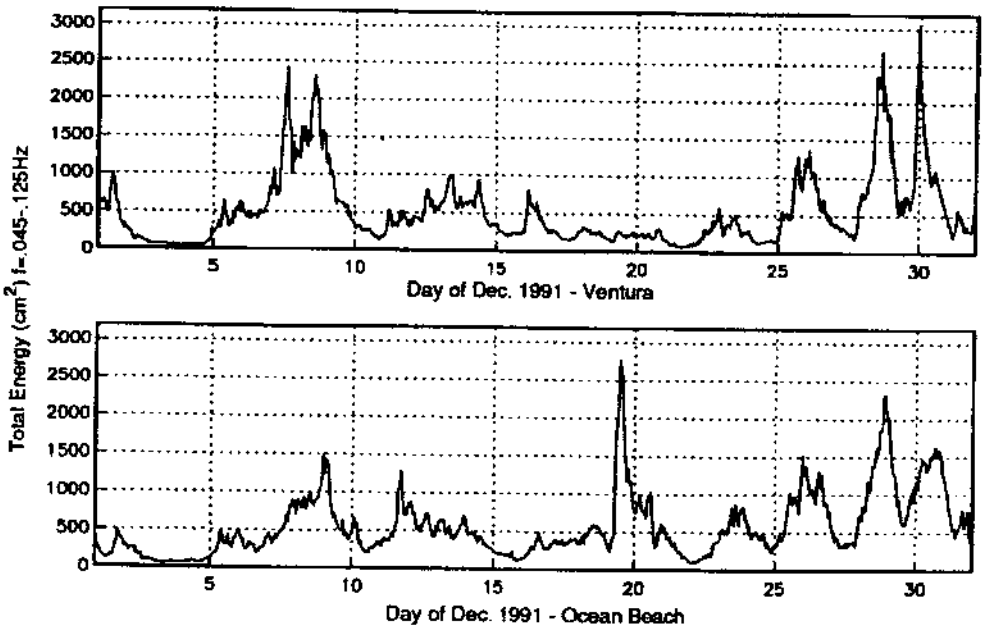
Data Report: Southern California Wave Experiment

W. C. O'Reilly
R. T. Guza
B. W. Waldorf
M. R. Kirk
W. A. Boyd
M. C. Clifton

University of California, San Diego
Scripps Institution of Oceanography
Center for Coastal Studies
La Jolla, California 92093-0209



Data report prepared for

California Department of Boating and Waterways
1629 "S" Street
Sacramento, California 95814

April 1992

SIO Reference Series No. 92-14

Data Report: Southern California Wave Experiment

W. C. O'Reilly
R. T. Guza
B. W. Waldorf
M. R. Kirk
W. A. Boyd
M. C. Clifton

University of California, San Diego
Scripps Institution of Oceanography
Center for Coastal Studies
La Jolla, California 92093-0209

Data report prepared for

California Department of Boating and Waterways
1629 "S" Street
Sacramento, California 95814

April 1992

SIO Reference Series No. 92-14

Table of Contents

		Page
	Abstract	1
	Acknowledgements	2
1.	Overview	3
2.	Experiment Plan	3
3.	Instrument Description	4
4.	Wave Data Description	4
	Figures	5
	Tables	7
	Fall Deployment Data	8
	Winter Deployment Data	45

ABSTRACT

This report contains data from Southern California Wave Experiment, funded by the California Department of Boating and Waterways and Sea Grant. Eleven pressure sensors were deployed throughout the Southern California Bight in two, three-month experiments, designed to test numerical wave modeling techniques in this bathymetrically complex region. The fall deployment took place from 14 August 1991 to 4 November 1991, and the winter deployment was from 4 November 1991 until 14 February 1992. All the sensors were deployed at a depth of approximately $30m$ and sampled continuously at $0.5Hz$. This data report contains hourly estimates of wave energies between $0.035Hz$ and $0.125Hz$, at the measurement sites.

ACKNOWLEDGEMENTS

The following wave data were collected from August, 1991 to February, 1992, during the Southern California Wave Experiment. The instrument deployments were extremely successful, with a 90% data return from the fall deployment and nearly 100% return from the winter deployment. This high rate of data return was primarily due to the work of Walt Waldorf, who was in charge of building and testing the instrumentation as well as designing the moorings and orchestrating their deployment and recovery. The reliability of the pressure sensing and cassette data acquisition systems was due to the electrical and mechanical design skills of Mike Kirk and Mike Clifton, respectively. Bill Boyd assisted in testing and deploying the instruments and handled the majority of the data playback from the cassettes. We wish to thank Steve Elgar, Ron Flick, Ron George, and Tom Herbers for assisting in the deployment and recovery of the instrument moorings, and the captain and crew of the R/V *Robert Gorden Sproul* for their expert ship handling and general hospitality.

The Southern California Wave Experiment was funded by the California Department of Boating and Waterways, as part of their continuing program of studies to enhance boating safety and to prevent beach erosion, and Sea Grant. This work is the result of research sponsored in part by the National Oceanic and Atmospheric Administration, National Sea Grant College Program, Department of Commerce, under grant number NA89AA-D-SG138, project number R/CZ-90, through the California Sea Grant College, and in part the California State Resources Agency. The U.S. Government is authorized to reproduce and distribute this report for governmental purposes.

1. Overview

The Southern California wave climate is spatially complex due the partial sheltering effects of the offshore islands and shoals and the nearshore influence of coastal submarine canyons (Figure 1). Compared to open coastlines, the wave conditions within the Bight are much more sensitive to the frequency and direction of the incident deep ocean waves. Spectral refraction and refraction-diffraction wave propagation models have been adapted for use in the Bight; however, there is insufficient field data available at the present time to assess the accuracy of these numerical methods. The wave prediction problem in the Bight is further complicated by the fact that relatively high resolution deep ocean directional spectra are required as input to the models. It has been shown that a pitch-and-roll buoy alone is of too low a resolution, and more advanced methods (e.g. SAR) have not yet reached the point where they are practical options.

To address this resolution problem, a linear inverse technique has been developed which uses sheltered wave data and the previously mentioned wave propagation models to infer the shape of the deep ocean directional spectra. These estimates can in turn be used as input to the wave model to predict the wave field at all coastal locations. Applications of this technique to several historical wave events have been quite promising, but the method has been limited by the the number and locations of the wave data stations operating in the Bight. Simulations with the inverse method suggest that more optimal locations exist for wave data collection.

The goal of the field experiment is to use 10 or 11 wave energy gages in the Bight at optimally selected sites for inverse estimates. The resulting deep ocean spectra will then be used with the wave models to predict wave energies and directional moments at other instrumented locations in the Bight. The comparisons of model predictions and field measurements will be used to assess the viability of these optimal networks for Bight-wide wave monitoring. Although a direct evaluation of the wave propagation models is impossible without high resolution deep ocean spectra, successful predictions by the inverse scheme would be an indirect verification of their accuracy.

2. Experiment Plan

Two field deployments were made, the first from mid-August to early November, 1991, and the second from early November until mid-February, 1992. The first deployment was designed to monitor Southern Hemisphere wave events, or more specifically, waves coming from compass headings 180-235°. The 10 deployed gages will be used with 3 existing offshore gages (Harvest Platform, NOAA buoy 46023, and the San Nicolas Island buoy) to provide inverse estimates of the deep ocean spectrum with 5° resolution. Because the Southern Hemisphere wave spectra are typically energetic at low frequencies, .04-.07*Hz* (i.e. generated by large storm events), it was assumed that all the wave energy would be from the south-southwest at these frequencies during most of the time period from August to September. October tends to be a period when Northern

and Southern Hemisphere swell mix, so the data will have to be used more selectively, based on available wave hindcast information. The 11 winter deployment locations were designed to monitor North Pacific swell (waves from compass headings 245-330°). The inverse estimates will have 5° resolution between 260° and 300 ° and 10 ° resolution for the more southwesterly and northwesterly directions.

The wave energy gages are bottom pressure sensors, deployed at a depth of ≈ 30*m*. The gages were mounted in the anchor of a mooring system consisting of a sub-surface buoy and a surface marker buoy, and were deployed and recovered by the R/V Robert Gordon Sproul. The first deployment cruise was from August 14-16, 1991. A turn-around cruise from November 4-8 recovered the gages from their fall sites and redeployed them at their winter locations. The final recovery of the gages took place February 16-18, 1992.

3. Instrument Description

The wave gage is a single pressure sensor which is completely self-contained, with internal battery power and cassette data tape storage. The gages stored up to 103 days of data on a 120 minute audio cassette, sampling continuously at .5*hz*. A Setra 100 psi pressure transducer was integrated with a 16 bit Crystal Semiconductor analog to digital converter (ADC). The ADC contains a six-pole gaussian filter to avoid aliasing problems in the wave frequency range of interest (.04-.12*Hz*). Field testing of the instruments at the end of Scripps pier included simultaneous deployments with a "standard" sensor used extensively in past nearshore experiments.

4. Wave Data

Maps showing the approximate locations of the gages for the fall and winter deployments are shown in Figures 1 and 2. The exact locations and depths of the sensors are given in Tables 1 and 2. The instruments were designed to measure wave energy between .04 and .12*Hz*. The continuous time series from the gages was broken down in records of approximately one hour (68 min 16s, or 2048 samples at .5*Hz*), centered on the hour. The records were FFT'd and the resulting energy spectra were merged into .01*Hz* frequency bands. The total energy between .04 and .12Hz, and the energy in the individual .01*Hz* bands are plotted vs. time on pages 9-44 for the fall deployment and pages 46-94 for the winter deployment.

Only one sensor failed to work properly during the experiment, and it was locate at Site #5 in the fall deployment. This sensor was repaired after the turn-around cruise in November and deployed at winter Site #2. A number of wave records had glitches which were replaced by previous segments of good data if they did not exceed one half an hour in length. There are several gaps which exceeded 30 minutes and these appear as zero energies in the appropriate plots.

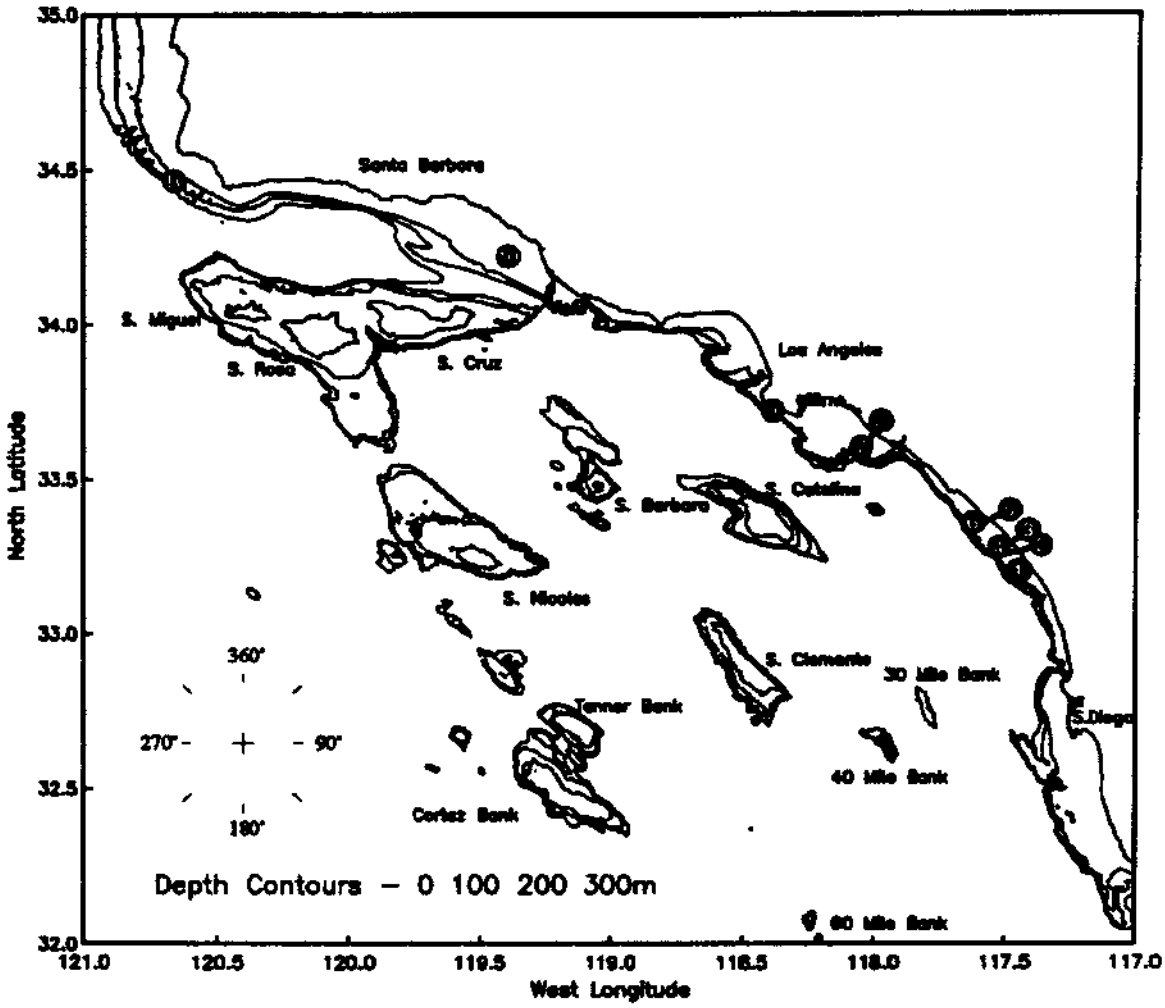


FIGURE 1. Fall Deployment Sites - SoCal Wave Experiment

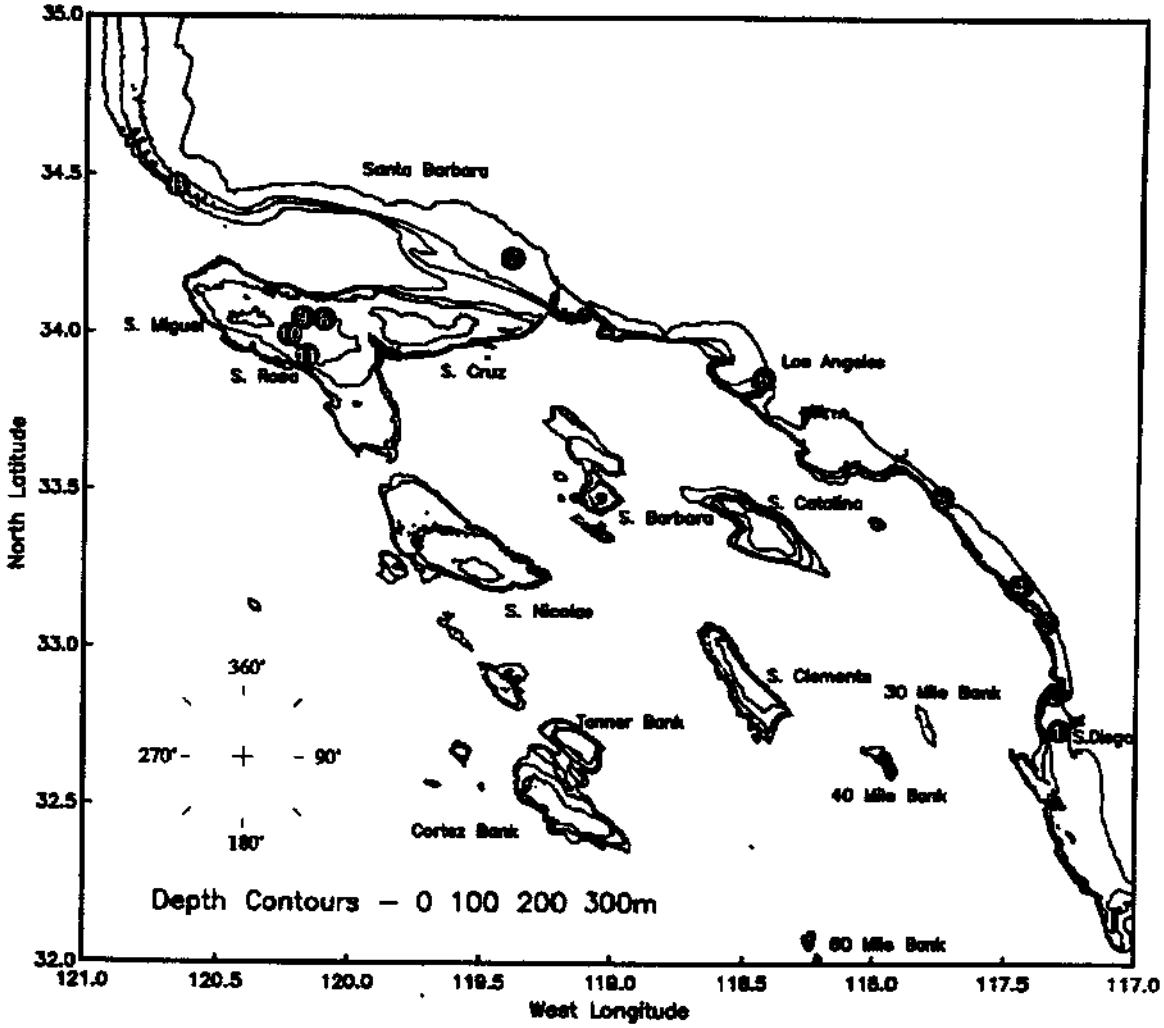


FIGURE 2. Winter Deployment Sites - SoCal Wave Experiment

SoCal Wave Experiment - Fall Deployment Sites August 14, 1991 to November 4, 1991					
Site #	Lat.	Lon.	Depth(m)	Region	Sensor #
1	33 11.90	117 26.47	31	Oceanside	1
2	33 15.17	117 28.99	29	Pendleton S	2
3	33 15.80	117 29.90	32	Pendleton	3
4	33 16.56	117 30.59	31	Pendleton N	4
5	33 20.76	117 35.75	32	San Onofre S	5
6	33 21.53	117 36.54	30	San Onofre N	6
7	33 36.39	118 02.65	33	Long Beach W	7
8	33 36.50	118 01.52	30	Long Beach E	8
9	33 43.57	118 21.99	28	Palos Verdes	9
10	34 13.72	119 24.52	32	Ventura	10

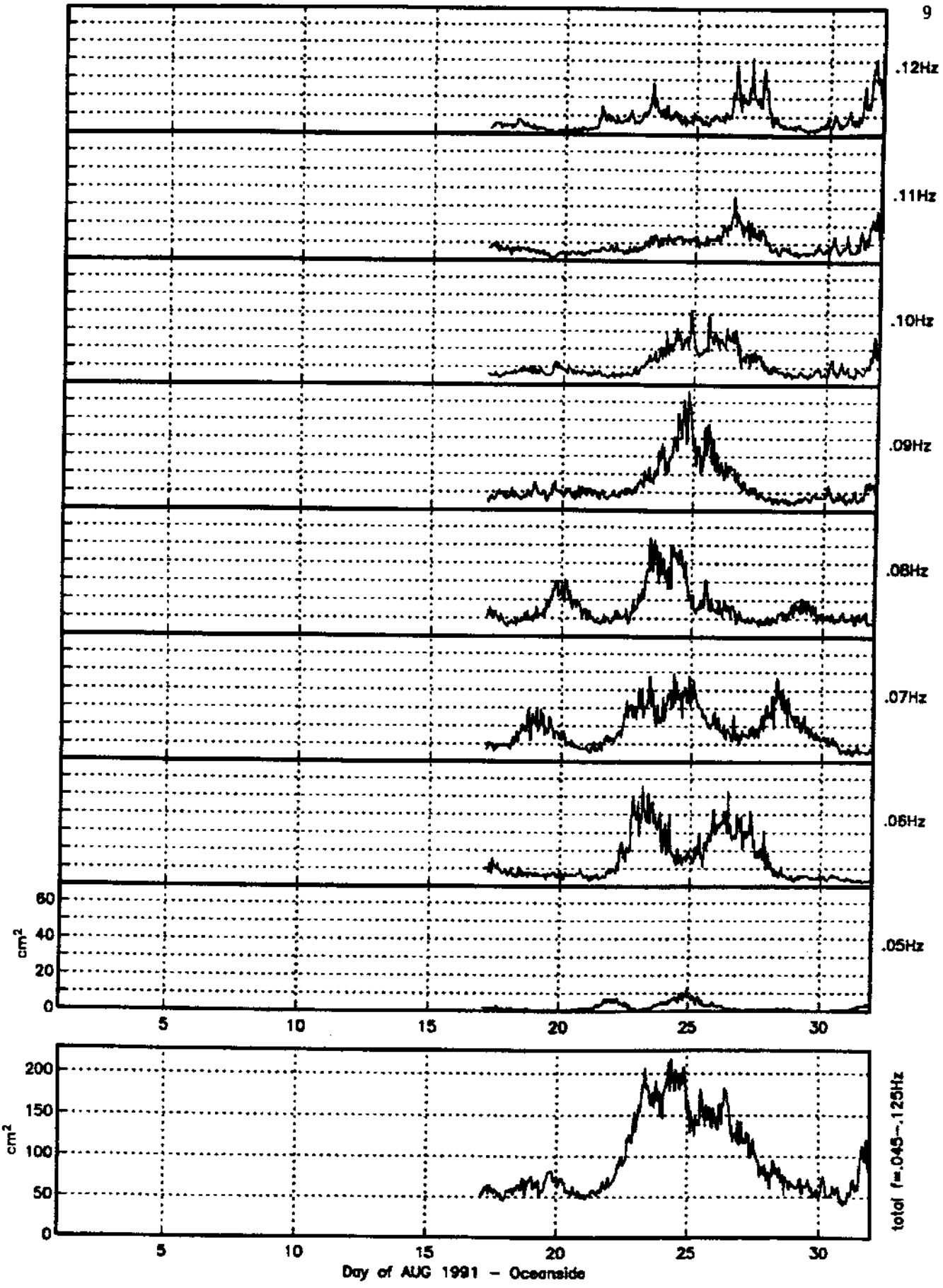
Table 1. Fall Deployment Information

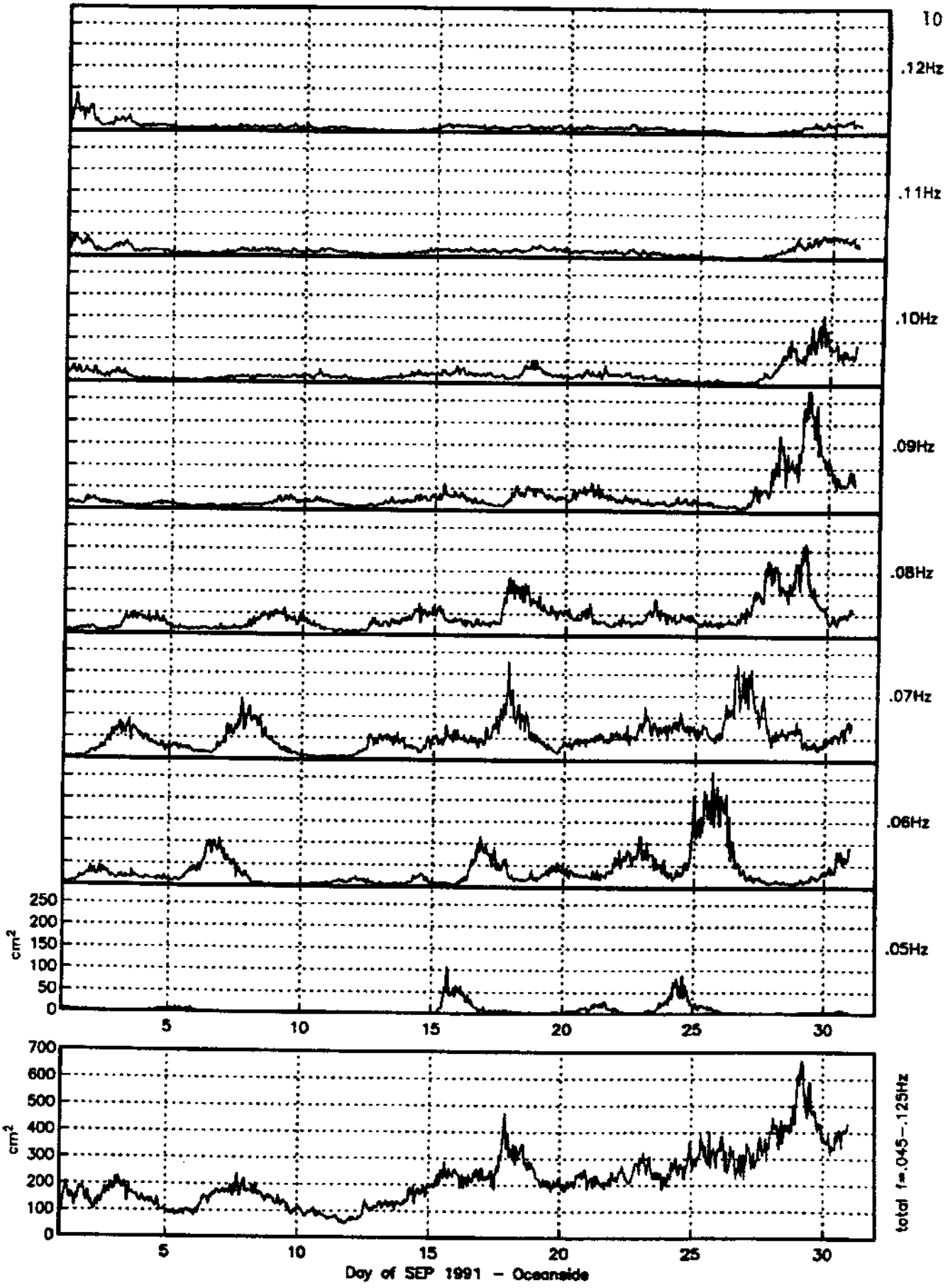
SoCal Wave Experiment - Winter Deployment Sites November 4, 1991 to February 18, 1992					
Site #	Lat.	Lon.	Depth(m)	Region	Sensor #
1	32 44.32	117 16.85	27	Ocean Beach	11
2	32 50.78	117 18.15	31	Pt. La Jolla	5
3	33 05.48	117 19.97	29	Batiguitos	1
4	33 11.63	117 26.05	30	Oceanside	10
5	33 28.58	117 44.32	30	Dana Point	2
6	33 51.80	118 25.75	30	Redondo	3
7	34 15.35	119 24.28	32	Ventura	4
8	34 03.03	120 08.45	29	Santa Rosa NE	6
9	34 03.25	120 11.42	33	Santa Rosa NW	7
10	34 00.45	120 15.95	30	Santa Rosa W	8
11	33 55.80	120 12.20	32	Santa Rosa SW	9

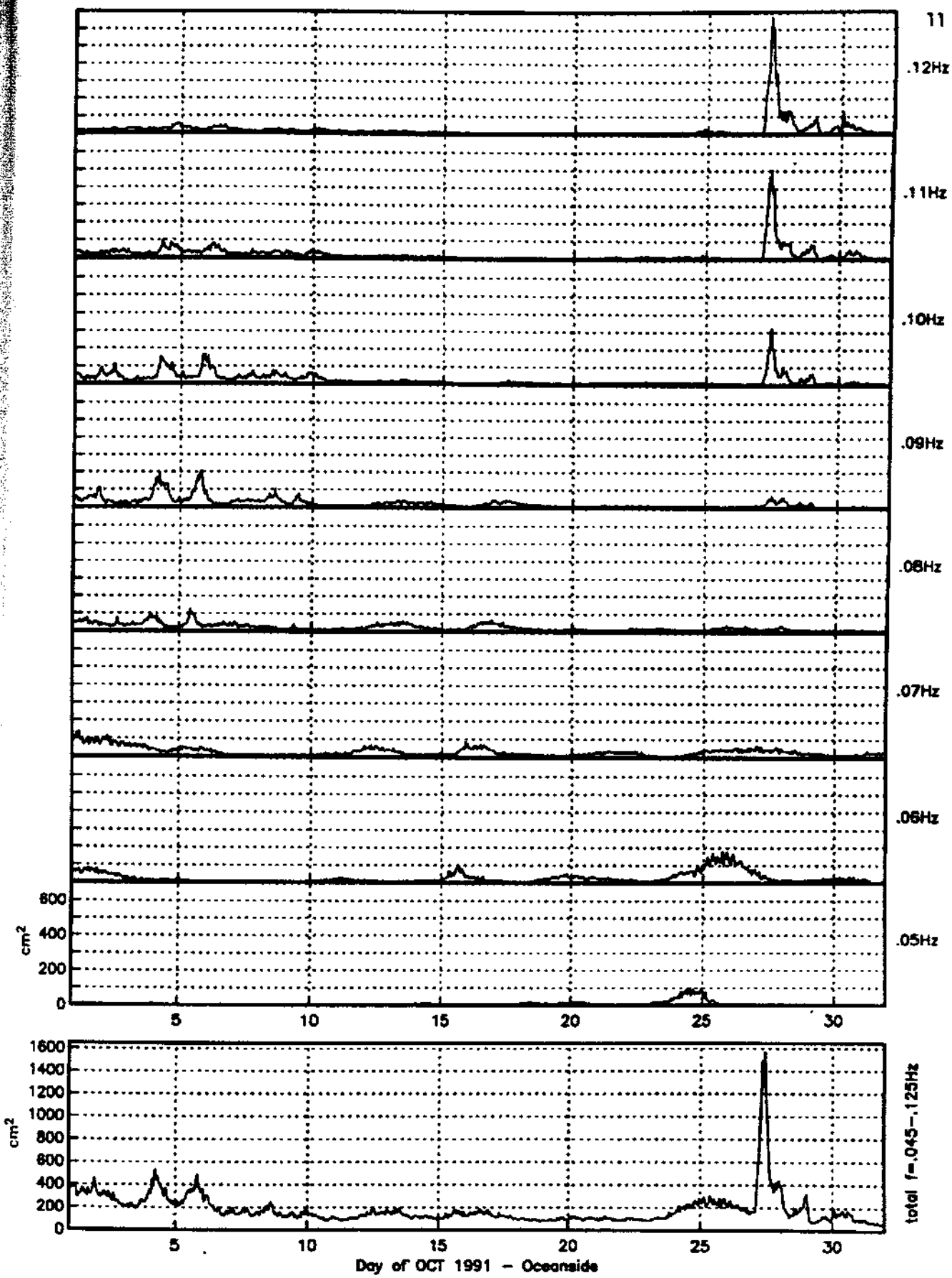
Table 2. Winter Deployment Information

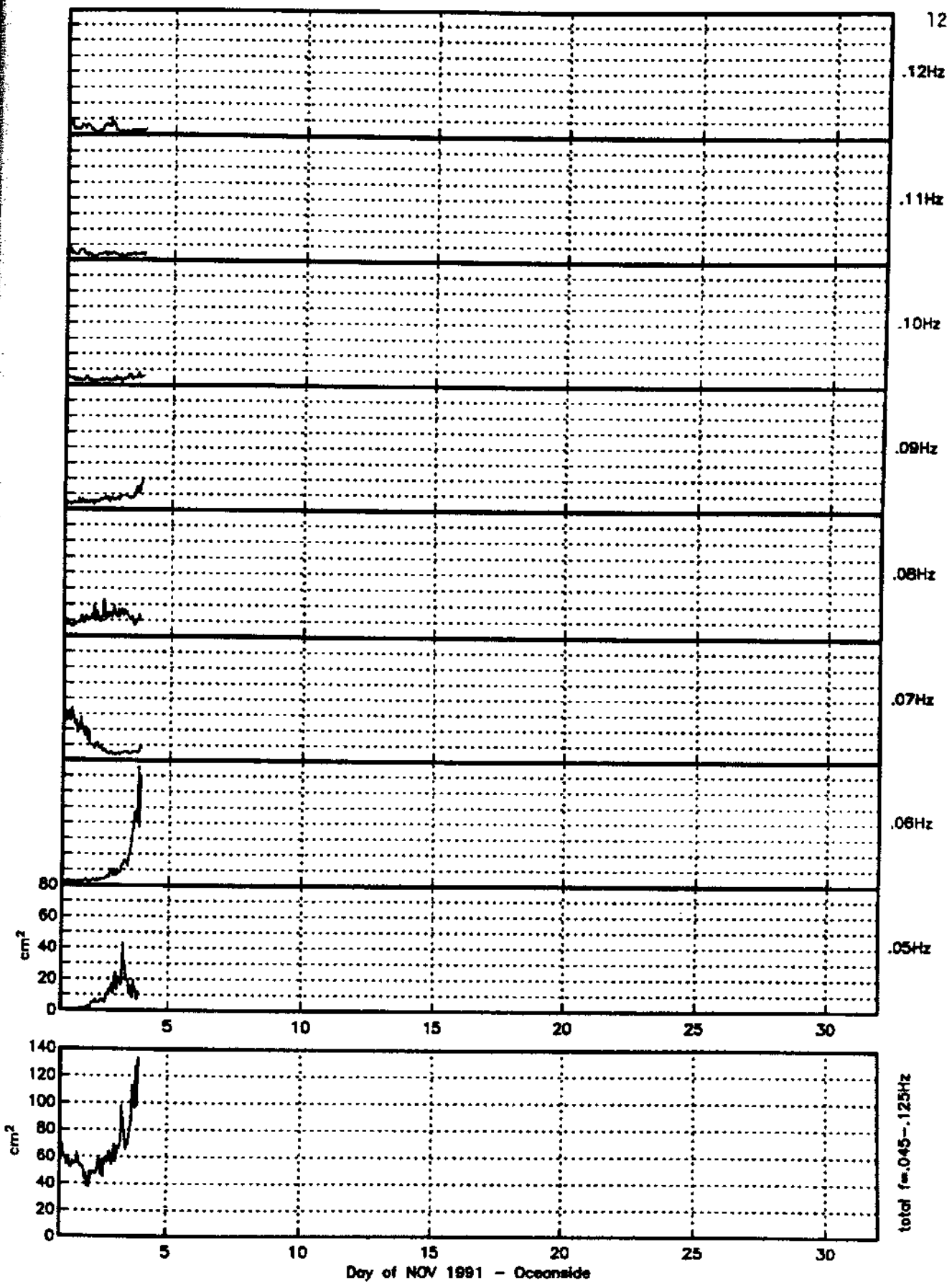
Fall Deployment Data

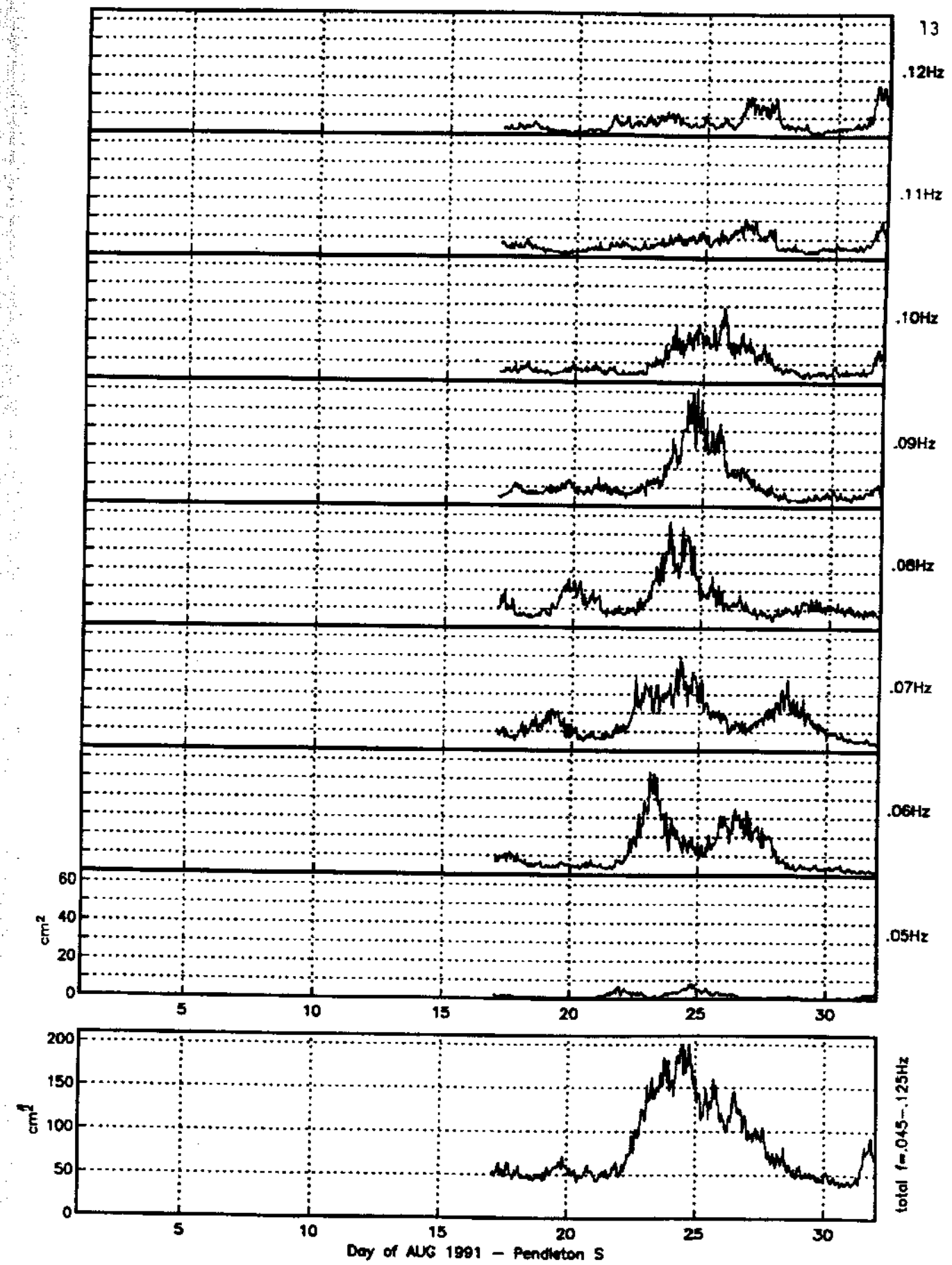
Site No.	Location	Page No.
1	Oceanside	9-12
2	Pendleton S	13-16
3	Pendleton	17-20
4	Pendleton N	21-24
5	San Onofre S	NO DATA
6	San Onofre N	25-28
7	Long Beach W	29-32
8	Long Beach E	33-36
9	Palos Verdes	37-40
10	Ventura	41-44

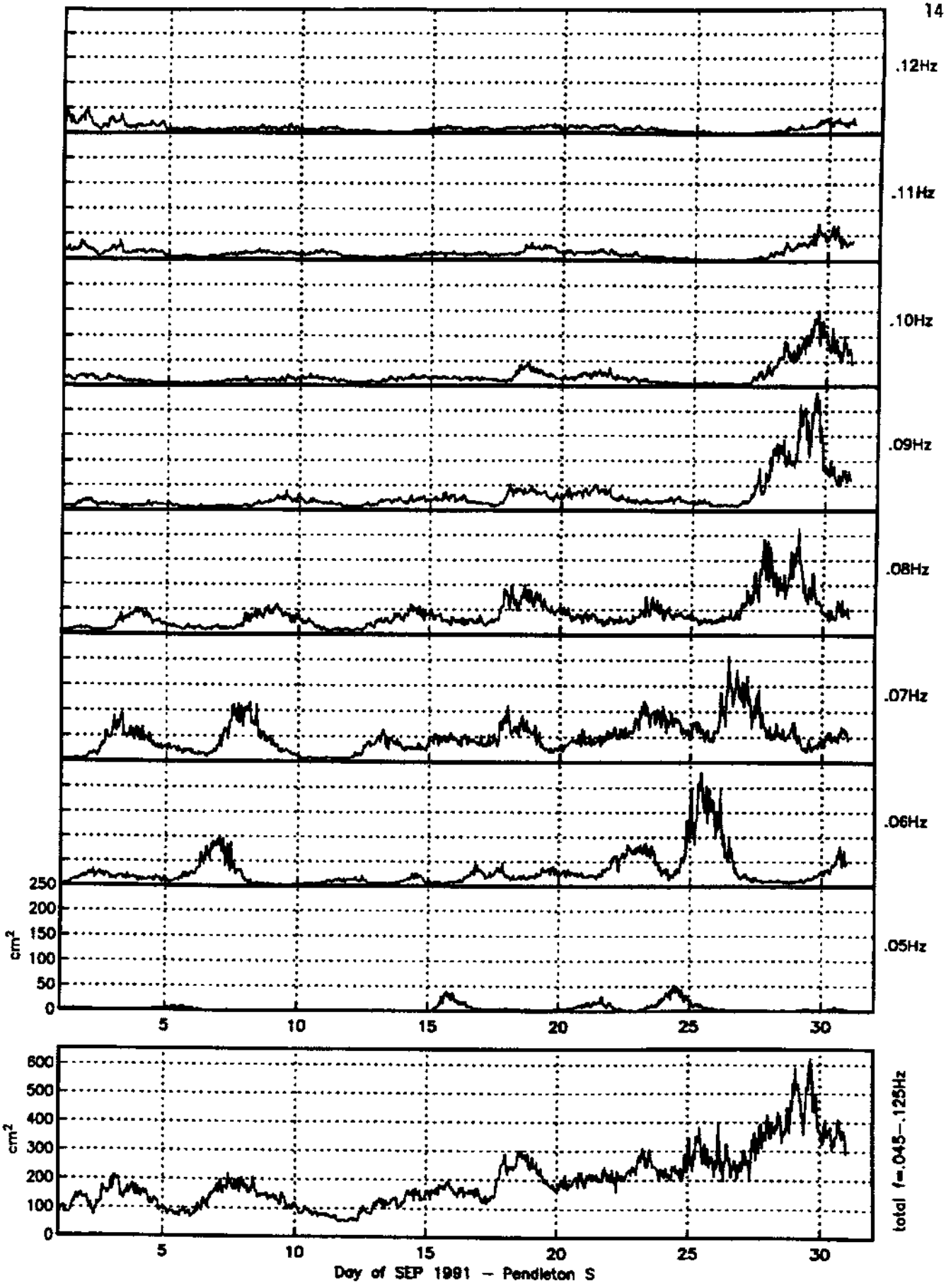

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
20
40
60
5
10
15
20
25
30
cm²
0
50
100
150
200
total f=.045-.125Hz
Day of AUG 1991 - Oceanside

