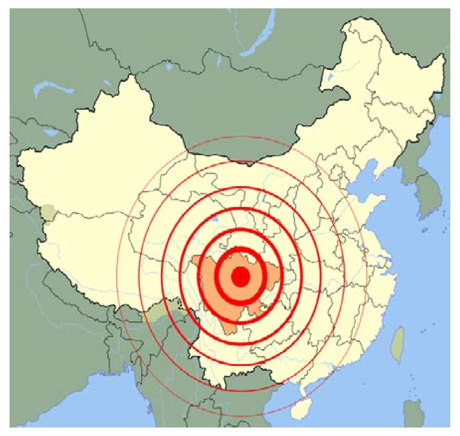

Rupture process of the 2008 Mw 8.0 Wenchuan Earthquake

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Seismic inversions

Here we tried to approach the rupture process of the 2008 Wenchuan earthquake based on the teleseismic data. We have formed a more comprehensive data set by manually selecting 62 body waves and 77 surface waves. Besides the fault geometry inferred from Global CMT (GCMT), we tested two plausible complex fault geometries. Based on these intermediate results, we concluded that
1) Right-lateral strike-slip rupture of the second major asperity of our preliminary result more likely occurred on a high angle fault rather than the fault plane inferred from the Global CMT.
2)Near the hypocenter, a concurrent rupture on both high angle and low angle faults could explain the data equally well.

I. Single-fault Model

Epicenter: NEIC epicenter (30.986N, 103.364E)
Fault plane: dip = 33 deg. strike = 227 deg.

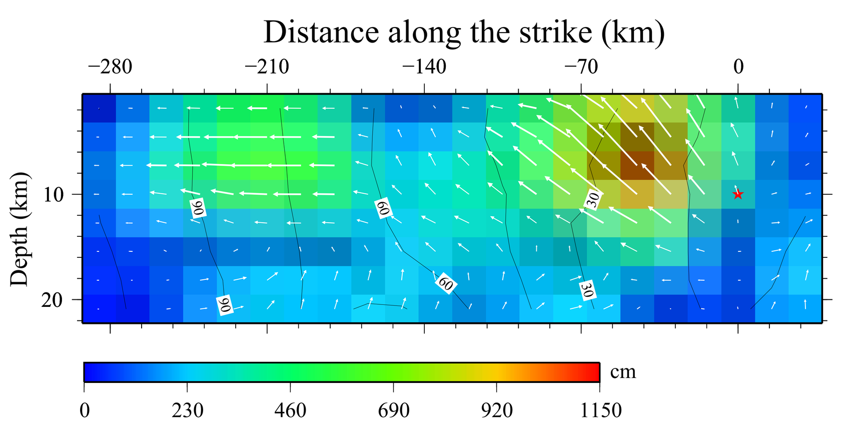


Figure 1.1. Cross-section of slip distribution. The hypocenter is denoted by the red star. The color shows the slip amplitude while the white arrows indicate the motion direction of the hanging wall relative to the footwall.

