Slip Rate of the Northern Hayward Fault at Point Pinole, California

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Investigations Undertaken

The initial phase of the project involved the development of a model taking into account all the data accumulated during drilling, trenching, and soil stratigraphic work completed at the site. A drilling and trenching plan was prepared for approval by the permitting agencies.

Results

The model developed for slip along the northern tip of the Hayward fault yields a tentative and unexpectedly low slip rate (3.5+0.5 mm/yr) since the Sangamon highstand at 122 ka. The model is based on evidence that landward transgression of San Francisco Bay planated over 1.9 km of the fault at Point Pinole. Subsequent offset along the fault produced a distinctive, partially buried embayment associated with the highstand. The embayment contains shallow-dipping regressive sediments over the eroded, flat-lying transgressive sediments of the Yerba Buena Formation, otherwise known in the area as "older bay mud." Northwesterly movement along the fault beheaded the embayment, producing characteristic landforms: a buried NE-facing linear scarp on the SE and a SW-facing linear scarp on the NW; right and left limbs currently above sea level; and matching low points that are currently below sea level. The geologic slip rate on the fault is 8 ± 1 mm/yr to the south, implying that the northern tip of the fault is involved in a stepover with the subparallel Rodgers Creek-Pinole fault 6 km to the northeast.

Offsets of the terrane produced by the high stand range from 228 to 566 m since 116 ka and 118 ka, yielding slip rates between 2.0 and 4.8 mm/yr. Best estimates are derived from the match between the northern +6-m scarp and the southern +4.5-m scarp (352 m since 116 ka), the length of the apparent alluvial train from Parchester Creek (476 m since 122 ka), and matching elevations restricted by the presence of the hillslope north of Parchester Creek (442 m since 118 ka). These yield slip rates of 3.0, 3.9, 3.7 mm/yr, with a preferred value of 3.5+0.5 mm/yr. The piercing point for the low point of the NE embayment should have an offset of 389 m since 111 ka. Plans are to drill a series of cores 1.2 km from the end of the fault to detect the low point of the offset embayment on the SW side of the fault.

The current model predicts that a strandline representing the Sangamon highstand should be found at an elevation of 8.8 m (6.1 m of eustatic sea level rise plus 2.7 m of uplift) on the NE

side of the fault. A thorough reexamination of the exposures along the Southern Pacific Railroad tracks resulted in the discovery of the inner edge of a gently SW-dipping wavecut platform at an elevation of 8.8 m. Like the wavecut platform previously studied at Pinole Point, this one also is overlain by distinctive marine sands, Quaternary alluvium, and associated paleosols.

Non-Technical Project Summary

This project will produce the first confirmed slip rate for the northern end of the Hayward fault at Point Pinole. Previous work established that wave action 122,000 years ago smoothed the surface of the fault when sea level was 20 feet higher. In the reconnaissance phase, we discovered that this buried surface has an embayment offset by the fault. We will use boring and trenching to determine the precise location of the other half of the embayment. If found where hypothesized, the offset embayment will yield a slip rate that is about the same as the creep rate (0.2 in/yr), indicating that catastrophic ground rupture is not expected at Point Pinole.

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