

New insights on Southern Coyote Creek Fault and Superstition Hills Fault



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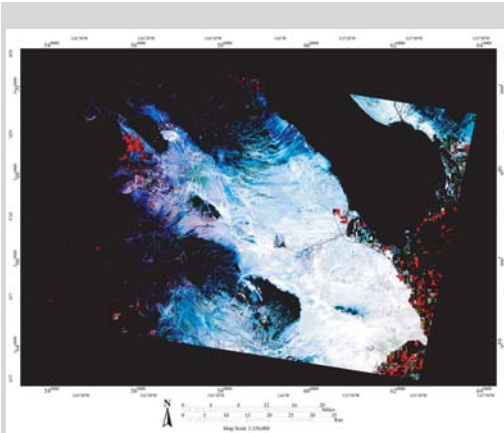


OBJECTIVE

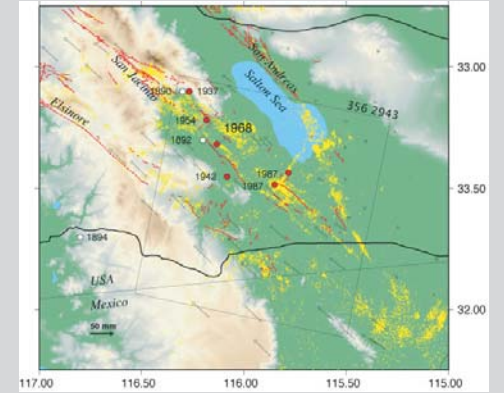
Recent field work has confirmed an extension of the southern Coyote Creek branch of the San Jacinto fault in the Western Salton Trough. The fault marks the western edge of an area of subsidence caused by groundwater extraction, and field measurements suggest that recent strike-slip motion has occurred on this fault as well. We attempt to determine whether this fault connects at depth with the Superstition Hills fault to the southeast by modeling observed surface deformation between the two faults measured by InSAR.

METHODS

- gather observed data
 - InSAR - stacked ERS (descending) InSAR data from 1992 to 2000
 - creepmeter data
 - field measurements
- model fault
- calculate error



A false-colored, multispectral ASTER image of the area (vegetation appears green). As water supplies for Borrego Springs and Allegretti Farms are almost entirely from groundwater, areas of high vegetation and density are a useful guide to groundwater use.



A shaded elevation map of the region covered by satellite radar marked with a box. Known fault traces are red with seismicity (from 1985-2000) in yellow (Magistrale, 2001). Red circles denote the epicenters of large earthquakes with magnitude greater than 6, and white circles are less reliable historical locations. Arrows mark GPS derived crustal velocity vectors with respect to North America (SCEC Crustal Velocity map, downloaded 2003.)

OBSERVED DATA

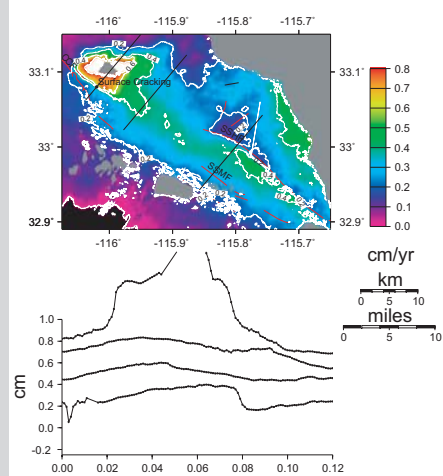
(TOP LEFT) Stacked ERS (descending) InSAR data from 1992 to 2000 was used to look at surface deformation patterns in the Western Salton Trough. Faults including the Superstition Hills fault (SHF), Coyote Creek fault (CCF), and Superstition Mountain fault (SMF) are drawn in red. Interferometric contours are drawn in white at a 0.2 cm/year contour interval. (TOP RIGHT) Surface cracking was discovered west of Fish Creek Wash. 3 cm of horizontal offset and 2 cm of vertical offset were observed. The surface crack extended a total of 0.5 km with a trend of N30W. The observed surface crack is located along the parameter of an area of known area of groundwater subsidence as observed by InSAR (Mellors and Boisvert, 2003). (BOTTOM) Creep meter data is observed from 1983 to 1993 with modeled creep projected to 2000 (Bilham et al., 2004).

FIELD MEASUREMENTS



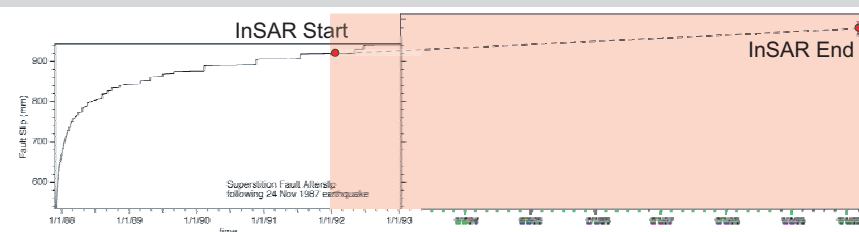
InSAR

Stacked Phase: 1992-2000



modeled using the Okada Solution after Wang et al., (2003). We generate two models: a Superstition Hills/Elmore Ranch Model that extends to the area of deformation. The top of the fault is varied from 0.001 km to 0.6 km. In the second model the parameters are the same except the top of the fault is varied from 0.001 km to 0.8 km.