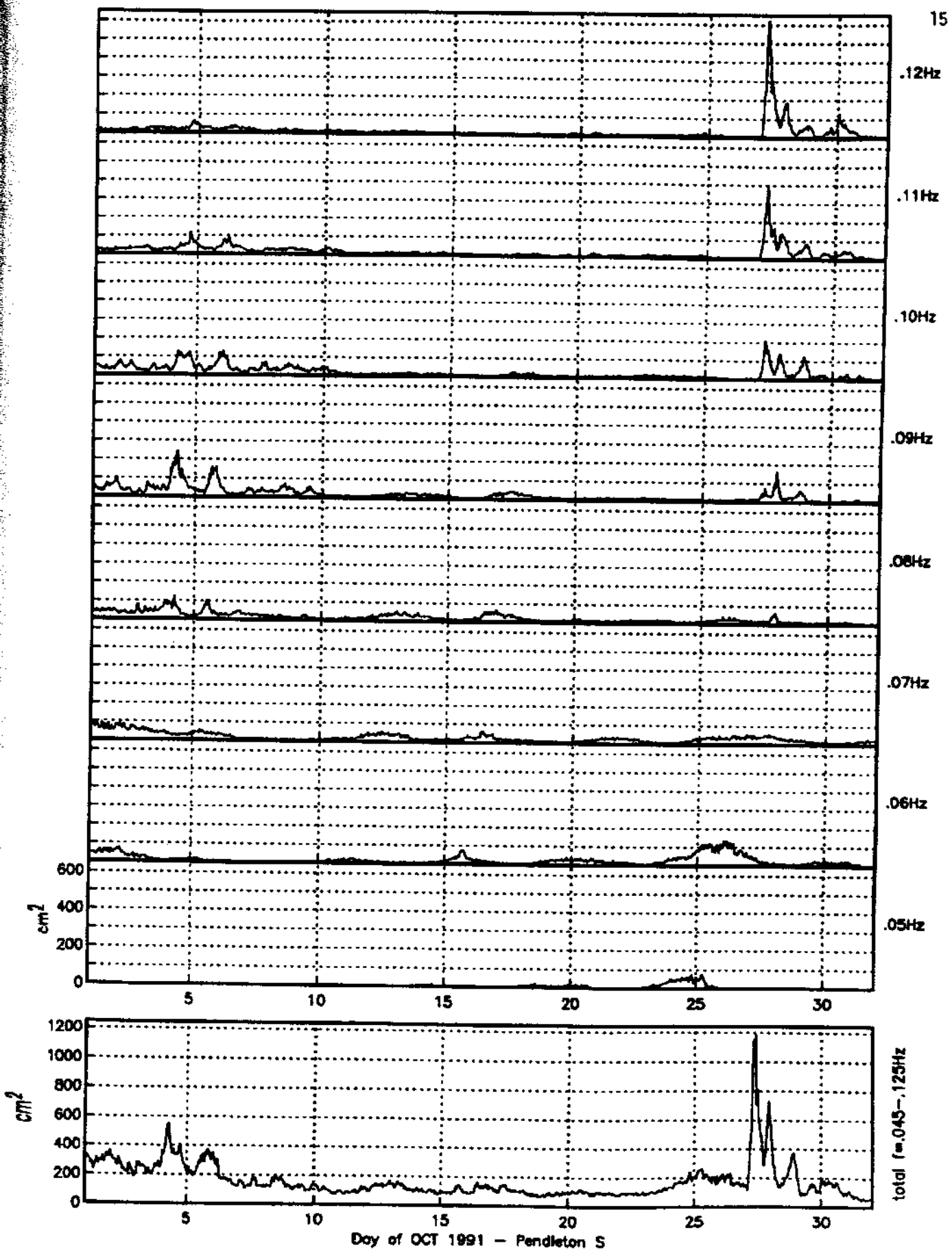

10
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
250
200
150
100
50
0
5
10
15
20
25
30
700
600
500
400
300
200
100
0
total f=.045-.125Hz
Day of SEP 1991 - Oceanside

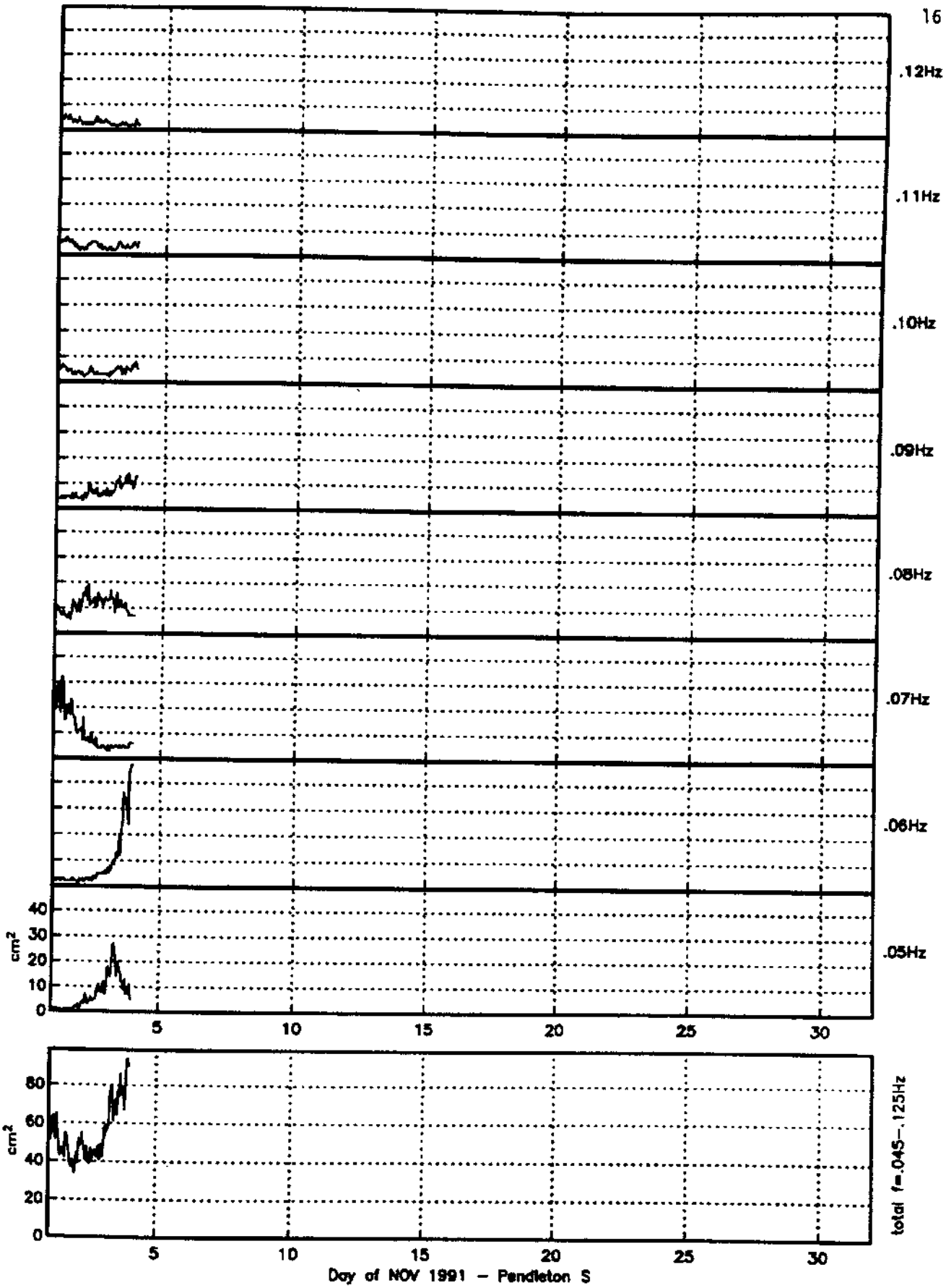

11
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
200
400
800
5
10
15
20
25
30
cm²
0
200
400
600
800
1000
1200
1400
1600
total f=.045-.125Hz
Day of OCT 1991 - Oceanside

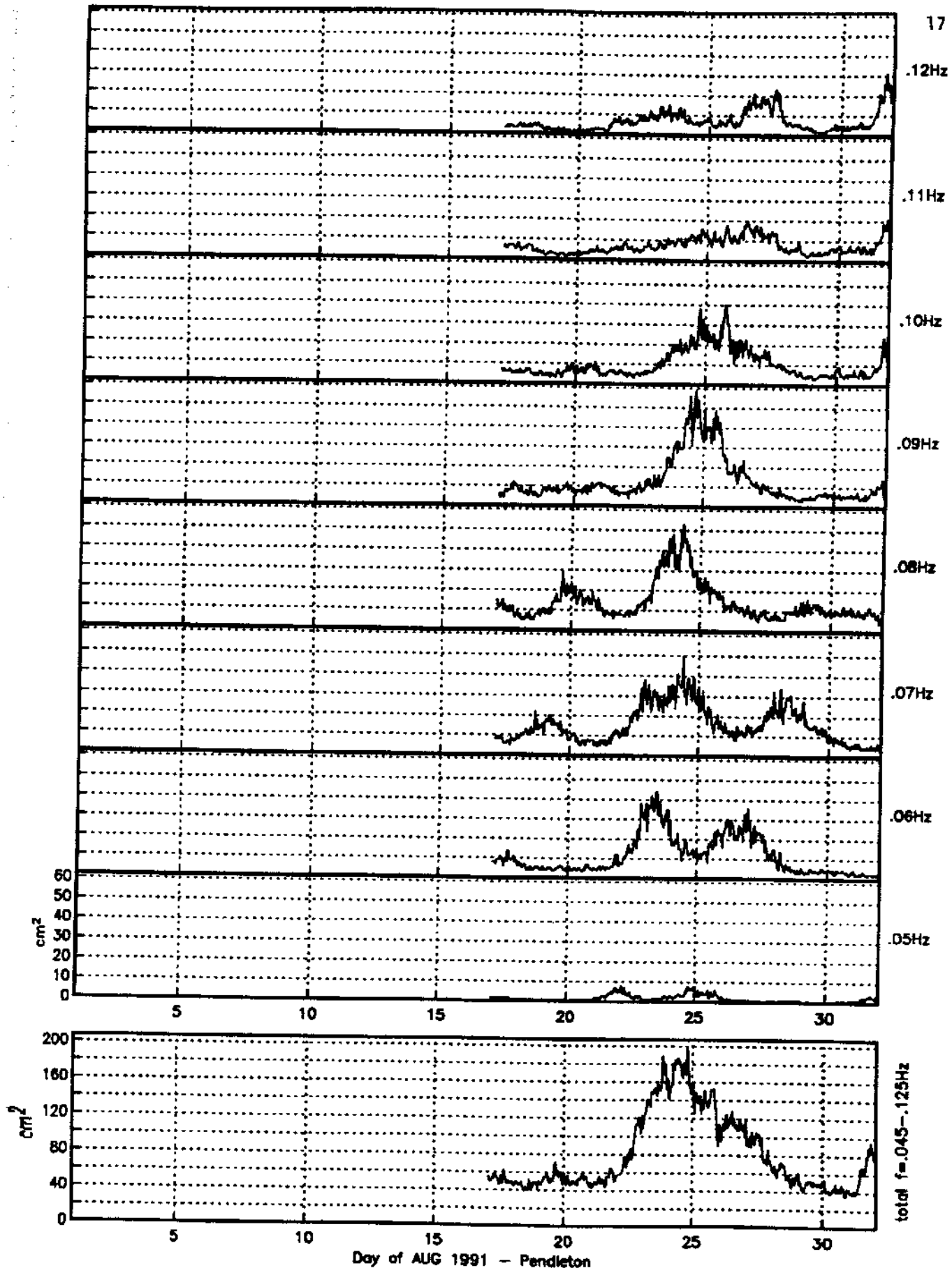

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
20
40
60
80
5
10
15
20
25
30
cm²
0
20
40
60
80
100
120
140
total f=.045-.125Hz
Day of NOV 1991 - Oceanside

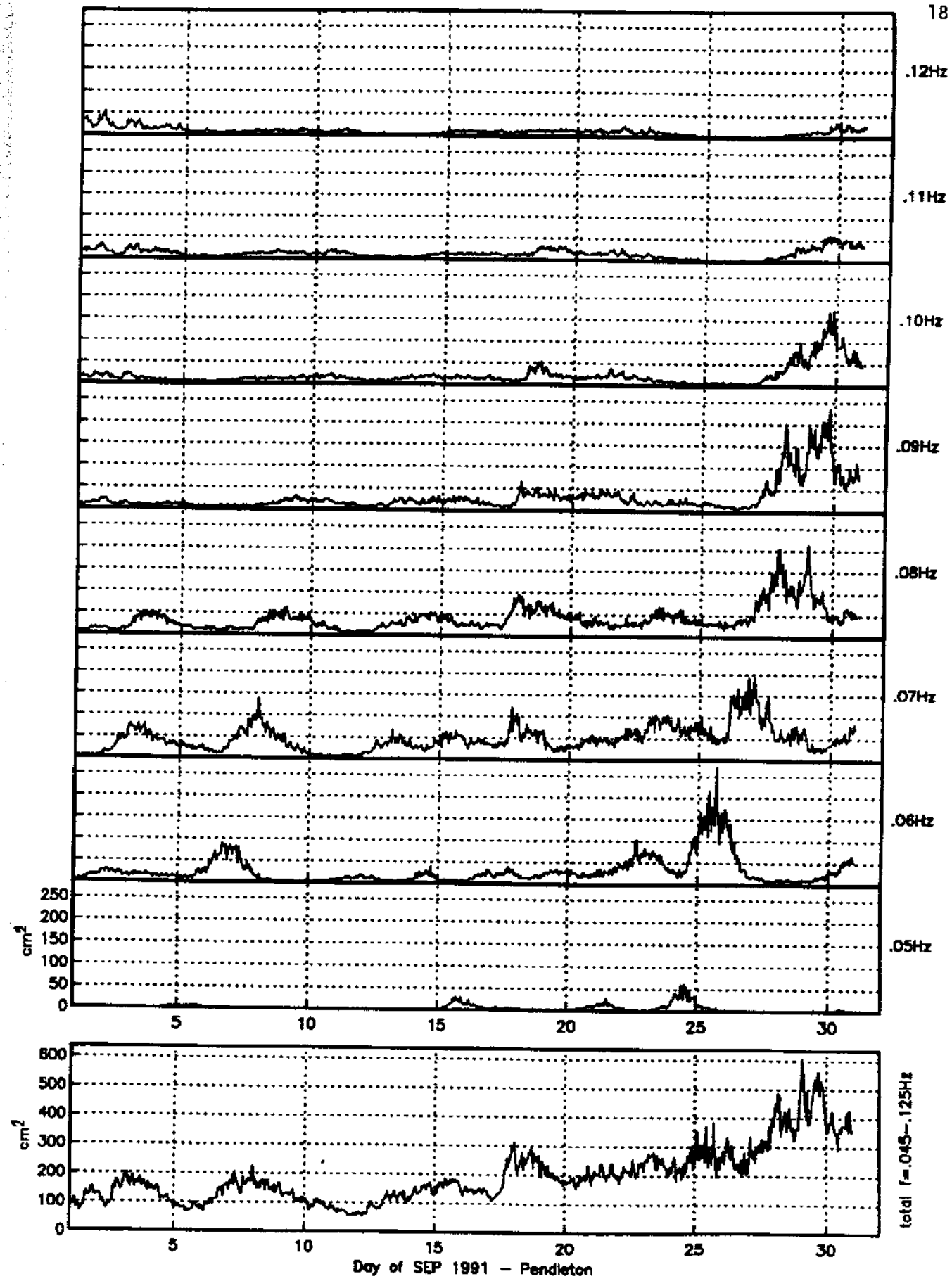

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
20
40
60
5
10
15
20
25
30
cm²
0
50
100
150
200
total f=.045-.125Hz
Day of AUG 1991 — Pendleton S

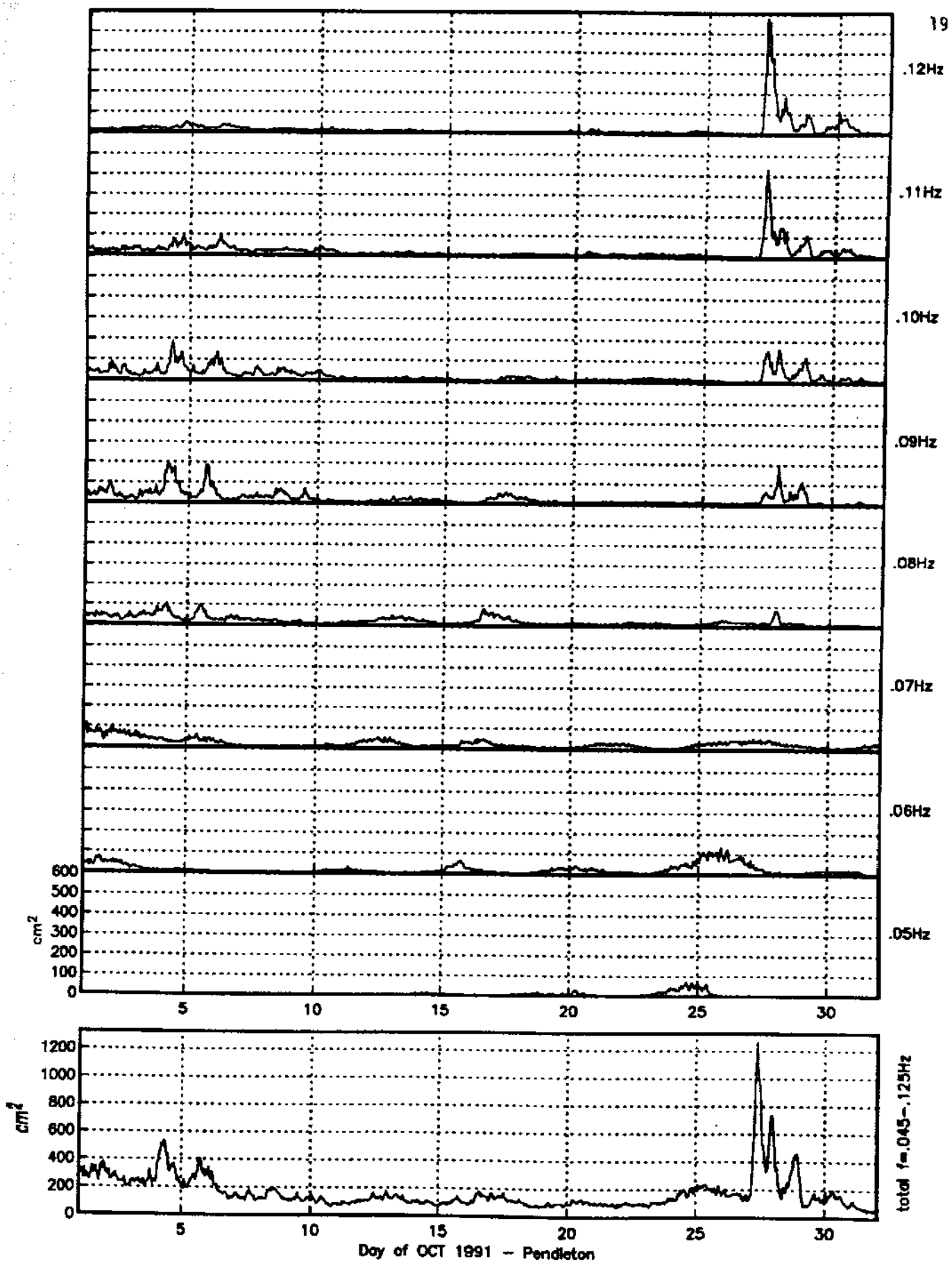

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
250
200
150
100
50
0
5
10
15
20
25
30
cm²
600
500
400
300
200
100
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of SEP 1991 - Pendleton S

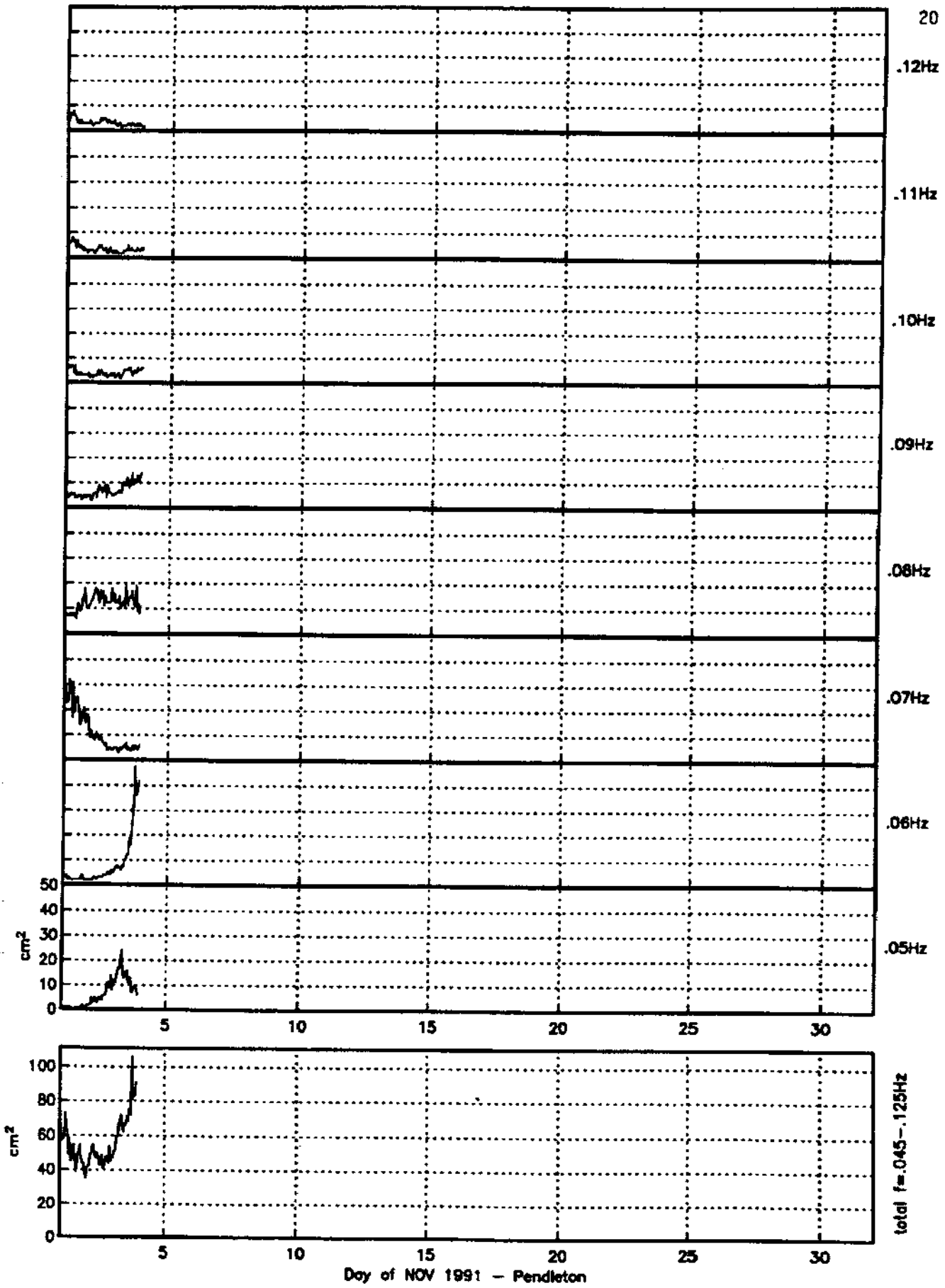

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
200
400
600
5
10
15
20
25
30
cm²
0
200
400
600
800
1000
1200
total f=.045-.125Hz
Day of OCT 1991 — Pendleton S

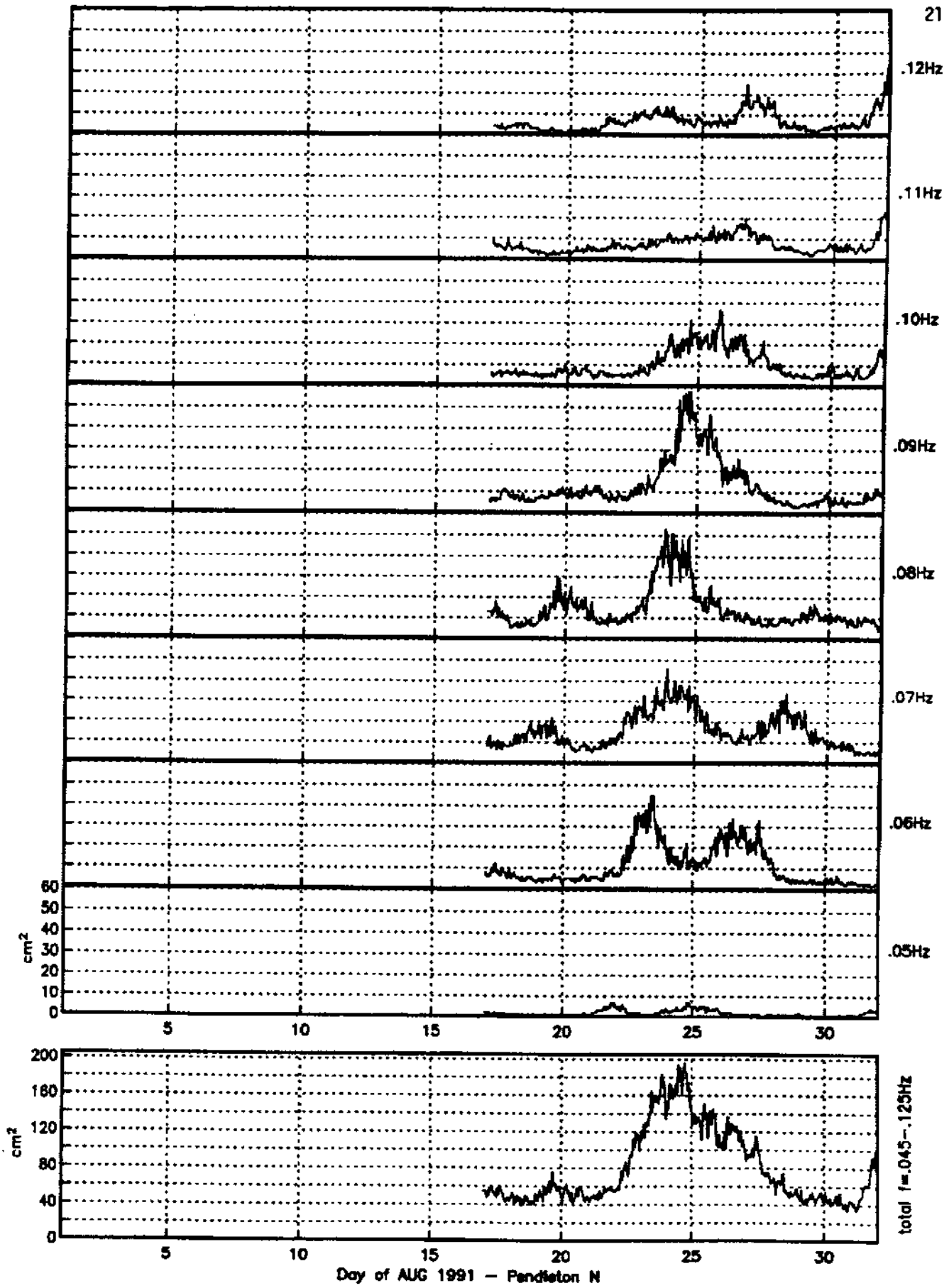

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
10
20
30
40
5
10
15
20
25
30
cm²
0
20
40
60
80
5
10
15
20
25
30
total f=.045-.125Hz
Day of NOV 1991 – Pendleton S

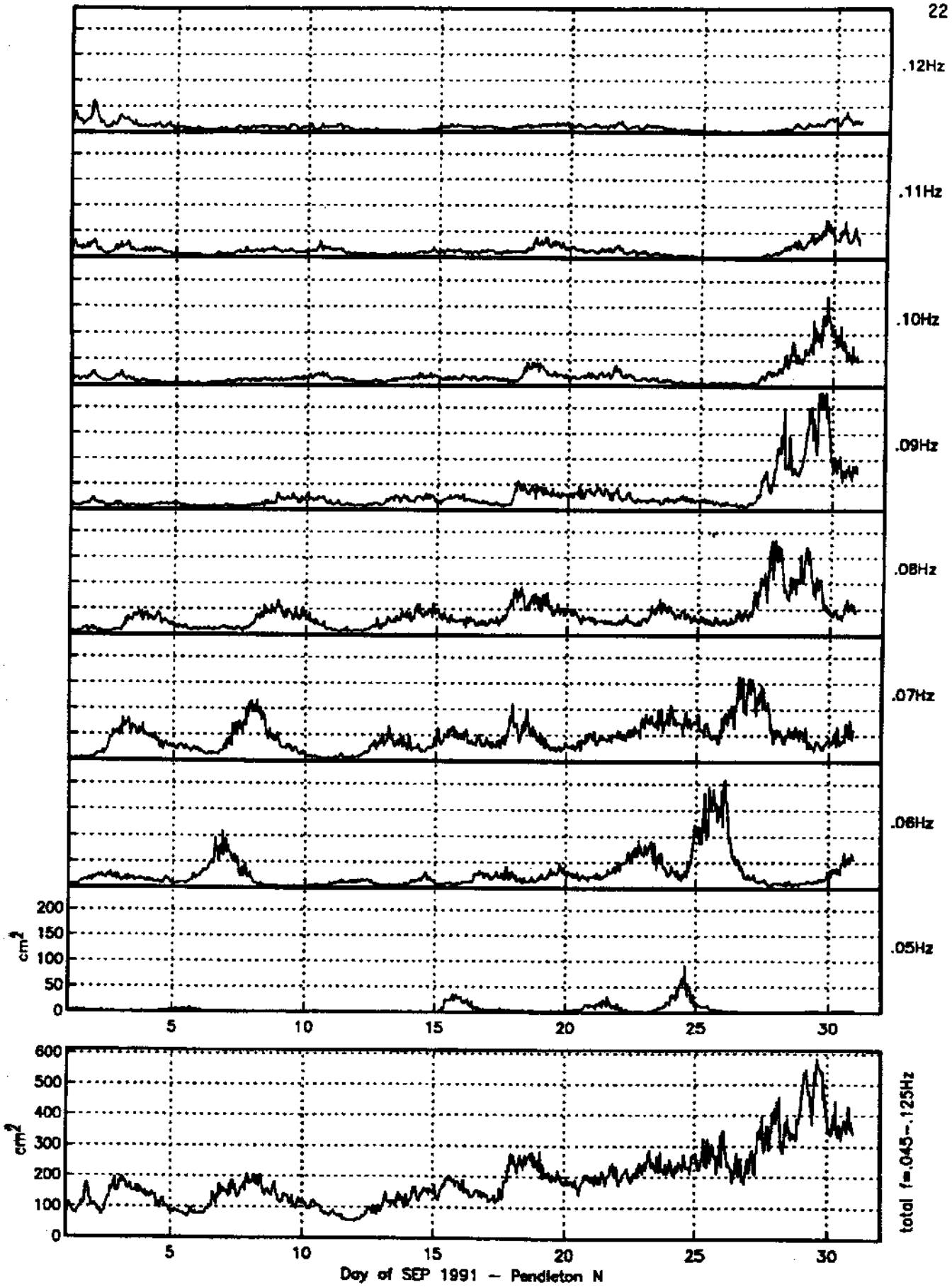

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
10
20
30
40
50
60
5
10
15
20
25
30
cm²
0
40
80
120
160
200
total f=.045-.125Hz
Day of AUG 1991 – Pendleton

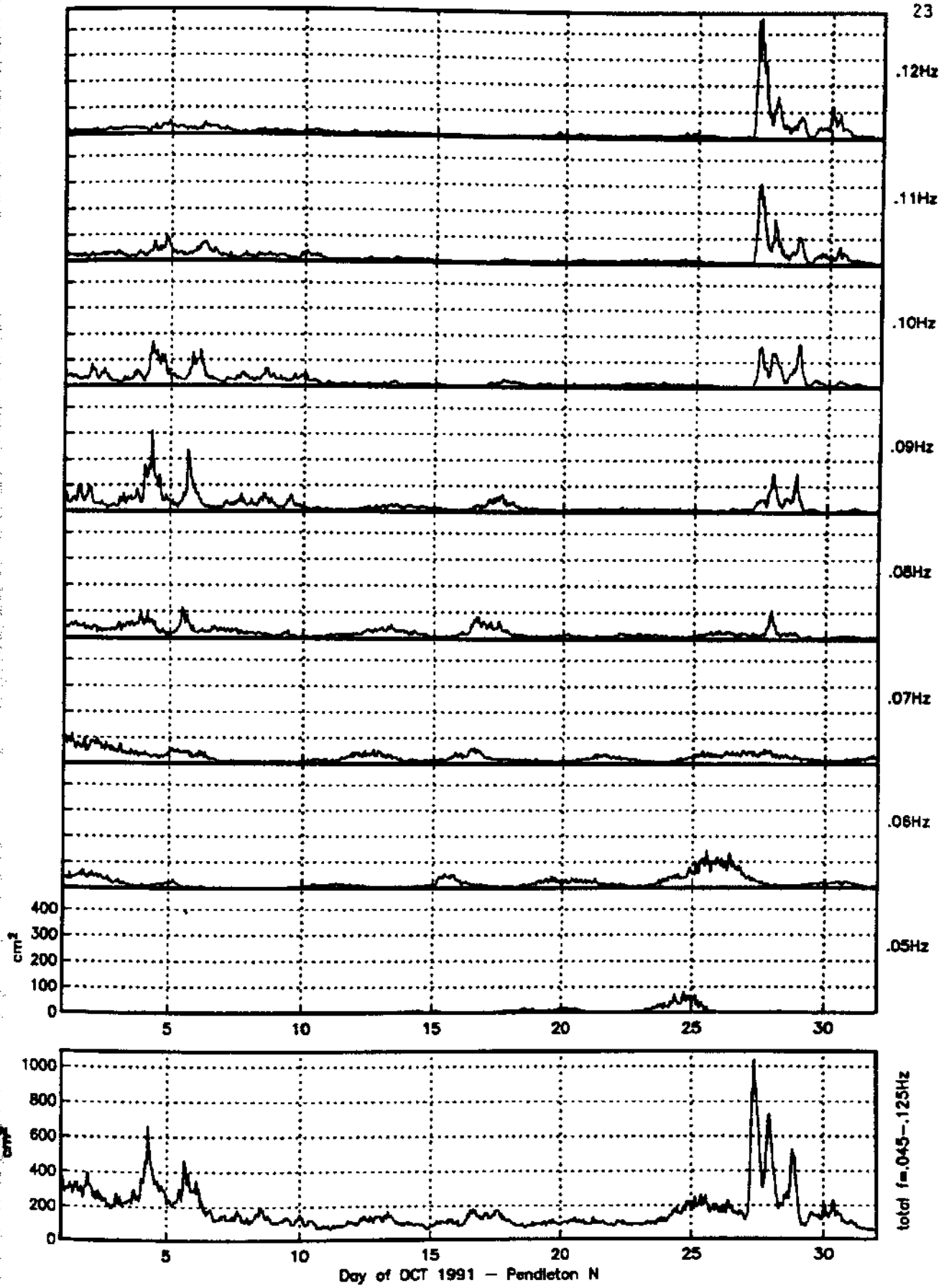

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
250
200
150
100
50
0
5
10
15
20
25
30
cm²
800
500
400
300
200
100
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of SEP 1991 – Pendleton

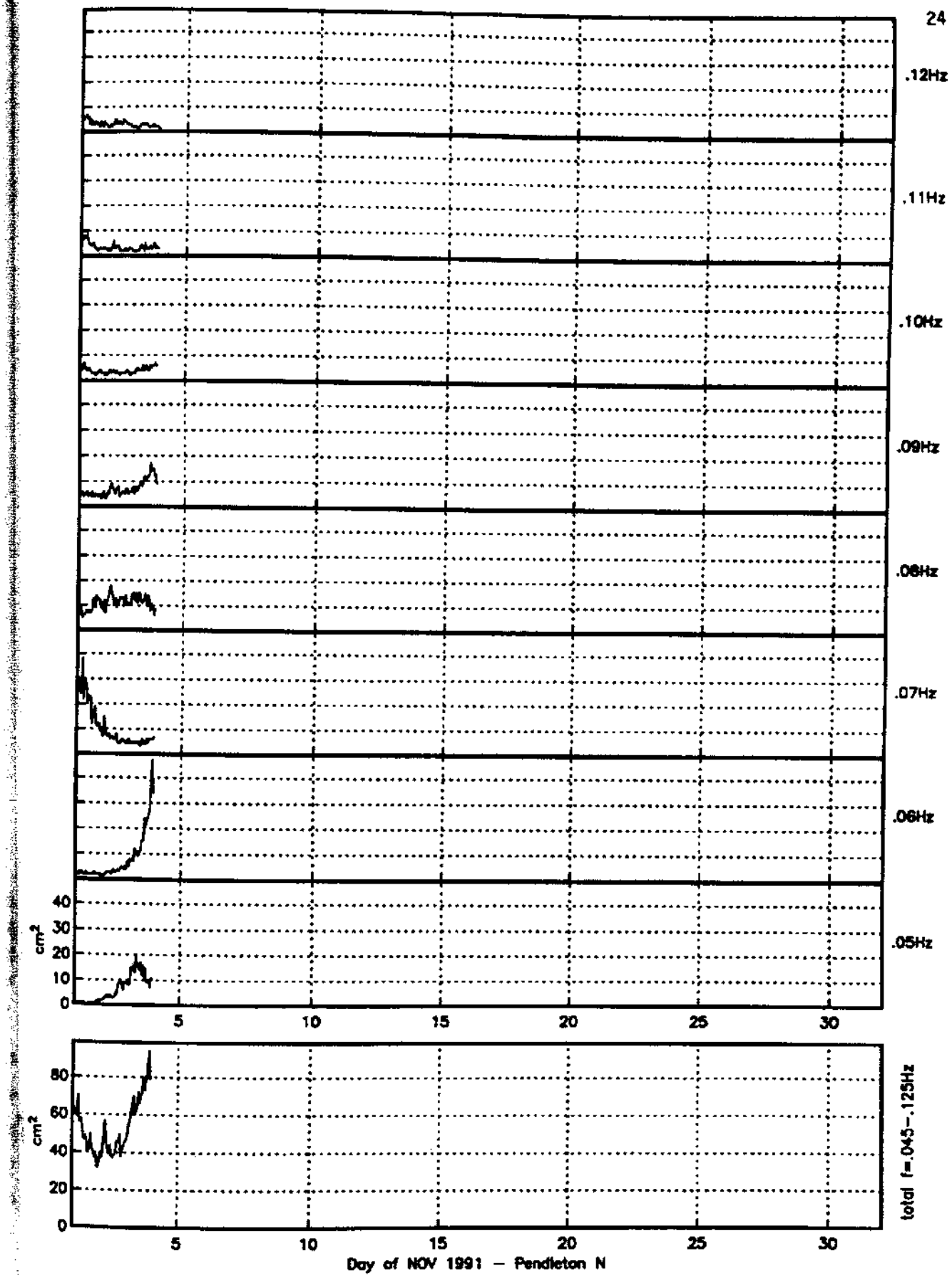

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
600
500
400
300
200
100
0
5
10
15
20
25
30
cm²
1200
1000
800
600
400
200
0
5
10
15
20
25
30
Day of OCT 1991 -- Pendleton
total f=.045-.125Hz

