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Sediment sizes produced by landslides in a threshold landscape

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The size of sediment that is produced on hillslopes and delivered to rivers exerts fundamental controls on fluvial morphodynamics and bedrock incision. A variety of hillslope processes supply sediment to rivers with different size distributions and different rates of delivery, making the full distribution difficult to measure and inhibiting our understanding of what controls the sediment size delivered to rivers. However, rapid hillslope erosion in threshold landscapes is dominated by landslides, reducing the relative importance of other erosion processes. Outside of threshold landscapes, the sediment that is supplied by landslides stands out for its role in supplying coarse sediment to river beds. Despite its importance, we have very little data to assess what controls the sediment sizes that are produced by landslides. To address this, we measured sediment sizes in 30 landslide deposits in the Southern Alps of New Zealand, a threshold landscape. We characterized the full grain size distribution produced by each landslide using pebble counts to measure the gravel-to-boulder size fraction, sieving to measure the fine fraction, and drone imagery to measure meter-scale boulders and larger clasts. These landslides occurred in a variety of lithologies (low- to high-grade schists, gabbros, and granodiorites) and in landscapes with a wide range of average erosion rates (10^{-1} to 10^{1} mm/yr). The size of individual landslides also varied from approximately 1,000 m^3 to 200,000 m^3. Preliminary results suggest that lithology and average erosion rate have surprisingly little influence on the grain sizes produced by landslides in the Southern Alps, but we find that larger landslides tend to produce coarser sediment in all settings. Consequently, landslide size may play a bigger role than previously thought in controlling river geometries and bedrock incision. In threshold landscapes, where landslides dominate sediment production, our results could potentially be combined with measured distributions of landslide size to estimate the full grain size distribution that is delivered to the river network.