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by  
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## Introduction

Since 1967 the U.S. Geological Survey has operated the Northern California Seismic Network (NCSN) to provide earthquake data for a wide range of research topics and hazard-reduction activities. In addition to regional earthquake monitoring, the network has played a role in advancing studies of earthquake forecasting, fault mechanics, tectonics, volcano hazards, earth structure, and geothermal phenomena. A review of the research derived from data recorded by the NCSN and a complete bibliography can be found in *Oppenheimer et al.* (1992). This bulletin documents the status of the network for 1992 and reviews highlights of the year's seismicity.

## Network Operations

The Northern California Seismic Network is designed to detect all local earthquakes having signal strength above the background level of microseisms. The network configuration was motivated by the need to monitor active faults and volcanoes with a station density sufficient to determine the focal depth of shallow (0-15 km) crustal earthquakes. Depending on the concentration of stations in a region, the magnitude ( $M$ ) level at which earthquake detection is complete varies from approximately 1.4 in parts of the central Coast Ranges to 2.6 in the Klamath Mountain range. However, earthquakes with  $M < 1.0$  are routinely detected throughout the network. The network in 1992 operated 359 stations, and recorded an additional 56 stations operated by other networks (Tables 1 and 2; Figure 1). During 1992 eight new stations were installed, and four were removed (Table 3).

Earthquake detection and location occurs on two independent data acquisition systems, the Real-Time-Picker (RTP) and CalTech-USGS-Seismic-Processing (CUSP) system. The RTP is a parallel microprocessor system developed by the NCSN (*Allen*, 1978, 1982) which measures station arrival times and coda-durations from all of the stations in the network. This information is then associated to calculate earthquake origin times, locations, and duration magnitudes. The RTP locations form the basis of the NCSN earthquake notification system that automatically alerts seismologists within minutes of the occurrence of any significant seismicity. Unlike the CUSP system, no seismograms are retained.

The same data are processed through the CUSP system, a complete earthquake detection, location, and data management system originally developed by Carl Johnson of the California Institute of Technology and subsequently enhanced by scientists from the Southern California Seismic Network (SCSN) and NCSN. The CUSP system digitizes 512 channels of input at 100 samples/sec with 12 bit A/D resolution, detects earthquakes, demultiplexes the digital data stream, and tags each "trigger" with a unique identification number for data management. The system then automatically computes the  $P$ -arrival times and coda durations, locates the earthquake, and "posts" the earthquake for review by seismic analysts. The analysts examine the digital seismograms on computer screens and revise the parameters as necessary to properly locate the earthquake. Subsequently the digital seismograms and earthquake locations are stored on magnetic and optical media for later research. In addition, a continuous digital recording of the entire network provides a backup. The combined power of the CUSP, RTP, and backup tape systems ensures complete recording of ongoing earthquake sequences.

Because of monitoring responsibilities, the NCSN has taken considerable efforts to operate their earthquake detection system with a high degree of reliability. Electricity for the computers and portions of the microwave telemetry system is supplied through an uninterruptable power supply with standby emergency power backup, critical hardware is seismically braced, and earthquake acquisition and monitoring functions occur simultaneously on backup computers. The NCSN also operates software that automatically notifies the seismologist on duty if seismicity exceeds pre-established criteria or if the computers malfunction.



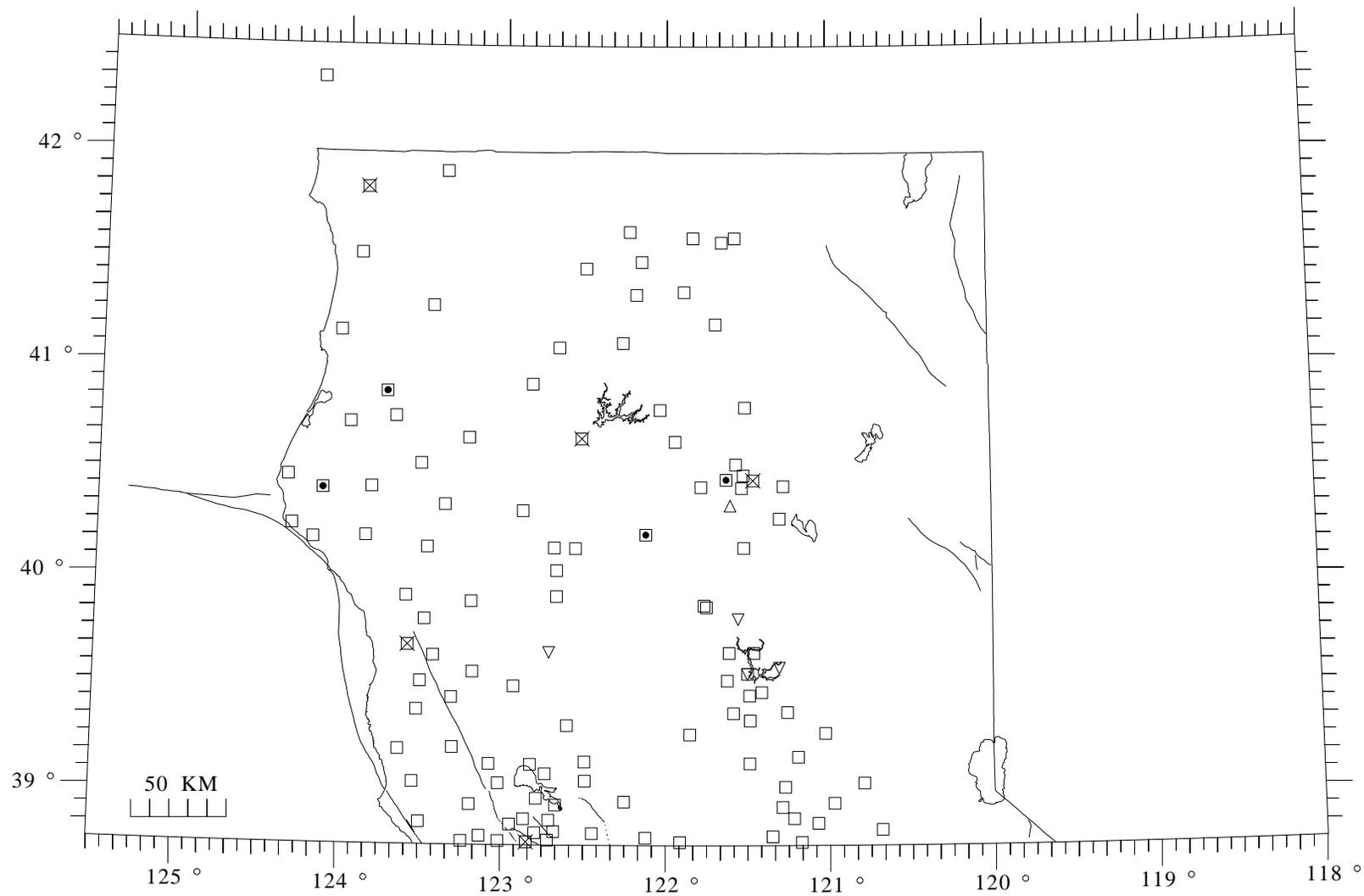


Figure 1. Seismic stations recorded by the NCSN during 1992. Solid lines depict faults with displacement during the Quaternary.

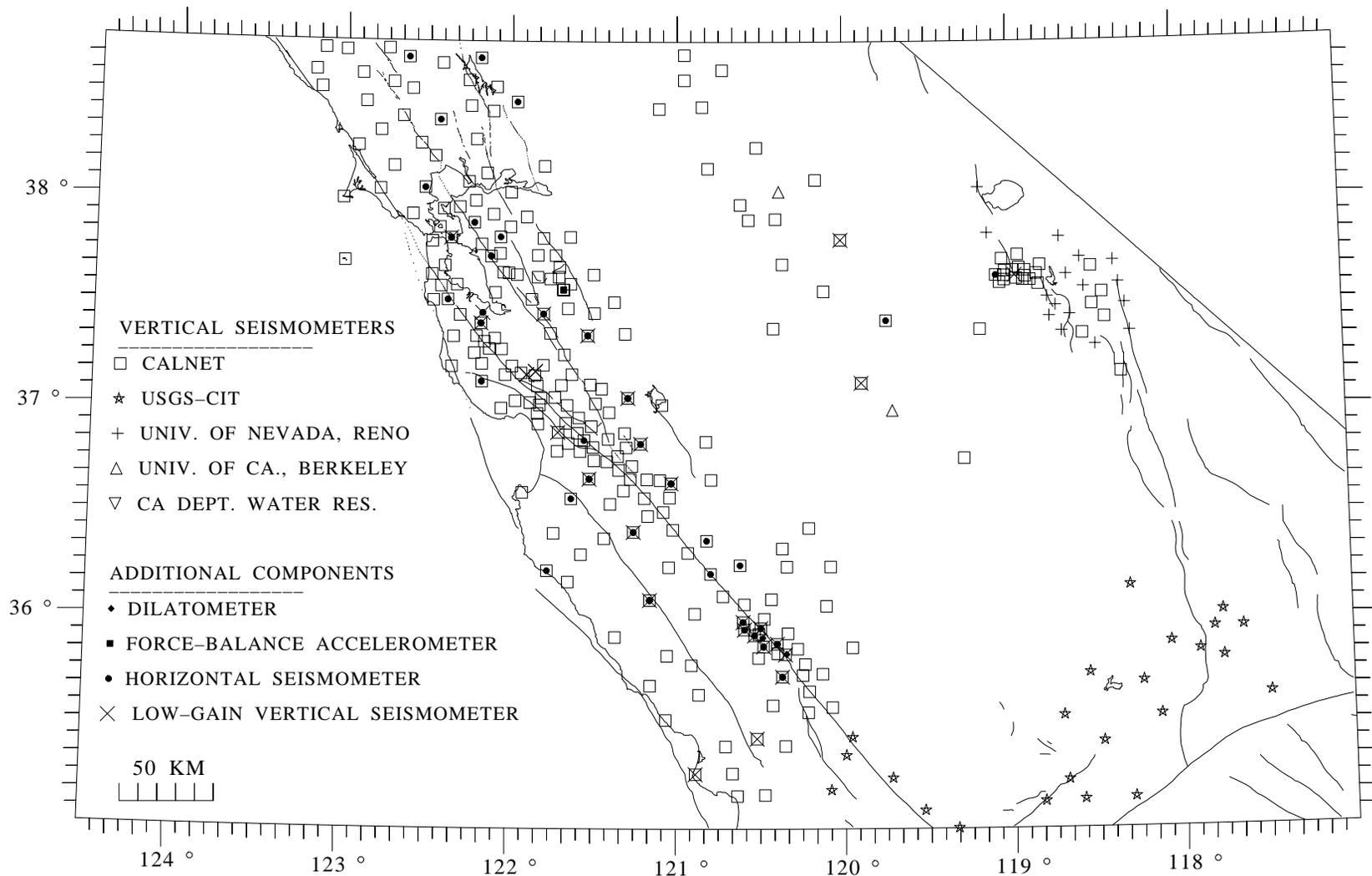


Figure 1 (cont.).

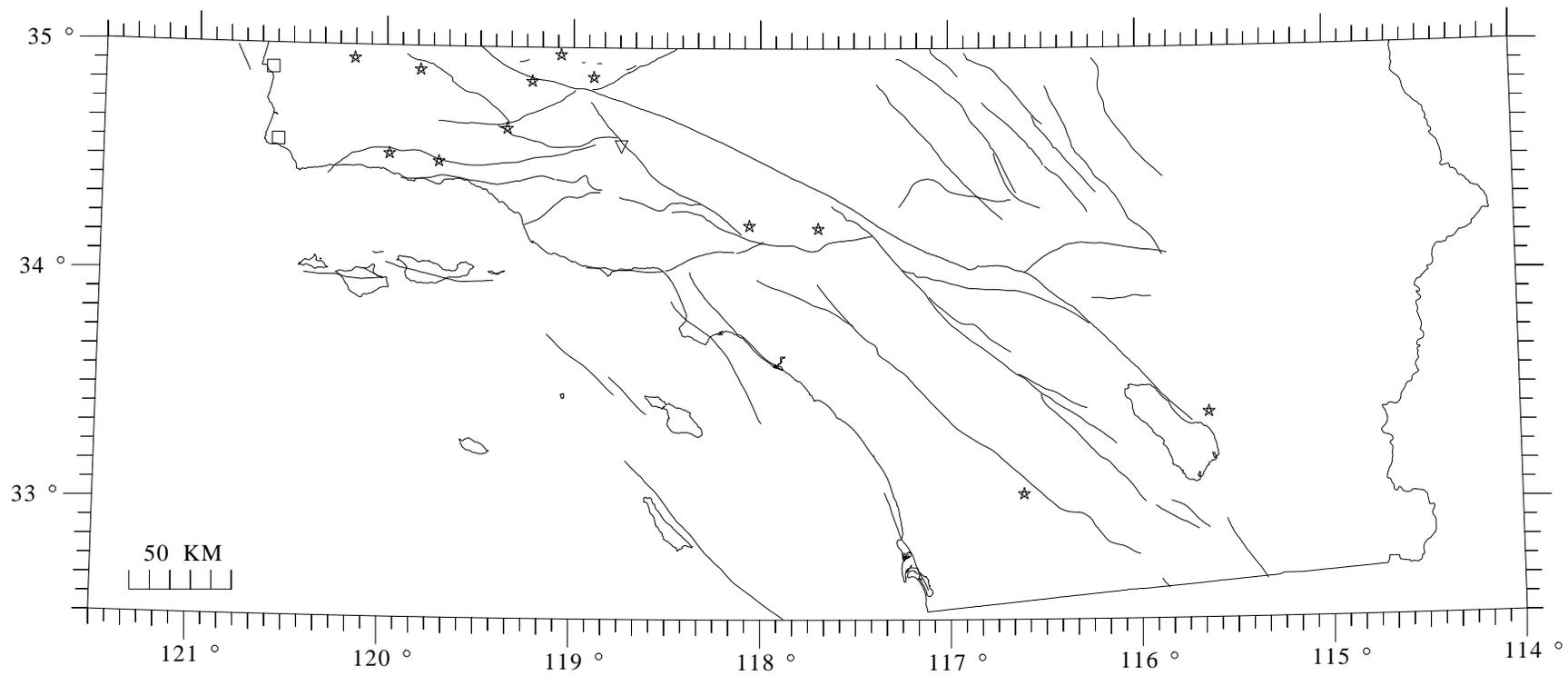


Figure 1 (cont.).

Table 1. Station Locations, Attenuations, Components, and Magnitude Correction Factors

Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$	Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$	Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$		
Code	(deg min)	(deg min)	Code	(dB)				Code	(deg min)	(deg min)	Code	(dB)				Code	(deg min)	(deg min)	Code	(dB)					
AAR	NC	39 16.57	121 1.53	VHZ	24	-0.06	-0.18	BSM	NC	36 23.00	121 25.67	VHZ	18	0.04	-0.10										
AAS	NC	38 25.80	121 6.51	VHZ	18	0.14	0.28	BSR	NC	36 39.99	121 31.12	VHZ	12	0.09	0.04			CSP	NC	37 57.45	122 18.65	VHZ	24	-0.26	-0.31
ABJ	NC	39 9.92	121 11.47	VHZ	18	0.28	0.13					VLZ	48	-0.14	-0.07			CST	NC	37 38.35	121 29.89	VHZ	12		
ABR	NC	39 8.11	121 29.21	VHZ	24	-0.18	-0.10					VLN	42	-0.04	0.02			CSV	NC	37 51.88	122 0.16	VHZ	24	-0.34	-0.24
ADW	NC	38 26.35	120 50.89	VHZ	12	0.19	0.18					VLE	42	-0.08	-0.10			CVA	NC	37 37.10	121 45.49	VHZ	18		
AFD	NC	38 56.88	120 58.34	VHZ	6	0.37	0.30	BVL	NC	36 34.51	121 11.34	VHZ	6	-0.06	0.08			CVL	NC	37 37.58	121 50.14	VHZ	12		
AFH	NC	39 2.51	120 47.48	VHZ	24	-0.09	-0.17	BVY	NC	36 44.96	121 24.80	VHZ	6	0.20	0.38			CVP	NC	37 53.04	122 13.32	VHZ	18		
AFR	NC	38 47.54	121 20.91	VHZ	24	-0.26	-0.15	CAD	NC	37 9.83	121 37.55	VHZ	18	0.11	0.00										
AHR	NC	38 51.26	121 4.23	VHZ	6	0.29	0.29	CAI	NC	37 51.68	122 25.77	VHZ	18	0.11	-0.05										
ALA	NC	38 34.00	120 57.37	VHZ	12	0.36	0.27	CAL	NC	37 27.07	121 47.95	VHZ	12	0.25	0.33			CYB	NC	37 48.68	122 21.65	VHZ	24		
ALN	NC	38 55.78	121 17.27	VHZ	24	-0.02	-0.04					VLZ	48	0.18	0.22										
AOD	NC	38 36.89	120 43.71	VHZ	12	0.24	0.19					VLN	42	0.25	0.21										
AOH	NC	39 22.52	121 15.36	VHZ	18	0.17	0.01					VLE	42	0.25	0.24										
APR	NC	38 52.62	121 13.03	VHZ	6	0.29	0.40	CAO	NC	37 20.96	121 31.96	VHZ	12	0.19	0.27			GAC	NC	38 52.37	122 51.73	VHZ	12	0.42	0.46
ARJ	NC	38 41.19	120 57.38	VHZ	12	0.28	0.23					VLZ	48	0.18	0.21			GAR	NC	38 57.31	122 15.13	VHZ	12	-0.30	-0.02
ARR	NC	38 45.92	121 10.31	VHZ	12	0.52	0.45					VLN	42	0.29	0.19			GAX	NC	38 42.65	122 45.30	VHZ	12	0.48	0.28
ASM	NC	38 49.40	120 41.00	VHZ	18	0.10	-0.05					VLE	42	0.34	0.20			GBD	NC	39 26.52	123 18.55	VHZ	18	0.01	0.06
AVR	NC	39 1.47	121 16.25	VHZ	6	0.39	0.34	CBR	NC	37 48.97	122 3.72	VHZ	18	0.09	0.07			GBG	NC	38 48.84	122 40.76	VHZ	18	0.09	0.14
BAP	NC	36 10.55	121 38.56	VHZ	18	0.00	-0.17					VLN	42	0.23	0.15			GBM	NC	39 8.51	122 29.64	VHZ	18	0.24	0.34
BAV	NC	36 38.75	121 1.79	VHZ	12	0.22	0.27					VLE	42	0.30	0.17			GCB	NC	39 23.03	123 31.28	VHZ	12	0.17	0.23
				VLZ	48	0.16	0.16					VLN	42	0.25	0.24			GCR	NC	38 46.39	122 42.92	VHZ	12	0.46	0.44
				VLE	42	0.30	0.17					VLN	42	0.23	0.15			GCV	NC	38 46.18	123 0.83	VHZ	12	0.24	0.20
BBG	NC	36 34.70	121 2.31	VHZ	18	-0.39	-0.21					VLN	42	0.23	0.24			GCW	NC	39 7.85	123 4.55	VHZ	12	0.27	0.28
BBN	NC	36 30.57	121 4.57	VHZ	6	-0.30	-0.04					VLE	42	0.34	0.20			GDC	NC	38 46.03	123 14.31	VHZ	12	0.17	0.07
BCG	NC	36 42.55	121 20.60	VHZ	18	0.01	0.07					VLN	42	-0.35	-0.17			GDX	NC	38 48.46	122 47.63	VHZ	12	0.55	0.57
BCW	NC	36 18.40	121 33.96	VHZ	18	0.17	-0.05					VLN	42	-0.17	-0.07			GGP	NC	38 45.88	122 50.65	VHZ	18	0.22	0.25
BEH	NC	36 39.88	121 10.45	VHZ	18	-0.19	-0.14					VLZ	42	0.11	0.11										
BEM	NC	36 39.68	121 5.76	VHZ	12	0.01	-0.05					VLZ	48	0.11	0.11			GGU	NC	38 51.39	123 29.87	VHZ	18	0.30	0.16
BHR	NC	36 43.67	121 15.83	VHZ	18	-0.30	-0.13					VLZ	42	0.11	0.11			GHC	NC	38 36.36	123 11.81	VHZ	12	0.31	0.21
BJC	NC	36 32.82	121 23.56	VHZ	6	0.28	0.20					VLZ	42	0.11	0.11			GHG	NC	39 7.70	122 49.47	VHZ	12	0.46	0.51
BJO	NC	36 36.65	121 18.81	VHZ	12	0.21	0.14					VLZ	42	0.11	0.11			GHL	NC	39 2.43	123 1.12	VHZ	6	0.47	0.48
BLR	NC	36 39.96	121 16.36	VHZ	12	-0.33	-0.07					VLZ	42	0.11	0.11			GHM	NC	39 29.74	122 55.80	VHZ	12	0.31	0.43
BMS	NC	36 39.78	120 47.51	VHZ	12	0.00	-0.05					VLZ	42	0.11	0.11			GHO	NC	39 2.67	123 32.41	VHZ	12		
BPC	NC	36 34.32	121 37.56	VHZ	12	-0.20	-0.16					VLZ	42	0.11	0.11			GHV	NC	39 5.10	122 44.06	VHZ	18	0.32	0.28
BPC	NC	36 34.32	121 37.56	VLN	42	-0.17	-0.15					VLZ	42	0.11	0.11			GMC	NC	38 47.56	123 7.80	VHZ	12	0.42	0.30
BPI	NC	36 29.40	121 10.11	VHZ	6	0.30	0.22					VLZ	42	0.11	0.11			GMO	NC	38 42.61	123 8.59	VHZ	6	0.44	0.42
BPO	NC	36 13.72	121 46.00	VHZ	12							VLZ	42	0.11	0.11			GNA	NC	39 11.85	123 37.85	VHZ	18	-0.08	-0.12
BPO	NC	36 13.72	121 46.00	VLN	42							VLZ	42	0.11	0.11			GPM	NC	38 50.85	122 56.78	VHZ	18	0.27	0.14
BPR	NC	36 24.42	121 43.77	VHZ	18	0.03	-0.13					VLZ	42	0.11	0.11			GRO	NC	39 55.04	122 40.23	VHZ	12		
BRM	NC	36 50.70	120 49.40	VHZ	18	-0.26	-0.21					VLZ	42	0.11	0.11			GRT	NC	38 56.32	122 40.18	VHZ	12	0.14	0.16
BRV	NC	36 25.49	121 1.10	VHZ	18	-0.15	0.02					VLZ	42	0.11	0.11			GSG	NC	38 52.03	122 42.58	VHZ	12	-0.07	-0.12
BSG	NC	36 24.83	121 15.22	VHZ	18	0.14	0.06					VLZ	48	0.02	0.07			GSN	NC	38 56.43	123 11.50	VHZ	12	0.24	0.13
				VLZ	48	0.02	0.07					VLN	42	0.14	0.09			GSS	NC	38 42.12	123 0.81	VHZ	12	0.30	0.16
				VLE	42	0.14	0.09					VLN	42	0.14	0.09			GTS	NC	39 18.70	122 36.15	VHZ	12	0.29	0.36
BSL	NC	36 46.53	121 20.96	VHZ	24	-0.57	-0.38					VLE	42	0.14	0.09			GWK	NC	39 3.12	122 29.46	VHZ	12	0.12	0.32
												VLN	42					GWR	NC	39 12.43	123 17.99	VHZ	18	0.18	0.21

Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$	Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$	Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$	
	Code	(deg min)	(deg min)	Code	(dB)				Code	(deg min)	(deg min)	Code	(dB)				Code	(deg min)	(deg min)	Code	(dB)			
HAZ	NC	36 53.08	121 35.45	VHZ	18	0.18	0.29	JHL	NC	37 6.54	121 49.99	VHZ	18	0.29	0.49	KIP	NC	39 48.52	123 28.83	VHZ	6	0.31	0.41	
HBT	NC	36 51.01	121 33.04	VHZ	24	0.04	0.26	JHP	NC	37 26.65	122 18.09	VHZ	18	-0.16	-0.10	KJJ	NC	40 14.86	124 18.41	VHZ	18			
				VLN	42	-0.06	0.16	JJR	NC	37 20.68	122 12.09	VHZ	18			KKP	NC	40 8.75	123 28.10	VHZ	12	0.25	0.27	
HCA	NC	37 1.52	121 29.02	VHZ	12	0.04	0.06	JLX	NC	37 12.11	121 59.17	VHZ	18	0.11	0.06	KMP	NC	40 25.04	124 7.21	VHZ	18	0.08	0.04	
HCB	NC	36 55.88	121 39.63	VHZ	18	-0.24	-0.14	JMG	NC	37 38.22	122 28.43	VHZ	18	0.12	0.13					VLN	42	-0.11	-0.36	
HCO	NC	36 53.25	121 42.49	VHZ	18	-0.53	-0.31	JMP	NC	37 27.33	122 9.93	VFZ	72	-0.34	-0.05					VLE	42	-0.08	-0.30	
				VLZ	48	-0.53	-0.25					VFN	72	-0.46	-0.33	KOM	NC	41 16.73	123 27.13	VHZ	6	0.43	0.42	
HCR	NC	36 57.46	121 35.01	VHZ	12	0.28	0.28					VFE	72	-0.52	-0.32	KPP	NC	40 20.76	123 21.73	VHZ	12	0.30	0.35	
HDL	NC	36 50.12	121 38.64	VHZ	12	0.22	0.18	JNA	NC	37 10.62	121 50.68	VLZ	36	-0.08	-0.01	KRK	NC	39 33.77	123 10.93	VHZ	12	0.25	0.41	
HER	NC	36 47.90	121 42.64	VHZ	24	-0.54	-0.14					VFZ	72	-0.38	-0.21	KRM	NC	41 31.31	123 54.31	VHZ	18	0.28	0.24	
HFE	NC	36 59.00	121 24.09	VHZ	18	0.07	0.04	JPL	NC	36 58.62	121 49.93	VHZ	18	-0.69	-0.37	KRP	NC	41 9.49	124 1.38	VHZ	12	0.23	0.46	
HFP	NC	36 45.22	121 29.43	VHZ	6	0.39	0.49	JPP	NC	37 15.81	122 12.78	VHZ	12	-0.24	0.00	KSC	NC	42 20.64	124 9.88	VLZ	18			
HGS	NC	37 5.75	121 26.83	VHZ	12	0.25	0.18	JPR	NC	37 47.70	122 28.43	VHZ	24	-0.25	-0.35	KSM	NC	40 11.15	124 10.48	VHZ	12	0.06	0.21	
HGW	NC	37 1.02	121 39.20	VHZ	12	0.27	0.23	JPS	NC	37 11.94	122 20.90	VHZ	18	-0.19	-0.14	KSP	NC	39 31.04	123 30.09	VHZ	12	0.22	0.37	
HJG	NC	36 47.88	121 34.43	VHZ	12	0.30	0.44	JRG	NC	37 2.22	121 57.87	VHZ	18	-0.36	-0.24	KSX	NC	41 49.85	123 52.55	VHZ	12	0.44	0.33	
HJS	NC	36 48.99	121 17.92	VHZ	12	0.08	0.16	JRR	NC	37 3.27	121 43.61	VHZ	12	0.22	0.17					VLZ	48	0.17	0.04	
HLT	NC	36 53.07	121 18.49	VHZ	12	0.19	0.37	JSA	NC	37 34.95	122 25.03	VHZ	18	0.18	-0.02	KTR	NC	41 54.52	123 22.59	VHZ	12			
HMO	NC	36 36.03	121 55.06	VHZ	18	0.24	0.01	JSB	NC	37 40.74	122 23.80	VHZ	24			LAS	NC	41 35.96	121 34.60	VHZ	18	0.36	0.12	
HOR	NC	36 55.03	121 30.46	VHZ	18	-0.54	-0.11	JSC	NC	37 17.07	122 7.42	VHZ	18	0.04	0.06	LBF	NC	41 20.82	121 53.42	VHZ	12	0.06	-0.05	
HPH	NC	36 51.38	121 24.37	VHZ	36	-0.80	-0.60	JSF	NC	37 24.31	122 10.55	VHZ	24	-0.21	-0.16	LBK	NC	41 5.05	122 39.91	VHZ	6	0.32	0.27	
HPL	NC	37 3.13	121 17.40	VHZ	18	0.31	0.23					VLZ	48	-0.25	-0.08	LBP	NC	40 19.10	122 52.88	VHZ	12	0.62	0.55	
				VLZ	48	0.30	0.26					VLN	42	-0.10	-0.07	LCF	NC	40 29.18	121 31.44	VHZ	18	-0.14	-0.24	
				VLN	42	0.43	0.27					VLE	42	0.09	0.17	LCM	NC	40 8.79	121 31.26	VHZ	18	-0.20	-0.22	
				VLE	42	0.30	0.23	JSG	NC	37 16.96	122 3.00	VHZ	18	-0.23	-0.08	LDB	NC	40 25.90	121 47.08	VHZ	18	-0.16	-0.21	
HQR	NC	36 50.02	121 12.76	VHZ	18	0.17	0.15	JSJ	NC	37 20.03	122 5.48	VHZ	24	-0.53	-0.44	LGB	NC	41 20.00	122 11.20	VHZ	12	-0.23	-0.17	
				VLZ	48	0.03	0.07	JSM	NC	37 12.74	122 10.06	VHZ	18	-0.06	-0.08	LGM	NC	41 35.98	121 50.11	VHZ	12	0.00	-0.06	
				VLN	42	0.11	0.00	JSS	NC	37 10.17	121 55.84	VHZ	18	0.09	0.07	LGP	NC	40 54.75	122 49.72	VHZ	6	0.35	0.29	
				VLE	42	0.11	0.05	JST	NC	37 12.41	121 47.84	VHZ	12	0.02	0.04	LHC	NC	40 48.30	121 30.84	VHZ	24	-0.11	-0.28	
HSF	NC	36 49.03	121 29.81	VHZ	18	-0.18	-0.02	JTG	NC	37 1.71	121 52.58	VHZ	18	-0.41	-0.24	LHE	NC	41 37.71	122 13.83	VHZ	18	0.09	-0.05	
HSL	NC	37 1.16	121 5.13	VHZ	18	-0.19	-0.23	JUC	NC	37 0.07	122 2.91	VHZ	12	0.08	0.04	LHK	NC	40 26.12	121 16.67	VHZ	12	-0.12	-0.17	
HSP	NC	37 6.91	121 30.94	VHZ	12	-0.03	0.01	JUM	NC	37 9.65	121 53.86	VLZ	36	0.10	0.07	LME	NC	40 32.27	121 34.21	VHZ	24	-0.11	-0.58	
JAL	NC	37 9.50	121 50.82	VHZ	18	0.06	0.02					VFZ	72	-0.10	-0.17	LMH	NC	41 34.74	121 39.44	VHZ	24	-0.16	-0.41	
JBC	NC	37 9.62	122 1.57	VHZ	18	0.14	0.27	KBB	NC	40 11.82	123 51.00	VHZ	12	0.02	0.06	LMP	NC	41 29.25	122 9.28	VHZ	12	-0.34	-0.26	
JBG	NC	37 20.52	122 20.34	VHZ	24	-0.30	-0.15	KBN	NC	39 53.56	123 11.64	VHZ	12	0.34	0.33	LPD	NC	41 11.72	121 41.76	VHZ	18	-0.08	-0.10	
JBL	NC	37 7.69	122 10.08	VHZ	18	0.14	0.12	KBR	NC	40 43.79	123 57.34	VHZ	12	0.36	0.25	LPG	NC	40 8.72	122 41.20	VHZ	12			
				VLN	42	0.21	0.20	KBS	NC	39 55.07	123 35.68	VHZ	12	0.11	0.14	LPK	NC	41 27.34	122 30.05	VHZ	6			
				VLE	42	0.23	0.22	KCP	NC	39 41.23	123 34.84	VHZ	18	-0.03	0.01	LRB	NC	40 8.60	122 33.40	VHZ	12			
JBM	NC	37 19.09	122 9.16	VHZ	12	0.06	0.22					VLZ	48	-0.10	-0.10	LRD	NC	40 27.78	121 27.85	VHZ	12	-0.28	-0.33	
JBZ	NC	37 1.07	121 49.15	VHZ	18	-0.63	-0.44	KCR	NC	40 25.58	123 49.11	VHZ	12	0.27	0.23					VLZ	48			
JCB	NC	37 6.71	121 41.33	VHZ	12	0.00	-0.10	KCS	NC	40 32.26	123 30.76	VHZ	12			LRR	NC	40 27.98	121 37.78	VHZ	18	-0.21	-0.33	
JCH	NC	37 31.02	122 22.56	VHZ	18			KCT	NC	40 28.55	124 20.18	VHZ	18	0.01	0.00					VLE	30			
				VLN	42			KFP	NC	39 38.35	123 25.44	VHZ	12	0.30	0.31	LSF	NC	40 39.49	122 31.36	VHZ	18	0.28	0.09	
				VLE	42			KGM	NC	40 45.53	123 40.46	VHZ	18	0.28	0.18					VLZ	48			
JCP	NC	37 35.29	122 19.33	VHZ	24			KHB	NC	40 39.61	123 13.11	VHZ	24			LSH	NC	40 47.59	122 2.29	VHZ	6	0.42	0.31	
JEC	NC	37 3.04	121 48.56	VHZ	12	0.05	0.16	KHM	NC	40 52.48	123 43.89	VHZ	18			LSL	NC	40 25.64	121 32.05	VHZ	12	0.20	0.07	
JEG	NC	37 30.84	122 27.74	VHZ	24	-0.14	-0.28					VLN	42			LSM	NC	40 17.00	121 18.09	VHZ	18	-0.09	-0.21	
JEL	NC	36 55.64	121 49.61	VHZ	24	-0.69	-0.33					VLE	42			LSR	NC	41 6.43	122 16.16	VHZ	12			

Name	IRIS <sup>‡</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$	Name	IRIS <sup>‡</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$	Name	IRIS <sup>‡</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$
Code	(deg min)	(deg min)	Code	(dB)				Code	(deg min)	(deg min)	Code	(dB)				Code	(deg min)	(deg min)	Code	(dB)			
LTC	NC	40 12.50	122 7.45	VHZ	18	-0.22	-0.11	NAD	NC	38 27.60	121 58.18	VLN	42	-0.14	-0.08	OWY	NC	39 27.19	121 29.20	VHZ	18	0.31	0.19
				VLN	42	-0.23	-0.12	NAP	NC	38 26.34	122 14.99	VHZ	18	-0.31	-0.13	PAB	NC	35 9.41	120 38.17	VHZ	24	-0.14	-0.25
LVR	NC	40 2.35	122 40.25	VHZ	12			NBP	NC	38 40.07	122 11.60	VHZ	12	-0.15	0.07	PAD	NC	35 38.36	120 51.86	VHZ	18	-0.25	-0.27
LWH	NC	40 38.66	121 56.70	VHZ	6	0.25	0.28					VLN	42	0.03	0.07	PAG	NC	35 43.92	120 14.96	VHZ	24	-0.05	-0.08
MBE	NC	36 45.75	119 16.90	VLZ	42			NBR	NC	38 15.65	122 32.99	VHZ	24	-0.16	-0.15	PAN	NC	35 46.78	120 54.44	VHZ	24	-0.27	-0.33
MBO	NC	37 41.35	120 21.86	VHZ	12	0.43	0.29	NCF	NC	38 19.28	122 47.73	VHZ	18	0.02	0.03	PAP	NC	35 54.77	121 21.70	VHZ	12	0.26	0.10
MBU	NC	37 33.58	120 7.00	VHZ	12			NCP	NC	38 47.17	122 7.33	VHZ	18	-0.19	0.00	PAR	NC	36 14.95	120 20.52	VHZ	18	-0.26	-0.16
MCD	NC	37 32.89	118 26.50	VHZ	18	-0.83	-0.56	NDH	NC	38 45.93	121 54.75	VHZ	12	-0.43	-0.02	PBI	NC	35 9.68	120 28.42	VHZ	24	-0.31	-0.41
MCL	NC	37 35.41	118 49.45	VHZ	18			NFI	NC	37 41.90	123 0.00	VHZ	24	0.26	0.07	PBM	NC	35 23.68	120 21.16	VHZ	24	0.29	0.02
MCM	NC	37 36.59	118 52.40	VHZ	18	-0.25	-0.55	NFR	NC	38 31.36	123 9.66	VHZ	12	0.13	0.02	PBP	NC	35 34.73	120 4.58	VHZ	24	-0.02	-0.16
MCS	NC	37 39.30	118 54.27	VHZ	18	-0.25	-0.42	NGV	NC	38 16.84	122 12.89	VHZ	18	-0.01	0.05	PBW	NC	36 18.90	120 55.75	VHZ	24	-0.17	0.02
MCU	NC	37 58.36	120 37.02	VHZ	6	0.30	0.24	NHF	NC	38 2.98	122 31.34	VHZ	18			PCA	NC	35 55.90	120 20.22	VHZ	24	-0.04	-0.11
MDC	NC	37 42.60	119 2.50	VHZ	12	0.24	-0.11					VLN	42			PCB	NC	35 31.11	121 3.56	VHZ	18	0.30	0.07
MDP	NC	37 37.94	119 4.74	VHZ	24	-0.03	-0.30					VLE	42			PCR	NC	36 5.65	120 26.08	VHZ	24	0.04	0.00
				VLN	42			NHM	NC	38 9.28	121 48.02	VHZ	18	-0.45	-0.08	PDR	NC	36 20.14	120 22.12	VHZ	18	-0.29	-0.14
MDR	NC	37 38.32	118 50.13	VHZ	18			NIM	NC	38 33.69	122 15.86	VHZ	12	0.11	0.17	PGH	NC	35 49.86	120 21.17	VHZ	24	0.32	0.28
MEM	NC	37 39.98	118 56.35	VHZ	18	-0.33	-0.57	NLH	NC	38 7.19	122 8.87	VHZ	18	-0.07	-0.01					VLZ	48	0.60	0.31
MFB	NC	37 25.77	118 25.70	VHZ	24	-0.89	-0.59	NLN	NC	38 9.15	122 42.75	VHZ	18	0.13	0.03	PHA	NC	35 50.16	120 23.91	VHZ	24	-0.28	-0.07
MGP	NC	37 37.59	118 54.08	VHZ	18	-0.58	-0.60	NMC	NC	38 35.46	122 54.74	VHZ	12	0.28	0.21	PHB	NC	36 14.93	120 4.96	VHZ	24	-0.57	-0.31
MHD	NC	37 7.36	119 53.60	VHZ	12	0.22	0.09	NMH	NC	38 40.17	122 37.93	VHZ	12	0.24	0.21	PHC	NC	35 40.93	121 9.15	VHZ	24	0.07	-0.11
				VLZ	48	0.00						VLN	42	0.14	0.14	PHF	NC	35 52.91	120 24.03	VHZ	24	0.12	0.05
MLC	NC	37 36.63	118 54.95	VHZ	24	-0.09	-0.39	NMI	NC	38 4.69	122 15.44	VHZ	24							VLZ	48	0.14	0.14
MLH	NC	37 40.78	118 48.75	VHZ	18			NMT	NC	38 48.34	122 26.76	VHZ	6	0.14	0.37					VLN	42	0.17	0.12
MLM	NC	37 43.73	118 56.79	VHZ	18	-0.46	-0.53	NMW	NC	38 33.03	122 43.37	VHZ	18	-0.10	-0.03					VLE	42	0.16	0.12
MLR	NC	38 5.44	120 9.84	VHZ	6	0.27	0.17	NOL	NC	38 2.50	122 47.64	VHZ	18	-0.20	-0.51	PHO	NC	35 52.12	120 28.88	VHZ	24	-0.40	-0.30
MMI	NC	37 25.20	119 44.56	VHZ	6	0.26	0.02	NPR	NC	37 59.79	123 0.98	VHZ	30	0.11	-0.07					VLZ	48	-0.34	-0.23
				VLN	42	0.12	0.04	NPV	NC	38 38.55	122 25.55	VHZ	18	0.15	0.21					VLN	42	-0.30	-0.21
MML	NC	37 39.36	118 58.68	VHZ	24	-0.56	-0.73	NRR	NC	38 31.82	122 5.73	VHZ	12	-0.07	0.11					VLE	42	-0.35	-0.29
MMP	NC	37 36.60	119 1.68	VHZ	18	0.03	-0.27	NSH	NC	38 31.20	122 36.43	VHZ	12	0.05	0.09	PHP	NC	35 59.13	120 36.12	VHZ	24	-0.18	-0.25
MMS	NC	37 37.83	119 1.84	VHZ	24			NSP	NC	38 12.02	122 27.82	VHZ	12	-0.01	0.03					VLZ	48	-0.22	-0.22
MMT	NC	37 22.55	119 10.68	VHZ	24	0.09	-0.26	NTA	NC	37 55.43	122 35.70	VHZ	18	0.37	0.32					VLN	42	-0.31	-0.38
MNH	NC	38 8.75	120 48.82	VHZ	6	0.25	0.24	NTB	NC	38 14.87	122 55.86	VHZ	18	0.07	-0.09					VLE	42	-0.33	-0.41
MOG	NC	37 29.50	118 30.19	VHZ	24	-0.74	-0.56	NTY	NC	38 23.37	122 39.70	VHZ	18	-0.14	-0.07	PHR	NC	36 22.38	120 49.10	VHZ	12	-0.26	-0.33
MOY	NC	37 54.00	120 34.04	VHZ	18	0.25	0.18	NVA	NC	38 24.92	122 6.88	VHZ	18	-0.05	0.06					VLN	42	0.04	0.13
MPR	NC	37 48.26	120 0.80	VHZ	12			NVE	NC	38 22.36	122 26.17	VHZ	24	-0.03	-0.01	PHS	NC	35 49.45	121 3.17	VHZ	24	-0.16	-0.18
				VLZ	48							VLN	42	-0.04	-0.02	PIR	NC	35 33.28	120 13.06	VHZ	24	-0.27	-0.22
MRC	NC	37 40.30	118 30.38	VHZ	24	-0.03	-0.35	NWR	NC	38 27.42	122 53.26	VHZ	24	-0.04	-0.04	PJL	NC	36 5.39	121 9.33	VHZ	18	-0.08	-0.12
MRD	NC	37 35.88	119 3.40	VHZ	18			OBH	NC	39 39.22	121 27.64	VHZ	18	0.07	-0.07					VLZ	48	-0.09	-0.03
MRF	NC	38 14.72	120 31.24	VHZ	18	0.29	0.14	OCH	NC	39 52.55	121 45.93	VHZ	12	-0.27	-0.05					VLN	42	-0.01	0.04
MSK	NC	37 39.18	119 1.44	VHZ	30	-0.27	-0.43	OCM	NC	39 31.43	121 37.40	VHZ	18	-0.23	-0.14					VLE	42	-0.03	-0.03
MSL	NC	37 37.00	118 57.30	VHZ	24	0.06	-0.19	OCR	NC	39 52.09	121 45.04	VHZ	12			PKE	NC	36 3.69	120 6.54	VHZ	24	-0.30	-0.23
MST	NC	37 54.27	120 24.29	VHZ	12	0.33	0.25	OGO	NC	39 39.22	121 36.72	VHZ	12	-0.07	-0.03	PKY	NC	35 15.83	120 39.94	VHZ	24	-0.19	-0.34
MTC	NC	37 37.90	118 57.90	VLZ	42	-0.27	-0.33	OHC	NC	39 20.18	121 29.05	VHZ	12	0.38	0.25	PLO	NC	36 14.79	121 2.55	VHZ	18	-0.34	-0.34
MTU	NC	37 21.20	118 33.81	VHZ	18	0.07	-0.21	ORA	NC	39 28.13	121 24.80	VHZ	12	0.33	0.14	PMC	NC	35 43.48	120 22.23	VHZ	24	-0.39	-0.21
MWB	NC	37 10.13	118 20.19	VHZ	12	-0.20	-0.28	ORD	NC	39 33.33	121 30.00	VHZ	18	0.33	0.12					VLZ	48	-0.26	-0.11
MYL	NC	37 23.02	120 25.16	VHZ	18	-0.29	-0.16	OST	NC	39 22.22	121 35.11	VHZ	18	-0.19	-0.06					VLN	42	0.02	0.02
NAD	NC	38 27.60	121 58.18	VHZ	18	-0.32	-0.09	OSU	NC	39 16.23	121 51.10	VHZ	12	-0.36	0.04					VLE	42	-0.19	-0.03

Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$
Code	(deg min)	(deg min)	Code	(dB)			
PMG	NC	35 25.79	120 31.22	VHZ	24	0.28	-0.01
				VLZ	48	0.20	-0.03
PML	NC	34 53.70	120 36.51	VHZ	24	-0.15	-0.27
PMM	NC	35 57.39	120 29.84	VHZ	24	-0.02	-0.03
				VLZ	48	-0.05	0.04
				VLN	42	-0.10	-0.08
				VLE	42	-0.08	-0.07
PMP	NC	36 12.91	120 47.69	VHZ	24	-0.10	0.02
PMP	NC	36 12.91	120 47.69	VLN	42	-0.09	0.09
PMR	NC	35 47.09	120 14.14	VHZ	24	0.01	-0.02
POP	NC	35 44.29	120 7.95	VHZ	24	-0.02	-0.05
PPB	NC	35 15.63	120 53.07	VHZ	24	-0.04	-0.18
				VLZ	48	0.09	-0.13
PPC	NC	35 56.98	120 35.66	VHZ	24	-0.03	-0.06
				VLZ	48	-0.16	-0.03
				VLN	42	-0.01	-0.04
				VLE	42	0.11	0.07
PPG	NC	35 51.78	119 57.35	VHZ	24	-0.48	-0.21
PPT	NC	36 6.50	120 43.27	VHZ	24	-0.34	-0.27
PRC	NC	36 15.37	120 37.20	VHZ	24	-0.03	0.07
				VLN	42	-0.15	-0.03
PRP	NC	36 0.05	120 28.60	VHZ	24		
PSA	NC	36 1.52	120 53.30	VHZ	24	-0.61	-0.34
PSC	NC	35 35.30	120 25.58	VHZ	24	-0.32	-0.08
PSM	NC	36 4.18	120 35.68	VHZ	24	-0.26	-0.31
PSR	NC	35 51.47	120 16.81	VHZ	24	0.06	0.01
PST	NC	35 55.73	120 30.50	VHZ	24	0.09	0.02
PTA	NC	35 23.56	120 42.40	VHZ	18	0.18	0.05
PTQ	NC	34 34.88	120 34.29	VHZ	24	0.17	0.03
PTR	NC	35 39.28	120 12.67	VHZ	24	-0.12	-0.13
PVC	NC	35 55.32	120 32.06	VHZ	24	-0.24	-0.30
				VLZ	48	-0.33	-0.28
				VLN	42	-0.29	-0.32
				VLE	42	-0.34	-0.32
PWK	NC	35 48.87	120 30.67	VHZ	24	-0.31	-0.02
PWM	NC	36 25.97	120 12.66	VHZ	24	-0.48	-0.14
FRI	BK	36 59.50	119 42.50	VHZ	24		
MIN	BK	40 20.70	121 36.30	VHZ	30		
ABL	CI	34 51.05	119 13.25	VHZ	6	0.29	0.10
ARV	CI	35 7.63	118 49.76	VHZ	12	0.30	0.03
BCH	CI	35 11.10	120 5.05	VHZ	12	0.10	0.12
BMT	CI	35 8.15	118 35.81	VHZ	6	0.36	0.15
CRG	CI	35 14.53	119 43.40	VHZ	12	-0.17	-0.14
FRK	CI	33 24.05	115 38.21	VHZ	18		
FTC	CI	34 52.25	118 53.51	VHZ	18	0.58	0.41
JUL	CI	33 2.90	116 36.77	VHZ	12		
MAR	CI	35 0.15	119 20.36	VHZ	12	-0.05	-0.02

Name	IRIS <sup>¶</sup>	Latitude	Longitude	Comp*	Attn <sup>†</sup>	$\Delta M_{\text{coda}}^{\ddagger}$	$\Delta M_{\text{amp}}^{\ddagger}$
Code	(deg min)	(deg min)	Code	(dB)			
MWC	CI	34 13.40	118 3.50	VHZ	15		
PKM	CI	34 53.75	119 49.13	VHZ	12	0.13	0.08
PLE	CI	34 58.11	119 4.08	VHZ	24	-0.16	-0.31
RYS	CI	34 38.60	119 21.10	VHZ	12	-0.12	-0.23
SCC	CI	34 56.48	120 10.32	VHZ	18	-0.07	-0.15
SIM	CI	35 21.02	119 59.74	VHZ	24	-0.39	-0.16
SLC	CI	34 29.79	119 42.81	VHZ	12	-0.03	0.04
SND	CI	35 8.58	118 18.13	VHZ	12		
SUN	CI	34 12.64	117 41.58	VHZ	24		
SYP	CI	34 31.63	119 58.67	VHZ	26		
TEJ	CI	35 13.79	118 41.37	VHZ	18		
TMB	CI	35 5.24	119 32.08	VHZ	30	-0.58	-0.64
TOW	CI	35 48.50	117 45.90	VHZ	12	-0.67	-0.37
WAS	CI	35 44.29	118 33.42	VHZ	12	0.24	0.12
WBS	CI	35 32.22	118 8.37	VHZ	12	0.12	-0.14
WCH	CI	35 52.98	118 4.48	VHZ	12	0.26	0.15
WJP	CI	35 24.65	118 28.84	VHZ	12	0.21	-0.01
WLH	CI	36 9.14	118 18.70	VHZ	12	0.03	-0.04
WNM	CI	35 50.57	117 54.29	VHZ	12		
WOF	CI	35 32.14	118 42.75	VHZ	6	0.40	0.20
WOR	CI	35 41.79	118 14.52	VHZ	12	0.37	0.06
WRC	CI	35 57.04	117 38.89	VHZ	6	-0.01	0.14
WSH	CI	35 37.96	117 29.50	VHZ	6	0.13	0.14
WVP	CI	35 56.98	117 49.02	VHZ	6	0.48	0.28
YEG	CI	35 26.18	119 57.56	VHZ	12	0.08	0.17
BCK	NN	37 41.85	118 22.32	VHZ	12		
BEN	NN	37 42.93	118 34.40	VHZ	6		
BHP	NN	37 17.97	118 29.24	VHZ	12		
CAS	NN	37 34.49	118 33.09	VHZ	12		
CWC	NN	37 29.69	118 18.38	VHZ	12		
HTC	NN	37 31.79	118 46.26	VHZ	12		
LUL	NN	38 3.14	119 10.82	VHZ	18		
MGN	NN	37 48.80	118 41.73	VHZ	12		
MLN	NN	37 35.63	118 20.56	VHZ	12		
ORC	NN	37 38.12	118 39.36	VHZ	36		
POC	NN	37 21.74	118 16.75	VHZ	12		
RCC	NN	37 29.26	118 43.30	VHZ	12		
SCH	NN	37 21.95	118 41.22	VHZ	12		
SLK	NN	37 50.04	119 7.72	VHZ	12		
STR	NN	37 26.20	118 45.60	VHZ	12		
WMD	NN	37 26.61	118 38.22	VHZ	12		
GAS	WR	39 39.29	122 42.91	VHZ	24		
KPK	WR	39 35.01	121 18.32	VHZ	24		
MGL	WR	39 48.71	121 33.42	VHZ	0		
ORV	WR	39 33.23	121 30.02	VHZ	12		

## Notes to Table 1.

<sup>¶</sup> IRIS codes for network operator:

NC = USGS-Menlo Park  
BK = Univ. CA Berkeley  
CI = USGS/Caltech-Pasadena  
NN = Univ. Nev. Reno  
WR = CA Div. Water Res.

\* Component Code Definition in use by NCSN and SCSN

Sensor type (first letter of 3-letter code)

V=short period seismometer

Gain (second letter)

H=high gain (0-24 dB attenuation)

L=low gain (36-48 dB attenuation)

F=very low gain (54-72 dB attenuation)

Orientation (third letter)

Z=vertical

E=east-west

N=north-south

<sup>†</sup> Attenuation down from 90dB gain, except staton GASW which is down from 120 dB. Please see non-NC operators for appropriate system responses.

<sup>‡</sup> Magnitude correction in magnitude units. Blank value indicates no correction available.

**Table 2. Summary of Seismic Stations Recorded by the NCSN**

OPERATOR	SITES	COMPONENTS
NCSN (NC)		
High-gain vertical	359	359
Low-gain vertical	33	35
Horizontal	42	65
Dilatometer	4	7
Force-balance accelerometer	1	2
USGS-CIT <sup>†</sup> (CI)	34	34
Univ. of Nevada, Reno <sup>†</sup> (NN)	16	16
U.C. Berkeley <sup>†</sup> (BK)	2	2
Ca Dept. Water Res. <sup>†</sup> (WR)	4	4
<hr/>		
Total	425	528 <sup>‡</sup>

<sup>†</sup>High-gain vertical only

<sup>‡</sup>Number of components exceeds digitizer channels due to network changes throughout year

**Table 3. Network Changes in 1992**

**NEW STATIONS**

CODE <sup>†</sup>	LAT	LONG	ELEV (M)	SITE NAME	SENSOR.	DATE INSTALLED
CGP VHZ	37° 38.72′	122° 00.62′	366	Garin Park (Surface)	L4	92/02/05
CYB VLE	37° 48.68′	122° 21.65′	24	Yerba Buena Island	L4	92/06/04
CYB VLN					L4	
CYB VHZ					L4	
CYB VLZ					L4	
HSF VHZ	36° 49.03′	121° 29.81′	183	St. Francis Retreat	L4	92/11/04
KCS VHZ	40° 32.26′	123° 30.76′	1640	Cold Springs	L4	92/08/13
KTR VHZ	41° 54.52′	123° 22.59′	1378	Thompson Ridge	L4	92/08/05
MBE VHZ	36° 45.75′	119° 16.90′	1023	Bear Mountain	L4	92/09/17
MBU VHZ	37° 33.58′	120° 07.00′	1265	Mt. Bullion	L4	92/09/16
OCR VHZ	39° 52.09′	121° 45.04′	564	Cohasset Ridge	L4	92/01/22

**DISCONTINUED STATIONS**

CODE <sup>†</sup>	LAT	LONG	SITE NAME	DATE REMOVED	REASON
HQR VLE	36° 50.02′	121°12.76′	Quien Sabe Ranch	92/10/19	Lost lease
HQR VLN					
HQR VHZ					
HQR VLZ					
HSF VHZ	36° 48.98′	121°29.88′	St Francis Retreat	92/11/04	Slight move (see Table 1)
OCH VHZ	39° 52.55′	121°45.93′	Cohasset Ridge	92/01/22	Moved to OCR (see Table 1)
PRP VHZ	36° 0.05′	120°28.60′	Reason Peak	92/09/15	Large rent increase

<sup>†</sup>CODE convention: Last 3 letters describe instrument as follows:

Letter 1 - Instrument

V- short-period

Letter 2 - Attenuation

H - high (0-24 db)  
L - low (36-42 db)

Letter 3 - Orientation

Z - vertical  
N - north-south  
E - east-west

## Earthquake Catalog

The NCSN maintains a catalog of earthquake locations for the area spanned by the seismograph net (Figure 1). All earthquakes have a minimum of 4  $P$  and  $S$  arrival time readings from at least 3 independent stations. During 1992 the NCSN located 21,365 earthquakes (Figure 2), bringing the total number of earthquakes in the catalog to about 324,000 events since 1968. Because the CUSP and RTP systems detect and locate earthquakes independently, their data are merged together to generate a comprehensive catalog. CUSP data takes precedence over RTP data for events which have data from both sources.

The merged arrival time data are relocated using the program Hypoinverse (Klein, 1989). The location program uses one of thirty-four crustal velocity models, whose velocity varies only with depth (Table 4; Figure 3), and associated station traveltimes corrections (Table 5). Multiple crustal models partly account for lateral velocity variations within the crust and consequently improve the accuracy of earthquake locations. The velocity model used depends on the current epicentral coordinates during the earthquake location iteration process; thus the model can change from that used for the trial hypocenter to the model appropriate for the final location. For some models the travel-time delays are assumed from an adjacent model if there is insufficient earthquake data to determine a value. Please note that the models given in Tables 4 and 5 reflect the location procedures at the time this report was written. The catalog periodically undergoes revision to reflect improved velocity models and location procedures.

All models have layers in which the velocity increases linearly with depth (gradient models) that have been adapted from homogenous layered velocity models referenced in Table 4. Events falling between regions are located with an interpolation between the closest two or three models. Two of the regions along the San Andreas fault, Loma Prieta and the Bear Valley, have different models for either side of the San Andreas Fault. An event in either of these regions uses separate models for stations on different sides of the fault regardless of which side of the fault the epicenter is on. The Loma Prieta region uses model LOM for stations on the west (Pacific) side and model LON for stations on the east (North American) side. The geographic region code LOM (see Table 7) labels all events that use these two models. The Bear Valley region uses model GAB for stations on the Gabilan (west) side and model DIA for stations on the Diablo (east) side. The three Parkfield areas use identical models but slightly different sets of station delays.

Duration and amplitude magnitudes are calculated using the equations of Eaton (1992) which produce magnitudes that are in close agreement with the  $M_L$  scale applied by U.C. Berkeley. The magnitude calculations utilize station corrections (Table 1), a distance and depth term, and the time dependent gain history of the seismic station.

## Data Access and Archival

With the advent of large capacity storage devices and computer networks, data access and exchange is improving. Because the number of earthquakes in the NCSN catalog exceeds 320,000, it is neither practical nor desirable to distribute the catalog through printed media. Instead, most users prefer to have the data in a computer-readable format. Therefore, we provide 24-hour access to the earthquake database for scientists anywhere in the world who are connected to the Internet computer network. The NCSN phase, location, and focal mechanism data is stored on a 330 Gbyte optical data storage system operated by U.C. Berkeley. This storage device provides random access to all files within seconds, and the optical storage media are purported to have a life on the order of 100 years. During 1992 the NCSN began transcribing the 230 Gbytes of digital waveform data acquired by the CUSP system since 1984 from 9-track tape to the optical storage device. The UCB - USGS data center also provides access to the broadband waveform data collected by UCB and historical phase and location data. Data requests by individuals without Internet access are routinely obliged through the distribution of computer tapes, floppy disks, customized maps, and paper records. Appendix A provides instructions for obtaining an account at the UCB - USGS data center. The Appendix also provides a list of commands for obtaining documentation on the programs at the data center that retrieve the seismic data.

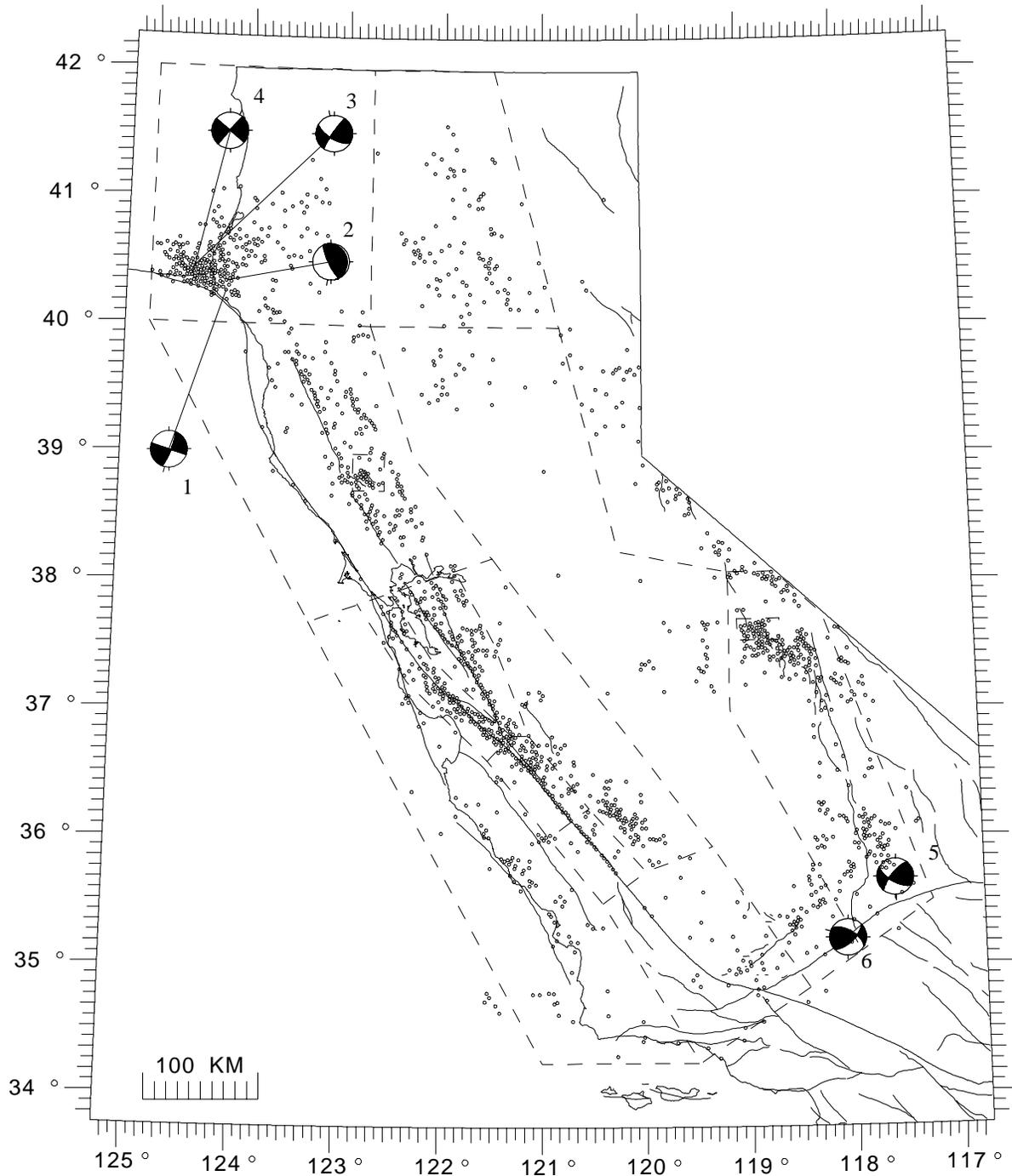


Figure 2. Seismicity recorded by the NCSN during 1992 (small circles) and focal mechanisms for  $M \geq 4.5$  earthquakes. Symbol size is independent of magnitude. All plotted earthquakes have at least 8  $P$  readings and horizontal and vertical location uncertainties less than 2.5 and 5.0 km, respectively. Epicenters within 2.5 km of other epicenters are not plotted. Focal mechanisms are lower-hemisphere, equal-area projections; the compressional quadrant is shaded solid. Numbers adjacent to focal mechanisms are referenced in text. The seismicity in each dashed polygonal region (see Figure 4) is discussed in text. The region enclosed by the dashed lines corresponds to the limits of reliable network coverage.

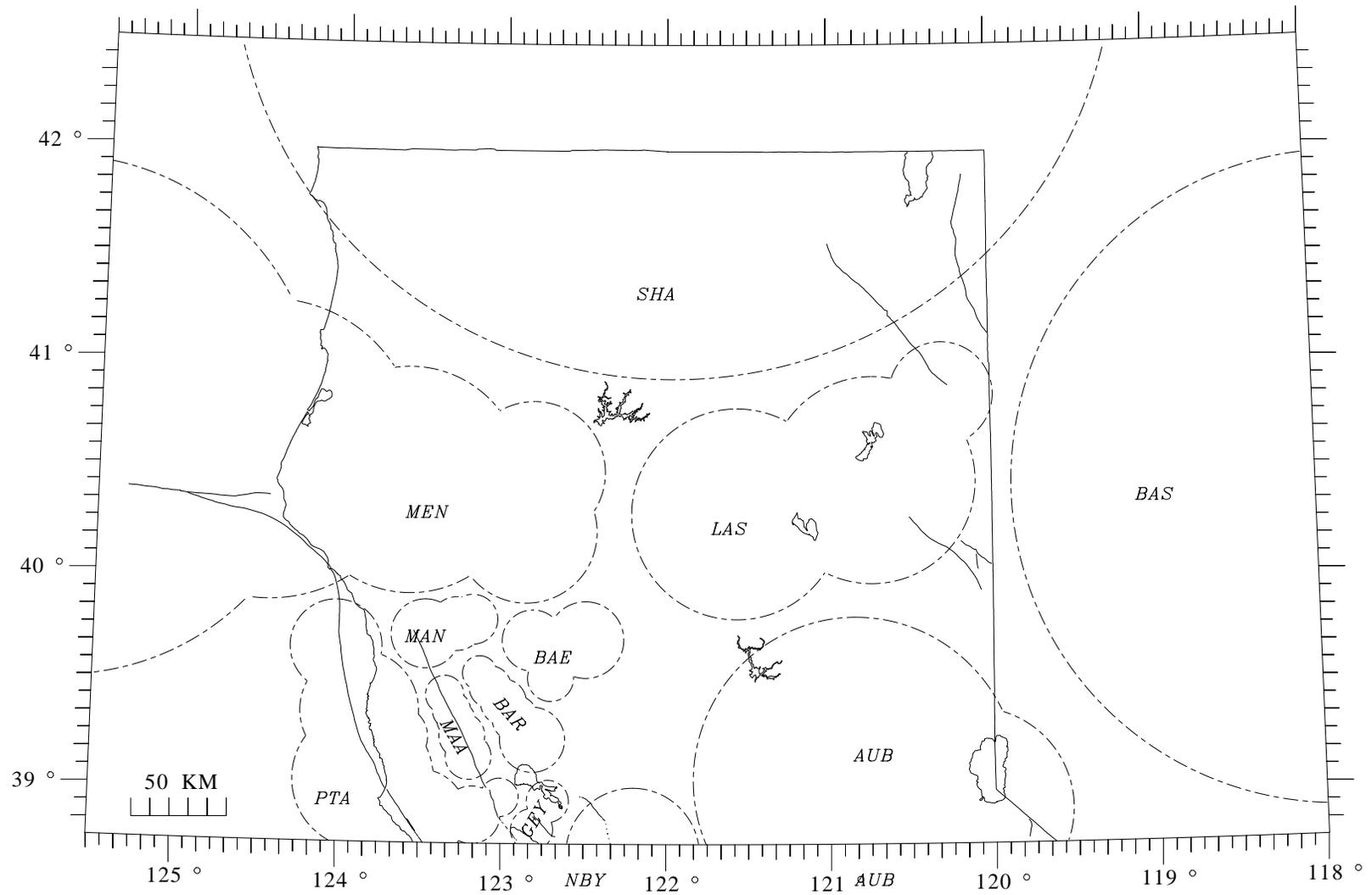


Figure 3. Boundaries of local velocity regions used by HYPOINVERSE (Klein, 1989) to locate earthquakes. The velocity-depth distribution for each region is given in Table 4. Earthquakes occurring between models have locations based on a combination of up to 3 adjacent models. The default Coast Range model (NCG, Table 4) is used to locate earthquakes in areas without a local model, such as the Great Valley and the Pacific Ocean.