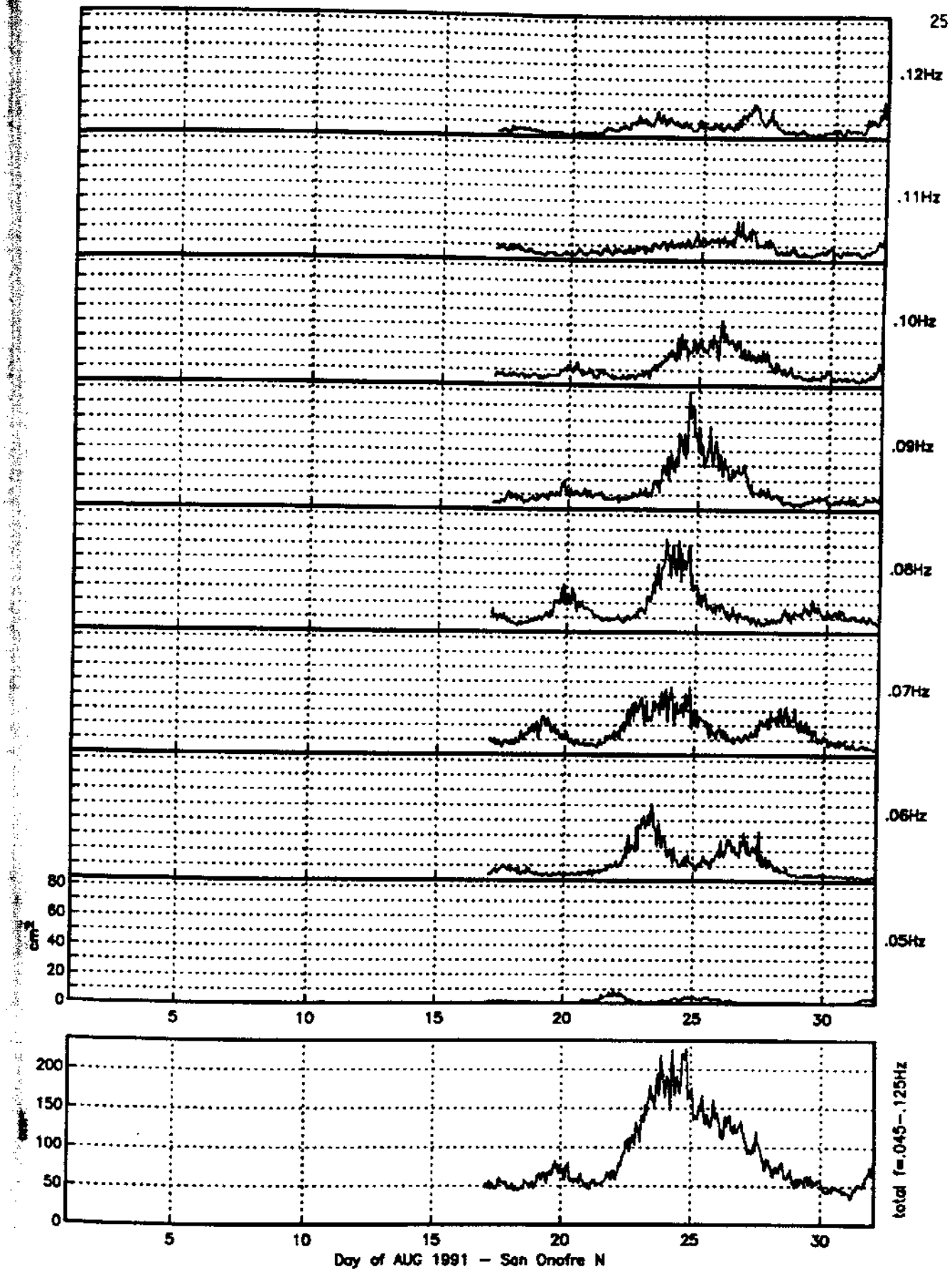

20
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
50
40
30
20
10
0
5
10
15
20
25
30
cm²
100
80
60
40
20
0
5
10
15
20
25
30
Day of NOV 1991 — Pendleton
total f=.045-.125Hz

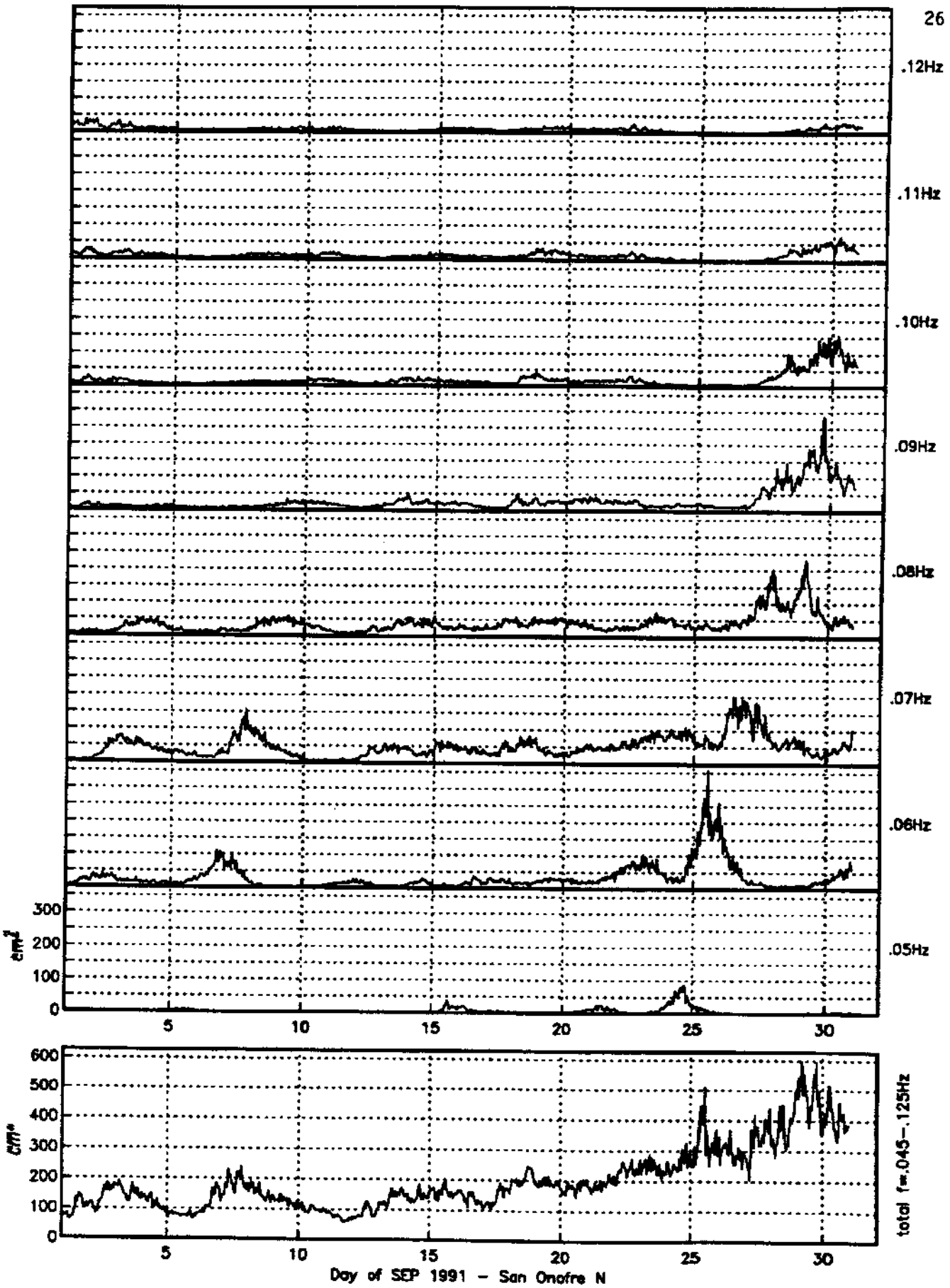

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
10
20
30
40
50
60
5
10
15
20
25
30
cm²
0
40
80
120
160
200
total f=.045-.125Hz
Day of AUG 1991 — Pendleton N

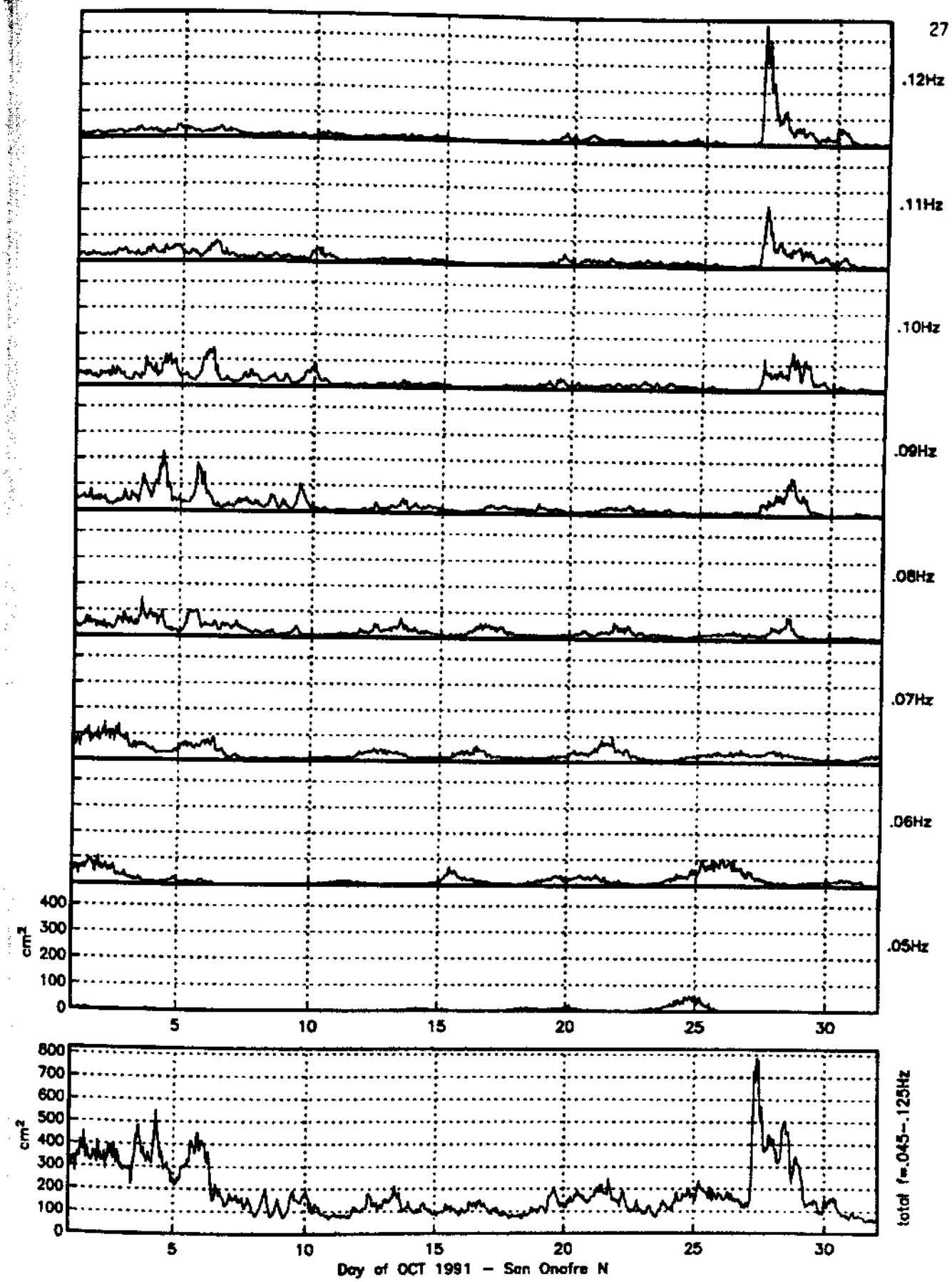

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
200
150
100
50
0
5
10
15
20
25
30
600
500
400
300
200
100
0
total f=.045-.125Hz
Day of SEP 1991 — Pendleton N

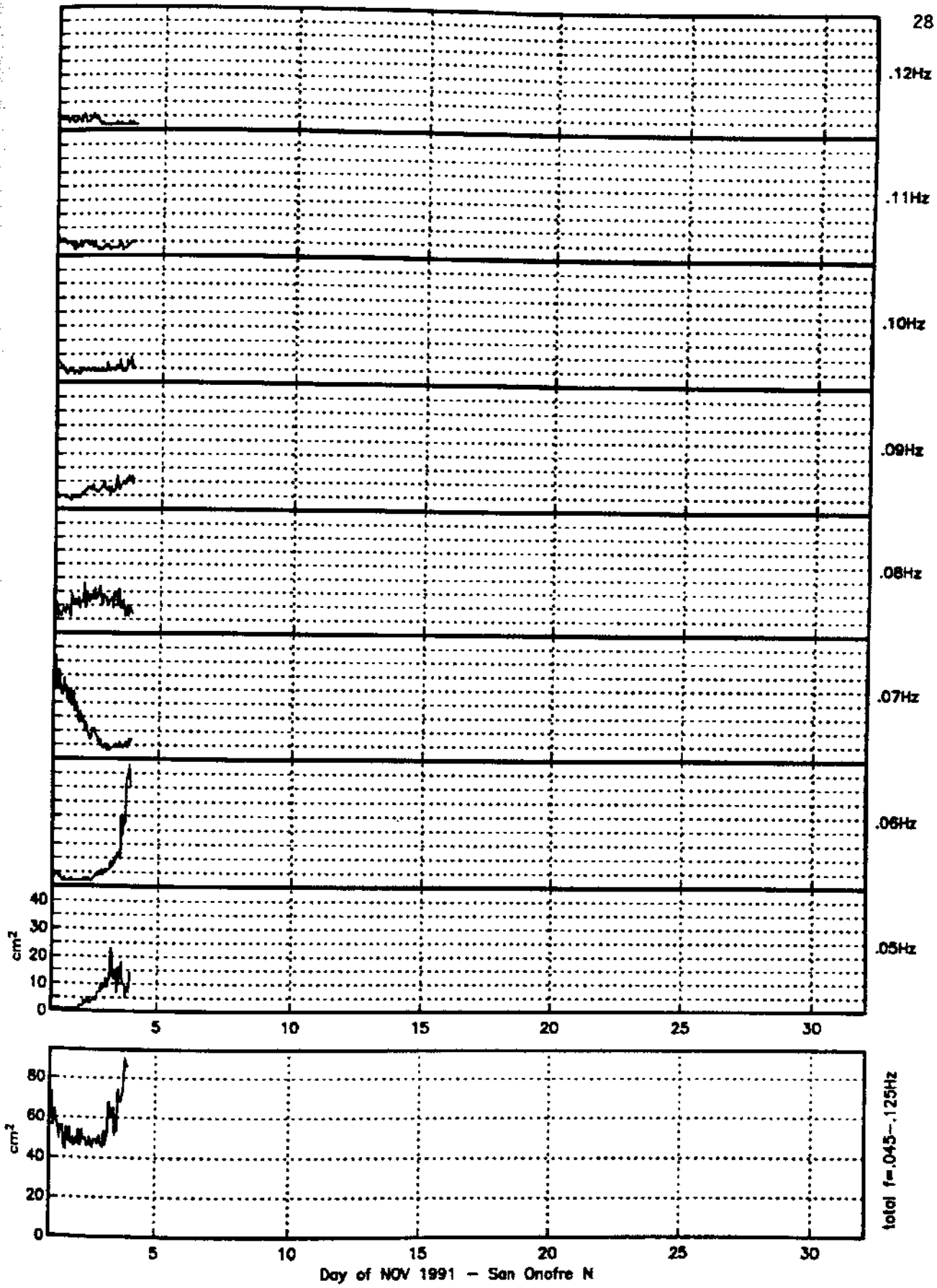

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
100
200
300
400
5
10
15
20
25
30
cm²
0
200
400
600
800
1000
total f=.045-.125Hz
Day of OCT 1991 — Pendleton N

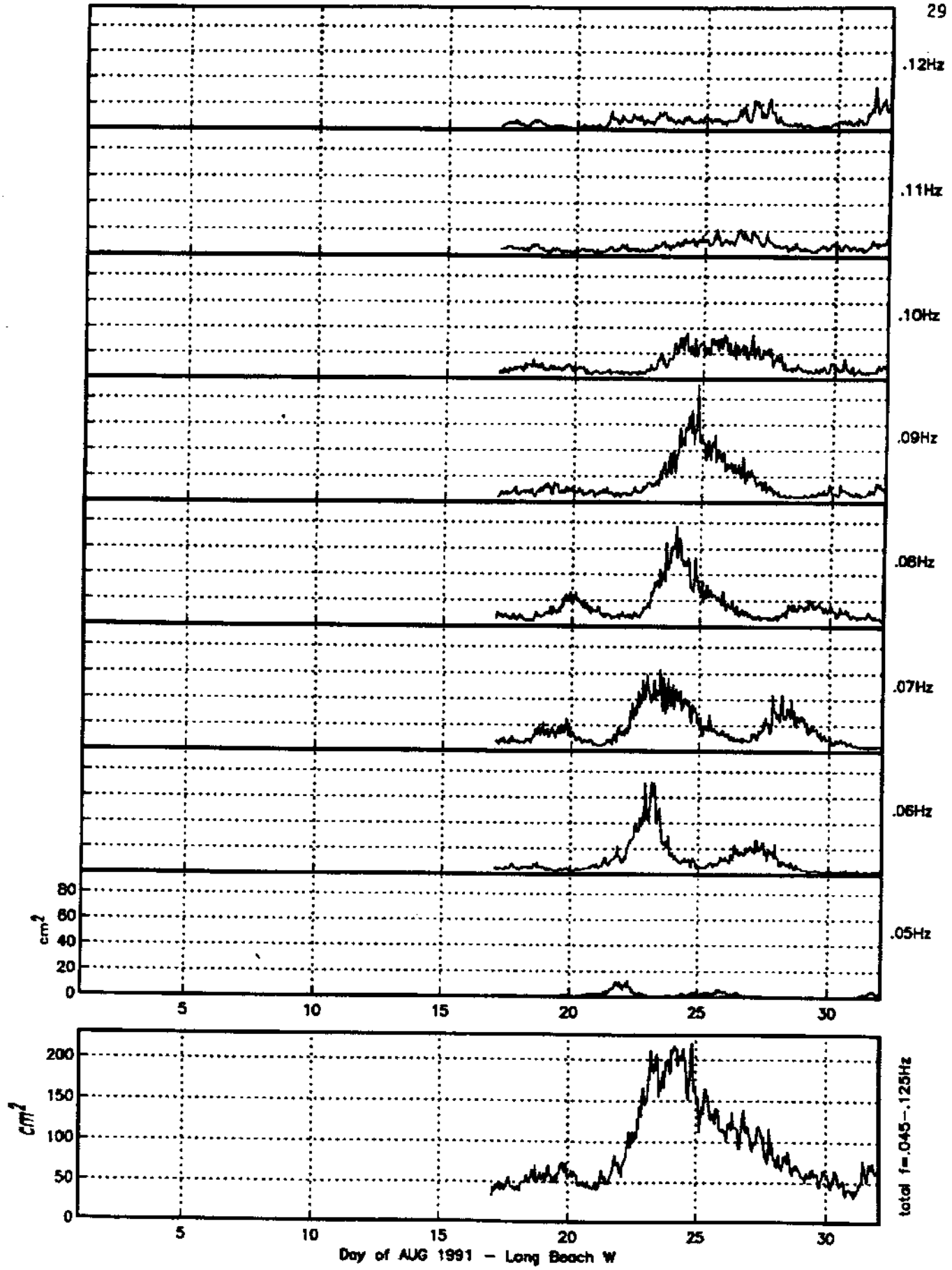

24
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
40
30
20
10
0
5
10
15
20
25
30
cm²
80
60
40
20
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of NOV 1991 — Pendleton N

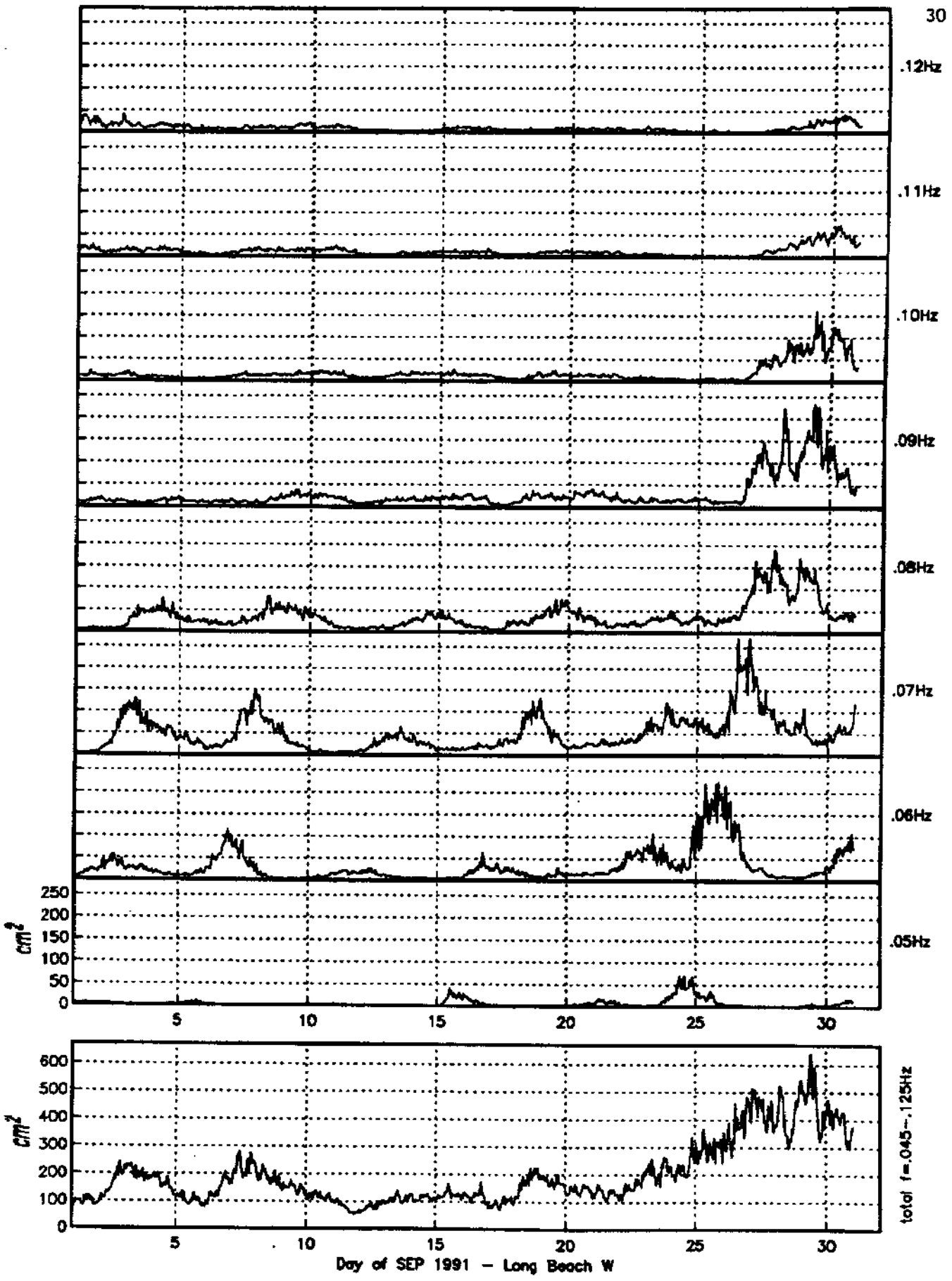

25
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm
80
60
40
20
0
5
10
15
20
25
30
200
150
100
50
0
total f=.045-.125Hz
Day of AUG 1991 — San Onofre N

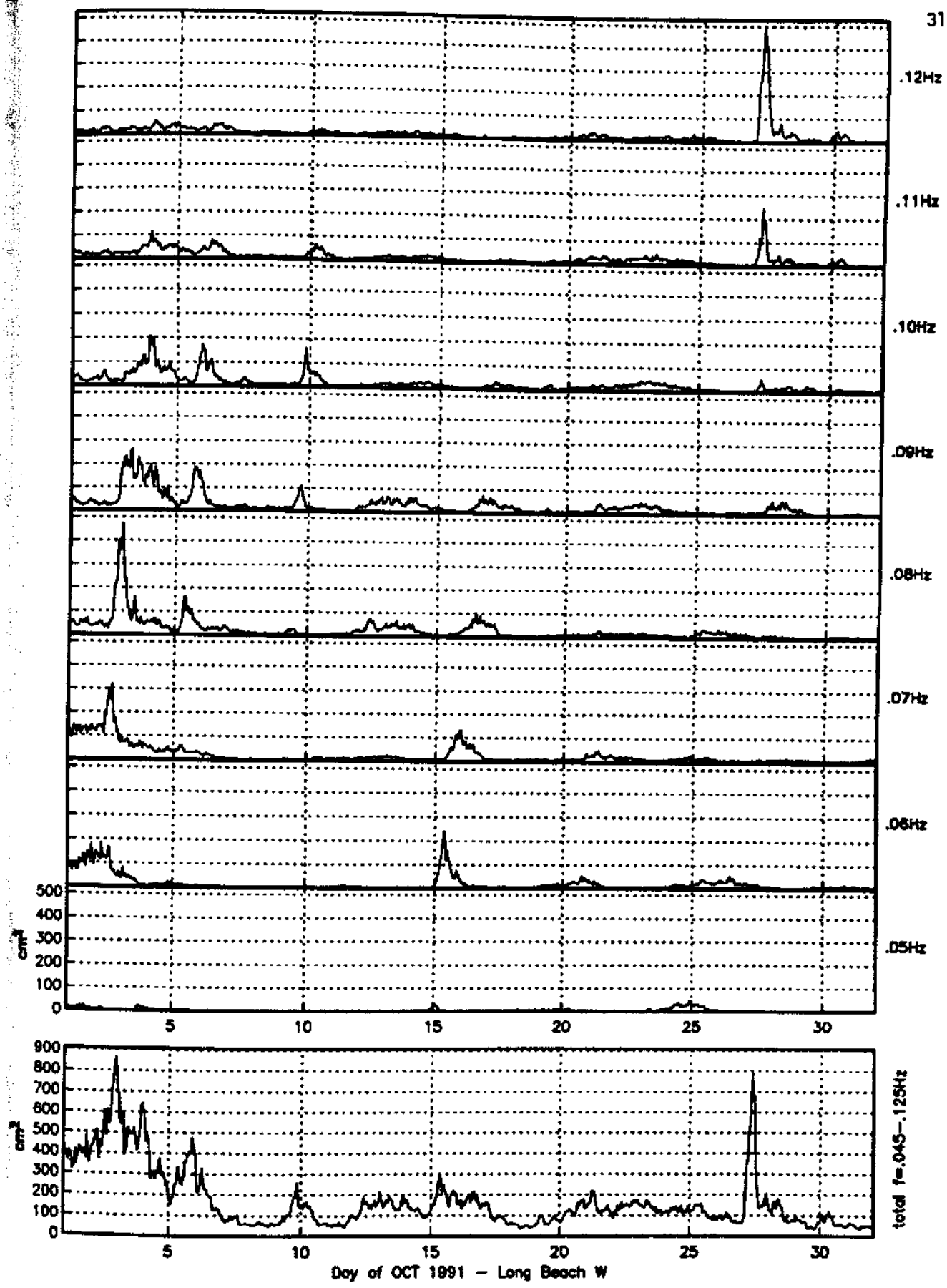

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
300
200
100
0
5
10
15
20
25
30
cm²
600
500
400
300
200
100
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of SEP 1991 - San Onofre N

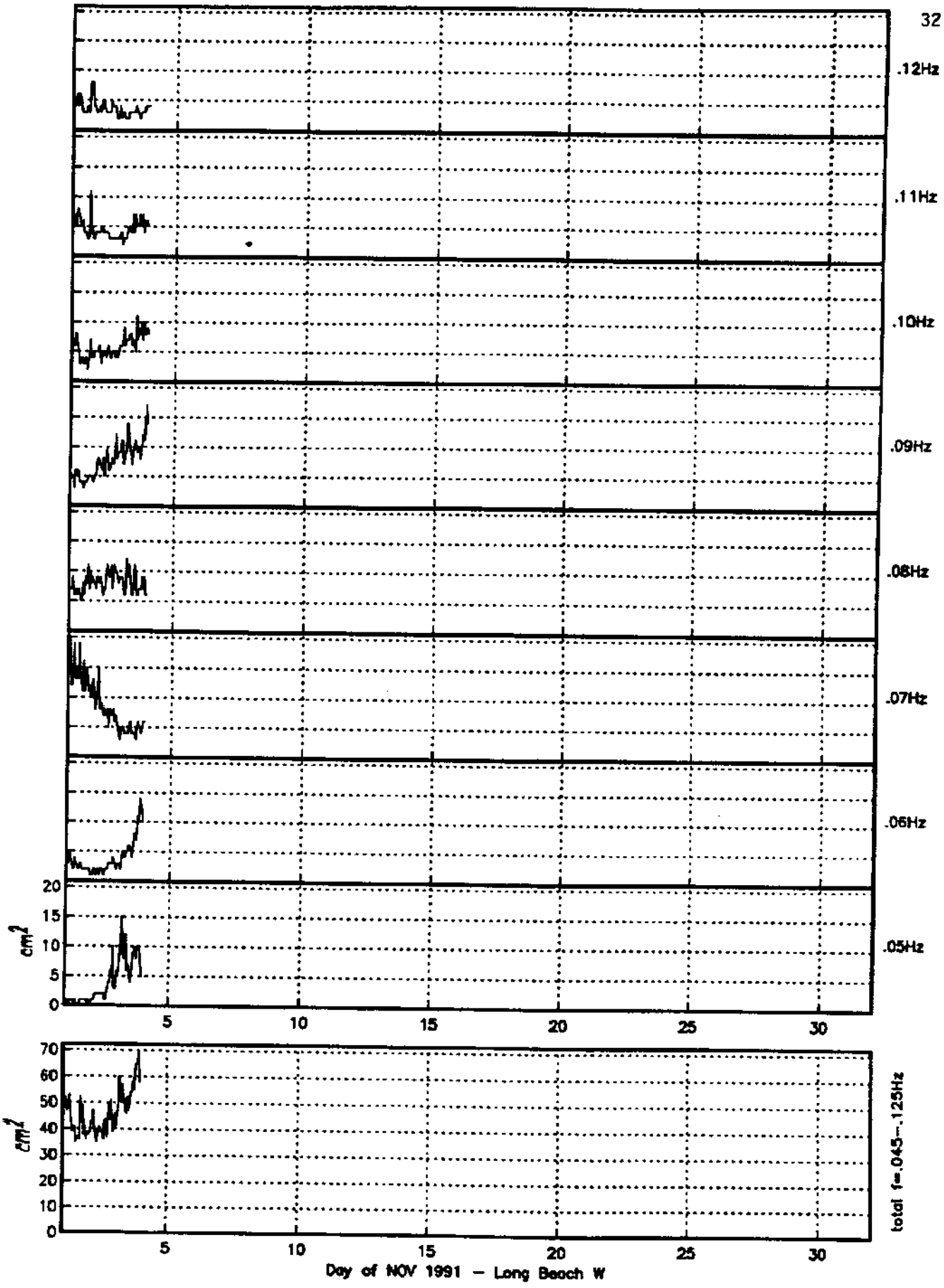

27
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
400
300
200
100
0
5
10
15
20
25
30
800
700
600
500
400
300
200
100
0
cm²
total f=.045-.125Hz
Day of OCT 1991 — San Onofre N

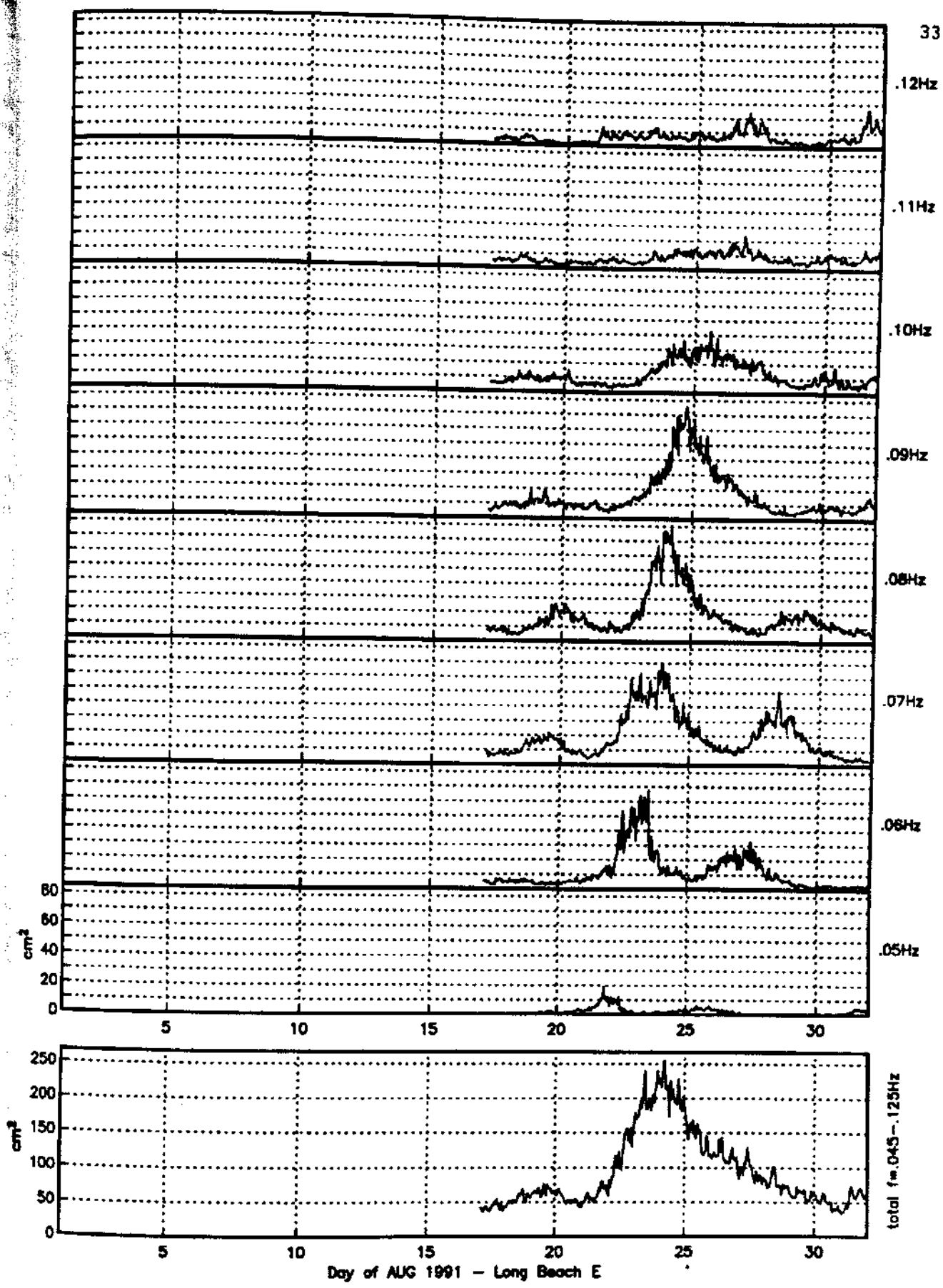

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
10
20
30
40
5
10
15
20
25
30
cm²
0
20
40
60
80
5
10
15
20
25
30
total f=.045-.125Hz
Day of NOV 1991 - San Onofre N

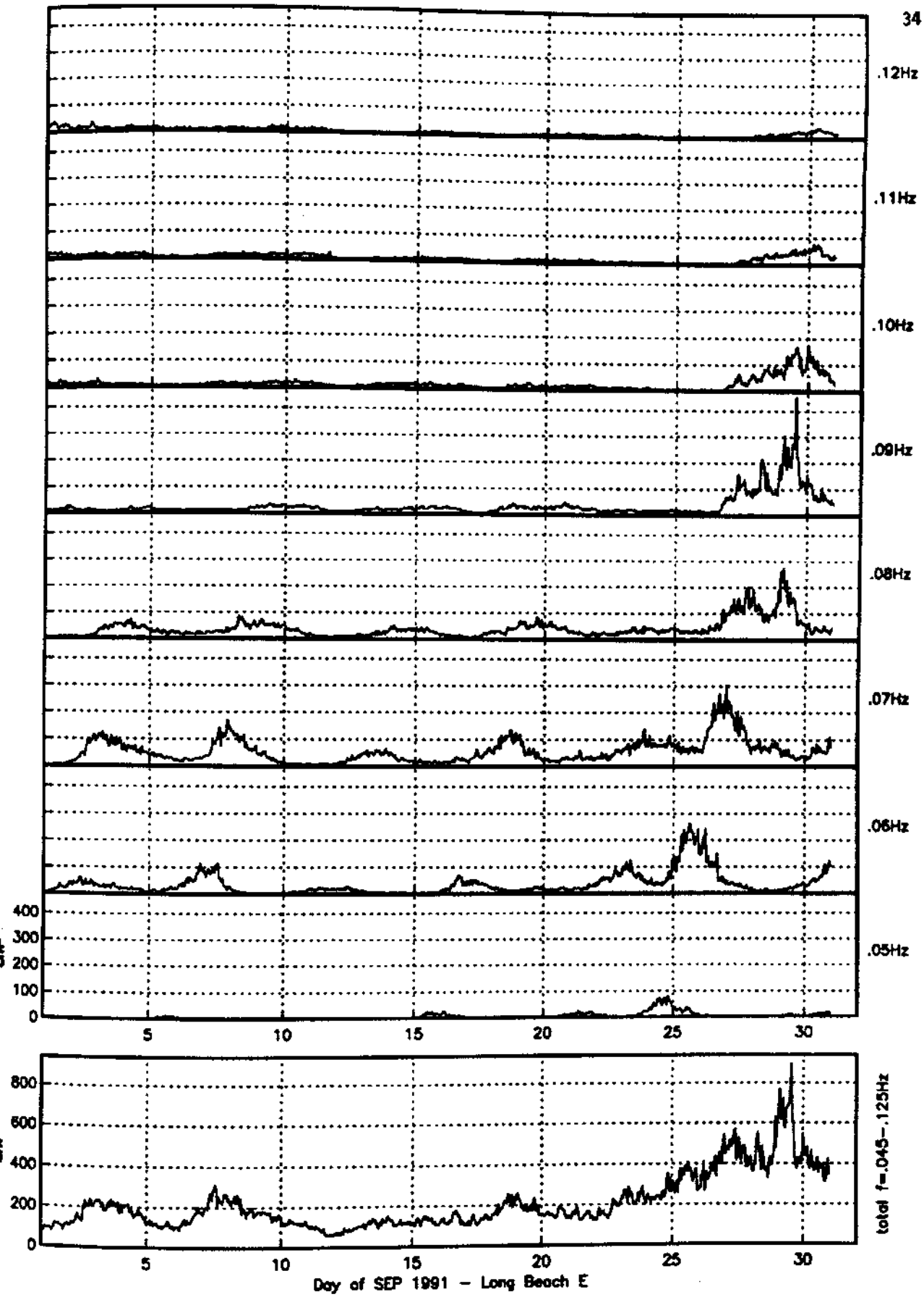

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
20
40
60
80
5
10
15
20
25
30
cm²
0
50
100
150
200
5
10
15
20
25
30
total f=.045-.125Hz
Day of AUG 1991 – Long Beach W

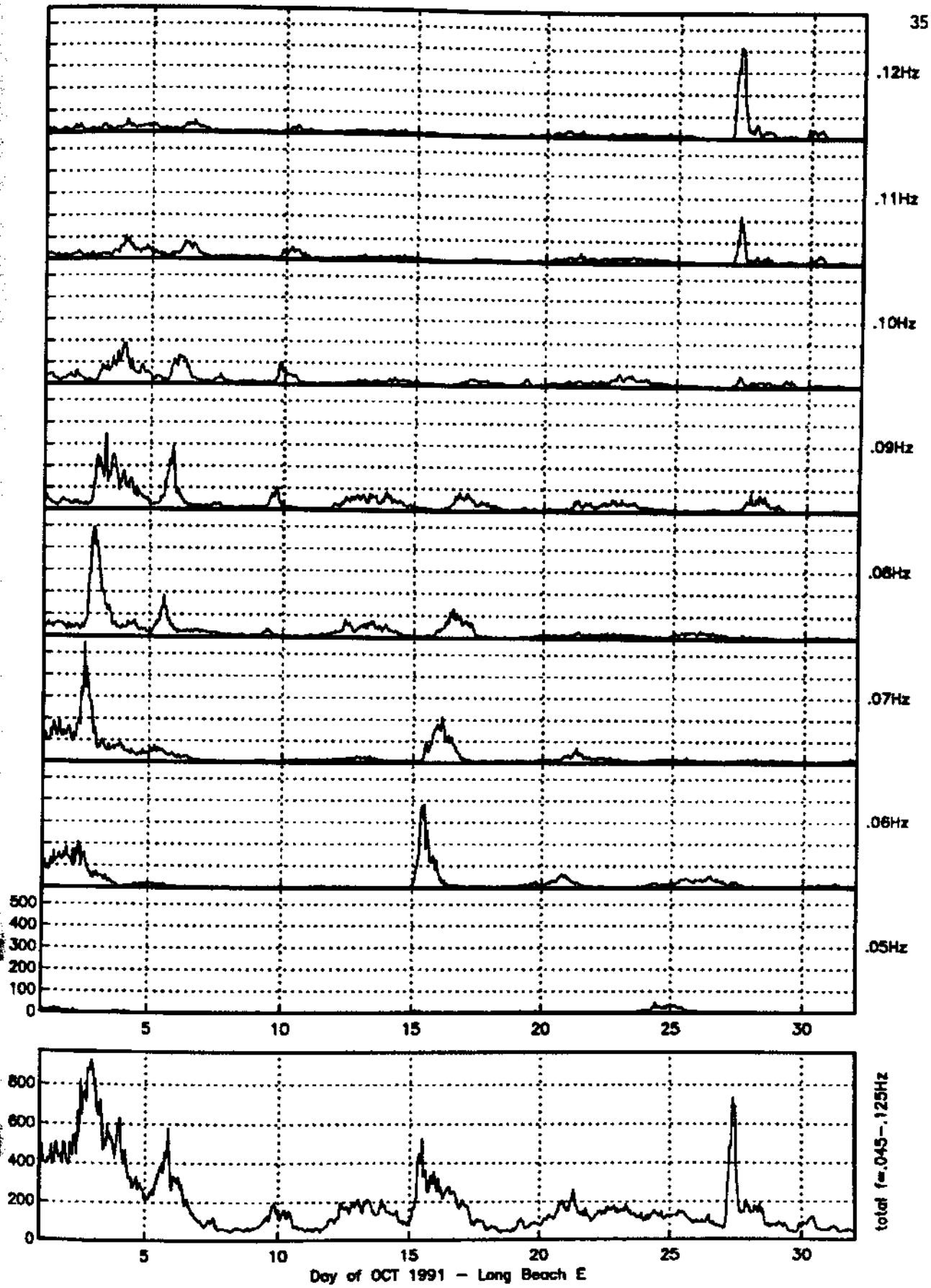

30
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
250
200
150
100
50
0
5
10
15
20
25
30
cm²
600
500
400
300
200
100
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of SEP 1991 — Long Beach W

