

New insight into rupture process and generating mechanism of the 2017 M_w 6.5 Jiuzhaigou earthquake

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On August 8th, 2017, a large earthquake occurred on a blind fault in the Jiuzhaigou Village, Sichuan Province, China, whose epicenter is just 170km away from the epicenter of the biggest earthquake in Sichuan Province, the 2008 Wenchuan earthquake. The focal mechanism showed a strike-slip fault event. According to the field investigation, there was no significant surface rupture around the epicenter, making it hard to identify the seismogenic fault and speculate the rupture zone of this event. A new inversion method was developed to extract information on fault geometry along with the slip-rate function from observed teleseismic waveforms (Shimizu et al. under review). In the method, they developed the potency-density tensor from two basis components to five basis components, resulting in estimating arbitrary fault slip that occurred underground. In this study, we applied this developed inversion method to the Jiuzhaigou earthquake and obtained reasonable results, because both the modelling errors of uncertainty of Green's function and uncertainty of fault geometry have been taken into account. Our results indicated that the estimated total seismic moment of this strike-slip event is $\sim 7.36 \times 10^{18}$ Nm, associated with a 46 km long and 26 km wide fault plane. For the hypocenter depth of this event, previous studies showed great differences, ranging from 5.0 km to 22 km. In our study, the best waveform match was obtained at the hypocenter depth of 13 km. The source duration is 10s and there are three-stage rupture processes (Fig. 1). During the first 2s, the rupture is mainly concentrated in the region below the hypocenter. Then, the rupture propagated up-dip along the fault near the hypocenter from 3s to 6s after the initial break. Since 5s, the rupture propagated to the northwest direction and the slip became smaller than before. Subsequently, the rupture propagated to northwest and southeast directions from 6s to 10s and such rupture feature lasted until the rupture stopped. In addition, we also obtained the velocity structure near the hypocenter by tomography method (Zhao et al., 1992). The tomography results showed that Jiuzhaigou earthquake started in the high velocity area, while large amounts of low velocity areas are observed in the western and lower regions of the hypocenter, which was related to crustal flow.

Keywords: Jiuzhaigou earthquake, Waveform inversion, Rupture process, Crustal flow, Generating mechanism

References

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