

GEOLOGICAL SURVEY OPEN-FILE REPORT 88-38

***STRONG-MOTION DATA FROM THE
WHITTIER NARROWS AFTERSHOCK OF OCTOBER 4, 1987***

By

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With contributions from

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STRONG-MOTION DATA FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987

The ML=5.9 Whittier Narrows earthquake of October 1, 1987 triggered accelerographs at 52 stations in the Los Angeles region that are operated as a part of the National Strong-Motion Instrumentation Network (NSMIN). Strong-motion data and information about NSMIN stations that triggered during this event have been presented in Etheredge and Porcella (1987). On October 4 at 1059 G.m.t. a significant set of strong-motion data was recorded at 30 of the main shock stations during an ML=5.3 aftershock. The purpose of this companion report is to present NSMIN data recorded during the October 4 Whittier Narrows aftershock. The reader is referred to Etheredge and Porcella (1987) for a general overview of the NSMIN and for other Network information, including instrumentation layout drawings of some of the more extensively instrumented structures in the greater Los Angeles region.

The October 4 aftershock was located at 34.070° N. lat. and 118.098° W. long., approx. 3 km northwest of the main shock epicenter. This event was reportedly responsible for at least one death, several injuries, and additional damage to many structures in the Whittier-Alhambra area that were already damaged by the main shock (Los Angeles Times, October 5, 1987).

Thirty NSMIN stations recorded this aftershock at epicentral distances of 2 km to 57 km at Palmdale (figures 1 and 2). These stations include 11 buildings, 9 dam/reservoir facilities, 4 VA hospital installations, and 5 ground sites. Peak horizontal ground accelerations were in the range $0.15 \underline{g}$ - $0.33 \underline{g}$ at 6 stations within an epicentral distance of 12 km. At 14-30 km distances the peak recorded motions are significantly lower, generally in the range $0.05 \underline{g}$ - $0.10 \underline{g}$, and beyond 30 km seldom exceed $0.05 \underline{g}$ (see table 1). Copies of accelerograms from all NSMIN stations are presented in figure 3.

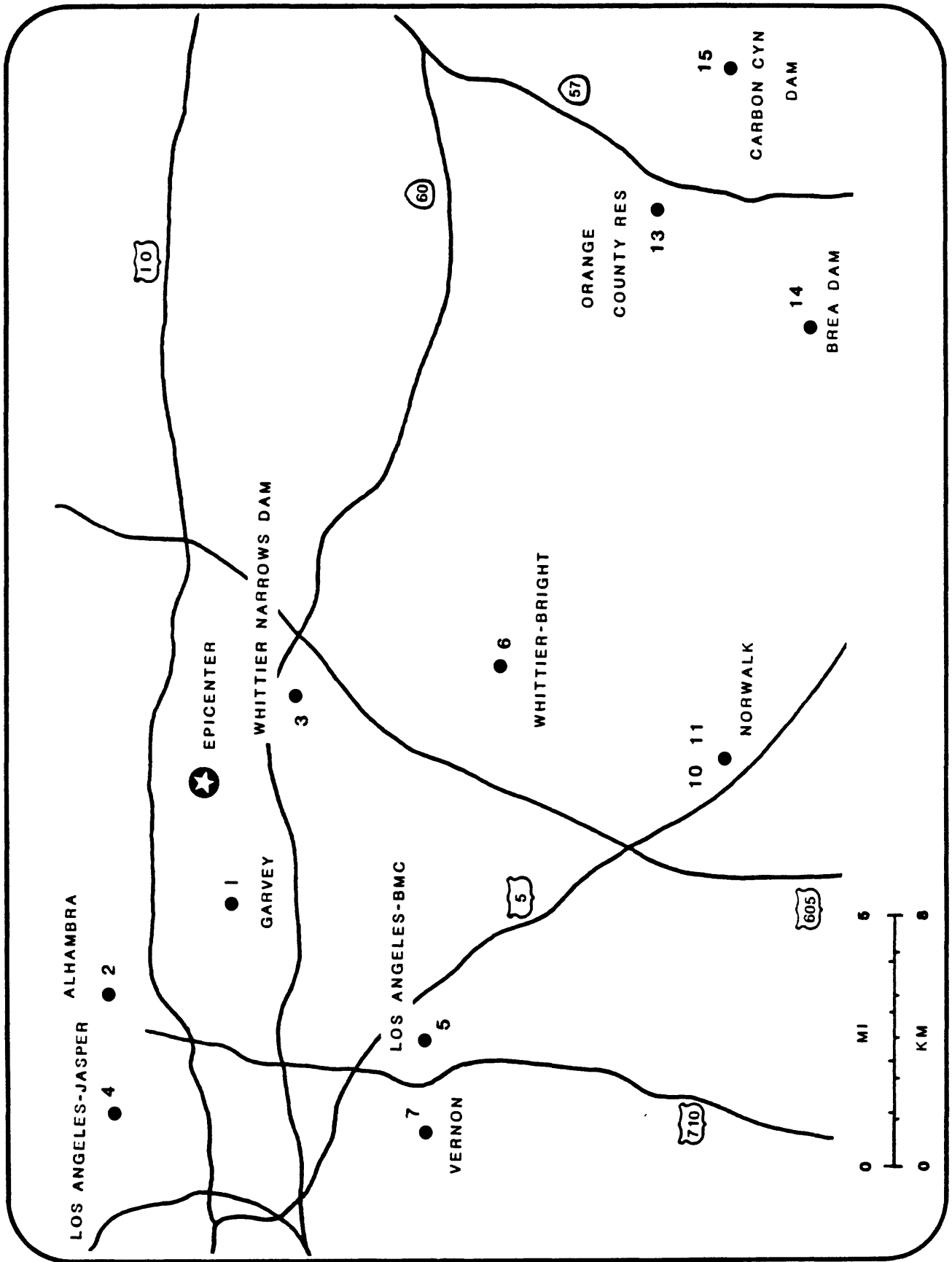


Figure 1. Close in map of USGS stations triggered during the Whittier Narrows aftershock.

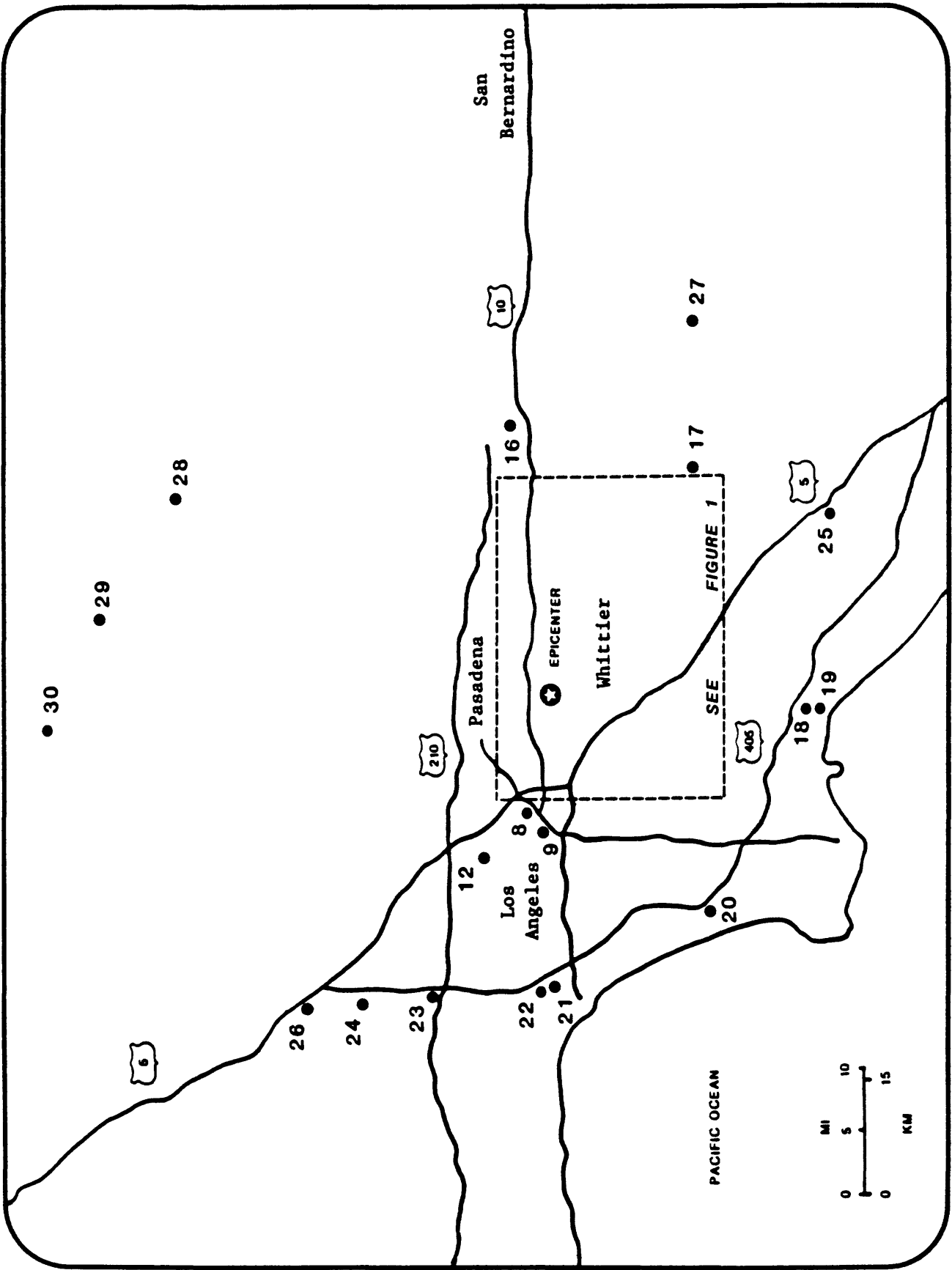


Figure 2. Regional map showing USGS stations triggered during the Whittier Narrows aftershock. Numbers on map may be referenced to table 1 index for station identification.

Table 1. STRONG-MOTION INFORMATION AND PEAK ACCELERATIONS FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987

[Station owners are Army Corps of Engineers (ACOE); Bechtel Power Corporation (BECH); U.S. Dept. of Energy (DOE); JCG Finance Corp. of America (JCG); Los Angeles Metro. Water District (MWD); U.S Geological Survey (USGS); and the Veterans Administration (VA). Epicentral distance is measured from station to epicenter at lat. 34.070 N., long. 118.098 W. Direction of acceleration is for upward trace deflection on accelerogram; vertical-component directions are listed as 'up' or 'down'.]

Station Identification				Acceleration			
Map Index Number	USGS Number	Name (Owner)	Coordinates (Lat. °N, Long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)	
1	709	Garvey Reservoir Abutment Bldg. (MWD)	34.05 118.11	2	060	0.19	
					Up	.13	
					330	.21	
2	482	Alhambra 900 S. Fremont (USGS)	34.09 118.15	5			
					Basement	090	.15
						Up	.10
					360	.11	
		6th Floor			090	.24	
					Up	.15	
					360	.17	
		12th Floor			090	.18	
					Up	.19	
	360	.13					
3	289	Whittier Narrows Dam (ACOE)	34.03 118.05	6			
					Crest	033	.21
						Up	.09
					303	.25	
		Upstream			152	Instrumen failed	
					Up		
	062						
4	5244	Los Angeles 4407 Jasper Street (USGS)	34.081 118.188	8	130	.17	
					Up	.10	
					040	.17	
5	5129	Los Angeles Bulk Mail Center (USGS)	33.99 118.16	11	010	.24	
					Up	.08	
					280	.25	

Table 1.--STRONG-MOTION INFORMATION AND PEAK ACCELERATIONS FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987 (continued)

Station Identification					Acceleration		
Map Index Number	USGS Number	Name (Owner)	Coordinates (Lat. °N, Long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)	
6	804	Whittier 7215 Bright Ave. (USGS)	33.977 118.036	12			
					Basement	180	0.30
						Up	.15
						090	.33
					5th Floor	180	.30
						Up	.28
						090	.58
					10th Floor	180	.17
						Up	.53
	090	.43					
7	288	Vernon 4814 Loma Vista Ave. (USGS)	34.00 118.20	12	007	.15	
						Up	.07
						277	.27
8	872	Los Angeles 1111 Sunset Blvd. (MWD)	34.07 118.25	14			
					Basement	348	.08
						Up	.05
						258	.08
					4th Floor	348	.11
						Up	.07
						258	.10
					Roof	348	.10
						Up	.10
	258	.08					
9	5233	Los Angeles 1100 Wilshire (JCG/USGS)	34.052 118.263	15			
					Basement 3, NE	298	.07
						Up	.04
						208	.09
					Basement 3, SE	298	.08
						Up	.04
						208	.08
					Basement 4, NW	298	.06
						Up	.05
	208	.07					

Table 1.--STRONG-MOTION INFORMATION AND PEAK ACCELERATIONS FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987 (continued)

Station Identification				Acceleration		
Map Index Number	USGS Number	Name (Owner)	Coordinates (Lat. °N, Long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)
9	5233	L.A., 1100 Wilshire (continued)				
		Structure Array:				
		Ch. 1- 12th Floor, North			298	0.09
		Ch. 2- 12th Floor, North			208	.11
		Ch. 3- 12th Floor, South			208	.08
		Ch. 4- 13th Floor, North			298	.11
		Ch. 5- 13th Floor, North			208	.14
		Ch. 6- 13th Floor, South			208	.08
		Ch. 7- 32nd Floor, North			298	.08
		Ch. 8- 32nd Floor, North			208	.20
		Ch. 9- 32nd Floor, South			208	.08
		Ch. 10- Ground Floor, North			298	.11
		Ch. 11- Ground Floor, North			208	.08
		Ch. 12- Ground Floor, South			208	.10
10	634	Norwalk 12400 Imperial Hiway (USGS/BECH)	33.92 118.07	17		
		Basement			090 Up 360	.05 .04 .05
		4th Floor			090 Up 360	.06 .07 .10
		Roof			090 Up 360	.10 .10 .08
		North Ground Site	-- removed for repair.		---	---
		South Ground Site			090 Up 360	.05 .10 .06
11	5239	Norwalk 12440 Imperial Hiway (USGS/BECH)	33.92 118.07	17		
		Basement			090 Up 360	.05 .05 .04
		North Ground Site			090 Up 360	.07 .06 .06
		South Ground Site			090 Up 360	.05 .08 .05

Table 1.--STRONG-MOTION INFORMATION AND PEAK ACCELERATIONS FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987 (continued)

