

COMPILATION OF STRONG-MOTION RECORDS  
RECOVERED FROM THE  
BISHOP, CALIFORNIA, EARTHQUAKE OF 4 OCTOBER, 1978

R.D. McJunkin

16 November 1978

California Division of Mines & Geology

PRELIMINARY

Subject to Rev.

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## DISCLAIMER

This preliminary data compilation has not been edited or reviewed for conformity with the standards and nomenclature of the Division of Mines and Geology. Although reasonable precautions have been taken to ensure the accuracy of the material presented, the preliminary nature of the data makes them all subject to change upon further verification. No measurements or scalings of the earthquake records should be attempted because of possible distortions in the photo copies.



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## ACKNOWLEDGEMENTS

The California Division of Mines and Geology extends appreciation to organizations and governmental agencies who provided space for locating strong motion instruments that recorded this seismic event. These include the

- (1) Los Angeles Department of Water and Power
- (2) Mammoth Lake School District
- (3) California Department of Transportation
- (4) National Park Service

## ABBREVIATIONS

### Organizations

CDMG	California Division of Mines and Geology
OSMS	Office of Strong Motion Studies
USGS	U.S. Geological Survey

### Instruments

SMA-1	Triaxial accelerograph (Kinometrics, Inc.) [film]
SMA-1T	Triaxial accelerograph with timer (Kinometrics, Inc.) [film]
RFT-250	Triaxial accelerograph (Teledyne Corp.) [film]
CR-1	Central Recording accelerograph (Kinometrics, Inc.) [film]
FBA-1	Force-balance accelerometer (Kinometrics, Inc.)
FBA-3	Triaxial force-balance accelerometer (Kinometrics, Inc.)

### Instrument Orientations

Direction	Case motion (not pendulum)
Stations not in structures	Orientation is in degrees azimuth (clockwise from north)
Stations in structures	Orientation is in quadrant notation



## INTRODUCTION

A moderate magnitude earthquake ( $M_L=5.7$ ; Berkeley Seismographic Station) occurred approximately 30 km northwest of Bishop, California at 16:42:47.3 (GMT) on 4 October 1978. The earthquake had a focal depth of 4.8 km and was located at latitude  $37.518^\circ\text{N}$  and longitude  $118.705^\circ\text{W}$ .

The Bishop area is moderately instrumented by 11 accelerograph sites within 100 km of the epicenter (Figure 1; Table 1). All instruments within the 100 km epicentral radius are owned and operated by the Office of Strong Motion Studies (OSMS), California Division of Mines and Geology (CDMG). Five of the eleven OSMS accelerograph stations were triggered (Figure 2) and produced records of the Bishop earthquake.

Three accelerograph sites beyond the 100 km epicentral radius were triggered by the 4 October 1978 earthquake. Two sites at the Pine Flat and Buchanan Dams (Ed Etheredge, 1978, person. commun.) are instrumented by the USGS; the third site, on the Fresno State University campus, is instrumented by OSMS. Records from these three distant stations are very weak and were determined to not be significant in comparison with data obtained from sites closer to the epicenter. For this reason, data from the three distant sites are excluded from this report.



## PRESENTATION OF THE DATA

As an aid to the analysis of records, stations, within 100 km of the earthquake epicenter are listed alphabetically (Table I) and in a north-south pattern (Table II). The relative positions of triggered stations with respect to the earthquake epicenter are listed by range and azimuth calculations (Table III). The performance of the station network for the Bishop region is examined with respect to increasing epicentral distance (Table IV). The peak uncorrected ground accelerations (horizontal components) are listed along with their corresponding azimuths.



Figure 1. Map of California showing region of interest (white) for the Bishop earthquake of 4 October 1978. Map scale is approximately 1:5,000,000.

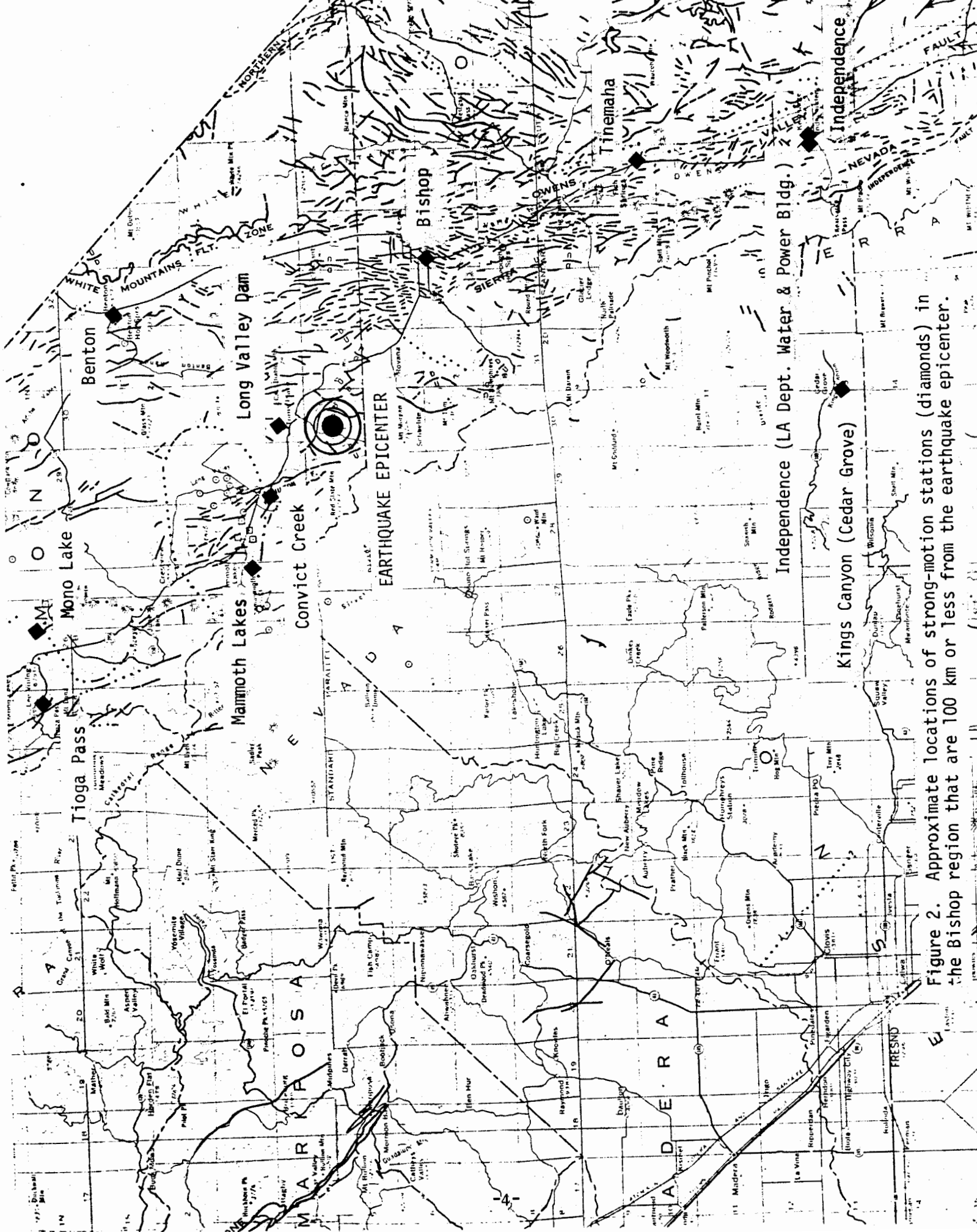


Figure 2. Approximate locations of strong-motion stations (diamonds) in the Bishop region that are 100 km or less from the earthquake epicenter.

