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Anisotropic velocity structure of the crust and upper mantle in the Taiwan region from local travel time tomography

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Taiwan Island located in a contact zone between the Eurasian and Philippine Sea plates, the tectonic processes in this area are mostly controlled by the relative kinematics of these two plates. In the east, the Philippine Sea plate subducts northward under the Eurasian plate along the Ryukyu trench. Off the southern tip of Taiwan, the South China Sea subplate, part of the Eurasian plate, subducts eastward under the Philippine Sea plate underneath the Luzon Island. The Taiwan Island is located at the junction between these two subduction zones.

Here we present anisotropic velocity model of the crust and upper mantle in the Taiwan region derived from local travel time tomography. We use more than 300 000 P and more than 150 000 S rays coming from 12910 earthquakes occurred in the Taiwan region and registered by 816 stations of different local Taiwanese seismic networks. The ANITA algorithm, for iterative nonlinear inversion of local earthquake data in orthorhombic anisotropic media with one predefined vertical orientation, was used for the tomographic inversion. This algorithm presumes anisotropy for only P velocity described as horizontally oriented ellipsoid. For S velocity we presume an isotropic model.

Results show a good agreement with tectonic structure of the region. Obtained isotropic P and S velocity models show fit to each other. The most prominent features of the models are Philippine Sea plate characterized by increased velocities and decreased velocities observed along the Luzon and Ryukyu arcs. We observe that orientation of the fast velocity axis within the Philippine Sea plate coincides with direction of its displacement. Along the Luzon and Ryukyu arcs orientation of the fast velocities axis coincide with the arcs extension. The results show that upper mantle beneath the eastern Taiwan characterized by decreased velocities and N-S orientation of the fast velocity axis. The western Taiwan characterized by alteration of the relatively small negative and positive anomalies with dominantly NW – SE orientation of the fast axis, which could reflect complex tectonic structure of the Taiwan Island. Special attention was paid to the verification of the obtained results.

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