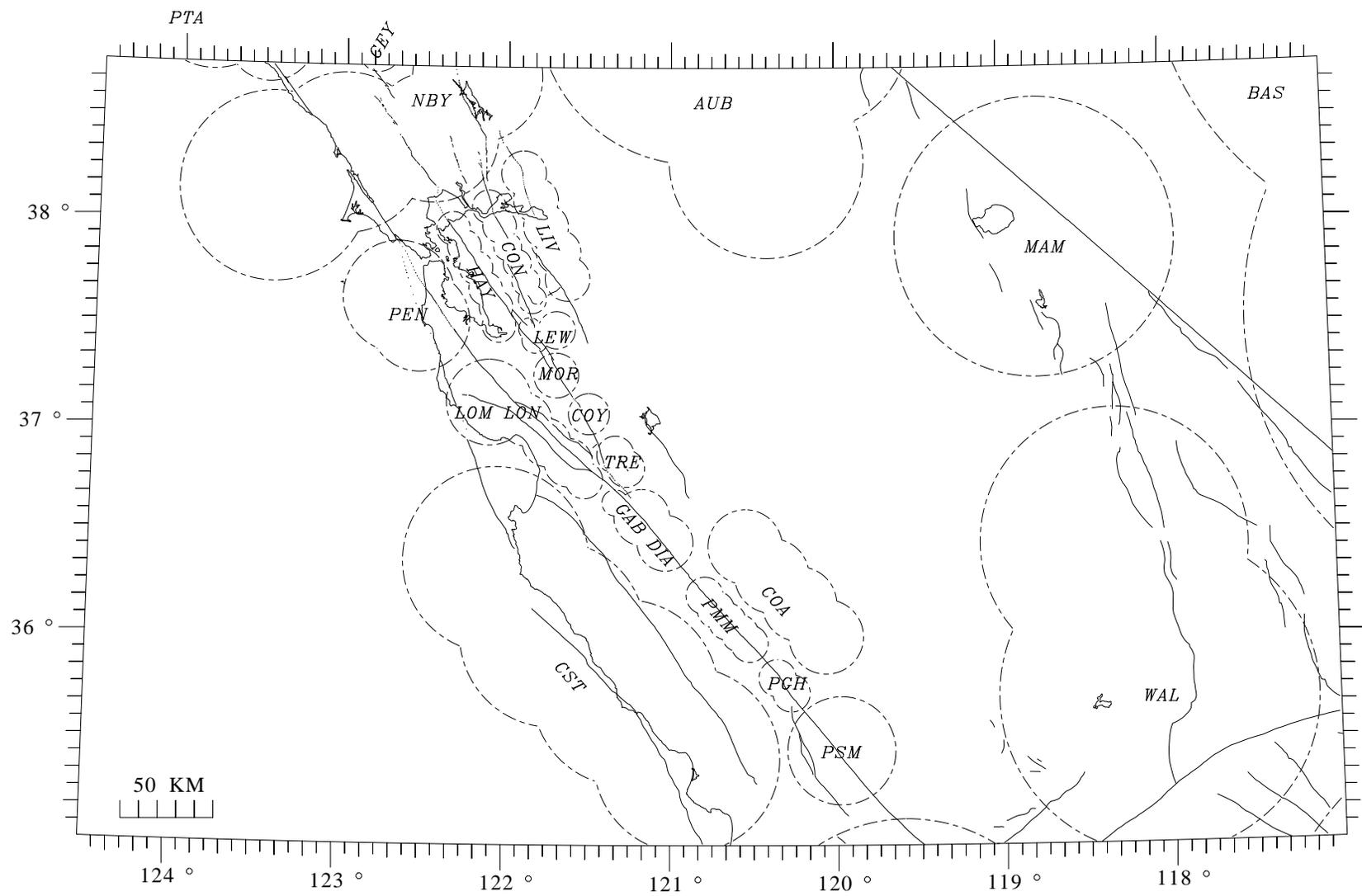


Figure 3 (cont.).

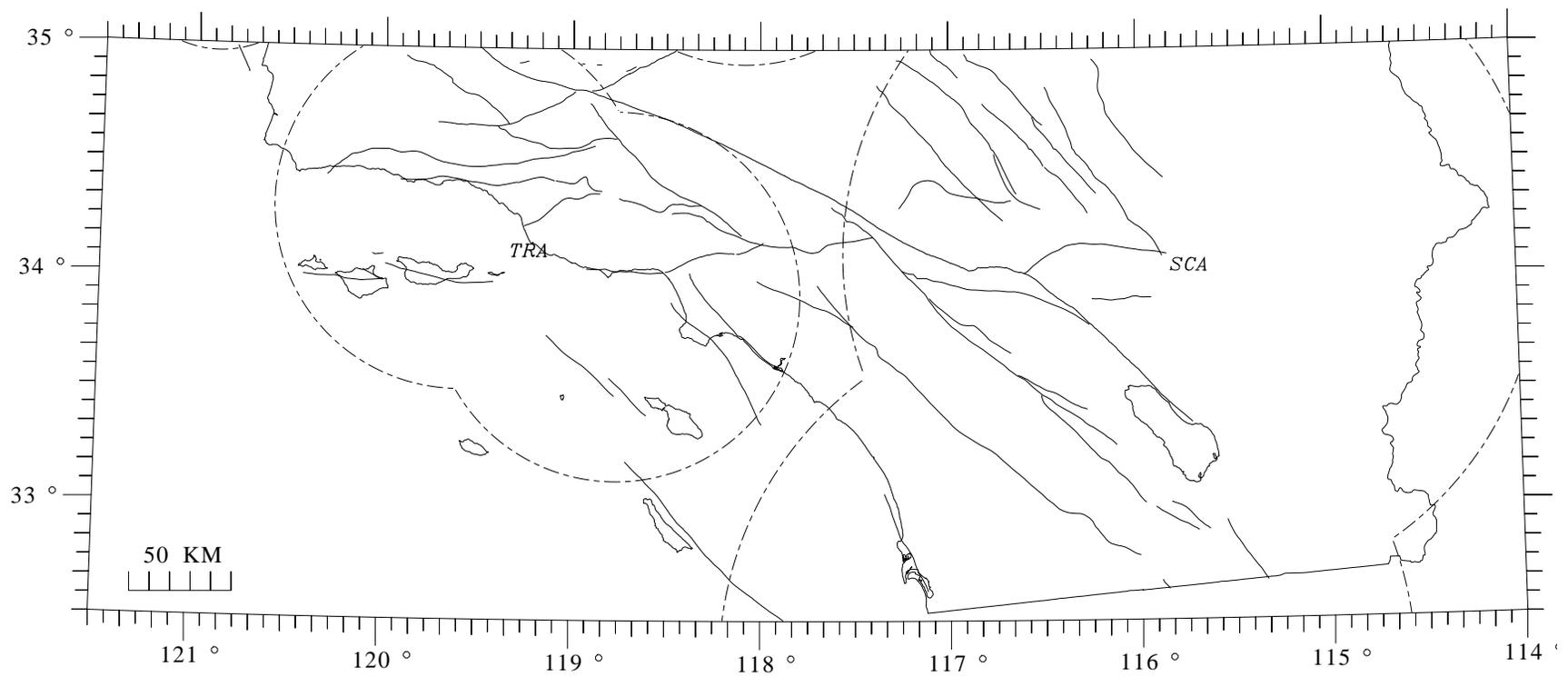


Figure 3 (cont.).

**Table 4: Gradient P-Velocity Models<sup>¶</sup>**

**Auburn - Sierra Foothills (AUB)<sup>2</sup>**

*Eaton & Simirenko (1980)<sup>‡</sup>*

Z (km) 0.00 1.00 34.00 36.00  
V (km/s) 4.80 6.20 6.85 8.00

**Bartlett Springs Fault - East (BAE)<sup>2</sup>**

*Castillo and Ellsworth (1993)\**

Z (km) 0.00 4.50 18.60 28.50  
V (km/s) 4.20 5.80 6.05 7.80

**Bartlett Springs Fault (BAR)<sup>2</sup>**

*Castillo and Ellsworth (1993)\**

Z (km) 0.00 2.00 19.00 21.00 29.00 31.00  
V (km/s) 4.00 5.46 6.08 6.60 6.80 7.80

**Basin & Range (BAS)<sup>0</sup>**

*Prodehl (1979)<sup>†</sup>*

Z (km) 0.00 7.10 28.60 32.60  
V (km/s) 4.00 5.95 6.60 7.85

**Coalinga (COA)<sup>2</sup>**

*Eaton (1985)<sup>‡</sup>*

Z (km) 0.00 2.20 14.00 26.00 30.00  
V (km/s) 2.00 4.30 6.25 6.80 7.95

**Concord-Calaveras Faults(CON)<sup>2</sup>**

*F. Klein pers. comm. (1991)\**

Z (km) 0.00 2.00 12.00 24.00 26.00  
V (km/s) 2.50 4.70 5.77 6.12 7.95

**Coyote Lake (COY)<sup>2</sup>**

*Reasenber & Ellsworth (1982)\**

Z (km) 0.00 1.40 5.80 10.60 24.00 26.00  
V (km/s) 3.80 5.30 6.12 6.37 6.59 8.00

**Central Coast Ranges (CST)<sup>2</sup>**

*K. Poley and J. Eaton (pers. comm.)<sup>‡</sup>*

Z (km) 0.00 2.50 8.00 23.80 26.80  
V (km/s) 2.95 5.13 6.20 6.65 8.12

**Bear Valley - Diablo Range side (DIA)<sup>2</sup>**

*L. Dietz (pers. comm.)\*; Walter & Mooney (1982)<sup>†</sup>*

Z (km) 0.00 1.50 5.80 14.40 15.60 29.00 31.00  
V (km/s) 2.45 4.62 5.80 6.05 6.85 7.15 7.95

**Bear Valley - Gabilan Range side (GAB)<sup>2</sup>**

*L. Dietz (pers. comm.)\*; Walter & Mooney (1982)<sup>†</sup>*

Z (km) 0.00 4.00 22.50 25.50  
V (km/s) 3.73 6.07 6.47 7.95

**The Geysers (GEY)<sup>2</sup>**

*Eberhart-Phillips & Oppenheimer (1984)\**

Z (km) 0.00 3.00 8.00 20.00 22.00  
V (km/s) 4.10 5.47 5.75 6.02 7.90

**Hayward Fault (HAY)<sup>2</sup>**

*F. Klein pers. comm. (1991)\**

Z (km) 0.00 3.00 9.00 24.00 26.00  
V (km/s) 3.70 5.17 5.90 6.38 7.98

**Lassen (LAS)<sup>2</sup>**

*S. Walter (pers. comm.)\**

Z (km) 0.00 4.50 9.00 29.00 31.00  
V (km/s) 4.00 6.00 6.28 6.55 8.05

**Mount Lewis (LEW)<sup>2</sup>**

*F. Klein pers. comm. (1991)\**

Z (km) 0.00 2.00 6.30 24.00 26.00  
V (km/s) 3.18 5.23 5.89 6.40 7.95

**Livermore-Antioch (LIV)<sup>2</sup>**

*F. Klein pers. comm. (1991)\**

Z (km) 0.00 6.80 14.00 24.00 26.00  
V (km/s) 2.27 5.85 6.10 6.44 7.95

**Loma Prieta - Pacific side (LOM)<sup>2</sup>**

*Dietz & Ellsworth (1990)\**

Z (km) 0.00 2.00 6.70 24.00 26.00  
V (km/s) 3.00 4.95 5.94 6.64 8.00

**Loma Prieta-North American side (LON)<sup>2</sup>**

*Dietz & Ellsworth (1990)\**

Z (km) 0.00 2.50 8.90 24.00 26.00  
V (km/s) 2.53 5.44 6.29 6.69 7.98

**Maacama Fault (MAA)<sup>2</sup>**

*Castillo and Ellsworth (1993)\**

Z (km) 0.00 3.60 16.60 24.00 26.00  
V (km/s) 3.93 5.55 5.96 6.80 7.80

**Mammoth Lakes - Long Valley (MAM)<sup>2</sup>**

*Kissling (1987)<sup>†</sup>; Cockerham & Kissling (pers. comm.)\**

Z (km) 0.00 1.30 2.80 7.00 29.00 31.00 49.00 51.00  
V (km/s) 3.52 3.67 5.53 6.03 6.28 6.51 6.85 8.00

**North Maacama/Bartlett Springs Faults - (MAN)<sup>2</sup>**

*Castillo and Ellsworth (1993)\**

Z (km) 0.00 2.10 14.00 24.00 26.00  
V (km/s) 4.00 5.43 5.93 6.78 7.80

**Cape Mendocino (MEN)<sup>2</sup>**

*M. Magee (pers. comm., 1992)\**

Z (km) 0.00 4.20 22.00 24.00  
V (km/s) 3.50 5.05 6.90 7.90

**Morgan Hill (MOR)<sup>2</sup>**

*Cockerham & Eaton (1987)\**

Z (km) 0.00 1.00 4.20 10.00 24.00 26.00  
V (km/s) 3.60 4.75 5.48 6.05 6.33 7.60

**North Bay - Coast Ranges (NBY)<sup>2</sup>**

*Eberhart-Phillips & Oppenheimer (1984)\**

Z (km) 0.00 3.00 8.00 20.00 22.00  
V (km/s) 4.10 5.47 5.75 6.02 7.90

**Default Northern California (NCG)<sup>1</sup>**

*J. Eaton (pers. comm.)<sup>‡</sup>*

Z (km) 0.00 3.50 23.00 27.00  
V (km/s) 2.70 5.70 6.80 8.05

**San Francisco Peninsula (PEN)<sup>2</sup>***Olson (1986)\**

Z (km) 0.00 3.00 9.00 24.00 26.00  
 V (km/s) 2.20 5.37 6.10 6.62 7.75

**Parkfield - Gold Hill (PGH)<sup>2</sup>***K. Poley and J. Eaton (pers. comm.)<sup>‡</sup>*

Z (km) 0.00 2.60 9.40 23.30 27.00  
 V (km/s) 2.25 5.30 6.10 6.70 8.00

**Parkfield - Middle Mountain (PMM)<sup>2</sup>***K. Poley and J. Eaton (pers. comm.)<sup>‡</sup>*

Z (km) 0.00 2.60 9.40 23.30 27.00  
 V (km/s) 2.25 5.30 6.10 6.70 8.00

**Parkfield - Simmler (PSM)<sup>2</sup>***K. Poley and J. Eaton (pers. comm.)<sup>‡</sup>*

Z (km) 0.00 2.60 9.40 23.30 27.00  
 V (km/s) 2.25 5.30 6.10 6.70 8.00

**Point Arena - Fort Bragg (PTA)<sup>2</sup>***Castillo and Ellsworth (1993)\**

Z (km) 0.00 2.50 19.80 26.60  
 V (km/s) 4.00 5.40 6.40 7.80

**Southern California (SCA)<sup>0</sup>***L. Jones (pers. comm.)<sup>‡</sup>*

Z (km) 0.00 5.50 16.60 31.00 33.00  
 V (km/s) 4.80 6.17 6.60 6.85 7.80

**Shasta (SHA)<sup>0</sup>***Zucca et al. (1986)<sup>†</sup>*

Z (km) 0.00 5.00 38.10 42.50  
 V (km/s) 3.10 6.20 6.80 7.95

**Transverse Ranges (TRA)<sup>0</sup>***Prodehl (1979)<sup>†</sup>*

Z (km) 0.00 7.00 32.30 36.80  
 V (km/s) 3.10 6.10 6.73 8.10

**Tres Piños (TRE)<sup>1</sup>***L. Dietz (pers. comm.)\*; Walter & Mooney (1982)<sup>†</sup>*

Z (km) 0.00 2.00 5.60 14.40 16.00 28.40 30.00  
 V (km/s) 2.70 5.33 5.75 6.00 6.83 7.07 7.95

**Walker Pass (WAL)<sup>1</sup>***Jones and Dollar (1986)<sup>‡</sup>*

Z (km) 0.00 1.20 36.40 38.00  
 V (km/s) 2.80 5.70 7.20 7.90

<sup>0</sup>No station delays at present.<sup>1</sup>Delays are from original investigator for layer model.<sup>2</sup>Delays revised for gradient model adaptation.

\*Derived from joint hypocenter-velocity determination

<sup>‡</sup>Derived from test/modify procedure<sup>†</sup>Derived from seismic refraction study<sup>¶</sup> $V_p/V_s = 1.78$







Name	IRIS	Delays (sec) By Velocity Model <sup>‡</sup>																																			
		CODE	AUB	BAE	BAR	BAS	COA	CON	COY	CST	DIA	GAB	GEY	HAY	LAS	LEW	LIV	LOM	LON	MAA	MAM	MAN	MEN	MOR	NBY	NCG	PEN	PGH	PMM	PSM	PTA	SCA	SHA	TRA	TRE	WAL	
JBM	NC					-0.40	-0.16			-0.08	-0.08	-0.08	-0.17			-0.02	-0.11	-0.05	-0.05							0.05	-0.08	-0.25	-0.31	-0.08	-0.08	-0.08					-0.08
JBZ	NC					0.44	0.23			0.36	0.36	0.19	0.11			0.31	0.56	0.21	0.21							0.44	0.19	0.15	0.01	0.19	0.19	0.19					0.26
JCB	NC					-0.28	-0.32	-0.04		-0.04	-0.04	-0.07	-0.44			0.01	-0.02	0.11	0.11							0.17	-0.07	-0.37	-0.34	-0.07	-0.07	-0.07					-0.33
JCH	NC																																				
JCP	NC																																				
JEC	NC					-0.06	-0.13	0.17		0.48	0.48	-0.04	-0.19			0.04	0.10	-0.05	-0.05						0.20	-0.04	-0.25	-0.22	-0.04	-0.04	-0.04					-0.21	
JEG	NC					-0.77				-0.14	-0.14	-0.14	-0.47			-0.52	-0.62	-0.49	-0.49						-0.34	-0.14	-0.14	-0.38	-0.14	-0.14	-0.14					-0.14	
JEL	NC																		0.11	0.11																	
JHL	NC					-0.35	-0.23	-0.09		-0.22	-0.22	-0.15	-0.24			-0.04	-0.08	-0.02	-0.02						0.18	-0.15	-0.39	-0.45	-0.15	-0.15	-0.15					-0.28	
JHP	NC					-0.39	0.03						-0.14			-0.19	-0.15	-0.13	-0.13						-0.18			-0.16									
JJR	NC																																				
JLX	NC					-0.39	-0.28			-0.40	-0.40	-0.07	-0.27			-0.17	-0.18	-0.03	-0.03						0.03	-0.07	-0.56	-0.44	-0.07	-0.07	-0.07					-0.07	
JMG	NC					-0.68				-0.10	-0.10	-0.10	-0.43			-0.51	-0.65	-0.32	-0.32						-0.29	0.04	-0.10	-0.35								-0.10	
JMP	NC																																				
JNA	NC																																				
JPL	NC					0.55	0.33	0.02		0.26	0.26	0.06	0.23			0.37	0.73	0.08	0.08					0.50	0.06	0.11	-0.24	0.06	0.06	0.06					0.31		
JPP	NC					-0.32	-0.05			0.06	0.06	-0.05	-0.04			0.07		-0.07	-0.07					0.18	-0.05	-0.29	-0.16	-0.05	-0.05	-0.05					-0.05		
JPR	NC					-0.46				-0.11	-0.11	-0.11	-0.21			-0.42	-0.57	-0.06	-0.06					-0.38	0.04	-0.11	-0.05									-0.11	
JPS	NC					-0.51	-0.11			0.49	0.49	-0.03	-0.07			-0.11	-0.21	-0.23	-0.23					-0.02	-0.03	-0.03	-0.09	-0.03	-0.03	-0.03					0.24		
JRG	NC					-0.22	0.02			-0.15	-0.15	-0.15	-0.12			0.02	0.16	-0.17	-0.17					0.23	-0.15	-0.43	-0.40	-0.15	-0.15	-0.15							
JRR	NC					-0.18	-0.31	-0.14		-0.20	-0.20	-0.20	-0.27			-0.06	0.04							0.07	-0.20	-0.49	-0.46	-0.20	-0.20	-0.20						-0.43	
JSA	NC					-0.59				-0.08	-0.08	-0.08	-0.30			-0.37	-0.50	-0.26	-0.26					-0.39	0.13	-0.08	-0.32									-0.08	
JSB	NC																																				
JSC	NC					-0.46	-0.18			-0.10	-0.10	-0.10	-0.19			-0.08	-0.09	-0.26	-0.26					0.01	-0.10	-0.10	-0.34	-0.10	-0.10	-0.10					-0.10		
JSF	NC					-0.32	0.10			0.09	0.09	0.09				-0.13	-0.15	0.22	0.22				-1.03	-0.06	0.09	0.09	-0.02	0.09	0.09	0.09					0.09		
JSG	NC					0.05	0.14			0.15	0.15	0.15	0.23			0.38	0.33	0.26	0.26					0.53	0.15	0.02	-0.17	0.15	0.15	0.15					0.15		
JSJ	NC					-0.08	0.41			0.16	0.16	0.16	0.19			0.24	0.25	0.42	0.42					0.40	0.16	0.19	-0.06	0.16	0.16	0.16					0.16		
JSM	NC					-0.25	-0.03			0.07	0.07	0.07	0.07			0.15	0.08	-0.13	-0.13					0.21	0.07	-0.10	-0.08	0.07	0.07	0.07					0.07		
JSS	NC					-0.35	-0.26			-0.44	-0.44	-0.09	-0.25			-0.09	-0.21	-0.03	-0.03					0.13	-0.09	-0.51	-0.39	-0.09	-0.09	-0.09					-0.30		
JST	NC					-0.31	-0.26	0.03		-0.05	-0.05	-0.10	-0.45			0.05	-0.08	0.15	0.15					0.26	-0.10	-0.37	-0.25	-0.10	-0.10	-0.10					-0.43		
JTG	NC					0.46	0.23	0.01		0.07	0.07	0.11	0.38			0.27	0.02	0.05	0.05					0.44	0.11	0.01	-0.17	0.11	0.11	0.11					0.13		
JUC	NC					-0.53	-0.17	-0.42		-0.29	-0.29	-0.16	-0.16			-0.28	-0.11	-0.33	-0.33					-0.01	-0.16	-0.62	-0.60	-0.16	-0.16	-0.16					0.05		
JUM	NC																																				
KBB	NC		0.06	0.06												0.82	0.82	0.44					0.26	0.16		0.18								0.34			
KBN	NC		-0.21	-0.07														0.33				0.23	0.50											0.35			
KBR	NC		-0.27	-0.27														-0.27				-0.27	-0.22												-0.27		
KBS	NC		0.49	-0.01														0.06				-0.13	0.06		0.16										-0.09		
KCP	NC		0.45	-0.03												0.59	0.59	0.07				-0.08	-0.05												-0.08		
KCR	NC		-0.12	-0.12														0.27				0.46	0.04		0.02										0.69		
KCS	NC																							0.25													
KCT	NC		0.09	0.09												0.25	0.25	0.19				0.09	0.15												-0.95		
KFP	NC		0.11	-0.30												0.69	0.69	-0.17				-0.21	-0.21												-0.01		
KGM	NC		0.13	0.13														0.13				0.13	0.15												0.13		
KHB	NC																							-0.04													
KHM	NC																							-0.02													
KIP	NC		0.10	-0.26												0.87	0.87	-0.13				-0.25	0.15														
KJJ	NC																							-0.02													
KKP	NC		0.22	0.22														0.40				0.22	0.55												0.26		



