Geological Survey Open-File Report 89-186

STRONG-MOTION DATA FROM THE MALIBU, CALIFORNIA, EARTHQUAKE OF JANUARY 19, 1989

By

D. A. Johnson and A. V. Acosta

U. S. Geological Survey

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INTRODUCTION

A magnitude (ML) 5.0 earthquake occurred under Santa Monica Bay near Malibu, California, at 0653 G.m.t. January 19, 1989. "Several dozen" aftershocks were recorded within twelve hours by the California Institute of Technology (CIT); the largest was a M=3.7 event at 2202 G.m.t.

The main shock epicenter was 17 kilometers west of Los Angeles International Airport and about 12 kilometers southeast of Malibu (fig. 1). Several thousand dollars in damages were reported, including damage to stores in Malibu and Santa Monica (Los Angeles Times, Jan. 20, 1989). The earthquake was felt from northern San Diego County to Santa Barbara and as far east as San Bernardino.

The earthquake triggered 14 accelerographs at ten stations in the National Strong-Motion Instrumentation Network (NSMIN) operated by the U. S. Geological Survey (USGS) within 19 to 45 kilometers of the epicenter (table 1). Four accelerographs were equipped with internal WWVB radio receivers that encode a precision time signal on the accelerogram.

Accelerograms were obtained at three Veterans Administration hospitals, two facilities of the Metropolitan Water District of Southern California, one Army Corps of Engineers dam, and at five USGS ground sites. Copies of all accelerograms from the NSMIN stations are shown in figure 2.

Peak horizontal ground accelerations were largest (0.10g) at two stations: Topanga Fire Station in the Santa Monica Mountains (19 kilometers from the epicenter) and Lawndale USGS office located in the Los Angeles basin (23 kilometers from the epicenter). Accelerations of 0.11-0.15g were recorded at four locations on the sixth level of Wadsworth VA Hospital in West Los Angeles (table 1). Additional event-station data are presented in table 2.

ACKNOWLEDGEMENT

The acceleration data presented in this report were recorded by instrumentation owned by the Army Corps of Engineers, Metropolitan Water District of Southern California, Veterans Administration, and others. The U. S. Geological Survey appreciates the assistance of all organizations that have allowed the use of their facilities for the operation of strong-motion instrumentation.

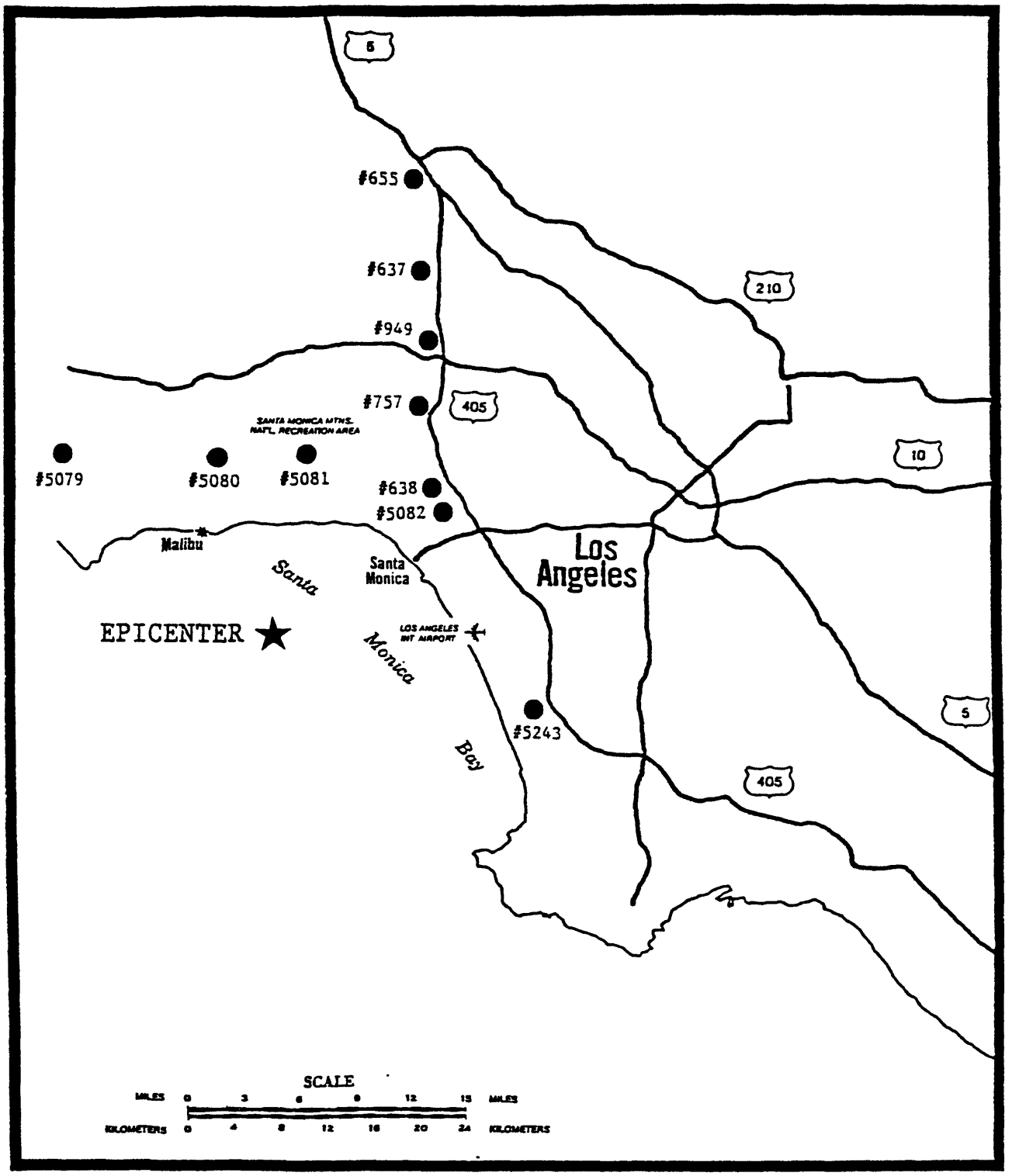

Figure 1. Map of NSMIN stations triggered during the Malibu earthquake. Numbers refer to USGS stations listed in table 1.

Table 1. Strong-motion data and peak accelerations from the Malibu, Caliornia, earthquake of January 19, 1989 (0653 G.m.t.)

