

**DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY**

**Preliminary isoseismal map for the Sierra Madre, California,
earthquake of June 28, 1991 UTC**

Open-File Report 91-388

by
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This report has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

Introduction

The Sierra Madre earthquake occurred on June 28, 1991. It was felt over a contiguous land area of approximately 58,500 km² of Southern California (fig. 1). The hypocenter parameters computed by the U.S. Geological Survey (USGS) are:

Origin time: 14 43 54.5 UTC

Location: 34.262°N., 118.002°W.

Depth: 11 km

Magnitude: 5.8 m_b, 5.2 M_s

California Institute of Technology, Pasadena computed a local magnitude of 5.8 M_L and the University of California, Berkeley computed a local magnitude 5.7 M_L.

The earthquake caused one death (another death by heart attack may have been caused by stress associated with the shaking), 107 injuries, and more than \$33.5 million in property damage. The greatest amount of damage occurred in Monrovia and Sierra Madre with similiar but less extensive damage in Arcadia, Pasadena, and San Gabriel. All these communities were assigned a Modified Mercalli Intensity (MMI, Wood and Neumann, 1931) of VII. The epicentral intensity is unknown as the earthquake occurred about 15 km north of Sierra Madre in the San Gabriel Mountains.

Isoseismal Map

Figure 1 shows the areal distribution of intensities for the 1991 Sierra Madre earthquake. The intensities are based on data from field notes by the authors of this report; mail questionnaires, and newspaper accounts.

The MMI II–III isoseismal in figure 1 defines the limit of perceptibility for the localities that felt the shaking. The contiguous felt area extends from San Diego northward along the coast to Santa Barbara and inland to Bakersfield and beyond Palm Springs. Two communities outside the felt area: Randsburg, Calif. and Las Vegas, Nev., reported feeling this earthquake. The felt area shown in figure 1 is approximately 58,500 km²; considerably less than the 110,00 km² felt area of the October 1, 1987 Whittier, Calif. earthquake of magnitude 5.9 M_L (this event had a magnitude 5.8 M_L).

Figure 2 shows the distribution of intensities in Los Angeles and surrounding areas. The maximum intensity as shown on this map is MMI VII in Monrovia and Sierra Madre where the damage was more general and in Arcadia, Pasadena, and San Gabriel where the major damage to several structures was scattered within the city. The epicenter was located in the Angeles National Forest in the San Gabriel Mountains, an area of limited accessibility and human habitation; thus there were no reports of damage in the epicentral area; only reports of strong shaking, landslides, and rockslides.

Although there were many instances of intensity VII damage it was not continuous throughout an area. The most common damage observed was broken and fallen chimneys; however, this was not widespread except in Monrovia and Sierra Madre. In general, the structures that suffered the most damage were the older homes, churches, and commercial buildings. Most of the newer buildings suffered little or no damage.

Intensities and Damage

On figure 2, the MMI VI isoseismal outlines 1,100 km² encompassing the region associated with damage to structures. This damage ranges from minor (broken windows, cracked chimneys, cracked plaster, and masonry walls, etc.) to major (intensity VII– broken and fallen chimneys, houses moved on and off foundations, severely cracked and broken masonry walls with fallen brick, etc.). The dollar damage estimated by the State of California, Governor's Office of Emergency Services as of August 9, 1991 was \$33.5 million (\$26.0 million to private property and \$7.5 million to public property).

Damage at the communities assigned intensity VI or VII are listed below:

Intensity VII–

Arcadia–One woman was killed by a 20-ft-long steel beam that fell from the Santa Anita Park grandstand. The Motel 6 at 225 E. Colorado Place suffered structural damage when the walls cracked exposing wiring; other damage included broken comodes, shattered windows, and moved walls. The Best Western motel at 161 E. Colorado Place lost several large windows and a reinforced brick wall buckled. General damage throughout the community included chimneys broken at the roof line, large cracks in exterior brick walls, broken windows, large cracks in interior plaster walls, and cracked masonry retaining walls.

Monrovia–Houses on North Alta Vista Street and Myrtle Avenue were shifted off their foundations; chimneys were broken and fallen throughout the northern part of the community (figs. 3 and 4); water and gas lines were broken in many areas; windows were shattered; one home (fig. 5) at 433 Primrose Avenue (built in 1906) was virtually destroyed and condemned; interior walls cracked; and electric lines were down on Canyon and Foothill Boulevards.