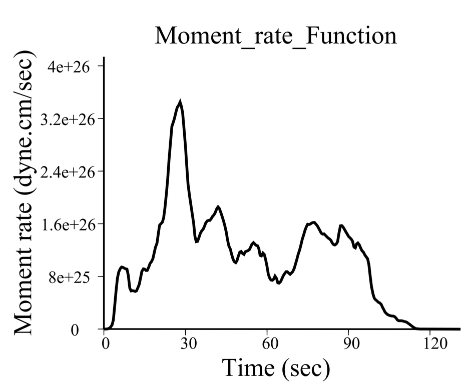


Figure 1.2 Moment rate function

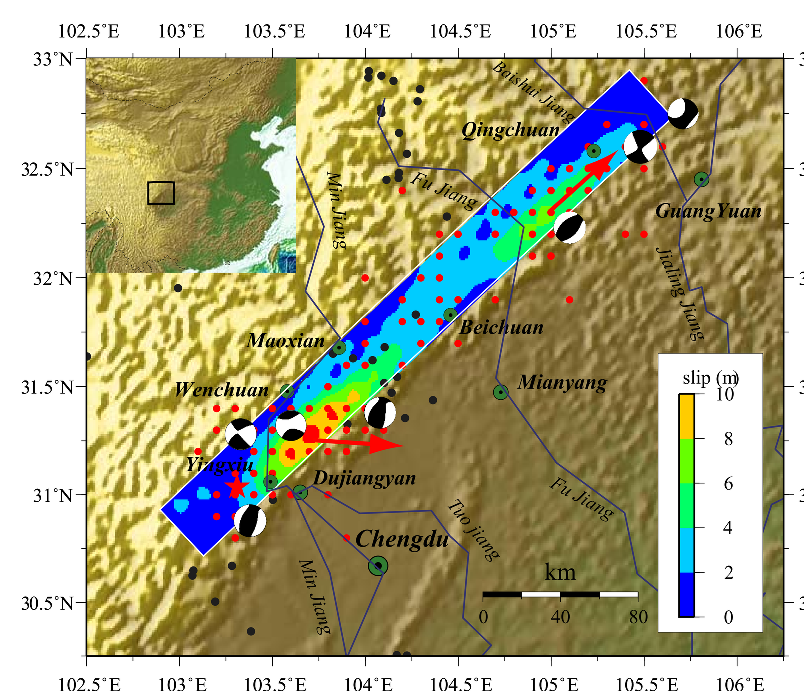
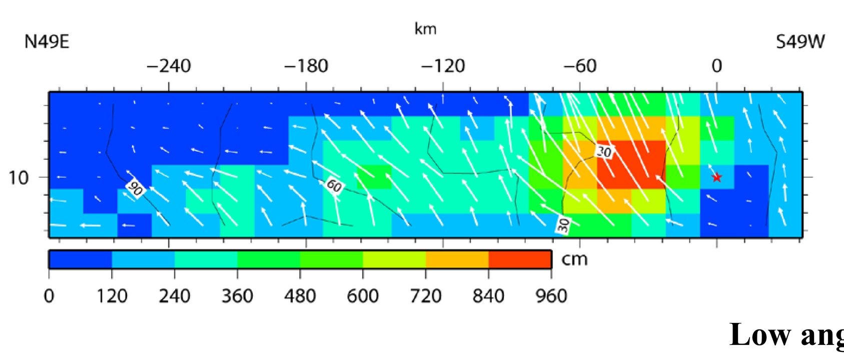


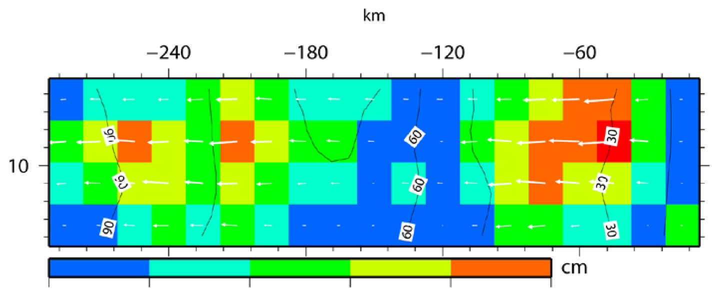
Figure 1.3. Surface projection of preferred single-fault model (Model I). The focal mechanisms of seven major aftershocks are reported by the Global CMT.

II. Whether the solution is unique?
Multi-fault Models

Model A: We first test whether the right-lateral strike-slip component of fault slip occurred on an high angle fault plane.



Low angle fault
Strike: 229 deg.
Dip: 33 deg.



High angle fault
Strike: 227 deg.
Dip: 70 deg.

Figure 2a.1. Cross-section of slip distribution of Model A. The red star indicates the hypocenter while the color and arrows shows the slip amplitude and direction, respectively.

