Analysis of Earthquake Data from the Greater Los Angeles Basin and Adjacent Offshore Area, Southern California

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INVESTIGATIONS

Seismotectonic analysis of earthquake data recorded by the CIT/USGS and USC networks during the last 15 years in the greater Los Angeles basin. Improve models of the velocity structure to obtain more accurate earthquake locations including depth and to determine focal mechanisms. Studies of the earthquake potential and the detailed patterns of faulting along major faults in the metropolitan area and adjacent regions.

A comprehensive study entitled: *The 1988 and 1990 Upland Earthquakes: Left-Lateral Faulting Adjacent to the Central Transverse Ranges.* is in press in the Journal of Geophysical Research

RESULTS

The 1988 and 1990 Upland Earthquakes: Left-Lateral Faulting Adjacent to the Central Transverse Ranges

Two earthquakes (M_L=4.6 and M_L=5.2) occurred at almost the same location in Upland, southern California, in June 1988 and February 1990 and had similar strike-slip focal mechanisms with left-lateral motion on a northeast striking plane (Figure 1). The focal mechanisms and aftershock locations showed that the causative fault was the San Jose fault, an 18-km-long concealed fault that splays west-southwest from the frontal fault of the central Transverse Ranges. Left-lateral strike-slip faults adjacent to the frontal faults may play an important role in the deformation of the Transverse Ranges and the Los Angeles basin as suggested by these Upland earthquakes, the left-lateral strike-slip 1988 (M_L=4.9) Pasadena earthquake on the Raymond fault, 30 km to the west of Upland, and scattered background seismicity along other active left-lateral faults. These faults may transfer slip away from part of the frontal fault toward the south. Alternatively, these faults could represent secondary faulting related to the termination of the northwest striking right-lateral strike-slip faults to the south of the range front (Figure 2). The 1988 and 1990 Upland earthquakes ruptured abutting or possibly overlapping segments of the San Jose fault. The edges of the overlapping aftershock zones, which are sharply defined, together with background seismicity, outline a 14-km-long aseismic segment of the San Jose fault. The 1988 mainshock originated at 9.5 km depth and caused aftershocks between 5 and 12 km. In contrast, the 1990 mainshock focus occurred at the top of its aftershock zone, at 5 km, and caused aftershocks down to 13 km depth. These deep aftershocks tapered off within 2 weeks. The rate of occurrence of aftershocks in magnitude-time space was the same for both sequences. The state of stress reflected in the focal mechanisms of the aftershocks is identical to that determined from background activity and did not change with time during the aftershock sequence. The constant stress state suggests that the 1988 and 1990 events did not completely release all the stored slip on that segment of the fault. The presence of 14 km of unbroken fault, the abrupt temporal termination of deep aftershocks, and the constant stress state all suggest that a future moderate-sized earthquake (M_L=6.0-6.5) on the San Jose fault is possible with a rupture length of at least 14 km and possibly 18 km.