Station owners are Army Corps of Engineers (ACOE); Metropolitan Water District of Southern California (MWD); U. S. Geological Survey (USGS); and the Veterans Administration (VA). Stations are listed in order of increasing epicentral distance. Epicentral distance is measured from station to epicenter at latitude 33.919°N and longitude 118.627°W. Direction of acceleration is for an upward trace deflection on the accelerogram; vertical component directions are listed as "up" or "down."

Station Identification				Acceleration	
USGS Number	Name (owner)	Coordinates (lat. °N, long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)
5080	Malibu Canyon, Monte Nido Fire Station (USGS)	34.078 118.693	19	090 up 360	0.07 <0.05 0.05
5081	Topanga Fire Station (USGS)	34.084 118.599	19	270 up 180	0.10 0.09 0.06
638	Los Angeles, Brentwood VA Hospital (VA)	34.063 118.463	22	285 up 195	<0.05 <0.05 <0.05
5082	Los Angeles, Wadsworth VA Hospital (VA)	34.053 118.452			
	Structure Array:		22		
	Ch. 1	6th floor, north		235	0.15
	Ch. 2	6th floor, north-center		235	0.11
	Ch. 3	6th floor, center		235	0.13
	Ch. 4	6th floor, center		055	0.11
	Ch. 5	6th floor, south		055	<0.05
	Ch. 6	6th floor, south		325	<0.05
	Ch. 7	Basement, north-center		325	0.10
	Ch. 8	Basement, north-center		235	0.07
	Ch. 9	Basement, north-center		down	<0.05
	South ground site (USGS)	34.050 118.448	22	325 up 235	<0.05 <0.05 0.07
5243	Lawndale, 15000 Aviation Blvd. (USGS)	33.895 118.377	23	360 up 270	0.10 <0.05 0.05

Table 1. Strong-motion data and peak accelerations from the Malibu, California, earthquake of January 19, 1989 (continued)

Station Identification				Acceleration	
USGS Number	Name (owner)	Coordinates (lat. °N, long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)
757	Sepulveda Canyon, Spillway roof (MWD)	34.097 118.478	24	166 up 076	<0.05 <0.05 <0.05
5079	Malibu, Kilpatrick School (USGS)	34.093 118.836	27	270 up 180	<0.05 <0.05 <0.05
949	Sepulveda Dam (ACOE)				
	Downstream	34.167 118.469	31	054 up 324	<0.05 <0.05 <0.05
	Crest	34.168 118.470	31	054 up 324	<0.05 <0.05 <0.05
637	Sepulveda VA Hospital (VA)	34.249 118.475	39	360 up 270	<0.05 <0.05 <0.05
655	Jensen Filter Plant (MWD)				
	Reservoir roof	34.309 118.499	45	022 up 292	<0.05 <0.05 <0.05
	Generator bldg., Ground	34.313 118.498	45	022 up 292	<0.05 <0.05 <0.05
	Administration bldg. basement	34.312 118.496	45	022 up 292	<0.05 <0.05 <0.05

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 5080 34.078°N, 118.693°W Malibu Canyon Monte Nido Fire Station Ground SMA # 1453 (USGS) EARTHQUAKE OF --- 19 January 1989 0653:32.8 G.m.t. (WWVB trigger time)	L 090°	Sens. = 1.81 cm/g Freq. = 26.1 Hz Damp. = 0.6 crit	0.07g
	V Up	Sens. = 1.82 cm/g Freq. = 25.9 Hz Damp. = 0.6 crit	<0.05g
	T 360°	Sens. = 1.81 cm/g Freq. = 25.7 Hz Damp. = 0.6 crit	0.05g

Epicentral distance = 19 km

Film speed = 1 cm/sec

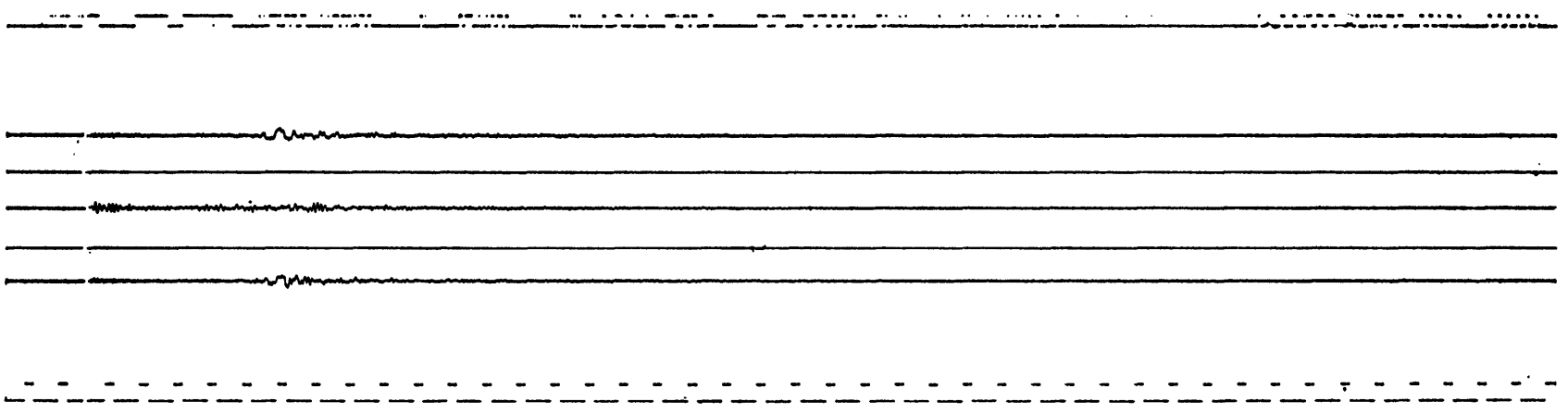

Figure 2. Copies of NSMIN accelerograms.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 5081 34.084°N, 118.599°W Topanga Fire Station Ground	L 270°	Sens. = 1.86 cm/g Freq. = 26.3 Hz Damp. = 0.6 crit	0.10g
SMA # 1520 (USGS)	V Up	Sens. = 1.87 cm/g Freq. = 25.6 Hz Damp. = 0.6 crit	0.09g
EARTHQUAKE OF 19 January 1989 0653:32.8 G.m.t. (WWVB trigger time)	T 180°	Sens. = 1.93 cm/g Freq. = 25.6 Hz Damp. = 0.6 crit	0.06g

