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Recovery of fault activity process and definition of paleo-earthquake events on the eastern segment of Haiyuan Fault (the Santang Section)

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High precision and spatial resolution images provide a key to examine the kinematics of active faults. Traditional photogrammetry develops rapidly and gains applications in a variety of fields with the ongoing development of LiDAR and Unmanned Air Vehicle (UAV) technology. Due to its high efficiency, simplicity, and speediness, photogrammetric technology has been applied in geoscience in recent years, especially in active tectonics research by establishing 3D image-based model of topography and trenches.

We unitized UAV technology to measure typical offset features in the eastern segment of the Haiyuan fault (the Santang section). Micro-landform with high spatial resolution was obtained by reconstructing the three-dimensional offset topography, which beyond the capability of traditional remote sensing. Our result reveals that the displaced landform is likely a result of an accumulation of at least four earthquakes, rather than generated during the 1920 Haiyuan earthquake as previously thought. We also obtained the displacement characteristic and fault movement pattern of the four paleoearthquake events and the three-dimensional fault kinematics model.

Three-dimensional trenches with high precision were built up based on photogrammetric technology. Three fault wedges are observed. Synthesize of previous research and reconstruction of paleoearthquake events, reveal that at least three paleoearthquakes with the similar magnitude as the Haiyuan earthquake occurred in the eastern segments of the Haiyuan fault before 6.0±0.5 ka, between 5.1±0.9 ka and 3.5±0.4 ka, and between 1.0±0.1 ka and 0.3±0.1 ka, respectively. The trench studies show consistent results with the offset geomorphic observations.