

**Evaluation of Paleearthquakes along the Northern San Andreas Fault,
Fort Ross State Historic Park, California**

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Element II: Research on Earthquake Occurrence and Effects

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Investigations Undertaken

The purpose of this project is to investigate the late Holocene paleoseismic history of the San Andreas fault in the vicinity of Fort Ross, California. The timing and recurrence of earthquakes along the San Andreas fault and fault segmentation are among the most critical issues to be resolved before reliable probabilistic analyses of seismic hazards in northern California can be completed. Our one-year trenching program is designed to assess the timing and recurrence of late Holocene earthquakes along the northern San Andreas fault. Ultimately this information will help evaluate possible segmentation scenarios for the northern San Andreas fault based on the timing of past events. This study directly addresses Element II (Research on Earthquake Occurrence and Effects - "determine paleoearthquake chronologies and refine slip-rate and recurrence estimates and evaluate segmentation models for major faults of the San Andreas system in the following priority: Hayward, San Andreas, ...") of the FY 2000 announcement.

During recent reconnaissance and past research in the Fort Ross area, we identified two sites near Fort Ross where late Holocene alluvial-fan sediments are deposited across the main trace of the San Andreas fault. These two locations, our "Fort Ross Creek" and "Orchard" sites, are approximately 600 m and 1000 m, respectively, northwest of our previously studied Archae Camp site. Each of these two sites likely preserves a record of late Holocene surface-rupturing earthquakes, in the form of upward fault terminations in alluvium, fissure fills, and scarp-derived colluvial stratigraphy. In addition, each site may provide an opportunity to better constrain the late Holocene slip rate, based on offset of alluvial-fan distributary channels and/or facies boundaries.

We have initiated a one-year program of limited paleoseismic trenching at the "Orchard" site to identify and preliminarily date evidence of past earthquakes, and assess if a late Holocene slip rate can be determined at the site. Our efforts thus far have included additional field reconnaissance of the site, limited field mapping, and obtaining necessary permits and approvals from the State Parks and Recreation. We hope to conduct detailed topographic surveying and exploratory trenching in late November, 2000.

Results

Based on our field reconnaissance, the Orchard site has excellent geomorphic relations that constrain the location of the main trace of the fault. In addition, the site contains late Holocene deposits overlying the fault trace and minimal cultural disturbance. The site is located about 1.1 km northwest of our previous study site at Archae Camp (Noller et al., 1993; Simpson et al., 1996), along a prominent, northwest-trending linear ridge directly south of Fort Ross Road (Figure 1). The site is named after an abandoned early 1800's-era orchard that encompasses the linear ridge and adjacent linear depression along the main fault strand. The site is attractive for paleoseismologic research for several reasons. First, the linear ridge and accompanying linear depression clearly mark the location of the main strand of the San Andreas fault (Figure 2). Matthes (in Lawson and others, 1908) noted that Fort Ross Road, which is directly northwest of the Orchard site, was offset approximately 7.5 ft (2.3 m) in 1906, and that a second dirt road 150 m south of the site was offset about 12 ft (3.6 m) (see Figure 1).

Second, the Orchard site contains an excellent depositional basin and a good source of alluvial sediments. The linear ridge traversing the site acts as a buttress for alluvial-fan sediment derived from a small drainage northeast of the site (Figure 2). Northeast of the fault, the drainage channel is incised into bedrock approximately 10 to 20 m, and it extends as much as 100 m higher in elevation above the site. Sediment from this channel has been deposited in a small alluvial fan along the main fault strand and within the linear depression. The bedded alluvial-fan silt, sand, and pebble deposits have nearly filled the linear depression along the fault trace at the mouth of this valley, partially burying the uphill-facing fault scarp. Because there is no evidence that the depression has been eroded, the alluvium filling the linear depression likely represents a fairly complete sedimentologic record across the San Andreas fault. To the northwest of the mouth of the valley, distal alluvial-fan sediments (e.g., silt and clay) appear also to have contributed to deposition within the depression. Thus, it is our opinion that the Orchard site contains a long-lived depositional history, and probably contains a good record of surface-rupture events along the fault. Although we do not know, at this time, how far the record may go back in time, we estimate that it may be as much as a thousand years or so.

We intend to excavate one trench across the alluvial-fan deposits trapped northeast of the linear ridge at the Orchard site. We anticipate that this trench will expose bedded alluvial sediment across the fault zone, and that this sediment will contain datable charcoal or other datable materials. Given the presence of the linear depression, we interpret that the fault zone may be as much as 5 to 10 m wide northeast of the linear ridge, and thus may contain numerous strands. We believe that the record of past ruptures at this site will be decipherable on the basis of upward fault terminations within the alluvial sediment, and perhaps on the basis of colluvium shed into the depression from the linear ridge.

Non-technical Summary

Understanding the timing of large paleoearthquakes on the San Andreas fault is critical for assessing seismic hazards in the populated San Francisco Bay area. In this study, we will excavate an exploratory trench across the northern San Andreas fault near Fort Ross, California, in order to obtain information on the timing and recurrence of past earthquakes along the fault. We anticipate developing a detailed topographic map of the site, and using radiometric analyses to date geologic strata that have been affected by past large earthquakes.