Epicentral distance = 19 km

Film speed = 1 cm/sec

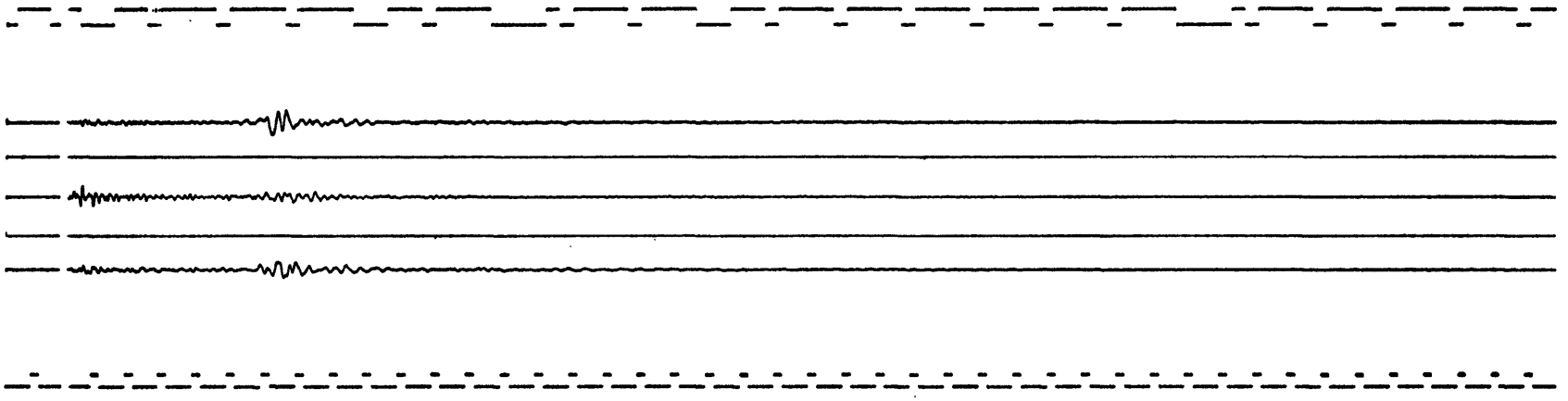

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 638 34.063°N, 118.463°W Los Angeles, Brentwood VA Hospital Ground SMA # 750 (USGS)	L 285°	Sens. = 1.78 cm/g Freq. = 26.5 Hz Damp. = 0.57 crit	<0.05g
	V Up	Sens. = 1.92 cm/g Freq. = 26.0 Hz Damp. = 0.55 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653 G.m.t.	T 195°	Sens. = 1.85 cm/g Freq. = 24.5 Hz Damp. = 0.59 crit	<0.05g
Epicentral distance = 22 km		Film speed = 1 cm/sec	

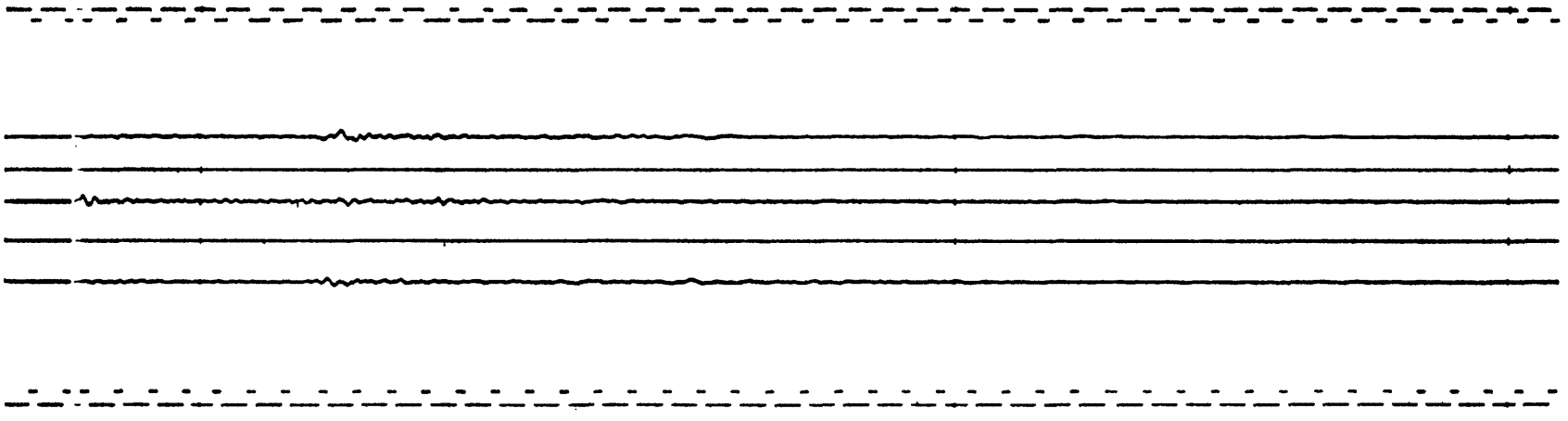

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	CH.	DIRECTION	LOCATION	SENSITIVITY	MAX. ACCELERATION
Station No. 5082	1	235°	6th floor, north	1.93	0.15g
34.053°N, 118.452°W	2	235°	6th floor, north-ctr	1.90	0.11g
Los Angeles	3	235°	6th floor, ctr	1.82	0.13g
Wadsworth VA Hospital	4	055°	6th floor, ctr	1.80	0.11g
Structure Array	5	055°	6th floor, south	1.80	<0.05g
CRA # 233 (VA)	6	325°	6th floor, south	1.95	<0.05g
EARTHQUAKE OF	7	325°	Basement, north-ctr	1.88	0.10g
19 January 1989	8	235°	Basement, north-ctr	1.92	0.07g
0653 G.m.t.	9	Down	Basement, north-ctr	1.70	<0.05g
Epicentral distance = 22 km			Film speed = 1 cm/sec		

[See accelerogram on next page]

Figure 2. Continued.

