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ESTUDIOS DE CAMPO

REPORT ON THE JANUARY 17, 1994 NORTHRIGDE EARTHQUAKE SEISMOLOGICAL AND ENGINEERING ASPECTS

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AREAS DE RIESGOS GEOLOGICOS Y DE ENSAYES SISMICOS

P R E S E N T A C I O N

La Coordinación de Investigación del Centro Nacional de Prevención de Desastres realiza estudios sobre las características de los fenómenos naturales y de las actividades humanas que son fuentes potenciales de desastres, así como sobre las técnicas y medidas que conducen a la reducción de las consecuencias de dichos fenómenos.

A menudo el personal técnico del CENAPRED realiza estudios de campo sobre el origen, desarrollo y efectos probables de fenómenos productores de desastres y sobre los daños producidos en diferentes sistemas por desastres. En este último rubro se encuentran las misiones de evaluación de daños sísmicos.

El CENAPRED ha emprendido la publicación de esta serie, dentro de los Cuadernos de Investigación, para difundir las observaciones de los trabajos de mayor interés.

CONTENT

PART A. SEISMOLOGICAL ASPECTS ON THE JANUARY 17, 1994 NORTHRIDGE EARTHQUAKE

1. INTRODUCTION

This is a report of seismological investigations of various aspects of the Northridge, California earthquake (M = 6.7) that occurred approximately 50 km northwest of the Los Angeles area on January 17, 1994. During the period between January 28 and February 1, we had a chance of visiting Seismological Laboratory, California Institute of Technology and United State Geological Survey, Pasadena, to investigate seismological and strong motion data of the earthquake, and the Northridge, Sylmar and San Fernando areas to investigate the general features of structural and ground damage due to this earthquake.

The following description includes two parts; one is the fundamental seismological information mainly based on the data obtained by Caltech and USGS, and the other is based on the strong motion observation data provided by Division of Mines and Geology, California Department of Conservation, USGS and School of Engineering, University of Southern California. The earthquake damage investigated will be described in a separate report.

2. SEISMOLOGICAL INFORMATION

2.1 Main shock

The main shock of the present earthquake occurred near the center of Northridge city about 50 km northwest of downtown Los Angeles at 04 h 30 m 51.4 s (PST) on January 17, 1994 The hypocenter was located at 34°13'N, 118°32'W at a depth of about 18 km. This is the point at which the rupture started. The epicentral area is located between a few geological faults trending east-westwards in the Los Angeles basin (as shown in Fig. 1), but its location does not seem to be directly associated with any of the pre-existing surface faults. The map (Fig. 1) shows that there have been quite a number of earthquakes in this area, and the present earthquake took place just west of the 1971 San Fernando earthquake (M = 6.6).

Source Parameters

The focal mechanism of the mainshock derived from the P-wave first motions indicates a W30°N striking nodal plane dipping 35°-45° to the south. On the other hand, the moment tensor solution calculated from long-period teleseismic waves gives its strike ranging between W21°-31°N and a southwestward dip of 42°-51° (Figs. 2 and 3), which is also supported by the spatial distribution of aftershocks as described below. The above evidence indicates a thrust-type mechanism on a southwestward dipping fault. The solution also provides estimates of seismic moment to be Mo = (0.88 - 1.50) x 10^{26} dyne cm, from which the corresponding moment magnitude is found to be Mw = 6.6 - 6.7.

2.2 Aftershocks and Fault Characteristics

More than 2,500 aftershocks have been recorded during 7 days up to January 24 by the southern California network operated jointly by several institutions. The numbers of aftershocks with relatively larger magnitudes were:

2 shocks for $5.0 < M < 5.6$

35 shocks for $4.0 < M < 4.9$

272 shocks for $3.0 < M < 3.9$

Another two large aftershocks with M = 5.0 and 4.5 occurred on January 29, which are not included in the above observations. The temporal decay of these aftershocks follows a normal pattern for California earthquakes, but is slightly more quickly than the average sequence. The Northridge aftershocks also seem to be a bit more energetic than the average.

Fig. 4 shows the horizontal distribution of the aftershocks that occurred during the period between January 22 and 27 The aftershock zone extends for 30 km in the east-west direction from San Fernando to Santa Susana, and for about 25 km from Northridge in the south to the Santa Clarita Valley in the north. The northernmost aftershocks reach the San Gabriel fault. It can be seen from Fig. 1 that part of these aftershocks were located within the aftershock area of the 1971 San Fernando earthquake. The main shock epicenter of the present earthquake was located near the southern edge of the aftershock zone. Fig. 5 shows the depth distribution of some of the aftershocks projected onto the vertical cross section along A-A' in Fig. 1. The distribution clearly indicates a northeast-southwestward slope of about 42° extending for about 20 km, which is almost consistent with the dip derived independently from the moment tensor fault-plane solution for the main shock. The main shock hypocenter was located near the deepest portion of the aftershock distribution. From the above evidence, it may be inferred that the main shock rupture initiated from the deepest point at 18 km and propagated upwards and northeastward to the shallowest point at depths of about 2 - 3 km. It was also found that most of the 300 larger aftershocks have thrust faulting mechanisms similar to that of the main shock, although a few of them show normal or strike-slip movement.

Figs. 6 and 7 show the horizontal and depth distributions of aftershocks that occurred in the period of January 26 to 29, respectively. Two large circles indicates the two larger aftershocks of January 29. The larger one (M = 5.0) took place very close to the main shock hypocenter with almost the same focal mechanism, while the lesser one (M = 4.5) was located in a very shallow position probably on the Santa Susana fault as indicated in Fig. 6, and its mechanism was of strike-slip type. Fig. 9 plots the spatio-temporal pattern of the aftershock sequence taking place in the area enclosed in Fig. 8, where the ordinate corresponds to the distance measured along B-B'. No specific clustering has been identified either in space or in time during this period, except 3 successive, moderate-size shocks with magnitudes between 4.3 and 4.5 on January 24.

2.3 Surface Faulting and Tectonics

1) Rupture on the ground surface has been identified along the south side of Potreo Canyon which is located just south of Castaic Junction. It extends about 5 km eastward from its junction with the Santa Clara river valley. About 10 - 20 cm offset has been observed on a previously unmapped south-dipping thrust faults (Caltech). However, the relationship between this surface faulting and the main shock fault plane of the present earthquake is still not known at this moment.

2) GPS measurements with high accuracy have been made on about 25 sites over the epicentral region by USGS, SCEC, JPL and others to detect possible surface displacements. Preliminary

results indicate that a GPS station on the ridge of the Santa Susana Mountains recorded displacements upward by 5.9 cm and northward by 2.4 cm during the earthquake, and that a second site north of Castaic Junction and east of I-5 moved down by 1.4 cm and south by 0.6 cm.

3) Seismologists and geologists from Seismological Laboratory, Caltech presented a hypothesis on the possible relationship between general tectonics of this region and fault movements that caused the present earthquake, as illustrated in Fig. 10. The hypothesis postulates the existence of the Santa Monica Mountains Fault with a low dip beneath the region extending from the Santa Monica Mountains to the San Gabriel Mountains. It is suggested that the main shock rupture initiated at a depth of about 15 km just beneath Northridge on the postulated fault and then propagated obliquely upwards on a southwestward-dipping fault, yielding thrust movement. This main movement might have triggered another slip on buried faults parallel and perpendicular (Santa Susana Fault) to the main shock fault. It might be possible for the hypothesis to account for various observations.

4) Seismologists from Southern California Earthquake Center (SCEC) affiliated institutions: Caltech, SDSU, UCLA, UCSB, UCSD, USC, Lamont, and the USGS in Pasadena, Menlo Park and Denver, have installed more than 75 seismometers to record aftershocks from the Northridge earthquake, most of which have been deployed in the San Fernando Valley and northern Los Angeles areas. It is expected that the data from these temporary stations will help locate the aftershocks more accurately and trace the temporal variations of aftershock sequence.

2.4 Waveforms Recorded by Broadband Seismographs

Figs. 11 and 12 show the broadband seismograms recorded at Pasadena during the main shock and one (M = 5.9) of the large aftershocks, which give the ground-velocity (in cm/sec) waveforms. It is to be noted that the aftershock record involves period components longer than 8 sec and lasts for more than 40 sec. The recorded waveforms are now being investigated by many seismologists.

3. STRONG MOTION DATA

In Southern California particularly around the Los Angeles area, a large number of strong motion stations have been installed, including the CSMIP (California Strong Motion Instrumentation Program) network operated by the California State Division of Mines and Geology, the NSMN network (National Strong Motion Network) operated by U.S Geological Survey, and the LASMA (Los Angeles Strong Motion Array) operated by University of Southern California During the Northridge earthquake, strong ground motions have been well recorded by various types of accelerographs at these stations.

1) The locations of the selected CSMIP stations in the Los Angeles area are plotted on maps in Figs. 13 and 14. The peak ground accelerations (unit: g) recorded at these 68 stations are summarized in Table 1, together with the station coordinates and their approximate epicentral distances (CSMIP, 5th Quick Report, Jan. 25, 1994). Some of the large accelerations recorded on the free field, at the base and on the top of structures are given below.

No.	24655	Los Angeles	6-story parking	(D=32 km)	1.21 g H	(st)
	24087	Arleta	Fire Station	(D= 8 km)	0.59 g V	(gr)
	24514	Sylmar	Olive View Hospital	(D=15 km)	0 91 g H, 0 60 g V	(gr)
					2.31 g H	(s6)
	24670	Los Angeles	I10/405 Junction	(D=23 km)	1.00 g H, 1.83 g V	(br)
	24416	Tarzana	Cedar Hill Nursery	(D= 7 km)	1 82 g H, 1.18 g V	(gr)
	24386	Van Nuys	7-story Hotel	(D= 6 km)	0 47 g H, 0 30 g V	(bs)
	24207	Pacoima Dam	Dam Left Abutment	(D=18 km)	2.3 g H, 1 7 g V	(dm)
					0.44 g H, 0.20 g V	(dm)

st structure, gr. ground surface, s6. 6th floor, br: bridge, bs basement, dm: dam

It is to be remarked here that all three components from the Tarzana free-field station, about 7 km south of the epicenter, recorded accelerations over 1.0 g for 7 - 8 sec, with a peak horizontal acceleration of 1.8 g. The Upper Left Abutment instruments at the Pacoima Dam, which had recorded high acceleration over 1.0 g during the 1971 San Fernando earthquake, again recorded accelerations greater than 1.7 g on all three components, while the Dam downstream records indicate accelerations less than 0.4 g comparable to the record at the Dam base. The former one may have been strongly affected by local topography. High accelerations over 1.0 g have also been recorded at a 6-story parking structure in Los Angeles, at the 6-story Olive View Hospital in Sylmar, and on a bridge at I5/405 Junction in Los Angeles. Figs. 15 to 19 provide the strong motion accelerograms recorded at Sylmar, Tarzana and Pacoima Dam. These records are characterized by large-amplitude S waves lasting for 7 sec.

2) The NSMS stations also recorded high ground accelerations very close to 1.0 g at two sites near the epicenter as shown below.

Sepulveda V. A. Hospital	(D= 8 km)	0.94 g H, 0.48 g V	(ground level)
Jensen Filter Plant	(D=12 km)	0.98 g H, 0 52 g V	(ground level)

3) A number of the USC stations located in the Northridge and Los Angeles areas recorded large accelerations during the present earthquake. The distributions of peak accelerations exceeding 0.2 g in the horizontal component and 0.1 g in the vertical component are shown on maps in Figs. 18 and 19. It can be seen from these maps that large accelerations have been recorded around and north of the Northridge, at several sites located between the Santa Susana and San Gabriel faults, and also in part of the Los Angeles and Santa Monica areas.