Pasadena– The press reported that 380 structures suffered some damage. This damage consisted of cracked and fallen chimneys, cracked interior and exterior walls, shattered windows, broken water lines, and damaged merchandise in stores. The Westminster Presbyterian Church on North Lake Avenue (fig. 6) had two eight-ft-high stone turrets fall from the 110-ft bell tower, one through the roof the church, the other breaking the sidewalk in front of a side entrance; also, two large stained glass windows were broken out and stones from the south wall fell. A large section of the south brick wall of the Pasadena Playhouse (fig. 7) fell through the roof of an adjoining business and a large portion of the

south wall of the Chicago for Ribes Restaurant (fig. 8) at 90 W. Colorado Boulevard collapsed. Many of the older buildings lost sections of bricks from the top portion of exterior walls.

Sierra Madre—Many homes and several businesses suffered damage. The homes had cracked and fallen chimneys; a few slid off their foundations; interior and exterior walls were cracked; windows were broken; and there was broken glassware throughout the interior. Business damage generally consisted of some bricks fallen from exterior walls, broken plate glass windows, broken water lines, and destroyed merchandise. Two apartments had badly cracked exterior walls and were condemned (figs. 9 and 10). The Passionate Community Monastery (built in 1931) on Sunnyside Avenue had large cracks in the walls throughout the building, stained glass windows were broken, and section of plaster fell from exterior walls. Two churches had cracked bell towers and the City Hall (fig. 11) had a badly cracked cupola that was later torn down. Retaining walls (fig. 12) were cracked and broken and furniture slid several feet across the floors of homes.

San Gabriel—The San Gabriel City Hall had broken windows, cracked walls, and ruptured water lines. Both the San Gabriel Civic Auditorium and the San Gabriel Mission, which were reinforced after the Whittier earthquake of 1987, suffered only a few fallen bricks and cosmetic damage. One home rebuilt after the 1971 San Fernando earthquake was severely damaged by fallen brick porch columns and cracked and fallen walls. Other damage in the area included cracked and fallen chimneys, cracked interior walls, broken underground pipes, and broken windows and glassware.

Intensity VI—

Alhambra—Windows broke; chimneys cracked; and plaster cracked.

Altadena—Windows broke; chimneys cracked; plaster cracked.

Baldwin Park—Chimneys cracked; plaster cracked; retaining walls cracked.

Boyle Heights—Plaster walls cracked.

Burbank—Cracked walls and water leaks at the Lockheed Corporation facilities.

East Los Angeles—Bricks fell from a few chimneys; plaster walls cracked; retaining walls cracked.

East Pasadena—Chimneys cracked; retaining walls cracked; windows broke.

Glendale—Plaster walls cracked; windows broke; plaster fell from the ceiling of the Glendale Galleria (mall).

La Canada—Plaster and brick walls cracked; retaining walls cracked; light covers and ceiling tiles fell.

La Verne—Exterior brick and stucco walls cracked; retaining wall partially fell.

Los Angeles—Interior walls cracked; many items fell off shelves.

Mount Wilson—Water pipes were broken; moderate landslides and rockslides occurred; a Forest Service water tower was damaged.

San Marino—Interior plaster walls cracked; windows broke in homes and businesses; heavy furniture items were displaced.

Temple City—Plate glass windows broke; ceiling tiles fell; plaster fell from ceilings; a condominium exterior cracked, and plaster fell from the ceilings inside.

REFERENCES

Wood, H.O., and Neumann, Frank, 1931, Modified Mercalli Intensity Scale of 1931: Seismological Society of America Bulletin, v. 21, no.4, p. 277–283.

