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A 98-station Seismic Array to Record Aftershocks of
the 1994 Northridge, California, Earthquake

By

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ABSTRACT

This report is intended to document the NEAR (Northridge Earthquake Aftershock Recording) experiment and data set so that it can be used by others in the seismological community. During March 26 to April 16, 1994 an array of 98 digital (Reftek) seismic stations recorded over 1,000 Northridge aftershocks. Fifty-three aftershocks were recorded by 40 or more stations. The stations were located in two clusters in Sherman Oaks and Santa Monica, respectively, and along two profiles traversing the San Fernando Valley and the NW part of the Los Angeles Basin. A triggering mode with 125 samples per second, 20 s pre-triggering length, and 60 s post-triggering length was used. The data set has been sorted into event files and submitted to both the SCEC (Southern California Earthquake Center) and IRIS (Incorporated Research Institutions for Seismology) data centers. Seventy-five stations were equipped with L28 4.5 Hz sensors, eight with L22 2.0 Hz sensors and fifteen with L4C 1 Hz sensors. All stations were equipped with 3-component seismometers. Among the over 200,000 files recorded by the network, 37,107 files were sorted into 1550 events. The total size of the sorted waveform data is 1.3

Gigabytes. The data is in SEGY format, which can be easily converted into SAC, AH, SEED, and SIERRA format using codes provided by the IRIS data center.

INTRODUCTION

During the January 17, 1994 $M_w=6.7$, depth=19 km Northridge earthquake (USGS and SCEC, 1994), Sherman Oaks and mid-Santa Monica experienced much greater damage than neighboring regions at similar distances from the epicenter. This is illustrated in Figure 1 which shows that the distribution of red-tagged buildings (Marshall and Stein, 1994) has higher concentrations in these areas than in the immediate surroundings. The boundary between the heavily damaged and the slightly damaged zones is relatively sharp; the transition takes place over a distance of less than one kilometer. There is no systematic difference in building types, building codes, or earthquake resistance between the heavily and slightly damaged zones. To understand the cause of the concentrated damage, we installed an array of seismic stations to record aftershocks in the two heavily damaged areas as well as along two profiles across the San Fernando valley and the northwestern part of the Los Angeles basin. The data set has been used to study localized amplification factors [Gao et al., 1996] using a Bayesian inversion approach [Jackson and Matsu'ura, 1985], and to test the validity of the use of coda wave amplification factors as an indication of S-wave amplification factors [Liu et al., 1996], as suggested by Kato et al. [1995]. Other work such as fi-

nite difference waveform modeling [e.g. Helmberger and Vidale, 1988; Vidale and Helmberger, 1988], and small array analysis [e.g. Frankel et al., 1991] are currently being conducted.

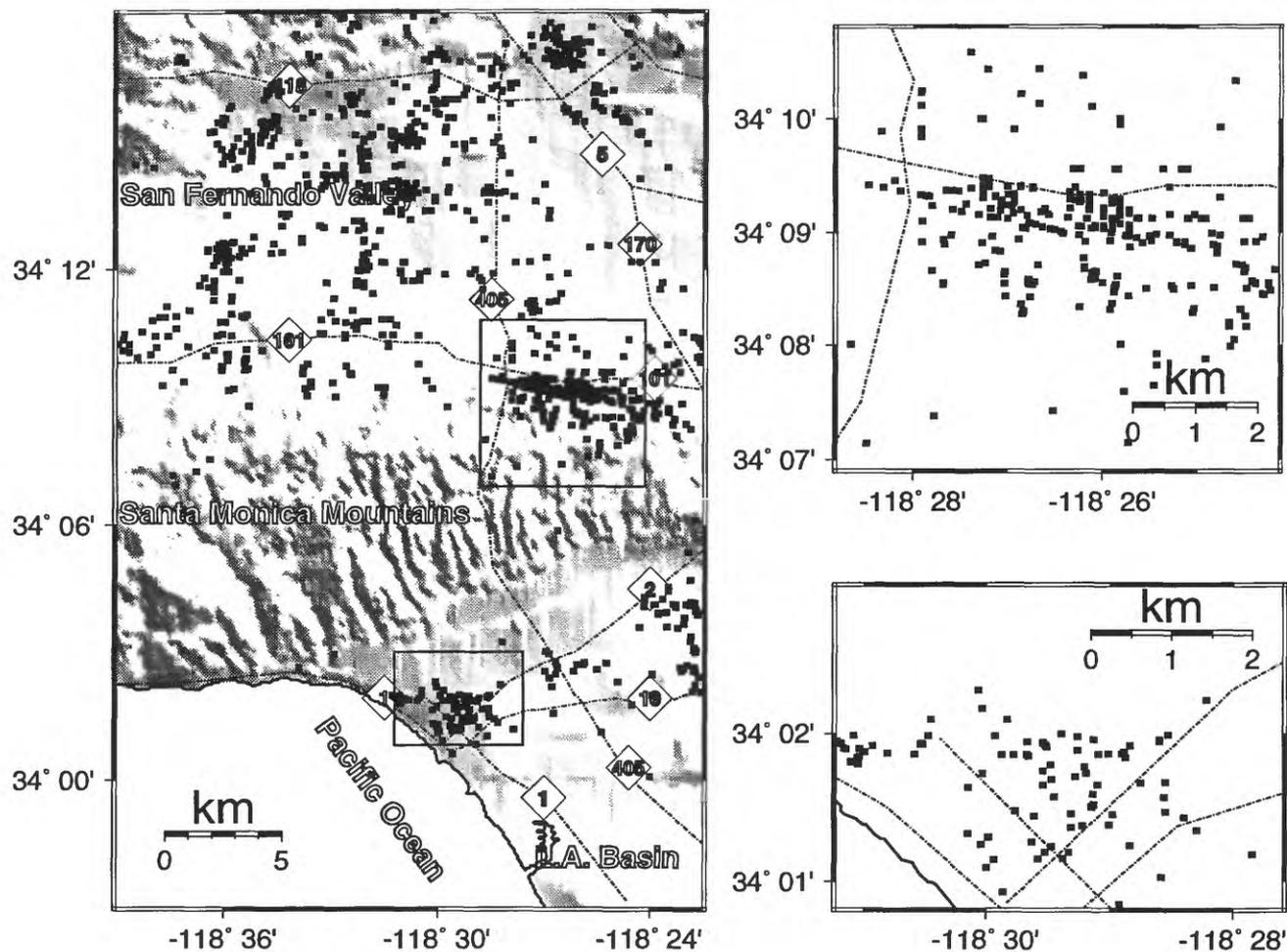


Figure 1. Distribution of red-tagged buildings and topography. The coordinates of the red-tagged buildings are from Marshall and Stein (1994). Diagrams on the right are enlargements of the inset areas.