Station Identification				Acceleration		
Map Index Number	USGS Number	Name (Owner)	Coordinates (Lat. °N, Long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)
11	5239	Norwalk, 12440 Imperial Hiway (continued)				
		Structure Array 1:				
		Ch. 1- 7th Floor, Center			090	0.09
		Ch. 2- 5th Floor, Center			090	.07
		Ch. 3- 2nd Floor, Center			090	.05
		Ch. 4- 1st Floor, Center			090	.06
		Ch. 5- Basement, East			360	.05
		Ch. 6- 5th Floor, West-Center			360	.07
		Ch. 7- Basement, Center			Up	.03
		Ch. 8- Basement, Center			090	.05
		Ch. 9- Basement, Center			360	.05
		Ch. 10- 30 ft. Downhole, Bldg. Center			Up	.03
		Ch. 11- 30 ft. Downhole, Bldg. Center			090	.04
		Ch. 12- 30 ft. Downhole, Bldg. Center			360	.03
		Structure Array 2:				
		Ch. 13- 7th Floor, East			360	.08
		Ch. 14- 5th Floor, East			360	.04
		Ch. 15- 2nd Floor, East			360	.03
		Ch. 16- 1st Floor, East			360	.05
		Ch. 17- 7th Floor, Center			360	.08
		Ch. 18- 5th Floor, Center			360	INOP
		Ch. 19- 2nd Floor, Center			360	.05
		Ch. 20- 1st Floor, Center			360	.07
		Ch. 21- 7th Floor, West			360	.09
		Ch. 22- 5th Floor, West			360	.05
		Ch. 23- 2nd Floor, West			360	.04
		Ch. 24- 1st Floor, West			360	.03
12	141	Los Angeles Griffith Park Observatory (USGS)	34.12 118.30	19	360 Up 270	.04 .05 .05
13	697	Orange County Reservoir Abutment (MWD)	33.935 117.883	25	096 Up 006	.06 .04 .07
14	951	Brea Dam (ACOE)	33.889 117.926	26		
		Crest			130 Up 040	.08 .07 .19
		Left Abutment			130 Up 040	.05 .05 .09
		Downstream			130 Up 040	.07 .05 .13

Table 1.--*STRONG-MOTION INFORMATION AND PEAK ACCELERATIONS FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987 (continued)*

Station Identification					Acceleration	
Map Index Number	USGS Number	Name (Owner)	Coordinates (Lat. °N, Long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)
15	108	Carbon Canyon Dam (ACOE)	33.92 117.84	29		
		Crest			130 Up 040	0.06 .04 .07
		Left Abutment			130 Up 040	.05 .03 .05
		Right Abutment			130 Up 040	.07 .03 .05
16	5164	Weymouth Filter Plant (MWD)	34.114 117.778	30		
		Bldg., Ground Level			017 Up 287	.02 .01 .03
		Water Tank, Top			017 Up 287	.05 .04 .07
17	698	Diemer Filter Plant (MWD)	33.91 117.82	31		
		Admin. Bldg. Basement			281 Up 191	.02 .01 .03
		Reservoir Roof			281 Up 191	.04 .05 .06
18	132	Long Beach, CSULB Humanities Bldg. Basement (USGS)	33.78 118.11	32	076 Up 346	.06 .03 .04
19	5106	Long Beach VA Hospital (VA)	33.78 118.12	32		
		Basement			360 Up 270	.06 .03 .05

Table 1.--*STRONG-MOTION INFORMATION AND PEAK ACCELERATIONS FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987 (continued)*

Station Identification				Acceleration		
Map Index Number	USGS Number	Name (Owner)	Coordinates (Lat. °N, Long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)
19	5106	Long Beach VA Hospital (continued)				
		6th Floor			360	0.09
					Up	.05
					270	.10
		11th Floor			360	.16
					Up	.07
					270	.17
20	5243	Lawndale 15000 Aviation Blvd. (USGS)	33.895 118.377	32	360	.04
					Up	.02
					270	.03
21	5082	Los Angeles Wadsworth VA Hospital (VA/USGS)	34.050 118.452	33		
		Bldg. 500 Structure Array:				
		Ch. 1- 6th Floor, North End			235	
		Ch. 2- 6th Floor, North Center			235	
		Ch. 3- 6th Floor, Center			235	
		Ch. 4- 6th Floor, Center			055	Not
		Ch. 5- 6th Floor, South End			055	triggere
		Ch. 6- 6th Floor, South End			325	
		Ch. 7- Basement, North Center			325	
		Ch. 8- Basement, North Center			235	
		Ch. 9- Basement, North Center			Down	
		North Ground Site			325	.03
					Up	.03
					235	.03
		South Ground Site			325	Not
					Up	triggere
					235	
22	638	Los Angeles, Brentwood VA Hospital, Ground level (VA)	34.058 118.457	33	285	.01
					Up	.02
					195	.03
23	949	Sepulveda Dam (ACOE)	34.17 118.47	36		
		Crest			054	.05
					Up	.04
					324	.04
		Downstream			054	.04
					Up	.05
					324	.04

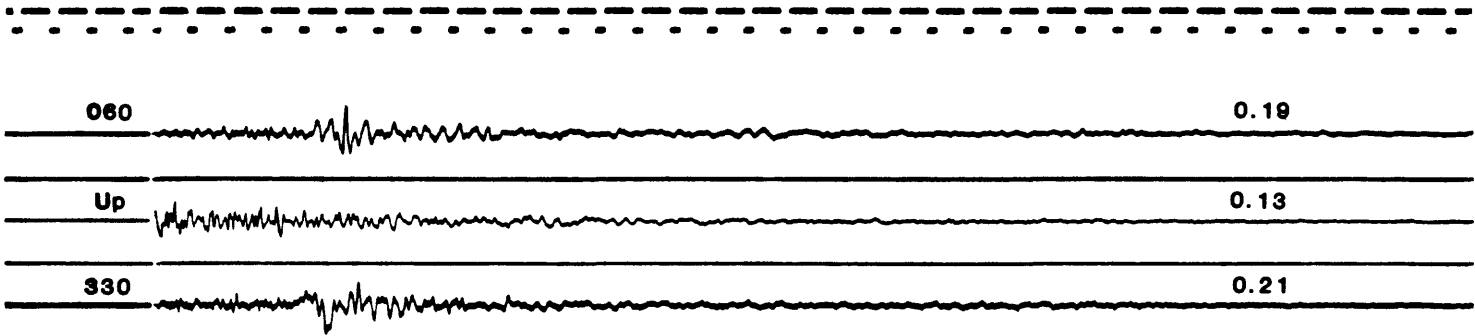
Table 1.--STRONG-MOTION INFORMATION AND PEAK ACCELERATIONS FROM THE WHITTIER NARROWS
AFTERSHOCK OF OCTOBER 4, 1987 (continued)

Station Identification				Acceleration			
Map Index Number	USGS Number	Name (Owner)	Coordinates (Lat. °N, Long. °W)	Epicentral Distance (km)	Direction (degrees)	Maximum (g)	
24	637	Sepulveda VA Hospital Ground level (VA)	34.249 118.475	40	360	0.04	
					Up	.02	
					270	.06	
25	281	Santa Ana, Orange County Engineering Bldg., Basement (USGS)	33.75 117.87	41	360	.02	
					Up	.02	
					270	.02	
26	655	Jensen Filter Plant (MWD)	34.309 118.499	46			
					Administration Bldg.	022	.02
						Up	.01
		292	.03				
		Generator Room	022	.02			
			Up	.01			
			292	.02			
		Reservoir Roof	022	.05			
			Up	.02			
292	.07						
27	969	Prado Dam (ACOE)	33.89 117.64	47			
					Crest	090	Not triggered
						Up	
		360					
		Left Abutment	090	Not triggered			
			Up				
			360				
		Downstream	090	.04			
			Up	.03			
360	.07						
28	5031	Valyermo Forest Station Ground Level (USGS)	34.44 117.85	47	300	.02	
					Up	.01	
					210	.01	
29	5030	Littlerock Post Office Ground Level (USGS)	34.521 117.991	51	300	.02	
					Up	.01	
					210	.01	
30	262	Palmdale Fire Station Ground Level (USGS)	34.58 118.11	57	120	.02	
					Up	.02	
					030	.02	

<u>Record</u>	<u>Page</u>
Garvey Reservoir - - - - -	12
Whittier Narrows Dam - - - - -	12
L.A. - 4407 Jasper St. - - - - -	12
Alhambra - 900 S. Fremont Ave. - - - - -	13
Whittier - 7215 Bright Ave. - - - - -	14
L.A. - Bulk Mail Center - - - - -	15
Vernon - - - - -	15
L.A. - Griffith Park - - - - -	15
L.A. - 1111 Sunset Blvd. - - - - -	16
L.A. - 1100 Wilshire Blvd. - - - - -	17-18
Norwalk - 12400 Imperial Highway - - - - -	19
Norwalk - 12440 Imperial Highway - - - - -	20-22
Orange County Reservoir - - - - -	23
Weymouth Filter Plant - - - - -	23
Brea Dam - - - - -	24
Carbon Canyon Dam - - - - -	25
Long Beach - CSULB - - - - -	26
Diemer Filter Plant - - - - -	26
Long Beach VA Hospital - - - - -	27
L.A. - Wadsworth VA Hospital - - - - -	28
L.A. - Brentwood VA Hospital - - - - -	28
Lawndale - 15000 Aviation Blvd. - - - - -	28
Sepulveda Dam - - - - -	29
Sepulveda VA Hospital - - - - -	29
Jensen Filter Plant - - - - -	30
Santa Ana - Orange County Bldg. - - - - -	31
Prado Dam - - - - -	31
Valerymo - - - - -	32
Littlerock - - - - -	32
Palmdale - - - - -	32

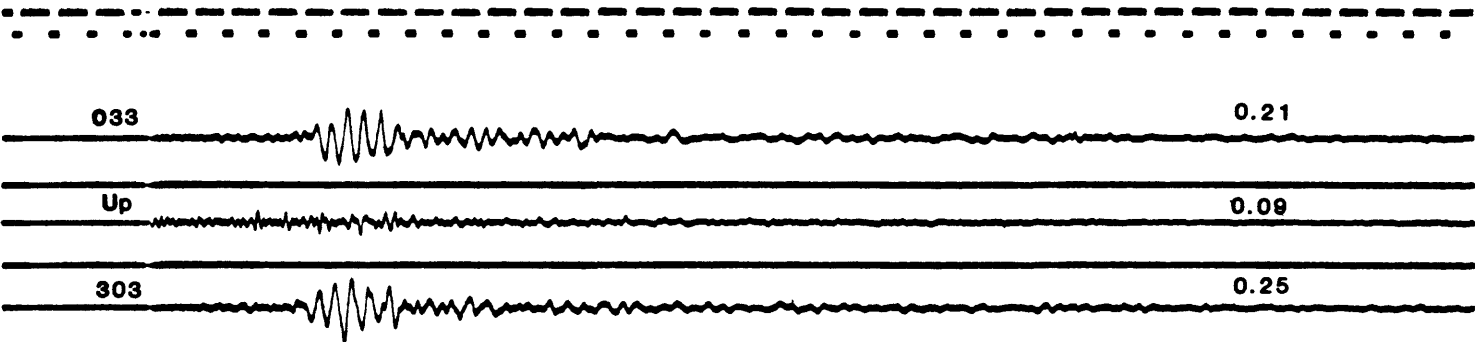
Figure 3. Copies of accelerograms recorded at USGS stations during the Whittier Narrows aftershock.

GARVEY RESERVOIR, ABUTMENT BLDG

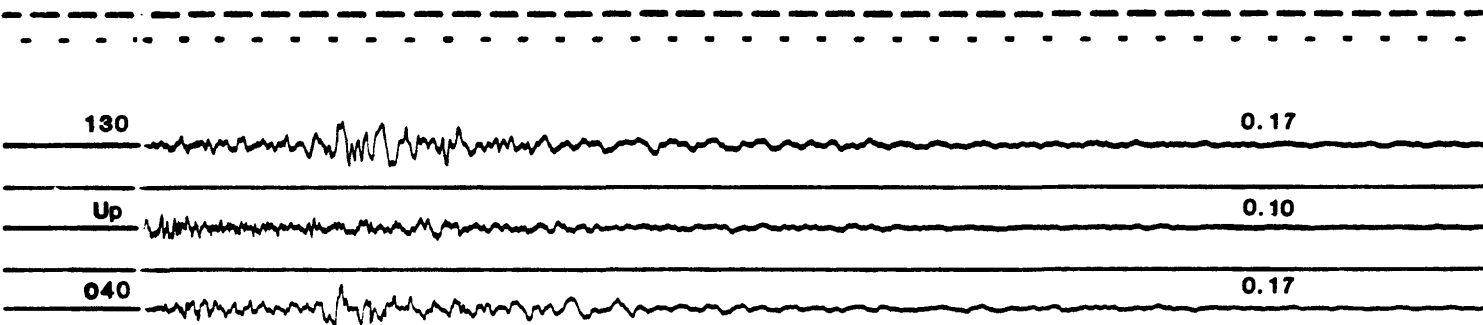


Crest

WHITTIER NARROWS DAM



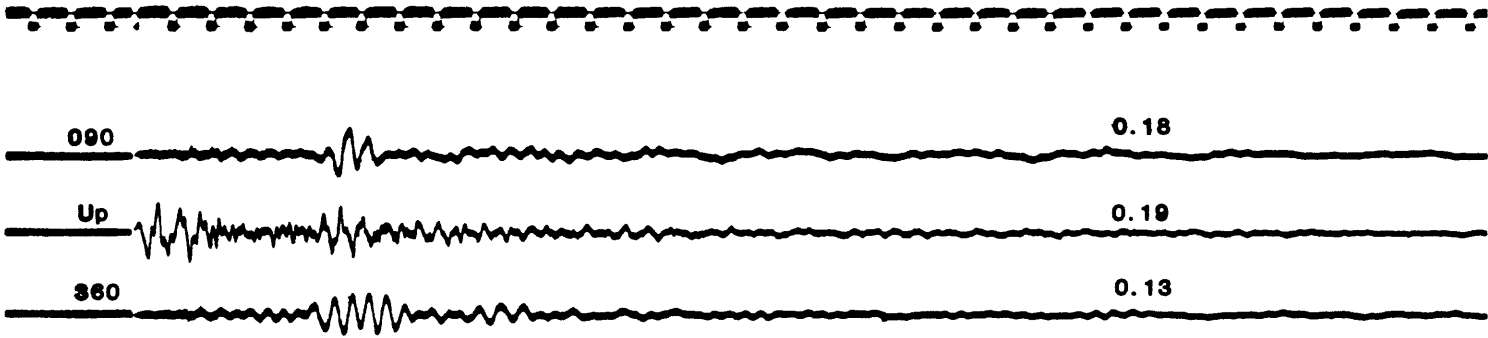
LOS ANGELES, 4407 JASPER STREET



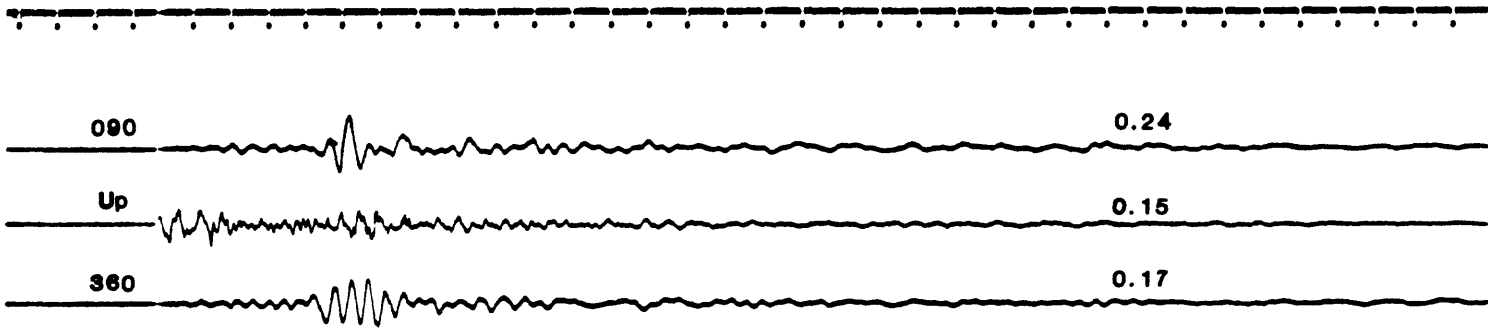
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ALHAMBRA, 900 SOUTH FREMONT