Name	IRIS	Delays (sec) By Velocity Model <sup>‡</sup>																																					
		CODE	AUB	BAE	BAR	BAS	COA	CON	COY	CST	DIA	GAB	GEY	HAY	LAS	LEW	LIV	LOM	LON	MAA	MAM	MAN	MEN	MOR	NBY	NCG	PEN	PGH	PMM	PSM	PTA	SCA	SHA	TRA	TRE	WAL			
MCU	NC					-0.54				0.17	0.17	0.17	-0.15		-0.63		0.45	0.45		-0.94			-0.55	0.17	0.02											0.17			
MDC	NC																				-0.16					-0.01													
MDP	NC																				-0.22					-0.05													
MDR	NC					1.96															0.07				0.11														
MEM	NC					1.86															0.06				0.17														
MFB	NC																				0.07				0.09														
MGP	NC																				0.01				0.09														
MHD	NC					-1.35	0.55			0.65	0.65				0.35		0.72	0.72			-0.41				0.14														
MLC	NC					1.52															-0.16				-0.05														
MLH	NC																				0.45				0.46														
MLM	NC					2.16															0.26				0.29														
MLR	NC						0.51						0.96				1.28	1.28			-0.77																		
MMI	NC						0.89										1.27	1.27																					
MML	NC					1.83															0.14				0.25														
MMP	NC																				-0.23				-0.06														
MMS	NC																																						
MMT	NC																																						
MNH	NC					-1.01				-0.03	-0.03	-0.03	-0.63			-0.04	0.33	0.33			-1.00			-0.03	-0.03											-0.03			
MOG	NC																				-0.02				-0.26														
MOY	NC					-0.46				0.11	0.11	0.11	-0.26			-0.60		0.38	0.38			-0.96		-0.45	0.11	-0.01		0.11	0.11	0.11						0.11			
MPR	NC																																						
MRC	NC																								0.04														
MRD	NC																																						
MRF	NC					0.06				-0.10	-0.10	-0.10	0.43			0.13		1.08	1.08			-1.07		-0.10	-0.03												-0.10		
MSK	NC																				0.04				0.07														
MSL	NC					1.50															-0.12				0.02														
MST	NC						0.06						0.16			0.12		0.64	0.64			-1.04			0.04														
MTC	NC					1.67																			0.20														
MTU	NC																								-0.02														
MWB	NC																																						
MYL	NC					-0.50				0.61	0.61		-0.03			-0.24		0.41	0.41			-0.49		-0.49		-0.13													
NAD	NC						0.43						0.98			0.40	1.22	1.22																					
NAP	NC						-0.37						0.18			-0.60	0.52	0.52																					
NBP	NC						-0.03			0.49	0.49	0.46	0.77			-0.07	-0.09	1.01	1.01					0.35	0.21		0.21	0.21	0.21									0.49	
NBR	NC						-0.57			-0.10	-0.10	-0.41	-0.04			-0.69	-0.79	0.35	0.35					0.11	-0.10	0.03	-0.10	-0.10	-0.10									-0.10	
NCF	NC						-0.94			-0.16	-0.16	-0.08	-0.32			-0.37	-0.74	-0.04	-0.04					-0.02	-0.17	-0.11	-0.17	-0.17	-0.17									-0.16	
NCP	NC						0.37									0.31	1.34	1.34																					
NDH	NC						0.54			0.18	0.18	0.18	0.44			-0.07	1.33	1.33						0.45	0.18		0.18	0.18	0.18									0.18	
NFI	NC						-0.77			-0.09	-0.09	-0.09	-0.56				-0.31	-0.31						-0.09	-0.09		-0.09	-0.09	-0.09									-0.09	
NFR	NC						-0.45			0.04	0.04	0.08	0.25					0.08	0.08				0.07	0.10	-0.04												0.04		
NGV	NC						-0.08			-0.13	-0.13	-0.50	0.34			-0.41	-0.51	0.39	0.39					-0.20	-0.13	0.24	-0.13	-0.13	-0.13									-0.13	
NHF	NC																																						
NHM	NC						0.54			0.51	0.51	0.51	0.93			1.06	0.91	1.01	1.01					0.36	0.51		0.51	0.51	0.51									0.51	
NIM	NC						-0.31						0.18				-0.74	0.43	0.43																				
NLH	NC												-0.01	0.52			0.02	-0.15	0.50	0.50				-0.12		0.50													
NLN	NC						-0.98			-0.11	-0.11	-0.13	-0.52			-0.58	-0.73	-0.77	-0.77					-0.15	-0.11	-0.19	-0.11	-0.11	-0.11									-0.11	
NMC	NC						-0.16						-0.25				-0.66	-0.66																					
NMH	NC						-0.20	-0.11		-0.39	-0.39	-0.39	0.09				-0.39	-0.01	-0.01						-0.05	-0.20													-0.39



Name	IRIS	Delays (sec) By Velocity Model <sup>‡</sup>																																					
		CODE	AUB	BAE	BAR	BAS	COA	CON	COY	CST	DIA	GAB	GEY	HAY	LAS	LEW	LIV	LOM	LON	MAA	MAM	MAN	MEN	MOR	NBY	NCG	PEN	PGH	PMM	PSM	PTA	SCA	SHA	TRA	TRE	WAL			
PHP	NC				-0.10	0.79			-0.20	0.06	0.06						0.36	0.36								-0.10		-0.31	-0.19	-0.31									
PHR	NC				-0.45	0.33			0.19	0.09	0.09	0.16					0.59	0.59							0.16	0.05		0.26	0.26	0.26								0.17	
PHS	NC				-0.38	0.52			-0.02	0.10	0.10						0.59	0.59										-0.16	-0.16	0.01								0.04	
PIR	NC																0.83	0.83																					
PJL	NC				-0.52	-0.33			0.02	0.18	0.18	-0.01					0.18	0.18						-2.93	-0.01	0.09		-0.20	-0.20	-0.20								0.21	
PKE	NC				-0.01																							1.56	1.56	1.56									
PKY	NC				-0.17				-0.09								0.37	0.37																					
PLO	NC				-0.62	0.28			-0.10	-0.09	-0.09	-0.23					0.24	0.24							-0.23	-0.06		-0.35	-0.35	-0.35								-0.07	
PMC	NC				-0.36				0.24	0.08	0.08	0.08					0.84	0.84							0.08	0.25		0.13	0.17	0.09								0.08	
PMG	NC				-0.88				-0.27			-0.13					0.28	0.28							-0.13	-0.22		-0.61	-0.61	-0.49								-0.13	
PML	NC																0.20	0.20										0.64	0.64	0.65									
PMM	NC				0.13				0.12	0.71	0.71						0.77	0.77							0.16			0.28	0.28	0.16									
PMP	NC				-0.15				0.09	0.39	0.39	0.11					0.48	0.48							0.11	0.24		-0.09	0.02	-0.09								0.33	
PMR	NC				-0.40				-0.03								1.06	1.06							0.12			0.07	0.13	0.18									
POP	NC																0.95	0.95																					
PPB	NC								0.12								0.01	0.01																					
PPC	NC				-0.29				-0.13	0.09	0.09						0.35	0.35								-0.14		-0.35	-0.27	-0.35									
PPG	NC																1.42	1.42																					
PPT	NC				-0.28	0.88			0.03	0.27	0.27	-0.01					0.47	0.47							-0.01	0.13		-0.01	-0.08	0.09								0.22	
PRC	NC				-0.33				0.37	0.28	0.28	0.13					0.98	0.98							0.13	0.01		0.70	0.66	0.70								0.23	
PRP	NC																																						
PSA	NC				-0.58	0.46			-0.02	0.09	0.09	0.02					0.42	0.42							0.02	0.01		-0.03	-0.29	-0.09								0.06	
PSC	NC				-0.45				-0.03								0.56	0.56								0.13		-0.03	-0.14	0.09									
PSM	NC				0.12				0.24	0.34	0.34	0.25					0.97	0.97							0.25	0.32		0.28	0.41	0.41								0.11	
PSR	NC				-0.19				-0.10								0.94	0.94								0.01		0.01	0.21	-0.13									
PST	NC				-0.11				-0.21	0.26	0.26						0.62	0.62							-0.12			-0.11	-0.15	-0.23								0.49	
PTA	NC																0.76	0.76																					
PTQ	NC																-0.13	-0.13																					
PTR	NC				-0.46				-0.10								0.65	0.65							0.07			-0.11	-0.11	-0.06									
PVC	NC				-0.16				-0.07	0.28	0.28						0.58	0.58							-0.08		-0.16	-0.08	-0.25										
PWK	NC				-0.21				0.23	0.60	0.60	0.11					0.83	0.83							0.11	-0.01		0.16	0.16	0.02								0.44	
PWM	NC				0.62												1.38	1.38								0.13		1.76	1.76	1.76									
FRI	BK				-1.26					-0.03	-0.03	-0.03					0.81	0.81							-0.50		-0.03	-0.02		-0.03	-0.03	-0.03						-0.03	-0.35
MIN	BK					0.74																																	
ABL	CI																0.52	0.52									-0.31											-0.30	
ARV	CI																1.15	1.15																				0.17	
BCH	CI				-1.16				-0.29								0.36	0.36								-0.13		-0.08	-0.08	-0.23									
BMT	CI																0.86	0.86									-0.02												
CRG	CI				-0.87				0.21								0.90	0.90								0.07				0.08									
FRK	CI																																					0.30	
FTC	CI																0.69	0.69																					
JUL	CI																																						
MAR	CI																0.98	0.98																					
MWC	CI																																						
PKM	CI																0.71	0.71								-0.04			-0.26										
PLE	CI																1.19	1.19																					
RYS	CI																1.09	1.09																					
SCC	CI				-0.15				-0.01								0.48	0.48								0.17			-0.27										

Name	IRIS	Delays (sec) By Velocity Model <sup>‡</sup>																																		
CODE		AUB	BAE	BAR	BAS	COA	CON	COY	CST	DIA	GAB	GEY	HAY	LAS	LEW	LIV	LOM	LON	MAA	MAM	MAN	MEN	MOR	NBY	NCG	PEN	PGH	PMM	PSM	PTA	SCA	SHA	TRA	TRE	WAL	
SIM	CI															0.87	0.87																			
SLC	CI															0.86	0.86																			
SND	CI																																			0.05
SUN	CI																																			
SYP	CI															0.75	0.75																			
TEJ	CI																																			-0.13
TMB	CI				-0.67											1.19	1.19								0.20											
TOW	CI																														0.40				0.40	
WAS	CI				-0.29											1.34	1.34		-0.70																0.10	
WBS	CI																		0.17																-0.03	
WCH	CI																		-0.61																0.04	
WJP	CI															1.26	1.26																			-0.15
WLH	CI				-0.07														-0.55																-0.30	
WNM	CI																		-0.60																-0.30	
WOF	CI				-1.29											0.85	0.85		-0.62																	0.02
WOR	CI																		-0.80																-0.30	
WRC	CI																		-0.34																	0.11
WSH	CI																		-0.59																	0.22
WVP	CI																		-1.00																	-0.05
YEG	CI				-0.67			0.11								0.84	0.84								-0.07		0.12	0.12	0.12							
BCK	NN																		-0.02						-0.04											
BEN	NN																		-0.20						-0.13											
BHP	NN																		-0.11						-0.02											
CAS	NN																		-0.01						0.10											
CWC	NN																		-0.08						-0.15											
HTC	NN																		0.08						0.04											
LUL	NN															2.73	2.73		-0.10																	
MGN	NN				2.37														0.07						0.06											
MLN	NN																		-0.01						0.04											
ORC	NN				2.02														-0.12						-0.05											
POC	NN																		-0.33						-0.05											
RCC	NN																		-0.14						-0.10											
SCH	NN				1.49														-0.17						-0.17											
SLK	NN																		-0.21						0.13											
STR	NN																		-0.02						0.02											
WMD	NN																		-0.19						-0.16		-0.23	-0.23	-0.23							
GAS	WR			0.02	-0.02													0.30		0.08	0.27		0.14	0.11									0.24			
KPK	WR		-0.01											0.03										0.22												0.06
MGL	WR		-0.03				0.83			0.07	0.07			-0.18		1.25	1.25																			0.07
ORV	WR													-0.60	-0.23											-0.05										-0.15

<sup>‡</sup>Blank delay field denotes a value of zero or no delay available.

## Network Response

Most of the stations in the NCSN have identical instrumentation but operate at different gains. The amplified output of each velocity transducer (seismometer) is frequency modulated, multiplexed, and transmitted to Menlo Park, California via a combination of radio, telephone, and microwave communications, so that all stations are digitized in common with the same time base. Most of the network is designed to record ground motion between 0.2 and 20 Hz with 40-50 db of dynamic range, but the passband and dynamic range is greater for special instrument clusters along the Hayward fault and at Parkfield. To provide on-scale recordings for larger earthquakes, the NCSN records 34 stations located throughout the network that have low-gain vertical seismometers (Figure 1, Table 1).

*Healy and O'Neill (1977)* showed how the response of the network can be modelled as a series of response functions, or filters, for each of the instrument components. These response functions are solutions of first and second order ordinary differential equations that describe the movement of a damped mass-and-spring system (*e.g.*, a seismometer) and the currents and voltages in an L-R-C electrical circuit. *Stewart and O'Neill (1980)* applied the method of *Healy and O'Neill* to determine the responses of the individual components used in the USGS short-period seismic networks. A discussion of the network and its response spectra previously and currently used by the NCSN is given by *Eaton (1993)*. Table 6 provides the instrument response in terms of the complex poles and zeroes of the spectral elements, following the convention of *Stewart and O'Neill (1980)*. The total response of the system at different attenuator settings is shown in Figure 4.

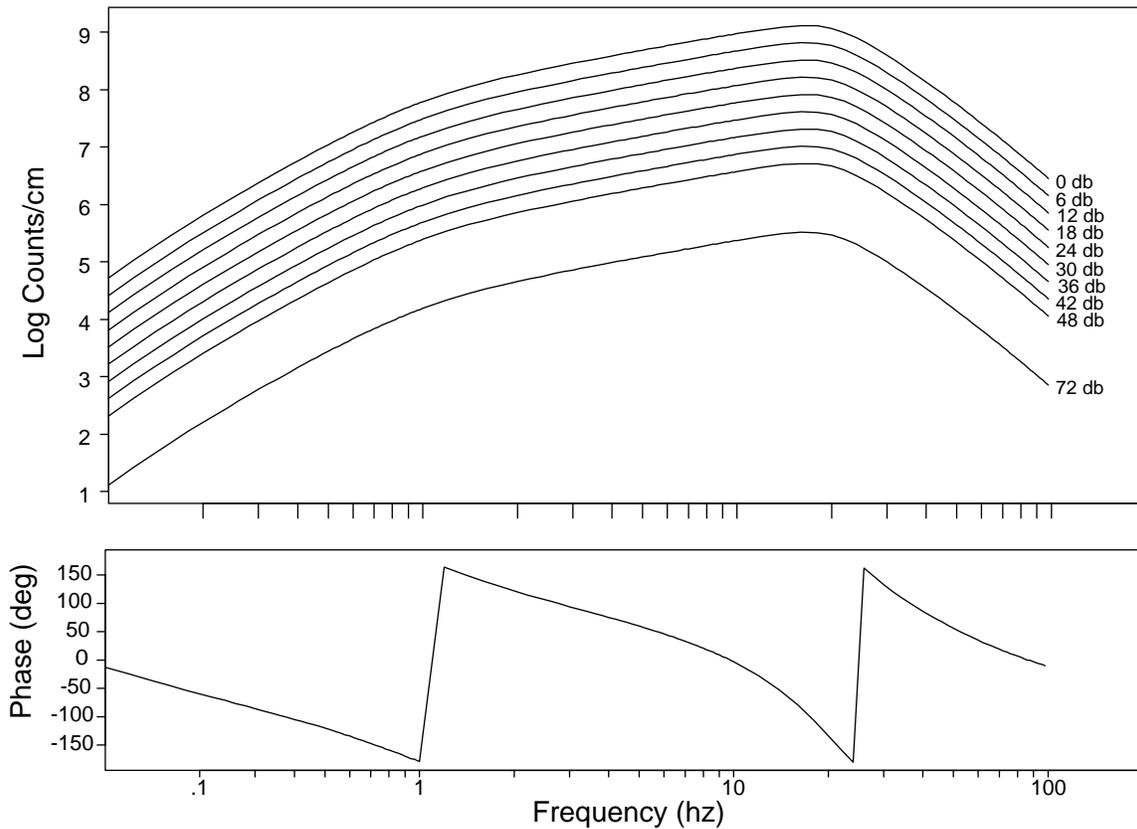


Figure 4. Amplitude and phase response of NCSN corresponding to parameters given in Table 6. Amplitude response is given as a function of attenuator settings.

**Table 6. USGS Instrument Response Parameters**

Instrument/ Amplitude function	$f_0$ (hz)	Damping	Poles <sup>1</sup> (rad/s)	Zeros	Amplitude constant
<b>Mark Products L4-C Seismometer</b> $\frac{i\omega^3}{(\omega - \alpha_j)(\omega - \alpha_k)}$	1.0	0.8	$\alpha_j = +3.7699 + 5.0265i$ $\alpha_k = -3.7699 + 5.0265i$	$0.0 + 0.0i$ $0.0 + 0.0i$ $0.0 + 0.0i$	1.0

Sensitivity:  $A_S = 1.00$  v/cm/sec

**J512 Preamp/Voltage control oscillator**

Hi-pass filter $\frac{\omega^2}{(\omega - \alpha_j)(\omega - \alpha_k)}$	0.095	1.0	$\alpha_j = 0.0 + 0.5969i$ $\alpha_k = 0.0 + 0.5969i$	$0.0 + 0.0i$ $0.0 + 0.0i$	1.0 1.0
Lo-pass filter $\frac{-1}{(\omega - \alpha_j)(\omega - \alpha_k)}$	44.0	1.0	$\alpha_j = 0.0 + 276.460i$ $\alpha_k = 0.0 + 276.460i$	none	276.46 276.46

Sensitivity:  $A_A =$  amplifier gain =  $10^{(92.6 - \text{attn})/20}$

$A_M =$  modulator gain =  $105/4.05 = 25.926$  hz/v

$A_{VCO} =$  VCO gain =  $25.926 \times 10^{(92.6 - \text{attn})/20} = 25.926 \times 10^{2.3/20} \times 10^{(90.3 - \text{attn})/20}$  hz/v

**121 Discriminator**

Lo-pass # 1 $\frac{-1}{(\omega - \alpha_j)(\omega - \alpha_k)}$	20.0	.3827	$\alpha_j = +116.0973 + 48.0915i$ $\alpha_k = -116.0973 + 48.0915i$	none	125.664 125.664
Lo-pass #2 $\frac{-1}{(\omega - \alpha_j)(\omega - \alpha_k)}$	20.0	.9239	$\alpha_j = +48.0832 + 116.1007i$ $\alpha_j = -48.0832 + 116.1007i$	none	125.664 125.664

Sensitivity:  $A_D =$  discriminator gain =  $2.2$  v/125 hz =  $0.0176$  v/hz

**12-bit Tustin digitizer**

Sensitivity:  $A_R =$  digitizer gain =  $2047$  counts/2.5 v =  $818.8$  counts/v.

**System sensitivity**

The response of the system as a whole is obtained by combining the spectral elements and sensitivity factors of its constituent parts. The overall system sensitivity  $A = A_S \times A_{VCO} \times A_D \times A_R = 486.4 \times 10^{(90.3 - \text{attn})/20}$  counts/cm/sec.

<sup>1</sup> The poles can be expressed in the SEED convention (IRIS, 1990) by multiplying by  $(0.0 + i)$ .

## Synopsis of Seismicity

In general, 1992 was notable for the absence of any significant earthquake sequences in the center of the network. However, two  $M > 7$  earthquakes occurred at the edge of the net. The first event occurred in April at Cape Mendocino, but its aftershocks occurred primarily in the Pacific ocean, where the network's ability to locate earthquakes is degraded. Then on 28 June the Landers earthquake occurred within the Southern California Seismic Network. Only the northernmost Landers aftershocks that occurred within the NCSN are discussed in this report. A total of 21,365 earthquakes and blasts were detected by the NCSN during 1992. Of this total, 170 events had a coda magnitude ( $M_c$ )  $\geq 3.5$  and 5 events were  $M \geq 5$  (Table 7, Figure 2). The following sections summarize the seismicity that occurred within the sub-regions shown in Figure 5. All origin times are UTC.

### Cape Mendocino Sub-region A

Two significant earthquake sequences occurred near the Mendocino Triple Junction, where the Pacific, North America, and southernmost Juan de Fuca (Gorda) plates meet. On 8 March at 03:43 a  $M$  5.3 earthquake occurred at a depth of 11.2 km (Table 7) and caused minor damage near the town of Honeydew. This strike-slip earthquake (#1, Figure 2) had only 11 aftershocks within 20 km of the mainshock epicenter in the following 30 days, of which the largest event was approximately  $M$  3.0. While this earthquake did not produce a large aftershock sequence, it should be noted that the magnitude of uniform detection for this region is approximately 1.9 due to the sparse network and the occurrence of earthquakes offshore. The aftershock distribution did not indicate which plane was the slip plane, but the prevailing geologic structure of the region would favor right-lateral slip on the vertical plane striking N60°W.