THE EXPERIMENT

Background of the experiment

In the middle of March, 1994, a set of PASSCAL (Program for Array Seismic Studies of the Continental Lithosphere) instruments arrived at UCLA, originally intended for use by USGS and SCEC to record seismic waves from shots detonated by the Navy in Santa Monica bay. The experiment was postponed until October, 1994 because of environmental concerns. We took advantage of the availability of the instruments to study differential damage caused by the Northridge earthquake. A plan for deployment was made quickly. An announcement was published in the *Daily Bruin*, UCLA's student newspaper, that asked volunteers to allow installation of a seismometer in their backyards. Responses were so abundant that some applicants had to be turned down. Because it was term exam time and most of the field team members were students, almost all of the deployment and disk changing jobs were done during weekends. The project was named the Northridge Earthquake Aftershock Recording (NEAR). The acronym was appropriate since this experiment is *near* UCLA, in contrast with others that we have been working on, such as those in Baikal-Mongolia, East Africa, and on Mars, which are *far* from UCLA. Limited funding was provided for the field work. The hard work of the volunteers was greatly appreciated.

Field setup

The 98 stations were located in two clusters and along two profiles (Figure 2 and Table 1). The distance between stations in the two clusters is about 1 km and for the profile stations is about 2 km. The western profile had twenty stations, and the eastern one, sixteen stations. Both profiles were about 35 km long, along lines with strike 165° , and traversed the San Fernando valley, Santa Monica Mountains, and the northwestern part of the Los Angeles Basin. The northern cluster of 36 stations was centered in Sherman Oaks in a 7 km by 7 km area; the distance and azimuth of the center of the Sherman Oaks cluster (station B16) from the epicenter are about 11 km, 133° , respectively. The southern cluster of 29 stations was centered in Santa Monica in a 4 km by 3 km area; the distance and azimuth of this cluster (station F10) from the epicenter are about 21 km, 168° , respectively (Figure 2).

A trigger-mode was used to record relatively strong events. The length of each seismogram was 80 s, which includes 20 s of pre-trigger time. The long pre-trigger time proved to be useful because the S-waves from some events were the triggering signals at some stations, and the long pre-trigger time saved the first P wave arrival. The sampling rate was set at 125 samples per second. The triggering rate and quality of the data depend on the magnitudes and other parameters of the events, as well as ground noise, which in the cities is directly related to local time. The triggering parameters differed from station to station in order to minimize 'false' triggering, which was mostly caused by passing vehicles.

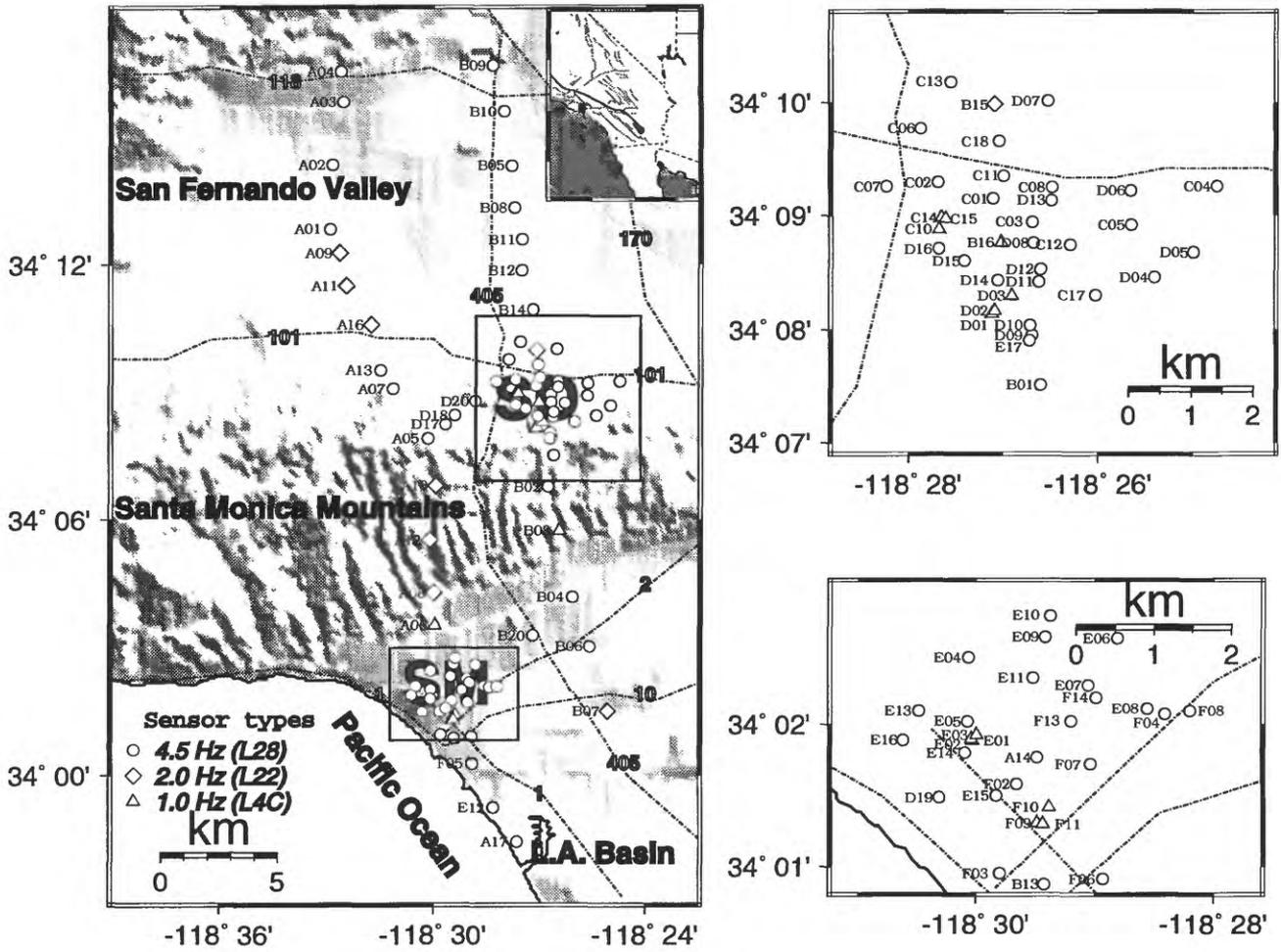


Figure 2. Station locations, station numbers, and sensor types. Circles are 4.5 Hz (L28) sensor stations, diamonds are 2.0 Hz (L22) sensor stations, and triangles are 1 Hz (L4C) stations. The inset in the upper right of the main map shows the location in Southern California (small black square). The Sherman Oaks (SO) and Santa Monica (SM) areas are enlarged at the right. Numbered lines are highways; highway 2 is Santa Monica Boulevard.