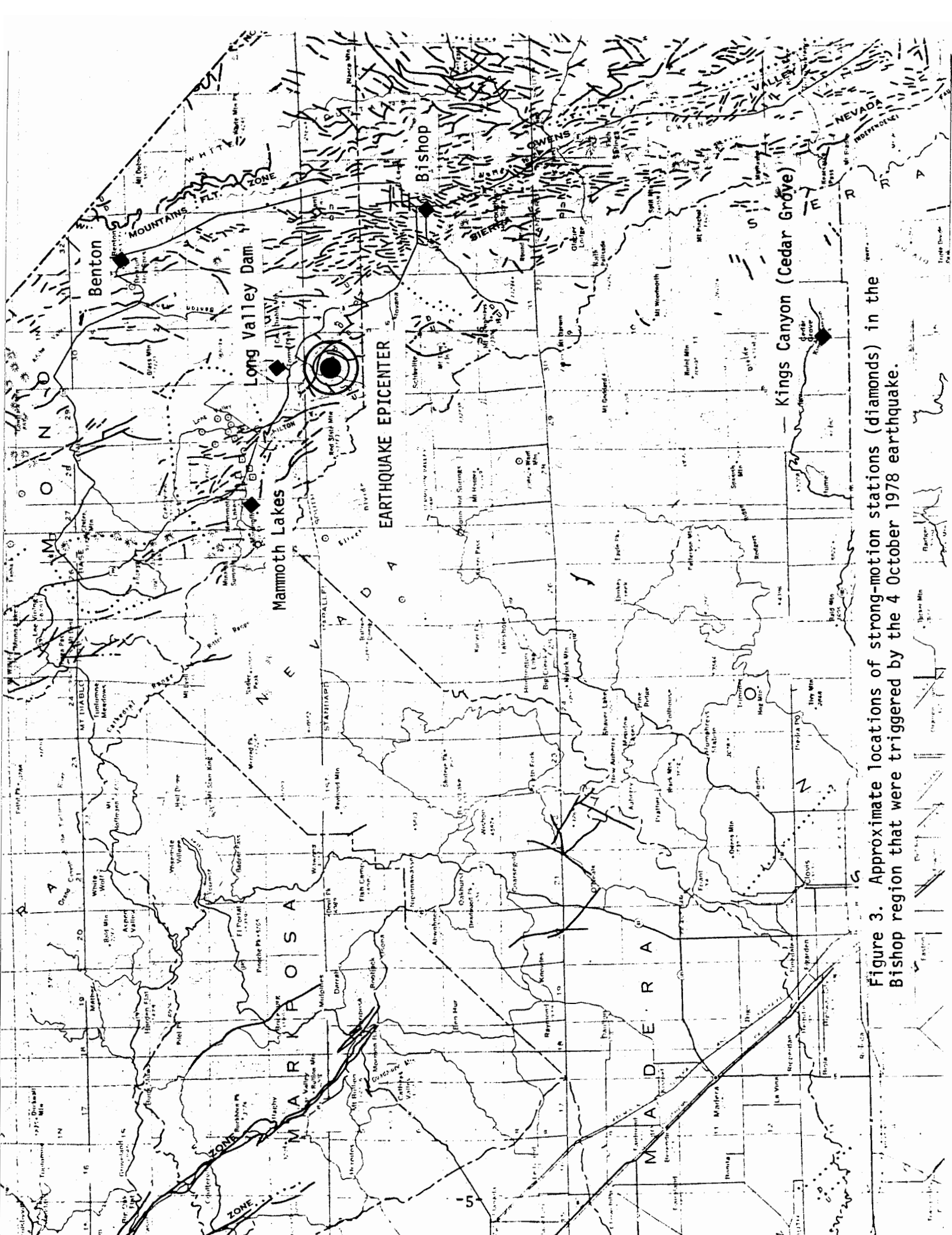


Figure 3. Approximate locations of strong-motion stations (diamonds) in the Bishop region that were triggered by the 4 October 1978 earthquake.

TABLE I

Alphabetical list of strong-motion stations within 100 km of the Bishop earthquake epicenter

	NUMBER		NAME	OWNER	DATA CHANNELS	REPORT PAGE(S)*
	CDMG	USGS				
1	100	1325	Benton	CDMG	3	10-11
2	171	1008	Bishop	CDMG	3	12-13
3	99	1324	Convict Creek	CDMG	3	
4	102	1327	Independence	CDMG	3	
5	298		Independence (L.S. Dept. Wat. Pow. Bldg.)	CDMG		
6	46	1283	Kings Canyon (Cedar Grove)	CDMG	3	14-15
7	214	1444	Long Valley Dam	CDMG	9	16-24
8	301	1490	Mammoth Lakes	CDMG	10	25-29
9	98	1323	Mono Lake	CDMG	3	
10	101	1326	Tinemaha	CDMG	3	

\*Stations without page numbers were not triggered by the 4 October 1978 Bishop earthquake.

TABLE II

North-south list of strong motion stations within 100 km of the Bishop earthquake epicenter

	STATION		NAME	LATITUDE	LONGITUDE
	CDMG	USGS			
1	98	1323	Monolake	37.94 N	119.06 W
2	31	1268	Tioga Pass	37.94 N	119.19 W
3	100	1325	Benton	37.82 N	118.48 W
4	301	1490	Mammoth Lakes	37.64 N	118.96 W
5	99	1324	Convict Creek	37.61 N	118.83 W
6	214	1444	Long Valley Dam	37.59 N	118.71 W
7	171	1008	Bishop	37.37 N	118.39 W
8	101	1326	Tinemaha	37.05 N	118.23 W
9	102	1327	Independence	36.83 N	118.16 W
10	298	--	Independence (L.A. Dept. Wat. Pow. Bldg.)	36.80 N	118.20 W
11	46	1283	Kings Canyon (Cedar Grove)	36.79 N	118.68 W

TABLE III

Range and Azimuth calculations for strong-motion stations triggered by the 4 October 1978 Bishop earthquake

		LOCATION		EPICENTRAL DISTANCE (DEG)	SURFACE RANGE (KM)	AZIMUTH (E)-(S)* (DEG)	AZIMUTH (S)-(E)* (DEG)		
		LATITUDE (DEG)	LONGITUDE (DEG)						
1	Long Valley Dam	214	1444	37.59	-118.71	.07	7.77	0.00	180.00
2	Mammoth Lakes	301	1490	37.65	-118.96	.24	26.38	303.24	123.08
3	Bishop	171	1008	37.36	-118.40	.29	32.68	122.82	303.01
4	Benton	100	1325	37.82	-118.48	.35	38.99	31.29	211.43
5	Kings Canyon(Cedar Grove)	46	1283	36.79	-118.68	.73	81.06	178.11	358.13

\* E - Epicenter  
S - Station

TABLE IV

Network performance matrix for the Bishop earthquake of 4 October 1978  
(stations are arranged in order of increasing epicentral distance)

NAME	Epicentral distance (KM)	Data Channels		Peak Ground Motion			Report Page(s)		
		Installed	Operational	Useable Record	Accel'n (g)	Accel'n / Orient'n (deg)		Accel'n / Orient'n (deg)	
1. Long Valley Dam	8	9	9	9	0.26	0.00	0.17	270	16-24
2. Mammoth Lakes High School	26	10	10	10	0.34	N	0.23	W	25-29
3. Bishop	33	3	3	3	0.03	270	0.06	180	12-13
4. Benton	39	3	3	3	0.06	0.00	0.06	90	10-11
5. Kings Canyon Nat'l Park (Cedar Grove)	81	3	3	3	0.06	320	0.05	230	14-15



CALIFORNIA STRONG MOTION INSTRUMENTATION PROGRAM

STRONG-MOTION RECORD - PRELIMINARY EVALUATION SHEET

Earthquake Date 4 Oct 1978 Time 16:42:47.3 (GMT)  
 Region Bishop, Ca.

Latitude 37.518°N  
 Longitude 118.705°W  
 Magnitude 5.7  
 Depth (km) 4.8  
 Intensity (maximum)

Epicentral Range (km) 39 Azimuth (E)-(S) (deg) 31  
 (deg) 0.35 (S)-(E) (deg) 211

Station Number CDMG 100 USGS 1325 Owner CDMG  
 Name Benton  
 Address Caltrans Garage County Mono  
 Jct. 6 & 120  
 Latitude 37.818°N Type Freefield  
 Longitude 118.475°W Structure Size  
 Installed 27 Mar 1974 Class  
 Removed In place

Instrument Type(s) SMA-1  
 Serial Number(s) 1577  
 Installed 27 Mar 1974 Removed In place

Record Installed 23 May 1978 By TM Recovered 5 Oct 1978 By  
 CDMG File No.