[The following summary is an excerpt from Oppenheimer et al. (1993) which provides a review of geophysical observations of the Cape Mendocino earthquake sequence and implications for the hazards of the region.] On 25 April, 1992 at 18:06 a surface wave magnitude ( $M_s$ ) 7.1 earthquake occurred near the town of Petrolia, California (#2, Figures 2 and 6). The mainshock was followed the next day by two  $M_s$  6.6 aftershocks at 07:41 (#3) and 11:41 (#4) located offshore approximately 25 km west-northwest of Petrolia. These three earthquakes generated more than 2000 recorded aftershocks in the triple junction region. The occurrence of a  $M$  7 earthquake is not unusual at the triple junction; over 60 earthquakes of Modified Mercalli intensity (1) ( $MMI$ )  $\geq VI$  or  $M \geq 5.5$  have occurred there since 1853 (Dengler et al., 1992). Damage estimates ranged from \$48 to \$66 million dollars, and the sequence caused 356 reported injuries, destroyed 202 buildings, and caused damage to an additional 906 structures primarily in the towns of Petrolia, Ferndale, Rio Dell, Scotia and Fortuna. It also triggered numerous landslides and rock falls and caused widespread liquefaction in local river valleys. The peak Modified Mercalli intensity was IX in the Petrolia region and decreased in approxi-

mately a radial pattern around the epicenter. The strong ground motions of the mainshock and two aftershocks were recorded on 14 instruments at epicentral distances from 5 to 130 km, and the peak accelerations were some of the highest ever recorded (Shakal et al., 1992).

The hypocenter of the 25 April 1992 mainshock was 4 km east of Petrolia at a depth of 10.6 km (Figure 6). A focal mechanism determined by inverting teleseismic mantle Rayleigh waves and aftershock locations indicate nearly pure thrust motion on a N10°W-striking fault plane dipping 13° to the east-northeast (Figures 2 and 6). The location of the hypocenter at the southeast end of the aftershock zone suggests that the fault ruptured unilaterally to the west. Most aftershocks less than 12 km deep occurred within 10 km of the coast in a region bounded on the east by the main shock epicenter, on the south by the Mendocino fault, and on the north by a west-northwest trend of earthquakes. The location, depth, and orientation of the rupture plane are consistent with the absence of surface faulting onshore.

The two  $M_s$  6.6 aftershocks locate 30 km west of the mainshock at depths near 20 km, and their mechanisms indicate right-lateral, strike-slip motion on planes striking to the southeast (Figure 6). The slip plane of the first aftershock is unknown because of the paucity of aftershocks. However, the second aftershock locates within a trend of smaller aftershocks at depths of 14 to 30 km on a southeast-striking plane dipping about 80° to the southwest; this orientation is consistent with the focal mechanism. The depths and mechanisms of the two large aftershocks provide evidence that rupture took place on faults in the Gorda plate and distinct from the mainshock fault. Although no large shocks ruptured the Mendocino fault during this sequence, many aftershocks occurred on the eastward projection of the fault. The aftershock activity was bounded on the south where the distribution of hypocenters is near vertical and extends to a depth of 25 km.

The elastic strain released by the mainshock caused significant horizontal and vertical deformation in the epicentral region. The mainshock elevated about 25 km of the coast from 3 km south of Punta Gorda to Cape Mendoci-

no. Many intertidal organisms inhabiting rocky reefs perished in the three weeks following the mainshock. Maximum uplift was  $140 \pm 20$  cm at Mussel Rock and 40 to 50 cm at the northernmost reef at Cape Mendocino. Modeling of coseismic horizontal and vertical site displacements measured by GPS surveys indicates shallow thrusting on a plane consistent with the teleseismic focal mechanism of the mainshock. The mainshock also generated a small tsunami recorded by sea level gauges along the California, southern Oregon, and Hawaiian coastlines. The largest tsunami amplitudes were recorded at Crescent City where two well-defined packets of wave energy with maximum positive heights of 35 and 53 cm within the first five hours were recorded.

## **Shasta and Lassen**

### **Sub-region B**

The most noteworthy seismicity recorded in this region occurred in response to the June 28  $M$  7.3 Landers earthquake (Figure 7) (Hill *et al.*, 1993). Significant increases in seismicity were triggered 12 minutes after the earthquake at Lassen (840 km) and 23 hours later at Burney (900 km). Otherwise, no unusual seismicity occurred in this region during 1992 (Figure 2). Of the 214 earthquakes located by the NCSN during this period, only three exceeded  $M$  3.5. The largest event, a  $M$  4.0 occurred on 16 July at a depth of 19 km approximately 18 km north-northeast of Red Bluff (Table 7). No aftershocks occurred within 20 km of the epicenter in the following 30 days.

## **Coast Ranges north of S.F. Bay**

### **Sub-region C**

The NCSN recorded 501 earthquakes primarily along the Rodgers Creek-Healdsburg-Maacama fault system and the Green Valley-Cedar Roughs-Bartlett Springs fault system (Figure 2) (see sub-region D for a discussion of The Geysers-lower Clear Lake region). No unusual earthquake sequences were recorded and no earthquakes above  $M$  3.5 occurred. The San Andreas fault was nearly aseismic except for five  $M \leq 2$  earthquakes near Gualala. A localized cluster of fourteen earthquakes ( $M \leq 2$ ) occurred throughout the year 60-65 km west-southwest of Red Bluff at a depth range of 2 to 13 km. Another cluster of  $M \leq 2$  events was located at depths of 6 - 8 km in the Montezuma Hills north of Antioch.

## **The Geysers - Lower Clear Lake**

### **Sub-region D**

The Geysers region continued to be one of the most seismogenic regions monitored by the NCSN. Earthquakes in this region are induced by activities associated with production of electricity, such as steam withdrawal, cooling of the reservoir, and fluid injection. We recorded an average

of 7 earthquakes per day in 1992 and over 2600 events for the year. Four earthquakes had  $M \geq 3.5$ ; the largest event, a  $M$  4.4, occurred on 19 September at 23:04 at a depth of 3 km beneath the northern region of the geothermal steam field. Two events, a  $M$  3.7 followed by a  $M$  3.5 occurred on 24 March at 14:27 and 14:28 at depths of 1.7 and 1.5 km near the same location as the  $M$  4.4 event. The Geysers was the only region in the northern San Andreas fault system which exhibited triggered seismicity in response to the Landers earthquake (distance = 740 km) (Hill *et al.*, 1993). A swarm of  $M < 1$  triggered seismicity occurred 30 s after the arrival of the main shock  $S$  wave.

## **Central California Coast Range**

### **Sub-region E**

There was very little seismicity recorded in sub-region E during 1992. Of the 155 events shown in Figure 2, only one event exceeded  $M$  3.5. This event had a magnitude of 4.1 and occurred on 2 July at 13:59 about 4 km south-southwest of San Simeon at a depth of 3 km.

## **Loma Prieta - S. F. Peninsula**

### **Sub-region F**

Of the 908 earthquakes recorded in this sub-region during 1992, 805 occurred in the aftershock region of the 1989  $M$  7 Loma Prieta earthquake. The number of aftershocks is 51% the number that occurred in 1991 and 24% of the number that occurred in 1990. The two largest events in this sub-region both were magnitude 3.7 and occurred within 5 minutes of each other on 12 December at 15:53 and 15:58. They ruptured the San Andreas fault 4 km west of San Juan Bautista at a depth of 4.5 km and produced about 24 aftershocks in the following week. The largest event on the San Francisco Peninsula, north of the Loma Prieta region, was a  $M$  3.4 event on 29 April at 01:16 that occurred at a depth of 6.7 km 1 km southeast of Pacifica.

## **San Francisco East Bay**

### **Sub-region G**

Seismicity in the East Bay continued on the same faults that have exhibited seismicity in the previous two decades. Two thirds of the activity (520 earthquakes) occurred on the Calaveras fault south of the Calaveras reservoir, with the remainder occurring primarily on the Hayward, Mission, Greenville, and Concord faults. The largest event to occur in this region during 1992 was a  $M$  3.9 event on 15 February; it occurred 14 km east of Livermore at a depth of 16.6 km near the Tesla fault. A  $M$  3.6 also occurred near San Leandro along the Hayward fault on 20 December at a depth of 5.5 km.

## **Creeping San Andreas**

### **Sub-region H**

The NCSN recorded 997 events in this region, and the largest event was a  $M$  3.7 event on 28 February at a depth of 6.3 km on the San Andreas fault 29 km east of King City. This earthquake was followed by a brief swarm of 25 events over the next two days. Scattered seismicity also occurred on the Tres Piños and Quien Sabe faults.

### **Parkfield**

#### **Sub-region I**

Two earthquakes in 1992 occurred in the vicinity of the nucleation points of the  $M$  6 1934 and 1966 Parkfield earthquakes. On 20 October at 05:28 a  $M$  4.5 event ruptured the San Andreas at a depth of 10.0 km near Middle Mountain, followed 6 days later by a  $M$  3.7 aftershock at 10.5 km on 26 October at 07:27. The former event triggered the first "A" level alert for the Parkfield experiment since its inception in 1985 (Bakun *et al.*, 1987), whereas the latter event resulted in a "B" level alert. The remaining 261 events located were otherwise typical (Parkfield Working Group, 1993).

### **Western margin of the S. Central Valley**

#### **Sub-region J**

Six earthquakes above  $M$  3.5 occurred in this region. A  $M$  4.3 on 16 September occurred at a depth of 10.6 km 20 km east of Avenal. This event was followed by a  $M$  4.2 event on 27 September. Three  $M$  3.7-3.8 events occurred in the Coalinga region (15 January 04:58; 22 April 16:52; 5 December 02:52). A  $M$  3.7 event also occurred 15 km west-northwest of Los Baños. The remaining 300 events were typical of activity of this region.

### **Central Valley/Western Sierra Nevada**

#### **Sub-region K**

More than two hundred events occurred in this region. The largest event was a  $M$  5.7 event on 11 July at 18:14 20 km north-northeast of Mojave (#6 Figure 2). This event is related to the Landers earthquake sequence and is discussed more fully in the SCSN Bulletin (Wald *et al.*, 1993). Similarly, about half of the events shown in Figure 2 are related to this earthquake. The remaining significant event was a poorly located  $M$  3.8 on 25 December 10 km east-northeast of Quincy.

### **Long Valley Caldera**

#### **Sub-region L**

This region continued to be very seismically active, recording 13% of all the seismicity in the network. Although there were no earthquakes greater than  $M$  3.8 in 1992 (29 June), several noteworthy swarms occurred (Figure 7). In

particular, the Long Valley region exhibited one of the most pronounced triggered seismicity responses to the Landers earthquake (Hill *et al.*, 1993). At an epicentral distance of about 415 km from the main shock, the number of earthquakes jumped from 38 in the week preceding the main shock to 340 in the week following the event. Seismicity commenced 9 minutes after the mainshock during the passage of the  $S$  wave and the Love and Rayleigh surface waves. Seismicity returned to the background level in the second half of July.

Most of the significant swarms occurred in the latter half of the year about 2 km east of Mammoth Lakes with focal depths of 5 to 8 km. The swarm of 27 August included a  $M$  2.9 event, and the largest event of the swarm of 23 September was  $M$  2.7. On 20 November a swarm of over 80 events occurred which included a  $M$  2.7 earthquake.

### **Central/Southern Sierra Nevada**

#### **Sub-region M**

The Rose Valley swarm began on February 15 near Coso Junction and was jointly recorded by the NCSN and SCSN networks (see Wald *et al.*, 1993) (Figures 2 and 7). The largest event in this swarm was a  $M$  4.1 event on 19 February at a depth of 6.6 km. The activity returned to normal by the end of March. Another  $M$  4.0 event occurred in the same vicinity on 4 September. The biggest event to occur in the region was a  $M$  4.5 on 30 June that occurred 6 km east of China Lake (#5 Figure 2). About another 12  $M$  3.5-4.0 events occurred in the Coso-Indian Wells region throughout the year, but this activity was typical. Similar magnitude events were recorded in the Round Valley, Mt. Morrison, Chalfant, Silver Peak, and Owens Valley regions.

The Coso-Indian Wells, Mono Basin, Chalfant Valley, and region south of Long Valley caldera also exhibited triggered seismicity in response to the 28 June Landers earthquake (Hill *et al.*, 1993). The Coso region sustained the largest triggered event ( $M$  4.4), and was closest to the source region (165-205 km). The seismicity in the Mono Basin region increased from 3 events in the week preceding Landers to 12 events in the week following the earthquake. Most triggered seismicity did not occur until 8 hours after the mainshock.

### **Carrizo Plain**

#### **Sub-region N**

No unusual seismicity was recorded except for a  $M$  3.6 event 10 km northeast of Taft at a depth of 21 km and a  $M$  3.8 event on 3 March 24 km northwest of Tejon Pass at a depth of 25 km.

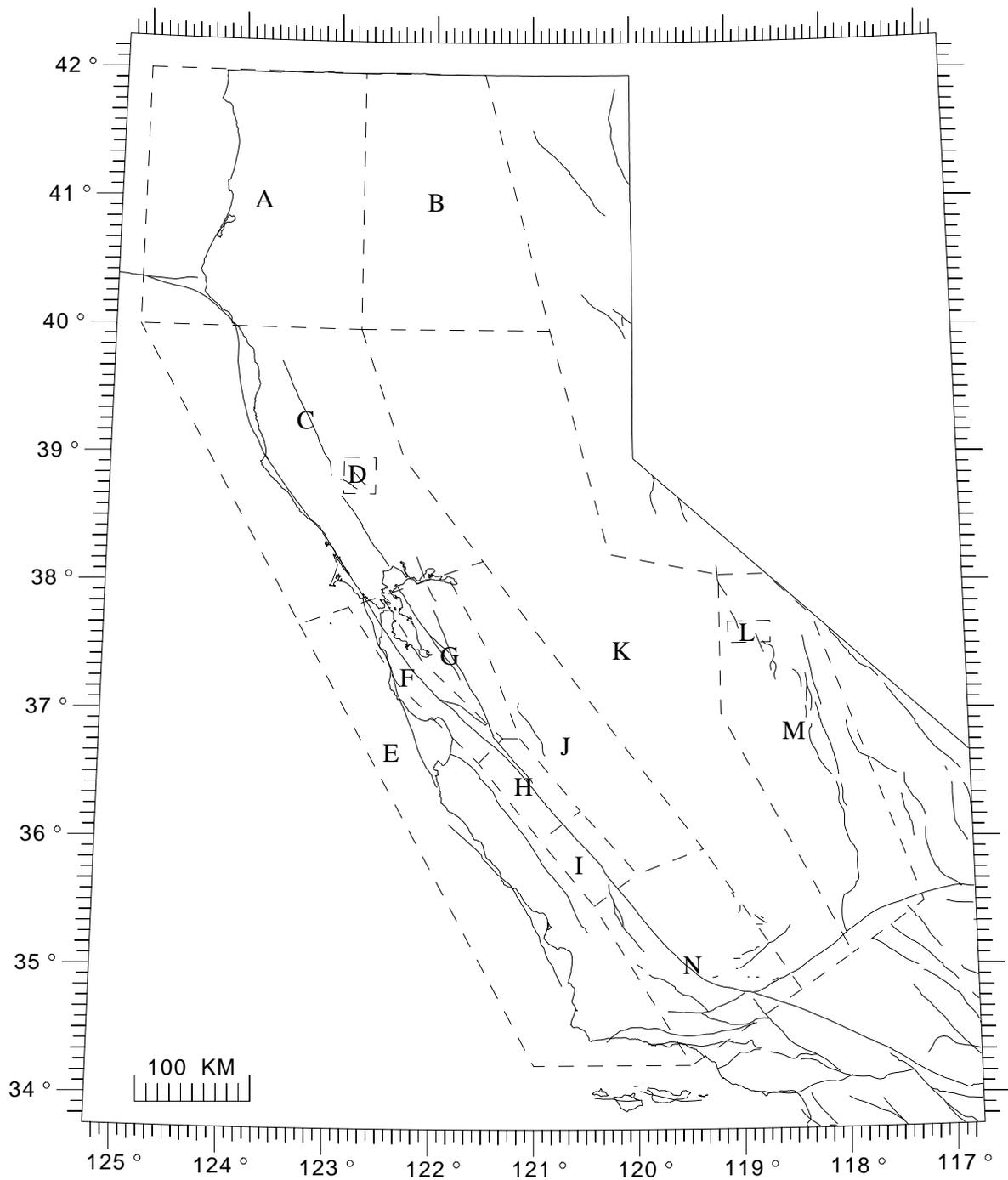


Figure 5. Boundaries of seismicity regions discussed in text.

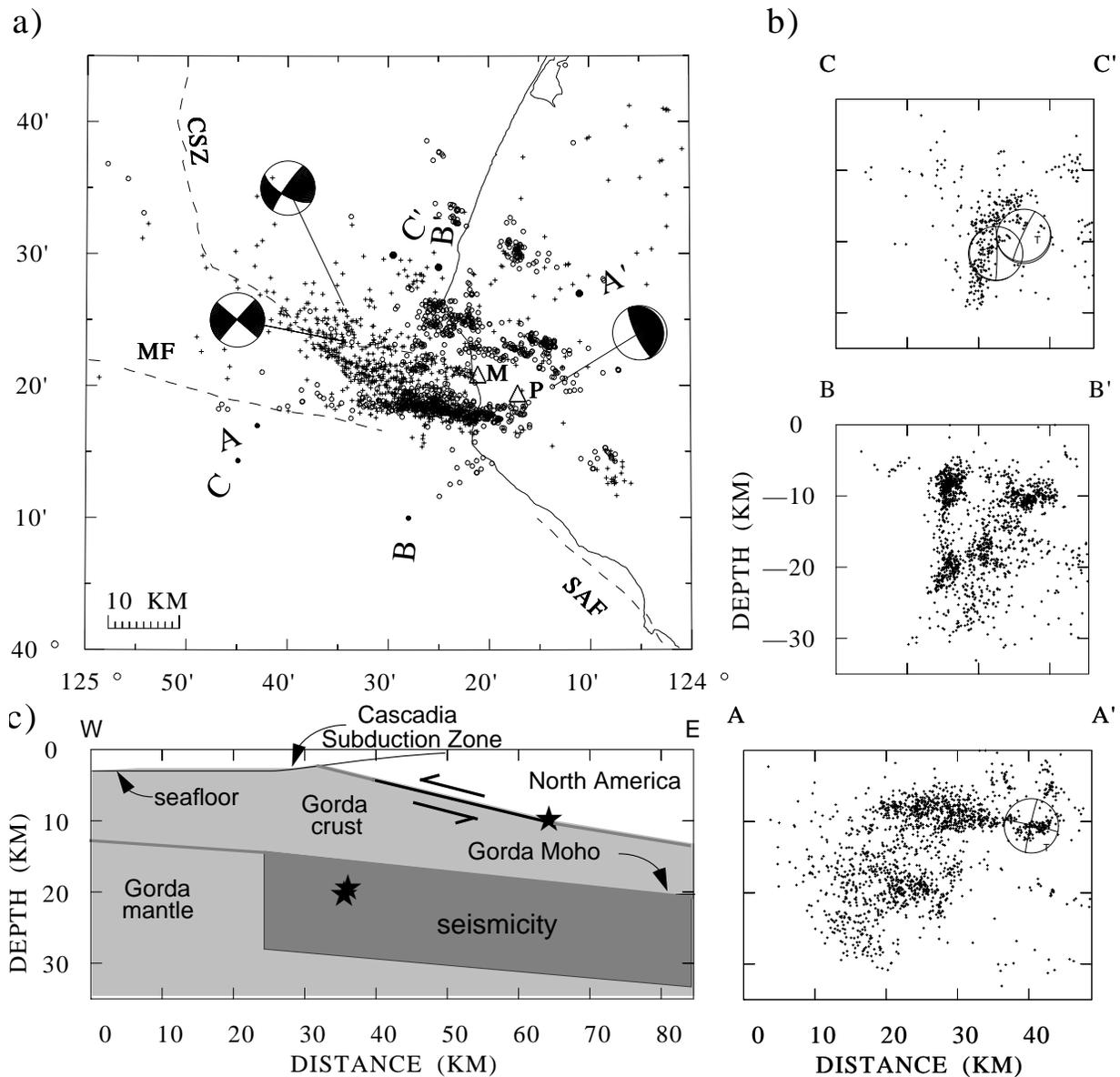


Figure 6. a) Focal mechanisms of the main shock and two large aftershocks at their epicentral locations and location of other aftershocks for 25 April 1992 to 30 September 1992 (open circles for foci < 12 km depth and plus symbols for deeper foci). b) Depth of earthquakes on cross sections aa' (perpendicular to mainshock strike, width  $\pm 20$  km), bb' (perpendicular to Mendocino fault, width  $\pm 20$  km), and cc' (perpendicular to strike of  $M_S$  6.6 aftershocks, width  $\pm 9$  km. Compressional quadrant marked by "T". c) East-west cross section depicts location of mainshock rupture plane (solid line), hypocenters (stars), and pre-main-shock seismicity with respect to plausible interpretation of Gorda North American plate geometry (Figure after *Oppenheimer et al.*, 1993).

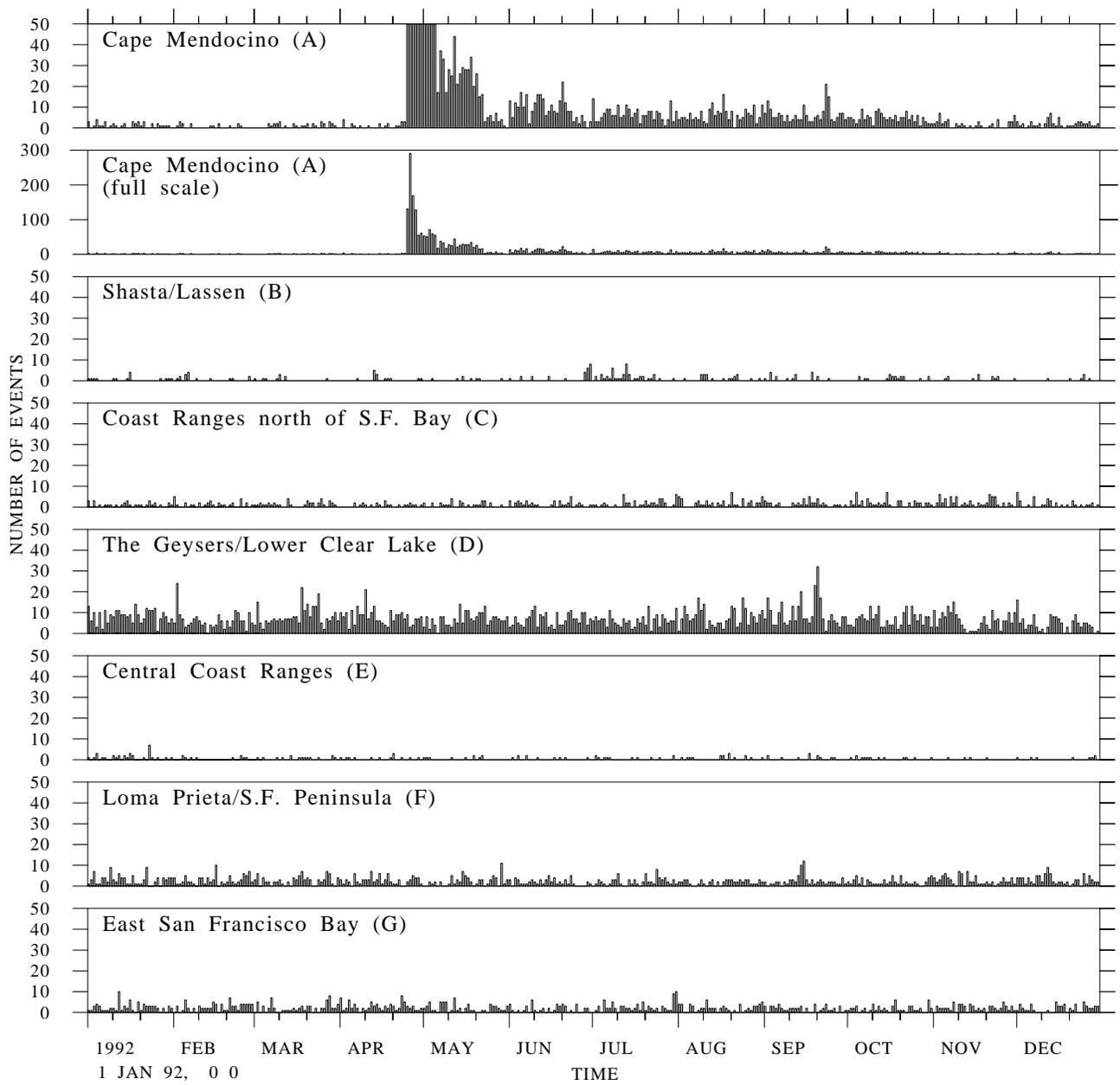


Figure 7. Time-histograms of the seismicity regions shown in Figures 2 and 5.