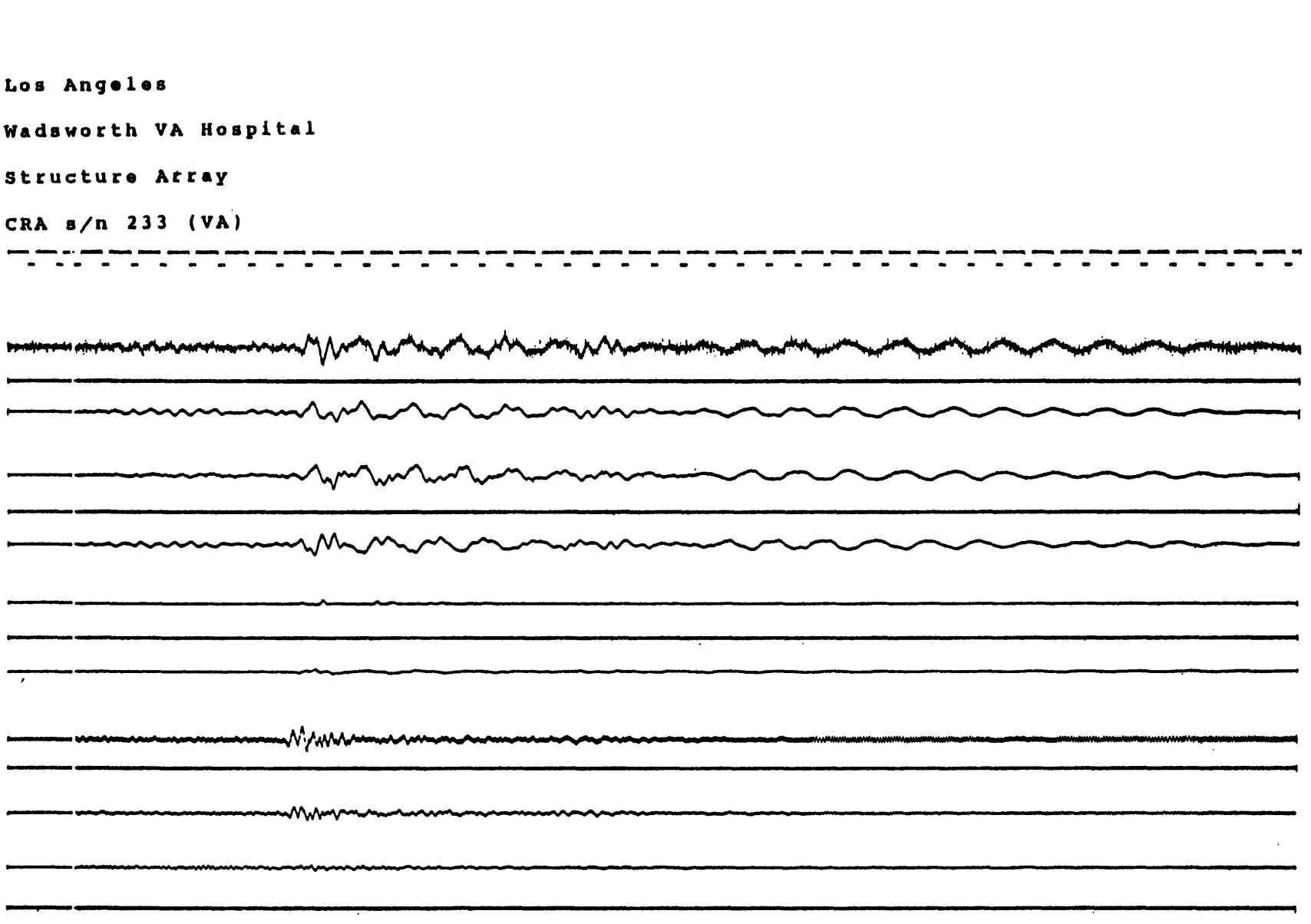

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 5082 34.050°N, 118.448°W Los Angeles, Wadsworth VA Hospital Ground site south SMA # 4979 (USGS)	L 325°	Sens. = 1.75 cm/g Freq. = 27.0 Hz Damp. = 0.55 crit	<0.05g
	V Up	Sens. = 1.80 cm/g Freq. = 25.6 Hz Damp. = 0.57 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653:33.8 G.m.t. (WWVB trigger time)	T 235°	Sens. = 1.75 cm/g Freq. = 27.7 Hz Damp. = 0.59 crit	0.07g
Epicentral distance = 22 km		Film speed = 1 cm/sec	

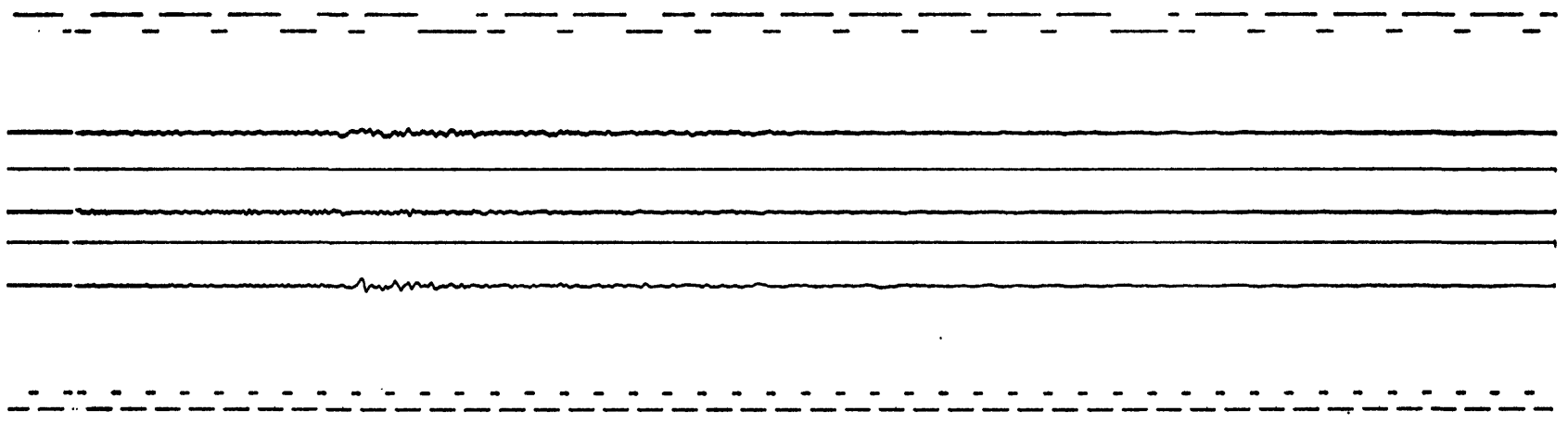

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 5243 33.895°N, 118.377°W Lawndale, 15000 Aviation Blvd. Ground SMA # 379 (USGS)	L 360°	Sens. = 1.95 cm/g Freq. = 25.7 Hz Damp. = 0.6 crit	0.10g
	V Up	Sens. = 2.00 cm/g Freq. = 26.0 Hz Damp. = 0.6 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653 G.m.t.	T 270°	Sens. = 1.75 cm/g Freq. = 26.5 Hz Damp. = 0.6 crit	0.05g
Epicentral distance = 23 km		Film speed = 1 cm/sec	

