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Study of the deep structure of the seismic danger regions to decrease seismic risk

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The most dangerous zones all over the world are transition zones between continents and oceans. They are characterized by the tremendous seismic activity, volcanic eruptions, tsunami and other catastrophic events. More than thirds of population of globe live in seismically dangerous zones of the Earth. Therefore the study of a deep structure and geodynamic conditions of such regions is necessary to minimize the population losses and destructions in case of natural hazards. As an example, we consider deep structure and geodynamic conditions formed in northern Sakhalin after the large Neftegorsk earthquake in 1995. Sakhalin Island was initially a part of the east coast of the Eurasian Continent. In the Late Cretaceous the Okhotsk Plate was being subducted under Sakhalin. In the Early Miocene the lithospheric plates movement has led to formation of the Tatar Strait rift. In the Late Miocene the subduction of the Okhotsk Plate has come to the end, but tectonic activity proceeded and the frequent earthquakes testified to the continuity of these processes beneath. Most earthquake hypocenters are concentrated in the crust. The Neftegorsk earthquake has occurred with magnitude Ms=7.2 on May 27, 1995 in the North Sakhalin caused victims and destructions. The hypocenter of Neftegorsk earthquake was determined at depth of 18 km. As a result of this disastrous earthquake seismic rupture of north-northeast strike of an overall length of 40 km appeared which caused right-lateral strike-slip fault displacement. The geodynamic model of the lithosphere for the Neftegorsk earthquake region was constructed. It represents the depth section crossing the North Sakhalin sedimentary basin, Deryugin Basin and ophyolite complex between them. The ophiolite belt of ultramafic magmatic rocks is an ancient (K2-Pg) paleosubduction zone separating the Deryugin Basin from the North Sakhalin Basin. As a result of movement along ancient subduction zone, considerable displacements in the crust along numerous faults and deformation of the earth surface go on. On a surface the subduction zone manifests itself as deep faults running along Sakhalin. The focus of the Neftegorsk earthquake was directly formed by burst of activity of this ancient subduction zone. The position of ancient subduction zone under Sakhalin is a cause of strong earthquakes here. Therefore this region is one of seismic dangerous in Russia.
Constructed on the basis of complex interpretation of the geologic-geophysical data the geodynamic models of seismic dangers regions give the chance: (a) to study a deep structure under seismic dangerous zones and volcanic areas; (b) to investigate a role of the deep processes in mantle which have an influence on formation of crust units; (c) to plot detailed maps with allocation of zones of increased risk to prevent active building or other economic activities in such dangerous regions. The risk will always be, but it should be estimated and minimized.Russian Foundation for Basic Research № 12-05-00029-a