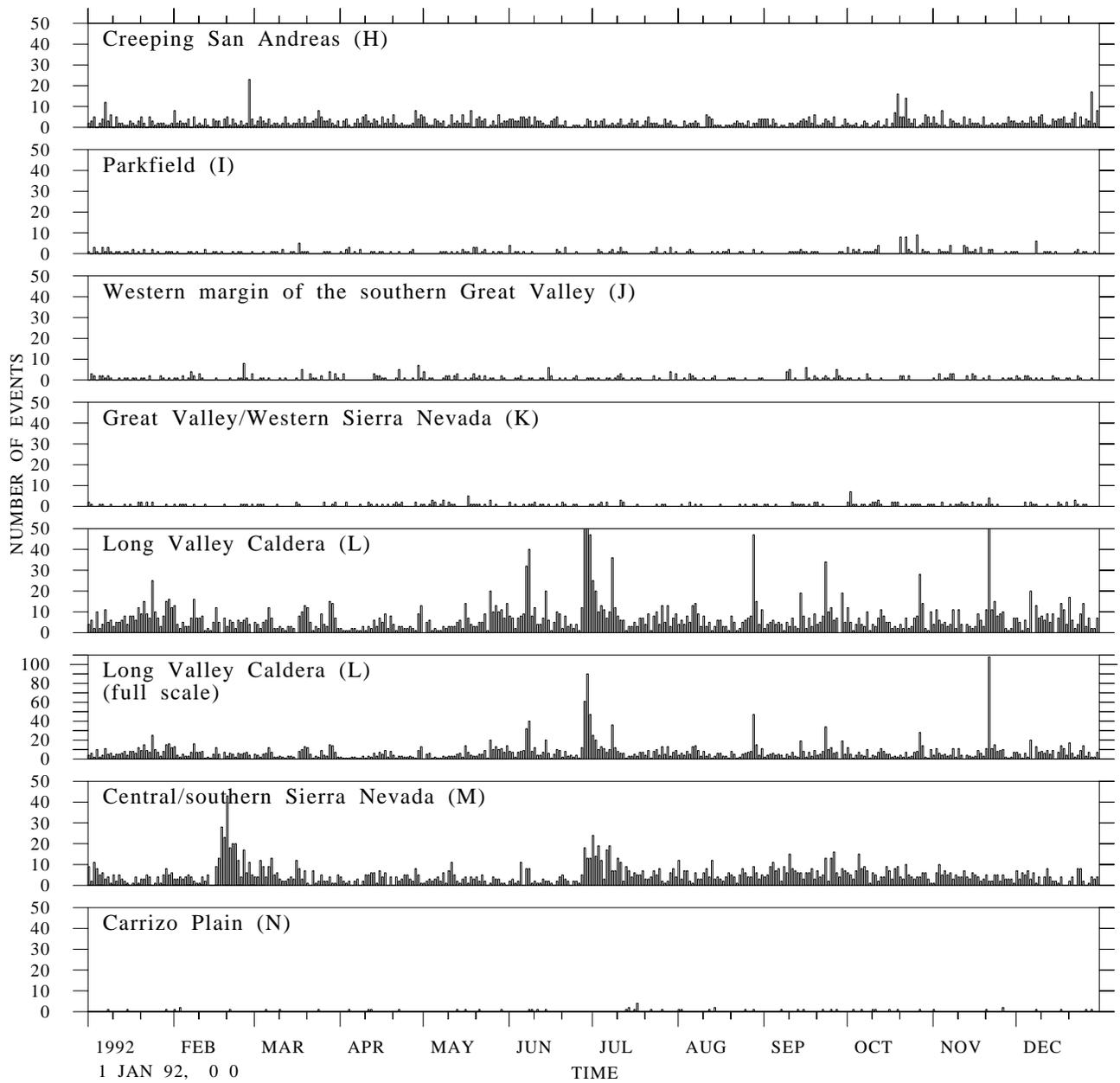


Figure 7 (cont.).

Table 7. M>3.5 Earthquakes Recorded during 1992 by the U.S.G.S. in Menlo Park

DATE	TIME	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (KM)	GEOGRAPHIC LOCATION	M <sub>D</sub>	# M <sub>D</sub>	MAD M <sub>D</sub>	M <sub>X</sub>	# M <sub>X</sub>	MAD M <sub>X</sub>	# P+S	# S	# VR	# FM	RMS (SEC)	ERH (KM)	ERZ (KM)	AZM-GAP (DEG)	DMIN (KM)	VEL MODEL	SOURCE PDX
92 JAN 15	458 50.36	36 18.03	120 27.32	12.63	COA	3.8	99	.11	3.6	13	.15	53	2	110	99	.13	.2	.5	84	9	COA	222
92 JAN 24	2026 55.04	40 17.65	124 28.88	21.04	MEN	3.7	99	.15	3.6	14	.13	25	2	103	99	.09	.9	.3	230	24	MEN	222
92 JAN 26	1820 37.51	35 53.12	117 37.25	58.07	IWV	3.6	14	.31				4	0	13	6	.01	1.8	2.2	221	30	WAL	22
92 FEB 10	1829 41.88	38 50.47	122 52.26	2.86	GEY	3.8	99	.18	3.8	26	.16	47	1	215	99	.08	.1	.6	28	4	GEY	222
92 FEB 15	1436 19.66	37 40.60	121 36.67	16.60	HAM	4.0	99	.12	4.0	15	.22	94	7	294	99	.19	.2	.3	85	9	LIV	222
92 FEB 19	1119 24.73	36 1.41	117 53.24	6.61	COS	4.1	99	.14	4.5	14	.16	11	0	132	99	.05	.5	1.0	179	10	WAL	222
92 FEB 19	1224 39.77	36 1.72	117 53.14	6.84	COS	3.6	99	.13	3.8	22	.27	11	0	110	99	.07	.6	1.3	182	11	WAL	222
92 FEB 21	417 54.63	36 1.03	117 53.33	6.53	COS	3.7	99	.14	3.8	11	.18	11	0	111	99	.05	.5	1.0	176	10	WAL	222
92 FEB 21	1459 44.63	36 1.47	117 53.31	6.97	COS	3.5	99	.14	3.2	6	.31	14	0	82	78	.06	.5	.9	127	11	WAL	222
92 FEB 21	1919 42.08	34 57.38	119 6.42	20.77	WWF	3.6	99	.15	3.4	10	.12	11	0	109	99	.09	.6	.9	111	4	TRA	222
92 FEB 22	332 20.51	36 1.63	117 53.36	6.01	COS	3.7	99	.14	3.8	15	.33	11	0	128	99	.06	.6	1.2	180	11	WAL	222
92 FEB 23	103 12.29	37 31.77	118 25.78	8.73	CHV	3.6	99	.11	3.3	6	.33	34	0	109	99	.05	.3	.6	94	2	MAM	222
92 FEB 27	2203 0.74	36 46.07	121 28.76	8.60	SJB	3.5	99	.13	3.6	23	.16	85	7	211	99	.23	.2	.5	35	2	LOM	222
92 FEB 28	329 20.48	36 13.22	120 47.18	5.83	BIT	3.7	99	.15	3.2	10	.12	48	1	52	49	.31	.5	1.8	65	1	PMM	222
92 MAR 3	807 49.33	35 45.60	118 1.60	7.82	WWF	3.8	99	.15				11	0	121	99	.06	.3	1.2	97	14	WAL	22
92 MAR 5	1824 22.31	35 12.63	119 22.67	25.21	BAK	3.8	99	.15	3.1	15	.10	35	0	123	99	.24	.4	.9	86	20	TRA	222
92 MAR 8	343 4.45	40 15.49	124 13.82	10.74	MEN	5.3	99	.34	5.3	30	.15	15	1	284	99	.15	.7	.4	191	9	MEN	222
92 MAR 9	451 15.82	40 34.39	123 22.42	35.63	KLA	4.4	99	.18	4.1	10	.14	42	3	198	99	.10	.2	.8	50	16	MEN	222
92 MAR 16	1208 6.39	40 19.46	124 36.06	18.56	MEN	3.7	99	.15	3.7	16	.12	48	2	164	99	.10	.6	.5	226	39	MEN	222
92 MAR 16	1920 22.18	36 0.15	117 52.73	5.51	COS	3.6	99	.12	3.5	8	.30	11	0	131	99	.04	.5	1.0	171	8	WAL	222
92 MAR 17	1156 35.71	36 0.26	117 52.58	5.29	COS	3.8	99	.14	4.1	30	.18	11	0	141	99	.05	.5	1.1	173	8	WAL	222
92 MAR 24	1427 6.12	38 50.63	122 47.86	1.71	GEY	3.7	99	.20				38	0	94	94	.07	.2	.7	35	4	GEY	22
92 MAR 24	1428 28.45	38 50.20	122 48.31	1.55	GEY	3.6	99	.27				28	0	41	41	.07	.2	.6	39	3	GEY	22
92 APR 22	1652 54.89	36 9.97	120 14.48	11.01	COA	3.7	99	.10	3.7	28	.12	42	1	167	99	.08	.2	.4	129	13	COA	222
92 APR 25	1501 48.16	40 18.18	124 31.84	21.28	MEN	3.5	99	.13	3.4	17	.14	16	1	97	79	.08	1.0	.4	254	20	MEN	222
92 APR 25	1806 5.18	40 19.96	124 13.77	10.21	MEN	6.5	99	.27	6.1	27	.22	9	0	346	99	.06	.3	.7	116	12	MEN	222
92 APR 25	1820 14.20	40 27.36	124 23.00	6.91	MEN	4.4	9	.49				14	0	15	15	.07	1.1	2.5	237	69	MEN	PP
92 APR 25	1825 18.21	40 25.68	124 31.62	7.46	MEN	3.6	7	.12				11	0	13	13	.08	3.6	2.8	278	59	MEN	PP
92 APR 25	1827 35.32	40 15.93	124 26.23	0.76	MEN	3.6	16	.46				22	0	26	26	.15	1.5	4.9	235	50	MEN	PP
92 APR 25	1828 58.08	40 22.61	124 25.55	12.27	MEN	4.2	15	.21				13	0	15	15	.07	2.9	2.4	284	56	MEN	PP
92 APR 25	1831 51.54	40 18.77	124 31.49	5.96	MEN	4.3	15	.20				17	0	22	22	.07	1.5	2.0	239	36	MEN	PP
92 APR 25	1832 58.06	40 19.36	124 47.20	5.02	MEN	3.9	14	.32				51	0	56	56	.32	3.8	21.6	267	125	MEN	PP
92 APR 25	1842 15.13	40 18.74	124 32.32	5.10	MEN	4.0	26	.28				23	0	84	84	.04	.8	1.7	235	68	MEN	PP
92 APR 25	1845 19.10	40 19.09	124 25.21	8.23	MEN	3.7	61	.27	3.5	6	.13	10	0	50	29	.11	1.8	.7	253	12	MEN	222
92 APR 25	1848 8.76	40 17.20	124 24.32	6.62	MEN	3.6	14	.28	3.1	3	.34	15	1	16	6	.10	1.2	.5	242	9	MEN	222
92 APR 25	1848 47.84	40 19.14	124 30.86	5.31	MEN	3.8	9	.10	3.6	2	.07	14	2	19	13	.08	.7	.4	248	19	MEN	222
92 APR 25	1853 18.01	40 16.76	124 27.57	6.44	MEN	4.0	36	.22	3.2	5	.21	19	0	19	9	.08	1.2	2.3	238	66	MEN	222
92 APR 25	1853 32.20	40 14.75	124 21.04	8.53	MEN	4.1	27	.21	4.0	2	.05	6	2	7	1	.09	1.9	1.0	260	27	MEN	222
92 APR 25	1909 27.43	40 20.07	124 22.54	5.53	MEN	3.7	16	.32				8	0	20	20	.05	.8	.6	223	11	MEN	PP
92 APR 25	1910 2.13	40 17.59	124 21.24	8.88	MEN	3.5	26	.30	3.6	2	.24	18	1	36	31	.10	.5	.3	223	6	MEN	222
92 APR 25	1914 51.74	40 18.81	124 32.62	2.82	MEN	4.7	15	.14				25	0	31	31	.11	1.4	2.4	232	38	MEN	PP
92 APR 25	1915 31.76	40 18.31	124 31.17	6.94	MEN	4.0	99	.28	4.2	10	.12	19	1	80	42	.13	1.3	.7	246	19	MEN	222
92 APR 25	1921 41.38	40 21.52	124 27.75	6.64	MEN	3.5	9	.11				8	0	15	15	.05	1.7	.7	266	17	MEN	PP
92 APR 25	1922 58.99	40 24.19	124 6.99	9.23	MEN	3.5	11	.10				8	0	10	10	.17	2.9	1.3	214	2	MEN	PP
92 APR 25	1930 44.26	40 17.84	124 24.30	8.49	MEN	3.8	17	.19				17	0	25	25	.05	1.2	.7	223	23	MEN	PP

DATE	TIME	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (KM)	GEOGRAPHIC LOCATION	M <sub>D</sub>	# M <sub>D</sub>	MAD M <sub>D</sub>	M <sub>X</sub>	# M <sub>X</sub>	MAD M <sub>X</sub>	# P+S	# S	# VR	# FM	RMS (SEC)	ERH (KM)	ERZ (KM)	AZM-GAP (DEG)	DMIN (KM)	VEL MODEL	SOURCE PDX			
92 APR 25	1939 30.39	40 24.62	124 21.10	9.64	MEN	3.6	90	.22				3.8	8	.09	17	1	74	61	.09	.5	.3	202	7	MEN	222
92 APR 25	1941 59.31	40 19.93	124 24.90	6.25	MEN	4.0	22	.19				11	0		33	33	.15	2.0	.7	244	13	MEN	PP		
92 APR 25	1942 46.83	40 17.73	124 24.63	7.31	MEN	3.8	34	.20				3.8	5	.15	21	2	52	43	.09	.6	.4	239	21	MEN	222
92 APR 25	1950 42.24	40 17.87	124 25.97	7.83	MEN	3.9	99	.18				4.1	14	.16	25	1	134	99	.07	.8	.5	237	25	MEN	222
92 APR 25	1955 6.57	40 25.94	124 24.53	9.86	MEN	3.6	45	.19				3.4	5	.07	21	2	60	58	.06	.5	.2	222	8	MEN	222
92 APR 25	2000 7.65	40 29.44	124 28.04	26.68	EUR	3.6	83	.19				3.7	10	.22	13	2	109	87	.09	1.2	.8	233	11	MEN	222
92 APR 25	2012 35.82	40 25.34	124 25.99	9.46	MEN	3.9	99	.33				3.9	12	.14	15	1	76	62	.09	.6	.3	250	10	MEN	222
92 APR 25	2029 17.10	40 24.52	124 22.00	10.36	MEN	3.7	94	.26				3.9	7	.12	18	2	106	88	.07	.6	.2	214	8	MEN	222
92 APR 25	2109 13.64	40 22.90	124 13.18	10.44	MEN	3.5	43	.14				15	0		49	49	.05	.3	.3	110	9	MEN	PP		
92 APR 25	2126 9.77	40 22.03	124 33.03	2.25	MEN	3.8	92	.29				3.8	6	.07	17	0	55	41	.13	1.4	1.6	247	22	MEN	222
92 APR 25	2136 49.44	40 20.90	124 26.77	19.41	MEN	3.6	99	.17				3.7	12	.16	13	1	45	30	.06	.9	.2	246	16	MEN	222
92 APR 25	2225 25.87	40 19.80	124 24.69	5.55	MEN	3.9	99	.21				4.2	16	.09	11	1	179	99	.13	1.6	.7	246	13	MEN	222
92 APR 26	40 26.01	40 17.97	124 23.48	8.46	MEN	3.5	95	.18				3.8	10	.11	12	1	65	56	.06	.7	.3	245	9	MEN	222
92 APR 26	49 17.42	40 21.40	124 26.36	7.07	MEN	3.5	73	.14				3.6	11	.15	10	0	53	40	.07	1.0	.5	256	16	MEN	222
92 APR 26	100 57.88	40 21.82	124 30.47	6.33	MEN	3.9	99	.23				4.2	7	.19	16	1	88	75	.11	1.1	.5	251	19	MEN	222
92 APR 26	127 14.56	40 18.50	124 28.16	8.63	MEN	3.6	71	.18				3.6	10	.12	10	0	44	41	.05	1.2	.4	271	15	MEN	222
92 APR 26	132 15.10	40 18.25	124 24.72	19.20	MEN	3.7	99	.19				3.5	9	.21	12	2	78	72	.05	.8	.3	253	11	MEN	222
92 APR 26	133 36.28	40 19.00	124 25.25	17.41	MEN	3.9	99	.23				3.9	8	.14	14	1	62	47	.09	1.1	.3	251	12	MEN	222
92 APR 26	207 6.04	40 18.22	124 24.67	19.07	MEN	3.9	99	.28				3.9	7	.15	12	1	84	81	.05	.9	.3	253	11	MEN	222
92 APR 26	208 9.33	40 17.83	124 24.42	18.62	MEN	4.0	33	.26				3.5	5	.22	14	2	26	13	.09	.8	.3	245	10	MEN	222
92 APR 26	450 17.19	40 25.34	124 22.22	10.14	MEN	3.5	99	.14				3.7	10	.16	12	1	68	61	.09	.8	.3	221	7	MEN	222
92 APR 26	741 39.76	40 25.63	124 35.79	19.42	MEN	6.3	99	.38				6.1	28	.25	17	0	362	99	.15	2.2	.6	253	23	MEN	222
92 APR 26	749 52.12	40 24.48	124 33.98	17.85	MEN	4.0	27	.23				3.5	6	.08	15	2	36	23	.08	.5	.6	257	21	MEN	222
92 APR 26	752 3.44	40 24.94	124 40.18	0.08	MEN	3.8	65	.27				3.9	7	.15	30	0	54	31	.47	2.7	5.9	233	36	MEN	222
92 APR 26	821 9.49	40 23.05	124 33.28	22.66	MEN	3.7	93	.26				3.8	10	.09	16	0	64	60	.15	2.4	.7	250	21	MEN	222
92 APR 26	843 28.57	40 19.89	124 33.99	18.80	MEN	3.5	64	.16				3.4	7	.14	20	1	31	18	.12	1.1	.3	247	24	MEN	222
92 APR 26	924 21.96	40 25.36	124 22.45	9.91	MEN	3.7	99	.19				4.0	9	.10	21	2	110	99	.05	.5	.2	216	7	MEN	222
92 APR 26	941 2.62	40 26.01	124 26.29	9.76	MEN	3.5	54	.31				2.8	2	.17	13	2	41	35	.08	.8	.5	232	10	MEN	222
92 APR 26	941 44.79	40 20.26	124 21.43	11.18	MEN	3.6	37	.16				3.6	6	.07	12	2	49	37	.07	.4	.3	210	11	MEN	222
92 APR 26	1118 25.66	40 22.52	124 35.12	22.63	MEN	5.9	49	.46				6.2	7	.15	12	0	329	99	.07	2.4	.6	263	24	MEN	202
92 APR 26	1128 50.85	40 22.95	124 31.47	14.15	MEN	4.1	50	.30				2.2	3	.16	16	1	21	13	.08	1.0	.6	251	24	MEN	222
92 APR 26	1129 7.58	40 26.27	124 35.33	10.78	MEN	4.1	53	.25				4.0	5	.11	24	1	46	26	.12	.8	.8	240	32	MEN	222
92 APR 26	1204 29.98	40 24.44	124 24.52	10.71	MEN	4.1	77	.23				4.1	4	.06	12	0	98	80	.06	.8	.3	227	10	MEN	222
92 APR 26	1428 23.77	40 21.84	124 27.50	18.93	MEN	3.7	38	.10				11	0		32	32	.10	1.7	.3	264	16	MEN	PP		
92 APR 26	2040 55.33	40 18.43	124 31.05	16.35	MEN	3.5	69	.19				3.4	8	.15	18	2	56	45	.06	.9	.2	264	19	MEN	222
92 APR 26	2118 4.95	40 23.90	124 35.40	18.50	MEN	4.0	99	.15				4.1	8	.18	33	1	152	99	.12	1.0	.4	240	23	MEN	222
92 APR 26	2208 0.30	40 21.39	124 31.94	18.03	MEN	3.8	99	.15				3.9	5	.17	17	1	102	97	.08	1.1	.3	249	21	MEN	222
92 APR 26	2225 52.97	40 19.29	124 32.84	9.76	MEN	4.2	99	.20				4.2	18	.20	18	0	173	99	.13	1.9	.7	250	22	MEN	222
92 APR 26	2339 15.61	40 19.53	124 37.02	6.02	MEN	4.0	99	.23				4.2	24	.18	30	2	144	99	.09	.8	.6	242	28	MEN	222
92 APR 27	6 23.80	40 19.29	124 37.09	5.53	MEN	3.5	87	.22				3.6	11	.20	24	2	70	63	.08	.9	.7	247	28	MEN	222
92 APR 27	33 34.42	40 20.62	124 28.35	18.53	MEN	3.6	99	.13				3.6	9	.16	15	1	111	99	.07	1.0	.3	248	18	MEN	222
92 APR 27	228 18.40	40 19.21	124 37.19	7.83	MEN	4.0	99	.19				4.2	15	.17	28	0	151	99	.15	1.5	1.0	247	28	MEN	222
92 APR 27	235 36.65	40 19.17	124 29.10	19.77	MEN	3.6	96	.16				3.6	11	.18	14	1	91	87	.05	.7	.2	250	17	MEN	222
92 APR 27	247 21.08	40 19.76	124 38.95	4.12	MEN	4.2	99	.27				4.4	12	.21	31	0	174	99	.10	1.0	1.1	240	30	MEN	222
92 APR 27	631 24.34	40 19.87	124 33.51	22.92	MEN	3.5	99	.12				3.3	12	.19	21	1	101	89	.11	1.5	.6	247	23	MEN	222
92 APR 27	907 10.92	40 22.89	124 35.34	23.36	MEN	3.5	99	.15				3.5	10	.20	22	1	115	99	.11	1.5	.8	248	24	MEN	222
92 APR 27	1537 57.10	40 18.90	124 32.96	8.59	MEN	3.7	99	.22				3.7	6	.16	18	1	57	52	.14	1.3	.7	251	22	MEN	222
92 APR 30	840 20.57	40 22.29	124 34.64	26.14	MEN	3.5	99	.15				3.5	11	.17	25	1	144	99	.10	1.2	1.0	243	23	MEN	222
92 APR 30	953 26.57	40 17.04	124 22.38	22.79	MEN	4.0	99	.19				3.9	11	.15	13	0	178	99	.09	1.4	.6	234	7	MEN	222