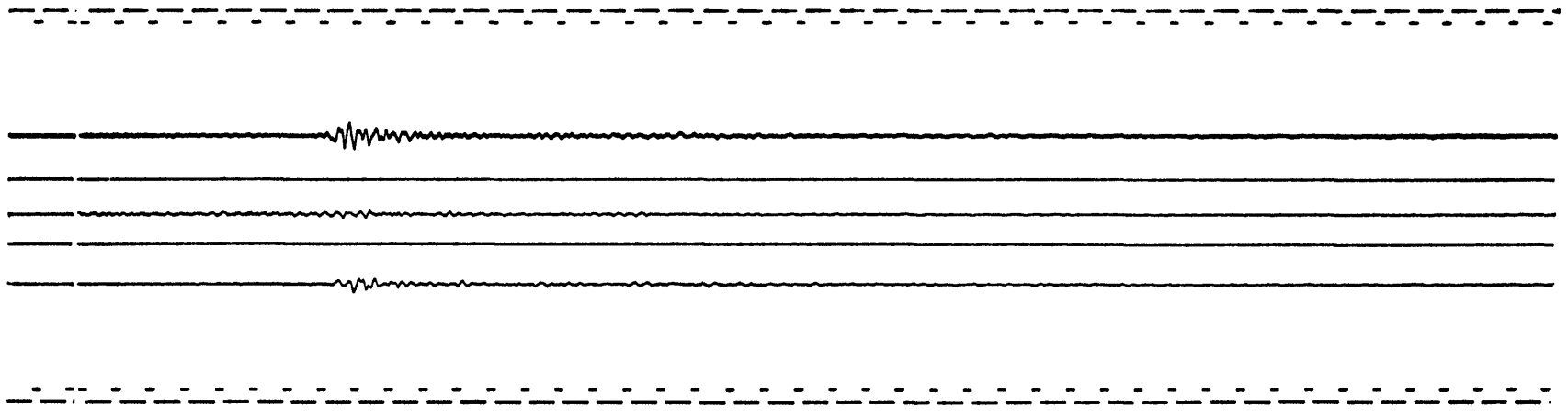

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 757 34.097°N, 118.478°W Sepulveda Canyon Spillway roof SMA # 1054 (MWD)	L 166°	Sens. = 1.84 cm/g Freq. = 26.3 Hz Damp. = 0.59 crit	<0.05g
	V Up	Sens. = 1.93 cm/g Freq. = 25.6 Hz Damp. = 0.59 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653 G.m.t.	T 076°	Sens. = 1.92 cm/g Freq. = 25.0 Hz Damp. = 0.59 crit	0.08g

Epicentral distance = 24 km

Film speed = 1 cm/sec

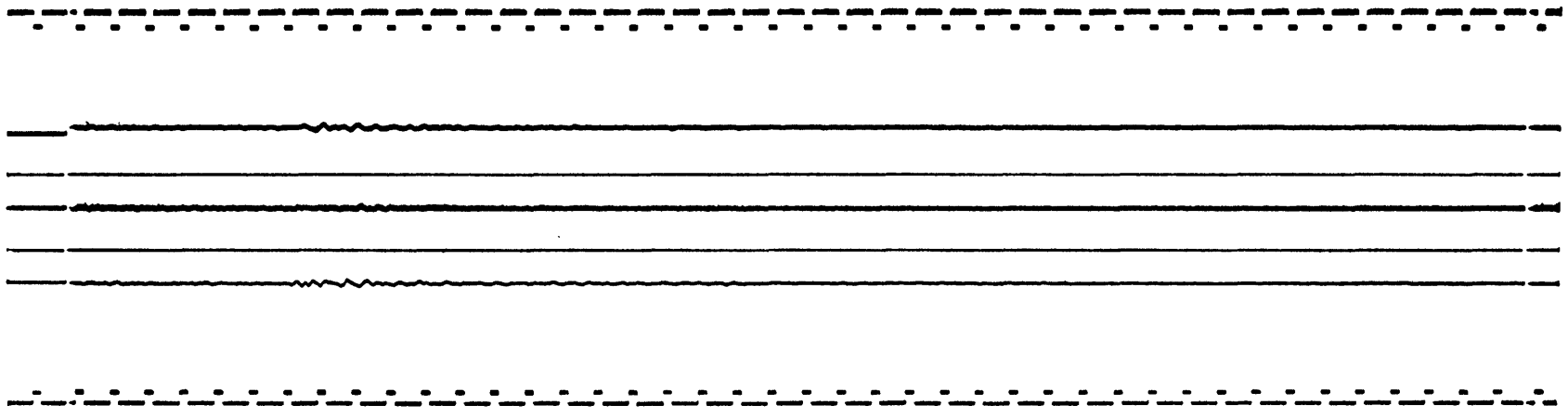

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 5079 34.093°N, 118.836°W Malibu, Kilpatrick School Ground	L 270°	Sens. = 1.89 cm/g Freq. = 26.1 Hz Damp. = 0.6 crit	<0.05g
SMA # 1528 (USGS)	V Up	Sens. = 1.97 cm/g Freq. = 25.8 Hz Damp. = 0.6 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653:36.6 G.m.t. (WWVB trigger time)	T 180°	Sens. = 1.80 cm/g Freq. = 26.3 Hz Damp. = 0.6 crit	<0.05g
Epicentral distance = 27 km		Film speed = 1 cm/sec	