The Reftek recorder computes the running ratio of the short-time average (STA) and long-time average (LTA) of a selected seismometer component, and an event is declared when the ratio exceeds a programmed threshold, which is called the trigger ratio. Initially, we used the triggering parameters, LTA window = 15 seconds, STA window = 0.2 seconds, Trigger Ratio=8.0 for most of the stations. After the first week, the parameters were adjusted for some of the stations based on their performance. For stations in populated valleys and basins, a lower trigger ratio of 3.0 to 5.0 and shorter STA window of 0.1 to 0.15 s was found to be more effective in discriminating signals in regions of high ground noise. In contrast, for stations on bedrock, a high trigger ratio of 10.0 to 15.0 and small LTA window 5.0 to 10.0 s were effective in reducing vehicle triggers. The number of events recorded by the stations are shown in Table 1.

About half of the stations were equipped with GPS (Global Positioning System) receivers and thus had relatively accurate times and locations (Table 1). The clocks of stations without GPS receivers were corrected every week during station service using external GPS clocks, and the locations for those stations were obtained from USGS 1:24,000 series topographic maps. We note that the GPS signal in the cities is much weaker compared to open areas due to the blockage of buildings. As a result, about 1/4 of the stations with GPS receivers locked on the satellite timing and location signals, on average, less than once a day. As

a further result, large uncertainties in the timing and station locations were introduced in some of the data. Clock types and number of locks for stations with GPS receivers are shown in Table 1.

Seventy-five stations were equipped with L28 4.5 Hz sensors, eight with L22 2.0 Hz sensors and fifteen with L4C 1 Hz sensors (Table 1). The amplification, free period, and damping factor are shown in Table 2, obtained by using the average of the calibration test results provided by Aaron Martin at UCSB. Please note that the waveforms submitted to the SCEC and IRIS data centers have not been corrected for instrument response, because we believe it can be done by users easily according to personal preference. Sensor types are listed in Table 1 and shown in Figure 2.

Except for station A17, all of the stations were equipped with either a 72A-06 or 72A-07 Reftek junior DAS (Data Acquisition System). The serial numbers of the DAS for the 06's and 07's start with '6' and '7', respectively. The only station (A17) that used another type of Reftek DAS did not record any useful data. The DAS numbers and DAS locations are shown in Table 3.

Seismograms from one of the best events are shown in Figure 3.

Participating personnel

M. Benthien, J. Boyce, J. Davis, M. Davis, P.M. Davis, S. Gao,

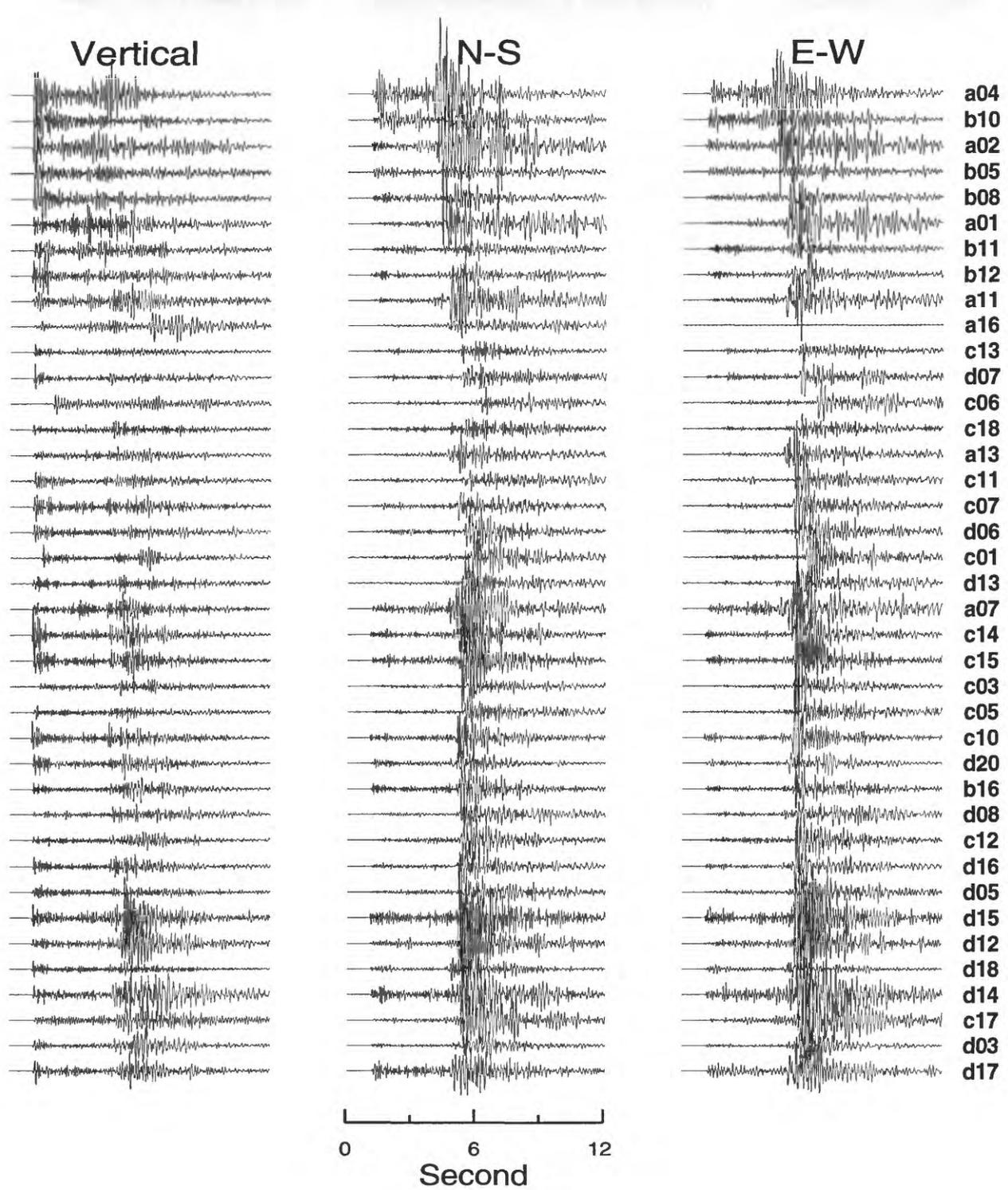
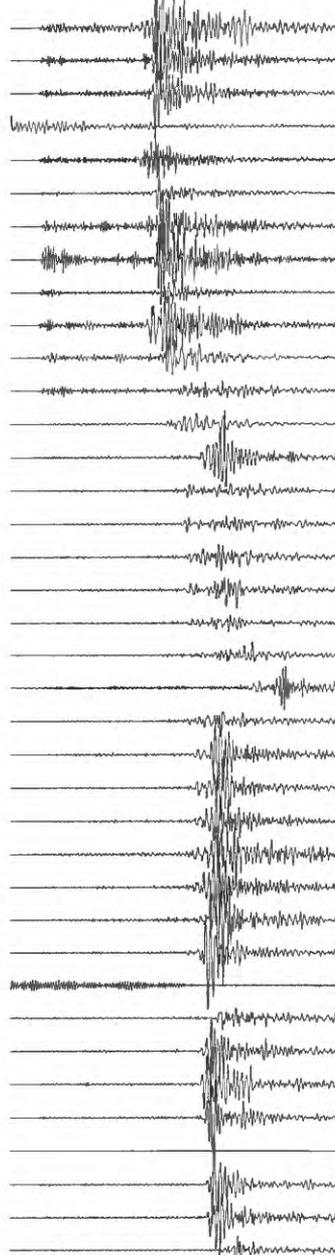
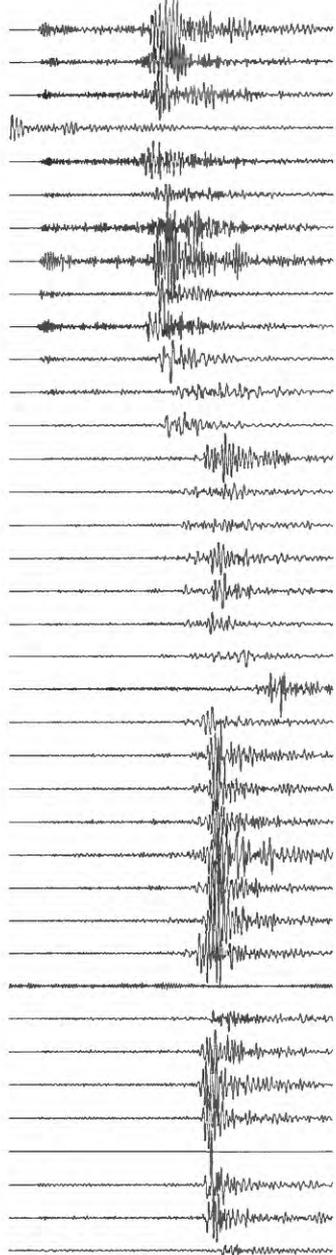
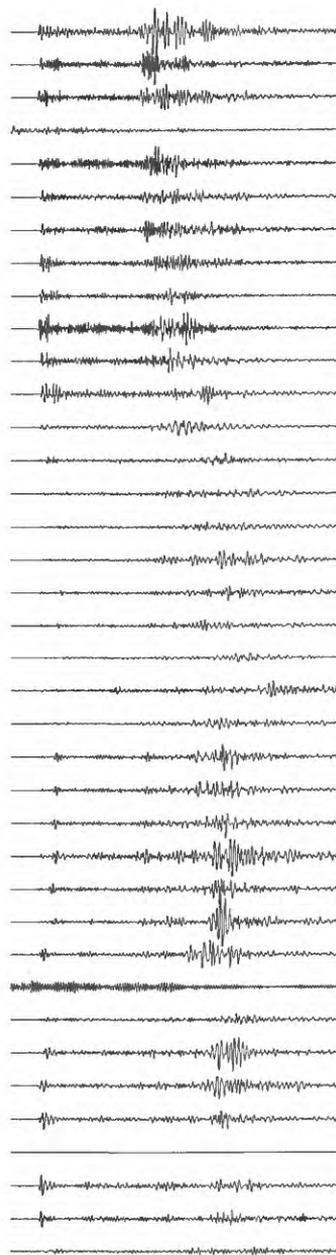