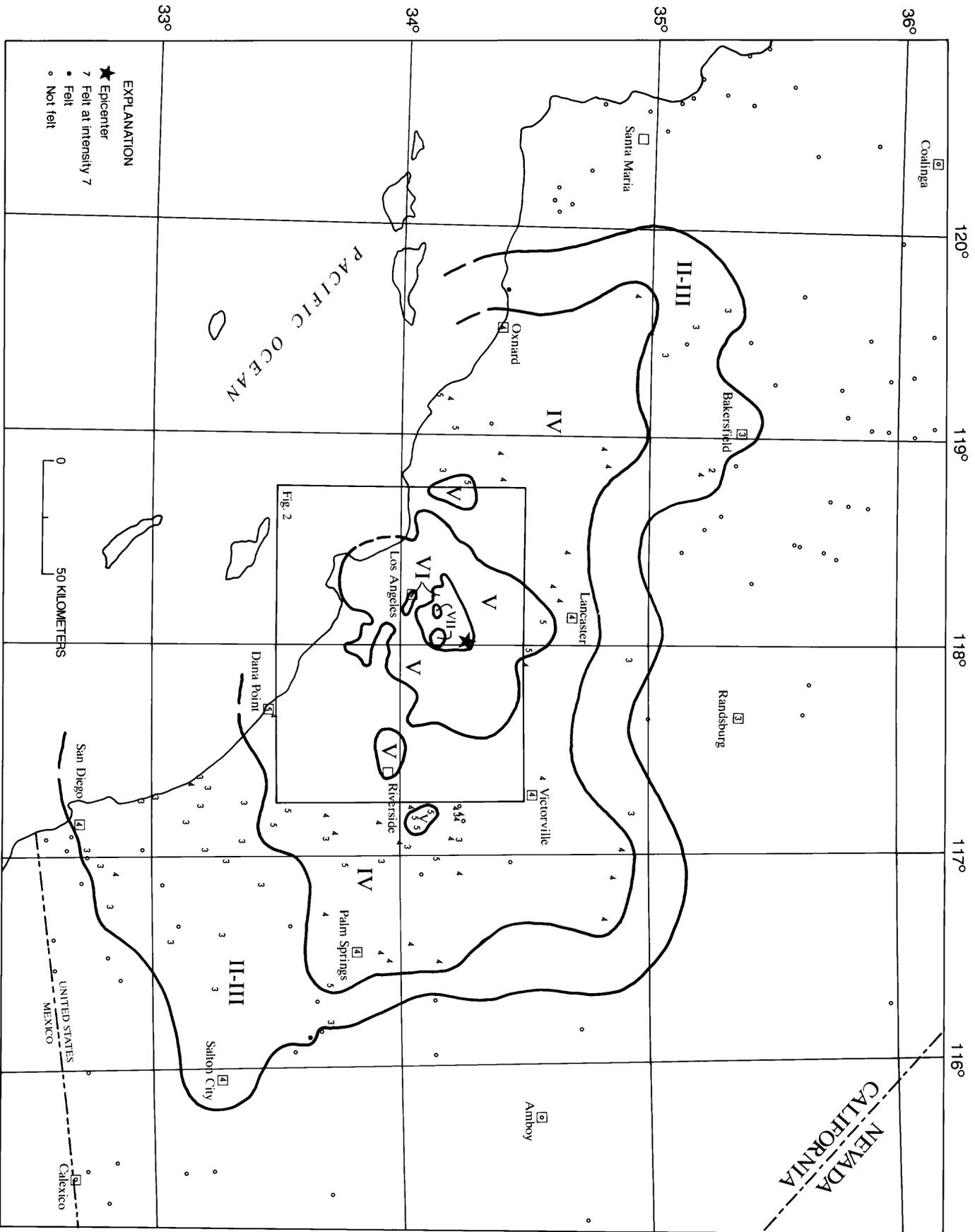


Figure 1. Isoseismal map for the Sierra Madre, California, earthquake of June 28, 1991.