The large accelerations recorded just north of the epicentral area may result from the concentration of seismic energy due to rupture propagation up- and northeast-wards from the deep hypocenter. The relatively large accelerations in the Los Angeles and Santa Monica areas might be attributed partly to local amplification effects from soft sedimentary layers beneath the recording sites and partly to possible movements of the foot-wall block located south of the thrust faulting in the present earthquake.

All the above descriptions are based on the preliminary reports available up to the present, and more detailed investigations are now being made by a number of seismologists and earthquake engineers. We wish to thank our many colleagues, particularly Prof. Hiroo Kanamori, Director of Seismological Laboratory, Caltech, and Dr Jim Mori, Director of the Pasadena office of U.S. Geological Survey for providing us various data and reports.

REFERENCES

1) California Institute of Technology, U.S. Geological Survey, Southern California Earthquake Center, and Jet Propulsion Laboratory, "The Magnitude 6.6 Northridge, California, Earthquake of January 17, 1994 and Its Aftershocks".

2) Department of Conservation, Division of Mines and Geology, Strong Motion Instrumentation Program, "Quick Reports on CSMIP Strong-Motion Data from the San Fernando Valley Earthquake of January 17, 1994".

3) Porcella, R., E. Etheredge, A. Acosta, E. Anjal, L. Foote and W. Jungblut, "The Ms=6.6 Northridge, California Earthquake of January 17, 1994: Selected USGS Accelerograms Recorded at National Strong-Motion Network Stations".

4) Trifunac, M., M. Todorovska and S. Ivanovic, "Preliminary Report on Distribution of Peak Accelerations During Northridge, January 17, 1994 California Earthquake".

