CONTEMPORARY AND PALEO-ROCKFALLS AS PROXIES FOR STRONG GROUND MOTIONS

QUIGLEY, Mark, School of Earth Sciences, University of Melbourne, Melbourne, 3010, Australia, BORELLA, Josh, Geological Sciences, University of Canterbury, Christchurch, 8140, New Zealand, MACKEY, Ben, Otago Regional Council, Otago Regional Council, Dunedin, 8000, New Zealand, SOHBATI, Reza, Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, University of Aarhus, Risoe DTU, Roskilde, DK-4000, Denmark, BRADLEY, Brendon A., Department of Civil and Natural Resources Engineering, University of Canterbury, Private Bag 4800, Christchurch, 8140, New Zealand, MURRAY, Andrew, Nordic Laboratory for Luminescence Dating, Risø DTU, Roskilde, 4000, Denmark and VICK, Louise, University of Canterbury, Christchurch, 8140, New Zealand, mark.quigley@canterbury.ac.nz

ABSTRACT

A major hazard accompanying earthquake shaking in areas of steep topography is the detachment of rocks from bedrock outcrops that subsequently slide, roll, or bounce downslope (i.e. rockfalls). The 2010-2011 Canterbury earthquake sequence caused recurrent and severe rockfall in parts of southern Christchurch. Coseismic rockfall caused five fatalities and significant infrastructural damage during the 2011 Mw 6.2 Christchurch earthquake. Here we examine a rockfall site in southern Christchurch in detail using geomorphic mapping, lidar analysis, geochronology (cosmogenic ^{3}He dating, radiocarbon dating, optically stimulated luminescence (OSL) from quartz, infrared stimulated luminescence from K-feldspar), numerical modeling of rockfall boulder trajectories, and ground motion prediction equations (GMPEs). Rocks fell from the source cliff only in earthquakes with interpolated peak ground velocities exceeding ~10 cm/s; hundreds of smaller earthquakes did not produce rockfall. On the basis of empirical observations, GMPEs and age chronologies we attribute paleo-rockfalls to strong shaking in prehistoric earthquakes. We conclude that earthquake shaking of comparable intensity to the strongest contemporary earthquakes in Christchurch last occurred at this site approximately 5000 to 7000 years ago, and that in some settings, rockfall deposits provide useful proxies for past strong ground motions.