12th Floor

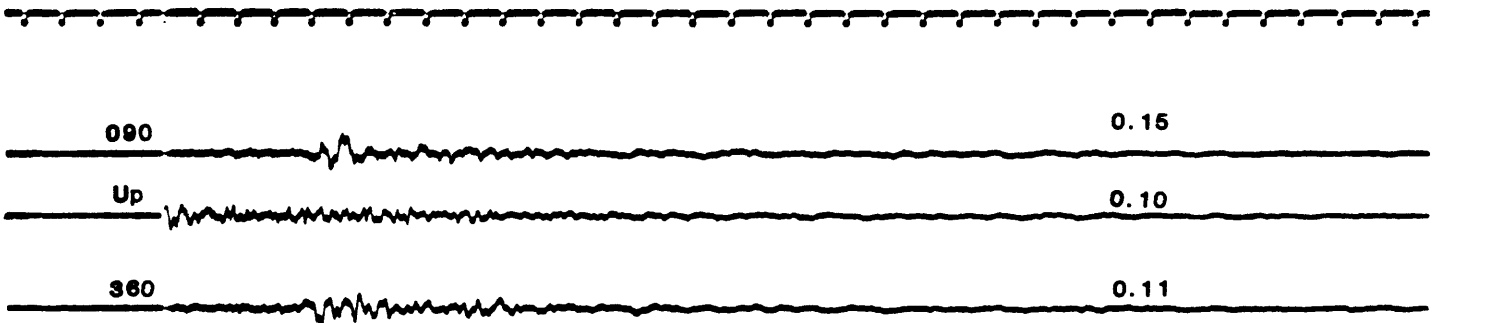


6th Floor



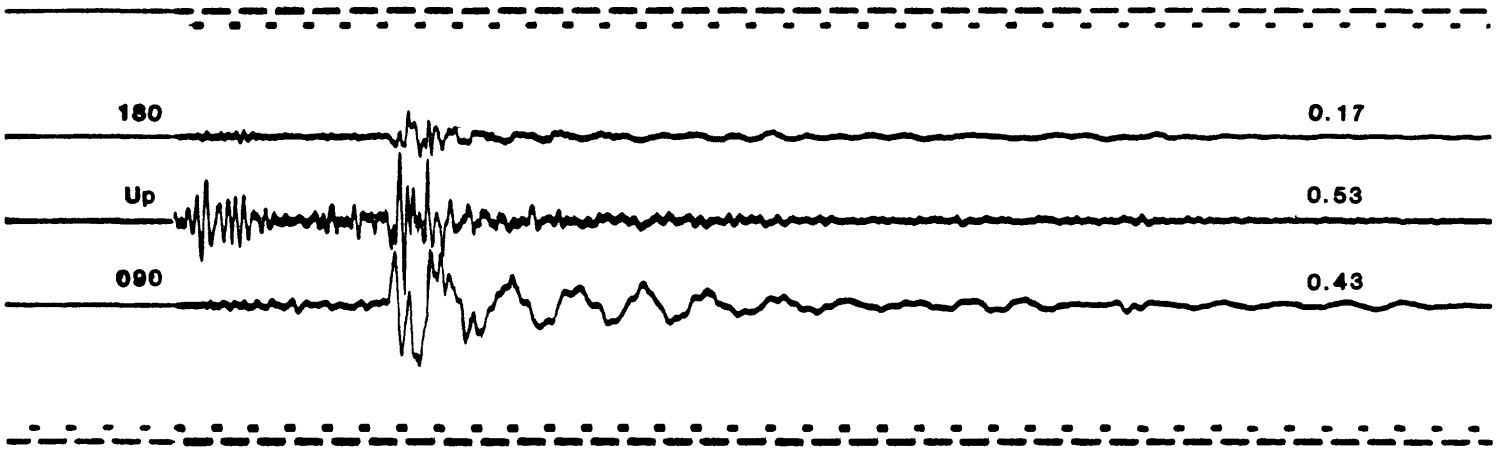
Basement

One cm/sec

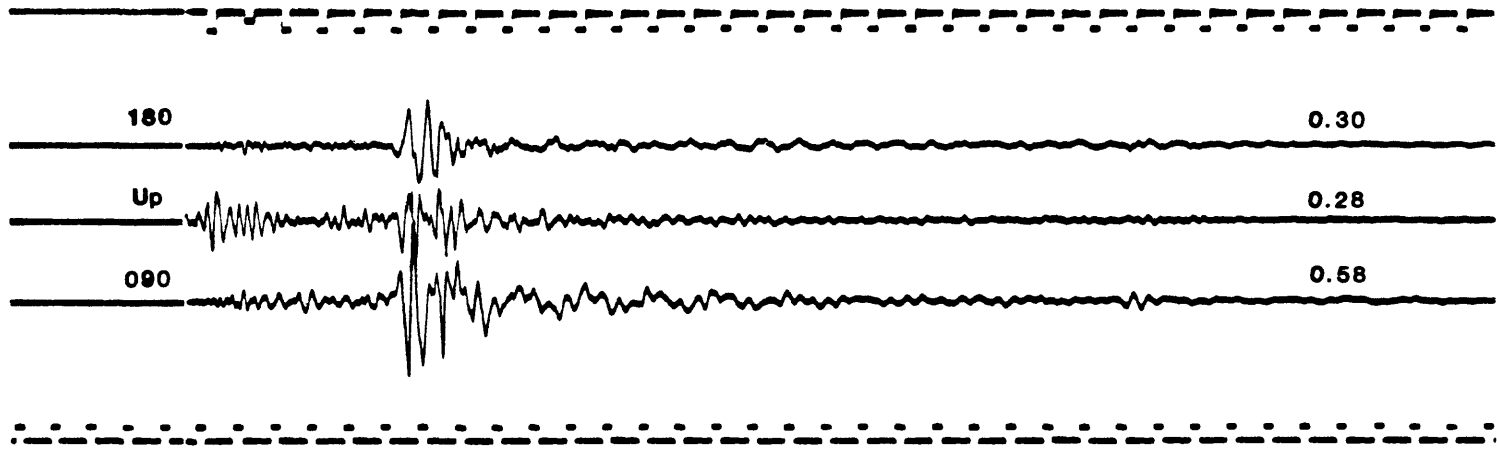


WHITTIER, 7215 BRIGHT AVE

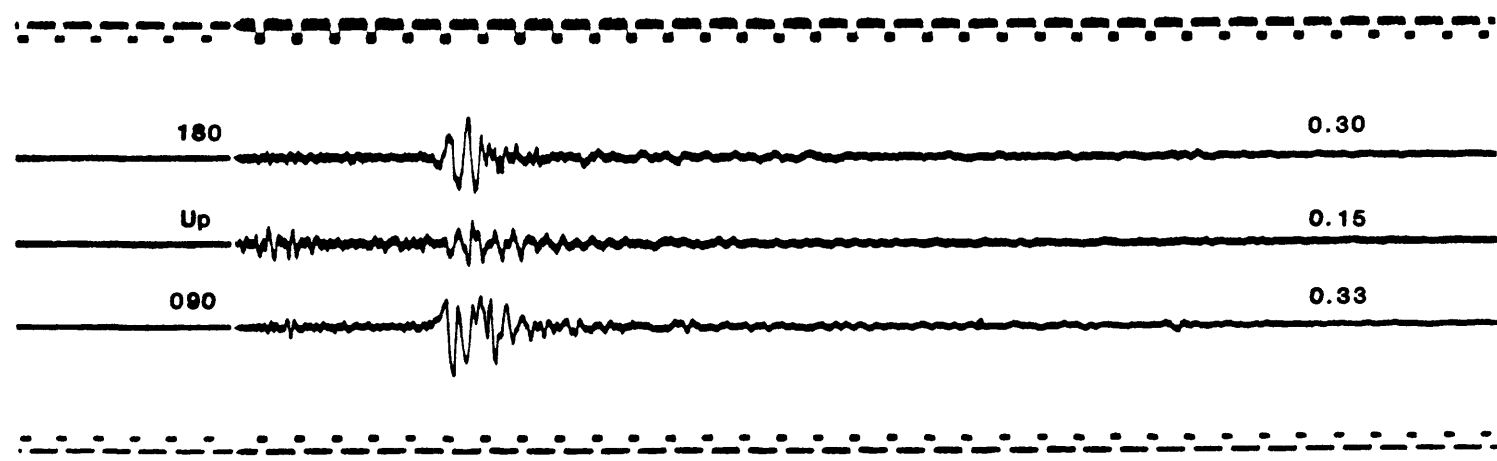
10th Floor



5th Floor

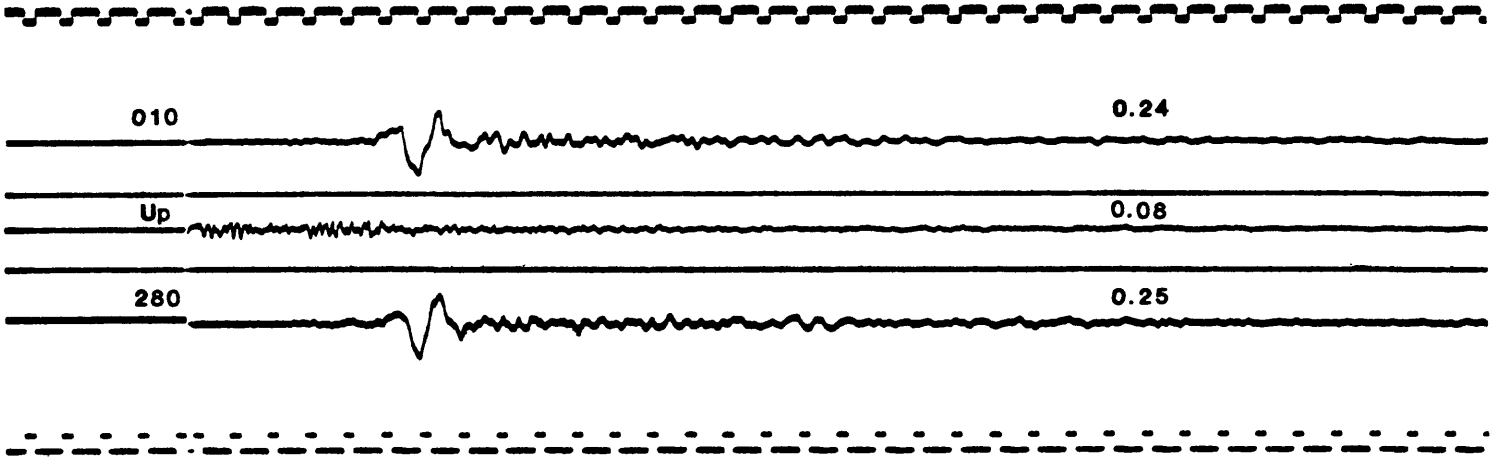


Basement

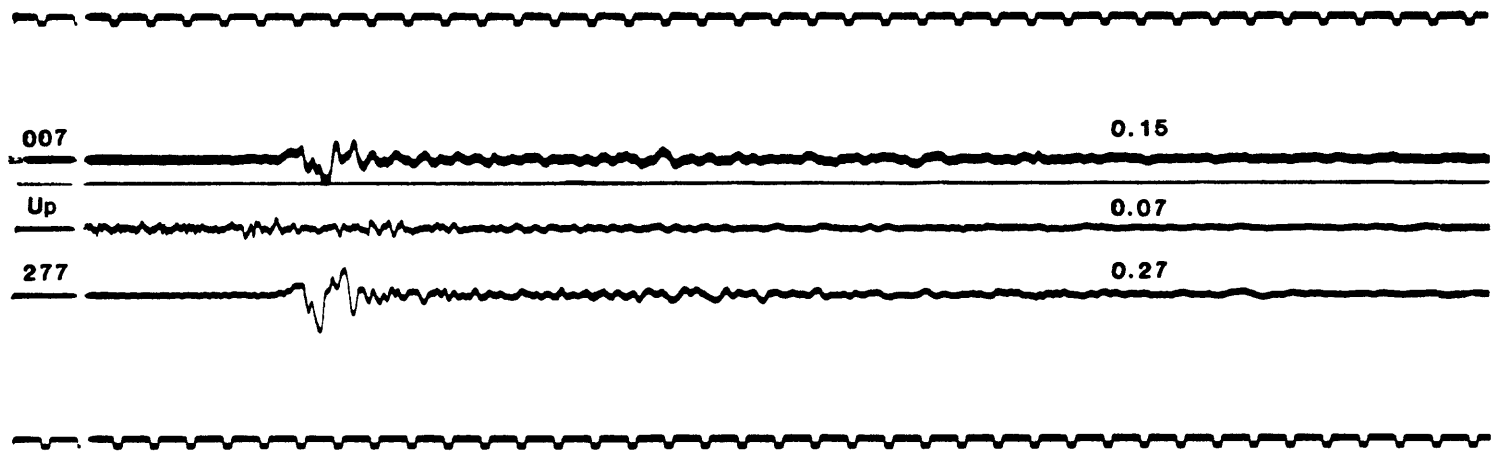


One cm/sec

LOS ANGELES, BULK MAIL CENTER



VERNON, 4814 LOMA VISTA AVE



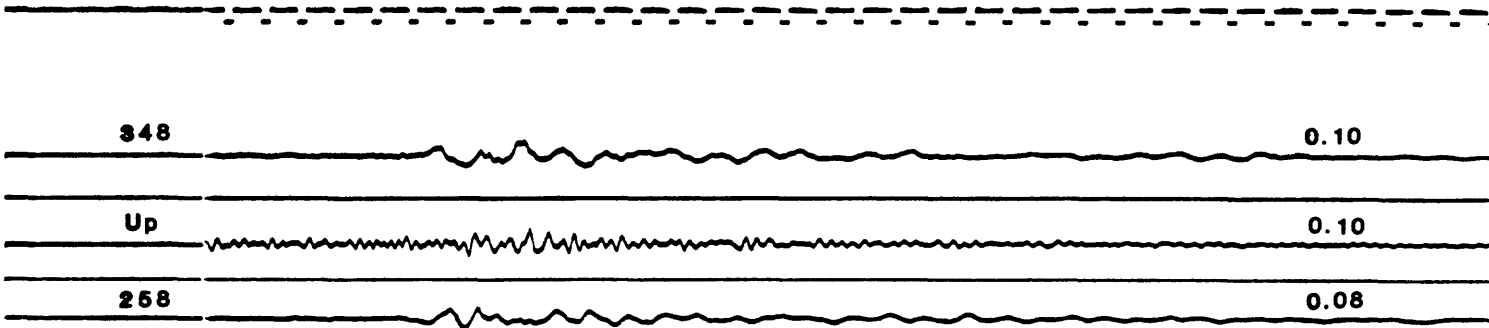
LOS ANGELES, GRIFFITH PARK OBSERVATORY



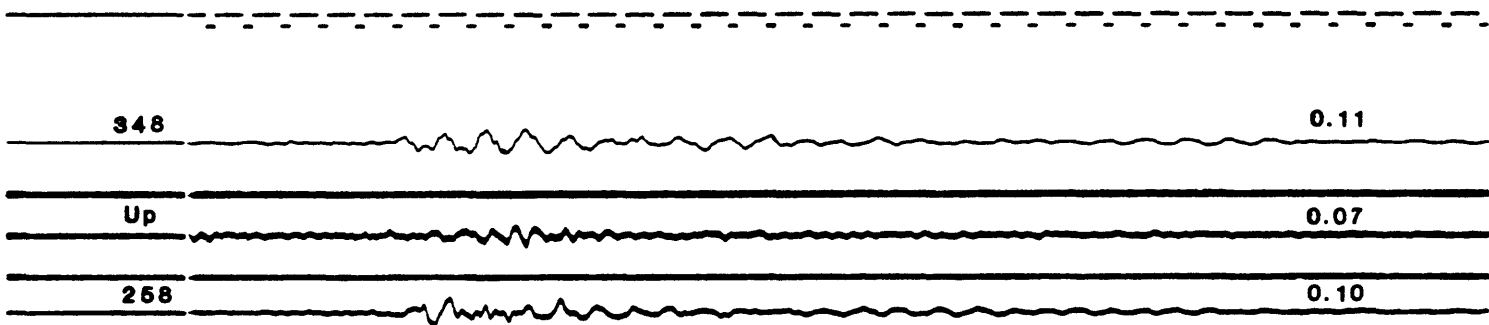
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LOS ANGELES, 1111 SUNSET BLVD