Figure 3. Record section from event 093-09-09 showing the vertical, north-south, and east-west components. Only the first 12 seconds after the first arrival are shown. The traces are aligned with the first P-arrivals at 1 sec and are plotted using the same scale.

Vertical

N-S

E-W



- d02
- d01
- d10
- d09
- a05
- e17
- b01
- b02
- b03
- a12
- a08
- b04
- a06
- b06
- e10
- e09
- e06
- e04
- e11
- e07
- e13
- f13
- e05
- e03
- e02
- e16
- e01
- e14
- a14
- f07
- b07
- e15
- d19
- f09
- f03
- f06
- b13
- f05

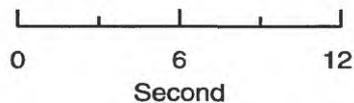


Figure 3. (continued)

L. Green, D. Guo, P. Jögi, L. Knopoff, S. Lee, H. Liu, J. Murphy, J. Norris, G. Pei, P. Slack, L. Sung, and M. Winter, were actively participants in the planning, installation, and operation of the stations.

DATA

Data sorting

In urban areas cultural noise can cause false triggering of the recorders. To make it easier for others to use the data set, we have sorted the approximately 200,000 files into events according to the event catalog provided by the SCEC data center. The theoretical P-wave arrival-time for an event to a given station, T , and the trigger time of all the files recorded by the station, t_i , where i is the file index, were calculated first. The difference between the two, $\delta t_i = |t_i - T|$, was then calculated and the file with the minimum δt was copied into the event directory if $\delta t_i \leq 60$ s. Apparent timing errors were taken into account in the sorting process. In all 1550 events were recorded by at least one of the stations, and 37,107 files out of the over 200,000 files were sorted into the 1550 events. Therefore about 80% of the files were false triggers. If two events occurred close to each other in time (less than 60 s), the above automatic sorting scheme may put a file in both event directories. In fact, the file may contain waveforms from both events.

Data format and file names

Data dumped from the station disks were converted to SEGY format using the REF2SEG Y (version 93.285) routine originally written by Early et al. at the PASSCAL Instrument center. The resulting SEG Y format data can easily be converted to other formats such as SAC, AH, SEED, and SIERRA by using routines provided by the IRIS data center.

The original files were identified by the hour, minute, and second of the file, the DAS number, and the channel number. The frequent movement of the DAS's (Table 3) made it difficult to identify the station at which a particular file was recorded. Information about DAS and sensor types were not included in the file names. The new file names contain the information about station and channel number, starting hour and minute of the event, and DAS and sensor types. For example, a file named *sssccyydddhhmmDxSy* indicates that it is an event with origin time at year *yy*, day *ddd*, hour *hh*, and minute *mm*; it was recorded by channel *cc* of station *sss*, where *cc=01* is the vertical component, *cc=02* is the NS component, and *cc=03* is the EW component; the Reftek DAS is *0x*, where *x=6* is for Reftek 72A-06, and *x=7* is for Reftek 72A-07; and the sensor type is *y*, where *y=1* represents L4C, *y=2* represents L22, and *y=3* represents L28.