Trace (from top)	Component	Orientation	Sensitivity (mm/g)	Period (sec)	Crit. Damp.	Peak Ampl. (mm)	Accel. (g)	Duration Sig. Run (sec)	Trace Qual.	Serv Rec.
1	L	0.0	18.9	0.039	56.0	1.1	0.06	10	Good	
2	V	Down	18.5	0.039	57.1	0.7	0.04	10	Good	
3	T	90.0	19.3	0.040	57.5	1.2	0.06	10	Good	

Time Code Quality Times: Trigger S-Wave Arrival  
 S-Wave-Trigger

Record Evaluated By McJunkin Date of This Sheet 15 Nov 1978

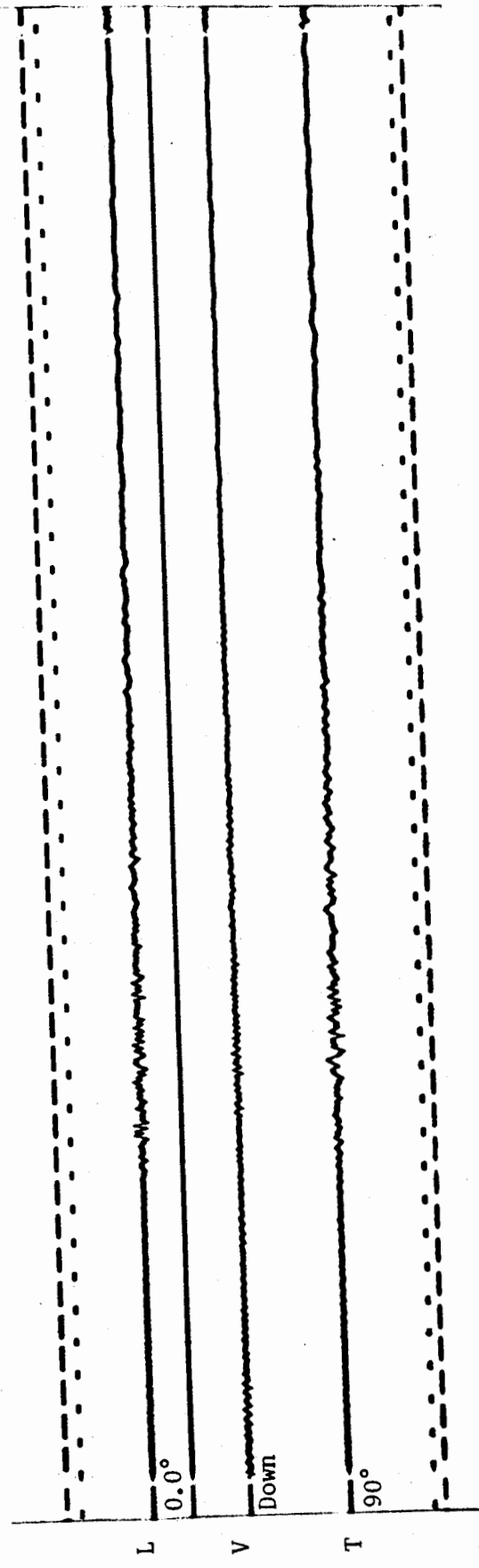
Remarks:

Bishop Earthquake 4 October 1978

CDMG Station 100 - Benton

SMA-1 Serial No. 1577

Time Scale (1 sec)



STRONG-MOTION RECORD - PRELIMINARY EVALUATION SHEET

Earthquake Date 4 Oct 1978 Time 16:42:47.3(GMT)  
 Region Bishop, Ca.

Latitude 37.518°N  
 Longitude 118.705 W Depth (km) 4.8  
 Magnitude 5.7 Intensity (maximum)

Epicentral Range (km) 33 Azimuth (E)-(S) (deg) 123  
 (deg)0.29 (S)-(E) (deg) 303

Station Number CDMG 171 USGS 1008 Owner CDMG  
 Name Bishop  
 Address 200 W. South St. County Inyo  
 Bishop, Ca. 93514  
 Latitude 37.370 °N Type Freefield  
 Longitude 118.395°W Structure Size  
 Installed 9 Nov 1974 Class  
 Removed In place

Instrument Type(s) SMA-1  
 Serial Number(s) 1718  
 Installed 9 Nov 1974 Removed in place

Record Installed 5-23-78 By McGrady Recovered 6 Oct 1978 By Guyer  
 CDMG File No.

Trace (from top)	Component	Orientation	Sensitivity (mm/g)	Period (sec)	Crit. Damp.	Peak Ampl. (mm)	Accel. (g)	Duration Sig. Run (sec)	Trace Qual.	Serv Rec.
. 1	L	270	18.6	0.04	55.7	0.5	0.03	10	Good	
. 2	V	UP	18.9	0.04	55.9	0.5	0.03	10	Good	
. 3	T	180	18.0	0.04	58.1	1.0	0.06	10	Good	
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Time Code Quality Times: Trigger S-Wave Arrival  
 S-Wave-Trigger  
 Record Evaluated By McJunkin Date of This Sheet 15 Nov 1978

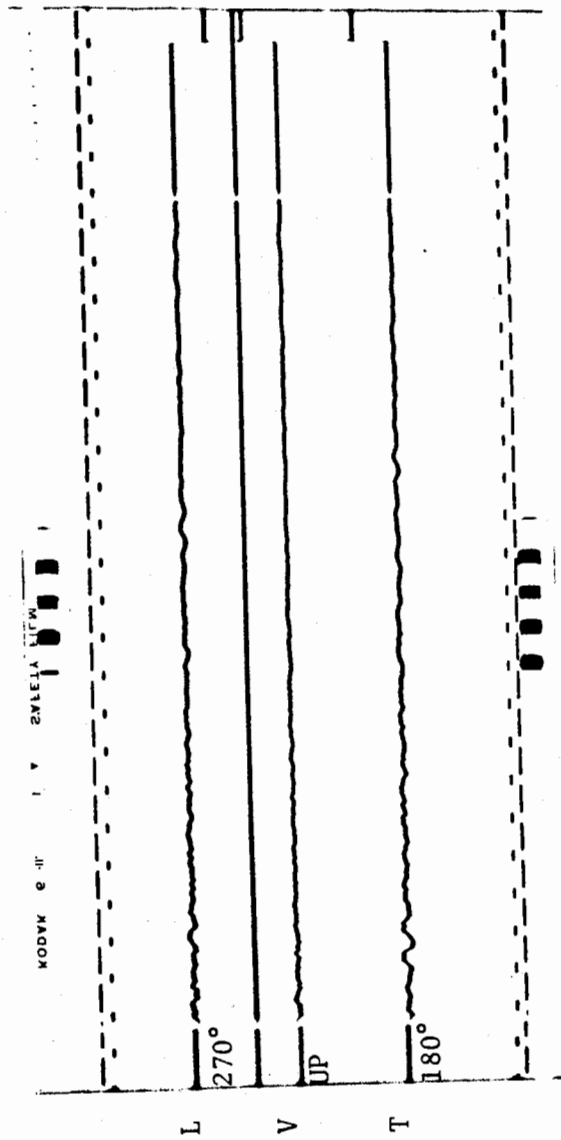
Remarks:

Bishop Earthquake 4 October 1978

CDMG 171 - Bishop

SMA-1 Serial No. 1718

Time Scale (1 sec)



## CALIFORNIA STRONG MOTION INSTRUMENTATION PROGRAM

## STRONG-MOTION RECORD - PRELIMINARY EVALUATION SHEET

Earthquake Date 4 Oct 1978 Time 16:42:47.3 (GMT)  
 Region Bishop, Calif  
 Latitude 37.518°N  
 Longitude 118.705°W Depth (km) 4.8  
 Magnitude 5.7(BSL) Intensity (maximum)

Epicentral Range (km) 81 Azimuth (E)-(S) (deg) 178  
 (deg) 0.73 (S)-(E) (deg) 358

Station Number CDMG 46 USGS 1283 Owner CDMG  
 Name Kings Canyon (Cedar Grove)  
 Address Kings Canyon Nat'l. Park County Fresno

Latitude 36.787°N Type Freefield  
 Longitude 118.675°W Structure Size  
 Installed 24 Oct 1973 Class  
 Removed In place

Instrument Type(s) RFT-250  
 Serial Number(s) 495  
 Installed 23 Oct 1973 Removed In place

Record Installed 2 June 1978 By Luzier Recovered 6 Oct 1978 By McGrady  
 CDMG File No.

