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Landslides triggered by the 1946 Ancash earthquake, Peru

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The 1946 M7.3 Ancash Earthquake triggered a large number of landslides in an epicentral area that straddled the Continental Divide of South America in the Andes of Peru. A small number of landslides were described in reconnaissance reports by E. Silgado and Arnold Heim published shortly after the earthquake, but further details of the landslides triggered by the earthquake have not been reported since. Utilising field traverses, aerial photograph interpretation and GIS, our study mapped 45 landslides inferred to have been triggered by the event. 83% were rock avalanches involving Cretaceous limestones interbedded with shales. The five largest rock/debris avalanches occurred at Rio Llama (est. vol. 37 M m3), Suytucocha (est. vol., 13.5 Mm3), Quiches (est. vol. 10.5 Mm3), Pelagatos (est. vol. 8 Mm3), and Shundoy (est. vol. 8 Mm3). The Suytucocha, Quiches, and Pelagatos landslides were reported by Silgado and Heim. Rock slope failure was most common on slopes with a southwest aspect, an orientation corresponding to the regional dip direction of major planar structures in the Andean foreland belt (bedding planes and thrust faults). In valleys oriented transverse to the NW-SE structural grain of the epicentral area, south-westerly dipping bedding planes combined with orthogonal joint sets to form numerous wedge failures. Many initial rock slope failures were transformed into rock/debris avalanches by the entrainment of colluvium in their path. At Acobamba, a rock avalanche that transformed into a debris avalanche (est. vol. 4.3 Mm3) overwhelmed a village resulting in the deaths of 217 people. The cumulative volume-frequency plot shows a strong power law relation below a marked rollover, similar in form to that derived for landslides triggered by the 1994 Northridge Earthquake. The total volume of the 45 landslides is approximately 93 Mm3. The data point for the Ancash Earthquake plots near the regression line calculated by Keefer (1994), and modified by Malamud et al. (2004), for Moment Magnitude of earthquake v. total volume moved by landslides during the earthquake.