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Seismic reflection transect and 3D structural model of blind-thrust systems in the Los Angeles basin

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In 2000, we initiated a new effort to develop a comprehensive, three-dimensional model of active fault systems in the northern Los Angeles basin. The 3-D model consists of detailed, triangulated fault surfaces in a precise geographic framework (Fig. 1). The model incorporates digital elevation data (DEM), remote sensing (LandsatTM) images, seismic reflection profiles, wells, subsurface geologic horizons, and earthquake hypocenters and focal mechanisms.

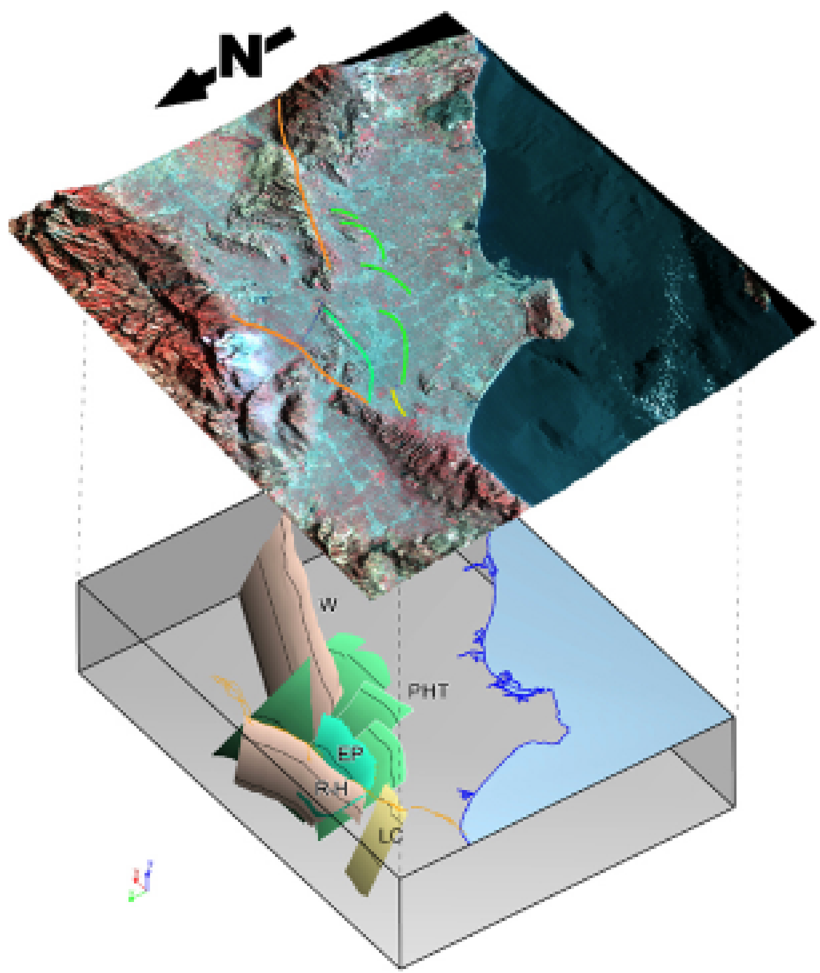

Figure 1: Perspective view of a three-dimensional fault model consisting of the Puente Hills (PHT), Elysian Park (EP), Raymond-Hollywood (R-H), Las Cienegas (LC), and Whittier (W) faults.