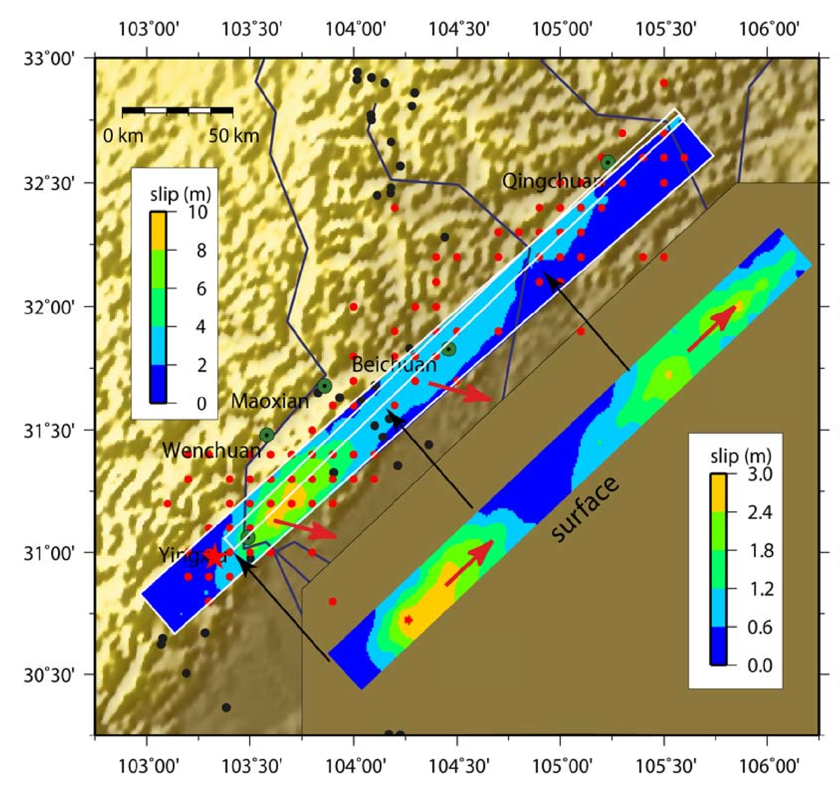


Figure 2a.2. The surface projection of Model A.

Model B: We then updated the preferred model by replacing the low angle fault plane with two high angle fault segments along the curved Beichuan fault.

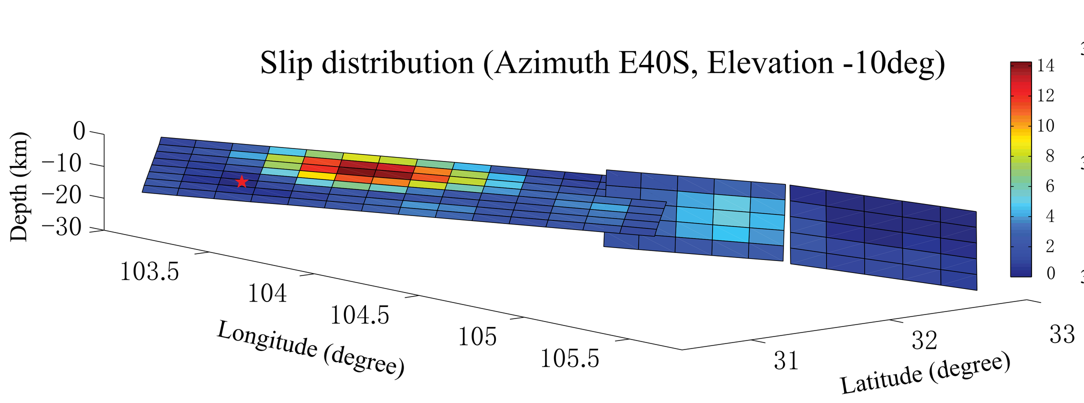


Figure 2b.1 3D view of the slip distribution of Model B. The red star indicates the hypocenter while the color shows the slip amplitude.

