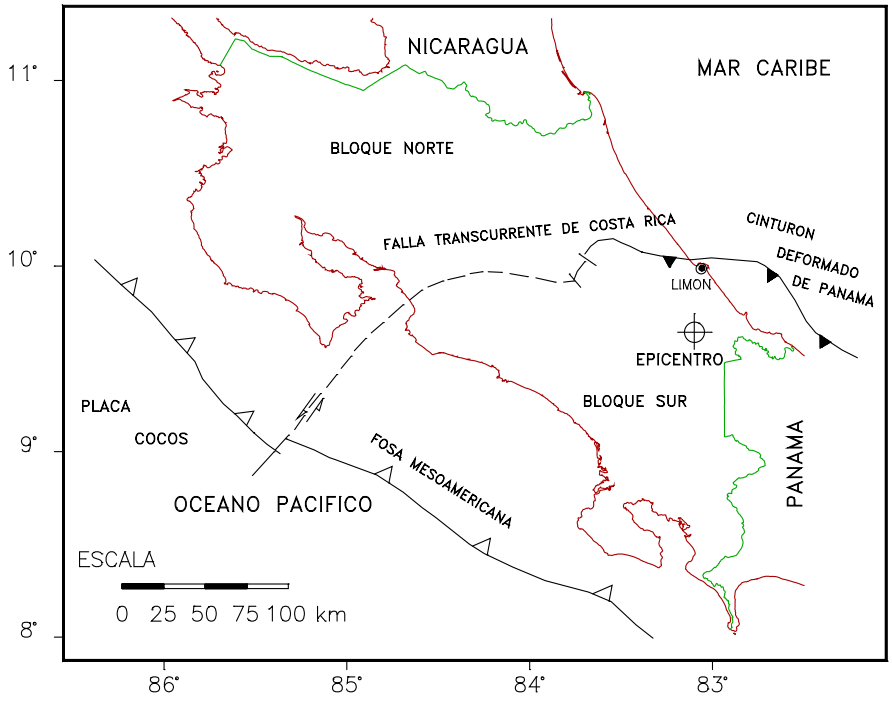
PROCESSED STRONG-MOTION RECORDS FROM THE LIMON, COSTA RICA EARTHQUAKE OF 22 APRIL 1991

R. B. DARRAGH
T. Q. CAO
C. H. CRAMER
A. F. SHAKAL

G. SANTANA

Laboratorio de Ingeniería Sísmica
Universidad de Costa Rica

California Strong Motion Instrumentation Program



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California Department of Conservation
Division of Mines and Geology
Office of Strong Motion Studies
801 K Street, MS 13-35, Sacramento, California 95814-3531

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INTRODUCTION

Strong-motion records were recovered from 15 accelerographs at 14 stations operated by the Strong Motion Instrumentation Program of the Earthquake Engineering Laboratory (EEL) at the University of Costa Rica (Santana and others, 1991) following the damaging Limón, Costa Rica earthquake of April 22, 1991. The sites range in epicentral distance from 73 to 160 km; peak horizontal accelerations at ground level ranged from 0.03 to 0.27 g. The accelerograms are characterized by long duration of strong shaking, of approximately 30 seconds.

An extensive strong motion data set from a moment magnitude (M_w) 7.5 earthquake is rare. Because of the importance of these data not only to Costa Rica but also to California, the California Strong Motion Instrumentation Program (CSMIP), in cooperation with the University of Costa Rica, digitized and processed these data for distribution to engineers, seismologists and others concerned with the seismic safety problem. This processed data is the second extensive set of data from an earthquake with magnitude between the magnitude 7 Loma Prieta earthquake and the magnitude 7.8 Chile and Tabas, Iran earthquakes.

During the preparation of this report the magnitude 7.3 Landers, California earthquake occurred on June 28, 1992. CSMIP recovered strong-motion records from 144 stations after this earthquake (Shakal and others, 1992). The records from the Landers, California and the Limón, Costa Rica earthquakes are both characterized by long durations (near 30 seconds) and significant amplitudes of acceleration, velocity and displacement at epicentral distances greater than 100 km.

The first part of this report includes a short overview of the earthquake characteristics, key aspects of the data (station distances, peak accelerations, etc.), and a description of the accelerogram digitization procedures. In Appendix A the results of the accelerogram digitization and processing are presented through a series of plots of the acceleration, velocity and displacement, and the absolute acceleration and the relative velocity response spectra.

EARTHQUAKE CHARACTERISTICS

The Limón, Costa Rica earthquake of April 22, 1991 occurred under the Caribbean coast of Costa Rica and Panama, approximately 110 km east of the Costa Rican capital of San José. According to the Earthquake Engineering Research Institute, the causative fault was a thrust fault striking southeast-northwest dipping to the southwest at less than 30° (EERI, 1991). Also, the Caribbean coast of Costa Rica was uplift by 1 to 1.5 m during the earthquake. Surface rupture was not observed because the projection of the fault to the surface occurs offshore.

In general, the earthquake caused severe damage that extended over a large region. Extensive soil liquefaction and failure was experienced in the alluvial plains in the Limón province along the Caribbean Coast. Liquefaction caused severe damage to roads, bridges, railways, ports and water systems. Damage to buildings in the Port of Limón was surprisingly light (EERI, 1991).

The Volcanological and Seismological Observatory of Costa Rica estimated the following earthquake origin time and epicenter:

Origin Time: 21:56:51.8 GMT (15:56 local time), 22 April 1991
Hypocenter: 9.644°N, 83.099°W, 21.5 km depth
Magnitude: 7.5 M_w 7.6 M_s (USGS: Preliminary Determination of Epicenters)

STRONG-MOTION STATIONS AND INSTRUMENTATION

The locations of the earthquake epicenter and the EEL strong-motion stations in Costa Rica are shown on the map in Figure 1. Records from 15 accelerographs at 14 stations were recovered; two other instruments malfunctioned (RCP in Ochomogo and INS in San José). All of the instruments were SMA-1's. Two of these were deployed at one station (the 17-story Hotel Aurola). All stations are between 73 and 160 km from the epicenter. Table 1 lists geographic coordinates, structure type, site geology, and peak values of motion at each of the stations.

The records from these 14 stations are shown in the Earthquake Engineering Laboratory report on the earthquake (Santana and others, 1991) and in the Earthquake Engineering Research Institute's reconnaissance report (EERI, 1991).

Fourteen of the accelerograms, from thirteen of the stations, have been digitized and processed. A maximum horizontal velocity at ground level of 20.7 cm/s was obtained for a station 94 km from the epicenter. Peak velocity for the other stations ranged from 2 to 14 cm/s at ground level. The maximum horizontal displacements at ground level ranged from 1 to 8 cm.

These data are valuable for the study of ground-motion characteristics in California and Costa Rica for large magnitude and long duration earthquakes. Before the Landers earthquake, there were few records in the Joyner and Boore (1982) data set with $7.0 \leq$ magnitude < 8.0. The results of this cooperative EEL/CSMIP effort will significantly increase the number of digitized records in this magnitude range.

ACCELEROGRAM DIGITIZATION AND PROCESSING

The digitization results presented in this report were obtained using the CSMIP computer-driven optical scanning system. This facility is patterned after the system developed at the

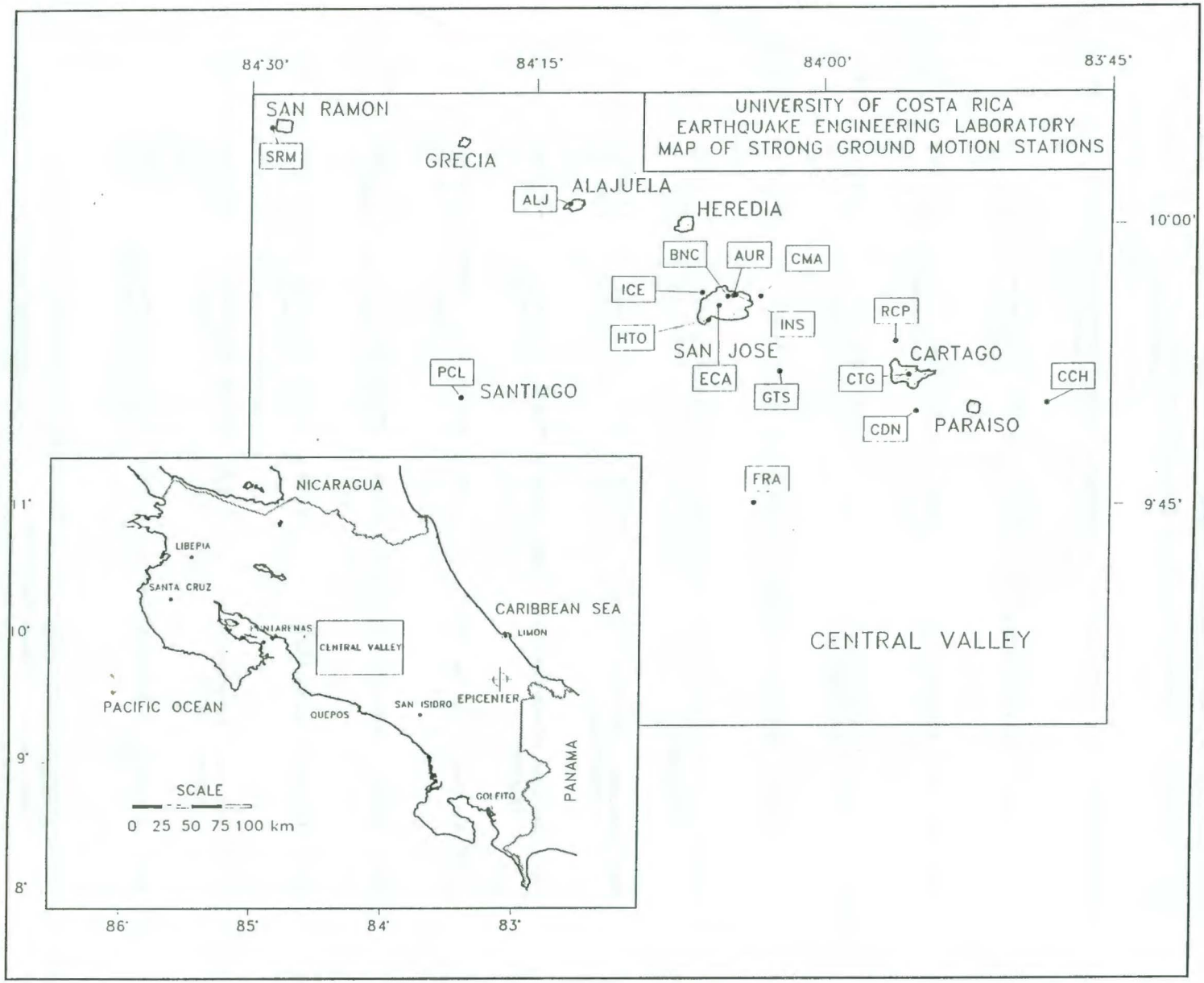

Figure 1 Map of Strong Ground-Motion Recording Stations in Costa Rica

Table 1 - Summary of Processed Records from the 1991

Station No.	Station Name	Station Coordinates N Lat.	W Long.	Site Geology	Instrument Housing *	Epicentral Dist. ** (km)
80057	San Isidro - Edificio INS (ISD)	9.374	83.708	Hard soil (sedimentary)	2-story bldg.	73
80058	Cachí - Represa ICE (CCH)	9.842	83.805	Volcanic rock (Tertiary)	Tunnel	80
80059	Cartago - Parque Central (CTG)	9.868	83.925	Soft, recent alluvium	Instr. shltr. D	94
80060	San José - Guatuso (GTS)	9.870	84.038	Rock (sedimentary)	1-story bldg.	106
80061	San José - Biblioteca Central UCR (CMA)	9.937	84.054	Soft soil (volcanic)	4-story bldg.	109
80062	Golfito - Hospital CCSS (GLF)	8.645	83.172	Soft soil	2-story bldg.	111
80063	San José - Hotel Aurola (AUR) (Basement)	9.938	84.078	Hard soil (volcanic)	17-story bldg.	113
80064	San José - Hotel Aurola (AUR) (15th Floor)	9.938	84.078	Hard soil (volcanic)	17-story bldg.	113
80070	San José - Banco Nacional (BNC) (Basement)	9.937	84.082	Hard soil (volcanic)	20-story bldg.	114
80065	San José - Hatillo (HTO)	9.916	84.099	Soft, recent alluvium	1-story bldg.	115
80066	Quepos - Centro de Salud (QPS)	9.431	84.166	Rock (sedimentary)	1-story bldg.	119
80067	Alajuela - CIPET (ALJ)	10.019	84.220	Soft soil (volcanic)	2-story bldg.	129
80068	Puriscal - Estación de Bomberos (PCL)	9.848	84.314	Soft soil (volcanic)	2-story bldg.	137
80069	San Ramón - Centro Regional UCR (SRM)	10.088	84.482	Soft soil (sedimentary)	1-story bldg.	161

* - Instrument shelter types:
Instr. shltr D - small metal box
** - Distance given relative to the epicenter at 9.644°N, 83.099°W.

Limon, Costa Rica Earthquake.

Component Azimuth (deg.)	Peak Accel. (g) #	Peak Velocity (cm/sec)	Peak Displ. (cm)	Usable Data Bandwidth	Processed Record Length (sec)
360	0.199	-14.3	4.5	0.09-23.6 Hz	60
UP	-0.171	5.5	-4.8	(0.04-11.7 sec)	
270	-0.150	-9.4	-3.8		
360	0.146	-11.4	3.9	0.09-23.6 Hz	68
UP	-0.060	-6.9	-5.5	(0.04-11.7 sec)	
270	0.093	10.6	6.2		
360	0.264	20.7	-4.4	0.09-23.6 Hz	80
UP	-0.135	-9.5	-4.3	(0.04-11.7 sec)	
270	0.221	-17.6	8.2		
360	-0.105	9.3	1.2	0.17-23.6 Hz	72
UP	-0.044	-4.1	1.4	(0.04-5.9 sec)	
270	-0.077	6.0	1.8		
93	-0.153	-10.5	-3.9	0.09-23.6 Hz	60
UP	-0.128	-5.4	3.3	(0.04-11.7 sec)	
3	-0.196	12.3	5.3		
360	-0.061	4.2	1.2	0.17-23.6 Hz	80
UP	-0.027	2.2	1.0	(0.04-5.9 sec)	
270	-0.047	-3.3	1.1		
95	-0.072	-5.7	-2.4	0.17-23.6 Hz	80
UP	-0.037	-3.6	1.5	(0.04-5.9 sec)	
5	0.061	5.9	2.0		
95	-0.074	-14.8	-5.8	0.17-23.6 Hz	80
UP	0.100	-6.1	1.6	(0.04-5.9 sec)	
5	-0.104	-18.0	6.3		
278	-0.075	-6.0	2.5	0.17-23.6 Hz	76
UP	0.075	-4.4	1.3	(0.04-5.9 sec)	
188	0.070	6.2	-2.6		
360	0.122	7.8	1.6	0.17-23.6 Hz	80
UP	0.056	-2.6	1.0	(0.04-5.9 sec)	
270	0.081	6.6	-1.5		
360	-0.039	-4.1	-3.5	0.09-23.6 Hz	60
UP	0.027	3.5	3.1	(0.04-11.7 sec)	
270	-0.032	5.8	4.4		
360	0.111	-10.2	-2.7	0.14-23.6 Hz	80
UP	-0.046	3.7	1.4	(0.04-7.35 sec)	
270	-0.118	10.6	2.8		
360	0.091	-7.6	-3.3	0.09-23.6 Hz	60
UP	-0.064	3.9	2.5	(0.04-11.7 sec)	
270	-0.068	7.7	3.3		
360	0.094	-11.2	1.4	0.17-23.6 Hz	80
UP	-0.077	-5.9	0.7	(0.04-5.9 sec)	
270	-0.093	9.3	-1.7		

Phase 1 (Volume 1) peak acceleration values.

University of Southern California (Trifunac and Lee, 1979). In this system, a direct photographic negative copy of the film accelerogram is mounted on a rotating drum, which is scanned by a photodensitometer. The photodensitometer is mounted on a carriage moving perpendicular to the rotational direction of the drum. The resulting x-y array of optical density values is converted to raw time series through several trace-reconstruction steps. Baseline and other corrections are then applied to this raw data to obtain the acceleration data for further processing and spectral analysis. The subsequent post-digitization processing is similar to that first developed at the California Institute of Technology (Trifunac and Lee, 1973). As discussed in greater detail below, a change of operators was made to improve the instrument correction procedure at high frequencies. In addition, the results of system noise analyses are used to guide the selection of filter corner frequencies in CSMIP processing.

The accelerograms digitized for this report are from SMA-1 accelerographs having 3 channels of data recorded on a 70 mm (2.75 in) wide film. For each accelerogram, the 70 mm film also contains one or two straight-line reference traces, and two time-mark traces.

The sequence of steps in digitizing and processing a record is summarized in the following:

1. The film record, 70 mm wide and about 80 cm long, is contact-copied onto a 25 cm by 25 cm high-contrast photographic negative; up to four sections of the record, each approximately 22 cm (22 seconds) in length, are copied onto a single negative. To facilitate subsequent reconstruction of the original record, adjacent sections are copied so that they have an overlap of approximately 2 seconds. For further details, refer to the report by Trifunac and Lee (1979).

2. The negative containing the four sections of the accelerogram is digitized into x and y coordinates by the optical scanner. The scanner sampling rate used for these records is 200 samples per centimeter in x and y. This is nominally equal to a time step of 0.005 second (200 samples/sec) and an acceleration increment of 0.003 g.

3. The raw x,y data from the individual sections are concatenated to form continuous acceleration traces, straight-line reference traces and timing traces.

4. Phase 1 (Volume 1) Processing. The reference traces are subtracted from the acceleration traces to remove any spurious film-movement effects. The axis of zero acceleration is determined by assuming the record has zero mean. The time-mark traces are used to obtain an accurate time scale. The starting

times of the acceleration channels are adjusted so any time phasing error from one channel to another is less than 0.02 sec (i.e., less than one time increment in the Phase 2 (Volume 2 data)). The instrument sensitivities are used to scale ordinate values to accelerations. The processed record length is between 60 and 80 seconds for all the records presented in this report.

5. Phase 2 (Volume 2) Processing. The Phase 1 (Volume 1) acceleration data are interpolated to obtain exactly 200 points/sec sampling (100 Hz Nyquist frequency). The instrumental data are corrected to true acceleration using a simple finite-difference based instrument correction operator. A high-frequency Ormsby filter with a corner frequency of 23 Hz and a roll-off termination frequency of 25 Hz is applied. The data are then decimated to 50 points/sec (25 Hz Nyquist). As discussed in Shakal and Ragsdale (1984), this order (instrument correction prior decimation) improves the accuracy of the instrument correction procedure at high frequencies while still using the same simple operator used in the original Caltech code (Trifunac and Lee, 1973). The acceleration data are initially corrected for long-period errors by using a low-frequency Ormsby filter with a ramp from 0.05 to 0.07 Hz. Velocity and displacement are integrated from acceleration and filtered using the same low-frequency Ormsby filter as for the acceleration. To prevent the introduction of spurious long-period energy through aliasing, an Ormsby filter rather than a running mean filter is used prior to the decimation associated with the long period filtering (Shakal, 1982; Shakal and Ragsdale, 1984).

6. Phase 3 (Volume 3) Processing. The response spectra for periods from 0.04 to 15 seconds and damping values of 0, 2, 5, 10 and 20 per cent of critical are calculated from the accelerations obtained in Step 5. The Fourier amplitude spectral values are also computed for these periods. A preliminary plot of the pseudo-velocity (PSV) response spectrum is generated for use in filter selection.

7. The Phase 2 Processing of Step 5 is repeated, but with a new low-frequency Ormsby filter to remove long-period noise in the record. The corner frequency of the filter used depends on the signal-to-noise ratio in the record and the noise level of the digitizing system. The long-period intersection of the PSV spectrum obtained in Step 6 and the CSMIP average noise spectrum shown in Figure 2 (from Shakal and Ragsdale, 1984) indicates the long-period limit of useful information. An iterative procedure is used, with the filter corner being set at progressively shorter periods in order to remove the long period noise while preserving as much of the signal as possible. The final value of filter bandwidth used is shown on the titles of the plots and explained in Appendix A. The acceleration, velocity and displacement time histories obtained using this filter are the

final Phase 2 (Volume 2) data written on a magnetic tape and floppy disks and presented in this report.

8. The final relative velocity response spectrum (SV), relative displacement response spectrum (SD), absolute acceleration response spectrum (SA), and Fourier amplitude spectrum (FS) are computed using the final filter settings. The pseudo-velocity response spectra (PSV) computed from SD are plotted on tripartite logarithmic paper and presented in this report. In addition, the SA spectra are plotted versus period with a linear scale.

Note that the optimal filter bandwidth is determined for each accelerogram; all accelerograms from a single earthquake are not restricted to have a single filter corner frequency. However, the same filter corner is used for all channels from a single accelerogram to make channel-to-channel comparisons convenient.

As discussed above, Figure 2 shows the average noise spectrum for the CSMIP digitization system. It is also useful to consider the noise characteristics in terms of actual time-domain amplitudes. Figure 3 shows typical noise amplitudes present in acceleration, in velocity, and in displacement time histories obtained for different long-period filter cutoff settings. For example, Figure 3 indicates that for a filter cutoff near 10 seconds, the expected noise level is near 0.002 g in acceleration, 1 cm/sec in velocity, and 1 cm in displacement.

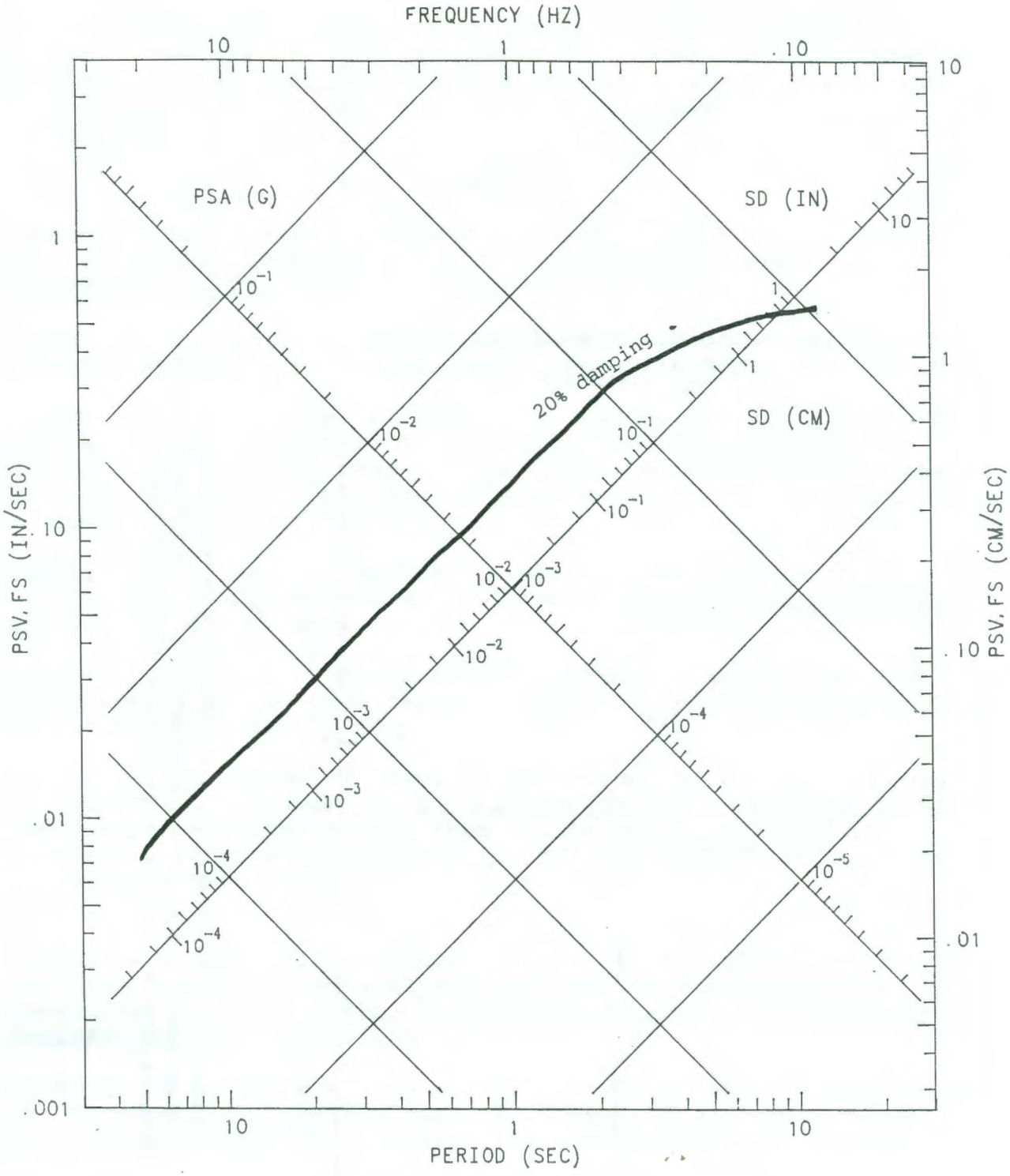

Fig. 2. Noise-level spectra (PSV, 20% damping) for the CSMIP digitization system (from Shakal and Ragsdale, 1984).

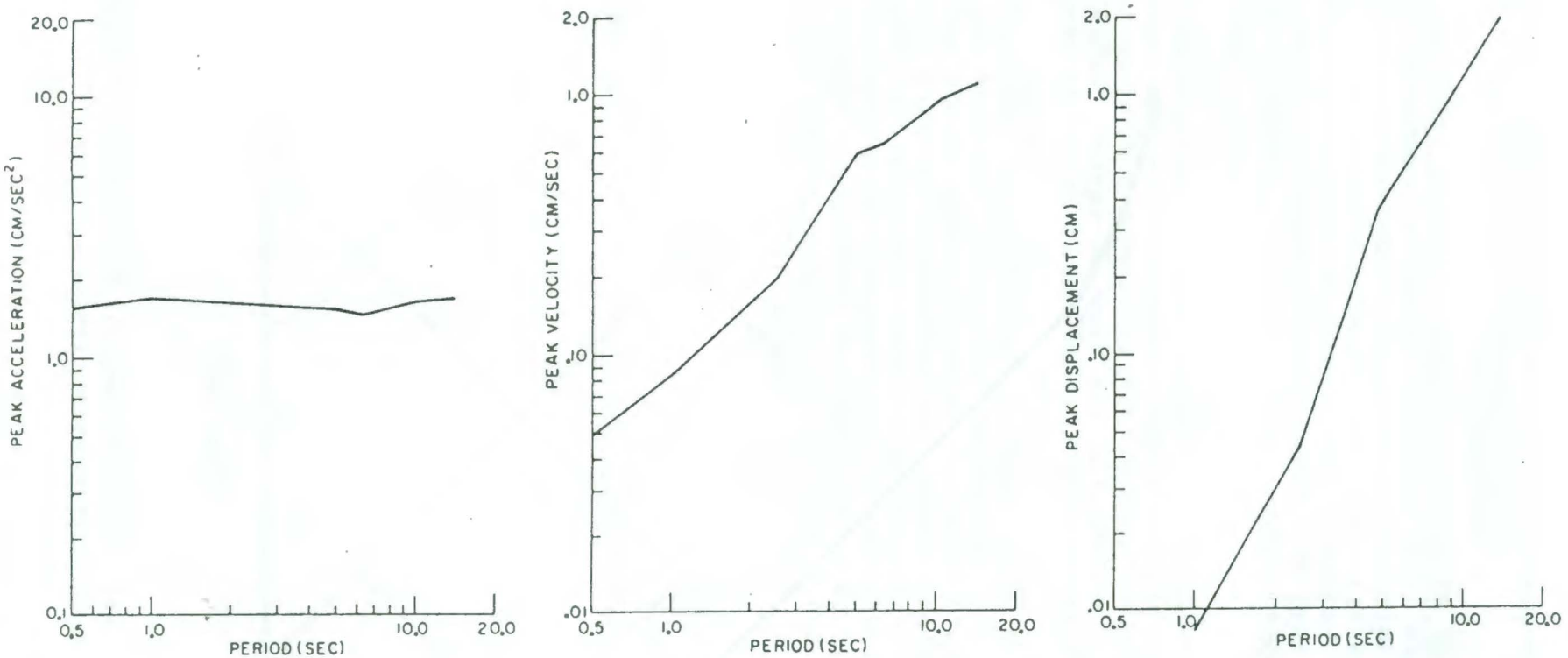

Fig. 3. Processing noise present in a typical acceleration (left), velocity (middle) and displacement (right) record processed with a long-period filter cut-off period ranging from 0.5 sec to 15 secs (from Shakal and Ragsdale, 1984).

ACKNOWLEDGEMENTS

The accelerographs of the Strong Motion Instrumentation Program of the University of Costa Rica were installed and maintained by W. Vargas, V. Sancho, C. Segura, A. Ramírez, and J. Altomirano. The efforts of Dr. J. Gutiérrez and Dr. R. Pujal are also appreciated.

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DATA AVAILABILITY

The processed data for the CSMIP ground-response records presented in this report are available on one magnetic tape, containing Phases 1, 2 and 3 (Vol. 1, 2 and 3) data (named COSTARICA91-G). The tape is written in a standard CSMIP format similar to that of the Caltech tapes (documented in Shakal and Huang, 1985). These tapes are available in standard ASCII or EBCDIC blocked (unlabeled) coding. In addition, the Phase 2 and 3 data are available on IBM-compatible 5¼" 1.2 Mb disks. These tapes and floppy disks can be obtained at nominal cost from either of the two institutions:

Data Reduction Manager
Office of Strong Motion Studies
Strong Motion Instrumentation Program
Division of Mines and Geology
California Department of Conservation
801 K Street, MS 13-35
Sacramento, California 95814-3531
Phone: (916) 322-3105
Fax: (916) 323-7778

Laboratorio de Ingenería Sísmica
Instituto de Investigaciones en Ingenería
2060 Universidad de Costa Rica
Costa Rica
Phone: (506) 224-2408
Fax: (506) 253-4911

APPENDIX A

PLOTS OF PROCESSED DATA

For each station, four sets of plots are presented in the following order:

1. Phase 1 (Vol. 1) data: Uncorrected accelerations. The acceleration data for the full processed length (between 60 and 80 seconds) are plotted with common amplitude and time scales of 0.3 g and 80 seconds. Three channels are plotted on one page.

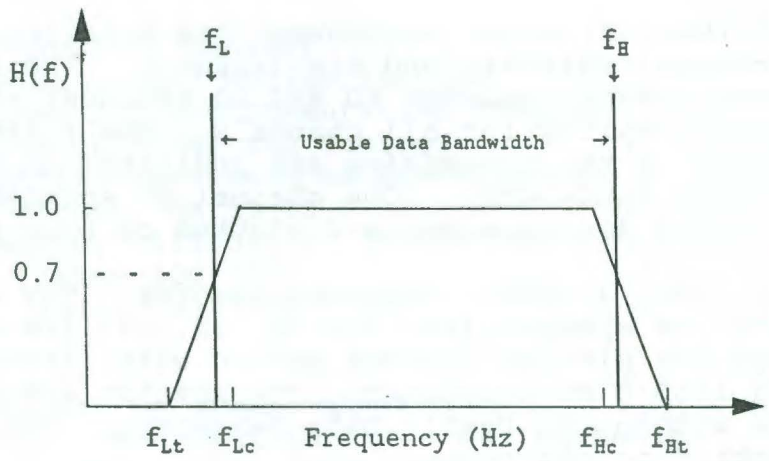
2. Phase 2 (Vol. 2) data: Instrument and baseline-corrected acceleration, velocity and displacement. The data for full processed length (between 60 and 80 seconds) are plotted with equal scaling for all channels. The filter frequencies determined in the processing are indicated on the plots (see Usable Data Bandwidth). One channel of acceleration, velocity and displacement are plotted on each page.

3. Phase 3 (Vol. 3) data: Response spectra. The absolute acceleration spectra (SA) for 0%, 2%, 5%, 10% and 20% dampings are plotted against period with linear-linear scaling from 0 to 4 seconds. The spectra are plotted for periods within the Usable Data Bandwidth. Three channels are plotted on one page.

4. Phase 3 (Vol. 3) data: Response spectra. The pseudo-velocity spectra (PSV), the pseudo-acceleration spectra (PSA), and the displacement spectra (SD) are presented on a tripartite logarithmic plot for each channel for 0%, 2%, 5%, 10%, and 20% dampings. The spectra are plotted for periods within the Usable Data Bandwidth. Three channels are plotted on one page.

DEFINITION OF USABLE DATA BANDWIDTH

The filter bands for each record are indicated on the plots for the Phase 2 and Phase 3 data. In standard processing, the digitized data are processed and filtered using Ormsby filters. The data are first low-pass filtered using a high-frequency filter with a corner frequency of 23 Hz and a roll-off termination frequency of 25 Hz. Then the data are high-pass filtered using a low-frequency filter with a corner frequency of 0.07 Hz and a roll-off termination of 0.05 Hz. Therefore, the Phase 2 data is the result of the digitized data being filtered by the bandpass filter H(f) with ramps as shown in the figure:

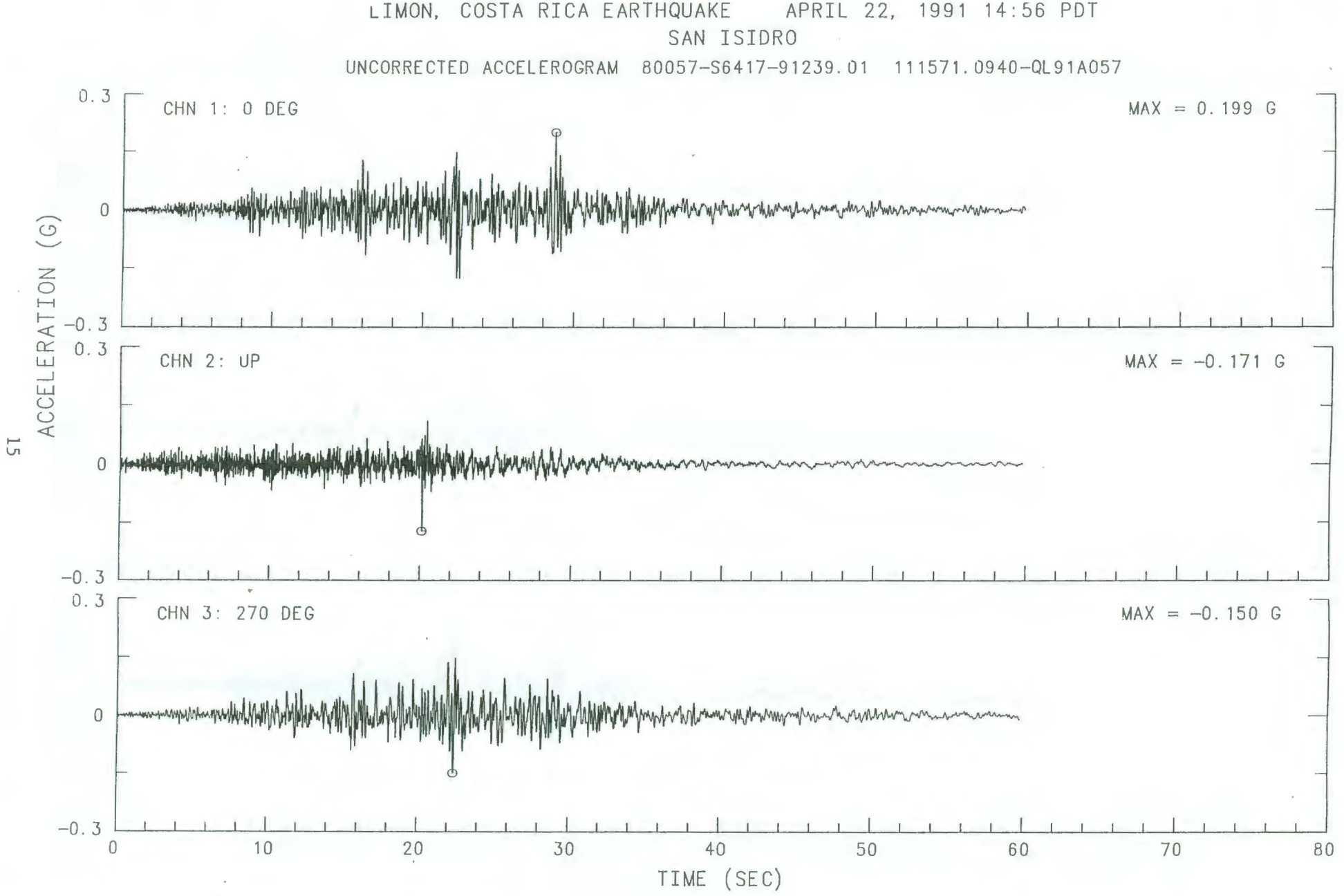


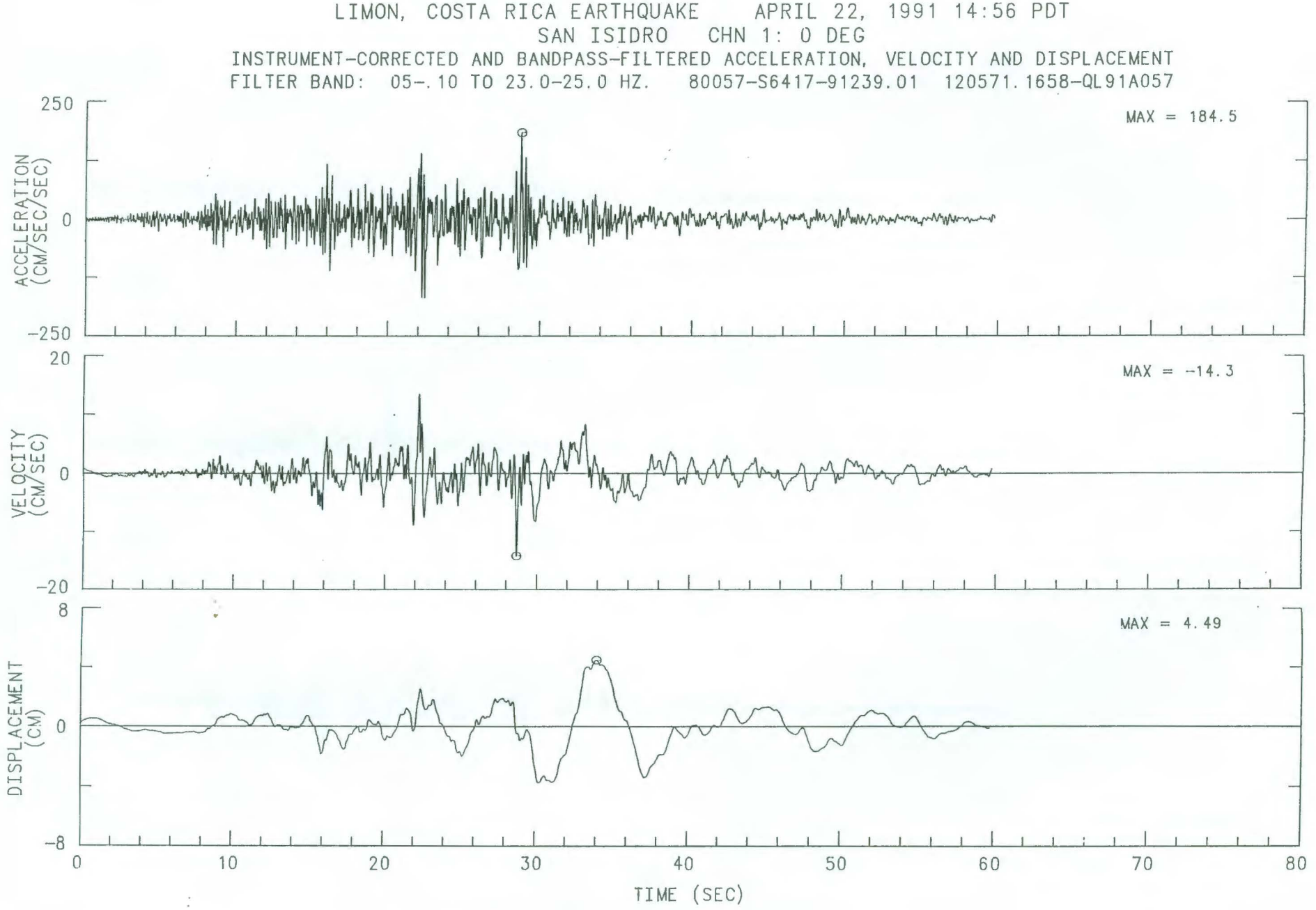
The Usable Data Bandwidth is defined as the band between frequencies f_H and f_L, where f_H and f_L are the -3 dB points on the high-frequency and low-frequency ramps, respectively. The value of H(f) is approximately equal to 0.7 for -3 dB (see Notes). The user should only use these data for analyses within this bandwidth.

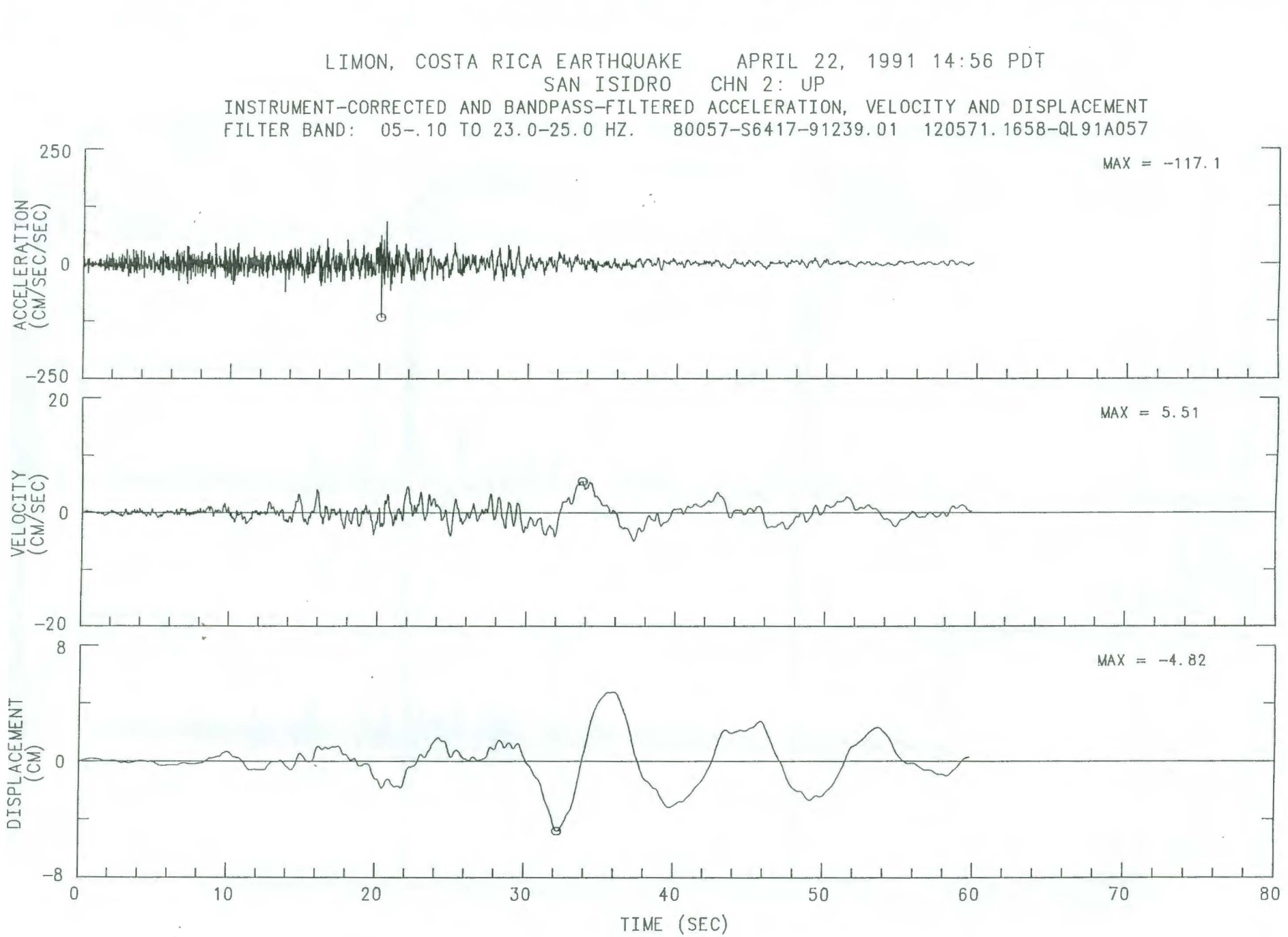
Notes:

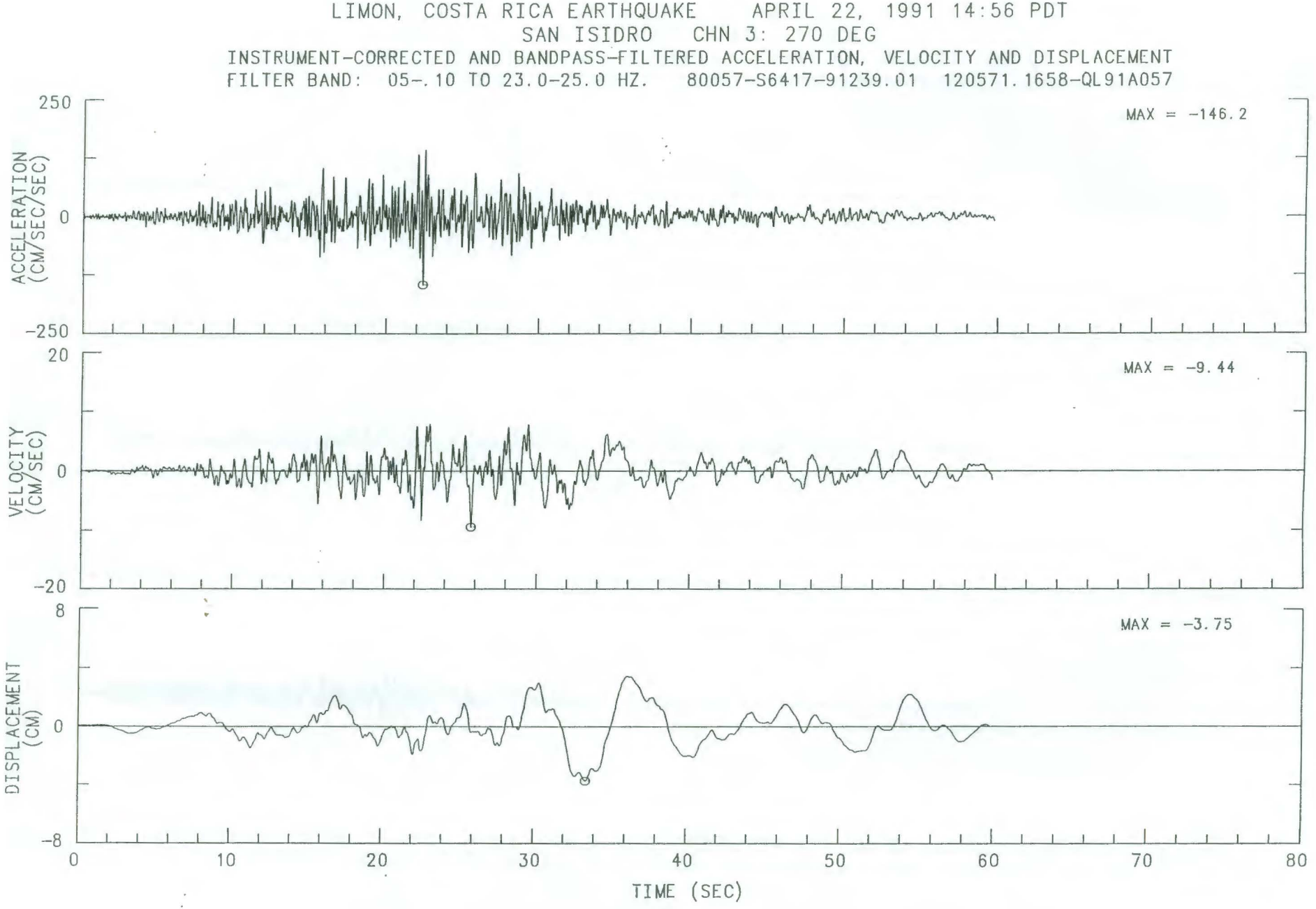
1) The values of f_H and f_L can be calculated from the corner frequencies (f_{Hc}, f_{Lc}) and the roll-off termination frequencies (f_{Ht}, f_{Lt}) used in the processing by using the formulas $f_H = f_{Hc} + 0.3 * (f_{Ht} - f_{Hc})$ and $f_L = f_{Lc} - 0.3 * (f_{Lc} - f_{Lt})$. For example, the Usable Data Bandwidth for data bandpass-filtered with ramps at 0.30 to 0.60 Hz and 23.0 to 25.0 Hz is 0.51 Hz to 23.6 Hz (0.042 to 2.0 seconds period).

