

Unaddressed Tectonic Problems in the Northern Los Angeles Basin

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Although it is clear that the Puente Hills thrust is a critical structure in earthquake hazard evaluation, this PowerPoint presentation focuses on other issues that are unresolved and may be important in understanding slip and slip-rate distribution in the Los Angeles Basin.

- (1) Strike slip is important. The 1933 Long Beach earthquake on the Newport-Inglewood fault got the State of California to begin serious upgrades of the building codes for schools. The Raymond fault is predominantly a left-lateral fault. The Elsinore, Whittier, and Chino faults contain major components of strike-slip, even though they have not ruptured historically (except for the 1910 Temescal Valley earthquake on the Elsinore fault). All three have an important reverse-fault component. The Whittier fault shows almost pure strike slip in trench excavations, but the convergent component is expressed in footwall anticlines that produce topography such that the fault is not at the range front except at its northwest end near Whittier Narrows.
- (2) The strike-slip faults die out northwards, including the Palos Verdes, Newport-Inglewood, East Montebello, and Chino faults. The Newport-Inglewood fault is clearly expressed at Inglewood and possibly at Cheviot Hills, but its along-strike continuation near the Santa Monica range front is part of a pull-apart basin at the left step between the Santa Monica and Hollywood faults. The East Montebello fault cannot be traced north of Interstate 10, and the Chino fault has no expression north of the Chino Hills. (The Central Avenue fault is probably inactive and should be removed from the southern California fault map.

- (3) Clockwise rotation might be important. Everybody knows the San Gabriel and Santa Monica Mountains are rotated, but so are the northern Peninsular Ranges. In the San Fernando and east Ventura basins, this rotation is Quaternary at a rate of $30^\circ/\text{m.y.}$, meaning that the hanging wall of the Santa Susana fault rotates clockwise around a major pivot at its northwestern fault tip and possibly a secondary pivot at Gillibrand Canyon. We don't know the age of rotations in the Los Angeles Basin because no one has studied the rotation of Quaternary strata there, including the San Pedro, Coyote Hills, La Habra, Duarte, and San Dimas formations.
- (4) Off-fault deformation is important. The paradigm that we can account for all slip on discrete, narrow fault zones expressed at the surface is simplistic. The decrease in slip rate between Glen Ivy Marsh on the Elsinore fault and Santa Ana Canyon and Olinda on the Whittier fault can be accounted for by taking into account a fold belt in the southeastern Puente Hills (Arena Blanca and Bryant Ranch synclines) and the Richfield, Kraemer, and Coyote fold belts, and the further decrease in slip rate to the East Montebello fault should consider a fold belt in the western Puente Hills including the Industry syncline,, Walnut anticline, Amar syncline, and San Jose anticline. The San Jose fault is an active reverse fault, not a strike-slip fault, and it becomes blind in the western San Jose Hills.

The tectonics of the Los Angeles Basin can be explained by an east-west escape-block model of triangular blocks, recognizing that this is not consistent with published GPS models. The San Gabriel Valley is an unfolded and unfaulted triangular block with its apex toward the south flanked on the east by the elusive Walnut Creek fault and a fold belt in the Puente Hills and on the west by the East Montebello fault and a fold belt including the Montebello and Elysian Park anticlines. The Puente Hills are another triangular block with its apex toward the north, where folds in the southeastern Puente Hills are flanked by the unfolded Chino Basin, which contains no known active faults, although it has moderate seismicity. This zone of triangular blocks is bounded on the

north by the Sierra Madre and Duarte faults and the San Gabriel Mountains and on the south by the Puente Hills thrust, the Santa Ana Mountains, and their buried western continuation in the southern Los Angeles Basin.

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