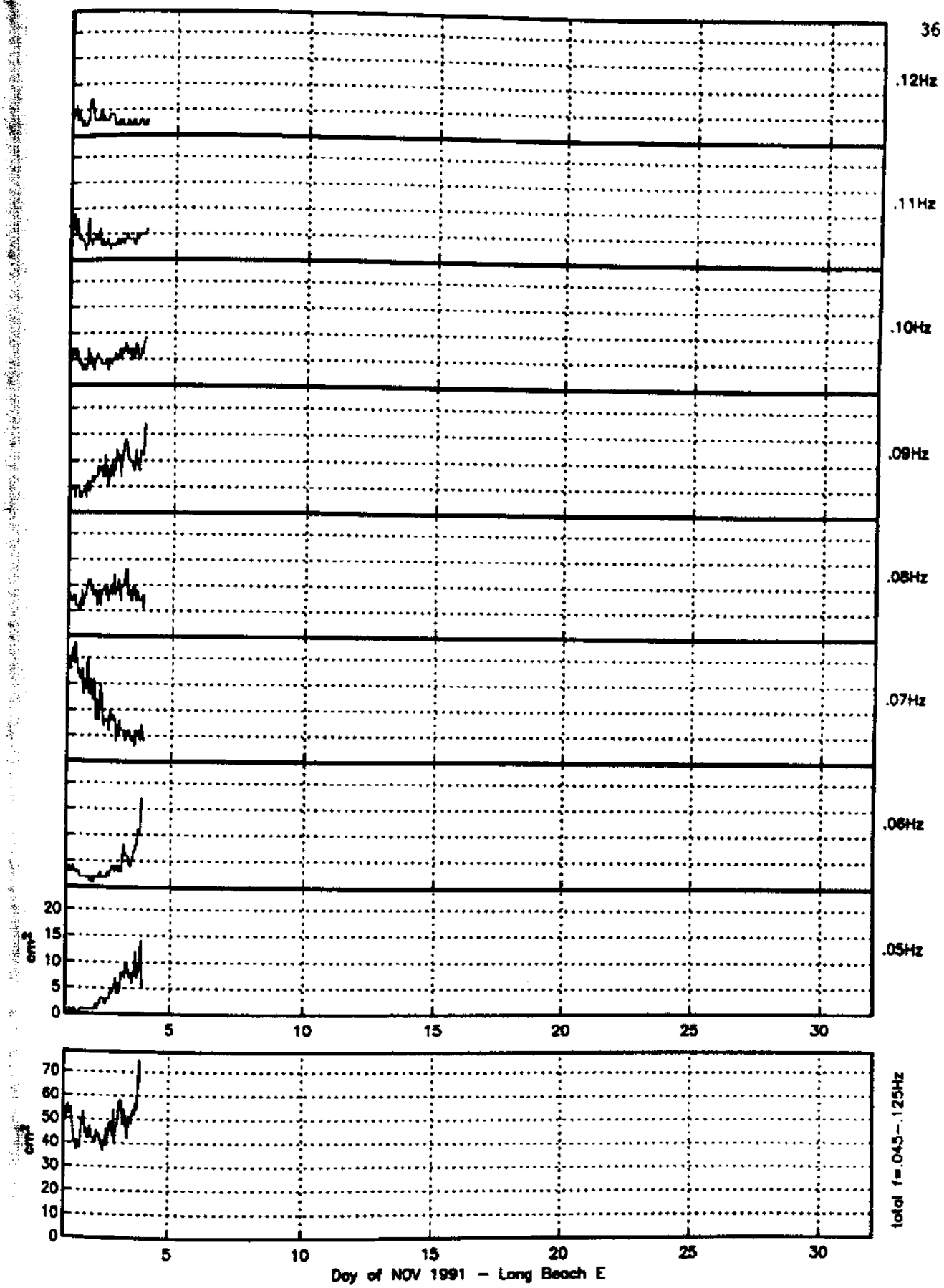

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
100
200
300
400
500
5
10
15
20
25
30
cm²
0
100
200
300
400
500
600
700
800
900
total f=.045-.125Hz
Day of OCT 1991 – Long Beach W

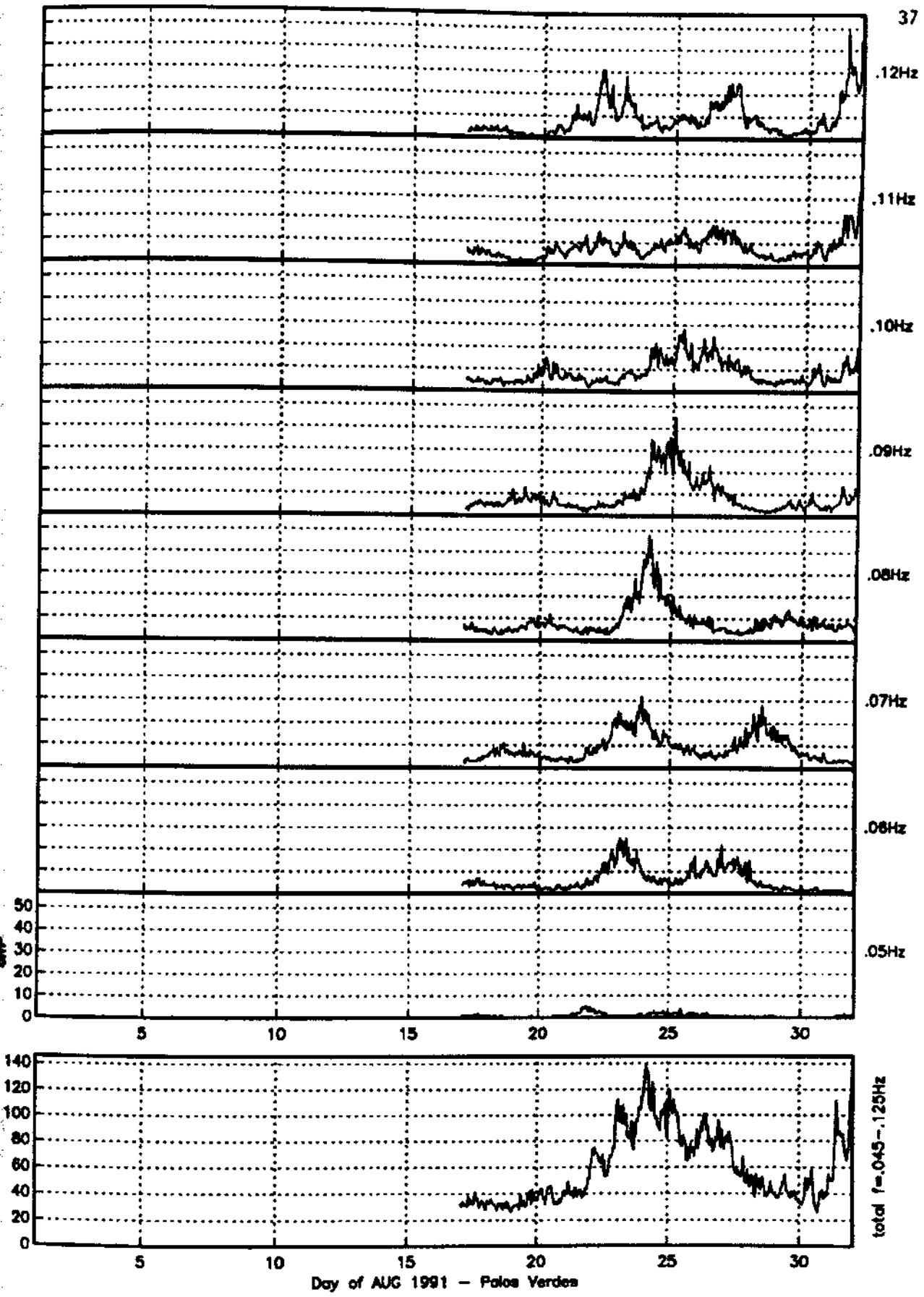

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
5
10
15
20
5
10
15
20
25
30
cm²
0
10
20
30
40
50
60
70
5
10
15
20
25
30
total f=.045-.125Hz
Day of NOV 1991 — Long Beach W

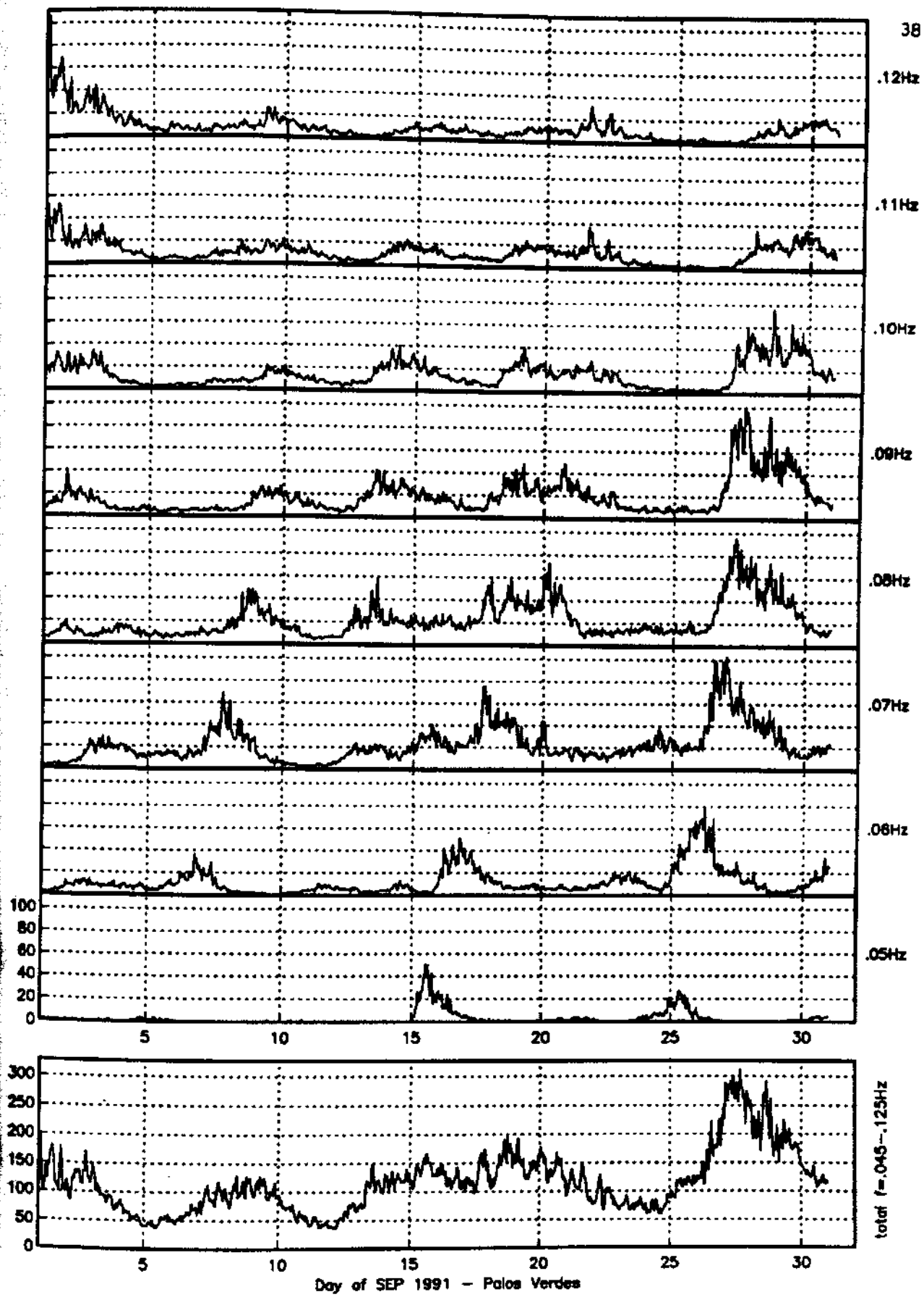

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
20
40
60
80
5
10
15
20
25
30
cm²
0
50
100
150
200
250
total fm.045-.125Hz
Day of AUG 1991 — Long Beach E

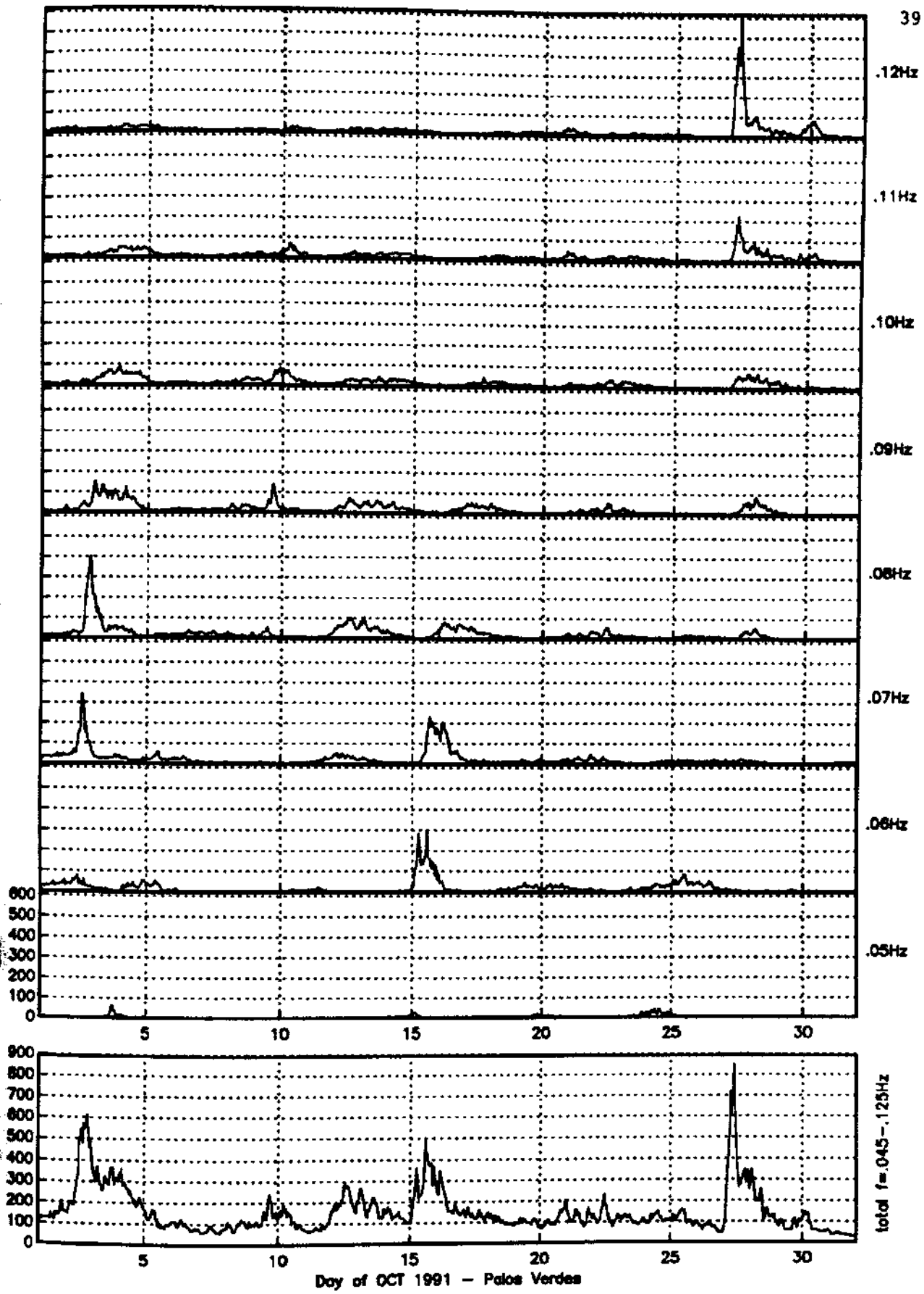

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
400
300
200
100
0
5
10
15
20
25
30
800
600
400
200
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of SEP 1991 - Long Beach E

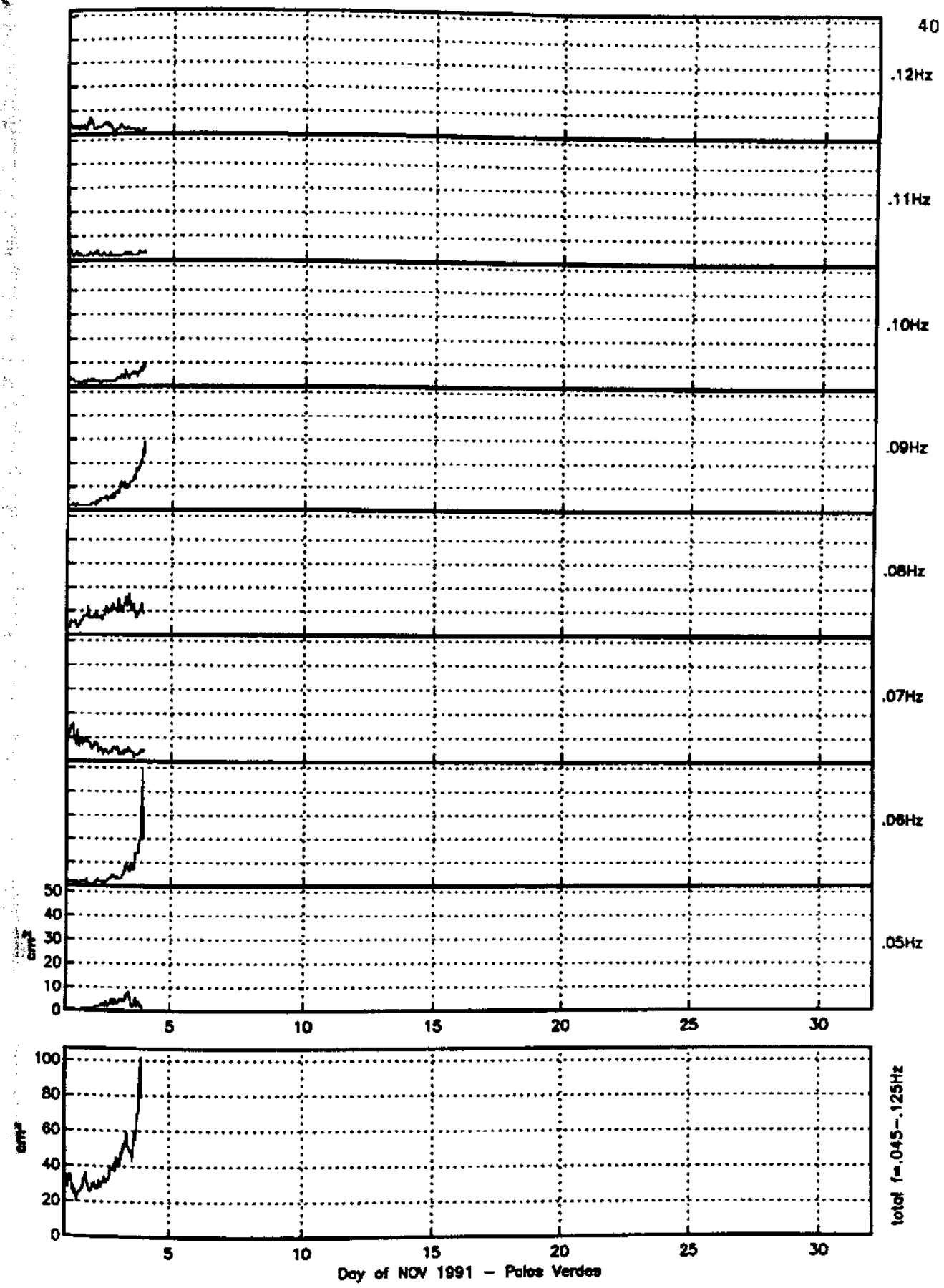

35
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
500
400
300
200
100
0
5
10
15
20
25
30
800
600
400
200
0
total f=.045-.125Hz
Day of OCT 1991 – Long Beach E

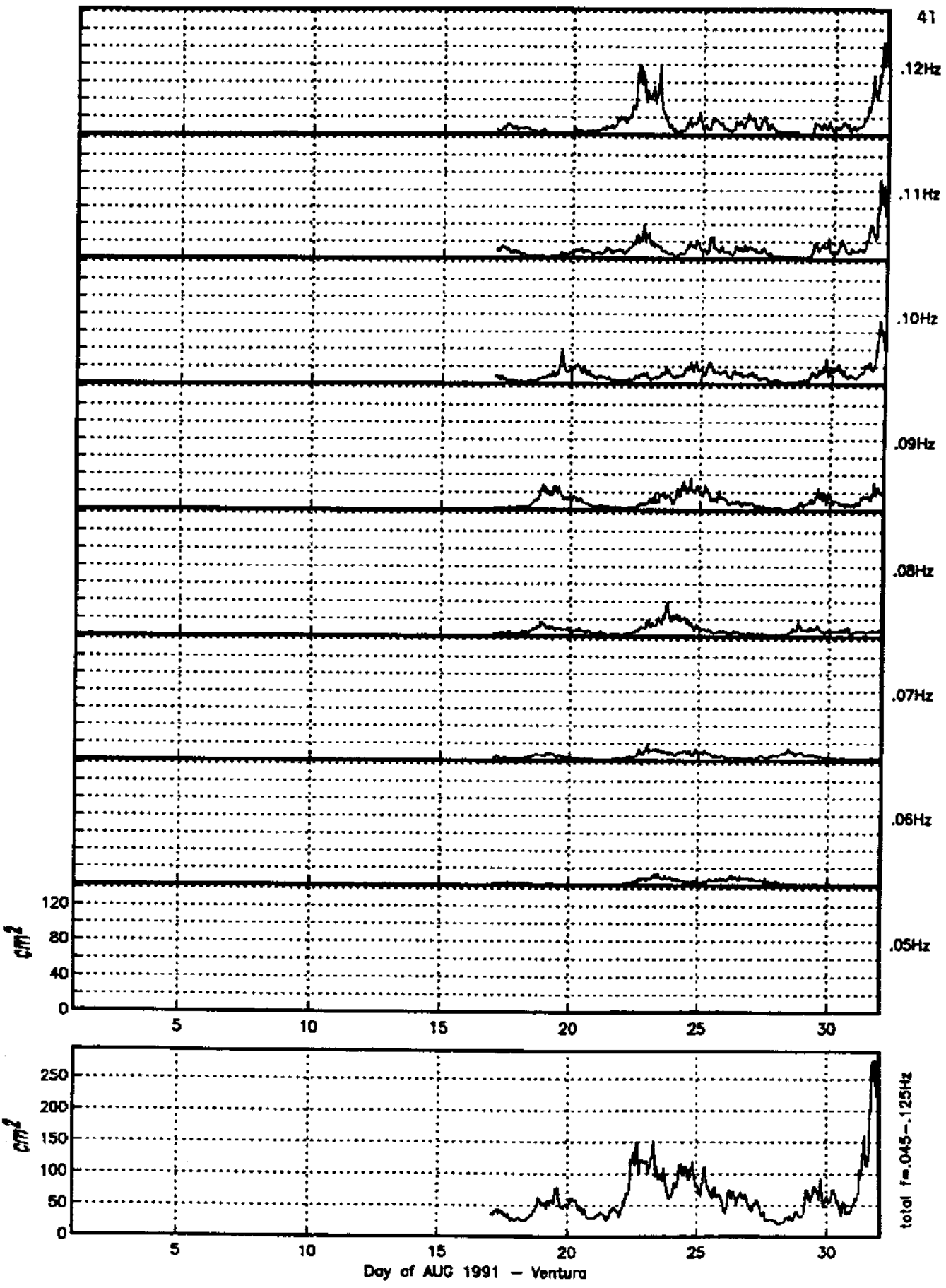

36
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
20
15
10
5
0
5
10
15
20
25
30
70
60
50
40
30
20
10
0
total f=.045-.125Hz
Day of NOV 1991 — Long Beach E

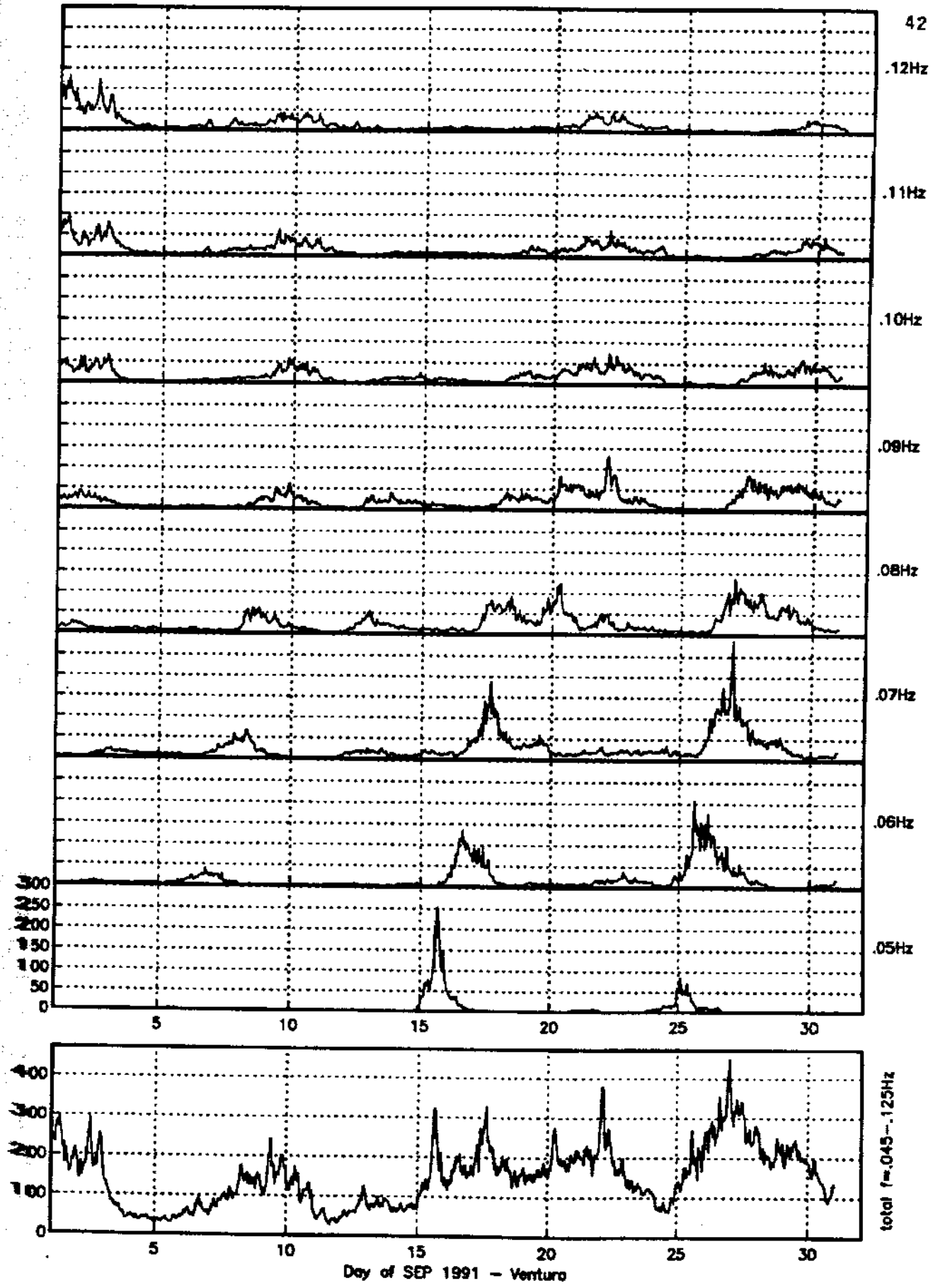

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
50
40
30
20
10
0
5
10
15
20
25
30
140
120
100
80
60
40
20
0
total f=.045-.125Hz
Day of AUG 1991 — Palos Verdes

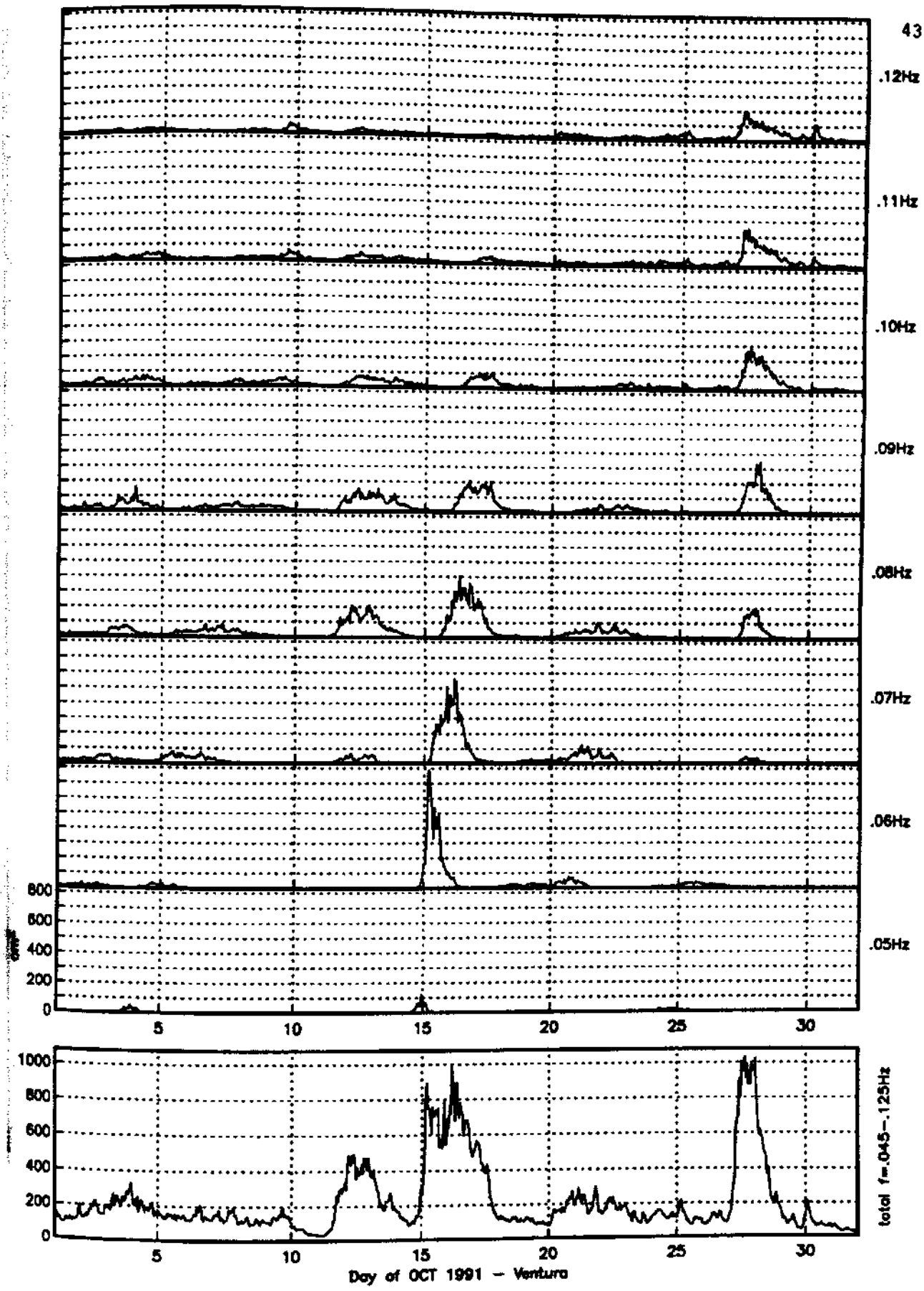

38
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
100
80
60
40
20
0
5
10
15
20
25
30
300
250
200
150
100
50
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of SEP 1991 - Palos Verdes

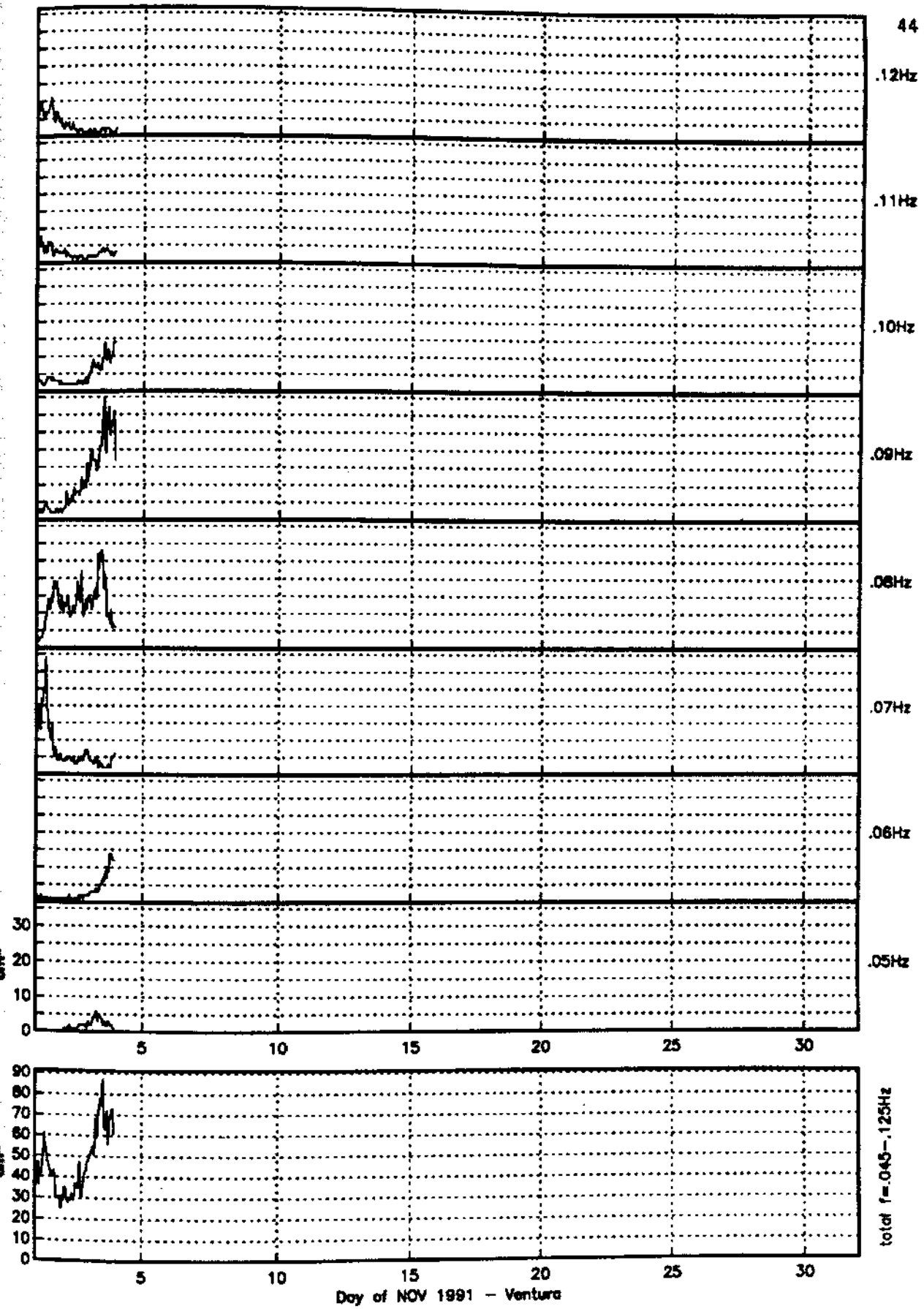

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
600
500
400
300
200
100
0
5
10
15
20
25
30
900
800
700
600
500
400
300
200
100
0
total f=.045-.125Hz
Day of OCT 1991 — Palos Verdes


40
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
50
40
30
20
10
0
5
10
15
20
25
30
100
80
60
40
20
0
total f=.045-.125Hz
Day of NOV 1991 — Palos Verdes


.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
120
80
40
0
5
10
15
20
25
30
cm²
250
200
150
100
50
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of AUG 1991 — Ventura

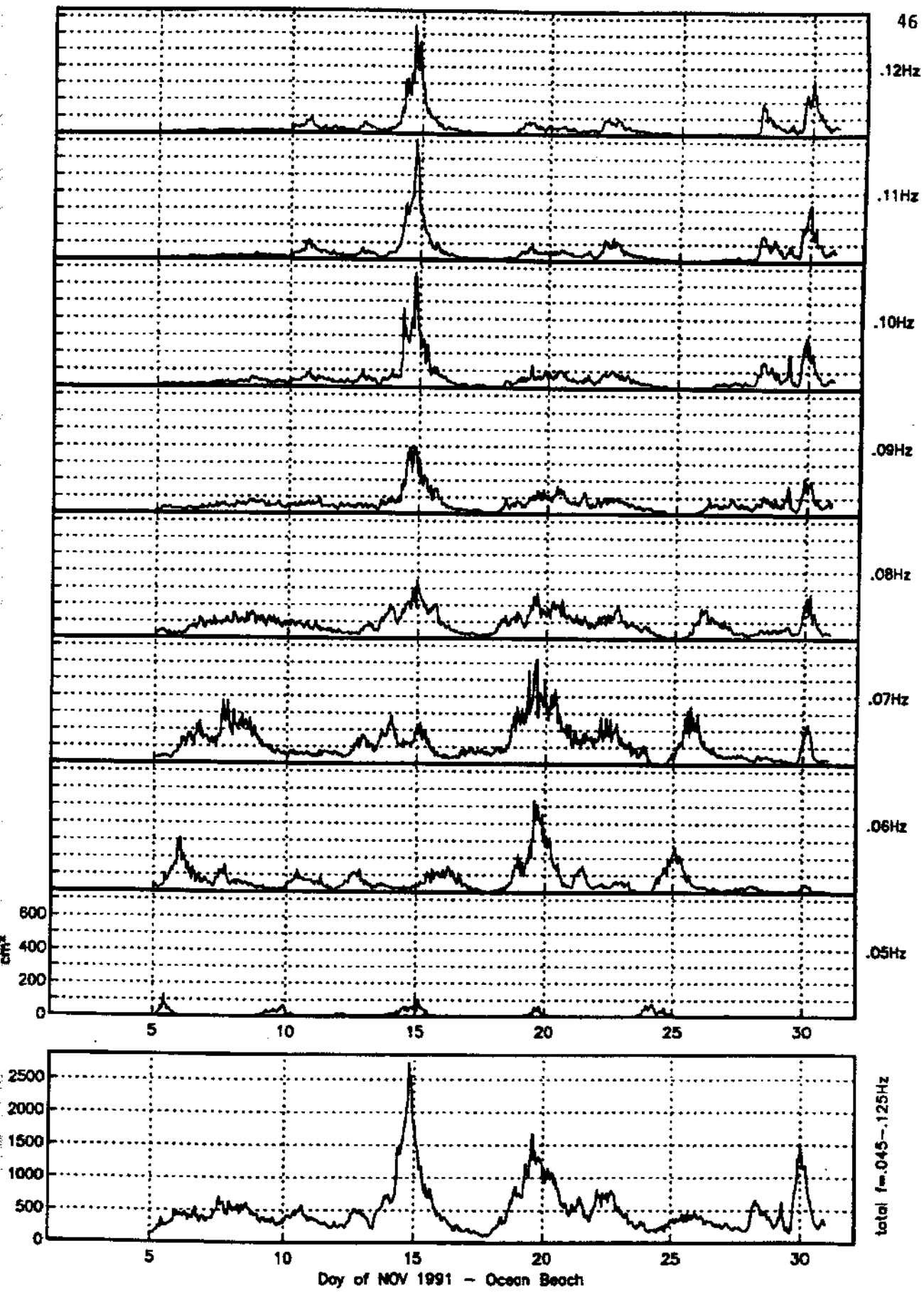

42
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
300
250
200
150
100
50
0
5
10
15
20
25
30
400
300
200
100
0
total f=.045-.125Hz
Day of SEP 1991 - Ventura

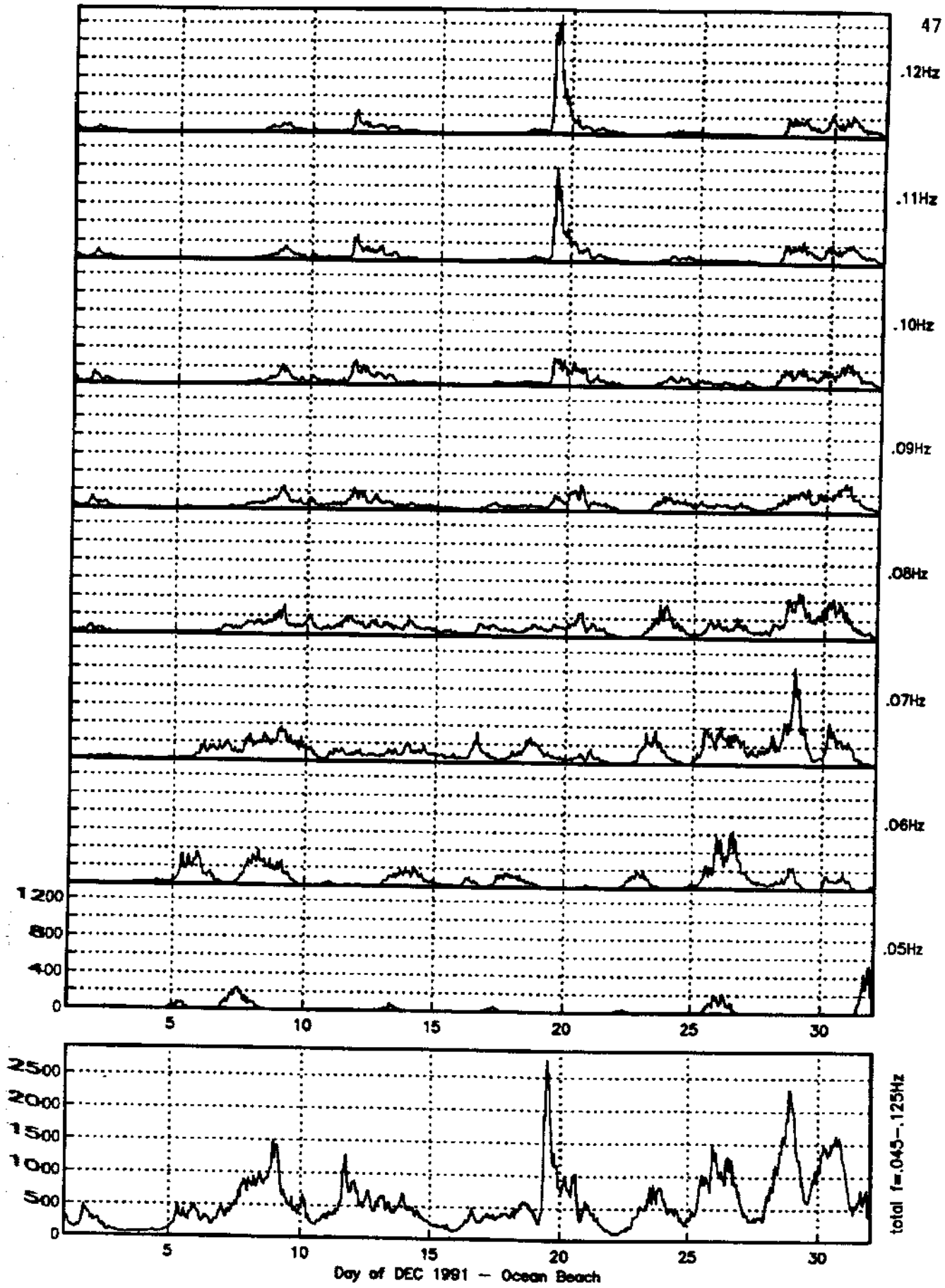

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
800
600
400
200
0
5
10
15
20
25
30
1000
800
600
400
200
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of OCT 1991 - Ventura

