The background, precursor and coseismic influence of the Wenchuan great earthquake revealed by geodetic data

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On 12 May 2008, the Ms8.0 Wenchuan earthquake (31.0° N, 103.4° E) hit the Longmenshan fracture in Sichuan province of China, its aftershocks have already reached the boundary where Gansu province, Shaanxi province and Sichuan province meet. Its generation background, medium- and short-term precursor and coseismic influence were revealed by geodetic data. Using the velocity field result of relative horizontal movement in Sichuan province and its neighborhoods (Yunnan province, the southeastern Gansu province and a part of Shaanxi province) in the period of 2004-2007 observed by GPS (after deducting the motion and rotation of the entire monitoring area from the velocity field relative to Eurasia), aided by the least square collocation (a kind of interpolation method) and the relationship between displacement and strain, we obtained the distribution of apparent strain field (displaying the difference movement between GPS stations), at the Longmenshan fracture, the rate of the maximum shear strain was lower but the rate of superficial expansion was higher (one of the three highest compressive regions, up to $-5 \times 10^{-8}$/a), according with the thrust background of Longmenshan fracture. The Ms6.4 earthquake on 3 June 2007, the Ms8.0 earthquake on 12 May 2008 and the Ms6.1 earthquake on 30 August 2008 occurred in above three highest compressive regions, revealing the generation background of strong earthquakes including the Wenchuan great earthquake. Moreover, from the observation curves of five cross-fault short-leveling sites at Longmenshan fracture, two sites was observed obvious jumping or trend turning deformation several months to two years before the Ms8.0 Wenchuan great earthquake, reflecting medium- and short-term precursor.

The velocity field result of relative horizontal movement after deducting the motion and rotation of the entire Sichuan province and
its neighborhood from August of 2007 to June of 2008 observed by GPS appeared remarkable thrust and weaker dextral coseismic deformation of the Wenchuan great earthquake; At the same time, it also displayed relatively distinct influence of the great earthquake on the eastern boundary between Gansu province and Sichuan province, the boundary where Gansu province, Shaanxi province and Sichuan province meet, together with the region where Xianshuihe fracture, Lonmenshan fracture and Anninghe fracture meet, mainly reflecting compression and possible promoting influence on the strain accumulation. In addition, two observation curves of cross-fault short-leveling sites at Longmenshan fracture was observed coseismic deformation of the Wenchuan great earthquake. Up to July of 2008, the cross-fault short-leveling sites revealing obvious influence of the great earthquake were merely located near the eastern boundary between Gansu province and Sichuan province (we haven’t any cross-fault short-leveling observation data in Shaanxi province).