

**Annual Report, 1999, to the Southern California Earthquake Center:**  
*Seismic reflection transect and geologic cross section across the central Los Angeles basin and San Pedro Bay*

John H. Shaw (PI)  
Dept. of Earth & Planetary Sciences, Harvard University  
20 Oxford St., Cambridge, MA 02138 (shaw@eps.harvard.edu)

**Seismic Reflection Transect**

We developed a regional seismic reflection transect across the Los Angeles basin extending from the Puente Hills southwest to San Pedro Bay. The nearly contiguous transect is composed of four 2D reflection profiles and part of a 3D seismic survey that were provided by petroleum industry sponsors. The migrated 2D data were reprocessed to ensure uniform content and visual display (Plate 1). Profiles were depth converted using a preliminary version of our regional 3D velocity volume, which is based on more than 180 sonic logs and 7000 stacking velocity measurements.

The section provides the most complete image of upper crustal structure in the Los Angeles basin to date. It images to depths of 10 km, and defines the network of large, potentially seismogenic faults that threaten the Los Angeles metropolitan region. These faults include major strike-slip (Whittier, Newport-Inglewood, Palos Verdes) and blind-thrust (Compton, Puente Hills, Elysian Park) systems.

Through collaboration with Egill Hauksson at Caltech, we have posted focal mechanisms and relocated hypocentral locations for earthquakes on the transect (Plate 1). These events define the activity and deep geometries of faults systems imaged in the profile. A southwest-dipping cluster of thrust and oblique-slip mechanisms appears to be associated with the Palos Verdes fault system, and similar mechanisms define activity in the northern LA basin thrust belt, which includes the Puente Hills and Elysian Park blind thrusts. Strike-slip and oblique focal mechanisms also illuminate the mid-crustal positions of the Newport-Inglewood and Whittier fault systems. In the second phase of this project, we plan to model the geometries of active faults systems using these focal mechanism and hypocentral locations, along with shallow faults and associated folds imaged by the reflection transect.

Information from several deep well penetrations are also posted on the transect. These wells locate dated geologic horizons that can be used to constrain the ages of faulting and folding in the basin. For example, the Santa Fe Springs and Compton-Los Alamitos structures deform shallow stratigraphic sequences indicating Quaternary activity on the underlying Compton and Puente Hills blind thrusts. In contrast, the Wilmington anticline does not fold the Quaternary, suggesting that the Wilmington thrust is now inactive. These contrasting growth patterns clearly distinguish the probabilities of large earthquakes on these fault

systems. Moreover, growth fold patterns can be used to define kinematic fault interactions at depth (Shaw & Suppe, 1996; Schneider et al., 1996). For example, similar growth patterns between two faults may indicate that the structures are linked, perhaps by a deep detachment, whereas dissimilar growth patterns would prohibit such a linkage. Viable solutions for the deep geometries and kinematic interactions of these faults will define size and geometric segmentation of potential earthquake sources, thereby influencing estimates of potential earthquake magnitudes. In its completed form, we hope to double the number of wells posted on the profile, and to use this information to evaluate various kinematic scenarios for fault interactions in the basin.

This “legacy” project incorporates results from various SCEC-sponsored efforts by Groups C & D. The completed transect and supporting data will be made available to the scientific community through our webpage (<http://structure.harvard.edu>). Moreover, the project will offer a clear, illustrated depiction of active faults systems in the Los Angeles basin that is suitable for outreach and educational activities and will document SCEC's legacy.

