

Inherited structures impact on co-seismic surface deformation pattern during the 2013 Balochistan, Pakistan, earthquake

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The understanding of earthquake processes and the interaction of earthquake rupture with Earth's free surface relies on the resolution of the observations. Recent and detailed post-earthquake measurements bring new insights on shallow mechanical behavior of rupture processes as it becomes possible to measure and locate surficial deformation distribution. The 2013 Mw 7.7 Balochistan earthquake, Pakistan, offers a nice opportunity to comprehend where and why surficial deformation might differs from at-depth localized slip. This earthquake ruptured the Hoshab fault over 200 km; the motion was mainly left lateral with a small and discontinuous vertical component in the southern part of the rupture. Using images with the finest resolution currently available, we measured the surface displacement amplitude and its orientation at the ground surface (including the numerous tensile cracks). We combined these measurements with the 1:500 scale ground rupture map to focus on the behavior of the frontal rupture in the area where deformation distributes. Comparison with orientations of inherited tectonic structures, visible in older rocks formation surrounding the actual 2013 rupture, shows the control exercised by such structures on co-seismic rupture distribution. Such observation raises the question on how pre-existing tectonic structures in a medium, mapped in several seismically active places around the globe; can control the co-seismic distribution of the deformation during earthquakes.