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TITLE: Tracing the Geomorphic Signature of Lateral Faulting

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ABSTRACT BODY: Active strike-slip faults are among the most dangerous geologic features on Earth. Unfortunately, it is challenging to estimate their slip rates, seismic hazard, and evolution over a range of timescales. An under-exploited tool in strike-slip fault characterization is quantitative analysis of the geomorphic response to lateral fault motion to extract tectonic information directly from the landscape. Past geomorphic work of this kind has focused almost exclusively on vertical motion, despite the ubiquity of horizontal motion in crustal deformation and mountain building. We seek to address this problem by investigating the landscape response to strike-slip faulting in two ways: 1) examining the geomorphology of the Marlborough Fault System (MFS), a suite of parallel strike-slip faults within the actively deforming South Island of New Zealand, and 2) conducting controlled experiments in strike-slip landscape evolution using the CHILD landscape evolution model. The MFS offers an excellent natural experiment site because fault initiation ages and cumulative displacements decrease from north to south, whereas slip rates increase over four fold across a region underlain by a single bedrock unit (Torlesse Greywacke). Comparison of planform and longitudinal profiles of rivers draining the MFS reveals strong disequilibrium within tributaries that drain to active fault strands, and suggests that river capture related to fault activity may be a regular process in strike-slip fault zones. Simple model experiments support this view. Model calculations that include horizontal motion as well as vertical uplift demonstrate river lengthening and shortening due to stream capture in response to shutter ridges sliding in front of stream outlets. These results suggest that systematic variability in fluvial knickpoint location, drainage area, and incision rates along different faults or fault segments may be expected in catchments upstream of strike-slip faults and could act as useful indicators of fault activity.

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