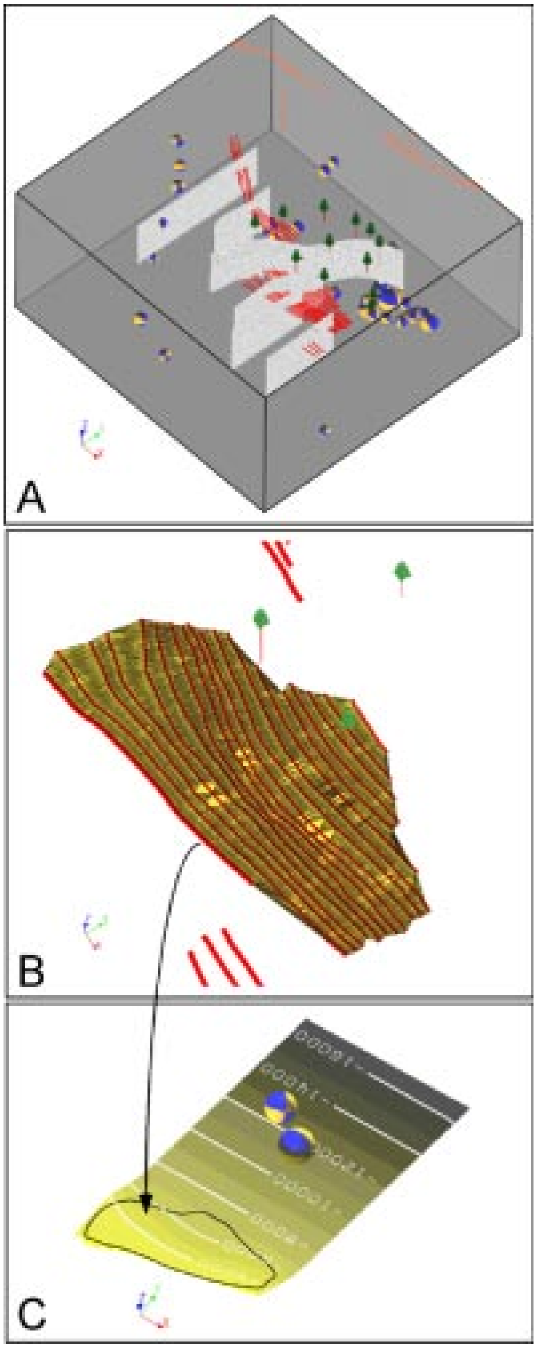

Figure 2: Demonstration of how fault surfaces are modeled. A: Seismic reflection profiles, wells, surface geology, and seismicity that define fault segments are integrated into a 3-D modeling environment. B: The fault surface is interpolated between control points. C: The fault surface is extrapolated to depth, where its location may be constrained by seismicity.

Modeled faults include the Puente Hills, Las Cienegas, and Elysian Park blind-thrusts, as well as the Whittier, Raymond, and Hollywood strike-slip systems. The model uses data and interpretations provided by a number of SCEC Investigators. Fault surfaces were defined by various constraints, including surface traces, fault plane reflections, fault penetrations in wells, and precisely located earthquakes (Fig. 2). These methods have been used by the authors to define several faults in southern California, including the Puente Hills (Shaw & Shearer, 1999) and Oceanside (Rivero et al., 2000) blind thrusts.

An important accomplishment of SCEC has been the recognition of active blind thrust faults beneath metropolitan Los Angeles. However, much confusion remains in the scientific and civic communities about the precise locations and earthquake potential of these faults. This is due, in large part, to the fact that several thrusts are stacked (imbricated) above one another in the northern Los Angeles basin. Our 3-D model helps to resolve these ambiguities, by defining the relative subsurface positions and geometries of each major blind thrust. For example, the Elysian Park thrust of Davis et al., (1989) and Shaw & Suppe (1996) is a deep, northwest-southeast trending thrust ramp that is distinct from the generally east-west trending thrust faults that lie in its hanging wall. These east-west trending faults include the Puente Hills (Shaw & Shearer, 1999), Las Cienegas, and San Vicente (Schneider et al., 1996) blind thrusts, as well as the newly defined fault beneath the Elysian Park anticline (*also termed the Elysian Park thrust by* Oskin et al., , 2000). The physical separation of these blind-thrust ramps (Fig. 1), combined with differences in ramp dip, total slip, slip rate, and age imply that each should be considered as an independent seismic source.

By compiling the results of many SCEC investigators in Groups C and D, our 3D model is intended to serve as a SCEC legacy product. The completed model and supporting data will be made available to the scientific community through our webpage (http://structure.harvard.edu). Moreover, this effort serves as a "pilot study" to evaluate various modeling techniques and software applications. Insights from these efforts have contributed to plans for a more comprehensive, community based fault modeling project as part of SCEC2. Comprehensive structural and velocity models of this type will improve the ability of seismologists, geodynamicists, and geologists to associate earthquakes, tectonic motions, and paleoseismic data with specific fault systems. Moreover, detailed fault models will also provide natural, complex topologies for studies of fault kinematics and mechanics, rupture dynamics, and earthquake triggering. Through these efforts, 3-D fault models will help to bridge geoscience disciplines, thereby promoting fundamental advances in our understanding of earthquake processes and hazards.

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