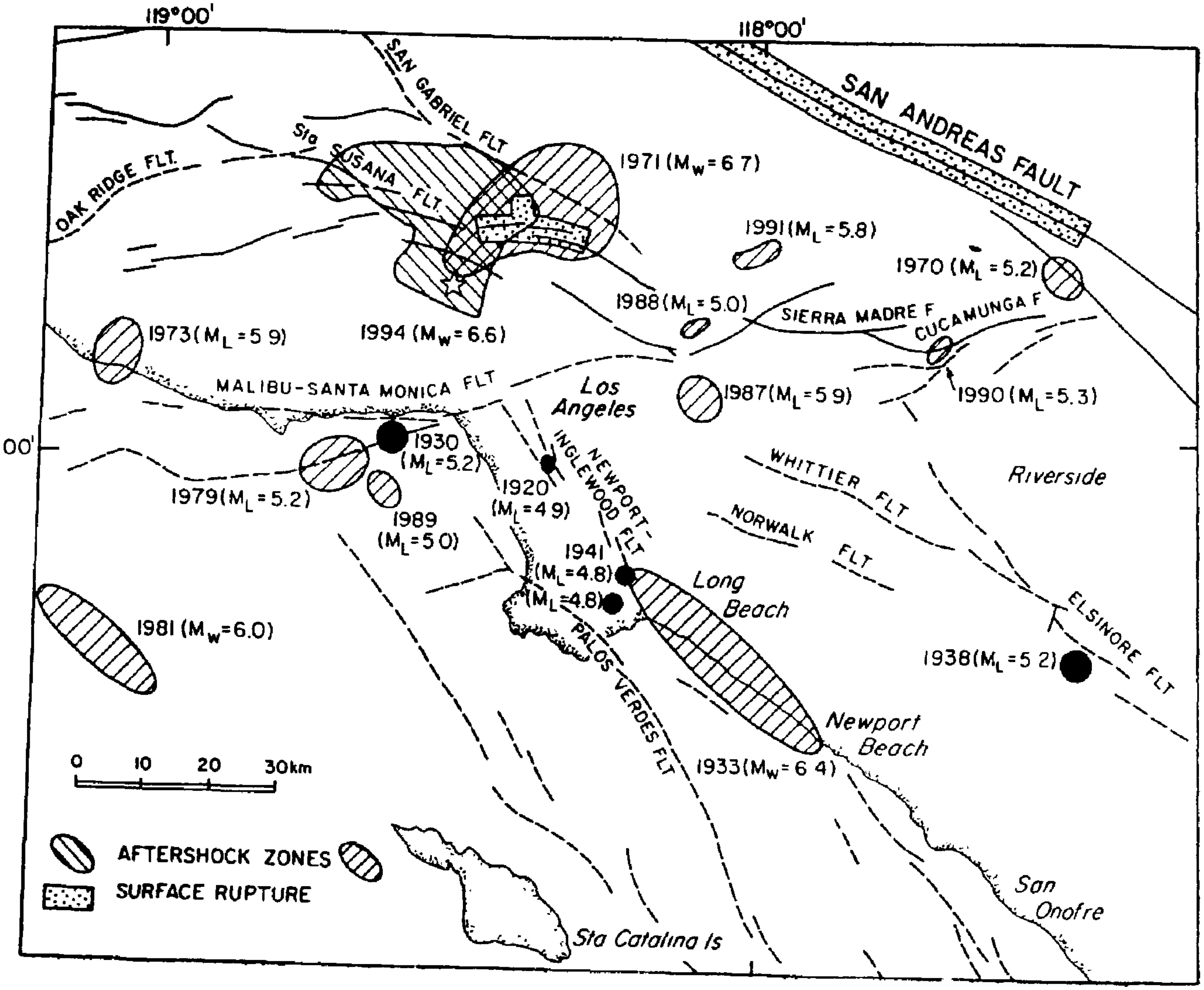

Fig.1 Significant earthquakes of M>4.8 that have occurred in the greater Los Angeles basin area since 1920

```
94/01/17 12:30:51.39
SOUTHERN CALIFORNIA
Epicenter:  34.027 -118.656
mb 6.1      MS 6.6

MOMENT TENSOR SOLUTION
Depth  21           No. of sta: 16
Moment Tensor;     Scale 10**18 Nm
  Mrr= 8.48         Mtt=-8.26
  Mff=-0.21         Mrt=-1.46
  Mrf=-1.48         Mtf= 1.83
 Principal axes:
  T  Val=  8.90  Plg=78  Azm=120
  N       -0.17     11      281
  P       -8.73      4       11

Best Double Couple:Mo=8.8*10**18
                   Mw=6.6
 NP1:Strike=113 Dip=42 Slip= 107
 NP2:       271     50       75
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Fig. 2 Moment tensor solution of the 1994 Northridge earthquake

Mechanism Solutions for the 1/17/1994 Northridge Earthquake

No.	dip	rake	strike	dip	rake	strike	M_0 (10^{26} d-c)	Depth (km)	Source
1	48	122	137	51	59	273	.88	10	Kawakatsu CMT
2	44	105	123	48	76	283	1.2	14	Dreger, waveform
3	42	107	113	50	75	271	.88	21	Needham
4	40	110	125					15	First Motion
5	47	130	137				1.0	20	Thio, Tel B
6				58	85	291	1.6		Thio, TERRA. R and L
7	50	108	126	43	70	279	1.2	17	Harvard
8	65	80	96				1.5	15	Thio CMT
9	48	93	118	42	87	294	1.6		K Global S. R and L

Fig. 3 Mechanism solutions for the 1994 Northridge earthquake

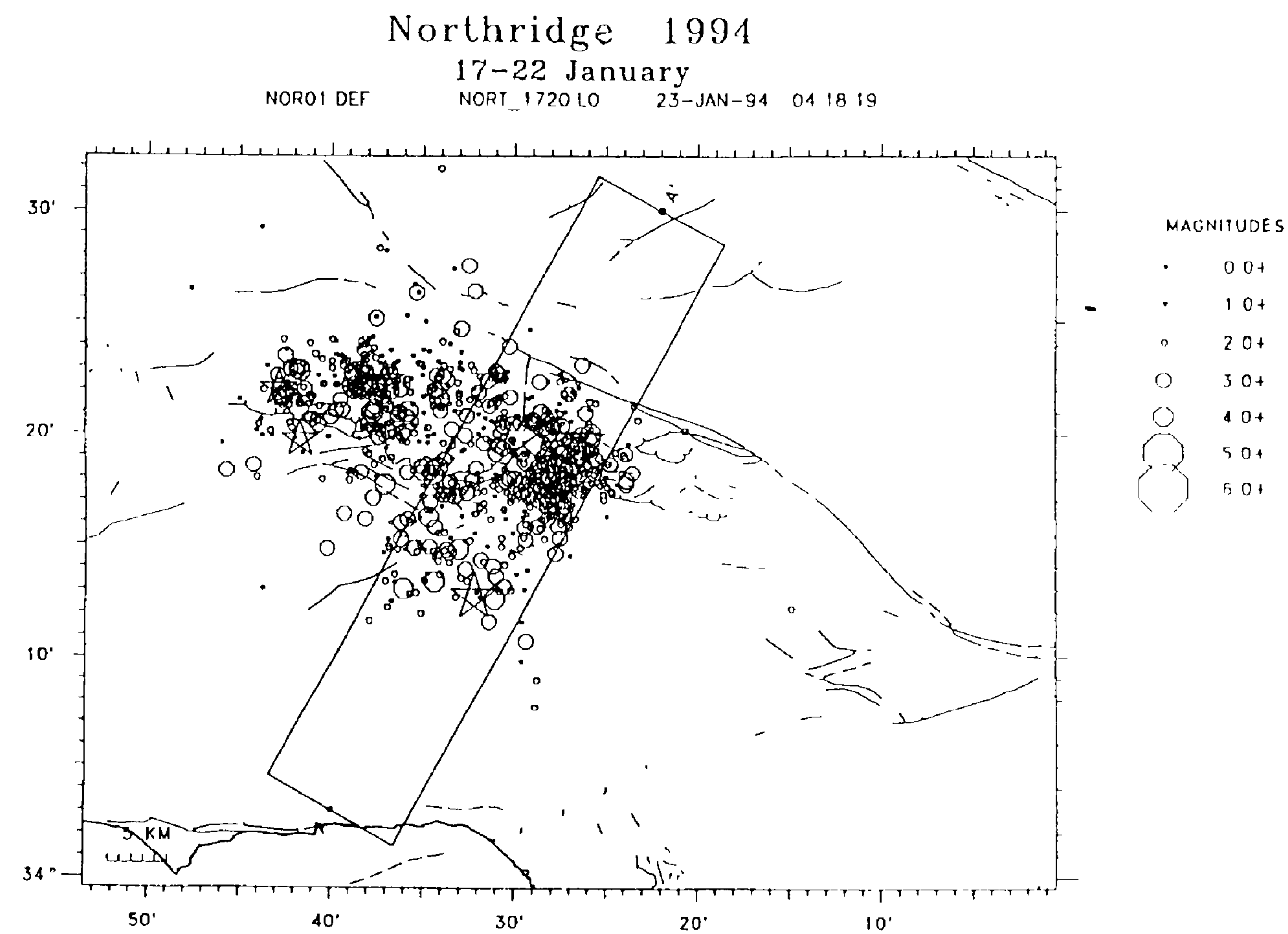


Fig 4 Horizontal distribution of aftershocks between January 17 and 22

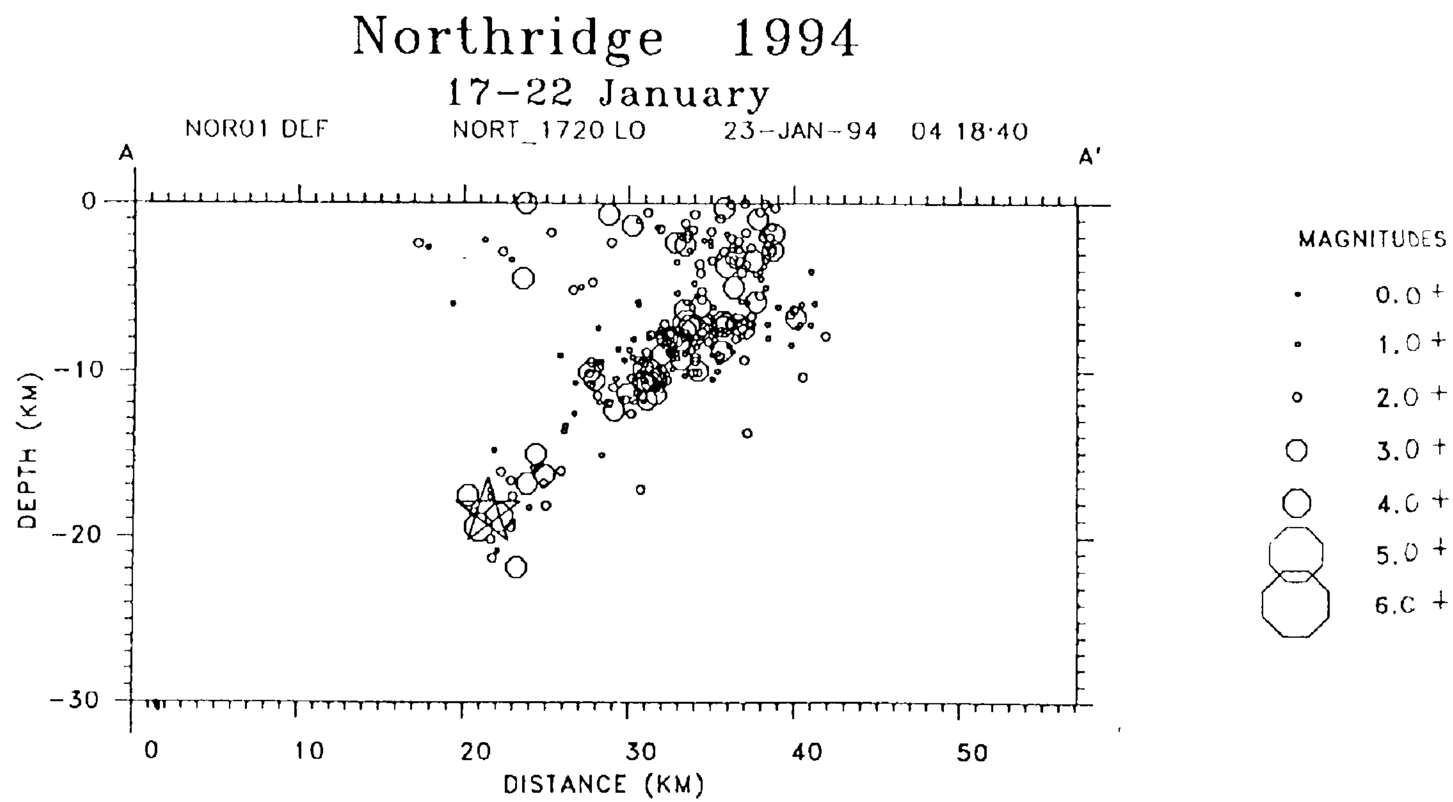


Fig 5 Depth distribution of some aftershocks

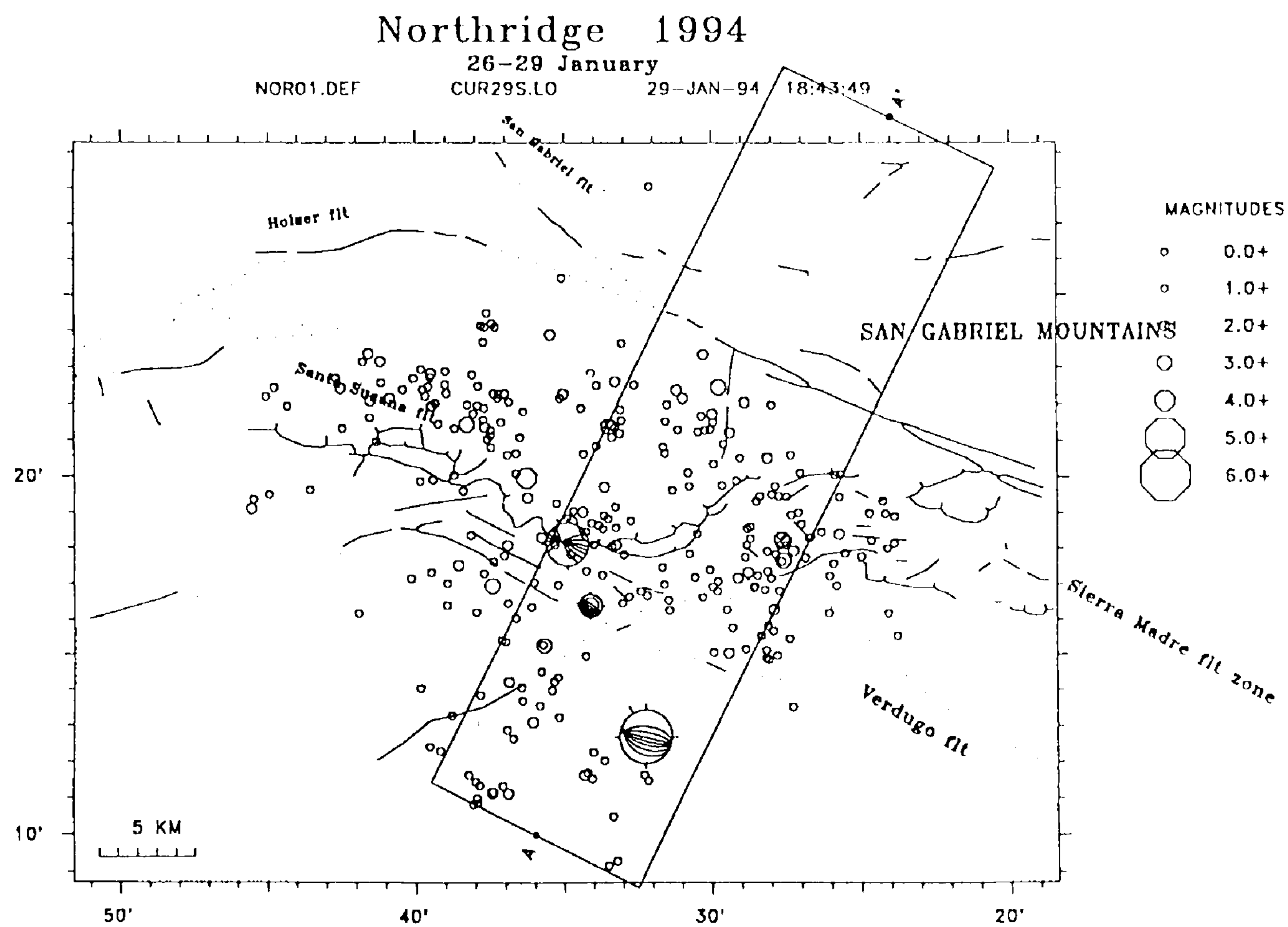


Fig. 6 Horizontal distribution of aftershocks between January 26 and 29

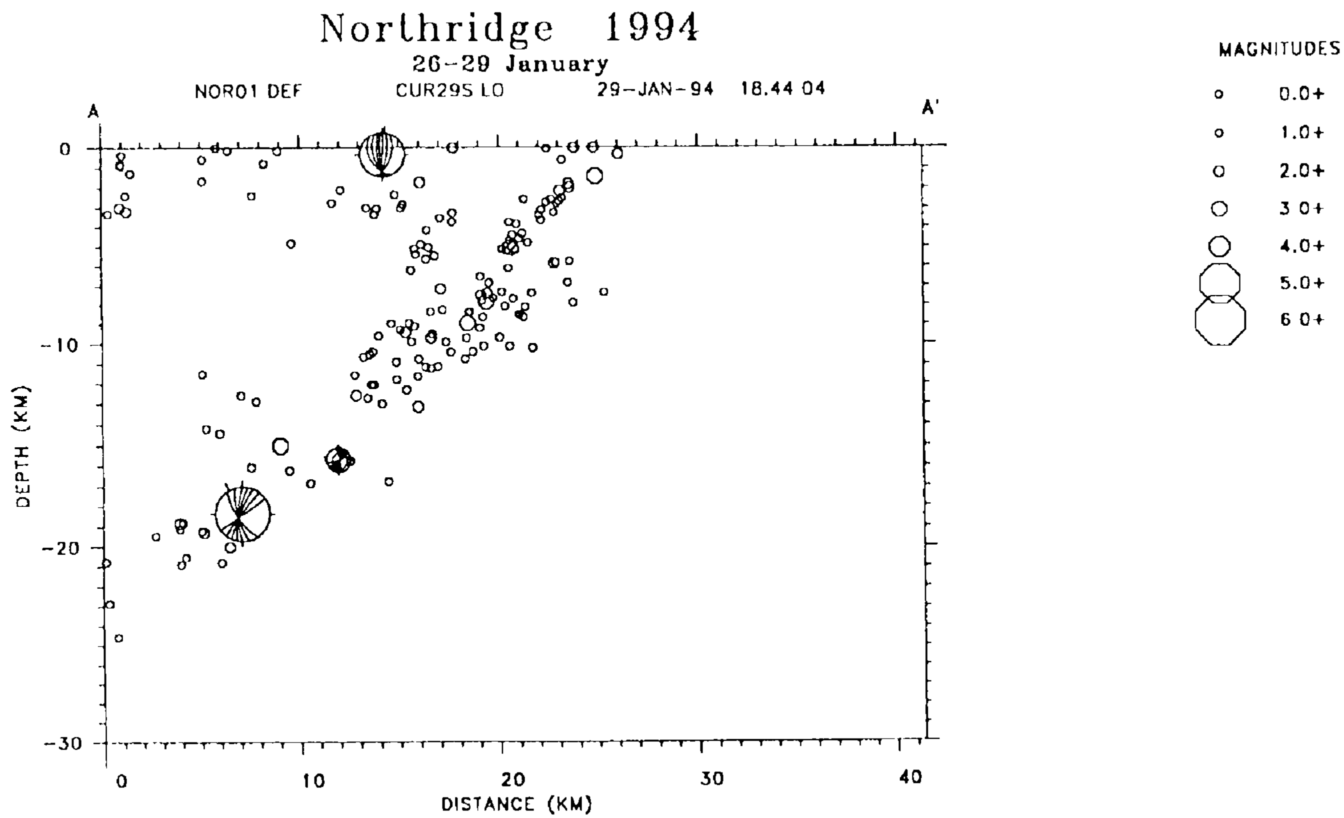


Fig 7 Depth distribution of aftershocks between January 26 and 29

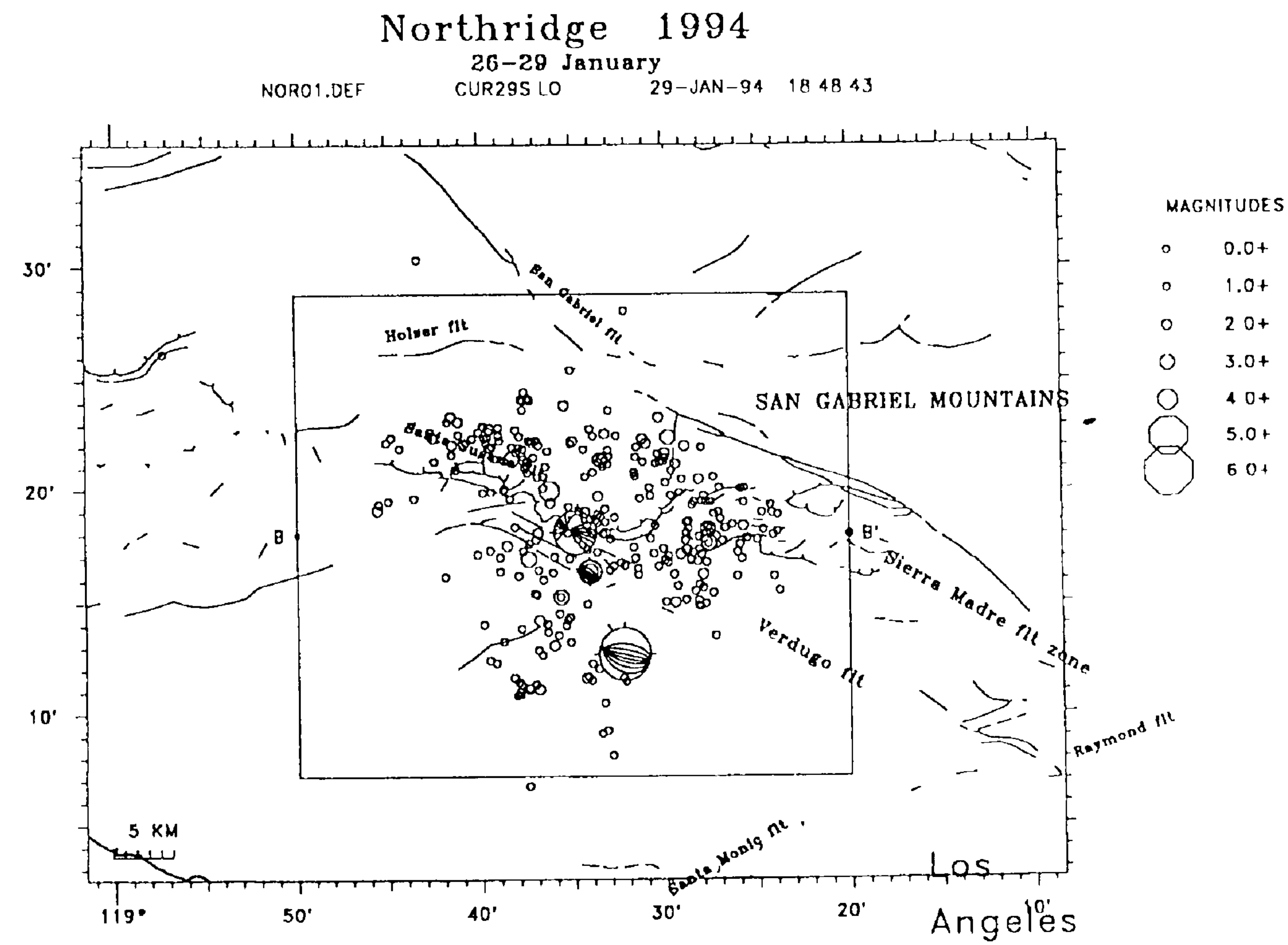


Fig 8 Horizontal distribution of aftershocks between January 26 and 29

