Continuous Broadband Monitoring of Strain Changes near active faults in Southern California

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This grant helps support the operation of Piñon Flat Observatory (PFO), providing a part of the funding needed to run the 160-acre facility and to maintain the reference-standard instruments there. (Other operational support is provided by SCEC, matching funds from SIO, and AFTAC.) The work done at PFO includes establishing the most reliable record of crustal deformation possible, something attained by operating the best instruments available and by a systematic intercomparison of results from many types of sensors. The result is data that give an accurate record of strain and tilt changes in the area near the observatory, between the active San Jacinto fault and southern San Andreas fault systems, and from this, a better understanding of the mechanics of faulting. PFO provides high-precision strain data, used both for studies of the seismic cycle in Southern California and for comparison with other types of measurements of crustal deformation, notably data from the growing SCIGN GPS array.

The pattern of strain accumulation continues to be similar to that seen in the past; the M 7.1 Hector Mine earthquake (1999:289:09) did not produce a large postseismic signal. **Figure 1** shows the record from the NW-SE laser strainmeter over a recent period. (The coseismic offset has been removed). It is clear that postseismic strains from Landers and from Hector Mine are not similar: following the Landers earthquake we saw a large and long-continued deformation (0.04 microstrain after a day, 0.09 microstrain after 10 days, 0.17 microstrain after 6 months); but for Hector Mine the total response seems to have decayed very rapidly, and amounted to only 0.02 microstrain at most). This certainly suggests that the immediate Landers-postseismic signal was neither a local response to the shaking (similar in both events) nor an effect from bulk response closer to the earthquake, but rather a difference in behavior of the two fault zones. The longer-term comparison will develop over time.

The award provides funding solely for operation of the observatory including support for power distribution, data recording, preliminary data-processing, and data distribution: all fairly basic activities, but all needed if the observatory is to operate. Part of the support is to cover the expense of an undergraduate student to continue to create well-edited versions of the data, under the supervision of the PI. (It remains the case that considerable skilled post-processing of the data replacement equipment).

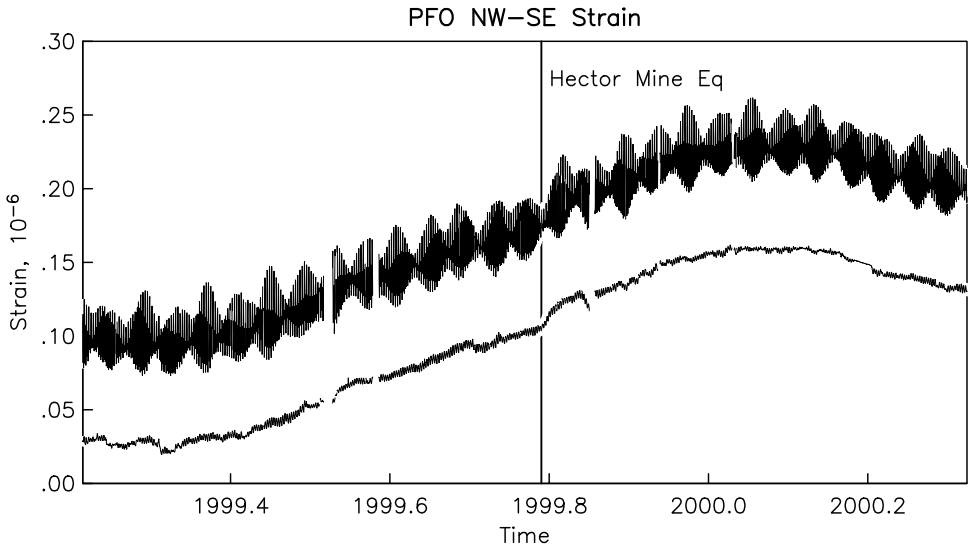

Figure 1

Figure 2 shows another kind of response measurement of the crust in southern California, namely its response to the forcing from the earth tides. It was long ago pointed out (Beaumont and Berger 1974) that any temporal changes in elastic modulus would be reflected in temporal fluctuations in the amplitude and phase of the earth tides measured in the area, with the largest signal being seen in the strain tides. **Figure 2** shows this amplitude and phase for the M_2 tide (the constituent with the largest signal-to-noise) again for the NW-SE strain record. It is clear that despite the occurrence of a large earthquake in the area of the strainmeter (Landers, at 1992.5) the tidal strains have shown no significant change.

