Seismic detection of the low-velocity anomaly at the crust and uppermost mantle beneath the central Tien Shan

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As one of the most active intracontinental orogenic belts in the world, the Tien Shan orogenic belt originated in the Paleozoic and then experienced tectonic activities such as plate subduction and closure of the Paleo-Asian Ocean. Previous seismological and geodynamic studies have shown the observed the low-velocity anomaly (LVA) beneath the central Tien Shan at the uppermost mantle, which has a significant influence on the formation and modification of the crust and mantle lithosphere (Lei et al., 2007). However, the distribution, morphology and physical property of the LVA are highly debatable.

We conduct 2-D forward waveform modeling based on spectral-element method (SEM) to investigate waveform distortions that were generated by the velocity contrast boundary of the LVA. The broadband P- and S-waves from three intermediate-depth earthquakes at Hindu Kush-Pamir were recorded by the Chinese Digital Seismograph Network (Zheng et al., 2010). We use these records to confirm the location, shape and velocity decrement of the LVA by fitting the observed records with the synthetics through SEM based on the 1D velocity structures (TSTB-B) of the central Tien Shan and northern Tarim basin (Gao et al., 2017). We find the LVA at 10–100 km beneath the eastern part of the central Tien Shan. And the northward under-thrusting of the Tarim Basin may trigger some mantle upwelling, contributing to the observed LVA.