Trace (from top)	Compo- nent	Orien- tation	Sensi- tivity (mm/g)	Period (sec)	Crit. Damp.	Peak Ampl. (mm)	Accel. (g)	Duration Sig. Run (sec)	Trace Qual.	Serv Rec.
. 1	L	320	17.4	0.05	63.4	1.1	0.06	10	Good	
. 2	V	UP	18.0	0.05	62.9	0.6	0.03	10	Good	
. 3	T	230	18.0	0.05	60.9	0.9	0.05	10	Good	
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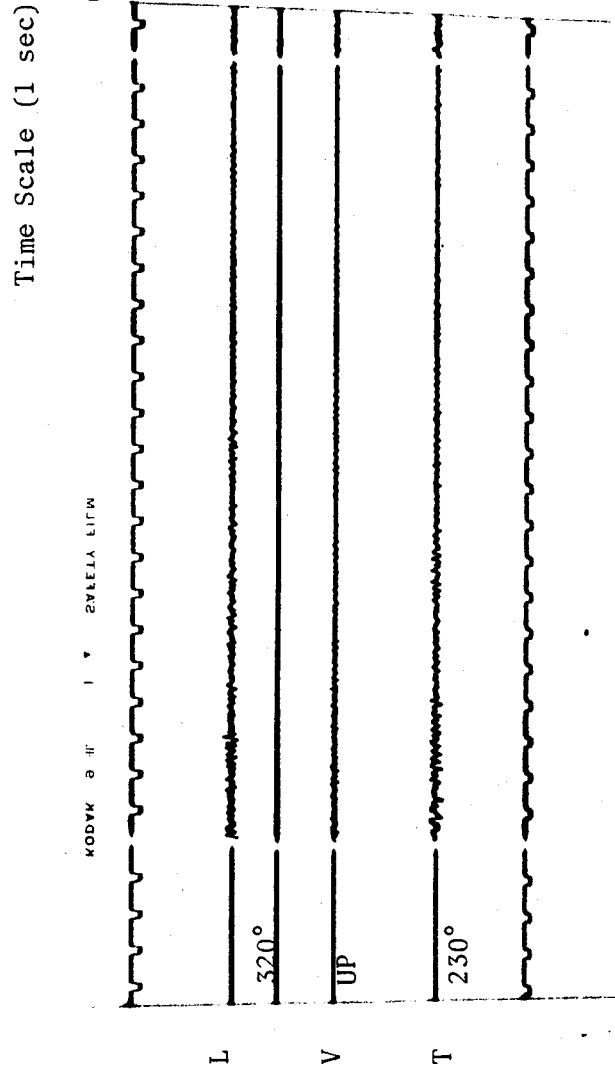
Time Code Quality Times: Trigger S-Wave Arrival

S-Wave-Trigger

Record Evaluated By McJunkin Date of This Sheet 15 Nov 1978

Remarks:

Bishop Earthquake 4 October 1978  
CDMG Station 46 Kings Canyon (Cddar Grove)  
RFT-250 Serial No. 495



CALIFORNIA STRONG MOTION INSTRUMENTATION PROGRAM

STRONG-MOTION RECORD - PRELIMINARY EVALUATION SHEET

Earthquake Date 4 Oct 1978 Time 16:42:47.3(GMT)  
 Region Bishop, Ca.  
 Latitude 37.518°N  
 Longitude 118.705°W Depth (km) 4.8  
 Magnitude 5.7 Intensity (maximum)  
 Epicentral Range (km) 8 Azimuth (E)-(S) (deg) 0.00  
 (deg) 0.07 (S)-(E) (deg) 180

Station Number CDMG 214 USGS 1444 Owner CDMG  
 Name Long Valley Dam  
 Address Rt. 3, Box 42, Bishop County Mono  
 Latitude 27.588°N Type Dam  
 Longitude 118.705°W Structure Size  
 Installed 19 Nov 1975 Class  
 Removed In place

Instrument Type(s) SMA-1, SMS-1, SMA-1T  
 Serial Number(s) 1700; 1712; 1821  
 Installed 19 Nov 1978 Removed In place

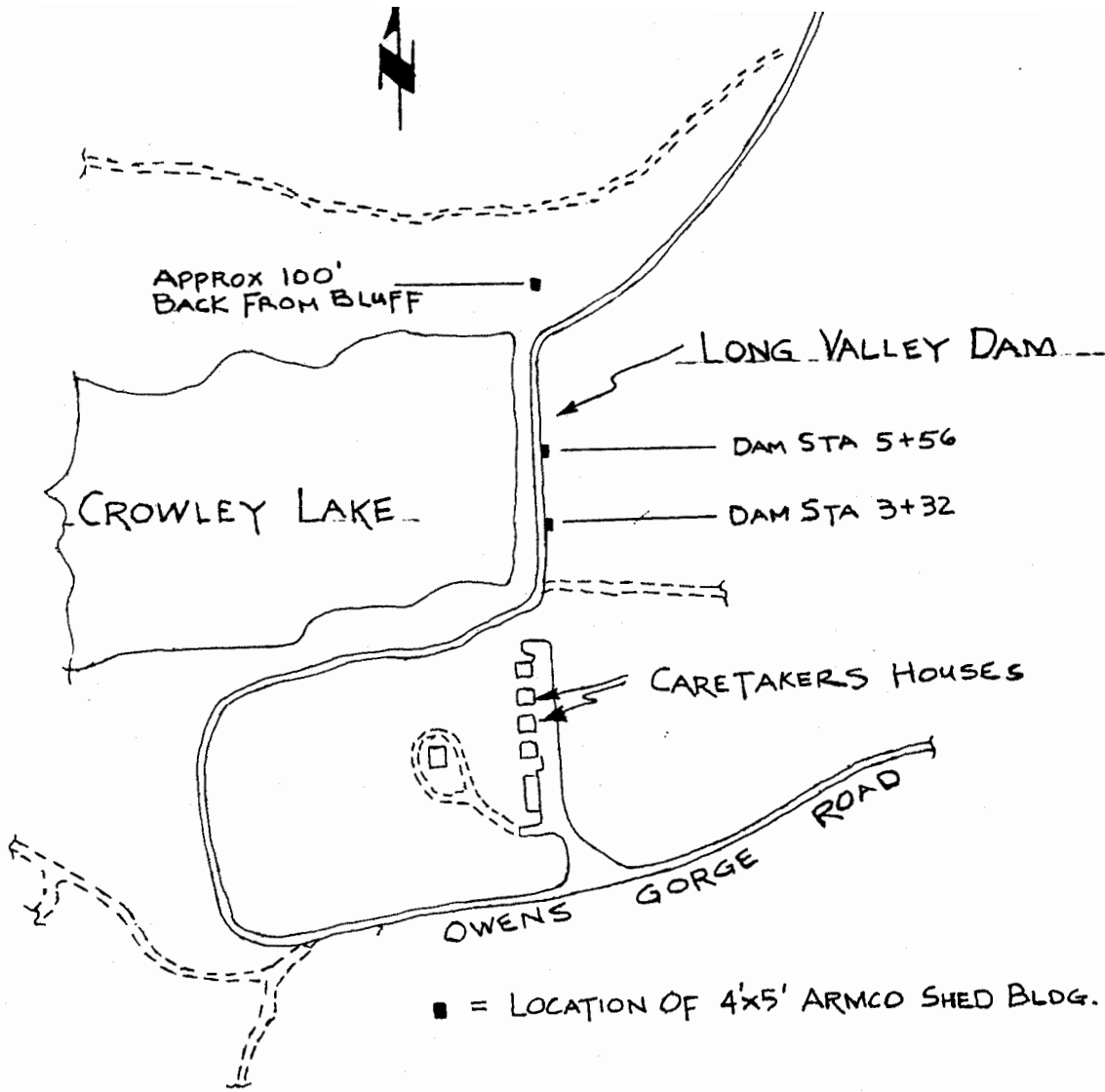
Record Installed 23 May 1978 By McGrady Recovered 5 Oct 1978 By Guyer  
 CDMG File No.