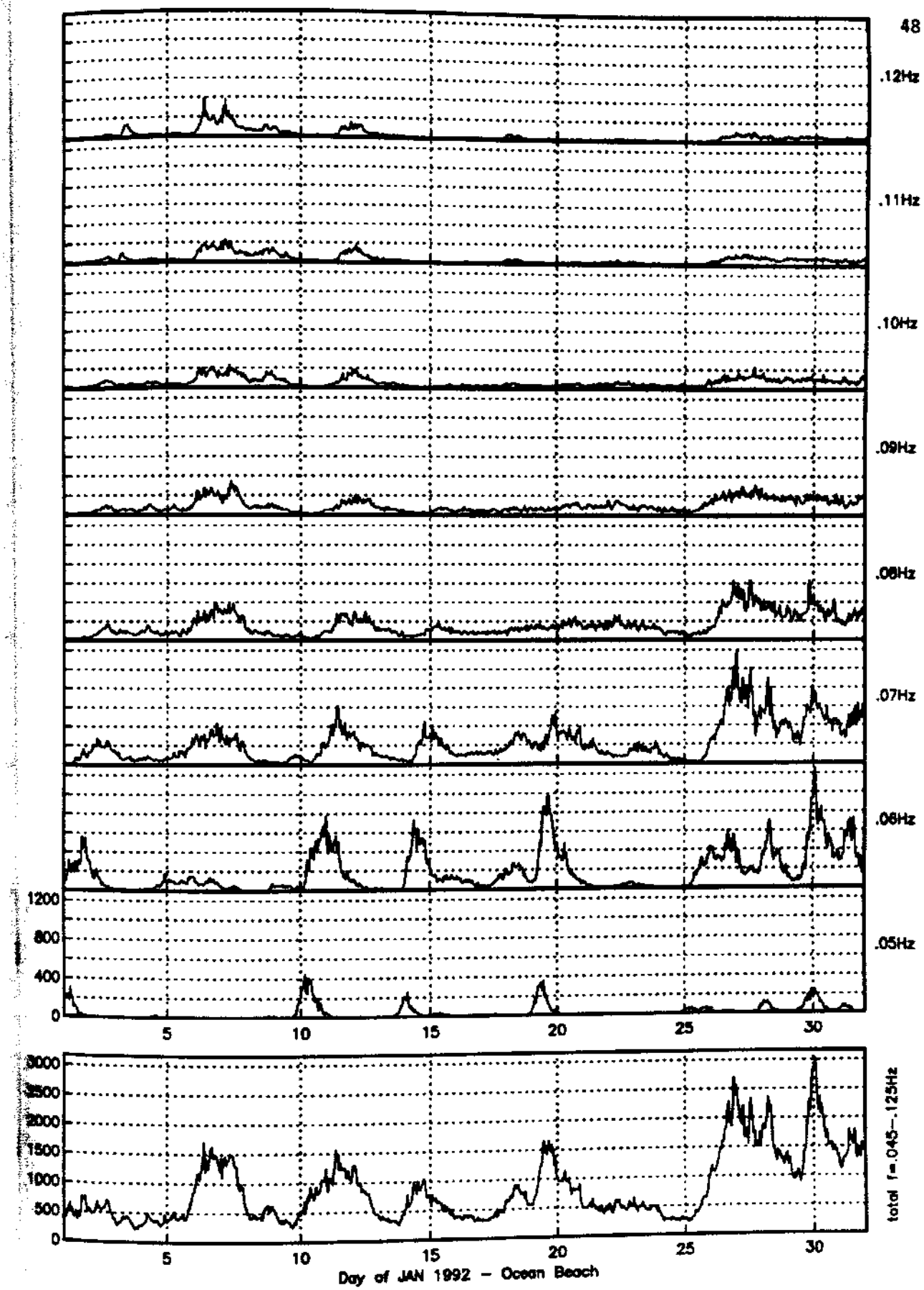

44
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
30
20
10
0
5
10
15
20
25
30
90
80
70
60
50
40
30
20
10
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of NOV 1991 - Ventura

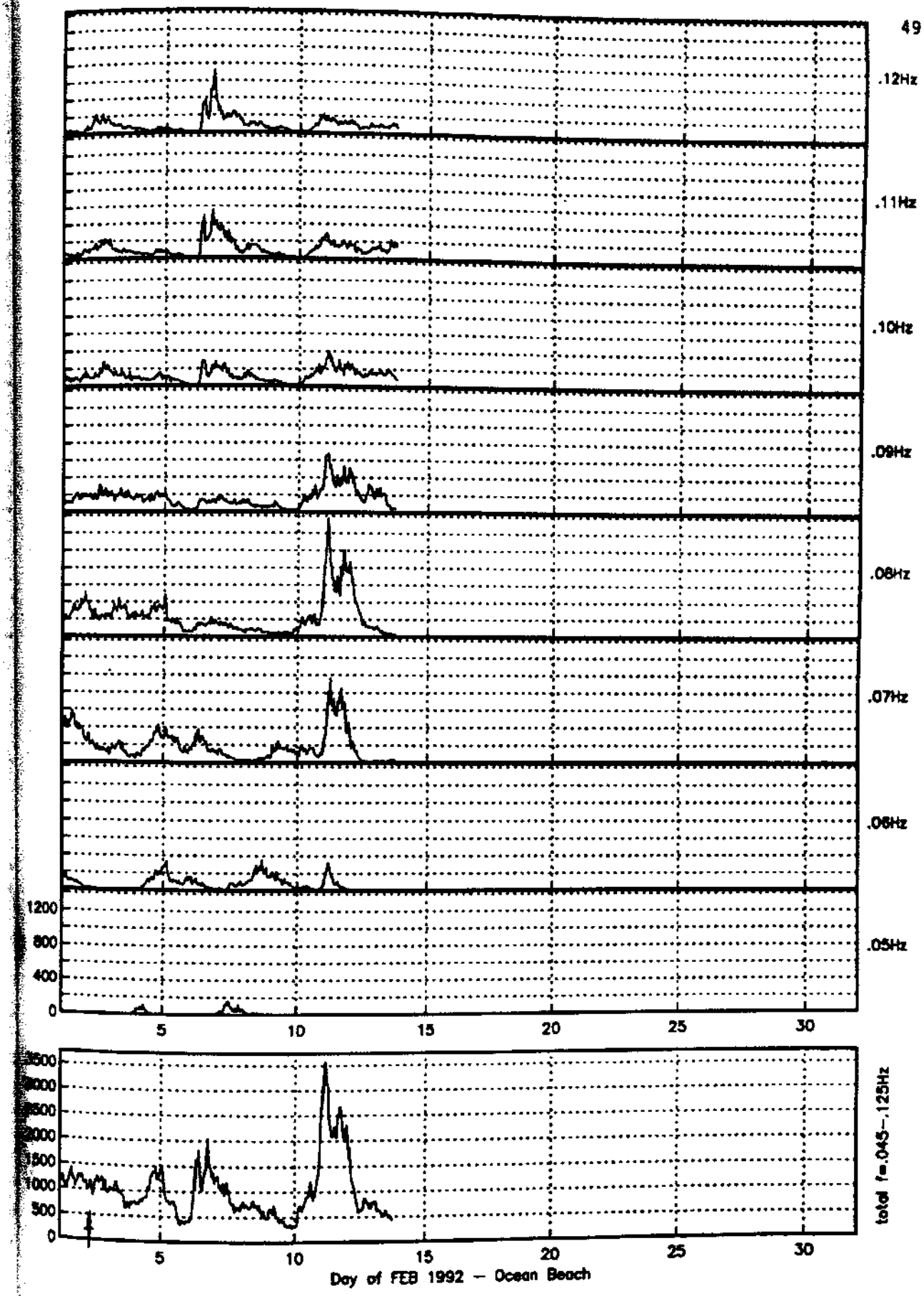
Winter Deployment Data

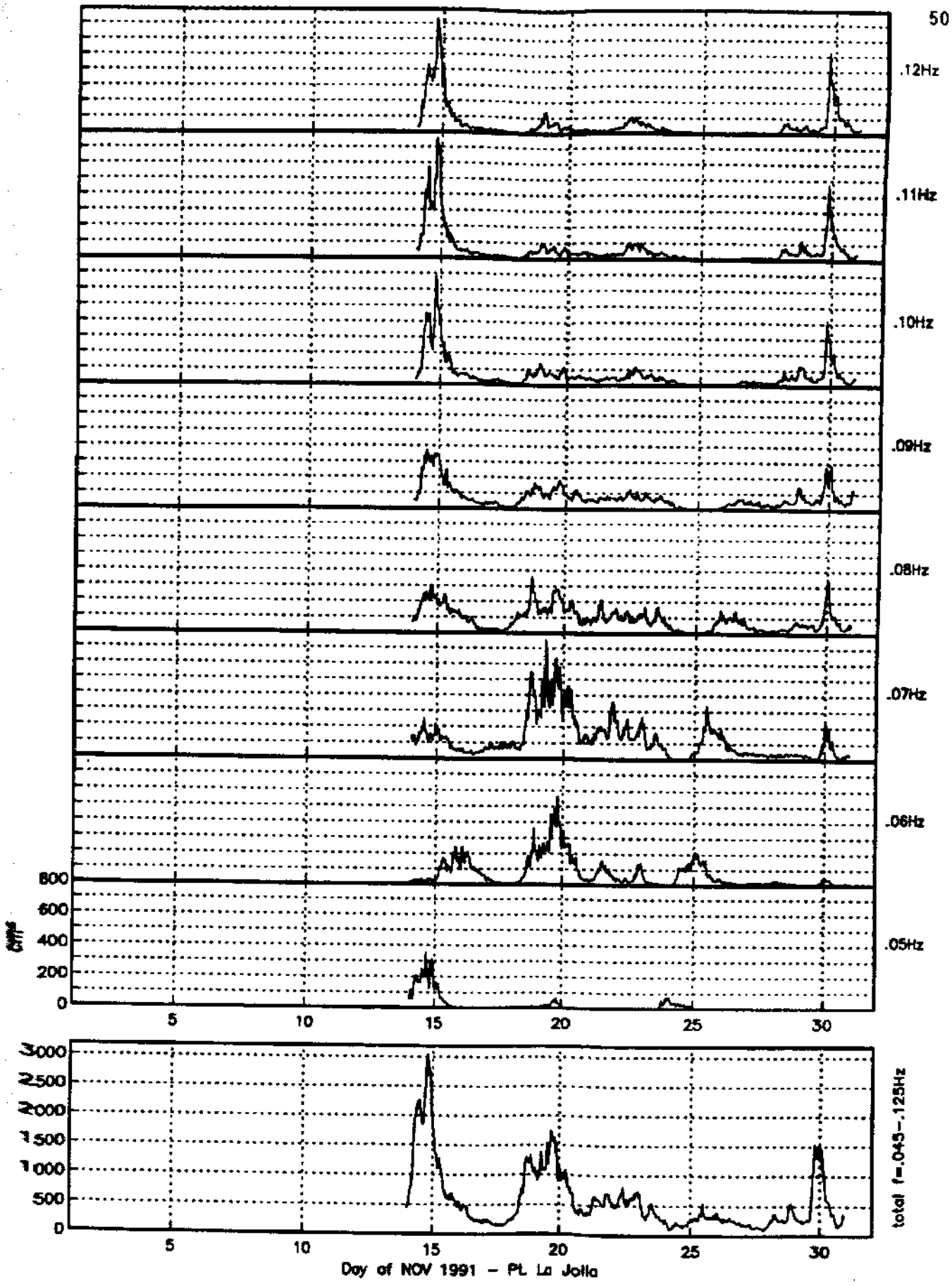
Site No.	Location	Page No.
1	Ocean Beach	46-49
2	Pt. La Jolla	50-53
3	Batiguitos	54-57
4	Oceanside	58-61
5	Dana Point	62-65
6	Redondo	66-69
7	Ventura	70-73
8	Santa Rosa NE	74-77
9	Santa Rosa NW	78-81
10	Santa Rosa W	82-85
11	Santa Rosa SW	86-89

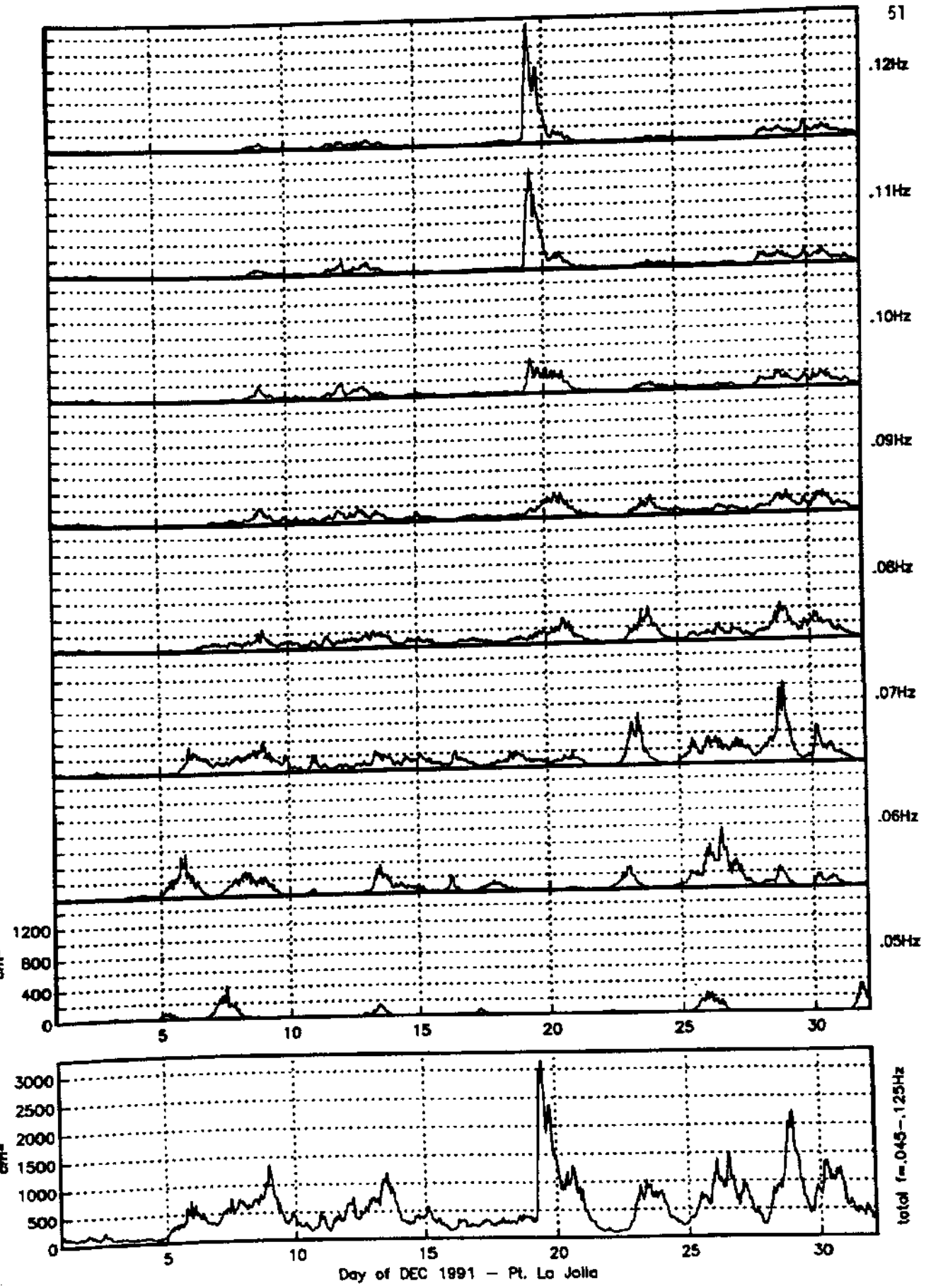

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm
600
400
200
0
5
10
15
20
25
30
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of NOV 1991 - Ocean Beach

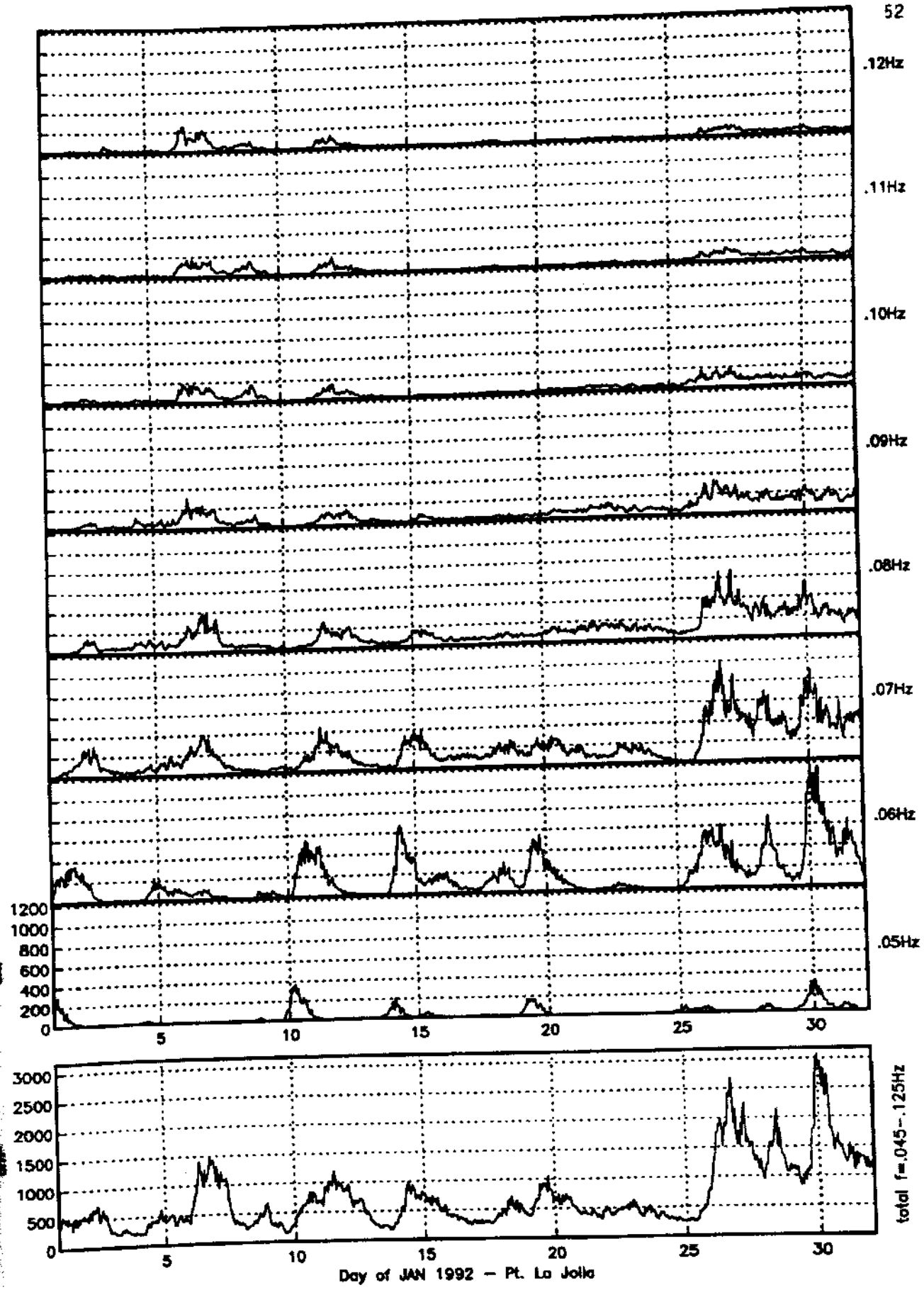

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
800
400
0
5
10
15
20
25
30
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of DEC 1991 — Ocean Beach

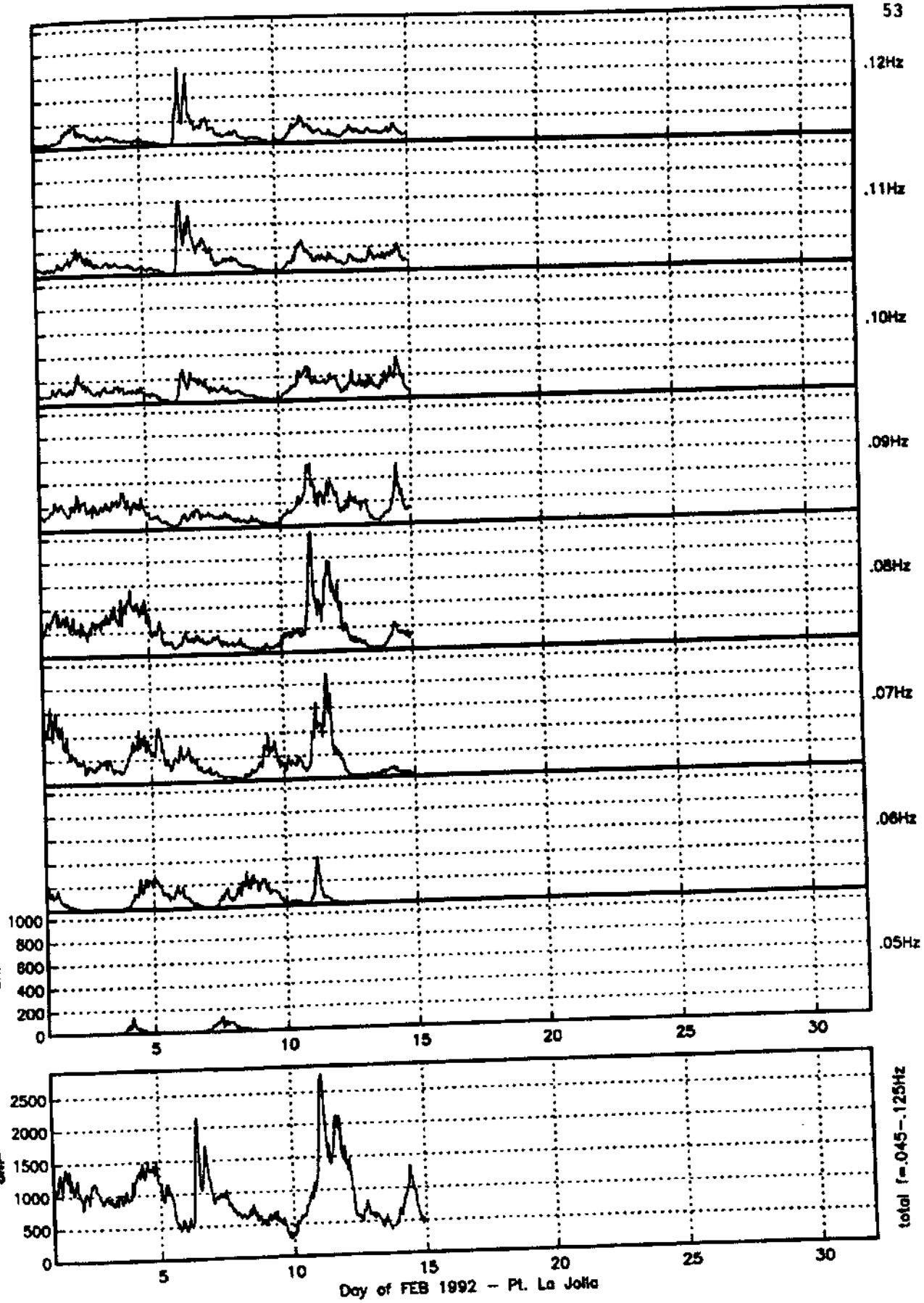

48
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
800
400
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of JAN 1992 - Ocean Beach

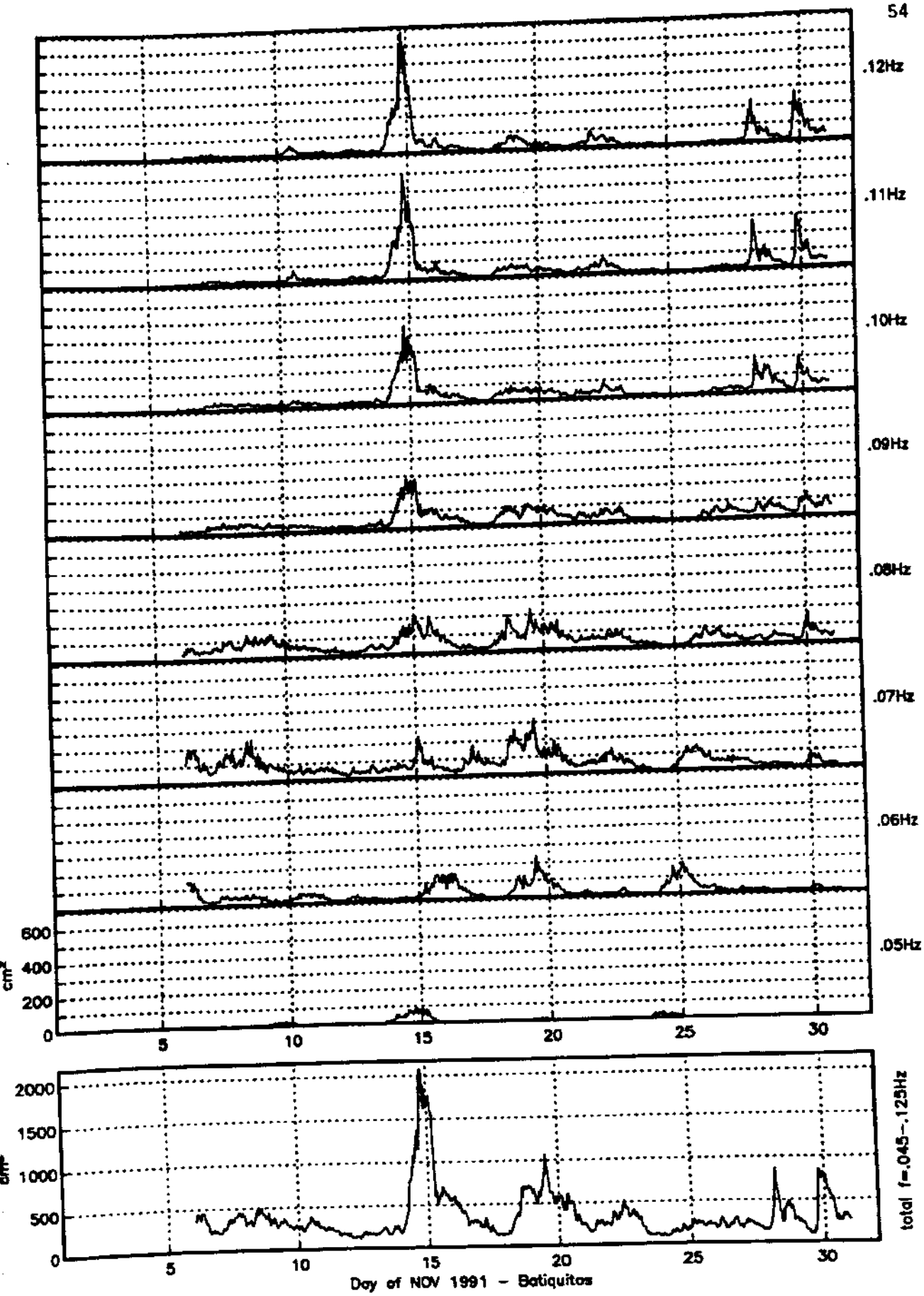

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
800
400
0
5
10
15
20
25
30
3500
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of FEB 1992 — Ocean Beach

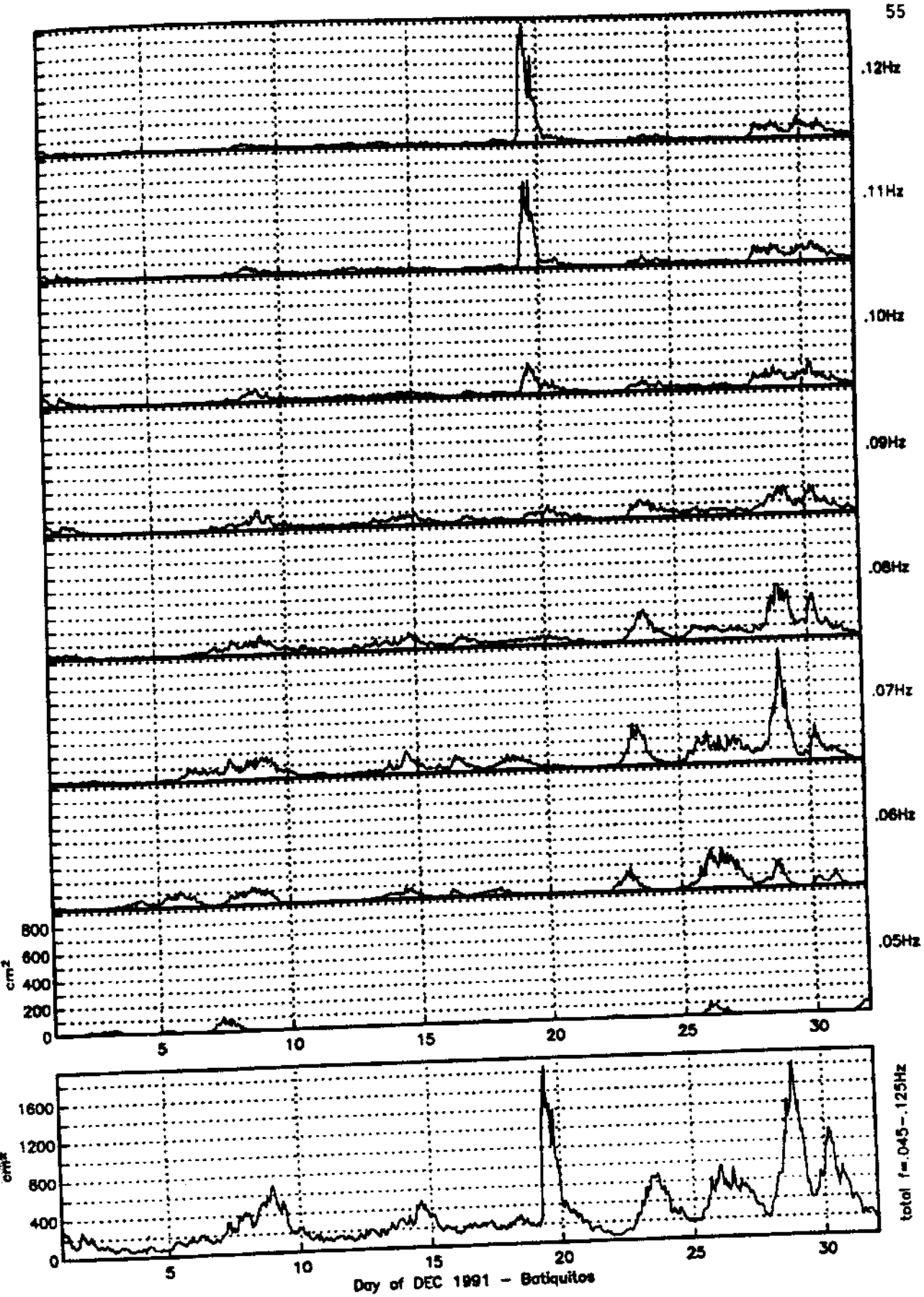

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
800
600
400
200
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of NOV 1991 - Pt. La Jolla

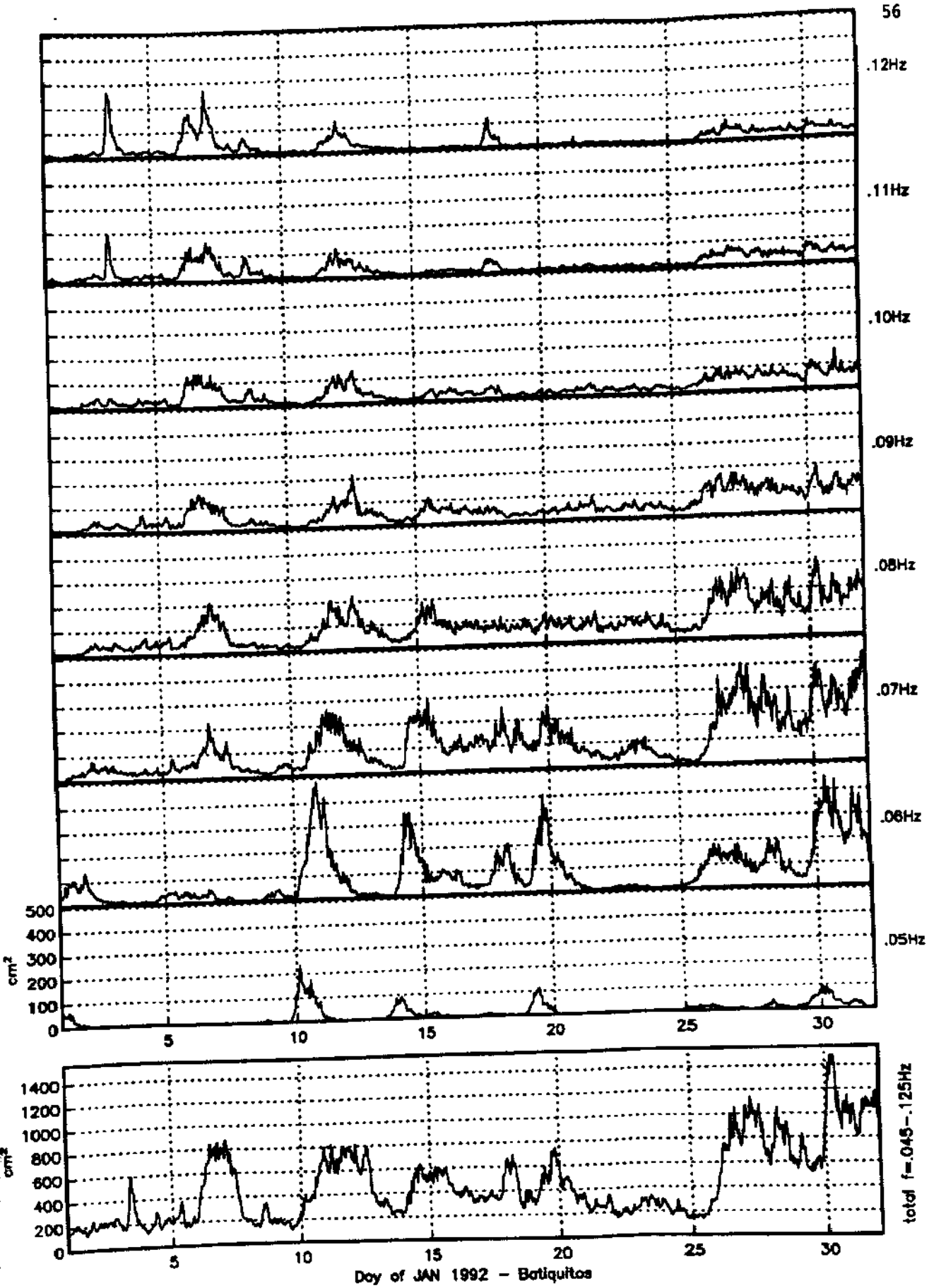

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
800
400
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of DEC 1991 — Pt. La Jolla

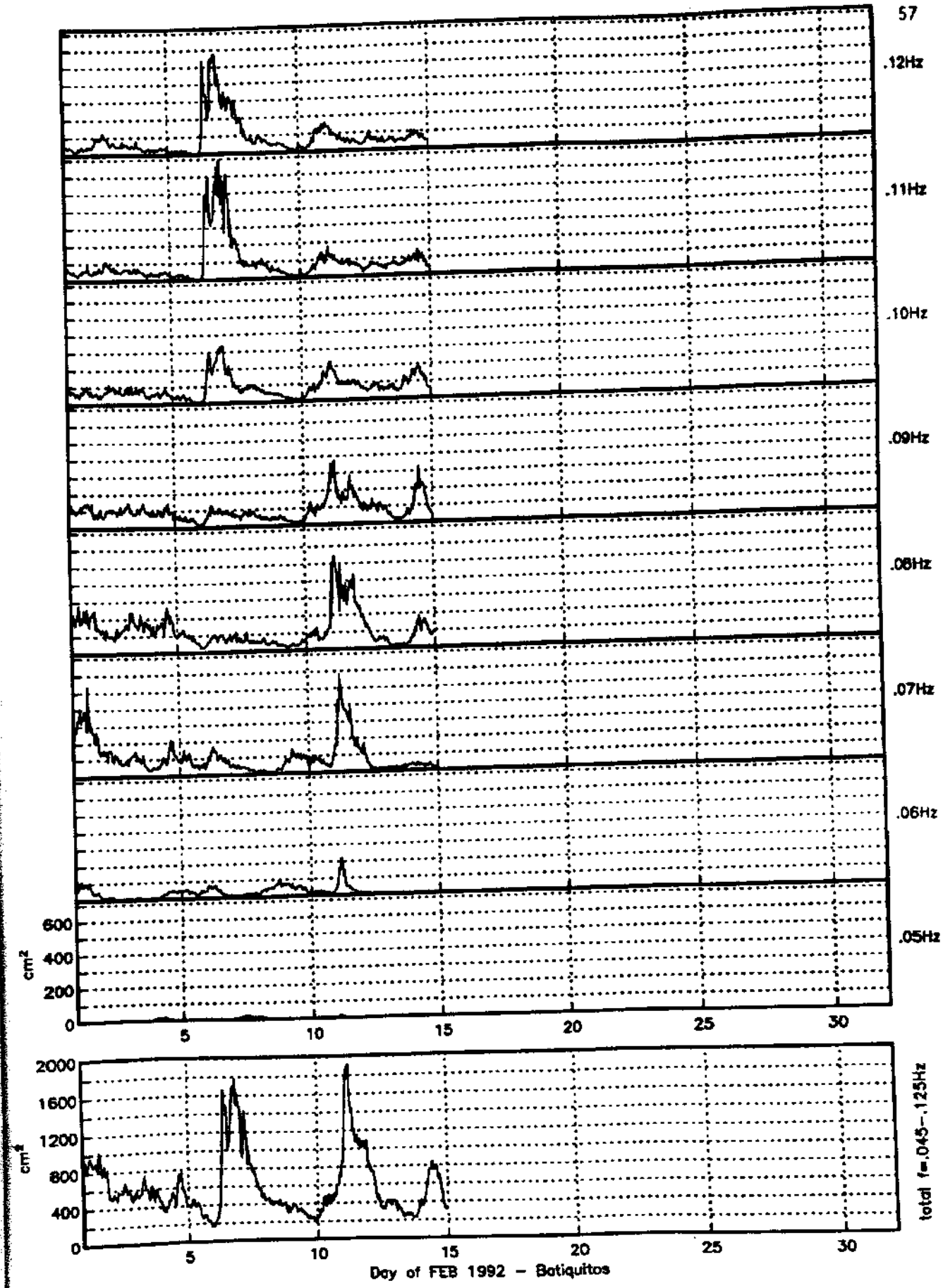

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
1000
800
600
400
200
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of JAN 1992 — Pt. La Jolla

