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3D P-wave velocity structure of the crust and relocation of earthquakes in the Lushan, China, source area

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Many researchers have investigated the Lushan source area with geological and geophysical approaches since the 2013 Lushan, China, earthquake happened. Compared with the previous tomographic studies, we have used a much large data set and an updated tomographic method to determine a small scale three-dimensional P wave velocity structure with spatial resolution less than 5km, which plays the important role for understanding the deep structure and the genetic mechanism beneath the Lushan area.
The double difference seismic tomography method is applied to 50,711 absolute first arrival P wave arrival times and 7,294,691 high quality relative P arrival times of 5,285 events of Lushan seismic sequence to simultaneously determine the detailed crustal 3D P wave velocity structure and the hypocenter parameters in the Lushan seismic area. This method takes account of the path anomaly biases explicitly by making full use of valuable information of seismic wave propagation jointly with absolute and relative arrival time data.
Our results show that the Lushan mainshock locates at 30.28N, 103.98E, with the depth of 16.38km. The front edge of aftershock in the northeast of mainshock present a spade with a steep dip angle, the aftershocks' extended length is about 12km. In the southwest of Lushan mainshock, the front edge of aftershock in low velocity zone slope gently, the aftershocks' extended length is about 23km. Our high-resolution tomographic model not only displays the general features contained in the previous models, but also reveals some new features. The Tianquan, Shuangshi and Daguan line lies in the transition zone between high velocity anomalies to the southeast and low velocity anomalies to the northwest at the ground surface. An obvious high-velocity anomaly is visible in Daxing area. With the depth increasing, Baoxing high velocity anomaly extends to Lingguan, while the southeast of the Tianquan, Shuangshi and Daguan line still shows low velocity. The high-velocity anomalies beneath Baoxing and Daxing connect each other in 10km depth, which makes the contrast between high and low velocity anomalies more sharp. Above 20km depth the velocity structure in southwest and northeast segment of mainshock shows a big difference: low-velocity anomalies are dominated the southwest segment, while high-velocity anomalies rule the northeast segment. Lushan aftershocks in southwest are distributed in low-velocity anomalies or the transition belt: the footwall represents low-velocity anomalies, while the hanging wall shows high-velocity anomalies. The northeastern aftershocks are distributed at the boundary between high-velocity anomalies in Baoxing and Daxing area.
The P wave velocity structure of Lushan seismic area shows obviously lateral heterogeneity. The P wave velocity anomalies represent close relationship with topographic relief and geological structure. In Baoxingarea the complex rocks correspond obvious high-velocity anomalies extending down to 15km depth [U+FF0C] while the Cenozoic rocks are correlated with low-velocity anomalies. Lushan mainshock locates at the leading edge of a low-velocity anomaly surrounded by the Baoxing and Daxing high-velocity anomalies. The main seismogenic layer dips to northwest. Meanwhile, a recoil seismic belt dips to southeast above the main seismogenic layer exists at the lower boundary of Baoxing high-velocity anomaly.