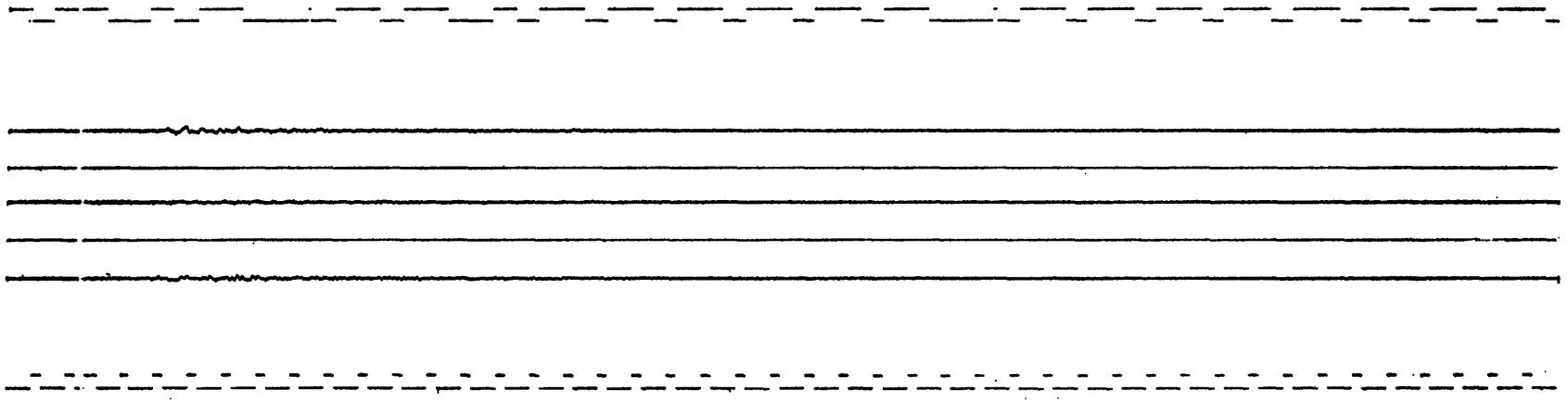

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 949 34.168°N, 118.470°W Sepulveda Dam Crest SMA # 5703 (ACOE)	L 054°	Sens. = 1.90 cm/g Freq. = 25.8 Hz Damp. = 0.6 crit	<0.05g
	V Up	Sens. = 1.99 cm/g Freq. = 25.1 Hz Damp. = 0.6 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653 G.m.t.	T 324°	Sens. = 1.88 cm/g Freq. = 25.4 Hz Damp. = 0.6 crit	<0.05g

Epicentral distance = 31 km

Film speed = 1 cm/sec

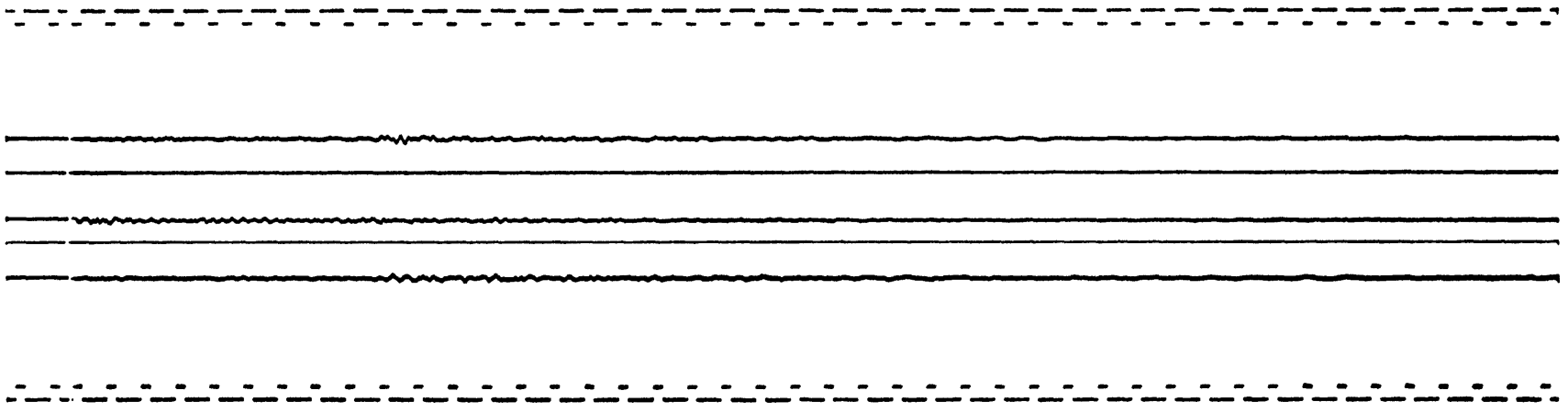

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 949 34.167°N, 118.469°W Sepulveda Dam Downstream SMA # 5702 (ACOE)	L 054°	Sens. = 1.70 cm/g Freq. = 26.6 Hz Damp. = 0.6 crit	<0.05g
	V Up	Sens. = 1.85 cm/g Freq. = 25.6 Hz Damp. = 0.6 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653 G.m.t.	T 324°	Sens. = 1.84 cm/g Freq. = 26.0 Hz Damp. = 0.6 crit	<0.05g
Epicentral distance = 31 km		Film speed = 1 cm/sec	

