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Earthquake depth distribution in the Baikal rift system and its rheological meaning

Natalia Radziminovich

Institute of the Earth‘s crust, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russian Federation (nradzim@crust.irk.ru)

Accurate determination of the earthquake source depth within the crust is possible provided that dense seismic network is operating and reliable velocity models are available. These conditions are not implemented in the Baikal rift system that leads to the ambiguity of the results and confusion with their interpretations. Meanwhile the earthquake depth is of special importance for the study of regional seismicity, the processes of rupturing, the geometry of faults and macroseismic effects. A special interest this parameter has for estimating strength properties of the lithosphere. This question, in turn, is a keystone for understanding the origin and development of the Baikal rift.

The main aim of the report is to review of all available data on the earthquake source depth for the Baikal region, to consider the peculiarities of depth distribution in different case studies (for background seismicity and swarm/aftershock sequences) and to construct yield stress envelopes.

The results show that the highest seismic activity is observed within the depth range of 10–20 km. The bottom of the seismically active part of the crust corresponding to the level, above which 90% of sources are located, lies at a depth of 25 km. The trend of the deepening of seismic sources is observed at the northeast flank of the rift zone, where seismic activity involves the lower part of the crust. No reliably localized sources are documented below the Moho discontinuity.

Crustal strength estimation was based on the assumptions concerning frictional sliding and dislocation creep at the upper and lower parts of the crust correspondingly. The mean regional values of surface heat flow and strain rate as well as varied composition and pore pressure were used in the calculations. The best fitting of the yield stress envelopes to the earthquake depth histograms is found under mainly mafic composition of the middle and lower crust, high pore pressure at depth and the crust heated less than could be expected for a rift zone.