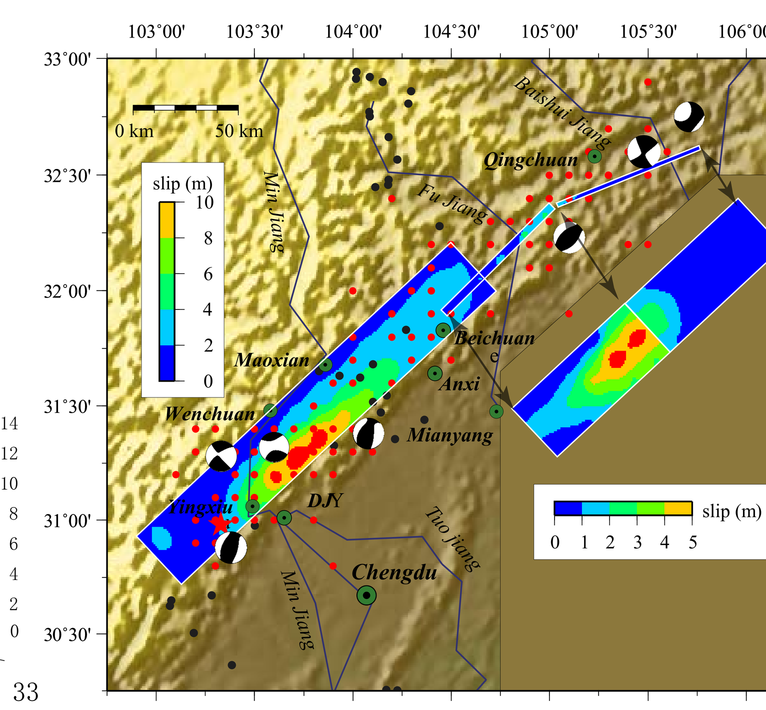
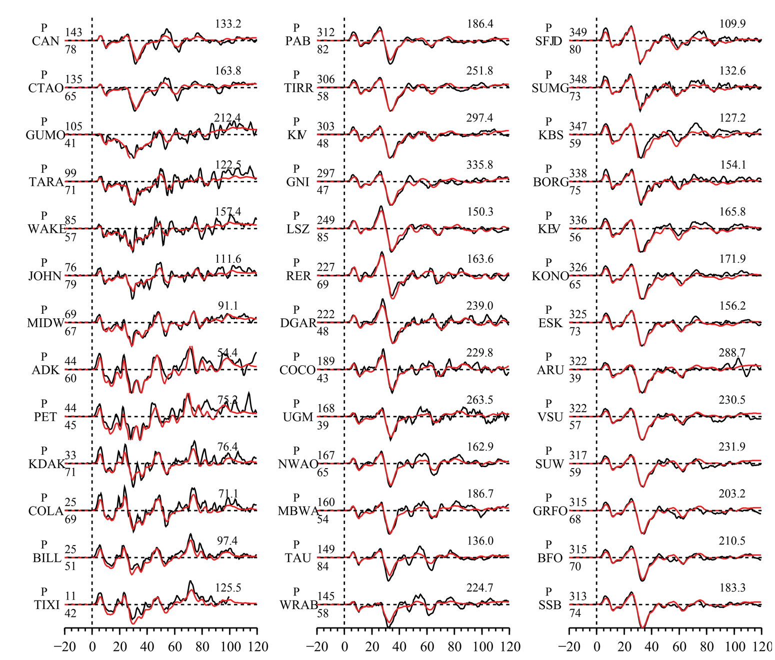


