Spatial distribution of the surface ruptures associated with the 2005 Pakistan earthquake, revealed by QuickBird imagery data

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The Pakistan Mw7.6 earthquake occurred on the 8 October, 2005 in the northern Pakistan. Some prompt reports after the earthquake and data available from the web sites provide the preliminary seismological and geological background and information for further studying the earthquake mechanism and seismotectonics. It is inferred that this earthquake was triggered by the pre-existing Muzaffarabad and Tanda faults striking northwest, which are thrusts with some right-lateral component (e.g. Nakata and Kumahara, 2005, 2006). Interferometric Synthetic Aperture Radar (InSAR) data analysis and field investigations show that the maximum uplift amount is about 5.5 m to 6 m and the maximum slip on the fault plane is calculated to be up to about 9 m (Fujiwara, et al., 2006; Awata et al., 2006). Spatial distribution and detail deformation features of the co-seismic surface ruptures, however, are still unclear due to lake of field investigation data. For solving this problem, the purpose of this study is to detect the spatial distribution of the co-seismic surface ruptures and to discuss the surface deformation mechanism in the Muzaffarabad region near the epicenter by using 60cm resolution QuickBird imagery 1m resolution IKONOS imagery data.

The analytical result shows that the co-seismic surface ruptures are mainly composed of a numerous of cracks which are discontinuously concentrated on the pre-existing active Muzaffarabad and Tanda faults and geological faults which are mostly the boundary between the Cenozoic and pre-Mesozoic sedimentary rocks. Spatially, the crack zones generally show a right-stepping en echelon pattern. In the northern Muzaffarabad City, the co-seismic surfaces are concentrated on a pre-existing fault scarp striking east-west, which forms a fault jog between the Muzaffarabad and Tanda faults. The length of individual cracks varies from meter-order to 1km, generally 10 m to 100 m. The co-seismic surface ruptures are mostly accompanied and buried by a lot of landslides. This made it very difficult to identify the trace of co-seismic surface rupture from the image data and field investigation. Several damaged bridges located in the footwall of the faults near the surface rupture zone indicate a northward ground motion. The geometric features and spatial distribution patterns of the co-seismic surface ruptures and the ground motion direction show that the co-seismic fault triggered the 2005 Pakistan Mw 7.6 earthquake is a thrust fault with a right-lateral slip component.