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Submeridional boundary zone in Asia: seismicity, lithospheric structure and distribution of convective flows in the upper mantle

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This study devoted to submeridional border in the form of a wide band that stretches roughly along the 105°E in the Central Asia. The strongest (≥8) continental earthquakes occurred during the past century only toward the West from this boundary. Understanding of the tectonic nature of transregional boundary zone largely would clarify its possibility to control current processes on a very large territory. This boundary observed in different models of the Central Asia lithosphere deep structure obtained from the interpretations of the most modern seismic velocities models. In some of these models, the boundary zone could be traced down to about 600 km depth (Koulakov, 2011; Kozhevnikov et al., 2014; etc.).

We present a comprehensive analysis of the relationships between the character of seismotectonic deformations (STD), the seismic anomalous structure of the lithosphere and the distribution of convective flows in the upper mantle. Our previous results have shown that variations of the lithosphere thickness significantly affect the structure of convection in the upper mantle [Chervov, Chernykh, 2014], and the pattern of these flows, in turn, can correlate with the distribution and the orientations of STD principal axes [Bushenkova, at al., 2014, 2016]. The 3D model of seismic anomalies distribution in the upper mantle of the study region was updated by addition of a new data from the ISC catalog. The calculations performed using the technique developed during the previous researches (Koulakov, Bushenkova, 2010). Then, taking into account the variations of the lithospheric thickness, we have calculated a numerical 3D model of thermal convection in the upper mantle. Reconstruction of the seismotectonic deformations field was carried out according to the data of 1495 earthquake focal mechanisms (M≥4.6) that occurred in Central Asia during the period from 1976 to June 2017 (from the catalog [www.globalcmt.org/CMTsearch.htm]). Uneven distribution of earthquakes hypocenters within the area with coordinates limits of 15-60°N. and 60-120°E is such that the size of the averaging area was chosen 1° in latitude and longitude.

We have compared seismotomographic and numerical thermogravitational models with distribution of STD principal axes orientations and the following features were found. The area of turning of STD principal axes orientations correlates with the downward convection flow in the obtained numerical thermogravitational model of the upper mantle. The azimuthal direction of the principal axes of shortening is different in the western and eastern parts of the study area. The western part of the territory characterized by submeridional shortening of the principal axes of deformation and the eastern part by sublatitudinal shortening. Turning of the directions of the shortening principal axes occurs at zone 93-105°E.

Note, that we observe obvious correlation the band of turning of STD principal axes and the change in the seismic regime with the extended submeridional downward flow in the mantle precisely along transregional Central Asian structure which going nearby the 105°E.

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