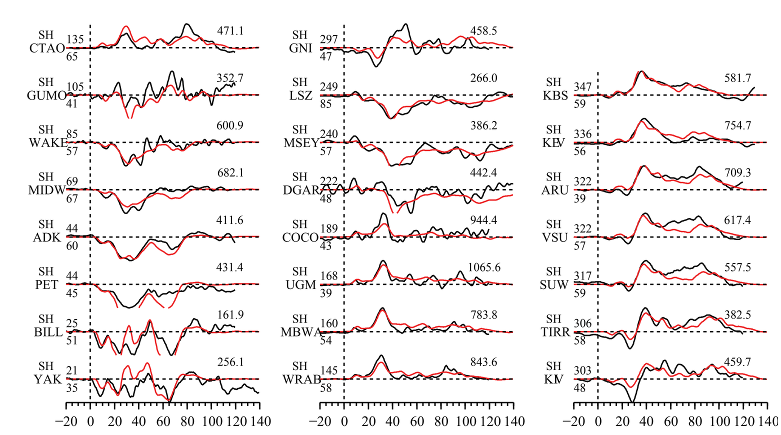
Figure 2b.2. The surface projection of Model B

Comparison of Data and synthetics

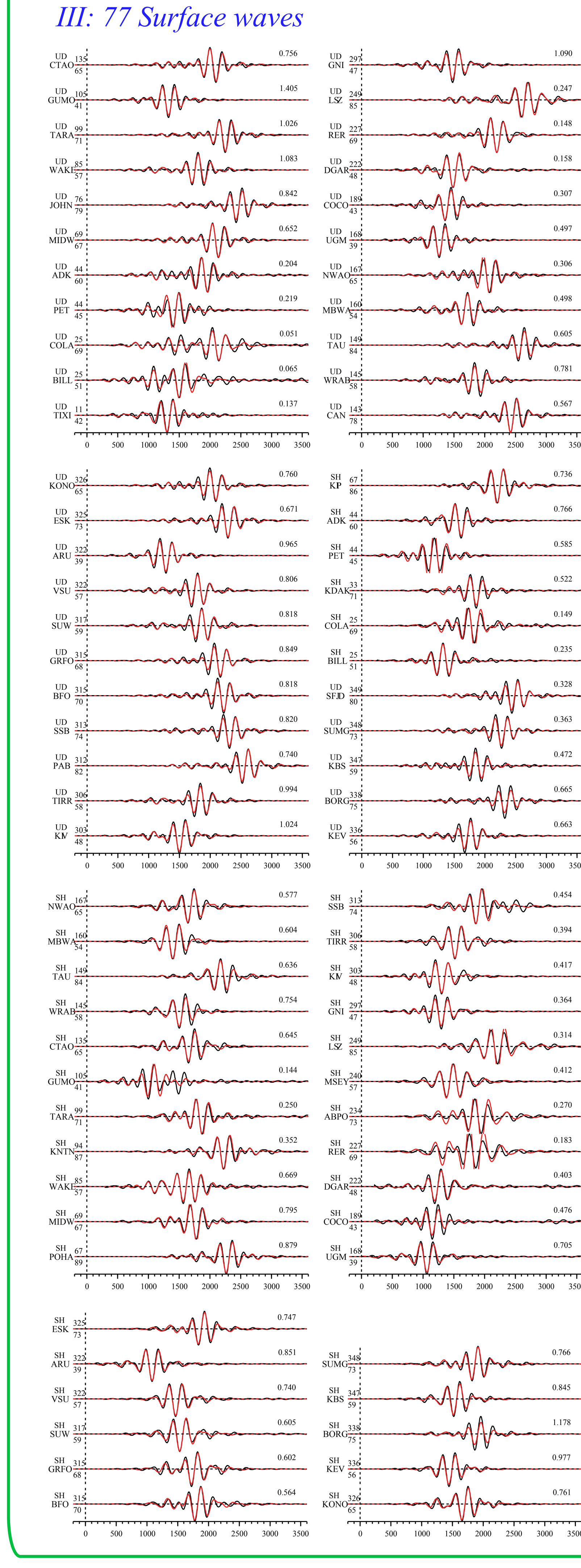
I: 39 P waves



II: 23 SH waves



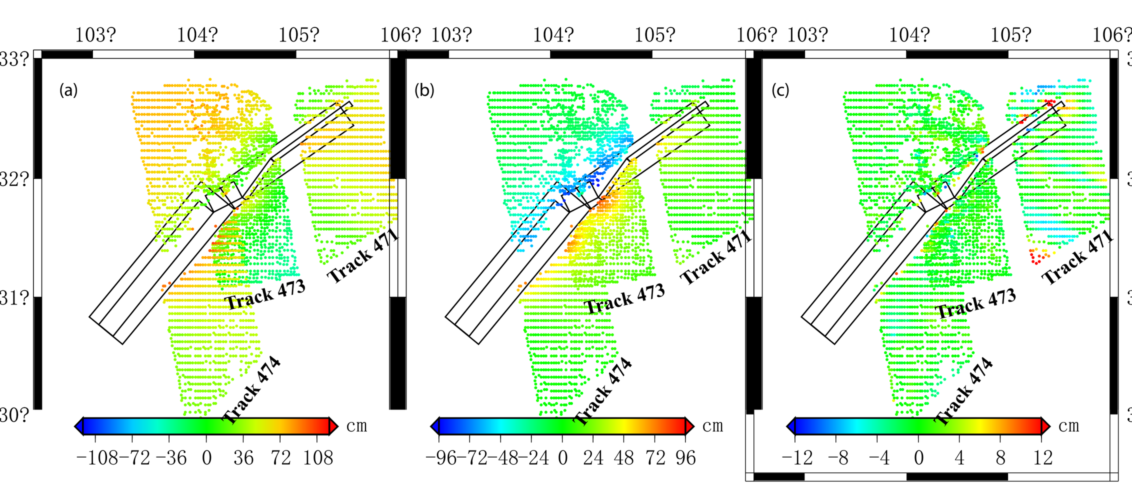
III: 77 Surface waves



Preliminary result of Combined Inversion: Seismic data + InSAR data

Here, we constrain the slip model by combined inverting the teleseismic data and 3 tracks of ALOS InSAR images. A complex six-segment fault geometry has been used to approximate the concurrent rupture along the low angle Pengguan Fault (figure 3.2a) and the high angle Yingxiu-Beichuan-Qingchuan Fault (figure 3.2b).

LOS displacement



Track 471: 29 Feb. 2008 - 31 May 2008
Track 473: 17 Feb. 2008 - 19 May 2008
Track 474: 5 March 2008 - 5 June 2008

Figure 3.1 (a) LOS unwrapped displacements at resampled points. The color indicates the displacement amplitude and the black lines denote the fault plane boudaries. (b) After removing the possible unwrapping errors, which are simultaneously constrained during the inversion. (c) Final residuals after further removing the synthetic contribution of this earthquake.

