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Reconstructing the magnitude and timing of late Pleistocene and Holocene strike-slip events within the Marlborough Fault Zone, New Zealand

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In most instances, information about the timing of pre-historic earthquake events comes from palaeoseismic trenches located within sediments that were deposited gradually and are close to the fault. Earthquake events are recognised by disturbed stratigraphy, and the timing provided by radiocarbon dating of organic materials that constrain the youngest disturbances for each event. In contrast, fault slip rates are typically derived from the dating of geomorphic features that are offset by one or more slip events. In this latter case, it is often hard to locate suitable organic material for dating these features which often comprise fluvial terraces or channels, and a variety of alternative chronological approaches has been taken including the use of terrestrial cosmogenic nuclides (TCNs; 10Be, 36Cl), U-series dating of carbonate overgrowths on pebbles, and/or luminescence dating of sediments.

Using luminescence dating based on single grains of K-feldspar and a post-IR IRSL (Infra-Red Stimulated Luminescence) measurement protocol, we have been able to control the age of several offset terrace units from a number of major strike slip faults of the Marlborough Fault Zone, New Zealand. In the past, arguments concerning the selection of which geomorphic terrace feature to date have been presented, and typically a single age estimate, or small number of dates were used to constrain the derived slip rate. In the Marlborough region, we have sampled several locations characterised by multiple fluvial terraces dating from the late Glacial period (c. 16,000 years ago) through the Holocene. By using a high sampling density involving multiple age estimates within each terrace, dating each one of the terraces, and applying a Bayesian statistical approach to constrain the age of deposition and incision events, we are able to approach a situation where we can derive slip-per-event data and event timing from the same dataset. This can overcome problems of relating observed slip events from geomorphic offsets to sedimentary evidence for earthquake shaking and deformation.