DATE	TIME	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (KM)	GEOGRAPHIC LOCATION	M <sub>D</sub>	# M <sub>D</sub>	MAD M <sub>D</sub>	M <sub>X</sub>	# M <sub>X</sub>	MAD M <sub>X</sub>	# P+S	# S	# VR	# FM	RMS (SEC)	ERH (KM)	ERZ (KM)	AZM-GAP (DEG)	DMIN (KM)	VEL MODEL	SOURCE PDX
92 MAY 1	102 28.83	37 6.19	121 0.79	1.07	JQN	3.5	99	.16	3.4	18	.18	73	3	190	99	.16	.4	1.4	184	11	NCG	222
92 MAY 1	1542 56.79	40 21.00	124 31.63	26.19	MEN	3.6	98	.14	3.6	9	.24	21	1	120	99	.12	1.3	.8	249	21	MEN	222
92 MAY 1	2241 52.53	40 19.24	124 34.21	8.57	MEN	3.6	79	.16	3.6	12	.23	25	0	78	69	.13	1.3	.7	235	24	MEN	222
92 MAY 2	1130 31.38	40 17.90	124 27.35	22.04	MEN	3.9	99	.11	3.9	16	.14	13	1	197	99	.08	1.1	.3	267	14	MEN	222
92 MAY 4	13 27.93	40 20.44	124 27.95	20.18	MEN	3.5	84	.20	3.5	10	.12	14	0	67	62	.07	1.5	.2	248	17	MEN	222
92 MAY 4	708 19.14	40 17.59	124 23.39	22.79	MEN	3.7	99	.12	3.6	9	.12	14	1	141	99	.08	1.1	.4	238	9	MEN	222
92 MAY 4	744 42.61	40 17.61	124 23.12	22.61	MEN	3.5	99	.14	3.6	9	.16	13	1	135	99	.09	1.1	.4	237	21	MEN	222
92 MAY 5	1046 17.24	40 17.36	124 19.77	7.55	MEN	4.3	99	.14	4.5	33	.16	13	1	238	99	.10	.7	.4	202	5	MEN	222
92 MAY 10	1758 3.17	40 26.01	124 25.73	10.44	MEN	4.1	99	.19	4.3	14	.12	13	0	107	86	.08	1.0	.5	230	9	MEN	222
92 MAY 11	249 23.65	40 17.71	124 26.63	22.41	MEN	3.5	99	.12	3.4	10	.10	13	1	101	97	.07	.8	.3	264	13	MEN	222
92 MAY 12	1217 20.93	40 18.46	124 27.72	8.07	MEN	3.6	99	.16	3.6	7	.16	12	0	79	66	.05	1.1	.5	269	15	MEN	222
92 MAY 18	742 31.43	40 21.54	124 45.95	13.92	MEN	3.8	99	.25	3.8	14	.23	54	1	162	99	.12	.6	.9	237	39	MEN	222
92 MAY 20	230 50.53	40 18.42	124 22.84	7.14	MEN	3.7	99	.17	3.9	20	.16	12	1	138	99	.08	.9	.4	235	9	MEN	222
92 MAY 21	338 0.88	40 18.75	124 25.39	20.64	MEN	3.9	99	.18	3.9	13	.16	12	1	105	92	.06	.9	.2	256	12	MEN	222
92 MAY 27	1532 38.38	40 17.85	124 20.67	8.41	MEN	3.5	87	.15	3.6	8	.18	12	1	62	57	.07	.4	.3	212	6	MEN	222
92 JUN 5	2146 42.98	40 18.66	124 24.80	20.41	MEN	4.8	99	.17	4.8	16	.21	10	0	201	99	.05	1.2	.3	252	11	MEN	222
92 JUN 16	345 8.44	40 27.99	124 35.70	23.44	MEN	3.5	85	.17	3.8	2	.04	17	1	105	99	.08	.7	.7	251	22	MEN	222
92 JUN 24	725 28.50	40 20.80	124 30.57	23.27	MEN	3.7	99	.15	3.7	10	.16	19	1	180	99	.12	1.4	.6	247	20	MEN	222
92 JUN 28	1210 42.44	40 27.77	121 32.73	4.40	LAS	3.5	28	.59	1.7	1	.00	13	1	13	9	.03	.3	.5	60	3	LAS	FFF
92 JUN 29	537 45.89	37 34.60	118 49.67	12.37	MOR	3.8	99	.21	3.7	2	.29	34	0	72	69	.07	.3	.6	77	2	MAM	222
92 JUN 30	1305 36.04	35 40.61	117 36.52	9.81	IWV	4.5	67	.16	11	0		83	83	.06	.7	1.5	145	12	WAL	RR		
92 JUL 1	616 56.39	35 40.62	117 36.71	8.65	IWV	4.4	99	.18	4.5	25	.16	10	0	130	99	.05	.5	1.7	136	12	WAL	222
92 JUL 2	701 10.51	35 37.41	118 3.63	13.54	WWF	3.9	89	.12	17	0		77	77	.22	2.3	.5	285	18	WAL	RR		
92 JUL 2	1359 20.49	35 36.31	121 12.58	3.02	SSM	4.1	99	.13	4.4	22	.35	40	0	137	99	.09	.3	.6	183	10	CST	222
92 JUL 3	1322 38.06	35 51.46	117 51.29	11.65	IWV	3.8	99	.14	3.9	13	.13	7	0	72	41	.03	.5	2.9	178	39	WAL	222
92 JUL 6	1949 10.78	36 38.75	118 1.87	0.31	OWV	3.9	99	.13	4.3	13	.10	69	0	74	60	.19	.7	2.9	170	60	WAL	222
92 JUL 11	1814 15.85	35 12.82	118 4.66	16.02	GAR	5.2	99	.22	5.5	48	.20	19	0	319	99	.10	.5	1.1	139	22	WAL	FFF
92 JUL 13	825 38.12	35 58.14	118 21.15	6.86	WWF	3.5	99	.13	3.5	15	.34	60	0	113	99	.15	.4	.7	107	32	WAL	222
92 JUL 13	953 6.13	35 58.75	118 23.19	0.31	WWF	4.1	99	.21	4.2	6	.08	72	0	124	99	.41	.7	4.3	105	31	WAL	O22
92 JUL 13	954 19.56	35 57.92	118 22.82	0.20	WWF	4.0	56	.28	3.4	4	.23	7	0	9	3	.05	2.2	6.7	269	32	WAL	222
92 JUL 14	24 59.59	35 57.42	118 21.12	7.76	WWF	3.6	99	.13	3.7	10	.21	53	0	107	99	.19	.3	.6	105	31	WAL	222
92 JUL 16	1538 0.19	40 19.43	122 9.73	18.86	SHA	4.0	99	.15	3.7	29	.26	19	1	164	94	.11	.4	1.2	125	13	LAS	222
92 JUL 18	658 39.52	37 29.34	118 56.94	2.87	SIL	3.9	99	.12	4.3	37	.18	36	0	308	99	.08	.3	1.4	116	14	MAM	222
92 JUL 27	2210 59.48	36 3.20	117 39.51	0.63	COS	3.9	99	.14	4.2	12	.21	32	0	34	23	.25	1.5	4.7	200	66	WAL	222
92 AUG 13	133 10.72	40 24.39	124 25.67	9.70	MEN	3.5	94	.16	3.6	7	.22	8	0	59	53	.06	1.1	.5	256	11	MEN	222
92 AUG 14	2327 56.62	35 50.40	117 40.27	11.24	IWV	3.7	99	.14	3.8	11	.19	10	0	94	75	.12	.5	1.1	135	9	WAL	222
92 AUG 18	238 29.00	37 20.37	118 22.79	12.26	OWV	3.7	99	.20	3.8	8	.33	28	0	51	43	.05	.4	1.1	148	10	MAM	222
92 AUG 25	1742 18.50	40 17.94	124 26.11	22.31	MEN	3.5	99	.15	3.5	10	.20	14	1	119	99	.08	.8	.3	263	12	MEN	222
92 SEP 4	1502 58.19	36 8.29	117 52.28	7.74	COS	4.0	99	.13	4.1	19	.17	15	0	113	84	.08	.5	1.1	156	22	WAL	222
92 SEP 5	2228 8.56	37 27.47	118 35.77	8.36	RVL	3.5	99	.16	3.7	10	.19	32	0	138	99	.10	.3	.7	81	4	MAM	222
92 SEP 14	1246 53.70	37 34.23	118 52.07	7.57	MOR	3.5	99	.13	3.7	23	.21	31	0	148	99	.07	.3	.5	85	4	MAM	222
92 SEP 16	614 33.28	36 0.00	119 54.66	10.55	COA	4.3	99	.16	4.3	28	.17	41	3	259	99	.17	.5	.7	216	16	COA	222
92 SEP 19	2304 46.84	38 51.59	122 47.61	3.01	GEY	4.3	99	.18	4.4	19	.15	49	0	322	99	.11	.2	.7	32	6	GEY	222
92 SEP 23	904 41.52	40 18.02	124 23.43	8.37	MEN	3.7	99	.15	4.0	13	.09	12	0	109	99	.06	.9	.4	244	9	MEN	222
92 SEP 23	1110 31.09	40 18.06	124 23.49	8.18	MEN	4.0	99	.22	4.2	23	.14	14	0	235	99	.06	.7	.3	244	9	MEN	222
92 SEP 27	1659 13.89	36 0.29	119 55.59	11.72	COA	4.2	99	.13	4.1	23	.17	47	3	198	99	.17	.5	1.0	187	18	COA	222
92 SEP 29	525 43.87	37 34.02	118 52.21	7.39	MOR	3.7	99	.15	3.9	17	.22	32	0	96	88	.07	.3	.5	86	5	MAM	222
92 OCT 5	1140 28.50	37 27.28	118 50.32	7.64	MOR	3.9	99	.11	4.3	15	.14	33	0	181	99	.07	.3	.9	129	7	MAM	222
92 OCT 8	1744 58.83	36 5.26	117 40.78	8.10	COS	3.6	99	.13	3.4	9	.21	11	0	62	47	.08	.9	1.3	243	20	WAL	222

DATE	TIME	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (KM)	GEOGRAPHIC LOCATION	M <sub>D</sub>	# M <sub>D</sub>	MAD M <sub>D</sub>	M <sub>X</sub>	# M <sub>X</sub>	MAD M <sub>X</sub>	# P+S	# S	# VR	# FM	RMS (SEC)	ERH (KM)	ERZ (KM)	AZM-GAP (DEG)	DMIN (KM)	VEL MODEL	SOURCE PDX
92 OCT 9	223 48.67	40 27.33	124 16.74	19.38	MEN	3.7	99	.14	3.7	9	.13	16	1	101	93	.06	.5	.3	109	5	MEN	222
92 OCT 14	2208 47.31	39 43.29	122 5.73	15.75	SAC	3.5	99	.18	3.3	28	.19	104	0	139	99	.38	.3	.7	36	34	NCG	222
92 OCT 20	528 8.91	35 55.72	120 28.35	9.99	MID	4.3	99	.14	4.5	46	.14	56	1	329	99	.10	.2	.3	31	2	PMM	222
92 OCT 26	727 40.47	35 56.66	120 29.40	10.45	MID	3.6	99	.12	3.7	6	.06	52	1	94	89	.09	.2	.3	40	2	PMM	222
92 NOV 21	1511 42.36	35 19.04	118 36.11	9.12	WWF	3.7	99	.13	3.8	20	.12	20	0	78	63	.16	.4	1.0	72	15	WAL	222
92 DEC 5	252 57.11	36 27.20	120 11.83	17.41	JQN	3.7	99	.14	3.5	29	.29	40	1	219	99	.13	.4	.3	207	3	COA	222
92 DEC 12	1553 46.17	36 51.26	121 35.06	4.85	SJB	3.7	99	.12	3.7	23	.20	79	1	152	99	.18	.2	.4	41	3	LOM	222
92 DEC 12	1558 52.47	36 51.18	121 34.83	4.46	SJB	3.7	99	.12	3.6	21	.15	79	0	130	99	.19	.2	.4	39	3	LOM	222
92 DEC 20	2105 20.79	37 44.92	122 8.99	4.23	HAY	3.6	99	.14	3.5	30	.15	75	2	185	99	.14	.2	.4	31	4	HAY	222
92 DEC 25	425 9.32	39 56.67	120 51.43	0.00	WAK	3.8	99	.14	4.0	6	.14	123	0	136	93	.48	.9	1.5	181	53	LAS	222

### Notes to Table 7

DATE TIME	Origin Time (Universal Coordinated Time)	ERH / (KM)	Horizontal error (km).
GEOGRAPHIC / LOCATION	Event location remark. (See Figure 4 and table below).	ERZ / (KM)	Vertical error (km).
M <sub>D</sub>	Coda duration magnitude (Eaton, 1991).	AZM-GAP / (DEG)	Maximum azimuthal Gap
# / M <sub>D</sub>	Total of duration magnitude weights (does not exceed 99).	DMIN / (KM)	Distance to nearest station (km).
MAD / M <sub>D</sub>	Median-absolute-difference of coda magnitudes.	VEL / MODEL	3-letter code of crust and delay model. (See Table 4).
M <sub>X</sub>	Primary amplitude magnitude (Eaton, 1991).	SOURCE / PDX	Most common P & S (P), M <sub>D</sub> (D), and M <sub>X</sub> (X) data source codes. where data source codes are as follows:
# / M <sub>X</sub>	Total of amplitude magnitude weights (does not exceed 99).		R Main RTP
MAD / M <sub>X</sub>	Median-absolute-difference of amplitude magnitudes		P Prototype RTP
# / P+S	Number of P & S times with final weights > than 0.1 (does not exceed 99).		O Motorola RTP
# / S	Number of S readings with weights > 0.1 (does not exceed 99).		2 CUSP Tustin A/D #2
# / VR	Number of valid P & S readings with weight > 0 (does not exceed 99).		F Digitized event from FM tape
# / FM	Number of P first motions (does not exceed 99).		
RMS / (SEC)	RMS travel time residual.		

### Hypoinverse Geographic Locations

ALM Lake Almanor	CON Concord Fault	GOL Gold Hill	LOM Loma Prieta	NMO North Moat	RVL Round Valley	SJB San Juan Bautista
ALU Alum Rock	COS Coso Range	GRN Greenville Fault	MAA Maacama Fault	ORE Oregon	SAC Sacramento Valley	SLA Slack Canyon
ANN Anno Nuevo	CRV Ciervo Hills	GVL Green Valley Fault	MAM Mammoth Mtn.	ORO Oroville	SAL Salinas Valley	SMO South Moat
AUB Auburn	CYN Coyote North	HAM Mt. Hamilton	MAR Marin	ORT Ortigaleta Fault	SAR Sargent Fault	SSM San Simeon
BAK Bakersfield	CYS Coyote South	HAY Hayward Fault	MCA Mono Caldera	OWV Owens Valley	SBA Santa Barbara	STN Stone Canyon
BAR Bartlett Springs Fault	DAN Danville	HCF Hilton Crk. Flt.	MEN Mendocino Escarpment	PAI Paicines	SCA Southern Calif.	SUN Sunol
BIT Bitterwater Valley	DEL Del Norte	HOL Hollister	MID Middle Mountain	PAN Panoche Pass	SCV Santa Clara Valley	SUR Big Sur
BLM Black Mountain	DEV Death Valley	INC Inyo Craters	MIS Mission Fault	PAR Point Arena	SFB South S.F. Bay	WAK Walker Lane
BUS Busch Fault	DOM Resurgent Dome	IWV Indian Wells Val.	MOD Modoc Plateau	PIN Pinnacles	SFL San Felipe	WCN Wheeler Crest No.
BVL Bear Valley	EMO East Moat	JQN San Joaquin Valley	MOL Mono Lake	PON Pacific Ocean N	SFP S.F. Peninsula	WCS Wheeler Crest So.
CAS Casa Diablo Mtn.	EUR Eureka	KAI Kaiser Peak	MON Monterey Bay	POS Pacific Ocean S	SHA Shasta	WHI White Mountains
CHA Chalk Bluffs	GAR Garlock Fault	KLA Klamath Mountains	MOR Mt. Morrison	QUI Quiensabe	SHE Sherwin Lakes	WMO West Moat
CHV Chalfant Valley	GEY Geysers	KON Konocti Bay	NAP West Napa Fault	ROB Paso Robles	SIL Silver Peak	WWF White Wolf Fault
COA Coalinga	GLA Glass Mtn.	LAS Lassen	NEV Nevada	ROG Rogers Creek Fault	SIM Simmler	YOS Yosemite

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## Appendix A. The UCB/USGS Seismology Data Center

The UCB/USGS Seismology Data Center is accessible via the Internet. As of the date of this publication, the data center is establishing individual accounts for each user accessing the data center. In the future we may migrate to a single publicly-accessible account similar to the IRIS bulletin board system. It is assumed that users are either familiar with or will obtain their own support on the use of the Unix operating system. The data center cannot provide consulting support on questions not directly related to the data center.

- Host Name: brkseis20.berkeley.edu
- Internet address: 128.32.146.106
- Computer: Sun SPARCstation 2
- Operating system: SunOS (Unix)

### To request an account at the data center:

1. Use telnet to connect to brkseis20.berkeley.edu. Depending on your local computer configuration, you may have to use the Internet address of the machine instead of the hostname:

```
telnet brkseis20.berkeley.edu
```

or

```
telnet 128.32.146.106
```

2. Login to special account "bulletin", which has a password of "board".
3. Select the option to request an account. It is currently the only option available, other than "quit". You will be prompted for information such as your name, address, institutional affiliation, email address, and phone number.
4. You should be contacted within 2 working days with your account information. If you do not hear within this time period, please contact:  
Douglas Neuhauser  
Seismographic Station  
Earth Science Building  
University of California  
Berkeley CA 94720  
510-642-0931
5. This computer account is to be used strictly for accessing and retrieving data explicitly provided by the data center. Any other use constitutes fraud.

## Sample session to the UCB/USGS Seismology Data Center

telnet brkseis20.berkeley.edu  
Trying 128.32.146.106 ...  
Connected to brkseis20.berkeley.edu.  
Escape character is '^]'.

SunOS UNIX (brkseis20.berkeley.edu)

login: bulletin  
Password:  
Last login: Mon Dec 7 11:14:13 from brkseis10.berkeley.edu

\*\*\*\*\*

UCB/USGS Seismology Data Center

\*\*\*\*\*

Welcome to the UCB/USGS Northern California Seismology Data Center.  
Your host is: brkseis20.berkeley.edu

Type "man info" to get more information about available resources.

\*\*\*\*\*

Welcome to the UCB/USGS Seismology Data Center

Enter 'a' to request an account  
      'n' to send a note to the data center staff.  
      'q' to QUIT

Enter your selection: a

UC Berkeley Seismographic Station / USGS  
Seismology Data Center

User ID request form:  
Please answer the following questions:  
(Terminate each reply with a 'return'.)  
(Type a control-D to abort account request.)

Full Name: Joe Smith  
Institution/Organization/Company: Podunk U, Dept of Seismology  
Full Address (1 line): 123 Earth Sciences Building, Podunk U, Podunk, NY 14882  
Office Phone #: 800-555-1212  
Internet/Bitnet address (0=none): joesmith@geo.podunk.edu  
preferred user ID name: joesmith

request logged...

You will be contacted at the above address with information about your account. If you have not heard by the end of two working days, please resubmit your request, and if that does not work, please call 510-642-0931 or 510-642-3977  
Thank you.

Enter 'a' to request an account  
Enter 'q' to QUIT

Enter your selection: q  
Connection closed by foreign host.

## Help files at the data center

After you have been notified that your data center account is open, you may obtain more information about NCSN data by typing the following commands:

man info	! General information on data available at the data center
more /data/dc1/calnet/parameters/history	! Documentation on date of significant changes in data at data center
man eqselect	! Program documentation for obtaining earthquake location data
man extract	! Program documentation for obtaining earthquake phase data
man calnet	! Overview of types of NCSN data available at the data center
man calnet.catalog	! Format of NCSN earthquake location files
man calnet.phase	! Format of NCSN earthquake phase files
man calnet.mech	! Format of NCSN first motion focal mechanism files
man ascii_mem	! Format of ASCII representation of CUSP .mem files
man getmem	! Program documentation for obtaining CUSP .mem files
man getseis	! Program documentation for obtaining CUSP seismograms
man cusp2ah	! Program documentation for converting seismograms to ahxdr format
man ucb	! Overview of type of UCB data available at the data center
man ucb.catalog	! Format of UCB earthquake location files
man ucb.phase	! Format of UCB earthquake phase files
man qdata	! Program documentation for obtaining UCB waveform data as Steim-1 ! compressed data blocks
man sdata	! Program documentation for obtaining UCB waveform data as SEED ! volumes