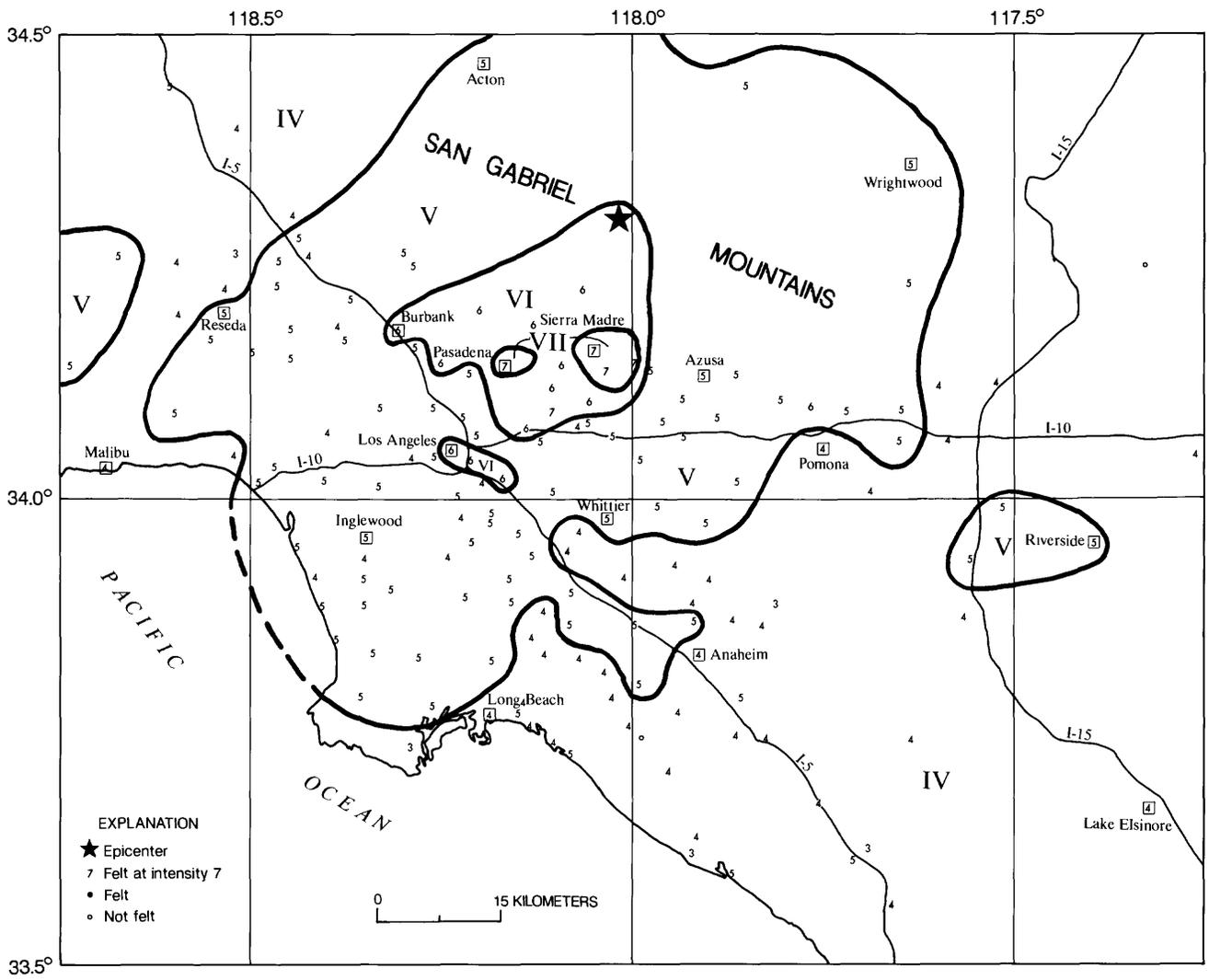


Figure 2. Isoseismal map for the Los Angeles area for the Sierra Madre, California, earthquake of June 28, 1991.



Figure 3. Fallen chimney on North Myrtle Avenue in Monrovia.



Figure 4. Fallen chimney on Patterson Drive in Monrovia.



Figure 5. Collapsed stone wall pillar of a home at 433 Primrose Avenue in Monrovia.



Figure 6. Damage to Westminster Presbyterian Church on North Lake Street in Pasadena.



Figure 7. Damage to the Pasadena Playhouse in Pasadena.



Figure 8. Damage to the Chicago for Ribs restaurant on Colorado Boulevard in Pasadena.



Figure 9. Cracked walls at the entrance to apartment building at 634 West Sierra Madre Boulevard in Sierra Madre.



Figure 10. Cracked west wall of the apartment building at 634 West Sierra Madre Boulevard in Sierra Madre.



Figure 11. Cracked cupola of the City Hall in Sierra Madre.



Figure 12. Broken retaining wall on Lima Street in Sierra Madre.