2) It is common in signal processing to plot 20 $\log_{10}[H(f)]$ versus frequency, and express the ordinate value in decibels (abbreviated dB). Accordingly, 0 dB corresponds to a value of H(f) equal to 1; 20 dB is equivalent to H(f) = 10, and -20 dB corresponds to H(f) = 0.1. Thus, at the -3 dB frequency point, the amplitude of the transfer function, H(f) is reduced to 0.7, while the power transmitted by the filter, $H^2(f)$, is reduced to 0.5.

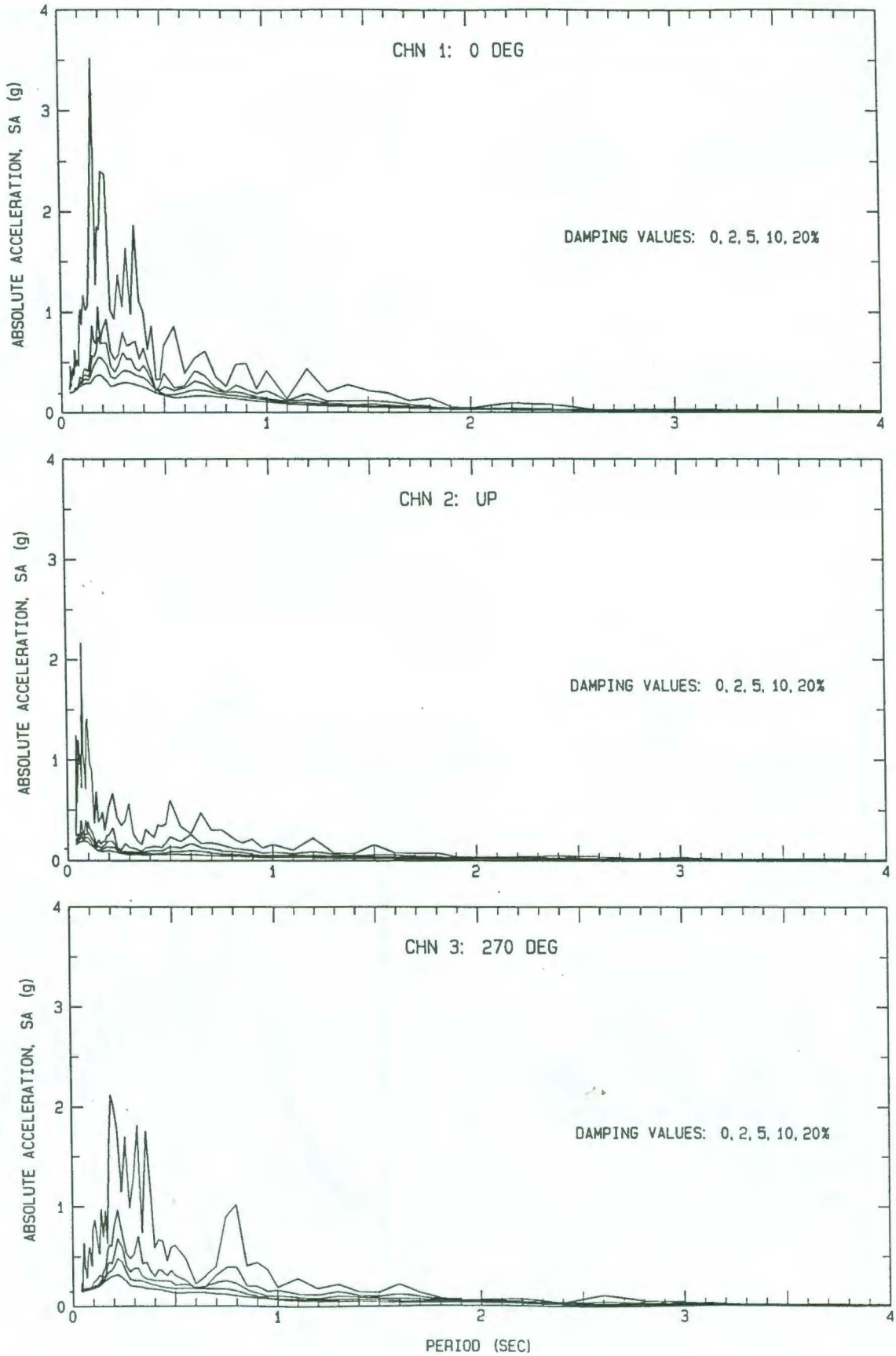

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN ISIDRO
UNCORRECTED ACCELEROGRAM 80057-S6417-91239.01 111571.0940-QL91A057
CHN 1: 0 DEG
MAX = 0.199 G
CHN 2: UP
MAX = -0.171 G
CHN 3: 270 DEG
MAX = -0.150 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN ISIDRO CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80057-S6417-91239.01 120571.1658-QL91A057
ACCELERATION (CM/SEC/SEC)
MAX = 184.5
VELOCITY (CM/SEC)
MAX = -14.3
DISPLACEMENT (CM)
MAX = 4.49
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN ISIDRO CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80057-S6417-91239.01 120571.1658-QL91A057
ACCELERATION (CM/SEC/SEC)
MAX = -117.1
VELOCITY (CM/SEC)
MAX = 5.51
DISPLACEMENT (CM)
MAX = -4.82
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN ISIDRO CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80057-S6417-91239.01 120571.1658-QL91A057
ACCELERATION (CM/SEC/SEC)
MAX = -146.2
VELOCITY (CM/SEC)
MAX = -9.44
DISPLACEMENT (CM)
MAX = -3.75
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN ISIDRO
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
80057-S6417-91239.01 050595.0847-QL91A057



SAN ISIDRO: CSMIP S/N 057

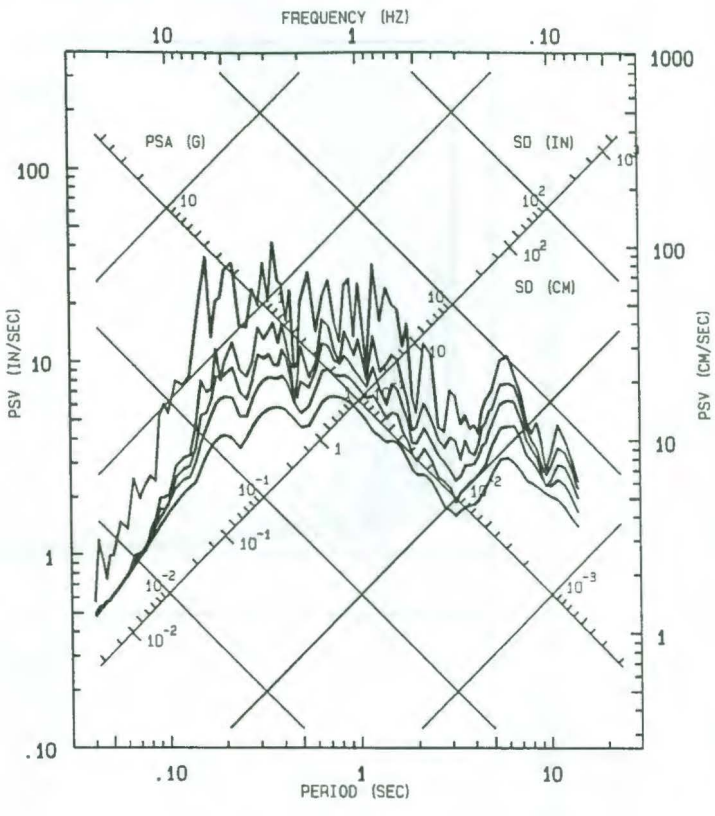
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.09 TO 23.6 HZ
(0.04 TO 11.8 SEC)

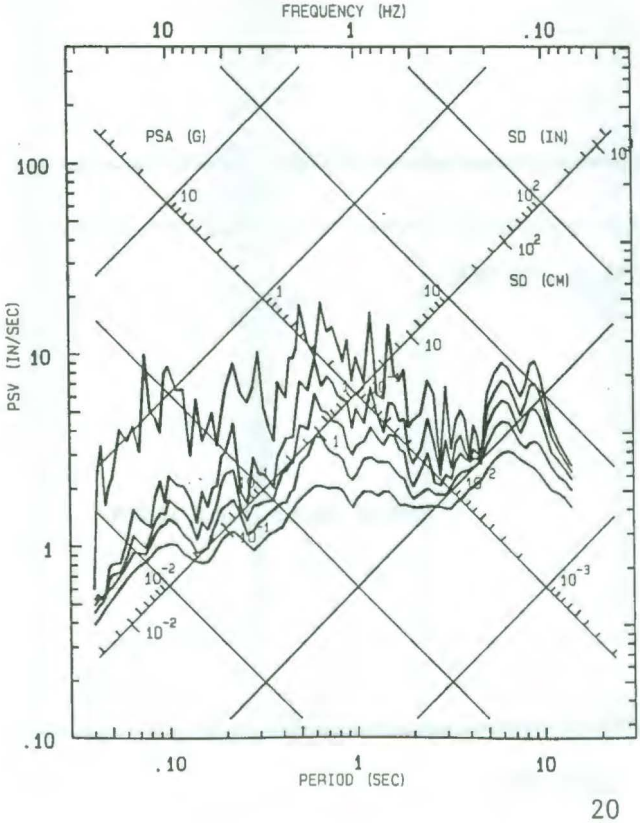
RECORD ID: 80057-S6417-91239.01

——— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

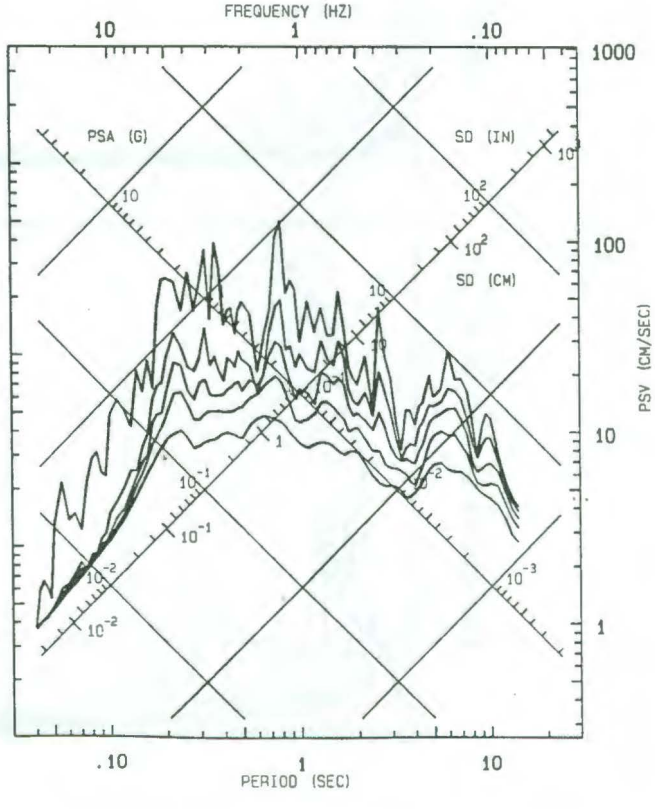
CHN 1: 0 DEG

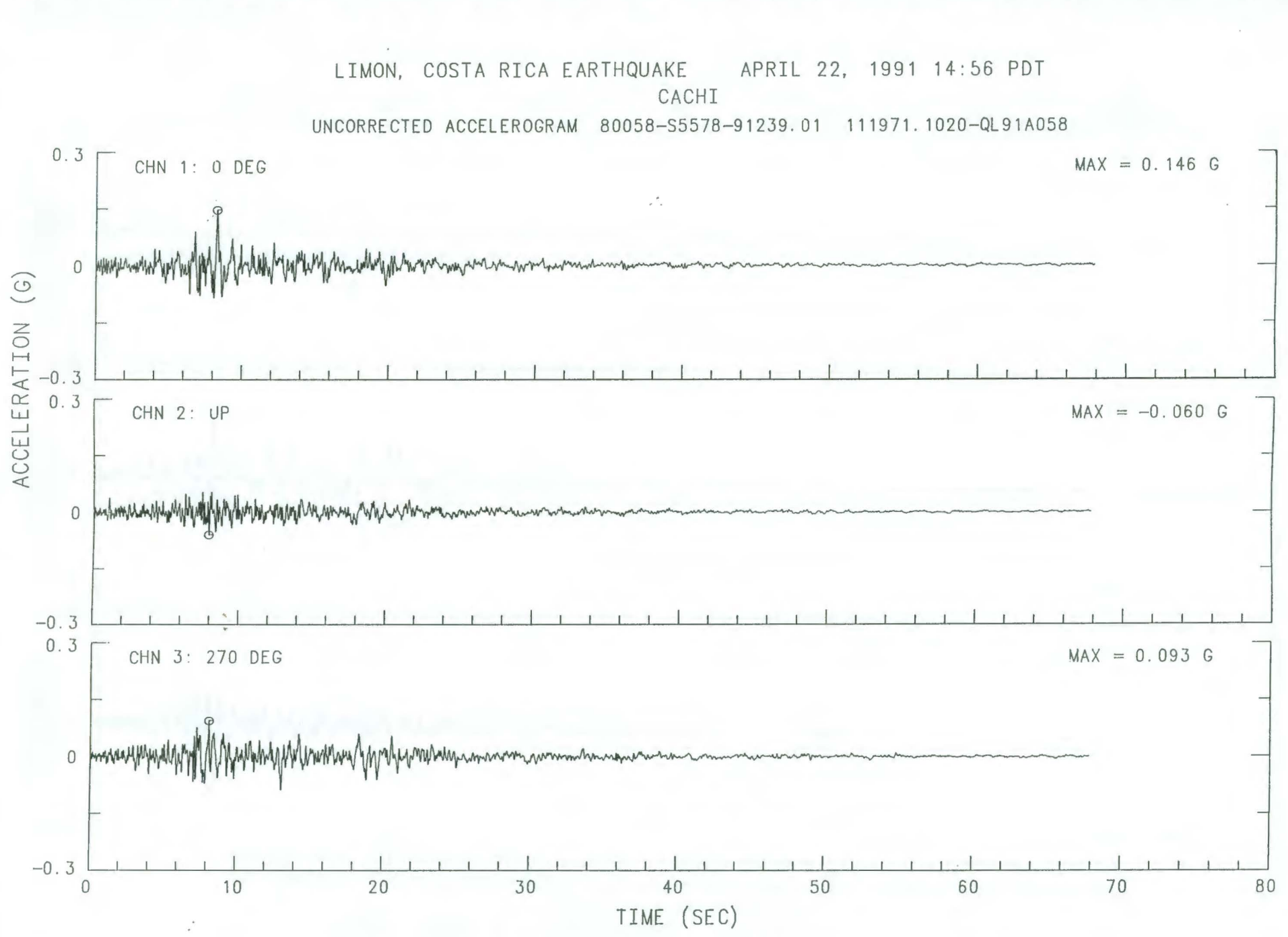


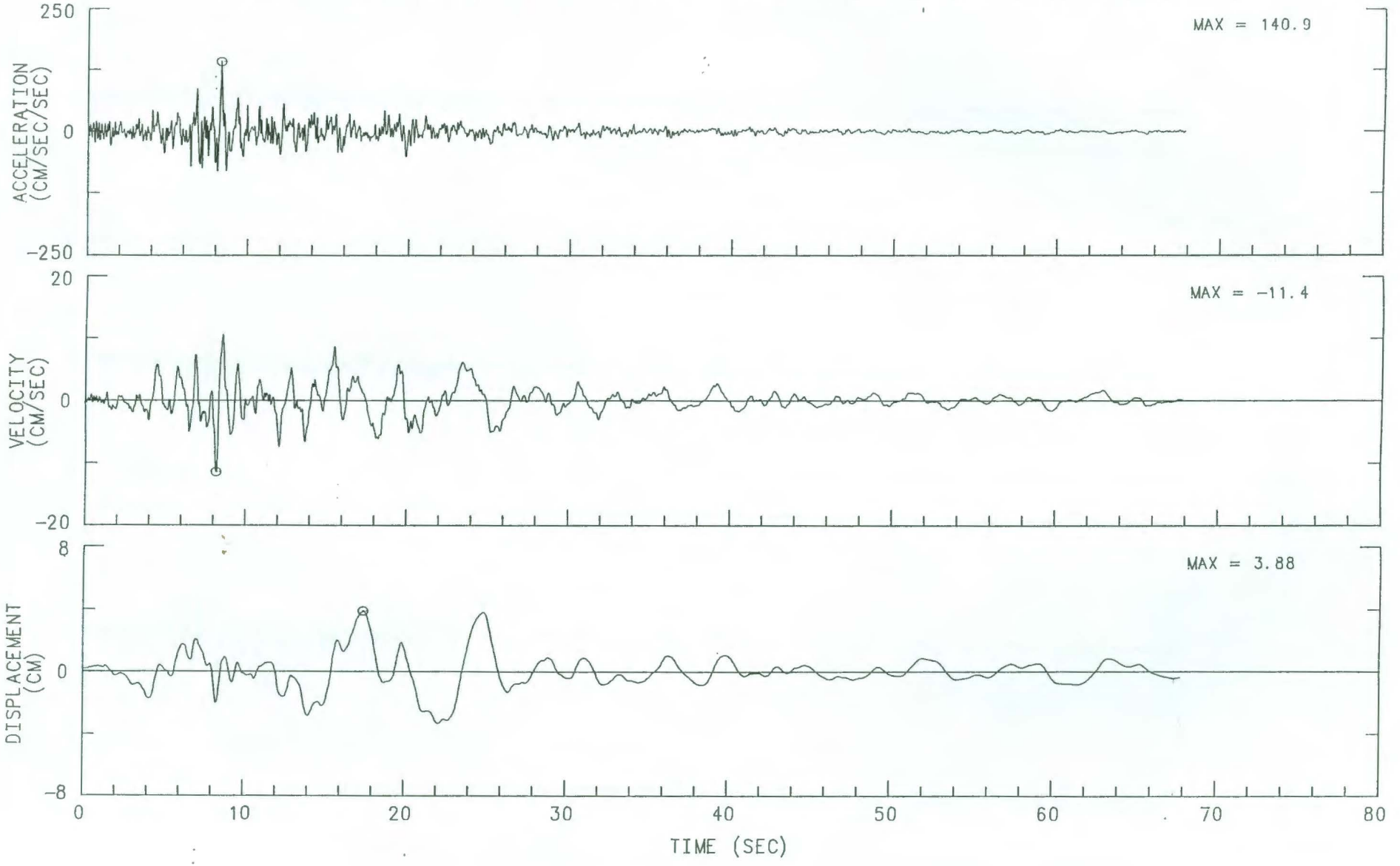
CHN 2: UP

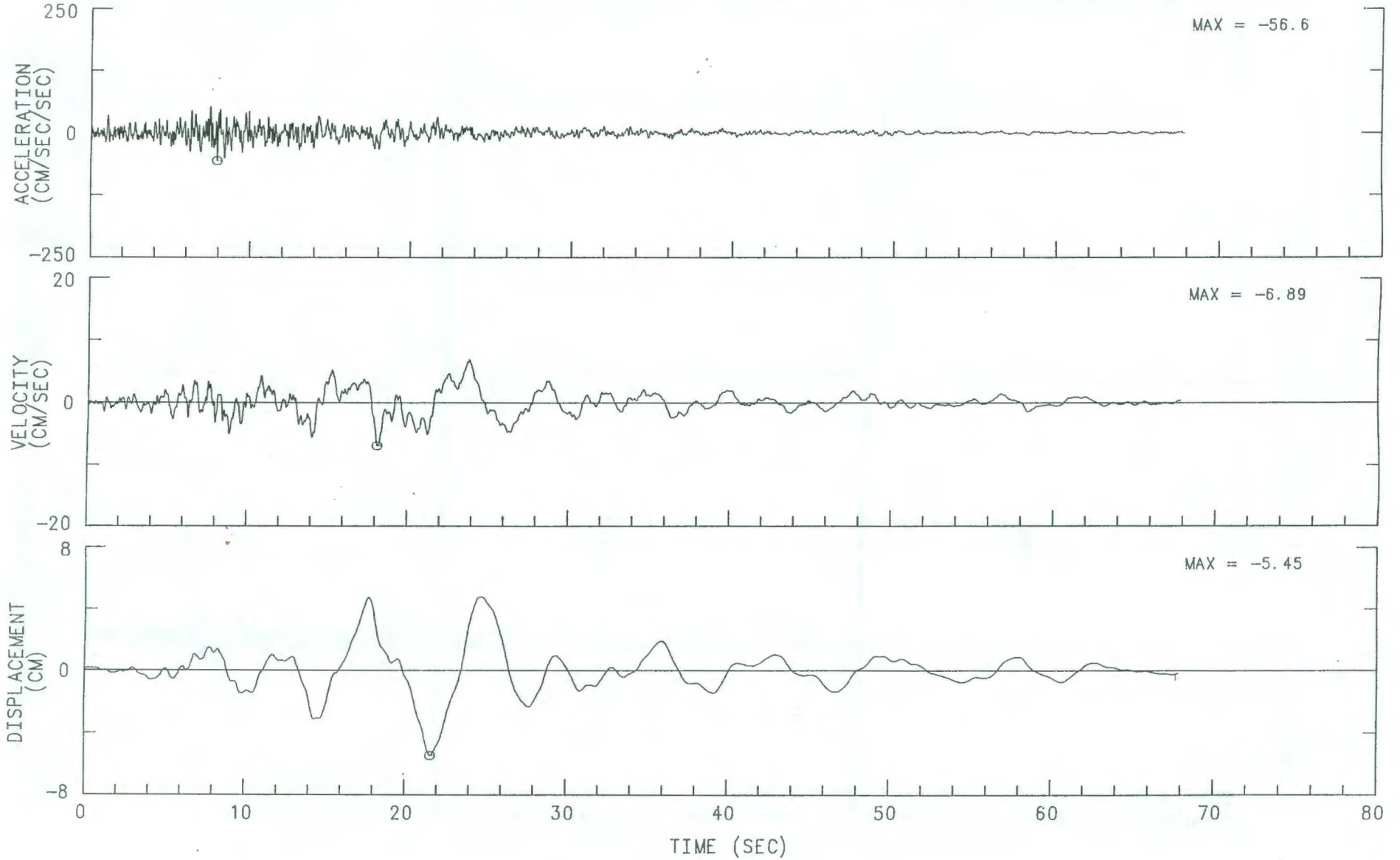


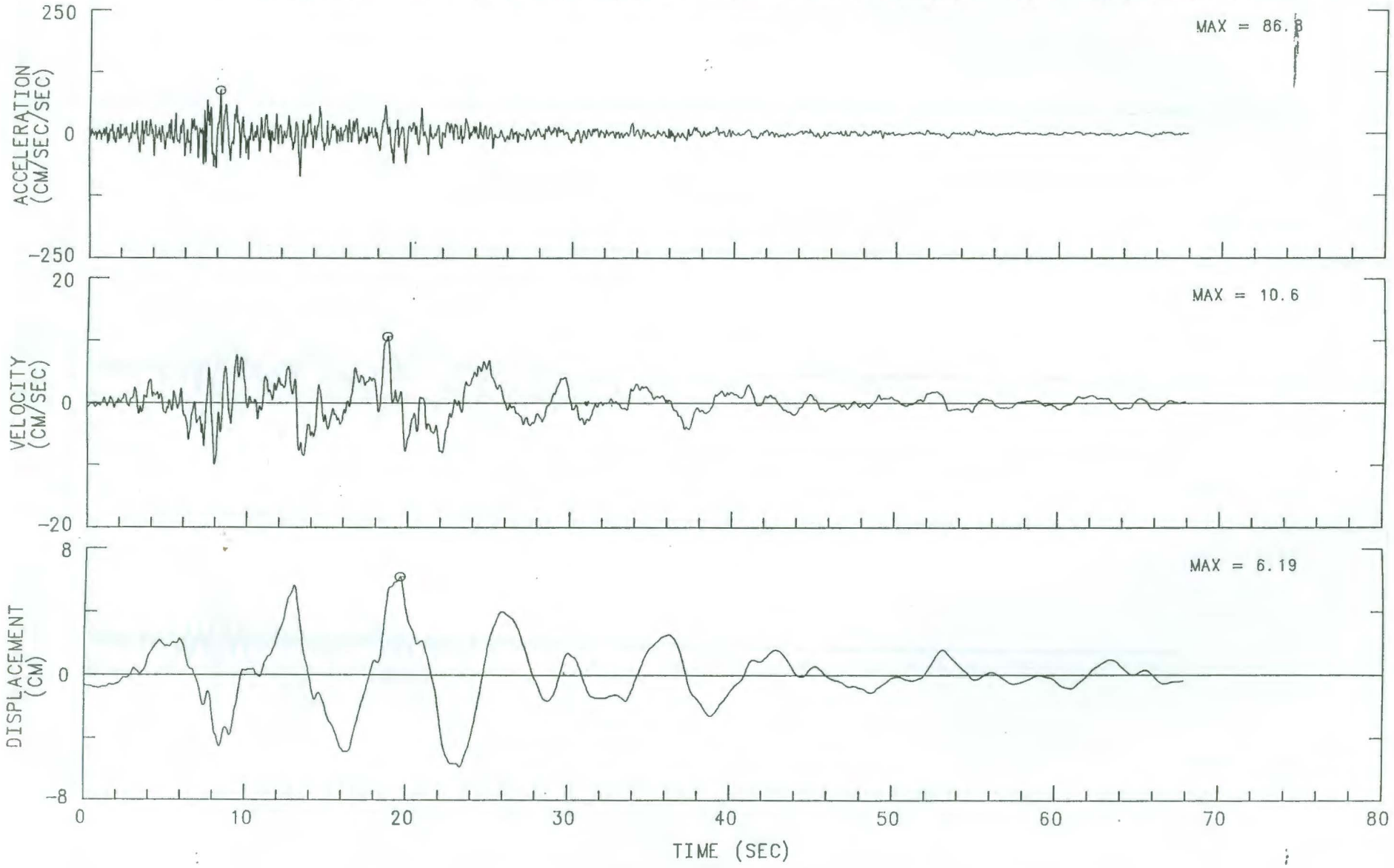
CHN 3: 270 DEG



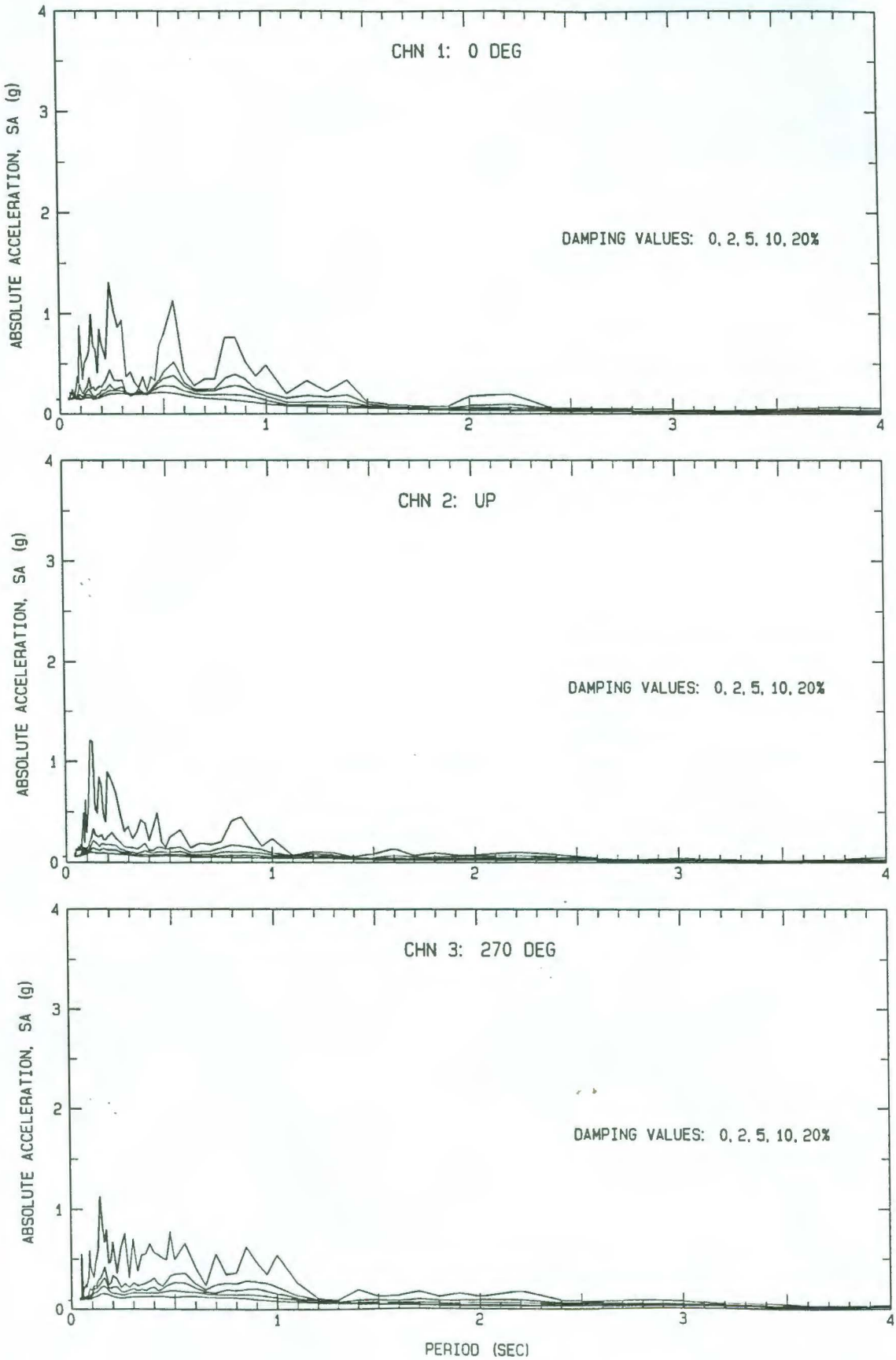

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CACHI
UNCORRECTED ACCELEROGRAM 80058-S5578-91239.01 111971.1020-QL91A058
CHN 1: 0 DEG
MAX = 0.146 G
CHN 2: UP
MAX = -0.060 G
CHN 3: 270 DEG
MAX = 0.093 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CACHI CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80058-S5578-91239.01 120571.1832-QL91A058
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 140.9
VELOCITY (CM/SEC)
20
0
-20
MAX = -11.4
DISPLACEMENT (CM)
8
0
-8
MAX = 3.88
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CACHI CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80058-S5578-91239.01 120571.1832-QL91A058
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -56.6
VELOCITY (CM/SEC)
20
0
-20
MAX = -6.89
DISPLACEMENT (CM)
8
0
-8
MAX = -5.45
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CACHI CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80058-S5578-91239.01 120571.1832-QL91A058
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 86.8
VELOCITY (CM/SEC)
20
0
-20
MAX = 10.6
DISPLACEMENT (CM)
8
0
-8
MAX = 6.19
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CACHI
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
B0058-S5578-91239.01 050595.0847-QL91A058



CACHI: CSMIP S/N 058

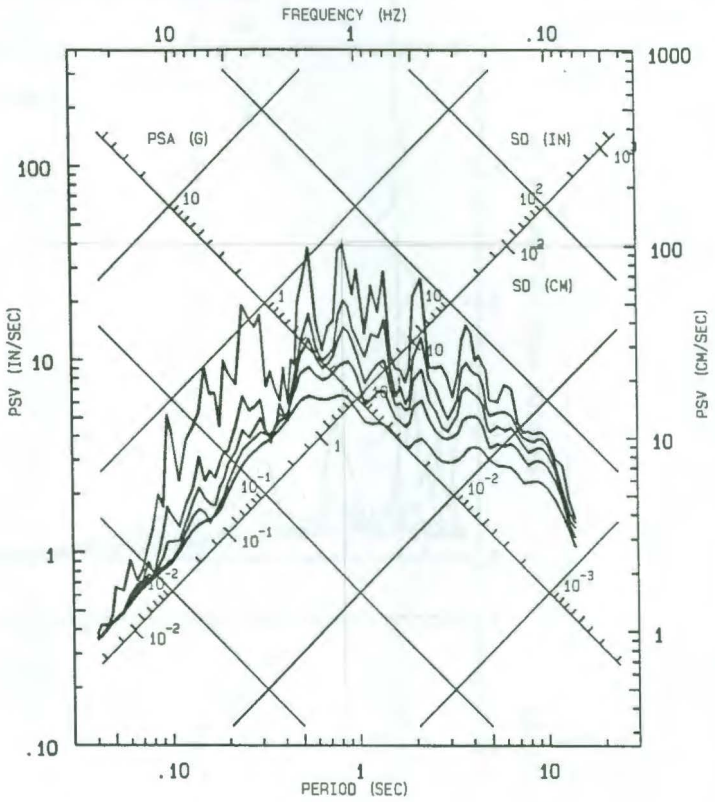
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.09 TO 23.6 HZ
(0.04 TO 11.8 SEC)

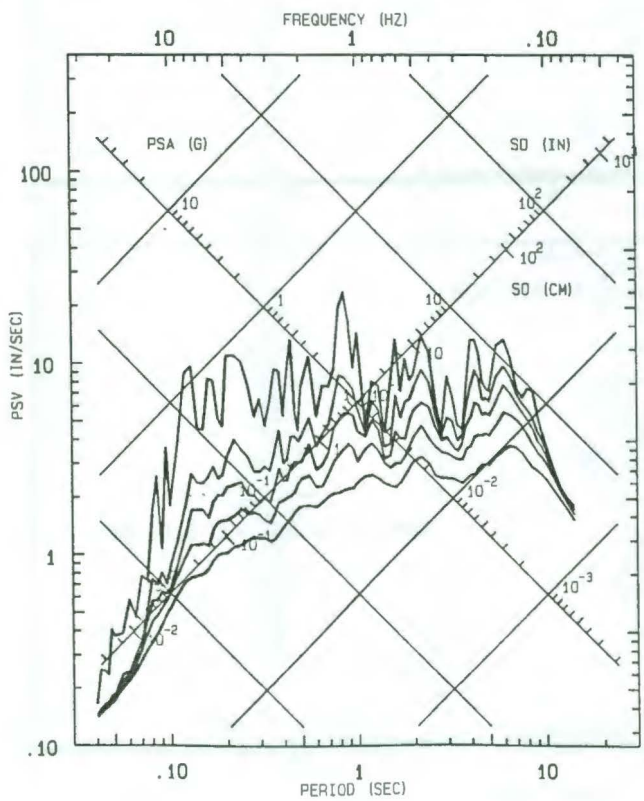
RECORD ID: 80058-S5578-91239.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