Earthquake Information

Figure 4 indicates that more than 1000 of the 1550 events were

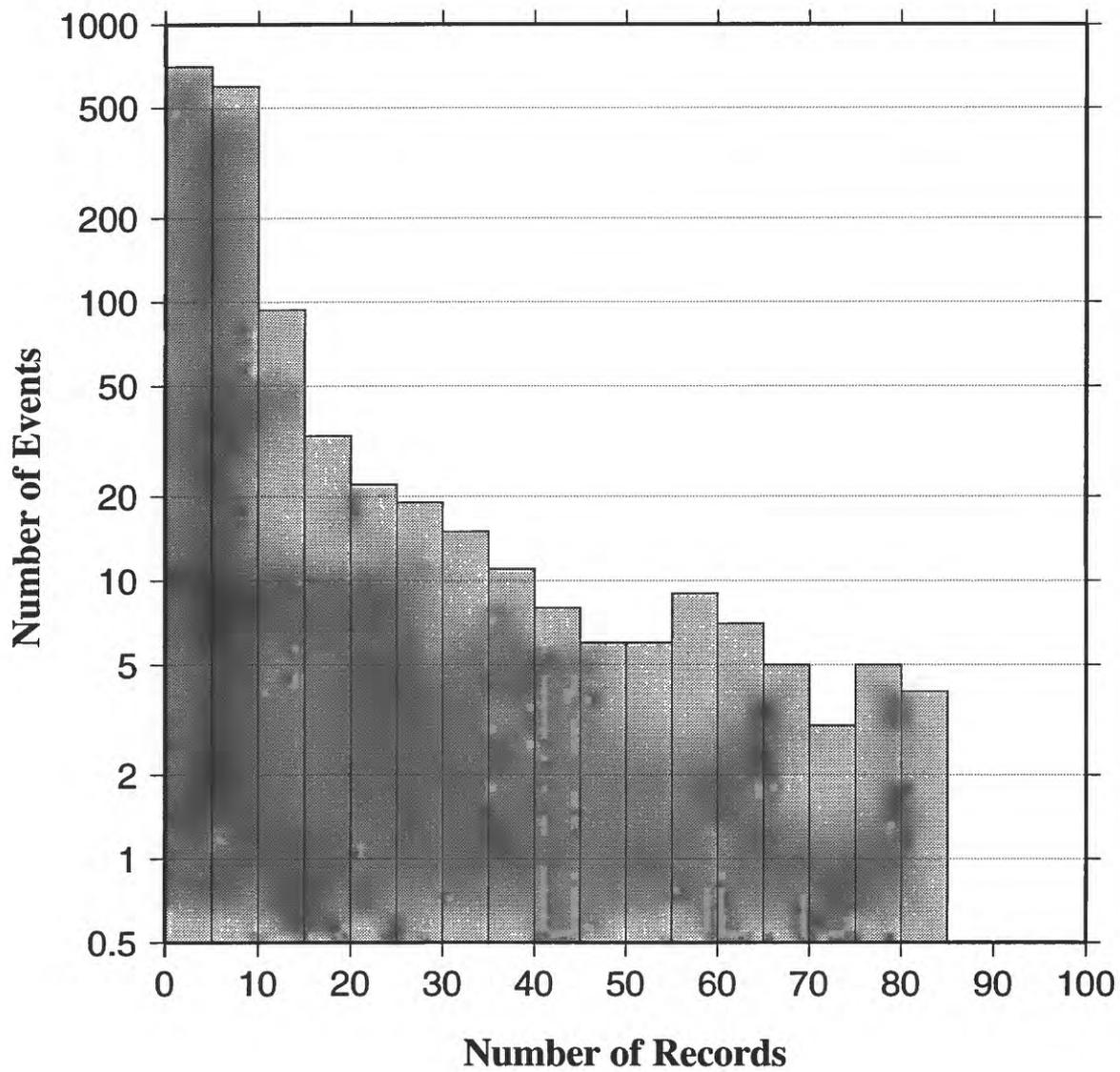


Figure 4. Histogram showing the distribution of events as a function of the number of recording stations. The width of bins is 5 stations. Note that a logarithmic scale is used on the Y-axis. More than 1000 events were recorded by less than 10 stations.

recorded by less than 10 stations. Source information on the fifty-three events recorded by at least 40 stations is listed in Table 4, and their locations are shown in Figure 5. Thirty-two of the 53 events were used in a previous report by Gao et al. [1996]. The majority of the events were located in the northern part of the aftershock zone. It must be pointed out that the files were sorted according to the original USGS-Caltech earthquake catalog, while in Gao et al. [1996] a modified catalog provided by Jim Mori at USGS was used. Only strong events are included in the modified catalog. The number of events in the modified catalog is about 1/3 of that in the original catalog. There is almost no difference between the two for data sorting of the strong events.

Log and error files

Log and error files provide important information about the data, such as recording parameters, clock state, volts per bit, and timing errors. The log files are named as *sss.ddd.rrrr.log*, and the error files are named as *sss.ddd.rrrr.err*, where *sss* is the station name, *ddd* is the day when the data was dumped from the disk to computer, *rrrr* is the DAS number. The total size of the log and error files is 26 Megabytes.

Data directory structure

There are 3 top-level directories in the tape. Under directory *Data/*, there are 1550 event directories, each contains all the waveform data from the corresponding event; Information about stations and events can be