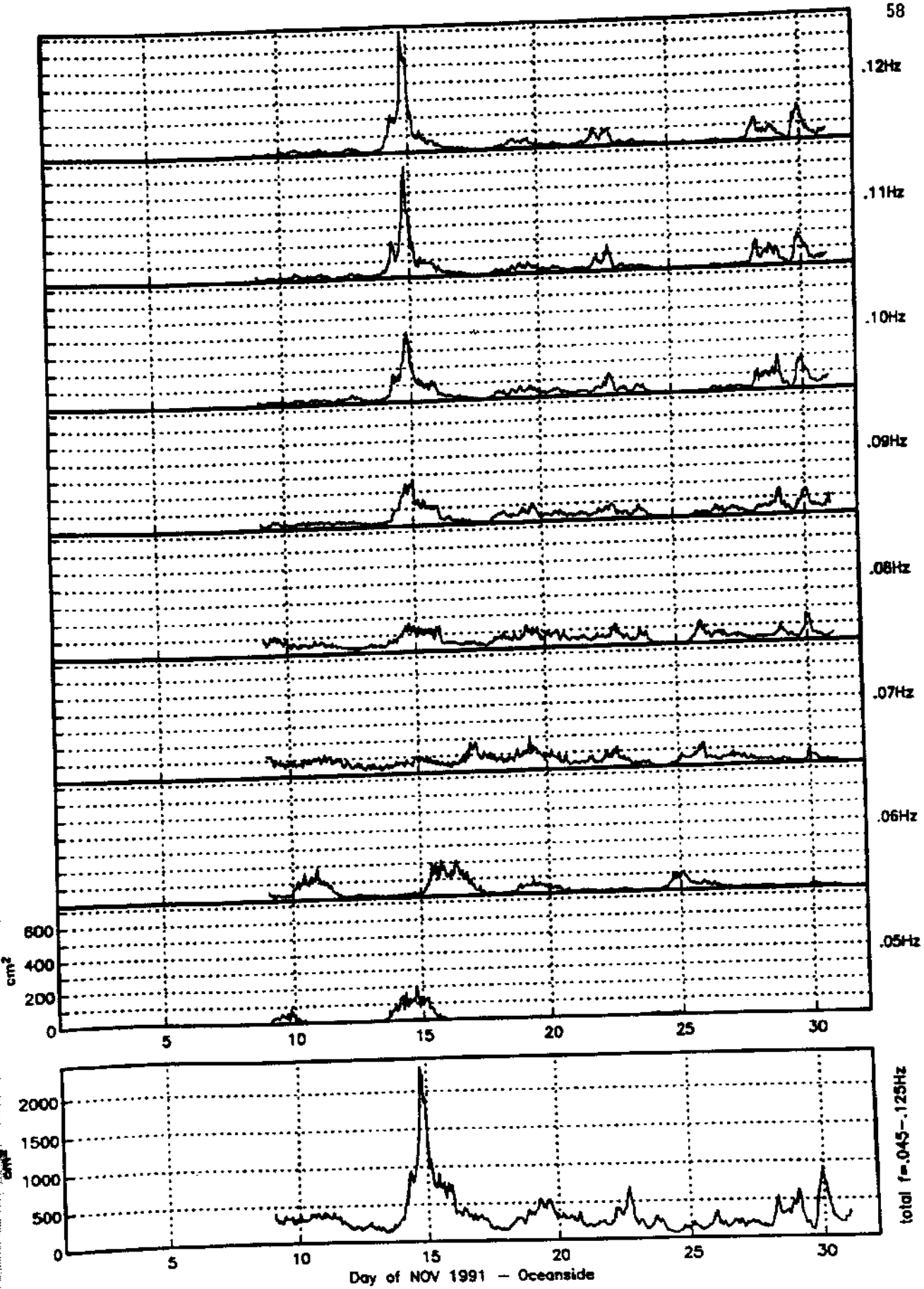

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1000
800
600
400
200
0
5
10
15
20
25
30
2500
2000
1500
1000
500
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of FEB 1992 -- Pt. La Jolla

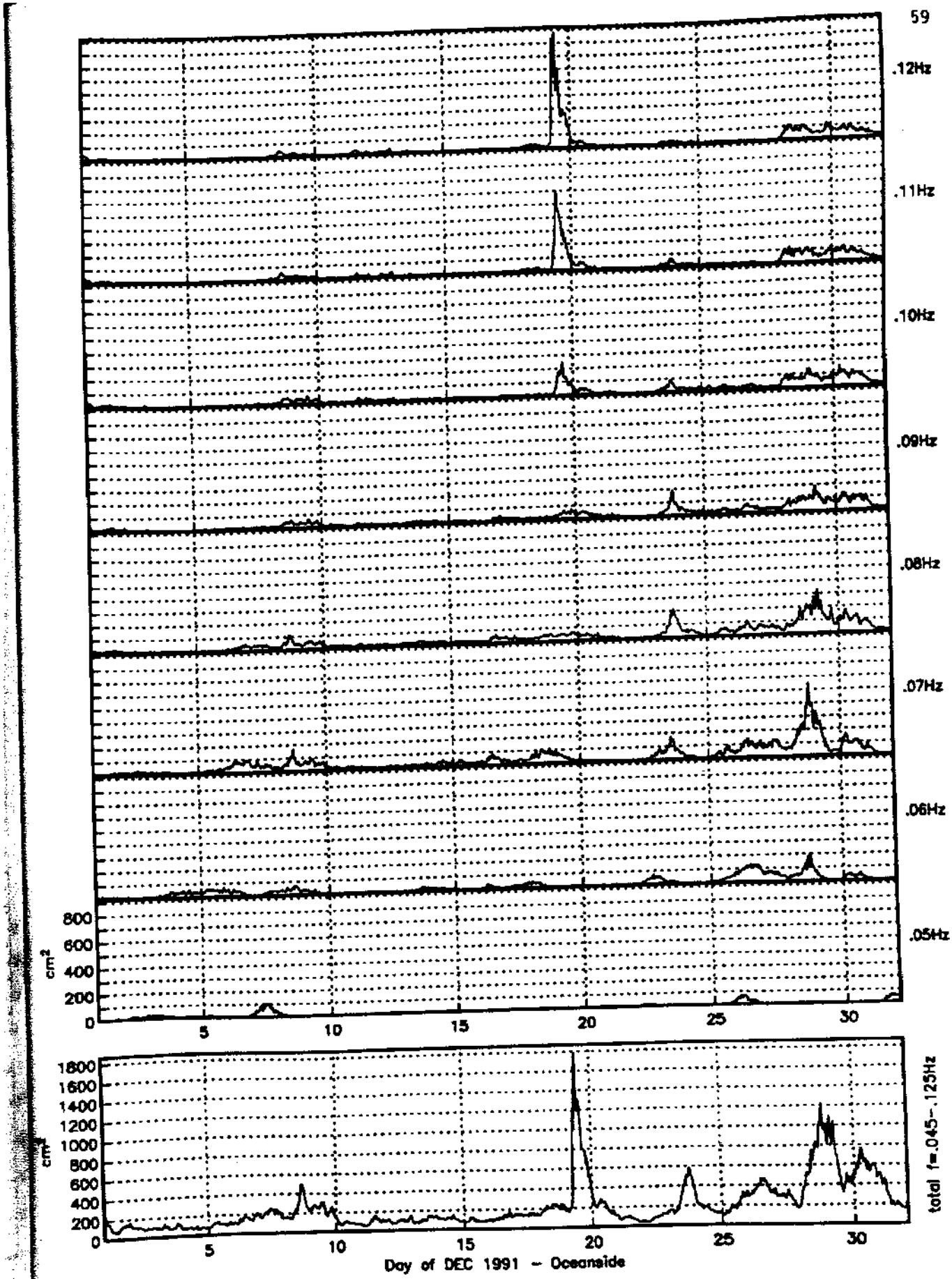

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
600
400
200
0
5
10
15
20
25
30
2000
1500
1000
500
0
total f=.045-.125Hz
Day of NOV 1991 - Batiquitos

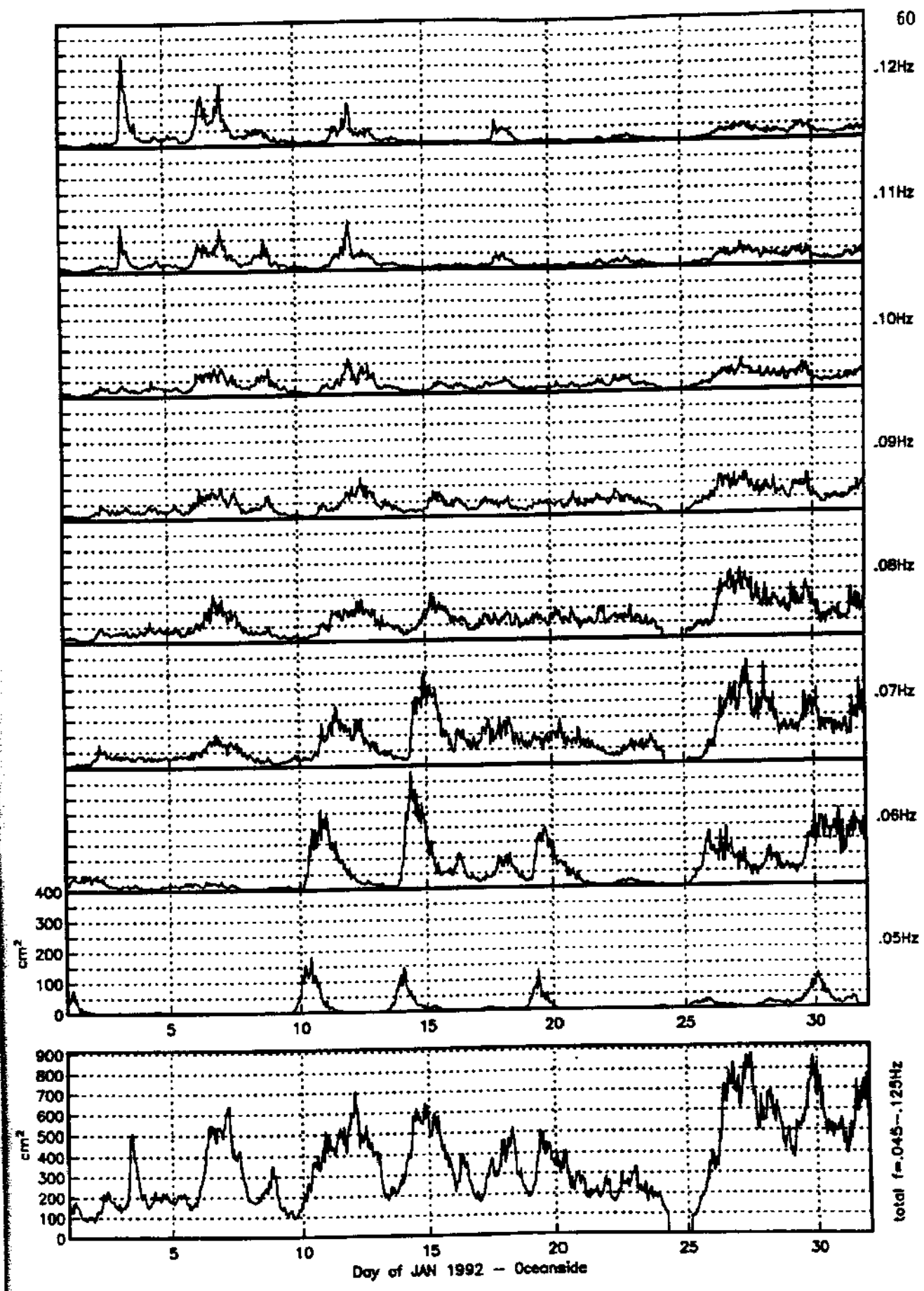

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
800
600
400
200
0
5
10
15
20
25
30
1600
1200
800
400
0
total f=.045-.125Hz
Day of DEC 1991 - Batiquitos

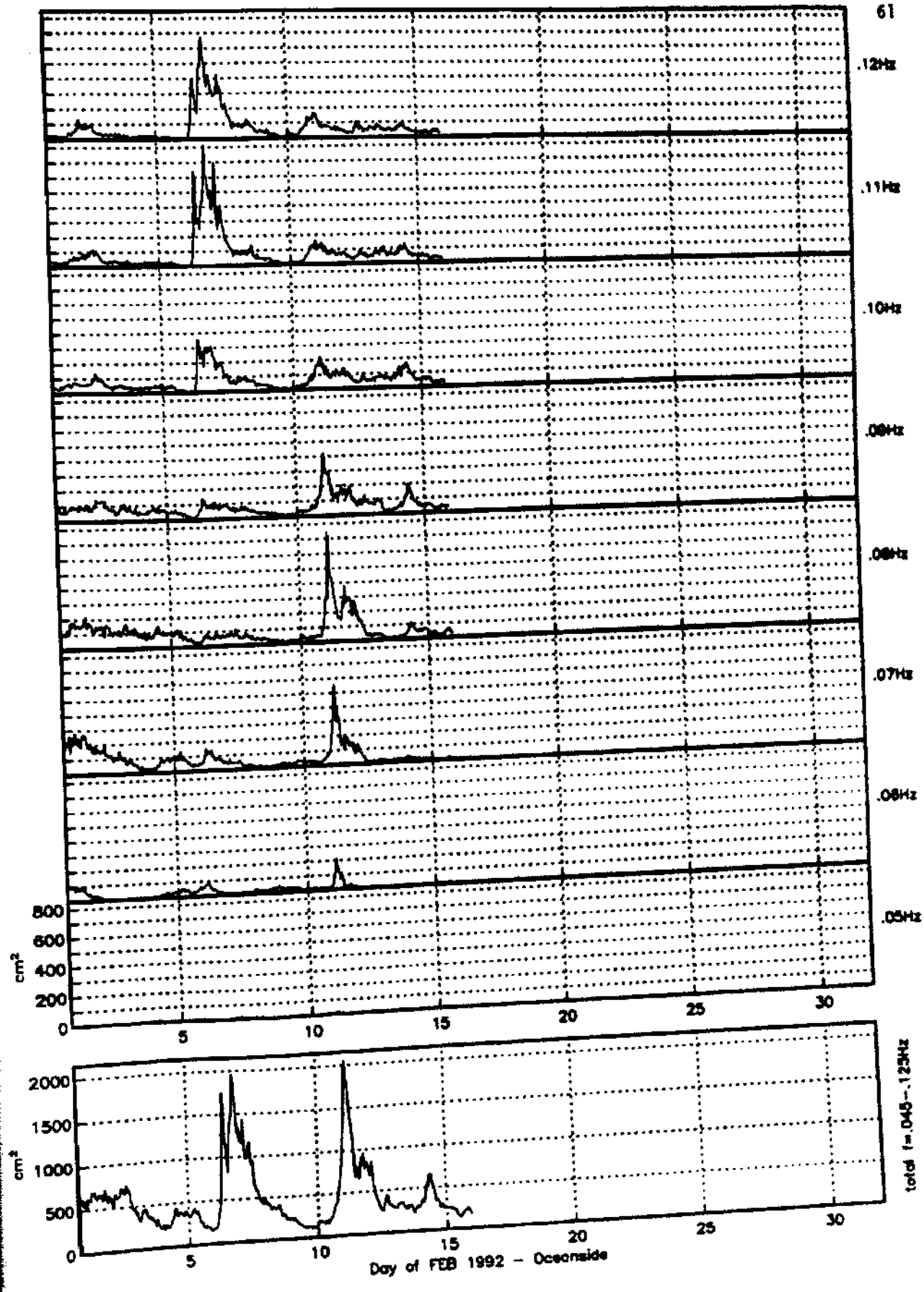

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
500
400
300
200
100
0
5
10
15
20
25
30
1400
1200
1000
800
600
400
200
0
total f=.045-.125Hz
Doy of JAN 1992 – Batiquitos

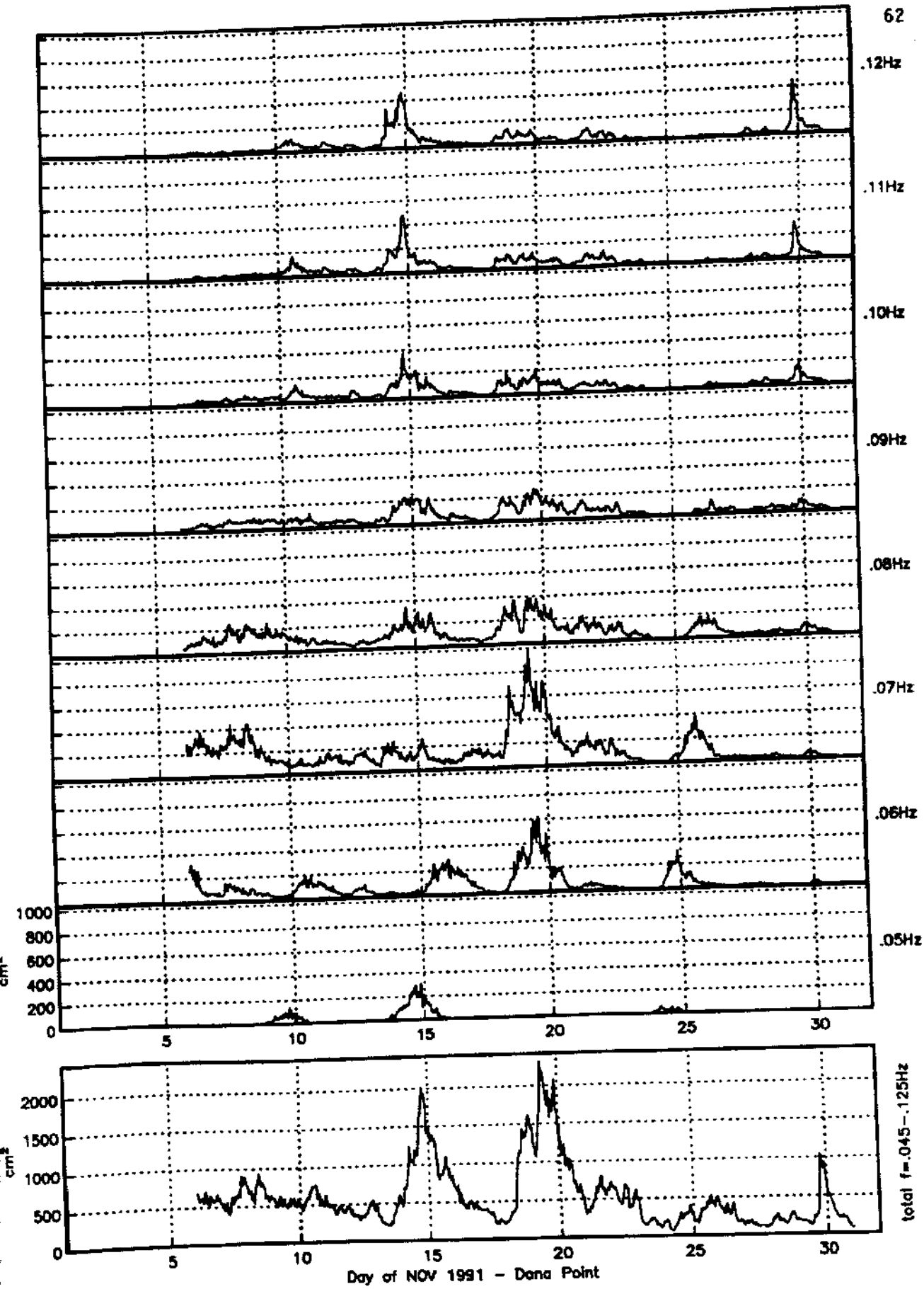

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
600
400
200
0
5
10
15
20
25
30
2000
1600
1200
800
400
0
total f=.045-.125Hz
Day of FEB 1992 – Batiquitos

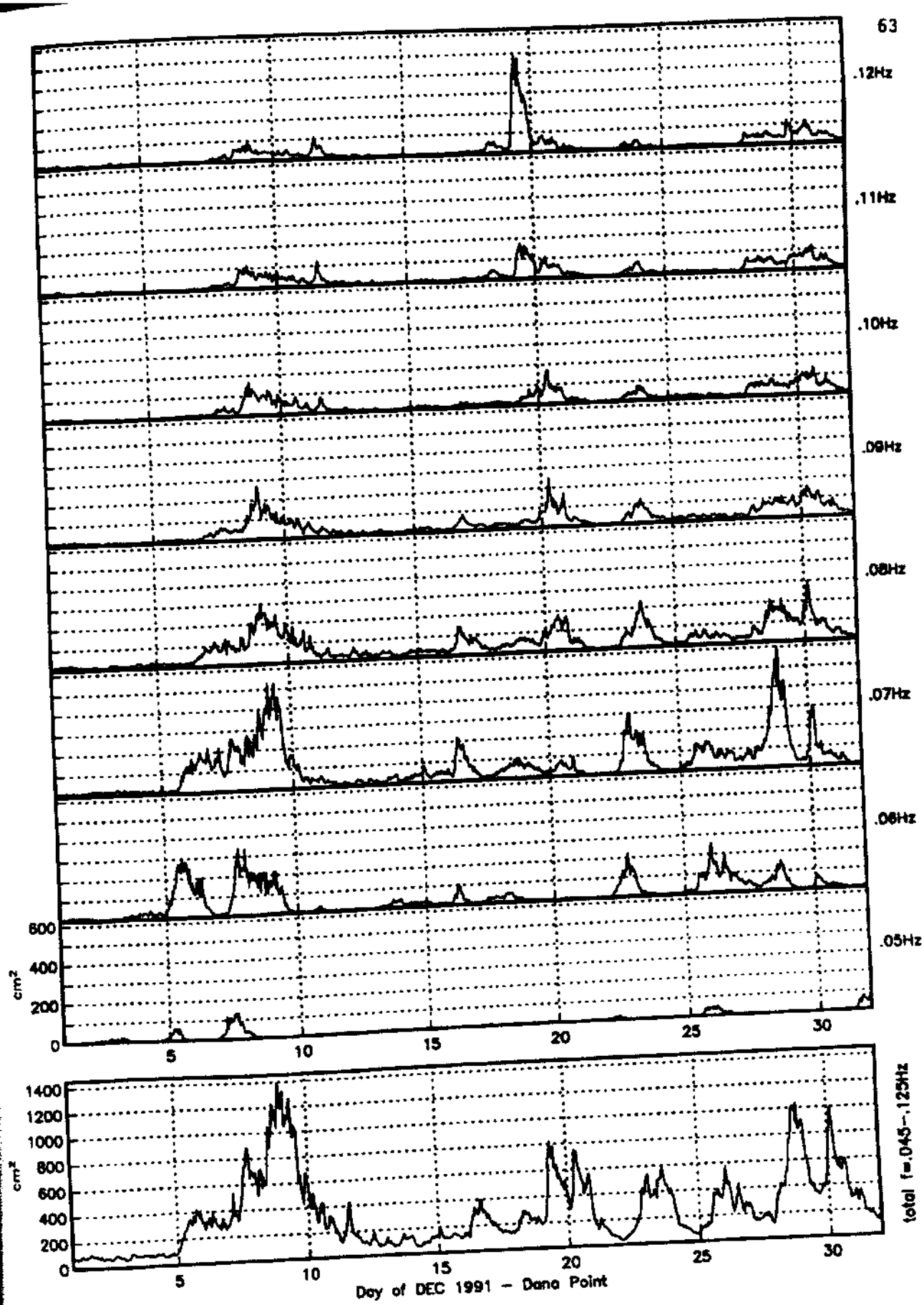

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
600
400
200
0
5
10
15
20
25
30
2000
1500
1000
500
0
total f=.045-.125Hz
Day of NOV 1991 — Oceanside

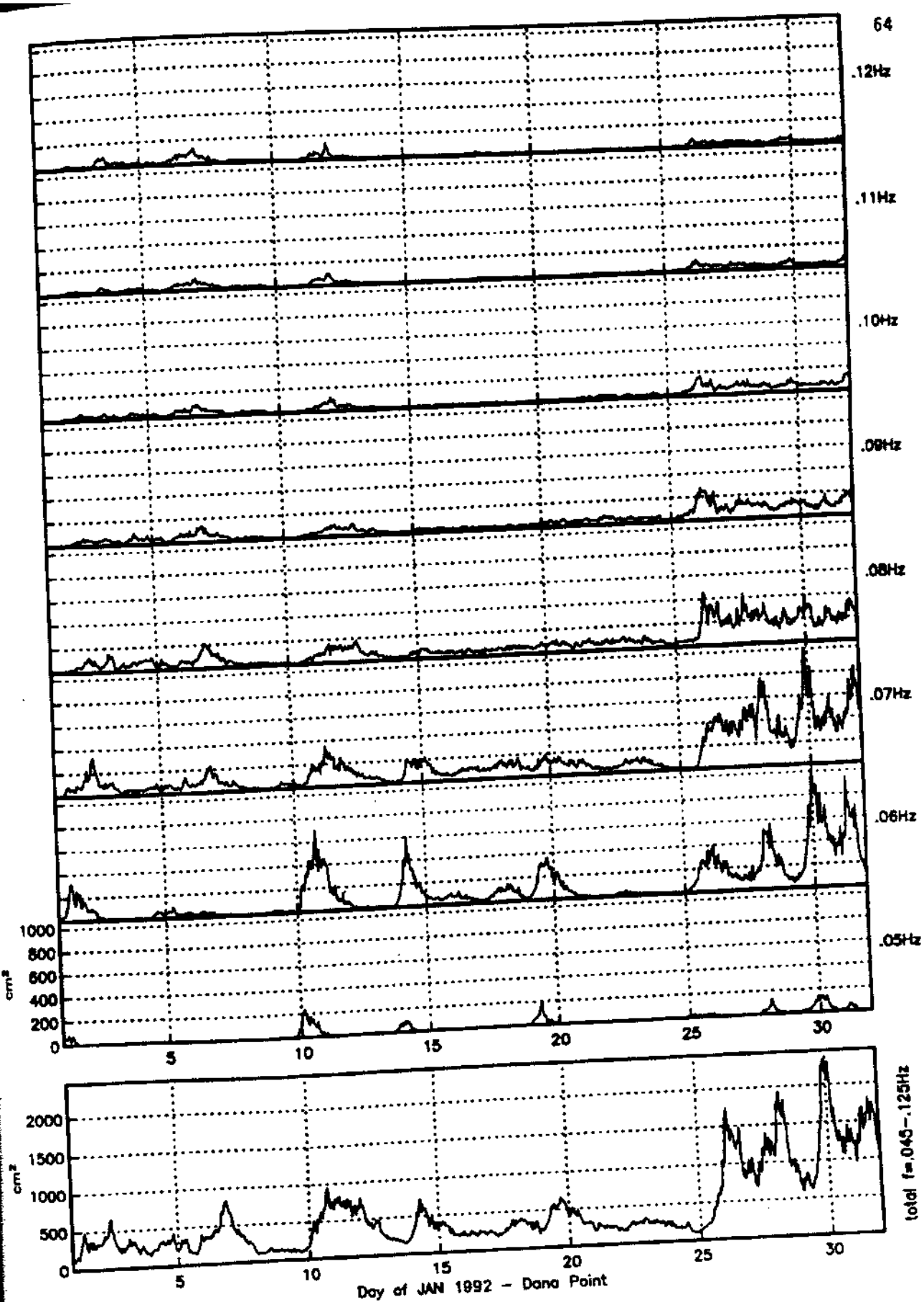

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
200
400
600
800
5
10
15
20
25
30
cm²
0
200
400
600
800
1000
1200
1400
1600
1800
5
10
15
20
25
30
total f=.045-.125Hz
Day of DEC 1991 -- Oceanside

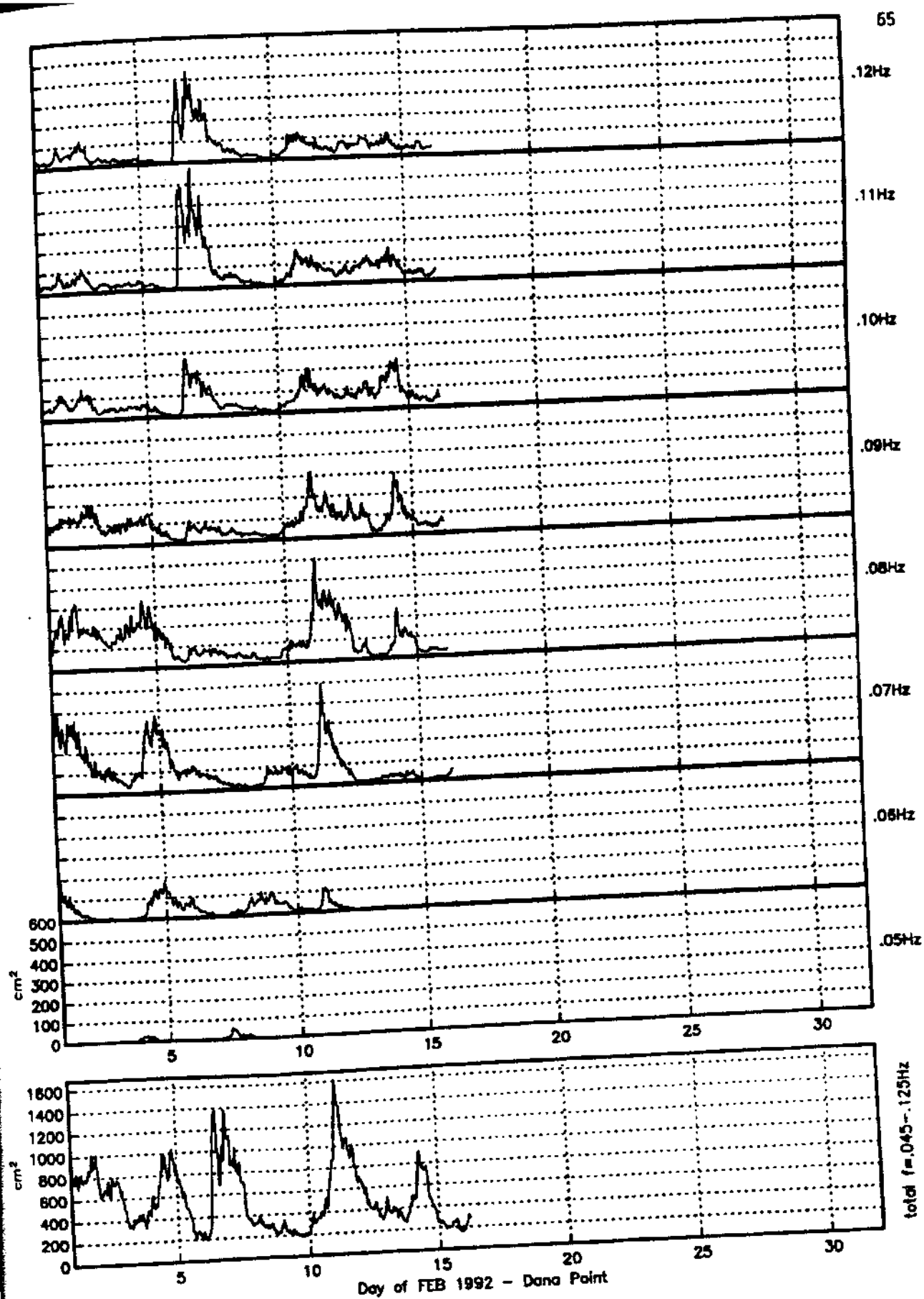

60
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
400
300
200
100
0
5
10
15
20
25
30
900
800
700
600
500
400
300
200
100
0
cm²
total f=.045-.125Hz
Day of JAN 1992 -- Oceanside

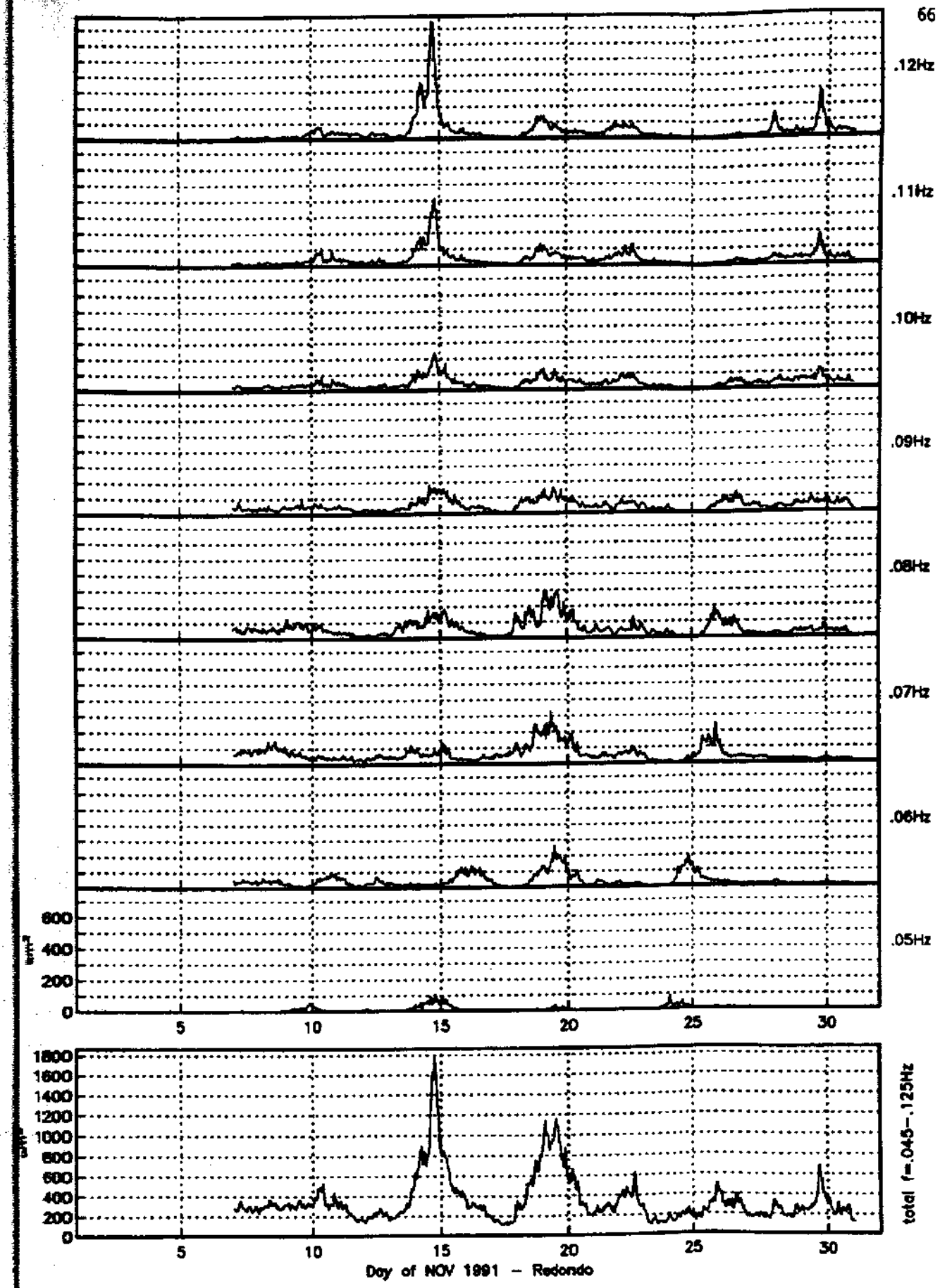

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
800
600
400
200
0
5
10
15
20
25
30
2000
1500
1000
500
0
total f=.045-.125Hz
Day of FEB 1992 - Oceanside

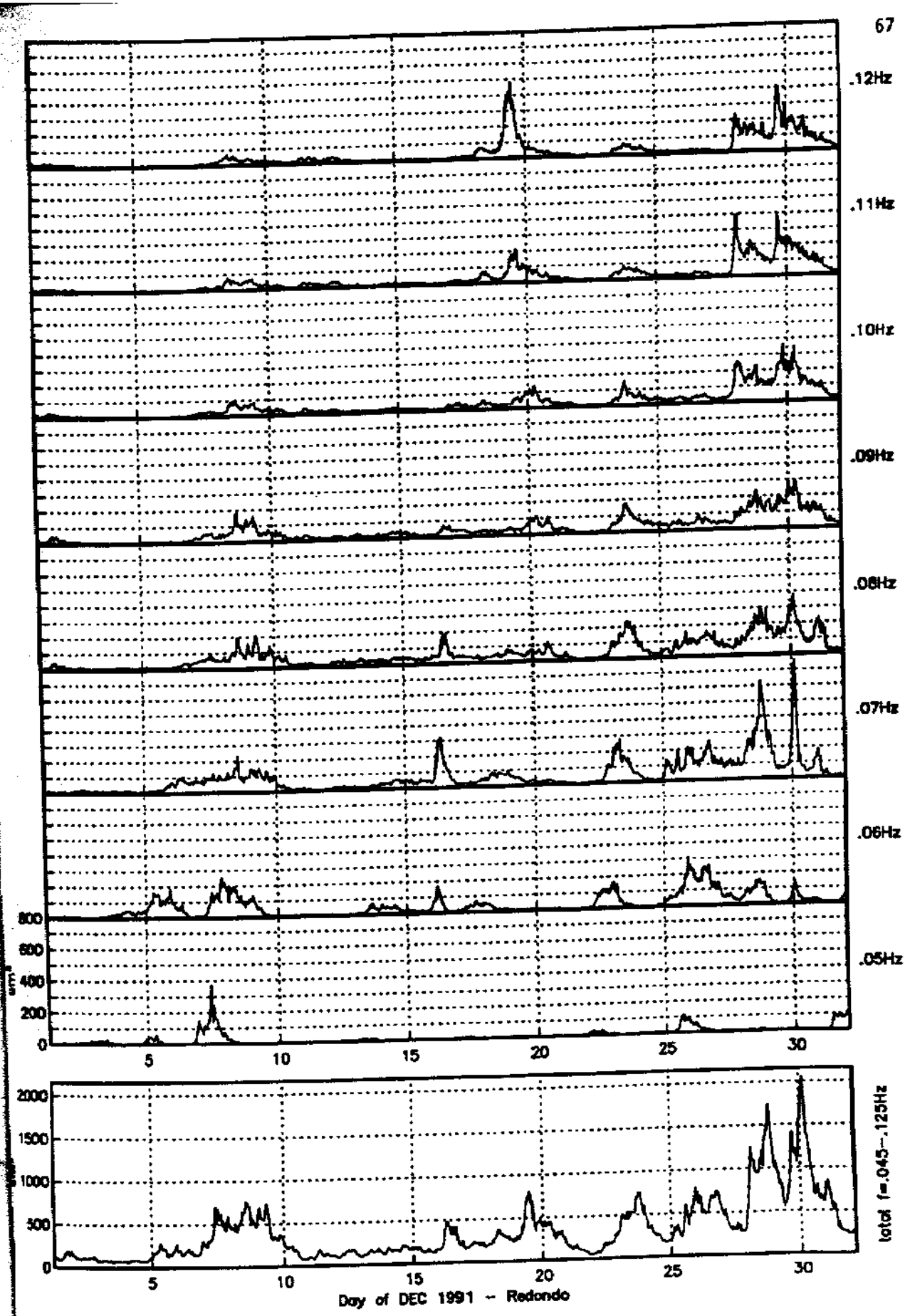

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
1000
800
600
400
200
0
5
10
15
20
25
30
cm²
2000
1500
1000
500
0
total f=.045-.125Hz
Day of NOV 1991 - Dana Point

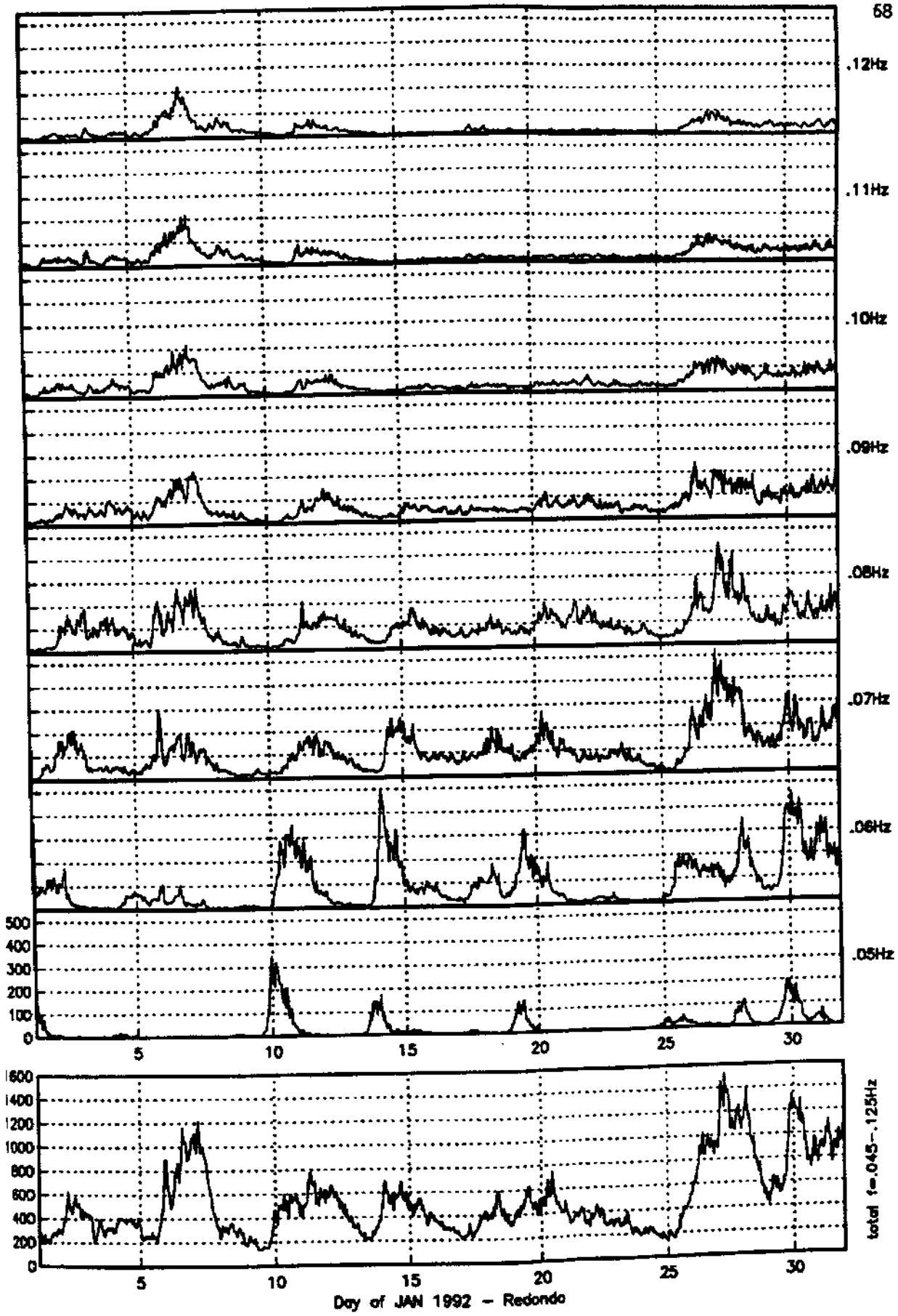

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
200
400
600
5
10
15
20
25
30
cm²
0
200
400
600
800
1000
1200
1400
5
10
15
20
25
30
Day of DEC 1991 – Dana Point
total f=.045-.125Hz