PUBLICATIONS and REPORTS

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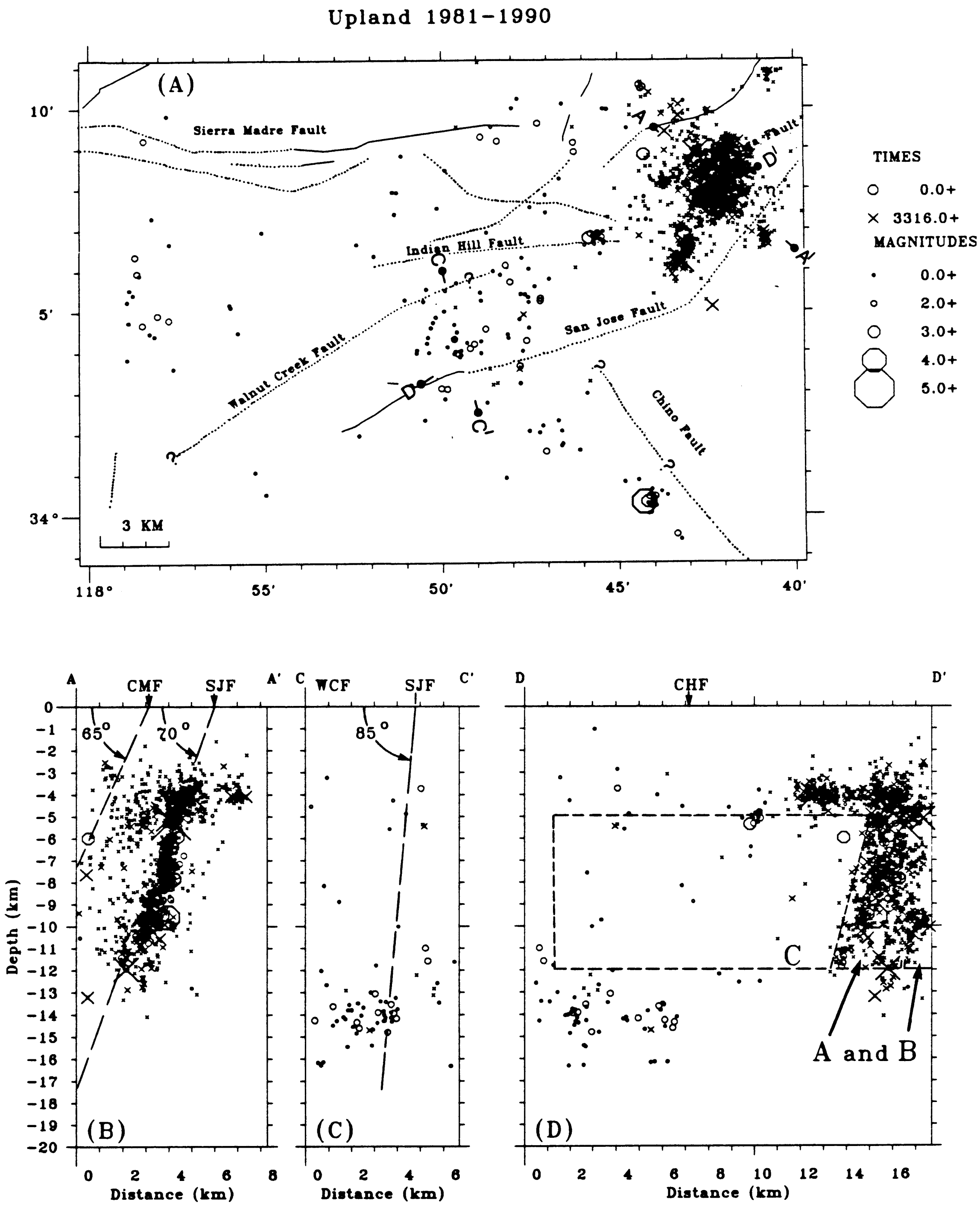

Figure. 1. Earthquakes recorded by the Southern California Seismic Network between 1981 and 1989 (shown by circles) and 1990 (shown by crosses). (*a*) A map showing earthquake epicenters and active faults and end points A-A', C-C', and D-D'. (*b*) The earthquake hypocenters within 4 km of the line A-A' projected onto the line. Dashed lines are projected at 65° and 70° from the surface traces of the Cucamonga and San Jose faults, respectively. (*c*) The earthquake hypocenters within 5 km of the line C-C' projected onto the line. Dashed line is projected at 85° from the surface trace of the San Jose fault. (*d*) The earthquake hypocenters within 6 km of the line D-D' projected onto the line, along strike of the San Jose fault. Three zones are outlined: the aftershock zone of 1988 (A), the aftershock zone of 1990 (A and B), and the aseismic zone (C).