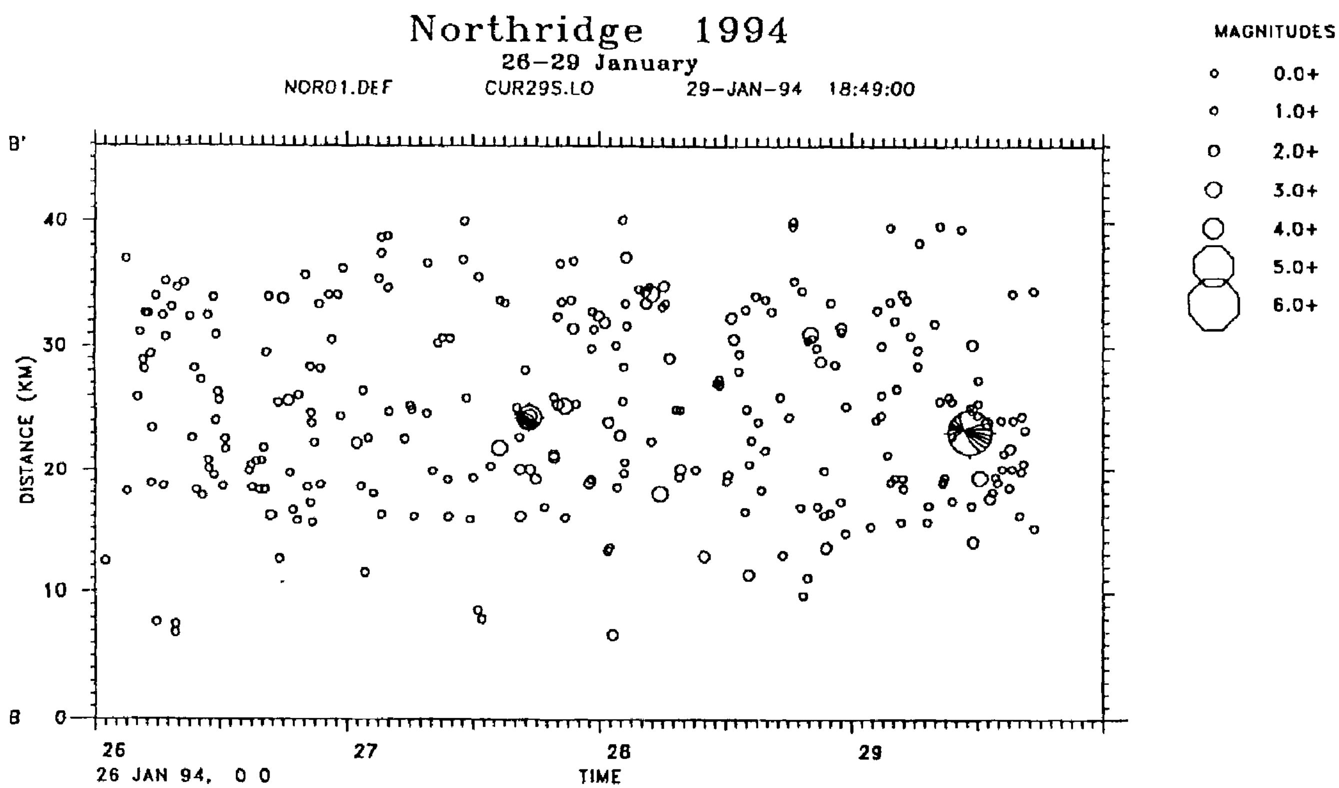
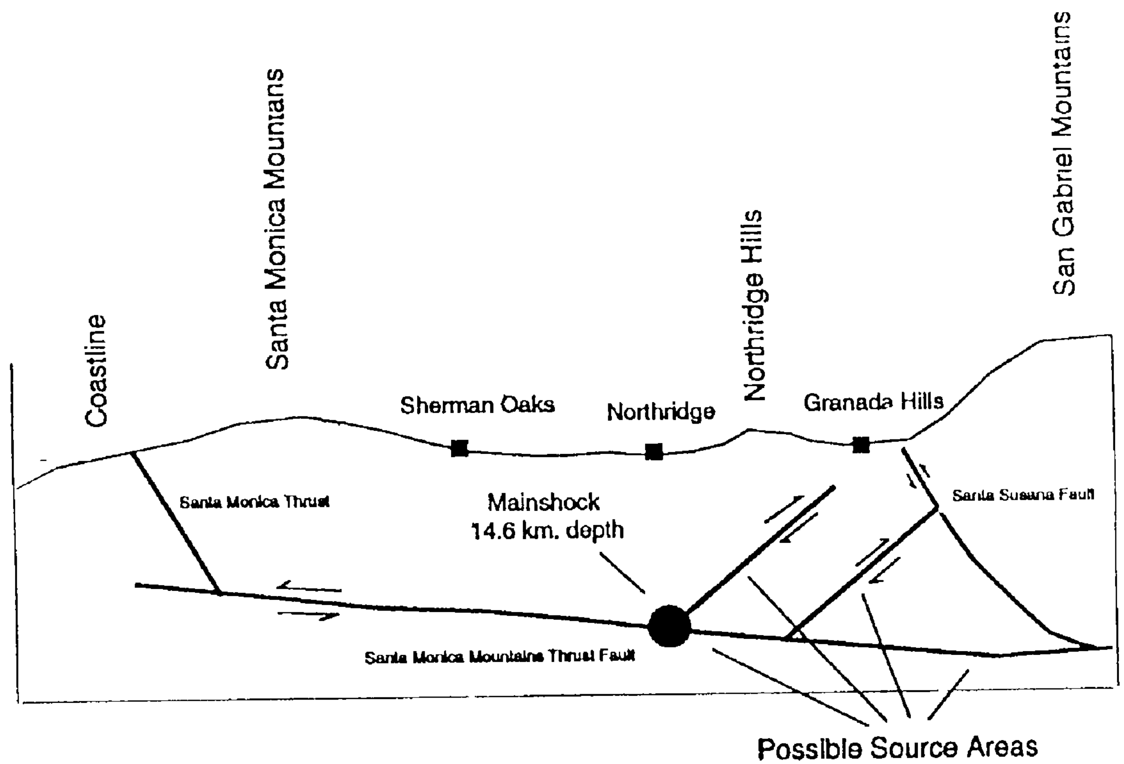


Fig. 9 Spatio–temporal pattern of the aftershock sequence taking place in the area enclosed in Fig. 8



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Pasadena, California

Fig. 10 Northridge earthquake — Preliminary cross section

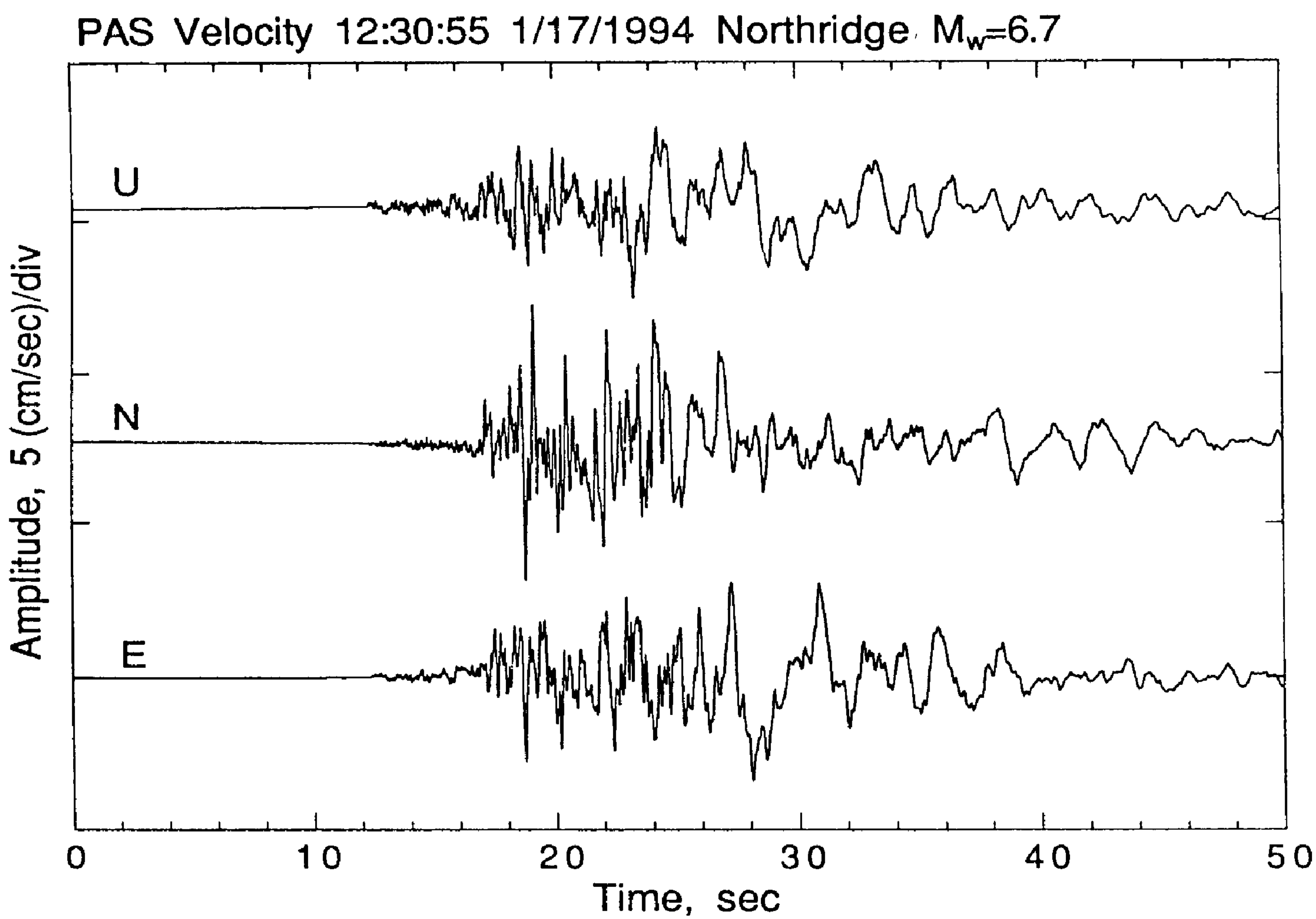


Fig. 11 Broadband seismogram recorded at Pasadena during the main shock

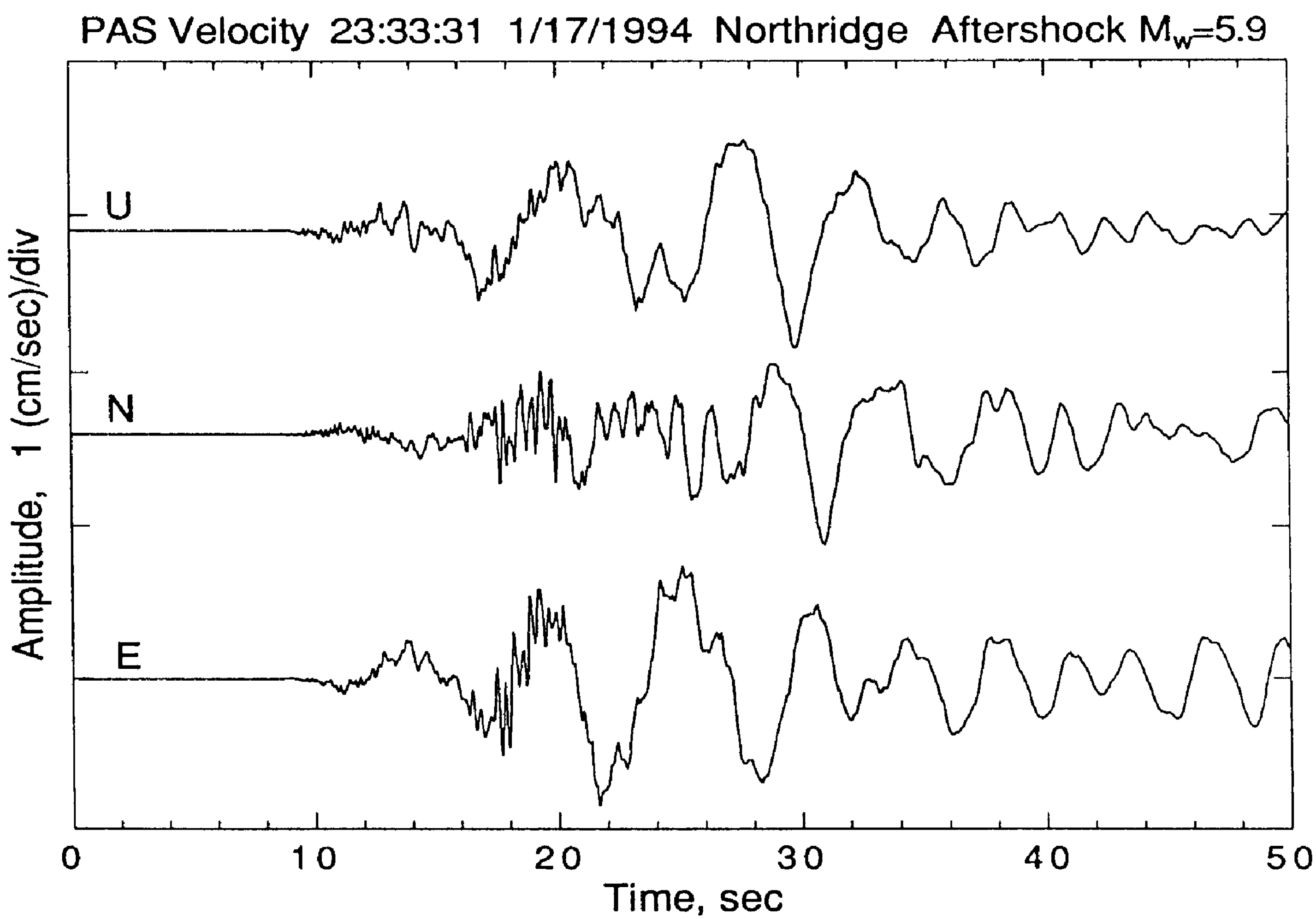


Fig. 12 Broadband seismogram recorded at Pasadena during one (M=5.9) aftershock

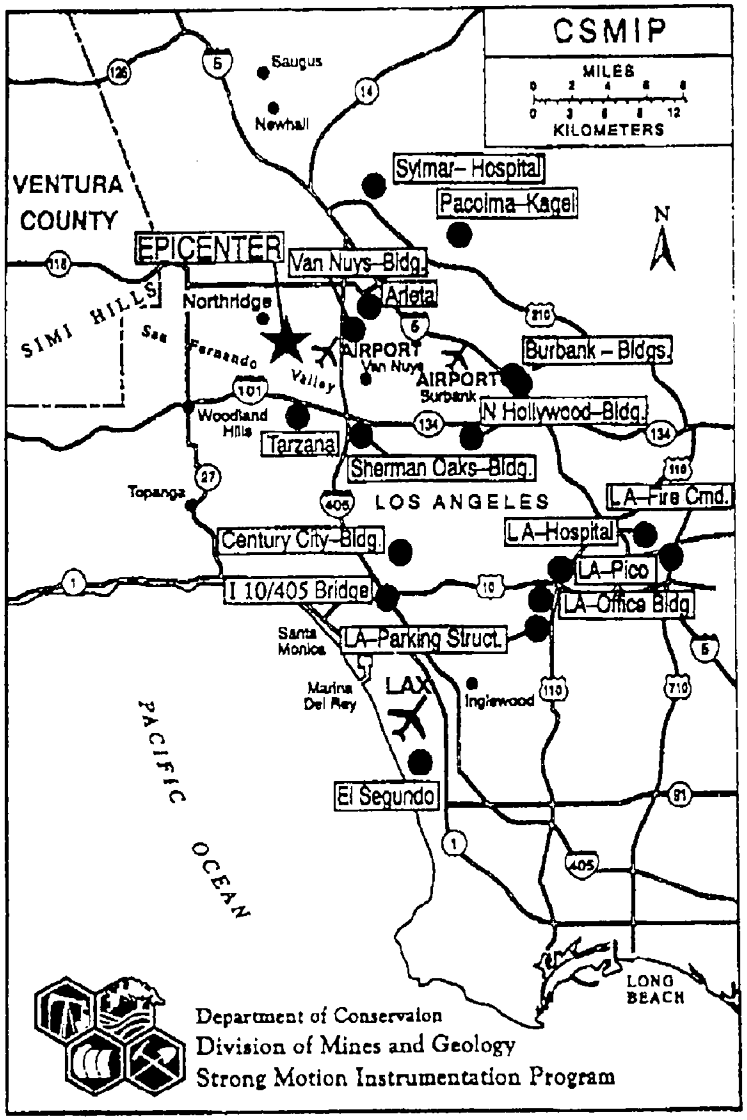


Fig. 13 Selected CSMIP stations in the Los Angeles area

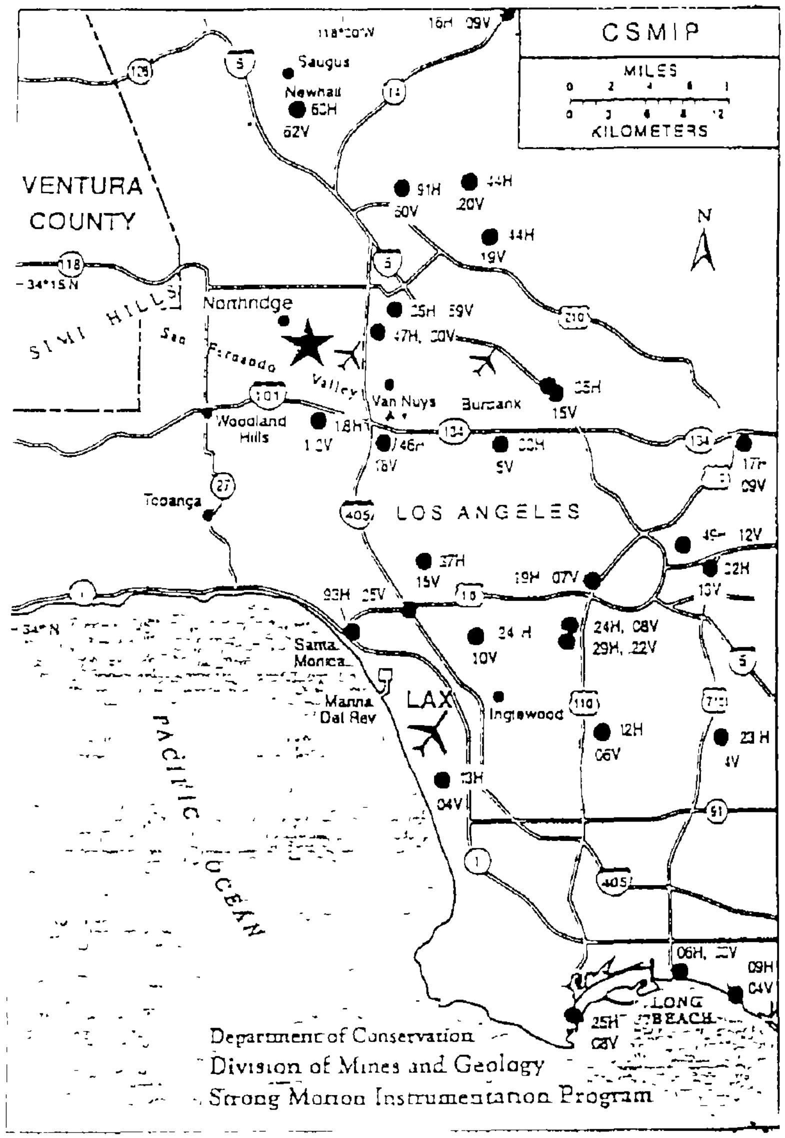


Fig 14 Selected CSMIP stations in the Los Angeles area

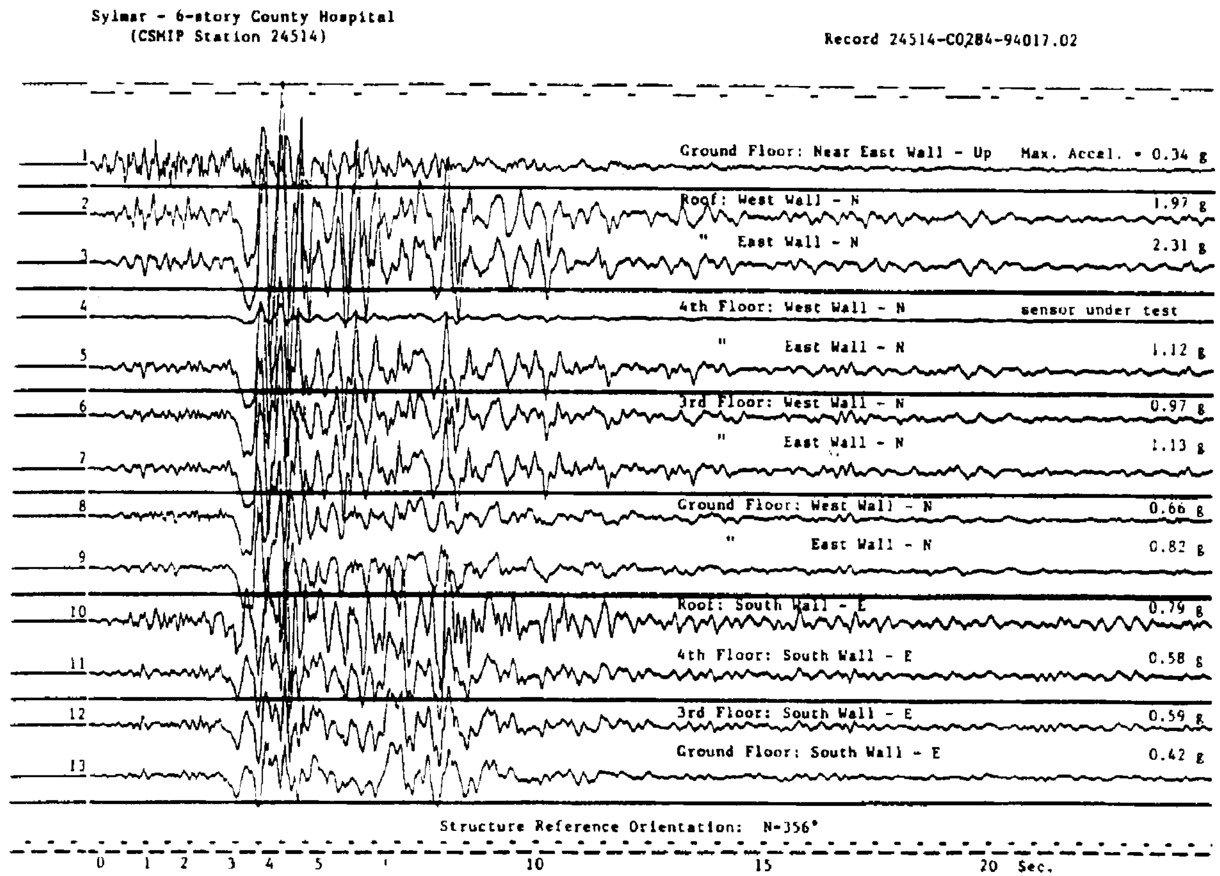


Fig. 15 Strong motion accelerograms recorded at Sylmar 6-story Country Hospital

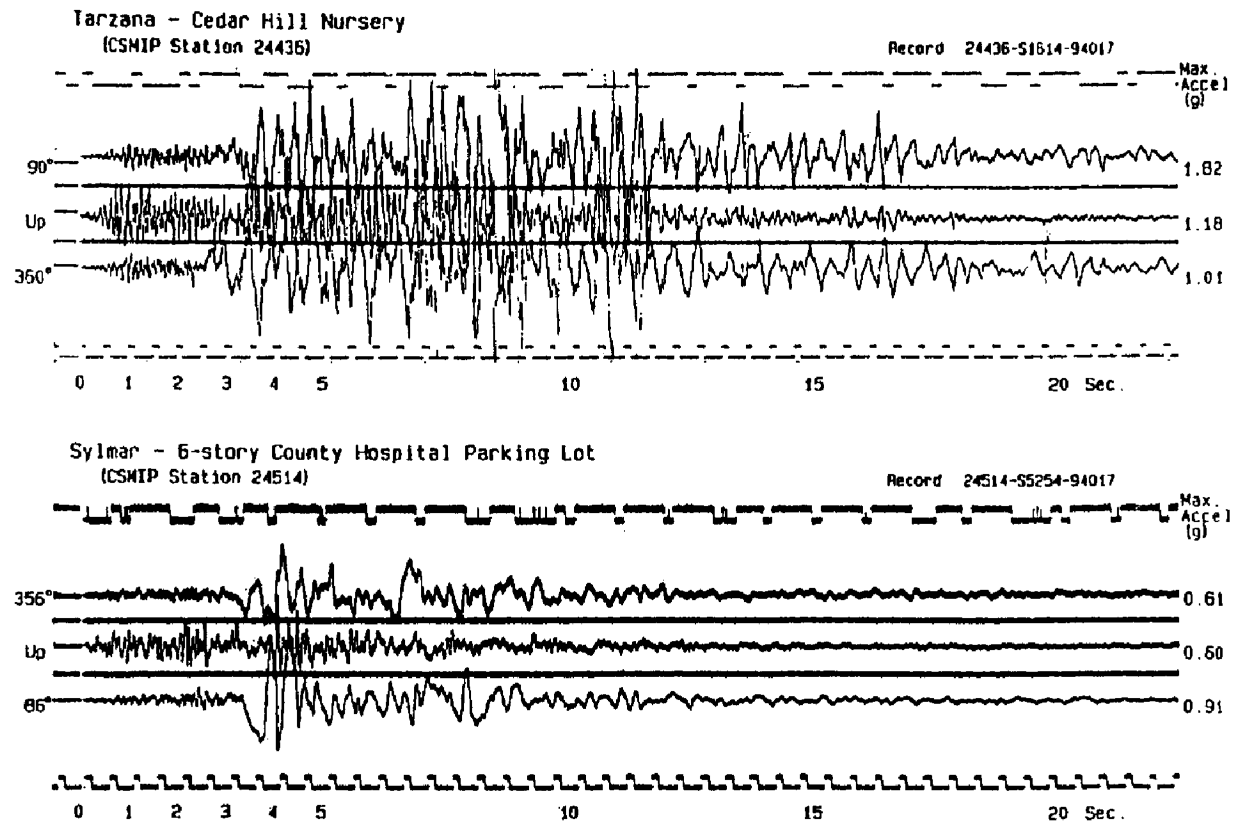
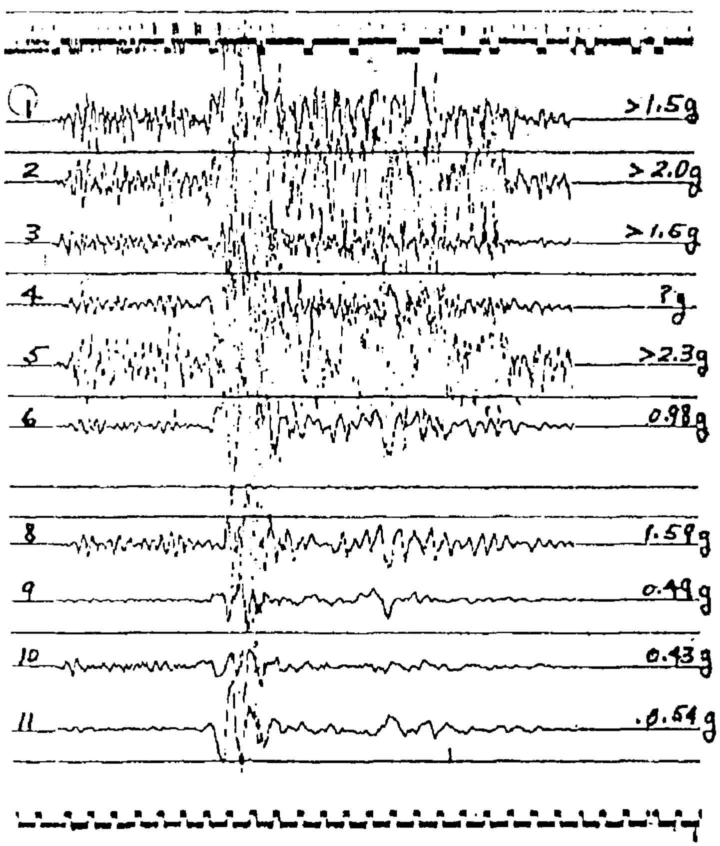


Fig. 16 Strong motion accelerograms recorded at Tarzana and Sylmar 6-story Country Hospital Parking Lot

Pacoima Dam — Northridge Earthquake



1 Crest: Right 1/6 - length Point - T*
2 Crest: Center - T
3 " " - Up
4 " " - R*
5 Crest: Left 1/4 - length Point - T
6 80% Height: Right 1/6 - length Point - T
8 " Left 1/4 - length Point - T
9 Dam Base: T
10 " Up
11 " R
12 Right (North) Abutment: W
13 " Up
15 Left (South) Abutment: W
16 " Up
17 " N

* R, T = Radial, Transverse to Dam Crest

Fig. 17 Strong motion accelerograms recorded at Pacoima Dam

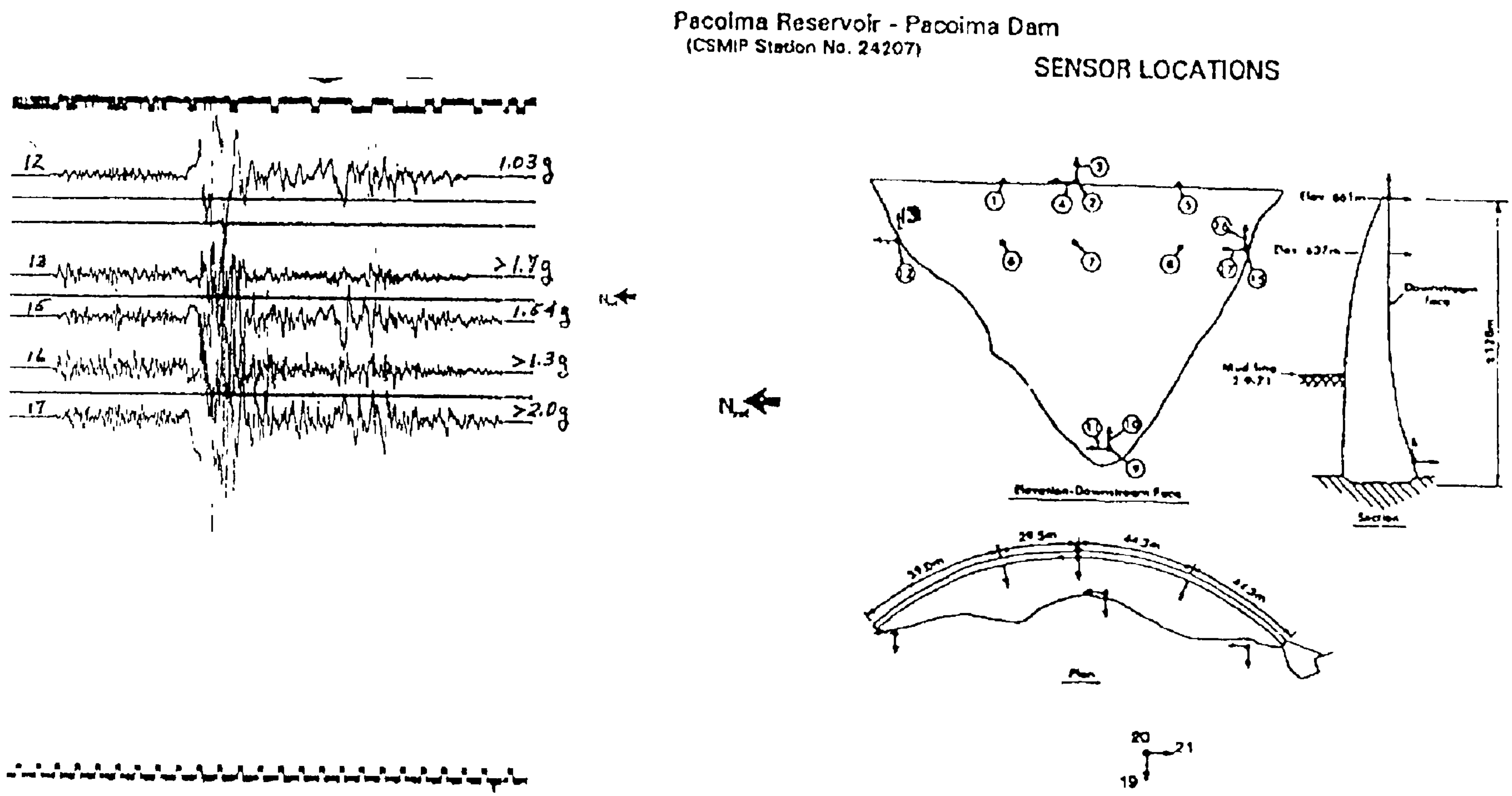


Fig 18 Strong motion accelerograms recorded at Pacoima Dam (continuation)

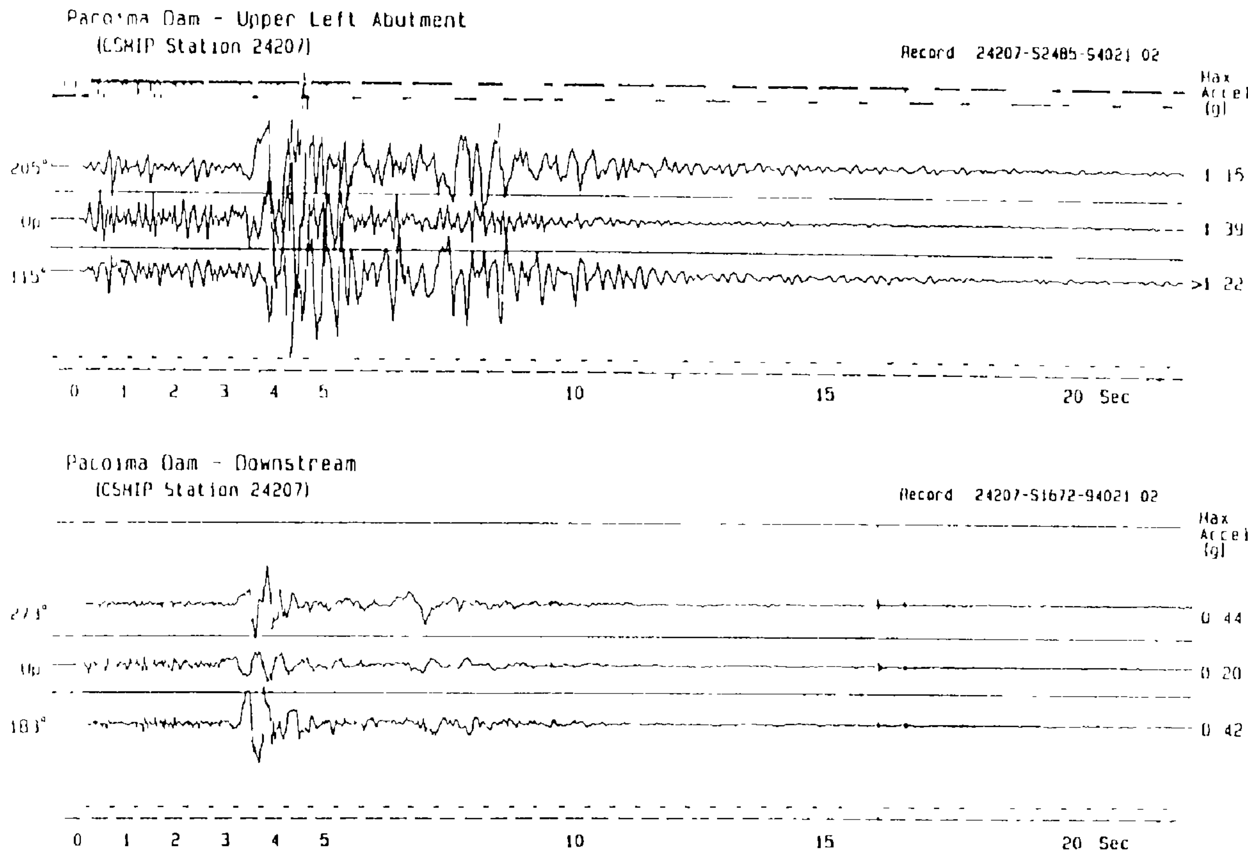


Fig 19 Strong motion accelerograms recorded at Pacoima Dam (continuation)

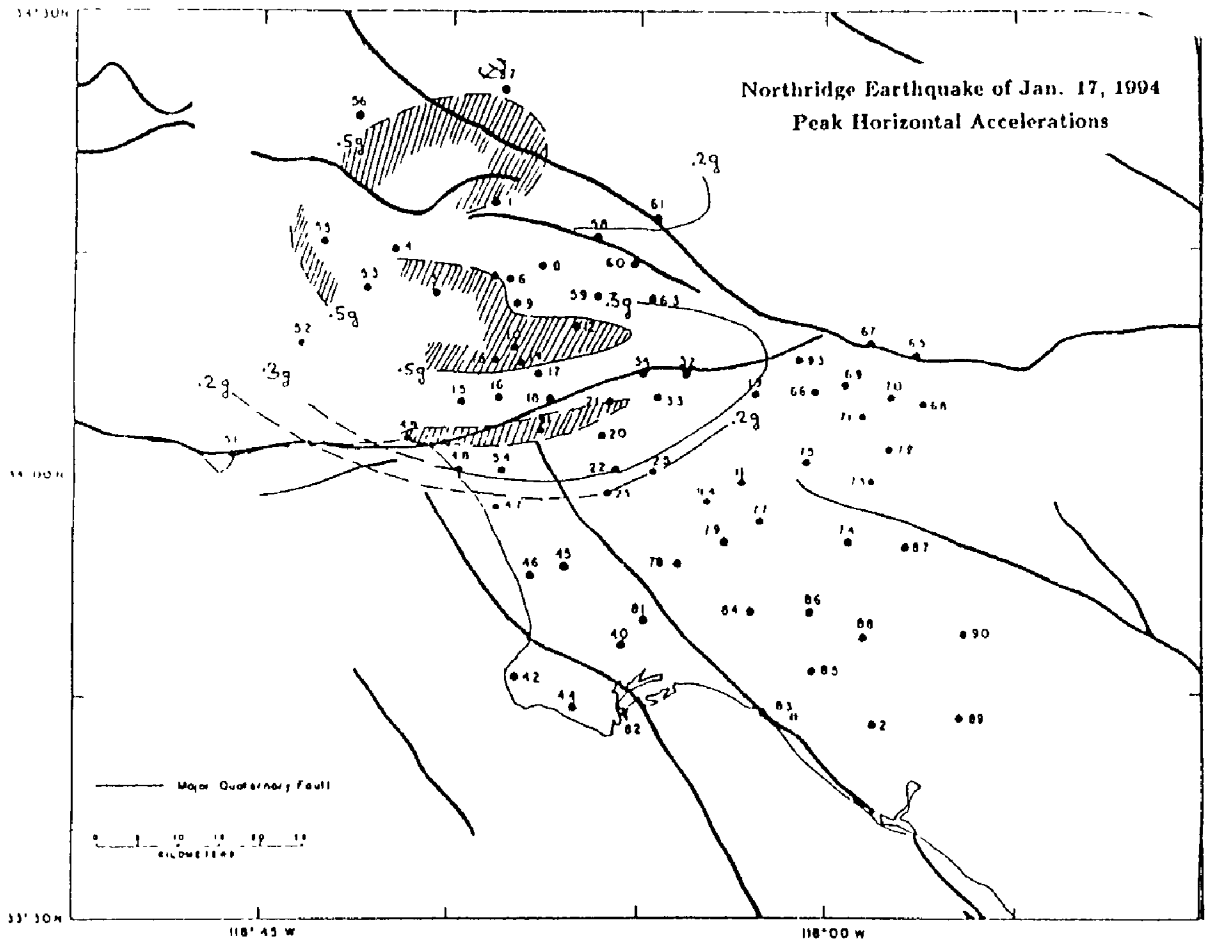


Fig 20 Distribution of horizontal peak accelerations exceding 0.2g