Trace (from top)	Component	Orientation	Sensitivity (mm/g)	Period (sec)	Crit. Damp.	Peak Ampl. (mm)	Accel. (g)	Duration Sig. Run (sec)	Trace Qual.	Serv. Rec.
. 1700	center crest									
. 1	L	0.00	18.3	0.04	55.9	3.2	0.17	10	Good	
. 2	V	UP	19.0	0.04	55.9	3.2	0.17	10	Good	
. 3	T	270	18.4	0.04	55.9	2.5	0.14	10	Good	
. 1712	right crest									
. 1	L	0.00	18.5	0.04	55.2	1.9	0.10	10	Good	
. 2	V	UP	18.1	0.04	55.7	2.8	0.15	10	Good	
. 3	T	270	18.1	0.04	55.2	2.2	0.12	10	Good	
. 1821	left abutment									
. 1	L	0.00	17.9	0.04	56.1	4.7	0.26	10	Good*	
. 2	V	UP	18.5	0.04	55.9	3.1	0.17	10	Good	
. 3	T	270	19.2	0.04	59.1	3.2	0.17	10	Good	

\*Traces=Good quality; numerous scratches on first film record will require hand digitization

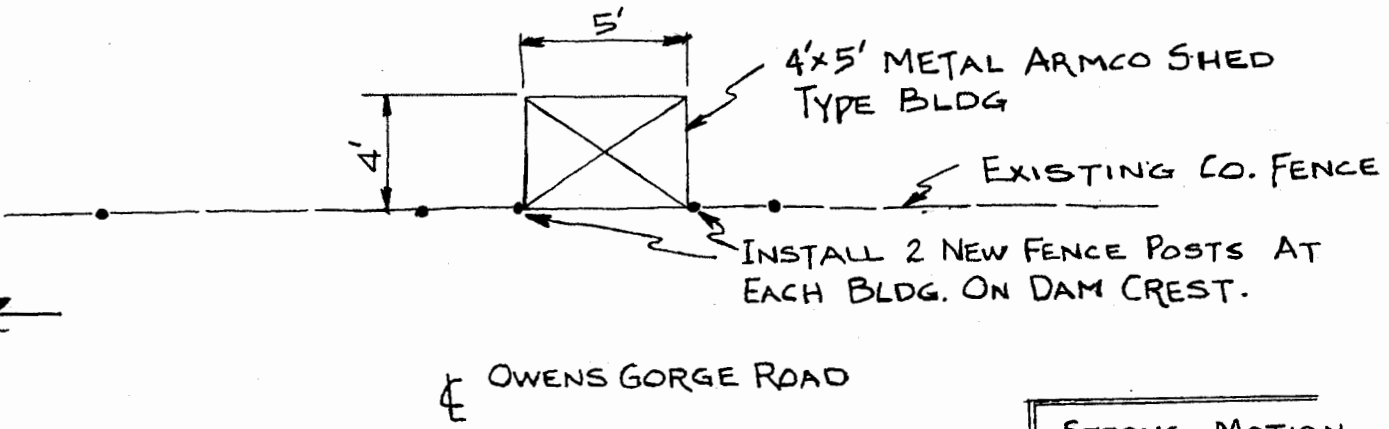
Time Code Quality Times: Trigger S-Wave Arrival  
 S-Wave-Trigger  
 Record Evaluated By Ragsdale Date of This Sheet 12 Oct 1978

Remarks: Cable between units removed by owner to permit construction; units were not interconnected.



SEC. 19  
T. 4S. & R. 29E.  
M.D.B.M.

PLAN  
NO SCALE



STRONG MOTION  
SEISMOGRAPH LOCATION  
AT LONG VALLEY DAM

EXISTING MONO CO. FENCE

TYPICAL BLDG. PLAN

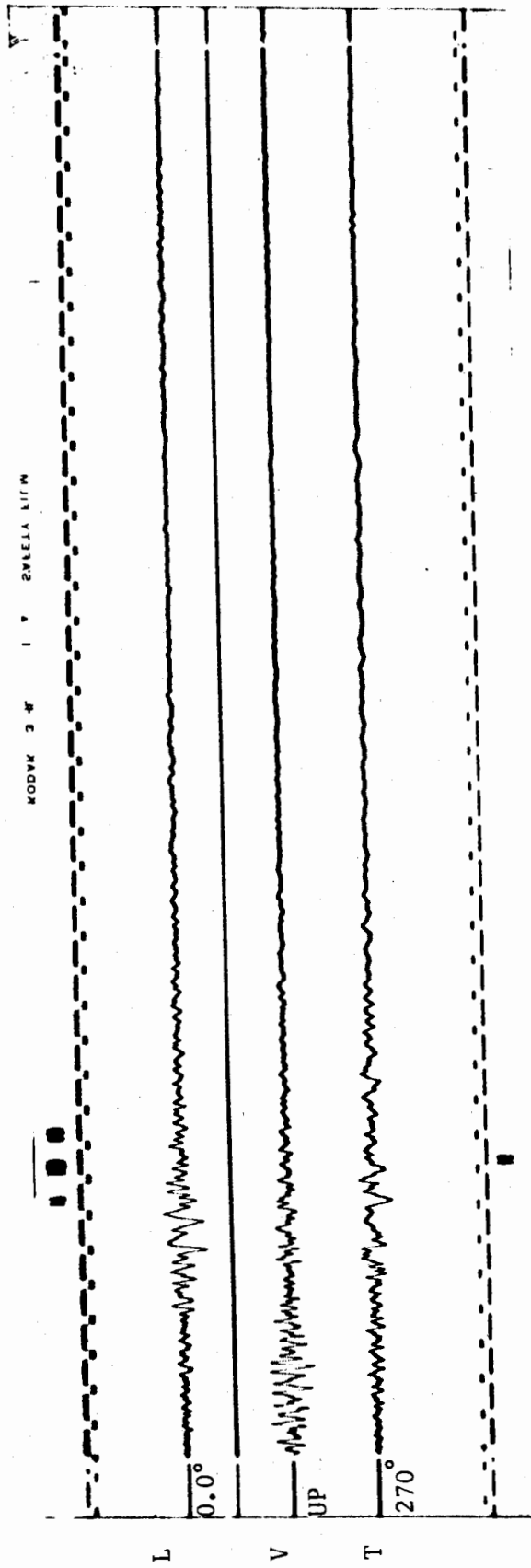


Bishop Earthquake 4 October 1978

CDMG 214 - Long Valley Dam (center crest)

SMA-1 Serial No. 1700

Time Scale (1 sec)

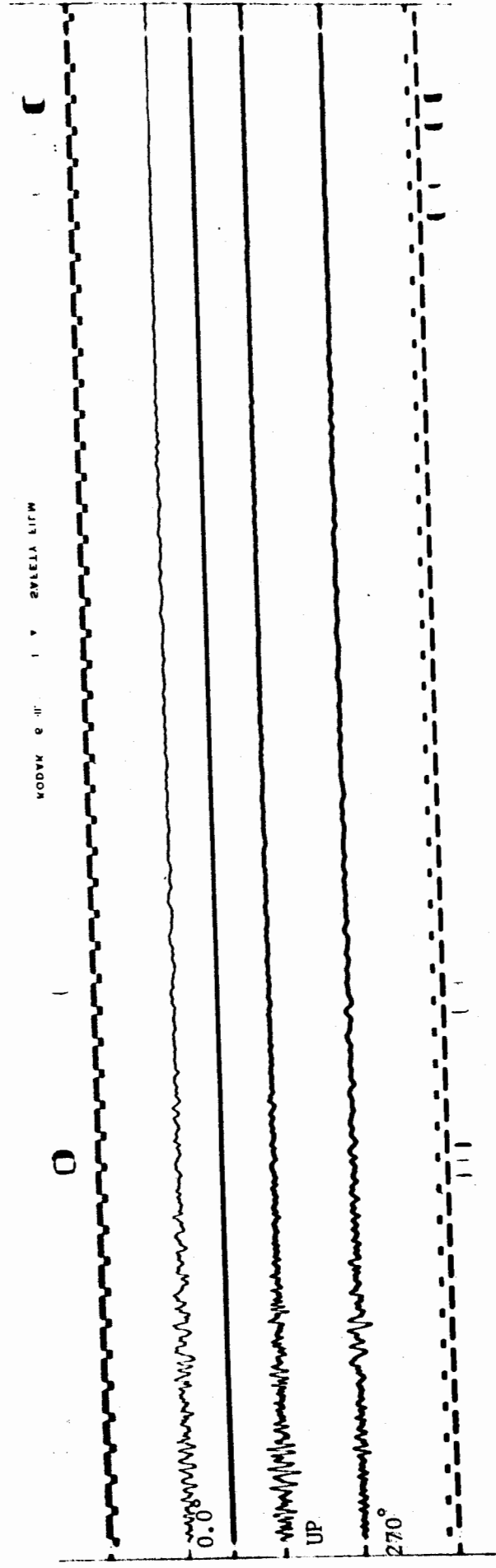


Bishop Earthquake 4 October 1978

CDMG 214 - Long Valley Dam (Right Crest)