Operation of the observatory was largely uneventful during the last year; we did not face any major difficulties with the facility which is unusual. Since our electricity is provided by a local agricultural cooperative (*Anza Cooperative Electric*) which has long-term contracts for its energy supply, we have been unaffected by the California power crisis (fortunately, so far). A substantial improvement in the utilities hookup was needed for an extensive Infrasound Observatory installed at PFO by DTRA, and was paid for by them. With strainmeters under development at two other sites (Los Angeles and Yucca Mountain) the EW laser strainmeter was used as a test-bed for new-design optics during much of this period. This instrument, the EW laser strainmeter at Piñon, is scheduled for complete rennovation in 2001/2002. The installation will be completely rebuilt with the hopes of achieving a data quality equal to that provided by the NW-SE strainmeter.

Non-Technical Summary

This grant supports the measurement of ground deformation between the San Jacinto and San Andreas faults using long-base laser strainmeters and long-base tiltmeters. This enables us to see small changes in the motion of the ground over very long times (days and years), which may correlate with earthquakes. So far, the measurements have not shown any unusual motions except for those induced by the Landers and Hector Mine earthquakes in 1992 and 1999.

Reports and Data Availability

We have not published any reports on the PFO measurements in the period covered by this report. Our digital data (5-minute sampling, and 1 Hz for transients of interest) is available by contacting the PI's through the address above.

Reference

Beaumont, C, and J. Berger (1974). Earthquake prediction: modification of the earth tide tilts and strains by dilatancy *Geophys. J. Roy. Astron. Soc.*, **39**, 111-121.

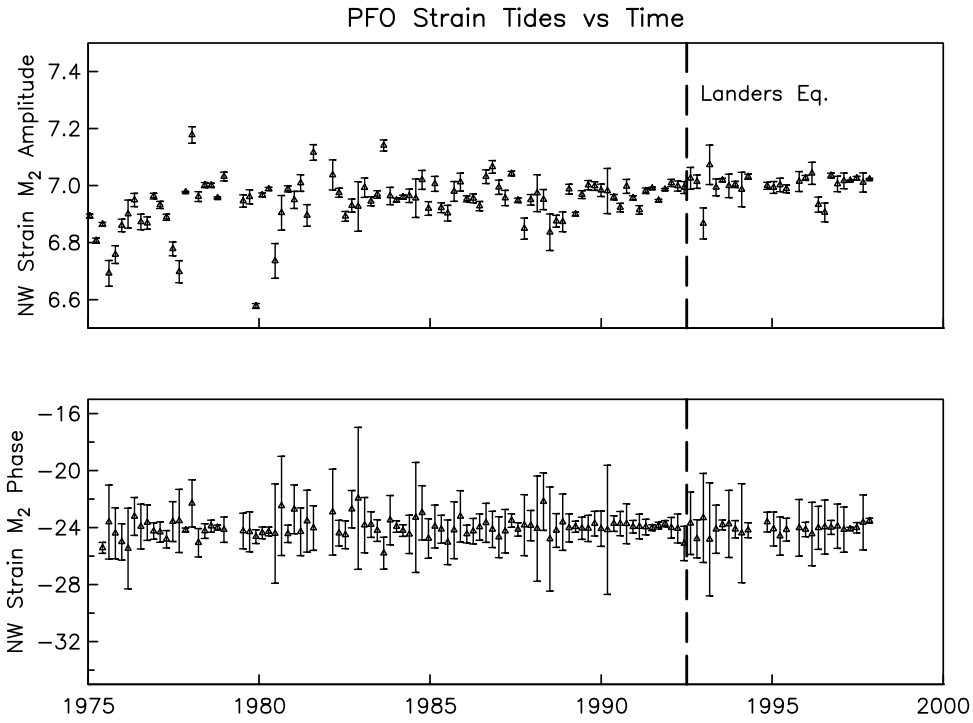

Figure 2