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New perspective of Earthquake generation in the east margins of Tibet, China

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Global seismic waveform inversion can reveal where rupture initiated and how it expanded for the 2013 Ms 7.0 Lushan earthquake, Sichuan province of China. To investigate the generation mechanism of the Lushan earthquake and its relation to the 2008 Wenchuan earthquake (Ms 8.0), we installed 50 temporal seismic stations at the source area following the Lushan earthquake. We also collected crustal stress data along the Longmen-Shan fault zone (LMFZ) to reveal its influence on the Lushan earthquake generation. Our seismic imaging and crustal stress analysis indicates that the Lushan earthquake occurred in a distinct area with high-velocity (Vp, Vs), low-Poisson's ratio (σp and high crustal stress. The high velocity zone at the Lushan source may reflect the metamafic seismogenic layer that enables the accumulation of high crustal stress for large earthquake generation. However, a sharp contrast gap zone with low velocity and high-gσ anomalies is clearly imaged in the upper crust under the conjunction area between the Lushan and Wenchuan earthquakes. Our seismic images indicate that the slow velocity gap zone is associated with fluid-bearing ductile flow from the lower crustal materials of Tibet being pushed into the weakened segment of the LMFZ. Our study suggests that the 2013 Lushan earthquake may have been triggered by the high crustal stress accumulation together with the high coseismic stress increased by the Wenchuan Earthquake in the metamafic seismogenic layer. The contrasting rheological variation in the crust and crustal stress change along the LMFZ controls the rupture processes of the Lushan and Wenchuan earthquakes, as well as the generation of new earthquakes in the future.