SMA-1 Serial No. 1712

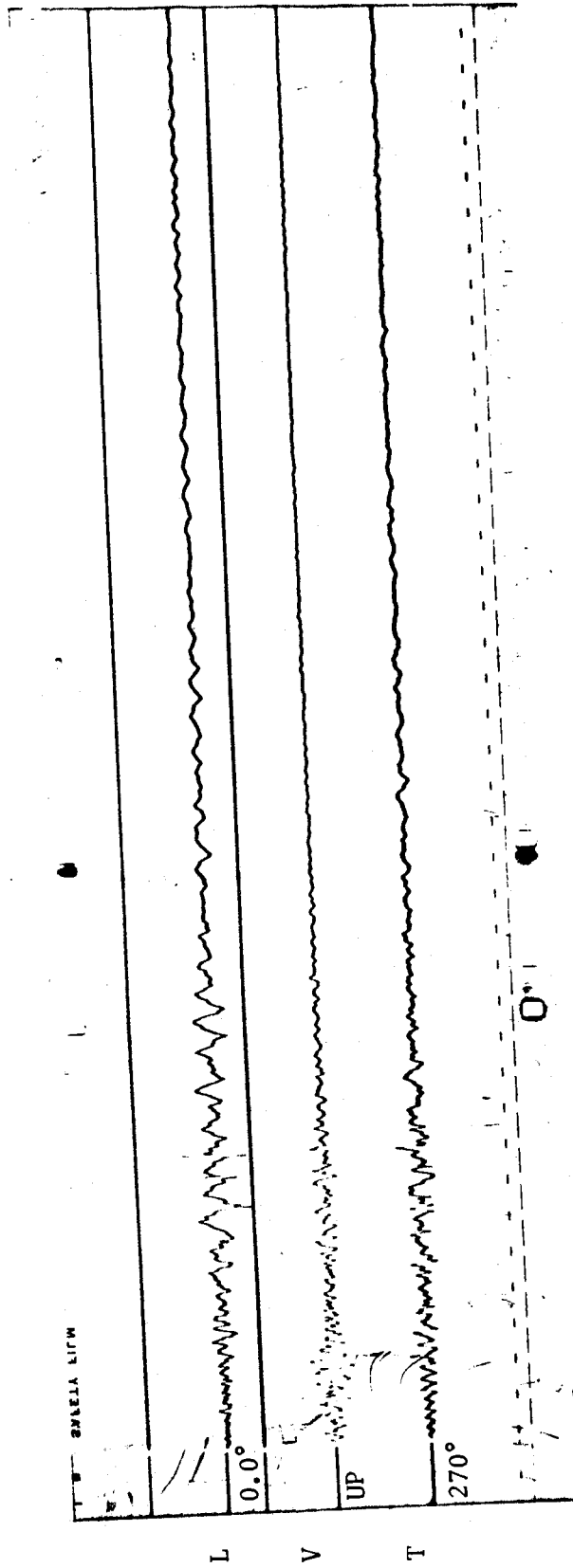
Time Scale (1 sec)



Bishop Earthquake 4 October 1978

CDMG 214 - Long Valley Dam (Left Abutment)

SMA-IT Serial No. 1821



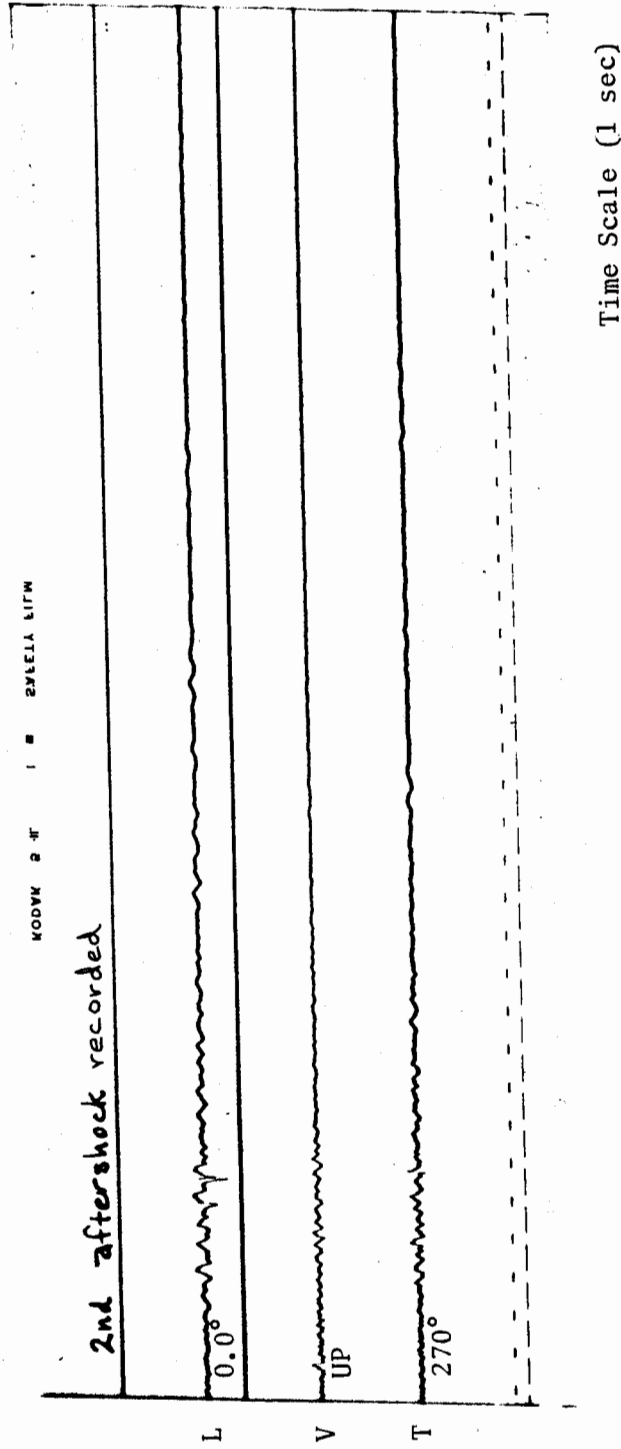
Time Scale (1 sec)



Bishop Earthquake - Aftershock 4 October 1978

CDMG 214 - Long Valley Dam (left abutment)

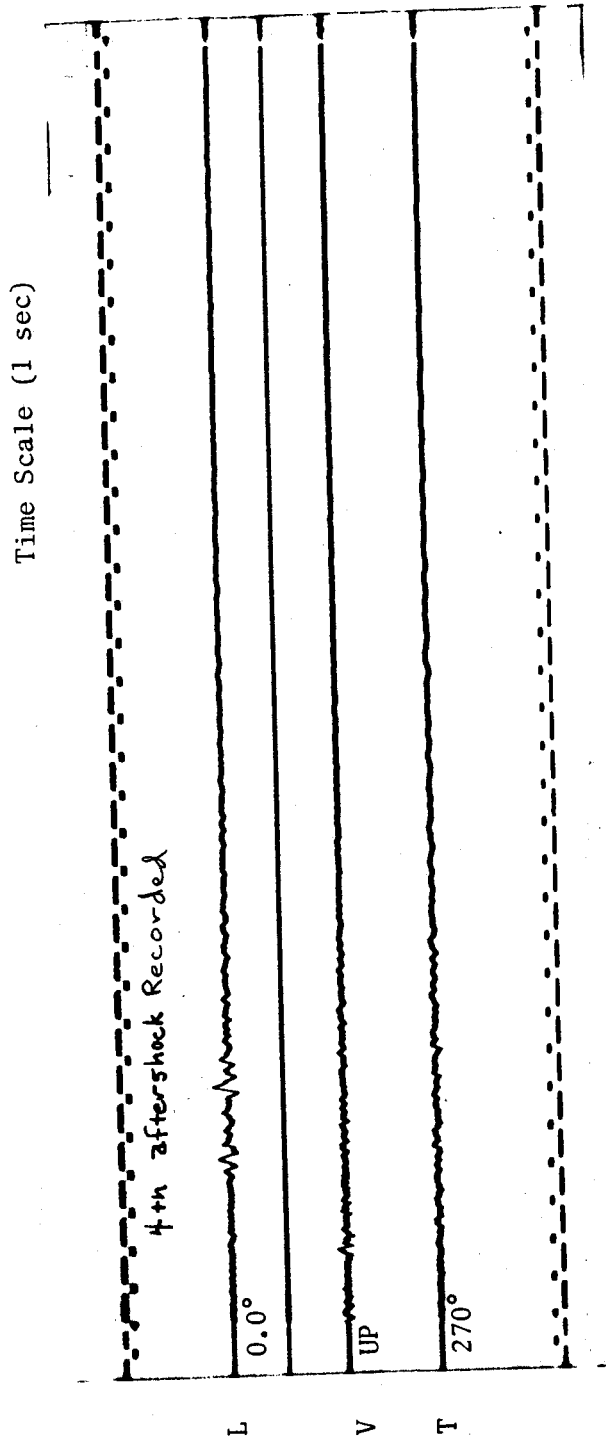
SMA-1T Serial No. 1821



Bishop Earthquake - Aftershock 4 October 1978

CDMG 214 - Long Valley Dam (center crest)