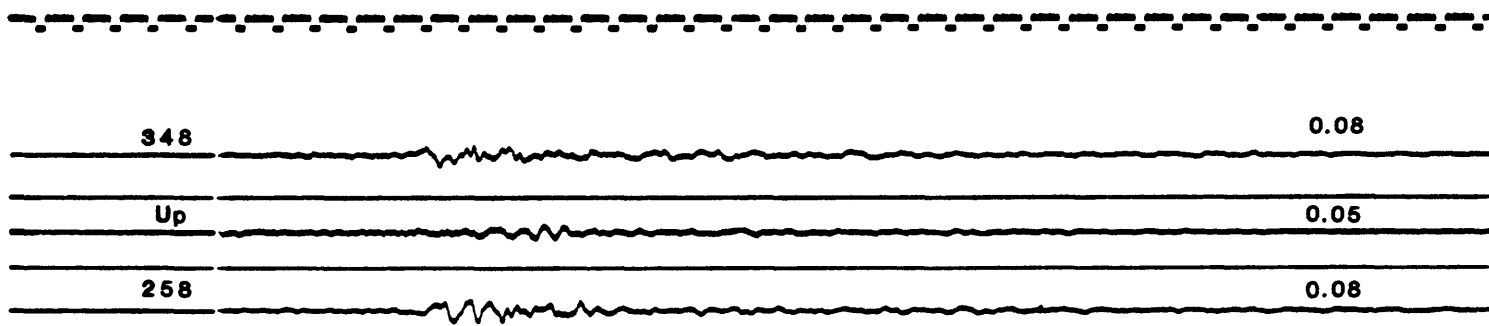
Roof



4th Floor



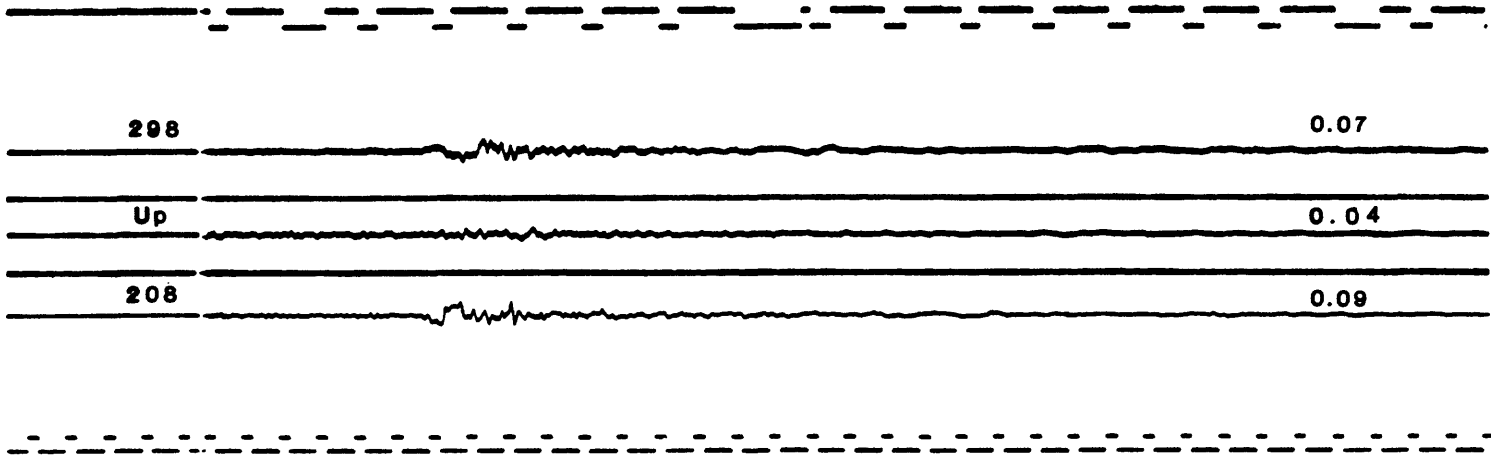
Basement



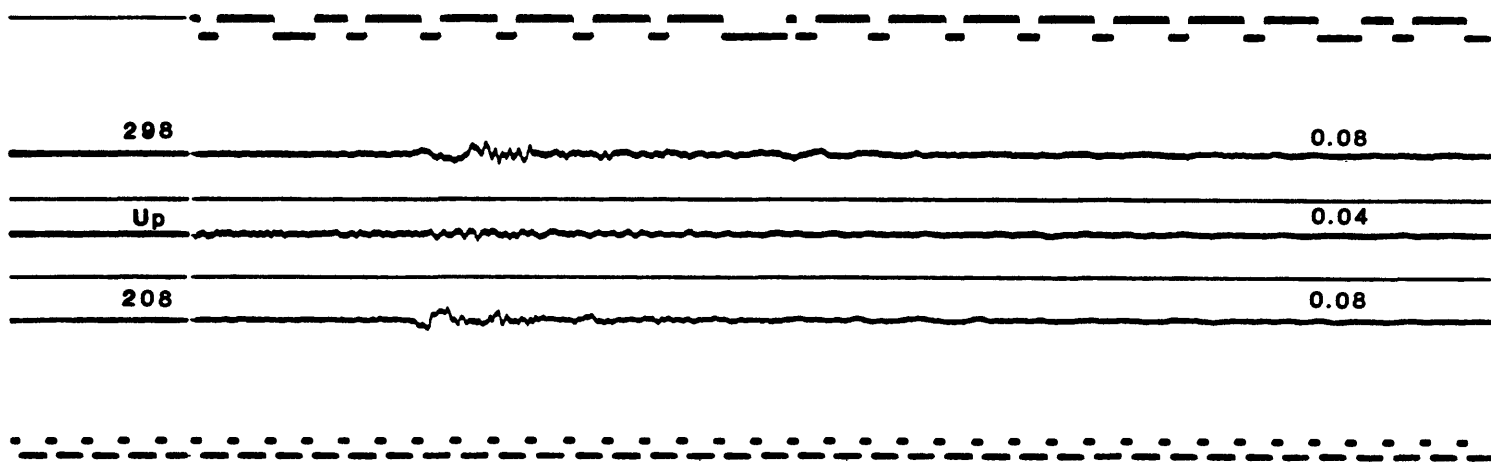
One cm/sec

LOS ANGELES, 1100 WILSHIRE BLVD

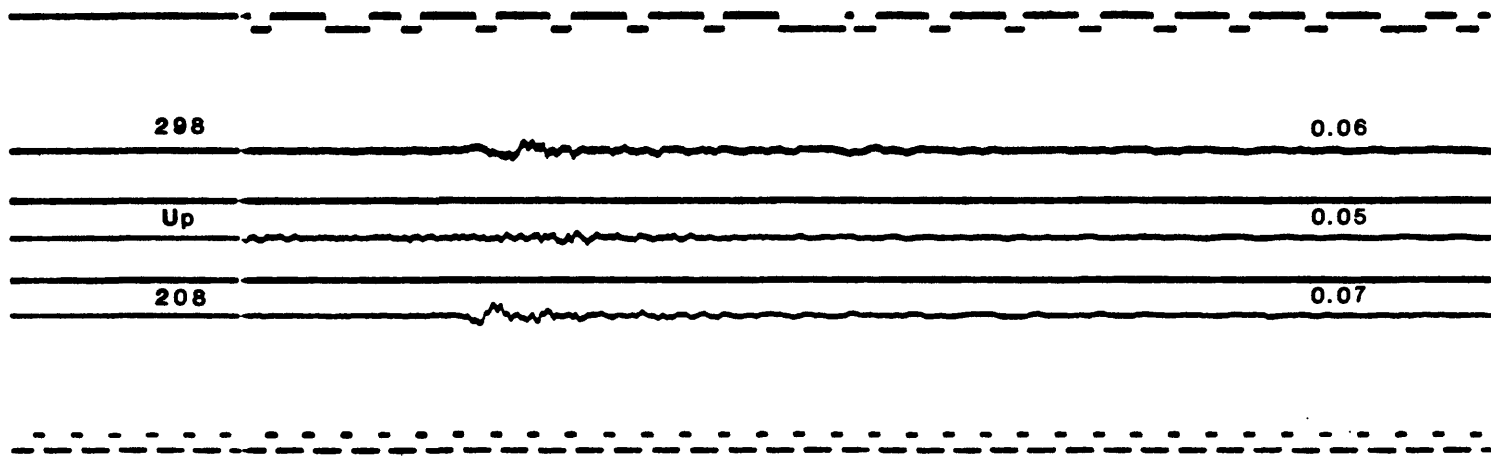
Basement 3, NE



Basement 3, SE



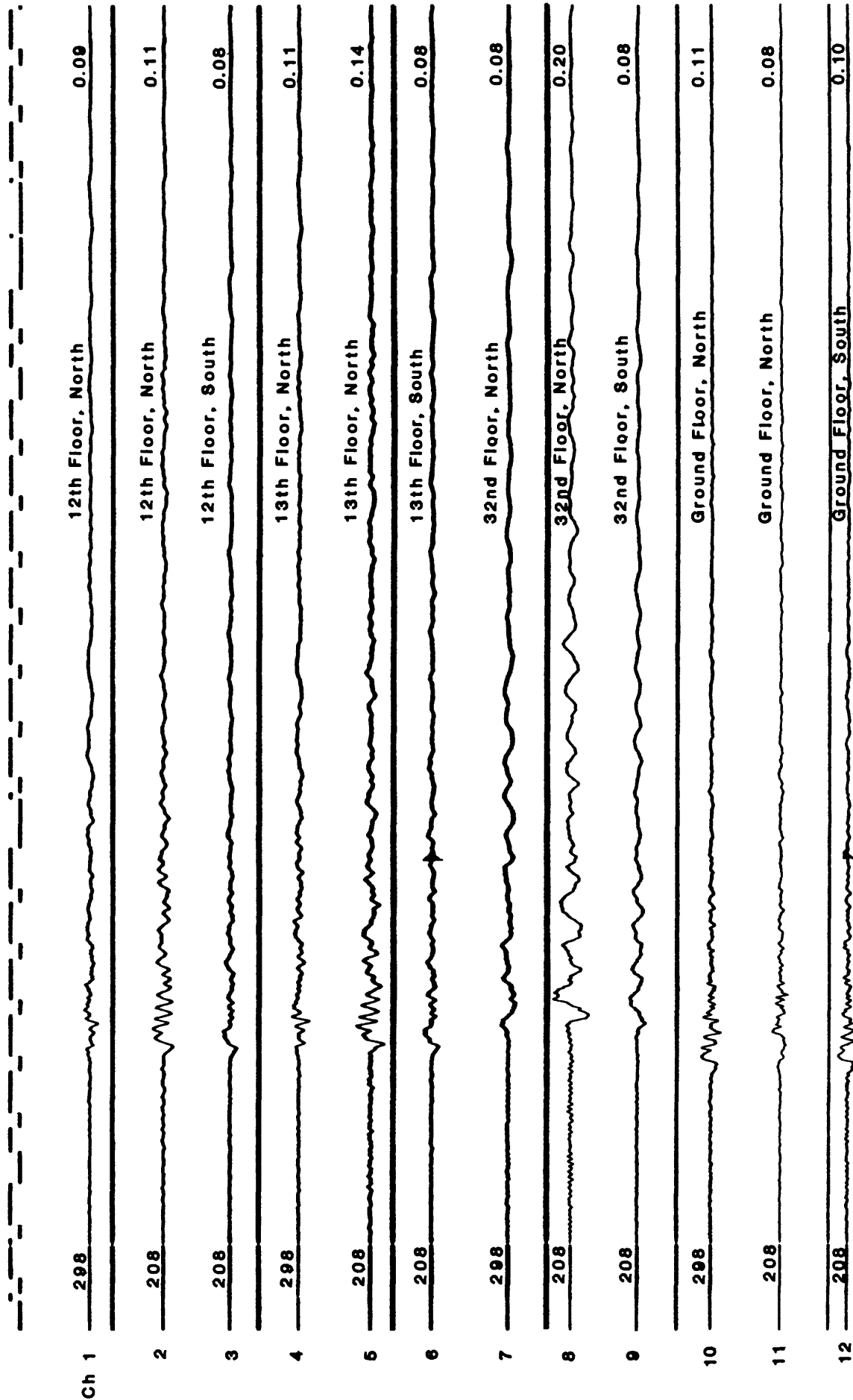
Basement 4, NW



One cm/sec

LOS ANGELES, 1100 WILSHIRE BLVD

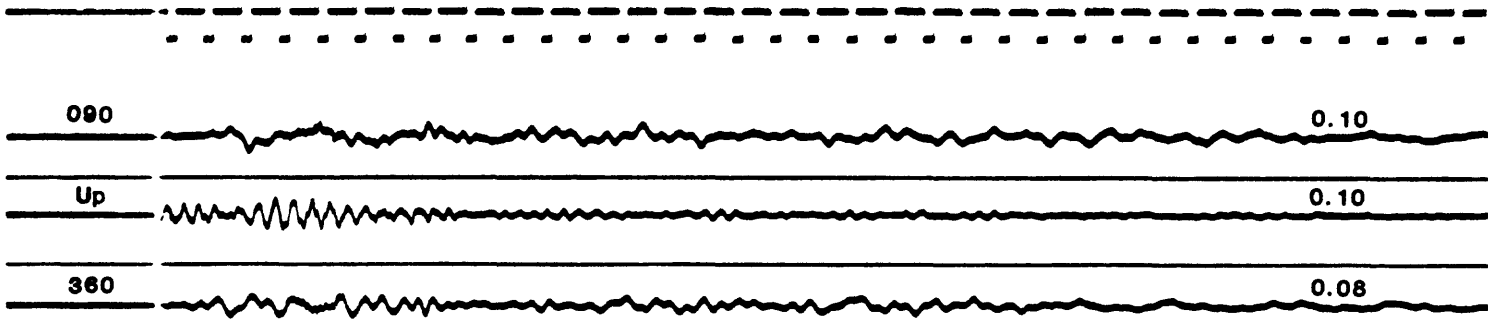
Structure Array



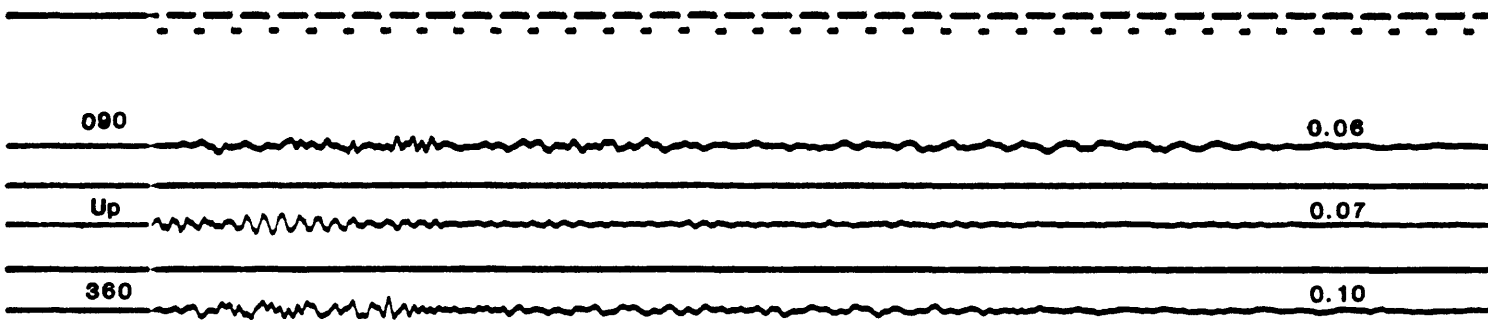
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NORWALK, 12400 IMPERIAL HIWAY