Slip model

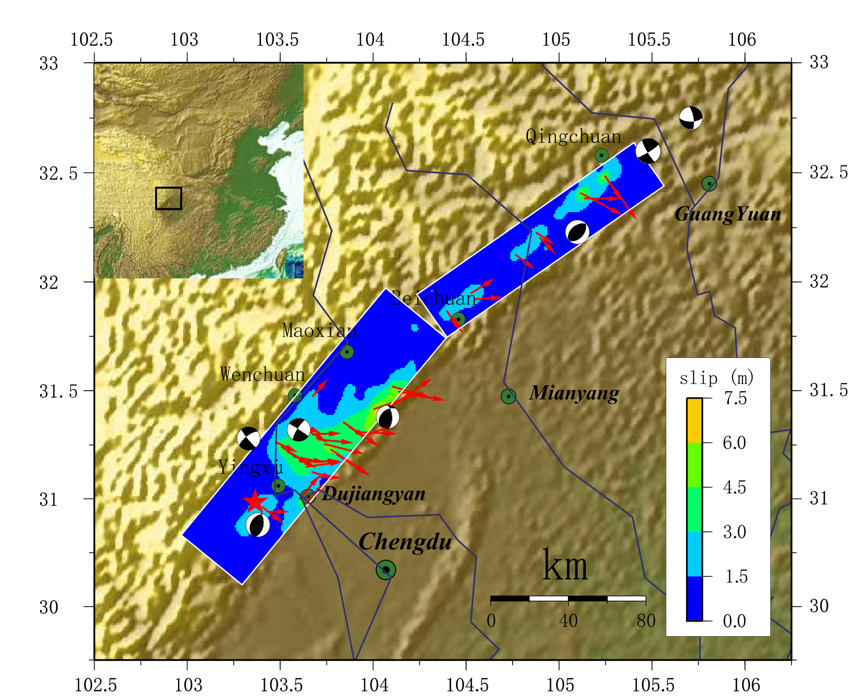


Figure 3.2a. The surface projection of the slip distribution on the Pengguan fault. The red arrows denote the slip direction of dominated asperities. The color shows the slip amplitude.

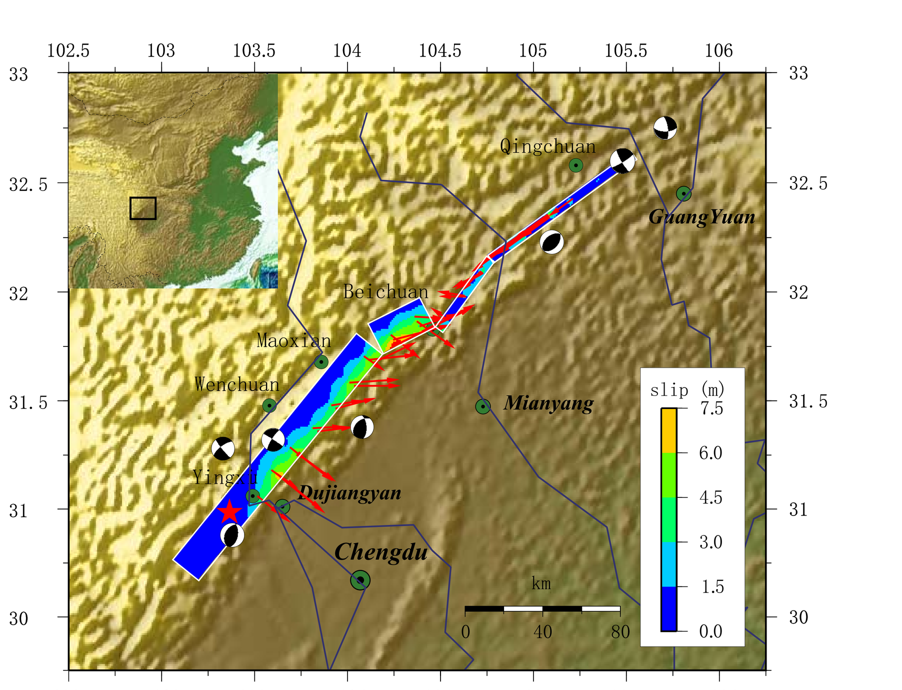


Figure 3.2b. The surface projection of the slip on the Yingxiu-Beichuan-Qingchuan fault.

