Merging Paleoseismic Data For a Joint, Long-Term Earthquake Chronology southern Hayward Fault

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Investigations undertaken.

The primary work undertaken during this project period was major field study and data compilation involving excavation of two major trenches and three minor trenches across the southern Hayward fault at Tule Pond (Tyson Lagoon) in Fremont California during Fall 2002. Additional work included in this project is the compilation of our earlier work at Tule Pond for use in publications with our USGS co-workers. This work preceded additional trenching conducted under subsequent funding that is now being interpreted. We believe that the results outlined below will provide a foundation for Hayward fault studies for years to come. Improvements to this work will come from refined age-dating, better understanding of the complex geologic structure across the Tule Pond field site, and elimination of uncertainty in cross-pond stratigraphic correlations.

Results

Joint field work conducted in Fall 2002, recovered evidence for 7 earthquakes from a new excavation across the western trace of the Hayward fault, and confirmed evidence for 4 events in Williams 1992 eastern-trace trench (W1, Figures 1, 2). Trench exposures were documented by complete photo mosaics of high-resolution color photographs. The geological relationships interpreted in the trenches were logged directly onto the photographic mosaic.

Previous work (Lienkaemper et al., 2002) documented the four youngest earthquakes between 1868 and about 500 years BP. Williams (1993) documented six earthquakes including the 1868 event, with five events spanning the period between about 500 and 1800 years BP. These studies have been found to complement one another to generate a 10-event southern Hayward fault earthquake chronology. This number of

events far surpasses earthquake evidence compiled for any other fault in northern California.

Surprisingly, direct correlation of stratigraphy across the pond was not easy, even with trenches open simultaneously across the eastern and western fault traces, and 3 deep pits opened between the trenches. Correlation of shallow stratigraphy was made between the sites, but deeper beds were not correlated with confidence. To this point the independent and combined chronological evidence indicates that we are close to recovering a complete long-term paleoseismology for this extremely important fault segment. To summarize: collaborative work between USGS and ourselves has yielded a joint interpretation of 10 separate earthquakes for the southern Hayward fault.

Non-technical summary

The Hayward fault is believed to present the greatest risk to life and property of any fault in the San Francisco Bay region (Working Group on California Earthquake Probabilities, USGS 1999, 2003). Our collaborative work with the USGS has yielded a joint interpretation of 9 prehistoric earthquakes for the southern Hayward fault. The combined evidence indicates this is probably a complete record of earthquakes for a 2000-year-period. The record will: 1) improve confidence in earthquake forecasting; 2) will permit us to evaluate variability of the past behavior for this fault; and 3) will extend knowledge of related faults in the San Francisco Bay region.

Reports Published:

Lienkaemper, J.L., T.E. Dawson, P.L. Williams, S.F Personius, G.G. Seitz, S.J. Heller, D.P. Schwartz, A 2000-Year Record of Large Earthquakes on the Southern Hayward Fault, EOS Trans. AGU (abstract), pp., ____, 2003.

Reports In Preparation:

Lienkaemper, J.L., T.E. Dawson, P.L. Williams, S.F Personius, G.G. Seitz, and D.P. Schwartz, Logs and data from trenches across the Hayward fault at Tyson's Lagoon (Tule Pond), Fremont, California, 2001-2003, USGS Open-File Report 03-XXX.

Williams, P.L, J.L. Lienkaemper, P.Holland, Early paleoearthquake data from Tule Pond, southern Hayward fault, California, manuscript in preparation.