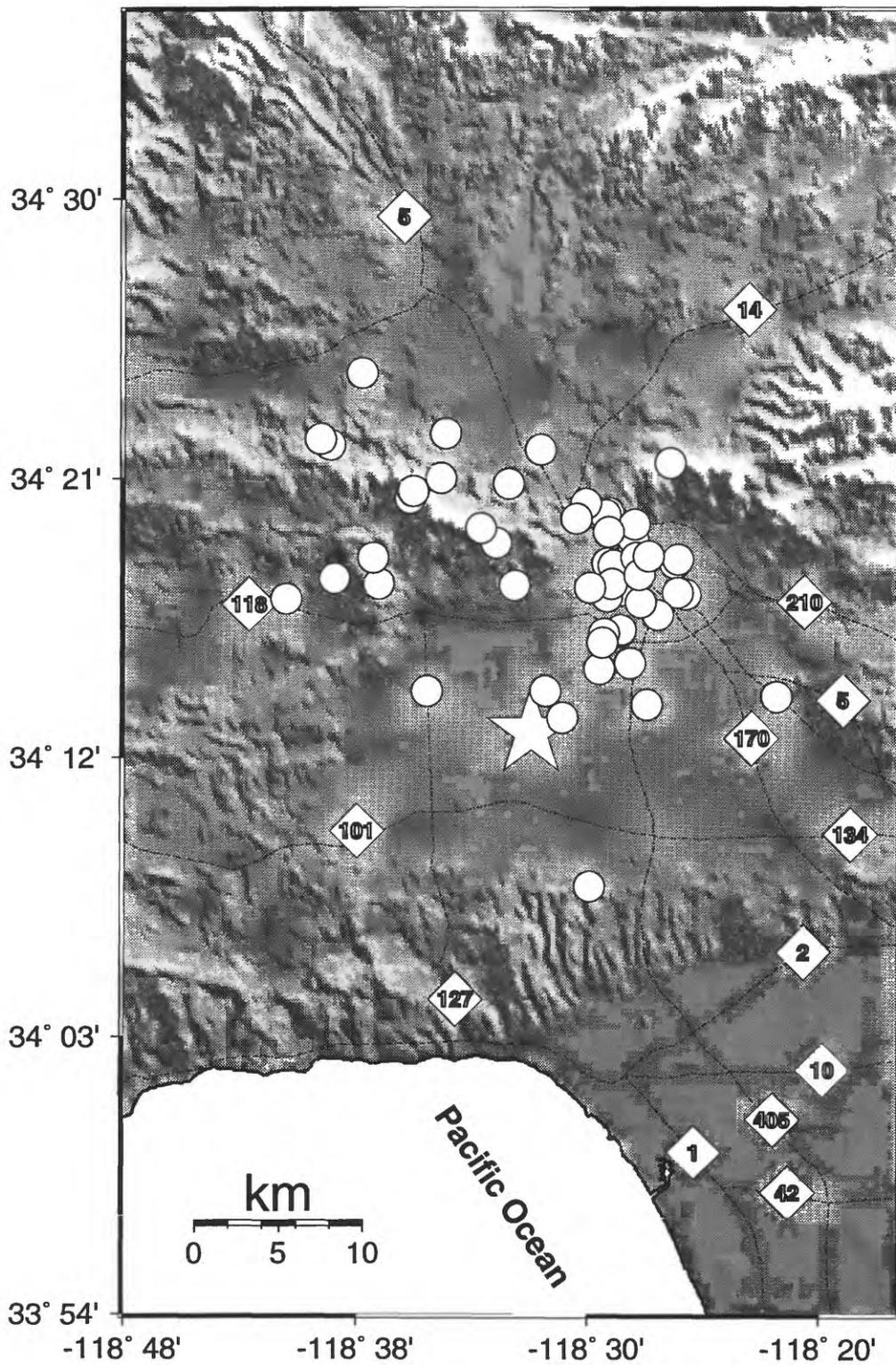


Figure 5. Epicenters of the 53 aftershocks which were recorded by at least 40 stations. Diamonds indicate major numbered highways. The epicenter of the main shock is indicated by the star.

found under directory Info/; and Log-files and error-files can be found under directory Logfiles/.

CONCLUSIONS

An array of 98 stations were installed in the San Fernando Valley, Santa Monica Mountains, and Santa Monica, California area for a 3 week period two months after the 1994 Northridge earthquake to record aftershocks. The data set, together with log and error files and other information such as station and event locations, has been submitted to the SCEC and IRIS data centers and is available for public access.

ACKNOWLEDGMENTS

We thank the residents of the San Fernando Valley, the Santa Monica Mountains and Santa Monica who kindly gave us permission to install seismic stations on their property. Jim Mori provided help in providing a 9GB disk for preparing the data set, in preparing the report, and in critical reviewing of the manuscript. S. Gao was supported by DARPA under contract F49620-94-1-0161. The field work was supported by the Southern California Earthquake Center under contract to working group D. The Reftek recorders were provided by the PASSCAL instrument center at Stanford University. Support from NSF grant EAR9416213 is also gratefully acknowledged. SCEC publication number 351.

Table 1. Station Information

Station Name	Coordinates		Sensor Type	No. of Events	Clock Type	No. of GPS Locks
	Latitude	Longitude				
A01	34.213924	-118.548698	L28	269	TRG	0
A02	34.238934	-118.547394	L28	283	TRG	0
A03	34.263672	-118.542450	L28	3	TRG	0
A04	34.275669	-118.543457	L28	131	GPS	4
A05	34.131889	-118.502686	L28	521	GPS	8
A06	34.058853	-118.499374	L4C	185	GPS	125
A07	34.151409	-118.519020	L28	118	GPS	13
A08	34.071354	-118.500000	L22	69	TRG	0
A09	34.204437	-118.544273	L22	279	TRG	0
A10	34.113281	-118.499084	L22	246	TRG	0
A11	34.191669	-118.540886	L22	201	TRG	0
A12	34.092056	-118.501823	L22	193	TRG	0
A13	34.158855	-118.524872	L28	249	TRG	0
A14	34.029427	-118.491402	L28	115	TRG	0
A16	34.176548	-118.529167	L22	79	TRG	0
A17	33.974091	-118.460670	L28	0	TRG	0
B01	34.125263	-118.443398	L28	150	GPS	239
B02	34.112915	-118.446220	L28	139	GPS	5
B03	34.095833	-118.440758	L4C	128	TRG	0
B04	34.069660	-118.434639	L28	120	TRG	0
B05	34.238670	-118.463280	L28	161	TRG	0
B06	34.050522	-118.426300	L28	120	TRG	0
B07	34.025185	-118.417915	L22	46	GPS	497
B08	34.222137	-118.461845	L28	217	TRG	0
B09	34.277996	-118.472137	L28	96	TRG	0
B10	34.259895	-118.466927	L28	95	TRG	0
B11	34.209637	-118.458328	L28	74	TRG	0
B12	34.197735	-118.458328	L28	106	TRG	0
B13	34.014610	-118.490417	L28	139	GPS	260
B14	34.182293	-118.453384	L28	222	TRG	0
B15	34.166416	-118.451508	L22	20	GPS	100
B16	34.146069	-118.450325	L4C	81	GPS	417
B20	34.054688	-118.453125	L28	7	TRG	0
C01	34.152493	-118.451706	L28	178	GPS	319
C02	34.154907	-118.461411	L28	14	GPS	124
C03	34.149090	-118.444923	L28	123	TRG	0
C04	34.154320	-118.412445	L28	9	GPS	3
C05	34.148598	-118.427498	L28	60	GPS	259
C06	34.162838	-118.464607	L28	38	GPS	112
C07	34.154297	-118.470573	L28	164	TRG	0
C08	34.154167	-118.441406	L28	2	TRG	0
C10	34.147968	-118.461243	L4C	256	GPS	99
C11	34.155861	-118.449867	L28	70	TRG	0
C12	34.145744	-118.438126	L28	184	GPS	148
C13	34.169792	-118.459114	L28	29	TRG	0

Table 1. (continued)