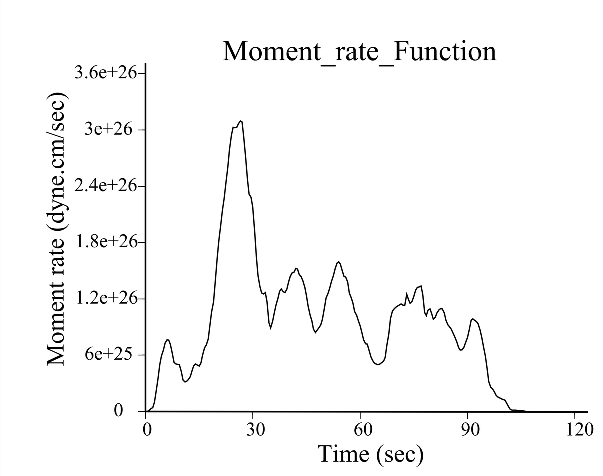


Figure 3.3 Moment rate function

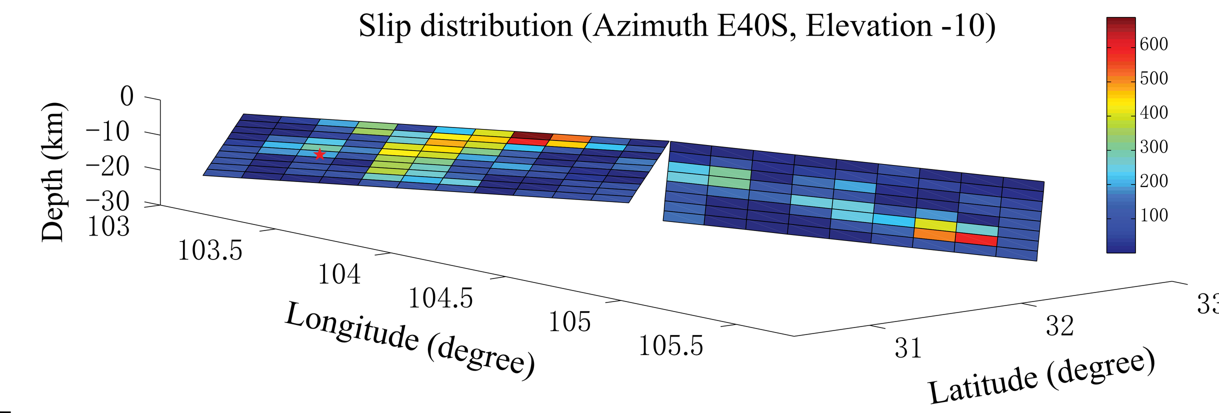


Figure 3.4a. 3D view of the slip distribution on the Pengguan fault. The red star indicates the hypocenter while the color shows the slip amplitude.

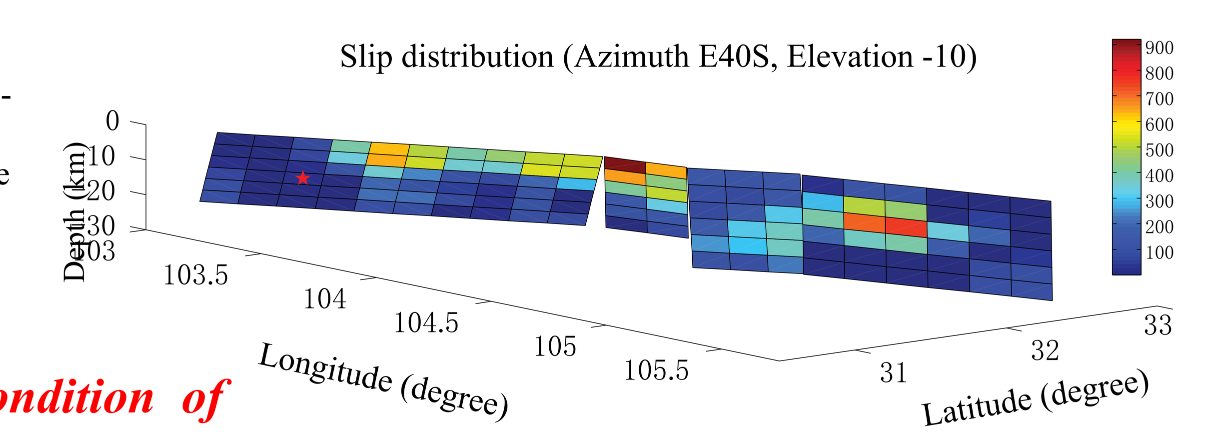


Figure 3.4b. 3D view of the slip distribution of the Beichuan fault. The red star indicates the hypocenter while the color shows the slip amplitude.

What is the dynamic condition of such a complex concurrent rupture?