Award number: 99-HQ-GR-0084

Title: **THEODOLITE MEASUREMENTS OF CREEP RATES ON SAN FRANCISCO BAY REGION FAULTS**

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TECHNICAL ABSTRACT

The northern San Andreas fault was not creeping at the surface before the Loma Prieta earthquake (LPEQ) and it is still not creeping. The northwestern end of the central part of the fault near San Juan Bautista was creeping at about 6.7 mm/yr right-laterally for about 20 years before the LPEQ but has been creeping at about 4 mm/yr faster since the quake.

Most of the Hayward fault creeps at about 4.5-5 mm/yr. This rate decreased for a few years along most of the fault following the LPEQ, but most sites have now returned to their pre-LPEQ rates. The present rate is about a mm/yr slower along a l0-15 km-long segment in Oakland. The greatest rate change occurred along the fault segment in Fremont that had been creeping for decades at about 8-9 mm/yr before the LPEQ. This portion of the fault stopped creeping for about 6 years following the LPEQ, moved about 2 cm in February 1996, but has still not returned to its pre-LPEQ rate.

The southern Calaveras fault in the Hollister area moves episodically, sometimes in response to seismic activity, but sometimes without any seismic trigger. Both Hollister sites showed more than a cm of triggered right slip due to the LPEQ, followed for several years by slower than usual creep. Site 4 has resumed its pre-LPEQ rate of 6.5 mm/yr but Site 6 is now creeping at about 9-10 mm/yr, about 2 mm/yr slower than its pre-LPEQ rate. About 25 km further north on the southern Calaveras at Coyote Ranch, the fault has been creeping at about 14 mm/yr for the past 4 years and has an overall rate of about 17 mm/yr for the past 32.7 years. The northern Calaveras fault was not creeping from 1980-92, but in late 1992 it began creeping at about 3.5-4 mm/yr.

The Concord fault in Concord moves episodically, with no apparent seismic trigger for times of faster movement. The overall rate is about 3-3.5 mm/yr, slightly slower than the 4-4.5 mm/yr rate on

the Green Valley segment of this fault system, about 25 km to the north.

The Maacama fault creeps at about 6.5 mm/yr in Willits and about 4.5 mm/yr just east of Ukiah.

The Seal Cove-San Gregorio fault, the Rodgers Creek fault, the West Napa fault, and the Antioch "fault" all appear to be non-creeping faults at the surface.

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NON-TECHNICAL ABSTRACT

We continued our theodolite measurements at 28 sites that cross faults in the seismically active San Francisco Bay region. Using data since we began measurements in 1979, we have been able to determine

the rates of present fault movements at the surface and have monitored changes in some of these rates that have occurred relative to certain seismic events. The central San Andreas, Hayward, Calaveras, Concord, Green Valley, and Maacama faults are all creeping at rates between about one-eighth and one-half inches per year. The Seal Cove-San Gregorio, Rodgers Creek, West Napa, Antioch, and northern San Andreas faults are all either not creeping or creeping at less than one-twentieth of an inch per year.