing province is the prevalence of strike-slips along the near E-W and N-S faults in the Siberian platform basement in the Paleozoic-Mesozoic. As a result of it, wide strike-slip zones occurred in the sedimentary cover above these faults. Kimberlite bodies are related with some of the certain architectural elements of the zones noted. The work has been financed by “ALROSA” Joint Stock Company.