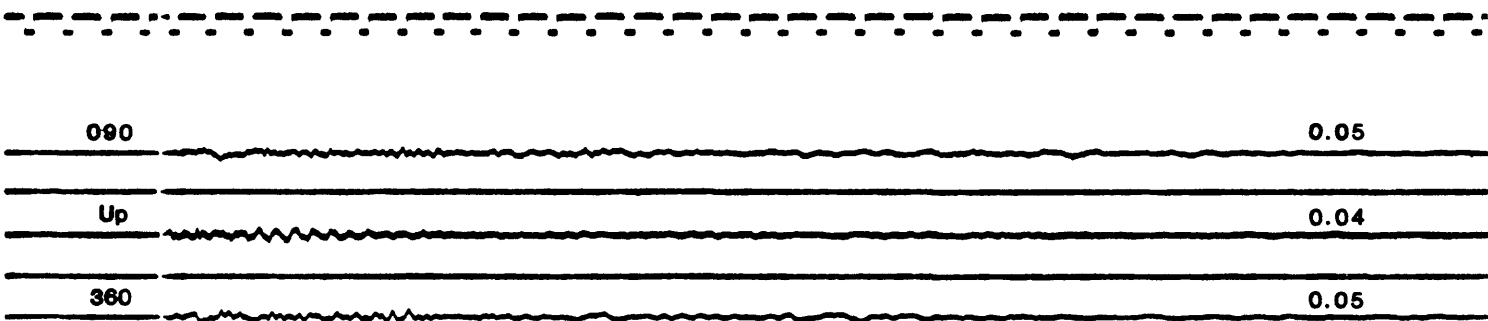
Roof



4th Floor

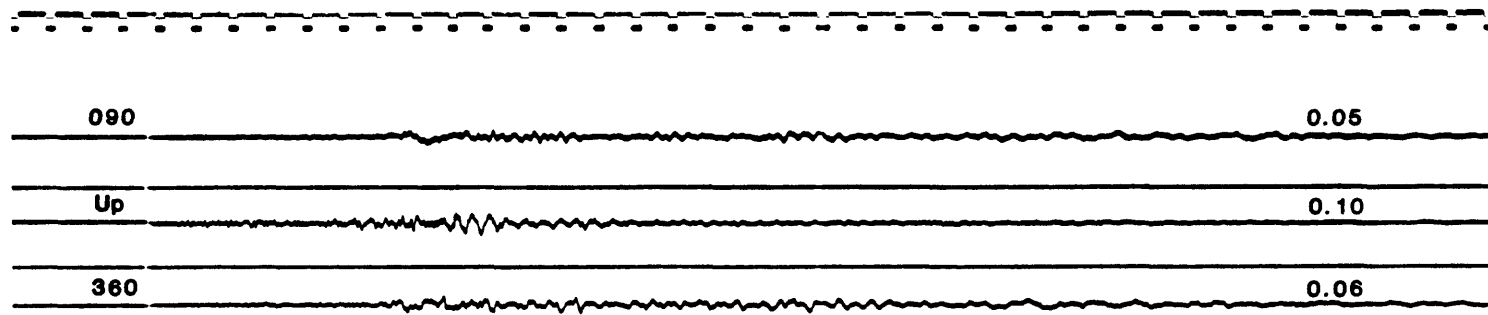


Basement



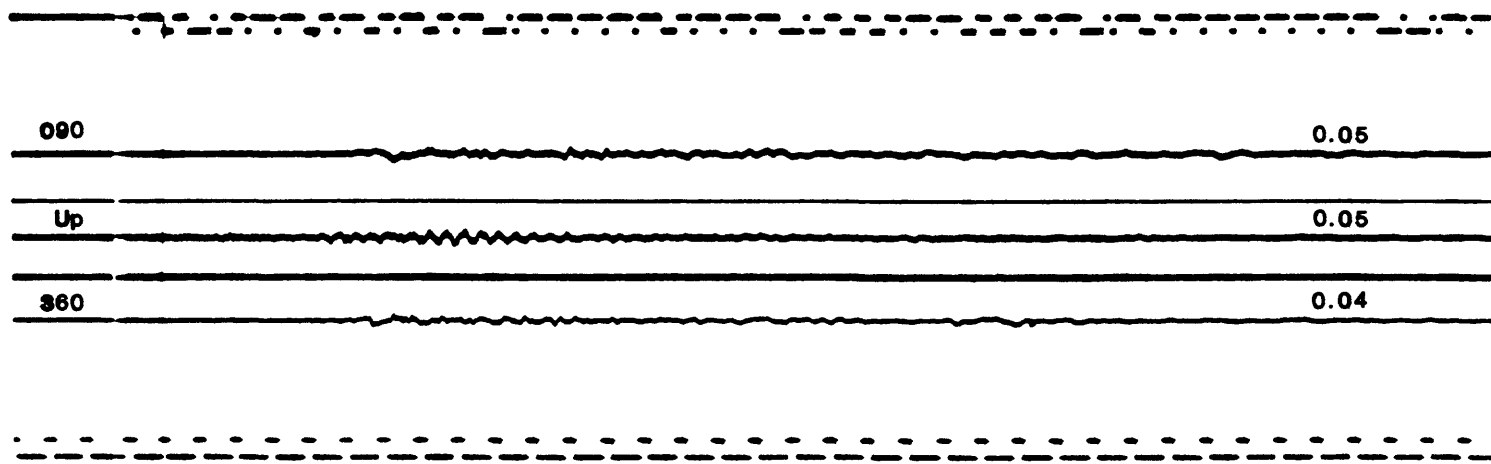
South Ground Site

One cm/sec

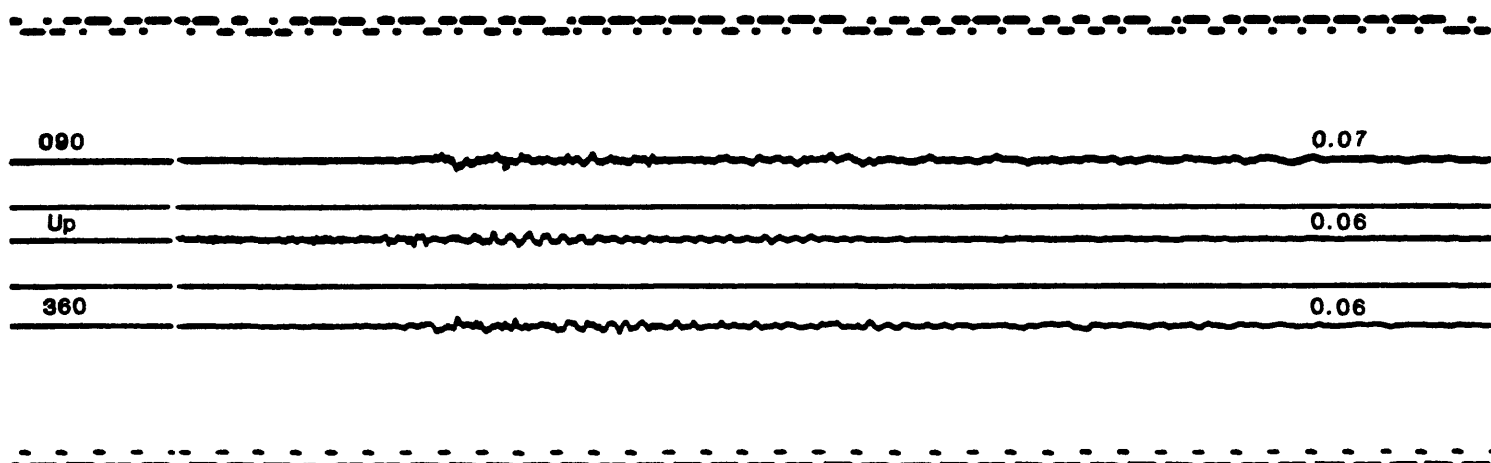


NORWALK, 12440 IMPERIAL HIWAY

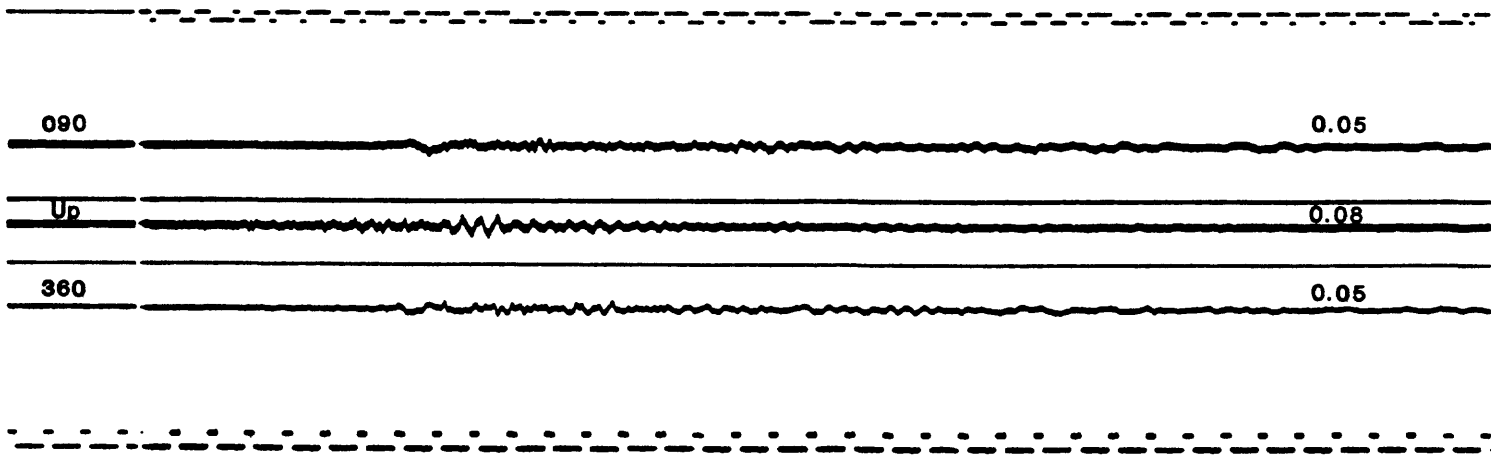
Basement



North Ground Site



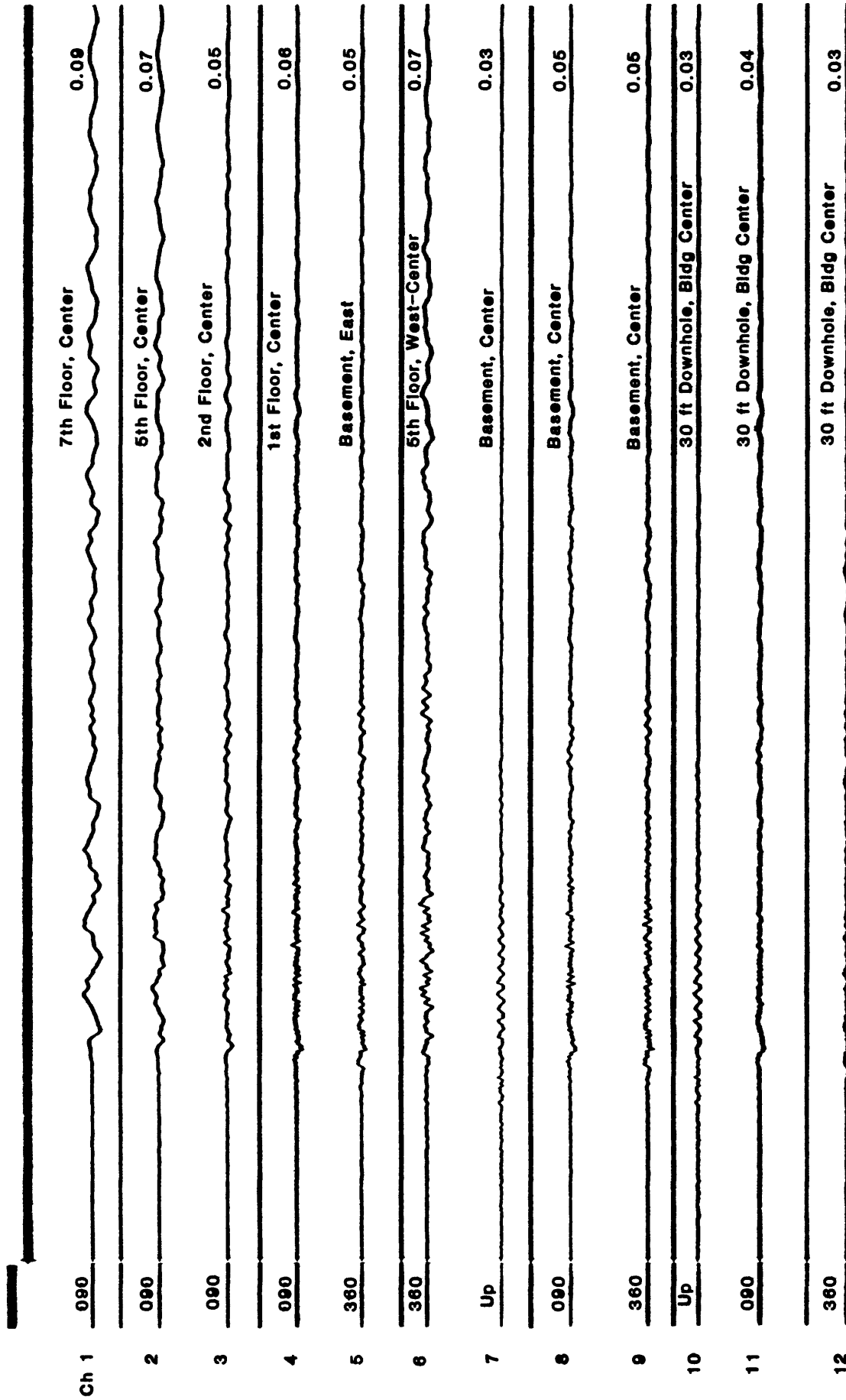
South Ground Site



One cm/sec

NORWALK, 12440 IMPERIAL HIWAY

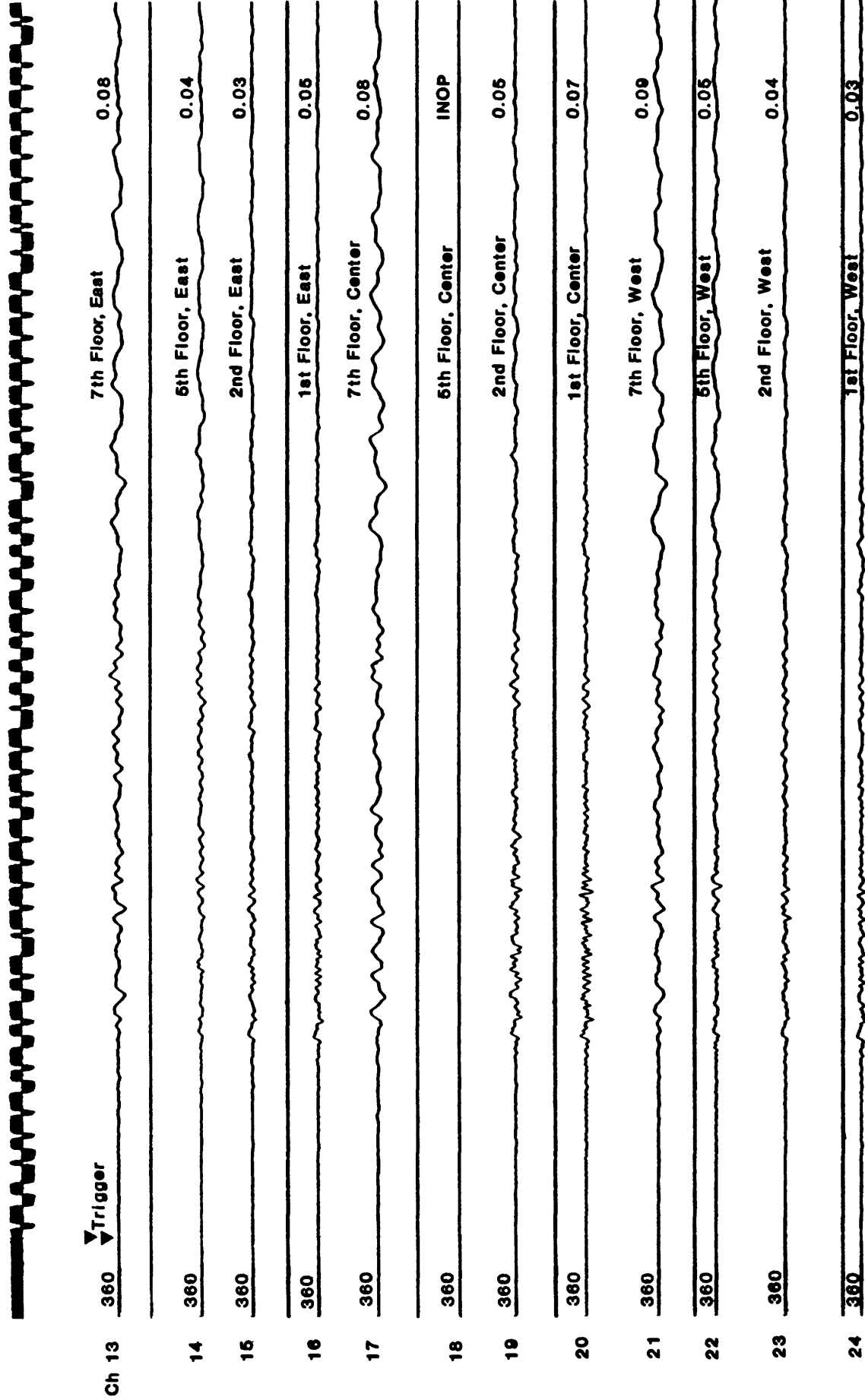
Structure Array 1



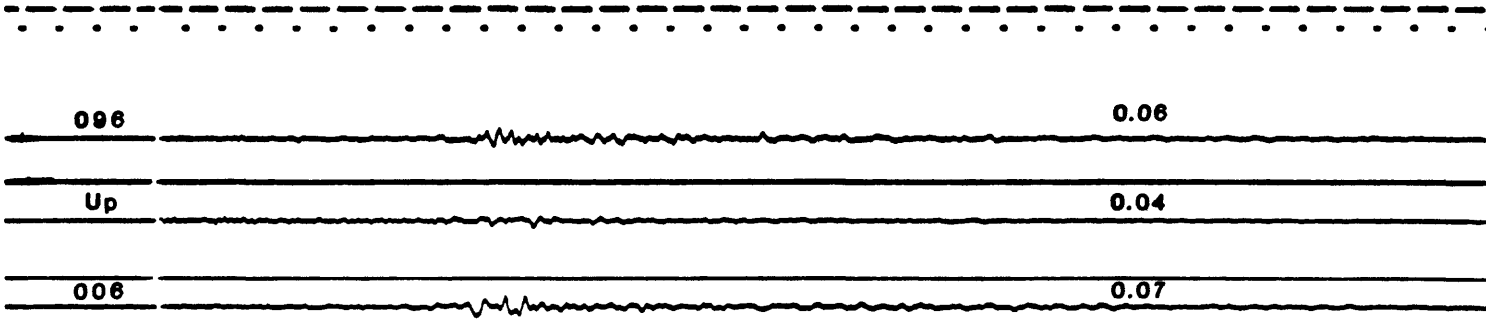
One cm/sec