Figures

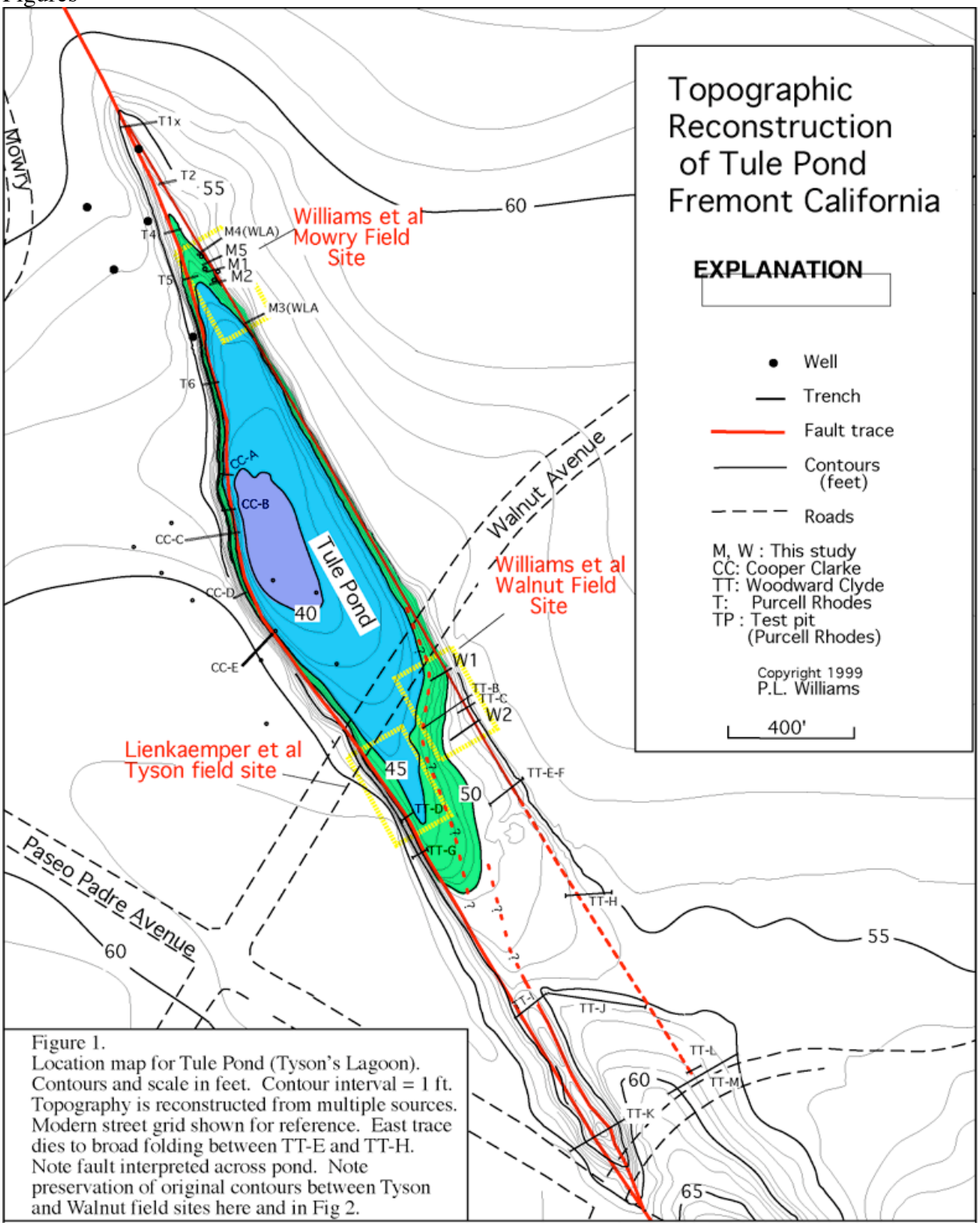

Figure 1.
Location map for Tule Pond (Tyson's Lagoon). Contours and scale in feet. Contour interval = 1 ft. Topography is reconstructed from multiple sources. Modern street grid shown for reference. East trace dies to broad folding between TT-E and TT-H. Note fault interpreted across pond. Note preservation of original contours between Tyson and Walnut field sites here and in Fig 2.

Figure 2. Detailed site map of southern Tule Pond. Trenches excavated in 2002 denoted 02A-E. Trench 03A was only excavated along the short eastern leg. Basin-crossing fault is interpreted from trench and landform data compiled in Figure 1, and shown here with widely spaced dash pattern. Contours within the "wet" part of the basin correspond to those developed from the various historical sources used to compile Figure 1. Figure 2 contouring based on Fall 2003 field work. Modified from Figure compiled by J. Lienkaemper.