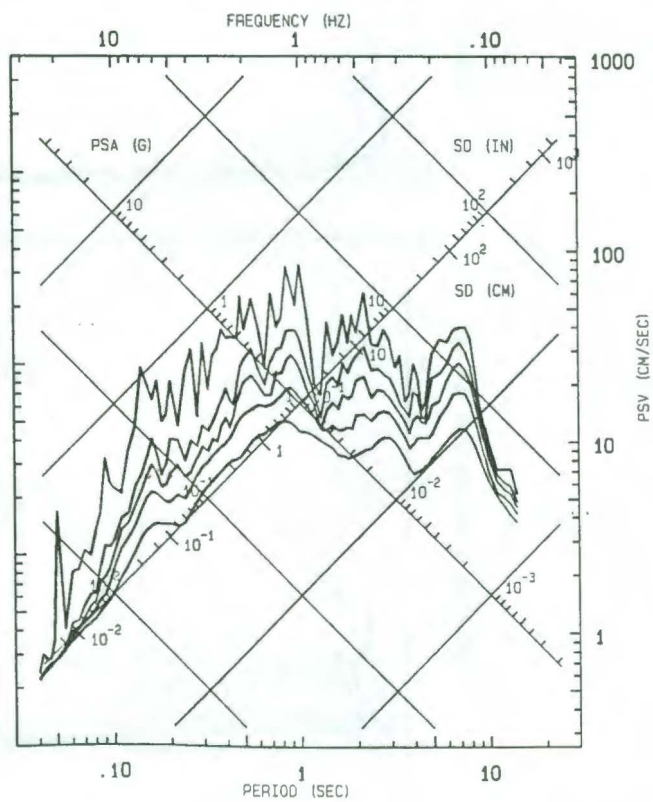
CHN 1: 0 DEG

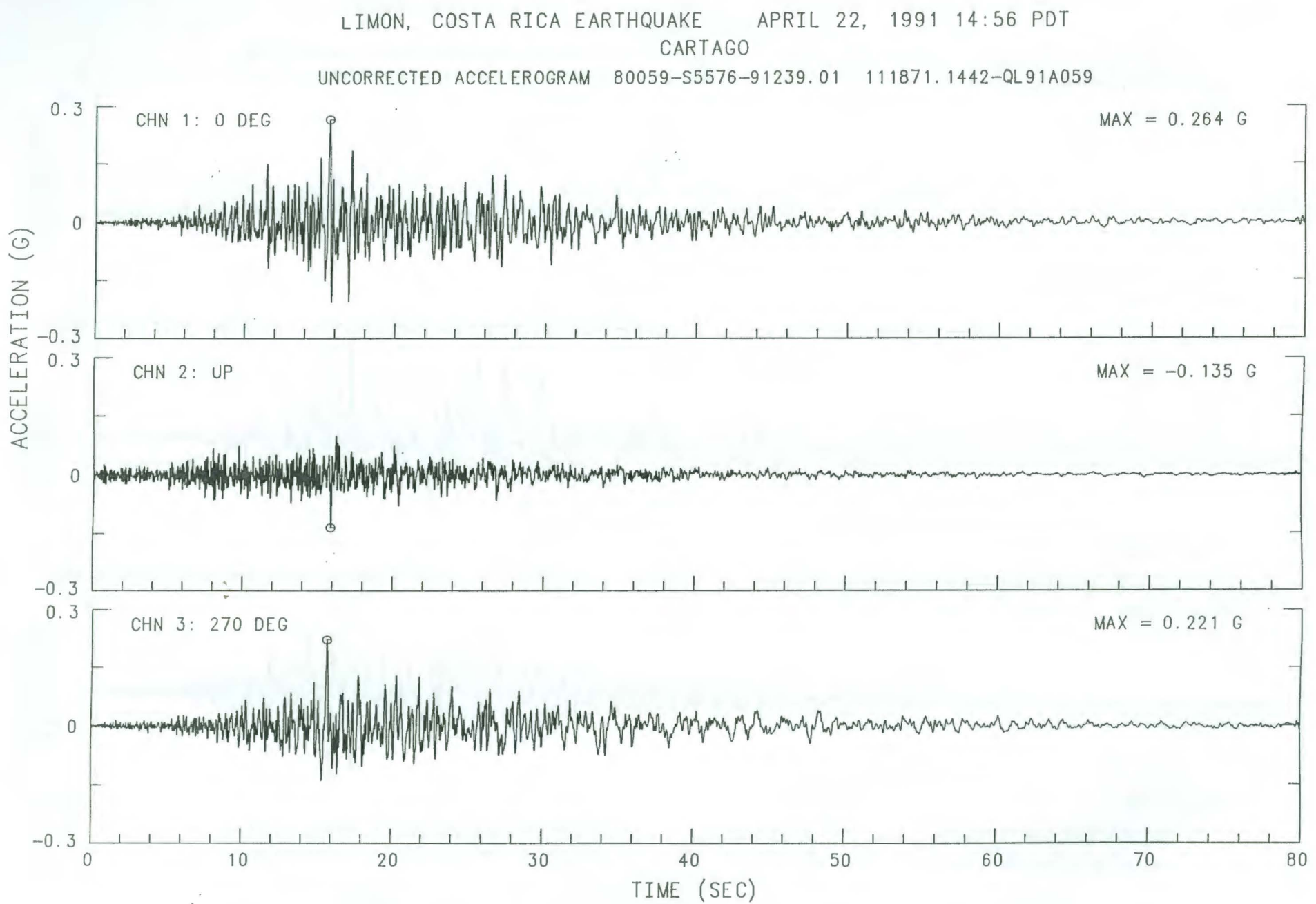


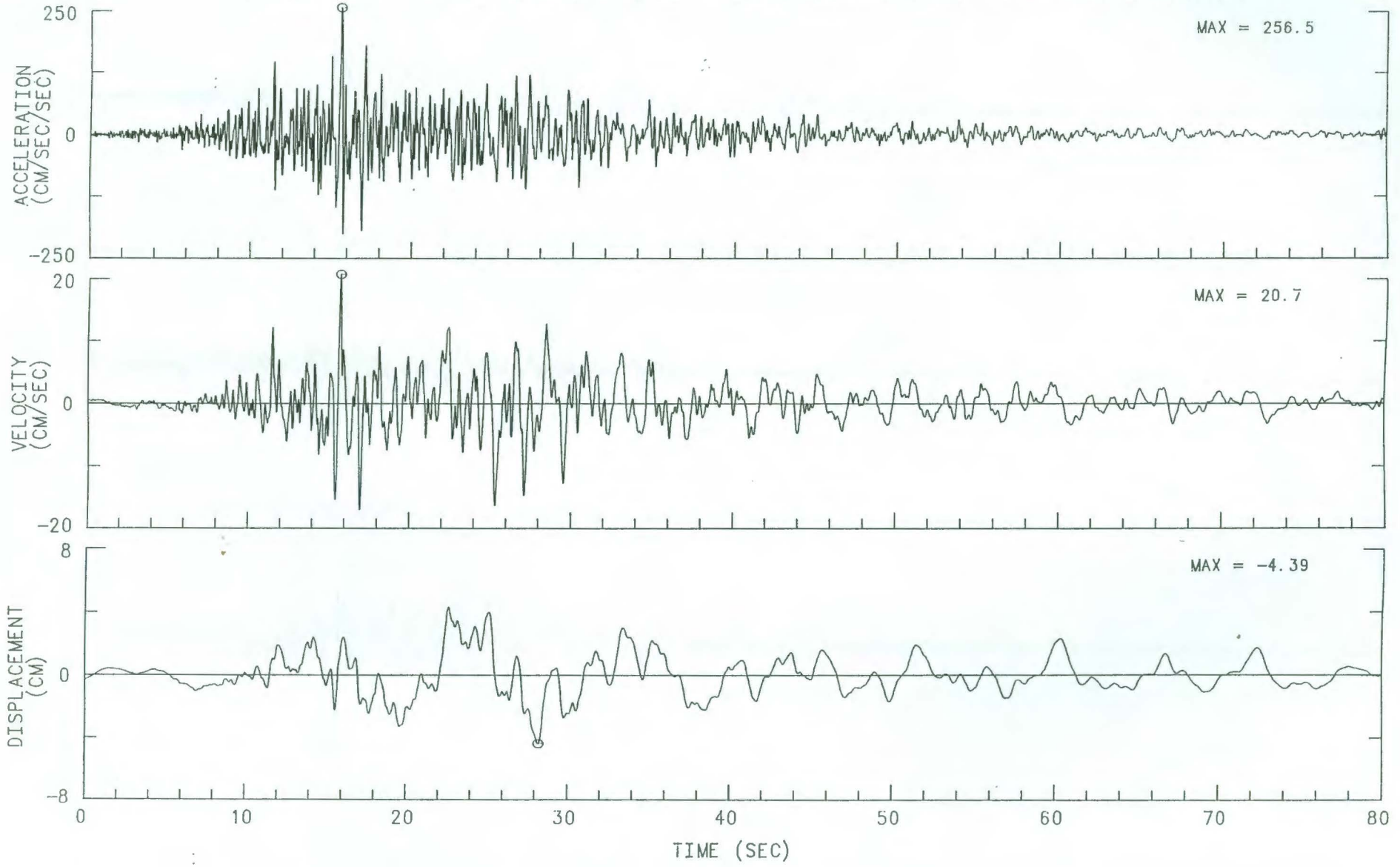
CHN 2: UP

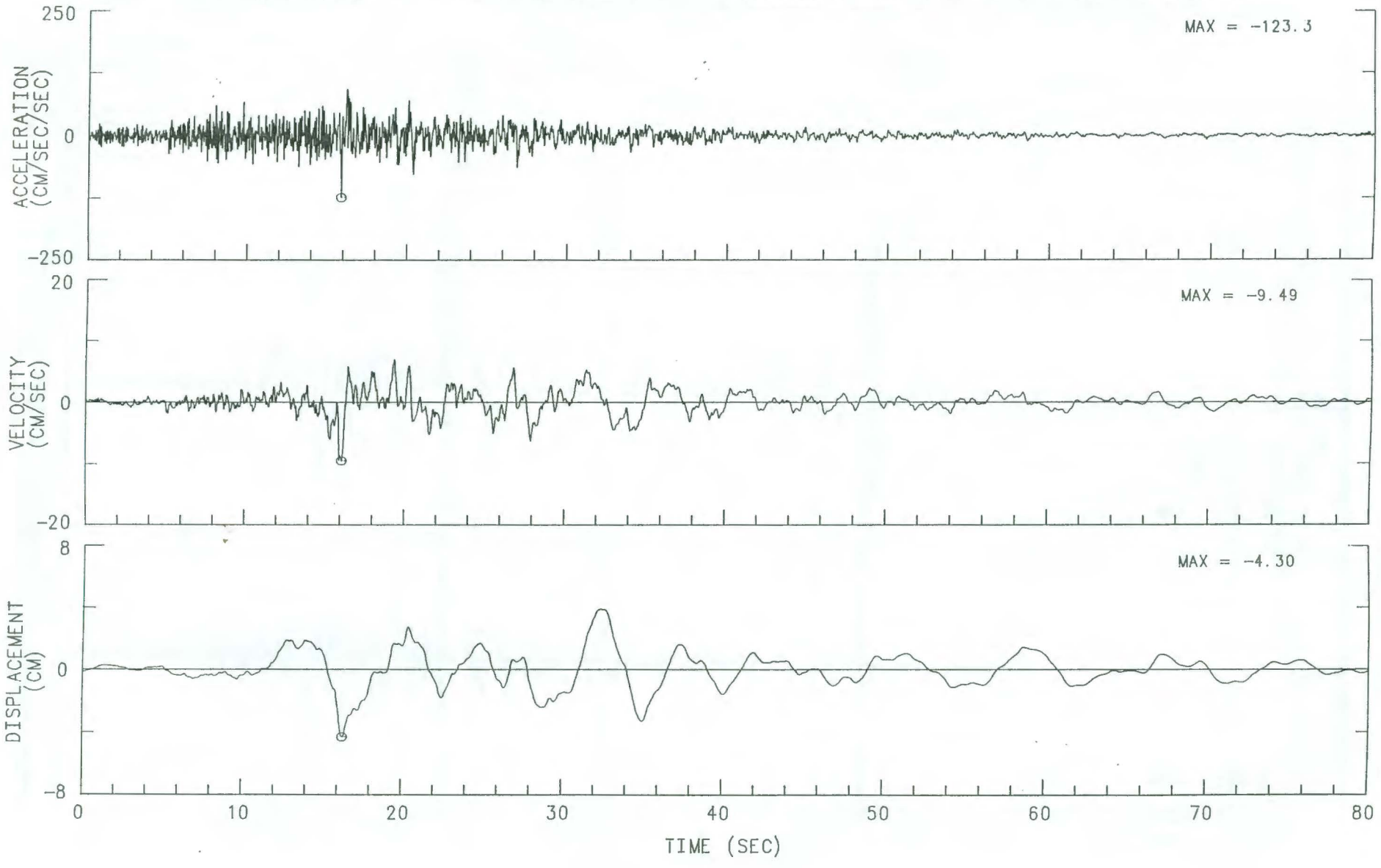


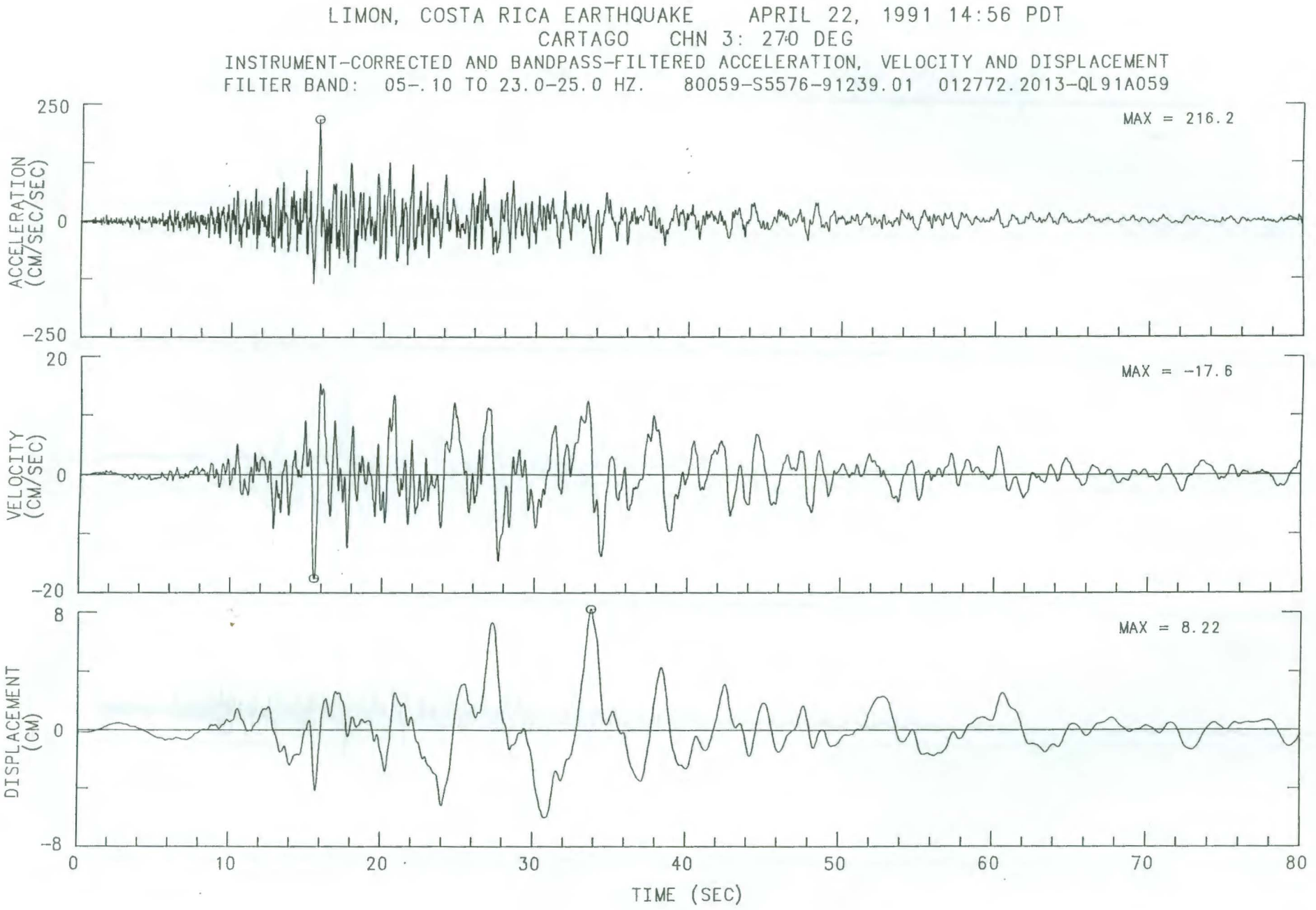
CHN 3: 270 DEG



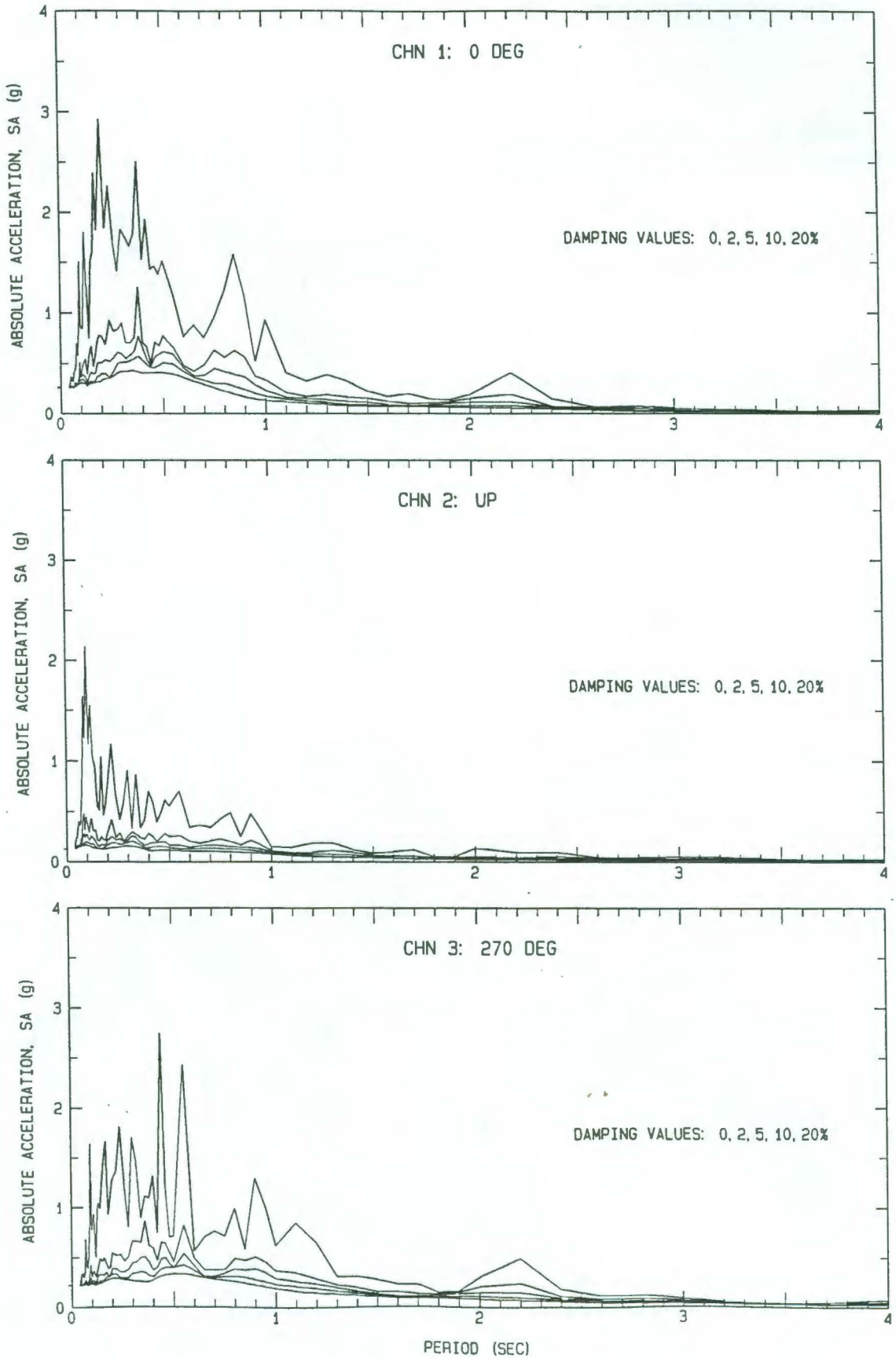

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CARTAGO
UNCORRECTED ACCELEROGRAM 80059-S5576-91239.01 111871.1442-QL91A059
CHN 1: 0 DEG
MAX = 0.264 G
CHN 2: UP
MAX = -0.135 G
CHN 3: 270 DEG
MAX = 0.221 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CARTAGO CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80059-S5576-91239.01 012772.2013-QL91A059
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 256.5
VELOCITY (CM/SEC)
20
0
-20
MAX = 20.7
DISPLACEMENT (CM)
8
0
-8
MAX = -4.39
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CARTAGO CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80059-S5576-91239.01 012772.2013-QL91A059
ACCELERATION (CM/SEC/SEC)
MAX = -123.3
VELOCITY (CM/SEC)
MAX = -9.49
DISPLACEMENT (CM)
MAX = -4.30
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CARTAGO CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80059-S5576-91239.01 012772.2013-QL91A059
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 216.2
VELOCITY (CM/SEC)
20
0
-20
MAX = -17.6
DISPLACEMENT (CM)
8
0
-8
MAX = 8.22
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
CARTAGO
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
80059-S5576-91239.01 050595.0847-QL91A059



CARTAGO: CSMIP S/N 059

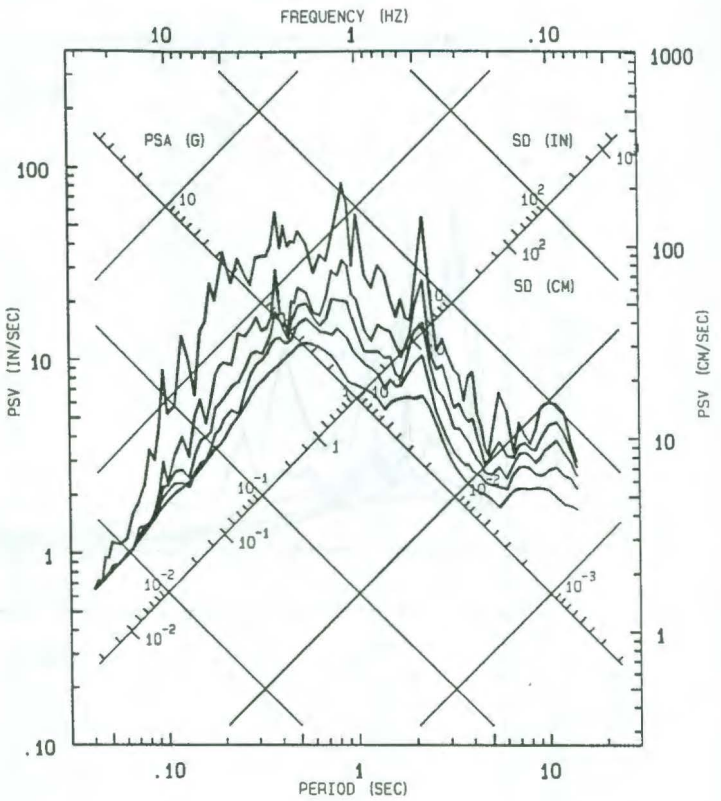
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.09 TO 23.6 HZ
(0.04 TO 11.8 SEC)

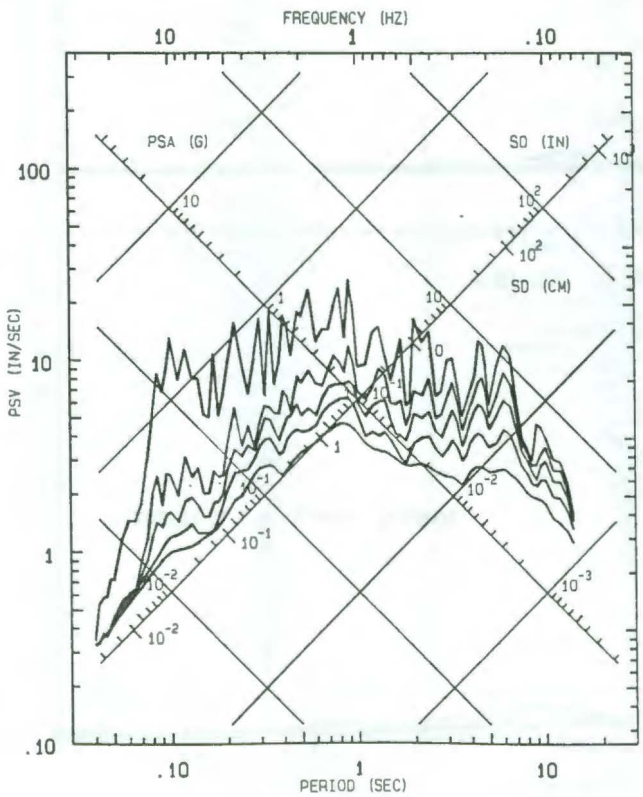
RECORD ID: 80059-S5576-91239.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

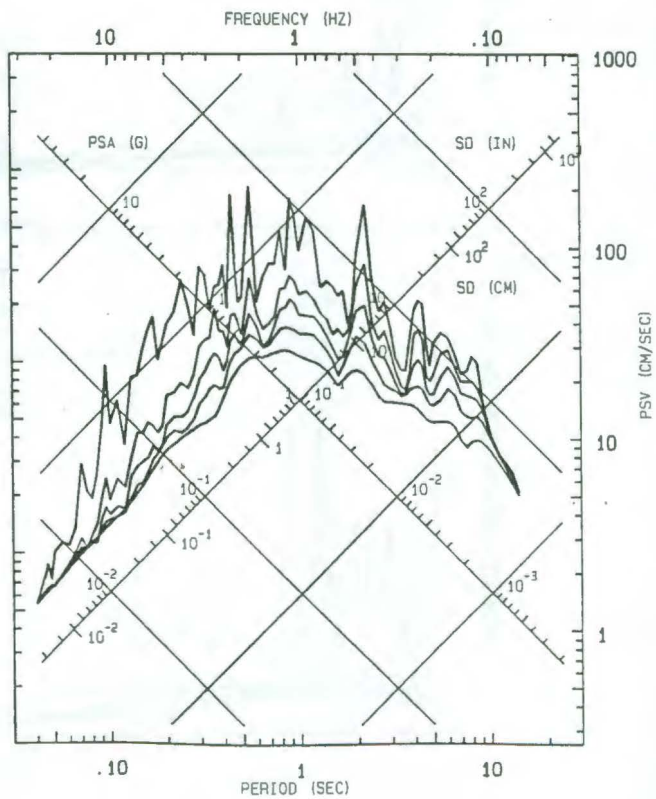
CHN 1: 0 DEG

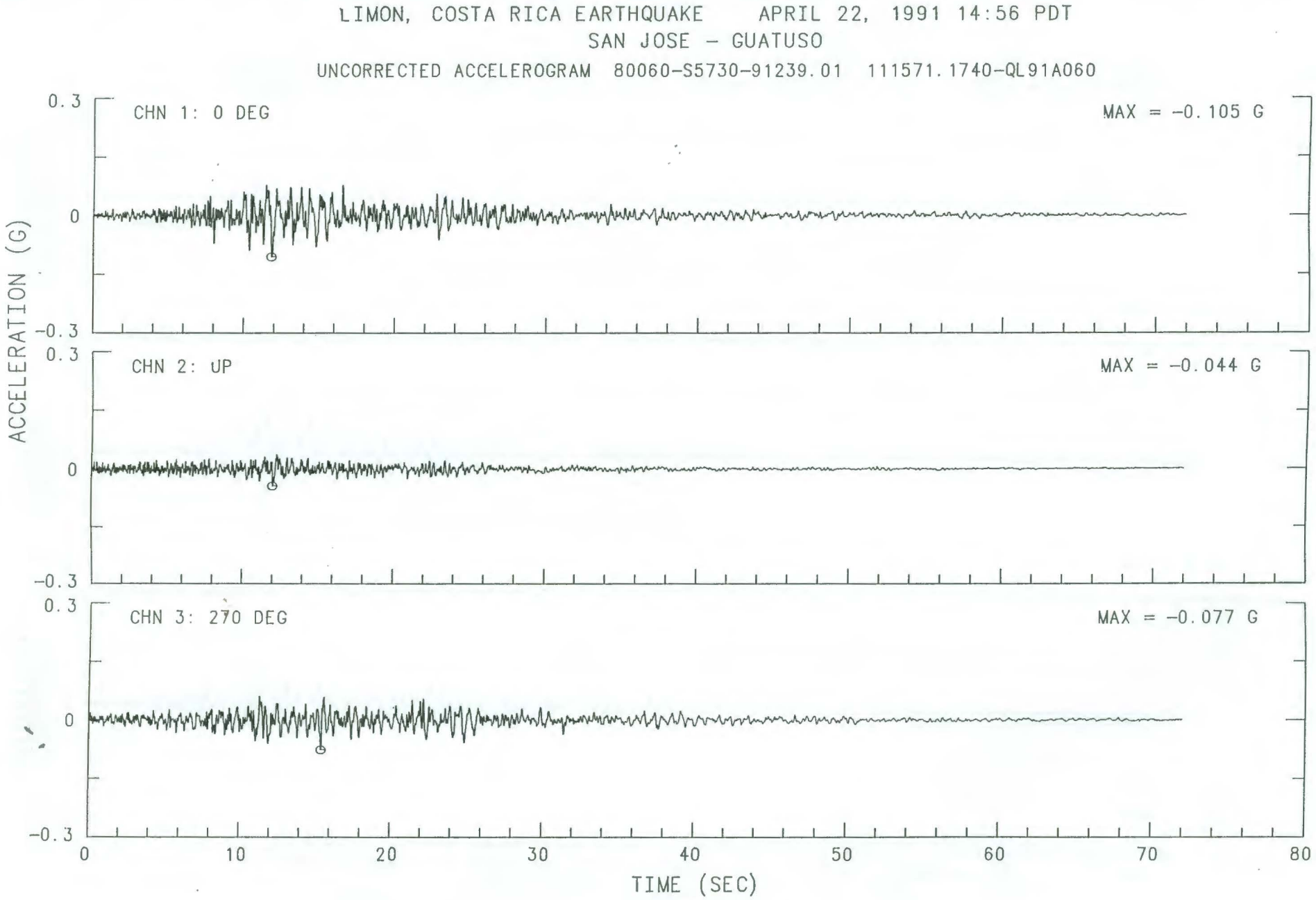


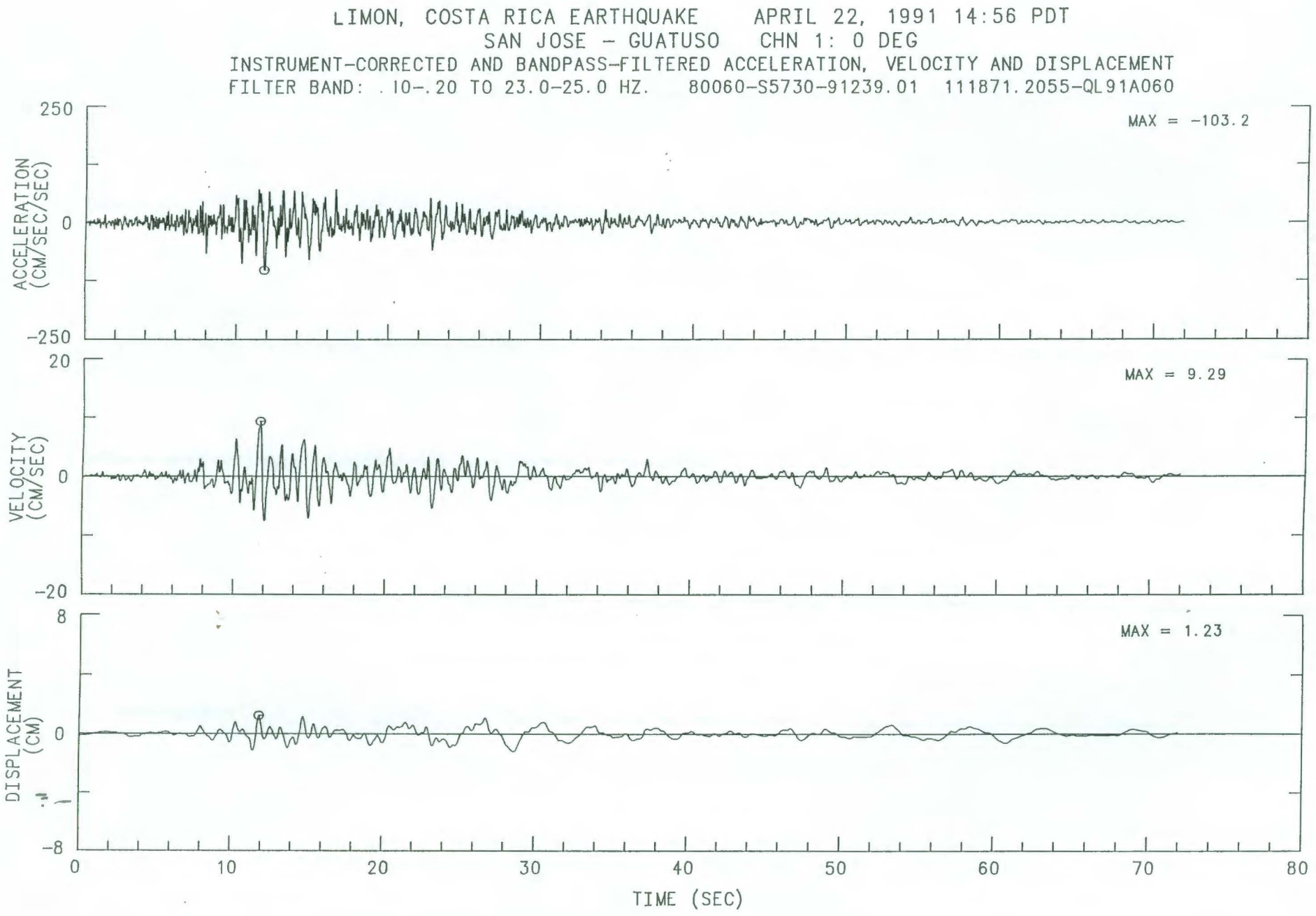
CHN 2: UP

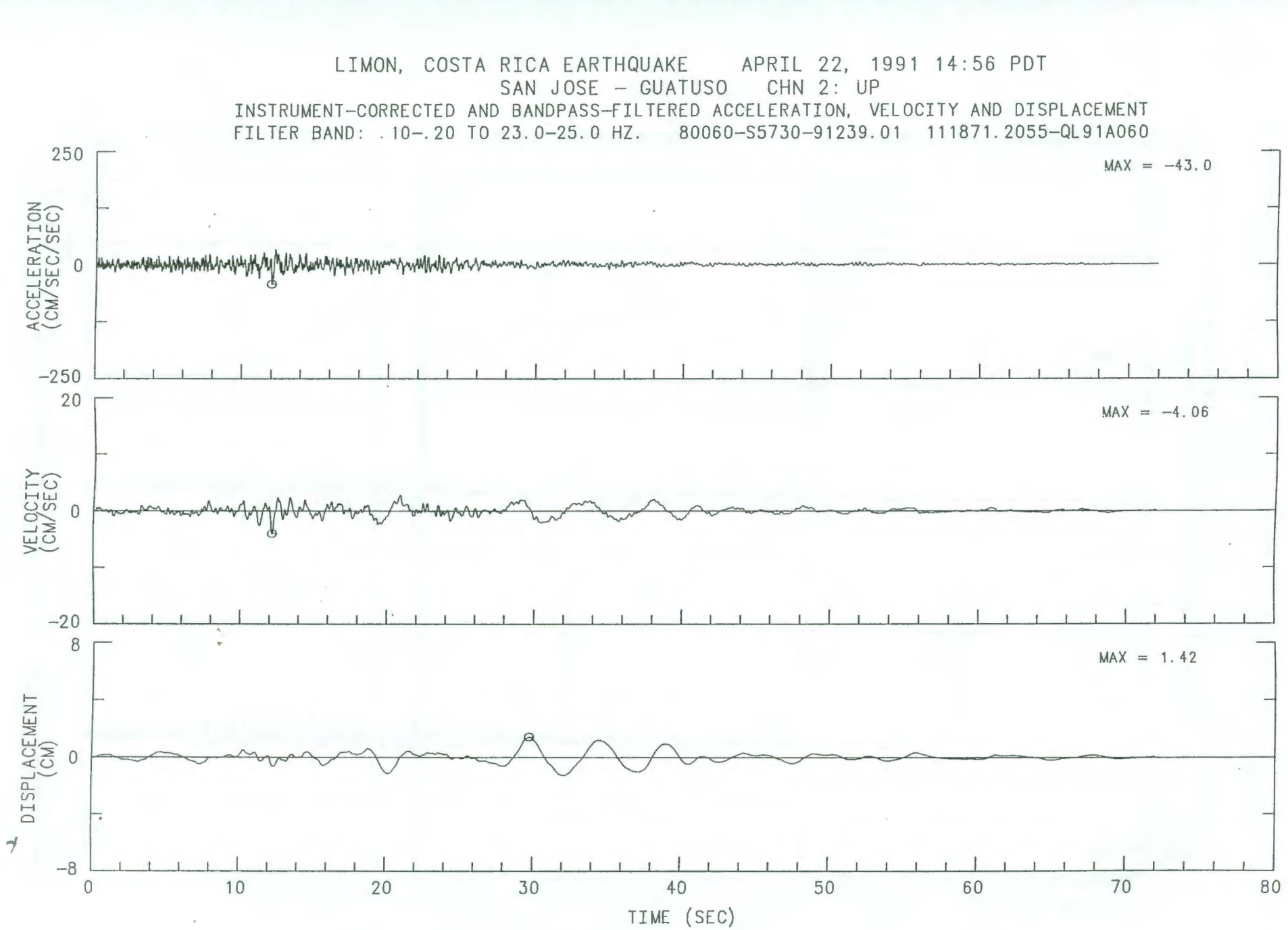


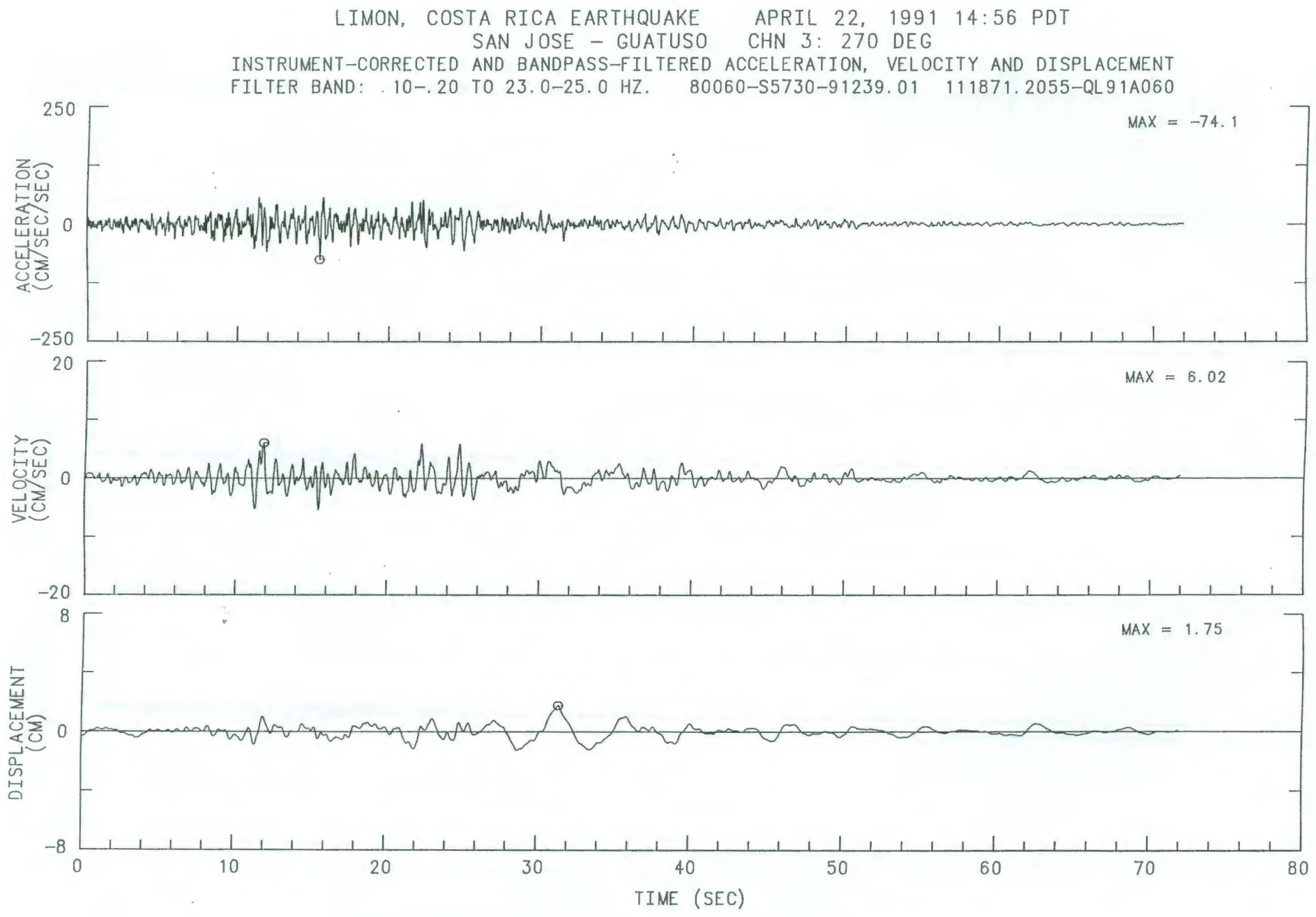
CHN 3: 270 DEG



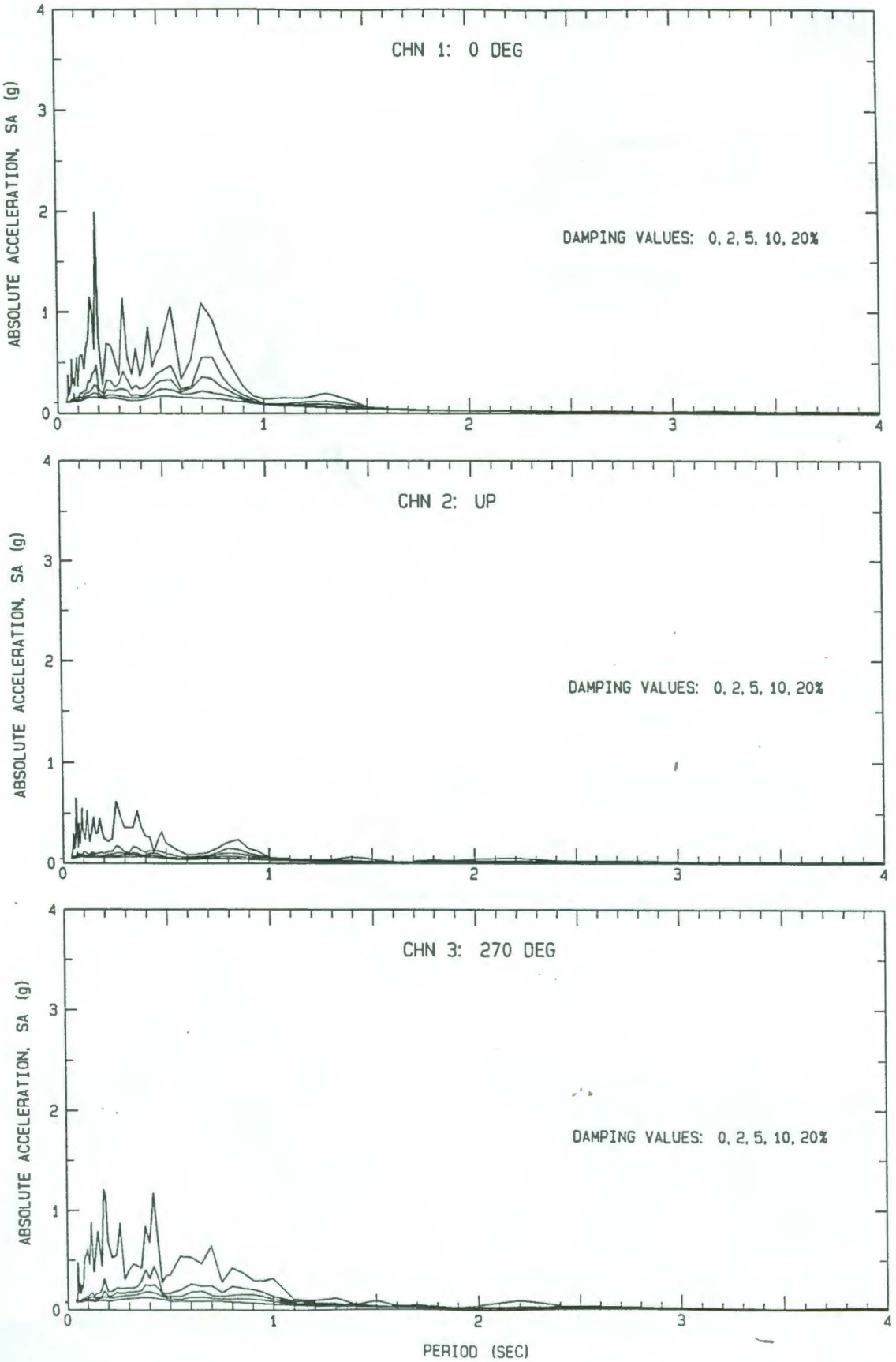

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - GUATUSO
UNCORRECTED ACCELEROGRAM 80060-S5730-91239.01 111571.1740-QL91A060
CHN 1: 0 DEG
MAX = -0.105 G
CHN 2: UP
MAX = -0.044 G
CHN 3: 270 DEG
MAX = -0.077 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - GUATUSO CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80060-S5730-91239.01 111871.2055-QL91A060
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -103.2
VELOCITY (CM/SEC)
20
0
-20
MAX = 9.29
DISPLACEMENT (CM)
8
0
-8
MAX = 1.23
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - GUATUSO CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80060-S5730-91239.01 111871.2055-QL91A060
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -43.0
VELOCITY (CM/SEC)
20
0
-20
MAX = -4.06
DISPLACEMENT (CM)
8
0
-8
MAX = 1.42
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - GUATUSO CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80060-S5730-91239.01 111871.2055-QL91A060
ACCELERATION (CM/SEC/SEC)
MAX = -74.1
VELOCITY (CM/SEC)
MAX = 6.02
DISPLACEMENT (CM)
MAX = 1.75
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - GUATUSO
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .10-.20 TO 23.0-25.0 HZ.
80060-S5730-91239.01 050595.0847-GL91A060



SAN JOSE - GUATUSO: CSMIP S/N 060

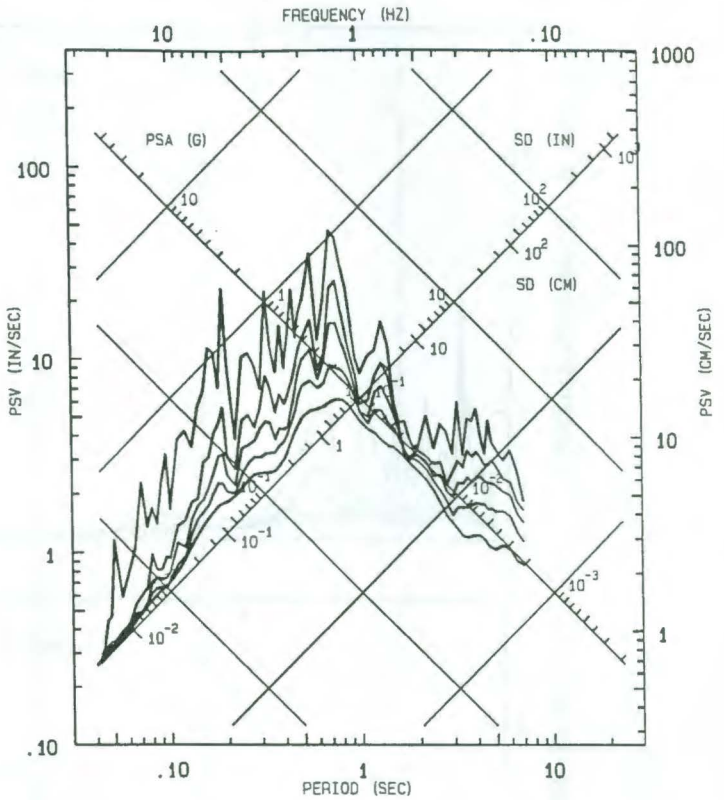
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.17 TO 23.6 HZ
(0.04 TO 5.88 SEC)

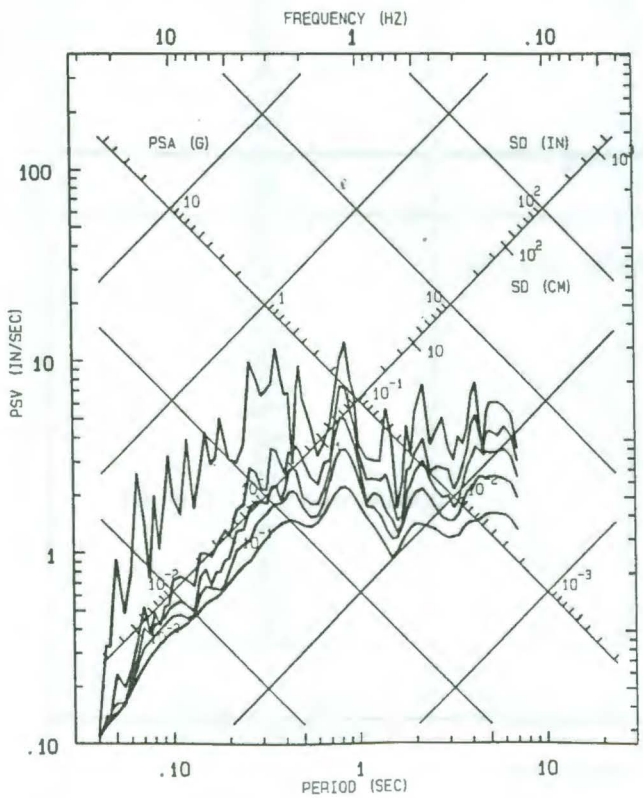
RECORD ID: 80060-S5730-91239.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