Station Name	Coordinates		Sensor Type	No. of Events	Clock Type	No. of GPS Locks
	Latitude	Longitude				
C14	34.149746	-118.460838	L4C	117	GPS	76
C15	34.149471	-118.460495	L4C	120	GPS	9
C17	34.138355	-118.433693	L28	167	GPS	271
C18	34.160938	-118.450775	L28	43	TRG	0
D01	34.135647	-118.451981	L4C	174	GPS	50
D02	34.136059	-118.451416	L4C	161	GPS	294
D03	34.138283	-118.448410	L4C	81	GPS	24
D04	34.140984	-118.423386	L28	311	GPS	13
D05	34.144588	-118.416656	L28	102	GPS	274
D06	34.153667	-118.427567	L28	104	GPS	235
D07	34.166927	-118.442055	L28	237	TRG	0
D08	34.146019	-118.444664	L28	144	TRG	0
D09	34.132534	-118.444878	L28	314	GPS	139
D10	34.133999	-118.445267	L28	185	GPS	263
D11	34.140366	-118.443619	L28	179	TRG	0
D12	34.142200	-118.443428	L28	255	GPS	7
D13	34.152264	-118.441460	L28	61	GPS	107
D14	34.140572	-118.450905	L28	70	GPS	31
D15	34.143444	-118.456841	L28	157	GPS	84
D16	34.145138	-118.461327	L28	66	GPS	100
D17	34.137371	-118.494400	L28	307	TRG	0
D18	34.140820	-118.489838	L28	269	TRG	0
D19	34.024738	-118.505211	L28	95	TRG	0
D20	34.146542	-118.480446	L28	51	GPS	38
E01	34.031418	-118.500587	L4C	153	GPS	325
E02	34.031605	-118.500717	L4C	74	GPS	129
E03	34.032093	-118.499985	L4C	110	GPS	33
E04	34.041210	-118.501053	L28	124	GPS	231
E05	34.033703	-118.501236	L28	135	GPS	84
E06	34.043381	-118.480064	L28	44	GPS	39
E07	34.037910	-118.484177	L28	43	GPS	54
E08	34.035156	-118.475914	L28	119	TRG	0
E09	34.043594	-118.490288	L28	9	GPS	6
E10	34.046093	-118.489578	L28	227	TRG	0
E11	34.038803	-118.492004	L28	81	TRG	0
E12	33.987370	-118.471619	L28	69	TRG	0
E13	34.034897	-118.508072	L28	198	TRG	0
E14	34.029949	-118.501564	L28	171	TRG	0
E15	34.025002	-118.497131	L28	76	TRG	0
E16	34.031467	-118.510361	L28	49	GPS	104
E17	34.131767	-118.445312	L28	101	TRG	0
F02	34.026291	-118.494270	L28	93	GPS	48
F03	34.015884	-118.496613	L28	45	TRG	0
F04	34.034504	-118.473434	L28	35	TRG	0
F05	34.004688	-118.481773	L28	60	TRG	0

Table 1. (continued)

Station Name	Coordinates		Sensor Type	No. of Events	Clock Type	No. of GPS Locks
	Latitude	Longitude				
F06	34.015224	-118.482063	L28	26	GPS	57
F07	34.028645	-118.483849	L28	141	TRG	0
F08	34.034908	-118.469986	L28	138	TRG	0
F09	34.021729	-118.491440	L4C	40	GPS	18
F10	34.023560	-118.489738	L4C	30	GPS	114
F11	34.021648	-118.490639	L4C	54	GPS	26
F13	34.033722	-118.486588	L28	60	TRG	0
F14	34.036457	-118.483070	L28	79	TRG	0

Table 2. Instrument constants

Sensor Name	Free Period	Magnification	Damping
L28	0.21	27.58	0.71
L22	0.46	84.38	0.79
L4C	0.94	180.07	0.76

Table 3. Reftek DAS movement

Station Name	Start Time			End Time			DAS Number
	Day	Hour	Minute	Day	Hour	Minute	
A01	084	22	50	120	00	00	7051
A02	084	23	00	092	19	50	6095
	092	19	51	120	00	00	7301
A03	084	22	00	120	00	00	7054
A04	085	00	00	092	20	55	7057
	092	21	00	120	00	00	7284
A05	087	00	00	093	01	20	6115
	093	01	22	120	00	00	7285
A06	085	18	00	092	23	35	6019
	092	23	37	120	00	00	7278
A07	086	19	00	092	17	25	6018
	092	17	27	120	00	00	7281
A08	085	22	00	092	23	58	7104
	093	00	00	120	00	00	7293
A09	087	00	00	120	00	00	7106
A10	086	00	00	120	00	00	7089
A11	087	19	00	120	00	00	7093
A12	089	00	00	120	00	00	7087
A13	086	21	00	120	00	00	7050
A14	087	19	00	120	00	00	7100
A16	086	21	00	120	00	00	7098
A17	088	23	00	120	00	00	0615
B01	085	18	00	120	00	00	7079
B02	085	18	00	093	01	38	7075
	093	01	58	120	00	00	6110
B03	085	20	00	120	00	00	7066
B04	086	01	00	120	00	00	7062
B05	086	19	00	120	00	00	7060
B06	089	00	00	120	00	00	7068
B07	089	01	00	120	00	00	7081
B08	086	20	00	120	00	00	7083
B09	086	17	30	120	00	00	7044
B10	086	18	00	120	00	00	7103
B11	086	14	00	120	00	00	7109
B12	086	22	00	120	00	00	7113
B13	087	21	00	092	23	50	6128
	093	00	00	120	00	00	7294
B14	086	23	00	120	00	00	7046
B15	087	00	00	092	23	58	6069
	093	00	00	120	00	00	7292
B16	087	01	00	093	00	33	6064
	093	00	38	120	00	00	7299
B20	085	00	00	120	00	00	7047
C01	085	18	00	120	00	00	6099
C02	085	22	00	120	00	00	6041

Table 3. (continued)

Station Name	Start Time			End Time			DAS Number
	Day	Hour	Minute	Day	Hour	Minute	
C03	085	20	00	120	00	00	6040
C04	085	23	00	120	00	00	6129
C05	085	19	00	092	17	47	6131
	092	17	53	120	00	00	7287
C06	085	20	00	099	00	40	6028
	099	00	42	120	00	00	7104
C07	085	17	00	120	00	00	7111
C08	085	15	00	120	00	00	7038
C10	086	18	00	092	21	35	6051
	092	22	15	120	00	00	7277
C11	087	20	00	099	01	09	6052
	099	01	10	120	00	00	7075
C12	087	20	00	099	01	42	6056
	099	01	45	120	00	00	7090
C13	086	17	30	093	16	52	6083
	093	16	53	120	00	00	7042
C14	086	18	00	120	00	00	7112
C15	086	22	00	092	22	35	7042
	092	22	39	120	00	00	7295
C17	087	23	00	120	00	00	6048
C18	087	18	00	120	00	00	6116
D01	085	17	00	092	20	21	6045
	092	20	25	120	00	00	7306
D02	085	21	00	092	20	05	6132
	092	20	08	120	00	00	7305
D03	085	22	00	092	19	35	6035
	092	19	40	120	00	00	7286
D04	086	01	00	098	23	42	6039
	098	23	55	120	00	00	7298
D05	085	00	00	120	00	00	6134
D06	086	00	00	120	00	00	6027
D07	085	16	00	120	00	00	7039
D08	085	18	00	120	00	00	7041
D09	086	16	00	120	00	00	7077
D10	086	18	00	120	00	00	7069
D11	086	18	00	092	21	55	7045
	092	22	00	120	00	00	7307
D12	086	19	00	092	21	35	7090
	092	21	40	120	00	00	7304
D13	086	19	00	120	00	00	6063
D14	086	21	00	092	23	16	6084
	092	23	17	120	00	00	6100
D15	086	22	00	120	00	00	6043
D16	086	21	00	120	00	00	6066
D17	089	19	00	120	00	00	7056