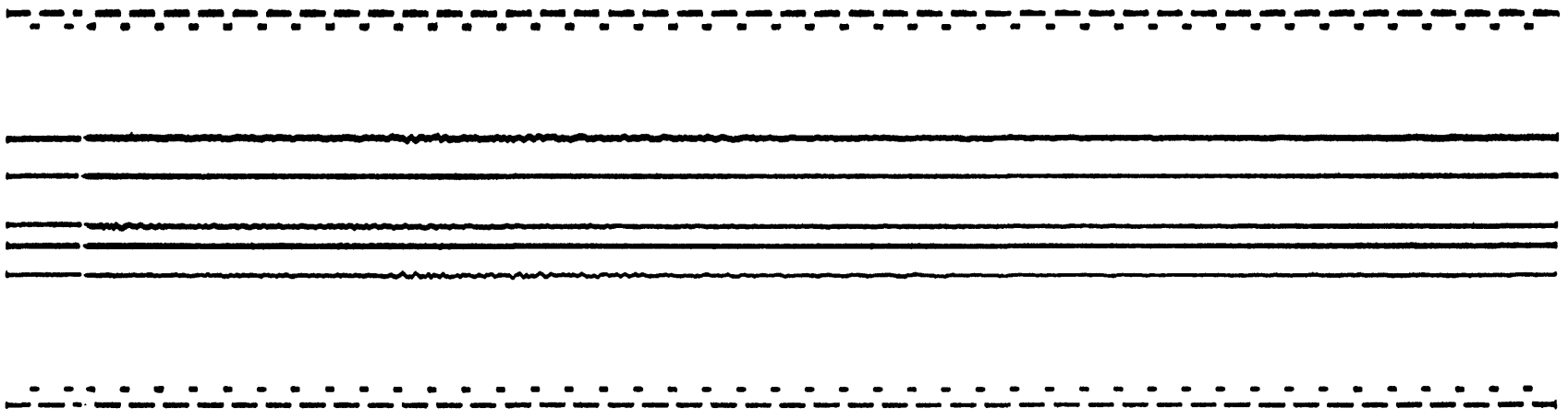

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 637 34.249°N, 118.475°W Sepulveda VA Hospital Ground SMA # 751 (VA)	L 360°	Sens. = 1.84 cm/g Freq. = 26.3 Hz Damp. = 0.55 crit	0.07g
	V Up	Sens. = 1.81 cm/g Freq. = 25.6 Hz Damp. = 0.55 crit	<0.05g
EARTHQUAKE OF 19 January 1989 0653 G.m.t.	T 270°	Sens. = 1.80 cm/g Freq. = 25.0 Hz Damp. = 0.55 crit	<0.05g
Epicentral distance = 39 km		Film speed = 1 cm/sec	

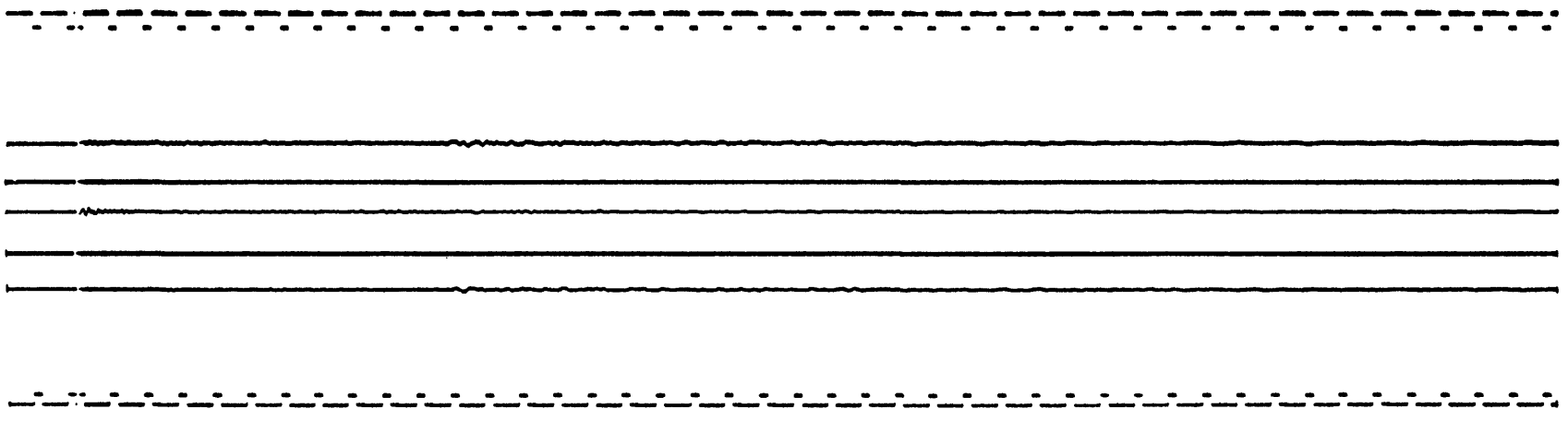

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 655	L 022°	Sens. = 1.75 cm/g	<0.05g
34.309°N, 118.499°W		Freq. = 20.4 Hz	
Jensen Filter Plant		Damp. = 0.57 crit	
Reservoir roof			
RFT-350 s/n 1003 (MWD)	V Up	Sens. = 1.72 cm/g	<0.05g
		Freq. = 21.7 Hz	
EARTHQUAKE OF		Damp. = 0.57 crit	
19 January 1989	T 292°	Sens. = 1.74 cm/g	<0.05g
0653 G.m.t.		Freq. = 20.4 Hz	
		Damp. = 0.57 crit	
Epicentral distance = 45 km		Film speed = 1 cm/sec	

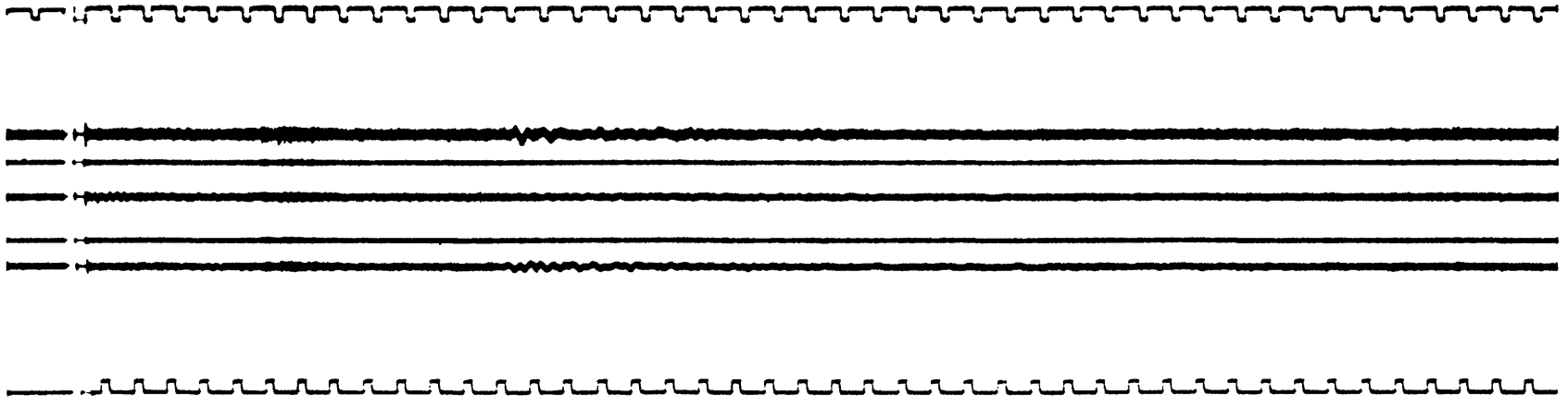

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 655 34.313°N, 118.498°W Jensen Filter Plant Generator building, ground RFT-350 s/n 1002 (MWD)	L 022°	Sens. = 1.85 cm/g Freq. = 20.0 Hz Damp. = 0.60 crit	<0.05g
	V Up	Sens. = 1.85 cm/g Freq. = 20.8 Hz Damp. = 0.55 crit	<0.05g
EARTHQUAKE OF --- 19 January 1989 0653 G.m.t.	T 292°	Sens. = 1.76 cm/g Freq. = 20.8 Hz Damp. = 0.55 crit	<0.05g