NORWALK, 12440 IMPERIAL HIWAY

Structure Array 2

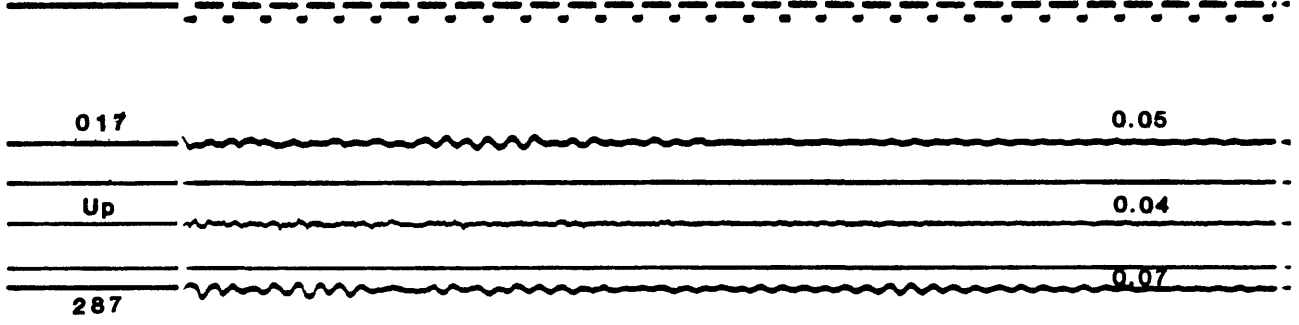


ORANGE COUNTY RESERVOIR, ABUTMENT

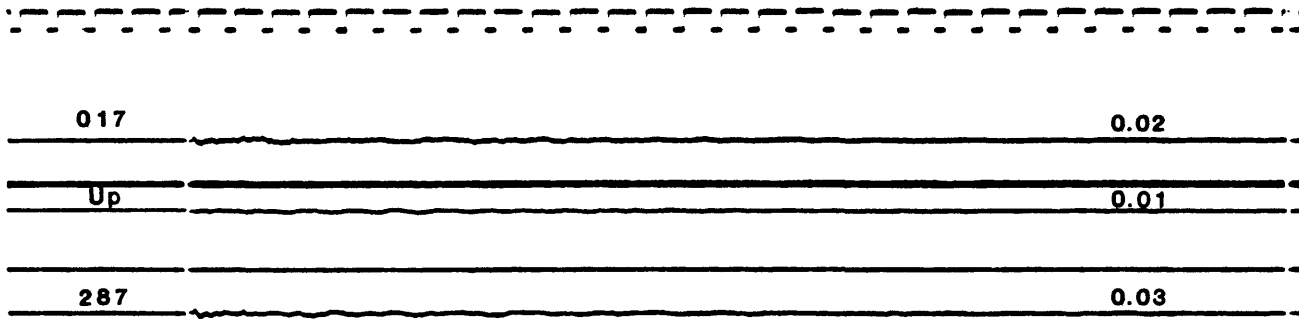


WEYMOUTH FILTER PLANT

Water Tank, Top



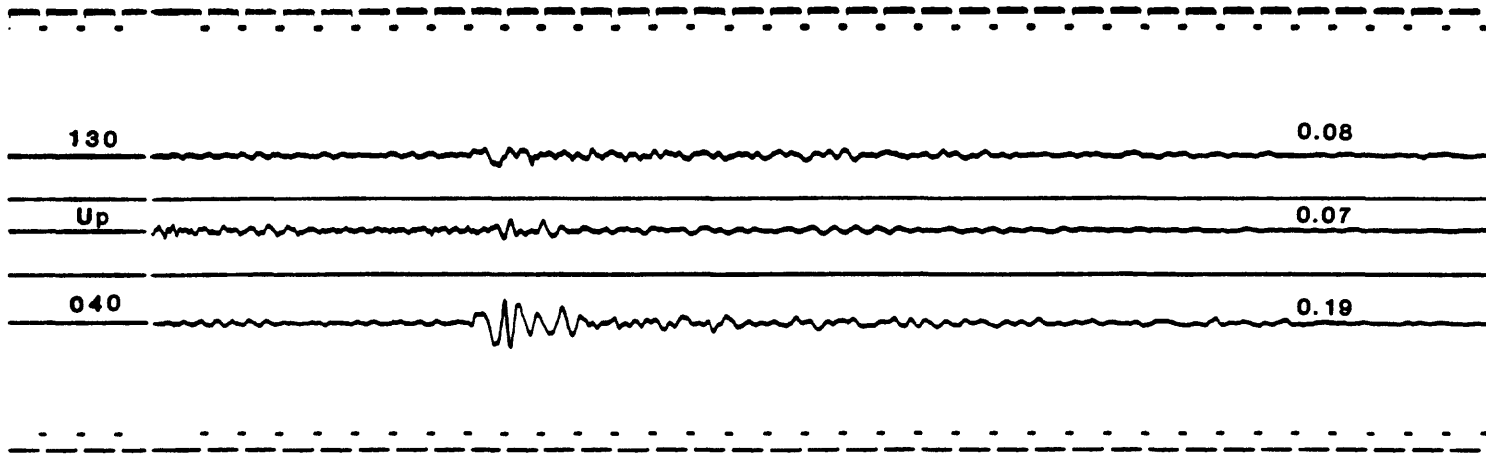
Bldg, Ground Level



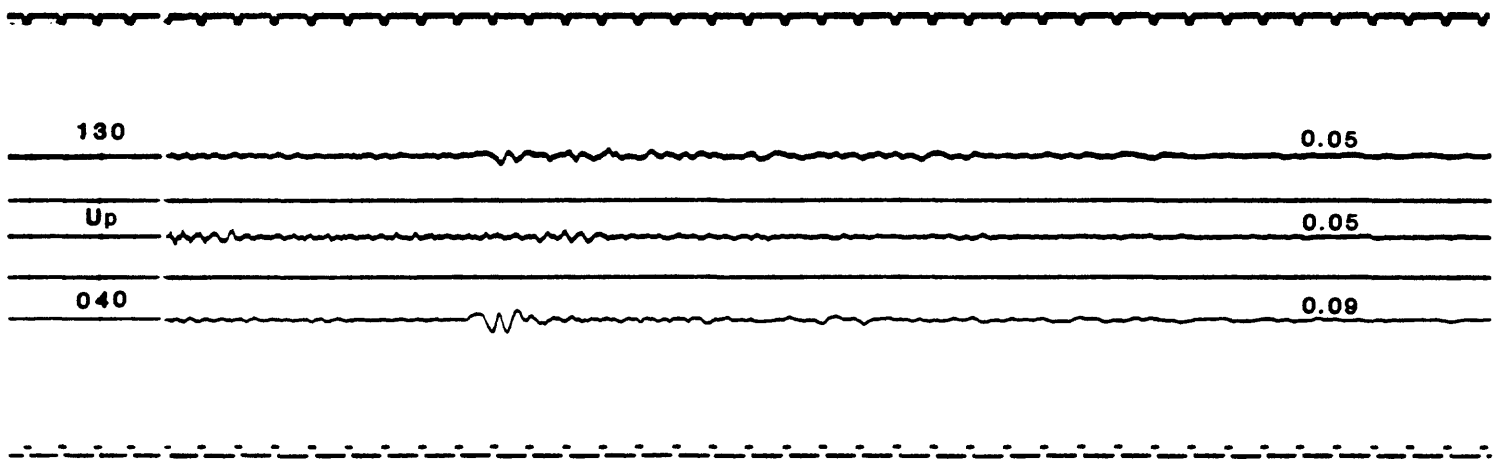
One cm/sec

BREA DAM

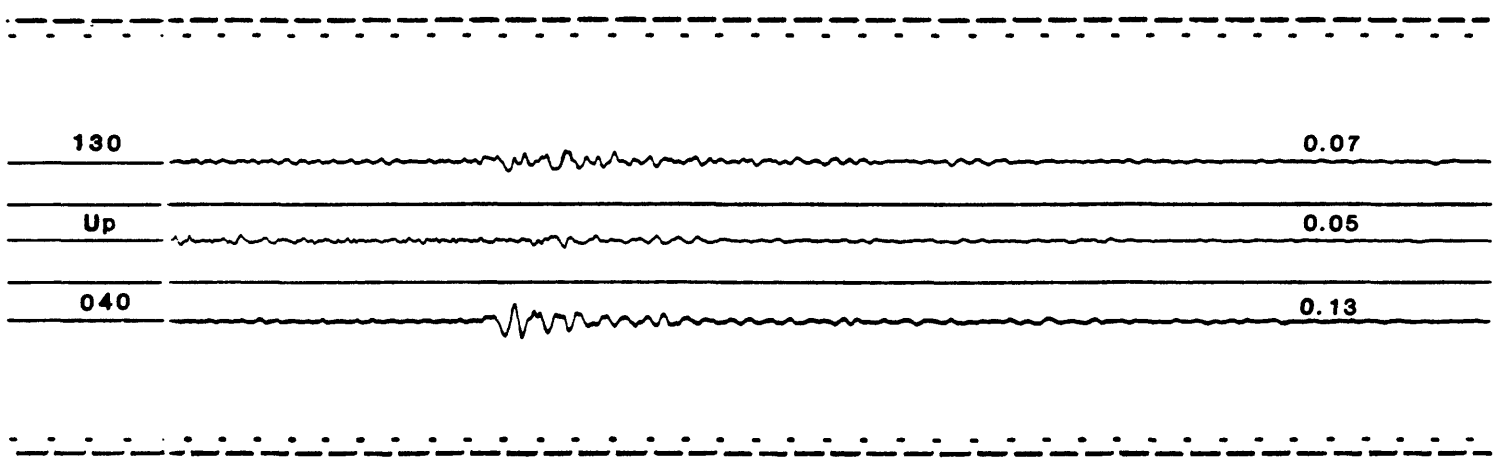
Crest



Left Abutment



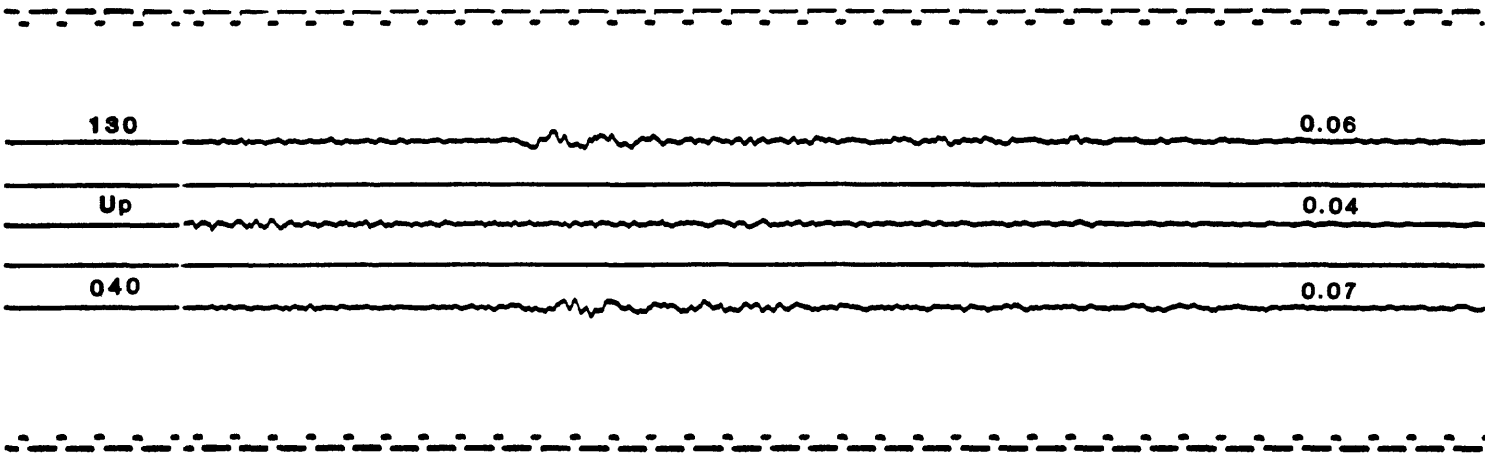
Downstream



One cm/sec

CARBON CANYON DAM

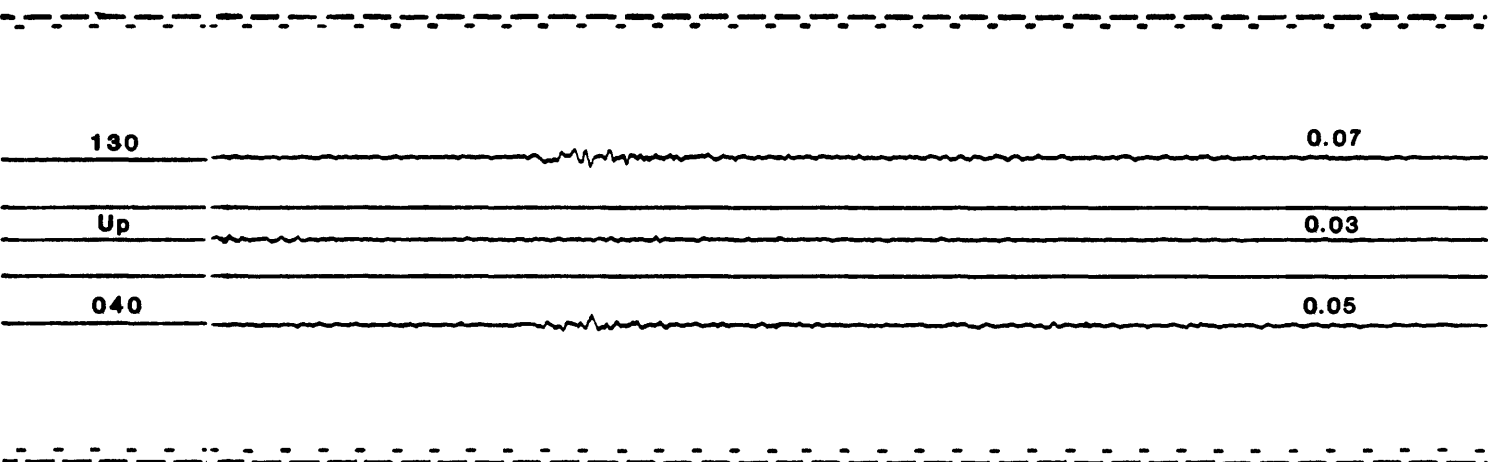
Crest



Left Abutment