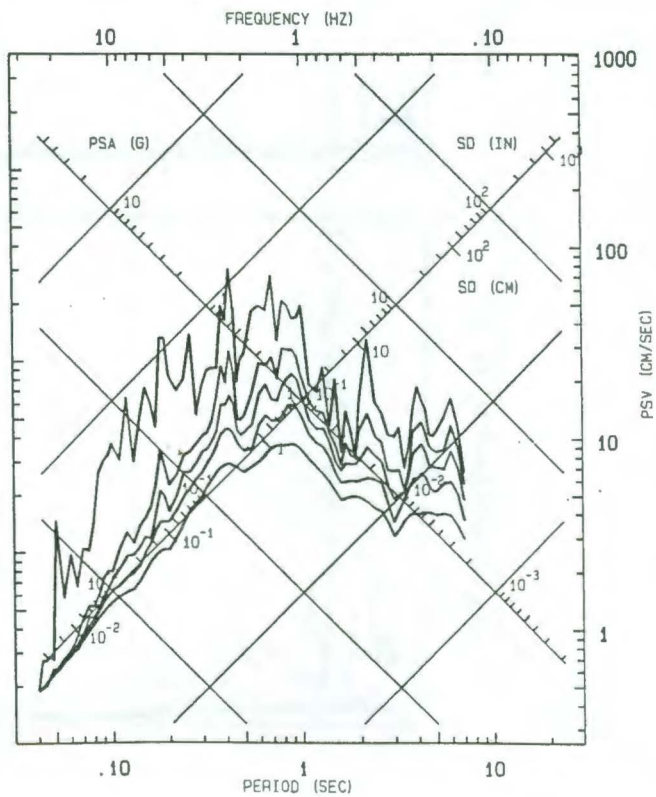
CHN 1: 0 DEG

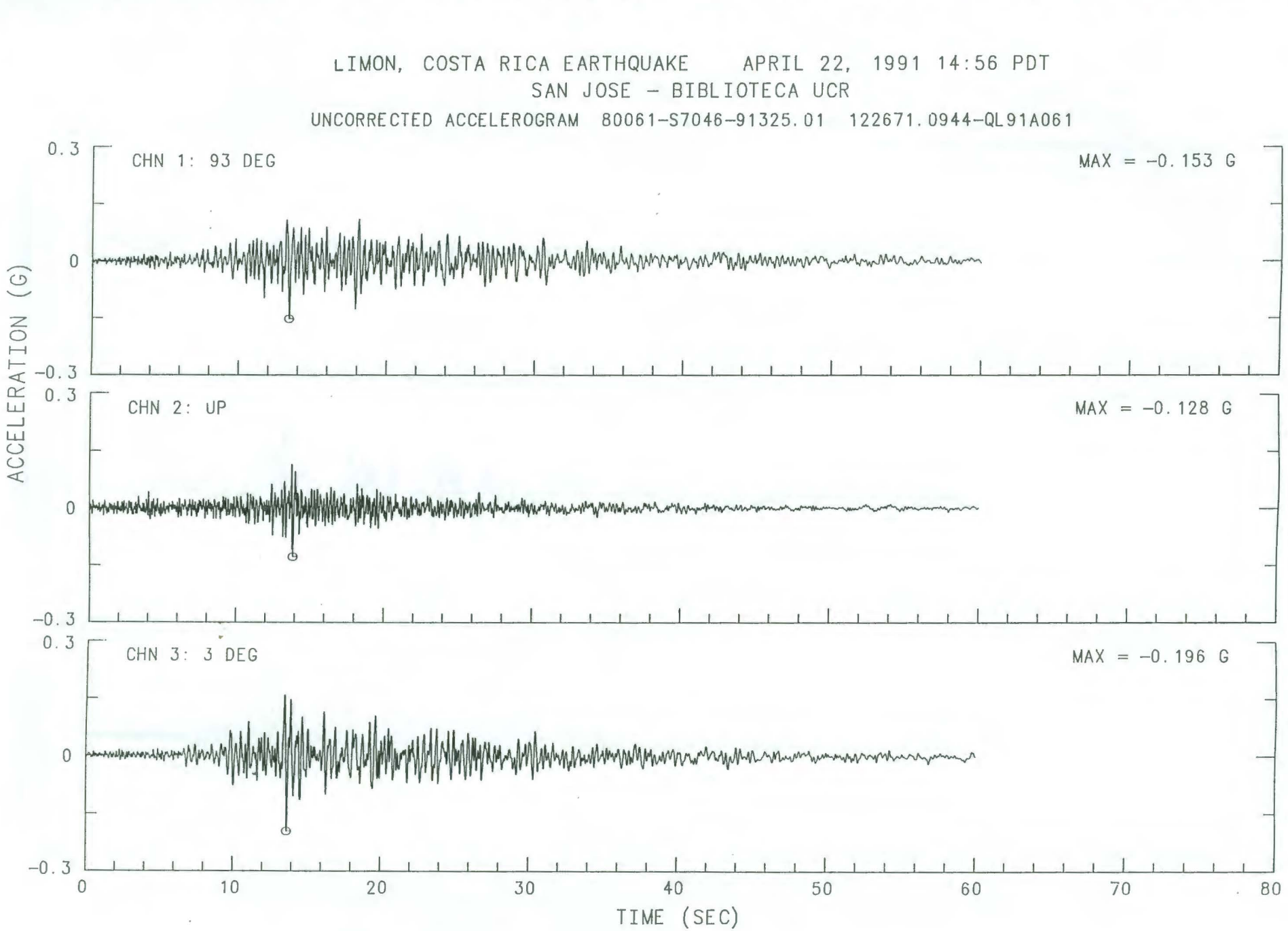


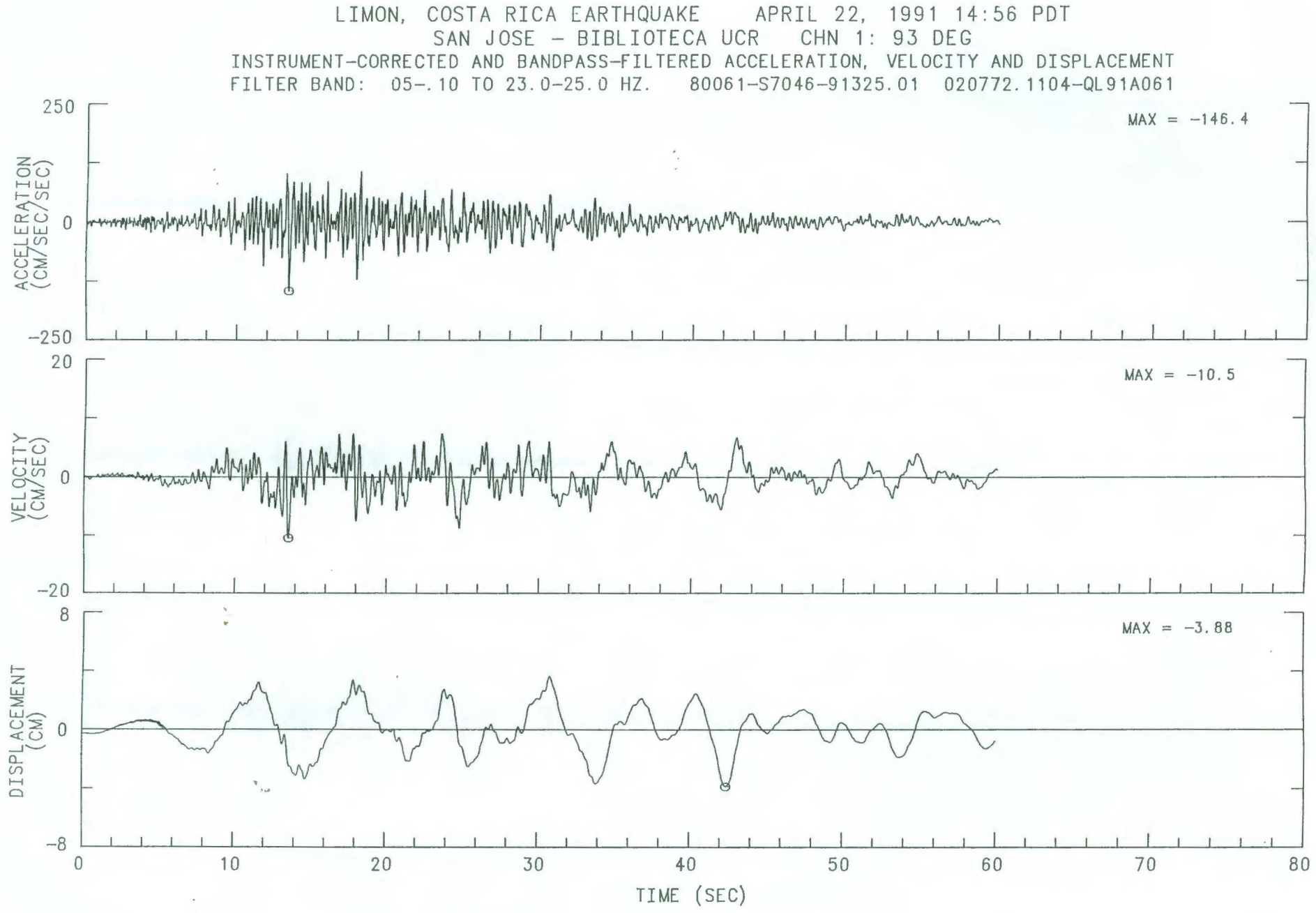
CHN 2: UP

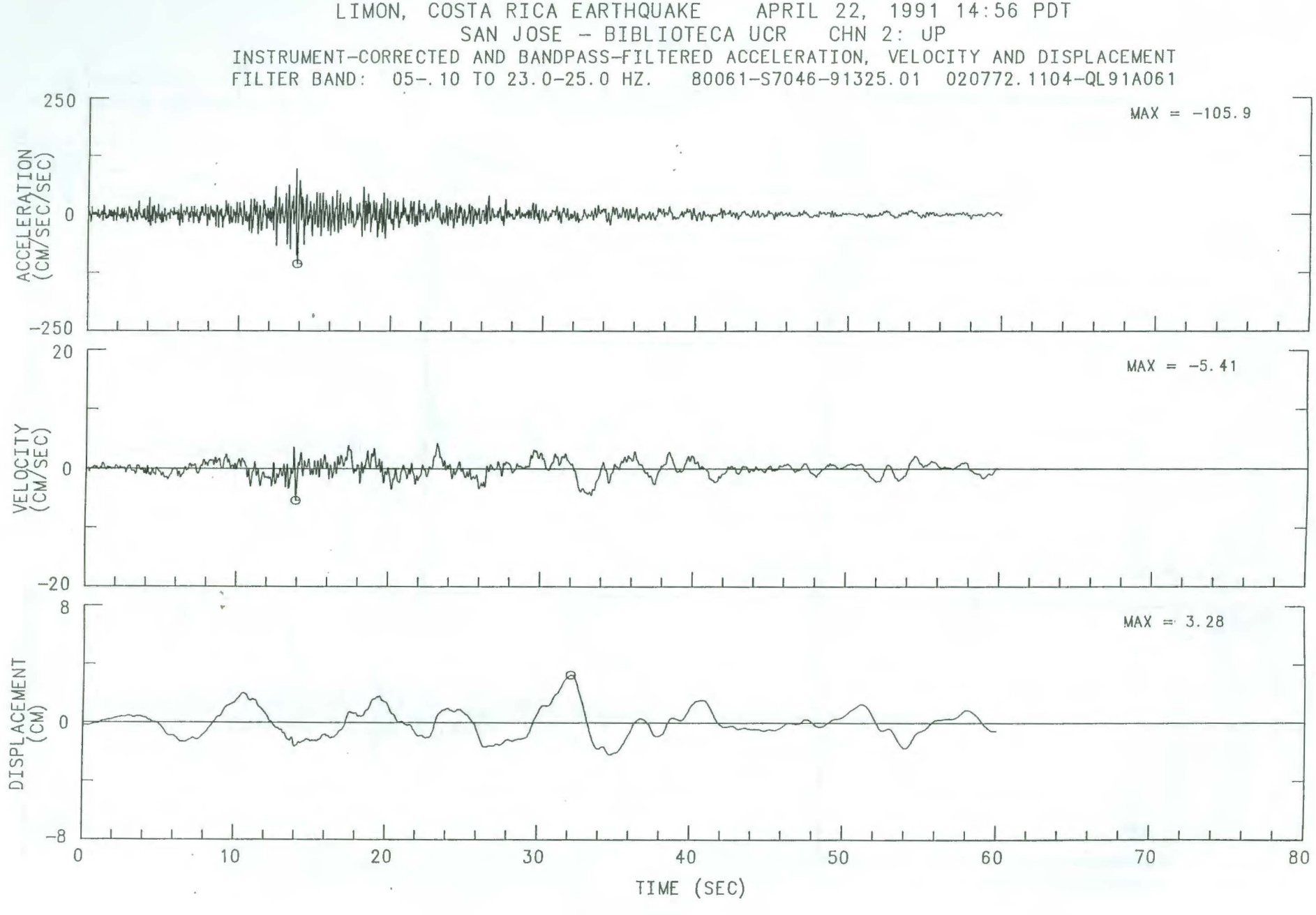


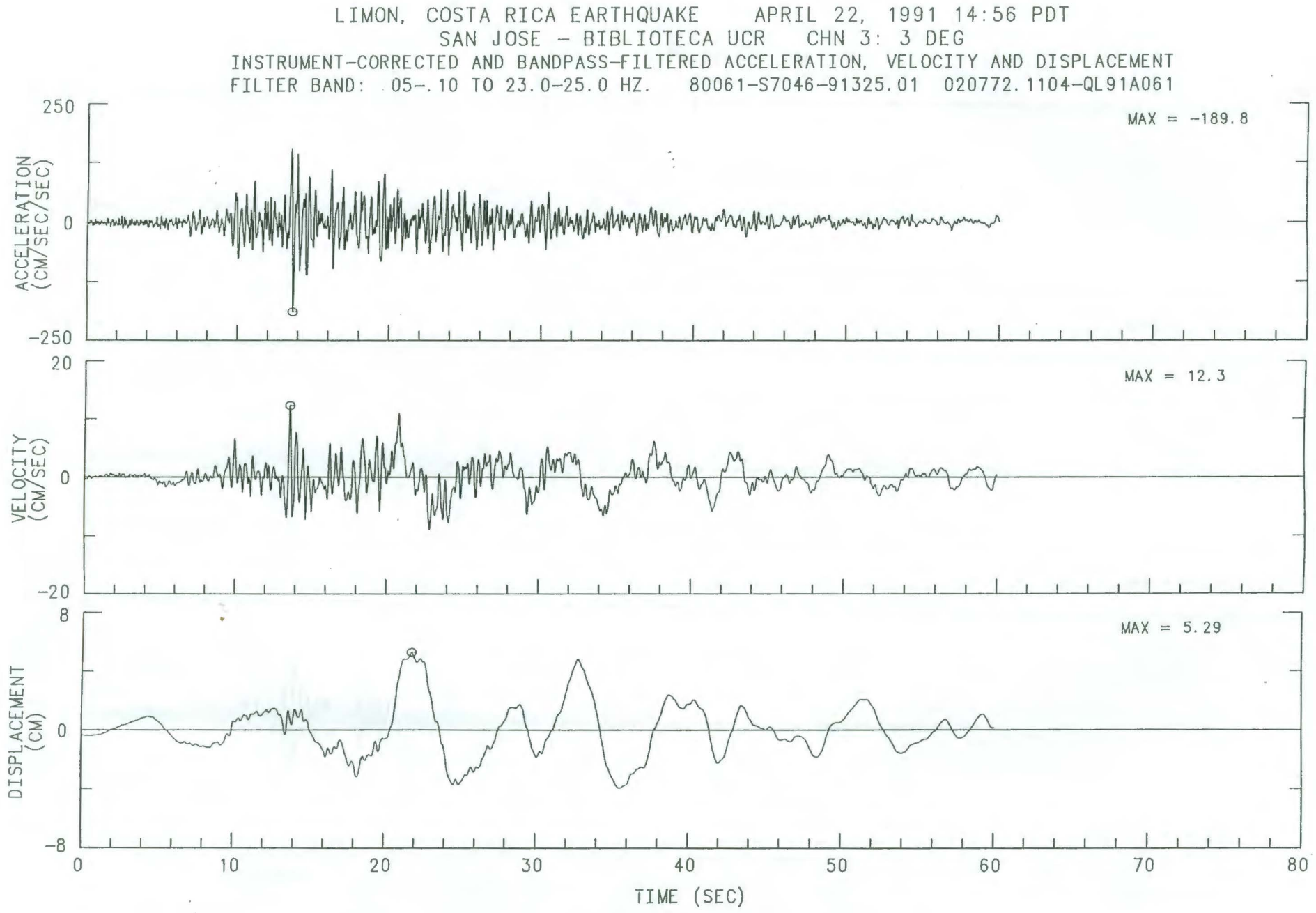
CHN 3: 270 DEG



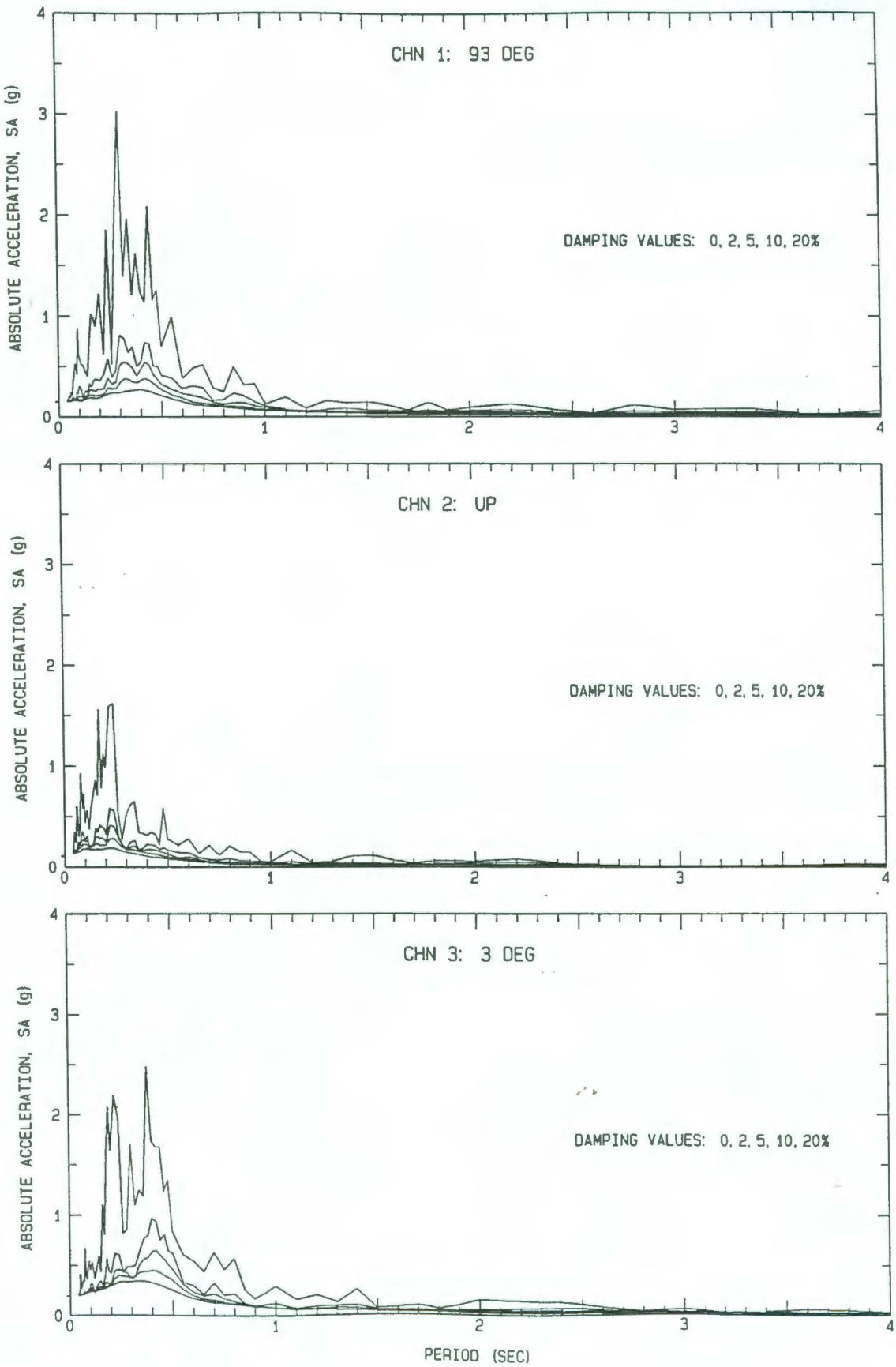

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BIBLIOTECA UCR
UNCORRECTED ACCELEROGRAM 80061-S7046-91325.01 122671.0944-QL91A061
CHN 1: 93 DEG
MAX = -0.153 G
CHN 2: UP
MAX = -0.128 G
CHN 3: 3 DEG
MAX = -0.196 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BIBLIOTECA UCR CHN 1: 93 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80061-S7046-91325.01 020772.1104-QL91A061
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -146.4
VELOCITY (CM/SEC)
20
0
-20
MAX = -10.5
DISPLACEMENT (CM)
8
0
-8
MAX = -3.88
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BIBLIOTECA UCR CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 05-.10 TO 23.0-25.0 HZ. 80061-S7046-91325.01 020772.1104-QL91A061
ACCELERATION (CM/SEC/SEC)
MAX = -105.9
VELOCITY (CM/SEC)
MAX = -5.41
DISPLACEMENT (CM)
MAX = 3.28
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BIBLIOTECA UCR CHN 3: 3 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80061-S7046-91325.01 020772.1104-QL91A061
ACCELERATION (CM/SEC/SEC)
MAX = -189.8
VELOCITY (CM/SEC)
MAX = 12.3
DISPLACEMENT (CM)
MAX = 5.29
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BIBLIOTECA UCR
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
80061-S7046-91325.01 050595.0847-QL91A061



SAN JOSE - BIBLIOTECA UCR: CSMIP S/N 061

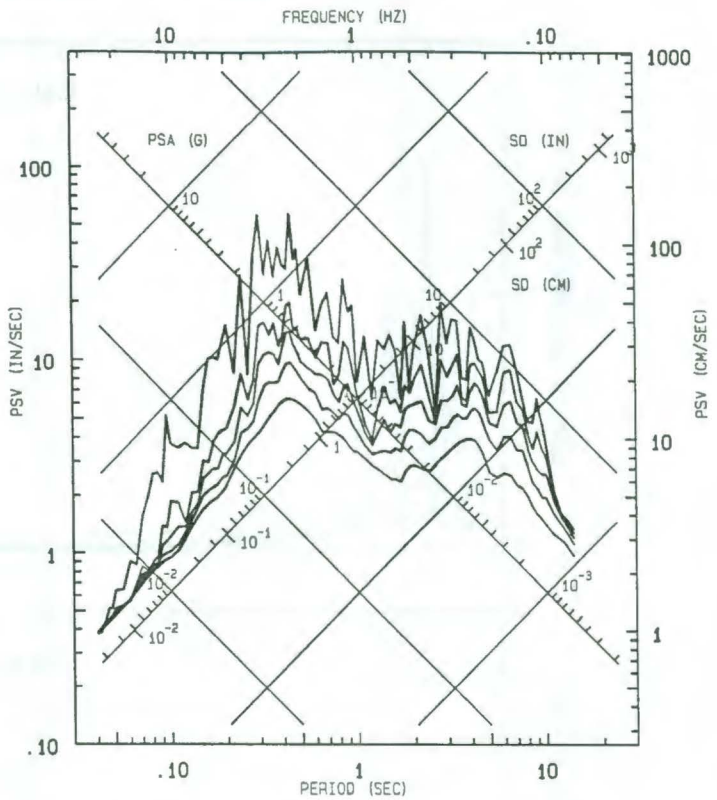
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.09 TO 23.6 HZ
(0.04 TO 11.8 SEC)

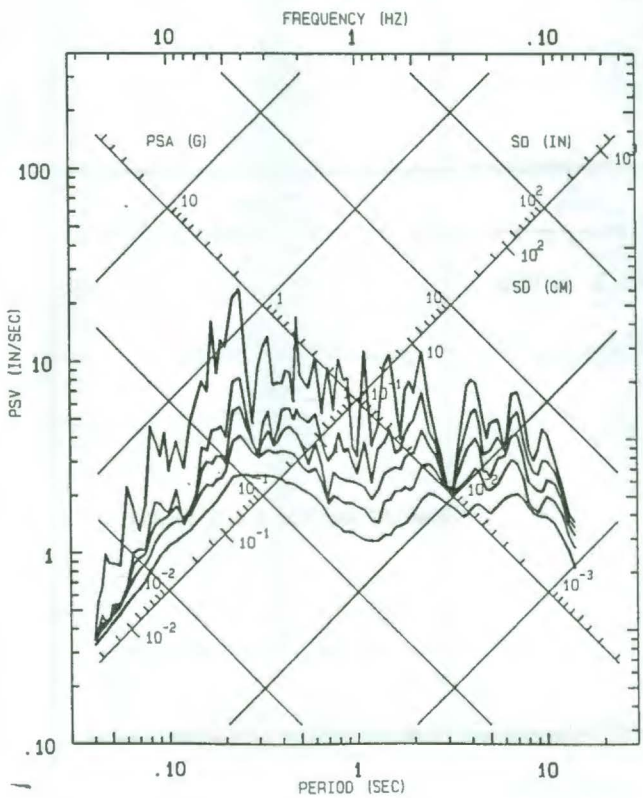
RECORD ID: 80061-S7046-91325.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

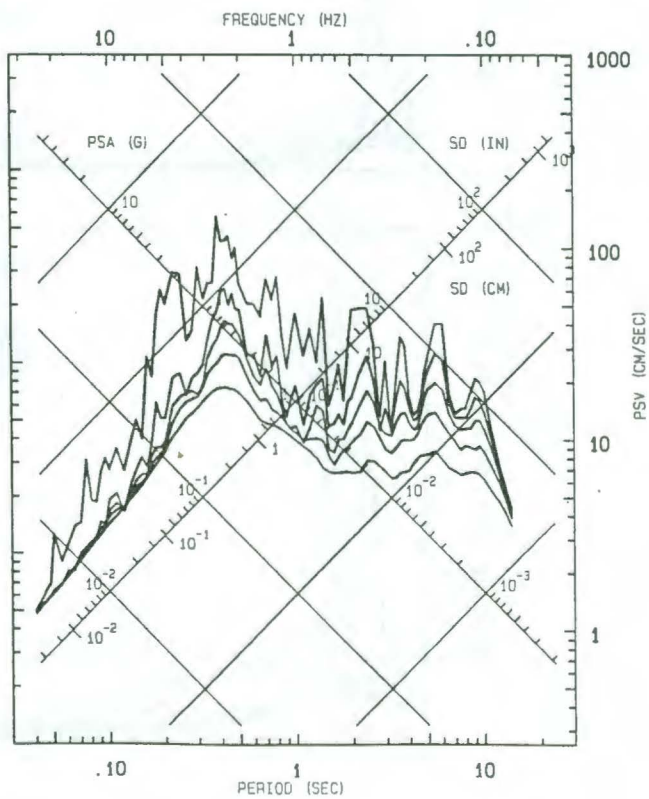
CHN 1: 93 DEG

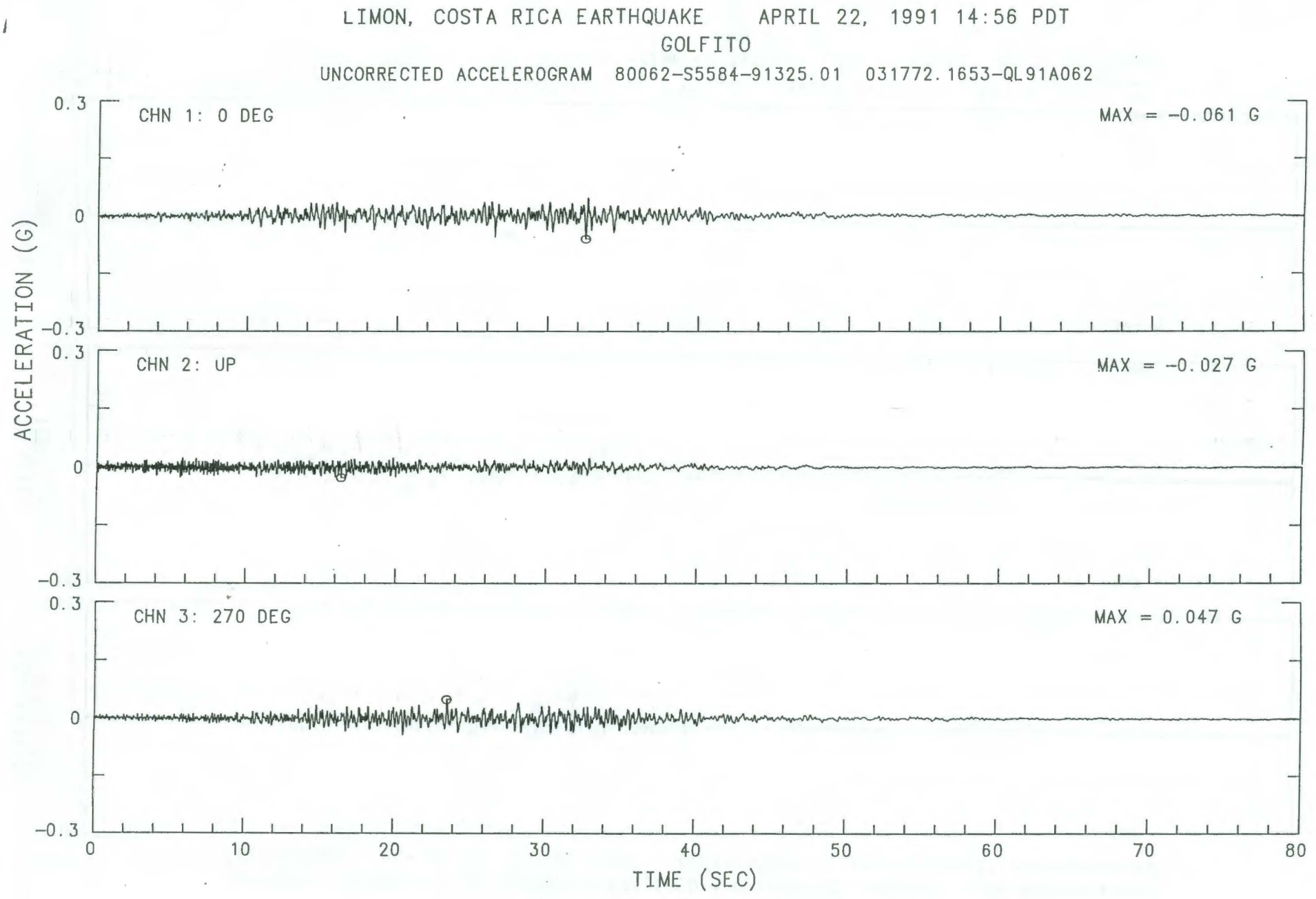


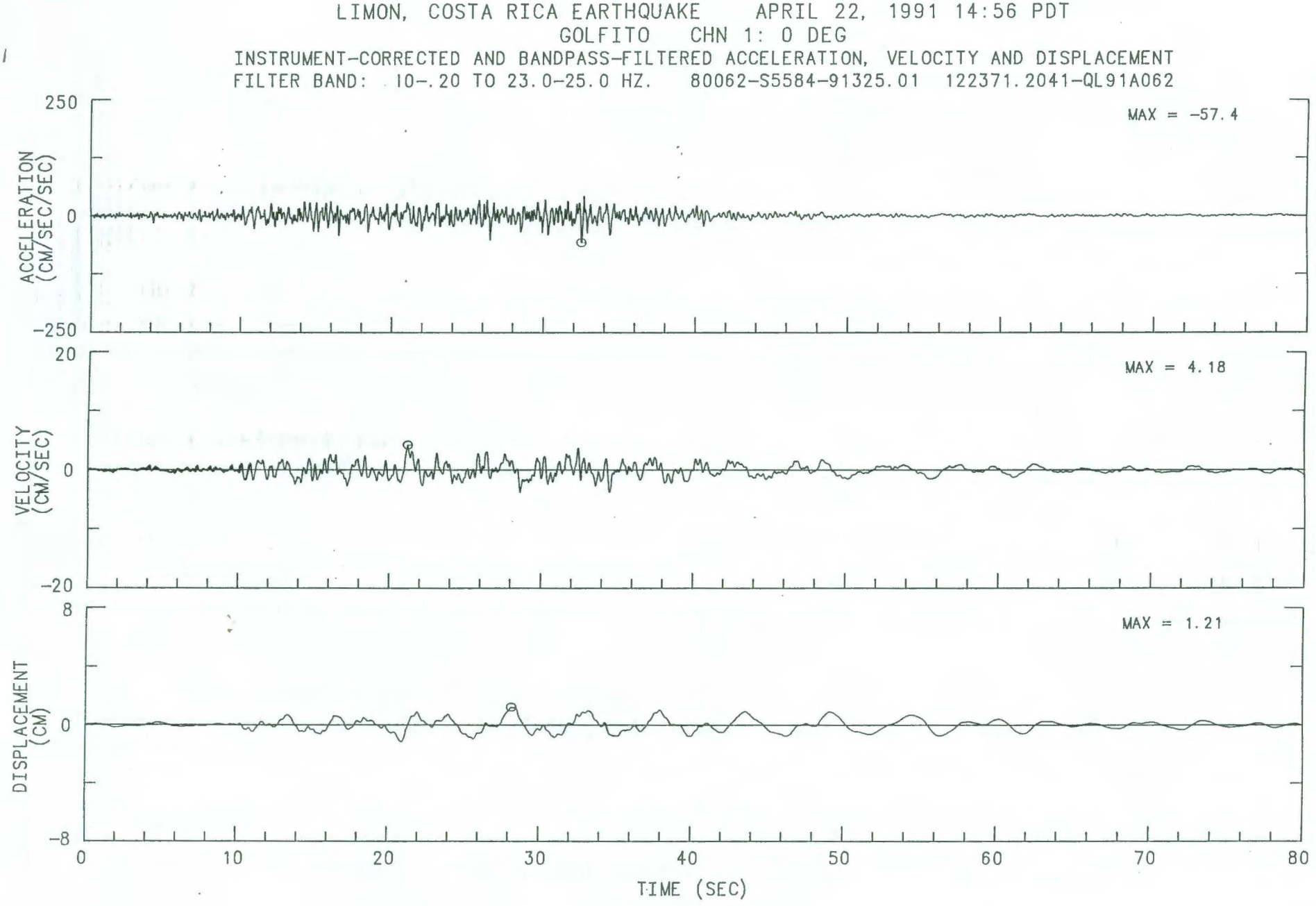
CHN 2: UP

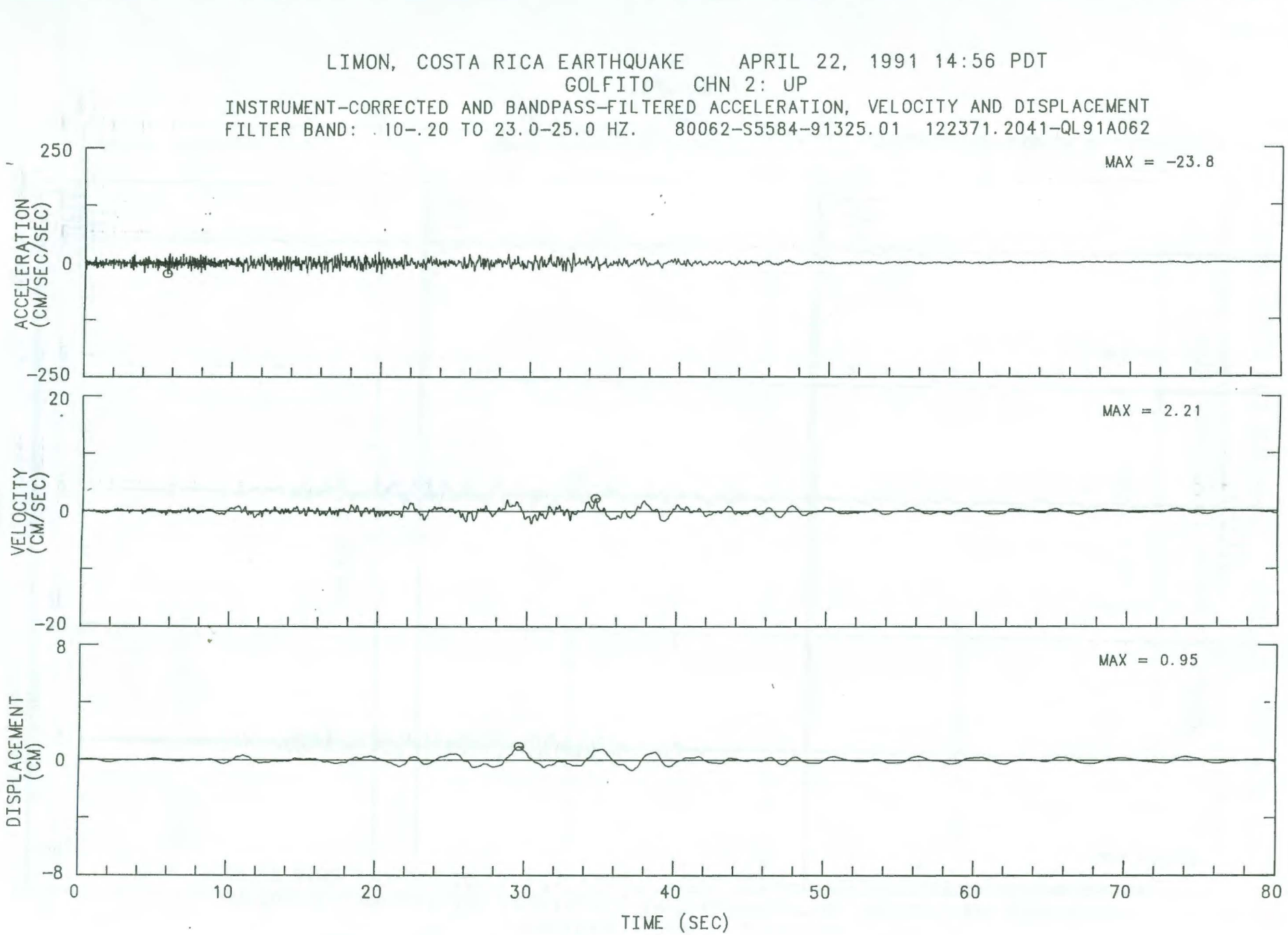


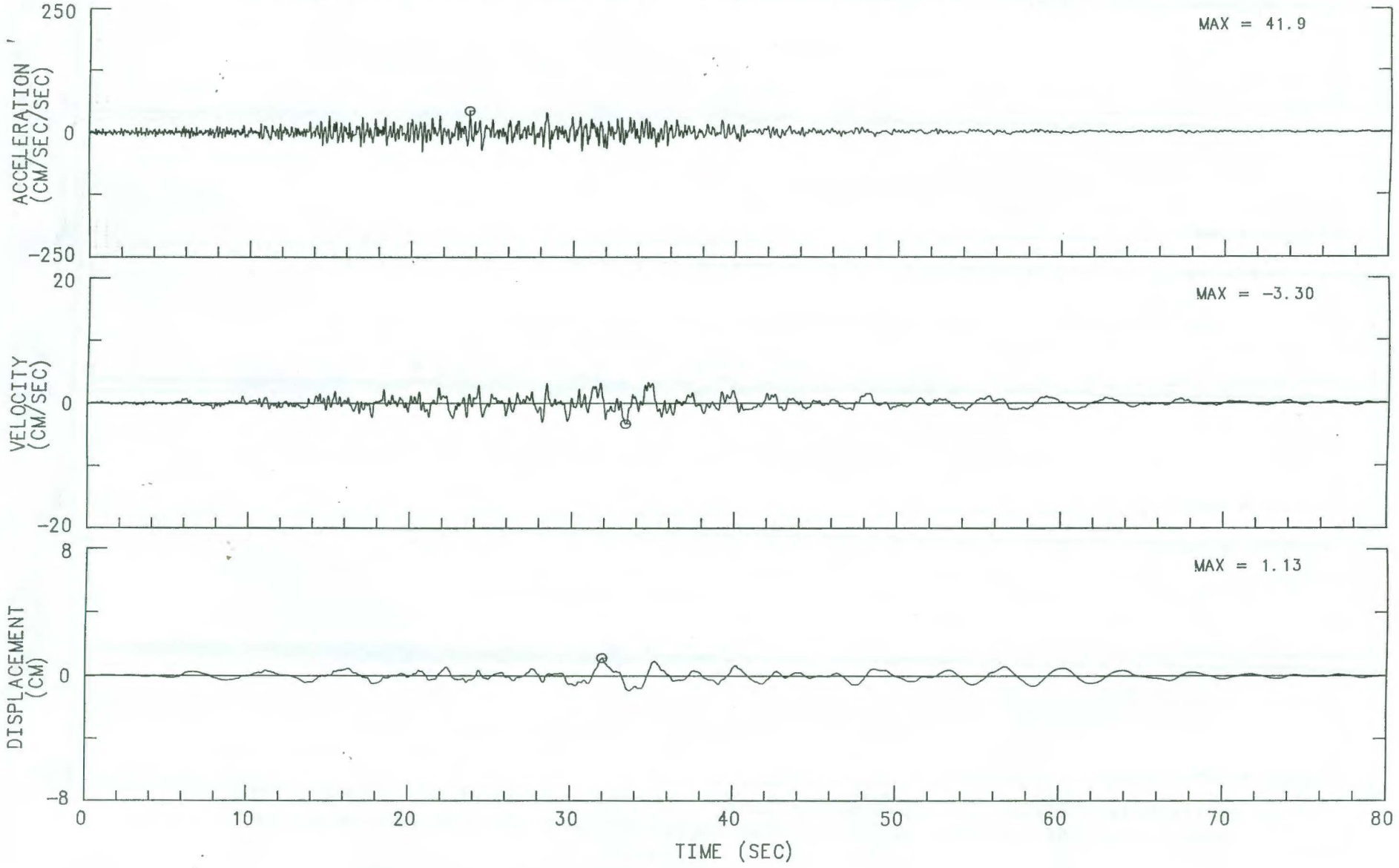
CHN 3: 3 DEG



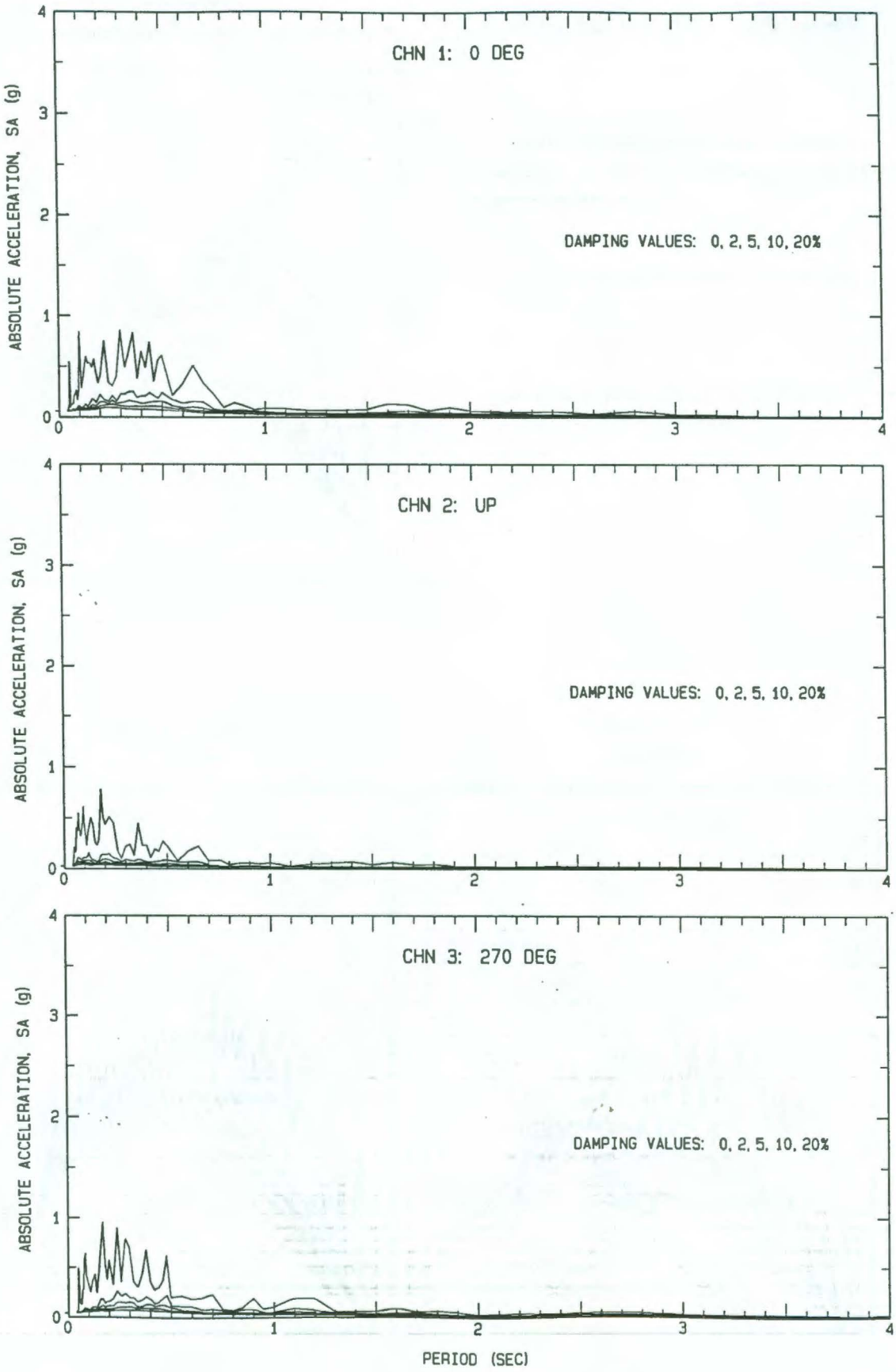

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
GOLFITO
UNCORRECTED ACCELEROGRAM 80062-S5584-91325.01 031772.1653-QL91A062
CHN 1: 0 DEG
MAX = -0.061 G
CHN 2: UP
MAX = -0.027 G
CHN 3: 270 DEG
MAX = 0.047 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
GOLFITO CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80062-S5584-91325.01 122371.2041-QL91A062
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -57.4
VELOCITY (CM/SEC)
20
0
-20
MAX = 4.18
DISPLACEMENT (CM)
8
0
-8
MAX = 1.21
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
GOLFITO CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80062-S5584-91325.01 122371.2041-QL91A062
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -23.8
VELOCITY (CM/SEC)
20
0
-20
MAX = 2.21
DISPLACEMENT (CM)
8
0
-8
MAX = 0.95
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
GOLFITO CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 10-.20 TO 23.0-25.0 HZ. 80062-S5584-91325.01 122371.2041-QL91A062
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 41.9
VELOCITY (CM/SEC)
20
0
-20
MAX = -3.30
DISPLACEMENT (CM)
8
0
-8
MAX = 1.13
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
GOLFITO
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .10-.20 TO 23.0-25.0 HZ.
80062-S5584-91325.01 050595.0847-QL91A062



GOLFITO: CSMIP S/N 062

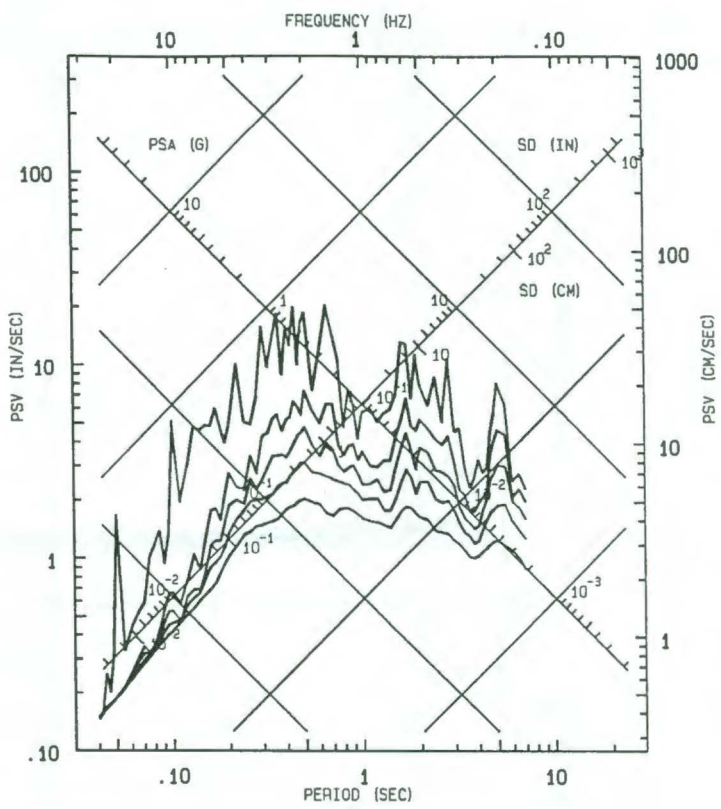
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.17 TO 23.6 HZ
(0.04 TO 5.88 SEC)

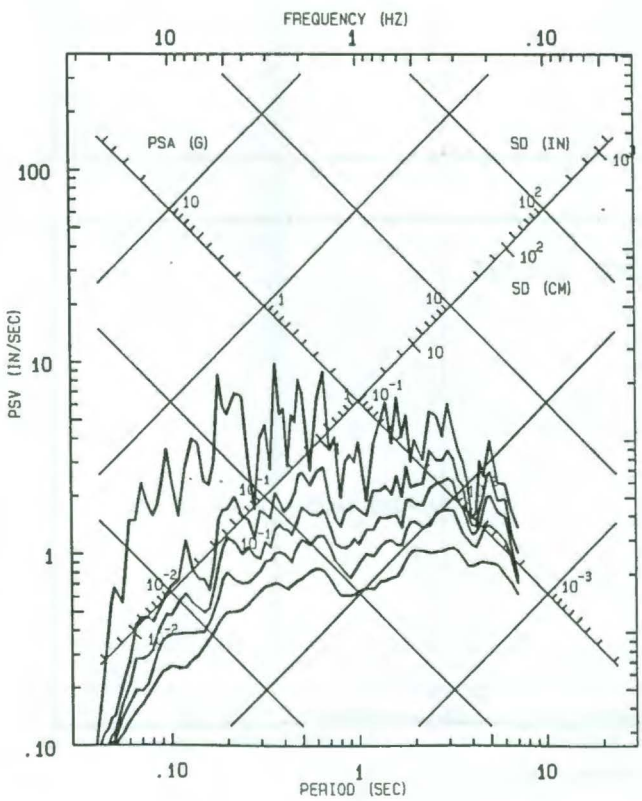
RECORD ID: 80062-S5584-91325.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