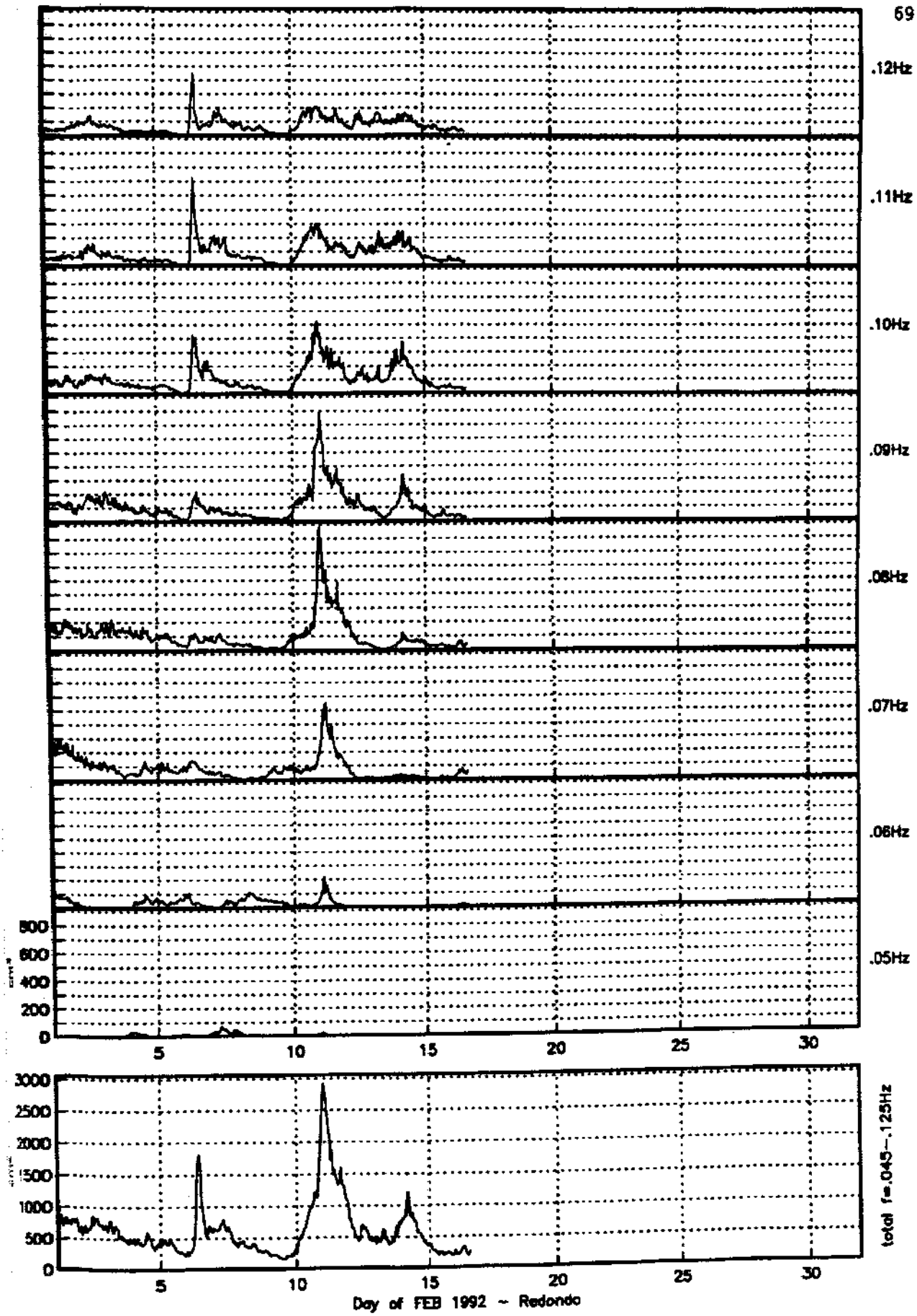

64
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1000
800
600
400
200
0
cm²
5
10
15
20
25
30
2000
1500
1000
500
0
cm²
total f=.045-.125Hz
Day of JAN 1992 - Dana Point

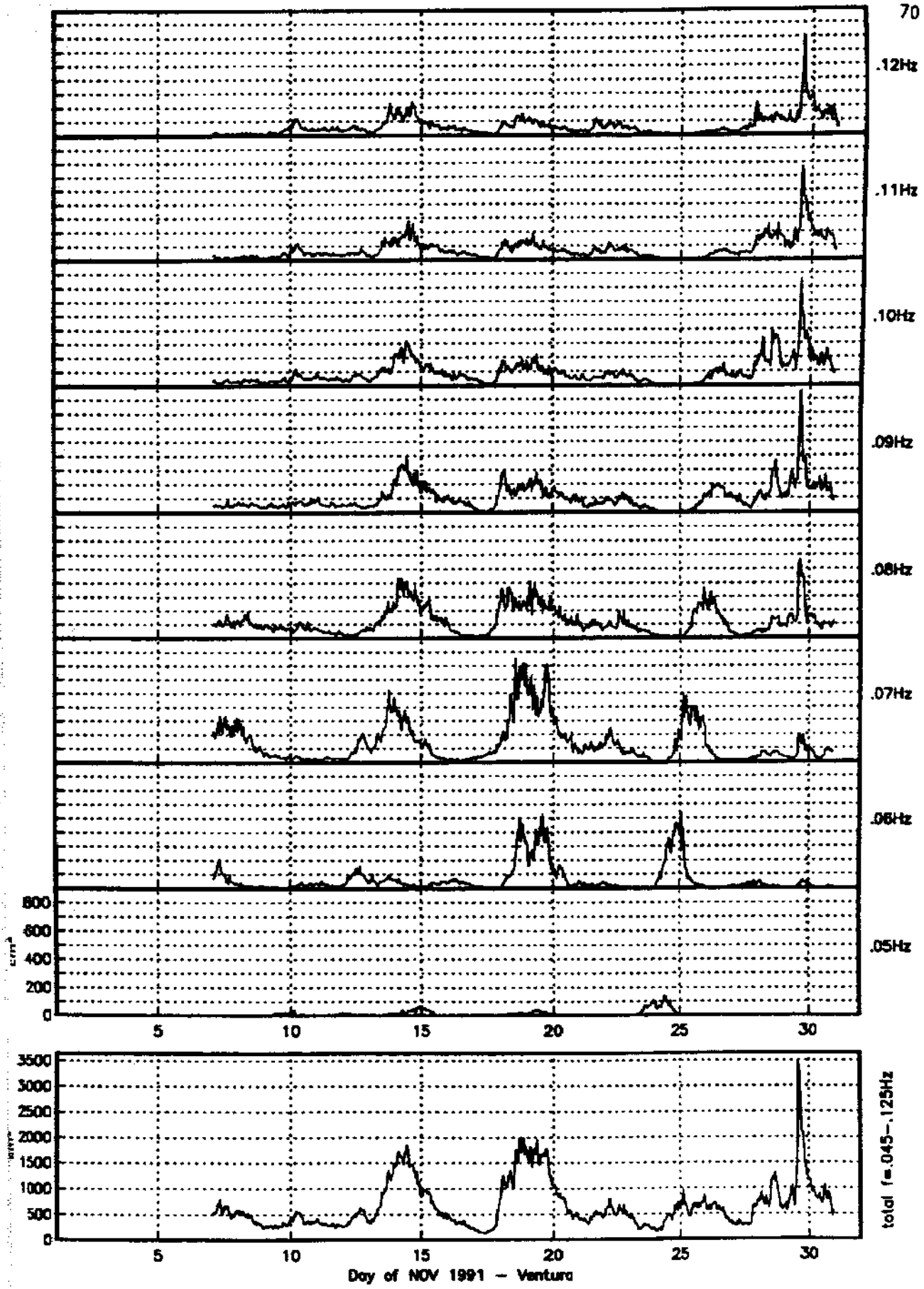

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
0
100
200
300
400
500
600
5
10
15
20
25
30
cm²
0
200
400
600
800
1000
1200
1400
1600
5
10
15
20
25
30
Day of FEB 1992 – Dana Point
total fm.045-.125Hz

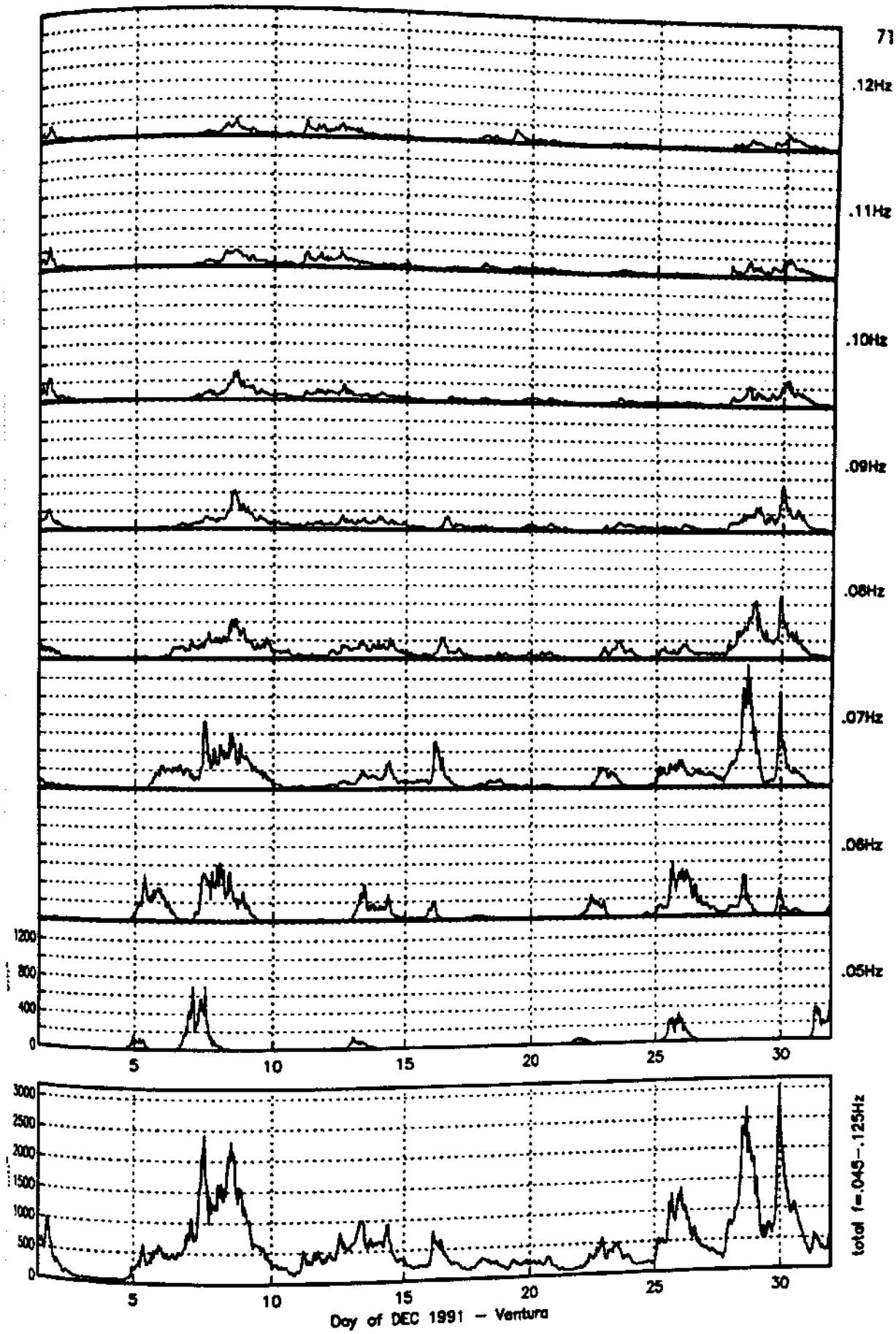

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
600
400
200
0
5
10
15
20
25
30
1800
1600
1400
1200
1000
800
600
400
200
0
total f=.045-.125Hz
Doy of NOV 1991 - Redondo

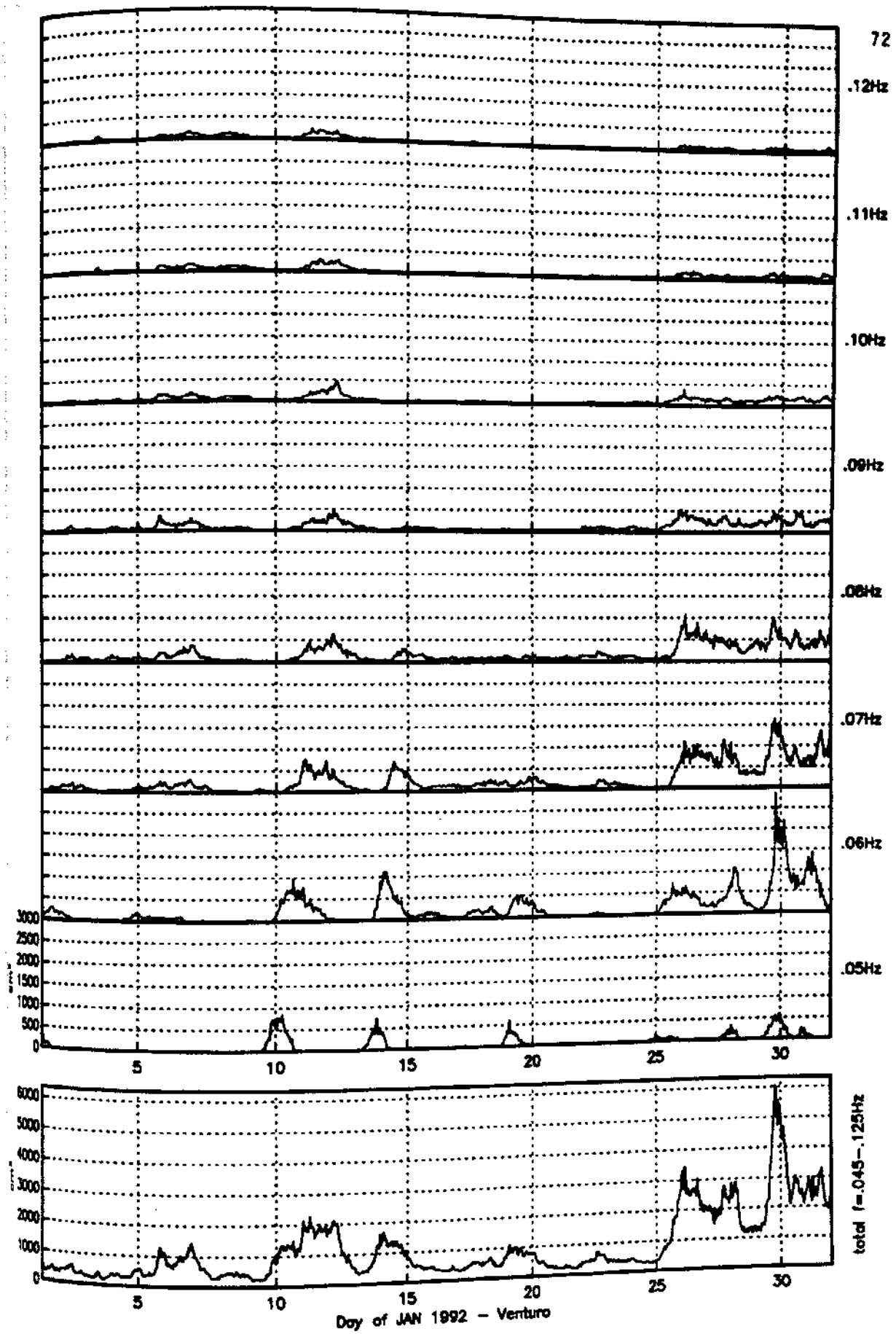

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
800
600
400
200
0
5
10
15
20
25
30
2000
1500
1000
500
0
total f=.045-.125Hz
Day of DEC 1991 -- Redondo

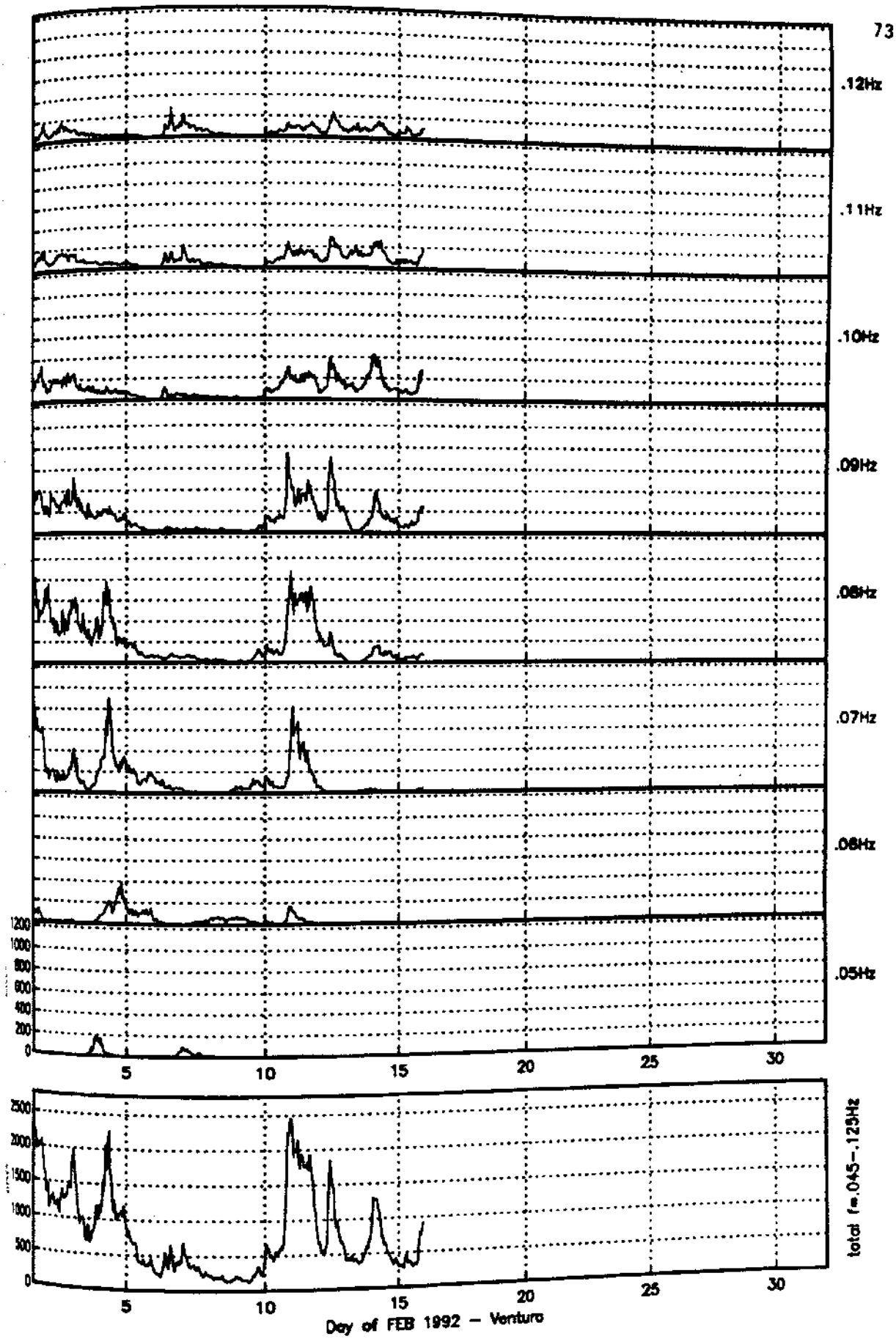

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
500
400
300
200
100
0
5
10
15
20
25
30
1600
1400
1200
1000
800
600
400
200
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of JAN 1992 - Redondo

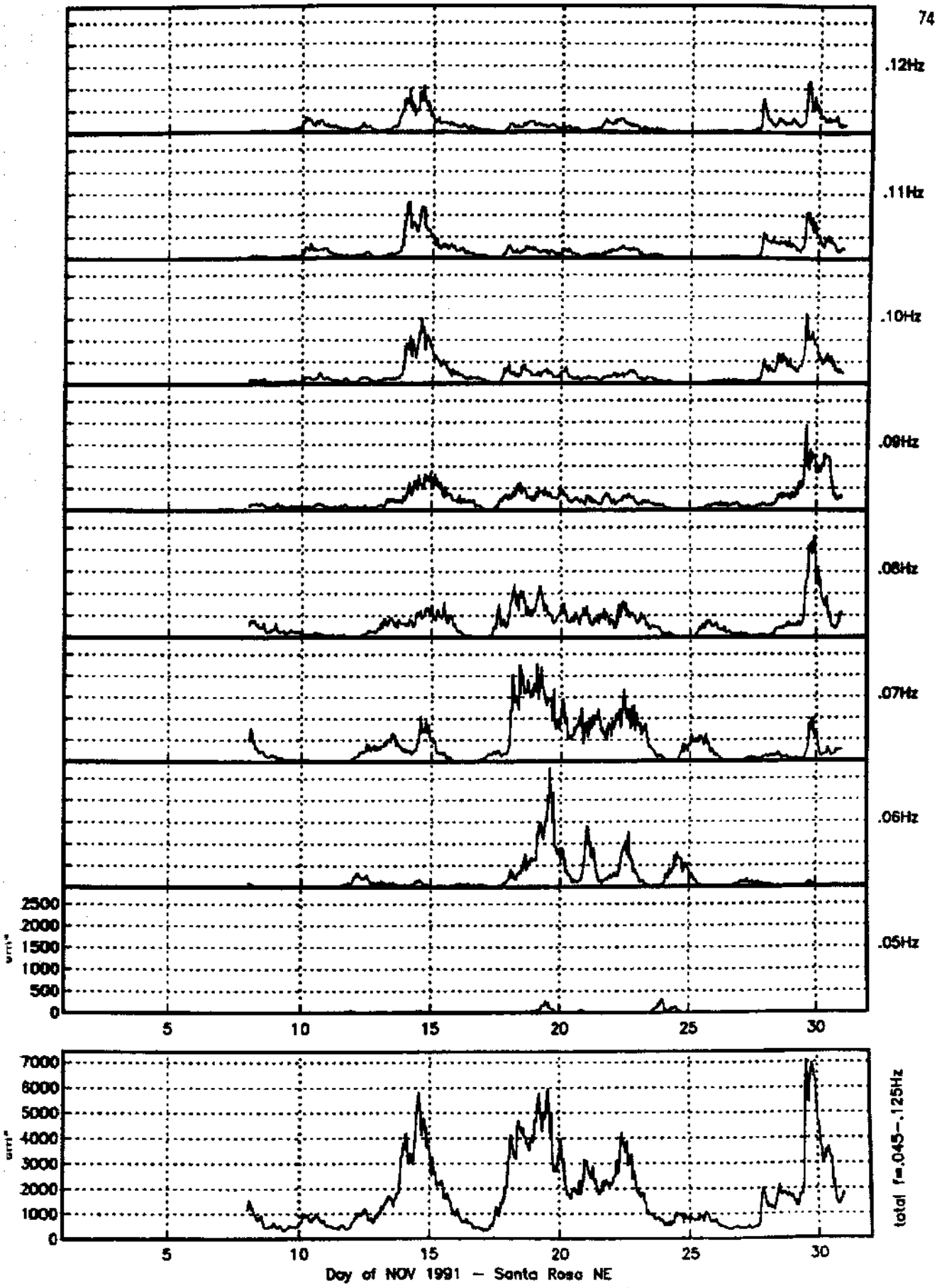

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
800
600
400
200
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045—.125Hz
Day of FEB 1992 ~ Redondo

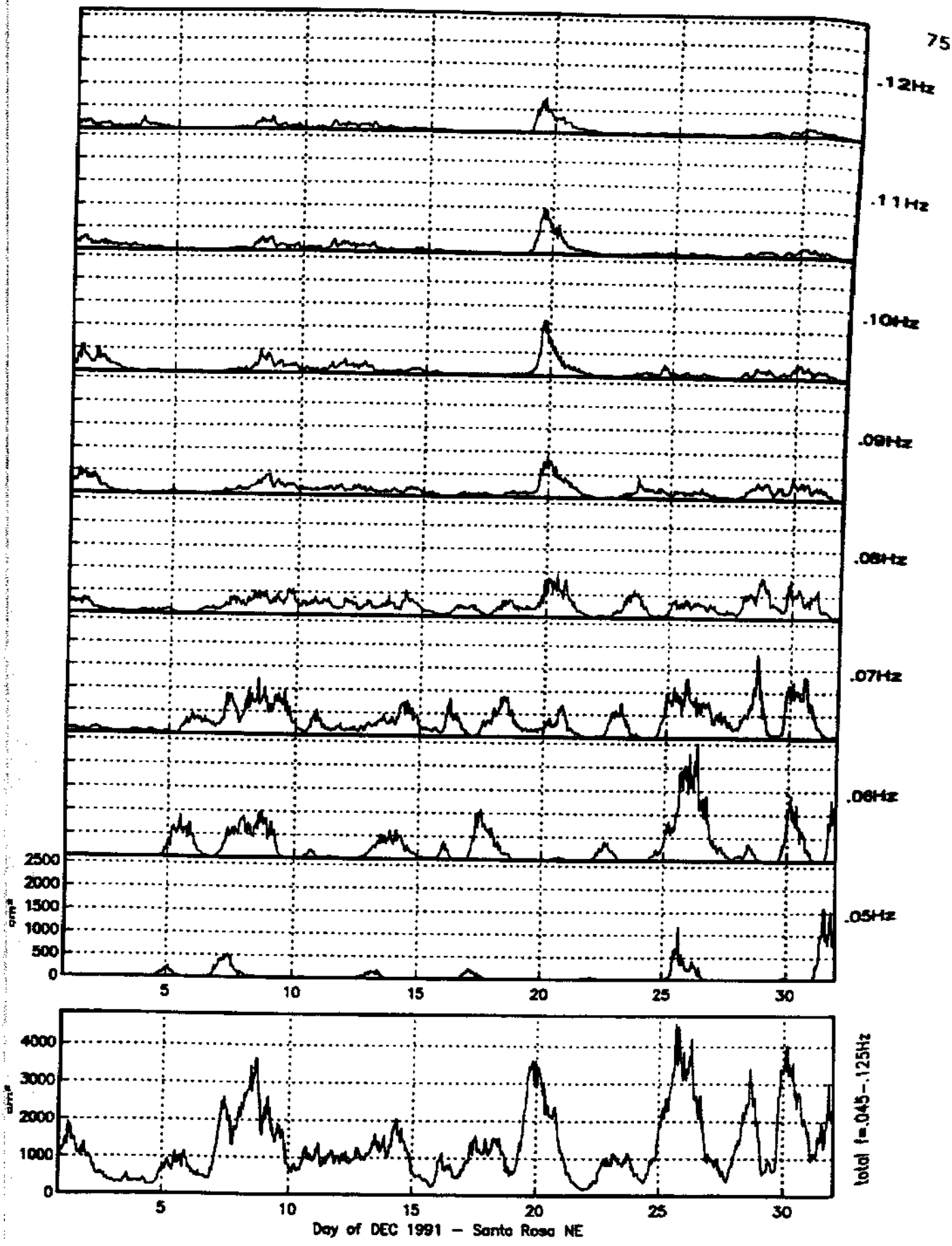

70
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
800
600
400
200
0
5
10
15
20
25
30
3500
3000
2500
2000
1500
1000
500
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of NOV 1991 - Ventura

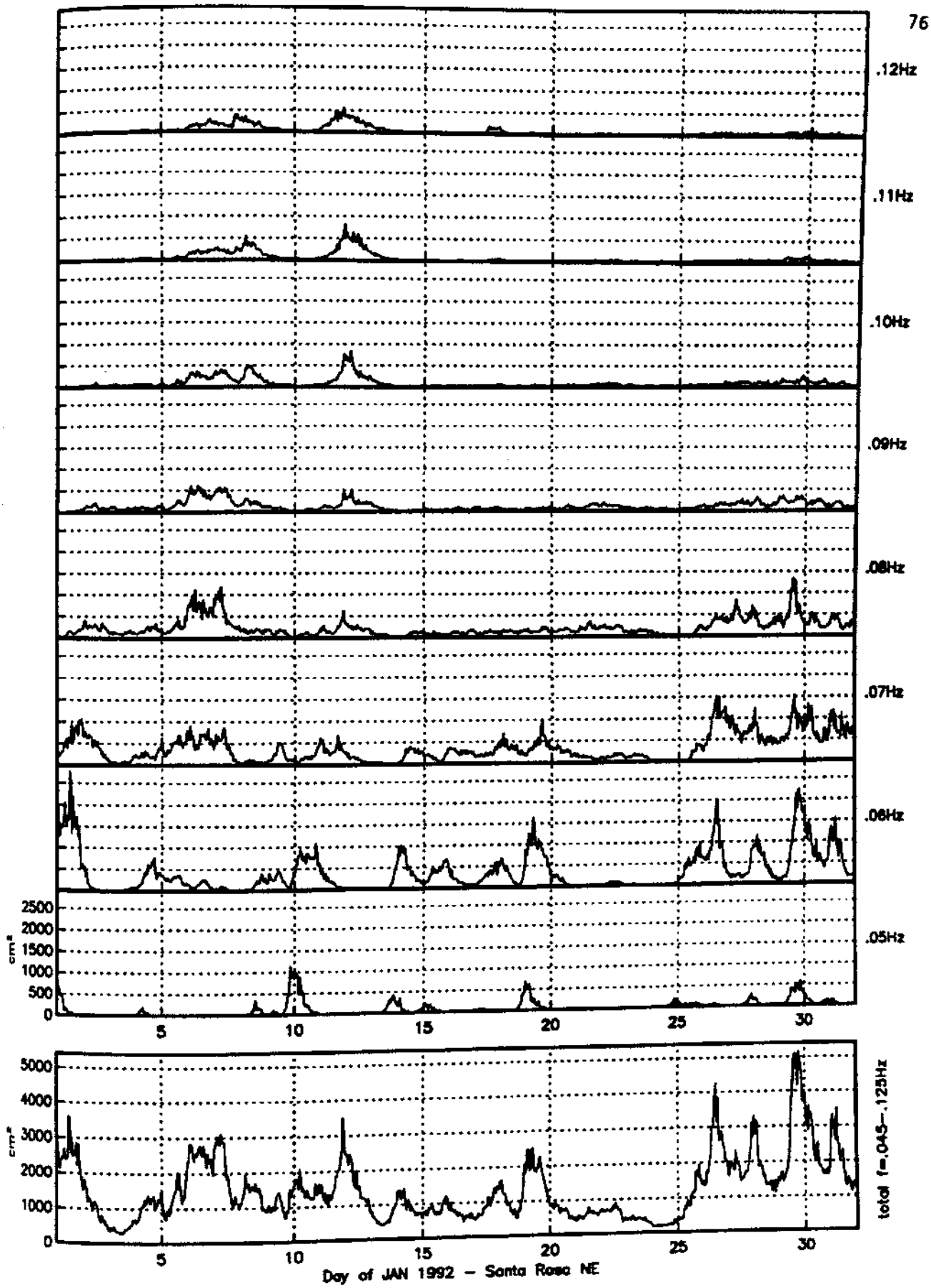

71
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
800
400
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of DEC 1991 – Ventura

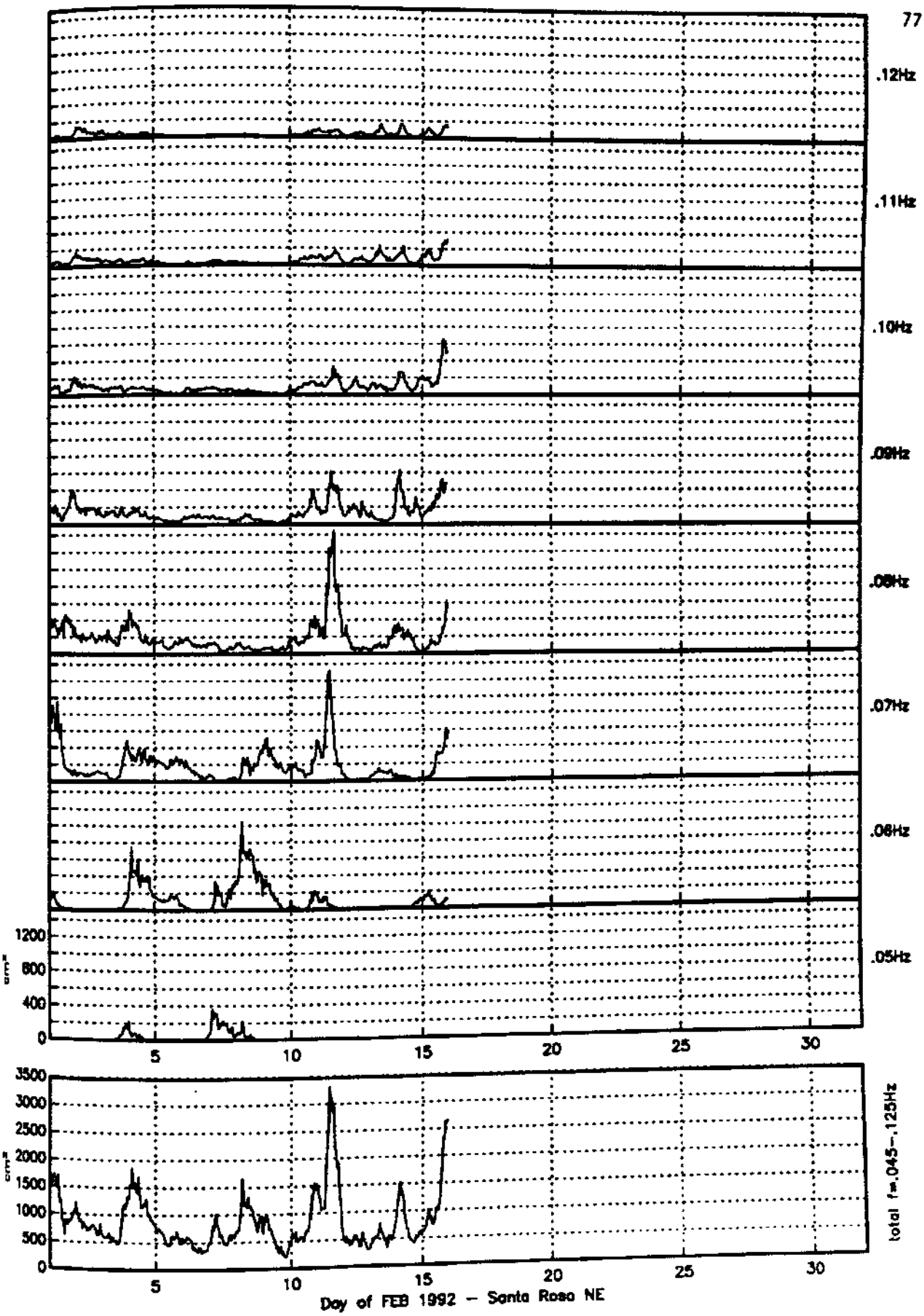

72
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
3000
2500
2000
1500
1000
500
0
5
10
15
20
25
30
6000
5000
4000
3000
2000
1000
0
total f=.045-.125Hz
Day of JAN 1992 – Venturo

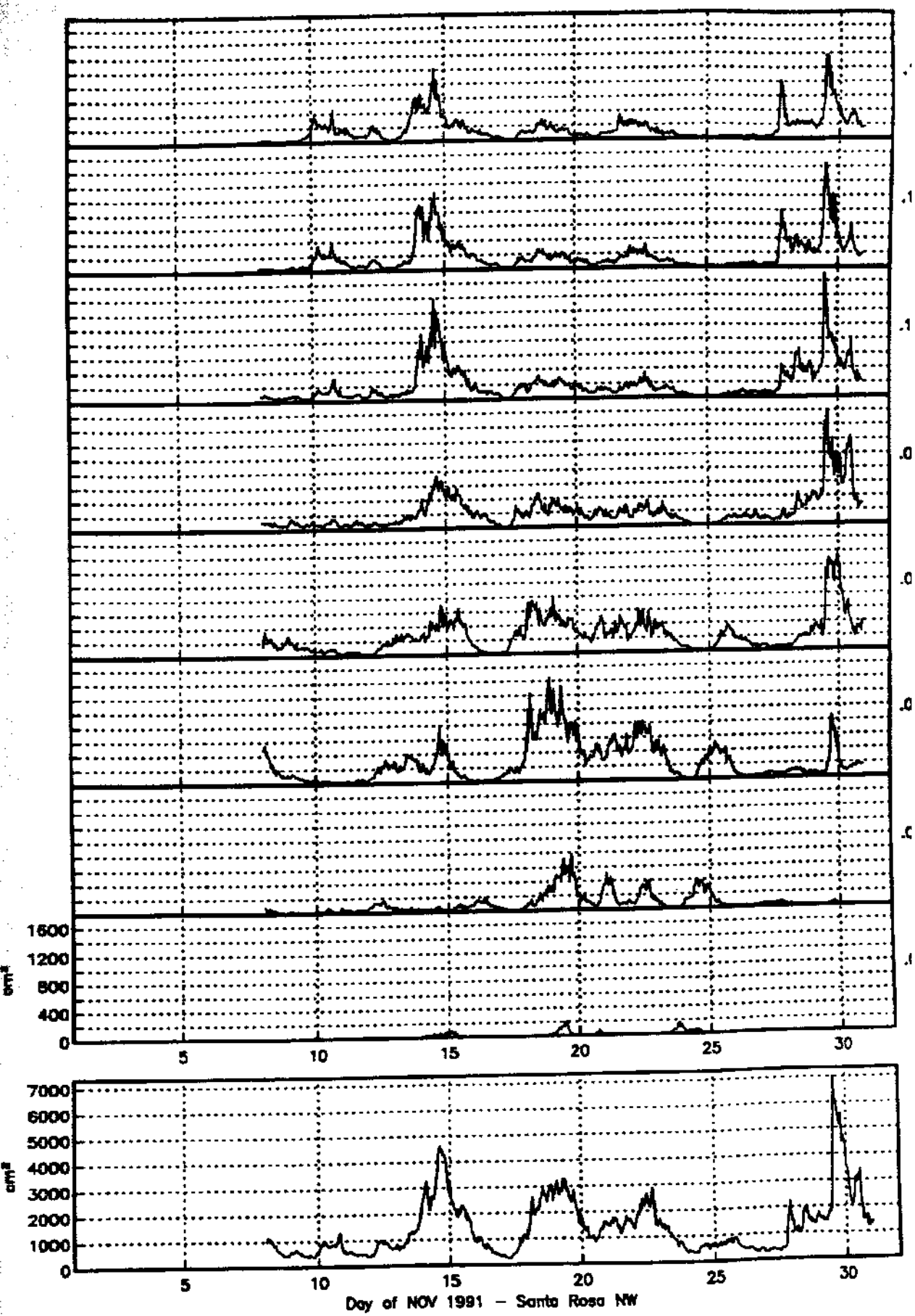

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
1000
800
600
400
200
0
5
10
15
20
25
30
2500
2000
1500
1000
500
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of FEB 1992 - Ventura

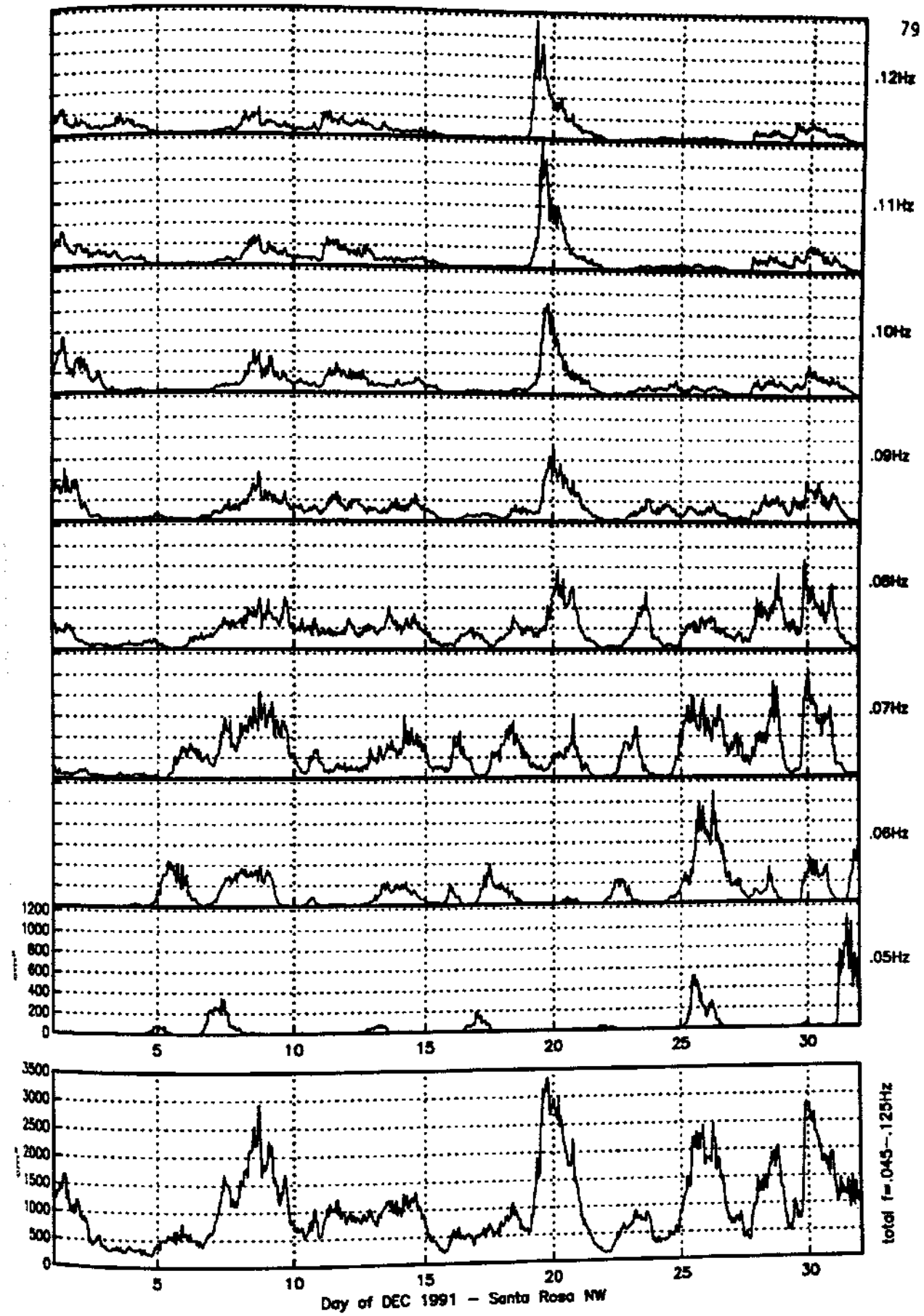

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
2500
2000
1500
1000
500
0
5
10
15
20
25
30
7000
6000
5000
4000
3000
2000
1000
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of NOV 1991 — Santa Rosa NE

