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Unraveling the Quaternary deformation history of the North Pamir collision zone: New paleoseismological data from the Pamir Frontal Thrust (39.5°N, 72.5°E), Kyrgyzstan, Central Asia.

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As a result of the ongoing Indian-Eurasian collision the Pamir mountain range accommodates nearly one-third of the 44 mm/yr total convergence. With high deformation rates over relatively short distances compared to other intracontinental orogenic settings, this seismically active area is capable of producing large-magnitude earthquakes of up to M7 or higher. In the intraplate settings of collision zones it is thought that deformation is likely distributed in space and time, withtout an orogenic front, low earthquake recurrence intervals, and often along complex patterns of reactivated pre-existing crustal anisotropies. GPS surveys, however, show that a large part of the shortening in the greater Pamir-Tien Shan collision zone is accommodated along the northward-propagating Pamir Frontal Thrust system (PFT), the northernmost and arc-shaped rim of the Pamir orogen, where it is separated from the Tien Shan by the Alai intermontane basin to the north. Despite an extensive data base of recent shallow and intermediate-depth earthquakes based on temporary seismic networks along the PFT, the relation between seismicity and surface rupture, as well as the geometry of the thrust zone are not well understood. Present seismicity might not reflect the long-term deformation history.
Here we present a paleoseismological study with new data from two trenches that cross the youngest manifestations of thrusting along the central seismotectonic segment of the PFT (39°28’42"N, 72°30’30"E). This fairly straight sector of the mountain front comprises several uplifted fluvial terraces in the hanging wall, and hosts fault scarps with colluvial wedges suggesting multiple seismic events in the recent past. The evaluation of the trench stratigraphy was combined with high-resolution structure-from-motion analysis of offset stratigraphic horizons and UAV-based DEM analysis and dGPS profiling of displaced landforms. In addition we collected radiocarbon and luminescence samples of event horizons to develop an earthquake chronology. Taken together our trench data reveal at least 4 seismic events that offset this alluvial-fan strata of the Pamir mountain front, thus providing new insights into the late Quaternary earthquake history, which will ultimately help refine the recurrence times along the central segment of the PFT.