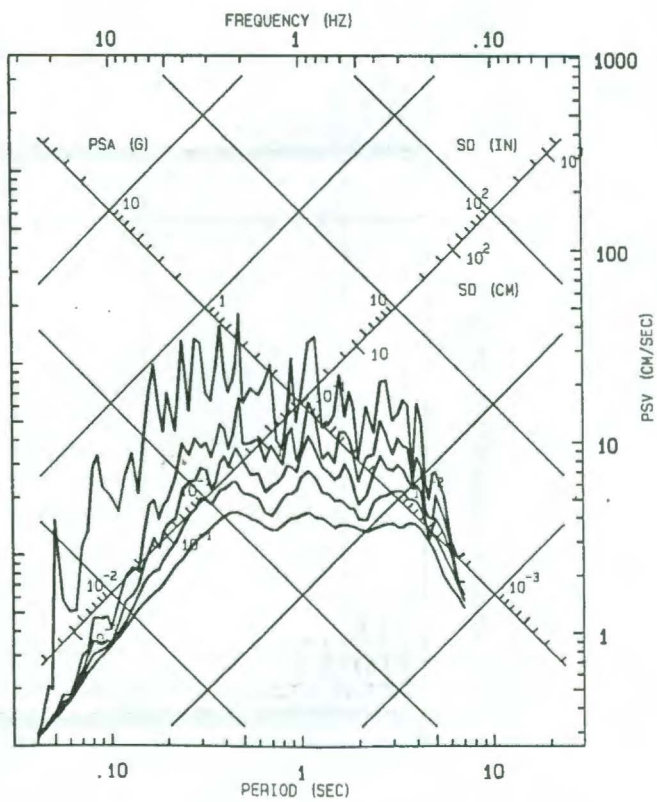
CHN 1: 0 DEG

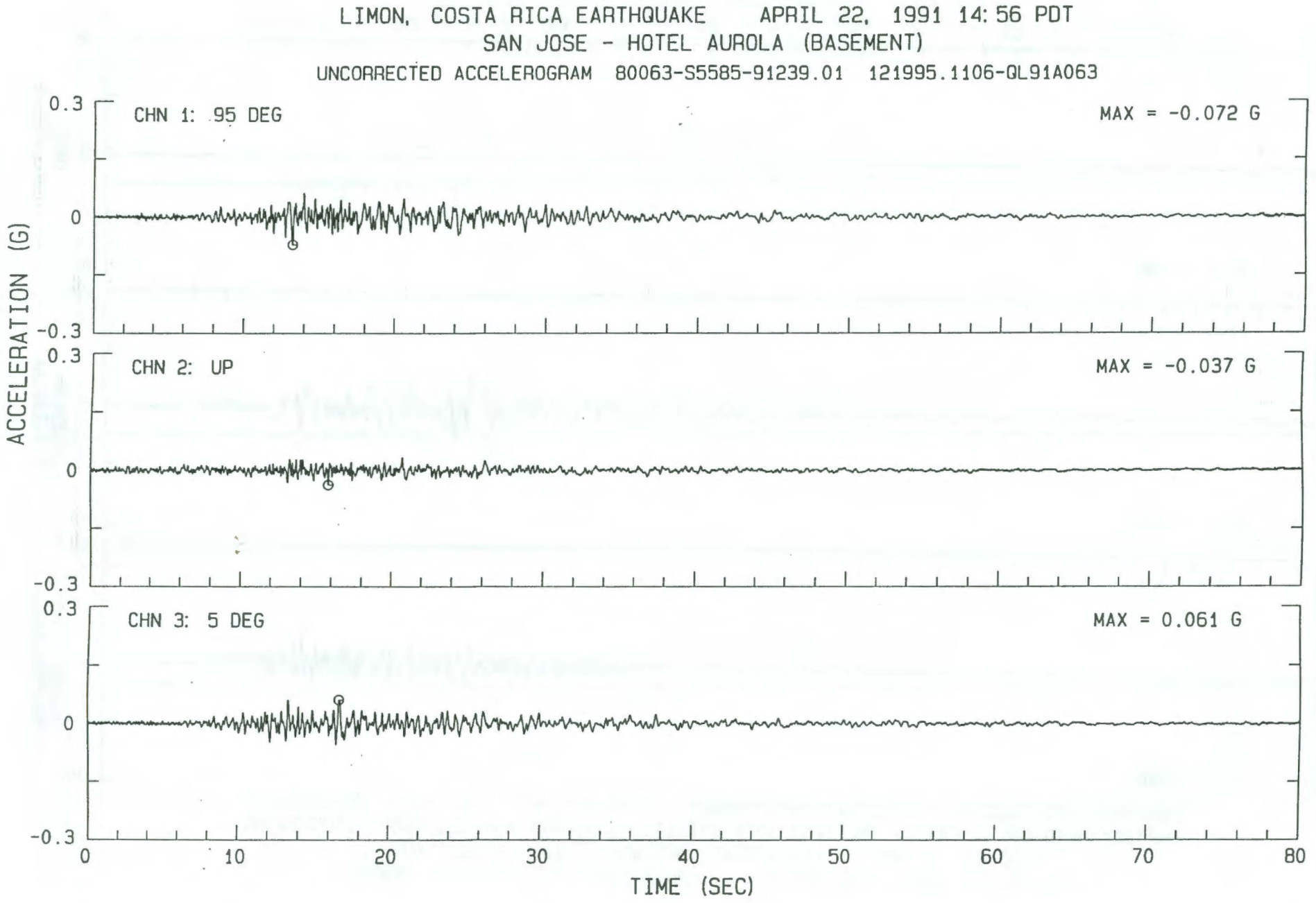


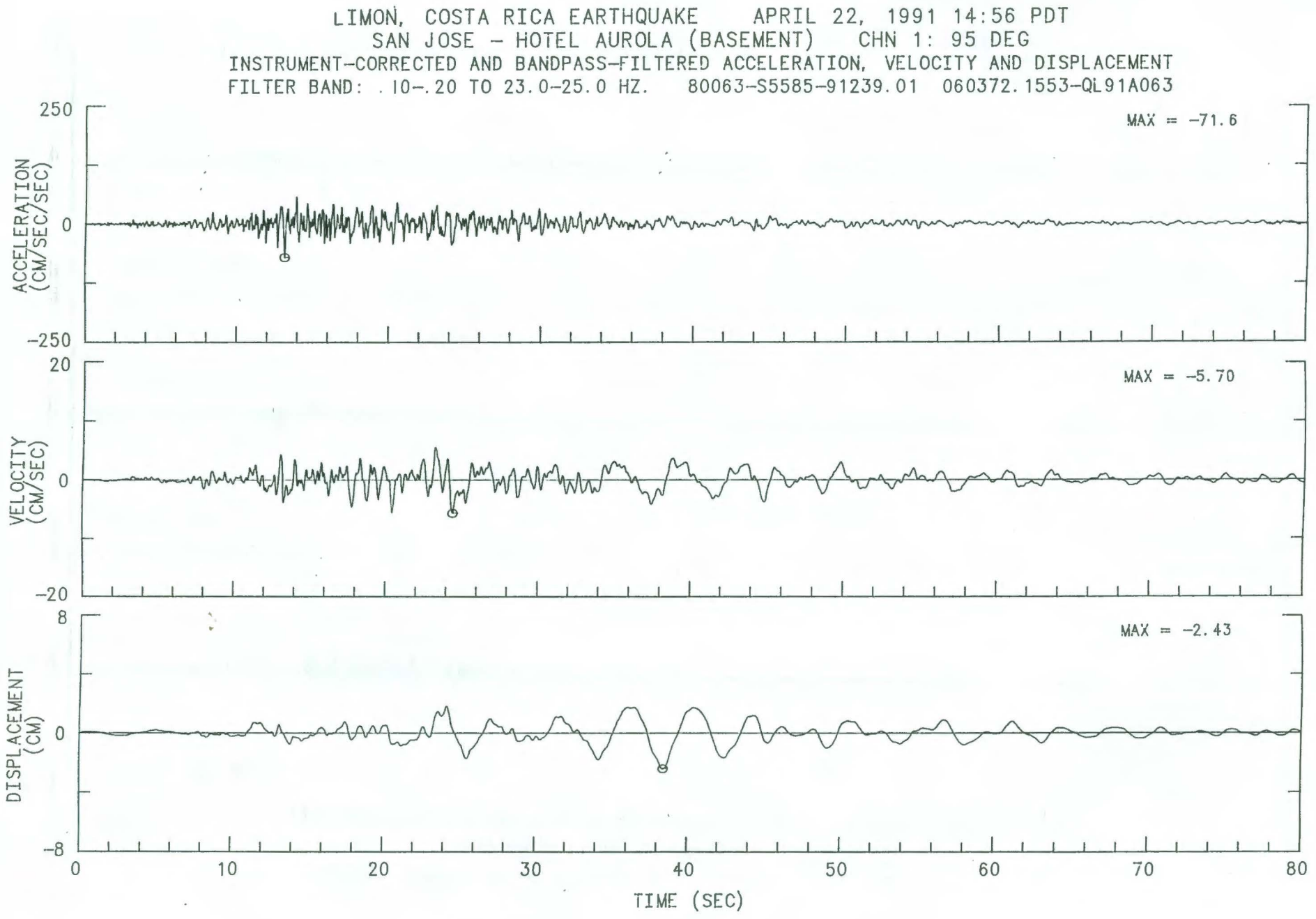
CHN 2: UP

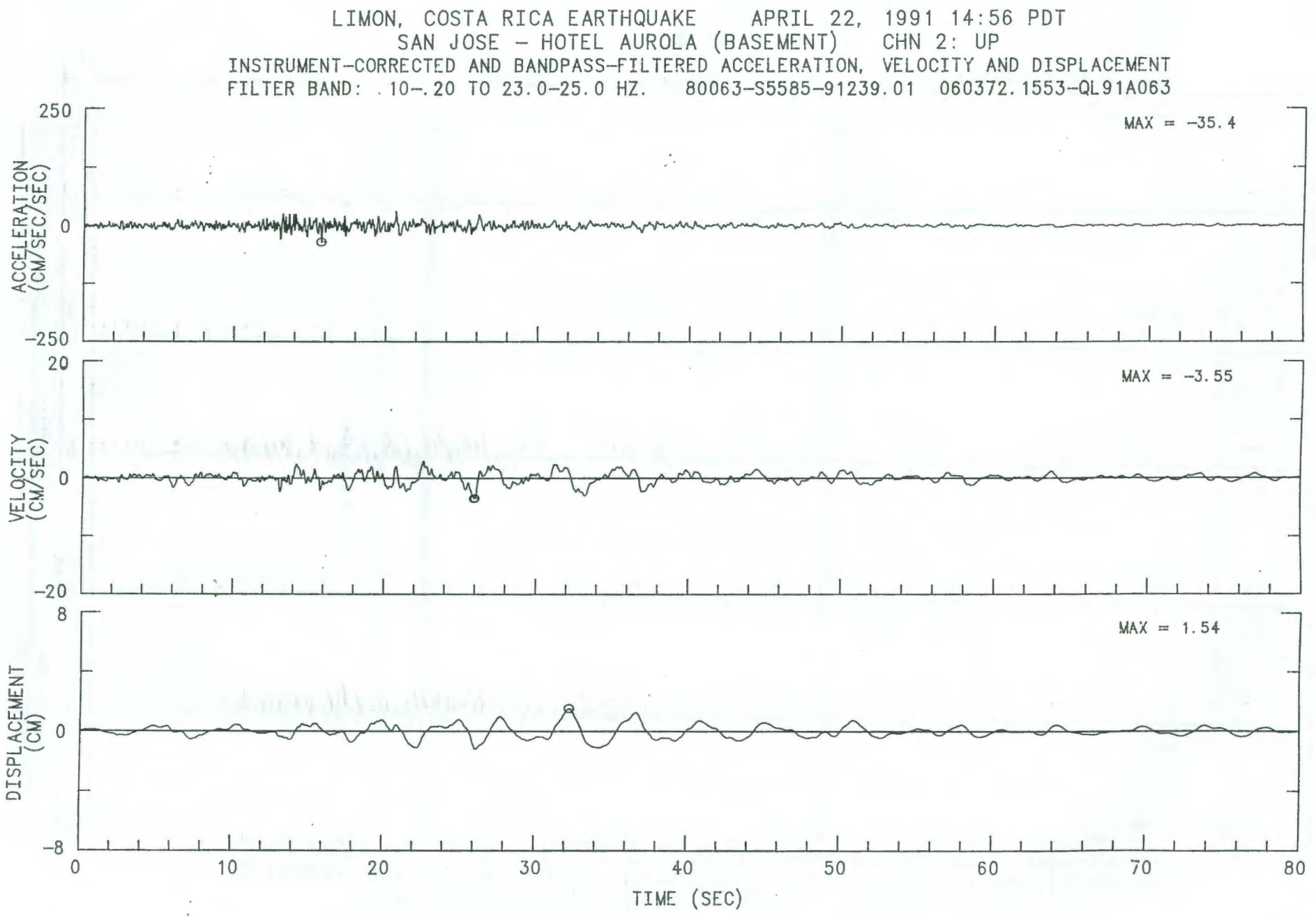


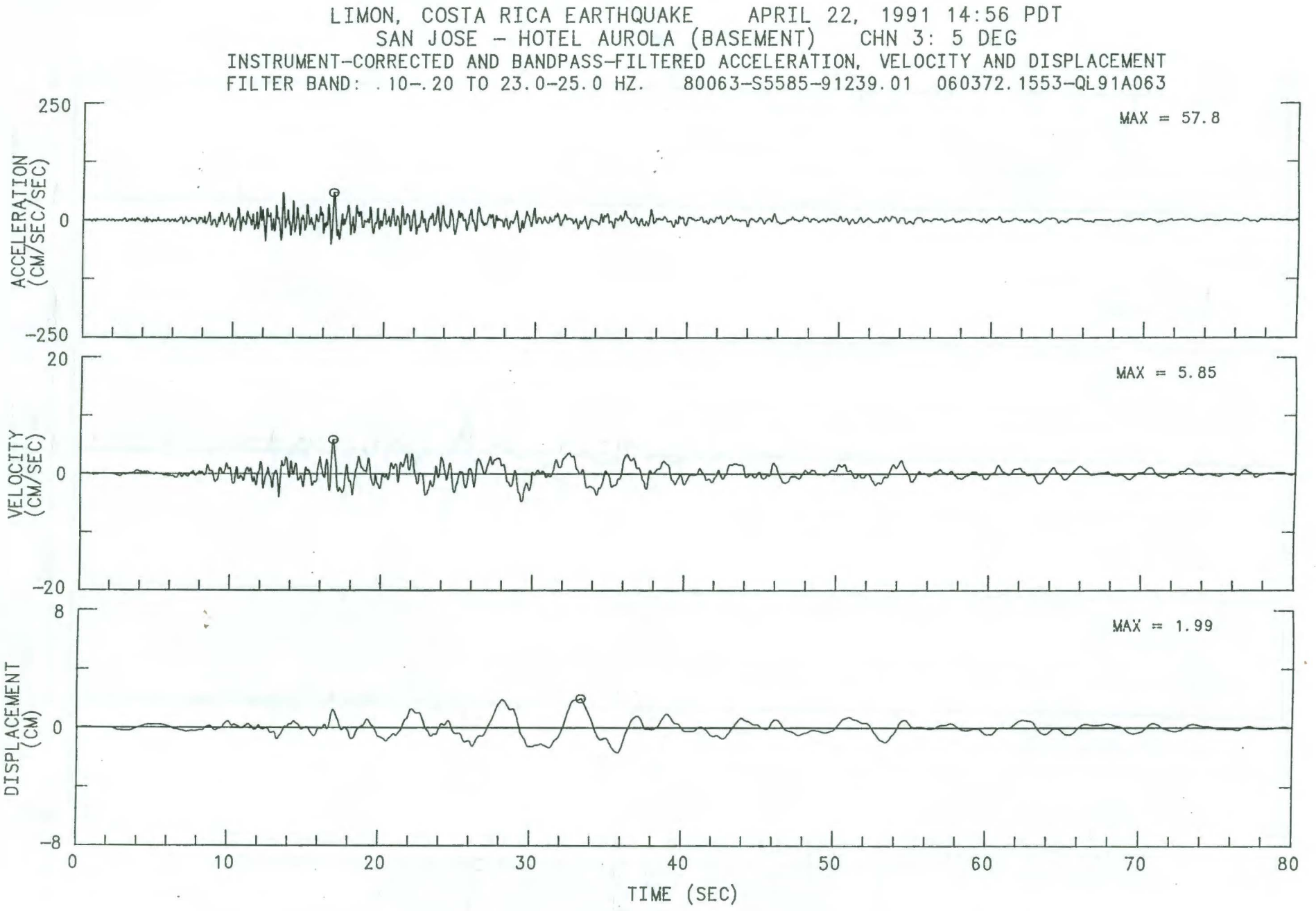
CHN 3: 270 DEG



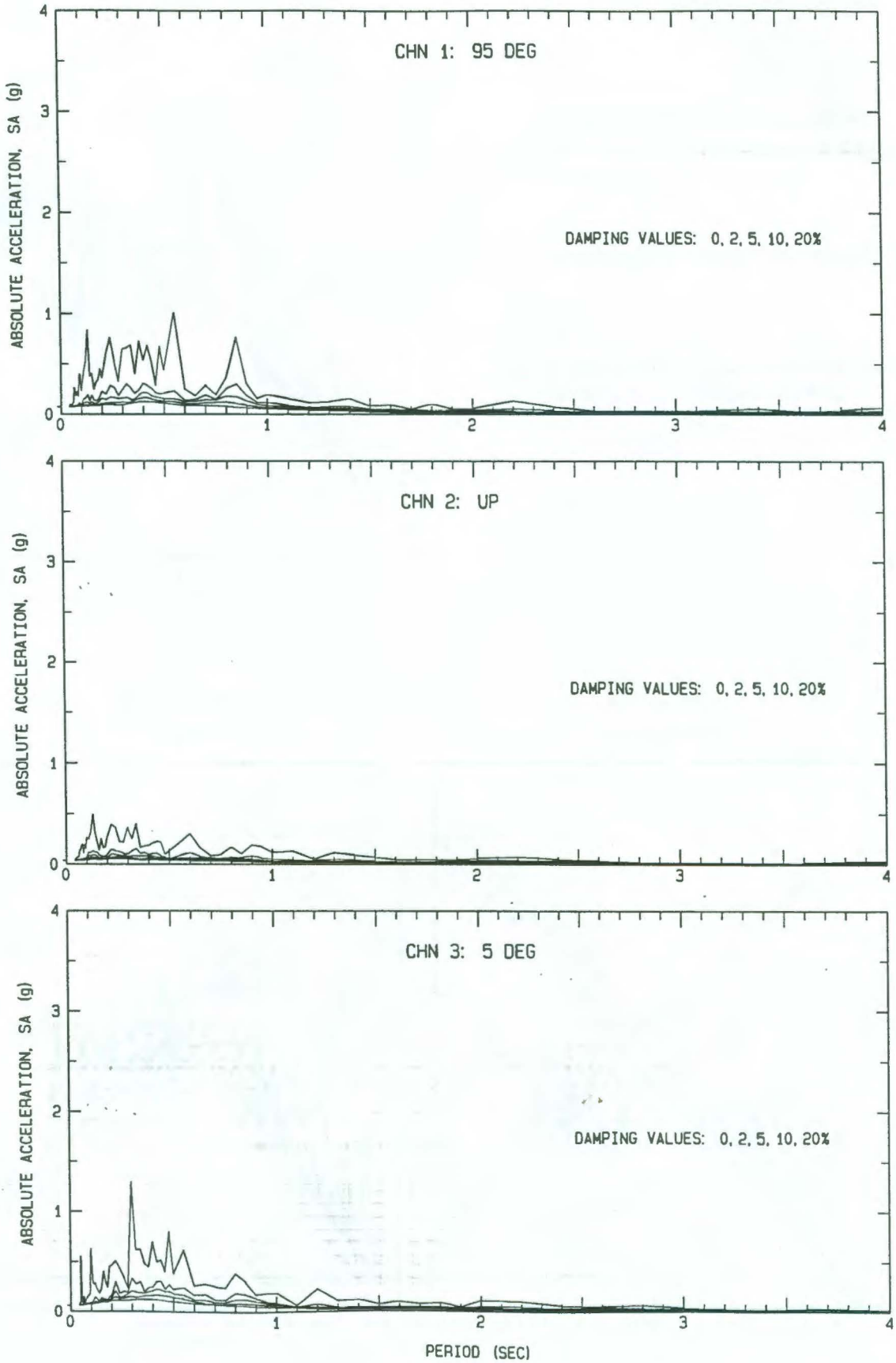

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (BASEMENT)
UNCORRECTED ACCELEROGRAM 80063-S5585-91239.01 121995.1106-QL91A063
CHN 1: 95 DEG
MAX = -0.072 G
CHN 2: UP
MAX = -0.037 G
CHN 3: 5 DEG
MAX = 0.061 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (BASEMENT) CHN 1: 95 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80063-S5585-91239.01 060372.1553-QL91A063
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -71.6
VELOCITY (CM/SEC)
20
0
-20
MAX = -5.70
DISPLACEMENT (CM)
8
0
-8
MAX = -2.43
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (BASEMENT) CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80063-S5585-91239.01 060372.1553-QL91A063
ACCELERATION (CM/SEC/SEC)
MAX = -35.4
VELOCITY (CM/SEC)
MAX = -3.55
DISPLACEMENT (CM)
MAX = 1.54
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (BASEMENT) CHN 3: 5 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80063-S5585-91239.01 060372.1553-QL91A063
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 57.8
VELOCITY (CM/SEC)
20
0
-20
MAX = 5.85
DISPLACEMENT (CM)
8
0
-8
MAX = 1.99
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (BASEMENT)
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .10-.20 TO 23.0-25.0 HZ.
80063-S5585-91239.01 050595.0848-QL91A063



SAN JOSE - HOTEL AUROLA (BASEMENT): CSMIP S/N 063

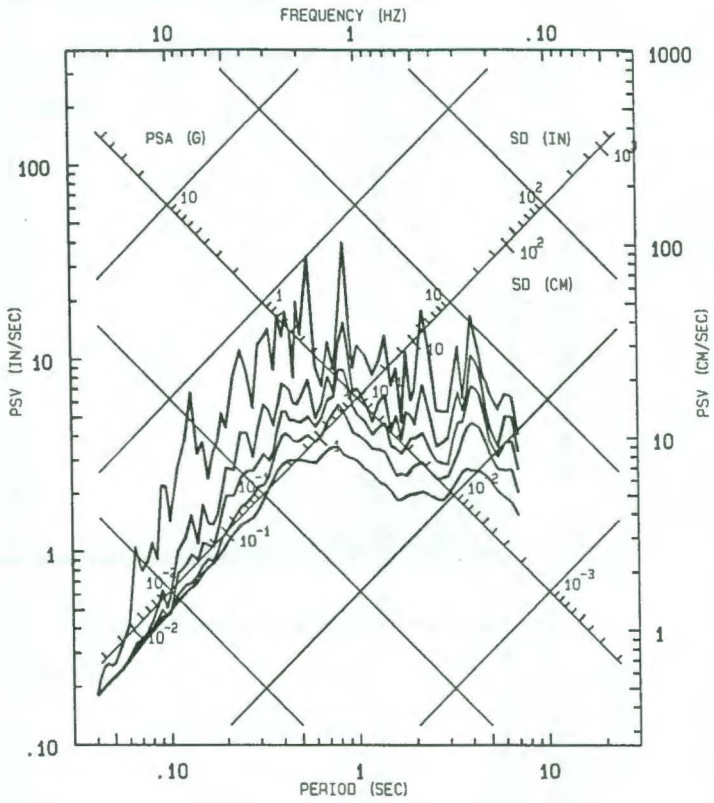
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.17 TO 23.6 HZ
(0.04 TO 5.88 SEC)

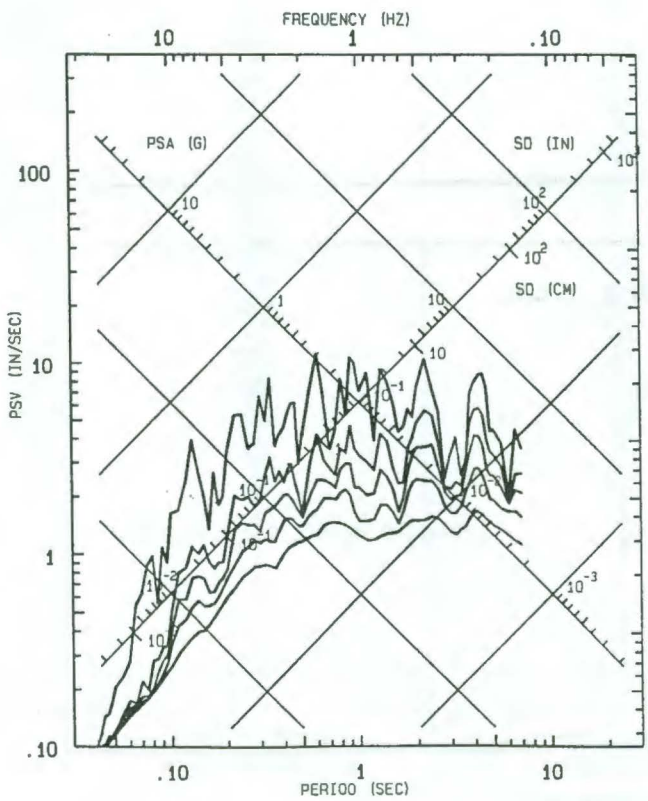
RECORD ID: 80063-S5585-91239.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

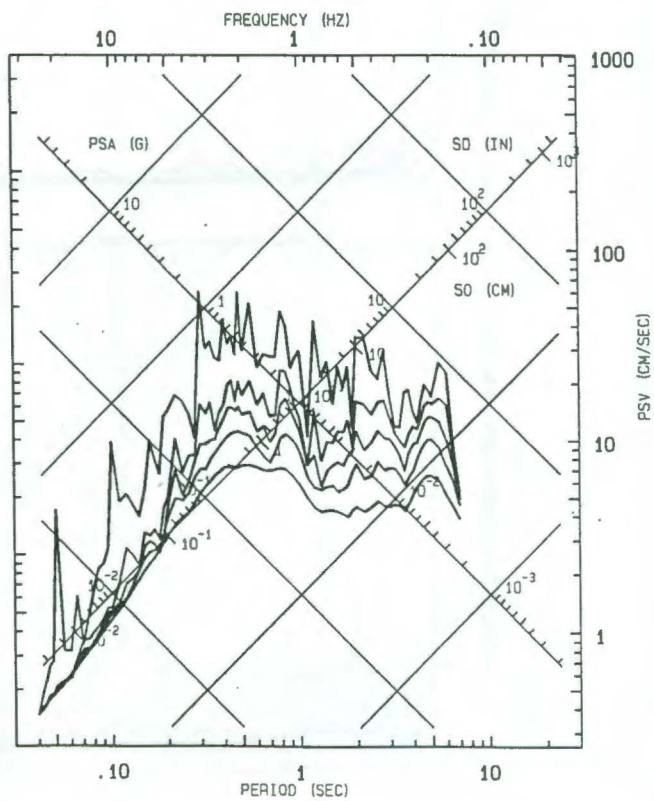
CHN 1: 95 DEG

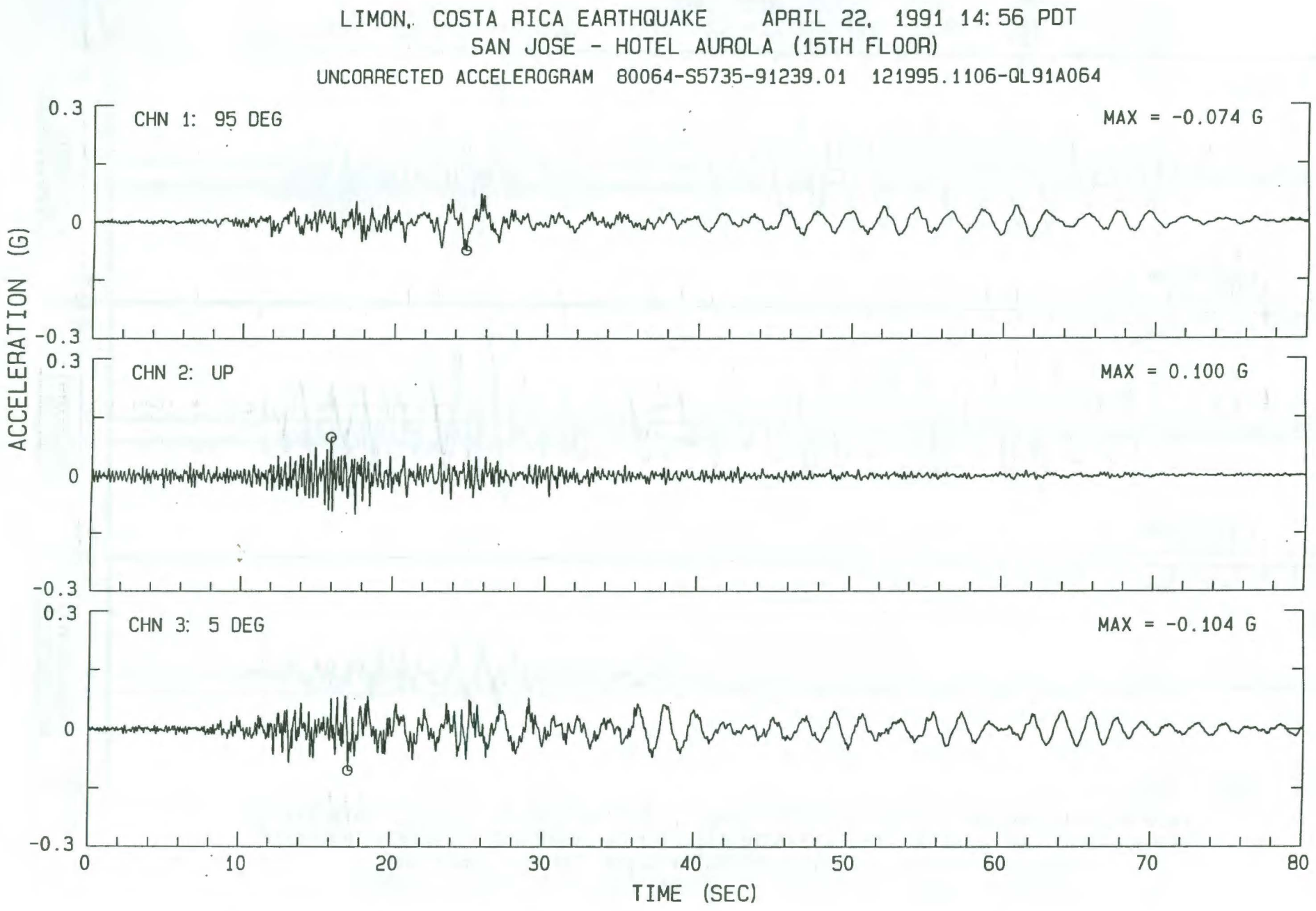


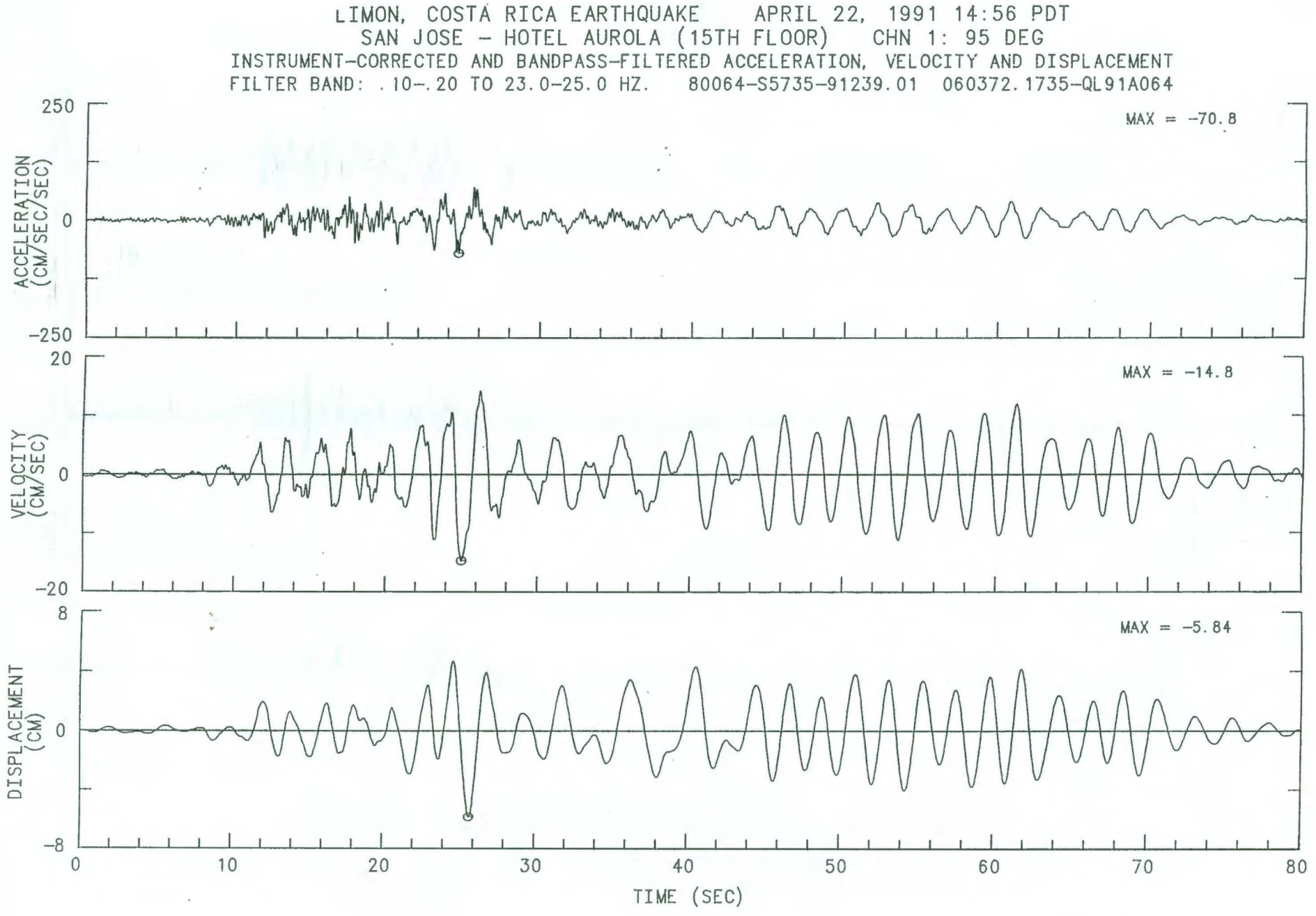
CHN 2: UP

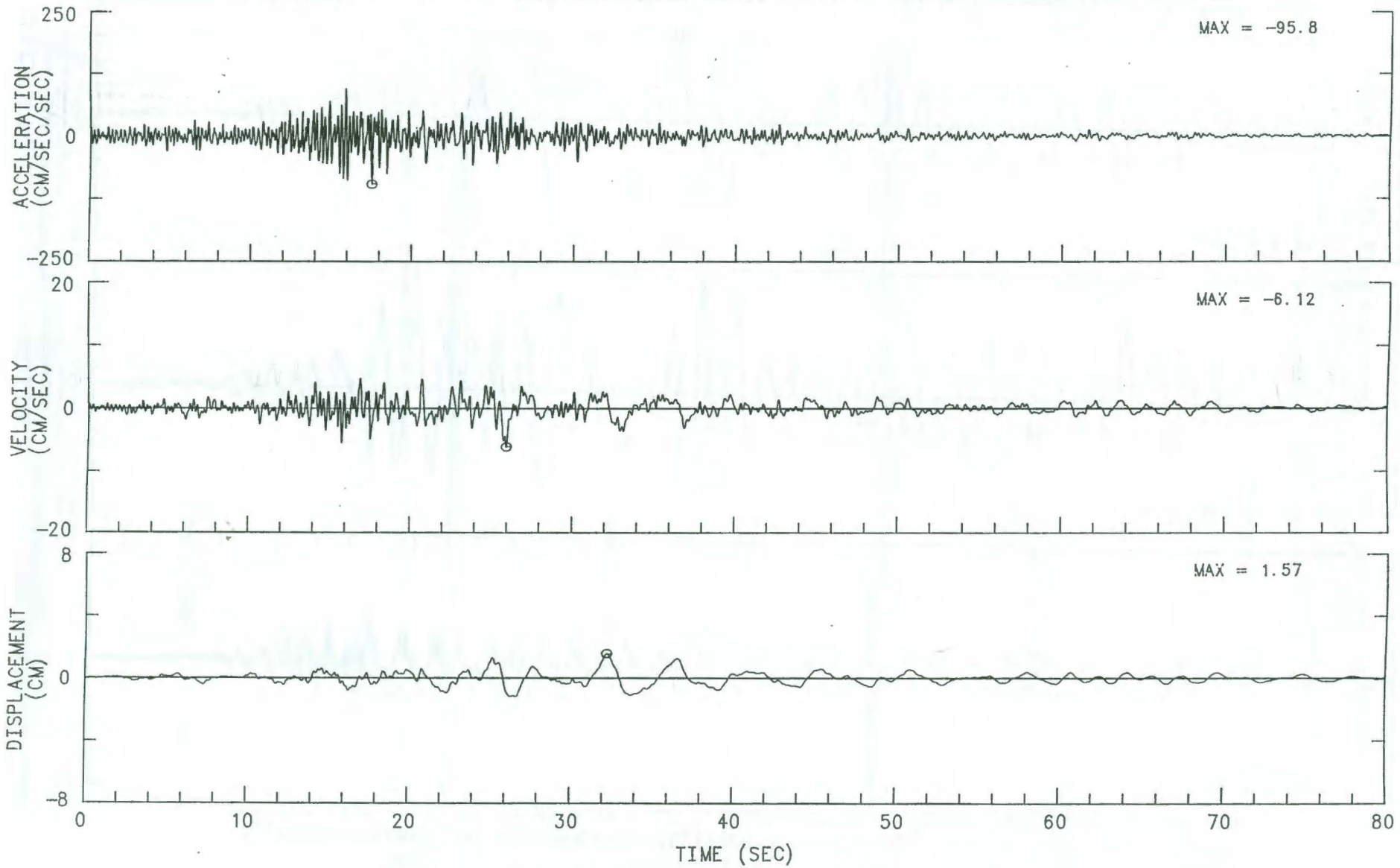


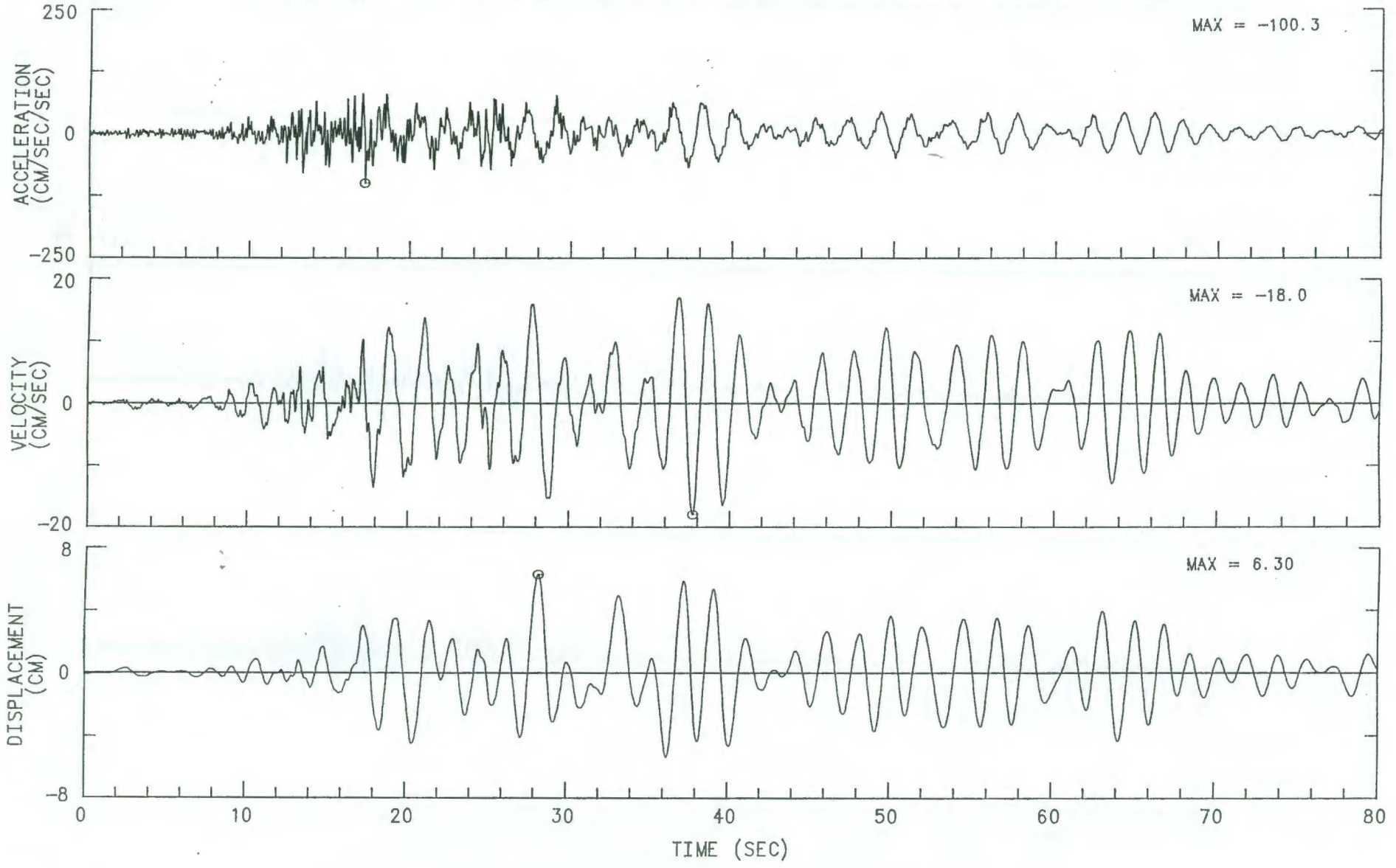
CHN 3: 5 DEG



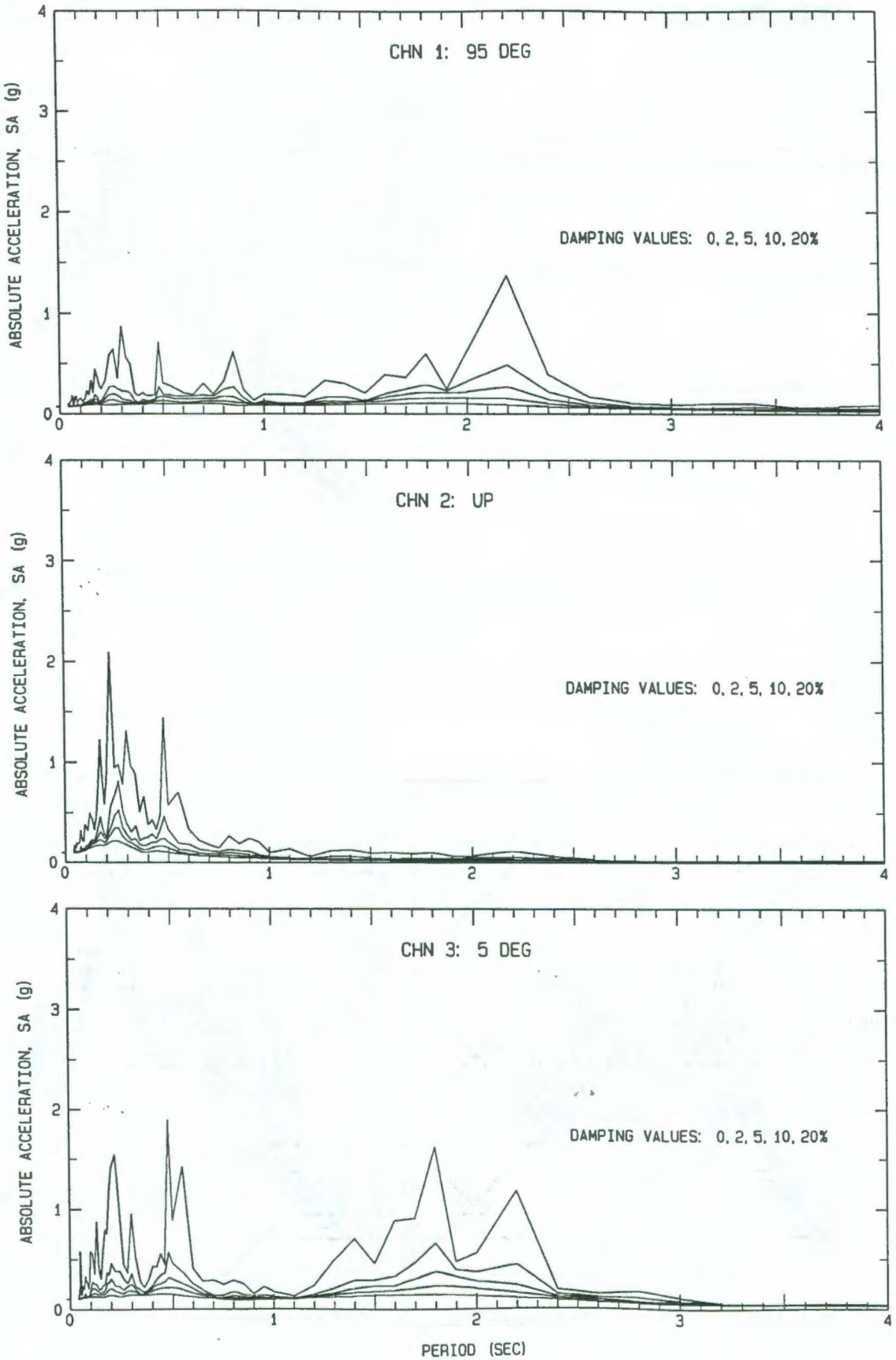

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (15TH FLOOR)
UNCORRECTED ACCELEROGRAM 80064-S5735-91239.01 121995.1106-QL91A064
CHN 1: 95 DEG
MAX = -0.074 G
CHN 2: UP
MAX = 0.100 G
CHN 3: 5 DEG
MAX = -0.104 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (15TH FLOOR) CHN 1: 95 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80064-S5735-91239.01 060372.1735-QL91A064
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -70.8
VELOCITY (CM/SEC)
20
0
-20
MAX = -14.8
DISPLACEMENT (CM)
8
0
-8
MAX = -5.84
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (15TH FLOOR) CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80064-S5735-91239.01 060372.1735-QL91A064
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -95.8
VELOCITY (CM/SEC)
20
0
-20
MAX = -6.12
DISPLACEMENT (CM)
8
0
-8
MAX = 1.57
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (15TH FLOOR) CHN 3: 5 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80064-S5735-91239.01 060372.1735-QL91A064
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -100.3
VELOCITY (CM/SEC)
20
0
-20
MAX = -18.0
DISPLACEMENT (CM)
8
0
-8
MAX = 6.30
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HOTEL AUROLA (15TH FLOOR)
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .10-.20 TO 23.0-25.0 HZ.
80064-S5735-91239.01 050595.0848-GL91A064



SAN JOSE - HOTEL AUROLA (15TH FLOOR): CSMIP S/N 064

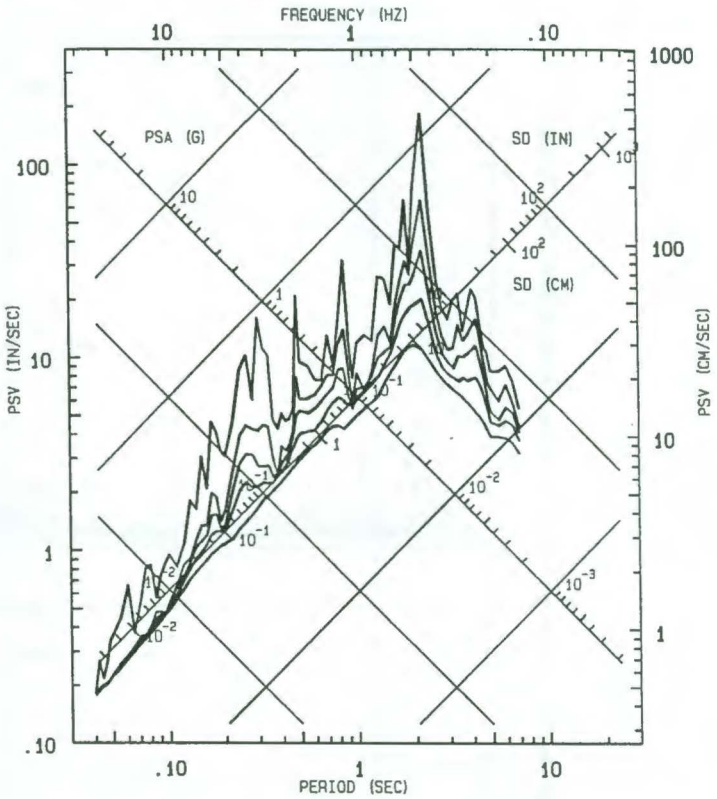
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.17 TO 23.6 HZ
(0.04 TO 5.88 SEC)

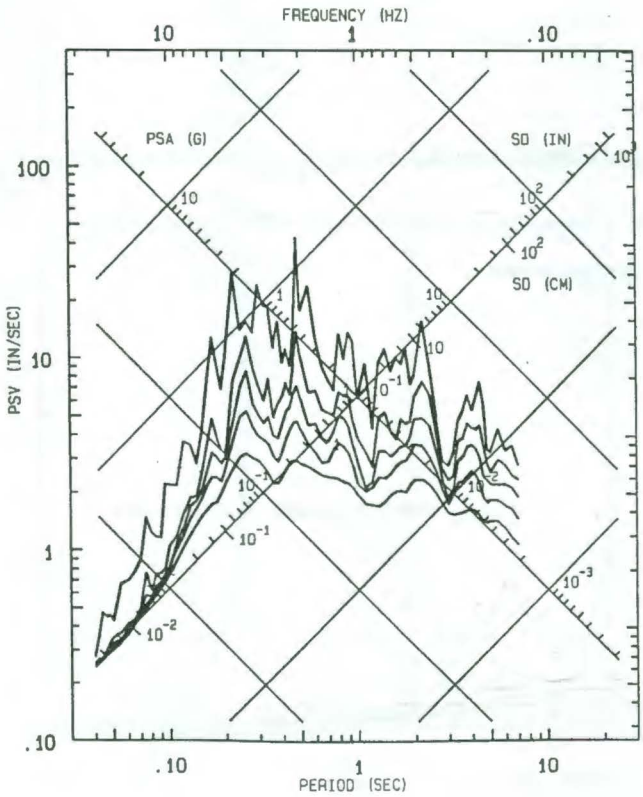
RECORD ID: 80064-S5735-91239.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

