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Evidence for southward subduction beneath the eastern Pamir constrained by teleseismic converted seismic waves

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Recent receiver function (RF) results show a southward-dipping low velocity zone (LVZ) in the mantle south of the Main Pamir Thrust (MPT). It is clearly observed in a north-south cross section by two parallel running velocity contrasts, the lower one with negative, the upper one with positive amplitudes. The thickness of the LVZ is approximately 15 km. It is resolved in the longitudinal interval ranging from 38N to 39.3N and in depth from 80 km to 150 km. The inclination is steepening southwards from 25° to 65° and its location coincides with the Wadati-Benioff zone formed by the hypocenters of the intermediate-depth earthquakes in this region. The LVZ crops out at the MPT and thus connects the crustal seismic activity at the MPT with the seismic activity in the upper mantle.

The analyzed data were collected within the framework of the Tien Shan Pamir Geodynamic program (TIPAGE) from 2008 to 2010. In the first year, we were running 24 stations in the eastern Pamir, forming the 350 km long north-south main TIPAGE seismic profile. The profile was elongated northwards with data collected in a temporary seismic experiment in the Ferghana Valley, which ran from 2009 to 2010. In the second year, we rearranged the deployment in order to get an equally distributed areal network with a station spacing of approximately 40 km. Further data of permanent stations in western Tajikistan were provided by the Geophysical Survey of Tajikistan.

A diagonal north-west to south-east cross sections of migrated RFs from the areal network shows the same main features as the north-south profile, indicating an arcuate configuration of the subduction. While in the eastern Pamir the LVZ is dipping due south, further west the dipping direction is bending south-east, following the S-shape formed by the epicenters of the mantle seismicity.

In addition, S-RFs are calculated and migrated along the main TIPAGE profile. Results for the lateral variation of the Moho depth gained by P- and S-RFs verify each other. Crustal thickness, which is determined by direct conversions and crustal multiples of P-RFs varies along the profile from 75 km beneath the southern Pamir to 64 km beneath the Tien Shan and then decreases to 45 km towards the Ferghana Valley.

For imaging of the dipping interface a migration procedure is used and tested that accounts for the inclination of the conversion layers. Migrated cross sections of Q- and T-components of the P-RFs are compared. In synthetic tests it is shown, that for the observed dipping structures and the given ray geometry the T-component shows a better signal than the Q-component. This is observed in the real data as well.