GEOLOGIC EXPRESSIONS OF CONTEMPORARY AND PALEO-LIQUEFACTION: INSIGHTS INTO STRONG GROUND MOTION AND SITE CHARACTERISTICS

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ABSTRACT

Recurrent liquefaction in Christchurch during the 2010-2011 Canterbury earthquake sequence created a wealth of shallow subsurface intrusions with geometries and orientations governed by (1) strong ground motion severity and duration, and (2) intrinsic site characteristics including liquefaction susceptibility, lateral spreading severity, geomorphic setting, host sediment heterogeneity, and anthropogenic soil modifications. We present a suite of case studies that demonstrate how each of these characteristics influenced the geologic expressions of contemporary liquefaction in the shallow subsurface. We compare contemporary features with paleo-features to show how geologic investigations of recurrent liquefaction can provide novel insights into the shaking characteristics of modern and paleo-earthquakes, the influence of geomorphology on liquefaction vulnerability, and the possible controls of anthropogenic activity on the geologic record. We conclude that (a) sites of paleo-liquefaction in the last 1000-2000 years corresponded with most severe liquefaction during the Canterbury earthquake sequence, (b) less vulnerable sites that only liquefied in the strongest and most proximal contemporary earthquakes are unlikely to have liquefied in the last 1000-2000 years or more, (c) proximal strong earthquakes with large vertical accelerations favoured sill formation at some locations, (d) contemporary liquefaction was more severe than paleoliquefaction at all study sites, and (e) stratigraphic records of successive dike formation were more complete at sites with severe lateral spreading, (f) anthropogenic fill suppressed surface liquefaction features and altered subsurface liquefaction architecture.