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How to reconcile OSL and TCN data: the potential of high-resolution sampling on the Choushui Tableland (West Central Taiwan)

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The determination of fault slip rate is often inferred from dating of Quaternary, deformed geomorphological surfaces affected by fault activity. For this reason, cosmogenic and luminescence methods now are widely applied to date the emplacement of geomorphic markers, but each method relates to different geomorphic processes. While the Terrestrial Cosmogenic Nuclides (TCN) method generally dates the exposure duration of the rock surface to cosmic rays, the Optically Stimulated Luminescence (OSL) method provides burial duration of the sediment after deposition. Age differences between these two methods may relate to the erosion-transport-deposition and aggradation processes experienced by the sediment prior its final deposition but combined may provide new insights into the processes affecting alluvial landforms.

Our case study is located in the Western Foothills, south of the Choushui River (Central Taiwan). There, slip on the Changhua blind thrust fault has caused the eastward tilt of a wide flight of fluvial terraces but slip rates on frontal faults are still debated due to large epistemic uncertainties in dating alluvial surfaces with OSL and TCN methods. To achieve a finer chronology of the deposits, a high-resolution sampling strategy has been deployed leading to a direct and unique comparison between OSL and TCN dating methods. Taking advantage of a natural exposure, we collected 10 samples for ^{10}Be dating completed by 5 OSL samples along a 7 m depth profile. The depth distribution of ^{10}Be concentrations show a complex depositional history with at least two depositional sequences, modelled to be older than ~38.7 ka.

As previous work has shown the difficulties of OSL dating in Taiwan, particular attention has been paid to luminescence characteristics of quartz and potential dosimetry issues. Our OSL analysis are in good agreement with ^{10}Be and previous ^{14}C dating and also reveal three depositional units, dated between ~9 ka and ~66 ka, that are evidenced by different OSL signal characteristics and variations in dosimetry.

This study shows that it is informative to have an exhaustive, detailed, and direct comparison between dating methods on a single depth profile to discuss the geomorphic processes and allow a more detailed understanding of the long-term rates of the Changhua Fault.