Reports Published (related to current effort)

Noller, J.S., Kelson, K.I., Lettis, W.R., Wickens, K.A., Simpson, G.D., Lightfoot, K., Wake, T., 1993, Preliminary characterizations of Holocene activity on the San Andreas fault based on offset archaeological sites, Ft. Ross State Historic Park, California: NEHRP Final Technical Report

Simpson, G.D., Noller, J.S., Kelson, K.I., and Lettis, W.R., 1996, Logs of trenches across the San Andreas fault, Archae camp, Fort Ross State Historic Park, Northern California: U.S. Geological Survey NEHRP Final Technical Report

Data Availability

Copies of the trench logs, radiometric analyses, and mapping data will be available from the author, at the address listed above.

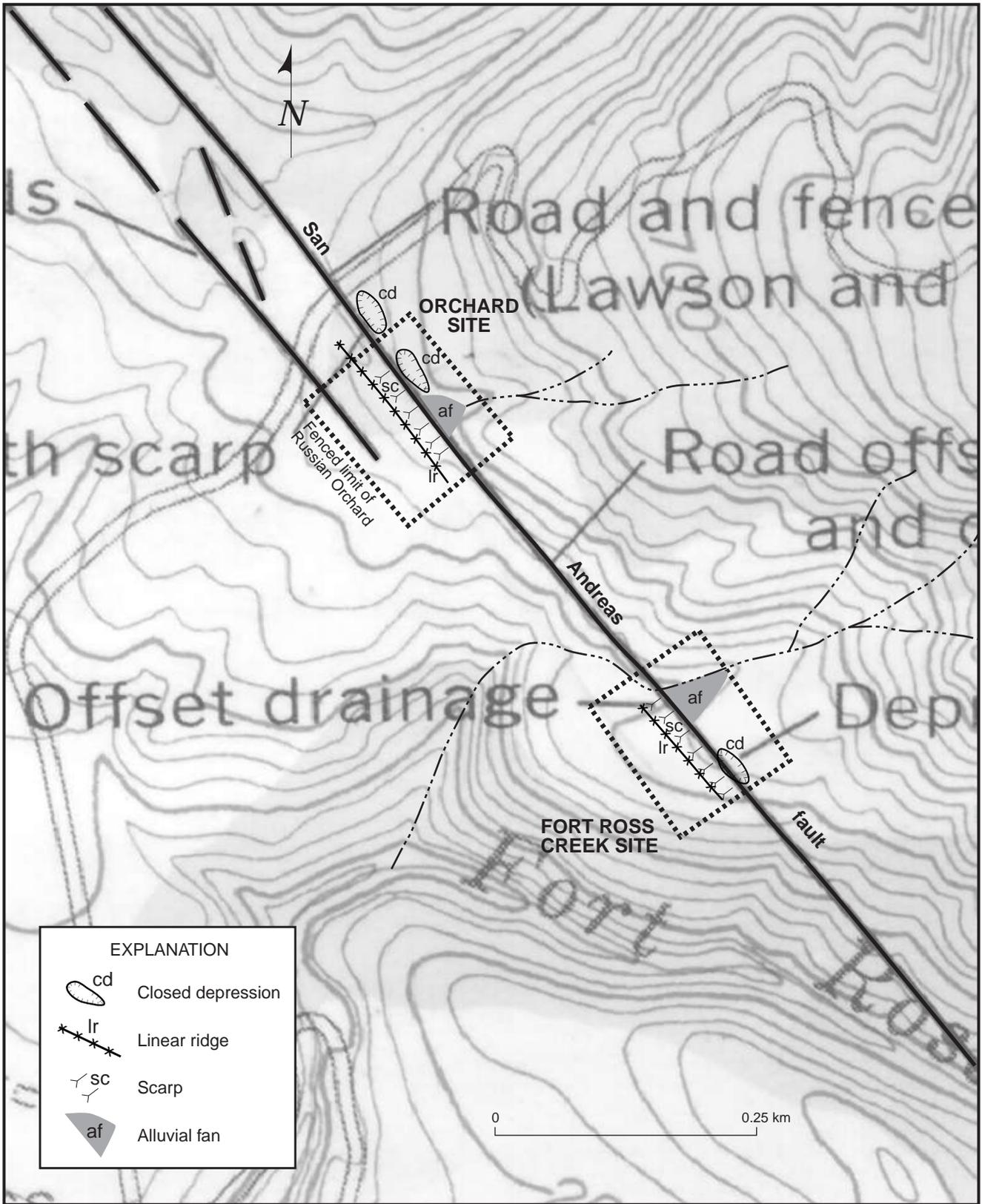


Figure 2. Enlarged fault map of Brown and Wolfe (1972), showing main strands of the San Andreas fault and reconnaissance geomorphic features at the Orchard and Fort Ross Creek sites.