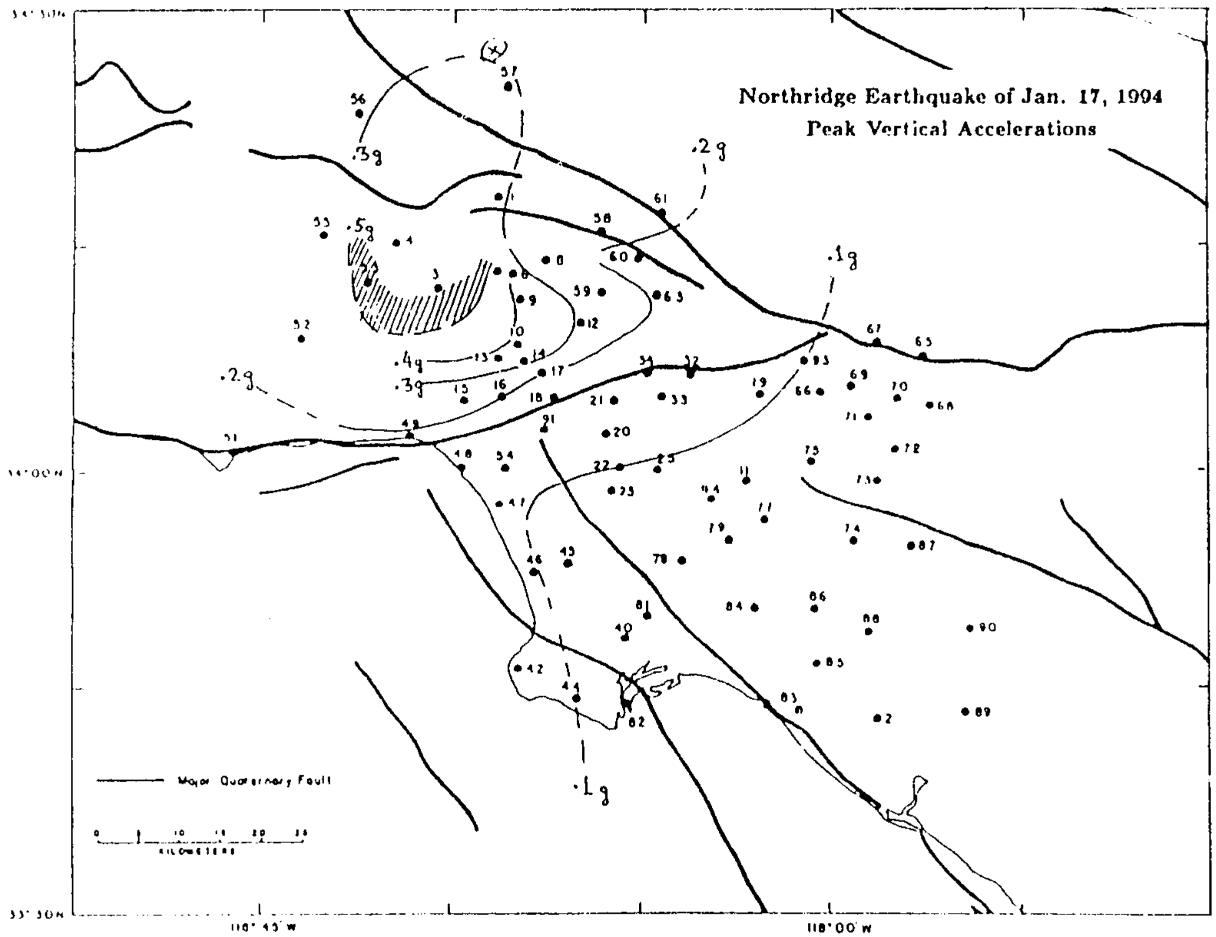


Fig. 21 Distribution of vertical peak accelerations exceding 0.1g

Table 1

Data Recovered From Selected Stations of the California Strong Motion Instrumentation Program (CSMIP) for the 17 January 1994 Northridge/San Fernando Valley Earthquake

No.	Station Name	N. Lat.	W. Long	Epicentral Distance*	Maximum Acceleration Free-Field	Base	Struct.
24386	Van Nuys - 7-story Hotel	34.221	118.471	6 km	—	0.47g H 0.30g V	0.59g H
24436	Tarzana Cedar Hill Nursery	34.160	118 534	7 km	1.82g H 1 18g V	—	—
24087	Arleta - Nordhoff Ave Fire Station	34 236	118 439	9 km	0.35g H 0.59g V	—	—
24322	Sherman Oaks - 13-story Commercial Bldg	34.154	118 465	10 km	—	0.46g H 0.18g V	0 90g H
24514	Sylmar - 6-story County Hospital	34.326	118 444	15 km	0.91g H 0 60g V	0 82g H 0 34g V	2.31g H
24088	Pacoima - Kagel Canyon Fire Sta. # 4	34 288	118.375	17 km	0.44g H 0.19g V	—	—
24207	Pacoima Reservoir - Pacoima Dam	34.334	118.396	18 km	0 44g H 0 20g V	0.54g H 0.43g V	> 2.3g H > 1.7g V
24279	Newhall - LA County Fire Station	34.387	118.530	19 km	0.63 g H 0 62g V	—	—
24464	North Hollywood - 20-story Hotel	34 138	118 359	19 km	—	0 33g H 0.15g V	0.66g H
24231	Los Angeles 7-story UCLA Math-Science Bldg.	34 069	118.442	19 km	—	0.29g H 0.25g V	0 77g H
24389	Century City LACC North	34.064	118 417	20 km	0 27g H 0 15g V	—	—
24643	Los Angeles - 19-story Office Bldg	34 059	118.416	21 km	—	0.32g H 0.13g V	0.65g H
24332	Los Angeles - 3-story Commercial Bldg	34.058	118 417	21 km	—	0 33g H 0 15g V	0 97g H 0 26g V
24385	Burbank - 10-story Residential Bldg	34.187	118 311	21 km	—	0 30g H 0 13g V	0 79g H
24370	Burbank - 6-story Commercial Bldg	34.185	118 308	22 km	—	0 35g H 0 15g V	0 49g H
24670	Los Angeles - 110/405 Interchange Brigde	34 031	118.433	23 km	—	—	1 00g H 1 83g V
24303	Los Angeles - Hollywood Storage Bldg Free Field	34 090	118 339	23 km	0 41g H 0 19g V	—	—