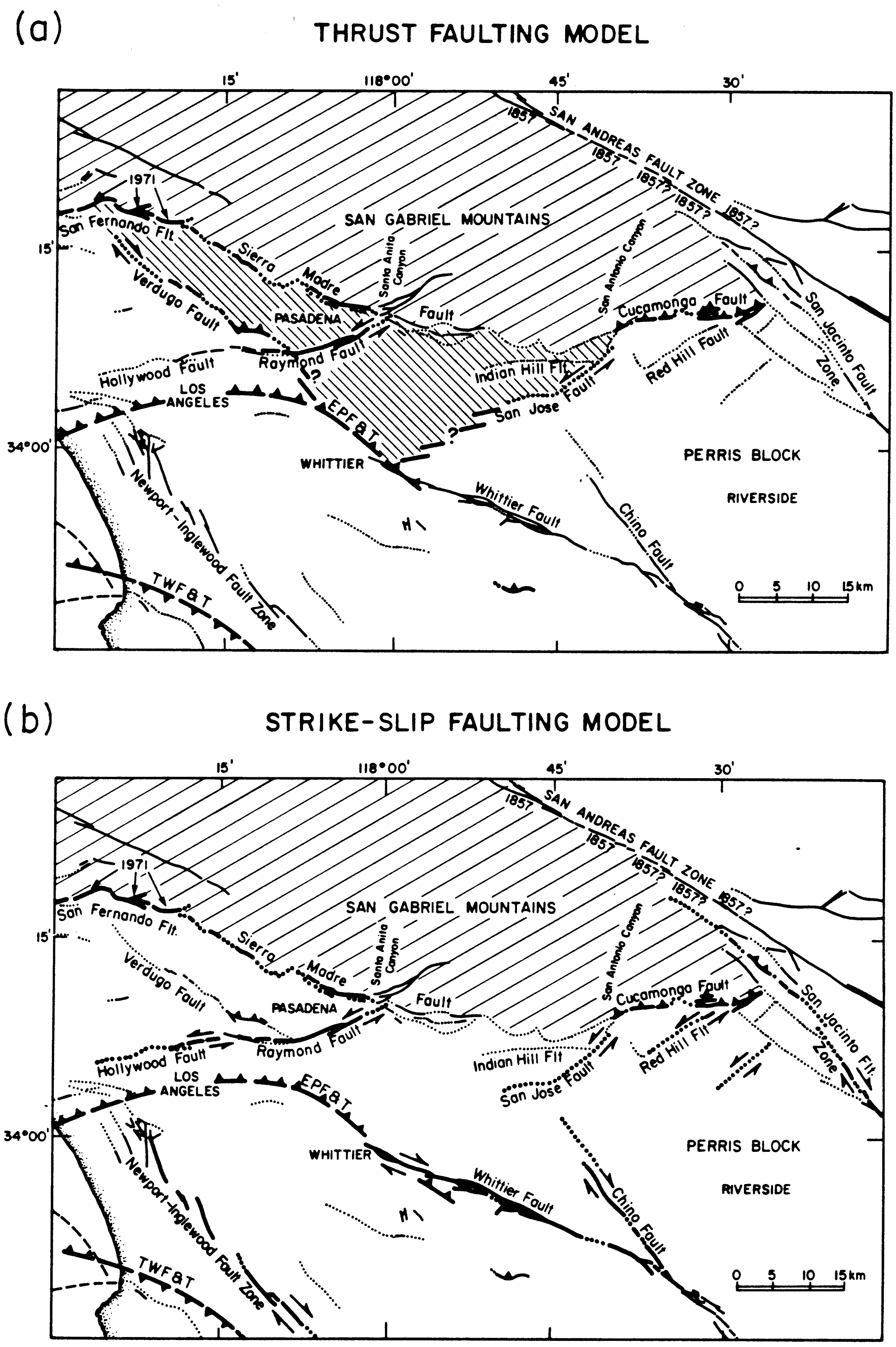

Figure. 2. Maps of the region of the Upland earthquakes showing active faults from *Ziony and Jones* [1989]. Faults are dotted where inferred, dashed where concealed, and solid where well located. (*a*) The thrust faulting model where the shading illustrates where the compressional tectonics of the Transverse Ranges may extend to the south of the Sierra Madre fault. In this model the San Jose fault transfers some of the thrust motion to the Elysian Park thrust, located to the south of the Sierra Madre fault. Some of the slip may be transferred back to the northwest along the Verdugo fault. (*b*) The strike-slip faulting model where the northeast trending strike-slip faults are secondary faults related to the abrupt termination of the northwest trending strike-slip faults.