Geophysical Research Abstracts, Vol. 9, 05211, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05211

Anisotropic local travel-time tomography with examples from the Baikal and Rwenzori regions

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We present an algorithm for anisotropic seismic tomography which provides information about seismic velocity variations along different directions. The algorithm is based on travel-time measurements from local events recorded at stations of local and/or regional networks. A preliminary localization of the events is performed using travel times computed in a 1D isotropic velocity model including corrections for station elevations. The anisotropic properties at each point within the volume of interest are characterized by a type of transverse isotropy which can be defined by four parameters: the fast and slow velocities and two angles defining the orientation of the symmetry axis. The parameters are obtained for each node of the parameterization grid simultaneously with source parameters (coordinate and origin time corrections) and station corrections after several iterations of the general inversion step.

We apply the algorithm to travel-time data from local and regional events recorded at two regions of continental rifting: the Baikal rift zone and the Rwenzori region, Uganda, within the western branch of the East-African rift. Beneath the Baikal rift, within the uppermost mantle, we observe a clear low-velocity zone. Anisotropic symmetry axes seem to indicate diverging flows away from the center of the rift. Beneath the Eastern Sayan zone, which is characterized by Cenozoic volcanism, the observed horizontal anisotropy is almost negligible. Preliminary results from Uganda show that orientations of the TI symmetry axes beneath the northern flank of the Rwenzori Mountains tend to align in N–S orientation. On the western side, near the Sempaya hot springs, anisotropic orientations change to SE–NW. The distribution of the velocity anomalies remains quite similar compared to the results of the isotropic inversion, however, the velocity anomalies become smoother and less significant.