Table 3. (continued)

Station Name	Start Time			End Time			DAS Number
	Day	Hour	Minute	Day	Hour	Minute	
D18	089	18	00	120	00	00	7059
D19	088	22	00	120	00	00	7063
D20	089	19	00	120	00	00	6098
E01	086	22	00	092	18	04	6109
	092	18	05	120	00	00	7300
E02	086	22	00	092	17	47	6113
	092	17	50	120	00	00	7290
E03	086	01	00	092	18	35	6046
	092	18	36	120	00	00	7283
E04	085	19	00	092	22	18	6021
	092	22	23	120	00	00	7297
E05	085	22	00	120	00	00	6024
E06	085	19	00	120	00	00	6118
E07	085	23	00	120	00	00	6122
E08	086	00	00	120	00	00	7101
E09	086	19	00	120	00	00	7085
E10	086	18	00	099	20	22	7088
	099	20	24	120	00	00	6104
E11	086	17	00	120	00	00	7080
E12	087	19	00	092	20	33	7067
	092	20	34	120	00	00	7282
E13	087	00	00	120	00	00	7053
E14	086	16	00	120	00	00	7064
E15	087	11	00	098	20	20	6111
	098	20	35	120	00	00	7057
E16	087	10	00	120	00	00	6121
E17	088	18	00	120	00	00	7070
F02	088	00	00	120	00	00	6034
F03	088	00	00	098	20	28	6026
	098	21	00	120	00	00	7045
F04	085	18	00	120	00	00	7099
F05	085	19	00	120	00	00	7091
F06	086	21	00	092	23	06	6061
	092	23	10	120	00	00	7302
F07	087	00	00	120	00	00	7092
F08	087	01	00	120	00	00	7082
F09	087	22	00	093	00	42	6107
	093	00	50	120	00	00	7291
F10	087	19	00	093	01	38	6114
	093	01	40	120	00	00	7279

Table 3. (continued)

Station Name	Start Time			End Time			DAS Number
	Day	Hour	Minute	Day	Hour	Minute	
F11	087	19	00	093	01	14	6124
	093	01	20	120	00	00	7289
F13	087	19	00	120	00	00	7108
F14	087	18	00	120	00	00	6032

Table 4. Events recorded by 40 or more stations

Origin Time			Coordinates		Mag.	Depth (km)	No. of Stations
Day	Hour	Minute	Lat.(°)	Lon.(°)			
088	02	04	34.25	-118.47	2.0	10.8	48
088	07	00	34.29	-118.55	1.9	6.5	42
088	17	24	34.36	-118.45	2.6	8.8	48
089	23	27	34.29	-118.48	2.1	10.2	44
090	09	05	34.23	-118.46	1.7	12.5	56
090	11	36	34.29	-118.64	2.2	13.8	73
090	12	52	34.13	-118.50	1.7	9.5	41
090	15	48	34.05	-118.13	2.6	12.0	40
090	19	25	34.27	-118.48	2.1	9.9	55
090	20	27	34.27	-118.48	2.2	9.8	61
091	06	09	34.29	-118.49	2.0	10.4	52
091	09	07	34.31	-118.64	2.6	8.4	77
092	04	46	34.31	-118.47	2.0	7.5	49
092	12	18	34.30	-118.49	2.0	9.2	59
092	14	10	34.37	-118.67	3.3	10.2	79
093	04	41	34.37	-118.59	2.6	5.2	49
093	09	09	34.34	-118.62	2.6	12.9	83
093	14	27	34.29	-118.44	1.8	5.9	50
093	18	28	34.24	-118.61	2.7	17.9	79
094	05	19	34.30	-118.44	2.2	7.9	67
094	10	06	34.31	-118.44	2.2	7.7	84
094	12	05	34.32	-118.47	1.9	7.2	53
095	05	47	34.24	-118.53	2.0	13.6	67
095	06	36	34.30	-118.48	1.9	9.8	45
095	08	15	34.35	-118.60	2.0	4.6	42
096	09	18	34.35	-118.55	2.9	4.6	82
096	10	51	34.25	-118.49	2.0	10.2	75
096	19	01	34.29	-118.44	1.7	11.1	67
097	04	19	34.33	-118.49	3.5	5.9	82
097	04	40	34.33	-118.49	2.6	5.7	54
097	09	55	34.30	-118.67	2.4	7.7	77
098	13	45	34.33	-118.47	2.3	8.0	60
098	14	36	34.27	-118.49	2.4	9.9	63
098	17	15	34.31	-118.47	2.8	8.1	59
099	12	29	34.28	-118.70	2.5	12.1	74
099	13	10	34.41	-118.65	2.5	13.9	56
099	15	15	34.29	-118.49	2.3	9.0	61
099	19	15	34.37	-118.67	2.8	10.2	65
099	21	18	34.28	-118.46	2.5	10.4	71
100	08	29	34.22	-118.52	1.7	18.0	57
100	16	01	34.34	-118.50	2.6	7.1	62
101	02	26	34.23	-118.38	1.8	4.8	40
101	04	08	34.33	-118.51	2.2	6.7	41
101	05	43	34.28	-118.47	1.8	10.1	62
101	12	05	34.31	-118.56	1.9	10.9	45

Table 4. (continued)

Origin Time			Coordinates		Mag.	Depth (km)	No. of Stations
Day	Hour	Minute	Lat.(°)	Lon.(°)			
102	08	06	34.30	-118.47	1.8	7.8	53
102	11	27	34.26	-118.49	1.8	11.8	58
102	15	12	34.32	-118.49	2.3	8.2	41
103	01	57	34.34	-118.61	3.2	10.4	64
103	05	59	34.31	-118.46	2.0	7.9	50
103	11	18	34.37	-118.53	2.8	2.0	66
103	15	29	34.29	-118.50	2.6	7.3	58
104	06	42	34.32	-118.57	2.5	3.4	59

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