24236	Los Angeles - Hollywood Storage Bldg.	34 090	118.338	23 km	0 41g H 0 19g V	0 29g H 0 11g V	1 61g H
24538	Santa Monica - City Hall Grounds	34 011	118.490	24 km	0 93g H 0 25g V	—	—
24251	Wood Ranch Reservoir - Main Dam & Dikes	34 240	118 820	26 km	—	—	0 39g H 0 18g V
24157	Los Angeles - Baldwin Hills	34 009	118.361	28 km	0 24g H 0.10g V	—	—
24612	Los Angeles - Pico and Sentous	34 043	118 271	31 km	0 19g H 0.07g V	—	—

* Distance from epicenter at 34 219°N, 118 538°W

Table 1 (continued)

Data Recovered From Selected Stations of the California Strong Motion Instrumentation Program (CSMIP) for the 17 January 1994 Northridge/San Fernando Valley Earthquake

No.	Station Name	N. Lat.	W. Long	Epicentral Distance*	Maximum Acceleration Free-Field	Base	Struct.
24602	Los Angeles - 52-story Office Bldg.	34.051	118.259	32 km	—	0.15g H 0.11g V	0.41g H
24611	Los Angeles - Temple and Hope	34 059	118.246	32 km	0 19g H 0.10g V	—	—
24655	Los Angeles - 6-story Parking Structure	34 021	118 289	32 km	—	0.26g H 0 22g V	1 21g H 0 52g V
24629	Los Angeles - 54-story Office Bldg.	34.048	118.260	32 km	—	0.14g H 0.08g V	0.19g H
24652	Los Angeles - 6-story Office Building	34.021	118.287	32 km	—	0.24g H 0.08g V	0.59g H 0.18g V
24569	Los Angeles - 15-story Govt. Office Bldg.	34 058	118 249	32 km	—	0 21g H 0.07g V	0.29g H
24579	Los Angeles - 9-story Office Bldg	34 044	118 261	32 km	—	0.18g H 0.12g V	0 34g H
24601	Los Angeles - 17-story Residential Bldg	34 053	118 248	33 km	—	0 26g H 0.08g V	0 58g H
24283	Moorpark	34.288	118.881	33 km	0 30g H 0 15g V	—	—
14654	El Segundo - 14-story Office Bldg	33 920	118 390	36 km	—	0.13g H 0.04g V	0.25g H 0 17g V
24605	Los Angeles - 7-story University Hospital (Base Isolated)	34 062	118 198	36 km	0 49g H 0 12g V	0 37g H 0 09g V	0.21g H 0 13g V