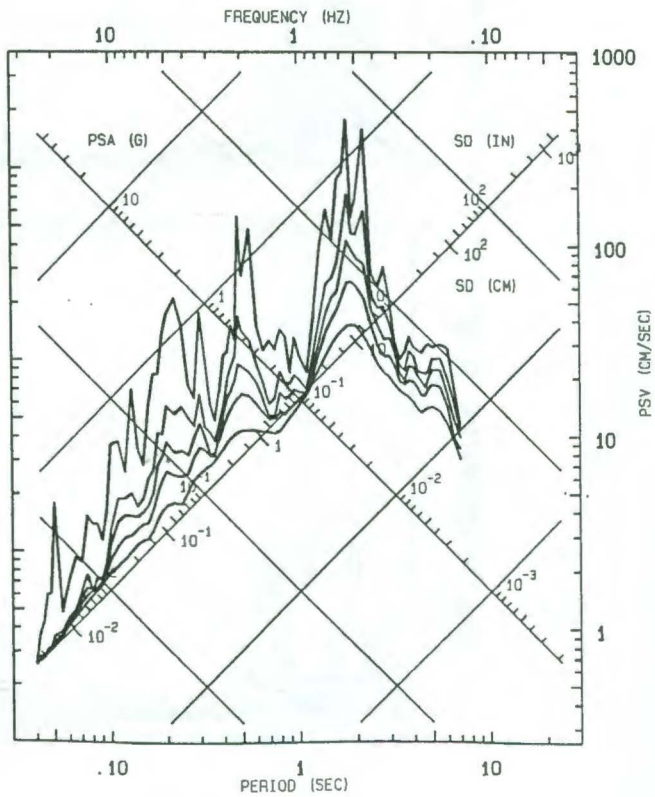
CHN 1: 95 DEG

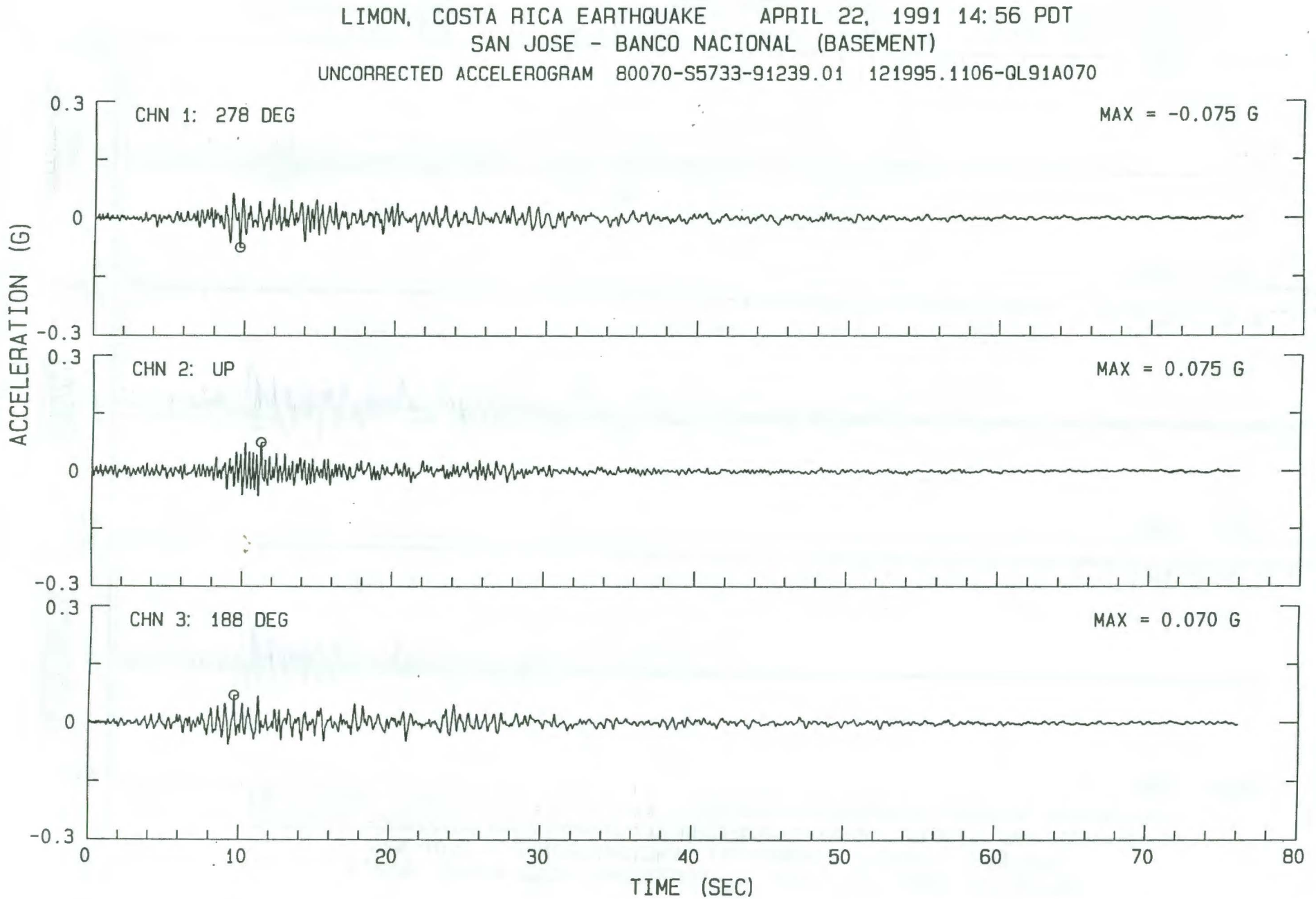


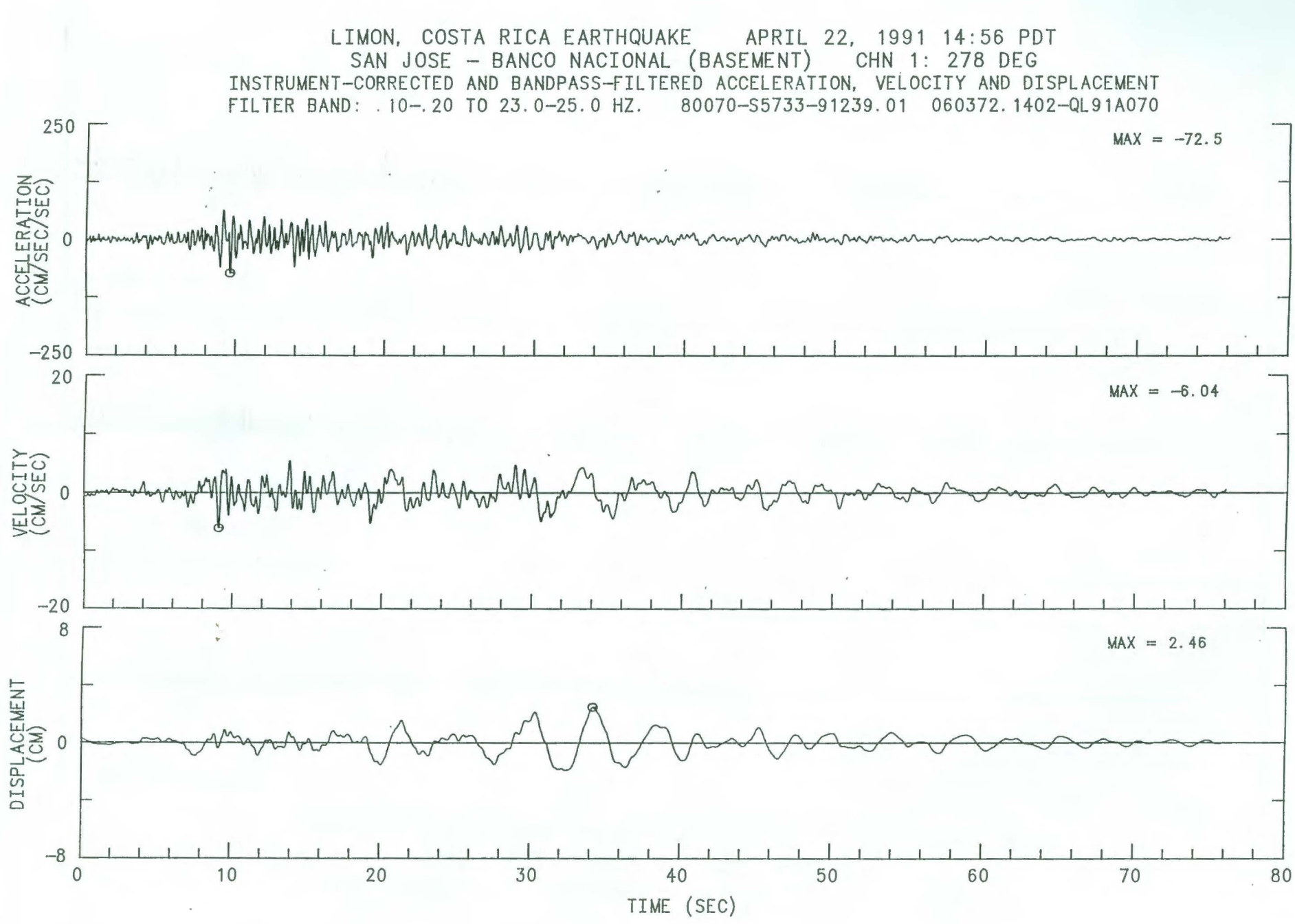
CHN 2: UP

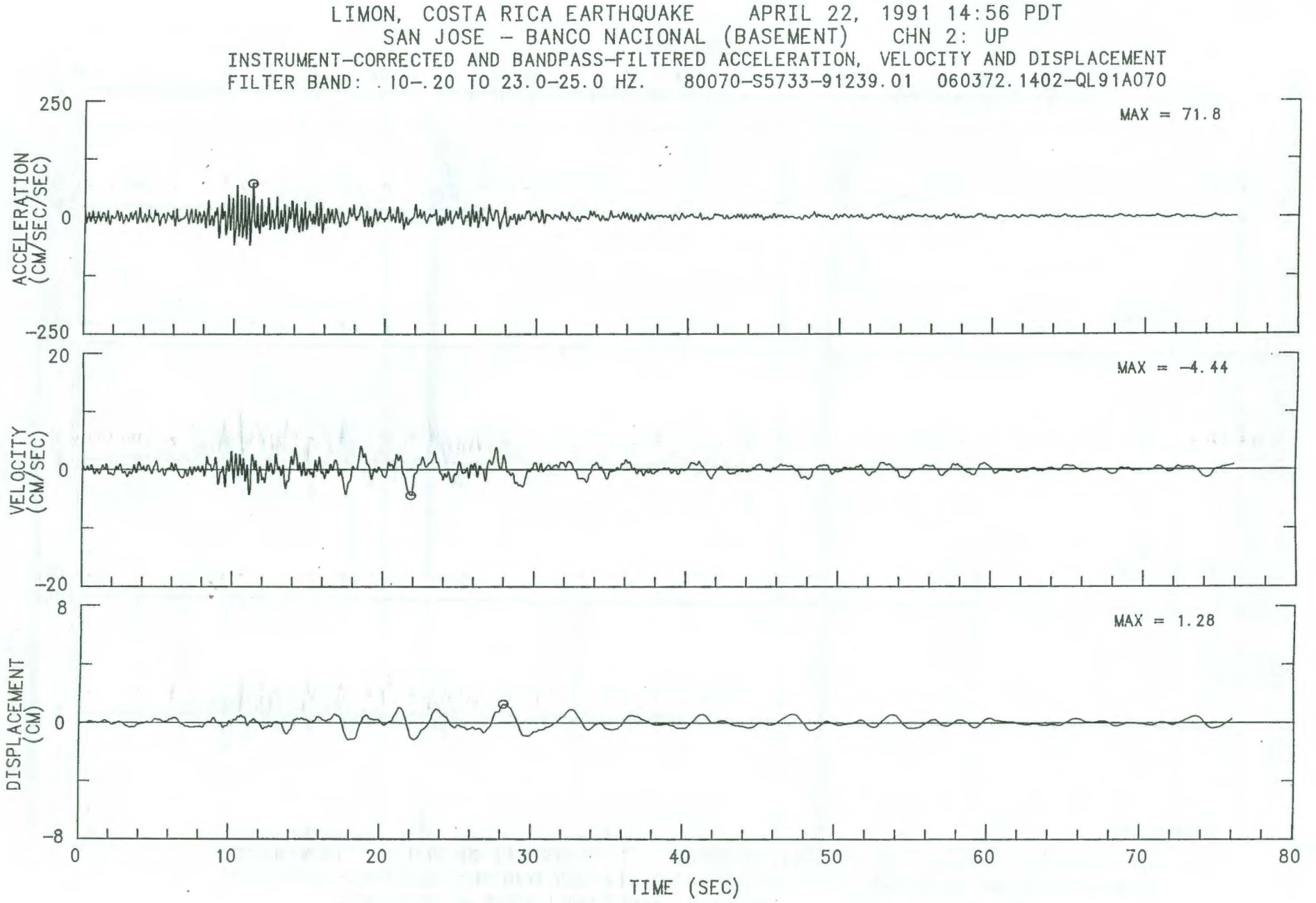


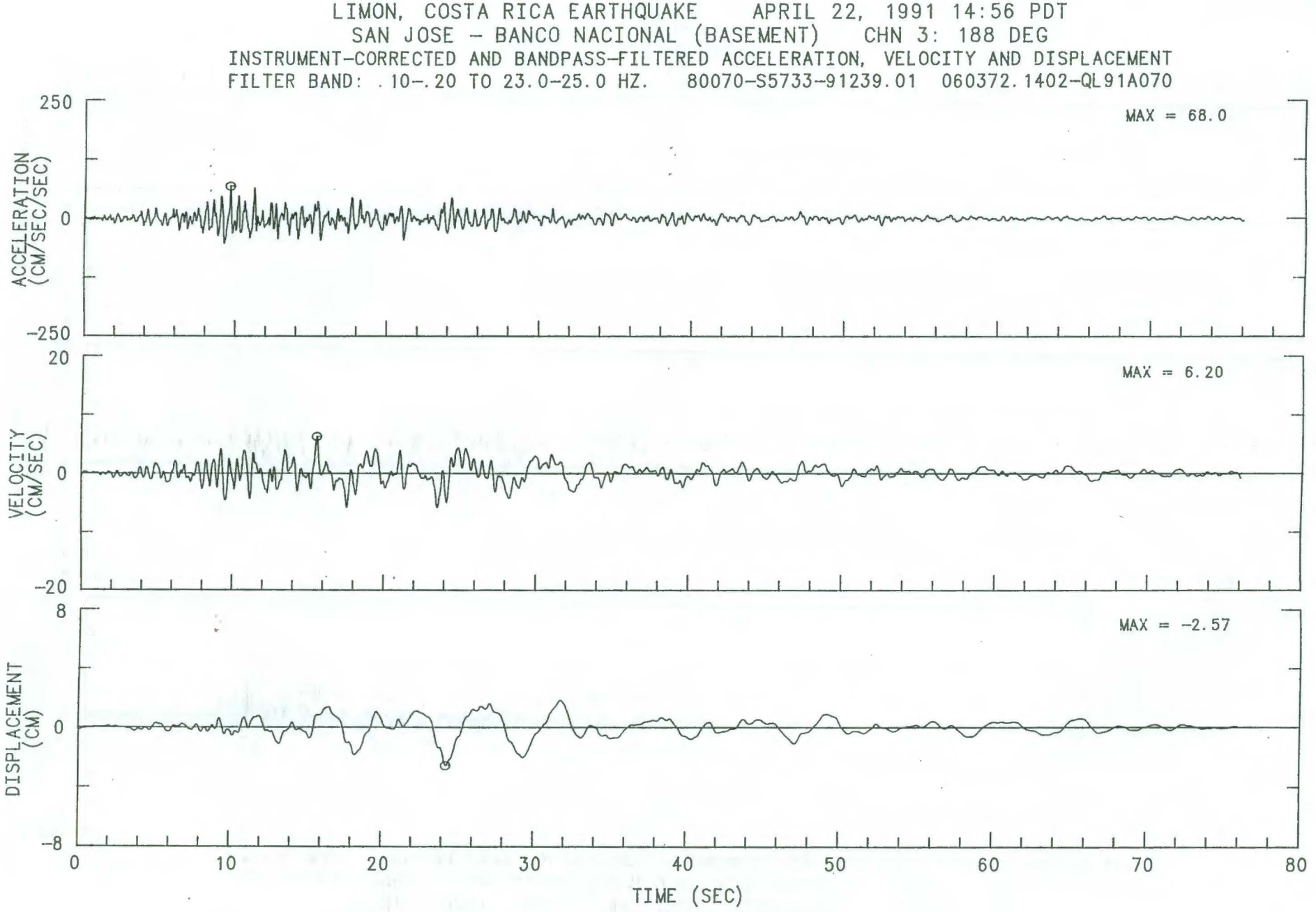
CHN 3: 5 DEG



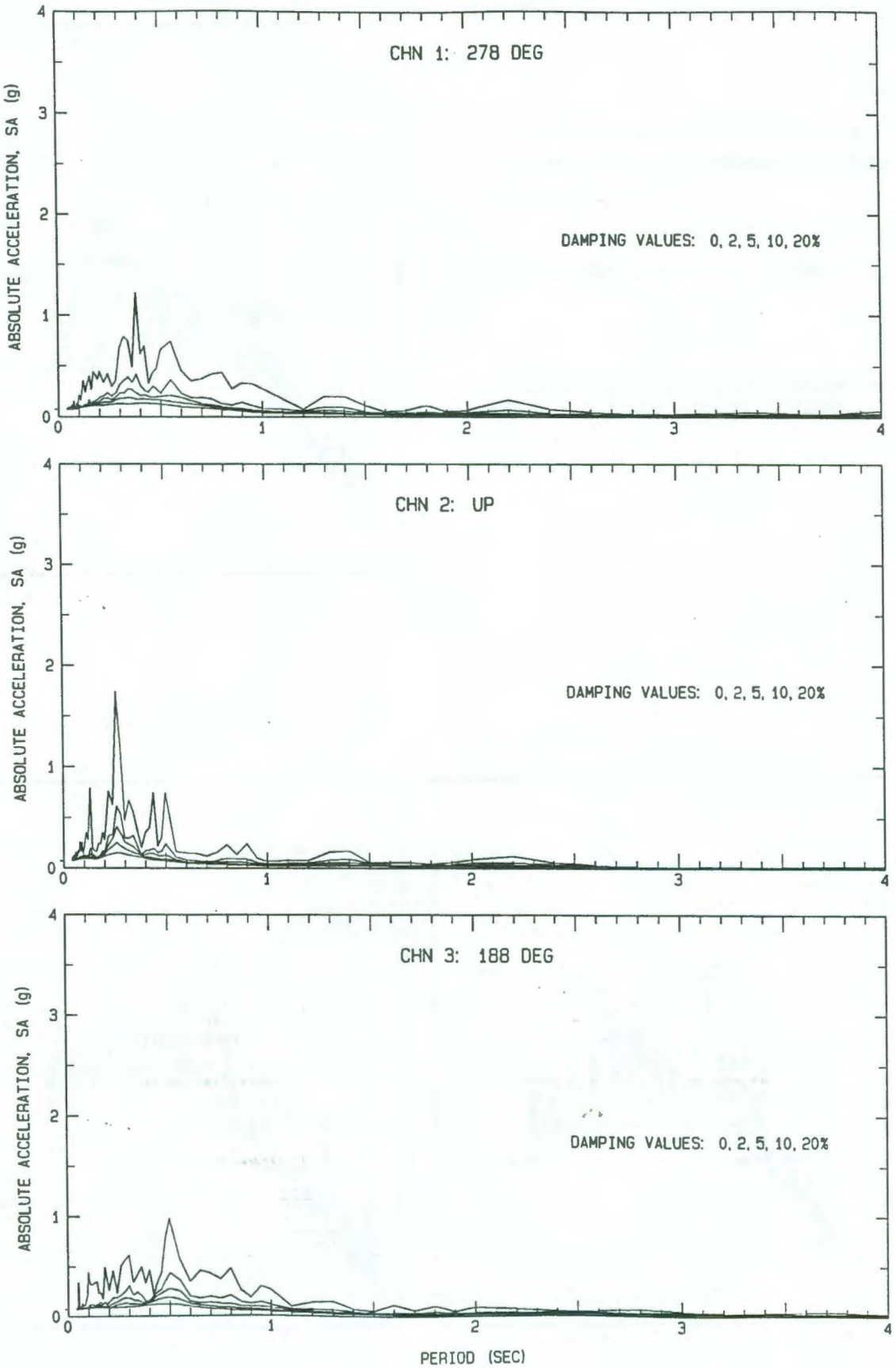

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BANCO NACIONAL (BASEMENT)
UNCORRECTED ACCELEROGRAM 80070-S5733-91239.01 121995.1106-QL91A070
CHN 1: 278 DEG
MAX = -0.075 G
CHN 2: UP
MAX = 0.075 G
CHN 3: 188 DEG
MAX = 0.070 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BANCO NACIONAL (BASEMENT) CHN 1: 278 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80070-S5733-91239.01 060372.1402-QL91A070
ACCELERATION (CM/SEC/SEC)
MAX = -72.5
VELOCITY (CM/SEC)
MAX = -6.04
DISPLACEMENT (CM)
MAX = 2.46
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BANCO NACIONAL (BASEMENT) CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80070-S5733-91239.01 060372.1402-QL91A070
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 71.8
VELOCITY (CM/SEC)
20
0
-20
MAX = -4.44
DISPLACEMENT (CM)
8
0
-8
MAX = 1.28
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BANCO NACIONAL (BASEMENT) CHN 3: 188 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80070-S5733-91239.01 060372.1402-QL91A070
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 68.0
VELOCITY (CM/SEC)
20
0
-20
MAX = 6.20
DISPLACEMENT (CM)
8
0
-8
MAX = -2.57
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - BANCO NACIONAL (BASEMENT)
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .10-.20 TO 23.0-25.0 HZ.
B0070-S5733-91239.01 050595.0848-QL91A070



SAN JOSE - BANCO NACIONAL (BASEMENT): CSMIP S/N 070

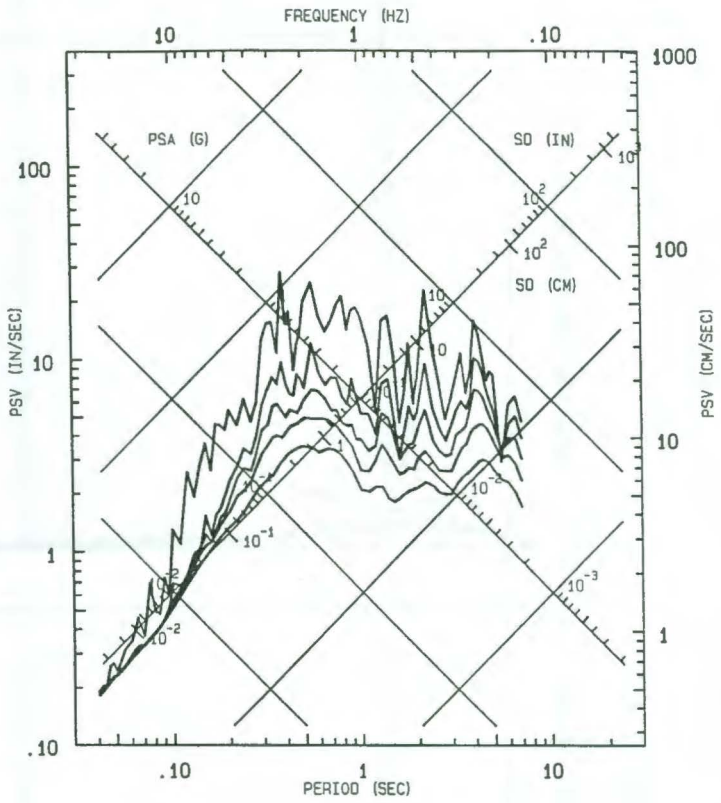
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.17 TO 23.6 HZ
(0.04 TO 5.88 SEC)

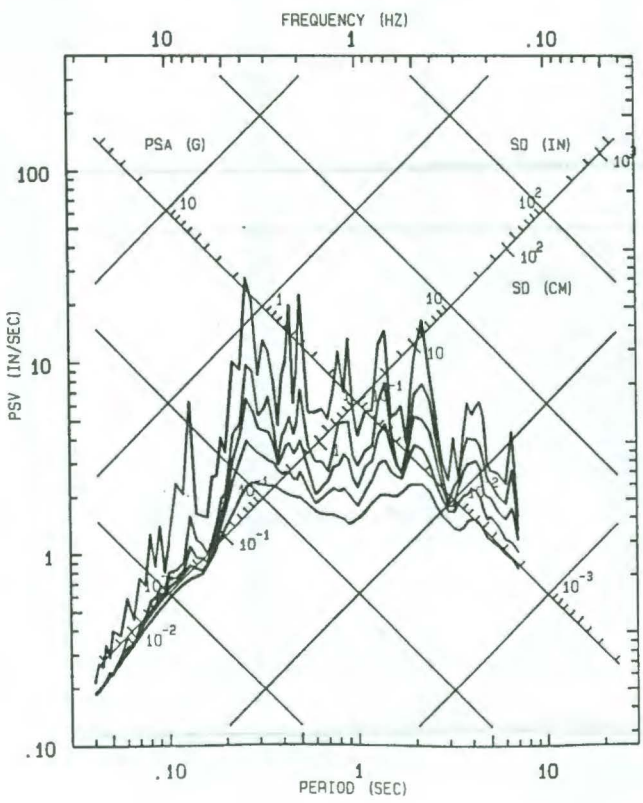
RECORD ID: 80070-S5733-91239.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

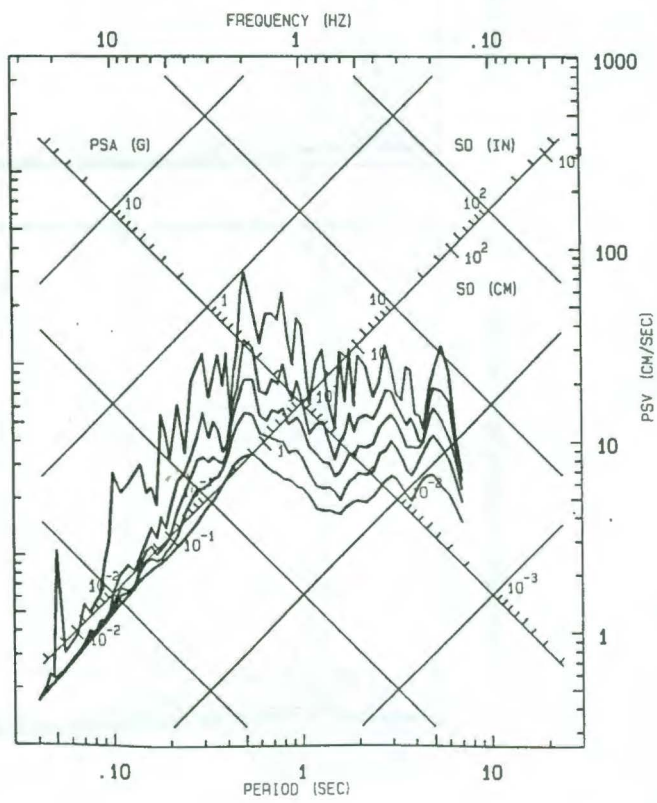
CHN 1: 278 DEG

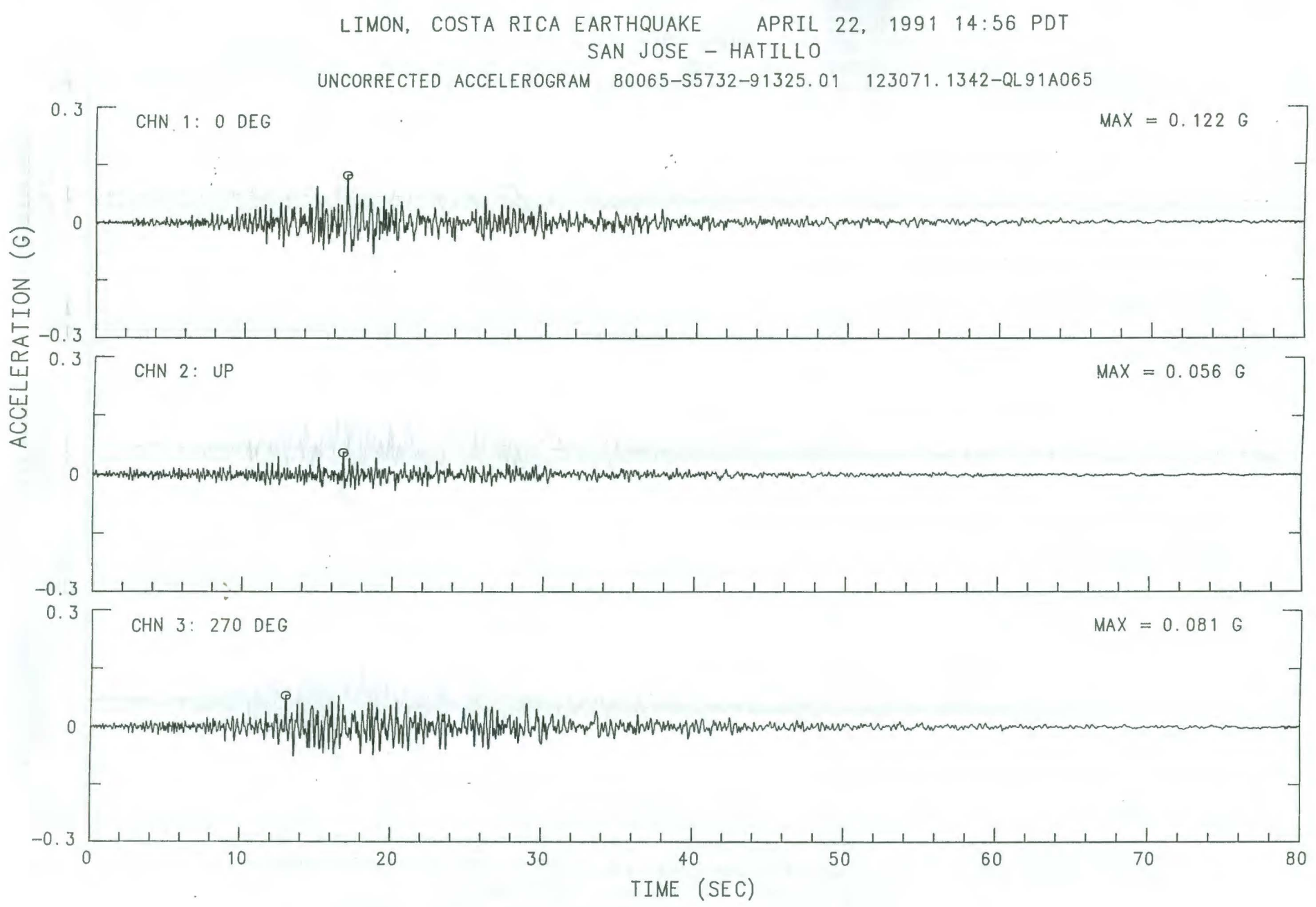


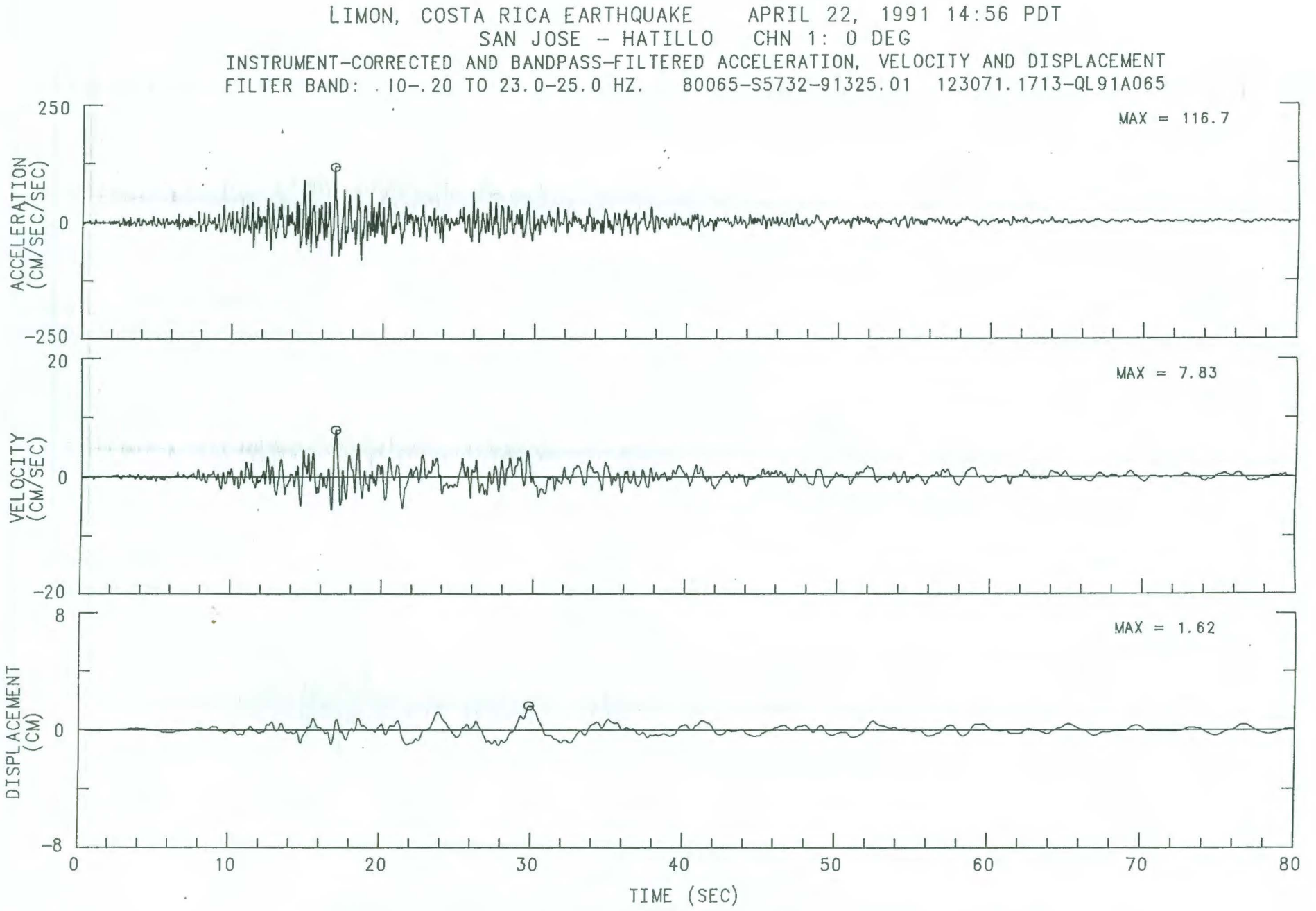
CHN 2: UP

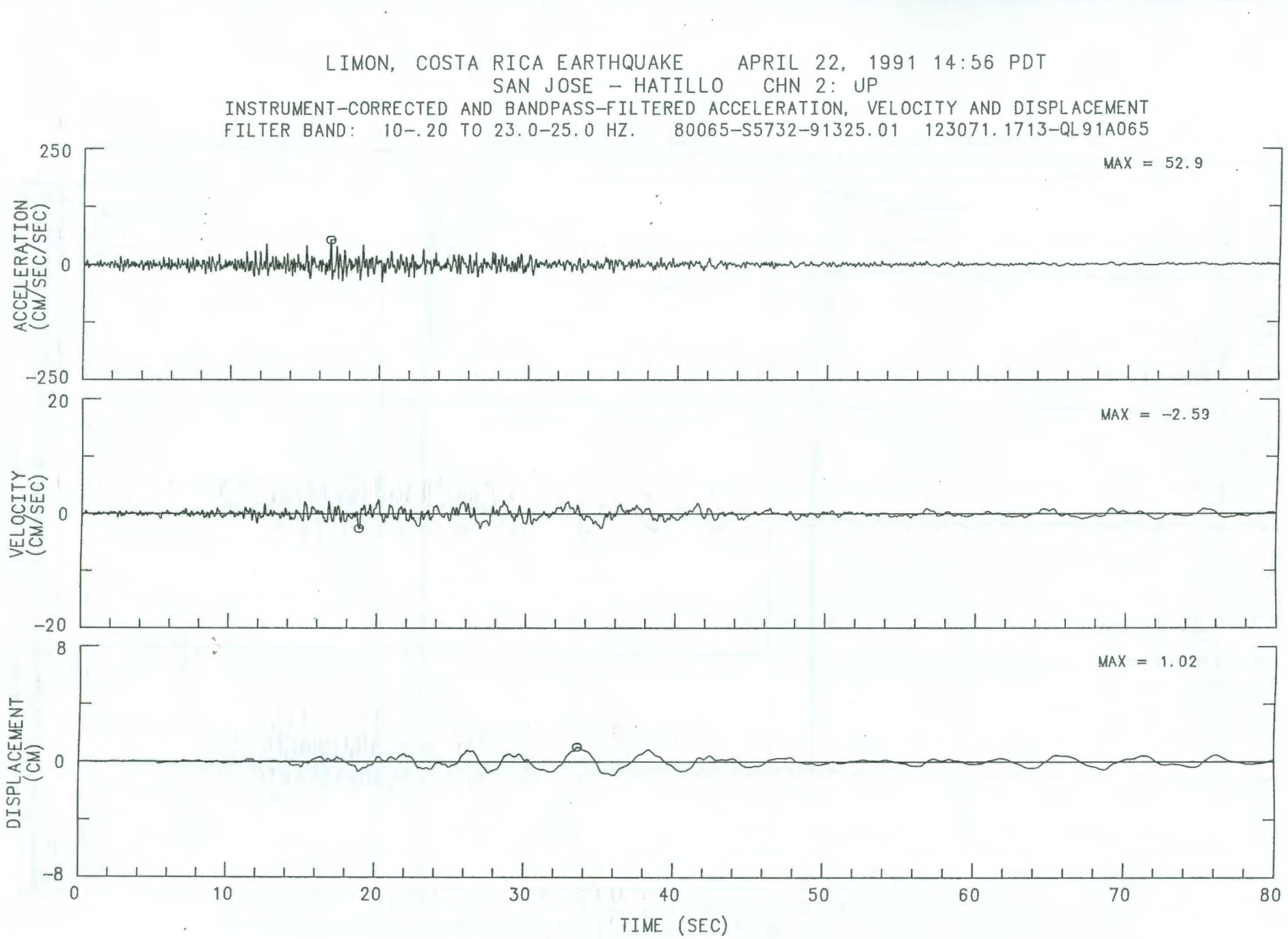


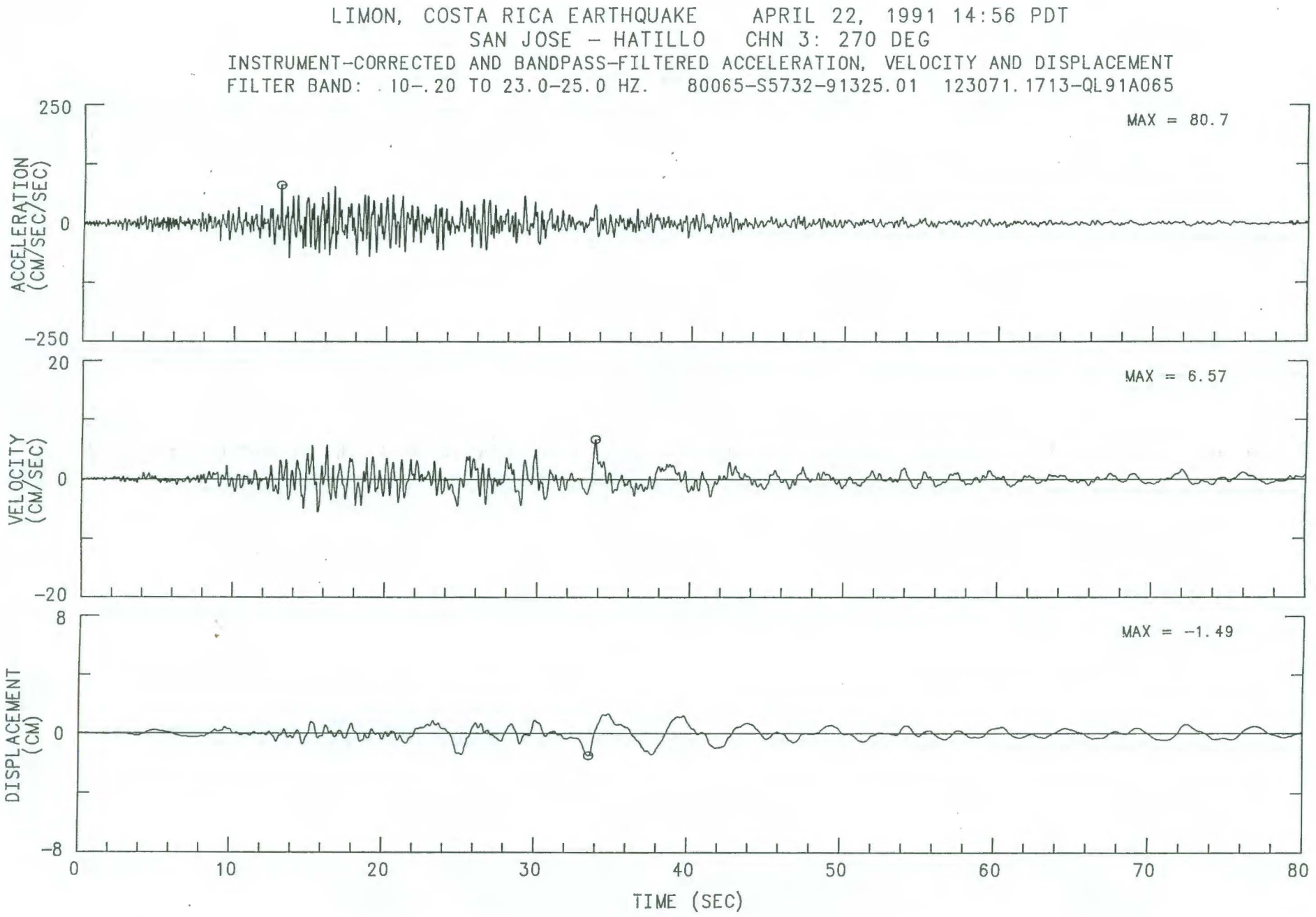
CHN 3: 188 DEG



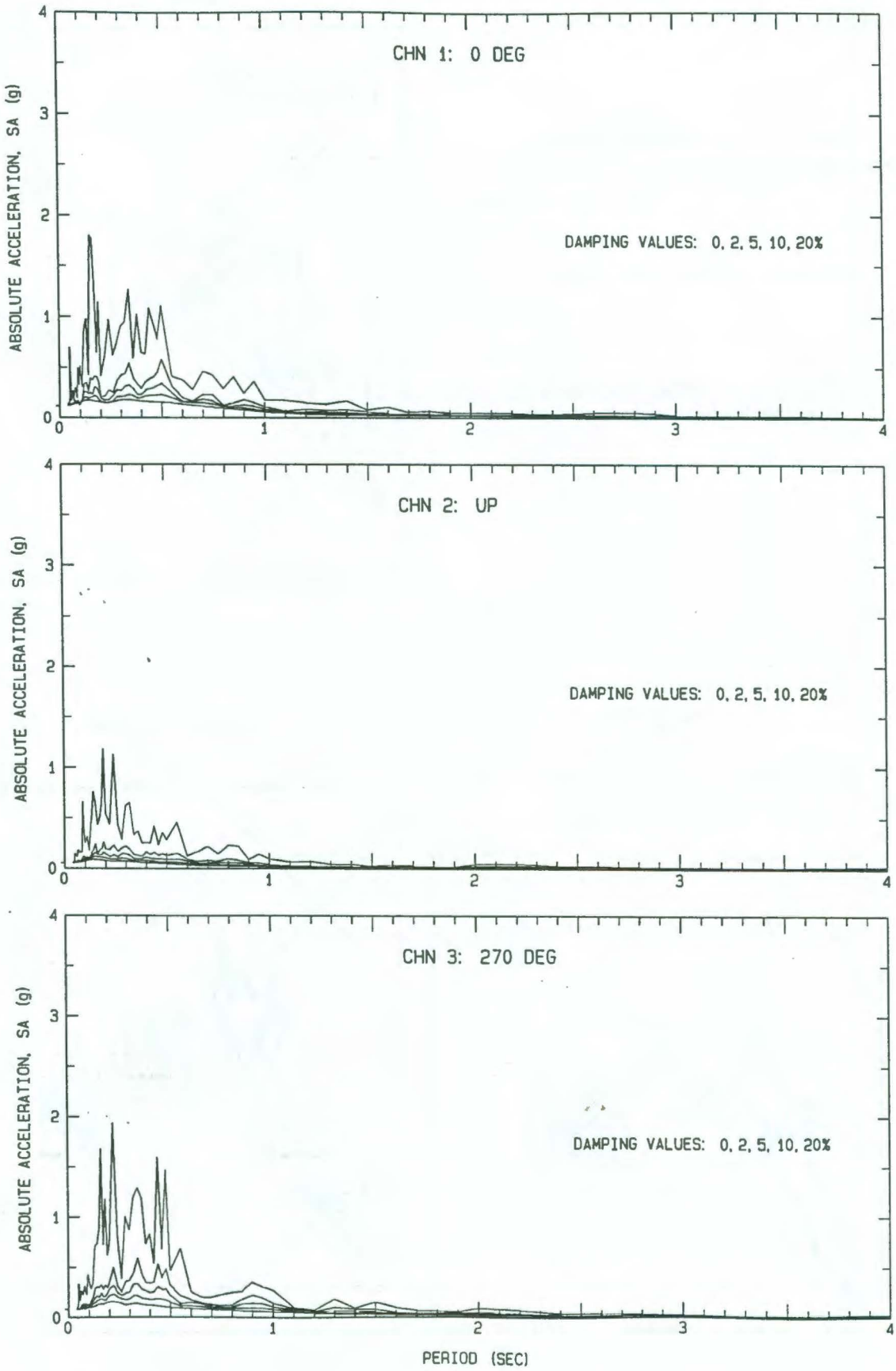

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HATILLO
UNCORRECTED ACCELEROGRAM 80065-S5732-91325.01 123071.1342-QL91A065
CHN 1: 0 DEG
MAX = 0.122 G
CHN 2: UP
MAX = 0.056 G
CHN 3: 270 DEG
MAX = 0.081 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HATILLO CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80065-S5732-91325.01 123071.1713-QL91A065
ACCELERATION (CM/SEC/SEC)
MAX = 116.7
VELOCITY (CM/SEC)
MAX = 7.83
DISPLACEMENT (CM)
MAX = 1.62
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HATILLO CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: 10-.20 TO 23.0-25.0 HZ. 80065-S5732-91325.01 123071.1713-QL91A065
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 52.9
VELOCITY (CM/SEC)
20
0
-20
MAX = -2.59
DISPLACEMENT (CM)
8
0
-8
MAX = 1.02
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HATILLO CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80065-S5732-91325.01 123071.1713-QL91A065
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 80.7
VELOCITY (CM/SEC)
20
0
-20
MAX = 6.57
DISPLACEMENT (CM)
8
0
-8
MAX = -1.49
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN JOSE - HATILLO
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .10-.20 TO 23.0-25.0 HZ.
80065-S5732-91325.01 050595.0848-GL91A065



SAN JOSE - HATILLO: CSMIP S/N 065

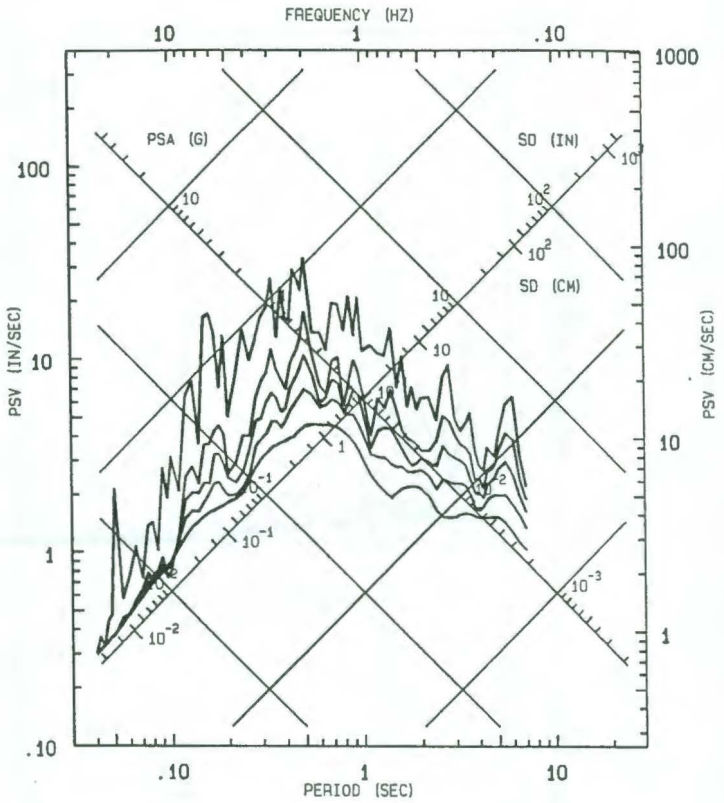
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.17 TO 23.6 HZ
(0.04 TO 5.88 SEC)

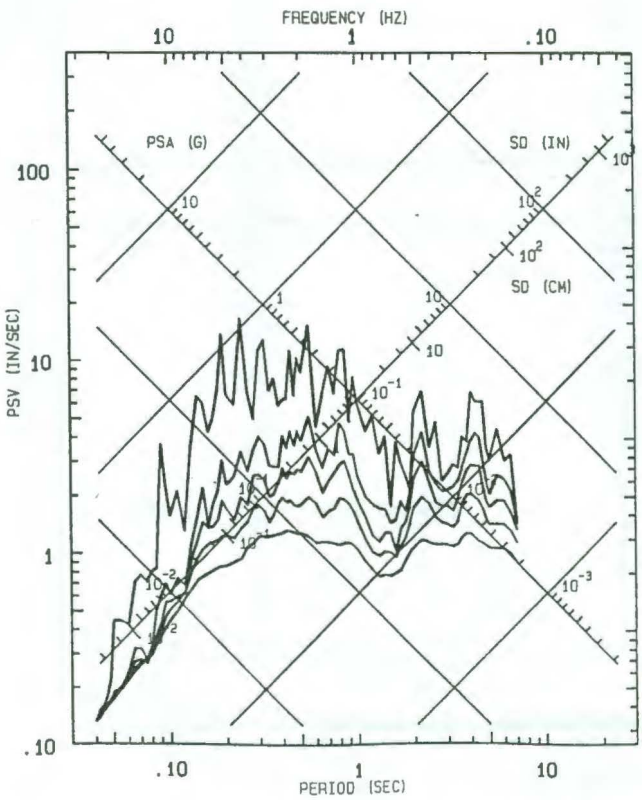
RECORD ID: 80065-S5732-91325.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