SMA - 1 Serial No. 1700

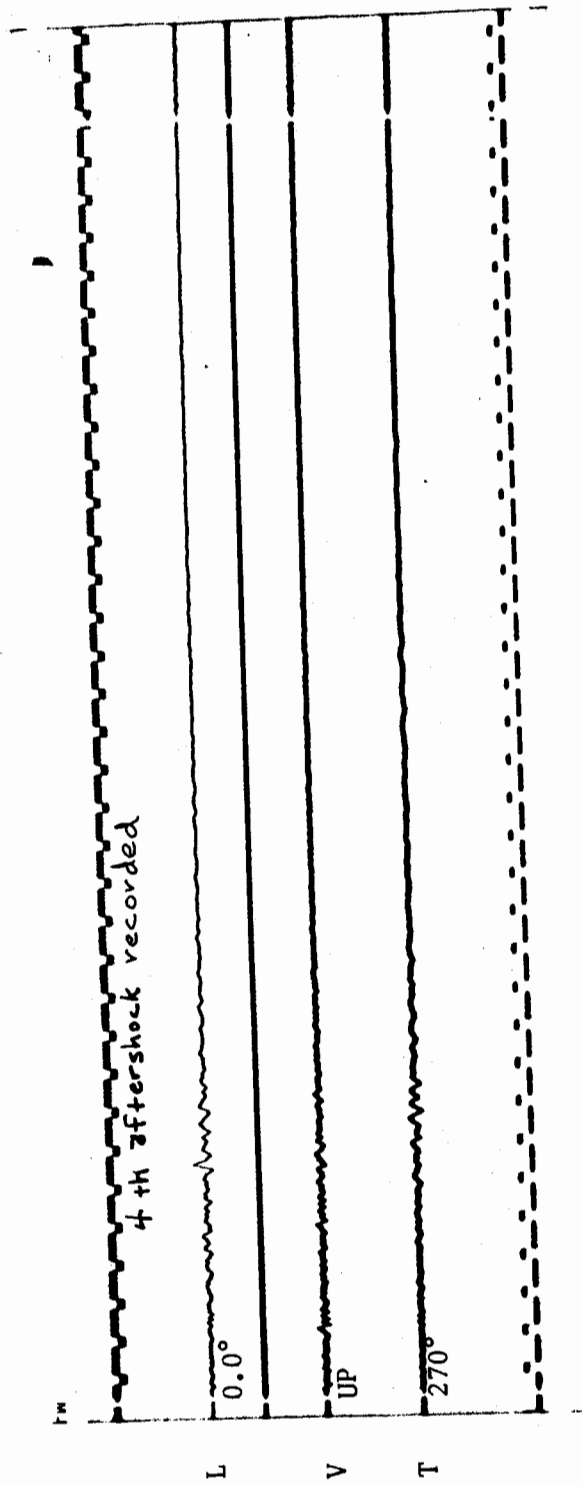


Bishop Earthquake - Aftershock 4 October 1978

CDMG 214 - Long Valley Dam (right crest)

SMA-1 Serial No. 1712

Time Scale (1 sec)



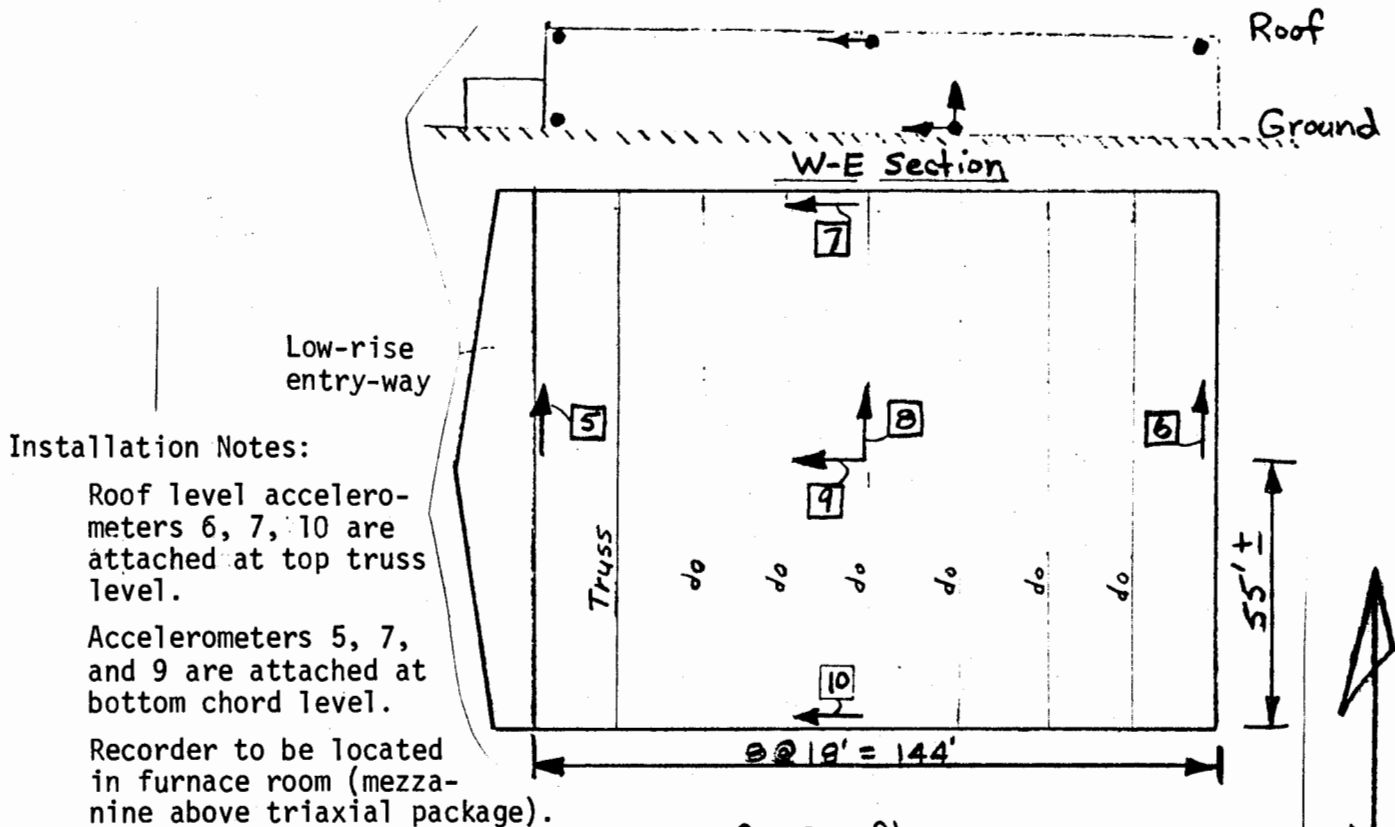




Bishop earthquake 4 October 1978  
 CDMG Station 301 Mammoth Lakes (High School)  
 CRA-1 Serial No. 135

STRONG-MOTION INSTRUMENTATION SCHEME

Mammoth High School Gymnasium, Sierra Par Rd & Meridian Blvd, Mammoth Lakes, CA



Installation Notes:

Roof level accelerometers 6, 7, 10 are attached at top truss level.