24463	Los Angeles - 5-story Warehouse	34 028	118 223	36 km	—	0 26g H 0 08g V	0 29g H
24047	Vasquez Rocks Park	34 492	118 327	36 km	0 16g H 0 09g V	—	—
24541	Pasadena - 6-story Office Building	34 146	118 147	37 km	—	0 17g H 0 09g V	0 21g H
24468	Los Angeles - 8-story CSULA Admin. Bldg.	34 067	118.168	38 km	—	0.17g H 0.06g V	0.25g H 0 17g V
24592	Los Angeles - City Terrace	34 053	118 171	39 km	0.32g H 0 13g V	—	—
24580	Los Angeles - Fire Command Control Bldg (Base Isolated)	34 053	118 171	39 km	0 32g H 0 13g V	0 22g H 0.11g V	0 35g H 0 30g V
24607	Lake Hughes 12A	34.571	118 560	39 km	0 26g H 0 12g V	—	—
24401	San Marino - Southwestern Academy	34 115	118 130	~39 km	0 16g H 0 09g V	—	—
24278	Castaic - Old Ridge Route	34 564	118 642	39 km	0 59g H 0 25g V	—	—
14403	Los Angeles - 116th Street School	33 929	118 260	41 km	0 20g H 0.06g V	—	—

* Distance from epicenter at 34 219°N, 118 538°W

Table 1 (continued)

Data Recovered From Selected Stations of the California Strong Motion Instrumentation Program (CSMIP) for the 17 January 1994 Northridge/San Fernando Valley Earthquake

No.	Station Name	N. Lat.	W. Long	Epicentral Distance*	Maximum Acceleration Free-Field	Base	Struct.
14196	Inglewood - Union Oil Yard	33.905	118.279	42 km	0.12g H 0 06g V	—	—
24272	Lake Hughes # 9	34.608	118.558	43 km	0 24g H 0 09g V	—	—
24399	Mt. Wilson - Caltech Seismic Station	34 224	118.057	44 km	0 23g H 0 11g V	—	—
14368	Downey County Maintenance Bldg.	33 924	118.167	47 km	0.23g H 0.14g V	—	—
14242	Long Beach - Rancho Los Cerritos	33.840	118.194	53 km	0 08g H 0 05g V	—	—
14606	Whittier 8-story Hotel	33 975	118 036	54 km	—	0.19g H 0 10g V	0.49g H
14406	Los Angeles - Vincent Thomas Bridge	33.750	118.271	58 km	—	0.25g H 0 08g V	0 65g H 0.44g V
14560	Long Beach - City Hall Grounds	33 768	118 196	59 km	0.06g H 0 03g V	—	—
14533	Long Beach - 15-story Govt. Office Bldg.	33 768	118 195	59 km	0.06g H 0.03g V	0.04g H 0.03g V	0 06g H 0 05g V