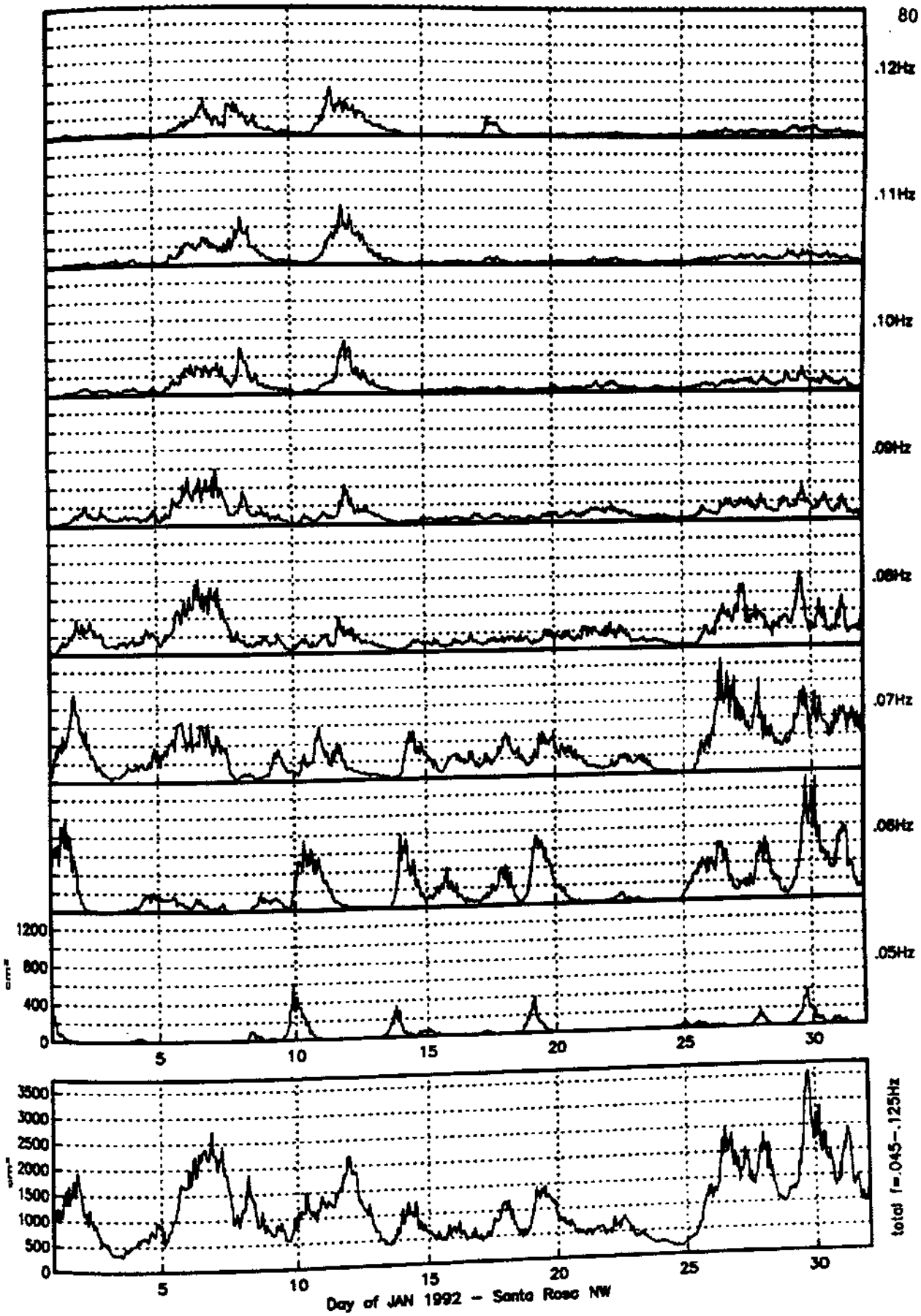

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
2500
2000
1500
1000
500
0
5
10
15
20
25
30
4000
3000
2000
1000
0
total f=.045-.125Hz
Day of DEC 1991 — Santa Rosa NE

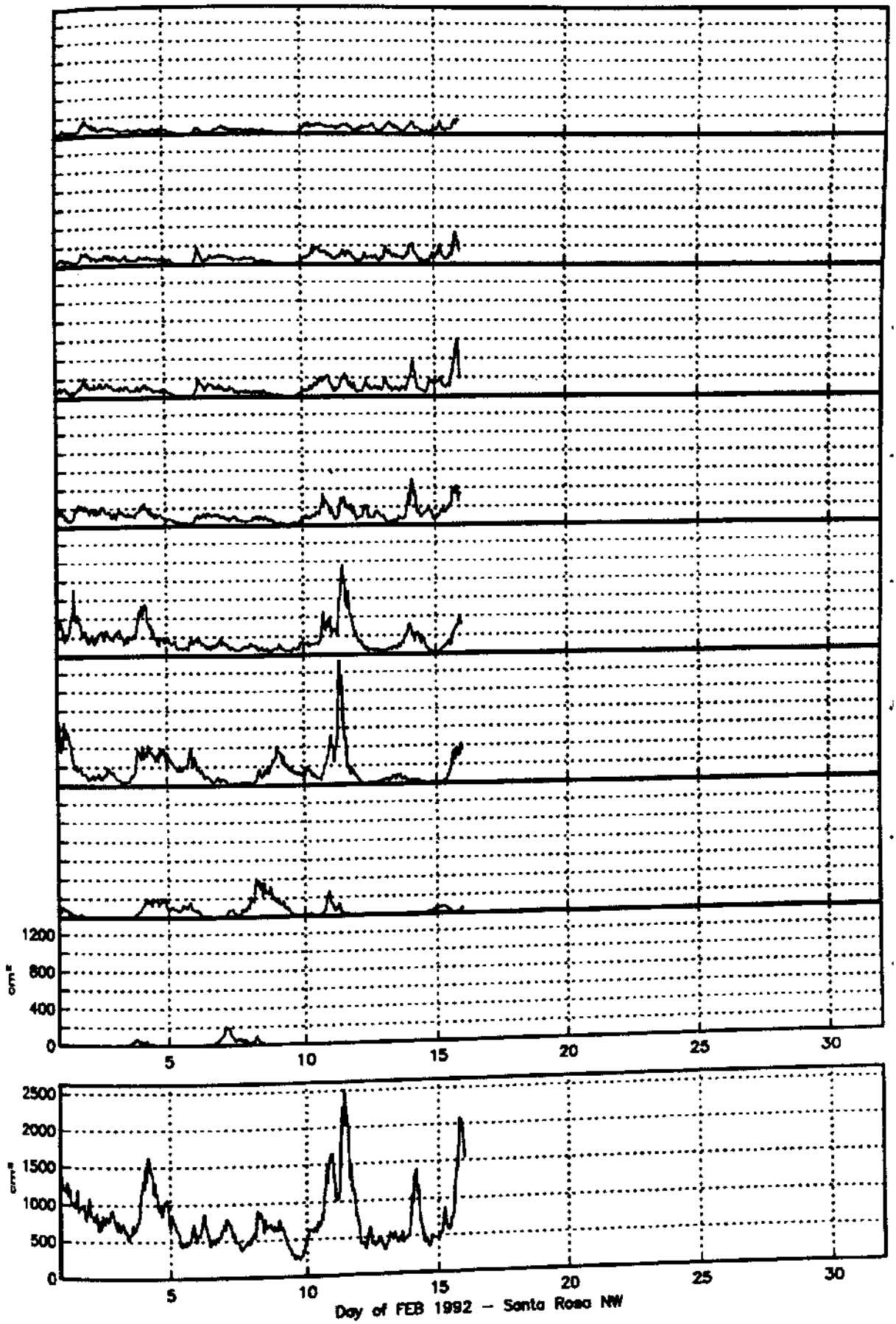

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
2500
2000
1500
1000
500
0
5
10
15
20
25
30
cm²
5000
4000
3000
2000
1000
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of JAN 1992 – Santa Rosa NE

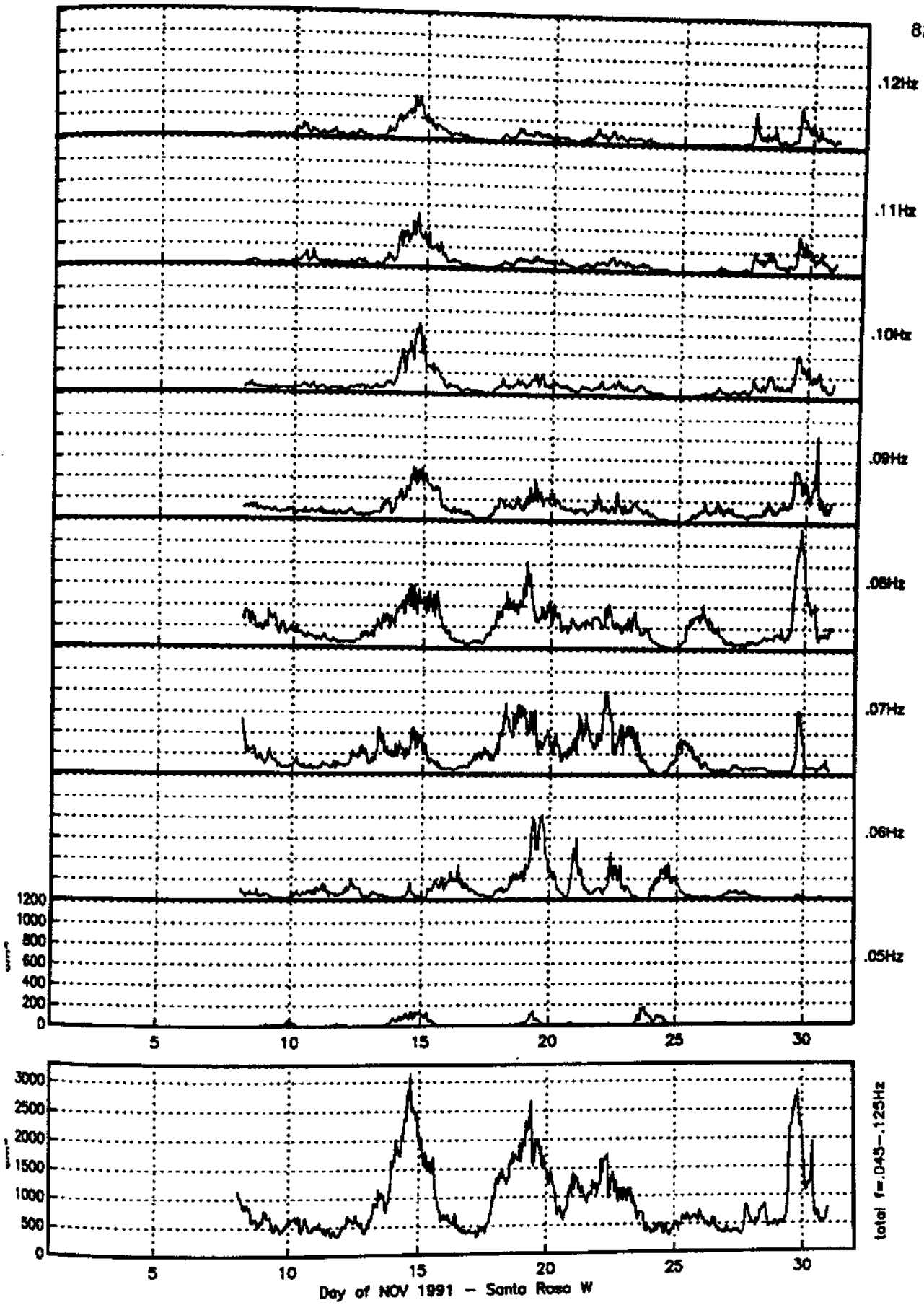

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
1200
800
400
0
5
10
15
20
25
30
3500
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of FEB 1992 — Santa Rosa NE

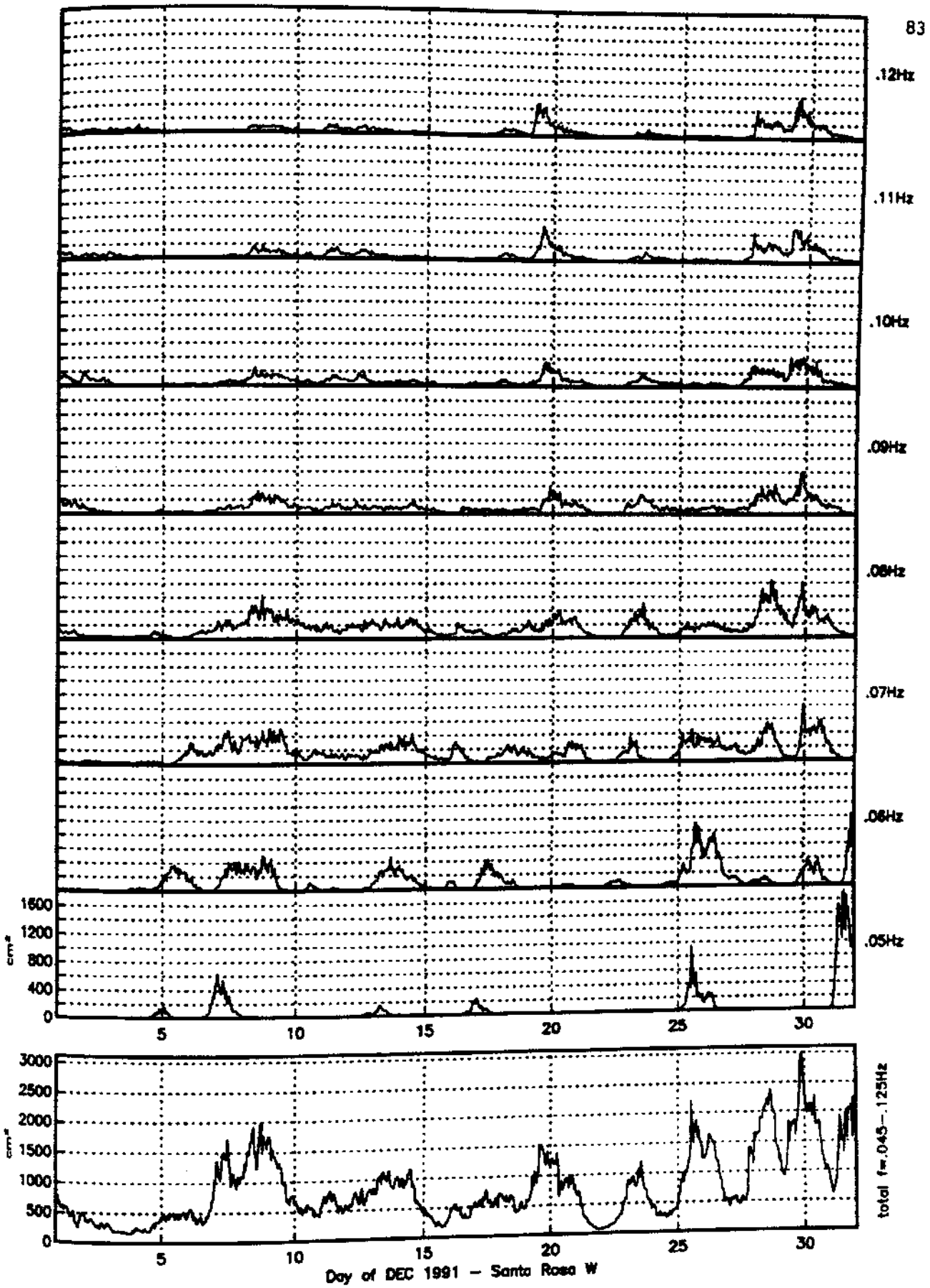

1600
1200
800
400
0
cms
5
10
15
20
25
30
7000
6000
5000
4000
3000
2000
1000
0
cms
5
10
15
20
25
30
Day of NOV 1991 – Santa Rosa NW

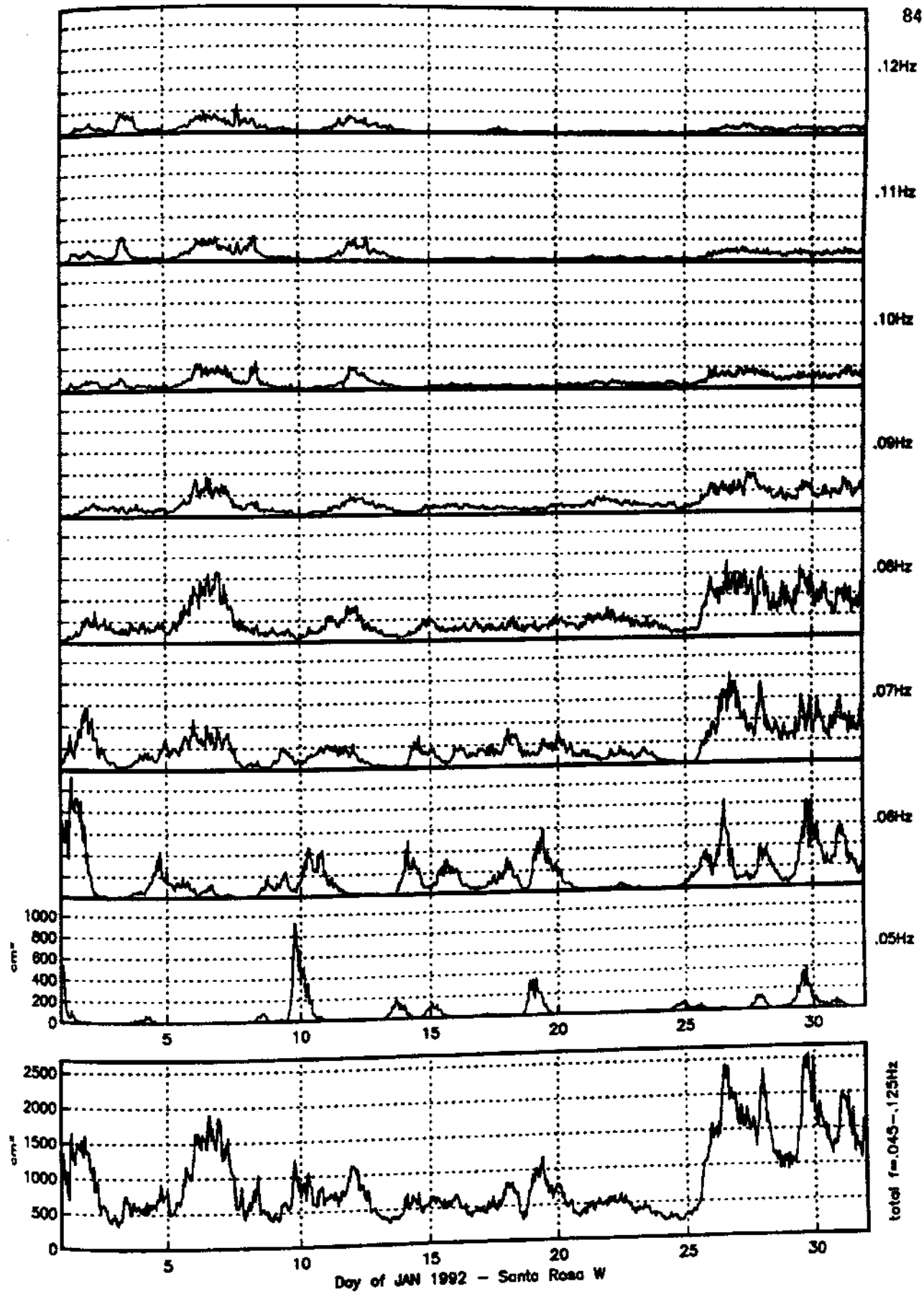

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
1000
800
600
400
200
0
5
10
15
20
25
30
3500
3000
2500
2000
1500
1000
500
0
5
10
15
20
25
30
total f=.045-.125Hz
Day of DEC 1991 - Santa Rosa NW

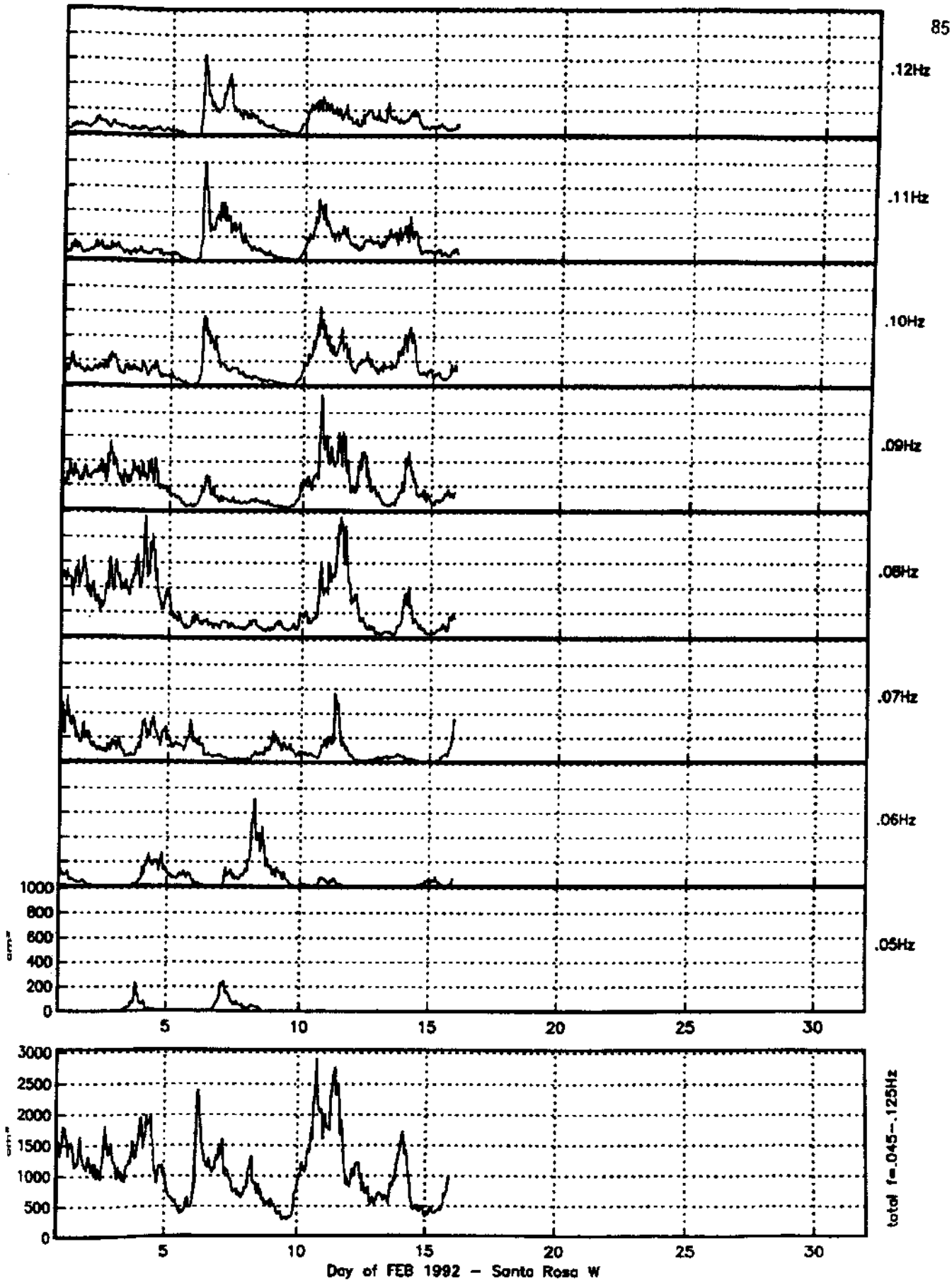

80
.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
1200
800
400
0
5
10
15
20
25
30
3500
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of JAN 1992 - Santa Rosa NW

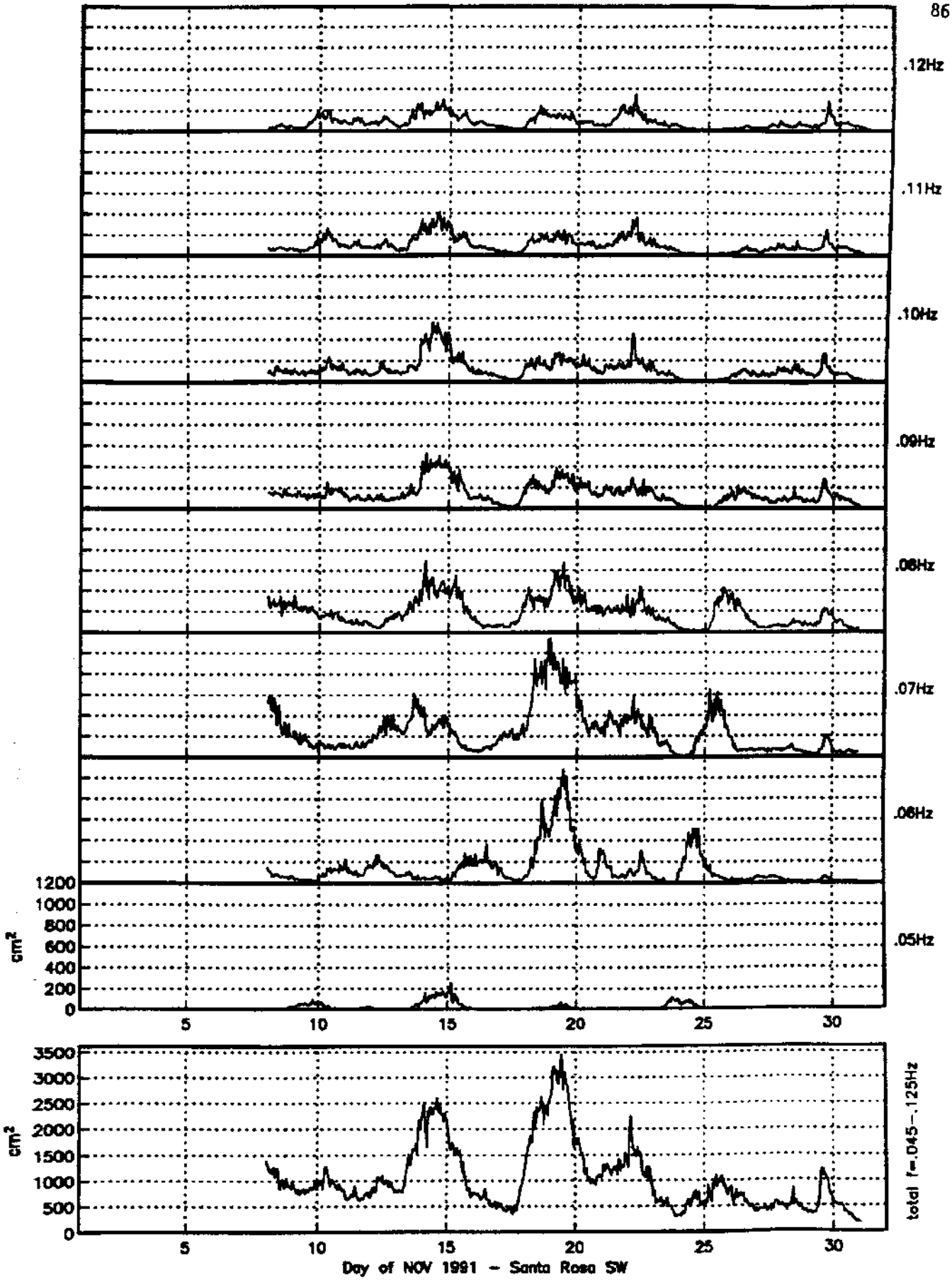

1200
800
400
0
cms
5
10
15
20
25
30
2500
2000
1500
1000
500
0
cms
5
10
15
20
25
30
Day of FEB 1992 – Santa Rosa NW

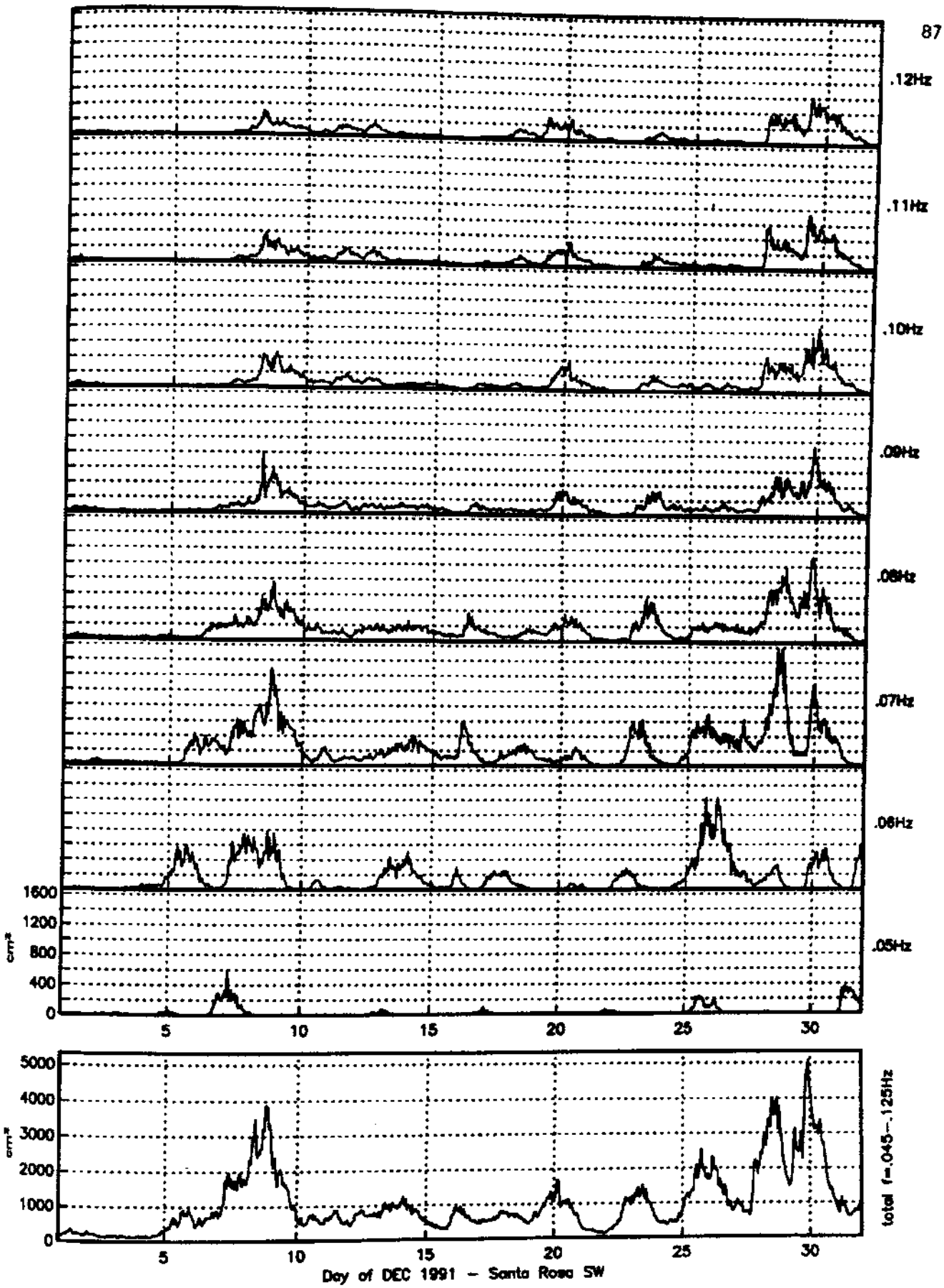

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1200
1000
800
600
400
200
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of NOV 1991 – Santa Rosa W

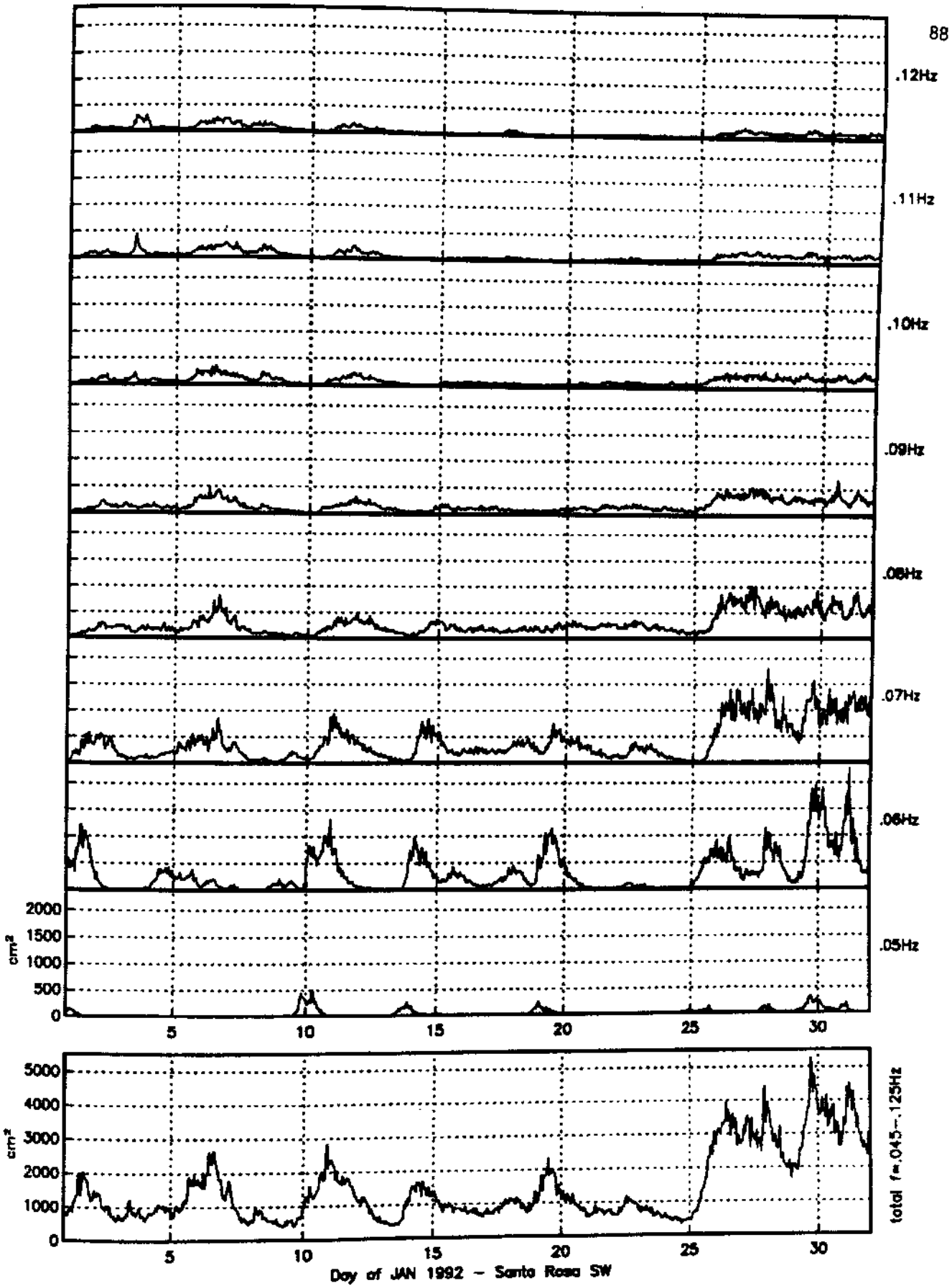

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
1600
1200
800
400
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of DEC 1991 – Santa Rosa W

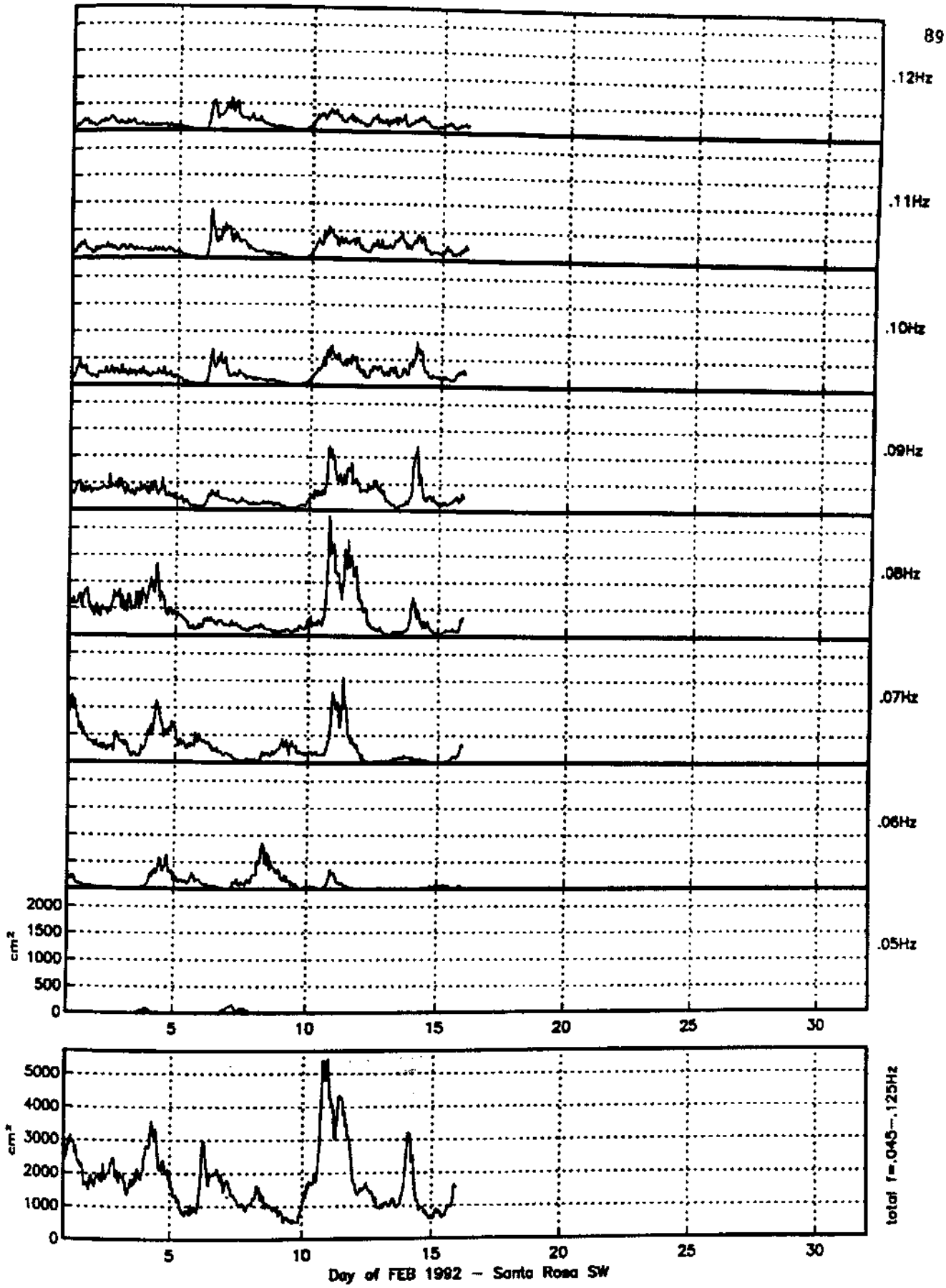

.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
1000
800
600
400
200
0
5
10
15
20
25
30
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of JAN 1992 – Santa Rosa W


.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
1000
800
600
400
200
0
5
10
15
20
25
30
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of FEB 1992 - Santa Rosa W


.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
1200
1000
800
600
400
200
0
5
10
15
20
25
30
cm²
3500
3000
2500
2000
1500
1000
500
0
total f=.045-.125Hz
Day of NOV 1991 - Santa Rosa SW


.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
1600
1200
800
400
0
5
10
15
20
25
30
cm²
5000
4000
3000
2000
1000
0
total f=.045-.125Hz
Day of DEC 1991 - Santa Rosa SW


.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
2000
1500
1000
500
0
5
10
15
20
25
30
cm²
5000
4000
3000
2000
1000
0
total f=.045-.125Hz
Day of JAN 1992 - Santa Rosa SW


.12Hz
.11Hz
.10Hz
.09Hz
.08Hz
.07Hz
.06Hz
.05Hz
cm²
2000
1500
1000
500
0
5
10
15
20
25
30
cm²
5000
4000
3000
2000
1000
0
total f=.045-.125Hz
Day of FEB 1992 - Santa Rosa SW