

Paleoseismic Investigation of the Northridge Hills fault, Northridge, California

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Progress Report

Paleoseismic investigation of the Northridge Hills fault in the northern San Fernando Valley, California, helps assess the timing and style of near-surface late Quaternary deformation in the epicentral area of the 1994 Northridge earthquake. The Northridge Hills fault, a 15-km-long, north-dipping reverse fault, exhibits geomorphic evidence of late Quaternary surface deformation, including topographic scarps across late Quaternary fluvial terraces and aligned alluvial-fan apices on the footwall block (Figure 1; Barnhart and Slosson, 1973; Saul, 1979; Dibblee, 1992; Hitchcock and Kelson, 1996). During FY1997 and FY1998, we excavated one 40-m-long trench and six test pits, and drilled nine boreholes across a 2-m-high scarp developed in probable Holocene terrace deposits adjacent to Aliso Canyon Wash (Figure 2). A continuous clayey gravel identified in the trench, test pits and boreholes defines a south-facing monocline with 6 ± 1 m of vertical separation across the Northridge Hills fault (Figure 3). The borehole data also suggest that an unconformity developed on the Plio-Pleistocene Saugus Formation is warped into a monocline that has 13 ± 2 m of vertical separation across the fault. These preliminary data yield a dip-slip rate of 1.0 ± 0.7 mm/yr for the Northridge Hills fault. The absence of distinct scarp-derived colluvium in trench exposures at the base of the scarp and secondary brittle fracturing or faulting suggests that the monocline is related to folding during small, incremental uplifts rather than large uplifts that generate distinct scarp relief. We postulate that such uplift could be produced via moderate-magnitude earthquakes $M_w 6^{1/4}$ on the Northridge Hills fault, or to secondary deformation induced by earthquakes on other faults. Evidence of surface uplift near the trench site during or following the 1994 earthquake suggests that all or part of the observed deformation (Johnson et al., 1996a; Johnson et al., 1996b) is a result of secondary slip on the Northridge Hills fault produced by movement on the underlying Northridge blind reverse fault or other nearby large structures. Based on our geologic investigations, the distribution of aftershocks following the 1994 earthquake (Hauksson et al., 1995; Unruh et al., 1997), and pre-and post-1994 leveling and geodetic surveys (Shen et al., 1996; Johnson et al., 1996a; Johnson et al., 1996b; Cruikshank et al., 1996; Donnellan and Lysenga, 1998; Donnellan et al., 1998), we interpret that the Northridge Hills fault underwent triggered slip during 1994. We present the findings of this investigation in our final report dated February 23, 1999, and titled "Late Quaternary fold deformation along the Northridge

Hills fault, Northridge, California: Deformation coincident with past Northridge blind thrust earthquakes and other nearby structures??"

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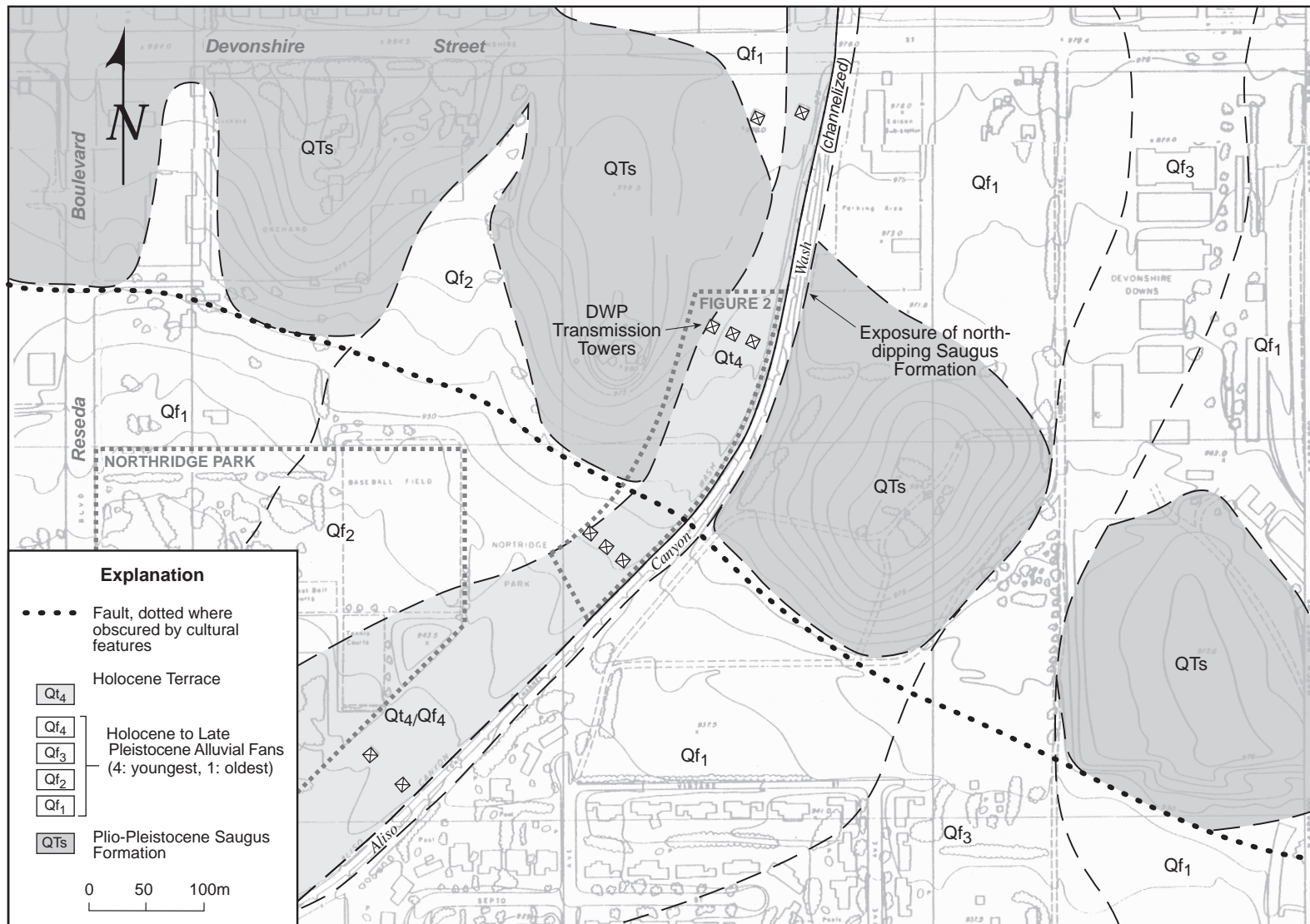