23595	Littlerock - Brainard Canyon	34.486	117.980	59 km	0.07g H 0 04g V	—	—
24609	Lancaster 5-story Hospital	34.688	118 158	63 km	—	0 07g H 0 04g V	0.28g H
14578	Seal Beach - 8-story Office Bldg (Base Isolated)	33.757	118 084	66 km	0 09g H 0 04g V	0.08g H 0 03g V	0 15g H 0 16g V
23247	Big Dalton Reservoir - Big Dalton Dam	34 170	117 808	68 km	—	—	0 18g H 0 04g V
23590	Wrightwood - Jackson Flat	34.381	117 737	76 km	0 06g H 0.03g V	—	—
23574	Wrightwood - Swarhout Valley	34.369	117 658	83 km	0 06g H 0 04g V	—	—
23598	Rancho Cucamonga Deer Canyon	34 169	117 579	89 km	0 07g H 0.03g V	—	—
23497	Rancho Cucamonga Law and Justice Center (Base Isolated)	34 104	117 574	90 km	0 08g H 0 03g V	0.05g H 0.03g V	0 10g H 0.03g V
23650	Devore - 115/215 Interchange Brigde	34 225	117.409	104 km	—	—	0 24g H 0 05g V
23634	San Bernardino - 5-story Hospital	34 132	117 321	113 km	—	0 06g H 0.03g V	0.24g H
23622	San Bernardino - 1-story Commercial Bldg.	34.098	117 293	116 km	—	0.05g H 0 02g V	0 15g H

* Distance from epicenter at 34 219°N, 118.538°W

Table 1 (continued)

Data Recovered From Selected Stations of the California Strong Motion Instrumentation Program (CSMIP) for the 17 January 1994 Northridge/San Fernando Valley Earthquake

					Maximum Acceleration		
No.	Station Name	N. Lat.	W. Long	Epicentral Distance*	Free-Field	Base	Struct.
23542	San Bernardino - E & Hospitality	34 065	117.292	116 km	0 10g H 0.04g V	—	—
23631	San Bernardino - 110/215 Interchange	34 064	117 296	116 km	0 10g H 0 04g V	0 13g H 0 04g V	0 47g H 0 31g V
12649	Beaumont - 110/60 Interchange Bridge	33 933	116.990	146 km	—	—	0 09g H 0.03g V
12636	Sage - Fire Station	33 580	116 931	165 km	0 03g H 0 02g V	—	—
12666	North Palm Springs 110/62 Interchange Bridge	33 915	116 608	181 km	—	—	0 11g H 0 02g V

* Distance from epicenter at 34 219°N, 118 538°W