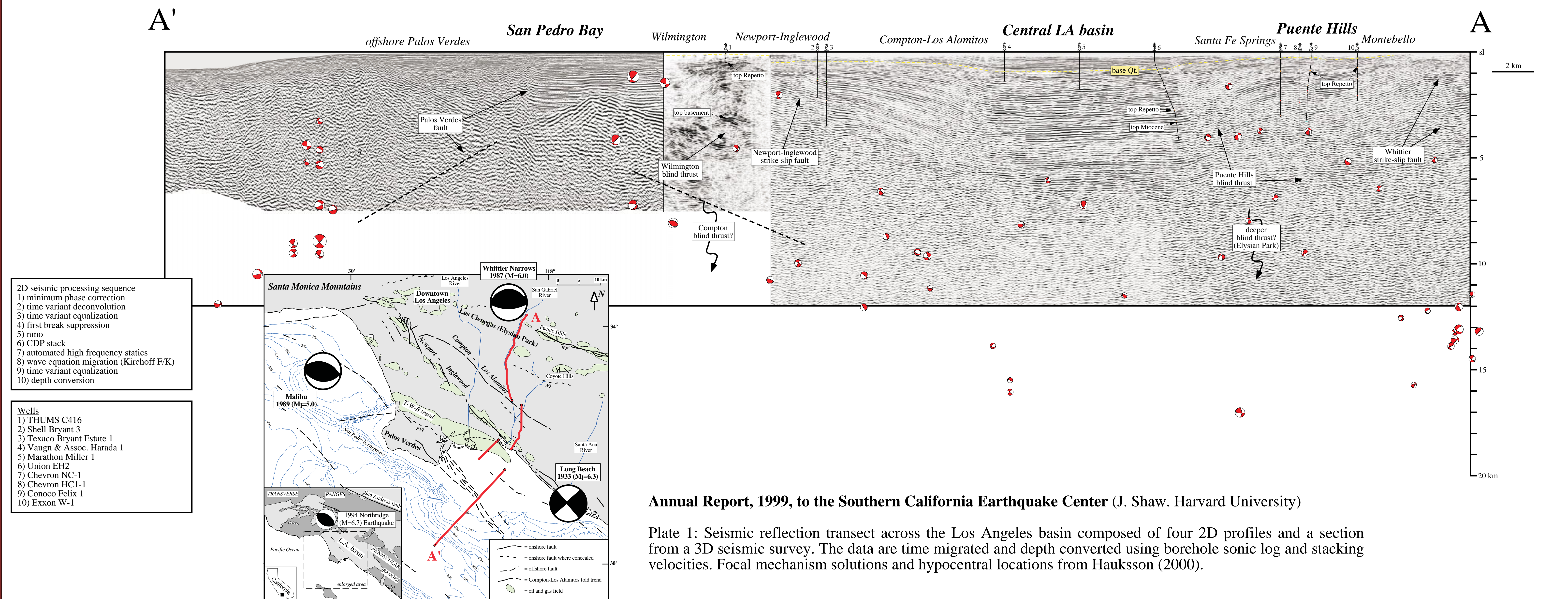
### **References**

- Schneider, C. L., C. Hummon, R. S. Yeats and G. L. Huftile, Structural evolution of the northern Los Angeles basin, California, based on growth strata, *Tectonics*, v. 15, p. 341-355, 1996.
- Shaw, J.H., and J. Suppe, Earthquake hazards of active blind-thrust faults under the central Los Angeles basin, California, *Journal of Geophysical Research*, 101/B4, 8623-8642, 1996.

### **Related Publications**

- Shaw, J.H., and P. Shearer, 1999, An elusive blind-thrust fault beneath metropolitan Los Angeles, *Science*, 283, 1516-1518.
- Novoa, E., J. Suppe, and J.H. Shaw, 1999, Inclined-shear restoration of growth folds, *AAPG Bulletin*, 84/6 (in press).
- Shaw, J.H., E. Novoa, and C. Connors, 1999, Structural controls on growth stratigraphy, in Thrust Tectonics-99, K. McClay, ed., *AAPG Special Publication* (in review).
- Shaw, J.H., M.P. Süß, & C. Rivero, 1999, Structural and seismologic investigations of concealed earthquake sources in the Los Angeles metropolitan area, SCEC Annual Meeting, Palm Springs, CA, (abs.)
- Shaw, J. H., C. Rivero, M. P. Suess, and K. Mueller, 1999, Defining concealed earthquake sources with subsurface structural models, seismicity, and surficial neotectonic constraints, GSA Annual Meeting, Denver, Colorado, Abstracts with Program (abs).
- Connors, Christopher D., and J. Shaw, 1999, Use of compressive growth strata to infer folding mechanism, *AAPG Annual Meeting*, San Antonio, Texas, Abstracts with Program (abs.).

# SCEC LA Basin Regional Seismic Transect (1999 Progress Report)



*Harvard Structural  
Geology & Tectonics*  
Preliminary Version 1.1  
(1/2000)