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The seismotectonic deformations main axes directions distribution in northern Asia

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The study is devoted to the analysis of seismotectonic deformations (STD) main axes directions distribution according to the mechanisms of earthquake foci and their complex comparison with the structure of the lithosphere based on the results of seismotomography and numerical modeling of the structure of convective flows in the upper mantle.

The International Seismological Center (ISC) catalog for 570 seismic events with M=5.0–8.0 was used to calculate the STD [http://www.isc.ac.uk/iscbulletin/search/fmechanisms/] that occurred between 1976 and May 2019 with the addition of materials on 154 foci 1905-1975 from [Radziminovich et al, 2016, Geodynamics & Tectonophysics; Imaev et al., 2000; Kuchay, 2013].

The STD field reconstruction was carried out for the region 38°-80° N and 63°-156° E using the technique described in [Bushenkova et al, 2018, Geodynamics & Tectonophysics; Kuchai, Kozina, 2015, Russian Geology and Geophysics]. The reconstructed STD field for each elementary volume of averaging shows that the predominant direction of the STD axes changes from West to East. The submeridional horizontal shortening, characteristic for the Tien Shan and Altai, turns to the NE, at ~ 93 меridian and persist up to 105 meridian, where the shortening in the Baikal rift zone occurs in the near-vertical direction and then again takes the NE orientation in Yakutia. The northern part of the study area is characterized by a near-vertical shortening. The predominant subhorizontal elongation appears in the Earth's crust in the eastern part of the study region.

The 3D seismotomographic model of the upper mantle velocity anomalies is based on ISC catalog data since 1964. When specifying boundary conditions in the 3D thermal convection numerical simulation, variations in the thickness of the lithosphere are taken into account (from geological and geophysical data, including seismotomographic data, specify the boundaries of the thickened lithosphere of plates and cratons surrounded by the thinned lithosphere of the northern Asia fold belts), according to the conclusions of our previous studies on the really significant effect of changes in lithosphere thickness on the structure of convective flows in the upper mantle [Bushenkova et al, 2018, Geodynamics & Tectonophysics; Chervov, Chernykh, 2014, Journal of Engineering Thermophysics].

Comparing the orientations distribution of the STD main axes with the seismotomographic model

of the region, we observe the areas of the STD axes directions turning coincide with the sharp boundaries of the seismic velocities anomalies sign change in the upper mantle.

Comparing the numerical model of thermal convection with the distribution of the STD main axes orientations we observe an obvious correlation of the STD main axes directions with extended downflows in the upper mantle (elongations are aligned along the strike of the downflow in the plan and shortenings across it). The orientation change occurs mainly above the convection upflows. The most clear correlation is observed in the southern half of the study region, because the lithosphere here has a smaller thickness and block size and the crust is less consolidated, which makes it more exposed to mantle processes.