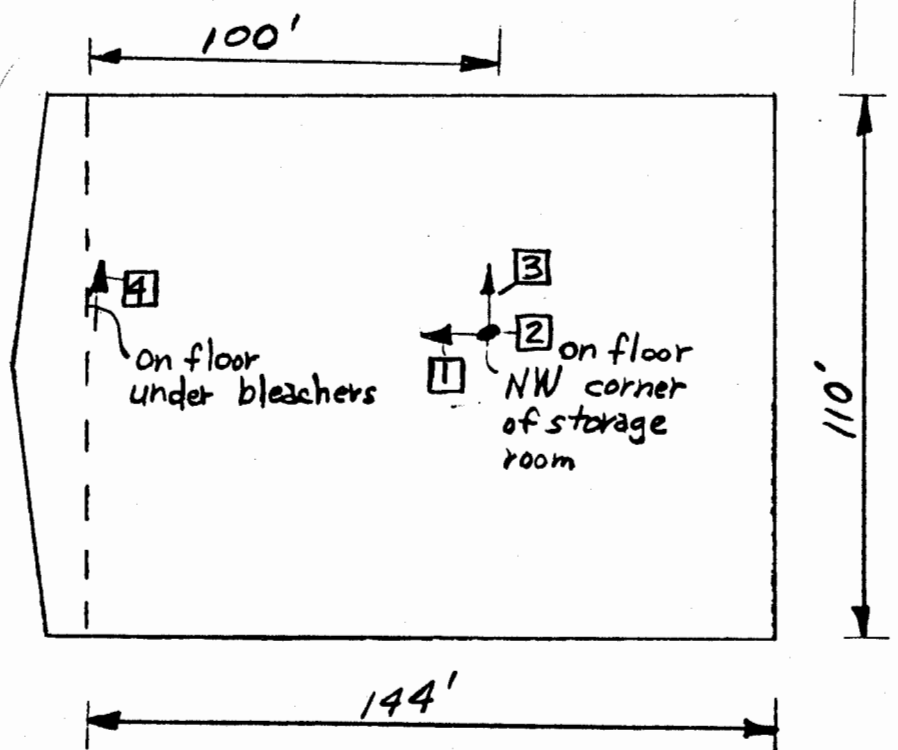
Accelerometers 5, 7, and 9 are attached at bottom chord level.

Recorder to be located in furnace room (mezzanine above triaxial package).

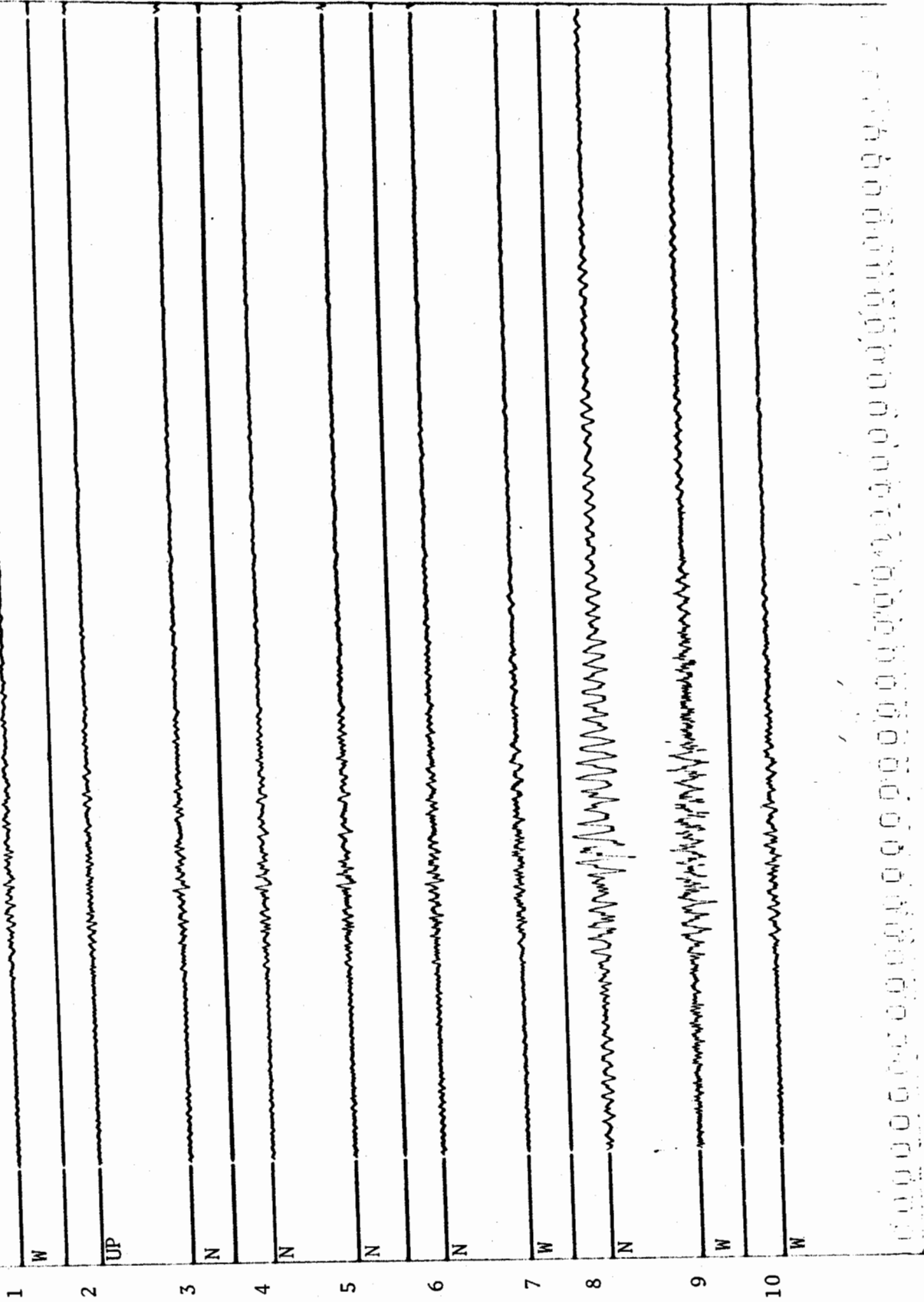
Roof Plan

Recorder Trace Order:

- Accelerometer 1
- Fixed trace
- Accelerometer 2
- ditto 3
- Fixed trace
- Accelerometer 4
- ditto 5
- Fixed trace
- Accelerometer 6
- ditto 7
- Fixed trace
- Accelerometer 8
- ditto 9
- Fixed trace
- Accelerometer 10
- Accelerometer traces spaced equidistantly.



Bishop Earthquake, 4 October 1978  
CDMG 301 - Mammoth Lakes  
CR-1 Serial No. 135



STRONG-MOTION RECORD - PRELIMINARY EVALUATION SHEET

Earthquake Date 4 Oct 1978 Time aftershock  
 Region Bishop, Ca

Latitude  
 Longitude Depth (km)  
 Magnitude Intensity (maximum)

Epicentral Range (km) Azimuth (E)-(S) (deg)  
 (deg) (S)-(E) (deg)

Station Number CDMG 301 USGS 1490 Owner CDMG  
 Name Mammoth Lakes High School  
 Address County

Latitude Type  
 Longitude Structure Size  
 Installed Class  
 Removed

Instrument Type(s) CR-1  
 Serial Number(s) 135  
 Installed Removed

Record Installed By Recovered By  
 CDMG File No.

Trace (from top)	Component	Orientation	Sensitivity (mm/g)	Period (sec)	Crit. Damp.	Peak Ampl. (mm)	Accel. (g)	Duration Sig. Run (sec)	Trace Qual.	Serv Rec.
. (1st aftershock recorded)										
.8	H	0.0	17.8	0.02	64	2.0	0.11*	10	Good	

\*Second highest acceleration N 0.09g w/ film peak=1.6mm

Note: All other aftershock trace accelerations  $\leq$  0.09g.

Time Code Quality Times: Trigger S-Wave Arrival  
 S-Wave-Trigger

Record Evaluated By McJunkin Date of This Sheet 15 Nov. 1978

Remarks:

Bishop Earthquake - Aftershock 4 Oct. 1978  
CDMG 301 - Mammoth Lakes  
CR-1 Serial No. 135

1st Aftershock Recorded