Figure 1. Map of surficial deposits and the Northridge Hills fault near Northridge Park, California. Topographic base from City of Los Angeles, dated 1970. With the exception of the 70 meter wide undeveloped corridor directly west of the Aliso Canyon channel, all areas shown on this map are culturally modified. Geologic units modified from Hitchcock and Wills (in review).

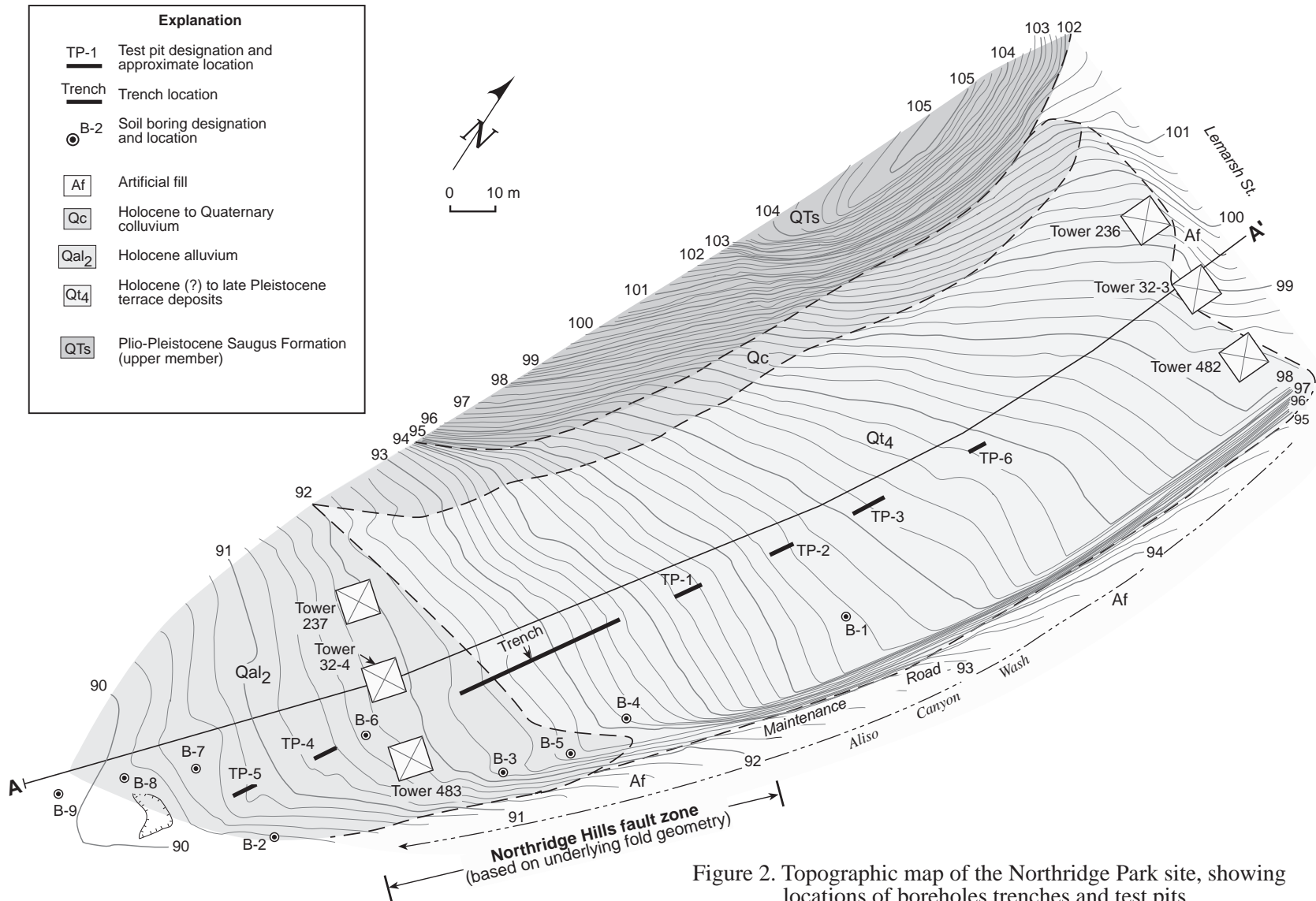


Figure 2. Topographic map of the Northridge Park site, showing locations of boreholes trenches and test pits.

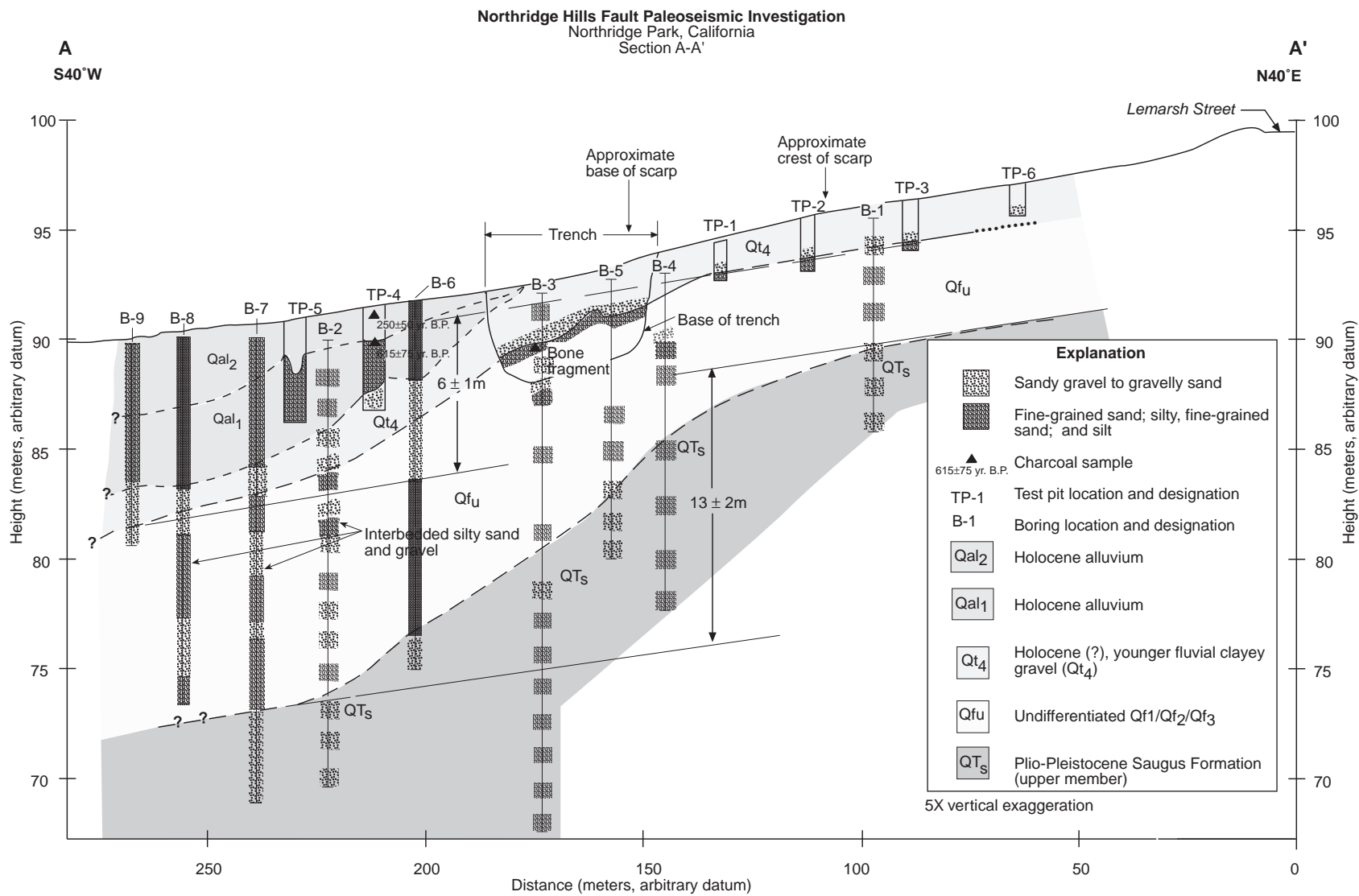


Figure 3. Cross-section showing warping of young Holocene fluvial deposits (Qfu) and upper member of the Plio-Pleistocene Saugus Formation at Northridge Park. See Figure 2 for cross-section location.