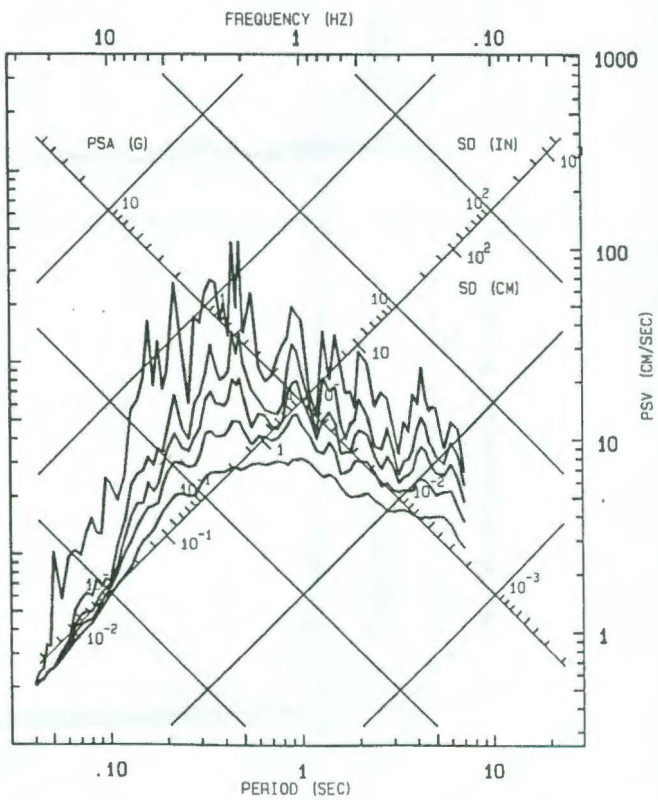
CHN 1: 0 DEG

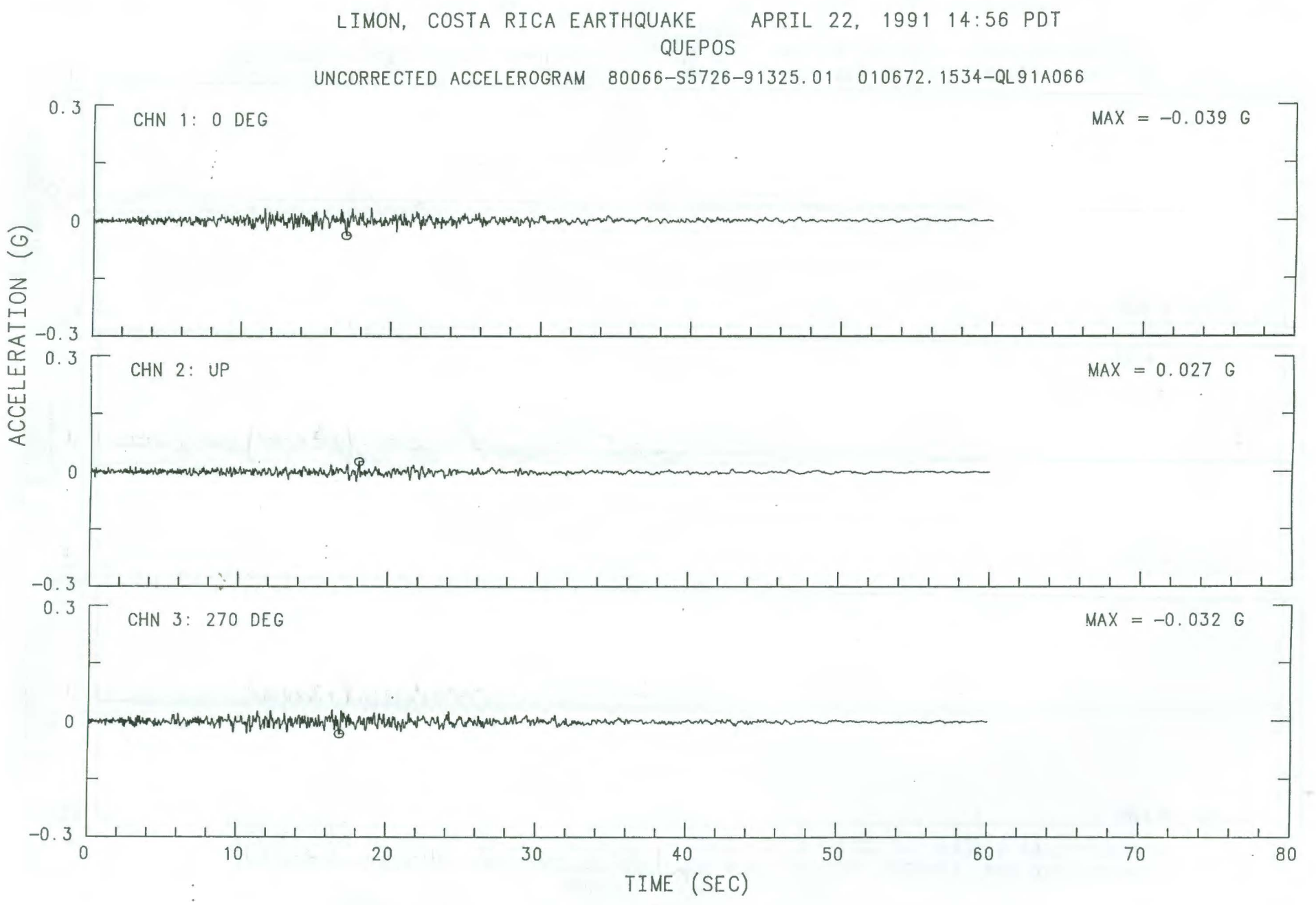


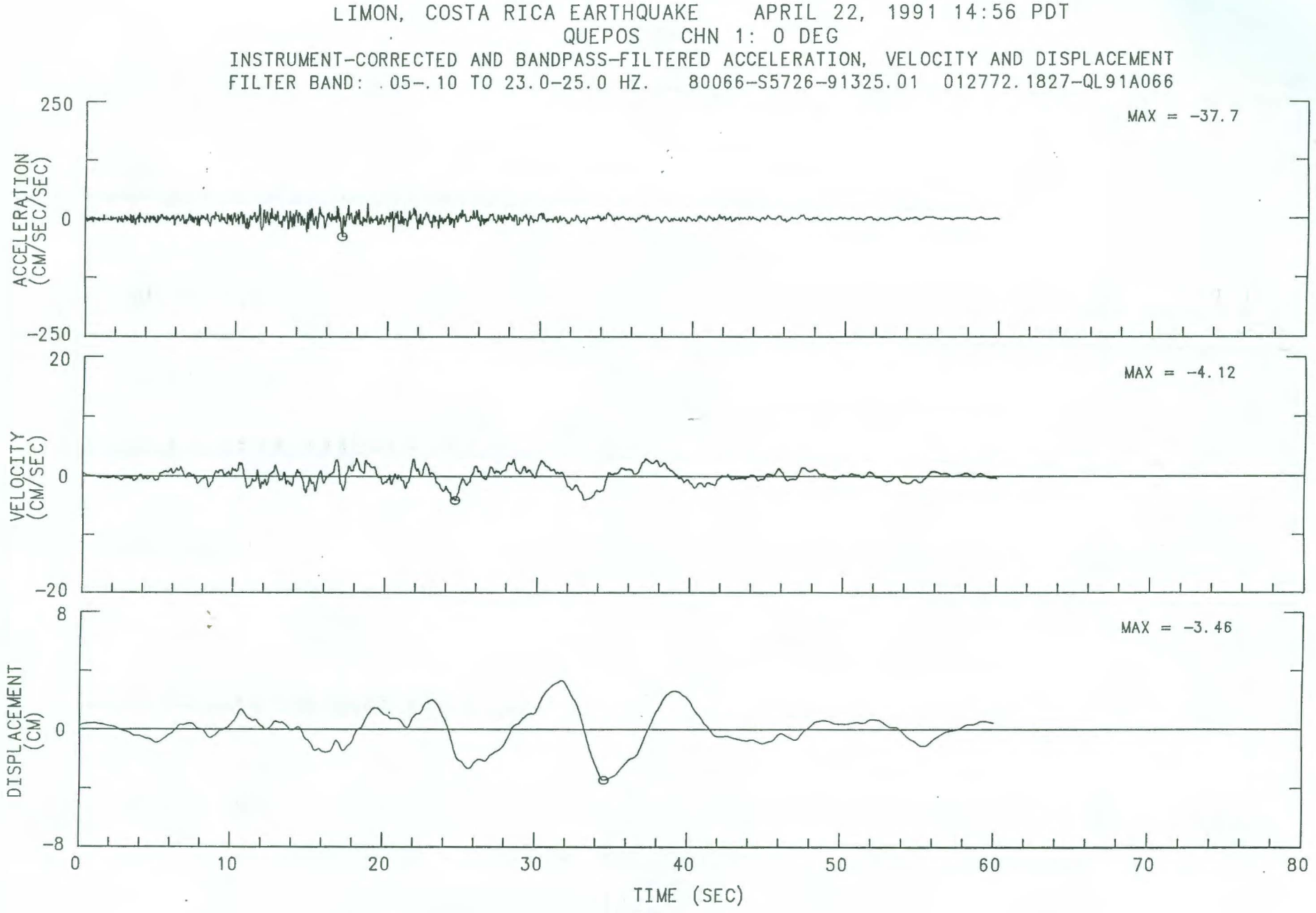
CHN 2: UP

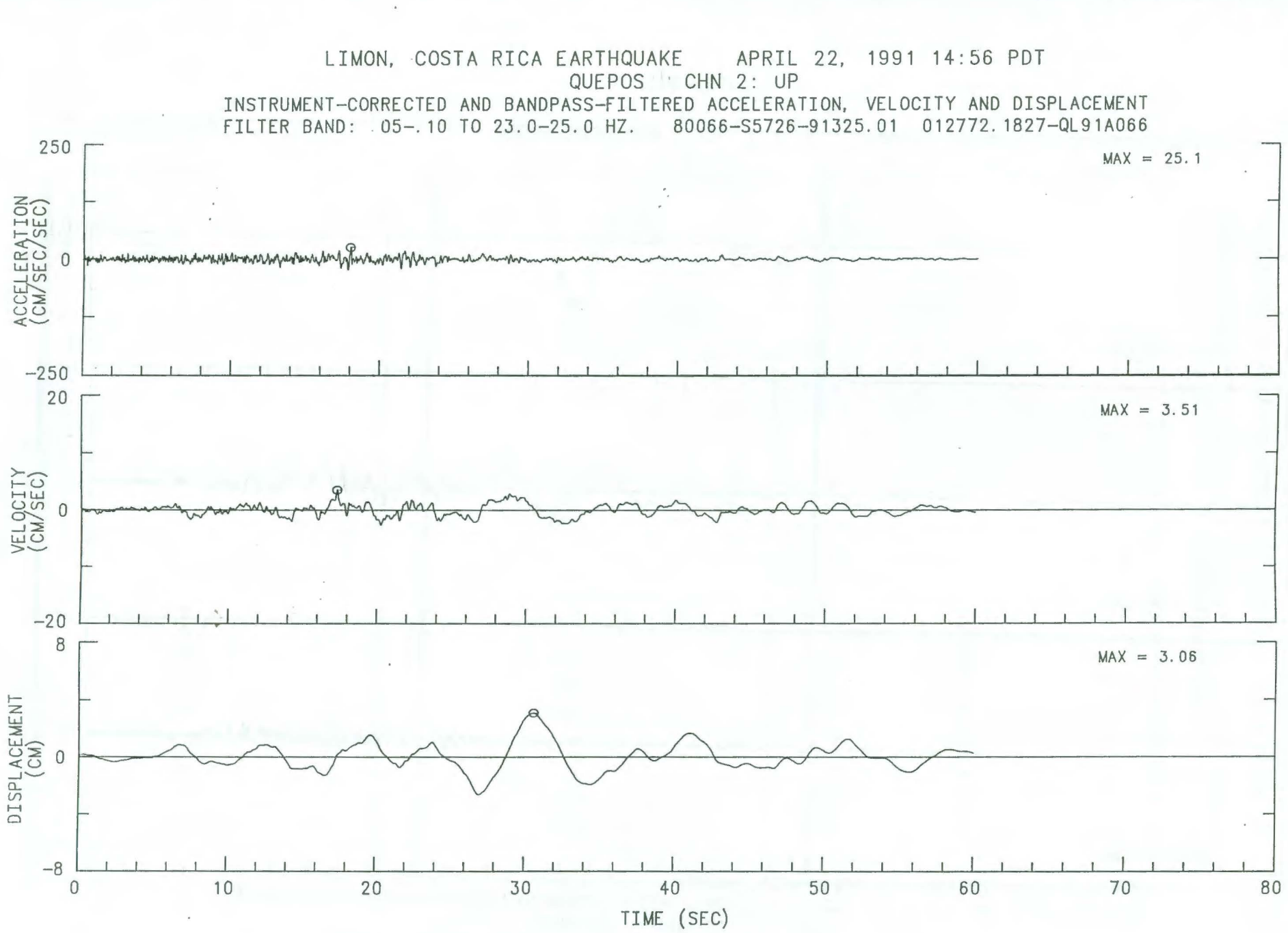


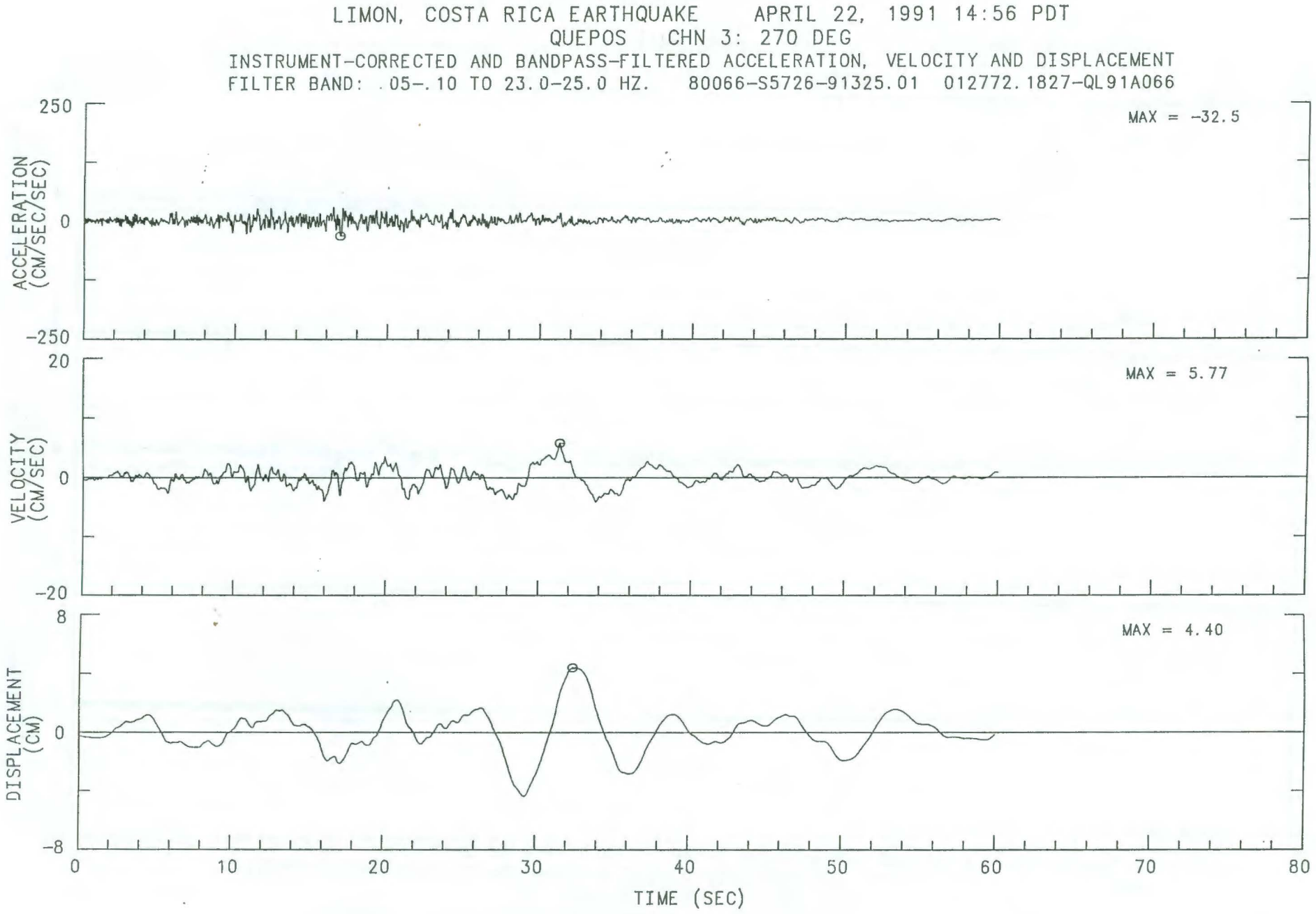
CHN 3: 270 DEG



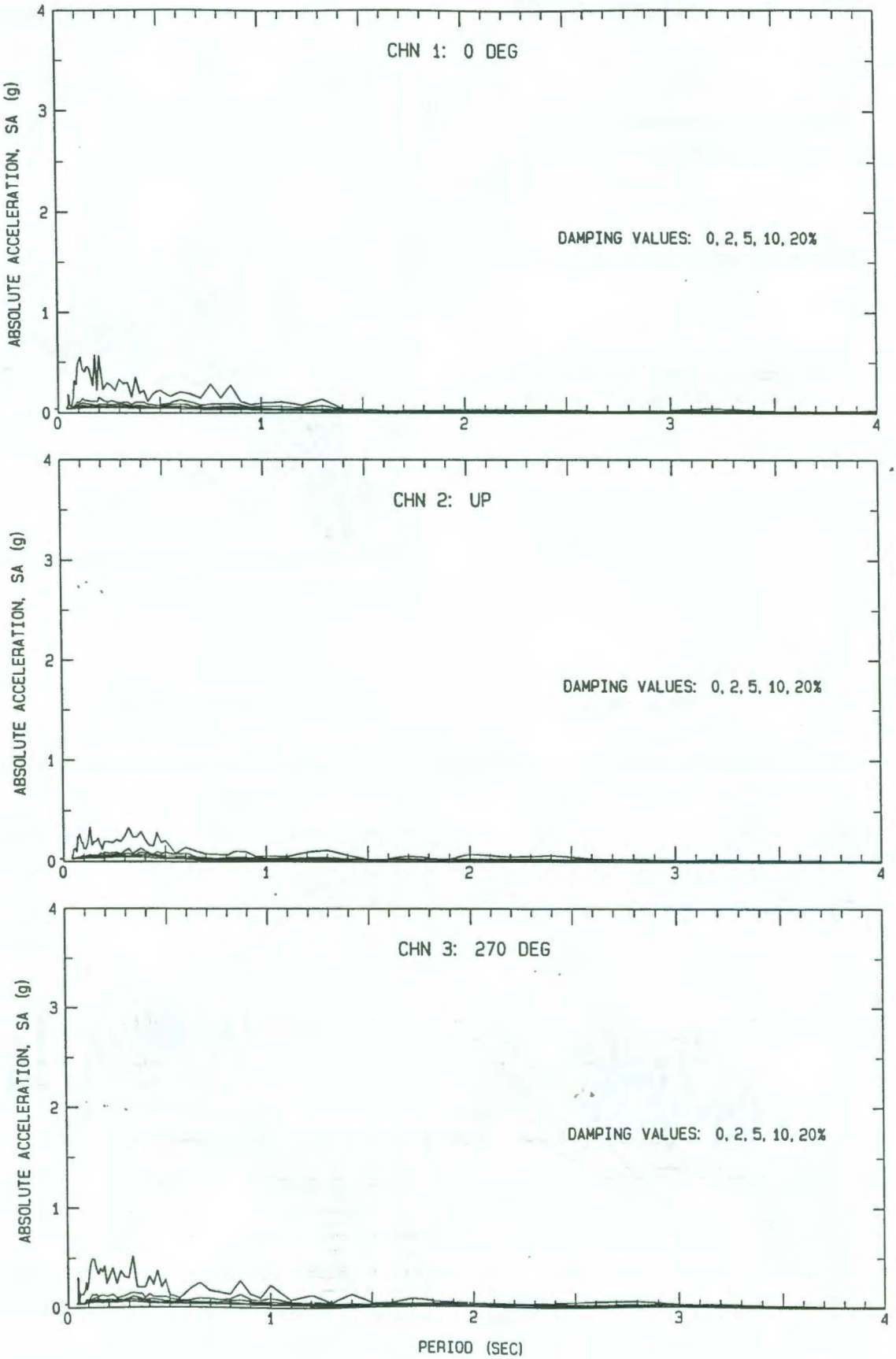

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
QUEPOS
UNCORRECTED ACCELEROGRAM 80066-S5726-91325.01 010672.1534-QL91A066
CHN 1: 0 DEG
MAX = -0.039 G
CHN 2: UP
MAX = 0.027 G
CHN 3: 270 DEG
MAX = -0.032 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
QUEPOS CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80066-S5726-91325.01 012772.1827-QL91A066
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -37.7
VELOCITY (CM/SEC)
20
0
-20
MAX = -4.12
DISPLACEMENT (CM)
8
0
-8
MAX = -3.46
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
QUEPOS CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80066-S5726-91325.01 012772.1827-QL91A066
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 25.1
VELOCITY (CM/SEC)
20
0
-20
MAX = 3.51
DISPLACEMENT (CM)
8
0
-8
MAX = 3.06
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
QUEPOS CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80066-S5726-91325.01 012772.1827-QL91A066
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -32.5
VELOCITY (CM/SEC)
20
0
-20
MAX = 5.77
DISPLACEMENT (CM)
8
0
-8
MAX = 4.40
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
QUEPOS
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
80066-S5726-91325.01 050595.0848-QL91A066



QUEPOS: CSMIP S/N 066

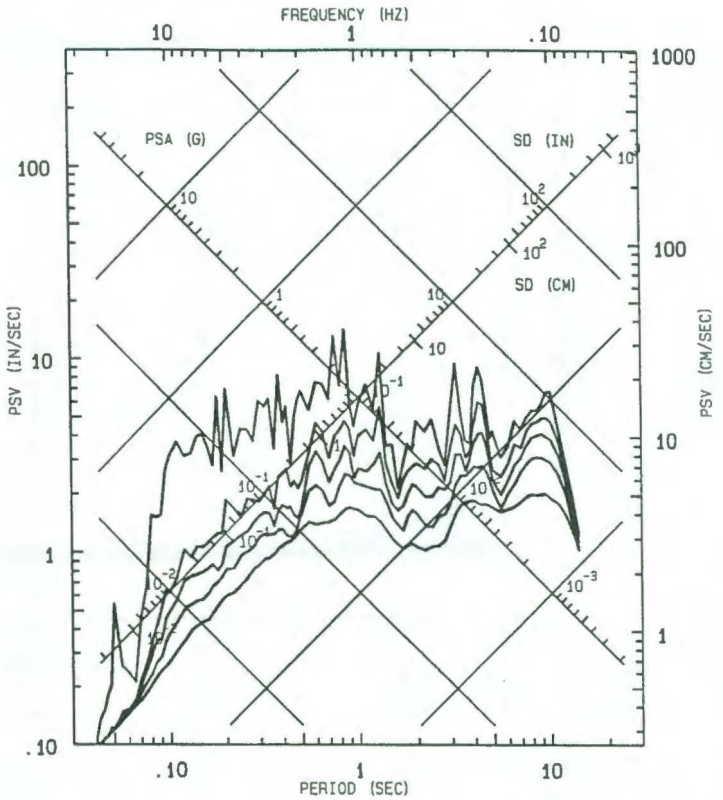
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.09 TO 23.6 HZ
(0.04 TO 11.8 SEC)

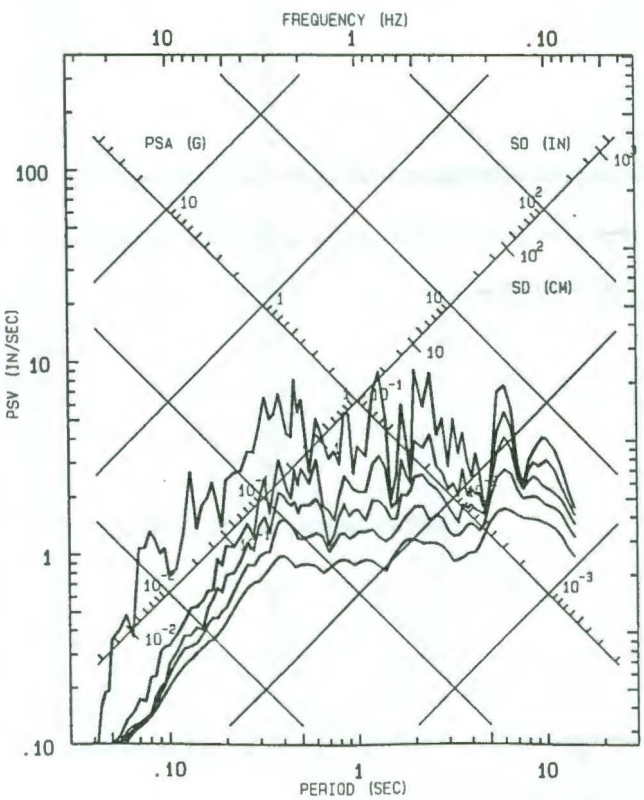
RECORD ID: 80066-S5726-91325.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

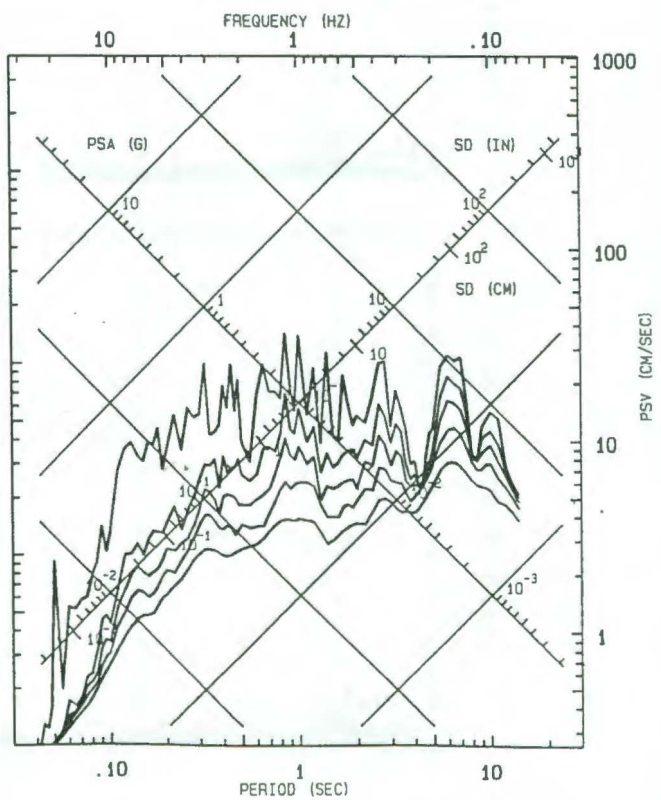
CHN 1: 0 DEG

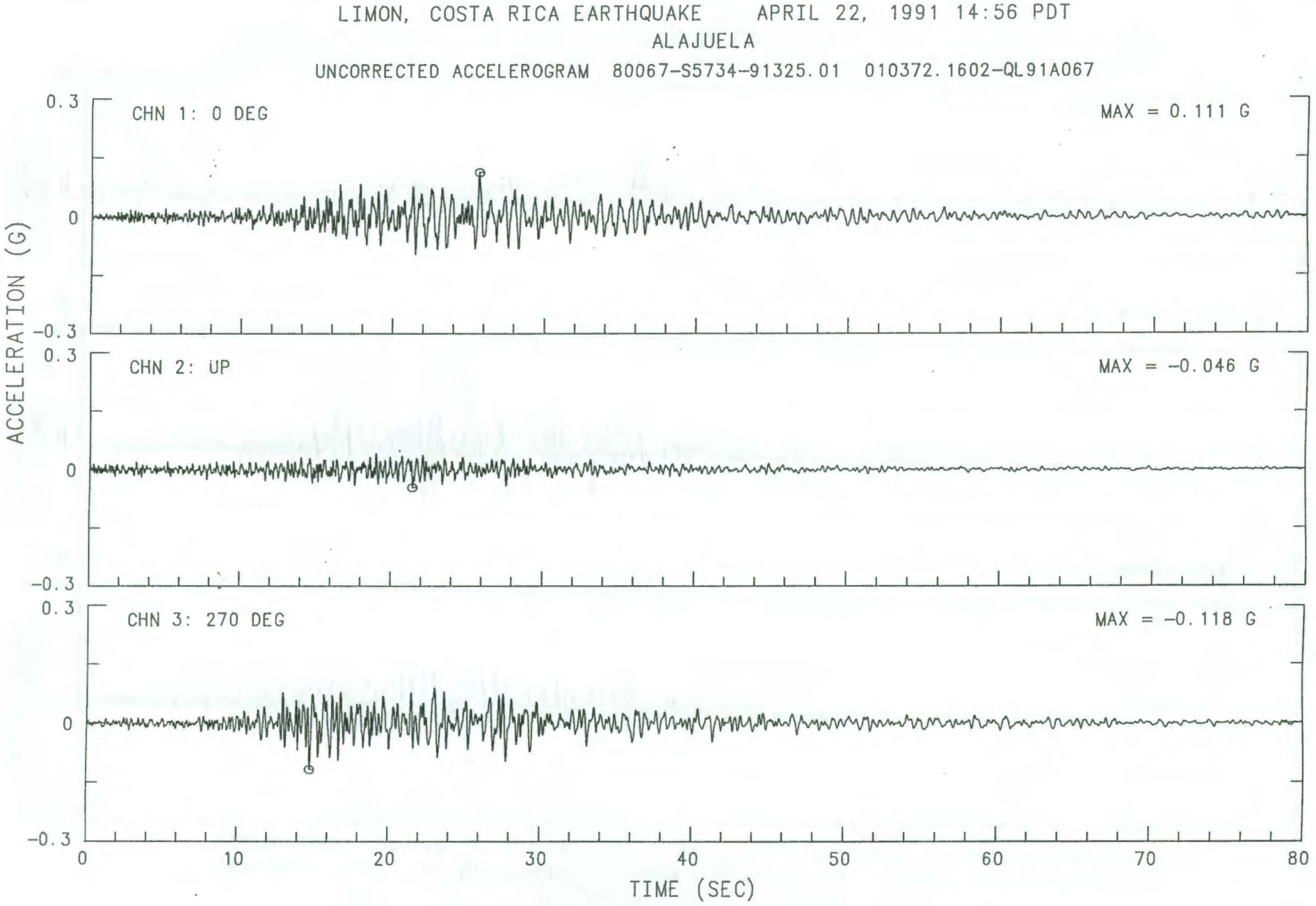


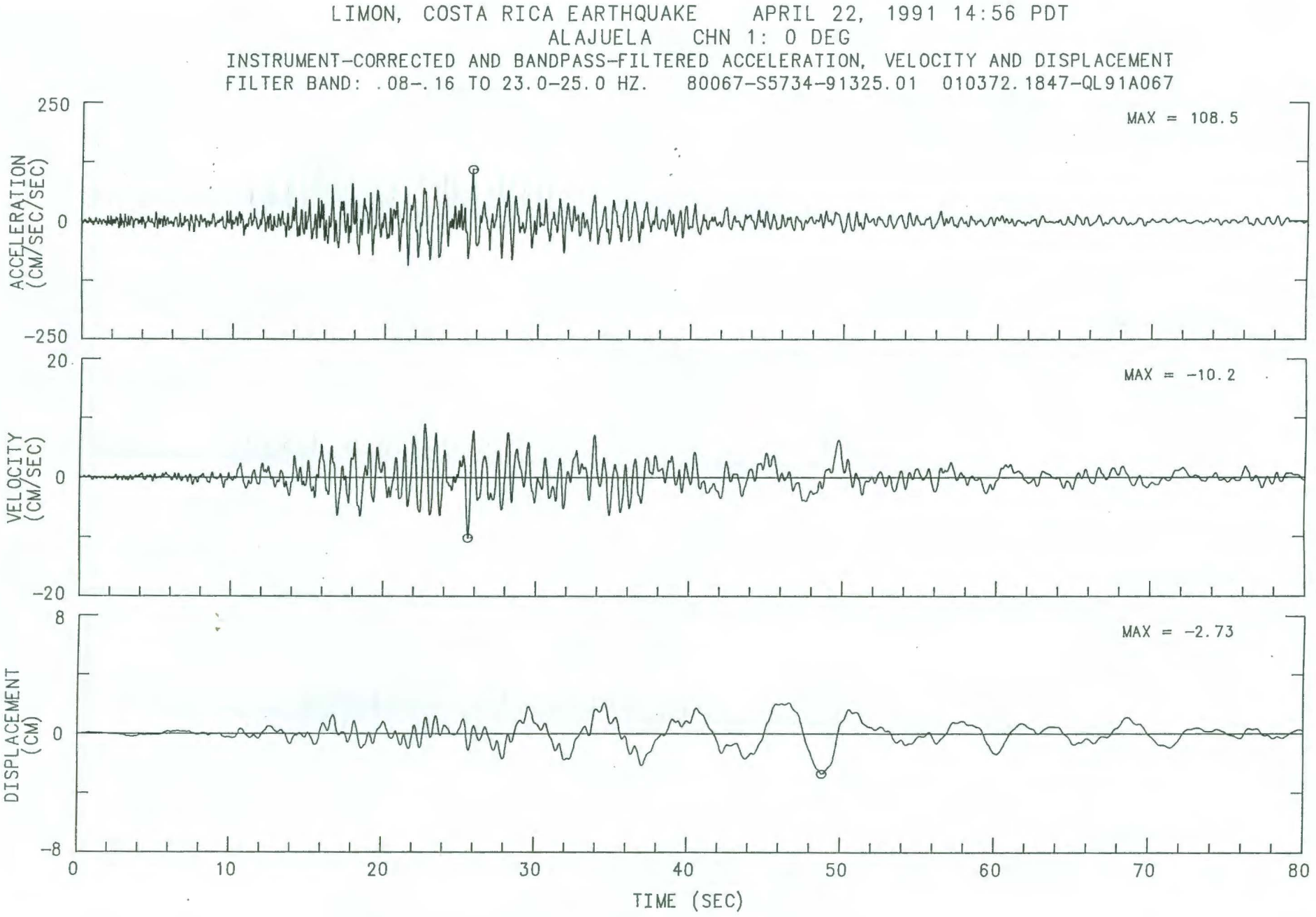
CHN 2: UP

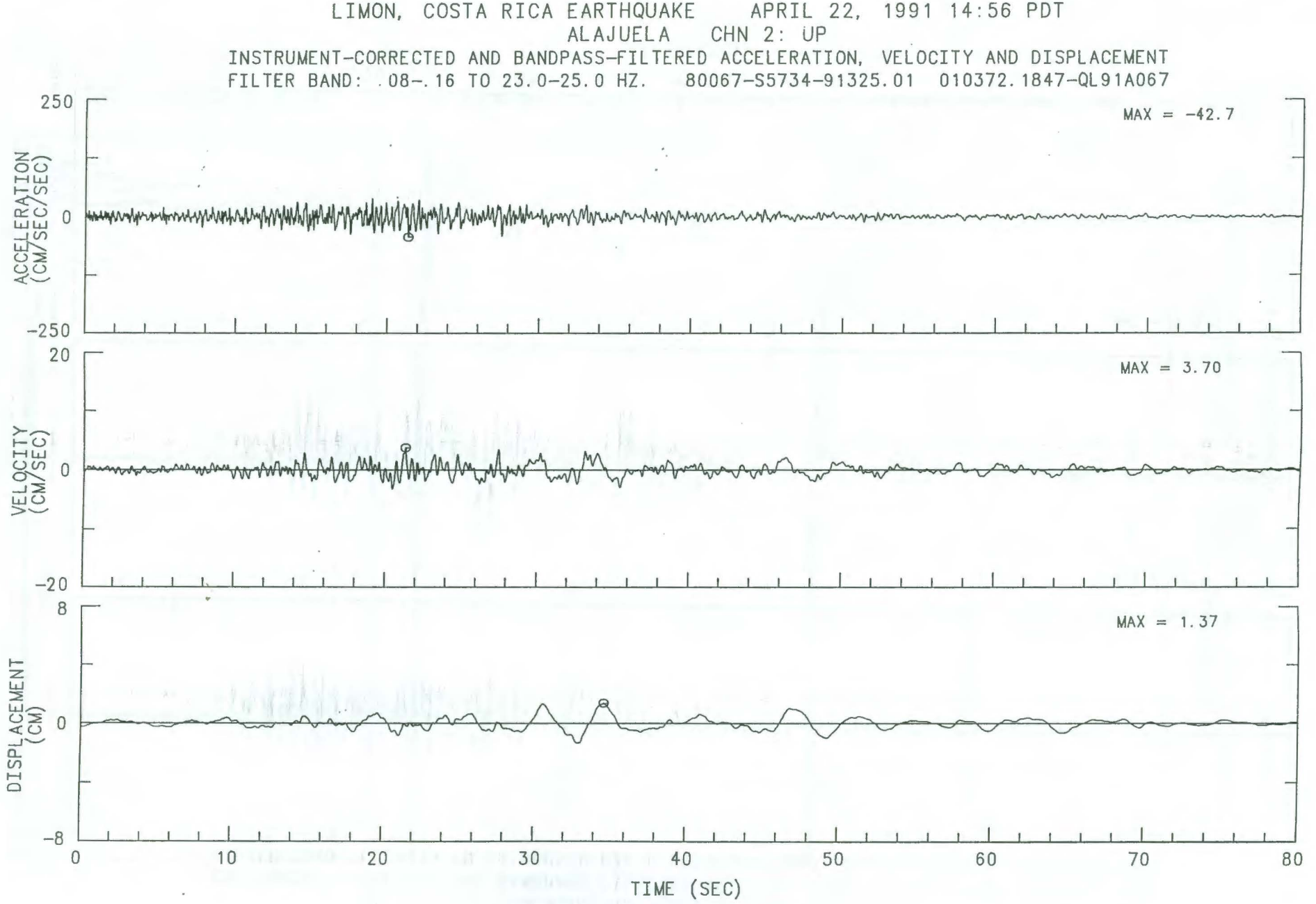


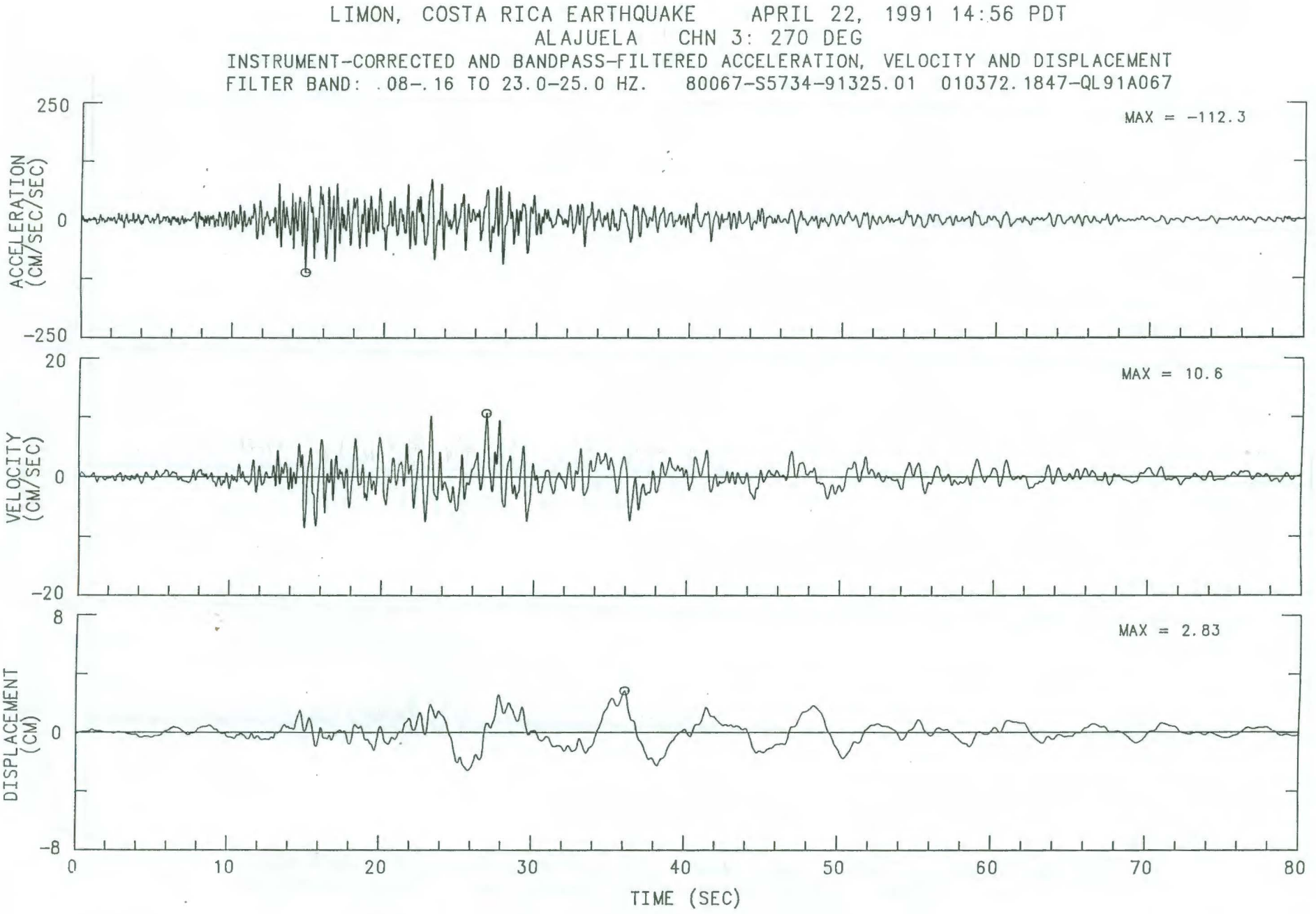
CHN 3: 270 DEG



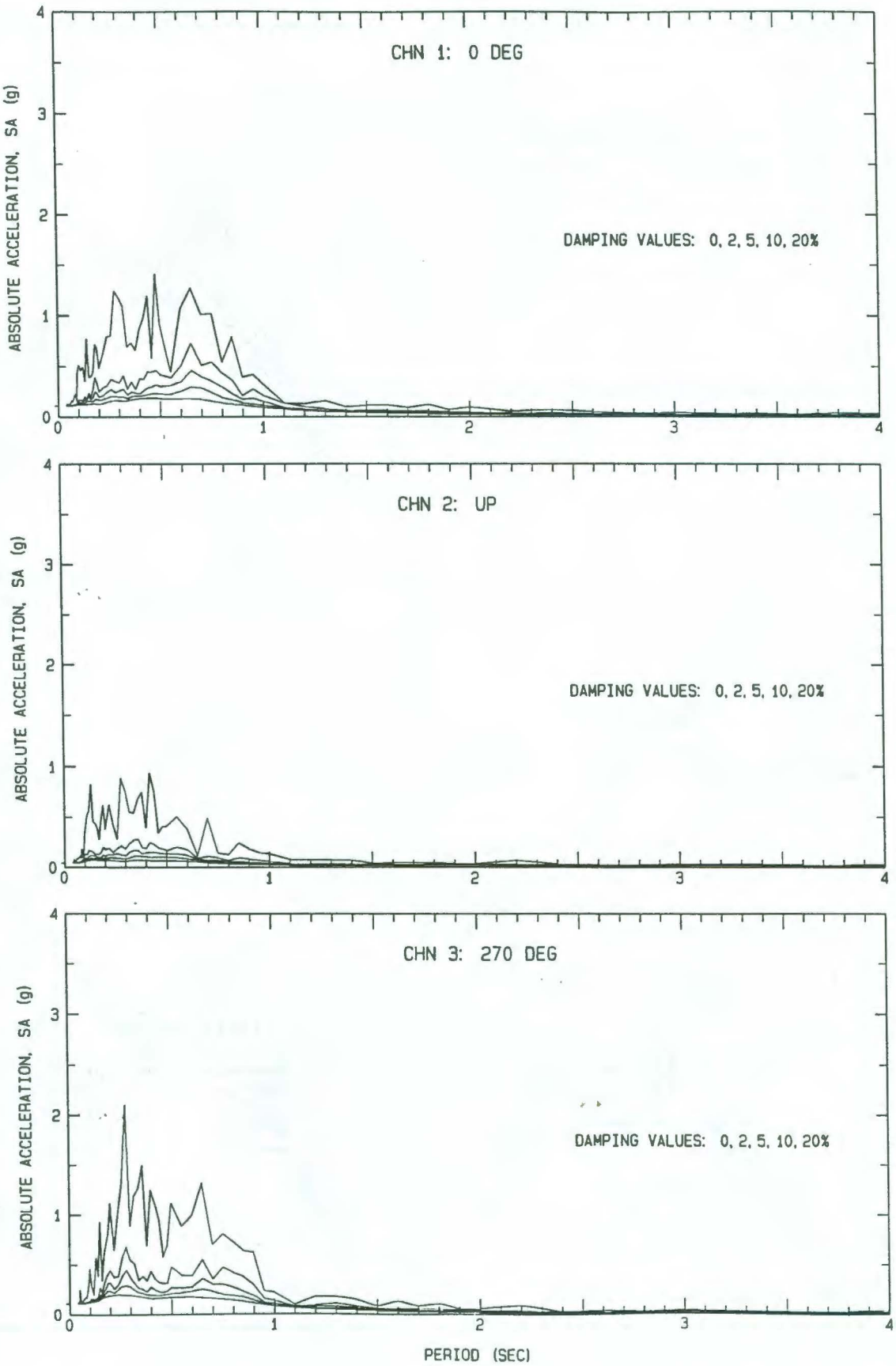

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
ALAJUELA
UNCORRECTED ACCELEROGRAM 80067-S5734-91325.01 010372.1602-QL91A067
CHN 1: 0 DEG
MAX = 0.111 G
CHN 2: UP
MAX = -0.046 G
CHN 3: 270 DEG
MAX = -0.118 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
ALAJUELA CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .08-.16 TO 23.0-25.0 HZ. 80067-S5734-91325.01 010372.1847-QL91A067
ACCELERATION (CM/SEC/SEC)
MAX = 108.5
VELOCITY (CM/SEC)
MAX = -10.2
DISPLACEMENT (CM)
MAX = -2.73
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
ALAJUELA CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .08-.16 TO 23.0-25.0 HZ. 80067-S5734-91325.01 010372.1847-QL91A067
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -42.7
VELOCITY (CM/SEC)
20
0
-20
MAX = 3.70
DISPLACEMENT (CM)
8
0
-8
MAX = 1.37
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
ALAJUELA CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .08-.16 TO 23.0-25.0 HZ. 80067-S5734-91325.01 010372.1847-QL91A067
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -112.3
VELOCITY (CM/SEC)
20
0
-20
MAX = 10.6
DISPLACEMENT (CM)
8
0
-8
MAX = 2.83
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
ALAJUELA
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .08-.16 TO 23.0-25.0 HZ.
80067-S5734-91325.01 050595.0848-QL91A067



ALAJUELA: CSMIP S/N 067

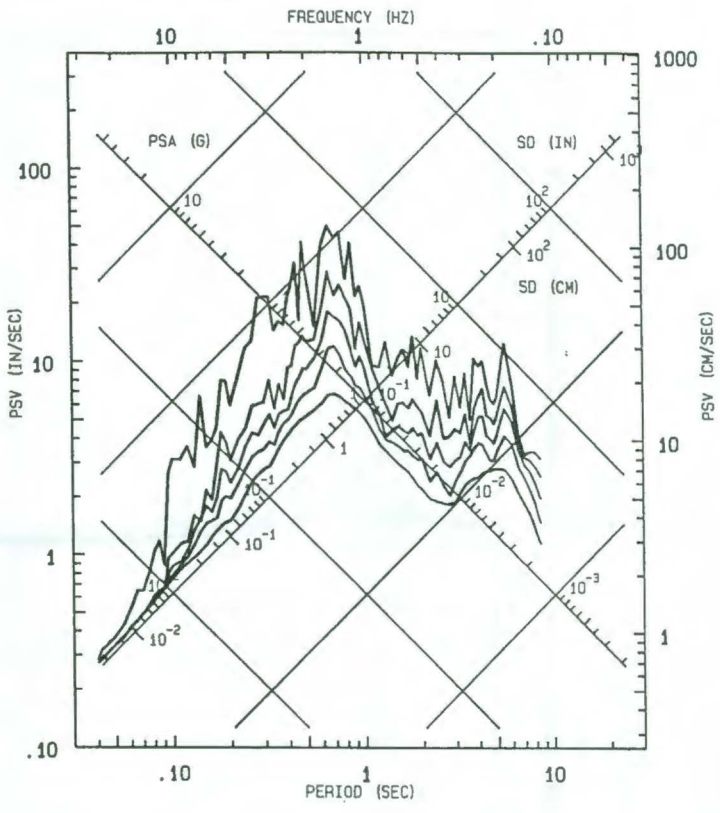
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.14 TO 23.6 HZ
(0.04 TO 7.35 SEC)

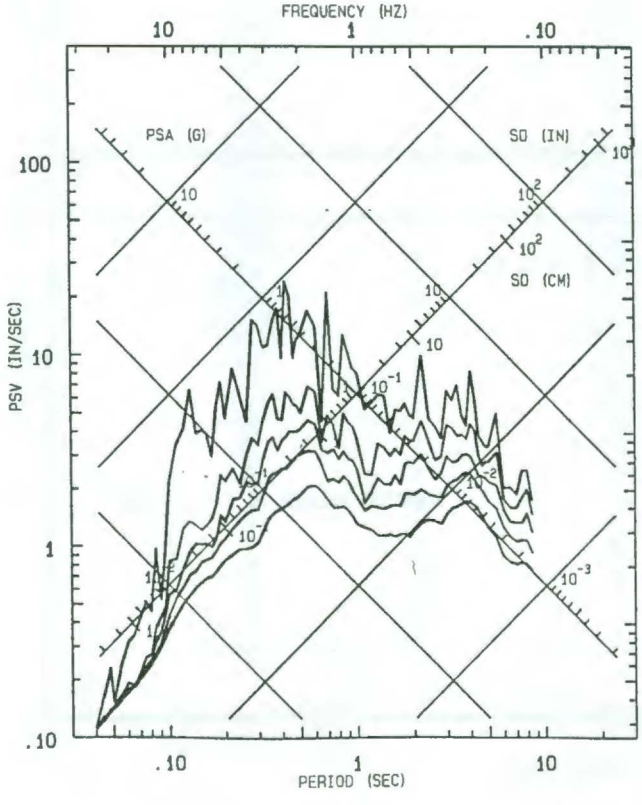
RECORD ID: B0067-S5734-91325.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