Epicentral distance = 45 km

Film speed = 1 cm/sec

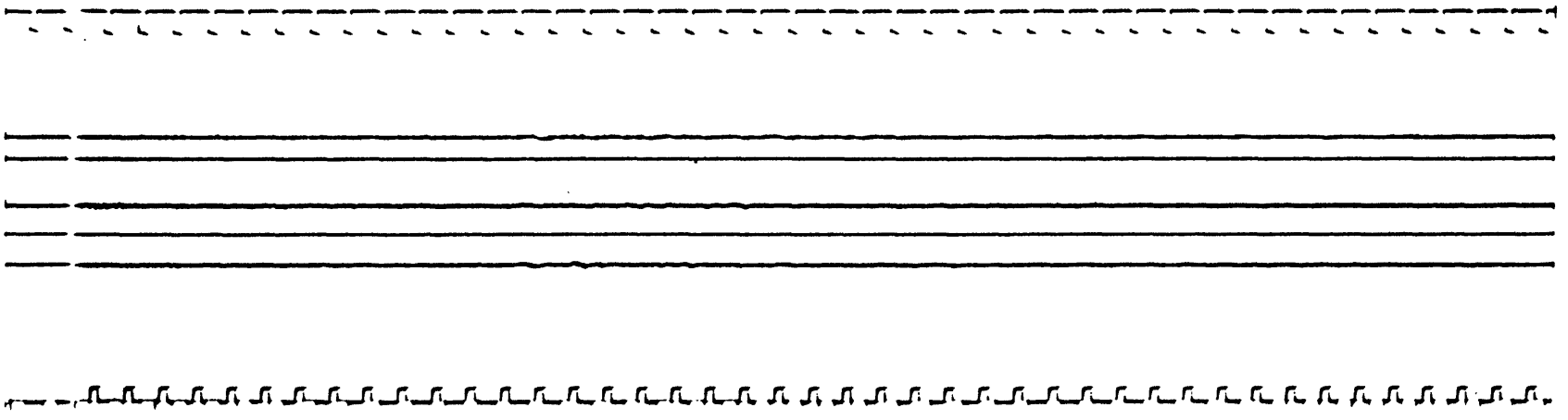

Figure 2. Continued.

U.S. STRONG-MOTION NETWORK	DIRECTION	CONSTANTS	MAX. ACCELERATION
Station No. 655	L 022°	Sens. = 1.78 cm/g	<0.05g
34.312°N, 118.496°W		Freq. = 26.3 Hz	
Jensen Filter Plant		Damp. = 0.57 crit	
Administration Bldg., basement			
SMA # 259 (MWD)	V Up	Sens. = 1.74 cm/g	<0.05g
		Freq. = 27.0 Hz	
EARTHQUAKE OF		Damp. = 0.55 crit	
19 January 1989	T 292°	Sens. = 1.63 cm/g	<0.05g
0653 G.m.t.		Freq. = 27.7 Hz	
		Damp. = 0.50 crit	
Epicentral distance = 45 km		Film speed = 1 cm/sec	

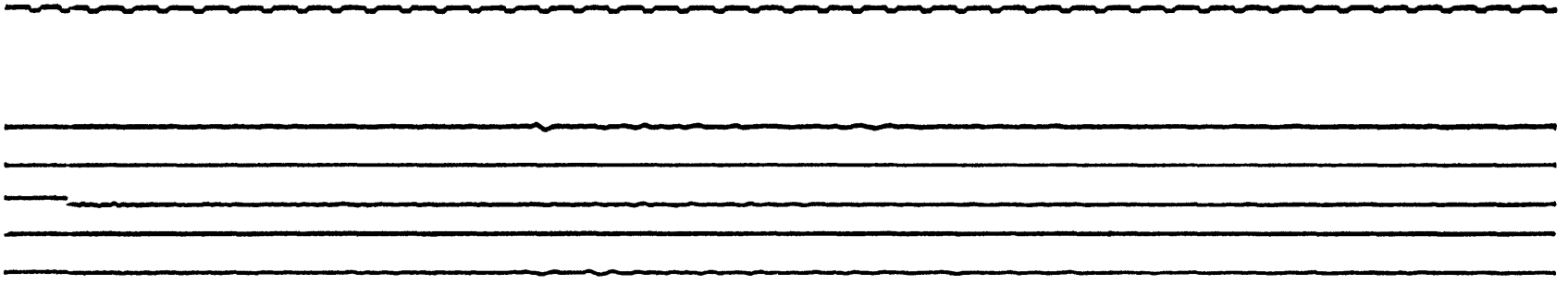

Figure 2. Continued.

Table 2. Epicentral and hypocentral distances to NSMIN stations

Earthquake date: January 19, 1989
Time: 0653 G.m.t
Magnitude: ML=5.0
Epicenter: 33.919°N, 118.627°W
Depth: 11.85 kilometers (CIT).

Station Name	Coordinates (lat. °N, long. °W)	Epicentral Distance (km)	Hypocentral Distance (km)	Azimuth from Epicenter (degrees)
Malibu Canyon, Monte Nido Fire Station	34.078 118.693	19	22	341.0
Topanga Fire Station	34.084 118.599	19	22	8.0
Los Angeles, Brentwood VA	34.063 118.463	22	25	45.3
Los Angeles, Wadsworth VA, Building	34.053 118.452	22	25	47.2
Los Angeles, Wadsworth VA, South ground site	34.050 118.448	22	25	48.5
Lawndale, 15000 Aviation Blvd.	33.895 118.377	23	26	96.5
Sepulveda Canyon Spillway roof	34.097 118.478	24	27	34.7
Malibu, Kilpatrick School	34.093 118.836	27	30	315.2
Sepulveda Dam, Crest	34.168 118.470	31	33	27.5
Sepulveda Dam, Downstream	34.167 118.469	31	33	27.8
Sepulveda VA	34.249 118.475	39	41	20.8
Jensen Filter Plant, Reservoir roof	34.309 118.499	45	46	15.2
Jensen Filter Plant, Generator bldg.	34.313 118.498	45	47	15.1
Jensen Filter Plant, Admin. bldg.	34.312 118.496	45	47	15.4