CREEPMETER DATA

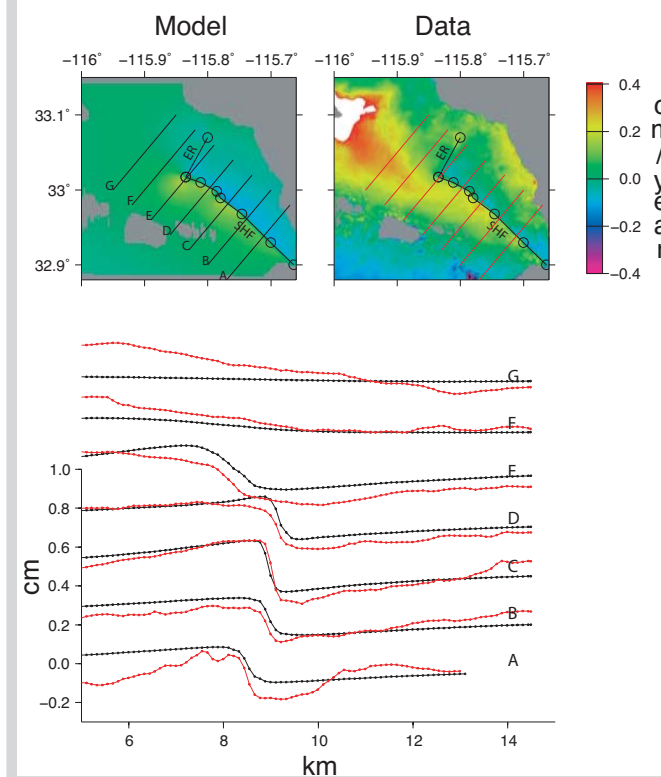


Creepmeter measurements on the south end of the Superstition Hills fault following the 1987 Superstition Hills Elmore Ranch Earthquakes with InSAR velocity of creep modeled results projected from 1992 to 2000 at 7.7 ± 2.2 mm/year (pink). (figure modified from Bilham et al., 2004)

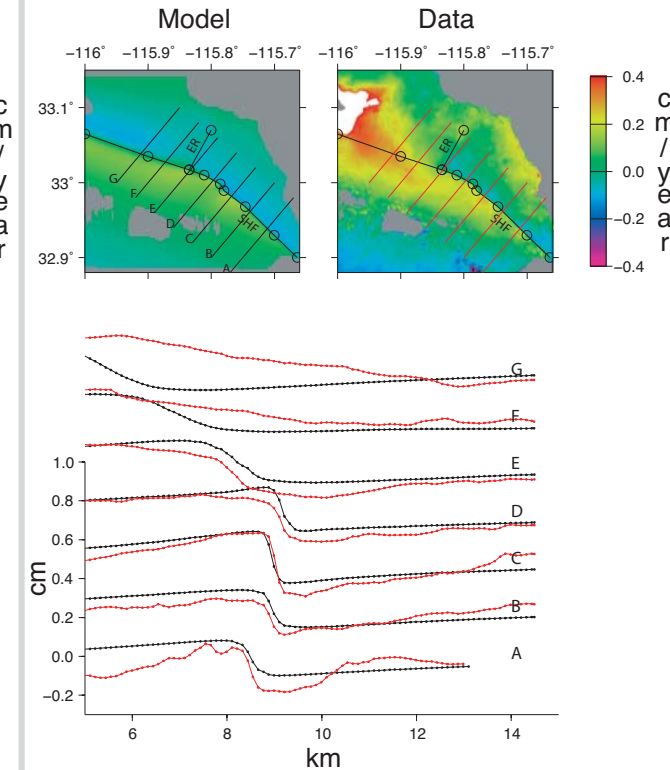
MODEL FAULT

The Superstition Hills/Elmore Ranch faults are modeled using the Okada Solution after Wang et al., (2003) using the program EDCMP. We generate two models: a Superstition Hills/Elmore Ranch Model, and a Superstition Hills/Elmore Ranch Model that extends to the area of deformation. In the first model slip rate is varied from 4 to 11 mm/year along the faults. Width of the faults is set at 5 km. The top of the fault is varied from 0.001 km to 0.6 km. In the second model the parameters are the same except the top of the fault is varied from 0.001 km to 0.8 km.

Superstition Hills/Elmore Ranch faults



Superstition Hills/Elmore Ranch faults extended to area of deformation



CONCLUSIONS

Modeled results suggest the slip rate and depth to the top of the fault of the Superstition Hills/Elmore Ranch faults varies along the strike of the faults. Modeled results also suggest that extending the Superstition Hills fault to northwest create a better fit to the observed data

NEXT STEP

Model the Superstition Hills fault, Elmore Ranch fault, with new proposed fault system using 3-d dynamic finite element solution. We will use the program PyLith.

REFERENCES

- Bilham, R., N. Suszek, and S. Pinkney (2004), California creepmeters, Seism. Res. Lett. 75(4), 481-492.
Magistrale, H. (2002), Contributions to crustal evolution of the Southwestern United States, Special Paper - Geol. Soc. Am. 365, 271-278.
Mellors, R. J. and A. Boisvert, (2003), Deformation near the Coyote Creek fault, Imperial County, California: tectonic or groundwater-related?, Geochemistry, Geophysics, and Geosystem, 4, (2), 1012, doi:10.1029/2001GC000254.
Southern California Earthquake Center, 2003. Crustal Velocity Map. Downloaded September 2004, from <http://www.scec.org/resources/>.
Wang, R., F. L. Martin, F. Roth (2003), Computation of deformation induced by earthquakes in a multi-layered elastic crust- FORTRAN programs EDGRN/EDCMP, Computers and Geosciences, 29, 195-207.