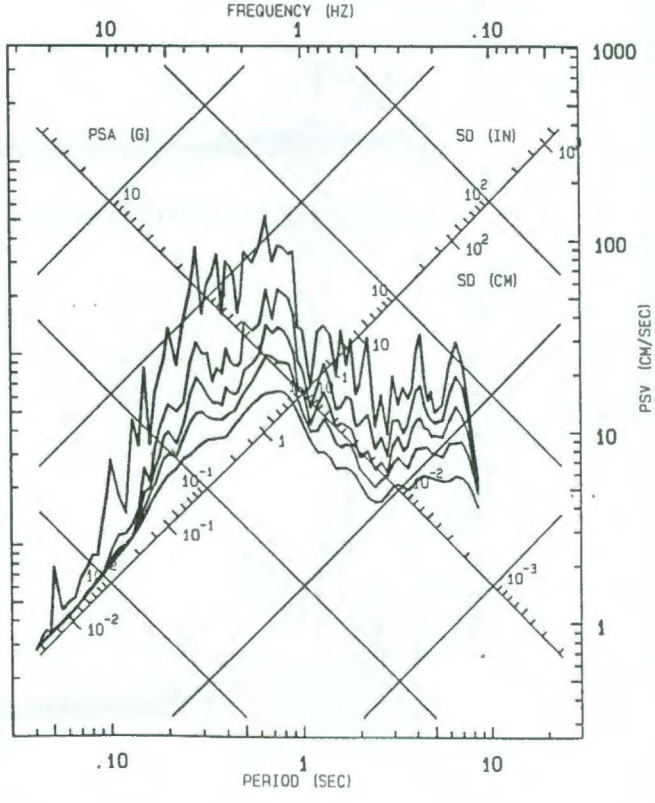
CHN 1: 0 DEG

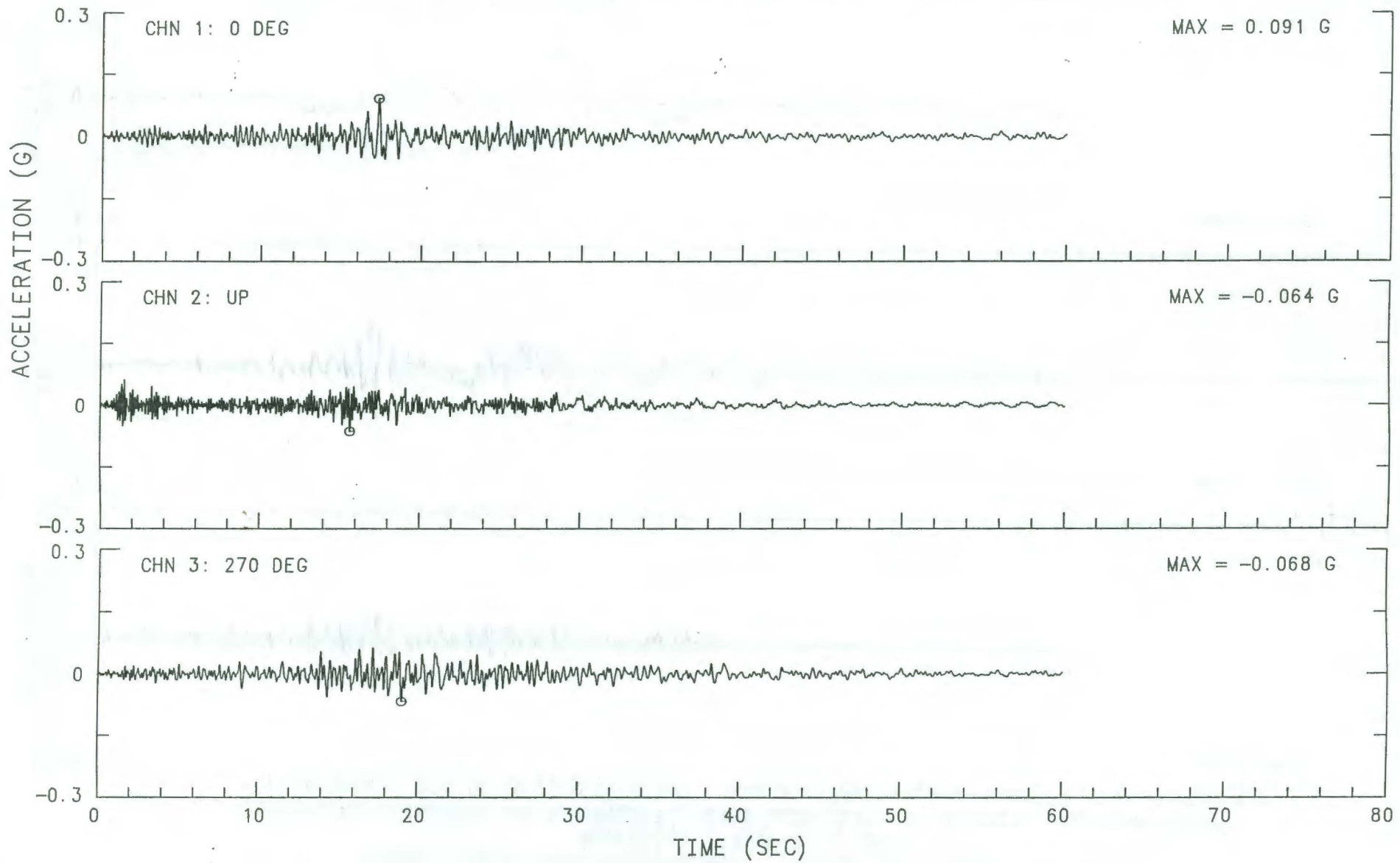


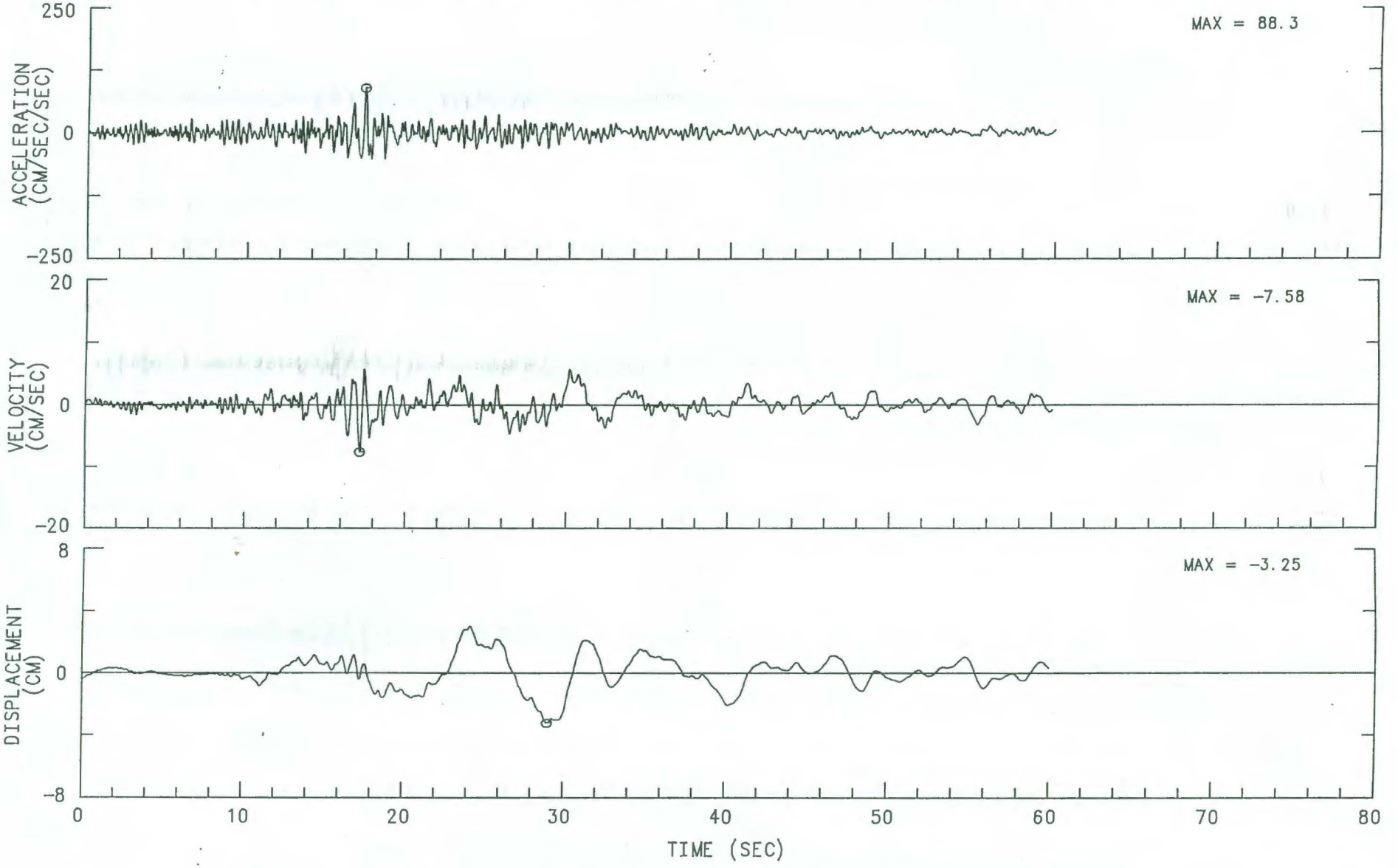
CHN 2: UP

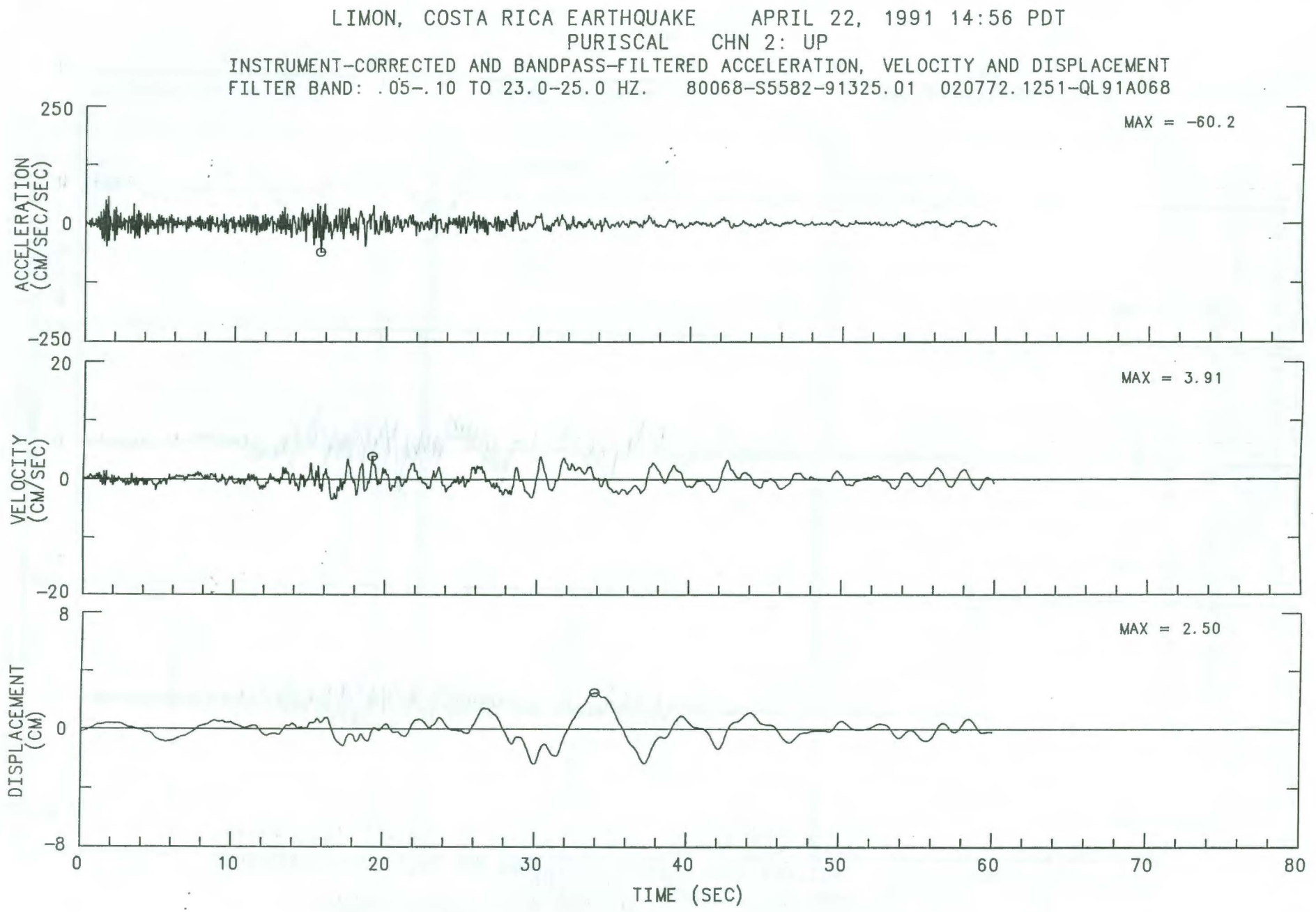


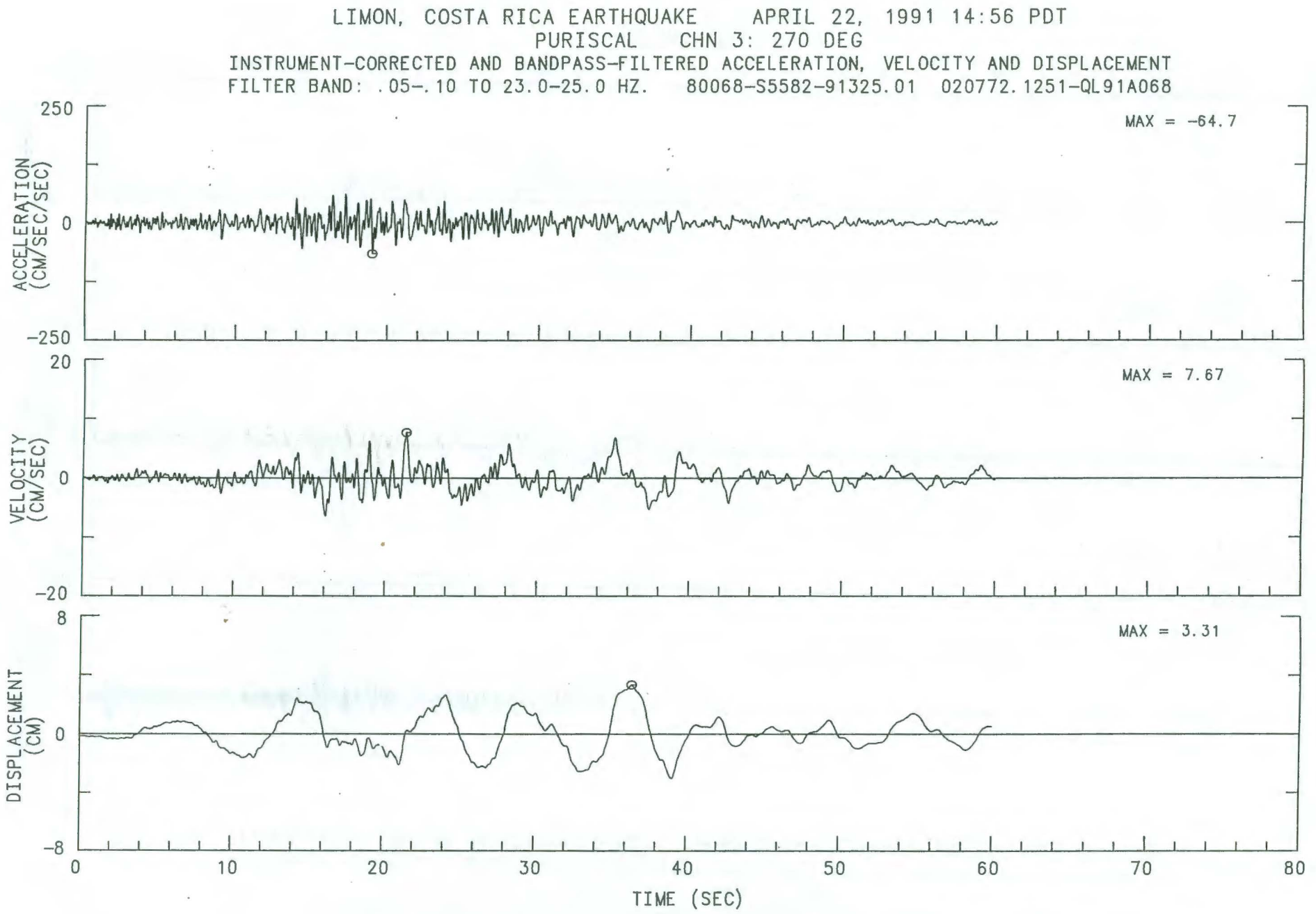
CHN 3: 270 DEG



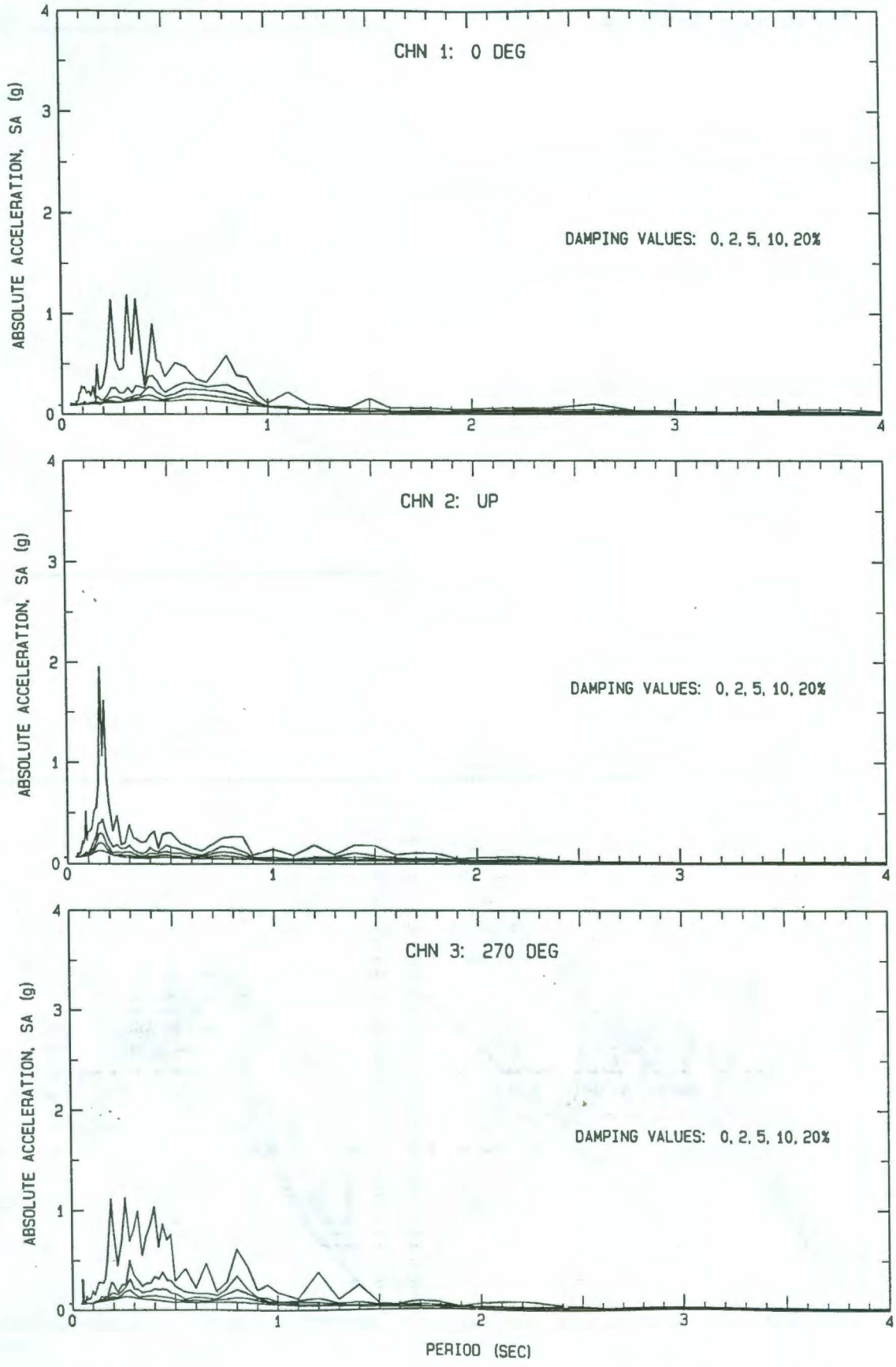

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
PURISCAL
UNCORRECTED ACCELEROGRAM 80068-S5582-91325.01 010972.1052-QL91A068
CHN 1: 0 DEG
MAX = 0.091 G
CHN 2: UP
MAX = -0.064 G
CHN 3: 270 DEG
MAX = -0.068 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
PURISCAL CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80068-S5582-91325.01 020772.1251-QL91A068
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 88.3
VELOCITY (CM/SEC)
20
0
-20
MAX = -7.58
DISPLACEMENT (CM)
8
0
-8
MAX = -3.25
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
PURISCAL CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80068-S5582-91325.01 020772.1251-QL91A068
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -60.2
VELOCITY (CM/SEC)
20
0
-20
MAX = 3.91
DISPLACEMENT (CM)
8
0
-8
MAX = 2.50
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
PURISCAL CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.10 TO 23.0-25.0 HZ. 80068-S5582-91325.01 020772.1251-QL91A068
ACCELERATION (CM/SEC/SEC)
MAX = -64.7
VELOCITY (CM/SEC)
MAX = 7.67
DISPLACEMENT (CM)
MAX = 3.31
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
PURISCAL
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .05-.10 TO 23.0-25.0 HZ.
80068-S5582-91325.01 050595.0848-QL91A068



PURISCAL: CSMIP S/N 068

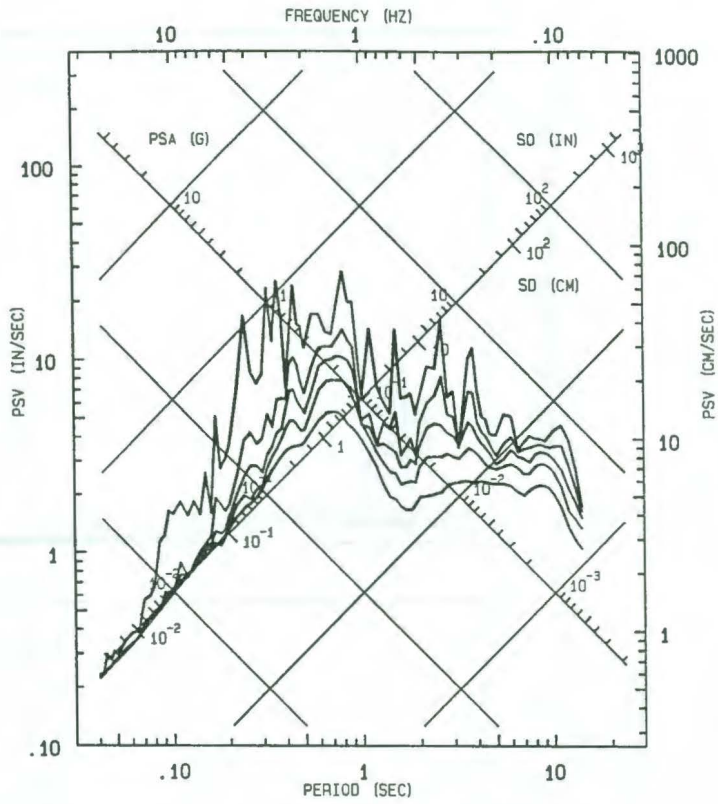
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.09 TO 23.6 HZ
(0.04 TO 11.8 SEC)

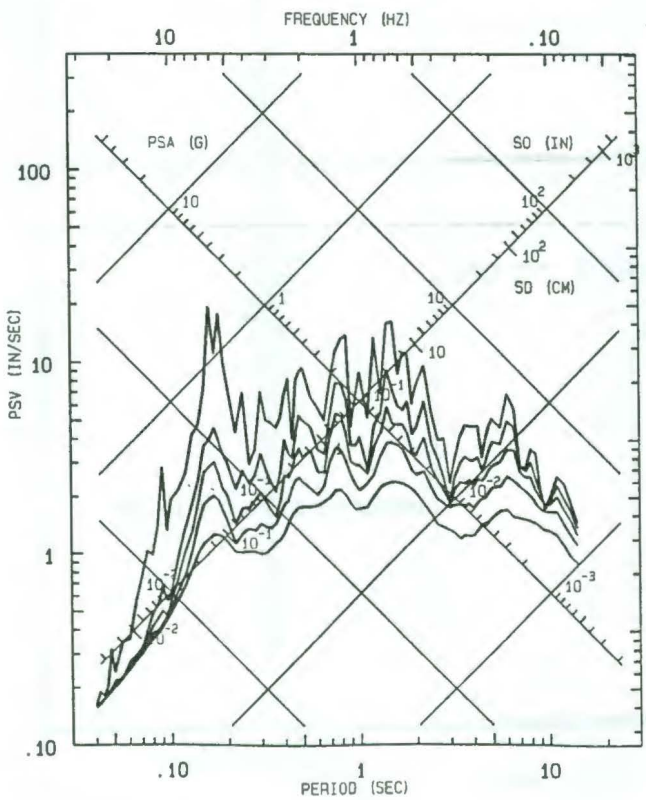
RECORD ID: 80068-S5582-91325.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

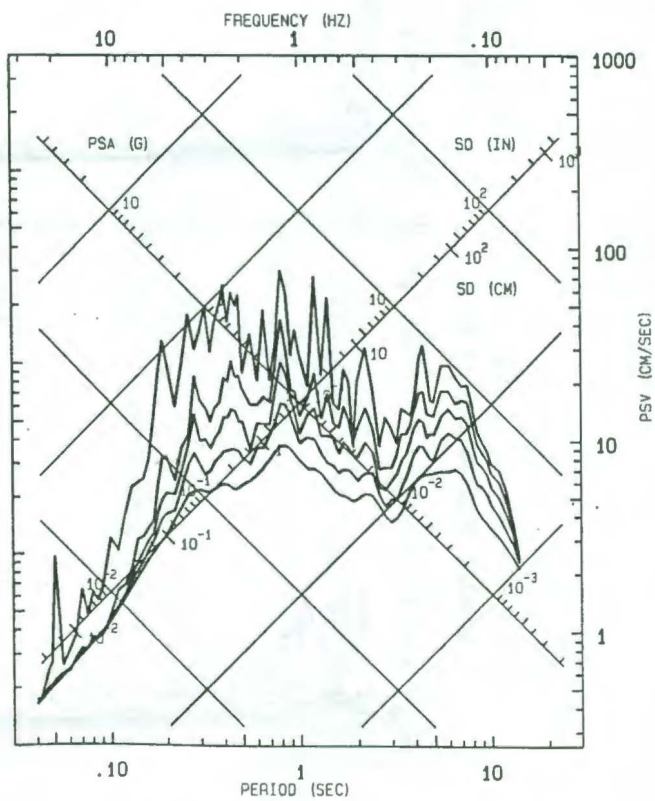
CHN 1: 0 DEG

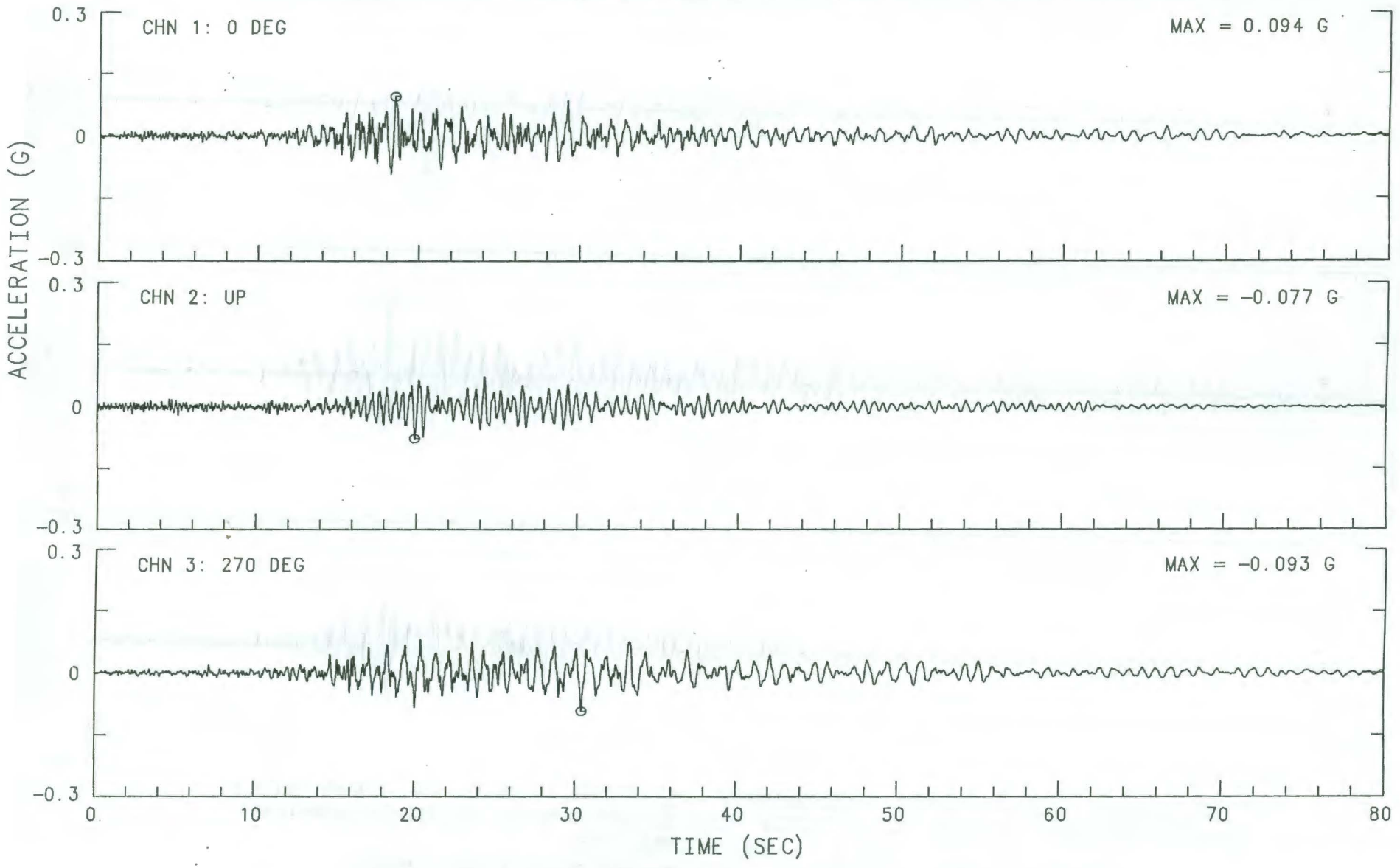


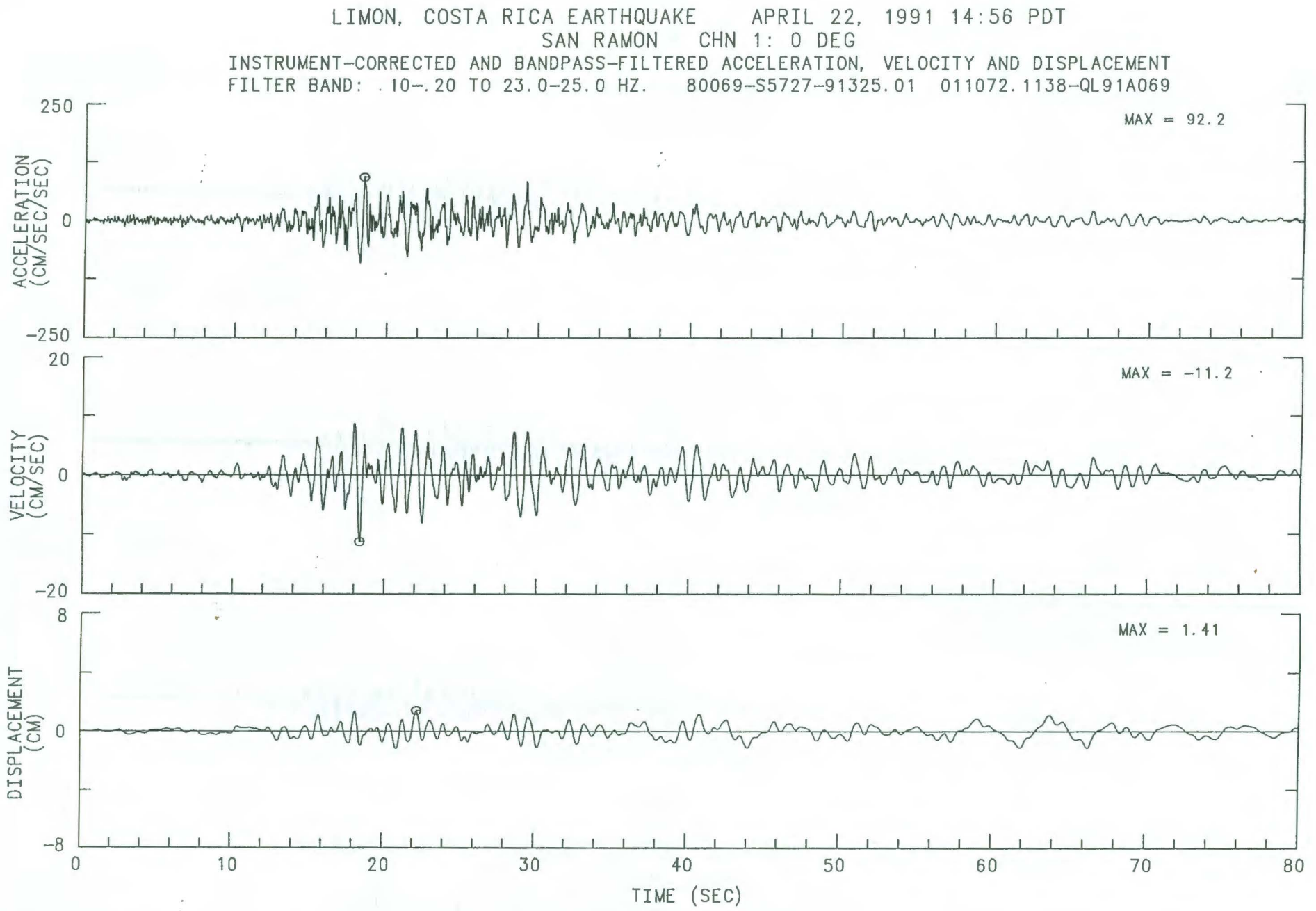
CHN 2: UP

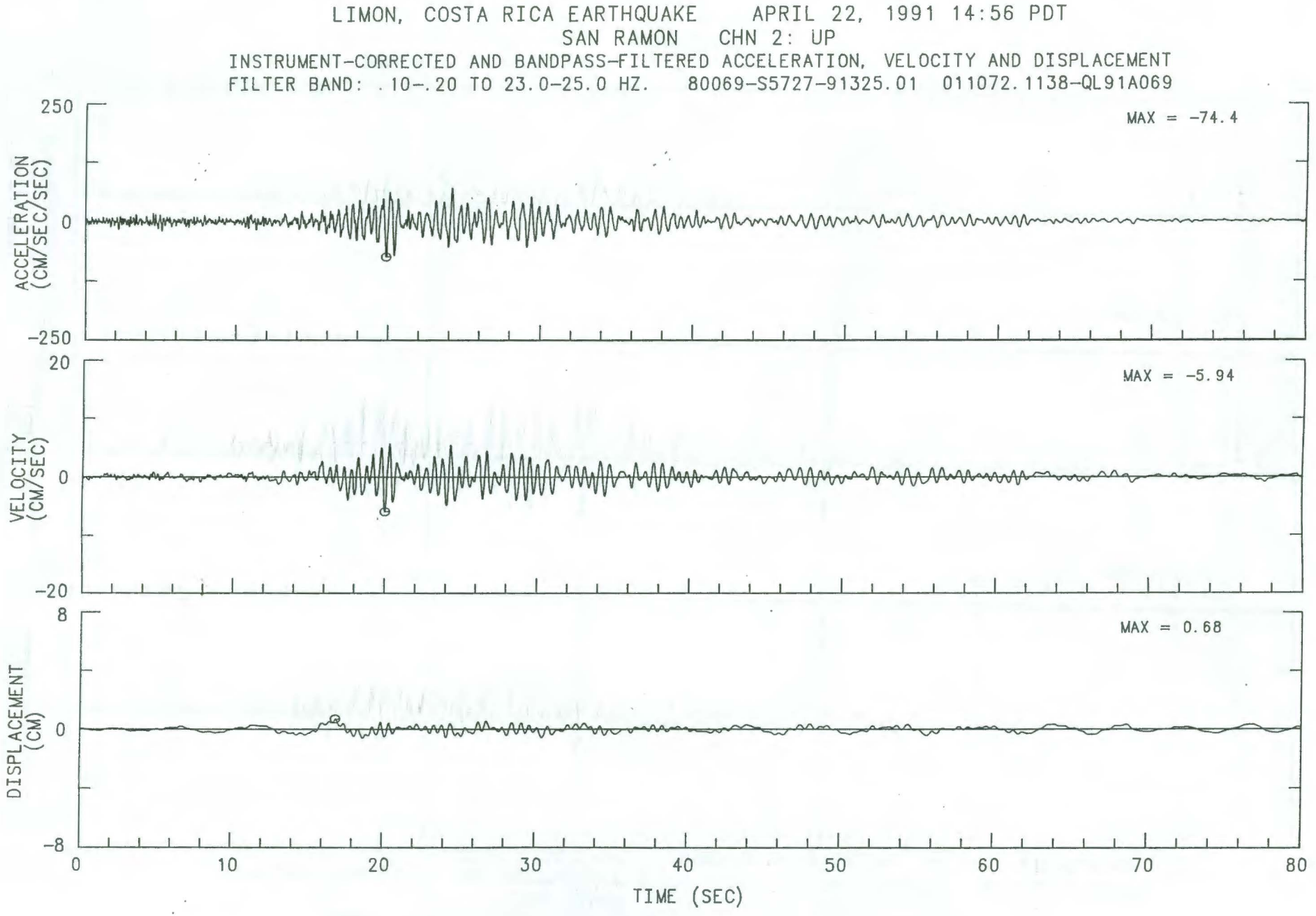


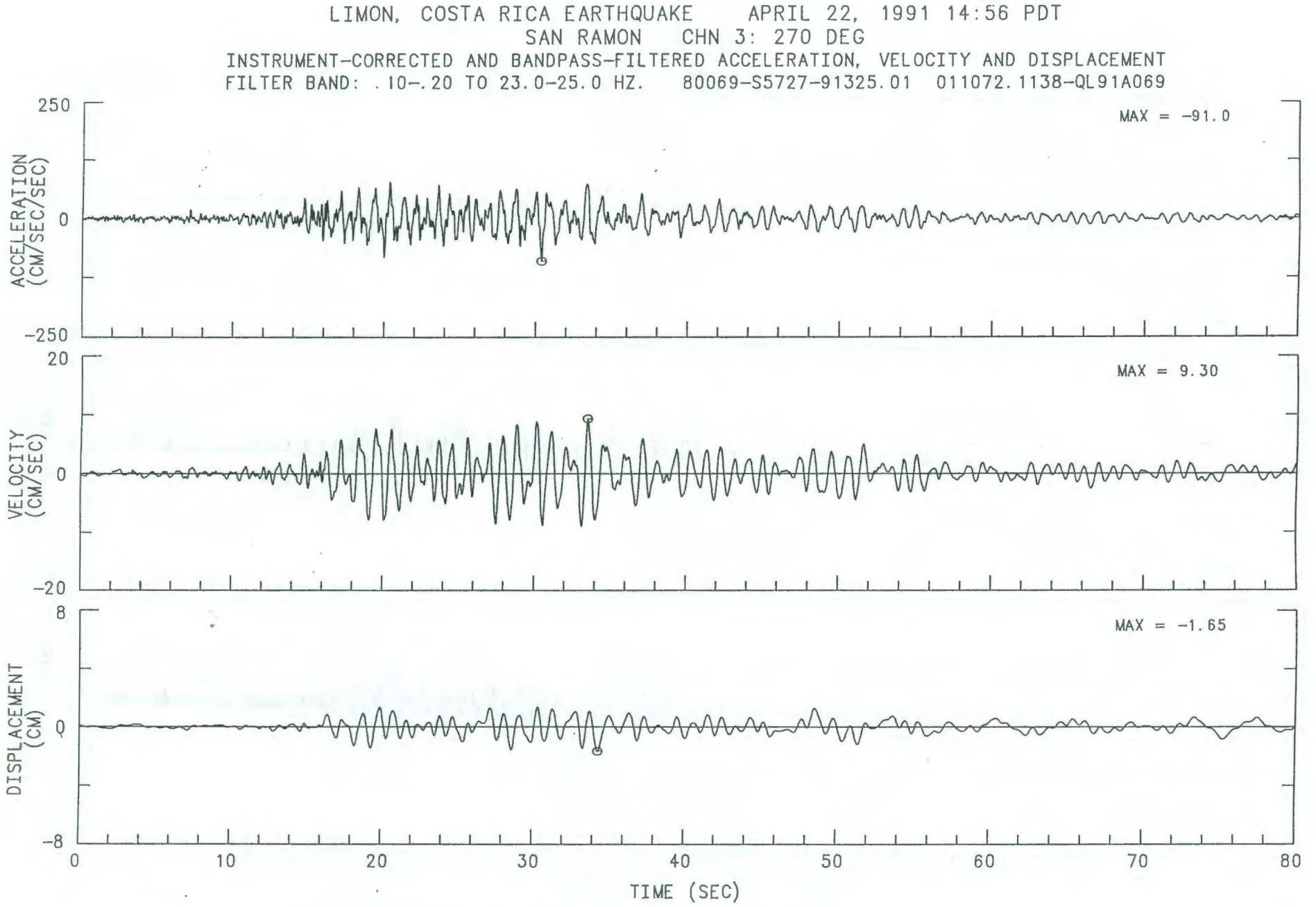
CHN 3: 270 DEG



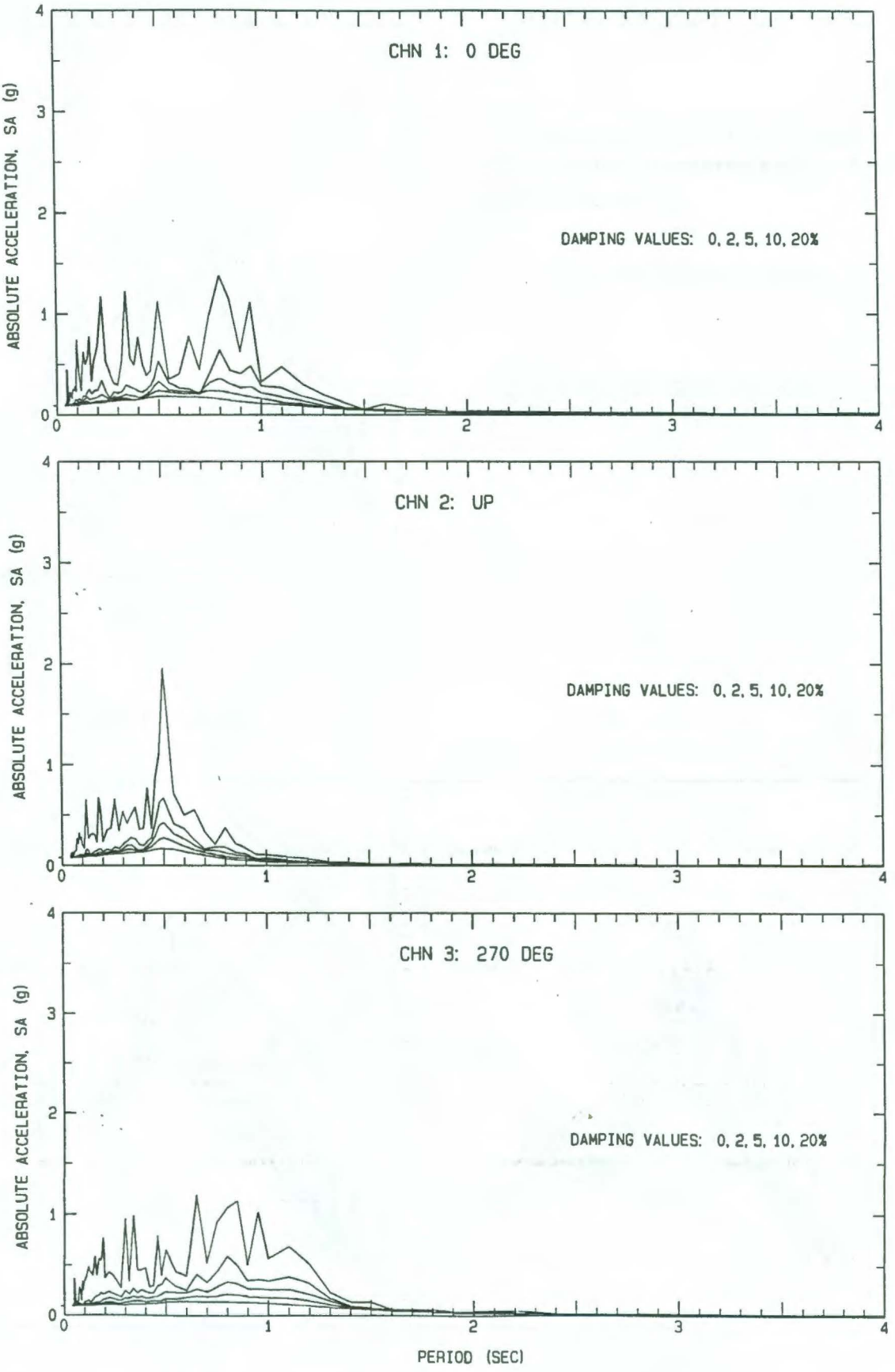

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN RAMON
UNCORRECTED ACCELEROGRAM 80069-S5727-91325.01 011072.0821-QL91A069
CHN 1: 0 DEG
MAX = 0.094 G
CHN 2: UP
MAX = -0.077 G
CHN 3: 270 DEG
MAX = -0.093 G
ACCELERATION (G)
0.3
0
-0.3
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN RAMON CHN 1: 0 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80069-S5727-91325.01 011072.1138-QL91A069
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = 92.2
VELOCITY (CM/SEC)
20
0
-20
MAX = -11.2
DISPLACEMENT (CM)
8
0
-8
MAX = 1.41
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN RAMON CHN 2: UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80069-S5727-91325.01 011072.1138-QL91A069
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -74.4
VELOCITY (CM/SEC)
20
0
-20
MAX = -5.94
DISPLACEMENT (CM)
8
0
-8
MAX = 0.68
0
10
20
30
40
50
60
70
80
TIME (SEC)


LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN RAMON CHN 3: 270 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .10-.20 TO 23.0-25.0 HZ. 80069-S5727-91325.01 011072.1138-QL91A069
ACCELERATION (CM/SEC/SEC)
250
0
-250
MAX = -91.0
VELOCITY (CM/SEC)
20
0
-20
MAX = 9.30
DISPLACEMENT (CM)
8
0
-8
MAX = -1.65
0
10
20
30
40
50
60
70
80
TIME (SEC)

LIMON, COSTA RICA EARTHQUAKE APRIL 22, 1991 14:56 PDT
SAN RAMON
ACCELEROGRAM BANDPASS-FILTERED WITH RAMPS AT .10-.20 TO 23.0-25.0 HZ.
80069-S5727-91325.01 050595.0848-QL91A069



SAN RAMON: CSMIP S/N 069

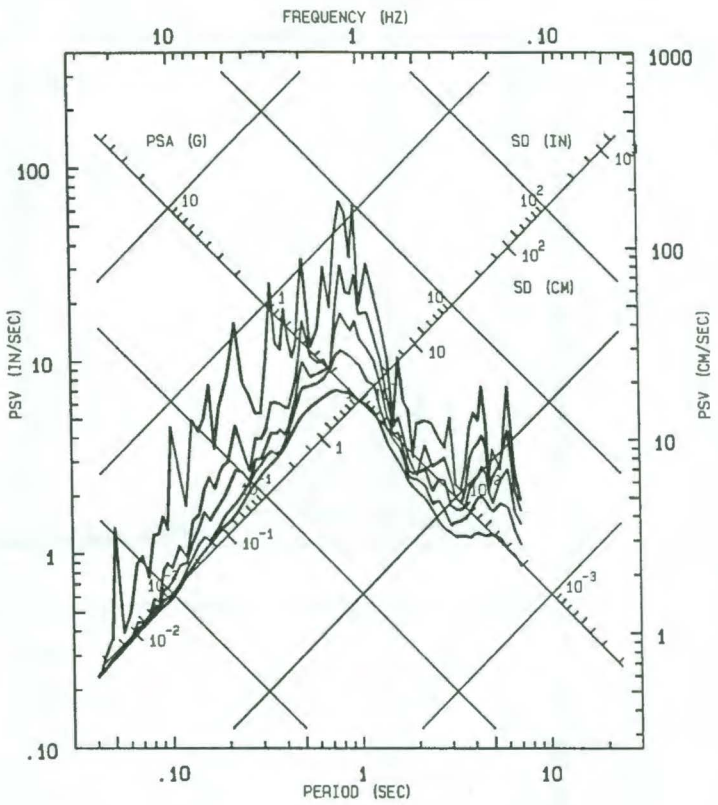
LIMON, COSTA RICA EARTHQUAKE
APRIL 22, 1991 14:56 PDT

PHASE 3 DATA: RESPONSE SPECTRA
USABLE DATA BANDWIDTH: 0.17 TO 23.6 HZ
(0.04 TO 5.88 SEC)

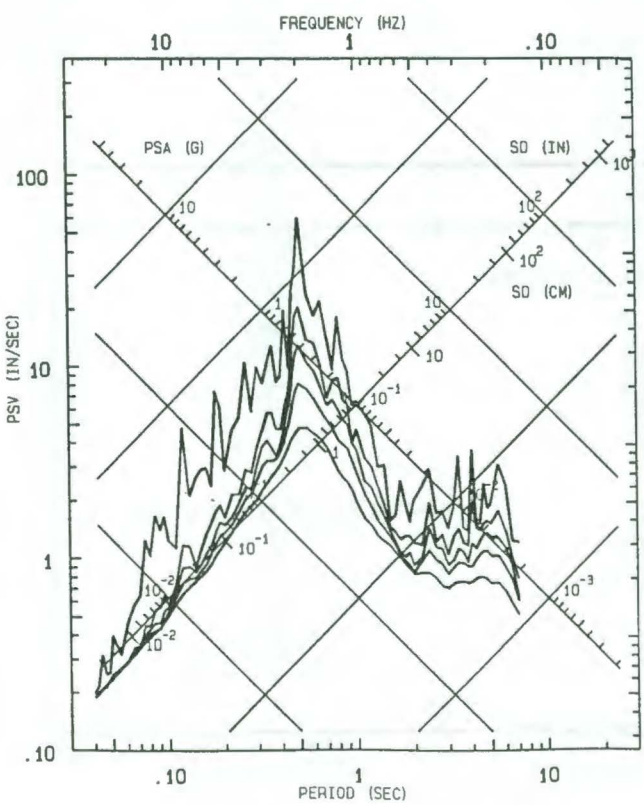
RECORD ID: 80069-S5727-91325.01

—— RESPONSE SPECTRA: PSV, PSA & SD
DAMPING VALUES: 0, 2, 5, 10, 20%

CHN 1: 0 DEG



CHN 2: UP



CHN 3: 270 DEG