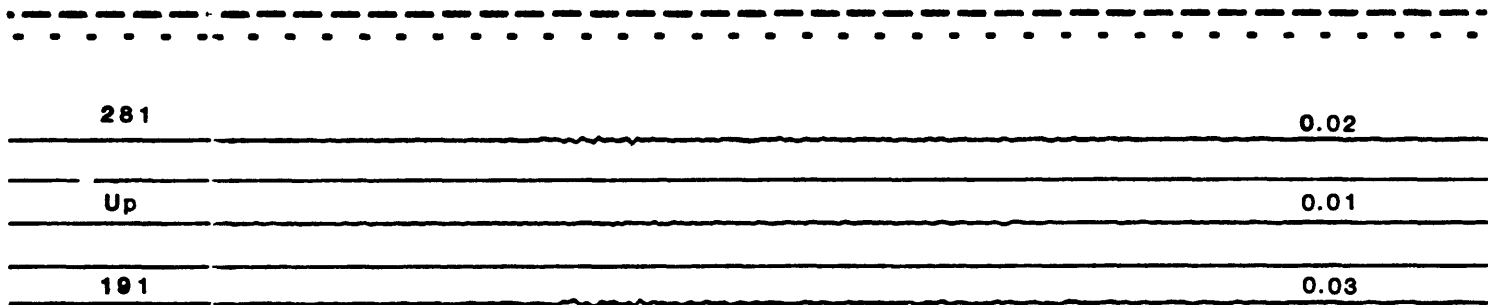
Right Abutment



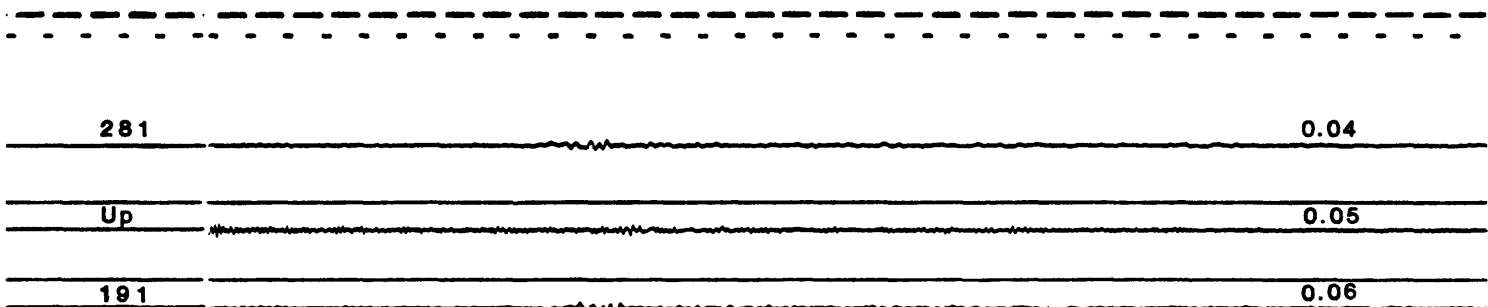
One cm/sec

DIEMER FILTER PLANT

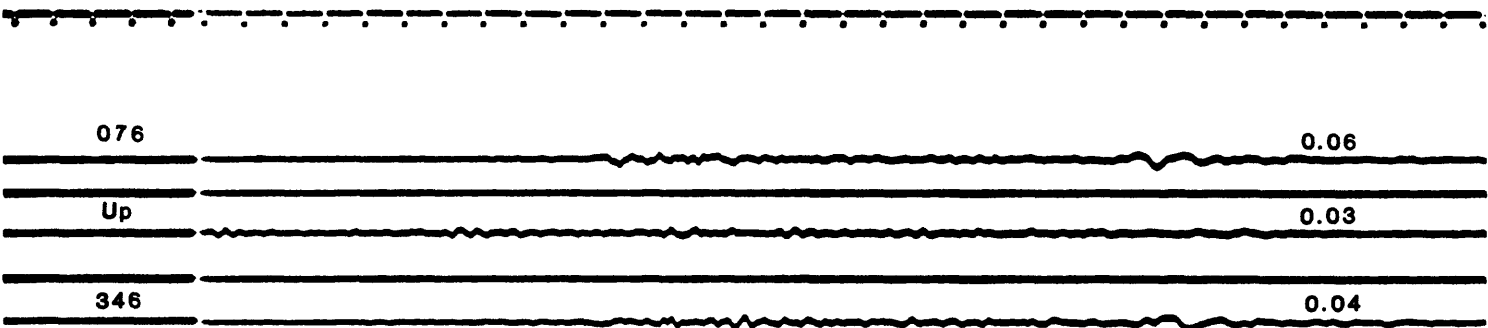
Admin. Bldg Basement



Reservoir Roof



LONG BEACH, CSULB



One cm/sec

Basement

LONG BEACH VA HOSPITAL

360

0.06

Up

0.03

270

0.05

6th Floor

360

0.09

Up

0.05

270

0.10

11th Floor

360

0.16

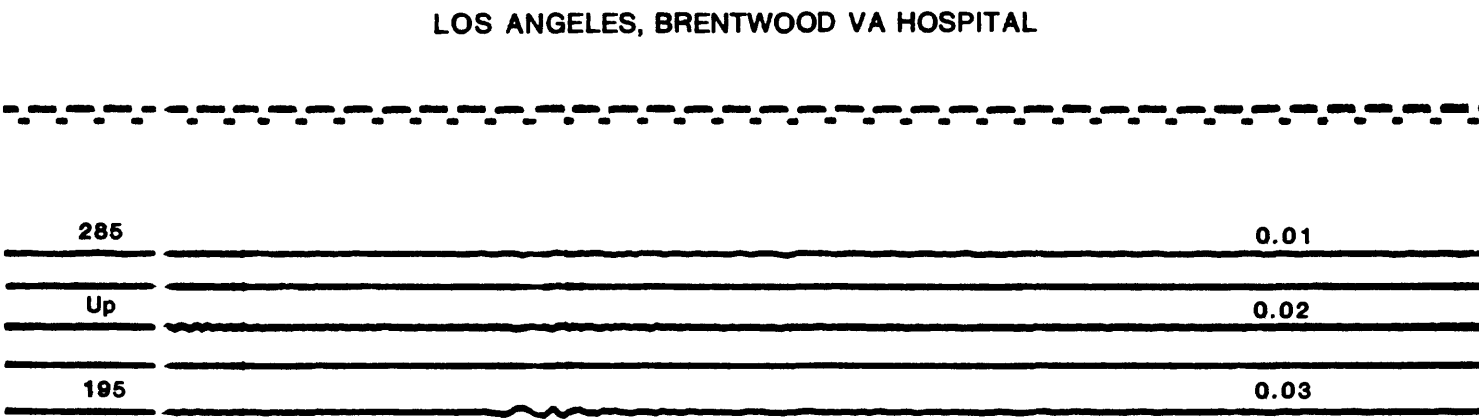
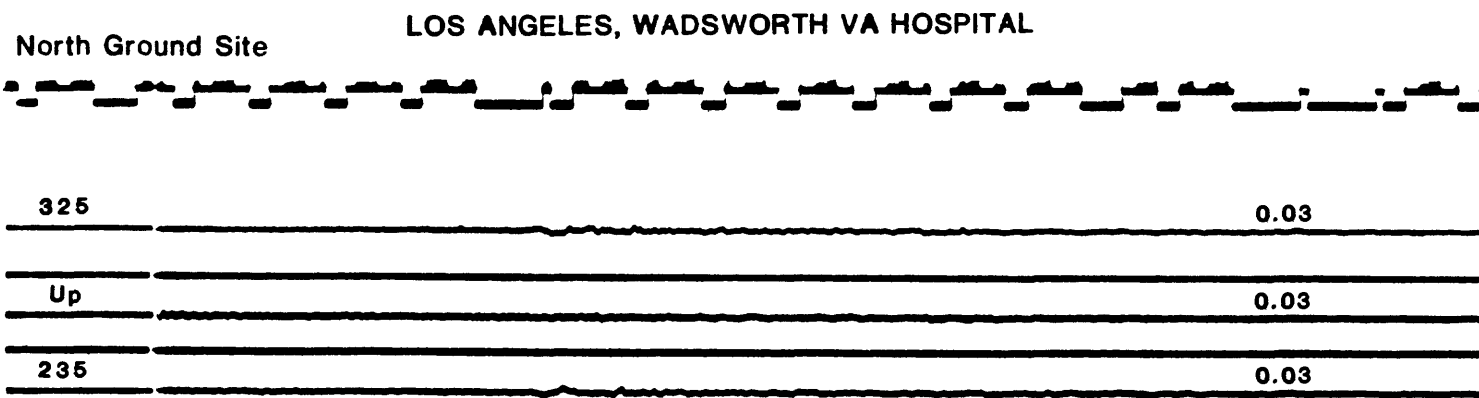
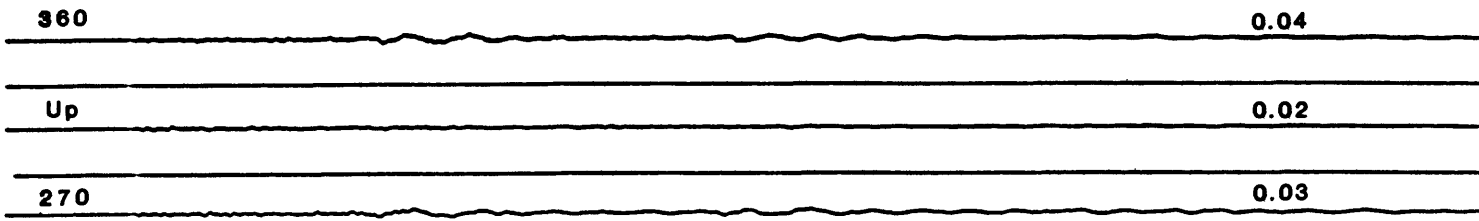
Up

0.07

270

0.17

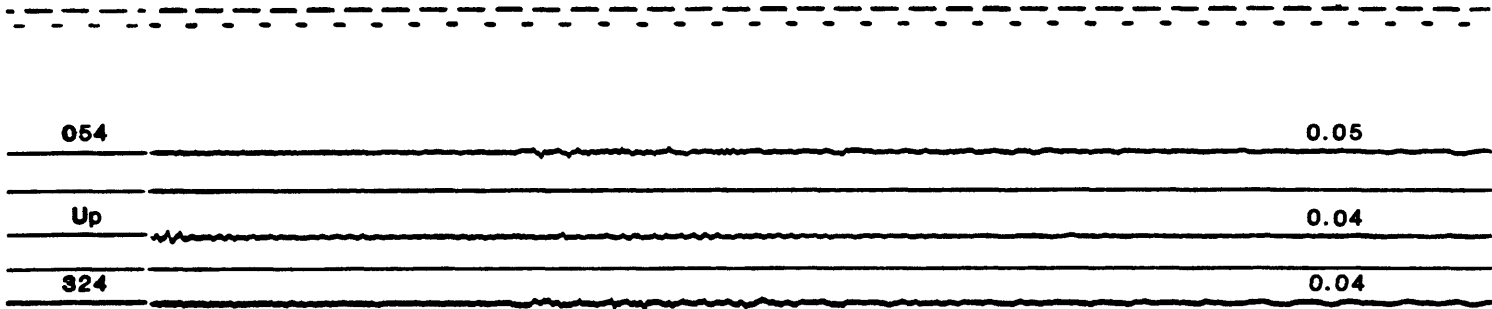
