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Comparison of seismotomographic and thermogravitational models with distribution of the seismotectonic deformation orientations for Kamchatka region

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In this study we reveal the relationships between the structure of the lithosphere, the distribution of convective flows in the upper mantle and the character of seismotectonic deformations (STD) that is especially important for regions of active continental margins. We present a comprehensive analysis of seismotomographic and thermogravitational models together with the distribution of the STD principal axes orientations for the Kamchatka region, where crustal displacements are accompanied with seismic and volcanic activity. Our previous results have shown that: the variations of the lithosphere thickness significantly affect the structure of convective flows in the upper mantle [Chervov, Chernykh, 2014]; the pattern of these flows, in turn, correlate with the distribution and the orientations of STD principal axes (for the Altai-Sayan region with surrounding areas [Bushenkova, at al., 2014]). Based on the upper mantle seismic tomography model beneath Kamchatka and adjacent regions by Koulakov et al. (2011) and taking into account the variations of the lithosphere structure, we have calculated a numerical 3D model of thermal convection in the upper mantle. Also, we have estimated the distribution of orientations of the STD principal axes. We used the focal mechanisms of 511 earthquakes occurred in the period of 1976-2015 [www.isc.ac.uk/iscbulletin/search/fmechanisms] in the Kamchatka region. These focal mechanisms were transformed to the 3D STD distributions based on the Riznichenko's method (1985). In this case, the STD was determined as an average seismic moment tensor of all earthquakes in a unit volume for the selected time. We found that the STD principal axes distribution is inherited for different depth layers along the entire eastern coast of Kamchatka. Abrupt changes in the orientation of the principal axes of elongation and shortening, and a change of the direction of their dipping are observed in area zone of 53.0- 54.50 N. This zone coincides with an area of structural changes in the tomography model at a depth of 200-400 km. In the numerical 3D model of convection in the upper mantle, the same zone corresponds to the connection of the downward flows. These results suggest that the southeastern descending flow corresponds to the abrupt changes of orientations of the principal axes of seismotectonic deformation. Moreover, the southwestern descending flow corresponds to the subducting slab patterns in the tomography model of the Kamchatka region.

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