LAWNDALE, 15000 AVIATION BLVD



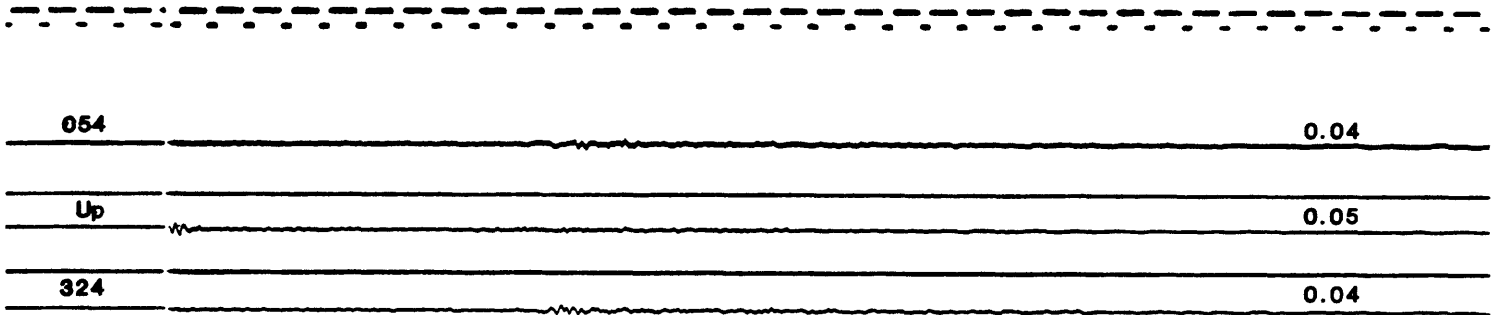
One cm/sec

SEPULVEDA DAM

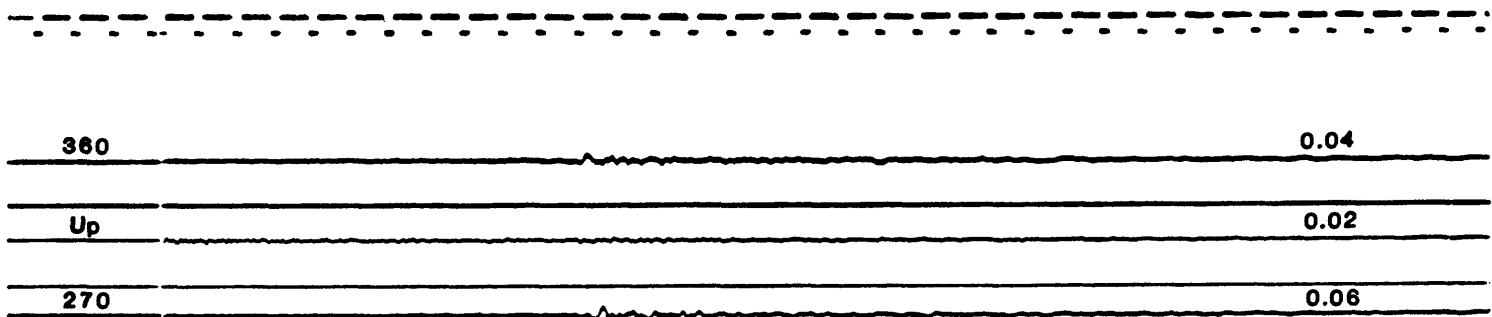
Crest



Downstream



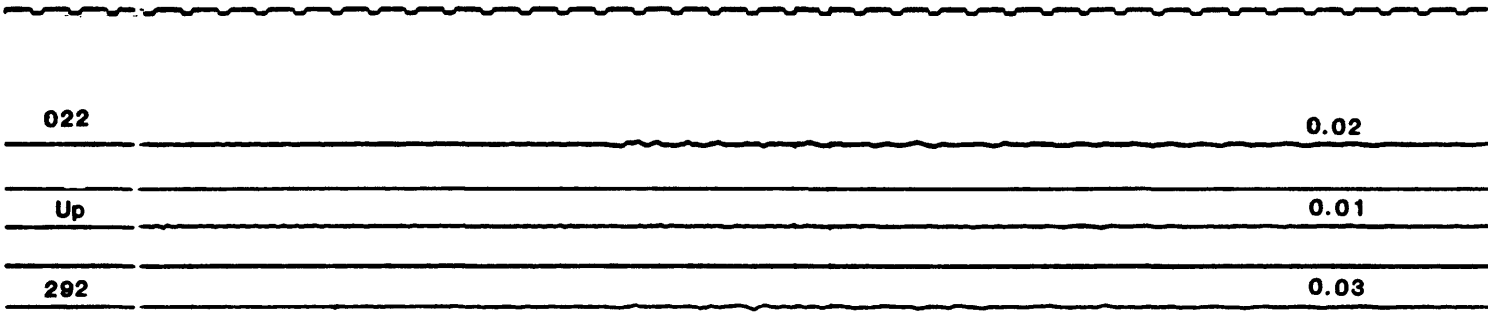
SEPULVEDA VA HOSPITAL



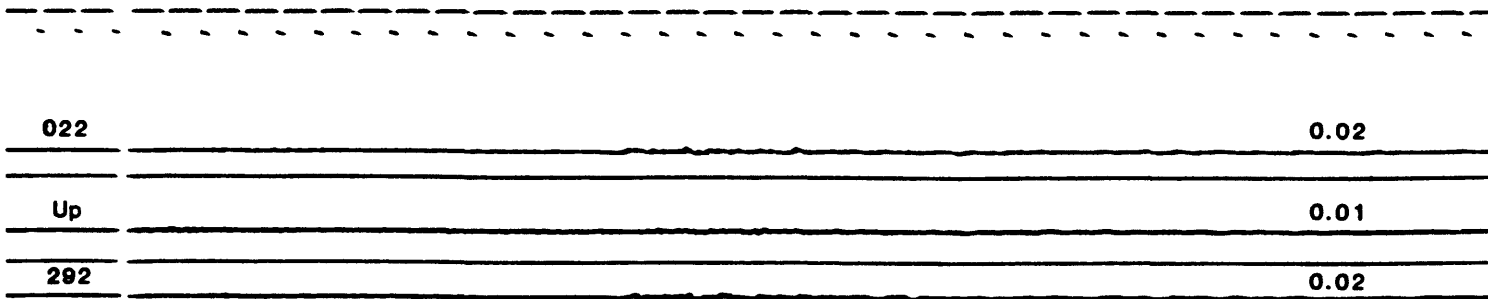
One cm/sec

JENSEN FILTER PLANT

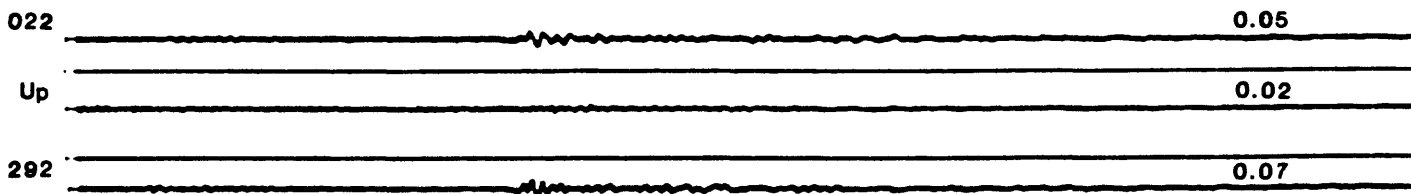
Admin. Bldg



Generator Room

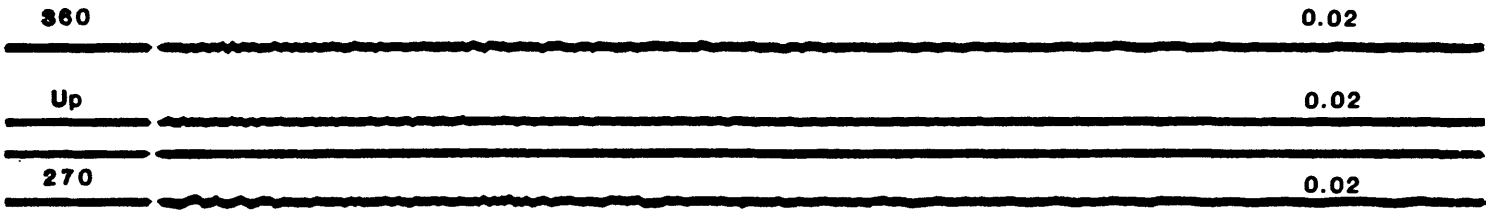


Reservoir Roof



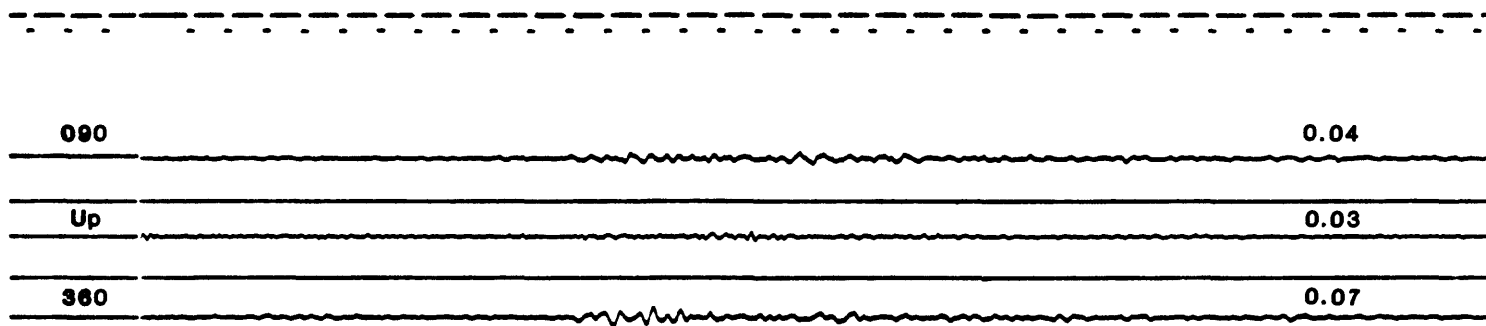
One cm/sec

SANTA ANA, ORANGE COUNTY ENGINEERING BLDG



PRADO DAM

Downstream



One cm/sec